

# Engine Management System

# BMW MSD81 6 Cyl

## Specification

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	Name	Department	Phone	Date	Sign
Designed by	Radlbeck Juergen	P ES SYS CSW CEE1 RBG4	+49 941 790 3558	2013-02-13	
Released by	Tettenborn Frank	P ES SYS PM	+49 941 790 3688	2013-02-13	

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def	7071	def	6975
ABC_MC_PFM_0_TOG		ABC_TQ_MAX_CLU_MON	
def	7071	def	6938
ABC_MC_PFM_1_RESP		ABC_TQ_MIN_CLU_MON	
def	7071	def	6952
ABC_MC_PFM_1_TOG		ABC_TQI_AV_AFS_MON	
def	7071	def	6899
ABC_MC_PFM_2_RESP		ABC_TQI_AV_AFS_MON2	
def	7071	def	7010
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def	7071	def	6917
ABC_MC_PFM_3_RESP		ABC_TQI_N_MAX_MON2	
def	7071	def	7010
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def	7071	def	5063
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def	7071	def	5063
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use .....	811, 903, 8291	use .....	7050, 7101, 7120, 7138
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def .....	1561	def .....	7079
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def .....	8283	def .....	7137
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use .....	6877, 6923, 6939, 6953	use .....	6851, 6903, 6987
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use .....	6877, 6923, 6939, 6953	use .....	6851, 6903, 6987
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def .....	8148	C_N_MAX_CDN_STALL	
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def .....	8148	C_N_MAX_CLC_MDBANL_10MS	
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def .....	1543	def .....	6226
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C_N_MAX_DIAG_TH		C_N_MAX_MPL_PUC	
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use .....	2864	def .....	1475
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def .....	1759	def .....	1475
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def .....	5423	C_N_MIN_SEG_AD_ER_AT	
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C_N_MIN_EFPPWM_I_AD		def .....	1475
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def .....	2735	def .....	5666
use .....	2865	C_N_MIN_TEG_SENS_DIAG_1	
C_N_MIN_FL		def .....	4714
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C_N_MIN_KWP_POIL		def .....	4456
def .....	7439	use .....	1506
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C_N_MIN_LAM_ADJ_P_ACT		C_N_OFS_ACC_DRI_MIN	
def .....	2592	def .....	7684
C_N_MIN_LAM_LSCL		C_N_OFS_ACC_MAX	
def .....	2468	def .....	7684
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def .....	1881	def .....	7684
C_N_MIN_MPL_PUC		C_N_OFS_MAX	
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C_N_MIN_MPL_ST		C_N_OFS_MIN	
def .....	1881	def .....	7684
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C_N_REL_CWP_HYS	def .....	3564
def .....	4538	C_N_SP_IS_CH_AST_MPLP_DRI
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def .....	5653	C_N_SP_IS_CH_L_HOM
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C_N_SP_INC_CS	def .....	6953
def .....	1124	C_N_ST_MIN_MON
C_N_SP_INC_PL	def .....	6799
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C_N_THD_FCUT_N_LIM_ETC_MON		C_NL_MAX_DIAG	
def .....	6799	def .....	4904
C_N_THD_FUP_DLY_1_MON		C_NL_MIN	
def .....	6761	def .....	1963
C_N_THD_FUP_DLY_2_MON		C_NL_MIN_DIAG	
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C_N_THD_MIS_INH		C_NOX_AD_ADD_MIN	
def .....	6284	def .....	3194
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def .....	2644	def .....	3069
C_N_TOL_FAC_H_RNG_LAM_AD		C_NOX_ADD_ZERO_MAX	
def .....	2644	def .....	3194
C_N_TOL_FAC_L_RNG_LAM_AD		C_NOX_ADD_ZERO_MIN	
def .....	2644	def .....	3194
C_N_TOL_LAM_AD_INJ		C_NOX_CONC_COR	
def .....	3351	def .....	2990
C_N_TOL_LAM_AD_WUP		use .....	3066
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C_N_TOL_LAMB_DIF_ACT		def .....	2990
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C_N_VAR_DIS_INJ		C_NOX_NS_AD_ADD [NC_NOX_SENS_CONF]	
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C_N_VAR_DIS_MISF		C_NOX_NS_AD_DELTA_MMV_MAX	
def .....	658	def .....	3194
C_N_VIM_H		C_NOX_NS_AD_DELTA_MMV_MIN	
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C_N_VIM_HYS		C_NOX_NS_AD_DIF_MON	
def .....	3623	def .....	2990
C_N_VIM_L		C_NOX_NS_AD_MAX_SENS_VLD	
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C_N_VS_CRU_GRD_FAC_GR_MAX		C_NOX_NS_DIAG_ACT_MIN	
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def .....	7229	def .....	6390
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C_N_WHEEL_MAX_DIF		C_NOX_NS_DIAG_PUC_MIN	
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C_NOX_OFS_DIAG_SEL		C_NR_MAX_MIS_A_LIH_CYL	
def .....	6379	def .....	6240
C_NOX_OFS_LOAD_OK_MAX		C_NR_MIN_AD_LAM_AD_INJ_COLD_ADD	
def .....	6379	def .....	3351
C_NOX_OFS_LOAD_OK_MIN		C_NR_PHA_LAM_AD_INJ	
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C_NOX_OFS_PUC_MAX		C_NR_PRI_CH_MOD	
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C_NOX_OFS_SEL		C_NR_PRI_CH_MOD_REQ	
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C_NOX_SENS_MAX_OFS		C_NR_REV_AD_REF_CAM_EX	
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C_NR_CYC_T_WAIT_LSL_OFS_ADJ_RED		def .....	1475
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C_NR_DET_MAX_MIS_B4		def .....	2959
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C_NR_EDGE_MIN_VLD_CAM_EX		C_NR_TDC_CMB_TRA_S_MIS	
def .....	873	def .....	6284
C_NR_EDGE_MIN_VLD_CAM_IN		C_NR_TDC_DLY_MIS_GEN	
def .....	873	def .....	7194
C_NR_END_DIAG_LS_DOWN [NC_CBK_EX_NR]		C_NR_TDC_IGA_BAS_DIF_MIS	
def .....	5450	def .....	6214
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def .....	5450	def .....	6214

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C_NR_TDC_INH_MIS	def .....	6226	C_NT_RGN_STOP_FL_SEL	def .....	2991
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C_NR_TDC_IV_OFF_DET_MIS_KNK	def .....	6284	C_NT_SO2P_EXT_ADJ_ACT	def .....	1124
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def .....	1809	def .....	2279
C_TEMP_HYS_SWI_HOMS_CH_L		C_TEMP_SP_OBD_LSH_DOWN	
def .....	1809	def .....	5200
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def .....	2867	def .....	2736
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def .....	3351	def .....	2736
C_TEMP_LAM_CYL_CST_MAX		C_TEMP_THD_TEG_SENS_DIAG_1	
def .....	2736	def .....	4714
use .....	2865	C_TEMP_UP_LIM_CAT_DIAG_AFL	
C_TEMP_LAM_CYL_CST_MIN		def .....	5554
def .....	2736	C_TFU_CUR_VCV_AD_MAX	
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C_TEMP_LAM_CYL_MIN		C_TFU_CUR_VCV_AD_MIN	
def .....	2736	def .....	3961
use .....	2865	C_TFU_EFP_OFS	
C_TEMP_LDC_CAT_DIAG_AFL		def .....	1233
def .....	5554	C_TFU_IV_SUB_LIM_DEC	
C_TEMP_MAP_DIP_MDL_FAC_MAX		def .....	1233
def .....	1199	C_TFU_IV_SUB_LIM_INC	
C_TEMP_MAP_DIP_MDL_FAC_MIN		def .....	1233
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C_TEMP_MAX_CAT		def .....	1233
def .....	5459	C_TFU_RAW_LIM_INC	
C_TEMP_MAX_LAM_AD_INJ_COLD		def .....	1233
def .....	3351	C_TFU_RAW_SWI_INI	
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C_TEMP_MAX_LAM_AD_INJ_HOT		C_TFU_SUB_STOP_INI	
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C_TEMP_MDL_IGC_HYS		C_TFU_VCV_PLAUS_MAX	
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C_TEMP_MDL_IGC_HYS_MAX		C_TFU_VCV_PLAUS_MIN	
def .....	1897	def .....	6067
C_TEMP_MDL_IGC_HYS_MIN		C_TFU_VFF_VCV_MIN_CLC_MAX	
def .....	1897	def .....	3961
C_TEMP_MDL_IGC_INI		C_TFU_VFF_VCV_MIN_CLC_MIN	
def .....	1897	def .....	3961
C_TEMP_MDL_IGC_INT_MAX		C_THD_DIF_L_RNG_LAM_AD	
def .....	1897	def .....	2680
C_TEMP_MDL_IGC_INT_MIN		C_THD_EFF_SCC_MIN_MON	
def .....	1897	def .....	6778
C_TEMP_MDL_IGC_MAX		C_THD_ER_CLC_GRD	
def .....	1882	def .....	6284
C_TEMP_MIN_CAT		C_THD_FAC_DELTA_L_RNG	
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C_TEMP_MIN_CAT_EOL		C_THD_GRD_TI_IDX_MON	
def .....	5460	def .....	6761

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use .....	6795	C_TI_ADD_AS_CBK_EX [NC_CBK_EX_NR]	
C_THD_MAX_LAMB_SENS_MON		def .....	2233
def .....	6778	C_TI_ADD_AS_GLOBAL	
C_THD_MAX_PV_AV		def .....	2233
def .....	1270	C_TI_AS [NC_CYL_NR]	
C_THD_MFF_AD_ADD_MAX_MON		def .....	2233
def .....	6762	C_TI_AS_CBK_EX [NC_CBK_EX_NR]	
C_THD_MFF_AD_FAC_MAX_MON		def .....	2233
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def .....	1270	C_TI_LAM_DIAGCPS_DIF	
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def .....	6762	C_TI_MIN_OFS	
C_THD_SOI_POST_MON		def .....	2005
def .....	6762	C_TI_THD_INH_DIAG_IV	
C_THD_T_TQ_DCC_CS		def .....	4803
def .....	1711	C_TIA_DE_MAX_DIAG_TH	
C_THD_TQ_ADD_PSTE_I_ISC		def .....	5653
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def .....	4195	C_TNT_MDL_MAX_OFS	
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def .....	4573	C_TNT_MDL_NOX_OFS_DIAG_MIN	
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def .....	5667	C_TNT_MDL_NT_AGI_DYW	
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def .....	5554	C_TNT_MDL_PURGE_MIN	
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def .....	1778	C_TNT_MDL_PURGE_REQ_MAX	
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def .....	1778	C_TNT_MDL_SO2P_FAST	
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def .....	3130	C_TOIL_POIL_SWI_MAX_DIAG	
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def .....	3130	C_TOIL_POIL_SWI_MIN_DIAG	
C_TNT_MDL_SO2P_MIN_EXT		def .....	4358
def .....	3130	C_TOIL_SUB_DIAG	
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def .....	3055	C_TOIL_THD_N_SP_IS	
C_TNT_MDL_THD_RGN_NOT_HYS		def .....	1125
def .....	3055	C_TOL_REF_CRK_CAM_EX	
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def .....	1779	use .....	1534
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def .....	1779	def .....	4422
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def .....	1809	C_TOL_TOOTH_OFF_CAM_EX	
C_TNT_MIN_SWI_HOMS_CH_L		def .....	1535
def .....	1810	C_TOL_TOOTH_OFF_CAM_IN	
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def .....	1814	def .....	4953
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def .....	1779	def .....	6555
C_TNT_THD_CH_L_OFF		C_TPS_DIF_DIAG_COR_MMV_MAX	
def .....	1779	def .....	4991
C_TNT_THD_CH_L_RGN		C_TPS_DIF_MAX_DIAG	
def .....	1779	def .....	4978
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C_TNT_THD_MIN_NS_SHIFT		C_TPS_JAM_PLS_CLOSE	
def .....	6431	def .....	6533
C_TNT_UP_LIM_CAT_DIAG_AFL		C_TPS_JAM_PLS_OPEN	
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def .....	1897	def .....	4953
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C_TOIL_NT_AGI_MAX		C_TPS_SP_CTL_MAX	
def .....	3108	def .....	6547

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def .....	6555	C_TQ_ADD_CH_LGRD_ON	
C_TPS_SP_LIH_DIF_HYS		def .....	6583
def .....	6547	C_TQ_ADD_CH_MPLH_MAN	
C_TPS_SP_MAX		def .....	6583
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def .....	6555	def .....	3545
C_TPS_SP_MIN_TPS_AD_REQ		C_TQ_ADD_MIN_CH_CST_LGRD	
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C_TPS_SP_PWL_LGRD		C_TQ_ADD_MIN_CH_LGRD	
def .....	6565	def .....	6597
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def .....	4953	def .....	6583
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def .....	4953	def .....	6583
C_TPS_SP_SPR_CHK_UP		C_TQ_ADD_SO2P_MAX_EXT_ADJ	
def .....	4953	def .....	6583
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def .....	6547	def .....	6583
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def .....	6547	def .....	6583
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def .....	6556	def .....	6583
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def .....	4991	def .....	6711
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def .....	3545	C_TQ_LIM_INC	
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def .....	3545	C_TQ_LIM_TCT_LGRD	
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def .....	6922	C_TQ_LIM_TOUT_AT_LGRD	
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C_VLS_GRD_NEG_VLS_SET		C_VLS_O2L_INT_CLC	
def .....	2993	def .....	5609
C_VLS_HYS_DIAG_SWT_LS_DOWN		C_VLS_OFS_DELTA_ADD	
def .....	5153	def .....	2317
C_VLS_HYS_R_IT_LS_DOWN		C_VLS_OFS_DELTA_CBK_EX_MAN	
def .....	1366	def .....	2317
C_VLS_MAIN_CAT_PURGE_THD		C_VLS_OFS_DIF_OK_LSL	
def .....	2928	def .....	2317
C_VLS_MAX_DIAG_FL_LS_DOWN		C_VLS_OFS_DIF_OK_LSL_L_GAIN	
def .....	4277	def .....	2317
C_VLS_MAX_RGN_1_STOP		C_VLS_OFS_MAX_ABSV_LSL	
def .....	2993	def .....	2317
C_VLS_MAX_RGN_2_STOP		C_VLS_OFS_MAX_ABSV_LSL_L_GAIN	
def .....	2993	def .....	2317
C_VLS_MIN_DIAG_PUC_LS_DOWN		C_VLS_OFS_SP_LSL	
def .....	4277	def .....	2317
use .....	8038	C_VLS_PUC_MIN_DIAG_SWT_LS_DOWN	
C_VLS_MIN_DIAG_RGN_LS_DOWN		def .....	5153
def .....	5143	C_VLS_REF_SO2P	
C_VLS_NOX_O2L_INT_CLC		def .....	3130
def .....	5608	C_VLS_REF_SO2P_LAMB_SP	
C_VLS_NOX_SENS [NC_NOX_SENS_CONF]		def .....	3151
def .....	1383	C_VLS_SO2P_HYS	
C_VLS_NOX_SENS_AFL_PURGE_OFF		def .....	3131
def .....	2993	C_VLS_SO2P_MIN	
C_VLS_NOX_SENS_AFL_PURGE_ON		def .....	3131
def .....	2993	C_VLS_SP_NS_SHIFT [NC_CBK_EX_NR]	
C_VLS_NOX_SENS_AFR_TRIM		def .....	3191
def .....	2993	C_VLS_THD_DIAG_SCG_LS_DOWN	
C_VLS_NOX_SENS_RGN_STOP		def .....	4268
def .....	2993	C_VLS_THD_DIAG_SCP_LS_DOWN	
C_VLS_NS_DIAG_AFR_MIN		def .....	4268
def .....	6390	use .....	8038
C_VLS_NS_DIAG_PUC_MAX		C_VLS_UP_AFS_MAX_PLAUS_LSL_UP	
def .....	6406	def .....	5239
C_VLS_NS_DIAG_SWI_END		C_VLS_UP_AFS_MIN_PLAUS_LSL_UP	
def .....	6339	def .....	5239
C_VLS_NS_DIAG_SWI_ST		C_VLS_UP_DIAG_AFS_PUC_LSL_UP	
def .....	6339	def .....	5298
C_VLS_NS_MMV_THD_LDC_ABSV		C_VLS_UP_DIAG_MAX_AIR_LSL_UP	
def .....	6432	def .....	5282
C_VLS_NS_RGN_2_VLD		C_VLS_UP_DIAG_MAX_PUC_LSL_UP	
def .....	2994	def .....	5298
C_VLS_NS_RGN_NT_END_MIN		C_VLS_UP_DIAG_MIN_OC_LSL_UP	
def .....	6339	def .....	4302
C_VLS_NS_RGN_STOP_DIAG		C_VLS_UP_DIAG_MIN_PUC_LSL_UP	
def .....	6349	def .....	5298
C_VLS_NS_THD		C_VLS_UP_MAX_DIAG_CTL_LSL_UP	
def .....	5590	def .....	5249
C_VLS_NS_THD_CMB_REQ_NS_SHIFT		C_VLS_UP_MAX_MAF_INT_AFR	
def .....	6432	def .....	4277
C_VLS_NS_THD_NS_SHIFT_EXT		C_VLS_UP_MAX_OC_AFS_LSL_UP	
def .....	6432	def .....	4302
C_VLS_NS_THD_NS_SHIFT_MAX		C_VLS_UP_MIN_DIAG_CTL_LSL_UP	

def .....	5249	C_VS_CS_DIAG	
C_VLS_UP_MIN_MAF_INT_AFR		def .....	5015
def .....	4277	C_VS_DELTA_CHK_FUC_MAX	
C_VLS_UP_MIN_OC_AFS_LSL_UP		def .....	5919
def .....	4302	C_VS_DIF_DELTA_I	
C_VLS_UP_THD_BOL		def .....	7238
def .....	1342	C_VS_DIF_DLY_CRU_NEG	
C_VLS_UP_THD_TOL		def .....	7229
def .....	1342	C_VS_DIF_DLY_CRU_POS	
C_VP_ACQ_CONV_HYS_MON		def .....	7229
def .....	6894	C_VS_DIF_LIH_TCT_DEAC	
C_VP_TCO_2_MAX_DIAG_TCO_2_EL		def .....	1158
def .....	4573	C_VS_DIF_MAX_AC_CRU	
C_VP_TCO_2_MIN_DIAG_TCO_2_EL		def .....	7238
def .....	4573	C_VS_DIF_MAX_CRU	
C_VP_TCO_MAX_DIAG_TCO_EL		def .....	7239
def .....	4497	C_VS_DIF_MAX_IS_CRU	
C_VP_TCO_MIN_DIAG_TCO_EL		def .....	7239
def .....	4497	C_VS_DIF_MAX_MON	
C_VP_TECU_MAX_DIAG		def .....	6801
def .....	4237	C_VS_DIF_MIN_AC_CRU	
C_VP_TECU_MIN_DIAG		def .....	7239
def .....	4237	C_VS_DIF_MIN_CRU_OVER	
C_VP_TEG_MES_GRD_MAX		def .....	7229
def .....	4714	C_VS_DIF_MIN_IS_CRU	
C_VP_TEG_PCAT_DOWN_DIAG_MAX		def .....	7239
def .....	4714	C_VS_DIF_RNG_CRU	
C_VP_TEG_PCAT_DOWN_DIAG_MIN		def .....	7239
def .....	4714	C_VS_DIF_STEP_MIN_HYS	
C_VP_TEG_SENS_ACT_DIAG		def .....	7202
def .....	4714	C_VS_DIF_STEP_MIN_K	
C_VP_TIA_MAX_DIAG		def .....	7202
def .....	4195	C_VS_DIF_STEP_MIN_M	
use .....	1226	def .....	7202
C_VP_TIA_MIN_DIAG		C_VS_DIF_STEP_PROG_K	
def .....	4195	def .....	7202
use .....	1226	C_VS_DIF_STEP_PROG_M	
C_VP_TIA_TCHA_UP_MAX_DIAG		def .....	7202
def .....	4189	C_VS_DIF_TIP_K	
C_VP_TIA_TCHA_UP_MIN_DIAG		def .....	7239
def .....	4189	C_VS_DIF_TIP_M	
C_VPLSL_THD_VNLSL_LIM		def .....	7239
def .....	2354	C_VS_DIF_TIP_PROG_K	
C_VS_AC_MAX_CRU		def .....	7202
def .....	7238	C_VS_DIF_TIP_PROG_M	
C_VS_AC_MIN_CRU		def .....	7202
def .....	7238	C_VS_DMTL_MAX	
C_VS_BOL_MIN_DIAG		def .....	5975
def .....	5023	C_VS_DOWN_LIM_CAT_DIAG_AFL	
C_VS_BRAKE_MAX		def .....	5554
def .....	4218	C_VS_EDGE_SUM_MIN	
C_VS_BRAKE_MIN		def .....	1177
def .....	4218	C_VS_EFF_IGA_CST_THD_PL	
C_VS_CHK_FUC_OPEN_CAN_MIN		def .....	6495
def .....	5919	C_VS_ENA_CHK_FUC_OPEN_MAX	
C_VS_CHK_FUC_OPEN_MAX		def .....	5919
def .....	5919	C_VS_ENA_CHK_FUC_OPEN_MIN	

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def .....	5919	def .....	1271
C_VS_FAC		C_VS_MAX_FAC_PV_COR_AT	
def .....	1177	def .....	1271
use .....	1183	C_VS_MAX_GRD	
C_VS_FIL_AMT_MON		def .....	5023
def .....	6987	C_VS_MAX_HYS	
C_VS_FTL_DIAG_MAX		def .....	1150
def .....	5975	C_VS_MAX_HYS_OFF	
C_VS_FUC_CAN_MIN		def .....	7267
def .....	5975	C_VS_MAX_HYS_ON	
C_VS_GB		def .....	7267
def .....	1177	C_VS_MAX_IS_CDN_TIA_PLAUS	
C_VS_HYS_N_SP_CS		def .....	5094
def .....	1125	C_VS_MAX_KWP	
C_VS_INH_PURGE		def .....	7439
def .....	2994	use .....	1122, 7766
C_VS_LIH_MON		C_VS_MAX_KWP_MON	
def .....	6801	def .....	6801
C_VS_MAX_0_DFT		C_VS_MAX_LIH_TCT_DEC	
def .....	1158	def .....	1158
use .....	1148	C_VS_MAX_LIH_TCT_INC	
C_VS_MAX_1		def .....	1158
def .....	1158	C_VS_MAX_MPLP_CH_AST	
use .....	1148	def .....	1802
C_VS_MAX_2		C_VS_MAX_N_SP_CS	
def .....	1158	def .....	1125
use .....	1148	C_VS_MAX_N_SP_IS_ARS	
C_VS_MAX_3		def .....	1125
def .....	1158	C_VS_MAX_NS_SHIFT_DIAG_ACT	
use .....	1148	def .....	6432
C_VS_MAX_ACCIN		C_VS_MAX_RR	
def .....	3589	def .....	6303
C_VS_MAX_AMT		C_VS_MAX_SWT_ENA	
def .....	1158	def .....	1159
C_VS_MAX_BRAKE		C_VS_MAX_TPS_JAM	
def .....	4218	def .....	6543
C_VS_MAX_CAT		C_VS_MAX_TQ_LIM_PBR	
def .....	5460	def .....	6698
C_VS_MAX_CH_AST		C_VS_MAX_WIN	
def .....	1779	def .....	5024
C_VS_MAX_CYL_BAL_AD_REQ_DC		C_VS_MIN_CAT	
def .....	4070	def .....	5460
C_VS_MAX_DIAG		C_VS_MIN_CRU_K	
def .....	7216	def .....	7229
C_VS_MAX_DIAG_MPL_LS_DOWN		C_VS_MIN_CRU_M	
def .....	5153	def .....	7229
C_VS_MAX_ECRAS_DIAG		C_VS_MIN_CRU_MON	
def .....	4517	def .....	6912
C_VS_MAX_EF_AC_1		C_VS_MIN_CYL_BAL_AD_REQ_DC	
def .....	3615	def .....	4070
C_VS_MAX_EF_AC_2		C_VS_MIN_DIAG_GRD	
def .....	3615	def .....	5024
C_VS_MAX_ERR_PUC_AT		C_VS_MIN_DIAG_MPL_LS_DOWN	
def .....	5023	def .....	5153
C_VS_MAX_ERR_PUC_MT		C_VS_MIN_DT	
def .....	5023	def .....	1310
C_VS_MAX_FAC_PV_COR		C_VS_MIN_EF_AC_1	


def .....	3615	C_VS_MIN_VLD_TAM_ERR	
C_VS_MIN_EF_AC_2		def .....	5078
def .....	3615	C_VS_MIN_WIN	
C_VS_MIN_EF_AT		def .....	5024
def .....	3615	C_VS_OBS_MIN	
C_VS_MIN_EF_MT		def .....	3077
def .....	3615	C_VS_POIL_EXT_ADJ_MAX_MON	
C_VS_MIN_FCO		def .....	6801
def .....	3847	C_VS_PSTE	
C_VS_MIN_FCUT_FAST		def .....	1421
def .....	6675	C_VS_PU_CS_MAX	
C_VS_MIN_FCUT_FAST_TCHA		def .....	1722
def .....	6675	C_VS_PU_CS_MIN	
C_VS_MIN_FL		def .....	1722
def .....	1760	C_VS_PURGE_MAX	
C_VS_MIN_GRD		def .....	2994
def .....	5024	C_VS_PURGE_REQ_MAX	
C_VS_MIN_LAMB_AFS		def .....	2994
def .....	3703	C_VS_SO2P_EXT_MAX	
C_VS_MIN_N_SP_EPS		def .....	3145
def .....	1125	C_VS_SO2P_EXT_MAX_MON	
C_VS_MIN_N_SP_IS_ARS		def .....	6801
def .....	1125	C_VS_SO2P_FAST_HYS	
C_VS_MIN_N_SP_PSTE		def .....	3131
def .....	1125	C_VS_SP_CRU_MAX_K	
C_VS_MIN_N_SP_PSTE_2		def .....	7239
def .....	1125	C_VS_SP_CRU_MAX_M	
C_VS_MIN_NS_SHIFT_DIAG_ACT		def .....	7239
def .....	6432	C_VS_SP_DIF_MAX_CRU	
C_VS_MIN_PLAUS_CRU		def .....	7229
def .....	7229	C_VS_SP_DIF_MIN_CRU	
C_VS_MIN_PROG		def .....	7229
def .....	7202	C_VS_SWI_AEB_HOM_AFL	
use .....	7220	def .....	4136
C_VS_MIN_PU		C_VS_SWI_AEB_HOM_AFS	
def .....	1722	def .....	4136
C_VS_MIN_RGN		C_VS_SWI_AEB_HYS	
def .....	3055	def .....	4136
C_VS_MIN_RGN_NOX_AD		C_VS_SWI_AEB_S	
def .....	3069	def .....	4136
C_VS_MIN_RR		C_VS_TCHA_DIAG_EXT_MAX_MON	
def .....	6303	def .....	6801
C_VS_MIN_RUN		C_VS_THD_CH_SO2P	
def .....	1177	def .....	1779
use .....	5015	C_VS_THD_H_VSL	
C_VS_MIN_SOF_AT		def .....	7259
def .....	3852	C_VS_THD_IS_CDN_RBM	
C_VS_MIN_SOF_MT		def .....	5859
def .....	3852	use .....	5746
C_VS_MIN_TCO_2_PLAUS		C_VS_THD_L_VSL	
def .....	5667	def .....	7259
C_VS_MIN_TEG_SENS_DIAG		C_VS_THD_MIN_DLY	
def .....	4714	def .....	5261
C_VS_MIN_TIA_PLAUS_DIAG		C_VS_THD_N_MAX_H_AT	
def .....	5094	def .....	1150
C_VS_MIN_TQI_LIM_PBR		C_VS_THD_N_MAX_H_AT_MAN	
def .....	6698	def .....	1150

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C_VS_THD_N_MAX_H_MT		CAM_DYW_SYN_IN	
def .....	1150	def .....	871
C_VS_THD_RBM		CAM_EX [NC_NR_CBK_IVVT]	
def .....	5859	def .....	8399
use .....	5746	use .....	2448, 2865, 7312, 7556
C_VS_THD_VS_MAX_AST		CAM_IN [NC_NR_CBK_IVVT]	
def .....	4493	def .....	8399
C_VS_THD_VS_MIN_AST		use .....	7312, 7556
def .....	4493	CAM_IN_H [NC_NR_CBK_IVVT]	
C_VS_TNT_MDL_MIN		use .....	7312
def .....	3055	CAM_IN_KWP	
C_VS_TNT_MDL_MIN_OFF		def .....	7307
def .....	3055	CAM_PSN_LST_REF_AD_EX [NC_NR_CAM_CBK]	
C_VS_TOL_DIAG		def .....	1533
def .....	5024	use .....	4421
C_VS_UP_LIM_CAT_DIAG_AFL		CAM_PSN_LST_REF_AD_IN [NC_NR_CAM_CBK]	
def .....	5554	def .....	1533
C_WAL_CONF_MIS		use .....	4421
def .....	5840	CAM_SHIFT_EX	
C_WG_DR_PWM_DIAG_MAX_SCG		def .....	2146
def .....	4207	use .....	2122
C_WG_DR_PWM_DIAG_MIN_OC		CAM_SHIFT_IN	
def .....	4207	def .....	2146
C_WG_DR_PWM_DIAG_MIN_SCB		CAM_SP_2_EX_EXT_ADJ	
def .....	4207	def .....	7431
C_WGPWM_MAX_LAM_CYL_SEL		CAM_SP_2_IN_EXT_ADJ	
def .....	2867	def .....	7431
C_WGPWM_MIN_LAM_AD		CAM_SP_CH_EX	
def .....	2724	def .....	3601
C_WGPWM_SUB_DIAG		use .....	8400
def .....	8140	CAM_SP_CH_IN	
C_WHEEL_GRD_CLC_DIAG		def .....	3601
def .....	6303	use .....	8400
C_WHEEL_GRD_CLC_RR		CAM_SP_EX_EXT_ADJ	
def .....	6303	def .....	7431
CAM_DYN_IVVT_EX_SAE [NC_NR_CBK_IVVT]		use .....	8291
def .....	8399	CAM_SP_IN_EXT_ADJ	
use .....	8038	def .....	7431
CAM_DYN_IVVT_EX_TOL_SAE [NC_NR_CBK_IVVT]		use .....	8291
def .....	8399	CAM_SP_IVVT_EX	
use .....	8038	def .....	8399
CAM_DYN_IVVT_IN_SAE [NC_NR_CBK_IVVT]		use .....	7312
def .....	8399	CAM_SP_IVVT_IN	
use .....	8038	def .....	8399
CAM_DYN_IVVT_IN_TOL_SAE [NC_NR_CBK_IVVT]		use .....	7312
def .....	8399	CAM_SP_IVVT_IN_KWP	
use .....	8038	def .....	7307
CAM_DYW_CRK_SYN_ADC_EX		CAM_SP_REF_EX	
def .....	871	def .....	8399
CAM_DYW_CRK_SYN_ADC_IN		use .....	7312
def .....	871	CAM_SP_REF_IN	
CAM_DYW_CRK_SYN_RTD_EX		def .....	8399
def .....	871	use .....	7312
CAM_DYW_CRK_SYN_RTD_IN		CAM_TYPE	
def .....	871	def .....	654
CAM_DYW_SYN_EX		CAN_ERR_NOX_SENS [NC_NOX_SENS_CONF]	
def .....	871	def .....	1398


use .....	1382, 7312	def .....	2241
CAN_HW_NS [NC_NOX_SENS_CONF]		CAPA_IV_2_CLC [NC_CYL_NR]	
def .....	1398	def .....	2035
use .....	1399, 3181	CAPA_IV_DIF_NOM [NC_CYL_NR]	
CAN_LAMB_NOX_SENS [NC_NOX_SENS_CONF]		def .....	2241
def .....	1398	CAPA_IV_POST_CLC [NC_CYL_NR]	
use .....	1382	def .....	2035
CAN_NOX_DIAG_NS [NC_NOX_SENS_CONF]		CASE_SEL_CYL	
def .....	1398	def .....	2307
use .....	6413	CAT_DIAG [NC_CBK_EX_NR]	
CAN_NOX_NOX_SENS [NC_NOX_SENS_CONF]		def .....	797
def .....	1398	CAT_DIAG_MOD_6 [NC_CBK_EX_NR]	
use .....	1382	def .....	1037
CAN_NOX_REF_NS [NC_NOX_SENS_CONF]		use .....	8114
def .....	1398	CAT_MAX_DIAG_MOD_6 [NC_CBK_EX_NR]	
use .....	6413	def .....	1037
CAN_R_RATIO_NOX_SENS [NC_NOX_SENS_CONF]		use .....	8114
def .....	1398	CC_ID	
use .....	1399, 3181	def .....	1561
CAN_STATE_DIAG_NS [NC_NOX_SENS_CONF]		CDN_DIAG_ACK_IGK_OFF	
def .....	1398	def .....	4939
use .....	1382	CDN_DIAG_AEB [NC_AEB_NR]	
CAN_STATE_NOX_SENS [NC_NOX_SENS_CONF]		def .....	4942
def .....	1398	CDN_DIAG_CTL_LSL_DI [NC_CBK_EX_NR]	
use .....	1382, 7312	def .....	5255
CAN_STATE_NS_DIAG_REQ [NC_NOX_SENS_CONF]		use .....	5248
def .....	1398	CDN_DIAG_CTL_LSL_INH [NC_CBK_EX_NR]	
use .....	1399	def .....	5255
CAN_STATE_NS_TMP [NC_NOX_SENS_CONF]		use .....	5248
def .....	1398	CDN_DIAG_CTL_LSL_UP [NC_CBK_EX_NR]	
use .....	1382, 6313	def .....	5248
CAN_SW_NS [NC_NOX_SENS_CONF]		CDN_DIAG_DMTLH	
def .....	1398	def .....	4622
use .....	6313	CDN_DIAG_EBOX_CFA	
CAN_TMP_BYTE_1 [NC_NOX_SENS_CONF]		def .....	4622
def .....	1398	CDN_DIAG_ECF_EL	
CAN_TMP_BYTE_2 [NC_NOX_SENS_CONF]		def .....	4507
def .....	1398	CDN_DIAG_ECFPWM_BAS [NC_ECF_NR]	
CAN_TMP_BYTE_3 [NC_NOX_SENS_CONF]		def .....	4507
def .....	1398	use .....	4508
CAN_TMP_BYTE_4 [NC_NOX_SENS_CONF]		CDN_DIAG_ECRAS_EL	
def .....	1398	def .....	4514
CAN_TMP_BYTE_5 [NC_NOX_SENS_CONF]		CDN_DIAG_ECRASPWM_BAS	
def .....	1399	def .....	4514
CAN_TMP_BYTE_6 [NC_NOX_SENS_CONF]		CDN_DIAG_ECT_EL	
def .....	1399	def .....	4529
CAN_TMP_BYTE_8 [NC_NOX_SENS_CONF]		CDN_DIAG_EF	
def .....	1399	def .....	4622
CAN_TMP_WORD_1 [NC_NOX_SENS_CONF]		CDN_DIAG_EL_CPS	
def .....	1399	def .....	4708
CAN_VLS_NOX_SENS [NC_NOX_SENS_CONF]		CDN_DIAG_IMOB_1	
def .....	1399	def .....	4783
use .....	1382	CDN_DIAG_IMOB_3	
CAPA_IV_1_CLC [NC_CYL_NR]		def .....	4783
def .....	2035	CDN_DIAG_IV [NC_CYL_NR]	
use .....	2241	def .....	4802
CAPA_IV_1_FIL [NC_CYL_NR]		CDN_DIAG_IV_RAW [NC_CYL_NR]	

def .....	2035	use .....	4614
use .....	4803	CHA_CDN_BAT	
CDN_DIAG_LSH_DOWN [NC_CBK_EX_NR]		def .....	797
def .....	4248	use .....	7683
use .....	944	CHA_IV_1_MES [NC_CYL_NR]	
CDN_DIAG_LSH_UP [NC_CBK_EX_NR]		def .....	2035
def .....	4315	use .....	6761, 7312
use .....	944	CHA_IV_2_MES [NC_CYL_NR]	
CDN_DIAG_PBK_IV [NC_PBK_IV_NR]		def .....	2035
def .....	4797	use .....	6761
CDN_DIAG_PBK_IV_RAW [NC_PBK_IV_NR]		CHA_IV_POST_MES [NC_CYL_NR]	
def .....	2035	def .....	2035
use .....	4797	use .....	6761
CDN_DIAG_POIL_DR		CHK_STAMP	
def .....	4357	def .....	7679
CDN_DIAG_PREV_XX		use .....	7556
def .....	4640	CHR_INJ_TRIM_0 [NC_PBK_IV_NR]	
CDN_DIAG_RAS		def .....	2035
def .....	4569	use .....	3432
CDN_DIAG_RFP_DR		CHR_INJ_TRIM_1 [NC_PBK_IV_NR]	
def .....	4203	def .....	2035
CDN_DIAG_RLY_ACCOUT		use .....	3432
def .....	4622	CHR_INJ_TRIM_2 [NC_PBK_IV_NR]	
CDN_DIAG_RLY_CRCV_HEAT		def .....	2035
def .....	4622	use .....	3432
CDN_DIAG_RLY_DMTL_PUMP		CHR_INJ_TRIM_3 [NC_PBK_IV_NR]	
def .....	4622	def .....	2035
CDN_DIAG_RLY_DMTLS		use .....	3432
def .....	4622	CHR_IV_MES_BEG_CHA	
CDN_DIAG_RLY_MAIN		def .....	2035
def .....	4933	CHR_IV_MES_END_CHA	
CDN_DIAG_RLY_MTC_HEAT		def .....	2035
def .....	5004	CHR_TRIM_DIF_0_FIL [NC_PBK_IV_NR]	
CDN_DIAG_RLY_ST		def .....	3432
def .....	4622	CHR_TRIM_DIF_1_FIL [NC_PBK_IV_NR]	
CDN_DIAG_SLV_IVVT_EX		def .....	3432
def .....	4622	CKS_CAN_CAS	
CDN_DIAG_SLV_IVVT_IN		def .....	1561
def .....	4623	CKS_CAN_ETCU	
CDN_DIAG_SOF		def .....	1561
def .....	4911	CKS_CAN_ETCU_3	
CDN_DIAG_VCV		def .....	1561
def .....	4729	use .....	4871
CDN_DIAG_VIM_1_BAS		CKS_CAN_LDM	
def .....	5063	def .....	1561
CDN_DIAG_VIM_1_EL		CKS_CAN_MSW	
def .....	5063	def .....	1561
CDN_DIAG_VIM_2_BAS		CKS_CAN_PBR	
def .....	5063	def .....	1561
CDN_DIAG_VIM_2_EL		use .....	4871
def .....	5063	CKS_CAN_REQ_PBR	
CDN_DIAG_WG_1_DR		def .....	1561
def .....	4206	use .....	4871
CDN_DIAG_WG_2_DR		CKS_CAN_TQ_AMT	
def .....	4206	def .....	1561
CDN_DIAG_XX		CKS_CAN_TQ_DCC	
def .....	4614	def .....	1561

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CKS_CAN_TQ_ETCU		CKS_CLC_TQ_WHEEL_1	
def .....	1561	def .....	1563
CKS_CAN_TQ_PBR		CKS_CLC_TQ_WHEEL_2	
def .....	1561	def .....	1563
use .....	4871	CKS_CLC_VEH_MOD	
CKS_CAN_TQ_PSTE_2		def .....	1563
def .....	1561	CL	
CKS_CAN_TQ_PSTE_3		def .....	3698
def .....	1561	use .....	3638
CKS_CAN_TQ_TCS		CL_MDL	
def .....	1562	def .....	3728
CKS_CAN_TQ_TCT		use .....	3701
def .....	1562	CL_MDL_SLOP	
CKS_CAN_VEH_MOD		def .....	3728
def .....	1562	CL_MDL_SLOP_FAC	
CKS_CLC_CAS		def .....	3728
def .....	1562	CL_MDL_SLOP_INT	
CKS_CLC_ECU1		def .....	3728
def .....	1562	CL_MMV	
CKS_CLC_ECU2		def .....	3698
def .....	1562	use 1759, 2865, 3129, 3562, 3630, 3638, 3680, 3728,	
CKS_CLC_ECU3		3737, 3757, 5378, 5459, 5929, 6095, 6199, 8229	
def .....	1562	CL_MMV_CLC_END	
CKS_CLC_ETCU		def .....	3635
def .....	1562	use .....	1002
CKS_CLC_ETCU_3		CL_MMV_DIAGCPS_MAX_SAE	
def .....	1562	def .....	5926
use .....	4871	use .....	8038
CKS_CLC_GS_IDC		CL_MMV_DIAGCPS_MIN_SAE	
def .....	1562	def .....	5926
CKS_CLC_LDM		use .....	8038
def .....	1562	CL_MMV_DYW_MAX	
CKS_CLC_MSW		def .....	3698
def .....	1562	CL_MMV_DYW_MIN	
CKS_CLC_PBR		def .....	3698
def .....	1562	CL_MMV_MEM_CL_MDL	
use .....	4871	def .....	3698
CKS_CLC_REQ_PBR		use .....	3728
def .....	1562	CL_MMV_MEM_CL_MDL_OLD	
use .....	4871	def .....	3698
CKS_CLC_TQ_AMT		use .....	3728
def .....	1562	CL_MMV_MEM_MDL	
CKS_CLC_TQ_DCC		def .....	3728
def .....	1562	CL_MMV_NORM_PURGE_END	
CKS_CLC_TQ_ETCU		def .....	1001
def .....	1562	use .....	5971
CKS_CLC_TQ_PBR		CL_MMV_SAE	
def .....	1562	def .....	5926
use .....	4871	use .....	7312, 8038, 8114
CKS_CLC_TQ_PSTE_2		CL_MMV_TMP_SAE	
def .....	1562	def .....	5926
CKS_CLC_TQ_PSTE_3		CLF_CSERS_INJ_PLS_TEST_CYL_ON [NC_NR_IV_PLS]	
def .....	1562	def .....	2044
CKS_CLC_TQ_TCS		CLF_EFP_AD_RST_L_PRS_LIH	
def .....	1562	def .....	3800
CKS_CLC_TQ_TCT		use .....	3823
def .....	1562	CLF_EGY_RNG_LAM_AD_INJ	

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def .....	3334	CPPWM_EXT_ADJ	
CLF_LS_CBK_EX_LAM_CYL_SEL_CONF		def .....	7431
def .....	2867	use .....	3749
CLF_N_WHEEL_DIAG_EL		CPPWM_LIH	
def .....	5045	def .....	4708
CLF_N_WHEEL_DIAG_NO_ERR		use .....	3749
def .....	5045	CPU_LOAD	
CLF_N_WHEEL_DIAG_OC		def .....	556
def .....	5045	use .....	561
CLF_N_WHEEL_DIAG_SCG		CPU_LOAD_FIL	
def .....	5045	def .....	556
CLF_N_WHEEL_DIAG_SCP		CPU_LOAD_FIL_MAX	
def .....	5045	def .....	556
CLF_VS_PLAUS_ENA		CPU_LOAD_MAX	
def .....	5024	def .....	556
CLF_VS_SENS_ERR		use .....	561
def .....	1177	CPU_LOAD_MAX_RST_DET [NC_RST_DBG_LIST_SIZE]	
CONC_O2_CLC_DIAG_DYN_S [NC_CBK_EX_NR]		def .....	560
def .....	5313	use .....	7312
CONC_O2_CLC_DIAG_DYN_S_ST [NC_CBK_EX_NR]		CPU_LOAD_RST_DET [NC_RST_DBG_LIST_SIZE]	
def .....	5313	def .....	560
CONC_O2_CLC_INT_DIAG_DYN_S [NC_CBK_EX_NR]		use .....	7312
def .....	5313	CPU_LOAD_RST_DET_KWP	
CONC_O2_DIF_INT_DIAG_DYN_S [NC_CBK_EX_NR]		def .....	7307
def .....	5313	CPU_LOAD_SES_CTR	
CONC_O2_MES_DIAG_DYN_S [NC_CBK_EX_NR]		def .....	556
def .....	5313	CPU_LOAD_TSK_PER_CTR	
CONC_O2_MES_DIAG_DYN_S_ST [NC_CBK_EX_NR]		def .....	556
def .....	5313	CPU_LOAD_TSK_PER_MIN	
CONC_O2_MES_MAX_DIAG_DYN_S [NC_CBK_EX_NR]		def .....	556
def .....	5313	CRK_ADD_CTR	
CONF_EF		def .....	853
def .....	7679	CRK_CHG_FAC_PHA_SHIFT_AD [NC_CBK_EX_NR]	
use .....	7556	def .....	2838
CONF_OIL_LEVEL_SENS		CRK_CTR	
def .....	654	def .....	853
CONF_SOF_SWI		CRK_CYL_LAM [NC_CYL_NR]	
def .....	654	def .....	2730
use .....	1583, 3851, 4911, 6795, 7556, 7683	use .....	973, 999
CONF_SWI_EFP_OUT		CRK_CYL_LAM_DELTA_INI [NC_CBK_EX_NR]	
def .....	654	def .....	2838
use .....	1583, 4721, 8291	use .....	7483
COUNT_VS_STEP		CRK_CYL_LAM_INT [NC_CBK_EX_NR]	
def .....	7201	def .....	2838
CPPWM		CRK_DIF_SOI_IGN	
def .....	3749	def .....	1999
use .....	5407	use .....	2448
CPPWM_ADD_AD		CRK_DIF_SOI_IGN_HOM	
def .....	3756	def .....	2122
use .....	3749	use .....	2004
CPPWM_ADD_AD_MEM		CRK_DIF_SOI_IGN_S	
def .....	3756	def .....	2140
use .....	7312	use .....	2004
CPPWM_CPS		CRK_DIF_SOI_LSL_POS [NC_CBK_EX_NR]	
def .....	3749	def .....	2448
use 915, 3701, 3757, 4708, 5801, 7312, 7556, 7896,		use .....	2464
7945		CRK_INJ_1_HOM	

def .....	2200	def .....	2460
CRK_INJ_1_S		CRLC_RATIO_MMV_NS_SHIFT_DIAG [NC_NOX_SENS_	
def .....	2212	CONF]	
CRK_INJ_2_HOM		def .....	6412
def .....	2204	CRLC_SEG_AD_ER	
CRK_INJ_2_S		def .....	1473
def .....	2216	use .....	1474
CRK_INJ_3_HOM		CTL_SHIFT_LOCK_CAN	
def .....	2208	def .....	1563
CRK_INJ_3_S		use .....	7766
def .....	2220	CTR	
CRK_INJ_BAS [NC_CYL_NR]		def .....	7117
def .....	2122	CTR_0_KNK_PRE_DET [NC_NR_FRF_KNK_PRE]	
use .....	811, 2041, 2140, 2146, 2188, 8233	def .....	1952
CRK_MISS_CTR		CTR_1_CPS_AD	
def .....	853	def .....	3756
CRK_PSN_ENG_IGN_INJ_UPD [NC_CYL_NR]		CTR_1_KNK_PRE_DET [NC_NR_FRF_KNK_PRE]	
def .....	2035	def .....	1952
CRK_PSN_INJ_BAS [NC_CYL_NR]		CTR_2_CPS_AD	
def .....	2035	def .....	3756
CRK_PSN_STAT_IGN_UPD_END		CTR_ABC_ALTER_COM	
def .....	3327	def .....	4832
use .....	2041	CTR_ABC_CWP_COM	
CRK_PSN_STAT_IGN_UPD_ST		def .....	4832
def .....	3327	CTR_ABC_DET_MIS_LAM_AD_INJ [NC_CBK_EX_NR]	
use .....	2041	def .....	3348
CRK_PSN_STAT_WIN_END		CTR_ABC_END_DIAG_XX	
def .....	3327	def .....	4581, 4640
use .....	2041	use .....	5694
CRK_PSN_STAT_WIN_ST		CTR_ABC_FTL_MIN	
def .....	3327	def .....	4762
use .....	2041	CTR_ABC_IV [NC_CYL_NR]	
CRK_WIN_SEL_IGN_INJ [NC_CYL_NR]		use .....	4803
def .....	2035	CTR_ABC_KNK_PRE_DIAG [NC_CYL_NR]	
CRK_WIN_SEL_PREV		def .....	4909
def .....	2036	CTR_ABC_QOIL_COM	
CRK_WIN_SEL_TMP		def .....	4832
def .....	2036	CTR_ABC_SENS_BAT_SMT_COM	
CRLC_2_LSL_MDL [NC_CBK_EX_NR]		def .....	4832
def .....	2460	use .....	4096
CRLC_CL		CTR_ABC_TCO_2_EL	
def .....	3698	use .....	4572
CRLC_CL_TMP_0		CTR_ABC_TCO_2_GRD	
def .....	3698	use .....	4572
CRLC_CL_TMP_INI		CTR_ABC_TCO_EL	
def .....	3698	use .....	4496
CRLC_DRV2_ER		CTR_ABC_TCO_GRD	
def .....	1454	use .....	4496
CRLC_FAC_LAM_MV_MMV_CP		CTR_ABC_TQ_REQ_CAN	
def .....	3698	def .....	4851
use .....	2464	CTR_ABC_TQI_REQ_LIM	
CRLC_FAC_LAM_TCO_X [NC_CBK_EX_NR]		def .....	5008
def .....	2677	CTR_ABC_VEH_POW_VAR	
CRLC_LAM_AD [NC_CBK_EX_NR]		def .....	4945
def .....	2721	CTR_ABC_XX	
use .....	2643	def .....	4581, 4640
CRLC_LSL_MDL [NC_CBK_EX_NR]		use .....	1064, 5694

CTR_ACT_MIL		CTR_CDN_OBD_RBM	
def .....	5899	def .....	5858
CTR_AD_COLD_LAM_AD_INJ		use .....	1583, 5694
def .....	3348	CTR_CDN_RBM [NC_NR_DIAG_RBM]	
use .....	3406, 7312, 7556	def .....	5858
CTR_AD_HOT_LAM_AD_INJ		use .....	5694, 7556
def .....	3348	CTR_CDN_RBM_CLC_CAT_1	
use .....	3406, 7313, 7556	def .....	8089
CTR_ADC_OUT		CTR_CDN_RBM_CLC_CAT_2	
def .....	560	def .....	8089
CTR_AFL_AFR_CYC_DLY [NC_CBK_EX_NR]		CTR_CDN_RBM_CLC_LEAK	
def .....	5258	def .....	8089
CTR_AFL_AFR_CYC_DLY_MMV [NC_CBK_EX_NR]		CTR_CDN_RBM_CLC_LS_DOWN_1	
def .....	5258	def .....	8089
CTR_AFL_CHK_LSL_UP [NC_CBK_EX_NR]		CTR_CDN_RBM_CLC_LS_DOWN_2	
def .....	5387	def .....	8089
CTR_AFL_CYC [NC_CBK_EX_NR]		CTR_CDN_RBM_CLC_LS_UP_1	
def .....	2439	def .....	8089
use .....	1365	CTR_CDN_RBM_CLC_LS_UP_2	
CTR_AFL_PURGE [NC_NT_NR]		def .....	8089
def .....	2982	CTR_CDN_RBM_CLC_SA	
CTR_AFR_CHK_LSL_UP [NC_CBK_EX_NR]		def .....	8089
def .....	5387	CTR_CDN_RBM_CLC_VVT	
CTR_ALTER_EVE_WR		def .....	8089
def .....	4093	CTR_CH_SO2P	
CTR_AVL_MAF		def .....	1789
def .....	654	use .....	7313
CTR_BOS_READ		CTR_CHK_FUC_OPEN	
def .....	7556	def .....	5918
CTR_BSD_CPT_COM_OK		CTR_CHK_MIS_A	
def .....	4093	def .....	6237
CTR_BSD_ERR_CHK_SUM_2		CTR_CHK_MIS_B4	
def .....	8367	def .....	6237
CTR_C_T_VS_BRAKE_MAX		CTR_CNL_ROUGH_LEAK_MES_FUC	
def .....	4214	def .....	5959
CTR_CAT_DIAG [NC_CBK_EX_NR]		CTR_CNL_SMALL_LEAK_MES	
def .....	5473	def .....	5959
CTR_CBK_EX_NR_ST_CLC		CTR_CNL_SMALL_LEAK_MES_VIRT	
def .....	1754	def .....	6037
use .....	3332	CTR_COLD_ST_DOWN	
CTR_CBK_EX_NR_ST_CLC_INJR		def .....	2442
def .....	3327	CTR_COLD_ST_NT	
CTR_CBK_EX_NR_STOP_CLC		def .....	3181
def .....	1754	CTR_COLD_ST_UP	
use .....	3332	def .....	2442
CTR_CBK_EX_NR_STOP_CLC_INJR		CTR_COM_CYC_MC_DEC_RST	
def .....	3327	def .....	7072
CTR_CBK_IN_NR_ST_CLC		CTR_COM_CYC_MC_DR_DI_TMP	
def .....	1754	def .....	7072
use .....	3332	CTR_COMP_RBM [NC_NR_DIAG_RBM]	
CTR_CBK_IN_NR_ST_CLC_INJR		def .....	5858
def .....	3327	use .....	5694, 7556
CTR_CBK_IN_NR_STOP_CLC		CTR_COMP_RBM_CLC_CAT_1	
def .....	1754	def .....	8089
use .....	3332	CTR_COMP_RBM_CLC_CAT_2	
CTR_CBK_IN_NR_STOP_CLC_INJR		def .....	8089
def .....	3327	CTR_COMP_RBM_CLC_LEAK	

def .....	8089	use .....	2004, 2122, 2130, 2133, 2136, 2140, 2142, 2144, 2146, 2261
CTR_COMP_RBM_CLC_LS_DOWN_1		CTR_CYL_NR_STOP_CLC	
def .....	8089	def .....	1754
CTR_COMP_RBM_CLC_LS_DOWN_2		use .....	3332, 6118, 8244
def .....	8089	CTR_CYL_NR_STOP_CLC_INJR	
CTR_COMP_RBM_CLC_LS_UP_1		def .....	3327
def .....	8089	CTR_DC [NC_NR_ERR_DYN]	
CTR_COMP_RBM_CLC_LS_UP_2		def .....	5767
def .....	8089	use .....	5694, 5744, 5885, 7391, 7556
CTR_COMP_RBM_CLC_SA		CTR_DC_DEC_XX	
def .....	8089	def .....	5811
CTR_COMP_RBM_CLC_VVT		CTR_DC_ENA_CHK_FUC	
def .....	8089	def .....	5918
CTR_CPS_AD_HOM_REQ		CTR_DC_ERR_DET [NC_NR_ERR_DYN]	
def .....	3756	def .....	5911
CTR_CQ_FIL_FALL [NC_CBK_EX_NR]		CTR_DC_ERR_DET_DIAG_CDN [NC_NR_ERR_DYN]	
def .....	2838	def .....	5911
CTR_CQ_MAX_OSC [NC_CBK_EX_NR]		CTR_DC_ERR_DET_DIAG_CMPL [NC_NR_ERR_DYN]	
def .....	2838	def .....	5911
CTR_CQ_MON_PHA_SHIFT_AD [NC_CBK_EX_NR]		CTR_DC_INC_XX	
def .....	2838	def .....	5811
CTR_CRU_FLASH_LIGHT		CTR_DC_MAX_XX	
def .....	7201	def .....	5811
CTR_CSERS_INJ_ERR		CTR_DELTA_LSL_UP_IF [NC_CBK_EX_NR]	
def .....	6109	def .....	4285
CTR_CUR_DMTL_REF_DIF_MAX		CTR_DET_MIS_A	
def .....	5959	def .....	6237
CTR_CUR_VCV_AST_MOVE_ACT		CTR_DET_MIS_B4	
def .....	3953	def .....	6237
CTR_CUR_VCV_MAX		CTR_DIAG_ACR_AD	
def .....	3953	def .....	4320
CTR_CYC_CAT_DIAG_AFL [NC_CBK_EX_NR]		CTR_DIAG_ACR_CTL	
def .....	5561	def .....	4337
CTR_CYC_ENG_PLAUS_CAM_EX [NC_NR_CAM_CBK]		CTR_DIAG_CFM_DMTL_MAX	
def .....	4445	def .....	5959
CTR_CYC_ENG_PLAUS_CAM_IN [NC_NR_CAM_CBK]		CTR_DIAG_CFM_DMTL_MIN	
def .....	4445	def .....	5959
CTR_CYC_T_WAIT_OFS_ADJ_RED [NC_CBK_EX_NR]		CTR_DIAG_CFM_DMTL_PLAUS	
def .....	2313	def .....	5959
CTR_CYCNR_CPS_AD		CTR_DIAG_CFM_DMTL_SIG	
def .....	3756	def .....	5959
CTR_CYCNR_IGA_ES		CTR_DIAG_CFM_ROUGH_LEAK	
def .....	1909	def .....	5959
CTR_CYCNR_R_IT_LS_DOWN_VLD [NC_CBK_EX_NR]		CTR_DIAG_CFM_SMALL_LEAK	
def .....	1364	def .....	5959
use .....	4267, 5199	CTR_DIAG_CKS_CAS	
CTR_CYCNR_R_IT_OBD_LS_DOWN [NC_CBK_EX_NR]		def .....	4857
def .....	5198	CTR_DIAG_CKS_ETCU	
CTR_CYCNR_SWT_LS_DOWN [NC_CBK_EX_NR]		def .....	4857
def .....	5151	CTR_DIAG_CKS_ETCU_3	
CTR_CYL_BAL_LAM_CBK_AD [NC_CBK_EX_NR]		def .....	4857
def .....	4043	CTR_DIAG_CKS_LDM	
CTR_CYL_NR_ST_CLC		def .....	4857
def .....	1754	CTR_DIAG_CKS_MSW	
use .....	3332, 6118, 8244, 8270	def .....	4857
CTR_CYL_NR_ST_CLC_INJR		CTR_DIAG_CKS_PBR	
def .....	3327		

def .....	4857	CTR_DIAG_TCC_CAN_TQ_PSTE_2	
CTR_DIAG_CKS_REQ_PBR		def .....	4858
def .....	4857	CTR_DIAG_TCC_CAN_TQ_PSTE_3	
CTR_DIAG_CKS_TQ_AMT		def .....	4858
def .....	4857	CTR_DIAG_TCC_CAN_TQ_TCS	
CTR_DIAG_CKS_TQ_DCC		def .....	4858
def .....	4857	CTR_DIAG_TCC_CAN_TQ_TCT	
CTR_DIAG_CKS_TQ_ETCU		def .....	4858
def .....	4857	CTR_DIAG_TCC_CAN_VEH_MOD	
CTR_DIAG_CKS_TQ_PBR		def .....	4858
def .....	4857	CTR_DIAG_TOUT_ACC	
CTR_DIAG_CKS_TQ_PSTE_2		def .....	4858
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use .....	7313		def .....	1960	
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def .....	6263	def .....	7679
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use .....	8038	CTR_NS_SHIFT_CYC_NOT_VLD [NC_NOX_SENS_CONF]	
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def .....	6425	def .....	8367
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def .....	3072	def .....	5151
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def .....	3072	def .....	5151
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def .....	7679	CTR_QUO_SWT_RBM_LS_DOWN [NC_CBK_EX_NR]	
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def .....	3072	def .....	4266
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def .....	2838	CTR_RGN_CYC_LAMB_RGN	
use .....	7483	def .....	2885
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def .....	3432	def .....	6378
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def .....	3432	def .....	3053
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def .....	3432	def .....	6347
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def .....	2036	def .....	6531
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use .....	8204	def .....	2838
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def .....	4950	def .....	5387
CTR_ST_CHK_CHK_LIH_1_READY		CTR_SUM_TQ_DIF_P_D_FAST	
def .....	4950	def .....	6493
CTR_STATE_ERR_CAN		CTR_SWI_AFS_MON	
def .....	1563	def .....	6856
CTR_STATE_PREV_PBK_IV [NC_PBK_IV_NR]		use .....	7313
def .....	2036	CTR_SWT_ACT_LS_DOWN [NC_CBK_EX_NR]	

def .....	5151	def .....	6225
CTR_SWT_ACT_RBM_LS_DOWN [NC_CBK_EX_NR]		CTR_TEG_SENS_DIAG_SUM	
def .....	5151	def .....	4713
CTR_SWT_LS_DOWN [NC_CBK_EX_NR]		CTR_TEST_MOD_IV [NC_CYL_NR]	
def .....	5151	def .....	2036
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def .....	5237	def .....	3327
CTR_SYM_DIAG_LSH_LSL_UP [NC_CBK_EX_NR]		CTR_TI_ER_BAL_ENA	
def .....	5276	def .....	4006
CTR_SYM_DIAG_RGN_NT_LS_DOWN [NC_CBK_EX_NR]		CTR_TOIL_MAX	
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def .....	4266	CTR_TOT_CAT_DIAG [NC_CBK_EX_NR]	
CTR_T_EFF_IGA_CST_IS		def .....	5473
def .....	6493	CTR_TOT_KNK_PRE_DET [NC_CYL_NR]	
CTR_T_EFF_IGA_CST_PL		def .....	1952
def .....	6493	CTR_TOT_MIS	
CTR_T_LAM_CYL_ADJ [NC_CBK_EX_NR]		def .....	6283
def .....	2730	CTR_TOUT_N_ECF_CAN	
CTR_T_PER_MAF_FRQ_GRD [NC_MAF_NR]		def .....	1563
def .....	833	CTR_TPS_JAM_DET_ACT	
use .....	4815	def .....	6531
CTR_T_PER_MAF_FRQ_GRD_0 [NC_MAF_NR]		use .....	6543
def .....	833	CTR_TPS_JAM_INH	
CTR_T_PER_MAF_FRQ_GRD_1 [NC_MAF_NR]		def .....	6531
def .....	833	CTR_TPS_JAM_PER	
CTR_T_PER_MAF_FRQ_RNG [NC_MAF_NR]		def .....	6531
def .....	833	CTR_TPS_JAM_PER_MAX	
use .....	4815	def .....	6531
CTR_T_PER_MAF_FRQ_RNG_0 [NC_MAF_NR]		CTR_TPS_JAM_PLS	
def .....	833	def .....	6531
CTR_T_PER_MAF_FRQ_RNG_1 [NC_MAF_NR]		CTR_TQ_MIN_TEG_SENS_DIAG	
def .....	833	def .....	4713
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def .....	4093	def .....	4713
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def .....	4093	def .....	940
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def .....	6565	CTR_V_FUP_1	
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def .....	4093	use .....	1283
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def .....	4093	def .....	5063
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def .....	6225	def .....	5063
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def .....	4814	CTR_VLS_DOWN_AFL_CYC [NC_CBK_EX_NR]	
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def .....	2677	CTR_VLS_MV_LSL_NR_SAMPLE [NC_CBK_EX_NR]	
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def .....	5959	CTR_VLS_UP_CYL_SEL_TRIG [NC_CYL_NR]	
CTR_TD_AD_SWI		def .....	973
def .....	932	use .....	1017
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def .....	6209	def .....	3846
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def .....	5345	def .....	5960
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use .....	7313	def .....	5960
CTR_WUP_CYC [NC_NR_ERR_DYN]		CUR_DMTL_COR_FIL	
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Ctrcbr		CUR_DMTL_COR_FIL_KWP	
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use .....	8291	CUR_DMTL_COR_FIL_MAX	
Ctrpcos		def .....	5960
def .....	8156	CUR_DMTL_COR_FIL_MIN	
use .....	8291	def .....	5960
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def .....	8156	def .....	5960
use .....	8291	CUR_DMTL_DIF	
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def .....	8156	CUR_DMTL_DIF_REF_ROUGH_LEAK	
use .....	8291	def .....	5960
Ctrpwrcos		CUR_DMTL_DMTLS_TEST	
def .....	8156	def .....	5960
use .....	8291	use .....	7313
Ctrpwspcos		CUR_DMTL_REF_DIF_MAX	
def .....	8156	def .....	5960
use .....	8291	CUR_DMTL_REF_LEAK	
CUR_ALTER_EXCT		def .....	5960
def .....	4093	use .....	7313
use .....	8369	CUR_DMTL_REF_LEAK_EOL	
CUR_ALTER_EXCT_LIM		def .....	5960
def .....	4093	use .....	7766
use .....	4096, 8369	CUR_DMTL_REF_LEAK_KWP	
CUR_ALTER_EXCT_LIM_SP		def .....	7307
def .....	8367	CUR_DMTL_ROUGH_LEAK_END	
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def .....	8367	CUR_DMTL_ROUGH_LEAK_LEN_END	
CUR_ALTER_MON		def .....	5960
def .....	6789	CUR_DMTL_ROUGH_LEAK_MIN	
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def .....	2036	use .....	7313
use .....	3432	CUR_DMTL_ROUGH_LEAK_MIN_EOL	
CUR_CHA_OFS_CNL_OUT [NC_PBK_IV_NR]		def .....	5960
def .....	3432	use .....	7766
use .....	2041	CUR_DMTL_ROUGH_LEAK_MIN_KWP	
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def .....	4093	CUR_DMTL_SMALL_LEAK_END	
use .....	7313	def .....	5960
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use .....	7313	def .....	5960
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use .....	7313	def .....	5961
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def .....	5960	def .....	5961
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def .....	5960	def .....	1563
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def .....	8368	def .....	797
use .....	1583	use .....	1912
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def .....	8285	def .....	5345
use .....	1583	CYCNR_DIAG_DYN_LSL_UP_ERR [NC_CBK_EX_NR]	
CUR_SC_MAX_CAN		def .....	5345
def .....	1563	CYCNR_DIAG_LSH_LSL_UP [NC_CBK_EX_NR]	
use .....	8291	def .....	5276
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def .....	1563	def .....	4903
use .....	8291	CYCNR_INH_IV_KNK_PRE_DET [NC_CYL_NR]	
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def .....	3953	CYCNR_INT_KNKS_DIAG [NC_NR_SENS_KNK]	
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def .....	3953	CYCNR_KNK_PRE_DET	
use .....	6062	def .....	1960
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def .....	3953	def .....	1952
use .....	6062	CYL_ID_KNK	
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def .....	3880	use .....	1952, 4909, 8304
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use .....	3956	def .....	8199
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def .....	3953	def .....	8156
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use .....	6062	use .....	5694, 5767
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def .....	3953	use .....	5694, 5767, 7556
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def .....	3953	DELTA_CRK_DIF_MAX_ER	
CUR_WKU_CAN		def .....	1473
def .....	1563	DELTA_LAMB_AV [NC_CBK_EX_NR]	
use .....	8291	def .....	2730
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def .....	1766	def .....	2730
use .....	811, 1720, 1925, 2100, 2179, 8221	DELTA_LAMB_CYL_SEL [NC_CBK_EX_NR]	
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def .....	1563	DELTA_LAMB_CYL_SEL_CQ [NC_CBK_EX_NR]	
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def .....	1563	use .....	2840
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def .....	4855	def .....	2730
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DELTA_LAMB_ERR [NC_CBK_EX_NR]		DIST_DTC_CLR	
def .....	2730	def .....	5899
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def .....	2730	DIST_IV_CHG [NC_CYL_NR]	
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def .....	1014	def .....	3261
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def .....	2730	def .....	5801
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def .....	1037	def .....	1183
use .....	2545	use .....	1223, 2289, 3261, 3349, 4044, 4145, 5801
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def .....	2613	def .....	3348
Dfds [16]		use .....	7313, 7557
def .....	8156	DIST_LAM_AD_INJ_HOT	
use .....	7556	def .....	3348
Dffgen		use .....	7313, 7557
def .....	8156	DIST_NS_NEW	
use .....	7313, 8369	def .....	3193
DFFGEN_FIL_MON		use .....	3074, 6428, 7557
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def .....	8368	use .....	3193
Dfmonitor		DIST_NT	
def .....	8156	def .....	3180
use .....	7557, 8369	use .....	3054, 3074, 3177, 3193, 6428
Dfsiggen		DIST_NT_NS_AD [NC_NOX_SENS_CONF]	
def .....	8368	def .....	3189
use .....	7313	use .....	7313, 7557
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def .....	5767	def .....	7679
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def .....	3072	def .....	6425
DIF_FCO_FTL		use .....	7313, 7557
def .....	5961	DIST_NT_NS_SHIFT_EXT_ADJ [NC_NOX_SENS_CONF]	
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def .....	5961	use .....	6428
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def .....	5961	def .....	3177
Disa_ist		DIST_REL_ACT_MIL	
def .....	8398	def .....	5899
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def .....	1183	def .....	5899
use .....	561, 1583, 2988, 5801, 5899	DIST_RESI_OIL	
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def .....	5899	use .....	1583
use .....	7313, 7391, 7896, 7945	DIST_RESI_OIL_KM	
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def .....	2982	def .....	4145
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def .....	1789	DIST_RST_DET [NC_RST_DBG_LIST_SIZE]	


def .....	560	use .....	8270
use .....	7313	Dwese2_kh_h	
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def .....	1789	DYW_KNKS_DIAG [NC_NR_SENS_KNK]	
use .....	7313	def .....	4903
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def .....	7307	def .....	8156
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def .....	1223	Dzw_agr_kor	
use .....	7391, 7557, 7683	def .....	8156
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def .....	8156	Dzw_annm	
use .....	8199, 8340	def .....	8156
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def .....	6133	Dzw_kh_s	
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def .....	1489	Dzw_kr [NC_CYL_NR]	
DLY_ER_RR		def .....	8304
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use .....	8279	def .....	1564
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def .....	8232	def .....	3596
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def .....	1454	ECFPWM_ECF	
use .....	6209	def .....	1045
DRV0_ER_SUM_OSC		use .....	915, 1232, 8226
def .....	6209	ECFPWM_ECF_EXT_ADJ	
DRV0_ER_SUM_THD_OSC		def .....	7431
def .....	6209	use .....	3596
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def .....	1454	def .....	3596
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def .....	1489	use .....	7313
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def .....	1454	def .....	8156
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def .....	8232	Eco_mz	
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def .....	8156	Eco_result1	

def .....	8156	def .....	5515
use .....	7738	EFF_EGR_S	
Eco_timo		def .....	6658
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def .....	3863	use .....	6494, 6656
use .....	915, 4516	EFF_IGA_AV_CAN	
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def .....	3858	use .....	1583
use .....	848, 915, 4530, 5660, 5672, 7313	EFF_IGA_AV_CBK [NC_CBK_EX_NR]	
ECTPWM_CLC		def .....	1845
def .....	8225	use .....	8381
use .....	3858	EFF_IGA_BAS_COR	
ECTPWM_EXT_ADJ		def .....	1845
def .....	7431	use .....	1583, 6661, 6665
use .....	3858	EFF_IGA_BAS_COR_CBK [NC_CBK_EX_NR]	
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def .....	8089	use .....	1948
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def .....	8089	def .....	1845
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def .....	8090	EFF_IGA_CST_LIM	
ECU_ID_SW [NC_NR_CAL_CHAR_LEN]		def .....	6597
def .....	8090	EFF_IGA_CST_LIM_EXT_ADJ	
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def .....	654	use .....	6597, 7544
use .....	1091	EFF_IGA_CST_QUO_IS	
ECU_STATE		def .....	6493
def .....	1091	use .....	6517, 6597
use 903, 1048, 1198, 1583, 3596, 3772, 3956, 4096,		EFF_IGA_CST_QUO_IS_MAX	
4233, 4357, 4627, 4824, 4851, 5971, 6532, 7313,		def .....	6493
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def .....	7556	EFF_IGA_CST_QUO_PL_MAX	
ecu_type [16]		def .....	6493
def .....	7386	use .....	7313
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def .....	8090	def .....	6493
EFF_CAT_DIAG [NC_CBK_EX_NR]		EFF_IGA_HOM_MON	
def .....	5535	def .....	6753
use 2590, 2613, 2622, 2913, 2928, 2958, 5217, 5553		EFF_IGA_HOM_MON2	
EFF_CAT_DIAG_HOM [NC_CBK_EX_NR]		def .....	7010
def .....	5473	EFF_IGA_HOMS_MON	
use .....	5515, 5535, 6428	def .....	6753
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def .....	5515	def .....	7010
use .....	1037, 7313, 8038	EFF_IGA_INV_COR_CBK	
EFF_CAT_DIAG_SUM		def .....	1948
def .....	5515	EFF_IGA_INV_COR_CBK_CAN	
EFF_CAT_DIAG_TMP [NC_CBK_EX_NR]		def .....	1948
def .....	5515	EFF_IGA_MIN	
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def .....	5515	use .....	6494, 6661, 8381
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EFF_CAT_MAX_DIAG_TMP [NC_CBK_EX_NR]		def .....	8390

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def .....	1948	use .....	811
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def .....	6493	def .....	6753
use .....	6597	use .....	6774
EFF_LAMB_AV		EFF_TOT_MON2	
def .....	8379	def .....	7010
use .....	981, 1583, 6656, 6661	EFF_TOT_WOUT_IGA	
EFF_LAMB_AV_CBK [NC_CBK_EX_NR]		def .....	981
def .....	8379	use .....	6597
use .....	1948	EFF_VOL_TEMP_COR	
EFF_LAMB_BAS_COR		def .....	1206
def .....	8379	EFF_VOL_TEMP_COR_MMV	
use .....	1583, 6661, 6665	def .....	1206
EFF_LAMB_HOM_MON		use .....	8279
def .....	6753	EFPPWM	
EFF_LAMB_HOM_MON2		def .....	3796
def .....	7010	use .....	989, 4733, 7313
EFF_LAMB_HOMS_MON		EFPPWM_BAS	
def .....	6753	def .....	3796
EFF_LAMB_HOMS_MON2		EFPPWM_CAN	
def .....	7010	def .....	988
EFF_LAMB_S_MON		use .....	1583, 8291
def .....	6753	EFPPWM_EXT_ADJ	
EFF_LAMB_S_MON2		def .....	7431
def .....	7010	use .....	3797
EFF_LAMB_SP_BAS		EFPPWM_I	
def .....	8379	def .....	3796
use .....	6661	use .....	6051, 7313
EFF_MFF_TQ_COR_MON		EFPPWM_I_AD	
def .....	6789	def .....	3796
use .....	6774	use .....	6051, 7313
EFF_MFF_TQ_COR_MON2		EFPPWM_I_AD_DIF	
def .....	7010	def .....	3796
EFF_PHA_S		EFPPWM_I_TMP	
def .....	6658	def .....	3796
EFF_SCC_AV		EFPPWM_KWP	
def .....	6665	def .....	7307
use .....	981, 1948, 2943, 3846, 6656, 6661, 6761, 8270	EFPPWM_MIN_AD	
EFF_SCC_AV_CAN		def .....	3796
def .....	6665	use .....	6051, 7313
use .....	1583	EFPPWM_P	

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def .....	3796	def .....	3215
EGR_RATIO		EGY_LEVEL_IV_BAL_CONV [NC_CYL_NR]	
def .....	8277	def .....	3215
use .....	2968, 2976, 3113	use .....	2261
EGR_RATIO_COR_2		EGY_LEVEL_IV_BAL_CTL [NC_CYL_NR]	
def .....	1921	def .....	3215
EGR_RATIO_SP		EGY_LEVEL_IV_BAL_CTL_MAX [NC_CYL_NR]	
def .....	8197	def .....	3215
use .....	1921	EGY_LEVEL_IV_BAL_LIM	
EGY_ADD_AD [NC_CYL_NR]		def .....	3215
def .....	2260	EGY_MAX_V_LIM [NC_CYL_NR]	
use .....	2278	def .....	2277
EGY_ADD_COR_EXT [NC_CYL_NR]		EGY_SP [NC_CYL_NR]	
def .....	2289	def .....	2277
use .....	2278	EGY_SP_IV_EXT [NC_CYL_NR]	
EGY_ADD_DUCY		def .....	2289
def .....	2230	use .....	2278
use .....	2278	EGY_SP_IV_EXT_ADJ [NC_CYL_NR]	
EGY_ADD_FUP [NC_CBK_HPP_NR]		def .....	7679
def .....	2228	use .....	2289, 4790, 7557
use .....	2278	EGY_SP_NOT_LIM [NC_CYL_NR]	
EGY_ADD_TEMP		def .....	2277
def .....	2226	EGY_STEP_INJ_CHA_GRD [NC_CYL_NR]	
use .....	2278	def .....	2277
EGY_COLD_IGC		use .....	2041, 7313
def .....	1896	EGY_STEP_INJ_CHA_GRD_BAS [NC_CYL_NR]	
EGY_DEW_END_NT		def .....	2277
def .....	3181	use .....	2261
use .....	7766	EGY_STEP_INJ_CHA_GRD_DIF_HOM [NC_CYL_NR]	
EGY_DEW_END_NT_INT		def .....	2260
def .....	3181	EGY_STEP_INJ_CHA_GRD_DIF_S [NC_CYL_NR]	
use .....	7766	def .....	2260
EGY_DEW_NT_DOWN		EGY_STEP_INJ_CHA_GRD_L [NC_CYL_NR]	
def .....	8236	def .....	2277
use .....	3181	use .....	2041
EGY_DEW_NT_STOP		EGY_STEP_INJ_CHA_GRD_LIM_NOT [NC_CYL_NR]	
def .....	3181	def .....	2260
EGY_HEAT_IGC		EGY_STEP_INJ_CHA_GRD_OFS	
def .....	1896	def .....	2277
EGY_HEAT_IGC_HOM		EGY_STEP_INJ_CHA_LIM_DIF [NC_CYL_NR]	
def .....	1896	def .....	2277
EGY_HEAT_IGC_S		use .....	2261
def .....	1896	EGY_STEP_INJ_DCHA_GRD [NC_CYL_NR]	
EGY_IV_1_CLC [NC_CYL_NR]		def .....	2277
def .....	2036	use .....	2041
use .....	2241, 2278	EGY_STEP_INJ_DCHA_GRD_L [NC_CYL_NR]	
EGY_IV_2_CLC [NC_CYL_NR]		def .....	2277
def .....	2036	use .....	2041
EGY_IV_POST_CLC [NC_CYL_NR]		Eisyagr_korfak_b	
def .....	2036	def .....	8156
EGY_LAM_ADJ_COR_LAM_AD_CUS [NC_CYL_NR]		use .....	7313
def .....	8308	Eisydk_korfak_b	
use .....	2289	def .....	8156
EGY_LEVEL_IV_BAL [NC_CYL_NR]		use .....	7557
def .....	3215	Eisydk_koroff_b	
use .....	2261	def .....	8157
EGY_LEVEL_IV_BAL_ADJ [NC_CYL_NR]		use .....	7557

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Eisyev_korfak_b		ENVD_PREV_OBD [NC_NR_ENVD_OBD][NC_NR_ENVD_	
def .....	8157	PREV]	
use .....	7557	def .....	5792
Eisyev_koroff_b		EOI_1_HOM	
def .....	8157	def .....	2122
use .....	7557	use .....	2130, 6118, 8270
Enginespeedhysteresisfordeactivationofruntimereduction		EOI_1_HOMS_EXT [NC_CYL_NR]	
def .....	1754	def .....	2146
Enginespeedthresholdforactivationofruntimereduction		use .....	2136
def .....	1754	EOI_1_MES [NC_CYL_NR]	
ENVD_0_MON_3		def .....	2036
def .....	7158	use .....	6118, 6761
use .....	7313	EOI_1_S [NC_CYL_NR]	
ENVD_1_MON_3		def .....	2140
def .....	7158	use .....	2041, 2212
use .....	7313	EOI_1_S_EXT [NC_CYL_NR]	
ENVD_2_MON_3		def .....	2146
def .....	7158	use .....	2140
use .....	7313	EOI_1_SOI_2_GAP_HOM	
ENVD_3_MON_3		def .....	2130
def .....	7158	EOI_2_DELTA_MPLH_CH	
use .....	7313	def .....	2159
ENVD_CONF_CUS_CMN [NC_NR_ENVD_CUS_CMN]		use .....	8233
def .....	5801	EOI_2_HOM [NC_CYL_NR]	
use .....	5792	def .....	2130
ENVD_CONF_CUS_SET_CMN [NC_NR_ENVD_CUS_SET_		use .....	2041, 2133, 2204, 6118
CMN]		EOI_2_HOM_CSERS_TEST [NC_CYL_NR]	
def .....	5801	def .....	2036
use .....	5792	EOI_2_HOM_CUS [NC_CYL_NR]	
ENVD_CONF_OBD [NC_NR_ENVD_OBD]		def .....	8269
def .....	5801	use .....	2146
use .....	5792	EOI_2_HOM_EXT [NC_CYL_NR]	
ENVD_CUS_CMN [NC_NR_ENVD_CUS_CMN][NC_NR_ERR_		def .....	2146
DYN]		use .....	2004, 2122, 2130
def .....	5792	EOI_2_HOM_INTER [NC_CYL_NR]	
use .....	5694, 7391	def .....	2130
ENVD_CUS_SET_CMN [NC_NR_ENVD_CUS_SET_CMN][NC_		EOI_2_HOMS [NC_CYL_NR]	
NR_FRF_SET][NC_NR_ERR_DYN]		def .....	2136
def .....	5792	use .....	2041
use .....	5694, 5744, 5825, 7381, 7391, 7557	EOI_2_HOMS_CUS [NC_CYL_NR]	
ENVD_CUS_SET_SPC [NC_NR_ENVD_CUS_SET_SPC][NC_		use .....	2146
NR_FRF_SET][NC_NR_ERR_DYN]		EOI_2_HOMS_EXT [NC_CYL_NR]	
def .....	5792	def .....	2146
use .....	5694, 7381, 7391, 7557	use .....	2136
ENVD_OBD [NC_NR_ENVD_OBD][NC_NR_ERR_DYN]		EOI_2_MES [NC_CYL_NR]	
def .....	5792	def .....	2036
use .....	5694, 7391, 7557	use .....	6118, 6761
ENVD_PREV_CUS_CMN [NC_NR_ENVD_CUS_CMN][NC_		EOI_2_S [NC_CYL_NR]	
NR_ENVD_PREV]		def .....	2142
def .....	5792	use .....	2216
ENVD_PREV_CUS_SET_CMN [NC_NR_ENVD_CUS_SET_		EOI_2_S_EXT [NC_CYL_NR]	
CMN][NC_NR_ENVD_PREV]		def .....	2146
def .....	5792	use .....	2142
ENVD_PREV_CUS_SET_SPC [NC_NR_ENVD_CUS_SET_		EOI_2_SOI_3_GAP_HOM	
SPC][NC_NR_ENVD_PREV]		def .....	2133
def .....	5792	EOI_3_HOM [NC_CYL_NR]	
		def .....	2133

use .....	2041, 2208, 6118	def .....	4762
EOI_3_HOM_CSERS_TEST [NC_CYL_NR]		ER_MMV_IS_DIAG [NC_CYL_NR]	
def .....	2037	def .....	4375
EOI_3_HOM_CUS [NC_CYL_NR]		use .....	7557
use .....	2146	ER_RAW	
EOI_3_HOM_EXT [NC_CYL_NR]		def .....	1454
def .....	2146	ER_STD_BAL [NC_CYL_NR]	
use .....	2004, 2133	def .....	1489
EOI_3_HOM_INTER [NC_CYL_NR]		ER_STD_DIF_BAL	
def .....	2133	def .....	1489
EOI_3_HOMS [NC_CYL_NR]		ER_STD_MMV_BAL [NC_CYL_NR]	
def .....	2136	def .....	1489
use .....	2041	use .....	4006, 4036
EOI_3_HOMS_CUS [NC_CYL_NR]		ER_STND	
def .....	8269	def .....	1454
use .....	2146	use .....	6276
EOI_3_HOMS_EXT [NC_CYL_NR]		ER_STND_BAL	
def .....	2146	def .....	1489
use .....	2136	ER_STND_CYL [NC_CYL_NR]	
EOI_3_S [NC_CYL_NR]		def .....	1454
def .....	2144	ER_STND_FAC_TI_ER_BAL	
use .....	2220	def .....	3298
EOI_3_S_CUS [NC_CYL_NR]		ER_STND_FIL_BAL	
def .....	8269	def .....	1489
use .....	2146	ER_STND_MFF_ADD_ER_BAL	
EOI_3_S_EXT [NC_CYL_NR]		def .....	3269
def .....	2146	ER_STND_MMV_BAL [NC_CYL_NR]	
use .....	2144	def .....	1489
EOI_INJ_UPD_PSN		use .....	4006, 4036
def .....	2037	ER_STND_MMV_DIF_ABSV_SUM_GRD [NC_CBK_EX_NR]	
EOI_LIM [NC_CYL_NR]		def .....	2838
def .....	797	ER_STND_MMV_DIF_ABSV_SUM_PRE [NC_CBK_EX_NR]	
use .....	7194	def .....	2838
EOI_LIM_HOM		ER_STND_MMV_DIF_BAL [NC_CYL_NR]	
def .....	2122	def .....	1489
use .....	2041	use .....	2840, 3269, 3298, 4044
EOI_LIM_POST		ER_STND_MMV_DIF_BAL_ABSV_SUM [NC_CBK_EX_NR]	
def .....	2188	def .....	2839
use .....	2041	ER_STND_MMV_DIF_BAL_DYW	
EOI_MES_CSERS [NC_NR_IV_PLS] [NC_CYL_NR]		def .....	4043
def .....	6117	ER_STND_MMV_DIF_BAL_MAX_DYW	
use .....	6109	def .....	4043
EOI_POST_INJ [NC_CYL_NR]		ER_STND_MMV_DIF_BAL_MIN_DYW	
def .....	2188	def .....	4043
EOI_POST_MES [NC_CYL_NR]		ER_STND_MMV_MV_BAL	
def .....	2037	def .....	1489
use .....	6118, 6761	ER_STND_MMV_STD_BAL [NC_CYL_NR]	
ER		def .....	1489
def .....	1454	use .....	4036
use .....	1469, 1489, 4763, 6276	ERR_COD_ERR_MEM_ACT	
ER_AV_QUO		def .....	7062
def .....	1469	ERR_COD_ERR_MEM_OLD	
use .....	8211	def .....	7062
ER_CYL [NC_CYL_NR]		ERR_COD_MC	
def .....	1454	def .....	7072
use .....	4375, 7313, 8211	use .....	7062, 7158
ER_FTL_MIN		ERR_COD_MU	



def .....	7072	ERR_DIAG_VCV	
use .....	7062, 7158	def .....	4729
ERR_DIAG_ACK_IGK_OFF		ERR_DIAG_VIM_1	
def .....	4939	def .....	5063
ERR_DIAG_AEB [NC_AEB_NR]		ERR_DIAG_VIM_2	
def .....	4942	def .....	5063
ERR_DIAG_CTL_LSL_UP [NC_CBK_EX_NR]		ERR_DIAG_WG_1_DR	
def .....	5248	def .....	4206
ERR_DIAG_DMTLH		ERR_DIAG_WG_2_DR	
def .....	4623	def .....	4206
ERR_DIAG_EBOX_CFA		ERR_DIAG_XX	
def .....	4623	def .....	4614
ERR_DIAG_ECFPWM [NC_ECF_NR]		use .....	4614
def .....	4507	ERR_DTC [NC_NR_ERR_DYN]	
use .....	4508	def .....	5756
ERR_DIAG_ECRASPWM		use .....	5821, 7381, 7384, 7391, 7557
def .....	4514	ERR_ECFPWM_FB [NC_ECF_NR]	
ERR_DIAG_ECT_EL		def .....	4507
def .....	4529	use .....	4508
ERR_DIAG_EF		ERR_ECRASPWM_FB	
def .....	4623	def .....	4514
ERR_DIAG_EL_CPS		ERR_HIS [NC_NR_ERR_HIS] [NC_NR_HIS]	
def .....	4708	def .....	5821
ERR_DIAG_IV [NC_CYL_NR]		ERR_HIS_CONF [NC_NR_HIS]	
def .....	4802	def .....	5825
ERR_DIAG_LSH_DOWN [NC_CBK_EX_NR]		use .....	5821
def .....	4248	ERR_HIS_DTC [NC_NR_ERR_HIS]	
use .....	944	def .....	5821
ERR_DIAG_LSH_UP [NC_CBK_EX_NR]		ERR_INH_FSD [NC_CBK_EX_NR]	
def .....	4315	def .....	1014
use .....	944	use .....	6199
ERR_DIAG_PBK_IV [NC_PBK_IV_NR]		ERR_INH_LAM_AD_ACT [NC_CBK_EX_NR]	
def .....	4797	def .....	1014
ERR_DIAG_POIL_DR		use .....	2721, 8310
def .....	4357	ERR_INH_LAM_ADJ [NC_CBK_EX_NR]	
ERR_DIAG_RAS		def .....	1014
def .....	4569	use .....	2613
ERR_DIAG_RFP_DR		ERR_INH_LSCL [NC_CBK_EX_NR]	
def .....	4203	def .....	1014
ERR_DIAG_RLY_ACCOUT		use .....	2545
def .....	4623	ERR_INTM_CTR_FRC [NC_NR_ERR_INTM]	
ERR_DIAG_RLY_CRCV_HEAT		def .....	4610
def .....	4623	ERR_INTM_DIAG_INST [NC_NR_ERR_INTM]	
ERR_DIAG_RLY_DMTL_PUMP		def .....	4610
def .....	4623	ERR_LS_DOWN [NC_CBK_EX_NR]	
ERR_DIAG_RLY_DMTLS		def .....	1006
def .....	4624	use .....	1017
ERR_DIAG_RLY_MTC_HEAT		ERR_LS_UP [NC_CBK_EX_NR]	
def .....	5004	def .....	1006
ERR_DIAG_RLY_ST		use .....	1017
def .....	4624	ERR_NS [NC_NOX_SENS_CONF]	
ERR_DIAG_SLV_IVVT_EX		def .....	1380
def .....	4624	use .....	4916
ERR_DIAG_SLV_IVVT_IN		ERR_PERM [NC_NR_ERR_PERM]	
def .....	4624	def .....	5842
ERR_DIAG_SOF		ERR_RLY_MAIN	
def .....	4911	def .....	4933

ERR_SYM_ACK_IGK_OFF	def .....	4862
def .....	4939	ERR_SYM_BN_GEAR_REV
ERR_SYM_ACR_AD	def .....	4862
def .....	4320	ERR_SYM_BN_ICL
ERR_SYM_ACR_CTL	def .....	4862
def .....	4337	ERR_SYM_BN_KM_ICL
ERR_SYM_ACR_DR	def .....	4862
def .....	4347	ERR_SYM_BN_LDM
ERR_SYM_AEB [NC_AEB_NR]	def .....	4862
def .....	4942	use .....
ERR_SYM_AIR_LSL_UP [NC_CBK_EX_NR]	def .....	6985
def .....	5282	ERR_SYM_BN_LTG_HDLP_L
ERR_SYM_ALTER_BN	def .....	4862
def .....	1049	ERR_SYM_BN_MSW
ERR_SYM_ALTER_BN_BAT	def .....	4863
def .....	1049	ERR_SYM_BN_PBR
ERR_SYM_ALTER_BN_RGN	def .....	4863
def .....	1049	ERR_SYM_BN_POW_GEN
ERR_SYM_ALTER_COM	def .....	4863
def .....	4832	ERR_SYM_BN_POW_VB
ERR_SYM_AMP	def .....	4863
def .....	4822	ERR_SYM_BN_REQ_PBR
ERR_SYM_AMP_PLAUS	def .....	4863
def .....	6128	ERR_SYM_BN_SPT_SWI
ERR_SYM_AMP_PLAUS_CUS	def .....	4863
def .....	1049	ERR_SYM_BN_STAT_TCT
ERR_SYM_BAT_SENS	def .....	4863
def .....	1049	ERR_SYM_BN_T_CLK
ERR_SYM_BAT_SENS_IT	def .....	4864
def .....	1049	ERR_SYM_BN_T_ICL
ERR_SYM_BAT_SENS_IT_EL	def .....	4864
def .....	1049	ERR_SYM_BN_TCS
ERR_SYM_BN_ACC	def .....	4864
def .....	4860	ERR_SYM_BN_TQ_AMT
ERR_SYM_BN_ANG_PSTE	def .....	4864
def .....	4860	use .....
ERR_SYM_BN_ARS	def .....	6985
def .....	4860	ERR_SYM_BN_TQ_DCC
use .....	1583	def .....
ERR_SYM_BN_CAS	def .....	4864
def .....	4861	use .....
ERR_SYM_BN_CDN_DOOR	def .....	1583, 5051, 6985
def .....	4861	ERR_SYM_BN_TQ_ETCU
ERR_SYM_BN_DHL_CTL	def .....	4864
def .....	4861	def .....
ERR_SYM_BN_EFP	def .....	4864
def .....	4861	ERR_SYM_BN_TQ_PSTE_2
ERR_SYM_BN_EFP_CRASH	def .....	4865
def .....	4861	def .....
ERR_SYM_BN_ETCU	def .....	4865
def .....	4861	ERR_SYM_BN_TQ_PSTE_3
use .....	6697, 6985	def .....
ERR_SYM_BN_ETCU_2	def .....	4865
def .....	4861	ERR_SYM_BN_TQ_TCS
ERR_SYM_BN_ETCU_3	def .....	4865
def .....	4862	def .....
ERR_SYM_BN_ETCU_DISP	def .....	1583, 6697
		ERR_SYM_BN_TQ_TCT
		def .....
		ERR_SYM_BN_TRL
		def .....
		ERR_SYM_BN_VEH_MOD
		def .....
		4865


ERR_SYM_BN_VS_TCS		ERR_SYM_CWP_PWR	
def .....	4865	def .....	4536
use .....	6697	ERR_SYM_CYL_BAL_ER [NC_CYL_NR]	
ERR_SYM_BN_WHEEL_CAN		def .....	5112
def .....	4866	ERR_SYM_CYL_BAL_LAM [NC_CYL_NR]	
ERR_SYM_BSD		def .....	5112
def .....	4833	ERR_SYM_DCC	
ERR_SYM_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]		def .....	5051
def .....	1050	ERR_SYM_DELTA_I_LAM [NC_CBK_EX_NR]	
ERR_SYM_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]		def .....	5215
def .....	1050	ERR_SYM_DIAGCPS	
ERR_SYM_CAN_BOFF		def .....	5926
def .....	4846	ERR_SYM_DMTL_MAX	
ERR_SYM_CAT_DIAG [NC_CBK_EX_NR]		def .....	5961
def .....	5515	ERR_SYM_DMTL_MIN	
use .....	5535	def .....	5961
ERR_SYM_CAT_DIAG_AFL [NC_CBK_EX_NR]		ERR_SYM_DMTL_PLAUS	
def .....	5561	def .....	5961
use .....	5535	ERR_SYM_DMTL_PUMP	
ERR_SYM_CAT_DIAG_SUM [NC_CBK_EX_NR]		def .....	4624
def .....	5535	ERR_SYM_DMTL_SIG	
ERR_SYM_CHG_LS_DOWN		def .....	5961
def .....	5387	ERR_SYM_DMTLH	
ERR_SYM_CHG_LS_UP		def .....	4624
def .....	5416	ERR_SYM_DMTLS	
ERR_SYM_CHK_FUC		def .....	4624
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FAC_TI_COR_IV_EGY_RNG_L [NC_CBK_HPP_NR]		FAC_TQ_ADD_IS_BOL_OPM_2	
def .....	2260	def .....	3544
use .....	2004, 2200, 2204, 2208, 2212, 2216, 2220	FAC_TQ_ADD_IS_OPM_SEL	
FAC_TI_DIF_BAL [NC_CYL_NR]		def .....	8212
def .....	3215	use .....	3442, 3544
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def .....	3298	def .....	8232
use .....	3215, 7314	use .....	6582
FAC_TI_ER_BAL_COR [NC_CYL_NR]		FAC_TQ_CRU	
def .....	3298	def .....	7237
FAC_TI_ER_BAL_CTL		use .....	6737
def .....	3298	FAC_TQ_CRU_INI	
FAC_TI_ER_BAL_CTL_I [NC_CYL_NR]		def .....	7237
def .....	3298	use .....	6737
FAC_TI_ER_BAL_CTL_MAX		FAC_TQ_DIF_IS_AD	
def .....	3298	def .....	3518
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def .....	3298	def .....	6710
FAC_TI_ER_BAL_LIM [NC_CYL_NR]		FAC_TQ_EF_THD	
def .....	3298	def .....	3614
FAC_TI_EXT_ADJ		FAC_TQ_EF_THD_CTOP	
def .....	3327	def .....	3614
use .....	2233	FAC_TQ_LOSS_OPM_SEL	
FAC_TI_L_PRS		def .....	8385
def .....	3327	use .....	3520
use .....	2004, 6761	FAC_TQ_REQ	
FAC_TI_PRS_COR_1		def .....	6706
def .....	1999	use .....	1112, 2585, 2633, 3614, 3851, 5350, 5506
use .....	6761	FAC_TQ_REQ_CLU	
FAC_TI_PRS_COR_1_HOM [NC_CBK_HPP_NR]		def .....	6706
def .....	1999	use .....	8391
FAC_TI_PRS_COR_2		FAC_TQ_REQ_CLU_LDM	
def .....	1999	def .....	6706
use .....	6761	use .....	1442
FAC_TI_PRS_COR_2_HOM [NC_CBK_HPP_NR]		FAC_TQ_REQ_CRU	
def .....	1999	def .....	6737
FAC_TI_PRS_COR_2_S [NC_CBK_HPP_NR]		use .....	1270, 6706, 6912, 7228, 7237, 8397
def .....	1999	FAC_TQ_REQ_CRU_MON	
FAC_TI_PRS_COR_3		def .....	6912
def .....	2000	use .....	6851
use .....	6761	FAC_TQ_REQ_CRU_MON2	
FAC_TI_PRS_COR_3_HOM [NC_CBK_HPP_NR]		def .....	7010
def .....	2000	FAC_TQ_REQ_DCC	
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use .....	1270, 6706	FAC_VS_CTL_CRU	
FAC_TQ_REQ_DELTA_LDC		def .....	7237
def .....	2585	FAC_VS_LGRD_CRU	
use .....	2545, 3349	def .....	7237
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def .....	6570	def .....	7259
use .....	1759, 6706, 6737, 7215, 7228, 7237	use .....	7253
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use .....	7237	use .....	7253
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def .....	6851	def .....	8285
use .....	6795	Fak_er_schw	
FAC_TQ_REQ_DRIV_MON2		def .....	8211
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def .....	2585	use .....	1583, 6428, 8291
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def .....	6851	def .....	3846
use .....	6795, 6938	FCO_AV_1	
FAC_TQ_REQ_MON2		def .....	3846
def .....	7010	use .....	6428
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def .....	3348	FCO_AV_DMTL	
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def .....	3851	FCO_AV_MMV	
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def .....	2090	FCO_DELTA_NS_SHIFT [NC_NOX_SENS_CONF]	
use .....	2041	def .....	6425
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def .....	3954	def .....	3846
FAC_V_SLOP_PVS_MON		use .....	5971
def .....	6961	FCO_FIL_DIF	
FAC_VAL_LAM_CYL_SEL_REAC		def .....	3846
def .....	2731	FCO_FIL_DIF_FB	
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def .....	5346	FCO_MFF_ADD_CYL_CP	
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FAC_VALUE_MAX_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]		def .....	8285
def .....	5346	Fho	
FAC_VALUE_MIN_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]		def .....	8277
def .....	5346	FLOW_COR_CPS	
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def .....	3954	def .....	3635
FAC_VFF_VCV_MIN		use .....	3701, 4377
def .....	3954	FLOW_CPS_OLD_1	

def .....	3635	FRQ_CPS_AD	
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def .....	3635	use .....	3749
FLOW_CPS_SP_MIN_PURGE		FRQ_POIL_PWM	
def .....	3630	def .....	8202
use .....	3638	FRQ_R_IT_OSC_LSL_IF_SPI_RD [NC_CBK_EX_NR]	
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def .....	3635	use .....	1313, 1321
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def .....	3635	FRQ_REQ_CP	
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def .....	3635	def .....	3954
use .....	3701	Ftbr	
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def .....	3635	FTL	
FLOW_DLY_OLD_2_CP		def .....	1564
def .....	3635	use .....	1777, 3630, 3823, 5801, 5919, 5971, 6051, 7314, 8292
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def .....	3635	def .....	5962
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def .....	3635	def .....	1564
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def .....	3630	FTL_LE_MMV	
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def .....	3630	def .....	4762
use .....	3638	FTL_OLD	
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def .....	3635	FTL_ST	
use .....	5929	def .....	5962
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def .....	1001	def .....	5962
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FLOW_TAR_CPS		def .....	3908
def .....	3635	FUEL_MASS_AD_DIF	
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def .....	3635	FUEL_MASS_REQ	
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def .....	3880	use .....	3956
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FUEL_MASS_REQ_I_CTL_H_RES		FUP_EFP_GRD	
def .....	3908	def .....	3796
use .....	3881, 3956	FUP_EFP_KWP	
FUEL_MASS_REQ_I_CTL_MMV		def .....	7307
def .....	3908	FUP_EFP_MES	
FUEL_MASS_REQ_I_CTL_SET		def .....	1290
def .....	3880	use .....	3823, 4733, 6051
use .....	3909	FUP_EFP_MMV	
FUEL_MASS_REQ_MFF		def .....	1290
def .....	3908	FUP_EFP_NOT_PLAUS	
FUEL_MASS_REQ_P_CTL		def .....	6050
def .....	3908	FUP_EFP_SP	
FUEL_MASS_REQ_PCTL		def .....	3792
def .....	3908	use .....	3797, 3823, 4733, 6051, 7314
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FUEL_MASS_REQ_TQ		FUP_EFP_ST_H	
def .....	3908	def .....	3822
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def .....	1283	def .....	3822
use 2100, 2109, 2721, 3823, 3881, 3909, 3931, 3956,		FUP_EFP_STOP_H	
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def .....	3954	def .....	3822
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def .....	3909	def .....	3822
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def .....	3909	FUP_H	
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def .....	3930	use .....	2179, 3332
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FUP_DIF_FUP_REQ_FPA_RST		use ..... 2004, 2122, 2200, 2204, 2208, 2212, 2228,	
def .....	3880	2241, 2261, 2278	
use .....	3931	FUP_H_SAE	
FUP_DIF_MMV		def .....	5801
def .....	3909	use .....	7945
FUP_DIF_PCTL		FUP_H_SP_S	
def .....	3909	def .....	3868
FUP_DIF_ST_FUEL_MASS_REQ_SET		use .....	2212
def .....	3880	FUP_H_SP_S_EXT	
FUP_EFP		def .....	8262
def .....	1290	use .....	3868
use ..... 1283, 3797, 3823, 4763, 6051, 7314		FUP_H_SP_S_INJ [NC_CBK_HPP_NR]	
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def .....	1290	use .....	2212, 2216, 2220
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def .....		1283
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use .....		5801, 7945
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use .....		7314
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def .....		3930
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def .....		988
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FUP_RNG_H_SP_OHP		
def .....		988
use .....		3868
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def .....		3868
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def .....		3868
use .....		3881, 3909, 3931, 3956, 4763, 6095
FUP_SP_CH		
def .....		3611
use .....		8233
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def .....		8262
use .....		3868
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def .....		7431
use .....		8262
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def .....		3930
FUP_SP_GRD_ACT		
def .....		3868
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use .....		3797
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def .....		3954
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use .....		1148, 1223, 1298, 2307, 2372, 2968, 3144, 3564, 3779, 4068, 6543, 6697, 6795, 7237, 7314, 7766, 8394
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use .....		7391, 7557
GEAR_INFO		
def .....		1564
use .....		1122, 1270, 1302, 6795, 7228, 7438, 7766
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use .....		7391, 7557, 7683
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def .....		8368
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def .....		8368
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def .....	8285	def .....	8158
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def .....	6789	def .....	8158
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def .....	6789	def .....	8159
use .....	6795	use .....	7557, 8370
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def .....	1302	def .....	8368
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def .....	798	def .....	8159
use .....	1302	use .....	8370
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def .....	1298	def .....	8159
use .....	1583	use .....	8370
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def .....	8285	def .....	8159
use .....	1298	use .....	7557, 8370
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def .....	1298	def .....	8159
use .....	1583	use .....	7557, 8370
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def .....	8286	def .....	2351
use .....	1298	use .....	1313
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use .....	8292	def .....	7014
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I_craweng		def .....	7239
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def .....	3703	ID_FAC_IPT_SENS_MDL	
ID_CL_MMV_HOM_T_AST_UP_CP		def .....	2547
def .....	3703	ID_FAC_MT_P_D_DT_IS	
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def .....	1526	ID_FAC_MT_P_D_DT_IS_SLOW	
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def .....	3407	ID_FAC_N_MAX_I_AT_GEAR	
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def .....	3407	ID_FAC_N_MAX_I_MT_GEAR	
ID_CRLC_VLS_DOWN_DYN_DIAG		def .....	3780
def .....	2614	ID_FAC_N_MAX_P_AT_GEAR	
ID_CRLC_VLS_DOWN_T_DLY		def .....	3780
def .....	2614	ID_FAC_N_MAX_P_MT_GEAR	
ID_CTR_CYL_NR_CLC		def .....	3780
def .....	1754	ID_FAC_NT_AGI_DIF_NS	
ID_CTR_ICPLSL_THD		def .....	3077
def .....	2354	ID_FAC_THD_CHG_FQ_DET	
ID_CTR_INC_FSD_STOP_OIL		def .....	2680
def .....	6133	ID_FAC_TOL_CRK_TOOTH	
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def .....	5239	ID_FAC_TQ_EF_THD_CTOP_CLOSE_AT	
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def .....	6134	ID_FAC_TQ_REQ_CRU_MON2	
ID_DLY_FUP_GRD		def .....	7014
def .....	3910	ID_FAC_TQ_SOF_THD_CTOP_CLOSE_AT	
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ID_EFF_MFF_TQ_COR_MON2		def .....	3852
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def .....	1964	ID_N_DEC_N_MAX_H_AT_MAN	
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ID_PREV_STATE_IV_MON2	def .....	7017	ID_T_CYL_BAL_HOM_REQ_INT_STOP [5]		
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ID_T_DLY_SOF_OPEN_CTOP_OPEN_AT		def .....	3108
def .....	3852	ID_TNT_MDL_NT_AGI_MAX	
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def .....	5094	ID_TQ_ADD_IS_OPM_AV	
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def .....	5682	use .....	3442
ID_T_MAX_LSCL_ACT_TCO		ID_TQ_ADD_IS_OPM_REQ	
def .....	2468	def .....	3545
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def .....	5682	ID_TQ_DIF_IS_AD_OPM_AV	
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def .....	1151	ID_TQ_DROF_ENA	
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def .....	3780	ID_TQ_DROF_ENA_MON	
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def .....	3780	ID_TQ_LOSS_MON2	
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ID_T_PER_PRS_COR_1_HOM		def .....	7018
def .....	2005	ID_TQ_MIN_CLU_MON2	
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ID_T_PRI_FAC_L_RNG_LAM_AD		def .....	7018
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def .....	2336	ID_TTIP_SP_DIF_LSH_UP	
ID_T_TQI_MON2		def .....	2388
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ID_VLS_DOWN_RGN_STOP		def .....	6789
def .....	2994	use .....	6761
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def .....	8202	def .....	2200
use .....	1583	IDX_TI_1_PRS_S_SP_TMP	
idfbosmg_w		def .....	2212
def .....	8286	IDX_TI_1_S_CLC [NC_CYL_NR]	
use .....	1583	def .....	2000
IDX_BAT_CAN		use .....	6795
def .....	1564	IDX_TI_1_STND_HOM [NC_CYL_NR]	
use .....	8292	def .....	2000
IDX_BSD_SDL_TBL		IDX_TI_1_STND_S_TMP [NC_CYL_NR]	
def .....	4093	def .....	2260
IDX_CP		IDX_TI_2_HOM_CLC [NC_CYL_NR]	
def .....	3692	def .....	2000
IDX_EDGE_CAM_EX [NC_NR_CAM_CBK]		use .....	6795
def .....	871	IDX_TI_2_MON [NC_CYL_NR]	
use .....	1506, 1534, 8400	def .....	6789
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def .....	871	IDX_TI_2_PRS_HOM_SP_TMP	
use .....	1506, 1534, 8400	def .....	2204
IDX_FRF [NC_NR_ERR_DYN]		IDX_TI_2_PRS_S_SP_TMP	
def .....	5792	def .....	2216
IDX_NR		IDX_TI_2_S_CLC [NC_CYL_NR]	
def .....	7100	def .....	2000
IDX_NR_ERR_MC_FCT_SPC_IST		use .....	6795
def .....	7100	IDX_TI_2_STND_HOM [NC_CYL_NR]	
IDX_NR_LID_MC_FCT_SPC_IST		def .....	2000
def .....	7100	IDX_TI_2_STND_S_TMP [NC_CYL_NR]	
IDX_NR_LID_MC_FCT_SPC_IST_OLD		def .....	2260
def .....	7100	IDX_TI_3_HOM_CLC [NC_CYL_NR]	
IDX_NR_LID_MC_FCT_SPC_IST_PRED		def .....	2000
def .....	7100	use .....	6795
IDX_NR_RESP_MC_FCT_SPC_IST		IDX_TI_3_PRS_HOM_SP_TMP	
def .....	7100	def .....	2208
IDX_PRS_COR_CYL_CLC_MPLH [NC_CBK_HPP_NR]		IDX_TI_3_PRS_S_SP_TMP	
def .....	3327	def .....	2220
use .....	2004, 2041, 2133, 2200, 2204, 2208	IDX_TI_3_S_CLC [NC_CYL_NR]	
IDX_PRS_COR_CYL_CLC_S [NC_CBK_HPP_NR]		def .....	2000
def .....	3327	use .....	6795
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IDX_RD_CP		def .....	2000
def .....	3692	IDX_TI_3_STND_S_TMP [NC_CYL_NR]	
IDX_STATE_SOPC		def .....	2260
def .....	7186	IDX_TI_HYS_IV_EGY_RNG	
use .....	7062, 7158	def .....	2260
IDX_STATE_SOPC_CPL		IDX_TI_POST_MON [NC_CYL_NR]	
def .....	7186	def .....	6789
use .....	7062	use .....	6761
IDX_STEP_CP		IDX_TI_THD_IV_EGY_RNG	
def .....	3692	def .....	2260
IDX_TEST_RCV_MC_FCT_SPC_IST		IDX_TMP_RBM	
def .....	7100	def .....	5694
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def .....	2000	def .....	7680
use .....	6795	lerr	

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use .....	7314	use .....	1828, 1846
lerr_grenz_ext		IGA_BAS_COR_KNK_ADD	
def .....	8368	def .....	1845
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def .....	1828	IGA_BAS_EGR_COR	
use .....	1952, 8266	def .....	1921
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def .....	8266	def .....	1921
use .....	1828	IGA_BAS_EGR_COR_S	
IGA_ADJ_KNK [NC_CYL_NR]		def .....	1921
def .....	1960	IGA_CH	
use .....	1828, 1952	def .....	798
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def .....	1960	IGA_DEC_KNK	
use .....	8266	def .....	1960
IGA_AV [NC_CYL_NR]		IGA_DIF_AV_CAN_H_RNG	
def .....	1005	def .....	1845
use .....	6213, 7194	IGA_DIF_AV_CBK_H_RNG [NC_CBK_EX_NR]	
IGA_AV_H_RNG [NC_CYL_NR]		def .....	1845
def .....	1828	IGA_DIF_AV_H_RNG	
use .....	1876, 2041, 2146	def .....	1845
IGA_AV_H_RNG_1 [NC_CYL_NR]		IGA_DIF_AV_H_RNG_HOM_MON	
def .....	1828	def .....	6753
IGA_AV_H_RNG_HOMS [NC_CYL_NR]		IGA_DIF_AV_H_RNG_HOM_MON2	
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use .....	2042	IGA_DIF_AV_H_RNG_HOMS_MON	
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def .....	8266	IGA_DIF_AV_H_RNG_HOMS_MON2	
use .....	1828	def .....	7010
IGA_AV_H_RNG_S [NC_CYL_NR]		IGA_DIF_AV_HOM_MON	
def .....	1828	def .....	6753
use .....	2042	IGA_DIF_BAS_CBK [NC_CBK_EX_NR]	
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def .....	8266	IGA_DIF_BAS_CRK_CYL_LAM	
use .....	1828	def .....	2864
IGA_AV_MV		IGA_DIF_BAS_KNK_FIL	
def .....	1005	def .....	1845
IGA_AV_MV_CAN_H_RNG		IGA_DIF_MIN_AST_H_RNG	
def .....	1828	def .....	1925
use .....	1846	IGA_DIF_MIN_DELTA_H_RNG	
IGA_AV_MV_CBK_H_RNG [NC_CBK_EX_NR]		def .....	1925
def .....	1828	IGA_DIF_MIN_H_RNG	
use .....	1846	def .....	1925
IGA_AV_MV_H_RNG		use .....	1828, 1846, 1939
def .....	1828	IGA_DIF_MIN_TEG_1_H_RNG	
use .....	1005, 1232, 1846, 2164	def .....	1939
IGA_BAS_COR		IGA_DIF_MIN_TEG_H_RNG	
def .....	8266	def .....	1939
use .....	6283, 8304	use .....	1846
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def .....	6213	IGA_MIN_CBK_H_RNG [NC_CBK_EX_NR]	
IGA_DIF_S_CH		def .....	1828
def .....	1943	IGA_MIN_H_RNG	
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def .....	1948	IGA_MIS	
IGA_DIF_SP_CBK_H_RNG		def .....	6213
def .....	1948	IGA_MIS_1	
IGA_DIF_SP_H_RNG		def .....	6213
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use .....	1925	def .....	6213
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def .....	1005	def .....	1960
use .....	7314, 7391, 7557, 7896, 7945	IGA_MV_ADJ_KNK_CUS	
IGA_IGC_0_5_H_RNG		def .....	8304
def .....	1559	use .....	1122
use .....	2865, 8266	IGA_MV_ADJ_KNK_RON	
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def .....	1876	use .....	4145
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def .....	2037	use .....	1846
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IGA_IGC_H_RNG_MON2 [NC_CYL_NR]		def .....	1960
def .....	7010	use .....	8304
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def .....	8304	def .....	1846
use .....	1828	IGA_REF_COR	
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def .....	1960	use .....	1925, 1939
use .....	1559, 1952, 8304	IGA_REF_COR_CBK [NC_CBK_EX_NR]	
IGA_KNK_0_5		def .....	8266
def .....	1559	use .....	1828, 1846, 1948
IGA_KNK_BAS [NC_CYL_NR]		IGA_REF_EGR_HOM_COR	
def .....	1960	def .....	8266
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def .....	1925	IGA_REF_EGR_HOMS_COR	
IGA_MIN_BAS_2_H_RNG		def .....	8266
def .....	1925	use .....	6795
IGA_MIN_BAS_2_OPM_1_H_RNG		IGA_REF_HOM_COR_EXT_MON	
def .....	1925	def .....	6789
IGA_MIN_BAS_2_OPM_2_H_RNG		use .....	6753
def .....	1925	IGA_REF_HOM_COR_EXT_MON2	
IGA_MIN_BAS_EXT_H_RNG		def .....	7010
def .....	1925	IGA_REF_HOMS_COR_EXT_MON	
IGA_MIN_BAS_H_RNG		def .....	6789
def .....	1925	use .....	6753
IGA_MIN_BAS_INT_H_RNG		IGA_REF_HOMS_COR_EXT_MON2	
def .....	1925	def .....	7010
IGA_MIN_BAS_OPM_H_RNG		IGA_REF_LAMB_COR	
def .....	1925	def .....	8266
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def .....	1925	IGA_REF_TEMP_COR	
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IP_V_EFC_CTL_LSH_UP	def .....	2388	IP_VS_DIF_THD_COR_MT	def .....	2999
IP_V_EFC_INI_LSH_DOWN	def .....	2423	IP_VS_SO2P_FAST_THD	def .....	3131
IP_V_EFC_INI_LSH_UP	def .....	2389	IP_WHEEL_GRD_MMV_THD_AT_VS	def .....	6303
IP_V_INT_KNKS_DIAG	def .....	4904	IP_WHEEL_GRD_MMV_THD_DIAG_AT_VS	def .....	6303
IP_V_IV_MAX	def .....	2279	IP_WHEEL_GRD_MMV_THD_DIAG_MT_VS	def .....	6303
IP_V_THD_RATIO_CHK_PVS_MON	def .....	6962	IP_WHEEL_GRD_MMV_THD_MT_VS	def .....	6303
IP_VCV_STATE_CUR_VCV_MAX	def .....	3963	IPLSL_COR [NC_CBK_EX_NR]	def .....	2313
IP_VFF_MAX_FUP_DIAG	def .....	6096	use .....	2352, 2372, 7896, 7945	
IP_VFF_VCV_I_CTL_SET	def .....	3882	IPLSL_COR_BEG_PURGE [NC_CBK_EX_NR]	def .....	2371
IP_VLS_DELTA_LAM_ADJ_CAT_DIAG	def .....	2614	IPLSL_COR_CHG_PURGE [NC_CBK_EX_NR]	def .....	2371
IP_VLS_DELTA_LAM_ADJ_DYN_DIAG	def .....		IPLSL_COR_MMV_FCUT [NC_CBK_EX_NR]	def .....	2371


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IPLSL_MMV_VLD_FCUT [NC_CBK_EX_NR]	use .....	7738, 8310
def .....	Klann_test2	
IPLSL_MV_PURGE [NC_CBK_EX_NR]	def .....	8159
def .....	use .....	7738, 8310
IPLSL_PURGE [NC_CBK_EX_NR]	Km_inj_tausch_zyl [NC_CYL_NR]	
def .....	def .....	8187
IPLSL_SYM_DIAG_LSL_UP [NC_CBK_EX_NR]	Km_st	
def .....	def .....	8286
IPLSL_VARI_PURGE [NC_CBK_EX_NR]	Km_st_1	
def .....	def .....	8286
IPLSL_VARI_VLD_FCUT [NC_CBK_EX_NR]	KNK_AD_SF [NC_CYL_NR]	
def .....	def .....	1960
lpm_typ_fp	KNK_CTL_DIS	
def .....	def .....	1952
ipm_typ_fp	use .....	1962, 4145, 8304, 8353
def .....	KNK_THD [NC_CYL_NR]	
lpm_typ_mdkw	def .....	1960
def .....	use .....	1559
ipm_typ_mdkw	KNK_THD_0_5	
def .....	def .....	1559
ISAPWM	KNK_THD_MAX	
def .....	def .....	1961
ISAPWM_ISA	KNK_THD_PRE	
def .....	def .....	1961
ISAPWM_MMV	KNKS [NC_CYL_NR]	
def .....	def .....	849
IV_EXT_ADJ [NC_CYL_NR]	use .....	1559, 1952, 1962, 4903, 7314
def .....	KNKS_0_5	
IV_PER_EXT_ADJ [NC_CYL_NR]	def .....	1559
def .....	KNKS_1_DIAG	
lvvtmot [NC_CYL_NR]	def .....	1961
def .....	use .....	4903
use .....	KNKS_2_DIAG	
IVVTPWM_0	def .....	1961
def .....	use .....	4903
use .....	KNKS_CMD_CONF [NC_CYL_NR]	
IVVTPWM_1	def .....	1961
def .....	use .....	849
use .....	KNKS_CMD_FIL [NC_CYL_NR]	
IVVTPWM_EX [NC_NR_CBK_IVVT]	def .....	1961
use .....	use .....	849
IVVTPWM_IN [NC_NR_CBK_IVVT]	KNKS_CMD_FIL_PRE [NC_CYL_NR]	
use .....	def .....	1961
lwakeupgr	use .....	849
def .....	KNKS_CMD_GAIN [NC_CYL_NR]	
	def .....	1961
	use .....	849
<b>K</b>	KNKS_CMD_GAIN_PRE [NC_CYL_NR]	
K_EWS4 [16]	def .....	1961
use .....	use .....	849
Klann_mw1	KNKS_CMD_INT [NC_CYL_NR]	
def .....	def .....	1961
use .....	use .....	849
Klann_mw2	KNKS_CMD_INT_PRE [NC_CYL_NR]	
def .....	def .....	1961
use .....	use .....	849
Klann_test1	KNKS_PRE [NC_CYL_NR]	
def .....		

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def .....	849	La_desu1	
use .....	1962	def .....	8199
KNKS_REL_NL [NC_CYL_NR]		La_desu2	
def .....	849	def .....	8199
use .....	1559, 7314	La_desu_kh1	
KNKS_REL_NL_0_5		def .....	8199
def .....	1559	La_desu_kh2	
KNKWb [NC_CYL_NR]		def .....	8199
def .....	1961	La_es	
use .....	849	def .....	8199
KNKWb_PRE [NC_CYL_NR]		La_kh1	
def .....	1961	def .....	8232
use .....	849	La_kh2	
KNKWE [NC_CYL_NR]		def .....	8232
def .....	1961	La_pruef1	
use .....	849	def .....	8195
KNKWE_PRE [NC_CYL_NR]		La_pruef2	
def .....	1961	def .....	8195
use .....	849	La_puls1	
Krnn_test		def .....	8199
def .....	8159	La_puls2	
use .....	7738	def .....	8199
Ktupcsctr		La_ref_homm	
def .....	8159	def .....	8160
use .....	8370	use .....	8340
Kvaverbr		La_rgn1	
def .....	8286	def .....	8199
Kw_pos		La_rgn2	
def .....	8215	def .....	8199
KWP_IO_VIN		La_soll1	
use .....	4149	use .....	8199
		La_soll2	
<b>L</b>		use .....	8199
L_pwmout		La_soll_stat1	
def .....	8225	use .....	8199
La_abgas1		La_soll_stat2	
def .....	8160	use .....	8199
use .....	8137	La_soll_tester [NC_CBK_EX_NR]	
La_abgas2		def .....	8286
def .....	8160	La_sollreg [NC_CBK_EX_NR]	
use .....	8137	def .....	8160
La_bas1		use .....	8340
def .....	8160	LAM_MMV_VLS_DIF_DLY_LDC [NC_CBK_EX_NR]	
use .....	8340	def .....	5215
La_bas2		LAM_MV [NC_CBK_EX_NR]	
def .....	8160	def .....	1014
use .....	8340	LAM_MV_LPF_CP [NC_CBK_EX_NR]	
La_bs1		def .....	1014
def .....	8160	Lam_son1	
use .....	8233	def .....	8195
La_bs2		Lam_son2	
def .....	8160	def .....	8195
use .....	8233	LAMB_1	
La_bszuli1		def .....	1006
def .....	8232	LAMB_2	
La_bszuli2		def .....	1006
def .....	8232	LAMBAMPL_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	


def .....	5346	use .....	1017, 5217, 5350, 7314
LAMB_AMPL_MAX_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]		LAMB_DELTA_AD_LAM_ADJ_SAE [NC_CBK_EX_NR]	
def .....	5346	def .....	1014
LAMB_AMPL_MIN_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]		use .....	5801, 7945
def .....	5347	LAMB_DELTA_BAS_LAM_ADJ_AD [NC_CBK_EX_NR]	
LAMB_AV_COR		def .....	2622
def .....	798	LAMB_DELTA_D_LAM_ADJ [NC_CBK_EX_NR]	
use .....	2988	def .....	2589
LAMB_AV_DELTA_LAM [NC_CBK_EX_NR]		LAMB_DELTA_DIF_I_LAM_ADJ_AD [NC_CBK_EX_NR]	
def .....	2544	def .....	2622
use .....	2465	use .....	2590
LAMB_BAS [NC_CBK_EX_NR]		LAMB_DELTA_DYN_DIAG [NC_CBK_EX_NR]	
def .....	8340	def .....	2544
use .....	2195, 7314	LAMB_DELTA_FALL [NC_CBK_EX_NR]	
LAMB_BAS_COR_MAX		def .....	5276
def .....	6658	LAMB_DELTA_FALL_LPF [NC_CBK_EX_NR]	
LAMB_BAS_H_RES [NC_CBK_EX_NR]		def .....	5276
def .....	8340	LAMB_DELTA_I_LAM_ADJ [NC_CBK_EX_NR]	
LAMB_CAT_DOWN [NC_CBK_EX_NR]		def .....	2589
def .....	5473	use .....	1017, 2627, 5217, 5350, 6396, 7314
LAMB_CAT_DOWN_MAX [NC_CBK_EX_NR]		LAMB_DELTA_I_LAM_ADJ_KWP [NC_CBK_EX_NR]	
def .....	5473	def .....	7307
LAMB_CAT_DOWN_MIN [NC_CBK_EX_NR]		LAMB_DELTA_I_MMV_LAM_ADJ [NC_CBK_EX_NR]	
def .....	5473	def .....	2589
LAMB_CAT_DOWN_MV [NC_CBK_EX_NR]		use .....	2622, 2627
def .....	5473	LAMB_DELTA_I_SAVE_DIAG [NC_CBK_EX_NR]	
LAMB_CAT_DOWN_ST_CYC [NC_CBK_EX_NR]		def .....	5215
def .....	5473	use .....	8107
LAMB_CAT_DOWN_SUM [NC_CBK_EX_NR]		LAMB_DELTA_I_SAVE_LAM_ADJ_H [NC_CBK_EX_NR]	
def .....	5473	def .....	2589
LAMB_CMB_S		LAMB_DELTA_LAM_ADJ [NC_CBK_EX_NR]	
def .....	2179	def .....	2589
LAMB_COP [NC_CBK_EX_NR]		use .....	1017, 2545, 5422
def .....	8232	LAMB_DELTA_LAM_ADJ_SAE [NC_CBK_EX_NR]	
LAMB_COP_CUS [i]		def .....	1014
def .....	2195	use .....	7945
use .....	8233	LAMB_DELTA_MAX_PLS	
LAMB_COR_AV_LAM [NC_CBK_EX_NR]		def .....	2958
def .....	2462	use .....	2563
LAMB_COR_DIAG_DYN_LS_UP [NC_CBK_EX_NR]		LAMB_DELTA_MAX_PLS_EXT	
def .....	5347	def .....	2579
LAMB_CYL_SEL [NC_CYL_NR]		use .....	2958
def .....	2731	LAMB_DELTA_P_LAM_ADJ [NC_CBK_EX_NR]	
LAMB_CYL_SEL_CQ_DIF_REF [NC_CBK_EX_NR]		def .....	2589
def .....	2732	use .....	1037, 2627
LAMB_CYL_SEL_CQ_REF [NC_CBK_EX_NR]		LAMB_DELTA_RISE [NC_CBK_EX_NR]	
def .....	2732	def .....	5276
LAMB_DE_INT_ACT_LSL_UP [NC_CBK_EX_NR]		LAMB_DELTA_RISE_LPF [NC_CBK_EX_NR]	
def .....	5237	def .....	5276
LAMB_DE_INT_LS_UP_READY [NC_CBK_EX_NR]		LAMB_DELTA_SUM_LAM_ADJ_AD [NC_CBK_EX_NR]	
def .....	2335	def .....	2622
LAMB_DE_LSL [NC_CBK_EX_NR]		use .....	2545
def .....	5237	LAMB_DIF [NC_CBK_EX_NR]	
LAMB_DE_TOT_ACT_LSL_UP [NC_CBK_EX_NR]		def .....	1014
def .....	5237	LAMB_DIF_AV_CTL_ST_IN [NC_CBK_EX_NR]	
LAMB_DELTA_AD_LAM_ADJ [NC_CBK_EX_NR]		def .....	2544
def .....	2622	LAMB_DIF_AV_CTL_ST_OUT [NC_CBK_EX_NR]	

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def .....	2544	def .....	2313
LAMB_DIF_FIL_MON		use .....	1008, 1017, 2988, 7314
def .....	6943	LAMB_LS_UP_MV_KWP	
LAMB_DIF_MAX_DYN_LSL_UP_COMP [NC_CBK_EX_NR]		def .....	7307
def .....	5347	LAMB_LS_UP_MV_TMP	
LAMB_DIF_MIN_DYN_LSL_UP_COMP [NC_CBK_EX_NR]		def .....	2313
def .....	5347	LAMB_LS_UP_OLD_DRV1 [NC_CBK_EX_NR]	
LAMB_DIF_MON		def .....	2544
def .....	6777	LAMB_LSL_MDL_OUT_TMP [NC_CBK_EX_NR]	
use .....	6943, 7314	def .....	2462
LAMB_DIF_MON_KWP		LAMB_MAX_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	
def .....	7307	def .....	5347
LAMB_DIF_NEG_MON		LAMB_MAX_DIAG_DYN_LSL_UP_COMP [NC_CBK_EX_NR]	
def .....	6943	def .....	5347
LAMB_DIF_POS_MON		LAMB_MAX_DIAG_DYN_LSL_UP_TMP [NC_CBK_EX_NR]	
def .....	6943	def .....	5347
LAMB_DLY_MON		LAMB_MAX_DYN_LSL_UP_COMP_TMP [NC_CBK_EX_NR]	
def .....	6777	def .....	5347
LAMB_HOM_AFL		LAMB_MDL_MON	
def .....	8340	def .....	6777
LAMB_KWP [NC_CBK_EX_NR]		use .....	6943
def .....	7307	LAMB_MDL_REF_MON	
LAMB_LPF_0_CP		def .....	6777
def .....	3699	LAMB_MIN	
LAMB_LPF_CP		def .....	1006
def .....	3699	LAMB_MIN_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	
LAMB_LPF_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]		def .....	5347
def .....	5347	LAMB_MIN_DIAG_DYN_LSL_UP_COMP [NC_CBK_EX_NR]	
LAMB_LPF_DIF_IT_CP		def .....	5347
def .....	3699	LAMB_MMV_0_CP	
LAMB_LPF_GRD_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]		def .....	3699
def .....	5347	LAMB_MMV_0_GRD_CP	
LAMB_LS_UP [NC_CBK_EX_NR]		def .....	3699
def .....	2313	LAMB_MMV_0_GRD_NEW_CP	
use 811, 1008, 2335, 2352, 2372, 2465, 2545, 2988,		def .....	3699
3069, 3107, 3113, 3129, 3150, 3701, 4763, 5170,		LAMB_MMV_0_TMP_CP	
5238, 5314, 5350, 5389, 5422, 5608, 6320, 6338,		def .....	3699
6347, 6389, 6396, 6405, 6428, 6777, 6943, 7314,		LAMB_MMV_ACT_LSL_UP [NC_CBK_EX_NR]	
7896, 7945, 8107, 8128, 8195		def .....	5237
LAMB_LS_UP_AFL_EOL [NC_CBK_EX_NR]		LAMB_MMV_COR_CP	
def .....	8128	def .....	3699
use .....	7766	LAMB_MMV_CP	
LAMB_LS_UP_AFR_EOL [NC_CBK_EX_NR]		def .....	3699
def .....	8128	LAMB_MMV_PUE_LS_DOWN [NC_CBK_EX_NR]	
use .....	7766	def .....	5168
LAMB_LS_UP_DRV1 [NC_CBK_EX_NR]		LAMB_MON	
def .....	2544	def .....	6777
LAMB_LS_UP_DRV1_MMV [NC_CBK_EX_NR]		use .....	6753, 6795
def .....	2544	LAMB_MON2	
LAMB_LS_UP_LAM_MMV [NC_CBK_EX_NR]		def .....	7010
def .....	2462	LAMB_MV	
LAMB_LS_UP_MIN		def .....	1006
def .....	2313	LAMB_MV_LS_UP_READY [NC_CBK_EX_NR]	
use .....	1008, 2988	def .....	2335
LAMB_LS_UP_MMV_NS [NC_CBK_EX_NR]		LAMB_NOX_SENS [NC_NOX_SENS_CONF]	
def .....	6320	def .....	1380
LAMB_LS_UP_MV		use .....	992, 2988, 7314


LAMB_NOX_SENS_DIAG [NC_NOX_SENS_CONF]	def .....	5168	LAMB_SP_BEG_DIAG_LS_UP_DOWN [NC_CBK_EX_NR]	def .....	5387
def .....	1380		use .....	2943	
use .....	992		LAMB_SP_BEG_LS_ACT_TEST_1	def .....	1006
LAMB_NOX_SENS_KWP	def .....	7307	LAMB_SP_BEG_LS_ACT_TEST_2	def .....	1006
LAMB_NS [NC_NOX_SENS_CONF]	def .....	991	use .....	2942	
def .....	991		LAMB_SP_CAT_PURGE_ADD_PUE	def .....	2939
use .....	3129, 3150, 6347, 6428		use .....	2939	
LAMB_NS_DIAG [NC_NOX_SENS_CONF]	def .....	991	LAMB_SP_CH [NC_CBK_EX_NR]	def .....	2169
def .....	991		use .....	2913, 6582, 8233	
use .....	1382, 6389, 6396, 6405		LAMB_SP_CH_SO2P [NC_CBK_EX_NR]	def .....	2169
LAMB_NS_DIAG_GRD_OSC [NC_NOX_SENS_CONF]	def .....	1380	use .....	8200	
LAMB_NS_DIAG_OLD_OSC [NC_NOX_SENS_CONF]	def .....	1380	LAMB_SP_DE_PLS	def .....	2958
LAMB_NS_MMV_NS_SHIFT [NC_NOX_SENS_CONF]	def .....	6425	use .....	2563, 5238, 5276	
LAMB_NS_MMV_NS_SHIFT_DIF_ABSV [NC_NOX_SENS_CONF]	def .....	6425	LAMB_SP_DE_PLS_EXT	def .....	2579
LAMB_PLS [NC_CBK_EX_NR]	def .....	2558	use .....	2958	
def .....	2558		LAMB_SP_DELTA_ADD_CAT_PURGE [NC_CBK_EX_NR]	def .....	2942
use .....	2439, 2465		use .....	2939	
LAMB_PLS_EXT [NC_CBK_EX_NR]	def .....	2579	LAMB_SP_DELTA_CAT_PURGE [NC_CBK_EX_NR]	def .....	2939
def .....	2579		use .....	2954, 8200	
use .....	2558		LAMB_SP_DELTA_IT_CAT_PURGE [NC_CBK_EX_NR]	def .....	2927
LAMB_PLS_EXT_CUS [NC_CBK_EX_NR]	def .....	8199	use .....	2939	
def .....	8199		LAMB_SP_DELTA_LAM [NC_CBK_EX_NR]	def .....	2544
use .....	2579		use .....	1017, 2465	
LAMB_PLS_O2L_OSC [NC_CBK_EX_NR]	def .....	2563	LAMB_SP_DELTA_LS_UP_DOWN [NC_CBK_EX_NR]	def .....	5387
def .....	2563		LAMB_SP_DELTA_OC_LSL_UP [NC_CBK_EX_NR]	def .....	4300
use .....	2558, 2958, 8199		LAMB_SP_DIAG_AFL [NC_CBK_EX_NR]	def .....	5589
LAMB_PULS_SO2P [NC_CBK_EX_NR]	def .....	3150	use .....	8200	
def .....	3150		LAMB_SP_DIAG_LS_UP_DOWN [NC_CBK_EX_NR]	def .....	2437
use .....	2169, 8200		use .....	1008, 8195	
LAMB_PULS_SO2P_H_RES [NC_CBK_EX_NR]	def .....	3150	LAMB_SP_DIAG_OC_LSL_UP [NC_CBK_EX_NR]	def .....	4300
def .....	3150		use .....	2437	
LAMB_RGN [NC_CBK_EX_NR]	def .....	2885	LAMB_SP_DIAG_OPL_LS_UP_DOWN [NC_CBK_EX_NR]	def .....	5387
def .....	2885		use .....	2437	
use .....	8200		LAMB_SP_DIAG_EXT_ADJ [NC_CBK_EX_NR]	def .....	7763
LAMB_RGN_FAC [NC_CBK_EX_NR]	def .....	2885	use .....	8292	
def .....	2885		LAMB_SP_FIL [NC_CBK_EX_NR]	def .....	1014
LAMB_SO2P [NC_CBK_EX_NR]	def .....	3129			
def .....	3129				
use .....	2169, 8200				
LAMB_SP	def .....	8340			
LAMB_SP [NC_CBK_EX_NR]	def .....	8340			
def .....	8340				
use .....	811, 1008, 1921, 2195, 2315, 2352, 2545, 3113, 3150, 3680, 4294, 4301, 5152, 5170, 5248, 5389, 5954, 7314, 7766				
LAMB_SP_1	def .....	1006			
def .....	1006				
LAMB_SP_2	def .....	1006			
def .....	1006				
LAMB_SP_ADD_PUE_LS_DOWN [NC_CBK_EX_NR]	def .....	1006			
def .....	1006				

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LAMB_SP_FIL_DELTA_FALL [NC_CBK_EX_NR]	def .....	2195
def .....	970	
use .....	5276	
LAMB_SP_FIL_DELTA_RISE [NC_CBK_EX_NR]	def .....	970
use .....	5276	
LAMB_SP_FIL_HOM [NC_CBK_EX_NR]	def .....	2462
use .....	970, 1017, 4763	
LAMB_SP_FIL_S [NC_CBK_EX_NR]	def .....	2462
use .....	1017, 3701, 5152, 5314	
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LC_EFF_SCC_SP_MAN	def .....	6666
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LC_EFPWM_CTL	def .....	6666
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LC_FUP_EFP_SP_MAN_ACT		LC_INH_DIAG_TAM_PLAUS	
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def .....	1127	def .....	1723, 2308
LC_FUP_MFP_PLAUS_VAR_2_ACT		LC_INH_DYN_DIAG_S_LSL_UP [NC_CBK_EX_NR]	
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def .....	3883	def .....	6666
LC_FUP_SP_MAN_ACT		LC_INH_FCUT_ASR	
def .....	3870	def .....	6666
LC_GS_IDC_TCT_ENA		LC_INH_FCUT_DCC	
def .....	1299	def .....	6666
LC_GS_PRED_ENA		LC_INH_FCUT_FAST	
def .....	2969	def .....	6666
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LC_INH_FUP_DIAG_ON_CH		LC_INJ_MOD_SP_MAN_ENA	
def .....	6068	def .....	3335
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def .....	2304	LC_INJ_UPD_OLD_MOD_ENA	
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def .....	3176	LC_IPLSL_CTL_ENA_MAN_SWI_LSL_IF	
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def .....	1507	LC_IPLSL_GAIN_SEL_LSL_GAIN_AD	
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def .....	5161	LC_IPLSL_SYM_DIAG_LSL_UP	
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def .....	3056	LC_ISC_ACT_AST_CDN_SWI	
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def .....	3056	LC_ISC_ACT_CDN_SWI	
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LC_INH_NTLD_REQ_NOX_SENS_AUTH		def .....	2045
def .....	3056	LC_IV_ADD_PLS_SNGH_ENA	
LC_INH_NTLD_REQ_NOX_SENS_VLD		def .....	2045
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def .....	2472	LC_LS_DOWN_OBD_2_MAN_DEAC [NC_CBK_EX_NR]	
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def .....	3177	def .....	2010
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def .....	2999	def .....	2010
LC_NT_RGN_STOP_IS		LC_PRS_COR_SNGH_ENA	
def .....	2999	def .....	2010
LC_NT_SO2P_EXT_MAN		LC_PRS_COR_SOI_DLY_ENA	
def .....	3145	def .....	2010
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use .....	7557	LC_STATE_NOX_CHG_OSC	
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def .....	2547	LC_STATE_VS_MIN_SOF_AT	
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def .....	7561	LC_STATE_VS_MIN_SOF_MT	
LC_SND_MSG_OIL_KEY_AUX		def .....	3853
def .....	1587	LC_STST_PRE_STOP_REQ_NT_ACT	
LC_SO2P_FAST_MAN		def .....	3056
def .....	3131	LC_STST_VAR_COD_ENA	


def .....	7685	def .....	4469
LC_SUL_SWI_1_THERMO_ACT		LC_T_ES_DIAG_1_SWI_2	
def .....	3079	def .....	4469
LC_SUL_THERMO_COR		LC_T_FUP_LIH_L_PRS_CTL_REQ	
def .....	3079	def .....	4001
LC_SUL_UPD		LC_T_MAX_WAL_ST_ENA	
def .....	3079	def .....	5828
LC_SUM_NTL_CYC_NEW		LC_T_MIN_PUC_MON	
def .....	3000	def .....	6778
LC_SWI_AEB_IGK_PREL_ENA		LC_T_REL_CAN_ST_MAN	
def .....	4136	def .....	1444
LC_SWI_AEB_ST		LC_T_WOUT_NS_AD	
def .....	4136	def .....	6471
LC_SWI_AEB_STOP		LC_TAM_MAN_AS	
def .....	4136	def .....	1587
LC_SWI_AEB_STST_PRE_STOP_ENA		LC_TCHA_CONF	
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LC_SWI_AEB_TYP		use .....	4044, 4068
def .....	4136	LC_TCHA_DIAG_EXT_REQ	
use .....	7314	def .....	8233
LC_SWI_AFS_MON		LC_TCO_PLAUS_TCO_SUB_DIAG_INH	
def .....	6786	def .....	5683
LC_SWI_CWP_INP		LC_TCO_ST_SEL	
def .....	4539	def .....	3056
LC_SWI_GAIN_LSL_IF_PUC_ACT		LC_TCO_SWI_NS_SHIFT	
def .....	2318	def .....	6433
LC_SWI_MOD_INH_IV_DYN		LC_TCO_TFU_IV_SUB	
def .....	2296	def .....	1235
LC_SWI_OPM_AV_MON		LC_TD_AD_CLR	
def .....	6803	def .....	933
LC_SWI_REP_ENA_DIAG_END		LC_TD_MPL_SPC_IGN_ACT	
def .....	6433	def .....	1897
LC_SWI_REP_ENA_NS_SHIFT		LC_TECU_SWI	
def .....	6433	def .....	1257
LC_SWI_RR_CAN		LC_TEG_MIN_DEAC	
def .....	6303	def .....	2336
LC_SWI_SIG_CLC_DIAG		LC_TEG_MIN_THD_DEAC_TEST	
def .....	5261	def .....	2336
LC_SWI_TCO_2_SUB		LC_TEMP_CAPA_IV_CLC_ENA	
def .....	1218	def .....	2242
LC_SWT_LS_DOWN_MV		LC_TEMP_CAPA_IV_ENA	
def .....	5154	def .....	2226
LC_T1_AD_DIAG_DYN_LSL_UP		LC_TEMP_CAPA_IV_EOL_MAN	
def .....	5355	def .....	2242
LC_T_AFL_DOWN_CTL		LC_TEMP_CAPA_TFU_IV_SWI	
def .....	3152	def .....	1235
LC_T_CON_DYN_LSL_UP		LC_TEMP_DEW_LSH_UP	
def .....	5355	def .....	2389
LC_T_DLY_1_2_S_EXT_MAN_ENA		LC_TEMP_FUEL_RAIL_WALL_TAM	
def .....	2147	def .....	1235
LC_T_DLY_2_3_S_EXT_MAN_ENA		LC_TEMP_IGC_VAR	
def .....	2147	def .....	1897
LC_T_DLY_TCO_PLAUS		LC_TFU_TIA_TCO_EX	
def .....	5683	def .....	1235
LC_T_ES_DIAG_1_RBM_SWI		LC_THD_SOI_POST_MON	
def .....	4478	def .....	6763
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def .....	2010	def .....	6628
LC_TI_1_S_MAN_ACT		LC_TQ_LOSS_PSTE_3_SWI	
def .....	2010	def .....	6628
LC_TI_2_HOM_MAN_ACT		LC_TQ_P_D_FAST_INH_AS	
def .....	2010	def .....	3447
LC_TI_2_S_MAN_ACT		LC_TQ_P_D_SLOW_INH_AS	
def .....	2011	def .....	3447
LC_TI_3_HOM_MAN_ACT		LC_TQ_SCC_ENA_MAN	
def .....	2011	def .....	6667
LC_TI_3_S_MAN_ACT		LC_TQ_SCC_INH_MAN	
def .....	2011	def .....	6667
LC_TI_AS_CBK_UPD_DIS		LC_TQI_MAF_MAN	
def .....	2233	def .....	1587
LC_TI_ER_BAL_STOP_MAN		LC_TQI_P_MAX_INH_AS	
def .....	4023	def .....	6699
use .....	4006, 4036	LC_USE_FUEL_MASS_REQ_CTL	
LC_TLDV_NOT_SEQ		def .....	3912
def .....	3682	LC_USE_FUP_EFP_SP_PLAUS_DIAG	
LC_TNT_MDL_MAX_OF5		def .....	4734
def .....	3056	LC_USE_IVVT_INH_MIS	
LC_TQ_ADD_CH_HOM_MAN_ACT		def .....	6288
def .....	6585	LC_USE_TPS_MAF_DIAG	
LC_TQ_ADD_CH_MPLH_MAN_ACT		def .....	4992
def .....	6585	LC_USE_V_FUP_EFP_DIF_PLAUS_DIAG	
LC_TQ_ADD_CP_INH		def .....	4734
def .....	3562	LC_V_ADC_REF_CAL_INJ	
LC_TQ_ADD_I_INH_AS		def .....	2045
def .....	3447	LC_V_ADC_REF_ENA	
LC_TQ_ADD_PL_DROF_ENA_BRAKE		def .....	2045
def .....	1114	LC_V_CUR_VCV_BOOT_INI_MAN	
LC_TQ_ADD_PSTE_2_SWI		def .....	3963
def .....	6628	LC_V_REF_R_IT_LS_UP	
LC_TQ_CAN_PLAUS_INFO		def .....	1323
def .....	4851	LC_VAR_DIS_CRU	
LC_TQ_CONV_CAN_INH		def .....	658
def .....	6712	LC_VAR_DIS_DMTL	
LC_TQ_CONV_DRI_INH		def .....	658
def .....	6712	LC_VAR_DIS_NOX	
LC_TQ_DIF_I_INH_AS		def .....	658
def .....	3447	LC_VAR_DIS_S_FCT	
LC_TQ_DIF_I_IS_DT_INI		def .....	658
def .....	3447	LC_VAR_DIS_TQ_LOSS_ARS	
LC_TQ_DIF_P_D_INH_AS		def .....	658
def .....	3447	LC_VAR_EBOX_CFA	
LC_TQ_DROF_ISC_OFF		def .....	659
def .....	1114	LC_VAR_ETCU_SPT_SWI	
LC_TQ_DROF_ISC_OFF_MON		def .....	1151, 3780
def .....	6803	LC_VAR_EX_CUS	
LC_TQ_LIM_INH		def .....	2614
def .....	6693	LC_VAR_GS_EOBD	
LC_TQ_LIM_INH_FAST		def .....	5010
def .....	6693	LC_VAR_NOX	
LC_TQ_LIM_INH_SLOW		def .....	659
def .....	6693	LC_VAR_OBDC_CAN	
LC_TQ_LOSS_ADD_FIL_MON		def .....	7836
def .....	6803	LC_VAR_SOF_SWI	
LC_TQ_LOSS_PSTE_2_SWI		def .....	3853

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def .....	3853	def .....	7216
LC_VAR_SOF_SWI_MON		LC_VS_MAX_VSL_MAN	
def .....	6803	def .....	7267
LC_VAR_SPT_SWI		LC_VSL_ACT_MAN	
def .....	659	def .....	7267
use .....	6795	LC_WARM_RST_ENA	
LC_VAR_TCO_2		def .....	561
def .....	659	LC_WGPWM_INH_LAM_AD_ENA	
LC_VB_L_SIM_MAN		def .....	2724
def .....	2355	LDP_1_ID_ERR_ENVD_XX	
LC_VCV_AST_MOVE_ACT_MAN		def .....	5793
def .....	3963	LDP_AC_CRU_FAC_TQ_CRU	
LC_VCV_ST_CLOSE_TRAN		def .....	7240
def .....	3963	LDP_AC_CRU_TQ_ADD_CONV	
LC_VEH_POW_VAR_ERR_DIS		def .....	6712
def .....	4946	LDP_AGI_SUL_IP_CTR	
LC_VEH_POW_VAR_TUN_ERR_DIS		def .....	3131
def .....	4946	LDP_ALTER_COD_0	
LC_VEL_ANG_PSTE_COR		def .....	8370
def .....	1421	LDP_AMP_DELTA_IP_FAC_FLOW_COR	
LC_VFF_DIF_LIM_VFF_EFP_COR_MAN		def .....	3631
def .....	3801	LDP_AMP_IP_CRK_DELTA_AMP	
LC_VFF_SWI		def .....	2736
def .....	3883	LDP_AMP_IP_FAC_FLOW_COR_CP	
LC_VFF_VCV_I_CTL_RST		def .....	3630
def .....	3912	LDP_AMP_IP_FAC_ST_AMP	
LC_VLS_COR_MV_LSL_ACT		def .....	2099
def .....	2318	LDP_AMP_IP_FAC_TQ_ADD_CH_AMP	
LC_VLS_DOWN_MMV		def .....	6583
def .....	5173	LDP_AMP_IP_IGA_DIF_MIN_CYC_AMP	
LC_VLS_DOWN_PUE_CON		def .....	1926
def .....	5173	LDP_AMP_IP_LOAD_CLC_AMP	
LC_VLS_DOWN_PUE_PUC_MIN		def .....	5802
def .....	5173	LDP_ANG_PSN_ENG_REL_ST	
LC_VLS_DOWN_PUE_STC_CLR		def .....	1913
def .....	5173	LDP_ANG_PSTE_STND_TQ_LOSS_MON	
LC_VLS_LAM_ADJ_NS_SHIFT [NC_CBK_EX_NR]		def .....	6803
def .....	3191	LDP_ANG_PSTE_STND_TQ_PSTE3_MON	
LC_VLS_MAIN_CAT_PURGE [NC_CBK_EX_NR]		def .....	6803
def .....	2928	LDP_CAPA_IP_TEMP_CAPA_IV_NOM	
LC_VLS_NS_AUTH_CHK		def .....	2242
def .....	3056	LDP_CASE_SEL_CYL_ID_PAT_SEL_CYL	
LC_VLS_NS_DYN_VLD_ON		def .....	2307
def .....	6339	LDP_CL_IP_FLOW_FAC	
LC_VLS_NS_VLD_AFL_PURGE		def .....	3641
def .....	3000	LDP_CL_IP_T_CL_MDL_CLL_ENA	
LC_VLS_NS_VLD_INH_RGN_ENA		def .....	3729
def .....	3057	LDP_CL_MDL_SLOP_0_IP_CL_SLOP	
LC_VLS_NS_VLD_RGN_STOP_MDL		def .....	3729
def .....	3000	LDP_CL_MDL_SLOP_INT_IP_CL_VALUE	
LC_VLS_UP_MV_ON		def .....	3729
def .....	1342	LDP_CL_MMV_IP_FAC_FLOW_MIN	
LC_VLS_UP_THD_SWI_GAIN_AFL_ACT		def .....	3631
def .....	2318	LDP_CL_MMV_IP_T_MAX_CP	
LC_VLS_UP_THD_SWI_GAIN_AFR_ACT		def .....	3738
def .....	2318	LDP_CL_MMV_IP_TQ_ADD_CP	


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def .....	3562	LDP_DIST_NS_DIF_ID_FAC_NT_AGI	
LDP_CLAS_B_ID_CLAS_FMY		def .....	3077
def .....	5811	LDP_DRV1_STND_BAL_IP_DLY_BAL	
LDP_CPPWM_IP_CPPWM_COR_FRQ		def .....	1490
def .....	3750	LDP_DUCY_IP_EGY_ADD_DUCY	
LDP_CPPWM_IP_FAC_CPPWM		def .....	2230
def .....	3704	LDP_ECFPWM [1]__POW_LOSS_EC]	
LDP_CRK_INJ_2_S_IP_PRS_INC_CMP		def .....	6580
def .....	2213	LDP_ECFPWM_ECF_IP_FAC	
LDP_CRK_INJ_IP_PRS_INC_CMP		def .....	1235
def .....	2204	LDP_EFF_CAT_DIAG_1_IP_EFF_CAT	
LDP_CRK_INJ_IP_PRS_INC_CMP_MON		def .....	5516
def .....	6762	LDP_EFF_CAT_DIAG_2_IP_EFF_CAT	
LDP_CTR_COLD_IP_DIST_LAM_AD_INJ		def .....	5516
def .....	3351	LDP_EFF_CAT_DIAG_AFL_IP_TEMP	
LDP_CTR_EGY_DEW_NT		def .....	5554
def .....	3182	LDP_EFF_CAT_DIAG_IP_FAC_1_PLS	
LDP_CTR_HOT_IP_DIST_LAM_AD_INJ		def .....	2959
def .....	3352	LDP_EFF_IGA_INV_COR_IP_IGA_DIF	
LDP_CTR_KM_CAN_IP_T_AST_COR_CH		def .....	1949
def .....	1802	LDP_EFF_SCC_SP__NR_PAT_SCC	
LDP_CTR_KNK_PRE_DET_NR		def .....	6666
def .....	1965	LDP_EGR_RATIO_COR_2__IGA_BAS	
LDP_CTR_MIS_ID_MFF_LAM_AD_INJ		def .....	1921
def .....	3407	LDP_EGY_IP_CAPA_COR_EGY_IV	
LDP_CTR_NR_COLD_ID_CTR		def .....	2242
def .....	3407	LDP_EOI_2_S_0_IP_PRS_INC_CMP_S	
LDP_CTR_NR_HOT_ID_CTR		def .....	2213
def .....	3407	LDP_EOI_IP_PRS_INC_CMP	
LDP_CUR_ALTER_MON__TQ_LOSS_MON		def .....	2204
def .....	6801	LDP_EOI_IP_PRS_INC_CMP_MON	
LDP_CUR_DIF_MMV_IP_CUR_I_CTL		def .....	6762
def .....	3962	LDP_ER_STND_FAC_TI_IP_I_ER_BAL	
LDP_CUR_DIF_REL_IP_CRLC_CUR		def .....	3299
def .....	3962	LDP_ER_STND_FAC_TI_IP_P_ER_BAL	
LDP_CUR_VCV_BAS_IP_CUR_VCV_LIM		def .....	3299
def .....	3962	LDP_ER_STND_MFF_ADD_IP_I_ER_BAL	
LDP_CUR_VCV_IP_FLOW_CUR_BAS		def .....	3270
def .....	6067	LDP_ER_STND_MFF_ADD_IP_P_ER_BAL	
LDP_CUR_VCV_IP_PWM_BAS		def .....	3270
def .....	3963	LDP_FAC_COMP_MV_DYN_LSL_UP	
LDP_DELTA_LAMB_DIF_CYL_I		def .....	5353
def .....	2736	LDP_FAC_DELTA_H_RNG_LAM_AD_PRI	
LDP_DELTA_LAMB_DIF_CYL_P		def .....	2644
def .....	2736	LDP_FAC_DELTA_L_RNG_LAM_AD_PRI	
LDP_DFFGEN_FIL_MON__LOSS_MON		def .....	2644
def .....	6801	LDP_FAC_DIAG_DYN_LSL_UP_ID_LAMB	
LDP_DIST_IV_DIF_IP_MFF_ADD_AGI		def .....	5239
def .....	3261	LDP_FAC_DYN_IP_FAC_IPT_SENS_MDL	
LDP_DIST_KWP_IP_ER_STND_DIF_DYW		def .....	2547
def .....	4046	LDP_FAC_IP_FAC_LAM_GRD_MMV	
LDP_DIST_KWP_IP_FAC_CYL_LAM_BAL		def .....	3705
def .....	4046	LDP_FAC_MAF_EGR_ID_CH_HOM_SO2P	
LDP_DIST_KWP_IP_FAC_L_LAM_BAL		def .....	3601
def .....	4046	LDP_FAC_MAF_EGR_ID_CH_MPLH_SO2P	
LDP_DIST_KWP_IP_FAC_MFF_LAM_BAL		def .....	3601
def .....	4046	LDP_FAC_MAF_MAX_IP_FAC_HOMS	

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def .....	2968	LDP_FUP_EFP_DIF_IP_EFPPWM_P	
LDP_FAC_MAF_MAX_IP_FAC_N_VIM		def .....	3800
def .....	3624	LDP_FUP_EFP_SP_IP_FAC_EFPPWM	
LDP_FAC_MAF_MAX_IP_FAC_S		def .....	3800
def .....	2976	LDP_FUP_FAC_TI_CAST	
LDP_FAC_MV_DIAG_DYN_S_LSL_UP		def .....	2100
def .....	5354	LDP_FUP_FAC_TI_COR_IV_EGY_RNG_L	
LDP_FAC_NOX_NS_AD_IP_FAC_NOX		def .....	2262
def .....	3195	LDP_FUP_FAC_TI_WUP	
LDP_FAC_NT_AGI_RGN_IP_EQU		def .....	2109
def .....	2888	LDP_FUP_GRD_IP_FUEL_MASS_REQ	
LDP_FAC_NT_AGI_RGN_IP_H_AMPL		def .....	3911
def .....	2888	LDP_FUP_H_INJ_IP_FAC_TI_FUP	
LDP_FAC_NT_AGI_RGN_IP_L_AMPL		def .....	3334
def .....	2888	LDP_FUP_IP_CUR_VCV_LIM_DEC	
LDP_FAC_SP_N_PSTE_IP_FAC_TQ		def .....	3962
def .....	6603	LDP_FUP_IP_EGY_ADD_FUP	
LDP_FAC_TI_SUM_BAL_IP_EGY_BAL		def .....	2228
def .....	3216	LDP_FUP_IP_EGY_STEP_INJ_CHA_GRD	
LDP_FAC_TQ_REQ_DROF_1		def .....	2279
def .....	1113	LDP_FUP_MFF_THD_IV_EGY_RNG	
LDP_FAC_TQ_REQ_IP_FAC_TQ_DROF		def .....	2263
def .....	1113	LDP_FUP_REQ_FPA_IP_CUR_SP_PRS	
LDP_FAC_TQ_REQ_MON__TQ_DROF		def .....	3962
def .....	6802	LDP_GEAR_1_DRVB	
LDP_FAC_TQ_REQ_MON__TQ_MAX_MON		def .....	2308
def .....	6938	LDP_GEAR_FAC_TQ_CRU	
LDP_FCO_IP_FCO_DELTA_NS_SHIFT		def .....	7240
def .....	6432	LDP_GR_AT__N_TUR	
LDP_FLOW_COR_CPS_IP_CPPWM		def .....	6711
def .....	3750	LDP_ICPLSL_IP_CTR_ICPLSL_THD	
LDP_FLOW_NT_MMV_IP_NOX_SENS_AT		def .....	2354
def .....	2995	LDP_IDX_BSD_SDL_TBL	
LDP_FLOW_NT_MMV_IP_NOX_SENS_MT		def .....	4097
def .....	2995	LDP_IDX_CTR_ALTER_EVE_WR	
LDP_FLOW_NT_MMV_IP_T_RGN_MAX		def .....	4097
def .....	2997	LDP_IDX_DS_ID_IDX_ACT_DS_CONF	
LDP_FRQ_REQ_V_CUR_VCV_MES		def .....	7439
def .....	3962	LDP_IDX_ENVD_ID_IDX_ACT_DS_CONF	
LDP_FTL_T_CUR_DMTL_STAT		def .....	7439
def .....	5976	LDP_IDX_LF_ALTER_EVE_WR	
LDP_FTL_T_ROUGH_LEAK_TEST		def .....	4097
def .....	5975, 5976	LDP_IDX_NR_ALTER_EVE_WR	
LDP_FTL_T_SMALL_LEAK_TEST		def .....	4097
def .....	5976	LDP_IDX_TI_1_INJR_MON	
LDP_FUP_DIF_CTL_IP_FUEL_MASS		def .....	6762
def .....	3911	LDP_IDX_TI_2_INJR_MON	
LDP_FUP_DIF_IP_EFPPWM_I_VCV_LIH		def .....	6762
def .....	3800	LDP_IGA_DIF_BAS_CYL_LAM_IP_CRK	
LDP_FUP_DIF_IP_EFPPWM_P_VCV_LIH		def .....	2867
def .....	3800	LDP_IGA_DIF_IP_EFF_IGA	
LDP_FUP_DIF_IP_FUP_REQ_FPA_RST		def .....	1846
def .....	3882	LDP_IGA_H_RNG_IP_MFF_2_MPLH_CH	
LDP_FUP_DIF_PCTL_IP_FAC_FUEL		def .....	2164
def .....	3911	LDP_IGA_IP_TEMP_OFS_MFF_SP	
LDP_FUP_EFP_DIF_IP_EFPPWM_I		def .....	1235
def .....	3800	LDP_IP_FAC_FUEL_MASS_SET	

def .....	3882	LDP_LOAD_IP_AFS_ER_IS_AT_CTL	
LDP_IPLSL_CHG_PURGE_IP_IPLSL		def .....	6286
def .....	2374	LDP_LOAD_IP_DELTA_IGA_BAS_MIS	
LDP_LAMB_DIF_IP_T_END_CP		def .....	6214
def .....	3706	LDP_LOAD_IP_DELTA_IGA_IS_MIS	
LDP_LAMB_DIF_IP_TQ_ADD_CH_L		def .....	6215
def .....	6584	LDP_LOAD_IP_FAC_ADD_ER_AT	
LDP_LAMB_DIF_MAX_DYN_LSL_UP		def .....	1455
def .....	5354	LDP_LOAD_IP_FAC_ADD_ER_MT	
LDP_LAMB_DIF_MIN_DYN_LSL_UP		def .....	1455
def .....	5354	LDP_LOAD_IP_FAC_ADD_ER_TCT	
LDP_LAMB_HOM_MON2_IP_EFF_MON2		def .....	1455
def .....	7019	LDP_LOAD_IP_FAC_DRV2_ER_IS_AT	
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def .....	4867	
LV_CDN_DIAG_BN_TQ_TCT	def .....	4536
def .....	4867	
LV_CDN_DIAG_BN_TRL	def .....	4536
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LV_CDN_DIAG_BN_VEH_MOD	def .....	4536
def .....	4867	
LV_CDN_DIAG_BN_VS_TCS	def .....	5112
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LV_CDN_DIAG_BN_WHEEL_CAN	def .....	5112
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LV_CDN_DIAG_BSD	def .....	5911
def .....	4833	
LV_CDN_DIAG_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	def .....	5051
def .....	1056	
LV_CDN_DIAG_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	def .....	5215
def .....	1056	
LV_CDN_DIAG_CAN_BOFF	def .....	5926
def .....	4846	
LV_CDN_DIAG_CAT_DIAG [NC_CBK_EX_NR]	def .....	5962
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LV_CDN_DIAG_CAT_DIAG_AFL [NC_CBK_EX_NR]	def .....	5962
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LV_CDN_DIAG_CAT_DIAG_SUM [NC_CBK_EX_NR]	def .....	5962
def .....	5535	
LV_CDN_DIAG_CHG_LS_DOWN	def .....	4626
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LV_CDN_DIAG_DUR_IGC_MPL	def .....	4772	def .....	6140
def .....	4772	use .....	5895	
LV_CDN_DIAG_DYN_VLD_LS_UP [NC_CBK_EX_NR]	def .....	5347	LV_CDN_DIAG_FSD_H_RNG [NC_CBK_EX_NR]	def .....
def .....	5347	def .....	6140	
LV_CDN_DIAG_EBOX_CFA	def .....	4626	LV_CDN_DIAG_FSD_LAM_LIM [NC_CBK_EX_NR]	def .....
def .....	4626	def .....	6140	
LV_CDN_DIAG_ECF_EL [NC_ECF_NR]	def .....	4507	use .....	5895
def .....	4507	LV_CDN_DIAG_FTL_LE_CAN	def .....	4745
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def .....	4507	def .....	4762	
LV_CDN_DIAG_ECRAS_DOWN_FB	def .....	4515	LV_CDN_DIAG_FTL_OBD	def .....
def .....	4515	def .....	4745	
LV_CDN_DIAG_ECRAS_EL	def .....	4515	LV_CDN_DIAG_FTL_RI_CAN	def .....
def .....	4515	def .....	4745	
LV_CDN_DIAG_ECRAS_UP_FB	def .....	4515	LV_CDN_DIAG_FUP	def .....
def .....	4515	def .....	4717	
LV_CDN_DIAG_ECT_EL	def .....	4529	LV_CDN_DIAG_FUP_CH	def .....
def .....	4529	def .....	6102	
LV_CDN_DIAG_ECT_EL_OC	def .....	4529	LV_CDN_DIAG_FUP_EFP	def .....
def .....	4529	def .....	4733	
LV_CDN_DIAG_ECT_EL_SCP	def .....	4529	LV_CDN_DIAG_FUP_EFP_NOT_PLAUS	def .....
def .....	4529	def .....	6050	
LV_CDN_DIAG_ECU_CKS	def .....	4232	LV_CDN_DIAG_FUP_MFP_PLAUS	def .....
def .....	4232	def .....	6061	
LV_CDN_DIAG_ECU_NVMY	def .....	4232	LV_CDN_DIAG_FUP_MFP_PLAUS_1	def .....
def .....	4232	def .....	6061	
LV_CDN_DIAG_ECU_RAM	def .....	4232	LV_CDN_DIAG_FUP_ORNG	def .....
def .....	4232	def .....	6061	
LV_CDN_DIAG_EF	def .....	4626	LV_CDN_DIAG_FUP_ST_DLY	def .....
def .....	4626	def .....	6061	
LV_CDN_DIAG_EFF_IGA_CST_IS	def .....	6517	LV_CDN_DIAG_FUP_ST_H_PRS	def .....
use .....	6597, 7738	def .....	6061	
LV_CDN_DIAG_EFF_IGA_CST_PL	def .....	6517	LV_CDN_DIAG_FUP_ST_NO_RISE	def .....
use .....	6597, 7738	def .....	6061	
LV_CDN_DIAG_EFP	def .....	4721	LV_CDN_DIAG_FUP_STOP	def .....
def .....	4721	LV_CDN_DIAG_GEN	def .....	1056
LV_CDN_DIAG_EFP_CRASH	def .....	4721	LV_CDN_DIAG_GEN_CLC_V_NOT_PLAUS	def .....
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LV_CDN_DIAG_EFPPWM_PLAUS	def .....	6050	LV_CDN_DIAG_GEN_CTL_NOT_PLAUS	def .....
def .....	6050	def .....	1056	
LV_CDN_DIAG_EGRV_PSN_PLAUS	def .....	1056	LV_CDN_DIAG_GEN_DIAG	def .....
def .....	1056	def .....	4924	
LV_CDN_DIAG_EGY_MIN	def .....	4926	LV_CDN_DIAG_GEN_EL	def .....
def .....	4926	def .....	1056	
LV_CDN_DIAG_EGY_MIN_2	def .....	4926	LV_CDN_DIAG_GEN_H_TEMP	def .....
def .....	4926	def .....	1056	
LV_CDN_DIAG_EL_LSL_UP [NC_CBK_EX_NR]	def .....	4293	LV_CDN_DIAG_GEN_H_TEMP_CLC	def .....
def .....	4293	def .....	1056	
LV_CDN_DIAG_ER_STRAT	def .....	1056	LV_CDN_DIAG_GEN_MEC	def .....
def .....	1056	def .....	1056	
LV_CDN_DIAG_ER_STRAT_WUP	def .....	1056	LV_CDN_DIAG_GEN_MSG_LOST	def .....
def .....	1056	def .....	1056	
LV_CDN_DIAG_FL_LS_DOWN [NC_CBK_EX_NR]	def .....	4275	LV_CDN_DIAG_GEN_TYP_NOT_PLAUS	def .....
def .....	4275	def .....	1056	
LV_CDN_DIAG_FSD [NC_CBK_EX_NR]	def .....		def .....	1056

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def .....	5010	def .....	4814
LV_CDN_DIAG_H_PRS_SYS_PRE		LV_CDN_DIAG_MAF_FRQ_RNG [NC_MAF_NR]	
def .....	6061	def .....	4814
LV_CDN_DIAG_H_PRS_SYS_PRE_2		LV_CDN_DIAG_MAF_LAMB_MAX	
def .....	6061	def .....	1056
LV_CDN_DIAG_IGC_SCG [NC_CYL_NR]		LV_CDN_DIAG_MAP_DIP_PLAUS	
def .....	4772	def .....	1056
LV_CDN_DIAG_IGC_SCP [NC_CYL_NR]		LV_CDN_DIAG_MAP_DIP_SENS	
def .....	4772	def .....	4824
use .....	920	LV_CDN_DIAG_MAP_DIP_SHIFT	
LV_CDN_DIAG_IM_BLS_PLAUS		def .....	4824
def .....	4209	LV_CDN_DIAG_MAP_PLAUS	
LV_CDN_DIAG_IM_BTS_PLAUS		def .....	1056
def .....	4209	LV_CDN_DIAG_MAP_TPS_PLAUS	
LV_CDN_DIAG_IMOB_0		def .....	1057
def .....	4783	LV_CDN_DIAG_MEC_IVVT_EX	
LV_CDN_DIAG_IMOB_1		def .....	1057
def .....	4783	LV_CDN_DIAG_MEC_IVVT_IN	
LV_CDN_DIAG_IMOB_2		def .....	1057
def .....	4783	LV_CDN_DIAG_MFF_MON_1	
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LV_CDN_DIAG_ISC		def .....	6263
def .....	4377	LV_CDN_DIAG_MIS_FTL_L	
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LV_CDN_DIAG_IV [NC_CYL_NR]		def .....	6264
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LV_CDN_DIAG_IV_SC [NC_CYL_NR]		def .....	7158
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LV_CDN_DIAG_KNK_PRE [NC_CYL_NR]		def .....	5058
def .....	4909	LV_CDN_DIAG_MSW_3	
LV_CDN_DIAG_KNKS [NC_NR_SENS_KNK]		def .....	5058
def .....	4903	LV_CDN_DIAG_MSW_TOG	
LV_CDN_DIAG_L_PRS_SYS		def .....	5058
def .....	6050	LV_CDN_DIAG_MTC_CTL_1	
LV_CDN_DIAG_LAM_AD_CUS [NC_CBK_EX_NR]		def .....	4977
def .....	8309	LV_CDN_DIAG_MTC_CTL_2	
LV_CDN_DIAG_LDM		def .....	4977
def .....	5054	LV_CDN_DIAG_MTC_CTL_3	
LV_CDN_DIAG_LOAD_TPS_PLAUS		def .....	4977
def .....	1056	LV_CDN_DIAG_MTC_DR	
LV_CDN_DIAG_LOCAN_BOFF		def .....	5002
def .....	4846	LV_CDN_DIAG_N_32_MON_1	
LV_CDN_DIAG_LSH_DOWN [NC_CBK_EX_NR]		def .....	6857
def .....	4248	LV_CDN_DIAG_N_MAX_DRIV_REQ	
LV_CDN_DIAG_LSH_LSL_UP [NC_CBK_EX_NR]		def .....	1057
def .....	5276	LV_CDN_DIAG_N_MAX_HOMS	
LV_CDN_DIAG_LSH_UP [NC_CBK_EX_NR]		def .....	1057
def .....	4315	LV_CDN_DIAG_N_WHEEL_FN_LE	
LV_CDN_DIAG_LSL_UP_IF [NC_CBK_EX_NR]		def .....	5043
def .....	4285	LV_CDN_DIAG_N_WHEEL_FN_RI	
LV_CDN_DIAG_MAF		def .....	5043
def .....	4814	LV_CDN_DIAG_N_WHEEL_RE_LE	
LV_CDN_DIAG_MAF_FRQ_EL [NC_MAF_NR]		def .....	5043
def .....	4814	LV_CDN_DIAG_N_WHEEL_RE_RI	

def .....	5043	LV_CDN_DIAG_POIL_CTL_DYN	
LV_CDN_DIAG_NEUT_PSN_GB_LRN		def .....	1057
def .....	1057	LV_CDN_DIAG_POIL_CTL_MEC	
LV_CDN_DIAG_NS_ACT [NC_NOX_SENS_CONF]		def .....	1057
def .....	6358	LV_CDN_DIAG_POIL_CTL_STAT	
LV_CDN_DIAG_NS_AFR [NC_NOX_SENS_CONF]		def .....	1057
def .....	6389	LV_CDN_DIAG_POIL_DR_SCG	
LV_CDN_DIAG_NS_AVL [NC_NOX_SENS_CONF]		def .....	4357
def .....	6368	LV_CDN_DIAG_POIL_PUMP	
LV_CDN_DIAG_NS_HTP [NC_NOX_SENS_CONF]		def .....	1057
def .....	6330	LV_CDN_DIAG_POIL_SENS_PLAUS	
LV_CDN_DIAG_NS_LSL_UP_DOWN [NC_NOX_SENS_CONF]		def .....	1057
def .....	6396	LV_CDN_DIAG_POIL_SWI	
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def .....	4915	LV_CDN_DIAG_POIL_SYS	
LV_CDN_DIAG_NS_OFS [NC_NOX_SENS_CONF]		def .....	1057
def .....	6378	LV_CDN_DIAG_PUC_LS_DOWN [NC_CBK_EX_NR]	
LV_CDN_DIAG_NS_PUC [NC_NOX_SENS_CONF]		def .....	4275
def .....	6405	LV_CDN_DIAG_PUC_VLD_LS_UP [NC_CBK_EX_NR]	
LV_CDN_DIAG_NS_SHIFT [NC_NOX_SENS_CONF]		def .....	5297
def .....	6412	LV_CDN_DIAG_PUT_EL	
LV_CDN_DIAG_NS_STOP [NC_NOX_SENS_CONF]		def .....	4828
def .....	6347	LV_CDN_DIAG_PUT_PLAUS	
LV_CDN_DIAG_NS_VERS [NC_NOX_SENS_CONF]		def .....	1057
def .....	6313	LV_CDN_DIAG_PVS_1	
LV_CDN_DIAG_NS_VLS_DYN [NC_NOX_SENS_CONF]		def .....	4215
def .....	6338	LV_CDN_DIAG_PVS_2	
LV_CDN_DIAG_NT_AGI		def .....	4215
def .....	6485	LV_CDN_DIAG_PVS_BLS_NOT_PLAUS	
LV_CDN_DIAG_NT_SO2P		def .....	4215
def .....	6485	LV_CDN_DIAG_PVS_DOUBLE	
LV_CDN_DIAG_OBD_LSH_DOWN [NC_CBK_EX_NR]		def .....	4215
def .....	5198	LV_CDN_DIAG_PVS_MON_1	
LV_CDN_DIAG_OBD_VLD_LSH_UP [NC_CBK_EX_NR]		def .....	6858
def .....	5438	LV_CDN_DIAG_PVS_RATIO	
LV_CDN_DIAG_OC_LS_DOWN [NC_CBK_EX_NR]		def .....	4215
def .....	4266	LV_CDN_DIAG_QOIL_COM	
LV_CDN_DIAG_OC_LSL_UP [NC_CBK_EX_NR]		def .....	4833
def .....	4300	LV_CDN_DIAG_QOIL_SENS	
LV_CDN_DIAG_OFS_LSL_UP [NC_CBK_EX_NR]		def .....	1057
def .....	5248	LV_CDN_DIAG_RAS	
LV_CDN_DIAG_PBK_IV [NC_PBK_IV_NR]		def .....	4569
def .....	4797	LV_CDN_DIAG_REF_CRK_CAM_EX [NC_NR_CAM_CBK]	
LV_CDN_DIAG_PER_CAM_EX [NC_NR_CAM_CBK]		def .....	4420
def .....	4425	LV_CDN_DIAG_REF_CRK_CAM_IN [NC_NR_CAM_CBK]	
LV_CDN_DIAG_PER_CAM_IN [NC_NR_CAM_CBK]		def .....	4420
def .....	4425	LV_CDN_DIAG_RFP_DR	
LV_CDN_DIAG_PLAUS_CAM_EX [NC_NR_CAM_CBK]		def .....	4203
def .....	4446	LV_CDN_DIAG_RLY_ACCOUT	
LV_CDN_DIAG_PLAUS_CAM_IN [NC_NR_CAM_CBK]		def .....	4626
def .....	4446	LV_CDN_DIAG_RLY_CRCV_HEAT	
LV_CDN_DIAG_PLAUS_IGK_3		def .....	4626
def .....	4929	LV_CDN_DIAG_RLY_MAIN	
LV_CDN_DIAG_PLAUS_IGK_BN		def .....	4933
def .....	4929	LV_CDN_DIAG_RLY_MAIN_DLY	
LV_CDN_DIAG_PLAUS_IV_CAL		def .....	4933
def .....	4790	LV_CDN_DIAG_RLY_MTC_HEAT	


def .....	5004	LV_CDN_DIAG_T_ES_TCO_FAST	
LV_CDN_DIAG_RLY_ST		def .....	4466
def .....	4626	LV_CDN_DIAG_T_ES_TCO_SLOW	
LV_CDN_DIAG_ROUGH_LEAK		def .....	4466
def .....	5962	LV_CDN_DIAG_T_SEG_ER	
LV_CDN_DIAG_SCG_LS_DOWN [NC_CBK_EX_NR]		def .....	4367
def .....	4266	LV_CDN_DIAG_TAM_CAN	
LV_CDN_DIAG_SCP_LS_DOWN [NC_CBK_EX_NR]		def .....	5076
def .....	4266	LV_CDN_DIAG_TAM_PLAUS	
LV_CDN_DIAG_SEG_AD_ER		def .....	5076
def .....	4367	LV_CDN_DIAG_TCHA_LEAK	
LV_CDN_DIAG_SENS_ACR		def .....	1057
def .....	4352	use .....	7314
LV_CDN_DIAG_SENS_BAT_SMT_COM		LV_CDN_DIAG_TCHA_PRS_CTL	
def .....	4833	def .....	1057
LV_CDN_DIAG_SENS_POIL		LV_CDN_DIAG_TCHA_PRS_DIF	
def .....	4365	def .....	1057
LV_CDN_DIAG_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR]		LV_CDN_DIAG_TCHA_PRS_HIGH	
def .....	5334	def .....	1057
LV_CDN_DIAG_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR]		LV_CDN_DIAG_TCHA_PRS_LOW	
def .....	5334	def .....	1057
LV_CDN_DIAG_SLV_IVVT_EX		LV_CDN_DIAG_TCHA_SYS_1	
def .....	4626	def .....	1057
LV_CDN_DIAG_SLV_IVVT_IN		LV_CDN_DIAG_TCO_2_EL	
def .....	4626	def .....	4572
LV_CDN_DIAG_SMALL_LEAK		LV_CDN_DIAG_TCO_2_GRD	
def .....	5962	def .....	4572
LV_CDN_DIAG_SOF		LV_CDN_DIAG_TCO_2_PLAUS	
def .....	4911	def .....	5666
LV_CDN_DIAG_SOF_REQ		LV_CDN_DIAG_TCO_EL	
def .....	4911	def .....	4496
LV_CDN_DIAG_SPI_KNK		LV_CDN_DIAG_TCO_GRD	
def .....	4245	def .....	4496
LV_CDN_DIAG_SPI_MPS		LV_CDN_DIAG_TCO_PLAUS	
def .....	4245	def .....	5682
LV_CDN_DIAG_SWI_AFS_MON		use .....	5687
def .....	6858	LV_CDN_DIAG_TCO_STUCK	
LV_CDN_DIAG_SWT_LS_DOWN [NC_CBK_EX_NR]		def .....	5691
def .....	5151	LV_CDN_DIAG_TCO_STUCK_RNG	
LV_CDN_DIAG_SYN_CAM_EX [NC_NR_CAM_CBK]		def .....	5675
def .....	4425	LV_CDN_DIAG_TECU	
LV_CDN_DIAG_SYN_CAM_IN [NC_NR_CAM_CBK]		def .....	4237
def .....	4425	LV_CDN_DIAG_TEG_PCAT_DOWN	
LV_CDN_DIAG_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]		def .....	4713
def .....	4446	LV_CDN_DIAG_TH	
LV_CDN_DIAG_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]		def .....	5652
def .....	4446	LV_CDN_DIAG_TIA_EL	
LV_CDN_DIAG_T_ES		def .....	4194
def .....	4465	LV_CDN_DIAG_TIA_GRD	
LV_CDN_DIAG_T_ES_DIAG_1		def .....	4194
def .....	4465	LV_CDN_DIAG_TIA_PLAUS	
LV_CDN_DIAG_T_ES_DIAG_1_CUS		def .....	5093
def .....	4466	LV_CDN_DIAG_TIA_TCHA_UP	
LV_CDN_DIAG_T_ES_DIAG_2		def .....	4189
def .....	4466	LV_CDN_DIAG_TMP_PUE_LS_DOWN [NC_CBK_EX_NR]	
LV_CDN_DIAG_T_ES_DIAG_3		def .....	5168
def .....	4466	LV_CDN_DIAG_TOIL_LEVEL	

def .....	1057	LV_CDN_DIAG_VIM_2_EL	
LV_CDN_DIAG_TOOTH_OFF_EX [NC_NR_CAM_CBK]		def .....	5064
def .....	4420	LV_CDN_DIAG_VIM_PLAUS	
LV_CDN_DIAG_TOOTH_OFF_IN [NC_NR_CAM_CBK]		def .....	1058
def .....	4420	LV_CDN_DIAG_VIMPWM_1_FB	
LV_CDN_DIAG_TPS		def .....	5064
def .....	4982	LV_CDN_DIAG_VIMPWM_2_FB	
LV_CDN_DIAG_TPS_1		def .....	5064
def .....	4989	LV_CDN_DIAG_VLS_DOWN_DIF [NC_CBK_EX_NR]	
LV_CDN_DIAG_TPS_2		def .....	5215
def .....	4989	LV_CDN_DIAG_VS	
LV_CDN_DIAG_TPS_AD		def .....	5020
def .....	4950	LV_CDN_DIAG_VS_BOL	
LV_CDN_DIAG_TPS_AD_BOL		def .....	5020
def .....	4950	LV_CDN_DIAG_VS_GRD	
LV_CDN_DIAG_TPS_JAM_DET		def .....	5021
def .....	6531	LV_CDN_DIAG_VS_PLAUS_POW	
LV_CDN_DIAG_TPS_MAF_1		def .....	5021
def .....	4989	LV_CDN_DIAG_VS_PLAUS_STUCK	
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def .....	6858	LV_CDN_DIAG_WARM_RST	
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def .....	4989	LV_CDN_DIAG_WG_1_DR	
LV_CDN_DIAG_TPS_ST_CHK_1		def .....	4206
def .....	4950	LV_CDN_DIAG_WG_2_DR	
LV_CDN_DIAG_TPS_ST_CHK_2		def .....	4206
def .....	4950	LV_CDN_DIAG_WHEEL_GRD_FR_LE	
LV_CDN_DIAG_TQ_CST		def .....	6300
def .....	1057	LV_CDN_DIAG_WHEEL_GRD_FR_RI	
LV_CDN_DIAG_TQ_DIF_ISC_MON_1		def .....	6300
def .....	6858	LV_CDN_DIAG_WHEEL_GRD_RE_LE	
LV_CDN_DIAG_TQ_EXT_MON_1		def .....	6300
def .....	6858	LV_CDN_DIAG_WHEEL_GRD_RE_RI	
LV_CDN_DIAG_TQ_REQ_CAN		def .....	6300
def .....	4851	LV_CDN_DIAG_XX	
LV_CDN_DIAG_TQ_REQ_MON_1		def .....	4581
def .....	6858	use .....	5694, 5744, 5885
LV_CDN_DIAG_TQI_AV_MON_1		LV_CDN_ENA_RATIO_T_AST	
def .....	6858	def .....	4493
LV_CDN_DIAG_TQI_N_MAX_MON_1		LV_CDN_ENA_TCO_2_PREL	
def .....	6858	def .....	4572
LV_CDN_DIAG_TTIP_MES_LSH_UP [NC_CBK_EX_NR]		LV_CDN_ENA_TCO_PREL	
def .....	5438	def .....	4496
LV_CDN_DIAG_V_REF_1		LV_CDN_ENA_TCO_SUB	
def .....	4215	def .....	1105
LV_CDN_DIAG_V_REF_2		LV_CDN_INI_TCO	
def .....	4215	def .....	1100
LV_CDN_DIAG_VAR_COD		LV_CDN_INI_TCO_2	
def .....	4945	def .....	1218
LV_CDN_DIAG_VCV_PLAUS		LV_CDN_ISC_CST_CLU	
def .....	6061	def .....	4377
LV_CDN_DIAG_VEH_POW_VAR		LV_CDN_MIS_A	
def .....	4945	def .....	6264
LV_CDN_DIAG_VIM_1_EL		use .....	6239
def .....	5064	LV_CDN_MIS_B1	

def .....	6264	def .....	1564
use .....	6239	use .....	6697
LV_CDN_MIS_B4		LV_CH	
def .....	6264	def .....	8232
use .....	6239	use .....	1789, 1962, 2241, 4022, 5929, 6062, 6102, 6118, 8244
LV_CDN_NT_AGI_THERMO_AD		LV_CH_AST_CDN	
def .....	3072	def .....	1777
LV_CDN_PRE_CSERS_INJ_DIAG		LV_CH_AST_ENA	
def .....	6117	def .....	1789
use .....	6109	use .....	1777
LV_CDN_RBM_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]		LV_CH_AST_MPLH_CDN	
def .....	1058	def .....	1801
LV_CDN_RBM_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]		LV_CH_AST_MPLP_CDN	
def .....	1058	def .....	1801
LV_CDN_RBM_LOAD_TPS_PLAUS		LV_CH_AST_REQ_TCHA_DIAG	
def .....	1058	def .....	8232
LV_CDN_RBM_MAP_DIP_PLAUS		use .....	1777, 1796, 6582
def .....	1058	LV_CH_DIAG_EXT_ACT	
LV_CDN_RBM_MEC_IVVT_EX		def .....	6597
def .....	1058	use .....	6508, 6582
LV_CDN_RBM_MEC_IVVT_IN		LV_CH_DIAG_EXT_REQ	
def .....	1058	def .....	7482
LV_CDN_RBM_TAM_PLAUS		use .....	6508, 6597, 7544
def .....	5076	LV_CH_FIRST_DEAC	
LV_CDN_RBM_TQ_CST		def .....	6117
def .....	1058	LV_CH_INH	
LV_CDN_RNG_L_REQ_MON		def .....	8232
def .....	6790	use .....	1789
LV_CDN_VB_BN_DIAG		LV_CH_L_CDN	
def .....	1185	def .....	1777
use .....	4851, 5044	LV_CH_L_ENA	
LV_CDN_VB_CAN_DIAG		def .....	1789
def .....	1185	use .....	1777
use .....	4721, 4846, 4855, 4921	LV_CH_L_RGN	
LV_CDN_VB_CAN_TQ_DIAG		def .....	1777
def .....	1185	LV_CH_N_SP_IS	
use .....	6615, 6623, 6650, 6719, 6731, 6742, 6985	def .....	1775
LV_CDN_VB_MIN_DIAG		use .....	1123, 3614, 4377, 4392
def .....	1185	LV_CH_SO2P_CDN	
use .....	657, 3863, 4209, 4496, 4508, 4516, 4537, 4572, 4627, 4834, 4911, 5004, 5065, 5691, 7766	def .....	1777
LV_CDN_VB_OBD1		LV_CH_SO2P_WOUT_LIM	
def .....	1185	def .....	3144
use .....	1046, 4203, 4207, 4247, 4290, 4314, 4357, 4530, 4627, 4712, 4729, 4773, 4803, 4815, 4939, 5010, 5065	use .....	1789, 7738
LV_CDN_VB_OBD2		LV_CH_TQ_ADD	
def .....	1185	def .....	799
use .....	1046, 4377, 4467, 4780, 5210, 5285, 5378, 5420, 5429, 5652, 5666, 5675	use .....	1925
LV_CDN_VB_OBD_2		LV_CH_TQ_ADD_IS	
use .....	5682	def .....	799
LV_CDN_VS_VLD_1		use .....	1925
def .....	4215	LV_CHECK_MDL_ST	
LV_CDN_VS_VLD_2		def .....	8236
def .....	4215	use .....	3181
LV_CFT_MOD_PBR		LV_CHK_DMTL_CUR_DMTL_VLD	
		def .....	5962
		LV_CHK_DMTL_CUR_DMTL_VLD_CFM	
		def .....	5962

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use .....	6037	def .....	1825
LV_CHK_DMTL_CUR_DMTL_VLD_VIRT		use .....	811, 1195, 1206, 2100, 2109
def .....	6037	LV_CLOSE_ACT_CP	
LV_CHK_DMTL_VLD		def .....	1000
def .....	5962	use .....	5971
LV_CHK_DMTL_VLD_CFM		LV_CLR_FTL	
def .....	5962	def .....	5962
use .....	6037	LV_CLU_SWI	
LV_CHK_FUC_CLOSE		def .....	996
def .....	5918	use .....	2968, 2988, 3144, 6795, 7766
LV_CHK_FUC_END		LV_CMB_TRAN_ACT	
def .....	5918	def .....	799
LV_CHK_FUC_OPEN		use .....	1541
def .....	5918	LV_CNL_DIAG_TAM_PLAUS	
LV_CHK_FUC_OPEN_ACT		def .....	5076
def .....	5918	LV_CNL_DIAG_TH	
LV_CHK_FUC_OPEN_CAN		def .....	5652
def .....	5918	LV_CONF_DMTL	
use .....	1583	def .....	654
LV_CITY		use .....	819, 912, 4627, 5919, 5971, 7766, 8114
def .....	799	LV_CP_ACT	
use .....	1302, 3851, 6795	def .....	3679
LV_CL_CALC_AVL		use .....	3630, 3638, 3692, 3701, 3728, 3737
def .....	1001	LV_CP_ACT_REQ	
LV_CL_CLC_AVL		def .....	3636
def .....	3635	use .....	8229
use .....	1002, 5378, 5459	LV_CP_AFL	
LV_CL_CLC_VLD		def .....	3699
def .....	3635	use .....	3638
use .....	3630, 3757	LV_CP_AFL_IT	
LV_CL_GRD_CHK_MAX		def .....	3636
def .....	3699	LV_CP_CAT_PURGE	
LV_CL_MDL_ACT		def .....	1540
def .....	3728	use .....	3638, 3728
use .....	3638, 3701, 5929	LV_CP_CAT_PURGE_AFL	
LV_CL_MDL_CAT_PURGE_ACT_CP		def .....	1540
def .....	3636	LV_CP_CDN_MIN_PURGE_FAST	
LV_CL_MDL_ENA		def .....	1540
def .....	3728	use .....	3638, 3728
use .....	3638, 3701	LV_CP_CDN_RAMP_OPEN	
LV_CL_MDL_END_CAT_PURGE		def .....	3636
def .....	3728	LV_CP_CDN_RAMP_OPEN_FAST	
use .....	1541	def .....	3636
LV_CL_MMV		LV_CP_CLL	
def .....	1001	def .....	3636
use .....	5954	use .....	1541, 3680, 3701, 3728, 5929
LV_CL_MMV_CAL_ACT		LV_CP_CLOSE_1	
def .....	3699	def .....	3679
use .....	1002, 2865, 5929	use .....	1541, 3638
LV_CL_MMV_TMP		LV_CP_CLOSE_2	
def .....	1001	def .....	3679
LV_CL_OK_CPS_AD		use .....	1541, 3638
def .....	3756	LV_CP_CLOSE_3	
LV_CLC_2SEG		def .....	3679
def .....	1825	use .....	1541
use .....	811, 1195, 1206, 1209, 2100, 2109	LV_CP_CLOSE_ACT	
LV_CLC_2SEG_ENA		def .....	3749


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use .....	1000, 1002, 2372, 2627, 3737, 6199, 8229	LV_CPS_AD_ST_CDN_OK	
LV_CP_CLOSE_REQ		def .....	3756
def .....	1540	LV_CPS_OK_CPS_AD	
use .....	3638, 3757	def .....	3756
LV_CP_CMU_CMB		LV_CRC_DONE_BOOT	
def .....	1540	def .....	799
use .....	3638	LV_CRC_DONE_CAL	
LV_CP_DYW		def .....	799
def .....	1540	LV_CRC_DONE_ECU	
use .....	3701	def .....	799
LV_CP_DYW_EXT		LV_CRC_ERR_BOOT	
def .....	3679	def .....	799
use .....	1541	LV_CRC_ERR_CAL	
LV_CP_ENA		def .....	799
def .....	3737	LV_CRC_ERR_ECU	
use .....	3630, 3638, 5954	def .....	799
LV_CP_INH_CUS		LV_CRC_STATUS_MU	
def .....	8229	def .....	799
use .....	3680	LV_CRK_CYL_LAM_DELTA_RST_LS_EXT [NC_CBK_EX_	
LV_CP_NEW_RAMP_OPEN		NR]	
def .....	3699	use .....	2840
use .....	1002, 3638	LV_CRK_DIF_SOI_EOI_LIM	
LV_CP_NEW_RAMP_OPEN_FAST		def .....	2122
def .....	3699	LV_CRK_FIRST_VLD_TOOTH	
use .....	3638	def .....	853
LV_CP_NEW_RAMP_OPEN_MEM		use .....	873, 1506
def .....	1001	LV_CRK_MISS_RUN_ENG	
LV_CP_OPP_WIN_1		def .....	1505
def .....	3699	use .....	4447
use .....	3728	LV_CRK_MISS_TOOTH	
LV_CP_OPP_WIN_2		def .....	853
def .....	3699	use .....	1506
LV_CP_PER_END_REQ_S_CP		LV_CRK_OSC_DET_ACT	
def .....	3699	def .....	6209
LV_CP_PU		LV_CRK_RUN	
def .....	1540	def .....	853
LV_CP_PUC		use .....	1506
def .....	1540	LV_CRK_STOP	
LV_CP_RAMP_OPEN_ACT		def .....	853
def .....	3636	use .....	1506
use .....	2465, 2721, 5217	LV_CRK_SYN	
LV_CP_WIN		def .....	853
def .....	1540	use .....	873, 1506, 1525, 4432, 4447
LV_CPPWM_EXT_ADJ		LV_CRCLC_CL_TRA	
def .....	7433	def .....	3699
use .....	3749	LV_CRU_ACT	
LV_CPS_AD_ACT		def .....	7227
def .....	3756	use .....	6737, 6870, 6912, 7201, 7220
use .....	3638, 3749	LV_CRU_ACT_INH	
LV_CPS_AD_HOM_REQ		def .....	7227
def .....	3756	use .....	1583
use .....	3701	LV_CRU_ACT_VLD	
LV_CPS_AD_INH		def .....	7227
def .....	3679	LV_CRU_DISP_HUD	
use .....	3757	def .....	7201
LV_CPS_AD_RUN_CDN_OK		use .....	1583
def .....	3756	LV_CRU_EXT_ADJ	



def .....	7433	def .....	799, 1565
LV_CRU_INH_MON		use .....	3614, 3851
def .....	6912	LV_CTR_CHK_PUE_LS_DOWN [NC_CBK_EX_NR]	
LV_CRU_MAIN_SWI		def .....	5168
def .....	7220	LV_CTR_CNL_SMALL_LEAK_MES	
use 1583, 6870, 6912, 7201, 7220, 7228, 7238, 7314		def .....	5962
LV_CRU_OFF_BY_ASR_ESP_CTL		LV_CTR_CNL_SMALL_LEAK_MES_CFM	
def .....	7215	def .....	5962
use .....	7228	use .....	6037
LV_CRU_OFF_IRR		LV_CTR_CNL_SMALL_LEAK_VIRT	
def .....	7227	def .....	6037
use .....	1583, 7220	LV_CTR_CYL_BAL_RST_EXT	
LV_CRU_OVER_ACT		def .....	7482
def .....	7227	use .....	5113
use .....	7238	LV_CTR_DC_CHK_FUC	
LV_CRU_OVER_ACT_ACK		def .....	5918
def .....	7237	LV_CTR_ERR_LSL_IF_SPI_MAN_INC [NC_CBK_EX_NR]	
use .....	7228	def .....	1318
LV_CS		use .....	956
def .....	8394	LV_CTR_HLD_EFF_IGA_CST	
use 1091, 1112, 1123, 1148, 1223, 1302, 1310, 1720, 3442, 4462, 6675, 6697, 7314, 7438, 7557, 7766		def .....	6493
LV_CS_2		LV_CTR_KM_CH_SO2P_INH	
def .....	1565	def .....	1789
use .....	6697, 8292	LV_CTR_KNK_CMB	
LV_CS_CHG		def .....	1961
def .....	6675	LV_CTR_MAX_TCO_MIN_INTER [NC_CBK_EX_NR]	
LV_CS_CUS		def .....	2677
def .....	1419	LV_CTR_OK_CPS_AD	
use .....	6283, 7315, 8353, 8394	def .....	3756
LV_CS_DIAG		LV_CTR_PBK_IV_INI_INC	
def .....	5015	def .....	2038
LV_CS_MON		LV_CTR_T_PER_MAF_FRQ_EL [NC_MAF_NR]	
def .....	6790	def .....	833
use .....	6795	use .....	4815
LV_CS_N_MAX		LV_CTR_T_PER_MAF_FRQ_GRD [NC_MAF_NR]	
def .....	4462	def .....	833
use .....	7391, 7557	LV_CTR_T_PER_MAF_FRQ_RNG [NC_MAF_NR]	
LV_CS_PUC		def .....	833
def .....	1720	LV_CTR_T_PER_MAF_FRQ_SENS [NC_MAF_NR]	
LV_CS_SWI		def .....	833
def .....	5015	use .....	4815
LV_CS_TOIL_MAX		LV_CTR_TPS_JAM_DET_ACT_EXT_ADJ	
def .....	1223	def .....	7482
use .....	7391, 7558, 7683	use .....	6532
LV_CSERS_INJ_PLS_TEST_MOD_ENA		LV_CUR_CHA_OFS_INI	
def .....	6117	def .....	2038
use .....	2042	LV_CUR_DMTL_DMTLS_TEST	
LV_CT		def .....	5963
def .....	1442	LV_CUR_DMTL_REF_DIF_MAX	
use .....	1720, 1759, 4983, 6675, 6795, 8391	def .....	5963
LV_CT_CHG		use .....	7766
def .....	6675	LV_CUR_DMTL_REF_MES_MAX	
LV_CT_MON		def .....	5963
def .....	6790	LV_CUR_DMTL_REF_MES_MIN	
use .....	6795	def .....	5963
LV_CTOP		LV_CUR_DMTL_THD_DIF_MES	
		def .....	5963

use .....	7766	LV_CYL_BAL_AD_EOL_EXT_ADJ	
LV_CUR_VCV_AST_MOVE_ACT		def .....	7483
def .....	3954	use .....	4044
LV_CUR_VCV_CTL_AD_ENA		LV_CYL_BAL_AD_HOM_REQ_DC	
def .....	3954	def .....	4066
LV_CUR_VCV_CTL_PRE_RUN		use .....	7315, 7484, 8188
def .....	3954	LV_CYL_BAL_AD_WG_OPEN_REQ [NC_CBK_EX_NR]	
use .....	3772	def .....	4066
LV_CUR_VCV_CTL_PRE_RUN_ACT		use .....	7315, 7484, 8188
def .....	3954	LV_CYL_BAL_AD_WG_OPEN_REQ_DC [NC_CBK_EX_NR]	
LV_CUR_VCV_CTL_PRE_RUN_EDGE		def .....	4066
def .....	3954	LV_CYL_BAL_AD_WG_OPEN_REQ_EOL [NC_CBK_EX_NR]	
LV_CUR_VCV_ST_ACT		def .....	4043
def .....	3954	use .....	4068
LV_CVT		LV_CYL_BAL_AD_WG_OPEN_TMP_EOL [NC_CBK_EX_NR]	
use .....	6276	def .....	4043
LV_CWP_BLOCK_DEAC		LV_CYL_BAL_ER_AD_ADD_EOL	
def .....	4094	def .....	4043
use .....	4537, 8353	use .....	4036, 7315, 7484, 8188
LV_CWP_COM_ACT		LV_CYL_BAL_ER_AD_FAC_EOL	
def .....	4094	def .....	4043
LV_CWP_HW_LIH_IN_CHK		use .....	4036, 7315, 7484
def .....	4094	LV_CYL_BAL_ER_CDN_BAS	
use .....	4537	def .....	4022
LV_CWP_LOCK		use .....	3261
def .....	4094	LV_CYL_BAL_HOM_REQ_EXT	
use .....	4537	def .....	3261
LV_CWP_NOT_PLAUS		use .....	4068
def .....	4536	LV_CYL_BAL_HOM_REQ_INT_DC	
LV_CWP_OFF		def .....	4066
def .....	4536	LV_CYL_BAL_LAM_AD_ADD [NC_CBK_EX_NR]	
LV_CWP_PRE_LOCK		def .....	4043
def .....	4094	use .....	4036
use .....	4537	LV_CYL_BAL_LAM_AD_ADD_DC [NC_CBK_EX_NR]	
LV_CWP_TEMP_HIGH		def .....	4066
def .....	4094	use .....	4036, 8188
use .....	4538	LV_CYL_BAL_LAM_AD_DC	
LV_CWP_TMP_OFF		def .....	4066
def .....	4536	use .....	4036, 7315, 7484, 8188
LV_CWP_VCC_PLAUS		LV_CYL_BAL_LAM_AD_ENA_DC	
def .....	4094	def .....	4066
use .....	4538	use .....	3737
LV_CYC_ROUGH_LEAK_MODE6		LV_CYL_BAL_LAM_AD_END [NC_CBK_EX_NR]	
def .....	5963	def .....	4066
use .....	6037	LV_CYL_BAL_LAM_AD_EOL	
LV_CYC_ROUGH_LEAK_SUSP		def .....	4043
def .....	5963	use .....	3680, 4036, 7315, 7484, 8188
use .....	5919	LV_CYL_BAL_LAM_AD_FAC [NC_CBK_EX_NR]	
LV_CYC_SMALL_LEAK_MODE6		def .....	4043
def .....	5963	use .....	4036
LV_CYC_SMALL_LEAK_MODE6_CFM		LV_CYL_BAL_LAM_AD_FAC_H_DC [NC_CBK_EX_NR]	
def .....	5963	def .....	4066
use .....	6037	use .....	4036
LV_CYCNR_DYN_LSL_UP_VLD [NC_CBK_EX_NR]		LV_CYL_BAL_LAM_AD_FAC_L_DC [NC_CBK_EX_NR]	
def .....	5347	def .....	4066
LV_CYL_BAL_AD_DC_EXT_ADJ		use .....	4036
def .....	7483	LV_CYL_BAL_LAM_AD_HOM_REQ_DC	

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def .....	4066	5954, 6037, 6062, 6102, 6118, 6130, 6226, 6239, 6264, 6313, 6508, 8221
LV_CYL_BAL_LAM_AD_REQ_CUS		
def .....	1015	LV_DC_CDN_CST_RBM
use .....	3261, 3680	def .....
LV_CYL_BAL_LAM_AD_REQ_CUS_FSD		5858
def .....	1015	use .....
LV_CYL_BAL_LAM_AD_REQ_CUS_LAM		5870
def .....	1015	LV_DC_MAX [NC_NR_ERR_DYN]
LV_CYL_BAL_LAM_AD_REQ_DC [NC_CBK_EX_NR]		def .....
def .....	4066	5767
LV_CYL_BAL_LAM_SEL_AD_COLD [NC_CBK_EX_NR]		use .....
def .....	4043	1064, 5694, 5744, 5827, 5853, 5881
use .....	4036	LV_DC_PERM
LV_CYL_BAL_LAM_SEL_AD_COLD_DC		def .....
def .....	4066	5746
use .....	3349, 4036	use .....
LV_CYL_BAL_LAM_SEL_AD_COLD_EOL		1583, 5842
def .....	4043	LV_DC_PERM_MEM
use .....	2865, 4036, 7315, 7484, 8188	def .....
LV_CYL_BAL_LAM_SEL_AD_HOT_DC		5842
def .....	4066	LV_DC_RBM
use .....	3349, 4036, 7315, 7484, 8188	def .....
LV_CYL_BAL_LAM_SEL_AD_HOT_EOL		5858
def .....	4043	use .....
use .....	2865, 4036, 7315, 7484, 8188	1583, 5010, 5870
LV_CYL_BAL_LAM_SEL_AD_REQ_DC [NC_CBK_EX_NR]		LV_DCC_DISABLE_CAN
def .....	4066	def .....
LV_CYL_BAL_LAM_SEL_AD_RNG_H [NC_CBK_EX_NR]		6731
def .....	4043	LV_DCC_ENA_INC
use .....	4036	def .....
LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC [NC_CBK_EX_		6731
NR]		use .....
def .....	4066	6731, 6737
use .....	4036	LV_DCC_INC_ACT
LV_CYL_BAL_LAM_SEL_AD_RNG_L [NC_CBK_EX_NR]		def .....
def .....	4043	6731
use .....	4036	use .....
LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC [NC_CBK_EX_		1720, 3846, 6665, 6985
NR]		LV_DCC_INC_LIH
def .....	4067	def .....
use .....	4036	6731
LV_CYL_BAL_LAM_SEL_AD_RNG_L [NC_CBK_EX_NR]		LV_DCC_LIH_CAN
def .....	4043	def .....
use .....	4036	1565
LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC [NC_CBK_EX_		use .....
NR]		1711, 6731, 6985
def .....	4067	LV_DCC_OFF_ACK
use .....	4036	def .....
LV_CYL_BAL_LAM_SEL_HOM_REQ_DC		1565
def .....	4067	use .....
LV_CYL_BAL_LAM_SEL_RNG_COLD_DC [NC_CBK_EX_		5051, 6985
NR]		LV_DCC_OFF_ECU
def .....	4067	def .....
use .....	4036	5051
LV_DBG_INFO_VLD [NC_NR_DBG_NVMY]		use .....
use .....	7315	1583, 6731, 6985
LV_DC		LV_DCC_OFF_ECU_MON
def .....	5746	def .....
use .....	1064, 1503, 1766, 2733, 2840, 3772, 4367, 4371, 4392, 4415, 4477, 4502, 4581, 4757, 4820, 4903, 5010, 5018, 5035, 5083, 5103, 5113, 5160, 5190, 5210, 5229, 5285, 5378, 5407, 5459, 5474, 5506, 5515, 5542, 5563, 5660, 5672, 5678, 5687, 5694, 5753, 5767, 5858, 5870, 5881, 5885, 5899, 5929,	6983
		LV_DCC_PUC_INH
		def .....
		1565
		use .....
		1720, 3846, 6665
		LV_DELTA_CRK_CYL_LAM_ERR [NC_CBK_EX_NR]
		def .....
		2839
		LV_DET_CFM_MIS
		def .....
		6237
		use .....
		3349, 6209
		LV_DET_ERR_PVS
		def .....
		4215
		LV_DET_ERR_TAM_PLAUS
		def .....
		5076
		LV_DET_ERR_TPS_RATIO
		def .....
		4990
		use .....
		4983
		LV_DET_FUC_OPEN
		def .....
		5963
		use .....
		7766
		LV_DET_MIS
		def .....
		6276

use .....	4022, 6239, 6264, 6283	LV_DIAG_ACT_END_LS_UP_DOWN [NC_CBK_EX_NR]	
LV_DET_MIS_A		def .....	5388
def .....	6237	use .....	5407
LV_DET_MIS_B4		LV_DIAG_ACT_END_LSL_UP [NC_CBK_EX_NR]	
def .....	6237	def .....	5237
LV_DET_NO_ROUGH_LEAK		use .....	4301
def .....	6037	LV_DIAG_ACT_INH_LS_UP_DOWN [NC_CBK_EX_NR]	
LV_DET_NO_SMALL_LEAK		def .....	5407
def .....	6037	use .....	5389, 7766
LV_DET_NOT_PLAUS_ACT		LV_DIAG_ACT_INH_LSL_UP [NC_CBK_EX_NR]	
def .....	4215	def .....	5245
use .....	1270	use .....	5238
LV_DET_REFU		LV_DIAG_ACT_INH_RBM_LS_UP_DOWN [NC_CBK_EX_NR]	
def .....	5963	NR]	
use .....	7766	def .....	5407
LV_DET_SMALL_LEAK		LV_DIAG_ACT_PUE_LS_DOWN [NC_CBK_EX_NR]	
def .....	6037	def .....	5168
LV_DET_SYM_EVE_DELTA_I_LAM [NC_CBK_EX_NR]		use .....	2943
def .....	5215	LV_DIAG_ACT_REQ_LS_DOWN [NC_CBK_EX_NR]	
LV_DET_THD_MIS		def .....	4266
def .....	6276	use .....	4252
LV_DI_AD_REF_CAM_IVVT_EX		LV_DIAG_ACT_RGN_NT_LS_DOWN [NC_CBK_EX_NR]	
def .....	8399	def .....	5142
use .....	1534	LV_DIAG_ACT_SHO_CDN_LSL_UP [NC_CBK_EX_NR]	
LV_DI_AD_REF_CAM_IVVT_IN		def .....	5237
def .....	8399	use .....	4301
use .....	1534	LV_DIAG_ACT_SYM_LSL_UP [NC_CBK_EX_NR]	
LV_DI_DIAGCPS		def .....	5237
def .....	5954	use .....	4301
use .....	5929	LV_DIAG_AFL_CDN_LS_UP_DOWN [NC_CBK_EX_NR]	
LV_DI_SUM_DIAGCPS		def .....	5388
def .....	5926	LV_DIAG_AFL_CHK_SYM_LSL_UP [NC_CBK_EX_NR]	
LV_DI_TQ_REQ_CAN_MPI_GDI		def .....	5388
def .....	800	use .....	5334
use .....	5051, 5054, 6623, 6650, 6719, 6742, 6985	LV_DIAG_AFL_END_LS_UP_DOWN [NC_CBK_EX_NR]	
LV_DIAG_ACT_CDN_DYN_NS_TMP [NC_NOX_SENS_CONF]		def .....	5388
def .....	6425	LV_DIAG_AFL_REQ	
LV_DIAG_ACT_CDN_DYN_TMP		def .....	5589
def .....	6425	use .....	8200
LV_DIAG_ACT_CDN_LS_UP_DOWN [NC_CBK_EX_NR]		LV_DIAG_AFL_SYM_PLAUS_LSL_UP [NC_CBK_EX_NR]	
def .....	5387	def .....	5422
LV_DIAG_ACT_CDN_LSL_UP [NC_CBK_EX_NR]		LV_DIAG_AFR_AFL_INH_LS_UP_DOWN [NC_CBK_EX_NR]	
def .....	5237	def .....	5407
LV_DIAG_ACT_CDN_STAT_NS_TMP [NC_NOX_SENS_CONF]		use .....	5389
def .....	6425	LV_DIAG_AFR_CDN_LS_UP_DOWN [NC_CBK_EX_NR]	
LV_DIAG_ACT_CDN_STAT_TMP		def .....	5388
def .....	6425	LV_DIAG_AFR_CHK_SYM_LSL_UP [NC_CBK_EX_NR]	
LV_DIAG_ACT_CDN_SUM [NC_NOX_SENS_CONF]		def .....	5388
def .....	6425	use .....	5334
LV_DIAG_ACT_CDN_VLS_DOWN_TMP		LV_DIAG_AFR_END_LS_UP_DOWN [NC_CBK_EX_NR]	
def .....	6425	def .....	5388
LV_DIAG_ACT_CHK_CDN_LSL_UP [NC_CBK_EX_NR]		LV_DIAG_AFR_SYM_PLAUS_LSL_UP [NC_CBK_EX_NR]	
def .....	5387	def .....	5422
LV_DIAG_ACT_CHK_END_LSL_UP [NC_CBK_EX_NR]		LV_DIAG_CDN_PLAUS_LS_DOWN [NC_CBK_EX_NR]	
def .....	5388	def .....	4275
LV_DIAG_ACT_EL_LSL_UP [NC_CBK_EX_NR]		use .....	4276
def .....	4293	LV_DIAG_CDN_PLAUS_LSL_UP [NC_CBK_EX_NR]	

def .....	5422	use .....	3863
LV_DIAG_CDN_PUC_LSL_UP [NC_CBK_EX_NR]		LV_DIAG_END_RLY_MAIN_DLY	
def .....	5297	def .....	4933
LV_DIAG_CDN_RST_PUE_LS_DOWN [NC_CBK_EX_NR]		use .....	2042, 3776, 7008, 7158
def .....	5168	LV_DIAG_END_SUM_DIAG_AFL [NC_CBK_EX_NR]	
LV_DIAG_CDN_TAM_PLAUS		def .....	5634
def .....	5083	use .....	5563
use .....	5077	LV_DIAG_EOL_AIR_LSL_UP [NC_CBK_EX_NR]	
LV_DIAG_CLC_PUE_LS_DOWN [NC_CBK_EX_NR]		def .....	5285
def .....	5169	LV_DIAG_EOL_AIR_LSL_UP_DC [NC_CBK_EX_NR]	
LV_DIAG_CST_ACT		def .....	5285
def .....	6508	LV_DIAG_EOL_DC_LS_UP_DOWN [NC_CBK_EX_NR]	
use .....	7738	def .....	5388
LV_DIAG_CYC_END_LS_DOWN [NC_CBK_EX_NR]		LV_DIAG_EOL_DYN_LS_UP [NC_CBK_EX_NR]	
def .....	5388	def .....	5377
use .....	4267	use .....	5259, 5350
LV_DIAG_DYN_CDN_LSL_UP [NC_CBK_EX_NR]		LV_DIAG_EOL_DYN_LS_UP_DC [NC_CBK_EX_NR]	
def .....	5347	def .....	5377
LV_DIAG_DYN_END_LSL_UP [NC_CBK_EX_NR]		LV_DIAG_EOL_END_LS_UP_DOWN [NC_CBK_EX_NR]	
def .....	5348	def .....	5388
use .....	5378	use .....	4301, 5199, 5217, 5282, 5334
LV_DIAG_DYN_INH_LSL_UP [NC_CBK_EX_NR]		LV_DIAG_EOL_PUC_LSL_UP [NC_CBK_EX_NR]	
def .....	5377	def .....	5291
use .....	5332, 5350	use .....	5298
LV_DIAG_DYN_LSL_UP_CYC_END [NC_CBK_EX_NR]		LV_DIAG_EOL_REQ_LS_UP_DOWN [NC_CBK_EX_NR]	
def .....	5348	def .....	5407
LV_DIAG_DYN_LSL_UP_ENA		use .....	5229, 5389
def .....	5348	LV_DIAG_EOL_REQ_OBD_LSH_DOWN [NC_CBK_EX_NR]	
LV_DIAG_DYN_LSL_UP_LDC_MAF		def .....	5210
def .....	5348	use .....	5199
LV_DIAG_DYN_LSL_UP_LDC_N		LV_DIAG_ERR_SUM_DIAG_AFL [NC_CBK_EX_NR]	
def .....	5348	def .....	5634
LV_DIAG_DYN_LSL_UP_LDC_TQ		use .....	5563
def .....	5348	LV_DIAG_IPLSL_CDN_LSL_UP [NC_CBK_EX_NR]	
LV_DIAG_DYN_S_LSL_UP_END [NC_CBK_EX_NR]		def .....	4293
def .....	5313	LV_DIAG_IPLSL_SYM_LSL_UP [NC_CBK_EX_NR]	
use .....	5350	def .....	4293
LV_DIAG_DYN_S_LSL_UP_ERR [NC_CBK_EX_NR]		LV_DIAG_MIS	
def .....	5313	def .....	6225
use .....	5350	use .....	6276
LV_DIAG_DYN_S_LSL_UP_SAMPLE [NC_CBK_EX_NR]		LV_DIAG_MPL_CDN_LS_DOWN [NC_CBK_EX_NR]	
def .....	5314	def .....	5151
LV_DIAG_DYN_S_LSL_UP_STOP [NC_CBK_EX_NR]		LV_DIAG_NS_OFS_VLD	
def .....	5314	def .....	6378
LV_DIAG_DYN_S_SWI_CMB		LV_DIAG_NS_SHIFT_END [NC_NOX_SENS_CONF]	
def .....	5332	def .....	6425
use .....	5314	LV_DIAG_OBD_CDN_LSH_UP [NC_CBK_EX_NR]	
LV_DIAG_DYN_SYM_LSL_UP [NC_CBK_EX_NR]		def .....	5438
def .....	5348	use .....	4301
LV_DIAG_ECRAS		LV_DIAG_OBD_END_LSH_UP [NC_CBK_EX_NR]	
def .....	4515	def .....	5438
use .....	3863	use .....	4301
LV_DIAG_ECRAS_END		LV_DIAG_OBD_SYM_LSH_UP [NC_CBK_EX_NR]	
def .....	4515	def .....	5438
use .....	3863	use .....	2352, 4301
LV_DIAG_ECRAS_ERR_END		LV_DIAG_OC_IF_OSC_DI_LSL_UP [NC_CBK_EX_NR]	
def .....	4515	def .....	4300

use .....	1339	LV_DIF_CDN_TIA_PLAUS_DIAG	
LV_DIAG_OPL_REQ_CBK [NC_CBK_EX_NR]		def .....	5093
def .....	5407	LV_DIST_DET_ROUGH_LEAK	
use .....	3680, 5389	def .....	5963
LV_DIAG_PLAUS_END_LSL_UP [NC_CBK_EX_NR]		LV_DIST_DMTL	
def .....	5422	def .....	5963
use .....	5334	LV_DLY_AD_IS	
LV_DIAG_PLAUS_INH_LSL_UP [NC_CBK_EX_NR]		def .....	3514
def .....	5429	LV_DLY_CH_MOD_REQ_SO2P_HOM	
use .....	5422	def .....	1813
LV_DIAG_PLAUS_SYM_LSL_UP [NC_CBK_EX_NR]		use .....	1796, 2169
def .....	5422	LV_DLY_DIAG_ACT_CDN [NC_CBK_EX_NR]	
use .....	5334	def .....	5259
LV_DIAG_PUC_CHG_LS_DOWN [NC_CBK_EX_NR]		LV_DLY_DIAG_ACT_CDN_DYN	
def .....	4275	def .....	5259
LV_DIAG_PUC_END_LSL_UP [NC_CBK_EX_NR]		LV_DLY_DIAG_ACT_CDN_STAT	
def .....	5297	def .....	5259
use .....	4301	LV_DLY_DIAG_ACT_EXT	
LV_DIAG_PUC_SYM_LSL_UP [NC_CBK_EX_NR]		def .....	5377
def .....	5297	use .....	5350
use .....	4301	LV_DLY_DIAG_ACT_LAM_GAIN	
LV_DIAG_PUE_LS_DOWN_ADD_ACT [NC_CBK_EX_NR]		def .....	5348
def .....	2942	use .....	5259
use .....	2928	LV_DLY_DIAG_END_EXT	
LV_DIAG_RAW_ACT_END_LSL_UP [NC_CBK_EX_NR]		def .....	5377
def .....	5237	use .....	5350
use .....	4301	LV_DLY_DIAG_REQ_LAM_GAIN [NC_CBK_EX_NR]	
LV_DIAG_RAW_ACT_SYM_LSL_UP [NC_CBK_EX_NR]		def .....	5259
def .....	5237	use .....	5350
use .....	4301	LV_DLY_END_LSL_DIAG [NC_CBK_EX_NR]	
LV_DIAG_REQ_NS_SHIFT [NC_NOX_SENS_CONF]		def .....	5259
def .....	6426	use .....	5350
use .....	1399	LV_DLY_ERR_LSL_DIAG [NC_CBK_EX_NR]	
LV_DIAG_RGN_NT_LS_DOWN_END [NC_CBK_EX_NR]		def .....	5348
def .....	5142	LV_DLY_FPA_CLL_REQ	
use .....	5152	def .....	3930
LV_DIAG_RGN_NT_LS_DOWN_ERR [NC_CBK_EX_NR]		LV_DLY_GAS_CP	
def .....	5142	def .....	3636
use .....	5152	LV_DLY_N_SP_IS	
LV_DIAG_RST_WIN_PUE_LS_DOWN [NC_CBK_EX_NR]		def .....	6710
def .....	5169	use .....	1123, 3564
LV_DIAG_SWT_LS_DOWN_S_ENA [NC_CBK_EX_NR]		LV_DMTL_ACT	
def .....	5152	def .....	5963
LV_DIAG_VLD_PUE_LS_DOWN [NC_CBK_EX_NR]		LV_DMTL_ASA	
def .....	5169	def .....	5963
LV_DIAG_WIN_CDN_1_PUE_LS_DOWN [NC_CBK_EX_NR]		LV_DMTL_EOL	
def .....	5169	def .....	5963
LV_DIAG_WIN_CDN_2_PUE_LS_DOWN [NC_CBK_EX_NR]		LV_DMTL_PUMP	
def .....	5169	def .....	5963
LV_DIAG_WIN_PUE_LS_DOWN [NC_CBK_EX_NR]		use .....	912, 4627, 7315
def .....	5169	LV_DMTL_PUMP_EXT_ADJ	
LV_DIAGCP_CPS_ACT		def .....	7433
def .....	1001	use .....	5971
use .....	3638	LV_DMTL_PUMP_ON	
LV_DIAGCPS_MIN_MOD		def .....	5963
def .....	5926	LV_DMTL_RST_ROUGH_LEAK	
use .....	3680	def .....	5963

LV_DMTL_STOP		LV_EBOX_CFA_EXT_ADJ	
def .....	5963	def .....	7433
LV_DMTLH_EXT_ADJ		use .....	4133
def .....	7433	LV_ECF_RLY_ACT	
use .....	5971	use .....	7315
LV_DMTLS		LV_ECFPWM_ECF_EXT_ADJ	
def .....	5963	def .....	7433
use .....	912, 7315	use .....	3596
LV_DMTLS_EXT_ADJ		LV_ECFPWM_FB_VLD [NC_ECF_NR]	
def .....	7433	def .....	4507
use .....	5971	use .....	4508
LV_DMTLS_ON		LV_ECFPWM_INH_DIAG_TH	
def .....	5963	def .....	5660
LV_DOWN_LS_1		LV_ECRAS	
def .....	1006	def .....	8225
LV_DOWN_LS_2		LV_ECRAS_CTL_CAN_1	
def .....	1006	def .....	1565
LV_DR_DMTL		LV_ECRAS_CTL_CAN_2	
def .....	5964	def .....	1565
LV_DR_DMTL_PUMP		LV_ECRAS_DOWN	
def .....	5964	def .....	8225
LV_DR_DMTLS		use .....	3863
def .....	5964	LV_ECRAS_DOWN_1	
LV_DR_OFF_MU_MON2		def .....	3863
def .....	7011	use .....	4516, 7315
LV_DRI		LV_ECRAS_DOWN_DET_ACT	
def .....	1302	def .....	4515
use .....	1123, 1310, 3520, 3544, 4377, 6276, 6582, 6697, 6710, 7558, 7683, 8353, 8394	use .....	3863
LV_DRIV_BELT_CLOSE		LV_ECRAS_DOWN_DET_RST	
def .....	800	def .....	4515
use .....	8292	LV_ECRAS_DOWN_DET_SET	
LV_DRIV_DOOR_OPEN		def .....	4515
def .....	1565	use .....	3863
use .....	8292	LV_ECRAS_DOWN_EXT_ADJ	
LV_DRV1_ER_BAL_ACT		def .....	7433
def .....	4022	use .....	3863, 7766
use .....	1489	LV_ECRAS_EOL	
LV_DRV1_STND_BAL_FDOUT		def .....	3863
def .....	1489	LV_ECRAS_EOL_END	
use .....	4006	def .....	3863
LV_DT		LV_ECRAS_EOL_INH	
def .....	1310	def .....	3863
use .....	1721, 2307, 3442, 3501, 6742	use .....	7766
LV_DYN_DIAG_ACT_EXT		LV_ECRAS_FB_DET	
def .....	5377	def .....	4515
use .....	5350	LV_ECRAS_FB_DIAG	
LV_DYN_DIAG_END_EXT		def .....	4515
def .....	5377	LV_ECRAS_UP	
use .....	5350	def .....	8225
LV_DYN_LIM_1_ACT		use .....	3594, 3863
def .....	4215	LV_ECRAS_UP_1	
LV_DYN_LIM_2_ACT		def .....	3863
def .....	4215	use .....	4516
LV_EBOX_CFA		LV_ECRAS_UP_EXT_ADJ	
def .....	4133	def .....	7433
use .....	912, 7315	use .....	3863, 7766
		LV_ECTPWM_EXT_ADJ	




def .....	7433	LV_EFPPWM_CTL_RST	
use .....	3858	def .....	3796
LV_ECTPWM_INH_DIAG_TH		LV_EFPPWM_CTL_STOP	
def .....	5660	def .....	3796
LV_ECU_LOCK		LV_EFPPWM_EXT_ADJ	
use .....	6051	def .....	800
LV_ECU_SLA		use .....	3797
def .....	800	LV_EFPPWM_I_AD_VLD	
use .....	1100, 4149, 4721, 4733, 4745, 4757, 6051	def .....	3796
LV_EDGE_DIAG_VIM_1		use .....	6051
def .....	5064	LV_EFPPWM_MIN_AD_ACT	
LV_EDGE_DIAG_VIM_2		def .....	3797
def .....	5064	LV_EFPPWM_MIN_VLD	
LV_EDGE_ECRAS_DOWN		def .....	3797
def .....	4515	use .....	6051
LV_EDGE_ECRAS_UP		LV_EGR_ACT	
def .....	4515	def .....	987
LV_EDGE_VIM_1		use .....	1921
def .....	5064	LV_EGR_RATIO_SP_AGI_ACT	
LV_EDGE_VIM_2		def .....	3072
def .....	5064	LV_EGY_AD_ENA	
LV_EF		def .....	2277
def .....	3614	LV_EGY_ADD_AD_LIM [NC_CYL_NR]	
use .....	912, 2988, 3074, 7315, 8292	def .....	2261
LV_EF_2_EXT_ADJ		use .....	2278
def .....	7433	LV_EGY_ADD_AD_LIM_TOL [NC_CYL_NR]	
LV_EF_AC		def .....	2261
def .....	3614	use .....	2278
LV_EF_AC_ACT		LV_EGY_ADD_ST_TMP	
def .....	3614	def .....	2226
LV_EF_AC_CDN		LV_EGY_PWM_LIM [NC_CYL_NR]	
def .....	3614	def .....	2277
LV_EF_EXT_ADJ		LV_EGY_RNG_HOM_EXT_ENA	
def .....	7434	def .....	3330
use .....	3614	use .....	2262
LV_EFP		LV_EGY_RNG_IV_PLS_1_ACK [NC_CYL_NR]	
def .....	3796	def .....	2038
LV_EFP_CTL_AD_CLR_EXT_REQ		use .....	2241, 2278
def .....	7483	LV_EGY_RNG_IV_PLS_1_ACT [NC_CYL_NR]	
use .....	3797, 3823	def .....	2038
LV_EFP_EXT_ADJ		LV_EGY_RNG_IV_PLS_1_HOM [NC_CYL_NR]	
def .....	7434	def .....	2261
use .....	811	use .....	2004, 2042, 2200
LV_EFP_MAX_REQ		LV_EGY_RNG_IV_PLS_1_S [NC_CYL_NR]	
def .....	3822	def .....	2261
use .....	3797	use .....	2004, 2042, 2212
LV_EFP_MIN_PLAUS_DIAG		LV_EGY_RNG_IV_PLS_2_HOM [NC_CYL_NR]	
def .....	4733	def .....	2261
LV_EFP_OFF_EXT_ADJ_CAN		use .....	2004, 2042, 2204
def .....	1565	LV_EGY_RNG_IV_PLS_2_S [NC_CYL_NR]	
LV_EFP_ON_EXT_ADJ_CAN		def .....	2261
def .....	1565	use .....	2004, 2042, 2216
LV_EFP_RUN_WKU		LV_EGY_RNG_IV_PLS_3_HOM [NC_CYL_NR]	
def .....	3822	def .....	2261
use .....	3797, 3956	use .....	2004, 2042, 2208
LV_EFPPWM_AD_STOP		LV_EGY_RNG_IV_PLS_3_S [NC_CYL_NR]	
def .....	3796	def .....	2261

use .....	2004, 2042, 2220	def .....	4337
LV_EGY_STEP_INJ_CHA_LIM [NC_CYL_NR]		LV_END_DIAG_ACR_DR	
def .....	2277	def .....	4347
use .....	2262	LV_END_DIAG_AEB [NC_AEB_NR]	
LV_ENA_CHK_FUC_REFU		def .....	4942
def .....	5918	LV_END_DIAG_AFL_TMP [NC_CBK_EX_NR]	
LV_ENA_CHK_FUC_ROUGH_LEAK		def .....	5561
def .....	5964	use .....	5553
use .....	3680, 5919	LV_END_DIAG_AIR_LSL_UP [NC_CBK_EX_NR]	
LV_ENA_CHK_FUC_ROUGH_LEAK_MES		def .....	5282
def .....	5918	use .....	5285, 5449
use .....	5971	LV_END_DIAG_ALTER_BN	
LV_ENA_ER		def .....	1058
def .....	1454	LV_END_DIAG_ALTER_BN_BAT	
use .....	1454, 1469, 1474, 4022, 6209, 6213, 6239, 6276, 6283	def .....	1058
LV_ENA_FCO_DIAG		LV_END_DIAG_ALTER_BN_RGN	
def .....	5964	def .....	1058
LV_ENA_FTL_DIAG		LV_END_DIAG_ALTER_COM	
def .....	5964	def .....	4833
LV_ENA_FUC		LV_END_DIAG_AMP	
def .....	5964	def .....	4822
LV_ENA_FUC_ROUGH_LEAK_MES		use .....	3701
def .....	5964	LV_END_DIAG_AMP_PLAUS	
LV_ENA_GRD_TI_IDX_MON		def .....	6128
def .....	6760	use .....	6130
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LV_END_DIAG_PVS_BLS_NOT_PLAUS	def ..... 800
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LV_END_DIAG_SEG_AD_ER	def .....	4466	LV_END_DIAG_T_SEG_ER	def .....	4367
def .....	4367		use .....	4477	
LV_END_DIAG_SENS_ACR	def .....	4352	LV_END_DIAG_TAM_CAN	def .....	5076
LV_END_DIAG_SENS_BAT_SMT_COM	def .....	4833	LV_END_DIAG_TAM_PLAUS	def .....	5076
LV_END_DIAG_SENS_POIL	def .....	4365	LV_END_DIAG_TCHA_LEAK	def .....	1060
LV_END_DIAG_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR]	def .....	5334	use .....	7315	
use .....	5340, 5449		LV_END_DIAG_TCHA_PRS_CTL	def .....	1060
LV_END_DIAG_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR]	def .....	5334	LV_END_DIAG_TCHA_PRS_DIF	def .....	1060
use .....	5340, 5449		LV_END_DIAG_TCHA_PRS_HIGH	def .....	1060
LV_END_DIAG_SLV_IVVT_EX	def .....	4626	use .....	7315	
LV_END_DIAG_SLV_IVVT_IN	def .....	4626	LV_END_DIAG_TCHA_PRS_LOW	def .....	1060
LV_END_DIAG_SMALL_LEAK	def .....	5965	use .....	7315	
LV_END_DIAG_SOF	def .....	4911	LV_END_DIAG_TCHA_SYS_1	def .....	1060
LV_END_DIAG_SOF_REQ	def .....	4911	LV_END_DIAG_TCO_2_EL	def .....	4572
LV_END_DIAG_SPI_KNK	def .....	4245	use .....	5083	
LV_END_DIAG_SPI_MPS	def .....	4245	LV_END_DIAG_TCO_2_GRD	def .....	4572
LV_END_DIAG_SWI_AFS_MON	def .....	6858	use .....	5083	
LV_END_DIAG_SWT_LS_DOWN [NC_CBK_EX_NR]	def .....	5152	LV_END_DIAG_TCO_2_PLAUS	def .....	5666
use .....	5449		LV_END_DIAG_TCO_EL	def .....	4496
LV_END_DIAG_SYN_CAM_EX [NC_NR_CAM_CBK]	def .....	4426	use .....	5083, 5675	
LV_END_DIAG_SYN_CAM_IN [NC_NR_CAM_CBK]	def .....	4426	LV_END_DIAG_TCO_GRD	def .....	4496
LV_END_DIAG_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]	def .....	4446	use .....	5083, 5675	
LV_END_DIAG_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]	def .....	4446	LV_END_DIAG_TCO_PLAUS	def .....	5682
LV_END_DIAG_T_ES	def .....	4466	LV_END_DIAG_TCO_STUCK	def .....	5691
use .....	4477		use .....	4467, 4502	
LV_END_DIAG_T_ES_DIAG_1	def .....	4466	LV_END_DIAG_TCO_STUCK_RNG	def .....	5675
use .....	4477		use .....	5678	
LV_END_DIAG_T_ES_DIAG_2	def .....	4466	LV_END_DIAG_TECU	def .....	4237
use .....	4477		LV_END_DIAG_TEG_PCAT_DOWN	def .....	4713
LV_END_DIAG_T_ES_DIAG_3	def .....	4466	LV_END_DIAG_TH	def .....	5652
use .....	4477		LV_END_DIAG_TIA_EL	def .....	4194
LV_END_DIAG_T_ES_TCO_FAST	def .....	4466	use .....	5083, 5093	
use .....	4477		LV_END_DIAG_TIA_GRD	def .....	4194
LV_END_DIAG_T_ES_TCO_SLOW			LV_END_DIAG_TIA_PLAUS		

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def .....	5093	def .....	4216
use .....	5103	LV_END_DIAG_VAR_COD	
LV_END_DIAG_TIA_TCHA_UP		def .....	4945
def .....	4189	LV_END_DIAG_VCV_PLAUS	
LV_END_DIAG_TOIL_LEVEL		def .....	6062
def .....	1060	LV_END_DIAG_VEH_POW_VAR	
LV_END_DIAG_TOOTH_OFF_EX [NC_NR_CAM_CBK]		def .....	4945
def .....	4421	LV_END_DIAG_VIM_1_EL	
use .....	4415	def .....	5064
LV_END_DIAG_TOOTH_OFF_IN [NC_NR_CAM_CBK]		LV_END_DIAG_VIM_2_EL	
def .....	4421	def .....	5064
use .....	4415	LV_END_DIAG_VIM_PLAUS	
LV_END_DIAG_TPS		def .....	1060
def .....	4982	LV_END_DIAG_VIMPWM_1_FB	
LV_END_DIAG_TPS_1		def .....	5065
def .....	4990	LV_END_DIAG_VIMPWM_2_FB	
LV_END_DIAG_TPS_2		def .....	5065
def .....	4990	LV_END_DIAG_VLS_DOWN_DIF [NC_CBK_EX_NR]	
LV_END_DIAG_TPS_AD		def .....	5215
def .....	4950	use .....	5229
use .....	5007	LV_END_DIAG_VS	
LV_END_DIAG_TPS_AD_BOL		def .....	5021
def .....	4950	use .....	5035
use .....	5007	LV_END_DIAG_VS_BOL	
LV_END_DIAG_TPS_JAM_DET		def .....	5021
def .....	6531	LV_END_DIAG_VS_GRD	
LV_END_DIAG_TPS_MAF_1		def .....	5021
def .....	4990	LV_END_DIAG_VS_PLAUS_POW	
LV_END_DIAG_TPS_MAF_2		def .....	5021
def .....	4990	LV_END_DIAG_VS_PLAUS_STUCK	
LV_END_DIAG_TPS_MON_1		def .....	5021
def .....	6858	LV_END_DIAG_VS_TOL	
LV_END_DIAG_TPS_RATIO		def .....	5021
def .....	4990	LV_END_DIAG_WARM_RST	
LV_END_DIAG_TPS_ST_CHK_1		def .....	560
def .....	4950	LV_END_DIAG_WG_1_DR	
LV_END_DIAG_TPS_ST_CHK_2		def .....	4206
def .....	4950	LV_END_DIAG_WG_2_DR	
LV_END_DIAG_TQ_CST		def .....	4206
def .....	1060	LV_END_DIAG_WHEEL_GRD_FR_LE	
LV_END_DIAG_TQ_DIF_ISC_MON_1		def .....	6300
def .....	6858	LV_END_DIAG_WHEEL_GRD_FR_RI	
LV_END_DIAG_TQ_EXT_MON_1		def .....	6300
def .....	6858	LV_END_DIAG_WHEEL_GRD_RE_LE	
LV_END_DIAG_TQ_REQ_CAN		def .....	6300
def .....	4851	LV_END_DIAG_WHEEL_GRD_RE_RI	
LV_END_DIAG_TQ_REQ_MON_1		def .....	6301
def .....	6858	LV_END_DIAG_WIN_CYL_BAL_ER [NC_CYL_NR]	
LV_END_DIAG_TQI_AV_MON_1		def .....	5112
def .....	6858	LV_END_DIAG_WIN_CYL_BAL_LAM [NC_CYL_NR]	
LV_END_DIAG_TQI_N_MAX_MON_1		def .....	5112
def .....	6858	LV_END_DIAG_WIN_DELTA_I_LAM [NC_CBK_EX_NR]	
LV_END_DIAG_TTIP_MES_LSH_UP [NC_CBK_EX_NR]		def .....	5216
def .....	5438	LV_END_DIAG_WIN_FSD [NC_CBK_EX_NR]	
LV_END_DIAG_V_REF_1		def .....	6140
def .....	4215	use .....	5895
LV_END_DIAG_V_REF_2		LV_END_DIAG_WIN_FSD_LAM_LIM [NC_CBK_EX_NR]	


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def .....	6140	use .....	8221
use .....	5895	LV_EOI_2_DELTA_HOM_CUS	
LV_END_DIAG_XX		def .....	8269
def .....	4581	use .....	2042, 2122, 2147
use .....	5694, 5744, 5767, 5881, 5899, 5911	LV_EOI_LIM_EOLP_OFS	
LV_END_MIS_A		def .....	800
def .....	6237	use .....	2122
LV_END_MIS_B1		LV_EOI_LIM_HOM	
def .....	6237	def .....	2122
use .....	6264	LV_EOI_ST_ENA	
LV_END_MIS_B4		def .....	8242
def .....	6237	use .....	2122
use .....	6264	LV_EOL_CPS	
LV_END_RBM_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]		def .....	7763
def .....	1060	use .....	5929, 5954, 8229
LV_END_RBM_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]		LV_EOL_CPS_ERR	
def .....	1060	def .....	5926
LV_END_RBM_DIAGCPS		use .....	7766
def .....	5926	LV_EOL_CPS_INI	
use .....	5954	def .....	5926
LV_END_RBM_LOAD_TPS_PLAUS		LV_EOL_OBD	
def .....	1060	def .....	800
LV_END_RBM_MAP_DIP_PLAUS		use .....	1469, 1474
def .....	1060	LV_EOL_OBD_DC	
LV_END_RBM_MEC_IVVT_EX		def .....	1061
def .....	1060	use .....	5881
LV_END_RBM_MEC_IVVT_IN		LV_ER_ABSV_SUM_GRD_RISE [NC_CBK_EX_NR]	
def .....	1060	def .....	2839
LV_END_RBM_TAM_PLAUS		LV_ER_BAL_HOM_CDN	
def .....	5076	def .....	800
use .....	5083	use .....	2590
LV_END_RBM_TQ_CST		LV_ER_BAL_HOM_RNG_IS_ENA_KWP	
def .....	1060	def .....	7483
LV_END_WIN_MIS_A		LV_ER_CLC_MIS_DET_CUS_SPC	
def .....	6238	def .....	8360
LV_END_WIN_MIS_B1		use .....	6276
def .....	6238	LV_ER_CLC_PREV_INI	
use .....	6264	def .....	6283
LV_END_WIN_MIS_B4		LV_ER_FDOUT	
def .....	6238	def .....	987
use .....	6264	use .....	4022
LV_ENG_BACK_CFM		LV_ER_STD_MMV_MAX_TI_ER_BAL	
def .....	1505	def .....	4006
use .....	4456	LV_ER_STND_ER_BAL_ACT	
LV_ENG_BACK_DET		def .....	4022
def .....	1505	use .....	1489, 2840
use .....	4456	LV_ER_STND_FAC_TI_ER_BAL	
LV_ENG_EXT_HEAT		def .....	3298
def .....	800	LV_ER_STND_MFF_ADD_ER_BAL	
use .....	4467	def .....	3269
LV_ENG_OFF_N_CON		LV_ER_STND_MMV_MAX_TI_ER_BAL	
def .....	988	def .....	4006
use .....	3823	LV_ERR_ACK_IGK_OFF	
LV_ENG_OK_CPS_AD		def .....	4939
def .....	3756	use .....	1064, 1583
LV_ENG_RUN_CMB		LV_ERR_ACP	
def .....	800	def .....	6658

LV_ERR_ACR_AD	LV_ERR_BN_ACC
def ..... 4320	def ..... 4869
use ..... 811, 1064, 3599, 4333, 4345	use ..... 3589
LV_ERR_ACR_CTL	LV_ERR_BN_ANG_PSTE
def ..... 4337	def ..... 4869
use ..... 811, 1064, 3599, 4345	use ..... 6623
LV_ERR_ACR_DR	LV_ERR_BN_ARS
def ..... 4347	def ..... 4869
use ..... 811, 3599, 4345	use ..... 1583, 6650
LV_ERR_AEB [NC_AEB_NR]	LV_ERR_BN_CAS
def ..... 4942	def ..... 4869
LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR]	LV_ERR_BN_CDN_DOOR
def ..... 5282	def ..... 4869
use 1008, 4252, 4309, 4763, 5160, 5190, 5229, 5245, 5273, 5291, 5378, 5407, 5429, 5433, 5450, 5506	use ..... 1583
LV_ERR_ALTER_BN	LV_ERR_BN_DHL_CTL
def ..... 1061	def ..... 4869
LV_ERR_ALTER_BN_BAT	use ..... 1583
def ..... 1061	LV_ERR_BN_EFP
LV_ERR_ALTER_BN_RGN	def ..... 4869
def ..... 1061	use ..... 1583, 4721
LV_ERR_ALTER_COM	LV_ERR_BN_EFP_CRASH
def ..... 4834	def ..... 4870
use ..... 1064, 4096, 6795	LV_ERR_BN_ETCU
LV_ERR_AMP	def ..... 4870
def ..... 4822	use ..... 1064, 4849, 6719, 6795, 6985, 7228
use 1017, 1064, 1163, 1583, 1789, 2383, 3398, 3512, 3680, 3701, 4252, 4392, 5000, 5035, 5148, 5160, 5190, 5229, 5285, 5378, 5407, 5429, 5506, 5634, 5954, 5971, 6037, 6130, 7766	LV_ERR_BN_ETCU_2
LV_ERR_AMP_LOCK [NC_CBK_EX_NR]	def ..... 4870
def ..... 1015	use ..... 1583, 4849
LV_ERR_AMP_PLAUS	LV_ERR_BN_ETCU_DISP
def ..... 6128	def ..... 4870
use 1017, 1064, 1163, 1789, 2383, 3398, 3512, 4252, 4392, 5000, 5035, 5148, 5160, 5190, 5229, 5285, 5378, 5407, 5429, 5506, 5634, 5870, 5954, 5971, 6037, 7766	LV_ERR_BN_GEAR_REV
LV_ERR_AMP_PLAUS_CUS	def ..... 4870
def ..... 1061	use ..... 1583, 3851, 6795
use ..... 1017, 1163, 5035, 5954	LV_ERR_BN_ICL
LV_ERR_AMT_INH_MON	def ..... 4870
def ..... 6983	use ..... 1064, 7215, 7228
use ..... 6795, 6859	LV_ERR_BN_KM_ICL
LV_ERR_ANG_PSTE_CAN	def ..... 4870
def ..... 1565	use ..... 5971
use ..... 1420, 6623	LV_ERR_BN_LDM
LV_ERR_BAT_SENS	def ..... 4870
def ..... 1061	use ..... 5054, 6615, 6985
LV_ERR_BAT_SENS_IT	LV_ERR_BN_LTG_HDLP_L
def ..... 1061	def ..... 4870
LV_ERR_BAT_SENS_IT_EL	use ..... 1583
def ..... 1061	LV_ERR_BN_MSW
LV_ERR_BLS_PLAUS	def ..... 4870
def ..... 4209	use ..... 7220, 7228
use ..... 1302, 1583, 4217, 4820, 5051, 5054, 6795, 6985, 7228	LV_ERR_BN_PBR
	def ..... 4870
	use ..... 1583
	LV_ERR_BN_POW_GEN
	def ..... 4870
	LV_ERR_BN_POW_VB

def .....	4870	use .....	1064, 4096, 4538, 4924, 6795, 8353
LV_ERR_BN_REQ_PBR		LV_ERR_CAM	
def .....	4870	def .....	1505
use .....	1583	use .....	917, 932, 2865, 3054, 3398, 4022, 4773
LV_ERR_BN_SPT_SWI		LV_ERR_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	
def .....	4870	def .....	1061
LV_ERR_BN_STAT_TCT		use .....	1017, 4371, 4392, 5160, 5190, 5229, 5285, 5378, 5407, 5506, 6508
def .....	4870	LV_ERR_CAM_CST_IVVT_EX_1	
use .....	1583, 4849	use .....	5035
LV_ERR_BN_T_CLK		LV_ERR_CAM_CST_IVVT_EX_2	
def .....	4870	use .....	5035
use .....	1584	LV_ERR_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	
LV_ERR_BN_T_ICL		def .....	1061
def .....	4870	use .....	1017, 4371, 4392, 5160, 5190, 5229, 5285, 5378, 5407, 5506, 6508
use .....	4200, 4477, 5077, 5083, 5103, 5660, 5678	LV_ERR_CAM_CST_IVVT_IN_1	
LV_ERR_BN_TCS		use .....	5035
def .....	4870	LV_ERR_CAM_CST_IVVT_IN_2	
use .....	1064, 5044, 6742, 6985, 7228	use .....	5035
LV_ERR_BN_TQ_AMT		LV_ERR_CAM_CUS	
def .....	4870	def .....	1042
use .....	6985, 7228	use .....	2383, 4392, 5148
LV_ERR_BN_TQ_DCC		LV_ERR_CAM_DE_IVVT_EX [NC_NR_CBK_IVVT]	
def .....	4870	def .....	800
use .....	1584, 5051, 6731, 6985	use .....	3398
LV_ERR_BN_TQ_ETCU		LV_ERR_CAM_DE_IVVT_IN [NC_NR_CBK_IVVT]	
def .....	4871	def .....	800
use .....	1584, 4849, 6710, 6719, 6985, 7228	use .....	3398
LV_ERR_BN_TQ_PBR		LV_ERR_CAM_EX [NC_NR_CAM_CBK]	
def .....	4871	def .....	4455
use .....	1584	use .....	1017, 1506, 2865
LV_ERR_BN_TQ_PSTE_2		LV_ERR_CAM_EX_1	
def .....	4871	use .....	5035
use .....	6623	LV_ERR_CAM_EX_2	
LV_ERR_BN_TQ_PSTE_3		use .....	5035
def .....	4871	LV_ERR_CAM_IN [NC_NR_CAM_CBK]	
use .....	1584, 6623	def .....	4455
LV_ERR_BN_TQ_TCS		use .....	1017, 1506, 2865
def .....	4871	LV_ERR_CAM_IN_2	
use .....	1584, 6742, 6985, 7228	use .....	5035
LV_ERR_BN_TQ_TCT		LV_ERR_CAM_LOCK [NC_CBK_EX_NR]	
def .....	4871	def .....	1015
use .....	1584, 4849, 6719	LV_ERR_CAM_TOT	
LV_ERR_BN_TRL		def .....	4455
def .....	4871	use .....	811, 1042
use .....	1584	LV_ERR_CAN_BOFF	
LV_ERR_BN_VEH_MOD		def .....	4846
def .....	4871	use .....	1176, 1298, 1302, 1584, 3512, 3589, 3851, 4200, 4477, 4721, 4849, 4945, 5044, 5077, 5083, 5103, 5660, 5678, 6051, 6302, 6615, 6623, 6650, 6710, 6719, 6731, 6742, 6795, 6985, 7215, 7220, 7228
use .....	3851, 6795	LV_ERR_CAN_STST	
LV_ERR_BN_VS_TCS		def .....	800
def .....	4871	use .....	8221
use .....	1176, 1298, 1302, 3512, 6650, 6742, 6795, 6985, 7215, 7228	LV_ERR_CAT_DIAG [NC_CBK_EX_NR]	
LV_ERR_BN_WHEEL_CAN		def .....	5515
def .....	4871		
use .....	1584, 5044		
LV_ERR_BSD			
def .....	4834		

use .....	1064, 2865, 3107, 3398, 4022, 5148, 5229, 5407, 5429, 6095	def .....	801
LV_ERR_CAT_DIAG_AFL [NC_CBK_EX_NR]		use .....	4721, 6051
def .....	5561	LV_ERR_COM_GB	
use .....	1064, 2865, 6469	def .....	801, 4849
LV_ERR_CAT_DIAG_AFL_TMP [NC_CBK_EX_NR]		use .....	1064
def .....	5561	LV_ERR_CONV_MON	
LV_ERR_CAT_DIAG_SUM [NC_CBK_EX_NR]		def .....	6894
def .....	5535	use .....	6795, 6859, 6870, 6877
use .....	2865	LV_ERR_CONV_MON2	
LV_ERR_CFM [NC_NR_ERR_DYN]		def .....	7011
def .....	5767	LV_ERR_CONV_MON_1	
use .....	5010, 5694, 5744, 5853	def .....	6858
LV_ERR_CHG_LS_DOWN		use .....	5035
def .....	5388	LV_ERR_CPS	
use .....	1008, 4252, 5148, 5160, 5190, 5378, 5450, 5506	def .....	1001
LV_ERR_CHG_LS_UP		use .....	1469, 2865, 3107, 3398
def .....	5416	LV_ERR_CPS_AD	
use .....	1008, 2383, 2865, 3680, 4252, 4309, 4392, 4763, 5148, 5160, 5190, 5229, 5245, 5273, 5285, 5291, 5378, 5407, 5429, 5433, 5450, 5506, 7766	def .....	3756
LV_ERR_CHK_FUC		LV_ERR_CPS_LOCK [NC_CBK_EX_NR]	
def .....	5918	def .....	1015
use .....	5954	LV_ERR_CRASH_SIG	
LV_ERR_CHK_LS_DOWN [NC_CBK_EX_NR]		def .....	801
def .....	5388	use .....	3931, 3956, 4001
use .....	1008, 4252, 5160, 5190, 5210, 5378, 5450, 5506	LV_ERR_CRIT_OVL_ECU_VVL	
LV_ERR_CLK_DRIFT_PBK_IV [NC_CYL_NR]		def .....	801
def .....	800	use .....	7228
LV_ERR_CLR [NC_NR_ERR_PERM]		LV_ERR_CRK	
def .....	5842	def .....	4455
LV_ERR_COM_1_BOFF		use .....	1017, 1112, 1298, 1447, 1469, 1506, 1584, 1952, 2383, 2865, 3398, 4022, 4780, 5035, 5051, 5054, 5148, 6795, 6985, 7766, 8215
def .....	800	LV_ERR_CRK_LOCK [NC_CBK_EX_NR]	
use .....	5022, 5044	def .....	1015
LV_ERR_COM_1_ST_UP		LV_ERR_CRK_OC	
def .....	800	def .....	4430
use .....	5022, 5044	use .....	4439, 4456
LV_ERR_COM_1_VS		LV_ERR_CRK_PLAUS	
def .....	800	def .....	4446
use .....	5022	use .....	1064, 4252, 4371, 4439, 4456, 5035, 5160, 5190, 5229, 5378, 5407, 5429, 5506, 5634, 6283, 6508
LV_ERR_COM_1_WHEEL_TCS		LV_ERR_CRK_SYN	
use .....	5044	def .....	4431
LV_ERR_COM_2_BOFF		use .....	1064, 4253, 4371, 4439, 4456, 5035, 5160, 5190, 5229, 5378, 5407, 5429, 5506, 5634, 6283, 6508
def .....	801	LV_ERR_CRK_TOOTH	
use .....	4200, 4477, 5077, 5083, 5103, 6051	def .....	4432
LV_ERR_COM_2_EFP		use .....	1064, 4253, 4371, 4439, 4456, 5035, 5160, 5190, 5229, 5378, 5407, 5429, 5506, 5634, 6283, 6508
def .....	801	LV_ERR_CRK_TOOTH_PER	
use .....	6051	def .....	4432
LV_ERR_COM_2_T_ICL		use .....	1064, 4253, 4371, 4439, 4456, 5035, 5160, 5190, 5229, 5378, 5407, 5429, 5506, 5634, 6283, 6508
def .....	801	LV_ERR_CRU_INH_MON	
use .....	4477, 5083	def .....	6790
LV_ERR_COM_2_TAM_ICL		use .....	6795, 7228
use .....	4200, 4477, 5077, 5083, 5103	LV_ERR_CRU_INH_MON_1	
LV_ERR_COM_3_BOFF		def .....	6858
def .....	801		
use .....	4721, 6051		
LV_ERR_COM_3_EFP			

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LV_ERR_CRU_MON		LV_ERR_DET_DMTL_MAX	
def .....	6912	def .....	5965
use .....	6795, 6859	LV_ERR_DET_DMTL_MIN	
LV_ERR_CS		def .....	5965
def .....	5015	LV_ERR_DET_FSD [NC_CBK_EX_NR]	
use .....	1302, 5051, 5054, 6985, 7228	def .....	1015
LV_ERR_CS_PLAUS		LV_ERR_DET_ROUGH_LEAK_MIN	
use .....	1064	def .....	5965
LV_ERR_CSERS_INJ		use .....	6037
def .....	6117	LV_ERR_DET_SMALL_LEAK_MIN	
LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR]		def .....	5965
def .....	5248	LV_ERR_DET_SMALL_LEAK_MIN_CFM	
use 1008, 2383, 2865, 4253, 4290, 4309, 4763, 5148,		def .....	5965
5160, 5190, 5229, 5245, 5273, 5285, 5291, 5332,		use .....	6037
5378, 5407, 5429, 5433, 5506, 6469		LV_ERR_DIAGCPS	
LV_ERR_CUR_H_VVL		def .....	5926
def .....	801	use 1017, 1064, 1469, 2383, 2865, 3398, 3512, 3680,	
use .....	7228	4253, 4309, 4392, 5000, 5035, 5148, 5160, 5190,	
LV_ERR_CWP_COM		5229, 5245, 5285, 5291, 5378, 5407, 5420, 5429,	
def .....	4834	5433, 5506, 5634, 5971, 6037, 6469, 7766	
use .....	1064, 4096, 4538	LV_ERR_DISA [NC_NR_ERR_DYN]	
LV_ERR_CWP_COM_PLAUS		def .....	5767
def .....	4537	use .....	5694, 5792, 5853
LV_ERR_CWP_INT_OFF		LV_ERR_DMTL_MAX	
def .....	4537	def .....	5965
use .....	1064	LV_ERR_DMTL_MIN	
LV_ERR_CWP_PLAUS		def .....	5965
def .....	4537	use .....	5954
use .....	1064	LV_ERR_DMTL_PLAUS	
LV_ERR_CWP_PWR		def .....	5965
def .....	4537	use .....	5954
use .....	1064	LV_ERR_DMTL_PUMP	
LV_ERR_CYL_BAL_ER [NC_CYL_NR]		def .....	4626
def .....	5112	use .....	5954, 5971, 6037
use .....	4022	LV_ERR_DMTL_SET	
LV_ERR_CYL_BAL_LAM [NC_CYL_NR]		def .....	5965
def .....	5112	LV_ERR_DMTL_SIG	
use .....	2865, 3398	def .....	5965
LV_ERR_DC [NC_NR_ERR_DYN]		LV_ERR_DMTLH	
def .....	5767	def .....	4626
use .....	5694, 5744, 5881, 5885, 5911	use .....	5954, 6037
LV_ERR_DC_PREV [NC_NR_ERR_DYN]		LV_ERR_DMTLM	
def .....	5767	def .....	5965
LV_ERR_DCC		use .....	6037
def .....	5051	LV_ERR_DMTLS	
LV_ERR_DCC_INH_MON		def .....	4627
def .....	6983	use .....	5954, 5971, 6037
use .....	6731, 6795, 6859	LV_ERR_DR_SC_VVL	
LV_ERR_DCC_IRREV_MON		def .....	801
def .....	6983	use .....	7228
LV_ERR_DCC_REV_MON		LV_ERR_DUR_IGC_MPL	
def .....	6983	def .....	4772
LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR]		LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR]	
def .....	5216	def .....	5348
use 1008, 1064, 2383, 3398, 4253, 4309, 4763, 5148,		use 1008, 2465, 2579, 4253, 4309, 4763, 5160, 5190,	
5160, 5190, 5245, 5273, 5291, 5378, 5407, 5433,		5229, 5245, 5273, 5285, 5291, 5407, 5429, 5433,	
5506, 5634		5450, 5506	



LV_ERR_EBOX_CFA		LV_ERR_EFF_IGA_CST_IS	
def .....	4627	def .....	6517
use .....	4133	use .....	6508
LV_ERR_ECF [NC_ECF_NR]		LV_ERR_EFF_IGA_CST_PL	
def .....	3861	def .....	6517
use .....	3596	use .....	6508
LV_ERR_ECF_EL [NC_ECF_NR]		LV_ERR_EFP	
def .....	4507	def .....	4721
use .....	1064, 3861	use .....	3931, 6051
LV_ERR_ECFPWM_FB [NC_ECF_NR]		LV_ERR_EFP_CRASH	
def .....	4507	def .....	4721
use .....	1064	LV_ERR_EFPPWM_PLAUS	
LV_ERR_ECFPWM_FB_3 [NC_ECF_NR]		def .....	6050
use .....	7315	use .....	2865, 3823
LV_ERR_ECFPWM_FB_4 [NC_ECF_NR]		LV_ERR_EGR	
use .....	7315	def .....	801
LV_ERR_ECRAS		use .....	1822, 3107
def .....	4515	LV_ERR_EGR_2	
use .....	3863	def .....	987
LV_ERR_ECRAS_DOWN_FB		use .....	2988, 3054, 3107
def .....	4515	LV_ERR_EGRV_PSN_PLAUS	
use .....	3863	def .....	1061
LV_ERR_ECRAS_EL		LV_ERR_EGY_MIN	
def .....	4515	def .....	4926
use .....	3863	LV_ERR_EGY_MIN_2	
LV_ERR_ECRAS_EOL		def .....	4926
def .....	3863	use .....	1584
use .....	7766	LV_ERR_EL_CPS	
LV_ERR_ECRAS_UP_FB		def .....	4708
def .....	4515	use 1002, 1017, 1064, 2383, 3512, 3681, 3749, 4253,	
use .....	3863	4309, 4392, 5000, 5035, 5148, 5160, 5190, 5229,	
LV_ERR_ECT		5245, 5285, 5291, 5378, 5407, 5420, 5429, 5433,	
def .....	4529	5506, 5634, 5954, 5971, 6037, 6095, 6469	
use .....	5672	LV_ERR_EL_LS_DOWN [NC_CBK_EX_NR]	
LV_ERR_ECT_EL		def .....	4267
def .....	4530	use .....	1008, 3107, 4276, 5199, 5450
use .....	1064, 3858, 5660	LV_ERR_EL_LSL_UP [NC_CBK_EX_NR]	
LV_ERR_ECT_EL_OC		def .....	4293
def .....	4530	use 1008, 1064, 1318, 2406, 4253, 4288, 4309, 4763,	
use .....	3858	5160, 5190, 5229, 5245, 5255, 5273, 5285, 5291,	
LV_ERR_ECT_EL_SCP		5378, 5407, 5429, 5433, 5450, 5506	
def .....	4530	LV_ERR_EL_SOV	
use .....	3858	def .....	1001
LV_ERR_ECT_MEC		LV_ERR_ER_STRAT	
def .....	1045	def .....	1061
use .....	4530	LV_ERR_ER_STRAT_WUP	
LV_ERR_ECU_CKS		def .....	1061
def .....	4232	LV_ERR_ETC_CTL_1	
use .....	1148, 6565, 8218	use .....	5035
LV_ERR_ECU_NVMY		LV_ERR_ETC_CTL_2	
def .....	4232	use .....	5035
use .....	4477, 5678	LV_ERR_ETC_DR_1	
LV_ERR_ECU_RAM		use .....	5035
def .....	4232	LV_ERR_ETC_DR_2	
use .....	1148, 5954, 6565, 8218	use .....	5035
LV_ERR_EF		LV_ERR_ETC_PWM_1	
def .....	4627	use .....	5035


LV_ERR_ETC_PWM_2		LV_ERR_FUP_CH	
use .....	5035	def .....	6102
LV_ERR_EXT_CAM_EX [NC_NR_CAM_CBK]		use .....	4001, 6062
def .....	4414	LV_ERR_FUP_DIAG_ACT_HPRS	
LV_ERR_EXT_CAM_IN [NC_NR_CAM_CBK]		def .....	4762
def .....	4414	LV_ERR_FUP_DIAG_ACT_LPRS	
LV_ERR_FL_LS_DOWN [NC_CBK_EX_NR]		def .....	4762
def .....	4275	LV_ERR_FUP_EFP	
use .....	4276, 5634	def .....	4733
LV_ERR_FPA		use .....	1290, 2865, 3398, 3797, 3823, 4763, 6051
def .....	801	LV_ERR_FUP_EFP_COPL	
use .....	3931	def .....	4743
LV_ERR_FPS		use .....	4733
def .....	801	LV_ERR_FUP_EFP_LIH	
use .....	1822	def .....	3822
LV_ERR_FSD [NC_CBK_EX_NR]		use .....	2865
def .....	6141	LV_ERR_FUP_EFP_NOT_PLAUS	
use 1064, 2383, 2865, 3398, 4253, 5000, 5148, 5160,		def .....	6050
5190, 5285, 5378, 5506, 5634, 5954, 6062, 7766		LV_ERR_FUP_MFP_PLAUS	
LV_ERR_FSD_H_RNG [NC_CBK_EX_NR]		def .....	6062
def .....	6141	use 1018, 1283, 2865, 3398, 3797, 3909, 4001, 4022,	
use .....	2865, 6062	4253, 4309, 4392, 4763, 5148, 5160, 5190, 5229,	
LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR]		5245, 5285, 5291, 5378, 5407, 5420, 5429, 5433,	
def .....	6141	5506, 5634, 5954, 6095, 6102, 6469, 6508	
use .....	1064, 2383, 2865, 3398, 4253, 5148, 5160,	LV_ERR_FUP_ORNG	
5190, 5285, 5378, 5506, 5634, 5954, 6062		def .....	6062
LV_ERR_FTL		use 1018, 1283, 2865, 3797, 4001, 4022, 4253, 4309,	
def .....	5965	4392, 5148, 5160, 5190, 5229, 5245, 5285, 5291,	
use .....	5919	5378, 5407, 5420, 5429, 5433, 5506, 5634, 5954,	
LV_ERR_FTL_LE_CAN		6095, 6102, 6469, 6508	
def .....	4745	LV_ERR_FUP_ST	
use .....	1584, 4757	def .....	6062
LV_ERR_FTL_MIN		use 1018, 2865, 4022, 4253, 4309, 4392, 5148, 5160,	
def .....	4762	5190, 5229, 5245, 5285, 5291, 5378, 5407, 5420,	
use 1064, 1123, 2865, 3332, 3398, 3823, 4253, 5229,		5429, 5433, 5506, 5634, 5954, 6469	
5255, 5285, 5378, 5407, 5420, 5429, 5506, 7767		LV_ERR_FUP_ST_DLY	
LV_ERR_FTL_OBD		def .....	6062
def .....	4745	LV_ERR_FUP_ST_H_PRS	
LV_ERR_FTL_OBD_COPL		def .....	6062
use .....	4745	LV_ERR_FUP_ST_NO_RISE	
LV_ERR_FTL_PLAUS		def .....	6062
def .....	5965	LV_ERR_FUP_STOP	
use .....	4745, 5919	def .....	6062
LV_ERR_FTL_RI_CAN		use .....	3956
def .....	4745	LV_ERR_GEN	
use .....	1584, 4757	def .....	1061
LV_ERR_FUEL_LOCK [NC_CBK_EX_NR]		use .....	6795
def .....	1015	LV_ERR_GEN_CLC_V_NOT_PLAUS	
LV_ERR_FUEL_TMP		def .....	1061
def .....	6468	LV_ERR_GEN_CTL_NOT_PLAUS	
use .....	2865	def .....	1061
LV_ERR_FUP		LV_ERR_GEN_DIAG	
def .....	4717	def .....	4924
use 1017, 1283, 2865, 3398, 3797, 3931, 4001, 4022,		use .....	6795
4253, 4309, 4392, 4763, 5148, 5160, 5190, 5229,		LV_ERR_GEN_EL	
5245, 5285, 5291, 5378, 5407, 5420, 5429, 5433,		def .....	1061
5506, 5634, 5954, 6095, 6102, 6469, 6943		LV_ERR_GEN_H_TEMP	

def .....	1061	use .....	5954, 6509
LV_ERR_GEN_H_TEMP_CLC		LV_ERR_ISC_CST	
def .....	1061	def .....	4377
LV_ERR_GEN_MEC		use .....	6509
def .....	1061	LV_ERR_IV [NC_CYL_NR]	
LV_ERR_GEN_MSG_LOST		def .....	4802
def .....	1061	use 1018, 1064, 1789, 2865, 3398, 4253, 4309, 5148,	
LV_ERR_GEN_TYP_NOT_PLAUS		5160, 5190, 5229, 5245, 5273, 5291, 5378, 5408,	
def .....	1062	5420, 5429, 5433, 5506, 6118	
LV_ERR_GS		LV_ERR_IV_LOCK [NC_CBK_EX_NR]	
def .....	5010	def .....	1015
LV_ERR_GS_INH_MON		LV_ERR_IV_LST_CYC	
def .....	6983	def .....	4810
use .....	6795, 6859	LV_ERR_IV_SC [NC_CYL_NR]	
LV_ERR_H_PRS_SYS		def .....	4803
def .....	6062	LV_ERR_IVVT	
use 1018, 2865, 3398, 4022, 4253, 4309, 4392, 5148,		def .....	1062
5160, 5190, 5229, 5245, 5285, 5291, 5378, 5408,		use ..... 2383, 2865, 3398, 4253, 5035, 5148, 5160,	
5420, 5429, 5433, 5506, 5634, 5954, 6469, 6509		5190, 5229, 5285, 5378, 5408, 5429, 6283	
LV_ERR_H_PRS_SYS_PRE		LV_ERR_IVVT_LOCK [NC_CBK_EX_NR]	
def .....	6062	def .....	1015
use .....	4001, 6102	LV_ERR_KNK_PRE [NC_CYL_NR]	
LV_ERR_HFM_SELF_DIAG_0		def .....	4909
use .....	5035	LV_ERR_KNKS [NC_NR_SENS_KNK]	
LV_ERR_HFM_SELF_DIAG_1		def .....	4903
use .....	5035	use .....	1952, 1962, 3599
LV_ERR_IGC		LV_ERR_L_PRS_SYS	
def .....	4772	def .....	6050
use .....	1018, 2383, 2865, 3512, 3681	use .....	2865
LV_ERR_IGC_SCG [NC_CYL_NR]		LV_ERR_LAM_AD_CUS [NC_CBK_EX_NR]	
def .....	4772	def .....	8309
use .....	1005	LV_ERR_LAM_ADJ [NC_CBK_EX_NR]	
LV_ERR_IGC_SCP [NC_CYL_NR]		def .....	5216
def .....	4773	use .....	3681, 5334, 5515
use .....	1005	LV_ERR_LAM_CYL_SEL [_i]	
LV_ERR_IM_BLS_PLAUS		def .....	5141
def .....	4209	LV_ERR_LAMB_NS_PUC [NC_NOX_SENS_CONF]	
LV_ERR_IM_BTS_PLAUS		use .....	1064
def .....	4209	LV_ERR_LAMB_TMP	
LV_ERR_IMOB_0		def .....	6468
def .....	4784	LV_ERR_LDM	
LV_ERR_IMOB_1		def .....	5054
def .....	4784	LV_ERR_LDM_INH_MON	
LV_ERR_IMOB_2		def .....	6983
def .....	4784	use .....	1584, 6615, 6795, 6859
LV_ERR_IMOB_3		LV_ERR_LDM_MON	
def .....	4784	def .....	6983
LV_ERR_IN_WIN_MIS_A		LV_ERR_LIH_CRK_CAM	
def .....	6238	def .....	1505
use .....	6264	LV_ERR_LOAD_TPS_PLAUS	
LV_ERR_IN_WIN_MIS_B1		def .....	1062
def .....	6238	use 1018, 1211, 1789, 2383, 2865, 3398, 3512, 3599,	
LV_ERR_IN_WIN_MIS_B4		3681, 4022, 4253, 4309, 4392, 4763, 4824, 5035,	
def .....	6238	5160, 5190, 5229, 5245, 5285, 5291, 5378, 5408,	
use .....	6264	5429, 5433, 5506, 5634, 5660, 5954, 6509, 7767	
LV_ERR_ISC		LV_ERR_LOAD_TPS_PLAUS_1	
def .....	4377	use .....	5035

LV_ERR_LOAD_TPS_PLAUS_2	use 1008, 1064, 2406, 4253, 4309, 4763, 5160, 5190, 5229, 5245, 5255, 5273, 5285, 5291, 5378, 5408, 5429, 5433, 5450, 5506
use .....	5035
LV_ERR_LOCAN_BOFF	
def .....	4846
use .....	992, 4721, 4855
LV_ERR_LS_DOWN [NC_CBK_EX_NR]	
def .....	5449
use .....	1008, 2416, 2465, 2928, 3176, 5199, 5515, 5634, 6095, 6469
LV_ERR_LS_DOWN_1	
def .....	1006
LV_ERR_LS_DOWN_2	
def .....	1006
LV_ERR_LS_DOWN_FSD_LOCK [NC_CBK_EX_NR]	
def .....	1015
LV_ERR_LS_DOWN_LAM_AD_ACT_LOCK [NC_CBK_EX_ NR]	
def .....	1015
LV_ERR_LS_DOWN_LAM_ADJ_LOCK [NC_CBK_EX_NR]	
def .....	1015
LV_ERR_LS_DOWN_LSCL_LOCK [NC_CBK_EX_NR]	
def .....	1015
LV_ERR_LS_UP [NC_CBK_EX_NR]	
def .....	5449
use .....	1008, 2335, 2352, 2383, 2865, 3054, 3681, 5000, 5515, 5634, 6095, 6469, 7767
LV_ERR_LS_UP_1	
def .....	1006
LV_ERR_LS_UP_2	
def .....	1006
LV_ERR_LS_UP_DYN_VLD_1	
def .....	1007
LV_ERR_LS_UP_DYN_VLD_2	
def .....	1007
LV_ERR_LS_UP_FSD_LOCK [NC_CBK_EX_NR]	
def .....	1015
LV_ERR_LS_UP_LAM_AD_ACT_LOCK [NC_CBK_EX_NR]	
def .....	1015
LV_ERR_LS_UP_LAM_ADJ_LOCK [NC_CBK_EX_NR]	
def .....	1016
LV_ERR_LS_UP_LSCL_LOCK [NC_CBK_EX_NR]	
def .....	1016
LV_ERR_LSH_DOWN [NC_CBK_EX_NR]	
def .....	4248
use 1008, 1365, 3107, 3398, 4253, 4267, 4276, 5160, 5190, 5199, 5210, 5229, 5378, 5408, 5429, 5450, 5506	
LV_ERR_LSH_DOWN_1	
def .....	1007
LV_ERR_LSH_DOWN_2	
def .....	1007
LV_ERR_LSH_LSL_UP [NC_CBK_EX_NR]	
def .....	5276
use .....	4253, 5285, 5450
LV_ERR_LSH_UP [NC_CBK_EX_NR]	
def .....	4315
use 1008, 1064, 2406, 4253, 4309, 4763, 5160, 5190, 5229, 5245, 5255, 5273, 5285, 5291, 5378, 5408, 5429, 5433, 5450, 5506	
LV_ERR_LSH_UP_1	
def .....	1007
LV_ERR_LSH_UP_2	
def .....	1007
LV_ERR_LSL_UP_IF [NC_CBK_EX_NR]	
def .....	4285
use 1008, 2406, 4253, 4288, 4290, 4309, 4763, 5160, 5190, 5229, 5245, 5255, 5273, 5285, 5291, 5378, 5408, 5429, 5433, 5450, 5506	
LV_ERR_LST_CLR_XX	
def .....	5767
LV_ERR_MAF	
def .....	4815
use 1064, 1211, 1789, 2383, 2865, 3054, 3398, 3512, 3599, 3681, 4253, 4309, 4392, 4763, 4820, 5000, 5035, 5148, 5160, 5190, 5229, 5245, 5285, 5291, 5378, 5408, 5420, 5429, 5433, 5506, 5660, 5801, 5954, 6469, 6543, 7767	
LV_ERR_MAF_FRQ_EL [NC_MAF_NR]	
def .....	4815
use .....	1018, 1064, 2865, 4371, 5507, 6509
LV_ERR_MAF_FRQ_EL_0	
use .....	5035
LV_ERR_MAF_FRQ_EL_1	
use .....	5035
LV_ERR_MAF_FRQ_GRD [NC_MAF_NR]	
def .....	4815
use .....	1018, 1064, 2865, 4371, 5507, 6509
LV_ERR_MAF_FRQ_GRD_0	
use .....	5035
LV_ERR_MAF_FRQ_RNG [NC_MAF_NR]	
def .....	4815
use .....	1018, 1064, 2865, 4371, 5507, 6509
LV_ERR_MAF_FRQ_RNG_0	
use .....	5035
LV_ERR_MAF_FRQ_RNG_1	
use .....	5035
LV_ERR_MAF_LAMB_MAX	
def .....	1062
LV_ERR_MAF_LOCK [NC_CBK_EX_NR]	
def .....	1016
LV_ERR_MAP	
def .....	982
use 1018, 3398, 3599, 5035, 5802, 6469, 6543, 6943	
LV_ERR_MAP_DIP_PLAUS	
def .....	1062
use 982, 1018, 2865, 3681, 4253, 4392, 5035, 5148, 5954, 6509	
LV_ERR_MAP_DIP_SENS	
def .....	4824
use 982, 1018, 1064, 1198, 2865, 3681, 4253, 4392, 5000, 5148, 5954, 6509	
LV_ERR_MAP_DIP_SHIFT	
def .....	4824

use ..... 1018, 1064, 2865, 3398, 3599, 3681, 4253, 4392, 5000, 5148, 5954, 6509	def ..... 7011
LV_ERR_MAP_LOCK [NC_CBK_EX_NR]	LV_ERR_MFF_MON_1
def ..... 1016	def ..... 6859
LV_ERR_MAP_PLAUS	use ..... 5035
def ..... 1062	LV_ERR_MIS [NC_CYL_NR]
use 1018, 2865, 3398, 4253, 4309, 5160, 5190, 5229, 5245, 5285, 5291, 5378, 5408, 5420, 5429, 5433, 5507, 5954	def ..... 6264
LV_ERR_MAP_SENS_1	use 1018, 1064, 2865, 4253, 4309, 5160, 5190, 5229, 5245, 5273, 5285, 5291, 5378, 5408, 5429, 5433, 5507, 5954
use ..... 5035	LV_ERR_MIS_A_IN_WIN_B
LV_ERR_MAP_SENS_2	def ..... 6238
use ..... 5035	use ..... 6264
LV_ERR_MAP_TPS_PLAUS	LV_ERR_MIS_FIRE_LOCK [NC_CBK_EX_NR]
def ..... 1062	def ..... 1016
use 1018, 1789, 2383, 2865, 3398, 3512, 3599, 4022, 4253, 4309, 4392, 4763, 4824, 5035, 5148, 5160, 5190, 5229, 5245, 5285, 5291, 5332, 5378, 5408, 5420, 5429, 5433, 5507, 5634, 5954, 6469, 6509	LV_ERR_MIS_FIRE_LOCK_LSCL [NC_CBK_EX_NR]
LV_ERR_MAP_TPS_PLAUS_1	def ..... 1016
use ..... 5035	LV_ERR_MIS_FTL_L
LV_ERR_MAP_TPS_PLAUS_2	def ..... 6264
use ..... 5035	use ..... 2865
LV_ERR_MEC_CLOSE_SOV	LV_ERR_MIS_LAM_AD_INJ [NC_CYL_NR]
def ..... 1001	def ..... 3348
LV_ERR_MEC_IVVT_EX	use ..... 3380
def ..... 1062	LV_ERR_MIS_MPL
use ..... 4371, 4392, 5160, 5190, 5229, 5285, 5378, 5408, 5507, 5634, 6509	def ..... 6264
LV_ERR_MEC_IVVT_EX [NC_NR_CBK_IVVT]	use ..... 1018, 2865, 5954
def ..... 801	LV_ERR_MKD [NC_NR_ERR_DYN]
LV_ERR_MEC_IVVT_EX_0	def ..... 5767
use ..... 5035	use ..... 5744
LV_ERR_MEC_IVVT_EX_1	LV_ERR_MON_3
use ..... 5035	def ..... 7158
LV_ERR_MEC_IVVT_EX_2	LV_ERR_MSR_INH_MON
use ..... 5035	def ..... 6983
LV_ERR_MEC_IVVT_IN	use ..... 6742, 6795, 6859, 6870
def ..... 1062	LV_ERR_MSW_2
use ..... 4371, 4392, 5160, 5190, 5229, 5285, 5378, 5408, 5507, 5634, 6509	def ..... 5058
LV_ERR_MEC_IVVT_IN_0	use ..... 6912, 7220, 7228
use ..... 5035	LV_ERR_MSW_3
LV_ERR_MEC_IVVT_IN_1	def ..... 5058
use ..... 5035	use ..... 6912, 7220, 7228
LV_ERR_MEC_IVVT_IN_2	LV_ERR_MSW_TOG
use ..... 5035	def ..... 5058
LV_ERR_MEC_OPEN_CPS	use ..... 6912, 7220, 7228
def ..... 1001	LV_ERR_MTC_CTL_1
use ..... 3398, 5148, 6095	def ..... 4977
LV_ERR_MEM_XX	use ..... 4952, 4983, 6687
def ..... 5767	LV_ERR_MTC_CTL_2
use ..... 1064, 5010, 5694, 5881, 5911, 8038, 8114	def ..... 4977
LV_ERR_MFF_MON	use 1018, 1064, 3398, 3599, 4253, 4309, 4371, 4952, 4983, 5160, 5190, 5229, 5245, 5285, 5291, 5378, 5408, 5429, 5433, 5507, 6283
def ..... 6943	LV_ERR_MTC_CTL_3
use ..... 6795, 6859, 6870, 6877	def ..... 4977
LV_ERR_MFF_MON2	use 1018, 1064, 3398, 3599, 4253, 4309, 4371, 4952, 4983, 5160, 5190, 5230, 5245, 5285, 5291, 5378, 5408, 5429, 5433, 5507, 6284
	LV_ERR_MTC_DR
	def ..... 5002

use 1018, 1064, 3398, 3599, 4253, 4309, 4371, 4952, 4983, 5160, 5190, 5230, 5245, 5285, 5291, 5378, 5408, 5429, 5433, 5507, 6284	LV_ERR_NS_CAN_MSG_LOST [NC_NOX_SENS_CONF]
LV_ERR_MU_MC	def ..... 991
def ..... 7072	use ..... 1382, 2943, 3054, 3066, 3107, 4916, 6469
use ..... 4810, 6565, 6795, 6877	LV_ERR_NS_GAIN [NC_NOX_SENS_CONF]
LV_ERR_MU_MC_CPL	def ..... 6377
def ..... 7072	use ..... 6321
LV_ERR_MU_MC_MON2	LV_ERR_NS_HTP [NC_NOX_SENS_CONF]
def ..... 7011	def ..... 6330
LV_ERR_N_32_MON	use ..... 1064, 6321
def ..... 7002	LV_ERR_NS_LSL_UP_DOWN [NC_NOX_SENS_CONF]
use ..... 6795, 6859, 6870, 6877	def ..... 6396
LV_ERR_N_32_MON2	use ..... 1064, 6321
def ..... 7011	LV_ERR_NS_OBD_1 [NC_NOX_SENS_CONF]
LV_ERR_N_32_MON_1	def ..... 4915
def ..... 6859	use ..... 3054, 3066, 3074, 3107, 6469, 8363
use ..... 5035	LV_ERR_NS_OBD_1_HTP [NC_NOX_SENS_CONF]
LV_ERR_N_MAX_DRIV_REQ	def ..... 4916
def ..... 1062	use ..... 1064, 2943
LV_ERR_N_MAX_HOMS	LV_ERR_NS_OBD_1_LAMB [NC_NOX_SENS_CONF]
def ..... 1062	def ..... 4916
LV_ERR_N_WHEEL_FN_LE	use ..... 1064
def ..... 5044	LV_ERR_NS_OBD_1_NOX [NC_NOX_SENS_CONF]
use ..... 1176	def ..... 4916
LV_ERR_N_WHEEL_FN_RI	use ..... 1065
def ..... 5044	LV_ERR_NS_OBD_1_VLS [NC_NOX_SENS_CONF]
use ..... 1176	def ..... 4916
LV_ERR_N_WHEEL_RE_LE	use ..... 1065, 2943
def ..... 5044	LV_ERR_NS_OBD_2 [NC_NOX_SENS_CONF]
use ..... 1176	def ..... 6320
LV_ERR_N_WHEEL_RE_RI	use ..... 2943, 6469, 8363
def ..... 5044	LV_ERR_NS_OFS [NC_NOX_SENS_CONF]
use ..... 1176	def ..... 6378
LV_ERR_NEUT_PSN_GB	use ..... 1065, 6321
use ..... 1064	LV_ERR_NS_PUC [NC_NOX_SENS_CONF]
LV_ERR_NEUT_PSN_GB_LRN	def ..... 6405
def ..... 1062	use ..... 1065, 6321
LV_ERR_NEUT_PSN_GB_PLAUS	LV_ERR_NS_PWR [NC_NOX_SENS_CONF]
use ..... 1064	use ..... 1065
LV_ERR_NOX_NS_PUC [NC_NOX_SENS_CONF]	LV_ERR_NS_RAW [NC_NOX_SENS_CONF]
use ..... 1064	use ..... 6321
LV_ERR_NOX_SENS_CAN_BOFF	LV_ERR_NS_SHIFT [NC_NOX_SENS_CONF]
def ..... 991	def ..... 6412
use ..... 1822	use ..... 6321, 6428
LV_ERR_NS_ACT [NC_NOX_SENS_CONF]	LV_ERR_NS_SHIFT_MNG_OLD [NC_NOX_SENS_CONF]
def ..... 6358	def ..... 6426
use ..... 1064, 6320	LV_ERR_NS_STOP [NC_NOX_SENS_CONF]
LV_ERR_NS_AFR [NC_NOX_SENS_CONF]	def ..... 6347
def ..... 6389	use ..... 1065, 6321
use ..... 1064, 6320	LV_ERR_NS_VERS [NC_NOX_SENS_CONF]
LV_ERR_NS_AVL [NC_NOX_SENS_CONF]	def ..... 6313
def ..... 6368	use ..... 6321
use ..... 1064, 6321	LV_ERR_NS_VLS_DYN [NC_NOX_SENS_CONF]
LV_ERR_NS_CAN_BOFF	def ..... 6338
def ..... 991	use ..... 1065, 6321
use ..... 1382, 2943, 3054, 4916, 6469	LV_ERR_NT_AGI
	def ..... 6485
	use ..... 1065, 6469


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LV_ERR_NT_SO2P	use 1018, 1065, 4253, 4371, 4415, 4456, 5161, 5191, 5230, 5379, 5408, 5429, 5507, 5634, 6509
def .....	6485
LV_ERR_OBD_LSH_DOWN [NC_CBK_EX_NR]	LV_ERR_PER_CAM_IN_1
def .....	5198
use ..... 1008, 3107, 4253, 5160, 5190, 5230, 5378, 5408, 5429, 5450, 5507	use .....
LV_ERR_OBD_LSH_DOWN_1	5035
def .....	1007
LV_ERR_OBD_LSH_DOWN_2	LV_ERR_PER_CAM_IN_2
def .....	1007
LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR]	use .....
def .....	5438
use 1008, 2406, 4253, 4763, 5161, 5191, 5230, 5255, 5273, 5286, 5378, 5408, 5429, 5450, 5507	5036
LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR]	LV_ERR_PERM [NC_NR_ERR_PERM]
def .....	4267
use ..... 1008, 4253, 4267, 5161, 5191, 5210, 5230, 5378, 5408, 5429, 5507, 5634	def .....
LV_ERR_OC_LSL_UP [NC_CBK_EX_NR]	5842
def .....	4300
use 1008, 1065, 1318, 2406, 4253, 4763, 5161, 5191, 5230, 5255, 5273, 5286, 5378, 5408, 5429, 5439, 5450, 5507	LV_ERR_PERM_CLR_OLD
LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR]	def .....
def .....	5248
use 1008, 2315, 2383, 2865, 4253, 4290, 4309, 4763, 5148, 5161, 5191, 5230, 5245, 5255, 5273, 5286, 5291, 5332, 5379, 5408, 5429, 5433, 5507, 6469	5842
LV_ERR_OPM_AV_MON	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK]
def .....	4446
use ..... 6859, 6870, 6877	use 1018, 1065, 4253, 4371, 4415, 4456, 5161, 5191, 5230, 5379, 5408, 5429, 5507, 5634, 6509
LV_ERR_OPM_AV_MON2	LV_ERR_PLAUS_CAM_EX_1
def .....	5036
LV_ERR_OSC_CHK [NC_CBK_EX_NR]	use .....
def .....	7011
LV_ERR_OVL_ECU_VVL	5036
def .....	801
use .....	7228
LV_ERR_PBK_IV [NC_PBK_IV_NR]	LV_ERR_PLAUS_CAM_EX_2
def .....	5036
use ..... 6118	5036
LV_ERR_PBK_IV_LST_CYC	LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK]
def .....	4446
LV_ERR_PBSU	use 1018, 1065, 4253, 4371, 4415, 4456, 5161, 5191, 5230, 5379, 5408, 5429, 5507, 5634, 6509
use .....	1065
LV_ERR_PBSU_PLAUS	LV_ERR_PLAUS_CAM_IN_1
use .....	5036
LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK]	use .....
def .....	4426
use 1018, 1065, 4253, 4371, 4415, 4456, 5161, 5191, 5230, 5379, 5408, 5429, 5507, 5634, 6509	5036
LV_ERR_PER_CAM_EX_1	LV_ERR_PLAUS_CAM_IN_2
use .....	5036
LV_ERR_PER_CAM_EX_2	LV_ERR_PLAUS_IGK_3
use .....	4929
LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK]	def .....
def .....	4426
LV_ERR_POIL_CTL_DYN	4929
def .....	5767
LV_ERR_POIL_CTL_DYN	use .....
def .....	1065
LV_ERR_POIL_CTL_MEC	LV_ERR_POIL_CTL_DYN
def .....	1062
LV_ERR_POIL_CTL_STAT	def .....
def .....	1062
LV_ERR_POIL_DR	LV_ERR_POIL_CTL_STAT
def .....	1062
LV_ERR_POIL_DR_SCG	def .....
def .....	4357
LV_ERR_POIL_PUMP	use .....
def .....	1065, 8204
LV_ERR_POIL_SENS_PLAUS	LV_ERR_POIL_DR_SCG
def .....	4357
LV_ERR_POIL_SWI	LV_ERR_POIL_PUMP
def .....	1062
	LV_ERR_POIL_SENS_PLAUS
	def .....
	1062
	LV_ERR_POIL_SWI
	def .....
	4357




LV_ERR_POIL_SYS	use .....	1065, 4096
def .....		1062
LV_ERR_PORT [NC_PORTPWM]	def .....	801
def .....		1822
use .....		
LV_ERR_PREL_TEG_PCAT_DOWN	def .....	4713
def .....		1253
use .....		
LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR]	def .....	4275
def .....		1008, 4253, 4276, 5161, 5191, 5230, 5379, 5408, 5429, 5507, 5634
use .....		
LV_ERR_PUC_VLD_LS_UP [NC_CBK_EX_NR]	def .....	5297
def .....		4253, 4763, 5161, 5191, 5230, 5273, 5286, 5379, 5408, 5429, 5450, 5507
use .....		
LV_ERR_PUE_LS_DOWN [NC_CBK_EX_NR]	def .....	5169
def .....		1008, 4253, 5230, 5379, 5408, 5429, 5450, 5507
use .....		
LV_ERR_PUT_EL	def .....	4828
def .....		1065, 1163, 1198, 1209, 5036, 6509, 7767
use .....		
LV_ERR_PUT_EL_1	use .....	5036
LV_ERR_PUT_PLAUS	def .....	1062
def .....		1163, 1209, 6509
use .....		
LV_ERR_PVS	def .....	4216
def .....		1112, 5051, 5054, 6795, 6870, 6985, 7228
use .....		
LV_ERR_PVS_1	def .....	4216
def .....		6509, 6961
use .....		
LV_ERR_PVS_2	def .....	4216
def .....		6509, 6961
use .....		
LV_ERR_PVS_BLS_NOT_PLAUS	def .....	4216
def .....		1270
use .....		
LV_ERR_PVS_DOUBLE	def .....	4216
def .....		3512, 3681, 4392, 5753, 5954
use .....		
LV_ERR_PVS_MON	def .....	6961
def .....		6795, 6859, 6870, 6877
use .....		
LV_ERR_PVS_MON2	def .....	7011
def .....		
use .....		
LV_ERR_PVS_MON_1	def .....	6859
def .....		
use .....		
LV_ERR_PVS_RATIO	def .....	4216
def .....		6961
use .....		
LV_ERR_PVS_RATIO_MON	def .....	6961
def .....		6795
use .....		
LV_ERR_QOIL_COM	def .....	4834
def .....		
use .....		
LV_ERR_QOIL_SENS	def .....	1062
def .....		1584
use .....		
LV_ERR_RAM_MON_3	def .....	7158
LV_ERR_RAS	def .....	4569
def .....		
use .....		
LV_ERR_RATIO_CHK	def .....	982
def .....		3398
use .....		
LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK]	def .....	4421
def .....		1018, 1065, 3398, 4253, 4371, 4415, 4456, 5161, 5191, 5230, 5379, 5408, 5430, 5507, 5634, 6509
use .....		
LV_ERR_REF_CRK_CAM_EX_1	use .....	5036
LV_ERR_REF_CRK_CAM_EX_2	use .....	5036
LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK]	def .....	4421
def .....		1018, 1065, 3398, 4253, 4371, 4415, 4456, 5161, 5191, 5230, 5379, 5408, 5430, 5507, 5634, 6509
use .....		
LV_ERR_REF_CRK_CAM_IN_1	use .....	5036
LV_ERR_REF_CRK_CAM_IN_2	use .....	5036
LV_ERR_REF_CYL_BAL_ER	def .....	5112
def .....		
use .....		
LV_ERR_REF_CYL_BAL_LAM [NC_CBK_EX_NR]	def .....	5112
def .....		
use .....		
LV_ERR_RFP_DR	def .....	4203
def .....		
use .....		
LV_ERR_RLY_ACCOUT	def .....	4627
def .....		1065
use .....		
LV_ERR_RLY_CRCV_HEAT	def .....	4627
def .....		4142
use .....		
LV_ERR_RLY_MAIN	def .....	4933
def .....		989
use .....		
LV_ERR_RLY_MAIN_DLY	def .....	4933
def .....		
use .....		
LV_ERR_RLY_MTC_HEAT	def .....	5004
def .....		6532
use .....		
LV_ERR_RLY_ST	def .....	4627
def .....		
use .....		
LV_ERR_RLY_VCV	def .....	988
def .....		6095
use .....		
LV_ERR_RLY_VVL	def .....	801
def .....		7228
use .....		
LV_ERR_ROUGH_LEAK	def .....	5965
def .....		
use .....		

use .....	5954	use .....	1065, 4371, 4392, 5161, 5191, 5230, 5286, 5379, 5408, 5507, 5634, 6509
LV_ERR_SA_SAFM		LV_ERR_SLV_IVVT_EX_0	
def .....	801	use .....	5036
use .....	7767	LV_ERR_SLV_IVVT_EX_1	
LV_ERR_SA_SAP		use .....	5036
def .....	801	LV_ERR_SLV_IVVT_EX_2	
use .....	7767	use .....	5036
LV_ERR_SA_SAV		LV_ERR_SLV_IVVT_IN	
def .....	801	def .....	4627
use .....	2383, 7767	use .....	1065, 4371, 4392, 5148, 5161, 5191, 5230, 5286, 5332, 5379, 5408, 5507, 5634, 6509
LV_ERR_SA_SAV_LSL		LV_ERR_SLV_IVVT_IN_0	
def .....	801	use .....	5036
use .....	2383, 7767	LV_ERR_SLV_IVVT_IN_1	
LV_ERR_SA_SYS		use .....	5036
def .....	802	LV_ERR_SLV_IVVT_IN_2	
use .....	7767	use .....	5036
LV_ERR_SAP		LV_ERR_SMALL_LEAK	
def .....	802	def .....	5965
use .....	2383, 7767	use .....	5954
LV_ERR_SAV		LV_ERR_SOF	
def .....	802	def .....	4911
use .....	2383, 7767	LV_ERR_SOF_INH_MON	
LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR]		def .....	6790
def .....	4267	use .....	3851, 6859
use .....	1008, 4253, 4267, 5161, 5191, 5210, 5230, 5379, 5408, 5430, 5507, 5634	LV_ERR_SOF_REQ	
LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR]		def .....	4911
def .....	4267	use .....	3851, 6795
use .....	1008, 4253, 4267, 5161, 5191, 5210, 5230, 5379, 5408, 5430, 5507, 5634	LV_ERR_SPI_KNK	
LV_ERR_SEG_AD_ER		def .....	4245
def .....	4367	use .....	1952, 4908
use .....	2865, 4022, 6284	LV_ERR_SPI_MPS	
LV_ERR_SENS_ACR		def .....	4245
def .....	4352	use .....	4203, 4207, 4247, 4288, 4314, 4357, 4508, 4516, 4535, 4569, 4627, 4712, 4810, 4911, 4942, 5004, 5065, 5954, 5971, 6037
use .....	811, 1065, 4345	LV_ERR_STST	
LV_ERR_SENS_BAT_SMT_COM		def .....	8220
def .....	4834	use .....	1584
use .....	1065, 4096	LV_ERR_SWI_AFS_MON	
LV_ERR_SENS_POIL		def .....	6859
def .....	4365	LV_ERR_SWT_LS_DOWN [NC_CBK_EX_NR]	
use .....	903, 1065	def .....	5152
LV_ERR_SET_VS_PLAUS_POW		use .....	1008, 4253, 5230, 5379, 5408, 5430, 5450, 5507
def .....	5021	LV_ERR_SYM_TQ_DCC_CS	
LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR]		def .....	1710
def .....	5334	use .....	4851
use .....	1008, 4253, 4309, 4763, 5161, 5191, 5245, 5273, 5286, 5291, 5379, 5408, 5430, 5433, 5450, 5507	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK]	
LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR]		def .....	4426
def .....	5334	use .....	1018, 1065, 4253, 4371, 4415, 4456, 5161, 5191, 5230, 5379, 5408, 5430, 5507, 5634, 6509
use .....	1008, 4253, 4309, 4763, 5161, 5191, 5245, 5273, 5286, 5291, 5379, 5408, 5430, 5433, 5450, 5507	LV_ERR_SYN_CAM_EX_1	
LV_ERR_SIG_DMTL		use .....	5036
def .....	5965	LV_ERR_SYN_CAM_EX_2	
LV_ERR_SLV_IVVT_EX		use .....	5036
def .....	4627	LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK]	

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def .....	4426	LV_ERR_TCHA_PRS_DIF	def .....	1063
use 1018, 1065, 4253, 4371, 4415, 4456, 5161, 5191, 5230, 5379, 5408, 5430, 5507, 5634, 6509		use .....	2865	
LV_ERR_SYN_CAM_IN_1		LV_ERR_TCHA_PRS_HIGH	def .....	1063
use .....	5036	use .....	2865	
LV_ERR_SYN_CAM_IN_2		LV_ERR_TCHA_PRS_LOW	def .....	1063
use .....	5036	use .....	2866	
LV_ERR_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]		LV_ERR_TCHA_SYS_1	def .....	1063
def .....	4447	LV_ERR_TCO	def .....	4496
use ..... 1018, 1065, 4253, 4371, 4415, 4456, 6509		use 1018, 1100, 1105, 1226, 1584, 2383, 2866, 3054, 3398, 3512, 3931, 4022, 4780, 5036, 5083, 5148, 5660, 5672, 5954, 5971, 6037, 7683, 7767		
LV_ERR_SYN_CRK_CAM_EX_1		LV_ERR_TCO_2	def .....	4572
use .....	5036	use .....	1045, 1218, 5036	
LV_ERR_SYN_CRK_CAM_EX_2		LV_ERR_TCO_2_EL	def .....	4572
use .....	5036	use .....	1065, 4578, 5672	
LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]		LV_ERR_TCO_2_GRD	def .....	4572
def .....	4447	use .....	1065, 5672	
use ..... 1018, 1065, 4253, 4371, 4415, 4456, 5161, 5191, 5230, 5379, 5408, 5430, 5507, 6509		LV_ERR_TCO_2_PLAUS	def .....	5666
LV_ERR_SYN_CRK_CAM_IN_1		use .....	1065, 4572	
use .....	5036	LV_ERR_TCO_2_PREL	def .....	4572
LV_ERR_SYN_CRK_CAM_IN_2		use .....	1218	
use .....	5036	LV_ERR_TCO_2_PREL_DET	def .....	4572
LV_ERR_T_ES		LV_ERR_TCO_EL	def .....	4496
def .....	4466	use ..... 1018, 1065, 4200, 4477, 4502, 5103, 5634, 5678, 5687, 6509		
use ..... 1444, 4477, 5083, 5678		LV_ERR_TCO_EX	def .....	1045
LV_ERR_T_ES_DIAG_1		LV_ERR_TCO_GRD	def .....	4496
def .....	4466	use ..... 1018, 1065, 4200, 4477, 4502, 5103, 5634, 5678, 5687, 6509		
LV_ERR_T_ES_DIAG_2		LV_ERR_TCO_LOCK [NC_CBK_EX_NR]	def .....	1016
def .....	4466	LV_ERR_TCO_PLAUS	def .....	5682
LV_ERR_T_ES_DIAG_3		use ..... 1018, 1065, 4200, 4477, 4496, 4502, 5103, 5634, 5678		
def .....	4466	LV_ERR_TCO_PREL	def .....	4496
LV_ERR_T_ES_TCO_FAST		use .....	1100	
def .....	4466	LV_ERR_TCO_PREL_DET	def .....	4496
use ..... 1444, 4477		LV_ERR_TCO_STUCK	def .....	5691
LV_ERR_T_ES_TCO_SLOW				
def .....	4466			
use ..... 1444, 4477				
LV_ERR_T_SEG_ER				
def .....	4367			
use ..... 2865, 4022, 6284				
LV_ERR_TAM				
def .....	5076			
use ..... 5660, 5971				
LV_ERR_TAM_CAN				
def .....	5076			
use ..... 1065, 2383, 4200, 4477, 5083, 5103, 5678, 5870, 6037				
LV_ERR_TAM_PLAUS				
def .....	5076			
use ..... 1065, 1584, 2383, 4200, 4477, 5103, 5678, 5870, 6037				
LV_ERR_TCHA_LEAK				
def .....	1062			
use .....	2865			
LV_ERR_TCHA_PRS_CTL				
def .....	1062			
use .....	2865			

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
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use .....	1018, 1065, 4200, 4477, 4496, 5103, 5634, 5678, 5687, 6509	def .....	7072
LV_ERR_TCO_STUCK_RNG		use .....	2042, 2295, 4794, 4810, 6565, 6877, 7158
def .....	5675	LV_ERR_TMP_MU_MC_CPL	
use .....	1018, 1065, 4200, 4477, 4496, 4502, 5103, 5634, 5687, 6037, 6509	def .....	7072
LV_ERR_TECU		LV_ERR_TMP_MU_MC_MON2	
def .....	4237	def .....	7011
use .....	1256	LV_ERR_TOIL	
LV_ERR_TEG_PCAT_DOWN		def .....	1063
def .....	4713	LV_ERR_TOIL_LEVEL	
use .....	1065, 1253, 1789, 3107, 3144, 6469	def .....	1063
LV_ERR_TEG_PCAT_DOWN [NC_CBK_EX_NR]		LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK]	
def .....	802	def .....	4421
LV_ERR_TH		use 1018, 1065, 3398, 4253, 4371, 4415, 4456, 5161, 5191, 5230, 5379, 5408, 5430, 5507, 6509	
def .....	5652	LV_ERR_TOOTH_OFF_EX_1	
use .....	1045, 1065	use .....	5036
LV_ERR_TIA		LV_ERR_TOOTH_OFF_EX_2	
def .....	4200	use .....	5036
use 984, 1226, 3681, 4502, 5036, 5083, 5103, 5660, 5672		LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK]	
LV_ERR_TIA_EL		def .....	4421
def .....	4194	use 1018, 1065, 3398, 4253, 4371, 4415, 4456, 5161, 5191, 5230, 5379, 5408, 5430, 5507, 6509	
use .....	4200, 5678, 5687	LV_ERR_TOOTH_OFF_IN_1	
LV_ERR_TIA_GRD		use .....	5036
def .....	4194	LV_ERR_TOOTH_OFF_IN_2	
use .....	4200, 5678, 5687	use .....	5036
LV_ERR_TIA_IM		LV_ERR_TOUT_AMT_1	
def .....	984	def .....	802
use .....	1100, 3107, 3398	use .....	6985, 7228
LV_ERR_TIA_IM_EL_2		LV_ERR_TOUT_ASR_1	
use .....	5036	def .....	802
LV_ERR_TIA_MES_PLAUS_1		use .....	1065, 1176, 1302, 3512, 6742, 6985, 7228
use .....	5036	LV_ERR_TOUT_ASR_3	
LV_ERR_TIA_MES_PLAUS_2		def .....	802
use .....	5036	use .....	6742, 6985, 7228
LV_ERR_TIA_PLAUS		LV_ERR_TOUT_EFP_CAN	
def .....	5093	def .....	802
use .....	1065, 4200, 5678, 5687	LV_ERR_TOUT_ETCU_1	
LV_ERR_TIA_PWM_EL_1		def .....	802
use .....	5036	use .....	1065, 4849, 6710, 6719, 6985, 7228
LV_ERR_TIA_PWM_EL_2		LV_ERR_TOUT_ETCU_2	
use .....	5036	def .....	802
LV_ERR_TIA_TCHA_UP		use .....	4849, 6719, 6985, 7228
def .....	4189	LV_ERR_TOUT_ICL_2	
use .....	1226	def .....	802
LV_ERR_TIA_THR		use .....	1065, 5971
def .....	984	LV_ERR_TOUT_ICL_3	
use .....	3398, 6543	def .....	802
LV_ERR_TIA_THR_MES_PLAUS_1		use .....	3589, 5077
use .....	5036	LV_ERR_TOUT_ICL_7	
LV_ERR_TIA_THR_MES_PLAUS_2		def .....	802
use .....	5036	use .....	1584, 4745, 5077
LV_ERR_TMP [NC_NR_ERR_DYN]		LV_ERR_TOUT_NOX_SENS [i]	
def .....	5767	def .....	4855
use .....	5695, 5744	use .....	992
LV_ERR_TMP_MU_MC		LV_ERR_TOUT_PSTE_1	
		def .....	802

use .....	6623	def .....	4990
LV_ERR_TPS		use 1018, 1065, 3398, 3599, 4309, 4371, 4983, 5161, 5191, 5230, 5286, 5291, 5379, 5408, 5433, 5507, 6284, 6943	
def .....	4982	LV_ERR_TPS_MAF_2_1	
use 1018, 2383, 2866, 3398, 3512, 3681, 4022, 4253, 4309, 4371, 4392, 4824, 5036, 5148, 5161, 5191, 5230, 5245, 5286, 5291, 5379, 5408, 5430, 5433, 5954, 6284, 6870		use .....	5036
LV_ERR_TPS_1		LV_ERR_TPS_MAF_2_2	
def .....	4990	use .....	5036
use 1018, 1065, 3398, 3599, 4309, 4371, 4952, 4983, 5161, 5191, 5230, 5286, 5291, 5379, 5408, 5433, 5507, 6284, 6509, 6943		LV_ERR_TPS_MON	
LV_ERR_TPS_1_1		def .....	6943
def .....	5036	use .....	6859, 6870, 6877
LV_ERR_TPS_1_2		LV_ERR_TPS_MON2	
use .....	5036	def .....	7011
LV_ERR_TPS_2		LV_ERR_TPS_MON_1	
def .....	4990	def .....	6859
use 1018, 1065, 3398, 3599, 4309, 4371, 4952, 4983, 5036, 5161, 5191, 5230, 5286, 5291, 5379, 5408, 5433, 5507, 6284, 6509, 6943		use .....	6284
LV_ERR_TPS_2_1		LV_ERR_TPS_RATIO	
use .....	5036	def .....	4990
LV_ERR_TPS_2_2		use 1018, 1065, 3398, 3599, 4309, 4371, 4393, 4952, 5161, 5191, 5230, 5286, 5291, 5379, 5408, 5433, 5507, 6284, 6943	
use .....	5036	LV_ERR_TPS_RATIO_1	
LV_ERR_TPS_AD		use .....	5036
def .....	4951	LV_ERR_TPS_RATIO_2	
use 1018, 1065, 2866, 3398, 3599, 4309, 4371, 4392, 4824, 5036, 5161, 5191, 5230, 5286, 5291, 5379, 5408, 5433, 5507, 5954, 6284		use .....	5036
LV_ERR_TPS_AD_1		LV_ERR_TPS_ST_CHK_1	
use .....	5036	def .....	4951
LV_ERR_TPS_AD_2		use .....	2866, 3398, 4393, 5036
use .....	5036	LV_ERR_TPS_ST_CHK_2	
LV_ERR_TPS_AD_BOL		def .....	4951
def .....	4951	use 1018, 1065, 2866, 3398, 3599, 4309, 4371, 4393, 4824, 5036, 5161, 5191, 5230, 5286, 5291, 5379, 5408, 5433, 5507, 5954, 6284	
use 1018, 1065, 2866, 3599, 4309, 4371, 4392, 4824, 5161, 5191, 5230, 5286, 5291, 5379, 5408, 5433, 5507, 5954, 6284		LV_ERR_TQ_CST	
LV_ERR_TPS_AD_SPR_1		def .....	1063
use .....	5036	LV_ERR_TQ_DIF_I_IS_MON	
LV_ERR_TPS_AD_SPR_2		def .....	6921
use .....	5036	use .....	6859, 6870, 6877
LV_ERR_TPS_JAM_DET		LV_ERR_TQ_DIF_I_IS_MON2	
def .....	6531	def .....	7011
LV_ERR_TPS_LOCK [NC_CBK_EX_NR]		LV_ERR_TQ_DIF_ISC_MON_1	
def .....	1016	def .....	6859
LV_ERR_TPS_MAF_1		LV_ERR_TQ_DIF_P_D_IS_MON	
def .....	4990	def .....	6921
use 1018, 1065, 3398, 3599, 4309, 4371, 4983, 5161, 5191, 5230, 5286, 5291, 5379, 5408, 5433, 5507, 6284, 6943		use .....	6859, 6870, 6877
LV_ERR_TPS_MAF_1_1		LV_ERR_TQ_DIF_P_D_IS_MON2	
use .....	5036	def .....	7011
LV_ERR_TPS_MAF_1_2		LV_ERR_TQ_EXT_MON_1	
use .....	5036	def .....	6859
LV_ERR_TPS_MAF_2		use .....	5036
		LV_ERR_TQ_LOSS_ARS_AV_CAN	
		def .....	1565
		use .....	6650
		LV_ERR_TQ_LOSS_ARS_SP_CAN	
		def .....	1565
		use .....	6650
		LV_ERR_TQ_LOSS_MON	

def .....	6975	use .....	6796
use .....	6859, 6870, 6877	LV_ERR_VAR_COD	
LV_ERR_TQ_LOSS_MON2		def .....	4945
def .....	7011	LV_ERR_VB	
LV_ERR_TQ_MAX_CLU_MON		def .....	802
def .....	6938	use .....	3931
use .....	6859, 6870, 6877	LV_ERR_VB_FB_0	
LV_ERR_TQ_MAX_CLU_MON2		def .....	802
def .....	7011	use .....	5273
LV_ERR_TQ_MIN_CLU_MON		LV_ERR_VB_FB_1	
def .....	6952	def .....	802
use .....	6859, 6870, 6877	use .....	5273
LV_ERR_TQ_MIN_CLU_MON2		LV_ERR_VB_FB_2	
def .....	7011	def .....	802
LV_ERR_TQ_REQ_CAN		use .....	5273
def .....	4851	LV_ERR_VB_FB_3	
LV_ERR_TQ_REQ_MON_1		def .....	802
def .....	6859	use .....	5273
use .....	5036	LV_ERR_VB_FB_DLY	
LV_ERR_TQI_AV_MON		def .....	802
def .....	6899	LV_ERR_VB_FB_INJ	
use .....	6795, 6859, 6870, 6877	use .....	5273
LV_ERR_TQI_AV_MON2		LV_ERR_VCC_ACR	
def .....	7011	def .....	4355
LV_ERR_TQI_AV_MON_1		use .....	4345
def .....	6859	LV_ERR_VCC_PVS_1_MON	
use .....	5036	def .....	6790
LV_ERR_TQI_LIM		use .....	6961
def .....	5008	LV_ERR_VCC_PVS_2_MON	
LV_ERR_TQI_N_MAX_MON		def .....	6790
def .....	6917	use .....	6961
use .....	4230, 6795, 6859, 6877, 7228	LV_ERR_VCC_PVS_MON	
LV_ERR_TQI_N_MAX_MON2		def .....	6790
def .....	7011	use .....	6961
LV_ERR_TQI_N_MAX_MON_1		LV_ERR_VCV	
def .....	6859	def .....	4729
use .....	5036	use 1018, 2866, 3398, 4001, 4022, 4254, 4309, 4393,	
LV_ERR_TQI_N_MAX_MON_1_SAVE		5148, 5161, 5191, 5230, 5245, 5286, 5291, 5379,	
def .....	6859	5408, 5430, 5433, 5507, 5634, 5954, 6095, 6102,	
LV_ERR_TRAN_1_MON		6469	
def .....	6877	LV_ERR_VCV_PLAUS	
LV_ERR_TRAN_1_MON2		def .....	6062
def .....	7011	use .....	2866, 3398, 4001
LV_ERR_TRAN_2_MON		LV_ERR_VEH_POW_VAR	
def .....	6877	def .....	4945
LV_ERR_TRAN_2_MON2		use .....	1065
def .....	7011	LV_ERR_VIM_1	
LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR]		def .....	5065
def .....	5438	use .....	3622
use 1008, 2335, 2383, 2866, 3398, 4254, 4763, 5148,		LV_ERR_VIM_1_EL	
5161, 5191, 5230, 5273, 5286, 5379, 5408, 5430,		def .....	5065
5507, 5634, 6469		use .....	1065
LV_ERR_V_REF_1		LV_ERR_VIM_2	
def .....	4216	def .....	5065
use .....	4355, 4952, 4983, 4991, 6796	use .....	3622
LV_ERR_V_REF_2		LV_ERR_VIM_2_EL	
def .....	4216	def .....	5065

use .....	1065	LV_ERR_WG_2_DR	
LV_ERR_VIM_PLAUS		def .....	4207
def .....	1063	use .....	1065
LV_ERR_VIMPWM_1_FB		LV_ERR_WG_DR [NC_CBK_EX_NR]	
def .....	5065	use .....	2866, 3398, 8140
use .....	1065	LV_ERR_WHEEL_GRD_FR_LE	
LV_ERR_VIMPWM_2_FB		def .....	6301
def .....	5065	LV_ERR_WHEEL_GRD_FR_RI	
use .....	1065	def .....	6301
LV_ERR_VLS_DOWN_1		LV_ERR_WHEEL_GRD_RE_LE	
def .....	1007	def .....	6301
LV_ERR_VLS_DOWN_2		LV_ERR_WHEEL_GRD_RE_RI	
def .....	1007	def .....	6301
LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR]		LV_ERR_XX	
def .....	5216	use .....	5695, 5744, 5767, 5827, 5881
use 1008, 2383, 3398, 4254, 4309, 4763, 5148, 5161,		LV_ES	
5191, 5245, 5273, 5291, 5379, 5408, 5433, 5507,		def .....	1720
5635		use .....	657, 811, 834, 940,
LV_ERR_VLS_MAIN_CAT_PURGE [NC_CBK_EX_NR]		984, 1002, 1045, 1100, 1183, 1198, 1209, 1214,	
def .....	2942	1218, 1256, 1290, 1302, 1310, 1339, 1365, 1379,	
use .....	2928	1444, 1469, 1504, 1584, 1766, 1775, 1801, 1828,	
LV_ERR_VLS_NS_PUC [NC_NOX_SENS_CONF]		1876, 1881, 1912, 1939, 1952, 1962, 2042, 2109,	
use .....	1065	2278, 2307, 2386, 2409, 2416, 2442, 2448, 2840,	
LV_ERR_VS		2882, 2885, 2988, 3181, 3188, 3442, 3544, 3576,	
def .....	5021	3589, 3614, 3681, 3737, 3772, 3823, 3846, 3851,	
use 1065, 1112, 1176, 1302, 1584, 3512, 4393, 5015,		3858, 3868, 3881, 3909, 3931, 3956, 4001, 4131,	
5018, 5083, 5103, 5379, 5507, 5660, 5672, 5753,		4136, 4294, 4301, 4333, 4538, 4745, 4763, 4773,	
5870, 5919, 5954, 5971, 6037, 6130, 6284, 6796,		4797, 4803, 4822, 4824, 4830, 4977, 5002, 5008,	
7215, 7228		5015, 5022, 5141, 5217, 5687, 5746, 5802, 5827,	
LV_ERR_VS_BOL		5899, 5971, 6118, 6133, 6226, 6239, 6555, 6565,	
def .....	5021	6580, 6623, 6651, 6692, 6719, 6742, 6985, 7228,	
use .....	5036	7438, 7484, 7558, 7683, 8022, 8215, 8279, 8400	
LV_ERR_VS_CAN		LV_ETCU_DISABLE	
def .....	1565	def .....	6718
use .....	1176, 1298, 6796, 7215, 7228	LV_ETCU_DISABLE_CAN	
LV_ERR_VS_GRD		def .....	6718
def .....	5021	use .....	1148, 5054, 6697, 6985
use .....	5036	LV_ETCU_LIH_CAN	
LV_ERR_VS_PLAUS		def .....	1565
def .....	5021	use .....	1711, 6719, 6985
use .....	1176, 1298, 5379, 5507, 6302	LV_ETCU_PUC_REQ	
LV_ERR_VS_PLAUS_POW		def .....	8209
def .....	5021	use .....	1721
LV_ERR_VS_PLAUS_STUCK		LV_ETCU_SPT_SWI	
def .....	5021	def .....	1565
use .....	5036	use .....	1302, 6796
LV_ERR_VS_TOL		LV_EXC_CUR_ALTER_EXCT_LIM_SP	
def .....	5021	def .....	4094
use .....	5036	LV_EXC_T_LOAD_RESP_ALTER_SP_0	
LV_ERR_VVL_ROT		def .....	4094
def .....	802	LV_EXC_V_ALTER_SP	
use .....	7228	def .....	4094
LV_ERR_WARM_RST		LV_FAC_COMP_DIAG_DYN_UP [NC_CBK_EX_NR]	
def .....	560	def .....	5348
LV_ERR_WG_1_DR		LV_FAC_COR_MFF_EXT_ADJ	
def .....	4207	def .....	803
use .....	1065	use .....	6777



LV_FAC_CTL_DYN_CHG_VSL		LV_FAC_L_RNG_LIM_MIN_FSD [NC_CBK_EX_NR]	
def .....	7259	def .....	6199
LV_FAC_CYL_LAM_COR_LIM_OSC [NC_CBK_EX_NR]		use .....	6142
def .....	2839	LV_FAC_L_RNG_LIM_MIN_LAM_AD [NC_CBK_EX_NR]	
LV_FAC_CYL_LAM_COR_OSC [NC_CBK_EX_NR]		def .....	2642
def .....	2839	use .....	1018, 6199
use .....	2733	LV_FAC_LAM_AD_CUS_SHIFT [NC_CBK_EX_NR]	
LV_FAC_CYL_LAM_LIM_MAX [NC_CYL_NR]		def .....	8309
def .....	2732	use .....	2722
use .....	2840	LV_FAC_LAM_AD_SHIFT [NC_CBK_EX_NR]	
LV_FAC_CYL_LAM_LIM_MIN [NC_CYL_NR]		def .....	2721
def .....	2732	use .....	2643
use .....	2840	LV_FAC_LAM_AD_SHIFT_END [NC_CBK_EX_NR]	
LV_FAC_CYL_LAM_OSC_MAX_THD [NC_CYL_NR]		def .....	2642
def .....	2839	use .....	8310
LV_FAC_CYL_LAM_OSC_MIN_THD [NC_CYL_NR]		LV_FAC_LAM_ADJ_LAM_AD [NC_CBK_EX_NR]	
def .....	2839	def .....	2642
LV_FAC_CYL_LAM_VIRT_LIM [NC_CBK_EX_NR]		use .....	2465
def .....	2732	LV_FAC_LAM_ADJ_LAM_AD_END [NC_CBK_EX_NR]	
LV_FAC_DLY_DIAG_MIN_MAX_RST [NC_CBK_EX_NR]		def .....	2463
def .....	5259	use .....	2643, 2679
LV_FAC_ER_BAL_HOM_EXT_ADJ_KWP		LV_FAC_LAM_ADJ_LAM_AD_WUP [NC_CBK_EX_NR]	
def .....	7483	def .....	2677
LV_FAC_GAIN_H_VLD_R_IT_LS_UP [NC_CBK_EX_NR]		use .....	2643
def .....	1320	LV_FAC_LAM_CAT_LDC [NC_CBK_EX_NR]	
LV_FAC_GAIN_L_VLD_R_IT_LS_UP [NC_CBK_EX_NR]		def .....	5542
def .....	1320	LV_FAC_LAM_CYL_ADJ_CST_LIM [NC_CBK_EX_NR]	
LV_FAC_H_RNG_LAM_AD [NC_CBK_EX_NR]		def .....	2732
def .....	2641	LV_FAC_LAM_CYL_SEL_ADJ_LIM [NC_CBK_EX_NR]	
use .....	2722, 4068, 6142	def .....	2732
LV_FAC_H_RNG_LAM_AD_INI [NC_CBK_EX_NR]		LV_FAC_LAM_DIAGCP	
def .....	2641	def .....	1001
LV_FAC_H_RNG_LIM_MAX_LAM_AD [NC_CBK_EX_NR]		use .....	2465
def .....	2641	LV_FAC_LAM_DIAGCP_END [NC_CBK_EX_NR]	
use .....	6142	def .....	2463
LV_FAC_H_RNG_LIM_MIN_LAM_AD [NC_CBK_EX_NR]		LV_FAC_LAM_DIF_CP_TMP	
def .....	2641	def .....	3699
use .....	6142	LV_FAC_LAM_LIM_MAX [NC_CBK_EX_NR]	
LV_FAC_L_RNG_LAM_AD [NC_CBK_EX_NR]		def .....	2463
def .....	2641	use 1541, 2590, 2866, 4254, 5334, 5350, 6142, 6199	
use .....	2722, 4044, 4068, 6142	LV_FAC_LAM_LIM_MIN [NC_CBK_EX_NR]	
LV_FAC_L_RNG_LAM_AD_INI [NC_CBK_EX_NR]		def .....	2463
def .....	2641	use 1541, 2590, 2866, 4254, 5335, 5350, 6142, 6199	
LV_FAC_L_RNG_LIM_MAX_EXT_LAM_AD [NC_CBK_EX_NR]		LV_FAC_LAM_LIM_NOT_STAT_CDN [NC_CBK_EX_NR]	
def .....	1016	def .....	2463
use .....	6199	use .....	1018, 2954
LV_FAC_L_RNG_LIM_MAX_FSD [NC_CBK_EX_NR]		LV_FAC_LAM_MAX_NOT_LAM_LIM [NC_CBK_EX_NR]	
def .....	6199	def .....	2463
use .....	6142	LV_FAC_LAM_MIN_NOT_LAM_LIM [NC_CBK_EX_NR]	
LV_FAC_L_RNG_LIM_MAX_LAM_AD [NC_CBK_EX_NR]		def .....	2463
def .....	2642	LV_FAC_LAM_SHIFT_CP	
use .....	1018, 6199	def .....	3699
LV_FAC_L_RNG_LIM_MIN_EXT_LAM_AD [NC_CBK_EX_NR]		use .....	2465, 3692
def .....	1016	LV_FAC_LAM_SHIFT_CP_AVL	
use .....	6199	def .....	3699
		use .....	3638
		LV_FAC_LAM_SHIFT_CP_END [NC_CBK_EX_NR]	

def .....	2463	def .....	853
use .....	3701	LV_FIRST_VLD_TOOTH	
LV_FAC_LIM_MAX_LAM_AD_CUS [NC_CBK_EX_NR]		def .....	1505
def .....	8309	use .....	1091, 1876, 1909, 3823, 3868, 3931, 3956, 4447, 8215
use .....	1018	LV_FL	
LV_FAC_LIM_MIN_LAM_AD_CUS [NC_CBK_EX_NR]		def .....	1759
def .....	8309	use .....	1881, 1962, 2988, 3054, 3150, 3599, 3614, 4022, 4276, 5282, 5408, 7558
use .....	1018	LV_FL_RAW	
LV_FAC_LSL_GAIN_AD_LIM_MAX [NC_CBK_EX_NR]		def .....	1759
def .....	2371	use .....	8391
LV_FAC_LSL_GAIN_AD_LIM_MIN [NC_CBK_EX_NR]		LV_FLOW_TAR_COR_CP	
def .....	2371	def .....	3679
LV_FAC_MFF_ADD_EXT_ADJ_NVMY		use .....	3638, 3701
def .....	7680	LV_FPAPWM_DIAG_AFS_REQ	
use .....	7558	def .....	803
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use .....	4916	def .....	4455
LV_INH_DIAG_NS_OBD_2_ACT [NC_NOX_SENS_CONF]		use .....	4426
def .....	6468	LV_INH_DIAG_PLAUS_CAM_EX [NC_NR_CAM_CBK]	
use .....	6358	def .....	4455
LV_INH_DIAG_NS_OBD_2_AVL [NC_NOX_SENS_CONF]		use .....	4447
def .....	6468	LV_INH_DIAG_PLAUS_CAM_IN [NC_NR_CAM_CBK]	
use .....	6368	def .....	4455
LV_INH_DIAG_NS_OBD_2_DYN [NC_NOX_SENS_CONF]		use .....	4447
def .....	6468	LV_INH_DIAG_PUC_LS_DOWN [NC_CBK_EX_NR]	
use .....	6338	def .....	4252
LV_INH_DIAG_NS_OBD_2_GAIN [NC_NOX_SENS_CONF]		use .....	4276
def .....	6468	LV_INH_DIAG_PUC_LSL_UP [NC_CBK_EX_NR]	
LV_INH_DIAG_NS_OBD_2_HTP [NC_NOX_SENS_CONF]		def .....	5291
def .....	6468	use .....	5298
use .....	6330	LV_INH_DIAG_PUE_LS_DOWN [NC_CBK_EX_NR]	
LV_INH_DIAG_NS_OBD_2_OFS [NC_NOX_SENS_CONF]		def .....	5190
def .....	6468	use .....	5170
use .....	6378	LV_INH_DIAG_RBM_AIR_LSL_UP [NC_CBK_EX_NR]	
LV_INH_DIAG_NS_OBD_2_PLAUS [NC_NOX_SENS_CONF]		def .....	5285
def .....	6468	LV_INH_DIAG_RBM_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	
use .....	6321, 6347, 6389, 6396, 6405	def .....	1063
LV_INH_DIAG_NS_OBD_2_RAW [NC_NOX_SENS_CONF]		LV_INH_DIAG_RBM_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	
def .....	6468	def .....	1063
LV_INH_DIAG_NS_OBD_2_SHIFT [NC_NOX_SENS_CONF]		LV_INH_DIAG_RBM_CAT_DIAG [NC_CBK_EX_NR]	
def .....	6468	def .....	5506
use .....	6413, 6428	LV_INH_DIAG_RBM_DIAGCPS	
LV_INH_DIAG_NS_OBD_2_VERS [NC_NOX_SENS_CONF]		def .....	5954
def .....	6468	LV_INH_DIAG_RBM_DLY_LAM [NC_CBK_EX_NR]	
use .....	6313	def .....	5229
LV_INH_DIAG_NT_AGI		LV_INH_DIAG_RBM_DMTL	
def .....	6490	def .....	6037
use .....	6485	LV_INH_DIAG_RBM_DYN_VLD_LS_UP [NC_CBK_EX_NR]	
LV_INH_DIAG_NT_SO2P		def .....	5377
def .....	6490	use .....	5507
use .....	6485	LV_INH_DIAG_RBM_EFF_IGA_CST	
LV_INH_DIAG_OBD_LSH_DOWN [NC_CBK_EX_NR]		def .....	6508
def .....	5210	LV_INH_DIAG_RBM_FTL_OBD	
use .....	5199	def .....	4757
LV_INH_DIAG_OBD_LSH_UP [NC_CBK_EX_NR]		LV_INH_DIAG_RBM_FUP_CH	
def .....	5433	def .....	6102
use .....	5439	LV_INH_DIAG_RBM_ISC	
LV_INH_DIAG_OC_LS_DOWN [NC_CBK_EX_NR]		def .....	4392
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LV_INH_DIAG_RBM_LOAD_TPS_PLAUS	def .....	1063	LV_INH_DIAG_SA	def .....	803
LV_INH_DIAG_RBM_MAP_DIP_PLAUS	def .....	1063	LV_INH_DIAG_SA	use .....	5911
LV_INH_DIAG_RBM_MEC_IVVT_EX	def .....	1063	LV_INH_DIAG_SCG_LS_DOWN [NC_CBK_EX_NR]	def .....	4252
LV_INH_DIAG_RBM_MEC_IVVT_IN	def .....	1063	LV_INH_DIAG_SCG_LS_DOWN [NC_CBK_EX_NR]	use .....	4267
LV_INH_DIAG_RBM_OBD_LSH_DOWN [NC_CBK_EX_NR]	def .....	5210	LV_INH_DIAG_SCP_LS_DOWN [NC_CBK_EX_NR]	def .....	4252
LV_INH_DIAG_RBM_OBD_LSH_UP [NC_CBK_EX_NR]	def .....	5433	LV_INH_DIAG_SCP_LS_DOWN [NC_CBK_EX_NR]	use .....	4267
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LV_INH_DIAG_RBM_OC_LSL_UP [NC_CBK_EX_NR]	def .....	4309	LV_INH_DIAG_SEG_AD_ER	use .....	4367
LV_INH_DIAG_RBM_PLAUS_LSL_UP [NC_CBK_EX_NR]	def .....	5429	LV_INH_DIAG_SENS_ACR	def .....	4355
LV_INH_DIAG_RBM_PLAUS_LSL_UP [NC_CBK_EX_NR]	use .....	5340	LV_INH_DIAG_SENS_ACR	use .....	4352
LV_INH_DIAG_RBM_PUC_LS_DOWN [NC_CBK_EX_NR]	def .....	4252	LV_INH_DIAG_SLV_IVVT_EX	def .....	4627
LV_INH_DIAG_RBM_PUC_LSL_UP [NC_CBK_EX_NR]	def .....	5291	LV_INH_DIAG_SLV_IVVT_IN	def .....	4627
LV_INH_DIAG_RBM_PUE_LS_DOWN [NC_CBK_EX_NR]	def .....	5190	LV_INH_DIAG_SOF	def .....	4911
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LV_INH_DIAG_REF_CRK_CAM_EX [NC_NR_CAM_CBK]	def .....	4455	LV_INH_DIAG_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]	def .....	4456
LV_INH_DIAG_REF_CRK_CAM_EX [NC_NR_CAM_CBK]	use .....	4421	LV_INH_DIAG_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]	use .....	4447
LV_INH_DIAG_REF_CRK_CAM_IN [NC_NR_CAM_CBK]	def .....	4455	LV_INH_DIAG_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]	def .....	4456
LV_INH_DIAG_REF_CRK_CAM_IN [NC_NR_CAM_CBK]	use .....	4421	LV_INH_DIAG_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]	use .....	4447
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LV_INH_DIAG_RGN_NT_LS_DOWN [NC_CBK_EX_NR]	use .....	5143	LV_INH_DIAG_T_ES_TCO_FAST	def .....	4477
LV_INH_DIAG_RLY_ACCOUT	def .....	4627	LV_INH_DIAG_T_ES_TCO_FAST	use .....	4467
LV_INH_DIAG_RLY_CRCV_HEAT	def .....	4627	LV_INH_DIAG_T_ES_TCO_SLOW	def .....	4477
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			LV_INH_DIAG_TCO_2_EL	def .....	4578
			LV_INH_DIAG_TCO_2_EL	use .....	4572
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LV_INH_DIAG_TCO_2_PLAUS		LV_INH_DPS_REG_CPSDIAG	
def .....	5672	def .....	803
use .....	5666	use .....	8353
LV_INH_DIAG_TCO_EL		LV_INH_DYN_DIAG_PRI_MNG [NC_CBK_EX_NR]	
def .....	4502	def .....	803
use .....	4496	use .....	5379
LV_INH_DIAG_TCO_GRD		LV_INH_DYN_DIAG_S_LSL_UP [NC_CBK_EX_NR]	
def .....	4502	def .....	5332
use .....	4496	use .....	5314
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def .....	5687	def .....	803
use .....	5682	use .....	6665
LV_INH_DIAG_TCO_STUCK		LV_INH_FCUT_GS	
def .....	4502	def .....	6718
use .....	5691	use .....	6665
LV_INH_DIAG_TCO_STUCK_RNG		LV_INH_FSD_STOP_OIL	
def .....	5678	def .....	6133
use .....	5675	use .....	2722, 6142
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def .....	5660	def .....	6283
use .....	5652	use .....	6214
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def .....	4200	def .....	6095
use .....	4194	use .....	6062
LV_INH_DIAG_TIA_GRD		LV_INH_FUP_ORNG	
def .....	4200	def .....	6095
use .....	4194	use .....	6062
LV_INH_DIAG_TIA_PLAUS		LV_INH_FUP_SENS_PLAUS	
def .....	5103	def .....	6095
use .....	5093	LV_INH_FUP_ST_BOL	
LV_INH_DIAG_TOOTH_OFF_EX [NC_NR_CAM_CBK]		def .....	6095
def .....	4456	use .....	6063
use .....	4415, 4421	LV_INH_FUP_STOP	
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def .....	4456	use .....	6063
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LV_INH_DIAG_VCV		def .....	1566
def .....	4732	use .....	1149, 3779
use .....	4729	LV_INH_GS_IDC_1	
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def .....	5065	LV_INH_GS_IDC_2	
LV_INH_DIAG_VIM_2_EL		def .....	1298
def .....	5065	LV_INH_H_PRS_SYS_PRE	
LV_INH_DIAG_VS_PLAUS		def .....	6095
def .....	5035	use .....	6063
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def .....	4207	def .....	6213
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def .....	4207	def .....	4773
LV_INH_DIAG_XX		use .....	1876, 1909, 4780
use .....	4614	LV_INH_IGC_DIAG_MIS	
LV_INH_DIAGCPS		def .....	6264
def .....	5954	use .....	6239
use .....	5929, 7767	LV_INH_INJ [NC_CYL_NR]	
LV_INH_DLY_DIAG_PRI_MNG [NC_CBK_EX_NR]		def .....	2038
def .....	803	LV_INH_INJ_DIAG_IGC	

def .....	4773	use .....	2315
use .....	4780	LV_INH_MAF_DIF_ER_AD	
LV_INH_INJ_OLD		def .....	1473
def .....	2038	LV_INH_MAP_CTL_DIAGCPS	
LV_INH_INJ_UPD_MOD_UPD [NC_CYL_NR]		def .....	5926
def .....	2038	use .....	8229
LV_INH_IV_DIAG_MIS		LV_INH_MAP_DIF_DET_MIS	
def .....	6264	def .....	6213
use .....	6239	LV_INH_MIS_CRK	
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def .....	6238	use .....	1447, 4367
LV_INH_IV_OFF_DET_MIS		LV_INH_N_MAX_DET_MIS	
def .....	6225	def .....	6225
LV_INH_LAM_AD_INJ [NC_CBK_EX_NR]		LV_INH_N_MIN_DET_MIS	
def .....	3398	def .....	6225
use .....	3349	LV_INH_NOX_MDL_CTRL_RGN	
LV_INH_LAM_AD_SDL		def .....	996
def .....	3679	use .....	2988
use .....	3737	LV_INH_NOX_SENS_RGN	
LV_INH_LAM_ADJ [NC_CBK_EX_NR]		def .....	3053
def .....	2613	use .....	2988
use .....	2590	LV_INH_NT_ACT	
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def .....	7483	use .....	2988
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def .....	2579	use .....	2988
use .....	2954	LV_INH_NT_AFL_NS_READY	
LV_INH_LAMB_PULS_SO2P		def .....	3053
def .....	3176	LV_INH_NT_AGI	
use .....	3150	def .....	3107
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def .....	6213	LV_INH_NT_AGI_BAS	
LV_INH_LOAD_GRD_MAX_ER_AD		def .....	3107
def .....	1473	use .....	3074
LV_INH_LOAD_MIN_DET_MIS		LV_INH_NT_AGI_ERR	
def .....	6225	def .....	3107
LV_INH_LSCL [NC_CBK_EX_NR]		LV_INH_NT_AGI_THD	
def .....	2544	def .....	3107
use .....	2465, 8195, 8353	LV_INH_NT_AGI_TNT	
LV_INH_LSCL_CUS [NC_CBK_EX_NR]		def .....	3107
def .....	8310	LV_INH_NT_AGI_TNT_BAS	
use .....	2545	def .....	3107
LV_INH_LSH_CTL_CLL_LSH_UP [NC_CBK_EX_NR]		use .....	3074
def .....	2406	LV_INH_NT_RGN_REQ	
use .....	2386	def .....	996
LV_INH_LSH_DOWN [NC_CBK_EX_NR]		use .....	6368
def .....	2435	LV_INH_NT_RGN_STOP_MDL_DIAG [NC_NOX_SENS_CONF]	
use .....	2422	def .....	6347
LV_INH_LSH_UP [NC_CBK_EX_NR]		use .....	2988
def .....	2406	LV_INH_NT_SO2P_REQ	
use .....	2386	def .....	3144
LV_INH_LSL_GAIN_AD [NC_CBK_EX_NR]		use .....	3129
def .....	2383	LV_INH_NTL_DEC_INT_DIAG [NC_NOX_SENS_CONF]	
use .....	2372	def .....	6347
LV_INH_LSL_OFS_ADJ [NC_CBK_EX_NR]		LV_INH_OBD_DET_MIS	
def .....	2333	def .....	6283

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def .....	5113	def .....	6790
LV_INH_OBD_DIAG_CYL_BAL_LAM [NC_CBK_EX_NR]		LV_INH_TTIP_LS_UP [NC_CBK_EX_NR]	
def .....	5113	def .....	1339
use .....	2733, 2866, 5141	use .....	1321
LV_INH_OBD_ER_AD		LV_INH_VCV_PLAUS	
def .....	1469	def .....	6095
use .....	1474	use .....	6063
LV_INH_PUC_CUS		LV_INH_WIN_DET_DELTA_I_LAM [NC_CBK_EX_NR]	
def .....	8209	def .....	1007
use .....	1721, 3846	LV_INH_WUP_CYC	
LV_INH_PWL_TRAN_ES_EL		def .....	5789
def .....	3776	use .....	5746
use .....	906, 1091	LV_INJ_CONF	
LV_INH_R_IT_LS_DOWN [NC_CBK_EX_NR]		def .....	654
def .....	1379	LV_INJ_CRASH_ACT	
use .....	1365	def .....	3330
LV_INH_RGN_AD		use .....	2042
def .....	996	LV_INJ_CUT	
use .....	2988	def .....	2295
LV_INH_RGN_REQ		use .....	1474, 6226
def .....	3053	LV_INJ_DEAC_BACK_ENG	
use .....	996, 2988	def .....	2038
LV_INH_RGN_REQ_NOX_SENS		LV_INJ_DI_PLS_UPD_MPLH	
def .....	3053	def .....	2146
use .....	2988	use .....	2042
LV_INH_RGN_REQ_NTLD		LV_INJ_MOD_UPD	
def .....	3053	def .....	2038
use .....	2988	LV_INJ_MPLP_CYL [NC_CYL_NR]	
LV_INH_S		def .....	2038
def .....	1822	LV_INJ_OFF_TMR_INJ_ENA	
use .....	2988, 8137, 8353	def .....	7158
LV_INH_S_MAN		use .....	2042, 4794, 4810
def .....	803	LV_INJ_OFF_TMR_INJ_ENA_TMP	
use .....	1822	def .....	7072
LV_INH_SDL_CP		use .....	7158
def .....	3737	LV_INJ_PLS_UPD_MPLH_DEAC	
LV_INH_SENS_DLY_DIAG [NC_CBK_EX_NR]		def .....	2146
def .....	5377	LV_INJ_PUC_ENA	
use .....	5259	def .....	3330
LV_INH_ST_DET_MIS		use .....	2295
def .....	6225	LV_INJ_REST_ENA	
LV_INH_STST_CDN		def .....	2038
def .....	8286	LV_INJ_UPD_CLC_ENA	
use .....	1584	def .....	2038
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def .....	6225	def .....	6790
LV_INH_TD_AD		LV_INTR_DIAG_ECRAS_EL	
def .....	937	def .....	4515
use .....	932	LV_INTR_DIAG_LS_DYN [NC_CBK_EX_NR]	
LV_INH_TD_MPL		def .....	803
def .....	1896	use .....	5350
use .....	1881	LV_IPLSL_COR_MMV_FCUT_VLD [NC_CBK_EX_NR]	
LV_INH_TPS_GRD_DET_MIS		def .....	2371
def .....	6213	LV_IPLSL_CTL_ENA_LSL_IF [NC_CBK_EX_NR]	
LV_INH_TPS_GRD_ER_AD		def .....	2351

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LV_IPLSL_CTL_ENA_PLS_ACT [NC_CBK_EX_NR]		LV_IV_EGY_RNG_3	
def .....	2351	def .....	2261
use .....	5248	use .....	6761
LV_IPLSL_CTL_INH_VNLSL_LIM [NC_CBK_EX_NR]		LV_IV_EXT_ADJ [NC_CYL_NR]	
def .....	2351	def .....	7434
LV_IPLSL_CTL_INH_VPLSL_LIM [NC_CBK_EX_NR]		LV_IV_MES_VLD	
def .....	2351	def .....	2038
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def .....	4290	LV_IV_OFF_DET_MIS	
use .....	4294	def .....	6225
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def .....	2351	def .....	2038
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def .....	2351	def .....	2179
use .....	1342, 2315, 2335, 2372, 2465, 2866, 3054, 4301, 5238, 5282, 5298, 5350, 5422, 7315	use .....	2004, 2042, 2262
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def .....	3512	def .....	1269
use .....	3514	use .....	1584, 6737, 7558
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def .....	3512	def .....	1566
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def .....	5093	def .....	906
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def .....	5753	def .....	1566
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def .....	1112	def .....	1961
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LV_IV_EGY_POST_MON		LV_KNK_CTL_PRE_INH	
def .....	6760	def .....	1961
LV_IV_EGY_RNG_1		LV_KNK_MAX	
def .....	2261	def .....	1961
use .....	6761	LV_KNK_PAS_TRAN_ACT	
LV_IV_EGY_RNG_2		def .....	1962
def .....	2261	LV_KNK_PRE	
		def .....	1962
		use .....	1953, 4909
		LV_KNK_TRA_MAF	
		def .....	1962
		LV_KNK_TRA_N	

def .....	1962	LV_LAM_AD_INJ_CLR_AD_EXT	
use .....	8304, 8353	def .....	7483
LV_KNKWE_PRE_GAP		use .....	3349, 3380, 3406
def .....	1962	LV_LAM_AD_INJ_COLD_END [NC_CBK_EX_NR]	
LV_KWP_ENA		def .....	3379
def .....	7680	use .....	3349
LV_KWP_PROG_DATA		LV_LAM_AD_INJ_CUS_ACK [NC_CBK_EX_NR]	
def .....	803	def .....	8269
use .....	7738	use .....	3332, 3380
LV_LAM_ACT_DC [NC_CBK_EX_NR]		LV_LAM_AD_INJ_EXT_ENA	
def .....	2448	def .....	3349
LV_LAM_AD_ACT [NC_CBK_EX_NR]		use .....	7484
def .....	2721	LV_LAM_AD_INJ_HOT_END [NC_CBK_EX_NR]	
use .....	2643	def .....	3379
LV_LAM_AD_ACT_ERR [NC_CBK_EX_NR]		use .....	3349
def .....	2721	LV_LAM_AD_INJ_INTR	
LV_LAM_AD_AFS_REQ		def .....	3349
def .....	2642	use .....	3380, 3406
LV_LAM_AD_CDN		LV_LAM_AD_INJ_INTR_2 [NC_CBK_EX_NR]	
def .....	2642	def .....	3349
use .....	1018, 3737	use .....	3380, 3406
LV_LAM_AD_CDN_ADD [NC_CBK_EX_NR]		LV_LAM_AD_INJ_INTR_LAM	
def .....	2721	def .....	3349
use .....	2643	use .....	3380, 3406
LV_LAM_AD_CDN_H_RNG [NC_CBK_EX_NR]		LV_LAM_AD_INJ_MV_CLC_END [NC_CBK_EX_NR]	
def .....	2721	def .....	3405
use .....	2643	use .....	3349, 3380
LV_LAM_AD_CDN_L_RNG [NC_CBK_EX_NR]		LV_LAM_AD_INJ_PHA_0 [NC_CBK_EX_NR]	
def .....	2721	def .....	3379
use .....	2643	LV_LAM_AD_INJ_REP	
LV_LAM_AD_DEAC_ERR [NC_CBK_EX_NR]		def .....	3349
def .....	2721	use .....	3380
use .....	2643, 2679, 8310	LV_LAM_AD_STOP [NC_CBK_EX_NR]	
LV_LAM_AD_ENA		def .....	2642
def .....	3737	use .....	4044, 4068
use .....	2643, 2722, 4068, 7767	LV_LAM_AD_STOP_CBK_EX	
LV_LAM_AD_END		def .....	2642
def .....	2642	LV_LAM_AD_WUP_ACT [NC_CBK_EX_NR]	
use .....	1018, 3737, 7767	def .....	2721
LV_LAM_AD_END_CBK [NC_CBK_EX_NR]		use .....	2679
def .....	2642	LV_LAM_AD_WUP_CHG_FQ_DET [NC_CBK_EX_NR]	
use .....	4068	def .....	2677
LV_LAM_AD_EXT		LV_LAM_AD_WUP_STOP [NC_CBK_EX_NR]	
def .....	1016	def .....	2678
use .....	2465, 2722, 3681, 6199, 8310	LV_LAM_ADJ_ACT [NC_CBK_EX_NR]	
LV_LAM_AD_EXT_ADJ		def .....	2589
def .....	7763	use .....	2613, 6428
use .....	3681	LV_LAM_ADJ_ACT_FAST_LAM_LSCL [NC_CBK_EX_NR]	
LV_LAM_AD_INJ_ACT		def .....	2613
def .....	3348	use .....	2590
use .....	2333, 2546, 2613, 2722, 2866	LV_LAM_ADJ_AD_CDN_OK [NC_CBK_EX_NR]	
LV_LAM_AD_INJ_ACT_COLD [NC_CBK_EX_NR]		def .....	2627
def .....	3348	use .....	2622
use .....	3380, 3406	LV_LAM_ADJ_AD_END [NC_CBK_EX_NR]	
LV_LAM_AD_INJ_ACT_HOT [NC_CBK_EX_NR]		def .....	2589
def .....	3349	use .....	2622
use .....	3380	LV_LAM_ADJ_AD_REQ [NC_CBK_EX_NR]	



def .....	2622	LV_LAM_CYL_SEL_CTL_FAST_REQ	def .....	2864
use .....	2590	LV_LAM_CYL_SEL_CTL_FAST_REQ	use .....	2733
LV_LAM_ADJ_CAT_DIAG [NC_CBK_EX_NR]		LV_LAM_CYL_SEL_LDC [NC_CBK_EX_NR]	def .....	2882
def .....	5473	LV_LAM_CYL_SEL_LDC [NC_CBK_EX_NR]	use .....	2866
use .....	2590, 2613, 2627, 6469	LV_LAM_CYL_SEL_SEG_REF_CLL [NC_CBK_EX_NR]	def .....	2732
LV_LAM_ADJ_D_ACT [NC_CBK_EX_NR]		LV_LAM_DI_REQ [NC_CBK_EX_NR]	def .....	5389
def .....	2589	LV_LAM_DI_REQ [NC_CBK_EX_NR]	use .....	2465
use .....	1018	LV_LAM_DIAGCPS	def .....	5926
LV_LAM_ADJ_I_ACT [NC_CBK_EX_NR]		LV_LAM_DIAGCPS	def .....	5926
def .....	2589	LV_LAM_GAIN_EXT	def .....	2463
use .....	1018, 2627, 5217	LV_LAM_GAIN_EXT	def .....	2463
LV_LAM_ADJ_LAM_AD_CUS_ENA		LV_LAM_GAIN_LS_DIAG	def .....	2463
def .....	8310	LV_LAM_GAIN_LS_DIAG	use .....	5350
LV_LAM_ADJ_NS_SHIFT_DIAG [NC_CBK_EX_NR]		LV_LAM_GAIN_SWI	def .....	2544
def .....	3191	LV_LAM_GAIN_SWI	use .....	2465
LV_LAM_ADJ_P_ACT [NC_CBK_EX_NR]		LV_LAM_I2_ACT	def .....	2463
def .....	2589	LV_LAM_I2_ACT	def .....	2463
use .....	1018, 5217	LV_LAM_LIM_CP	def .....	1540
LV_LAM_ADJ_REQ_DYN_LSL_UP [NC_CBK_EX_NR]		LV_LAM_LIM_LAM_AD [NC_CBK_EX_NR]	def .....	6141
def .....	5348	LV_LAM_LIM_LAM_AD [NC_CBK_EX_NR]	use .....	2722, 3681, 8310
use .....	2590, 2613	LV_LAM_LSCL [NC_CBK_EX_NR]	def .....	2463
LV_LAM_ADJ_RNG_VLD_CAT_DIAG [NC_CBK_EX_NR]		LV_LAM_LSCL [NC_CBK_EX_NR]	use .....	1018, 1541, 2448, 2590, 2679, 2722, 2733, 2866, 2954, 3681, 4254, 4763, 5389, 5416, 5459, 6063, 6133, 7558
def .....	1037	LV_LAM_MV_LDC_DLY [NC_CBK_EX_NR]	def .....	2633
use .....	5459	LV_LAM_MV_LDC_DLY [NC_CBK_EX_NR]	def .....	2633
LV_LAM_COR_LIM_INTR [NC_CBK_EX_NR]		LV_LAM_NOT_STAT_CDN	def .....	2448
def .....	1016	LV_LAM_NOT_STAT_CDN	use .....	2465
LV_LAM_CYL_ACT [NC_CBK_EX_NR]		LV_LAM_ORNG_LAM_AD_REQ [NC_CBK_EX_NR]	def .....	6141
def .....	2732	LV_LAM_ORNG_LAM_AD_REQ [NC_CBK_EX_NR]	use .....	3261
LV_LAM_CYL_DEAC_VIM		LV_LAM_OUT_CP	def .....	1540
def .....	2864	LV_LAM_OUT_CP	def .....	1540
LV_LAM_CYL_ENA [NC_CBK_EX_NR]		LV_LAM_STOP [NC_CBK_EX_NR]	def .....	1016, 2448
def .....	2864	LV_LAM_STOP [NC_CBK_EX_NR]	use .....	1541, 2465, 2590, 2643, 2679, 2722, 2954, 4763, 5276, 5416, 5459
use .....	973, 999, 2733, 8188	LV_LAM_STOP_AE	def .....	988
LV_LAM_CYL_ENA_CYL_BAL_DC [NC_CBK_EX_NR]		LV_LAM_STOP_REQ [NC_CBK_EX_NR]	def .....	2545
def .....	2864	LV_LAM_STOP_REQ [NC_CBK_EX_NR]	use .....	2448
use .....	4044	LV_LAM_STOP_SHO_PER [NC_CBK_EX_NR]	def .....	2448
LV_LAM_CYL_SEL_ADJ_H_RNG_VLD [NC_CBK_EX_NR]		LV_LAM_STOP_SHO_PER [NC_CBK_EX_NR]	use .....	1541, 2465, 2590, 5420
def .....	2732	LV_LAM_STOP_SHO_PER_CDN [NC_CBK_EX_NR]	def .....	5420
use .....	7484	LV_LAM_STOP_SHO_PER_CDN [NC_CBK_EX_NR]	def .....	5420
LV_LAM_CYL_SEL_ADJ_L_RNG_VLD [NC_CBK_EX_NR]				
def .....	2732			
use .....	7484			
LV_LAM_CYL_SEL_ADJ_OFS_EXT_REQ				
def .....	999			
use .....	2866			
LV_LAM_CYL_SEL_ADJ_OFS_REQ [NC_CBK_EX_NR]				
def .....	2864			
use .....	2733			
LV_LAM_CYL_SEL_ADJ_RST_IV_EXT [NC_CBK_EX_NR]				
def .....	7483			
use .....	2733			
LV_LAM_CYL_SEL_ADJ_VLD [NC_CBK_EX_NR]				
def .....	2732			
use .....	4044, 4068			
LV_LAM_CYL_SEL_CTL_DRIFT_PRED [NC_CBK_EX_NR]				
def .....	2732			
use .....	2840, 2866			

use .....	5416	LV_LAMB_OHP [NC_CBK_EX_NR]	def .....	1016
LV_LAM_STOP_SHO_PER_REQ [NC_CBK_EX_NR]		use .....	2590	
def .....	2545	LV_LAMB_PARK_AFL_DEAC	def .....	2885
use .....	2448	LV_LAMB_PLAUS_FTL_MIN_DIAG_TMP	def .....	4762
LV_LAM_SUM_DIAGCPS		LV_LAMB_PLS_ACT [NC_CBK_EX_NR]	def .....	2954
def .....	5927	use .....	2315, 2439, 2546, 2563, 2590, 2627, 2958, 5238, 5277, 5350, 5459	
LV_LAM_THD		LV_LAMB_PLS_ACT_CAT_PURGE [NC_CBK_EX_NR]	def .....	2954
def .....	3728	LV_LAMB_PLS_AFL_COR_ACT [NC_CBK_EX_NR]	def .....	2558
LV_LAMB_AFS_AMP_CP		LV_LAMB_PLS_AFR_COR_ACT [NC_CBK_EX_NR]	def .....	2558
def .....	3700	LV_LAMB_PLS_LS_DIAG	def .....	2579
LV_LAMB_AFS_CP		use .....	5350	
def .....	3700	LV_LAMB_PLS_MST_CBK [NC_CBK_EX_NR]	def .....	2563
use .....	8229	LV_LAMB_PLS_O2L_OSC_POS [NC_CBK_EX_NR]	def .....	2563
LV_LAMB_AFS_T_AST_CP		LV_LAMB_PLS_REQ_CAT_DIAG [NC_CBK_EX_NR]	def .....	5473
def .....	3700	use .....	2958	
LV_LAMB_CH		LV_LAMB_PLS_REQ_DIAG_LSH_UP [NC_CBK_EX_NR]	def .....	5438
def .....	803	LV_LAMB_PLS_REQ_DYN_LSL_UP [NC_CBK_EX_NR]	def .....	5348
use .....	8353	LV_LAMB_PLS_REQ_EXT	def .....	2579
LV_LAMB_COP [NC_CBK_EX_NR]		use .....	2958	
def .....	8233	LV_LAMB_PLS_SWI_OFF [NC_CBK_EX_NR]	def .....	2313
use .....	1018, 2546, 2866, 5408, 6582	LV_LAMB_PLS_SWI_OFF [NC_CBK_EX_NR]	use .....	1008
LV_LAMB_COP_CUS [i]		LV_LAMB_PLS_SYN_CBK	def .....	2563
def .....	2195	use .....	2958	
LV_LAMB_CYL_SEL_CQ_DRIFT [NC_CBK_EX_NR]		LV_LAMB_PULS_DYN_DIAG	def .....	1007
def .....	2732	LV_LAMB_RANGE_SNG [NC_CBK_EX_NR]	def .....	6396
LV_LAMB_DELTA_AD_LAM_ADJ_CLC [NC_CBK_EX_NR]		LV_LAMB_REQ_DEAC_NS [NC_NOX_SENS_CONF]	def .....	6426
def .....	2613	LV_LAMB_SP_AFL_REQ_DIAG_ACT [NC_CBK_EX_NR]	def .....	5389
use .....	2622	def .....	5389	
LV_LAMB_DELTA_AD_LAM_ADJ_EXT		use .....	5422	
def .....	2613	LV_LAMB_SP_AFL_THD [NC_CBK_EX_NR]	def .....	2545
LV_LAMB_DELTA_I_LAM_ADJ_DEAC [NC_CBK_EX_NR]		LV_LAMB_SP_AFR_REQ_DIAG_ACT [NC_CBK_EX_NR]	def .....	5389
def .....	2613	def .....	5389	
use .....	2590	use .....	5422	
LV_LAMB_DIF_AFL_ACT		LV_LAMB_SP_AFR_THD [NC_CBK_EX_NR]	def .....	2545
def .....	1016	LV_LAMB_SP_CH_ACT_CAT_PURGE [NC_CBK_EX_NR]	def .....	2545
LV_LAMB_LS_UP_ESTIM [NC_CBK_EX_NR]				
def .....	2352			
LV_LAMB_LS_UP_LDC				
def .....	6320			
LV_LAMB_LS_UP_LDC_SNG [NC_CBK_EX_NR]				
def .....	6320			
LV_LAMB_LS_UP_VLD [NC_CBK_EX_NR]				
def .....	2352			
use .....	2372, 4763, 6469, 6796, 7767, 8195			
LV_LAMB_LS_UP_VLD_MON [NC_CBK_EX_NR]				
def .....	6790			
use .....	6777, 6870, 6943			
LV_LAMB_NOT_PLAUS_SNG [NC_CBK_EX_NR]				
def .....	6396			
LV_LAMB_NS_AUTH [NC_NOX_SENS_CONF]				
def .....	991			
LV_LAMB_NS_DIAG_VLD [NC_NOX_SENS_CONF]				
def .....	991			
use .....	6389, 6396, 6405			
LV_LAMB_NS_VLD [NC_NOX_SENS_CONF]				
def .....	991			
use .....	6347			

def .....	2912	use .....	6615, 6985
LV_LAMB_SP_DIAG_AFL_PARK [NC_CBK_EX_NR]		LV_LDM_OFF	
def .....	5589	def .....	8286
LV_LAMB_SP_EXT_ADJ [NC_CBK_EX_NR]		LV_LDM_OFF_ECU	
def .....	7763	def .....	5054
LV_LAMB_SP_REQ_DIAG_ACT [NC_CBK_EX_NR]		use .....	1584, 6615, 6985
def .....	2437	LV_LDM_OFF_ECU_1	
use .....	1008, 8195	def .....	5054
LV_LAMB_SP_SWI		LV_LDM_OFF_ECU_1_MON	
def .....	2885	def .....	6983
use .....	5589	LV_LDM_OFF_ECU_2	
LV_LAMB_STI_OFF_LSL_OFS_ADJ [NC_CBK_EX_NR]		def .....	5054
def .....	2313	LV_LDM_OFF_ECU_2_MON	
use .....	2352, 2579	def .....	6983
LV_LAMB_VLD_AFR_SNG [NC_CBK_EX_NR]		LV_LDM_OFF_ECU_MON	
def .....	6389	def .....	6983
LV_LAMB_VLD_PUC		LV_LDM_PUC_INH	
def .....	6405	def .....	6615
LV_LAMB_VLD_PUC_SNG [NC_CBK_EX_NR]		use .....	1721, 3846, 6665
def .....	6405	LV_LEVEL_IS	
LV_LAMB_VLD_TMP		def .....	1566
def .....	6396	LV_LIH_COC_ON	
LV_LDC_DLY [NC_CBK_EX_NR]		def .....	8225
def .....	2633	use .....	1584
use .....	2613	LV_LIH_ERR_CAM	
LV_LDC_LAM_AD [NC_CBK_EX_NR]		def .....	1505
def .....	2721	LV_LIH_ERR_CRK	
use .....	1541, 2679	def .....	1505
LV_LDC_LAM_AD_INJ [NC_CBK_EX_NR]		use .....	1447, 3398, 4432
def .....	3349	LV_LOAD_GRD_CAT_LDC	
LV_LDC_LAM_ADJ [NC_CBK_EX_NR]		def .....	5542
def .....	2613	LV_LOAD_H	
use .....	2590, 2627, 5277	def .....	3053
LV_LDM_ACT		use .....	2988
def .....	6615	LV_LOAD_IS_CDN_TIA_PLAUS	
use .....	5022, 6665, 6985	def .....	5093
LV_LDM_BRAKE_PLAUS_ERR		LV_LOAD_RESP_ALTER_CND_1	
def .....	5054	def .....	4094
use .....	6615	use .....	8353, 8370
LV_LDM_CAN_INI		LV_LOAD_RESP_ALTER_THD_ACT	
def .....	1566	def .....	4095
use .....	5054, 6985	use .....	8370
LV_LDM_DISABLE_CAN		LV_LOAD_RESP_ALTER_THD_ACT_SP	
def .....	6615	def .....	8368
LV_LDM_DRIV_ACT		use .....	4096, 8353
def .....	8286	LV_LOAD_VLD [NC_CBK_EX_NR]	
use .....	6737	def .....	2678
LV_LDM_ENA		LV_LOCK_IMOB	
def .....	6615	use .....	1909, 4149, 7391, 7553
use .....	1270, 6706, 6737, 8292	LV_LOIL_VLD_WR	
LV_LDM_ENA_PLAUS_ERR		def .....	8202
def .....	5054	LV_LOST_SYN_CRK	
use .....	6615, 6985	def .....	853
LV_LDM_LIH		use .....	1506, 4432
def .....	6615	LV_LS_CBK_LAM_CYL_SEL_CONF_VLD	
LV_LDM_LIH_CAN		def .....	2864
def .....	1566	LV_LS_DIAG_MNG_PRIO_CAT_ACT	

def .....	5348	def .....	2335
LV_LS_DIAG_MNG_PRIO_CAT_END		use 1008, 1321, 2315, 2352, 2372, 5277, 5439, 7558	
def .....	5348	LV_LS_UP_READY_CDN [NC_CBK_EX_NR]	
LV_LS_DIAG_MNG_PRIO_DLY_ACT		def .....	2335
def .....	5348	use .....	1321, 2315, 2352, 2386
LV_LS_DIAG_MNG_PRIO_DLY_END		LV_LS_UP_READY_RAW [NC_CBK_EX_NR]	
def .....	5348	def .....	2335
LV_LS_DIAG_MNG_PRIO_DLY_REQ		use .....	1321
def .....	5349	LV_LSCL [NC_CBK_EX_NR]	
LV_LS_DIAG_MNG_PRIO_DYN_ACT		def .....	1016
def .....	5349	LV_LSH_CTL_CLL_LSH_UP [NC_CBK_EX_NR]	
LV_LS_DIAG_MNG_PRIO_DYN_END		def .....	2385
def .....	5349	LV_LSH_DOWN_OFF_REQ [NC_CBK_EX_NR]	
LV_LS_DIAG_MNG_PRIO_DYN_REQ		def .....	8220
def .....	5349	LV_LSH_NS_OFF_REQ	
LV_LS_DIAG_MNG_PRIO_EXT		def .....	8220
def .....	5377	LV_LSH_SCG_ACT_LSH_UP [NC_CBK_EX_NR]	
use .....	5350	def .....	4315
LV_LS_DIAG_REQ_INH_CAT_DIAG		LV_LSH_UP_MAN_ACT [NC_CBK_EX_NR]	
def .....	5349	def .....	2385
use .....	5507	use .....	1321, 2315, 2352
LV_LS_DIAG_REQ_INH_CAT_DIAG_EXT		LV_LSH_UP_OFF_REQ [NC_CBK_EX_NR]	
def .....	5377	def .....	8220
use .....	5350	LV_LSHPWM_DOWN_EXT_ADJ [NC_CBK_EX_NR]	
LV_LS_DOWN_DIAG_END [NC_CBK_EX_NR]		def .....	7434
def .....	5449	use .....	2435
use .....	5515, 5635	LV_LSHPWM_UP_EXT_ADJ [NC_CBK_EX_NR]	
LV_LS_DOWN_OBD_1_MAN_DEAC [NC_CBK_EX_NR]		def .....	7434
def .....	5449	use .....	2406
use .....	4247, 4254	LV_LSL_DEAC [NC_CBK_EX_NR]	
LV_LS_DOWN_OBD_2_MAN_DEAC [NC_CBK_EX_NR]		def .....	955
def .....	5449	use .....	1322, 2335, 2352
use .....	5148	LV_LSL_DIAG_LSH_LSL_UP_DEAC	
LV_LS_DOWN_OBD_MAN_DEAC_EXT		def .....	5273
def .....	5457	use .....	970, 5277
use .....	5450	LV_LSL_ENA_LSL_IF [NC_CBK_EX_NR]	
LV_LS_DOWN_READY [NC_CBK_EX_NR]		def .....	1318
def .....	2416	use .....	1313
use 1008, 2422, 2465, 2590, 2928, 4267, 4276, 5143, 5152, 5170, 5199, 5238, 5422, 5459, 7315, 7558, 7767		LV_LSL_FCUT_MES_NOT_PLAUS [NC_CBK_EX_NR]	
LV_LS_DOWN_READY_DEAC [NC_CBK_EX_NR]		def .....	2371
def .....	2416	LV_LSL_FCUT_MES_REP_INH [NC_CBK_EX_NR]	
LV_LS_UP_DIAG_END [NC_CBK_EX_NR]		def .....	2371
def .....	5449	LV_LSL_FIRST_GAIN_AD [NC_CBK_EX_NR]	
use .....	5515, 5635	def .....	2372
LV_LS_UP_OBD_1_MAN_DEAC [NC_CBK_EX_NR]		LV_LSL_GAIN_AD_FCUT_NOT_OK [NC_CBK_EX_NR]	
def .....	5449	def .....	2372
use .....	4288, 4290, 4309, 4314, 5292	LV_LSL_GAIN_AD_REQ [NC_CBK_EX_NR]	
LV_LS_UP_OBD_2_MAN_DEAC [NC_CBK_EX_NR]		def .....	2372
def .....	5449	LV_LSL_GAIN_AD_REQ_VLD [NC_CBK_EX_NR]	
use .....	5161, 5191, 5230, 5245, 5255, 5286, 5379, 5408, 5420, 5430, 5433	def .....	2372
LV_LS_UP_OBD_MAN_DEAC_EXT		LV_LSL_IF_RST [NC_CBK_EX_NR]	
def .....	5457	def .....	1318
use .....	5450	use .....	956
LV_LS_UP_READY [NC_CBK_EX_NR]		LV_LSL_IF_SPI_RST_END [NC_CBK_EX_NR]	
		def .....	1313
		use .....	1322, 2315, 2352, 4285, 4294
		LV_LSL_OFS_ACT_AST [NC_CBK_EX_NR]	


def .....	2313	LV_MAF_INT_NT_AGI_0	
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def .....	2313	LV_MAF_LDC_DLY	
use .....	1322, 2352, 5248	def .....	2633
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def .....	5248	def .....	1192
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def .....	2313	LV_MAF_SP_TQI_DYW_DIAGCPS	
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def .....	1007	use .....	7767
LV_LSL_OFS_PULS_2		LV_MAP_CONF	
def .....	1007	use .....	1195
LV_LSL_UP_ERR_SUSP [NC_CBK_EX_NR]		LV_MAP_CTL	
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def .....	2313	LV_MAP_DIF_DIAGCPS_1	
use .....	2448	def .....	5927
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def .....	4293	def .....	981
use .....	956	use .....	2372
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def .....	4820	LV_MC_COM_ERR_CPL	
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def .....	1211	LV_MC_DR_OFF	
use .....	1195	def .....	7072
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def .....	6493	LV_MC_DR_OFF_CPL	
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def .....	2545	def .....	7049
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use .....	7073	use .....	6142
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use .....	7073	use .....	6199
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use .....	4006	use .....	1584, 5827, 5899
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use .....	3269	use .....	5899
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use .....	3399, 4022, 5840, 6264, 6368	use .....	1149, 8218
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use .....	3177	use .....	6347
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use .....	3129	def .....	1566
LV_NT_SO2P_INH_IS		use .....	1584
def .....	3129	LV_OBD_TAM_RCV	
LV_NT_STC_MAX_AFL_ACT		def .....	1566
def .....	996	LV_OFF_IV_MON	
use .....	2988	def .....	6877
LV_NT_STST		use .....	2295
def .....	3053	LV_OFF_IV_MON2	
use .....	2988	def .....	7011
LV_NT_TOUT_AFR		LV_OFF_IV_N_LIM_ETC_MON	
def .....	996	def .....	6790
use .....	6347	use .....	6877
LV_NTL_DEC_INT_AFR		LV_OFF_IV_N_LIM_ETC_MON2	
def .....	2983	def .....	7012
LV_NTL_DEC_INT_STOP_RGN		LV_OFF_IV_N_LIM_ETC_TMP_MON	
def .....	2983	def .....	6877
LV_NTLD_ADJ		LV_OFF_IV_N_LIM_ETC_TMP_MON2	
def .....	3053	def .....	7012
use .....	2988	LV_OFF_MTC_MON	
LV_NVMY_CUS_WRG		def .....	6877
use .....	1087	use .....	6565, 6742
LV_O2L_AFL_CDN_MAT [NC_CBK_EX_NR]		LV_OFF_MTC_MON2	
def .....	5561	def .....	7012
LV_O2L_CAT_DIAG_AFL [NC_CBK_EX_NR]		LV_OIL_CNS_WARN_1	
def .....	5561	def .....	8286
LV_O2L_CAT_DIAG_AFL_SUM		use .....	1584
def .....	5561	LV_OIL_CNS_WARN_2	
LV_O2L_CLC_ACT_CDN [NC_CBK_EX_NR]		def .....	8287
def .....	5553	use .....	1584
use .....	5563, 5589, 5608	LV_OPG_ACR_INI_REQ	
LV_O2L_CLC_ACT_CMB_CDN		def .....	4345
def .....	5553	use .....	1097
LV_O2L_CLC_ACT_LDC_TEMP_TMP [NC_CBK_EX_NR]		LV_OPG_SP_ACR_EXT_ADJ	
def .....	5553	def .....	7434
LV_O2L_CLC_ACT_MAF_INT [NC_CBK_EX_NR]		use .....	3576
def .....	5553	LV_OPG_SP_AD_ACR	
LV_O2L_CLC_ACT_OPP_TMP		def .....	4320
def .....	5553	use .....	3573, 3576
LV_O2L_CLC_ACT_TCO_TMP		LV_OPG_SP_EXT_ACR	
def .....	5553	def .....	3576
LV_O2L_CLC_ACT_TEMP_TMP [NC_CBK_EX_NR]		use .....	3573
def .....	5553	LV_OPG_SP_LIH_ACR	
LV_O2L_CLC_LOAD [NC_CBK_EX_NR]		def .....	3576
def .....	5607	use .....	3573
LV_O2L_CLC_PARK [NC_CBK_EX_NR]		LV_OPG_SP_POP_ACR	
def .....	5607	def .....	3576
LV_O2L_CLC_READY [NC_CBK_EX_NR]		use .....	3573
def .....	5562	LV_OPM_AV_CNG_DIAGCPS	
LV_O2L_CLC_RGN_H_AMPL [NC_CBK_EX_NR]		def .....	5927
def .....	5607	LV_OPM_AV_DIAGCPS_P_THR	


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def .....	5927	def .....	7434
LV_OPM_SEL_TQ_IS_AD_1		use .....	8204
def .....	3518	LV_POIL_SWI	
LV_OPM_SEL_TQ_IS_AD_2		def .....	903
def .....	3518	use .....	1584, 4357, 7315
LV_ORNG_CAM_SYN_CRK		LV_POIL_SWI_CUS	
def .....	871	def .....	8202
use .....	1506, 4447, 4456	use .....	903
LV_ORNG_NR_TOOTH_CRK		LV_POIL_SWI_SUB	
def .....	853	def .....	903
use .....	4432	LV_POST_INJ_ACT	
LV_ORNG_PER_CAM_EX [NC_NR_CAM_CBK]		def .....	2179
def .....	871	use .....	2042, 6796
use .....	4426	LV_POW_CLAS_VEH_CAN_RCV	
LV_ORNG_PER_CAM_IN [NC_NR_CAM_CBK]		def .....	1567
def .....	871	use .....	4945
use .....	4426	LV_POW_CLAS_VEH_CAN_REQ	
LV_ORNG_RATIO_CAM_EX [NC_NR_CAM_CBK]		def .....	4945
def .....	871	use .....	1584
use .....	1506, 4426	LV_POW_CORD_INH	
LV_ORNG_RATIO_CAM_IN [NC_NR_CAM_CBK]		use .....	6580
def .....	871	LV_POW_IBS_ERR_DET_CDN	
use .....	1506, 4426	def .....	804
LV_ORNG_TOOTH_PER_CRK		LV_POW_MNG_BAT_CHG	
def .....	853	def .....	7483
use .....	4432, 4456	use .....	8370
LV_PAS_RAMP_ACT_I_CHG_MON		LV_POW_MNG_HIS_RST	
def .....	6790	def .....	7680
use .....	6870, 6922	use .....	8370
LV_PAS_RAMP_ACT_I_IS		LV_POW_MNG_MES_MOD	
def .....	3440	def .....	7483
use .....	7315	use .....	7544, 7738, 8370
LV_PAS_RAMP_ACT_P_D_CHG_MON		LV_PROG_STEP_1	
def .....	6791	def .....	7201
use .....	6870, 6922	use .....	1584, 7220
LV_PAS_RAMP_ACT_P_D_IS		LV_PROG_STEP_IF_ACT	
def .....	3440	def .....	7201
LV_PIN_ICH		LV_PRS_COR_MPLH_ENA	
def .....	988	def .....	3331
use .....	3797, 3823	use .....	2004
LV_PL		LV_PRS_COR_MPLH_ENA_CUS	
def .....	1720	def .....	8270
use .....	1105, 1123, 1766, 1881, 2307, 3150, 3501, 3599, 5282, 5666, 5971, 6358, 6494, 6675, 6742, 7767	use .....	3332
LV_PLAUS_ASR_CTL		LV_PRS_COR_SNGH_ENA	
def .....	1567	def .....	3331
use .....	7215	use .....	2004
LV_PLAUS_ESP_CTL		LV_PRS_COR_SNGH_ENA_CUS	
def .....	1567	def .....	8270
use .....	7215	use .....	3333
LV_POIL_EXT_ADJ_ACT		LV_PSTE_2_DISABLE	
def .....	7763	def .....	6621
use .....	6796	use .....	1123
LV_POIL_PWM_EXT_ADJ		LV_PSTE_2_DISABLE_CAN	
def .....	7434	def .....	6621
use .....	8204	LV_PSTE_2_ENA	
LV_POIL_SP_EXT_ADJ		def .....	6621
		use .....	6796

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LV_PSTE_2_ERR		LV_PUMP_AMT_ON	
def .....	1567	def .....	1567
use .....	6623	LV_PUMP_PRE_RUN_STOP	
LV_PSTE_3_DISABLE		def .....	3822
def .....	6621	LV_PUT_DIAG_ENG_RUN	
use .....	1123	def .....	4830
LV_PSTE_3_DISABLE_CAN		LV_PV_AV_LIM_ACT	
def .....	6621	def .....	4216
LV_PSTE_3_ENA		LV_PV_GRD_NS_DIAG	
def .....	6621	def .....	6468
use .....	6796	LV_PVS_BLS_NOT_PLAUS_ACT	
LV_PSTE_3_INTV		def .....	4216
def .....	1567	use .....	1270
LV_PSTE_DISABLE		LV_PWL	
def .....	6621	def .....	988
use .....	1123	use .....	5746, 5858, 5899, 6063, 8310
LV_PSTE_DISABLE_CAN		LV_PWL_ACT	
def .....	6621	def .....	3776
LV_PSTE_ENA		use .....	989, 4467
def .....	6621	LV_PWL_ACT_MEM	
use .....	6796	def .....	4466
LV_PU		LV_PWL_CWP	
def .....	1720	use .....	7315
use 1105, 1542, 1759, 1881, 2307, 2315, 2988, 3150,		LV_PWL_LOCK_CDN_CUS_INH	
3501, 3792, 3868, 4903, 5971, 6368, 6396, 6494,		def .....	7483
6582, 6597, 6675, 6742, 8209		use .....	8370
LV_PUC		LV_PWL_LOCK_CDN_HPDI	
def .....	1720	def .....	3954
use 1105, 1302, 1542, 1584, 1759, 1881, 2195, 2295,		LV_PWM_ACR_OFF_REQ	
2307, 2315, 2335, 2372, 2409, 2416, 2442, 2449,		def .....	4345
2465, 2913, 2928, 2943, 2954, 2988, 3069, 3113,		use .....	987, 3587, 3599, 4333
3150, 3193, 3792, 3797, 3846, 3868, 3881, 3957,		LV_QOIL_COM_ACT	
4022, 4276, 4493, 4733, 4763, 4903, 5152, 5170,		def .....	4095
5277, 5298, 5408, 5682, 5971, 6051, 6239, 6330,		LV_R_IT_CAL_ENA_LSL_IF [NC_CBK_EX_NR]	
6405, 6428, 6582, 6597, 6796, 7558, 8209		def .....	1320
LV_PUC_CHG_H_L		use .....	1313
def .....	2942	LV_R_IT_DET_LS_DOWN [NC_CBK_EX_NR]	
LV_PUC_CHG_L_H		def .....	1364
def .....	2942	LV_R_IT_OSC_ENA_LSL_IF [NC_CBK_EX_NR]	
LV_PUC_DET_MIS		def .....	1320
def .....	6225	use .....	1313, 4301
LV_PUC_INH_TEMP_CAT		LV_R_IT_REQ_LS_DOWN [NC_CBK_EX_NR]	
def .....	8233	def .....	1364
use .....	1721, 3846	use .....	967
LV_PUC_LOCK_TNT		LV_R_IT_REQ_LS_UP [NC_CBK_EX_NR]	
def .....	8199	def .....	1320
use .....	1721, 3846	use .....	967
LV_PUC_MAF_INT_OLD		LV_R_IT_SWI_RNG_LSL_IF [NC_CBK_EX_NR]	
def .....	2942	def .....	1320
LV_PUC_OLD [NC_CBK_EX_NR]		use .....	1313
def .....	2912	LV_R_IT_VLD_DIAG_OC_LS_DOWN [NC_CBK_EX_NR]	
LV_PUC_REQ		def .....	4267
def .....	1720	LV_RAMP_OPEN_ACT	
use .....	2988, 3846	def .....	3636
LV_PUC_SA_INH		LV_RAMP_P_D_BEG_VALUE_WRG_MON	
def .....	804	def .....	6921
use .....	1721, 3846	LV_RAS	

def .....	3594	def .....	4095
LV_RAS_EXT_ADJ		LV_REQ_GEN_WR_REG1	
def .....	7434	def .....	4095
use .....	3594	LV_REQ_GEN_WR_REG3	
LV_RAS_OUT		def .....	4095
def .....	3594	LV_REQ_HEAT	
use .....	4569, 7315	def .....	1567
LV_RATIO_SUM_CLC_ACT [NC_NOX_SENS_CONF]		use .....	1123, 6602, 8292, 8353
def .....	6412	LV_REQ_HEAT_ACC_ENA	
LV_RD_FTL		def .....	6602
def .....	5966	LV_REQ_HEAT_N_SP_IS	
LV_READY_XX		def .....	1122
def .....	5881	LV_REQ_INH_MIS	
use .....	1065, 5695, 5744, 5842, 8038, 8114	def .....	6225
LV_READY_XXX		use .....	1469, 6264, 6276
use .....	7874, 7878	LV_REQ_ISC	
LV_REF_GAP		def .....	3501
def .....	853	use .....	1948, 2546, 3442, 3514, 3846, 4377, 6796, 6870, 6922, 7683, 8212, 8353
LV_REF_LEAK_ROUGH_LEAK_SUSP		LV_REQ_LAMB_SP_LS_ACT_TEST [NC_CBK_EX_NR]	
def .....	5966	def .....	1007
LV_REFU		LV_REQ_PWL_DMTL	
def .....	5966	def .....	5967
use .....	4145, 5919, 6037	use .....	1584
LV_REFU_1		LV_REQ_PWL_DMTL_SND	
def .....	5966	def .....	1567
LV_REFU_DMTL		LV_REQ_PWL_ROUGH_LEAK	
def .....	5966	def .....	5967
LV_REFU_DMTL_SMALL_LEAK		LV_REQ_PWL_SMALL_LEAK	
def .....	5966	def .....	5967
LV_REFU_DMTLM		LV_REQ_ROUGH_LEAK	
def .....	5967	def .....	5967
LV_REFU_END		LV_REQ_SEG_AD_MMV_ER_APP	
def .....	5967	def .....	1469
LV_REFU_RLS_DIAG		use .....	1474
def .....	5967	LV_REQ_SEG_AD_RST_EOL	
LV_REFU_VAL		def .....	804
def .....	5967	use .....	1469
use .....	5919, 6038	LV_REQ_TCO_L	
LV_REFU_VAL_1		def .....	1567
def .....	5967	use .....	8226
LV_REP_CHK_FUC		LV_REST	
def .....	5918	def .....	1766
LV_REQ_ACK_IGK_OFF		use .....	2094, 8244
def .....	1567	LV_RFPPWM_EXT_ADJ [NC_NR_TCHA]	
LV_REQ_APP_CTR_MIS_A		def .....	7434
def .....	6264	use .....	8140
use .....	6239	LV_RGN_AGI [NC_NT_NR]	
LV_REQ_APP_INH_MIS		def .....	2983
def .....	6213	LV_RGN_AGI_VLD [NC_NT_NR]	
use .....	6226	def .....	2983
LV_REQ_ENA_ROUGH_LEAK		LV_RGN_CDN	
def .....	5967	def .....	2983
LV_REQ_GEN_RD_REG2		LV_RGN_NT_REQ	
def .....	4095	def .....	2983
LV_REQ_GEN_RD_REG5		use .....	996, 1037, 1721, 2885, 3054, 4022, 5563, 5589, 6428, 8353
def .....	4095		
LV_REQ_GEN_WR_REG0			

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LV_RGN_NT_REQ_AFL_PREV	def .....	1567		
def .....	5562		use .....	3823, 7315, 8292, 8353
LV_RGN_NT_REQ_OLD	def .....	2885	LV_RLY_ST_EXT_ADJ	def .....
def .....	2885		def .....	7434
LV_RGN_REQ_AD	def .....	996	use .....	3844
def .....	996		LV_RLY_ST_STST	def .....
use .....	2988		def .....	804
LV_RGN_REQ_NOX_SENS	def .....	2983	use .....	3772
def .....	2983		LV_RLY_VCV_EXT_ADJ	def .....
use .....	3074		def .....	7434
LV_RGN_REQ_NOX_SENS_TMP [NC_NT_NR]	def .....	2983	LV_RLY_VVL_EXT_ADJ	def .....
def .....	2983		def .....	7434
LV_RGN_REQ_NTLD	def .....	2983	LV_RNG_L	def .....
def .....	2983		def .....	1302
use .....	3074		use .....	6570
LV_RGN_REQ_NTLD_AFS	def .....	2983	LV_RNG_L_AT	def .....
def .....	2983		def .....	1302
use .....	8200		use .....	6570
LV_RGN_STOP_MDL	def .....	2983	LV_RNG_L_AT_MON	def .....
def .....	2983		def .....	6791
LV_RGN_STOP_SENS	def .....	2983	LV_RNG_L_MON	def .....
def .....	2983		def .....	6791
use .....	996		LV_RNG_L_REQ	def .....
LV_RGN_STOP_TOUT	def .....	2983	def .....	6570
def .....	2983		use .....	1270, 1721, 6796, 7238, 8292
LV_RLY_CRCV_HEAT	def .....	4142	LV_RON_STC_CLR_KWP	def .....
def .....	4142		def .....	7483
use .....	912, 7315		use .....	4145
LV_RLY_CRCV_HEAT_EXT_ADJ	def .....	7434	LV_RON_STC_DEACT	def .....
def .....	7434		def .....	4145
use .....	4142		LV_ROUGH_LEAK_MES_LEN	def .....
LV_RLY_HPDI	def .....	7315	def .....	5967
def .....	7315		LV_ROUGH_LEAK_SUSP	def .....
LV_RLY_HPDI_EXT_ADJ	def .....	7434	def .....	5967
def .....	7434		use .....	5919
LV_RLY_MAIN	def .....	3772	LV_ROUGH_LEAK_SUSP_CHK_FUC	def .....
def .....	3772		def .....	5918
use .....	912, 989, 1091, 1167, 4934		LV_ROUGH_LEAK_SUSP_SET	def .....
LV_RLY_MAIN_DLY_ERR	def .....	4933	def .....	5967
def .....	4933		LV_RR_PREV_INI	def .....
use .....	2042, 7008, 7158		def .....	6301
LV_RLY_MAIN_EXT_ADJ	def .....	7434	LV_RST_DET	def .....
def .....	7434		def .....	560
use .....	3772		LV_RST_DET_DISP	def .....
LV_RLY_MAIN_SYS	def .....	3772	def .....	560
def .....	3772		LV_RST_MFF_ADD_EXT_ADJ_NVMY	def .....
LV_RLY_MTC_2_HEAT_EXT_ADJ	def .....	7434	def .....	7680
def .....	7434		use .....	7558
LV_RLY_MTC_HEAT	def .....	6531	LV_RUN_ENG	def .....
def .....	6531		def .....	1505
LV_RLY_MTC_HEAT_EXT_ADJ	def .....	7434	use .....	1042, 1091, 1232, 1525, 4432, 6226, 6264
def .....	7434		LV_S_ACT	def .....
use .....	6532		def .....	8137
LV_RLY_ST	def .....	3844	use .....	981, 1018, 1721, 1801, 1809, 1813, 2988, 3074, 3150, 3215, 4022, 5143, 5152, 5608, 6214, 6276, 6284, 6338, 6656, 8244
def .....	3844		LV_S_CLC	
use .....	912, 3931, 7315			
LV_RLY_ST_CAN				


def .....	1822	def .....	1473
use 1820, 2004, 2136, 2140, 2142, 2144, 2147, 2212, 2216, 2220, 2262, 3333, 8137, 8244, 8266, 8271, 8353		use .....	1474
LV_S_ENA		LV_SEG_AD_LIM_ER	
def .....	8137	def .....	1473
use .....	1801	use .....	1474, 4022, 4367
LV_S_REQ_EGR		LV_SEG_AD_RAW_ER	
def .....	804	def .....	1473
use .....	6368	use .....	1474
LV_S_RUN		LV_SEG_AD_RST_ER_EOL	
def .....	8137	def .....	1469
use .....	1875, 6659	use .....	1474
LV_SA_END		LV_SEG_NR_UPD_REQ	
def .....	804	def .....	1717
use .....	2546, 3681	use .....	1506, 1525
LV_SAP		LV_SEL_CYL	
def .....	804	def .....	2307
use .....	2352, 5408, 6796	use .....	2295
LV_SAP_EXT_ADJ		LV_SEND_CC_ID_BENCH	
def .....	7435	def .....	1567
LV_SAV		LV_SEND_CC_ID_TRA	
def .....	804	def .....	1567
use .....	2352, 5408	LV_SEND_CC_ID_XX	
LV_SAV_2_EXT_ADJ		def .....	1567
def .....	7435	LV_SENS_AFR [NC_NT_NR]	
LV_SAV_EXT_ADJ		def .....	2983
def .....	7435	use .....	996, 2885, 6359, 6378, 6428
LV_SAWUP		LV_SENS_AFR_INH_OFS_DIAG	
def .....	804	def .....	6378
use .....	1822, 2913, 5408, 5459	LV_SENS_AFR_TRIM	
LV_SAWUP_OLD [NC_CBK_EX_NR]		def .....	2983
def .....	2912	LV_SENS_AFR_TRIM_TMP [NC_NT_NR]	
LV_SCC [NC_CBK_EX_NR]		def .....	2983
def .....	2295	LV_SENS_BAT_SMT_ACT	
use .....	2195, 2988, 3150, 5286, 6368, 8271	def .....	4095
LV_SCG_IGC [NC_CYL_NR]		use .....	8370
def .....	920	LV_SENS_BAT_SMT_COM_ACT	
use .....	932, 4773	def .....	4095
LV_SCP_IGC [NC_CYL_NR]		LV_SENS_BAT_SMT_DET	
def .....	920	def .....	4095
use .....	932, 4773	use .....	7558, 7683, 8353, 8370
LV_SDR_DMTL		LV_SENS_MDL_OFF_ACT [NC_CBK_EX_NR]	
def .....	5967	def .....	2463
LV_SEG_AD_AVL_ER		LV_SENS_RGN_1_READY	
def .....	1473	def .....	2983
use .....	1474, 4022, 4367, 7315, 7558	use .....	2885
LV_SEG_AD_DIF_MAX_ER		LV_SENS_RGN_1_READY_OLD	
def .....	1473	def .....	2885
use .....	1474	LV_SF_TQD_MON	
LV_SEG_AD_ER		def .....	6791
def .....	1473	use .....	6742
use .....	1474, 4367	LV_SMALL_LEAK_MES_LEN	
LV_SEG_AD_FDOUT_ER		def .....	5967
def .....	1473	LV_SNG_INJ_ACT [NC_CBK_EX_NR]	
use .....	1474	def .....	3379
LV_SEG_AD_FDOUT_ER_EOL		use .....	3349, 3406
		LV_SO2P_ACT	
		def .....	3129

use .....	3074, 3113, 8353	LV_SOI_ACT_SWI [NC_CYL_NR]	
LV_SO2P_ACT_LAMB [NC_CBK_EX_NR]		def .....	2038
def .....	3129	LV_SOI_ACT_UPD [NC_CYL_NR]	
LV_SO2P_ACT_TNT		def .....	2038
def .....	3129	LV_SOIL_VLD_LOIL	
LV_SO2P_AFR [NC_CBK_EX_NR]		def .....	804
def .....	3150	use .....	8204
use .....	3129	LV_SOIL_VLD_LOIL_CUS	
LV_SO2P_AFR_CORD		def .....	8202
def .....	3129	LV_SP_RATE_CYL_EGR_SWI	
LV_SO2P_AFR_CTR		def .....	8137
def .....	3129	use .....	1921
LV_SO2P_FAST_REQ		LV_ST	
def .....	3129	def .....	1720
use .....	2169, 8200	use .....	917,
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def .....	3129	1828, 1846, 1881, 1912, 1939, 1962, 2307, 2442,	
use .....	3150, 3601, 8200	2885, 2988, 3181, 3188, 3501, 3589, 3614, 3681,	
LV_SO2P_REQ		3851, 4136, 4538, 4708, 4745, 4773, 4822, 4824,	
def .....	3129	4952, 4977, 5002, 5015, 5675, 6226, 6532, 6623,	
use .....	1040, 1789, 2988, 3074, 6428, 6469, 8200	6651, 6683, 6710, 6719, 6742, 7201, 8310, 8370	
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def .....	3073	def .....	1720
use .....	3129, 7558	use 1112, 1123, 1149, 1283, 1339, 1365, 1444, 1584,	
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def .....	3073	2099, 2100, 2122, 2130, 2133, 2136, 2140, 2142,	
use .....	1777, 1789, 3144, 7315, 7558, 7738	2144, 2147, 2151, 2195, 2200, 2204, 2208, 2212,	
LV_SO2P_REQ_2_EXT_ADJ		2216, 2220, 2228, 2230, 2241, 2262, 2289, 2295,	
def .....	7680	2304, 2315, 2335, 2352, 2383, 2386, 2406, 2422,	
use .....	3074	2437, 2439, 2465, 2546, 2558, 2563, 2579, 2585,	
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def .....	3073	2958, 2968, 2976, 3150, 3181, 3215, 3261, 3333,	
use .....	7558	3512, 3564, 3622, 3681, 3797, 3823, 3858, 3868,	
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def .....	7680	4314, 4377, 4393, 4502, 4516, 4627, 4733, 4790,	
use .....	3074	4815, 4916, 4921, 4924, 4991, 5000, 5022, 5044,	
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def .....	3851	5217, 5332, 5335, 5389, 5420, 5433, 5439, 5450,	
use .....	912, 7315	5553, 5589, 5608, 5652, 5660, 5666, 5672, 5678,	
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def .....	7435	6330, 6338, 6347, 6359, 6368, 6396, 6469, 6485,	
use .....	3851	6490, 6494, 7767, 8204, 8209, 8215, 8221, 8237,	
LV_SOF_SWI		8244, 8264, 8271, 8310	
def .....	3851	LV_ST_END_OLD [NC_CBK_EX_NR]	
use .....	657, 7315, 8353	def .....	2912
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def .....	3851	def .....	1444
use .....	657	LV_ST_ES	
LV_SOF_SWI_AMT_REQ		def .....	1766
def .....	3851	LV_ST_H_PRS	
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def .....	6791	use .....	3868, 3931, 3957, 6063
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use .....	1302, 6570, 7315	use .....	3333
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def .....	6791	def .....	8242

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use .....	2042	LV_STATE_PREV_PBK_IV [NC_PBK_IV_NR]	
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use .....	6214	use .....	8204
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def .....	3679	use .....	8221
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use .....	8221	use .....	6859
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use .....	8221	use .....	6786
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def .....	8220	def .....	6786
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def .....	804	def .....	6791
use .....	1912, 4136	use .....	6786
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use .....	1584	use .....	6786
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def .....	8220	def .....	7012
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def .....	8287	def .....	2313
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def .....	805	def .....	6791
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use .....	7558	use .....	4945
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use .....	3074	use .....	1158
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use .....	912	def .....	6109
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def .....	7435	LV_SYM_FUP_ST_NO_RISE	
use .....	4136	def .....	8262
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def .....	7435	LV_SYN_CAM_EX [NC_NR_CAM_CBK]	
use .....	4136	def .....	872
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def .....	6791	LV_SYN_CAM_IN [NC_NR_CAM_CBK]	

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def .....	1506	LV_T_MIN_EFF_IGA_CST_PL	
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def .....	805	use .....	3737
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use .....	1008, 2446, 8237	LV_TI_3_HOM_MIN	
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LV_TQ_AMT_INC_REQ		use .....	3512	
def .....	1568	LV_TQ_MAX_ARS	def .....	6650
use .....	1711, 6985	use .....	1584	
LV_TQ_ASR_REQ		LV_TQ_MAX_TQI_N_CTL_TCT_MON	def .....	6791
def .....	1568	LV_TQ_MIN_CLU	def .....	8379
use .....	1711, 6742, 6985, 7215	use .....	6683, 6952, 8353	
LV_TQ_CRU_ACT		LV_TQ_MSR_REQ	def .....	1568
def .....	6706	use .....	1711, 6742, 6985	
use .....	8353, 8391	LV_TQ_P_D_ACT_FAST	def .....	3440
LV_TQ_DCC_ACT		LV_TQ_P_D_ACT_FAST_TEMP	def .....	3440
def .....	6737	LV_TQ_P_D_ACT_SLOW	def .....	3440
LV_TQ_DCC_INC_REQ		LV_TQ_PSTE_3_CAN_DI	def .....	1568
def .....	1568	use .....	6623	
use .....	1711, 6731, 6870	LV_TQ_PSTE_3_CAN_ENA	def .....	1568
LV_TQ_DIF_I_IS_INI_ACT		LV_TQ_PSTE_3_CAN_LIH	def .....	1568
def .....	3440	use .....	6623	
LV_TQ_DIF_IS_AD_CONV_ACT		LV_TQ_SCC_INH	def .....	6658
def .....	6710	use .....	6665	
LV_TQ_DROF_ACT_MON		LV_TQ_SCC_REQ	def .....	6658
def .....	6791	use .....	6665	
use .....	6796	LV_TQ_SCC_INH	def .....	6658
LV_TQ_DROF_IS_AD_INH		use .....	6665	
def .....	1112	LV_TQ_WHEEL_LDM_BN_ERR	def .....	1568
use .....	3512	use .....	1711, 6615, 6737, 6985	
LV_TQ_GS_DEC_REQ		LV_TQ_WHEEL_LDM_REQ	def .....	1568
def .....	1568	use .....	1711, 5054, 6615, 6870, 6985	
use .....	1711, 6719	LV_TQI_BOL_SET	def .....	8379
LV_TQ_GS_IGA				
def .....	6658			
use .....	6665			
LV_TQ_GS_INC_REQ				
def .....	1568			
use .....	1711, 6719, 6985			
LV_TQ_GS_SCC				
def .....	6658			
use .....	6665			
LV_TQ_IGA_ACT				
def .....	1948			
use .....	1925, 8304, 8353			
LV_TQ_IGA_ENA				
def .....	8379			
use .....	1948			
LV_TQ_IGA_REQ				
def .....	1948			
LV_TQ_ISC_I_TQ_PSTE				
def .....	3440			
use .....	4393, 5929			


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use .....	1721	def .....	1320
LV_TQI_BOL_SET_S		use .....	2335, 2372, 2386, 5439
def .....	805	LV_V_TECU_VLD	
use .....	1721	def .....	1256
LV_TQI_MON_ACT_MON		LV_VAR_4WD	
def .....	6791	def .....	655
use 6753, 6761, 6774, 6777, 6786, 6796, 6851, 6859,		use .....	4871, 6276
6870, 6899, 6903, 6912, 6922, 6938, 6943, 6952,		LV_VAR_ACIN	
6975, 6985, 8193		def .....	655
LV_TQI_MON_ACT_MON2		use .....	1123, 4627, 4871, 7558, 7683
def .....	7012	LV_VAR_AEB	
LV_TQI_REQ_CAN_INH		def .....	655
def .....	6687	use .....	4136, 4942, 7558, 7683
use 5051, 5054, 6623, 6651, 6719, 6742, 6985, 7228		LV_VAR_AMT	
LV_TRIG_AFR_AFL		def .....	655
def .....	2983	use .....	1298, 1584, 1711, 4871, 6675, 6796, 7215,
LV_TTIP_MES_VLD_LS_UP [NC_CBK_EX_NR]		7228, 7438, 7558, 7683, 7767	
def .....	1320	LV_VAR_ARS	
use .....	2315, 2335, 2386, 5248, 5439	def .....	655
LV_UP_LS_1		use .....	1123, 1584, 4871, 6651, 7558, 7683
def .....	1007	LV_VAR_ASR	
LV_UP_LS_2		def .....	655
def .....	1007	use .....	1176, 1584, 6742, 7215, 7683
LV_V_ALTER_SP_EXT_ADJ		LV_VAR_ASR_3	
def .....	7435	def .....	655
use .....	8292	use .....	7558, 7684
LV_V_CUR_VCV_BOOT_NOT_VLD		LV_VAR_ASR_4	
def .....	3955	def .....	655
LV_V_EFC_LIM_BOL_LSH_DOWN [NC_CBK_EX_NR]		use .....	7558, 7684
def .....	2421	LV_VAR_BN	
LV_V_EFC_LIM_BOL_LSH_UP [NC_CBK_EX_NR]		def .....	655
def .....	2385	use 906, 1065, 1149, 1711, 3779, 3851, 4096, 4721,	
LV_V_EFC_LIM_MAX_LSH_DOWN [NC_CBK_EX_NR]		4784, 4911, 4929, 4945, 5010, 5955, 6623, 6651,	
def .....	2421	6719, 6742, 6796, 6985, 7201, 7228, 7238, 7558,	
LV_V_EFC_LIM_MAX_LSH_UP [NC_CBK_EX_NR]		8292, 8370	
def .....	2385	LV_VAR_BN_EFP	
LV_V_EFC_LIM_PROT_VB_LSH_DOWN [NC_CBK_EX_NR]		def .....	655
def .....	2421	use .....	1584, 4721, 4871, 7558, 7684
LV_V_EFC_LIM_PROT_VB_LSH_UP [NC_CBK_EX_NR]		LV_VAR_BN_GEAR_REV	
def .....	2385	def .....	655
LV_V_EFC_LIM_TOL_LSH_DOWN [NC_CBK_EX_NR]		use .....	4871, 7558, 7684
def .....	2421	LV_VAR_BN_LDM	
LV_V_EFC_LIM_TOL_LSH_UP [NC_CBK_EX_NR]		def .....	655
def .....	2385	use .....	1270, 1711, 4871, 5054, 6615, 6737, 7202,
LV_V_H_DET_MU		7220, 7228, 7558, 7684	
def .....	7073	LV_VAR_BN_LTG_HDLP_L	
use .....	7062	def .....	655
LV_V_L_DET_MU		use .....	4871, 7558, 7684
def .....	7073	LV_VAR_BN_MSW	
use .....	7062	def .....	655
LV_V_LIM_ENA		use .....	4871, 5059, 7215, 7220, 7558, 7684
def .....	2277	LV_VAR_BN_TRL	
LV_V_OFS_ADJ_VLD_R_IT_LS_UP [NC_CBK_EX_NR]		def .....	655
def .....	1320	use .....	4871, 7558, 7684
LV_V_OFS_MES_VLD_R_IT_LS_UP [NC_CBK_EX_NR]		LV_VAR_CWP_LIN	
def .....	1320	use .....	7684
LV_V_REF_VLD_R_IT_LS_UP [NC_CBK_EX_NR]		LV_VAR_DCC	


def .....	655	def .....	656
use .....	1270, 1584, 4871, 5051, 6731, 6737, 6985, 7202, 7220, 7228, 7558, 7684, 8292	use .....	5059, 7220, 7558, 7684
LV_VAR_EAC		LV_VAR_NOX	
def .....	805	def .....	656
use .....	7558	use .....	4921, 7558, 7684
LV_VAR_EBOX_CFA		LV_VAR_OBDC_CAN	
def .....	655	def .....	7681
use .....	4133, 4627, 7558, 7684	use .....	7833
LV_VAR_ECRAS		LV_VAR_PBR	
def .....	805	def .....	656
LV_VAR_ECRAS_DOWN		use .....	1584, 4871
def .....	4515	LV_VAR_PSTE	
use .....	1584, 3863, 7558, 7684, 8226	def .....	656
LV_VAR_ECRAS_UP		use .....	4871, 6623, 7558, 7684
def .....	655	LV_VAR_PSTE_2	
use .....	1584, 3863, 4516, 7558, 8226	def .....	656
LV_VAR_EF		use .....	1123, 4871, 6623, 6796, 7558, 7684
def .....	655	LV_VAR_PSTE_3	
use .....	3614, 4627, 7558, 7684	def .....	656
LV_VAR_EFP_COM_2		use .....	1123, 4871, 6623, 6796, 7558, 7684
def .....	805	LV_VAR_RLY_ACCOUT	
use .....	6051	def .....	656
LV_VAR_EFP_COM_3		use .....	912, 3589, 4627, 7558, 7684
def .....	805	LV_VAR_RLY_ST	
use .....	6051	def .....	656
LV_VAR_EFP_CRASH		use .....	912, 4627, 7558, 7684
def .....	655	LV_VAR_SAP	
use .....	4871	def .....	805
LV_VAR_ETCU		use .....	819, 7558, 7684
def .....	655	LV_VAR_SAV	
use .....	1584, 4871, 7558, 7684	def .....	805
LV_VAR_ETCU_3		use .....	7558, 7684
def .....	655	LV_VAR_SOF	
use .....	1584, 4871	def .....	656
LV_VAR_ETCU_SPT		use .....	3851, 4911, 7558, 7684
def .....	656	LV_VAR_SPT_SWI	
use .....	1302, 6796, 7558, 7684	def .....	656
LV_VAR_ICL		use .....	4871
def .....	656	LV_VAR_STST	
use .....	1584, 4871, 7558, 7684	def .....	805
LV_VAR_L6		use .....	1584, 3772, 7558, 8292
def .....	805	LV_VAR_TCHA	
use .....	4929, 4934	def .....	656
LV_VAR_LSH_DOWN		use .....	843, 915, 1163, 1192, 1198, 1209, 1226, 2613, 2866, 4189, 4203, 4207, 4713, 4828, 4830, 6675, 8140, 8148, 8279
def .....	656	LV_VAR_TCO_2	
use .....	1379, 2435, 4254, 5210, 5230, 5457, 7558, 7684	def .....	656
LV_VAR_LSH_UP		use .....	1218, 5077, 5083
def .....	656	LV_VAR_TCT	
use .....	2406, 2633, 2866, 3681, 5433, 5457, 7558, 7684	def .....	656
LV_VAR_MAF		use .....	997, 1112, 1123, 1149, 1270, 1298, 1303, 1310, 1419, 1454, 1474, 1584, 1711, 1721, 2968, 3442, 3512, 3544, 3779, 4377, 4871, 5010, 5015, 5018, 6284, 6665, 6675, 6697, 6710, 6719, 6796, 6985, 7215, 7228, 7438, 7558, 7684, 7767, 8394
def .....	656		
use .....	834, 4815, 4820, 5000, 7558, 7684		
LV_VAR_MAF_LEARNT			
def .....	656		
use .....	834, 7315, 7684		
LV_VAR_MSW			

LV_VAR_TCT_MON	def .....	8277	LV_VIM_2_EXT_ADJ	def .....	7435
def .....	6791		use .....	3622	
LV_VAR_TQ_PBR	def .....	656	LV_VIM_2_EXT_ADJ	def .....	7435
use .....	1584, 4871, 7558, 7684		use .....	3622	
LV_VAR_VEH	def .....	656	LV_VIM_INH_CUS	def .....	8277
use .....	1584, 4096, 4871, 7558, 8370		use .....	3622	
LV_VAR_VEH_MOD	def .....	1568	LV_VIM_RLS	def .....	3622
use .....	4871		use .....	8279	
LV_VAR_VVL	def .....	805	LV_VIM_RLS_TMP	def .....	3622
use .....	5273		LV_VIMPWM_1_FB_VLD	def .....	5065
LV_VB_CDN_OBD_1	def .....	1046	LV_VIMPWM_2_FB_VLD	def .....	5065
use .....	4248, 4254, 4315, 4569, 4828, 4942		LV_VLD_PSN_CAM_EX [NC_NR_CAM_CBK]	def .....	872
LV_VB_CDN_OBD_2	def .....	1046	use .....	1534, 4421, 8400	
use .....	4309, 5161, 5191, 5199, 5230, 5255, 5292, 5408, 5433, 5439		LV_VLD_PSN_CAM_IN [NC_NR_CAM_CBK]	def .....	872
LV_VB_DIF_MAX	def .....	5967	use .....	1534, 4421, 8400	
use .....	7767		LV_VLS_DIF_DLY_LDC [NC_CBK_EX_NR]	def .....	5216
LV_VB_JUMP	def .....	1185	use .....	5350, 5422	
use .....	4924, 7767, 8370		LV_VLS_DIF_DLY_LDC_LAM_MV [NC_CBK_EX_NR]	def .....	5216
LV_VB_NS_OK [NC_NOX_SENS_CONF]	def .....	991	LV_VLS_DIF_DLY_LDC_MAF	def .....	5216
use .....	6330, 6368		LV_VLS_DIF_DLY_LDC_N	def .....	5216
LV_VB_RANGE_DMTL	def .....	5967	LV_VLS_DOWN_ACT_CAT_PURGE [NC_CBK_EX_NR]	def .....	2927
use .....	7767		LV_VLS_DOWN_AFL [NC_CBK_EX_NR]	def .....	3150
LV_VCV_RLY	def .....	988	LV_VLS_DOWN_DRV1_CDN_R_LS [NC_CBK_EX_NR]	def .....	1364
use .....	3957, 6095		LV_VLS_DOWN_MMV_ACT [NC_CBK_EX_NR]	def .....	2409
LV_VEL_ANG_PSTE_MIN_DET	def .....	1420	use .....	1365	
LV_VFF_VCV_MIN	def .....	3881	LV_VLS_DOWN_MMV_LIM [NC_CBK_EX_NR]	def .....	2409
LV_VFF_VCV_MIN_AD_ENA	def .....	3955	use .....	1365	
LV_VIM	def .....	3622	LV_VLS_DOWN_NOT_STAT	def .....	2416
LV_VIM_1	def .....	3622	LV_VLS_DOWN_PUC_AFR_VLD [NC_CBK_EX_NR]	def .....	4276
use .....	2866, 5065		LV_VLS_DOWN_PUE_CAT_PURGE [NC_CBK_EX_NR]	def .....	5169
LV_VIM_1_CUS	def .....	8277	LV_VLS_DOWN_RNG_CDN_R_LS [NC_CBK_EX_NR]	def .....	1364
use .....	3622		LV_VLS_DOWN_THD_AFL_LAM [NC_CBK_EX_NR]	def .....	2464
LV_VIM_1_EXT_ADJ	def .....	7435	LV_VLS_DOWN_THD_AFR_LAM [NC_CBK_EX_NR]	def .....	2464
use .....	3622		LV_VLS_DOWN_TRA [NC_CBK_EX_NR]		
LV_VIM_2	def .....	3622			
use .....	5065				
LV_VIM_2_CUS					

def .....	3150	def .....	5076
LV_VLS_EOL_SHIFT_REP_INH		LV_VS_CDN_TIA_PLAUS_DIAG	
def .....	8128	def .....	5093
LV_VLS_GRD_NEG		LV_VS_DIAG_NOT_PLAUS	
def .....	2983	def .....	7215
use .....	2885	use .....	7228
LV_VLS_GRD_NEG_SET_VLS		LV_VS_MAX	
def .....	2984	def .....	1148
LV_VLS_MAIN_CAT_PRE_PURGE_ACT [NC_CBK_EX_NR]		use .....	4462, 7228
def .....	2927	LV_VS_MAX_LIH_TCT_ACT	
LV_VLS_MAIN_CAT_PURGE_ACT [NC_CBK_EX_NR]		def .....	1158
def .....	2927	LV_VS_MAX_VSL	
LV_VLS_MAIN_CAT_PURGE_READY [NC_CBK_EX_NR]		def .....	7267
def .....	2942	use .....	7228, 7253, 7259, 7265, 7270
use .....	2928	LV_VS_RUN	
LV_VLS_NS_AUTH [NC_NOX_SENS_CONF]		def .....	1176
def .....	991	use .....	1584, 1717, 3514
use .....	2943, 3054	LV_VS_STUCK	
LV_VLS_NS_DIAG_VLD [NC_NOX_SENS_CONF]		def .....	5021
def .....	991	LV_VST	
use .....	6338, 6389, 6405	def .....	1176
LV_VLS_NS_VLD [NC_NOX_SENS_CONF]		LV_VVL_MIN_EXT_ADJ	
def .....	992	def .....	7681
use .....	2416, 2885, 2988, 3054, 5635, 6348	LV_VVL_MIN_NVMY_EXT_ADJ	
LV_VLS_OFS_ADJ_CMPL [NC_CBK_EX_NR]		def .....	7681
def .....	2314	LV_WAKE_UP	
use .....	5248	def .....	906
LV_VLS_OFS_ADJ_ENA_LSL_IF [NC_CBK_EX_NR]		LV_WAL_1	
def .....	2314	def .....	5827
use .....	1313, 2352	use .....	1584
LV_VLS_OFS_LIM_LSL [NC_CBK_EX_NR]		LV_WAL_1_ACT_REQ	
def .....	2314	def .....	5840
use .....	5248	use .....	5827
LV_VLS_OFS_LIM_LSL_L_GAIN [NC_CBK_EX_NR]		LV_WAL_1_CAN	
def .....	2314	def .....	1568
use .....	5249	use .....	7315
LV_VLS_UP_AFS_DIAG_OC_LSL_UP [NC_CBK_EX_NR]		LV_WAL_1_EXT_ADJ	
def .....	4300	def .....	7435
LV_VLS_UP_INIT [NC_CBK_EX_NR]		use .....	1584
def .....	1341	LV_WAL_2	
use .....	2315, 2352, 2372	def .....	5827
LV_VLS_UP_MIN_DIAG_OC_LSL_UP [NC_CBK_EX_NR]		LV_WAL_2_ACT_REQ	
def .....	4300	def .....	5840
LV_VLS_UP_VLD [NC_CBK_EX_NR]		use .....	5827
def .....	1341	LV_WAL_ST	
use .....	2315, 2352, 2372, 5238	def .....	5827
LV_VNLSL_LIM [NC_CBK_EX_NR]		use .....	1584
def .....	955	LV_WARM_RST	
use .....	2352, 5249	def .....	560
LV_VPLSL_LIM [NC_CBK_EX_NR]		use .....	4233
def .....	955	LV_WGPWM_EXT_ADJ [NC_NR_TCHA]	
use .....	2352, 2372, 2866, 5249	def .....	7435
LV_VPLSL_LIM_ACT [NC_CBK_EX_NR]		use .....	8140
def .....	2352	LV_WHEEL_CAN_FN_LE_ERR	
LV_VS_BOL		def .....	1568
def .....	5021	use .....	5044
LV_VS_CDN_TAM_ERR		LV_WHEEL_CAN_FN_RI_ERR	

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def .....	1568	use .....	8038, 8114
use .....	5044	M6_CUR_DMTL_SMALL_LEAK_END_SAVE	
LV_WHEEL_CAN_RE_LE_ERR		def .....	5968
def .....	1568	M6_CUR_DMTL_THD_DMTLS_TEST	
use .....	5044	def .....	5968
LV_WHEEL_CAN_RE_RI_ERR		use .....	8038, 8114
def .....	1568	M6_CUR_DMTL_THD_DMTLS_TEST_SAVE	
use .....	5044	def .....	5968
LV_WUP		M6_CUR_DMTL_THD_ROUGH_LEAK	
def .....	1775	def .....	5968
use .....	1584, 2109, 7315	use .....	8038, 8114
LV_WUP_CAN		M6_CUR_DMTL_THD_ROUGH_LEAK_LEN	
def .....	1766	def .....	5968
use .....	1584	use .....	8038, 8114
LV_WUP_CYC		MAF	
def .....	5746	def .....	8277
use .....	5010, 5767, 5899, 8304	use 1192, 1195, 1206, 1474, 1542, 1813, 1921, 1953,	
LV_WUP_SCDN_EQU [NC_NR_WIN_SCDN]		1962, 2154, 2159, 2164, 2179, 2465, 2546, 2585,	
def .....	5885	2622, 2633, 2733, 2866, 2885, 3150, 3544, 3638,	
LV_ZDLY_DIAG_MIS		3692, 4903, 5015, 5093, 5217, 5350, 5459, 5542,	
def .....	6225	5589, 5802, 5929, 6214, 6321, 6396, 6428, 6675,	
use .....	6276	6777, 7315	
<b>M</b>		MAF_ADD_MAX	
M6_CTR_CNL_SMALL_LEAK_MES		def .....	8390
def .....	5967	MAF_CP	
use .....	8038, 8114	def .....	3636
M6_CTR_CNL_SMALL_LEAK_MES_SAVE		MAF_CP_OLD_1	
def .....	5967	def .....	3636
M6_CUR_DMTL_COR_FIL_CID18		MAF_CP_OLD_2	
def .....	5968	def .....	3636
use .....	8038, 8114	MAF_CPS	
M6_CUR_DMTL_COR_FIL_CID18_SAVE		def .....	3636
def .....	5968	use .....	3692, 8229
M6_CUR_DMTL_COR_FIL_CID19		MAF_CPS_OLD_1	
def .....	5968	def .....	3636
use .....	8114	MAF_CPS_OLD_2	
M6_CUR_DMTL_COR_FIL_CID19_SAVE		def .....	3636
def .....	5968	MAF_CYL	
M6_CUR_DMTL_DMTLS_TEST		def .....	8277
def .....	5968	use 1167, 1209, 1212, 2416, 2449, 2546, 2563, 2590,	
use .....	8038, 8114	2627, 2722, 2882, 2928, 2943, 2954, 3333, 3349,	
M6_CUR_DMTL_DMTLS_TEST_SAVE		3406, 3630, 3638, 3692, 3701, 4276, 5217, 5314,	
def .....	5968	5389, 5416, 5422, 5459, 5474, 5542, 5553, 5589,	
M6_CUR_DMTL_REF_LEAK		5608, 6413, 6428, 8128	
def .....	5968	MAF_CYL_INT_NS_SHIFT	
use .....	8038, 8114	def .....	6426
M6_CUR_DMTL_REF_LEAK_SAVE		MAF_CYL_INT_NS_SHIFT_DYN [NC_NOX_SENS_CONF]	
def .....	5968	def .....	6426
M6_CUR_DMTL_ROUGH_LEAK_END		MAF_CYL_STK	
def .....	5968	def .....	8277
use .....	8038, 8114	MAF_DELTA_LDC	
M6_CUR_DMTL_ROUGH_LEAK_LEN_END		def .....	2585
def .....	5968	use .....	2546, 2722, 2882, 3349
use .....	8038, 8114	MAF_DEW_ADD_DOWN	
M6_CUR_DMTL_SMALL_LEAK_END		def .....	2442
def .....	5968	MAF_DEW_ADD_UP	
		def .....	2442

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MFF_CP		MFF_POST_INJ [NC_CYL_NR]	
def .....	3700	def .....	2179
use .....	1820, 3639	use .....	2188
MFF_CPS		MFF_RED_OPM_THD_CP	
def .....	3692	def .....	3680
MFF_DELTA_ADD_LAM_AD [NC_CBK_EX_NR]		MFF_SP [NC_CBK_EX_NR]	
def .....	2642	def .....	2151
MFF_DELTA_ADD_LAM_AD_H_RES [NC_CBK_EX_NR]		use 1019, 1167, 2643, 2679, 2734, 3113, 3406, 3846	
def .....	2642	MFF_SP_0_CP	
MFF_DELTA_ADD_LAM_AD_INJ [NC_CBK_EX_NR]		def .....	3700
def .....	3405	MFF_SP_1_EXT_COR [NC_CYL_NR]	
MFF_DELTA_LAM_CYL_SEL_REAC		def .....	8242
def .....	2733	use .....	6761
MFF_GRD_CP		MFF_SP_1_HOM [NC_CYL_NR]	
def .....	3680	def .....	8242
MFF_GRD_MMV_CP		use .....	2004, 2151, 2200, 3333, 3406
def .....	3680	MFF_SP_1_HOM_COR_INJ [NC_CYL_NR]	
MFF_IV_1_MON		def .....	2000
def .....	6760	MFF_SP_1_HOMS [NC_CYL_NR]	
MFF_IV_2_MON		def .....	8242
def .....	6760	MFF_SP_1_S [NC_CYL_NR]	
MFF_IV_POST_MON		def .....	8242
def .....	6760	use .....	2004, 2151, 2212, 2262
MFF_KGH_MAX_CP		MFF_SP_1_S_COR_INJ [NC_CYL_NR]	
def .....	3630	def .....	2001
MFF_LAM_ADD_LAM_AD_OUT [NC_CBK_EX_NR]		MFF_SP_1_S_TMP	
def .....	2642	def .....	8242
use .....	2465, 8244	MFF_SP_2_EXT_COR [NC_CYL_NR]	
MFF_LAM_CP		def .....	8242
def .....	3700	use .....	6761
MFF_LAMB_MON		MFF_SP_2_HOM [NC_CYL_NR]	
def .....	6760	def .....	8242



use .....	2004, 2151, 2204, 2262	def .....	2151
MFF_SP_2_HOM_COR_INJ [NC_CYL_NR]		use .....	3630
def .....	2001	MFF_SP_HOM_MPG_TMP [NC_NR_IV_PLS]	
MFF_SP_2_HOMS [NC_CYL_NR]		def .....	8243
def .....	8242	MFF_SP_HOM_MV	
MFF_SP_2_MPLH_CH		def .....	988
def .....	2164	MFF_SP_HOM_TMP [NC_NR_IV_PLS]	
use .....	2159, 8244	def .....	8243
MFF_SP_2_S [NC_CYL_NR]		MFF_SP_HOMS	
def .....	8242	def .....	8243
use .....	2004, 2151, 2216, 2262	use .....	2968
MFF_SP_2_S_COR_INJ [NC_CYL_NR]		MFF_SP_HOMS_PRED	
def .....	2001	def .....	8243
MFF_SP_2_S_TMP		use .....	2968
def .....	8242	MFF_SP_LAM_CYL_SEL	
MFF_SP_3_EXT_COR [NC_CYL_NR]		def .....	2864
def .....	8242	use .....	2734
use .....	6761	MFF_SP_MPLP [NC_CYL_NR]	
MFF_SP_3_HOM [NC_CYL_NR]		def .....	8243
def .....	8243	use .....	2179
use .....	2004, 2151, 2208, 2262	MFF_SP_MPLP_EXT_COR [NC_CYL_NR]	
MFF_SP_3_HOM_COR_INJ [NC_CYL_NR]		def .....	8243
def .....	2001	MFF_SP_MV	
MFF_SP_3_HOMS [NC_CYL_NR]		def .....	2151
def .....	8243	use 920, 1232, 1943, 1962, 2179, 2188, 2262, 2278,	
use .....	2004, 2151, 2220, 2262	2289, 3215, 3350, 3630, 3639, 3681, 3701, 4903,	
MFF_SP_3_S [NC_CYL_NR]		7315, 8244	
def .....	8243	MFF_SP_MV_KWP	
use .....	2004, 2151, 2220, 2262	def .....	7308
MFF_SP_3_S_COR_INJ [NC_CYL_NR]		MFF_SP_S	
def .....	2001	def .....	8243
MFF_SP_AD [NC_CBK_EX_NR]		use .....	1820, 1921, 2976, 3069, 3107, 4006
def .....	2721	MFF_SP_S_PRED	
use .....	2643	def .....	8243
MFF_SP_BAS		use .....	2976
def .....	8243	MFF_SP_S_SWI_HOM	
use .....	3846	def .....	8243
MFF_SP_BAS_S		use .....	2722, 2866, 3350
def .....	8243	MFF_SP_SAVE_LAM_CYL_SEL	
MFF_SP_FCO_COR		def .....	2733
def .....	8243	MFF_THD_EGY_RNG_IV	
use .....	3847	def .....	2261
MFF_SP_FUP_CTL		MFF_TI_MON	
def .....	2151	def .....	6777
use 989, 3792, 3797, 3868, 3881, 3909, 3957, 6051,		MFF_TOT_CP	
6063		def .....	3692
MFF_SP_HOM [NC_CBK_EX_NR]		MFF_TQ_MON	
def .....	2151	def .....	6760
use .....	8244	use .....	6753, 6774, 6796
MFF_SP_HOM_BAS [NC_CBK_EX_NR]		MFF_TQ_MON2	
def .....	8243	def .....	7012
use .....	2151	MIN_INJ_EGY_LEVEL	
MFF_SP_HOM_BAS_MV		def .....	2278
def .....	2151	Minhub	
use .....	2722, 2866	def .....	806
MFF_SP_HOM_BAS_TMP [NC_CBK_EX_NR]		use .....	7558
def .....	8243	Minhub_roh	
MFF_SP_HOM_ENG [NC_CBK_EX_NR]			

def .....	806	use .....	8244
use .....	7558	Mkzyl_soll_hs [NC_CYL_NR][NC_NR_IV_PLS]	
Minhubvs		def .....	8162
def .....	806	use .....	8244
use .....	7558	Mkzyl_soll_s [NC_CYL_NR][4]	
Minhubvs_ist		def .....	8162
def .....	806	MOD_1_PID_1_DIAG	
use .....	7558	def .....	7831
Minhubvsnv		use .....	7896
def .....	806	MOD_1_PID_2_DIAG	
use .....	7558	def .....	7831
MIS_A_FAC		use .....	7896
def .....	6238	MOD_1_PID_3_DIAG	
MIS_A_FAC_BUF [NC_SIZE_THD_ER_BUF]		def .....	7831
def .....	6238	use .....	7896
MIS_CTR_A [NC_CYL_NR]		MOD_1_PID_4_DIAG	
def .....	6238	def .....	7831
MIS_CTR_B [NC_CYL_NR]		use .....	7896
def .....	6238	MOD_1_PID_5_DIAG	
use .....	8360	def .....	7831
MIS_DET_CDN_APP_INH		use .....	7896
def .....	6213	MOD_1_PID_6_DIAG	
MIS_DET_CDN_APP_INH_NR		def .....	7831
def .....	6213	use .....	7896
MIS_DET_CDN_INH		MOD_1_PID_7_DIAG	
def .....	6225	def .....	7831
MIS_DET_CDN_INH_NR		use .....	7896
def .....	6225	MOD_1_PID_8_DIAG	
MIS_DET_CYL_INH		def .....	7831
def .....	6276	use .....	7896
MIS_DET_ENA_CUS_SPC		MOD_1_PID_9_DIAG	
def .....	8360	def .....	7831
MIS_NR_TDC_A		use .....	7896
def .....	6238	MOD_1_PID_A_DIAG	
MIS_NR_TDC_B		def .....	7831
def .....	6238	use .....	7896
MIS_STATE_CUS_SPC		MOD_1_PID_B_DIAG	
def .....	8360	def .....	7831
use .....	6276	use .....	7896
MIS_STATE_ER		MOD_1_PID_C_DIAG	
def .....	6276	def .....	7831
MIS_SUM_A		use .....	7896
def .....	6238	MOD_2_PID_1_DIAG	
use .....	8360	def .....	7831
MIS_SUM_A_CBK [NC_CBK_EX_NR]		use .....	7933
def .....	6238	MOD_2_PID_2_DIAG	
use .....	8360	def .....	7831
MIS_SUM_B		use .....	7933
def .....	6238	MOD_2_PID_3_DIAG	
use .....	8360	def .....	7831
MIS_SUM_B_CBK [NC_CBK_EX_NR]		use .....	7933
def .....	6239	MOD_2_PID_4_DIAG	
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def .....	8162	use .....	7933
use .....	8244	MOD_2_PID_5_DIAG	
Mk_soll_s		def .....	7831
def .....	8162	use .....	7933

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def .....	7831	def .....	7832
use .....	7933	use .....	8107
MOD_2_PID_7_DIAG		MOD_5_TID_3_DIAG	
def .....	7831	def .....	7832
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def .....	7831	def .....	7832
use .....	7933	use .....	8107
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def .....	7832	def .....	7832
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def .....	7832	def .....	7833
use .....	7933	use .....	8107
MOD_5_TID_10_DIAG		MOD_5_TID_9_DIAG	
def .....	7832	def .....	7833
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def .....	7832	def .....	7833
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MOD_5_TID_12_DIAG		def .....	7833
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use .....	8107	MOD_6_TID_3_DIAG	
MOD_5_TID_13_DIAG		def .....	7833
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use .....	8107	MOD_6_TID_4_DIAG	
MOD_5_TID_14_DIAG		def .....	7833
def .....	7832	use .....	8114
use .....	8107	MOD_9_VIT_1_DIAG	
MOD_5_TID_15_DIAG		def .....	7833
def .....	7832	use .....	7858
use .....	8107	MOD_9_VIT_2_DIAG	
MOD_5_TID_16_DIAG		def .....	7833
def .....	7832	use .....	7858
use .....	8107	MOD_9_VIT_3_DIAG	
MOD_5_TID_17_DIAG		def .....	7833
def .....	7832	use .....	7858
use .....	8107	MOD_9_VIT_4_DIAG	
MOD_5_TID_18_DIAG		def .....	7833
def .....	7832	use .....	7858
use .....	8107	Mrnn_test_dk	
MOD_5_TID_19_DIAG		def .....	8162
def .....	7832	use .....	7738, 8279
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MOD_5_TID_1_DIAG		def .....	8162
def .....	7832	use .....	7738
use .....	8107	Mrnn_test_vvt	
MOD_5_TID_20_DIAG		def .....	806
def .....	7832	use .....	7738
use .....	8107	Ms_res_max	

def .....	8163	MTCPWM_P	
use .....	8391	def .....	6546
Ms_sl		MTCPWM_VB_FAC	
def .....	8376	def .....	6546
Msa_arravrs [60]		MU_DI_STATE	
def .....	8163	def .....	7073
use .....	7558		
Msa_indexrs		<b>N</b>	
def .....	8163	N	
use .....	7558	def .....	1525
Msagr		use .....	561, 657, 1112, 1123, 1149, 1192, 1223, 1232, 1270, 1298, 1303, 1342, 1454, 1506, 1542, 1711, 1717, 1721, 1759, 1828, 1912, 1953, 2278, 2289, 2465, 2546, 2585, 2633, 2734, 2866, 3215, 3333, 3432, 3443, 3501, 3544, 3599, 3601, 3622, 3757, 3779, 3957, 4133, 4217, 4375, 4377, 4462, 4713, 4790, 4815, 4952, 5022, 5170, 5217, 5230, 5259, 5350, 5542, 5652, 5666, 5885, 5929, 6209, 6214, 6226, 6239, 6264, 6276, 6284, 6321, 6494, 6543, 6570, 6580, 6602, 6623, 6675, 7194, 7215, 7238, 7315, 7391, 7438, 7484, 7558, 7767, 7896, 7945, 8148, 8204, 8215, 8244, 8279
def .....	8163	N_32	
use .....	8279	def .....	1525
Msainfo [50]		use .....	853, 873, 917, 920, 932, 1042, 1167, 1198, 1206, 1270, 1442, 1447, 1454, 1474, 1489, 1534, 1542, 1584, 1721, 1754, 1759, 1766, 1777, 1801, 1813, 1820, 1822, 1825, 1846, 1873, 1875, 1881, 1896, 1921, 1925, 1943, 1953, 1962, 2042, 2100, 2109, 2154, 2159, 2164, 2169, 2179, 2188, 2230, 2262, 2353, 2373, 2386, 2422, 2465, 2579, 2590, 2622, 2627, 2643, 2679, 2734, 2866, 2885, 2943, 2958, 2968, 2976, 2988, 3054, 3069, 3107, 3113, 3144, 3150, 3350, 3520, 3589, 3611, 3614, 3622, 3630, 3639, 3692, 3701, 3749, 3779, 3792, 3797, 3823, 3844, 3847, 3851, 3868, 3881, 3909, 3931, 4006, 4045, 4136, 4245, 4430, 4432, 4717, 4773, 4803, 4903, 4909, 5015, 5065, 5238, 5314, 5350, 5422, 5459, 5474, 5553, 5589, 5608, 5802, 6051, 6063, 6095, 6102, 6133, 6209, 6214, 6239, 6264, 6276, 6284, 6396, 6428, 6565, 6582, 6602, 6623, 6651, 6692, 6697, 6710, 7002, 7238, 7267, 7315, 7767, 8026, 8391
def .....	8163	N_32_0_CP	
use .....	7558	def .....	3700
Msastz		N_32_DIF_REL_MON	
def .....	8163	def .....	7002
use .....	7558	N_32_LIM_DYN_DLY_ABS	
Msastzmsa		def .....	5259
def .....	8163	N_32_MON	
use .....	7558	def .....	7002
Msdk		use .....	6753, 6761, 6774, 6796, 6851, 6870, 6899, 6917, 6938, 6943, 6952, 6961, 6975, 7315
def .....	8163	N_32_MON2	
use .....	8279	def .....	7012
Msdk_f		N_32_MON_SAVE	
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def .....	8278		
Mshfm_ist			
def .....	8278		
Mslui			
def .....	8278		
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def .....	8163		
use .....	7315		
Mste			
def .....	8229		
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def .....	8163		
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MTCPWM_I_ADD			
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use .....	7315	N_DIF_PRED_OPM_1	
N_ab_m		def .....	3544
def .....	8287	N_DIF_PRED_OPM_2	
N_ALTER		def .....	3544
def .....	8368	N_DIF_PRED_PL_DROF	
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N_CAN		use .....	7315
def .....	1568	N_DIF_ST	
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def .....	560	N_DISP_DYN	
use .....	7315	def .....	8287
N_CRK_WIN		use .....	1584
def .....	1525	N_DYW_CP	
N_DELTA_LDC		def .....	1540
def .....	2585	N_dzm	
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def .....	5927	N_ECF	
N_DIF		def .....	1568
def .....	1122	use .....	8292
use .....	1112, 1270, 1925, 3514, 3544, 5929, 6683	N_ECF_CAN	
N_DIF_COR		def .....	1569
def .....	1122	use .....	8292
use .....	2307, 3443, 3501	N_ECF_CAN_2	
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def .....	6791	N_EF	
N_DIF_DROF		def .....	3614
def .....	1112	N_EFP_AV	
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def .....	4377	def .....	1525
N_DIF_MAX_LIM		use .....	1123
def .....	3779	N_FAST_INJ	
N_DIF_MIN_DIAG_ISC_CST		def .....	3331
def .....	4377	N_FIL_CST	
N_DIF_MMV		def .....	6494
def .....	1122	N_GB	
use .....	1721	def .....	1569
N_DIF_MMV_MON		use .....	3501, 8292
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N_DIF_MON		def .....	1569
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def .....	3544	def .....	8163
N_DIF_OFS_PRED_CS_OPM_2		use .....	8370
def .....	3544	N_GRD	
N_DIF_OFS_PRED_OPM_1		def .....	1525
def .....	3544	use .....	1112, 1717, 1721, 1759, 1962, 2307, 3443, 3501, 3545, 3779, 4462, 6656, 6710, 7316, 8215
N_DIF_OFS_PRED_OPM_2		N_GRD_FAC_P_D	
def .....	3544	def .....	3440
N_DIF_PRED_CS_OPM_1			

N_GRD_FAC_P_D_SLOW		N_KWP_OFS_VB	
def .....	3440	def .....	7681
N_GRD_FIL		use .....	7558
def .....	3779	N_KWP_OFS_VB_KWP	
N_GRD_FIL_FIL		def .....	7681
def .....	3779	N_KWP_OFS_VB_NVMY	
N_GRD_FIL_ISC_ACT_AST		def .....	7681
def .....	3501	N_LIH_PRS_OIL	
N_GRD_H_RES		def .....	8218
def .....	1525	use .....	1149
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def .....	3440	def .....	5259
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def .....	4462	def .....	4462
use .....	7391, 7558	use .....	7391, 7558, 7684
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def .....	3440	def .....	1569
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def .....	1720	def .....	1148
N_HYS_MIN_PUC		N_MAX_DROF	
def .....	1720	def .....	1148
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def .....	8287	def .....	1148
N_IGA_DIF_MAX_KNK [NC_NR_FRF_KNK_RTD]		N_MAX_LIH_EGS	
def .....	1952	def .....	1148
N_KNK		N_MAX_LIH_ETC	
def .....	1962	def .....	1148
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def .....	1952	def .....	1148
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def .....	7681	def .....	1148
use .....	7558	N_MAX_LIH_STATE_CMB_S	
N_KWP_OFS_ACC		def .....	8218
def .....	7681	use .....	1149
use .....	7558	N_MAX_MT	
N_KWP_OFS_ACC_DRI		def .....	1148
def .....	7681	N_MAX_SCDN_EQU [NC_NR_WIN_SCDN]	
use .....	7558	def .....	5885
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def .....	7681	def .....	1148
N_KWP_OFS_ACC_DRI_NVMY		use .....	3779
def .....	7681	N_MAX_THD_1	
N_KWP_OFS_ACC_KWP		def .....	1148
def .....	7681	use .....	1584
N_KWP_OFS_ACC_NVMY		N_MAX_THD_1_CAN	
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N_KWP_OFS_DRI		N_MAX_THD_2	
def .....	7681	def .....	1148
use .....	7558	use .....	1584, 8218
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def .....	7681	def .....	1569
N_KWP_OFS_DRI_NVMY		N_MAX_THD_LIH	
def .....	7681	def .....	1148
N_KWP_OFS_KWP		N_MAX_TOL_ST	
def .....	7681	def .....	1122
N_KWP_OFS_NVMY		use .....	1721
def .....	7681	N_MAX_VS_MAX	

def .....	1148	N_REL_CWP_2_2_DIF	
N_MIN_PUC		use .....	7316
def .....	1720	N_REL_CWP_DIF	
use .....	8209	def .....	4537
N_MIN_SCDN_EQU [NC_NR_WIN_SCDN]		use .....	7316
def .....	5885	N_REL_CWP_GRD	
N_MMV		def .....	1105
def .....	1525	N_REL_CWP_SP	
N_MMV_CAT_LDC		def .....	8225
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def .....	5757	def .....	626
use .....	645	use .....	2042, 4794, 4810
NC_ERR_DTC_REQ_CUS		NC_IDX_DIAG_AMP	
def .....	5695	use .....	4393
use .....	645	NC_IDX_DIAG_AMP_PLAUS	
NC_ERR_DTC_REQ_OBD		use .....	4393
def .....	5695	NC_IDX_DIAG_BN_T_ICL	
use .....	645	use .....	4477, 5083, 5103
NC_ERR_PRI_H		NC_IDX_DIAG_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	
def .....	5811	use .....	4393
use .....	645, 5853	NC_IDX_DIAG_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	
NC_ERR_SWI_MC_LEVEL_2_CAL		use .....	4393
def .....	7136	NC_IDX_DIAG_CAN_BOFF	
use .....	7160	use .....	4477, 5083, 5103
NC_ERR_SWI_MC_LEVEL_2_COD		NC_IDX_DIAG_CHG_LS_UP	
def .....	7136	use .....	4393
use .....	7160	NC_IDX_DIAG_COM_2_BOFF	
NC_ERR_SYM_FSD_CONF		use .....	4477, 5083, 5103
def .....	826	NC_IDX_DIAG_COM_2_T_ICL	
NC_FAC_10_SAMPLE		use .....	4477, 5083
def .....	1342	NC_IDX_DIAG_COM_2_TAM_ICL	
use .....	651	use .....	4477, 5083, 5103
NC_FAC_5_SAMPLE		NC_IDX_DIAG_CRK_PLAUS	
def .....	1342	use .....	4393
use .....	651	NC_IDX_DIAG_CRK_SYN	
NC_FAC_MAF_INT_20		use .....	4393
def .....	651	NC_IDX_DIAG_CRK_TOOTH	
use .....	2633, 8128	use .....	4393
NC_FAC_MAF_INT_AFR		NC_IDX_DIAG_CRK_TOOTH_PER	
def .....	6390	use .....	4393
NC_FAC_MAF_INT_LDC		NC_IDX_DIAG_CWP_COM_PLAUS	
def .....	6321		

use .....	4538	NC_IDX_DIAG_H_PRS_SYS_PRE	use .....	989, 6063
NC_IDX_DIAG_CWP_INT_OFF		NC_IDX_DIAG_ISC	use .....	4377
use .....	4538	NC_IDX_DIAG_ISC_CST	use .....	4377
NC_IDX_DIAG_CWP_PLAUS		NC_IDX_DIAG_IV [NC_CYL_NR]	use .....	6118
use .....	4538	NC_IDX_DIAG_LAM_AD_CUS	def .....	8311
NC_IDX_DIAG_CWP_PWR		NC_IDX_DIAG_LOAD_TPS_PLAUS	use .....	4393
use .....	4538	NC_IDX_DIAG_MAF	use .....	4393
NC_IDX_DIAG_DIAGCPS		NC_IDX_DIAG_MAP_DIP_PLAUS	use .....	4393
use .....	4393	NC_IDX_DIAG_MAP_DIP_SENS	use .....	4393
NC_IDX_DIAG_DYN_VLD_LS_UP		NC_IDX_DIAG_MAP_DIP_SHIFT	use .....	4393
use .....	5350	NC_IDX_DIAG_MEC_IVVT_EX [NC_NR_CBK_IVVT]	use .....	4393
NC_IDX_DIAG_ECU_NVMY		NC_IDX_DIAG_MEC_IVVT_IN [NC_NR_CBK_IVVT]	use .....	4393
use .....	4477	NC_IDX_DIAG_MTC_CTL_2	use .....	4393
NC_IDX_DIAG_EFF_IGA_CST_IS		NC_IDX_DIAG_MTC_CTL_3	use .....	4393
def .....	6509	NC_IDX_DIAG_MTC_DR	use .....	4393
use .....	6517	NC_IDX_DIAG_N_WHEEL_FN_LE	def .....	5045
NC_IDX_DIAG_EFF_IGA_CST_PL		NC_IDX_DIAG_N_WHEEL_FN_RI	def .....	5045
def .....	6509	NC_IDX_DIAG_N_WHEEL_RE_LE	def .....	5045
use .....	6517	NC_IDX_DIAG_N_WHEEL_RE_RI	def .....	5045
NC_IDX_DIAG_EFP		NC_IDX_DIAG_NS_ACT [NC_NOX_SENS_CONF]	use .....	6359
use .....	4721	NC_IDX_DIAG_NS_AFR [NC_NOX_SENS_CONF]	use .....	6389
NC_IDX_DIAG_EFP_CRASH		NC_IDX_DIAG_NS_AVL [NC_NOX_SENS_CONF]	use .....	6368
use .....	4721	NC_IDX_DIAG_NS_HTP [NC_NOX_SENS_CONF]	use .....	6330
NC_IDX_DIAG_EL_CPS		NC_IDX_DIAG_NS_LSL_UP_DOWN [NC_NOX_SENS_CONF]	use .....	6396
use .....	4393	NC_IDX_DIAG_NS_OFS [NC_NOX_SENS_CONF]	use .....	6378
NC_IDX_DIAG_FSD [NC_CBK_EX_NR]		NC_IDX_DIAG_NS_PUC [NC_NOX_SENS_CONF]	use .....	6405
def .....	6200	NC_IDX_DIAG_NS_STOP [NC_NOX_SENS_CONF]	use .....	6348
use .....	1019, 6142	NC_IDX_DIAG_NS_VLS_DYN [NC_NOX_SENS_CONF]	use .....	6338
NC_IDX_DIAG_FSD_H_RNG [NC_CBK_EX_NR]		NC_IDX_DIAG_NT_AGI		
use .....	6142			
NC_IDX_DIAG_FSD_LAM_LIM [NC_CBK_EX_NR]				
use .....	6142			
NC_IDX_DIAG_FTL_LE_CAN				
use .....	4746, 4757			
NC_IDX_DIAG_FTL_RI_CAN				
use .....	4746, 4757			
NC_IDX_DIAG_FUP				
use .....	4393			
NC_IDX_DIAG_FUP_EFP				
def .....	4734			
NC_IDX_DIAG_FUP_MFP_PLAUS				
use .....	4393, 6063			
NC_IDX_DIAG_FUP_ORNG				
use .....	4393, 6063			
NC_IDX_DIAG_FUP_ST				
use .....	4393			
NC_IDX_DIAG_FUP_ST_DLY				
use .....	6063			
NC_IDX_DIAG_FUP_ST_H_PRS				
use .....	6063			
NC_IDX_DIAG_FUP_ST_NO_RISE				
use .....	6063			
NC_IDX_DIAG_FUP_STOP				
use .....	6063			
NC_IDX_DIAG_H_PRS_SYS				
def .....	989			
use .....	4393			


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use .....	6485	NC_IDX_DIAG_SYN_CRK_CAM_IN_1	
NC_IDX_DIAG_NT_SO2P		use .....	4393
use .....	6485	NC_IDX_DIAG_T_ES	
NC_IDX_DIAG_OBD_VLD_LSH_UP [NC_CBK_EX_NR]		use .....	4477, 5083
use .....	5439	NC_IDX_DIAG_T_ES_TCO_FAST	
NC_IDX_DIAG_PBK_IV [NC_PBK_IV_NR]		use .....	4477
use .....	6118	NC_IDX_DIAG_T_ES_TCO_SLOW	
NC_IDX_DIAG_PER_CAM_EX [NC_NR_CAM_CBK]		use .....	4477
def .....	4416	NC_IDX_DIAG_TAM_CAN	
NC_IDX_DIAG_PER_CAM_EX_1		use .....	4477, 5083, 5103
use .....	4393	NC_IDX_DIAG_TAM_PLAUS	
NC_IDX_DIAG_PER_CAM_IN [NC_NR_CAM_CBK]		use .....	4477, 5103
def .....	4416	NC_IDX_DIAG_TCO_EL	
NC_IDX_DIAG_PER_CAM_IN_1		use .....	4477, 5083, 5103
use .....	4393	NC_IDX_DIAG_TCO_GRD	
NC_IDX_DIAG_PLAUS_CAM_EX [NC_NR_CAM_CBK]		use .....	4477, 5083, 5103
def .....	4416	NC_IDX_DIAG_TCO_PLAUS	
NC_IDX_DIAG_PLAUS_CAM_EX_1		use .....	4477, 5083, 5103
use .....	4393	NC_IDX_DIAG_TCO_STUCK	
NC_IDX_DIAG_PLAUS_CAM_IN [NC_NR_CAM_CBK]		use .....	4477, 5083, 5103
def .....	4416	NC_IDX_DIAG_TCO_STUCK_RNG	
NC_IDX_DIAG_PLAUS_CAM_IN_1		use .....	4477, 5083, 5103
use .....	4393	NC_IDX_DIAG_TECU	
NC_IDX_DIAG_PUC_VLD_LS_UP [NC_CBK_EX_NR]		use .....	4237
use .....	5298	NC_IDX_DIAG_TIA_EL	
NC_IDX_DIAG_PVS_DOUBLE		use .....	4194, 5083, 5103
use .....	4393	NC_IDX_DIAG_TIA_GRD	
NC_IDX_DIAG_REF_CRK_CAM_EX [NC_NR_CAM_CBK]		use .....	4194, 5083, 5103
def .....	4416	NC_IDX_DIAG_TIA_PLAUS	
NC_IDX_DIAG_REF_CRK_CAM_EX_1		use .....	5083, 5093
use .....	4393	NC_IDX_DIAG_TIA_TCHA_UP	
NC_IDX_DIAG_REF_CRK_CAM_IN [NC_NR_CAM_CBK]		use .....	4189
def .....	4416	NC_IDX_DIAG_TOOTH_OFF_EX [NC_NR_CAM_CBK]	
NC_IDX_DIAG_REF_CRK_CAM_IN_1		def .....	4417
use .....	4393	NC_IDX_DIAG_TOOTH_OFF_EX_1	
NC_IDX_DIAG_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR]		use .....	4393
use .....	5335	NC_IDX_DIAG_TOOTH_OFF_IN [NC_NR_CAM_CBK]	
NC_IDX_DIAG_SHIFT_AFR_LSL_UP		def .....	4417
use .....	5335	NC_IDX_DIAG_TOOTH_OFF_IN_1	
NC_IDX_DIAG_SLV_IVVT_EX [NC_NR_CBK_IVVT]		use .....	4393
use .....	4393	NC_IDX_DIAG_TPS_1	
NC_IDX_DIAG_SLV_IVVT_IN [NC_NR_CBK_IVVT]		use .....	4393
use .....	4393	NC_IDX_DIAG_TPS_2	
NC_IDX_DIAG_SYN_CAM_EX [NC_NR_CAM_CBK]		use .....	4393
def .....	4416	NC_IDX_DIAG_TPS_AD	
NC_IDX_DIAG_SYN_CAM_EX_1		use .....	4393
use .....	4393	NC_IDX_DIAG_TPS_AD_BOL	
NC_IDX_DIAG_SYN_CAM_IN [NC_NR_CAM_CBK]		use .....	4393
def .....	4416	NC_IDX_DIAG_TPS_MAF_1	
NC_IDX_DIAG_SYN_CAM_IN_1		use .....	4393
use .....	4393	NC_IDX_DIAG_TPS_MAF_2	
NC_IDX_DIAG_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]		use .....	4393
def .....	4416	NC_IDX_DIAG_TPS_RATIO	
NC_IDX_DIAG_SYN_CRK_CAM_EX_1		use .....	4393
use .....	4393	NC_IDX_DIAG_TPS_ST_CHK_2	
NC_IDX_DIAG_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]		use .....	4393
def .....	4416	NC_IDX_DIAG_TTIP_MES_LSH_UP [NC_CBK_EX_NR]	

use .....	5439	NC_INI_CTR_DEAC	
NC_IDX_DIAG_VCV		def .....	920
use .....	4393	NC_INJ_CONF	
NC_IDX_DIAG_VCV_PLAUS		def .....	626
use .....	6063	use 645, 5420, 5802, 5870, 5895, 7896, 7933, 7945, 8005	
NC_IDX_DIAG_VS		NC_INJ_CONF_GDI	
def .....	5024	def .....	626
use .....	4393, 5083, 5103	NC_INJ_INH_SWI_IV_SHIFT_NR	
NC_IDX_DIAG_VS_BOL		def .....	626
def .....	5024	use .....	2042, 2295
NC_IDX_DIAG_VS_GRD		NC_INJ_MOD_DI	
def .....	5024	def .....	2045
NC_IDX_DIAG_VS_PLAUS_POW		NC_INJ_MOD_HOM	
def .....	5024	def .....	1897, 2045
NC_IDX_DIAG_VS_PLAUS_STUCK		use .....	1876, 1881, 2004, 2262
def .....	5024	NC_INJ_MOD_HOMS	
NC_IDX_DIAG_VS_TOL		def .....	2045
def .....	5024	NC_INJ_MOD_MASK_1	
NC_IDX_DIAG_XX		def .....	1897, 2045
use .....	5870	use .....	1876, 1881, 2004, 2262
NC_IDX_NR_WRG_MC_FCT_SPC_IST		NC_INJ_MOD_MASK_2	
def .....	7100	def .....	2045
use .....	7160	use .....	6118, 8244
NC_IDX_RESP_MC_FCT_SPC_IST [NC_TEST_REC_IDX_		NC_INJ_MOD_MULT1	
MAX_MON2]		def .....	2045
def .....	7101	use .....	2216, 2262, 8244
use .....	7160	NC_INJ_MOD_MULT1_PLS3	
NC_IDX_RESP_WRG_MC_FCT_SPC_IST		def .....	2045
def .....	7101	NC_INJ_MOD_S	
use .....	7160	def .....	1897, 2045
NC_IDX_STATE_SOPC_DFCT		NC_INJ_MOD_SINGLE	
def .....	7186	def .....	2045
use .....	7160	use .....	2122, 3333, 6118, 8244
NC_IDX_TBL_DIAG_RBM [NC_NR_DIAG_RBM]		NC_INJ_MOD_TEST_PLS	
def .....	5871	def .....	2045
NC_IDX_TEST_MC_FCT_SPC_IST [NC_TEST_REC_IDX_		NC_IV_CONF	
MAX_MON2]		def .....	626
def .....	7101	NC_IV_CRASH	
use .....	7160	def .....	626
NC_IGBT_CUT_OFF_T		use .....	2042
def .....	920	NC_K_EWS_MAX	
use .....	604	use .....	7558, 7684
NC_IGC_CONF		NC_K_EWS_UNLOCKED	
def .....	917	use .....	7558
NC_IGC_DLY		NC_KEY_OFF_NR	
def .....	4773	def .....	906
NC_IGK_NR		use .....	604
def .....	906	NC_KEY_OFF_THR	
NC_IGK_ON_NR		def .....	906
use .....	604	use .....	604
NC_IGN_DIAG_TYP		NC_KNKS_CONF	
def .....	4774	def .....	1967
NC_IMOB_MODE		use .....	604, 1962, 4903
def .....	828	NC_KNKWB_INI	
NC_IN_REF		def .....	1967
def .....	812	use .....	604
use .....	1754		

NC_KNKWB_PRE_INI		NC_MISF_VERS	
def .....	1967	def .....	635
NC_KNKWE_INI		use .....	604
def .....	1967	NC_MOD_1_PID_1_DIAG	
use .....	604	def .....	7836
NC_KNKWE_PRE_INI		NC_MOD_1_PID_2_DIAG	
def .....	1967	def .....	7836
NC_LAM_SWI		NC_MOD_1_PID_3_DIAG	
def .....	604	def .....	7836
NC_LAMB_REF [NC_CYL_NR]		NC_MOD_1_PID_4_DIAG	
def .....	812	def .....	7836
use .....	1754, 2296, 2866, 3847, 8244, 8271, 8310	NC_MOD_1_PID_5_DIAG	
NC_LDP_1_DTC_TABLE_SIZE		def .....	7836
def .....	5757	NC_MOD_1_PID_6_DIAG	
use .....	645	def .....	7836
NC_LDP_2_DTC_MIS_TABLE_SIZE		NC_MOD_1_PID_7_DIAG	
def .....	5757	def .....	7836
use .....	645	NC_MOD_1_PID_8_DIAG	
NC_LDP_2_DTC_TABLE_SIZE		def .....	7836
def .....	5757	NC_MOD_1_PID_9_DIAG	
use .....	645	def .....	7836
NC_LSHPWM_BOL_LSH_DOWN		NC_MOD_1_PID_A_DIAG	
def .....	2423	def .....	7836
use .....	651, 2435	NC_MOD_1_PID_B_DIAG	
NC_LSHPWM_BOL_LSH_UP		def .....	7836
def .....	2389	NC_MOD_1_PID_C_DIAG	
use .....	651	def .....	7836
NC_LSHPWM_TOL_LSH_DOWN		NC_MOD_2_PID_1_DIAG	
def .....	2423	def .....	7836
use .....	651	NC_MOD_2_PID_2_DIAG	
NC_LSHPWM_TOL_LSH_UP		def .....	7836
def .....	2389	NC_MOD_2_PID_3_DIAG	
use .....	651	def .....	7836
NC_MAF_CONF		NC_MOD_2_PID_4_DIAG	
def .....	604	def .....	7836
NC_MAF_FAC_CYL		NC_MOD_2_PID_5_DIAG	
def .....	2889	def .....	7837
use .....	604, 1167, 1192, 8279	NC_MOD_2_PID_6_DIAG	
NC_MAF_NR		def .....	7837
def .....	834	NC_MOD_2_PID_7_DIAG	
use .....	1019, 2866, 4371, 4815, 5507	def .....	7837
NC_MAF_SENS_CONF		NC_MOD_2_PID_8_DIAG	
def .....	604	def .....	7837
use .....	8279	NC_MOD_2_PID_9_DIAG	
NC_MAP_CONF		def .....	7837
def .....	604	NC_MOD_2_PID_A_DIAG	
NC_MAP_SENS_NR		def .....	7837
use .....	1019, 7316, 7767	NC_MOD_2_PID_B_DIAG	
NC_MAX_ADC_OUT		def .....	7837
def .....	561	NC_MOD_2_PID_C_DIAG	
NC_MAX_IGN_MPL_NR		def .....	7837
def .....	1883	NC_MOD_5_TID_10_DIAG	
NC_MAX_SEG_CSERS_INJ		def .....	7837
def .....	6110	NC_MOD_5_TID_11_DIAG	
NC_MIL_CHK_TYP		def .....	7837
def .....	5828	NC_MOD_5_TID_12_DIAG	
use .....	645	def .....	7837

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NC_MOD_5_TID_13_DIAG	use .....	638
def .....		7837
NC_MOD_5_TID_14_DIAG	NC_N_DIF_MIN_CRLC	1127
def .....	def .....	7837
NC_MOD_5_TID_15_DIAG	use .....	604
def .....	NC_N_MAX	854
NC_MOD_5_TID_16_DIAG	def .....	854
def .....	use .....	604, 638
NC_MOD_5_TID_17_DIAG	NC_N_MAX_IV_TEST_MOD	627
def .....	def .....	7837
NC_MOD_5_TID_18_DIAG	use .....	2042
def .....	NC_N_MIN	854
NC_MOD_5_TID_19_DIAG	def .....	854
def .....	use .....	604, 638, 1721
NC_MOD_5_TID_1_DIAG	NC_N_MIN_VLS_UP_MV	1342
def .....	def .....	7837
NC_MOD_5_TID_20_DIAG	use .....	651
def .....	NC_N_REF_MAX	1151
NC_MOD_5_TID_2_DIAG	def .....	1151
def .....	use .....	604
NC_MOD_5_TID_3_DIAG	NC_N_SEG_HALF_END	854
def .....	def .....	854
NC_MOD_5_TID_4_DIAG	use .....	638
def .....	NC_NOX_SENS_CONF	643
NC_MOD_5_TID_5_DIAG	def .....	643
def .....	use .....	811,
NC_MOD_5_TID_6_DIAG	992, 1382, 1399, 2885, 2943, 2976, 2988, 3054,	
def .....	3066, 3069, 3074, 3107, 3129, 3150, 3189, 3193,	
NC_MOD_5_TID_7_DIAG	4916, 4921, 5589, 5608, 5635, 6313, 6321, 6330,	
def .....	6338, 6348, 6359, 6368, 6377, 6378, 6389, 6396,	
NC_MOD_5_TID_8_DIAG	6405, 6413, 6428, 6469, 7316, 7558, 7684, 7767,	
def .....	8363	
NC_MOD_5_TID_9_DIAG	NC_NR_BK_INJ	627
def .....	def .....	7838
NC_MOD_6_TID_1_DIAG	NC_NR_BUF_SAMPLE_LEN	1342
def .....	def .....	7838
NC_MOD_6_TID_2_DIAG	use .....	651
def .....	NC_NR_BUF_SUM_LEN	1343
NC_MOD_6_TID_3_DIAG	def .....	1343
def .....	use .....	651
NC_MOD_6_TID_4_DIAG	NC_NR_BURST_MOD_INJ	627
def .....	def .....	7838
NC_MOD_9_VIT_1_DIAG	NC_NR_CAL_CHAR_LEN	8090
def .....	def .....	7838
NC_MOD_9_VIT_2_DIAG	NC_NR_CAM_CBK	1507
def .....	def .....	7838
NC_MOD_9_VIT_3_DIAG	use 638, 2613, 2866, 4371, 4456, 5161, 5230, 5409,	
def .....	5430, 5507, 5635, 7316, 7559, 8215, 8400	
NC_MOD_9_VIT_4_DIAG	NC_NR_CBK_IVVT	604
def .....	def .....	7838
NC_MPL_IGN_H_RNG_CRK_MAX	use 811, 2449, 2866, 4371, 4393, 5161, 5191, 5230,	
def .....	5286, 5379, 5409, 5507, 5635, 7316, 8400	
NC_MPL_T_MAX	NC_NR_CONF_CAM	639
def .....	def .....	1883
use .....	NC_NR_CONF_LSH_RLY	651
NC_N_CRK_WIN_ENA	def .....	651
def .....	NC_NR_CP_BUF	3693
def .....	def .....	854

use .....	604, 632	NC_NR_FRF_KNK_RTD	
NC_NR_CP_LAM_AD		def .....	1953
def .....	3739	NC_NR_FRF_SET	
use .....	632	def .....	5793
NC_NR_CPS_CP		use .....	645, 5802
use .....	7316, 8038	NC_NR_GAP	
NC_NR_DBG_NVMY		def .....	874
use .....	7316	use .....	604, 638, 853
NC_NR_DCDC_INJ		NC_NR_HIS	
def .....	627	def .....	5821
use .....	2042	use .....	645, 5825
NC_NR_DIAG_RBM		NC_NR_IDX_MFF_1_INJ	
def .....	5871	def .....	627
use .....	645, 5695, 5858, 7559	use .....	2004
NC_NR_DIST_RBM		NC_NR_IDX_MFF_2_INJ	
def .....	5871	def .....	627
NC_NR_DTC_FMT		use .....	2004
def .....	5757	NC_NR_IDX_MFF_SP_2	
use .....	645, 5695	def .....	627
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NC_NR_EDGE_CAM_IN		use .....	2004
def .....	874	NC_NR_IDX_PRS_DEC_INJ	
use .....	604, 638, 1534, 7559, 8400	def .....	627
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use .....	645, 5802	def .....	627
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def .....	2968	NOX_NS_AD_TMP [NC_NOX_SENS_CONF]	
use .....	2989	def .....	2984
NOX_COR_HOMS_PRED_TMP		NOX_NS_DIAG [NC_NOX_SENS_CONF]	
def .....	2968	def .....	992
NOX_COR_HOMS_TMP		use .....	3194, 6359, 6378, 6389, 6405, 6429
def .....	2968	NOX_NS_DIAG_ACT_GRD_MAX [NC_NOX_SENS_CONF]	
NOX_COR_INT		def .....	6358
def .....	2984	NOX_NS_DIAG_ACT_MAX [NC_NOX_SENS_CONF]	
NOX_COR_RED		def .....	6358
def .....	2984	NOX_NS_DIAG_ACT_MMV [NC_NOX_SENS_CONF]	
use .....	6378	def .....	6358
NOX_COR_RED_MMV		NOX_NS_DIAG_ACT_OLD [NC_NOX_SENS_CONF]	
def .....	2984	def .....	6358
NOX_COR_S		NOX_NS_KWP	
def .....	2976	def .....	7308
use .....	2989, 3069	NOX_NS_OFS_AD_MIN [NC_NOX_SENS_CONF]	
NOX_COR_S_MMV		def .....	3193
def .....	3069	NOX_OFS_LOAD [NC_NOX_SENS_CONF]	
NOX_COR_S_PRED		def .....	3193
def .....	2976	use .....	7316
use .....	2989	NOX_OFS_LOAD_DIAG [NC_NOX_SENS_CONF]	
NOX_COR_S_PRED_TMP		def .....	6378
def .....	2976	NOX_OFS_PUC [NC_NOX_SENS_CONF]	
NOX_COR_S_TMP		def .....	3193
def .....	2976	use .....	7316
NOX_EFF [NC_NT_NR]		NOX_OUT_INT_TMP [NC_NOX_SENS_CONF]	
def .....	3073	def .....	2984
NOX_FLOW		NOX_OUT_MDL	
def .....	2984	def .....	2985
NOX_HOMS_PRED_HYS		NOX_OUT_MDL_INT	
def .....	2984	def .....	2985
NOX_HOMS_PRED_THD		NOX_OUT_MES [NC_NOX_SENS_CONF]	
def .....	2984	def .....	3066
NOX_NOX_SENS [NC_NOX_SENS_CONF]		NOX_OUT_MES_INT [NC_NOX_SENS_CONF]	
def .....	1381	def .....	3066
use .....	992	use .....	2989
NOX_NOX_SENS_DIAG [NC_NOX_SENS_CONF]		NOX_S_PRED_HYS	
def .....	1381	def .....	2985
use .....	992	NOX_S_PRED_THD	
NOX_NOX_SENS_DIAG_H_RES [NC_NOX_SENS_CONF]		def .....	2985
def .....	1381	NOX_SENS_MAX	
NOX_NOX_SENS_H_RES [NC_NOX_SENS_CONF]		def .....	2985
def .....	1381	NOX_SENS_MAX_BAS	
NOX_NS [NC_NOX_SENS_CONF]		def .....	2985
def .....	992	NOX_SENS_TEMP [NC_NOX_SENS_CONF]	
use .....	3193, 6378, 7316	def .....	1381
NOX_NS_AD [NC_NOX_SENS_CONF]			

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use .....	992, 1382	def .....	988
NR_ADD_IBS		use .....	3868
def .....	8368	NR_EGY_CTL_CYL_CLC	
NR_ALTER_EVE_WR		def .....	2278
def .....	4095	NR_IBS	
NR_BUF_SAMPLE [NC_NR_BUF_SAMPLE_LEN][NC_CBK_EX_NR]		def .....	8368
def .....	1341	NR_INJ_PLS_HOM_REQ	
NR_CBK_EX		def .....	8243
def .....	944	use .....	3333
use .....	5409	NR_INJ_PLS_HOM_REQ_TMP	
NR_CBK_EX_LS_DOWN		def .....	8243
def .....	2416	NR_INJ_PLS_S_REQ	
NR_CBK_EX_NOT_LS_DOWN		def .....	8243
def .....	2416	use .....	3333
NR_CONF_CBK_EX		NR_MPL_CYL_IGN [NC_CYL_NR]	
def .....	944	def .....	1896
use .....	2416	use .....	1881
NR_CRU_DIF_STEP		NR_MU_COMP	
def .....	7201	def .....	7135
NR_CTR_IDX_MON		NR_MU_HW_VERS	
def .....	6760	def .....	7135
NR_CYC_EGY_LEVEL_IV_BAL_CTL_MAX		NR_PAT	
def .....	3215	def .....	2295
NR_CYC_FAC_TI_ER_BAL_CTL_MAX		NR_PAT_OLD	
def .....	3298	def .....	2295
NR_CYC_MFF_ADD_ER_BAL_CTL_MAX		NR_PAT_SCC	
def .....	3269	def .....	6665
NR_CYL_CLC_RED_INJ		use .....	2296, 4462
def .....	3331	NR_PAT_SCC_N_MAX	
use .....	2005, 2122, 2130, 2133, 2136, 2140, 2142, 2144, 2147, 2262	def .....	4462
NR_CYL_DIAG_IV		use .....	7391, 7559
def .....	4803	NR_PAT_SEL_CYL	
NR_CYL_INH_IV_DYN		def .....	2307
def .....	2039	use .....	2296
NR_CYL_INJ_BAS		NR_PBK_IV_INI	
def .....	2039	def .....	2039
use .....	2241, 2278, 4803	NR_PHA_LAM_AD_INJ_COLD [NC_CBK_EX_NR]	
NR_CYL_INJ_BAS_DIAG_IV_TMP		def .....	3379
def .....	4803	NR_PHA_LAM_AD_INJ_HOT [NC_CBK_EX_NR]	
NR_CYL_INJ_BAS_PREV		def .....	3379
def .....	2039	NR_PRI_CH_MOD	
use .....	4803	def .....	1796
NR_CYL_INJ_BAS_PREV_DIAG_IV_TMP		use .....	8233
def .....	4803	NR_PRI_CH_MOD_REQ	
NR_CYL_IV_TEST_MOD		def .....	1796
def .....	3331	use .....	8233
use .....	2042	NR_PRI_CH_MOD_REQ_L	
NR_CYL_LAM_AD_INJ [NC_CBK_EX_NR]		def .....	1809
def .....	3379	use .....	1796
use .....	3350, 3406	NR_SAMPLE_1_SUM	
NR_CYL_OFS_INH_IV_DYN		def .....	1341
def .....	2039	NR_SAMPLE_2_SUM	
NR_CYL_SCC_TEG [NC_CBK_EX_NR]		def .....	1341
def .....	2446	NR_SAMPLE_TOT_MV [NC_CBK_EX_NR]	
NR_CYL_VVL_H_ACT		def .....	1341
		NR_SEL_CYL	
		def .....	2307


NR_STEP_ON		NT_AGI_SO2P_FQ_SUM_EXT_ADJ	
def .....	7201	def .....	7682
NR_VALUE_BUF_SAMPLE		use .....	3075
def .....	1341	NT_AGI_SUL	
NR_VALUE_BUF_SUM		def .....	3073
def .....	1341	use 1789, 2885, 3129, 3194, 6378, 6485, 7316, 7559	
NR_VLS_UP_BUF_IDX [NC_CBK_EX_NR]		NT_AGI_SUL_KWP	
def .....	1341	def .....	7308
NR_VLS_UP_RAW_BUF_IDX		NT_AGI_SUL_SNG [NC_NT_NR]	
def .....	1341	def .....	3073
NR_VLS_UP_RAW_SAMPLE_MV		use .....	6378, 7559
def .....	1341	NT_AGI_SUL_SNG_EXT_ADJ [NC_NT_NR]	
NR_VS_CRU		def .....	7682
def .....	7201	use .....	3075
use .....	1584	NT_AGI_THERMO	
NR_VS_CRU_IF		def .....	3073
def .....	1569	use ..... 2885, 3108, 6429, 6485, 7316, 7559, 8365	
use .....	7202	NT_AGI_THERMO_GRD	
Nsl_koor		def .....	3107
def .....	8163	use .....	8365
use .....	8212	NT_AGI_THERMO_SNG [NC_NT_NR]	
Nslb		def .....	3074
def .....	8164	use .....	3113, 7559
use .....	8212	NT_AGI_THERMO_SNG_EXT_ADJ [NC_NT_NR]	
Nsllm		def .....	7682
def .....	8212	use .....	3075
Nstat		NT_AGI_THERMO_ST	
def .....	8212	def .....	3107
NT_AGI		NT_EFF	
def .....	3073	def .....	2985
use ..... 1777, 2416, 2885, 2989, 3054, 3194, 4068,		NT_EFF_BAS	
5589, 6378, 7316, 7559, 7684		def .....	2985
NT_AGI_AV		NT_EFF_COR	
def .....	2985	def .....	2985
use .....	3075	NT_EFF_COR_RGN_ST	
NT_AGI_BAS [NC_NT_NR]		def .....	2985
def .....	3073	use .....	3075
NT_AGI_INC_SO2P [NC_NT_NR]		NT_O2_STC	
def .....	3113	def .....	2985
use .....	3075	NT_O2_STC_AD	
NT_AGI_KWP		def .....	3177
def .....	7308	use .....	2989
NT_AGI_NTLD		NT_O2_STC_BAS	
def .....	3073	def .....	2985
use .....	2989	use .....	3177
NT_AGI_OBS		NT_O2_STC_OFS	
def .....	3073	def .....	3177
NT_AGI_OBS_SNG [NC_NT_NR]		NT_STC_BAS_RNG_H	
def .....	3073	def .....	2985
NT_AGI_S_RED		use .....	3075
def .....	3073	NT_STC_RNG_H	
use .....	2989	def .....	2985
NT_AGI_SO2P_FQ		NT_SUL	
def .....	3073	def .....	3113
NT_AGI_SO2P_FQ_SUM		use ..... 3054, 3075, 3129, 3144, 3194, 6379, 6485,	
def .....	3073	7316, 7738, 7767	
use .....	7559	NT_SUL_32 [NC_NT_NR]	

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def .....	3113	def .....	2986
use .....	6379, 7559	use .....	6348
NT_SUL_32_EXT_ADJ [NC_NT_NR]		NTL_RGN_ST_NOX	
def .....	7682	def .....	2986
use .....	3113	use .....	3075
NT_SUL_AGI		NTLD	
def .....	3074	def .....	2986
NT_SUL_AGI_DELTA [NC_NT_NR]		use .....	3054, 3075, 6379, 6405, 6429, 6469
def .....	3113	NTLD_AGI [NC_NT_NR]	
NT_SUL_AGI_SNG [NC_NT_NR]		def .....	3074
def .....	3074	NTLD_MAX	
use .....	3113	def .....	2986
NT_SUL_DELTA [NC_NT_NR]		NTLD_MAX_AFS	
def .....	3113	def .....	2986
NT_SUL_H		NTLD_MAX_AFS_BAS	
def .....	3113	def .....	2986
use .....	3075, 6485	NTLD_MAX_VS	
NT_SUL_H_32 [NC_NT_NR]		def .....	2986
def .....	3113	NTLD_MDL	
use .....	7559	def .....	2986
NT_SUL_H_32_EXT_ADJ [NC_NT_NR]		use .....	3075
def .....	7682	NTLD_MDL_DIF	
use .....	3113	def .....	996
NT_SUL_H_DELTA [NC_NT_NR]		use .....	2989
def .....	3113	NTLD_RGN_ST	
NT_SUL_H_SO2P_BEG [NC_NT_NR]		def .....	2986
def .....	3113	Nturb	
NT_SUL_KWP		def .....	8288
def .....	7308	Nwa1_pos	
NT_SUL_MAX [NC_NT_NR]		def .....	8399
def .....	3113	Nwa1_time	
NT_SUL_SO2P_BEG [NC_NT_NR]		def .....	8399
def .....	3113	Nwe	
NT_SUL_UPD		def .....	8209
def .....	3074	Nwe1_pos	
use .....	3113	def .....	8400
NT_SUL_UPD_OLD		Nwe1_time	
def .....	3113	def .....	8400
NTL		<b>O</b>	
def .....	2985	O2_FLOW	
NTL_DEC [NC_NT_NR]		def .....	2986
def .....	2985	O2L	
NTL_DEC_INT [NC_NT_NR]		def .....	2986
def .....	2985	O2L_ADD_LAMB_PLS [NC_CBK_EX_NR]	
use .....	2943, 6348	def .....	2563
NTL_DEC_INT_AD		O2L_AFL_CDN_MAT [NC_CBK_EX_NR]	
def .....	996	def .....	5562
use .....	3177	O2L_AFR_CDN_COR [NC_CBK_EX_NR]	
NTL_DEC_INT_SWI [NC_NT_NR]		def .....	5562
def .....	2985	O2L_AFR_CDN_COR_MAT [NC_CBK_EX_NR]	
NTL_DEC_INT_THD [NC_NOX_SENS_CONF]		def .....	5562
def .....	6347	O2L_CAT_DIAG_AFL [NC_CBK_EX_NR]	
NTL_H		def .....	5562
def .....	2985	use .....	5535, 6429
NTL_MIN		O2L_CAT_DIAG_AFL_SUM	
def .....	2985	def .....	5562
NTL_RGN_ST			

O2L_DELTA_AFR_CDN [NC_CBK_EX_NR]		O2L_RLS_SP_PCAT_PURGE [NC_CBK_EX_NR]	
def .....	5562	def .....	2912
O2L_H_AMPL_MV [NC_CBK_EX_NR]		use .....	2928
def .....	5562	O2L_RLS_TOT_CAT_PURGE [NC_CBK_EX_NR]	
O2L_H_AMPL_SUM [NC_CBK_EX_NR]		def .....	2927
def .....	5562	O2L_SP_HALF_LAMB_PLS [NC_CBK_EX_NR]	
O2L_INT_LOAD_PHA [NC_CBK_EX_NR]		def .....	2563
def .....	5607	O2L_SP_NEW_LAMB_PLS [NC_CBK_EX_NR]	
O2L_INT_PARK_PHA [NC_CBK_EX_NR]		def .....	2563
def .....	5607	O2L_SP_PLS	
O2L_INT_RGN_H_AMPL_PHA [NC_CBK_EX_NR]		def .....	2958
def .....	5607	use .....	2563
O2L_INT_RGN_L_AMPL_PHA [NC_CBK_EX_NR]		O2L_SP_PLS_EXT	
def .....	5607	def .....	2579
O2L_INT_THD_TMP_DIAG_AFL [NC_CBK_EX_NR]		use .....	2958
def .....	5607	O2L_SUM_CAT_DIAG_AFL [NC_CBK_EX_NR]	
O2L_L_AMPL_MV [NC_CBK_EX_NR]		def .....	5563
def .....	5562	OBD_AMP	
O2L_L_AMPL_SUM [NC_CBK_EX_NR]		def .....	7308
def .....	5562	use .....	5802
O2L_LAMB_PLS [NC_CBK_EX_NR]		OBD_EGR_DIF	
def .....	2563	def .....	5801
O2L_LOAD_MV [NC_CBK_EX_NR]		use .....	7896, 7945
def .....	5562	OBD_FTL	
O2L_LOAD_PHA [NC_CBK_EX_NR]		def .....	5801
def .....	5607	use .....	7896, 7945
use .....	5563	OBD_FUP	
O2L_LOAD_SUM [NC_CBK_EX_NR]		use .....	5802
def .....	5562	OBD_FUP_RNG_H	
O2L_MMV_CAT_DIAG_AFL [NC_CBK_EX_NR]		def .....	7308
def .....	5562	use .....	7559
O2L_NT_MAT		OBD_FUP_RNG_H_H	
def .....	5562	def .....	7308
O2L_OUT_INT_DLY_DIAG_LSL [NC_CBK_EX_NR]		OBD_FUP_RNG_H_L	
def .....	5259	def .....	7308
O2L_PARK_MV [NC_CBK_EX_NR]		OBD_IGA_IGC	
def .....	5563	def .....	7308
O2L_PARK_PHA [NC_CBK_EX_NR]		use .....	5802
def .....	5607	OBD_LAM_AD [NC_CBK_EX_NR]	
use .....	5563	def .....	1017
O2L_PARK_SUM [NC_CBK_EX_NR]		OBD_LAM_COR [NC_CBK_EX_NR]	
def .....	5563	def .....	7308
O2L_RGN_H_AMPL_PHA [NC_CBK_EX_NR]		OBD_LAMB_SP	
def .....	5607	def .....	7308
use .....	5563	OBD_MAF	
O2L_RGN_L_AMPL_PHA [NC_CBK_EX_NR]		def .....	7308
def .....	5607	use .....	5802
use .....	5563	OBD_N	
O2L_RLS_ADD_CAT_PURGE [NC_CBK_EX_NR]		def .....	7308
def .....	2927	use .....	5802
O2L_RLS_MAIN_CAT_PURGE [NC_CBK_EX_NR]		OBD_PV_1	
def .....	2927	def .....	5801
O2L_RLS_PCAT_PURGE [NC_CBK_EX_NR]		use .....	7896, 7945
def .....	2927	OBD_PV_2	
use .....	2913	def .....	5801
O2L_RLS_REST_CAT_PURGE [NC_CBK_EX_NR]		use .....	7896, 7945
def .....	2927	OBD_TAM	

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def .....	1569	def .....	3576
use .....	5802, 7316, 7896, 7945	use .....	3573
OBD_TCO		OPG_SP_REQ_ACR	
def .....	7308	def .....	8197
use .....	5802	use .....	3573, 3576
OBD_TIA		OPG_SP_SEL_ACR	
def .....	7308	def .....	3573
use .....	5802	OPM_AV	
OBD_TPS_1		def .....	8137
def .....	5801	use .	937, 1105, 1112, 1123, 1584, 1721, 1925, 1962, 2383, 2989, 3054, 3443, 3520, 3545, 3681, 3847, 4136, 4763, 5217, 5332, 5955, 6265, 6284, 6429, 6683, 6796, 7767, 8304
use .....	1584, 7896, 7945	OPM_AV_DIAGCPS	
OBD_TPS_2		def .....	5954
def .....	5801	use .....	7767
use .....	7896, 7945	OPM_AV_MON	
OBD_TPS_REL		def .....	6792
def .....	5801	use .....	6753, 6777, 6899, 6944
use .....	7896, 7945	OPM_AV_MON2	
OBD_TPS_SP		def .....	7012
def .....	5801	OPM_AV_SEL_TQ_ST	
use .....	7896, 7945	def .....	6683
OBD_VB		OPM_EXT_REQ	
def .....	7309	def .....	1763
use .....	5802	use .....	8292
OPG_ACR		OPM_EXT_REQ_TMP	
def .....	1097	def .....	1763
use .....	987, 3580, 7316, 8197	OPM_REQ	
OPG_ACR_KWP		def .....	8137
def .....	7309	use .....	1925, 3443, 3520, 3545
OPG_DIF_ACR		OPM_REQ_CUS	
def .....	3580	def .....	8137
use .....	4337, 5802	use .....	2976, 3191, 6429, 8128
OPG_DIF_ACR_ERR_MAX		Oz_krz2cnt	
def .....	4337	def .....	8164
OPG_SP_ACR		Oz_krzcnt	
def .....	3573	def .....	8164
use .....	3580, 4337, 5802, 7316, 7896, 7945	use .....	7316
OPG_SP_ACR_EXT_ADJ		Oz_krzkor	
def .....	7435	def .....	8164
use .....	3576	Oz_krzkor2k	
OPG_SP_ACR_FIL		def .....	8164
def .....	4337	Oz_krzor	
OPG_SP_ACR_GRD		use .....	7316
def .....	4337	Oz_kvbog	
OPG_SP_ACR_KWP		def .....	8164
def .....	7309	use .....	7316
OPG_SP_AD_ACR		Oz_kvbsm_ul	
def .....	4320	def .....	8164
use .....	3573	use .....	7316, 8204
OPG_SP_CTL_ACR		Oz_lf1c	
def .....	3580	def .....	8203
OPG_SP_EXT_ACR		use .....	7316
def .....	3576	Oz_lf1t	
use .....	3573	def .....	8164
OPG_SP_LIH_ACR		use .....	7316
def .....	3576	OPG_SP_POP_ACR	
use .....	3573	def .....	8164
OPG_SP_POP_ACR		use .....	7316




def .....	8203	def .....	8288
P_rail_kh		use .....	1584
def .....	8233	POW_CTL_PRI_PEAK_RED_CFT	
Pbrems		def .....	8288
def .....	8288	use .....	1584
Pbremsu		POW_CTL_PWR_CNS_1	
def .....	8288	def .....	8288
PBSU		use .....	1584
def .....	807	POW_CTL_PWR_CNS_2	
use .....	7316, 8292	def .....	8288
PBSU_KWP		use .....	1584
def .....	7309	POW_INT_MIN_OBD_LSH_DOWN_TMP	
PHA_SHIFT_CAM_EX [NC_CBK_EX_NR]		def .....	5198
def .....	2864	POW_INT_OBD_LSH_DOWN [NC_CBK_EX_NR]	
use .....	2734	def .....	5198
Pldr_soll		POW_MMV_LSH_DOWN [NC_CBK_EX_NR]	
def .....	8165	def .....	1364
use .....	7316	POW_OUT_ECF	
Pm_klemmstat		def .....	3861
def .....	8165	POW_REL_ALTER	
Pmbakup [7]		def .....	4095
def .....	8165	use .....	4131, 8370
use .....	7559	POW_REL_ALTER_CLC	
Pminfo1 [37]		def .....	8368
def .....	8165	use .....	1584, 4097, 4924, 6796
use .....	7559	POW_REL_ALTER_L_RES	
Pminfo2 [29]		def .....	4096
def .....	8165	use .....	8370
use .....	7559	PQ	
Pmrestore [7]		def .....	8278
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use .....	8354	use .....	7317
St_vvt_err		STATE_ACK_IGK_OFF	
def .....	807	def .....	1570
use .....	7560	use .....	3772, 8292
St_wdkdiag		STATE_ACR_AD	
def .....	8352	def .....	4320
St_wesb_s		use .....	4333, 7317
def .....	8174	STATE_ACR_CTL	
use .....	8271	def .....	3587
St_wese		use .....	987, 3576, 3580, 4333, 4343, 4350
def .....	8174	STATE_ACR_CTL_REQ	
St_wk		def .....	3576
def .....	8289	use .....	3587
St_wm		STATE_AFL_PURGE [NC_NT_NR]	
def .....	8352	def .....	2986
St_wm1		STATE_ALTER	
def .....	8174	def .....	8368
use .....	8354	use .....	1585, 6580
St_wuerg		STATE_ALTER_VALUE_WR	
def .....	8352	def .....	4096
St_zwbts		STATE_AMT	
def .....	8352	def .....	1570
St_zwbts1		use .....	6985
def .....	8174	STATE_AMT_INTV	
use .....	8354	def .....	1570
St_zwgemad		use .....	1711
def .....	8352	STATE_AMT_OBD	
St_zwgrund		def .....	1570
def .....	8174	STATE_AMT_OBD_ERR	
use .....	8354	def .....	1570
St_zwktibs		STATE_AMT_OLD_MON	
def .....	8352	def .....	6983
St_zylab		STATE_ARS_CAN	
def .....	8352	def .....	1570
STACK_ADR_RST [NC_NR_DBG_NVMY][NC_NR_STACK_		use .....	6651
ADR_RST]		STATE_AVL_BOS_RST	
use .....	7317	def .....	1570
Startsegmentnumberforruntimeactivation		use .....	8292
def .....	1754	STATE_BN_MSW	
Stat_fofumx_anf		def .....	1571
def .....	8175	use .....	7220, 7228
use .....	8264	STATE_BRAKE_PRS	
Stat_fofumx_ist		def .....	1571

use .....	4217	def .....	1040
STATE_BSD_COM		use .....	8233
def .....	4096	STATE_CH_MOD_IVVT_REQ	
STATE_BSD_CPT		def .....	1040
def .....	4096	use .....	8233
STATE_BSD_MSG_COM_STOP		STATE_CH_MOD_L	
def .....	4834	def .....	1809
use .....	4097	use .....	1796
STATE_BYTE_SWI_KWP		STATE_CH_MOD_REQ	
def .....	7309	def .....	1796
STATE_CAN_DNM_D		use .....	1040, 1943, 2154, 2159, 2164, 2169, 2179, 2188, 3601, 3611, 6582
use .....	906, 4784	STATE_CH_MOD_REQ_AST	
STATE_CAT_DIAG [NC_CBK_EX_NR]		def .....	1801
def .....	5474	use .....	1796
use .....	2315, 2866, 3108, 3399, 5350, 5515, 5535	STATE_CH_MOD_REQ_L	
STATE_CAT_DIAG_AFL [NC_CBK_EX_NR]		def .....	1809
def .....	5607	use .....	1796
use .....	5563, 5589	STATE_CH_MOD_REQ_SO2P	
STATE_CAT_DIAG_AFL_OLD [NC_CBK_EX_NR]		def .....	1813
def .....	5563	use .....	1796
STATE_CAT_DIAG_CYC_VLD [NC_CBK_EX_NR]		STATE_CH_MOD_SO2P	
def .....	5474	def .....	1813
STATE_CAT_DIAG_OLD [NC_CBK_EX_NR]		use .....	1796
def .....	5515	STATE_CKS_BOOT_1_SAE	
STATE_CAT_PURGE [NC_CBK_EX_NR]		def .....	8073
def .....	2912	STATE_CKS_BOOT_2_SAE	
STATE_CC		def .....	8073
def .....	1571	STATE_CKS_CAL_SAE	
use .....	5022, 6284, 7238, 8292	def .....	8073
STATE_CC_ETCU		use .....	8090
use .....	5022	STATE_CKS_ECU_SAE	
STATE_CC_KEY		def .....	8073
def .....	1571	use .....	8090
STATE_CC_TEST_BENCH_OBD_1		STATE_CKS_SEL_SEG_SAE	
def .....	1571	def .....	8073
STATE_CC_TEST_BENCH_OBD_2		STATE_CKS_SEL_SEG_SPC_SAE	
def .....	1571	def .....	8073
STATE_CDN_CP		STATE_CL_MDL	
def .....	1541	def .....	3728
use .....	3639, 3728	STATE_CL_MDL_0	
STATE_CDN_LAM_CYL_SEL_ADJ_RNG [NC_CBK_EX_NR]		def .....	3728
def .....	2864	STATE_CLC_CAL_ID_SRV_9	
use .....	4068	def .....	819
STATE_CH		STATE_CLC_RED	
def .....	1777	def .....	1754
use .....	811, 1040, 1775, 1789, 1796, 1801, 1809, 1813, 1943, 2154, 2159, 2164, 2169, 2179, 2188, 3564, 3601, 3868, 4393, 6494, 6509, 6529, 6582, 6597, 7738, 8233, 8354	STATE_CLL_DEAC_CP	
STATE_CH_MOD		def .....	3637
def .....	1796	use .....	1002, 1542, 3701
use .....	1943, 2154, 2159, 2164, 2169, 2179, 2188, 3564, 3601, 3611, 6529, 6582	STATE_CLL_DEAC_CP_MEM	
STATE_CH_MOD_AST		def .....	3700
def .....	1801	STATE_CLU_AMT	
use .....	1796	def .....	1571
STATE_CH_MOD_IVVT		use .....	8292, 8354
		STATE_CMB_CTL	
		def .....	8137
		use .....	1822, 2005, 6397




STATE_CMB_CTL_KNK	def .....	1962	STATE_CYL_BAL_ER_AD_EOL	def .....	4537
STATE_CMB_CTL_KWP	def .....	7683	STATE_CYL_BAL_LAM_AD [NC_CBK_EX_NR]	def .....	4067
STATE_CMB_CTL_NVMY_KWP	def .....	7683	STATE_CYL_BAL_LAM_AD_DC	def .....	4067
STATE_CMB_CTL_TMP	def .....	1962	STATE_CYL_BAL_LAM_AD_EOL	def .....	4044
STATE_CMPL_OBD	def .....	5899	STATE_CYL_BAL_LAM_SEL_AD_DC	def .....	4067
	use .....	7896, 7945	STATE_CYL_BAL_LAM_SEL_AD_EOL	def .....	4044
STATE_COC	def .....	8225	STATE_DC_PERM	def .....	5746
	use .....	1585	STATE_DC_RBM	def .....	5858
STATE_CP	def .....	3637	STATE_DCC	def .....	1572
	use .....	1002, 1542, 3562, 3681, 3701, 3728, 3737, 3757, 5379, 5459, 5955, 6095, 6199, 8230	STATE_DCC_CTL	def .....	1572
STATE_CP_MEM	def .....	3700	STATE_DCC_INTV	def .....	1572
STATE_CP_MEM_AD	def .....	1001		use .....	1711, 5051, 6985
STATE_CPS_AD	def .....	3757	STATE_DCC_OFF_REQ	def .....	1572
STATE_CPS_AD_REQ	def .....	3757		use .....	6731, 6985
STATE_CRU	def .....	7227	STATE_DCC_PUC_INH	def .....	1572
	use .....	1585, 7202, 7238, 7317		use .....	6731, 6985
STATE_CRU_BN	def .....	1571	STATE_DELTA_CRK_CYL_LAM [NC_CBK_EX_NR]	def .....	2839
STATE_CRU_CAN	def .....	7227		use .....	2734, 5113
	use .....	1585	STATE_DHL_CTL	def .....	1572
STATE_CRU_OFF_IRR	def .....	7227		use .....	7228
	use .....	7317, 7391, 7560	STATE_DI_PUC	def .....	1572
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	use .....	7317, 7391, 7560	STATE_DIAG_ACT_LS_UP_DOWN [NC_CBK_EX_NR]	def .....	5389
STATE_CTL_TI_ER_BAL	def .....	4006		use .....	5230, 5335
	use .....	5113	STATE_DIAG_DR_VVL	def .....	807
STATE_CTR_RBM [NC_NR_DIAG_RBM]	def .....	5858	STATE_DIAG_EFP	def .....	1573
STATE_CUR_ENG_CNS	def .....	8369		use .....	4721
	use .....	1585	STATE_DIAG_GS	def .....	5010
STATE_CUS_LDM_CAN	def .....	1571		use .....	1585
STATE_CUT_OFF_DT	def .....	807	STATE_DIAG_IV	def .....	4803
	use .....	1585		use .....	2278, 6118, 6239
STATE_CWP_INT	def .....	4537	STATE_DIAG_MIS	def .....	6225
	use .....	8226	STATE_DIAG_OC_LSL_UP [NC_CBK_EX_NR]		
STATE_CWP_INT_MODE					

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def .....	4300	use .....	7896, 7945
use .....	5439	STATE_END_NS_OBD_2 [NC_NOX_SENS_CONF]	
STATE_DIAG_PBK_IV		def .....	6320
def .....	4797	use .....	3054, 5635
use .....	6118	STATE_ENG	
STATE_DIAG_SA_LS		def .....	1720
use .....	7767	use .....	1163, 1192, 1382, 2307, 4713, 5022, 7317, 7484, 8226
STATE_DIAG_SA_SAFM		STATE_ENG_OLD_OSC	
def .....	808	def .....	1381
use .....	7391, 7767	STATE_ENGG_POS	
STATE_DIAGCPS		def .....	8289
def .....	5927	use .....	1585, 6615
use .....	7767	STATE_EOL_DGNC_CH_DIAG	
STATE_DIAGCPS_RBM		def .....	6508
def .....	5928	use .....	7738
STATE_DMTL		STATE_EOL_KWP_CPS	
def .....	5969	def .....	7763
use .....	5919, 7767	use .....	7317
STATE_DMTL_EOL		STATE_EOL_KWP_DMTL	
def .....	5970	def .....	7764
use .....	7767	use .....	7317
STATE_DYN_DIAG [NC_CBK_EX_NR]		STATE_EOL_KWP_ECRAS	
def .....	5349	def .....	7764
use .....	2866	STATE_EOL_KWP_N_SP_IS	
STATE_ECRAS_FB		def .....	7764
def .....	4516	use .....	6796, 7317
STATE_ECRAS_SYS		STATE_EOL_KWP_NS_SHIFT_DIAG [NC_NOX_SENS_CONF]	
def .....	3863	def .....	6427
use .....	7317, 7767	use .....	7767
STATE_ECRAS_SYS_KWP_H		STATE_EOL_KWP_SA	
def .....	7309	def .....	7765
STATE_ECRAS_SYS_KWP_L		use .....	7317
def .....	7310	STATE_EOL_KWP_VLS	
STATE_ECRAS_UP_VAR		def .....	7765
use .....	7560	use .....	7317
STATE_EFP		STATE_EOL_KWP_VVL_AD	
def .....	3797	def .....	7765
use .....	3792, 3823, 6051	STATE_ERR_AMT_CAN	
STATE_EFP_CAN		def .....	808
def .....	1573	STATE_ERR_AMT_MON	
STATE_EFP_CRASH_CAN		def .....	6983
def .....	1573	STATE_ERR_DET_TQ_MIN_MON	
use .....	3333, 3823, 5971, 8370	def .....	6792
STATE_EFP_CTL		use .....	6952
def .....	1573	STATE_ERR_EL_LSL_UP [NC_CBK_EX_NR]	
STATE_EFP_CTL_ECU		def .....	4294
def .....	1573	use .....	7317
STATE_EFP_TRAN		STATE_ERR_FTL	
def .....	3822	def .....	4763
use .....	3797	STATE_ERR_IDC_ERR_MEM_ACT	
STATE_EGY_CNS_OFF		def .....	7062
def .....	8289	STATE_ERR_IDC_ERR_MEM_OLD	
STATE_EGY_MIN_KWP		def .....	7062
def .....	7483	STATE_ERR_IDC_MC	
use .....	1149, 4926, 6697, 7560, 8292	def .....	7073
STATE_ENA_OBD		use .....	7062
def .....	5899		

STATE_ERR_IDC_MU		STATE_ERR_VNLSL [NC_CBK_EX_NR]	
def .....	7073	def .....	955
use .....	7062	use .....	4294
STATE_ERR_IPLSL [NC_CBK_EX_NR]		STATE_ERR_VRCLSL [NC_CBK_EX_NR]	
def .....	955	def .....	955
use .....	2335, 2353, 4294, 5249	use .....	4294
STATE_ERR_IV		STATE_ETC_LIH	
def .....	4803	def .....	4982
use .....	1469, 2383, 3512, 3681, 3931, 4022, 4810, 5286, 6095, 6118, 6944	use .....	1169, 1759, 4952, 4978, 6742, 8354
STATE_ERR_IV_CYL [NC_CYL_NR]		STATE_ETCU_CLU	
def .....	4803	def .....	1573
STATE_ERR_IV_CYL_RAW [NC_CYL_NR]		use .....	1270, 1419, 1721, 6710, 8292
def .....	2039	STATE_ETCU_INTV	
use .....	4803	def .....	1574
STATE_ERR_IV_CYL_TMP [NC_CYL_NR]		use .....	1711
def .....	4803	STATE_ETCU_OBD	
STATE_ERR_LSL [NC_CBK_EX_NR]		def .....	1574
def .....	955	use .....	5010, 5840
STATE_ERR_NS_OBD_2 [NC_NOX_SENS_CONF]		STATE_ETCU_OBD_ERR	
def .....	6320	def .....	1574
use .....	3054, 3066, 3075, 3108, 5635, 6469	STATE_ETCU_PROG_INFO	
STATE_ERR_PBK_IV		def .....	1574
def .....	4797	use .....	1149, 1303, 3779, 6796, 8292
use .....	3432, 4794, 6118	STATE_ETCU_SPT_SWI	
STATE_ERR_PBK_IV_RAW [NC_PBK_IV_NR]		def .....	1574
def .....	2039	use .....	657
use .....	4797	STATE_EVAP_SAE	
STATE_ERR_PBK_IV_ST_RAW [NC_PBK_IV_NR]		def .....	819
def .....	2040	use .....	8038
use .....	4797	STATE_EXT_POW_CNS	
STATE_ERR_SYM_FTL_LE_CAN		def .....	1574
def .....	1573	STATE_FAC_GAIN_PID_EXT [NC_CBK_EX_NR]	
use .....	4746	def .....	2464
STATE_ERR_SYM_FTL_RI_CAN		STATE_FAC_GAIN_TRIM_PID_EXT [NC_CBK_EX_NR]	
def .....	1573	def .....	2589
use .....	4746	STATE_FUP	
STATE_ERR_SYM_PBK_IV [NC_PBK_IV_NR]		def .....	3930
def .....	4797	STATE_FUP_CTL	
STATE_ERR_SYM_PBK_IV_ST [NC_PBK_IV_NR]		def .....	3881
def .....	4797	use .....	3957, 6063
use .....	4794	STATE_FUP_CTL_TRAN	
STATE_ERR_SYM_TAM_CAN		def .....	3881
def .....	1573	STATE_FUP_TRAN	
use .....	5077	def .....	3931
STATE_ERR_TQ_DIF_I_IS_MON		STATE_GAP_MSW	
def .....	6921	def .....	1574
STATE_ERR_TQ_DIF_P_D_IS_MON		STATE_GEAR_REV_AT_AMT	
def .....	6921	def .....	1302
STATE_ERR_TQ_MIN_CLU_MON		use .....	1149, 1270, 3145, 6570, 6796
def .....	6952	STATE_GEAR_REV_CAN	
STATE_ERR_VGLSL [NC_CBK_EX_NR]		def .....	1574
def .....	955	use .....	1270, 6570, 6796, 8394
use .....	4294	STATE_HLD_PBR	
STATE_ERR_VIPLSL [NC_CBK_EX_NR]		def .....	1574
def .....	955	use .....	6697
use .....	4294	STATE_HOM_AFS_REQ_EXT_ADJ	
		def .....	7683


use .....	1763	def .....	3332
STATE_I_CRU		use .....	2179
def .....	7237	STATE_INJ_UPD_ENA	
STATE_I_ISC		def .....	3332
def .....	3440	use .....	2042
STATE_IBS_SW_CHG		STATE_INJ_UPD_TRM	
def .....	8369	def .....	2040
STATE_ID2_BOS_RST		STATE_IPLSL_AD_FCUT [NC_CBK_EX_NR]	
def .....	1574	def .....	2372
use .....	8293	STATE_IPLSL_GAIN_AD [NC_CBK_EX_NR]	
STATE_ID_FCT_BOS_RST		def .....	2372
def .....	1574	STATE_IV_CHG	
use .....	8292	def .....	7683
STATE_IF_ICL_BN_MSW		use .....	2289, 3350, 3406, 8310
def .....	1574	STATE_KWP_IMOB_STORE_K_EWS_ENA	
use .....	7228	def .....	7483
STATE_IGK_CAN		STATE_KWP_SO2P	
def .....	1574	def .....	3144
use .....	906	use .....	7767
STATE_IGK_HW		STATE_KWP_SRV_AD_REQ_VVL	
def .....	1575	use .....	7767
use .....	906, 8293	STATE_LAM [NC_CBK_EX_NR]	
STATE_IGN_UPD_ENA		def .....	2464
def .....	2040	STATE_LAM_AD [NC_CBK_EX_NR]	
STATE_IMOB		def .....	2643
def .....	7391	use .....	2722, 4068, 6142, 6199, 8310
STATE_IMOB_0_ERR		STATE_LAM_AD_INJ [NC_CBK_EX_NR]	
use .....	4784	def .....	3405
STATE_IMOB_2_ERR		STATE_LAM_AD_INJ_ACT [NC_CBK_EX_NR]	
use .....	4149, 4784	def .....	3379
STATE_IMOB_K_EWS		use .....	3350, 8188, 8271
use .....	7560, 7684	STATE_LAM_AD_INJ_MNG [NC_CBK_EX_NR]	
STATE_INH_IV_DYN		def .....	3380
def .....	2295	STATE_LAM_CYL_SEL [NC_CBK_EX_NR]	
use .....	2042	def .....	2733
STATE_INH_NS_OBD_2_EXT_ADJ [NC_NOX_SENS_CONF]		use .....	2840
use .....	6469	STATE_LAM_CYL_SEL_ADJ [NC_CBK_EX_NR]	
STATE_INI_DT		def .....	2733
def .....	808	use .....	4045, 4069, 5113
use .....	1585	STATE_LAM_GAIN_REQ_LS_DIAG	
STATE_INJ_CRASH_ACT		def .....	5349
def .....	2040	use .....	2465, 2546, 2590
STATE_INJ_DR		STATE_LAMB_CYL_SEL_CQ_SLOP [NC_CBK_EX_NR]	
def .....	2040	def .....	2733
STATE_INJ_MOD_HOM_REQ		use .....	2840, 7484
def .....	3331	STATE_LAMB_PLS [NC_CBK_EX_NR]	
use .....	2147, 2262	def .....	2563
STATE_INJ_MOD_HOMS_REQ		use .....	2958
def .....	3331	STATE_LAMB_PLS_DET_VALUE	
use .....	2005, 2262	def .....	2958
STATE_INJ_MOD_REQ		use .....	2558, 2579, 5259, 5474
def .....	3332	STATE_LAMB_PLS_REQ_LS_DIAG	
use .....	2005, 2262, 2289	def .....	5349
STATE_INJ_MOD_S_REQ		use .....	2579
def .....	3332	STATE_LAMB_PLS_REQ_LS_DIAG_EXT	
use .....	2005, 2262	def .....	5377
STATE_INJ_MOD_SWI_ACT		use .....	5350

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def .....	1575	use .....	8293	
use .....	5054, 8293	STATE_MC	def .....	7135
STATE_LDM_INTV	def .....	1575	use .....	7049, 7062, 7073, 7100, 7118, 7161, 7186
def .....	1575	STATE_MC_PFM_CTL_BYTE [NC_NR_MC_PFM]	def .....	7117
use .....	5054	STATE_MC_RESP_SOPC	def .....	7186
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def .....	3638	use .....	5827	
use .....	1542	use .....	1019, 1585, 5899, 7945	
STATE_LOIL	def .....	8203	STATE_MIL_ON_DIS_EXT_REQ	def .....
def .....	8203	use .....	7683	
use .....	1585	STATE_MOD_GB	use .....	1585, 7560
STATE_LRN_ECU	def .....	657	def .....	1575
def .....	657	use .....	3520, 6697	
use .....	3776, 7317	STATE_MOD_GB_WLC	def .....	6697
STATE_LRN_ECU_KWP	def .....	7310	STATE_MPL_CYL_IGN	def .....
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def .....	2448	use .....	1896	
use .....	2546, 2679, 3380, 3399	STATE_MPLH_MOD	def .....	988
STATE_LS_SAE [NC_CBK_EX_NR]	def .....	2448	def .....	988
def .....	2448	use .....	3868	
use .....	1019, 5802, 7317, 7896, 7945	STATE_MSW_CAN	def .....	7220
STATE_LSH_DOWN [NC_CBK_EX_NR]	def .....	2421	def .....	7220
def .....	2421	use .....	7317, 7391	
use .....	1365, 2409, 2416, 2928, 4248, 4267, 4276, 5199, 5459, 7317, 7391, 7767	STATE_MSW_DATA	def .....	5059
STATE_LSH_UP [NC_CBK_EX_NR]	def .....	2385	def .....	5059
def .....	2385	use .....	7220	
use .....	2315, 2335, 2353, 4294, 4315, 5298, 5439, 7317, 7391, 7767	STATE_MTC_HEAT	def .....	6532
STATE_LSL_IF_CONF_SPI_RD [NC_CBK_EX_NR]	def .....	956	def .....	6532
def .....	956	use .....	7438	
use .....	1313, 2353	STATE_MU_TMP	def .....	7049
STATE_LSL_IF_CONF_SPI_WR [NC_CBK_EX_NR]	def .....	1313	def .....	7049
def .....	1313	use .....	7062	
use .....	956	STATE_MU_TMP_CPL	def .....	7049
STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR]	def .....	956	def .....	7049
def .....	956	use .....	7062	
use .....	1313, 1322, 1339, 1342, 2315, 2333, 2335, 2353, 2373, 4290	STATE_MU_TMP_PFM	def .....	7117
STATE_LSL_IF_SPI_RD_OLD [NC_CBK_EX_NR]	def .....	1341	def .....	7117
def .....	1341	STATE_N_LIM_ETC_REQ	use .....	7317
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T2histshort		T_AFL_CHK_LS_DOWN [NC_CBK_EX_NR]	
def .....	8175	def .....	5389
use .....	7317	T_AFL_CYC [NC_CBK_EX_NR]	
T3histshort		def .....	2439
def .....	8175	T_AFL_CYC_HLD [NC_CBK_EX_NR]	
use .....	7317	def .....	2439
T4histshort		use .....	1365
def .....	8175	T_AFL_CYC_HLD_R_IT_LS_DOWN [NC_CBK_EX_NR]	
use .....	7317	def .....	1364
T_ABSV_COM		T_AFL_DOWN_LOCK [NC_CBK_EX_NR]	
use .....	5802	def .....	3150
T_ACC		T_AFL_INH_OFS_DIAG	
def .....	3589	def .....	6378
use .....	6602	T_AFL_MDL_CTL	
T_ACC_DLY		def .....	3053
def .....	3589	T_AFL_MDL_CTL_SUM	
T_ACK_IGK_OFF		def .....	3053
def .....	3772	T_AFL_NS_SHIFT_DIAG_INH	
T_ACQ_IPLSL_PURGE [NC_CBK_EX_NR]		def .....	6427
def .....	2372	T_AFL_PUC	
T_ACT_CUR_DMTL_STAT		def .....	2987
def .....	5971	use .....	3194
T_ACT_ECFPWM_FB [NC_ECF_NR]		T_AFL_SUM	
def .....	4508	def .....	2987
T_ACT_LEAK_MES		T_AFR_CHK_LS_DOWN [NC_CBK_EX_NR]	
def .....	5971	def .....	5389
use .....	7317	T_AFR_CYC [NC_CBK_EX_NR]	
T_ACT_MIL		def .....	2439
def .....	5899	T_AMT_INH_MON	
use .....	812, 7945	def .....	6983
T_ACT_MIL_60		T_ASR_LIH_CTR	
def .....	5899	def .....	6741
use .....	812	T_AST	
T_ACT_MIL_SAE		def .....	1766
def .....	809	use 1105, 1123, 1149, 1232, 1542, 1721, 1759, 1801,	
use .....	7896	2169, 2386, 2422, 2465, 2590, 2613, 2958, 3054,	
T_ACT_MIL_SAE_60		3181, 3261, 3350, 3443, 3564, 3589, 3599, 3601,	
def .....	809	3611, 3614, 3681, 3792, 3797, 3823, 3851, 3868,	
T_ACT_PLS_DIAG_OC_LS_DOWN [NC_CBK_EX_NR]		3881, 4022, 4142, 4377, 4763, 4924, 5022, 5077,	
def .....	4267	5675, 5919, 5971, 6051, 6063, 6095, 6102, 6509,	
T_ACT_PLS_DIAG_SCG_LS_DOWN [NC_CBK_EX_NR]		7738, 8221	
def .....	4267	T_AST_BAL	
T_ACT_REF_LEAK_MES		def .....	3261
def .....	5971	use .....	4045, 4069, 8293
T_ACT_SWI_AFS_MFF_MON		T_AST_COR_CH	
def .....	6943	def .....	1801
T_ACT_VIMPWM_1_FB		use .....	1777, 6582
def .....	5065	T_AST_CP	
T_ACT_VIMPWM_2_FB		def .....	3680
def .....	5065	use .....	3701, 3737, 3757
T_AD		T_AST_CST_RBM	
def .....	3737	def .....	5858
T_AFL		T_AST_DC_CON	
def .....	2987	def .....	809
use .....	3075, 3194, 5608, 6379	use .....	1789
T_AFL_CDN_OUT [NC_CBK_EX_NR]		T_AST_DIAG	

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def .....	1766	def .....	2001
use .....	4189, 4194, 4237, 4713, 5093	use .....	2043
T_AST_DIAG_TCO_PLAUS		T_CHA_PER_S_1 [NC_CYL_NR]	
def .....	5682	def .....	2001
T_AST_DMTL_RBM		use .....	2043
def .....	6037	T_CHA_PER_S_2 [NC_CYL_NR]	
T_AST_ENA_N_WHEEL_DIAG		def .....	2001
def .....	5044	use .....	2043
T_AST_MAX_DIAG_TCO_PLAUS		T_CHA_PER_S_3 [NC_CYL_NR]	
def .....	5682	def .....	2001
T_AST_PERM		use .....	2043
def .....	5746	T_CL_MDL_ACT	
T_AST_RBM		def .....	3728
def .....	5858	T_CL_MDL_CAT_PURGE_ENA	
T_AST_REST		def .....	3728
def .....	1766	T_CL_MDL_CLL_ENA	
use .....	2094	def .....	3728
T_AST_SAE		T_CL_MMV_DIAGCPS	
def .....	1766	def .....	5928
use .....	1399, 3054, 5802, 6313, 6429, 7317, 7896, 7945	T_CL_MMV_DIAGCPS_2	
T_AST_SAE_KWP		def .....	5928
def .....	7310	T_CLK_ICL_DISP_1	
T_AUTH_TI_MIN_AFL		def .....	1579
def .....	2001	use .....	8293
T_batt		T_CLK_ICL_DISP_2	
def .....	8175	def .....	1579
use .....	7317	use .....	8293
T_batt_kwp		T_CLK_ICL_DISP_3	
def .....	7310	def .....	1579
T_BTS_PLAUS		use .....	8293
def .....	4209	T_CON_LAMB_AFL_DYN_LS_UP [NC_CBK_EX_NR]	
T_CAN		def .....	5349
def .....	1579	T_CON_LAMB_AFR_DYN_LS_UP [NC_CBK_EX_NR]	
use .....	8293	def .....	5349
T_CAN_IGK_TOUT		T_CONV	
def .....	906	def .....	6710
T_CDN_DIAG_OC_LS_DOWN [NC_CBK_EX_NR]		T_COOL_LOIL	
def .....	4267	def .....	809
T_CDN_T_ES_DIAG_2		use .....	8204
def .....	4467	T_CP	
T_CH_CST		def .....	3737
def .....	6494	T_CP_PER_RUN_CP	
T_CH_SO2P_ACT		def .....	3701
def .....	1789	T_CPS_AD_HOM_REQ	
use .....	7317	def .....	3757
T_CH_SO2P_ACT_KWP		T_CRK_WIN_ENSD	
def .....	7310	def .....	853
T_CHA_PER_HOM [NC_CYL_NR]		use .....	1525
def .....	2001	T_CRU_INH_MON	
use .....	2042	def .....	6912
T_CHA_PER_HOM_2 [NC_CYL_NR]		T_CTL_CRU	
def .....	2001	def .....	7237
use .....	2042	use .....	7238
T_CHA_PER_HOM_3 [NC_CYL_NR]		T_CTR_ES	
def .....	2001	def .....	8221
use .....	2043	T_CTR_PU_ISC_ACT	
T_CHA_PER_POST		def .....	3501


use .....	6796	def .....	4068
T_CTR_REL_CAN		T_CYL_BAL_LAM_SEL_AD_WAIT_DC	
def .....	1579	def .....	4068
T_CTR_SWI_OFF_VB		T_CYL_BAL_LAM_SEL_CBK_AD [NC_CBK_EX_NR]	
def .....	1579	def .....	4044
T_CTR_TD_MPL		T_CYL_BAL_LAM_SEL_DC	
def .....	1881	def .....	4068
T_CUR_VCV_CTL_PRE_RUN		use .....	4036
def .....	3956	T_CYL_BAL_LAM_SEL_RNG_COLD_DC [NC_CBK_EX_NR]	
T_CWP_4		def .....	4068
def .....	4537	T_DCC_BRAKE_DET	
T_CWP_5		def .....	5051
def .....	4537	T_DCC_BRAKE_DET_MON	
T_CWP_CDN_DIAG_INT_OFF		def .....	6984
def .....	4537	T_DCC_INH_MON	
T_CWP_CDN_DIAG_PWR		def .....	6984
def .....	4537	T_DCC_LIH_CTR	
T_CWP_DIF		def .....	6731
def .....	4537	T_DCHA_PER_HOM [NC_CYL_NR]	
T_CWP_DIF_END_DIAG		def .....	2001
def .....	4537	use .....	2043
T_CWP_LOCK		T_DCHA_PER_HOM_2 [NC_CYL_NR]	
def .....	4537	def .....	2001
T_CWP_TEMP_HIGH		use .....	2043
def .....	4537	T_DCHA_PER_HOM_3 [NC_CYL_NR]	
T_CWP_VCC_PLAUS		def .....	2001
def .....	4537	use .....	2043
T_CYL_BAL_ER_AD		T_DCHA_PER_POST	
def .....	4044	def .....	2002
T_CYL_BAL_ER_AD_DYW		use .....	2043
def .....	4044	T_DCHA_PER_S_1 [NC_CYL_NR]	
T_CYL_BAL_HOM_REQ_INT_DC		def .....	2002
def .....	4067	use .....	2043
T_CYL_BAL_HOM_REQ_INT_DC_STOP		T_DCHA_PER_S_2 [NC_CYL_NR]	
def .....	4067	def .....	2002
T_CYL_BAL_LAM_AD		use .....	2043
def .....	4044	T_DCHA_PER_S_3 [NC_CYL_NR]	
T_CYL_BAL_LAM_AD_ADD_DC [NC_CBK_EX_NR]		def .....	2002
def .....	4067	use .....	2043
T_CYL_BAL_LAM_AD_DC		T_DEC_FSD_STOP_OIL	
def .....	4068	def .....	6133
use .....	4036	T_DI_CP	
T_CYL_BAL_LAM_AD_FAC_H_DC [NC_CBK_EX_NR]		def .....	3638
def .....	4068	T_DIAG_ACT_AFL_LS_UP_DOWN [NC_CBK_EX_NR]	
T_CYL_BAL_LAM_AD_FAC_L_DC [NC_CBK_EX_NR]		def .....	5389
def .....	4068	T_DIAG_ACT_AFR_LS_UP_DOWN [NC_CBK_EX_NR]	
T_CYL_BAL_LAM_AD_REQ_DC [NC_CBK_EX_NR]		def .....	5389
def .....	4068	T_DIAG_ACT_OFS [NC_CBK_EX_NR]	
T_CYL_BAL_LAM_AD_WAIT_DC		def .....	5248
def .....	4068	T_DIAG_AST	
T_CYL_BAL_LAM_SEL_AD		def .....	4493
def .....	4044	use .....	4496, 4572, 5682
T_CYL_BAL_LAM_SEL_AD_REQ_DC [NC_CBK_EX_NR]		T_DIAG_DYN_LSL_UP_LDC_MAF	
def .....	4068	def .....	5349
T_CYL_BAL_LAM_SEL_AD_RNG_H_DC [NC_CBK_EX_NR]		T_DIAG_ECRAS	
def .....	4068	def .....	4516
T_CYL_BAL_LAM_SEL_AD_RNG_L_DC [NC_CBK_EX_NR]		T_DIAG_END_PUC_LSL_UP [NC_CBK_EX_NR]	

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def .....	5297	T_DLY_2_3_S_CUS [NC_CYL_NR]	
T_DIAG_FTL_MIN		def .....	8270
def .....	4763	use .....	2147
T_DIAG_OC_LSL_UP [NC_CBK_EX_NR]		T_DLY_2_3_S_EXT [NC_CYL_NR]	
def .....	4300	def .....	2146
T_DIAG_OC_RST_LAMB_SP_REQ [NC_CBK_EX_NR]		use .....	2005, 2043, 2142
def .....	4300	T_DLY_ACT_DIAG_LAM_GAIN_ACT [NC_CBK_EX_NR]	
T_DIAG_OC_RST_OSC_DI [NC_CBK_EX_NR]		def .....	5259
def .....	4300	T_DLY_AMP_SUB	
T_DIAG_SYM_PUC_LSL_UP [NC_CBK_EX_NR]		def .....	1163
def .....	5297	T_DLY_CAT_PURGE_CP_AFL_TMP	
T_DIAG_VIMPWM_1_FB		def .....	1541
def .....	5065	T_DLY_CAT_PURGE_CP_TMP	
T_DIAG_VIMPWM_2_FB		def .....	1541
def .....	5065	T_DLY_CHK_LS_UP_READY [NC_CBK_EX_NR]	
T_DIAGCPS_DLY		def .....	2335
def .....	5928	T_DLY_CL_MDL	
T_DIAGCPS_DLY_1_RBM		def .....	3638
def .....	5928	use .....	3728
T_DIAGCPS_DLY_2_RBM		T_DLY_CL_MMV	
def .....	5928	def .....	1001
T_DIAGCPS_LAM_1		T_DLY_CL_MMV_READY	
def .....	5928	def .....	1002
T_DIAGCPS_MAF		T_DLY_CMU_CP_TMP	
def .....	5928	def .....	1541
T_DIAGCPS_MAF_RBM		T_DLY_CP	
def .....	5929	def .....	3638
T_DIAGCPS_N_MAP_1		T_DLY_CP_LAMB_CH	
def .....	5929	def .....	3680
T_DIAGCPS_N_MAP_1_RBM		T_DLY_CP_OPEN	
def .....	5929	def .....	3638
T_DIAGCPS_N_MAP_2		T_DLY_CP_OPM_AV	
def .....	5929	def .....	3680
T_DIAGCPS_N_MAP_3		T_DLY_CP_PU_TMP	
def .....	5929	def .....	1541
T_DIF_EDGE_CAM_EX [NC_NR_CAM_CBK]		T_DLY_CP_PUC_TMP	
def .....	1534	def .....	1541
T_DIF_EDGE_CAM_IN [NC_NR_CAM_CBK]		T_DLY_CPS_AD_HOM_REQ	
def .....	1534	def .....	3757
T_DLY_1_1_HOM		T_DLY_CRU	
def .....	2002	def .....	7227
T_DLY_1_2_HOM		T_DLY_DI_LSL_IF [NC_CBK_EX_NR]	
def .....	2002	def .....	1318
T_DLY_1_2_S_CUS [NC_CYL_NR]		use .....	1313
def .....	8270	T_DLY_DIAG_EL_LSL_UP [NC_CBK_EX_NR]	
use .....	2147	def .....	4294
T_DLY_1_2_S_EXT [NC_CYL_NR]		T_DLY_DIAG_PUC_LSL_UP [NC_CBK_EX_NR]	
def .....	2146	def .....	5297
use .....	2005, 2043, 2140	T_DLY_DIAG_SHIFT_DOWN [NC_CBK_EX_NR]	
T_DLY_2_3_HOM		def .....	5334
def .....	2002	T_DLY_DYW_CP	
T_DLY_2_3_MIN_HOMS [NC_CYL_NR]		def .....	1541
def .....	2146	T_DLY_EF	
use .....	2136	def .....	3614
T_DLY_2_3_MIN_HOMS_CUS [NC_CYL_NR]		T_DLY_EF_AC	
def .....	8270	def .....	3614
use .....	2147	T_DLY_ERR_FUP	

def .....	3931	T_DLY_TCO_SUB_COR_STATE_COC	
T_DLY_ERR_SYM_FUP_ST_DLY		def .....	1105
def .....	6062	T_DLY_THD_TCO_SUB_ST	
T_DLY_FPA_CLL_REQ		def .....	1105
def .....	3931	T_DLY_TPS_DIAG_REQ_HOM_ACT	
T_DLY_FPA_PROT		def .....	4990
def .....	3931	T_DLY_TQ_MAX_ARS	
T_DLY_FUP_MAX		def .....	6650
def .....	3931	T_DLY_TRIG_LSH_UP [NC_CBK_EX_NR]	
T_DLY_IPLSL_COR_MMV_FCUT_VLD [NC_CBK_EX_NR]		def .....	5276
def .....	2372	use .....	970
T_DLY_IPLSL_CTL_ENA [NC_CBK_EX_NR]		T_DLY_VIM_OPEN_1	
def .....	2352	def .....	3622
T_DLY_LAM_LIM_CP_TMP		T_DLY_VIM_OPEN_2	
def .....	1541	def .....	3622
T_DLY_LAM_OUT_CP_TMP		T_DLY_VLS_UP_INIT [NC_CBK_EX_NR]	
def .....	1541	def .....	1341
T_DLY_LAMB_STI_OFF_OFS_ADJ [NC_CBK_EX_NR]		T_DLY_VNLSL_LIM_ACT [NC_CBK_EX_NR]	
def .....	2314	def .....	2352
T_DLY_LS_UP_READY_TEG_MIN [NC_CBK_EX_NR]		T_DMTL_EOL	
def .....	2335	def .....	5971
T_DLY_LSL_OFS_ADJ [NC_CBK_EX_NR]		T_DTC_CLR	
def .....	2314	def .....	5899
T_DLY_LSL_OFS_ADJ_IS [NC_CBK_EX_NR]		use .....	7896, 7945
def .....	2314	T_DYN_DIAG_AFL [NC_CBK_EX_NR]	
T_DLY_LSL_OFS_ADJ_PUC_END [NC_CBK_EX_NR]		def .....	5349
def .....	2314	T_DYN_DIAG_AFL_COMP [NC_CBK_EX_NR]	
T_DLY_MAF_SP_TQI_DIAG_ISC		def .....	5349
def .....	4392	T_DYN_DIAG_AFL_THD [NC_CBK_EX_NR]	
T_DLY_MAX_CP		def .....	5349
def .....	3638	T_DYN_DIAG_AFR [NC_CBK_EX_NR]	
use .....	1542	def .....	5349
T_DLY_OBD_LSH_DOWN_TMP		T_DYN_DIAG_AFR_COMP [NC_CBK_EX_NR]	
def .....	5199	def .....	5350
T_DLY_PURGE_DIAGCPS		T_DYN_DIAG_AFR_THD [NC_CBK_EX_NR]	
def .....	1002	def .....	5350
use .....	5929	T_ECFPWM_FB [NC_ECF_NR]	
T_DLY_R_IT_IPLSL_CTL_ACT [NC_CBK_EX_NR]		def .....	4508
def .....	1321	T_ECFPWM_INH_DIAG_TH	
T_DLY_REQ_CP_TMP		def .....	5660
def .....	3638	T_ECRAS_DOWN_DET	
T_DLY_RLY_MAIN_DIAG		def .....	4516
def .....	4934	T_ECRAS_DOWN_DET_NEG	
use .....	1091	def .....	4516
T_DLY_SENS_MDL_ACT [NC_CBK_EX_NR]		T_ECRAS_DOWN_DET_POS	
def .....	2464	def .....	4516
T_DLY_SOF		T_ECRAS_UP_DET	
def .....	3851	def .....	3863
T_DLY_SOF_OPEN		T_ECRASPWM_FB	
def .....	3851	def .....	4516
T_DLY_SOI_LSL_POS [NC_CBK_EX_NR]		T_ECTPWM_AST	
def .....	2464	def .....	3858
use .....	1019, 6777	T_ECTPWM_INH_DIAG_TH	
T_DLY_TCO_2_PLAUS		def .....	5660
def .....	5666	T_EDGE_FALL_LOIL	
T_DLY_TCO_SUB		def .....	809
def .....	1105	use .....	8204


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T_EFP		T_FAC_FCO_FIL [2]	
def .....	3823	def .....	3846
T_EFP_ACT_H		T_FAC_TQ_REQ_GRD_SUM_DLY	
def .....	3823	def .....	2633
T_EFP_ACT_L		T_FCUT_AJ	
def .....	3823	def .....	2307
T_EFP_EFPPWM_MAX_PLAUS_DIAG		T_FIL_CUR_EXCT_ALTER	
def .....	4733	def .....	4096
T_EFP_EFPPWM_MIN_PLAUS_DIAG		use .....	8370
def .....	4733	T_FSD_SET_END_DIAG [NC_CBK_EX_NR]	
T_EFP_MEM_H		def .....	6199
def .....	3823	T_FUEL_MASS_REQ_I_CTL_SET	
T_EFP_MEM_L		def .....	3881
def .....	3823	T_FUP_CH_DIAG_MAX	
T_EFP_RUN_WKU		def .....	6102
def .....	3823	T_FUP_CH_DIAG_MIN	
use .....	3797	def .....	6102
T_EFPPWM_PLAUS_0		T_FUP_EFP_NOT_PLAUS_PWM_SWI	
def .....	6050	def .....	6051
T_END_DIAG_ACT_LS_DOWN		T_FUP_EFP_OFS_NOT_PLAUS	
def .....	5389	def .....	4733
T_END_DIAG_AIR_LSL_UP [NC_CBK_EX_NR]		T_FUP_STOP	
def .....	5282	def .....	6062
T_END_DIAG_RBM_FUP_CH		T_FUP_VCV_MOVE_ACT	
def .....	6102	def .....	3931
T_ERR_N_ENG		T_FUP_VCV_MOVE_DET	
def .....	1579	def .....	3931
T_ERR_VS_CAN		T_FUP_VCV_MOVE_READY	
def .....	1176	def .....	3931
use .....	7228	T_GEAR_VS_MAX	
T_ES		def .....	1148
def .....	1444	T_GS_DEC_LIH_CTR	
use .....	1232, 2241, 3823, 7317	def .....	6718
T_ES_2		T_GS_INC_LIH_CTR	
def .....	1444	def .....	6718
use .....	2094, 3181	T_GS_INH_MON	
T_ES_CUS		def .....	6984
def .....	1444	T_HOM_ACT_OFS_ADJ	
use .....	1777, 2442, 4467, 5077, 5675, 6038, 7317, 8221	def .....	2333
T_ES_CUS_DIAG_1		T_ICPLSL_DLY_PWL [NC_CBK_EX_NR]	
def .....	4467	def .....	2352
T_ES_CUS_DIAG_2		T_IGK_DLY	
def .....	4467	def .....	4467
T_ES_CUS_DIAG_3		T_IGK_DLY_2	
def .....	4467	def .....	4467
T_ES_CUS_KWP		T_IGK_DLY_3	
def .....	7310	def .....	4467
T_ES_CUS_ST_DIAG		T_IGK_OFF_ACK_DIAG_PLS	
def .....	4467	def .....	3772
T_ES_CUS_TCO_FAST_DIAG_MAX		T_ikat1	
def .....	4467	def .....	8175
T_ES_CUS_TCO_SLOW_DIAG_MIN		use .....	8237
def .....	4467	T_ikat1_stat	
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def .....	4377	def .....	3701
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def .....	2314	def .....	2335
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def .....	3406	def .....	6468
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def .....	2352	def .....	3701
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def .....	4392	def .....	6615
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def .....	5858	def .....	4493
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def .....	4990	def .....	1382
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def .....	5015	def .....	6358
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def .....	5169	use .....	2043
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T_SEG_HALF_ENSD		def .....	6141
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use .....	1526	def .....	5216
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def .....	6984	def .....	4462
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def .....	8176	use .....
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TACE	def .....	1580	TCC_CAN_LDM	def .....	1580
def .....	6658		TCC_CAN_MSW	def .....	1580
TAM	def .....	1579	TCC_CAN_PBR	def .....	1580
use 1105, 1123, 1198, 1214, 1223, 1232, 1896, 2373,			use .....	4871	
2442, 2722, 3181, 3333, 4194, 4493, 4508, 4713,			TCC_CAN_REQ_PBR	def .....	1580
5077, 5093, 5652, 5660, 5871, 5911, 5971, 6038,			use .....	4871	
6133, 6602, 7317, 7768, 8135			TCC_CAN_TQ_AMT	def .....	1580
TAM_DIF_DIAG	def .....	5077	TCC_CAN_TQ_DCC	def .....	1580
TAM_DIF_MAX_DIAG	def .....	5077	TCC_CAN_TQ_ETCU	def .....	1580
TAM_DIF_MIN_DIAG	def .....	5077	TCC_CAN_TQ_PBR	def .....	1580
TAM_DIF_PLAUS	def .....	5077	use .....	4871	
TAM_DSL_CMN	def .....	5870	TCC_CAN_TQ_PSTE_2	def .....	1580
use .....	5858		TCC_CAN_TQ_PSTE_3	def .....	1580
TAM_ST	def .....	1214	TCC_CAN_TQ_TCS	def .....	1580
use 3181, 4467, 5077, 5094, 5675, 5971, 6038, 7317			TCC_CAN_TQ_TCT	def .....	1580
TAM_ST_DSL_CMN	def .....	5858	TCC_CAN_VEH_MOD	def .....	1580
TAM_STOP	def .....	1214	TCC_END_DIAG_OBD_LSH_UP [NC_CBK_EX_NR]	def .....	5439
use .....	5077		TCC_ERR_FAC_GAIN_H_R_LS_UP [NC_CBK_EX_NR]	def .....	1321
TAM_TOIL_MAX	def .....	1223	TCC_ERR_FAC_GAIN_L_R_LS_UP [NC_CBK_EX_NR]	def .....	1321
use .....	7391, 7560, 7684		TCC_ERR_OBD_LSH_DOWN [NC_CBK_EX_NR]	def .....	5199
Tans	def .....	8135	TCC_ERR_OBD_LSH_UP [NC_CBK_EX_NR]	def .....	5439
use .....	7317		TCC_ERR_V_OFS_ADJ_R_IT_LS_UP [NC_CBK_EX_NR]	def .....	1321
TCC_CAN_ARS	def .....	1579	TCC_ERR_V_OFS_MES_R_IT_LS_UP [NC_CBK_EX_NR]	def .....	1321
TCC_CAN_BN_SPT_SWI	use .....	4871	TCC_FAC_GAIN_H_R_IT_LS_UP [NC_CBK_EX_NR]	def .....	1321
TCC_CAN_CAS	def .....	1579	TCC_FAC_GAIN_L_R_IT_LS_UP [NC_CBK_EX_NR]	def .....	1321
TCC_CAN_DISP_ECU	def .....	1579	TCC_MC_FCT_SPC_IST_WRG_RESP	def .....	7100
TCC_CAN_ECU	def .....	1579	TCC_MC_PFM_TOG [NC_NR_MC_PFM_TCC]	def .....	7117
TCC_CAN_ECU1	def .....	1579	TCC_MC_PFM_TOG_6	def .....	7117
TCC_CAN_ECU2	def .....	1579	TCC_NS_AFR_DIAG [NC_NOX_SENS_CONF]	def .....	6389
TCC_CAN_ECU3	def .....	1579	TCC_NS_AVL [NC_NOX_SENS_CONF]		
TCC_CAN_ETCU	def .....	1580			
TCC_CAN_ETCU_3	def .....	1580			
use .....	4871				
TCC_CAN_GS_IDC	def .....	1580			
TCC_CAN_ICL					


def .....	6368	def .....	1218
TCC_NS_LSL_UP_DOWN [NC_NOX_SENS_CONF]		use .....	5077
def .....	6396	TCO_A_LAM_AD_WUP [NC_CBK_EX_NR]	
TCC_NS_OFS [NC_NOX_SENS_CONF]		def .....	2678
def .....	6378	TCO_B_LAM_AD_WUP [NC_CBK_EX_NR]	
TCC_NS_PUC_DIAG [NC_NOX_SENS_CONF]		def .....	2678
def .....	6405	TCO_C_LAM_AD_WUP [NC_CBK_EX_NR]	
TCC_THD_ERR_OBD_LSH_DOWN_TMP		def .....	2678
def .....	5199	TCO_CMN	
TCC_THD_OBD_LSH_DOWN_TMP		def .....	642
def .....	5199	use .....	1717
TCC_V_OFS_ADJ_R_IT_LS_UP [NC_CBK_EX_NR]		TCO_D_LAM_AD_WUP [NC_CBK_EX_NR]	
def .....	1321	def .....	2678
TCC_V_OFS_MES_R_IT_LS_UP [NC_CBK_EX_NR]		TCO_DE_DIAG_TH	
def .....	1321	def .....	5652
TCC_VLD_OBD_LSH_DOWN [NC_CBK_EX_NR]		TCO_DE_INI_DIAG_TH	
def .....	5199	def .....	5652
Tchip		TCO_DIAG_TH	
def .....	8369	def .....	5652
use .....	7317	TCO_DIF_DIAG_TCO_PLAUS	
TCHIP_KWP		def .....	5682
def .....	7310	TCO_DIF_NOX_HOMS	
TCO		def .....	2968
def .....	1100	TCO_DIF_NOX_S	
use .....	642,	def .....	2976
937, 1019, 1105, 1123, 1149, 1198, 1206, 1218,		TCO_DSL_CMN	
1223, 1226, 1232, 1379, 1454, 1542, 1585, 1721,		def .....	5789
1759, 1766, 1777, 1828, 1874, 1881, 1896, 1912,		use .....	5746
1921, 1925, 1953, 1962, 2005, 2043, 2094, 2100,		TCO_E_LAM_AD_WUP [NC_CBK_EX_NR]	
2109, 2154, 2169, 2179, 2241, 2278, 2373, 2449,		def .....	2678
2465, 2590, 2643, 2679, 2722, 2734, 2866, 2943,		TCO_EX	
2968, 2976, 3350, 3443, 3512, 3514, 3545, 3599,		def .....	1045
3601, 3614, 3622, 3630, 3681, 3737, 3797, 3823,		use .....	1198, 1232
3844, 3858, 3957, 4006, 4045, 4069, 4194, 4333,		TCO_EX_MES	
4377, 4467, 4538, 4773, 4810, 4952, 5077, 5094,		def .....	1045
5143, 5152, 5210, 5379, 5422, 5459, 5553, 5666,		TCO_IGA_DIF_MAX_KNK [NC_NR_FRF_KNK_RTD]	
5682, 5789, 5929, 5955, 6051, 6102, 6133, 6142,		def .....	1952
6214, 6226, 6276, 6284, 6532, 6543, 6565, 6602,		TCO_MEM_FUP_EFP_H	
6675, 6683, 6903, 7317, 7438, 7684, 7768, 8226		def .....	3823
TCO_1_2		TCO_MEM_FUP_EFP_L	
def .....	1218	def .....	3823
TCO_2		TCO_MES	
def .....	1218	def .....	1100
use .....	1045, 5077, 7317, 8226	use .....	4496, 5652, 5675, 5691, 7317, 7391, 7560,
TCO_2_DIF_TCO_2_PLAUS		7896, 7945	
def .....	5666	TCO_MES_DIF_DIAG_TCO_STUCK	
TCO_2_MES		def .....	5691
def .....	1218	TCO_MES_MAX_DIAG_TCO_STUCK	
use .....	1045, 4572, 5666, 7317, 7560	def .....	5691
TCO_2_MES_ST		TCO_MES_MIN_DIAG_TCO_STUCK	
def .....	1218	def .....	5691
use .....	5666	TCO_MIN_INTER_LAM_AD_WUP [NC_CBK_EX_NR]	
TCO_2_PLAUS_H		def .....	2678
def .....	5666	TCO_MIN_LAM_AD_WUP [NC_CBK_EX_NR]	
TCO_2_PLAUS_L		def .....	2679
def .....	5666	TCO_MON	
TCO_2_ST		def .....	6903

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use .....	6796, 6952, 6975	def .....	1873
TCO_REST		use .....	1876, 2043
def .....	1766	TD_AD [NC_CYL_NR]	
TCO_ST		def .....	932
def .....	1100	use .....	1876, 2043, 4773
use 1105, 1232, 1777, 1801, 2109, 2226, 2335, 2442,		TD_AD_H [NC_CYL_NR]	
2465, 2613, 2679, 2913, 3054, 3181, 3261, 3564,		def .....	932
3611, 3681, 3792, 3823, 3868, 3957, 4377, 4467,		TD_AD_L [NC_CYL_NR]	
5077, 5652, 5666, 5682, 5691, 5789, 5971, 6038,		def .....	932
6063, 6133, 6226, 6429, 6494, 6509, 6517, 6582,		TD_CLC	
6597, 7317, 7738, 8226, 8310		def .....	937
TCO_ST_BAL		Td_f_ierr	
def .....	3261	def .....	8369
use .....	4045, 4069	TD_FAC	
TCO_ST_DC		def .....	1874
def .....	1100	use .....	1873, 1875
use .....	3054, 3350, 6429, 8226	TD_FAC_MAX	
TCO_ST_DIAG_TMP		def .....	917
def .....	4467	use .....	1876
TCO_ST_DSL_CMN		TD_FAC_MAX_TMP	
def .....	5789	def .....	1876
use .....	5746, 5858	TD_FAC_MIN	
TCO_ST_NS		def .....	917
def .....	3054	use .....	1876
TCO_ST_STUCK_RNG		TD_FAC_MIN_TMP	
def .....	5675	def .....	1876
TCO_STOP		TD_FAC_TCO	
def .....	1100	def .....	1874
use .....	2094, 4467, 8226	TD_IGC [NC_CYL_NR]	
TCO_STOP_DIAG_TMP		def .....	1876
def .....	4467	use .....	932, 4773, 7194
TCO_STOP_ST		TD_IGC_ACT [NC_CYL_NR]	
def .....	4467	def .....	2040
TCO_STOP_TAM		use .....	1876
def .....	4467	TD_IGC_ACT_MAX	
TCO_SUB		def .....	1876
def .....	1105	TD_IGC_ACT_MIN	
use .....	1100, 5653, 5660, 5682, 5691, 6903	def .....	1876
TCO_SUB_DIF_DIAG_TCO_STUCK		TD_LIM_MAX	
def .....	5691	def .....	1876
TCO_SUB_INC		use .....	2043
def .....	1105	TD_MPL	
TCO_SUB_MAX_DIAG_TCO_STUCK		def .....	1881
def .....	5691	TD_MPL_1	
TCO_SUB_MIN_DIAG_TCO_STUCK		def .....	1881
def .....	5691	TD_MPL_1_DLY	
TCO_TMP_H		def .....	1881
def .....	3823	TD_MPL_DLY	
TCO_TMP_L		def .....	1881
def .....	3823	Td_og_cnt	
TCO_TOIL_MAX		def .....	8203
def .....	1223	Td_og_icnt	
use .....	7391, 7560, 7684	def .....	8203
TCYL_MDL_CUS		TD_og_tk	
def .....	8270	def .....	8203
use .....	3333	TD_og_tr	
TD		def .....	8204

Td_og_tv	def .....	3188	def .....	3188
def .....	8204	use .....	3181	
Td_og_uplcnt	def .....	8204	TEG_PCAT_DOWN_COR [NC_CBK_EX_NR]	def .....
Td_rdgenreg2	def .....	8369	use .....	8238
TD_S	def .....	1875	TEG_PCAT_DOWN_RAW	def .....
use .....	1876, 2043	TEG_PCAT_DOWN_ST	def .....	1253
TD_TMP_SYN	def .....	2040	TEG_PCAT_DOWN_WIDE_RNG	def .....
Td_wese [NC_CYL_NR][2]	def .....	8177	def .....	1253
use .....	8271	TEG_PCAT_DOWN_WIDE_RNG_ST	def .....	1253
Td_wese23min_hs [NC_CYL_NR]	def .....	8177	TEG_STAT_MAX	def .....
use .....	8271	def .....	8236	
TECU	def .....	1256	TEG_STAT_MAX_1	def .....
use .....	1896, 2043, 2278, 3957, 4133, 7317, 8226	def .....	8236	
TECU_MC	def .....	1256	TEG_STAT_MAX_2	def .....
TEG_CAT_DOWN [i]	def .....	2195	def .....	8236
TEG_CAT_DOWN_MDL	def .....	8236	TEG_TUR_UP_MES [NC_NR_TEG_SENS]	def .....
use 1008, 1253, 2195, 4713, 7317, 7768, 7896, 7945		use .....	809	
TEG_CAT_DOWN_MDL [i]	def .....	8236	TEG_WALL_CAT_DOWN_MDL [NC_CBK_EX_NR]	def .....
TEG_CAT_DOWN_MDL_BAS [NC_CBK_EX_NR]	def .....	8236	def .....	8236
TEG_CAT_UP_MDL [i]	def .....	8236	use .....	2435
use .....	812, 1009, 1939, 2195, 2866, 7896, 7945	TEG_WALL_CAT_UP_MDL [NC_CBK_EX_NR]	def .....	8237
TEG_CAT_UP_MDL [NC_CBK_EX_NR]	def .....	8236	use .....	2406
TEG_CAT_UP_MDL_MAX	def .....	1939	TEG_WALL_NT_DOWN_MDL	def .....
use .....	6265	use .....	8237	
TEG_DYN	def .....	8236	use .....	3181, 7768
use .....	1039, 4763	TEG_WALL_NT_DOWN_MDL_ST	def .....	8237
TEG_DYN_HYS	def .....	1939	use .....	3181
TEG_DYN_LS_DOWN [NC_CBK_EX_NR]	def .....	1007	TEMP_ALTER	def .....
use 1365, 2416, 2422, 4248, 4267, 5171, 5199, 5422		TEMP_ALTER_MC	def .....	8369
TEG_DYN_LS_UP [NC_CBK_EX_NR]	def .....	1008	def .....	4096
use .....	2386, 4315, 5277, 5298, 5439	use .....	4131, 8370	
TEG_DYN_STOP	def .....	1039	TEMP_CAPA_IV [NC_CYL_NR]	def .....
use .....	1232	use .....	2241	
TEG_PCAT_DOWN [NC_CBK_EX_NR]	def .....	1253	def .....	2241
use .....	812, 2195, 3181, 7317	TEMP_CAPA_IV_MV	def .....	2241
TEG_PCAT_DOWN_ADD		5143, 5152, 5171, 5459, 5474, 5553, 5608	use .....	1232, 2005, 2226, 2278, 2866, 3350

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TEMP_CAT_STAT_MDL [NC_CBK_EX_NR]	use .....	7013
def .....	8237	
use .....	5474, 5608	
TEMP_COOL		
def .....	1896	
TEMP_DIF_OBD_LSH_DOWN [NC_CBK_EX_NR]		
def .....	5199	
TEMP_DIF_TCO_TIA		
def .....	1232	
TEMP_EL_CWP		
def .....	4096	
use .....	4538, 7317	
TEMP_EL_CWP_2_1		
use .....	7317	
TEMP_EL_CWP_2_2		
use .....	7318	
TEMP_FUEL_RAIL_SUB		
def .....	1232	
TEMP_FUEL_RAIL_WALL		
def .....	1232	
TEMP_GB		
def .....	1580	
use .....	8205	
TEMP_INI_LS_DOWN [NC_CBK_EX_NR]		
def .....	2435	
use .....	2422	
TEMP_INI_LS_UP [NC_CBK_EX_NR]		
def .....	2406	
use .....	2386	
TEMP_LAM_AD_INJ		
def .....	3349	
use .....	3406	
TEMP_LAM_CYL_SEL		
def .....	2864	
use .....	2734	
TEMP_LDC_CAT_DIAG_AFL [NC_CBK_EX_NR]		
def .....	5553	
TEMP_MAIN_CAT_PURGE [NC_CBK_EX_NR]		
def .....	2942	
use .....	2928	
TEMP_MAP_DIP_MDL		
def .....	1198	
TEMP_MDL_IGC		
def .....	1896	
use .....	1881	
TEMP_MOT_VVL		
def .....	809	
TEMP_PRS_COR_1_HOM		
def .....	2002	
TEMP_PRS_COR_2_HOM		
def .....	2002	
TEMP_SEL_EGY_CTL		
def .....	2278	
TEMP_SWI_MES_MAX_VVL		
def .....	809	
TEST_REC_IDX_MON2		
def .....	7100	
	tester_control [16]	7386
	Tevt_mdl	
	def .....	8177
	use .....	8271
	TFPA	
	def .....	4004
	TFU	
	def .....	1232
	use .....	3792, 3797, 3909, 3957, 4004, 6063
	TFU_ADD_FUEL_FLOW	
	def .....	1232
	TFU_EFP	
	def .....	1232
	use .....	3797
	TFU_INJ	
	def .....	3332
	use .....	2005, 2224, 2226, 2262, 2278, 3350
	TFU_IV	
	def .....	1232
	use .....	2866, 3333, 3350
	TFU_IV_ST	
	def .....	1232
	TFU_IV_SUB	
	def .....	1232
	TFU_IV_SUB_BAS	
	def .....	1232
	TFU_IV_SUB_MV	
	def .....	1232
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	def .....	1232
	TFU_LPF_TCO	
	def .....	1232
	TFU_OFS_AIR	
	def .....	1232
	TFU_RAW	
	def .....	1232
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	def .....	1232
	Tgen	
	def .....	8177
	use .....	8370
	Tget	
	def .....	8204
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	def .....	8177
	use .....	7318, 7560
	Tget_b2	
	def .....	8177
	use .....	7318, 7560
	Tget_b3	
	def .....	8177
	use .....	7318, 7560
	Tget_b4	

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def .....	8177	TI_1_S_CLC_MIN	
use .....	7318, 7560	def .....	2003
Tget_b5		TI_1_STND_HOM [NC_CYL_NR]	
def .....	8177	def .....	2003
use .....	7318, 7560	TI_2_HOM [NC_CYL_NR]	
THD_AD_ER		def .....	2003
def .....	1474	use .....	1559, 2043, 2130, 6118, 8271
use .....	1454	TI_2_HOM_0_5	
THD_ER		def .....	1559
def .....	6276	TI_2_HOM_CLC [NC_CYL_NR]	
use .....	1469, 6276	def .....	2003
THD_ER_BUF [NC_SIZE_THD_ER_BUF]		TI_2_HOM_CLC_MAX	
def .....	6276	def .....	2003
THD_ER_CLC		TI_2_HOM_CLC_MIN	
def .....	6283	def .....	2003
use .....	6276	TI_2_HOM_CSERS_TEST [NC_CYL_NR]	
THD_ER_CLC_PREV		def .....	2040
def .....	6283	Ti_2_homext	
THD_ER_CYL [NC_CYL_NR]		def .....	8270
def .....	6276	TI_2_MES [NC_CYL_NR]	
TI_1_ADD_DLY_HOM		def .....	2040
def .....	2040	use .....	2230, 6118, 6761, 6796
TI_1_HOM [NC_CYL_NR]		TI_2_MON [NC_CYL_NR]	
def .....	2002	def .....	6793
use .....	1559, 2043, 2122, 6118, 7391, 7560, 8271	use .....	6761
TI_1_HOM_0_5		TI_2_PRS_HOM_SP [NC_CYL_NR]	
def .....	1559	def .....	2204
TI_1_HOM_CLC [NC_CYL_NR]		use .....	2005
def .....	2002	TI_2_PRS_HOM_SP_TMP	
TI_1_HOM_CLC_MAX		def .....	2204
def .....	2002	TI_2_PRS_S_SP_TMP	
use .....	2122	def .....	2216
TI_1_HOM_CLC_MIN		TI_2_S [NC_CYL_NR]	
def .....	2003	def .....	2003
TI_1_HOM_CSERS_TEST [NC_CYL_NR]		use .....	1559, 2043, 2136, 2142, 2147
def .....	2040	TI_2_S_0_5	
Ti_1_homext		def .....	1559
def .....	8270	TI_2_S_CLC [NC_CYL_NR]	
TI_1_MES [NC_CYL_NR]		def .....	2003
def .....	2040	TI_2_S_CLC_MIN	
use .....	2230, 2241, 2278, 4803, 6118, 6761, 6796, 7318	def .....	2003
TI_1_MES_IDX_MON		TI_2_STND_HOM [NC_CYL_NR]	
def .....	6760	def .....	2003
TI_1_MON [NC_CYL_NR]		TI_2_STND_S [NC_CYL_NR]	
def .....	6793	def .....	2216
use .....	6761	use .....	2005
TI_1_PRS_HOM_SP_TMP		TI_3_HOM [NC_CYL_NR]	
def .....	2200	def .....	2003
TI_1_PRS_S_SP_TMP		use .....	2043, 2133, 6118, 8271
def .....	2212	TI_3_HOM_CLC [NC_CYL_NR]	
TI_1_S [NC_CYL_NR]		def .....	2003
def .....	2003	TI_3_HOM_CLC_MAX	
use .....	1559, 2043, 2136, 2140, 2147	def .....	2003
TI_1_S_0_5		TI_3_HOM_CLC_MIN	
def .....	1559	def .....	2003
TI_1_S_CLC [NC_CYL_NR]		TI_3_HOM_CSERS_TEST [NC_CYL_NR]	
def .....	2003	def .....	2040


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TI_3_PRS_HOM_SP [NC_CYL_NR]	use .....	2005, 2179, 2262
def .....	TI_IDX_1_MON	
use .....	def .....	6760
TI_3_PRS_HOM_SP_TMP	TI_IDX_2_MON	
def .....	def .....	6760
TI_3_PRS_S_SP_TMP	TI_IDX_POST_MON	
def .....	def .....	6760
TI_3_S [NC_CYL_NR]	TI_IV_1_COR_MON	
def .....	def .....	6761
use .....	TI_IV_2_COR_MON	
2043, 2144, 2147	def .....	6761
TI_3_S_CLC [NC_CYL_NR]	TI_IV_POST_COR_MON	
def .....	def .....	6761
2003	TI_LAM_COR [NC_CBK_EX_NR]	
TI_3_S_CLC_MIN	def .....	1017
def .....	use .....	5929
2003	TI_LAM_DIAGCPS_DIF [NC_CBK_EX_NR]	
TI_3_STND_HOM [NC_CYL_NR]	def .....	5929
def .....	TI_LAM_DIAGCPS_MAX [NC_CBK_EX_NR]	
2003	def .....	5929
TI_3_STND_S [NC_CYL_NR]	TI_LAM_DIAGCPS_MIN [NC_CBK_EX_NR]	
def .....	def .....	5929
2220	TI_MES_4 [NC_NR_IV_PLS] [NC_CYL_NR]	
use .....	def .....	6118
2005	use .....	6109
TI_4 [NC_NR_INJ_CMB] [NC_NR_IV_PLS] [NC_CYL_NR]	TI_MIN_HOM	
def .....	def .....	2003
6118	TI_POST_INJ [NC_CYL_NR]	
use .....	def .....	2179
6109	use .....	2043, 2188, 6796
TI_4_CSERS_MAX [NC_NR_IV_PLS] [NC_CYL_NR]	TI_POST_MES [NC_CYL_NR]	
def .....	def .....	2041
6109	use .....	2230, 6118, 6761, 6796
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def .....	def .....	6793
6109	use .....	6761
TI_4_MEM [NC_NR_IV_PLS]	TI_TEMP	
def .....	def .....	2109
6109	TI_TUN_ADD_IV [NC_CYL_NR]	
TI_ACT_SWI [NC_CYL_NR]	def .....	2233
def .....	use .....	2005, 6761
2041	TI_TUN_IV [NC_CYL_NR]	
TI_ACT_UPD [NC_CYL_NR]	def .....	2233
def .....	use .....	2005, 2262, 6761
2041	TI_WUP	
TI_ADD [NC_CYL_NR]	def .....	2109
def .....	use .....	6761, 8244
999	TI_WUP_1	
use .....	def .....	2109
2005	TI_WUP_1_ADD	
TI_ADD_AS_CBK_EX [NC_CBK_EX_NR]	def .....	2109
def .....	use .....	1775
2233	TI_WUP_1_ADD_H_PRS	
TI_ADD_PULSE_MIN	def .....	2109
def .....	TI_WUP_1_ADD_LIH_L_PRS	
2041	def .....	2109
TI_AS	TI_WUP_1_H_PRS	
def .....		
2233		
TI_AS_CBK_EX [NC_CBK_EX_NR]		
def .....		
2233		
TI_CAST		
def .....		
2100		
use .....		
1766, 6761, 8244		
TI_CAST_H_PRS		
def .....		
2100		
TI_CAST_LIH_L_PRS		
def .....		
2100		
TI_DIF_MES_IDX_MON		
def .....		
6760		
TI_EXT_ADJ [NC_CYL_NR]		
def .....		
3332		
use .....		
2043		
TI_FAC [NC_CYL_NR]		
def .....		
999		

def .....	2109	TIMEOUT_TIME_20_KWP	
TI_WUP_1_LIH_L_PRS		def .....	7435
def .....	2109	TIMEOUT_TIME_2A_KWP	
TIA		def .....	7435
def .....	1226	TIMEOUT_TIME_32_KWP	
use . 984, 1112, 1192, 1198, 1585, 1912, 1953, 2100,		def .....	7436
2109, 2442, 2722, 3545, 3622, 3692, 3823, 4133,		TIMEOUT_TIME_80_KWP	
4142, 4237, 4952, 5077, 6429, 6532, 7318, 7560,		def .....	7436
7768, 8135		TIMEOUT_TIME_82_KWP	
TIA_DE_DIAG_TH		def .....	7436
def .....	5652	TIMEOUT_TIME_83_KWP	
TIA_DE_INH_DIAG_TH		def .....	7436
def .....	5660	TIMEOUT_TIME_84_KWP	
TIA_DIF_DIAG		def .....	7436
def .....	5093	TIMEOUT_TIME_85_KWP	
TIA_DIF_MAX_DIAG		def .....	7436
def .....	5093	TIMEOUT_TIME_87_KWP	
TIA_DIF_MIN_DIAG		def .....	7436
def .....	5093	TIMEOUT_TIME_88_KWP	
TIA_IGA_DIF_MAX_KNK [NC_NR_FRF_KNK_RTD]		def .....	7436
def .....	1952	TIMEOUT_TIME_89_KWP	
TIA_IM		def .....	7436
def .....	984	TIMEOUT_TIME_8A_KWP	
use ..... 1100, 1206, 2968, 2976, 3108, 6133		def .....	7436
TIA_MES		TIMEOUT_TIME_8B_KWP	
def .....	1226	def .....	7436
use ..... 4194, 5094, 7318, 7391, 7896, 7945		TIMEOUT_TIME_9E_KWP	
TIA_MES_SAE [NC_SENS_NR_TIA]		def .....	7436
use ..... 5802, 7945		TIMEOUT_TIME_A4_KWP	
TIA_MIN_DIAG_TH		def .....	7436
def .....	5652	TIMEOUT_TIME_AB_KWP	
TIA_MIN_INH_DIAG_TH		def .....	7436
def .....	5660	TIMEOUT_TIME_AC_KWP	
TIA_PLAUS_MAX_DIAG		def .....	7436
def .....	5093	TIMEOUT_TIME_AD_KWP	
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def .....	1226	def .....	7436
TIA_TCHA		TIMEOUT_TIME_B6_KWP	
def .....	1226	def .....	7436
use ..... 1192, 7318, 8135		TIMEOUT_TIME_B7_KWP	
TIA_TCHA_KWP		def .....	7436
def .....	7310	TIMEOUT_TIME_BF_KWP	
TIA_THR		def .....	7436
def .....	984	TIMEOUT_TIME_C1_KWP	
use ..... 1542, 3639, 4496, 4572, 5653, 5660, 6543		def .....	7437
TIA_THR_MES_SAE [NC_SENS_NR_TIA_THR]		TIMEOUT_TIME_C2_KWP	
use ..... 5802, 7945		def .....	7437
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def .....	7437	TIMEOUT_TIME_ED_KWP	
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def .....	7437	TIMEOUT_TIME_EE_KWP	
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TIMEOUT_TIME_C9_KWP		def .....	7438
def .....	7437	Tka	
TIMEOUT_TIME_CA_KWP		def .....	8225
def .....	7437	Tkat_mod	
TIMEOUT_TIME_CB_KWP		def .....	8237
def .....	7437	Tlrfgn	
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def .....	7437	use .....	7318
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def .....	7437	def .....	8177
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def .....	7437	use .....	7768
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def .....	7437	def .....	8226
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def .....	7437	def .....	8177
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def .....	7437	Tmot_b2	
TIMEOUT_TIME_D4_KWP		def .....	8177
def .....	7437	use .....	7318, 7560
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def .....	7437	def .....	8177
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TIMEOUT_TIME_D8_KWP		def .....	8177
def .....	7437	use .....	7318, 7560
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def .....	7438	Tn_abstell	
TIMEOUT_TIME_E2_KWP		def .....	8221
def .....	7438	use .....	7768
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def .....	7438	def .....	8221
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def .....	7438	Tn_abstellm_kwp	
TIMEOUT_TIME_E5_KWP		def .....	7310
def .....	7438	Tn_start_10	
TIMEOUT_TIME_E6_KWP		def .....	8221
def .....	7438	Tn_start_1s	
TIMEOUT_TIME_E7_KWP		def .....	8221
def .....	7438	Tn_start_k15	
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def .....	1777	use .....	7318, 7560
use .....	2179, 6582	Toel_b5	
TNT_DIF_CH_SO2P		def .....	8178
def .....	1813	use .....	7318, 7560
use .....	6582	Toel_getr	
TNT_MDL_1 [NC_NT_NR]		def .....	8204
def .....	8237	Toel_mdl	
use .....	3108, 6348	def .....	8204
TNT_MDL_2 [NC_NT_NR]		Toel_oz	
def .....	8237	def .....	8178
use .....	3108, 6348	TOIL	
TNT_MDL_H		def .....	8204
def .....	8237	use .....	1112, 1123, 1223, 1585, 1896, 2109, 3108, 3545, 4357, 6133, 6710
use .....	1777, 1809, 2195, 2958, 2989, 3054, 3108, 3129, 3194, 6348, 6359, 6379	TOIL_CAN	
TNT_MDL_H_1		def .....	1580
def .....	8237	TOIL_MAX_WARN	
TNT_MDL_H_2		def .....	1223
def .....	8237	use .....	7391, 7560, 7684
TNT_MDL_L		TOIL_MES	
def .....	8237	def .....	8204
use .....	1777, 1813, 2989, 3108, 3194, 6330, 6348, 6359, 6379, 7768	use .....	7318
TNT_MDL_L_COR_CH_L		TOIL_STOP	
def .....	1777	def .....	8204
TNT_MDL_MAX		TOIL_THD_TOIL_MAX	
def .....	2987	def .....	1223
TNT_MDL_MAX_AVL		use .....	7391, 7560, 7684
def .....	8237	TOUT_I_I2_SHIFT_VLD_AFL [NC_CBK_EX_NR]	
TNT_MDL_MAX_OFS		def .....	2464
def .....	3054	TOUT_I_I2_SHIFT_VLD_AFR [NC_CBK_EX_NR]	
use .....	2989	def .....	2464
TNT_MDL_MIN		TPS_AD_SLOP_GAIN_1	
def .....	2987	def .....	4951
TNT_MDL_MV		use .....	1169
def .....	8237	TPS_AD_STEP	
use .....	1789, 2989, 3075, 3108, 3129, 3145, 6348, 6405, 6413, 6429, 7768	def .....	4951
TNT_MDL_MV_SNG [NC_NT_NR]		use .....	7318
def .....	8237	TPS_AD_STEP_KWP [NC_ETC_NR]	
use .....	2886, 3114, 5553, 5608, 6348	def .....	7310
TNT_MDL_NT_AGI_DYW [NC_NT_NR]		TPS_AV	
def .....	3107	def .....	1169
Toel		use .....	1198, 1474, 4824, 4952, 5802, 6214, 6532, 6546, 6555, 7318, 7391, 8377
def .....	8177	TPS_AV_1	
use .....	7318, 7768, 8205	def .....	1169
Toel_b1		use .....	4991, 7318, 7560
def .....	8177	TPS_AV_2	
use .....	7318, 7560	def .....	1169
Toel_b2		use .....	4991, 7318
def .....	8177	TPS_AV_CTL	
use .....	7318, 7560	def .....	1169
Toel_b3		use .....	6546
def .....	8177	TPS_AV_CTL_1	
use .....	7318, 7560	def .....	1169
Toel_b4		TPS_AV_CTL_2	
def .....	8177	def .....	1169
		TPS_AV_CTL_GAIN_1	


def .....	1169	def .....	7438
TPS_AV_GAIN_1		TPS_SP_AD	
def .....	1169	def .....	4952
TPS_AV_KWP [NC_ETC_NR]		use .....	6555
def .....	7310	TPS_SP_CTL	
TPS_AV_LIH_DIF		def .....	6546
def .....	6546	TPS_SP_ES	
TPS_DIF		def .....	6565
def .....	6546	use .....	6555
use .....	4978, 6532	TPS_SP_EXT	
TPS_DIF_DIAG_1		def .....	6565
def .....	4990	use .....	6555
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def .....	4990	def .....	7438
TPS_DIF_DIAG_COR_1		use .....	6565
def .....	4990	TPS_SP_JAM	
TPS_DIF_DIAG_COR_2		def .....	6532
def .....	4990	use .....	6555
TPS_DIF_DIAG_COR_MMV_1		TPS_SP_JAM_TMP	
def .....	4990	def .....	6532
TPS_DIF_DIAG_COR_MMV_2		TPS_SP_LIH_DIF	
def .....	4990	def .....	6546
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def .....	6546	def .....	6555
TPS_GRD		TPS_SP_LIM_1	
def .....	1169	def .....	6555
use .....	1474, 6214	TPS_SP_LIM_2	
TPS_JAM_ACT		def .....	6555
def .....	6532	TPS_SP_MDL	
TPS_JAM_PLS		def .....	8377
def .....	6532	use .....	5802, 6532, 6555, 7318
TPS_LIH		TPS_SP_PWL	
def .....	1169	def .....	6565
use .....	4952, 6546, 6555	use .....	6555
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def .....	4952	use .....	5802, 7945
use .....	1169	TPS_SP_SEL	
TPS_LIH_2		def .....	6555
def .....	4952	TPS_SUB_DIAG	
use .....	1169	def .....	8377
TPS_LIH_INI		use .....	4991
def .....	4952	TPS_SUM_DIF_DIAG_COR_1	
use .....	1169	def .....	4990
TPS_REL_SAE [NC_ETC_NR]		TPS_SUM_DIF_DIAG_COR_1_OLD	
use .....	5802, 7945	def .....	4990
TPS_SEG		TPS_SUM_DIF_DIAG_COR_2	
def .....	1169	def .....	4991
TPS_SEG_1		TPS_SUM_DIF_DIAG_COR_2_OLD	
def .....	1169	def .....	4991
TPS_SEG_2		TQ_ACCIN_CAN	
def .....	1169	def .....	1580
TPS_SEG_GAIN_1		use .....	6602
def .....	1169	TQ_AD_ADD_S_SWI	
TPS_SP		def .....	6658
def .....	6555	TQ_ADD_ACC	
use .....	6546, 7318	def .....	6602
TPS_SP_2_EXT_ADJ		use .....	1048

TQ_ADD_CH	def .....	6582	TQ_ADD_PSTE_2	def .....	6621
use .....	1925, 3443, 6284, 6597, 8233		use .....	1047	
TQ_ADD_CH_DIAG	def .....	6582	TQ_ADD_PSTE_3	def .....	6622
use .....	6494		TQ_ADD_REQ_ACT_FIL_CH	def .....	6658
TQ_ADD_CH_TCHA_DIAG	def .....	8233	TQ_ADD_SO2P	def .....	6582
use .....	6582		use .....	8200	
TQ_ADD_CONV	def .....	6710	TQ_ADD_SO2P_I	def .....	6582
use .....	6710		TQ_ADD_SO2P_MAX	def .....	6582
TQ_ADD_CONV_2	def .....	6710	TQ_ADD_SO2P_P	def .....	6582
use .....	6710		TQ_ADD_SO2P_PCTL	def .....	6582
TQ_ADD_CP	def .....	3562	TQ_ADD_SO2P_RAW	def .....	6582
use .....	8230		TQ_ADD_ST	def .....	810
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use .....	1048		TQ_ADD_TCT	def .....	6710
TQ_ADD_I_IS	def .....	3441	use .....	6710	
TQ_ADD_I_IS_MON	def .....	6921	TQ_ADD_TRANS	def .....	6710
TQ_ADD_I_RAMP	def .....	3441	use .....	8394	
TQ_ADD_IS_BOL	def .....	3544	TQ_AMT_FAST_BN	def .....	1580
use .....	8212		use .....	1711, 6985	
TQ_ADD_IS_BOL_OPM_1	def .....	3544	TQ_AMT_FAST_DEC_BN	def .....	1710
TQ_ADD_IS_BOL_OPM_2	def .....	3544	TQ_AMT_FAST_INC_BN	def .....	1710
TQ_ADD_IS_BOL_SEL	def .....	3544	TQ_AMT_MON	def .....	6984
TQ_ADD_MAX	def .....	8390	use .....	6796	
use .....	6582		TQ_AMT_SLOW_BN	def .....	1581
TQ_ADD_MIN_CH	def .....	6597	use .....	1711, 6985	
TQ_ADD_MIN_CLU_MON	def .....	6793	TQ_AMT_SLOW_DEC_BN	def .....	1710
use .....	6952		TQ_AMT_SLOW_INC_BN	def .....	1710
TQ_ADD_P_D_IS_MON	def .....	6921	TQ_ASR_FAST_DEC_BN	def .....	1710
TQ_ADD_P_D_RAMP_FAST	def .....	3441	use .....	1585, 6742	
TQ_ADD_P_D_RAMP_SLOW	def .....	3441	TQ_ASR_SLOW_DEC_BN	def .....	1710
TQ_ADD_PL_DROF	def .....	1112	use .....	6742	
use .....	8212		TQ_AV	def .....	6656
TQ_ADD_PSTE	def .....	6621	use .....	1112, 1585, 4377, 4713, 5022, 8381	
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TQ_AX_MAX		TQ_DIF_IS_AD	
use .....	7318	def .....	3518
TQ_AX_MAX_KWP		use .....	6975, 8212
def .....	7310	TQ_DIF_IS_AD_ACC	
TQ_AX_MIN		def .....	3518
use .....	7318	use .....	6602
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def .....	7310	def .....	3518
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def .....	6710	def .....	3518
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TQ_CONV_CAN		def .....	3518
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use .....	6710	def .....	3518
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def .....	6710	def .....	3518
TQ_CONV_MAX_MDL_MON		TQ_DIF_IS_AD_ACC_CONV_INTER	
def .....	6793	def .....	3518
TQ_CONV_MAX_MON		TQ_DIF_IS_AD_ACC_CONV_OPM_1	
def .....	6793	def .....	3518
use .....	6952	TQ_DIF_IS_AD_ACC_CONV_OPM_2	
TQ_CONV_STN		def .....	3518
def .....	6710	TQ_DIF_IS_AD_ACC_NEUT	
TQ_DCC_FAST_BN		def .....	3518
def .....	1581	TQ_DIF_IS_AD_ACC_NEUT_INTER	
use .....	1711, 6731, 6985	def .....	3519
TQ_DCC_FAST_INC_BN		TQ_DIF_IS_AD_ACC_NEUT_OPM_1	
def .....	1710	def .....	3519
use .....	6731	TQ_DIF_IS_AD_ACC_NEUT_OPM_2	
TQ_DCC_MON		def .....	3519
def .....	6984	TQ_DIF_IS_AD_CONV	
use .....	6796	def .....	3519
TQ_DCC_SLOW_BN		use .....	6710
def .....	1581	TQ_DIF_IS_AD_CONV_1	
use .....	1711, 6731, 6985	def .....	3519
TQ_DCC_SLOW_INC_BN		TQ_DIF_IS_AD_CONV_1_INTER	
def .....	1710	def .....	3519
use .....	6731	TQ_DIF_IS_AD_CONV_1_OPM_1	
TQ_DELTA_MAX_CLU		def .....	3519
def .....	6737	TQ_DIF_IS_AD_CONV_1_OPM_2	
TQ_DIF_ADD_IS_TOL		def .....	3519
def .....	3544	TQ_DIF_IS_AD_CONV_NEUT	
use .....	8212	def .....	3519
TQ_DIF_I_IS		TQ_DIF_IS_AD_CONV_NEUT_INTER	
def .....	3441	def .....	3519
use .....	3350, 3406, 3520, 6922, 8212	TQ_DIF_IS_AD_CONV_NEUT_OPM_1	
TQ_DIF_I_IS_1		def .....	3519
def .....	3441	TQ_DIF_IS_AD_CONV_NEUT_OPM_2	
TQ_DIF_I_IS_2		def .....	3519
def .....	3441	TQ_DIF_IS_AD_INTER	
TQ_DIF_I_IS_DIF_MON		def .....	3520
def .....	6921	TQ_DIF_IS_AD_OPM_1	
TQ_DIF_I_IS_MON		def .....	3520
def .....	6921	TQ_DIF_IS_AD_OPM_2	
use .....	6952, 7318	def .....	3520
TQ_DIF_I_IS_RAMP_MON		TQ_DIF_P_D_DT_IS_1	

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def .....	3441	def .....	6793
TQ_DIF_P_D_DT_IS_1_SLOW		TQ_DROF_MON	
def .....	3441	def .....	6793
TQ_DIF_P_D_DT_IS_OPM_1		use .....	6851
def .....	3441	TQ_DROF_MON2	
TQ_DIF_P_D_DT_IS_OPM_2		def .....	7012
def .....	3441	TQ_DROF_SLOW	
TQ_DIF_P_D_DT_IS_SEL		def .....	1112
def .....	3441	use .....	6796, 8212
TQ_DIF_P_D_DT_IS_SLOW_OPM_1		TQ_ECU_ETCU	
def .....	3441	def .....	8290
TQ_DIF_P_D_DT_IS_SLOW_OPM_2		use .....	1585
def .....	3441	TQ_EMS_BN	
TQ_DIF_P_D_DT_IS_SLOW_SEL		def .....	1581
def .....	3441	TQ_GS_FAST_BN	
TQ_DIF_P_D_FAST_IS		def .....	1581
def .....	3441	use .....	1711, 6719, 6985
use .....	6494, 6796, 7318, 8212	TQ_GS_FAST_DEC_BN	
TQ_DIF_P_D_IS_DIF_MON		def .....	1710
def .....	6922	use .....	6719
TQ_DIF_P_D_IS_FAST		TQ_GS_FAST_INC_BN	
def .....	3441	def .....	1710
TQ_DIF_P_D_IS_MAX_2_MON		use .....	6719, 6985
def .....	6793	TQ_GS_MON	
TQ_DIF_P_D_IS_MAX_MON		def .....	6984
def .....	6793	use .....	6796
use .....	6922	TQ_GS_SLOW_BN	
TQ_DIF_P_D_IS_MON		def .....	1581
def .....	6793	use .....	1711, 6719, 6985, 8381
use .....	6851, 6922	TQ_GS_SLOW_DEC_BN	
TQ_DIF_P_D_IS_MON2		def .....	1710
def .....	7012	use .....	6719
TQ_DIF_P_D_IS_OPM_1		TQ_GS_SLOW_INC_BN	
def .....	3441	def .....	1710
TQ_DIF_P_D_IS_OPM_2		use .....	6719
def .....	3441	TQ_I_DT_IS_OPM_1	
TQ_DIF_P_D_IS_RAMP_MON		def .....	3442
def .....	6922	TQ_I_DT_IS_OPM_2	
TQ_DIF_P_D_IS_SEL		def .....	3442
def .....	3441	TQ_I_DT_IS_SEL	
TQ_DIF_P_D_IS_SLOW		def .....	3442
def .....	3442	TQ_I_IS_OPM_1	
TQ_DIF_P_D_IS_SLOW_OPM_1		def .....	3442
def .....	3442	TQ_I_IS_OPM_2	
TQ_DIF_P_D_IS_SLOW_OPM_2		def .....	3442
def .....	3442	TQ_I_IS_SEL	
TQ_DIF_P_D_IS_SLOW_SEL		def .....	3442
def .....	3442	TQ_IS_SNG_INJ_LAM_AD_INJ	
TQ_DIF_P_D_SLOW_IS		def .....	3406
def .....	3442	use .....	3350
use .....	3350, 3406, 6796, 7318, 8212	TQ_LIM_AT	
TQ_DIF_SUM_P_D_FAST		def .....	6697
def .....	6494	TQ_LIM_I_IS	
TQ_DROF_FAST		def .....	3442
def .....	1112	TQ_LIM_TCT	
use .....	6796, 8212	def .....	6697
TQ_DROF_MDL_MON		TQ_LIM_WLC	

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def .....	6697	def .....	6658
TQ_LOSS		use .....	8226
def .....	8385	TQ_LOSS_ECF	
use .....	1123, 1585, 3614, 6494, 6656, 6697, 6719, 6731, 6737, 6742, 6975	def .....	6580
TQ_LOSS_ACC		use .....	8226
def .....	6602	TQ_LOSS_FIL_MMV_MON	
use .....	1048, 6796	def .....	6794
TQ_LOSS_ACC_INP		TQ_LOSS_MDL_MON	
def .....	6602	def .....	6975
TQ_LOSS_ACC_MON		TQ_LOSS_MON	
def .....	6793	def .....	6975
TQ_LOSS_ADD		use .....	6796, 6851, 6952, 6985, 7318
def .....	8385	TQ_LOSS_MON2	
use .....	1721	def .....	7012
TQ_LOSS_ADD_FIL		TQ_LOSS_PSTE	
def .....	8193	def .....	6622
use .....	6796	use .....	1047, 3443
TQ_LOSS_ADD_FIL_MON		TQ_LOSS_PSTE_1	
def .....	6793	def .....	6622
use .....	6975	use .....	6796
TQ_LOSS_ADD_MON		TQ_LOSS_PSTE_1_MON	
def .....	6793	def .....	6794
use .....	6975	TQ_LOSS_PSTE_2	
TQ_LOSS_ALTER		def .....	6622
def .....	8369	use .....	6796
use .....	6796	TQ_LOSS_PSTE_2_AV	
TQ_LOSS_ALTER_MDL_MON		def .....	6622
def .....	6794	TQ_LOSS_PSTE_2_AV_CAN	
TQ_LOSS_ALTER_MON		def .....	1581
def .....	6794	use .....	6623
TQ_LOSS_ARS		TQ_LOSS_PSTE_2_DIF	
def .....	6650	def .....	6622
use .....	980, 6796	TQ_LOSS_PSTE_2_GRD	
TQ_LOSS_ARS_AV_CAN		def .....	6622
def .....	1581	TQ_LOSS_PSTE_2_MON	
use .....	6651	def .....	6794
TQ_LOSS_ARS_AV_MAX		TQ_LOSS_PSTE_2_RAW	
def .....	6650	def .....	6622
TQ_LOSS_ARS_AV_MAX_1		TQ_LOSS_PSTE_2_SP	
def .....	6650	def .....	6622
TQ_LOSS_ARS_DIF		TQ_LOSS_PSTE_2_SP_CAN	
def .....	6650	def .....	1581
TQ_LOSS_ARS_GRD		use .....	1721, 6623
def .....	6650	TQ_LOSS_PSTE_2_TMP	
TQ_LOSS_ARS_MON		def .....	6622
def .....	6794	TQ_LOSS_PSTE_3	
TQ_LOSS_ARS_SP_CAN		def .....	6622
def .....	1581	use .....	6796
use .....	1721, 6651	TQ_LOSS_PSTE_3_AV	
TQ_LOSS_ARS_SP_CAN_MAX		def .....	6622
def .....	6650	TQ_LOSS_PSTE_3_AV_CAN	
TQ_LOSS_ARS_SP_MAX		def .....	1581
def .....	6650	use .....	6623
TQ_LOSS_ARS_SP_MAX_1		TQ_LOSS_PSTE_3_DIF	
def .....	6650	def .....	6622
TQ_LOSS_CWP_EL		TQ_LOSS_PSTE_3_GRD	
		def .....	6622

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TQ_LOSS_PSTE_3_MON		TQ_MIN_CLU_DIF_MON	
def .....	6794	def .....	6952
TQ_LOSS_PSTE_3_RAW		use .....	7318
def .....	6622	TQ_MIN_CLU_MDL_2_MON	
TQ_LOSS_PSTE_3_SP		def .....	6952
def .....	6623	TQ_MIN_CLU_MDL_5_MON	
TQ_LOSS_PSTE_3_SP_CAN		def .....	6952
def .....	1581	TQ_MIN_CLU_MON	
use .....	6623	def .....	6952
TQ_LOSS_PSTE_MON		use .....	6851
def .....	6794	TQ_MIN_CLU_MON2	
TQ_LOSS_REQ_CLU		def .....	7012
def .....	8385	TQ_MIN_WHEEL_L	
use .....	6975	def .....	8290
TQ_LOSS_REQ_CLU_MDL_MON		use .....	1585
def .....	6975	TQ_MMV_DIAG_DYN_LSL_UP	
TQ_LOSS_REQ_CLU_MON		def .....	5350
def .....	6975	TQ_MSR_FAST_INC_BN	
use .....	6938, 6952	def .....	1711
TQ_LOSS_SA_MON		use .....	6742
def .....	6794	TQ_MSR_MON	
TQ_LOSS_SCHA		def .....	6984
def .....	6658	use .....	6796
use .....	8385	TQ_MSR_SLOW_INC_BN	
TQ_LOSS_THERMO		def .....	1711
def .....	6659	use .....	6742
use .....	8385	TQ_N_MAX_DIF	
TQ_LOSS_WIN_HEAT		def .....	3779
def .....	6659	TQ_N_MAX_DIF_I	
use .....	8385	def .....	3779
TQ_MAF		TQ_N_MAX_DIF_P	
def .....	1581	def .....	3779
use .....	8381	TQ_N_MAX_INP_I	
TQ_MAX_ACC		def .....	3779
def .....	8290	TQ_PAS_I_ACC_IS_OPM_1	
use .....	1585	def .....	3442
TQ_MAX_ACC_CAN		TQ_PAS_I_ACC_IS_OPM_2	
def .....	1581	def .....	3442
TQ_MAX_CLU		TQ_PAS_I_ACC_IS_SEL	
def .....	8380	def .....	3442
use .....	1585, 3909, 6737, 6938	TQ_PAS_I_IS_OPM_1	
TQ_MAX_CLU_DIF_MON		def .....	3442
def .....	6938	TQ_PAS_I_IS_OPM_2	
use .....	7318	def .....	3442
TQ_MAX_CLU_MAX_MON		TQ_PAS_I_IS_SEL	
def .....	6938	def .....	3442
TQ_MAX_CLU_MON		TQ_REQ_CLU	
def .....	6938	def .....	8390
use .....	6851	use .....	3520, 3614, 3909, 6796, 7318
TQ_MAX_CLU_MON2		TQ_REQ_CLU_GB	
def .....	7012	def .....	8193
TQ_MAX_WHEEL		use .....	6797
def .....	8290	TQ_REQ_CLU_GRD_MON	
use .....	1585	def .....	6794
TQ_MIN_CLU		TQ_REQ_CLU_LIM	
def .....	8380	def .....	3909
use .....	6737, 6952	TQ_REQ_CLU_MON	

def .....	6794	use .....	3545
TQ_REQ_IPM		TQI_AMT_FAST_DEC	
def .....	8390	def .....	810
TQ_SP_WHEEL		use .....	6986
def .....	6615	TQI_AMT_FAST_INC	
use .....	6985, 8293	def .....	810
TQ_ST		use .....	6986
def .....	6683	TQI_AMT_MON	
TQ_ST_1		def .....	6984
def .....	6683	use .....	6797
TQ_ST_MON		TQI_AMT_PLAUS_MON	
def .....	6952	def .....	6984
TQ_TCS_FAST_BN		TQI_AMT_REQ	
def .....	1582	def .....	810
use .....	1711, 6742, 6985	TQI_AMT_REQ_CAN	
TQ_TCS_SLOW_BN		def .....	810
def .....	1582	use .....	6986
use .....	1711, 6742, 6985	TQI_AMT_SLOW_DEC	
TQ_TCT_CAN		def .....	810
def .....	1582	TQI_AMT_SLOW_INC	
use .....	3512, 6711, 8293	def .....	810
TQ_VS_MAX_DIF_I		TQI_ASR_FAST	
def .....	7253	def .....	6741
use .....	7270	use .....	980
TQ_VS_MAX_DIF_P		TQI_ASR_FAST_CAN	
def .....	7253	def .....	810
use .....	7270	use .....	6986
TQ_WHEEL		TQI_ASR_FAST_REQ	
def .....	8291	def .....	6741
use .....	1585	TQI_ASR_FAST_REQ_1	
TQ_WHEEL_LDM_BN		def .....	6741
def .....	1582	TQI_ASR_FAST_REQ_CAN	
use .....	1711, 6615, 6737, 6986	def .....	810
TQ_WHEEL_LDM_INC_DEC_BN		use .....	6742
def .....	1711	TQI_ASR_SLOW	
use .....	6615	def .....	6741
TQ_WHEEL_LDM_MON		use .....	980
def .....	6984	TQI_ASR_SLOW_REQ	
use .....	6797	def .....	6741
TQ_WHEEL_LDM_REQ		TQI_ASR_SLOW_REQ_1	
def .....	6615	def .....	6741
TQ_WHEEL_TCS_FAST		TQI_ASR_SLOW_REQ_CAN	
def .....	810	def .....	810
use .....	8293	use .....	6742
TQ_WHEEL_TCS_SLOW		TQI_AV	
def .....	810	def .....	981
use .....	8293	use .....	1223, 2989, 3757, 3779, 5259, 5553, 6214, 6429, 6656, 6692, 7270, 7318, 7560
TQE		TQI_AV_H_RNG_MON	
def .....	6656	use .....	7318
TQE_DIF		TQI_AV_H_RNG_MON_KWP	
def .....	6656	def .....	7310
TQI_ADD_CP		TQI_AV_HOM	
def .....	3692	def .....	8380
TQI_ADD_MAX		use .....	981, 6656
def .....	8390	TQI_AV_LIM_DYN_DLY_ABS	
TQI_ADD_MAX_TOL		def .....	5259
def .....	8391		

TQI_AV_LIM_DYN_DLY_MMV	use .....	7318, 8394
def .....	5259	
TQI_AV_MON	def .....	6718
def .....	6774	
use .....	6797, 6899, 7318	
TQI_AV_MON2	def .....	7012
def .....	7012	
TQI_AV_S	def .....	8380
def .....	8380	
use .....	981, 4022, 6656	
TQI_AV_TOIL_MAX	def .....	1223
def .....	1223	
use .....	7391, 7560, 7684	
TQI_BAS	def .....	6661
def .....	6661	
use .....	6597, 8381	
TQI_BAS_MAX	def .....	810
def .....	810	
use .....	7270	
TQI_CAT_PROT	def .....	6659
def .....	6659	
use .....	8381	
TQI_DCC_FAST_INC	def .....	6731
def .....	6731	
use .....	1585, 6737, 6986, 8397	
TQI_DCC_FAST_INC_REQ	def .....	6731
def .....	6731	
TQI_DCC_FAST_INC_REQ_1	def .....	6731
def .....	6731	
TQI_DCC_SLOW_INC	def .....	6731
def .....	6731	
use .....	8397	
TQI_DCC_SLOW_INC_REQ	def .....	6731
def .....	6731	
TQI_DCC_SLOW_INC_REQ_1	def .....	6731
def .....	6731	
TQI_DIF_AV_MON	def .....	6899
def .....	6899	
TQI_DIF_AV_MON2	def .....	7013
def .....	7013	
TQI_DIF_LIM	def .....	6692
def .....	6692	
TQI_DIF_MAX_MON	def .....	6899
def .....	6899	
TQI_DIF_MAX_MON2	def .....	7013
def .....	7013	
TQI_DIF_SP_MON	def .....	6899
def .....	6899	
TQI_DIF_SP_MON2	def .....	7013
def .....	7013	
TQI_DYW_CP	def .....	1541
def .....	1541	
TQI_EMS	def .....	8391
def .....	8391	
use .....	1585	
TQI_GS_FAST_DEC	def .....	6718
def .....	6718	
use .....	7318, 8394	
TQI_GS_FAST_DEC_REQ	def .....	6718
def .....	6718	
TQI_GS_FAST_DEC_REQ_1	def .....	6718
def .....	6718	
TQI_GS_FAST_INC	def .....	6718
def .....	6718	
use .....	6986, 8394	
TQI_GS_FAST_INC_REQ	def .....	6718
def .....	6718	
TQI_GS_FAST_INC_REQ_1	def .....	6718
def .....	6718	
TQI_GS_FAST_REQ	def .....	810
def .....	810	
use .....	6719	
TQI_GS_FAST_REQ_CAN	def .....	810
def .....	810	
use .....	6719, 6986	
TQI_GS_MON	def .....	6984
def .....	6984	
use .....	6797	
TQI_GS_SLOW_DEC	def .....	6719
def .....	6719	
use .....	8394	
TQI_GS_SLOW_DEC_REQ	def .....	6719
def .....	6719	
TQI_GS_SLOW_DEC_REQ_1	def .....	6719
def .....	6719	
TQI_GS_SLOW_INC	def .....	6719
def .....	6719	
use .....	8394	
TQI_GS_SLOW_INC_REQ	def .....	6719
def .....	6719	
TQI_GS_SLOW_INC_REQ_1	def .....	6719
def .....	6719	
TQI_GS_SLOW_REQ	def .....	810
def .....	810	
use .....	6719	
TQI_GS_SLOW_REQ_CAN	def .....	810
def .....	810	
use .....	6719	
TQI_INC_CAN_MON	def .....	6794
def .....	6794	
use .....	6797	
TQI_INC_EXT_MON	def .....	6794
def .....	6794	
use .....	6851	
TQI_INC_EXT_MON2	def .....	7013
def .....	7013	
TQI_LDC_CAT_DIAG_AFL	def .....	5553
def .....	5553	
TQI_MAF	def .....	1582
def .....	1582	
TQI_MAX	def .....	8380
def .....	8380	
use .....	812	
TQI_MIN_HOMS		


def .....	8380	TQI_OFS_ST_MON	
TQI_MIN_PU_MAX_MON		def .....	6795
def .....	6794	TQI_P_MAX	
TQI_MIN_PU_MON		def .....	6697
def .....	6794	use .....	8391
use .....	6851	TQI_PBR_MAX	
TQI_MIN_PU_MON2		def .....	6697
def .....	7013	use .....	8391
TQI_MIN_S		TQI_REF	
def .....	8380	def .....	8380
use .....	6665	use .....	1948, 6597, 6656, 6661, 6665
TQI_MMV_NOX		TQI_REF_IGA	
def .....	2987	def .....	6661
TQI_MMV_NS_SHIFT		TQI_REF_IGA_LAMB	
def .....	6427	def .....	6661
TQI_MMV_NS_SHIFT_DIF_ABSV		TQI_REF_IGA_MIN_LAMB	
def .....	6427	def .....	6661
TQI_MSR_CAN		use .....	1585
def .....	811	TQI_REF_IGA_SCC	
use .....	6986, 7318	def .....	6661
TQI_MSR_FAST		TQI_REF_LAMB	
def .....	6741	def .....	6661
use .....	980, 6986	TQI_REF_LAMB_SCC	
TQI_MSR_FAST_REQ		def .....	6661
def .....	6742	TQI_REF_MAX	
TQI_MSR_FAST_REQ_1		def .....	8380
def .....	6742	use .....	812, 1585
TQI_MSR_MON		TQI_REF_S	
def .....	6984	def .....	8380
use .....	6797	TQI_REF_SCC	
TQI_MSR_REQ_CAN		def .....	6661
def .....	811	TQI_REQ_EF_AC_THD	
use .....	6742	def .....	3614
TQI_MSR_SLOW		TQI_REQ_FAST	
def .....	6742	def .....	8391
use .....	980	use .....	1777, 1801, 2989, 6665
TQI_MSR_SLOW_REQ		TQI_REQ_FAST_FIL_CH_SO2P	
def .....	6742	def .....	1777
TQI_MSR_SLOW_REQ_1		TQI_REQ_FAST_SEL	
def .....	6742	def .....	8391
TQI_N_CTL_TCT_FAST		use .....	6986
def .....	8193	TQI_REQ_LIM_1	
use .....	6797	def .....	6692
TQI_N_CTL_TCT_MON		TQI_REQ_LIM_2	
def .....	6794	def .....	6692
TQI_N_CTL_TCT_SLOW		TQI_REQ_LIM_3	
def .....	8193	def .....	6692
use .....	6797	TQI_REQ_LIM_4	
TQI_N_MAX		def .....	6692
def .....	3779	TQI_REQ_LIM_DIF	
use .....	8218	def .....	6692
TQI_N_MAX_1		TQI_REQ_LIM_DIF_MAX	
def .....	3779	def .....	6692
TQI_N_MAX_2		TQI_REQ_LIM_DIF_OFS	
def .....	3779	def .....	6692
TQI_N_MAX_REF		TQI_REQ_LIM_FAST	
def .....	3779	def .....	6692



use .....	8391	def .....	6659, 7270
TQI_REQ_LIM_SLOW		use .....	7253
def .....	6692	TRT	
use .....	8391	def .....	1504
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def .....	4276	VLS_DOWN_TOL [NC_CBK_EX_NR]	
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def .....	4276	use .....	1365
use .....	8039	VLS_DOWN_TRAN_PUC [NC_CBK_EX_NR]	
VLS_DOWN_PUE_BOL_SAE [NC_CBK_EX_NR]		def .....	5152
def .....	5169	VLS_MAIN_CAT_PURGE [NC_CBK_EX_NR]	
use .....	8039	def .....	2942
VLS_DOWN_PUE_DRV1_MMV [NC_CBK_EX_NR]		use .....	2928
def .....	5169	VLS_MAX_TMP	
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def .....	2315	def .....	3129
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def .....	2315	def .....	2590
VLS_MV_LSL_BUF [NC_CBK_EX_NR]		use .....	3191, 5474
def .....	2315	VLS_UP [NC_CBK_EX_NR]	
VLS_NOX_SENS [NC_NOX_SENS_CONF]		def .....	1341
def .....	1382	use .....	970, 2316, 4276, 7318, 7560
use .....	992, 2989, 5608, 7318	VLS_UP_10_RAW [NC_CBK_EX_NR]	
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def .....	7312	def .....	2315
VLS_NOX_SENS_MMV		VLS_UP_CYL_SEL [NC_CYL_NR]	
def .....	2987	def .....	973
VLS_NS [NC_NOX_SENS_CONF]		use .....	1019
def .....	992	VLS_UP_DELTA_FALL [NC_CBK_EX_NR]	
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VLS_NS_DIAG [NC_NOX_SENS_CONF]		use .....	5277
def .....	992	VLS_UP_DELTA_RISE [NC_CBK_EX_NR]	
use .....	6338, 6390, 6405	def .....	970
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def .....	6428	VLS_UP_DIAG [NC_CBK_EX_NR]	
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def .....	6428	use .....	4301, 5238, 5249, 5282, 5298
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def .....	2885	def .....	5298
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def .....	6428	def .....	1342
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def .....	6428	def .....	1342
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def .....	6428	def .....	7312
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def .....	6428	def .....	1342
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def .....	2315	def .....	1342
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def .....	7312	VP_LS_CYL_SEL	
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def .....	2315	VP_LS_DOWN	
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	use .....	6894	VS	def .....
VP_MC_AN_DIG_MON_CPL	def .....	7135		1176
VP_MC_AN_DIG_MON_TMP	def .....	7135	use .	979, 1105, 1123, 1149, 1163, 1223, 1298, 1310,
VP_MC_AN_DIG_MON_TMP_CPL	def .....	7135		1420, 1585, 1721, 1759, 1777, 1801, 2386, 2422,
VP_MU_AN_DIG_MON	def .....	7135		2989, 3054, 3069, 3075, 3130, 3145, 3501, 3589,
	use .....	6894		3614, 3622, 3701, 3847, 3851, 4069, 4136, 4217,
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VP_TCO [NC_NR_TCO_SENS]	def .....	1100		5077, 5094, 5152, 5259, 5459, 5553, 5666, 5746,
	use .....	812, 1218, 4496, 4572, 7319		5858, 5919, 5929, 5971, 6038, 6128, 6209, 6302,
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VP_TCO_KWP [NC_NR_TCO_SENS]	def .....	7312		1582
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				use .....
				7253, 7259
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				2987
				VS_DIF_STEP_PROG
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				7201
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				2987
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				1176
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				1183
				VS_EDGE_T_AV
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				VS_EDGE_T_AV_DIF
				def .....
				1176
				VS_EDGE_T_AV_MAX
				def .....
				1176
				VS_FIL
				def .....
				1176
				use .....
				1112, 1198, 1270, 3545, 6651, 6697, 6737,
				6797, 6912, 6986, 7215
				VS_FIL_CH_SO2P
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				1777
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				def .....
				1176
				use .....
				812, 1233, 1303, 8293
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use .....	7560	def .....	7237
VS_HIGH_RES		VS_SP_DIF_CRU	
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use .....	1158, 5022	VS_SP_DRIV_CRU	
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def .....	7201	use .....	1585
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def .....	1582	def .....	7237
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def .....	7683	use .....	1585
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def .....	2988	use .....	1585
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def .....	6795	def .....	1582
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def .....	7237	Vsadm_md6_mx	
use .....	7228	def .....	8179
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def .....	7237	Vsadm_md6_tst	
use .....	7202, 7228	def .....	8179

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def .....	8291	Wesb4_s [NC_CYL_NR]	
Vse_spri		def .....	8180
def .....	8179	Wesb_s [NC_CYL_NR]	
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def .....	8179	Wese2_h [NC_CYL_NR]	
use .....	8400	def .....	8180
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def .....	8179	Wese2_hs [NC_CYL_NR]	
use .....	8400	def .....	8180
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def .....	8179	use .....	6302
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def .....	8179	use .....	6302
use .....	8271	WHEEL_GRD	
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def .....	8180	use .....	7560
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def .....	8360	use .....	7561
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def .....	8180	Zr_lvszyl_5	
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use .....	7560	def .....	8221
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def .....	8180	def .....	8360
use .....	7560	Zrbkmx_auss_a [NC_CBK_EX_NR]	
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use .....	7560	def .....	8291
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use .....	8267
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def .....	8181
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# 0 - Basic SW General Operation

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## 0.1 Non volatile data management general

### 0.1.1 Introduction

This document specifies the high level SW specification of the NVMY function. It allows storing and restoring some data manipulated by the Engine Control Unit as adaptative values, error flags for the diagnosis, and engine environments on several driving cycles in case of failure.

The non volatile data management shall provide:

- a common interface between the aggregates in the ECU and the function NVMY i.e. the mechanism to access to the memory for writing and reading stored data,
- different services provided to the aggregates,
- a safety data storage

### 0.1.2 Abbreviations and terms

HW	HardWare
SW	SoftWare
ECU	Engine Control Unit
CRC	Cyclic Redundancy Checksum
EEPROM	Electrically Erasable PROM
NVMY	Non Volatile MemorY

FLASH EEPROM emulation means that NVMY data are stored into the flash device.

In the rest of this document the term memory designs either EEPROM or FLASH EEPROM emulation.

### 0.1.3 General description

Usually the manager provides the capability to initialise, memorize and restore data. The NVMY manager shall ensure the NVMY data recording, and also secure the NVMY data integrity.

The NVMY manager shall support:

- a scheduler to handle the priority of the tasks,
- a supervisor, called regularly by the operating system, handles the real time,
- an executor of the services,
- the return of error cases to the others aggregates,
- the initialisation of the data and the integrity of the data in the memory structure.

### 0.1.4 Hardware constraints

The NVMY manager is hardware independent and shall administrate the NVMY data on EEPROM and/or FLASH EEPROM emulation.

#### EEPROM:

Writing of NVMY data could be done in live (write on "fly") while the ECU is running. This operation must be limited in order to save the EEPROM life duration regarding the hardware write/erase cycles.

Also, the application needs to take in account the EEPROM size capability.

#### FLASH EEPROM emulation:

Both accesses to flash data are available regarding flash hardware definition:

- **One bank:** the operating system is blocking while erase/write operation. The write/erase operation has to ensure that the SW is in a safe ECU mode (shutdown phase). Application has to guaranty that all NVMY data must be store at shutdown phase.
- **Dual banks:** the operating system is not blocking while erase/write operation. There is the possibility to store NVMY data while applicative SW is running.

Two specific flash segments are requested (at least).

### Recommendation:

The writing of NVMY data on "fly" must be limited to one per ECU cycle in order to save the memory life duration.

### Pre-emptive operation:

Application must ensure to not perform operation on memory while it is used by the NVMY manager.

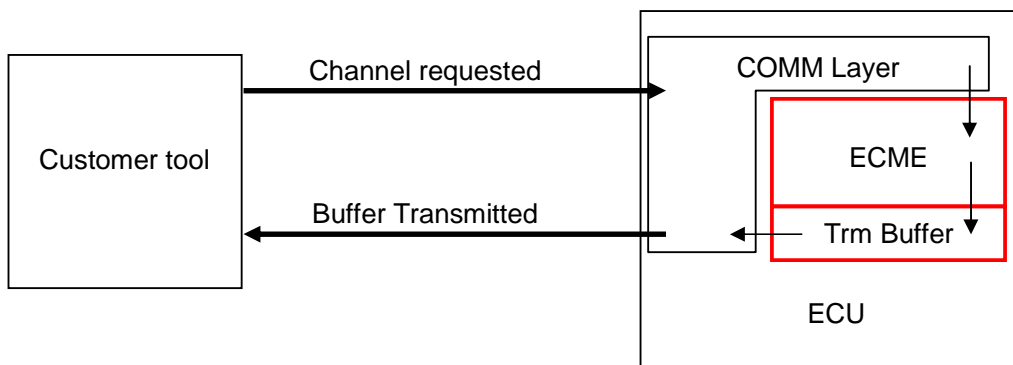
## 0.1.5 NVMY system events

Three related system events are defined:

- **NVMRES:** read-out (restore) non volatile data from the memory. It happens before the reset event. In case of error, NVMINI happens afterwards
- **NVMINI:** initialize the non-volatile data with defined default values. It happens after NVMRES and before the reset event in case of error during NVMRES
- **NVMSTO:** store the non-volatile data into the memory. It happens in a safe ECU mode (ECU shutdown). By extension, the write on "fly" functionality uses the same system event.

## 0.1.6 Flight recorder on customer tool request

On special communication request, a configured channel can be sent to a customer tool.



Via the communication media, the tool first asks for one specific channel.

On reception of this message, ECME scheduler will prepare itself to read out the asked channel. As soon as the channel is available, a transmission buffer to the communication media is filled. After this, the channel can be sent to the customer tool.

## 0.2 Non volatile data management manager

Basically, this module contains the scheduler and the supervisor related to NVMY functionality.

The supervisor is a state machine that contains the way that NVMY channel s operation are performed in addition to the type of operations enabled depending on the current state.

Furthermore, the supervisor only decides when NVMY operations should be performed.

Indeed, depending on the state of engine control management, the NVMY operations are performed either in BACKGROUND or FOREGROUND mode.

Foreground mode means that ECME s aggregate keeps hand till operation is finished.

On the contrary, BACKGROUND mode intends that NVMY operations are performed step by step while engine maybe running.

### 0.2.1 NVMY Manager

The picture below, presents all manager states :

*Active tasks :*

- : disabled

I : Init task enabled

W : Write task enabled

R : Read task enabled

U : Update task enabled

S : Synchronisation task enabled

*Operation mode :*


F : Foreground

B : Background

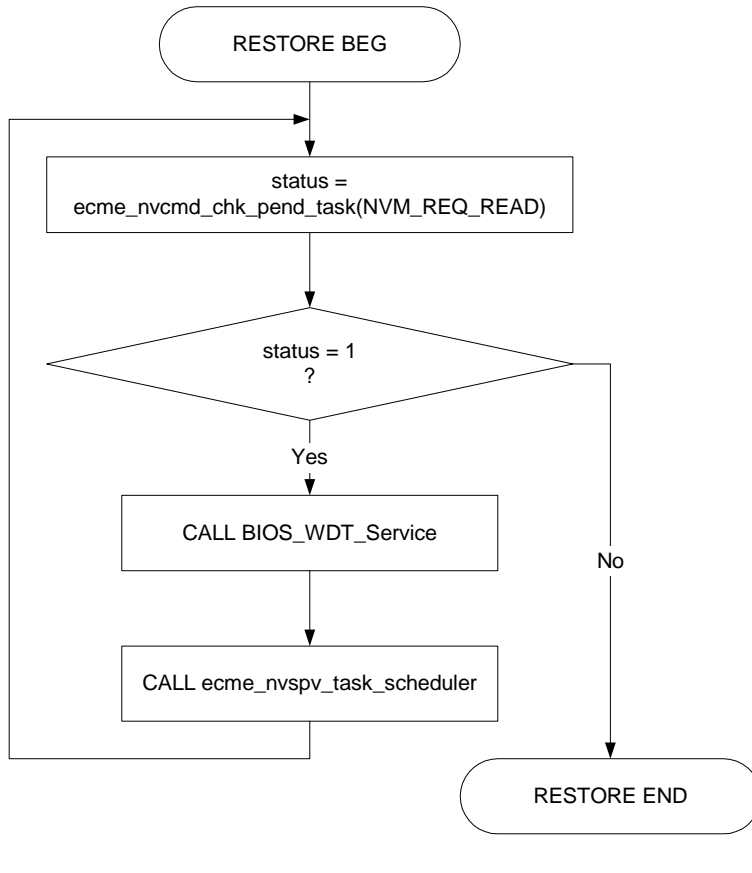
### 0.2.2 STATES description

- IDLE state

The supervisor simply does nothing.

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- RESTORE state :



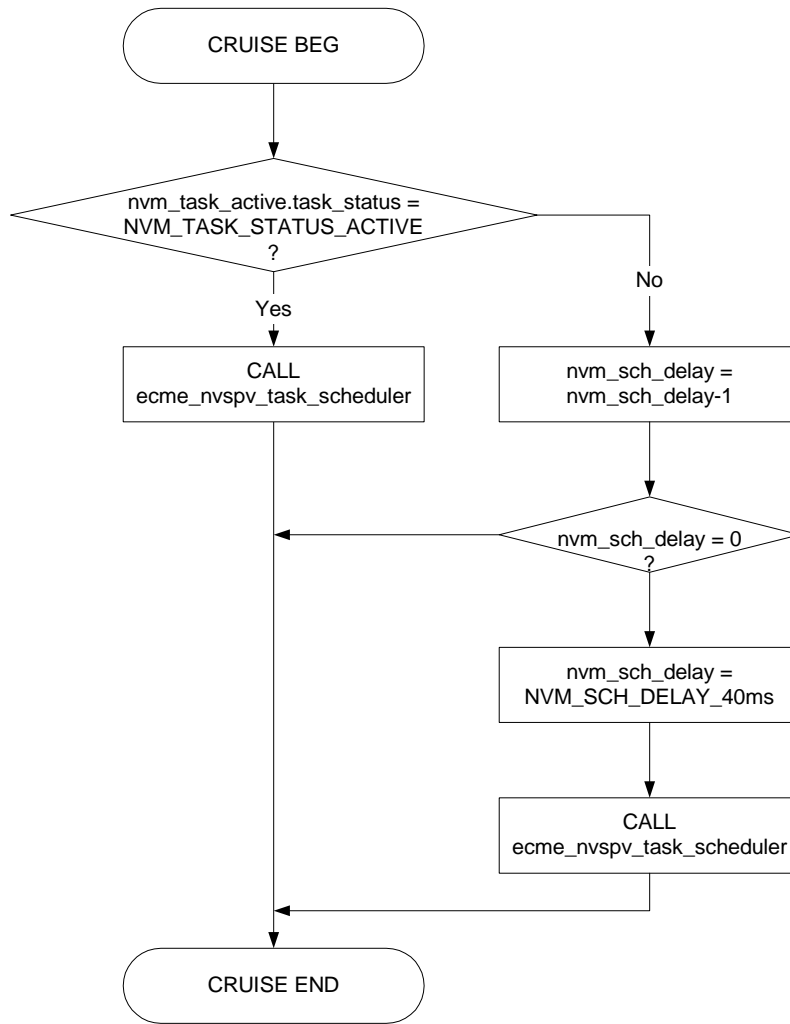
This state is working in FOREGROUND. the NVMY scheduler is called till READ requests do not remain. As a complete RESTORE may take a long time, the Watchdog shall be rearmed periodically.

- CRUISE state :

This state is working in BACKGROUND. Each NVMY task should be performed step by step. The time base of 5ms for calling the supervisor is the good compromise according to the FLASH and EEPROM hardware data sheets.

Nevertheless, a new NVMY task shall be started 40ms after the end of the previous one, in order to minimize the load on SPI bus since engine maybe running.

Concerning watchdog, it is rearmed within OS operation.



- STORE state :

The NVMY scheduler (ecme\_nvspv\_task\_scheduler ) is simply called within this state.

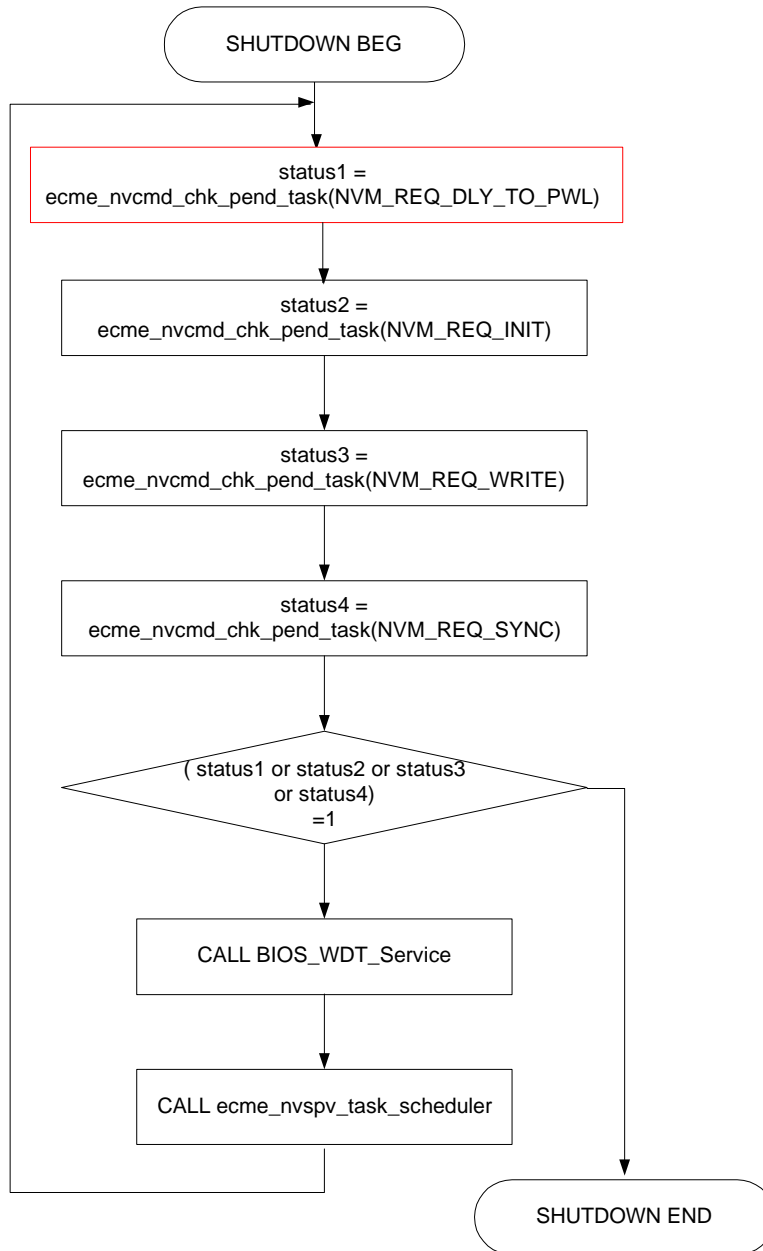
**REMARK :**

Though this state is no more than a call, it may be found useless. Nevertheless, it might be used in future release of NVMY, in the case that STORE operations are started at the beginning of the power-latch.

- SHUTDOWN STATE

This state is working in FOREGROUND. This state is mainly used to complete STORE operations. The scheduler is either called till WRITE requests or INIT requests or SYNCHRONISATION requests are not pending.

As RESTORE operations, SHUTDOWN may take a long time. Therefore, Watchdog shall be periodically rearmed.



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## 0.3 Non volatile data management services definitions

This module especially contains all services offered to external aggregate. These services are used to request operation from outside ECME aggregate

### 0.3.1 RESTORE service (FOREGROUND)

This service is in charge to restore a list of channels defined by parameter. In addition, it may proceed with different kind of initialisation:

- First power on initialization
- Tuning initialization

This service is only available during RESTORE state according to NVMY supervisor. It implies that it acts in Foreground only during ECU start-up. That is to say, OS is not active.

**Therefore, it must be used during ECU start-up only.**

#### 0.3.1.1 Implementation

ECME_NVCMD				
ECME_NVMCMD_RESTORE_LST				
Parameters	Name	Type	Value(s)	Comment
INPUT	list_name	U8 *	-	list name
OUTPUT	-	void	-	-

### 0.3.2 CLEAR INIT request (FOREGROUND)

This service is in charge to cancel an INIT request if the concerned channel is detected as corrupted at RESTORE stage.

It only acts in foreground during ECU s start-up.

#### 0.3.2.1 Implementation

ECME_NVCMD				
ECME_NVMCMD_CLEAR_INIT_REQ				
Parameters	Name	Type	Value(s)	Comment
INPUT	nvmsetname	-	-	channel name
OUTPUT	-	void	-	-

### 0.3.3 READ service (FOREGROUND)

This service is in charge to read a single channel defined by parameter. It only acts in foreground during ECU s start-up.

#### 0.3.3.1 Implementation

ECME_NVCMD				
ECME_NVMCMD_READ_CH				
Parameters	Name	Type	Value(s)	Comment
INPUT	nvmsetname	-	-	channel name
OUTPUT	-	void	-	-



### 0.3.4 READ FOR DIAG service (BACKGROUND)

This service is in charge to read a single channel when a diagnosis tool requires it.  
It only acts in background during ECU s cruise operation.  
It is only supported by specific channel configuration.

#### 0.3.4.1 Implementation

ECME_NVCMD				
ECME_NVMCMD_READ_FOR_DIAG_CH				
Parameters	Name	Type	Value(s)	Comment
INPUT	nvmsetname	-	-	channel name
OUTPUT	-	void	-	-

### 0.3.5 WRITE service (BACKGROUND)

This service is in charge to write a single channel defined by parameter.  
It only acts in foreground during ECU s cruise operation.

However, it may not work with flash that does not support basic operation while CPU fetches code (example: flash with simple bank). In this case the write operation is delay to the STORE ECME operation (done in the power latch).

Moreover, NVMY channel writing execution is delayed to running state, if writing is ordered during ECU start-up.

#### 0.3.5.1 Implementation

ECME_NVCMD				
ECME_NVMCMD_WRITE_CH				
Parameters	Name	Type	Value(s)	Comment
INPUT	nvmsetname	-	-	channel name
OUTPUT	-	void	-	-

### 0.3.6 STORE service (BACKGROUND)

This service is in charge to prepare the store of all channels.  
This service only acts in background during ECU s store operation.

#### 0.3.6.1 Implementation

ECME_NVCMD				
ecme_nvcmd_write_ch_req				
Parameters	Name	Type	Value(s)	Comment
INPUT	-	-	-	-
OUTPUT	-	-	-	-

### 0.3.7 SHUTDOWN service (FOREGROUND)

This service is in charge to store all channels.  
This service only acts in background during ECU s shutdown operation.

### 0.3.7.1 Implementation

ECME_NVCMD				
ecme_nvcmd_shutdown				
Parameters	Name	Type	Value(s)	Comment
INPUT	-	-	-	-
OUTPUT	-	-	-	-

### 0.3.8 NVMY coherency error services (FOREGROUND)

ECME aggregate provides two services for the NVMY coherency check functionality in order to set or clear coherency error.

These services are based on two macros defined below. Basically, these macros respectively set nvm\_sw\_coherency\_err to 1 or 0.

#### 0.3.8.1 Implementation

ECME_NVCMD				
ECME_NVMCMD_VLD_CHK_OK				
Parameters	Name	Type	Value(s)	Comment
INPUT	-	-	-	-
OUTPUT	-	-	-	-

Figure 0.3.1: ECME\_NVCMD

ECME_NVCMD				
ECME_NVMCMD_VLD_CHK_NOK				
Parameters	Name	Type	Value(s)	Comment
INPUT	-	-	-	-
OUTPUT	-	-	-	-

## 0.4 Non volatile data management mechanisms

This section deals with all cases of NVMY channel initialization.

The initialization consists in initializing channel(s) with their default values.

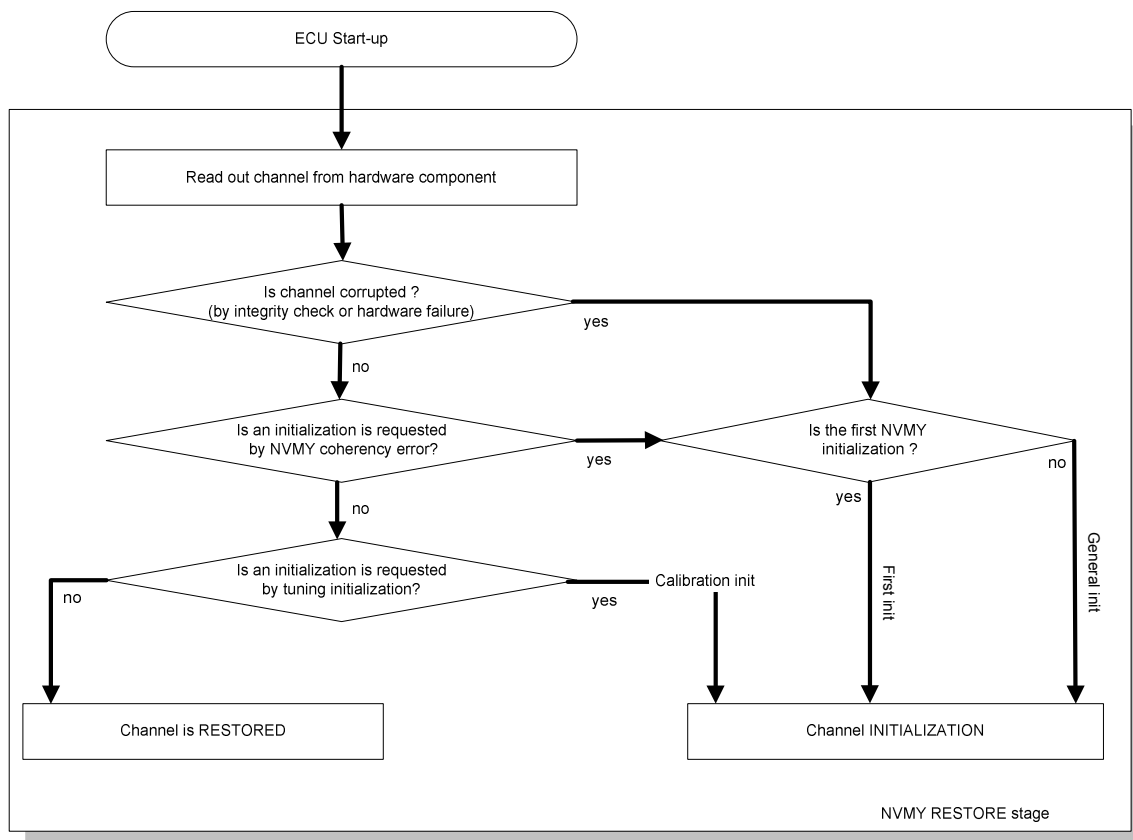
The Channels set may be either partially or completely initialized depending on the case.

In addition, we can distinguish 3 kind of initialization:

- First initialization
- General initialization
- Calibration initialization

NVMY data initialization is performed during the NVMY RESTORE stage.

The following diagram depicts all kind of NVMY channel initialization:



### 0.4.1 Initialization in case of corrupted channel

Basically, this initialization is requested by the NVMY executor in case of a reading error occurred toward a single channel. Reading failure can be generated by a hardware failure or integrity channel problem (according to the channel attribute configuration).

### 0.4.2 Initialization in case of NVMY coherency error

During RESTORE stage, NVMY functionality should ensure that restore data match with Applicative software functionalities, which are using NVMY data.

NVMY coherency mainly relies on a check at RESTORE stage in order to determine whether NVMY contents (all channels) is compatible or not with applicative software.

Usually, problem may occur if ECU is restarted after it has been previously reprogrammed, because channel definition may have change in between from one software version to another. Without coherency check, it may lead Applicative software to run with NVMY data that are not correct, so coherency check is mandatory before restoring whole NVMY contents.

#### Strategy:

The NVMY coherency check relies on two channels (named SWVER\_FIX and SWVER), which contains data related to coherency check (ECU-SW coherence identifier).

In the same way, Applicative software contains the same data. At restore stage, both channels are read before applicative channel reading. If NVMY content doesn't fit with current applicative software, a status notification is sent to the NVMY manager.

The below picture defines the channel allocation.



SWVER\_FIX is the first written channel.

SWVER is the last written channel.

### 0.4.3 Initialization in case of tuning request

NVMY function provides the possibility to force channel initialization during RESTORE stage. This is only restricted to the ECU development phase.

This kind of initialization is limited and can only be applied to a limited number of channels, pre-defined with configuration. Therefore channels are grouped according to 3 possible levels of initialization.

#### Tuning calibration:


The following calibrations are defined under DDS and allow channel initialization:

Calibration name	Value	Purpose
lc_req_ini_nvm	PASSIVE	No request for initialization
	ACTIVE	Initialization is required
c_req_ini_nvm_grp	0	unused
	1	channels that belong to group level 1 should be initialized
	2	channels that belong to group level 2 should be initialized
	3	channels that belong to group level 3 should be initialized
	4	reserved for future purpose
	5	reserved for future purpose
	6	reserved for future purpose
	7	reserved for future purpose

### 0.4.4 Initialization in case of "First power-on"

In case of brand new ECU, the initialization of all channels with their default values is called initialization "first power-on".

Usually, this kind of initialization may occur only one time during ECU s lifetime.

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This procedure relies on one channel (named ECME\_1\_FIX), which contains data related to the first power-on detection. Since this data is not set, all channels are supposed to be initialized. It implies that this data is false when ECU is delivered at the customer.

### 0.4.5 Hard initialization

Hardware means that channel is initialized with default values within hardware component.

Since these initialization may be performed during engine running (ECME CRUISE stage), it saves up writing time at the end of the power-latch.

Though this task is applied to EEPROM and FLASH, this initialization is only relevant for EEPROM.

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 525 of 8404</b>	
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## 0.5 Non volatile data management configuration

### Input data:

LC_EFPPWM_I_AD_CLR {p. 3801}	LC_ERR_FMY_CLR {p. 5767}		
---------------------------------	-----------------------------	--	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_AD_CLR	V	0... 1H	0 ...1	1	-
Logical constant for initializing all selective adaptation range values					
LC_AD_CLR_ALTER	V	0... 1H	0 ...1	1	-
Logical constant for initializing the alternator profile nvmy data					
LC_AD_CLR_ATI	V	0... 1H	0 ...1	1	-
Logical constant for initializing ATI nvmy data					
LC_AD_CLR_BAL	V	0... 1H	0 ...1	1	-
Logical constant for initializing the balancing nvmy data					
LC_AD_CLR_CAN	V	0... 1H	0 ...1	1	-
Logical constant for initializing CAN nvmy data					
LC_AD_CLR_CILC	V	0... 1H	0 ...1	1	-
Logical constant for initializing the cyl. ind. lambda controller (CILC) nvmy data					
LC_AD_CLR_CRU	V	0... 1H	0 ...1	1	-
Logical constant for initializing CRU nvmy data					
LC_AD_CLR_DMTL	V	0... 1H	0 ...1	1	-
Logical constant for initializing DMTL nvmy data					
LC_AD_CLR_ECM2	V	0... 1H	0 ...1	1	-
Logical constant for initializing the ECM2 nvmy data					
LC_AD_CLR_EGCP	V	0... 1H	0 ...1	1	-
Logical constant for initializing EGCP nvmy data					
LC_AD_CLR_EGR	V	0... 1H	0 ...1	1	-
Logical constant for initializing EGR nvmy data					
LC_AD_CLR_ENRD	V	0... 1H	0 ...1	1	-
Logical constant for initializing the ENRD nvmy data					
LC_AD_CLR_ENSD	V	0... 1H	0 ...1	1	-
Logical constant for initializing ENSD nvmy data					
LC_AD_CLR_ENTE	V	0... 1H	0 ...1	1	-
Logical constant for initializing the ENTE nvmy data					
LC_AD_CLR_EVAC	V	0... 1H	0 ...1	1	-
Logical constant for initializing EVAC nvmy data					
LC_AD_CLR_EXTD	V	0... 1H	0 ...1	1	-
Logical constant for initializing the EXT D nvmy data					
LC_AD_CLR_INJR	V	0... 1H	0 ...1	1	-
Logical constant for initializing INJR nvmy data					
LC_AD_CLR_INSY	V	0... 1H	0 ...1	1	-
Logical constant for initializing the INSY nvmy data					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_AD_CLR_IVVT	V	0... 1H	0 ...1	1	-
Logical constant for initializing IVVT nvmy data					
LC_AD_CLR_LACO	V	0... 1H	0 ...1	1	-
Logical constant for initializing the LACO nvmy data					
LC_AD_CLR_LAM	V	0... 1H	0 ...1	1	-
Logical constant for initializing LAMBDA nvmy data					
LC_AD_CLR_LIF	V	0... 1H	0 ...1	1	-
Logical constant for initializing LIF nvmy data					
LC_AD_CLR_LONG_LAM_1	V	0... 1H	0 ...1	1	-
Logical constant for initializing Long Term Lambda Adaptation (Bk1) nvmy data					
LC_AD_CLR_LONG_LAM_2	V	0... 1H	0 ...1	1	-
Logical constant for initializing Long Term Lambda Adaptation (Bk2) nvmy data					
LC_AD_CLR_MIS	V	0... 1H	0 ...1	1	-
Logical constant for initializing MISFIRE nvmy data					
LC_AD_CLR_N_MAX	V	0... 1H	0 ...1	1	-
Logical constant for initializing the N_MAX nvmy data					
LC_AD_CLR_N_SP_IS	V	0... 1H	0 ...1	1	-
Logical constant for initializing N_SP_IS nvmy data					
LC_AD_CLR_NOX	V	0... 1H	0 ...1	1	-
Logical constant for initializing the NOx nvmy data					
LC_AD_CLR_OBD2	V	0... 1H	0 ...1	1	-
Logical constant for initializing OBDII nvmy data					
LC_AD_CLR_POW	V	0... 1H	0 ...1	1	-
Logical constant for initializing the POW nvmy data					
LC_AD_CLR_PSTE	V	0... 1H	0 ...1	1	-
Logical constant for initializing PSTE nvmy data					
LC_AD_CLR_ROM	V	0... 1H	0 ...1	1	-
Logical constant for initializing ROM nvmy data					
LC_AD_CLR_SOF	V	0... 1H	0 ...1	1	-
Logical constant for initializing the sound flap /sport switch					
LC_AD_CLR_STC_ROM	V	0... 1H	0 ...1	1	-
Switch to reset ROM statistical data in NVMY via application tool.					
LC_AD_CLR_TECU	V	0... 1H	0 ...1	1	-
Logical constant for initializing TECU nvmy data					
LC_AD_CLR_TOIL	V	0... 1H	0 ...1	1	-
Logical constant for initializing TOIL nvmy data					
LC_AD_CLR_TOIL_MAX	V	0... 1H	0 ...1	1	-
Logical constant for initializing TOIL_MAX nvmy data					
LC_AD_CLR_TPS	V	0... 1H	0 ...1	1	-
Logical constant for initializing TPS nvmy data					
LC_AD_CLR_TQDR	V	0... 1H	0 ...1	1	-
Logical constant for initializing TQDR nvmy data					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_AD_CLR_TQI_LIM	V	0... 1H	0 ...1	1	-
Logical constant for initializing TQI_LIM nvmy data					
LC_AD_CLR_TQLO	V	0... 1H	0 ...1	1	-
Logical constant for initializing TQLO nvmy data					
LC_AD_CLR_VAR	V	0... 1H	0 ...1	1	-
Logical constant for initializing VAR nvmy data					

## General information

This section gives a summary of ECME features in order to advise you in the way that you define your data into channels organisation.

Each aggregate that want to use some Non Volatile data must create a channel containing all data to be saved.

## 0.5.1 Non Volatile Data – read from/write to memory

### General information:

Non volatile datas are stored in the E2PROM. Non volatile datas are:

- All adaptation values
- The debounced errors in the dynamic error memory (max. 15)
- Some datas from the last engine run

This specification describes the non volatile data handling in connection with the E2PROM and how to initialize those values by calibration system.

**The variables of each aggregate/module that shall be stored to nonvolatile memory, are specified in the respective aggregate/module specification with mode "S".**

### Application conditions:

#### Initialisation:

-

#### Activation:

```

1st writing-task:
    If LV_VAR_BN = 1 and LV_CONF_
DMTL = 0
    - -> at (T_PWL > C_T_MIN_PWL) and (ECU_STATE = PWL)

    If LV_VAR_BN = 1 and LV_CONF_
DMTL = 1
    - -> at [(T_PWL > C_T_MIN_PWL) and (ECU_STATE = PWL)] and
    at transition PWL_LOCK_CDN (bit DMTL) 1 - -> 0
    If LV_VAR_BN = 0
    - -> no writing

2nd writing-task:
    - at transition PWL_LOCK_CDN (with exception of NVMY-Bit) 1
    - -> 0 (all locks reversed)

```

#### Deactivation:

-

#### Recurrence:

100ms

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## Function description:

## Formula section:

### 0.5.1.1 Channel organisation

The NVMY is divided into channels that physically represent a part of the hardware component.

Each channel is divided into two parts. The first part so-called Header contains the data related to the saving criteria. In other words, the data that ensures saving data integrity. The second part only contains the saved data that belongs to the same aggregate.

Basically, the contents of non-volatile memory looks like as follow:

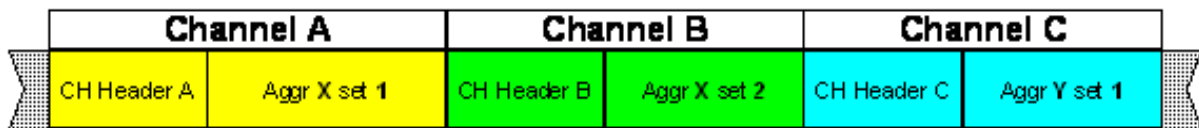


Figure 0.5.1:

Each aggregate (or function) can define one or several channels depending on its requirements. Nevertheless two different Aggregates could not share their channel.

**One aggregate can hold one or more channels but can not share any channel with a different Aggregate**

### 0.5.1.2 Saving criteria

Data that belongs to the same channel are secured by a single saving criterion taken from the list below:

- **CRC 16 :** channel integrity is covered by checksum calculation CRC16

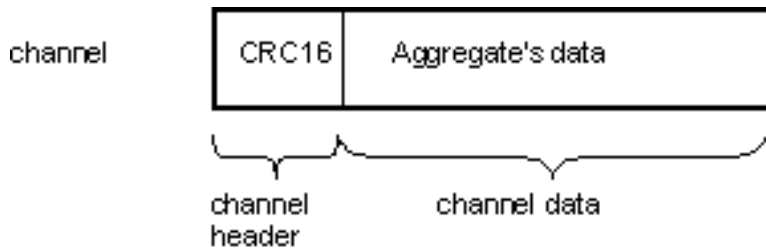


Figure 0.5.2:

If the CRC16 coherency check with the aggregate's data is failed, the channel is declared as corrupted: initialization needs to be performed.

- **MASTER and COPY** : aggregate's data and CRC16 are duplicated in a zone called COPY

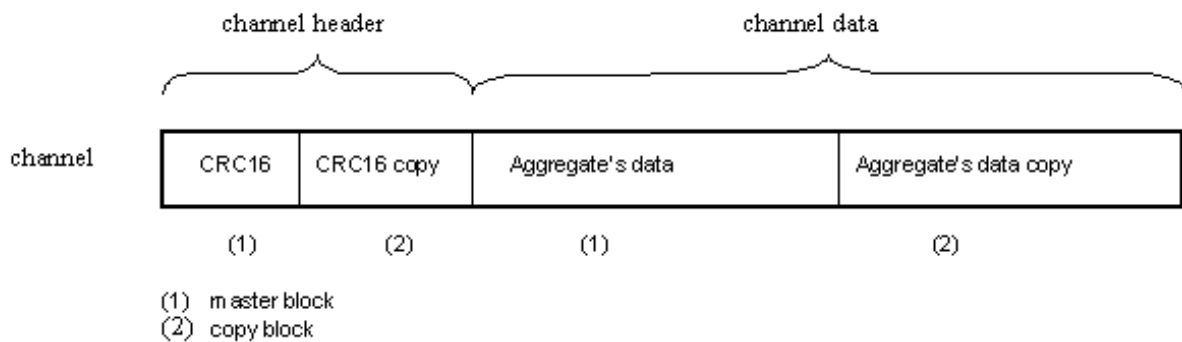


Figure 0.5.3:

### Process of restoration:

Master check block (*)	Copy block check (*)	Result block	comment
ok	ok	master	last updated information
ok	nok	master	last updated information
nok	ok	copy	last updated information
nok	nok	initialization has to be done	both blocs are corrupted

(\*) master/copy check block is ok means that CRC16 coherency check is coherent with the aggregate's data

This method is only available for EEPROM hardware component.

- **NONE:** there is not saving criterion to guaranty the channel data integrity.

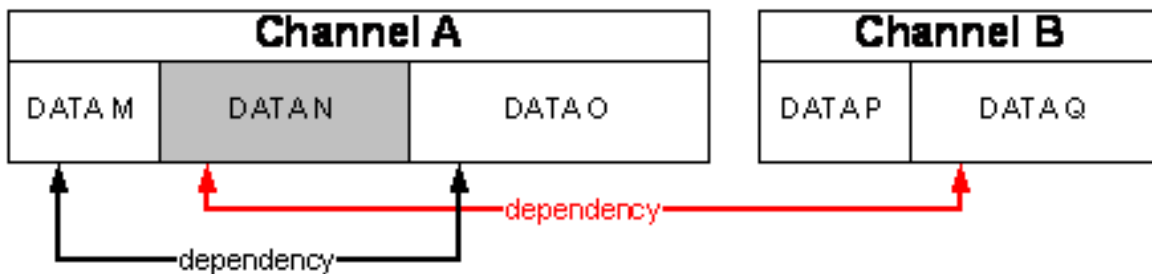
Non volatile memory data that should be secured with two different criteria can not share the same channel. Nevertheless, you may take the strongest criteria in order to group these data.

**NVMY data within a channel are secured with the same saving criteria**

### 0.5.1.3 NVMY data coherency

As NVMY channels are separately handled by ECME aggregate, you should take care in the way you group data. Indeed, you should not separate data that are linked together. That is to say data that might be initialised at the same time in case of failure.

## WRONG ORGANIZATION



## CORRECT ORGANIZATION

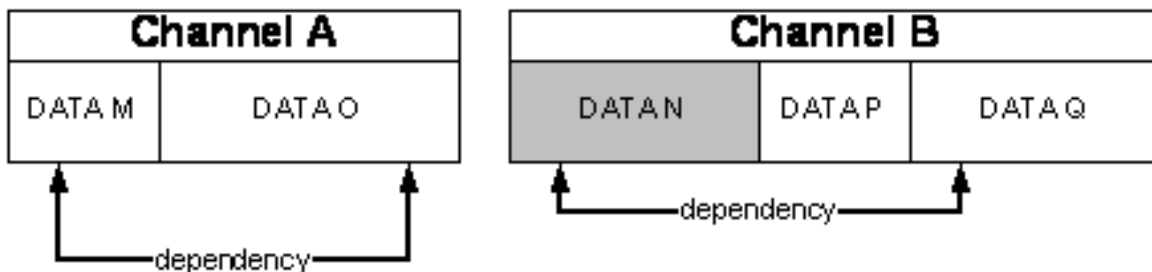


Figure 0.5.4:

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**DATA of the same Aggregate that are functionally linked should be grouped in the same channel.**

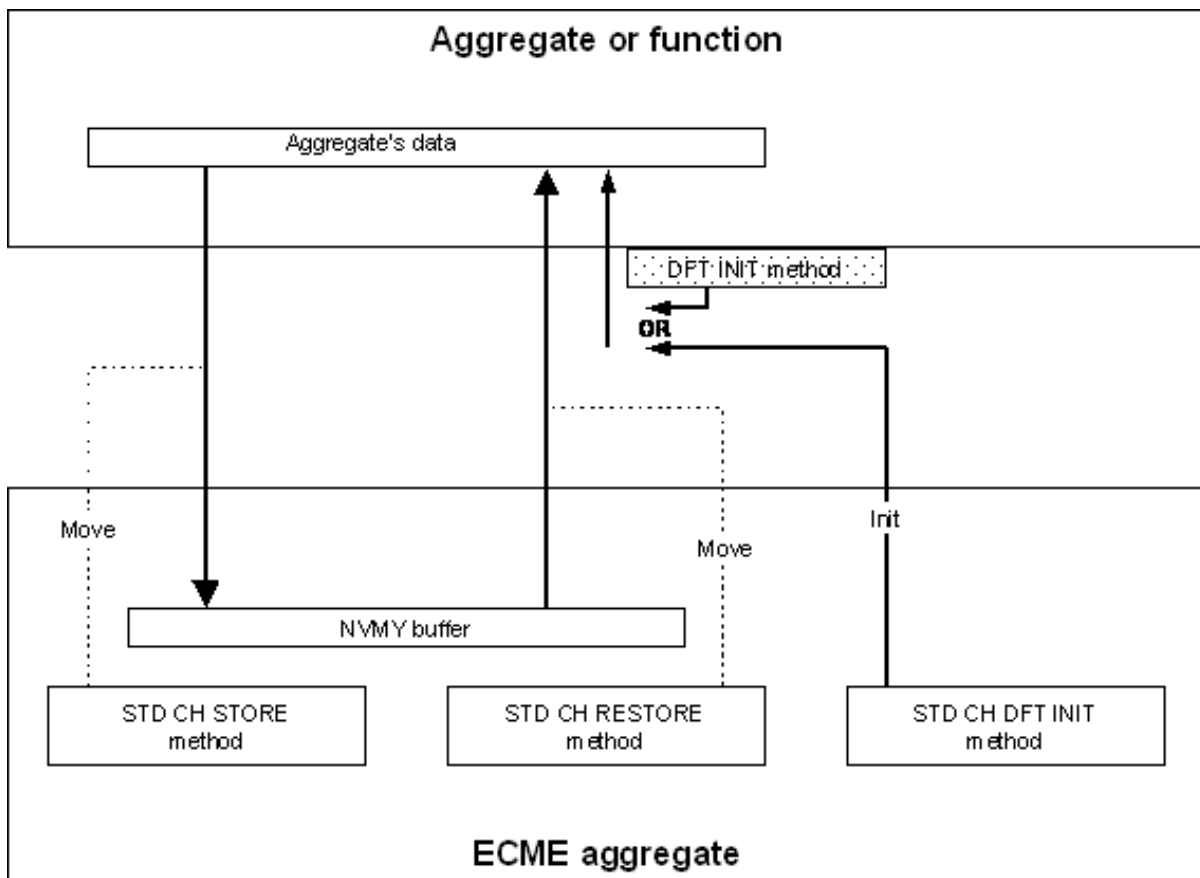
### 0.5.1.4 Channel management /Standard channel

Aggregate do not have to provide any routine for NVMY data management except an initialisation routine if the default value does not match the Aggregate requirement (\*).

In this case, the Aggregate relies on the ECME services for following purposes:

- RESTORE from Hardware component to Aggregate's data
- STORE from Aggregate's data to Hardware component
- DEFAULT INITIALIZATION [ **optional** \* ]

The following picture describes the way that non-volatile data are managed in case of a STANDARD channel:





 : optional

Figure 0.5.5:

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**REMARK:**

Aggregate's data memory location is known by the method boxes.  
Accordingly, ECME aggregate should know of Aggregate's data declaration.

The use of STANDARD channel should be limited in order to avoid constant management overhead.

**STANDARD Channel should be used for a few data only.  
Therefore, you should consider that a STANDARD channel can not hold more than 10 data.**

**Channel configuration**

An ECME aggregate provides several MACROS that help the designer in order to define Channel configuration.

This configuration takes place into the ECME\_ANVM.CFG component that is described in later section of this document.

Standard channels are defined according to the following scheme:

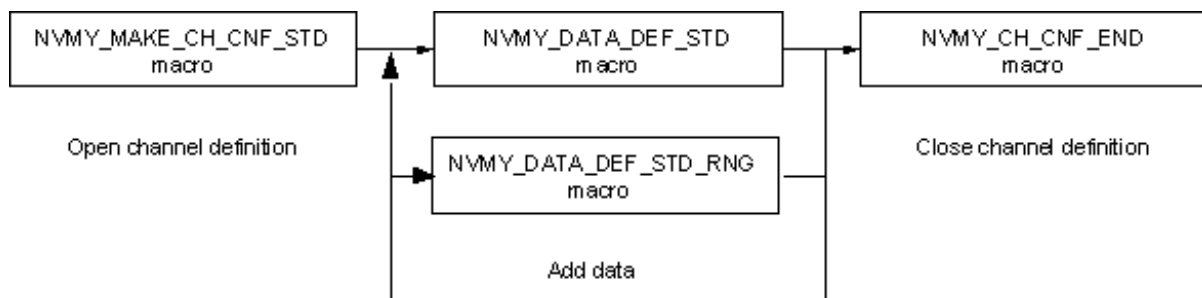


Figure 0.5.6:

**MACROS description**

- **NVMY\_MAKE\_CH\_CNF\_STD** ( CH\_ID,  
TGT\_ID,  
VERSION\_CHK,  
TUNING\_LVL,  
SAVING\_METH,  
DFT\_INIT\_METH )

This macro opens a standard channel definition.  
Besides, it helps to define all channel characteristics.


Parameters definition:

Parameter	Value	Purpose	Comment
CH_ID	NAME_N[_FIX ]( 1 )	Channel identifier	Used to order ECME operation on a channel
TGT_ID	E2P	EEprom is the Preferred hardware location for storing this channel.	<b>This channel is stored to Eeprom if component is available. Otherwise, it will be stored to FLASH.</b>
	SIM_E2P	FLASH is the Preferred hardware location for storing this channel.	<b>This channel is stored to Eeprom if component is available. Otherwise, it will be stored to EEPROM.</b>
VERSION_CHK	CHK	Channel is sensitive to NVMY coherency check	If the NVMY contents coherency checking failed, the channel's data should be initialized with default values
	NO_CHK	Channel is not sensitive to NVMY coherency check	Channel's data is not initialized even if NVMY contents coherency checking failed
TUNING_LVL	LV0( 2 )	Channel is part of level 0 group for tuning initialization	Protected group : ECME's Tuning calibration has no effect on this group
	LV1	Channel is part of level 1 group for tuning initialization	Channel's contents may be initialized with default values if tuning calibration is set to level 1
	LV2	Channel is part of level 2 group for tuning initialization	Channel's contents may be initialized with default values if tuning calibration is set to level 2
	LV3	Channel is part of level 3 group for tuning initialization	Channel's contents may be initialized with default values if tuning calibration is set to level 3
STORE	NO_STRQ (4)	Synchronization for store operation	Copy data from previous block and don't take in account data from current driving cycle.
	NO_SYNC (5)	No operation done at Store phasis	Synchronisation and write operation is forbidden.
	END_PWL	Store at the end of Powerlatch	END_PWL and BEG_PWL do the same operations : store is done at the end of powerlatch
	BEG_PWL	Store at the beginning of powerlatch	
SAVING_METH	CRC16	CRC16 method	Channel's data are secured with CRC16 method
	MACOPY	MACOPY method	Channel's data are secured with MACOPY method
	NONE	NONE method	Channel's data are secured with NONE method
DFT_INIT_METH	NVMY_DATA_INIT_DFT	Aggregate uses the ECME's default init method	Channel data are initialized by ECME's method in case of troubles.
	Default Initfunction name ( 3 )	specific method provided by Aggregate	Aggregate provides a method in order to initialize channel's data.

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Remarks:

(1): According to the "C coding guideline", the channel identifier name is limited to **17** characters.

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For convenience, **NAME** shall refer to Aggregate's short name. **N** is a digit that may be used in the case that Aggregates holds more than one channel. The **FIX** may be added to channel identifier name if channel is not sensitive to NVMY data coherency checking.

(2): This level is basically used to protect channels against tuning initialisation. For instance, the channel dedicated to NVMY data coherency is protected

(3): Basically, this field refers to the function name defined by Aggregate.

(4): The channels that have the NO\_STRQ parameter are only synchronized at powerlatch. For the first powerlatch, they are stored but in the case that the first powerlatch is interrupted the channels are not stored and will be initialized at every power on until they are stored into flash. The aggregate should take this into account and store the channel separately in case of initialization.

(5): The channels that have NO\_SYNC parameter are never stored nor synchronized memory. The aggregate should take this into account and store the channel separately.

- **NVMY\_DATA\_DEF\_STD**(nvmy\_data )

This macro helps to add a single data to the channel.

The nvmy\_data corresponds to the real name of the NVMY data.

The name of the data must be limited to 15 characters.

- **NVMY\_DATA\_DEF\_STD\_RNG**( name, address, size )

This macro helps to add a data to the channel.

The name must be limited to 15 characters.

Address corresponds to the NVMY data address begin.

Size is the length of the NVMY data in byte and must be limited in order to not increase the channel size excessively.

- **NVMY\_CH\_CNF\_END**(CH\_ID)


This macro closes a standard channel definition.

CH\_ID is the same as the one defined by NVMY\_MAKE\_CH\_CNF\_STD macro.

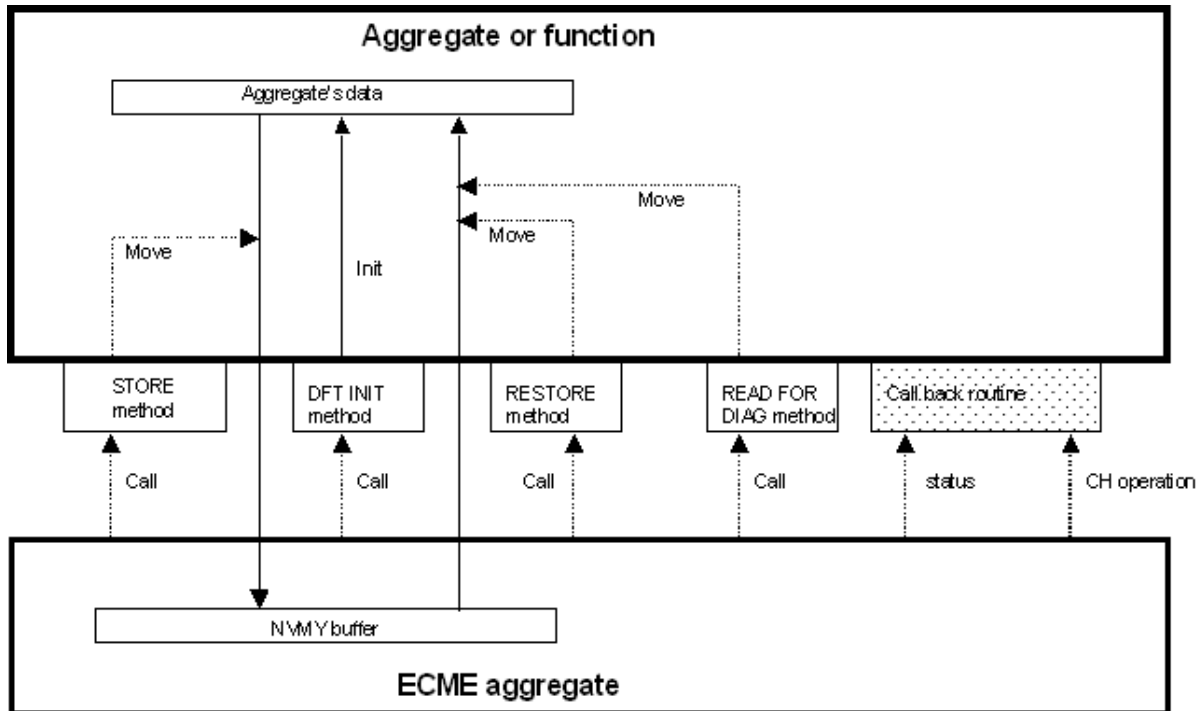
### 0.5.1.5 Channel management /Specific channel

Aggregates provide all methods for NVMY data management as follows:

- **RESTORE** from Hardware component to Aggregate's data
- **STORE** from Aggregate's data to Hardware component
- **DEFAULT INITIALIZATION** Aggregate's data initialization with default value

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- CALLBACK routine [optional] Call back routine called by ECME aggregate after a store operation in order to get its status.
- READ FOR DIAGNOSIS  
From hardware component to the data used by the Read for diagnosis service




 : optional

Figure 0.5.7:

### REMARK:

Aggregate's data memory location is known by the method boxes.  
Thus, ECME aggregate does not have to know Aggregate's data memory location.

### Channel configuration

An ECME aggregate provides several MACROs that help the designer in order to define Channel configuration.

This configuration takes place into the ECME\_ANVM.CFG component that is described in later section of this document.

Standard channel are defined according to the following scheme:


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Figure 0.5.8:

### MACROs description

**NVMY\_MAKE\_CH\_CNF\_SPEC (** CH\_ID,  
TGT\_ID,  
VERSION\_CHK,  
TUNING\_LVL,  
SAVING\_METH,  
STORE\_METH,  
RESTORE\_METH,  
CBACK\_METH,  
DFT\_INIT\_METH,  
READ\_FOR\_DIAG\_METH)**)**

This macro opens a standard channel definition.  
Besides, it helps to define all channel characteristics.

#### Parameters definition:


Parameter	Value	Purpose	Comment
CH_ID	NAME_N_FIX [( 1 )]	Channel identifier	Used to order ECME operation on a channel
TGT_ID	E2P	EEPROM is the Preferred hardware location for storing this channel.	<b>This channel is stored to Eeprom if component is available. Otherwise, it will be stored to FLASH.</b>
	SIM_E2P	FLASH is the Preferred hardware location for storing this channel.	<b>This channel is stored to Eeprom if component is available. Otherwise, it will be stored to EEPROM.</b>
VERSION_CHK	CHK	Channel is sensitive to NVMY coherency check	If the NVMY contents coherency checking failed, the channel's data should be initialized with default values
	NO_CHK	Channel is not sensitive to NVMY coherency check	Channel's data is not initialized even if NVMY contents coherency checking failed
TUNING_LVL	LV0( 2 )	Channel is part of level 0 group for tuning initialization	Protected group : ECME's Tuning calibration has no effect on this group

Continued on next page

	LV1	Channel is part of level 1 group for tuning initialization	Channel's contents may be initialized with default values if tuning calibration is set to level 1
	LV2	Channel is part of level 2 group for tuning initialization	Channel's contents may be initialized with default values if tuning calibration is set to level 2
	LV3	Channel is part of level 3 group for tuning initialization	Channel's contents may be initialized with default values if tuning calibration is set to level 3

Parameter	Value	Purpose	Comment
STORE	NO_STRQ (4)	Synchronization for store operation	Copy data from previous block and don't take in account data from current driving cycle.
	NO_SYNC (5)	No operation done at Store phasis	Synchronisation and write operation is forbidden.
	END_PWL	Store at the end of Powerlatch	END_PWL and BEG_PWL do the same operations : store is done at the end of powerlatch
	BEG_PWL	Store at the beginning of powerlatch	
SAVING_METH	CRC16	CRC16 method	Channel's data are secured with CRC16 method
	MACOPY	MACOPY method	Channel's data are secured with MACOPY method
	NONE	NONE method	Channel's data are secured with NONE method
STORE_METH	Storefunction name (3)	specific method provided by Aggregate	Aggregate provides a method in order to copy NVMY data from ram to nvmy buffer ( ECME )
RESTORE_METH	Restorefunction name (3)	specific method provided by Aggregate	Aggregate provides a method in order update its NVMY data thanks to NVMY buffer
CBACK_METH	NVMY_DFT_CBACK	ECME call-back default method	Call back is not active for this channel.
	call backfunction name (3)	specific method provided by Aggregate	Aggregate provides a method that will be called by ECME in case of writing on fly
DFT_INIT_METH	NVMY_DATA_INIT_DFT	Aggregate uses the ECME's default init method	Channel data are initialized by ECME's method in case of troubles.
	Default Initfunction name (3)	specific method provides by Aggregate	Aggregate provides a method in order to initialize channel's data.
			Continued on next page

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<b>READ_FOR_DIAG_METH</b>	NVMY_DFT_READ_FOR_DIAG	Aggregate uses the ECME's Read For Diag default method	Read For Diagnosis is not active for this channel
	Read for diagfunction name ( 3 )	specific method provides by Aggregate	Aggregate provides a method in order to Read For Diagnosis channel's data.

### Remarks:

- (1): According to the "C coding guideline", the channel identifier name is limited to **17** characters.  
For convenience, **NAME** shall refer to Aggregate's short name.  
**N** is a digit that may be used in the case that Aggregates holds more than one channel.  
The **FIX** may be added to channel identifier name if channel is not sensitive to NVMY data coherency checking.
- (2): This level is basically used to protect channels against tuning initialisation.  
For instance, the channel dedicated to NVMY data coherency is protected.
- (3): Basically, this field refers to the function name defined by Aggregate.
- (4): The channels that have the NO\_STRQ parameter are only synchronized at powerlatch. For the first powerlatch, they are stored but in the case that the first powerlatch is interrupted the channels are not stored and will be initialized at every power on until they are stored into flash. The aggregate should take this into account and store the channel separately in case of initialization.
- (5): The channels that have NO\_SYNC parameter are never stored nor synchronized to memory. The aggregate should take this into account and store the channel separately.
- **NVMY\_DATA\_DEF\_SPEC(aggr\_typedef\_struct)**  
  
This macro is used to add a package of NVMY data to channel.  
This package is defined through the typedef structure provided by Aggregate
  - **NVMY\_CH\_CNF\_END(CH\_ID)**  
  
This macro closes a specific channel definition.
- CH\_ID is the same as the one defined by NVMY\_MAKE\_CH\_CNF\_SPEC macro.

## 0.5.2 Non Volatile Data - Selective adaptation ranges

### General information:

Non-volatile-datas can be initialized by calibration system.

The following Non-Volatile-Datas can be initialized by a calibration constant:

- All Adaptation-Values (with exceptions as specified in the table below)
- Error-memory (= all debounced active and not active errors are initialized with 0).
- Selective adaptive range values

### Important hints:

- The initialization will be executed once per transition, if the calibration constant transits from 0 -> 1.
- The initialization by calibration constant has an impact to the variables in RAM only.
- A complete PWL phase is necessary to store the initialized values to Non Volatile Memory.

### Application conditions:

**Initialisation:** -  
**Activation:** -  
**Deactivation:** -  
**Recurrence:** 1 s

### Function description:

#### Formula section:

Initialize all Adaptation-Datas:

```
If      LC_AD_CLR = 1
Then    All Selective Adaptive Range Values are initialized
          (with exceptions as specified in the table below)
Endif
```

Clear the Error-memory

```
If      LC_ERR_FMY_CLR = 1
Then    The Error-memory is cleared
Endif
```

Initialize selective Non-Volatile-Datas:

```
If      LC_AD_CLR_XXXX = 1      (XXXX = selective adaptation range)
Then    Selective adaptive values are initialized
Endif
```

Clear KLANN-Adaptation values:

```
If      LC_AD_CLR_LACO 0 -> 1
Then    call klann_clrad(void)
Endif
```

### 0.5.2.1 Configuration Listing Of Channels

Internal ECME-Channels (channel "ECME_1_FIX" must remain the lowest rank 0)								
NVMY-Channel (Channel ID)	Nr	Version Check	Tun- ing Level	Store Option	Saving Method	Restore	lc_ad_ clr	lc_ad_clr_ XXX
ECME_1_FIX	0	NO_ CHK	LV0	END_ PWL	CRC16	PRE_AS	0	0
SWVER_FIX	Allocated in Fix area Application-SW							
SWVER	Allocated in normal area							

Fix Area Application-SW (Don't re-arrange, channels were not initialized if SW-Version changes)								
NVMY-Channel (Channel ID)	Nr	Version Check	Tun- ing Level	Store Option	Saving Method	Restore	lc_ad_ clr	lc_ad_clr_ XXX
calid	1	NO_ CHK	LV1	NO_ SYNC	CRC16	NOR- MAL	0	0
bmw_coding	2	NO_ CHK	LV1	NO_ SYNC	CRC16	NOR- MAL	0	0
trt	3	NO_ CHK	LV1	END_ PWL	MA- COPY	NOR- MAL	0	0
dist	4	NO_ CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
tecu	5	NO_ CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_tecu
vima	6	NO_ CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
FSC_ews4_A	7	NO_ CHK	LV1	NO_ SYNC	CRC16	NOR- MAL	0	0
PRNG	8	NO_ CHK	LV0	NO_ SYNC	CRC16	PRE_ CAN	0	0
bal	9	NO_ CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_bal
laco	10	NO_ CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_laco
enrd	11	NO_ CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_ enrd
long_lam	12	NO_ CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
cilc	13	NO_ CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_cilc

Continued on next page


injai_fix_mst	14	NO_ CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	lc_ad_clr_injr
tecu2	15	NO_ CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_tecu
injai_fix_cpy	16	NO_ CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
SWVER_FIX	17	NO_ CHK	LV0	END_ PWL	CRC16	0	0	0
fsc_xmax_fix	18	NO_ CHK	LV1	NO_ SYNC	CRC16	NOR- MAL	0	0
swt_vin_can_fix	19	NO_ CHK	LV1	NO_ SYNC	MA- COPY	NOR- MAL	0	0
nvrnm_fix_0	20	NO_ CHK	LV1	END_ PWL	MA- COPY	NOR- MAL after nvrnm channels	0	0
stc_ron	21	NO_ CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	lc_ad_clr_stc_ ron

Normal Area (initialized if SW-Version changes)								
NVMY-Channel (Channel ID)	Nr	Version Check	Tun- ing Level	Store Option	Saving Method	Restore	lc_ad_ clr	lc_ad_clr_ XXX
tps_mst	22	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	1	lc_ad_clr_tps
tps_cpy	23	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	1	lc_ad_clr_tps
lam	24	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_lam
misf	25	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_mis
cru	26	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	1	lc_ad_clr_cru
ati	27	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_ati
cons_start_fmy	28	CHK	LV0	END_ PWL	CRC16	PRE_ CAN	0	0
fmy	29	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	0	0
frf_0	30	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	0	0
frf_1	31	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	0	0

Continued on next page

frf_2	32	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	0	0
frf_3	33	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	0	0
frf_4	34	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	0	0
frf_5	35	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	0	0
frf_6	36	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	0	0
frf_7	37	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	0	0
frf_8	38	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	0	0
frf_9	39	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	0	0
frf_10	40	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	0	0
frf_11	41	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	0	0
frf_12	42	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	0	0
frf_13	43	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	0	0
frf_14	44	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	0	0
envd_prev_0	45	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	0	0
fmy_hmem	46	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	0	0
cons_end_fmy	47	CHK	LV0	END_ PWL	CRC16	PRE_ CAN	0	0
lif	48	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_lif
toil	49	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_toil
ccp	50	CHK	LV1	END_ PWL	CRC16	PRE_AS	0	0
n_is	51	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	1	lc_ad_clr_n_ sp_is
can	52	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	1	lc_ad_clr_can
var	53	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	1	lc_ad_clr_var
ron	54	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	1	lc_ad_clr_ron
n_max	55	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_n_ max
Continued on next page								


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obd2	56	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_ obd2
sof	57	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	1	lc_ad_clr_sof
tqi_lim	58	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_tqi_ lim
pste	59	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_pste
dmtl	60	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_dmtl
cps	61	CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
co_is	62	CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
eobd	63	CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
vvti	64	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_ivvt
cpuload	65	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	0
ente	66	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	1	lc_ad_clr_ente
pow	67	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_pow
egy	68	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	0
ensd	69	CHK	LV1	END_ PWL	CRC16	PRE_ CAN	1	lc_ad_clr_ ensd
fup	70	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	0
mfp	71	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	0
cons_start_nvram	72	CHK	LV0	END_ PWL	CRC16	NOR- MAL	0	0
nvram	73	CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
nvram_1	74	CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
nvram_2	75	CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
nvram_3	76	CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
nvram_4	77	CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
nvram_5	78	CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
nvram_6	79	CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0

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nvram_7	80	CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
nvram_8	81	CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
nvram_9	82	CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
nvram_10	83	CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
nvram_11	84	CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
nvram_12	85	CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
cons_end_nvram	86	CHK	LV0	END_ PWL	CRC16	NOR- MAL	0	0
chkfilcap	87	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_dmtl
toil_max	88	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_toil_ max
egcp	89	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_ egcp
extd	90	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_extd
tam	91	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	0
bsd	92	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	0
insy	93	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_insy
evac	94	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_ evac
rst_det	95	CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
acrc	96	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_egr
efp	97	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	0
efppwm	98	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_efppwm_i_ ad_clr
egtr	99	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	0
egtr_aggr	100	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	0
injr	101	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_injr
ecm2	102	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_ ecm2
igre	103	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	0

Continued on next page

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imob_rst_det	104	CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
profalter	105	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_alter
tqlo	106	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_tqlo
extc	107	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	0
mfma	108	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	0
tqdr	109	CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_tqdr
SWVER	110	CHK	LV0	END_ PWL	CRC16	PRE_AS	0	0

## 0.6 Customer reprogramming

### 0.6.1 Introduction

This document describes the flash reprogramming concept. The concept is always applied. It is a generic specification. For the customer particular requirements another document called ECU reprogramming, SW specification describes the software specification of the reprogramming function. In addition to this current document the customer specific parts (diagnosis protocol, logistics and historic field) have to be described in other files referring to this document. This document does not describe the first programming of an ECU at the Supplier production line or the first programming of prototypes.

### 0.6.2 General description

The usage of suitable segmented flash memories, with the opportunity to delete and (re-) program parts of the module separately, enables the development of a strategy called reprogramming of the Flash memory at the customer.

The car manufacturers use this feature in order to delete the Calibration data and/or ECU-SW and to program them again. With this method it is possible to avoid the exchange of the ECU when functional changes or errors of the ECU-SW occur.

The result is a considerable decrease in expenses of the after-sales service for the customer and the supplier.

The activation of the function and the communication actions are done through a unique communication line (diagnosis line) without applying an external voltage to a specific pin of the ECU connector.

The ECU memory is divided into three principal and functional independent parts : Boot sector, ECU-SW sector and Calibration data sector.


The reprogramming function needs always an existing Boot-SW because all the software routines for a reprogramming session are located in the Boot sector (Boot-SW).

The fundamental restriction is that this sector is not erasable.

The effects resulting from the user actions during a reprogramming session (e.g. key off/key on, false use of the tool, manipulation) and external disruptions on the communication line are not predictable. So the ECU has to ensure that unauthorized actions or failures in the reprogramming session have no impact on the operation of the Boot-SW /ECU-SW.

The following principle requirements have to be taken into consideration for the implementation of the reprogramming function :

- The reprogramming function can be used for the end of line and the field programming.
- The routines for the programming /erasing of the flash memory must be executed from outside the Flash memory itself, because a read access to the flash memory is not possible during programming /erasing.
- For the activation of the reprogramming function and the communication during the session only one physical layer (e.g. K-line) is used.
- For the reprogramming function the customer specific diagnostic protocol is used.
- The software is divided into three independent parts (Boot-SW, ECU-SW, and Calibration data).
- Each part of the SW is protected with its own, separate checksum.
- The reprogramming function needs always an existing Boot-SW.
- For the customer it is not possible to reprogram the Boot-SW.
- Security concept to protect the ECUs against unauthorized manipulation.
- Security concept to avoid the recycling ECUs when the reprogramming is not correct.

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- Check mechanism for compatibility between Boot-SW, ECU-SW and calibration data.
- Information about the reprogramming status of the ECU easily available for the tool.

### 0.6.3 Communication between reprogramming Tool and ECU

The communication between the reprogramming tool and the ECU is carried out through a unique bi-directional data link (in general K-line).

The reprogramming services are part of the diagnosis services. The basic services are listed below :

- Communication initialization,
- ECU identification (read logistics information),
- Reprogramming Tool identification (security access),
- Erase action (Calibration data sector and/or ECU-SW sector),
- Transfer actions (read /write Calibration data and/or ECU-SW),
- Reprogramming control and report (checksum, coherence Boot-SW /ECU-SW /Calibration data),
- Historic update (write bytes in Boot sector),
- End communication.

All the diagnostic services that are needed for a reprogramming session must be stored in the Boot-SW (non-erasable sector).

The performance (duration) of a reprogramming session depends on the performance of the communication protocol, except for the Flash memory erase sequence, that depends on the Flash memory type.

The diagnosis protocol and services have to be described in other documents.

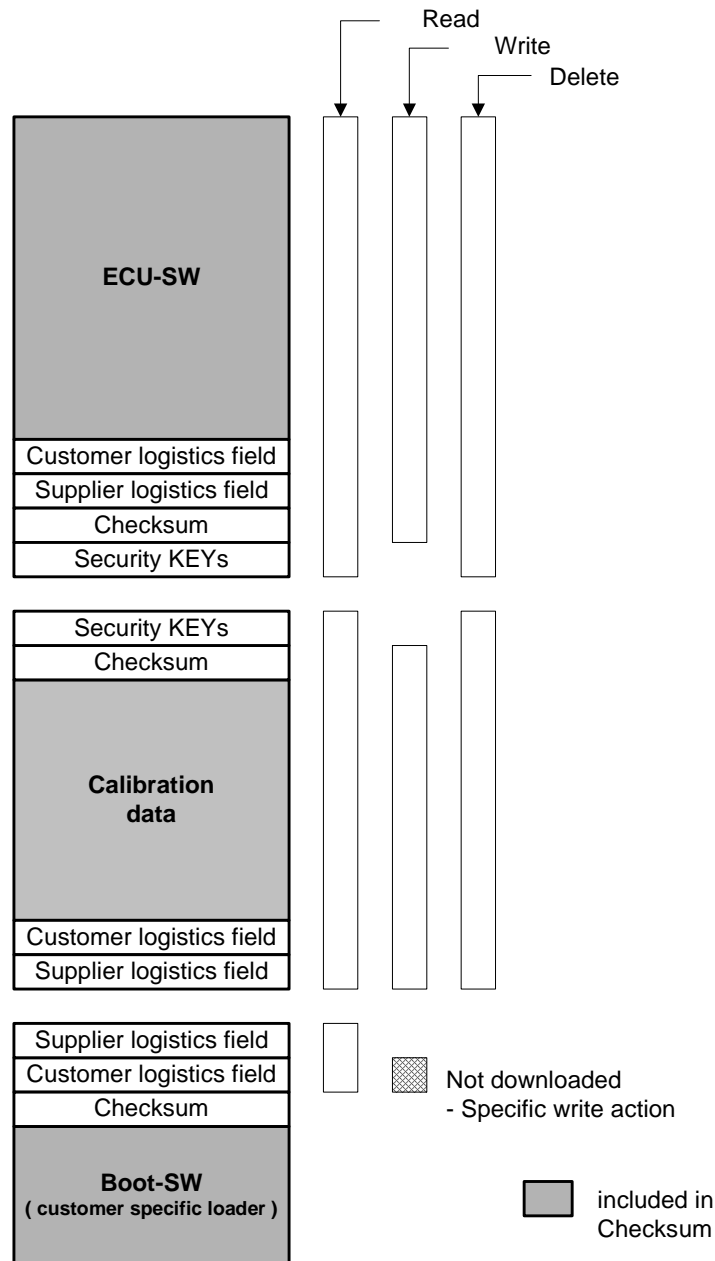
### 0.6.4 Functional memory layout

The software is divided into three parts :

- Boot-SW cannot be reprogrammed through the customer protocol, size depends on the used flash memory.
- ECU-SW reprogrammable, size depends on the used flash memory.
- Calibration data reprogrammable, size depends on the used flash memory.

The following picture shows the principle architecture.

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### 0.6.4.1 Boot-SW

This sector is not erasable through the customer protocol; it contains all routines used at start-up of the system and all diagnosis services for a reprogramming session. A field is reserved for customer logistics information.

Contents :

- Interface for ECU-SW,
- Minimum operating system,
- RAM-Test,
- Key\_on /Key\_off recognition mechanism,
- Customer specific communication protocol layer,
- Diagnosis communication services for reprogramming and logistics,

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- Reprogramming routines (delete, start, transfer, exit and check) for the flash memory (please report to chapter 1.7 -Reprogramming states),
- Flash access routines for erasing and reprogramming,
- Supplier logistics information field (test results of the Supplier production line, logistics data, identifiers, checksum),
- Customer logistics information field (e.g. the historic of the reprogramming actions stored at the end of reprogramming session),
- Security mechanisms (checksum calculation, coherence and security keys check),
- Seed /Key procedure.

### 0.6.4.2 ECU-SW

The ECU-SW size depends on the functional system requirements. The limitation to a maximum size depends on the used flash device.

This part contains all routines of the applicative SW of the system.

The reprogramming actions affect the complete area, except the security fields (please report to chapter 1.5 - Security mechanisms).

Contents :

- Interface for Boot-SW,
- Basic SW functions which are not necessary for the reprogramming,
- All I/O and applicative SW routines,
- Communication protocol routines,
- Seed /Key procedure,
- Security keys for ECU-SW which guarantee the correct reprogramming,
- Logistic information field (Supplier and Customer),
- Interrupt vector table.

The logistic information field of the ECU-SW, the checksum information and the interrupt vector table are located at fixed addresses in the same way as the interface table for the Boot-SW. The calibration data contains all information for engine tuning.

The reprogramming actions affect the complete area, except the security fields (please report to chapter 1.5 -Security mechanisms).

Contents :

- All constants and calibration maps tuned via application tool,
- Security keys for the calibration data which guarantee the correct reprogramming,
- Identification field ( comparable to logistic information field within the software ),
- Customer logistics field (if necessary).

The checksum information has a definite size and is located at a fixed address within the calibration data.

## 0.6.5 Security mechanisms

The effects resulting from user actions during a reprogramming session or caused by unauthorized manipulation are not predictable. So a protection is necessary to avoid erroneous flash contents as a consequence of such an influence.

The SW has to ensure a high level of security so that the above mentioned cases have no impact on the operation of the ECU. Therefore special security mechanisms are implemented. Some for protection and the other for a safe detection if correct reprogrammed.

- Security keys in flash memory and RAM to secure the reprogramming session,
- Status word in RAM to guaranty the proper sequence of the reprogramming states,
- Seed/Key procedure (according to SAE J2186 /J2190) via the data link to allow a reprogramming session,
- When an ECU-SW reprogramming session is active, only reprogramming within the ECU-SW memory address range is allowed.

- When a calibration data session is active, only reprogramming within the calibration memory address range is allowed.
- ADD-ON programming for logistics data is only allowed, when no ECU-SW or Calibration data reprogramming is active.
- Checksum test to detect data transmission errors on the data link,
- Check mechanism using a coherence system,
- All logistics data in the BOOT-SW cannot be deleted over the lifetime of the ECU.
- As long as a reprogramming session is not successfully completed, the ECU remains in the reprogramming state (only activation of Boot-SW); this is necessary to avoid recycling ECUs .

### 0.6.5.1 Security Access

To avoid unauthorized manipulation (read /erase /write actions) of the ECU data, security accesses (Supplier /Customer) are implemented to allow /forbid access to the content of the flash memory.

It is not possible to reprogram the ECU-SW and/or the calibration data if the ECU is not unlocked by a successfully security access phase (according to SAE J2186) between the reprogramming tool and the ECU.

The access to higher security levels (or unlocked state) is realized by two successfully handshake messages (request /response) between the tool and the ECU. Thus the ECU certifies the tool.

### 0.6.5.2 Reprogramming Keys in RAM

To avoid unpredictable erase /write actions of the ECU data, the basic routines for erase and write actions are inhibited if the Reprogramming Keys are not initialized.

The Reprogramming Keys, 4 RAM bytes, are initialized at each erase /write request that concerns the reprogramming function. These keys are tested by the basic routines (erase /write).

At the end of each erase /write routine and on ECU reset, these bytes are set to 00h.

### 0.6.5.3 Checksum calculation

To guaranty the validity of the reprogrammed data transmitted through the communication line an independent checksum value is stored in each area (ECU-SW, Calibration data).

This checksum is tested at the end of a reprogramming session. If the calculated values do not fit with the stored values in ECU-SW area and Calibration data area, the applicative software is inhibited and there is no engine operation.

### 0.6.5.4 Coherence System

The Coherence System ensures that the three independent SW-parts fit together. The coherence identifiers are implemented in the Boot-SW, the ECU-SW and the Calibration data and are checked at the end of a reprogramming session and at start-up of the ECU.

If the three identifiers do not fit together, the applicative software is inhibited and there is no engine operation.


### 0.6.5.5 Security Keys in flash memory

To guaranty that a reprogramming session is successfully completed, a four bytes Security Key is implemented in each part, which can be reprogrammed (ECU-SW, Calibration data).

These keys are updated at the end of a reprogramming session, and tested at start-up of the ECU. If one of the Security Keys is not valid, the applicative software is inhibited and there is no engine operation.

Functional description of the Security Keys :

- After a reprogramming request, the Security Key is set to 00h.
- During the erase operation the Security Key is automatically set to default value of the flash.
- At the end of the reprogramming operation the checksum and the Coherence System are checked, in case of a proper reprogramming session the Security Key is set to a fixed value.

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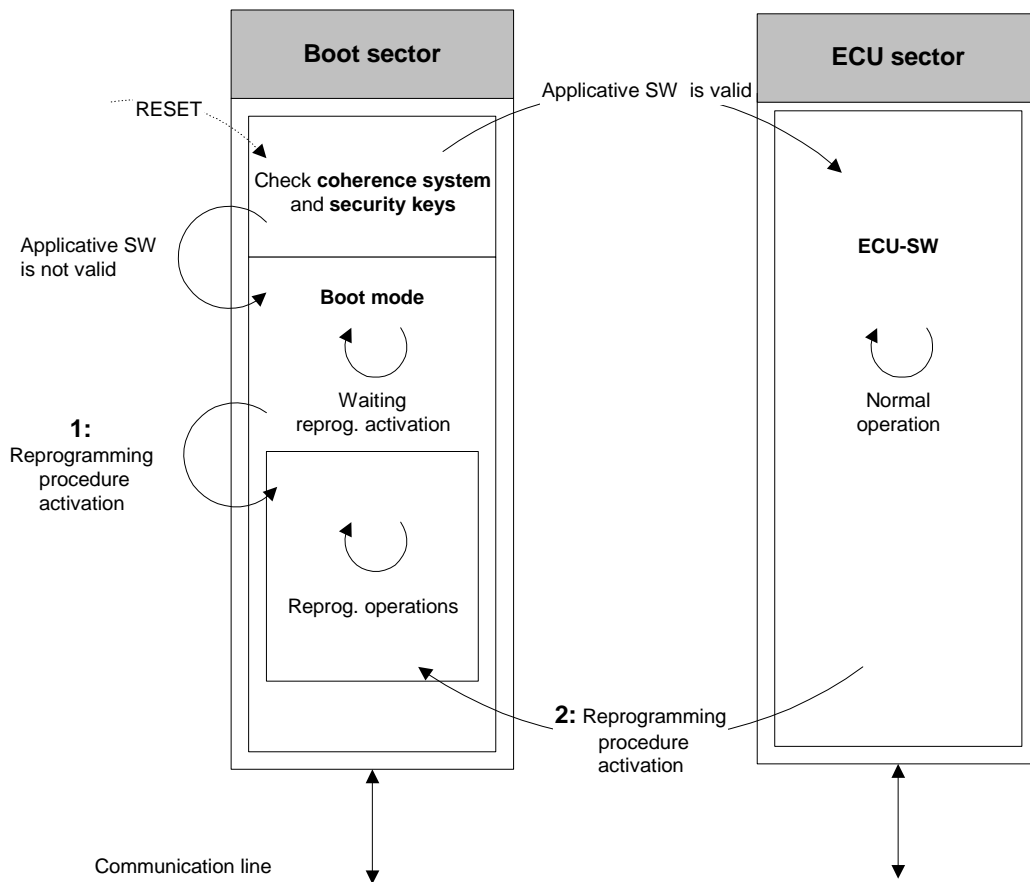
### 0.6.5.6 Reprogramming session status

To guaranty the proper sequence of the reprogramming session, a session status is tested and updated in each basic action (please report to chapter 1.7 -Reprogramming states). This mechanism avoids to skip a phase of the reprogramming states.

### 0.6.6 Reprogramming procedure activation

The following picture shows the principle mechanisms to activate a reprogramming session :

1. In that case, the applicative SW is inhibited; the Boot-SW controlled the communication line interface and the diagnosis services for the reprogramming activation.
2. In that case, ECU is in applicative mode. It should switch to Boot mode before to launch the reprogramming function.



The applicative SW is only activated if all parts are correct reprogrammed and fit together. If one part is missing or not correct reprogrammed the system activates the Boot-SW.

The following conditions are possible at start-up (Key-On, Reset) of the system :

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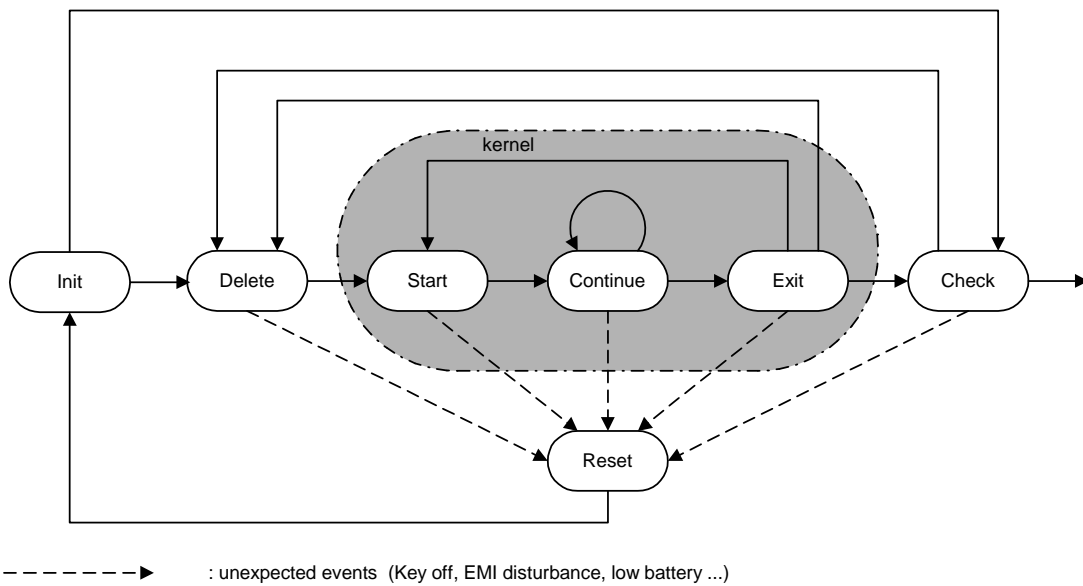
Boot-SW	ECU-SW	Calib. data	ECU action
X	[-]	[-]	ECU activates only Boot-SW, no engine operation
X	[-]	X	ECU activates only Boot-SW, no engine operation
X	[X]	X	ECU activates only Boot-SW, no engine operation
X	[X]	[X]	ECU activates only Boot-SW, no engine operation
X	X	[-]	ECU activates only Boot-SW, no engine operation
X	X	[X]	ECU activates only Boot-SW, no engine operation
X	X	X	ECU normal operation = engine operation

(X = available, [X] = wrong reprogrammed or coherence system value not correct, [-] = erased)

### 0.6.7 Reprogramming states

These reprogramming states are only possible when the ECU is unlocked by the tool.

#### REPROGRAMMING STATES



#### 0.6.7.1 State Init

First step to the flash access, only necessary once during an ECU reprogramming session.

- Prepare a reprogramming session
- The diagnostic session has to be opened.
- The timings of the protocol have to be set to higher limits in order to reduce the reprogramming duration.
- Unlock ECU for a reprogramming session

#### 0.6.7.2 State Delete

- The only action is to delete either calibration data or ECU-SW.
- This state also activates the Boot SW mode.

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### 0.6.7.3 State Start

- Open a reprogramming session for calibration data or ECU-SW.
- No data are deleted.
- No reprogramming of data.
- Check if address area is allowed.

### 0.6.7.4 State Continue

- An active reprogramming session for calibration data or ECU-SW is continued.
- Reprogramming of data will be done.
- No data are deleted.

**Note:** If a session for reprogramming of calibration data is opened, reprogramming of ECU-SW is not possible and vice versa.

### 0.6.7.5 State Exit

- Close a reprogramming session for calibration data or ECU-SW.
- No checks are done.
- No reprogramming of data.

### 0.6.7.6 State Check

- The calibration data and ECU-SW are checked (coherence system, checksums).
- No reprogramming of data (except the Security Keys if necessary to write).
- Update of the reprogramming status word; please report to the chapter 1.8 -Reprogramming Status Word definition.

### 0.6.7.7 State Reset


- Reset the status information for reprogramming. Useful when the communication end or a break was detected.

## 0.6.8 Reprogramming Status Word definition

The Reprogramming Status Word informs users on the validity of the applicative SW.

This word content is a dynamic information (RAM) and is only valid if the check of reprogramming have been previously performed.

At reset this information is lost.

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Bit #	Bit definition	Group definition
#15 #14 #13 #12	Checksum of Calibration data is correct Security Keys for Calibration data are not written Security Keys for Calibration data are correct Calibration data is correct	Calibration data information
#11 #10 #9 #8	Checksum of ECU-SW is correct Security Keys for ECU-SW are not written Security Keys for ECU-SW are correct ECU-SW is correct	ECU-SW information
#7 #6	Reprogramming of ECU is successfully completed ECU is not at the end of reprogramming session	General ECU information
#5 #4 #3 #2 #1 #0	Coherence identifiers fit together Calibration data does not fit to ECU-SW ECU-SW does not fit to Boot-SW Coherence identifier in Calibration data is erroneous Coherence identifier in ECU-SW is erroneous Coherence identifier in Boot-SW is erroneous	Coherence system information

When the bit definition is right, the bit value is set to 1.  
e.g. just at the end of successful reprogramming session, the value is BBh A0h.

## 0.7 CPU measurement

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CPU_LOAD	O/V	0... 400H	0... 100	0.0977	%
Type: U16. CPU load above measurement level.					
CPU_LOAD_FIL	O/V	0... 400H	0... 100	0.0977	%
Type: U16. Filtered CPU load above measurement level.					
CPU_LOAD_FIL_MAX	O/V/S	0... 400H	0... 100	0.0977	%
Type: U16. Maximum detected filtered CPU load above measurement level.					
CPU_LOAD_MAX	O/V/S	0... 400H	0... 100	0.0977	%
Type: U16. Maximum detected CPU load above measurement level.					
CPU_LOAD_SES_CTR	O/V	8000... 7FFFH	-32768 ...32767	1	-
Type: S16. Session counter of CPU load measurement.					
CPU_LOAD_TSK_PER_CTR	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Type: U32. Numbers of calls of TASK_BG_MES.					
CPU_LOAD_TSK_PER_MIN	O/V	0... FFFFFFFFH	0... 4294967295	1	Ticks
Type: U32. Minimum time between 2 Instances of TASK_BG_MES.					

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CPU_LOAD_FTC	-	0... FFFFH	0... 0.9999	1/65536	-
Type: U16. Filter time constant for CPU_LOAD_FIL.					
C_CPU_LOAD_PER	-	1... 7FFFH	1... 32767	1	-
Type: S16. Time factor between 2 measurement sessions depending on the task recurrence.					
C_CPU_LOAD_SES_CTR_INI	-	8000... 0H	-32768 ...0	1	-
Type: S16. Start delay of measurement session.					
C_CPU_LOAD_SES_T_END	-	1... 1F4H	1... 500	1	-
Type: S16. End of meas. session. In a 2ms task the max. allowed session time of 1s is set by using factor 500.					
C_CPU_LOAD_TSK_MES_DLY	-	0... FFFFH	0... 65535	1	-
Type: U16. Temporization for background task duration.					
C_CPU_LOAD_TSK_PER_MIN	-	0... FFFFH	0... 65535	1	Ticks
Type: U16. Learned minimum time between 2 Instances of TASK_BG_MES.					

### FUNCTION DESCRIPTION:

#### General information:

In a priority-based system, working with a background task (task configured at the lowest priority level and systematically running when no higher priority treatments are triggered), the real processor load is always 100%. Nevertheless, the CPU time spent for the background task can be considered as potential free CPU time (if a higher priority treatment is triggered, the background task will be interrupted).

As a consequence, the CPU load (CPU\_LOAD) is then defined as the processor activity above the background level (priority level 0).

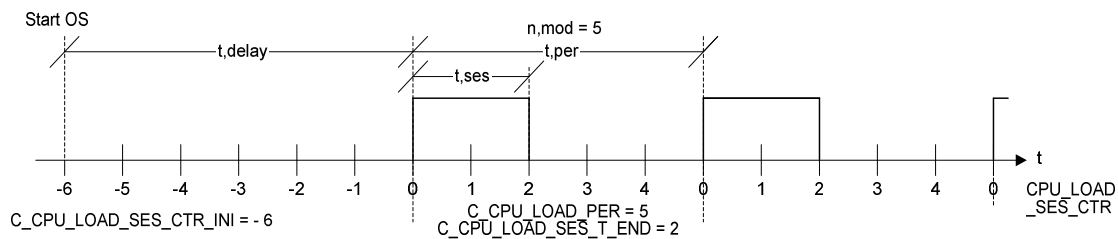
The computation of the CPU load consumed above the background level (priority 0) is based on the usage of a measurement background task (TASK\_BG\_MES) of fixed and known net duration  $t_{TASK\_BG\_MES,net}$  (automatically characterized by the minimum time between two tasks occurrences: CPU\_LOAD\_TSK\_PER\_MIN) at the priority level 1 and a time function in a task (priority > 1) with fixed recurrence (e.g. 100ms). The duration of TASK\_BG\_MES can be tuned with the temporization value C\_CPU\_LOAD\_TSK\_MES\_DLY. The temporization is necessary to increase the measurement background task time having enough measurement resolution.

The detected minimum duration time (depending on the chosen temporization) is shown in value CPU\_LOAD\_TSK\_PER\_MIN and shall be put to C\_CPU\_LOAD\_TSK\_PER\_MIN.

After having fixed C\_CPU\_LOAD\_TSK\_MES\_DLY and C\_CPU\_LOAD\_TSK\_PER\_MIN, these two calibrations, plus C\_CPU\_LOAD\_PER and C\_CPU\_LOAD\_SES\_T\_END (see description below) shall be set none tunable in DDS in order to make sure that no miscalibration is possible.

During a measurement session  $t_{ses}$  of period  $t_{per}$  occurring every fixed modulo counter  $n_{mod}$  (C\_CPU\_LOAD\_PER), TASK\_BG\_MES is triggered once from the application and then continuously re-activates itself.

This measurement session  $t_{ses}$  starts at the beginning of the period  $t_{per}$  and can be tuned up to 100% of the period  $t_{per}$  (boundary case, where C\_CPU\_LOAD\_SES\_T\_END is set equal C\_CPU\_LOAD\_PER). The measurement session  $t_{ses}$  shall be less than or equal to 1 second. A start delay of measurement can be defined by setting the session counter CPU\_LOAD\_SES\_CTR to a negative value at initialization (calibration C\_CPU\_LOAD\_SES\_CTR\_INI).



The potential free CPU factor  $CPU_{free}$  is obtained by multiplying the counted occurrences  $n$  (CPU\_LOAD\_TSK\_PER\_CTR) of measurement background task (TASK\_BG\_MES) over the measurement session with the duration of the measurement background task.

$$CPU_{free} = \frac{n \cdot t_{TASK\_BG\_MES,net}}{t_{ses}}$$

The CPU load value (CPU\_LOAD) is then deduced from the potential  $CPU_{free}$  value.

$$CPU_{load} = 1 - CPU_{free} = 1 - \frac{n \cdot t_{TASK\_BG\_MES,net}}{t_{ses}}$$

Due to a continuous activity at priority level 1 during the measurement period, it must be noticed that the background treatments running at priority 0 will not occur during the measurement session.

CPU\_LOAD\_FIL is the  $PT_1$  filtered value of CPU\_LOAD with  $P=1$  and  $T_1$  set by C\_CPU\_LOAD\_FTC (see description of calibration).

The variable CPU\_LOAD\_MAX represents the maximum detected CPU load value. The variable CPU\_LOAD\_FIL\_MAX represents the maximum of the filtered CPU load value.

The following diagram summarizes the principle of the measurement method:

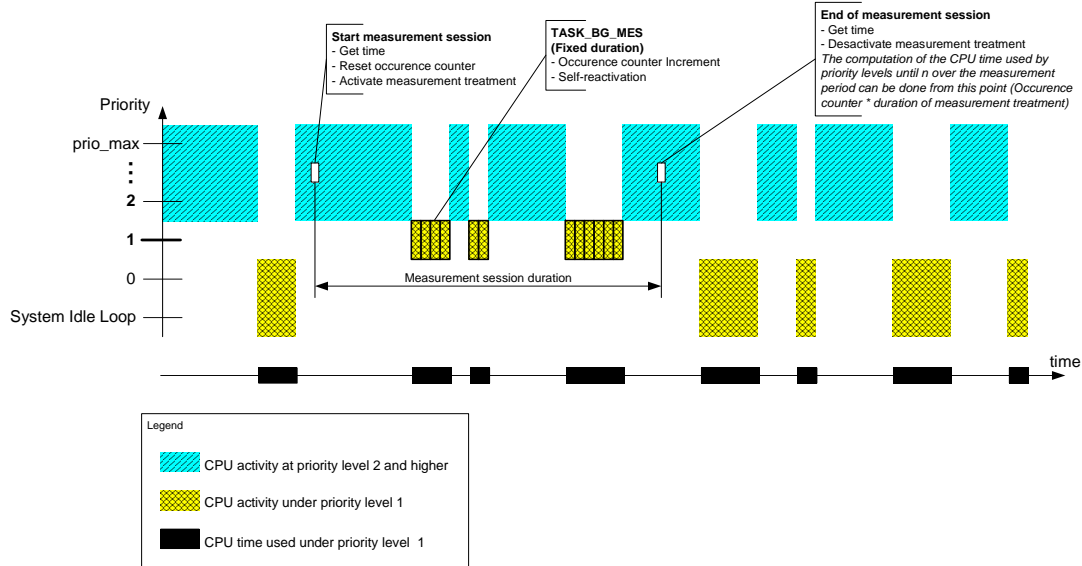


Figure 0.7.1: : The principle of the measurement method

Three APIs are available in order to have a flexible measurement method:

**Measurement enable API:**

This API shall be called at least at initialization if the measurement has to be done. After measurement disable API was called measurement enable API shall be used to enable measurement again.

**Measurement disable API:**

Shall be used to disable measurement method.

**Clear Maximum API:**

Shall be used to clear CPU\_LOAD\_MAX and CPU\_LOAD\_FIL\_MAX.

**C\_CPU\_LOAD\_TSK\_PER\_MIN and C\_CPU\_LOAD\_TSK\_MES\_DLY:**

The calibration C\_CPU\_LOAD\_TSK\_PER\_MIN must be set equal to the value CPU\_LOAD\_TSK\_PER\_MIN after it is computed depending on the temporization value C\_CPU\_LOAD\_TSK\_MES\_DLY.

**C\_CPU\_LOAD\_PER and C\_CPU\_LOAD\_SES\_T\_END:**

The measurement window is to be set with C\_CPU\_LOAD\_PER (modulo counter of measurement session, measurement window always starts if counter is zero and if start is allowed) and C\_CPU\_LOAD\_SES\_T\_END (measurement window stops at this counter value). If C\_CPU\_LOAD\_PER is equal to C\_CPU\_LOAD\_SES\_T\_END the duty cycle of the measurement is 100%.

**C\_CPU\_LOAD\_SES\_CTR\_INI:**

With C\_CPU\_LOAD\_SES\_CTR\_INI an easy start delay of measurement session can be set. The content of the value is calculated with

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$$C\_CPU\_LOAD\_SES\_CTR\_INI = - \frac{\text{requested start delay}}{\text{time triggered function recurrence}}$$

Example: The requested start delay after OS initialization is 500ms. The time triggered function is called every 100ms.

$$C\_CPU\_LOAD\_SES\_CTR\_INI = - \frac{500\text{ms}}{100\text{ms}} = -5$$

**C\_CPU\_LOAD\_FTC:**


Filter time constant for filtered CPU load (CPU\_LOAD\_FIL).

$$C\_CPU\_LOAD\_FTC = \frac{T \cdot n_{mod}}{T \cdot n_{mod} + T_1}$$

, with T = recurrence of time triggered function,  $n_{mod}$  is the modulo counter C\_CPU\_LOAD\_PER and T1 is the needed filter time.

Example: The time triggered function is called every 100ms.  $n_{mod}$  is set to 6. The filter time shall be 2s.

$$C\_CPU\_LOAD\_FTC = \frac{100\text{ms} \cdot 6}{100\text{ms} \cdot 6 + 2\text{s}} = \frac{600\text{ms}}{600\text{ms} + 2000\text{ms}} = 0.2308 \text{ phys.} \rightarrow 15124\text{d (3B14H)}$$

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## 0.8 ECU warm reset detection

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CPU_LOAD_MAX_RST_DET [NC_RST_DBG_LIST_SIZE]	O/V/S	0... 400H	0... 100	0.0976563	%
Max. CPU load from reset detection					
CPU_LOAD_RST_DET [NC_RST_DBG_LIST_SIZE]	O/V/S	0... 400H	0... 100	0.0976563	%
CPU load at reset					
CTR_ADC_OUT	V	0... FFH	0... 255	1	-
Counter for the number of ADC interface error messages					
DIST_RST_DET [NC_RST_DBG_LIST_SIZE]	O/V/S	0... FFFFFFFFH	0... 429496729500	100	m
Mileage counter at reset					
ERR_SYM_WARM_RST	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
detected error symptom ECU-reset					
LV_CDN_DIAG_WARM_RST	O/V	0... 1H	0 ...1	1	-
diagnosis condition ECU-reset					
LV_END_DIAG_WARM_RST	O/V	0... 1H	0 ...1	1	-
end of diagnosis ECU-reset					
LV_ERR_WARM_RST	O/V	0... 1H	0 ...1	1	-
error bit of ECU-Reset detection					
LV_RST_DET	V/S	0... 1H	0 ...1	1	-
Warm-reset during ECU-lifetime (until clearing FMY) occurred					
LV_RST_DET_DISP	-	0... 1H	0 ...1	1	-
ECU-Warm-Reset displayed in error management					
LV_WARM_RST	O/V	0... 1H	0 ...1	1	-
flag shows, that a reset during current ECU-run has occurred					
N_CPU_LOAD_MAX_RST_DET [NC_RST_DBG_LIST_SIZE]	O/V/S	0... 1FE0H	0... 8160	1	rpm
Engine speed at max. cpu load from reset detection					
N_RST_DET [NC_RST_DBG_LIST_SIZE]	O/V/S	0... 1FE0H	0... 8160	1	rpm
Engine speed at reset					
RST_CLAS_SEC [NC_RST_DBG_LIST_SIZE]	O/V/S	0... FFH	0... 255	1	-
Security info					
RST_CLAS_TYP [NC_RST_DBG_LIST_SIZE]	O/V/S	0... FFH	0... 255	1	-
Reset type					
RST_DBG_BACK_INFO_VLD [NC_RST_DBG_LIST_SIZE]	O/V/S	0... 1H	0 ...1	1	-
background info for last reset valid					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
RST_DBG_BACKTRACE_ADDRESS [NC_RST_DBG_LIST_SIZE][NC_RST_DBG_BACKTRACE_SIZE]	O/V/S	0... FFFFFFFFH	0... 4294967295	1	-
Info last available caller addresses (default 0)					
RST_INFO_ADD [NC_RST_DBG_LIST_SIZE]	O/V/S	0... FFFFFFFFH	0... 4294967295	1	-
Additional reset info (cause)					
RST_INFO_CTR	O/V	0... FFH	0... 255	1	-
Number of atypical warm-resets since last power-up (BSW)					
RST_SEC	O/V	0... FFH	0... 255	1	-
Status-byte: security info for atypical reset (reset-save memory)					
RST_TYP	O/V	0... FFH	0... 255	1	-
Status-byte: reset type during current ECU-run					
TRT_RST_DET [NC_RST_DBG_LIST_SIZE]	O/V/S	0... FFFFFFFFH	0... 119304.64708	27.7999e-6	h
Total runtime at reset					

**Input data:**

CPU_LOAD {p. 556}	CPU_LOAD_MAX {p. 556}	DIST {p. 1183}	N {p. 1525}
TRT {p. 1504}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_RST_DET	-	0... 1FE0H	0... 8160	1	rpm
Engine speed for activation of reset detection in error-management					
LC_WARM_RST_ENA	-	0... 1H	0 ...1	1	-
Entry in error management enabled (=1)					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CTR_MAX_ADC_OUT	-	0... FFH	0... 255	1	-
Maximum counter for ADC interface error messages					
NC_MAX_ADC_OUT	-	0... FFH	0... 255	1	-
Maximum number timeout ADC					
NC_RST_DBG_BACKTRACE_SIZE	-	0... FFH	0... 255	1	-
Number of byte in backtrace info array					
NC_RST_DBG_LIST_SIZE	-	0... FFH	0... 255	1	-
Number of bytes in info array					

**Import actions:**

<b>ACTION_INFR_GetBiosAdcStatus</b> (OUT<Bios_adc_status>)
--

### 0.8.1 Export Actions

<b>ACTION_SetRstInfo_ECM3</b>	
Action sets reset information of ecm3 security system	

**General information:**

The goal is to memorise the number and the reason of irregular ECU-resets (not at the normal power-up !!), in order to support the ECU-development.  
 The reset-information will NOT be saved in E<sup>2</sup>PROM for evaluation at the car-service-station.  
 Related hardware: TC1796 /system Units32-Bit /Single-Chip Microcontroller

The new debug driver is called by debug events which are typically resets. After a debug event it is necessary to ensure that the event- and the diagnosis-information is stored.

In case of E2PROM error or standby function call all informations are cleared.

The following figures show, which different values and additional info can be evaluated and stored for later access:

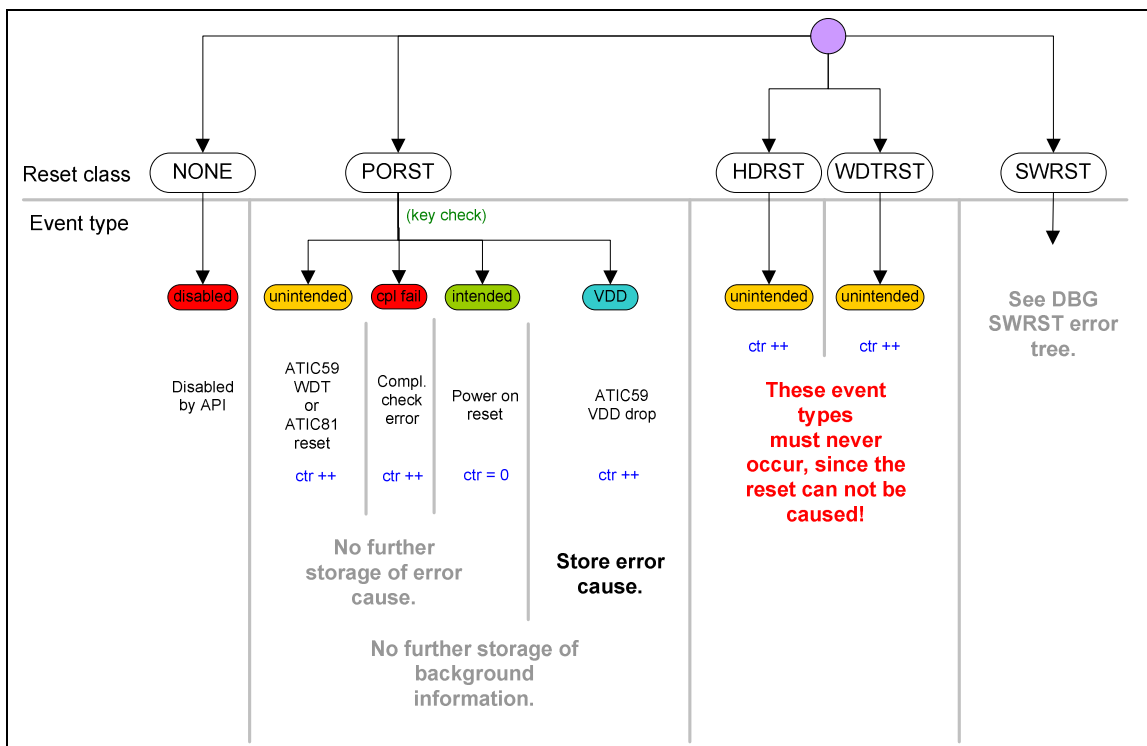


Figure 0.8.1: : DBG main reset class

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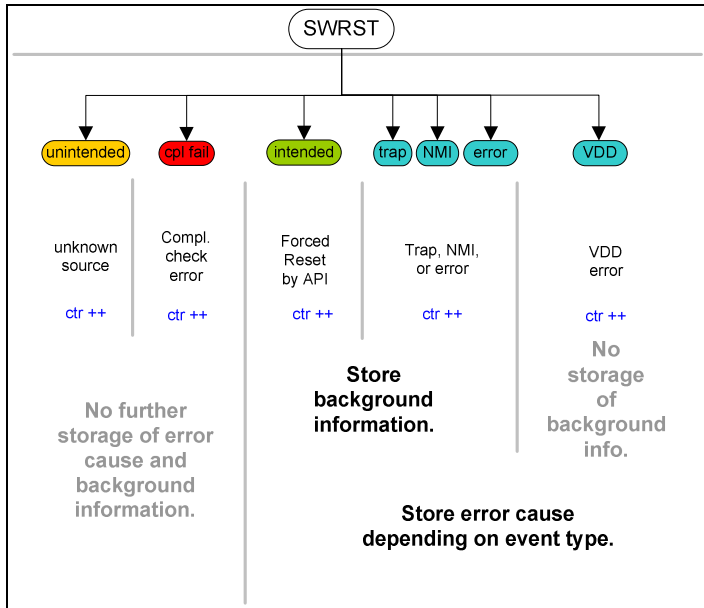


Figure 0.8.2: : DBG SWRST reset tree

As described in figure1 the reset class represents a main category of reset types and the described event. The type represents a more detailed description of an occurred reset, only the event type is used here as RST\_TYP.

The error cause is more detailed or is set to 0 if not valid. It is used here as RST\_INFO\_ADD.

The background information is only stored/updated for event types as shown above. Only some back-trace information is provided at the moment, named RST\_DBG\_BACKTRACE\_ADDRESS. The information is marked valid or invalid through RST\_DBG\_BACK\_INFO\_VLD. The complete info is set to 0 if not valid.

In a further step a warm/cold-Reset-detection is done by following mechanism:

A reset-save key which is written at ECU power-up and destroyed at regular ECU power-down. Checking this key against its init-value allows to detect a warm-reset.

By comparing the debug driver and the reset-save key it is possible to distinguish between internal or external MC-resets.

Reset-detection is done by evaluating low level functionality at startup:

**RST\_TYP**

This value represents, whether an intended Power-on reset (cold start, 12h) or any other reset is detected at startup.

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Hex-val	Description
01h	Error at evaluation (ERROR_TYPE)
02h	Driver disabled (DISABLED_TYPE)
10h	Unintended Power-On Reset (WDT or ATIC81, PORST_TYPE_UNINTENDED)
11h	Complement error at Power-On Reset (PORST_TYPE_CPL_FAIL)
12h	Intended Power-On Reset (Cold Start, PORST_TYPE_INTENDED)
13h	VDD Error at Power-On Reset (PORST_TYPE_VDD_ERROR)
20h	Hardware Reset (HDRST_TYPE_UNINTENDED)
30h	Watchdog Reset (WDRST_TYPE_UNINTENDED)
40h	Unintended Software Reset (SWRST_TYPE_UNINTENDED)
41h	Complement error at Software Reset (SWRST_TYPE_CPL_FAIL)
42h	Intended Software Reset (SWRST_TYPE_INTENDED)
43h	VDD Error at Software Reset (SWRST_TYPE_VDD_ERROR)
44h	Trap (detected trap, SWRST_TYPE_TRAP)
-h	NMI (detected NMI/Trap class 7, SWRST_TYPE_NMI)
46h	Error at Reset (SWRST_TYPE_ERROR)

This value represents, whether a Power-on reset or any other reset is detected at startup.

### RST\_SEC

This value represents, whether the implemented security mechanism ECM3 has notified the module after restart through the interface ACTION\_SetRstInfo\_Ecm3 (see below) about an executed reset.


Hex-val	Description
00h	No additional Security info
01h	Additional Security info registered since last power-up

### RST\_INFO\_CTR

Hex-val	Description
00h	Unspecified / Additional Reset info invalid
xxh	Number of atypical warm resets since last power-up

This value represents the number of atypical warm resets since last power-up, if additional reset info is valid. On Power-on reset this value is reset to 0.

Except for an intended Power-on reset (cold start, 12h) some additional informations may be provided as a list of the last detected resets. The list entry [0] represents the last/newest one, [1] that one before

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the last and so on up to the maximum size of the list with the length of NC\_RST\_DBG\_LIST\_SIZE. Before evaluating a new reset the whole list is shifted by one step and therefore the oldest list entry [NC\_RST\_DBG\_LIST\_SIZE-1] is lost.

Information lists are defined as arrays:

NC\_RST\_DBG\_LIST\_SIZE (see module configuration data: e.g. MSx80=2 except MSD81.0=1, MSD85=1)

NC\_RST\_DBG\_BACKTRACE\_SIZE = 5

RST\_CLAS\_TYP[NC\_RST\_DBG\_LIST\_SIZE]

This list value represents the same value as RST\_TYP (see above), if reset differs from an intended Power-on reset at startup.

RST\_CLAS\_SEC[NC\_RST\_DBG\_LIST\_SIZE]

This list value represents the same value as RST\_SEC (see above), if reset differs from an intended Power-on reset at startup.

RST\_INFO\_ADD[NC\_RST\_DBG\_LIST\_SIZE]

This list value represents an additional info on the cause of the reset.

RST\_INFO\_ADD at RST\_CLAS\_TYP = 42h (Intended Software Reset)

If an intended software reset is triggered by the following cases, the equivalent value is stored:

Hex-val	Description
00000000h	no info available
00000100h	Caused by Immobilizer (IMOB)
00000200h	Caused by Reprog. (REPROG learn)
00000201h	Caused by Reprog. (REPROG kwp)
00000300h	Caused by Security Control (SEC_MC)
00000400h	Caused by Memory Support (SUPRAM)
00000401h	Caused by Memory Support (NVMY)
00000402h	Caused by ADC driver (BIOS_ADC)
00000500h	Caused by Vlgk Peak (VDD_IGK)

RST\_INFO\_ADD at RST\_CLAS\_TYP = 44h (Trap)

If a software reset by trap occurred, the equivalent value is stored in format:

Hex-val	Description
xxxx0000h	Trap value (high word)
0000yyyyh	Tin value (low word)

The trap classes represent more in detail, which type of trap occurred.

A trap occurs as a result of an event such as a Non-Maskable Interrupt (NMI), an instruction exception, memory-management exception or an illegal access. Traps are always active; i.e. they cannot be disabled by software action.

The TriCore architecture specifies general classes for traps. Each class has its own trap handler, accessed through a trap vector of 32 bytes per entry, indexed by the hardware-defined trap class number.

Hex-val	Description
00FFh	No trap detected
0000h	memory management unit
0001h	Internal Protection Traps
0002h	Instruction Error
0003h	Context Management
0004h	System bus and peripherals error
0005h	Assertion traps

Within each trap class, specific traps are distinguished by a Trap Identification Number (TIN) that is loaded by hardware into a register before the first instruction of the trap handler is executed.

*Note: The TC1796 does not include a MMU, no traps in class 0 will be generated.*

The following Tin information is available depending on the trap class:

#### Info TIN in trap class 0

Hex-val	Description
FFh	no tin detected
00h	Virtual Address Fill
01h	Virtual Address Protection

#### Info TIN in trap class 1

Hex-val	Description
FFh	no tin detected
01h	Privileged Instruction
02h	Memory Protection: Read Access
03h	Memory Protection: Write Access
04h	Memory Protection: Execution Access
05h	Memory Protection: Peripheral Access
06h	Memory Protection: Null Address
07h	Global Register Write Protection

#### Info TIN in trap class 2

Hex-val	Description
FFh	no tin detected
01h	Privileged Instruction
02h	Memory Protection: Read Access
03h	Memory Protection: Write Access
04h	Memory Protection: Execution Access
05h	Memory Protection: Peripheral Access
06h	Memory Protection: Null Address
07h	Global Register Write Protection

#### Info TIN in trap class 3

Hex-val	Description
01h	Free context list depleted (FCX == LCX)
02h	Call depth overflow
03h	Call depth underflow
04h	Free context list underflow (FCX == 0)
05h	Call stack underflow (PCX == 0)
06h	Context type error (PCXI.UL wrong)
07h	Nesting error: RFE with non-zero call depth

#### Info TIN in trap class 4

Hex-val	Description
01h	Program fetch bus error
02h	Data load bus error
03h	Data store bus error

#### Info TIN in trap class 5

Hex-val	Description
01h	Arithmetic overflow
02h	Sticky arithmetic overflow

#### RST\_INFO\_ADD at RST\_CLAS\_TYP = -h (NMI)

If an NMI is the reason one of the following cases with their equivalent value is stored:

Hex-val	Description
00000100h	External NMI
00000200h	NMI caused by WDT
00000300h	PLL loss of lock
00000400h	Parity error in DMI memory
00000401h	Parity error in SPRAM or Instruction cache
00000402h	Parity error in PMI memory
00000403h	Parity error in DMU memory
00000404h	Parity error in PCP RAM memory
00000405h	Parity error in PCP ROM memory
00000406h	Parity error in CAN memory

#### RST\_DBG\_BACK\_INFO\_VLD[NC\_RST\_DBG\_LIST\_SIZE]

If additional background information is available, this info shows, whether these info is valid. In other cases 0.

Hex-val	Description
00h	Additional Background infos invalid
01h	Additional Background infos valid

RST\_DBG\_BACKTRACE\_ADDRESS[NC\_RST\_DBG\_LIST\_SIZE][NC\_RST\_DBG\_BACKTRACE\_SIZE]

If additional background information is valid, a list of NC\_RST\_DBG\_BACKTRACE\_SIZE 32-bit values is provided for further investigation purposes.

Hex-val	Description
xxxxxxxh	Backtrace address 0
yyyyyyyh	Backtrace address 1
zzzzzzzh	...

All additional reset-debug-informations are saved in EEPROM and contain the cause for the last warm-resets.

**Activation:**

once, directly after each ECU-reset; before starting the operation-system

**Formula section:**

Evaluate controller information:

RST\_TYP

RST\_SEC = 0 (reset to 0)

**If (1)** RST\_TYP = 12h (Intended Power-On Reset)

**Then (1)**

Power-On-Reset detected

LV\_WARM\_RST = 0

**Else (1)**

warm-Reset detected

RST\_INFO\_CTR = Reset Counter from Debug driver

Shift all list entries by one, eg. (first in first out of stored informations)

RST\_CLASS\_TYP[NC\_RST\_DBG\_LIST\_SIZE-2]

-> RST\_CLASS\_TYP[NC\_RST\_DBG\_LIST\_SIZE-1]

->

RST\_CLASS\_TYP[0]

-> RST\_CLASS\_TYP[1]

Erase newest list entries, eg.

RST\_CLASS\_TYP[0] = 0

Evaluate and store actual values in list

RST\_CLASS\_TYP[0] = RST\_TYP

RST\_INFO\_ADD[0] = Cause from Debug driver (Additional Info)

CPU\_LOAD\_MAX\_RST\_DET[0] = CPU\_LOAD\_MAX at reset

N\_CPU\_LOAD\_MAX\_RST\_DET[0] = N\_MAX at CPU\_LOAD\_MAX

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```

CPU_LOAD_RST_DET[0] = CPU_LOAD at reset
N_RST_DET[0] = N at reset
DIST_RST_DET[0] = DIST at reset
TRT_RST_DET[0] = TRT at reset
If (2) RST_CLASS_TYP[0] = 42h (Intended Software Reset)
    RST_LPRC_RESET_ADDRESS[0] = Last LPRC caller address
Else (2)
    RST_LPRC_RESET_ADDRESS[0] = 0
Endif (2)
RST_DBG_BACK_INFO_VLD[0] = Validation info from Debug driver
If (2) RST_DBG_BACK_INFO_VLD[0] = 1
    RST_DBG_BACKTRACE_ADDRESS[0][ ] = Backtrace from Debug driver
Endif (2)
LV_WARM_RST = 1
LV_RST_DET = 1
Endif (1)
    
```

Later notification from security system:

**Activation:**            **Action at notification from ECM3 (ACTION\_SetRstInfo\_Ecm3)**

**Formula section:**

```

LV_RST_DET_DISP = 0            (reset flag until error reported)
RST_SEC = 1                    (add ECM3 security info)
    
```

The safety-concept will submit the information after a reset, when rst-information from the MU is available. As it is not known, whether or when such a reset can be detected by security system, the trap reset can set error SYM\_0 before it will be set to SYM\_1 by security system.

Clearing of stored data can be done on demand:

**Activation:**            **Action at clearing FMY (e.g. by service-tester)**

**Formula section:**


```

RST_TYP = 0
RST_INFO_CTR = 0            Clear Reset counter from Debug driver also
RST_SEC = 0
LV_RST_DET_DISP = 0
LV_RST_DET = 0
LV_WARM_RST = 0
    
```

Clear all list entries, eg.  
RST\_CLASS\_TYP[NC\_RST\_DBG\_LIST\_SIZE-2] = 0  
...  
RST\_CLASS\_TYP[0] = 0

**Activation:**            **Action for status ADC from interface (ACTION\_GetBiosAdcStatus)**

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called every 10ms

Hint:

The `Adc_watchdog_timeout` describes the timeout of ADC interface in BIOS.  
When the `Adc_watchdog_timeout >= NC_MAX_ADC_OUT` the interface is detected as out of operation and debug driver is called.

**Formula section:**

`NC_MAX_ADC_OUT = 50` (Configuration BIOS: `adc_watchdog_max_timeout`)  
`NC_CTR_MAX_ADC_OUT = 50`

`ACTION_INFR_GetBiosAdcStatus (Bios_adc_status)`

set counter `CTR_ADC_OUT` according `STD_INI`

```

IF      ACTION_INFR_GetBiosAdcStatus delivers ADC error
THEN    CTR_ADC_OUTn = CTR_ADC_OUTn-1 + 1
ELSE    IF CTR_ADC_OUTn > 0
        THEN CTR_ADC_OUTn = CTR_ADC_OUTn-1 - 1
        ELSE CTR_ADC_OUTn = 0
        END
END

IF      CTR_ADC_OUT >= NC_CTR_MAX_ADC_OUT
THEN    call Reset Debug driver      (execute Reset caused by ADC interface)
        CTR_ADC_OUT = 0
END
    
```

**0.8.2 Handling of ECU-Reset detection in error management**

**FUNCTION DESCRIPTION:**

**Description:**

The following section describes the mechanism of failure handling in error management.

after each ECU-reset


As information from the safety concept is only available late after restart, it has to be checked cyclic for changes (see later). So it is supposed first, that errors will be cleared first.

An entry in error management has occurred if the reset counter `RST_INFO_CTR` is incremented.

In this case actually the byte `RST_CLAS_TYP[0]` which include the causes of resets is additionally sent to error management.

Error symptoms are defined to this diagnosis function as follows:

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- Intended software reset (SWRST) (= SYM\_0)
- Reset by safety-concept (= SYM\_1)
- Reset unintended by software (= SYM\_2)
- Reset unintended by hardware (= SYM\_3)

Reset class	RST_TYPE	RST_INFO_ADD	RST_SEC	Symptom in ERRM
None	disabled #02h			
PORST	unintended #10h		0 1	SYM_3 SYM_1
	cpl fail #11h			SYM_3
	intended #12h			SYM_3
	VDD #13h			SYM_3
	HDRST	unintended #20h		
WDTRST	unintended #30h			SYM_3
SWRST	unintended #40h			SYM_2
	cpl fail #41h			SYM_3
	intended #42h	000h 300h (SEC_MC) 400h 401h (NVMY) 402h (ADC) 500h (VDD) 100h 200h 201h other (not expected)		SYM_0 SYM_1 SYM_0 SYM_0 SYM_0 SYM_3 NO SYM NO SYM NO SYM SYM_0
	trap #44h			SYM_2
	NMI #-h			SYM_2
	error #46h			SYM_2
	VDD #43h			SYM_3

at clearing FMY

The error is present until clearing FMY by application constant or flash. Additionally an information about current presence of failure is performed.

Hint: As described also in ASW the CPU\_LOAD\_MAX is reset with LC\_CPU\_LOAD\_MAX\_RST.

cyclic data collection

recurrency:                      10 ms

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In the warm-reset memory several data are cyclic saved every 10ms. CPU\_LOAD\_RST\_DET is updated with CPU\_LOAD. In case of an occurred warm-reset the memory is read at initialisation of ECU. CPU\_LOAD\_RST\_DET represents the CPU\_LOAD at warm-reset. N\_RST\_DET is the related engine speed at this warm-reset. The CPU\_LOAD\_MAX\_RST\_DET is the occurred maximum and saved in non-volatile memory. It gives information about several cycles. N\_CPU\_LOAD\_MAX\_RST\_DET is the related engine speed at this maximum.

Related to warm-reset memory DIST\_RST\_DET represents the distance and TRT\_RST\_DET represents the total runtime at the last occurred warm-reset.

By preparing the freeze frame it is necessary to hand over the relevant values. So the configured freeze frame is read out of warm-reset memory.

The data listed in the table are enabled to configure in freeze frame as environment data.

If a reset occurs and send to error-management the freeze frame is saved. Via tester the data are readable on the diagnostic communication line.

No.	Environment data
1.	RST_TYP
2.	RST_INFO_CTR
3.	RST_CLAS_TYP[0]
4.	RST_CLAS_SEC[0]
5.	RST_INFO_ADD[0]
6.	RST_DBG_BACK_INFO_VLD[0]
7.	RST_DBG_BACKTRACE_ADDRESS[0][0]
8.	CPU_LOAD_MAX_RST_DET[0]
9.	N_CPU_LOAD_MAX_RST_DET[0]
10.	CPU_LOAD_RST_DET[0]
11.	N_RST_DET[0]
12.	DIST_RST_DET[0]
13.	TRT_RST_DET[0]

Cyclic stored CPU\_LOAD = CPU\_LOAD

Cyclic stored N = N

Cyclic stored DIST = DIST

Cyclic stored TRT = TRT

**if** CPU\_LOAD\_MAX > Cyclic stored CPU\_LOAD\_MAX

Cyclic stored CPU\_LOAD\_MAX = CPU\_LOAD\_MAX

Cyclic stored N\_MAX = N

**Endif**

### Application conditions

**Recurrence:** *100ms*

**Initialisation:** after clearing FMY  
 LV\_CDN\_DIAG\_WARM\_RST = 1  
 LV\_RST\_DET\_DISP = 0

**Activation:** (LV\_WARM\_RST = 1 AND  
 LC\_WARM\_RST\_ENA = 1 AND  
 N\_RST\_DET[0] > C\_N\_RST\_DET) //cyclic saved engine  
 speed//




```

    THEN(3)
        ERR_SYM_WARM_RST = SYM_0
    ELSEIF(3)      RST_INFO_ADD[0] = 00000300h (SEC_MC)
    THEN(3)
        ERR_SYM_WARM_RST = SYM_1
    ELSEIF(3)      (RST_INFO_ADD[0] = 00000100h (IMOB)
    OR             RST_INFO_ADD[0] = 00000200h (REPROG learn)
    OR             RST_INFO_ADD[0] = 00000201h (REPROG kwp)
    THEN(3)
        Nothing (no error)
    ELSEIF(3)      RST_INFO_ADD[0] = 00000500h (VDD_IGK)
    THEN(3)
        ERR_SYM_WARM_RST = SYM_3
    ELSE(3)
        ERR_SYM_WARM_RST = SYM_0 (should not happen)
    ENDIF(3)
ELSEIF(2)      RST_CLAS_TYP[0] = 43h (VDD Error at Software Reset)
THEN(2)
    ERR_SYM_WARM_RST = SYM_3
ELSEIF(2)      RST_CLAS_TYP[0] = 44h (TRAP)
THEN(2)
    ERR_SYM_WARM_RST = SYM_2
ELSEIF(2)      RST_CLAS_TYP[0] = -h (NMI)
THEN(2)
    ERR_SYM_WARM_RST = SYM_2
ELSEIF(2)      RST_CLAS_TYP[0] = 46h (Error at Reset)
THEN(2)
    ERR_SYM_WARM_RST = SYM_2
ELSE(2)
    ERR_SYM_WARM_RST = SYM_3 (should not happen)
ENDIF(2)
LV_RST_DET_DISP = 1 (error reporting done)
LV_END_DIAG_WARM_RST = 1
ENDIF(1)


```

The anti-bounce-algorithm is not used. The symptom is set and reset immediately.

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# 1 - General

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# 1.1 ENTE Configuration data

**Input data:**

NC_ECTPWM_MAX {p. 3858}	NC_ECTPWM_MIN {p. 3858}	NC_ECTPWM_SUB_DIAG {p. 3858}	NLC_TCO_2_CONF
----------------------------	----------------------------	---------------------------------	----------------

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ECF_CONF	-	0... 3H	0 ...3	1	-
System configuration switch for cooling fan control strategy (RLY    PWM    RLY and PWM)					
NC_ECF_NR	-	1... FFH	1... 255	1	-
Number of available cooling fans (hardware components) at the vehicle					
NC_ECF_RLY_NR	-	0... FFH	0... 255	1	-
Number of RLY output stages per cooling fan (hardware components)					
NC_NR_TCO_SENS	-	1... FFH	1... 255	1	-
Number of available coolant temperature sensors (hardware components) at the vehicle					
NLC_ECT_CONF	-	0... 1H	0 ...1	1	-
System configuration flag (compiler) if an electronic controlled thermostat is available (=1) or not (=0)					

**FUNCTION DESCRIPTION:**

**General information:**

The logical constants NC(NLC)\_xxx\_CONF are necessary to adapt the Aggregate to a given system environment. The values describe either the variant of a used system component, or a vehicle component is available or not.

With use of the logical constant **NLC\_ECT\_CONF** the availability of an electronically controlled thermostat within the system is determined. In case of a vehicle configuration with an ECT, the component control and diagnosis is included within the aggregate version. (refer: ENTE A.I.D.)

With use of the logical constant **NLC\_TCO\_2\_CONF** the availability of a coolant temperature sensor at radiator outlet is determined. In case of a vehicle configuration with a TCO\_2 sensor, the sensor signal acquisition and diagnosis is included within the aggregate version. (refer: ENTE A.I.D.)

The configuration constant **NC\_ECF\_CONF** allows to determine the wanted fan control strategy. In principal it is possible to choose between a RLY- or a PWM-control architecture. A RLY/PWM fan control strategy in parallel is also existing. In this case the aggregate architecture allows switching either the control of RLY-fan(s) or the control of PWM-fan(s) during ECU runtime depending on the setting of a corresponding configuration bit. The control of both variants (RLY- and PWM-fan(s)) at the same time is not allowed and not supported within the aggregate.


Independent on the chosen fan control strategy (PWM/RLY), the configuration constant **NC\_ECF\_NR** describes the number of available cooling fans (hardware components) at the vehicle. In case of a PWM-fan configuration, the number of available PWM cooling fans at the vehicle is always equal to the number of PWM fan output stages provided by the ECU hardware.

Because one or more RLY-switch(es) may control only one cooling fan (hardware component) in case of a RLY-fan configuration, the number of RLY-switch(es) per cooling fan can be different. With use of the configuration constant **NC\_ECF\_RLY\_NR**, the number of RLY output stages per cooling fan are determined.

With use of the constant **NC\_ECTPWM\_xxx** it is possible to adjust the PWM output range of the electronic controlled thermostat signal during normal operation conditions or when a thermostat error occurs. In case of a thermostat failure the PWM output signal is set to a defined value for safety issues.

The following describes the general rules for determination of the configuration data.

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### 1.1.1 Local configuration data

Here are listed the configuration data, which are used only in the ENTE aggregate.

Data	Value
NLC_ECT_CONF	[1] Electronically controlled thermostat (ECT) is available
NLC_TCO_2_CONF	[1] Coolant temperature sensor at radiator outlet is available
NC_ECF_CONF	[1] Control of PWM-fan(s) requested (only PWM fan(s) )
NC_ECF_NR	[1] Number of available cooling fans (hardware components) at the vehicle
NC_ECF_RLY_NR	[0] Number of RLY output stages per cooling fan (hardware components) (NC_ECF_RLY_NR=0 have to be adjusted in case of NC_ECF_CONF=1)
NC_ECTPWM_MAX	99,6 % Maximum limitation of ECTPWM signal
NC_ECTPWM_MIN	0,4 % Minimum limitation of ECTPWM signal
NC_ECTPWM_SUB_DIAG	[4,31%] - (B08H) Adjusted ECTPWM signal in case of failures
NC_NR_TCO_SENS	2

## 1.2 System overview and description

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CHECK_SUM	-	0... FFFFH	0... 65535	1	-
Constant to activate the dataset checksum calculation					
C_DATA_ID_0	-	0	ASCII	1	-
Dataset identifier string 1					
C_DATA_ID_1	-	0	ASCII	1	-
Dataset identifier string 2					
C_DATA_ID_2	-	0	ASCII	1	-
Dataset identifier string 3					

In the software the cylinders are numbered logically with 0...5. The relating physical cylinders are numbered from 1...6. If in the specification a cylinder-specific-variable is mentioned with ...\_x or ...CYL then always the logic value is ment. The correct firing order of any 6 cylinder engine has to be guaranteed by the wiring harness, see system picture.

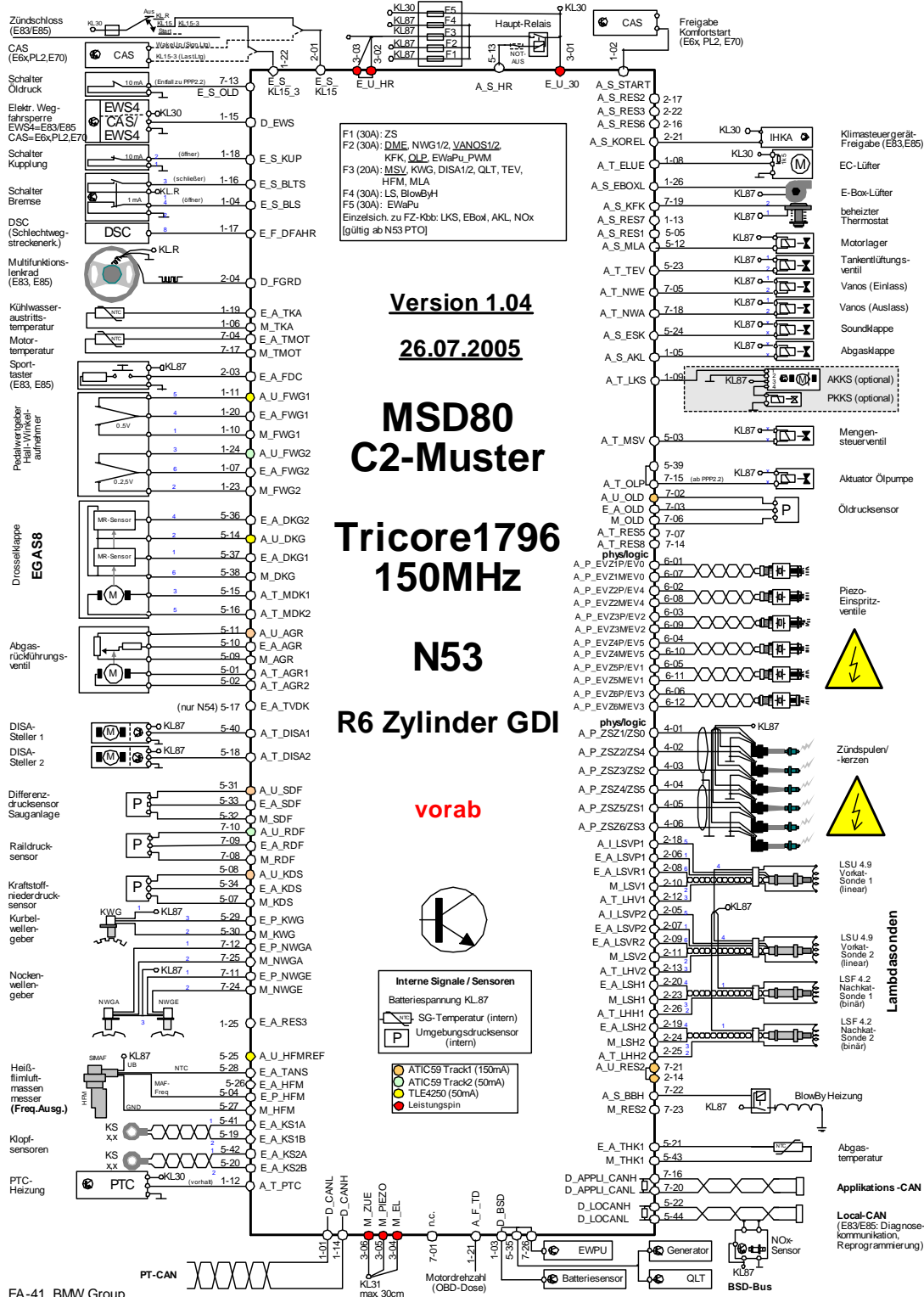
The following graphic shows examples of physical cylinder numbers:

M54 / M56 / NG R6
Flywheel
6
5
4
3
2
1

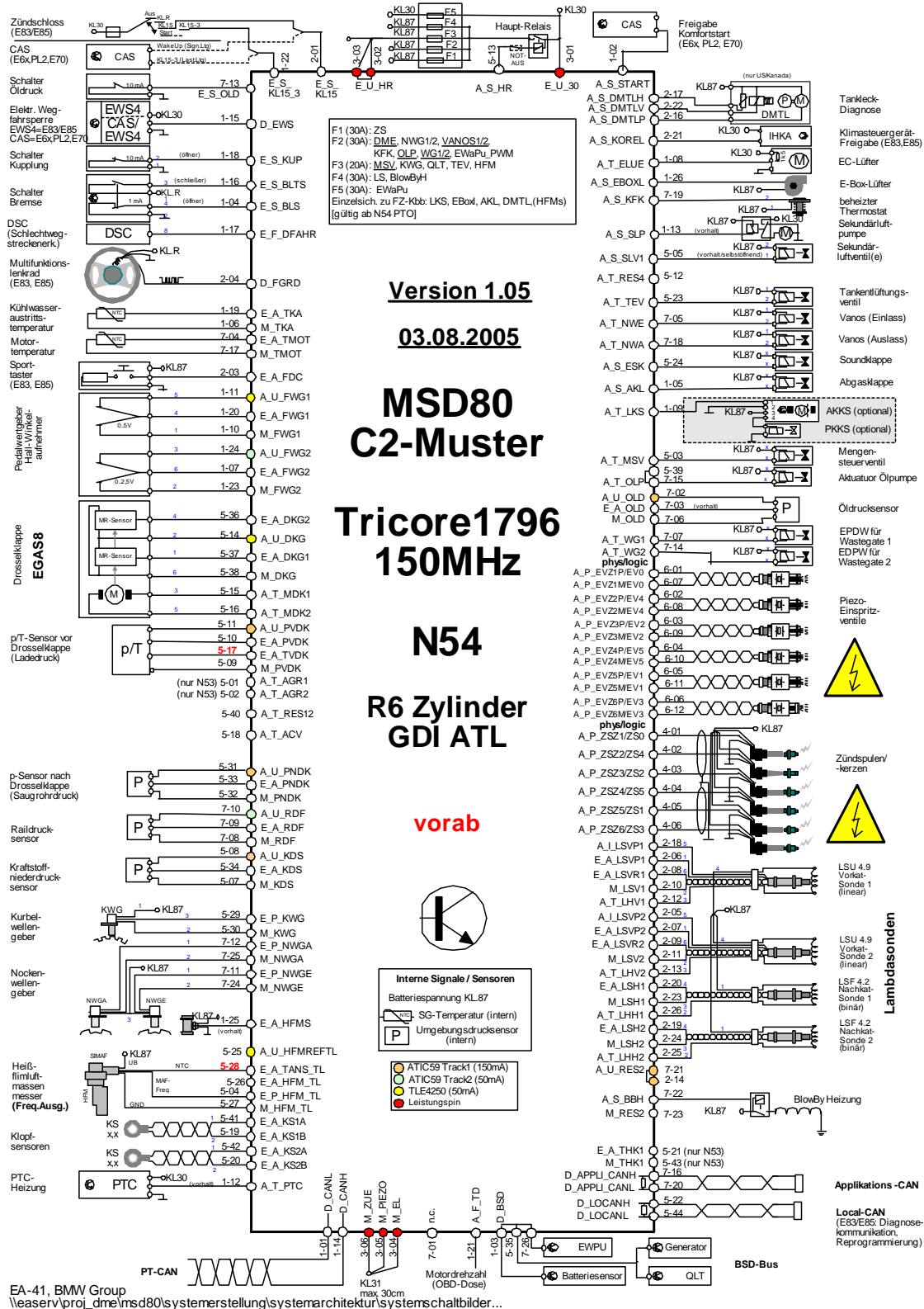
The relation between logical and physical cylinder numbers is as follows:

Logic	Physical M5x / NG R6	bank
0	1	1
1	5	2
2	3	1
3	6	2
4	2	1
5	4	2

### 1.2.1 System Pictures



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## 1.2.2 Dataset identification and checksum calculation


### FUNCTION DESCRIPTION:

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### General information:

The INCA application tool doesn't store a dataset identifier when a dataset is sent to the ECU. Therefore it is not possible to empathise which dataset really is in an ECU. To solve this problem three calibratable variables C\_DATA\_ID\_0, C\_DATA\_ID\_1 and C\_DATA\_ID\_2 are introduced. Every variable can be calibrated with 5 ASCII signs, which are the identifier of the dataset. The variables are only visible in INCA (SAM doesn't support ASCII format).

To activate or deactivate the checksum calculation over the dataset with the help of INCA, the constant C\_CHECK\_SUM has been introduced. If the value of C\_CHECK\_SUM is = 0000h, the checksum calculation is deactivated. If the value of C\_CHECK\_SUM is <> 0000h, the checksum calculation is active.


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## 1.3 Nomenclature of the used data names and abbreviations

Keyword	English definition	German definition
0, 1, ...	Index 0, 1, ... n	Index
A, B, ...	Index A ... Z	Index
AAI	Air assisted injector	luftumfaßte Einspritzventile
ABC	Anti-Bounce counter	Entprellzähler
ABS	Antilock Breaking System	Antiblockiersystem
ABSV	absolute value	Betrag
AC	acceleration	Beschleunigung
ACC	Air conditioning compressor	Klimakompressor
ACCIN	Air conditioning compressor request signal	Klimakompressor
ACCOUT	Air conditioning compressor output signal	Klimakompressor Ausgangssignal
ACF	Aktivated charcoal filter	Aktivkohlefilter
ACIN	Air conditioning request signal	Klimaanlage
ACK	Acknowledge	Bestätigung
ACLS	air conditioning load signal	Klimalastsignal
ACP	Air conditioning pressure	Druck Klimaanlage
ACPPWM	Air condition pressure PWM	Tastverhältnis Klimadruck
ACQ	Acquisition	Akquisition
ACR	actuator	Ansteller
ACT	active	aktiv
AD	Adaptive	Adaption
ADC	Advance (early)	früh
ADD	Additive	Additive Korrektur
ADJ	adjustment	Verstellung
ADR	Address	Adresse
AE	Acceleration enrichment	Beschleunigungs-anreicherung
AEB	active engine brackets	aktive Motorlager
AETCU	Autarkic electronic transmission control unit	autarke elektronische Getriebesteuerung
AFL	Air fuel lean	mageres Gemisch
AFR	Air fuel rich	fett
AFS	Air fuel stoichiometric	stöchiometrisches Gemisch
AGI	aging	Alterung
AI	air injection	Luft einblasung
AIRB	airbag	Airbag
AJ	Anti-jerk-function	Anti-Ruckel-Funktion
ALS	Alarm system	Diebstahlwarnanlage
ALTER	alternator	Lichtmaschine
ALTI	altitude	Höhe
ALTPWM	alternator PWM	Tastverhältnis Lichtm.
AM	ambient	Umgebung
AMP	Ambient pressure	Umgebungsdruck
AMPL	amplitude	Amplitude
AN	Analog	analog


Keyword	English definition	German definition
ANTI	Anti	anti
APP	Application generated parameter	
AR	Area	Fläche
ARP	air rail pressure	
AS	Application system	Applikationssystem
ASA	After sale service	Kundendienst
ASC	Asynchronous serial communication interface	
ASR	Anti slip regulation	Antischlupfregelung
AST	After-start	Nachstart
AT	Automatic shifted transmission	Automatikgetriebe
ATJS	automatic transmission jump start	Knallstart
AUT	Automatic	automatisch
AUTH	Authorize	autorisieren
AV	Actual value	Istwert
AVL	available	verfügbar
BACK	back	zurück
BAS	Base	Basis
BD	burning duration	Brenndauer
BDC	Bottom dead center	unterer Totpunkt
BEG	Begin	Anfang
BFS	bi fuel switch	
BHC	Burner heated catalyst	Brennerkat
BIT	Bit	Bit
BLS	Brake light switch	Bremslichtschalter
BOFF	bus off mode	
BOL	Bottom limit	untere Grenze
BOOT	boot	
BOP	Boost pressure ( diesel )	Ladedruck
BPAPWM	PWM of boost pressure adjustment (diesel)	Tastverhältnis Ladedrucksteller
BRAKE	brake	Bremse
BRI	Bridge contact	Brücke
BTS	Brake test switch	Bremslichttest-schalter
BUF	buffer	
BUZ	buzzer	Summer
BWL	Byte word long	
BYTE	byte	byte
C	calibration data changeable with the application system	vom Applikationssystem änderbare Daten
CAL	calibration	Abstimmung, Eichung
CALL	call	
CAM	Camshaft	Nockenwellensignal
CAN	Controlled area network	Controlled area network
CAP	charge air pressure	Ladeluftdruck
CASE	case	Fall (-unterscheidung)

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Keyword	English definition	German definition
CAST	Cold after-start	Kaltnachstart
CAT	Catalyst	Katalysator
CBG	continuous gearbox	
CBK	cylinder bank	Zylinderbank
CC	Converter clutch	Wandlerkupplung
CCH	Combustion chamber heating function	Brennraumaufheiz-funktion
CDN	Condition	Bedingung
CEI	combustion efficiency index	
CFA	Cooling fan	Ventilator
CFB	current feedback	Stromrückmeldung
CFM	Confirmation	Bestätigung
CH	catalyst heating	Katheizen
CHG	change	Änderung
CHK	check	Überprüfung
CIS	carried idle switch	mitgeführter Leerlauf-kontakt
CKS	Checksum	Prüfsumme
CL	canister load	Beladungsgrad Aktivkohlefilter
CLC	calculated	berechnet
CLDT	cold test	Kalttest
CLK	clock	clock
CLOSE	close	geschlossen
CLR	Clear	Löschsignal
CLU	Clutch	Kupplung
CMB	combustion	Verbrennung
CMD	Command	Befehl
CMP	compression	Verdichtung
CMT	comfort manual transmission	
CNL	cancel	aufheben, streichen
CNV	convection	Konvektion
COD	Code	Code
COL	collector	Sammler
COLD	Cold	kalt
COM	Communication	Kommunikation
COMP	comparison	Vergleich
CON	Constant	Konstante
CONC	concentration	Konzentration
CONF	Configuration	Konfiguration
CONV	converter	Wandler
COP	catalyst overheating prevention	Kat-Schutz
COR	Correction	Korrektur
CORD	Coordination	Koordination
CP	Canister purge	Tankentlüftung
CPL	Complement	
CPP	canister purge pump	


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Keyword	English definition	German definition
CPPWM	Pulse width modulation of canister-purge	Tastverhältnis Tankentlüftung
CPS	Canister purge solenoid	Tankentlüfungsventil
CQ	characteristic quantity	KenngroÙe
CR	controlled reset	Rücksteuerung
CRASH	Crash	ZusammenstoÙ
CRIT	critical	kritisch
CRK	Crankshaft/ Crankshaft angle	Kurbelwelle/Kurbel-wellenwinkel
CRLC	Correlation constant	Mittelungskonstante
CRU	Cruise control	Fahrgeschwindigkeits-regelung (Tempomat)
CRUS	Cruise control switch	Fahrgeschwindigkeitsregelungsschalter
CS	Clutch switch	Kupplungsschalter
CSI	Cold start injector	Kaltstart Einspritzdüse
CST	Cold start	Kaltstart
CT	closed throttle	geschlossene DK
CTC	clamped tube check	clamped tube check
CTL	Control	Regelung
CTR	Counter	Zähler
CTS	Closed throttle switch	Leerlaufschalter
CUR	Current	Strom
CUS	customer	Kunde
CVC	canister vent check	canister vent check
CWP	cooling water pump	Kühlwasserpumpe
CYC	Cycle	Zyklus
CYCNR	Number of Cycles	Zyklenanzahl
CYL	Cylinder	Zylinder
D	Differential part of PID	differentieller Anteil
DAMP	damping	Dämpfung
DC	driving cycle	driving cycle
DCC	distance cruise control	Abstandsregel-tempomat
DE	deviation	Abweichung
DEAC	deactivation	Deaktivierung
DEC	Decrementation	Dekrementieren
DECE	deceleration	Verzögerung
DELTA	delta	Delta
DEP	Depression	Unterdruck
DET	Detection	Erkennung
DEV	development	Entwicklung
DFCT	defective	
DFT	Default	Voreinstellung
DGO	Diagnostic output	Diagnoseausgang
DHL	down hill	bergab
DHP	Dashpot	Dashpot
DI	disable	ausschalten, nicht zulassen
DIAG	Diagnosis	Diagnose

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Keyword	English definition	German definition
DIAGCP	Diagnosis canister purge	Diagnose Tankentlüftung
DIAGCPS	diagnosis canister purge solenoid	Diagnose Tankentlüftungsventil
DIF	Difference	Differenz
DIG	Digital	Digital
DIGIS	digital idle speed stabilization with ignition	digitale Leerlaufstabilisierung
DIP	differential pressure	Differenzdruck
DIR	direction	Richtung
DIRE	directory	Verzeichnis
DIS	Discrete	Diskret
DISP	Display	Anzeige
DIST	distance	Entfernung
DIV	Division	Division
DL	Data line	Datenleitung
DLL	data link layer	
DLY	Delay	Totzeit
DOWN	down	nach
DPS	Diagnostic power stage	Diagnosetreiber IC
DR	driver (HW)	Endstufe
DRI	Drive (Gear engaged)	Fahrstufe
DRIFT	Drift	Drift
DRIV	driver	Fahrer
DROF	drive off	anfahen
DRV0	Static value	statischer Wert
DRV1	Derivative 1	1. Ableitung
DRV2	Derivative 2	2. Ableitung
DS	Diagnostic service	Diagnosetelegramm
DS2	DS2 protocol (BMW)	
DSK	disk	Disk
DSLIP	Deceleration slip	Verzögerungsschlupf
DT	drive train	Antriebsstrang
DTC	Diagnostic trouble code	
DTP	Differential fuel tank pressure	Differenzdruck Tank
DUCY	duty cycle	Tastverhältnis
DUI	dual injection	
DUMMY	dummy	Dummy
DUR	Duration	Dauer
DVC	device	
DYN	Dynamic	dynamisch
DYNO	dynamometer	Prüfstand
DYW	Dynamic window	Dynamikfenster/Band-breite/Toleranzwert
E2P	E2PROM	E2PROM
EBOX	electronic housing	
ECF	electronically controlled cooling fan	elektronisch geregelter Lüftermotor


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Keyword	English definition	German definition
ECFPWM	electronic coolant fan PWM	Tastverhältnis elektronischer Lüfter
ECT	electronically controlled thermostat	elektronisch geregelter Thermostat
ECTPWM	electronically controlled thermostat	Tastverhältnis elektr. geregelter Thermostat
ECU	Electronic control unit	Steuergerät
EDGE	edge	Flanke
EDIT	edit	eingeben
EF	exhaust flap	Abgasklappe
EFC	effective	effektiv
EFF	efficiency	Wirkungsgrad
EFP	Electric fuel pump	elektronische Kraftstoffpumpe
EG	Exhaust gas	Abgas
EGBP	exhaust gas back pressure	Abgasgegendruck
EGR	Exhaust gas recirculation	Abgasrückführung
EGRPWM	PWM of exhaust gas recirculation	Tastverhältnis Abgasrückführsteller
EGRV	EGR valve	EGR Ventil
EGY	Energy	Energie
EHC	Electrical heated catalyst	elektrisch beheizter Katalysator
EL	Electrical	elektrisch
EMS	Engine management system	elektronische Motorsteuerung
ENA	enable	zulassen
END	End	Ende
ENG	Engine	Motor
ENVD	Environmental Data	Umweltbedingungen
EOA	end of air	Ende Lufteinblasung
EOF	End of filling ( diesel )	Füllendewinkel
EOI	End of injection	Einspritzendewinkel
EOL	end of line	Bandende
EOLP	end of line programming	Bandende-programmierung
EP	Enrichment potentiometer	Anreicherungs-messung
EQU	equal	gleich
EQUIP	equipment	Ausstattung
ER	Engine roughness	Laufunruhe
ERR	Error	Fehler
ERU	engine running	Motor läuft
ES	Engine stop	Motor steht
ESB	enable Symptom Byte	Fehlerspeicherfreigabe
ESP	electronic stability program	elektronisches Stabilitätsprogramm
ESS	Engine speed signal	Drehzahlsignal
ESTIM	estimated	geschätzt
ET	emission test	Abgasuntersuchung
ETC	Electronic throttle control	elektronische Motor-leistungsregelung
ETCU	Electronic transmission control unit	elektronische Getriebesteuerung


Keyword	English definition	German definition
ETCUPWM	Electronic transmission control unit PWM	Tastverhältnis elektronische Getriebesteuerung
EVAP	evaporative system	Tankentlüftungssystem
EVE	Event	Ereignis
EVSL	engine vehicle speed limiter	motorischer Geschw.-begrenzer
EWRN	Error warning status mode	
EX	Exhaust	Auslaß
EXO	exotherm	
EXPV	expansion valve	Entspannungsventil
EXT	external	extern
EXV	Exhaust valve	Auslaßventil
FAC	Factor , coefficient	Faktor
FAC	factor, coefficient	Faktor
FAD	fuel air delay	Verzögerung Kraftstoff- Gemischeinspritzung
FALL	falling	fallend
FAN	fan	Lüfter
FAST	Fast	Schnell
FB	Feed back	Rückmeldung
FCO	Fuel consumption	Kraftstoffverbrauchsanzeige
FCOPWM	Fuel consumption PWM	Tastverhältnis Kraftstoffverbrauch
FCT	functional	Funktional
FCUT	Fuel cutoff	Kraftstoffabschaltung
FDIN	fade in	einblenden
FDOUT	fade out	ausblenden
FE	fuel enrichment	Anfettung
FIL	Filter	Filter
FILE	file	Datei
FINE	fine	fein
FIRST	first	zuerst, erst
FL	Full load	Vollast
FLL	flash light	Blinkcode
FLOOD	Flood	Absaufen des Motors
FLOW	flow	Fluß
FLS	Flash	
FLUC	fluctuation	Schwankung
FM	frequency modulation	Frequenzmodulation
FMT	Format	Format
FMY	Failure memory	Fehlerspeicher
FN	front	vorn
FOL	Follower	folgend
FP	Fast pulse	Fast pulse
FPA	Fuel pressure actuator	Kraftstoffdrucksteller
FPAPWM	Fuel pressure PWM	Tastverhältnis Kraftstoffdruck
FPS	fuel pressure sensor	Benzindrucksensor

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Keyword	English definition	German definition
FPV	Flash programming voltage enable (switch)	Programmierspannungsfreigabe (Schalter)
FRC	frequency counter	Häufigkeitszähler
FRF	freeze frame	OBD II Umweltbedingungen
FRQ	Frequency	Frequenz
FRS	Fuel reserve signal (4-liter-signal)	Füllstandssignal Tank (4-Liter-Signal)
FSD	fuel system diagnosis	Kraftstoffsystem-diagnose
FTL	Fuel tank level	Füllstandsniveau
FUC	fuel cap	Tankdeckel
FUEL	fuel	Kraftstoff
FUP	Fuel pressure	Kraftstoffdruck
FW	freewheeling	Freilaufkreis
GAC	actual gear code	aktueller Gang, kodiert
GAIN	Gain	Verstärkung
GAP	gap	Lücke
GAS	gas	Gas
GB	gear box	Getriebe
GC	Gear change	Getriebeeingriff
GCB	Gear change begin	Getriebeeingriff-beginn
GCD	Gear change duration	Getriebeeingriffs-dauer
GEAR	gear	Gang
GEN	generator	Generator
GENC	Generator charge connection	Generatorladeleitung
GL	Glow	glühen
GND	Ground	Masse
GP	gear protection	Getriebeschutz
GR	gear ratio	Gang-Verhältnis
GRD	Gradient/slope	Gradient
GS	Gear shift signal	Getriebeschaltssignal
GSC	Gear shift characteristic	Schaltcharakteristik
GSPWM	gear shift signal PWM	Tastverhältnis Getriebeschaltssignal
H	High	high
HAST	Hot after-start	Heißnachstart
HB	high byte	high byte
HC	hydro carbon	Kohlenwasserstoff
HCHPWM	PWM of HC heater	
HD	header	
HDLP	head lamp	Frontscheinwerfer
HEAT	Heat	Beheizen
HFM	Hot film air mass meter	Heißfilmluftmassen-messer
HIV	heater inlet valve	Heizungsvorlaufventil
HLD	Hold	halten
HOM	homogeneous	homogen
HOT	Hot	heiß
HPF	Hight pass filter	Hochpaßfilter

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Keyword	English definition	German definition
HST	hot start	Heißstart
HTP	heating performance	Heizleistung
HYS	Hysteresis	Hysterese
I	Integral part of PID	Integraler Anteil
I2C	I <sup>2</sup> C Bus (similar SPI)	
IC	integrated circuit	integrated circuit
ICL	instrument cluster	Kombiinstrument
ICO	intercooler	Ladeluftkühler
ID	index table with arbitrary many inputs without interpolation	Tabelle mit n-Eingängen ohne Interpolation.
IDM	ID table which is used in different modules with different input data	Tabelle, die in mehreren Modulen mit unterschiedlichen Eingangsgrößen benutzt wird.
IDX	index	Index
IF	Interface	Interface
IGA	Ignition angle	zylinderindividueller Gesamtzündwinkel
IGC	Ignition coil	Zündspule
IGCFB	Ignition current feedback	Zündstromrückmeldung
IGK	Ignition key	Zündspannung
IGN	ignition	Zündung
IL	interactive layer	
ILSH	Current in the lambda sensor heater	Strom an der Lambda sondenheizung
IM	Intake manifold	Saugrohr
IMOB	Immobilizer	elektronische Wegfahrsperr
IMP	Impulse	Impuls
IN	Intake	Einlaß
INC	Increase	Inkrementierung
IND	Individual	individuell
INDU	inductive	induktiv
INF	intercept function	Abfangfunktion
INFO	information	Information
INH	Inhibition	hemmen
INI	Initialization	Initialisierungswert
INJ	injection	Einspritzung
INP	Input	Eingang
INT	Integral	Integral
INTER	Intermediary	Zwischenwert
INTM	intermittent	diskontinuierlich, sporadisch
INTR	interrupt	Unterbrechung
INTV	intervention	eingreifen
INV	intake valve	Einlaßventil
IP	index table with arbitrary many inputs with interpolation	Tabelle mit n-Eingängen mit Interpolation.
IPLSL	pumping current of LSL	Strom an der linearen Lambdasonde
IPLSLPWM	PWM of pumping current of LSL	Tastverhältnis Strom an der linearen LS

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Keyword	English definition	German definition
IPM	IP table which is used in different modules with different input data	Kennfeld, das in mehreren Modulen mit unterschiedlichen Eingangsgrößen benutzt wird.
IPS	Idle position sensor	Leerlaufstellersensor
IS	Idle Speed	Leerlauf/Leerlauf-regler
ISA	Idle speed actuator	Leerlauffüllungssteller
ISAPWM	Pulse width modulation of idle speed actuator	Tastverhältnis Leerlauffüllungssteller
ISC	idle speed controller	Leerlaufregler
IT	internal	intern
ITC	integration time constant	Integrationszeit-konstante
IV	Injection valve	Einspritzventil
IVS	invers	invers
IVVT	infinitely variable valve timing	Regelvanos
IVVTHPWM	Holding pulse width modulation of infinitely variable valve timing	Haltetastverhältnis Regelvanos
IVVTPWM	Pulse width modulation of infinitely variable valve timing	Tastverhältnis Regelvanos
JAM	jam	klemmen
JERK	Jerk	Ruckeln
JUMP	Jump-start	Jump-start
KD	kick down	Kick down
KGH	Kilogram per hour	Kilogramm / Stunde
KM	kilometer	
KNK	Knock control	Klopfregelung
KNKS	Knock control signal	Kopfregelungssignal
KNKWB	Beginning of knock control window	Klopfregelungsfenster-Beginnwinkel
KNKWD	Knock control window duration	Klopfregelungsfenster-Dauerwinkel
KNKWE	End of knock window	Klopfregelungsfenster-Endwinkel
KWP	Keyword protocol 2000	
L	Low	Low
LAM	Lambda controller	Lambda/Lambda-regler
LAMB	Lambda	Lambda
LAT	lateral	
LB	low byte	
LBG	line breakage	Leitungsbruch
LC	logic calibration data	logische Konstante
LD	Loading degree determination	Beladungsgrad-ermittlung
LDC	limited dynamic conditions	begrenzte Dynamik
LDP	list of data points	Stützstellen einer Eingangs-variablen einer Tabelle.
LDPM	repeatedly used list of data points	Stützstellen einer Eingangs-variablen einer Tabelle, die mehrfach verwendet wird
LE	left	links
LEN	Length	Länge
LEVEL	level	Niveau
LFC	Long fuel circulation	großer Kraftstoffkreislauf

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Keyword	English definition	German definition
LGD	Low gear detection	Low Gang Erkennung
LGRD	Limitating gradient	Änderungs-begrenzung
LGT	longitudinal	
LID	local identifier	
LIH	Limp home	Notlauf
LIM	Limitation	Begrenzung
LINP	logical input	
LOAD	load	Last
LOADPWM	Load output	Tastverhältnis Lastsignal
LOC	local variable	lokale Variable
LOCK	lock	sperrern
LOIL	Oil level	Ölniveau
LOILPWM	Oil level PWM	Tastverhältnis Ölniveau
LOSS	loss	Verlust
LOST	lost	verloren
LOUT	logical output	
LPF	Low pass filter	Tiefpaßfilter
LS	Lambda sensor	Lambdasonde
LSCL	Lamda sensor close loop	geschlossener Kreis
LSH	Lambda sensor heater	Lambdasondenheizung
LSHPWM	Pulse width modulation of lambda sensor heater	Tastverhältnis Lambdasondenheizung
LSL	linear lambda sensor	lineare Lambdasonde
LSOL	Lambda sensor open loop	offener Kreis
LST	last	zuletzt, letzter
LTC	load transient correction	Lastschlagdämpfung
LV	Logic variables data	logische Variable
MAF	Mass air flow	Luftmasse
MAFM	Mass air flow meter	Luftmassenmesser
MAIN	Main	hauptsächlich
MAN	Manual	von Hand
MAP	Manifold air pressure	Saugrohrdruck
MASK	mask	maskieren, verbergen
MASS	mass	Masse
MAT	mathematical	mathematisch
MAX	Maximum	Maximum
MC	main controller	
MCL	missing cap lamp	Diagnoselampe für fehlenden Tankdeckel
MCPS	magnetic crank shaft position sensor	induktiver KW Sensor
MDL	model	Modell
MEC	mechanic	mechanisch
MEM	Memorise	Speicher
MES	measured	gemessen
MF	Fuel mass ( diesel )	Einspritzmasse

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Keyword	English definition	German definition
MFF	mass fuel flow	Kraftstoffmassenstrom
MIL	Malfunction indication light	Diagnose-Fehler, -Lampe
MILM	Malfunction indication light memory	Fehlerspeicher für Anzeigelampe
MIN	Minimum	Minimum
MIS	Misfire	Verbrennungsaussetzer
MISS	missing	fehlen
MMV	Moving mean value	gleitender Mittelwert
MOD	Mode	Modus
MON	monitoring	überwachen
MON2	copy of process monitoring	Kopie der Prozeßüberwachung
MOSE	model series	Baureihe
MOT	motor	Motor
MOVE	movement	Bewegung
MPG	mapping	
MPH	miles per hour	Meilen / Stunde
MPL	Multiple	mehrfach
MSG	message	
MSR	Deceleration slip control	Motorschlepp-momentenregelung
MST	master	Master
MSW	multifunctional steering wheel	Multifunktionslenkrad
MT	Manual shifted transmission	Handschaltgetriebe
MTC	Main throttle control	Motordrosselklappe
MTCPWM	PWM-signal of MTC	Tastverhältnis MDK
MU	monitoring unit	Kontroll Einheit
MUX	Multiplexer	Multiplexer
MV	Mean value	Mittelwert
MWSS	magnetic wheel speed sensor	induktiver Raddrehzahlsensor
N	Engine speed	Motordrehzahl
NACK	no acknowledge	keine Bestätigung
NAME	name	Name
NAT	Natural	natürlich
NC	no calibrated data	vom Applikationssystem nicht änderbare Daten
NEG	Negative	negativ
NEUT	neutral	neutral
NEW	new	neu
NF	Natural frequency	natural frequency
NL	Noise level	Geräuschwert
NLC	non calibratable logical constant	nicht applizierbare logische Konstante
NOISE	noise	Rauschen
NOT	Not ...	nicht
NOX	NOX	NOX
NR	Number	Nummer


Keyword	English definition	German definition
NT	NOX trap	NOX Speicherkat.
NTL	NOX trap loading	NOX Speicherkatbeladung
NTLD	NOX trap loading degree	NOX Speicherkat-beladungsgrad
NULL	null	Null
NVMY	non volatile memory	nichtflüchtiger Speicher
O2	oxygen	Sauerstoff
O2L	oxygen loading	Sauerstoffbeladung
OBD	On board diagnosis	On board diagnosis
OBS	observe	beobachten
OC	Open circuit (hard.)	offener Schaltkreis
OCT	Octal power stage (ATM 39)	
OFF	Off	aus
OFS	Offset	Offset
OIL	oil	Öl
OK	ok	ok (bestanden, erledigt)
OLD	old	alt
ON	On	ein
OP	Opening period (diesel)	Offnungsdauer
OPEN	open	offen
OPL	Open loop	offener Regelkreis
OPM	operating mode	Betriebsart
OPP	operating mode	Betreibspunkt / Arbeitspunkt
OPT	optional	optional
OPTM	optimum	optimal
ORNG	out of range	außerhalb des Bereichs
OS	operating system	
OSC	Oscillate	oszillieren
OUT	output	Ausgang
OV	output value	
OVB	overboost	
OVER	over	über
OVF	overflow	
OVS	oversteering	übersteuern
P	Proportional part of PID	proportionaler Anteil
PAR	parity	Parität
PARK	park	parken
PAS	Passive	passiv
PAT	Pattern	Muster
PCD	pressure control device	Druckregler
PCTL	pre-control	Vorsteuerung
PCU	Pump control unit (diesel)	Pumpensteuergerät
PCV	high pressure pump pressure control valve	
PEAK	peak	

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Keyword	English definition	German definition
PER	Period	Periode
PERC	per cent	Prozent
PGAS	gas pressure	Gasdruck
PHA	Phase	Phase
PHY	physical	physikalisch
PIA	parallel interface adapter	
PIN	pin	Pin
PL	Part load	Teillast
PLAUS	plausible	plausibel
PM	Puls modulator	Phasengeber
PN	Park neutral	Park neutral
POIL	Oilpressure	Öldruck
PONCLOFA	Power on to closure offset angle ( diesel )	Magnetventil-Anzugswinkel
POP	post operating phase	Rechnernachlauf
PORT	port	Durchgang, Öffnung
PORTPWM	Port PWM	Tastverhältnis Drallklappe
POS	Positive	positiv
POST	Post	nach
POTI	Potentiometer	Potentiometer
POW	power	Leistung
PQ	Pressure quotient	Druckquotient
PR	positive response	
PRED	predicted	prädiziert
PREL	preliminary	vorläufig
PRES	Present	momentan
PREV	Previous	vor, vorab
PRG	progression	Progression
PRI	priority	Vorrang
PRIM	primary	primär
PRJ	project	Projekt
PROG	programming	programmieren
PROP	Proportional	proportional
PROT	protection	Schutz
PRS	Pressure	Druck
PS	Pump shaft ( diesel )	Pumpenwelle
PSI	Flow rate	Durchflußwert
PSN	position	Position
PSTE	Power steering	Servolenkung
PTR	pointer	Zeiger
PU	Pull	Schub
PUB	Pull begin	Schubbeginn
PUC	Pull fuel cutoff	Schubabschaltung
PUE	Pull end	Schubende

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Keyword	English definition	German definition
PULS	pulsation	Pulsation
PUR	Pull reduction	Schubreduzierung
PV	Pedal value	Pedalwert
PVS	Pedal value sensor ( diesel )	Pedalwert
PVSL	permanent vehicle speed limiter	permanenter Geschw.-begrenzer
PWL	power latch	Hauptrelais
PWM	Pulse width modulation	Tastverhältnis
PWR	Power supply	Stromversorgung
QC	quantified charge	normierte Füllung
QF	Fuel quantity (diesel)	Einspritzmenge
QGAS	gas quality	Gasqualität
QOIL	Oil quality	Ölqualität
QOILPWM	Oil quality PWM	Tastverhältnis Ölqualität
QPS	Quad power stage (ATM 36 oder ATM 38)	
QUO	quotient	Quotient
R	Resistance	Widerstand
RA	general gas constant	allg. Gaskonstante
RAA	run away avoidance	Hochlaufunterdrückung
RAE	reactivation acceleration enrichment	Wiedereinsetzen BA
RAF	ratio of air fuel	Luftverhältnis
RAM	RAM	RAM
RAMP	ramp	Rampe
RAS	Radiator shutter	Kühlerjalousie
RATE	rate	Rate
RATIO	Ratio	Verhältnis
RAW	raw value	Rohwert
RCV	receive	erhalten, empfangen
RD	read	lesen
RE	rear	hinten
REAC	reactivation	Wiedereinsetzen
READY	readiness identification	Bereitschaftserkennung
REC	record	aufzeichnen
RED	Reduction	Reduktion
REF	Reference	Referenz
REFU	refuel	betanken
REINF	reinforce	
REL	Relative	relativ
REQ	Request	Anforderung
RESI	residual	Rest
RESP	response	Antwort
REST	Restart	Wiederholstart
RESU	resume	wiederaufnehmen
REV	Revolution	Umdrehung

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Keyword	English definition	German definition
RFL	Reactivation Full Load	Wiedereinsetzen Vollast
RFP	recirculation flap	Umluftklappe
RFPPWM	recirculation flap PWM	Tastverhältnis Umluftklappe
RFU	Returnless fuel system	
RG	Residual exhaust gas	Restgas
RGL	regular	normal
RGN	regeneration	Regenerierung
RHO	Density	Dichte
RI	right	rechts
RIS	Reactivation Idle Speed	Wiedereinsetzen Leerlauf
RISE	rising	steigend
RLS	release	Freigabe
RLV	relevant	relevant
RLY	Relay	Relais
RND	random	Zufall
RNG	range	Bereich
ROLL	Rolling	Rollen
ROM	read only memory	
RON	research octane number	
RPG	reprogramming	
RPL	Reactivation Part Load	Wiedereinsetzen Teillast
RPU	Reactivation Pull	Wiedereinsetzen Schub
RR	Rough road	Schlechtwegstrecke
RS	reed switch	Reed switch
RST	Reset	rücksetzen
RT	runtime	Laufzeit
RTD	Retard	spät
RUL	Running losses	running losses
RUN	Runing (working)	laufen
RVL	Reversing light	Rückfahrlicht
RWUP	Rich warm up	fetter Warmlauf
S	stratified	geschichtet
SA	Secondary air	Sekundärluft
SAF	secondary air flow	Sekundärluft-massenstrom
SAM	Supplier Application and Measurement System	
SAMPLE	sample	Sample
SAMS	SAMS	SAMS
SAP	Secondary air pump	Sekundärluftpumpe
SAPPWM	secondary air pump PWM	
SAS	Safety Cut Off	Sicherheits-schubabschalten
SAV	Secondary air valve	Sekundärluftventil
SAVE	save	speichern
SAVPWM	Secondary air valve PWM	Tastverhältnis Sekundärluftventil


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Keyword	English definition	German definition
SAWUP	secondary air warm up	
SC	supercharged	aufgeladen
SCA	Scale	Skala
SCAN	scan	
SCB	short circuit brush	Schleiferkurzschluß
SCC	Single cylinder cut off (MSR)	Einzelzylinder-abschaltung
SCG	Short circuit ground	Masseschluß
SCHA	supercharger	mechanischer Lader
SCP	Short circuit plus	auf Betriebsspannung
SDL	scheduler	Verteiler
SDR	status diagnostic result	Status Diagnoseergebnis
SDWN	Shift down	zurückschalten
SECU	Security	Sicherheit
SEED	Seed	Zugangsberechtigung
SEG	Segment	Segment
SEL	selective	selektiv
SEM	successive error management	Folgefehlerbetrachtung
SENS	Sensor	Sensor
SEQ	Sequential	sequentiell
SER	serie	Serie
SERVO	servo	Servo
SET	Set	einstellen
SF	status flag	Status Flag
SFC	Short fuel circulation	kleiner Kraftstoffkreislauf
SFT	sensor frequency time	Sensorfrequenzzeit
SHD	Shield	Schirmung
SHIFT	shift	Verschiebung
SIF	serial interface	serielle Schnittstelle
SIG	signal	Signal
SIM	Simulation	Simulation
SLAVE	Slave	
SLIP	Slip	Schlupf
SLM	Smoke limitation ( diesel )	Rauchdichtebegrenzung
SLOP	slope	Steigung
SLOW	Slow	langsam
SLV	solenoid valve	Magnetventil
SND	send	
SO2	sulphur dioxide	Schwefeldioxid
SO2P	desulfuration	Entschwefelung
SOA	start of air	Start Lufteinblasung
SOI	Start of injection	Einspritzbeginnwinkel
SOIL	Oil sensor signal	Ölsensorsignal
SOP	Start of pumping (diesel)	Förderbeginnwinkel


Keyword	English definition	German definition
SOV	Shut off valve of evap function	Aktivkohlefilterabsperrventil
SP	Setpoint	Sollwert
SPARE	Spare	Reserve
SPI	Serial peripheral interface	
SPR	spring	Feder
SRC	Source	Quelle
ST	Starting	Start
STAB	stability	
STALL	Stalling	Motor abwürgen
STAT	stationary	stationär
STATE	State	Zustand
STB	Standby	Standby
STC	statistic	statistisch
STC	storage capacity	Speicherkapazität
STD	standard deviation	Standardabweichung
STE	Start enable	Startfreigabe
STEP	Step	Stufe
STK	stroke	Hub
STND	Standardization	Normierung
STOP	stop	stop
STP	Stepper motor	Schrittmotor
STR	starter relais	Anlasser Relais
SUB	Substitute	Ersatzgröße
SUBT	Subtractive	subtraktive Korrektur
SUM	Sum	Anzahl
SUP	Shift up	hochschalten
SUPP	suppress	unterdrücken
SUSP	suspicion	Verdacht
SVL	Service vehicle light	Servicelampe
SW	software	Software
SWI	Switch	Schalter
SWT	sensor switching time	Sensorsprungzeit
SYM	Symptom	Symptom
SYN	Synchro	Synchron
SYS	system	System
T	time	Zeit
TAC	After catalyst temperature	Abgastemperatur nach Katalysator
TACE	evaporative temp.air conditioning	
TAM	ambient temperature	Umgebungstemperatur
TAR	target	Ziel
TBA	Boost air temperature ( diesel )	Ladelufttemperatur
TBAT	battery temperature	Batterietemperatur
TBL	table	

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Keyword	English definition	German definition
TC	throttle control	
TCC	test cycle counter	Prüfintervallzähler
TCI	coolant temperature in	TKW Motoreintritt
TCO	Coolant temperature	Kühlwassertemperatur
TCOPWM	Coolant temperature PWM	Tastverhältnis Kühltemperatur
TCS	traction control system	Traktionskontrolle
TCSPWM	Traction control PWM	Tastverhältnis Traktionskontrolle
TCU	Time control unit	
TCYL	cylinder air temperature	Lufttemp. im Zylinder
TD	Time dwell	Schließzeit
TDC	Top dead center	oberer Totpunkt
TEG	Exhaust gas temperature	Abgastemperatur
TEGR	EGR temperature	Temperatur AGR
TEMP	Temperature	Temperatur
TEST	test	Test
TFU	Fuel temperature	Kraftstofftemperatur
TGAS	gas temperature	Gastemperatur
TGT	tightness	Dichtigkeit
TH	Thermostat	Thermostat
THD	Threshold	Schwellwert
THE	Theoretical	theoretisch
THEAT	heater temperature	Heizlufttemperatur
THERMO	thermo	thermisch
THM	Thermic inertia of the engine	
THR	Throttle	Drosselklappe
TI	Injection time	Einspritzzeit
TIA	Intake air temperature	Ansauglufttemperatur
TIP	tip	getastet
TIPO	Post injection time	Nacheinspritzer-Einspritzzeit
TIPR	Pre injection time	Vorabeinspritzer-Einspritzzeit
TIT	Titanium	Titan
TLDP	Tank leakage detection pump	Tankleckagediagnosepumpe
TLDV	tank leakage detection valve	Leckdiagnoseabschaltventil
TMAG	coil temperature of magnetic valve IVVT	Spulentemperatur VANOS Magnetventil
TMP	temporary	temporär
TNT	temperature Nox trap	
TOG	toggle	toggle
TOIL	Oil-Temperature	Öltemperatur
TOILPWM	Oil temperature PWM	Tastverhältnis Öltemperatur
TOL	Top limit	obere Grenze
TOOTH	Tooth	Zahn
TORS	torsion	Torsion
TOT	Total	gesamt
TOUT	time out	


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Keyword	English definition	German definition
TPC	Pre catalysator temperature	Abgastemperatur vor Katalysator
TPS	throttle position sensor	Drosselklappensensor
TPSPWM	Throttle position sensor PWM	Tastverhältnis TPS
TQ	Torque	Moment
TQB	braking torque	Bremsmoment
TQD	Driving torque at clutch	Antriebsmoment an der Kupplung
TQDW	Torque at driving wheels	Moment an den Antriebsrädern
TQE	effective engine torque	effektives Motormoment
TQFR	Friction torque	Reibmoment
TQI	Indicated engine torque	Indiziertes Motormoment
TQPWM	Torque PWM	Tastverhältnis Moment
TQR	Torque reduction ( MSR )	Motormomentenreduktion
TQZ	Zero driving torque	Nullmoment
TRA	Transient	instationär
TRAN	transition	Übergang
TRANS	transmission	Getriebe
TRCOM	Trip computer signal	Trip computer signal
TREAT	treatment	Behandlung
TRIG	Trigger	Triggerung
TRIP	trip related parameter	TRIPbezogener Parameter
TRM	transmit	übertragen, senden
TRO	trouble	Störung
TRT	total running time	Betriebsstundenzähler
TSCHA	air temperature supercharger	Lufttemperatur mech. Lader
TSLIP	Traction slip	Antriebsschlupf
TUR	turbine	Turbine
TURB	Turbulence	Turbulenz
TYP	type	
UP	up	vor
UPD	update	Aktualisierung
USE	Compiler switch	
V	Voltage	Spannung
VAC	vacuum	Vakuum
VAL	Valuated	gewichtet
VALUE	value	Wert
VAP	vapor	Dampf
VAR	variant	Variante
VB	Battery-voltage	Batteriespannung ( KL30 )
VCC	Supply voltage	Versorgungsspannung ( 5V )
VCV	high pressure pump volume control valve	
VEH	vehicle	Fahrzeug
VEL	Velocity	Verstellgeschwindigkeit
VEPU	Venturi pump	Saugstrahlpumpe
VERS	version	Version

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Keyword	English definition	German definition
VIC	Variable intake control	variabler Einlaß
VIM	Variable intake manifold	Schaltsaugrohr
VIRT	virtual	virtuell
VLD	Valid	gültig
VLFT	valve lift	Ventilhub
VLS	Lambda sensor voltage	Lambdasonden-Spannung
VLSL	linear lambda sensor voltage	Spannung lineare Lanbdasonde
VO	Valve overlap	Ventilüberschneidung
VOL	Volume	Volumen
VP	pumping voltage	Pumpspannung
VPROG	Programming voltage	Programmier-spannung
VS	Vehicle speed	Tachosignal
VST	vehicle stopped	Fahrzeug steht
VVL	variable valve lift	variabler Ventilhub
VVSL	variable vehicle speed limiter	variabler Geschwindigkeitsbegrenzer
VVSLS	variable vehicle speed limiter switch	Schalter für variabl. Geschwindigkeitsbegr.
VVT	Variable valve timing	variable Nockenwellensteuerung, Schaltvanos
VVTPWM	PWM signal of VVT	Tastverhältnis Schaltvanos
WAIT	wait	warten
WAL	warning lamp	Warnlampe
WARN	warning	warnen
WF	Wall film	Wandfilm
WG	Waste gate	
WGPWM	Waste gate pulse width modulation	
WHEEL	Wheel speed	Rad
WIN	Window	Fenster
WIND	Windscreen	Windschutzscheibe
WКУ	Wake up	wake up
WKUL	Wake up line	Reizleitung-Signal
WORD	word	word
WORK	work	Arbeit
WOUT	without	ohne
WR	write	schreiben
WUP	Warm up	Warmlauf
ZR	Zirconium	Zirkon

The designation of the variables used informs about the type (index table, table, constant), the input and output variables (e.g. TI, TCO etc.), the operating state (e.g. FL, PL, IS) and the dependent parameters, if any (e.g. f (engine speed)).


The designation index table (IP\_) means that the index table value is obtained by interpolation in a unidimensional or multidimensional area.

A table (ID\_) also can be uni- or multidimensional.

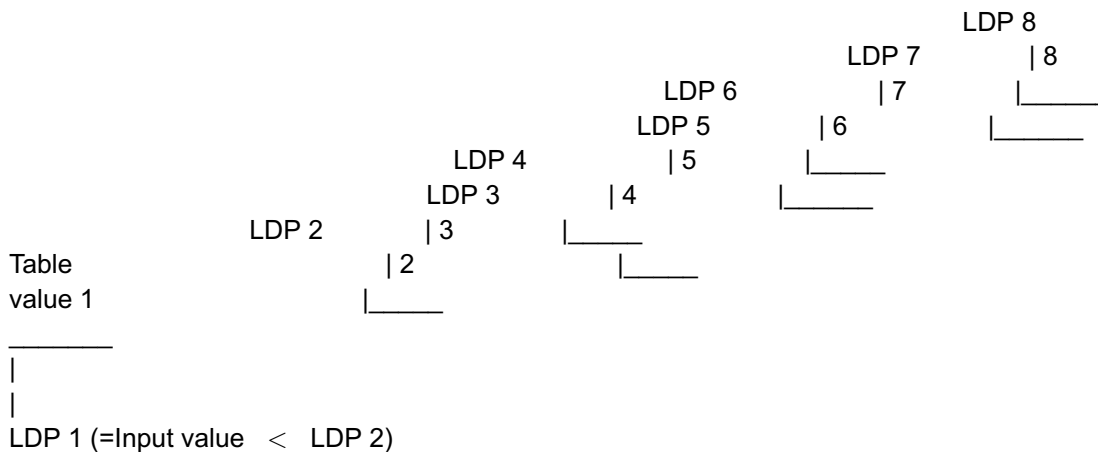
The table value is not obtained by interpolation.

The allocation of the table values to the data points is defined as follows:

A table value  $i$  applies if the input value is greater than or equal to the data point  $i$ .

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Exception: The table value 1 applies in case of input values less than the data point 2.



Unless otherwise specified, the data points are not subject to hysteresis.

Example of nomenclature:

The term "IP\_TIB\_\_N\_\_MAF" means that the index table value TIB (basic injection period) is obtained by a two-dimensional interpolation.

The dependence of the index table value is defined by the suffix \_\_N\_\_MAF :

TIB is a function of the engine speed data point and of the air mass data point, i.e. of the general engine speed and air mass data points.

The descriptions of variables and of the free adjustable data points, together with their value ranges and resolutions, are shown in the Annex.

## 1.4 SYCF Configuration data


### Input data:

NC_CBK_EX_NR {p. 1829}	NC_CRK_WIN_SEG_LEN {p. 854}	NC_CYL_NR {p. 1526}	NC_FAC_VB_RATIO {p. 1186}
NC_IGBT_CUT_OFF_T {p. 920}	NC_IGK_ON_NR	NC_KEY_OFF_NR {p. 906}	NC_KEY_OFF_THR {p. 906}
NC_KNKS_CONF {p. 1967}	NC_KNKWB_INI {p. 1967}	NC_KNKWE_INI {p. 1967}	NC_MAF_FAC_CYL {p. 2889}
NC_MISF_VERS {p. 635}	NC_MPL_T_MAX {p. 1883}	NC_N_DIF_MIN_CRLC {p. 1127}	NC_N_MAX {p. 854}
NC_N_MIN {p. 854}	NC_N_REF_MAX {p. 1151}	NC_NR_CP_BUF {p. 3693}	NC_NR_EDGE_CAM_EX {p. 874}
NC_NR_EDGE_CAM_IN {p. 874}	NC_NR_ERR_DYN {p. 5768}	NC_NR_ERR_HIS {p. 5821}	NC_NR_GAP {p. 874}
NC_NR_TCHA	NC_NR_TOOTH {p. 854}	NC_NR_TOOTH_GAP {p. 854}	NC_NR_TOOTH_STALL {p. 854}
NC_NR_TOOTH_TOL_ ADD {p. 854}	NC_NR_TOOTH_TOL_ MISS {p. 854}	NC_NR_VLD_TOOTH {p. 854}	NC_OFS_TDC0_REF_CRK {p. 854}
NC_PHA_SEG_ER_ENSD {p. 854}	NC_PSD_DLY_CPS {p. 4708}	NC_PSN_SEG_TDC_REF {p. 854}	NC_SEG_TOOTH_RR {p. 6303}
NC_SIZE_SEG_T_COR_ BUF {p. 1448}	NC_STATE_LSL_UP_IF {p. 651}	NC_STATE_VLS_UP_SIG_ ACQ {p. 651}	NC_V_IGK_MAX {p. 847}
NC_VB_MAX {p. 845}	NC_VB_SAMPLE_NR {p. 845}	NLC_USE_ER_STND_MIS {p. 6277}	

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CBK_IN_NR	-	1... 4H	1 ...4	1	-
Number of intake cylinder banks					
NC_LAM_SWI	-	0... 1H	0 ...1	1	-
switch for linear lambda sensor					
NC_MAF_CONF	-	0... 2H	0 ...2	1	-
System configuration flag (compiler) if an air-flow sensor is available (= 1) or not (= 0)					
NC_MAF_SENS_CONF	-	0... 2H	0 ...2	1	-
Flag for MAF sensor configuration (only for turbo variant; 1 = FRQ sensor; 2 = FRQ and AN sensor)					
NC_MAP_CONF	-	0... 2H	0 ...2	1	-
System configuration flag (compiler) if a MAP sensor is available (= 1) or not (= 0)					
NC_NR_CBK_IVVT	-	1... 2H	1 ...2	1	-
Number of camshaft cylinder banks					
NC_T_SEG_FRQ	-		-	-	-
Timer frequency used for T_SEG measurement					
NC_TD_LIM	-	0... 30D4H	0... 50	0.004	ms
maximum value for dwell time					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
USE_SW_VER	-	1H	NC_4V0 (MSV70)	-	-
		2H	NC_4V4 (MSS70)		
		3H	NC_4V5 (MSV80)		
		4H	NC_4D0 (MSD80)		
		5H	NC_4D4 (MSD80-4Cyl)		
		6H	NC_4D8 (MSD80-8Cyl)		
SW-switch indicating the current software project					

### General information:

This is a list of important non-calibratable data used in MSD80 6 Cylinder.

### Description:

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Name	Value
NC_CBK_IN_NR	2
NC_CBK_EX_NR	2
NC_CBK_NR	2
NC_CRK_WIN_SEG_LEN	30 °
NC_CYL_NR	6
NC_FAC_VB_RATIO	1.1076923
NC_IGBT_CUT_OFF_T	5 ms
NC_IGK_ON_NR	6
NC_KEY_OFF_NR	3
NC_KEY_OFF_THR	0.6933576 V
NC_KNKS_CONF	42
NC_KNKWB_INI	12 °crk
NC_KNKWE_INI	54 °crk
NC_LAM_SWI	1 (1 for linear Lam.)
NC_MAF_CONF	1
NC_MAF_FAC_CYL	5555.5
NC_MAP_CONF	1
NC_MISF_VERS	1
NC_MPL_T_MAX	60 ms
NC_N_DIF_MIN_CRLC	-150 1/min
NC_N_MAX	8160 1/min
NC_N_MIN	22 1/min
NC_N_REF_MAX	8160 1/min
NC_NR_CP_BUF	80
NC_NR_EDGE_CAM_EX	6
NC_NR_EDGE_CAM_IN	6
NC_NR_ERR_DYN	15
NC_NR_ERR_HIS	10
NC_NR_GAP	1
NC_NR_TOOTH	60
NC_NR_TOOTH_GAP	2
NC_NR_TOOTH_STALL	3
NC_NR_TOOTH_TOL_ADD	2
NC_NR_TOOTH_TOL_MISS	2
NC_NR_VLD_TOOTH	6
NC_OFS_TDC0_REF_CRK	60 °
NC_PHA_SEG_ER_ENSD	42 °
NC_PSD_DLY_CPS	2
NC_PSN_SEG_TDC_REF	54 °
NC_SEG_TOOTH_RR	4
NC_SIZE_SEG_T_COR_BUF	7
NC_STATE_LSL_UP_IF	1
NC_STATE_VLS_UP_SIG_ACQ	1
NC_T_SEG_FRQ	0x401CD0 (hex)
NC_TD_LIM	10 ms
NC_VB_SAMPLE_NR	8
NLC_USE_ER_STND_MIS	0
USE_SW_VER	= "NC_4D0" for MSD70
NC_NR_CBK_IVVT	1
NC_MAF_SENS_CONF	2
NC_NR_TCHA	2

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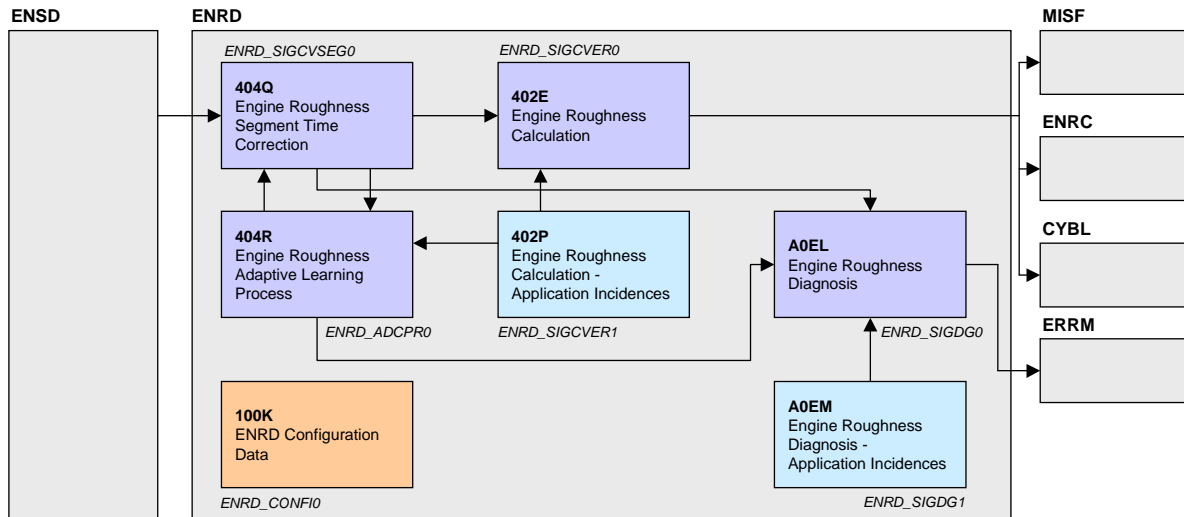
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# 1.5 ENRD General

## 1.5.1 General description

The goal of the ENRD is to provide an engine roughness information to functions linked to combustion process like misfire monitoring, engine roughness control and cylinder balancing.

## 1.5.2 Architecture Overview



## 1.5.3 Description of the containing functions

### 1.5.3.1 404Q Engine roughness segment time correction

Segment times coming from ENSD are managed and corrected according adaptive learning values obtained in 404R module.

### 1.5.3.2 402P Engine roughness calculation - Application Incidences

Application specific requirements, fade-out requests are handled to act on the generic function core. (Template module, modified by the project according its integration environment)

### 1.5.3.3 402E Engine roughness calculation

Engine roughness indexes calculation is grounded on corrected segment time samples provided by 404Q module.

### 1.5.3.4 404R Engine roughness adaptive learning process


Engine roughness adaptive learning process provides adaptive values to 404Q module, to minimise noises produced by flywheel mechanical tolerances.

This module also consumes fade-out requests coming from 402P module.

### 1.5.3.5 A0EM Engine roughness diagnosis - Application Incidences

Application specific requirements, fade-out requests are handled to act on the generic engine roughness diagnosis function. (Template module, modified by the project according its integration environment)

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### 1.5.3.6 A0EL Engine roughness diagnosis


This module provides two diagnosis :

- A diagnosis for the ER segment acquisition (thin synchronisation default criterion).
- A check range diagnosis for the ER adaptive values obtained by the 404R module.

### 1.5.3.7 100K ENRD Configuration data

This module defines ENRD configuration data used during software integration & compilation. These configuration options defines mainly data and buffer size according the number of cylinders. This module is not attached to a software task.

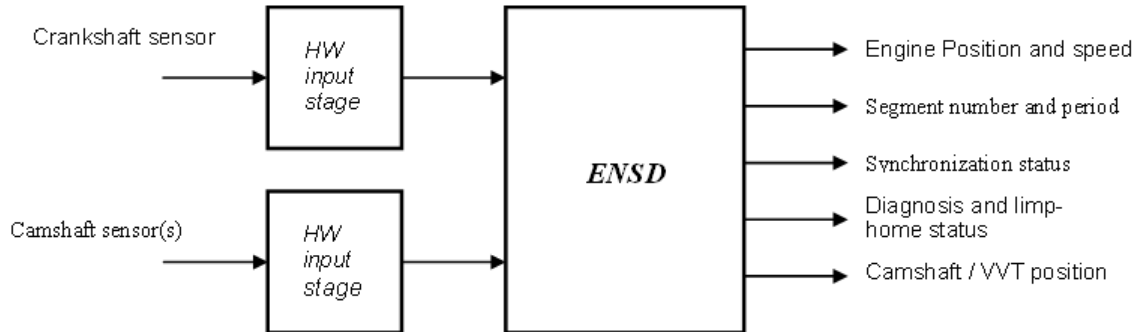
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## 1.6 ENSD General

### 1.6.1 General Description



Up to 4 camshaft sensors are supported.

The ENSD aggregate calculates all output data which depend on crankshaft and camshaft sensor information. This includes:

- engine position
- engine speed
- engine speed gradient
- segment number and period
- synchronization status
- diagnosis and limp-home flags
- camshaft /VVT position feedback
- min./max. engine position for pre-injection

At engine start, three synchronization modes are activated:

1. Crankshaft (self-)synchronization:

The purpose of this synchronization mode is to identify the crankshaft position (0...360° CRK). The crankshaft position is clearly identified at the reference gap of the crankshaft target wheel.

1. Camshaft (self-)synchronization:

The purpose of this synchronization mode is to identify the camshaft position (0..720° CRK). The camshaft position is clearly identified as soon as an unambiguous camshaft edge pattern is found.

1. Camshaft/crankshaft synchronization:

The purpose of this synchronization mode is to identify the engine position (0..720° CRK). The engine position is clearly identified as soon as an unambiguous crankshaft to camshaft position is found.

Injection /Ignition can be enabled as soon as


- engine position is identified (MPI engines)
- engine position is validated (DI /DS engines)

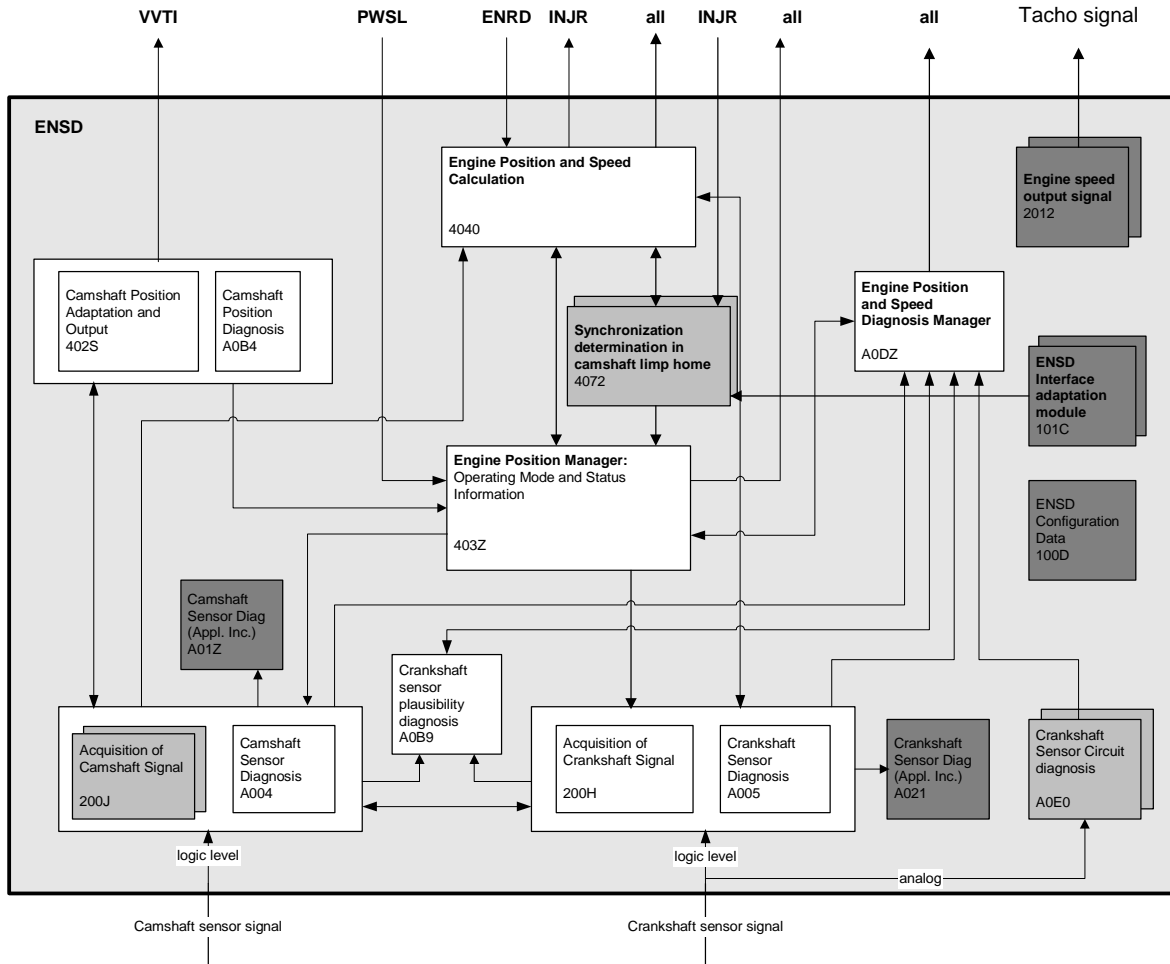
A corresponding status information (LV\_SYN\_ENG /LV\_SYN\_VLD) is produced and sent to the other aggregates.

### Overview

The following figure shows the functional breakdown of the ENSD aggregate:

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The light shaded blocs represent modules which are chosen in function of the actual system configuration (Hook modules).

The dark shaded blocs represent modules which have to be modified by the project ( templates - Hook modules)

### 1.6.2 Short description of the containing functions

#### 200H: Acquisition of crankshaft signal

Crankshaft synchronization, reference gap detection and crankshaft tooth validation. Measurements of tooth periods and segment periods


#### 200J: Acquisition of camshaft signal

cam/crk synchronization (engine position offset determination), camshaft self-synchronization and engine position determination before engine synchronization (for pre-injection).

#### 403Z: Engine position manager

Selection of operating modes (normal mode, camshaft or crankshaft limp-home) and generation of synchronization status information.

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**4040: Engine position and speed calculation**

Calculation of engine position, speed, speed gradient, fast engine speed, segment period and number.

**4072: Synchronization determination in camshaft limp-home**

Engine synchronization determination in camshaft camshaft limp-home by specific injection pattern management

**402S: Camshaft adaptation and position output**

Camshaft edge position adaptation and camshaft position feedback for VVT-controller.

**A0DZ: Engine position and speed diagnosis manager**

Generation of diagnosis information and diagnosis inhibition flags.

**A004: Camshaft sensor diagnosis**

Camshaft segment period diagnosis and camshaft ratio check.

**A0B4: Camshaft position diagnosis**

Diagnosis of camshaft to crankshaft reference position.

**A005: Crankshaft sensor diagnosis**

Crankshaft tooth number and tooth period diagnosis.


**A0B9: Crankshaft sensor plausibility diagnosis**

Failure detection if crankshaft synchronization cannot be achieved, if camshaft signal is missing and if camshaft signal not valid for engine synchronization.

**A021: Crankshaft sensor circuit diagnosis**

Detection of open circuit and short circuit for magnetic crankshaft position sensor.

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# 1.7 ERRM General

## General Information

### Architecture Overview

Principle of the dynamic error management is to receive diagnoses results (filtered or not by anti-bounce, multi-condition, or statistical algorithms). These results are managed as diagnoses failures, according **CARB** and **EOBD** standards.

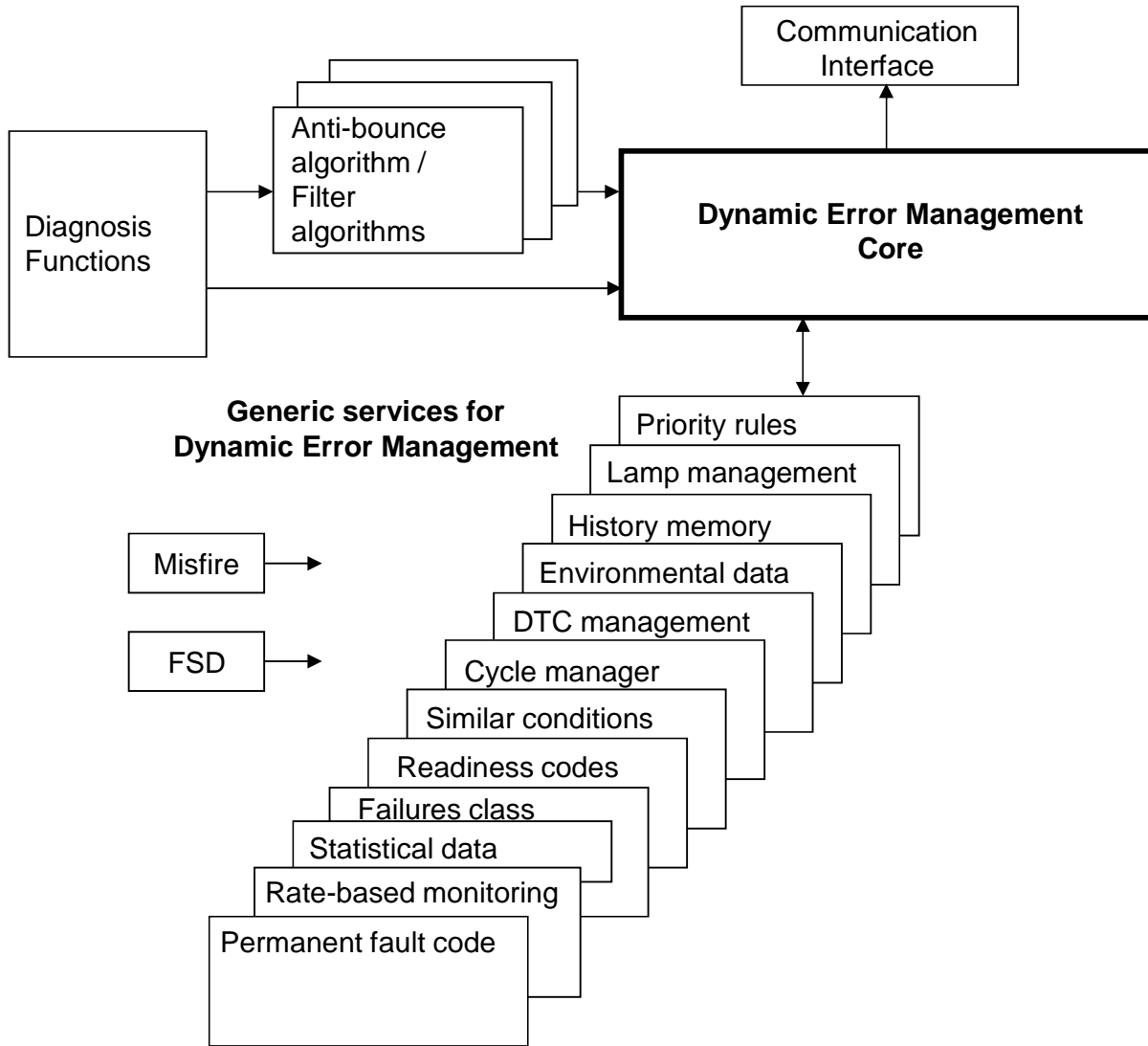



Figure 1.7.1:

### Target /Objectives of ERRM function

The purpose of the Error Management is :

- to collect, store and provide diagnostics information for repair and inspection programs

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- to inform the driver via dashboard lamps from malfunctions which could affect emissions compliance with regulations (CARB for US market /EOBD for European market).

### Description of the containing functions

- Dynamic Error Management core

The dynamic error management core manages different failures states thanks to the fault detection performed by the diagnoses : detected, present, temporary, pending, disappeared and confirmed. All failures are detected without any limitation on quantity. On the contrary, the number of present failures able to be stored into dynamic memory is limited. Management of this limitation is performed thanks to priority rules mechanism.

When a failure is stored into dynamic memory, the related environment data is stored, the lamp management may force lamp illumination (MIL, WAL,...), and DTCs management is done until failure is deleted. When deleted, failures are stored into history memory.

- History memory

History memory permits to trace historic of deleted failures. Some specific information are stored for each deleted failure. Only the more pertinent data linked to failure shall be stored.

- Debounce algorithm

The debounce algorithms is in charge of detected failures filtering according several available and pre-defined filters.

- Multi-conditions debounce algorithm

Debounce algorithm able to filter failures according a conditions per symptoms based algorithm.

- Cycle manager

Cycle manager computes driving cycle and warm-up cycle according to engine states and engine coolant temperature. Cycle manager permits to evaluate failure states.

- Failures class

Each failure can be configured to obtain a specific behaviour : emission relevant or not, can illuminate MIL or not ... This module contain to all the predefined behaviours each failure can be associated with. It permits to simplify greatly tuning of diagnosis by decreasing quantity of calibrations.

- DTC management

DTC management permits to catch some data when a failure becomes present and to generate a code identifier, called DTC. It permits to identify default of the function.

- Communication interface

This module allow to access failure memory data related to error management such as freeze frame, stored DTCs, readiness codes.


- Priority rules

This module manages dynamic memory size limitation. It defines criteria, called priority rules, to store or not a new failure into this dynamic memory.

- Environmental data

This module describes the structure of the freeze frame and its management : storage and delete.

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- Similar conditions

Similar conditions are additional conditions based on engine and load status to erase a failure in memory (for Misfire and Fuel system failure only).

- Lamp management

Lamp management module can manage illumination of several warning lamps ( MIL and other warning lamps ) including pre-drive check.

- Readiness codes

Readiness codes allow to know if a diagnosis has been performed or not.

- Rate-based monitoring

Rate-base monitoring functionality : monitoring performances under real world conditions. Performs statistics calculation on diagnoses.


- Statistical data

Statistical data allows monitoring and storage of statistical data on error management data flow.

- Permanent fault code

This module manages the permanent fault codes into a new dedicated dynamic memory.

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## 1.8 IGRE General

### Introduction

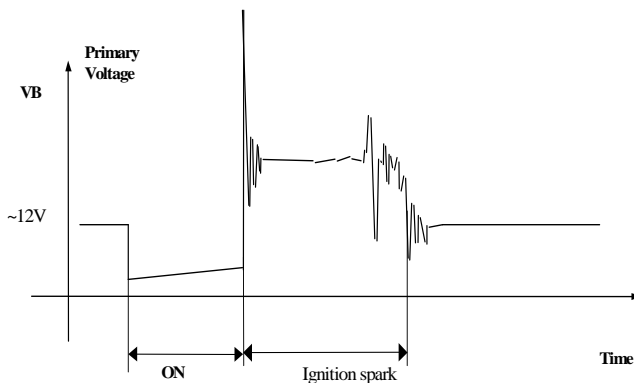
This document is the Aggregate Integration Document of the IGRE Aggregate. Its aim is to describe the integration constraints of this aggregate with the others. It aims with interfaces (imported and exported), architecture, and configuration. This document covers all versions of the IGRE aggregate.

### 1.8.1 Purpose

The IGRE Aggregate defines the calculation of the dwell time, the ignition realization and the ignition diagnosis functions.

Basically the ignition command function has to fulfill two main tasks; to ensure that there is enough energy in the ignition coil and to start the combustion at the requested ignition angle. Knowing the desired ignition advance, engine speed and several other parameters, this aggregate determines the correct timing for switching ON and OFF the power stage in order to bring the ignition coil to the necessary primary current value. The time during ON state (load phase) of the switch is often improperly called Dwell time (with reference to the dwell ratio in breaker systems).

At the end of this Dwell time the ignition stage is switched OFF and the ignition spark is created. The OFF event corresponds to the advance ignition angle (IGA\_IGC).



The ignition command functions and the linked diagnostic functions are regrouped in the ignition realization aggregate.

### Function Description


This function sets the angular position of the dwell time turn on in order to have the time to set up the necessary current in the ignition coil.

The strategy is based on a priority of the ignition angle. If dwell time priority is requested the minimum dwell time is equal to maximum dwell time.

The strategy respects ignition coils with dual and single outputs. This function could be used independently of the number of cylinders (x) and the geometry of the crankshaft target wheel.

All of the functions described in this section operate over the entire engine speed range.

- Realization of minimum 1 ignition spark per cycle
- Realization of a number of multiple spark
- Physical limits of the ignition angle  $+60^{\circ}\text{CRK} / -35,625^{\circ}\text{CRK}$
- In case of an acceleration of 10 000 RPM/s the ignition spark output tolerance depending on engine speed.

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# 1.9 LACO General

## General information:

The Aggregate LACO fulfils the following tasks:

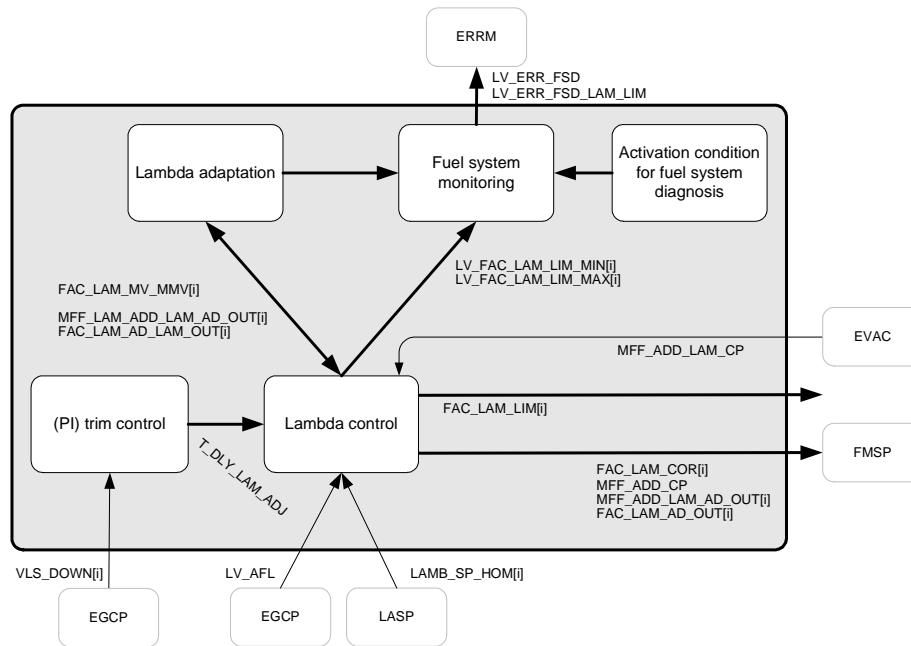
- Lambda control based von upstream oxygen sensor signal
- Trim control based on downstream oxygen sensor signal
- Lambda adaptation
- Fuel system monitoring

The aggregate is available in 2 variants:

- Variant 1 : bin/bin
- Variant 2 : lin/bin


## Architecture Overview:

Variant 1:

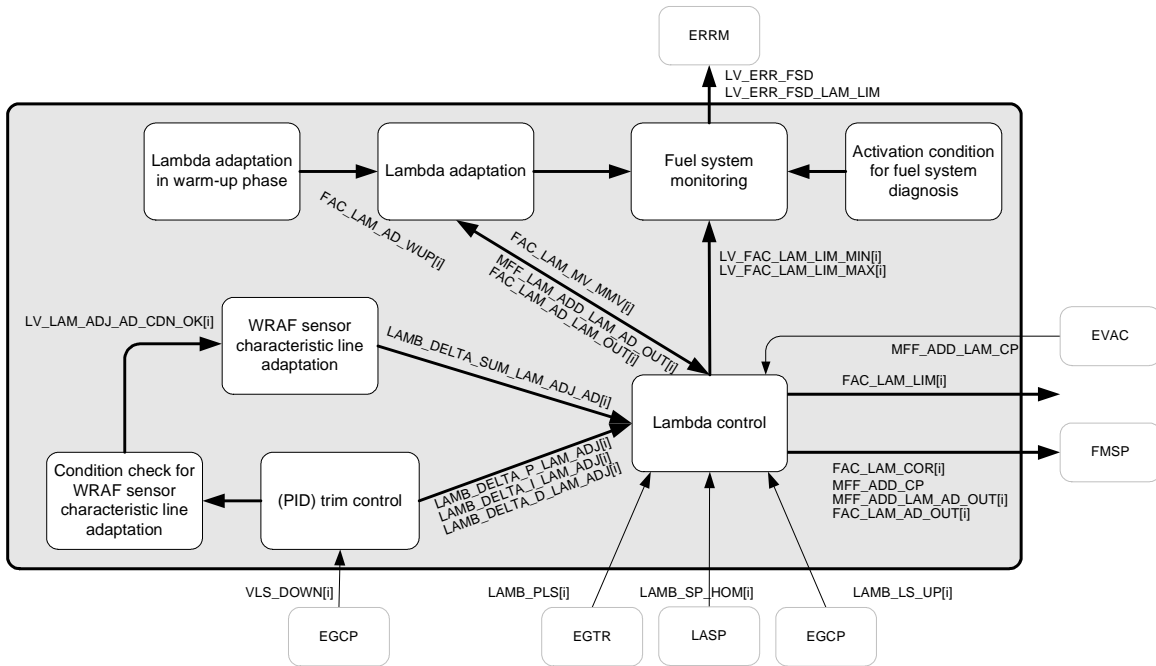


Variant 2:

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## Functional Overview:

### 1.9.1 Lambda control

The Lambda Control Correction adjusts the fuel-air mixture to the desired ratio. It controls the factor `FAC_LAM_COR` which is adjusted to produce a leaner or a richer mixture according to the oxygen sensor information. The `FAC_LAM_COR` forms a multiplicative factor in the fuel mass set point calculation thus exerting direct influence on the injected quantity.

### 1.9.2 Lambda control conditions (Variant 2: Lin/Bin only)

This function manages the stop modes of the linear lambda controller, defines non stationary conditions, calculates the crankshaft difference between start of fuel injection and the position where the sensor detects the exhaust gas, detects whether lambda closed loop control was active at least once during the actual driving cycle and evaluates the fuel system status.

### 1.9.3 Lambda adaptation

In order to compensate serial production tolerances of components, an adaptive correction is calculated (one additive and two multiplicative) based on the filtered lambda controller output. Depending on load and engine speed three different adaptation fields (one offset and two factor areas) are observed. The additive and multiplicative adaptation corrections are used for calculating the injection time for all engine operating states, except at engine stop and engine start. Lambda adaptation learning, for precision reason, needs to be performed at lambda equal 1 conditions. The function itself is activated by the corresponding `LV_LAM_AD_ACT[i]`.

### 1.9.4 Lambda adaptation in warm-up phase (Variant 2: Lin/Bin only)

The Lambda adaptation in warmup phase enhances the Lambda adaptation functionality to obtain a more precise correction at low temperatures ( $< 50^{\circ}\text{C}$ ). The adaptive correction is applied to compensate serial production tolerances of components at low.

TCO dependent correction factors (%) are learned in five temperature ranges. The correction factors are derived from the Lambda controller output. They are learned in an adaptation field specified by MFF\_SP[i] and N\_32. They are, however, to correct the injection time for all engine states. Learning of these factors requires that the Lambda controller is in the state 'ON'.

### 1.9.5 Dynamic fuel trim

The trim-controller causes a better observance of the catalyst window during all the life of the vehicle. The control value is determined depending on the trim control sensor signal (downstream binary signal). The difference of the sensor voltage from set point value is the basic characteristic. The set point value can be applied depending on the operating point, so that the dynamic lambda can be adjusted according to the operating range. For Variant 1 : bin/bin a PI controller is used while for Variant 2 : lin/bin an additional D share increases the control dynamics (PID controller). Variant 1 : bin/bin furthermore includes an adaptation functionality at the end of a driving cycle in order to compensate ageing effects of the upstream O2-sensor. This functionality is covered for Variant 2 : lin/bin by the module "WRAF sensor characteristic line adaptation with trim control" described hereafter.

### 1.9.6 WRAF sensor characteristic line adaptation with trim control (Variant 2: Lin/Bin only)

This function adapts the WRAF sensor characteristic line by observing the I share of the trim control function. A basic (load depending) lambda shift of the WRAF sensor can be corrected by means of an additional offset. This offset can change due to ageing of the sensor.

### 1.9.7 Valid cond. check for WRAF sensor char. line adap. with trim control (Variant 2: Lin/Bin only)

This function checks several conditions that must be fulfilled in order to start the WRAF sensor characteristic line adaption. These conditions shall define a stable state of the downstream sensor signal used by trim control.

### 1.9.8 Mean value calculation for limited dynamics

This function calculates only differences between base values and their moving means values. These differences or deltas are to be used within the function that needs limited dynamic conditions. The evaluation of the limited dynamic bit is part of the function that need this flag. So the mean value calculation is concentrated in this function.

### 1.9.9 Fuel system monitoring


The objective of the fuel system diagnosis is to monitor the lambda control output and the lambda adaptation values in various areas. It should also cover the PCV monitoring where the lambda control output is considered in the idle range.

Breaking the adaptation and lambda controller limits for a long time, which may have been caused by failures in the fuel or intake system will involve emission rise and therefore shall be diagnosed by fuel system diagnosis.

### 1.9.10 Activation of fuel system monitoring

This function checks all necessary activation conditions in order to activate fuel system diagnosis. High rate of evaporated fuel during rich warmup phase under cold start conditions could lead to wrong failure detection and therefore a special inhibition flag for that case is generated.

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# 1.10 MISF General

## General Information

The goal of the MISF is execute a misfire monitoring according legal requirements (conditions, engine area, errors & symptoms handling...) and provide to the ERRM aggregate following CARB misfire legal informations to manage the MIL and corresponding error Pcodes

- **CARB A misfire failure criterion:**

Risk of catalyst damage, monitoring interval over 200 crankshaft during the driving cycle.

- **CARB B1 misfire failure criterion:**

Emission increase, monitoring interval over the first 1000 crankshaft revolutions of the driving cycle.

- **CARB B4 misfire failure criterion:**

Emission increase, monitoring interval over 1000 crankshaft revolutions. For error detection, misfire must take place for 4 monitoring intervals (consecutive or not).

## Architecture Overview

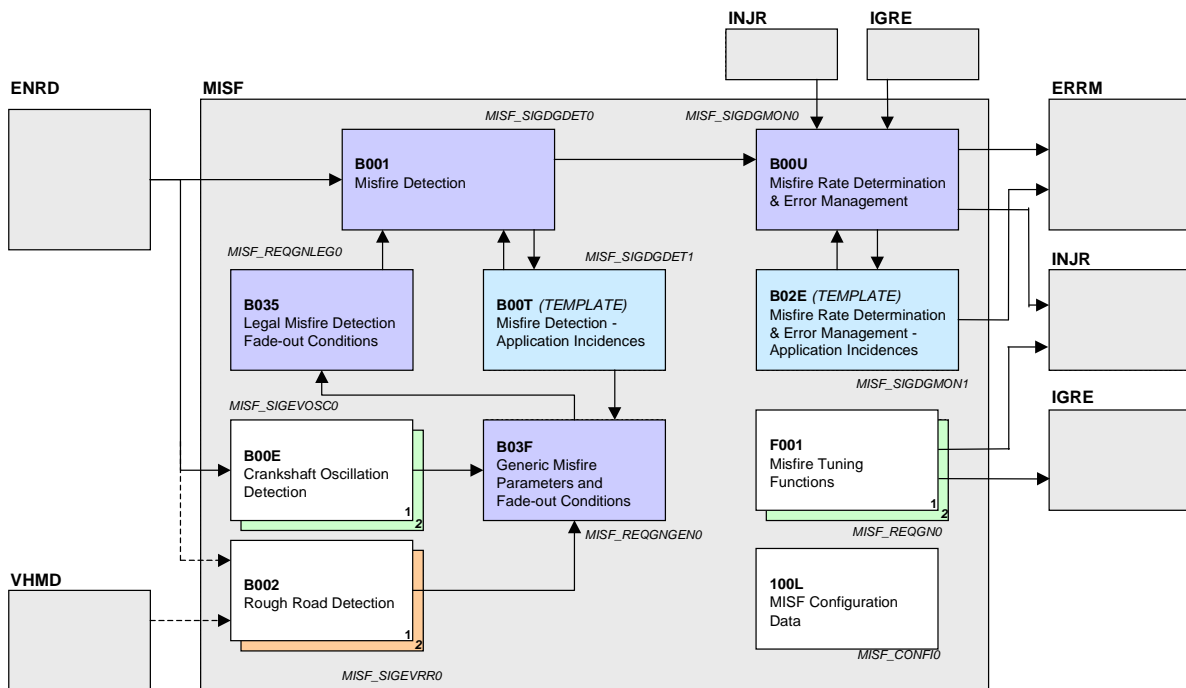



Figure 1.10.1:

## Description of the containing functions

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**B00E - Crankshaft oscillation detection**

The crankshaft oscillation detection module uses engine roughness components to identify drivetrain oscillations than could cause wrong misfire detections in a defined engine operating area. If such oscillation occurs, this module triggers a fade-out.

**B002 - Rough road detection**

The rough road detection module uses informations coming from wheel speed sensor(s) or from ABS module (via harness or CAN) to identify transmission oscillations than could cause wrong misfire detections in a defined engine operating area. If such oscillation occurs, this module triggers a fade-out.

**B03F - Generic misfire parameters & fade-out conditions**

This module provides parameters needed for the misfire detection process (data delayed, data stacks, and zero load line...). It also managed all generic misfire fade-out conditions linked to the misfire detection method.

**B035 - Legal misfire detection fade-out conditions**

This module manages all legal misfire fade-out conditions defined in legal texts (US & EC).

**B00T - Misfire detection - Application incidences**

*This module defines specific corrections for detection thresholds, application specific fade-out with standardised outputs to the generic modules.*

**B001 - Misfire detection**

Detection core function based on engine roughness index provided by ENRD.

**B00T - Misfire detection - Application incidences**

*Some functionality for calibration ease can be launched after detection.*

**B02E - Misfire rate determination & error management - Application Incidences**

*This module defines application specific fade-out & informations with standardised outputs to the generic misfire rate determination module. Diagnosis conditions are defined in this module.*

*Must be executed before B00U module.*

**B00U - Misfire rate determination & error management**

This module defines the Misfire criterions according legal texts description (*MIS\_A = misfire damage catalyst criterion, MIS\_B1 = misfire emission criterion at engine warm-up & MIS\_B4 = misfire emission criterion*) and identify the cylinders in failures

**B02E - Misfire rate determination & error management - Application Incidences**

*This module defines misfire errors according the type chosen by NC\_TREAT\_DIAG\_MIS: errors defined per misfire criterions or errors defined per cylinder.*

*Failures like Misfire with low fuel tank level, Multiple cylinder misfire, Random cylinder misfire are also managed in this module.*


Must be executed after B00U module.

**F001 - Misfire Tuning Functions**

This module allows to generate misfire patterns (continuous or pseudo random) via injection and/or ignition shut-off interfaces.

This module is optionnal and can be integrated during validation and calibration stages. It is strongly recommended to remove this functionality on serial product software (integration choice via NC\_USE\_MIS\_GEN compilation switch).

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## 1.11 VHSL General

### General information:

The Aggregate VHSL replaces previous function which was engine speed based. Aim of function is to provide better control of vehicle speed, particularly in the avoidance of overshoot of the setpoint, and stability after gear changes (esp. in CVT vehicles).

The aggregate consists of the following main functions:

#### **Vehicle speed limitation manager**

Interface not used for the fix limitation ->VHSL\_1.0.0. The state variable STATE\_VSL is used only as aggregate internal interface in case of a variable vehicle speed limitation.

#### **Vehicle speed limitation controller**

This modules aims to limit the vehicle speed to C\_VS\_MAX\_VSL. A PI controller is used to define the engine torque limitation. In order to minimise speed overshoot, a predicted vehicle speed is calculated and the I controller is initialised with a calculated torque reduction.

#### **Vehicle speed limitation output**

This functionality limits the engine torque output by TQI\_VS\_MAX. The value of TQI\_VS\_MAX is initialised with the current engine output torque requirement. This will be calculated as the maximum of TQI\_AV and minimum of TQI\_BAS\_MIN, TQI\_REQ\_TRA. This starting value of TQI\_VS\_MAX is then stored.

#### **Vehicle speed limit calculation**

A filtered vehicle acceleration, AC\_VEH\_MMV is used to predict a future vehicle speed VS\_PRED. The vehicle speed limit, VS\_MAX is also determined at this point. For the fix limitation this limit will be given by the constant C\_VS\_MAX\_VSL.

Another part is the calculation of the vehicle speed deviation which is an essential variable for the vehicle speed controller.

#### **Vehicle speed limitation manager (Appl. Inc.)**

This module deals with the activation of the fix vehicle speed limitation functionality. The function is switched on, LV\_VS\_MAX\_VSL is set, when the vehicle speed, VS\_HIGH\_RES exceeds the set point minus an offset, C\_VS\_MAX\_VSL - C\_VS\_MAX\_HYS\_ON. On the other hand the function is reset, and turned off, when the vehicle speed, VS\_HIGH\_RES drops below the set point minus a hysteresis

#### **Vehicle speed limitation controller (Appl. Inc.)**


The control dynamic is determined by LV\_FAC\_CTL\_DYN\_CHG\_VSL. The I and PD control parameters are calculated based on the dynamic behaviour of the controller.

The aggregate is available in 2 variants:

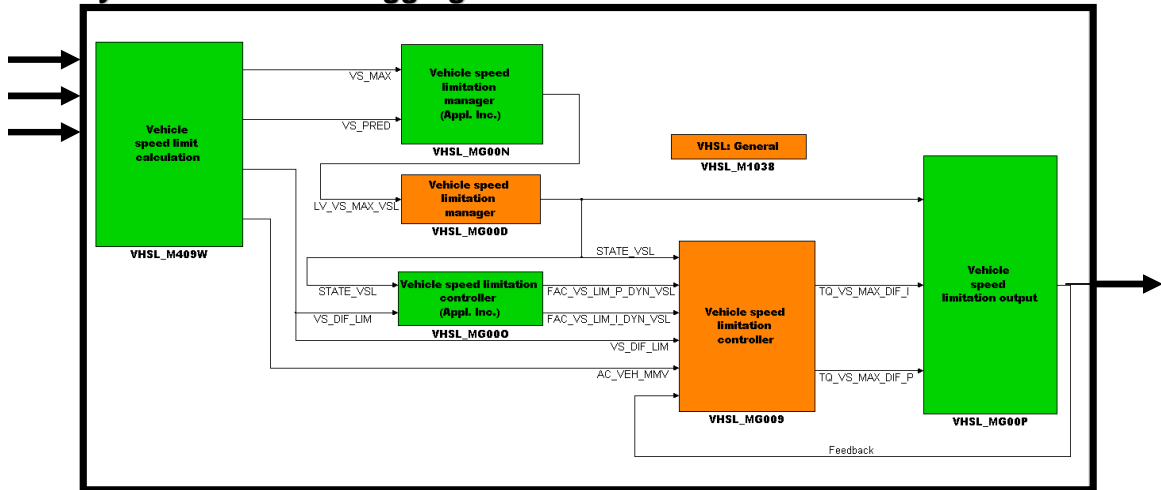
- Variant 1 : Fix Vehicle Speed Limitation
- Variant 2 : Variable Vehicle Speed Limitation

### Architecture Overview:


Variant 1:

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### System Architecture Aggregate VHSL Version 1



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# 1.12 OBDC General

## General Information

### Architecture Overview

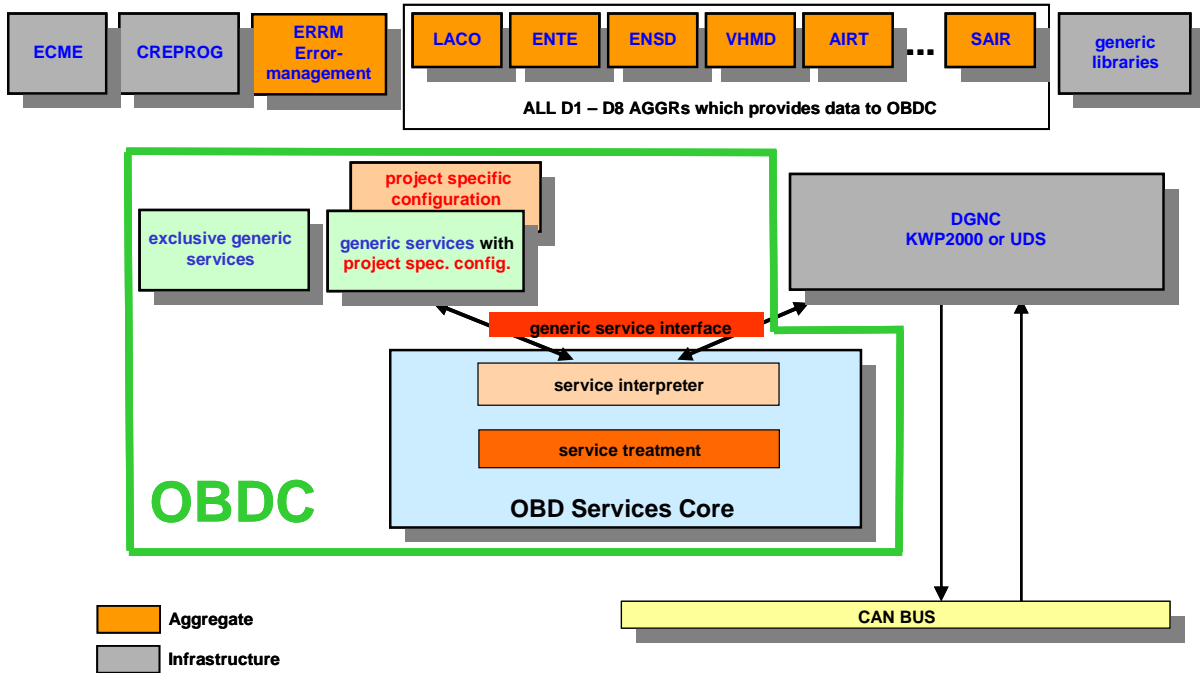


Figure 1.12.1:

### Target /Objectives of EOBD function

The purpose of On Board Diagnostic Communication is:

- to provide OBD services to the scantool

### Description of the containing functions


- SID 01h: Request current powertrain diagnostic data

This module is related to service 01h and allow access to current emission-related data values, including analogue inputs and outputs, digital inputs and outputs, and system status information.

- SID 02h: Request powertrain freeze frame data

This module is related to service 02h and allow access to emission-related data values in a freeze frame. This allows expansion to meet manufacturer-specific requirements not necessarily related to the required freeze frame, and not necessarily containing the same data values as the required freeze frame.

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- SID 03h: Request emission-related diagnostic trouble codes

This module is related to service 03h and the purpose of this service is to enable the external test equipment to obtain “confirmed” emission-related DTCs.

- SID 04h: Clear/reset emission-related diagnostic inf.

This module is related to service 04h and the purpose of this service is to provide a means for the external test equipment to command ECUs to clear all emission-related diagnostic information.

- SID 06h: Request on-board monitoring testS - specific syst

This module is related to service 06h and the purpose of this service is to allow access to the results for on-board diagnostic monitoring tests of specific components/systems that are continuously monitored (e.g. misfire monitoring) and non-continuously monitored (e.g. catalyst system).

- SID 07h: Request emission-related diagnostic trouble codes - pending

This module is related to service 07h and the purpose of this service is to enable the external test equipment to obtain “pending” diagnostic trouble codes detected during current or last completed driving cycle for emission-related components/systems.

- SID 08h: Request control of on-board system, test/component

This module is related to service 08h and the purpose of this service is to enable the external test equipment to control the operation of an on-board system, test or component.

- SID 09h: Request vehicle information

This module is related to service 09h and the purpose of this service is to enable the external test equipment to request vehicle-specific vehicle information such as Vehicle Identification Number (VIN) and Calibration IDs.

- SID 0Ah: Request emission-related diagnostic trouble codes – permanent

This module is related to service 0Ah and the purpose of this service is to enable the external test equipment to obtain all DTCs with "permanentDTC" status. These DTCs have been previously cleared by a successful execution of a \$04 Clear/reset emissionrelated diagnostic information service but remain in the non-volatile memory of the server until the appropriate monitors for each DTC have successfully passed.


- OBDC Service Interpreter

This module allows to access OBD services.

## Normative reference

This implementation and the description of diagnostic communication protocol are based on the following standards:


## ISO Standards :

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<b>Standard Name</b>	<b>Description</b>
ISO/DIS 15031-5: 2006-01-15	Road Vehicles – Communication between vehicle and external equipment for emission related diagnostics – Part 5: Emission-related diagnostic services
SAE J1979: 2007-04 draft edition	This document supersedes SAE J1979 Apr 2002, and is technically equivalent to ISO 15031-5:2006, with the addition of new capabilities required by revised regulations from the California Air Resources Board

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## 1.13 INJR Configuration data

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CHA_DIAG_IV_MAX	-	0... 3FFH	0... 2272.6968	2.2216	µAs
ATIC63 diagnosis threshold: maximum valid charge					
NC_CHA_DIAG_IV_MIN	-	0... 3FFH	0... 2272.6968	2.2216	µAs
ATIC63 diagnosis threshold: minimum valid charge					
NC_CHR_INJ_REF	-	8000... 7FFFH	-3276.8 ...3276.7	0.1	µAs
Reference charge value used for integrator gain calibration.					
NC_CRK_INJ_ANG_IMDT	-	0... 780H	0... 720	0.375	°CRK
Injection angle to perform an injection pulse immediate					
NC_CRK_INJ_BAS_REF	-	0... 780H	0... 720	0.375	°CRK
End of phasing base reference angle related to NC_CRK_INJ_REF_TDC.					
NC_CRK_INJ_REF_TDC	-	FC40... 0H	-360 ...0	0.375	°CRK
(NC_CRK_INJ_REF_TDC + NC_CRK_INJ_BAS_REF) defines the zero position of the co-ordinate system of the injection system with reference to the ignition TDC of logical cylinder 0.					
NC_CRK_INJ_RNG	-	0... 780H	0... 720	0.375	°CRK
Definition of maximum injection range, depending on power stages configuration for injection valves.					
NC_CSERS_INJ_PLS_TEST_ANG_ADD [NC_NR_IV_PLS]	-	FF01... FFH	-95.625 ...95.625	0.375	°CRK
Configured offset to change injection phase for CSERS_INJ demo mode					
NC_CSERS_INJ_PLS_TEST_TI_FAC [NC_NR_IV_PLS]	-	0... FFH	0 ...1	3.9216e-3	-
Configured factor to change injection time for CSERS_INJ demo mode					
NC_CTR_MAX_IV_TEST_MOD	-	0... FFH	0... 255	1	-
Max. number of actuator test pulses before an engine run event has to be occurred to start the functionality again					
NC_IDX_CYL_HPP_REF [NC_CYL_NR]	-	0... 7H	0 ...7	1	-
Array to assign each injector (cylinder) to the corresponding high pressure bank					
NC_IDX_CYL_PBK_IV_REF [NC_CYL_NR]	-	0... 7H	0 ...7	1	-
Array to assign each injector (cylinder) to the corresponding injector power bank					
NC_INJ_CONF	-	0H 1H 3H	MPI HPDI PIEZO	-	-
Injection Mode					
NC_INJ_CONF_GDI	-	0H 1H 3H	MPI HPDI PIEZO	-	-
Injection mode for gasoline direct injection					
NC_INJ_INH_SWI_IV_SHIFT_NR	-	3... 10H	3... 16	1	-
Constant which defines how many bits are used for the shut off sequence					
NC_IV_CONF	-	0... 1H	0 ...1	1	-
Switch to select the kind of injector valve					
NC_IV_CRASH	-	0... FFH	0... 255	1	-
Injection valve opening pattern					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_N_MAX_IV_TEST_MOD	-	0... FFH	0... 8160	32	rpm
Maximum engine speed up to an actuator test is possible					
NC_NR_BK_INJ	-	1... 8H	1 ...8	1	-
Number of power stages					
NC_NR_BURST_MOD_INJ	-	0... 1H	0 ...1	1	-
Number of burst modes					
NC_NR_DCDC_INJ	-	1... 8H	1 ...8	1	-
Number of DC/DC converters for the injection power stages					
NC_NR_IDX_MFF_1_INJ	-	0... FFH	0... 255	1	-
Number of axis points for MFF_SP axis of MFF_IDX_TI map					
NC_NR_IDX_MFF_2_INJ	-	0... FFH	0... 255	1	-
Number of axis points for MFF axis of MFF TI map.					
NC_NR_IDX_MFF_SP_2	-	0... FFH	0... 255	1	-
Number of axis points for MFF axis of the correction of mass flow difference map					
NC_NR_IDX_MFF_SP_3	-	0... FFH	0... 255	1	-
Number of axis points for MFF axis of the correction of mass flow difference map					
NC_NR_IDX_PRS_DEC_INJ	-	0... FFH	0... 255	1	-
Number of axis points for pressure difference axis of MFF TI map.					
NC_NR_IDX_PRS_DEC_INJ_2	-	0... FFH	0... 255	1	-
Number of axis points for pressure difference axis of MFF TI map					
NC_NR_IDX_T_DLY_1_2_S_COR	-	0... FFH	0... 255	1	-
Number of axis points for the T_DLY axis of the correction of mass flow difference map (second injection duration)					
NC_NR_IDX_T_DLY_1_2_S_DLY_COR	-	0... FFH	0... 255	1	-
Number of axis points for the T_DLY axis of the correction of mass flow difference map (first to second injection)					
NC_NR_IDX_T_DLY_2_3_S_COR	-	0... FFH	0... 255	1	-
Number of axis points for the T_DLY axis of the correction of mass flow difference map (third injection duration)					
NC_NR_IDX_T_DLY_2_3_S_DLY_COR	-	0... FFH	0... 255	1	-
Number of axis points for the T_DLY axis of the correction of mass flow difference map (second to third injection)					
NC_NR_IDX_TI_1_INJ	-	0... FFH	0... 255	1	-
Number of axis points for TI axis of high injector needle lift map					
NC_NR_IDX_TI_2_INJ	-	0... FFH	0... 255	1	-
Number of axis points for TI axis of low injector needle lift map					
NC_NR_IDX_TI_2_S	-	0... FFH	0... 255	1	-
Number of axis points for TI axis the correction of mass flow difference map					
NC_NR_IDX_TI_3_S	-	0... FFH	0... 255	1	-
Number of axis points for TI axis the correction of mass flow difference map					
NC_NR_INJ_CMB	-	1... 8H	1 ...8	1	-
Number of combustion modes for injection.					
NC_NR_IV_PLS	-	1... 10H	1... 16	1	-
Number of pulses per cylinder and working cycle (720°CRK)					
NC_NR_PAC_INJ	-	1... 10H	1... 16	1	-
Number of injection pulse packets					
NC_NR_PLS_INJ_PAC_0	-	0... 10H	0... 16	1	-
Number of injection pulses combined in packet number 0					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_PLS_INJ_PAC_1	-	0... 10H	0... 16	1	-
Number of injection pulses combined in packet number 1					
NC_NR_PLS_INJ_PAC_2	-	0... 10H	0... 16	1	-
Number of injection pulses combined in packet number 2					
NC_NR_PLS_INJ_PAC_3	-	0... 10H	0... 16	1	-
Number of injection pulses combined in packet number 3					
NC_NR_PLS_INJ_PAC_4	-	0... 10H	0... 16	1	-
Number of injection pulses combined in packet number 4					
NC_NR_PLS_INJ_PAC_5	-	0... 10H	0... 16	1	-
Number of injection pulses combined in packet number 5					
NC_NR_PLS_INJ_PAC_6	-	0... 10H	0... 16	1	-
Number of injection pulses combined in packet number 6					
NC_NR_PLS_INJ_PAC_7	-	0... 10H	0... 16	1	-
Number of injection pulses combined in packet number 7					
NC_NR_SAMPLE_BURST_CHN_INJ	-	0... 1FFH	0... 511	1	-
Maximum number of sampled points of a single burst					
NC_NR_SYM_IV	-	1... FH	1... 15	1	-
Available symptoms for injection valve diagnostic					
NC_PBK_IV_NR	-	1... 8H	1...8	1	-
Number of power stage banks for the injection valves					
NC_PBK_IV_TYP	-	0... FFH	0... 255	1	-
Configuration of injection due to hardware driver; 0 = ATIC63, 1 = ATIC88					
NC_PWM_DCDC_SP_MAX	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Maximum limit of PWM signal for DCDC converter voltage setpoint; limitation required by HW					
NC_PWM_DCDC_SP_MIN	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Minimum limit of PWM signal for DCDC converter voltage setpoint; limitation required by HW					
NC_PWM_EGY_INJ_MAX	-	0... 4000H	0... 100	6.1035e-3	%
Maximum PWM value for injection charge and discharge current; hardware limit.					
NC_PWM_EGY_INJ_MIN	-	0... 4000H	0... 100	6.1035e-3	%
Minimum PWM value for injection charge and discharge current; hardware limit.					
NC_STATE_STST_ENA	-	0... 1H	0...1	1	-
Switch to indicate engine stop start automatic enabled (= 1) or disabled (= 0)					
NC_T_DIAG_IV_OCC	-	0... FFFFH	0... 65.535	0.001	ms
ATIC63 diagnosis threshold: Maximum time till the injector discharge is started and the negative current is detected, after EOI was reached.					
NC_T_MES_DLY_BEG	-	0... 11H	1... 18	1	µs
Time delay at begin of charge/discharge phase					
NC_T_MES_DLY_END	-	0... 11H	1... 18	1	µs
Time delay at end of charge/discharge phase					
NC_T_MIN_OFS_INJ_CYL	-	0... FFFFH	0... 65.535	0.001	ms
Minimum off time between two injection on corresponding cylinders					
NC_T_MIN_OFS_INJ_PLS	-	0... FFFFH	0... 65.535	0.001	ms
Minimum off time between two injection pulses					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_TI_CRASH	-	0... FFFFH	0... 655350	10	ms
Injection time during vehicle crash condition is true					
NC_TI_TEST_PLS_PER	-	0... FFFFH	0... 65.535	0.001	ms
Injection valve open time for actuator test					
NC_USE_TI_AS_CBK	-	0... 1H	0 ...1	1	-
Compiler switch to enable external TI adjustment caused by application system					
NC_V_ADC_REF_INJ	-	0... FFFFH	0... 9.99984	152.6e-6	V
ADC reference calibration voltage.					
NC_V_DIAG_IV_MAX	-	0... 7FFFH	0... 639.98046	0.0195312	V
ATIC63 diagnosis threshold: maximum voltage at opened injector					
NC_V_DIAG_IV_MIN	-	0... 7FFFH	0... 639.98046	0.0195312	V
ATIC63 diagnosis threshold: minimum voltage at opened injector					
NC_V_DIAG_IV_MIN_SCB	-	0... 7FFFH	0... 639.98046	0.0195312	V
ATIC63 diagnosis threshold: minimum injector voltage for diagnosis of a short circuit to battery error					
NC_V_DIAG_IV_MIN_SCG	-	0... 7FFFH	0... 639.98046	0.0195312	V
ATIC63 diagnosis threshold: minimum injector voltage for diagnosis of a short circuit to ground error					
NLC_CSERS_INJ_PLS_TEST_CONF	-	0... 1H	0 ...1	1	-
Configurated switch if configurated (0) or calibrated (1) injection pulse change is active for demo mode					
NLC_INJ_MPI_AUX	-	0... 1H	0 ...1	1	-
Enable if MPI-functionality is used additionally to SDI					

## INJR Configuration Data

The following document describes the general rules for definition of the configuration data for INJR Aggregate.

### General information:

The following document describes the general rules for definition of the configuration data for INJR Aggregate

### 1.13.1 Global configuration data

Here are listed the configuration data, which are not only used in the modules of the INJR aggregate.


Data	Value
NC_INJ_CONF	1
NC_IV_CONF	1
NC_INJ_CONF_GDI	1

### 1.13.2 Local configuration data

The configuration data are listed here which are used only in the INJR aggregate.

Data	Value
NC_INJ_INH_SWI_IV_SHIFT_NR	6
NC_CRK_INJ_REF_TDC	-360 °CRK
NC_CRK_INJ_BAS_REF	180 °CRK
NC_IDX_CYL_PBK_IV_REF[NC_CYL_NR]	[0 1 0 1 0 1]
NC_NR_IV_PLS	3
NC_NR_PLS_INJ_PAC_0	3
NC_NR_PLS_INJ_PAC_1	1
NC_NR_PLS_INJ_PAC_2	0
NC_NR_PLS_INJ_PAC_3	0
NC_NR_PLS_INJ_PAC_4	0
NC_NR_PLS_INJ_PAC_5	0
NC_NR_PLS_INJ_PAC_6	0
NC_NR_PLS_INJ_PAC_7	0
NC_PBK_IV_NR	2
NC_NR_DCDC_INJ	1
NC_USE_TI_AS_CBK	0
NC_N_MAX_IV_TEST_MOD	0 rpm
NC_CTR_MAX_IV_TEST_MOD	5
NC_TI_TEST_PLS_PER	1ms
NC_IV_CRASH	0x3 (00000011 binary)
NC_TI_CRASH	1000 ms
NC_T_MIN_OFS_INJ_CYL	0.400 ms
NC_T_MIN_OFS_INJ_PLS	0.240 ms
NC_CRK_INJ_RNG	240 °CRK
NC_CHA_DIAG_IV_MIN	300 µAs
NC_CHA_DIAG_IV_MAX	1200 µAs
NC_V_DIAG_IV_MIN	50 V
NC_V_DIAG_IV_MAX	210 V
NC_V_DIAG_IV_MIN_SCG	4 V
NC_V_DIAG_IV_MIN_SCB	16 V
NC_T_DIAG_IV_OCC	100 µs
NC_PBK_IV_TYP	1 (ATIC88)
NC_PWM_DCDC_SP_MAX	80.6 %
NC_PWM_DCDC_SP_MIN	58.1 %
NC_CHR_INJ_REF	565.6 µAS
NC_NR_BK_INJ	NC_PBK_IV_NR
NC_NR_PAC_INJ	2 (Sum of Packets (NC_NR_PLS_INJ_PAC_x) with number of pulses != 0)
NC_NR_BURST_MOD_INJ	0
NC_NR_SAMPLE_BURST_CHN_INJ	0
NC_IDX_CYL_HPP_REF	[0 0 0 0 0 0]
NC_STATE_STST_ENA	0
NC_PWM_EGY_INJ_MAX	73.2 %
NC_PWM_EGY_INJ_MIN	19.5 %
NC_V_ADC_REF_INJ	3.1 V
NC_NR_IDX_MFF_2_INJ	16
NC_NR_IDX_PRS_DEC_INJ	12
NC_NR_IDX_MFF_1_INJ	16
NC_NR_IDX_PRS_DEC_INJ_2	12
NC_NR_IDX_TI_1_INJ	8
NC_NR_IDX_TI_2_INJ	8
NC_NR_IDX_T_DLY_1_2_S_COR	2
NC_NR_IDX_T_DLY_2_3_S_COR	2
NC_NR_IDX_T_DLY_1_2_S_DLY_COR	6
NC_NR_IDX_T_DLY_2_3_S_DLY_COR	4

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Data	Value
NC_NR_IDX_MFF_SP_2	12
NC_NR_IDX_MFF_SP_3	8
NC_NR_IDX_TI_2_S	2
NC_NR_IDX_TI_3_S	2
NLC_CSERS_INJ_PLS_TEST_CONF	1 (CSERS_INJ demo mode changes calibratable)
NC_CSERS_INJ_PLS_TEST_TI_FAC[0]	0.2
NC_CSERS_INJ_PLS_TEST_TI_FAC[1]	0
NC_CSERS_INJ_PLS_TEST_TI_FAC[2]	0
NC_CSERS_INJ_PLS_TEST_ANG_ADD[0]	-30°CRK
NC_CSERS_INJ_PLS_TEST_ANG_ADD[1]	+30°CRK
NC_CSERS_INJ_PLS_TEST_ANG_ADD[2]	+30°CRK
NC_NR_INJ_CMB	1
NLC_INJ_MPI_AUX	0 (without MPI)

## 1.14 EVAC Configuration data

### Input data:

NC_NR_CP_BUF {p. 3693}	NC_NR_CP_LAM_AD {p. 3739}	NC_PSD_DLY_CPS {p. 4708}	
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### General information:

The following document describes the general rules for definition of the configuration data for EVAC aggregate.

#### 1.14.1 Local configuration data

Data	Value
NC_NR_CP_LAM_AD	9
NC_NR_CP_BUF	80
NC_PSD_DLY_CPS	2

NC\_NR\_CP\_LAM\_AD: (default value = 9)

Number of fixed cp /Lambda adaptation slices after engine start. This value is used in the time control between purge and lambda adaptation (903P) to have maximum of flexibility.

NC\_NR\_CP\_BUF: (default value = 20)

size of the fuel buffer fuel\_flow\_add\_buf. The default value is 20 but some applications which have long engine displacement need a greater value to simulate the distance between canister purge valve and injectors (80 for example).

NC\_PSD\_DLY\_CPS: (default value = 2)

Canister purge valve diagnosis: Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met.



## 1.15 IGRE Configuration data

NC_IGN_DIAG_TYP	NC_TD_LIM_MIN	NC_TD_LIM_MAX_H	NC_MPL_T_MAX
NC_MAX_IGN_MPL_NR	NC_IGC_DLY	NC_MPL_IGN_H_RNG_CRK_MAX	NC_IGC_CONF
NC_TD_AD_TYP	NC_INI_CTR_DEAC	NC_IGBT_CUT_OFF_T	NC_T_MIN_SCP
NC_CFB_DIAG_SCP_CHN	NC_TD_AD_CHN_L	NC_TD_LIM_MAX_L	NC_TD_AD_CHN_H

### General information :

The following describes the general rules for determination of the configuration data

### 1.15.1 Global configuration data

Data	Value

### 1.15.2 Local configuration data

Here are listed the configuration data, which are used only in the IGRE aggregate.

Data	Value
NC_IGN_DIAG_TYP	ATM46: Diag with ATM46 or ATIC71 circuit ATIC29: : Diag with ATIC29 circuit SHUNT: Diag with SHUNT (not supported yet)
NC_TD_LIM_MIN	TD_MIN >= NC_TD_LIM_MIN Typical value for debug = 1 ms
NC_TD_LIM_MAX_H	High maximum value for dwell time Typical value for debug = 20 ms
NC_TD_LIM_MAX_L	Low maximal value for dwell time Typical value for debug = 10 ms
NC_MAX_IGN_MPL_NR	Maximum number of multi spark Typical value for debug = 7
NC_IGC_DLY	Number of recurrence after engine start, which had to pass by to activate the diagnosis Typical value = 16
NC_MPL_T_MAX	Absolute duration of multispark Typical value 60 ms
NC_MPL_IGN_H_RNG_CRK_MAX	Maximum ignition angle after TDC to start TD_MPL (normal value 12 to 18 °CRK)
NC_IGC_CONF	Ignition mode : half or full static Typical value = Full
NC_TD_AD_TYP	Type of adaptive dwell time control: NONE or FLAG or (CURR not supported today)
NC_INI_CTR_DEAC	Time delay after IGBT response before switching OFF the IGBT - typical value 600µs
NC_IGBT_CUT_OFF_T	Inhibition of "IGBT protection cut off function" (ATM46 or ATIC71 usage without shunt) - typical value 5ms
NC_T_MIN_SCP	Minimum time to detect SCB with current feedback flag (ATIC71 usage) - typical value 1.5ms
NC_CFB_DIAG_SCP_CHN	Selection of the channel number to be used to do the SCB diagnosis with current feedback flag
NC_TD_AD_CHN_L	Selection of channel number where current feedback flag is read to do dwell time adaptation
NC_TD_AD_CHN_H	Selection of channel number where current feedback flag is read to do dwell time adaptation in satrt phase

**Note:** care has to be taken with the setting of NC\_TD\_LIM\_MAX in order to avoid Dwell Time /coil charging recovery:

- For half-static coil configuration, Dwell Time has to be shorter than 360°CRK (= delay time between 2 coil charging request).  
This means, for a maximal engine speed of eg. 7500rpm, Dwell Time < 8ms
- For full-static coil, Dwell Time has to be shorter than 720°CRK  
This means, for a maximal engine speed of eg. 7500rpm, Dwell Time < 16ms

NC\_TD\_LIM\_MAX should be tuned in consequence to respect coil charging time no recovery and coil capacity

**Formula Section:**

NC_IGN_DIAG_TYP	= "ATM46"
NC_TD_LIM_MIN	= 1ms
NC_TD_LIM_MAX_L	= 10ms
NC_TD_LIM_MAX_H	= 20ms
NC_MAX_IGN_MPL_NR	= 20
NC_IGC_DLY	= 16
NC_MPL_T_MAX	= 60ms
NC_MPL_IGN_H_RNG_CRK_MAX	= 180°CRK
NC_IGC_CONF	= FULL
NC_TD_AD_TYP	= "Flag"
NC_INI_CTR_DEAC	= 852s
NC_IGBT_CUT_OFF_T	= 5ms
NC_T_MIN_SCP	= 1.5ms
NC_CFB_DIAG_SCP_CHN	= 1
NC_TD_AD_CHN_L	= 0
NC_TD_AD_CHN_H	= 1

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## 1.16 MISF Configuration data

### Input data:

NC_CBK_EX_NR_MISF [NC_CYL_NR] {p. 6241}	NC_CONF_RR_MIS	NC_CYL_NR {p. 1526}	NC_SIZE_THD_ER_BUF {p. 6277}
NLC_TREAT_DIAG_MIS {p. 6265}	NLC_USE_CRK_OSC_MIS {p. 6210}	NLC_USE_ER_STND_MIS {p. 6277}	NLC_USE_MIS_GEN {p. 7194}
SEG_NR_ER {p. 1454}			

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_MISF_VERS	-	0... FFH	0... 255	1	-
MISF aggregate version					

### General information:

The following describes the general rules for determination of the configuration data

#### 1.16.1 Global configuration data

Here are listed the configuration data, which can be used in other aggregates :

Data	Value
NLC_TREAT_DIAG_MIS	<b>1</b>

#### 1.16.2 Local configuration data


Here are listed the configuration data, which are used only in the MISF aggregate.

Data	Value
NC_MISF_VERS	<b>1</b>
NLC_USE_ER_STND_MIS	<b>0</b>
NC_SIZE_THD_ER_BUF	<b>4</b>
NC_CONF_RR_MIS	<b>OTHER</b>
NLC_USE_CRK_OSC_MIS	<b>1</b>
NLC_USE_MIS_GEN	<b>1</b>
NC_CBK_EX_NR_MISF[NC_CYL_NR]	<i>see table below</i>

### Configuration for NC\_CBK\_EX\_NR\_MISF:

*Cylinders 0, 2 & 4 located on exhaust cylinder bank 0  
Cylinders 1, 3 & 5 located on exhaust cylinder bank 1*

SEG_NR_ER	0	1	2	3	4	5
NC_CBK_EX_NR_MISF	0	1	0	1	0	1

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## 1.17 ENRD Configuration data

### Input data:

NC_CYL_NR {p. 1526}	NC_SEG_DLY_ER_MES {p. 1448}	NC_SIZE_SEG_T_COR_ BUF {p. 1448}	NLC_CONF_GAIN_ADD_ ER {p. 1456}
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### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ENRD_VERS	-	0.. FFH	0.. 255	1	-
ENRD aggregate version					

### General information :

The following describes the general rules for determination of the configuration data

#### 1.17.1 Local configuration data

Here are listed the configuration data, which are used only in the ENRD aggregate.

Data	Value
NC_ENRD_VERS	1
NC_SIZE_SEG_T_COR_BUF	7
NC_SEG_DLY_ER_MES	1
NLC_CONF_GAIN_ADD_ER	1

### Default configurations:

NC_CYL_NR	NC_SIZE_SEG_T_COR_BUF
3	7
4	9
5	11
6	7
8	9

## 1.18 ENSD Configuration data

### Input data:

NC_ACT_CAM_EDGE_LIH {p. 874}	NC_ACT_CAM_EDGE_SYN {p. 874}	NC_ACT_CRK_EDGE {p. 854}	NC_CRK_WIN_SEG_LEN {p. 854}
NC_CYL_NR {p. 1526}	NC_N_CRK_WIN_ENA {p. 854}	NC_N_MAX {p. 854}	NC_N_MIN {p. 854}
NC_N_SEG_HALF_END {p. 854}	NC_NR_CAM_CBK {p. 1507}	NC_NR_EDGE_CAM_EX {p. 874}	NC_NR_EDGE_CAM_IN {p. 874}
NC_NR_GAP {p. 874}	NC_NR_TOOTH {p. 854}	NC_NR_TOOTH_FIRST_GAP_MIN {p. 854}	NC_NR_TOOTH_GAP {p. 854}
NC_NR_TOOTH_STALL {p. 854}	NC_NR_TOOTH_TOL_ADD {p. 854}	NC_NR_TOOTH_TOL_MISS {p. 854}	NC_NR_VLD_TOOTH {p. 854}
NC_OFS_TDC0_REF_CRK {p. 854}	NC_PHA_SEG_ER_ENSD {p. 854}	NC_PRI_LIH_CAM_CBK {p. 1507}	NC_PRI_LIH_CAM_IN {p. 1507}
NC_PRI_SYN_CAM_CBK {p. 1507}	NC_PRI_SYN_CAM_IN {p. 1507}	NC_PSN_EDGE_CAM_EX [NC_NR_EDGE_CAM_EX][NC_NR_CAM_CBK] {p. 874}	NC_PSN_EDGE_CAM_IN [NC_NR_EDGE_CAM_IN][NC_NR_CAM_CBK] {p. 874}
NC_PSN_SEG_TDC_REF {p. 854}	NC_T_SEG_MAX_CAM_EX {p. 874}	NC_T_SEG_MAX_CAM_IN {p. 874}	NC_T_SEG_MIN_CAM_EX {p. 874}
NC_T_SEG_MIN_CAM_IN {p. 874}	NLC_CAM_EX {p. 1507}	NLC_CAM_IN {p. 1507}	NLC_LIH_CAM_EX {p. 1507}
NLC_LIH_CAM_IN {p. 1507}			

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CAM_LIH_SWI	-	0H	NONE	-	-
		1H	INJ		
		2H	FUP		
		3H	MAF		
Method for synchronization determination in camshaft limp home					
NC_CAM_SENS_TYP	-	0H	MCAM	-	-
		1H	ACAM		
		2H	ACAM_TPO		
Camshaft sensor technology					
NC_CAM_WHEEL_TYP	-	0H	SINGLE_TOOTH	-	-
		1H	MULTI_TEETH_1_GAP		
		2H	MULTI_TEETH_2_GAPS		
Camshaft target wheel type					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CRK_SENS_TYP	-	0H 1H	ACPS MCPS	-	-
Crankshaft sensor technology					
NC_NR_CONF_CAM	-	1... 2H	1 ...2	1	-
Number of camshaft target wheel configurations					
NLC_ESS	-	0H 1H	NOT_ PRESENT PRESENT	-	-
Engine speed (Tacho) hardware output controlled by basic SW present					

### General information :

The following describes the general rules for determination of the configuration data

#### 1.18.1 Global configuration data

Here are listed the configuration data, which can be used in other aggregates :


Data	Value
NC_CYL_NR	6
NC_N_MIN	22
NC_N_MAX	8160
NLC_CAM_IN	1: intake camshaft sensor(s) present in system
NLC_CAM_EX	1: exhaust camshaft sensor(s) present in system
NC_NR_CAM_CBK	1: camshaft sensor present on cylinder bank 1
NC_NR_EDGE_CAM_IN	6
NC_NR_EDGE_CAM_EX	6

#### 1.18.2 Local configuration data

Here are listed the configuration data, which are used only in the ENSD aggregate.

Data	Value
NLC_LIH_CAM_IN	1: intake camshaft sensor available for crankshaft limp-home
NLC_LIH_CAM_EX	1: exhaust camshaft sensor available for crankshaft limp-home
NC_PRI_LIH_CAM_IN	Camshaft selection priority for crankshaft limp-home: 1: intake camshaft sensor(s)
NC_PRI_LIH_CAM_CBK	Camshaft selection priority for crankshaft limp-home: 1: sensor(s) on cylinder bank 1
NC_PRI_SYN_CAM_IN	Camshaft selection priority for engine synchronization: 1: intake camshaft sensor(s)
NC_PRI_SYN_CAM_CBK	Camshaft selection priority for engine synchronization: 1: sensor(s) on cylinder bank 1
NC_T_SEG_MIN_CAM_IN	Intake camshaft sensor minimum signal duration: 0,000694
NC_T_SEG_MIN_CAM_EX	Exhaust camshaft sensor minimum signal duration: 0,000694
NC_T_SEG_MAX_CAM_IN	Intake camshaft sensor maximum signal duration: 1,409090
NC_T_SEG_MAX_CAM_EX	Exhaust camshaft sensor maximum signal duration: 1,409090
NC_CRK_SENS_TYP	Crankshaft sensor type: 0: ACPS
NC_CAM_SENS_TYP	Camshaft sensor type: 2: ACAM TPO
NC_CAM_WHEEL_TYP	Camshaft target wheel type: 1: multi-teeth, 1 gap on crk
NC_NR_CONF_CAM	Number of camshaft target wheel configurations: 1: only 1 configuration
NC_ACT_CRK_EDGE	Active edge of crankshaft signal: 0: falling edges
NC_ACT_CAM_EDGE_SYN	Active edge of camshaft signal for cam/crk synchronization: 3: falling and rising edges
NC_ACT_CAM_EDGE_LIH	Active edge of camshaft signal for crankshaft limp-home: 3: falling and rising edges
NC_NR_TOOTH	60
NC_NR_GAP	1
NC_NR_TOOTH_GAP	2
NC_NR_TOOTH_TOL_ADD	2
NC_NR_TOOTH_TOL_MISS	2
NC_NR_TOOTH_STALL	3

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Data	Value
NC_NR_VLD_TOOTH	6
NC_OFS_TDC0_REF_CRK	60°
NC_PSN_SEG_TDC_REF	54°
NC_PHA_SEG_ER_ENSD	42°
NC_CRK_WIN_SEG_LEN	30°
NLC_ESS	1: engine speed (tacho) output controlled by basic SW
NC_CAM_LIH_SWI	0: No specific method for synchronization determination in camshaft limp home
NC_N_SEG_HALF_END	22
NC_NR_TOOTH_FIRST_GAP_MIN	2: minimum number of teeth to be simulated to detect the first reference gap
NC_N_CRK_WIN_ENA	0: minimum engine speed for enabling acceptance windows for crankshaft acquisition

### Application conditions

**Recurrence:** once, at ignition key on (ECU reset)

### Formula Section:

Edge index z	1	2	3	4	5	6
NC_PSN_EDGE_z_CAM_IN_1	80	210	390	430	570	30
NC_PSN_EDGE_z_CAM_EX_1	80	210	390	430	570	30

### Note:

- Per definition edge #1 is the first electrical **FALLING** edge after TDC0
- Camshaft edge positions are given in °CRK relative to TDC0
- Camshaft edge positions are given for VVT passive and are only valid for BMW NG6 engines with a 3 teeth camshaft wheel

# 1.19 ENSD interface adaptation module

**Data definition:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TCO_CMN	O/V	0... FFH	-50 ...205	1	°C
Coolant temperature (ENSD internal)					
VB_CMN	O/V	0... FFH	0... 28.8	112.999e-3	V
Battery voltage (ENSD internal)					

**Input data:**

NC_CAM_LIH_SWI {p. 638}	TCO {p. 1100}	VB {p. 1185}	
-------------------------	---------------	--------------	--

**FUNCTION DESCRIPTION:**

**General information:**

The aim is to get a common definition for coolant temperature and battery voltage inside ENSD aggregate whatever their definition is in the rest of software.

**Description:**

TCO\_CMN and VB\_CMN are stubbed

**Application conditions**

- Initialisation:** *none*
- Recurrence:** *at reset*
- Activation:** `NC_CAM_LIH_SWI ≠ "INJ"`
- Deactivation:** `NC_CAM_LIH_SWI = "INJ"`

**Formula section:**

TCO\_CMN = 0  
VB\_CMN = 0

Remark: As this module is only a stub, TCO and VB are not used.

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## 1.20 NOXD Configuration data

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NOX_SENS_CONF	-	0... 2H	0 ...2	1	-
Number of NOx sensors within the exhaust system					

### FUNCTION DESCRIPTION:

#### General information:

The following describes the general rules for determination of the configuration data:

- All configuration data shall be defined by project with information from customer.

#### Formula section:

##### Global configuration data

Here are listed the configuration data, which can be used in other aggregates:

Data	Value
NC_NOX_SENS_CONF	1

##### Local configuration data

Here are listed the configuration data, which are used only in the NOXD aggregate:

Data	Value
-	

## 1.21 NOXM Configuration data

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NT_CONF	-	0... 1H	0 ...1	1	-
configuration data for single/twin branched exhaust line (0: one NOx trap, 1: two NOx traps)					
NC_NT_NR	-	1... 4H	1 ...4	1	-
Number of NOx catalysts					

### FUNCTION DESCRIPTION:

#### General information:

The following describes the general rules for determination of the configuration data:

- All configuration data shall be defined by project with information from customer.

#### Formula section:

##### Global configuration data

Here are listed the configuration data, which can be used in other aggregates:

Data	Value
NC_NT_NR	2

##### Local configuration data

Here are listed the configuration data, which are used only in the NOXM aggregate:

Data	Value
NC_NT_CONF	1

## 1.22 ERRM Configuration data


### Input data:

NC_ABC_CONF_FCT_ DIAG_XX {p. 4581}	NC_CYL_NR {p. 1526}	NC_ENVD_CUS_CMN_ UPD {p. 5793}	NC_ERR_DTC_CONF {p. 5757}
NC_ERR_DTC_REQ_CUS {p. 5695}	NC_ERR_DTC_REQ_OBD {p. 5695}	NC_ERR_PRI_H {p. 5811}	NC_INJ_CONF {p. 626}
NC_LDP_1_DTC_TABLE_ SIZE {p. 5757}	NC_LDP_2_DTC_MIS_ TABLE_SIZE {p. 5757}	NC_LDP_2_DTC_TABLE_ SIZE {p. 5757}	NC_MIL_CHK_TYP {p. 5828}
NC_NR_DIAG_RBM {p. 5871}	NC_NR_DTC_FMT {p. 5757}	NC_NR_ENVD_CUS_CMN {p. 5793}	NC_NR_ENVD_CUS_SET_ CMN {p. 5793}
NC_NR_ENVD_CUS_SET_ SPC {p. 5793}	NC_NR_ENVD_OBD {p. 5793}	NC_NR_ENVD_PREV {p. 5793}	NC_NR_ERR_DYN {p. 5768}
NC_NR_ERR_HIS {p. 5821}	NC_NR_ERR_INTM {p. 4610}	NC_NR_ERR_PERM {p. 5842}	NC_NR_FRF_SET {p. 5793}
NC_NR_HIS {p. 5821}	NC_NR_LAMP {p. 5840}	NC_NR_SYM_XX {p. 4640}	NC_NR_WIN_SCDN {p. 5885}
NC_STATE_STST_ENA {p. 628}	NLC_ABC_INI_DC_END_ DIAG {p. 4581}	NLC_BENCH_MODE {p. 4581}	NLC_CTR_OCC_ENA {p. 5768}
NLC_INC_ERR_PRI {p. 5853}	NLC_MIL_ACT_REQ {p. 5899}	NLC_OBD_DSL {p. 5789}	NLC_OBD_ENA_PRI_ PERM {p. 5853}
NLC_OBD_FRF_PND {p. 5695}	NLC_OLD_ERR_PRI {p. 5853}		

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ERR_DET_UPD	-	0... FFH	0... 255	1	-
Sporadic errors storage and visualisation modes (0: disabled, 1:enabled, 2:enabled with enhanced information)					
NLC_CAN_LAMP_ACT	-	0... 1H	0 ...1	1	-
Selection of the strategy to drive warning lamps (0: wire, 1: CAN)					
NLC_ENA_MULTI_CDN	-	0... 1H	0 ...1	1	-
Activation/deactivation of multi-condition debounce algorithm (0: disabled, 1: enabled)					
NLC_ENA_SCDN	-	0... 1H	0 ...1	1	-
Boolean to indicate if similar conditions functionality is present (1) or not (0)					
NLC_ENA_SCDN_NEW	-	0... 1H	0 ...1	1	-
Activation of old/new similar conditions functionality (0:old strategy, 1:new strategy)					
NLC_ENA_SYM_DIAG_AD	-	0... 1H	0 ...1	1	-
Activation/deactivation of adaptations modules for symptom based diagnostics connection					
NLC_OBD_PERM_ENA	-	0... 1H	0 ...1	1	-
Activation/deactivation of permanent fault code functionality (0: disabled, 1: enabled)					
NLC_OBD_RBM_ENA	-	0... 1H	0 ...1	1	-
Activation of rate-based monitoring functionality (0: disabled, 1: enabled)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_OBD_READY_CAL	-	0... 1H	0 ...1	1	-
Activation/deactivation of calibratable readiness classes					

### 1.22.1 Global configuration data

There is no global configuration data defined in this aggregate.

Data	Value
	Typical values are listed below
NLC_CAN_LAMP_ACT	1 Warning lamps interface type 0: warning lamps hardwired to ECU <b>1: warning lamps status sended to CAN inter-system</b>
NC_ERR_DET_UPD	0 Configuration for all diagnoses : <b>00H: no sporadic error detection</b> 01H: sporadic error detection 02H: sporadic error detection with extended information
NLC_ENA_MULTI_CDN	1 Activation/deactivation of multi-condition debounce algorithm 0 : Multi-condition debounce algorithm unused <b>1 : Multi-condition debounce algorithm used</b>
NLC_ENA_SCDN	1 Similar conditions present or not : 0 : Similar conditions disable, acceptable for Europe applications. <b>1 : Similar conditions enable, for US applications</b>
NLC_ENA_SCDN_NEW	1 Old or new Similar conditions functionality used : 0 : old SCDN functionality used <b>1 : new SCDN functionality used</b>
NLC_OBD_RBM_ENA	1 Rate-based monitoring functionality present or not : 0 : Rate-based monitoring disabled <b>1 : Rate-based monitoring enabled</b>
NLC_OBD_PERM_ENA	1 Activation/deactivation of permanent fault code functionality (0: disabled, 1: enabled) 0 : disabled <b>1 : enabled</b>
NLC_OBD_READY_CAL	0 Activation/deactivation of calibratable readiness classes : <b>0 : readiness classes are not calibratable</b> 1 : readiness classes are calibratable
NLC_ENA_SYM_DIAG_AD	0 Activation/deactivation of adaptations modules for symptom based diagnostics : <b>0 : adaptation not required</b> 1 : adaptation used to connect symptom based diagnostics

### 1.22.2 Local configuration data, project specific for 4-cyl /6-cyl /8-cyl engines


Here are listed the configuration data, which are used only in the ERRM aggregate.

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Data	Value	
	Typical values are listed below	
NC_NR_ERR_DYN	10	Dynamic memory size (quantity of failures)
NLC_CTR_OCC_ENA	0	Configuration to enable or disable CTR_OCC computations : <b>0 : disabled (typical value)</b> 1 : enabled
NLC_OLD_ERR_PRI	0	Selection of old failure priority face to new failure : <b>0 : to give priority to new failure regarding old failure</b> 1: to give priority to old failure regarding new failure
NLC_INC_ERR_PRI	0	Enable/disable increased failure priority : Set this bit to 1 to enable increased failure priority <b>Set this bit to 0 to disable increased failure priority</b>
NC_ERR_PRI_H	6	Failure priority level linked to NLC_INC_ERR_PRI
NC_NR_ENVD_OBD		Size of OBD environmental data, Quantity of data byte
	40 64	If NC_CYL_NR = 4 or 6 If NC_CYL_NR = 8
NC_NR_ENVD_CUS_CMN	1	Number of different environment data (in bytes) which are common for all diagnosis instance (stored one time)
NC_NR_ENVD_CUS_SET_CMN		Number of different environment data bytes which are common for all diagnoses instances (stored many time)
	10 3	If USE_L6 = 1 If USE_L6 = 0
NC_NR_ENVD_CUS_SET_SPC	4	Number of different environment data bytes which are specific to each diagnosis instance (stored many time). Typical value is 4.
NC_NR_FRF_SET	3	Number of different environment data groups (sets) which can be stored for one freeze frame. Typical value is 3.
NC_NR_ENVD_PREV	See ENVD (AI) spec	Number of XX diagnostics using pre-stored freeze frame functionality 0: No pre-stored freeze frame functionality required 01h...FFh : Quantity of failure instances XX using pre-stored freeze frame.
NC_ENVD_CUS_CMN_UPD	1	Selection of FRF_CUS_CMN update method 0: FRF_CUS_CMN is not updated when failure status changes from "disappeared" to "temporary/confirmed". <b>1: FRF_CUS_CMN is updated when failure status changes from "disappeared" to "temporary/confirmed".</b>
NC_NR_WIN_SCDN	See SCDN (AI) Spec	Quantity of diagnosis using similar conditions - quantity of diagnosis
NC_NR_ERR_HIS	10	Size of history memory (quantity of failures)
NC_NR_HIS	9	Size of data stored for a single failure in history memory (quantity of data bytes)
NC_ERR_DTC_REQ_OBD	0	Selection of OBD DTC reading method, by symptom or failure : <b>0 : to read OBD DTC by symptom</b> 1 : to read OBD DTC by failure
NC_ERR_DTC_REQ_CUS	1	Selection of Customer DTC reading method, by symptom or failure 0 : to read Customer DTC by symptom <b>1 : to read Customer DTC by failure</b>

Data	Value	
	Typical values are listed below	
NC_ERR_DTC_CONF	3	<p>Selection of DTCs displaying strategies for ERR_DTC_IDX :</p> <p>1 : One unique global DTC whatever the symptom detected. The DTC is encoded according OBD J2012.</p> <p><b>3 : One unique global DTC whatever the symptom detected. The DTC is encoded according customer specific format.</b></p> <p>0 : One unique DTC which corresponds to the first symptom detected (ERR_SYM_MEM_IDX). The DTC is encoded according OBD J2012.</p> <p>2 : One unique DTC which corresponds to the first symptom detected (ERR_SYM_MEM_IDX). The DTC is encoded according customer specific format.</p> <p>4 : One unique DTC which corresponds to the last symptom detected (ERR_SYM_LST_IDX). The DTC is encoded according OBD J2012.</p> <p>5 : One unique DTC which corresponds to the last symptom detected (ERR_SYM_LST_IDX). The DTC is encoded according customer specific format.</p>
NC_LDP_1_DTC_TABLE_SIZE	1	Table size definition for ID_ERR_DTC_XX. Must be set to NC_NR_DTC_FMT+1.
NC_LDP_2_DTC_TABLE_SIZE	6	Table size definition for ID_ERR_DTC_XX. Must be set to 6 - NC_NR_DTC_FMT.
NC_LDP_2_DTC_MIS_TABLE_SIZE	NR Not used	Table size definition for ID_ERR_DTC_MIS. Must be to NC_CYL_NR+2.
NC_NR_DTC_FMT	0	<p>Selection of 6 or 10 DTCs configurations</p> <p>Defines 1 or 2 different DTC identifiers per symptom.</p> <p>Defintion with 1 DTC permits DTC usage in common for OBD and customer.</p> <p>0 : a single DTC per symptom (a single one for OBD and cutomer)</p> <p>1 : 2 DTCs defined per symptom (one for OBD, one for cutomer)</p>

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Data	Value	
	Typical values are listed below	
NC_MIL_CHK_TYP	2 3 3	Pre-drive check configuration Bit 0 = 0 : disable pre-drive check between "stalling event/engine start" Bit 0 = 1 : enable pre-drive check between "stalling event/engine start" Bit 1 = 0 : disable readiness status display during pre-drive check (MIL blinking) Bit 1 = 1 : enable readiness  If NC_CYL_NR = 4 OR NC_STATE_STST_ENA = 1 If NC_CYL_NR = 6 AND NC_STATE_STST_ENA = 0 If NC_CYL_NR = 8 AND NC_STATE_STST_ENA = 0
NLC_OBD_FRF_PND	0	Definition of the EOBD/CARB freeze frame strategy : 0 : EOBD/CARB freeze frame data of Mode 02h will be returned after detection of a confirmed failure 1 : EOBD/CARB freeze frame data of Mode 02h will be returned : - after detection of a confirmed emission relevant failure if confirmed in memory - after pending emission relevant detection if not confirmed in memory
NC_NR_DIAG_RBM	See RBM(AI) Spec	Instance number (1...255) of monitors with real in-use performances tracked by the Rate-Based monitoring functionality.
NC_NR_LAMP	0	Number of warning lamps
NC_NR_ERR_PERM	5	Maximum number of failure defined in permanent failure memory structure (CARB required minimum value : 4) - If NLC_OBD_PERM_ENA = 1 then NC_NR_ERR_PERM must be greater than or equal to 4 (US configuration) - If NLC_OBD_PERM_ENA = 0 then NC_NR_ERR_PERM must be set to 1 (not CARB compliant)
NLC_OBD_ENA_PRI_PERM	1	Activation/deactivation of special priority rule treatment for failures which are permanent 0: permanent failures are not protected <b>1: permanent failures are protected (typical value mandatory for US projects)</b>
NLC_OBD_DSL	0	Selection of engine type : gasoline (0) or diesel (1)
NLC_MIL_ACT_REQ	0	External MIL request is taken or not into account for DIST_ACT_MIL and T_ACT_MIL calculations. 0 : External MIL request not taken into account 1 : External MIL request taken into account

Data	Value	
	Typical values are listed below	
Filters		
NC_NR_SYM_XX	07H	Available symptom(s) for XX diagnostic. This constant is used in the multicondition filtering algorithm. 03H: Symptoms 0 and 1 available <b>07H: Symptoms 0, 1 and 2 available (typical value)</b> 0FH: Symptoms 0, 1, 2 and 3 available Please take note that this configuration shall be mentioned in "table of failure" module for each diagnosis.
NC_ABC_CONF_FCT_DIAG_XX	**)	Configuration depends on each diagnosis XX behaviour : 00h: Standard configuration STD <b>03h: Standard configuration STD_INI with initialisation(only this config is available for multicondition)</b> 0Bh: memory configuration MEM 0Eh: memory configuration MEM_INI 10h: decrement calibration configuration DEC_CAL 13h: statistical configuration STC  **) see Initialization of each diagnosis
NLC_ABC_INI_DC_END_DIAG	1	Initialisation of LV_END_DIAG_XX at LV_DC transition or not : 00h : Initialisation of LV_END_DIAG_XX at LV_IGK 0→1 transition or ECU reset <b>01h : Initialisation of LV_END_DIAG_XX at LV_DC 0→1 transition</b>
NC_NR_ERR_INTM	1	Size of the sporadic error memory. When NC_ERR_DET_UPD = 00H, then NC_NR_ERR_INTM must be set to 1.
NLC_BENCH_MODE	1  0	Bench mode configuration. The maximum CPU optimisation is reached when NLC_BENCH_MODE =0.  1 : bench mode activation is possible when LC_ABC_BENCH = 1 0 : bench mode can't be activated whatever LC_ABC_BENCH = 0  For all Production - SW releases bench mark must be deactivated

## 1.23 EGCP Configuration data

### Input data:

NC_FAC_10_SAMPLE {p. 1342}	NC_FAC_5_SAMPLE {p. 1342}	NC_FAC_R_REF_LS_ DOWN {p. 1367}	NC_LSHPWM_BOL_LSH_ DOWN {p. 2423}
NC_LSHPWM_BOL_LSH_ UP {p. 2389}	NC_LSHPWM_TOL_LSH_ DOWN {p. 2423}	NC_LSHPWM_TOL_LSH_ UP {p. 2389}	NC_N_MIN_VLS_UP_MV {p. 1342}
NC_NR_BUF_SAMPLE_ LEN {p. 1342}	NC_NR_BUF_SUM_LEN {p. 1343}	NC_NR_RAW_BUF_LEN {p. 1343}	NC_PSD_DLY_LSH_ DOWN {p. 4249}
NC_PSD_DLY_LSH_UP {p. 4316}	NC_R_REF_LS_DOWN {p. 1367}	NC_T_SEG_LEN_MIN {p. 1343}	NC_VLS_DOWN_CUR_ PUMP_REF {p. 1367}

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CBK_EX_NR	-	1... 4H	1 ...4	1	-
Number of exhaust cylinder banks					
NC_FAC_MAF_INT_20	-	0... FFFFH	0... 0.89236	13.5999e-6	s
unit adaptation factor					
NC_FRQ_LSHPWM_DOWN	-	0... FFFFH	0... 4095.9375	0.0625	Hz
PWM frequency for the downstream oxygen sensor heater					
NC_FRQ_LSHPWM_UP	-	0... FFFFH	0... 4095.9375	0.0625	Hz
PWM frequency for the upstream oxygen sensor heater					
NC_NR_CONF_LSH_RLY	-	0... 7H	0 ...7	1	-
Numerical constant which describes the lambda sensor heater wiring					
NC_STATE_LSL_UP_IF	-	0... 7H	0 ...7	1	-
Interface to lambda sensor linear upstream					
NC_STATE_VLS_UP_SIG_ACQ	-	0... 7H	0 ...7	1	-
Configuration switch for optional signal acquisition					
NLC_LSH_RLY_EFP	-	0... 1H	0 ...1	1	-
Configuration switch to indicate whether lambda sensor heater is connected to EFP or main relay					

### 1.23.1 Global configuration data

Here are listed the configuration data specific for the projects using the Tricore processor and which can be used in other aggregates:

ATTENTION: NC\_CBK\_EX\_NR has the value 2 for 4 and 6 cylinder engines. For N43 UL the second bank is virtual to fit the system.

Data	Value
NC_CBK_EX_NR	2
NC_STATE_LSL_UP_IF	1
NC_STATE_VLS_UP_SIG_ACQ	1
NC_FRQ_LSHPWM_UP	100 Hz
NC_FRQ_LSHPWM_DOWN	10 Hz
NC_PSD_DLY_LSH_UP	2
NC_PSD_DLY_LSH_DOWN	2
NC_FAC_R_REF_LS_DOWN	0.07957
NC_R_REF_LS_DOWN	3740 Ohm
NC_VLS_DOWN_CUR_PUMP_REF	3.22 V

### 1.23.2 Local configuration data

Here are listed the configuration data, which are used only in the EGCP aggregate.

Data	Value
NC_LSHPWM_BOL_LSH_DOWN	1 %
NC_LSHPWM_TOL_LSH_DOWN	99 %
NC_LSHPWM_BOL_LSH_UP	0 %
NC_LSHPWM_TOL_LSH_UP	97.265625 %
NC_FAC_10_SAMPLE	2
NC_FAC_5_SAMPLE	4
NC_NR_BUF_SAMPLE_LEN	12
NC_NR_RAW_BUF_LEN	10
NC_N_MIN_VLS_UP_MV	500 rpm
NC_T_SEG_LEN_MIN	0.01 s
NC_NR_BUF_SUM_LEN	24
NLC_LSH_RLY_EFP	0
NC_NR_CONF_LSH_RLY	0
NC_FAC_MAF_INT_20	20/3.6 msec

#### Notes:

- The configuration switch *NC\_STATE\_VLS\_UP\_SIG\_ACQ* denotes whether signal filtering shall be applied to the linear lambda sensor's raw signal provided by the BSW prior to further signal processing. If signal filtering shall be applied *NC\_STATE\_VLS\_UP\_SIG\_ACQ* shall be set to 1. If not or if binary upstream sensor is used *NC\_STATE\_VLS\_UP\_SIG\_ACQ* shall be set to 0.
- The PWM frequency for the oxygen sensor heater must be adjusted to values larger than 5Hz, i.e.  $NC\_FRQ\_LSHPWM\_UP \geq 5Hz$  and  $NC\_FRQ\_LSHPWM\_DOWN \geq 5Hz$ . Usually no values larger than 100 Hz are applied, the exact value has to be derived from the corresponding sensor specification.

## 1.24 FUSL Configuration data

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_V_CUR_VCV_MES	-	0... 2H	0 ...2	1	-
Value to select ECU with VCV shunt or not (0= not shunt, 1= shunt available, 2= feedback from ATIC)					

### FUNCTION DESCRIPTION:

#### 1.24.1 Local configuration data ECU with current feedback of VCV via ATIC 39

Data	Value (physical)
NC_V_CUR_VCV_MES	2 [2H]

The following data is stored in the flash at end of ECU production and the values will never change during ECU live. The values are used to reduce the tolerances of the current feedback of the ATIC 39 for the VCV current control.

Name	Dim	Hex. limits	Phys. limits	Resol.	Unit
C_V_CUR_VCV_BOOT_H	1	8000...7FFFH	-5...4.99984	0.1526e-3	[V]
Measured voltage at high current					
C_V_CUR_VCV_BOOT_H_CMPL	1	8000...7FFFH	-5...4.99984	0.1526e-3	[V]
Measured voltage at high current complement					
C_V_CUR_VCV_BOOT_L	1	8000...7FFFH	-5...4.99984	0.1526e-3	[V]
Measured voltage at low current					
C_V_CUR_VCV_BOOT_L_CMPL	1	8000...7FFFH	-5...4.99984	0.1526e-3	[V]
Measured voltage at low current complement					

## 1.25 Variant coding

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CAM_TYPE	O/V	0H 1H 2H	3_SEG 4_SEG_SYM 4_SEG_ASYM	-	-
configuration of camshaft sensor disc					
CONF_OIL_LEVEL_SENS	O/V	0... 2H	0 ...2	1	-
configuration of EFP-control					
CONF_SOF_SWI	O/V/S	0H 1H 2H	NO_SOF_SWI SOF_SWI SOF_SWI_ AMT	-	-
Configuration of sport-switch					
CONF_SWI_EFP_OUT	O/V	0... 2H	0 ...2	1	-
configuration of EFP-control					
CTR_AVL_MAF	V	0... FFFFFFFFH	0... 4294967295	1	-
Counter HFM learning function for case HFM is available					
CTR_LRN_ECU	-	0... FFH	0... 255	1	-
Timeout counter for learning					
CTR_LRN_ECU_OK_B0_LOT0	-	0... FFH	0... 255	1	-
good counter for B0_LOT0 detection					
CTR_LRN_ECU_OK_C1_LOT1	-	0... FFH	0... 255	1	-
good counter for C1_LOT1 detection					
CTR_LRN_ECU_OK_C2_LOT2	-	0... FFH	0... 255	1	-
good counter for C2_LOT2 detection					
CTR_LRN_ECU_OK_C2_SERIAL	-	0... FFH	0... 255	1	-
good counter for C2_SERIAL detection					
CTR_NOT_AVL_MAF	V	0... FFFFFFFFH	0... 4294967295	1	-
Counter HFM learning function for case HFM not available					
ECU_LOCK_REQ	O/V	0... 1H	0 ...1	1	-
Bit indicating ECU locked					
LV_AT	O/V	0... 1H	0 ...1	1	-
Gearbox is an automatic gearbox					
LV_CBK_MPL	O/V	0... 1H	0 ...1	1	-
logical variable multiple cylinder banks (0 = single bank, 1 = multiple banks, presently not available)					
LV_CONF_DMTL	O/V	0... 1H	0 ...1	1	-
configuration of DMTL					
LV_INJ_CONF	O/V	0... 1H	0 ...1	1	-
logical variable injection configuration (0 = intake manifold injection, 1 = direct injection)					
LV_ISA_CONF	O/V	0... 1H	0 ...1	1	-
logical variable idle speed actuator configuration (0 = no idle speed actuator, 1 = idle speed actuator)					
LV_IVVT_IN_AND_EX	O/V	0... 1H	0 ...1	1	-
logical variable IVVT (0 = inlet cam variable, 1 = inlet & exhaust cam variable)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_VAR_4WD	O/V/S	0... 1H	0 ...1	1	-
Logical variable indicating an 4 wheel drive variant					
LV_VAR_ACIN	O/V/S	0... 1H	0 ...1	1	-
air conditioning recognized					
LV_VAR_AEB	O/V/S	0... 1H	0 ...1	1	-
Active engine bracket configured [stored]					
LV_VAR_AMT	O/V/S	0... 1H	0 ...1	1	-
SSG-transmission recognized					
LV_VAR_ARS	O/V/S	0... 1H	0 ...1	1	-
LV anti-roll-stabilisation detected - BN2000					
LV_VAR_ASR	O/V/S	0... 1H	0 ...1	1	-
ASR device recognised					
LV_VAR_ASR_3	O/V/S	0... 1H	0 ...1	1	-
ASR 3 device recognised					
LV_VAR_ASR_4	O/V/S	0... 1H	0 ...1	1	-
ASR 4 device recognised					
LV_VAR_BN	O/V	0... 1H	0 ...1	1	-
PT-CAN Variant (0 = CAN11h /1= BN2000)					
LV_VAR_BN_EFP	O/V/S	0... 1H	0 ...1	1	-
EFP via CAN recognised (BN2000 only)					
LV_VAR_BN_GEAR_REV	O/V/S	0... 1H	0 ...1	1	-
reverse gear via CAN recognised (BN2000/E60 - MT only)					
LV_VAR_BN_LDM	O/V/S	0... 1H	0 ...1	1	-
LDM detected (E9x only)					
LV_VAR_BN_LTG_HDLP_L	O/V/S	0... 1H	0 ...1	1	-
Dipped Beam via CAN recognised (BN2000 only)					
LV_VAR_BN_MSW	O/V/S	0... 1H	0 ...1	1	-
LV cruise control detected - BN2000					
LV_VAR_BN_TRL	O/V/S	0... 1H	0 ...1	1	-
TRL detected					
LV_VAR_DCC	O/V/S	0... 1H	0 ...1	1	-
LV distance cruise control detected - BN2000					
LV_VAR_EBOX_CFA	O/V/S	0... 1H	0 ...1	1	-
variant of E-box-fan recognised					
LV_VAR_ECRAS_UP	O/V/S	0... 1H	0 ...1	1	-
ECRAS system with ECRAS_UP flap detected (2 flap system)					
LV_VAR_EF	O/V/S	0... 1H	0 ...1	1	-
variant of exhaust flap recognised					
LV_VAR_EFP_CRASH	O/V/S	0... 1H	0 ...1	1	-
EFP_CRASH-message detected					
LV_VAR_ETCU	O/V/S	0... 1H	0 ...1	1	-
BN (SSG or EGS)-transmission recognised					
LV_VAR_ETCU_3	O/V/S	0... 1H	0 ...1	1	-
Transmission control unit, using 'Getriebedaten 3' message detected					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_VAR_ETCU_SPT	S	0... 1H	0 ...1	1	-
variant sport gear box					
LV_VAR_ICL	O/V	0... 1H	0 ...1	1	-
CAN instrument cluster ("Kombiinstrument") recognised					
LV_VAR_LSH_DOWN	O/V/S	0... 1H	0 ...1	1	-
variant of CAT/exhaust type with upstream + downstream lambda sensors recognised					
LV_VAR_LSH_UP	O/V/S	0... 1H	0 ...1	1	-
Variant of CAT/exhaust type with upstream lambda sensors recognized					
LV_VAR_MAF	O/V/S	0... 1H	0 ...1	1	-
variant mass air flow meter					
LV_VAR_MAF_LEARNT	O/V	0... 1H	0 ...1	1	-
HFM learning function has been carried out					
LV_VAR_MSW	O/V/S	0... 1H	0 ...1	1	-
LV cruise control detected					
LV_VAR_NOX	O/V	0... 1H	0 ...1	1	-
NOx sensor message detected					
LV_VAR_PBR	O/V/S	0... 1H	0 ...1	1	-
Bit indicating electro-mechanical park brake variant					
LV_VAR_PSTE	O/V/S	0... 1H	0 ...1	1	-
LV power steering detected - BN2000					
LV_VAR_PSTE_2	O/V/S	0... 1H	0 ...1	1	-
PSTE_2 device recognized (BN2000 only)					
LV_VAR_PSTE_3	O/V/S	0... 1H	0 ...1	1	-
PSTE 3 (EHB3) device detected					
LV_VAR_RLY_ACCOUT	O/V/S	0... 1H	0 ...1	1	-
variant of ACC-relay recognised					
LV_VAR_RLY_ST	O/V/S	0... 1H	0 ...1	1	-
variant of starter relay recognised					
LV_VAR_SOF	O/V/S	0... 1H	0 ...1	1	-
variant of sound-flap					
LV_VAR_SPT_SWI	O/V	0... 1H	0 ...1	1	-
Sport switch available (M-Drive)					
LV_VAR_TCHA	O/V	0... 1H	0 ...1	1	-
Configuration for turbo charger					
LV_VAR_TCO_2	O/V	0... 1H	0 ...1	1	-
TCO_2 sensor is available (=1)					
LV_VAR_TCT	O/V/S	0... 1H	0 ...1	1	-
TCT-transmission recognised					
LV_VAR_TQ_PBR	O/V/S	0... 1H	0 ...1	1	-
Bit indicating electro-mechanical park brake torque request information variant					
LV_VAR_VEH	O/V	0... 1H	0 ...1	1	-
Vehicle Variant with power module recognised - BN2000 only					
PSN_LS	O/V	0... FFH	0... 255	1	-
OBD-communication, OS-configuration Mode01 PID13					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
PSN_LS_1	O/V	0... FFH	0... 255	1	-
OBD-communication, OS-configuration Mode01 PID1D					
St_varkat	O/V	0... FFH	0... 255	1	-
Status Variante Abgasanlage (mono/stereo)					
STATE_LRN_ECU	O/V/S	0H 1111H 2A2AH 4E4EH 5A5AH A2A2H A5A5H AEAEH BCBCH E4E4H FFFFH	NOT_ LEARNED FAILED_C1_ LOT1 C2_LOT3 B0_LOT0 C1_LOT2 C2_LOT2 C1_LOT3 SERIAL_ECU C2_LOT1 NOT_ LEARNED ROM_NOT_ PLAUSLEARN- ING_	-	-
Variant ECU (MSD81)					
STATE_VAR_DET_CUS_1	O/V	0... FFFFFFFFH	0... 4294967295	1	-
carrier double-word 1 of all learned variants for customer environment					
STATE_VAR_DET_CUS_2	O/V	0... FFFFFFFFH	0... 4294967295	1	-
carrier double-word 2 of all learned variants for customer environment					
VAR_VEH	O/V	0H 1H 2H	E60 E65 PL2	-	-
Vehicle variant					
VIM_TYPE	O/V	0H 1H	CLOSED_ LOOP SWITCHED	-	-
VIM configuration					

**Input data:**

LC_AD_CLR_VAR {p. 528}	LV_ACCIN {p. 1564}	LV_ACIN {p. 1564}	LV_CDN_VB_MIN_DIAG {p. 1185}
LV_ES {p. 1720}	LV_SOF_SWI {p. 3851}	LV_SOF_SWI_AMT {p. 3851}	N {p. 1525}
NC_CBK_EX_NR {p. 1829}	NC_FLS_DFT	NC_HW_REV	STATE_ETCU_SPT_SWI {p. 1574}
STATE_PSTE_3_SRC {p. 1576}	T_PER_MAF_FRQ_BAS [NC_MAF_NR] {p. 834}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CONF_AEB	-	0... FFH	0... 255	1	-
Configuration of active engine brackets learning					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CONF_CAT	-	0... 3H	0 ...3	1	-
Configuration of exhaust type learning					
C_CONF_DMTL	-	0... 1H	0 ...1	1	-
configuration bit for tank leakage detection					
C_CONF_OIL_LEVEL_SENS	-	0... 2H	0 ...2	1	-
configuration bit for EFP - control					
C_CONF_SWI_EFP_OUT	-	0... 2H	0 ...2	1	-
configuration bit for EFP - control					
C_CTR_AVL_MAF	-	0... FFFFFFFFH	0... 4294967295	1	-
Minimum cycle number to learn HFM component is available					
C_CTR_NOT_AVL_MAF	-	0... FFFFFFFFH	0... 4294967295	1	-
Minimum cycle number to learn HFM component is not available					
C_LEARN_HFM_OVERRIDE	-	0... 2H	0 ...2	1	-
Overwrite HFM learning: 0 = HFM learning enabled, 1 = HFM is available, 2 = HFM is not available					
C_N_VAR_DIS_ER	-	0... FFH	0... 8160	32	rpm
switch off threshold for engine roughness					
C_N_VAR_DIS_INJ	-	0... FFH	0... 8160	32	rpm
switch off threshold for cylinder balancing					
C_N_VAR_DIS_MISF	-	0... FFH	0... 8160	32	rpm
switch off threshold for misfire					
C_T_DET_VAR_CAN	-	0... FFH	0... 255	1	s
time for learning variants via CAN after ignition key on					
C_T_PER_MAF_FRQ_AVL_MAX	-	0... FFFFH	0... 65535	1	µs
max Threshold to learn frequency HFM component					
C_T_PER_MAF_FRQ_AVL_MIN	-	0... FFFFH	0... 65535	1	µs
min Threshold to learn frequency HFM component					
C_VAR_VEH	-	0H 1H 2H	E60 E65 PL2	-	-
vehicle configuration code					
LC_TCHA_CONF	-	0... 1H	0 ...1	1	-
System configuration flag for turbo charged engine (=1), for naturally aspirated engine (=0)					
LC_VAR_DIS_CRU	-	0... 1H	0 ...1	1	-
switch off function cruise control					
LC_VAR_DIS_DMTL	-	0... 1H	0 ...1	1	-
Switch off tank leakage diagnosis					
LC_VAR_DIS_NOX	-	0... 1H	0 ...1	1	-
switch off function for NOx functions					
LC_VAR_DIS_S_FCT	-	0... 1H	0 ...1	1	-
Switch off stratified functions					
LC_VAR_DIS_TQ_LOSS_ARS	-	0... 1H	0 ...1	1	-
Switch off function torque loss anti-roll-stabilization					



3) Variant is Twin clutch transmission with BN2000 :  
 LV\_VAR\_TCT = 1  
 LV\_VAR\_AMT = 0  
 LV\_AT = 0

Re-learning conditions:

receiving CAN message DREHMOMENT\_ANF\_DKG (BN2000)

4) Variant is Automated manual transmission (SSG) with BN2000 :  
 LV\_AT = 0  
 LV\_VAR\_AMT = 1  
 LV\_VAR\_TCT = 0

Re-learning conditions:

receiving CAN message DREHMOMENT\_ANF\_SSG (BN2000)

additional 1) Variant is BN 2000 transmission (SSG, DKG or EGS) :  
 LV\_VAR\_ETCU = 1

Re-learning conditions:

receiving CAN message GETRIEBEDATEN (BN2000)

additional 2) Variant is BN 2000 sportgear box" (DKG or EGS) :  
 LV\_VAR\_ETCU\_SPT = 1

Re-learning conditions:

receiving STATE\_ETCU\_SPT\_SWI = 1 of CAN message GETRIEBEDATEN\_2 (BN2000)

#### Air conditioner

1) Vehicle without air conditioner LV\_VAR\_ACIN = 0  
 2) Vehicle with air conditioner LV\_VAR\_ACIN = 1

Re-learning conditions:

receiving the LV\_ACCIN bit (STATE\_ACIN\_CAN > 0H) of CAN message  
 WAERMESTROM\_KLIMA (IHKA, BN2000).

#### Dashboard with CAN interface

All vehicles are equipped with dashboard therefore

LV\_VAR\_ICL = 1 //default value

#### Vehicle with ASR device

1) Vehicle without ASR LV\_VAR\_ASR = 0  
 2) Vehicle with ASR LV\_VAR\_ASR = 1

Re-learning conditions:

receiving CAN message DREHMOMENT\_ANF\_DSC (BN2000)

LV\_VAR\_ASR\_3 = 0  
 LV\_VAR\_ASR\_4 = 0  
 LV\_VAR\_MSW = 0


#### BN-Vehicle with Multifunctional steering wheel (CRU interface) - (BN2000 only)

1) Vehicle without multifunctional steering wheel LV\_VAR\_BN\_MSW = 0  
 2) Vehicle with multifunctional steering wheel LV\_VAR\_BN\_MSW = 1

Re-learning conditions: receiving CAN-message BEDIENUNG\_TEMPOMAT (SZ-Lenksäule)

#### Vehicle with PSTE (Power steering) device

1) Vehicle without PSTE LV\_VAR\_PSTE = 0

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2) Vehicle with PSTE LV\_VAR\_PSTE = 1  
 Re-learning conditions:  
 receiving CAN message LENKRADWINKEL (SZ-Lenksäule, BN2000)

**Distance Cruise Control (BN2000 only)**

1) Vehicle without DCC LV\_VAR\_DCC = 0  
 2) Vehicle with DCC LV\_VAR\_DCC = 1  
 Re-learning conditions:  
 receiving the CAN message DREHMOMENT\_ANF\_ACC (ACC, BN2000)

**Anti-roll-stabilisation (BN2000 only)**

1) Vehicle without ARS LV\_VAR\_ARS = 0  
 2) Vehicle with ARS LV\_VAR\_ARS = 1  
 Re-learning conditions: receiving the CAN message STAT\_ARS (ARS, BN2000)

**Active Front Steering (BN2000 only)**

1) Vehicle without AFS LV\_VAR\_PSTE\_2 = 0  
 2) Vehicle with AFS LV\_VAR\_PSTE\_2 = 1  
 Re-learning conditions:  
 receiving the CAN message DREHMOMENT\_ANF\_AFS (AFS, BN2000)

**Electrical Fuel Pump (BN2000 only)**

1) Vehicle without EFP-control-unit LV\_VAR\_BN\_EFP = 0  
 2) Vehicle with EFP-control-unit LV\_VAR\_BN\_EFP = 1  
 Re-learning conditions: receiving the CAN message STAT\_EKP (EKP, BN2000)

**Reverse Gear via CAN (E60 - MT only)**

1) MT-Vehicle without GEAR\_REV LV\_VAR\_BN\_GEAR\_REV = 0  
 2) MT-Vehicle with GEAR\_REV LV\_VAR\_BN\_GEAR\_REV = 1  
 Re-learning conditions:  
 receiving the CAN message STAT\_GANG\_RUECKWAERTS (LM, BN2000)

**Dipped Beam via CAN (BN2000 only)**

1) Vehicle without LTG\_HDLP\_L LV\_VAR\_BN\_LTG\_HDLP\_L = 0  
 2) Vehicle with LTG\_HDLP\_L LV\_VAR\_BN\_LTG\_HDLP\_L = 1  
 Re-learning conditions: receiving the CAN message LAMPENZUSTAND (LM, BN2000)

**Längsdynamikmodul (Longitudinal dynamics module) - LDM (E9x only)**

1) Vehicle without LDM LV\_VAR\_BN\_LDM = 0  
 2) Vehicle with LDM LV\_VAR\_BN\_LDM = 1  
 Re-learning conditions:  
 receiving the CAN message "Anforderung Radmoment Antriebsstrang" (LDM, BN2000)


**Status Anhänger (State Trailer) - TRL (BN2000 only)**

1) Vehicle without TRL LV\_VAR\_BN\_TRL = 0  
 2) Vehicle with TRL LV\_VAR\_BN\_TRL = 1  
 Re-learning conditions:  
 receiving the CAN message STAT\_ANHAENGER (K-CAN/AHM, BN2000)

**Steuerung Crashabschaltung EKP (BN2000 only)**

1) Vehicle without EKP\_CRASH on CAN LV\_VAR\_EFP\_CRASH = 0  
 2) Vehicle with EKP\_CRASH on CAN LV\_VAR\_EFP\_CRASH = 1

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Re-learning conditions:

receiving the CAN message CTR\_CRASH\_SWO\_EKP (MRSZ, BN2000)

**EHB3 - Steering (BN2000 only)**

- 1) Vehicle without EHB3 LV\_VAR\_PSTE\_3 = 0
- 2) Vehicle with EHB3 LV\_VAR\_PSTE\_3 = 1

Re-learning conditions:

receiving the CAN message DREHMOMENT\_ANF\_STE (EHB3, BN2000)

**NOx - sensor**

IF LC\_VAR\_NOX = 1

THEN

LV\_VAR\_NOX = 1

ELSE

Learning of NOx - sensor

- 1) Vehicle without NOx - sensor LV\_VAR\_NOX = 0
- 2) Vehicle with NOx - sensor LV\_VAR\_NOX = 1

Re-learning conditions:

receiving the CAN message ID = 130h or ID = 135h on LoCAN

ENDIF

**PBR - park brake (EMF) (BN2000 only)**

- 1. vehicle without PBR: LV\_VAR\_PBR = 0
- 2. vehicle with PBR: LV\_VAR\_PBR = 1

Re-learning conditions:

Receiving the CAN message STATUS\_EMF (EMF, BN2000)

**TQ\_PBR - park brake torque information (EMF) (BN2000 only)**

- 1. vehicle without TQ\_PBR: LV\_VAR\_TQ\_PBR = 0
- 2. vehicle with TQ\_PBR: LV\_VAR\_TQ\_PBR = 1

Re-learning conditions:

Receiving the CAN message ST\_RQ\_EMF (EMF, BN2000)

**Getriebedaten 3 - some transmission control units (BN2000 only)**

- 1) Vehicle without ETCU\_3 LV\_VAR\_ETCU\_3 = 0
- 2) Vehicle with ETCU\_3 LV\_VAR\_ETCU\_3 = 1

Re-learning conditions:

receiving the CAN message GETRIEBEDATEN\_3 (EGS\_EL, BN2000)

**Sollmomentanforderung - DXC message (BN2000 only)**

- 1) Vehicle without DXC LV\_VAR\_4WD = 0
- 2) Vehicle with DXC LV\_VAR\_4WD = 1

Re-learning conditions:

receiving the CAN message SOLL\_MOM\_ANF (DXC, BN2000)

**1.25.2.1 Sport-Switch /Sound-Flap**

Sport-Mode-Switch:

Two states have been defined for automatic learning of the Sport-Switch interface:

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- 1) Vehicle without Sport-Switch
- 2) Vehicle with Sport-Switch (normal sport switch /AMT sport switch)

The state which is valid in each case is saved in the non-volatile memory after the ECU holding phase. The state is initialized with 1) in the case of a new control unit and when the variant is reseted .

Re-learning from the 1 variant to 2 variant is possible at each engine operating state. Learning is based on the evaluation of LV\_SOF\_SWI or LV\_SOF\_SWI\_AMT (Switch pressed).

At each engine operating state the learning is effected.

```

If          CONF_SOF_SWI = 0
  Then If    LV_SOF_SWI = 1
    Then      CONF_SOF_SWI = 1
    Else      If          LV_SOF_SWI_AMT = 1
      Then      CONF_SOF_SWI = 2
      Else      CONF_SOF_SWI = 0
      Endif
    Endif
  Else      CONF_SOF_SWI = CONF_SOF_SWI
Endif
  
```

### Application conditions

**Initialisation:** *in case of new control unit: CONF\_SOF\_SWI = 0*

**Recurrence:** *100ms*

**Activation:** *at every engine operating state*

Meaning of CONF\_SOF\_SWI:

- 0: no Sport-switch
- 1: Sport-switch
- 2: Sport-switch AMT^

### 1.25.2.2 Automatically learnt variants by power stage diagnosis

#### FUNCTION DESCRIPTION:

##### Description:

The components which are automatically learnt by powerstage diagnosis are:

--> see table in formula section.


The learning of the lambda sensors (here: via diagnosis of the lambda sensor heater) is a special case, because only specific combinations of the possibilities are valid.

Two states have been defined:

- 1) Vehicle without component EF, etc.
- 2) Vehicle with component EF, etc.

The state which is valid in each case is saved in the non-volatile memory after the ECU holding phase. The state is initialized with 1) in the case of a new control unit and when the variant is reset.

The re-learning from state 1) to state 2) is done only once after each ECU-initialisation (if the activation conditions are fulfilled). If a variant has been learnt and is afterwards reset to zero (via LC\_AD\_CLR\_VAR), relearning is only possible after reset.

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Learning of the components is based on the evaluation of the powerstage diagnosis of the related components. Therefore the components have to be activated for the learning cycle in order to get a proper power stage diagnosis. In state 1) the diagnosis is effected, however, an entry into the failure memory is suppressed.

The diagnosis result of the first 100ms-(or 200ms-)cycle must be rejected (due to initialisation). From the second cycle on the diagnosis is effected 10 times (1 check per recurrence). If at least 7 checks are error-free (symptom open load is zero) and valid (in case of LV\_VAR\_xxx = 0), the variant EF, ECRAS\_UP, EBOX\_CFA, AEB etc. has been learnt and LV\_VAR\_xxx = 1. With this state, the related powerstage diagnosis is cleared completely, i.e. the error entry is enabled.

If the variant LV\_VAR\_ECRAS\_UP has been learnt, the detection of the ECRAS\_DOWN variant (the lower ECRAS flap) is enabled (LV\_VAR\_ECRAS\_DOWN). The algorithm and setting of LV\_VAR\_ECRAS\_DOWN is done in ECRAS diagnosis module, not in the variant coding module.

The variant LV\_VAR\_EBOX\_CFA is only learnt if LC\_VAR\_EBOX\_CFA = 0. If LC\_VAR\_EBOX\_CFA = 1, then LV\_VAR\_EBOX\_CFA is also set 1 without learning.

### Application conditions

**Initialisation:**

```

if new control unit or
   failure of nonvolatile memory recognized or
   LC_AD_CLR_VAR 01 then LV_
VAR_xxx = 0
LC_AD_CLR_SOF 01 then LV_VAR_SOF =
0
LV_VAR_TCHA 01 then LV_VAR_AEB
= 0
    
```

**Recurrence:**

```

200 ms LSH_UP/ _DOWN (due to low PWM frequency)
100 ms all other components
    
```

**Activation:**

```

after every reset (once):
if LV_CDN_VB_MIN_DIAG = 1 and
LV_VAR_xxx = 0
    
```


### Formula section:

Table for automatically learnt variants by power stage diagnosis - LV\_VAR\_xxx:

Component	Variant Keyword xxx	LV_VAR_xxx = 0	LV_VAR_xxx = 1
ACC-Relay	RLY_ACCOUT	no RLY_ACCOUT	RLY_ACCOUT
E-BOX-fan	EBOX_CFA	no EBOX_CFA	EBOX_CFA
Starter Relay	RLY_ST	no RLY_ST	RLY_ST
Electronically controlled radiator shutters (upper flap)	ECRAS_UP	no ECRAS_UP	ECRAS_UP
Exhaust flap	EF	no EF	EF
Sound flap	SOF	no SOF	SOF
Exhaust type	LSH_UP	no CAT, no lambda sensors	with CAT and lambda sensors
Exhaust type	LSH_DOWN	no monitor lambda sensors	with monitor lambda sensors
Active engine brackets	AEB	no AEB or LV_VAR_TCHA=1	AEB and LV_VAR_TCHA=0

### Learning of LV\_VAR\_EBOX\_CFA

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```

if          LC_VAR_EBOX_CFA = 1
then       LV_VAR_EBOX_CFA = 1
else       LV_VAR_EBOX_CFA learnt by power stage diag.
endif
    
```

*Configuration and learning of CAT/exhaust type*

```

If          C_CONF_CAT = 2                2 banks, control + monitor sensors    (no
learning)
then       LV_VAR_LSH_UP  = 1
            LV_VAR_LSH_DOWN = 1
endif
    
```

```

If          C_CONF_CAT = 1
then       learning of exhaust type:
            All 4 sensors will be checked by power stage diagnosis as mentioned above.
    
```

```

if          none of the 4 sensors is recognized                without CAT
then       LV_VAR_LSH_UP  = 0
            LV_VAR_LSH_DOWN = 0
if          none of the 2 monitor sensors (...DOWN...) is recognized but at least one
of the 2 control sensors (...UP...) is recognized                2 banks, control sensors
then       LV_VAR_LSH_UP  = 1
            LV_VAR_LSH_DOWN = 0

if          at least 1 of the 2 monitor sensors is recognized
                                                    2 banks, control + monitor sensors
then       LV_VAR_LSH_UP  = 1
            LV_VAR_LSH_DOWN = 1
    
```

**endif**

```

If          C_CONF_CAT = 0
then       limited learning of exhaust type:
            Only the 2 control sensors will be checked.
if          at least one sensor is recognized                2 banks, control sensors
then       LV_VAR_LSH_UP  = 1
            LV_VAR_LSH_DOWN = 0
Else       LV_VAR_LSH_UP  = 0
            LV_VAR_LSH_DOWN = 0                without CAT
    
```

**endif**

```

If          LV_VAR_LSH_UP = 0
then       no sensors available
            PSN_LS = 00000000 bin
            PSN_LS_1 = 00000000 bin
    
```

**Endif**

```

If          LV_VAR_LSH_UP = 1 and LV_VAR_LSH_DOWN = 0
then       PSN_LS = 00010001 bin(bank 1 sensor 1 and bank 2 sensor 1)
    
```

```

                PSN_LS_1 = 0000101 bin
endif

If            LV_VAR_LSH_UP = 1 and LV_VAR_LSH_DOWN = 1
then         PSN_LS = 00110011 bin(bank 1 sensor1/2 and bank 2 sensor 1/2)
                PSN_LS_1 = 00001111 bin
endif
    
```

### Configuration and learning of AEB/active engine brackets

```

If            C_CONF_AEB = 0
then         no learning of active engine brackets
elseif       C_CONF_AEB = 1
then         if            LV_VAR_TCHA = 0
                then learning of active engine brackets by powerstage diagnosis
                    else LV_VAR_AEB = 0
                        // variant active engine brackets only allowed in case of no turbo charger, because of
                        double pin reservation
                endif
elseif       C_CONF_AEB = 2
then         if            LV_VAR_TCHA = 0
                    then            LV_VAR_AEB = 1
                    else            LV_VAR_AEB = 0
                        // variant active engine brackets only allowed in case of no turbo charger, because of
                        double pin reservation
                endif
else         //same behavior like C_CONF_AEB = 1
learning of AEB:
Component AEB will be checked by power stage diagnosis as mentioned above.
    
```

## 1.25.3 Calibrateable or automatically learnt variants

### 1.25.3.1 Mass air flow meter ( HFM )

#### General information:

The aim of these function is to check the availability of a mass air flow meter (HFM). The function is solely active at initial operation. The learned availability of a HFM can be manually overwritten by the use of C\_LEARN\_HFM\_OVERRIDE.

#### Application conditions

**Initialisation:** LV\_VAR\_MAF = 0 at first reset, if learnt -> initialised from NVMY;  
 LV\_VAR\_MAF\_LEARNT = 0 at first reset, if learnt -> initialised from NVMY  
 CTR\_AVL\_MAF = 0 at reset  
 CTR\_NOT\_AVL\_MAF = 0 at reset

**Recurrence:** 10ms

**Activation:** **If** LV\_ES = 1

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## 1.25.5 Calibrateable Variants

### 1.25.5.1 Variant of DMTL

#### General information:

All calibratable variants are updated only during ECU initialization.

If a component is deactivated by variant coding, the related function and diagnosis will **not** be executed.

#### Application conditions

**Initialisation:**                    *at reset:*                     $LV\_CONF\_DMTL = C\_CONF\_DMTL$

**Recurrence:**                    -

**Activation:**                    *at every engine operating state*

**Deactivation:**                    -

#### Formula Section:

Meaning of LV\_CONF\_DMTL and C\_CONF\_DMTL

- 0 = no DMTL available, diagnosis of tank leakage detection is inhibited
- 1 = DMTL available, diagnosis of tank leakage detection is enabled

### 1.25.5.2 Variant of TCO\_2

#### General information:

All calibratable variants are updated only during ECU initialization.

If a component is deactivated by variant coding, the related function and diagnosis will **not** be executed.

#### Application conditions

**Initialisation:**                    *at reset:*                     $LV\_VAR\_TCO\_2 = LC\_VAR\_TCO\_2$

**Recurrence:**                    -

**Activation:**                    *at every engine operating state*


**Deactivation:**                    -

#### Formula Section:

Meaning of LV\_VAR\_TCO\_2 and LC\_VAR\_TCO\_2

- 0 = no TCO\_2 sensor available
- 1 = TCO\_2 sensor available

### 1.25.5.3 Variant for EFP-control

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### General information:

All calibratable variants are updated only during ECU initialization.  
If a component is deactivated by variant coding, the related function and diagnosis will **not** be executed.

### Application conditions

**Initialisation:**                    *at reset:*                    `CONF_SWI_EFP_OUT = C_CONF_SWI_EFP_OUT`  
**Recurrence:**                        `-`  
**Activation:**                        *at every engine operating state*  
**Deactivation:**                      `-`

### Formula Section:

Meaning of CONF\_SWI\_EFP\_OUT and C\_CONF\_SWI\_EFP\_OUT

- 0 = no CAN-EFP available, EFP control via PWM output stage
- 1 = CAN-EFP signal via local CAN, EFP control via local CAN
- 2 = CAN-EFP signal via powertrain CAN, EFP control via powertrain CAN

## 1.25.5.4 Variant for Oil Level or Quality sensor

### General information:

All calibratable variants are updated only during ECU initialization.

### Application conditions

**Initialisation:**                    *at reset:*                    `CONF_OIL_LEVEL_SENS = C_CONF_OIL_LEVEL_SENS`  
**Recurrence:**                        `-`  
**Activation:**                        *at every engine operating state*  
**Deactivation:**                      `-`

### Formula Section:

Meaning of CONF\_OIL\_LEVEL\_SENS


- 0 = no Sensor
- 1 = TOENS are available
- 2 = Oil quality sensor on BSD interface are available

## 1.25.5.5 Variant for Turbo Charger or Stratified combustion

### General information:

All calibratable variants are updated only during ECU initialization.

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### Application conditions

**Initialisation:**            **at reset:**            LV\_VAR\_TCHA = LC\_TCHA\_CONF  
**Recurrence:**                -  
**Activation:**                at every engine operating state  
**Deactivation:**             -

### Formula Section:

Meaning of LC\_TCHA\_CONF and LV\_VAR\_TCHA

- 0 = N53 configuration
- 1 = N54 Configuration

LV\_VAR\_TCHA = 0 disabled Functions

DMTL		17B00401.00A
		17B00C01.00D
		17B00Y01.00C
CHRG	PUT-Diag	43A0GH01 43A0GI01
CHRG	RFP-Diag	43A08F01
CHRG	WG-Diag	43A0HF01

LV\_VAR\_TCHA = 1 disabled Functions


NOX:		
EGR	ACR	43301601.00A 30408501.00A 14601201.00B 30908I01.00B 30908J01.00B 30908K01.00B 30908L01.00A 43903J02.00A 30A0IK01.00B 30A0IL01.00B 30A0IM01.00A 30A0IN01.00A 30A0IO01.00A 30A0IP01.00A 30A0IQ01.00A 30A0IR01.00B 30A0IS01.00A 43R01801.00A

### 1.25.5.6 Vehicle Variant

#### General information:

The manual setting of the vehicle variant is possible by using the constant C\_VAR\_VEH. Depending on this constant the flags for "Bordnetz" and "Power module" will be set. This makes sure the compatibility to older revisions.

Depending on the variant the flags are set in the following way:

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C_VAR_VEH		LV_VAR_BN	LV_VAR_VEH
Phys. value	Hex		
E60	00H	1	0
E65	01H	1	1
PL2	02H	1	0

### Application conditions

**Initialization:** at ECU-reset

**Recurrence:** -

**Activation:** at reset

// Berechnung nur bei ECU-Init

// kompatible Berechnung von LV\_VAR\_BN und LV\_VAR\_VEH:

```
VAR_VEH = C_VAR_VEH
```

```
LV_VAR_BN = 1 // BN2000
```

```
if (VAR_VEH == E65)
then LV_VAR_VEH = 1 // Vehicle with Powermodule (E65)
else LV_VAR_VEH = 0 // Vehicle without Powermodule (E6x)
endif
```

### 1.25.5.7 Variant of St\_varkat

#### Application conditions

**Initialisation at reset:** *if* NC\_CBK\_EX\_NR = 2 *then* St\_varkat = 1  
*else* St\_varkat = 0  
*endif*

**Recurrence:** -

**Activation:** at every engine operating state

**Deactivation:** -

**Formula Section:** -

### 1.25.5.8 Variant of M-DRIVE

**Application conditions**

**Initialisation:** LV\_VAR\_SPT\_SWI = LC\_VAR\_SPT\_SWI  
**Recurrence:** -  
**Activation:** at every engine state

**Formula section:**

-

**1.25.6 Merge of learned variants for BMW- environment**

**FUNCTION DESCRIPTION:**

**General information:**

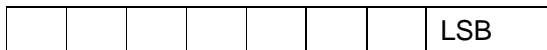
All learned variants LV\_VAR\_xx must be merged in two variables for customer use. This variables (carrier double-words) are calculated once per driving cycle after the automatically learning of variants has been finished or if LV\_VAR\_MAF changes from 0 -> 1. The LV\_VAR- bits for each variant has to be mirrored in the bits of the carrier double-words. The places of the variants in the words are described in the table in the formula section.

**Application conditions**

**Initialisation:** all 0  
**Recurrence:** 1000 ms  
**Activation:** at reset  
**Deactivation:** -

**Formula section:**


The table contains the LV\_VAR\_xx- flags, how they have to be mirrored in the carrier double-words STATE\_VAR\_DET\_CUS\_1 and STATE\_VAR\_DET\_CUS\_2. Position 0x0 is the LSB, position 0x80000000 is the MSB of the carrier double-word (like shown in the picture below).



| \_\_\_\_\_ LV\_VAR\_ACIN

Content of STATE\_VAR\_DET\_CUS\_1:

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Position (0 =LSB)	Position Hex	Varname
0	0x 0	LV_VAR_ACIN
1	0x 1	LV_VAR_AMT
2	0x 2	LV_VAR_ARS
3	0x 4	LV_VAR_ASR
4	0x 8	LV_VAR_ASR_3
5	0x 10	LV_VAR_ASR_4
6	0x 20	LV_VAR_BN
7	0x 40	LV_VAR_BN_EFP
8	0x 80	LV_VAR_BN_GEAR_REV
9	0x 100	LV_VAR_BN_LDM
10	0x 200	LV_VAR_BN_LTG_HDLP_L
11	0x 400	LV_VAR_BN_MSW
12	0x 800	LV_VAR_DCC
13	0x 1000	LV_VAR_EBOX_CFA
14	0x 2000	0
15	0x 4000	LV_VAR_EF
16	0x 8000	LV_VAR_ETCU
17	0x 10000	LV_VAR_ICL
18	0x 20000	LV_VAR_LSH_DOWN
19	0x 40000	LV_VAR_LSH_UP
20	0x 80000	LV_VAR_MSW
21	0x 100000	LV_VAR_PSTE
22	0x 200000	LV_VAR_PSTE_2 OR (LV_VAR_PSTE_3 AND STATE_PSTE_3_SRC=="AFS")
23	0x 400000	LV_VAR_RLY_ACCOUT
24	0x 800000	LV_VAR_RLY_ST
25	0x 1000000	LV_VAR_AEB
26	0x 2000000	reserve
27	0x 4000000	LV_VAR_SOF
28	0x 8000000	LV_AT
29	0x 10000000	LV_VAR_TCT
30	0x 20000000	LV_VAR_VEH
31	0x 40000000	LV_VAR_BN_TRL

Content of STATE\_VAR\_DET\_CUS\_2:

Position (0 =LSB)	Position Hex	Varname
0	0x 0	LV_VAR_MAF
1	0x 1	0
2	0x 2	LV_VAR_ETCU_SPT
3	0x 4	0
4	0x 8	0
5	0x 10	0
6	0x 20	0
7	0x 40	0
8	0x 80	0
9	0x 100	0
10	0x 200	0
11	0x 400	0
12	0x 800	0
13	0x 1000	0
14	0x 2000	0
15	0x 4000	0
16	0x 8000	0
17	0x 10000	0
18	0x 20000	0
19	0x 40000	0
20	0x 80000	0
21	0x 100000	0
22	0x 200000	0
23	0x 400000	0
24	0x 800000	0
25	0x 1000000	0
26	0x 2000000	0
27	0x 4000000	0
28	0x 8000000	0
29	0x 10000000	0
30	0x 20000000	0
31	0x 40000000	0


## 1.25.7 Runtime solution

### Description:

The tables show the configuration switches to inhibit function blocks. If a function block is disabled (= 1) or exceeds the engine speed threshold, the outputs of these modules are then frozen.

Switch	Description	Modules
C_N_VAR_DIS_MISF	Misfire (AGGR MISF)	00S08201.00F
		17B00T02.00E
		17B02E02.00F
		17100L01.00C
		30F00102.00D
		17B00201.00A
		30B00E02.00C
C_N_VAR_DIS_ER	Engine roughness	00S08401.00H
		17100K01.00C
		→02P02.00D
		17A0EM01.00C
C_N_VAR_DIS_INJ	Cylinder balancing	30402U01.00B
LC_VAR_DIS_OBD_CAT	Cat efficiency	17B00801.00C
		01B00A02.00O
		01B02D02.00E
LC_VAR_DIS_NOX	NOx functions	02703O01.00C
		02703002.00E
		43705S01.00B
		43703N01.00B
		02706401.00A
		02706001.00B
		02704M01.00B
		02704F03.00C
		02705X01.00E
		02706301.00A
		02706202.00C
		02705101.00A
		02703Q03.00P
		02704G02.00F
		02704901.00I
		02703P03.00Q
		02705V01.00I
		02706I01.00C
		02705T01.00C
		43704A01.00B
02702Z06.00E		
02703801.00E		
02A0B202.00B		
LC_VAR_DIS_CRU	Cruise control	17G00101.00G
		17G00201.00H
		17G00301.00E
		17G00401.00C

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		17G00E01.00J
LC_VAR_DIS_TQ_LOSS_ARS	Torque loss - anti-roll-stabilization	17D02601.00E
LC_VAR_DIS_DMTL	LDP function	17B00C01.00J
LC_VAR_DIS_S_FCT	Lambda testing for stratified mode	43500J01.00A
Disabled functions	Sound flap diagnosis	43A0CJ01.00A

## 1.25.8 Learnt ECU variants

### 1.25.8.1 Import Actions

ACTION_ECM3_DisableReq()	ACTION_INFR_McRestart()	
--------------------------	-------------------------	--

#### Description for actions:

ACTION_INFR_GetLd(OUT <V_VAR_LD>)					
This action returns the LOT detection for ECU variant coding					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
V_VAR_LD	OUT	0 ... 7FFFH	0 ... 5	1.5259e-4	V
Voltage for LOT detection					

#### General information:

The detection of ECU variants is realised by a learning function. The state for a successful ECU variant detection is checked at every ECU initialisation. The according information has to be detected in a previous ECU initialisation by the learning function and has to be stored in the non-volatile memory. If the check, which ECU variant is identified, gets to a valid result, the learning function for ECU detection won't be started again. Otherwise it will start up like in the description below:

#### Combination table:

Muster	Lot-Detection (v_var_id)			digits(soll)	digits(limits)
	minimal	nominal	maximal		
B0_LOT0	0.000V	0.000V	0.097V	0	0...30
C1_LOT1	0.203V	0.300V	0.397V	93	63...123
C2_LOT2	0.484V	0.581V	0.677V	180	150...210
LOT3	0.935V	1.031V	1.129V	320	290...350
LOT4	1.226V	1.320V	1.419V	410	380...440
LOT5	1.555V	1.650V	1.748V	512	482...542
LOT6	1.890V	1.980V	2.084V	616	586...646
LOT7	2.126V	2.222V	2.319V	689	659...719
LOT8	2.400V	2.493V	2.594V	774	744... 804
LOT9	2.784V	2.877V	2.977V	893	863...923
LOT10 (Serie)	3.203V	3.300V	3.300V	1023	993...1023

**For Initialization Only:**

**SWITCH (NC\_HW\_REV)**

```

case STATE_LRN_ECU_B0_LOT0
STATE_LRN_ECU = "B0_LOT0"

case STATE_LRN_ECU_C1_LOT1
STATE_LRN_ECU = "C1_LOT1"

case STATE_LRN_ECU_C2_LOT2
STATE_LRN_ECU = "C2_LOT2"

case STATE_LRN_ECU_SERIAL_ECU
STATE_LRN_ECU = "SERIAL_ECU"

case STATE_LRN_ECU_NOT_LEARNED:
STATE_LRN_ECU = "NOT_LEARNED"

case STATE_LRN_ECU_LEARNING_FAILED:
STATE_LRN_ECU = "LEARNING_FAILED"


break
default
STATE_LRN_ECU = ROM_NOT_PLAUS /* Status cannot be stored in flash */
endswitch
    
```

**For cyclical learning:**

```

ACTION_INFR_GetLd(V_VAR_LD) /*read LOT value from the ADC */
If(1) NC_HW_REV != NC_FLS_DFT
Then(1)
Do nothing /*nc_hw_rev already set (plausible or not plausible)*/
Else(1)
If(2) STATE_LRN_ECU == NOT_LEARNED
Then(2)
If(3) CTR_LRN_ECU < 10
Then(3)
    
```

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```

        CTR_LRN_ECU++          /* time out counter*/
If(4)          0 <= V_VAR_LD <= 0.097V          (B-Muster)
Then(4)
        If(5)          ++CTR_LRN_ECU_OK_B0_LOT0 >= 7
        Then(5)          STATE_LRN_ECU = "B0_LOT0"
        Endif(5)
Endif(4)
        If(4)          0.203V <= V_VAR_LD <= 0.397V          (C-Muster LOT1)
Then(4)
        If(5)          ++CTR_LRN_ECU_OK_C1_LOT1 >= 7
        Then(5)          STATE_LRN_ECU = "C1_LOT1"
        Endif(5)
Endif(4)
        If(4)          0.484V <= V_VAR_LD <= 0.677V          (C-Muster LOT2)
Then(4)
        If(5)          ++CTR_LRN_ECU_OK_C2_LOT2 >= 7
        Then(5)          STATE_LRN_ECU = "C2_LOT2"
        Endif(5)
Endif(4)
        If(4)          3.203V <= V_VAR_LD <= 3.300V          (Serial ECU)
Then(4)
        If(5)          ++CTR_LRN_ECU_OK_C2_SERIAL >= 7
        Then(5)          STATE_LRN_ECU = "Serial ECU"
        Endif(5)
Endif(4)
Else(3)
        STATE_LRN_ECU = "LEARNING_FAILED"
Endif(3)
Else(2)
If(3)          ACTION_ECM3_DisableReq()
Then(3)
        Store the detected LOT immedatily into Flash
        ACTION_INFR_McRestart()
Elsed(3)
        /*wait until MU shutdown*/
Endif(3)

Endif(2)
Endif(1)

```

## 1.26 SDA - AT library short description

### General information:

#### 1.26.1 General

This document is a short reference to all AT Library blocks. It aims to help the reading of SDA based specifications. The complete library reference is available with the current SDA installation.

Optional inputs and outputs: Some blocks can have optional inputs and outputs, which are made available when necessary. These outputs are normally not shown in the example pictures, but described on the explanations.

Maps, curves and axis: Maps and curves are related to their axis definitions. This information can be consulted at the calibration section in the given specification.

Index base: Block inputs for indices can be one-based (standard) or zero-based (special cases). The index base is shown subscripted. For instance R<sub>0</sub> stands for "row index, zero-based". Other examples: bit\_sel<sub>0</sub>, x<sub>1</sub>, y<sub>0</sub>. See "selector" block example, on this document in chapter 1.8, page 9.

Triggered blocks: Most of the blocks have an optional trigger input. This port accepts function-call connection, which determinate when these blocks shall be calculated. Example:

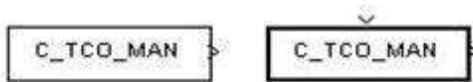


Figure 1.26.1:


#### 1.26.2 Block versioning

The block version is shown since SDA 5.0 release. Please note the following:

- Blocks from previous SDA versions do not show any version information.
- The version information is shown on the block icon or below it in the format "V X.Y".
- Functional change or relevant appearance changes reflects on version information update (only on "X"). A change in "Y" is not functional or appearance relevant. For instance, the versions 5.1, 5.4, 5.13 have all the same appearance and functional behavior.
- The part "X" of the block version number is not coupled to SDA release number. The first block version since SDA 5.0 is "5." for all libraries though.
- All functional changes done to AT Library blocks between SDA releases are shown in this document and in the according library documentation within the SDA installation.

#### 1.26.3 Functional behaviour

The blocks of version 6.x have the same functional behaviour than the blocks of version 5.x. The changes in the blocks are only related to code generation and/or to adaptation to the ASAM MBFS standard.

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### 1.26.4 Action Handling

**Action\_Data\_Store (V. 5)**      **Action\_Data\_Store\_Init (V. 5),**  
**Read\_Action\_Data\_Store (V. 5)**    **Write\_Action\_Data\_Store (V. 5)**

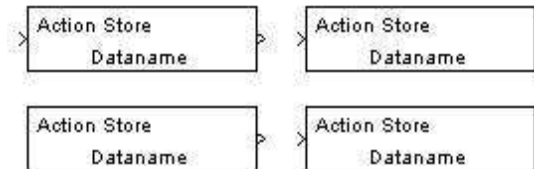


Figure 1.26.2:

These blocks are used to model the initialization and read/write access to an action internal storage that can be accessed by all instances of this action and inside the module defining the action.

If this storage is only used inside the action instance or inside the defining module it is listed as local data on the specification.

### Input\_Action\_Signal (V. 5)

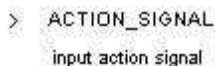


Figure 1.26.3:

This block is used to model nested Actions (reused Action inside an Action). Here the Action Signal needed for the reused Action is fed in by an Action Input.

**Input\_To\_Action (V. 5)**      **Output\_From\_Action (V. 5)**



Figure 1.26.4:

The Input\_To\_Action block is used to model an input to an Action that is unique for all action instances and calculated outside of the module that defines the action.

The Output\_From\_Action block is used to model an output of an action (shared storage) and of the defining module. The value can be set by all instances of the action and inside the module defining the action.

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### IRS (V. 5)



Figure 1.26.5:

This block indicates that the according subsystem belongs to an Infrastructure Requirement Specification (IRS).

### Action Parameters (V. 5.)



Figure 1.26.6:

The blocks PAR\_IN, PAR\_OUT and PAR\_INOUT are used to model action input, output and input-output parameters.

## 1.26.5 Application Condition

### APP\_CDN (V. 5) (V. 6)

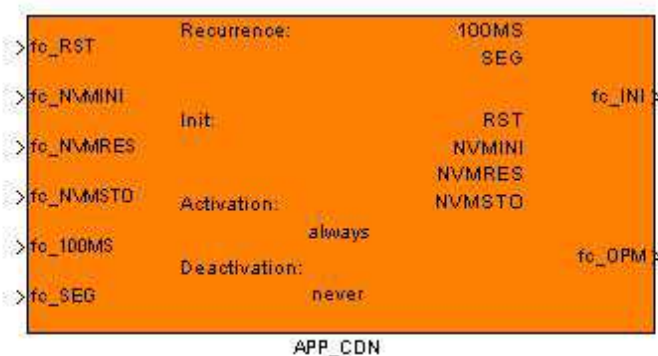


Figure 1.26.7:

The Application Condition block displays the activation conditions for the according module. It controls when the module is activated or deactivated. All function calls triggering or initializing the functionality of a module are input to the APP\_CDN block. Dependent on the activation condition the function calls are fed through the block or not. The Application Conditions are displayed in textual form within the specification.

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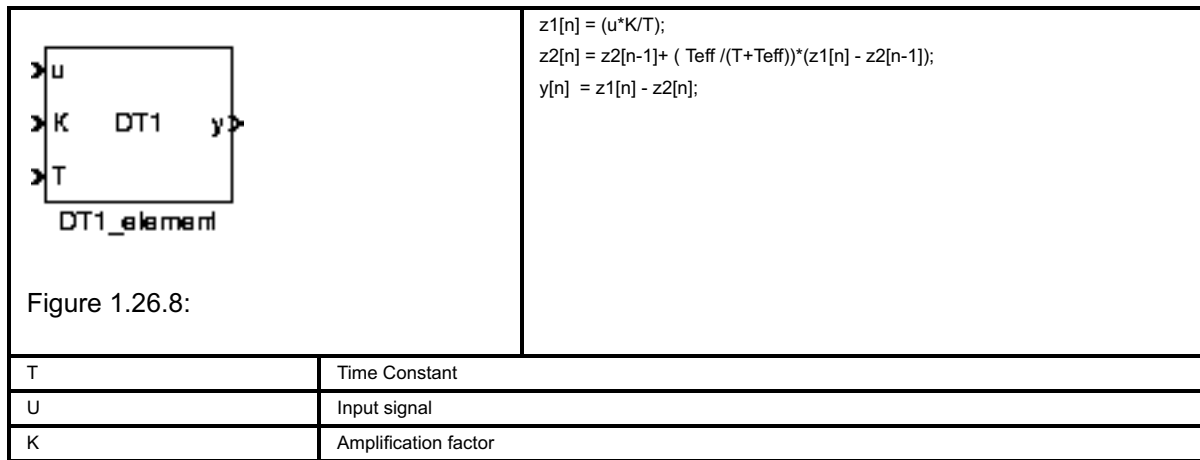
In the above example of the block the according module is always active and never inactive. The initialization is triggered by the Reset (RST) event and the Nonvolatile Memory (NVM...) events. The according function calls are output in bus of function calls fc\_INI.

The operate mode is triggered by the 100ms event and the segment synchronous event. The according function calls are output in a bus of function calls fc\_OPM.

### 1.26.6 Basic Algorithms

#### DT1 Element (V. 5.) (V. 6)

The output signal y is calculated from the input signal u, the amplification factor K and the time constant T according to the following functions:



#### mean\_value (V. 5.) (V. 6)

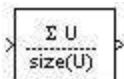


Figure 1.26.9:

This block outputs mean value of elements of a single input vector.

#### fading (V. 5.) (V. 6)

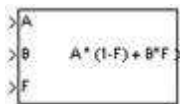


Figure 1.26.10:

This block implements the fading calculation:

Inputs: A, B, F.

Output:  $Out = A \cdot (1 - F) + B \cdot F$ .

## 1.26.7 Calibration\_Data\_Handling

### Constant (V. 5.) (V. 6)

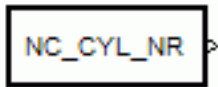


Figure 1.26.11:

Outputs the value specified by a constant or parameter, which can be a scalar or array. The example's output gives the value contained in the constant NC\_CYL\_NR (a configuration data).

### from\_data\_definition (V. 5.) (V. 6)

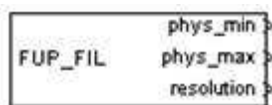


Figure 1.26.12:

This block reads chosen fields from data definition of specified data (e.g. FUP\_FIL) and gives them as outputs. The possible fields to output: minimal physical value, maximal physical value, resolution and states (only for state variables).

### Get Curve Index (V. 5.)

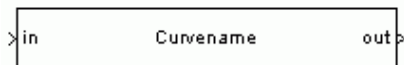


Figure 1.26.13:

This block outputs the next smallest index from the input axis value. It considers the axis of the selected curve. Indexing starts from zero.

In	Axis value on the axis of the curve
Out	Index of the axis value on the axis of the curve

### Get Map Index (V. 5.) (V. 6)

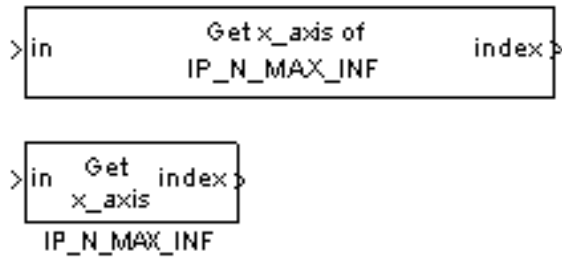


Figure 1.26.14:

This block outputs the next smallest index of the input axis value on the selected axis (x\_axis or y\_axis) of the selected map. Indexing starts from zero.

in	Axis value of the specified axis in a map
index	Index of the axis value on the specified axis of the map

**getCurveArray (V. 5.)**

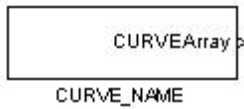


Figure 1.26.15:

Generates a signal which carries the values from the selected calibration data (an array of curves).

**getMapArray (V. 5.) (V. 6)**

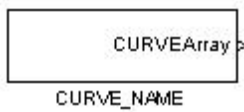


Figure 1.26.16:

Generates a signal which carries the values from the selected calibration data (an array of maps).

**id\_lookup (V. 5.) (V. 6)**

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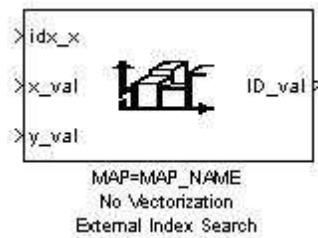


Figure 1.26.17:

This block implements the lookup operation over a non interpolated map or array of maps. A single map has one dimension (calibration curve) or two dimensions (calibration map).

The name of the map is specified by "MAP".

The block supports 3 different modes:

- "local": The map is read from base workspace and only the look up value is exported via the output
- "exported": The map is read from base workspace and the look up value together with the complete map array is exported.
- "imported": The map is read from an inport, as an array signal.

The block outputs the lookup value "ID\_val" connected with the next smaller index to the axis values "x\_val" and "y\_val". There is no interpolation or extrapolation between axis values.

With the option "External Index Search", the search for the axis indices can be done externally (see index\_search block). The ports "x\_val" and "y\_val" are named "x\_frac" and "y\_frac". In this case, the values on "x\_frac" and "y\_frac" are directly used as index and fraction values for the map lookup.

The ports "idx\_x", "idx\_y" and "idx\_z" specify the indices selecting a map to be read from the given map array, if an array of maps is used. Their availability as input ports depends on the array dimensions, which can be consulted at the calibration section in the given specification.

For access to an array of maps, the block can be set to:


- "Scalar vectorization" mode: All maps in the array are read with the same inputs for "x\_val" and "y\_val". The output is a vector carrying the lookup values.
- "Array vectorization" mode: All maps in the array are read with separate values from the inputs "x\_val" and "y\_val", which are arrays. The output is a vector carrying the lookup values.
- "No vectorization" mode: The lookup operation is calculated for one map which is selected through the inputs "idx\_x", "idx\_y" and "idx\_z". Values for "x\_val" and "y\_val" are than scalar, as also the output lookup value.

### index\_search (V. 5.) (V. 6)



Figure 1.26.18:

The index-search block calculates the zero-based indices and interval fractions for the input value for a selected axis.

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The block generates a pair of outputs for each input value by calculating the zero-based index of the breakpoint set element that is less than or equal to the input value and the resulting fractional value ( $f$  where:  $0 \leq f < 1$ ). This represents the input value's normalized position between the index and the next index value for in-range input.

### ip\_lookup (V. 5.) (V. 6)

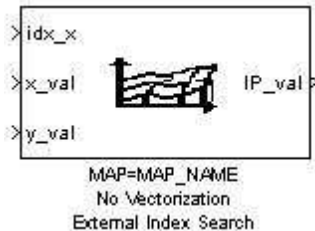


Figure 1.26.19:

This block is analogous to the id\_lookup block. The difference is the output lookup value, which is interpolated.

IP\_val is calculated by a linear interpolation through the map values. There is linear interpolation between axis values.

The name of the map is specified by "MAP".

The block supports 3 different modes:

- "local": The map is read from base workspace and only the look up value is exported via the output
- "exported": The map is read from base workspace and the look up value together with the complete map array is exported.
- "imported": The map is read from an inport, as an array signal.

With the option "External Index Search", the search for the axis indices can be done externally (see index\_search block). The ports "x\_val" and "y\_val" are named "x\_frac" and "y\_frac". In this case, the values on "x\_frac" and "y\_frac" are directly used as index and fraction values for the map interpolation.

The ports "idx\_x", "idx\_y" and "idx\_z" specify the indices selecting a map to be read from the given map array, if an array of maps is used. Their availability as input ports depends on the array dimensions, which can be consulted at the calibration section in the given specification.

For access to an array of maps, the block can be set to:

- "Scalar vectorization" mode: All maps in the array are read with the same inputs for "x\_val" and "y\_val". The output is a vector carrying the lookup values.
- "Array vectorization" mode: All maps in the array are read with separate values from the inputs "x\_val" and "y\_val", which are arrays. The output is a vector carrying the lookup values.
- "No vectorization" mode: The lookup operation is calculated for one map which is selected through the inputs "idx\_x", "idx\_y" and "idx\_z". Values for "x\_val" and "y\_val" are than scalar, as also the output lookup value.

### read\_Map\_Array (V. 5.) (V. 6)

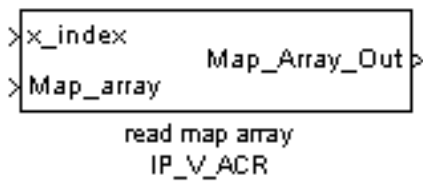


Figure 1.26.20:

This block selects and output the map specified by the input indexes "x\_index", "y\_index" and "z\_index" as a signal. Not shown indexes have standard value "1". The input is an array of maps.

**to\_resolution (V. 5.) (V. 6)**



Figure 1.26.21:

This block provides the possibility to reduce data with a higher resolution to a lower one. Three types of reduction are possible: truncation (ceils or floor) and round-up to a given resolution. The chosen conversion method is shown in the block icon: ROUND, CEIL or FLOOR. The resolution value can be obtained from the optional input port "res" or given as a block annotation.

**write\_Map\_Array (V. 5.) (V. 6)**

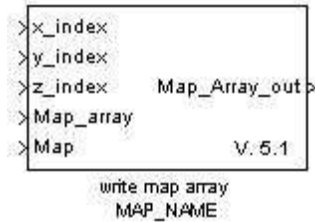


Figure 1.26.22:

Outputs a map array signal "Map\_Array\_out" which is a copy from the input array signal "Map\_Array", where the single map specified by the input indexes "x\_index", "y\_index" and "z\_index" is substituted by the values of the input "Map". Not shown indexes have standard value "1".


**1.26.8 Control Structures**

**Compiler\_switch\_if (V. 5.) (V. 6)**

**compiler\_switch (V. 5.) (V. 6)**

These blocks are used to model compiler switches.

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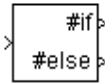
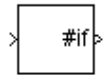


Figure 1.26.23:

compiler\_switch\_if : If condition is true then output function call '#if'.

compiler\_switch: If condition is true then output function call '#if' else output function call '#else'

### do\_while\_loop (V. 5.)     while\_loop (V. 5.)

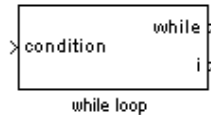
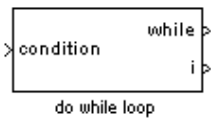


Figure 1.26.24:

While-Control Structure and Do-While-Control Structure:

As long as condition is true the function call "while" is cast. The only difference between the blocks is when the condition is checked for the first time. The while\_loop block checks the condition before it performs first function call. do\_while\_loop performs the function call at first and only after that checks the condition. The optional output 'i' indicates the current number of execution.

To omit an endless loop the while is only executed as long as the number of iterations is smaller than the defined maximum (default 500, for model simulation).

### for\_loop (V. 5.)

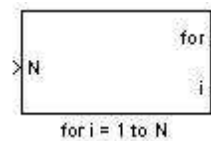



Figure 1.26.25:

For-Loop-Control Structure:

Executes for-loops function-calls, where the optional output "i" runs from 0 (or 1) to N. The output "for" is a function call signal triggering the according subsystem that contains the functionality within the for loop.

### If (V. 6)

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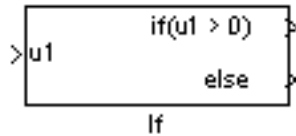


Figure 1.26.26:

If...Then...Else-Control Structure: If condition 'u1' is true then output action call 'if' else output action call 'else'. In difference to the following if-then-else blocks this block outputs SL action calls instead of function calls.

**If...Then (V. 5.) (V. 6)**

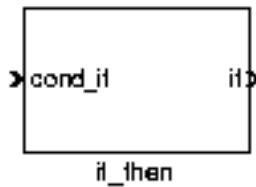


Figure 1.26.27:

If...Then-control structure: If condition 'cond\_if' is true then output function-call 'if'.

**If...Then...Else (V. 5.) (V. 6)**

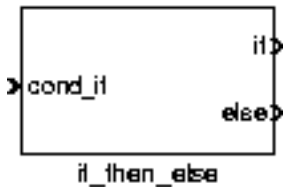


Figure 1.26.28:

If...Then...Else-Control Structure: If condition 'cond\_if' is true then output function call 'if' else output function call 'else'.

**sequencer (V. 5.) (V. 6)**

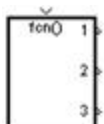



Figure 1.26.29:

This block generates an ordered sequence of function calls. The number of output ports is variable. The user has a possibility to select in the block mask between three operation variants:

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- "not triggered" - the output function calls are generated when the block is calculated;
- "function call triggered" - the output function calls are generated when the block is triggered. In this case block has an extra function call trigger input;
- "logical triggered" - the block has an extra input port "trigg". The output function calls are generated when this input has a value different than zero.

**Triggeroutput\_2\_fcn\_call (V. 5)**

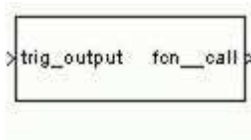


Figure 1.26.30:

This block generates a function call if the input is different to zero. The block can be used in connection with a trigger block output.

**Triggeroutput\_2\_logical (V. 5)**

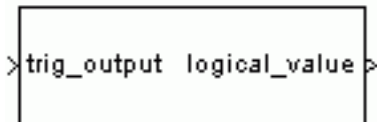


Figure 1.26.31:

Conversion of a trigger signal into a logical value. This block generates a logical 1 if the input is different to zero. The output is zero otherwise. The block can be used in connection with a trigger block output.

**1.26.9 Signal Types**

**FROM\_DATA (V. 5)**  
**FROM\_VISIBLE (V. 5)**

**FROM\_FCT\_CALL (V. 5)**  
**FROM\_ACTION\_CALL (V. 5)**

**FROM\_TRIG (V. 5)**

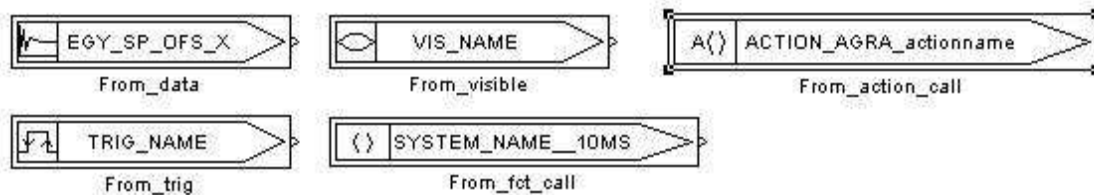


Figure 1.26.32:

From\_data, From\_fct\_call, From\_trig or From\_visible is a From block with scope global for the use with global data, function call, trigger or visible signals only. This From blocks gets the signal from a corresponding Goto block.

**GOTO\_DATA (V. 5)**  
**GOTO\_VISIBLE (V. 5)**

**GOTO\_FCT\_CALL (V. 5)**  
**GOTO\_ACTION\_CALL (V. 5)**

**GOTO\_TRIG (V. 5)**

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Figure 1.26.33:

Goto\_data, Goto\_fct\_call, Goto\_trig or Goto\_visible is a Goto block with scope global for the use with global data, function call, trigger or visible signals only. The signal is sent to a corresponding From block.

**GOTO**

**FROM**



Figure 1.26.34:

Goto and From blocks with scope local. The blocks represent a signal line between the Goto and the From block. In the example the signal TCO is submitted between the blocks.

**1.26.10 Signals**

**branch (V. 5.) (V. 6)**

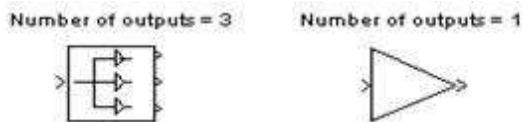


Figure 1.26.35:

This block creates one or more copies from the input signal, which can then be directly used as input to a merge block.

Input signal can be a scalar, a vector or a bus. In case input signal is a bus, every output signal is also a bus with the same bus structure as the input.

**BusMerge (V. 5.) (V. 6)**

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Figure 1.26.36:

This block constructs a bus output holding the union of all elements of the input busses in a flat bus structure. Flat structure means that the exported bus has only one hierarchy level. Signals that are input on more than one of the input busses are merged separately before being added to the output bus.

### case\_multiport\_switch (V. 5.) (V. 6)

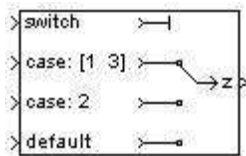


Figure 1.26.37:

The block connects one of the "case" input ports (or default port) to the output port.

It receives a value on the input port "switch", which is compared to case conditions that determine which of the other input ports is connected to the output port.

If the value on the control port "switch" does not match any case condition, the "default" input is connected to the output.

In the example picture, if the value of "switch" is 1 or 3, the port "case: [1 3]" is connected to the output. If its value is 2, then the port "case: 2". Else, the default port is used.

### constant\_value (V. 5.) (V. 6)

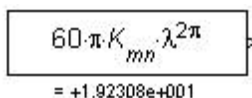


Figure 1.26.38:

Outputs a constant value with the possibility to show the icon as formula expression. The calculated value is shown on the block annotation.

### FeedThrough (V. 5.) (V. 6)

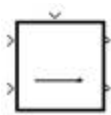


Figure 1.26.39:

The FeedThrough block outputs the input values if the function-call occurs. The output maintains its last changed value. The number of input and output ports is variable.

### Selector (V. 5.) (V. 6)



Figure 1.26.40:

The Selector block generates as output selected elements of an input vector or matrix. It accepts either vector or matrix signals as input. The block icon changes to reflect the type of input used. The way the block determines the elements to select differs slightly, depending on the type of input.

#### Vector Input

If the input type is vector, a Selector block outputs a vector of selected elements. The block determines the indices of the elements to select either from the block's Elements parameter or from an external signal.

The elements to be selected must be specified as a vector unless only one element is being selected. For example, the following model shows the Selector block icon and the output for an input vector of [2 4 6 8 10] and an Elements parameter value of [5 1 3].

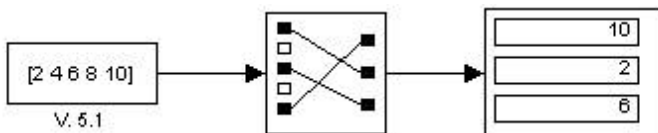


Figure 1.26.41:

The block icon displays the ordering of input vector elements graphically if the block icon is large enough. If external source for element indices is used, the block adds an input port for the element indices signal.

#### Matrix Input

If the input type is matrix, the Selector block outputs a matrix of elements selected from the input matrix. The block determines the row and column indices of the elements to select either from its Rows and Columns parameters or from external signals (input ports "R", for row, and "C" for column selection).

The indices of the row and columns to be selected must be specified as vectors (or a scalar if only one row or column is to be selected). For example, the Rows expression [2 1] and the Columns expression [1 3] specifies output of a 2x2 matrix whose first row contains the first and third elements of the input matrix's second row and whose second row contains the first and third elements of the input matrix's first row.

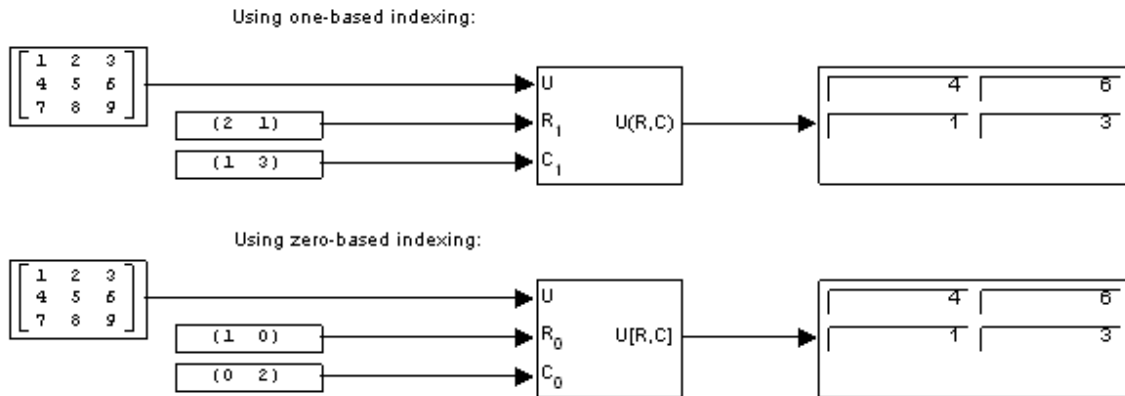


Figure 1.26.42:

### Switch\_Case (V. 5.) (V. 6)

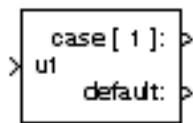


Figure 1.26.43:

The following shows a completed Simulink C-like switch control flow statement in the subsystem of the SwitchCase block.

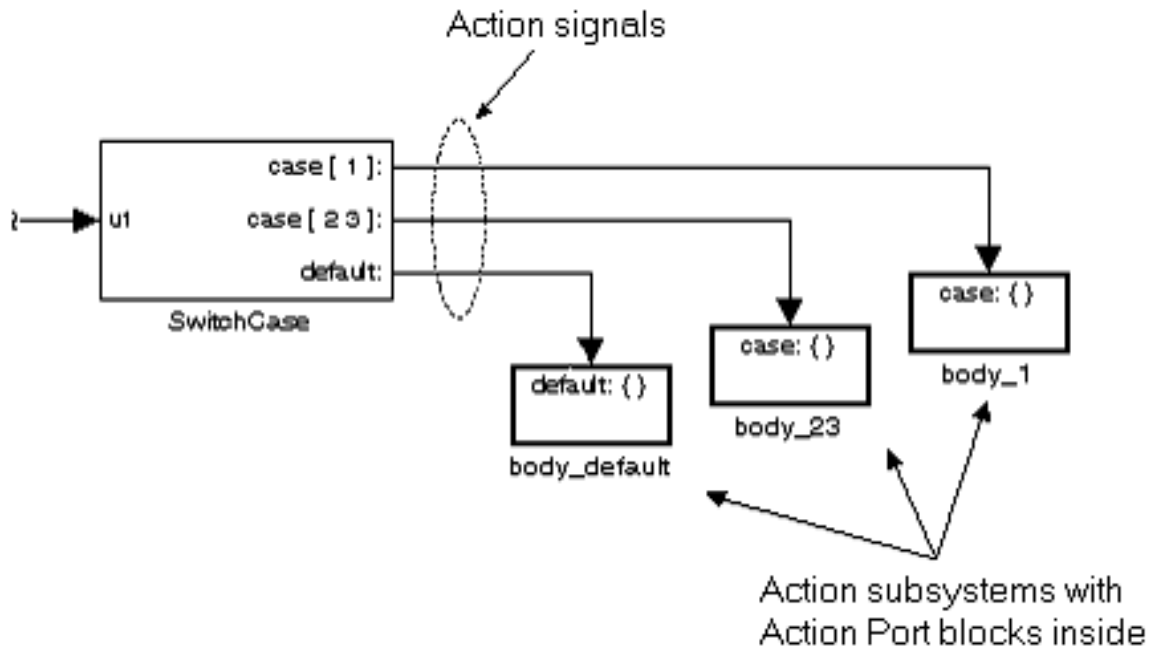


Figure 1.26.44:

As shown in the above example, a Switch\_Case block receives a single input, which it uses to form case conditions that determine which Action subsystem to execute. Each output port case condition is attached to an Action subsystem. The cases are evaluated topdown starting with the top case. If a case value (in brackets) corresponds to the actual value of the input, its Action subsystem is executed.

The above switch control flow statement can be represented by the following pseudo code:

```
switch (u1) {
  case [u1=1]:
    body_1;
    break;
  case [u1=2 or u1=3]:
    body_23;
    break;
  default:
    bodydefault;
}
```

**Note:** As demonstrated in the pseudo code example above, cases for the SwitchCase block contain an implied break after their Action subsystem is executed. There is no "fall through" behaviour for the Simulink switch control flow statement as found in standard C switch statements.

**Note:** The naming "Action" in this block is not connected to "Actions" defined in the Supplier Action concept.

### logical\_value (V. 5.) (V. 6)



Figure 1.26.45:  
Block outputs logical TRUE or FALSE.

**Merge (V. 5.) (V. 6)**



Figure 1.26.46:  
The Merge block combines its inputs into a single output line whose value at any time is equal to the most recently computed output of its driving blocks. The Merge block often is used to merge a calculation signal with a reset signal.

**SignalManager (V. 5.) (V. 6)**

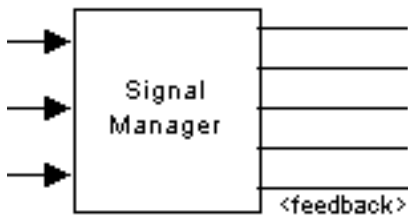



Figure 1.26.47:  
This block merges signals contained in the input busses. It supports two or more input busses. Optional configurations:  
- Output with "feedback" bus, which contains all merged signals. The feedback bus is routed back to the operate subsystem.  
- "Show signal names on the mask". Where:

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 696 of 8404	
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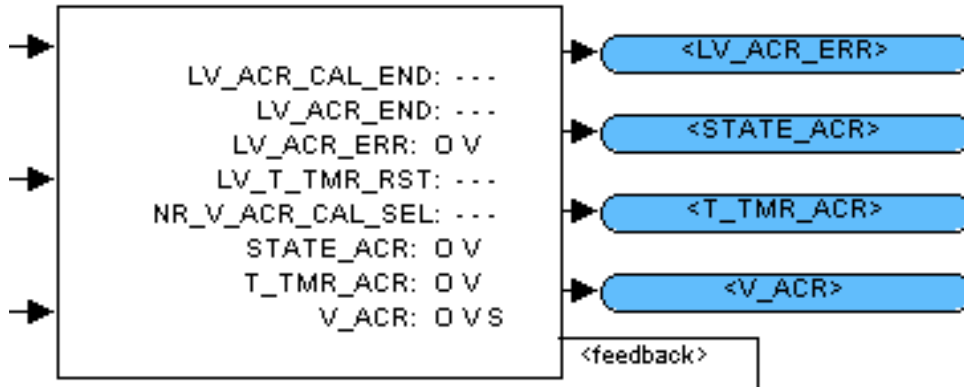


Figure 1.26.48:

- Outports represent the module outputs;
- "O": module output;
- "V": visible variable;
- "S": NVMY data;
- "- --": Local variable

**Note:** Only local signals that are present on one of the input busses to this block are displayed on the block mask

### 1.26.11 Vectors and Matrices

#### Assignment (V. 5.) (V. 6)

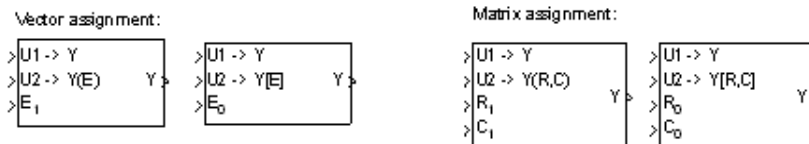


Figure 1.26.49:

The Assignment block assigns values from input U2 to selected elements of array input U1, producing the array output Y. Equivalent operation:

Vector assignment:	Matrix assignment:
Y = U1; Y[E] = U2;	Y = U1; Y[R,C] = U2;

On a vector assignment, the input E is used to select the assignment position. On a matrix assignment, the inputs R (row) and C (column) are used to select the assignment position. The assignment position can be a scalar, a vector or a matrix, depending on the dimension of E, or the combined dimensions of R and C.

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Example: iterated Assignment

The Assignment block can be used to assign values computed in an iterator (For or While) loop to a vector or matrix signal. The iterator block generates the indices required by the Assignment block. Two iterator blocks are needed to compute row and column indices separately. For example, the following model uses a For block to create a vector signal each of whose elements equals  $3 \cdot i$  where  $i$  is the index of the assignment element.

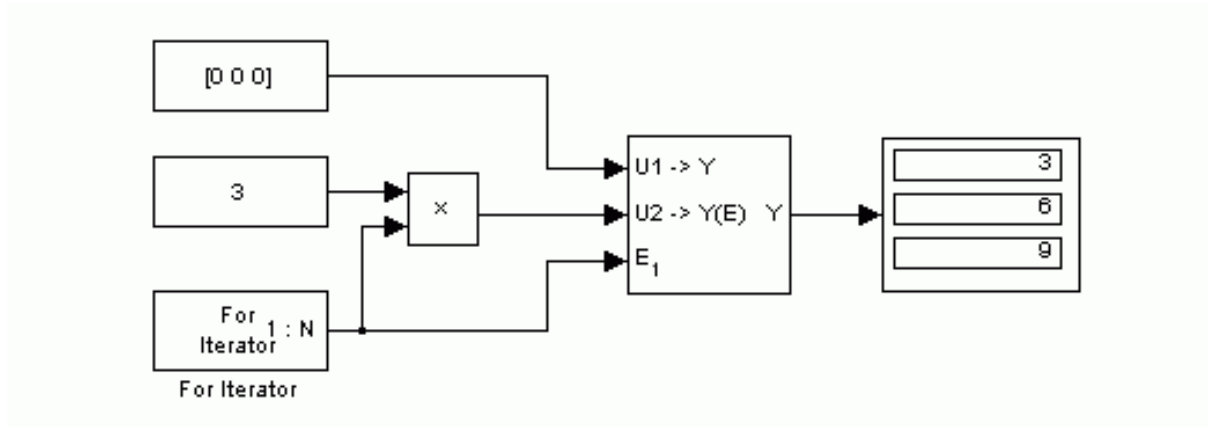


Figure 1.26.50:

**Dec2Bin (V. 5.) (V. 6)**                      **Bin2Dec (V. 5.) (V. 6)**

These blocks convert an integer into a binary number and vice versa. The number of bits can be set to 8, 16, 32 or 64. For decimal numbers the digits after the comma will be cut off. The binary numbers are displayed with leading highest exponent:  $[2^n, \dots, 2^1, 2^0]$ .

**Important:** these blocks suffered functional modification from version 3.1 to 4.0. See below.

<b>Pseudo-code since SDA 4.0</b>	<b>Pseudo-code for SDA 3.1</b>
Continued on next page	

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```

Dec2Bin:
for ( i=0; i<no_bits; i++) {
    bit_vector[ no_bits - i] =
        num_dec.i;
}
    
```

```

Bin2Dec:
num_dec = 0;
for ( i=0; i<no_bits; i++) {
    num_dec = num_dec +
        bit_vector[no_bits-i]
        * 2i;
}
    
```

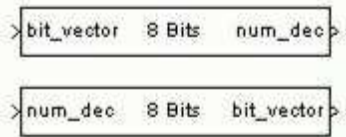


Figure 1.26.51:

First element in bit vector is most significant bit. E.g. **10000000** is equal to **128**

```

Dec2Bin:
for ( i=0; i<8; i++) {
    8bit_vector[j+1] = num_dec.i;
}
    
```

```

Bin2Dec:
num_dec = 0;
for ( i=0; i<8; i++) {
    num_dec = num_dec +
        8bit_vector[i+1]
        * 2i;
}
    
```

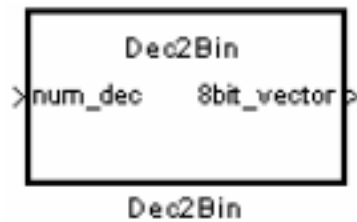


Figure 1.26.52:

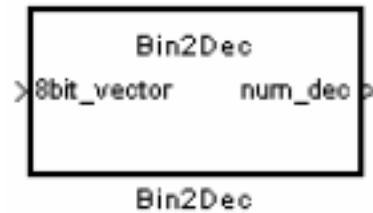


Figure 1.26.53:

First element in bit vector is less significant bit. E.g. **10000000** is equal to **1**

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## DirectLookUp (V. 5.) (V. 6)

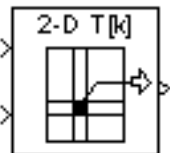


Figure 1.26.54:

Index into an N-dimensional table to retrieve a scalar, vector or 2-D matrix. The Direct Look-Up Table (n-D) block uses its block inputs as zero-based indices into an n-D table. The number of inputs varies with the shape of the output desired. The output can be a scalar, a vector, or a 2-D matrix. The look-up table uses **zero-based** indexing.

A set of output values can be defined as the Table data parameter. The output can be a scalar, a vector or a 2-D matrix. The first input specifies the zero-based index to the first dimension higher than the number of dimensions in the output, the second input specifies the index to the next table dimension, and so on, as shown by this figure:

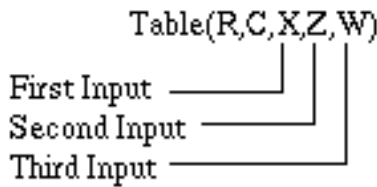


Figure 1.26.55:

The figure shows a 5-D table with an output shape set to "2-D Matrix"; the output is a 2-D Matrix with R rows and C columns.

This figure shows the set of all the different icons that the Direct Look-Up Table block shows (depending on which options you choose in the block's dialog box).

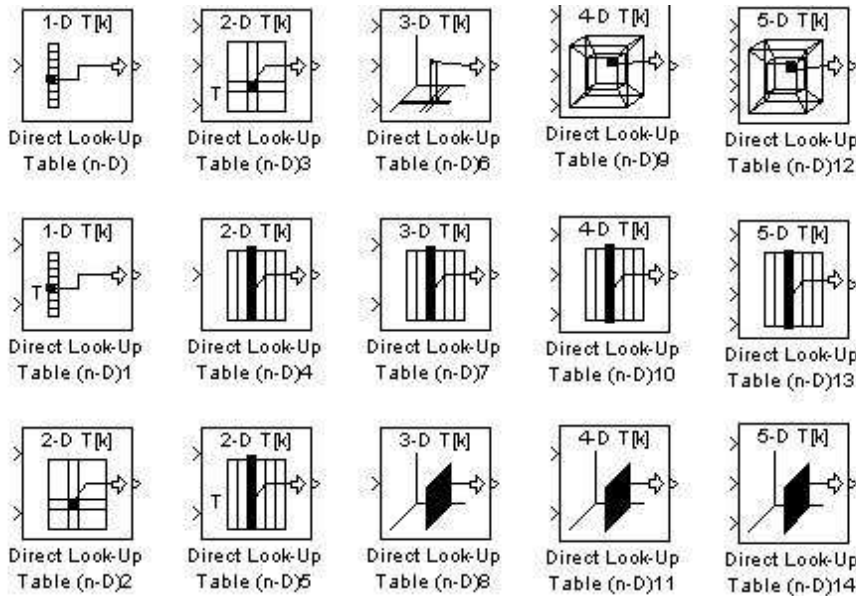


Figure 1.26.56:

With dimensions higher than 4, the icon matches the 4-D icons, but will show the exact number of dimensions in the top text, e.g., "8-D T[k]." The top row of icons is used when the block output is made from one or more single-element lookups on the table. The blocks labelled "n-D Direct Table Lookup5," 6, 8 and 12 are configured to extract a column from the table and the two blocks ending in 7 and 9 are extracting a plane from the table. Blocks in the figure ending in 10, 11 and 12 are configured to have the table be an input instead of a parameter.

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### get\_bit (V. 5.) (V. 6)

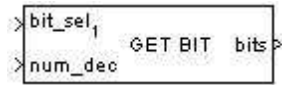


Figure 1.26.57:

This block gets the values of specific bits of the decimal number obtained from the input port "num\_dec". The output can be either single value or vector depending on the input given through "bit\_sel" input port. The input "bit\_sel" can be a single value or a vector. It selects the bits used in this operation. Bits are selected by its position number from the less significant bit (position 0 or 1) to the most significant bit (7, 15, 31, 63 or 8, 16, 32, 64). The user has possibility to select between zero or one based indexing for "bit\_sel".

### MatrixConcatenation (V. 5.) (V. 6)

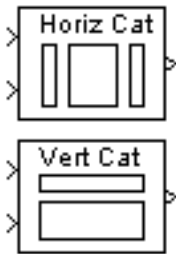


Figure 1.26.58:

The MatrixConcatenation block concatenates input matrices  $u_1, u_2, \dots, u_n$  along rows or columns, where  $n$  is specified by the number of input ports.

#### Horizontal Matrix Concatenation

In the horizontal concatenation mode, the block concatenates the input matrices along rows.

$$y = [u_1 \ u_2 \ u_3 \ \dots \ u_n] \quad \% \text{ Equivalent MATLAB code}$$

For horizontal concatenation, inputs must all have the same row dimension,  $M$ , but may have different column dimensions. The output matrix has dimension  $M$ -by-  $N_i$ , where  $N_i$  is the number of columns in input  $u_i$  ( $i = 1, 2, \dots, n$ ). When some of the inputs are length- $M$  1-D vectors while others are  $M$ -by- $N_i$  matrices, the vector inputs are treated as  $M$ -by-1 matrices.

#### Vertical Matrix Concatenation

In the vertical concatenation mode, the block concatenates the input matrices along columns.

$$y = [u_1; u_2; u_3; \dots; u_n] \quad \% \text{ Equivalent MATLAB code}$$

For vertical concatenation, inputs must all have the same column dimension,  $N$ , but may have different row dimensions. The output matrix has dimension  $M_i$ -by- $N$ , where  $M_i$  is the number of rows in input  $u_i$  ( $i = 1, 2, \dots, n$ ). When some of the inputs are length- $M_i$  1-D vectors while others are  $M_i$ -by-1 matrices, the vector inputs are treated as  $M_i$ -by-1 matrices. (1-D vector inputs are not accepted for vertical concatenation when the other inputs have column dimension greater than 1.)

## 1-D Vector Concatenation

When all inputs to the Matrix Concatenation block are length-Mi 1-D vectors, the output is a Mi-by-1 matrix containing all input elements concatenated in port order: the elements in the vector input to the top port appear as the first elements in the output, and the elements in the vector input to the bottom port appear as the last elements in the output.

### read\_array (V. 5.) (V. 6)

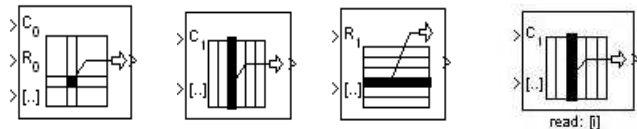


Figure 1.26.59:

This block reads elements (values, rows or columns) from input array. There are three possible modes:

- "read single value" - block reads the single value  $A(R,C)$  from the input array  $A$  at the given positions  $C$  (columns) and  $R$  (rows).
- "read row(s)" - block reads row(s)  $A(R)$  from the input array  $A$  at the given position(s)  $R$ .
- "read column(s)" - block reads column(s)  $A(C)$  from the input array  $A$  at the given position(s)  $C$ .

In the modes "read row(s)" and "read column(s)" it is possible to give a vector as an input for coordinates  $R$  or  $C$ . So it is possible to get more than one row or column in the output at once.

Each coordinate  $R$  and  $C$  can be obtained from the corresponding input port or as a block parameter. The user has a possibility to select between zero or one based indexing for coordinates  $R$  and  $C$ , indicated as subscripted 0 or 1 (e.g.  $C_0$  or  $C_1$ ).

**Bus support:** The input [...] can be either an array or a bus of arrays. If the input signal is a bus, the output signal is a bus with the same structure as the input. Every element of the bus signal gets the suffix specified below the block (read: [i]). The forth block shows the annotation "read: [i]" which means that every signal name in the output bus gets the suffix [i] to indicate that the i-th element of the array is selected.

### set\_array (V. 5.) (V. 6)

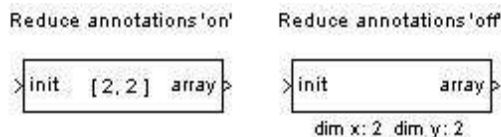


Figure 1.26.60:

This block outputs the array filled with the given initial value. The initial value can be obtained from the block input ('external source') or can be entered as the block parameter ('internal source'). The size of the output array can be entered directly as the block parameter or can be obtained from the existent data definition.

### set\_bit (V. 5.) (V. 6)



Figure 1.26.61:

The block sets or resets the bits of decimal number "dec\_num" chosen through input port "bit\_sel" depending on the value of "bit". User can specify "bit" value either in the parameter "Bit value" or as an input port. The "bit" input port value can be a vector. In this case "bit" vector length should be the same as in "bit\_sel" vector.

The decimal value can be obtained from the input port "num\_dec" or it can be stored in internal memory and initialized by zero. The user has the possibility to select between zero or one based indexing for "bit\_sel", indicated as subscribed 0 or 1 (e.g. bit\_sel<sub>0</sub> or bit\_sel<sub>1</sub>).

### Two\_power\_n (V. 5.) (V. 6)

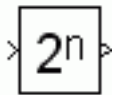


Figure 1.26.62:

This block calculates 2 to the power of n. The input n has to be an integer. Otherwise the digits after the comma are cut off (floor[n]).

### Width (V. 5) (V. 6)



Figure 1.26.63:

Output the width of the input signal. If an the input is an array of size 3 the output is 3.

### write\_array (V. 5.) (V. 6)

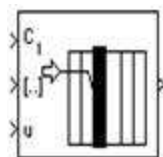


Figure 1.26.64:

This block writes elements (values, rows or columns) into input array. It is possible to select between zero or one based indexing for coordinates.

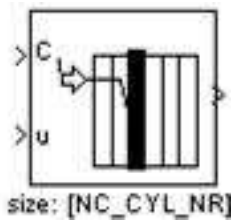


Figure 1.26.65:

There are three possible operation modes:

- "write single value" - block writes the single value  $A(R,C)$  into the input array  $A$  at the given positions  $R$  (columns) and  $C$  (rows).
- "write row(s)" - block writes row(s)  $A(R)$  into the input array  $A$  at the given position(s)  $R$ .
- "write column(s)" - block writes column(s)  $A(C)$  into the input array  $A$  at the given position(s)  $C$ .

In the modes "write row(s)" and "write column(s)" it is possible to give a vector as an input for coordinates  $R$  or  $C$ . So it is possible to write more than one row or column in the output array at once.

The input row or column in "write row(s)" or "write column(s)" mode should either be scalar (single value) or have the same length as the according dimension of the input array.

It is possible to obtain the input array  $A$  from an input port or from an internal memory. When block uses internal memory to store the array  $A$  the size of this array is shown as block annotation like in the second block example. The size of the array in this case is  $NC\_CYL\_NR$ . The dimension can also be obtained from an existent data definition.

**Bus support:** The input "[.]" can be either an array or a bus of arrays. When using a bus of arrays, the input "u" can be a single signal or a bus of signals. When both inputs are buses, there is a correspondence between signals with the same names: the signal "X\_i" from "u" is used to write on the array "X" from "[.]".

### Write Matrix (V. 5.) (V. 6)

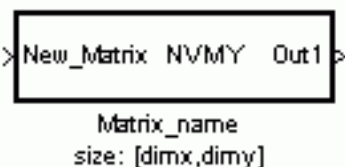


Figure 1.26.66:

The block writes a Matrix 'Matrix\_name' directly in the Workspace. This block is used if data in the simulation has to be saved in the nonvolatile memory NVMY (e.g. at  $PWL\_OFF$ ). In the data definition table of the specification the matrix name is set to Mode S. The parameters 'Matrix\_name', number of rows 'dimx Rows' and number of columns 'dimy Col' are shown in the block icon.



### Write To Matrix (V. 5.)

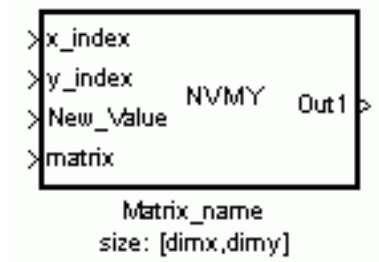


Figure 1.26.67:

The Block writes a new value to a given position in a 2-dimensional Matrix 'MatrixName' not only in the Simulation but also directly in the Workspace. The new value is given by 'New\_Value' and the position in the matrix is given by the indices 'x\_index' and 'y\_index' (Indexing starts from zero).

This block can be used if data in the simulation has to be saved in the nonvolatile memory NVMY (e.g. at PWL\_OFF). In the specification the matrix name is set to Mode S. The parameters 'Matrix\_name', number of rows 'dimx Rows' and number of columns 'dimy Col' are shown in the block icon.

### inverse\_lookup\_x (V. 5.) (V. 6)

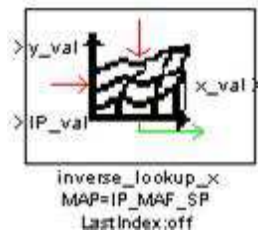


Figure 1.26.68:

This block extracts the value on the x\_axis for the map given by Mapname based on the input of the actual map value and the value for the y-axis.

### inverse\_lookup\_y (V. 5.) (V. 6)

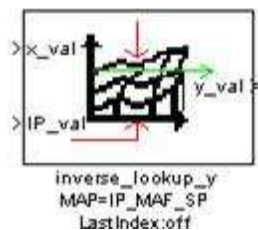



Figure 1.26.69:

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	Document key 10171571 SPE 000 AO	Pages Page 705 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

This block extracts the value on the y\_axis for the map given by Mapname based on the input of the actual map value and the value for the x-axis.

### 1.26.12 SDA 4.0 and 3.1 specific blocks

**Note:** The version information is not available on block icon for blocks from SDA 4.0 and 3.1 releases.

#### Read Vector

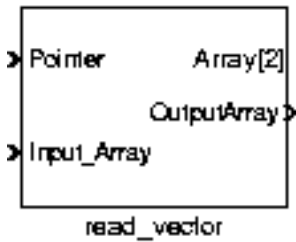


Figure 1.26.70:

Description

This block returns the value of the array element at the position selected by 'Pointer'. Indexing in this block starts from 1. The size of the array can be directly given in the 'Size of Array' parameter or by a variable set in Workspace.

Pointer	Position of the selected element in the input vector (array index)
Input_Array	input vector
OutputArray	Selected element of the input vector
Array[NC,...]	Size of array

#### Write Vector

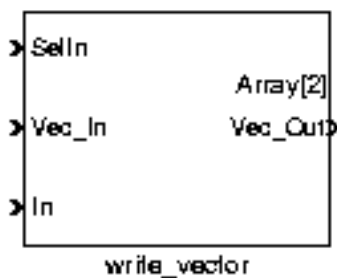


Figure 1.26.71:

Writes a given value to the selected position in the vector. The block writes a given value to the selected position in the vector. The value is given by 'In' and the position in the vector by 'SelIn' (Indexing starts from 1).The dimension of the array is specified by the 'Size of Array' parameter.

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Selln	Index of the vector position
Vec_In	Input vector
In	Value that is written to vector position 'Selln'
Vec_Out	Output vector
Array[NC,...]	Size of array

### Set Vector

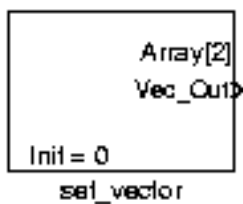


Figure 1.26.72:

The block initializes all values in a vector with the value 'Init'. The size of the vector can be given directly by the 'Size of Array' parameter or by a variable set in Workspace. 'Vec\_Out' outputs the initialized vector.

### Write Matrix

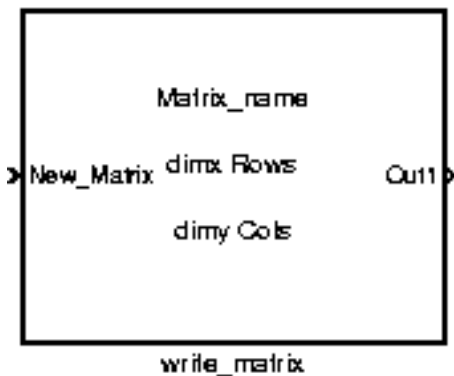


Figure 1.26.73:

The block writes a Matrix 'Matrix\_name' directly in the Workspace. This block can be used if data in the simulation has to be saved in the nonvolatile memory NVMY (e.g. at PWL\_OFF). In the specification the matrix name is set to Mode S. The parameters 'Matrix\_name', number of rows 'dimx Rows' and number of columns 'dimy Col' are shown in the block icon.

New_Matrix	Matrix Elements
Out	2-dimensional Matrix, written in the Workspace

### Write To Matrix

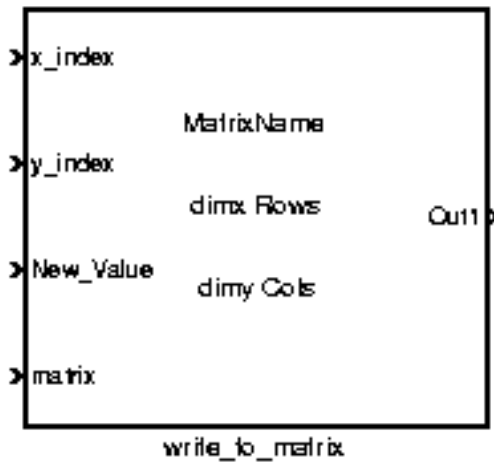


Figure 1.26.74:

The Block writes a new value to a given position in a 2-dimensional Matrix 'MatrixName' not only in the Simulation but also directly in the Workspace. The new value is given by 'New\_Value' and the position in the matrix is given by the indices 'x\_index' and 'y\_index' (Indexing starts from zero).

This block can be used if data in the simulation has to be saved in the nonvolatile memory NVMY (e.g. at PWL\_OFF). In the specification the matrix name is set to Mode S. The parameters 'Matrix\_name', number of rows 'dimx Rows' and number of columns 'dimy Col' are shown in the block icon.

x_index	x-index of the matrix position
y_index	y-index of the matrix position
matrix	Input matrix
New_Value	Value that is written to matrix position 'x_index' and 'y_index'
Out	Output matrix

### Lookup ID Curve

Looks up an ID\_Curve (No interpolation). Outputs the 'ID\_value' connected with the next smallest index to the axis value 'x\_value'. There is no interpolation between axis values. The names of the axis are given by list\_curve in the Workspace. There is also no extrapolation outside the axes values.

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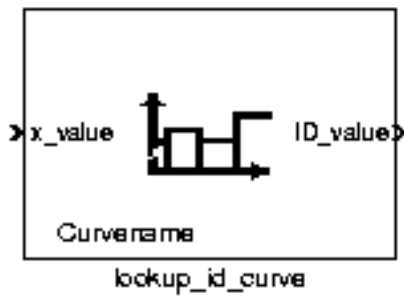


Figure 1.26.75:  
triggered (optional)

x_value	Input axis value
ID_value	Output curve value connected with the next smallest index to the axis value

### Lookup ID Curve Array

Looks up an ID\_Curve\_array (No interpolation). [triggered (optional)]

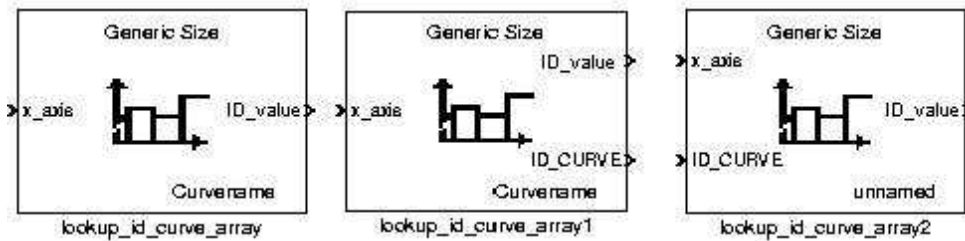


Figure 1.26.76:

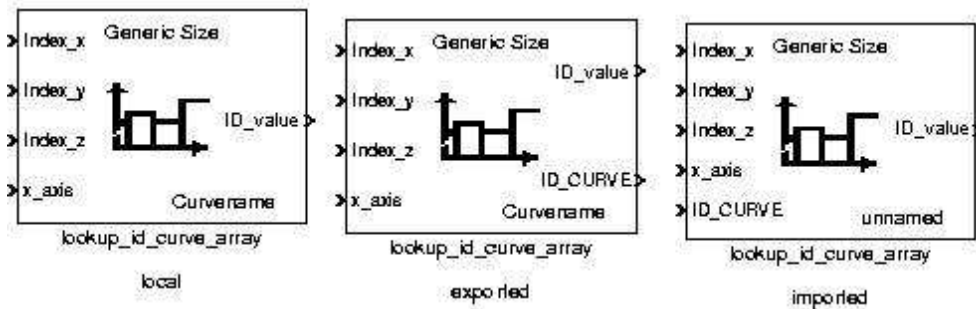



Figure 1.26.77:

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	Document key 10171571 SPE 000 AO	Pages Page 709 of 8404	
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## Modes

Mode local: 'Curvename' is defined within the block in block parameter 'ID\_CURVE'.

Mode exported: 'Curvename' is defined within the block in block parameter 'ID\_CURVE' and is exported via an output (if lookup table is input to another specification).

Mode imported: 'Curvename' is imported via an inport (if lookup table is defined in another specification).

## Description

Outputs the 'ID\_map' value connected with the next smallest index to the axis value 'x\_axis'. There is no interpolation between axis values. Index\_x, Index\_y and Index\_z specify the indices of the ID\_Curve in the curve array. The names of the axes and the size of the curve array are given by list\_curve in the Workspace. There is no extrapolation outside the axes values.

x_axis	Input x-axis value
ID_map	Output curve value connected with the next smallest index to the x-axis value
Index_x	Input: x-index of the curve in the curve array (optional)
Index_y	Input: y-index of the curve in the curve array (optional)
Index_z	Input: z-index of the curve in the curve array (optional)
ID_CURVE	Input: imports the name of the curve (Mode: imported) (optional)
ID_CURVE	Ouput: exports the name of the curve (Mode: exported) (optional)

## Lookup ID Map

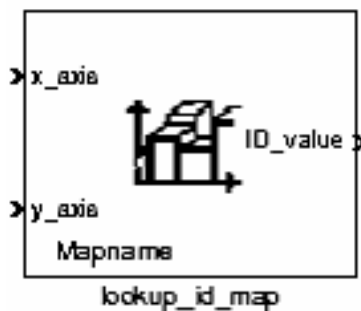


Figure 1.26.78:

Looks up an ID\_Map (No interpolation).

triggered (optional)

Outputs the 'ID\_map' value connected with the next smallest index to the axis values 'x\_axis' and 'y\_axis'. There is no interpolation between axis values. The names of the axes are given by list\_map in the Workspace. There is no extrapolation outside the axes values.

x_axis	Input: x-axis value
y_axis	Input: y-axis value
ID_map	Output: Map value connected with the next smallest index to the x- and y-axis values

## Lookup ID Map Array

Looks up an ID\_Map\_array (No interpolation). [triggered (optional)]

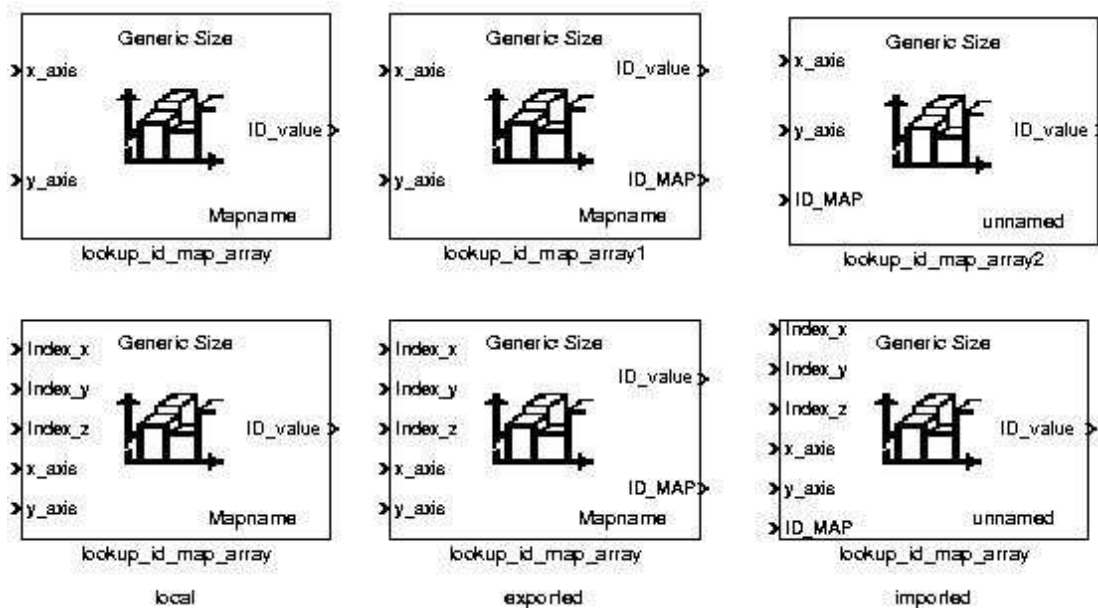


Figure 1.26.79:

### Modes

Mode local: 'Mapname' is defined within the block in block parameter 'ID\_Map'.

Mode exported: 'Mapname' is defined within the block in block parameter 'ID\_Map' and is exported via an output (if lookup table is input to another specification).

Mode imported: 'Mapname' is imported via an input (if lookup table is defined in another specification).

### Description

Outputs the 'ID\_map' value connected with the next smallest index to the axis values 'x\_axis' and 'y\_axis'. There is no interpolation between axis values. Index\_x, Index\_y and Index\_z specify the indices of the ID\_Map in the Map array. The names of the axis and the size of the map array are given by list\_map in the Workspace. There is no extrapolation outside the axes values.

x_axis	Input x-axis value
y_axis	Input y-axis value
ID_map	Map value connected with the next smallest index to the x-axis and y-axis value
Index_x	x-index of the map in the map array (optional)
Index_y	y-index of the map in the map array (optional)
Index_z	z-index of the map in the map array (optional)
ID_MAP	Imports the name of the map (Mode: imported) (optional)
ID_MAP	Exports the name of the map (Mode: exported) (optional)

### Lookup IP Curve

Looks up an IP\_Curve (With interpolation).

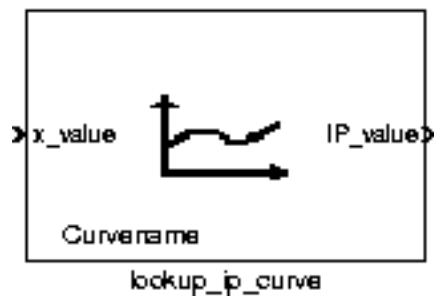


Figure 1.26.80:  
triggered (optional)

Outputs the 'IP\_value' connected with the linear interpolated index of the axis value 'x\_value'. There is a linear interpolation between axis values. The names of the axes are given by list\_curve in the Workspace. There is no extrapolation outside the axes values.

x_axis	Input x-axis value
IP_value	Value obtained interpolating the curve

### Lookup IP Curve Array

Looks up an IP\_Curve\_array (With interpolation). [triggered (optional)]



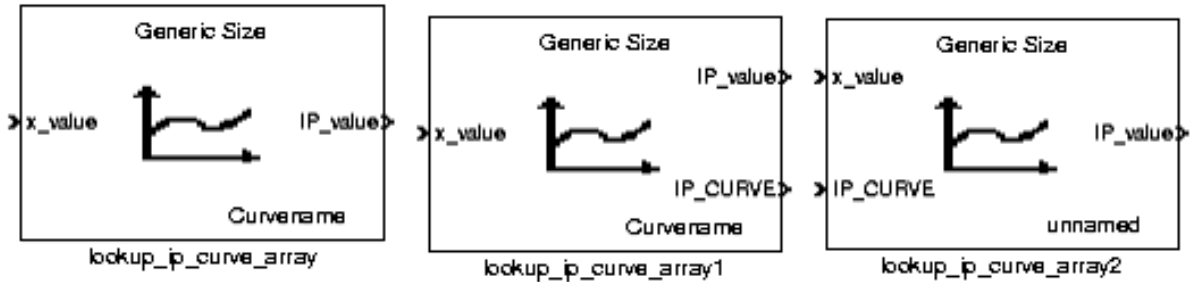


Figure 1.26.81:

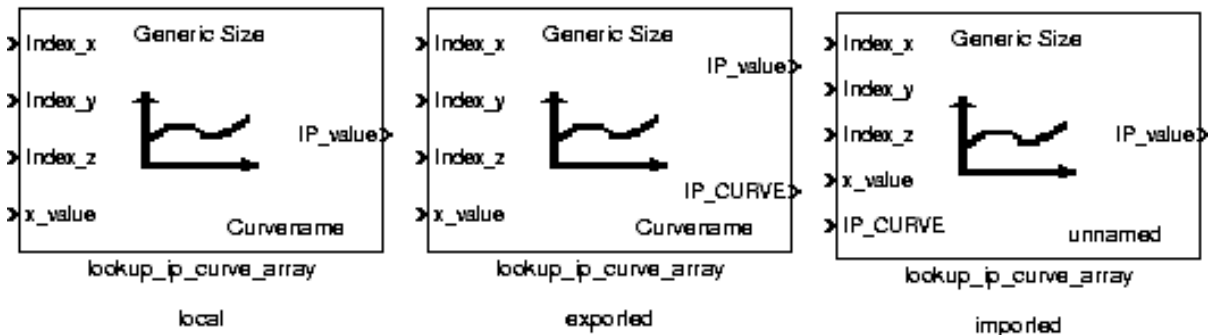


Figure 1.26.82:

### Modes

Mode local: 'Curvename' is defined within the block in block parameter 'ID\_CURVE'.

Mode exported: 'Curvename' is defined within the block in block parameter 'ID\_CURVE and is exported via an output (if lookup table is input to another specification).

Mode imported: 'Curvename' is imported via an inport (if lookup table is defined in another specification).

### Description

Outputs the 'IP\_value' connected with the linear interpolated index to the axis value 'x\_value'. There is a linear interpolation between axis values. Index\_x, Index\_y and Index\_z specify the indices of the IP\_Curve in the curve array. The names of the axis and the size of the curve array are given by list\_curve in the Workspace. There is no extrapolation outside the axes values.

x_axis	Input x-axis value
IP_value	Value obtained interpolating the curve
Index_x	Input: x-index of the curve in the curve array
Continued on next page	

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Index_y	Input: y-index of the curve in the curve array
Index_z	Input: z-index of the curve in the curve array
IP_CURVE	Imports the name of the curve (Mode: imported)
IP_CURVE	Exports the name of the curve (Mode: exported)

### Lookup IP Map

Looks up an IP\_Map (With interpolation).

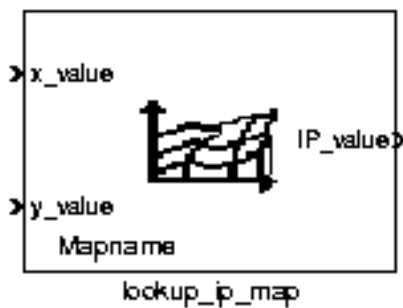


Figure 1.26.83:

triggered (optional)

Outputs the 'IP\_value' connected with the linear interpolated index of the axis values 'x\_value' and 'y\_value'. There is a linear interpolation between axis values. The names of the axis are given by list\_map in the Workspace. There is no extrapolation outside the axes values.

x_value	x-axis value
y_value	y-axis value
IP_value	Map value connected with the linear interpolated indices to the x- and y-axis values

### Lookup IP Map Array

Looks up an IP\_Map\_array (With interpolation).[ triggered (optional)]

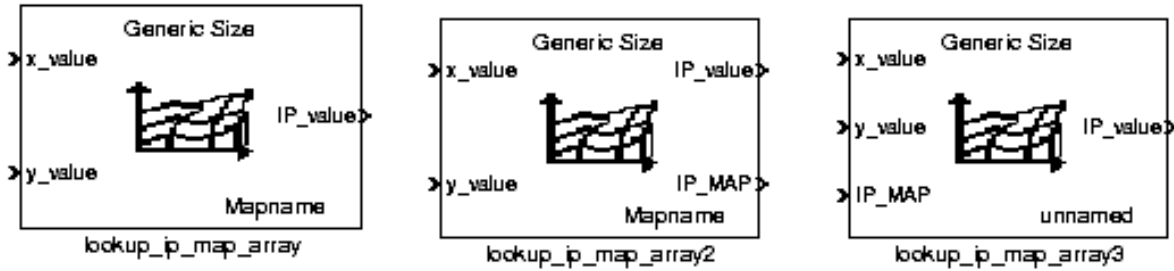


Figure 1.26.84:

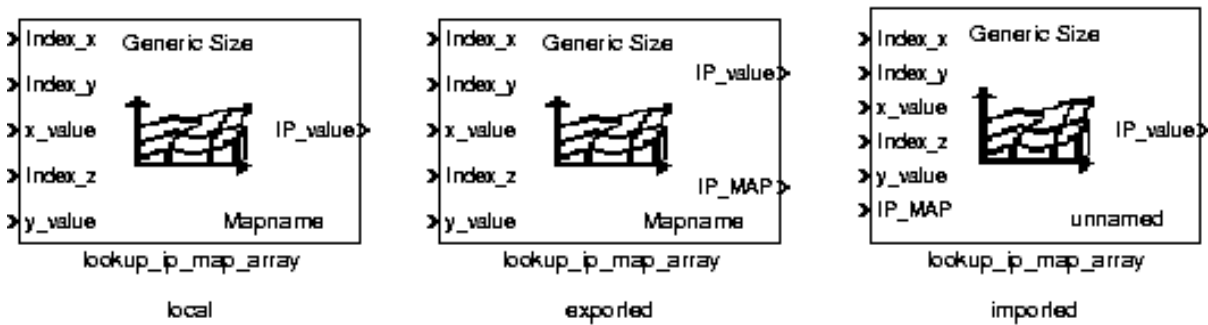


Figure 1.26.85:

### Modes

Mode local: 'Mapname' is defined within the block in block parameter 'IP\_Map'.

Mode exported: 'Mapname' is defined within the block in block parameter 'IP\_Map' and is exported via an output (if lookup table is input to another specification).

Mode imported: 'Mapname' is imported via an inport (if lookup table is defined in another specification).

### Description

Outputs the 'IP\_value' connected with the linear interpolated index to the axis values 'x\_value' and 'y\_value'. There is linear interpolation between axis values, but there is no extrapolation outside the axes values. 'Index\_x', 'Index\_y' and 'Index\_z' specify the indices of the IP\_Map in the map array. The names of the axes and the size of the map array are given by list\_map in the Workspace.

x_value	x-axis value
y_value	y-axis value
IP_value	Map value connected with the linear interpolated index to the x-axis and y-axis value
Continued on next page	

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Index_x	x-index of the map in the map array
Index_y	y-index of the map in the map array
Index_z	z-index of the map in the map array
IP_MAP	Imports the name of the map (Mode: imported)
IP_MAP	Exports the name of the map (Mode: exported)

### Lookup Multiple ID Curve

Looks up multiple ID\_Curves (No interpolation).

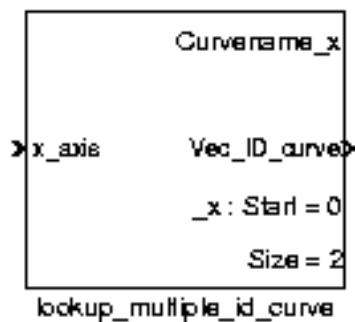


Figure 1.26.86:

triggered (optional)

If the parameter 'Curvename' contains one of the tokens (\_x, \_i, \_j), this is replaced automatically by a given range from 1 to 'Size' or 0 to ('Size'-1). The number of curves accessed is given by 'Size'.

Outputs a vector of length 'Size' of ID\_values 'Vec\_ID\_curve' connected with the next smallest index of the axis values 'x\_value' of the different curves.

There is no interpolation between the axis values and no extrapolation outside the axes values. The axis names are given by list\_curve in the Workspace.

x_axis	Axis value
Vec_ID_curve	Vector of Curve values with dimension 'Size' connected with the next smallest index of the x-axis value

### Lookup Multiple ID Map

Looks up multiple ID\_Maps (No interpolation).

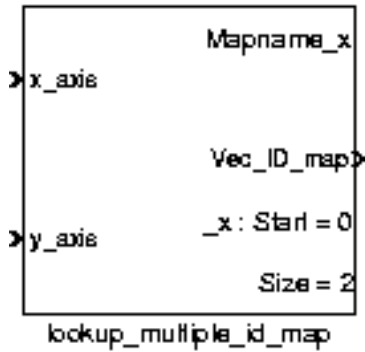


Figure 1.26.87:  
triggered (optional)

If the parameter 'Curvname' contains one of the tokens (x, i, j), this is replaced automatically by a given range from 1 to 'Size' or 0 to ('Size'-1). The number of maps accessed is then given by 'Size'. Outputs a vector of length 'Size' of ID\_values 'Vec\_ID\_map' connected with the next smallest indices to the axis values 'x\_axis' and 'y\_axis'. There is no interpolation between the axis values. The axis names are given by list\_curve in the Workspace. There is no extrapolation outside the axes values.

x_axis	x-axis value
y_axis	y-axis value
Vec_ID_map	Vector of Curve values connected with the next smallest index of the x-axis and y-axis value

### Lookup Multiple IP Curve

Looks up multiple IP\_Curves (With interpolation).

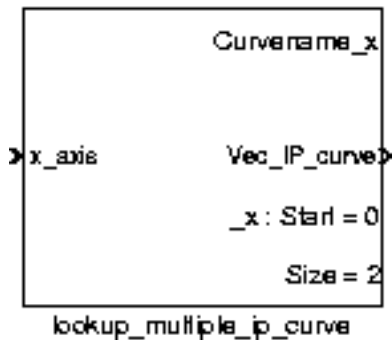


Figure 1.26.88:  
triggered (optional)

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If the parameter 'Curvname' contains one of the tokens (\_x, \_i, \_j), this is replaced automatically by a given range from 1 to 'Size' or 0 to ('Size'-1). The number of curves accessed is then given by 'Size'.

Outputs a vector of length 'Size' of IP\_values 'Vec\_IP\_curve' connected with the linear interpolated index of the axis value 'x\_axis'. There is linear interpolation between the axis values and no extrapolation outside the axes values. The axis names are given by list\_curve in the Workspace.

x_axis	Axis value
Vec_IP_curve	Vector of Curve values connected with the linear interpolated index to the x-axis value

### Lookup Multiple IP Map

Looks up multiple IP\_Maps (With interpolation).

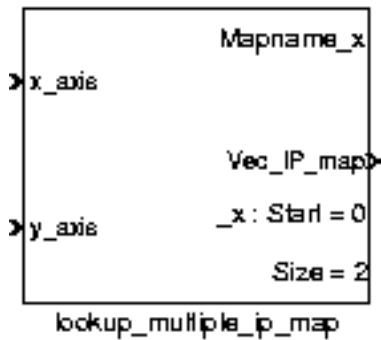


Figure 1.26.89:  
triggered (optional)

If the parameter 'Curvname' contains one of the tokens (\_x, \_i, \_j), this is replaced automatically by a given range from 1 to 'Size' or 0 to ('Size'-1). The number of maps accessed is then given by 'Size'.

Outputs a vector of length 'Size' of IP\_values 'Vec\_IP\_map' connected with the linear interpolated index to the axis values 'x\_axis' and 'y\_axis'.

There is linear interpolation between the axis values, but there is no extrapolation outside the axes values. The axis names are given by list\_map in the Workspace.

x_axis	x-axis value
y_axis	y-axis value
Vec_IP_map	Curve value connected with the linear interpolated index to the x-axis and y-axis value

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## 1.27 SDA - AT basic blocks short description

### General information:

#### 1.27.1 Remarks for block version V 5.x

##### Multi-rate and single-rate block versions

Some blocks have two versions: multi-rate and single-rate. The multi-rate version (with R\_FC and CLC\_FC inputs) is used in case of system resets have to be simulated. R\_FC and CLC\_FC are shortcuts for "reset function call" and "calculate function call" respectively.

Various blocks have also optional inputs and outputs, which are chosen according to the model specific needs. The following picture shows an example of a block in its both versions, single-rate and multi-rate. The third picture also shows optional inputs and outputs (internal state):

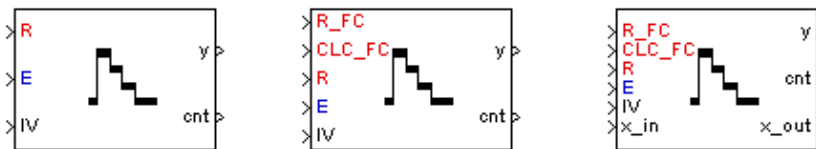


Figure 1.27.1:

For each block the functionality is described by an "Init-code" (executed at the start of simulation) and pseudo code (for methods run(), finalize(), pass(), out() and reset()) executed during simulation).

The block functionality, given with the pseudo-code and init-code, remains the same in both versions, multi-rate and single-rate.

In the multi-rate version, the block is only calculated if a function-call triggers the input R\_FC or CLC\_FC. Triggering the block through the input R\_FC simulates a system reset. The calculation done when a R\_FC triggers the block is shown in the given pseudo-code "R\_FC". The block outputs are not calculated in the R\_FC code. Triggering the block through the input CLC\_FC runs the execution of this block, calculating a new output value. This calculation is shown in the given pseudo-code for each block.

In the single-rate version, the block calculation is executed every time the subsystem containing the block is triggered. This means, that the block calculation occurs as for every other non triggered block or subsystem. The order of calculation in the single-rate mode is exactly the same as for CLC\_FC.

Besides the system reset (R\_FC function call) the blocks also implement a logical reset (functional reset). There are two versions of the logical reset which can occur in single-rate mode or in multi-rate mode when CLC\_FC triggers the block:

- *State based*: Reset occurs as long as signal R equals 1 (blocks with the suffix \_RE)
- *Edge based*: Reset occurs on signal RT rising edge (blocks with the suffix \_RTE)

Unlike reset via the R\_FC function call, when the logical reset occurs, the block calculates its outputs.

While no logical reset occurs in single-rate mode or while CLC\_FC function-call in multi-rate mode, the block computations are defined by the value of the Enable signal E. While E is not equal to zero, the

block performs the necessary computation and updates its internal state(s). While E is equal to zero, the internal states are not updated and the output of the block is based on the previously stored value of its internal state.

CLC\_FC function uses the following sub-functions:

- reset() initializes internal state(s) with initial value(s) (IV, IV1, IV2...)
- run() performs general block computations while no logical reset is occurred and the enable signal E is not equal to zero
- finalize() performs general block computations while the logical reset is occurred or the enable signal E is not equal to zero
- pass() performs necessary computations while no logical reset is occurred and enable signal E is equal to zero.
- out() assigns values to output signal

The current implementation of these blocks is described with the following C-pseudo code:

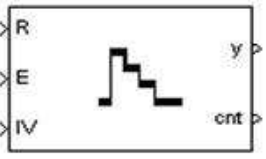
State detecting reset blocks ( -RE blocks )	Edge detecting reset blocks ( -RTE blocks )
<pre>function R_FC ( {   reset(); }</pre>	<pre>function R_FC ( {   reset();   R_1 = 0; }</pre>
<pre>function CLC_FC ( {   if (R) {     reset();     finalize();   }   else if (E) {     run();     finalize();   }   else {     pass();   }   out(); }</pre>	<pre>function CLC_FC ( {   if (R &amp; !R_1) {     reset();     finalize();   }   else if (E) {     run();     finalize();   }   else {     pass();   }   out();   R_1 = R; }</pre>

In the description later on, for these kinds of blocks, the C-like code for each of these sub-functions is given beside the block icon as shown in the example below:

Continued on next page

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 <p>Figure 1.27.2:</p>	<b>Variables:</b> E: logic R: logic IV: real y: logic x: int cnt: int	<b>Init-code:</b> x = 0;  <b>reset ( )</b> x = round(IV);  <b>run ( )</b> if (x > 0) { x = x - 1; } 	<b>finalize ( )</b>  <b>pass ( )</b>  <b>out ( )</b> y = (x > 0); cnt = x;
---	---	--	--

The additional inputs and outputs used to set and get internal states have the suffixes "\_in" and "\_out" after the referred state name respectively. These inputs and outputs are optional.

The following list shows the standard input and output names, with their corresponding descriptions:

### Inputs


Port	Description
E	Enable: suppresses the block calculation while 0
R	Resets the block states to their initial values while 1
RT	Resets the block states to their initial values on rising edge 0 -> 1
IV	Initial value set upon reset
R_FC	System reset (multirate version)
CLC_FC	System calculation request (multirate version)
dT	Sample time
MX	Upper state limit
MN	Lower state limit
x_in	Direct input of an internal state if the block has one internal state
x1_in	Direct input of an internal state 1 if the block has 2 internal states
x2_in	Direct input of an internal state 2 if the block has 2 internal states

### Outputs

Port	Description
B_max	True if the upper limitation active
B_min	True if the lower limitation active
x_out	Direct output of an internal state if the block has one internal state
x1_out	Direct output of a internal state 1 if the block has 2 internal states
x2_out	Direct output of a internal state 2 if the block has 2 internal states
y	Out
cnt	Internal counter state

## 1.27.2 Remarks for block version V 6.x

### Functional behaviour

Released by Tettenborn Frank		Date 2013-02-13	File 30102403.00A
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 721 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

The blocks of version 6.x have the same functional single rate behaviour than the blocks of version 5.x. The changes in the blocks are only related to code generation and to adaptation to the ASAM MBFS standard.

### Single-rate block version

Version 6 blocks do not support the multi-rate option. Many blocks have optional inputs and outputs, which are chosen according to the model specific needs. The following picture shows an example for block configuration:

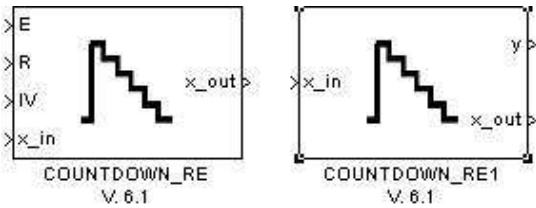


Figure 1.27.3:

In the single-rate version, the block calculation is executed every time the subsystem containing the block is triggered. This means, that the block calculation occurs as for every other non triggered block or subsystem.

While no logical reset occurs in single-rate mode, the block computations are defined by the value of the Enable signal E. While E is not equal to zero, the block is calculated and updates its internal state(s). While E is equal to zero, the internal states are not updated and the output of the block is based on the previously stored value of its internal state.

### x\_in and x\_out interface

The inputs x\_in and outputs x\_out are used to export and import the internal state x of the blocks. The internal state is exported in order to be able to initialize the state at system reset via the SignalManager on top module level. This system reset handling replaces the multirate option of the blocks.

#### 1.27.2.1 Input/Output port details for V6 blocks:

##### Inputs

Port	Description
E	Enable: suppresses the block calculation while 0
R	Resets the block states to their initial values while 1
RT	Resets the block states to their initial values on rising edge 0 - -> 1
IV	Initial value set upon reset
dT	Sample time
MX	Upper state limit
MN	Lower state limit
x_in	Direct input of an internal state if the block has one internal state
x1_in	Direct input of an internal state 1 if the block has 2 internal states

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x2_in	Direct input of an internal state 2 if the block has 2 internal states
-------	--

### Outputs

Port	Description
B_max	True if the upper limitation active
B_min	True if the lower limitation active
x_out	Direct output of an internal state if the block has one internal state
x1_out	Direct output of a internal state 1 if the block has 2 internal states
x2_out	Direct output of a internal state 2 if the block has 2 internal states
y	Output

### 1.27.3 Directly triggered blocks

The blocks without internal states (and, as a result, without reset) have the 'Triggered block' parameter. This is a checkbox which can be 'on' or 'off'. When this option is 'off' the calculation for these blocks is executed every time the subsystem, which they are placed in, is triggered. When this option is 'on', the additional control input port is added at the top of these blocks. This port accepts function-call connection (as CLC\_FC does) and these blocks are calculated only when a function-call triggers the control port.

### 1.27.4 Block versioning

The block version is shown since SDA 5.0 release. Please note the following:  
Blocks from previous SDA versions do not show any version information.

The version information is shown on the block icon or below it in the format "V X.Y". Functional change or relevant appearance changes reflects on version information update (only on "X"). A change in "Y" is not functional or appearance relevant. For instance, the versions 5.1, 5.4, 5.13 have all the same appearance and functional behavior.

The part "X" of the block version number is not coupled to SDA release number. The first block version since SDA 5.0 is "5." for all libraries though.

All functional changes done to AT Library blocks between SDA releases are shown in this document and in the according library documentation within the SDA installation.

### 1.27.5 Arithmetic Operators

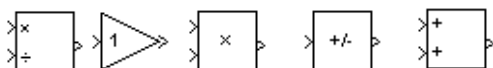


Figure 1.27.4:

**Div (V. 5) (V. 6)**

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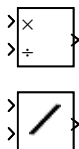


Figure 1.27.5:

The block divides the elements of the first (upper) input by the elements of the second (lower) input. Case the upper input is a vector or matrix, it performs an element-wise division.

**Gain (simulink block)**



Figure 1.27.6:

The Gain block generates its output by multiplying its input by a specified gain factor. The input and gain can be a scalar, vector, or matrix. Only unitary gain is allowed in SDA models.

**Mul (V. 5) (V. 6)**

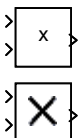


Figure 1.27.7:

The block multiplies the elements of the first (upper) input by the elements of the second (lower) input (element wise multiplication).

**Neg (V. 5) (V. 6)**



Figure 1.27.8:

Negates the input signal. The input signal can be a scalar, a vector or a matrix.


**Sum (V. 5) (V. 6)**



Figure 1.27.9:

The Sum block performs addition ("+" input) or subtraction ("- " input) on its inputs. This block can add or subtract scalar, vector, or matrix inputs. It can also collapse the elements of a single input vector.

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 724 of 8404	
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### 1.27.6 Comparison Operators

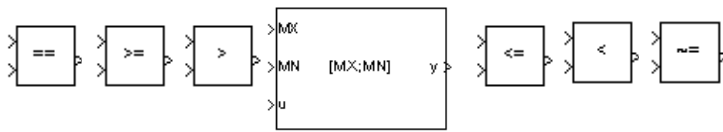


Figure 1.27.10:

#### Interval (V. 5) (V. 6)

Output y is true if the input signal u lies between MN and MX.

	<b>Variables:</b> MX: real MN: real u: real y: logic	<b>run ( )</b> <pre>                 if((u &lt; MX) &amp;&amp; (u &gt; MN)){                     y = 1;                 }                 else {                     y = 0;                 }             </pre>
--	--	---

Figure 1.27.11:

The braces are used to indicate if the interval limits MX and MN are contained ("[MX...", "...MN]") or not ("]MX...", "...MN[") in the interval. The ">" or "<" signs are then changed in ">=" or "<=", accordingly.

Port	I/O	Description
u	IN	Input signal
MX	IN	Maximum value for input signal
MN	IN	Minimum value for input signal
y	OUT	Boolean value, true if u lies in the Interval [MN,MX]

#### EQ, GE, GT, LE, LT, NE (V. 5) (V. 6)

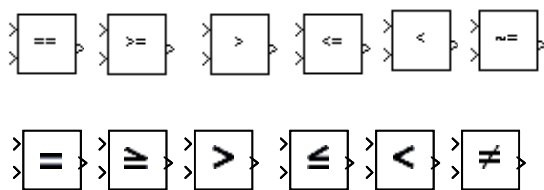


Figure 1.27.12:

The blocks EQ, GE, GT, LE, LT and NE performs a relational operation on its two inputs and produces output according to the following table.

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Operator	Output
==	TRUE if the first input is equal to the second input
~=	TRUE if the first input is not equal to the second input
<	TRUE if the first input is less than the second input
<=	TRUE if the first input is less than or equal to the second input
>=	TRUE if the first input is greater than or equal to the second input
>	TRUE if the first input is greater than the second input

If the result is TRUE, the output is 1; if FALSE, it is 0. Inputs can be specified as scalars, arrays, or a combination of a scalar and an array:

- For scalar inputs, the output is a scalar.
- For array inputs, the output is an array of the same dimensions, where each element is the result of an elementwise comparison of the input arrays.
- For mixed scalar/array inputs, the output is an array, where each element is the result of a comparison between the scalar and the corresponding array element.

The block icon displays the selected operator.

### 1.27.7 Counter and Timer

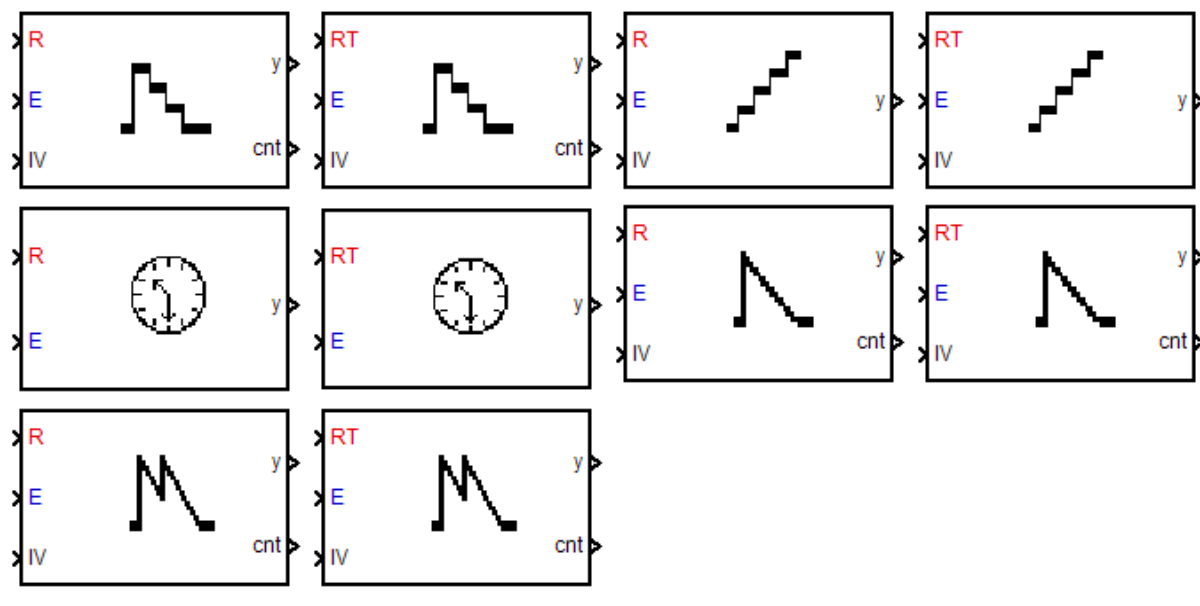
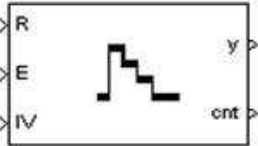


Figure 1.27.13:

Optional ports:	R, E, RT, R_FC, CLC_FC, x_in, x_out, dT
-----------------	---

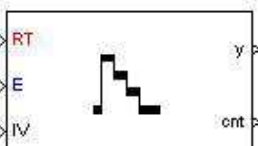
### CountDownRE (V. 5) (V. 6)

Output y is true, if the number of block evaluations since the last reset is less than the initial number of block evaluations IV. The block has state based reset.

 <p>Figure 1.27.14:</p>	<b>Variables:</b> E: logic R: logic IV: real y: logic x: int cnt: int	<b>Init-code:</b> x = 0;  <b>reset ( )</b> x = round(IV);  <b>run ( )</b> if (x > 0) { x = x - 1; }	<b>finalize( )</b>  <b>pass ( )</b>  <b>out ( )</b> y = (x>0); cnt = x;
--	---	--	---

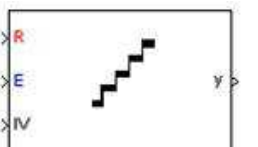
**CountDownRTE (V. 5) (V. 6)**

Output is true, if the number of block evaluations since the last reset is less than the initial number of block evaluations IV. The block has edge based reset.

 <p>Figure 1.27.15:</p>	<b>Variables:</b> E: logic RT: logic IV: real y: logic x: int cnt: int	<b>Init-code:</b> x = 0;  <b>reset ( )</b> x = round(IV);  <b>run ( )</b> if (x1 > 0) { x = x - 1; }	<b>finalize( )</b>  <b>pass ( )</b>  <b>out ( )</b> y = (x>0); cnt = x;
---	--	---	---

**CounterRE (V. 5) (V. 6)**

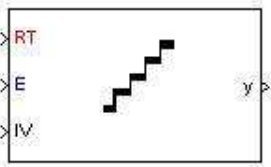
Counts up and gives out the number of block evaluations since the last reset. The block has state based reset.

 <p>Figure 1.27.16:</p>	<b>Variables:</b> E: logic R: logic IV: real y: real x: int	<b>Init-code:</b> x = 0;  <b>reset ( )</b> x = round(IV);  <b>run ( )</b> x = x + 1;	<b>finalize( )</b>  <b>pass ( )</b>  <b>out ( )</b> y = x;
--	--	---	---

**CounterRTE (V. 5) (V. 6)**

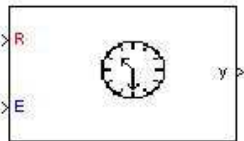
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Counts up and gives out the number of block evaluations since last reset. The block has edge based reset.

 <p>Figure 1.27.17:</p>	<b>Variables:</b> E: logic RT: logic IV: real y: real x: real	<b>Init-code:</b> x = 0;  <b>reset ( )</b> x = IV;  <b>run ( )</b> x = x + 1; <b>pass ( )</b>	<b>finalize( )</b>  <b>out ( )</b> y = x;
--	--	---	--


### StopWatchRE (V. 5) (V. 6)

The block outputs the time since the system init or the last reset. The block has state based reset.

 <p>Figure 1.27.18:</p>	<b>Variables:</b> E: logic R: logic y: real x: real	<b>Init-code:</b> x = 0.0;  <b>reset ( )</b> x = 0.0;  <b>run ( )</b> x = x + dT	<b>finalize( )</b>  <b>pass ( )</b>  <b>out ( )</b> y = x;
---	---	---	---

### StopWatchRTE (V. 5) (V. 6)

The block outputs the time since the system init or the last reset. The block has edge based reset.


 <p>Figure 1.27.19:</p>	<b>Variables:</b> E: logic RT: logic y: real x: real	<b>Init-code:</b> x = 0.0;  <b>reset ( )</b> x = 0.0;  <b>run ( )</b> x = x + dT;;	<b>finalize( )</b>  <b>pass ( )</b>  <b>out ( )</b> y = x;
--	--	---	---

### TimerRE (V. 5) (V. 6)

The block indicates true, if the initial time IV has not passed since the last reset of the block. Reset can only be performed, if the counter has run down to zero. The block has state based reset.


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 <p>Figure 1.27.20:</p>	<b>Variables:</b> E: logic R: logic IV: real y: logic x: real cnt: real	<b>Init-code:</b> x = 0.0;  <b>reset ( )</b> if (x <= 0) { x = IV; }  <b>run ( )</b> x = MAX(x - dT, 0.0);	<b>finalize( )</b>  <b>pass ( )</b>  <b>out ( )</b> cnt = x; y = (x>0);
--	---	---	---

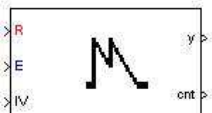
### TimerRTE (V. 5) (V. 6)

The block indicates true, if the initial time IV has not passed since the last reset of the block. Reset can only be performed, if the counter has run down to zero. The block has edge based reset.

 <p>Figure 1.27.21:</p>	<b>Variables:</b> E: logic R: logic IV: real y: logic x: real cnt: real	<b>Init-code:</b> x = 0.0;  <b>reset ( )</b> if(x<= 0.0) { x = IV; }  <b>run ( )</b> x = x - 1;	<b>finalize( )</b>  <b>pass ( )</b>  <b>out ( )</b> cnt = x; y = (x1>0);
---	---	--	--

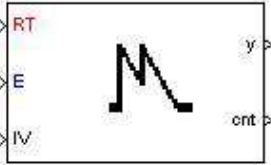
### TimerRetriggerRE (V. 5) (V. 6)

The block indicates true, if the initial time IV has not passed since the last reset of the block. Reset is always possible and independent of the current timer value. The block has state based reset.

 <p>Figure 1.27.22:</p>	<b>Variables:</b> E: logic R: logic IV: real y: logic x: real cnt: real	<b>Init-code:</b> x = 0.0;  <b>reset ( )</b> x = IV;  <b>run ( )</b> cnt = x; x = MAX(x - dT, 0.0);	<b>finalize( )</b>  <b>pass ( )</b>  <b>out ( )</b> y = (x>0);
--	---	---	---

### TimerRetriggerRTE (V. 5) (V. 6)

The block indicates true, if the initial time IV has not passed since the last reset of the block. Reset is always possible and independent of the current timer value. The block has edge based reset.

 <p>Figure 1.27.23:</p>	<b>Variables:</b> E: logic RT: logic IV: real y: logic x: real cnt: real	<b>Init-code:</b> x = 0.0;  <b>reset ( )</b> x = IV;  <b>out ( )</b> cnt = x; y = (x>0);	<b>finalize( )</b>  <b>run ( )</b> x = MAX(x - dT, 0.0);  <b>pass ( )</b>
--	--	--	--

### 1.27.8 Delay Blocks

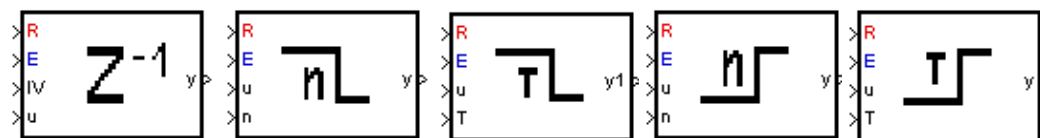
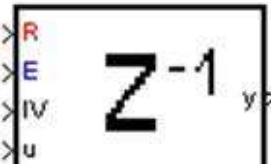


Figure 1.27.24:

Optional ports:	R, E, R_FC, CLC_FC, x_in, x_out, dT
-----------------	-------------------------------------

#### Delay\_RE (V. 5) (V. 6)

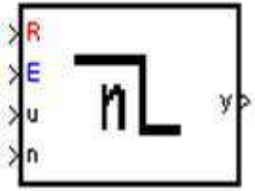
Delays the input signal u by one sample time. The reset value IV has direct influence on the output. DelayResetEnabled, Delay\_RE and Unit Delay depend on individual simulation purposes.

 <p>Figure 1.27.25:</p>	<b>Variables:</b> E: logic R: logic IV: real u: real y: real x: real	<b>Init-code:</b> x = 0;  <b>reset ( )</b> x = IV; y = IV  <b>run ( )</b> y = x; x = u	<b>finalize( )</b>  <b>pass ( )</b> y = x;  <b>out ( )</b>
--	--	---	---

#### TurnOffDelaySample (V. 5) (V. 6)


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A falling edge of the input signal u is delayed by n block evaluations (E).

 <p>Figure 1.27.26:</p>	<p><b>Variables:</b> E: logic R: logic n: real u: logic y: logic x: int temp: int</p>	<p><b>Init-code:</b> x = 0;</p> <p><b>reset ( )</b> x = round(n);</p> <p><b>pass ( )</b></p> <p><b>out ( )</b> y = ((temp&gt;0)    u);</p>	<p><b>finalize ( )</b> temp = x; if(u) {   x = round(n); } else {   if(temp &gt; 0) {     x = x - 1;   } } <b>run ( )</b></p>
--	---	--	---

**TurnOffDelayTime (V. 5) (V. 6)**

A falling edge of the input signal u is delayed by the time T, if the input remains false for minimum the whole period T.

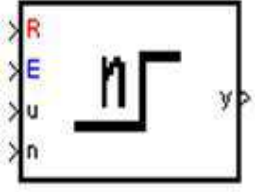
 <p>Figure 1.27.27:</p>	<p><b>Variables:</b> T: real R: logic E: logic y: logic x: real temp: real</p>	<p><b>Init-code:</b> x = 0.0;</p> <p><b>reset ( )</b> x = T;</p> <p><b>pass ( )</b></p> <p><b>out ( )</b> y = ((temp&gt;0)    u);</p>	<p><b>finalize ( )</b> temp = x; if(u) {   x = T; } else {   if(temp &gt; 0.0) {     x = x - dT;   } } <b>run ( )</b></p>
--	--	---	---

**TurnOnDelaySample (V. 5) (V. 6)**

A rising edge of the input signal u is delayed by n block evaluations.

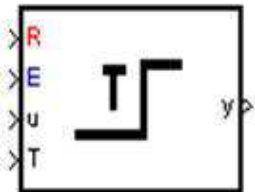
Continued on next page

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 <p>Figure 1.27.28:</p>	<b>Variables:</b> E: logic R: logic n: real u: logic y: logic x: int temp: int	<b>Init-code:</b> x = 0;  <b>reset ( )</b> x = round(n);  <b>pass ( )</b>  <b>out ( )</b> y = ((temp <= 0) & & u);	<b>finalize ( )</b> temp = x; if(u) { if(temp > 0) { x = x - 1; } } else { x = round(n); } <b>run ( )</b>
--	---	---	---

### TurnOnDelayTime (V. 5) (V. 6)

A rising edge of the input signal u is delayed by the time T, if the input signal remains high (true) for minimum this period T.

 <p>Figure 1.27.29:</p>	<b>Variables:</b> E: logic R: logic T: real y: logic x: real temp: real	<b>Init-code:</b> x = 0.0;  <b>reset ( )</b> x = T;  <b>pass ( )</b>  <b>out ( )</b> y = ((temp <= 0) & & u);	<b>finalize ( )</b> temp = x; if(u) { if(temp > 0.0) { x = x - dT; } } else { x = T; } <b>run ( )</b>
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### 1.27.9 Integrators

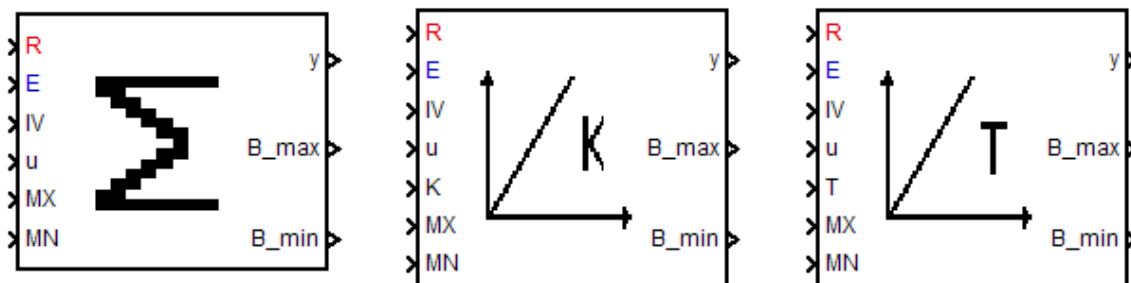


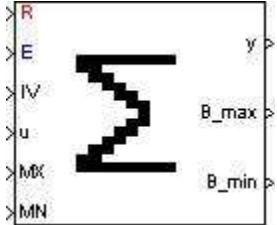
Figure 1.27.30:

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Optional ports:	R, E, R_FC, CLC_FC, x_in, x_out, dT, B_max, B_min
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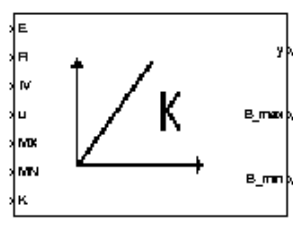
### AccumulatorREL (V. 5) (V. 6)

A time discrete integrator. The integrator value y is limited to the maximum MX and the minimum MN.

 <p>Figure 1.27.31:</p>	<p><b>Variables:</b></p> <p>MX: real MN: real u: real E: logic R: logic IV: real y: real B_max: logic B_min: logic x: real</p>	<p><b>Init-code:</b></p> <p>x = 0.0;</p> <p><b>reset ( )</b></p> <p>x = IV;</p> <p><b>run ( )</b></p> <p>x = x + u;</p> <p><b>pass ( )</b></p> <p><b>finalize ( )</b></p>	<p><b>out ( )</b></p> <pre> if (x &gt; MX) {     x = MX;     B_max = 1;     B_min = 0; } else if (x &lt; MN) {     x = MN;     B_max = 0;     B_min = 1; } else {     B_max = 0;     B_min = 0; } y = x;                     </pre>
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### IntegratorKREL (V. 5) (V. 6)

A time discrete integrator with gain K. The integrated value and therefore the output y are limited by the inputs MX and MN.

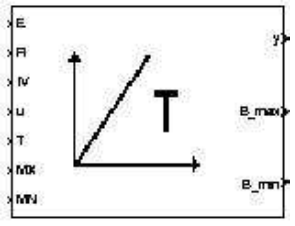
 <p>Figure 1.27.32:</p>	<p><b>Variables:</b></p> <p>MX: real MN: real K: real u: real E: logic R: logic IV: real y: real B_max: logic B_min: logic x: real</p>	<p><b>Init-code:</b></p> <p>x = 0.0;</p> <p><b>reset ( )</b></p> <p>x = IV;</p> <p><b>run ( )</b></p> <p>x = x + K*u*dT;</p> <p><b>pass ( )</b></p> <p><b>finalize ( )</b></p>	<p><b>out ( )</b></p> <pre> if (x &gt; MX) {     x = MX;     B_max = 1;     B_min = 0; } else if (x &lt; MN) {     x = MN;     B_max = 0;     B_min = 1; } else {     B_max = 0;     B_min = 0; } y = x;                     </pre>
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### IntegratorTREL (V. 5) (V. 6)

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Released by Tetenborn Frank		Date 2013-02-13	File 30102403.00A
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 733 of 8404	
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A time discrete integrator with gain 1/T. The integrated value and therefore the output y are limited by the inputs MX and MN.

 <p>Figure 1.27.33:</p>	<p><b>Variables:</b></p> <p>MX: real MN: real T: real u: real E: logic R: logic IV: real y: real B_max: logic B_min: logic x: real</p>	<p><b>Init-code:</b></p> <p>x = 0.0;</p> <p><b>reset ( )</b></p> <p>x = IV;</p> <p><b>run ( )</b></p> <p>x = x + u*dT/T;</p> <p><b>pass ( )</b></p> <p><b>finalize ( )</b></p>	<p><b>out ( )</b></p> <pre> if (x &gt; MX) {     x = MX;     B_max = 1;     B_min = 0; } else if (x &lt; MN) {     x = MN;     B_max = 0;     B_min = 1; } else {     B_max = 0;     B_min = 0; } y = x;         </pre>
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### 1.27.10 Logical Operators (V. 5) (V. 6)

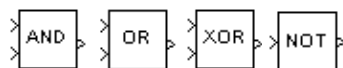


Figure 1.27.34:

#### Logical Operators

These blocks performs the logical operations on its inputs: AND, OR, XOR, and NOT. The output depends on the number of inputs, and their dimensionality. The output is 1 if TRUE and 0 if FALSE. The block icon shows the corresponding operator.

If the block has more than one input, the output has the same dimensions as the inputs (after scalar expansion) and each output element is the result of applying the specified logical operation to the corresponding input elements. For example, if the operation is 'AND' and the inputs are 2-by-2 arrays, the output is a 2-by-2 array whose top, left element is the result of applying AND to the top, left elements of the inputs, etc.

If the block has a single input and the block is not the NOT operator, the input must be vector-like, i.e. a scalar, a 1-D array, or a one-row or one-column 2-D array. The output is a scalar value equal to the result of applying the operation to the elements of the input.

When configured as a multi-input XOR gate, this block performs an addition modulo two operations as mandated by the IEEE standard for logic elements.

All blocks support **bitwise** operations. In this case, the logical operation is calculated bit by bit between the input ports. The block mode is identified by the annotation "bitwise" under its icon.

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### 1.27.11 Low and highpass

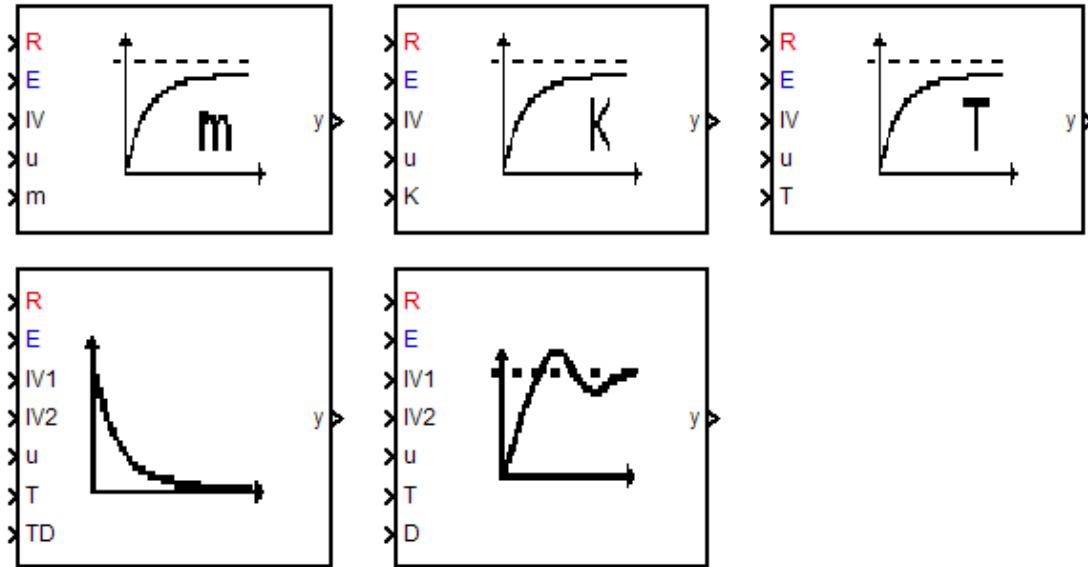


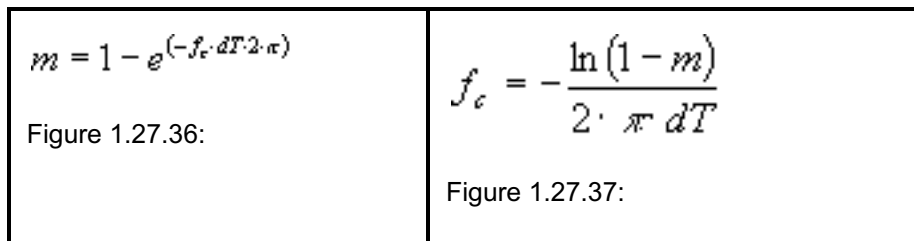
Figure 1.27.35:

Optional ports:	R, E, RT, R_FC, CLC_FC, x_in, x_in, x1_in, x2_in, x1_out, x2_out, dT
-----------------	--

#### DigitalLowpassRE (V. 5) (V. 6)

A discrete time first order lowpass. Value m indicates the percentage of the current approximation of the output value to the aimed input value.

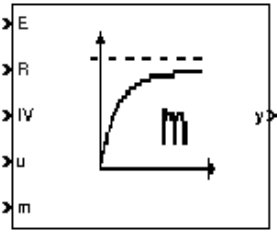
Relationship between the cut-off-frequency (fc) and m:



with sample Time dT.

Continued on next page

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 <p>Figure 1.27.38:</p>	<p><b>Variables:</b></p> <p>E: logic R: logic IV: real u: real m: real y: real x: real</p>	<p><b>Init-code:</b></p> <p>x = 0.0;</p> <p><b>reset ( )</b></p> <p>x = IV;</p> <p><b>run ( )</b></p> <p>x = x + m*(u - x);</p>	<p><b>finalize ( )</b></p> <p><b>pass ( )</b></p> <p><b>out ( )</b></p> <p>y = x;</p>
--	--	---	---

### HighpassTRE (V. 5) (V. 6)

This block performs a discretized first order high pass filter with the continuous time Laplace notation:

$$G(s) = \frac{TD \cdot s}{1 + T \cdot s}$$

Figure 1.27.39:

If TD=T the CSD discrete highpass is recovered. In this case the relationship between the highpass cut-off-frequency ( $f_c$ ) and T is :

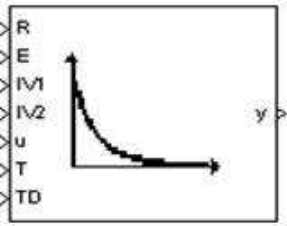
$T = \left(1 - e^{(-f_c \cdot dT \cdot 2\pi)}\right) \cdot dT$ <p>Figure 1.27.40:</p>	$f_c = -\frac{\ln\left(1 - \frac{T}{dT}\right)}{2 \cdot \pi \cdot dT}$ <p>Figure 1.27.41:</p>
---	---

with sample Time dT.

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 <p>Figure 1.27.42:</p>	<p><b>Variables:</b></p> <p>E: logic R: logic IV: real y: logic x1: real x2: real T: real TD: real</p>	<p><b>Init-code:</b></p> <p>x1 = 0.0; x2 = 0.0;</p> <p><b>pass ( )</b></p> <p><b>out ( )</b></p> <p>y = x1;</p>	<p><b>finalize ( )</b></p> <p><b>reset ( )</b></p> <p>x1 = IV1; x2 = IV2;</p> <p><b>run ( )</b></p> <p>x1 = x1 + (TD*(u-x2) - x1*dT)/T; x2 = u;</p>
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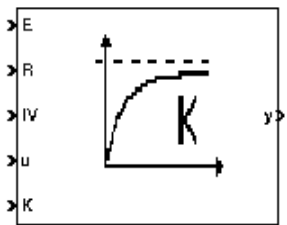
Input IV1	Initial value (for time step n) set upon reset
Input IV2	Initial value (for time step n-1) set upon reset

**LowpassKRE (V. 5) (V. 6)**

A discrete time first order lowpass filter with time constant 1/K.  
Relationship between the cut-off-frequency (f<sub>c</sub>) and K:

$K = \frac{(1 - e^{(-f_c \cdot dT \cdot 2 \cdot \pi)})}{dT}$ <p>Figure 1.27.43:</p>	$f_c = -\frac{\ln(1 - K \cdot dT)}{2 \cdot \pi \cdot dT}$ <p>Figure 1.27.44:</p>
---	--

with sample Time dT. The input K is the inverse time constant.

 <p>Figure 1.27.45:</p>	<p><b>Variables:</b></p> <p>E: logic R: logic IV: real u: real K: real y: real x: real</p>	<p><b>Init-code:</b></p> <p>x = 0.0;</p> <p><b>reset ( )</b></p> <p>x = IV;</p> <p><b>run ( )</b></p> <p>x = x + K*dT*(u-x);</p>	<p><b>finalize ( )</b></p> <p><b>pass ( )</b></p> <p><b>out ( )</b></p> <p>y = x;</p>
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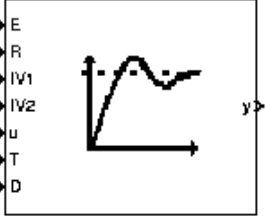
**LowpassSecOrdRE (V. 5) (V. 6)**

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A discrete time second order lowpass filter with time constant T and damping factor D (PT2) with continuous time Laplace notation:

$$G(s) = \frac{1}{s^2 \cdot T^2 + s \cdot 2 \cdot D \cdot T + 1}$$

Figure 1.27.46:

 <p>Figure 1.27.47:</p>	<b>Variables:</b> E: logic R: logic IV1: real IV2: real u: real T: real D: real y: real x1: real x2: real temp: real temp1: real	<b>Init-code:</b> x1 = 0.0; x2 = 0.0;  <b>reset ( )</b> x1 = IV1; x2 = IV2;  <b>pass ( )</b>  <b>out ( )</b> y = x1;	<b>finalize ( )</b>  <b>run ( )</b> temp = x2; temp1 = pow(T,2) + 2*D*T*dT; x2 = x1; x1 = x2 + (pow(dT,2)*(u-x2))/temp1 + pow(T,2)*(x2-temp)/temp1;
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T	Time constant (real)
D	Damping factor (real)
IV1	Initial value set upon reset
IV2	Initial value set upon reset

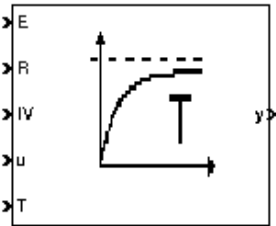
### LowpasTRE (V. 5) (V. 6)

This block performs a first order lowpass filter with T as time constant. Relationship between the cut-off-frequency (fc) and T:

$K = \frac{(1 - e^{(-f_c \cdot dT \cdot 2 \cdot \pi)})}{dT}$ <p>Figure 1.27.48:</p>	$f_c = -\frac{\ln(1 - K \cdot dT)}{2 \cdot \pi \cdot dT}$ <p>Figure 1.27.49:</p>
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with sample Time dT.

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 <p>Figure 1.27.50:</p>	<p><b>Variables:</b></p> <ul style="list-style-type: none"> <li>E: logic</li> <li>R: logic</li> <li>IV: real</li> <li>u: real</li> <li>T: real</li> <li>y: real</li> <li>x: real</li> </ul>	<p><b>Init-code:</b></p> <pre>x = 0.0;</pre> <p><b>reset ()</b></p> <pre>x = IV;</pre> <p><b>run ()</b></p> <pre>x = x + dT*(u-x)/T;</pre>	<p><b>finalize ()</b></p> <pre>pass ()</pre> <p><b>out ()</b></p> <pre>y = x;</pre>
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### 1.27.12 Memory Blocks

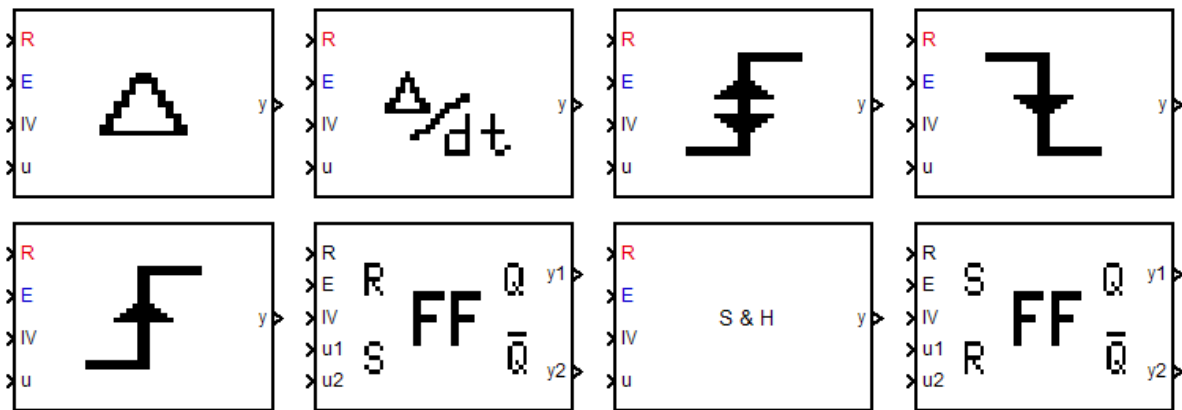


Figure 1.27.51:

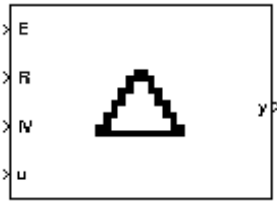
Optional ports:	R, E, RT, R_FC, CLC_FC, x_in, x_out, dT
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### DeltaOneStep (V. 5) (V. 6)

Calculates the difference between the current and the last input value.

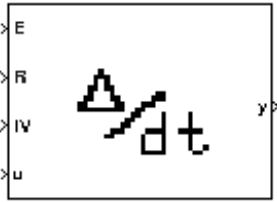
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 <p>Figure 1.27.52:</p>	<b>Variables:</b> E: logic R: logic IV: real u: real y: real x: real	<b>Init-code:</b> x = 0.0;  <b>reset ( )</b> x = IV;  <b>run ( )</b>	<b>finalize( )</b> y = u - x; x = u;  <b>pass ( )</b>  <b>out ( )</b>
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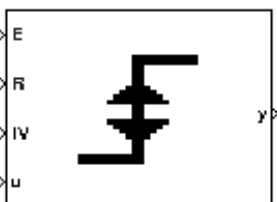
### DifferenceQuotient (V. 5) (V. 6)

Calculates the rate of change of the input signal over time.

 <p>Figure 1.27.53:</p>	<b>Variables:</b> E: logic R: logic IV: real u: real y: real x: real	<b>Init-code:</b> x = 0.0;  <b>reset ( )</b> x = IV;  <b>run ( )</b>	<b>finalize( )</b> y = (u - x)/dT; x = u;  <b>pass ( )</b>  <b>out ( )</b>
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### EdgeBi (V. 5) (V. 6)

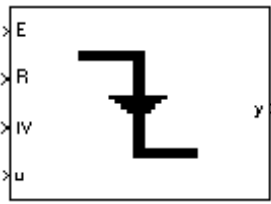
The output y indicates true at any change of the logical input value.

 <p>Figure 1.27.54:</p>	<b>Variables:</b> E: logic R: logic IV: real u: logic y: logic x: logic	<b>Init-code:</b> x = 0;  <b>reset ( )</b> x = IV;  <b>run ( )</b>	<b>finalize( )</b> y = (x != u); x = u;  <b>pass ( )</b>  <b>out ( )</b>
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### EdgeFalling (V. 5) (V. 6)


The output y indicates true if the input value changes from true to false.

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 <p>Figure 1.27.55:</p>	<b>Variables:</b> E: logic R: logic IV: logic u: logic y: logic x: logic	<b>Init-code:</b> x = 0;  <b>reset ( )</b> x = IV;  <b>run ( )</b>	<b>finalize ( )</b> y = (x & & !u); x = u;  <b>pass ( )</b>  <b>out ( )</b>
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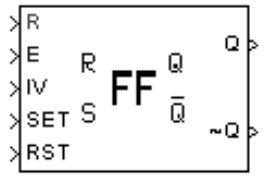
### EdgeRising (V. 5) (V. 6)

The output y indicates true if the input value changes from false to true.

 <p>Figure 1.27.56:</p>	<b>Variables:</b> E: logic R: logic IV: logic u: logic y: logic x: logic	<b>Init-code:</b> x = 0;  <b>reset ( )</b> x = IV;  <b>run ( )</b>	<b>finalize ( )</b> y = (!x & & u); x = u;  <b>pass ( )</b>  <b>out ( )</b>
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### RSFlipFlop (V. 5) (V. 6)

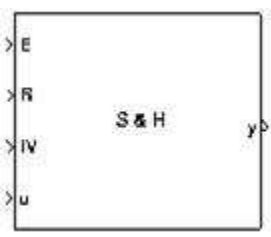
A flip flop. The second input (reset) dominates the first input (set).

 <p>Figure 1.27.57:</p>	<b>Variables:</b> SET: logic RST: logic Q: logic ~Q: logic x: logic	<b>Init-code:</b> x = 0;  <b>reset ( )</b> x = IV;  <b>pass ( )</b>  <b>out ( )</b> Q = x; ~Q = !x;	<b>finalize ( )</b>  <b>run ( )</b> if(RST) { x = 0; } else if(SET) { x = 1; }
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### SampleAndHoldRE (V. 5) (V. 6)

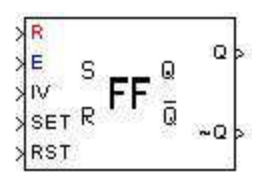
Sample and Hold or just a simple memory block with enable and reset ports.

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 <p>Figure 1.27.58:</p>	<p><b>Variables:</b>          E: logic          R: logic          IV: real          u: real          y: real          x: real</p>	<p><b>Init-code:</b>          x = 0.0;</p> <p><b>reset ( )</b>          x = IV;</p> <p><b>run ( )</b>          x = u;</p>	<p><b>finalize ( )</b></p> <p><b>pass ( )</b></p> <p><b>out ( )</b>          y = x;</p>
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**SRFlipFlop (V. 5) (V. 6)**

A flip flop. The first input (set) dominates the second input (reset).

 <p>Figure 1.27.59:</p>	<p><b>Variables:</b>          SET: logic          RST: logic          Q: logic          ~Q: logic          x: logic</p>	<p><b>Init-code:</b>          x = 0;</p> <p><b>reset ( )</b>          x = IV;</p> <p><b>pass ( )</b></p> <p><b>out ( )</b>          Q = x;          ~Q = !x;</p>	<p><b>finalize ( )</b></p> <p><b>run ( )</b>          if(SET) {            x = 1;          }          else if(RST) {            x = 0;          }          }</p>
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**1.27.13 Nonlinear Blocks - automotive blockset**

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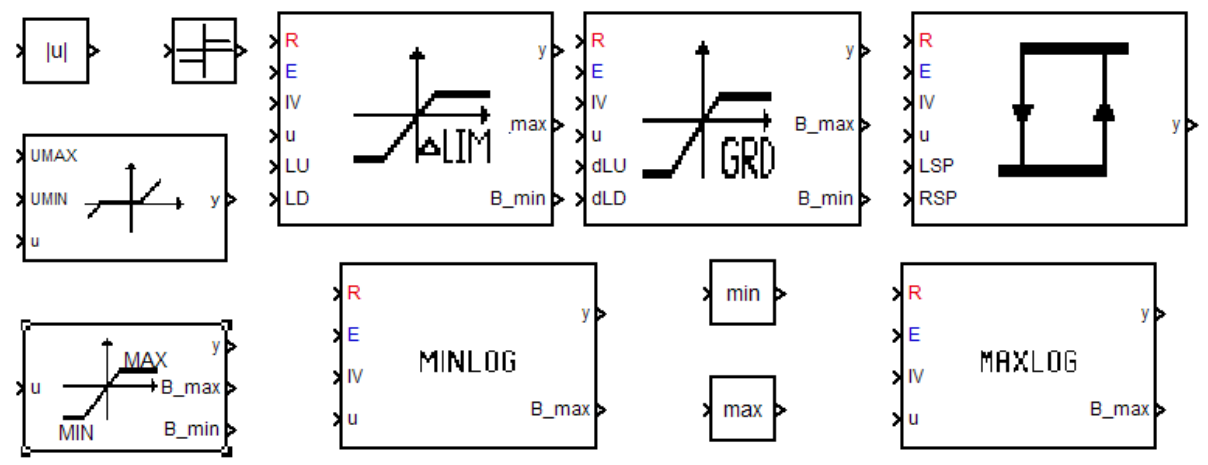


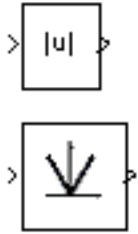
Figure 1.27.60:

Some blocks have multirate version. The Multirate version of these blocks (with R\_FC and CLC\_FC inputs) is used if system resets have to be simulated. Other optional inputs and outputs in these blocks are:

Optional ports:	R, E, RT, R_FC, CLC_FC, x_in, x_out, dT, B_max, B_min
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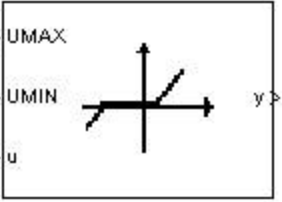
**Abs (V. 5) (V. 6)**

The Abs block generates as output the absolute value of the input.

 <p>Figure 1.27.61:</p>	<p><b>Variables:</b></p> <p>u: real y: real</p>	<p><b>run ()</b></p> <pre> if(u &gt;= 0) {     y = u; } else {     y = -u; }                     </pre>
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**Dead Band (V. 5) (V. 6)**

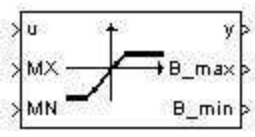
Outputs zero, if the input value is between UMIN and UMAX. Otherwise the output signal is the input signal reduced by the input limits.

 <p>Figure 1.27.62:</p>	<p><b>Variables:</b></p> <p>UMAX: real UMIN: real u: real y: real</p>	<p><b>run ()</b></p> <pre> if(u &lt; UMAX &amp;&amp; u &gt; UMIN) {     y = 0.0; } else if(u &gt;= UMAX) {     y = u - UMAX; } else {     y = u - UMIN; }                     </pre>
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**Limit (V. 5) (V. 6)**

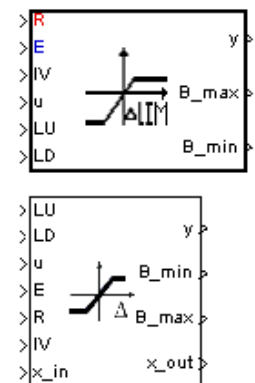
The input signal u is limited between maximum value MX and minimum value MN. The boolean output flags B\_MAX and B\_MIN represent an active limitation in both directions.

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 <p>Figure 1.27.63:</p>	<p><b>Variables:</b></p> <p>MX: real MN: real u: real y: real B_min: logic B_max: logic</p>	<pre>run () if(u &gt; MX) {   y = MX;   B_max = 1;   B_min = 0; } else if(u &lt; MN) {   y = MN;   B_max = 0;   B_min = 1; } else {   y = u;   B_max = 0;   B_min = 0; }</pre>
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**DifferenceLimiter (V. 5) (V. 6)**

The output value is limited in its difference to the last input value. The maximum valid difference is LU, the minimum valid difference is LD. Only for a sampling time of 1s this block behaves like a Gradient limiter. For other sampling times this time has to be taken into account in setting the correct values for LU and LD.

 <p>Figure 1.27.64:</p>	<p><b>Variables:</b></p> <p>E: logic R: logic IV: real u: real LU: real LD: real y: logic B_max: logic B_min: logic x: real</p>	<pre>run () if((u-x)&gt;LU) {   x = x + LU;   B_min = 0;   B_max = 1; } else if((u - x)&lt; LD) {   x = x + LD;   B_min = 1;   B_max = 0; } else {   x = u;   B_min = 0;   B_max = 0; }</pre>	<pre>finalize () pass () out () y = x; Init-code: x = 0.0; reset () x = IV;</pre>
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**GradientLimiter (V. 5) (V. 6)**

The output value is limited in its gradient to the last input value. The maximum valid difference is dLU, the minimum valid difference is dLD. The values of dLD and dLU have to be given per second.

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<p>Figure 1.27.65:</p>	<p><b>Variables:</b></p> <ul style="list-style-type: none"> <li>E: logic</li> <li>R: logic</li> <li>IV: real</li> <li>u: real</li> <li>dLU: real</li> <li>dLD: real</li> <li>y: real</li> <li>B_min: logic</li> <li>B_max: logic</li> <li>x: real</li> </ul>	<p><b>Init-code:</b></p> <pre>x = 0.0;</pre> <p><b>reset ( )</b></p> <pre>x = IV;</pre> <p><b>pass ( )</b></p> <p><b>finalize( )</b></p> <p><b>out ( )</b></p> <pre>y = x;</pre>	<p><b>run ( )</b></p> <pre>if((u - x)/dT &gt; dLU) {   x = x + dLU*dT;   B_min = 0;   B_max = 1; } else if((u - x)/dT &lt; dLD) {   x = x + dLD*dT;   B_min = 1;   B_max = 0; } else {   x = u;   B_min = 0;   B_max = 0; }</pre>
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### Hysteresis (V. 5) (V. 6)

The Output of this block is a logical 1 if the input value is greater than the RSP and logical 0 if the input is below the LSP.

<p>Figure 1.27.66:</p>	<p><b>Variables:</b></p> <ul style="list-style-type: none"> <li>E: logic</li> <li>R: logic</li> <li>IV: logic</li> <li>u: real</li> <li>RSP: real</li> <li>LSP: real</li> <li>y: logic</li> <li>x: logic</li> </ul>	<p><b>Init-code:</b></p> <pre>x = 0;</pre> <p><b>reset ( )</b></p> <pre>x = IV;</pre> <p><b>pass ( )</b></p> <p><b>out ( )</b></p> <pre>y = x;</pre>	<p><b>finalize ( )</b></p> <pre>if(u &gt; RSP) {   x = 1; } else if(u &lt; LSP) {   x = 0; }</pre> <p><b>run( )</b></p>
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RSP	Upper threshold value
LSP	Lower threshold value

### Min, Max (V. 5) (V. 6)

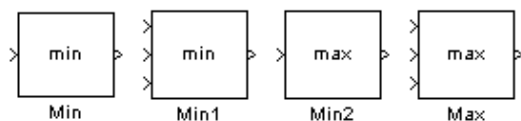


Figure 1.27.67:

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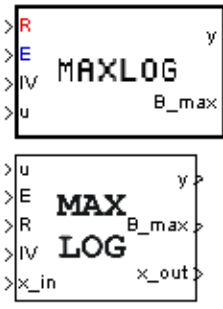
The MinMax block outputs either the minimum or the maximum element or elements of the input(s).

If the block has one input port, the input must be a scalar or a vector. The block outputs a scalar equal to the minimum or maximum element of the input vector.

If the block has multiple input ports, the nonscalar inputs must all have the same dimensions. The block expands any scalar inputs to have the same dimensions as the nonscalar inputs. The block outputs a signal having the same dimensions as the input. Each output element equals the minimum or maximum of the corresponding input elements.

**MaxLogRE (V. 5) (V. 6)**

The output value is the maximum value of all input values u between resets, with respect to the initial value IV.


 <p>Figure 1.27.68:</p>	<p><b>Variables:</b>                  E: logic                  R: logic                  IV: real                  u: real                  y: real                  B_max: logic                  x: real</p>	<p><b>Init-code:</b>                  x = 0.0;                  B_max = 0;</p> <p><b>reset ( )</b>                  x = IV;</p> <p><b>out ( )</b>                  y = x;</p>	<p><b>finalize( )</b></p> <p><b>run ( )</b>                  B_max = 0;                  if(u &gt; x) {                    x = u;                    B_max = 1;                  }  <b>pass( )</b></p>
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**MinLogRE (V. 5) (V. 6)**

The output value y is the minimum value of all input values u between resets, with respect to the initial value IV.

Continued on next page

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 <p>Figure 1.27.69:</p>	<b>Variables:</b> E: logic R: logic IV: real u: real y: logic B_min: logic x: real	<b>Init-code:</b> x = 0.0; B_min = 0;  <b>reset ( )</b> x = IV;  <b>out ( )</b> y = x;	<b>finalize ( )</b>  <b>run ( )</b> B_min = 0; if(u < x) { x = u; B_min = 1; }  <b>pass ( )</b>
--	---	--	--

## Sign (V. 5) (V. 6)



Figure 1.27.70:

The Sign block indicates the sign of the input:

- The output is 1 when the input is greater than zero.
- The output is 0 when the input is equal to zero.
- The output is -1 when the input is less than zero.

### 1.27.14 Controller\_Blocks (AT\_Extended\_Lib)

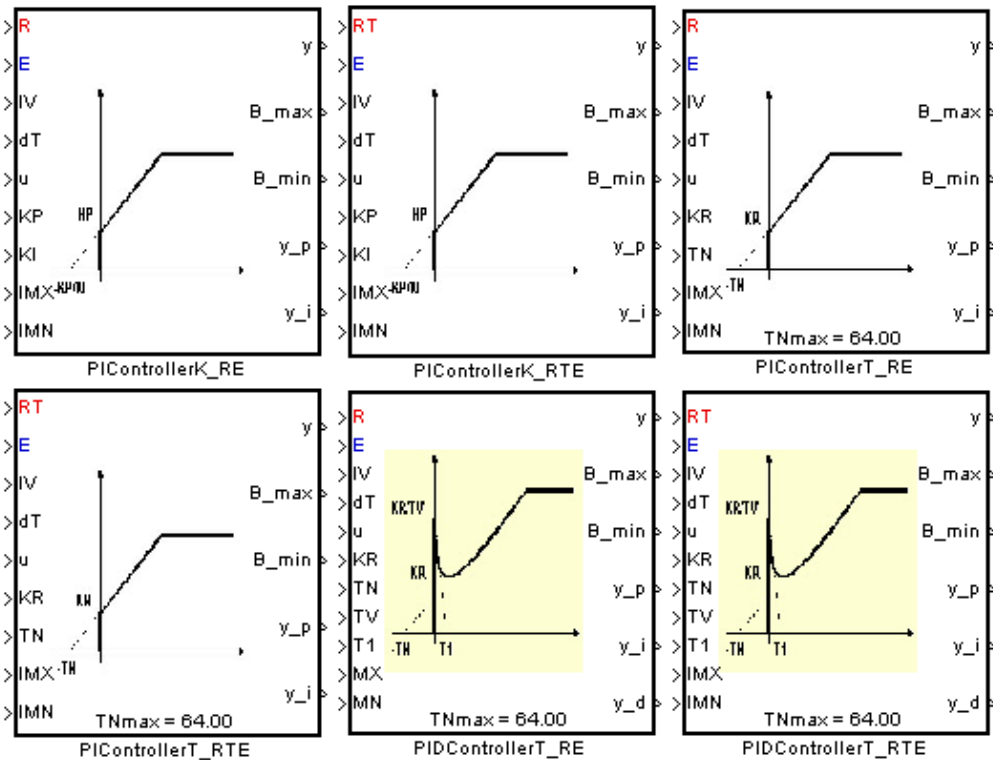


Figure 1.27.71:

The blocks could be figured for single- and multi-rate version. Multirate version (with inport R\_FC and CLC\_FC) are used for system reset. Each of PIControllerK, PIControllerT and PIDControllerT has two version with different function reset inport: R (state based) and RT (edge based).

Controller blocks can be configured for single- and multirate mode.

Optional ports:	R, E, RT, R_FC, CLC_FC, IV, xi_in, xd_in, xi_out, xd_out, y_p, y_i, y_d, B_max, B_min
-----------------	---

IMX	I-state upper limitation value
IMN	I-state lower limitation value
y_p	Level of proportional part of the controller output
y_i	Level of integral part of the controller output

#### PIControllerK\_RE (V.5) and PIControllerK\_RTE (V.5)

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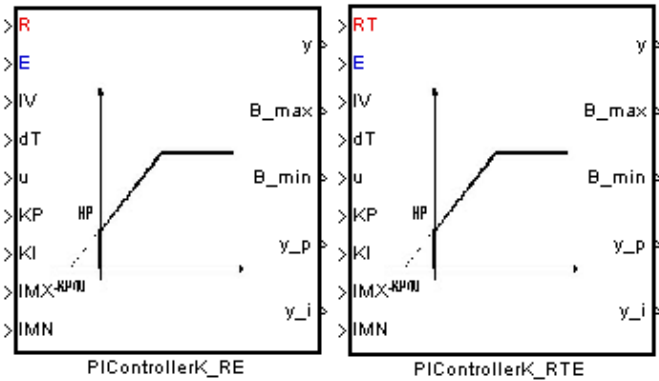


Figure 1.27.72:

This block presents a resetable (integral part) PI controller with variable parameters and state limitation. It is based on the transfer function :  $G(s) = KP + KI/s$ , but with full consideration of parameter variability and with the discretization (used method: euler backward) in integrator part.

The limits affect the integral state only. The output is the unlimited sum of the unlimited proportional part and the limited integral part.

KP	Proportional gain
KI	Integration gain
y_p	Level of proportional part of the controller output
y_i	Level of integral part of the controller output

### PIControllerT\_RE (V.5) and PIControllerT\_RTE (V.5)

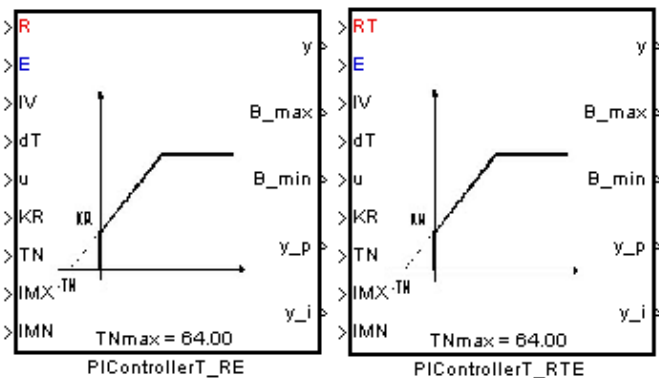


Figure 1.27.73:

state limitation. It is based on the transfer function :  $G(s) = KR * (1 + 1/(TN*s))$ , but with full consideration of parameter variability and with the discretization (used method: euler backward) in integrator part.

The limits affect the integral state only. The output is the unlimited sum of the unlimited proportional part and the limited integral part.

Setting TN to or below the sample time disables the proportional part ( $TN \leq dt$   $KR = 0$ ).

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Setting TN to or above the maximum value disables integration (TN >= TNmax The integrator's part is constant).

KR	Controller amplification
TN	Integrator adjusting time

**PIDControllerT\_RE (V.5) and PIDControllerT\_RTE (V.5)**

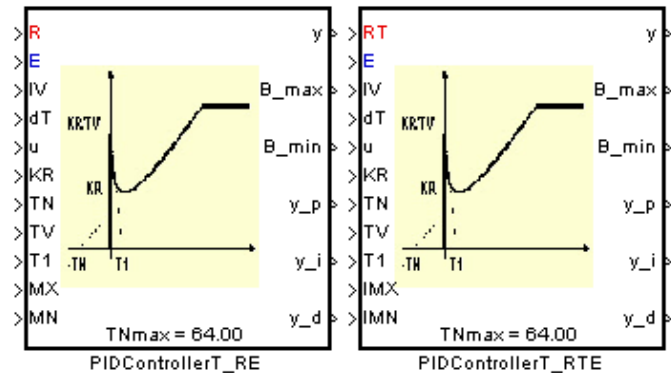


Figure 1.27.74:

This block represents resetable (integral and derivative part), limitable PID controller with variable parameters. It is based on the transfer function:

$$G(s) = KR * ( 1 + 1/(TN*s) + TV*s/(1 + T1*s) )$$

but with full consideration of parameter variability. The discretization (used method: euler backward) is used in integrator part and derivative part (the discretization of each part is separately).

Setting TN to or below the sample time disables the proportional part.

Setting TN to or above the maximum value disables integration.

To disable the derivative part, set TV=0.

KR	Controller amplification
TN	Integrator adjusting time
TV	Derivative adjusting time
T1	Derivative adjusting time
y_d	Level of derivative part of the controller output

**1.27.15 Nonlinear**

**Modulo (V. 5) (V. 6)**

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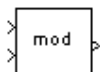


Figure 1.27.75:

The Modulo block outputs the modulus after division. The inputs must be real arrays of the same size, or real scalars.

**Multiport Switch (Simulink block)**



Figure 1.27.76:

The Multiport Switch block chooses between a number of inputs.

The first (top) input is the control input and the other inputs are data inputs. The value of the control input determines which data input to pass through to the output port.

If the control input is not an integer value, the Multiport Switch truncates the value to the nearest integer and issues a warning. If the (truncated) control input is less than one or greater than the number of input ports, the switch issues an out-of-bounds error. Otherwise, the switch passes the data input that corresponds to the (truncated) control input. The following table summarizes the Multiport Switch's behavior.

(Truncated) Control Input	Passes This Data Input
Less than 1	Out of bounds error
1	First input
2	Second input
etc.	etc.
Greater than the number of data inputs	Out of bounds error

Data inputs can be scalar or vector. The control input can be a scalar or a vector. The block output is determined by these rules:

- If inputs are scalar, the output is a scalar.
- If the block has more than one data input, at least one of which is an array, the output is an array. Any scalar inputs are expanded to arrays.
- If the block has only one data input, the input must be a scalar or a vector (1-D array). If the input is a vector, the block output is the element of the vector that corresponds to the truncated value of the control input.

**Quantizer (V. 5)**

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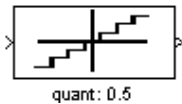


Figure 1.27.77:

The Quantizer block passes its input signal through a stair-step function so that many neighbouring points on the input axis are mapped to one point on the output axis. The effect is to quantize a smooth signal into a stair-step output. The output is computed using the round-to-nearest method, which produces an output that is symmetric about zero:  $y = q * \text{round}(u/q)$ , where  $y$  is the output,  $u$  the input, and  $q$  the Quantization interval parameter.

**Saturation (V. 5)**

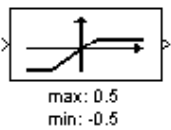


Figure 1.27.78:

The Saturation block imposes upper and lower bounds on a signal. When the input signal is within the range specified by the Lower limit and Upper limit parameters, the input signal passes through unchanged. When the input signal is outside these bounds, the signal is clipped to the upper or lower bound. When the parameters are set to the same value, the block outputs that value.

**Switch (V. 5) (V. 6)**

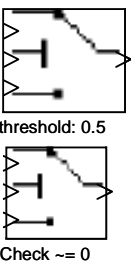


Figure 1.27.79:


The Switch block propagates one of two inputs to its output depending on the value of a third input, called the control input.

Switch with threshold: If the signal on the control (second) input is greater than or equal to the Threshold parameter, the block propagates the first input; otherwise, it propagates the third input. This figure shows the use of the block ports.

Switch with check unequal 0: If the signal on the control (second) input is unequal to 0, the block propagates the first input; otherwise, it propagates the third input.

This figure shows the use of the block ports:

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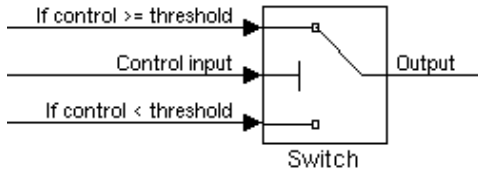


Figure 1.27.80:

## 1.27.16 Signals & Systems

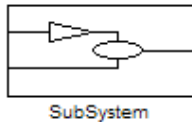


Figure 1.27.81:

### Subsystem

Represent a nested subsystem within another system.

Subsystems can be virtual or atomic, depending on the value of its Treat as Atomic Unit parameter. Simulink ignores virtual subsystem boundaries when determining block update order. By contrast, Simulink executes all blocks within an atomic subsystem before moving on to the next block. Conditionally executed subsystems are atomic. Unconditionally executed subsystems are virtual by default. You can, however, designate an unconditionally executed subsystem as atomic. This is useful if you need to ensure that a subsystem is executed in its entirety before any other block is executed. An atomic subsystem is identified by bold boundaries.

### Function\_Call\_Subsystem

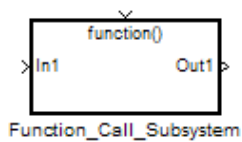


Figure 1.27.82:

Represent a subsystem that can be invoked as a function by another block. Function-call subsystems are not executed directly by Simulink; rather, the Stateflow charts or other blocks determine when to execute the subsystem. They can be executed repeatedly during the same simulation time step. When the subsystem completes execution, control returns to the caller.

### For Iterator Subsystem

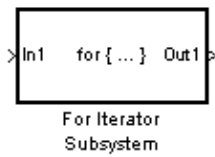


Figure 1.27.83:

This block is a Subsystem block that is preconfigured to serve as a starting point for creating a subsystem that executes repeatedly during a simulation time step. It contains the For Iterator block.

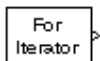


Figure 1.27.84:

The For Iterator block, when placed in a subsystem, implements a C-like for control flow statement in Simulink as a For subsystem. In the For subsystem, the For Iterator block has iterative control over any Simulink blocks present. For each iteration value of the For Iterator block, the accompanying blocks execute. The number of iterations is set internally for the For Iterator block or externally with data input. The following example shows a completed for control flow statement that increments an initial value of zero by 10 over 20 iterations.

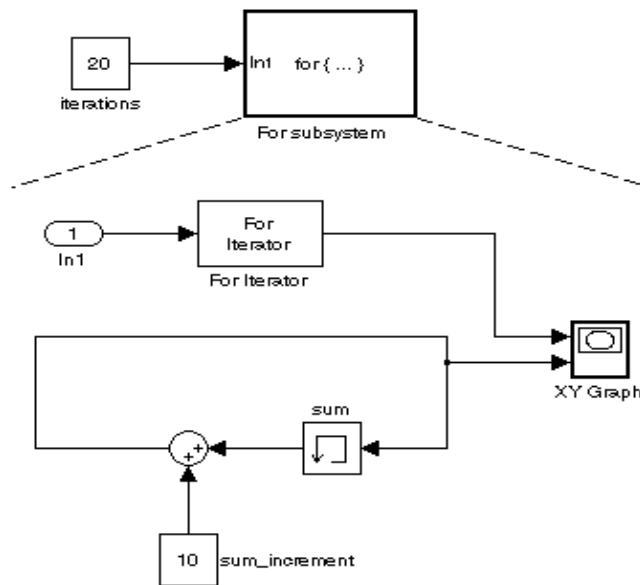



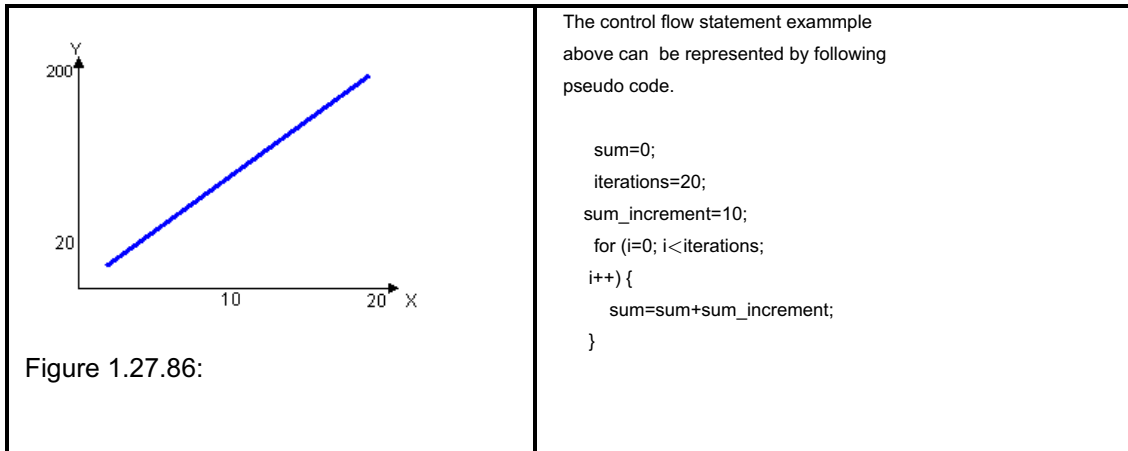
Figure 1.27.85:

In the example above, a For subsystem receives an input, which it passes to the For Iterator block inside. The For Iterator block uses this input to determine the number of times it executes the blocks of its subsystem, in this case, 20 times. Each time the blocks execute, a value of 10 is added to a sum, which is initially zero. In addition, for each time the blocks of the subsystem execute, the For Iterator block outputs a value equal to the number of times that the blocks have executed, including the current

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execution. This is referred to as the iterator value. This value, along with the sum value, is sent to an XY Graph block:



Example of a For loop:

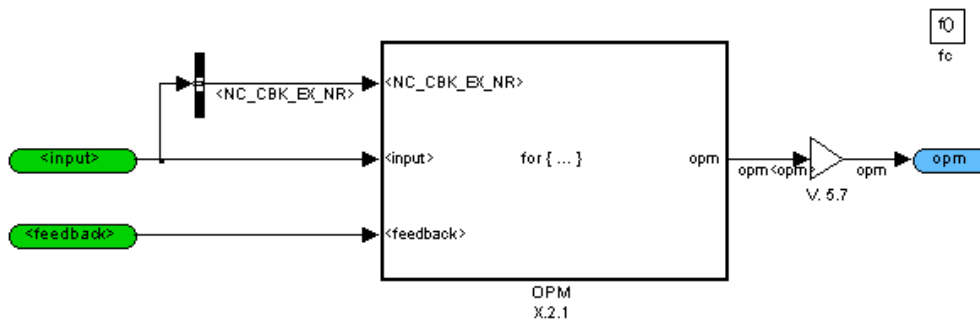


Figure 1.27.87:

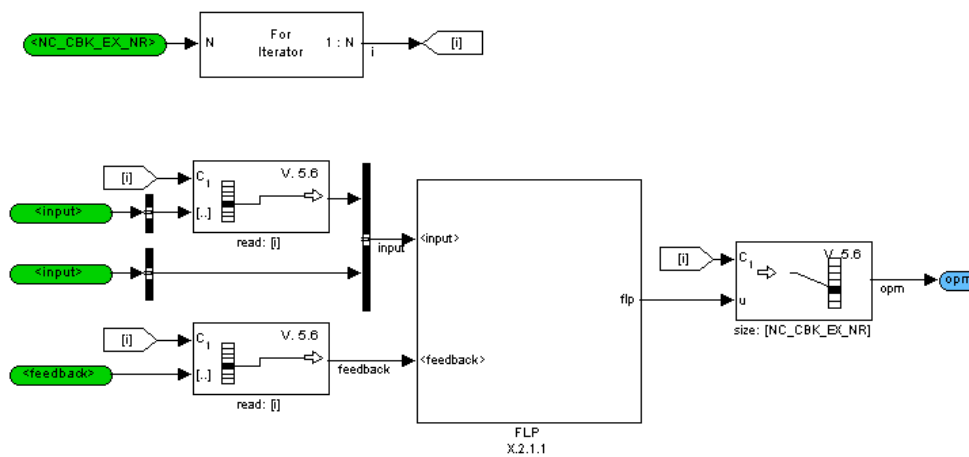


Figure 1.27.88:

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### Switch Case Action Subsystem

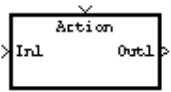


Figure 1.27.89:

This block is a Subsystem block that is preconfigured to serve as a starting point for creating a subsystem whose execution is triggered by a Switch Case block. It contains the Action Port that links to a signal from a switch case block:

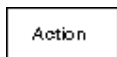


Figure 1.27.90:

**Note:** The naming "Action" within this block is different to "Actions" which are connected to the supplier Action concept

### While Iterator Subsystem

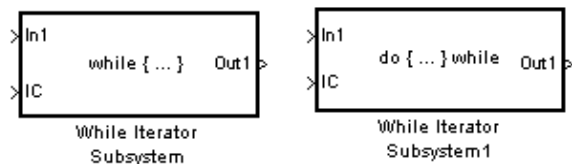


Figure 1.27.91:

Represent a subsystem that executes repeatedly while a condition is satisfied during a simulation time step. This block is a Subsystem block that is preconfigured to serve as a starting point for creating a subsystem that executes repeatedly while a condition is satisfied during a simulation time step. It contains the While Iterator block.

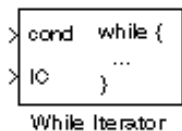


Figure 1.27.92:

The While Iterator block, when placed in a subsystem, implements a C-like while or do-while control flow statement in Simulink as a While subsystem. It has iterative control over any accompanying Simulink block programming placed in the same subsystem with it.

For each iteration of the While Iterator block, the accompanying blocks perform one execution. Iteration takes place as long as the input conditions are true. This applies to an initial condition for the first

execution (input port labeled IC) and a condition for succeeding executions (input port labeled cond). The following While subsystem example increments an initial value of 0 by 10 for every execution.

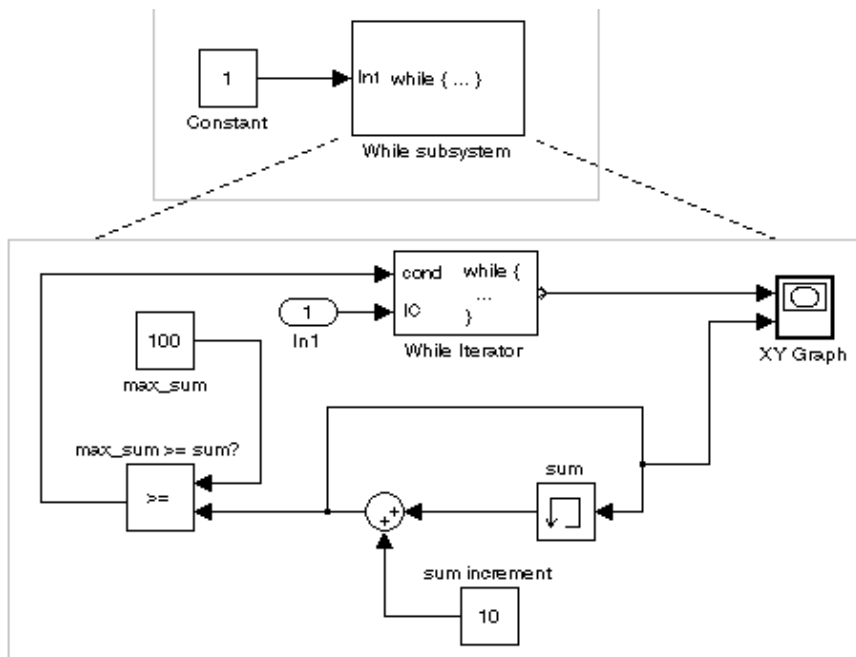


Figure 1.27.93:

In the above example, a subsystem with a While block receives an input, which it passes to the IC (initial condition) port of the While block inside. If this value is true, the While block executes the blocks of the subsystem it is in. Since this value is 1 (true), the blocks execute and a value of 10 is added to a sum, which is initially 0. The sum is then compared to a value of 100. If the sum is less than or equal to 100, a value of true is passed to the While block through the cond (condition) port. This causes the blocks to execute again and again until the value passed to the While Iterator block is false and execution ceases.

In addition, for each time the blocks of the subsystem execute, the While block outputs a value equal to the number of times that the blocks have executed, including the current execution. This value, along with the sum value, is sent to the x and y coordinate inputs, respectively, of an XY Graph block with the following result.



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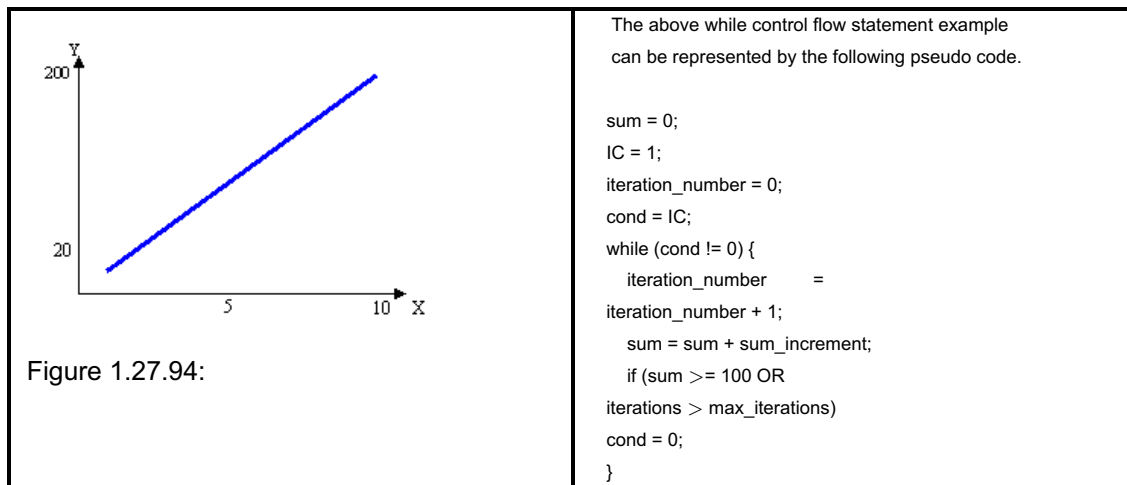


Figure 1.27.94:

The equivalent pseudo code for a do-while iteration in the example above (minus the IC port) is as follows:

```

sum = 0;
iteration_number = 0;
cond = 1;
do {
    iteration_number = iteration_number + 1;
    sum = sum + sum_increment;
    if (sum >= 100 AND iterations > max_iterations) cond = 0;
} while (cond);
    
```

When you change the While Iterator block to do-while operation, the IC (initial condition) input disappears from the While Iterator block. The important distinction between the while and do-while modes of the While Iterator block is that the do-while mode runs the While subsystem at least once. In while mode, the While subsystem may not run its blocks at all depending on the value of the initial condition (IC).

**Inport**

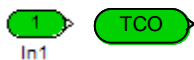


Figure 1.27.95:

Inport blocks are the links from outside a system into the system. The signal name (here: TCO) can optionally be displayed on the input

**Output**

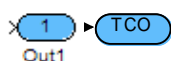


Figure 1.27.96:

Output blocks are the links from a system to a destination outside the system. The signal name (here: TCO) can optionally be displayed on the output.

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## Bus Creator



Figure 1.27.97:

The Bus Creator block combines a set of signals into a bus, i.e., a group of signals represented by a single line in a block diagram. The Bus Creator block, when used in conjunction with the Bus Selector block, reduces number of lines required to route signals from one part of a diagram to another.

## Bus Selector



Figure 1.27.98:

Select signals from an incoming bus. The Bus Selector block accepts input from a Bus Creator block or another Bus Selector block. This block has one input port. The number of output ports depends on the state of the Muxed output check box. If you check Muxed output, then the signals are combined at the output port and there is only one output port; otherwise, there is one output port for each selected signal.

## Mux



Figure 1.27.99:

Combine several input signals into a vector or bus output signal. The Mux block combines its inputs into a single output. An input can be a scalar, vector, or matrix signal. Depending on its inputs, the output of a Mux block is a vector or a composite signal, i.e., a signal containing both matrix and vector elements. If all of a Mux block's inputs are vectors or vector-like, the block's output is a vector. A vector-like signal is any signal that is a scalar (one-element vector), a vector, or a single-column or single-row matrix. If any input is a nonvector-like matrix signal, the output of the Mux is a bus signal. Bus signals can drive only virtual blocks, e.g., a Demux, Subsystem, or Go To block.

## Demux



Figure 1.27.100:

Extract and output the elements of a bus or vector signal. The Demux block extracts the components of an input signal and outputs the components as separate signals. The block accepts either vector (1-D array) signals or bus signals.

## Ground


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Figure 1.27.101:

The Ground block can be used to connect blocks whose input ports are not connected to other blocks. The Ground block outputs a signal with zero value. The data size of the signal is the same as that of the port to which it is connected.

### Terminator



Figure 1.27.102:

The Terminator block can be used to cap blocks whose output ports are not connected to other blocks.

### Enable



Figure 1.27.103:

Adding an Enable block to a subsystem makes it an enabled subsystem. An enabled subsystem executes while the input received at the Enable port placed at the top of the subsystem is greater than zero.

### Trigger and function call




Figure 1.27.104:

Adding a Trigger block to a subsystem makes it a triggered subsystem. A triggered subsystem executes once on each simulation step when the value of the signal that passes through the trigger port changes in a specifiable way (described below). A subsystem can contain no more than one Trigger block.

The Trigger type parameter allows you to choose the type of event that triggers execution of the subsystem:

- rising triggers execution of the subsystem when the control signal rises from a negative or zero value to a positive value (or zero if the initial value is negative).
- falling triggers execution of the subsystem when the control signal falls from a positive or a zero value to a negative value (or zero if the initial value is positive).
- either triggers execution of the subsystem when the signal is either rising or falling.
- function-call causes execution of the subsystem to be controlled by logic internal to another block (and the subsystem becomes a Function\_Call\_Subsystem, see

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description above).



Figure 1.27.105:

### 1.27.17 Stateflow

#### Stateflow Chart

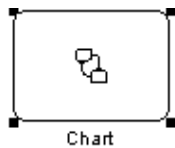


Figure 1.27.106:

This block indicates a Stateflow Chart, which is mainly used to model state machines. The chart can be triggered and contain variable number of outputs and inputs.

### 1.27.18 Functional differences between blocks from SDA 5.0 and blocks from 4.0 and 3.1

#### Version information


All SDA 5.0 blocks in Automotive Blockset show version information on the block icon. Every block has own version 5.XX.

Blocks from SDA 4.0 and 3.1 releases do not show version information on the block icon.

#### Functional differences

All SDA 5.0 blocks from Automotive Blockset are compatible with the MSR specification (V. 1.12). The previous (4.0 and 3.1) block versions have different functional behavior, which is listed below:

1. Group 1: Blocks which perform reset at the first calculation step after Reset signal (R) becomes zero.
2. Group 2: Blocks which do not perform functional reset (R) correctly if on first step after reset the enable signal E is not zero. In this case, the calculation uses a new state value equal to current input IV instead of stored input IV during the functional reset.
3. Group 3: Blocks which do not assign value to output if enable (E) signal is equal to zero and no logical reset (R or RT) is requested. It can produce mistakes in multi-rate mode after R\_FC function call.
4. Group 4: Blocks which have wrong simulation behavior.

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Block	1	2	3	4		Block	1	2	3	4	
CountDownRE	x	x				DigitalLowpassRE	x	x	x		
CountDownRTE						HighpassTRE	x			x	
CounterRE	x	x				LowpassKRE	x	x	x		
CounterTRE						LowpassSecOrdRE	x	x			
StopWatchRE	x	x	x			LowpassTRE	x	x	x		
StopWatchTRE			x			DeltaOneStep	x	x			
TimerRetriggerRE	x	x				DifferenceLimiter	x	x	x		
TimerRetriggerRTE						GradientLimiter	x	x	x		
TimerRE			x			DiffirenceQuotient	x	x	x		
TimerRTE						EdgeBi	x	x	x	x	
DelayResetEnabled	x					EdgeFalling	x	x	x	x	
TurnOffDelaySample	x	x				EdgeRising	x	x	x	x	
TurnOffDelayTime	x	x				SampleAndHoldRE	x	x	x		
TurnOnDelaySample	x	x				MaxLogRE	x			x	
TurnOnDelayTime	x	x				MinLogRE	x			x	
AccumulatorREL	x	x				Hysteresis	x		x	x	
IntegratorKREL	x	x				Delay_RE					
IntegratorTREL	x	x									

5. TimerRE: Functional reset is different from MSR specification (see pseudo-code).

### Pseudo-code from previous versions

This section lists the pseudo-code for blocks from previous versions (4.0 and 3.1) which have RE or RTE modes.

<p>Standard ports:</p> <p>E: Suppresses the block calc.</p> <p>R: Resets to init values</p> <p>IV: Initial value set upon reset</p>	<p>Optional ports:</p> <p>State1_in: Direct input of internal state (x)</p> <p>State1_out: Direct output of internal state (x)</p> <p>R_FC: System reset request</p> <p>CLC_FC: System calculation request</p>
---	--

#### CountDownRE

Continued on next page

<p><b>Port I/O Description</b></p> <p>y: if counter state is zero cnt: Out internal counter state</p> <p><b>System-Init-Code</b></p> <p>x = 0; R1 = 0; y = 0; cnt = 0;</p> <p><b>Init-Code (R_FC)</b></p> <p>x = round(IV); R1 = R;</p>	<p><b>Run-Code (CLC_FC)</b></p> <pre>if (R    R1) {   x = round(IV); } else if (E) {   if (x &gt; 0){     x = x - 1;   } } y = (x &gt; 0); cnt = x; R1 = R;</pre>
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<b>StopWatchRE</b>	
<p><b>Port I/O Description</b></p> <p>y Out Time since last reset cnt: Out Internal counter state</p> <p><b>Optional ports:</b></p> <p>dT: Sample Time input</p> <p><b>System-Init-Code</b></p> <p>x = 0.0; R1 = 0; cnt = 0.0; y = 0.0;</p>	<p><b>Init-Code (R_FC)</b></p> <p>x = 0.0; R1 = R;</p> <p><b>Run-Code (CLC_FC)</b></p> <pre>if (R    R1) {   x = 0.0; } else if (E) {   x = x + dT; } y = x; cnt = x; R1 = R;</pre>

<b>CounterRE</b>
Continued on next page

<p><b>Port I/O Description</b> y: Out counter value cnt: Out Internal counter state</p> <p><b>System-Init-Code</b> x = 0; R1 = 0; cnt = 0; y = 0;</p> <p><b>Init-Code (R_FC)</b> x = round (IV); R1 = R;</p>	<p><b>Run-Code</b> if (R    R1) {   x = round(IV); } else if (E) {   x = x + 1; } y = x; cnt = x; R1 = R;</p>
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<b>CountDownRTE</b>	
<p><b>Port I/O Description</b> y: Out counter value cnt: Out Internal counter state</p> <p><b>System-Init-Code</b> x = 0; RT_1 = 0; cnt = 0; y = 0;</p> <p><b>Init-Code (R_FC)</b> x = round (IV); RT_1 = 0;</p>	<p><b>Run-Code</b> if (RT &amp; &amp; !RT_1) {   x = round(IV); } else if (E) {   if (x &gt; 0) {     x = x - 1;   } } RT_1 = RT; y = (x &gt; 0); cnt = x;</p>

<b>CounterRTE</b>	
<p><b>Port I/O Description</b> y: Out counter value cnt: Out Internal counter state</p> <p><b>System-Init-Code</b> x = 0; cnt = 0; y = 0;</p> <p><b>Init-Code (R_FC)</b> x = round (IV); RT_1 = 0;</p>	<p><b>Run-Code</b> if (RT &amp; &amp; !RT_1) {   x = round(IV); } else if (E) {   x = x + 1; } RT_1 = RT; y = x; cnt = x;</p>

StopWatchRTE	
<p><b>Port I/O Description</b></p> <p>y: Out Time since last reset cnt: Out Internal counter state</p> <p><b>Optional ports:</b></p> <p>dT: Sample Time input</p> <p><b>System-Init-Code</b></p> <p>x = 0.0; cnt = 0.0; y = 0.0;</p>	<p><b>Init-Code (R_FC)</b></p> <pre>x = 0.0; RT_1 = 0;</pre> <p><b>Run-Code (CLC_FC)</b> <pre>if (RT &amp; !IRT_1) {   x = 0.0; } else if (E) {   x = x + dT; } RT_1 = RT; y = x; cnt = x;</pre> </p>

Delay_RE	
<p><b>Port I/O Description</b></p> <p>u: Source signal (real) y: Output signal, delay by 1</p> <p><b>System-Init-Code</b></p> <p>x = 0; y = 0;</p> <p><b>Init-Code (R_FC)</b></p> <p>Not implemented.</p>	<p><b>Run-Code (CLC_FC)</b> <pre>if (R) {   y = IV;   x = y = IV; } else if (E) {   y = x;   x = u; } else {   y = x; }</pre> </p>

TimerRetriggerRE
Continued on next page

<p><b>Port I/O Description</b></p> <p>y: Timer is running (time &gt;0) cnt: Out Internal counter state</p> <p><b>Optional ports:</b></p> <p>dT: Sample Time input</p> <p><b>System-Init-Code</b></p> <p>x = 0.0; R1 = 0; cnt = 0.0; y = 0.0;</p>	<p><b>Init-Code (R_FC)</b></p> <p>x = IV;</p> <p><b>Run-Code (CLC_FC)</b></p> <pre>if (R    R1) {   x = IV; } else if (E) {   x = MAX(x-dT, 0.0); } y = (x &gt; 0.0); cnt = x; R1 = R;</pre>
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<b>TimerRetriggerRTE</b>	
<p><b>Port I/O Description</b></p> <p>y: Timer is running (time &gt;0) cnt: Out Internal counter state</p> <p><b>Optional ports:</b></p> <p>dT: Sample Time input</p> <p><b>System-Init-Code</b></p> <p>x = 0.0; cnt = 0.0; y = 0.0;</p>	<p><b>Init-Code (R_FC)</b></p> <p>x = IV; RT_1 = 0;</p> <p><b>Run-Code (CLC_FC)</b></p> <pre>if (RT &amp; !RT_1) {   x = IV; } else if (E) {   x = MAX(x-dT,0.0); } RT_1 = RT; y = (x &gt; 0.0); cnt = x;</pre>

<b>TimerRE (V. 4.0)</b>	
<p><b>Port I/O Description</b></p> <p>y: Timer is running (time &gt;0) cnt: Out Internal counter state</p> <p><b>Optional ports:</b></p> <p>dT: Sample Time input</p> <p><b>System-Init-Code</b></p> <p>x = 0.0; cnt = 0.0; y = 0.0;</p>	<p><b>Init-Code (R_FC)</b></p> <p>x = IV;</p> <p><b>Run-Code (CLC_FC)</b></p> <pre>if (R &amp;&amp; (x &lt;= 0.0)) {   x = IV; } else if (E) {   x = MAX(x-dT, 0.0); } y = (x &gt; 0.0); cnt = x;</pre>

TimerRE (V. 3.1)	
<p><b>Port I/O Description</b></p> <p>y: Timer is running (time &gt;0) cnt: Out Internal counter state</p> <p><b>Optional ports:</b></p> <p>dT: Sample Time input</p> <p><b>System-Init-Code</b></p> <p>x = 0.0; cnt = 0.0; y = 0.0;</p>	<p><b>Init-Code (R_FC)</b></p> <pre>if (x &lt;= 0.0){   x = IV; }</pre> <p><b>Run-Code (CLC_FC)</b></p> <pre>if (R){   if (x &lt;= 0.0){     x = IV;   } } else if (E) {   x = MAX(x-dT, 0.0); } y = (x &gt; 0.0); cnt = x;</pre>

DelayResetEnabled	
<p><b>Port I/O Description</b></p> <p>u: Source signal (real) y: Output signal, delay by 1</p> <p><b>System-Init-Code</b></p> <p>x = 0; R1 = 0; y = 0;</p> <p><b>Init-Code (R_FC)</b></p> <p>x = IV; R1 = R;</p>	<p><b>Run-Code (CLC_FC)</b></p> <pre>if (R) {   x = IV;   y = x; } else {   if (R1) {     x = IV;   }   if (E) {     y = x;     x = u;   }   else {     y = x;   } } R1 = R;</pre>

TurnOffDelaySample
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<p><b>Port I/O Description</b></p> <p>n: Number of delays  u: Source signal (boolean)  y: Falling edge u, delay by n</p> <p><b>System-Init-Code</b></p> <pre>x = 0; /* counter */ y1 = 0; /* y */ y = 0; R1 = 0;</pre> <p><b>Init-Code (R_FC)</b></p> <pre>x = round(n); y1 = (u    (x&gt;0)); if (!u &amp;&amp; (x&gt;0)) {   x = x - 1; } R1 = R;</pre>	<p><b>Run-Code (CLC_FC)</b></p> <pre>if (R    R1) {   x = round(n);   y1 = (u    (x&gt;0));   if (!u &amp;&amp; (x&gt;0)) {     x = x - 1;   } } else if (E) {   y1 = (u    (x&gt;0));   if (u) {     x = round(n);   }   else if (x &gt; 0) {     x = x - 1;   } } y = y1; R1 = R;</pre>
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<b>TurnOffDelayTime</b>	
<p><b>Port I/O Description</b></p> <p>T: Delay time  u: Source signal (boolean)  y: Falling edge u, delay by T</p> <p><b>Optional ports:</b></p> <p>dT: Sample Time input</p> <p><b>System-Init-Code</b></p> <pre>x = 0.0; /* timer */ y1 = 0; /* y */ y = 0; R1 = 0;</pre> <p><b>Init-Code (R_FC)</b></p> <pre>x = T</pre>	<p><b>Run-Code (CLC_FC)</b></p> <pre>if (R    R1) {   x = T; /* reset */   y1 = (u    (x&gt;0.0));   if (!u &amp;&amp; (x&gt;0)) {     x = x - dT;   } } else if (E) {   y1 = (u    (x&gt;0.0));   if (u) {     x = T;   }   else if (x &gt; 0.0) {     x = x - dT;   } } y = y1; R1 = R;</pre>

**TurnOnDelaySample**

Continued on next page



<p><b>Port I/O Description</b></p> <p>n: Number of delays  u: Source signal (boolean)  y: Rising edge u, delay by n</p> <p><b>System-Init-Code</b></p> <pre>x = 0; /* counter */ y1 = 0; /* y */ y = 0; R1 = 0;</pre> <p><b>Init-Code (R_FC)</b></p> <pre>x = round(n); y1 = (u &amp; (x &lt;= 0)); if (u &amp; (x &gt; 0)) {     x = x - 1; } R1 = R;</pre>	<p><b>Run-Code (CLC_FC)</b></p> <pre>if (R    R1) {     x = round(n);     y1 = (u &amp; (x &lt;= 0));     if (u &amp; (x &gt; 0)) {         x = x - 1;     } } else if (E) {     y1 = (u &amp; (x &lt;= 0));     if (!u) {         x = round(n);     }     else if (x &gt; 0) {         x = x - 1;     } } y = y1; R1 = R;</pre>
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<b>TurnOnDelayTime</b>	
<p><b>Port I/O Description</b></p> <p>T: Delay time  u: Source signal (boolean)  y: Rising edge u, delay by n</p> <p><b>System-Init-Code</b></p> <pre>x = 0.0; /* timer */ y1 = 0; /* y */ y = 0; R1 = 0;</pre> <p><b>Init-Code (R_FC)</b></p> <pre>x = T</pre>	<p><b>Run-Code (CLC_FC)</b></p> <pre>if (R    R1) {     x = T;     y1=(u&amp; (x&lt;=0.0));     if (u&amp; (x&gt;0.0)) {         x = x - dT;     } } else if (E) {     y1=(u&amp; (x&lt;=0.0));     if (!u) {         x = T;     }     else if (x &gt; 0.0) {         x = x - dT;     } } y = y1; R1 = R;</pre>

<b>AccumulatorREL</b>
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<p><b>Port I/O Description</b></p> <p>u: Input signal to accumulate  MX: Upper state limit  MN: Lower state limit  y: u accumulated (running sum)  B_max Out True if upper limitation active  B_min Out True if lower limitation active</p> <p><b>System-Init-Code</b></p> <pre>x = 0; R1 = 0; y = 0; B_min = 0; B_max = 0;</pre> <p><b>Init-Code (R_FC)</b></p> <pre>x = IV; if (x &gt; MX) {   x = MX; } else if (x &lt; MN) {   x = MN; } R1 = R;</pre>	<p><b>Run-Code (CLC_FC)</b></p> <pre>if (R    R1) {   x = IV; } else if (E) {   x = x + u; } /* limit */ if (x &gt; MX) {   x = MX;   B_max = 1;   B_min = 0; } else if (x &lt; MN) {   x = MN;   B_max = 0;   B_min = 1; } else {   B_max = 0;   B_min = 0; } y = x; /* out */ R1 = R;</pre>
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IntegratorKREL

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<p><b>Port I/O Description</b></p> <p>u: Input signal to integrate  MX: Upper state limit  MN: Lower state limit  K: Gain  y: integrated value of u  B_max Out True if upper limitation active  B_min Out True if lower limitation active</p> <p><b>System-Init-Code</b></p> <pre>x = 0.0; R1 = 0; y = 0.0; B_min = 0; B_max = 0;</pre> <p><b>Init-Code (R_FC)</b></p> <pre>x = IV; if (x &gt; MX) {   x = MX; } else if (x &lt; MN) {   x = MN; } R1 = R;</pre>	<p><b>Run-Code (CLC_FC)</b></p> <pre>if (R    R1) {   x = IV; } else if (E) {   x = x + K*u*dT; } /* limit */ if (x &gt; MX) {   x = MX;   B_max = 1;   B_min = 0; } else if (x &lt; MN) {   x = MN;   B_max = 0;   B_min = 1; } else {   B_max = 0;   B_min = 0; } y = x; /* out */ R1 = R;</pre>
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IntegratorTREL

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<p><b>Port I/O Description</b></p> <p>u: Input signal to integrate  MX: Upper state limit  MN: Lower state limit  T: Time constant (1/Gain)  y: integrated value of u  B_max Out True if upper limitation active  B_min Out True if lower limitation active</p> <p><b>System-Init-Code</b></p> <pre>x = 0.0; R1 = 0; y = 0.0; B_min = 0; B_max = 0;</pre> <p><b>Init-Code (R_FC)</b> <pre>x = IV; if (x &gt; MX) {   x = MX; } else if (x &lt; MN) {   x = MN; } R1 = R;</pre> </p>	<p><b>Run-Code (CLC_FC)</b> <pre>if (R    R1) {   x = IV; } else if (E) {   x = x + u*dT/T; } /* limit */ if (x &gt; MX) {   x = MX;   B_max = 1;   B_min = 0; } else if (x &lt; MN) {   x = MN;   B_max = 0;   B_min = 1; } else {   B_max = 0;   B_min = 0; } y = x; /* out */ R1 = R;</pre> <p><b>Optional ports:</b></p> <p>dT: Sample Time input</p> </p>
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<b>DigitalLowpassRE</b>	
<p><b>Port I/O Description</b></p> <p>u: Source signal (real)  m: Filter factor  y: Filtered signal</p> <p><b>System-Init-Code</b></p> <pre>x = 0.0; R1 = 0; y = 0.0;</pre>	<p><b>Init-Code (R_FC)</b> <pre>x = IV; R1 = R;</pre> <p><b>Run-Code (CLC_FC)</b> <pre>if (R    R1) {   x = IV; } else if (E) {   x = x + m*(u - x); } y = x; R1 = R;</pre> </p></p>

<b>LowpassKRE</b>
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<p><b>Port I/O Description</b></p> <p>u: Source signal (real) K: Filter factor y: Filtered signal</p> <p><b>System-Init-Code</b></p> <p>x = 0.0; R1 = 0; y = 0.0;</p>	<p><b>Init-Code (R_FC)</b></p> <p>x = IV; R1 = R;</p> <p><b>Run-Code (CLC_FC)</b></p> <pre>if (R    R1) {   x = IV; } else if (E) {   x = x+ K*dT*(u-x); } y = x; R1 = R;</pre>
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<b>HighpassTRE</b>	
<p><b>Port I/O Description</b></p> <p>IV1: IV (for timestep n) at reset IV2: IV (for timestep n-1) at reset u: Source signal (real) T: Time constant TD: Time constant y: Highpass filtered signal</p> <p><b>Optional ports:</b></p> <p>State1_in: Direct input of internal state (x1) State2_in: Direct input of internal state (x2) State1_out: Direct output of internal state (x1) State2_out: Direct output of internal state (x2)</p> <p><b>System-Init-Code</b></p> <p>x1 = 0.0; x2 = 0.0; R1 = 0; y = 0.0;</p> <p><b>Note:</b>Wrong behavior on simulation if IV values are not constant.</p>	<p><b>Init-Code (R_FC)</b></p> <p>x1 = IV1; x2 = IV2; R1 = R;</p> <p><b>Run-Code (CLC_FC)</b></p> <pre>if (R) {   x1 = IV1;   x2 = IV2; } else {   if (R1) {     x1 = IV1;     x2 = IV2;   }   if (E) {     x1=x1+(TD*u-TD*x2-       dT*x1)/T;   } } y = x1; x2 = u; R1 = R;</pre>

<b>LowpassSecOrdRE</b>
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<p><b>Port I/O Description</b></p> <p>IV1: IV (for timestep n) at reset  IV2: IV (for timestep n-1) at reset  u: Source signal (real)  T: Time constant  D: Damping constant  Y: Highpass filtered signal</p> <p><b>Optional ports:</b></p> <p>State1_in: Direct input of internal state (x1)  State2_in: Direct input of internal state (x2)  State1_out: Direct output of internal state (x1)  State2_out: Direct output of internal state (x2)</p> <p><b>System-Init-Code</b></p> <p>x1 = 0.0;  x2 = 0.0;  R1 = 0;  y = 0.0;</p>	<p><b>Init-Code (R_FC)</b></p> <p>x1 = IV1;  x2 = IV2;  R1 = R;</p> <p><b>Run-Code (CLC_FC)</b></p> <pre>if (R    R1) {   x1 = IV1;   x2 = IV2; } else if (E) {   temp1 = T*T+2*D*T*dT;   x1 = x1+[dT*dT*(u-x1)     + T*T*(x1-x2)] /     temp1; } y = x1; x2 = x1; R1 = R;</pre>
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<b>LowpasTRE</b>	
<p><b>Port I/O Description</b></p> <p>u: Source signal (real)  T: time constant  y: Filtered signal</p> <p><b>System-Init-Code</b></p> <p>x = 0.0;  R1 = 0;  y = 0.0;</p>	<p><b>Init-Code (R_FC)</b></p> <p>x = IV;  R1 = R;</p> <p><b>Run-Code (CLC_FC)</b></p> <pre>if (R    R1) {   x = IV; } else if (E) {   x = x+ dT/T*(u-x); } y = x; R1 = R;</pre>

<b>DeltaOneStep</b>
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<p><b>Port I/O Description</b> u: Source signal (real) y: Difference signal</p> <p><b>System-Init-Code</b> x = 0.0; R1 = 0; y = 0.0;</p>	<p><b>Init-Code (R_FC)</b> x = IV; R1 = R;</p> <p><b>Run-Code (CLC_FC)</b> if (R    R1) {   x = IV;   y = u - x; } else if (E) {   y = u - x; } x = u; R1 = R;</p>
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<b>EdgeBi</b>	
<p><b>Port I/O Description</b> u: Source signal (boolean) y: Edge pulse</p> <p><b>System-Init-Code</b> x = 0.0; R1 = 0; y = 0.0;</p>	<p><b>Init-Code (R_FC)</b> x = IV; R1 = R;</p> <p><b>Run-Code (CLC_FC)</b> if (R    R1) {   x = IV;   y = (x != u);   x = u; } else if (E) {   y = (x != u);   x = u; } R1 = R;</p>

<b>EdgeFalling</b>
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<p><b>Port I/O Description</b> u: Source signal (boolean) y: Edge pulse</p> <p><b>System-Init-Code</b> x = 0.0; R1 = 0; y = 0.0;</p> <p><b>Init-Code (R_FC)</b> x = IV; R1 = R;</p>	<p><b>Run-Code (CLC_FC)</b> if (R    R1) {   x = IV;   y = (x &amp; &amp; !u);   x = u; } else if (E) {   y = (x &amp; &amp; !u);   x = u; } R1 = R;</p>
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<b>EdgeRising</b>	
<p><b>Port I/O Description</b> u: Source signal (boolean) y: Edge pulse</p> <p><b>System-Init-Code</b> x = 0.0; R1 = 0; y = 0.0;</p> <p><b>Init-Code (R_FC)</b> x = IV; R1 = R;</p>	<p><b>Run-Code (CLC_FC)</b> if (R    R1) {   x = IV;   y = (!x &amp; &amp; u);   x = u; } else if (E) {   y = (!x &amp; &amp; u);   x = u; } R1 = R;</p>

<b>SampleAndHold</b>	
<p><b>Port I/O Description</b> u: Source signal (real) y: Captured signal B_max: True if upper limitation active B_min: True if lower limitation active</p> <p><b>System-Init-Code</b> x = 0.0; R1 = 0; y = 0.0;</p>	<p><b>Init-Code (R_FC)</b> x = IV; R1 = R;</p> <p><b>Run-Code (CLC_FC)</b> if (R    R1) {   x = IV; } else if (E) {   x = u; } y = x; R1 = R;</p>



Hysteresis	
<p><b>Port I/O Description</b></p> <p>u: Source signal (real)  RSP: Upper threshold (real)  LSP: Lower threshold (real)  y: Hysteresis signal (boolean)</p> <p><b>System-Init-Code</b></p> <p>x = 0.0;  R1 = 0;  y = 0.0;  B_max = 0;  B_min = 0;</p> <p><b>Init-Code (R_FC)</b></p> <p>x = IV;  R1 = R;</p>	<p><b>Run-Code (CLC_FC)</b></p> <pre>if (R    R1) {     x = IV;     y = x; } if(R    R1    E){     if (u &gt; RSP) {         x = 1;     }     else if (u &lt; LSP) {         x = 0;     }     y = x; } R1 = R;</pre>

DifferenceQuotient	
<p><b>Port I/O Description</b></p> <p>u: Source signal (real)  y: Rate of change (gradient)</p> <p><b>System-Init-Code</b></p> <p>x = 0.0;  R1 = 0;  y = 0.0;</p>	<p><b>Init-Code (R_FC)</b></p> <p>x = IV;  R1 = R;</p> <p><b>Run-Code (CLC_FC)</b></p> <pre>if (R    R1) {     x = IV;     y = (u - x)/dT;     x = u; } else if (E) {     y = (u - x)/dT;     x = u; } R1 = R;</pre>

DifferenceLimiter
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<p><b>Port I/O Description</b></p> <p>u: Source signal (real)  LU: Upper limit of difference (real)  LD: Lower limit of difference (real)  y: Limited signal (real)  B_min: Lower limit exceeded (boolean)  B_max: Upper limit exceeded (boolean)</p> <p><b>System-Init-Code</b></p> <p>x = 0.0;  R1 = 0;  y = 0.0;  B_max = 0;  B_min = 0;</p> <p><b>Init-Code (R_FC)</b></p> <p>x = IV;  R1 = R;</p>	<p><b>Run-Code (CLC_FC)</b></p> <pre> if (R    R1) {   x = IV;   y = x; } else if (E) {   if ( (u - x) &gt; LU ) {     x = x + LU;     B_min = 0;     B_max = 1;   }   else if ( (u - x) &lt; LD ) {     x = x + LD;     B_min = 1;     B_max = 0;   } } else {   x = u;   B_min = 0;   B_max = 0; } y = x; } R1 = R; </pre>
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<b>DifferenceLimiter</b>
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Continued on next page
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<p><b>Port I/O Description</b></p> <p>u: Source signal (real)  dLU: Upper gradient [unit(u)/s] (real)  dLD: Lower gradient [unit(u)/s] (real)  y: Limited signal (real)  B_min: Lower limit exceeded (boolean)  B_max: Upper limit exceeded (boolean)</p> <p><b>System-Init-Code</b></p> <p>x = 0.0;  R1 = 0;  y = 0.0;  B_max = 0;  B_min = 0;</p> <p><b>Init-Code (R_FC)</b></p> <p>x = IV;  R1 = R;</p>	<p><b>Run-Code (CLC_FC)</b></p> <pre> if (R    R1) {     x = IV;     y = x; } else if (E) {     if ((u-x)&gt;dLU*dT) {         x = x+ dLU * dT;         B_min = 0;         B_max = 1;     }     else if((u-x)&lt;         dLD*dT)     {         x = x+ dLD * dT;         B_min = 1;         B_max = 0;     }     else {         x = u;         B_min = 0;         B_max = 0;     } } y = x; } R1 = R; </pre>
--	--

<b>MaxLogRE</b>	
<p><b>Port I/O Description</b></p> <p>u: Source signal (real)  y: Maximum value  B_max: Current input is new max. (boolean)</p> <p><b>System-Init-Code</b></p> <p>x = 0.0;  R1 = 0;  y = 0.0;  B_max = 0;</p> <p><b>Init-Code (R_FC)</b></p> <p>x = IV;  R1 = R;</p>	<p><b>Run-Code (CLC_FC)</b></p> <pre> B_max = 0; if (R) {     x = IV; } else {     if (R1) {         x = IV;     }     if (E) {         if (u &gt; x) {             x = u;             B_max = 1;         }     } } y = x; R1 = R; </pre>

MaxLogRE	
<p><b>Port I/O Description</b></p> <p>u: Source signal (real)</p> <p>y: Minimum value</p> <p>B_min: Current input is new min. (boolean)</p> <p><b>System-Init-Code</b></p> <p>x = 0.0;</p> <p>R1 = 0;</p> <p>y = 0.0;</p> <p>B_min = 0;</p> <p><b>Init-Code (R_FC)</b></p> <p>x = IV;</p> <p>R1 = R;</p>	<p><b>Run-Code (CLC_FC)</b></p> <pre> B_min = 0; if (R) {   x = IV; } else {   if (R1) {     x = IV;   }   if (E) {     if (u &lt; x) {       x = u;       B_min = 1;     }   } } y = x; R1 = R; </pre>

## 1.28 SDA - How to read SDA based specification

### General information:

[1] Matlab, Simulink, and Stateflow are registered trademarks of TheMathworks, Inc. Other product or brand names are trademarks or registered trademarks of their respective holders.

### 1.28.1 Introduction

The aim of this document is to enable the reader to understand the formalism of a SDA-model based specification. It is dedicated to customers or users dealing with the graphical specification.

SDA (System Design Automation) is the Matlab/Simulink/Stateflow<sup>1</sup> based function development environment used at Continental AG.

To understand the benefit of this new specification structure and formalism, this document first gives a very brief overview to a SDA model. SDA models are set up as Simulink/Stateflow models and have a clearly defined and unique structure as described in the following sections. Each SDA based specification is based on part of the complete and executable Model.

### 1.28.2 Matlab/Simulink/Stateflow.

This subchapter describes with a few words the tool used for modeling the behavior of a complete ECU. This tool is called Matlab. Matlab abbreviates "Matrix Laboratory" and has been developed for Technical Computing.

**Matlab** is:

- an interactive programming environment
- a high performance language
- a developers tool and
- a library of mathematical functions.

There are various software tools featured by Matlab the so-called **Matlab-Toolboxes**. They belong to the Matlab product family and are application-specific libraries of Matlab functions that customize Matlab for solving particular classes of problems. One of these toolboxes is Simulink.

**Simulink** is a graphical mouse-driven program for:


- the modeling of linear and non-linear dynamic systems,
- the simulation of them
- and of their analysis.

Simulink models are developed and parameterized as block diagrams. Pictures of these block diagrams are used to describe the functionality in the automatic generated specification.

**Simulink-Blocksets** are application-specific libraries for Simulink models. One of these blocksets is Stateflow.

**Stateflow** is a special blockset of Simulink for the design of:

- complex control structures,
- i.e. for event driven systems,
- for their simulation and
- analysis.

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Stateflow models are developed and programmed as state machines. Pictures of these state machines are used to describe the functionality in the automatic generated specification.

### 1.28.3 SDA model overview

#### Model

Although the final specification represents only a sub part of a complete SDA model, this section gives a short overview of a complete SDA - model.

A SDA model consists of five main parts:


- Stimuli (STI\_PRJ\_AGGR)  
The stimuli subsystem provides all signals and data inputs needed for the simulation of the model
- Display (DISP\_PRJ\_AGGR)  
In the display subsystem all outputs of the models are collected and visualized or saved to the Matlab Workspace.
- Plant (PLA\_PRJ\_AGGR)  
The plant contains a model of the system that has to be controlled by the Controller Unit. The behavior of the plant can be bypassed with input data in the Stimuli.
- Controller (PRJ\_AGGR)  
The Engine Control Unit (ECU) holds the functionality of the controller. It is subdivided into aggregates (see below) which are again subdivided into modules.

For each module a separate specification is generated.

#### Aggregates

An aggregate holds the functionality of a specific function together with its inputs and outputs. The main part of an aggregate in the SDA environment is the subsystem called "*modules\_<AGGR>*", where <AGGR> stands for the aggregate name (see Figure 1). In Simulink a subsystem is a graphical mean to group any portion of a model.

The subsystem "*modules\_<AGGR>*" includes all modules of the aggregate. The modules themselves are once again subsystems. The signal flow between the modules is represented by signal lines and signal buses. Bus selectors are used to select and distribute the appropriate signal to the modules. All data inputs and outputs are defined on this level of the aggregate as shown in the following figure. In future this figure will be used in the specification to give an overview of an aggregate.

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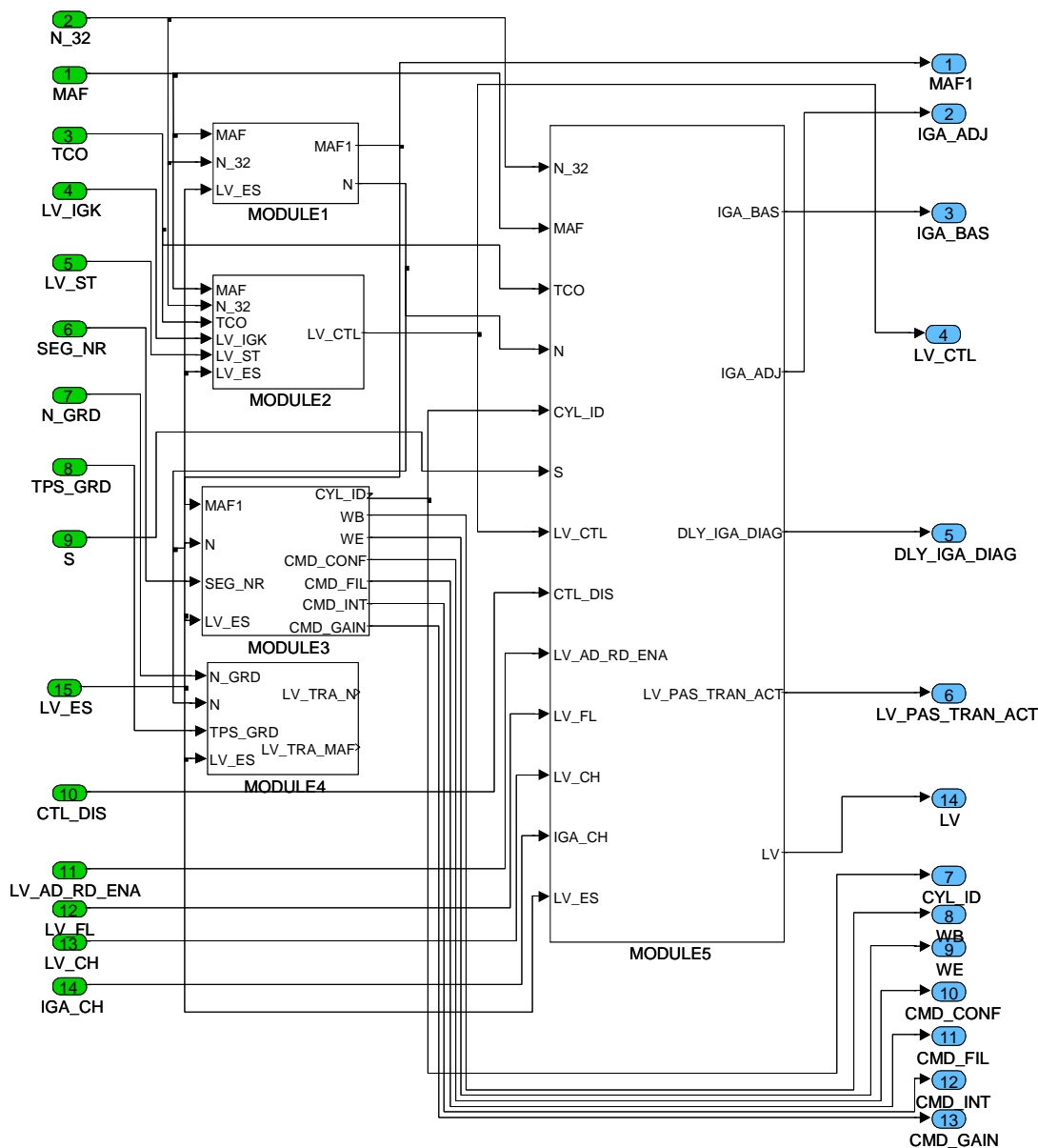


Figure 1.28.1: Schematic picture of the content of an aggregate. This picture shows the subsystem named "modules\_<AGGR>" including all the five modules (Module1 to Module5) of the aggregate. For each module a separate specification is generated.

## Modules

A module is the lowest level modular component in the model. All modules are included in the subsystem "modules\_<AGGR>". The whole functionality of the model is placed inside triggered subsystems within the modules. There is no restriction to the number of subsystem levels. Content of the subsystems in the modules is shown in the graphical software requirement specification (SDA-SRS). This means that only the part relevant for the calibration is shown in the pictures in the SRS. Beside the pictures there is also some textual description for the separate functionality. These text explanations are directly followed by their respective pictures, as shown in the graphical software requirement specification (SDA-SRS).

## 1.28.4 SDA specific Simulink notation

The functionality of the modules is build up with Simulink blocks that are placed inside triggered subsystems. The pictograms on the Simulink blocks represent a special functionality.

The blocks that are allowed for modeling within the SDA environment are included in separate libraries:

- the AT\_Basic\_Blocks ("Automotive Blockset")
- the AT\_Lib library

In "Documentation Automotive Blockset" and "Documentation AT\_Lib" a short description of the different blocks is given. The blocks are connected by signal lines, which represent the signal flow between them. Moreover the control flow in the model is driven by function calls that trigger the different subsystems, i.e. a function call is a signal that initiates the calculation of a functionality grouped in a subsystem.

SDA generated SRS include some special layout features that are listed here and demonstrated in the example in Figure 2:

- Thin lines mark scalar signals.
- Thick lines mark multidimensional signals e.g. arrays, vectors...
- Threefold lines.

Threefold lines represent bus signals, i.e. different signals that are collected together and represented by one "bus"-signal. This is similar to a data structure in Software. The block "bus creator" is used to collect the data "signal2" from the input "In1" and the data "Signal1" from the block "Constant1".

The block "bus\_selector" is used to select dedicated signals from the bus. An example is shown in the figure with "Signal1" and "signal2". This example shows also that:

- Dashed lines represent function calls or triggers. In the example a so-called "Function-call generator" is used to initiate the evaluation of the constant block "Constant1" which write the array [1,2,3] to its output.
- Instead of signal lines local Goto/From blocks can be used to connect two subsystems as a kind of invisible signal line.
- Signal names are written beside the signal line.
- Input ports (e.g. the block "In1") and output ports (the block "Out1" or "Out2") provide the interface of the subsystem to the environment, i.e. they show the input and output data of a subsystem.

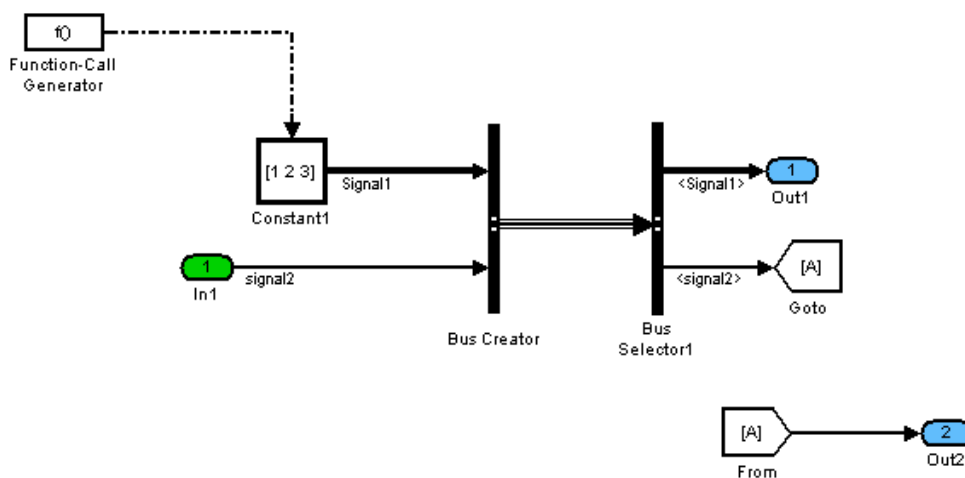



Figure 1.28.2: Example

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- The port names are shown on the respective subsystem (in this example: "In1", "Out1" and "Out2").
- There exist different **global** Goto/From blocks for data signals, visibles, function calls and triggers. E.g. the Goto blocks:

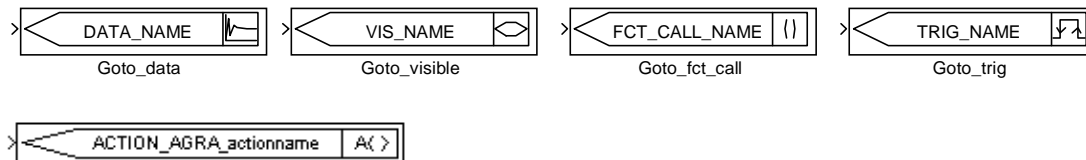


Figure 1.28.3:

- All visibles are available via the application system.
- All goto/from data are outputs/inputs of modules.
- If a subsystem has an input signal that is also an output signal of this subsystem, the suffixes "\_in" are added to the input port name and "\_out" to the output port name.

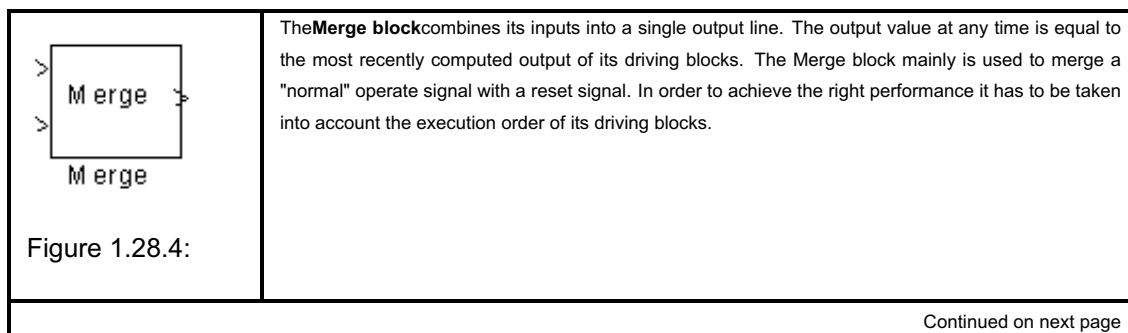
This means for example if the signal "A1" is both, input and output data of a subsystem, the input port is named "A1\_in" and the output port "A1\_out".

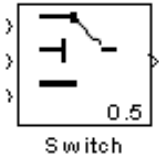

### 1.28.5 Structure of the SDA-Specification

The SDA-SRS layout is based on the layout of the standard WinWord Specifications. The first section includes tables of all output, input, calibration and configuration data. For output data the name, mode, hex. limits, phys. limits, resolution and unit is given in the table, whereas for the calibration and configuration data the dimension is given instead of mode. The input data table only holds the names of the variables.

An optional textual description and an overview picture of the module follow this section. Afterwards the contents of the subsystems with optional textual descriptions are included in hierarchical order. The pictures in a SRS are always shown after their respective text description.

### 1.28.6 Special Simulink blocks and their usage



 <p>Figure 1.28.5:</p>	<p>The <b>Switch block</b> propagates one of two inputs to its output, depending on the value of a third input, called the control input. If the signal on the control (second) input is greater than or equal to the Threshold parameter (shown in the block) the first input; otherwise, it propagates the third input.</p>
 <p>Figure 1.28.6:</p>	<p>The <b>if-then-else block</b> provides the possibility to implement an if-then-else control structure in Simulink. The input of this block is the condition "cond_if". If the condition is true (= 1) then the function call "if" is sent out. Else the function call "else" is sent out. These function calls can be used to trigger the corresponding subsystems.</p>

## 1.28.7 How to read SDA conform Stateflow charts

### Introduction

The aim of this chapter is to enable the reader of SDA based specifications to understand the Stateflow charts used in SDA models. This document is not a Stateflow reference, it shows only the usage according to the SDA Guidelines.

### Stateflow objects overview

#### Graphical objects

Name	Description <sup>[2]</sup>
State	States are the primary objects of Stateflow. They represent modes of a system.
Transition	A transition is a pathway for a chart or state to change from one mode (state) to another.
Default transition	Default transitions tell Stateflow which of several possible states to enter first for a chart or superstate.
Connective junction	A connective junction represents a decision point between alternative transition paths.
History junction	A history junction records the most recently active state of the chart or superstate in which it is placed.
Function	Functions that are graphically defined by a flow graph. The flow graph is contained inside a box with the function name.
Box	Boxes are used to group parts of a diagram.

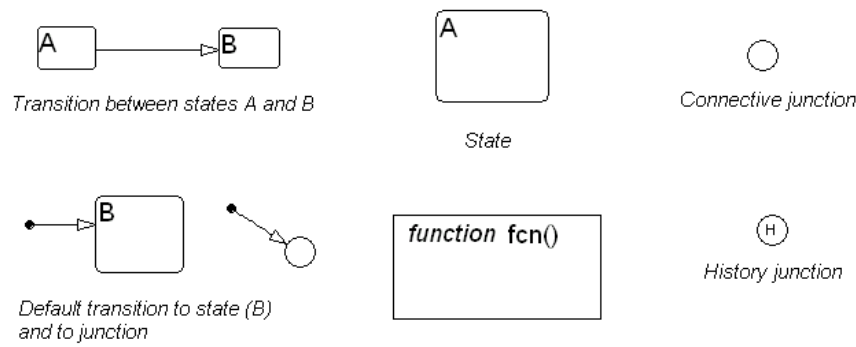


Figure 1.28.7: Symbols used to represent graphical Stateflow objects

Non graphical objects:

**Data object:** data used in a state chart to control its execution. It can be created in the Stateflow chart itself (local data) or be imported from the Simulink model that calls the chart (input data). Simulink models can also read the Stateflow data, when it is declared as an output from the chart (output data).

**Event object:** an event can trigger whole Stateflow charts or individual actions in a chart. A Stateflow chart reacts on events and can broadcast events to its internal objects or send events to the Simulink model. Events are triggers or function calls.

Interface to Simulink

Figure 5 shows the interface between a Stateflow chart and the Simulink model. As shown, function calls and triggers can awake the chart. The chart can also send events to the model, use data as inputs and produce data as outputs.

The chart runs only one event input at each time.

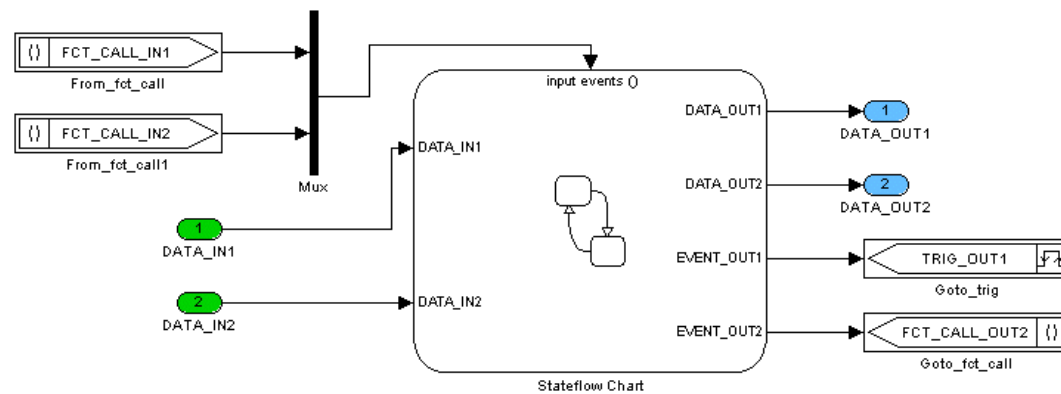


Figure 1.28.8: Interface between a Simulink model and a Stateflow chart

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## States

A state describes a mode of a reactive Stateflow chart. The chart always has one or more active states. An active state tells that the chart is in this state's mode. Figure 6 shows a chart that can assume two modes: stop and running.



Figure 1.28.9: Transition between two states

Assume: State "STOP" is at the beginning active.

### Chart reaction on certain events:

1. Event "STOP\_EV" wakes the chart  
... nothing happens.
2. Event "GO\_EV" wakes the chart.  
"STOP" is deactivated.  
"RUNNING" is activated.
3. Event "STOP\_EV" wakes the chart.  
"RUNNING" is deactivated  
"STOP" is activated.

### Activation

A transition between two states, state A to state B, changes state A to inactive and state B to active. A transition occurs always from an active state to an inactive state. The transitions are driven by events and controlled by conditions. The whole transition path between both active and inactive states must be evaluated and be valid so that the transition can occur.

### Hierarchy

Every state is part of a hierarchy. States can be superstates, substates or just states. A state is a superstate if it contains other states, which are called substates. When a superstate turns active, one of its substates - if existent - turns also active. In the same way, when a substate turns active, it makes its superstate also active. See in Figure 7 some examples. The Stateflow chart itself is, in a SDA model, the highest hierarchical element.

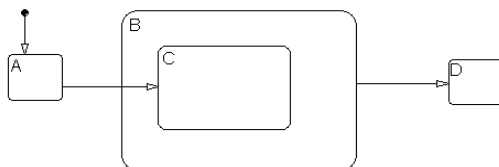



Figure 1.28.10: Hierarchical relation between states

### The chart is awoken for the first time:

Default transition occurs and state A is activated.

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**The chart is awoken for the second time:**

1. Transition between A and C is valid
2. A is deactivated
3. Transition occurs
4. B is activated
5. C is activated

**The chart is awoken for the third time:**

1. Transition between B and D is valid
2. C is deactivated
3. B is deactivated
4. Transition occurs
5. D is activated


Decomposition

Each state can be decomposed in substates. There are two kinds of decomposition: AND and EXCLUSIVE OR. See an example on Figure 8.

**Parallel AND decomposition:** one or more substates can be active at the same time. The substates are drawn with dashed borders.

**Parallel EXCLUSIVE OR decomposition:** only one substate can be active. The substates are drawn with continuous borders.

*Substates of an superstate with parallel AND decomposition are drawn with dashed borders. When such a superstate activates, its substates are then activated in the order they appear - beginning at the top left side and finishing at the bottom right side. Only superstates with AND parallel decomposition can have two or more active substates at the same time.*

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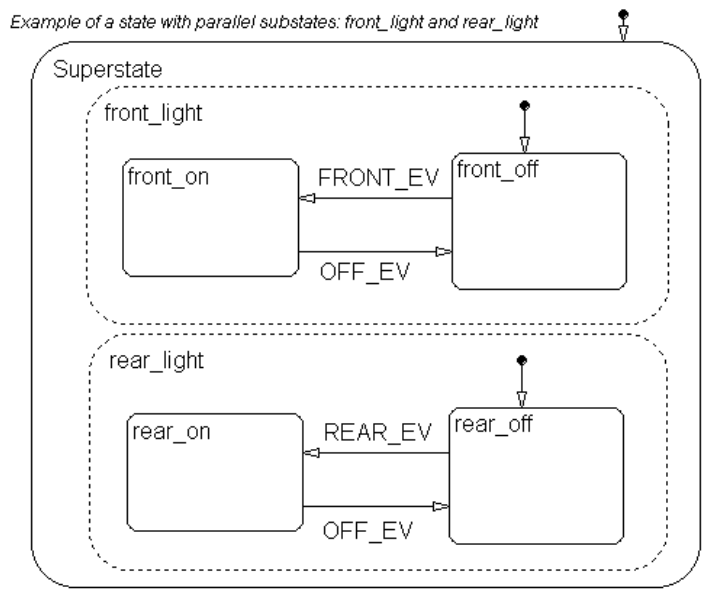


Figure 1.28.11: Example of parallel state decomposition

This example shows a chart with three hierarchy levels:

1. First level: is the chart itself, contains the state "superstate" inside.
2. Second: content from state "superstate".
3. Third: content from the states "front\_light" and "rear\_light"

Decomposition:

- "superstate" has AND decomposition.
- "front\_light", "rear\_light" and the chart itself have EXCLUSIVE OR decomposition.

Activation order in the AND decomposition:

- "front\_light" is activated first ("1") and then "rear\_light" ("2"). Both are active during the same time.
- The deactivation of parallel substates occurs in the inverse order.
- In this example, if "superstate" will be deactivated, first "rear\_light" will be deactivated, then "front\_light" and finally "superstate".

History

*A state also has history that applies to its level of hierarchy in the Stateflow diagram. When a superstate deactivates, it implies that its substates are also turning deactivated. When a history junction is present, activating the superstate again will reactivate the same substate that was activated before the last deactivation.*

Stateflow actions

Stateflow action type

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Actions are statements with mathematical expressions or event broadcasting. The Figure 9 shows some examples of actions.

*In SDA Stateflow charts, actions can be either event broadcasting or value assignment. If a data is an input from Simulink, it can be used only on right hand side operations (is not possible to assign new values to it). If a data is an output to Simulink or a local data, it can be used on both sides. Multiple actions can be ordered in a list, separated with semi-colons to each other. The actions in a list are executed in the order they appear.*

## State actions

*Four action types can be specified for one state: entry:, during:, exit:, or on: <<event\_name>> actions. This actions are specified in the state label, after the state name followed by a slash:*

### **STATE\_NAME/**

**entry:**<< action list >>; /\* Actions are executed right after the state activation. \*/

**during:**<< action list >>; /\* Actions are executed if the state is active and there is no valid transition to another state. \*/

**exit:**<< action list >> /\* Actions are executed right after the state deactivation. \*/

**on <<event\_name>>:**<< action list >> /\* Actions are executed when the specified event occurs \*/

*Note: entry: and exit: actions are executed always after a transition has occurred. A during: action is execution as long as no transition has occurred. Entry, during and exit are also referred as en:, du: and ex:.*

## Transition evaluation

### Transition path

A transition path is a sequence of transitions joined by connective junctions. A path doesn't necessary lead to a valid transition between two states.


*Evaluating a transition doesn't mean that this transition will occur. A transition (between two states) occurs only if the hole path is valid. Nevertheless, the evaluation of all possible transitions follows always the sequence established by their precedence rules. That means, if a transition containing a condition statement is valid, its condition action (if it exists) runs at the evaluation time, without taking care if this transition is in a path that will lead to a transition between states or not. The same is not true for transition actions: they run only if the whole path containing them is true and also only **after** the transition between both states (initial and final) has occurred.*

### Transition label

The switching from one state to another may be driven by events (function call, trigger) or conditions that are labeled to the transition arrow. The label notation has the following syntax:

**event\_name[condition\_statement]{condition\_ actions;}/transition\_ action;**

All three parts of the label notation are optional: event\_name, transition action, and the set condition expression plus condition action. It is not obligatory to specify a condition action for a condition expression.

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A transition action happens only if the whole path containing the transition is true. The action happens after the transition has occurred. Transition actions are declared after a slash at the end of the transition label. Transition actions are **not** allowed in SDA transition action labels.

The condition label [condition\_statement] is evaluated as an expression with Boolean result. A transition containing a condition statement can only be valid if the condition result is true.

A condition action happens whenever a condition is evaluated and is true. The action happens right after the condition evaluation. Condition actions are declared inside brackets {<< action list >>} after the condition declaration.

A condition statement can contain a call to an *In*(<<state\_name>>) function, that is evaluated true when the state "state\_name" is active. See the tables at the end of this documentation for more information about operations precedence and syntax. See in Figures 6, 8 and 9 some transition label examples.

### Precedence rules for transition evaluation

The evaluation of transitions coming from a single source obeys the following precedence order:

1. **End point hierarchy:** transitions whose end points are attached to higher hierarchical levels are evaluated first.
2. **Label:** transitions are ordered for evaluation according to the types of action language present in their labels, with precedence as follows:
  - 2.1. Labels with events and conditions.
  - 2.2. Labels with events
  - 2.3. Labels with conditions
  - 2.4. No label
3. **Transition angular position in its source:** evaluation order based on the angular position of the transition on the surface of the originating object:
  - A - Multiple outgoing transitions from states  
Are evaluated in a clockwise progression starting at the upper left corner of the source state.
  - B - Multiple outgoing transitions from connective junctions  
Are evaluated in a clockwise progression starting at the twelve o'clock position on the junction.

The following flow chart was made observing the SDA guidelines:



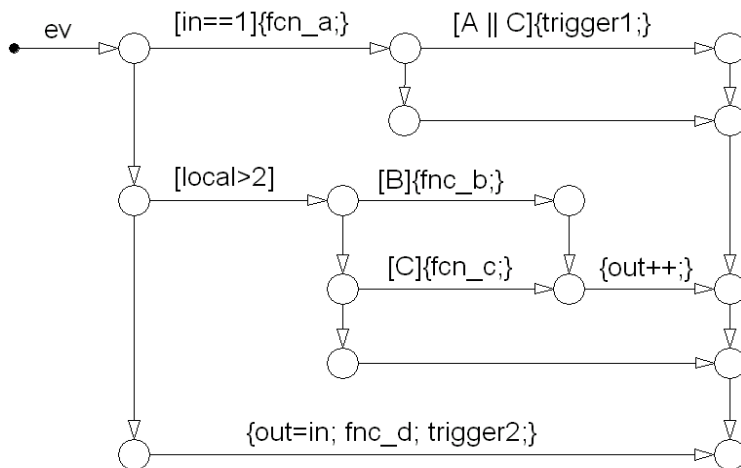


Figure 1.28.12: Example: if - then - else construction

**Events:**

ev, trigger1, trigger2, fnc\_a, fnc\_b, fnc\_c, fnc\_d

**Data:**

in, out, local, A, B, C, D

**Conditions present in the chart:**

ev, [in==1], [A||C], [B], [C], [local&gt;2]

**Actions present in the chart:**

```
{fnc_a;}, {trigger1;},{fnc_b;},
{fnc_c}, {out++}, {out=in, fnc_d; trigger2;}
```

Attempting the precedence rules between transitions, a possible representation of this flow chart in c-like pseudo-code could be (this is not a suggestion!):

```
transition_occurred_flag=0;
if(arriving_event==ev){
    if(in==1){
        fnc_a();
        if(A||C){
            transition_occurred_flag=1;
            trigger(trigger1);
        }
        if(1)
            transition_occurred_flag=1;
    }
    if(!transition_occurred_flag && local>2){
        if(B){
            transition_occurred_flag=1;
            fnc_b();
        }
        if(!transition_occurred_flag && C){
            transition_occurred_flag=1;
        }
    }
}
```

```
        fnc_c();  
    }  
    if(transition_occurred_flag)  
        out++;  
    }  
    if(1)  
        transition_occurred_flag=1;  
}  
if(!transition_occurred_flag){  
    out=in;  
    fnc_d();  
    trigger(trigger2);  
    transition_occurred_flag=1;  
}  
}
```

**Inner transition**

An inner transition is a transition that does not exit the source state. It is represented as an internal transition from a superstate to a substate or to the superstate itself. When an inner transition occurs, it has the same result as when the superstate was deactivated and then reactivated, but the state remains active all the time.  
The inner transition is part of the state it belongs to. It is evaluated only during this state, like other transitions inside the same state.

That means: when the inner transition occurs, the active substate exits and a new substate is activated. The new active substate is chosen by the inner transition. When it points to the superstate itself, the rules are the same as if the superstate is being activated from an external state. In this case, a default transition inside the superstate or a history junction will take effect. In Figure 10, the transitions 1, 3 and 4 are inner transition of state A. Transition 2 is self-loop transition, not an inner transition.

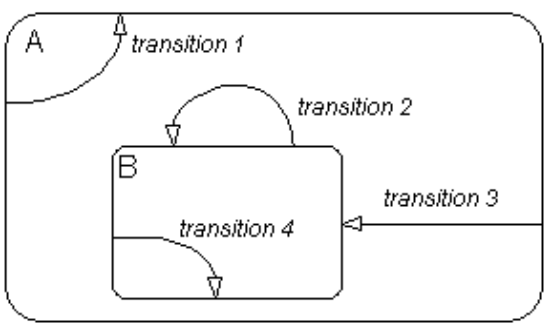


Figure 1.28.13: Inner transition examples: transitions 1, 3 and 4.

**Direct event broadcast**

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It is possible to broadcast an event directly to another state in the same chart (local event) using the action command *send*:

*send(event\_name,state\_name)*: Broadcasts the event "event\_name" to the state "state\_name" and any of its offspring in the hierarchy. "state\_name" must be already active in order to receive the sent event.

## Notes

1. Matlab, Simulink, and Stateflow are registered trademarks of TheMathworks, Inc. Other product or brand names are trademarks or registered trademarks of their respective holders.
2. From the Matlab, Simulink and Stateflow documentation.

## Tables

The following tables show the possible Stateflow operations used to write statements (Stateflow action language) and conditions. The precedence order must be considered.

### Assignment operations

Example	Description <sup>[2]</sup>
a = expression	Simple assignment
a += expression	Equivalent to a = a + expression
a -= expression	Equivalent to a = a - expression
a *= expression	Equivalent to a = a * expression
a /= expression	Equivalent to a = a /expression

### In C-like bit operations:

Example	Description <sup>[2]</sup>
a  = expression	Equivalent to a = a   expression (bit operation).
a &= expression	Equivalent to a = a & expression (bit operation).
a ^= expression	Equivalent to a = a ^ expression (bit operation).

### Unary operations

Example	Description <sup>[2]</sup>
~a	Logical NOT of a
!a	Logical NOT of a
-a	Negative of a

### Unary actions

Example	Description <sup>[2]</sup>
a++	Increment a
a--	Decrement a

## Binary and Bitwise operations

Example	Precedence	Description <sup>[2]</sup>
a * b	10	Multiplication
a / b	10	Division
a %% b	10	Modulus
a + b	9	Addition
a - b	9	Subtraction
a >> b	8	Shift operand a right by b bits. Noninteger operands for this operator are first cast to integers before the bits are shifted.
a << b	8	Shift operand a left by b bits. Noninteger operands for this operator are first cast to integers before the bits are shifted.
a > b	7	Comparison of the first operand greater than the second operand
a < b	7	Comparison of the first operand less than the second operand
a >= b	7	Comparison of the first operand greater than or equal to the second operand
a <= b	7	Comparison of the first operand less than or equal to the second operand
a == b	6	Comparison of equality of two operands
a != b	6	Comparison of inequality of two operands
a <> b	6	Comparison of inequality of two operands
a & b	5	Logical AND of two operands or Bitwise AND of two operands
a ^ b	4	Operand a raised to power b or Bitwise XOR of two operands
a   b	3	Logical OR of two operands or Bitwise OR of two operands
a && b	2	Logical AND of two operands
a    b	1, last precedence	Logical OR of two operands

## 1.29 Initialization of variables from non implemented functions

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
AC_VEH	O/V	8000... 7FFFH	-27.77088 ...27.77003	847.5e-6	m/s**2
Current vehicle acceleration					
ANG_1_RAW_VVL	O	0... 1FFFH	0... 179.97802	0.0219727	°
Recent as valid selected raw value in actual sampling time of sensor1					
ANG_DE_ABSV_PLAUS_CHK_VVL	O	0... 1FFFH	0... 179.97802	0.0219727	°
Absolute value of angle deviation between sensor 1 and 2 for plausibility check					
ANG_EXC_VVL	O	0... 238EH	0... 200	0.0219732	°
Selected current value in grad after jitter filtration					
ANG_REL_VVL	O	0... 1FFFH	0... 99.98779	0.012207	%
Selected Actual Value of VVL angle position for position controller					
ANG_SP_CTL_VVL	O	0... 1FFFH	0... 99.98779	0.012207	%
Setpoint for the position controller					
ANG_SP_VVL	O	0... 238EH	0... 200	0.0219732	°
Desired position of the excenter shaft in degree					
ANG_SP_VVL_CUS	O	0... 238EH	0... 200	0.0219732	°
Desired position of the excenter shaft in degree for customer position controller					
ANG_STK_VVL	O	0... 238EH	0... 200	0.0219732	°
Effective stroke (linearised value)					
B_mareghub_ad	O	0... 1H	0 ...1	1	-
Flag indicating "Adaption Massenstromregler auf Hub erstmalig erfolgt"					
B_msadxcav	O/V	0... 1H	0 ...1	1	-
Bedingung MSA-Abscaltverhinderer vom DxC					
CAT_DIAG [NC_CBK_EX_NR]	O/S	0... 7FH	0... 1.98437	0.015625	-
At ended diagnosis final value for catalyst conversion capability					
CHA_CDN_BAT	O	0... FFH	0... 127.5	0.5	-
No description given					
CTR_EDGE_FALL_LOIL	O	0... FFH	0... 255	1	-
Zähler für fallende Flanken im Töns Signal					
CTR_GB_NEUT_NOT_PLAUS_SUM	O/S	0... FFH	0... 255	1	-
Sum counter for confirmed neutral gear plausibility errors					
CTR_SIG_NOT_VLD_LOIL	O	0... FFH	0... 255	1	-
Zähler für unplausible Signale					
CYC_ST	O	0... FFFFH	0... 65535	1	-
cycle counter at start and after start					
EAC_COD_SENS	O	0... FFH	0... 255	1	-
result of decoding process of the EAC sensor					
EOI_LIM [NC_CYL_NR]	O	F100... F00H	-1440 ...1440	0.375	°CRK
Cylinder individual zero position for phasing					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Exwink_ist	O	0... 238EH	0... 200	0.0219732	°
Actual position of the excenter shaft in degree					
Exwinkkor	O	DC72... 238EH	-200 ...200	0.0219732	°
Korrekturwinkel Excenterwelle zur Hubkorrektur					
F_minhub	O	0... FFFFH	0... 0.99998	15.3e-6	-
Faktor Ein-/Ausblendung Minhub über Tmot und Nkw					
F_reib_ba	-	0... FFH	0... 0.99609	3.9062e-3	-
Factor for operation mode transition					
F_tikorrvr [8]	O	0... FFFFH	0... 1.99996	30.5e-6	-
Korrekturfaktor für Einspritzung aus Verbrennungsregelung					
FAC_COR_MFF_EXT_ADJ [NC_CYL_NR]	O	0... FFFFH	0... 1.99996	0.0000305	-
temporary correction factor for OBD-demo					
FAC_COR_MFF_EXT_ADJ_NVMY [NC_CYL_NR]	O/S	0... FFFFH	0... 1.99996	0.0000305	-
correction factor for OBD-demo					
FAC_LAM_DIAGCP [NC_CBK_EX_NR]	O	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
lambda controller mean value at the beginning of CPS opening					
FAC_LAMB_SP_SA	O	0... FFFFH	0... 3.99993	61e-6	-
Lambda deviation through secondary air					
FAC_RON	O/V	0... FFH	0 ...1	3.9216e-3	-
RON factor indicating fuel quality					
GR_SUB_MT	O	0... 7H	0 ...7	1	-
Substitute gear ratio with error					
IGA_CH	O	0... 80H	-48 ...0	0.375	°CRK
dummy					
IGA_TRA_KNK	O	0... 80H	-48 ...0	0.375	°CRK
Spark retard till high MAP_DRV1 applied to engine					
IGC_x_EXT_ADJ	O	FA60... 5A0H	-90 ...90	0.0625	°CRK
External Ignition Adjustment					
INH_CYC_IV	O	0... FFH	0... 255	1	-
Shut-off request for cylinder bitmask					
INH_IV_STST	O	0... FFH	0... 255	1	-
Cylinder shut off pattern for engine shut down due to stop request					
Ivvtmot [NC_CYL_NR]	O	8000... 7FFFH	-2048... 2047.9375	0.0625	A
Array of VVLI DC motor current					
LAMB_AV_COR	O	0... 7FFFH	0... 31.99902	976.599e-6	-
average lambda value					
LOAD_MAX_SCDN_MIS	O/S	0... FFH	0... 99.60937	0.390625	%
Maximal load of similar condition window for LV_ERR_MIS					
LOAD_MIN_SCDN_MIS	O/S	0... FFH	0... 99.60937	0.390625	%
Minimal load of similar condition window for LV_ERR_MIS					
LV_ACT_ECRAS_EXT_ADJ	O	0... 1H	0 ...1	1	-
adjustment value for radiator shutters 0 = off, 1 = on					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ACT_SA_EOL	O	0... 1H	0 ...1	1	-
Activation bit for secondary air EOL test					
LV_ALTER_RD_TBL_6	O	0... 1H	0 ...1	1	-
logical variable: software switch for condition read register 6					
LV_AMT_CRAWL_ON	O	0... 1H	0 ...1	1	-
Active AMT clutch torque					
LV_AMT_DEC_ACT	O	0... 1H	0 ...1	1	-
Logical variable for torque intervention due to gear shift					
LV_AMT_INC_ACT	O	0... 1H	0 ...1	1	-
Logical variable for torque intervention due to gear shift					
LV_ASR_PLAUS	O	0... 1H	0 ...1	1	-
Logical variable plausibility ASR					
LV_BAT_CUS_CDN	O	0... 1H	0 ...1	1	-
Condition total discharge of battery					
LV_BRAKE_REQ	O	0... 1H	0 ...1	1	-
hom. mod is requested by critical break under pressure					
LV_CAM_SP_CH	O	0... 1H	0 ...1	1	-
--					
LV_CAT_DIAG_REQ_EOL	O	0... 1H	0 ...1	1	-
Interface flag from COMS: end of line check requested for catalyst diagnosis					
LV_CH_TQ_ADD	O	0... 1H	0 ...1	1	-
Catalyst Heating Function "torque reserve" (late ignition angle)					
LV_CH_TQ_ADD_IS	O	0... 1H	0 ...1	1	-
Catalyst Heating Function "torque reserve for first idle phases"					
LV_CITY	O	0... 1H	0 ...1	1	-
City mode SSG					
LV_CMB_TRAN_ACT	O	0... 1H	0 ...1	1	-
Combustion mode transition active					
LV_CRC_DONE_BOOT	O	0... 1H	0 ...1	1	-
-					
LV_CRC_DONE_CAL	O	0... 1H	0 ...1	1	-
-					
LV_CRC_DONE_ECU	O	0... 1H	0 ...1	1	-
-					
LV_CRC_ERR_BOOT	O	0... 1H	0 ...1	1	-
-					
LV_CRC_ERR_CAL	O	0... 1H	0 ...1	1	-
-					
LV_CRC_ERR_ECU	O	0... 1H	0 ...1	1	-
-					
LV_CRC_STATUS_MU	O	0... 1H	0 ...1	1	-
Flag indicating an error in the Standard ROM Check					
LV_CTOP	O	0... 1H	0 ...1	1	-
State convertible top: 0 = closed, 1 = open					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DI_TQ_REQ_CAN_MPI_GDI	O	0... 1H	0 ...1	1	-
logical variable for disabling ARS intervention due to EMS error					
LV_DRIV_BELT_CLOSE	O	0... 1H	0 ...1	1	-
Driver seat belt fastened					
LV_ECU_SLA	O	0... 1H	0 ...1	1	-
ECU is in slave-mode 0=Master (or no Master/Slave system); 1=Slave					
LV_EFPWM_EXT_ADJ	O	0... 1H	0 ...1	1	-
Logical variable indicating external controlling of EFPWM by service tool					
LV_END_DIAG_SA_SAFM	O	0... 1H	0 ...1	1	-
End of SAFM diagnosis					
LV_END_DIAG_SA_SAP	O	0... 1H	0 ...1	1	-
End of SA minimum flow rate - diagnosis					
LV_END_DIAG_SA_SAV	O	0... 1H	0 ...1	1	-
End of Mechanically jammed SAV-diagnosis					
LV_END_DIAG_SA_SYS	O	0... 1H	0 ...1	1	-
End of SA minimum flow rate diagnosis					
LV_ENG_EXT_HEAT	O	0... 1H	0 ...1	1	-
Logical variable indicating engine has been preheated before start by an external appliance for e.g. by a block heater or auxiliary vehicle heater					
LV_ENG_RUN_CMB	O	0... 1H	0 ...1	1	-
Running engine without starter, only through combustion					
LV_EOI_LIM_EOLP_OFS	O	0... 1H	0 ...1	1	-
Flag to indicate first start at end of line (EOL).					
LV_EOL_OBD	O	0... 1H	0 ...1	1	-
Flag which indicates that EOL is required					
LV_ER_BAL_HOM_CDN	O	0... 1H	0 ...1	1	-
Conditions for cylinder balancing homogenous reached					
LV_ERR_CAM_DE_IVVT_EX [NC_NR_CBK_IVVT]	O	0... 1H	0 ...1	1	-
Present failure: failure after filtering of diagnosis enduring exhaust camshaft deviation					
LV_ERR_CAM_DE_IVVT_IN [NC_NR_CBK_IVVT]	O	0... 1H	0 ...1	1	-
Present failure: failure after filtering of diagnosis crankshaft to inlet camshaft mechanics violation					
LV_ERR_CAN_STST	O	0... 1H	0 ...1	1	-
CAN error of MSA relevant signals					
LV_ERR_CLK_DRIFT_PBK_IV [NC_CYL_NR]	O	0... 1H	0 ...1	1	-
Error flag for clock drift failure in ATIC88 or too high input voltage in injector					
LV_ERR_COM_1_BOFF	O	0... 1H	0 ...1	1	-
Bus off error on communication bus 1 (Flexray)					
LV_ERR_COM_1_ST_UP	O	0... 1H	0 ...1	1	-
Present error flexray controller startup					
LV_ERR_COM_1_VS	O	0... 1H	0 ...1	1	-
Present error communication bus 1 (Flexray)					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_COM_2_BOFF	O	0... 1H	0 ...1	1	-
Bus off error on communication bus 2 (FA-CAN)					
LV_ERR_COM_2_EFP	O	0... 1H	0 ...1	1	-
Present error communication on bus 2 (FA-CAN)					
LV_ERR_COM_2_T_ICL	O	0... 1H	0 ...1	1	-
Present error communication bus 2 (FA-CAN)					
LV_ERR_COM_3_BOFF	O	0... 1H	0 ...1	1	-
Bus off error on communication bus 3 (A-CAN)					
LV_ERR_COM_3_EFP	O	0... 1H	0 ...1	1	-
Present error communication on bus 3 (A-CAN)					
LV_ERR_COM_GB	O	0... 1H	0 ...1	1	-
Error indicating problem in communication from gearbox to engine management					
LV_ERR_CRASH_SIG	O	0... 1H	0 ...1	1	-
Boolean for error currently present on location "Crash Signal front impact"					
LV_ERR_CRIT_OVL_ECU_VVL	O	0... 1H	0 ...1	1	-
Boolean for error currently present on driver overload					
LV_ERR_CUR_H_VVL	O	0... 1H	0 ...1	1	-
Error motor current critical high					
LV_ERR_DR_SC_VVL	O	0... 1H	0 ...1	1	-
Short circuit error detected of VVL driver					
LV_ERR_EGR	O	0... 1H	0 ...1	1	-
Error currently present on exhaust gas recirculation system					
LV_ERR_FPA	O	0... 1H	0 ...1	1	-
error bit indicating fuel pressure actuator					
LV_ERR_FPS	O	0... 1H	0 ...1	1	-
Error currently present on fuel pressure sensor					
LV_ERR_MEC_IVVT_EX [NC_NR_CBK_IVVT]	O	0... 1H	0 ...1	1	-
Error Flag for functional error on the exhaust CAM adjustment					
LV_ERR_OVL_ECU_VVL	O	0... 1H	0 ...1	1	-
Boolean for error currently present on OVL_ECU_VVL					
LV_ERR_PORT [NC_PORTPWM]	O	0... 1H	0 ...1	1	-
Flag for Port-flap power stage electrical failure currently present					
LV_ERR_RLY_VVL	O	0... 1H	0 ...1	1	-
Boolean for error currently present on relay controll /capacitor pre-charge					
LV_ERR_SA_SAFM	O	0... 1H	0 ...1	1	-
Present failure: Component Secondary air flow meter failure					
LV_ERR_SA_SAP	O	0... 1H	0 ...1	1	-
Present failure: Minimum secondary air flow rate failure after filtering					
LV_ERR_SA_SAV	O	0... 1H	0 ...1	1	-
Present failure: Mechanically jammed SAV after filtering					
LV_ERR_SA_SAV_LSL	O	0... 1H	0 ...1	1	-
Present failure: Mechanical jammed SAV after filtering					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_SA_SYS	O	0... 1H	0 ...1	1	-
Present failure: Minimum secondary air flow rate failure after filtering					
LV_ERR_SAP	O	0... 1H	0 ...1	1	-
Boolean for error currently present on secondary air pump command signal.					
LV_ERR_SAV	O	0... 1H	0 ...1	1	-
Boolean for error currently present on secondary air valve command signal					
LV_ERR_TEG_PCAT_DOWN [NC_CBK_EX_NR]	O	0... 1H	0 ...1	1	-
Temp. after precatlyst error flag					
LV_ERR_TOUT_AMT_1	O	0... 1H	0 ...1	1	-
Logical variable timeout error CAN message SSG1					
LV_ERR_TOUT_ASR_1	O	0... 1H	0 ...1	1	-
logical variable timeout error CAN message ASC1					
LV_ERR_TOUT_ASR_3	O	0... 1H	0 ...1	1	-
Logical variable timeout error CAN message ASC3					
LV_ERR_TOUT_EFP_CAN	O	0... 1H	0 ...1	1	-
logical variable timeout error CAN message EKP					
LV_ERR_TOUT_ETCU_1	O	0... 1H	0 ...1	1	-
Logical variable timeout error CAN message EGS1					
LV_ERR_TOUT_ETCU_2	O	0... 1H	0 ...1	1	-
logical variable timeout error CAN message EGS2					
LV_ERR_TOUT_ICL_2	O	0... 1H	0 ...1	1	-
logical variable timeout error CAN message INSTR2					
LV_ERR_TOUT_ICL_3	O	0... 1H	0 ...1	1	-
Logical variable timeout error CAN message INSTR3					
LV_ERR_TOUT_ICL_7	O	0... 1H	0 ...1	1	-
Logical variable timeout error CAN message INSTR7					
LV_ERR_TOUT_PSTE_1	O	0... 1H	0 ...1	1	-
logical variable timeout error CAN message LWS1					
LV_ERR_VB	O	0... 1H	0 ...1	1	-
Present failure after filtering of diagnosis of battery voltage					
LV_ERR_VB_FB_0	O	0... 1H	0 ...1	1	-
Boolean for error detected at the voltage supply KL15Nx					
LV_ERR_VB_FB_1	O	0... 1H	0 ...1	1	-
Boolean for error detected at engine fuse KL15N1					
LV_ERR_VB_FB_2	O	0... 1H	0 ...1	1	-
Boolean for error detected at engine fuse KL15N2					
LV_ERR_VB_FB_3	O	0... 1H	0 ...1	1	-
Boolean for error detected at engine fuse KL15N3					
LV_ERR_VB_FB_DLY	O	0... 1H	0 ...1	1	-
Boolean for error detected for delayed switching of KL15Nx					
LV_ERR_VVL_ROT	O	0... 1H	0 ...1	1	-
Error flag for rotation sense diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_FAC_COR_MFF_EXT_ADJ	O	0... 1H	0 ...1	1	-
logical value for activation of temporary correction factor for OBD-demo ( 0 -disabled, 1 - enabled)					
LV_FAN_VAR_AD	O	0... 1H	0 ...1	1	-
-					
LV_FPAPWM_DIAG_AFS_REQ	O	0... 1H	0 ...1	1	-
hom. mod is requested by fuel pressure pwm diagnosis					
LV_FUP_HOM_REQ	O	0... 1H	0 ...1	1	-
Anforderung Diagnose-Raildruck Homogen					
LV_GP	O	0... 1H	0 ...1	1	-
LV indicating mode gearbox - AMT					
LV_IGC_x_EXT_ADJ	O	0... 1H	0 ...1	1	-
External Adjustment for Ignition Angle					
LV_IGK_OFF_ACK_PERM_DEAC	O	0... 1H	0 ...1	1	-
Bit indicating permanent deactivation of ignition off acknowledgement					
LV_IGK_OFF_ACK_TMP_DEAC	O	0... 1H	0 ...1	1	-
Bit indicating temporay deactivation of ignition off acknowledgement					
LV_IND_FCUT	O	0... 1H	0 ...1	1	-
At least one cylinder is shut off					
LV_INH_CYL_BAL_ER_LIH_CTL	O	0... 1H	0 ...1	1	-
Inhibit engine roughness adaptation because limp home mode					
LV_INH_CYL_BAL_LAM_LIH_CTL	O	0... 1H	0 ...1	1	-
Inhibit cylinder individual lambda adaptation because limpe home mode					
LV_INH_DIAG_SA	O/V	0... 1H	0 ...1	1	-
Secondary air system diagnosis: application incidence to inhibit the diagnosis					
LV_INH_DLY_DIAG_PRI_MNG [NC_CBK_EX_NR]	O	0... 1H	0 ...1	1	-
Delay Diagnosis inhibition by priority manager					
LV_INH_DPS_REG_CPDIAG	O	0... 1H	0 ...1	1	-
--					
LV_INH_DYN_DIAG_PRI_MNG [NC_CBK_EX_NR]	O	0... 1H	0 ...1	1	-
Dynamic Diagnosis inhibition by priority manager					
LV_INH_FCUT_AMT	O	0... 1H	0 ...1	1	-
Logical variable inhibiting FCUT during AMT-intervention					
LV_INH_S_MAN	O/S	0... 1H	0 ...1	1	-
manual inhibiting startified mode by application system					
LV_INTR_DIAG_LS_DYN [NC_CBK_EX_NR]	O	0... 1H	0 ...1	1	-
Fade out bit of linear lambda dynamic diagnosis - LAMB_MV dynamic fdout					
LV_ISC_INH_EXT_ADJ	O	0... 1H	0 ...1	1	-
Logical variable to switch off the idle speed controller					
LV_KWP_PROG_DATA	O	0... 1H	0 ...1	1	-
State variable for requesting for programming the calibration data after power latch phase					
LV_LAMB_CH	O	0... 1H	0 ...1	1	-
indicates that lambda catalyst heating is active					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_MFF_S_POST_CH	O	0... 1H	0 ...1	1	-
--					
LV_MSR_PLAUS	O	0... 1H	0 ...1	1	-
Logical variable plausibility MSR					
LV_NT_AGI_INI_EXT_ADJ_NEW_CAT	O	0... 1H	0 ...1	1	-
initialization signal for a new cat via scan tool					
LV_NT_AGI_INI_EXT_ADJ_NEW_ECU	O	0... 1H	0 ...1	1	-
initialization signal for a new ECU via scan tool					
LV_POW_IBS_ERR_DET_CDN	O	0... 1H	0 ...1	1	-
Condition for IBS powerfail detected					
LV_PUC_SA_INH	O	0... 1H	0 ...1	1	-
Inhibition of PUC during SA active for the first time					
LV_REQ_SEG_AD_RST_EOL	O	0... 1H	0 ...1	1	-
Variable to reset SAG_AD variables due to a EOL request					
LV_RLY_ST_STST	-	0... 1H	0 ...1	1	-
HW-control of the starter relay via MSA					
LV_S_REQ_EGR	O	0... 1H	0 ...1	1	-
Logical constant stratified mode requested for EGR LIH					
LV_SA_END	O	0... 1H	0 ...1	1	-
secondary air function ended for this cycle (lambda adaptation obstruct)					
LV_SAP	O	0... 1H	0 ...1	1	-
Flag for secondary air pump activation					
LV_SAV	O	0... 1H	0 ...1	1	-
Flag for secondary air valve activation					
LV_SAWUP	O	0... 1H	0 ...1	1	-
secondary air injection time correction active					
LV_SOIL_VLD_LOIL	O	0... 1H	0 ...1	1	-
Oil temperature valid					
LV_STATE_RLY_VVL	O	0... 1H	0 ...1	1	-
Pre-charge relay state, 0 = relay open, 1 = relay closed					
LV_STATE_RUN_LOIL	O	0... 1H	0 ...1	1	-
State machine once passed					
LV_STATE_STST_ENG_STOP	O	0... 1H	0 ...1	1	-
Engine stop requested by STST					
LV_STST_DEAC_ACT	O	0... 1H	0 ...1	1	-
MSA deactivation due to permanent errors					
LV_STST_ES	O	0... 1H	0 ...1	1	-
Logical variable indicating engine stop caused by start stop automatic					
LV_STST_INH_ACT	O	0... 1H	0 ...1	1	-
MSA inhibition due to reversible errors					
LV_STST_INH_CDN_AD	O	0... 1H	0 ...1	1	-
MSA inhibition due to adaption					
LV_STST_ST_REQ	O	0... 1H	0 ...1	1	-
Logical variable indicating the validated start request from start stop manager					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_STST_STOP_CYC	O	0... 1H	0 ...1	1	-
Logical variable indicating MSA stop cycle active (from stop request until start end)					
LV_STST_STOP_CYC_MEM	O	0... 1H	0 ...1	1	-
Memorized flag LV_STST_STOP_CYC for the time after end of start until engine stop					
LV_STST_STOP_REQ	O	0... 1H	0 ...1	1	-
Logical variable indicating the validated stop request from start stop manager					
LV_STST_SWI_ACT	O	0... 1H	0 ...1	1	-
Engine start stop automatic switched on					
LV_T_COOL_VLD_LOIL	O	0... 1H	0 ...1	1	-
Cool off time valid					
LV_TEMP_BOL	O	0... 1H	0 ...1	1	-
Activation of homogeneous request due to coolant temperature reasons					
LV_TEMP_MAX_SAP_COIL	O	0... 1H	0 ...1	1	-
Inhibition bit for SA-function					
LV_TQI_BOL_SET_S	O	0... 1H	0 ...1	1	-
Logical variable is set if TQI_SP_S falls below the minimim allowable torque in stratified					
LV_VAR_EAC	O/S	0... 1H	0 ...1	1	-
variant EAC					
LV_VAR_ECRAS	O/S	0... 1H	0 ...1	1	-
variant of ECRAS recognized					
LV_VAR_EFP_COM_2	O	0... 1H	0 ...1	1	-
Variant EFP at FA_CAN					
LV_VAR_EFP_COM_3	O/S	0... 1H	0 ...1	1	-
Variant EFP at A_CAN					
LV_VAR_L6	O/S	0... 1H	0 ...1	1	-
Bit indicating L6 board network					
LV_VAR_SAP	O	0... 1H	0 ...1	1	-
Vehicle with secondary air pump					
LV_VAR_SAV	O	0... 1H	0 ...1	1	-
vehicle with secondary air valve (dsk_byte_0 bit 5)					
LV_VAR_STST	O/S	0... 1H	0 ...1	1	-
Variant for engine start stop function (STST)					
LV_VAR_VVL	O	0... 1H	0 ...1	1	-
Variant with (=1) or without (=0) valvetronic.					
MAF_HB	O	0... FFH	0... 1389	5.4470588	mg/stk
-					
MAF_SP_S	O	0... FFFFH	0... 1389	0.0211948	mg/stk
MAF setpoint for stratified mode					
MAF_SUB_COR_MMV_MON	O	0... FFH	0... 1389	5.4470588	mg/stk
Low pass filtered MAF_SUB_COR_MON					
MAP_DIP_SP_MMV	O	8000... 7FFFH	-1280... 1279.96093	0.0390625	hPa
Filtered setpoint of manifold differential pressure					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MFF_AD_ADD_MMV_REL [NC_CBK_EX_NR]	O	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
Relative additive adaptive factor					
MFF_AD_FAC_MMV_REL [NC_CBK_EX_NR]	O	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Relative multiplicative adaptive factor					
MFF_ADD_EXT_ADJ [NC_CBK_EX_NR]	O	8000... 7FFFH	-694.5... 694.4788	0.02119-	mg/stk
Mass fuel flow for CO adjustment at idling, value for injection correction					
MFF_ADD_EXT_ADJ_NVMY	O/S	8000... 7FFFH	-694.5... 694.4788	0.02119-	mg/stk
Mass fuel flow for CO adjustment at idling, value for storing in NVMY					
Minhub	O	0... FFFFH	0... 65.535	0.001	mm
Ergebnis der Minhub-Adaption					
Minhub_roh	O	0... FFFFH	0... 65.535	0.001	mm
Minhubroh wert aus Adaption					
Minhubvs	O	0... FFFFH	0... 65.535	0.001	mm
Vorgabe Minhub über Tester					
Minhubvs_ist	O	0... FFFFH	0... 65.535	0.001	mm
Tatsächlich wirksamer Minhub aus Verstelleingriff (vor Ein-/Ausblendungsfaktoren)					
Minhubvsnv	O	0... FFFFH	0... 65.535	0.001	mm
dauerhaft fest programmierter Minhub					
Mrnn_test_vvt	O	8000... 7FFFH	-1... 0.99996	30.5e-6	-
Testerwert NN VVT-Adaption					
N_VS	O/V	0... FFH	0... 255	1	rpm/(km/h)
Division n/vs					
N_WHEEL_FN_LE	O	8000... 7FFFH	-512... 511.703	0.0156207	1/s
Actual value for RPM wheel front left					
N_WHEEL_FN_RI	O	8000... 7FFFH	-512... 511.703	0.0156207	1/s
Actual value for RPM wheel front right					
N_WHEEL_RE_LE	O	8000... 7FFFH	-512... 511.703	0.0156207	1/s
Actual value for RPM wheel rear left					
N_WHEEL_RE_RI	O	8000... 7FFFH	-512... 511.703	0.0156207	1/s
Actual value for RPM wheel rear right					
NC_STATE_ECU_MST_SLA	O	0H 1H 2H 3H	NOT_MST_ SLA MST_SLA MST SLA	-	-
Configuration whether ECU works in a Master/Slave system and how its role as Master or Slave is defined					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Oz_manip	O	0... FFH	0... 255	1	-
Manipulationsbyte					
PBSU	O	0... FFFFH	0... 5434	0.0829175	hPa
Absolute pressure in the brake servo					
PRS_EX_PCAT_UP	O	0... FFFFH	0... 5434	0.0829175	hPa
Exhaust gas pressure pre catalyst (absolute pressure)					
PSN_ENG_REL	O	0... 77FH	0... 719.625	0.375	°CRK
Relative engine position before next TDC					
PSN_ENG_REL_ST	O	0... 77FH	0... 719.625	0.375	°CRK
Relative engine position before next TDC at re-start					
PWM_DR_OUT_SET_VVL	O	0... 1FFH	0... 99.80468	0.1953125	%
PWM to be set by PWM generator see VVL chopper control too					
PWM_VALUE_HIV_PERC	O	0... FH	0... 150	10	%
control signal for heater inlet valve					
S_vsmnhb	O	0... FFH	0... 255	1	-
Schalter für Testereingriff					
S_vsmnhbnv	O/S	0... FFH	0... 255	1	-
Schalter für Testereingriff					
SAF_DIAG_MAX	O	0... FF00H	0... 255	3.9062e-3	kg/h
Mean diagnosis value of maximum air flow					
SAF_DIAG_MAX_SAE	O/S	0... FF00H	0... 255	3.9062e-3	kg/h
Mean diagnosis value of maximum secondary air flow for SAE					
SAF_DIAG_MIN	O	0... FF00H	0... 255	3.9062e-3	kg/h
Mean diagnosis value of minimum air flow					
SAF_DIAG_MIN_SAE	O/S	0... FF00H	0... 255	3.9062e-3	kg/h
Mean diagnosis value of minimum secondary air flow for SAE					
SAF_KGH	O	0... FFFFH	0... 1023.98437	0.015625	kg/h
Corrected value of SA mass flow					
SAF_KGH_MES_BAS	O	0... FFFFH	0... 2047.96875	0.03125	kg/h
Raw secondary air-mass flow measured					
SOI_MAX	O	0... 780H	0... 720	0.375	°CRK
Earliest possible SOI					
St_dvovrld	O	0... FFH	0... 255	1	-
carrierbyte for status of VVLI overload (overload diagnosis ECU /DC motor)					
St_vbrvs_aus	O	0... FFFFH	0... 65535	1	-
Status Verbrennungsregelung					
St_vbrvs_ein	O	0... FFH	0... 255	1	-
Status Verbrennungsregelung					
St_vvt_err	O	0... FFH	0... 255	1	-
carrierbyte for status of VVL failures (indicating the ability of the position control)					
STATE_CUT_OFF_DT	O	0... FFH	0... 255	1	-
state cut off drivetrain					
STATE_DIAG_DR_VVL	O	0... FFH	0... 255	1	-
State of ATIC61 self- diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_DIAG_SA_SAFM	O	0H 1H 2H 3H 4H 5H 6HH	SAFM_DIAG_ OFF SAFM_SAFM_ MONIT SAFM_MIN_ DIAG SAFM_WAIT_ SAV_DIAG SAFM_SAV_ DIAG SAFM_DIAG_ END SAFM_DIAG_ CNL	-	-
States of secondary air system diagnosis					
STATE_ERR_AMT_CAN	O	0... 5H	0...5	1	-
State of AMT Error intervention CAN 11H					
STATE_INI_DT	O	0... FFH	0... 255	1	-
state initialisation drivetrain					
STATE_N_MAX_MON	O	0... FFFFH	0... 65535	1	-
Error bit indication					
STATE_OBD_SA	O	0... FFH	0... 255	1	-
Commanded SA-Status for Scan-Tool					
STATE_RBM_EFF_IGA_CST	O	0... FFH	0... 255	1	-
IGA efficiency monitor with Rate-Based Monitoring statistics: monitoring conditions met long enough (bit 0 = 1) monitoring inhibition because of system failure(s) (bit 1 = 1) individual RBM monitoring conditions encountered within this DC (bit 2 = 1)					
STATE_SA	O	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H AH BH CHH	SA_INACTIVE SA_DELAY SA_ACTIVE INTERRUPT SAP_DELAY FINISHED CANCELLED EXT_ADJ EXT_ADJ_FIN EOL_SA_ACT EOL_SA_SAP_ ACT EOL_SA_FIN SAV_CLN	-	-
State of Secondary Air Function					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_STST_REQ_CAN	O	0H 1H 2H 3H 4H 5H 6H 7HH	NO_REQ START_REQ STOP_REQ START_INH STOP_INH NOT_USED NOT_USED INVALID_ SIGNAL	-	-
State indicating request from CAN for STST (MSA) functionality					
STATE_TBL_DRIV [8][6]	O/S	0... FFH	0... 99.60937	0.390625	%
Table of driving profile over torque request and engine speed (saved in NVMY)					
STATE_TQ_AMT_PLAUS	O	0... FFH	0... 255	1	-
Bitwise coded State for AMTintervention state					
STATE_TQ_WHEEL_DRIV_ASI	O	0... FFH	0... 255	1	-
qualifier /state of signal TQ_WHEEL_DRIV_ASI					
STATE_TQ_WHEEL_TCS_SLOW	O	0... FFH	0... 255	1	-
Qualifier concept to target wheel torque on powertrain					
STATE_VEH_ROLL_CDN	O	0... 7H	0 ...7	1	-
Rolling direction detection					
T_ACT_MIL_SAE	O/V	0... FFFFH	0... 65535	1	min
PID 4D Time run by the engine while MIL activated					
T_ACT_MIL_SAE_60	O/V	0... 3CH	0... 60	1	s
Seconds run by the engine while MIL activated for T_ACT_MIL_SAE calculation (0 ... 59)					
T_AST_DC_CON	O	0... FFFFH	0... 6553.5	0.1	s
Time after start based on driving cycle (calculation continued during DC)					
T_COOL_LOIL	O	0... FFFFH	0... 6553.5	0.1	-
Cool off time of LOIL sensor					
T_EDGE_FALL_LOIL	O	0... FFFFH	0... 655.35	0.01	s
Time between flanks					
T_REF_SIG_LEN_LOIL	O	0... FFFFH	0... 6553.5	0.1	ms
Length of reference signal of the thermal oil level sensor					
T_TEMP_SIG_LEN_LOIL	O	0... FFFFH	0... 6553.5	0.1	s
Abkühlzeit vom Töns					
TEG_TUR_UP_MES [NC_NR_TEG_SENS]	O	0... FFE0H	-273.15 ...1773.85	0.03125	°C
measured exhaust gas temperature upstream of turbo charger					
TEMP_MOT_VVL	O	E800... 7FFFH	-48... 255.99218	0.0078125	°C
Estimated DC motor temperature					
TEMP_SWI_MES_MAX_VVL	O	8000... 7FFFH	-1024... 1023.96875	0.03125	°C
Maximal measured temperature of the chopper switch transistors.					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_ADD_ST	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve at engine start					
TQ_WHEEL_TCS_FAST	O	8000... 7FFFH	-32768 ...32767	1	Nm
Target wheel torque on powertrain for fast stabilization					
TQ_WHEEL_TCS_SLOW	O	8000... 7FFFH	-32768 ...32767	1	Nm
Target wheel torque on powertrain for slow stabilization					
TQI_AMT_FAST_DEC	O	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque decrement for fast torque intervention during gear shift					
TQI_AMT_FAST_INC	O	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque increase for fast torque intervention during gear shift					
TQI_AMT_REQ	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque request SSG					
TQI_AMT_REQ_CAN	O	0... FFH	0... 99.60937	0.390625	%
Torque request SSG via CAN					
TQI_AMT_SLOW_DEC	O	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque decrement for slow torque intervention during gear shift					
TQI_AMT_SLOW_INC	O	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque increase for slow torque intervention during gear shift					
TQI_ASR_FAST_CAN	O	0... FFH	0... 99.60937	0.390625	%
Relative indicated engine torque requested by ASR (fast path)					
TQI_ASR_FAST_REQ_CAN	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Relative indicated engine torque requested by ASR (fast path)					
TQI_ASR_SLOW_REQ_CAN	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Relative indicated engine torque requested by ASR (slow path)					
TQI_BAS_MAX	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum available torque at basic conditions EFF_TOT_BAS					
TQI_GS_FAST_REQ	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
absolute torque request during gear shift intervention - fast					
TQI_GS_FAST_REQ_CAN	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
relative torque request during gear shift intervention - fast					
TQI_GS_SLOW_REQ	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
absolute torque request during gear shift intervention - slow					
TQI_GS_SLOW_REQ_CAN	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
relative torque request during gear shift intervention - slow					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQI_MSR_CAN	O	0... FFH	0... 99.60937	0.390625	%
Relative indicated engine torque requested by MSR					
TQI_MSR_REQ_CAN	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Relative indicated engine torque requested by MSR					
TQI_SLOW_AMT_REQ	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque request (slow) SSG					
TQI_SP_SLOW	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Slow indicated engine torque					
V_MAF	O	0... FFH	0... 4.98046	0.0195312	V
Mass air flow sensor raw acquisition.					
V_SAF	O	0... FFH	0... 4.98046	0.0195312	V
Secondary air mass flow sensor raw acquisition					
V_VCC_SENS_VVL	O	0... FFFFH	0... 511.99218	0.0078125	V
Sensor supply voltage					
V_VCC_SENS_VVL_RAW	O	0... 3FFFH	0... 4.99511	4.8828e-3	V
Voltage supply for VVL sensor					
VCC_DR_VVL	O	0... FFFFH	0... 511.99218	0.0078125	V
Supply voltage filtered with fast filter					
VLFT_MIN	O/S	0... FFFFH	0... 65.535	0.001	mm
Result of adaptation of minimal variable valve lift					
VLS_NT_DOWN [NC_NOX_SENS_CONF]	O	0... 3FFFH	0... 4.99511	4.8828e-3	V
voltage of lambda sensor downstream NOx-catalyst					
VP_TCO_COPL [NC_NR_TCO_SENS]	O	0... 7FFFH	0... 4.99984	152.6e-6	V
Sensor raw acquisition of all available coolant temperature sensors on master ECU					
VS_H_N_MAX	O/S	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed at highest event					
VS_HIGH_RES	O/V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed with higher resolution					
Vvt_soll	O	0... 238EH	0... 200	0.0219732	°
Desired position of the excenter shaft in degree for customer position controller					
Zylhubkor	O	0... FFH	0... 255	1	-
Für Hubkorrektur ausgewählter Zylinder					

**Input data:**

AC_VEH_LGT_TCS {p. 1561}	CRK_INJ_BAS [NC_CYL_NR] {p. 2122}	CYC_CAST {p. 1766}	EFF_TOT_BAS {p. 6661}
INH_IV {p. 2295}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_CLC_2SEG {p. 1825}
LV_CLC_2SEG_ENA {p. 1825}	LV_EFP_EXT_ADJ {p. 7434}	LV_ERR_ACR_AD {p. 4320}	LV_ERR_ACR_CTL {p. 4337}
LV_ERR_ACR_DR {p. 4347}	LV_ERR_CAM_TOT {p. 4455}	LV_ERR_SENS_ACR {p. 4352}	LV_ES {p. 1720}
LV_FCUT_IND {p. 2295}	MAF_SP {p. 8278}	N_VS_RATIO {p. 1302}	NC_CBK_EX_NR {p. 1829}
NC_NOX_SENS_CONF {p. 643}	NC_NR_CBK_IVVT {p. 604}	SOI_LIM {p. 2122}	STATE_CH {p. 1777}

T_ACT_MIL {p. 5899}	T_ACT_MIL_60 {p. 5899}	TEG_CAT_UP_MDL [i] {p. 8236}	TEG_PCAT_DOWN [NC_CBK_EX_NR] {p. 1253}
TQI_MAX {p. 8380}	TQI_REF_MAX {p. 8380}	TQI_REQ_SLOW {p. 8391}	VP_TCO [NC_NR_TCO_SENS] {p. 1100}
VS_H {p. 1176}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CAM_OP_EX	-	0... FFH	175.125 ...270.75	0.375	°CRK
Opening period of exhaust valve					
C_DIAM_WHEEL	-	0... FFFFH	0... 4095.9375	0.0625	mm
Wheeldiameter for speedcalculation if vehicle is on the roller test bench					
C_LAMB_BAS_COR_MIN	-	0... 7FFFH	0... 1.99993	61e-6	-
Minimal value for lambda setpoint					
C_SAF_DIAG_MAX	-	0... FF00H	0... 255	3.9062e-3	kg/h
Error detection threshold for maximum deviation					
C_SAF_DIAG_MIN	-	0... FF00H	0... 255	3.9062e-3	kg/h
Error detection threshold for minimum deviation					
LC_AD_CLR_CPS	-	0... 1H	0 ...1	1	-
Logical constant for initializing CPS nvmy data					
LC_AD_CLR_IDLE	-	0... 1H	0 ...1	1	-
Logical constant for initializing IDLE nvmy data					
LC_AD_CLR_IMM	-	0... 1H	0 ...1	1	-
Logical constant for initializing IMM nvmy data					
LC_AD_CLR_SA	-	0... 1H	0 ...1	1	-
Logical constant for initializing SA nvmy data					
LC_AD_CLR_VVL_STATE_NVMY	-	0... 1H	0 ...1	1	-
Calibration data to reset adaptation status flags					
NC_CBK_HPP_NR [1]	-	1... FFH	1... 255	1	-
System constant for number of used high pressure pumps (1 = one pump, 2 = two pumps, ...; SW: 0 = one pump; 1 = 2 pumps, ...) - Anzahl Hochdruckpumpen im System					
NC_CMB_CONF	-	0H 1H 2H 3H	AFS AFS_S AFS_AFL AFS_AFL_S	-	-
Engine combustion modes target					
NC_IN_REF	-	0... FFH	0... 255	1	-
Pattern for allocation of physical cylinders to intake bank					
NC_LAMB_REF [NC_CYL_NR]	-	0... FFH	0... 255	1	-
Pattern for allocation of physical cylinders to exhaust bank					
NC_STATE_STST_ENA	-	0... 1H	0 ...1	1	-
Switch to indicate engine stop start automatic enabled (= 1) or disabled (= 0)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

All defined LV\_ERR\_XXX shall not be given ENVD data for the .a2L file (normally automatically defined)

EXCEPT: LV\_ERR\_TEG\_PCAT\_DOWN[NC\_CBK\_EX\_NR]  
LV\_ERR\_EGR

### 1.29.1 Miscellaneous

#### Application conditions

**Configuration values:** NC\_CMB\_CONF = AFS\_AFL\_S (4H)  
NC\_CBK\_HPP\_NR = 1

**Initialisation at reset:** 0,

**except :**

IGA\_TRA\_KNK = 0 °crk  
PWM\_VALUE\_HIV\_PERC = 100%  
TQI\_AMT\_FAST\_DEC = 1024 Nm  
TQI\_AMT\_SLOW\_DEC = 1024 Nm  
FAC\_RON = 1

**Recurrence:** same recurrence as corresponding input data

#### Formula section:

CYC\_ST = CYC\_CAST

LAMB\_AV\_COR = 0.5 \* (LAMB\_LS\_UP[1] + LAMB\_LS\_UP[2])

MAF\_HB = MAF

MAF\_SP\_S = MAF\_SP

TQI\_SP\_SLOW = TQI\_REQ\_SLOW

LV\_EFP\_PWM\_EXT\_ADJ = LV\_EFP\_EXT\_ADJ

AC\_VEH = AC\_VEH\_LGT\_TCS

N\_VS = N\_VS\_RATIO

VS\_HIGH\_RES = VS\_H

TQI\_BAS\_MAX = MIN (TQI\_MAX, TQI\_REF\_MAX \* EFF\_TOT\_BAS)

### 1.29.2 Variables definition for missing Secondary air function

#### Application conditions

**Initialisation at reset:** 0, except:  
FAC\_LAMB\_SP\_SA = 1.00  
LV\_SA\_END = 1  
STATE\_OBD\_SA = 00000100b

(SAP deactivated, Atmosphere

/ off)

### 1.29.3 Error Flags

**Hinweis:** Die hier definierten Bits LV\_ERR\_XXX unterliegen nicht der alg. Fehlerspeicherverwaltung.

### Application conditions

**Initialisation at reset:** 0

**Activation:** at every engine state

**Recurrence:** same recurrence as corresponding input data

### Formula section:

```

LV_ERR_TEG_PCAT_DOWN[NC_CBK_EX_NR] = LV_ERR_TEG_PCAT_DOWN
LV_ERR_EGR = LV_ERR_ACR_AD or LV_ERR_ACR_CTL or LV_ERR_ACR_
DR or LV_ERR_SENS_ACR

```

## 1.29.4 Interfaces to chapter serial communication

In the chapter I 'Serial Communication' are a lot of variables used which are not defined yet. Since there is no update of this chapter all unsatisfied inputs are defined here.

### Application conditions

**Initialisation:**

```

0FFFFh: St_vbrvs_aus
0FFh: St_vbrvs_ein
0: other

```

## 1.29.5 Outputs due to aggregate implementation

**FUNCTION DESCRIPTION:** --

### Application conditions

**Initialisation:** 0

**Recurrence :** every segment

**Activation:** every state if LV\_CLC\_2SEG = 1 or LV\_CLC\_2SEG\_ENA = 0  
*Configuration data:* NC\_IN\_REF = 42 // one intake bank  
NC\_LAMB\_REF = 42 //(101010B)

### Formula section:

```

EOI_LIM[NC_CYL_NR] = CRK_INJ_BAS[NC_CYL_NR]
INH_CYC_IV = INH_IV
LV_IND_FCUT = LV_FCUT_IND
SOI_MAX = SOI_LIM

```

## 1.29.6 Adaptation module for non implemented VVL functions

**FUNCTION DESCRIPTION:** --

### Application conditions

**Initialisation:** 0, except: ANG\_EXC\_VVL = 200 °

## 1.29.7 Adaptation module for non implemented STST (MSA) functions

**FUNCTION DESCRIPTION:****Application conditions:**

Initialisation: 0

**1.29.8 Adaptation module for non implemented TÖNS functions****FUNCTION DESCRIPTION:****Application conditions:**

Initialisation: 0

**1.29.9 For non implemented serielle communication**

**FUNCTION DESCRIPTION:** only for satisfaction of ISCAN-tools

**Application conditions**

**Initialisation:** 0FFFFh: Exwinkkor, F\_minhub, F\_tikorrvr[0..7],  
Minhub, Minhub\_roh, Minhubvs, Minhubvs\_ist,  
Minhubvsnv  
0FFh: S\_vsmnhb, S\_vsmnhbnv, Zylhubkor,  
STATE\_TO\_WHEEL\_TCS\_SLOW,  
STATE\_TO\_WHEEL\_DRIV\_ASI  
-32000 Nm: TO\_WHEEL\_TCS\_SLOW, TO\_WHEEL\_TCS\_FAST  
0: other

**Formula section:** --

**1.29.10 Variable definitions for missing CAN11hex functionality****Application conditions**

**Initialisation:** 0

**Formula section:** --

**1.29.11 Variables only necessary for IScan**

**FUNCTION DESCRIPTION:** only for satisfaction of ISCAN-tools


**Application conditions**

**Initialisation at reset:** 0,

**except :**

IGA\_CH = 0 °crk

LV\_END\_DIAG\_SA\_SAFM = 1  
LV\_END\_DIAG\_SA\_SAP = 1  
LV\_END\_DIAG\_SA\_SAV = 1  
LV\_END\_DIAG\_SA\_SYS = 1

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**Formula section:**     --  
 PRS\_EX\_PCAT\_UP =     PRS\_EX

**If** STATE\_CH = 1h  
**Then** LV\_LAMB\_CH = 1  
**Else** LV\_LAMB\_CH = 0  
**Endif**

TEG\_PCAT\_DOWN[NC\_CBK\_EX\_NR]     = TEG\_PCAT\_DOWN\_i

## 1.29.12 Variables required by Software

### Application conditions

**Initialisation:**     0

**Formula section:**     --  
 VP\_TCO\_COPL[NC\_NR\_TCO\_SENS] = VP\_TCO[NC\_NR\_TCO\_SENS]

## 1.29.13 Variables used by OBDC

### Application conditions

**Initialisation:**     T\_ACT\_MIL\_SAE = T\_ACT\_MIL     (read from NYMY)  
                           T\_ACT\_MIL\_SAE\_60 = T\_ACT\_MIL\_60     (read from NYMY)

**Recurrence:**     1s

**Activation:**     at every engine state

### Formula section:

T\_ACT\_MIL\_SAE = T\_ACT\_MIL  
 T\_ACT\_MIL\_SAE\_60 = T\_ACT\_MIL\_60

## 1.29.14 Output AGGR's - EGCP

### Application conditions

**Initialisation:**     at reset all 0

**Recurrence:**     same recurrence as corresponding input data


**Activation:**     at every engine state

**Deactivation:**     -

### Function description:

### Formula section:

LV\_INTR\_DIAG\_LS\_DYN[NC\_CBK\_EX\_NR] = 0

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## 1.29.15 Output AGGR's - VHMD

### Application conditions

**Initialisation:** at reset: all 0  
 expect: state\_veh\_roll\_cdn = 0x04 (hex)  
 vs\_plaus\_ERR\_IDX = no\_error\_ERR\_IDX

**Recurrence:** same recurrence as corresponding input data

**Activation:** at every engine state

**Deactivation:** -

### Function description:

#### Formula section:

LV\_ERR\_COM\_1\_BOFF = 0  
 LV\_ERR\_COM\_1\_VS = 0  
 LV\_ERR\_COM\_1\_ST\_UP = 0  
 STATE\_VEH\_ROLL\_CDN = 0x04 (hex)  
 vs\_plaus\_ERR\_IDX = no\_error\_ERR\_IDX

## 1.29.16 Output AGGR's - DGNC

### General information:

### Application conditions:

**Initialisation:** at reset:  
 FAC\_COR\_MFF\_EXT\_ADJ = 1 phys.  
 FAC\_COR\_MFF\_EXT\_ADJ\_NVMY = 1 phys.  
 LV\_FAC\_COR\_MFF\_EXT\_ADJ = 0

**Recurrence:** same recurrence as corresponding input data

**Activation:** at every engine state


**Deactivation:** -

### Function description:

#### Formula section:

FAC\_COR\_MFF\_EXT\_ADJ = 1 phys.  
 FAC\_COR\_MFF\_EXT\_ADJ\_NVMY = 1 phys.  
 LV\_FAC\_COR\_MFF\_EXT\_ADJ = 0

## 1.29.17 Output AGGR's - ENSS

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**General information:****Application conditions:**

*Initialisation:* at reset:  
                   T\_AST\_DC\_CON = 0 phys.  
*Recurrence:* same recurrence as corresponding input data  
*Activation:* at every engine state  
*Deactivation:* -

**Function description:****Formula section:**


T\_AST\_DC\_CON = 0 phys.

**1.29.18 Output AGGR's - SYCF****General information:****Application conditions:**

*Initialisation:* at reset:  
                   LV\_VAR\_EFP\_COM\_2 = 0  
                   LV\_ERR\_COM\_2\_EFP = 0  
                   LV\_VAR\_EFP\_COM\_3 = 1  
*Recurrence:* same recurrence as corresponding input data  
*Activation:* at every engine state  
*Deactivation:* -

**Function description:****Formula section:**

LV\_VAR\_EFP\_COM\_2 = 0  
 LV\_ERR\_COM\_2\_EFP = 0  
 LV\_VAR\_EFP\_COM\_3 = 1

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## 1.30 OBDC Configuration data

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_CLC_CAL_ID_SRV_9	O	0... FFH	0... 255	1	-
Status to calculate CAL-ID of \$09 according US (=1) or EU (=0)					
STATE_EVAP_SAE	O	0... FFH	0... 255	1	-
SAE status of EVAP monitor (0 = not supported, >0 = supported)					
STATE_PSN_FUP_SAE	O	0... FFH	0... 255	1	-
Support of Fuel Pressure Control System Data (PID 6D)					
STATE_PSN_LS_1_SAE	O	0... FFH	0... 255	1	-
Position of oxygen sensors for OBD (4 Banks 2 Sensors)					
STATE_PSN_LS_SAE	O	0... FFH	0... 255	1	-
Position of oxygen sensors for OBD (2 Banks 4 Sensors)					
STATE_PSN_MAF_SAE	O	0... FFH	0... 255	1	-
Support of Mass Air Flow Sensor Data (PID 66)					
STATE_PSN_TIA_SAE	O	0... FFH	0... 255	1	-
Support of Intake Air Temperature Sensor Data (PID 68)					
STATE_PSN_TPS_SAE	O	0... FFH	0... 255	1	-
Support of Throttle Actuator Control System Data (PID 6C)					
STATE_VAR_SAP_SAE	O	0... FFH	0... 255	1	-
SAE status of secondary air pump (0 = not supported, >0 = supported)					

### Input data:

LV_CONF_DMTL {p. 654}	LV_VAR_SAP {p. 805}	PSN_LS {p. 656}	
-----------------------	---------------------	-----------------	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_OBD_SRV	V	0... FFFFH	0... 65535	1	-
Word which indicates the EOBD services supported by the project					
C_STATE_PSN_FUP_SAE	V	0... FFH	0... 255	1	-
Support of Fuel Pressure Control System Data (PID 6D)					
C_STATE_PSN_MAF_SAE	V	0... FFH	0... 255	1	-
Support of Mass Air Flow Sensor Data (PID 66)					
C_STATE_PSN_TIA_SAE	V	0... FFH	0... 255	1	-
Support of Intake Air Temperature Sensor Data (PID 68)					
C_STATE_PSN_TPS_SAE	V	0... FFH	0... 255	1	-
Support of Throttle Actuator Control System Data (PID 6C)					
LC_CLC_CAL_ID_SRV_9	V	0... 1H	0...1	1	-
Switch to calculate CAL-ID of \$09 according US (=1) or EU (=0)					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_STATE_OBD_CONF	-	0... FFH	0... 255	1	-
Byte which indicates the configuration of EOBD/ARB					
NC_STATE_PID_13_PSN_LS	-	0... FFH	0... 255	1	-
Configuration of oxygen sensors (2 Banks 4 Sensors)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_STATE_PID_1D_PSN_LS	-	0... FFH	0... 255	1	-
Configuration of oxygen sensors (4 Banks 2 Sensors)					
NLC_STATE_EVAP	-	0... 1H	0 ...1	1	-
Configuration of EVAP Monitor					
NLC_STATE_PRJ_SPC_CAL	-	0... 1H	0 ...1	1	-
Indicates the usage of project specific calibration data					
NLC_STATE_VAR_SAP	-	0... 1H	0 ...1	1	-
Configuration of Commanded Secondary Air Status					

### General information:

This module is for configuration of the On-Board-Diagnosis Communication functionality.

### 1.30.1 Configuration of OBD services

0 : the SERVICE is not supported

1 : the SERVICE is supported

C_STATE_OBD_SRV		Supported EOBD SERVICES from 01h – 09h
BIT	Function	Supported
0	SERVICE 01h : Request current powertrain diagnostic data	1
1	SERVICE 02h : Request powertrain freeze frame data	1
2	SERVICE 03h : Request emission-related diagnostic trouble codes	1
3	SERVICE 04h : Clear/reset emission-related diagnostic information	1
4	SERVICE 05h : Request oxygen sensor monitoring test results	0
5	SERVICE 06h : Request on-board monitoring test results for specific monitored systems	1
6	SERVICE 07h : Request emission-related diagnostic trouble codes detected during current or last completed driving cycle	1
7	SERVICE 08h : Request control of on-board system, test or component	0
8	SERVICE 09h : Request vehicle information	1
9	SERVICE 0Ah : Request emission-related diagnostic trouble codes with permanent status after a Clear/reset emission-related diagnostic information service	1
10	RESERVED	0
11	RESERVED	0
12	RESERVED	0
13	RESERVED	0
14	RESERVED	0
15	RESERVED	0

### 1.30.2 Autolearning and microcontroller configuration

NC_STATE_OBD_CONF		Supported EOBD/ARB Configuration
BIT	Function	Configured
Continued on next page		

0	Internal format of the microcontroller	0
1	Sensor configuration	1
2	Autolearning	1
3	RESERVED	0
4	RESERVED	0
5	RESERVED	0
6	RESERVED	0
7	RESERVED	0

Internal format of the microcontroller	
Value	Description
0	The internal format of the microcontroller is INTEL
1	The internal format of the microcontroller is MOTOROLA

Sensor configuration	
Value	Description
0	BINARY Sensor configuration
1	LINEAR Sensor configuration

Autolearning – for O2 sensors configuration	
Value	Description
0	Without autolearning
1	With autolearning


### 1.30.3 Configuration of project specific calibration data

Project specific calibration data - NLC_STATE_PRJ_SPC_CAL	
Value	Description
0	EOBD is configured by generic configuration data
1	EOBD is configured by project specific calibration data

#### Formula section:

NLC\_STATE\_PRJ\_SPC\_CAL = 1

### 1.30.4 Configuration of oxygen sensors (PID13)

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NC_STATE_PID_13_PSN_LS		
BIT	Function	Value
0	Bank 1 Sensor 1 (upstream 1)	1
1	Bank 1 Sensor 2 (downstream 1)	1
2	Bank 1 Sensor 3	0
3	Bank 1 Sensor 4	0
4	Bank 2 Sensor 1 (upstream 2)	1
5	Bank 2 Sensor 2 (downstream 2)	1
6	Bank 2 Sensor 3	0
7	Bank 2 Sensor 4	0

Each bit indicates the presence or absence of the oxygen sensors for each cylinder bank, the first sensor being the nearest of the engine.

- 0 : sensor not present
- 1 : sensor present

### 1.30.5 Position of oxygen sensors (PID13)

#### Formula section:

```

IF      (NC_STATE_OBD_CONF & 0x04)
THEN   With autolearning
        STATE_PSN_LS_SAE = PSN_LS //set to the value defined by the project
ELSE   STATE_PSN_LS_SAE = NC_STATE_PID_13_PSN_LS
ENDIF
    
```

### 1.30.6 Configuration of oxygen sensors (PID1D)

NC_STATE_PID_1D_PSN_LS		
BIT	Function	Value
0	Bank 1 Sensor 1 (upstream 1)	0
1	Bank 1 Sensor 2 (downstream 1)	0
2	Bank 2 Sensor 1 (upstream 2)	0
3	Bank 2 Sensor 2 (downstream 2)	0
4	Bank 3 Sensor 1	0
5	Bank 3 Sensor 2	0
6	Bank 4 Sensor 1	0
7	Bank 4 Sensor 2	0


Each bit indicates the presence or absence of the oxygen sensors for each cylinder bank, the first sensor being the nearest of the engine.

- 0 : sensor not present
- 1 : sensor present

### 1.30.7 Position of oxygen sensors (PID1D)

#### Formula section:

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STATE\_PSN\_LS\_1\_SAE = NC\_STATE\_PID\_1D\_PSN\_LS

### 1.30.8 Configuration of secondary air pump for PID12

Configuration of secondary air pump – NLC_STATE_VAR_SAP	
Value	Description
0	Secondary air pump NOT supported
1	Secondary air pump supported

**Formula section:**

NLC\_STATE\_VAR\_SAP = 1

### 1.30.9 Support of secondary air pump

**Formula section:**

```

IF      (NC_STATE_OBD_CONF & 04h)
THEN    With autolearning
        STATE_VAR_SAP_SAE (bit 0) = LV_VAR_SAP
ELSE    STATE_VAR_SAP_SAE is set to NLC_STATE_VAR_SAP
ENDIF
  
```

### 1.30.10 Configuration of EVAP Monitor

Configuration of EVAP Monitor – NLC_STATE_EVAP	
Value	Description
0	EVAP Monitor NOT supported
1	EVAP Monitor supported

**Formula section:**

NLC\_STATE\_EVAP = 1

### 1.30.11 Support of EVAP Monitor

**Formula section:**

```

IF      (NC_STATE_OBD_CONF & 04h)
THEN    With autolearning
        STATE_EVAP_SAE (bit 0) = LV_CONF_DMTL
ELSE    STATE_EVAP_SAE = NLC_STATE_EVAP
ENDIF
  
```

### 1.30.12 Support of Mass Air Flow Sensor Data (PID 66)

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Calibration of C_STATE_PSN_MAF_SAE	
Bit	Value /Description
0	MAF sensor A data supported (=1)
1	MAF sensor B data supported (=1)
2 - 7	Reserved (=0)

**Formula section:**

STATE\_PSN\_MAF\_SAE = C\_STATE\_PSN\_MAF\_SAE

**1.30.13 Support of Intake Air Temperature Sensor Data (PID 68)**

Calibration of C_STATE_PSN_TIA_SAE	
Bit	Description
0	TIA sensor Bank 1 Sensor 1 supported (=1)
1	TIA sensor Bank 2 Sensor 1 supported (=1)
2	TIA sensor Bank 3 Sensor 1 supported (=1)
3	TIA sensor Bank 1 Sensor 2 supported (=1)
4	TIA sensor Bank 2 Sensor 2 supported (=1)
5	TIA sensor Bank 3 Sensor 2 supported (=1)
6	Reserved (=0)
7	Reserved (=0)

**Formula section:**

STATE\_PSN\_TIA\_SAE = C\_STATE\_PSN\_TIA\_SAE

**1.30.14 Support of Throttle Actuator Control System Data (PID 6C)**

Calibration of C_STATE_PSN_TPS_SAE	
Bit	Description
0	Commanded TPS – A supported (=1)
1	Relative TPS – A supported (=1)
2	Commanded TPS – B supported (=1)
3	Relative TPS – B supported (=1)
4	Reserved (=0)
5	Reserved (=0)
6	Reserved (=0)
7	Reserved (=0)

**Formula section:**

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STATE\_PSN\_TPS\_SAE = C\_STATE\_PSN\_TPS\_SAE

### 1.30.15 Support of Fuel Pressure Control System Data (PID 6D)

Calibration of C_STATE_PSN_FUP_SAE	
Bit	Description
0	Commanded FUP – A supported (=1)
1	Measured FUP – A supported (=1)
2	Temperature FUP – A supported (=1)
3	Commanded FUP – B supported (=1)
4	Measured FUP – B supported (=1)
5	Temperature FUP – B supported (=1)
6	Reserved (=0)
7	Reserved (=0)

**Formula section:**

STATE\_PSN\_FUP\_SAE = C\_STATE\_PSN\_FUP\_SAE

### 1.30.16 Configuration for service \$09 – CAL-ID calculation (used for L6)

**Formula section:**

STATE\_CLC\_CAL\_ID\_SRV\_9 = LC\_CLC\_CAL\_ID\_SRV\_9

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## 1.31 LACO Configuration data

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ERR_SYM_FSD_CONF	-	1... 2H	1 ...2	1	-
Number of failure locations in FSD					
NC_NR_FAC_GAIN_LAM	-	0... 1FH	0... 31	1	-
Number of breakpoints for Lambda controller gain parameter axis					

### General information :

The following describes the general rules for determination of the configuration data

### 1.31.1 Local configuration data

Here are listed the configuration data, which are used only in the EGCP aggregate.

Data	Value
NC_ERR_SYM_FSD_CONF	1
NC_NR_FAC_GAIN_LAM	8

To be defined by project with information from customer.

## 1.32 MFMA Configuration data

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_MIS_REP_LAM_AD_INJ	O	0... FFH	0... 255	1	-
Maximum number of interruptions of lambda adaptation via injection mode due to misfire per cylinder					
NC_NR_MPL_INJ_LAM_AD_INJ	O	0... FFH	0... 255	1	-
Number of multiple injections for lambda adaptation via injection mode					
NC_NR_PHA_LAM_AD_INJ	O	0... FFH	0... 255	1	-
Number of phases for lambda adaptation via injection mode					

### General information:

The following describes the general rules for determination of the configuration data

#### 1.32.1 Global Configuration Data

Here are listed the configuration data, which can be used in other aggregates:

Data	Value

#### 1.32.2 Local Configuration Data

Here are listed the configuration data, which are used:

Data	Value
NC_NR_PHA_LAM_AD_INJ	7
NC_NR_MIS_REP_LAM_AD_INJ	10
NC_NR_MPL_INJ_LAM_AD_INJ	3

## 1.33 IMMO Configuration data

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IMOB_MODE	-	0... FFH	0... 255	1	-
Configuration immobilizer [IMOB] mode					
NC_SWT_MODE	-	0... FFH	0... 255	1	-
Configuration SWT mode					

### FUNCTION DESCRIPTION:

#### General information:

The logical constants NC(NLC)\_xxx Configuration data are necessary to adapt the Aggregate IMMO to a given system environment. The values describe either the variant of a used system component, or a vehicle component is available or not.

With use of the logical constant **NC\_IMOB\_MODE** the availability of a electronically components within the system is determined. In case of a vehicle configuration with an start stop system MSA, the component control/recognition and diagnosis is included within the aggregate version. The flexible handling is necessary because the immobilizer is different for different hardware components.

With use of the logical constant **NC\_SWT\_MODE** the availability of special SWT enabling functions. The logical constants NC\_SWT\_MODE0X\_MASKS represents one set bit in a byte and should be used for bit masking operations.

The following describes the general rules for determination of the configuration data.

#### Local configuration data

Here are listed the configuration data, which are used only in the IMMO aggregate.

Data	Value
<b>NC_IMOB_MODE</b>	Compiler switch to activate special IMOB functionality <b>0</b> = No special mode active ( all other projects) <b>1</b> = MSA (Motor Start/Stop-Automatik) Authentication: <b>Activated only for 4DB + 4DH</b> <b>2</b> = DH-Server 1 active (EGS) *plattform L6, preparation E71* <b>4</b> = DH-Server 2 active (N/A) reserved <b>8</b> = DH-Server 3 active (N/A) reserved 16 = N/A 32 = N/A 64 = N/A 128 = N/A
<b>NC_SWT_MODE</b>	Compiler switch to activate special SWTfunctionality <b>0</b> = No special SWT Mode <b>1</b> = VMAX enabling with SWT /* activated for 4DS */ <b>2</b> = PMAX enabling with SWT /* activated for 4DC */ 4 = N/A 8 = N/A 16 = N/A 32 = N/A 64 = N/A 128 = N/A
<b>NC_SWT_MODE01_MASK</b>	1
<b>NC_SWT_MODE02_MASK</b>	2
<b>NC_SWT_MODE03_MASK</b>	4
<b>NC_SWT_MODE04_MASK</b>	8
<b>NC_SWT_MODE05_MASK</b>	16
<b>NC_SWT_MODE06_MASK</b>	32
<b>NC_SWT_MODE07_MASK</b>	64
<b>NC_SWT_MODE08_MASK</b>	128

For 4DS Project (S63)


NC\_SWT\_MODE = 1

For 4DC Project (4DC)

NC\_SWT\_MODE = 2

# 2 - Basic SW Inputs and Outputs

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## 2.1 Standard analog inputs

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MAP_BAS	O	0... 3FFH	0... 4.99511	4.8828e-3	V
manifold air pressure (form mux)					
PUT_BAS	O	0... 3FFH	0... 4.99511	4.8828e-3	V
manifold air pressure up throttle (turbo)					
V_AMP	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Ambient pressure sensor raw acquisition					
V_FUP	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
LPG pressure in the fuel rail, voltage raw value (10 bits).					
V_FUP_EFP	O	8000... 7FFFH	-5... 4.99984	152.6e-6	V
Low fuel pressure EFP sensor raw acquisition					
V_IGK_BAS	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Battery voltage after key raw acquisition					
V_LS_DOWN_1	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Downstream oxygen sensor Voltage raw acquisition - Bank n° 1					
V_LS_DOWN_2	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Downstream oxygen sensor Voltage raw acquisition - Bank n° 2					
V_LS_UP_1	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Upstream oxygen sensor Voltage raw acquisition - Bank n° 1					
V_LS_UP_2	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Upstream oxygen sensor Voltage raw acquisition - Bank n° 2					
V_POIL	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Oil pressure sensor raw acquisition					
V_PVS_1	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Voltage of pedal value sensor 1					
V_PVS_2	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Voltage of pedal value sensor 2					
V_SOF_SWI	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Voltage of sport switch					
V_SOF_SWI_MON	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Voltage of sport flitch for monitoring					
V_TPS_1	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Throttle position sensor 1 raw acquisition					
V_TPS_2	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Throttle position sensor 2 raw acquisition					
V_VAR_ECU	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Voltage for ECU Lot detection					
VB_BAS	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Battery voltage after relay raw acquisition.					
VCC_PVS_1	O/V	0... 3FFH	0... 9.99023	9.7656e-3	V
Voltage supply for pedal value sensor 1 (and TPS) raw acquisition					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VCC_PVS_2	O/V	0... 3FFH	0... 9.99023	9.7656e-3	V
Voltage supply for pedal value sensor 2 raw acquisition					

### Direct analog inputs

Name	Acquisition rate (msec)	Port - Channel	Remark
V_IGK_BAS	1	2-01	
VB_BAS	1	3-01	
V_LS_UP_1	10	2-06	
V_LS_UP_2	10	2-07	
V_AMP	100	-	
V_LS_DOWN_1	10	2-20	
V_LS_DOWN_2	10	2-19	
V_PVS_1	10	1-20	
V_PVS_2	10	1-07	
VCC_PVS_1	10	1-11	only input data available
VCC_PVS_2	10	1-24	only input data available
V_TPS_1	5 and segmentsync.	5-37	
V_TPS_2	5 and segmentsync.	5-36	
V_VAR_ECU	100	-	Voltage for ECU LOT detection
V_PVS_1_MON	40	1-20	
V_PVS_2_MON	40	1-07	
V_TPS_1_MON	40	5-37	
V_TPS_2_MON	40	5-36	
V_SOF_SWI	10	2-03	Sportschalter
V_SOF_SWI_MON	10	2-03	
MAP_BAS	1	5-33	
V_FUP		7-09	
V_FUP_EFP	1	5-34	
V_POIL	10	7-03	Oil pressure sensor
V_DMTL_BAS	1	2-16	tank leakage sensor

### Additional direct inputs for LV\_VAR\_TCHA = 1 (N54)

PUT_BAS	1	5-10	
---------	---	------	--



## 2.2 Acquisition of air mass flow for frequency air mass sensor

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_MAF_FRQ_KGH_SUM [NC_MAF_NR]	O/V	0... FFFFH	0... 65535	1	-
number of valid accumulated mass air flows during one segment					
CTR_MAF_FRQ_KGH_SUM_0 [NC_MAF_NR]	V	0... FFFFH	0... 65535	1	-
number of accumulated mass air flows during one segment					
CTR_MAF_FRQ_KGH_SUM_1 [NC_MAF_NR]	V	0... FFFFH	0... 65535	1	-
number of accumulated mass air flows during one segment					
CTR_PER_MAF_FRQ_EL [NC_MAF_NR]	V	0... FFH	0... 255	1	-
number of times without a flank					
CTR_T_PER_MAF_FRQ_GRD [NC_MAF_NR]	O/V	0... FFFFH	0... 65535	1	-
number of accumulated gradient failures during one segment					
CTR_T_PER_MAF_FRQ_GRD_0 [NC_MAF_NR]	V	0... FFFFH	0... 65535	1	-
number of accumulated gradient failures during one segment for buffer 0					
CTR_T_PER_MAF_FRQ_GRD_1 [NC_MAF_NR]	V	0... FFFFH	0... 65535	1	-
number of accumulated gradient failures during one segment for buffer 1					
CTR_T_PER_MAF_FRQ_RNG [NC_MAF_NR]	O/V	0... FFFFH	0... 65535	1	-
number of accumulated range failures during one segment					
CTR_T_PER_MAF_FRQ_RNG_0 [NC_MAF_NR]	V	0... FFFFH	0... 65535	1	-
number of accumulated range failures during one segment for buffer 0					
CTR_T_PER_MAF_FRQ_RNG_1 [NC_MAF_NR]	V	0... FFFFH	0... 65535	1	-
number of accumulated range failures during one segment for buffer 1					
LV_CTR_T_PER_MAF_FRQ_EL [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
failure (electrical) of the mean period time for frequency MAF sensor					
LV_CTR_T_PER_MAF_FRQ_GRD [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
failure (gradient) of the mean period time for frequency MAF sensor					
LV_CTR_T_PER_MAF_FRQ_RNG [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
failure (range) of the mean period time for frequency MAF sensor					
LV_CTR_T_PER_MAF_FRQ_SENS [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
failure (sensor) of the mean period time for frequency MAF sensor					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_MAF_FRQ_SEG [NC_MAF_NR]	V	0... 1H	0 ...1	1	-
indicates if segment number is even or odd to choose the right buffer					
MAF_FRQ_KGH_BAS [NC_MAF_NR]	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
basic value of the air mass flow (freq. MAF)					
MAF_FRQ_KGH_MES [NC_MAF_NR]	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
measured mass air flow					
MAF_FRQ_KGH_SUM [NC_MAF_NR]	V	0... FFFFFFFFH	0... 134217727.96875	0.03125	kg/h
accumulated mass air flow					
MAF_FRQ_KGH_SUM_0 [NC_MAF_NR]	V	0... FFFFFFFFH	0... 134217727.96875	0.03125	kg/h
accumulated mass air flow measured every sampling pulse time					
MAF_FRQ_KGH_SUM_1 [NC_MAF_NR]	V	0... FFFFFFFFH	0... 134217727.96875	0.03125	kg/h
accumulated mass air flow measured every sampling pulse time					
T_PER_MAF_FRQ [NC_MAF_NR]	O/V	0... FFFFH	0... 65535	1	µs
arithmetic average of the period time					
T_PER_MAF_FRQ_BAS [NC_MAF_NR]	O/V	0... FFFFH	0... 65535	1	µs
basic arithmetic average of the period time					

**Input data:**

LV_ES {p. 1720}	LV_VAR_MAF {p. 656}	LV_VAR_MAF_LEARNT {p. 656}	
-----------------	---------------------	-------------------------------	--

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_PER_MAF_FRQ_EL	-	0... FFH	0... 255	1	-
Maximum threshold for electrical diagnosis					
C_T_PER_MAF_FRQ_GRD_DIAG	-	0... FFFFH	0... 65535	1	µs
maximum threshold for gradient check of T_PER_MAF_FRQ_SUM					
C_T_PER_MAF_FRQ_MAX_DIAG	-	0... FFFFH	0... 65535	1	µs
maximum threshold for range check of T_PER_MAF_FRQ_SUM_j					
C_T_PER_MAF_FRQ_MIN_DIAG	-	0... FFFFH	0... 65535	1	µs
minimum threshold for range check of T_PER_MAF_FRQ_SUM_j					
C_T_PER_MAF_FRQ_SENS	-	0... FFFFH	0... 65535	1	µs
minimum threshold for range check of T_PER_MAF_FRQ_SENS					
C_T_PER_MAX_FRQ_OFS	-	0... FFFFH	0... 65535	1	µs
offset of the period time for conversion table					
ID_MAF_FRQ_TAB [NC_MAF_NR]	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_T_PER_MAF_FRQ_OFS	256	0... FFFFH	0... 65535	1	µs
conversion table for the frequency MAF sensor					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_MAF_NR	-	0... FFH	0... 255	1	-
number of MAF- sensors					

**Import actions:**

<b>ACTION_INFR_GetResultTimeStamp</b> (OUT<CTR_T_PER_MAF_FRQ_SUM[NC_MAF_NR]>,OUT<T_PER_MAF_FRQ_SUM[NC_MAF_NR]>)
---

## FUNCTION DESCRIPTION:

### General information:

#### Calculation of basic air mass flow for a frequency MAF sensor

The determination of basic air mass flow from the input signal to the ECU in general is done in 3 steps.

#### First step:

Using these informations the mean value of time periods between falling edges during the last sampling time is calculated:

$$T\_PER\_MAF\_FRQ[NC\_MAF\_NR] = T\_PER\_MAF\_FRQ\_SUM[NC\_MAF\_NR] / CTR\_T\_PER\_MAF\_FRQ\_SUM[NC\_MAF\_NR]$$

#### Second step:

The mean value of time periods (T\_PER\_MAF\_FRQ[NC\_MAF\_NR]) is converted into air mass flows (MAF\_FRQ\_KGH\_BAS[NC\_MAF\_NR]) with help of a map (ID\_MAF\_FRQ\_TAB[NC\_MAF\_NR]).

#### Third step:


During a segment time the air mass flows of each millisecond (MAF\_FRQ\_KGH\_BAS[NC\_MAF\_NR]) are summed up (MAF\_FRQ\_KGH\_SUM[NC\_MAF\_NR]) in order to calculate the mean value of air mass flow:

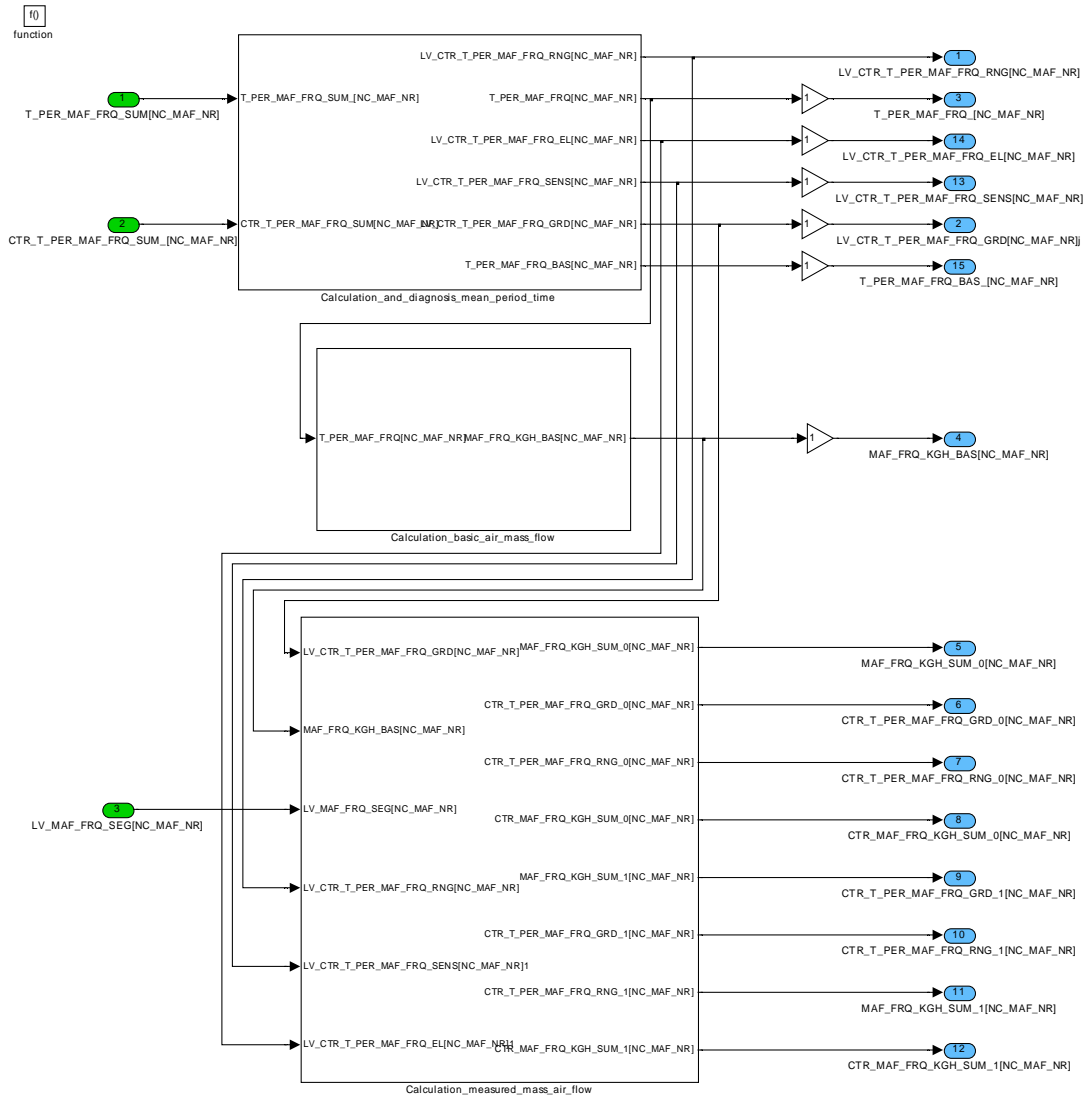
$$MAF\_FRQ\_KGH\_MES[NC\_MAF\_NR] = MAF\_FRQ\_KGH\_SUM[NC\_MAF\_NR] / CTR\_MAF\_FRQ\_KGH\_SUM[NC\_MAF\_NR]$$

### Description:

This is a global overview about all input and output signals of this function. Details are shown in the following chapters.

### Overview

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The function to do all calculations is splitted into three parts:

- calculation of mean period time
- calculation of basic mass air flow
- calculation of mean mass air flow during one segment

Besides the number of MAF sensors is fixed.

## 2.2.1 Calculation and Diagnosis of the mean period time

### Application conditions

**Initialisation:** -

**Recurrence:** 1 ms

**Activation:** **If** (LV\_VAR\_MAF\_LEARNT = 0 **and** LV\_VAR\_MAF = 0) **or**

(LV\_VAR\_MAF\_LEARNT = 0 **and** LV\_VAR\_MAF = 1) **or**

$$(LV\_VAR\_MAF\_LEARNT = 1 \text{ and } LV\_VAR\_MAF = 1)$$

**Deactivation:**      **If**  $(LV\_VAR\_MAF\_LEARNT = 1 \text{ and } LV\_VAR\_MAF = 0)$

### FUNCTION DESCRIPTION:

The logical value  $LV\_CTR\_T\_PER\_MAF\_FRQ\_RNG[NC\_MAF\_NR]$  will be set, if the mean period time is not within a maximum and minimum threshold.

Additionally the logical value  $LV\_CTR\_T\_PER\_MAF\_FRQ\_GRD[NC\_MAF\_NR]$  will be set, if the gradient of the mean period time is higher than  $C\_T\_PER\_MAF\_FRQ\_GRD\_DIAG$ .

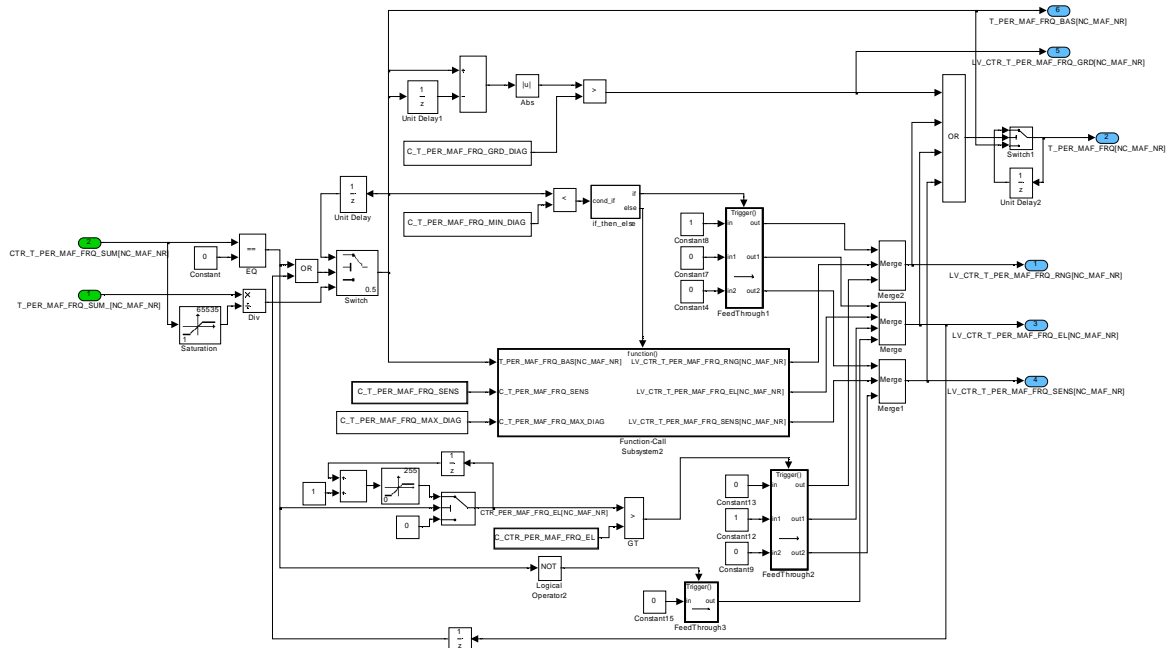
If one of the error bits  $LV\_CTR\_T\_PER\_MAF\_FRQ\_EL/SENS/RNG/GRD[NC\_MAF\_NR]$  is set, the old period time is used.

If one of the error bits  $LV\_CTR\_T\_PER\_MAF\_FRQ\_EL/SENS/RNG$  is set, then the other error bits has to be set to zero.

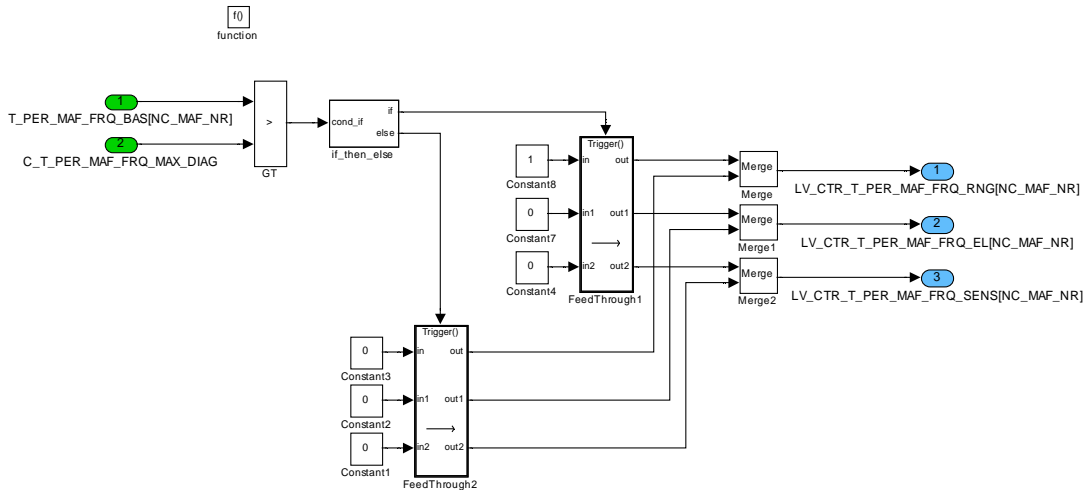
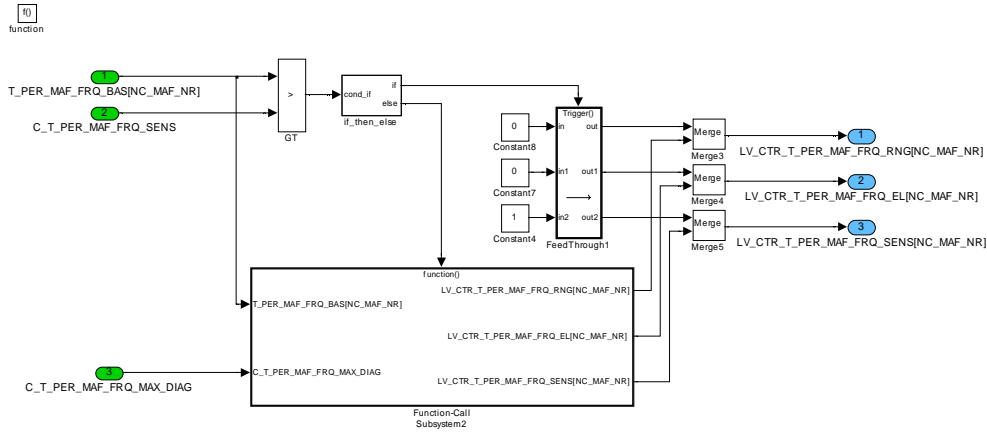
For setting of  $LV\_CTR\_T\_PER\_MAF\_FRQ\_EL[NC\_MAF\_NR]$  a counter is started everytime  $CTR\_T\_PER\_MAF\_FRQ\_SUM[NC\_MAF\_NR] = 0$ , if the counter is over a calibratable threshold  $LV\_CTR\_T\_PER\_MAF\_FRQ\_EL[NC\_MAF\_NR]$  is set.

If  $LV\_CTR\_T\_PER\_MAF\_FRQ\_EL[NC\_MAF\_NR] = 1$  the first value  $T\_PER\_MAF\_FRQ\_SUM[NC\_MAF\_NR] \neq 0$  delivered by infrastructure is not used.

Signal flow diagram:



In the following 2 signal flow diagrams, the function call function call subsystem2 is shown:



## 2.2.2 Basic air mass flow calculation for frequency MAF sensor

### Application conditions

**Initialisation:** —

**Recurrence:** 1 ms

**Activation:** **If** (LV\_VAR\_MAF\_LEARNT = 0 **and** LV\_VAR\_MAF = 0) **or**

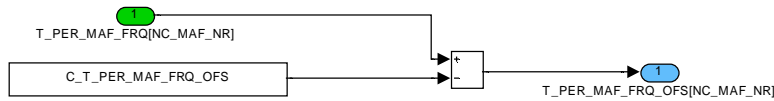
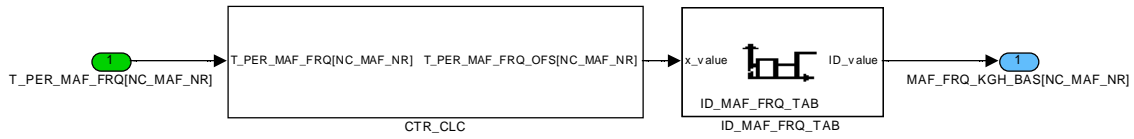
(LV\_VAR\_MAF\_LEARNT = 0 **and** LV\_VAR\_MAF = 1) **or**

(LV\_VAR\_MAF\_LEARNT = 1 **and** LV\_VAR\_MAF = 1)

**Deactivation:** **If** (LV\_VAR\_MAF\_LEARNT = 1 **and** LV\_VAR\_MAF = 0)

### FUNCTION DESCRIPTION:

The limited mean value of the period time T\_PER\_MAF\_FRQ[NC\_MAF\_NR] are converted by a table ID\_MAF\_FRQ\_TAB[NC\_MAF\_NR] into values with the unit [kg/h].

**Signal flow diagram:****2.2.3 Calculation of measured air mass flow buffer****Application conditions****Initialisation:** -**Recurrence:** 1 ms**Activation:** **If** (LV\_VAR\_MAF\_LEARNT = 0 **and** LV\_VAR\_MAF = 0) **or**(LV\_VAR\_MAF\_LEARNT = 0 **and** LV\_VAR\_MAF = 1) **or**(LV\_VAR\_MAF\_LEARNT = 1 **and** LV\_VAR\_MAF = 1)**Deactivation:** **If** (LV\_VAR\_MAF\_LEARNT = 1 **and** LV\_VAR\_MAF = 0)**FUNCTION DESCRIPTION:**

The calculation of measured air mass flow consists of two different parts.

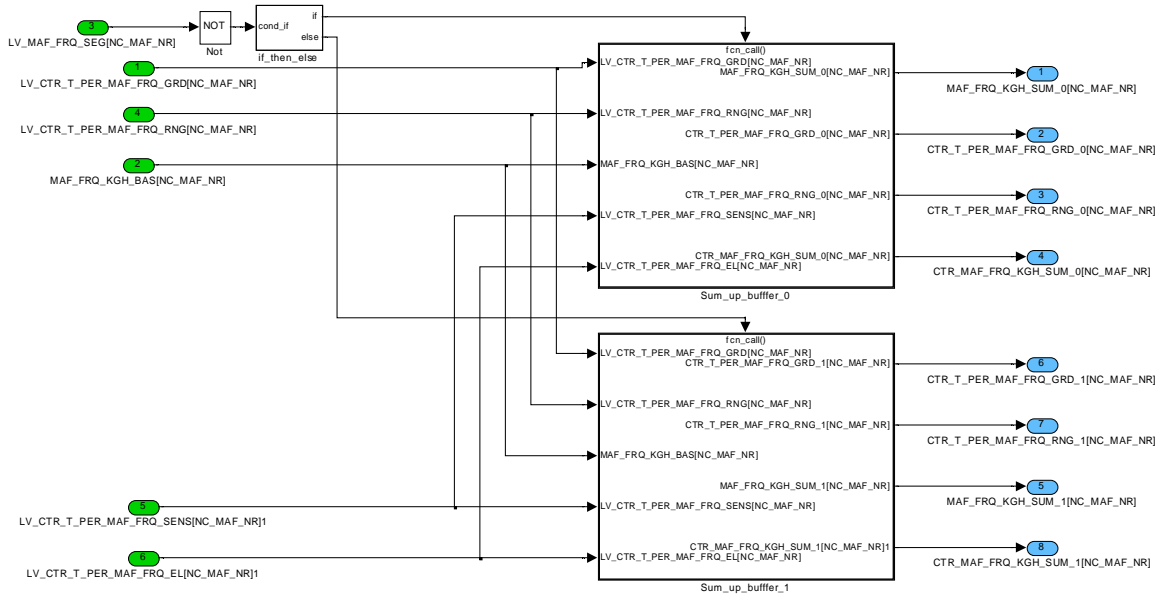
**Accumulation of air mass flow during one segment:**

The air mass flows `MAF_FRQ_KGH_BAS[NC_MAF_NR]` are summed up in alternating buffers, if there is no failure. The number of summed up values is counted in `CTR_MAF_FRQ_KGH_SUM_0[NC_MAF_NR]` or `CTR_MAF_FRQ_KGH_SUM_1[NC_MAF_NR]`.

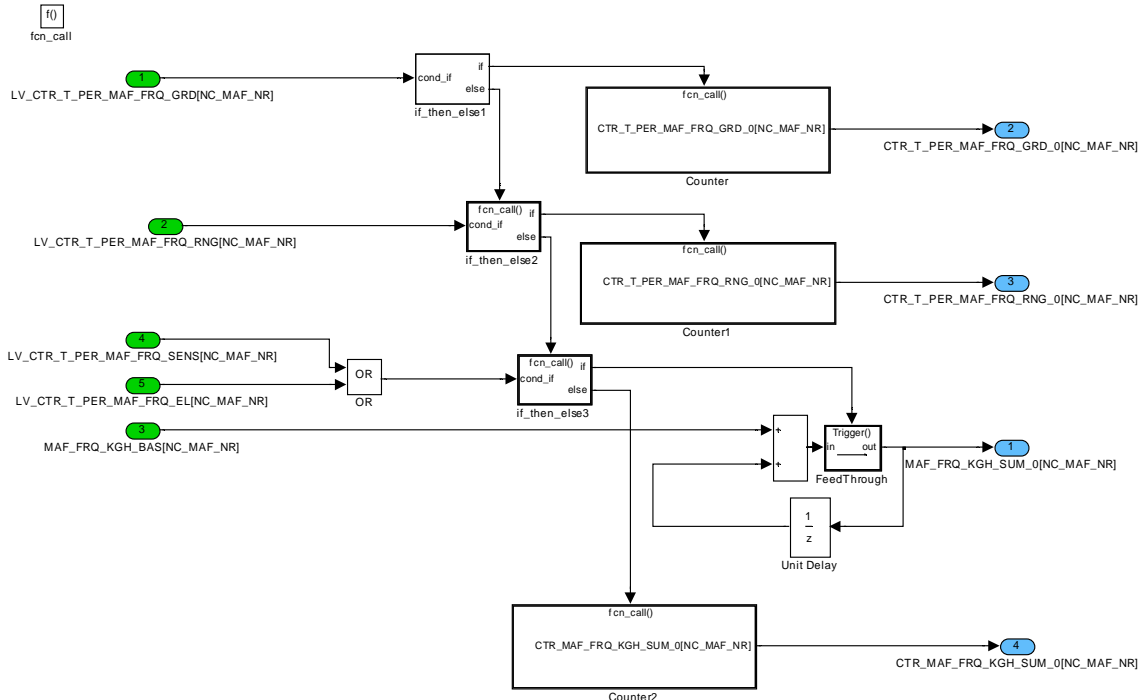
Depending on the logical value `LV_MAF_FRQ_SEG` one of the two buffers and counters is selected for writing whereas the content of the other buffer and counter is used for calculation.

After having read out one buffer, it needs to be cleared as well as the corresponding counter. Such a two-buffer-system is used to avoid incorrect mass air flow calculation. The buffer alternate at each change of segment.

**Signal flow diagram:**




**Sum up buffer:**

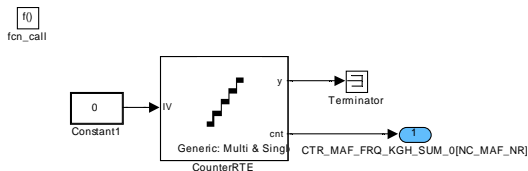
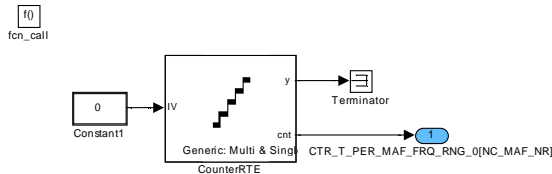
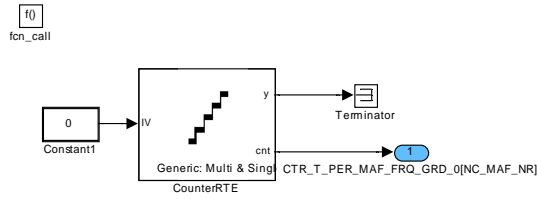


**Description of the defined counter:**

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*The calculation above is defined only for the buffer 0, the calculation of the necessary variables for buffer 1 has to be done analogous.*

## 2.2.4 Calculation of measured mean value of air mass flow

### Application conditions

**Initialisation:** at  $LV\_ES\ 0 \rightarrow 1$ , set  $MAF\_FRQ\_KGH\_MES[NC\_MAF\_NR] = 0$

**Recurrence:** every segment

**Activation:** **If**  $LV\_ES = 0$  **and**  $(LV\_VAR\_MAF\_LEARNT = 0 \text{ and } LV\_VAR\_MAF = 0)$  **or**

$(LV\_VAR\_MAF\_LEARNT = 0 \text{ and } LV\_VAR\_MAF = 1)$  **or**

$(LV\_VAR\_MAF\_LEARNT = 1 \text{ and } LV\_VAR\_MAF = 1)$

**Deactivation:** **If**  $(LV\_VAR\_MAF\_LEARNT = 1 \text{ and } LV\_VAR\_MAF = 0)$

### FUNCTION DESCRIPTION:

Selection of the sum up buffer:

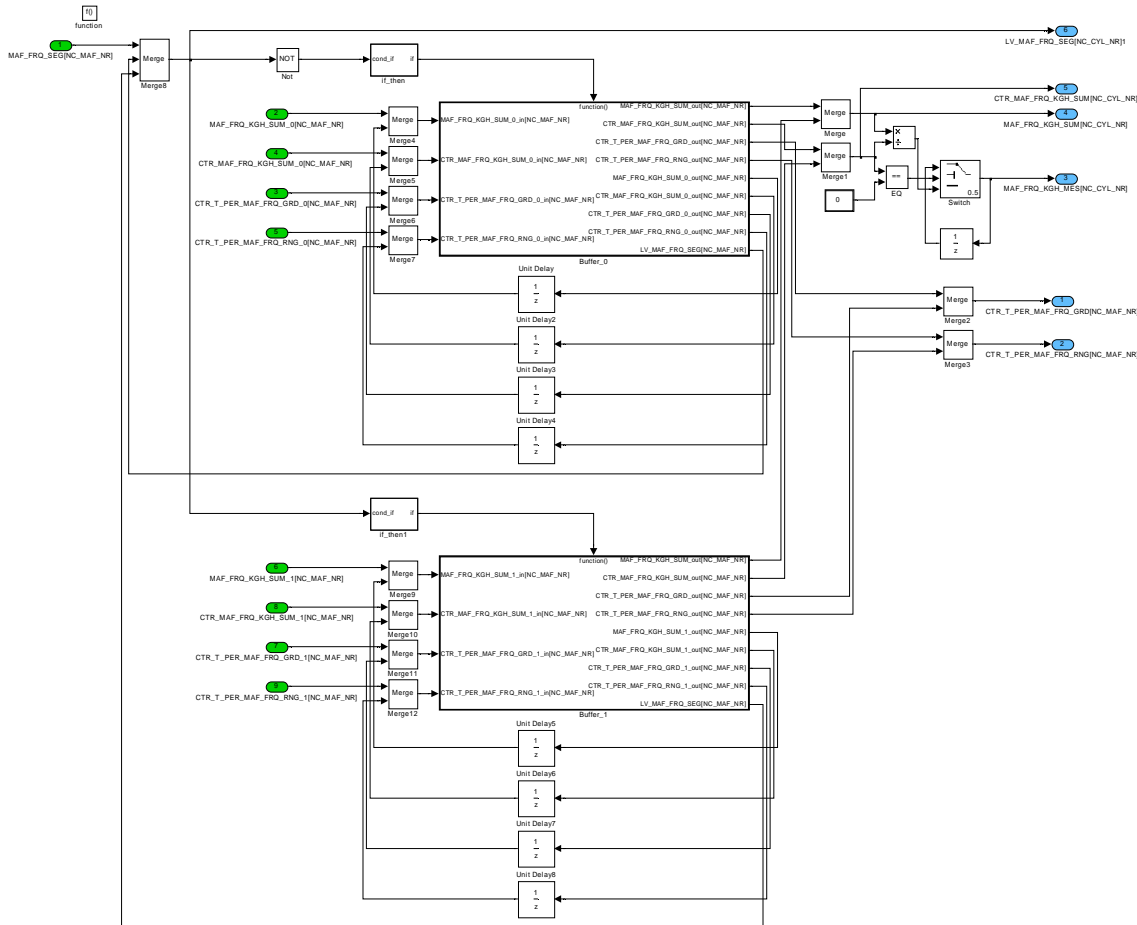
$LV\_MAF\_FRQ\_SEG[NC\_MAF\_NR] = 1 - LV\_MAF\_FRQ\_SEG[NC\_MAF\_NR]$

switching  $LV\_MAF\_FRQ\_SEG[NC\_MAF\_NR]$  once per segment

mean value of the mass air flow during a segment:


$$MAF\_FRQ\_KGH\_MES[NC\_MAF\_NR] = MAF\_FRQ\_KGH\_SUM[NC\_MAF\_NR] / CTR\_MAF\_FRQ\_KGH\_SUM[NC\_MAF\_NR]$$

**Signal flow diagram:**



**The calculation above is defined only for the buffer 0, the calculation of the necessary variables for buffer 1 has to be done analogous.**

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## 2.3 Manifold air pressure acquisition

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MAP_CTR	O/V	0... FFFFH	0... 65535	1	-
Number of MAP samples in buffer					
MAP_CTR_1	O/V	0... FFFFH	0... 65535	1	-
Number of MAP samples in buffer1					
MAP_SUM	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Acquisition sum, buffer					
MAP_SUM_1	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Acquisition sum, buffer1					
PUT_CTR	O/V	0... FFFFH	0... 65535	1	-
Number of PUT samples in buffer					
PUT_CTR_1	O/V	0... FFFFH	0... 65535	1	-
Number of PUT samples in buffer1					
PUT_SUM	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Acquisition sum pressure up throttle, buffer					
PUT_SUM_1	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Acquisition sum pressure up throttle, buffer1					

### Input data:

LV_MAP_SEG {p. 1198}	LV_VAR_TCHA {p. 656}	MAP_BAS {p. 831}	PUT_BAS {p. 831}
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### FUNCTION DESCRIPTION:

The raw value (voltage) for MAP\_BAS (PUT\_BAS) is measured every 1 ms. The values (10 bit) are summed up in one of the two buffers, MAP\_SUM or MAP\_SUM\_1 (PUT\_SUM or PUT\_SUM\_1). The number of values is counted in MAP\_CTR or MAP\_CTR\_1 (PUT\_CTR or PUT\_CTR\_1).

A two-buffer-system is used to avoid incorrect MAP\_MES\_BAS calculation.

### Calculation Description:

If (LV\_MAP\_SEG == 0) then

$$\text{MAP\_SUM} = \sum_{i=1}^{\text{MAP\_CTR}} \text{MAP\_BAS}_i$$

and in case the alternate buffer is active for writing (LV\_MAP\_SEG == 1)

$$\text{MAP\_SUM\_1} = \sum_{i=1}^{\text{MAP\_CTR\_1}} \text{MAP\_BAS}_i$$

MAP\_BAS<sub>i</sub>: MAP acquisition, raw values from the ad\_buffer

**additional variables for LV\_VAR\_TCHA = 1 (turbo)**


If (LV\_MAP\_SEG == 0) then

$$\text{PUT\_SUM} = \sum_{i=1}^{\text{PUT\_CTR}} \text{PUT\_BAS}_i$$

and in case the alternate buffer is active for writing (LV\_MAP\_SEG == 1)

$$\text{PUT\_SUM\_1} = \sum_{i=1}^{\text{PUT\_CTR\_1}} \text{PUT\_BAS}_i$$

PUT\_BAS<sub>i</sub>: PUT acquisition, raw values from the ad\_buffer

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## 2.4 Acquisition of after relay battery voltage

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VB_MES	0	0... 3FFH	0... 28.7055	28.1e-3	V
Computed battery voltage					

### Input data:

VB_BAS {p. 831}			
-----------------	--	--	--

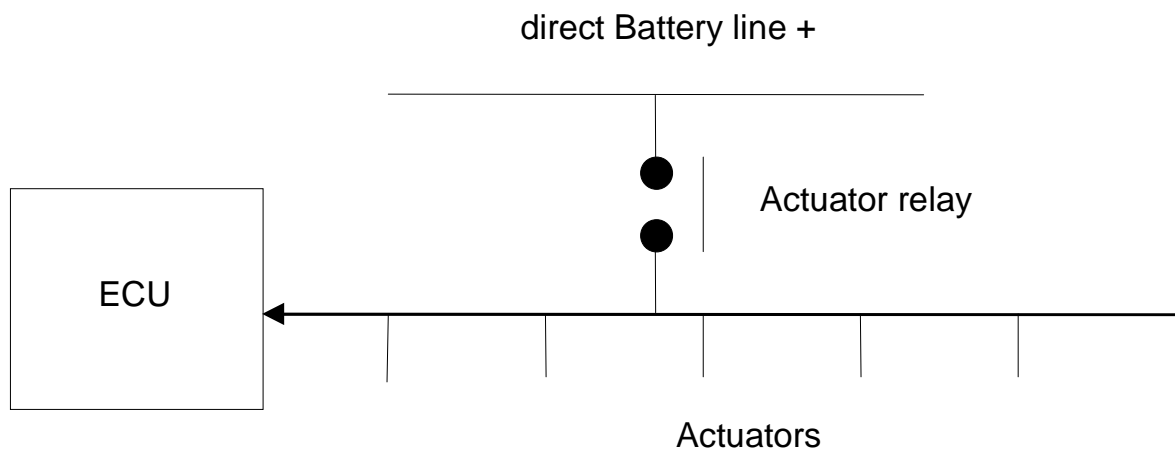
### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_VB_MAX	-	B4... 140H	18 ...32	0.1	V
Maximum battery voltage linked to the voltage divisor					
NC_VB_SAMPLE_NR	-	0... FFH	0... 255	1	-
Number of acquisition for filtering					

### FUNCTION DESCRIPTION:

#### General information:

The acquisition of the raw values is performed every 1 ms with the resolution of 10 bits.



### Application conditions

- Activation:** at reset
- Initialization:** VB\_MES = 0.
- Recurrence :** NC\_VB\_SAMPLE\_NR ms


#### System Description:

The range of VB\_BAS and VB\_MES depends to the voltage divider (means 0 - 5V at ADC) at the input of the  $\mu$ C. The input is the ADC-value of the VB-Pin.

**Formula section:**

$$VB\_MES = \left( \frac{1}{NC\_VB\_SAMPLE\_NR} \right) * \sum_{n=1}^{NC\_VB\_SAMPLE\_NR} VB\_BAS_n$$

$NC\_VB\_SAMPLE\_NR = 2^n ; 1 \leq n \leq 6$  (NC\_VB\_SAMPLE\_NR is initialized with 4 or 8)

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## 2.5 Acquisition of after key battery voltage

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
V_IGK_MES	O/V	0... 3FFH	0... 28.7055	28.1e-3	V
Computed ignition key voltage					

### Input data:

V_IGK_BAS {p. 831}			
--------------------	--	--	--

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_V_IGK_MAX	-	B4... 140H	18 ...32	0.1	V
Maximum battery voltage linked to the voltage divisor of the key voltage					
NC_V_IGK_SAMPLE_NR	-	0... FFH	0... 255	1	-
Number of acquisition for filtering					

### FUNCTION DESCRIPTION:

#### General information:

The acquisition of the raw values is performed every 1 ms with the resolution of 10 bits.

V\_IGK\_BAS is the same ADC-value which is used in Key on/Key off detection.

#### Application conditions

<b>Activation:</b>	at reset
<b>Initialization:</b>	V_IGK_MES = 0
<b>Recurrence :</b>	NC_V_IGK_SAMPLE_NR ms

#### Formula section:

$$V\_IGK\_MES = \left( \frac{NC\_V\_IGK\_SAMPLE\_NR}{NC\_V\_IGK\_SAMPLE\_NR} \right) * IGK\_BAS_n$$

$$n=1$$

$$NC\_V\_IGK\_SAMPLE\_NR = 2^n ; 1 \leq n \leq 6 \quad (NC\_V\_IGK\_SAMPLE\_NR \text{ is initialized with 4 or 8})$$

## 2.6 ENTE - Requirements to infrastructure interface (ECT)

### Input data:

ECTPWM {p. 3858}			
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### 2.6.1 Pulse width modulated outputs

#### FUNCTION DESCRIPTION:

#### General information:

Not all vehicles are equipped with an electronic controlled thermostat for the regulation of the coolant liquid circulation. Depending on the hardware configuration a pulse width modulated value (ECTPWM) for the electronic controlled thermostat is calculated or not. Only in case of a vehicle configuration with an electronic controlled thermostat a pulse width modulated signal is generated at the ECU output.

PWM output name	Frequency	Updating of duty cycle	Range of duty cycle
ECTPWM	hardware dependent	1000 ms	0 -100%

#### Application conditions

**Initialisation at reset:**  $ECTPWM = 0\%$

**Activation:** *at every engine operating state*

**Deactivation:** -



## 2.7 Acquisition of combustion noise

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
KNKS [NC_CYL_NR]	O/V	0... FFFFH	0... 4.99992	76.3e-6	V
Knock noise raw signal for cylinder x					
KNKS_PRE [NC_CYL_NR]	O/V	0... FFFFH	0... 4.99992	76.3e-6	V
Knock noise raw signal for cylinder x (first window after TDC)					
KNKS_REL_NL [NC_CYL_NR]	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
Relative knock value					

### Input data:

KNKS_CMD_CONF [NC_CYL_NR] {p. 1961}	KNKS_CMD_FIL [NC_CYL_NR] {p. 1961}	KNKS_CMD_FIL_PRE [NC_CYL_NR] {p. 1961}	KNKS_CMD_GAIN [NC_CYL_NR] {p. 1961}
KNKS_CMD_GAIN_PRE [NC_CYL_NR] {p. 1961}	KNKS_CMD_INT [NC_CYL_NR] {p. 1961}	KNKS_CMD_INT_PRE [NC_CYL_NR] {p. 1961}	KNKWB [NC_CYL_NR] {p. 1961}
KNKWB_PRE [NC_CYL_NR] {p. 1961}	KNKWE [NC_CYL_NR] {p. 1961}	KNKWE_PRE [NC_CYL_NR] {p. 1961}	NL [NC_CYL_NR] {p. 1962}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_KNKS_REL_INI	-	0... FFFFH	0... 0.99998	15.3e-6	-
ini value of relative knock signal					

### General information:

Activation :           at ENG\_STOP to SYN\_ENG\_IGK\_ON  
                  or RUN\_ENG to SYN\_ENG\_IGK\_ON  
                  T\_KNK\_ENABLE


Deactivation :        at SYN\_ENG\_IGK\_ON to RUN\_ENG (if supported by ECOP)  
                          or SYN\_ENG\_IGK\_ON to ENG\_STOP  
                          or SYN\_ENG\_IGK\_OFF to PWL  
                          T\_KNK\_DISABLE

Initialization :      at reset or engine running to engine stop  
                          KNKS\_REL\_NL[x] = C\_KNKS\_REL\_INI           (T\_KNK\_INIT)

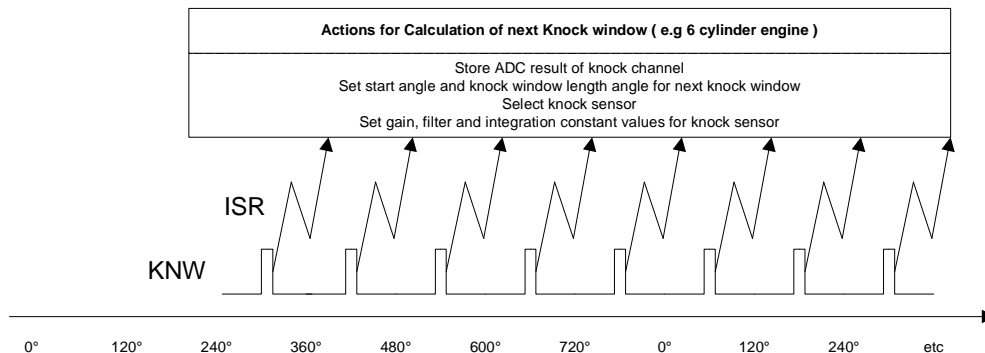
The knock detection is performed for cylinder-individually defined measurement windows since knock-typical oscillations only occur for certain crankshaft angles. For the time of the knock window the knock signal is integrated. At the end of the knock window the integrated signal is sampled and converted to the digital value KNKSx.

KNKS\_REL\_NL[NC\_CYL\_NR] is the relative knocking value, it is the quotient of KNKS[NC\_CYL\_NR] and NL[NC\_CYL\_NR].

The knock window for cylinder x+1 is reprogrammed at the end of the knock window for cylinder x. The parameters KNKS\_CMD\_FIL[NC\_CYL\_NR], KNKS\_CMD\_FIL\_PRE[NC\_CYL\_NR], KNKS\_CMD\_INT[NC\_CYL\_NR], KNKS\_CMD\_INT\_PRE[NC\_CYL\_NR], KNKS\_CMD\_GAIN[NC\_CYL\_NR], KNKS\_

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GAIN\_PRE[NC\_CYL\_NR], KNKS\_CMD\_CONF[NC\_CYL\_NR], KNKWB KNKWB\_PRE[NC\_CYL\_NR], KNKWE\_PRE[NC\_CYL\_NR] and KNKWE have to be stable at this time. The knock channel adc is configured for triggering on the end of the knock window. The end of conversion generates an interrupt in which the parameters for the next knock window are set. The following picture illustrates this.



The knock function may be activated by T\_KNK\_INIT or T\_KNK\_ENABLE and deactivated by T\_KNK\_DISABLE.

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## 2.8 Standard management of logic inputs

### 2.8.1 Standard management of logic inputs

#### FUNCTION DESCRIPTION:

##### General information:

Logic inputs are inputs whose state is acquired by a  $\mu$ P port read.

Logic inputs which are connected to a pull-up inside the ECU are valid only when VBR is present.

Without VBR these inputs are read as a low level.

##### Initialization:

See general Initialization chapter.

##### Logic state:

The input is ON when the voltage level is high at the ECU connector and is OFF when the voltage level is low at the ECU connector.

##### Recurrence:

Logical inputs are read every 10 ms with a jitter of 1 ms maximum.


##### Filtering of the interferences:

When the state of the logical input is changed, the acquisition is checked by another acquisition after 40  $\mu$ s delay. If the new acquisition is not the same the change is ignored.

This filtering is proposed as a base in order to provide a more reliable information. In case of bigger interferences or bounces, a complementary application filtering should be added.

##### Diagnostic:

No diagnostic is done on logic inputs into basic software.

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## 2.9 Definition of logic inputs

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_IM_BLS	O/V	0... 1H	0 ...1	1	-
brake light switch					
LV_IM_BLS_MON	O	0... 1H	0 ...1	1	-
brake light switch for Monitoring					
LV_IM_BTS	O/V	0... 1H	0 ...1	1	-
brake test switch					
LV_IM_BTS_MON	O	0... 1H	0 ...1	1	-
brake test switch for Monitoring					
LV_IM_CS_PN	O/V	0... 1H	0 ...1	1	-
clutch switch					

### List of logic Inputs

Name	Port - Channel	Logic state
LV_PIN_CS_PN	E_S_KUP	Positive Logic
LV_PIN_BTS	E_S_BLTS	Positive Logic
LV_PIN_BLS	E_S_BLS	Positive Logic

## 2.10 Acquisition of crankshaft signal (internal version)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_ADD_CTR	-	0... FFH	0... 255	1	-
Crankshaft additional teeth counter					
CRK_CTR	-	0... FFH	0... 255	1	-
Crankshaft counter					
CRK_MISS_CTR	-	0... FFH	0... 255	1	-
Crankshaft missing teeth counter					
LV_CRK_FIRST_VLD_TOOTH	O	0... 1H	0 ...1	1	-
Flag for first valid crankshaft tooth detected ready to synchronize					
LV_CRK_MISS_TOOTH	O/V	0... 1H	0 ...1	1	-
At least one missing tooth has been simulated					
LV_CRK_RUN	O	0... 1H	0 ...1	1	-
Flag for Running engine					
LV_CRK_STOP	O	0... 1H	0 ...1	1	-
Flag for Stop Engine request					
LV_CRK_SYN	O/V	0... 1H	0 ...1	1	-
Flag for crankshaft acquisition synchronized					
LV_FIRST_REF_GAP	-	0... 1H	0 ...1	1	-
First Reference gap is found					
LV_LOST_SYN_CRK	O/V	0... 1H	0 ...1	1	-
Crankshaft synchronization lost					
LV_ORNG_NR_TOOTH_CRK	O/V	0... 1H	0 ...1	1	-
Crankshaft tooth count incorrect at reference gap					
LV_ORNG_TOOTH_PER_CRK	O/V	0... 1H	0 ...1	1	-
Invalid crankshaft tooth period					
LV_REF_GAP	-	0... 1H	0 ...1	1	-
Second Reference gap is found					
ST_CRK_SYN	-	0... 7H	0 ...7	1	-
Crankshaft synchronisation state					
T_CRK_WIN_ENSD	O/V	0... 7FFFFFFH	0... 1.9965	237.999e-9	s
Crankshaft tooth window at end of segment					
T_SEG_ENSD	O	0... 7FFFFFFH	0... 1.9965	237.999e-9	s
Fine resolution segment period					
T_SEG_ER	O/V	0... 7FFFFFFH	0... 1.9965	237.999e-9	s
Crankshaft segment period for misfire detection (ER algorithm)					
T_SEG_HALF_ENSD	O	0... 7FFFFFFH	0... 1.9965	237.999e-9	s
Fine resolution half-segment period					
T_TOOTH	O	0... 7FFFFFFH	0... 1.9965	237.999e-9	s
Crankshaft tooth period					

### Input data:

LV_ACT_CRK {p. 1505}	N_32 {p. 1525}	NC_CYL_NR {p. 1526}	NC_NR_GAP {p. 874}
----------------------	----------------	---------------------	--------------------

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_CRK_DLY	-	0... 29083H	0... 40000	0.2380003	µs
Sensing delay time after first active crankshaft signal edge					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_FAC_TOL_CRK_TOOTH	-	0... FH	0... 0.9375	0.0625	-
LDP_N_32_ID_FAC_TOL_CRK_TOOTH	6	0... FFH	0... 8160	32	rpm
Factor for calculation of expected tooth period					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ACT_CRK_EDGE	-	0H 1H	FALLING RISING	-	-
Active edge of crankshaft signal					
NC_CRK_WIN_SEG_LEN	-	0... FFH	0... 95.625	0.375	°CRK
Width of crankshaft tooth window in °CRK at end of segment					
NC_N_CRK_WIN_ENA	-	0... 1FE0H	0... 8160	1	rpm
Minimum engine speed for enabling acceptance windows for crankshaft acquisition					
NC_N_MAX	-	0... 3FC0H	0... 16320	1	rpm
Maximum engine speed					
NC_N_MIN	-	0... 1FE0H	0... 8160	1	rpm
Minimum engine speed					
NC_N_SEG_HALF_END	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for half-segment trigger					
NC_NR_TOOTH	-	1... FFH	1... 255	1	-
Theoretical number of teeth per crankshaft revolution					
NC_NR_TOOTH_FIRST_GAP_MIN	-	1... 2H	1 ...2	1	-
Minimum number of teeth to be simulated to detect the first reference gap					
NC_NR_TOOTH_GAP	-	1... 2H	1 ...2	1	-
Number of missing teeth forming the reference gap					
NC_NR_TOOTH_STALL	-	2... 7H	2 ...7	1	-
Number of consecutive missing teeth for engine stalling detection					
NC_NR_TOOTH_TOL_ADD	-	1... 2H	1 ...2	1	-
Number of additional teeth tolerated between two reference gap occurrences					
NC_NR_TOOTH_TOL_MISS	-	1... 2H	1 ...2	1	-
Number of missing teeth tolerated between two reference gap occurrences					
NC_NR_VLD_TOOTH	-	0... FH	0... 15	1	-
Number of valid teeth necessary for validation of crankshaft rotation					
NC_OFS_TDC0_REF_CRK	-	0... 780H	0... 720	0.375	°CRK
Reference gap position in °CRK before TDC0					
NC_PHA_SEG_ER_ENSD	-	0... FFH	0... 95.625	0.375	°CRK
Misfire segment start in °CRK after TDC					
NC_PSN_SEG_TDC_REF	-	0... 780H	0... 720	0.375	°CRK
Segment start in °CRK before TDC					

**FUNCTION DESCRIPTION:****2.10.1 Crankshaft Synchronization****General information:**

The crankshaft signal is generated by the crankshaft sensor in conjunction with the crankshaft target wheel. The target wheel has a theoretical number of NC\_NR\_TOOTH (typically 60) teeth, and NC\_

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NR\_TOOTH\_GAP missing teeth (typically 2) forming the reference gap ( 60-2 ). The crankshaft sensor converts the mechanical shape into an electrical signal.

*Magnetic Crankshaft Position Sensors (MCPS)* deliver an AC signal with amplitude depending primarily on crankshaft speed, and sensor air gap. The signal is shaped into a rectangular signal by the ECU input circuitry. Each edge of that signal represents a tooth or a gap of the target wheel. Only signal edges generated from teeth will be processed by software (active signal edge definition). These may be falling or rising edges, depending on sensor polarity.

*Active Crankshaft Position Sensors (ACPS)* switch an open collector output on and off with every tooth or gap passing. Connecting the sensor output to a pull-up resistor inside the ECU generates a signal with rectangular shape. Each edge of that signal represents a tooth or a gap of the target wheel. Only falling signal edges will be processed by software (active signal edge definition), because they are faster. Design and installation of the sensor must ensure that falling signal edges are generated from teeth.

The corresponding configuration data is NC\_ACT\_CRK\_EDGE.

The choice is taken in a way not to use the unprecise signal edge generated in the crankshaft reference gap.

It may be 0 (falling) or 1 (rising) with MCPS, depending on sensor polarity.

With ACPS it should always be 0, because the falling edge is faster due to the sensor's open collector interface. The unprecise signal edge in the reference gap is avoided by choosing the correct installation of the sensor relative to the target wheel motion direction.

### **Application conditions:**

#### *Recurrence:*

For set of the RAM as flags, a mirror area is defined which contains a copy of the output and calibration data in the basic software area (see figure below).

The mirror area of the output data is updated by the lower layer at every active signal edge.


The mirror area of the calibration data is updated by the upper layer each 10ms.

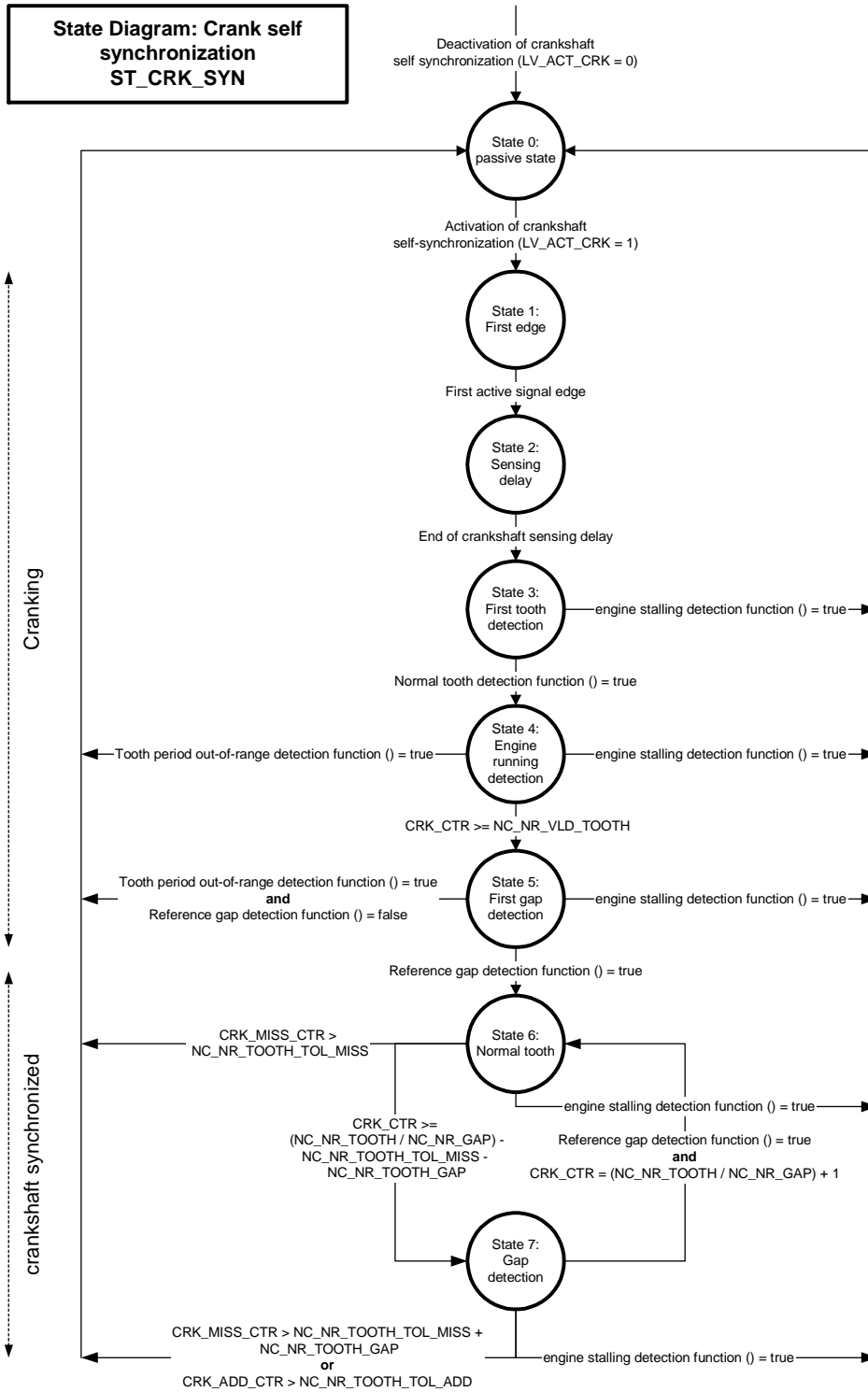
The output data is copied from the mirror area every 10 ms

**Crankshaft  
acquisition**

*Mirror area: updated  
every active edge*

### **State Flow Diagram:**

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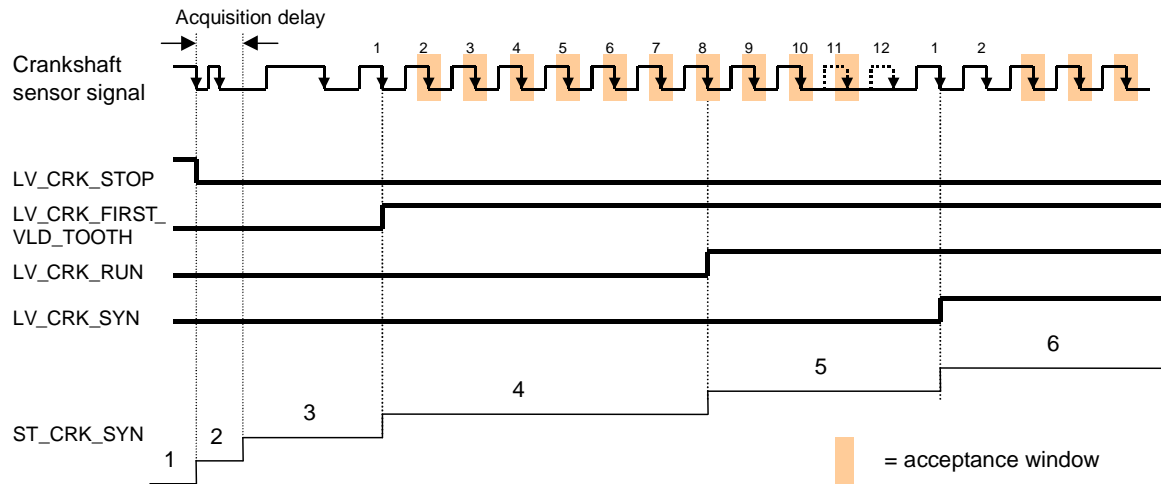


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**Timing Diagram (example):**

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### Formula section:

#### State 0: Crankshaft passive state

##### Input condition:

- From state 4, 5: Tooth period out-of-range detection function () = true
  - From state 6:  $CRK\_MISS\_CTR > NC\_NR\_TOOTH\_TOL\_MISS$
  - From state 7:  $CRK\_ADD\_CTR > NC\_NR\_TOOTH\_TOL\_ADD$
- Or
- $CRK\_MISS\_CTR > NC\_NR\_TOOTH\_TOL\_MISS + NC\_NR\_TOOTH\_GAP$
- From state 3,4,5,6,7: Engine stalling detection function () = true
  - From EPM:  $LV\_ACT\_CRK = 0$

##### Output condition:

- To State 1: Activation of crk self-synchronization ( $LV\_ACT\_CRK = 1$ )

##### Action in the state:

$LV\_CRK\_FIRST\_VLD\_TOOTH = 0$   
 $LV\_CRK\_SYN = 0$   
 $CRK\_CTR = 0$   
 $LV\_CRK\_STOP = 1$   
 $LV\_CRK\_RUN = 0$   
 $CRK\_MISS\_CTR = 0$   
 $CRK\_ADD\_CTR = 0$   
 $LV\_FIRST\_REF\_GAP = 0$   
 $LV\_REF\_GAP = 0$

##### Transient action:

None

#### State 1: First signal edge

##### Input condition:

- From state 0: Activation of crk self-synchronization ( $LV\_ACT\_CRK = 1$ )

**Output condition:**

To state 2: First active signal edge

**Action in the state:**

Wait for first active signal edge  
LV\_CRK\_STOP = 0

**Transient action:**

No actions

**State 2: Crankshaft sensing delay****Input condition:**

From state 1: First active signal edge detected

**Output condition:**

To state 3: End of crankshaft acquisition delay time

**Action in the state:**

Crankshaft signal acquisition inactive during a time interval C\_T\_CRK\_DLY.

**Transient action:**

To state 3: LV\_ORNG\_TOOTH\_PER\_CRK = 0  
LV\_ORNG\_NR\_TOOTH\_CRK = 0  
LV\_LOST\_SYN\_CRK = 0

**State 3: First tooth detection****Input condition:**

From state 2: End of crankshaft acquisition delay time

**Output condition:**

State 4: Normal tooth detection function () = true  
State 0: Engine stalling detection function () = true

**Action in the state**

Wait two next active signal edges in order to compute the first period  
*Activation of Normal tooth detection function ()*  
T\_TOOTH n-1 = T\_TOOTH n  
*Activation of Tooth period out-of-range detection function ()*  
*Activation of Engine stalling detection function ()*

**Transient action:**

To state 4: LV\_CRK\_FIRST\_VLD\_TOOTH = 1  
Increment CRK\_CTR

**State 4: Engine running detection****Input condition:**

From state 3: Normal tooth detection function () = true

**Output condition:**

State 5: CRK\_CTR >= NC\_NR\_VLD\_TOOTH  
 State 0: Engine stalling detection function () = true  
 Or  
 Tooth period out-of-range detection function () = true

**Action in the state:**

**If** Normal tooth detection function () = true  
*/\* tested only when no acceptance window can be applied \*/*  
**Or**  
 Tooth period out-of-range detection function () = false  
*/\* tested only when acceptance window can be applied \*/*  
**Then** Increment CRK\_CTR  
**Endif**

**If** Tooth period out-of-range detection function () = true  
**Then** LV\_ORNG\_TOOTH\_PER\_CRK = 1  
**Endif**

**Action in transient:**

To state 5: LV\_CRK\_RUN = 1 (Engine speed can be computed)

**State 5: First gap detection****Input condition:**

From state 4: CRK\_CTR >= NC\_NR\_VLD\_TOOTH

**Output conditions:**

To state 6: Reference gap detection function () = true  
 To State 0: Engine stalling detection function () = true  
 Or  
 (Tooth period out-of-range detection function () = true  
 And  
 Reference gap detection function () = false)

**Action in the state:**

*Activation of Reference gap detection function ()*  
*Activation of Missing tooth simulation in gap position function ()*  
**If** Tooth period out-of-range detection function () = false  
**Then** Increment CRK\_CTR  
**Endif**

**If** Tooth period out-of-range detection function () = true  
 And  
 Reference gap detection function () = false  
**Then** LV\_ORNG\_TOOTH\_PER\_CRK = 1  
**Endif**

**Transient action:**

To state 6: LV\_CRK\_SYN = 1  
 CRK\_CTR = 1  
 LV\_FIRST\_REF\_GAP = 1

State 6: Normal tooth*Input conditions:*

From State 5: Reference gap detection function () = true  
 From State 7: Reference gap detection function () = true  
 And  
 $CRK\_CTR = (NC\_NR\_TOOTH / NC\_NR\_GAP) + 1$

*Output conditions:*

To State 7:  $CRK\_CTR \geq (NC\_NR\_TOOTH / NC\_NR\_GAP) -$   
 $NC\_NR\_TOOTH\_GAP - NC\_NR\_TOOTH\_TOL\_MISS$

To State 0:  $CRK\_MISS\_CTR > NC\_NR\_TOOTH\_TOL\_MISS$   
 Or  
 Engine stalling detection function () = True

*Action in the state:*

*Deactivation of Missing tooth simulation in gap position function ()*  
*Activation of Missing tooth simulation function ()*

**If** Normal tooth detection function () = true  
*/\* tested only when no acceptance window can be applied \*/*

**Or**

Tooth period out-of-range detection function () = false  
*/\* tested only when acceptance window can be applied \*/*

**Then** Increment CRK\_CTR

**Endif**

**If** Tooth period out-of-range detection function () = true

**Then** LV\_ORNG\_TOOTH\_PER\_CRK = 1

**Endif**

*Transient action:*

To State 0: **If**  $CRK\_MISS\_CTR > NC\_NR\_TOOTH\_TOL\_MISS$   
**Then** LV\_LOST\_SYN\_CRK = 1  
**Endif**

State 7: Gap detection*Input condition:*

From state 6:  $CRK\_CTR \geq (NC\_NR\_TOOTH / NC\_NR\_GAP) -$   
 $NC\_NR\_TOOTH\_GAP - NC\_NR\_TOOTH\_TOL\_MISS$

*Output condition:*

To State 6: Reference gap detection function () = true  
 And  
 $CRK\_CTR = (NC\_NR\_TOOTH / NC\_NR\_GAP) + 1$

To State 0:  $CRK\_MISS\_CTR > NC\_NR\_TOOTH\_TOL\_MISS +$   
 $NC\_NR\_TOOTH\_GAP$

Or

$CRK\_ADD\_CTR > NC\_NR\_TOOTH\_TOL\_ADD$

Or  
 Engine stalling detection function () = True

*Action in the state:*

*Deactivation of Missing tooth simulation function ()*  
*Activation of Missing tooth simulation in gap position function ()*  
**If** Tooth period out-of-range detection function () = false  
**Then** Increment CRK\_CTR  
     **If** CRK\_CTR > (NC\_NR\_TOOTH / NC\_NR\_GAP) -  
         NC\_NR\_TOOTH\_GAP  
         **Then** Increment CRK\_ADD\_CTR  
         **Endif**  
**Endif**  
  
**If** Tooth period out-of-range detection function () = true  
     And  
     Reference gap detection function () = false  
**Then** LV\_ORNG\_TOOTH\_PER\_CRK = 1  
**Endif**

*Transient action:*

To state 6:  
     **If** CRK\_MISS\_CTR > 0  
     Or  
     CRK\_ADD\_CTR > 0  
**Then** LV\_ORNG\_NR\_TOOTH\_CRK = 1  
**Endif**  
 CRK\_CTR = 1  
 CRK\_MISS\_CTR = 0  
 CRK\_ADD\_CTR = 0  
 LV\_REF\_GAP = 1

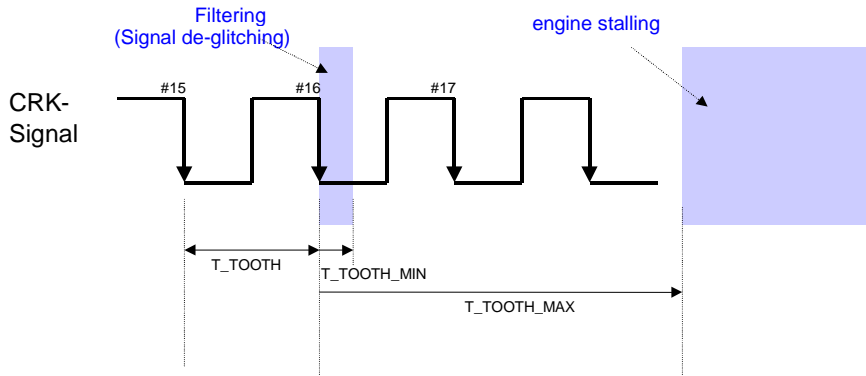
To State 0:  
 MISS +  
     **If** CRK\_MISS\_CTR > NC\_NR\_TOOTH\_TOL\_  
         NC\_NR\_TOOTH\_GAP  
     Or  
     CRK\_ADD\_CTR > NC\_NR\_TOOTH\_TOL\_ADD  
**Then** LV\_LOST\_SYN\_CRK = 1  
**Endif**

## 2.10.2 Definition of the sub function task

### 2.10.2.1 Normal tooth detection function ()

#### General information:

The purpose of this function is to validate the tooth period of a normal tooth when no acceptance window can be applied (first valid tooth, first tooth after a reference gap ...). The function returns false when the tooth period is too small (Signal edges detected before a delay time of T\_TOOTH\_MIN are not valid).



**Formula section:**

$$T\_TOOTH\_MIN = \frac{60}{NC\_NR\_TOOTH * NC\_N\_MAX}$$

```

If          T_TOOTH => T_TOOTH_MIN
Then       return (true)
Else       return (false)
Endif
    
```

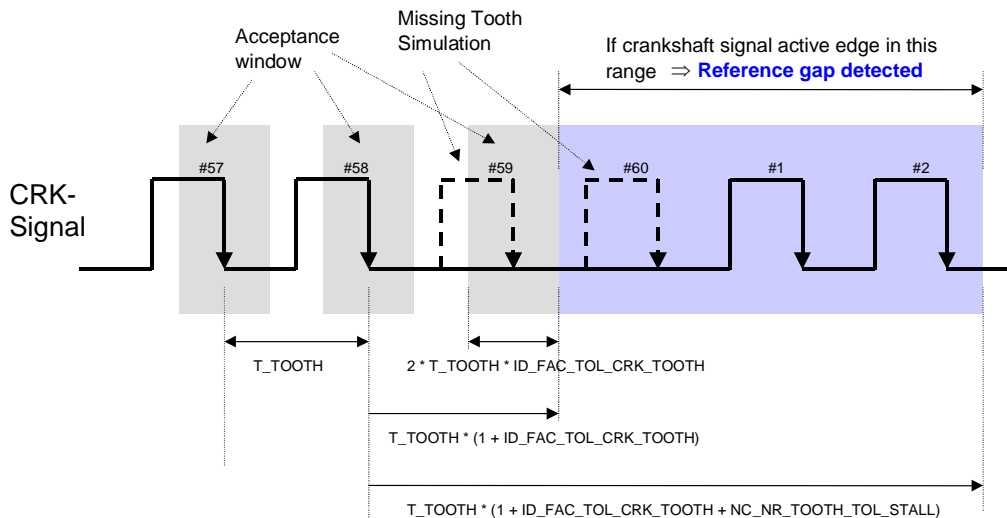
**2.10.2.2 Reference gap detection function ()**

**General information:**


The purpose of this function is to detect a reference gap.

A reference gap is detected if no signal edge was detected inside the crankshaft acceptance window and at least 1 (after synchronization) or NC\_NR\_TOOTH\_FIRST\_GAP\_MIN (first gap detection) teeth have been completely simulated.

The follow figure shows the reference gap detection after synchronization:



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**Formula section:**

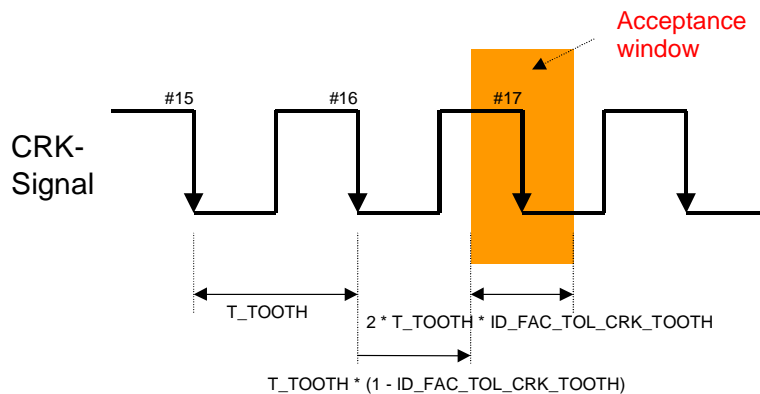
```

If                LV_CRK_SYN = 1
Then              If          Number of simulated missing teeth in gap position >=1
                    Then        If          (NC_NR_TOOTH /NC_NR_GAP) - CRK_MISS_CTR <=
                                        CRK_CTR <=
                                        (NC_NR_TOOTH /NC_NR_GAP) + CRK_ADD_CTR
                    Then          (correct tooth counter)
                                        CRK_CTR = CRK_CTR + CRK_MISS_CTR - CRK_ADD_CTR
                                        return (true)
                    Else          return (false)
                    Endif
Else              If          Number of simulated missing teeth in gap position >=
                                        NC_NR_TOOTH_FIRST_GAP_MIN
                    Then          return (true)
                    Endif
Endif

```

**2.10.2.3 Tooth period out-of-range detection function ()****General information:**

The purpose of this function is to check if the tooth period is within a defined window area. The function returns true if the tooth period is outside the acceptance window.

**Formula section:**

Before first reference gap:

```

If                T_TOOTH n-1 * (1 - ID_FAC_TOL_CRK_TOOTH) T_TOOTH n T_TOOTH n-1 * (1
+ ID_FAC_TOL_CRK_TOOTH)

```

```

Then              return (false)

```

```

Else              return (true)

```

After first reference gap:

```

If                T_TOOTH n-1 * (1 - ID_FAC_TOL_CRK_TOOTH) T_TOOTH n

```

```

Then              return (false)


```

```

Else              return (true)

```

Remark: If  $T\_TOOTH > T\_TOOTH\ n-1 * (1 + ID\_FAC\_TOL\_CRK\_TOOTH)$  after first reference gap, then a tooth is simulated (see below Missing Tooth Simulation Function ).

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The acceptance window is disabled

- on the first and second crankshaft signal edge after a reference gap detection
- on the first and second crankshaft signal edge after simulation of a missing tooth
- after engine synchronization, it could also be disabled below an engine speed, for example for engines having strong accelerations/decelerations at start:

If  $N < NC\_N\_CRK\_WIN\_ENA$   
 And  $CRK\_CTR > NC\_NR\_TOOTH\_TOL\_ADD$   
 And  $CRK\_CTR < (NC\_NR\_TOOTH / NC\_NR\_GAP) - NC\_NR\_TOOTH\_GAP - NC\_NR\_TOOTH\_TOL\_MIS - 2$  (for latency time)

This effectively means that the acceptance window is only applied for GAP detection below the configured engine speed threshold.

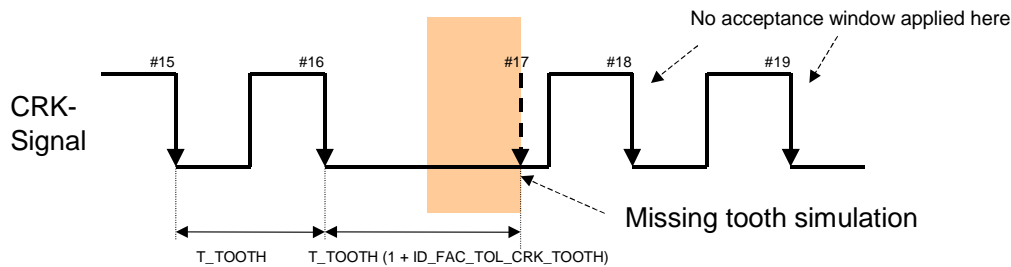
### 2.10.2.4 Missing Tooth Simulation Function ()

#### General information:

Simulate a tooth with tooth period  $T\_TOOTH$  n-1 (last measured tooth period).

All measurements shall be based on the simulated tooth not on real edges.

Simulation starts at the last (real or simulated) signal edge if no signal edge is detected inside the acceptance window defined by  $ID\_FAC\_TOL\_CRK\_TOOTH$ .



#### Formula section:

Increment  $CRK\_CTR$ .

Increment  $CRK\_MISS\_CTR$ .

$LV\_CRK\_MISS\_TOOTH = 1$

### 2.10.2.5 Missing Tooth Simulation in Gap Position Function ()

#### General information:

Simulate a tooth with tooth period  $T\_TOOTH$  n-1 (last measured tooth period).


Simulation starts at the last (real or simulated) signal edge if no signal edge is detected inside the acceptance window defined by  $ID\_FAC\_TOL\_CRK\_TOOTH$ .

Simulation stops when a edge is detected after the first simulated missing tooth.

All measurements shall be based on the simulated tooth not on real edges.

#### Formula section:

Increment  $CRK\_CTR$ .

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```

If          number of simulated teeth < NC_NR_TOOTH_GAP
              And
              Missing tooth simulation stopped
Then       Increment CRK_MISS_CTR
              High acceleration during reference gap: only one tooth could be simulated
Endif

If          number of simulated teeth > NC_NR_TOOTH_GAP
Then       Increment CRK_ADD_CTR
              High deceleration during reference gap: more than NC_NR_TOOTH_GAP teeth simulated
Endif

```

### 2.10.2.6 Engine stalling detection function ()

#### General information:

Engine stalling is detected when the number of consecutive simulated teeth exceeds NC\_NR\_TOOTH\_STALL or when the tooth period is greater than T\_TOOTH\_MAX.

#### Formula section:

$$T\_TOOTH\_MAX = \frac{60}{NC\_NR\_TOOTH * NC\_N\_MIN}$$

```

If          more than NC_NR_TOOTH_STALL consecutive teeth are simulated
              Or
              T_TOOTH (1 + ID_FAC_TOL_CRK_TOOTH) >= T_TOOTH_MAX
Then       return (true)
Else       return (false)
Endif

```

## 2.10.3 Requirements to infrastructure

### 2.10.3.1 Crankshaft Tooth Time Measurement (T\_TOOTH)

#### General information:

System request accuracy <= 4 us


The crankshaft tooth period T\_TOOTH is the measured time between two consecutive valid active crankshaft signal edges (falling or rising according to configuration).

If a missing tooth is simulated, T\_TOOTH represents the time period between the last two real valid signal edges. T\_TOOTH keeps the latest value until a new measured value is available.

### 2.10.3.2 Segment Period Measurement (T\_SEG\_ENSD) and Trigger Generation

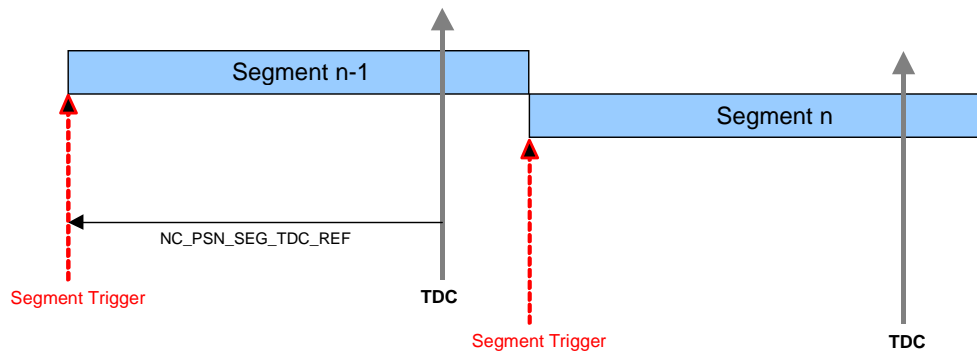
#### General information:

System request accuracy <= 1 us

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At Segment event, a trigger is defined and a control signal is generated to trigger execution of segment synchronous tasks.

The corresponding time intervals  $T\_SEG\_ENSD$  are measured between tooth events located  $NC\_PSN\_SEG\_TDC\_REF$  degrees before each TDC.



### Application conditions

**Initialisation:**  $T\_SEG\_ENSD$  is set to the maximum value

**Recurrence :** before synchronization: once (when  $LV\_CRK\_RUN$  is set)  
after synchronization:  $NC\_PSN\_SEG\_TDC\_REF$  degrees before each TDC (segment trigger)

**Activation :**  $LV\_CRK\_RUN = 1$

**Deactivation :**  $LV\_CRK\_STOP = 1$

### Formula section:

Before synchronization, one segment time is output at the moment when crankshaft rotation is validated. The first segment period is calculated from the most recent tooth period:

$$T\_SEG\_ENSD = (2 * T\_TOOTH * NC\_NR\_TOOTH) / NC\_CYL\_NR$$

The same calculation applies to the first segment after synchronization.

After synchronization:

$T\_SEG\_ENSD$  = time interval between tooth events located  $NC\_PSN\_SEG\_TDC\_REF$  degrees before each TDC

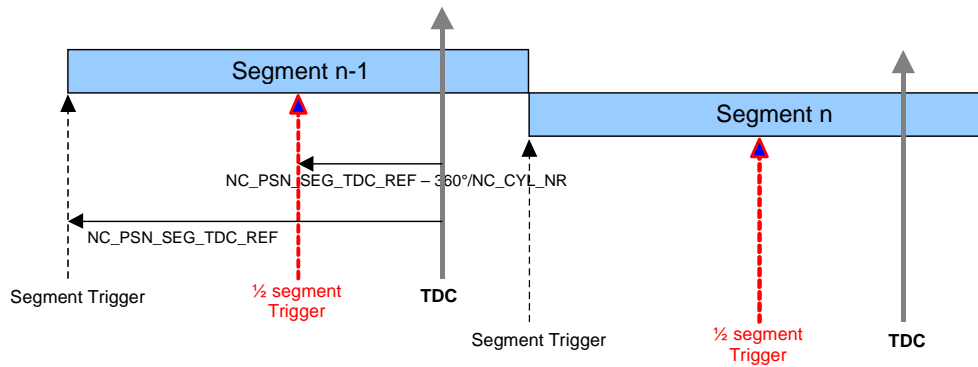
### **2.10.3.3 Half-Segment Period Measurement ( $T\_SEG\_HALF\_ENSD$ ) and Trigger Generation**

#### General information:

System request accuracy  $\leq 1$  us

At the half of a segment (in the middle of two segment events) a half-segment event is generated and an half-segment trigger is defined and send to the ASW if the engine speed is lower than a threshold defined by  $NC\_N\_SEG\_HALF\_END$ .

This function provides a output value for the half-segment period. This measured time is send to the ASW.



### Application conditions

**Initialisation:** T\_SEG\_HALF\_ENSD is set to the maximum value

**Recurrence:** before synchronization: once (when LV\_CRK\_RUN is set)  
after synchronization:  
NC\_PSN\_SEG\_TDC\_REF degrees before each TDC (segment trigger)  
**and**  
NC\_PSN\_SEG\_TDC\_REF - 360° CRK / NC\_CYL\_NR degrees before each  
TDC (half-segment trigger) **if** T\_SEG\_HALF\_ENSD >= 60 / (NC\_  
CYL\_NR \* NC\_N\_SEG\_HALF\_END)

**Activation:** LV\_CRK\_RUN = 1

**Deactivation:** LV\_CRK\_STOP = 1

### Formula section:

The first half segment period is calculated from the most recent tooth period:

$$T\_SEG\_HALF\_ENSD = (T\_TOOTH * NC\_NR\_TOOTH) / NC\_CYL\_NR$$

After synchronization:

$$T\_SEG\_HALF\_ENSD = \text{time elapsed between}$$

- a segment event and a half-segment event or
- a half-segment event and a segment event

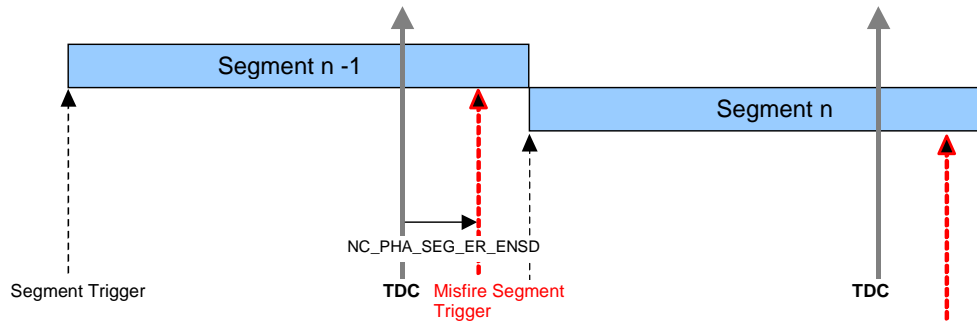
### 2.10.3.4 Misfire Segment Period Measurement (T\_SEG\_ER)

#### General information:

System request accuracy <= 1 us

The function provides output values for the misfire segment period.

The misfire segment period T\_SEG\_ER corresponds to the TDC period, measured at the tooth events, which are closest to NC\_PHA\_SEG\_ER\_ENSD after each TDC.



### Application conditions

**Initialisation:** T\_SEG\_ER is set to the maximum value

**Recurrence:** every misfire segment

### Formula section:

$T\_SEG\_ER$  = time interval between misfire segment tooth events.

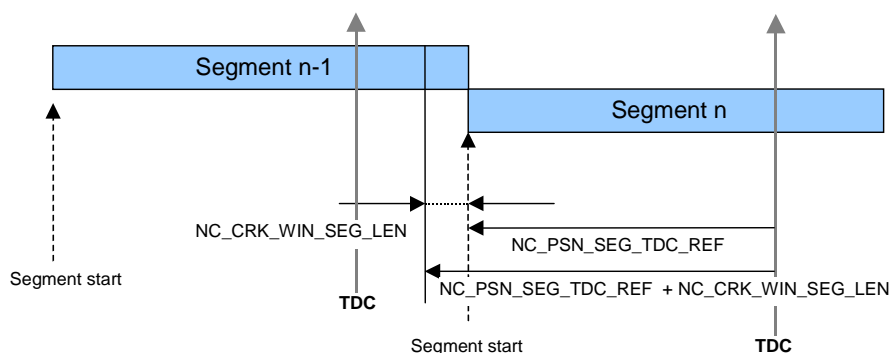
### 2.10.3.5 Crankshaft tooth window measurement (T\_CRK\_WIN\_ENSD)

#### General information:

System request accuracy  $\leq 1 \mu s$

The time interval elapsed between tooth events located between NC\_CRK\_WIN\_SEG\_LEN degrees before the end of each segment and the segment trigger is measured and send to the ASW segment synchronous

It provides and measures the time of the last NC\_CRK\_WIN\_SEG\_LEN teeth period before segment event.



### Application conditions

**Initialisation:** T\_CRK\_WIN\_ENSD is set to the maximum value

**Recurrence:** every segment

**Activation:** LV\_CRK\_SYN = 1

**Deactivation:** LV\_CRK\_STOP = 1

### Formula section:

**If** LV\_CRK\_SYN is set to 1 between NC\_CRK\_WIN\_SEG\_LEN degrees before the end of the segment and the segment trigger event

**Then** /\* Recalculation from last available tooth period \*/

$$T\_CRK\_WIN = (T\_TOOTH * NC\_NR\_TOOTH) / (360^\circ / CRK\_NC\_CRK\_WIN\_SEG\_LEN)$$

**Else** /\* Normal calculation \*/

$$T\_CRK\_WIN\_ENSD = \text{time interval between tooth events located between NC\_CRK\_WIN\_SEG\_LEN degrees before the end of each segment and the segment trigger}$$

**Endif**

### 2.10.3.6 ID\_FAC\_TOL\_CRK\_TOOTH calculation

#### General information:

ID\_FAC\_TOL\_CRK\_TOOTH[0rpm] is used until crankshaft synchronization (i.e. until first gap is detected, LV\_CRK\_SYN is set).

Then after crankshaft synchronization, ID\_FAC\_TOL\_CRK\_TOOTH is calculated depending on engine speed value (N\_32).

## 2.10.4 System requirements to sensor signal

### 2.10.4.1 General

With both sensor technologies, there is an angular offset between the mechanical reference (usually the trailing edge of a tooth) and the timing reference of the sensor (zero crossing of the MCPS signal, output switching of the ACPS) for an active edge. This offset will further on be referred to as phase angle. The phase angle depends strongly on sensor tolerances, installation tolerances (air gap), and operating conditions (speed, temperature).

The tolerances given in the following paragraphs refer to the angular position of the crankshaft target wheel when an active signal edge is recognized by the input port of the  $\mu\text{P}$ , or to the rotation angle between such events, respectively.

### 2.10.4.2 Relative phase angle tolerances

The usual synchronization algorithms can accept 3% tolerance of the target wheel rotation angle between consecutive active signal edges.

e.g. for a 60-2 target wheel, this is  $6^\circ$  ( $18^\circ$ )  $0.2^\circ$

The sensor/target wheel combination has to fulfill this requirement at all operating conditions.

The permissible accumulation of tooth angle tolerances over a TDC segment is 0.25% of the angle for one TDC segment ( $720^\circ / NC\_CYL\_NR$ ) at segment reference conditions.

e.g. for four-cylinder engines  $180^\circ$   $0.^\circ$


e.g. for six-cylinder engines  $120^\circ$   $0.3^\circ$

Segment reference conditions are: 2000rpm,  $80^\circ\text{C}$ .

Please note that for engines with more than 8 cylinders, this requirement is more stringent than the requirement for consecutive signal edges.

### 2.10.4.3 Relative phase angle stability

The angle for one TDC period measured under segment reference conditions must not have a drift  $> 0.0^\circ$  versus speed variation from 2000 rpm...7000 rpm and temperature variation within the complete

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range. This requirement has to be fulfilled for all tolerances and all possible displacements of the target wheel relative to the sensor (air gap, radial run-out, crankshaft flexion, bearing clearance...).

In case of MCPS sensors, phase angle stability must be measured with the ECU hardware stage.

#### 2.10.4.4 Repeatability

Two different definitions of repeatability are functionally equal. The choice depends on the sensor test bench and measurement equipment.

##### 1. Phase angle repeatability

(mechanical edge to signal edge for the same tooth) 0.025°

##### 1. Interval repeatability

(signal edge to signal edge for the same pair of teeth) 0.05°

In both cases the repeatability is determined from the maximum and minimum value out of a large number of measurements under constant conditions.

### 2.10.5 Hardware and HAL requirements

#### 2.10.5.1 EMI

Any signal disturbance must be suppressed as far as possible. Supplemental trigger events must not be generated due to such disturbance, particularly not at the slow zero crossing in the reference gap.

#### 2.10.5.2 Phase shift repeatability

At constant operating conditions, the phase shift introduced by the input circuitry must be constant within 0.1 µs

## 2.11 Acquisition of camshaft signal (internal version)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CAM_DYW_CRK_SYN_ADC_EX	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Tolerance window advance for exhaust camshaft to crankshaft reference in crankshaft synchronization mode					
CAM_DYW_CRK_SYN_ADC_IN	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Tolerance window advance for intake camshaft to crankshaft reference in crankshaft synchronization mode					
CAM_DYW_CRK_SYN_RTD_EX	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Tolerance window retard for exhaust camshaft to crankshaft reference in crankshaft synchronization mode					
CAM_DYW_CRK_SYN_RTD_IN	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Tolerance window retard for intake camshaft to crankshaft reference in crankshaft synchronization mode					
CAM_DYW_SYN_EX	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Tolerance window for angle between exhaust camshaft signal edges in crankshaft synchronization mode					
CAM_DYW_SYN_IN	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Tolerance window for angle between intake camshaft signal edges in crankshaft synchronization mode					
CTR_EDGE_CAM_EX [NC_NR_CAM_CBK]	O/V	0... FFH	0... 255	1	-
Continuous camshaft signal edge counter					
CTR_EDGE_CAM_IN [NC_NR_CAM_CBK]	O/V	0... FFH	0... 255	1	-
Continuous camshaft signal edge counter					
IDX_EDGE_CAM_EX [NC_NR_CAM_CBK]	O/V	0... FH	1... 16	1	-
Index of the last camshaft signal edge					
IDX_EDGE_CAM_IN [NC_NR_CAM_CBK]	O/V	0... FH	1... 16	1	-
Index of the last camshaft signal edge					
LV_CAM_STOP_EX [NC_NR_CAM_CBK]	O	0... 1H	0 ...1	1	-
Self synchronization on Exhaust camshaft i is stopped					
LV_CAM_STOP_IN [NC_NR_CAM_CBK]	O	0... 1H	0 ...1	1	-
Self synchronization on Intake camshaft i is stopped					
LV_CAM_SYN_CRK	O/V	0... 1H	0 ...1	1	-
Camshaft acquisition ready for crankshaft synchronization.					
LV_ORNG_CAM_SYN_CRK	O/V	0... 1H	0 ...1	1	-
Camshaft signal for crankshaft synchronization out of range					
LV_ORNG_PER_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Exhaust camshaft segment period out of range					
LV_ORNG_PER_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Intake camshaft segment period out of range					
LV_ORNG_RATIO_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Exhaust camshaft segment ratio out of range					
LV_ORNG_RATIO_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Intake camshaft segment ratio out of range					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_SYN_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Exhaust camshaft synchronized					
LV_SYN_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Intake camshaft synchronized					
LV_VLD_PSN_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Exhaust camshaft position measurement valid					
LV_VLD_PSN_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Intake camshaft position measurement valid					
PSN_CAM_CAM	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Theoretical angular distance between consecutive active camshaft edges					
PSN_CAM_CAM_1	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Theoretical angular distance between the active camshaft edge and the following active edge					
PSN_ENG_CRK_OFS	O	0... 2CFFH	0... 719.9375	0.0625	°CRK
Engine position offset for initialization at crankshaft synchronization.					
PSN_ENG_SYN_CAM_MAX	O	0... 2CFFH	0... 719.9375	0.0625	°CRK
Maximum engine position during crankshaft synchronization phase.					
PSN_ENG_SYN_CAM_MIN	O	0... 2CFFH	0... 719.9375	0.0625	°CRK
Minimum engine position during crankshaft synchronization phase.					
PSN_TOOTH1_CAM	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Theoretical angular distance between crankshaft tooth #1 and camshaft edge					
RATIO_PER_CAM_EX [NC_NR_CAM_CBK]	-	0... FFH	0.0625 ...16	0.0625	-
Camshaft period ratio for synchronization					
RATIO_PER_CAM_IN [NC_NR_CAM_CBK]	-	0... FFH	0.0625 ...16	0.0625	-
Camshaft period ratio for synchronization					
RATIO_PSN_EDGE_CAM_EX [NC_NR_EDGE_CAM_EX][NC_NR_CAM_CBK]	-	0... FFH	0.0625 ...16	0.0625	-
Theoretical exhaust camshaft i period ratio at edge z					
RATIO_PSN_EDGE_CAM_IN [NC_NR_EDGE_CAM_IN][NC_NR_CAM_CBK]	-	0... FFH	0.0625 ...16	0.0625	-
Theoretical intake camshaft i period ratio at edge z					
REL_ANG_CAM_REF_GAP	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Measured angular distance between reference gap and camshaft edge					
REL_ANG_CRK_CAM	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Measured angular distance between consecutive active camshaft edges					
ST_CAM_CRK_S	-	0... 4H	0 ...4	1	-
Cam crank synchronization state					
ST_CAM_PRE_INJ_S	-	0... 3H	0 ...3	1	-
Cam crank synchronization state					
ST_CAM_SS	-	0... 5H	0 ...5	1	-
Camshaft self synchronization state					
T_SEG_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 7FFFFFFH	0... 1.9965	237.999e-9	s
Camshaft segment period					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_SEG_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 7FFFFFFH	0... 1.9965	237.999e-9	s
Camshaft segment period					

**Input data:**

LV_ACT_CAM_EX [NC_NR_CAM_CBK] {p. 1505}	LV_ACT_CAM_IN [NC_NR_CAM_CBK] {p. 1505}	LV_ACT_SYN_CRK_CAM_ EX [NC_NR_CAM_CBK] {p. 1505}	LV_ACT_SYN_CRK_CAM_ IN [NC_NR_CAM_CBK] {p. 1505}
LV_CAM_LOCK_IVVT_EX [NC_NR_CBK_IVVT] {p. 8399}	LV_CAM_LOCK_IVVT_IN [NC_NR_CBK_IVVT] {p. 8399}	LV_CRK_FIRST_VLD_ TOOTH {p. 853}	LV_CRK_SYN {p. 853}
LV_STOP_ENG {p. 1505}	N_32 {p. 1525}	NC_NR_TOOTH {p. 854}	NC_OFS_TDC0_REF_CRK {p. 854}
NLC_IVVT_EX {p. 8400}	NLC_IVVT_IN {p. 8401}	PSN_ENG_CRK {p. 1506}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CAM_ADJ_VVT_SYN_CRK_ADC_IN	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Extension of tolerance window CAM_DYW_CRK_SYN_ADC_IN when VVT is not in locked position at start					
C_CAM_ADJ_VVT_SYN_CRK_RTD_EX	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Extension of tolerance window CAM_DYW_CRK_SYN_RTD_EX when VVT is not in locked position at start					
C_CAM_ADJ_VVT_SYN_EX	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Extension of tolerance window CAM_DYW_SYN_EX when VVT is not in locked position at start					
C_CAM_ADJ_VVT_SYN_IN	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Extension of tolerance window CAM_DYW_SYN_IN when VVT is not in locked position at start					
C_CRK_ANG_DLY	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Crankshaft angle threshold after start of cranking to reduce the possible engine position range for pre-injection					
C_CRK_ANG_DLY_LST_CAM	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Crankshaft angle threshold after last cam edge to reduce the possible engine position range for pre-injection					
C_DYW_CAM_CRK_SYN_ADC_EX	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Tolerance window advance for exhaust camshaft to crankshaft reference in crankshaft synchronization mode					
C_DYW_CAM_CRK_SYN_ADC_IN	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Tolerance window advance for intake camshaft to crankshaft reference in crankshaft synchronization mode					
C_DYW_CAM_CRK_SYN_RTD_EX	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Tolerance window retard for exhaust camshaft to crankshaft reference in crankshaft synchronization mode					
C_DYW_CAM_CRK_SYN_RTD_IN	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Tolerance window retard for intake camshaft to crankshaft reference in crankshaft synchronization mode					
C_DYW_CAM_SYN_EX	-	0... 1FFH	0... 31.9375	0.0625	°CRK
Tolerance window for angle between exhaust camshaft signal edges in crankshaft synchronization mode					
C_DYW_CAM_SYN_IN	-	0... 1FFH	0... 31.9375	0.0625	°CRK
Tolerance window for angle between intake camshaft signal edges in crankshaft synchronization mode					
C_NR_EDGE_MIN_VLD_CAM_EX	-	0... FFH	0... 255	1	-
Number of exhaust camshaft signal edges for valid position output					
C_NR_EDGE_MIN_VLD_CAM_IN	-	0... FFH	0... 255	1	-
Number of intake camshaft signal edges for valid position output					
ID_FAC_CAM_EX	-	10... FFH	1... 15.9375	0.0625	-

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_N_32_1_ENSD	16	0... FFH	0... 8160	32	rpm
Period ratio tolerance factor for exhaust camshaft					
ID_FAC_CAM_IN	-	10... FFH	1... 15.9375	0.0625	-
LDPM_N_32_1_ENSD	16	0... FFH	0... 8160	32	rpm
Period ratio tolerance factor for intake camshaft					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ACT_CAM_EDGE_LIH	-	1... 3H	1 ...3	1	-
Active edge of camshaft signal for crankshaft limp-home					
NC_ACT_CAM_EDGE_SYN	-	1... 3H	1 ...3	1	-
Active edge of camshaft signal for cam/crk synchronization					
NC_NR_EDGE_CAM_EX	-	1... FH	1... 15	1	-
Number of signal edges per exhaust camshaft revolution					
NC_NR_EDGE_CAM_IN	-	1... FH	1... 15	1	-
Number of signal edges per intake camshaft revolution					
NC_NR_GAP	-	1... 2H	1 ...2	1	-
Number of reference gaps per engine revolution					
NC_PSN_EDGE_CAM_EX [NC_NR_EDGE_CAM_EX][NC_NR_CAM_CBK]	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Ideal engine position relative to TDC0 for exhaust camshaft i signal edge z					
NC_PSN_EDGE_CAM_IN [NC_NR_EDGE_CAM_IN][NC_NR_CAM_CBK]	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Ideal engine position relative to TDC0 for intake camshaft i signal edge z					
NC_T_SEG_MAX_CAM_EX	-	0... FFFFFFFH	0... 3.99999	238.4e-9	s
Maximum time between camshaft signal edges					
NC_T_SEG_MAX_CAM_IN	-	0... FFFFFFFH	0... 3.99999	238.4e-9	s
Maximum time between camshaft signal edges					
NC_T_SEG_MIN_CAM_EX	-	0... FFFFFFFH	0... 3.99999	238.4e-9	s
Minimum time between camshaft signal edges					
NC_T_SEG_MIN_CAM_IN	-	0... FFFFFFFH	0... 3.99999	238.4e-9	s
Minimum time between camshaft signal edges					

**General information:**

This specification is dedicated to acquisition of the signal from sensors and target wheels on up to 4 camshafts (intake and exhaust, cylinder bank 1 and 2).


The operating mode of the signal acquisition is controlled for each camshaft separately.

A diagnostic output is delivered to allow detection of camshaft signal failure.

The signal is used for:

1. Self synchronization of all camshafts: timing validation of the camshaft signal edges in correspondence with its theoretical position (used for VVT controller, for detection of crankshaft signal failure, and for limp-home in case of crankshaft signal failure).
2. Camshaft /crankshaft synchronization of the selected camshaft: determination of the offset for the engine position calculation.
3. Engine position interface for pre-injection (with the selected camshaft used for cam/crank synchronization)

These three functions are described with three states diagrams.

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**Application conditions:***Recurrence:*

For set of the RAM as flags, a mirror area is defined which contains a copy of the output and calibration data in the basic software area (see figure below).

The mirror area of the output data is updated by the lower layer at every signal edge.


The mirror area of the calibration data is updated by the upper layer each 10ms.

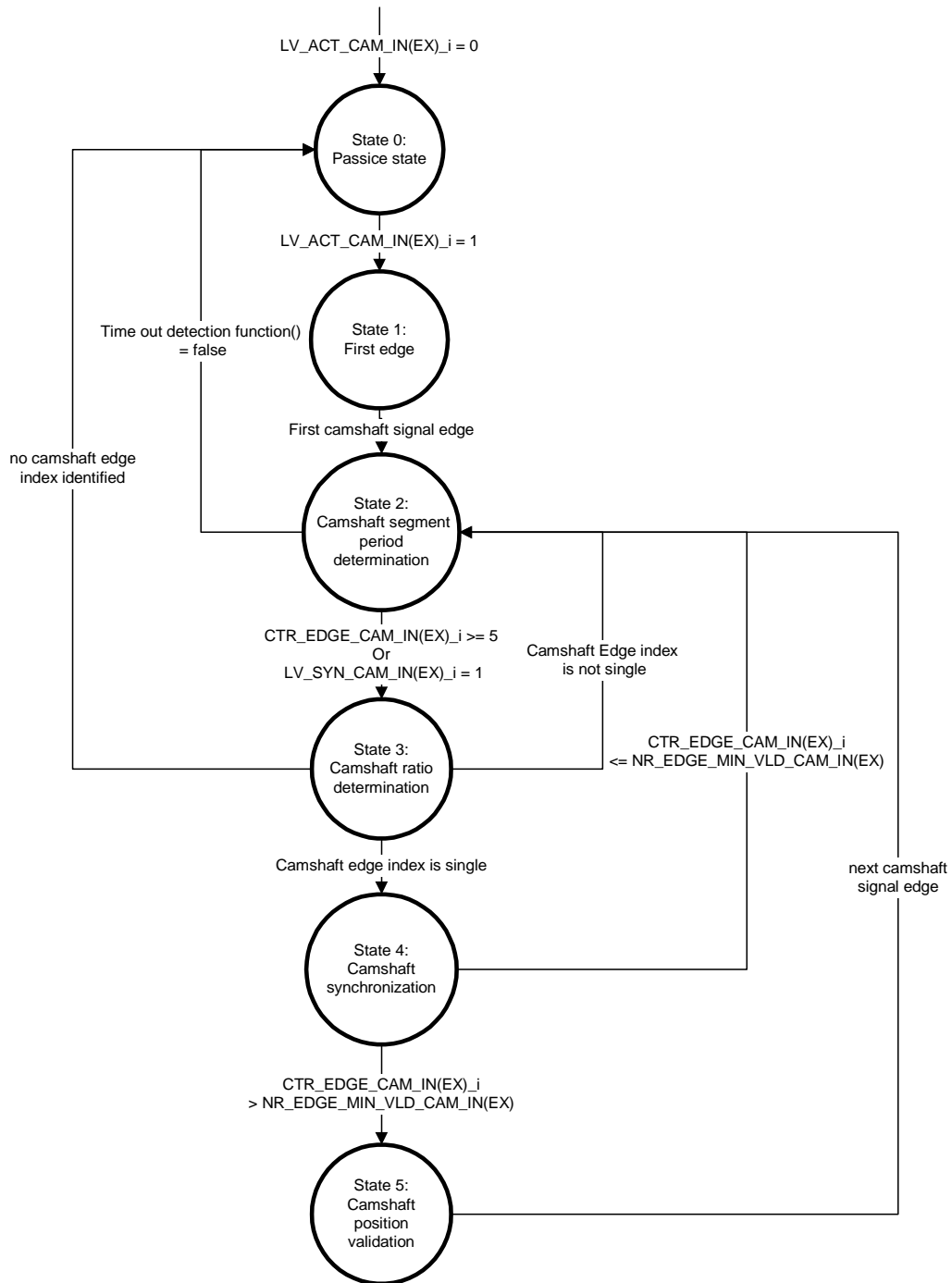
The output data is copied from the mirror area every 10 ms

**2.11.1 Camshaft Self-Synchronization****Application conditions**

**Recurrence:** *every camshaft signal edge (falling and rising)*

**Signal flow diagram (ST\_CAM\_SS):**

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### Formula section:

$$i = 1 \dots NC\_NR\_CAM\_CBK$$

$$z = 0 \dots NC\_NR\_EDGE\_CAM\_IN(EX)$$

State 0: Passive State

*Input condition :*

From EPM :

$$LV\_ACT\_CAM\_IN(EX)[i] = 0$$

From state 2 :

$$\text{Time out detection function } () = \text{false}$$

From state 3 : No cam edge index identified

*Output condition :*

No output conditions

*Action in the state :*

LV\_CAM\_STOP\_IN[i] = LV\_CAM\_STOP\_EX[i] = 1  
 T\_SEG\_CAM\_IN[i] = NC\_T\_SEG\_MAX\_CAM\_IN  
 T\_SEG\_CAM\_EX[i] = NC\_T\_SEG\_MAX\_CAM\_EX  
 LV\_SYN\_CAM\_IN[i] = LV\_SYN\_CAM\_EX[i] = 0  
 LV\_VLD\_PSN\_CAM\_IN[i] = LV\_VLD\_PSN\_CAM\_EX[i] = 0  
 CTR\_EDGE\_CAM\_IN[i] = CTR\_EDGE\_CAM\_EX[i] = 0  
 IDX\_EDGE\_CAM\_IN[i] = IDX\_EDGE\_CAM\_EX[i] = 1  
 RATIO\_PER\_CAM\_IN(EX)[i] = 0  
 RATIO\_PSN\_EDGE\_CAM\_IN(EX)[z][i] = 0

*Action in transient:*

No actions

State 1: First edge

*Input condition:*

From state 0: LV\_ACT\_CAM\_IN(EX)[i] = 1

*Output condition:*

To state 2 First camshaft signal edge

*Action in the state:*

LV\_CAM\_STOP\_IN(EX)[i] = 0  
 LV\_ORNG\_PER\_CAM\_IN(EX)[i] = 0  
 LV\_ORNG\_RATIO\_CAM\_IN(EX)[i] = 0

Level detection: The indexes of the camshaft edge leading to the camshaft signal level will be determined (example: if the signal level is high, all indexes corresponding to a rising signal edges).  
 Wait for first camshaft signal edge

*Action in transient:*

No actions

State 2: Camshaft segment period determination

*Input condition :*

From state 1 First camshaft signal edge occurred  
 From state 3: Cam Edge index is not single  
 From state 4: CTR\_EDGE\_CAM\_IN(EX)[i] <=  
 C\_NR\_EDGE\_MIN\_VLD\_CAM\_IN(EX)  
 And next camshaft signal edge  
 From state 5: next camshaft signal edge

**Output condition :**

To state 0 : Time out detection function () = False

To state 3 : CTR\_EDGE\_CAM\_IN(EX)[i] >= 5  
Or  
LV\_SYN\_CAM\_IN(EX)[i] = 1

**Action in the state:**

```

If Invalid segment period detection function() = true
    Then LV_ORNG_PER_CAM_IN(EX)[i] = 1
    Else Activation of Time out detection function ()
        Increment CTR_EDGE_CAM_IN(EX)[i]
        Indexes of the possible cam edges table are incremented
        by one modulo NC_NR_EDGE_CAM_IN(EX).
Endif

```

**Action in transient:**

No actions

**State 3: Camshaft ratio determination****Input condition :**

From state 2: CTR\_EDGE\_CAM\_IN(EX)[i] >= 5  
Or  
LV\_SYN\_CAM\_IN(EX)[i] = 1

**Output condition :**

To state 0: No Cam Edge index identified  
To state 2: Cam Edge index is not single  
To state 4: Cam Edge index is single

**Action in the state :**

Activation of Camshaft segment ratio calculation function ()  
Activation of Camshaft edge recognition function ()

**Action in transient :**


To state 0: LV\_ORNG\_RATIO\_CAM\_IN(EX)[i] = 1  
To state 4: LV\_SYN\_CAM\_IN(EX)[i] = 1

**State 4: Camshaft synchronization****Input condition :**

From state 3: Cam Edge index is single

**Output condition :**

To state 2: CTR\_EDGE\_CAM\_IN(EX)[i] <=  
C\_NR\_EDGE\_MIN\_VLD\_CAM\_IN(EX)  
To state 5: CTR\_EDGE\_CAM\_IN(EX)[i] >

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### C\_NR\_EDGE\_MIN\_VLD\_CAM\_IN(EX)

*Action in the state:*  $IDX\_EDGE\_CAM\_IN(EX)[i] = \text{camshaft edge index}$   
Wait next camshaft signal edge.

*Action in transient:*

To state 5:  $LV\_VLD\_PSN\_CAM\_IN(EX)[i] = 1$

#### State 5: Validation of camshaft position

*Input condition:*

From state 4:  $CTR\_EDGE\_CAM\_IN(EX)[i] >$   
 $C\_NR\_EDGE\_MIN\_VLD\_CAM\_IN(EX)$

*Output condition:*

To state 2: Next camshaft signal edge

*Action in the state:*

Wait next camshaft signal edge.

*Action in transient:*

None

## 2.11.2 Camshaft/Crankshaft Synchronization

### General information:

Cam/crk synchronization is set as soon as the engine position is identified:

- Reference gap detected and
- Engine position offset determined

The engine position offset (PSN\_ENG\_CRK\_OFF) can be

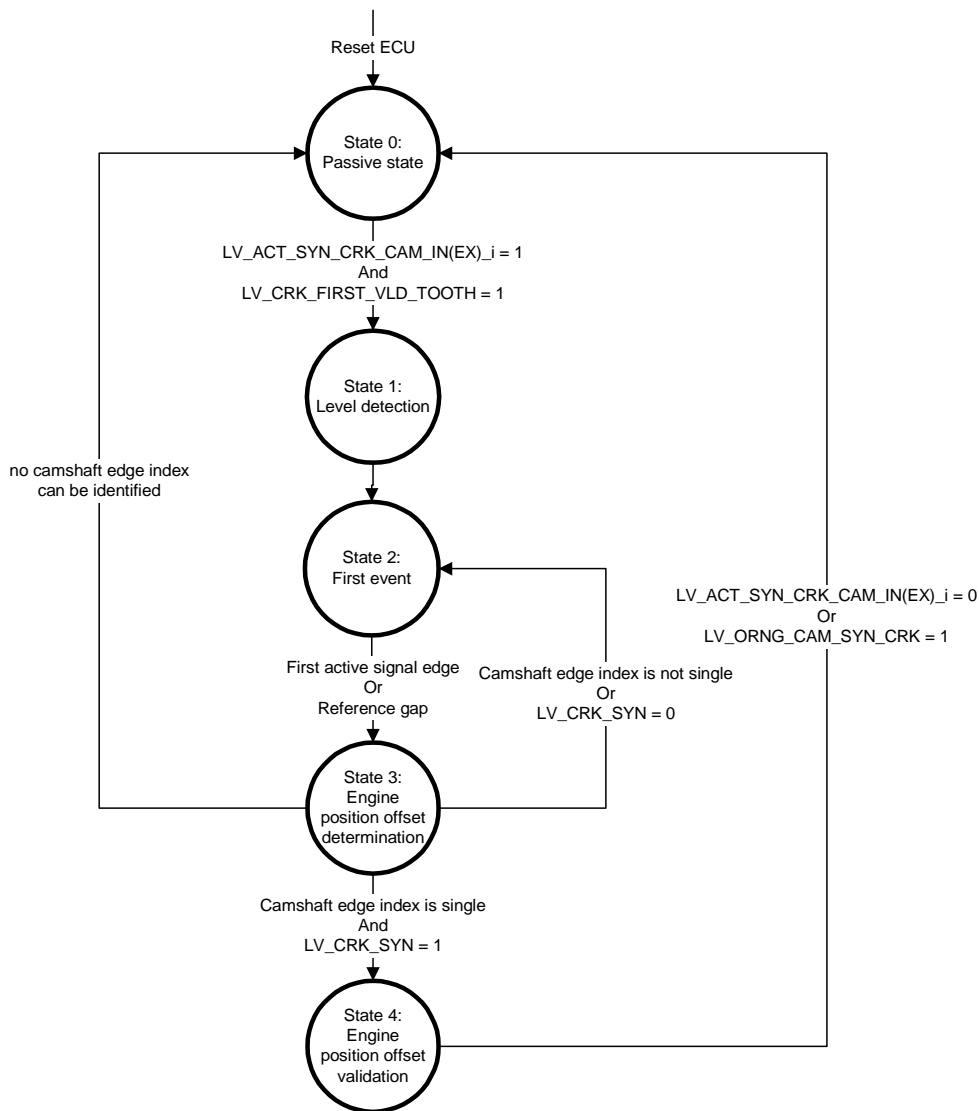
- 360° or 720° for NC\_NR\_GAP = 1
- 180°, 360°, 540°, 720° for NC\_NR\_GAP = 2

### Application conditions

#### **Recurrence:**

every falling camshaft signal edge and every reference gap  
if  $NC\_ACT\_CAM\_EDGE\_SYN = 1$   
every rising camshaft signal edge and every reference gap if  
 $NC\_ACT\_CAM\_EDGE\_SYN = 2$   
every camshaft signal edge (rising and falling) and every reference  
gap if  $NC\_ACT\_CAM\_EDGE\_SYN = 3$

### Signal flow diagram ST\_CAM\_CRK\_S:



### Formula section:

#### State 0: Passive State

##### Input condition :

External event:

Reset ECU

From State 4 :

$LV\_ACT\_SYN\_CRK\_CAM\_IN(EX)[i] = 0$

Or

$LV\_ORNG\_CAM\_SYN\_CRK = 1$

##### Output condition :

none

##### Action in the state:

$PSN\_ENG\_CRK\_OFS = 0^\circ \text{ CRK}$

$LV\_CAM\_SYN\_CRK = 0$



PSN\_ENG\_SYN\_CAM\_MIN = 0° CRK  
 PSN\_ENG\_SYN\_CAM\_MAX = 720° CRK  
 Activation of VVT lock check function ()

*Action in transient :*

none

State 1: Level Detection*Input condition:*

From state 0 : LV\_ACT\_SYN\_CRK\_CAM\_IN(EX)[i] = 1  
 And  
 LV\_CRK\_FIRST\_VLD\_TOOTH = 1

*Output condition :*

To state 2: At the end of the action in the state

*Action in the state :*

**If** NC\_ACT\_CAM\_EDGE\_SYN = 1  
**Then** Index list = {1,3, ..., NC\_NR\_EDGE\_CAM\_IN(EX)-1}  
 Keep only falling camshaft edges  
 Keep initialization values for PSN\_ENG\_SYN\_CAM\_MIN(MAX)  
**Elseif** NC\_ACT\_CAM\_EDGE\_SYN = 2  
**Then** Index list = {2,4, ..., NC\_NR\_EDGE\_CAM\_IN(EX)}  
 Keep only rising edges  
 Keep initialization values for PSN\_ENG\_SYN\_CAM\_MIN(MAX)  
**Else** The indexes of the camshaft edge leading to the camshaft  
 signal level will be determined (p.e. if the signal level is high, all indexes  
 corresponding to a rising signal edges).  
 Keep initialization values for PSN\_ENG\_SYN\_CAM\_MIN(MAX)  
**Endif**

*Action in transient :*

To state 2: LV\_ORNG\_CAM\_SYN\_CRK = 0

State 2: First event*Input condition :*

From state 1: At the end of the action in the state 1  
 From state 3: Camshaft edge index is not single  
 Or  
 LV\_CRK\_SYN = 0

*Output condition :*

To state 3: camshaft signal active edge for synchronization  
 Or  
 crankshaft reference gap

*Action in the state :*

Wait camshaft signal active edge or reference gap

*Action in transient :*

none

State 3: Engine Position Offset Determination*Input condition :*

From state 3: camshaft signal active edge for synchronization  
Or  
crankshaft reference gap

*Output condition :*

To state 4 : Camshaft signal edge index is single  
And  
LV\_CRK\_SYN = 1.  
To state 2 : Camshaft signal edge index is not single  
Or  
LV\_CRK\_SYN = 0  
To state 0 : If no cam edge index can be identified.

*Action in the state :*

Activation of camshaft edge index determination function ()

*Action in transient :*

To state 4 : LV\_CAM\_SYN\_CRK = 1  
To state 0 : LV\_ORNG\_CAM\_SYN\_CRK = 1

State 4: Engine Position Offset Validation*Input condition :*

To state 4 : Camshaft signal edge index is single  
And  
LV\_CRK\_SYN = 1.

*Output condition :*

To state 0 : LV\_ACT\_SYN\_CRK\_CAM\_IN(EX)[i] = 0  
Or  
LV\_ORNG\_CAM\_SYN\_CRK = 1

*Action in the state :*

Activation of Cam/crk synchronization validation function()  
**If** Cam/crk synchronization validation function() = false  
**Then** LV\_ORNG\_CAM\_SYN\_CRK = 1  
**Endif**

*Action in transient :*

None

## 2.11.3 Engine Position Interface for Pre-Injection

General information:

For rapid start of port-injection engines it is useful to start injection before synchronization on crankshaft signal is achieved. An approximative information about engine position is necessary for phasing the injection in a way to avoid emissions increase.

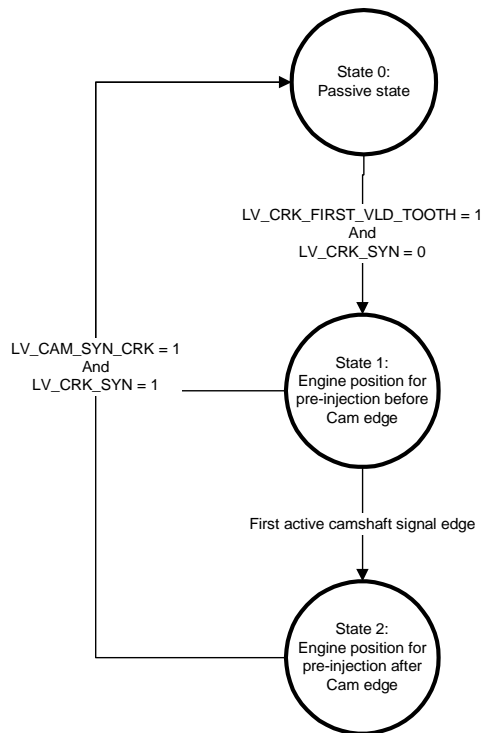
Released by Tettenborn Frank		Date 2013-02-13	File 30200J04.00D
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For this purpose, a minimum and the maximum engine position is determined according to the actual possible camshaft signal edge indexes found by camshaft signal acquisition for crankshaft synchronization. The minimum and the maximum position will converge gradually during the synchronization process.

### Application conditions

**Recurrence:** every falling camshaft signal edge and every reference gap if  $NC\_ACT\_CAM\_EDGE\_SYN = 1$   
 every rising camshaft signal edge and every reference gap if  $NC\_ACT\_CAM\_EDGE\_SYN = 2$   
 every camshaft signal edge (rising and falling) and every reference gap if  $NC\_ACT\_CAM\_EDGE\_SYN = 3$

### Signal flow diagram (ST\_CAM\_PRE\_INJ\_S):



### Formula section:


#### State 0: Passive State

##### Input condition :

From state 1,2 :  $LV\_CRK\_SYN = 1$   
 And  
 $LV\_CAM\_SYN\_CRK = 1$

##### Output condition :

To state 1:  $LV\_CRK\_FIRST\_VLD\_TOOTH = 1$   
 And

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LV\_CRK\_SYN = 0

*Action in the state :*

None

*Action in transient :*

None

State 1: Engine position for pre-injection before cam edge state

*Input condition :*

From state 1: End of the state 1

*Output condition :*

To state 2 : camshaft signal active edge for synchronization  
To state 0 : LV\_CRK\_SYN = 1 and LV\_CAM\_SYN\_CRK = 1

*Action in the state :*

*Activation of Pre-injection interface computation before cam edge function ()*

*Action in transient :*

To state 0 : PSN\_ENG\_SYN\_CAM\_MIN  
= PSN\_ENG\_SYN\_CAM\_MAX  
= PSN\_ENG\_CRK

State 2: Engine position for pre-injection after cam edge state

*Input condition :*

From state 1: camshaft signal active edge for synchronization

*Output condition :*

To state 0 : LV\_CRK\_SYN = 1 and LV\_CAM\_SYN\_CRK = 1

*Action in the state :*

*Activation of Pre-injection interface computation after Cam edge function ()*

*Action in transient :*

To state 0 : PSN\_ENG\_SYN\_CAM\_MIN  
= PSN\_ENG\_SYN\_CAM\_MAX  
= PSN\_ENG\_CRK

## 2.11.4 Definition of the sub function tasks


### 2.11.4.1 Time-out detection function ()

#### General information:

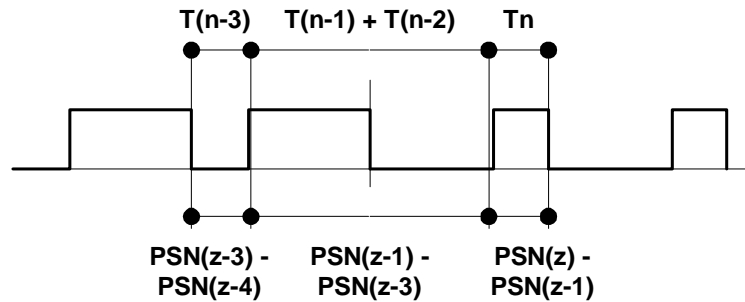
Time-out is detected when the segment period exceeds NC\_T\_SEG\_MAX\_CAM\_IN(EX). Time out detection is used for engine stalling detection during crankshaft limp-home.

#### Formula section:

If  $T\_SEG\_CAM\_IN(EX)[i] \leq NC\_T\_SEG\_MAX\_CAM\_IN(EX)$

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#### 2.11.4.4 Camshaft edge recognition ()

##### General information:

The purpose of this function is to compare the measured camshaft edge ratio to the theoretical camshaft edge ratio. The camshaft edge is removed from the camshaft index table if both ratios (theoretical and measured) are different more than ID\_FAC\_CAM\_IN(EX).

$i = 1 \dots NC\_NR\_CAM\_CBK$

$z = 0 \dots NC\_NR\_EDGE\_CAM\_IN(EX)$

##### Application conditions

**Recurrence:** *every camshaft edge.*

##### Formula section:

For all remaining indexes z:

**If**  $RATIO\_PSN\_EDGE\_CAM\_IN(EX)[z][i] * ID\_FAC\_CAM\_IN(EX) > RATIO\_PER\_CAM\_IN(EX)[i]$   
 $> RATIO\_PSN\_EDGE\_CAM\_IN(EX)[z][i] / ID\_FAC\_CAM\_IN(EX)$

**Then** keep index z in the table

**Else** eliminate index z from the table

**Endif**

#### 2.11.4.5 Camshaft edge index determination function ()

##### General information:

This function determines the possible camshaft signal indexes and returns the engine position offset when the index is identified.

This function is used for

- determination of position offset for engine synchronization
- determination of min/max engine position for pre-injection


The actions and tests of this function shall be performed for all remaining indexes of the list of possible camshaft signal indexes.

$i = 1 \dots NC\_NR\_CAM\_CBK$

$z = 0 \dots NC\_NR\_EDGE\_CAM\_IN(EX)$

##### Application conditions

**Recurrence:** *every falling camshaft signal edge and every reference gap*  
*if NC\_ACT\_CAM\_EDGE\_SYN = 1*

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every rising camshaft signal edge and every reference gap if  
 $NC\_ACT\_CAM\_EDGE\_SYN = 2$   
 every camshaft signal edge (rising and falling) and every reference  
 gap if  $NC\_ACT\_CAM\_EDGE\_SYN = 3$

### Formula section:

**If** active camshaft signal edge  
**Then** **If**  $NC\_ACT\_CAM\_EDGE\_SYN = 3$   
**Then** Increment indexes in the list of possible camshaft signal index by 1 modulo  $NC\_NR\_EDGE\_CAM\_IN(EX)$   
**Else** Increment by 2 indexes in the list of possible camshaft signal index by 2 modulo  $NC\_NR\_EDGE\_CAM\_IN(EX)$

### Endif

Calculate theoretical angular distance between crankshaft tooth #1 and camshaft edge #z:

$$PSN\_TOOTH1\_CAM = NC\_OFS\_TDC0\_REF\_CRK + NC\_PSN\_EDGE\_CAM\_IN(EX)[z][i]$$

Calculate theoretical angular distance between two successive active camshaft edges:

$PSN\_CAM\_CAM$  is the distance between the current camshaft edge and the previous one, whereas  $PSN\_CAM\_CAM\_1$  is the distance between the current camshaft edge and the next one.  $PSN\_CAM\_CAM\_1$  is used in Test 10 in case of [ CAM - CRK-Angle ].

**If**  $NC\_ACT\_CAM\_EDGE\_SYN = 3$   
**Then** *Falling and rising camshaft edges*  
 $PSN\_CAM\_CAM = NC\_PSN\_EDGE\_CAM\_IN(EX)[z][i] - NC\_PSN\_EDGE\_CAM\_IN(EX)[z-1][i]$   
 $PSN\_CAM\_CAM\_1 = NC\_PSN\_EDGE\_CAM\_IN(EX)[z+1][i] - NC\_PSN\_EDGE\_CAM\_IN(EX)[z][i]$

**Else** *Only Falling or only rising camshaft edges*  
 $PSN\_CAM\_CAM = NC\_PSN\_EDGE\_CAM\_IN(EX)[z][i] - NC\_PSN\_EDGE\_CAM\_IN(EX)[z-2][i]$   
 $PSN\_CAM\_CAM\_1 = NC\_PSN\_EDGE\_CAM\_IN(EX)[z+2][i] - NC\_PSN\_EDGE\_CAM\_IN(EX)[z][i]$

### Endif

The number of possible indexes z will be reduced by checking the conditions described below.

The following table shows the actions to perform in function of the current event (n), previous event (n-1) and last event (n-2).

The event is a detection of a active camshaft edge (**CAM**) for synchronization or a detection of reference gap (**GAP**). If no event took place before (**none**), the tests are executed with the measured angular distance between engine start and current event.

To reduce the possible engine position range for pre-injection, the event could also be a measured crankshaft angle (**CRK-Angle**) from the last CAM event. The event should occur when :

$$REL\_ANG\_CRK\_CAM = C\_CRK\_ANG\_DLY\_LST\_CAM.$$

Note that two calibration datas are defined :

- $C\_CRK\_ANG\_DLY$  is the one used in case of [ CRK-Angle - CAM ] in Test 9 ;
- $C\_CRK\_ANG\_DLY\_LST\_CAM$  is the one used in case of [ CAM - CRK-Angle ] in Test 10.

This pre-injection improvement can be disabled by setting these calibration datas to 0°CRK.

<b>Event (n)</b>	CAM	CAM	GAP	GAP	CAM	CAM	GAP	CRK-Angle
<b>Event (n-1)</b>	None	CAM	None	CAM	GAP	GAP	GAP	CAM
<b>Event (n-2)</b>	-	-	-	-	None	CAM	-	-
<b>Test</b>	Test 1 Test 9	Test 2 Test 11	Test 3 Test 12	Test 4 Test 12	Test 1 Test 5 (1)	Test 2 Test 5 (1)	(2)	Test 10 (3)

(1) The first test shall be executed with event **n** and **n-2**. The second test shall be executed with event **n** and **n-1**

(2) No Camshaft index can be identified (All remaining indexes shall be removed)

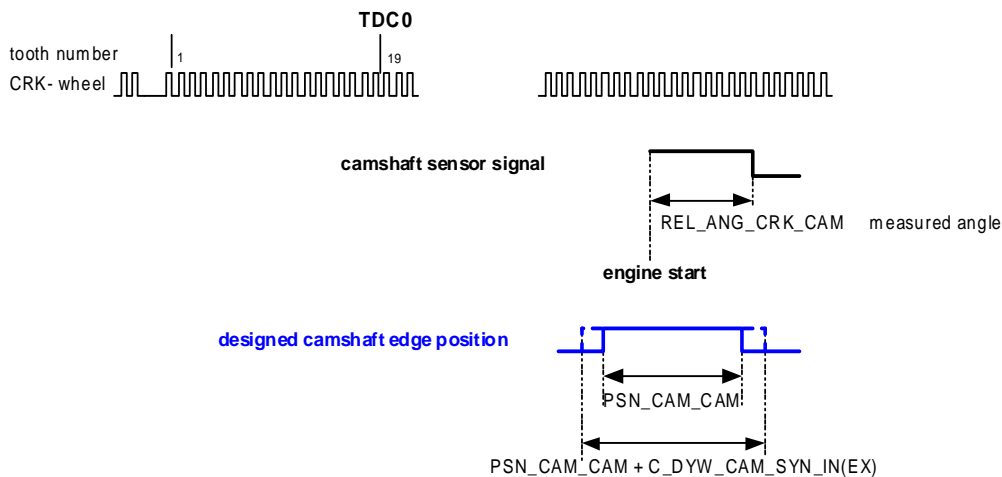
(3) CRK-Angle event will never be in position (n-1) as it will be replaced in the memory by the next event instead to be recorded in (n-1) position

NB1: The calculation of the CRK-Angle delay begins at each CAM edge, but is also reset in case of GAP event. No test should be performed in case of GAP - - CRK-Angle.

NB2: In all the following calculations, PSN\_TOOTH1\_CAM represents PSN\_TOOTH1\_CAM[z] (= PSN\_TOOTH1\_CAM for the camshaft edge z). If an other camshaft edge is used for computation, then PSN\_TOOTH1\_CAM[z] is mentioned.

### Test 1:

Active camshaft edge detected. No active camshaft edge occurred before.



**If**  $REL\_ANG\_CRK\_CAM < PSN\_CAM\_CAM + CAM\_DYW\_SYN\_IN(EX)$

**Then** (no operation)

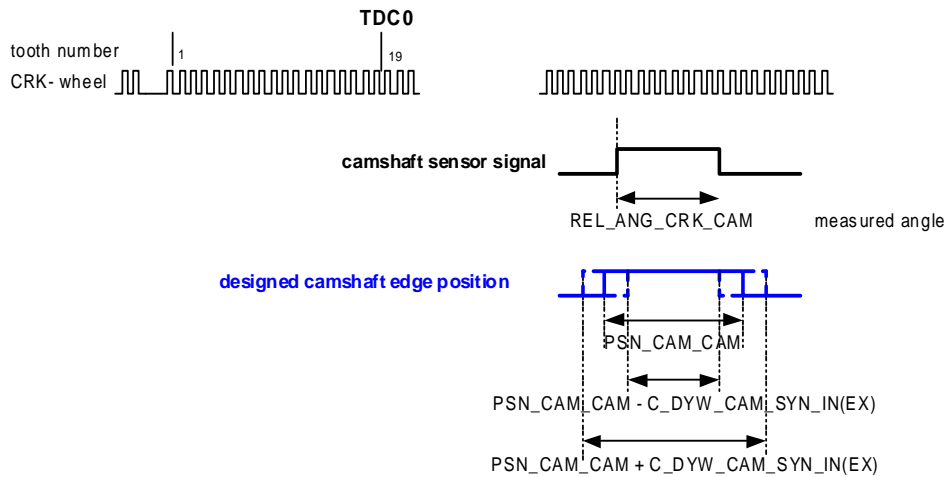
**Else** Remove index z from list of possible camshaft signal edge indexes

**Endif**

### Test 2:



Active camshaft edge detected. Last event was also an active camshaft edge.



$PSN\_GAP$  = engine position offset for camshaft edge #z

**If**  $PSN\_CAM\_CAM - CAM\_DYW\_SYN\_IN(EX)$

<  $REL\_ANG\_CRK\_CAM$  <

$PSN\_CAM\_CAM + CAM\_DYW\_SYN\_IN(EX)$

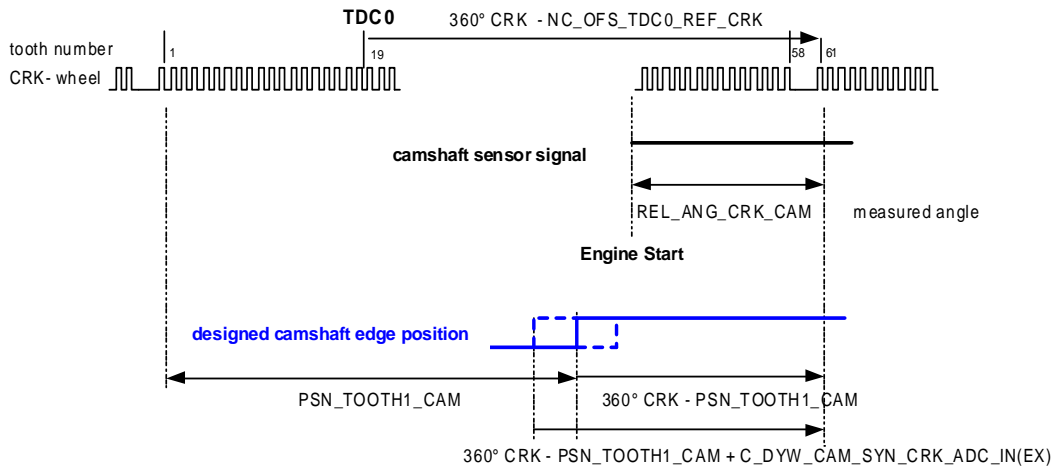
**Then**  $PSN\_ENG\_CRK\_OFS = PSN\_GAP - 360^\circ CRK$

**Else** Remove index z from list of possible camshaft signal edge indexes

**Endif**

### Test 3:

First reference gap detected. No active camshaft edge occurred before.



$PSN\_GAP$  = engine position offset for camshaft edge #z +  $360^\circ CRK / NC\_NR\_GAP$

**If**  $REL\_ANG\_CRK\_CAM$  <

$PSN\_GAP - PSN\_TOOTH1\_CAM + CAM\_DYW\_CRK\_SYN\_ADC\_IN(EX)$

**And**

```

Then      REL_ANG_CRK_CAM < 360° CRK /NC_NR_GAP
          Engine position is PSN_GAP - NC_OFS_TDC0_REF_CRK

Else

If        The camshaft edge can be found on both sides of the
reference gap, it is not removed
PSN_GAP - PSN_TOOTH1_CAM < CAM_DYW_CRK_SYN_
RTD_IN(EX)

Then      Keep index z

Else      Remove index z from list of possible camshaft signal edge
indexes

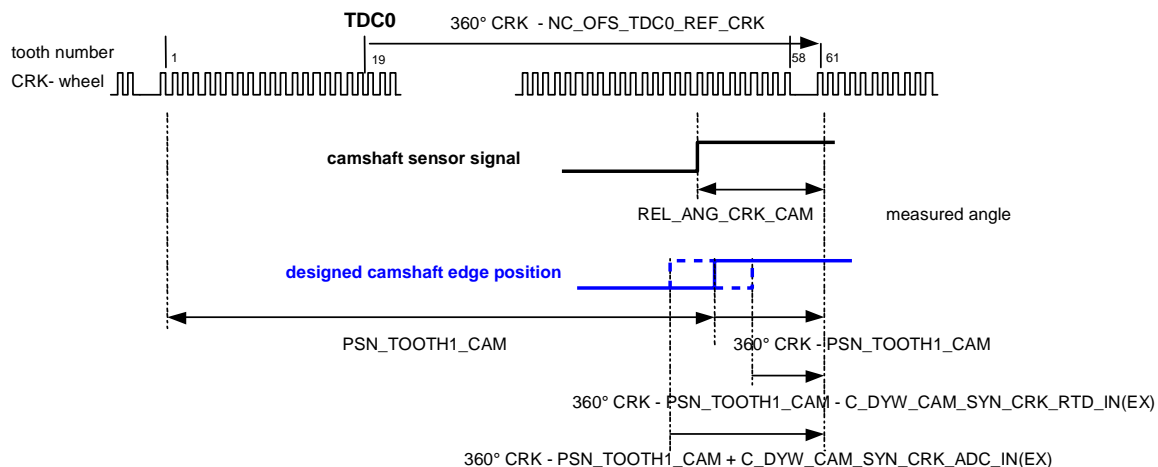
Endif

Endif

```

**Test 4:**

Reference gap detected. Last event was an active camshaft edge.



$PSN\_GAP = \text{engine position offset for camshaft edge \#z} + 360^\circ \text{ CRK} / NC\_NR\_GAP$

```

If        PSN_GAP - PSN_TOOTH1_CAM - CAM_DYW_CRK_SYN_RTDC_IN(EX)
< REL_ANG_CRK_CAM <
PSN_GAP - PSN_TOOTH1_CAM + CAM_DYW_CRK_SYN_ADC_IN(EX)

```

**And**

$REL\_ANG\_CRK\_CAM < 360^\circ \text{ CRK} / NC\_NR\_GAP$

```

Then      Engine position is PSN_GAP - NC_OFS_TDC0_REF_CRK

PSN_ENG_CRK_OFS = PSN_GAP - 360° CRK

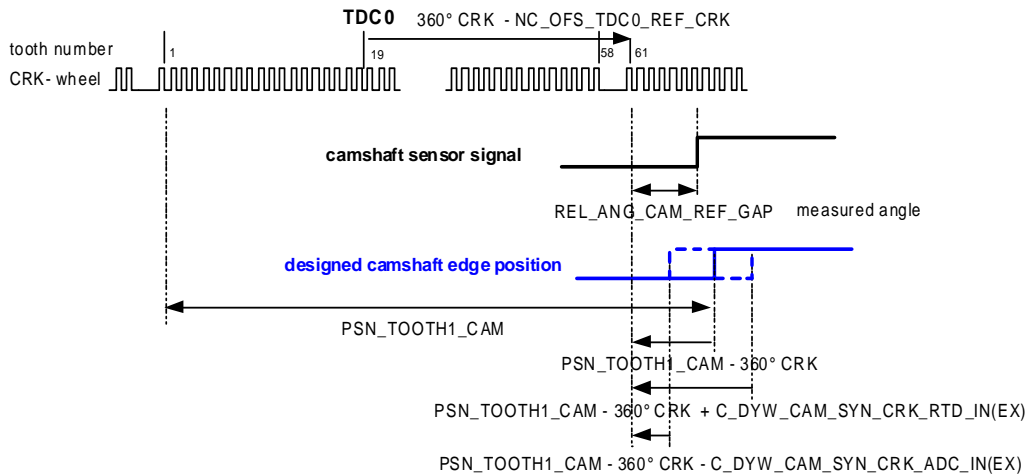
Else      Remove index z from list of possible camshaft signal edge indexes

Endif

```

**Test 5:**

Active camshaft edge detected. Last event was reference gap.



PSN\_GAP = engine position offset for camshaft edge #z

```

If PSN_TOOTH1_CAM - PSN_GAP - CAM_DYW_CRK_SYN_ADC_IN(EX)
    < REL_ANG_CAM_REF_GAP <
    PSN_TOOTH1_CAM - PSN_GAP + CAM_DYW_CRK_SYN_RTD_IN(EX)
    And
    REL_ANG_CAM_REF_GAP < 360° CRK / NC_NR_GAP
Then Engine position is PSN_GAP - NC_OFS_TDC0_REF_CRK
    PSN_ENG_CRK_OFS = PSN_GAP - 360° CRK
Else
    Remove index z from list of possible camshaft signal edge indexes
Endif
  
```

**Test 9:**

Active camshaft edge detected. No active camshaft edge occurred before.

This test is executed after test 1 only if no GAP occurred before CAM edge.

If an angular distance greater than the crank angle delay calibration has been measured without any new event, this test allows to eliminate the corresponding camshaft edges that should occur.

```

If NC_ACT_CAM_EDGE_SYN = 3 (both falling and rising edges used)
    And C_CRK_ANG_DLY > 0
    And REL_ANG_CRK_CAM >= C_CRK_ANG_DLY
    And the cam edge z can not be seen on both sides of the reference gap
    ((PSN_TOOTH1_CAM[z] - C_DYW_CAM_SYN_CRK_ADC_IN(EX)) modulo (360/
    NC_NR_GAP)) < ((PSN_TOOTH1_CAM[z] + C_DYW_CAM_SYN_CRK_RTD_IN(EX))
    modulo (360/NC_NR_GAP))
    And the cam edge z-1 can not be seen on both sides of the reference gap
    ((PSN_TOOTH1_CAM[z-1] - C_DYW_CAM_SYN_CRK_ADC_IN(EX)) modulo (360/
    NC_NR_GAP)) < ((PSN_TOOTH1_CAM[z-1] + C_DYW_CAM_SYN_CRK_RTD_
    IN(EX)) modulo (360/NC_NR_GAP))

Then
    If REL_ANG_CRK_CAM <
  
```

```

        PSN_TOOTH1_CAM modulo (360/NC_NR_GAP) + CAM_DYW_CRK_SYN_
        RTD_IN(EX)
    Then
        Keep index z
        Engine position range will be calculated in Pre-injection interface computa-
        tion after Cam edge function (Pre-inj action 2)
    Else
        Remove index z from list of possible camshaft signal edge indexes
    Endif
Else (no operation)
Endif

```

**Test 10:**

Crankshaft angle event detected. An active camshaft edge occurred before.

```

If C_CRK_ANG_DLY_LST_CAM > 0
Then
    If REL_ANG_CRK_CAM <
        PSN_CAM_CAM_1 + CAM_DYW_SYN_IN(EX)

    Then (No operation)
    Else Remove index z from list of possible camshaft signal edge indexes
    Endif

```

On the remaining cam edges, after the first test has been performed on all edges:

PSN\_GAP = engine position offset for camshaft edge #z

```

If The cam edge z can not be seen on both sides of the reference gap
((PSN_TOOTH1_CAM[z] - C_DYW_CAM_SYN_CRK_ADC_IN(EX)) modulo (360/
NC_NR_GAP)) < ((PSN_TOOTH1_CAM[z] + C_DYW_CAM_SYN_CRK_RTD_IN(EX))
modulo (360/NC_NR_GAP))

```

```

Then
    If REL_ANG_CRK_CAM <
        (720 - PSN_TOOTH1_CAM) modulo (360/NC_NR_GAP) + CAM_DYW_
        CRK_SYN_ADC_IN(EX)
    Then Keep index z
        Engine position range will be calculated in Pre-injection interface computa-
        tion after Cam edge function (Pre-inj action 5)
        Engine position is PSN_GAP - NC_OFS_TDC0_REF_CRK
        PSN_ENG_CRK_OFS = PSN_GAP - 360° CRK
    Else
        Remove index z from list of possible camshaft signal edge indexes
    Endif
Else No operation
Endif
Else No operation
Endif


```

**Test 11:**

Active camshaft edge detected. Last event was also an active camshaft edge.

This test is done after test 2. So we know that any Gap is between the two camshaft edge events.

We can remove all indexes where a Gap is located between those and the previous cam edge.

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On the remaining cam edges, after the first test has been performed on all edges:

```

If   NC_ACT_CAM_EDGE_SYN = 3 (both falling and rising edges used)
      And
        The cam edge z can not be seen on both sides of the reference gap
        ((PSN_TOOTH1_CAM[z] - C_DYW_CAM_SYN_CRK_ADC_IN(EX)) modulo (360/
        NC_NR_GAP)) < ((PSN_TOOTH1_CAM[z] + C_DYW_CAM_SYN_CRK_RTD_IN(EX))
        modulo (360/NC_NR_GAP))
      And
        The cam edge z-1 can not be seen on both sides of the reference gap
        ((PSN_TOOTH1_CAM[z-1] - C_DYW_CAM_SYN_CRK_ADC_IN(EX)) modulo (360/
        NC_NR_GAP)) < ((PSN_TOOTH1_CAM[z-1] + C_DYW_CAM_SYN_CRK_RTD_
        IN(EX)) modulo (360/NC_NR_GAP))

Then

      If       PSN_TOOTH1_CAM[z-1] > PSN_TOOTH1_CAM[z]
            Or
              PSN_TOOTH1_CAM[z-1] < 360/NC_NR_GAP < PSN_TOOTH1_
              CAM[z]
            Or
              PSN_TOOTH1_CAM[z-1] < 360 < PSN_TOOTH1_CAM[z]
            Or
              PSN_TOOTH1_CAM[z-1] < 360*(2-1/NC_NR_GAP) < PSN_TOOTH1_
              CAM[z]

      Then
        Remove index z

      Else
        Keep index z

      Endif

Endif

```

### Test 12:

This test is executed on Gap after the test 3 or 4.

On the remaining cam edges, has been performed on all edges:


```

If       NC_ACT_CAM_EDGE_SYN = 3 (both falling and rising edges used)
      And
        The cam edge z can not be seen on both sides of the reference gap
        ((PSN_TOOTH1_CAM[z] - C_DYW_CAM_SYN_CRK_ADC_IN(EX))
        modulo (360/NC_NR_GAP)) < ((PSN_TOOTH1_CAM[z] + C_DYW_
        CAM_SYN_CRK_RTD_IN(EX)) modulo (360/NC_NR_GAP))
      And
        The cam edge z+1 can not be seen on both sides of the reference gap
        ((PSN_TOOTH1_CAM[z+1] - C_DYW_CAM_SYN_CRK_ADC_IN(EX))
        modulo (360/NC_NR_GAP)) < ((PSN_TOOTH1_CAM[z+1] + C_DYW_
        CAM_SYN_CRK_RTD_IN(EX)) modulo (360/NC_NR_GAP))

Then

      If       PSN_TOOTH1_CAM[z] > PSN_TOOTH1_CAM[z+1]
            Or
              PSN_TOOTH1_CAM[z] < 360/NC_NR_GAP < PSN_
              TOOTH1_CAM[z+1]
            Or

```

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```

PSN_TOOTH1_CAM[z] < 360 < PSN_TOOTH1_
CAM[z+1]
Or
PSN_TOOTH1_CAM[z] < 360*(2-1/NC_NR_GAP)
< PSN_TOOTH1_CAM[z+1]

Then
    Keep index z

Else
    Remove index z

Endif

Endif

```

### 2.11.4.6 Cam/crk synchronization validation function ()

#### General information:

The purpose of this function is to check the angular distance between cam/crk events. The function returns false if the active camshaft signal edge z is outside the defined tolerance window.

i = 1...NC\_NR\_CAM\_CBK                      z = 0...NC\_NR\_EDGE\_CAM\_IN(EX)

#### Application conditions

**Recurrence:**                      every falling camshaft signal edge and every reference gap  
if NC\_ACT\_CAM\_EDGE\_SYN = 1  
every rising camshaft signal edge and every reference gap if  
NC\_ACT\_CAM\_EDGE\_SYN = 2  
every camshaft signal edge (rising and falling) and every reference  
gap if NC\_ACT\_CAM\_EDGE\_SYN = 3

#### Formula section:

```

If                      active camshaft signal edge
Then                    If                      NC_ACT_CAM_EDGE_SYN = 3
                         Then Increment indexes in the list of possible camshaft signal index by 1 modulo NC_NR_
                         EDGE_CAM_IN(EX)
                         Else Increment by 2 indexes in the list of possible camshaft signal index by 2 modulo
                         NC_NR_EDGE_CAM_IN(EX)

Endif

```

Calculate theoretical angular distance between crankshaft tooth #1 and camshaft edge #z:

$$PSN\_TOOTH1\_CAM = NC\_OFS\_TDC0\_REF\_CRK + NC\_PSN\_EDGE\_CAM\_IN(EX)[z][i]$$

Calculate theoretical angular distance between two successive active camshaft edges:

```


If                      NC_ACT_CAM_EDGE_SYN = 3
Then                    Falling and rising camshaft edges
                         PSN_CAM_CAM = NC_PSN_EDGE_CAM_IN(EX)[z][i] -
                         NC_PSN_EDGE_CAM_IN(EX)[z-1][i]

Else                    Only Falling or only rising camshaft edges
                         PSN_CAM_CAM = NC_PSN_EDGE_CAM_IN(EX)[z][i] -
                         NC_PSN_EDGE_CAM_IN(EX)[z-2][i]

Endif

```

The following table shows the actions to perform in function of the current (n) and last event (n-1).

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The event is a detection of a active camshaft signal edge for synchronization (CAM) or a detection of reference gap (GAP). Tests and edge elimination shall only be performed on active camshaft signal edges with current value of REL\_ANG\_CRK\_CAM.

<b>Event (n)</b>	CAM	GAP	CAM	GAP
<b>Event (n-1)</b>	CAM	CAM	GAP	GAP
<b>Test</b>	Test 6	Test 7	Test 8	(*)

(\*) No Camshaft index can be identified (All remaining indexes shall be removed)

#### **Test 6:**

Active camshaft edge detected. Last event was also a active camshaft edge.

```

If PSN_CAM_CAM - CAM_DYW_SYN_IN(EX)
    < REL_ANG_CRK_CAM <
    PSN_CAM_CAM + CAM_DYW_SYN_IN(EX)
Then camshaft signal edge is valid
    return (true)
Else Invalid camshaft signal edge, synchronization validation failed
    return (false)
Endif

```

#### **Test 7:**

Reference gap detected. Last event was a active camshaft signal edge.

```

PSN_GAP = current engine position offset
If PSN_GAP - PSN_TOOTH1_CAM - CAM_DYW_CRK_SYN_RTD_IN(EX)
    < REL_ANG_CRK_CAM <
    PSN_GAP - PSN_TOOTH1_CAM + CAM_DYW_CRK_SYN_ADC_IN(EX)
And
    REL_ANG_CRK_CAM <= 360° CRK /NC_NR_GAP
Then camshaft signal edge is valid
    return (true)
Else Invalid camshaft signal edge
    return (false)
Endif

```

#### **Test 8:**

Active camshaft signal edge detected. Last event was a reference gap.

```

PSN_GAP = current engine position offset
If PSN_TOOTH1_CAM - PSN_GAP - CAM_DYW_CRK_SYN_ADC_IN(EX)
    < REL_ANG_CAM_REF_GAP <
    PSN_TOOTH1_CAM - PSN_GAP + CAM_DYW_CRK_SYN_RTD_IN(EX)
And
    REL_ANG_CAM_REF_GAP <= 360° CRK /NC_NR_GAP
Then camshaft signal edge is valid
    return (true)

```

```

    Else          Invalid camshaft signal edge
    return (false)
Endif

```

### 2.11.4.7 Pre-injection interface computation before Cam edge function ()

#### General information:

A truth table is used in order to define the possible engine position.

#### Application conditions

**Recurrence :**            *every crankshaft edge (CRK) or every reference gap (GAP)*

#### Formula section:

Event (n)	CRK	GAP
Pre-inj Action	1	2

#### Pre-inj Action 1

$$\text{PSN\_ENG\_SYN\_CAM\_MIN}_n = \text{PSN\_ENG\_SYN\_CAM\_MIN}_{n-1} + 360^\circ/\text{NC\_NR\_TOOTH}$$

$$\text{PSN\_ENG\_SYN\_CAM\_MAX}_n = \text{PSN\_ENG\_SYN\_CAM\_MAX}_{n-1}$$

#### Pre-inj Action 2

$$\text{PSN\_ENG\_SYN\_CAM\_MIN}_n = \text{PSN\_ENG\_SYN\_CAM\_MIN}_{n-1} + (\text{NC\_NR\_TOOTH\_GAP}+1)^* 360^\circ/\text{NC\_NR\_TOOTH}$$

$$\text{PSN\_ENG\_SYN\_CAM\_MAX}_n = \text{PSN\_ENG\_SYN\_CAM\_MAX}_{n-1}$$

### 2.11.4.8 Pre-injection interface computation after Cam edge function ()

#### General information:

A truth table is used in order to define the possible engine position.

#### Application conditions

**Recurrence:**            every falling camshaft signal edge (CAM), every reference gap (GAP) or every active crankshaft edge (CRK) if NC\_ACT\_CAM\_EDGE\_SYN = 1  
                               every rising camshaft signal (CAM), every reference gap (GAP) or every active crankshaft edge (CRK) if NC\_ACT\_CAM\_EDGE\_SYN = 2  
                               every falling and rising camshaft signal edge (CAM), every reference gap (GAP) or every active crankshaft edge (CRK) if NC\_ACT\_CAM\_EDGE\_SYN = 3



**Formula section:**

Event (n)	CRK	CRK	CAM	GAP	GAP	CRK-Angle
Event (n-1)	CRK	CAM	CRK	CRK	CAM	CRK
Pre-inj Action	1	1	2	3	4	5

**Pre-inj Action 1**

$$\text{PSN\_ENG\_SYN\_CAM\_MIN}_n = \text{PSN\_ENG\_SYN\_CAM\_MIN}_{n-1} + 360^\circ/\text{NC\_NR\_TOOTH}$$

$$\text{PSN\_ENG\_SYN\_CAM\_MAX}_n = \text{PSN\_ENG\_SYN\_CAM\_MAX}_{n-1} + 360^\circ/\text{NC\_NR\_TOOTH}$$

**Pre-inj Action 2**

$$\text{PSN\_ENG\_SYN\_CAM\_MIN} = \text{NC\_PSN\_EDGE\_CAM\_IN(EX)}[z][i] - \text{CAM\_DYW\_SYN\_IN(EX)}$$

for the lowest possible signal edge index z

$$\text{PSN\_ENG\_SYN\_CAM\_MAX} = \text{NC\_PSN\_EDGE\_CAM\_IN(EX)}[z][i] + \text{CAM\_DYW\_SYN\_IN(EX)}$$

for the highest possible signal edge index z

Note: The possible signal edges z are determined by checking the conditions of Camshaft Edge Index determination function(). This function must be executed before action 2.

**Pre-inj Action 3**

$$\text{PSN\_ENG\_SYN\_CAM\_MIN}_n = \text{PSN\_ENG\_SYN\_CAM\_MIN}_{n-1} + (\text{NC\_NR\_TOOTH\_GAP}+1) * 360^\circ/\text{NC\_NR\_TOOTH}$$

$$\text{PSN\_ENG\_SYN\_CAM\_MAX}_n = \text{PSN\_ENG\_SYN\_CAM\_MAX}_{n-1} + (\text{NC\_NR\_TOOTH\_GAP}+1) * 360^\circ/\text{NC\_NR\_TOOTH}$$

**Pre-inj Action 4**

A camshaft edge has occurred during the reference gap (when the camshaft edge is detected Pre-inj Action 2 is performed and when the first crankshaft edge after the reference is detected Pre-inj Action 4 is performed)

$$\text{PSN\_ENG\_SYN\_CAM\_MIN}_n = \text{PSN\_ENG\_SYN\_CAM\_MIN}_{n-1} + \text{REL\_ANG\_CRK\_CAM}$$

$$\text{PSN\_ENG\_SYN\_CAM\_MAX}_n = \text{PSN\_ENG\_SYN\_CAM\_MAX}_{n-1} + \text{REL\_ANG\_CRK\_CAM}$$

**Pre-inj Action 5**

A crank-angle event has occurred. A precise calculation of the engine position for pre-injection is possible.


$$\text{PSN\_ENG\_SYN\_CAM\_MIN} = \text{NC\_PSN\_EDGE\_CAM\_IN(EX)}[z][i] - \text{CAM\_DYW\_SYN\_IN(EX)} + \text{REL\_ANG\_CRK\_CAM}$$

for the lowest possible signal edge index z

$$\text{PSN\_ENG\_SYN\_CAM\_MAX} = \text{NC\_PSN\_EDGE\_CAM\_IN(EX)}[z][i] + \text{CAM\_DYW\_SYN\_IN(EX)} + \text{REL\_ANG\_CRK\_CAM}$$

for the highest possible signal edge index z

Note: The possible signal edge z is determined by checking the conditions of Camshaft Edge Index determination function(). This function must be executed before action 5.

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### 2.11.4.9 VVT lock check function ()

#### General information:

The purpose of this function is to check the VVT lock position flag and to extend the cam/crk tolerance windows if the VVT is not in locked position at engine start.

#### Application conditions

**Recurrence:** at transition of LV\_STOP\_ENG from 0 to 1  
Or  
Reset ECU

#### Formula section:

**If** LV\_CAM\_LOCK\_IVVT\_IN(EX)[i] = 0 for the camshaft sensor selected for cam/crk synchronization

**And**

NLC\_IVVT\_IN(EX) = 1

**Then** VVT not in locked position at engine start

CAM\_DYW\_SYN\_IN = C\_DYW\_CAM\_SYN\_IN + C\_CAM\_ADJ\_VVT\_SYN\_IN

CAM\_DYW\_SYN\_EX = C\_DYW\_CAM\_SYN\_EX + C\_CAM\_ADJ\_VVT\_SYN\_EX

CAM\_DYW\_CRK\_SYN\_ADC\_IN = C\_DYW\_CAM\_CRK\_SYN\_ADC\_IN + C\_CAM\_ADJ\_VVT\_SYN\_CRK\_ADC\_IN

CAM\_DYW\_CRK\_SYN\_ADC\_EX = C\_DYW\_CAM\_CRK\_SYN\_ADC\_EX

CAM\_DYW\_CRK\_SYN\_RTD\_IN = C\_DYW\_CAM\_CRK\_SYN\_RTD\_IN

CAM\_DYW\_CRK\_SYN\_RTD\_EX = C\_DYW\_CAM\_CRK\_SYN\_RTD\_EX + C\_CAM\_ADJ\_VVT\_SYN\_CRK\_RTD\_EX

**Else**

VVT in locked position at engine start or no VVT at all

CAM\_DYW\_SYN\_IN = C\_DYW\_CAM\_SYN\_IN

CAM\_DYW\_SYN\_EX = C\_DYW\_CAM\_SYN\_EX

CAM\_DYW\_CRK\_SYN\_ADC\_IN = C\_DYW\_CAM\_CRK\_SYN\_ADC\_IN

CAM\_DYW\_CRK\_SYN\_ADC\_EX = C\_DYW\_CAM\_CRK\_SYN\_ADC\_EX

CAM\_DYW\_CRK\_SYN\_RTD\_IN = C\_DYW\_CAM\_CRK\_SYN\_RTD\_IN

CAM\_DYW\_CRK\_SYN\_RTD\_EX = C\_DYW\_CAM\_CRK\_SYN\_RTD\_EX

**Endif**

## 2.11.5 Requirements to Infrastructure


### 2.11.5.1 Camshaft segment period measurement

#### General information:

System request accuracy  $\leq 4$  us

The camshaft segment period T\_SEG\_CAM\_IN(EX)[i] is the measured time between two consecutive valid camshaft signal edges.

### 2.11.5.2 Measurement of angular distance to active camshaft edge

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**General information:**

The purpose of this function is to provide a measurement for

- the angular distance between the first valid crankshaft teeth and the first active camshaft edge
- the angular distance between two consecutive valid active camshaft signal edges

Only active camshaft signal edges shall be processed. The active camshaft edge for synchronization is defined by NC\_ACT\_CAM\_EDGE\_SYN.

**Application conditions**

**Recurrence:** *every active camshaft edge and every active crankshaft edge.*

**Formula section:**

```

If          LV_CRK_FIRST_VLD_TOOTH = 0
Then       REL_ANG_CRK_CAM = 0
Else       If          active camshaft signal edge
            Then       REL_ANG_CRK_CAM = 0
            Else       If          active crankshaft signal edge or after missing tooth simulation
                        Then       REL_ANG_CRK_CAM = REL_ANG_CRK_CAM +
                                (360° CRK /NC_NR_TOOTH)
                        Else       REL_ANG_CRK_CAM is frozen
            Endif
        Endif
Endif

```

**2.11.5.3 Measurement of angular distance from reference gap to active camshaft edge****General information:**

The purpose of this function is to provide a measurement for

- the angular distance between a crankshaft reference gap and a active camshaft signal edge

**Application conditions**

**Recurrence:** *every active crankshaft signal edge*

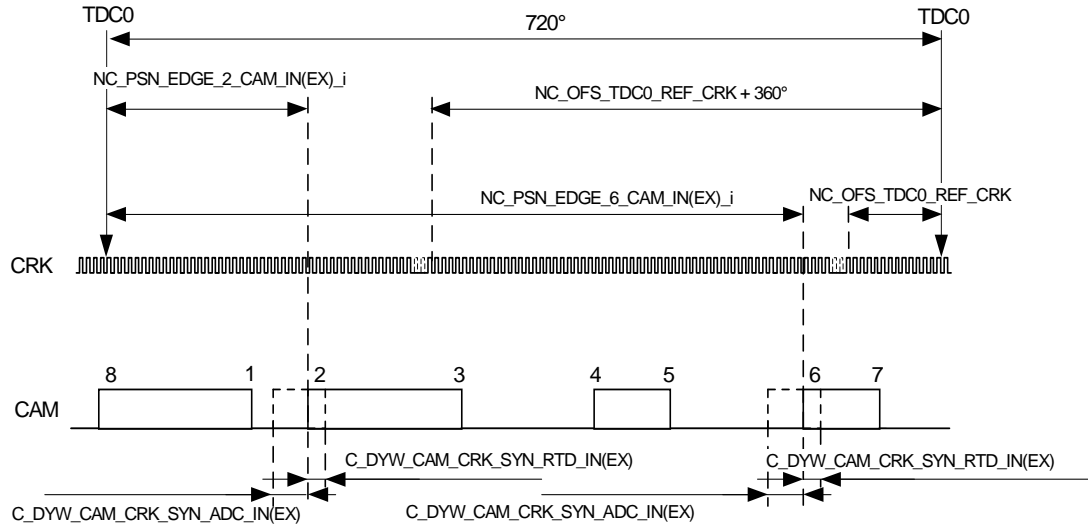
**Formula section:**

```


If          Reference Gap is detected
Then       REL_ANG_CAM_REF_GAP = 0
Else       If          crank active edge
            Then       REL_ANG_CAM_REF_GAP = REL_ANG_CAM_REF_GAP +
                                (360° CRK /NC_NR_TOOTH)
            Else       REL_ANG_CAM_REF_GAP is frozen
            Endif
Endif

```

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## 2.12 Acquisition of wheel speed sensor

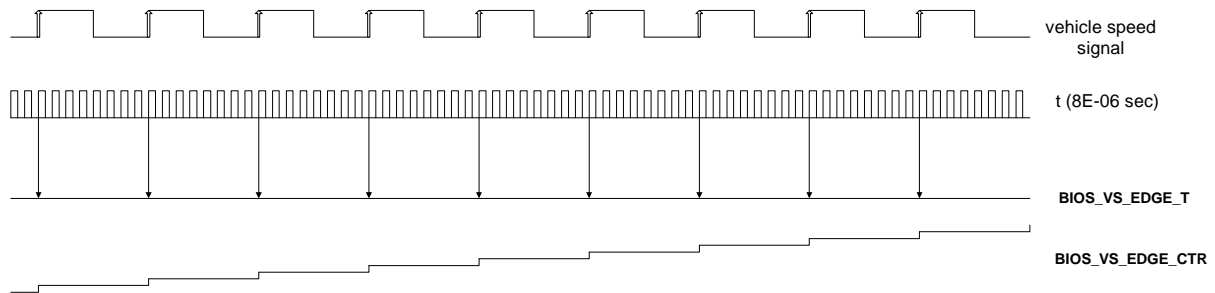
### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
BIOS_VS_EDGE_CTR	O	0... FFFFH	0... 65565	1	-
Vehicle speed sensor tooth counter (free running counter)					
BIOS_VS_EDGE_T	O	0... FFFFH	0... 524280	8	(s
timestamp of last tooth (free running timer)					

### FUNCTION DESCRIPTION:


### General information:

The wheel sensor signal (high and low) is recorded by incrementation of the free running edge counter BIOS\_VS\_EDGE\_CTR with one digit at every change from low to high. The value is stored as BIOS\_VS\_EDGE\_CTR in a free running counter too.



**Signal flow diagram:**

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## 2.13 Acquisition of oil sensor

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_BIOS_POIL_SWI	O/V	0... 1H	0 ...1	1	-
Logical variable for non debounced oil pressure switch signal					
LV_POIL_SWI	O/V	0... 1H	0 ...1	1	-
logical variable oil pressure switch (1= oil pressure o.k.)					
LV_POIL_SWI_SUB	-	0... 1H	0 ...1	1	-
Logical variable for oil pressure switch or oil pressure sensor					
POIL	O/V	B1E0... 4E10H	-20 ...20	1.0004e-3	bar
Oil pressure (Relative Sensor)					
T_POIL_SWI	V	0... FFH	0... 25.5	0.1	s
timer for delayed oil switch					

### Input data:

AC_VEH_LGT_TCS {p. 1561}	AC_VEH_TRV_TCS {p. 1561}	C_T_MIN_PWL {p. 3776}	C_V_POIL_MAX_DIAG {p. 4365}
C_V_POIL_MIN_DIAG {p. 4365}	ECU_STATE {p. 1091}	LV_ERR_SENS_POIL {p. 4365}	LV_IGK {p. 906}
LV_POIL_SWI_CUS {p. 8202}	T_PWL {p. 3776}	V_POIL {p. 831}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_POIL_AC_VEH_LGT_TCS	-	8010... 7FF0H	-51.175 ...51.175	0.0015625	m/s**2
threshold for longitudinal acceleration for oil pressure switch					
C_POIL_AC_VEH_TRV_TCS	-	8010... 7FF0H	-51.175 ...51.175	0.0015625	m/s**2
threshold for transversal acceleration for oil pressure switch					
C_POIL_ERR_SUB	-	0... 4E20H	0... 20	0.001	bar
Substitute value of oil pressure in case of an sensor error					
C_T_POIL_SWI_BAS	-	0... FFH	0... 25.5	0.1	s
Basis time delay for oil pressure switch					
C_T_POIL_SWI_LGT	-	0... FFH	0... 25.5	0.1	s
time delay for oil pressure switch due to LGT					
C_T_POIL_SWI_TRV	-	0... FFH	0... 25.5	0.1	s
time delay for oil pressure switch due to TRV					
IP_POIL_V_POIL_REL	-	31E0... CE20H	-20 ...20	0.001	bar
LDP_V_POIL_IP_POIL_V_POIL_REL	8	0... 3FFH	0... 4.99511	4.8828e-3	V
Oil pressure sensor linearisation table for relative sensor					
LC_POIL_CTL_ENA	-	0... 1H	0 ...1	1	-
Boolean to enable oil pressure control					

### 2.13.1 Acquisition of oil pressure switch

#### Import action:





**Endif**

**Endif**

## 2.13.2 Acquisition of oil pressure sensor

### FUNCTION DESCRIPTION:

#### General information:

The sensor voltage signal V\_POIL is converted via a linearisation table into the oil pressure POIL. In case of an oil sensor error a substitute value can be used.

#### Application conditions

##### **Initialisation:**

```

at transition LV_IGK 0 -> 1 or reset
if      V_POIL < C_V_POIL_MIN_DIAG      or
        V_POIL > C_V_POIL_MAX_DIAG
then    POIL = C_POIL_ERR_SUB
else    POIL = IP_POIL_V_POIL_REL
endif
    
```

##### **Recurrence:**

10 ms

##### **Activation:**

ECU\_STATE <> PWL **and** LC\_POIL\_CTL\_ENA = 1

##### **Deactivation:**

```

if      ECU_STATE = PWL      or      LC_POIL_CTL_ENA = 0
then    POIL = POIL(n-1)
endif
    
```

#### Formula section:

```

if      LV_ERR_SENS_POIL = 0
then    POIL = IP_POIL_V_POIL_REL
else    POIL = C_POIL_ERR_SUB
endif
    
```

## 2.14 Key position determination

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_IGK	O/V	0... 1H	0 ...1	1	-
Key on flag					
LV_IGK_PREL	O/V	0... 1H	0 ...1	1	-
Preliminary ignition flag for 'ignition switch off'					
LV_KEY_OFF	V	0... 1H	0 ...1	1	-
Key off flag					
LV_WAKE_UP	O/V	0... 1H	0 ...1	1	-
Wake Up flag					
STATE_PLAUS_IGK_BN	O/V	0... 8H	0 ...8	1	-
state plausibility IGK - signal via CAN/via HW (BN2000 only)					
T_CAN_IGK_TOUT	O/V	0... FFH	0... 2550	10	ms
Timeout ignition key via CAN bus					
T_WAKE_UP_ON	O/V	0... FFH	0... 2550	10	ms
Timer ECU wake up					

### Input data:

B_sleepwait {p. 8346}	LV_INH_PWL_TRAN_ES_ EL {p. 3776}	LV_VAR_BN {p. 655}	PWL_LOCK_CDN {p. 3776}
STATE_CAN_DNM_D	STATE_IGK_CAN {p. 1574}	STATE_IGK_HW {p. 1575}	V_IGK_BAS {p. 831}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DLY_IGK_OFF_PREL	-	0... FFH	0... 2.55	0.01	s
Delay time ignition off after driver's command					
C_T_IGK_LIH	-	0... FFH	0... 2.55	0.01	s
Timeoutzeit for LV_IGK = 1, if no Can message "Klemmenstatus" available					
C_T_TEMP_IGK_OFF_PREL	-	0... FFFFH	0... 655.35	0.01	s
Temp. time prel. ignition off after CAS-HW-error during dc					

### Configuration data:

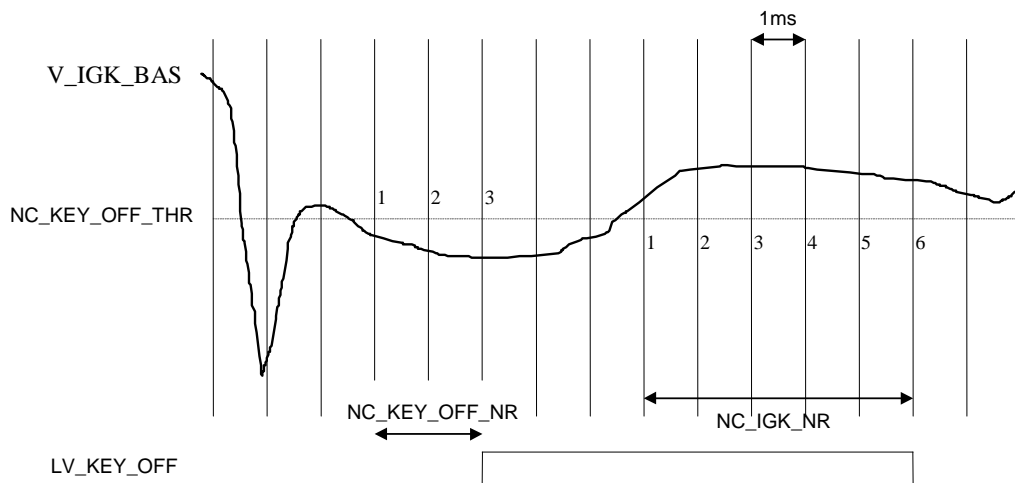
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IGK_NR	-	0... FFH	0... 255	1	-
Samples filter for key on detection ( typical value : 6 )					
NC_KEY_OFF_NR	-	0... FFH	0... 255	1	-
Samples filter for key off detection ( typical value : 3 )					
NC_KEY_OFF_THR	-	0... 3FFH	0... 28.7055	0.0280601	V
Threshold for key off detection ( typical value : 142 = 4 Volts )					

## FUNCTION DESCRIPTION:

### General information:

According to the battery voltage raw value (V\_IGK\_BAS) after ignition key, the ignition key ON /OFF recognition is performed.

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See on Analogic Acquisition Sampling chapter the recurrence of V\_IGK\_BAS acquisition.

### Application conditions

**Activation:** *at reset*

**Initialization:** `if` first value V\_IGK\_BAS > NC\_KEY\_OFF\_THR  
`then` LV\_KEY\_OFF = 0  
`else` LV\_KEY\_OFF = 1  
`endif`

*Recurrency:* 1ms

### Formula section:

*Ignition key ON recognised :*

**If** V\_IGK\_BAS > NC\_KEY\_OFF\_THR  
for at least NC\_IGK\_NR number of successive samples ( \* 1 msec. )  
**then** LV\_KEY\_OFF = 0 (ON)

*Ignition key OFF recognised :*

**If** V\_IGK\_BAS < NC\_KEY\_OFF\_THR  
for at least NC\_KEY\_OFF\_NR number of successive samples ( \* 1 msec. )  
**then** LV\_KEY\_OFF = 1 (OFF)

## 2.14.1 Ignition : Key on recognition


### FUNCTION DESCRIPTION:

### Application conditions

**Activation:** *at reset*

**Initialization:** LV\_IGK = 0

LV\_WAKE\_UP = 0

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```

T_IGK_LIH = C_T_IGK_LIH
LV_IGK_PREL = 1
T_DLY_IGK_OFF_PREL = C_T_DLY_IGK_OFF_
PREL
T_TEMP_IGK_OFF_PREL = C_T_TEMP_IGK_OFF_PREL
Recurrency:          10ms

```

### Formula section:

#### 2.14.1.1 Vehicle without BN2000 (LV\_VAR\_BN = 0)

```

if      LV_KEY_OFF = 1 and T_DLY_IGK_OFF_PREL > 0
then    LV_IGK_PREL = 0
          T_DLY_IGK_OFF_PREL - - //decremented by
10ms
if      T_DLY_IGK_OFF_PREL = 0
then    LV_IGK = 0
else    LV_IGK = 1
endif
else
if      LV_INH_PWL_TRAN_ES_EL = 1 or LV_KEY_OFF = 1
then    LV_IGK = 0, LV_IGK_PREL = 0
else    LV_IGK = 1, LV_IGK_PREL = 1,
          T_DLY_IGK_OFF_PREL = C_T_DLY_IGK_OFF_PREL
endif
endif

```

#### 2.14.1.2 Vehicle with BN2000 (LV\_VAR\_BN = 1)

##### Determination of LV\_WAKE\_UP

```

if      LV_KEY_OFF = 0 and LV_INH_PWL_TRAN_ES_EL = 0
then    LV_WAKE_UP = 1
          T_WAKE_UP_ON++ (limit: 0xFF)

else    LV_WAKE_UP = 0
          T_WAKE_UP_ON = 0
endif

```

##### NM mode depending on LV\_WAKE\_UP and other conditions:

```

if      LV_WAKE_UP = 1 or B_sleepwait = 1
Then    NM mode awake
Else    NM mode bus sleep
Endif


```

##### Determination of STATE\_PLAUS\_IGK\_BN and of LV\_IGK=1

```

if(1)    (CAN message Klemmenstatus available) and
          no alive-counter error CAS // alive counter counts regularly and
          no check-sum error CAS // sent checksum = calculated checksum)
then(1)  T_IGK_LIH = C_T_IGK_LIH
          T_CAN_IGK_TOUT = 0
if(2a)  STATE_IGK_CAN = 0h
then(2a) LV_T_DLY_IGK_OFF_PREL = 1 // timer should be decremented

```

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```

if(3b) LV_KEY_OFF = 0
  then(3b) STATE_PLAUS_IGK_BN = 1H //SYM_0//SCB, Master CAN
  else(3b) STATE_PLAUS_IGK_BN = 0H //NO_SYM
  endif(3b)
else(2a)
  if(3c) STATE_IGK_CAN = 1
    then(3c) LV_IGK = 1
              T_DLY_IGK_OFF_PREL = C_T_DLY_IGK_OFF_PREL
              LV_T_DLY_IGK_OFF_PREL = 0 //timer should be reset to max.-value
    if(4a) LV_KEY_OFF = 0
      then(4a) STATE_PLAUS_IGK_BN = 0H //NO_SYM
      else(4a) STATE_PLAUS_IGK_BN = 2H //SYM_1//SCG, Master CAN
      endif(4a)
    else(3c) STATE_PLAUS_IGK_BN = 8H //SYM_3//CAN-signal not plausi-
  ble
    if(4b) LV_WAKE_UP = 1
      then(4b) LV_IGK = 1
                T_DLY_IGK_OFF_PREL = C_T_DLY_IGK_OFF_PREL
                LV_T_DLY_IGK_OFF_PREL = 0 //timer should be reset to max.-value
      else(4b) LV_IGK=0
    endif(4b)
  endif(3c)
endif(2a)
else(1)
  if(2b) STATE_CAN_DNM_D > 0 and PWL_LOCK_CDN[BN2000] = 1
    then(2b) T_CAN_IGK_TOUT++ (limit: 0xFF)
    if(3d) T_IGK_LIH = 0
      then(3d) STATE_PLAUS_IGK_BN = 4H //SYM_2//CAS error, Master HW
      if(4c) LV_WAKE_UP = 1
        then(4c) LV_IGK = 1
                  T_DLY_IGK_OFF_PREL = C_T_DLY_IGK_OFF_PREL
                  LV_T_DLY_IGK_OFF_PREL = 0 //timer should reset to max-value
        else(4c) LV_IGK=0
      endif(4c)
    else(3d) T_IGK_LIH --
    endif(3d)
    else(2b) T_IGK_LIH = C_T_IGK_LIH
              T_CAN_IGK_TOUT = 0xFF
  endif(2b)
endif(1)

```

#### Calculation of Timer T\_DLY\_IGK\_OFF\_PREL

```

IF LV_T_DLY_IGK_OFF_PREL = 1 and
     T_DLY_IGK_OFF_PREL > 0
THEN T_DLY_IGK_OFF_PREL --
      IF STATE_IGK_HW = 0 or T_DLY_IGK_OFF_PREL = 0
      THEN LV_IGK = 0
      ENDIF
ENDIF

```

#### Determination of LV\_IGK\_PREL

```

if STATE_IGK_HW = 1

```

```


Then      if          T_TEMP_IGK_OFF_PREL > 0
              then      T_TEMP_IGK_OFF_PREL --
              endif
else      T_TEMP_IGK_OFF_PREL = C_T_TEMP_IGK_OFF_PREL
Endif

```

```

If          STATE_IGK_HW = 2           or
              (T_TEMP_OFF_IGK_PREL = 0)
then      LV_IGK_PREL = 1
else      LV_IGK_PREL = 0
endif

```

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## 2.15 General management of logic outputs

### 2.15.1 General management of logic outputs

#### FUNCTION DESCRIPTION:

##### General information:

Logic outputs are outputs which are piloted by software without PWM or CAPCOM.

##### Initialization:

At initialization phase, each logical output is set or reset versus function need.

See detail file of each output.

##### Logic state:

Positive logic means the connector output is "active" or "ON" (current present through the load) when the corresponding boolean is true.

The output is ON when the voltage level is low at the ECU connector and is OFF when the voltage level is high at the ECU connector.

##### Update recurrence:

All logical outputs are updated at application recurrence except those piloted by SPI octal link which are updated at 10 ms with jitter < 1ms.

##### Diagnostic:

Several options are proposed. For detail see chapter on output diagnostic.

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## 2.16 Definition of logic outputs

### Input data:

LV_ACCOUT_RLY {p. 3589}	LV_CONF_DMTL {p. 654}	LV_DMTL_PUMP {p. 5963}	LV_DMTLS {p. 5963}
LV_EBOX_CFA {p. 4133}	LV_EF {p. 3614}	LV_HDMTL_ON {p. 5966}	LV_RLY_CRCV_HEAT {p. 4142}
LV_RLY_MAIN {p. 3772}	LV_RLY_ST {p. 3844}	LV_SOF {p. 3851}	LV_SWI_AEB {p. 4136}
LV_VAR_RLY_ACCOUT {p. 656}	LV_VAR_RLY_ST {p. 656}		

### Description:

Name	ECU Pin Name	Definition
Switched internal	A_S_HR	main relay
Switched internal	Internal	power latch
LV_EBOX_CFA	A_S_EBOXL	E-box cooling fan
LV_ACCOUT_RLY	A_S_KOREL	air conditioning compressor relay
LV_RLY_ST	A_S_START	starter relay
LV_EF	A_S_AKL	exhaust flap, only if CONF_EF_B_KL61 = 0
LV_SWI_AEB	A_S_MLA	Automatic engine brackets
LV_SOF	A_S_ESK	sound flap
LV_RLY_CRCV_HEAT	A_T_PTC	crankcase ventilation heater relay
LV_RLY_MAIN	A_S_HR	main relay

### Additional for LV\_CONF\_DMTL = 1

Name	ECU Pin Name	Definition
LV_DMTL_PUMP	A_S_DMTLP	tank leakage detection motor
LV_DMTLS	A_S_DMTLV	tank leakage detection vent
LV_HDMTL_ON	A_S_DMTLH	tank leakage detection heater

### General information:

As there are no free logical output stages left for the activation/deactivation of the crankcase ventilation heater relay and the sound flap, PWM output stages are used for this purpose. To keep changes/efforts as lean as possible the pins which were supposed to be used for a PWM-controlled PTC-heater/sound flap are now used for the crankcase ventilation heater relay/sound flap control, thus resulting in an "incorrect" naming of the pins themselves (A\_T\_PTC/A\_T\_ESK).

### 2.16.1 Definition of logic outputs

#### 2.16.1.1 LV\_LS\_UP/DOWN\_0/1

The logic outputs for the lambda sensor input resistors are set corresponding to switch SW1 described in chapter System Variables, Upstream/Downstream oxygen sensor internal resistance determination

#### 2.16.1.2 Logic outputs controlled by learning algorithm

##### ACC-Relay:

If LV\_VAR\_RLY\_ACCOUT = 0  
then the related PIN is controlled by the learning algorithm (see chapter General:



Variant Coding/Automatically learnt variants via powerstage-dignosis )  
 else the PIN is controlled by LV\_ACCOUT\_RLY

#### Starter-Relay:


If LV\_VAR\_RLY\_ST = 0  
 then the related PIN is controlled by the learning algorithm (see chapter General:  
 Variant Coding/Automatically learnt variants via powerstage-dignosis )  
 else the PIN is controlled by LV\_RLY\_ST

#### Crankcase ventilation heater relay:

As there is a 100% installation in all variants of NG6 engines the Pin is always controlled by LV\_RLY\_CRCV\_HEAT.

## 2.16.2 Engine speed signal ESS

The engine speed signal ESS (ECU Pin A\_F\_TD) is a tooth-fixed event. The ESS signal is set at the teeth 5, 25, -, 65, 85, 105 and reset at the teeth 15, 35, 55, 75, 95, 115. The artificially generated teeth are used in the CAM limp home. Since the cylinder group assignment for the output of the ESS signal is not decisive, the CRK limp home has no influence on the output of the ESS signal.

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## 2.17 General management of PWM outputs

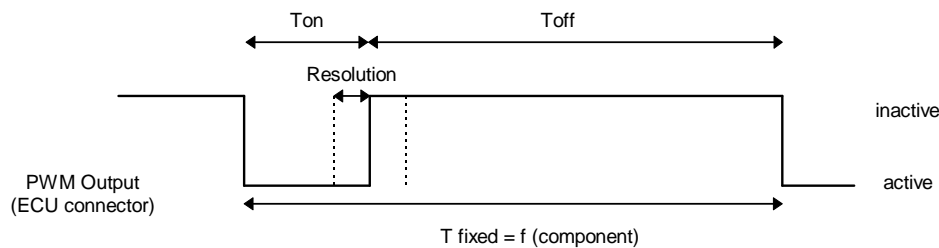
### 2.17.1 General management of PWM outputs :

#### FUNCTION DESCRIPTION:

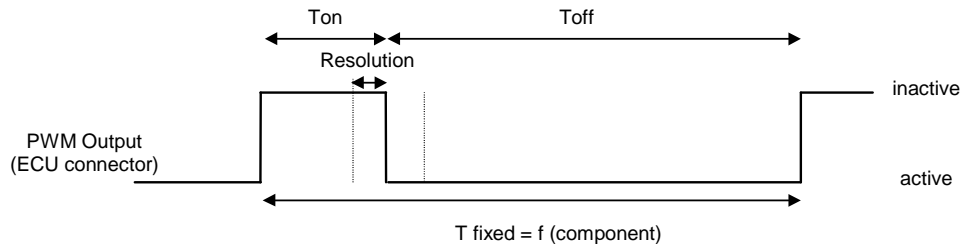
##### General information:

PWM management principle :

Positive PWM :



Negative PWM :



Duty cycle =  $T_{on} / T$

PWM outputs are 2 types :

- True PWM using a POUT  $\mu$ P output. In this case the duty cycle range could be 0 . . 100%
- Pseudo PWM using a CAPCOM  $\mu$ P output. In this case, minimum  $T_{on}$  and minimum  $T_{off}$  are 300  $\mu$ s with standard priority.

##### Initialization:

During hard reset and software initialization, all PWM outputs are inactive. As soon as application software start, the PWM outputs are piloted. Inactive output means inactive driver output.

## 2.18 List of PWM outputs/Definition of PWM outputs

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IVVTPWM_0	O/V	0... FFFFH	0... 99.99847	1.53e-3	%
PWM for inlet VANOS					
IVVTPWM_1	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
PWM for outlet VANOS					

### Input data:

CPPWM_CPS {p. 3749}	ECFPWM_ECF {p. 1045}	ECRAPWM {p. 3863}	ECPWM {p. 3858}
FPAPWM	LC_POIL_CTL_ENA {p. 903}	LSHPWM_DOWN [NC_CBK_EX_NR] {p. 2421}	LSHPWM_UP [NC_CBK_EX_NR] {p. 2385}
LV_VAR_TCHA {p. 656}	MTCPWM {p. 6546}	POIL_PWM {p. 8203}	PWM_ACR {p. 3580}
VCPWM	VIMPWM_1 {p. 3622}	VIMPWM_2 {p. 3622}	WGPWM [NC_CBK_EX_NR] {p. 8140}

### 2.18.1 List of PWM outputs

#### 2.18.1.1 Data Definition

Name	ECU Pin Name (Output)	Definition / Remark	Frequency (Hz)
MTCPWM	A_T_MDK	Main throttle control	600
LSHPWM_UP_1	A_T_LHV1	LSH bank 1 upstream	See EGCP configuration
LSHPWM_UP_2	A_T_LHV2	LSH bank 2 upstream	
LSHPWM_DOWN_1	A_T_LHH1	LSH bank 1 downstream	
LSHPWM_DOWN_2	A_T_LHH2	LSH bank 2 downstream	
ECPWM	A_S_KFK	electronically controlled thermostat	1
IVVTPWM_0	A_T_NWE1	VANOS unit 1 (inlet 1 or inlet)	244
IVVTPWM_1	A_T_NWE2	VANOS unit 2 (inlet 2 or outlet)	244
CPPWM_CPS	A_T_TEV	canister purge valve	Def. in EVAC
ECFPWM_ECF	A_T_ELUE1	cooling fan	100 (10 during power latch)
VCPWM	A_T_MSV	Flow control valve	201
PWM_ACR	A_T_AGR1/2	Exhaust gas recirculation valve	976
ECRAPWM	A_T_LKS	Electronical controlled radiator shutter	200

#### Switchover between FPAPWM and POIL\_PWM

If LC\_POIL\_CTL\_ENA = 0  
then

FPAPWM	A_T_DSV	Pressure control valve	1)
--------	---------	------------------------	----

else

POIL_PWM	A_T_DSV	Electronically controlled oil pressure actuator	2)
----------	---------	---	----

endif

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- 1.) According module ' High pressure pump control (Appl. Inc.)'
- 2.) According module 'Cus adap module: ENLU'

#### **Additional for LV\_VAR\_TCHA = 0**

Name	ECU Pin Name (Output)	Definition / Remark	Frequency (Hz)
VIMPWM_1	A_T_DISA1	variable intake manifold chanel 1	200
VIMPWM_2	A_T_DISA2	variable intake manifold chanel 2	200

#### **Additional for LV\_VAR\_TCHA = 1**

Name	ECU Pin Name (Output)	Definition / Remark	Frequency (Hz)
WGPWM[2]	A_T_WG2	wastegate chanel 2	300
WGPWM[1]	A_T_WG1	wastegate chanel 1	300

#### **List of corresponding logic values:**

Name	Definition
LV_MTC_DIR	direction of MTC
LV_MTC_DIS	disable MTC

### **2.18.2 Output PWM for inlet and outlet VANOS**

The PWM outputs for both VANOS actuators are driven directly by BMW- objects via function call. To know the actual PWM- value in the system, the registers of the PWM- outputs are mirrored into system variables (IVVTPWM\_0 and IVVTPWM\_1). To reach a permanent micro-movement of the control piston in the valve a variable Frequency-Control is implemented driven directly by BMW- objects via function call: PWM\_FRQ\_NWA1(), PWM\_FRQ\_NWE1().

The minimum frequency, which can be adjusted, is 75 Hz

### **2.18.3 Output for HPDI relay**

CH\_PWM\_DCDC = 80%

## 2.19 Spark advance and dwell output

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TD_FAC_MAX	O/V	1... FFH	1... 255	1/128	-
Maximal dwell time control					
TD_FAC_MIN	O/V	1... FFH	1... 255	1/128	-
Minimal dwell time control					

### Input data:

LDPM_N_32_1_IGRE	LV_ERR_CAM {p. 1505}	LV_ST {p. 1720}	N_32 {p. 1525}
NC_CYL_NR {p. 1526}	VB {p. 1185}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TD_FAC_ST_MAX	-	1... FFH	1... 255	1/128	-
Factor for maximum dwell time					
C_TD_FAC_ST_MIN	-	1... FFH	1... 255	1/128	-
Factor for minimum dwell time					
C_TD_VB_MAX	-	0... FFH	0... 26	0,102	V
Maximum battery voltage to activate MPL (typical value : 16V)					
IP_TD_FAC_MAX	-	1... FFH	1... 255	1/128	-
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Max dwell time factor					
IP_TD_FAC_MIN	-	1... FFH	1... 255	1/128	-
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Min dwell time factor					
LC_IGC_LIH_CONF	-		-	-	-
Configuration Choice for Half static Mode in case of CAM limp home: 0 = no Limp Home - 1 = Half Static					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IGC_CONF	-		-	-	-
Half static or full static (Typical value for debug = full static)					

### Import actions:

<b>ACTION_INFR_SetIgnCtl</b> (IN<Ign_ctl_mod>)
--

### FUNCTION DESCRIPTION:

This function sets the angular position of the dwell time turn on in order to have the time to set up the necessary current in the ignition coil.

The strategy is based on a priority of the ignition angle. If dwell time priority is requested the minimum dwell time is equal to maximum dwell time.

The strategy respects ignition coils with dual and single outputs. This function could be used independently of the number of cylinders (n) and the geometry of the crankshaft target wheel.

This function could be used for homogeneous combustion mode and for stratified combustion mode. The calculation of the spark advance is in both cases the same. All of the functions described in this section operate over the entire engine speed range. This specification includes two mode following the IGR version: PI or PI + DI

### 2.19.1 Minimum /Maximum dwell time calculation

#### FUNCTION DESCRIPTION:

The two values are calculated independently of all environment factors. The aim is to have a larger window at start and low engine speed to obtain a better flexibility to apply the requested ignition angle. These 2 values are expressed in term of min/max factor to be applied to the nominal dwell time and transferred to the Basic SW

The cylinder individual nominal Dwell Time to be applied requested by ASW function is defined in TD\_IGC[x] taking into account the combustion mode switch

#### Application conditions

**Initialisation:**  $TD\_FAC\_MIN = TD\_FAC\_MAX = 1$  at reset

**Recurrence:** 10 ms

#### Formula section:

```

If          LV_ST = 1
Then(Start mode)
  If          VB > C_TD_VB_MAX
  Then          TD_FAC_MAX = 1
                 TD_FAC_MIN = Min[ C_TD_FAC_ST_MIN , 1]
  Else          TD_FAC_MAX = Max[ C_TD_FAC_ST_MAX , 1]
                 TD_FAC_MIN = Min[ C_TD_FAC_ST_MIN , 1]
Else (run mode)
  If          VB > C_TD_VB_MAX
  Then          TD_FAC_MAX = 1
                 TD_FAC_MIN = Min[ IP_TD_FAC_MIN , 1]
  Else          TD_FAC_MAX = Max[ IP_TD_FAC_MAX , 1]
                 TD_FAC_MIN = Min[ IP_TD_FAC_MIN , 1]
Endif
    
```

### 2.19.2 Half static of full static

*Recurrence:* engine stop to engine run

#### Formula section:


Following NC\_IGC\_CONF = Half or full, the ignition is half static controlled or full static controlled  
**ACTION\_INFR\_SetIgnCtl**(NC\_IGC\_CONF)

### 2.19.3 Limp home without cam signal

*Recurrence:* engine stop to engine run

#### Formula section:

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In case of CAM failure, the cylinder in combustion cannot be unequivocally identified. Engine phasing might be wrong. In such a case, a limp home mode function on Ignition is provided in order to have the possibility to drive the engine. Nevertheless, in this case, since the right cylinder phasing is not known, Ignition coil have to be driven in Half-Static mode to be sure to execute at least an ignition on the cylinder in combustion.

Decision to use such Limp Home functionality will depend on the setting of LC\_IGC\_LIH\_CONF. If LC\_IGC\_LIH\_CONF = 0, no Limp Home is provided in CAM failure and Ignition is stopped. If LC\_IGC\_LIH\_CONF = 1, then Half-Static Ignition mode is done in case of CAM failure

If LV\_ERR\_CAM is active, the ignition coil control will be executed in half-static ignition-coil control mode if selected by the settings of LC\_IGC\_LIH\_CONF


In such a case (*half-static mode activation in CAM failure*) the same Ignition and Dwell Time will be applied to the 2 Crank synchronous cylinders (eg. on a 4 cyl engine, cyl. 1 and 4 and cyl. 2 and 3 will be fed with the same Ignition and Dwell Time)

The limp home function could be applied only if the number of cylinders is even (2, 4, 6, ...)

```

If                NC_IGC_CONF = full
Then             If      LV_ERR_CAM = 1      And      LC_IGC_LIH_CONF = 1
                   Then      ACTION_INFR_SetIgnCtl(HALF_STATIC)
                   Else      ACTION_INFR_SetIgnCtl(FULL_STATIC)
                   EndIf
Else             ACTION_INFR_SetIgnCtl(HALF_STATIC)
EndIf

```

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## 2.20 Ignition output diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_SCG_IGC [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Diagnostic of primary short circuit to ground (cylinder selected)					
LV_SCP_IGC [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Diagnostic of primary short circuit to battery (cylinder selected)					
V_DUR_IGC [NC_CYL_NR]	O/V	0... FFFFH	0... 262.14	0,004	ms
Burn time duration for diagnosis validation					

### Input data:

LV_CDN_DIAG_IGC_SCP [NC_CYL_NR] {p. 4772}	LV_SYN_ENG {p. 1506}	MFF_SP_MV {p. 2151}	N_32 {p. 1525}
NC_CYL_NR {p. 1526}	SEG_NR {p. 1525}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_V_DUR_IGC_MIN	-	0... FFFFH	0... 262.14	0,004	ms
LDP_N_32_ID_V_DUR_IGC_MIN	8	0... FFH	0... 8160	32	rpm
LDP_MFF_SP_MV_ID_V_DUR_IGC_MIN	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Minimum duration of the Burntime to detect ignition errors					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IGBT_CUT_OFF_T	-	0... FFFFH	0... 262.14	0,004	ms
Inhibition of IGBT protection cut off function					
NC_INI_CTR_DEAC	-	0... FFFFH	0... 262.14	0,004	ms
Time delay after IGBT threshold response before switching OFF the IGBT - typical value 600 us					
NC_T_MIN_SCP	-	0... FFFFH	0... 262.14	0.004ms	ms
Minimum time to detect SCB with current feedback flag					

### Import actions:

<b>ACTION_INFR_GetIgnScgDiag</b> (IN<No Name available>,IN<No Name available>,OUT<No Name available>,OUT<No Name available>)
<b>ACTION_INFR_GetIgnScpDiag</b> (IN<No Name available>,OUT<No Name available>)

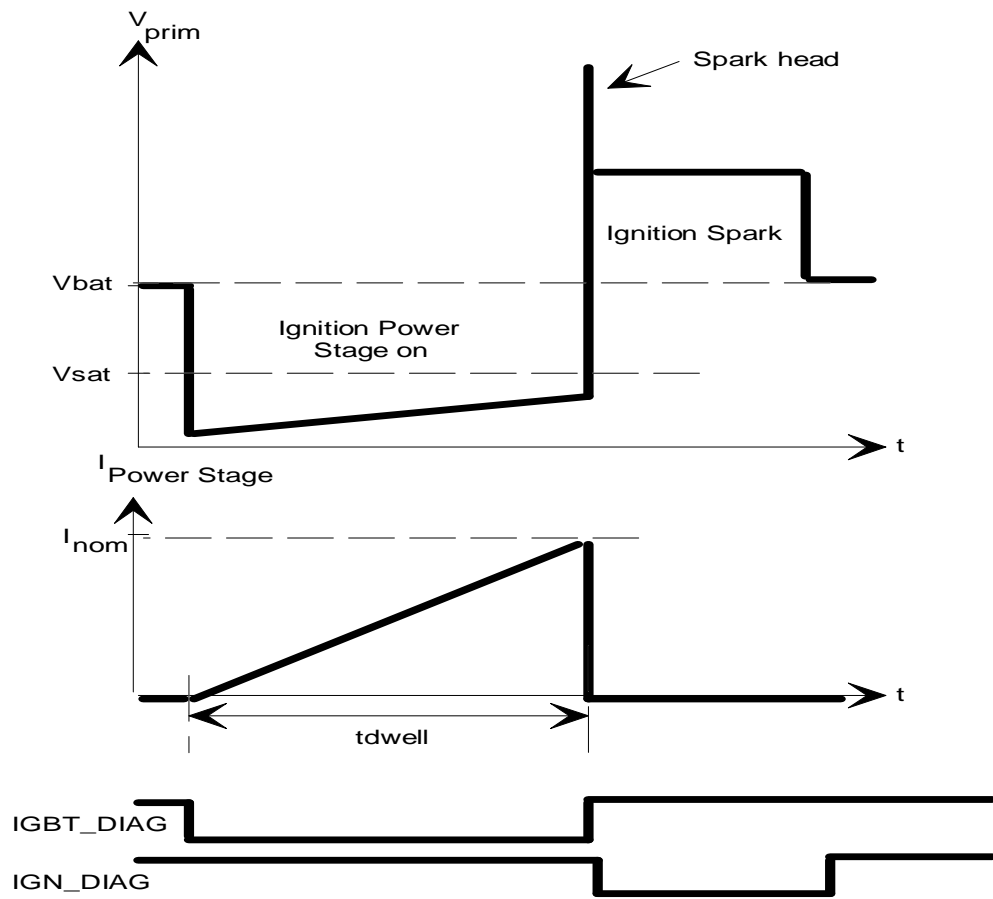
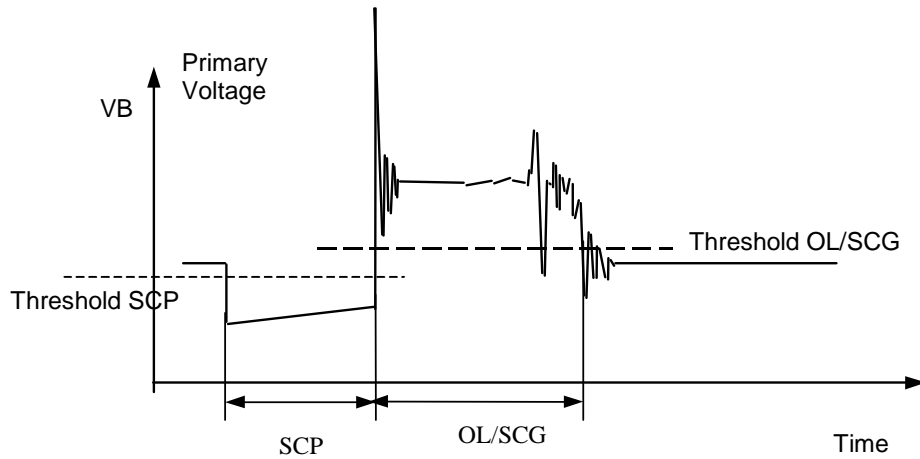
Each ATM46 could analyze 4 ignition coils. If diagnostics for more than 4 coils are necessary, a parallel ATM46 has to be used.

The diagnosis is based on ignition coil primary over voltage measurement.

The input signal of the ATM 46 is the IGBT collector voltage.

In case of an ignition system with single output coils, the function does not work in camshaft limp home mode.






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### 2.20.1 IGBT Protection (with ATM46 /Combined ASIC )

#### FUNCTION DESCRIPTION:

The aim of the present function is to protect the ignition power stage against short circuit to battery (SCP).

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The purpose of ignition power stage diagnostic is to detect a short circuit to battery voltage condition (SCP). At each Dwell Time On event, the ignition power stage is switched on. In normal condition, the current increase in the ignition power stage is limited by the inductance of the ignition coil solenoid.

In case of a short circuit to battery, the coil external device does not limit the current in the ignition power stage. In this situation the current is only limited by the current capability of the ignition power stage. This power dissipation would destroy the power stage. From the Dwell Time ON event in SCP condition, the IGBT's can withstand this overload current only for a very short time (*750µs for IGBT without shunt*). So, it is necessary to switch off this IGBT transistor for safety and protection reasons by software (*IGBT deactivation by switching off the charging command in SW*) in case of an overload condition and after a certain time delay has elapsed (NC\_INI\_CTR\_DEAC). This time delay is necessary in order to filter parasitic spikes. On the other hand this time delay must not exceed the maximum rating of the IGBT's.

For ignition power stage diagnostic, the voltage across the ignition power stage is compared to a fixed threshold voltage. This threshold voltage is chosen to be higher than the maximum saturation voltage of the ignition power stage during a dwell time in normal operation. If there is no short to battery voltage condition, the voltage across the ignition power stage drops below this fixed threshold voltage at each dwell time. In case of a short to battery voltage failure, this voltage is not (or only for a short time) passed. A micro controller monitoring the ignition power stage diagnostic output is able to detect this fault.

This ignition power stage diagnostic circuit is designed for an engine management system including four ignition power stages. This four diagnostic information can be evaluated at one output by having a logic OR function of them.

After each deactivation from this protection function, the cut off IGBT will be reactivated again in the next ignition cycle

The function could be used for ignition systems with single-output coils and double-output coils. The IGBT protection function is cylinder selectively deactivated in case of single-output coil and linked dual cylinders for ½ static coils.

### Application conditions

**Activation:** LV\_SYN\_ENG = 1

### Formula section:

Initialization: at reset  
LV\_SCP\_IGC[x] = 0  
Update rate: segment

### System description:

The ATM46 is used to generate a signal evaluated by the SW for overload condition detection.

To perform the IGBT protection and SCP diagnostic, the BSW provides one functional service (BSW driver - one driver for one ATM46 protection and SCP diagnostic line)

As only one IGBT diagnosis output signal from the "ATM 46" exists (all channels are linked by a wired "OR") and only one BSW functional service (*this BSW functional service used is described in the following paragraph*) is used in connection to this diagnosis output signal line, the function is limited to non-overlapping dwell time pulses. In case of overlapping Dwell Time, the last TD ON event that occurs will re-trigger the call of this function and thus be considered for diagnosis purpose.

### Formula section:

**ACTION\_INFR\_GetIgnScpDiag(SEG\_NR -2, LV\_SCP\_IGC[SEG\_NR-2])**

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### 2.20.1.1 Ignition Actuator Tests Diagnosis

#### Formula section:

*Initialization:* LV\_SCP\_IGC[x] = 0 at reset

#### System description:

For ignition coil actuator tests purpose, the SCP diagnostic function has to be enabled and activated upon the tests requests

The same case and comments (see before) apply here also.

#### Formula section:

```

For      x = 0 to NC_CYL_NR - 1
      If  LV_CDN_DIAG_IGC_SCP[x] = 1
      Then ACTION_INFR_GetIgnScpDiag(SEG_NR -2, LV_SCP_IGC[SEG_NR-2])

      EndIf
EndFor

```

### 2.20.1.2 SCG (Burn Time measurement) - Acquisition of the burn time

#### Description:

This ignition diagnosis function evaluates the primary over voltage duration **V\_DUR\_IGC[x]** provided after the ignition coil cut off.

The aim of this spark burning diagnostic function is to measure the spark duration by detecting the presence of a spark on an ignition plug. The over-voltage at the primary coil of an ignition solenoid is equal to the voltage across the spark gap of the ignition plug divided by the transmission ratio of the ignition solenoid and superimposed on the battery voltage. The time where the voltage at the primary coil of the ignition solenoid is higher than a battery voltage dependent threshold voltage ( $V_{BD\_th}$ ) gives the spark duration.

In the moment, when the ignition power stage (IGBT) is switched OFF (*ie. at TD OFF event occurrence*), the voltage  $V_C$  at the collector of the IGBT rises, due to self-induction, and ignition occurs. As long as the ignition spark is burning, the voltage is well exceeding the battery voltage.

By means of a hardware defined threshold ( $V_{BD\_TH}$ ; typical value:  $V_{Bat} + 3V$ ) the burn condition is detected and a matching signal is generated, *eg. Here by the combined ASIC ATM46*. This signal is used to measure the overall burning duration.


The Ignition Burning diagnostic signal IGN\_DIAG is generated by this combined ASIC. This time for the burning spark IGN\_DIAG is calculated via the duration of the diagnostic signal staying above the threshold of  $V_{BD\_TH}$ .

This ATM46 ignition diagnostic circuit is designed for an engine management system including up to 4 ignition coils/solenoids. This four diagnostic information are then evaluated on one output by applying a logic NOR function on them. The output signal IGN\_DIAG of the ignition diagnostic circuit is processed by the  $\mu P$ .

Due to combustion chamber turbulence the spark of an ignition plug is not stable. The result is an unstable primary voltage at the ignition solenoid. Therefore a filter in the output signal IGN\_DIAG is necessary to prevent the  $\mu P$  from high frequency inputs.

The ignition coil primary over voltage on the ignition output is roughly equal to the voltage across the spark gap divided by the ignition coil transformation ratio, superimposed on the battery voltage.

The Burn Time measurement is used today only for Spark /Combustion Diagnosis Purpose. It is a rough measurement of the effective Burn Time.

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Please note that the SCG detection is equivalent to the detection of an Open Load.

### Application conditions

**Activation:** LV\_SYN\_ENG = 1


**Initialisation:** LV\_SCG\_IGC[x] = 0  
at reset

V\_DUR\_IGC[x] = 0

**Recurrence:** segment

### Formula section:

**ACTION\_INFR\_GetIgnScgDiag**(SEG\_NR-2, ID\_V\_DUR\_IGC\_MIN,  
V\_DUR\_IGC[SEG\_NR-2], LV\_SCG\_IGC[SEG\_NR-2])

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## 2.21 Engine speed (Tacho) output


### FUNCTION DESCRIPTION:

The engine speed signal TD is a tooth-fixed event at the ECU Pin A\_F\_TD. The signal is set to high at the teeth 1, 21, 41, 61, 81, 101 and reset to low at the teeth 11, 31, 51, 71, 91, 111. This means: falling edge at every TDC, rising edge at every BDC (of any cylinder).

The artificially generated teeth are used in the CAM limp home. Since the cylinder group assignment is not decisive for the output of the TD signal, the CRK limp home has no influence on the output of the TD signal.

### Initialisation :

The output signal is initialised with a low logic state (0).

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## 2.22 BIOS H-bridge diagnosis function

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
BIOS_HBR_FAULT_STATUS_VIM	0	0H 1H	NO_ERROR ETC_HBR_ ERROR	-	-
STATUS OF H-BRIDGE DISA					

### FUNCTION DESCRIPTION:

#### General information:

The function Bios H-Bridge Diagnosis manages detection of H-Bridge faults witch deactivate the DISA H-Bridge.

#### Description:

The following error conditions can be distinguished:

- Undervoltage
- Overcurrent
- Overtemperature

#### Application conditions

**Initialisation:** 0

**Recurrence:** 10 ms

#### Formula section:

```

if          one error condition is fulfilled
then       BIOS_HBR_FAULT_STATUS_VIM = 1
else       BIOS_HBR_FAULT_STATUS_VIM = 0
endif
  
```

## 2.23 KWP 2000

### General information

#### 2.23.1 Normative reference

##### General information:

This implementation and the description of diagnostic communication protocol KWP 2000 is based on the following standards:

ISO/FDIS 14229, 1996 Road vehicles-Diagnostic systems - Diagnostic Services Specification

ISO/FDIS 14230-1, 1996 Road vehicles-Diagnostic systems  
Keyword Protocol 2000 part 1 : Physical Layer

ISO/FDIS 14230-2, 1996 Road vehicles-Diagnostic systems  
Keyword Protocol 2000 part 2 : Data Link Layer

ISO/FDIS 14230-3, 1996 Road vehicles-Diagnostic systems  
Keyword Protocol 2000 part 3 : Implementation

ISO/DIS 14230-4 Road vehicles-Diagnostic systems  
Keyword Protocol 2000 part 4 : KWP2000 requirements for emission-related systems

VDA/WD 14230-2, 1998 Keyword Protocol 2000 part 2 : Data Link Layer, VDA-recommended practice

VDA/WD 14230-3, 1998 Keyword Protocol 2000 part 3 : Implementation, VDA-recommended practice

##### Application conditions:

**Initialisation:** —

**Activation:** —


**Deactivation:** —

**Recurrence:** —

##### Function description:

##### Formula section:

#### 2.23.2 Customers reference

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**General information:**

7 507 660.4	Index a	2003	CP-DME Diagnoselastenheft Revision 2.5
6 942 417.6	Index b	2003	LH Diagnose Teil 2: Systembeschreibung
6 942 418.6	Index b	2003	LH Diagnose Teil 3: Feinspezifikation
6 942 422.6	Index b	2003	LH Diagnose Teil 7: KWP2000 Diagnostic


**Application conditions:**

<b>Initialisation:</b>	—
<b>Activation:</b>	—
<b>Deactivation:</b>	—
<b>Recurrence:</b>	—

**Function description:**

**Formula section:**

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## 2.24 Segment time calculation

### Action definition

<b>ACTION_INFR_DisableT5T</b> ()	Mode: O
This action deactivates segment time acquisition for 5 teeth- segments	
<b>ACTION_INFR_EnableT5T</b> ()	Mode: O
This action activates segment time acquisition for 5 teeth- segments	
<b>ACTION_INFR_GetT5T</b> (IN<idx>,OUT<time>)	Mode: O
Acquisition of partial segment time over 5 teeth	
<b>ACTION_INFR_GetT5TDiag</b> (OUT<diag>)	Mode: O
Diagnostic information for acquisition of 5-teeth- segments	

### Description for actions:


<b>ACTION_INFR_EnableT5T()</b>					
This action activates segment time acquisition for 5 teeth- segments					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit

<b>ACTION_INFR_DisableT5T()</b>					
This action deactivates segment time acquisition for 5 teeth- segments					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit

<b>ACTION_INFR_GetT5T(IN &lt;idx&gt;, OUT &lt;time&gt;)</b>					
Signal acquisition for 5 teeth- segments					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
idx	IN	0...18H	0...23	1	[-]
Index of the array of measured partial segment time					
time	OUT	0...FFFFH	0...65,535	0,001	ms
Measured partial segment time over 5 teeth					

<b>ACTION_INFR_GetT5T_Diag(diag)</b>					
Diagnostic information for acquisition of 5-teeth- segments					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
diag	OUT	0...1H	0...1	1	[-]
Diagnostic for partial segment time acquisition, set to 1 when buffer content is valid					

### General information:

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The function shall sample a time stamp every 5 teeth and calculate the difference of the actual and the last time stamp. The result is stored in a buffer with 24 values. The return value of ACTION\_INFR\_GetT5T(idx,time) is the time from the indexed cell of the array.

Acquisition shall start at TDC cylinder 0. Values are written to the appropriate location of the array (e.g., the first partial segment time measured after TDC 0 is written to the first location of the array).

In case of overflow (below approx. 80rpm), the measured segment time is limited to the maximum value.

When enabling or disabling action is called, all buffer values are set to maximum value.

A diagnostic action delivers information about validity of the buffer contents. The return value is 0 after enabling as long as buffer content is not valid, and changes to one as soon as the buffer is ready to be read out. Buffer content is regarded as valid as soon as all 24 values in the buffer are filled.

**Requirements for ACTION\_INFR\_EnableT5T:**

Data acquisition					
Parameter	Absolute precision	Relative precision	Resolution	Coincidence with parameter	Comment

**Diagnosis:**

**Coincidence requirements:**

**Requirements for ACTION\_INFR\_DisableT5T:**

Data acquisition					
Parameter	Absolute precision	Relative precision	Resolution	Coincidence with parameter	Comment

**Diagnosis:**

**Coincidence requirements:**

**Requirements for ACTION\_INFR\_GetT5T:**

Data acquisition					
Parameter	Absolute precision	Relative precision	Resolution	Coincidence with parameter	Comment
index	1	1	1		
time		0,001ms	0,001ms		

**Diagnosis:**

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**Coincidence requirements:** Acquisition shall start at the start of segment 0, and repeat every 5 teeth.

**Requirements for ACTION\_INFR\_GetT5TDiag:**

Data acquisition					
Parameter	Absolute precision	Relative precision	Resolution	Coincidence with parameter	Comment
Diag	1		1		

**Diagnosis:** no diagnosis done here

**Coincidence requirements:** end of acquisition for the buffer (all 24 values filled)

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## 2.25 Dwell time adaptation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_TD_AD_SWI	V	0... FFH	0... 255	1	-
Counter used for the switch in between low and high mode currents					
LV_TD_AD_ACQ_VLD	V		-	-	-
Flag indicating validity of current measurement					
LV_TD_AD_SWI	V	0... 1H	0 ...1	1	-
Flag indicating switch in between low and high mode currents					
T_SUM_TD_AD [NC_CYL_NR]	V	0... FFFFH	0... 262.14	0.004	ms
Sum of added time on TD_AD without reaching current threshold					
TD_AD [NC_CYL_NR]	O/V	8000... 7FFFH	-131.072 ...131.068	0.004	ms
Dwell time adaptative					
TD_AD_H [NC_CYL_NR]	V/S	8000... 7FFFH	-131.072 ...131.068	0.004	ms
Dwell time adaptative during high mode current					
TD_AD_L [NC_CYL_NR]	V/S	8000... 7FFFH	-131.072 ...131.068	0.004	ms
Dwell time adaptative in low mode current					

### Input data:

LV_ERR_CAM {p. 1505}	LV_INH_TD_AD {p. 937}	LV_SCG_IGC [NC_CYL_NR] {p. 920}	LV_SCP_IGC [NC_CYL_NR] {p. 920}
LV_TD_AD_H {p. 937}	N_32 {p. 1525}	NC_CYL_NR {p. 1526}	SEG_NR {p. 1525}
T_THD_IGCFB {p. 937}	TD_IGC [NC_CYL_NR] {p. 1876}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_DEC_TD_AD	-	0... FFH	0... 0.996	3.9e-3	-
Factor applied on T_THD_IGCFB to calculate time to be removed to TD_AD					
C_N_32_MIN_TD_AD	-	0... FFH	0... 8160	32	rpm
Engine speed threshold at which the TD_AD calculation change its recurrence					
C_T_SUM_TD_AD_MAX	-	0... FFFFH	0... 262.14	0.004	ms
Maximum time allowed to be added in TD_AD without reaching target threshold					
C_T_THD_IGCFB_MAX	-	0... FFFFH	0... 262.14	0.004	ms
Maximum measured time for valid sample					
C_TD_AD_INC	-	0... FFH	0... 1.02	0.004	ms
Increment on dwell time in case current threshold is not reached					
C_TD_AD_MAX	-	8000... 7FFFH	-131.072 ...131.068	0.004	ms
Maximum value for dwell time adaptative					
C_TD_AD_MIN	-	8000... 7FFFH	-131.072 ...131.068	0.004	ms
Minimum value for dwell time adaptative					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TD_AD_THD	-	0... FFFFH	0... 262.14	0.004	ms
Definition of threshold to enable dwell adaptation					
C_TD_IGC_OL_MIN	-	0... FFFFH	0... 262.14	0.004	ms
Minimum value at which we inhibit the adaptation of dwell time in case of open load					
LC_TD_AD_CLR	-	0... 1H	0 ...1	1	-
Logical value enabling reset of variables TD_AD[x]					

### Action definition

<b>ACTION_IGRE_GetIgnDwellAdNvmy (IN&lt;PRM_Cyl&gt;,OUT&lt;PRM_Td_ad_l&gt;,OUT&lt;PRM_Td_ad_h&gt;)</b>	Mode: O
This action allows getting the values of dwell time adaptation stored in NVMY.	

<b>ACTION_IGRE_RstIgnDwellAdNvmy (IN&lt;PRM_Cyl&gt;)</b>	Mode: O
This action allows resetting the values of dwell time adaptation.	

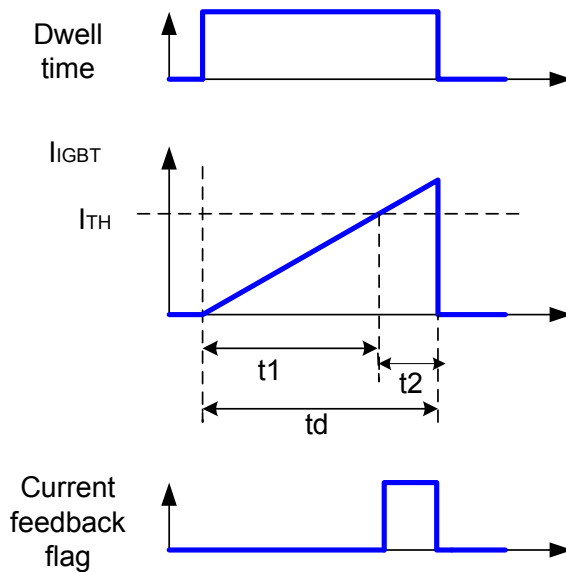
### Description for actions:

<b>ACTION_IGRE_GetIgnDwellAdNvmy(IN &lt; PRM_Cyl&gt;, OUT &lt; PRM_Td_ad_l&gt;, OUT &lt; PRM_Td_ad_h&gt;)</b>					
This action allows getting the values of dwell time adaptation stored in NVMY. For specified cylinder Cyl, the dwell time adaptative values TD_AD_L and TD_AD_H will be read. If cylinder number received is not in the range of the engine cylinder number, the maximum value will be put in output for TD_AD_L and TD_AD_H.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_Cyl	IN	0...7	0...7	1	-
Cylinder number on which we want to get the dwell time adaptative values					
PRM_Td_ad_l	OUT	8000...7FFFH	-131.072...131.068	0.004	ms
Dwell time adaptative for low current mode					
PRM_Td_ad_h	OUT	8000...7FFFH	-131.072...131.068	0.004	ms
Dwell time adaptative for high current mode					

<b>ACTION_IGRE_RstIgnDwellAdNvmy (IN &lt;PRM_Cyl&gt;)</b>					
This action allows resetting the values of dwell time adaptation stored in NVMY. This action will reset for the specified cylinder the adaptative values TD_AD_L and TD_AD_H to 0 ms.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_Cyl	IN	0...7	0...7	1	-
Cylinder number on which we want to reset the dwell time adaptative values					

### FUNCTION DESCRIPTION:

This function should be used with ATIC71 component. Through the 2 current feedback flags of the component it is possible to measure the time spent above a given current threshold during the main dwell pulse.



Two different current thresholds can be used depending on which engine condition we are. The current threshold is fixed by hardware component at the current target the coils have to reach. If the threshold is not reached we increase the dwell time. In the other case we will decrease the dwell time by the time  $t_2$  (time measured above the current threshold).

Please note that in this whole specification  $x$  corresponds to SEG\_NR-2.

### Application conditions:

#### Initialisation:

in case of EEPROM fault or new ECU: All TD\_AD[x] = 0 ms

At reset :

```

if      LC_TD_AD_CLR = 1
then    for x = 0 to NC_CYL_NR-1
            TD_AD_H[x] = 0
            TD_AD_L[x] = 0
            Endfor
Else    TD_AD_H[x] = saved value
            TD_AD_L[x] = saved value
endif

```

After power latch : all TD\_AD\_H[x] and all TD\_AD\_L[x] are stored into the non-volatile memory

At reset: T\_SUM\_TD\_AD[x] = 0ms  
 TD\_AD[x] = TD\_AD\_H[x] for all cylinders

Recurrence: segment  
**if** N\_32 > C\_N\_32\_MIN\_TD\_AD  
**Then** recurrence = 1 out of NC\_CYL\_NR-1 segment  
**EndIf**

Activation: at the 3rd segment occurrence

Deactivation:

### Formula section:

Detection of current threshold switch

```

If          LV_TD_AD_Hn != LV_TD_AD_Hn-1
Then      for x = 0 to NC_CYL_NR-1
              T_SUM_TD_AD[x] = 0
              Endfor
              CTR_TD_AD_SWI = NC_CYL_NR + 1
              LV_TD_AD_SWI = 1
Else
              If          CTR_TD_AD_SWI = 0
Then      nop // non operating: no action
              Elseif CTR_TD_AD_SWI = 1
Then      CTR_TD_AD_SWI = CTR_TD_AD_SWI - 1
              LV_TD_AD_SWI = 0
              Else          CTR_TD_AD_SWI = CTR_TD_AD_SWI - 1
              Endif
Endif

If          CTR_TD_AD_SWI = NC_CYL_NR
For x = 0 to NC_CYL_NR-1
              Then          If          LV_TD_AD_H = 1
                              Then      TD_AD[x] = TD_AD_H[x]
                              Else      TD_AD[x] = TD_AD_L[x]
                              Endif
              End if
endfor
endif

```

Check of the validity of current feedback flag result

```

If          T_THD_IGCFB          ≥          C_T_THD_IGCFB_MAX
Or          (LV_SCG_IGC[x]      ==          1 And TD_IGC[X] > C_TD_IGC_OL_MIN)
Or          LV_SCP_IGC[x]        ==          1
Or          LV_ERR_CAM           ==          1
Or          LV_INH_TD_AD         ==          1
Or          LV_TD_AD_SWI         ==          1
Then      LV_TD_AD_ACQ_VLD       ==          0
Else      LV_TD_AD_ACQ_VLD       ==          1
Endif

```

Calculation of TD\_AD

```

If          LV_TD_AD_ACQ_VLD = 1
Then
              if          T_THD_IGCFB=0
Then      If          T_SUM_TD_AD[x]n < C_T_SUM_TD_AD_MAX
Then      TD_AD[x]n = TD_AD[x]n-1 + C_TD_AD_INC
              T_SUM_TD_AD[x]n = T_SUM_TD_AD[x]n-1 + C_TD_AD_INC
              Endif
Elseif T_THD_IGCFB > C_TD_AD_THD
Then      TD_AD[x]n = TD_AD[x]n-1 - C_FAC_DEC_TD_AD * T_THD_IGCFB
              T_SUM_TD_AD[x]n = 0

```

```

Else      T_SUM_TD_AD[x]n = 0
Endif

```

Limitation to maximum and minimum values authorized for dwell time adaptation

```

If        TD_AD[x] > C_TD_AD_MAX
Then      TD_AD[x] = C_TD_AD_MAX

```

```
Endif
```

```

If        TD_AD[x] < C_TD_AD_MIN
Then      TD_AD[x] = C_TD_AD_MIN


```

```
Endif
```

```

If        LV_TD_AD_H = 1
Then      TD_AD_H[x] = TD_AD[x]
Else      TD_AD_L[x] = TD_AD[x]
Endif
Endif

```

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## 2.26 Dwell time adaptation (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_TD_AD	O/V	0... 1H	0 ...1	1	-
Flag indicating that dwell time adaptative function is inhibited					
LV_TD_AD_H	O/V	0... 1H	0 ...1	1	-
Flag indicating dwell time adaptation is done in start					
T_THD_IGCFB	O/V	0... FFFFH	0... 262.14	0.004	ms
Time measurement between current threshold and end of dwell					
TD_CLC	O/V	0... FFFFH	0... 262.14	0.004	ms
Dwell time calculated by BSW					

### Input data:

LV_ST {p. 1720}	OPM_AV {p. 8137}	TCO {p. 1100}	
-----------------	------------------	---------------	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_TD_AD_SWI	-	0... FEH	-48... 142.5	0.75	°C
TCO threshold to enable switch from channel NC_TD_AD_CHN_ST to NC_TD_AD_CHN					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CFB_DIAG_SCP_CHN	-		-	-	-
Selection of the channel number to be used to do the SCB diagnosis with current feedback flag 0 : CURR_TH1 1 : CURR_TH2					
NC_TD_AD_CHN_H	-		-	-	-
Selection of channel number where current feedback flag is read to do dwell time adaptation during start phase 0 : CURR_TH1 1 : CURR_TH2					
NC_TD_AD_CHN_L	-		-	-	-
Selection of channel number where current feedback flag is read to do dwell time adaptation 0 : CURR_TH1 1 : CURR_TH2					

### Import actions:

<b>ACTION_INFR_GetIgnDwellAd</b> (IN,<IN>,OUT,<OUT>)
<b>ACTION_INFR_SetIgnConfigDiag</b> (IN<No Name available>)

### 2.26.1 Channel configuration for diagnosis

#### FUNCTION DESCRIPTION:

In case of dwell time adaptation by current feedback flag, the SCB diagnosis is also done by current feedback flag.

It is necessary in this case to select on which channel will be done the SCB diagnosis.

### Application conditions:

*Initialisation:*

*Activation:* at engine stop to engine run

*Deactivation:*

### Formula section:

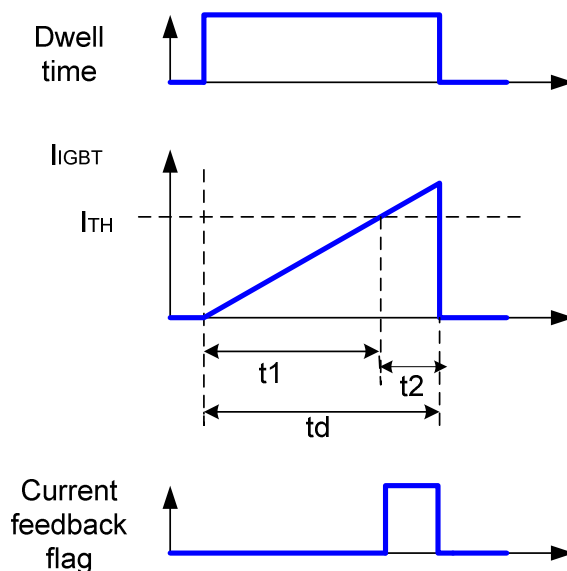
Channel configuration for SCB diagnosis with current feedback flag

**ACTION\_INFR\_SetIgnConfigDiag(NC\_CFB\_DIAG\_SCP\_CHN)**

## 2.26.2 Reading of current feedback flag for dwell time adaptation


### FUNCTION DESCRIPTION:

This function should be used with ATIC71 component. Through the 2 current feedback flags of the component it is possible to measure the time spent above a given current threshold during the main dwell pulse.



Two different current thresholds can be used depending on which engine condition we are.

The current threshold is fixed by hardware component at the current target the coils have to reach. If the threshold is not reached we increase the dwell time. In the other case we will decrease the dwell time by the time  $t_2$  (time measured above the current threshold).

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**Application conditions:**

*Initialisation:* at reset LV\_INH\_TD\_AD = 0

*Recurrence:* segment

*Activation:* at the 3rd segment occurrence

*Deactivation:*

**Formula section:**

Reading of the result of current feedback flag

**If** (LV\_ST = 1) or TCO < C\_TCO\_TD\_AD\_SWI

**Then**

LV\_TD\_AD\_H = 1

**ACTION\_INFR\_GetIgnDwellAd**(NC\_TD\_AD\_CHN\_H,SEG\_NR-2,T\_THD\_IGCFB, TD\_CLC)

**Elseif** OPM\_AV = 1H or OPM\_AV = 3H (S or AFL = HOM\_S mode)

**Then**

**ACTION\_INFR\_GetIgnDwellAd**(NC\_TD\_AD\_CHN\_H,SEG\_NR-2,T\_THD\_IGCFB, TD\_CLC)

LV\_TD\_AD\_H = 1

**Else** LV\_TD\_AD\_H = 0

**ACTION\_INFR\_GetIgnDwellAd**(NC\_TD\_AD\_CHN\_L,SEG\_NR-2, T\_THD\_IGCFB, TD\_CLC)

**Endif**

## 2.27 Acquisition of fuel pressure

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_V_FUP	O/V	0... FFFFH	0... 65535	1	-
Number of samples in buffer V_FUP_SUM					
CTR_V_FUP_1	O/V	0... FFFFH	0... 65535	1	-
Number of samples in buffer V_FUP_SUM_1					
LV_FUP_SEG_OLD	O	0... 1H	0 ...1	1	-
Logical variable indicating the buffer to read the sensor voltage in BSW old value					
V_FUP	V	0... 7FFFH	0... 4.99984	152.6e-6	V
LPG pressure in the fuel rail, voltage raw value (10 bits).					
V_FUP_SUM	O/V	0... FFFFFFFFH	0... 655359.99984	152.6e-6	V
Accumulated manifold air pressure measurements for segment number (2n-1), n=1,2,3,...					
V_FUP_SUM_1	O/V	0... FFFFFFFFH	0... 655359.99984	152.6e-6	V
Accumulated manifold air pressure measurements for segment number (2n), n=1,2,3,...					

### Input data:

LV_ES {p. 1720}	LV_FUP_SEG {p. 1283}		
-----------------	----------------------	--	--

### Import actions:

ACTION_INFR_GetVFupSens (OUT<V_Fup>)
--------------------------------------

### FUNCTION DESCRIPTION:

#### Signal flow diagram:

#### General information:

The raw value (voltage) for FUP is measured by continuous conversion every 1 ms. The values (10 bit) are summed up in two alternating buffers, V\_FUP\_SUM or V\_FUP\_SUM\_1. The numbers of values are counted in comparable buffers CTR\_V\_FUP or CTR\_V\_FUP\_1. This mechanism is necessary to synchronize the measurement and the calculation of FUP\_MES (build mean value with a standardized range)


Depending on the logical variable LV\_FUP\_SEG one of the two buffers — V\_FUP\_SUM or V\_FUP\_SUM\_1 — and the respective counter — CTR\_V\_FUP or CTR\_V\_FUP\_1 — are selected for writing, the contents of the other buffer (counter) is used for calculations and diagnosis (after this buffer and the corresponding counter have been read they are cleared).

After having read out one buffer — V\_FUP\_SUM or V\_FUP\_SUM\_1 — the buffer has to be cleared as well as the corresponding counter — CTR\_V\_FUP or CTR\_V\_FUP\_1.

A two-buffer-system is used to avoid incorrect FUP calculation.

The buffers will be filled when the segment is changing.

#### Application conditions

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**Initialisation:****At** Reset

After HW reset, the buffers - V\_FUP\_SUM and V\_FUP\_SUM\_1 - and the corresponding counters - CTR\_V\_FUP and CTR\_V\_FUP\_1 - have to be cleared.

```
V_FUP_SUM      = 0
V_FUP_SUM_1    = 0
CTR_V_FUP      = 0
CTR_V_FUP_1    = 0
LV_FUP_SEG_OLD = 0
```

**Recurrence:**

1ms

**Activation:**

-

**Deactivation:**

-

**Formula section:****If(1)** ( LV\_FUP\_SEG = 0 and LV\_FUP\_SEG\_OLD = 1 )**Then(1)**

```
V_FUP_SUM =
CTR_V_FUP = 0
```

**Else(1)****If(2)** ( LV\_FUP\_SEG = 1 and LV\_FUP\_SEG\_OLD = 0 )**Then(2)**

```
V_FUP_SUM_1 =
CTR_V_FUP_1 = 0
```

**Else(2)**

Do nothing

**Endif(2)****Endif(1)**

$$LV\_FUP\_SEG\_OLD_{(n)} = LV\_FUP\_SEG_{(n-1)}$$
**If(1)** ( LV\_FUP\_SEG = 0 )**Then(1)**

```
V_FUP_SUM = V_FUP_{(n)} + V_FUP_{(n+1)}
CTR_V_FUP_{(n)} = CTR_V_FUP_{(n-1)} + 1
```

**Else(1)**

```
V_FUP_SUM_1 = V_FUP_{(n)} + V_FUP_{(n+1)}
CTR_V_FUP_1_{(n)} = CTR_V_FUP_1_{(n-1)} + 1
```

**Endif(1)**

## 2.28 Multi function steering wheel interface

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
BIOS_CRU_DATA	O/V	6EH	RESUME	-	-
		B6H	SET_		
		DAH	ACCELERATE		
		FCH	OFF		
		FEH	DECELERATE		
NONE					
Status off MSW module					
BIOS_CRU_NEW_DATA	O	0... 1H	0 ...1	1	-
Validation Bit for Status off MSW					
BIOS_CRU_TOG	O	0... 1H	0 ...1	1	-
Togglebit for MSW Module					

### General information

The multifunction steering wheel (MSW) with buttons the position of which is transferred digitally through a serial data line serves as interface between the driver and the CRU system. According to extension stage, a distinction is made between low and high version with 8-bit and 16-bit transmission protocol. Only the 8-bit data frame is relevant for the engine control. For plausibility check whether the MSW is still active, a toggle bit is appended to the 7-bit information. This bit changes its level cyclically.

### Application conditions:

<b>Initialisation:</b>	–
<b>Activation:</b>	–
<b>Deactivation:</b>	–
<b>Recurrence:</b>	10 ms

### Function description:

### Formula section:

#### 2.28.1 Serial data line from the MSW

The buttons of the multifunction steering wheel are not interlocked mechanically against one another, which means that a priority must be introduced for the switch position. The S/A and DEC functions are an exception. Here the buttons are formed as rocker in the MSW and thus cannot be actuated simultaneously. The position of the buttons is encoded digitally the MSW control unit and transferred through a serial data line. In the 8-bit data frame, which is transmitted by the MSW, the buttons are encoded as follows:

8-bit data frame of the transmission module

S = Start bit  
N = Zero bit  
E = One bit

## I = Info bit

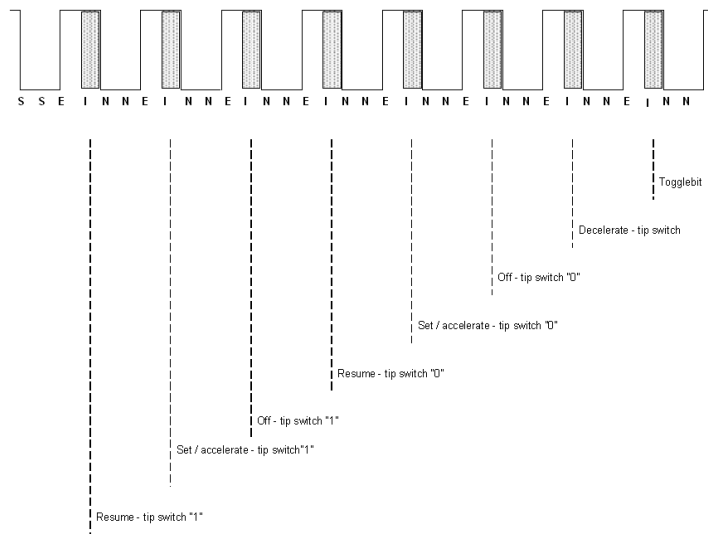


Figure 2.28.1:

Resume, setting/acceleration as well as off buttons are encoded redundantly and numbered for differentiating the information (0;1). The encoding of the buttons is high active, i.e. for a pressed button a 1 is transmitted as useful information. Furthermore a toggle bit is transmitted in the bit position 0 of the 8-bit data frame, a special bit information which changes its level cyclical. The toggle bit can thus also be used for error detection, like the switch positions, which are encoded redundantly.

The following distinctions are made in the transmitted functions of the MSW:

1. Rest: SET/ACC and DEC and RES and OFF not pressed.
2. SET/ACC: SET/ACC and no DEC pressed
3. DEC: DEC and no SET/ACC pressed
4. RES: RES pressed.
5. OFF: OFF pressed.

## 2.29 EGCP configuration of infrastructure interface

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NR_CBK_EX	O/V	1... 4H	1 ...4	1	-
current number of exhaust gas cylinder banks					
NR_CONF_CBK_EX	O/V	0... FFH	0... 255	1	-
current configuration of the technical structure of the exhaust bank with its components.					

### Input data:

CDN_DIAG_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	CDN_DIAG_LSH_UP [NC_CBK_EX_NR] {p. 4315}	ERR_DIAG_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	ERR_DIAG_LSH_UP [NC_CBK_EX_NR] {p. 4315}
NC_CBK_EX_NR {p. 1829}	VLS_NS [NC_NOX_SENS_CONF] {p. 992}		

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NR_CBK_EX	-	1... 4H	1 ...4	1	-
Define the number of exhaust gas cylinder banks					
C_NR_CONF_CBK_EX	-	0... FFH	0... 255	1	-
Define the technical structure of the exhaust bank with its components					

### Action definition

<b>ACTION_INFR_DisableCilc</b> ()	Mode: O
This action sets the deactivation of CILC	

<b>ACTION_INFR_EnableCilc</b> ()	Mode: O
This action sets the activation of CILC (cylinder individuel lambda control)	


<b>ACTION_INFR_GetCilc</b> (IN<x>,OUT<v_adc>,OUT<ctr>)	Mode: O
Signal acquisition for CILC	

<b>ACTION_INFR_GetEIDiagLshDown</b> (IN<i>,OUT<cdn_diag>,OUT<err_diag>)	Mode: O
This action reads the failure and the conditions information for each symptom from the infrastructure	

<b>ACTION_INFR_GetEIDiagLshUp</b> (IN<i>,OUT<cdn_diag>,OUT<err_diag>)	Mode: O
This action reads the failure and the conditions information for each symptom from the infrastructure	

<b>ACTION_INFR_GetHeatCoupling</b> (IN<PRM_NC_CBK_EX_NR>,OUT<PRM_LAMB_SP_FIL_DELTA_RISE>,OUT<PRM_LAMB_SP_FIL_DELTA_FALL>,OUT<PRM_VLS_UP_DELTA_RISE>,OUT<PRM_VLS_UP_DELTA_FALL>)	Mode: O
This action gets the value from the WRAF controller for the heater coupling diagnosis	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_NC_CBK_EX_NR	in	0... 1H	1 ...2	1	-
Index of exhaust cylinder banks					
PRM_LAMB_SP_FIL_DELTA_RISE	out	0... 7FFFH	0... 1.9999389648437	61.0351e-6	-

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Acquired lambda model value at the rising edge of heater PWM					
PRM_LAMB_SP_FIL_DELTA_FALL	out	0... 7FFFH	0... 1.9999389648437	61.0351e-6	-
Acquired lambda model value at the falling edge of heater PWM					
PRM_VLS_UP_DELTA_RISE	out	0... 3FFH	0... 4.9951171875	0.00488281	V
Acquired oxygen sensor voltage at the rising edge of heater PWM					
PRM_VLS_UP_DELTA_FALL	out	0... 3FFH	0... 4.9951171875	0.00488281	V
Acquired oxygen sensor voltage at the falling edge of heater PWM					

<b>ACTION_INFR_GetVAdcLsDown</b> (IN<i>,OUT<v_adc>)	Mode: O
This action gets the oxygen sensor voltage downstream	

<b>ACTION_INFR_GetVAdcLsUp</b> (IN<i>,OUT<v_adc>)	Mode: O
This action gets the raw value from the upstream oxygen sensor voltage	

<b>ACTION_INFR_GetVAdcTempLsUp</b> (IN<i>,OUT<v_adc>)	Mode: O
This action gets the oxygen sensor voltage upstream	

<b>ACTION_INFR_GetWrafControl</b> (IN<i>,OUT<lv_lsl_deac>,OUT<state_err_vnlsl>,OUT<state_err_vglsl>,OUT<state_err_viplsl>,OUT<state_err_vrcsl>,OUT<state_err_ipsl>,OUT<state_err_lsl>,OUT<state_lsl_if_spi_rd>,OUT<state_lsl_if_conf_spi_rd>,OUT<frq_r_it_osc_lsl_if_spi_rd>,OUT<ctr_err_lsl_if_spi_wr>,OUT<ctr_err_lsl_if_spi_it_osc_ena>,OUT<lv_vpisl_lim>,OUT<lv_vnlsl_lim>)	Mode: O
This action reads the values from the WRAF controller	

<b>ACTION_INFR_SetCilc</b> (IN<x>,IN<crk>)	Mode: O
This action provide actual phase displacement for each cylinder	

<b>ACTION_INFR_SetCmdLsDown</b> (IN<i>,IN<lv_swi_ls_down>)	Mode: O
This action starts the internal resistance determination by "pumping" the sensor.	

<b>ACTION_INFR_SetCmdLsUp</b> (IN<i>,IN<lv_swi_ls_up>)	Mode: O
This action starts the internal resistance determination by "pumping" the sensor.	

<b>ACTION_INFR_SetHeatCoupling</b> (IN<PRM_NC_CBK_EX_NR>,IN<PRM_T_DLY_TRIG_LSH_UP>,IN<PRM_LAMB_SP_FIL_HOM>)	Mode: O
This action sets the value of the WRAF controller for the heater coupling diagnosis	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_NC_CBK_EX_NR	in	0... 1H	1 ...2	1	-
Index of exhaust cylinder banks					
PRM_T_DLY_TRIG_LSH_UP	in	0... FFH	0... 0.255	0.001	s
Time delay for acquisition of oxygen sensor signal and lambda model					
PRM_LAMB_SP_FIL_HOM	in	0... 7FFFH	0... 1.9999389648437	61.0351e-6	-
output signal of the WRAF sensor model for homogeneous mode					

<b>ACTION_INFR_SetPwmLshDown</b> (IN<i>,IN<ducy>)	Mode: O
This action sets the lambda heater downstream driver	

<b>ACTION_INFR_SetPwmLshUp</b> (IN<i>,IN<ducy>)	Mode: O
This action sets the lambda heater upstream driver	

<b>ACTION_INFR_SetWrafControl</b> (IN<i>,IN<state_lsl_if_spi_wr>,IN<state_lsl_if_conf_spi_wr>,IN<frq_r_it_osc_lsl_if_spi_wr>,IN<lv_lsl_if_rst>,IN<lv_lsl_up_spi_com_inh>,IN<lv_ctr_err_lsl_if_spi_man_inc>)	Mode: O
This action sets the values of the WRAF controller	

**Import actions:**

<b>ACTION_INFR_CDisableCilc</b> ()
<b>ACTION_INFR_CEnableCilc</b> ()
<b>ACTION_INFR_CGetCilc</b> (IN<x>,OUT<v_adc>,OUT<ctr>)
<b>ACTION_INFR_CGetEIDiagLshDown</b> (IN<i>,OUT<cdn_diag>,OUT<err_diag>)
<b>ACTION_INFR_CGetEIDiagLshUp</b> (IN<i>,OUT<cdn_diag>,OUT<err_diag>)
<b>ACTION_INFR_CGetHeatCoupling</b> (IN<i>,OUT<lamb_sp_fil_delta_rise>,OUT<lamb_sp_fil_delta_fall>,OUT<vls_up_delta_rise>,OUT<vls_up_delta_fall>)
<b>ACTION_INFR_CGetVAdcLsDown</b> (IN<i>,OUT<v_adc>)
<b>ACTION_INFR_CGetVAdcLsUp</b> (IN<i>,OUT<v_adc>)
<b>ACTION_INFR_CGetVAdcTempLsUp</b> (IN<i>,OUT<v_adc>)
<b>ACTION_INFR_CGetWrafControl</b> (IN<i>,OUT<lv_lsl_deac>,OUT<state_err_vnsl>,OUT<state_err_vglsl>,OUT<state_err_viplsl>,OUT<state_err_vrcsl>,OUT<state_err_iplsl>,OUT<state_err_lsl>,OUT<state_lsl_if_spi_rd>,OUT<state_lsl_if_conf_spi_rd>,OUT<frq_r_it_osc_lsl_if_spi_rd>,OUT<ctr_err_lsl_if_spi_wr>,OUT<ctr_err_lsl_if_spi_it_osc_ena>,OUT<lv_vplsl_lim>,OUT<lv_vnsl_lim>)
<b>ACTION_INFR_CSetCilc</b> (IN<x>,IN<crk>)
<b>ACTION_INFR_CSetCmdLsDown</b> (IN<i>,IN<lv_swi_ls_down>)
<b>ACTION_INFR_CSetCmdLsUp</b> (IN<i>,IN<lv_swi_ls_up>)
<b>ACTION_INFR_CSetHeatCoupling</b> (IN<i>,IN<t_dly_trig_lsh_up>,IN<lamb_sp_fil_hom>)
<b>ACTION_INFR_CSetPwmLshDown</b> (IN<i>,IN<ducy>)
<b>ACTION_INFR_CSetPwmLshUp</b> (IN<i>,IN<ducy>)
<b>ACTION_INFR_CSetWrafControl</b> (IN<i>,IN<state_lsl_if_spi_wr>,IN<state_lsl_if_conf_spi_wr>,IN<frq_r_it_osc_lsl_if_spi_wr>,IN<lv_lsl_if_rst>,IN<lv_lsl_up_spi_com_inh>,IN<lv_ctr_err_lsl_if_spi_man_inc>)

**Description for actions:**

<b>ACTION_INFR_SetPwmLshUp(i, ducy)</b>					
This action sets the lambda heater upstream driver					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
i	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
Ducy	IN	0...FFH	0...99.609375	0.390625	%
Up Heater driver PWM duty cycle					

<b>ACTION_INFR_SetPwmLshDown(i, ducy)</b>					
This action sets the lambda heater downstream driver					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
i	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
Ducy	IN	0...FFH	0...99.609375	0.390625	%
Down Heater driver PWM duty cycle					

<b>ACTION_INFR_GetVAdcLsUp( i, v_adc )</b>					
This action gets the raw value from the upstream oxygen sensor voltage.					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
I	IN	0H	1	1	-
		1H	2		
Index of exhaust cylinder banks					
v_adc	OUT	0...7FFFH	0...4.99984741	1.52588E-4	V
Raw value of upstream oxygen sensor voltage					

<b>ACTION_INFR_GetVAdcLsDown( i, v_adc )</b>					
This action gets the oxygen sensor voltage upstream					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
I	IN	0H	1	1	-
		1H	2		
Index of exhaust cylinder banks					
v_adc	OUT	0...7FFFH	0...4.99984741	1.52588E-4	V
Downstream oxygen sensor voltage					

<b>ACTION_INFR_GetVAdcTempLsUp( i, v_adc )</b>					
This action sets the upstream lambda sensor temperature voltage					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
I	IN	0H	1	1	-
		1H	2		
Index of exhaust cylinder banks					
v_adc	OUT	0...7FFFH	0...4.99984741	1.52588E-4	V
Upstream lambda sensor temperature voltage					

<b>ACTION_INFR_EnableCilc()</b>					
This action sets the activation of CILC (cylinder individuel lambda control)					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit

<b>ACTION_INFR_DisableCilc()</b>					
This action sets the deactivation of CILC					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit

<b>ACTION_INFR_GetCilc( x, v_adc, ctr )</b>					
Signal acquisition for CILC					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
X	IN	0...7H	0...7	1	-
logical index of cylinder to be acquired					
v_adc	OUT	0...7FFFH	0...4.99984741	1.52588E-4	V
upstream oxygen sensor acquisition (cylinder individual)					
Ctr	OUT	0...FFH	0...255	1	-
cylinder selective update counter for trigger event					

<b>ACTION_INFR_SetCilc( x, crk )</b>					
This action provide actual phase displacement for each cylinder. Remark: The maximum angle delay which can be realized by the BSW is 720°CRK. Larger values shall be calculated beginning with 0°CRK.					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
X	IN	0...7H	0...7	1	-
logical index of cylinder to be changed					
Crk	IN	0...F0H	0...1440	6	°CRK
Value of phase displacement					

<b>ACTION_INFR_GetEIDiagLshUp( i, cdn_diag, err_diag )</b>					
This action reads the failure and the conditions information for each symptom from the infrastructure The readout of the power stage is performed autonomous and the information is gathered. When calling this Action the information inside the Infrastructure is reset after returning the OUT parameters.					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
I	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
cdn_diag	OUT	0...7H	0...7	1	-
Bit 0: Set, if error symptom SCP (SYM_0) is detected Bit 1: Set, if error symptom SCG (SYM_1) is detected Bit 2: Set, if error symptom OC (SYM_2) is detected					
err_diag	OUT	0...7H	0...7	1	-
Raw value of error symptom. The relevant bit is set, if the error has been detected.					

<b>ACTION_INFR_GetEIDiagLshDown( i, cdn_diag, err_diag )</b>					
This action reads the failure and the conditions information for each symptom from the infrastructure The readout of the power stage is performed autonomous and the information is gathered. When calling this Action the information inside the Infrastructure is reset after returning the OUT parameters.					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
I	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
cdn_diag	OUT	0...7H	0...7	1	-
Bit 0: Set, if error symptom SCP (SYM_0) is detected Bit 1: Set, if error symptom SCG (SYM_1) is detected Bit 2: Set, if error symptom OC (SYM_2) is detected					
err_diag	OUT	0...7H	0...7	1	-
Raw value of error symptom. The relevant bit is set, if the error has been detected.					

<b>ACTION_INFR_GetWrafControl</b> ( i, lv_lsl_deac, state_err_vnlsI, state_err_vglsI, state_err_viplsI, state_err_vrclsI, state_err_ipslsI, state_err_lsl, state_lsl_if_spi_rd, state_lsl_if_conf_spi_rd, frq_r_it_osc_lsl_if_spi_rd, ctr_err_lsl_if_spi_wr, ctr_err_lsl_if_spi_it_osc_ena, lv_vplsl_lim, lv_vnlsI_lim )					
This action reads the values from the WRAF controller.					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
l	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
lv_lsl_deac	OUT	0...1H	0...1	1	-
Boolean flag indicating OBDI signal fault pending					
state_err_vnlsI	OUT	0H 1H 2H	NO_FAULT SCG SCB	1	[-]
Diagnosis status of the Nernst Cell positive pin.					
state_err_vglsI	OUT	0H 1H 2H	NO_FAULT SCG SCB	1	[-]
Diagnosis status of the Virtual Ground pin.					
state_err_viplsI	OUT	0H 1H 2H	NO_FAULT SCG SCB	1	[-]
Diagnosis status of the Pump Cell pin.					
state_err_vrclsI	OUT	0H 1H 2H	NO_FAULT SCG SCB	1	[-]
Diagnosis status of the Calibration Resistance pin.					
state_err_ipslsI	OUT	0H 1H 2H	NO_FAULT CURRENT_LOW CURRENT_HIGH	1	[-]
Diagnosis status of the Pumping Current.					
state_err_lsl	OUT	0H 1H	NO_FAULT FAULT	1	[-]
OBDI General Status					
state_lsl_if_spi_rd	OUT	0...FFH	0...255	1	[-]
Bit-field, mapping verified contents of WRAF controller Configuration Register					
state_lsl_if_conf_spi_rd	OUT	0...FFH	0...255	1	[-]
Content of the configuration register comprising sensor disconnection time delay and lcp value					
frq_r_it_osc_lsl_if_spi_rd	OUT	0...7FH	0...127	1	[-]
Content of the configuration register comprising Ri-measurement frequency and bit for pin selective disabling					
ctr_err_lsl_if_spi_wr	OUT	0...FFH	0...255	1	[-]
Counter indicating number of invalid INIT_REG_x write validation cycles which have been detected					
ctr_err_lsl_if_spi_it_osc_ena	OUT	0...FFH	0...255	1	[-]
Counter indicating number of invalid transmissions of "R_IT_OSC_ENA" bit					
lv_vplsl_lim	OUT	0...1H	0...1	1	[-]
Boolean flag indicating that Pump Cell voltage has reached its limits					
lv_vnlsI_lim	OUT	0...1H	0...1	1	[-]
Boolean flag indicating overvoltage at Nernst Cell positive pin (reverse lcp cut-off)					

<b>ACTION_INFR_SetWrafControl</b> ( i, state_lsl_if_spi_wr, state_lsl_if_conf_spi_wr, frq_r_it_osc_lsl_if_spi_wr, lv_lsl_if_rst, lv_lsl_up_spi_com_inh, lv_ctr_err_lsl_if_spi_man_inc)					
This action sets the values of the WRAF controller					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
i	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
state_lsl_if_spi_wr	IN	0...FFH	0...255	1	-
Bit-field mapping of contents to be written to WRAF controller INIT_REG_1					
state_lsl_if_conf_spi_wr	IN	0...FFH	0...255	1	-
Bit-field mapping of contents to be written to WRAF controller INIT_REG_1					
frq_r_it_osc_lsl_if_spi_wr	IN	0...7FH	0...127	1	-
Mapping of contents to be written to WRAF controller INIT_REG_1					
lv_lsl_if_rst	IN	0...1H	0...1	1	-
Boolean flag to reset the WRAF controller					
lv_lsl_up_spi_com_inh	IN	0...1H	0...1	1	-
Inhibit bit for the SPI-communication related to electrical diagnosis on BSW level					
lv_ctr_err_lsl_if_spi_man_inc	IN	0...1H	0...1	1	-
BSW interface for manual increase of value of SPI communication error counter					

<b>ACTION_INFR_SetCmdLsUp</b> ( i, lv_swi_ls_up )					
This action starts the internal resistance determination by "pumping" the the sensor.					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
i	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
lv_swi_ls_up	IN	0H 1H	Switch off Switch on	1	-
Digital command parameter for the setting of pump current for binary upstream lambda sensor Remark: Switch on equal to activation (high or low level)					

<b>ACTION_INFR_SetCmdLsDown</b> ( i, lv_swi_ls_down )					
This action starts the internal resistance determination by "pumping" the the sensor.					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
i	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
lv_swi_ls_down	IN	0H 1H	Switch off Switch on	1	-
Digital command parameter for the setting of pump current for binary downstream lambda sensor Remark: Switch on equal to activation (high or low level)					

<b>ACTION_INFR_SetHeatCoupling</b> ( i, t_dly_trig_lsh_up, lamb_sp_fil_hom )					
This action sets the value of the WRAF controller for the heater coupling diagnosis.					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
i	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
t_dly_trig_lsh_up	IN	0...FFH	0...0.255	0.001	s
Time delay for acquisition of oxygen sensor signal and lambda model					
lamb_sp_fil_hom	IN	0...7FFFH	0...1.999939	6.10351573229163 E-5	-
output signal of the WRAF sensor model for homogeneous mode					

<b>ACTION_INFR_GetHeatCoupling( i, lamb_sp_fil_delta_rise, lamb_sp_fil_delta_fall, vls_up_delta_rise, vls_up_delta_fall )</b>					
This action gets the value from the WRAF controller for the heater coupling diagnosis.					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
i	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
lamb_sp_fil_delta_rise	OUT	0...7FFFH	0...1.99993896484375	6.10351562E-5	-
Acquired lambda model value at the rising edge of heater PWM					
lamb_sp_fil_delta_fall	OUT	0...7FFFH	0...1.99993896484375	6.10351562E-5	-
Acquired lambda model value at the falling edge of heater PWM					
vls_up_delta_rise	OUT	0...7FFFH	0...4.99984741	1.52588E-4	V
Acquired oxygen sensor voltage at the rising edge of heater PWM					
vls_up_delta_fall	OUT	0...7FFFH	0...4.99984741	1.52588E-4	V
Acquired oxygen sensor voltage at the falling edge of heater PWM					

## FUNCTION DESCRIPTION:

### General information:

- a) **i** = **NC\_CBK\_EX\_NR** (Number of exhaust gas cylinder banks)
- b) **x** = **NC\_CYL\_NR** (Number of engine cylinders)

Depending on the value of **NC\_CBK\_EX\_NR** and the states of the variable **NR\_CONF\_CBK\_EX** following rules are defined which have to be used for all actions.

The symbolic item **param\_list** represents the complete dedicated action parameters, except the explicitly given one.

#### **RULE 1:**     *%% used in general for upstream SET-ACTION*

**# IF**            **NC\_CBK\_EX\_NR = 2**

**# THEN**

Case selection        **NR\_CBK\_EX**  
= 1:

                  for i = 1: **ACTION\_INFR\_Command(IN < i = 1 >, param\_list) =**  
**TION\_INFR\_CCommand( IN < i = 1 >, param\_list)**  
                  for i = 2: no ACTION activity

= 2:

**ACTION\_INFR\_Command(IN <i>, param\_list) =**  
                  **ACTION\_INFR\_CCommand ( IN < i>, param\_list)**

**# ELSE**

**ACTION\_INFR\_Command(IN <i>, param\_list) =**  
                  **ACTION\_INFR\_CCommand ( IN < i>, param\_list)**

**# ENDIF**

#### **RULE 2:**     *%% used in general for downstream SET-ACTION*

**# IF**            **NC\_CBK\_EX\_NR = 2**

**# THEN**

Case selection        **NR\_CONF\_CBK\_EX**

```

= 1:
    for i = 1: ACTION_INFR_Command(IN < i = 1 >, param_list) =
TION_INFR_CCommand( IN < i = 1 >, param_list)
    for i = 2:      no ACTION activity
= 2:
    ACTION_INFR_Command(IN < i >, param_list) =
        ACTION_INFR_CCommand( IN < i >, param_list)
= 3:
    for i = 1:      no ACTION activity
    for i = 2: ACTION_INFR_Command(IN < i = 2 >, param_list) =
TION_INFR_CCommand( IN < 2 >, param_list)
= 4:
    for i = 1: ACTION_INFR_Command(IN < i = 1 >, param_list) =
TION_INFR_CCommand( IN < i = 1 >, param_list)
    for i = 2:      no ACTION activity
# ELSE
    ACTION_INFR_Command(IN < i >, param_list) =
        ACTION_INFR_CCommand( IN < i >, param_list)
# ENDIF

```

**RULE 3:** *%% used in general for upstream GET-ACTION*

```

# IF      NC_CBK_EX_NR = 2
# THEN
    Case selection      NR_CBK_EX
= 1:
    for i = 1: ACTION_INFR_Command(IN < i = 1 >, param_list) =
TION_INFR_CCommand( IN < i = 1 >, param_list)
    for i = 2: ACTION_INFR_Command(IN < i = 2 >, param_list) =
TION_INFR_CCommand( IN < i = 1 >, param_list)
= 2:
    ACTION_INFR_Command(IN < i >, param_list) =
        ACTION_INFR_CCommand( IN < i >, param_list)
# ELSE
    ACTION_INFR_Command(IN < i >, param_list) =
        ACTION_INFR_CCommand( IN < i >, param_list)
# ENDIF


```

**RULE 4:** *%% used in general for downstream GET-ACTION*

```

# IF      NC_CBK_EX_NR = 2
# THEN
    Case selection      NR_CONF_CBK_EX
= 1:
    for i = 1: ACTION_INFR_Command(IN < i = 1 >, param_list) =
TION_INFR_CCommand( IN < i = 1 >, param_list)
    for i = 2: ACTION_INFR_Command(IN < i = 2 >, param_list) =
TION_INFR_CCommand( IN < i = 1 >, param_list)
= 2:
    ACTION_INFR_Command(IN < i >, param_list) =
        ACTION_INFR_CCommand( IN < i >, param_list)
= 3:
    for i = 1: ACTION_INFR_Command(IN < i = 1 >, param_list) =
TION_INFR_Command(IN < i = 1 >, OUT < VLS_NS[1] >)

```

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```

                % physical value of VLS_NS shall be output as VLS_DOWN[1]
    for i = 2: ACTION_INFR_Command(IN < i = 2 >, param_list) =
TION_INFR_CCommand( IN < i = 2 >, param_list)
    = 4:
        for i = 1: ACTION_INFR_Command(IN < i = 1 >, param_list) =
TION_INFR_CCommand( IN < i = 1 >, param_list)
        for i = 2: ACTION_INFR_Command(IN < i = 2 >, param_list) =
TION_INFR_Command(IN < i = 2 >, OUT < VLS_NS[1] >)
                % physical value of VLS_NS shall be output as VLS_DOWN[2]
# ELSE
    ACTION_INFR_Command(IN < i >, param_list) =
        ACTION_INFR_CCommand( IN < i >, param_list)
# ENDIF

```

**RULE 5:**

```
ACTION_INFR_Command(param_list) = ACTION_INFR_CCommand(param_list)
```

**RULE 6:**

%% used for upstream Heater diagnosis with ATIC39.

%% relies on the assumption that a **call for bank 1 made immediately before the call for bank 2.**

```

# IF      NC_CBK_EX_NR = 2
# THEN
    Case selection      NR_CBK_EX
    = 1:
        for i = 1: ACTION_INFR_Command(IN < i = 1 >, param_list) =
TION_INFR_CCommand( IN < i = 1 >, param_list)
        for i = 2: ACTION_INFR_Command(IN < i = 2 >, param_list) =
TION_INFR_Command( IN < i = 2 >,
                    OUT < cdn_diag = CDN_DIAG_LSH_UP[1] >,
                    OUT < err_diag = ERR_DIAG_LSH_UP[1] >)
    = 2:
        ACTION_INFR_Command(IN < i >, param_list) =
        ACTION_INFR_CCommand( IN < i >, param_list)
# ELSE
    ACTION_INFR_Command(IN < i >, param_list) =
        ACTION_INFR_CCommand( IN < i >, param_list)
# ENDIF

```

**RULE 7:**


%% used for downstream Heater diagnosis with ATIC39

%% relies on the assumption that a **call for bank 1 made immediately before the call for bank 2.**

```

# IF      NC_CBK_EX_NR = 2
# THEN
    Case selection      NR_CBK_EX
    = 1:
        for i = 1: ACTION_INFR_Command(IN < i = 1 >, param_list) =
TION_INFR_CCommand( IN < i = 1 >, param_list)
        for i = 2: ACTION_INFR_Command(IN < i = 2 >, param_list) =
TION_INFR_Command( IN < i = 2 >,
                    OUT < cdn_diag = CDN_DIAG_LSH_DOWN[1] >,

```

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```

                                OUT < err_diag = ERR_DIAG_LSH_DOWN[1] >)
= 2:
    ACTION_INFR_Command(IN < i >, param_list) =
        ACTION_INFR_CCommand( IN < i >, param_list)
# ELSE
    ACTION_INFR_Command(IN < i >, param_list) =
        ACTION_INFR_CCommand( IN < i >, param_list)
# ENDIF

```

### Application conditions

**Initialisation:**            *at reset:*            NR\_CONF\_CBK\_EX = C\_NR\_CONF\_CBK\_EX  
    NR\_CBK\_EX = C\_NR\_CBK\_EX

**Recurrence:**                - (the assignment of NR\_CONF\_CBK\_EX is only performed once during initialization)

**Activation:**                always, under all conditions and states

**Deactivation:**             - -

### Formula section:

ACTION	RULE
ACTION_INFR_SetPwmLshUp(IN <i>, IN <ducy>)	1
ACTION_INFR_SetPwmLshDown(IN <i>, IN <ducy>)	2
ACTION_INFR_GetVAdcLsUp(IN <i>, OUT <v_adc>)	3
ACTION_INFR_GetVAdcLsDown(IN <i>, OUT <v_adc>)	4
ACTION_INFR_GetVAdcTempLsUp(IN <i>, OUT <v_adc>)	3
ACTION_INFR_EnableCilc()	5
ACTION_INFR_DisableCilc()	5
ACTION_INFR_GetCilc(IN <x>, OUT <v_adc>, OUT <ctr>)	5
ACTION_INFR_SetCilc(IN <x>, IN <crk>)	5
ACTION_INFR_GetEIDiagLshUp(IN <i>, OUT <cdn_diag>, OUT <err_diag>)	6
ACTION_INFR_GetEIDiagLshDown(IN <i>, OUT <cdn_diag>, OUT <err_diag>)	7
ACTION_INFR_GetWrafControl(IN <i>, OUT <lv_lsl_deac>, OUT <state_err_vnlsl>, OUT <state_err_vglsl>, OUT <state_err_viplsl>, OUT <state_err_vrclsl>, OUT <state_err_iplsl>, OUT <state_err_lsl>, OUT <state_lsl_if_spi_rd>, OUT <state_lsl_if_conf_spi_rd>, OUT <frq_r_it_osc_lsl_if_spi_rd>, OUT <ctr_err_lsl_if_spi_wr>, OUT <ctr_err_lsl_if_spi_it_osc_ena>, OUT <lv_vplsl_lim>, OUT <lv_vnlsl_lim>)	3
ACTION_INFR_SetWrafControl(IN <i>, IN <state_lsl_if_spi_wr>, IN <state_lsl_if_conf_spi_wr>, IN <frq_r_it_osc_lsl_if_spi_wr>, IN <lv_lsl_if_rst>, IN <lv_lsl_up_spi_com_inh>, IN <lv_ctr_err_lsl_if_spi_man_inc>)	1
ACTION_INFR_SetCmdLsUp(IN <i>, IN <lv_swi_ls_up>)	1
ACTION_INFR_SetCmdLsDown(IN <i>, IN <lv_swi_ls_down>)	2
ACTION_INFR_SetHeatCoupling(IN <i>, IN <t_dly_trig_lsh_up>, IN <lamb_sp_fil_hom>)	1
ACTION_INFR_GetHeatCoupling(IN <i>, OUT <lamb_sp_fil_delta_rise>, OUT <lamb_sp_fil_delta_fall>, OUT <vls_up_delta_rise>, OUT <vls_up_delta_fall>)	3

- The configuration calibration data C\_NR\_CONF\_CBK\_EX define the hardware configuration of the exhaust gas as describe below:

```

= 1:    standard one bank
       = 2:    standard two banks
       = 3:    two bank system in a Y-configuration without lambda sensor downstream
               at position bank 1 and with one NOx-sensor after the NOx catalyst
               (NC_NOX_SENS_CONF = 1).
       = 4:    two bank system in a Y-configuration without lambda sensor downstream
               at position bank 2 and with one NOx-sensor after the NOx catalyst
               (NC_NOX_SENS_CONF = 1).

```

## 2.30 O2 sensor (lin, up) SPI interface BSW

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ERR_LSL_IF_SPI_IT_OSC_ENA [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter indicating number of invalid transmissions of "R_IT_OSC_ENA" bit					
CTR_ERR_LSL_IF_SPI_WR [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Counter indicating number of invalid INIT_REG_x write validation cycles which have been detected					
FRQ_R_IT_OSC_LSL_IF_SPI_RD [NC_CBK_EX_NR]	O/V	0... 7FH	0... 127	1	-
Content of the configuration register comprising Ri-measurement frequency and bit for pin selective disabling					
LV_LSL_DEAC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating OBDI signal fault pending					
LV_VNLSL_LIM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating overvoltage at Nernst Cell positive pin (reverse Icp cut-off)					
LV_VPLSL_LIM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that Pump Cell voltage has reached its limits					
STATE_ERR_IPLSL [NC_CBK_EX_NR]	O/V	0H 1H 2H	NO_FAULT CURRENT_ LOW CURRENT_ HIGH	-	-
Diagnosis status of the Pumping Current.					
STATE_ERR_LSL [NC_CBK_EX_NR]	O/V	0H 1H	NO_FAULT FAULT	-	-
OBDI General Status					
STATE_ERR_VGLSL [NC_CBK_EX_NR]	O/V	0H 1H 2H	NO_FAULT SCG SCB	-	-
Diagnosis status of the Virtual Ground pin.					
STATE_ERR_VIPLSL [NC_CBK_EX_NR]	O/V	0H 1H 2H	NO_FAULT SCG SCB	-	-
Diagnosis status of the Pump Cell pin.					
STATE_ERR_VNLSL [NC_CBK_EX_NR]	O/V	0H 1H 2H	NO_FAULT SCG SCB	-	-
Diagnosis status of the Nernst Cell positive pin.					
STATE_ERR_VRCLSL [NC_CBK_EX_NR]	O/V	0H 1H 2H	NO_FAULT SCG SCB	-	-
Diagnosis status of the Calibration Resistance pin.					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_LSL_IF_CONF_SPI_RD [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Content of the configuration register comprising sensor disconnection time delay and lcp value					
STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Bit-field, mapping verified contents of ATIC42 Configuration Register					

**Input data:**

FRQ_R_IT_OSC_LSL_IF_ SPI_WR [NC_CBK_EX_NR] {p. 1320}	LV_CTR_ERR_LSL_IF_ SPI_MAN_INC [NC_CBK_EX_NR] {p. 1318}	LV_IGK {p. 906}	LV_LSL_IF_RST [NC_CBK_EX_NR] {p. 1318}
LV_LSL_UP_SPI_COM_ INH [NC_CBK_EX_NR] {p. 4293}	NC_CBK_EX_NR {p. 1829}	STATE_LSL_IF_CONF_ SPI_WR [NC_CBK_EX_NR] {p. 1313}	STATE_LSL_IF_SPI_WR [NC_CBK_EX_NR] {p. 1313}

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CTR_ERR_LSL_IF_SPI_OSC_ENA	-	0... FFH	0... 255	1	-
Limit of counter indicating number of invalid transmissions of "R_IT_OSC_ENA" bit					

**Import actions:**

<b>ACTION_INFR_GetWrafControl</b> (IN<i>,OUT<lv_lsl_deac>,OUT<state_err_vnlsl>,OUT<state_err_vglsl>,OUT<state_err_viplsl>,OUT<state_err_vrclsl>,OUT<state_err_iplsl>,OUT<state_err_lsl>,OUT<state_lsl_if_spi_rd>,OUT<state_lsl_if_conf_spi_rd>,OUT<frq_r_it_osc_lsl_if_spi_rd>,OUT<ctr_err_lsl_if_spi_wr>,OUT<ctr_err_lsl_if_spi_it_osc_ena>,OUT<lv_vplsl_lim>,OUT<lv_vnlsl_lim>)
<b>ACTION_INFR_SetWrafControl</b> (IN<i>,IN<state_lsl_if_spi_wr>,IN<state_lsl_if_conf_spi_wr>,IN<frq_r_it_osc_lsl_if_spi_wr>,IN<lv_lsl_if_rst>,IN<lv_lsl_up_spi_com_inh>,IN<lv_ctr_err_lsl_if_spi_man_inc>)


**2.30.1 Acquire raw data from the Infrastructure (BSW)****FUNCTION DESCRIPTION:****General information:****Application conditions:**

*Initialisation: at reset the actual input data will be send to and get from the infrastructure through calling the Actions*

```

ACTION_INFR_GetWrafControl(
    IN          i
    OUT         LV_LSL_DEAC[i]
    OUT         STATE_ERR_VNLSL[i]
    OUT         STATE_ERR_VGLSL[i]
    OUT         STATE_ERR_VIPLSL[i]
    OUT         TATE_ERR_VRCLSL[i]

```

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```

OUT      STATE_ERR_IPLSL[i]
OUT      STATE_ERR_LSL[i]
OUT      STATE_LSL_IF_SPI_RD[i]
OUT      STATE_LSL_IF_CONF_SPI_RD[i]
OUT      FRQ_R_IT_OSC_LSL_IF_SPI_RD[i]
OUT      CTR_ERR_LSL_IF_SPI_WR[i]
OUT      CTR_ERR_LSL_IF_SPI_IT_OSC_ENA[i]
OUT      LV_VPLSL_LIM[i]
OUT      LV_VNLSL_LIM[i]

```

ACTION\_INFR\_SetWrafControl(

```

IN      i
IN      STATE_LSL_IF_SPI_WR[i]
IN      STATE_LSL_IF_CONF_SPI_WR[i]
IN      FRQ_R_IT_OSC_LSL_IF_SPI_WR[i]
IN      LV_LSL_IF_RST[i]
IN      LV_LSL_UP_SPI_COM_INH[i]
IN      LV_CTR_ERR_LSL_IF_SPI_MAN_INC[i])

```

*Recurrence:*

T\_SAMPLE = 10 ms.

*Activation:*

--

*Deactivation:*

--

### **Formula section:**

*has to be executed before all other functions of EGCP which have the same recurrence.*

ACTION\_INFR\_GetWrafControl(...)

*has to be executed after all other functions of EGCP which have the same recurrence.*

ACTION\_INFR\_SetWrafControl(...)

## **2.30.2 Descripton of the interaction between infrastructure and the WRAF controller**

### **FUNCTION DESCRIPTION:**

#### **General information:**

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

The function shall describe the interface between the Wide Range Air-Fuel (WRAF) sensor, its controll device, the ATIC42 in its final development step (2<sup>nd</sup> Silicon, B5), and ECU.

The digital control part of the interface is realised in hardware by means of a Serial Peripheral Interface (SPI) bus between the ECU and the ATIC42. Latter acts as slave while the microcontroller acts as master. Via the SPI it shall be possible to carry out the following tasks:

- [Read from the two IC identity registers IDENT\_REG\_1[i] and IDENT\_REG\_2[i] - currently not implemented in generic SW!]
- Configure and initialise the 1-byte long **initialisation register**, which comprehends the following switches:

bit position	description
0	Set Ip measurement gain (16 or 8)
1	Enable/disable pumping current (Ip) offset measurement
2	Enable/disable reference pumping current (Icp)
3	Enable/disable Ip controller
4	Enable/disable Nernst Cell inner resistance (Ri) calibration
5	Start/stop oscillator for Ri measurement
6	Enable/disable sensor
7	Set Ri measurement range (range2, range1)

- Configure and initialise the **second configuration register** containing the 5 bit setting for the Icp-current value, and the 3-bit register for protection time prior to sensor disconnecting in case of electrical failure.
- Configure and initialise the 7-bit register containing Ri measurement frequency and the activation switch for selective pin disabling during sensor protection time.
- Read out the sensor pin electrical diagnostic register.
- Read out the general status register
- [Reset the ATIC42 - currently not implemented in generic SW!]

The individual timing requirements and the general description of the SPI may be found in the ATIC42 Component Specification and shall not be repeated here. Only those points that serve to clarify the interface between the ATIC42 and the microcontroller will be elaborated upon.

### 2.30.3 BSW Description

General remark regarding handling of read (RD), and write (WR) variables of SPI interface: Access to status bits which are part of STATE\_LSL\_IF... SPI\_RD[i] variables has to be realized by directly addressing the individual bit STATE\_LSL\_IF ... SPI\_RD[i].bitX . The contents of STATE\_LSL\_IF ... SPI\_WR[i] variables can either be accessed directly via STATE\_LSL\_IF ... SPI\_WR[i].bitX or by corresponding logical variables, e.g. LV\_LSL\_ENA\_LSL\_IF[i].

#### 2.30.3.1 SPI command sequencing

Immediately after a HW-reset or after ECU RESET, the standard command sequence stated below shall be executed. All the initialization information shall be sent once. Afterwards the sequence is repeated at every recurrence of BSW, i.e. every T\_SAMPLE, containing up-to-date control information (command identifiers according to ATIC42 specification dated 24/07/02 are stated in brackets):

RD\_DIAG\_1(M1) + RD\_DIAG\_2(M2)  
 + WR\_CONF\_INIT\_1(F) + WR\_CONF\_INIT\_2(I)  
 + WR\_INIT\_R\_FRQ\_1(K) + WR\_INIT\_R\_FRQ\_2(L)  
 + WR\_INIT\_1(C) + WR\_INIT\_2(D)  
 [+ RD\_IDENT\_1(A1) dummy command]

In order to receive the answer to the last write command sent, which is evaluated for communication monitoring purposes, WR\_INIT\_2(D), a dummy read command - has been added to the sequence.

*Remark:* With transmission of command n, response to command n-1 is received in communication cycle n.

WR\_INIT\_2(D) command is sent at the end of each communication cycle to allow for all configuration data to be updated before setting sensor status (enable/disable).

### 2.30.3.2 Deactivation of WRAFsensor

Decoupling of WRAF sensor due to presence of electrical fault is handled by ASW/BSW interface (Appl Inc), 403B.

With LV\_LSL\_UP\_SPI\_COM\_INH[i] = 1, ATIC42 SPI-responses related to electrical diagnosis status (contents of General Status Register and Pin Diagnosis Register) are no longer used to update contents of corresponding interface variables STATE\_ERR\_XXX[i], LV\_LSL\_VP\_LIM[i], and LS\_VNLSL\_LIM[i]. The value of these variables thus preserves OBDI error status at the very moment of successful error debouncing for the remainder of the current driving cycle.

### 2.30.3.3 Reading the identification registers ( currently not implemented in generic SW! )

If required, the identification registers can be read via the commands RD\_IDENT\_1(A1) and RD\_IDENT\_2(A2).

The command RD\_IDENT\_2(A2) reads the 8 MSB of the IC code while the command RD\_IDENT\_1(A1) reads the 3 LSB of the IC code, the 2 bit supplier index, and the 3 bit IC version number. The received information could be placed in a 16-bit output variable STATE\_LSL\_IF\_IC\_INFO[i] (V, 0...FFFFH, 0...65535, 1, -).

### 2.30.3.4 Reading the diagnostic registers

Diagnostic information regarding electrical sensor failures can be retrieved with the command sequence RD\_DIAG\_1(M1) + RD\_DIAG\_2(M2) which addresses the ATIC42 status registers.

Upon reading the general status register contents, the contents of both diagnosis registers are deleted. Therefore the two commands have to be performed in the appropriate sequence specified above: first the single pin diagnosis status has to be evaluated ( RD\_DIAG\_1(M1) ), then the general status register can be read ( RD\_DIAG\_2(M2) ) - deleting all electrical diagnosis information the very same moment!

The pin diagnosis register DIAG\_REG\_1 contains information regarding the type and location of electrical sensor faults. The following failure categories can be detected and for each fault a diagnosis bit is latched:

bit position	description
0	Short circuit to Ground (SCG) at pin RCD
1	Short circuit to Battery (SCB) at pin RCD
2	SCG at pin VIP
3	SCB at pin VIP
4	SCG at pin VG
5	SCB at pin VG
6	SCG at pin VN
7	SCB at pin VN

Two bits are associated with every sensor pin (RCD, VIP, VG, VN). Their combination provides four possible failure states (00 = no failure, 01 = SCG, 10 = SCB, 11 = presently not used).

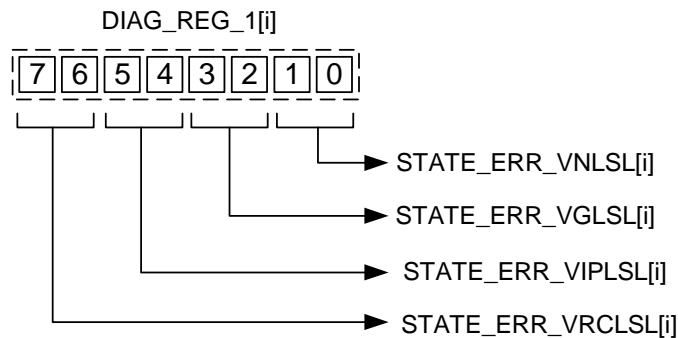
DIAG\_REG\_2 contains information regarding general failure status, Pump Cell voltage and pumping current limit status, and overvoltage at VN pin. The following diagnoses can be evaluated :

1. General status of diagnosis.



2. Pump cell voltage at allowed limits. A special bit is set but not latched - as soon as the limitation is over, this bit is reset.
3. Pumping current (Ip) at its limits. A special bit is set but not latched - as soon as the violation disappears, this bit is reset.
4. Overvoltage at Nernst Cell positive pin which might impair voltage headroom for generation of reference pumping current. Therefore Icp generation is disabled by ATIC42 HW to prevent reverse Icp. Diagnosis bit is set but not latched.

As faults may occur while reading the diagnostic registers, it is advised to verify the contents of the diagnosis registers regularly. This shall be carried out by comparing the responses related to two consecutive RD\_DIAG commands.



If after two consecutive RD\_DIAG\_x[i] command sequences a fault persists, the function shall decode the contents of both DIAG\_REG\_x[i] registers. The contents of the DIAG\_REG\_1[i] shall be placed in the appropriate output data variables, as it is shown in the picture above.

STATE\_ERR\_VNLSL[i] mirrors the diagnosis of Nernst cell positive pin, STATE\_ERR\_VGLSL[i] the diagnosis of virtual ground pin, STATE\_ERR\_VIPLSL[i] the diagnosis of Pump Cell positive pin, and STATE\_ERR\_VRCLSL[i] the diagnosis of the RCD pin.

The following diagnosis are decoded in each STATE-variable:

- 00H means no fault,
- 01H means short circuit to ground
- 02H means short circuit to battery.

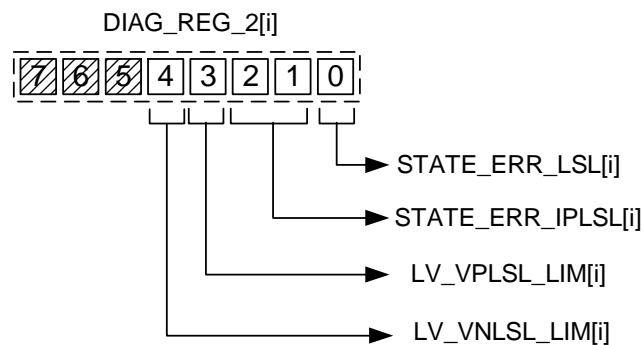


Figure 2.30.1: The contents of the DIAG\_REG\_2[i] shall be placed in the appropriate output data variables:

STATE\_ERR\_LSL[i] gives the general status of the diagnosis in the ATIC42, where 00H means no fault and 01H means a fault is present. LV\_VPLSL\_LIM[i] shall be activated if the pump cell voltage reaches allowed bounds. STATE\_ERR\_IPLSL[i] gives a diagnosis when the pump cell current is out of range, where 00H means no fault, 01H means Ip current too low and 02H means Ip current too high.



LV\_VNLSL\_LIM[i] signals detection of overvoltage at positive Nernst Cell pin which leads to disabling of reference pumping current in order to avoid reverse current flow.

Additionally, a Boolean flag LV\_LSL\_DEAC[i] shall be set if at any time a single valid RD\_DIAG\_x data byte returns an electrical fault at one sensor pin (excluding Pump Cell voltage at allowed bonds, VN overvoltage, and Ip limitation). The flag shall only be reset should the function receive two valid consecutive RD\_DIAG command return data bytes indicating that the specific fault is no longer present.

### 2.30.3.5 Writing to the initialisation register (WR\_INIT)

The application software (ASW) shall be permitted to write to both configuration registers of the ATIC42 to perform control of its different functionalities.

The interface to the ASW shall be facilitated by defining input data variables STATE\_LSL\_IF\_SPI\_WR[i], STATE\_LSL\_IF\_CONF\_SPI\_WR[i], FRQ\_R\_IT\_OSC\_LSL\_IF\_SPI\_WR[i] and the communication error counter CTR\_ERR\_LSL\_IF\_SPI\_RD[i].

*The BSW function shall service the ASW as follows:*

**The WRITE command sequence shall be carried out every recurrence**, independently of any new information made available by the ASW via the interfaces STATE\_LSL\_IF\_SPI\_WR[i], STATE\_LSL\_IF\_CONF\_SPI\_WR[i], FRQ\_R\_IT\_OSC\_LSL\_IF\_SPI\_WR[i], and of the previous write command being incorrectly executed.

The function shall latch the current content of the three input data variables STATE\_LSL\_IF\_XXX\_SPI\_WR[i](n) to STATE\_LSL\_IF\_XXX\_SPI\_WR[i](n-1). Thus any further changes to the information during a WRITE cycle are prevented.

Next, the STATE\_LSL\_IF\_XXX\_SPI\_WR[i](n-1) information shall be sent via the SPI to the ATIC42. The content written shall thereupon be verified via the corresponding answer which is received when sending the next command of the current SPI sequence.

Next, the STATE\_LSL\_IF\_XXX\_SPI\_WR[i](n-1) information shall be sent via the SPI to the ATIC42. The content written shall thereupon be verified via the corresponding answer which is received when sending the next command of the current SPI sequence.

Should any WRITE command within current SPI transmission cycle be invalid or the written content not match the read content, the counter CTR\_ERR\_LSL\_IF\_SPI\_WR[i] shall be incremented once.

For write validation procedure, sensor enable bit LV\_LSL\_ENA\_LSL\_IF[i] in the initialisation register is NOT considered because it is automatically reset by ATIC42 HW upon detection of an electrical sensor failure, regardless of the last transmitted SPI command. This asynchronous change in bit value assignment does not represent a communication error.


In addition, bit6 of FRQ\_R\_IT\_OSC\_LSL\_IF\_SPI\_xx[i] which represents the status of the Pin Selective Disabling feature shall also not be evaluated for SPI communication monitoring at present. Due to an ATIC42 HW error, command execution is performed but not monitored in ASIC response.

For manual increment of SPI communication error counter an interface to ASW (403B) is provided. This feature is introduced for purpose of SW test.

As the ATIC42 has a serial interface, the response to the currently transmitted command represents the answer to the previously executed command. As example, in the ATIC42 standard command sequence, the response received with command WR\_CONF\_INIT\_1 corresponds to the answer to the preceding command RD\_DIAG\_2(M2). The BSW shall accordingly transfer the command responses to the correspondent output data variable (STATE\_LSL\_IF\_SPI\_RD[i], STATE\_LSL\_IF\_CONF\_SPI\_RD[i], or FRQ\_R\_IT\_OSC\_LSL\_IF\_SPI\_RD[i], resp.).

Up to ATIC42, 2nd Silicon, B5 step, a workaround for SPI transmission of R\_IT\_OSC\_ENA bit has to be implemented. The ASIC shows random deviation between SPI request to set this bit and its physical reaction. If ATIC42 fails in switching on the oscillator for Ri determination, its correct response does not fit the transmitted request.

Since this behaviour does not represent a communication error, its direct evaluation shall be excluded for the regular communication error counter CTR\_ERR\_LSL\_IF\_SPI\_RD[i]. To be able to distinguish between HW based mismatch of request and response and SPI communication error, an additional cascaded error counter is introduced (CTR\_ERR\_LSL\_IF\_SPI\_IT\_OSC\_ENA[i]) to deal with the R\_

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IT\_OSC\_ENA bit. Its value is limited to  $NC\_CTR\_ERR\_LSL\_IF\_SPI\_OSC\_ENA = 3$ . This threshold represents maximum number of sequential retries for setting R\_IT\_OSC\_ENA bit before SPI communication error is recognized and reported to global error counter CTR\_ERR\_LSL\_IF\_SPI\_RD[i]. Should transmission be successful before supplementary counter reaches threshold value, it is reset. Once CTR\_ERR\_LSL\_IF\_SPI\_IT\_OSC\_ENA[i] reaches threshold value, this value is kept until next successful processing of R\_IT\_OSC\_ENA bit and every additional erroneous transmission leads to direct incrementation of global error counter (see also Drawing 1).

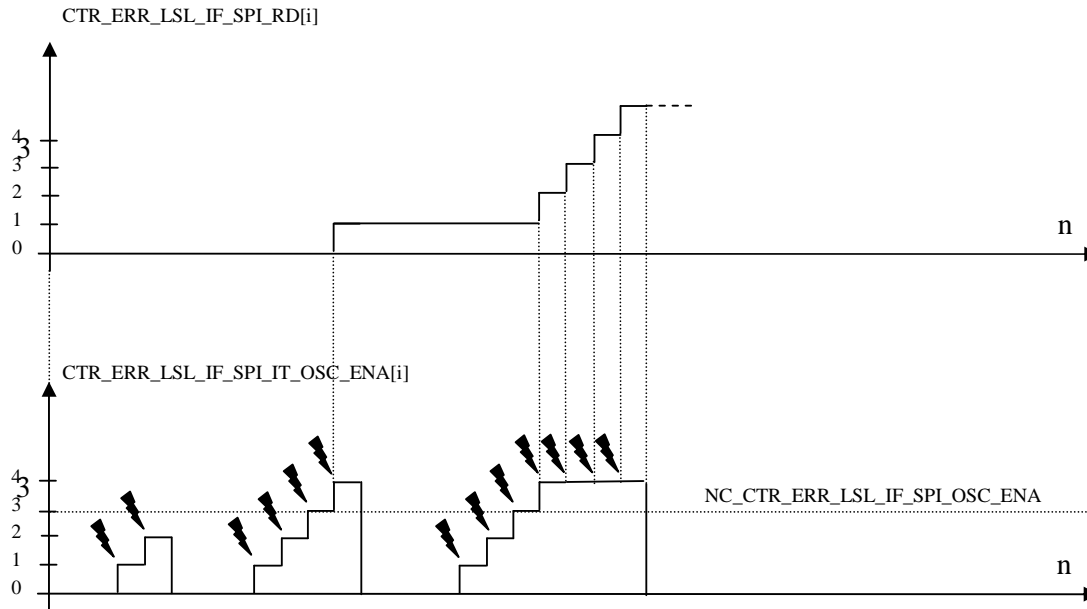


Figure 2.30.2: Drawing 1: Relation between global and cascaded communication error counter

### 2.30.3.6 Performing a SW reset at the ATIC42 IC (currently not implemented in generic SW!)

The command RESET\_IC(O) shall be executed if there exists a request to reset the ASIC via SW ( $LV\_LSL\_IF\_RST[i] = 1$ ). The activation of this flag as well as the priority definition should be handled in the WRAF sensor interface (ASW-BSW) Appl Inc, 403B. With the reset command the internal reset line is activated and all SPI registers are set to their default state provided by ATIC42 HW!

In order to deal with daisy chain communication comprehending multiple WRAF controllers (requiring identical number of commands provided to each controller but individual data contents), two alternative reset sequences can be thought of and should be discussed with the specific project prior to implementation:

- Repeated transmission of reset commands - equaling number of commands in regular sequence - to WRAF controller which is to be reset.
- Reset performance on all connected WRAF controllers.

#### Application conditions

#### Initialisation:

$NC\_CTR\_ERR\_LSL\_IF\_SPI\_OSC\_ENA = 3$

The following variable initialisation shall take place at the activation of the BSW:

$CTR\_ERR\_LSL\_IF\_SPI\_WR[i] = 0$

$CTR\_ERR\_LSL\_IF\_SPI\_IT\_OSC\_ENA\_i = 0$

```

LV_LSL_DEAC[i] = 0
LV_VPLSL_LIM[i] = 0
LV_VNLSL_LIM[i] = 0
STATE_LSL_IF_SPI_RD[i] = 0
STATE_LSL_IF_CONF_SPI_RD[i] = 0
FRQ_R_IT_OSC_LSL_IF_SPI_RD[i] = 0
STATE_ERR_LSL[i] = NO FAULT (0H)
STATE_ERR_VNLSL[i] = NO FAULT (0H)
STATE_ERR_VGLSL[i] = NO FAULT (0H)
STATE_ERR_VIPLSL[i] = NO FAULT (0H)
STATE_ERR_VRCLSL[i] = NO FAULT (0H)
STATE_ERR_IPLSL[i] = NO FAULT (0H)

```

**Note:**

The interface variables STATE\_LSL\_IF\_SPI\_WR[i] and STATE\_LSL\_IF\_CONF\_SPI\_WR[i] shall be initialized in the WRAF sensor interface (ASW - BSW). The corresponding ASW (Oxygen sensor temperature, 402A) shall do the initialization of FRQ\_R\_IT\_OSC\_LSL\_IF\_SPI\_RD[i].

**Recurrence:**

T\_SAMPLE = 10 ms.

**Activation:**

After every ECU RESET.

**Deactivation:**

--

**Formula section:**

```

if          LV_CTR_ERR_LSL_IF_SPI_MAN_INC[i] == 1
then       CTR_ERR_LSL_IF_SPI_WR[i] = CTR_ERR_LSL_IF_SPI_WR[i] + 1
endif
if          LV_CTR_ERR_LSL_IF_SPI_MAN_INC[i] == 1 -> 0
then       CTR_ERR_LSL_IF_SPI_WR[i] = 0
endif

```

**Valid SPI-Commands:**


The following SPI-commands consist of a 4 bit command plus 4 bit data partition each:

```

RD_IDENT_1(A1)          0H + 1H
RD_IDENT_2(A2)          0H + 2H
WR_INIT_1(C)            2H + D0D1D2D3 (see Table 3)
WR_INIT_2(D)            3H + D4D5D6D7 (see Table 3)
WR_CONF_INIT_1(F)      5H + D0D1D2D3 (see Table 4)
WR_CONF_INIT_2(I)      8H + D4D5D6D7 (see Table 4)
WR_INIT_R_FRQ_1(K)     AH + D0D1D2D3
WR_INIT_R_FRQ_2(L)     BH + D4D5D6D7
RD_DIAG_1(M1)          CH + 1H (read pin diagnosis register)
RD_DIAG_2(M2)          CH + 2H (read general status register)
RESET_IC(O)            FH + FH

```

Following a RD\_IDENT\_2(A2) command, the data byte of the returned message is defined as follows:

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Bit Pos.	Bit Name	Description
0	STATE_LSL_IF_IC_INFO[i].bit_8	8 MSB of IC Code
1	STATE_LSL_IF_IC_INFO[i].bit_9	Ditto
2	STATE_LSL_IF_IC_INFO[i].bit_10	Ditto
3	STATE_LSL_IF_IC_INFO[i].bit_11	Ditto
4	STATE_LSL_IF_IC_INFO[i].bit_12	Ditto
5	STATE_LSL_IF_IC_INFO[i].bit_13	Ditto
6	STATE_LSL_IF_IC_INFO[i].bit_14	Ditto
7	STATE_LSL_IF_IC_INFO[i].bit_15	Ditto

Figure 2.30.3: Table 1: Data byte equivalence of the response to command RD\_IDENT\_2(A2) and the output variable STATE\_LSL\_IF\_IC\_INFO[i]

Similarly the answer to RD\_IDENT\_1(A1) is defined as:

Bit Pos.	Bit Name	Description
0	STATE_LSL_IF_IC_INFO[i].bit_0	Bits 0 through 2, 3 LSB of IC Code
1	STATE_LSL_IF_IC_INFO[i].bit_1	Ditto
2	STATE_LSL_IF_IC_INFO[i].bit_2	Ditto
3	STATE_LSL_IF_IC_INFO[i].bit_3	Bits 4 through 5, Supplier index
4	STATE_LSL_IF_IC_INFO[i].bit_4	Ditto
5	STATE_LSL_IF_IC_INFO[i].bit_5	Bits 6 through 7, Chip version number *)
6	STATE_LSL_IF_IC_INFO[i].bit_6	Ditto
7	STATE_LSL_IF_IC_INFO[i].bit_7	Ditto

Figure 2.30.4: Table 2: Data byte equivalence between the response to RD\_IDENT\_1 and STATE\_LSL\_IF\_IC\_INFO[i]

\*) 000 for A1, A2, B1 samples; 001 for B2 samples!

Output data STATE\_LSL\_IF\_SPI\_RD[i] shall be defined to be a byte mirroring the content of the register INIT\_REG\_1, which represents a collection of individual bits as shown in the following table:

Bit Pos.	Bit Name	Description
D0	SWI_GAIN	Set Ip measurement gain to 8 (0) or 16 (1)
D1	VLS_OFS_ADJ_ENA	IP-offset-measurement (0) disable (1) enable
D2	ICPLSL_ENA	Icp current: (0) disable (1) enable
D3	IPLSL_CTL_ENA	Ip controller: (0) disable (1) enable
D4	R_IT_CAL_ENA	Ri calibration mode: (0) disabled, (1) enabled
D5	R_IT_OSC_ENA	Oscilator: (0) off, (1) on
D6	LSL_ENA	Enable / Disable linear lambda sensor
D7	R_IT_SWI_RNG	Ri measurement gain: (0) Range 1, (1) Range 2

Figure 2.30.5: Table 3: Data byte for command WR\_INIT\_1(C) and WR\_INIT\_2(D)

Similarly the output data STATE\_LSL\_IF\_CONF\_SPI\_RD[i] shall be defined to be a byte mirroring the content of the WR\_CONF\_INIT\_1(F) and WR\_CONF\_INIT\_2(I) as follows:

Bit Pos.	Bit Name	Description
0	ICPLSL[i].bit_0	Bits 0 through 4, Icp current
1	ICPLSL[i].bit_1	
2	ICPLSL[i].bit_2	
3	ICPLSL[i].bit_3	
4	ICPLSL[i].bit_4	
5	T_DLY_DI[i].bit_0	Bits 5 through 7, sensor protection time
6	T_DLY_DI[i].bit_1	
7	T_DLY_DI[i].bit_2	

Figure 2.30.6: Table 4: Data byte for command WR\_CONF\_INIT\_1(F) and WR\_CONF\_INIT\_2(I)

Following a RD\_DIAG\_1(M1) command, the data byte of the returned message is defined as follows:

Bit Pos.	Bit Name	Description
0	STATE_ERR_VNLSL[i].bit_0	VN -short circuit to gnd (0) no (1) yes
1	STATE_ERR_VNLSL[i].bit_1	VN -short circuit to battery (0) no (1) yes
2	STATE_ERR_VGLSL[i].bit_0	VG -short circuit to gnd (0) no (1) yes
3	STATE_ERR_VGLSL[i].bit_1	VG -short circuit to battery (0) no (1) yes
4	STATE_ERR_VIPLSL[i].bit_0	VIP -short circuit to gnd (0) no (1) yes
5	STATE_ERR_VIPLSL[i].bit_1	VIP -short circuit to battery (0) no (1) yes
6	STATE_ERR_VRCLSL[i].bit_0	RCD -short circuit to gnd (0) no (1) yes
7	STATE_ERR_VRCLSL[i].bit_1	RCD -short circuit to battery (0) no (1) yes

Figure 2.30.7: Table 5: Data byte equivalence between the register DIAG\_REG\_1[i] and the diagnosis output variables

Following a RD\_DIAG\_2(M2) command, the data byte of the returned message is defined as follows:

Bit Pos.	Bit Name	Description
0	STATE_ERR_LSL[i]	General diagnosis status: (0) no fault, (1) fault
1	STATE_ERR_IPLSL[i].bit_0	IP current low: (0) no (1) yes
2	STATE_ERR_IPLSL[i].bit_1	IP current high: (0) no (1) yes
3	LV_VPLSL_LIM[i]	VP at the allowed bounds: (0) no (1) yes
4	LV_VNLSL_LIM[i]	Overvoltage at VN pin: (0) no (1) yes

Figure 2.30.8: Table 6: Data byte equivalence between the register DIAG\_REG\_2[i] and the corresponding diagnosis output variables

## 2.31 O2 sensor signal acquisition general

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
V_TEMP_LS_UP [NC_CBK_EX_NR]	O	0... 3FFH	0... 4.99511	4.8828e-3	V
Upstream lambda sensor temperature voltage					
VLS_DOWN [NC_CBK_EX_NR]	O	0... 3FFH	0... 4.99511	4.8828e-3	V
Downstream sensor voltage measured					
VLS_DOWN_H_RES [NC_CBK_EX_NR]	O	0... 7FFFH	0... 4.99984	152.6e-6	V
Downstream sensor voltage measured with high resolution					
VLS_UP_RAW [NC_CBK_EX_NR]	O	0... 3FFH	0... 4.99511	4.8828e-3	V
Raw value of upstream oxygen sensor voltage					
VP_LS_DOWN	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Temporary storage for conversion of VLS_DOWN ADC value to resolution required in EGCP					
VP_LS_UP_RAW	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Temporary storage for conversion of VLS_UP ADC value to resolution required in EGCP					
VP_TEMP_LS_UP	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Temporary storage for conversion of V_TEMP_LS_UP ADC value to resolution required in EGCP					

### Input data:

LV_R_IT_REQ_LS_DOWN [NC_CBK_EX_NR] {p. 1364}	LV_R_IT_REQ_LS_UP [NC_CBK_EX_NR] {p. 1320}	NC_CBK_EX_NR {p. 1829}	NC_STATE_LSL_UP_IF {p. 651}
NC_STATE_VLS_UP_SIG_ ACQ {p. 651}			

### Import actions:

ACTION_INFR_GetVAdcLsDown (IN<i>,OUT<v_adc>)
ACTION_INFR_GetVAdcLsUp (IN<i>,OUT<v_adc>)
ACTION_INFR_GetVAdcTempLsUp (IN<i>,OUT<v_adc>)

## FUNCTION DESCRIPTION:


### General information:

Name	Acquisition recurrence	Acquisition precision	Notes
VLS_UP_RAW[i]	10ms	10bit	NC_STATE_VLS_UP_SIG_ACQ = 0
	1ms	10bit	NC_STATE_VLS_UP_SIG_ACQ = 1
V_TEMP_LS_UP[i]	10ms	10bit	-
VLS_DOWN[i]	10ms	10bit	-
VLS_DOWN_H_RES[i]	10ms	12bit	-

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

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i = 2, for exhaust cylinder bank 2  
 otherwise (NC\_CBK\_EX\_NR = 1)  
 i = 1, for single exhaust cylinder bank.

If the lambda sensor signal shall be filtered prior to further processing NC\_STATE\_VLS\_UP\_SIG\_ACQ has to be set to 1, otherwise to 0.

### Description:

Voltages of lambda sensors offered by Basic SW are read from infrastructure in standard ECU06 resolution and transformed to application system specific variables.

### Application conditions

**Activation:** at every engine operating state  
**Deactivation:** -  
**Update rate:** **VLS\_UP\_RAW[i]:** 10 ms for NC\_STATE\_VLS\_UP\_SIG\_ACQ = 0  
 1 ms for NC\_STATE\_VLS\_UP\_SIG\_ACQ = 1  
**VLS\_DOWN[i] :** 10 ms  
**VLS\_DOWN\_H\_RES[i] :** 10ms  
**V\_TEMP\_LS\_UP[i] :** 10 ms  
**Initialization:** at reset: VLS\_UP\_RAW[i] = 0  
 VLS\_DOWN[i] = 0  
 VLS\_DOWN\_H\_RES[i] = 0  
 V\_TEMP\_LS\_UP[i] = 0

### Formula section:

```
# If      NC_STATE_LSL_UP_IF = 0                % Masking shall only be done for binary
sensor

# then   If      LV_R_IT_REQ_LS_UP[i] = 0
        then    acquire VLS_UP_RAW[i]
              ACTION_INFR_GetVAdcLsUp(
                    IN      i
                    OUT     VP_LS_UP_RAW)
              VLS_UP_RAW[i] = VP_LS_UP_RAW
        else    VLS_UP_RAW[i]N = VLS_UP_RAW[i]N-1
        endif

# else   acquire VLS_UP_RAW[i]
        ACTION_INFR_GetVAdcLsUp(
              IN      i
              OUT     VP_LS_UP_RAW)
        VLS_UP_RAW[i] = VP_LS_UP_RAW
        acquire V_TEMP_LS_UP[i]
        ACTION_INFR_GetVAdcTempLsUp(
              IN      i
              OUT     VP_TEMP_LS_UP)
        V_TEMP_LS_UP[i] = VP_TEMP_LS_UP


# endif
```



```

if          LV_R_IT_REQ_LS_DOWN[i] = 0
then       acquire VLS_DOWN_H_RES [i]
            ACTION_INFR_GetVAdcLsDown(
                IN          i
                OUT         VP_LS_DOWN)
            VLS_DOWN_H_RES[i] = VP_LS_DOWN
            VLS_DOWN[i] = VLS_DOWN_H_RES[i]
else       VLS_DOWN[i]N = VLS_DOWN[i]N-1
            VLS_DOWN_H_RES[i]N = VLS_DOWN_H_RES[i]N-1
endif

```

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## 2.32 O2 sensor (lin, up) signal acquisition for heater coupling diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_SP_FIL_DELTA_FALL [NC_CBK_EX_NR]	O	0... 7FFFH	0... 1.9999389648437	61.0351e-6	-
Acquired lambda model value at the falling edge of heater PWM					
LAMB_SP_FIL_DELTA_RISE [NC_CBK_EX_NR]	O	0... 7FFFH	0... 1.9999389648437	61.0351e-6	-
Acquired lambda model value at the rising edge of heater PWM					
VLS_UP_DELTA_FALL [NC_CBK_EX_NR]	O	0... 3FFFH	0... 4.9951171875	0.00488281	V
Acquired oxygen sensor voltage at the falling edge of heater PWM					
VLS_UP_DELTA_RISE [NC_CBK_EX_NR]	O	0... 3FFFH	0... 4.9951171875	0.00488281	V
Acquired oxygen sensor voltage at the rising edge of heater PWM					
VP_LS_UP_DELTA_FALL	-	0... 7FFFH	0... 4.9998474121093	152.587e-6	V
Temporary storage for conversion of VLS_UP ADC readout at PWM fall to resolution required in EGCP					
VP_LS_UP_DELTA_RISE	-	0... 7FFFH	0... 4.9998474121093	152.587e-6	V
Temporary storage for conversion of VLS_UP ADC readout at PWM rise to resolution required in EGCP					

### Input data:

LAMB_SP_FIL_HOM [NC_CBK_EX_NR] {p. 2462}	LSHPWM_UP [NC_CBK_EX_NR] {p. 2385}	LV_LSL_DIAG_LSH_LSL_ UP_DEAC {p. 5273}	NC_CBK_EX_NR {p. 1829}
T_DLY_TRIG_LSH_UP [NC_CBK_EX_NR] {p. 5276}	VLS_UP [NC_CBK_EX_NR] {p. 1341}		

### Import actions:

<b>ACTION_INFR_GetHeatCoupling</b> (IN<PRM_NC_CBK_EX_NR>,OUT<PRM_LAMB_SP_FIL_DELTA_RISE>,OUT<PRM_LAMB_SP_FIL_DELTA_FALL>,OUT<PRM_VLS_UP_DELTA_RISE>,OUT<PRM_VLS_UP_DELTA_FALL>)
<b>ACTION_INFR_SetHeatCoupling</b> (IN<PRM_NC_CBK_EX_NR>,IN<PRM_T_DLY_TRIG_LSH_UP>,IN<PRM_LAMB_SP_FIL_HOM>)

### General information

The calculation shall be done for all exhaust cylinder banks.


For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

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This function shall deliver the inputs needed by the heater coupling diagnosis specific for UEGO Sensors controlled with the ATIC42. This functions describes how the upstream sensor signal and the lambda model shall be acquired synchronously with the heater signal.

### Application conditions:

**Initialisation:** at reset  
VLS\_UP\_DELTA\_RISE[i] = 0  
VLS\_UP\_DELTA\_FALL[i] = 0  
LAMB\_SP\_FIL\_DELTA\_RISE[i] = 0  
LAMB\_SP\_FIL\_DELTA\_FALL[i] = 0

**Activation:** - -

**Deactivation:** - -

**Recurrence:** 10 ms

### Function description:

### Signal flow diagram:

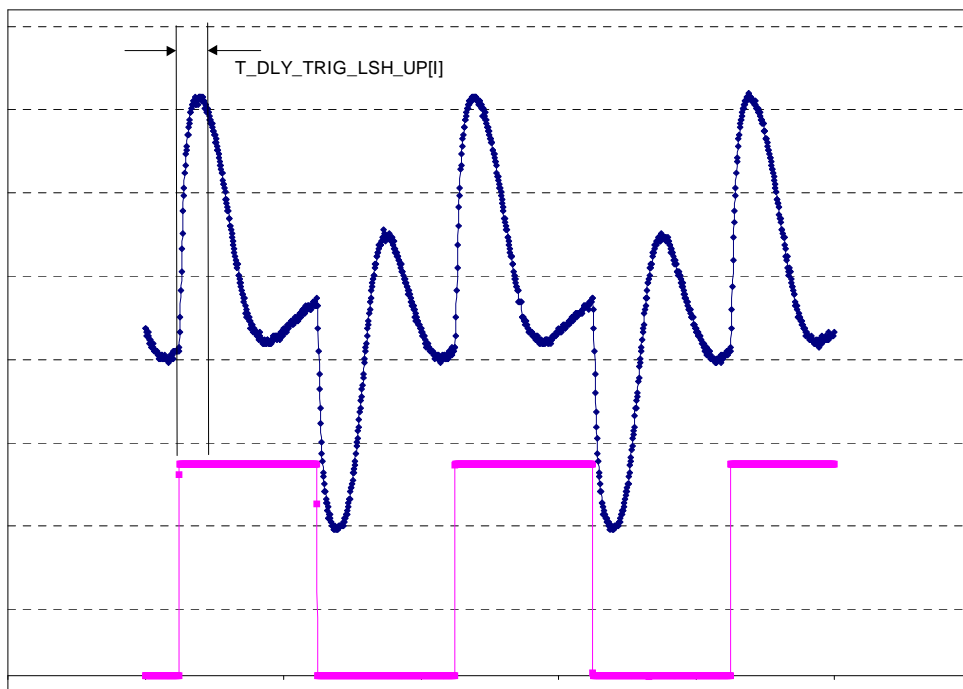


Figure 2.32.1:

### Description:

In case a rising edge of the lambda sensor heater PWM is detected, the delay timer shall be started. After the delay timer expired its maximum value, the sensor signal VLS\_UP[i] and the  $\lambda$ -model LAMB\_SP\_FIL[i] shall be acquired and transferred to the variables VLS\_UP\_DELTA\_RISE[i] and LAMB\_SP\_FIL\_DELTA\_RISE[i] respectively.

Analogously, after a lambda sensor heater PWM falling edge occurred and the delay is expired the variables VLS\_UP\_DELTA\_FALL[i] and LAMB\_SP\_FIL\_DELTA\_FALL[i] shall be updated.

The delay timer maximum value comprehends the value of T\_DLY\_TRIG\_LSH\_UP[i] updated at the last **falling** edge and shall be valid for one LSHPWM\_UP[i] period at least. In case an edge comes before the time delay counter is expired, neither the lambda signal nor the lambda model shall be acquired. In this case the respective variables shall retain their old values until a new update is possible.

Also at the every falling edge the variables VLS\_UP\_DELTA\_RISE[i], VLS\_UP\_DELTA\_FALL[i], LAMB\_SP\_FIL\_DELTA\_RISE[i] and LAMB\_SP\_FIL\_DELTA\_FALL[i] shall be handed over to the ASW.


### Formula section:

```

If      LV_LSL_DIAG_LSH_LSL_UP_DEAC = 0
then    write data to infrastructure
          ACTION_INFR_SetHeatCoupling(
              IN      i
              IN      T_DLY_TRIG_LSH_UP[i]
              IN      LAMB_SP_FIL_HOM[i])

          get data from infrastructure
          ACTION_INFR_GetHeatCoupling(
              IN      i
              OUT     LAMB_SP_FIL_DELTA_RISE[i]
              OUT     LAMB_SP_FIL_DELTA_FALL[i]
              OUT     VP_LS_UP_DELTA_RISE
              OUT     VP_LS_UP_DELTA_FALL)
          VLS_UP_DELTA_RISE[i] = VP_LS_UP_DELTA_RISE
          VLS_UP_DELTA_FALL[i] = VP_LS_UP_DELTA_FALL
endif

```

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## 2.33 O2 sensor (lin, up) signal acquisition for CILC

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_VLS_UP_CYL_SEL_TRIG [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
cylinder selective update counter for trigger event					
VLS_UP_CYL_SEL [NC_CYL_NR]	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
upstream oxygen sensor acquisition (cylinder individual)					
VP_LS_CYL_SEL	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Temporary storage for conversion of infrastructure data to resolution required in EGCP					

### Input data:

CRK_CYL_LAM [NC_CYL_NR] {p. 2730}	LV_LAM_CYL_ENA [NC_CBK_EX_NR] {p. 2864}	NC_CYL_NR {p. 1526}	
--------------------------------------	---	---------------------	--

### Import actions:

<b>ACTION_INFR_DisableCilc</b> ()
<b>ACTION_INFR_EnableCilc</b> ()
<b>ACTION_INFR_GetCilc</b> (IN<x>,OUT<v_adc>,OUT<ctr>)
<b>ACTION_INFR_SetCilc</b> (IN<x>,IN<crk>)

## FUNCTION DESCRIPTION:

### General information:

The function shall serve as a detector for a precise signal acquisition of the Wide Range Air-Fuel (WRAF) sensor in accordance with the identified cylinder. Therefore, the phase displacement, CRK\_CYL\_LAM[x] shall be considered. Since for dual-bank engines, the signal acquisition is dual-port, the phase shift shall be allocated to the right cylinder and cylinder bank. The phase displacement CRK\_CYL\_LAM[x] is computed once every combustion cycle (ASW) and shall be considered for all cylinders.

The calculation shall be done for  $x = 0 : NC\_CYL\_NR - 1$ .

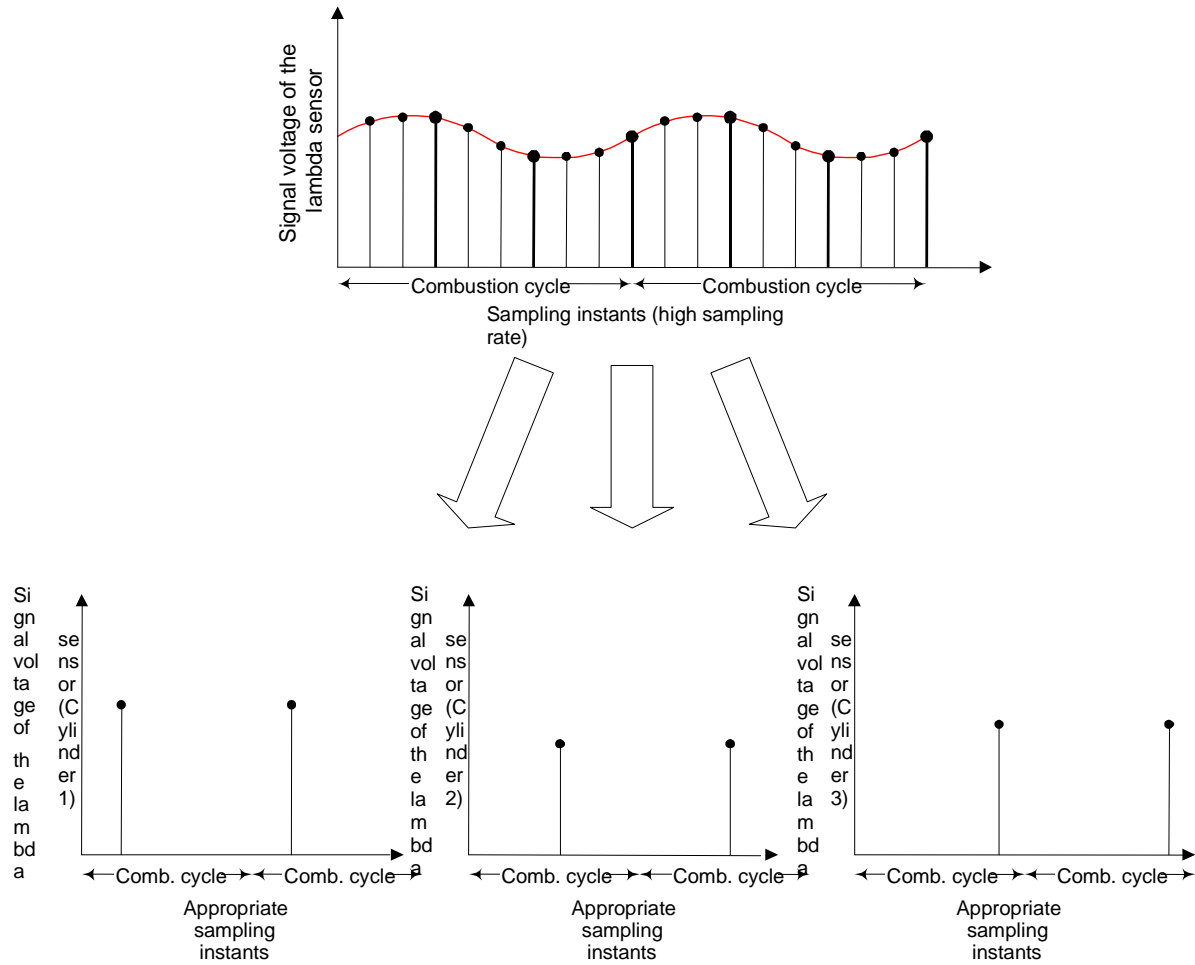


Figure 2.33.1: : Cylinder individual signal acquisition of WRAF sensor

**Application conditions:**

*Recurrence:* segment synchronous, synchron to cylinder individual lambda control (ASW)

*Activation:* LV\_LAM\_CYL\_ENA[i] = 0 -> 1  
ACTION\_INFR\_EnableCilc()

*Deactivation:* LV\_LAM\_CYL\_ENA[i] = 1 -> 0  
ACTION\_INFR\_DisableCilc()

**Formula section:**


*write data a synchronous to infrastructure*

```
ACTION_INFR_SetCilc(
    IN      x
    IN      CRK_CYL_LAM[x])
```

*get data a synchronous to infrastructure*

```
ACTION_INFR_GetCilc(
```

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```

      IN      x
      OUT     VP_LS_CYL_SEL
      OUT     CTR_VLS_UP_CYL_SEL_TRIG[x])
VLS_UP_CYL_SEL[x] = VP_LS_CYL_SEL

```

### Description:

#### Signal acquisition and trigger event

In coordination with TDC the port selected signal voltage of the WRAF sensor shall be sampled (VLS\_UP\_CYL\_SEL[x]) after the phase shift CRK\_CYL\_LAM[x] for each segment and the trigger counter for respective cylinder (CTR\_VLS\_UP\_CYL\_SEL\_TRIG[x]) shall be incremented.


```

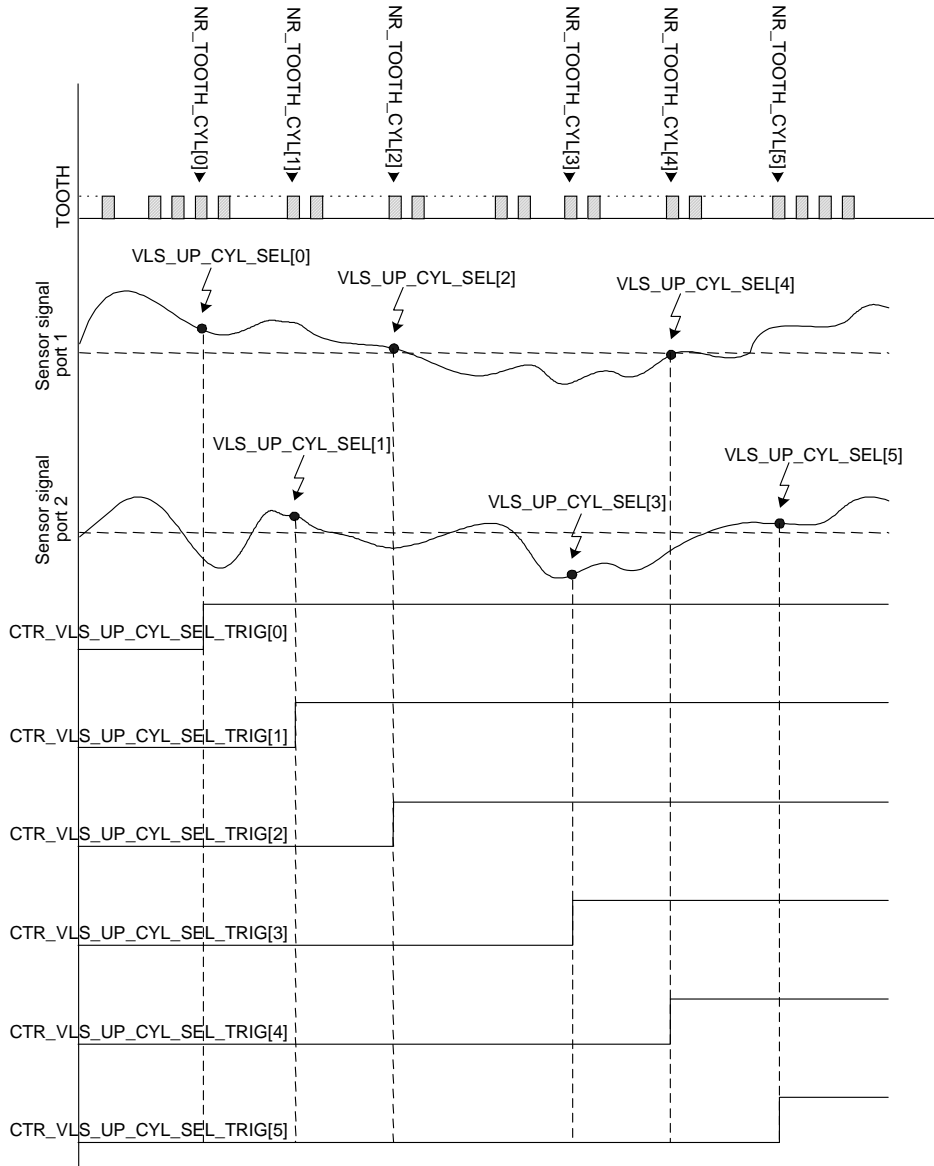
TDC      ->      CRK_CYL_LAM[x]      ->      VLS_UP_CYL_SEL[x]      ->
                                                CTR_VLS_UP_CYL_SEL_TRIG[x] ++

```

### Remark:

For instance, see figure 2, which represents the sensor signal acquisition for a dual-bank engine (6 cylinders).

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**Figure 2: WRAF sensor signal acquisition of a dual-bank catalyst system (6 cylinders)**

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# 3 - AGGR adaptation modules

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## 3.1 AGGR adaptation: DRPD

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
PV	-	0... 3FFH	0... 99.90234	97.6999e-3	%
Global degree of activation of the accelerator pedal (high resolution)					

### Input data:

PV_AV {p. 1269}			
-----------------	--	--	--

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

### Application conditions

**Initialisation:** 0 % at reset

**Recurrence :** 10 ms, as input data (sequencing: input before output)

**Activation:** *every engine state*

### Formula section:

$PV = PV\_AV$

## 3.2 AGGR adaptation: VHMD

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
V	O/V	0... 168H	0... 360	1	km/h
Vehicle speed					

### Input data:

VS {p. 1176}			
--------------	--	--	--

### 3.2.1 Outputs for BMW which are not defined as VHMD exported data

#### FUNCTION DESCRIPTION:

Adaption to BMW environment.

#### Application conditions

**Initialisation:** 0  
**Recurrence:** 100ms  
**Activation:** after reset (always)  
**Deactivation:** -

#### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

$V = VS$

## 3.3 AGGR adaptation: VHST

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Md_na_ars	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Torque losses active rolling stabilisation					
Mdi_asr_l	O/V	0... 2710H	0... 1000	0.1	Nm
Torque decrement for slow torque intervention during TCS					
Mdi_asr_s	O/V	0... 2710H	0... 1000	0.1	Nm
Torque decrement for fast torque intervention during TCS					
Mdi_msr_l	O/V	0... 2710H	0... 1000	0.1	Nm
Torque increase for slow torque intervention during MSR					
Mdi_msr_s	O/V	0... 2710H	0... 1000	0.1	Nm
Torque increase for fast torque intervention during MSR					

### Input data:

TQ_LOSS_ARS {p. 6650}	TQI_ASR_FAST {p. 6741}	TQI_ASR_SLOW {p. 6741}	TQI_MSR_FAST {p. 6741}
TQI_MSR_SLOW {p. 6742}			

### 3.3.1 Outputs for BMW functions which are not defined as VHST exported data

#### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

*Remark:* The really possible physical limits of the outputs are different to the specified values due to the input data attributes.

#### Application conditions

**Initialisation:** 0  
**Recurrence :** 10 ms  
**Activation:** *every engine state*

#### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

Md\_na\_ars = TQ\_LOSS\_ARS

Mdi\_asr\_l = TQI\_ASR\_SLOW

Mdi\_asr\_s = TQI\_ASR\_FAST

Mdi\_msr\_l = TQI\_MSR\_SLOW

Mdi\_msr\_s = TQI\_MSR\_FAST

### 3.4 AGGR adaptation: TQDR

**Data definition:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_TOT_WOUT_IGA	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Total actual efficiency (in homogeneous mode) without EFF_IGA					
LV_MAP_PUC_LIM_ACT_LSL_GAIN_AD	O/V	0... 1H	0 ...1	1	-
Logical variable is set if MAP limitation is activated					
TQI_AV	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Actual indicated engine torque					

**Input data:**

EFF_LAMB_AV {p. 8379}	EFF_SCC_AV {p. 6665}	LV_S_ACT {p. 8137}	TQI_AV_HOM {p. 8380}
TQI_AV_S {p. 8380}			

**FUNCTION DESCRIPTION:**

Adaptation to aggregate environment.

**Application conditions**

- Initialisation:** LV\_MAP\_PUC\_LIM\_ACT\_LSL\_GAIN\_AD = 0 (never changed after initialisation)  
EFF\_TOT\_WOUT\_IGA = 1
- Recurrence:** 10 ms
- Activation:** always
- Deactivation:** never

**Formula section:**

If LV\_S\_ACT = 0  
 Then TQI\_AV = TQI\_AV\_HOM  
 Else TQI\_AV = TQI\_AV\_S

$$EFF\_TOT\_WOUT\_IGA = EFF\_SCC\_AV * EFF\_LAMB\_AV$$

**REMARK:** Actually FAC\_MFF\_TQ\_COR\_SCAV (Eta\_md\_uesp) should have be also added for the EFF\_TOT\_WOUT\_IGA calculation. But this factor is already included at the TQI\_REF calculation. And due the fact that EFF\_TOT\_WOUT\_IGA is multiplied with TQI\_REF later, it is not added here.

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## 3.5 AGGR adaptation: INSY

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
AMP	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Ambient pressure (measured or adapted)					
AMP_AD	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Ambient pressure (adapted)					
AMP_MDL	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Ambient pressure (modelled)					
LV_ERR_MAP	O/V	0... 1H	0 ...1	1	-
MAP sensor error					
LV_ERR_RATIO_CHK	O	0... 1H	0 ...1	1	-
Boolean for actual value MAF or TPS ratio check is present (yet available only for interface)					
MAF_INT_PUC	O/V	0... FFFFH	0... 2912.66666	0.0444444	g
air mass flow integral during pull cut off phase					
MAF_INT_PUE	O/V	0... FFFFH	0... 2912.66666	0.0444444	g
air mass flow integral out of pull cut off phase					

### Input data:

AMP_MES {p. 1163}	LV_ERR_MAP_DIP_PLAUS {p. 1062}	LV_ERR_MAP_DIP_SENS {p. 4824}	MAF_INT_PUC_ACT {p. 2942}
MAF_INT_PUC_NOT_ACT {p. 2942}			

### 3.5.1 Outputs for supplier aggregates

#### FUNCTION DESCRIPTION:

#### Application conditions

**Initialisation:** AMP = AMP\_AD = AMP\_MDL = AMP\_MES  
MAF\_INT\_PUC\_ACT, MAF\_INT\_PUC\_NOT\_ACT 0 g at reset

**Recurrence:** AMP, AMP\_AD, AMP\_MDL 100ms  
MAF\_INT\_PUC ; MAF\_INT\_PUE 20 ms, as input data (sequencing:  
input before output)  
LV\_ERR\_RATIO\_CHK, LV\_ERR\_MAP: 10ms

**Activation:** at every engine state

**Deactivation:** -


#### Formula section:

AMP = AMP\_MES  
AMP\_AD = AMP\_MES  
AMP\_MDL = AMP\_MES  
  
MAF\_INT\_PUC = MAF\_INT\_PUC\_ACT

```
MAF_INT_PUE          = MAF_INT_PUC_NOT_ACT
```

```
LV_ERR_RATIO_CHK = 0
```

```
IF          LV_ERR_MAP_DIP_SENS = 1      OR      LV_ERR_MAP_DIP_PLAUS =
1
THEN      LV_ERR_MAP = 1
ELSE      LV_ERR_MAP = 0
ENDIF
```

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## 3.6 AGGR adaptation: AIRT

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_TIA_IM	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present which might affect temperature TIA_IM (after debounce)					
LV_ERR_TIA_THR	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present which might affect temperature TIA_THR (after debounce)					
TIA_IM	O/V	0... FEH	0... 142.5	0.75	°C
Air temperature in the intake manifold					
TIA_THR	O/V	0... FEH	0... 142.5	0.75	°C
Air temperature at the throttle body					
TIA_THR_ST	O/V	0... FEH	0... 142.5	0.75	°C
Air temperature at the throttle body at start					

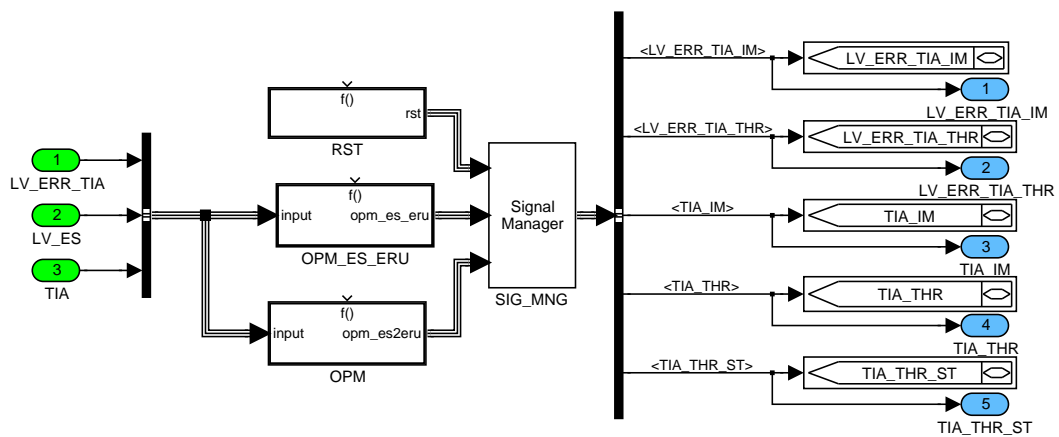
### Input data:

LV_ERR_TIA {p. 4200}	LV_ES {p. 1720}	TIA {p. 1226}	
----------------------	-----------------	---------------	--

### Function Description

Adaptation of AIRT variables to MSV70 environment.

### Function Description



SDA\_SRS / SDA 4.0 29-Jul-2005

Figure 3.6.1: AIRT\_M300B

### 3.6.1 Calculation at reset

#### Initialization at reset

TIA\_THR\_ST is initialised at engine start.



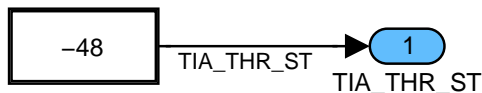


Figure 3.6.2: AIRT\_M300B/RST/INI

### 3.6.2 Calculations at Engine stop to engine run

#### Initialization

TIA is assigned to output variable TIA\_THR\_ST

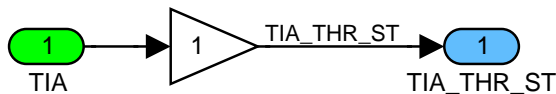


Figure 3.6.3: AIRT\_M300B/OPM\_ES\_ERU/INI

### 3.6.3 Formula section

#### Calculation of outputs

Output variables TIA\_IM, TIA\_THR, LV\_ERR\_TIA\_IM and LV\_ERR\_TIA\_THR are calculated here. TIA is assigned to TIA\_IM and TIA\_THR, LV\_ERR\_TIA is assigned to LV\_ERR\_TIA\_THR and LV\_ERR\_TIA\_IM.

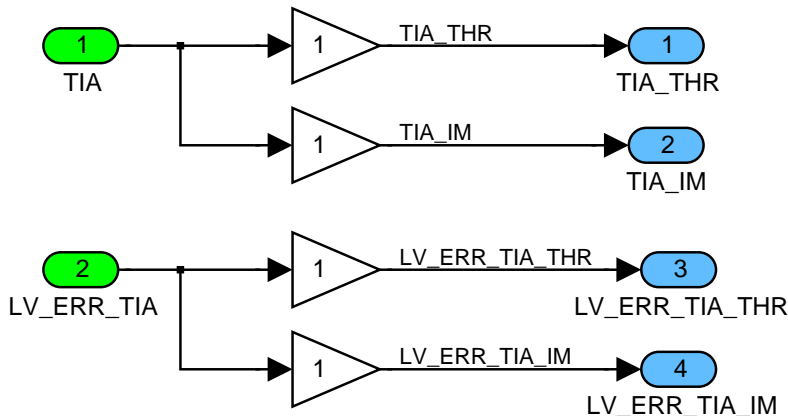



Figure 3.6.4: AIRT\_M300B/OPM/SUB\_CLC

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## 3.7 AGGR adaptation: THRO

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
V_TPS_GAIN_1	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Throttle position sensor 1 multiplied with 4 raw acquisition					

### FUNCTION DESCRIPTION:

#### General information:

Adaptation module throttle variables

#### Application conditions

<b>Initialisation:</b>	<i>all = 0 at reset</i>
<b>Recurrence:</b>	<i>same as input values</i>
<b>Activation:</b>	<i>every ECU operating state</i>
<b>Deactivation:</b>	-

## 3.8 AGGR adaptation: EGRC

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
AV_OPEN_EGR	O/V	0... FFH	0... 99.60937	0.390625	%
Actual opening value of the EGR valve after adaptation					
LV_EGR_ACT	O/V	0... 1H	0 ...1	1	-
Logical value for EGR-control active					
LV_ER_FDOUT	O	0... 1H	0 ...1	1	-
LV_ER_FDOUT					
LV_ERR_EGR_2	O/V	0... 1H	0 ...1	1	-
Stuck valve or potentiometer failure					
STK_AV_EGR	O/V	0... FFH	0... 99.60937	0.390625	%
Actual value of the stroke of EGR valve					

### Input data:

LV_PWM_ACR_OFF_REQ {p. 4345}	OPG_ACR {p. 1097}	STATE_ACR_CTL {p. 3587}	
---------------------------------	-------------------	-------------------------	--

### FUNCTION DESCRIPTION:

This function is used for the adaptation of the actuator control modules to the remaining software system. The Module has to be executed after the ACRC functionality has been calculated.

### Application conditions

**Initialization:** at RST set all to zero and LV\_ER\_FDOUT = 0  
**Recurrences:** 10 ms  
**Activation:** at all engine operating states  
**Deactivation:** no deactivation

### Formula section:

AV\_OPEN\_EGR = OPG\_ACR  
 STK\_AV\_EGR = OPG\_ACR  
 LV\_EGR\_ACT = (STATE\_ACR\_CTL == PWM\_CTL)  
 LV\_ERR\_EGR\_2 = LV\_PWM\_ACR\_OFF\_REQ

## 3.9 AGGR adaptation: FUSL

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFPPWM_CAN	O/V	0... FFH	0... 99.609375	0.390625	%
Pump speed of the electrical fuel pump as 8 bit PWM signal					
FUP_AD	O/V	8000... 7FFFH	-173890 ...173884	5.30669108	hPa
Adaptation value for fuel pressure adaptation					
FUP_RES_H_SP_CH	O	0... FFFFH	0... 255.99609375	0.00390625	MPa
Fuel pressure setpoint during catalyst heating					
FUP_RNG_H_SP_CH	O	0... FFFFH	0... 255.99609375	0.00390625	MPa
Fuel pressure setpoint for catalyst heating					
FUP_RNG_H_SP_OHP	O	0... FFFFH	0... 255.99609375	0.00390625	MPa
Fuel pressure setpoint for overheating prevention					
LV_ACR_EFPPWM_TEST_REQ	O	0... 1H	0 ...1	1	-
Electrical fuel pump actuator test active					
LV_ENG_OFF_N_CON	O	0... 1H	0 ...1	1	-
Logical value engine stop mode active					
LV_ERR_RLY_VCV	O	0... 1H	0 ...1	1	-
Boolean for error currently present on RLY_VCV command signal					
LV_FUP_EFP_SP_EXT_REQ	O	0... 1H	0 ...1	1	-
External request of fuel pressure setpoint (low pressure)					
LV_FUP_LIH_REQ	O	0... 1H	0 ...1	1	-
Limp home mode for HPP requested					
LV_LAM_STOP_AE	O	0... 1H	0 ...1	1	-
stop-flag for lambda controller					
LV_PIN_ICH	O	0... 1H	0 ...1	1	-
Independent car heater request for electrical fuel pump					
LV_PWL	O	0... 1H	0 ...1	1	-
The power-latch phase has started					
LV_VCV_RLY	O	0... 1H	0 ...1	1	-
Flag for controlling the volume control valve relay					
MFF_SP_HOM_MV	O	0... FFFFH	0... 1389	0.02119478	mg/stk
Mass fuel flow setpoint for homogeneous mode, mean value					
NR_CYL_VVL_H_ACT	O	0... 8H	0 ...8	1	-
Number of active cylinder for high mode					
STATE_MPLH_MOD	O	0H 1H 2H 3H	MPLH_OFF MPLH_CH MPLH_OPP MPLH_OHP	-	-
State of the multiple injection in hom. mode					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VFF_EFP	O/V	0... FFH	0... 255	1	l/h
Required amount of fuel					

**Input data:**

EFPPWM {p. 3796}	LV_ERR_RLY_MAIN {p. 4933}	LV_PWL_ACT {p. 3776}	LV_RLY_MAIN {p. 3772}
MFF_SP_FUP_CTL {p. 2151}	NC_IDX_DIAG_H_PRS_ SYS_PRE	VFF_EFP_REQ {p. 3797}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_IDX_TRIM	V	0... FFH	0... 255	1	-
Index defining the trim procedure used to trim VCV and PBK_IV					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_DIAG_H_PRS_SYS	O	0... FFFFH	0... 65535	1	-
ERRM diagnosis identifier of high pressure system					
NC_NR_MFF_SP_FUP_SP	O	0... 1FH	1... 32	1	-
Number of mass fuel flow datapoints for FUP_SP					
NC_NR_N_FUP_SP	O	0... 1FH	1... 32	1	-
Number of engine speed datapoints for FUP_SP					

**General information****3.9.1 Outputs for SV aggregates, SV internally****General information:**

Adaptation to aggregate environment.

**Application conditions:**

**Initialisation:** at reset: NC\_IDX\_DIAG\_H\_PRS\_SYS = NC\_IDX\_DIAG\_H\_PRS\_SYS\_PRE

```
VFF_EFP      = VFF_EFP_REQ
               MIN (VFF_EFP, FEH)
EFPPWM_CAN  = EFPPWM
               MIN (EFPPWM_CAN, FEH)
FUP_AD      = 0
```

**Activation:** every engine operating state

**Deactivation:** never

**Recurrence:** If LV\_ST\_END == 1  
then the recurrency is every segment

If LV\_ST\_END == 0  
then the recurrency is every 10 ms

**Function description:****Formula section:**

```
VFF_EFP      = VFF_EFP_REQ
              MIN (VFF_EFP, FEH)
EFPPWM_CAN  = EFPPWM
              MIN (EFPPWM_CAN, FEH)
FUP_AD      = 0
```

**3.9.2 Miscellaneous****General information:**

```
NC_NR_N_FUP_SP    = 8
NC_NR_MFF_SP_FUP_SP = 10
```

**Application conditions:****Initialisation:**

```
at reset:
LV_ENG_OFF_N_CON      = 0
LV_PIN_ICH            = 0
LV_ACR_EFPPWM_TEST_REQ = 0
LV_FUP_EFP_SP_EXT_REQ = 0
LV_FUP_LIH_REQ        = 0
FUP_RES_H_SP_CH       = 0
MFF_SP_HOM_MV         = MFF_SP_FUP_CTL
STATE_MPLH_MOD        = 0
FUP_RNG_H_SP_CH       = 0
FUP_RNG_H_SP_OHP      = 0
NR_CYL_VVL_H_ACT      = 0
LV_PWL                 = LV_PWL_ACT
LV_LAM_STOP_AE        = 0
LV_ERR_RLY_VCV        = LV_ERR_RLY_MAIN
LV_VCV_RLY             = LV_RLY_MAIN
```

**Activation:** every engine operating state

**Deactivation:** never

**Recurrence:** 100 ms

**Function description:****Formula section:**

```
LV_PWL          = LV_PWL_ACT
LV_ERR_RLY_VCV  = LV_ERR_RLY_MAIN
LV_VCV_RLY      = LV_RLY_MAIN
MFF_SP_HOM_MV   = MFF_SP_FUP_CTL
```

## 3.10 AGGR adaptation: NOXD

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_NS [NC_NOX_SENS_CONF]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda value, measured by NOx-Sensor					
LAMB_NS_DIAG [NC_NOX_SENS_CONF]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda value for diagnosis functions, measured by NOx-Sensor					
LV_ERR_NOX_SENS_CAN_BOFF	O/V	0... 1H	0 ...1	1	-
CAN bus, at which the NOx sensor is connected, has the state "busoff"					
LV_ERR_NS_CAN_BOFF	O/V	0... 1H	0 ...1	1	-
CAN bus, at which the NOx sensor is connected, has the state "busoff"					
LV_ERR_NS_CAN_MSG_LOST [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor CAN message lost failure is present					
LV_LAMB_NS_AUTH [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the Lambda signal has be reached the valid state after start					
LV_LAMB_NS_DIAG_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the Lambda signal is valid for use into the diagnosis functions					
LV_LAMB_NS_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the Lambda signal is valid					
LV_NOX_NS_AUTH [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the NOx signal has reached the valid state after the start					
LV_NOX_NS_DIAG_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the NOx signal is valid for use into the diagnosis functions					
LV_NOX_NS_MDL_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the NOx signal is valid for use. The state "valid" is debounced present.					
LV_NOX_NS_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the NOx signal is valid					
LV_TEMP_MIN_THD_CAN [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Dew point recognition for NOx-Sensor					
LV_TEMP_NS_OK [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor CAN message: temperature is OK					
LV_VB_NS_OK [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor CAN message: power supply voltage is OK					
LV_VLS_NS_AUTH [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the binary O2 signal has be reached the valid state after start					
LV_VLS_NS_DIAG_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the binary O2 signal is valid for use into the diagnosis functions					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_VLS_NS_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the binary O2 signal is valid					
NOX_NS [NC_NOX_SENS_CONF]	O/V	FF9C... 05DCH	-100 ...1500	1	ppm
NOx concentration value, measured by NOx-Sensor					
NOX_NS_DIAG [NC_NOX_SENS_CONF]	O/V	FF9C... 05DCH	-100 ...1500	1	ppm
NOx concentration value for diagnosis functions, measured by NOx sensor					
T_LAMB_NS_HLD [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 655.35	0.01	s
Timer for hold of last valid Lambda signal value					
T_NOX_NS_HLD [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 655.35	0.01	s
Timer for hold of last valid NOx signal value					
T_NOX_NS_MDL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 655.35	0.01	s
Timer for debounce of signal state "valid" after re-entry into state "valid"					
T_NOX_NS_MDL [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 655.35	0.01	s
Timer for debounce of signal state "valid" after re-entry into state "valid"					
T_TEMP_NS [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 655.35	0.01	s
Timer for debounce of NOx sensor temperature readiness					
T_VLS_NS_HLD [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 655.35	0.01	s
Timer for hold of last valid binary O2 signal value					
VLS_NS [NC_NOX_SENS_CONF]	O/V	0... 578H	-200 ...1200	1	mV
Binary O2 signal voltage for diagnosis functions, raw value, measured by NOx-Sensor					
VLS_NS_DIAG [NC_NOX_SENS_CONF]	O/V	0... 578H	-200 ...1200	1	mV
Binary O2 signal voltage for diagnosis functions, raw value, measured by NOx-Sensor					

**Input data:**

LAMB_NOX_SENS [NC_NOX_SENS_CONF] {p. 1380}	LAMB_NOX_SENS_DIAG [NC_NOX_SENS_CONF] {p. 1380}	LV_CAN_TEMP_MIN_THD [NC_NOX_SENS_CONF] {p. 1399}	LV_ERR_LOCAN_BOFF {p. 4846}
LV_ERR_TOUT_NOX_SENS [i] {p. 4855}	LV_NOX_SENS_LAMB_AUTH [NC_NOX_SENS_CONF] {p. 1380}	LV_NOX_SENS_LAMB_DIAG_VLD [NC_NOX_SENS_CONF] {p. 1380}	LV_NOX_SENS_LAMB_VLD [NC_NOX_SENS_CONF] {p. 1380}
LV_NOX_SENS_NOX_AUTH [NC_NOX_SENS_CONF] {p. 1380}	LV_NOX_SENS_NOX_DIAG_VLD [NC_NOX_SENS_CONF] {p. 1380}	LV_NOX_SENS_NOX_MDL_VLD [NC_NOX_SENS_CONF] {p. 1380}	LV_NOX_SENS_NOX_VLD [NC_NOX_SENS_CONF] {p. 1380}
LV_NOX_SENS_VLS_AUTH [NC_NOX_SENS_CONF] {p. 1380}	LV_NOX_SENS_VLS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 1380}	LV_NOX_SENS_VLS_VLD [NC_NOX_SENS_CONF] {p. 1381}	NC_NOX_SENS_CONF {p. 643}
NOX_NOX_SENS [NC_NOX_SENS_CONF] {p. 1381}	NOX_NOX_SENS_DIAG [NC_NOX_SENS_CONF] {p. 1381}	NOX_SENS_TEMP [NC_NOX_SENS_CONF] {p. 1381}	T_NOX_SENS_LAMB_HLD [NC_NOX_SENS_CONF] {p. 1381}
T_NOX_SENS_NOX_HLD [NC_NOX_SENS_CONF] {p. 1381}	T_NOX_SENS_NOX_MDL [NC_NOX_SENS_CONF] {p. 1382}	T_NOX_SENS_VLS_HLD [NC_NOX_SENS_CONF] {p. 1382}	VLS_NOX_SENS [NC_NOX_SENS_CONF] {p. 1382}
VLS_NOX_SENS_DIAG [NC_NOX_SENS_CONF] {p. 1382}			



**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_TEMP_NS	-	0... FFFFH	0... 655.35	0.01	s
Minimum time of sensor temperature readiness to set LV_TEMP_NS_OK[i]					

**FUNCTION DESCRIPTION:**

**General information:**

This module handles all variable interfaces of aggregate NOXD. It adapts inputs to aggregate NOXD and outputs from aggregate NOXD on project specific requirements or aggregate structure requirements.

**3.10.1 Inputs to aggregate NOXD - 10ms (fast variable assignments)**

**Application conditions**

**Initialisation:** at reset:  
 LV\_ERR\_NOX\_SENS\_CAN\_BOFF = 0  
 LV\_ERR\_NS\_CAN\_BOFF = 0  
 LV\_ERR\_NS\_CAN\_MSG\_LOST[i] = 0

**Recurrence:** 10ms

**Activation:** after reset

**Deactivation:** -

**Formula section:**

LV\_ERR\_NS\_CAN\_BOFF = LV\_ERR\_LOCAN\_BOFF  
 LV\_ERR\_NS\_CAN\_MSG\_LOST[i] = LV\_ERR\_TOUT\_NOX\_SENS[i]  
 LV\_ERR\_NOX\_SENS\_CAN\_BOFF = LV\_ERR\_LOCAN\_BOFF

**3.10.2 Outputs of aggregate NOXD - 10ms**

**Application conditions**

**Initialisation:** at reset:

```

LV_TEMP_NS_OK[i] = 0
LV_VB_NS_OK[i] = 0
LV_NOX_NS_AUTH[i] = 0
LV_TEMP_MIN_THD_CAN[i] = 0
LV_VLS_NS_DIAG_VLD[i] = 0
LV_LAMB_NS_DIAG_VLD[i] = 0
LV_LAMB_NS_VLD[i] = 0
LV_VLS_NS_VLD[i] = 0
NOX_NS[i] = 0
NOX_NS_DIAG[i] = 0
LAMB_NS[i] = 0
    
```

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```

VLS_NS[i] = 0
LV_NOX_NS_VLD[i] = 0
LAMB_NS_DIAG[i] = 0
T_LAMB_NS_HLD[i] = 0
T_NOX_NS_HLD[i] = 0
VLS_NS_DIAG[i] = 0
T_VLS_NS_HLD[i] = 0
LV_NOX_NS_DIAG_VLD[i] = 0
LV_NOX_NS_MDL_VLD[i] = 0
T_TEMP_NS[i] = 0
LV_LAMB_NS_AUTH[i] = 0
LV_VLS_NS_AUTH[i] = 0
T_NOX_NS_MDL[i] = 0

```

**Recurrence:** 10ms  
**Activation:** after reset  
**Deactivation:** -

### Formula section:

```
LV_TEMP_MIN_THD_CAN[i] = LV_CAN_TEMP_MIN_THD[i]
```

```

if      bit0( NOX_SENS_TEMP[i] ) = 1
then    if      T_TEMP_NS[i] >= C_T_TEMP_NS
        then    LV_TEMP_NS_OK[i] = 1
        else    LV_TEMP_NS_OK[i] = 0
        increment T_TEMP_NS[i]
    endif
else    LV_TEMP_NS_OK[i] = 0
        T_TEMP_NS[i] = 0
endif

```

```
LV_VB_NS_OK[i] = bit1( NOX_SENS_TEMP[i] )
```

```

NOX_NS[i] = NOX_NOX_SENS[i]
NOX_NS_DIAG[i] = NOX_NOX_SENS_DIAG[i]
T_NOX_NS_HLD[i] = T_NOX_SENS_NOX_HLD[i]
LV_NOX_NS_VLD[i] = LV_NOX_SENS_NOX_VLD[i]
LV_NOX_NS_DIAG_VLD[i] = LV_NOX_SENS_NOX_DIAG_VLD[i]
LV_NOX_NS_AUTH[i] = LV_NOX_SENS_NOX_AUTH[i]
T_NOX_NS_MDL[i] = T_NOX_SENS_NOX_MDL[i]

```

```


LAMB_NS[i] = LAMB_NOX_SENS[i]
LAMB_NS_DIAG[i] = LAMB_NOX_SENS_DIAG[i]
T_LAMB_NS_HLD[i] = T_NOX_SENS_LAMB_HLD[i]
LV_LAMB_NS_VLD[i] = LV_NOX_SENS_LAMB_VLD[i]
LV_LAMB_NS_DIAG_VLD[i] = LV_NOX_SENS_LAMB_DIAG_VLD[i]
LV_LAMB_NS_AUTH[i] = LV_NOX_SENS_LAMB_AUTH[i]

```

```

VLS_NS[i] = VLS_NOX_SENS[i]
VLS_NS_DIAG[i] = VLS_NOX_SENS_DIAG[i]
T_VLS_NS_HLD[i] = T_NOX_SENS_VLS_HLD[i]
LV_VLS_NS_VLD[i] = LV_NOX_SENS_VLS_VLD[i]


```

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LV\_VLS\_NS\_DIAG\_VLD[i] = LV\_NOX\_SENS\_VLS\_DIAG\_VLD[i]

LV\_VLS\_NS\_AUTH[i] = LV\_NOX\_SENS\_VLS\_AUTH[i]

LV\_NOX\_NS\_MDL\_VLD[i] = LV\_NOX\_SENS\_NOX\_MDL\_VLD[i]

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
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## 3.11 AGGR adaptation: NOXM

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CLU_SWI	O/V	0... 1H	0 ...1	1	-
Boolean for clutch switch detection					
LV_INH_NOX_MDL_CTRL_RGN	O/V	0... 1H	0 ...1	1	-
Prohibition of regeneration by controller controlled NOx-Signal					
LV_INH_NT_RGN_REQ	O/V	0... 1H	0 ...1	1	-
flag inhibiting the request of a NOx catalyst regeneration					
LV_INH_RGN_AD	O/V	0... 1H	0 ...1	1	-
flag inhibiting a regeneration request by NOx-Sensor or loading degree model					
LV_NOX_AD_CMPL	O/V	0... 1H	0 ...1	1	-
Logical value for active NOx emission adaptation					
LV_NT_AD_CMPL	O/V	0... 1H	0 ...1	1	-
flag for communication with NOx catalyst aging module indicating a successful adaptation cycle					
LV_NT_AD_VLD	O/V	0... 1H	0 ...1	1	-
flag indicating that the evaluation of the adaption values is allowed					
LV_NT_MDL_AFR	O/V	0... 1H	0 ...1	1	-
Model rich exhaust gas (stop of regeneration)					
LV_NT_O2_STC_ACT	O/V	0... 1H	0 ...1	1	-
flag for active O2_STC measurement					
LV_NT_RGN_REQ	O/V	0... 1H	0 ...1	1	-
Logical value for regeneration phase request					
LV_NT_RGN_REQ_AD	O/V	0... 1H	0 ...1	1	-
Request for a full regeneration for adaptation or elongated stratified mode					
LV_NT_RGN_STOP_SENS	O/V	0... 1H	0 ...1	1	-
Flag indicating: Stop of Rgn by sensor enabled					
LV_NT_SENS_AFR [NC_NT_NR]	O/V	0... 1H	0 ...1	1	-
downstream sensor measures rich exhaust gas (stop of regeneration)					
LV_NT_STC_MAX_AFL_ACT	O/V	0... 1H	0 ...1	1	-
flag for active lean phase of full saturation					
LV_NT_TOUT_AFR	O/V	0... 1H	0 ...1	1	-
rich exhaust gas after timeout (stop of regeneration)					
LV_RGN_REQ_AD	O/V	0... 1H	0 ...1	1	-
Request for a full regeneration for adaptation or elongated stratified mode					
NOX_AD_FAC	O/V	0... FFH	0... 1.99218	0.0078125	-
NOx emission adaptation factor					
NTL_DEC_INT_AD	O/V	0... FFFFH	0... 10485.6	0.16	mg
RAI signal during adaptation (sum of both benches)					
NTLD_MDL_DIF	O/V	8000... 7FFFH	-0.5... 0.49998	15.3e-6	-
Correction of the closed loop control NOx catalyst model					

### Input data:

LV_AT {p. 654}	LV_IM_CS_PN {p. 852}	LV_INH_RGN_REQ {p. 3053}	LV_MDL_AFR {p. 2982}
LV_NT_RGN_REQ_AD {p. 996}	LV_RGN_NT_REQ {p. 2983}	LV_RGN_STOP_SENS {p. 2983}	LV_SENS_AFR [NC_NT_NR] {p. 2983}

LV_TOUT_AFR {p. 2983}	LV_VAR_TCT {p. 656}	NC_NT_NR {p. 644}	
-----------------------	---------------------	-------------------	--

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_NOX_MDL_CTRL_ACT	-	0... 1H	0 ...1	1	-
Switch to activate closed loop control for the NOx-Catalyst model					
LC_NOX_RGN_CMPL	-	0... 1H	0 ...1	1	-
Switch whether regenerations are "completely" or not					

**FUNCTION DESCRIPTION:****General information:**

This module handles all variable interfaces of aggregate NOXM. It adapts inputs to aggregate NOXM and outputs from aggregate NOXM on project specific requirements or aggregate structure requirements.

**3.11.1 Inputs to aggregate NOXM - 20ms****Application conditions**

**Initialisation:** at reset:  
LV\_CLU\_SWI = 0

**Recurrence:** 20ms

**Activation:** after reset

**Deactivation:** -

**Formula section:**

$LV\_CLU\_SWI = (LV\_IM\_CS\_PN = 1) \text{ AND } (LV\_AT = 0) \text{ AND } (LV\_VAR\_TCT = 0)$


**3.11.2 Outputs of aggregate NOXM - 20ms****Application conditions**

**Initialisation:** at reset:  
LV\_INH\_NT\_RGN\_REQ = 0  
LV\_RGN\_REQ\_AD = 0  
LV\_NT\_MDL\_AFR = 0  
LV\_NT\_RGN\_STOP\_SENS = 0  
LV\_NT\_SENS\_AFR[i] = 0  
LV\_NT\_TOUT\_AFR = 0  
LV\_NT\_RGN\_REQ = 0

**Recurrence:** 20ms

**Activation:** after reset

**Deactivation:** -

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**Formula section:**

LV\_INH\_NT\_RGN\_REQ = LV\_INH\_RGN\_REQ  
 LV\_RGN\_REQ\_AD = LV\_NT\_RGN\_REQ\_AD  
 LV\_NT\_MDL\_AFR = LV\_MDL\_AFR  
 LV\_NT\_RGN\_STOP\_SENS = LV\_RGN\_STOP\_SENS  
 LV\_NT\_SENS\_AFR[i] = LV\_SENS\_AFR[i]  
 LV\_NT\_TOUT\_AFR = LV\_TOUT\_AFR  
 LV\_NT\_RGN\_REQ = LV\_RGN\_NT\_REQ

**3.11.3 Non implemented functions**

*Initialisation:* at reset:  
*NOx Catalyst model controller (02706I01.00D)*

NTLD\_MDL\_DIF = 0  
 LV\_INH\_NOX\_MDL\_CTRL\_RGN = 0

*NOX Engine out Emission Adaptation (02705V01.00J)*

NOX\_AD\_FAC = 1  
 LV\_NOX\_AD\_CMPL = 0

*NOx catalyst management - auxiliary functionalities (02704F03.00D)*


LV\_INH\_RGN\_AD = 0  
 LV\_NT\_RGN\_REQ\_AD = 0  
 LV\_NT\_STC\_MAX\_AFL\_ACT = 0  
 LV\_NT\_O2\_STC\_ACT = 0  
 LV\_NT\_AD\_VLD = 0  
 LV\_NT\_AD\_CMPL = 0  
 NTL\_DEC\_INT\_AD = 0

*Recurrence:* -

*Activation:* -

*Deactivation:* -

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## 3.12 AGGR adaptation: CYBL

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAM_CYL_SEL_ADJ_OFS_EXT_REQ	O/V	0... 1H	0 ...1	1	-
External request for calculation of cylinder individual lambda adaptation in the additive area					
TI_ADD [NC_CYL_NR]	O/V	8000... 7FFFH	-32.768 ...32.767	0.001	ms
Total additive correction value for cylinder balancing					
TI_FAC [NC_CYL_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
injection time correction due to external demand (interface for INJR AGGR)					

### Input data:

CRK_CYL_LAM [NC_CYL_NR] {p. 2730}	FAC_TI_BAL [NC_CYL_NR] {p. 3215}	LV_LAM_CYL_ENA [NC_CBK_EX_NR] {p. 2864}	NC_CBK_EX_NR {p. 1829}
NC_CYL_NR {p. 1526}			

### Application conditions:

#### Initialization at Reset:

LV\_LAM\_CYL\_SEL\_ADJ\_OFS\_EXT\_REQ = 0

```

FOR m = 0 to NC_CYL_NR - 1
    TI_ADD[m] = 0
    TI_FAC[m] = 1
END FOR

```

Recurrence: every TDC

Activation: every engine state

Deactivation: -

### Formula section:

```

FOR m = 0 to NC_CYL_NR - 1
    TI_FAC[m] = FAC_TI_BAL[m]
END FOR

```

## 3.13 AGGR adaptation: EVAC

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CLOSE_ACT_CP	O/V	0... 1H	0 ...1	1	-
Logical value for CPS valve closed					

### Input data:

LV_CP_CLOSE_ACT {p. 3749}			
------------------------------	--	--	--

### FUNCTION DESCRIPTION:

Adaptation to aggregate environment.

### Application conditions

**Initialisation:** at reset:  
                   LV\_CLOSE\_ACT\_CP = LV\_CP\_CLOSE\_ACT from  
                   NVMY

**Recurrence:** 20ms

**Activation:** at every engine state

**Deactivation:** -

### Formula section:

LV\_CLOSE\_ACT\_CP = LV\_CP\_CLOSE\_ACT




## 3.14 AGGR adaptation: EVAM

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CL_MMV_NORM_PURGE_END	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Canister load at the end of MAX_PURGE operation					
FLOW_SP_CPS_EVAP	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Flow setpoint through the CPS during functional check CPS (interface to EVAC AGGR)					
LV_CL_CALC_AVL	O/V	0... 1H	0 ...1	1	-
interface flag to cat.diag.: cl known					
LV_CL_MMV	O/V	0... 1H	0 ...1	1	-
Interface flag to functional check cps					
LV_CL_MMV_TMP	V	0... 1H	0 ...1	1	-
Intermediate value for interface flag to functional check cps					
LV_CP_NEW_RAMP_OPEN_MEM	O/V	0... 1H	0 ...1	1	-
locally memorised version of LV_CP_NEW_RAMP_OPEN					
LV_DIAGCP_CPS_ACT	O/V	0... 1H	0 ...1	1	-
Flag indicating FLOW_SP_CPS_EVAP is controlled by EVAM					
LV_ERR_CPS	O/V	0... 1H	0 ...1	1	-
Flag indicating failure on canister purge valve					
LV_ERR_EL_SOV	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on canister shut off valve command signal.					
LV_ERR_MEC_CLOSE_SOV	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present due to canister shut off valve stuck in closed position					
LV_ERR_MEC_OPEN_CPS	O/V	0... 1H	0 ...1	1	-
Boolean for CPS stuck in open position (after debounce)					
LV_FAC_LAM_DIAGCP	O/V	0... 1H	0 ...1	1	-
flag for lambda control to set initialize controller output					
LV_T_DLY_CL_MMV_READY	O/V	0... 1H	0 ...1	1	-
Flag when the first transition Wait Ramp Open to Ramp Open occurs					
LV_TLDV_REQ	O/V	0... 1H	0 ...1	1	-
Flag indicating the activation requirement for the diagnosis (1)					
STATE_CP_MEM_AD	O/V	0H	CP_NOT_ACT	-	-
		1H	NO_PURGE		
		2H	RAMP_TO_NO_PURGE		
		3H	WAIT_RAMP_OPEN		
		4H	MIN_PURGE		
		5H	-		
		6H	-		
		7H	-		
		8H	RAMP_OPEN		
		9H	RAMP_OPEN_FAST		
AH	MAX_PURGE				
BH	RAMP_CLOSE				
Locally memorised version of STATE_CP					
T_DLY_CL_MMV	V	0... FFFFH	0... 1310.7	0.02	s
Delay time for setting LV_CL_MMV 0 -> 1					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_DLY_CL_MMV_READY	V	0... FFFFH	0... 1310.7	0.02	s
Delay time after which TEV check starts once Ramp_open has been started					
T_DLY_PURGE_DIAGCPS	O/V	0... FFFFH	0... 1310.7	0.02	s
Delay time for activating DIAGCPS-diagnosis (step 2) after LV_CL_MMV 0 -> 1					

**Input data:**

CL_MMV_CLC_END {p. 3635}	FLOW_SP_CP_DIAGCPS {p. 5926}	LV_ACT_DIAGCPS {p. 5926}	LV_CL_CLC_AVL {p. 3635}
LV_CL_MMV_CAL_ACT {p. 3699}	LV_CP_CLOSE_ACT {p. 3749}	LV_CP_NEW_RAMP_ OPEN {p. 3699}	LV_ERR_EL_CPS {p. 4708}
LV_ES {p. 1720}	LV_IGK {p. 906}	STATE_CLL_DEAC_CP {p. 3637}	STATE_CP {p. 3637}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DLY_CL_MMV	-	0... FFFFH	0... 1310.7	0.02	s
Delay time for setting LV_CL_MMV 0 -> 1					
C_T_DLY_CL_MMV_READY	-	0... FFFFH	0... 1310.7	0.02	s
Delay time after which TEV check starts once Ramp_open has been started					
C_T_DLY_PURGE_DIAGCPS	-	0... FFFFH	0... 1310.7	0.02	s
Delay time for activating DIAGCPS-diagnosis (step 2) after LV_CL_MMV 0 -> 1					

### 3.14.1 Interface from/to TEV-check, leak detection and other supplier internal functions

**FUNCTION DESCRIPTION:**

Adaptation to (non-aggregate) TEV-check and leak detection.

**Application conditions****Initialisation:**

```

at reset or LV_IGK = 0 -> 1
  CL_MMV_NORM_PURGE_END      = 0
  LV_CL_MMV                  = 0
  T_DLY_PURGE_DIAGCPS        = C_T_DLY_PURGE_DIAGCPS
T_DLY_CL_MMV                 = C_T_DLY_CL_MMV
  LV_DIAGCP_CPS_ACT          = 0
  LV_ERR_CPS                  = 0
  LV_ERR_MEC_OPEN_CPS        = 0
  FLOW_SP_CPS_EVAP           = FLOW_SP_CP_DIAGCPS
  LV_FAC_LAM_DIAGCP          = 0
  LV_ERR_EL_SOV              = 0
  LV_TLDV_REQ                 = 0
  T_DLY_CL_MMV_READY         = C_T_DLY_CL_MMV_READY
T_DLY_CL_MMV_READY = 0
  LV_CL_MMV_TMP               = 0
  LV_ERR_MEC_CLOSE_SOV       = 0
at reset or LV_ES = 0 -> 1:
  LV_DIAGCP_CPS_ACT          = 0
  LV_TLDV_REQ                 = 0
  all other values            = 0

```

LV\_

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**Recurrence :** 20 ms  
**Activation:** every ECU state  
**Deactivation:** - -

**Formula section:**

```
// interface to leak detection
If LV_ES = 0
Then CL_MMV_NORM_PURGE_END = CL_MMV_CLC_END
Else --
Endif

// interface to functional check cps
If (1) STATE_CP_MEM_AD = WAIT_RAMP_OPEN and
STATE_CP = RAMP_OPEN
Then(1) LV_CL_MMV_TMP = 0 /* reset interface flag */
T_DLY_PURGE_DIAGCPS = C_T_DLY_PURGE_DIAGCPS
T_DLY_CL_MMV = C_T_DLY_CL_MMV
LV_T_DLY_CL_MMV_READY = 1
Else(1)
If(2) STATE_CP_MEM_AD = RAMP_OPEN and
STATE_CP RAMP_OPEN and
STATE_CLL_DEAC_CP = CP_NO_DEAC and
LV_CP_NEW_RAMP_OPEN_MEM = 0
Then (2) T_DLY_CL_MMV = C_T_DLY_CL_MMV
Else(2)
If(3) LV_CL_MMV_CAL_ACT = 1 and
STATE_CP = MAX_PURGE
Then(3) T_DLY_CL_MMV -- /*decrement counter
If(4) T_DLY_CL_MMV > 0
Then(4) LV_CL_MMV_TMP = 0
Else(4) LV_CL_MMV_TMP = 1/* set temporary interface flag when
RAMP_OPEN inished and time delay elapsed*
dif (4)
Else(3)
If(5) T_DLY_CL_MMV = 0 and
STATE_CP = MAX_PURGE
Then(5) LV_CL_MMV_TMP = 1
Endif(5)
Endif(3)
Endif(2)
Endif
--
If LV_T_DLY_CL_MMV_READY = 1
Then T_DLY_CL_MMV_READY -- /*decrement counter
Endif
--
If(1) LV_CL_MMV_TMP = 1
Then(1)
If(2) T_DLY_CL_MMV_READY = 0
Then(2) LV_CL_MMV =1
```

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```

                Else(2)      LV_CL_MMV =0
                Endif(2)
Else(1)      LV_CL_MMV =0
Endif(1)

- - -
If          LV_CL_MMV = 1          and
           STATE_CP = MAX_PURGE
Then       T_DLY_PURGE_DIAGCPS --      /*decrement counter
Endif

```

```

// memorisation of relevant variables for next recurrence
STATE_CP_MEM_AD = STATE_CP
LV_CP_NEW_RAMP_OPEN_MEM = LV_CP_NEW_RAMP_OPEN

```

#### calibration hint:

The RAMP\_OPEN interruption time C\_T\_DI\_RAMP\_OPEN\_CP should be set to minimum 40ms to prevent a wrong setting of LV\_CL\_MMV at short RAMP\_OPEN interruption.

```


FLOW_SP_CPS_EVAP      = FLOW_SP_CP_DIAGCPS
LV_ERR_CPS            = LV_ERR_EL_CPS
LV_CL_CALC_AVL       = LV_CL_CLC_AVL

```

```

If          LV_ACT_DIAGCPS = 1 or
           (LV_ACT_DIAGCPSn-1 = 1 and LV_ACT_DIAGCPSn = 0)
Then       LV_DIAGCP_CPS_ACT = 1
Else       LV_DIAGCP_CPS_ACT = 0
Endif

```

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## 3.15 AGGR adaptation: IGRE

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA_AV [NC_CYL_NR]	O/V	0... FFH	-35.625 ...60	0.375	°CRK
Ignition Angle Applied on CYL					
IGA_AV_MV	O/V	0... FFH	-35.625 ...60	0.375	°CRK
Mean value of actual ignition angle					
IGA_IGC [NC_CYL_NR]	O/V	0... FFH	-35.625 ...60	0.375	°CRK
Applied Ignition angle					

### Input data:

IGA_AV_MV_H_RNG {p. 1828}	IGA_IGC_H_RNG [NC_CYL_NR] {p. 1876}	LV_ERR_IGC_SCG [NC_CYL_NR] {p. 4772}	LV_ERR_IGC_SCP [NC_CYL_NR] {p. 4773}
------------------------------	--	---	---

### 3.15.1 Reset of New Ignition Angle Range to old in Integration process

#### Information:

Function is applied for Integration of IGRE3.0.0 to keep variables in old ignition angle range. With update to IGRE3.1.0, only new variables will be used. This, except in a few modules that will not be touched due to affection of different projects

#### Formula section:

IGA\_AV\_MV = IGA\_AV\_MV\_H\_RNG

IGA\_IGC[NC\_CYL\_NR] = IGA\_IGC\_H\_RNG[NC\_CYL\_NR]

IGA\_AV[NC\_CYL\_NR] = IGA\_IGC[NC\_CYL\_NR]

## 3.16 AGGR adaptation: EGCP

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Bitmask of Upstream Lambda Sensor errors					
ERR_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Bit word for bank selective calculation of deactivation of lambda adaptation due to upstream oxygen sensor error.					
FAC_DYN_LSL_DIAG_SAE [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	-
Mode6 output of diagnostic result. Either from Dynamic diag or from Dynamic diag after NOx cat regeneration					
FAC_DYN_LSL_DIAG_TOL_SAE [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	-
Mode6 Output : Maximum test limit. Either from Dynamic diag (homogen) or Dynamic diag after Nox-Cat regeneration.					
LAMB_1	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda signal value of the WRAF sensor of exhaust bank 1					
LAMB_2	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda signal value of the WRAF sensor of exhaust bank 2					
LAMB_MIN	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Minimum lambda in multiple-branched exhaust gas lines					
LAMB_MV	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Mean value of lambda in multiple-branched exhaust gas lines					
LAMB_SP_1	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda set point of exhaust gas line - Bk1					
LAMB_SP_2	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda set point of exhaust gas line Bk2					
LAMB_SP_BEG_LS_ACT_TEST_1	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Initial value of lambda set point of exhaust bank 1					
LAMB_SP_BEG_LS_ACT_TEST_2	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Initial value of lambda set point of exhaust bank 2					
LAMB_SP_LS_ACT_TEST [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda set point for active plausibility test					
LV_DOWN_LS_1	O/V	0... 1H	0 ...1	1	-
Logical variable for operative readiness of downstream oxygen sensor bank 1					
LV_DOWN_LS_2	O/V	0... 1H	0 ...1	1	-
Logical variable for operative readiness of downstream oxygen sensor bank 2					
LV_ERR_LS_DOWN_1	O/V	0... 1H	0 ...1	1	-
Final diagnostic of the downstream oxygen sensor Bk1					
LV_ERR_LS_DOWN_2	O/V	0... 1H	0 ...1	1	-
Final diagnostic of the downstream oxygen sensor Bk2					
LV_ERR_LS_UP_1	O/V	0... 1H	0 ...1	1	-
Final diagnostic of the upstream oxygen sensor Bk1					
LV_ERR_LS_UP_2	O/V	0... 1H	0 ...1	1	-
Final diagnostic of the upstream oxygen sensor Bk2					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_LS_UP_DYN_VLD_1	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the validation of correspondent symptom (transmitted to the error management) Bk1					
LV_ERR_LS_UP_DYN_VLD_2	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the validation of correspondent symptom (transmitted to the error management) Bk2					
LV_ERR_LSH_DOWN_1	O/V	0... 1H	0 ...1	1	-
Error flag for downstream heater diagnosis OBD I after debouncing					
LV_ERR_LSH_DOWN_2	O/V	0... 1H	0 ...1	1	-
Error flag for downstream heater diagnosis OBD I after debouncing Bk2					
LV_ERR_LSH_UP_1	O/V	0... 1H	0 ...1	1	-
Error flag for upstream heater diagnosis OBD I after debouncing					
LV_ERR_LSH_UP_2	O/V	0... 1H	0 ...1	1	-
Error flag for upstream heater diagnosis OBD I after debouncing Bk2					
LV_ERR_OBD_LSH_DOWN_1	O/V	0... 1H	0 ...1	1	-
Lambda Sensor Heater Error in Bk1					
LV_ERR_OBD_LSH_DOWN_2	O/V	0... 1H	0 ...1	1	-
Lambda Sensor Heater Error in Bk2					
LV_ERR_VLS_DOWN_1	O/V	0... 1H	0 ...1	1	-
Lambda Sensor Electrical in Bk1					
LV_ERR_VLS_DOWN_2	O/V	0... 1H	0 ...1	1	-
Lambda Sensor Electrical Error in Bk2					
LV_INH_WIN_DET_DELTA_I_LAM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag to inhibit window calculation					
LV_LAMB_PULS_DYN_DIAG	O/V	0... 1H	0 ...1	1	-
Request forced stimulation parameters specific for the WRAF sensor dynamic					
LV_LSL_OFS_PULS_1	O/V	0... 1H	0 ...1	1	-
State of the offset measurement for lambda stimulation Bk1					
LV_LSL_OFS_PULS_2	O/V	0... 1H	0 ...1	1	-
State of the offset measurement for lambda stimulation Bk2					
LV_REQ_LAMB_SP_LS_ACT_TEST [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Lambda coordination request to change set point for active plausibility test					
LV_TEMP_DEW_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that dew point is passed at lambda sensor down catalyst					
LV_TEMP_DEW_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that dew point is passed at lambda sensor up catalyst					
LV_UP_LS_1	O/V	0... 1H	0 ...1	1	-
Logical variable for operative readiness of upstream oxygen sensor bank 1					
LV_UP_LS_2	O/V	0... 1H	0 ...1	1	-
Logical variable for operative readiness of upstream oxygen sensor bank 2					
TEG_DYN_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Exhaust gas temperatures at the lambda sensor downstream catalyst					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TEG_DYN_LS_UP [NC_CBK_EX_NR]	O/V	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Exhaust gas temperatures at the lambda sensor upstream catalyst					
VLS_DOWN_1	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Downstream sensor voltage measured Bk1					
VLS_DOWN_2	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Downstream sensor voltage measured Bk2					

**Input data:**

FAC_DYN_LSL_UP_DIAG_SAE [NC_CBK_EX_NR] {p. 5346}	FAC_DYN_LSL_UP_DIAG_TOL_SAE [NC_CBK_EX_NR] {p. 5346}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_LS_UP_MIN {p. 2313}
LAMB_LS_UP_MV {p. 2313}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LAMB_SP_BEG_DIAG_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5387}	LAMB_SP_DIAG_LS_UP_DOWN [NC_CBK_EX_NR] {p. 2437}
LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_CHG_LS_DOWN {p. 5388}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CHK_LS_DOWN [NC_CBK_EX_NR] {p. 5388}
LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_LS_DOWN [NC_CBK_EX_NR] {p. 4267}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_LS_DOWN [NC_CBK_EX_NR] {p. 5449}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}
LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5198}	LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}
LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}
LV_ERR_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5169}	LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}
LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SWT_LS_DOWN [NC_CBK_EX_NR] {p. 5152}	LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}
LV_LAMB_PLS_SWI_OFF [NC_CBK_EX_NR] {p. 2313}	LV_LAMB_SP_REQ_DIAG_ACT [NC_CBK_EX_NR] {p. 2437}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_LS_UP_READY [NC_CBK_EX_NR] {p. 2335}
LV_TEG_CAT_DOWN_MIN_THD [NC_CBK_EX_NR] {p. 2446}	LV_TEG_MIN_THD [NC_CBK_EX_NR] {p. 2446}	NC_CBK_EX_NR {p. 1829}	TEG_CAT_DOWN_MDL {p. 8236}



TEG_CAT_UP_MDL [i] {p. 8236}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}		
---------------------------------	-------------------------------------	--	--

### FUNCTION DESCRIPTION:

Adaptation to aggregate environment.

i = 1 ... NC\_CBK\_EX\_NR

### Application conditions


**Initialisation:** 0

**Recurrence :** same recurrence as corresponding input data

**Activation:** *every engine operating state*

### Formula section:

FAC_DYN_LSL_DIAG_SAE[i] =	FAC_DYN_LSL_UP_DIAG_SAE[i]	
FAC_DYN_LSL_DIAG_TOL_SAE[i] =	FAC_DYN_LSL_UP_DIAG_TOL_SAE[i]	
LAMB_1 =	LAMB_LS_UP[1]	
LAMB_2 =	LAMB_LS_UP[2]	
LAMB_MIN =	LAMB_LS_UP_MIN	
LAMB_MV =	LAMB_LS_UP_MV	
LAMB_SP_BEG_LS_ACT_TEST_1 =	LAMB_SP_BEG_DIAG_LS_UP_DOWN[1]	
LAMB_SP_BEG_LS_ACT_TEST_2 =	LAMB_SP_BEG_DIAG_LS_UP_DOWN[2]	
LV_LAMB_PULS_DYN_DIAG =	LV_LAMB_PLS_REQ_DYN_LSL_UP[1]	or
	LV_LAMB_PLS_REQ_DYN_LSL_UP[2]	
LV_UP_LS_1 =	LV_LS_UP_READY[1]	
LV_UP_LS_2 =	LV_LS_UP_READY[2]	
LV_ERR_LS_UP_1 =	LV_ERR_LS_UP[1]	
LV_ERR_LS_UP_2 =	LV_ERR_LS_UP[2]	
LV_ERR_LSH_UP_1 =	LV_ERR_LSH_UP[1]	
LV_ERR_LSH_UP_2 =	LV_ERR_LSH_UP[2]	
LV_ERR_LS_UP_DYN_VLD_1 =	LV_ERR_DYN_VLD_LS_UP[1]	
LV_ERR_LS_UP_DYN_VLD_2 =	LV_ERR_DYN_VLD_LS_UP[2]	
LAMB_SP_1 =	LAMB_SP[1]	
LAMB_SP_2 =	LAMB_SP[2]	
LV_DOWN_LS_1 =	LV_LS_DOWN_READY[1]	
LV_DOWN_LS_2 =	LV_LS_DOWN_READY[2]	
LV_ERR_LS_DOWN_1 =	LV_ERR_LS_DOWN[1]	
LV_ERR_LS_DOWN_2 =	LV_ERR_LS_DOWN[2]	
LV_ERR_LSH_DOWN_1 =	LV_ERR_LSH_DOWN[1]	
LV_ERR_LSH_DOWN_2 =	LV_ERR_LSH_DOWN[2]	
LV_ERR_OBD_LSH_DOWN_1 =	LV_ERR_OBD_LSH_DOWN[1]	
LV_ERR_OBD_LSH_DOWN_2 =	LV_ERR_OBD_LSH_DOWN[2]	
LV_ERR_VLS_DOWN_1 =	LV_ERR_EL_LS_DOWN[1]	
LV_ERR_VLS_DOWN_2 =	LV_ERR_EL_LS_DOWN[2]	
VLS_DOWN_1 =	VLS_DOWN[1]	
VLS_DOWN_2 =	VLS_DOWN[2]	
LV_REQ_LAMB_SP_LS_ACT_TEST[i] =	LV_LAMB_SP_REQ_DIAG_ACT[i]	
LAMB_SP_LS_ACT_TEST[i] =	LAMB_SP_DIAG_LS_UP_DOWN[i]	

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```

TEG_DYN_LS_UP[i] =          TEG_CAT_UP_MDL[i]
TEG_DYN_LS_DOWN[i] =      TEG_CAT_DOWN_MDL[i]
LV_TEMP_DEW_LS_UP[i] =    LV_TEG_MIN_THD[i]
LV_TEMP_DEW_LS_DOWN[i] =  LV_TEG_CAT_DOWN_MIN_THD[i]
LV_INH_WIN_DET_DELTA_I_LAM[i] = 0
LV_LSL_OFS_PULS_1 =      LV_LAMB_PLS_SWI_OFF[1]
LV_LSL_OFS_PULS_2 =      LV_LAMB_PLS_SWI_OFF[2]

```

### Calculation of EGCP- failure- bitmasks for QVM LACO

```

IF LV_ERR_AIR_LSL_UP[1] = 1      THEN Bit 0 of ERR_LS_UP[1] = 1
ELSE Bit 0 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_CHG_LS_UP = 1          THEN Bit 1 of ERR_LS_UP[1] = 1

ELSE Bit 1 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_CTL_LSL_UP[1] = 1      THEN Bit 2 of ERR_LS_UP[1] = 1

ELSE Bit 2 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_DELTA_I_LAM[1] = 1     THEN Bit 3 of ERR_LS_UP[1] = 1

ELSE Bit 3 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_DYN_VLD_LS_UP[1] = 1   THEN Bit 4 of ERR_LS_UP[1] = 1

ELSE Bit 4 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_EL_LSL_UP[1] = 1       THEN Bit 5 of ERR_LS_UP[1] = 1

ELSE Bit 5 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_LSH_UP[1] = 1         THEN Bit 6 of ERR_LS_UP[1] = 1

ELSE Bit 6 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_LSL_UP_IF[1] = 1      THEN Bit 7 of ERR_LS_UP[1] = 1

ELSE Bit 7 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_OBD_VLD_LSH_UP[1] = 1 THEN Bit 8 of ERR_LS_UP[1] = 1

ELSE Bit 8 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_OC_LSL_UP[1] = 1      THEN Bit 9 of ERR_LS_UP[1] = 1

ELSE Bit 9 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_OFS_LSL_UP[1] = 1     THEN Bit 10 of ERR_LS_UP[1] = 1


ELSE Bit 10 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_PUC_VLD_LS_UP[1] = 1  THEN Bit 11 of ERR_LS_UP[1] = 1

ELSE Bit 11 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_SHIFT_AFL_LSL_UP[1] = 1 THEN Bit 12 of ERR_LS_UP[1] = 1

ELSE Bit 12 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_SHIFT_AFR_LSL_UP[1] = 1 THEN Bit 13 of ERR_LS_UP[1] = 1

ELSE Bit 13 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_TTIP_MES_LSH_UP[1] = 1 THEN Bit 14 of ERR_LS_UP[1] = 1

```

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```
ELSE Bit 14 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_VLS_DOWN_DIF[1] = 1 THEN Bit 15 of ERR_LS_UP[1] = 1
ELSE Bit 15 of ERR_LS_UP[1] = 0 ENDIF
```

```
#IF NC_CBK_EX_NR = 2 THEN
IF LV_ERR_AIR_LSL_UP[2] = 1 THEN Bit 0 of ERR_LS_UP[2] = 1
ELSE Bit 0 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_CHG_LS_UP = 1 THEN Bit 1 of ERR_LS_UP[2] = 1
```

```
ELSE Bit 1 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_CTL_LSL_UP[2] = 1 THEN Bit 2 of ERR_LS_UP[2] = 1
```

```
ELSE Bit 2 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_DELTA_I_LAM[2] = 1 THEN Bit 3 of ERR_LS_UP[2] = 1
```

```
ELSE Bit 3 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_DYN_VLD_LS_UP[2] = 1 THEN Bit 4 of ERR_LS_UP[2] = 1
```

```
ELSE Bit 4 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_EL_LSL_UP[2] = 1 THEN Bit 5 of ERR_LS_UP[2] = 1
```

```
ELSE Bit 5 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_LSH_UP[2] = 1 THEN Bit 6 of ERR_LS_UP[2] = 1
```

```
ELSE Bit 6 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_LSL_UP_IF[2] = 1 THEN Bit 7 of ERR_LS_UP[2] = 1
```

```
ELSE Bit 7 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_OBD_VLD_LSH_UP[2] = 1 THEN Bit 8 of ERR_LS_UP[2] = 1
```

```
ELSE Bit 8 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_OC_LSL_UP[2] = 1 THEN Bit 9 of ERR_LS_UP[2] = 1
```

```
ELSE Bit 9 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_OFS_LSL_UP[2] = 1 THEN Bit 10 of ERR_LS_UP[2] = 1
```


```
ELSE Bit 10 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_PUC_VLD_LS_UP[2] = 1 THEN Bit 11 of ERR_LS_UP[2] = 1
```

```
ELSE Bit 11 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_SHIFT_AFL_LSL_UP[2] = 1 THEN Bit 12 of ERR_LS_UP[2] = 1
```

```
ELSE Bit 12 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_SHIFT_AFR_LSL_UP[2] = 1 THEN Bit 13 of ERR_LS_UP[2] = 1
```

```
ELSE Bit 13 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_TTIP_MES_LSH_UP[2] = 1 THEN Bit 14 of ERR_LS_UP[2] = 1
```

```
ELSE Bit 14 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_VLS_DOWN_DIF[2] = 1 THEN Bit 15 of ERR_LS_UP[2] = 1
ELSE Bit 15 of ERR_LS_UP[2] = 0 ENDIF
ENDIF
```

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```

IF LV_ERR_CHG_LS_DOWN = 1          THEN Bit 0 of ERR_LS_DOWN[1] = 1

ELSE Bit 0 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_CHK_LS_DOWN[1] = 1      THEN Bit 1 of ERR_LS_DOWN[1] = 1

ELSE Bit 1 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_DELTA_I_LAM[1] = 1      THEN Bit 2 of ERR_LS_DOWN[1] = 1
ELSE Bit 2 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_LSH_DOWN[1] = 1         THEN Bit 3 of ERR_LS_DOWN[1] = 1

ELSE Bit 3 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_OBD_LSH_DOWN[1] = 1     THEN Bit 4 of ERR_LS_DOWN[1] = 1

ELSE Bit 4 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_OC_LS_DOWN[1] = 1       THEN Bit 5 of ERR_LS_DOWN[1] = 1

ELSE Bit 5 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_PUC_LS_DOWN[1] = 1      THEN Bit 6 of ERR_LS_DOWN[1] = 1

ELSE Bit 6 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_PUE_LS_DOWN[1] = 1      THEN Bit 7 of ERR_LS_DOWN[1] = 1

ELSE Bit 7 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_SCG_LS_DOWN[1] = 1      THEN Bit 8 of ERR_LS_DOWN[1] = 1

ELSE Bit 8 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_SCP_LS_DOWN[1] = 1      THEN Bit 9 of ERR_LS_DOWN[1] = 1

ELSE Bit 9 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_SWT_LS_DOWN[1] = 1      THEN Bit 10 of ERR_LS_DOWN[1] = 1

ELSE Bit 10 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_VLS_DOWN_DIF[1] = 1     THEN Bit 11 of ERR_LS_DOWN[1] = 1
ELSE Bit 11 of ERR_LS_DOWN[1] = 0 ENDIF
//remark: Bits 12...15 always 0

```

```

#IF NC_CBK_EX_NR = 2 THEN
IF LV_ERR_CHG_LS_DOWN = 1          THEN Bit 0 of ERR_LS_DOWN[2] = 1


ELSE Bit 0 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_CHK_LS_DOWN[2] = 1      THEN Bit 1 of ERR_LS_DOWN[2] = 1

ELSE Bit 1 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_DELTA_I_LAM[2] = 1      THEN Bit 2 of ERR_LS_DOWN[2] = 1

ELSE Bit 2 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_LSH_DOWN[2] = 1         THEN Bit 3 of ERR_LS_DOWN[2] = 1

ELSE Bit 3 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_OBD_LSH_DOWN[2] = 1     THEN Bit 4 of ERR_LS_DOWN[2] = 1

```

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```
ELSE Bit 4 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_OC_LS_DOWN[2] = 1 THEN Bit 5 of ERR_LS_DOWN[2] = 1

ELSE Bit 5 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_PUC_LS_DOWN[2] = 1 THEN Bit 6 of ERR_LS_DOWN[2] = 1

ELSE Bit 6 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_PUE_LS_DOWN[2] = 1 THEN Bit 7 of ERR_LS_DOWN[2] = 1


ELSE Bit 7 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_SCG_LS_DOWN[2] = 1 THEN Bit 8 of ERR_LS_DOWN[2] = 1

ELSE Bit 8 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_SCP_LS_DOWN[2] = 1 THEN Bit 9 of ERR_LS_DOWN[2] = 1

ELSE Bit 9 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_SWT_LS_DOWN[2] = 1 THEN Bit 10 of ERR_LS_DOWN[2] = 1

ELSE Bit 10 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_VLS_DOWN_DIF[2] = 1 THEN Bit 11 of ERR_LS_DOWN[2] = 1
ELSE Bit 11 of ERR_LS_DOWN[2] = 0 ENDIF
ENDIF
//remark: Bits 12...15 always 0
```

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## 3.17 AGGR adaptation: LACO

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DELTA_LAMB_I_H_RES [NC_CBK_EX_NR]	O/V	F800... 800H	-0.125 ...0.125	61e-6	-
High word of lambda-shift from I-share with high resolution					
ERR_INH_FSD [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Error bit word to inhibit fuel system diagnosis					
ERR_INH_LAM_AD_ACT [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Error bit word to inhibit lambda adaptation					
ERR_INH_LAM_ADJ [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Error bit word to inhibit Down stream fuel trim					
ERR_INH_LSCL [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Error bit word to inhibit lamda sensor in close loop					
FAC_LAM_AD_BAL [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Lambda adaption output to be used in the MFF correction					
FAC_LAM_AD_SAE [NC_CBK_EX_NR]	O/V	0... FFH	-100... 99.21875	0.78125	%
PID07 Long term fuel trim Bank 1/3 - PID09 Long term fuel trim Bank 2 /4					
FAC_LAM_LIM_FIL [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Filtered Lambda Controller Output					
FAC_LAM_LIM_SAE [NC_CBK_EX_NR]	O/V	0... FFH	-100... 99.21875	0.78125	%
PID06 Short term fuel trim Bank 1 /3 - PID08 Short term fuel trim Bank 2 /4					
FAC_LAM_MV	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
mean value of lambda controller output bank 1 and bank 2					
FAC_LAM_PCTL_CUS [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Customer lambda pre-control value					
LAM_MV [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
sum of the controller output from the I-and I2-share					
LAM_MV_LPF_CP [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Mean value of the controller output, used by canister purge					
LAMB_DELTA_AD_LAM_ADJ_SAE [NC_CBK_EX_NR]	O/V	0... FFH	-100... 99.21875	0.78125	%
PID 56: Long Term Secondary O2 Sensor Fuel Trim Data A Bank 1; Data B Bank 3; PID 58: Long Term Secondary O2 Sensor Fuel Trim Data A Bank 2; Data B Bank 4					
LAMB_DELTA_LAM_ADJ_SAE [NC_CBK_EX_NR]	O/V	0... FFH	-100... 99.21875	0.78125	%
PID 55: Short Term Secondary O2 Sensor Fuel Trim Data A Bank1; Data B Bank 3; PID 57: Short Term Secondary O2 Sensor Fuel Trim Data A Bank 2; Data B Bank 4					
LAMB_DIF [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-1... 0.99996	30.5e-6	-
Controller difference (richness)					
LAMB_SP_FIL [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Output signal of the lambda-sensor model					
LAMB_SP_FIL_S_CP [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Output signal of the lambda-sensor model in stratified mode, used by canister purge					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_SP_SAE	O/V	0... FFFFH	0... 1.99996	0.0000305	-
Lambda setpoint SAE J1979					
LV_CYL_BAL_LAM_AD_REQ_CUS	O/V	0... 1H	0 ...1	1	-
Request bit for fast adaption due to lamb shift in stratified mode or FSD error					
LV_CYL_BAL_LAM_AD_REQ_CUS_FSD	V	0... 1H	0 ...1	1	-
Request bit for fast lamb adaption due to FSD error					
LV_CYL_BAL_LAM_AD_REQ_CUS_LAM	V	0... 1H	0 ...1	1	-
Request bit for fast lamb adaption due to lamb shift in stratified mode					
LV_ERR_AMP_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for AMP error					
LV_ERR_CAM_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for CAM error					
LV_ERR_CPS_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for CPS error					
LV_ERR_CRK_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for CRK error					
LV_ERR_DET_FSD [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Error detection flag FSD diagnosis					
LV_ERR_FUEL_LOCK [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Temporary vector for FUEL error					
LV_ERR_IV_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for IV error					
LV_ERR_IVVT_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for IVVT error					
LV_ERR_LS_DOWN_FSD_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for down stream lambda sensor error relavent to FSD					
LV_ERR_LS_DOWN_LAM_AD_ACT_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for down stream lambda sensor error relavent to LAM_AD_ACT					
LV_ERR_LS_DOWN_LAM_ADJ_LOCK [NC_CBK_EX_NR]	S	0... 1H	0 ...1	1	-
Temporary vector for down stream lambda sensor error relavent to LAM_ADJ					
LV_ERR_LS_DOWN_LSCL_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for down stream lambda sensor error relavent to LSCL					
LV_ERR_LS_UP_FSD_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for up stream lambda sensor error relavent to FSD					
LV_ERR_LS_UP_LAM_AD_ACT_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for up stream lambda sensor error relavent to LAM_AD_ACT					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_LS_UP_LAM_ADJ_LOCK [NC_CBK_EX_NR]	S	0... 1H	0 ...1	1	-
Temporary vector for up stream lambda sensor error relavent to LAM_ADJ					
LV_ERR_LS_UP_LSCL_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for up stream lambda sensor error relavent to LSCL					
LV_ERR_MAF_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for MAF error					
LV_ERR_MAP_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for MAP error					
LV_ERR_MIS_FIRE_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for mis fire error					
LV_ERR_MIS_FIRE_LOCK_LSCL [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for mis fire error (LSCL)					
LV_ERR_PLAUS_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for PLAUS error					
LV_ERR_TCO_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for TCO error					
LV_ERR_TPS_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for TPS error					
LV_FAC_L_RNG_LIM_MAX_EXT_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating Lambda Adaptation external to LACO is over its max. limit threshold					
LV_FAC_L_RNG_LIM_MIN_EXT_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating Lambda Adaptation external to LACO is under its min. limit threshold					
LV_LAM_AD_EXT	O/V	0... 1H	0 ...1	1	-
Logical variable indicating that Lambda Adaptation is carried out outside from LACO					
LV_LAM_COR_LIM_INTR [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Limitation under non stationary operating conditions (threshold exceeded)					
LV_LAM_STOP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation signal for the lambda controller stop mode					
LV_LAMB_DIF_AFL_ACT	V	0... 1H	0 ...1	1	-
Steady state condition for lamb signal is reached					
LV_LAMB_OHP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating enrichment for overheating prevention					
LV_LSCL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation flag of lambda control					
LV_MFF_AD_CDN	O/V	0... 1H	0 ...1	1	-
flag for time scheduler indicating good conditions for lambda adaptation					
LV_MFF_AD_END	O/V	0... 1H	0 ...1	1	-
logical value indicating temporary end of lambda adaptation					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MFF_AD_ADD_MMV_REL_QUO [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
relative additive adaptive value quotient					
MFF_AD_FAC_MMV_REL [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Relative multiplicative adaptive factor					
OBD_LAM_AD [NC_CBK_EX_NR]	-	0... FFH	-100... 99.21875	0.78125	%
Lambda adaptation factor SAE J1979					
T_LAMB_ADD_AFL	V	0... FFFFH	0... 6553.5	0.1	s
Timer indicating how long LV_CYL_BAL_LAM_AD_REQ_CUS is already requested to deactivate					
T_LAMB_DIF_AFL_STEADY [NC_CBK_EX_NR]	V	0... 9F6H	0... 255	0.1	s
Timer indicating how long la_abgas is within boundaries					
T_MFF_AD_MIN	O/V	0... FFFFH	0... 6553.5	0.1	s
Time indicating the minimum time for next requested lambda adaptation					
TI_LAM_COR [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Controller output signal in consideration of the canister purge function and lambda adaptation					
VLS_CYL [NC_CYL_NR]	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
upstream oxygen sensor acquisition (cylinder individual)					
VLS_CYL_TRIG [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
cylinder selective update counter for trigger event					

**Input data:**

CTR_VLS_UP_CYL_SEL_ TRIG [NC_CYL_NR] {p. 973}	ERR_LS_DOWN [NC_CBK_EX_NR] {p. 1006}	ERR_LS_UP [NC_CBK_EX_NR] {p. 1006}	ERR_SYM_FSD [NC_CBK_EX_NR] {p. 6140}
FAC_DIF_LAM_IN [NC_CBK_EX_NR] {p. 2460}	FAC_LAM_AD_CUS [NC_CBK_EX_NR] {p. 8308}	FAC_LAM_AD_OUT [NC_CBK_EX_NR] {p. 2461}	FAC_LAM_ADJ_COR_ LAM_AD_CUS [NC_CBK_EX_NR] {p. 8309}
FAC_LAM_LIM [NC_CBK_EX_NR] {p. 2461}	FAC_LAM_MV_MMV_CP [NC_CBK_EX_NR] {p. 2462}	FAC_MFF_ADD_FAC_ LAM_AD [NC_CBK_EX_NR] {p. 2641}	FAC_MFF_ADD_LAM_AD_ OUT [NC_CBK_EX_NR] {p. 2641}
LAMB_DELTA_AD_LAM_ ADJ [NC_CBK_EX_NR] {p. 2622}	LAMB_DELTA_I_LAM_ADJ [NC_CBK_EX_NR] {p. 2589}	LAMB_DELTA_LAM_ADJ [NC_CBK_EX_NR] {p. 2589}	LAMB_LS_UP_MV {p. 2313}
LAMB_SP_DELTA_LAM [NC_CBK_EX_NR] {p. 2544}	LAMB_SP_FIL_HOM [NC_CBK_EX_NR] {p. 2462}	LAMB_SP_FIL_S [NC_CBK_EX_NR] {p. 2462}	LAMB_SP_HOM [NC_CBK_EX_NR] {p. 8340}
LAMB_SP_S_EXT {p. 8136}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_AMP_PLAUS_ CUS {p. 1061}
LV_ERR_CAM_CST_IVVT_ EX [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAM_CST_IVVT_ IN [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAM_EX [NC_NR_CAM_CBK] {p. 4455}	LV_ERR_CAM_IN [NC_NR_CAM_CBK] {p. 4455}
LV_ERR_CRK {p. 4455}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_EL_CPS {p. 4708}	LV_ERR_FUP {p. 4717}

LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}
LV_ERR_IGC {p. 4772}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}	LV_ERR_MAF_FRQ_EL [NC_MAF_NR] {p. 4815}
LV_ERR_MAF_FRQ_GRD [NC_MAF_NR] {p. 4815}	LV_ERR_MAF_FRQ_RNG [NC_MAF_NR] {p. 4815}	LV_ERR_MAP {p. 982}	LV_ERR_MAP_DIP_PLAUS {p. 1062}
LV_ERR_MAP_DIP_SENS {p. 4824}	LV_ERR_MAP_DIP_SHIFT {p. 4824}	LV_ERR_MAP_PLAUS {p. 1062}	LV_ERR_MAP_TPS_PLAUS {p. 1062}
LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MIS_MPL {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}
LV_ERR_MTC_DR {p. 5002}	LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}
LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_TCO {p. 4496}
LV_ERR_TCO_EL {p. 4496}	LV_ERR_TCO_GRD {p. 4496}	LV_ERR_TCO_PLAUS {p. 5682}	LV_ERR_TCO_STUCK {p. 5691}
LV_ERR_TCO_STUCK_RNG {p. 5675}	LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TPS {p. 4982}
LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_BOL {p. 4951}
LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_TPS_ST_CHK_2 {p. 4951}
LV_ERR_VCV {p. 4729}	LV_FAC_L_RNG_LIM_MAX_LAM_AD [NC_CBK_EX_NR] {p. 2642}	LV_FAC_L_RNG_LIM_MIN_LAM_AD [NC_CBK_EX_NR] {p. 2642}	LV_FAC_LAM_LIM_NOT_STAT_CDN [NC_CBK_EX_NR] {p. 2463}
LV_FAC_LIM_MAX_LAM_AD_CUS [NC_CBK_EX_NR] {p. 8309}	LV_FAC_LIM_MIN_LAM_AD_CUS [NC_CBK_EX_NR] {p. 8309}	LV_IGK {p. 906}	LV_LAM_AD_CDN {p. 2642}
LV_LAM_AD_END {p. 2642}	LV_LAM_ADJ_D_ACT [NC_CBK_EX_NR] {p. 2589}	LV_LAM_ADJ_I_ACT [NC_CBK_EX_NR] {p. 2589}	LV_LAM_ADJ_P_ACT [NC_CBK_EX_NR] {p. 2589}
LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LAMB_COP [NC_CBK_EX_NR] {p. 8233}	LV_MIS_STATE_A {p. 6238}	LV_S_ACT {p. 8137}

MFF_SP [NC_CBK_EX_NR] {p. 2151}	NC_CBK_EX_NR {p. 1829}	NC_CBK_HPP_NR [1] {p. 812}	NC_IDX_DIAG_FSD [NC_CBK_EX_NR] {p. 6200}
NC_MAF_NR {p. 834}	NC_MAP_SENS_NR	STATE_LS_SAE [NC_CBK_EX_NR] {p. 2448}	STATE_MIL {p. 5827}
T_DLY_SOI_LSL_POS [NC_CBK_EX_NR] {p. 2464}	T_PRI_TOT_LAM_AD {p. 2643}	T1_LSL_UP [NC_CBK_EX_NR] {p. 2464}	TCO {p. 1100}
VLS_UP_CYL_SEL [NC_CYL_NR] {p. 973}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ERR_LS_DOWN_FSD_CBK	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective in Fuel system monitoring due to error in downstream oxygen sensor (1 = Error active)					
C_ERR_LS_DOWN_FSD_CBK_NOT	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective in Fuel system monitoring due to no error in downstream oxygen sensor (1 = Error active)					
C_ERR_LS_DOWN_LAM_AD_ACT_CBK	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective adaptation due to downstream oxygen sensor error (1 = Error active)					
C_ERR_LS_DOWN_LAM_AD_ACT_CBK_NOT	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective adaptation due to no error in downstream oxygen sensor (1 = Error active)					
C_ERR_LS_DOWN_LAM_ADJ_CBK	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective long term adaptation due to downstream oxygen sensor error (1 = Error active)					
C_ERR_LS_DOWN_LAM_ADJ_CBK_NOT	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective long term adaptation due to no error in downstream oxygen sensor (1 = Error active)					
C_ERR_LS_DOWN_LAM_LSCL_CBK	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective inhibition due to error in closed loop lambda sensor (1 = Error active)					
C_ERR_LS_DOWN_LAM_LSCL_CBK_NOT	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective inhibition due to no error in closed loop lambda sensor (1 = Error active)					
C_ERR_LS_UP_FSD_CBK	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective in Fuel system monitoring due to error in upstream oxygen sensor (1 = Error active)					
C_ERR_LS_UP_FSD_CBK_NOT	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective in Fuel system monitoring due to no error in upstream oxygen sensor (1 = Error active)					
C_ERR_LS_UP_LAM_AD_ACT_CBK	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective adaptation due to upstream oxygen sensor error (1 = Error active)					
C_ERR_LS_UP_LAM_AD_ACT_CBK_NOT	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective adaptation due to no error in upstream oxygen sensor (1 = Error active)					
C_ERR_LS_UP_LAM_ADJ_CBK	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective long term adaptation due to upstream oxygen sensor error (1 = Error active)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ERR_LS_UP_LAM_ADJ_CBK_NOT	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective long term adaptation due to no error in upstream oxygen sensor (1 = Error active)					
C_ERR_LS_UP_LAM_LSCL_CBK	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective inhibition due to error in closed loop lambda sensor (1 = Error active)					
C_ERR_LS_UP_LAM_LSCL_CBK_NOT	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective inhibition due to no error in closed loop lambda sensor (1 = Error active)					
C_LAMB_DIF_AFL_STEADY	-	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda deviation allowed to define lambda as steady state					
C_N_BOL_LAMB_DIF_ACT	-	0... FFH	0... 8160	32	rpm
minimum engine speed for hom switching					
C_N_TOL_LAMB_DIF_ACT	-	0... FFH	0... 8160	32	rpm
maximum engine speed for hom switching					
C_T_DIF_AFL_STEADY	-	0... 9F6H	0... 255	0.1	s
Timer adjustment to monitor steady state of la_abgas					
C_T_MAX_LAMB_ADD_AFL	-	0... FFFFH	0... 6553.5	0.1	s
Timer adjustment to end LV_CYL_BAL_LAM_AD_REQ_CUS request					
C_T_MAX_LAMB_ADD_AFL_FSD	-	0... FFFFH	0... 6553.5	0.1	s
Timer adjustment to end LV_CYL_BAL_LAM_AD_REQ_CUS request due to FSD error					
C_TCO_LAMB_DIF_ACT	-	0... FEH	-48... 142.5	0.75	°C
Coolant temperature activation condition for HOM request					
ID_MFF_SP_BOL_LAMB_DIF_ACT	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_32_ID_MFF_SP_BOL_LAMB_DIF	8	0... FFH	0... 8160	32	rpm
minimum fuel mass set point for hom switching					
ID_MFF_SP_TOL_LAMB_DIF_ACT	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_32_ID_MFF_SP_TOL_LAMB_DIF	8	0... FFH	0... 8160	32	rpm
maximum fuel mass set point for hom switching					
IP_CRLC_FAC_LAM_LIM_FIL	V	0... FFH	0... 0.99609	3.9062e-3	-
LDP_N_IP_CRLC_FAC_LAM_LIM_FIL	8	0... 1FE0H	0... 8160	1	rpm
LDP_MAF_IP_CRLC_FAC_LAM_LIM_FIL	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Correlation constant for filtering the lambda controller output					
IP_LAMB_DIF_THD	-	0... 7FFFH	0... 31.99902	976.599e-6	-
LDP_LAMB_LS_UP_MV	8	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda deviation in stratified mode causing hom request					
LC_CYL_BAL_LAM_AD_REQ_FSD	-	0... 1H	0 ...1	1	-
Activation Flag to Request Lambda Adaption due to FSD Error					
LC_FAC_LAM_LIM_FIL_ENA	-	0... 1H	0 ...1	1	-
Logical switch to enable filtering of the lambda controller output					
LC_LAM_AD_EXT	-	0... 1H	0 ...1	1	-
Logical switch between LACO internal (=0) and external (=1) Lambda Adaptation source					


### Import actions:

**ACTION\_ERRM\_CheckPendingStatus** (IN<PRM\_IDX\_DIAG>,OUT<PRM\_LV\_ERR\_PND>)

**ACTION\_ERRM\_GetLvEndDiag** (IN<IDX\_DIAG>,OUT<LV\_END\_DIAG>)

## 3.17.1 Outputs for SV aggregates, SV internally

### FUNCTION DESCRIPTION:

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 1020 of 8404	
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Adaptation to aggregate environment.  
i = 1 ... NC\_CBK\_EX\_NR

**Application conditions**

**Initialisation:** 0  
**Recurrence :** same recurrence as corresponding input data  
**Activation:** every engine operating state

**Formula section:**

LV\_MFF\_AD\_END = LV\_LAM\_AD\_END  
 LV\_MFF\_AD\_CDN = LV\_LAM\_AD\_CDN  
 LV\_LSCL\_i = LV\_LAM\_LSCL[i]  
 TI\_LAM\_COR\_i = FAC\_LAM\_LIM[i]  
 LAMB\_DIF\_i = FAC\_DIF\_LAM\_IN[NC\_CBK\_EX\_NR]  
 LV\_LAM\_COR\_LIM\_INTR\_i = LV\_FAC\_LAM\_LIM\_NOT\_STAT\_CDN[NC\_CBK\_EX\_NR]  
 LV\_LAM\_STOP\_i = LV\_LAM\_STOP[NC\_CBK\_EX\_NR]  
 LAM\_MV\_i = FAC\_LAM\_MV[NC\_CBK\_EX\_NR]  
 LAM\_MV\_LPF\_CP\_i = FAC\_LAM\_MV\_MMV\_CP[NC\_CBK\_EX\_NR]  
 LAMB\_SP\_FIL\_i = LAMB\_SP\_FIL\_HOM[NC\_CBK\_EX\_NR]  
 LAMB\_SP\_FIL\_S\_CP\_i = LAMB\_SP\_FIL\_S[NC\_CBK\_EX\_NR]  
 T\_MFF\_AD\_MIN = T\_PRI\_TOT\_LAM\_AD  
 VLS\_CYL\_x = VLS\_UP\_CYL\_SEL[x]  
 VLS\_CYL\_TRIG\_x = CTR\_VLS\_UP\_CYL\_SEL\_TRIG[x]  
 LV\_LAMB\_OHP[i] = LV\_LAMB\_COP[i]  
 FAC\_LAM\_MV = ( FAC\_LAM\_MV[0] + FAC\_LAM\_MV[1] ) /2  
 DELTA\_LAMB\_I\_H\_RES\_i = LAMB\_DELTA\_I\_LAM\_ADJ[NC\_CBK\_EX\_NR]  
 FAC\_LAM\_PCTL\_CUS[i] = (LAMB\_SP\_DELTA\_LAM[i]/LAMB\_SP\_HOM[i]) \* 100%

Note: Interface to BMW Lambda Adaptation (KLANN)  
 LV\_LAM\_AD\_EXT = LC\_LAM\_AD\_EXT

**If** LV\_LAM\_AD\_EXT = 1

**Then**

FAC\_LAM\_AD\_BAL[i]=  
                   FAC\_LAM\_AD\_CUS[i] + FAC\_LAM\_ADJ\_COR\_LAM\_AD\_CUS[i]  
 OBD\_LAM\_AD[i] = FAC\_LAM\_AD\_CUS[i] %please mind the variable definition differences  
 LV\_FAC\_L\_RNG\_LIM\_MIN\_EXT\_LAM\_AD[i] = LV\_FAC\_LIM\_MIN\_LAM\_AD\_CUS[i]  
 LV\_FAC\_L\_RNG\_LIM\_MAX\_EXT\_LAM\_AD[i] = LV\_FAC\_LIM\_MAX\_LAM\_AD\_CUS[i]


**Else**

FAC\_LAM\_AD\_BAL[i] =  
                   FAC\_LAM\_AD\_OUT[i] + FAC\_LAM\_ADJ\_COR\_LAM\_AD\_CUS[i]  
 OBD\_LAM\_AD[i] = FAC\_MFF\_ADD\_FAC\_LAM\_AD[i]  
 %please mind the variable definition differences  
 LV\_FAC\_L\_RNG\_LIM\_MIN\_EXT\_LAM\_AD[i] = LV\_FAC\_L\_RNG\_LIM\_MIN\_LAM\_AD[i]  
 LV\_FAC\_L\_RNG\_LIM\_MAX\_EXT\_LAM\_AD[i]= LV\_FAC\_L\_RNG\_LIM\_MAX\_LAM\_AD[i]

**Endif**

**If** ERR\_SYM\_FSD\_i ≠ 0  
**Then** LV\_ERR\_DET\_FSD[i] = 1

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	Document key 10171571 SPE 000 AO	Pages Page 1021 of 8404	
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```
Else          LV_ERR_DET_FSD[i] = 0
Endif
```

Note: Filtering the lambda controller output (requested for the N54 engine)

```
If LC_FAC_LAM_LIM_FIL_ENA = 1
```

```
Then
```

```
FAC_LAM_LIM_FIL[i]k = FAC_LAM_LIM_FIL[i]k-1 * (1-IP_CRLC_FAC_LAM_LIM_FIL) + FAC_LAM_LIM[i] * IP_CRLC_FAC_LAM_LIM_FIL
```

```
Else
```

```
FAC_LAM_LIM_FIL[i] = FAC_LAM_LIM[i]
```

```
Endif
```

### 3.17.2 Activation flag for HOM-mode due to difference in lambda values in stratified

#### FUNCTION DESCRIPTION:

In case of drift between lamb setpoint and lamb sensor signal in stratified mode after a long time of not adapting, hom mode is requested and canister purge is inhibited.

i = 1 ... NC\_CBK\_EX\_NR

n: current calculation cycle; n-1: calculation cycle before current one

#### Application conditions

**Initialisation:** LV\_IGK 0 -> 1: all variables set to zero

**Recurrence :** 100ms

**Activation:** LV\_DC = 1

#### Formula section:

% Setting LV\_CYL\_BAL\_LAM\_AD\_REQ\_CUS = 1:

```
If(0)          LV_S_ACT = 1                                     and
              LV_CYL_BAL_LAM_AD_REQ_CUS = 0
```

% Observation of steady state condition for lamb signal:

```
If(1a)        |LAMB_SP_S_EXT(n)-LAMB_SP_S_EXT(n-1)| <
              C_LAMB_DIF_AFL_STEADY
```

**Then(1a)** increment T\_LAMB\_DIF\_AFL\_STEADY[i] cyl. bank selective

```
If(2a)        (T_LAMB_DIF_AFL_STEADY[1] >= T_DLY_SOI_LSL_POS[1] +
              T1_LSL_UP[1] + C_T_DIF_AFL_STEADY          and
              T_LAMB_DIF_AFL_STEADY[2] >= T_DLY_SOI_LSL_POS[2] +
              T1_LSL_UP[2] + C_T_DIF_AFL_STEADY          )
```

```
Then(2a)      LV_LAMB_DIF_AFL_ACT = 1
```

```
Else(2a)      LV_LAMB_DIF_AFL_ACT = 0
```

```
Endif(2a)
```

```
Else(1a)      T_LAMB_DIF_AFL_STEADY[i] = 0
              LV_LAMB_DIF_AFL_ACT = 0
```

```
Endif(1a)
```

% Setting of HOM-Request flag:

```

If(1b)          |LAMB_SP_S_EXT - LAMB_LS_UP_MV| > IP_LAMB_DIF_THD      and
                  N_32 > C_N_BOL_LAMB_DIF_ACT                        and
                  N_32 < C_N_TOL_LAMB_DIF_ACT                        and
                  (MFF_SP[1] > ID_MFF_SP_BOL_LAMB_DIF_ACT           or
                  MFF_SP[2] > ID_MFF_SP_BOL_LAMB_DIF_ACT           )      and
                  (MFF_SP[1] < ID_MFF_SP_TOL_LAMB_DIF_ACT           or
                  MFF_SP[2] < ID_MFF_SP_TOL_LAMB_DIF_ACT           )      and
                  LV_LAMB_DIF_AFL_ACT = 1                          and
                  TCO >= C_TCO_LAMB_DIF_ACT
Then(1b)          LV_CYL_BAL_LAM_AD_REQ_CUS_LAM = 1
Else(1b)          LV_CYL_BAL_LAM_AD_REQ_CUS_LAM = 0
Endif(1b)
Endif(0) %end of LV_S_ACT condition
    
```

% FSD pending status condition for HOM-request:

```

If(1c)          LV_CYL_BAL_LAM_AD_REQ_CUS = 0                      and
                  LC_CYL_BAL_LAM_AD_REQ_FSD = 1
Then(1c)
    For(2c) i=1 to NC_CBK_EX_NR
        ACTION_ERRM_CheckPendingStatus( <NC_IDX_DIAG_FSD[i]>, <PendingStatus> )
        ACTION_ERRM_GetLvEndDiag( <NC_IDX_DIAG_FSD[i]>, <EndFlag> )
        if(3c) (PendingStatus==1or STATE_MIL==1) and EndFlag==0
            then(3c)    LV_CYL_BAL_LAM_AD_REQ_CUS_FSD = 1
            else(3c)    LV_CYL_BAL_LAM_AD_REQ_CUS_FSD = 0
            endif(3c)
    endfor(2c)
Endif(2c)
    
```

% General Decision about HOM-Request Flag:

```


If(1d)          LV_CYL_BAL_LAM_AD_REQ_CUS = 0
    If(2d)          LV_CYL_BAL_LAM_AD_REQ_CUS_LAM = 1                or
                  LV_CYL_BAL_LAM_AD_REQ_CUS_FSD = 1
    Then(2d)       LV_CYL_BAL_LAM_AD_REQ_CUS = 1
    Else(2d)       do nothing
    Endif(2d)
Endif(2d)
    
```

% ReSetting LV\_CYL\_BAL\_LAM\_AD\_REQ\_CUS = 0:

```

If(1e)          LV_CYL_BAL_LAM_AD_REQ_CUS = 1
Then(1e)         increment T_LAMB_ADD_AFL
    If(2e)          (T_LAMB_ADD_AFL >= C_T_MAX_LAMB_ADD_AFL          and
                  LV_CYL_BAL_LAM_AD_REQ_CUS_FSD = 0                and
                  LV_CYL_BAL_LAM_AD_REQ_CUS_LAM = 1)                or
                  (T_LAMB_ADD_AFL >= C_T_MAX_LAMB_ADD_AFL_FSD      and
                  LV_CYL_BAL_LAM_AD_REQ_CUS_FSD = 1                and
                  LV_CYL_BAL_LAM_AD_REQ_CUS_LAM = 0)                or
    Then(2e)       LV_CYL_BAL_LAM_AD_REQ_CUS = 0
    Endif(2e)
Else(1e)         T_LAMB_ADD_AFL = 0
Endif(1e)
    
```

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### 3.17.3 Calculation of bitmasks for Lamda controller functions.

#### General Information

This is an aggregate adaptation module for LACO in order to Lock the diagnostic instance based on the QVM (Cross-dependence Matrix).

16 components are being used to calculate the inhibition flag for Fuel system diagnosis, Lambda adaptation, Down stream fuel trim, Linear lambda control closed loop.


1. Throttle position sensor (TPS error)
2. Infinitely variable valve timing (IVVT error)
3. Canister purge solenoid (CPS error)
4. Upstream lamda sensor (LS\_UP error)
5. Downstream lamda sensor (LS\_DOWN error)
6. Injection valve (IV error)
7. Misfire (MISFIRE error)
8. Camshaft sensor error (CAM error)
9. Crankshaft sensor error (CRK error)
10. Coolant temperature (TCO error)
11. Ambient pressure (AMP error)
12. Fuel pressure (FUP, VCV error)
13. Mass air flow (MAF error)
14. Manifold air pressure (MAP error)
15. Ignition Coil (IGC error)
16. Plausibility of MAP\_TPS and LOAD\_TPS (PLAUS error)

Adaptation to aggregate environment.

i = 1 ... NC\_CBK\_EX\_NR

The bit pattern for each of the diagnosis is described as below

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Fuel system diagnosis	Lambda adaptation	Down stream fuel trim	Lin laco closed loop
ERR_INH_FSD [NC_CBK_EX_NR]	ERR_INH_LAM_AD_AC T [NC_CBK_EX_NR]	ERR_INH_LAM_ADJ [NC_CBK_EX_NR]	ERR_INH_LSCL [NC_CBK_EX_NR]
bit 0 TPS LOCK	bit 0 TPS LOCK	bit 0 TPS LOCK	bit 0 TPS LOCK
bit 1 IVVT LOCK	bit 1 IVVT LOCK	bit 1 IVVT LOCK	bit 1 IVVT LOCK
bit 2 CPS LOCK	bit 2 CPS LOCK	bit 2 CPS LOCK	bit 2 CPS LOCK
bit 3 LS_UP_LOCK	bit 3 LS_UP_LOCK	bit 3 LS_UP_LOCK	bit 3 LS_UP_LOCK
bit 4 LS_DOWN_LOCK	bit 4 LS_DOWN_LOCK	bit 4 LS_DOWN_LOCK	bit 4 LS_DOWN_LOCK
bit 5 IV LOCK	bit 5 IV LOCK	bit 5 IV LOCK	bit 5 IV LOCK
bit 6 MIS FIRE LOCK	bit 6 MIS FIRE LOCK	bit 6 MIS FIRE LOCK	bit 6 MIS FIRE LOCK
bit 7 CAM LOCK	bit 7 CAM LOCK	bit 7 CAM LOCK	bit 7 CAM LOCK
bit 8 CRK LOCK	bit 8 CRK LOCK	bit 8 CRK LOCK	bit 8 CRK LOCK
bit 9 TCO LOCK	bit 9 TCO LOCK	bit 9 TCO LOCK	bit 9 TCO LOCK
bit 10 AMP LOCK	bit 10 AMP LOCK	bit 10 AMP LOCK	bit 10 AMP LOCK
bit 11 FUEL LOCK ( FUP , VCV )	bit 11 FUEL LOCK ( FUP , VCV )	bit 11 FUEL LOCK ( FUP , VCV )	bit 11 FUEL LOCK ( FUP , VCV )
bit 12 MAF LOCK	bit 12 MAF LOCK	bit 12 MAF LOCK	bit 12 MAF LOCK
bit 13 MAP LOCK	bit 13 MAP LOCK	bit 13 MAP LOCK	bit 13 MAP LOCK
bit 14 IGC LOCK	bit 14 IGC LOCK	bit 14 IGC LOCK	bit 14 IGC LOCK
bit 15 PLAUS LOCK	bit 15 PLAUS LOCK	bit 15 PLAUS LOCK	bit 15 PLAUS LOCK

### Application conditions:

**Initialisation:** ERR\_INH\_FSD[NC\_CBK\_EX\_NR],  
ERR\_INH\_LSCL[NC\_CBK\_EX\_NR],  
ERR\_INH\_LAM\_ADJ [NC\_CBK\_EX\_NR],  
ERR\_INH\_LAM\_AD\_ACT[NC\_CBK\_EX\_NR] are set to zero.

**Recurrence:** 10ms

**Activation:** always

**Deactivation:** never

### Formula section:

#### 3.17.3.1 Calculation of Temporary vectors for each of the error lock:

{FOR i = 0; i < NC\_CBK\_EX\_NR, i++

LV\_ERR\_TPS\_LOCK[i] = (LV\_ERR\_TPS OR

LV\_ERR\_TPS\_AD OR


LV\_ERR\_TPS\_MAF\_1 OR

LV\_ERR\_TPS\_MAF\_2 OR

LV\_ERR\_TPS\_RATIO OR  
 LV\_ERR\_TPS\_1 OR  
 LV\_ERR\_TPS\_2 OR  
 LV\_ERR\_TPS\_ST\_CHK\_2 OR  
 LV\_ERR\_MTC\_CTL\_2 OR  
 LV\_ERR\_MTC\_CTL\_3 OR  
 LV\_ERR\_MTC\_DR OR  
 LV\_ERR\_TPS\_AD\_BOL OR)  
 LV\_ERR\_IVVT\_LOCK[i] = (LV\_ERR\_MEC\_IVVT\_IN OR  
 LV\_ERR\_MEC\_IVVT\_EX OR  
 LV\_ERR\_SLV\_IVVT\_IN OR  
 LV\_ERR\_SLV\_IVVT\_EX OR  
 LV\_ERR\_CAM\_CST\_IVVT\_IN\_1 OR  
 LV\_ERR\_CAM\_CST\_IVVT\_EX\_1 )  
 LV\_ERR\_CPS\_LOCK[i] = (LV\_ERR\_DIAGCPS OR  
 LV\_ERR\_EL\_CPS)  
 LV\_ERR\_MIS\_FIRE\_LOCK\_LSCL[i] = LV\_MIS\_STATE\_A  
 LV\_ERR\_CAM\_LOCK[i] = (LV\_ERR\_SYN\_CAM\_IN\_1 OR  
 LV\_ERR\_PLAUS\_CAM\_IN\_1 OR  
 LV\_ERR\_PER\_CAM\_IN\_1 OR  
 LV\_ERR\_REF\_CRK\_CAM\_IN\_1 OR  
 LV\_ERR\_TOOTH\_OFF\_IN\_1 OR  
 LV\_ERR\_SYN\_CRK\_CAM\_IN\_1 OR  
 LV\_ERR\_SYN\_CAM\_EX\_1 OR  
 LV\_ERR\_PLAUS\_CAM\_EX\_1 OR

LV\_ERR\_PER\_CAM\_EX\_1 OR  
 LV\_ERR\_REF\_CRK\_CAM\_EX\_1 OR  
 LV\_ERR\_TOOTH\_OFF\_EX\_1 OR  
 LV\_ERR\_SYN\_CRK\_CAM\_EX\_1)  
  
 LV\_ERR\_CRK\_LOCK[i] = LV\_ERR\_CRK  
 LV\_ERR\_TCO\_LOCK[i] = (LV\_ERR\_TCO\_EL OR  
 LV\_ERR\_TCO\_GRD OR  
 LV\_ERR\_TCO\_PLAUS OR  
 LV\_ERR\_TCO\_STUCK OR  
 LV\_ERR\_TCO\_STUCK\_RNG)  
 LV\_ERR\_AMP\_LOCK[i] = (LV\_ERR\_AMP OR  
 LV\_ERR\_AMP\_PLAUS OR  
 LV\_ERR\_AMP\_PLAUS\_CUS)  
 LV\_ERR\_FUP\_LOCK[i] = (LV\_ERR\_FUP OR  
 LV\_ERR\_FUP\_MFP\_PLAUS OR  
 LV\_ERR\_FUP\_ORNG OR  
 LV\_ERR\_H\_PRS\_SYS OR  
 LV\_ERR\_FUP\_ST OR  
 LV\_ERR\_VCV)}  
 LV\_ERR\_MAF\_LOCK[i] = (LV\_ERR\_MAF\_FRQ\_EL\_1 OR  
 LV\_ERR\_MAF\_FRQ\_RNG\_1 OR  
 LV\_ERR\_MAF\_FRQ\_GRD\_1)}  
 LV\_ERR\_MAP\_LOCK[i] = (LV\_ERR\_MAP\_DIP\_SENS OR  
 LV\_ERR\_MAP\_DIP\_SHIFT OR  
 LV\_ERR\_MAP\_PLAUS OR

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LV\_ERR\_MAP\_DIP\_PLAUS)

LV\_ERR\_PLAUS\_LOCK[i] = (LV\_ERR\_LOAD\_TPS\_PLAUS OR

LV\_ERR\_MAP\_TPS\_PLAUS)

End of For i}

LV\_ERR\_LS\_UP\_LSCL\_LOCK[0] = (ERR\_LS\_UP[0] bitwise & &

C\_ERR\_LS\_UP\_LAM\_LSCL\_CBK) = 1 OR

(ERR\_LS\_UP[1] bitwise & &

C\_ERR\_LS\_UP\_LAM\_LSCL\_CBK\_NOT) = 1

LV\_ERR\_LS\_UP\_LSCL\_LOCK[1] = (ERR\_LS\_UP[1] bitwise & &

C\_ERR\_LS\_UP\_LAM\_LSCL\_CBK) = 1 OR

(ERR\_LS\_UP[0] bitwise & &

C\_ERR\_LS\_UP\_LAM\_LSCL\_CBK\_NOT) = 1

LV\_ERR\_LS\_UP\_LAM\_ADJ\_LOCK[0] = (ERR\_LS\_UP[0] bitwise & &

C\_ERR\_LS\_UP\_LAM\_ADJ\_CBK)= 1 OR

(ERR\_LS\_UP[1] bitwise & &

C\_ERR\_LS\_UP\_LAM\_ADJ\_CBK\_NOT)= 1

LV\_ERR\_LS\_UP\_LAM\_ADJ\_LOCK[1] = (ERR\_LS\_UP[1] bitwise & &

C\_ERR\_LS\_UP\_LAM\_ADJ\_CBK)= 1 OR

(ERR\_LS\_UP[0] bitwise & &

C\_ERR\_LS\_UP\_LAM\_ADJ\_CBK\_NOT)= 1

LV\_ERR\_LS\_UP\_LAM\_AD\_ACT\_LOCK[0] = (ERR\_LS\_UP[0] bitwise & &

C\_ERR\_LS\_UP\_LAM\_AD\_ACT\_CBK)= 1 OR

(ERR\_LS\_UP[1] bitwise & &

C\_ERR\_LS\_UP\_LAM\_AD\_ACT\_CBK\_NOT)=1


LV\_ERR\_LS\_UP\_LAM\_AD\_ACT\_LOCK[1] =(ERR\_LS\_UP[1] bitwise & &

C\_ERR\_LS\_UP\_LAM\_AD\_ACT\_CBK)= 1 OR

(ERR\_LS\_UP[0] bitwise & &


C\_ERR\_LS\_UP\_LAM\_AD\_ACT\_CBK\_NOT)=1

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$LV\_ERR\_LS\_UP\_FSD\_LOCK[0] = (ERR\_LS\_UP[0] \text{ bitwise } \& \&$   
 $C\_ERR\_LS\_UP\_FSD\_CBK) = 1 \text{ OR}$   
 $(ERR\_LS\_UP[1] \text{ bitwise } \& \&$   
 $C\_ERR\_LS\_UP\_FSD\_CBK\_NOT) = 1$   
 $LV\_ERR\_LS\_UP\_FSD\_LOCK[1] = (ERR\_LS\_UP[1] \text{ bitwise } \& \&$   
 $C\_ERR\_LS\_UP\_FSD\_CBK) = 1 \text{ OR}$   
 $(ERR\_LS\_UP[0] \text{ bitwise } \& \&$   
 $C\_ERR\_LS\_UP\_FSD\_CBK\_NOT) = 1$   
 $LV\_ERR\_LS\_DOWN\_LSCL\_LOCK[0] = (ERR\_LS\_DOWN[0] \text{ bitwise } \& \&$   
 $C\_ERR\_LS\_DOWN\_LAM\_LSCL\_CBK) = 1 \text{ OR}$   
 $(ERR\_LS\_DOWN[1] \text{ bitwise } \& \&$   
 $C\_ERR\_LS\_DOWN\_LAM\_LSCL\_CBK\_NOT) = 1$   
 $LV\_ERR\_LS\_DOWN\_LSCL\_LOCK[1] = (ERR\_LS\_DOWN[1] \text{ bitwise } \& \&$   
 $C\_ERR\_LS\_DOWN\_LAM\_LSCL\_CBK) = 1 \text{ OR}$   
 $(ERR\_LS\_DOWN[0] \text{ bitwise } \& \&$   
 $C\_ERR\_LS\_DOWN\_LAM\_LSCL\_CBK\_NOT) = 1$   
 $LV\_ERR\_LS\_DOWN\_LAM\_ADJ\_LOCK[0] = (ERR\_LS\_DOWN[0] \text{ bitwise } \& \&$   
 $C\_ERR\_LS\_DOWN\_LAM\_ADJ\_CBK) = 1 \text{ OR}$   
 $(ERR\_LS\_DOWN[1] \text{ bitwise } \& \&$   
 $C\_ERR\_LS\_DOWN\_LAM\_ADJ\_CBK\_NOT) = 1$   
 $LV\_ERR\_LS\_DOWN\_LAM\_ADJ\_LOCK[1] = (ERR\_LS\_DOWN[1] \text{ bitwise } \& \&$   
 $C\_ERR\_LS\_DOWN\_LAM\_ADJ\_CBK) = 1 \text{ OR}$   
 $(ERR\_LS\_DOWN[0] \text{ bitwise } \& \&$   
 $C\_ERR\_LS\_DOWN\_LAM\_ADJ\_CBK\_NOT) = 1$   
 $LV\_ERR\_LS\_DOWN\_LAM\_AD\_ACT\_LOCK[0] = (ERR\_LS\_DOWN[0] \text{ bitwise } \& \&$   
 $C\_ERR\_LS\_DOWN\_LAM\_AD\_ACT\_CBK) = 1 \text{ OR}$   
 $(ERR\_LS\_DOWN[1] \text{ bitwise } \& \&$   
 $C\_ERR\_LS\_DOWN\_LAM\_AD\_ACT\_CBK\_NOT) = 1$

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$LV\_ERR\_LS\_DOWN\_LAM\_AD\_ACT\_LOCK[1] = (ERR\_LS\_DOWN[1] \text{ bitwise } \& \&$   
 $C\_ERR\_LS\_DOWN\_LAM\_AD\_ACT\_CBK) = 1 \text{ OR}$   
 $(ERR\_LS\_DOWN[0] \text{ bitwise } \& \&$   
 $C\_ERR\_LS\_DOWN\_LAM\_AD\_ACT\_CBK\_NOT) = 1$   
 $LV\_ERR\_LS\_DOWN\_FSD\_LOCK[0] = (ERR\_LS\_DOWN[0] \text{ bitwise } \& \&$   
 $C\_ERR\_LS\_DOWN\_FSD\_CBK) = 1 \text{ OR}$   
 $(ERR\_LS\_DOWN[1] \text{ bitwise } \& \&$   
 $C\_ERR\_LS\_DOWN\_FSD\_CBK\_NOT) = 1$   
 $LV\_ERR\_LS\_DOWN\_FSD\_LOCK[1] = (ERR\_LS\_DOWN[1] \text{ bitwise } \& \&$   
 $C\_ERR\_LS\_DOWN\_FSD\_CBK) = 1 \text{ OR}$   
 $(ERR\_LS\_DOWN[0] \text{ bitwise } \& \&$   
 $C\_ERR\_LS\_DOWN\_FSD\_CBK\_NOT) = 1$   
 $LV\_ERR\_IV\_LOCK[0] = (\text{BIT } [0] \text{ of } STATE\_ERR\_IV \text{ OR}$   
 $\text{BIT } [2] \text{ of } STATE\_ERR\_IV \text{ OR}$   
 $\text{BIT } [4] \text{ of } STATE\_ERR\_IV)$   
 $LV\_ERR\_IV\_LOCK[1] = (\text{BIT } [1] \text{ of } STATE\_ERR\_IV \text{ OR}$   
 $\text{BIT } [3] \text{ of } STATE\_ERR\_IV \text{ OR}$   
 $\text{BIT } [5] \text{ of } STATE\_ERR\_IV)$   
 $LV\_ERR\_MIS\_FIRE\_LOCK[0] = (LV\_ERR\_MIS\_MPL \text{ OR}$   
 $LV\_ERR\_MIS[0] \text{ OR}$   
 $LV\_ERR\_MIS[2] \text{ OR}$   
 $LV\_ERR\_MIS[4])$   
 $LV\_ERR\_MIS\_FIRE\_LOCK[1] = (LV\_ERR\_MIS\_MPL \text{ OR}$   
 $LV\_ERR\_MIS[1] \text{ OR}$   
 $LV\_ERR\_MIS[3] \text{ OR}$   
 $LV\_ERR\_MIS[5])$   
 $LV\_ERR\_IGC\_LOCK[0] = (LV\_ERR\_IGC\_SCG[0] \text{ OR}$   
 $LV\_ERR\_IGC\_SCG[2] \text{ OR}$   
 $LV\_ERR\_IGC\_SCG[4] \text{ OR}$

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LV\_ERR\_IGC\_SCP[0]                    OR  
 LV\_ERR\_IGC\_SCP[2]                    OR  
 LV\_ERR\_IGC\_SCP[4])  
 LV\_ERR\_IGC\_LOCK[1]                    = (LV\_ERR\_IGC\_SCG[1]                    OR  
 LV\_ERR\_IGC\_SCG[3]                    OR  
 LV\_ERR\_IGC\_SCG[5]                    OR  
 LV\_ERR\_IGC\_SCP[1]                    OR  
 LV\_ERR\_IGC\_SCP[3]                    OR  
 LV\_ERR\_IGC\_SCP[5])

Calculation of bit mask for error selection for each function  
 The bit pattern for ERR\_INH\_XXX is as described below

Bit Pattern for ERR_INH_XXX	
Bit 0 of ERR_INH_XXX	TPS_LOCK
Bit 1 of ERR_INH_XXX	IVVT_LOCK
Bit 2 of ERR_INH_XXX	CPS_LOCK
Bit 3 of ERR_INH_XXX	LS_UP_LOCK
Bit 4 of ERR_INH_XXX	LS_DOWN_LOCK
Bit 5 of ERR_INH_XXX	IV_LOCK
Bit 6 of ERR_INH_XXX	MIS_FIRE_LOCK
Bit 7 of ERR_INH_XXX	CAM_LOCK
Bit 8 of ERR_INH_XXX	CRK_LOCK
Bit 9 of ERR_INH_XXX	TCO_LOCK
Bit 10 of ERR_INH_XXX	AMP_LOCK
Bit 11 of ERR_INH_XXX	FUEL_LOCK (FUP, VCV)
Bit 12 of ERR_INH_XXX	MAF_LOCK
Bit 13 of ERR_INH_XXX	MAP LOCK
Bit 14 of ERR_INH_XXX	IGC LOCK
Bit 15 of ERR_INH_XXX	PLAUS LOCK

### 1.3.2.1 Temporary vector representing bit pattern for Fuel system diagnosis ERR\_INH\_FSD[NC\_CBK\_EX\_NR]

Bit 0 of ERR\_INH\_FSD[0] = LV\_ERR\_TPS\_LOCK[0]  
 Bit 0 of ERR\_INH\_FSD[1] = LV\_ERR\_TPS\_LOCK[1]  
 Bit 1 of ERR\_INH\_FSD[0] = LV\_ERR\_IVVT\_LOCK[0]  
 Bit 1 of ERR\_INH\_FSD[1] = LV\_ERR\_IVVT\_LOCK[1]  
 Bit 2 of ERR\_INH\_FSD[0] = LV\_ERR\_CPS\_LOCK[0]  
 Bit 2 of ERR\_INH\_FSD[1] = LV\_ERR\_CPS\_LOCK[1]  
 Bit 3 of ERR\_INH\_FSD[0] = LV\_ERR\_LS\_UP\_FSD\_LOCK[0]  
 Bit 3 of ERR\_INH\_FSD[1] = LV\_ERR\_LS\_UP\_FSD\_LOCK[1]  
 Bit 4 of ERR\_INH\_FSD[0] = LV\_ERR\_LS\_DOWN\_FSD\_LOCK[0]  
 Bit 4 of ERR\_INH\_FSD[1] = LV\_ERR\_LS\_DOWN\_FSD\_LOCK[1]  
 Bit 5 of ERR\_INH\_FSD[0] = 0 (IV LOCK)  
 Bit 5 of ERR\_INH\_FSD[1] = 0 (IV LOCK)  
 Bit 6 of ERR\_INH\_FSD[0] = LV\_ERR\_MIS\_FIRE\_LOCK[0]  
 Bit 6 of ERR\_INH\_FSD[1] = LV\_ERR\_MIS\_FIRE\_LOCK[1]  
 Bit 7 of ERR\_INH\_FSD[0] = LV\_ERR\_CAM\_LOCK[0]  
 Bit 7 of ERR\_INH\_FSD[1] = LV\_ERR\_CAM\_LOCK[1]  
 Bit 8 of ERR\_INH\_FSD[0] = 0 (CRK LOCK)  
 Bit 8 of ERR\_INH\_FSD[1] = 0 (CRK LOCK)  
 Bit 9 of ERR\_INH\_FSD[0] = LV\_ERR\_TCO\_LOCK[0]  
 Bit 9 of ERR\_INH\_FSD[1] = LV\_ERR\_TCO\_LOCK[1]  
 Bit 10 of ERR\_INH\_FSD[0] = LV\_ERR\_AMP\_LOCK[0]  
 Bit 10 of ERR\_INH\_FSD[1] = LV\_ERR\_AMP\_LOCK[1]




Bit 11 of ERR\_INH\_FSD[0] = LV\_ERR\_FUP\_LOCK[0]  
 Bit 11 of ERR\_INH\_FSD[1] = LV\_ERR\_FUP\_LOCK[1]  
 Bit 12 of ERR\_INH\_FSD[0] = LV\_ERR\_MAF\_LOCK[0]  
 Bit 12 of ERR\_INH\_FSD[1] = LV\_ERR\_MAF\_LOCK[1]  
 Bit 13 of ERR\_INH\_FSD[0] = LV\_ERR\_MAP\_LOCK[0]  
 Bit 13 of ERR\_INH\_FSD[1] = LV\_ERR\_MAP\_LOCK[1]  
 Bit 14 of ERR\_INH\_FSD[0] = 0 (IGC\_LOCK)  
 Bit 14 of ERR\_INH\_FSD[1] = 0 (IGC\_LOCK)  
 Bit 15 of ERR\_INH\_FSD[0] = LV\_ERR\_PLAUS\_LOCK[0]  
 Bit 15 of ERR\_INH\_FSD[1] = LV\_ERR\_PLAUS\_LOCK[1]

//remark: Bits other than 0,1,2,3,4,6,7,9,10,11,12,13 and 15 are always 0

### 1.3.2.2 Temporary vector representing bit pattern for **closed loop lambda sensor ERR\_INH\_LSCL[NC\_CBK\_EX\_NR]**

Bit 0 of ERR\_INH\_LSCL[0] = 0(TPS LOCK)  
 Bit 0 of ERR\_INH\_LSCL[1] = 0(TPS LOCK)  
 Bit 1 of ERR\_INH\_LSCL[0] = 0(IVVT LOCK)  
 Bit 1 of ERR\_INH\_LSCL[1] = 0(IVVT LOCK)  
 Bit 2 of ERR\_INH\_LSCL[0] = 0(CPS LOCK)  
 Bit 2 of ERR\_INH\_LSCL[1] = 0(CPS LOCK)  
 Bit 3 of ERR\_INH\_LSCL[0] = LV\_ERR\_LS\_UP\_LSCL\_LOCK[0]  
 Bit 3 of ERR\_INH\_LSCL[1] = LV\_ERR\_LS\_UP\_LSCL\_LOCK[1]  
 Bit 4 of ERR\_INH\_LSCL[0] = LV\_ERR\_LS\_DOWN\_LSCL\_LOCK[0]  
 Bit 4 of ERR\_INH\_LSCL[1] = LV\_ERR\_LS\_DOWN\_LSCL\_LOCK[1]  
 Bit 5 of ERR\_INH\_LSCL[0] = LV\_ERR\_IV\_LOCK[0]  
 Bit 5 of ERR\_INH\_LSCL[1] = LV\_ERR\_IV\_LOCK[1]  
 Bit 6 of ERR\_INH\_LSCL[0] = LV\_ERR\_MIS\_FIRE\_LOCK\_LSCL[0]  
 Bit 6 of ERR\_INH\_LSCL[1] = LV\_ERR\_MIS\_FIRE\_LOCK\_LSCL[1]  
 Bit 7 of ERR\_INH\_LSCL[0] = 0(CAM LOCK)  
 Bit 7 of ERR\_INH\_LSCL[1] = 0(CAM LOCK)  
 Bit 8 of ERR\_INH\_LSCL[0] = 0(CRK LOCK)  
 Bit 8 of ERR\_INH\_LSCL[1] = 0(CRK LOCK)  
 Bit 9 of ERR\_INH\_LSCL[0] = 0(TCO LOCK)  
 Bit 9 of ERR\_INH\_LSCL[1] = 0(TCO LOCK)  
 Bit 10 of ERR\_INH\_LSCL[0] = 0(AMP LOCK)  
 Bit 10 of ERR\_INH\_LSCL[1] = 0(AMP LOCK)  
 Bit 11 of ERR\_INH\_LSCL[0] = 0(FUP LOCK)  
 Bit 11 of ERR\_INH\_LSCL[1] = 0(FUP LOCK)  
 Bit 12 of ERR\_INH\_LSCL[0] = 0(MAF LOCK)  
 Bit 12 of ERR\_INH\_LSCL[1] = 0(MAF LOCK)  
 Bit 13 of ERR\_INH\_LSCL[0] = 0(MAP LOCK)  
 Bit 13 of ERR\_INH\_LSCL[1] = 0(MAP LOCK)  
 Bit 14 of ERR\_INH\_LSCL[0] = LV\_ERR\_IGC\_LOCK[0]  
 Bit 14 of ERR\_INH\_LSCL[1] = LV\_ERR\_IGC\_LOCK[1]  
 Bit 15 of ERR\_INH\_LSCL[0] = 0(PLAUS LOCK)  
 Bit 15 of ERR\_INH\_LSCL[1] = 0(PLAUS LOCK)

//remark: Bits other than 3,4 5 6 & 14 are always 0

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### 1.3.2.3 Temporary vector representing bit pattern for **down stream fuel trim ERR\_INH\_LAM\_ADJ[NC\_CBK\_EX\_NR]**


Bit 0 of ERR\_INH\_LAM\_ADJ[0] = LV\_ERR\_TPS\_LOCK[0]  
 Bit 0 of ERR\_INH\_LAM\_ADJ[1] = LV\_ERR\_TPS\_LOCK[1]  
 Bit 1 of ERR\_INH\_LAM\_ADJ[0] = LV\_ERR\_IVVT\_LOCK[0]  
 Bit 1 of ERR\_INH\_LAM\_ADJ[1] = LV\_ERR\_IVVT\_LOCK[1]  
 Bit 2 of ERR\_INH\_LAM\_ADJ[0] = 0(CPS LOCK)  
 Bit 2 of ERR\_INH\_LAM\_ADJ[1] = 0(CPS LOCK)  
 Bit 3 of ERR\_INH\_LAM\_ADJ[0] = LV\_ERR\_LS\_UP\_LAM\_ADJ\_LOCK[0]  
 Bit 3 of ERR\_INH\_LAM\_ADJ[1] = LV\_ERR\_LS\_UP\_LAM\_ADJ\_LOCK[1]  
 Bit 4 of ERR\_INH\_LAM\_ADJ[0] = LV\_ERR\_LS\_DOWN\_LAM\_ADJ\_LOCK[0]  
 Bit 4 of ERR\_INH\_LAM\_ADJ[1] = LV\_ERR\_LS\_DOWN\_LAM\_ADJ\_LOCK[1]  
 Bit 5 of ERR\_INH\_LAM\_ADJ[0] = 0(IV LOCK)  
 Bit 5 of ERR\_INH\_LAM\_ADJ[1] = 0(IV LOCK)  
 Bit 6 of ERR\_INH\_LAM\_ADJ[0] = 0(MIS\_FIRE LOCK)  
 Bit 6 of ERR\_INH\_LAM\_ADJ[1] = 0(MIS\_FIRE LOCK)  
 Bit 7 of ERR\_INH\_LAM\_ADJ[0] = LV\_ERR\_CAM\_LOCK[0]  
 Bit 7 of ERR\_INH\_LAM\_ADJ[1] = LV\_ERR\_CAM\_LOCK[1]  
 Bit 8 of ERR\_INH\_LAM\_ADJ[0] = LV\_ERR\_CRK\_LOCK[0]  
 Bit 8 of ERR\_INH\_LAM\_ADJ[1] = LV\_ERR\_CRK\_LOCK[1]  
 Bit 9 of ERR\_INH\_LAM\_ADJ[0] = 0(TCO LOCK)  
 Bit 9 of ERR\_INH\_LAM\_ADJ[1] = 0(TCO LOCK)  
 Bit 10 of ERR\_INH\_LAM\_ADJ[0] = 0(AMP LOCK)  
 Bit 10 of ERR\_INH\_LAM\_ADJ[1] = 0(AMP LOCK)  
 Bit 11 of ERR\_INH\_LAM\_ADJ[0] = 0(FUP LOCK)  
 Bit 11 of ERR\_INH\_LAM\_ADJ[1] = 0(FUP LOCK)  
 Bit 12 of ERR\_INH\_LAM\_ADJ[0] = 0(MAF LOCK)  
 Bit 12 of ERR\_INH\_LAM\_ADJ[1] = 0(MAF LOCK)  
 Bit 13 of ERR\_INH\_LAM\_ADJ[0] = 0(MAP LOCK)  
 Bit 13 of ERR\_INH\_LAM\_ADJ[1] = 0(MAP LOCK)  
 Bit 14 of ERR\_INH\_LAM\_ADJ[0] = 0(IGC LOCK)  
 Bit 14 of ERR\_INH\_LAM\_ADJ[1] = 0(IGC LOCK)  
 Bit 15 of ERR\_INH\_LAM\_ADJ[0] = 0(PLAUS LOCK)  
 Bit 15 of ERR\_INH\_LAM\_ADJ[1] = 0(PLAUS LOCK)

//remark: Bits other than 0,1,3,4,7 & 8 are always 0

### 1.3.2.4 Temporary vector representing bit pattern for **Lambda adaptation ERR\_INH\_LAM\_AD\_ACT[NC\_CBK\_EX\_NR]**

Bit 0 of ERR\_INH\_LAM\_AD\_ACT[0] = LV\_ERR\_TPS\_LOCK[0]  
 Bit 0 of ERR\_INH\_LAM\_AD\_ACT[1] = LV\_ERR\_TPS\_LOCK[1]  
 Bit 1 of ERR\_INH\_LAM\_AD\_ACT[0] = LV\_ERR\_IVVT\_LOCK[0]  
 Bit 1 of ERR\_INH\_LAM\_AD\_ACT[1] = LV\_ERR\_IVVT\_LOCK[1]  
 Bit 2 of ERR\_INH\_LAM\_AD\_ACT[0] = LV\_ERR\_CPS\_LOCK[0]  
 Bit 2 of ERR\_INH\_LAM\_AD\_ACT[1] = LV\_ERR\_CPS\_LOCK[1]  
 Bit 3 of ERR\_INH\_LAM\_AD\_ACT[0] = LV\_ERR\_LS\_UP\_LAM\_AD\_ACT\_LOCK[0]

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Bit 3 of ERR\_INH\_LAM\_AD\_ACT[1] = LV\_ERR\_LS\_UP\_LAM\_AD\_ACT\_LOCK[1]  
 Bit 4 of ERR\_INH\_LAM\_AD\_ACT[0] = LV\_ERR\_LS\_DOWN\_LAM\_AD\_ACT\_LOCK[0]  
 Bit 4 of ERR\_INH\_LAM\_AD\_ACT[1] = LV\_ERR\_LS\_DOWN\_LAM\_AD\_ACT\_LOCK[1]  
 Bit 5 of ERR\_INH\_LAM\_AD\_ACT[0] = 0(IV LOCK)  
 Bit 5 of ERR\_INH\_LAM\_AD\_ACT[1] = 0(IV LOCK)  
 Bit 6 of ERR\_INH\_LAM\_AD\_ACT[0] = LV\_ERR\_MIS\_FIRE\_LOCK[0]  
 Bit 6 of ERR\_INH\_LAM\_AD\_ACT[1] = LV\_ERR\_MIS\_FIRE\_LOCK[1]  
 Bit 7 of ERR\_INH\_LAM\_AD\_ACT[0] = LV\_ERR\_CAM\_LOCK[0]  
 Bit 7 of ERR\_INH\_LAM\_AD\_ACT[1] = LV\_ERR\_CAM\_LOCK[1]  
 Bit 8 of ERR\_INH\_LAM\_AD\_ACT[0] = 0(CRK LOCK)  
 Bit 8 of ERR\_INH\_LAM\_AD\_ACT[1] = 0(CRK LOCK)  
 Bit 9 of ERR\_INH\_LAM\_AD\_ACT[0] = LV\_ERR\_TCO\_LOCK[0]  
 Bit 9 of ERR\_INH\_LAM\_AD\_ACT[1] = LV\_ERR\_TCO\_LOCK[1]  
 Bit 10 of ERR\_INH\_LAM\_AD\_ACT[0] = LV\_ERR\_AMP\_LOCK[0]  
 Bit 10 of ERR\_INH\_LAM\_AD\_ACT[1] = LV\_ERR\_AMP\_LOCK[1]  
 Bit 11 of ERR\_INH\_LAM\_AD\_ACT[0] = LV\_ERR\_FUP\_LOCK[0]  
 Bit 11 of ERR\_INH\_LAM\_AD\_ACT[1] = LV\_ERR\_FUP\_LOCK[1]  
 Bit 12 of ERR\_INH\_LAM\_AD\_ACT[0] = LV\_ERR\_MAF\_LOCK[0]  
 Bit 12 of ERR\_INH\_LAM\_AD\_ACT[1] = LV\_ERR\_MAF\_LOCK[1]  
 Bit 13 of ERR\_INH\_LAM\_AD\_ACT[0] = LV\_ERR\_MAP\_LOCK[0]  
 Bit 13 of ERR\_INH\_LAM\_AD\_ACT[1] = LV\_ERR\_MAP\_LOCK[1]  
 Bit 14 of ERR\_INH\_LAM\_AD\_ACT[0] = 0 (IGC\_LOCK)  
 Bit 14 of ERR\_INH\_LAM\_AD\_ACT[1] = 0 (IGC\_LOCK)  
 Bit 15 of ERR\_INH\_LAM\_AD\_ACT[0] = LV\_ERR\_PLAUS\_LOCK[0]  
 Bit 15 of ERR\_INH\_LAM\_AD\_ACT[1] = LV\_ERR\_PLAUS\_LOCK[1]

//remark: Bits other than 0,1,2,3,4,6,7,9,10,11,12,13 and 15 are always 0

### 3.17.4 Update according to SAE paper

#### Application conditions

**Initialisation:** LV\_IGK 0 -> 1: all variables set to zero  
**Recurrence :** 20ms  
**Activation:** always


#### Formula section:

**FOR i=1 to NC\_CBK\_EX\_NR**

```
{
  if STATE_LS_SAE[i] = not(CL)
  then FAC_LAM_LIM_SAE[i] = 0%
  else
    FAC_LAM_LIM_SAE[i] = FAC_LAM_LIM[i] %limited closed-loop controller correction
  w/o
  end
precontrol-path correction
```

FAC\_LAM\_AD\_SAE[i] = OBD\_LAM\_AD[i]

if (LV\_LAM\_ADJ\_P\_ACT[i] or LV\_LAM\_ADJ\_I\_ACT[i] or LV\_LAM\_ADJ\_D\_ACT[i])

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```

then   LAMB_DELTA_LAM_ADJ_SAE[i] = LAMB_DELTA_LAM_ADJ [i]
else
        LAMB_DELTA_LAM_ADJ_SAE[i] = 0%
end
LAMB_DELTA_AD_LAM_ADJ_SAE[i] = LAMB_DELTA_AD_LAM_ADJ[i]
    %fuel system in open-loop means trim-control or lambda control in open loop
    %if lambda control is open-loop, trim control is deactivated automatically

} NEXT i

LAMB_SP_SAE = LAMB_SP_FIL_HOM[1] %incl. forced lambda stimulation and trim control interven-
tion

```

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## 3.18 AGGR adaptation: EGTR

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CAT_DIAG_MOD_6 [NC_CBK_EX_NR]	O/V/S	0... 7FH	0... 1.98437	0.015625	-
Cat. Diag. value for OBD Scantool Mod 6 output					
CAT_MAX_DIAG_MOD_6 [NC_CBK_EX_NR]	O/V/S	0... 7FH	0... 1.98437	0.015625	-
Actually threshold for Scantool Mod 6 Output					
DELTA_LAMB_SP_O2L_MDL [NC_CBK_EX_NR]	O/V	F800... 800H	-0.125 ...0.125	61e-6	-
lambda set point shift of catalyst O2 loading condition function					
LV_LAM_ADJ_RNG_VLD_CAT_DIAG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating Trim Ctr P-Share is inside a calibrateable window					
LV_NT_REQ_RGN	O/V	0... 1H	0 ...1	1	-
Logical value for regeneration phase request					

### Input data:

EFF_CAT_DIAG_OBD [NC_CBK_EX_NR] {p. 5515}	EFF_CAT_MAX_DIAG_OBD [NC_CBK_EX_NR] {p. 5515}	LAMB_DELTA_P_LAM_ADJ [NC_CBK_EX_NR] {p. 2589}	LV_RGN_NT_REQ {p. 2983}
NC_CBK_EX_NR {p. 1829}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_DELTA_P_LAM_ADJ_MAX	-	F800... 800H	-0.125 ...0.125	61e-6	-
max. P share threshold of trim controller for catalyst diagnosis activation					

### 3.18.1 Outputs for supplier aggregates, supplier internally

#### FUNCTION DESCRIPTION:

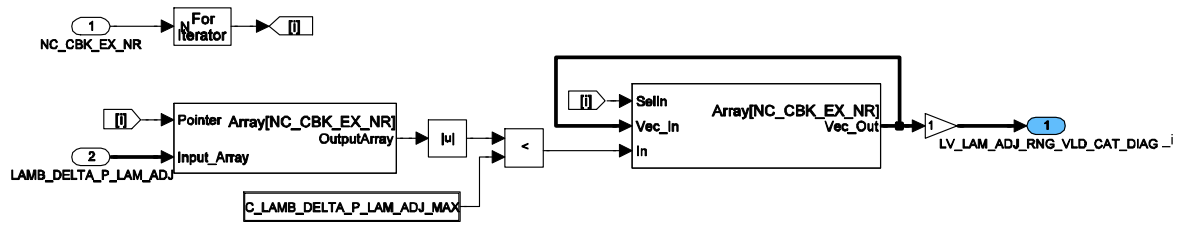
Adaptation to aggregate environment.

#### Application conditions


**Initialisation:** 0  
**Recurrence :** same recurrence as corresponding input data  
**Activation:** every engine operating state

#### Formula section:

LV\_NT\_REQ\_RGN = LV\_RGN\_NT\_REQ  
 CAT\_DIAG\_MOD\_6[i] = EFF\_CAT\_DIAG\_OBD[i]  
 CAT\_MAX\_DIAG\_MOD\_6[i] = EFF\_CAT\_MAX\_DIAG\_OBD[i]



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## 3.19 AGGR adaptation: EXTD

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TEG_DYN_STOP	O/V/S	0... 7FF0H	0... 2047	0.0625	°C
Modelled exhaust gas temperature at last engine stop					

### Input data:

TEG_DYN {p. 8236}			
-------------------	--	--	--

### FUNCTION DESCRIPTION:

#### Application conditions

**Initialisation:** at Engine run to Engine stop (ERU\_to\_ES)  
TEG\_DYN\_STOP = TEG\_DYN

**Recurrence:** -

**Activation:** -

**Deactivation:** -

#### Formula section:

-

## 3.20 AGGR adaptation: EXTC

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_CH_MOD_IVVT	O/V	0... FFH	0... 255	1	-
Bit-coded mask, containing combustion-mode-request for catalyst heating and the desulfation strategy; 2. Prio					
STATE_CH_MOD_IVVT_REQ	O/V	0... FFH	0... 255	1	-
Bit-coded mask, containing combustion-mode-request for catalyst heating and the desulfation strategy; 1. Prio					

### Input data:

LV_SO2P_REQ {p. 3129}	STATE_CH {p. 1777}	STATE_CH_MOD_REQ {p. 1796}	STATE_OPM_IVVT_CH {p. 3601}
-----------------------	--------------------	-------------------------------	--------------------------------

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_STATE_CH_MOD_IVVT	V	0... FFH	0... 255	1	-
LDPM_STATE_CH_MOD_REQ	5	0... 4H	0 ...4	1	-
LDPM_STATE_OPM_IVVT_CH	3	0... 2H	0 ...2	1	-
Matrix of Bit-mask for 2.Prio-Request					
ID_STATE_CH_MOD_IVVT_SO2P	V	0... FFH	0... 255	1	-
LDPM_STATE_CH_MOD_REQ	5	0... 4H	0 ...4	1	-
LDPM_STATE_OPM_IVVT_CH	3	0... 2H	0 ...2	1	-
Matrix of Bit-mask in case of desulfation for 2.Prio-Request					
ID_STATE_CH_MOD_REQ_IVVT	V	0... FFH	0... 255	1	-
LDPM_STATE_CH_MOD_REQ	5	0... 4H	0 ...4	1	-
LDPM_STATE_OPM_IVVT_CH	3	0... 2H	0 ...2	1	-
Matrix of Bit-mask for 1.Prio-Request					
ID_STATE_CH_MOD_REQ_IVVT_SO2P	V	0... FFH	0... 255	1	-
LDPM_STATE_CH_MOD_REQ	5	0... 4H	0 ...4	1	-
LDPM_STATE_OPM_IVVT_CH	3	0... 2H	0 ...2	1	-
Matrix of Bit-mask in case of desulfation for 1.Prio-Request					

### General information


Adaptation to BMW environment.

### Application conditions:

<b>Initialisation:</b>	<i>0 at reset except</i>
<b>Activation:</b>	<i>every engine state</i>
<b>Deactivation:</b>	-
<b>Recurrence:</b>	10 ms

### Function description:

### Formula section:

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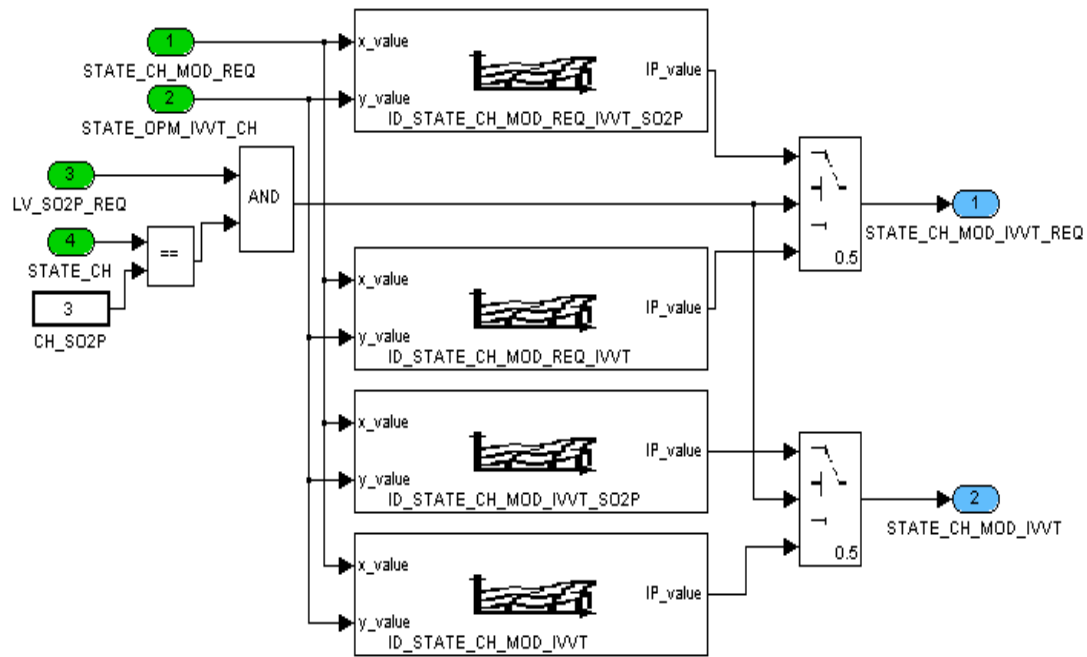


Figure 3.20.1:

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## 3.21 AGGR adaptation: ENSD

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_CAM_CUS	O/V	0... 1H	0 ...1	1	-
Customer specific CAM error					
LV_T_SEG_5_TOOTH_ACT	-	0... 1H	0 ...1	1	-
Flag: acquisition of partial segment times active					
LV_T_SEG_5_TOOTH_VLD	O/V	0... 1H	0 ...1	1	-
Flag: acquisition of partial segment times valid					
N_TOOTH_CUS	O/V	0... 1FE0H	0... 8160	1	rpm
fast engine speed generated especially for engine start (independently of C_N_FAST_SWI)					

### Input data:

C_N_TOOTH_END {p. 1526}	LV_ERR_CAM_TOT {p. 4455}	LV_RUN_ENG {p. 1505}	N_32 {p. 1525}
NC_NR_TOOTH {p. 854}	T_TOOTH {p. 853}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_32_MAX_SEG_5_TOOTH	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for acquisition of partial segment time over 5 teet					

### Import actions:

ACTION_INFR_DisableT5T ()
ACTION_INFR_EnableT5T ()
ACTION_INFR_GetT5TDiag (OUT<diag>)

## 3.21.1 Outputs for supplier functions

### 3.21.1.1 Generation of N\_TOOTH

#### FUNCTION DESCRIPTION:

#### Description:

As there is a strong request for a fast engine speed especially for engine start, and ENSD solely has the possibility to generate one out of four (N\_FAST can either be similar to N\_TOOTH or three differently calculated N\_FASTs - see engine position and speed calculation ), N\_TOOTH has to be calculated additionally in this module.

#### Application conditions

**Initialisation:**  $N\_TOOTH\_CUS = 0$

**Recurrence:**  $10ms$

**Activation:**  $LV\_RUN\_ENG = 1$  **and**

N\_32 C\_N\_TOOTH\_END

**Deactivation:** LV\_RUN\_ENG = 0 **or**  
N\_32 > C\_N\_TOOTH\_END

**Formula section:**

N\_TOOTH\_CUS (phys) = 60 / (NC\_NR\_TOOTH \* T\_TOOTH)

**3.21.1.2 Generation of LV\_ERR\_CAM\_CUS**

**Description:**

LV\_ERR\_CAM\_CUS is for customer specific adaptations on the ENSD interface LV\_ERR\_CAM\_TOT.

**Application conditions**

**Initialisation:** LV\_ERR\_CAM\_CUS = 0 at reset, LV\_IGK 0->1 and clearance of failurememory

**Recurrence:** every Camshaft signal edge (just after calculation of all CAM diagnosis)

**Activation:** every engine operating state

**Formula section:**

LV\_ERR\_CAM\_CUS = LV\_ERR\_CAM\_TOT

**3.21.2 Segment time acquisition for partial segments**

**FUNCTION DESCRIPTION:**

**General information:**

The function shall measure the period for segments of 5 teeth, and output the result as an array of 24 values for the whole engine cycle.

Acquisition shall start at regular segment event for cylinder 0 (SEG\_NR = 0). Every 5 teeth a time stamp shall be sampled, the period calculated as the difference of the actual and the last time stamp, and written to the array of temporary values at the appropriate location (e.g., the first partial segment time measured after start of regular segment 0 is written to the first location of the array).


**Application conditions**

**Activation:** at ENG\_STOP to SYN\_ENG\_IGK\_ON  
or RUN\_ENG to SYN\_ENG\_IGK\_ON

**Deactivation :** at SYN\_ENG\_IGK\_ON to RUN\_ENG (if supported by ECOP)  
or SYN\_ENG\_IGK\_ON to ENG\_STOP  
or SYN\_ENG\_IGK\_OFF to PWL :  
ACTION\_INFR\_DisableT5T()

LV\_T\_SEG\_5\_TOOTH\_VLD = 0  
LV\_T\_SEG\_5\_TOOTH\_ACT = 0

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**Initialization :**           at reset :

```

LV_T_SEG_5_TOOTH_VLD = 0
LV_T_SEG_5_TOOTH_ACT = 0

```


**Recurrence:**           segment

**Formula section:**

```

If(1)           N_32 <= C_N_32_MAX_SEG_5_TOOTH
Then(1)
                  If(2)                   (LV_T_SEG_5_TOOTH_ACT = 0)
Then(2)       ACTION_INFR_EnableT5T()
                  LV_T_SEG_5_TOOTH_ACT = 1
                  Endif(2)
                  get diagnostic information from infrastructure
                  ACTION_INFR_GetT5TDiag(
                                          OUT                   LV_T_SEG_5_TOOTH_VLD)
Else (1)
                  If(3) ( LV_T_SEG_5_TOOTH_ACT = 1 )
Then(3)       ACTION_INFR_DisableT5T()
                                          LV_T_SEG_5_TOOTH_ACT = 0
                                          LV_T_SEG_5_TOOTH_VLD = 0
                  Endif(3)
Endif(1)

```

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 1044 of 8404</b>	
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## 3.22 AGGR adaptation: ENTE

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ECFPWM_ECF	O/V	0... FFH	0... 99.60937	0.390625	%
Electric fan control pulse width modulation					
LV_ERR_ECT_MEC	O/V	0... 1H	0 ...1	1	-
Boolean for electronic controlled thermostat mechanical error					
LV_ERR_TCO_EX	O/V	0... 1H	0 ...1	1	-
Adaptation of TCO_2 diagnosis to ERRM					
TCO_EX	O/V	0... FEH	-48... 142.5	0.75	°C
TCO_2 adaptation					
TCO_EX_MES	O/V	0... FEH	-48... 142.5	0.75	°C
TCO_2_MES adaptation					

### Input data:

ECFPWM [NC_ECF_NR] {p. 3596}	LV_ERR_TCO_2 {p. 4572}	LV_ERR_TH {p. 5652}	LV_ES {p. 1720}
TCO_2 {p. 1218}	TCO_2_MES {p. 1218}		

### FUNCTION DESCRIPTION:

Adaptation of ENTE variables to MSD70 environment.

### General information:

At the MSD70 platform only one electronic controlled cooling fan is available. The number of cooling fans is configured with "1" therefore. In this case the following condition is permitted:

$$ECFPWM[NC\_ECF\_NR] = ECFPWM[1]$$

### Application conditions

**Initialisation:** all 0 at reset  
except:  
LV\_ERR\_ECT\_MEC = LV\_ERR\_TH

**Recurrence:** 1000 ms

**Activation:** every engine state

### Formula section:

$$TCO\_EX = TCO\_2$$

$$TCO\_EX\_MES = TCO\_2\_MES$$

$$LV\_ERR\_TCO\_EX = LV\_ERR\_TCO\_2$$

$$ECFPWM\_ECF = ECFPWM[1]$$

$$LV\_ERR\_ECT\_MEC = LV\_ERR\_TH$$

## 3.23 AGGR adaptation: PWSL

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_VB_CDN_OBD_1	O/V	0... 1H	0 ...1	1	-
Boolean for battery voltage condition fulfilled for OBD-I diagnosis					
LV_VB_CDN_OBD_2	O/V	0... 1H	0 ...1	1	-
Boolean for battery voltage condition fulfilled for OBD-II diagnosis					

### Input data:

LV_CDN_VB_OBD1 {p. 1185}	LV_CDN_VB_OBD2 {p. 1185}		
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### 3.23.1 Outputs for supplier aggregates, supplier internally

#### FUNCTION DESCRIPTION:

Adaptation to aggregate environment.

#### Application conditions

**Initialisation:** 0

**Recurrence :** same recurrence as corresponding input data

**Activation:** *every engine operating state*

#### Formula section:

LV\_VB\_CDN\_OBD\_1 = LV\_CDN\_VB\_OBD1

LV\_VB\_CDN\_OBD\_2 = LV\_CDN\_VB\_OBD2

## 3.24 AGGR adaptation: STSY

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Md_na_sl	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Torque losses for power steering					
Mdi_res_afs	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Engine torque reserve active front steering					
Mdi_res_sl	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Engine torque reserve for power steering					

### Input data:

TQ_ADD_PSTE {p. 6621}	TQ_ADD_PSTE_2 {p. 6621}	TQ_LOSS_PSTE {p. 6622}	
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### 3.24.1 Outputs for BMW functions which are not defined as STSY exported data

#### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

#### Application conditions

**Initialisation:** 0 Nm  
**Recurrence :** 10 ms  
**Activation:** *every engine state*

#### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

Md\_na\_sl = TQ\_LOSS\_PSTE

Mdi\_res\_afs = TQ\_ADD\_PSTE\_2

Mdi\_res\_sl = TQ\_ADD\_PSTE

## 3.25 AGGR adaptation: HVAC

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_korel	O/V	0... 1H	0 ...1	1	-
condition air compressor					
Md_na_ac	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
torque losses air conditioning compressor					
Mdi_res_ac	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
torque reserve for switching on air conditioning compressor					
Mdi_res_heiz	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
Torque reserve for switching on additional heating by ACC					

### Input data:

ECU_STATE {p. 1091}	LV_ACCIN {p. 1564}	TQ_ADD_ACC {p. 6602}	TQ_ADD_HEAT_ACC {p. 6602}
TQ_LOSS_ACC {p. 6602}			

### 3.25.1 Outputs for BMW functions which are defined as HVAC exported data

#### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

#### Application conditions

**Initialisation:** *0 at reset*

**Recurrence :** 10 ms

**Activation:** *every engine state*

#### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

Mdi\_res\_ac = TQ\_ADD\_ACC  
Mdi\_res\_heiz = TQ\_ADD\_HEAT\_ACC

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if      ECU_STATE = 4Hex    "power latch"
then    B_korel = 0
          Md_na_ac = 0
else    B_korel = LV_ACCIN
          Md_na_ac = TQ_LOSS_ACC
endif
    
```



## 3.26 AGGR adaptation: ERRM

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_ALTER_BN	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error PM board network diagnosis					
ERR_SYM_ALTER_BN_BAT	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error PM battery diagnosis					
ERR_SYM_ALTER_BN_RGN	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected ALTER_BN_RGN error symptom					
ERR_SYM_AMP_PLAUS_CUS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error AMP plausibility diagnosis					
ERR_SYM_BAT_SENS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BAT_SENS (component) communication					
ERR_SYM_BAT_SENS_IT	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BAT_SENS component					
ERR_SYM_BAT_SENS_IT_EL	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BAT_SENS electrical					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
For each symptom : status of failure (set to 1 when failure symptom detected); exhaust during catalyst heating					
ERR_SYM_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
For each symptom : status of failure (set to 1 when failure symptom detected); inlet during catalyst heating					
ERR_SYM_EGRV_PSN_PLAUS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom for exhaust gas recirculation valve position plausibility					
ERR_SYM_ER_STRAT	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom for engine roughness improvement at stratified mode					
ERR_SYM_ER_STRAT_WUP	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom for engine roughness improvement at stratified mode at warmup					
ERR_SYM_GEN	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error generator diagnosis					
ERR_SYM_GEN_CLC_V_NOT_PLAUS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom CLC_V_NOT_PLAUS					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_GEN_CTL_NOT_PLAUS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom in generator controller plausibility diagnosis					
ERR_SYM_GEN_EL	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom in electrical generator diagnosis					
ERR_SYM_GEN_H_TEMP	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom in generator high temperature diagnosis					
ERR_SYM_GEN_H_TEMP_CLC	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom in calculated generator high temperature diagnosis					
ERR_SYM_GEN_MEC	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom in mechanical generator diagnosis					
ERR_SYM_GEN_MSG_LOST	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom GEN_MSG_LOST					
ERR_SYM_GEN_TYP_NOT_PLAUS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom in generator type plausibility diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_LOAD_TPS_PLAUS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom load/TPS plausibility check					
ERR_SYM_MAF_LAMB_MAX	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom for maximum mass air flow calculated from lambda					
ERR_SYM_MAP_DIP_PLAUS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected MAP_DIP_PLAUS error symptom					
ERR_SYM_MAP_PLAUS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom Manifold pressure plausibility diagnosis					
ERR_SYM_MAP_TPS_PLAUS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error MAP ratio plausibility diagnosis					
ERR_SYM_MEC_IVVT_EX	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom on the exhaust CAM adjustment					
ERR_SYM_MEC_IVVT_IN	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom on the inlet CAM adjustment					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_N_MAX_DRIV_REQ	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom for too high engine rotation speed at vehicle stop					
ERR_SYM_N_MAX_HOMS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error engine overspeed for changing the combustion mode diagnosis					
ERR_SYM_NEUT_PSN_GB_LRN	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error Neutral gear learning diagnosis					
ERR_SYM_POIL_CTL_DYN	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error oil pressure controller (static)					
ERR_SYM_POIL_CTL_MEC	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error Oilpressure valve diagnosis					
ERR_SYM_POIL_CTL_STAT	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error oil pressure controller (static)					
ERR_SYM_POIL_PUMP	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error Oilpump diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_POIL_SENS_PLAUS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error Oilpressure sensor diagnosis					
ERR_SYM_POIL_SYS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error Oilsystem diagnosis					
ERR_SYM_PUT_PLAUS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error PUT plausibility diagnosis					
ERR_SYM_QOIL_SENS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected quality Oil Sensor Symptom					
ERR_SYM_TCHA_LEAK	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error charger leakage diagnosis					
ERR_SYM_TCHA_PRS_CTL	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error charger pressure controller diagnosis					
ERR_SYM_TCHA_PRS_DIF	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error charger pressure difference diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TCHA_PRS_HIGH	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error charger pressure to high diagnosis					
ERR_SYM_TCHA_PRS_LOW	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error charger pressure to low diagnosis					
ERR_SYM_TCHA_SYS_1	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error charger system diagnosis 1					
ERR_SYM_TOIL_LEVEL	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error TOENS sensor					
ERR_SYM_TQ_CST	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected TQ_CST error symptom					
ERR_SYM_VIM_PLAUS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected VIM_PLAUS error symptom					
LV_CDN_DIAG_ALTER_BN	V	0... 1H	0 ...1	1	-
condition PM board network diagnosis					
LV_CDN_DIAG_ALTER_BN_BAT	V	0... 1H	0 ...1	1	-
condition PM battery diagnosis					
LV_CDN_DIAG_ALTER_BN_RGN	V	0... 1H	0 ...1	1	-
Diagnosis Condition ALTER_BN_RGN error					
LV_CDN_DIAG_AMP_PLAUS_CUS	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on AMP plausibility diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_BAT_SENS	V	0... 1H	0 ...1	1	-
condition for BAT_SENS-diagnosis fulfilled					
LV_CDN_DIAG_BAT_SENS_IT	V	0... 1H	0 ...1	1	-
condition for BAT_SENS-diagnosis (electrical) fulfilled					
LV_CDN_DIAG_BAT_SENS_IT_EL	V	0... 1H	0 ...1	1	-
condition for BAT_SENS-diagnosis (communication) fulfilled					
LV_CDN_DIAG_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled); exhaust during catalyst heating					
LV_CDN_DIAG_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled); inlet during catalyst heating					
LV_CDN_DIAG_EGRV_PSN_PLAUS	V	0... 1H	0 ...1	1	-
Diagnosis condition for diagnosis instance of exhaust gas recirculation valve position plausibility					
LV_CDN_DIAG_ER_STRAT	V	0... 1H	0 ...1	1	-
Diagnosis condition for engine roughness improvement at stratified mode					
LV_CDN_DIAG_ER_STRAT_WUP	V	0... 1H	0 ...1	1	-
Diagnosis condition for engine roughness improvement at stratified mode at warmup					
LV_CDN_DIAG_GEN	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on generator diagnosis					
LV_CDN_DIAG_GEN_CLC_V_NOT_PLAUS	V	0... 1H	0 ...1	1	-
Diagnosis condition GEN_CLC_V_NOT_PLAUS					
LV_CDN_DIAG_GEN_CTL_NOT_PLAUS	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present for generator controller plausibility diagnosis					
LV_CDN_DIAG_GEN_EL	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present for electrical generator diagnosis					
LV_CDN_DIAG_GEN_H_TEMP	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present for generator high temperature diagnosis					
LV_CDN_DIAG_GEN_H_TEMP_CLC	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present for calculated generator high temperature diagnosis					
LV_CDN_DIAG_GEN_MEC	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present for mechanical generator diagnosis					
LV_CDN_DIAG_GEN_MSG_LOST	V	0... 1H	0 ...1	1	-
Diagnosis condition GEN_MSG_LOST					
LV_CDN_DIAG_GEN_TYP_NOT_PLAUS	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present for generator type plausibility diagnosis					
LV_CDN_DIAG_LOAD_TPS_PLAUS	V	0... 1H	0 ...1	1	-
Diagnosis Condition LOAD_TPS_PLAUS error					
LV_CDN_DIAG_MAF_LAMB_MAX	V	0... 1H	0 ...1	1	-
Diagnosis condition for maximum mass air flow calculated from lambda					
LV_CDN_DIAG_MAP_DIP_PLAUS	V	0... 1H	0 ...1	1	-
Diagnosis Condition MAP_DIP_PLAUS error					
LV_CDN_DIAG_MAP_PLAUS	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for Manifold pressure plausibility					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_MAP_TPS_PLAUS	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on MAP ratio plausibility diagnosis					
LV_CDN_DIAG_MEC_IVVT_EX	V	0... 1H	0 ...1	1	-
Diagnosis Condition exhaust CAM adjustment					
LV_CDN_DIAG_MEC_IVVT_IN	V	0... 1H	0 ...1	1	-
Diagnosis Condition inlet CAM adjustment					
LV_CDN_DIAG_N_MAX_DRIV_REQ	V	0... 1H	0 ...1	1	-
Diagnosis condition for too high engine rotation speed at vehicle stop					
LV_CDN_DIAG_N_MAX_HOMS	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on engine overspeed for changing the combustion mode diagnosis					
LV_CDN_DIAG_NEUT_PSN_GB_LRN	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on Neutral gear learning diagnosis					
LV_CDN_DIAG_POIL_CTL_DYN	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on oil pressure contoller (dynamic)					
LV_CDN_DIAG_POIL_CTL_MEC	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on Oilpressure valve diagnosis					
LV_CDN_DIAG_POIL_CTL_STAT	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on oil pressure contoller (static)					
LV_CDN_DIAG_POIL_PUMP	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on Oilpump diagnosis					
LV_CDN_DIAG_POIL_SENS_PLAUS	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on Oilpressure sensor diagnosis					
LV_CDN_DIAG_POIL_SYS	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on Oilsystem diagnosis					
LV_CDN_DIAG_PUT_PLAUS	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on PUT plausibility diagnosis					
LV_CDN_DIAG_QOIL_SENS	V	0... 1H	0 ...1	1	-
oil quality Diagnosis Condition					
LV_CDN_DIAG_TCHA_LEAK	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on charger leakage diagnosis					
LV_CDN_DIAG_TCHA_PRS_CTL	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on charger pressure controller diagnosis					
LV_CDN_DIAG_TCHA_PRS_DIF	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on charger pressure difference diagnosis					
LV_CDN_DIAG_TCHA_PRS_HIGH	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on charger pressure to high diagnosis					
LV_CDN_DIAG_TCHA_PRS_LOW	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on charger pressure to low diagnosis					
LV_CDN_DIAG_TCHA_SYS_1	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on charger system diagnosis 1					
LV_CDN_DIAG_TOIL_LEVEL	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on TOENS sensor					
LV_CDN_DIAG_TQ_CST	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on TQ_CST sensor					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_VIM_PLAUS	V	0... 1H	0 ...1	1	-
Diagnosis Condition VIM_PLAUS error					
LV_CDN_RBM_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	V	0... 1H	0 ...1	1	-
Flag set if CST_IVVT diagnosis condition RBM is fulfilled					
LV_CDN_RBM_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	V	0... 1H	0 ...1	1	-
Flag set if CST_IVVT diagnosis condition RBM is fulfilled					
LV_CDN_RBM_LOAD_TPS_PLAUS	V	0... 1H	0 ...1	1	-
Flag set if LOAD_TPS_PLAUS diagnosis condition RBM is fulfilled					
LV_CDN_RBM_MAP_DIP_PLAUS	V	0... 1H	0 ...1	1	-
Flag set if MAP_DIP_PLAUS diagnosis condition RBM is fulfilled					
LV_CDN_RBM_MEC_IVVT_EX	V	0... 1H	0 ...1	1	-
Flag set if IVVT diagnosis condition RBM is fulfilled					
LV_CDN_RBM_MEC_IVVT_IN	V	0... 1H	0 ...1	1	-
Flag set if IVVT diagnosis condition RBM is fulfilled					
LV_CDN_RBM_TQ_CST	V	0... 1H	0 ...1	1	-
Flag set if TQ_CST diagnosis condition RBM is fulfilled					
LV_END_DIAG_ALTER_BN	V	0... 1H	0 ...1	1	-
end of PM board network diagnosis					
LV_END_DIAG_ALTER_BN_BAT	V	0... 1H	0 ...1	1	-
end of PM battery diagnosis					
LV_END_DIAG_ALTER_BN_RGN	V	0... 1H	0 ...1	1	-
End of ALTER_BN_RGN error sensor diagnosis					
LV_END_DIAG_AMP_PLAUS_CUS	V	0... 1H	0 ...1	1	-
End of diagnosis AMP plausibility diagnosis					
LV_END_DIAG_BAT_SENS	V	0... 1H	0 ...1	1	-
End of Diagnosis BAT_SENS communication					
LV_END_DIAG_BAT_SENS_IT	V	0... 1H	0 ...1	1	-
End of Diagnosis BAT_SENS component					
LV_END_DIAG_BAT_SENS_IT_EL	V	0... 1H	0 ...1	1	-
End of Diagnosis BAT_SENS electrical					
LV_END_DIAG_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	V	0... 1H	0 ...1	1	-
Diagnosis done completely at least one time; exhaust					
LV_END_DIAG_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	V	0... 1H	0 ...1	1	-
Diagnosis done completely at least one time; inlet					
LV_END_DIAG_EGRV_PSN_PLAUS	V	0... 1H	0 ...1	1	-
Diagnosis result available for diagnosis instance exhaust gas recirculation valve position plausibility					
LV_END_DIAG_ER_STRAT	V	0... 1H	0 ...1	1	-
Diagnosis result available for daignosis instance of engine roughness improvement at stratified mode					
LV_END_DIAG_ER_STRAT_WUP	V	0... 1H	0 ...1	1	-
Diagnosis result available for daignosis instance of engine roughness improvement at stratified mode at warmup					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_GEN	V	0... 1H	0 ...1	1	-
End of diagnosis generator diagnosis					
LV_END_DIAG_GEN_CLC_V_NOT_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis GEN_CLC_V_NOT_PLAUS					
LV_END_DIAG_GEN_CTL_NOT_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis flag for generator controller plausibility diagnosis					
LV_END_DIAG_GEN_EL	V	0... 1H	0 ...1	1	-
End of diagnosis flag for electrical generator diagnosis					
LV_END_DIAG_GEN_H_TEMP	V	0... 1H	0 ...1	1	-
End of diagnosis flag for generator high temperature diagnosis					
LV_END_DIAG_GEN_H_TEMP_CLC	V	0... 1H	0 ...1	1	-
End of diagnosis flag for calculated generator high temperature diagnosis					
LV_END_DIAG_GEN_MEC	V	0... 1H	0 ...1	1	-
End of diagnosis flag for mechanical generator diagnosis					
LV_END_DIAG_GEN_MSG_LOST	V	0... 1H	0 ...1	1	-
End of diagnosis GEN_MSG_LOST					
LV_END_DIAG_GEN_TYP_NOT_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis flag for generator type plausibility diagnosis					
LV_END_DIAG_LOAD_TPS_PLAUS	V	0... 1H	0 ...1	1	-
End of LOAD_TPS_PLAUS error sensor diagnosis					
LV_END_DIAG_MAF_LAMB_MAX	V	0... 1H	0 ...1	1	-
Diagnosis result available for daignosis instance of maximum mass air flow calculated from lambda					
LV_END_DIAG_MAP_DIP_PLAUS	V	0... 1H	0 ...1	1	-
End of MAP_DIP_PLAUS error sensor diagnosis					
LV_END_DIAG_MAP_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis flag for Manifold pressure plausibility diagnosis					
LV_END_DIAG_MAP_TPS_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis MAP ratio plausibility diagnosis					
LV_END_DIAG_MEC_IVVT_EX	V	0... 1H	0 ...1	1	-
End of exhaust CAM adjustment Diagnosis					
LV_END_DIAG_MEC_IVVT_IN	V	0... 1H	0 ...1	1	-
End of inlet CAM adjustment Diagnosis					
LV_END_DIAG_N_MAX_DRIV_REQ	V	0... 1H	0 ...1	1	-
Diagnosis result available for daignosis instance of too high engine rotation speed at vehicle stop					
LV_END_DIAG_N_MAX_HOMS	V	0... 1H	0 ...1	1	-
End of diagnosis engine overspeed for changing the combustion mode diagnosis					
LV_END_DIAG_NEUT_PSN_GB_LRN	V	0... 1H	0 ...1	1	-
End of diagnosis Neutral gear learning diagnosis					
LV_END_DIAG_POIL_CTL_DYN	V	0... 1H	0 ...1	1	-
End of diagnosis oil pressure contoller (dynamic)					
LV_END_DIAG_POIL_CTL_MEC	V	0... 1H	0 ...1	1	-
End of diagnosis Oilpressure valve diagnosis					
LV_END_DIAG_POIL_CTL_STAT	V	0... 1H	0 ...1	1	-
End of diagnosis oil pressure contoller (static)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_POIL_PUMP	V	0... 1H	0 ...1	1	-
End of diagnosis Oilpump diagnosis					
LV_END_DIAG_POIL_SENS_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis Oilpressure sensor diagnosis					
LV_END_DIAG_POIL_SYS	V	0... 1H	0 ...1	1	-
End of diagnosis Oilsystem diagnosis					
LV_END_DIAG_PUT_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis PUT plausibility diagnosis					
LV_END_DIAG_QOIL_SENS	V	0... 1H	0 ...1	1	-
End of quality Oil Diagnosis					
LV_END_DIAG_TCHA_LEAK	V	0... 1H	0 ...1	1	-
End of diagnosis charger leakage diagnosis					
LV_END_DIAG_TCHA_PRS_CTL	V	0... 1H	0 ...1	1	-
End of diagnosis charger pressure controller diagnosis					
LV_END_DIAG_TCHA_PRS_DIF	V	0... 1H	0 ...1	1	-
End of diagnosis charger pressure difference diagnosis					
LV_END_DIAG_TCHA_PRS_HIGH	V	0... 1H	0 ...1	1	-
End of diagnosis charger pressure to high diagnosis					
LV_END_DIAG_TCHA_PRS_LOW	V	0... 1H	0 ...1	1	-
End of diagnosis charger pressure to low diagnosis					
LV_END_DIAG_TCHA_SYS_1	V	0... 1H	0 ...1	1	-
End of diagnosis charger system diagnosis 1					
LV_END_DIAG_TOIL_LEVEL	V	0... 1H	0 ...1	1	-
End of diagnosis TOENS sensor					
LV_END_DIAG_TQ_CST	V	0... 1H	0 ...1	1	-
End of TQ_CST error diagnosis					
LV_END_DIAG_VIM_PLAUS	V	0... 1H	0 ...1	1	-
End of VIM_PLAUS error sensor diagnosis					
LV_END_RBM_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	V	0... 1H	0 ...1	1	-
Flag set if CST_IVVT diagnosis cycle RBM is finished					
LV_END_RBM_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	V	0... 1H	0 ...1	1	-
Flag set if CST_IVVT diagnosis cycle RBM is finished					
LV_END_RBM_LOAD_TPS_PLAUS	V	0... 1H	0 ...1	1	-
Flag set if LOAD_TPS_PLAUS diagnosis cycle RBM is finished					
LV_END_RBM_MAP_DIP_PLAUS	V	0... 1H	0 ...1	1	-
Flag set if MAP_DIP_PLAUS diagnosis cycle RBM is finished					
LV_END_RBM_MEC_IVVT_EX	V	0... 1H	0 ...1	1	-
Flag set if IVVT diagnosis cycle RBM is finished					
LV_END_RBM_MEC_IVVT_IN	V	0... 1H	0 ...1	1	-
Flag set if IVVT diagnosis cycle RBM is finished					
LV_END_RBM_TQ_CST	V	0... 1H	0 ...1	1	-
Flag set if TQ_CST diagnosis cycle RBM is finished					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_EOL_OBD_DC	O/V	0... 1H	0 ...1	1	-
Flag for EOL activation in driving cycle					
LV_ERR_ALTER_BN	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on PM board network					
LV_ERR_ALTER_BN_BAT	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on PM battery					
LV_ERR_ALTER_BN_RGN	O/V	0... 1H	0 ...1	1	-
Error Flag for ALTER_BN_RGN error					
LV_ERR_AMP_PLAUS_CUS	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on AMP plausibility diagnosis					
LV_ERR_BAT_SENS	O/V	0... 1H	0 ...1	1	-
communication error BAT_SENS					
LV_ERR_BAT_SENS_IT	O/V	0... 1H	0 ...1	1	-
internal error (component) BAT_SENS					
LV_ERR_BAT_SENS_IT_EL	O/V	0... 1H	0 ...1	1	-
internal error (electrical) BAT_SENS					
LV_ERR_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	O/V	0... 1H	0 ...1	1	-
Present failure: failure after filtering of diagnosis enduring exhaust camshaft deviation at steady setpoint during catalyst heating					
LV_ERR_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	O/V	0... 1H	0 ...1	1	-
Present failure: failure after filtering of diagnosis enduring inlet camshaft deviation at steady setpoint during catalyst heating					
LV_ERR_EGRV_PSN_PLAUS	O/V	0... 1H	0 ...1	1	-
Error flag for position of exhaust gas recirculation valve plausibility					
LV_ERR_ER_STRAT	O/V	0... 1H	0 ...1	1	-
Error flag for engine roughness improvement at stratified mode					
LV_ERR_ER_STRAT_WUP	O/V	0... 1H	0 ...1	1	-
Error flag for engine roughness improvement at stratified mode at warmup					
LV_ERR_GEN	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on Generator					
LV_ERR_GEN_CLC_V_NOT_PLAUS	O/V	0... 1H	0 ...1	1	-
Flag for calculated generator voltage plausibility error					
LV_ERR_GEN_CTL_NOT_PLAUS	O/V	0... 1H	0 ...1	1	-
Flag for calculated generator controller plausibility error					
LV_ERR_GEN_EL	O/V	0... 1H	0 ...1	1	-
Flag for electrical generator error					
LV_ERR_GEN_H_TEMP	O/V	0... 1H	0 ...1	1	-
Flag for generator high temperature error					
LV_ERR_GEN_H_TEMP_CLC	O/V	0... 1H	0 ...1	1	-
Flag for calculated generator high temperature error					
LV_ERR_GEN_MEC	O/V	0... 1H	0 ...1	1	-
Flag for mechanical generator error					
LV_ERR_GEN_MSG_LOST	O/V	0... 1H	0 ...1	1	-
Present error GEN_MSG_LOST					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_GEN_TYP_NOT_PLAUS	O/V	0... 1H	0 ...1	1	-
Flag for generator type not plausible error					
LV_ERR_IVVT	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present IVVT system					
LV_ERR_LOAD_TPS_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean that indicates inconsistencies between actual load and throttle position					
LV_ERR_MAF_LAMB_MAX	O/V	0... 1H	0 ...1	1	-
Error flag for maximum mass air flow calculated from lambda					
LV_ERR_MAP_DIP_PLAUS	-	0... 1H	0 ...1	1	-
Error Flag for MAP_DIP_PLAUS error					
LV_ERR_MAP_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for detected error of Manifold pressure plausibility diagnosis					
LV_ERR_MAP_TPS_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for error MAP ratio plausibility diagnosis					
LV_ERR_MEC_IVVT_EX	O/V	0... 1H	0 ...1	1	-
Error Flag for functional error on the exhaust CAM adjustment					
LV_ERR_MEC_IVVT_IN	O/V	0... 1H	0 ...1	1	-
Error Flag for functional error on the inlet CAM adjustment					
LV_ERR_N_MAX_DRIV_REQ	O/V	0... 1H	0 ...1	1	-
Error flag for too high engine rotation speed at vehicle stop					
LV_ERR_N_MAX_HOMS	O/V	0... 1H	0 ...1	1	-
Boolean for error engine overspeed for changing the combustion mode					
LV_ERR_NEUT_PSN_GB_LRN	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on Neutral gear learning diagnosis					
LV_ERR_POIL_CTL_DYN	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on oil pressure contoller (dynamic)					
LV_ERR_POIL_CTL_MEC	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on Oilpressure valve diagnosis					
LV_ERR_POIL_CTL_STAT	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on oil pressure contoller (static)					
LV_ERR_POIL_PUMP	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on Oilpump diagnosis					
LV_ERR_POIL_SENS_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on Oilpressure sensor diagnosis					
LV_ERR_POIL_SYS	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on Oilsystem diagnosis					
LV_ERR_PUT_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on PUT plausibility diagnosis					
LV_ERR_QOIL_SENS	O/V	0... 1H	0 ...1	1	-
Error Flag for quality Oil Sensor					
LV_ERR_TCHA_LEAK	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on charger leakage diagnosis					
LV_ERR_TCHA_PRS_CTL	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on charger pressure controller diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_TCHA_PRS_DIF	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on charger pressure difference diagnosis					
LV_ERR_TCHA_PRS_HIGH	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on charger pressure to high diagnosis					
LV_ERR_TCHA_PRS_LOW	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on charger pressure to low diagnosis					
LV_ERR_TCHA_SYS_1	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on charger system diagnosis 1					
LV_ERR_TOIL	O/V	0... 1H	0 ...1	1	-
Flag for oil temperature error (set to "0" because TOIL_MDL is used if no value from sensor or CAN is available)					
LV_ERR_TOIL_LEVEL	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on TOENS sensor					
LV_ERR_TQ_CST	O/V	0... 1H	0 ...1	1	-
Error Flag for TQ_CST error					
LV_ERR_VIM_PLAUS	O/V	0... 1H	0 ...1	1	-
Flag to indicate VIM failure global error					
LV_INH_DIAG_RBM_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	V	0... 1H	0 ...1	1	-
Flag set if CST_IVVT diagnosis is inhibited due to present OBD error					
LV_INH_DIAG_RBM_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	V	0... 1H	0 ...1	1	-
Flag set if IVVT diagnosis is inhibited due to present OBD error					
LV_INH_DIAG_RBM_LOAD_TPS_PLAUS	V	0... 1H	0 ...1	1	-
Flag set if LOAD_TPS_PLAUS diagnosis is inhibited due to present OBD error					
LV_INH_DIAG_RBM_MAP_DIP_PLAUS	V	0... 1H	0 ...1	1	-
Flag set if MAP_DIP_PLAUS diagnosis is inhibited due to present OBD error					
LV_INH_DIAG_RBM_MEC_IVVT_EX	V	0... 1H	0 ...1	1	-
Flag set if IVVT diagnosis is inhibited due to present OBD error					
LV_INH_DIAG_RBM_MEC_IVVT_IN	V	0... 1H	0 ...1	1	-
Flag set if IVVT diagnosis is inhibited due to present OBD error					
LV_INH_DIAG_RBM_TQ_CST	V	0... 1H	0 ...1	1	-
Flag set if TQ_CST diagnosis is inhibited due to present OBD error					
STATE_RBM_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	O/V	0... FFH	0... 255	1	-
Interface of monitor CAM_CST_IVVT_EX[NC_NR_CBK_IVVT] for the rate based monitoring statistics					
STATE_RBM_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	O/V	0... 7H	0 ...7	1	-
Interface of CAM_CST_IVVT_IN monitor with the Rate-Based Monitoring statistics					
STATE_RBM_LOAD_TPS_PLAUS	O/V	0... 7H	0 ...7	1	-
Interface of LOAD_TPS_PLAUS monitor with the Rate-Based Monitoring statistics					
STATE_RBM_MAP_DIP_PLAUS	O/V	0... 7H	0 ...7	1	-
Interface of MAP_DIP_PLAUS monitor with the Rate-Based Monitoring statistics					
STATE_RBM_MEC_IVVT_EX	O/V	0... 7H	0 ...7	1	-
Interface of MEC_IVVT_EX monitor with the Rate-Based Monitoring statistics					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_RBM_MEC_IVVT_IN	O/V	0... 7H	0 ...7	1	-
Interface of MEC_IVVT_IN monitor with the Rate-Based Monitoring statistics					
STATE_RBM_TQ_CST	O/V	0... 7H	0 ...7	1	-
Interface of TQ_CST monitor with the Rate-Based Monitoring statistics					

**Input data:**

CTR_ABC_XX {p. 4640}	ERR_SYM_MEM [NC_NR_ERR_DYN] {p. 5756}	LV_DC {p. 5746}	LV_DC_MAX [NC_NR_ERR_DYN] {p. 5767}
LV_ERR_ACK_IGK_OFF {p. 4939}	LV_ERR_ACR_AD {p. 4320}	LV_ERR_ACR_CTL {p. 4337}	LV_ERR_ALTER_COM {p. 4834}
LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_BN_ETCU {p. 4870}	LV_ERR_BN_ICL {p. 4870}
LV_ERR_BN_TCS {p. 4870}	LV_ERR_BSD {p. 4834}	LV_ERR_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}	LV_ERR_CAT_DIAG_AFL [NC_CBK_EX_NR] {p. 5561}
LV_ERR_COM_GB {p. 4849}	LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}
LV_ERR_CRK_TOOTH_ PER {p. 4432}	LV_ERR_CS_PLAUS	LV_ERR_CWP_COM {p. 4834}	LV_ERR_CWP_INT_OFF {p. 4537}
LV_ERR_CWP_PLAUS {p. 4537}	LV_ERR_CWP_PWR {p. 4537}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}
LV_ERR_ECF_EL [NC_ECF_NR] {p. 4507}	LV_ERR_ECFPWM_FB [NC_ECF_NR] {p. 4507}	LV_ERR_ECT_EL {p. 4530}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FTL_MIN {p. 4762}
LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_LAMB_NS_PUC [NC_NOX_SENS_CONF]	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_MAF {p. 4815}
LV_ERR_MAF_FRQ_EL [NC_MAF_NR] {p. 4815}	LV_ERR_MAF_FRQ_GRD [NC_MAF_NR] {p. 4815}	LV_ERR_MAF_FRQ_RNG [NC_MAF_NR] {p. 4815}	LV_ERR_MAP_DIP_SENS {p. 4824}
LV_ERR_MAP_DIP_SHIFT {p. 4824}	LV_ERR_MEM_XX {p. 5767}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}
LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}	LV_ERR_NEUT_PSN_GB	LV_ERR_NEUT_PSN_GB_ PLAUS
LV_ERR_NOX_NS_PUC [NC_NOX_SENS_CONF]	LV_ERR_NS_ACT [NC_NOX_SENS_CONF] {p. 6358}	LV_ERR_NS_AFR [NC_NOX_SENS_CONF] {p. 6389}	LV_ERR_NS_AVL [NC_NOX_SENS_CONF] {p. 6368}
LV_ERR_NS_HTP [NC_NOX_SENS_CONF] {p. 6330}	LV_ERR_NS_LSL_UP_ DOWN [NC_NOX_SENS_CONF] {p. 6396}	LV_ERR_NS_OBD_1_HTP [NC_NOX_SENS_CONF] {p. 4916}	LV_ERR_NS_OBD_1_ LAMB [NC_NOX_SENS_CONF] {p. 4916}



LV_ERR_NS_OBD_1_NOX [NC_NOX_SENS_CONF] {p. 4916}	LV_ERR_NS_OBD_1_VLS [NC_NOX_SENS_CONF] {p. 4916}	LV_ERR_NS_OFS [NC_NOX_SENS_CONF] {p. 6378}	LV_ERR_NS_PUC [NC_NOX_SENS_CONF] {p. 6405}
LV_ERR_NS_PWR [NC_NOX_SENS_CONF]	LV_ERR_NS_STOP [NC_NOX_SENS_CONF] {p. 6347}	LV_ERR_NS_VLS_DYN [NC_NOX_SENS_CONF] {p. 6338}	LV_ERR_NT_AGI {p. 6485}
LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_PBSU	LV_ERR_PBSU_PLAUS	LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PND [NC_NR_ERR_DYN] {p. 5767}
LV_ERR_POIL_DR {p. 4357}	LV_ERR_PUT_EL {p. 4828}	LV_ERR_QOIL_COM {p. 4834}	LV_ERR_REF_CRK_CAM_ EX [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_REF_CRK_CAM_ IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_RLY_ACCOUT {p. 4627}	LV_ERR_SENS_ACR {p. 4352}	LV_ERR_SENS_BAT_ SMT_COM {p. 4834}
LV_ERR_SENS_POIL {p. 4365}	LV_ERR_SLV_IVVT_EX {p. 4627}	LV_ERR_SLV_IVVT_IN {p. 4627}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CRK_CAM_ EX [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_SYN_CRK_CAM_ IN [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_TAM_CAN {p. 5076}
LV_ERR_TAM_PLAUS {p. 5076}	LV_ERR_TCO_2_EL {p. 4572}	LV_ERR_TCO_2_GRD {p. 4572}	LV_ERR_TCO_2_PLAUS {p. 5666}
LV_ERR_TCO_EL {p. 4496}	LV_ERR_TCO_GRD {p. 4496}	LV_ERR_TCO_PLAUS {p. 5682}	LV_ERR_TCO_STUCK {p. 5691}
LV_ERR_TCO_STUCK_ RNG {p. 5675}	LV_ERR_TEG_PCAT_ DOWN {p. 4713}	LV_ERR_TH {p. 5652}	LV_ERR_TIA_PLAUS {p. 5093}
LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOUT_ASR_1 {p. 802}	LV_ERR_TOUT_ETCU_1 {p. 802}
LV_ERR_TOUT_ICL_2 {p. 802}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}
LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}
LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_VEH_POW_VAR {p. 4945}	LV_ERR_VIM_1_EL {p. 5065}	LV_ERR_VIM_2_EL {p. 5065}
LV_ERR_VIMPWM_1_FB {p. 5065}	LV_ERR_VIMPWM_2_FB {p. 5065}	LV_ERR_VLS_NS_PUC [NC_NOX_SENS_CONF]	LV_ERR_VS {p. 5021}
LV_ERR_WG_1_DR {p. 4207}	LV_ERR_WG_2_DR {p. 4207}	LV_READY_XX {p. 5881}	LV_VAR_BN {p. 655}
WAL_CONF_XX {p. 5811}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_LOAD_TPS_PLAUS	-	0... FFH	0... 255	1	-
Decrement of the load/TPS plausibility check anti-bounce counter					
C_ABC_INC_ALTER_BN	-	0... FFH	0... 255	1	-
Debounce counter increment ALTER_BN diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_ALTER_BN_BAT	-	0... FFH	0... 255	1	-
Debounce counter increment ALTER_BN_BAT diagnosis					
C_ABC_INC_ALTER_BN_RGN	-	0... FFH	0... 255	1	-
Debounce counter increment ALTER_BN_RGN diagnosis					
C_ABC_INC_AMP_PLAUS_CUS	-	0... FFH	0... 255	1	-
Debounce counter increment AMP_PLAUS_CUS diagnosis					
C_ABC_INC_BAT_SENS	-	0... FFH	0... 255	1	-
Debounce counter increment BAT_SENS diagnosis					
C_ABC_INC_BAT_SENS_IT	-	0... FFH	0... 255	1	-
Debounce counter increment BAT_SENS_IT diagnosis					
C_ABC_INC_CAM_CST_IVVT_EX	-	0... FFH	0... 255	1	-
Antibounce counter increment during catalyst heating exhaust					
C_ABC_INC_CAM_CST_IVVT_IN	-	0... FFH	0... 255	1	-
Antibounce counter increment during catalyst heating intake					
C_ABC_INC_EGRV_PSN_PLAUS	-	0... FFH	0... 255	1	-
Antibounce counter increment for exhaust gas recirculation valve position plausibility					
C_ABC_INC_ER_STRAT	-	0... FFH	0... 255	1	-
Anti-bounce increment value for engine roughness improvement at stratified mode					
C_ABC_INC_ER_STRAT_WUP	-	0... FFH	0... 255	1	-
Anti-bounce increment value for engine roughness improvement at stratified mode at warmup					
C_ABC_INC_GEN	-	0... FFH	0... 255	1	-
Debounce counter increment - GEN diagnosis					
C_ABC_INC_GEN_CLC_V_NOT_PLAUS	-	0... FFH	0... 255	1	-
Debounce counter increment GEN_CLC_V_NOT_PLAUS diagnosis					
C_ABC_INC_GEN_CTL_NOT_PLAUS	-	0... FFH	0... 255	1	-
Debounce counter increment GEN_CTL_NOT_PLAUS diagnosis					
C_ABC_INC_GEN_EL	-	0... FFH	0... 255	1	-
Debounce counter increment GEN_EL diagnosis					
C_ABC_INC_GEN_H_TEMP	-	0... FFH	0... 255	1	-
Debounce counter increment GEN_H_TEMP diagnosis					
C_ABC_INC_GEN_H_TEMP_CLC	-	0... FFH	0... 255	1	-
Debounce counter increment GEN_H_TEMP_CLC diagnosis					
C_ABC_INC_GEN_MEC	-	0... FFH	0... 255	1	-
Debounce counter increment GEN_MEC diagnosis					
C_ABC_INC_GEN_MSG_LOST	-	0... FFH	0... 255	1	-
Debounce counter increment GEN_MSG_LOST diagnosis					
C_ABC_INC_GEN_TYP_NOT_PLAUS	-	0... FFH	0... 255	1	-
Debounce counter increment GEN_TYP_NOT_PLAUS diagnosis					
C_ABC_INC_LOAD_TPS_PLAUS	-	0... FFH	0... 255	1	-
Debounce counter increment LOAD_TPS_PLAUS diagnosis					
C_ABC_INC_MAF_LAMB_MAX	-	0... FFH	0... 255	1	-
Anti-bounce increment value for mass air flow calculated from lambda					
C_ABC_INC_MAP_DIP_PLAUS	-	0... FFH	0... 255	1	-
Debounce counter increment MAP_DIP_PLAUS diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_MAP_PLAUS	-	0... FFH	0... 255	1	-
Increment of the MAP Plausibility anti-bounce counter					
C_ABC_INC_MAP_TPS_PLAUS	-	0... FFH	0... 255	1	-
Debounce counter increment MAP ratio plausibility diagnosis					
C_ABC_INC_MEC_IVVT_EX	-	0... FFH	0... 255	1	-
Debounce counter increment - MEC_IVVT_EX diagnosis					
C_ABC_INC_MEC_IVVT_IN	-	0... FFH	0... 255	1	-
Debounce counter increment - MEC_IVVT_IN diagnosis					
C_ABC_INC_N_MAX_DRIV_REQ	-	0... FFH	0... 255	1	-
Anti-bounce increment value for too high engine rotation speed at vehicle stop					
C_ABC_INC_N_MAX_HOMS	-	0... FFH	0... 255	1	-
Debounce counter engine overspeed for changing the combustion mode diagnosis					
C_ABC_INC_NEUT_PSN_GB_LRN	-	0... FFH	0... 255	1	-
Debounce counter increment Neutral gear learning diagnosis					
C_ABC_INC_POIL_CTL_DYN	-	0... FFH	0... 255	1	-
Debounce counter increment oil pressure controller (dynamic)					
C_ABC_INC_POIL_CTL_MEC	-	0... FFH	0... 255	1	-
Debounce counter increment Oilpressure valve diagnosis					
C_ABC_INC_POIL_CTL_STAT	-	0... FFH	0... 255	1	-
Debounce counter increment oil pressure controller (static)					
C_ABC_INC_POIL_PUMP	-	0... FFH	0... 255	1	-
Debounce counter increment Oelpump diagnosis					
C_ABC_INC_POIL_SENS_PLAUS	-	0... FFH	0... 255	1	-
Debounce counter increment Oilpressure sensor diagnosis					
C_ABC_INC_POIL_SYS	-	0... FFH	0... 255	1	-
Debounce counter increment Oelsystem diagnosis					
C_ABC_INC_PUT_PLAUS	-	0... FFH	0... 255	1	-
Debounce counter increment PUT_PLAUS diagnosis					
C_ABC_INC_QOIL_SENS	-	0... FFH	0... 255	1	-
Debounce counter increment - QOIL_SENS diagnosis					
C_ABC_INC_TCHA_LEAK	-	0... FFH	0... 255	1	-
Debounce counter increment charger leakage diagnosis					
C_ABC_INC_TCHA_PRS_CTL	-	0... FFH	0... 255	1	-
Debounce counter increment charger pressure controller diagnosis					
C_ABC_INC_TCHA_PRS_DIF	-	0... FFH	0... 255	1	-
Debounce counter increment charger pressure difference diagnosis					
C_ABC_INC_TCHA_PRS_HIGH	-	0... FFH	0... 255	1	-
Debounce counter increment charger pressure to high diagnosis					
C_ABC_INC_TCHA_PRS_LOW	-	0... FFH	0... 255	1	-
Debounce counter increment charger pressure to low diagnosis					
C_ABC_INC_TCHA_SYS_1	-	0... FFH	0... 255	1	-
Debounce counter increment charger system diagnosis 1					
C_ABC_INC_TOIL_LEVEL	-	0... FFH	0... 255	1	-
Debounce counter increment TOIL_LEVEL diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TQ_CST	-	0... FFH	0... 255	1	-
Debounce counter increment TQ_CST diagnosis					
C_ABC_INC_VIM_PLAUS	-	0... FFH	0... 255	1	-
Debounce counter increment VIM_PLAUS diagnosis					
C_ABC_MAX_ALTER_BN	-	1... FFH	1... 255	1	-
Debounce counter maximum value ALTER_BN diagnosis					
C_ABC_MAX_ALTER_BN_BAT	-	1... FFH	1... 255	1	-
Debounce counter maximum value ALTER_BN_BAT diagnosis					
C_ABC_MAX_ALTER_BN_RGN	-	1... FFH	1... 255	1	-
Debounce counter maximum value ALTER_BN_RGN diagnosis					
C_ABC_MAX_AMP_PLAUS_CUS	-	1... FFH	1... 255	1	-
Debounce counter maximum value AMP_PLAUS_CUS diagnosis					
C_ABC_MAX_BAT_SENS	-	1... FFH	1... 255	1	-
Debounce counter maximum value BAT_SENS diagnosis					
C_ABC_MAX_BAT_SENS_IT	-	1... FFH	1... 255	1	-
Debounce counter maximum value BAT_SENS_IT diagnosis					
C_ABC_MAX_CAM_CST_IVVT_EX	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter during catalyst heating exhaust					
C_ABC_MAX_CAM_CST_IVVT_IN	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter during catalyst heating intake					
C_ABC_MAX_EGRV_PSN_PLAUS	-	1... FFH	1... 255	1	-
Maximal value of antibounce counter for exhaust gas recirculation valve position plausibility					
C_ABC_MAX_ER_STRAT	-	1... FFH	1... 255	1	-
Maximal value of antibounce counter for engine roughness improvement at stratified mode					
C_ABC_MAX_ER_STRAT_WUP	-	1... FFH	1... 255	1	-
Maximal value of antibounce counter for engine roughness improvement at stratified mode at warmup					
C_ABC_MAX_GEN	-	1... FFH	1... 255	1	-
Debounce counter maximum value - GEN diagnosis					
C_ABC_MAX_GEN_CLC_V_NOT_PLAUS	-	1... FFH	1... 255	1	-
Debounce counter maximum value GEN_CLC_V_NOT_PLAUS diagnosis					
C_ABC_MAX_GEN_CTL_NOT_PLAUS	-	1... FFH	1... 255	1	-
Debounce counter maximum value GEN_CTL_NOT_PLAUS diagnosis					
C_ABC_MAX_GEN_EL	-	1... FFH	1... 255	1	-
Debounce counter maximum value GEN_EL diagnosis					
C_ABC_MAX_GEN_H_TEMP	-	1... FFH	1... 255	1	-
Debounce counter maximum value - GEN_H_TEMP diagnosis					
C_ABC_MAX_GEN_H_TEMP_CLC	-	1... FFH	1... 255	1	-
Debounce counter maximum value GEN_H_TEMP_CLC diagnosis					
C_ABC_MAX_GEN_MEC	-	1... FFH	1... 255	1	-
Debounce counter maximum value GEN_MEC diagnosis					
C_ABC_MAX_GEN_MSG_LOST	-	1... FFH	1... 255	1	-
Debounce counter maximum value GEN_MSG_LOST diagnosis					
C_ABC_MAX_GEN_TYP_NOT_PLAUS	-	1... FFH	1... 255	1	-
Debounce counter maximum value GEN_TYP_NOT_PLAUS diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_LOAD_TPS_PLAUS	-	1... FFH	1... 255	1	-
Debounce counter maximum value LOAD_TPS_PLAUS diagnosis					
C_ABC_MAX_MAF_LAMB_MAX	-	1... FFH	1... 255	1	-
Maximal value of antibounce counter for maximum of mass air flow calculated from lambda					
C_ABC_MAX_MAP_DIP_PLAUS	-	1... FFH	1... 255	1	-
Debounce counter maximum value MAP_DIP_PLAUS diagnosis					
C_ABC_MAX_MAP_PLAUS	-	1... FFH	1... 255	1	-
Threshold to be reached, before permanently activating MAP Plausibility error					
C_ABC_MAX_MAP_TPS_PLAUS	-	1... FFH	1... 255	1	-
Debounce counter maximum MAP ratio plausibility diagnosis					
C_ABC_MAX_MEC_IVVT_EX	-	1... FFH	1... 255	1	-
Debounce counter maximum value - MEC_IVVT_EX diagnosis					
C_ABC_MAX_MEC_IVVT_IN	-	1... FFH	1... 255	1	-
Debounce counter maximum value - MEC_IVVT_IN diagnosis					
C_ABC_MAX_N_MAX_DRIV_REQ	-	1... FFH	1... 255	1	-
Maximal value of antibounce counter for too high engine rotation speed at vehicle stop					
C_ABC_MAX_N_MAX_HOMS	-	1... FFH	1... 255	1	-
Debounce counter maximum engine overspeed for changing the combustion mode diagnosis					
C_ABC_MAX_NEUT_PSN_GB_LRN	-	1... FFH	1... 255	1	-
Debounce counter maximum value Neutral gear learning diagnosis					
C_ABC_MAX_POIL_CTL_DYN	-	1... FFH	1... 255	1	-
Debounce counter maximum value pressure controller (dynamic)					
C_ABC_MAX_POIL_CTL_MEC	-	1... FFH	1... 255	1	-
Debounce counter maximum value Oilpressure valve diagnosis					
C_ABC_MAX_POIL_CTL_STAT	-	1... FFH	1... 255	1	-
Debounce counter maximum value pressure controller (static)					
C_ABC_MAX_POIL_PUMP	-	1... FFH	1... 255	1	-
Debounce counter maximum value Oelpump diagnosis					
C_ABC_MAX_POIL_SENS_PLAUS	-	1... FFH	1... 255	1	-
Debounce counter maximum value Oilpressure sensor diagnosis					
C_ABC_MAX_POIL_SYS	-	1... FFH	1... 255	1	-
Debounce counter maximum value Oelsystem diagnosis					
C_ABC_MAX_PUT_PLAUS	-	1... FFH	1... 255	1	-
Debounce counter maximum value PUT_PLAUS diagnosis					
C_ABC_MAX_QOIL_SENS	-	1... FFH	1... 255	1	-
Debounce counter maximum value - QOIL_SENS diagnosis					
C_ABC_MAX_TCHA_LEAK	-	1... FFH	1... 255	1	-
Debounce counter maximum charger leakage diagnosis					
C_ABC_MAX_TCHA_PRS_CTL	-	1... FFH	1... 255	1	-
Debounce counter maximum charger pressure contoller diagnosis					
C_ABC_MAX_TCHA_PRS_DIF	-	1... FFH	1... 255	1	-
Debounce counter maximum charger pressure difference diagnosis					
C_ABC_MAX_TCHA_PRS_HIGH	-	1... FFH	1... 255	1	-
Debounce counter maximum charger pressure to high diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_TCHA_PRS_LOW	-	1... FFH	1... 255	1	-
Debounce counter maximum charger pressure to low diagnosis					
C_ABC_MAX_TCHA_SYS_1	-	1... FFH	1... 255	1	-
Debounce counter maximum charger lsystem diagnosis 1					
C_ABC_MAX_TOIL_LEVEL	-	1... FFH	1... 255	1	-
Debounce counter maximum value TOIL_LEVEL diagnosis					
C_ABC_MAX_TQ_CST	-	1... FFH	1... 255	1	-
Debounce counter maximum value TQ_CST diagnosis					
C_ABC_MAX_VIM_PLAUS	-	1... FFH	1... 255	1	-
Debounce counter maximum value VIM_PLAUS diagnosis					

### Action definition

<b>ACTION_ERRM_CLCed_report</b> (IN<f_index>,IN<err_mask>,OUT<err_status>)	Mode: O
This action is called by customer OBJ File to inform supplier error manager concerning actual failure situation in customer OBJs. Error Status is sent back to customer OBJs.	
<b>ACTION_ERRM_CLCed_status</b> (IN<f_index>,OUT<err_status>)	Mode: O
This action is called by customer in order to get informations concerning a specific failure index.	
<b>ACTION_ERRM_CLCrbm_report</b> (IN<rbm_index>,IN<rbm_data>)	Mode: O
This action is called by customer OBJ File to inform supplier error manager concerning actual failure situation for RBM	

## 3.26.1 General interface description

### FUNCTION DESCRIPTION:


#### General information:

This three Action Calls are used to exchange failure memory informations through the interface module (Layer) between supplier SW environment and Customer OBJs. The error handling is performed in the error mangement in the supplier SW. Even the anti-bounce algorithm for Customer OBJ exported failures is handled by supplier SW.

#### Description:

The transformation between the dynamicly created error index list (f\_index) /(rbm\_index) on the customer OBJ Files side and the as well dynamicly created error index list on supplier SW side is realized by the help of the following translation table.

<b>Syntax :</b>	ACTION_ERRM_CLCed_report (IN <f_index>, IN <err_mask>, OUT <err_status>)	
<b>Parameter (in) :</b>	f_index	Index of failure based on dynamic list of the customer OBJ
	err_mask	Includes ERR_SYM_XX and LV_CDN_DIAG_XX
<b>Parameter (out) :</b>	err_status	Includes several informations concerning the corresponding
		index of failure

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Short description : *This action is called by customer OBJ File to inform supplier error manager concerning actual error situation in customer OBJs. Error Status is sent back to customer OBJs.*

-----  
 -----  
**Syntax :** ACTION\_ERRM\_CLCrbm\_report (IN <rbm\_index>, IN <rbm\_data>)  
**Parameter (in) :** rbm\_index Index of RBM - failure based on list of the customer OBJ  
 rbm\_data Includes LV\_END\_RBM\_XX and LV\_INH\_RBM\_XX and LV\_CDN\_RBM\_XX

**Parameter (out) :** --  
 Short description : *This action is called by customer OBJ File to inform supplier error manager concerning actual error situation in customer OBJs for RBM statistics. There is no return value.*

-----  
 -----  
**Syntax :** ACTION\_ERRM\_CLCed\_status (IN <f\_index>, OUT <err\_status>)  
**Parameter (in) :** f\_index Index of failure based on dynamic list of the customer OBJ  
**Parameter (out) :** err\_status Includes several informations concerning the corresponding index of failure

Short description : *This action is called by customer in order to get informations concerning a specific failure index.*

### **Application conditions**


**Initialisation:** --  
**Recurrence:** *depending on the index of failure*  
**Activation:** *at action request*

### **Formula section:**

**f\_index:**

f_index BMW	I/O	Failure BMW / FI_	Description BMW	Failure Flag supplier XX	Description supplier
1	I	TANS	Sensorspannung Ansauglufttemperatur	LV_ERR_TIA_EL or LV_ERR_TIA_PLAUS	Intake air temperature sensor
2	I	TKA	Sensorspannung Temperatur Kühlerausgang	LV_ERR_TCO_2_EL or LV_ERR_TCO_2_GRD or LV_ERR_TCO_2_PLAUS	Coolant temperature sensor (radiator out)
3	I	TMOT	Sensorspannung Motortemperatur	LV_ERR_TCO_EL or LV_ERR_TCO_PLAUS or LV_ERR_TCO_GRD or LV_ERR_TCO_STUCK or LV_ERR_TCO_STUCK_RNG	Coolant temperature sensor
4	I	UB	Batteriespg. nach HR	<b>Not available !</b>	
5	I	DK	Fehler Drosselklappe	LV_ERR_TPS_1 or LV_ERR_TPS_2 or LV_ERR_TPS_MAF_1 or LV_ERR_TPS_MAF_2 or LV_ERR_MTC_CTL_2 or LV_ERR_MTC_CTL_3 or LV_ERR_TPS_ST_CHK_2 or LV_ERR_TPS_AD or LV_ERR_TPS_AD_BOL or LV_ERR_MTC_DR or LV_ERR_TPS_RATIO	TPS - electrical diagnosis  TPS - controller - diagnosis  TPS - adaptation  TPS - powerstage diagnosis TPS - Ratio error
6	I	HFM	Luftmassenmesser	LV_ERR_MAF_FRQ_RNG_0 or LV_ERR_MAF_FRQ_FRQ_0 or LV_ERR_MAF_FRQ_EL_0	Mass air flow sensor diagnosis  (only for 6 cylinder)
6	I	HFM	Luftmassenmesser	LV_ERR_MAF	Mass air flow sensor diagnosis (only for 4 cylinder)
7	I	PUS	Umgebungsdrucksensor	LV_ERR_AMP or LV_ERR_AMP_PLAUS	Ambient pressure sensor signal diagnosis
8	I	DPSR	Drucksensor Saugrohr (Differenzdruck)	LV_ERR_MAP_DIP_SENS or LV_ERR_MAP_DIP_SHIFT	Manifold pressure electrical diagnosis (N53)
9	I	LSV	Lambda-Sonde vor Kat	LV_ERR_EL_LSL_UP_1 or LV_ERR_OC_LSL_UP_1	EI. Diagnosis WRAF sensor
10	I	HSV	Lambdasonden-Heizung vor Katalysator	LV_ERR_LSH_UP_1	Lambda sensor upstream heater

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					diagnosis
11	I	LSV2	Lambda-Sonde vor Kat Bank 2	LV_ERR_EL_LSL_UP_2 or LV_ERR_OC_LSL_UP_2	El. Diagnosis WRAF sensor OBD1
12	I	HSV2	Lambdasonden-Heizung vor Katalysator Bank 2	LV_ERR_LSH_UP_2	Lambda sensor upstream heater diagnosis
13	I	KOSE	Klima-Kompressorsteuerung Endstufe	LV_ERR_RLY_ACCOUT	Air cond. Compr. Relais diagnosis
14	I	ELUEE	E-Luefter Endstufe	LV_ERR_ECF_EL[NC_ECF_NR] or LV_ERR_ECFPWM_FB[NC_ECF_NR]	El. Cooling fan diagnosis
15	I	INS	Fehler Can-Botschaft vom Instrumentenkombi	LV_ERR_TOUT_ICL_2 v ((LV_VAR_BN=0/1)) LV_ERR_BN_ICL	Diagnosis CAN timeout (INST2) v BN2000 diagnosis KOMBI (Status)
16	I	EGS	Fehler Can-Botschaft Automatikgetriebe	LV_ERR_TOUT_ETCU_1 v ((LV_VAR_BN=0/1)) LV_ERR_BN_ETCU	Diagnosis CAN timeout (EGS1) v BN2000 diagnosis AT Gearbox (Status)
17	I	ASC	Fehler Can-Botschaft ASC	LV_ERR_TOUT_ASR_1 v ((LV_VAR_BN=0/1)) LV_ERR_BN_TCS	Diagnosis CAN timeout (ASC1) v BN2000 diagnosis Traction control system (Status DSC)
18	I	TUMG	Fehler Umgebungstemperatur	LV_ERR_TAM_CAN or LV_ERR_TAM_PLAUS	Ambient temperature diagnosis (CAN / PlaUS)
19	O	ENWS	Fehler Einlassnockenwellensteuerung	LV_ERR_MEC_IVVT_IN	Functional diagnosis of IVVT inlet CAM
20	O	ANWS	Fehler Auslassnockenwellensteuerung	LV_ERR_MEC_IVVT_EX	Functional diagnosis of IVVT exhaust CAM
21	O	GEN	Fehler Generator	LV_ERR_GEN	Alternator diagnosis
22	O	BSD	Fehler Kommunikation		<b>Not supported from BWM</b>
23	I	ENWSE	Fehler Endstufe Einlassnockenwellensteuerung	LV_ERR_SLV_IVVT_IN	Driver diagnosis of solenoid valve IVVT inlet CAM
24	I	ANWSE	Fehler Endstufe Auslassnockenwellensteuerung	LV_ERR_SLV_IVVT_EX	Driver diagnosis of solenoid valve IVVT exhaust CAM
25	I	BM	Fehler Bezugsmarke (KW-Geber)	LV_ERR_CRK_SYN or LV_ERR_CRK_PLAUS or LV_ERR_CRK_TOOTH_PER or LV_ERR_CRK_TOOTH	Crankshaft sensor diagnosis; teeth not plausible
26	I	PH0_PER	Fehler Periode CAM 0	LV_ERR_PER_CAM_IN_1 or LV_ERR_SYN_CAM_IN_1	Camshaft sensor diagnosis
27	I	PH0_PSN	Fehler Position CAM 0	LV_ERR_REF_CRK_CAM_IN_1	Camshaft sensor diagnosis (position)

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				or LV_ERR_TOOTH_OFF_IN_1	
28	I	PH0_PLA	Fehler Plausibilisierung CAM 0	LV_ERR_PLAUS_CAM_IN_1 or LV_ERR_SYN_CRK_CAM_IN_1	Camshaft sensor diagnosis
29	I	PH1_PER	Fehler Periode CAM 1	LV_ERR_PER_CAM_EX_1 or LV_ERR_SYN_CAM_EX_1	Camshaft sensor diagnosis
30	I	PH1_PSN	Fehler Position CAM 1	LV_ERR_REF_CRK_CAM_EX_1 or LV_ERR_TOOTH_OFF_EX_1	Camshaft sensor diagnosis (position)
31	I	PH1_PLA	Fehler Plausibilisierung CAM 1	LV_ERR_PLAUS_CAM_EX_1 or LV_ERR_SYN_CRK_CAM_EX_1	Camshaft sensor diagnosis
32	O	QLT	Fehler QLT	LV_ERR_QOIL_SENS	Oil sensor diagnosis
33	O	IBS1	Fehler Kommunikationsverlust IBS	LV_ERR_BAT_SENS	Intelligent battery sensor diagnosis
34	O	IBS2	Fehler IBS unplausibel	LV_ERR_BAT_SENS_IT	Intelligent battery sensor diagnosis
35	O	IBS3	Fehler IBS allgemein	LV_ERR_BAT_SENS_IT_EL	Intelligent battery sensor diagnosis
36	O	PMBN	Fehler PM-Bordnetz	LV_ERR_ALTER_BN	Powermanagement diagnosis
37	O	PMBATT	Fehler PM-Batterie	LV_ERR_ALTER_BN_BAT	Powermanagement diagnosis
38	I	VFZ	Fehler Fahrzeuggeschwindigkeit	LV_ERR_VS	Vehicle speed signal diagnosis
39	I	MDZ0	Aussetzer Zündung 0	LV_ERR_MIS_0	Cylinder specific misfire failure
40	I	MDZ1	Aussetzer Zündung 1	LV_ERR_MIS_1	Cylinder specific misfire failure
41	I	MDZ2	Aussetzer Zündung 2	LV_ERR_MIS_2	Cylinder specific misfire failure
42	I	MDZ3	Aussetzer Zündung 3	LV_ERR_MIS_3	Cylinder specific misfire failure
43	I	MDZ4	Aussetzer Zündung 4	LV_ERR_MIS_4	Cylinder specific misfire failure, not supported for 4- cylinder SW
44	I	MDZ5	Aussetzer Zündung 5	LV_ERR_MIS_5	Cylinder specific misfire failure, not supported for 4- cylinder SW
-	I	MDZ6	Aussetzer Zündung 6		<b>Not implemented in MSDxx</b>
46	I	MDZ7	Aussetzer Zündung 7		<b>Not implemented in MSDxx</b>
47	I	KFT	Fehler Kennfeldthermostat	LV_ERR_ECT_EL or LV_ERR_TH	Electronically controlled thermostat diagnosis
48	I	EWAPU	Fehler elektrische Wasserpumpe	LV_ERR_CWP_PWR or LV_ERR_CWP_PLAUS or LV_ERR_CWP_INT_OFF	Cooling water pump diagnosis
49	O	WMKD	Fehler koordinierung		<b>Not supported from</b>

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			Wärmemanagement		<b>BWM</b>
50	I	PLD	Druck vor Drosselklappe	LV_ERR_PUT_EL	Pressure-up throttle sensor - electrical diagnosis (not supported for 4-cylinder SW !)
51	O	HF MPL	HFM plausibilisierung	LV_ERR_LOAD_TPS_PLAUS	Load - TPS ratio check
52	O	DISAPL	DISA plausibilisierung	LV_ERR_VIM_PLAUS	VIM plausibility diagnosis
53	O	DPSRPL	Saugrohrdrucksensor plausibilisierung	LV_ERR_MAP_DIP_PLAUS	MAP_DIP_SENS plausibility diagnosis
54	O	TEVPL	Tankent-lüftungsventil plausibilisierung		<b>Not supported from BWM</b>
55	O	SLPPL	Sekundärluftpumpe plausibilisierung		<b>Not supported from BWM</b>
56	I	DKALRN	Drosselklappe - Lernen untere Anschlag	LV_ERR_TPS_AD_BOL	TPS adaption lower position
57	I	TEVE	Endstufe Tankentlüftungsventil	LV_ERR_EL_CPS or LV_ERR_DIAGCPS	ATIC39 Powerstage-diagnosis CPS / TEV check
58	I	SLPE	Endstufe Sekundärluftpumpe		<b>Not implemented in MSDxx</b>
59	I	KSD_1	Kraftstoffsystemdiagnose	LV_ERR_FSD_1 or LV_ERR_DELTA_I_LAM_1 or LV_ERR_FSD_LAM_LIM_1	Fuel-system diagnosis
60	I	KSD_2	Kraftstoffsystemdiagnose	LV_ERR_FSD_2 or LV_ERR_DELTA_I_LAM_2 or LV_ERR_FSD_LAM_LIM_2	Fuel-system diagnosis
61	I	DISAE_H	Endstufe DISA-H	LV_ERR_VIM_1_EL or LV_ERR_VIMPWM_1_FB	ATIC39 Powerstage-diagnosis VIM_1
62	I	DISAE_L	Endstufe DISA-L	LV_ERR_VIM_2_EL or LV_ERR_VIMPWM_2_FB	ATIC39 Powerstage-diagnosis VIM_2
63	I	BSD_0	Kommunikation BSD	LV_ERR_SENS_BAT_SMT_CO M	BSD diagnosis
64	I	BSD_1	Kommunikation BSD		<b>Not implemented in MSDxx</b>
65	I	BSD_2	Kommunikation BSD		<b>Not implemented in MSDxx</b>
66	I	BSD_3	Kommunikation BSD	LV_ERR_CWP_COM	BSD diagnosis, CWP device
67	I	BSD_4	Kommunikation BSD	LV_ERR_QOIL_COM	BSD diagnosis, QOIL device
68	I	BSD_5	Kommunikation BSD		<b>Not implemented in MSDxx</b>
69	I	BSD_6	Kommunikation BSD	LV_ERR_ALTER_COM	BSD diagnosis, ALTER device
70	I	BSD_7	Kommunikation BSD		<b>Not implemented in MSDxx</b>
71	O	PMRUHVERL	Powermanagement Ruhestromverletzung	LV_ERR_ALTER_BN_RGN	Powermanagement diagnosis
72	I	BSDGLOB	Fehler BSD global	LV_ERR_BSD	BSD diagnosis
73	O	TOENS	Fehler Toens	LV_ERR_TOIL_LEVEL	TOENS fehler

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74	I	PWRVAR	Fehler OL / UL	LV_ERR_VEH_POW_VAR	Vehicle power variant not plausible
75	O	PUSPL	Fehler Umgebungsdrucksensor	LV_ERR_AMP_PLAUS_CUS	Ambient pressure sensor not plausible
76	I	DKOBD	Fehler Drosselklappe OBD relevant	LV_ERR_TPS_1 or LV_ERR_TPS_2 or LV_ERR_TPS_MAF_1 or LV_ERR_TPS_MAF_2 or LV_ERR_MTC_CTL_2 or LV_ERR_MTC_CTL_3 or LV_ERR_TPS_ST_CHK_2 or LV_ERR_TPS_AD or LV_ERR_TPS_AD_BOL or LV_ERR_MTC_DR	Emission relevant throttle error.
77	I	SEGRADP	Segmentzeitadaptionfehler	LV_ERR_SEG_AD_ER	Segment-time adaptation values out of range
78	I	AGR_AD	EGR -adaptionfehler	LV_ERR_ACR_AD	Adaptation of EGR valve
79	I	AGR_SENS	EGR -Sensorfehler	LV_ERR_SENS_ACR	EGR sensor diagnosis
80	I	AGR_DR	EGR - Endstufenfehler	LV_ERR_ACR_DR	EGR powerstage diagnosis
81	I	AGR_CTL	Fehler EGR -lageregler	LV_ERR_ACR_CTL	EGR controller diagnosis
82	I	AGR_VCC	VCC Überwachung EGR ventil	LV_ERR_V_REF_1	Power supply diagnosis PVS / EGR....
83	O	NWEKW	Versatz Einlass NW zu KW		<b>Not supported in MSDxx</b>
84	O	NWAKW	Versatz Auslass NW zu KW		<b>Not supported in MSDxx</b>
85	O	ENWSAD	Einlassnockenwellensteuerung Adaption		<b>Not supported in MSDxx</b>
86	O	ANWSAD	Auslassnockenwellensteuerung Adaption		<b>Not supported in MSDxx</b>
87	O	ATLRMX	Lader Systemdiagnosis 1	LV_ERR_TCHA_SYS_1	
88	O	PLDMN	Lader Systemdiagnosis 3	LV_ERR_TCHA_PRS_LOW	Charger pressure to low
89	O	ATLLEKFAST	Lader Systemdiagnosis 5	LV_ERR_TCHA_LEAK	Charger leakage
90	O	ATLGLS	Lader Systemdiagnosis 7	LV_ERR_TCHA_PRS_DIF	Charger pressure difference
91	O	PLDMX	Lader Systemdiagnosis 4	LV_ERR_TCHA_PRS_HIGH	Charger pressure to high
92	I	POELSENS	Öldrucksensor	LV_ERR_SENS_POIL	Oilpressure sensor error
93	I	POELREGVE	Öldruck Regentventil Endstufe	LV_ERR_POIL_DR	Oilpressure valve powerstage error
94	O	POELRSTAT	Öldruckregellung statisch	LV_ERR_POIL_CTL_STAT	Oilpressure static - control error
95	O	POELRDYN	Öldruckregellung	LV_ERR_POIL_CTL_DYN	Oilpressure dynamic -


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			dynamisch		control error
96	I	DKRAT1	?	LV_ERR_TPS_MAF_1	
97	I	DKRAT2	?	LV_ERR_TPS_MAF_2	
98	I	DKRATIO	?	LV_ERR_TPS_RATIO	
99	I	ABGAS_TSENS	Fehler Abgastemperatur	LV_ERR_TEG_PCAT_DOWN	Exhaust temperature sensor
100	I	NOX_SENS	Fehler NOx Sensor		<b>Not supported in MSDxx</b>
101	I	DK_EF	Fehler einfach elektrisch an DK	LV_ERR_TPS_1 or LV_ERR_TPS_2	Electrical throttle error
102	I	PVDKDS	Fehler elektrisch Druck vor DK	LV_ERR_PUT_EL	Pressure-up throttle sensor - electrical diagnosis (not supported for 4-cylinder SW !)
103	I	PS_ABS	Drucksensor Saugrohr (Absolutdruck)	LV_ERR_MAP_DIP_SENS	Manifold pressure electrical diagnosis (N54)
104	O	PVDKDS_PL	Fehler Plausibilität Druck vor Drosselklappe	LV_ERR_PUT_PLAUS	Pressure-up throttle sensor - plausibility diagnosis
105	O	PSABS_PL	Fehler Plausibilität Absolutdrucksensor	LV_ERR_MAP_PLAUS	Ambient pressure sensor not plausible
106	I	DK_NL	Fehler DK Notlauf		<b>Not defined yet</b>
107	O	DMDKH		LV_ERR_TQ_CST	Cold start monitoring - Torque reserve catalyst heating
108	O	POILREGV	Fehler Öldruckregelventil mechanisch	LV_ERR_POIL_CTL_MEC	Oilpressure control valve mechanical error
109	O	POILSENS_PL	Fehler Öldrucksensor	LV_ERR_POIL_SENS_PLAUS	Oilpressure sensor not plausible
110	I	PBREMSU	Fehler Bremsunterdrucksensor	LV_ERR_PBSU	Brake pressure sensor error (only 4 cylinder)
111	I	NGANG	Fehler Nullgangsensor	LV_ERR_NEUT_PSN_GB	Neutral gear sensor (only 4 cylinder)
112	O	NGLERN	Fehler Nullgangsensorlernen	LV_ERR_NEUT_PSN_GB_LRN	Neutral gear sensor learning
113	O	POILPUMP	Fehler Oeldruckpumpe	LV_ERR_POIL_PUMP	Oilpressure pump
114	O	POILSYS	Fehler Oeldrucksystem allg.	LV_ERR_POIL_SYS	Oelpressure system
115	O	GENEL	Elektrischer Fehler Generator	LV_ERR_GEN_EL	electrical generator error
116	O	GENMECH	Mechanischer Fehler Generator	LV_ERR_GEN_MEC	mechanical generator error
117	O	GENHT	Hochtemperaturfehler Generator	LV_ERR_GEN_H_TEMP	generator high temperature error
118	O	GENUPL	Generatortyp unplausibel	LV_ERR_GEN_TYP_NOT_PLAUS	generator type not plausible
119	O	GENKOMM	Keine Generatorkommunikation	LV_ERR_GEN_MSG_LOST	generator message lost
120	O	GENELB	Generatorspannung aus Berechnung unplausibel	LV_ERR_GEN_CLC_V_NOT_PLAUS	generator voltage not plausible
121	O	GENHTB	Hochtemperaturfehler Generator aus Berechnung	LV_ERR_GEN_H_TEMP_CLC	calculated generator high temperature error
122	O	GENREGUPL	Generatorregler	LV_ERR_GEN_CTL_NOT_PLAUS	calculated generator

			unplausibel	S	controller plausibility error
123	O	AGRPL	AGR - Ventil unplausibel	LV_ERR_EGRV_PSN_PLAUS	Error flag for position of exhaust gas recirculation valve plausibility
124	I	KAT	Fehler Katalysator	LV_ERR_CAT_DIAG[1] or LV_ERR_CAT_DIAG[2]	Present failure catalyst efficiency
125	I	WG	Fehler Wastegate Ansteuerung	LV_ERR_WG_1_DR or LV_ERR_WG_2_DR	Waste gate driver error cylinder bank 1 or 2 detected (only 6 cylinder)
126	I	TVLD	Fehler Temperatursensor vor Verdichter	LV_ERR_TEG_PCAT_DOWN	TEG sensor diagnosis
127	O	ATL_CTL	Fehler Ladedruckregelung	LV_ERR_TCHA_PRS_CTL	error currently present on charger pressure controller diagnosis
128	I	KATH_DIAG	Fehlerort Katdiagnose	LV_ERR_CAT_DIAG_AFL[1] or LV_ERR_CAT_DIAG_AFL[2]	Present failure after filtering of diagnostic CAT_DIAG_AFL
129	I	NSOBD2	Wenn der NOx - Sensor defekt erkannt wird	LV_ERR_NS_ACT [1] or LV_ERR_NS_AFR[1] or LV_ERR_NS_AVL[1] or LV_ERR_NS_HTP[1] or LV_ERR_NS_LSL_UP_DOWN[1] or LV_ERR_NS_OFS[1] or LV_ERR_NS_PUC[1] or LV_ERR_NS_STOP[1] or LV_ERR_NS_VLS_DYN[1]	NOx sensor OBD 2 failure is present (only 6 cylinder)
130	I	NSOBD2	Wenn der NOx - Sensor defekt erkannt wird	LV_ERR_NS_ACT [1] or LV_ERR_NS_AFR[1] or LV_ERR_NS_AVL[1] or LV_ERR_NS_HTP[1] or LV_ERR_NS_LSL_UP_DOWN[1] or LV_ERR_NS_OFS[1] or LV_ERR_NS_PWR [1] or LV_ERR_NS_STOP[1] or LV_ERR_NS_VLS_DYN[1] or LV_ERR_VLS_NS_PUC[1] or LV_ERR_LAMB_NS_PUC[1] or LV_ERR_NOX_NS_PUC[1]	NOx sensor OBD 2 failure is present (only 4 cylinder)

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130	I	NTAGI	Wenn der NOx - Kat defekt erkannt wird	LV_ERR_NT_AGI	Error flag of NOx catalyst aging diagnosis
131	I	NSOBD1	NOX - Sensor	LV_ERR_NS_OBD_1_HTP[i] or LV_ERR_NS_OBD_1_NOX[i] or LV_ERR_NS_OBD_1_LAMB[i] or LV_ERR_NS_OBD_1_VLS[i]	NOx sensor 1 or 2 OBD I failure is present
132	I	EV_DIAG_0	Einspritzventil Diagnose	LV_ERR_IV[0]	at least one IV is detected as faulty
133	I	EV_DIAG_1	Einspritzventil Diagnose	LV_ERR_IV[1]	at least one IV is detected as faulty
134	I	EV_DIAG_2	Einspritzventil Diagnose	LV_ERR_IV[2]	at least one IV is detected as faulty
135	I	EV_DIAG_3	Einspritzventil Diagnose	LV_ERR_IV[3]	at least one IV is detected as faulty
136	I	EV_DIAG_4	Einspritzventil Diagnose	LV_ERR_IV[4]	at least one IV is detected as faulty (not supported in 4 cylinder sw)
&permill; ;	I	EV_DIAG_5	Einspritzventil Diagnose	LV_ERR_IV[5]	at least one IV is detected as faulty (not supported in 4 cylinder sw)
138	O	NMAX_BA	Fehler Drehzahlbegrenzung durch Notlaufmanager	LV_ERR_N_MAX_HOMS	engine overspeed for changing the combustion mode
139	O	DKPSABS_PL	Fehler Saugrohrdruck-DK Verhältnis Plausibilisierung	LV_ERR_MAP_TPS_PLAUS	Boolean for error MAP ratio plausibility diagnosis
140	I	NG_PLAUS	Plauibilität Signal Nullganssensor	LV_ERR_NEUT_PSN_GB_PLAUS	Neutral gear sensor plausibility error
141	O	MSLAM_MX	Ueberschreitung des maximalen Luftmassenstromes	LV_ERR_MAF_LAMB_MAX	Error flag for maximum mass air flow calculated from lambda
142	I	PBU_PLAUS	Plausibilität Bremsunterdrucksignal	LV_ERR_PBSU_PLAUS	Plausibility error brake pressure sensor (only for 4 cylinder)
143	O	LVS_AKTIV	Eingriff über LVS aktiv	LV_ERR_ER_STRAT	Error flag for engine roughness improvement at stratified mode
144	O	LVSWL_AKT	Eingriff über LVS aktiv im Motorwarmlauf	LV_ERR_ER_STRAT_WUP	Error flag for engine roughness improvement at stratified mode at warmup
1-	I	MSALTG	Fehler MSA Leitung	LV_ERR_ACK_IGK_OFF	Starter relay MSA power stage error (only 4 cylinder)
146	I	KUPP_PLAUS	Kupplungssignal nicht plausibel	LV_ERR_CS_PLAUS	Clutch switch plausibility error (only 4 cylinder)
147	O	PWGLL_NKW	Drehzahlreduzierung umd	LV_ERR_N_MAX_DRIV_REQ	Error flag for too high




		RED	EML Lampe durch Vollgas		engine rotation speed at vehicle stop
148	I	GS_KOM	Kommunikation zu Getriebesteuergerät	LV_ERR_COM_GB	Gear box communication error
149	O	ENWS_KH	Einlassnockenwellensteuerung bei Katheizen	LV_ERR_CAM_CST_IVVT_IN[1]	functional error on the intake CAM adjustment at coldstart
150	O	ANWS_KH	Auslassnockenwellensteuerung bei Katheizen	LV_ERR_CAM_CST_IVVT_EX[1]	functional error on the exhaust CAM adjustment at coldstart
151	I	FTLMIN	Zylinderabschaltung wegen Tankleerfahrtdiagnose	LV_ERR_FTL_MIN	Fuel tank level low Injection intervention

## rbm\_index:

rbm_index BMW	Failure BMW	Description BMW	RBM data supplier XX	Description supplier
0	FI_ENWS	Fehler Einlassnockenwellensteuerung	LV_END_RBM_MEC_IVVT_IN LV_INH_DIAG_RBM_MEC_IVVT_IN LV_CDN_RBM_MEC_IVVT_IN	Functional diagnosis of IVVT inlet CAM
1	FI_ANWS	Fehler Auslassnockenwellensteuerung	LV_END_RBM_MEC_IVVT_EX LV_INH_DIAG_RBM_MEC_IVVT_EX LV_CDN_RBM_MEC_IVVT_EX	Functional diagnosis of IVVT exhaust CAM
2	FI_HFMPL	HFM plausibilisierung	LV_END_RBM_LOAD_TPS_PLAUS LV_INH_DIAG_RBM_LOAD_TPS_PLAUS LV_CDN_RBM_LOAD_TPS_PLAUS	Load - TPS ratio check
3	FI_DPSRPL	Saugrohrdrucksensor plausibilisierung	LV_END_RBM_MAP_DIP_PLAUS LV_INH_DIAG_RBM_MAP_DIP_PLAUS LV_CDN_RBM_MAP_DIP_PLAUS	MAP_DIP_SENS plausibility diagnosis
4	FI_TEVPL	Tankentlüftungsventil plausibilisierung	<b>Not supported !</b>	
5	FI_NWEKW	Fehler Versatz Einlass-NW zu KW	<b>Not supported !</b>	
6	FI_NWAKW	Fehler Versatz Auslass-NW zu KW	<b>Not supported !</b>	
7	FI_ENWSAD	Fehler Einlassnockenwellensteuerung Anschlagsadaptation	<b>Not supported !</b>	
8	FI_ANWSAD	Fehler Auslassnockenwellensteuerung Anschlagsadaptation	<b>Not supported !</b>	
9	FI_DMDKH	No Text	LV_END_RBM_TQ_CST LV_INH_DIAG_RBM_TQ_CST LV_CDN_RBM_TQ_CST	Cold start monitoring - Torque reserve catalyst heating
10	FI_ENWS_KH	Fehler Einlassnockenwellensteuerung bei Katheizen	LV_END_RBM_CAM_CST_IVVT_IN_1 LV_INH_DIAG_RBM_CAM_CST_IVVT_IN_1 LV_CDN_RBM_CAM_CST_IVVT_IN_1	functional error on the intake CAM adjustment at coldstart
11	FI_ANWS_KH	Fehler Auslassnockenwellensteuerung bei Katheizen	LV_END_RBM_CAM_CST_IVVT_EX_1 LV_INH_DIAG_RBM_CAM_CST_IVVT_EX_1 LV_CDN_RBM_CAM_CST_IVVT_EX_1	functional error on the exhaust CAM adjustment at coldstart

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**err\_mask:**

```

ERR_SYM_XX           = bit 0-3    //detected symptom
LV_CDN_DIAG_XX      = bit 4      //diagnosis condition
LV_INH_DIAG_RBM_XX  = bit 5      //RBM inhibition due to OBD error, only used
                                for RBM diagnosis
    
```

**rbm\_data:**

```

LV_END_RBM_XX       = bit 0      //diagnosis cycle for RBM finished
LV_INH_DIAG_RBM_XX  = bit 1      //RBM inhibition due to OBD error
LV_CDN_RBM_XX       = bit 2      //Special RBM diagnosis condition
not used            = bit 3-7
    
```

**err\_status:**

**Remark:**

For some f\_index BMW there are more then one LV\_ERR\_xx (Diagnosis instances) which fit, thus a algorithm to set the bits in the right way is defined:  
 e.g. f\_index 1 = LV\_ERR\_TIA\_EL or LV\_ERR\_TIA\_PLAUS  
 => Formula section below is described in the way LV\_ERR\_XX or LV\_ERR\_YY

Status of memorised symptom

```

bit 3-0 of error_status = ERR_SYM_MEM_IDX with IDX = f(XX)
(In case of more then one ERR_SYM_MEM_IDX,
only the first is considered )
    
```

Status of MIL activation

```

bit 4 of error_status if LV_DC_MAX_IDX = 1
with IDX = f(XX)
& bit 2 of WAL_CONF_XX = 1 or
LV_DC_MAX_IDX = 1
with IDX = f(YY)
& bit 2 of WAL_CONF_YY = 1
then bit 4 of error_status = 1
else bit 4 of error_status = 0
    
```


Status of present error and passive symptom

```

bit 5 of error_status if CTR_ABC_xx = 0 or
CTR_ABC_yy = 0 or
LV_ERR_xx = 1 or
LV_ERR_yy = 1
then bit 5 of error_status = 1
else bit 5 of error_status = 0
    
```

Status of present error

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bit 6 of error\_status if LV\_ERR\_XX = 1 **or**  
 LV\_ERR\_YY = 1  
**then** bit 6 of error\_status = 1  
**else** bit 6 of error\_status = 0

Status of end of diagnosis cycle

bit 7 of error\_status if LV\_END\_DIAG\_XX = 1 **and**  
 LV\_END\_DIAG\_YY = 1  
**then** bit 7 of error\_status = 0  
**else** bit 7 of error\_status = 1

Status of OBD readiness

bit 8 of error\_status if LV\_READY\_XX = 0 **and**  
 LV\_READY\_YY = 0  
**then** bit 8 of error\_status = 0  
**else** bit 8 of error\_status = 1

Status if present error is stored in ERRM

bit 9 of error\_status if LV\_ERR\_MEM\_XX = 1 **or**  
 LV\_ERR\_MEM\_YY = 1  
**then** bit 9 of error\_status = 1  
**else** bit 9 of error\_status = 0

Status of diagnosis condition

bit 10 of error\_status if LV\_CDN\_DIAG\_XX = 1 **or**  
 LV\_CDN\_DIAG\_YY = 1  
**then** bit 10 of error\_status = 1  
**else** bit 10 of error\_status = 0

Status of detected symptom

bit 11 of error\_status if ERR\_SYM\_XX != 0 **or**  
 ERR\_SYM\_YY != 0  
**then** bit 11 of error\_status = 1  
**else** bit 11 of error\_status = 0

Status if error is pending

bit 14 of error\_status if LV\_ERR\_PND\_IDX = 1 **with** IDX =  
 f(XX) **or**  
 LV\_ERR\_PND\_IDX = 1 **with** IDX = f(YY)  
**then** bit 14 of error\_status = 1  
**else** bit 14 of error\_status = 0

Status if error is calibrated as OBD relevant

bit 15 of error\_status if bit 4 of WAL\_CONF\_XX = 1 **or**  
 bit 4 of WAL\_CONF\_YY = 1  
**then** bit 15 of error\_status = 1  
**else** bit 15 of error\_status = 0

### 3.26.2 Output - data of diagnosis handled by customer OBJ File

#### FUNCTION DESCRIPTION:

##### General information:


All failures are fed by the customer diagnosis algorithm which detects malfunctions. The relevant informations for the error management are transferred with the help of the action call. To give a reflection of the actual status of the failure memory management - which might as well be used for QVM related affairs (if desired) and/or for the information of system developers - the relevant supplier variables remain defined. Since the debounce algorithm is part of the supplier failure memory management, all corresponding calibration variables (C\_ABC\_...) remain on supplier side. All diagnosis are using the STD\_INI debounce algorithm (not valid for LOAD\_TPS\_PLAUS diagnosis).

##### Description:

The following diagnosis LV\_ERR\_(DIAG\_INST) are defined:

- ENWS (DIAG\_INST = MEC\_IVVT\_IN )
- ANWS (DIAG\_INST = MEC\_IVVT\_EX )
- GEN (DIAG\_INST = GEN )
- QLT (DIAG\_INST = QOIL\_SENS )
- IBS1 (DIAG\_INST = BAT\_SENS )
- IBS2 (DIAG\_INST = BAT\_SENS\_IT )
- IBS3 (DIAG\_INST = BAT\_SENS\_IT\_EL )
- PMBN (DIAG\_INST = ALTER\_BN )
- PMBATT (DIAG\_INST = ALTER\_BN\_BAT )
- HFMPPL (DIAG\_INST = LOAD\_TPS\_PLAUS )
- DISAPL (DIAG\_INST = VIM\_PLAUS )
- DPSRPL (DIAG\_INST = MAP\_DIP\_PLAUS )
- PMRUHVERL (DIAG\_INST = ALTER\_BN\_RGN )
- TOENS (DIAG\_INST = TOIL\_LEVEL )
- PUSPL (DIAG\_INST = AMP\_PLAUS\_CUS )
- PLDMN (DIAG\_INST = TCHA\_PRS\_LOW )
- ATLLKFAST (DIAG\_INST = TCHA\_LEAK )
- ATGLS (DIAG\_INST = TCHA\_PRS\_DIF )
- PLDMX (DIAG\_INST = TCHA\_PRS\_HIGH )
- POELRSTAT (DIAG\_INST = POIL\_CTL\_STAT )
- POELRDYN (DIAG\_INST = POIL\_CTL\_DYN )
- PVDKDS\_PL (DIAG\_INST = PUT\_PLAUS )
- PSABS\_PL (DIAG\_INST = MAP\_PLAUS )
- DMDKH (DIAG\_INST = TQ\_CST )
- POILREGV (DIAG\_INST = POIL\_CTL\_MEC )
- POILSENS\_PL (DIAG\_INST = POIL\_SENS\_PLAUS )
- NGLERN (DIAG\_INST = NEUT\_PSN\_GB\_LRN )
- POILPUMP (DIAG\_INST = POIL\_PUMP )
- POILSYS (DIAG\_INST = POIL\_SYS )
- GENEL (DIAG\_INST = GEN\_EL )
- GENMECH (DIAG\_INST = GEN\_MEC )
- GENHT (DIAG\_INST = GEN\_H\_TEMP )

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- GENUPL (DIAG\_INST = GEN\_TYP\_NOT\_PLAUS)
- GENKOMM (DIAG\_INST = GEN\_MSG\_LOST)
- GENELB (DIAG\_INST = GEN\_CLC\_V\_NOT\_PLAUS)
- GENHTB (DIAG\_INST = GEN\_H\_TEMP\_CLC)
- GENREGUPL (DIAG\_INST = GEN\_CTL\_NOT\_PLAUS)
- AGRPL (DIAG\_INST = EGRV\_PSN\_PLAUS)
- ATL\_CTL (DIAG\_INST = TCHA\_PRS\_CTL)
- NMAX\_BA (DIAG\_INST = N\_MAX\_HOMS)
- DKPSABS\_PL (DIAG\_INST = MAP\_TPS\_PLAUS)
- ATLRMX (DIAG\_INST = TCHA\_SYS\_1)
- MSLAM\_MX (DIAG\_INST = MAF\_LAMB\_MAX)
- LVS\_AKTIV (DIAG\_INST = ER\_STRAT)
- LVSWL\_AKT (DIAG\_INST = ER\_STRAT\_WUP)
- PWGLL\_NKWRED (DIAG\_INST = N\_MAX\_DRIV\_REQ)
- ENWS\_KH (DIAG\_INST = CAM\_CST\_IVVT\_IN\_1)
- ANWS\_KH (DIAG\_INST = CAM\_CST\_IVVT\_EX\_1)

### Application conditions

**Initialisation:** according **STD\_INI** configuration  
*(all 0 at LV\_IGK 0->1 or reset)*  
 only for DIAG\_INST = LOAD\_TPS\_PLAUS  
 according **STD\_INI** and **DEC\_CAL** configuration  
*(all 0 at LV\_IGK 0->1 or reset + cal. Decrement)*  
 only for DIAG\_INST = PUT\_PLAUS  
 according **STD** configuration  
 all other Output data 0 at LV\_IGK 0->1 or reset

**Recurrence:** *see activation*

**Activation:** *at ACTION\_ERRM\_CLCed\_report (IN <f\_index>, IN <err\_mask>, OUT <err\_status>)*

### Formula section:

According the data delivered by the err\_masks (includes ERR\_SYM\_(DIAG\_INST) and LV\_CDN\_DIAG\_(DIAG\_INST) the anti-bounce algorithm is called:

**If** ERR\_SYM\_(DIAG\_INST) is not NO\_SYM  
**Then** debounce of LV\_ERR\_(DIAG\_INST) using general debounce algorithm  
**Else** rebound of LV\_ERR\_(DIAG\_INST) using general debounce algorithm  
**Endif**

*End of diagnosis calculation LV\_END\_DIAG\_(DIAG\_INST) = 1:  
 --> see chapter Anti-bounce Algorithm: Calculation of end of diagnosis*

### 3.26.3 Rate - base monitor Interface for OBJ-file diagnosis

#### FUNCTION DESCRIPTION:

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**General information:**

With this module the interface between the Object-file diagnosis and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_xx data.

Within STATE\_RBM\_xx, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0) (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1) (depending on failure status: pending)
- Monitor individual RBM conditions encountered within this DC (bit 2)

xx = applied for MEC\_IVVT\_IN /MEC\_IVVT\_EX /MAP\_DIP\_PLAUS /LOAD\_TPS\_PLAUS / TQ\_CST

**Application conditions:**

*Initialisation :*

at LV\_DC 0 1 transition :  
     bit 0, bit 1 and bit 2 of STATE\_RBM\_xx = 0  
 on failure memory reset :  
     bit 1 of STATE\_RBM\_xx = 0

*Recurrence:* see activation

*Activation:* at ACTION\_ERRM\_CLCrbm\_report (IN <rbm\_index>, IN <rbm\_data>)

*Deactivation:* LV\_DC = 0

**Formula section:**

Algorithm must be applied sperate for each defined xx diagnosis

```

if bit 0 of STATE_RBM_xx = 0
Then
    if LV_END_RBM_xx = 1
        Then bit 0 of STATE_RBM_xx = 1
        Endif
    Endif
if bit 1 STATE_RBM_xx = 0
Then
    if LV_INH_DIAG_RBM_xx = 1
        Then bit 1 of STATE_RBM_xx = 1
        Endif
    Endif
if bit 2 STATE_RBM_xx = 0
Then
    if LV_CDN_RBM_xx = 1
        Then bit 2 of STATE_RBM_xx = 1
        Endif
    Endif

```


**3.26.4 Outputs for supplier aggregates, supplier internally**

**FUNCTION DESCRIPTION:**

**General information:**

Adaptation to aggregate-environment.

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**Application conditions**

**Initialisation:**                *0 at reset*  
**Recurrence:**                 *same as corresponding input data*  
**Activation:**                 *every engine operating state*

**Formula section:**

LV\_EOL\_OBD\_DC = 0

Global error flag for IVVT system

```

if          LV_ERR_MEC_IVVT_IN          = 1
Or         LV_ERR_MEC_IVVT_EX          = 1
Or         LV_ERR_SLV_IVVT_IN          = 1
Or         LV_ERR_SLV_IVVT_EX          = 1
Or         LV_ERR_CAM_CST_IVVT_EX[NC_NR_CBK_IVVT] = 1
Or         LV_ERR_CAM_CST_IVVT_IN[NC_NR_CBK_IVVT] = 1
Then       LV_ERR_IVVT                 = 1
Else       LV_ERR_IVVT                 = 0
Endif

```

Global error flag for OIL system

```

if          LV_ERR_TOIL_LEVEL          = 1
Or         LV_ERR_QOIL_SENS           = 1
Then       LV_ERR_TOIL                = 1
Else       LV_ERR_TOIL                = 0
Endif

```

## 3.27 AGGR adaptation: ECME

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_PWF	O/V	0... 1H	0 ...1	1	-
0: reading of customer adaptation block in the E2PROM was successful // 1: not successful					

### Input data:

LV_NVMY_CUS_WRG			
-----------------	--	--	--

### General information

There are customer provided adaptation values stored in the E2Prom. Therefore the information has to be created whether the re-loading of this values out of the NVMY was successful or not. The bit B\_pwf is containing this information (0 = upload was successful // 1 = upload failed).

### Application conditions:

- Initialisation:** B\_pwf = 0 at reset
- Activation:** after up-loading the customer adaptation values out of the E2Prom
- Deactivation:** after set of B\_pwf
- Recurrence:** once after up-loading of the adaptation values out of the E2Prom

### Function description:

### Formula section:

B\_pwf = LV\_NVMY\_CUS\_WRG if non-volatile stored data of storage class .Nvram (all customer adaptation values) could not be re-loaded error free out of the E2PROM

## 3.28 AGGR adaptation: OBDC

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
SAF_DIAG_MAX_SAE	O/S	0... FF00H	0... 255	3.9063e-3	kg/h
Mean diagnosis value of maximum secondary air flow for SAE					
SAF_DIAG_MIN_SAE	O/S	0... FF00H	0... 255	3.9063e-3	kg/h
Mean diagnosis value of minimum secondary air flow for SAE					
SUM_AFL_VLS_DIAG_SA_1_SAE	O/V	0... FFFFH	0... 65535	1	-
Counter of lean events within the secondary air diagnosis					
SUM_AFL_VLS_DIAG_SA_2_SAE	O/V	0... FFFFH	0... 65535	1	-
Counter of lean events within the secondary air diagnosis					
VLS_COR_LSL [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Corrected output signal of lambda sensor					

### Input data:

VLS_UP_COR [NC_CBK_EX_NR] {p. 2315}			
---	--	--	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_SUM_AFL_VLS_MIN_DIAG_SA_1	-	0... FFFFH	0... 65535	1	-
Threshold of lean events within the secondary air diagnosis					
LC_SA_SWI_ACQ	-	0... 1H	0...1	1	-
Logical constant for the decision SAF_KGH through model value (=0) or SAFM is used (=1)					

### 3.28.1 Initialization of secondary-air variables

#### FUNCTION DESCRIPTION:

#### General information:

Secondary air system diagnosis is not supported in MSD projects, thus all needed variables must be stubbed.

#### Application conditions

**Initialisation:** *at reset all variables = 0*

**Recurrence:** -

**Activation:** -

### 3.28.2 Calculation of non-implemented variables

#### FUNCTION DESCRIPTION:



**General information:**

VLS\_COR\_LSL[i] is not supported in MSD projects, thus all needed variables must be calculated.

**Application conditions**


**Initialisation:** *at reset = 0*

**Recurrence:** *10ms*

**Activation:** *every engine operating state*


**Formula section:**

VLS\_COR\_LSL[i] = VLS\_UP\_COR[i] *//calculation is done in physical way*

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# 4 - System variables

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## 4.1 ECU state detection

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ECU_STATE	O/V	0H	ENG_STOP	-	-
		1H	RUN_ENG		
		2H	SYN_ENG_		
			IGK_ON		
		3H	SYN_ENG_		
			IGK_OFF		
		4H	PWL		
		5H	ENG_LOCK		
		6H	WAKE_UP		
information on ECU state					
FAST_ECU_TRAN_PWL_CTR	V	0... FFFFH	0... 655.35	0.01	s
fast transition counter for transition from SYN_ENG_IGK_OFF to PWL despite of engine running					

### Input data:

C_VB_RLY_MAIN_DIAG {p. 4934}	ECU_LOCK_REQ {p. 654}	LV_CS {p. 8394}	LV_FIRST_VLD_TOOTH {p. 1505}
LV_IGK {p. 906}	LV_INH_PWL_TRAN_ES_ EL {p. 3776}	LV_RLY_MAIN {p. 3772}	LV_RUN_ENG {p. 1505}
LV_STOP_ENG {p. 1505}	LV_SYN_ENG {p. 1506}	T_DLY_RLY_MAIN_DIAG {p. 4934}	VB {p. 1185}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DI_ENG_RUN	-	0... FFFFH	0... 655.35	0.01	s
Time of disabled ENG_RUN after engine stall during drive off					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_FAST_TRAN_PWL	-	0... FFFFH	0... 655.35	0.01	s
maximum delay for transition from SYN_ENG_IGK_OFF to PWL despite engine running					

### Application conditions


**Recurrence:** If LV\_ES = 1 segment-synchronous  
If LV\_ES = 0 10ms

### FUNCTION DESCRIPTION:

### General information:

The function ECU-state manages detection of the operating states of the ECU and transitions between them referring to the main inputs key detection and crankshaft synchronization.

The ECU-state offers system events corresponding to those transitions that can be used by other functions (e.g. ignition function that asks for ignition reset on the transition engine running to engine stop).

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```

If          ECU_LOCK_REQ = 0          and
              LV_IGK = 1                and
              LV_RLY_MAIN = 1           and
              (VB >= C_VB_RLY_MAIN_DIAG or
              T_DLY_RLY_MAIN_DIAG = 0)
Then        offer an interface for project specific activities on this state transition
              ECU_STATE = ENG_STOP
Endif
    
```

### ENGINE STOP (ENG\_STOP)

The crankshaft does not turn (no valid crank- or cam-edges are recognized), ignition key is ON and no engine lock condition is set. An interface for project specific activities on this state does exist.

#### **ENG\_STOP => PWL**

```

If          LV_IGK = 0
Then        offer an interface for project specific activities
              LV_T_DI_ENG_RUN = 0
              ECU_STATE = PWL
Endif
    
```

#### **ENG\_STOP => ENG\_LOCK**

```

If          ECU_LOCK_REQ > 0        and
              LV_IGK = 1
Then        offer an interface for project specific activities
              ECU_STATE = ENG_LOCK
Endif
    
```

#### **ENG\_STOP => ENG\_STOP**

```

If          LV_STOP_ENG = 1
Then        offer an interface for project specific activities
              ECU_STATE = ENG_STOP
              Decrement timer_disable_engine_run till 0
              If timer_disable_engine_run = 0
              Then LV_T_DI_ENG_RUN = 0
              Endif
Endif
    
```

#### **ENG\_STOP => ENG\_RUN**


```

If          LV_RUN_ENG = 1          and
              LV_SYN_ENG = 0          and
              LV_T_DI_ENG_RUN = 0
Then        offer an interface for project specific activities
              ECU_STATE = RUN_ENG
Endif
    
```

#### **ENG\_STOP => SYN\_ENG\_IGK\_ON**

```

If          LV_RUN_ENG = 1          and
              LV_SYN_ENG = 1
Then        offer an interface for project specific activities for transition of state RUN_ENG
              offer a second interface for project specific activities on the state transition in      state
              SYN_ENG_IGK_ON
    
```

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ECU\_STATE = SYN\_ENG\_IGK\_ON

**Endif**

**RUNNING ENGINE (ENG\_RUN)**

This state corresponds to a turning engine without synchronization on crankshaft.  
An interface for project specific activities on this state does exist.

**ENG\_RUN => PWL**

**If** LV\_IGK = 0

**Then** offer an interface for project specific activities on this state transition.  
ECU\_STATE = PWL

**Endif**

**ENG\_RUN => ENGINE LOCK**

**If** ECU\_LOCK\_REQ > 0

**Then** offer an interface for projekt specific activities,  
ECU\_STATE = ENG\_LOCK

**Endif**

**ENG\_RUN => ENG\_STOP**

**If** LV\_STOP\_ENG = 1

**Then** offer an interface for project specific activities,  
ECU\_STATE = ENG\_STOP

**Endif**

**ENG\_RUN => SYN\_ENG\_IGK\_ON**

**If** LV\_SYN\_ENG = 1

**Then** offer an interface for project specific activities  
ECU\_STATE = SYN\_ENG\_IGK\_ON

**Endif**

**SYNCHRON ENGINE: IGNITION KEY ON (SYN\_ENG\_IGK\_ON)**

This state corresponds to a synchronized engine and ignition key on.

**SYN\_ENG\_IGK\_ON => ENG\_LOCK**

**If** ECU\_LOCK\_REQ > 0

**Then** offer an interface for project specific activities  
ECU\_STATE = ENG\_LOCK

**Endif**

**SYN\_ENG\_IGK\_ON => ENGINE STOP**

**If** LV\_STOP\_ENG = 1

**Then** offer an interface for project specific activities


**If** LV\_CS = 1

**Then** start timer\_disable\_engine\_run with C\_T\_DI\_ENG\_RUN  
LV\_T\_DI\_ENG\_RUN = 1

**Endif**

ECU\_STATE = ENG\_STOP

**Endif**

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**SYN\_ENG\_IGK\_ON => SYN\_ENG\_IGK\_OFF**

```

If          LV_IGK = 0
Then       offer an interface for project specific activities,
              ECU_STATE = SYN_ENG_IGK_OFF
Endif
    
```

**Fast transition counter FAST\_ECU\_TRAN\_PWL\_CTR**

The transition SYN\_ENG\_IGK\_OFF => PWL FAST\_ECU\_TRAN\_PWL\_CTR is done if engine is stopped or if LV\_IGK = 0 and fast transition counter FAST\_ECU\_TRAN\_PWL\_CTR = 0. The fast transition counter is started at transition from SYN\_ENG\_IGK\_ON => SYN\_ENG\_IGK\_OFF and is decremented at every recurrence by 10 ms.

```

If          transition ECU_STATE = SYN_ENG_IGK_OFF => ECU_STATE = PWL
Then       FAST_ECU_TRAN_PWL_CTR = FAST_ECU_TRAN_PWL_CTR - 10 ms
Else       FAST_ECU_TRAN_PWL_CTR = NC_FAST_TRAN_PWL
Endif
    
```

**SYNCHRON ENGINE: IGNITION KEY OFF (SYN\_ENG\_IGK\_OFF)**

This state corresponds to a synchronized engine and ignition key off.

**SYN\_ENG\_IGK\_OFF => SYN\_ENG\_IGK\_ON**

```

If          LV_IGK = 1
Then       offer an interface for project specific activities
              ECU_STATE = SYN_ENG_IGK_ON
Endif
    
```

**SYN\_ENG\_IGK\_OFF => PWL**

```

If          LV_STOP_ENG = 1                                or
              FAST_ECU_TRAN_PWL_CTR = 0
Then       offer an interface for project specific activities
              ECU_STATE = PWL
Endif
    
```

**POWER LATCH (PWL)**

Non volatile data are stored and ECU shutdown is prepared. An interface for project specific activities on this state does exist.

**PWL => ENG\_LOCK**

```


If          LV_IGK = 1                                and
              LV_INH_PWL_TRAN_ES_EL = 0                and
              (ECU_LOCK_REQ > 0)                        or
              LV_RLY_MAIN = 0                          or
              (VB < C_VB_RLY_MAIN_DIAG                 and
              T_DLY_RLY_MAIN_DIAG > 0))
Then       ECU_STATE = ENG_LOCK
Endif
    
```

**PWL => ENG\_STOP**

```

If          LV_IGK = 1                                and
    
```

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```

LV_INH_PWL_TRAN_ES_EL = 0      and
ECU_LOCK_REQ = 0              and
LV_RLY_MAIN = 1               and
(VB >= C_VB_RLY_MAIN_DIAG     or
T_DLY_RLY_MAIN_DIAG = 0)
Then
ECU_STATE = ENG_STOP
Endif

```

**PWL => PWL**

```

If
    LV_IGK=0                  or
    LV_INH_PWL_TRAN_ES_EL = 1
Then
    The condition LV_INH_PWL_TRAN_ES_EL = 1 indicates that the monitoring
    unit disabled the powerstages of MTC and injection outputs. IGK ON recognition
    is not accepted without reset.
    ECU_STATE = PWL
Endif

```

**WAKE UP MODE (WAKE\_UP)**

The Wake UP Mode can only be reached after ECU\_Reset (Shut Down Mode).  
This mode indicates that the LV\_WAKE\_UP was set and the Ignition Key is off.

**WAKE\_UP => ENG\_LOCK**

```

If
    LV_IGK = 1                and
    LV_INH_PWL_TRAN_ES_EL = 0 and
    (ECU_LOCK_REQ > 0         or
    LV_RLY_MAIN = 0           or
    (VB < C_VB_RLY_MAIN_DIAG and
    T_DLY_RLY_MAIN_DIAG > 0))
Then
    ECU_STATE = ENG_LOCK
Endif

```

**WAKE\_UP => ENG\_STOP**

```

If
    LV_IGK = 1                and
    LV_INH_PWL_TRAN_ES_EL = 0 and
    ECU_LOCK_REQ = 0          and
    LV_RLY_MAIN = 1           and
    (VB >= C_VB_RLY_MAIN_DIAG or
    T_DLY_RLY_MAIN_DIAG = 0)
Then
    ECU_STATE = ENG_STOP
Endif

```



## 4.2 Actuator position determination

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
OPG_ACR	O/V	0... FFFH	0... 99.9756	0.02441	%
Measured opening of the actuator valve					
V_ACR	O/V	0... 3FFH	0... 4.995117	0.00488	V
Voltage value for actuator position control delivered from the measuring system					
V_ACR_BAS	V	0... 3FFH	0... 4.995117	0.00488	V
Raw value of the measuring system for actuator position control					
V_ACR_MV	V	0... 7FFH	0... 4.997559	0.002441	V
Voltage value for actuator position control delivered from the measuring system with higher resolution					

### Input data:

FAC_ACR_SLOP {p. 4320}	LV_OPG_ACR_INI_REQ {p. 4345}	V_ACR_AD_BOL {p. 4320}	
------------------------	---------------------------------	------------------------	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_OPG_ACR_INI	-	0... FFFH	0... 99.9756	0.02441	%
Replacement value for sensor signal acquisition					

### Import actions:

ACTION_INFR_GetVAcr (OUT<V_acr_bas>)
--------------------------------------

### General information

The electrical actuator is equipped with a linear position sensor system. The propose of this module is to determine the actual valve position for the closedloop digital position control.

### Application Condition

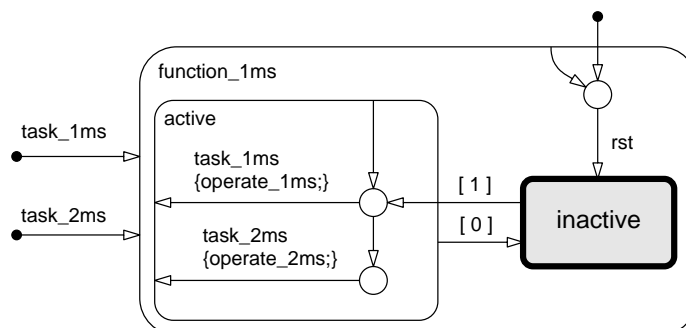


Figure 4.2.1: ACRC\_position\_determination/APP\_CDN/APP\_CDN

### Function Description

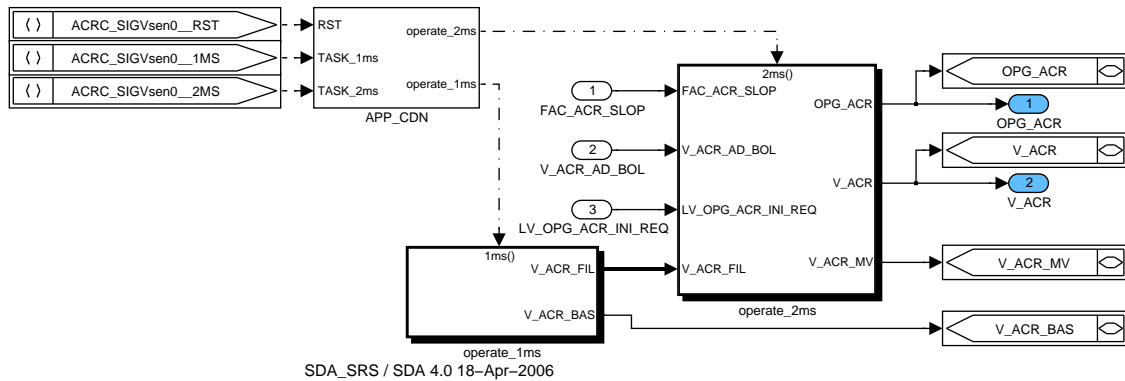


Figure 4.2.2: ACRC\_POSITION\_DETERMINATION

#### 4.2.1 Signal pre processing

The described filter function is a part of signal processing. The AD value of the measuring system has a resolution of 10 bit (1024 increments) according to the AD converter. The smallest signification bit (one increment) is the fault of the AD conversion process and this bit can alternate from conversion to conversion. To compensate this behaviour the described bit filter is used, see below.

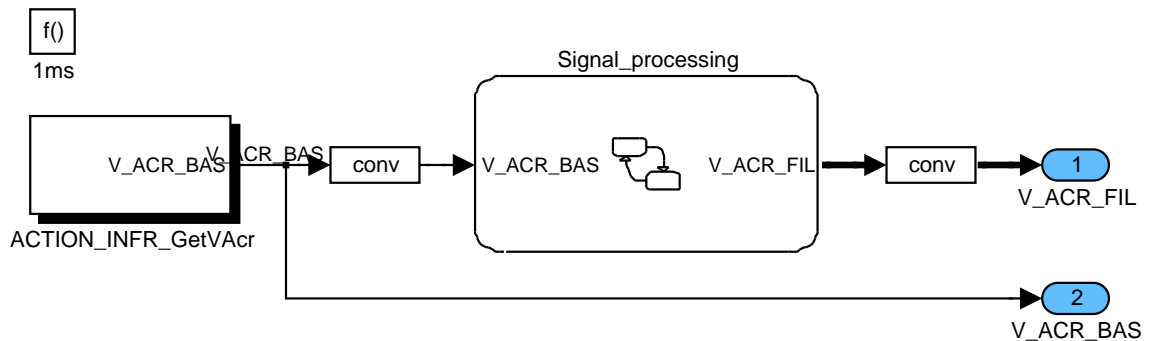


Figure 4.2.3: ACRC\_POSITION\_DETERMINATION/OPERATE\_1MS

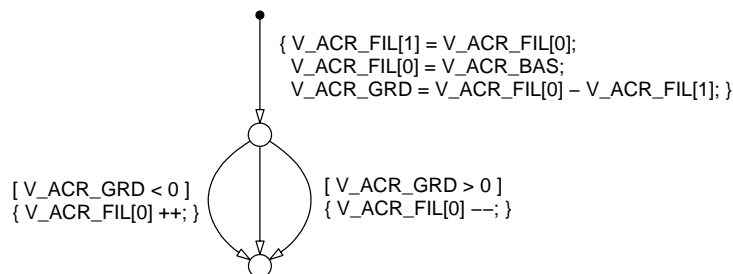


Figure 4.2.4: ACRC\_position\_determination/operate\_1ms/Signal\_processing

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## 4.2.2 Signal standardization

The aim of this chapter is to provide the valve position for the digital position controller. The signal voltage of the measuring system is determined by oversampling and averaging after the signal preprocessing. Afterwards the position signal is standardised by the electrical valve adaptation value and the standard slop of the measuring system and is limited in the range between 0 % and 100 %.

The output of the signal acquisition is set to C\_OPG\_ACR\_INI if the replacement value for the sensor signal acquisition has been requested.

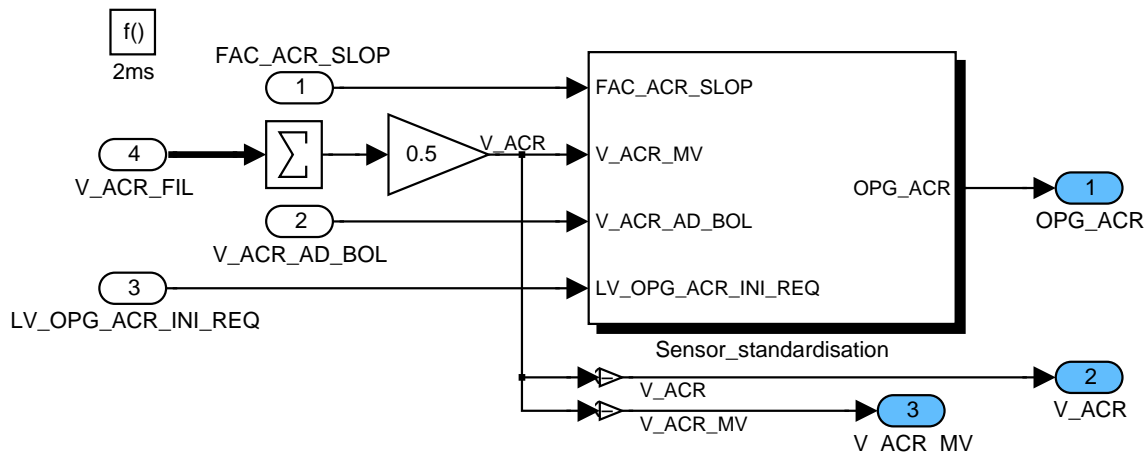


Figure 4.2.5: ACRC\_POSITION\_DETERMINATION/OPERATE\_2MS

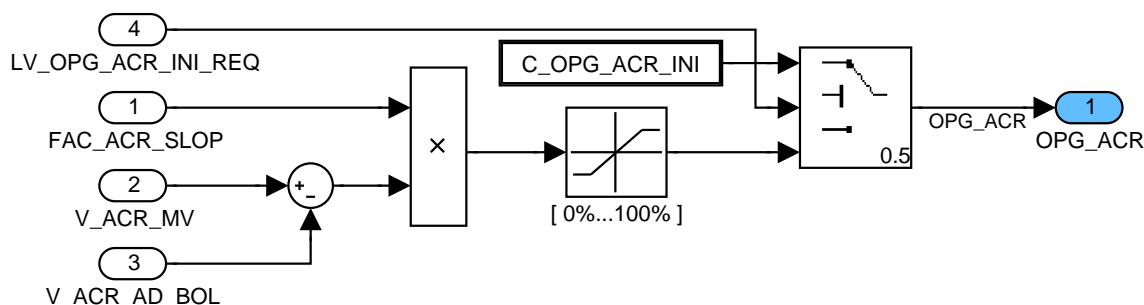


Figure 4.2.6: ACRC\_POSITION\_DETERMINATION/OPERATE\_2MS/SENSOR\_STANDARDISATION

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## 4.3 Coolant temperature

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_INI_TCO	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature initialisation conditions					
TCO	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature					
TCO_MES	O/V	0... FEH	-48... 142.5	0.75	°C
Measured coolant temperature					
TCO_ST	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature at start					
TCO_ST_DC	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature at first start of driving cycle					
TCO_STOP	O/V/S	0... FEH	-48... 142.5	0.75	°C
Coolant temperature at transition to engine stop (ES)					
VP_TCO [NC_NR_TCO_SENS]	O/V	0... 7FFFH	0... 4.99984	152.6e-6	V
Sensor raw acquisition of all available coolant temperature sensors					

### Input data:

LV_ECU_SLA {p. 800}	LV_ERR_TCO {p. 4496}	LV_ERR_TCO_PREL {p. 4496}	LV_ERR_TIA_IM {p. 984}
LV_ES {p. 1720}	NC_NR_TCO_SENS {p. 576}	TCO_SUB {p. 1105}	TIA_IM {p. 984}
VP_TCO_COPL [NC_NR_TCO_SENS] {p. 811}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_INI_TIA_IM	-	0... FEH	-48... 142.5	0.75	°C
Coolant temperature initialization value in case of a coolant- and intake air- temperature failure					
C_TCO_MES_GRD_MAX	-	0... FEH	0... 190.5	0.75	°C
Maximum permissible temperature gradient for coolant temperature gradient monitoring					
IP_TCO_INI_TIA_IM	-	0... FEH	-48... 142.5	0.75	°C
LDP_TIA_IM_IP_TCO_INI_TIA_IM	6	0... FEH	-48... 142.5	0.75	°C
Coolant temperature initialization value in case of a coolant temperature failure					
IP_TCO_MES	-	0... FEH	-48... 142.5	0.75	°C
LDP_VP_TCO_IP_TCO_MES	16	0... 7FFFH	0... 4.99984	152.6e-6	V
Linearization of the coolant temperature sensor voltage for temperature acquisition					

### Import actions:

<b>ACTION_INFR_GetVpTco (OUT&lt;No Name available&gt;)</b>
--

### FUNCTION DESCRIPTION:

**General information:**

The coolant temperature raw sensor voltage is measured with use of an 10bit A/D converter by the ECU hardware. The software then is generating a modified sensor signal (VP\_TCO[0]), which is requested by the application software for further execution.

The modified sensor signal (VP\_TCO[0]) is converted into a measured temperature value (TCO\_MES) with use of a one-dimension interpolation table (IP\_TCO\_MES).

**Application conditions:**

See separate chapters:

**4.3.1 Coolant temperature gradient monitoring****FUNCTION DESCRIPTION:****General information:**

The measured coolant temperature (TCO\_MES) is monitored for not plausible gradients. It is checked if the temperature difference between the old and the new measured coolant temperature (TCO\_MES) exceeds the permissible gradient C\_TCO\_MES\_GRD\_MAX. In this case the old measured value remains unchanged. If the temperature difference between the measured coolant temperature values is exceeding the permissible gradient again during the next measurement, the new measured value is transferred into the working memory. A measured value can be inhibited only if the gradient exceeded for one time (recurrence).

The monitoring of the coolant temperature gradient does not lead to failure entries. The only purpose is to extract implausible measured values (noise).

**Application conditions****Initialisation at Reset:**

```


FOR k = 0 to NC_NR_TCO_SENS -1
    IF LV_ECU_SLA =1
        THEN VP_TCO[k] = VP_TCO_COPL[k]
        ELSE
            ACTION_INFR_GetVpTco (VP_TCO[k])
    ENDIF
END FOR
// all sensor values are imported and provided as output
TCO_MES(n) = TCO_MES(n-1) = IP_TCO_MES
// acquisition of the main coolant temperature measurement
signal

```

**Recurrence:** 100 ms

**Activation:** at every engine operating state

**Deactivation:** -

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**Formula section:**

```
// all sensor values are imported and provided as output
FOR k = 0 to NC_NR_TCO_SENS - 1
  IF LV_ECU_SLA =1
    THEN VP_TCO[k] = VP_TCO_COPL[k]
    ELSE
      ACTION_INFR_GetVpTco(VP_TCO[k])
  ENDIF
END FOR
// VP_TCO[0] is used as input signal for the interpolation table IP_TCO_MES
TCO_MES = IP_TCO_MES
// acquisition of the main coolant temperature measurement signal
If          I TCO_MES(n-1) - TCO_MES(n) I > C_TCO_MES_GRD_MAX
then          TCO_MES(n) = TCO_MES(n-1)          (only one time!)
else          TCO_MES(n) = TCO_MES(n)
endif
```

**4.3.2 Coolant temperature acquisition**

**FUNCTION DESCRIPTION:**

**General information:**

The actualisation of the coolant temperature value (TCO) is only executed, if no coolant temperature error /preliminary error is detected. In case of a detected error, the TCO value will be set to the calculated coolant temperature substitute value (TCO\_SUB).

The initialisation of the coolant temperature value (TCO) is always performed as long as the engine operating state "Engine stop" is active.

**Application conditions:**

*Initialisation:*

at Reset TCO = TCO\_MES  
 at Reset or Engine stop: LV\_CDN\_INI\_TCO = 1  
 at Engine stop to Engine run (ES\_to\_ERU): LV\_CDN\_INI\_TCO = 0

*Activation:* at every engine operating state


*Deactivation:* -

**4.3.2.1 Coolant temperature acquisition at engine stop**

**Application conditions**

**Recurrence:** 10 ms  
**Activation:** LV\_CDN\_INI\_TCO = 1  
**Deactivation:** LV\_CDN\_INI\_TCO = 0

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**Formula section:**

```

if (1)          LV_ERR_TCO = 0          and
                LV_ERR_TCO_PREL = 0
then (1)       TCO = TCO_MES
else (1)
    if (2)       LV_ERR_TIA_IM = 0
    then (2)     TCO = IP_TCO_INI_TIA_IM
    else (2)     TCO = C_TCO_INI_TIA_IM
    endif (2)
endif (1)
    
```

**4.3.2.2 Coolant temperature acquisition at engine run**

*Recurrence:* 100 ms

*Activation:* LV\_CDN\_INI\_TCO = 0

*Deactivation:* LV\_CDN\_INI\_TCO = 1

**Formula section:**

```

if (1)          LV_ERR_TCO = 0
then (1)
    if (2)       LV_ERR_TCO_PREL = 0
    then (2)     TCO = TCO_MES
    else (2)     TCO(n) = TCO(n-1)
    endif (2)
else (1)       TCO = TCO_SUB
endif (1)
    
```

**4.3.3 Coolant temperature at engine start**

**FUNCTION DESCRIPTION:**

**General information:**

The coolant temperature at engine start (TCO\_ST) is determined as long as the engine operating state “Engine stop” is detected. During this time, TCO\_ST is set with the actual coolant temperature value TCO.

**Application conditions**


**Initialisation at Reset:** TCO\_ST = TCO\_MES  
TCO\_ST\_DC = TCO\_MES

**Recurrence:** 10 ms

**Activation:** LV\_ES = 1

**Deactivation:** LV\_ES = 0

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## 4.4 Coolant temperature substitute model

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_N_REL_CWP_H	V	0... FFH	0... 255	1	-
Counter to activate TCO-SUB correction if Heater is active					
FAC_TCO_SUB_COR	V	0... FFH	0... 1.99218	0.0078125	-
Coolant temperature substitute value correction factor					
FAC_TCO_SUB_COR_N_REL_CWP	V	0... FFFFH	0... 255.99609	3.9063e-3	-
Coolant temperature substitute value correction factor for CWP functionality					
FAC_TCO_SUB_COR_STATE_COC	V	0... FFH	0... 51	0.2	-
Coolant temperature substitute value correction factor after warm-up					
FAC_TCO_SUB_VS	V	0... FFFFH	-8... 7.99975	244.1e-6	-
Coolant temperature substitute value vehicle speed correction factor					
LV_CDN_ENA_TCO_SUB	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature substitute model initialisation condition					
N_REL_CWP_GRD	V	8000... 7FFFH	-32768 ...32767	1	-
Gradient of N_REL_CWP					
T_DLY_TCO_SUB	V	0... FFFFH	0... 65535	1	s
Delay time counter for coolant temperature substitute value calculation during pull fuel cutoff or idle speed					
T_DLY_TCO_SUB_COR_STATE_COC	V	0... FFFFH	0... 65535	1	s
Delay time counter for coolant temperature substitute value calculation after warm-up					
T_DLY_THD_TCO_SUB_ST	V	0... FFFFH	0... 6553.5	0.1	s
Delay time threshold for coolant temperature substitute value depending on CWP speed					
T_N_REL_CWP_GRD_H	V	0... FFH	0... 255	1	s
Timer to block coolant temperature model correction					
TCO_SUB	O/V	0... FE00H	-48... 142.5	2.9297e-3	°C
Coolant temperature substitute value					
TCO_SUB_INC	V	0... FE00H	-48... 142.5	2.9297e-3	°C
Coolant temperature substitute increment value					

### Input data:

LV_ERR_TCO {p. 4496}	LV_IS {p. 1720}	LV_PL {p. 1720}	LV_PU {p. 1720}
LV_PUC {p. 1720}	LV_ST {p. 1720}	MAF_KGH {p. 1195}	N_REL_CWP {p. 4095}
OPM_AV {p. 8137}	T_AST {p. 1766}	TAM {p. 1579}	TCO {p. 1100}
TCO_ST {p. 1100}	VS {p. 1176}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_N_REL_CWP_H	-	0... FFH	0... 255	1	-
counter to correct TCO-SUB model via colling water pump gradient					
C_FAC_TCO_SUB_COR	-	0... FFH	0... 1.99218	0.0078125	-
Multiple Coolant temperature substitute value correction factor					
C_FAC_TCO_SUB_COR_STATE_COC	-	0... FFH	0... 51	0.2	-
Coolant temperature substitute value correction factor after warm-up					
C_N_REL_CWP_THD_COC	-	0... FFH	0... 255	1	-
CWP speed threshold for detecting running or stopped CWP					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_REL_CWP_THD_GRD_H_MIN	-	8000... 7FFFH	-32768 ...32767	1	-
Threshold to el. cooling water pump to correct TCO_SUB model					
C_N_REL_CWP_THD_H_MIN	-	0... FFH	0... 255	1	-
Minimum cooling water pump speed for correcting coolant thermostat diagnosis					
C_T_DLY_TCO_SUB_COR_STATE_COC	-	0... FFFFH	0... 65535	1	s
Delay time after warm-up for coolant temperature substitute value correction factor					
C_T_DLY_TCO_SUB_IS_1	-	0... FFFFH	0... 65535	1	s
Delay time after idle speed to stop the coolant temperature substitute value calculation					
C_T_DLY_TCO_SUB_IS_2	-	0... FFFFH	0... 65535	1	s
Delay time after idle speed to activate the coolant temperature substitute value calculation					
C_T_DLY_TCO_SUB_PUC	-	0... FFFFH	0... 65535	1	s
Delay time after pull fuel cutoff to activate the coolant temperature substitute value calculation					
C_T_DLY_TCO_SUB_ST_CWP_OFF	-	0... FFFFH	0... 6553.5	0.1	s
Delay time after start to activate the coolant temperature substitute value calculation for stopped CWP					
C_T_DLY_TCO_SUB_ST_CWP_ON	-	0... FFFFH	0... 6553.5	0.1	s
Delay time after start to activate the coolant temperature substitute value calculation for running CWP					
C_T_N_REL_CWP_GRD_H	-	0... FFH	0... 255	1	s
Threshold to initialize timer to block TCO-SUB-Model correction					
C_TCO_SUB_COR_H_ON	-	0... FEH	-48... 142.5	0.75	°C
Correction TCO-SUB-model if el. waterpump begins to run					
C_TCO_SUB_MIN_FAC_VS	-	0... FEH	-48... 142.5	0.75	°C
Minimum model temperature to activate the vehicle speed correction factor					
IP_FAC_TCO_SUB_COR_N_REL_CWP	-	0... FFH	0... 4.98046	0.0195313	-
LDP_N_REL_CWP_IP_FAC_TCO_SUB	4	0... FFH	0... 255	1	-
Coolant temperature substitute value correction factor dependend on CWP speed					
IP_FAC_TCO_SUB_INC	V	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_MAF_KGH_IP_TCO_SUB	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDPM_TCO_SUB_IP_TCO_SUB	6	0... FE00H	-48... 142.5	2.9297e-3	°C
Increment factor for the coolant temperature substitute value calculation					
IP_FAC_TCO_SUB_INC_S	V	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_MAF_KGH_IP_TCO_SUB_S	4	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_TCO_SUB_IP_TCO_SUB_S	4	0... FE00H	-48... 142.5	2.9297e-3	°C
Increment factor for the coolant temperature substitute value calculation at operation mode stratified					
IP_FAC_TCO_SUB_VS	V	0... FFFFH	-8... 7.99975	244.1e-6	-
LDP_VS_IP_FAC_TCO_SUB_VS	6	0... FFH	0... 255	1	km/h
LDPM_MAF_KGH_IP_TCO_SUB	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Coolant temperature substitute value correction factor dependend on vehicle speed and engine load					
IP_TCO_SUB_DEC	V	0... FE00H	0... 190.5	2.9297e-3	°C
LDPM_TCO_SUB_IP_TCO_SUB	6	0... FE00H	-48... 142.5	2.9297e-3	°C
LDPM_TAM_IP_TCO_SUB	6	0... FEH	-48... 142.5	0.75	°C
Decrement value for the coolant temperature substitute value calculation					
IP_TCO_SUB_INC	V	0... FE00H	0... 190.5	2.9297e-3	°C
LDPM_MAF_KGH_IP_TCO_SUB	6	0... FFFFH	0... 2047.96875	0.03125	kg/h

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_TAM_IP_TCO_SUB	6	0... FEH	-48... 142.5	0.75	°C
Increment value for the coolant temperature substitute value calculation					
IP_TCO_SUB_INC_IS	V	0... FE00H	-48... 142.5	2.9297e-3	°C
LDP_TCO_SUB_IP_TCO_SUB_INC	6	0... FE00H	-48... 142.5	2.9297e-3	°C
LDP_TAM_IP_TCO_SUB_INC	6	0... FEH	-48... 142.5	0.75	°C
Decrement value for the coolant temperature substitute value calculation					
IP_TCO_SUB_INC_S	V	0... FE00H	0... 190.5	2.9297e-3	°C
LDPM_MAF_KGH_IP_TCO_SUB_S	4	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_TAM_IP_TCO_SUB_S	4	0... FEH	-48... 142.5	0.75	°C
Increment value for the coolant temperature substitute value calculation at operation mode stratified					
IP_TCO_SUB_MAX_TAM	-	0... FEH	-48... 142.5	0.75	°C
LDPM_TAM_IP_TCO_SUB	6	0... FEH	-48... 142.5	0.75	°C
Coolant temperature substitute maximum value dependend on ambient air temperature					

## FUNCTION DESCRIPTION:

### General information:

The coolant temperature substitute model (TCO\_SUB) is initialized with the coolant temperature at engine start (TCO\_ST) as soon as the system event “Engine stop” to “Engine run” is detected. The substitute model increment values are dependent on the actual engine performance (equivalent to mass air flow MAF\_KGH), ambient temperature and vehicle speed. To take the smaller incrementation values at higher coolant temperatures into consideration, the increment values are weighted.

During “Idle speed” and “Pull fuel cutoff” phases the calculation of the coolant temperature substitute value remains activated.

A delay time after engine start to activate the incrementation of the temperature substitute value is incremented, to simulate the warm up of the real coolant temperature very efficient.

In case of a coolant temperature acquisition failure (LV\_ERR\_TCO = 1), the coolant temperature substitute value is reinitialized with the latest valid coolant temperature value. In this case the model incrementation starts from the initialization value on.

### Application conditions

**Initialisation at Engine stop to Engine run (ES\_to\_ERU):**  $T\_DLY\_TCO\_SUB = 0$

$T\_DLY\_TCO\_SUB\_COR\_STATE\_COC = 0$

$TCO\_SUB_{(n)} = TCO\_SUB_{(n-1)} = TCO\_ST$

$FAC\_TCO\_SUB\_COR\_STATE\_COC = 1$

**Initialisation at Exit start (EXIT\_ST):**  $LV\_CDN\_ENA\_TCO\_SUB = 1$

$T\_N\_REL\_CWP\_GRD\_H = C\_T\_N\_REL\_CWP\_GRD\_H$

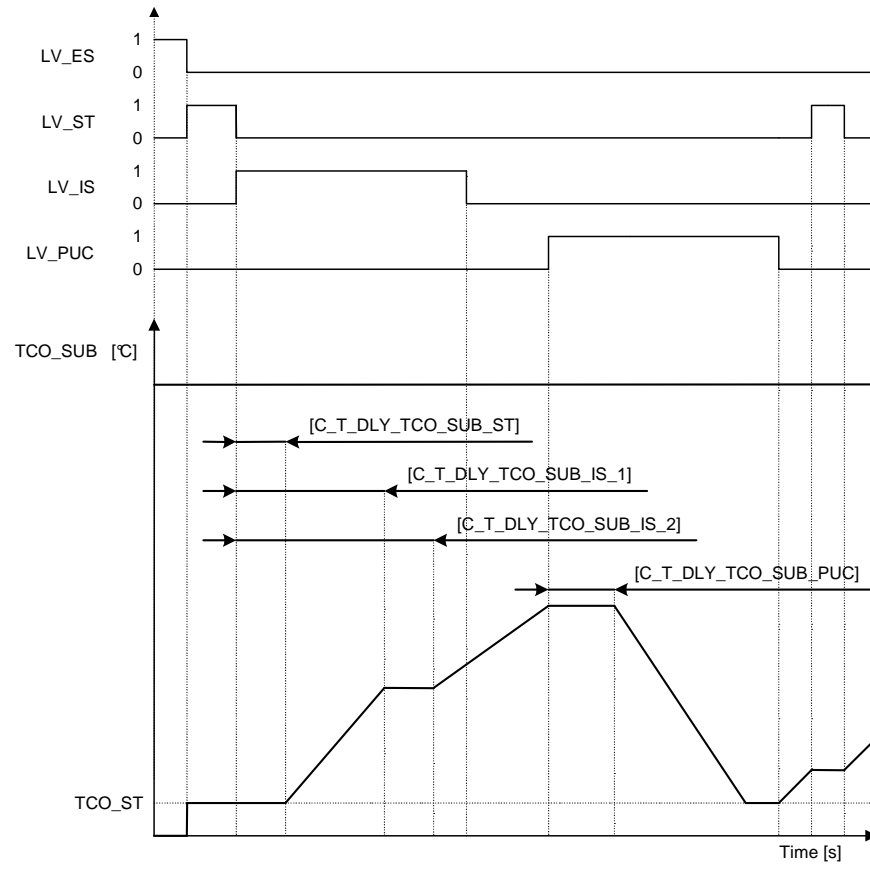
$CTR\_N\_REL\_CWP\_H = C\_CTR\_N\_REL\_CWP\_H$

**Initialisation at Engine run to Engine stop (ERU\_to\_ES):**  $LV\_CDN\_ENA\_TCO\_SUB = 0$

**Recurrence:**  $1000\ ms$

**Activation:**  $LV\_CDN\_ENA\_TCO\_SUB = 1$

**Deactivation:**  $LV\_CDN\_ENA\_TCO\_SUB = 0$

**Signal flow diagram:****Formula section:**

Calculation of the factor  $FAC\_TCO\_SUB\_COR\_STATE\_COC$  for CWP functionality:

```


if N_REL_CWP < C_N_REL_CWP_THD_COC
then T_DLY_TCO_SUB_COR_STATE_COC = 0
      T_DLY_THD_TCO_SUB_ST = C_T_DLY_TCO_SUB_ST_CWP_OFF
      FAC_TCO_SUB_COR_STATE_COC = 1
else T_DLY_THD_TCO_SUB_ST = C_T_DLY_TCO_SUB_ST_CWP_ON
      if T_DLY_TCO_SUB_COR_STATE_COC
          < C_T_DLY_TCO_SUB_COR_STATE_COC
          then FAC_TCO_SUB_COR_STATE_COC =
              C_FAC_TCO_SUB_COR_STATE_COC
          else FAC_TCO_SUB_COR_STATE_COC = 1
          endif
      T_DLY_TCO_SUB_COR_STATE_COC =
          T_DLY_TCO_SUB_COR_STATE_COC + 1 s
endif

```

Calculation of factor  $FAC\_TCO\_SUB\_COR\_N\_REL\_CWP$  for CWP functionality:

$$FAC\_TCO\_SUB\_COR\_N\_REL\_CWP = IP\_FAC\_TCO\_SUB\_COR\_N\_REL\_CWP * FAC\_TCO\_SUB\_COR\_STATE\_COC$$

Calculation of the substitute model increment value during "Engine start":

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```

if                LV_ST = 1
then              TCO_SUB_INC = 0
endif

```

Calculation of factor FAC\_TCO\_SUB\_VS for vehicle speed functionality:

```

if (TCO_SUB >= C_TCO_SUB_MIN_FAC_VS)
then
    FAC_TCO_SUB_VS = IP_FAC_TCO_SUB_VS
else
    FAC_TCO_SUB_VS = 1
endif

```

Calculation of the substitute model increment value during "Part load" or "Pull":

```

if (1)            LV_PL = 1                                or
                  LV_PU = 1
then (1)
    if (2) OPM_AV= S (at operation mode stratified)
    then (2)
        TCO_SUB_INC =
            IP_TCO_SUB_INC_S * IP_FAC_TCO_SUB_INC_S *
            FAC_TCO_SUB_COR * FAC_TCO_SUB_COR_N_REL_CWP *
            FAC_TCO_SUB_VS
    else (2)
        TCO_SUB_INC =
            IP_TCO_SUB_INC * IP_FAC_TCO_SUB_INC * FAC_TCO_SUB_COR
            * FAC_TCO_SUB_COR_N_REL_CWP * FAC_TCO_SUB_VS
    endif (2)
endif (1)

```

Calculation of the substitute model increment value during "Pull fuel cutoff":

```

if Transition:  LV_PUC = 0 -> LV_PUC = 1
then
    T_DLY_TCO_SUB = 0
endif
if (1)
    LV_PUC = 1
then (1)
    if (2)
        T_DLY_TCO_SUB < C_T_DLY_TCO_SUB_PUC
    then (2)
        TCO_SUB_INC = 0
    else (2)
        TCO_SUB_INC = -( IP_TCO_SUB_DEC )
    endif (2)
    T_DLY_TCO_SUB = T_DLY_TCO_SUB + 1 s
endif (1)

```

Calculation of the substitute model increment value during "Idle speed":

```

if Transition:  LV_IS = 0 -> LV_IS = 1
then
    T_DLY_TCO_SUB = 0
endif
if (1)
    LV_IS = 1
then (1)
    if (2)
        T_DLY_TCO_SUB < C_T_DLY_TCO_SUB_IS_1 or
        T_DLY_TCO_SUB > C_T_DLY_TCO_SUB_IS_2
    if (3) OPM_AV= S (at operation mode stratified)
    then (3)
        TCO_SUB_INC =

```

```

        IP_TCO_SUB_INC_S * IP_FAC_TCO_SUB_INC_S*
        FAC_TCO_SUB_COR* FAC_TCO_SUB_COR_N_REL_CWP
    else (3)
        TCO_SUB_INC =
        IP_TCO_SUB_INC * IP_FAC_TCO_SUB_INC * FAC_TCO_SUB_COR
        * FAC_TCO_SUB_COR_N_REL_CWP
    endif (3)
else (2)
    TCO_SUB_INC = IP_TCO_SUB_INC_IS
endif (2)
    T_DLY_TCO_SUB = T_DLY_TCO_SUB + 1 s
endif (1)

```

Correction of the coolant temperature substitute model value during N\_REL\_CWP increasing:

Gradient of N\_REL\_CWP:

```

N_REL_CWP_GRD = N_REL_CWP - N_REL_CWP_OLD
N_REL_CWP_OLD = N_REL_CWP

```

TCO\_SUB correction if N\_REL\_CWP is active

```

if
    N_REL_CWP_GRD > C_N_REL_CWP_THD_GRD_H_MIN
    AND N_REL_CWP > C_N_REL_CWP_THD_H_MIN
    AND CTR_N_REL_CWP_H > 0
    AND T_N_REL_CWP_GRD_H = 0
                                (timer is finished)
then
    T_N_REL_CWP_GRD_H = C_T_N_REL_CWP_GRD_H
    CTR_N_REL_CWP_H = CTR_N_REL_CWP_H - 1
    TCO_SUB = TCO_SUB + C_TCO_SUB_COR_H_ON;
                                (initialize timer)
                                (reduce counter)
                                (reduce TCO_SUB)
endif

if
    T_N_REL_CWP_GRD_H > 0
then
    T_N_REL_CWP_GRD_H = T_N_REL_CWP_GRD_H - 1 (timer)
endif

```

Calculation of the coolant temperature substitute model value:

```

if (1)
    LV_ERR_TCO = 0
then (1)
    FAC_TCO_SUB_COR = 1
else (1)
    FAC_TCO_SUB_COR = C_FAC_TCO_SUB_COR
endif (1)


if (1)
    T_AST < T_DLY_THD_TCO_SUB_ST
then (1)
    TCO_SUB(n) = TCO_SUB(n-1)
else (1)
    if (2)
        Transition: LV_ERR_TCO = 0 -> LV_ERR_TCO = 1
    then (2)
        TCO_SUB(n) = TCO(n-1)
        (re-initialization of TCO_SUB with the last plausible TCO value)
    endif
endif

```

```

else (2)
  if(3)      TCO_SUB(n-1) <= IP_TCO_SUB_MAX_TAM      or
              TCO_SUB_INC < 0
  then(3)    TCO_SUB(n) = TCO_SUB(n-1) + TCO_SUB_INC
              else(3)
                TCO_SUB(n) = TCO_SUB(n-1)
              endif(3)
  endif (2)
endif (1)

```

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 1111 of 8404</b>	
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## 4.5 Driving off assistance

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ISC_OFF_DROF	O/V	0... 1H	0 ...1	1	-
Boolean to enable/disable idle speed controller during drive off; 1=disabled					
LV_TQ_DROF_IS_AD_INH	O/V	0... 1H	0 ...1	1	-
flag for inhibition of IS control adaptations					
N_DIF_DROF	V	8000... 7FFFH	0... 32767	1	rpm
Engine speed deviation for DROF					
N_DIF_PRED_PL_DROF	V	8000... 7FFFH	0... 32767	1	rpm
Predicted idle speed control variable at drive off support					
TQ_ADD_PL_DROF	O/V	0... 7FFFH	0... 1023.97	0.03125004	Nm
TQ reserve for drive off support					
TQ_DROF_FAST	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
TQ request for drive off assistance					
TQ_DROF_SLOW	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
TQ request for drive off assistance					

### Input data:

FAC_TQ_REQ {p. 6706}	LV_AT {p. 654}	LV_BRAKE_DET {p. 4209}	LV_CS {p. 8394}
LV_ERR_CRK {p. 4455}	LV_ERR_PVS {p. 4216}	LV_ERR_VS {p. 5021}	LV_N_SP_IS_CS {p. 1122}
LV_ST_END {p. 1720}	LV_VAR_TCT {p. 656}	N {p. 1525}	N_DIF {p. 1122}
N_GRD {p. 1525}	N_SP_IS {p. 1122}	OPM_AV {p. 8137}	TIA {p. 1226}
TOIL {p. 8204}	TQ_AV {p. 6656}	VS_FIL {p. 1176}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_DIF_DROF_MAX	-	8000... 7FFFH	0... 32767	1	rpm
Maximum N_DIF_DROF for function TQ_DROF					
C_N_DIF_DROF_MIN	-	8000... 7FFFH	0... 32767	1	rpm
Minimum N_DIF_DROF for function TQ_DROF					
C_T_TQ_DROF_DLY_AD	-	0... FFH	0... 2.55	0.01	s
timer TQ_DROF for inhibition of IS control adaptations					
C_TQ_ADD_PL_DROF_LGRD	-	0... FFH	0... 7.96875	0.03125	Nm
Gradient limitation for drive off support TQ reserve					
C_TQ_DROF_AD	-	8000... 7FFFH	0... 1023.97	0.03125	Nm
threshold TQ_DROF for inhibition of IS control adaptations					
ID_IDX_OPM_DROF	-	0... 1H	0 ...1	1	-
LDPM_OPM_AV	8	0... 8H	0 ...8	1	
Switch map to choose DROF calculation path (OPM_1 or OPM_2) depending on OPM_AV					
ID_TQ_DROF_ENA	-	0... 1H	0 ...1	1	-
LDP_N_DIF_DROF_ID_TQ_DROF	3	0... FFFFH	0... 32767	1	rpm
LDP_N_GRD_ID_TQ_DROF	3	0... FFH	0... 4064	32	rpm/s
enable conditions					
IP_FAC_N_GRD_TQ_AV	-	0... FFFFH	0... 1.999969	305.176e3	-
LDP_TQ_AV_IP_FAC_N_GRD	4	0... FFFFH	0... 1023.97	0.03125	Nm
Weighing of additive part of N_DIF_DROF dependant from actual torque					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_TEMP_TQ_ADD_DROF_OPM_1	-	0... FFFFH	0... 1.99996948	305.176e3	-
LDP_TIA_IP_FAC_TEMP_TQ_ADD_1	6	0... FEH	0... 142.5	0.75	°C
LDP_TOIL_IP_FAC_TEMP_TQ_ADD_1	6	0... C8H	0... 160	1	°C
Temperature correction for IP_TQ_ADD_PL_DROF in operation mode 1					
IP_FAC_TEMP_TQ_ADD_DROF_OPM_2	-	0... FFFFH	0... 1.99996948	305.176e3	-
LDP_TIA_IP_FAC_TEMP_TQ_ADD_1	6	0... FEH	0... 142.5	0.75	°C
LDP_TOIL_IP_FAC_TEMP_TQ_ADD_1	6	0... C8H	0... 160	1	°C
Temperature correction for IP_TQ_ADD_PL_DROF in operation mode 2					
IP_FAC_TQ_DROF_FAC_TQ_REQ	-	0... FFFFH	0... 1.999969	305.176e3	-
LDP_FAC_TQ_REQ_IP_FAC_TQ_DROF	6	0... FFFFH	0... 1.99996	305e3	
Weighing of IP_TQ_DROF dependant from FAC_TQ_REQ					
IP_FAC_TQ_DROF_VS_OPM_1	-	0... FFFFH	0... 1.99996948	305.176e3	-
LDP_VS_FIL_IP_FAC_TQ_DROF_VS_1	6	0... FFFFH	0... 511.99218	0.0078125	km/h
LDP_N_IP_FAC_TQ_DROF_VS_1	6	0... 1FE0H	0... 8160	1	rpm
Weighing of IP_TQ_DROF dependant from engine and vehicle speed in operation mode 1					
IP_FAC_TQ_DROF_VS_OPM_2	-	0... FFFFH	0... 1.99996948	305.176e3	-
LDP_VS_FIL_IP_FAC_TQ_DROF_VS_1	6	0... FFFFH	0... 511.99218	0.0078125	km/h
LDP_N_IP_FAC_TQ_DROF_VS_1	6	0... 1FE0H	0... 8160	1	rpm
Weighing of IP_TQ_DROF dependant from engine and vehicle speed in operation mode 2					
IP_FAC_VS_TQ_ADD_PL_DROF	-	0... FFFFH	0... 1.999969	305.176e3	-
LDP_VS_FIL_IP_FAC_VS_TQ_ADD_PL	4	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed correction for IP_TQ_ADD_PL_DROF					
IP_N_DIF_ADD_DROF_OPM_1	-	0... FFFFH	0... 32767	1	rpm
LDP_N_GRD_IP_N_DIF_ADD_DROF_1	4	0... FFH	0... 4064	32	rpm/s
LDP_N_SP_IS_IP_N_DIF_ADD_DROF_1	4	0... 1FE0H	0... 8160	1	rpm
Additive part of N_DIF_DROF dependant from engine speed gradient in operation mode 1					
IP_N_DIF_ADD_DROF_OPM_2	-	0... FFFFH	0... 32767	1	rpm
LDP_N_GRD_IP_N_DIF_ADD_DROF_1	4	0... FFH	0... 4064	32	rpm/s
LDP_N_SP_IS_IP_N_DIF_ADD_DROF_1	4	0... 1FE0H	0... 8160	1	rpm
Additive part of N_DIF_DROF dependant from engine speed gradient in operation mode 2					
IP_T_N_DIF_OFS_PRED_DROF	-	0... FFH	0... 7.96875	0.03125	s
LDPM_N_T_N_DIF_OFS_PRED	8	0... 1FE0H	0... 8160	1	rpm
Time constant for calculation of predicted engine speed deviation at drive off support (PL)					
IP_TQ_ADD_PL_DROF_OPM_1	-	0... 7FFFH	0... 1023.97	0.03125	Nm
LDP_N_DIF_PRED_FAC_TQ_ADD_IS_1	6	0... FFFFH	0... 32767	1	rpm
LDP_FAC_TQ_REQ_DROF_1	6	0... FFFFH	0... 1.99996	305e3	
Torque reserve at part load for drive off support in operation mode 1					
IP_TQ_ADD_PL_DROF_OPM_2	-	0... 7FFFH	0... 1023.97	0.03125	Nm
LDP_N_DIF_PRED_FAC_TQ_ADD_IS_1	6	0... FFFFH	0... 32767	1	rpm
LDP_FAC_TQ_REQ_DROF_1	6	0... FFFFH	0... 1.99996	305e3	
Torque reserve at part load for drive off support in operation mode 2					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TQ_DROF_FAST_OPM_1	-	0... FFFFH	0... 1023.97	0.03125	Nm
LDPM_N_DIF_DROF_IP_TQ_DROF_1	11	0... FFFFH	0... 32767	1	rpm
LDPM_N_GRD_IP_TQ_DROF_1	10	0... FFH	0... 4064	32	rpm/s
Torque for driving off assistance, basic value value in operation mode 1					
IP_TQ_DROF_FAST_OPM_2	-	0... FFFFH	0... 1023.97	0.03125	Nm
LDPM_N_DIF_DROF_IP_TQ_DROF_1	11	0... FFFFH	0... 32767	1	rpm
LDPM_N_GRD_IP_TQ_DROF_1	10	0... FFH	0... 4064	32	rpm/s
Torque for driving off assistance, basic value value in operation mode 2					
IP_TQ_DROF_GRD_DEAC_OPM_1	-	0... 7FFFH	0... 1023.97	0.03125	Nm
LDP_TQ_DROF_GRD_DEAC_1	6	0... 7FFFH	0... 1023.97	0.03125	Nm
Decrement for the termination ramp of TQ_DROF_SLOW/_FAST in operation mode 1					
IP_TQ_DROF_GRD_DEAC_OPM_2	-	0... 7FFFH	0... 1023.97	0.03125	Nm
LDP_TQ_DROF_GRD_DEAC_2	6	0... 7FFFH	0... 1023.97	0.03125	Nm
Decrement for the termination ramp of TQ_DROF_SLOW/_FAST in operation mode 2					
IP_TQ_DROF_SLOW_OPM_1	-	0... FFFFH	0... 1023.97	0.03125	Nm
LDPM_N_DIF_DROF_IP_TQ_DROF_1	11	0... FFFFH	0... 32767	1	rpm
LDPM_N_GRD_IP_TQ_DROF_1	10	0... FFH	0... 4064	32	rpm/s
Torque for driving off assistance, basic value in operation mode 1					
IP_TQ_DROF_SLOW_OPM_2	-	0... FFFFH	0... 1023.97	0.03125	Nm
LDPM_N_DIF_DROF_IP_TQ_DROF_1	11	0... FFFFH	0... 32767	1	rpm
LDPM_N_GRD_IP_TQ_DROF_1	10	0... FFH	0... 4064	32	rpm/s
Torque for driving off assistance, basic value in operation mode 2					
LC_TQ_ADD_PL_DROF_ENA_BRAKE	-	0... 1H	0 ...1	1	-
Switch to select deactivation of drive off support TQ reserve by brake pedal; 0: deactivation when brake, 1: no deactivation when brake					
LC_TQ_DROF_ISC_OFF	-	0... 1H	0 ...1	1	-
Boolean to enable/disable idle speed controller during drive off; 1=disabled					

## FUNCTION DESCRIPTION:

The function Driving off assistance shall prevent the engine from stalling at driving off. Therefore an extra torque reserve is put at disposal if the necessity is given. This is shown by LV\_N\_SP\_IS\_CS = 1.defined in Engine speed setpoint calculation

In addition, an extra torque request is calculated under individual conditions. While this extra torque is effective, the idle speed controller can be suppressed or not via LC\_TQ\_DROF\_ISC\_OFF.

## Application Condition

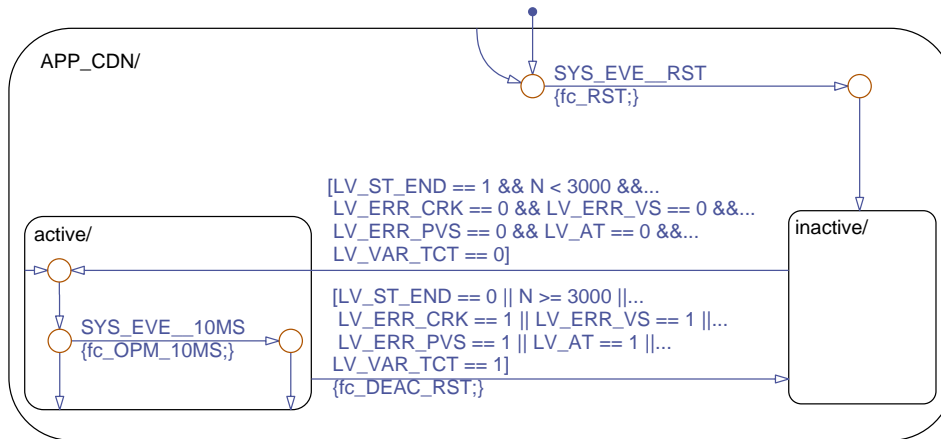



Figure 4.5.1: ENSC\_M4067/APP\_CDN/Chart

**Function Description**

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 1115 of 8404</b>	
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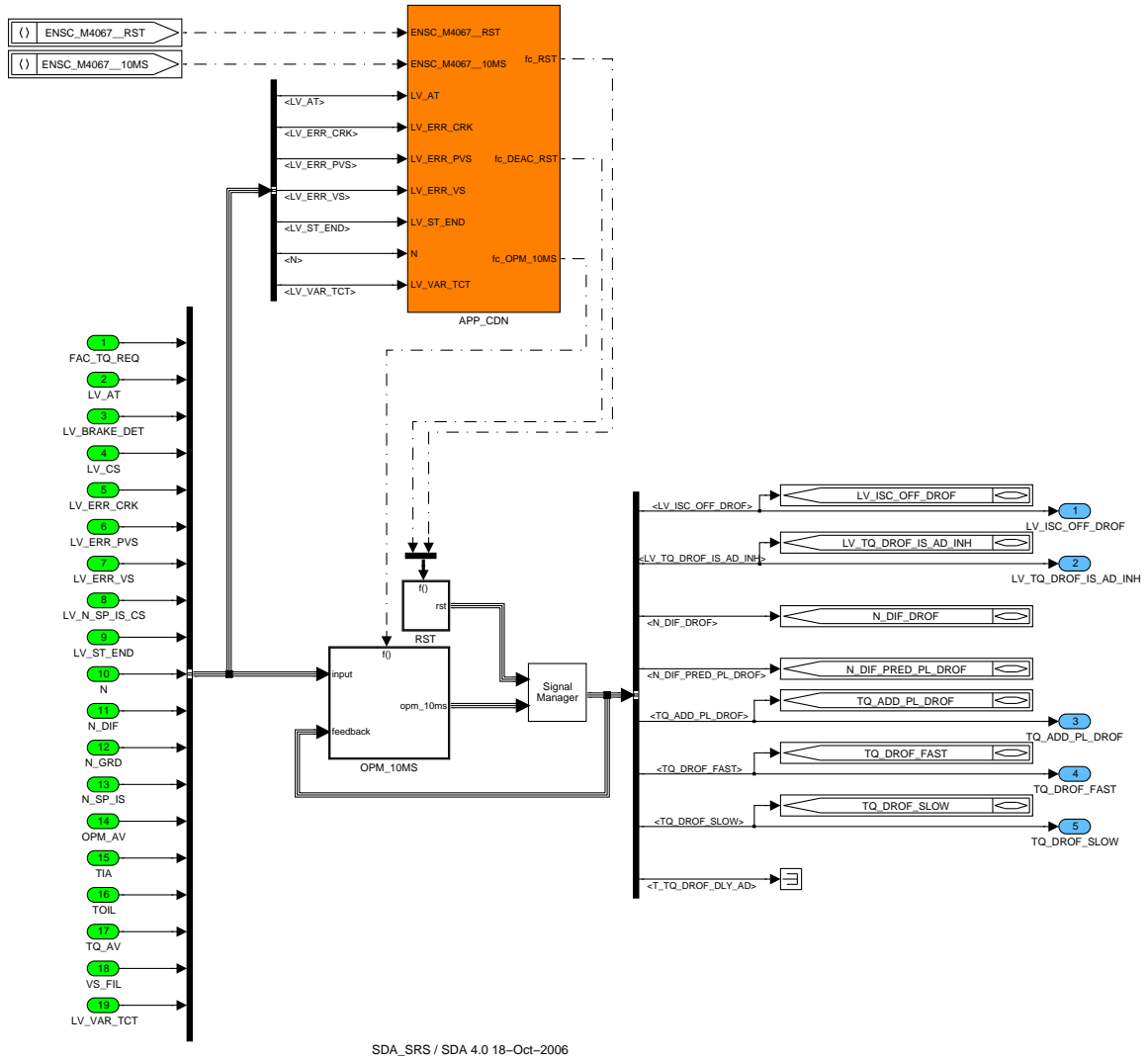


Figure 4.5.2: ENSC\_M4067

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### 4.5.1 Initialisation:

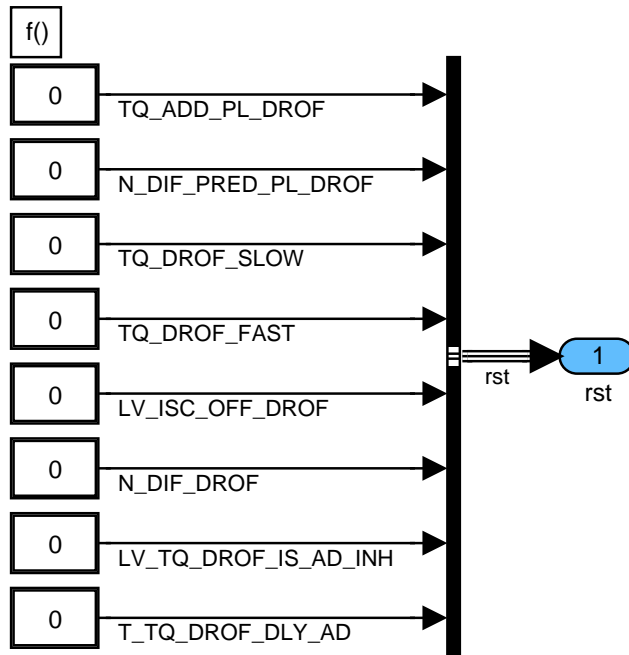


Figure 4.5.3: ENSC\_M4067/RST

### 4.5.2 Function Overview:

#### Calculation of additive & predicted drive off:

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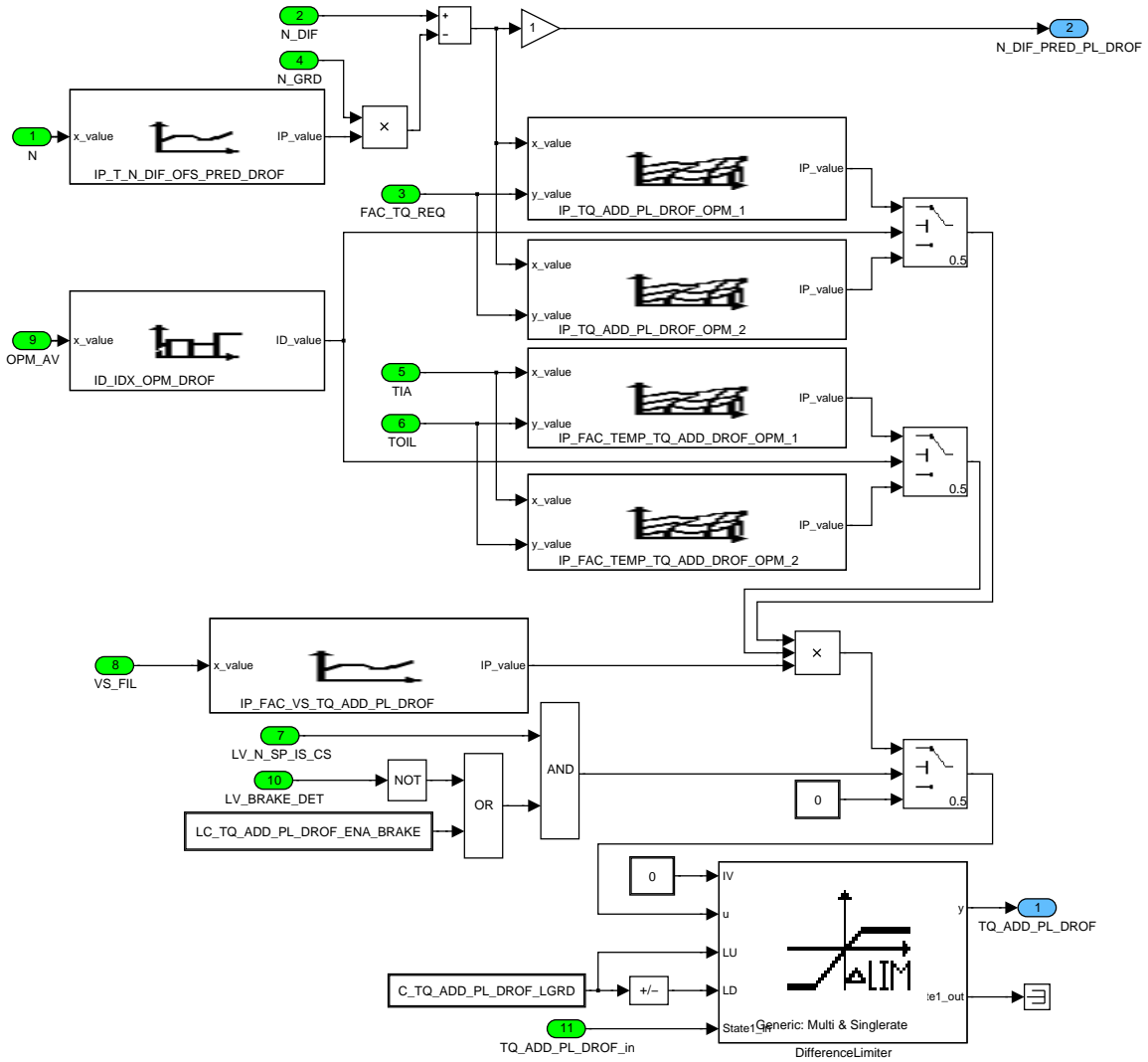


Figure 4.5.4: ENSC\_M4067/OPM\_10MS/CLC\_TQ\_ADD\_PL\_DROF

**Determination of TQ\_DROF\_FAST, TQ\_DROF\_SLOW and LV\_ISC\_OFF\_DROF:**

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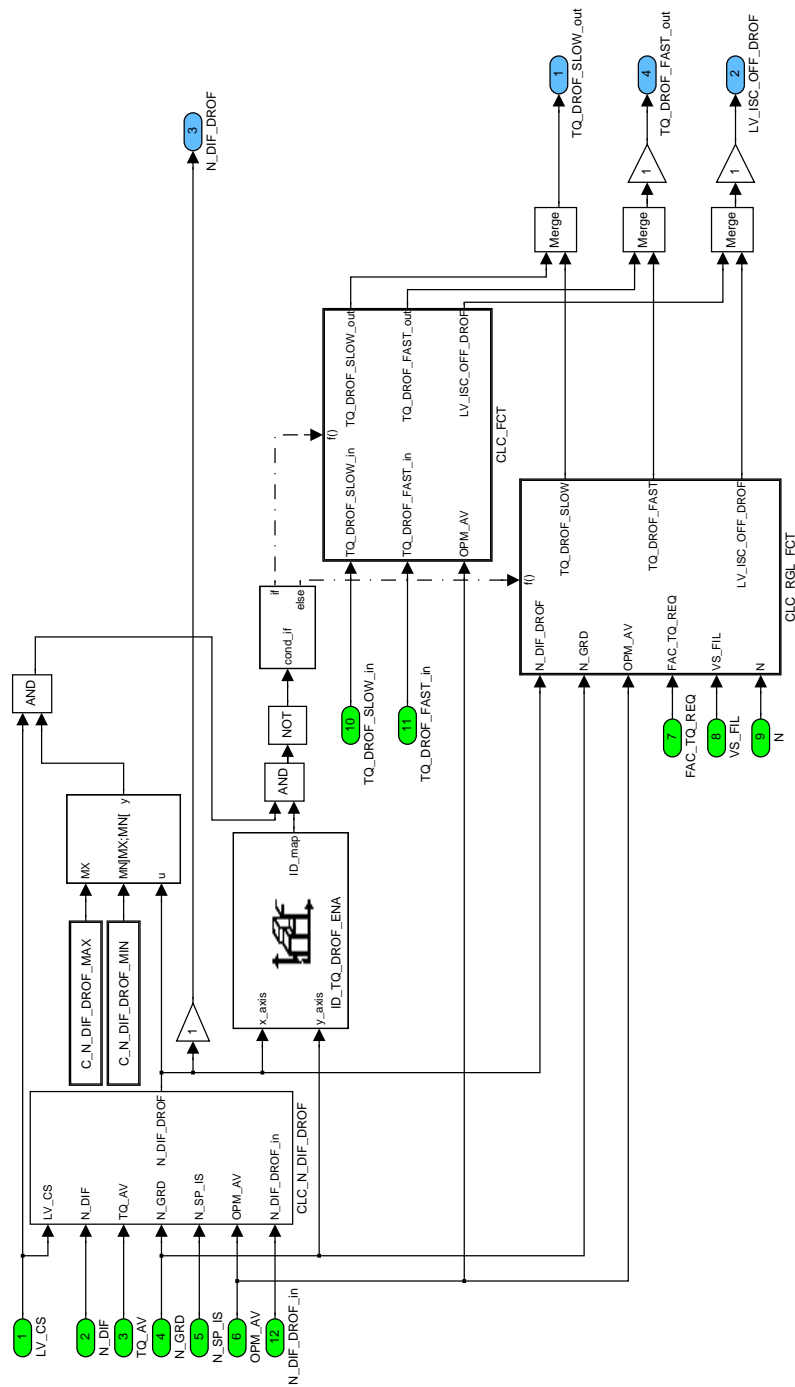



Figure 4.5.5: ENSC\_M4067/OPM\_10MS/CLC\_INH\_FAST\_SLOW\_DROF

**Calculation of N\_DIF\_DROF:**

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	Document key 10171571 SPE 000 AO	Pages Page 1119 of 8404	
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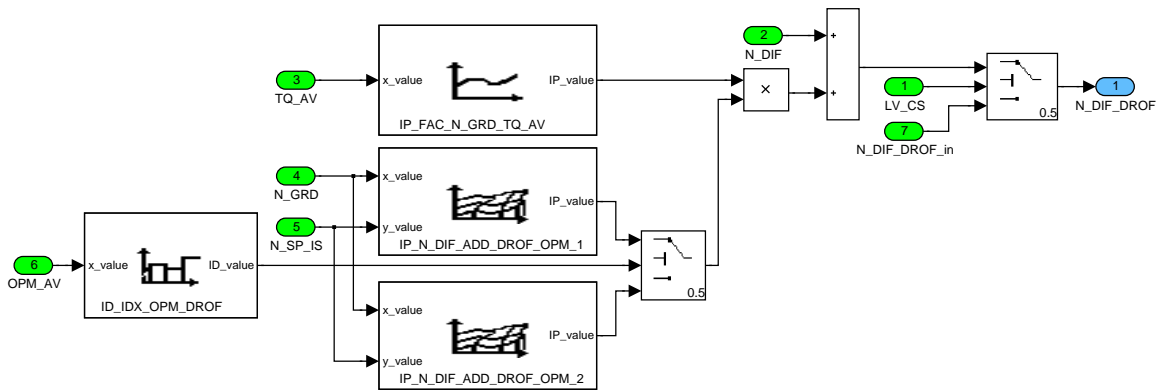


Figure 4.5.6: ENSC\_M4067/OPM\_10MS/CLC\_INH\_FAST\_SLOW\_DROF/CLC\_N\_DIF\_DROF

**Function termination:**

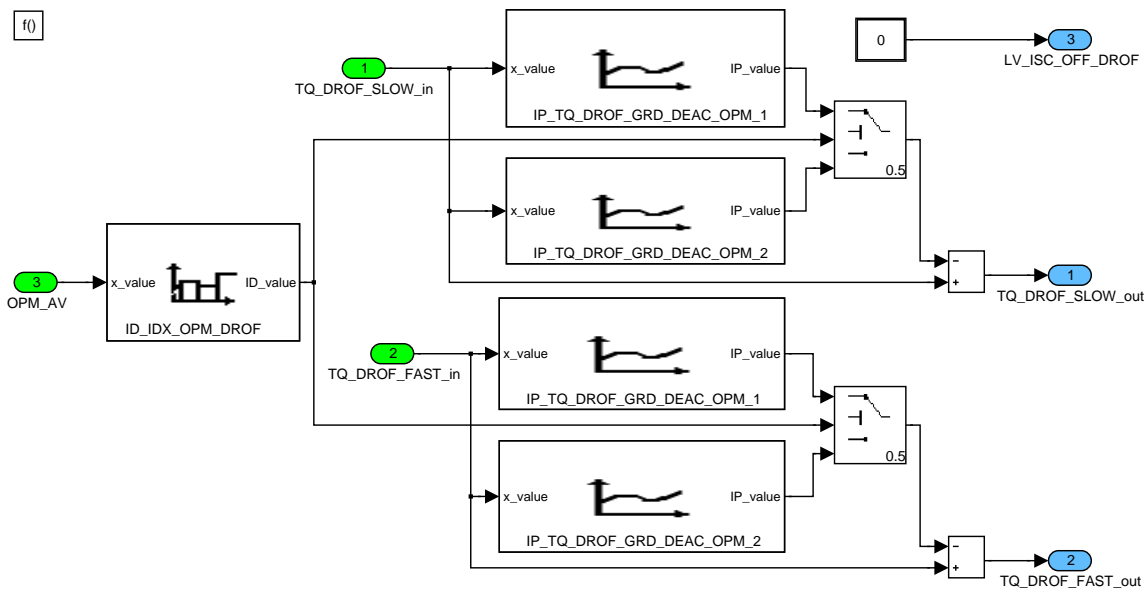


Figure 4.5.7: ENSC\_M4067/OPM\_10MS/CLC\_INH\_FAST\_SLOW\_DROF/CLC\_FCT

**Regular function:**

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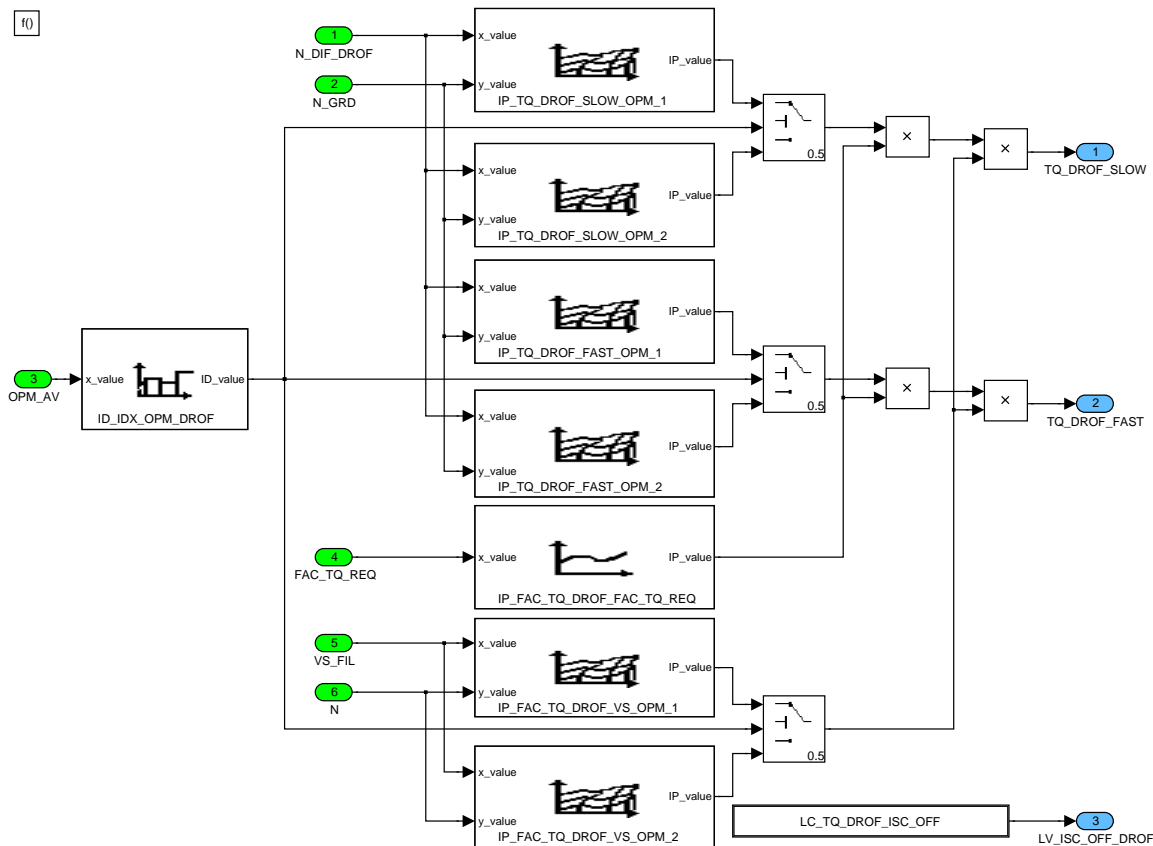


Figure 4.5.8: ENSC\_M4067/OPM\_10MS/CLC\_INH\_FAST\_SLOW\_DROF/CLC\_RGL\_FCT

**Condition for initialisation of IS control adaptations:**

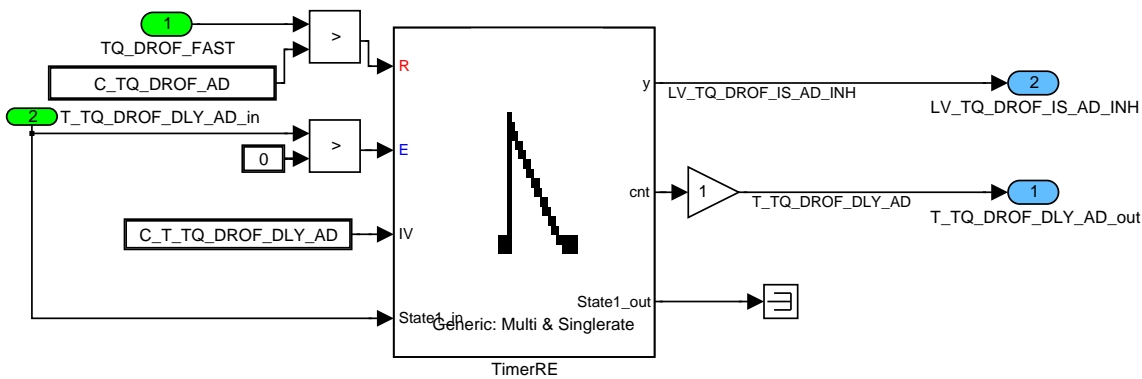


Figure 4.5.9: ENSC\_M4067/OPM\_10MS/CLC\_IS\_AD

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## 4.6 Engine speed setpoint calculation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_N_SP_IS_CS	O/V	0... 1H	0 ...1	1	-
1: conditions for increased idle speed /torque reserve for drive-off-support fulfilled					
LV_N_SP_IS_PSTE	O/V	0... 1H	0 ...1	1	-
1: conditions for increased idle speed /torque reserve for power steering					
LV_N_SP_IS_PSTE_2	O/V	0... 1H	0 ...1	1	-
1: conditions for increased idle speed /torque reserve for power steering for second VS threshold					
LV_REQ_HEAT_N_SP_IS	V	0... 1H	0 ...1	1	-
1: idle Speed setpoint required from heating control unit					
N_DIF	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
Engine speed deviation N_SP_IS-N					
N_DIF_COR	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
Idle speed control variable					
N_DIF_MMV	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
N_DIF moving mean value					
N_DIF_ST	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
Engine speed deviation N_MAX_TOL_ST - N					
N_MAX_TOL_ST	O/V	0... FFH	0... 8160	32	rpm
Top level end of start engine speed					
N_SP_IS	O/V	0... 1FE0H	0... 8160	1	rpm
Idle Speed Setpoint					
N_SP_IS_2	O/V	0... 1FE0H	0... 8160	1	rpm
basis idle speed setpoint					
N_SP_IS_3	V	0... 1FE0H	0... 8160	1	rpm
greatest of all idle speed setpoints					
N_SP_IS_CS	O/V	0... 1FE0H	0... 8160	1	rpm
Idle-speed setpoint given by DROF					
N_SP_IS_POW	V	0... 1FE0H	0... 8160	1	rpm
active nominal idle speed setpoint by power management active					
N_SP_IS_PWR_STAB	V	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint for power supply stability					
N_SP_IS_RATIO	O/V	0... FFFFH	0... 7.9998779296875	122.07e-6	-
Ratio between actual engine speed and engine speed setpoint					
N_SP_IS_TCT	V	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoints for TCT					

### Input data:


ANG_PSTE {p. 1561}	C_N_MAX_KWP {p. 7439}	C_VS_MAX_KWP {p. 7439}	CTR_KM_CAN {p. 1563}
GEAR_INFO {p. 1564}	ID_IDX_OPM_DROF {p. 1112}	IGA_MV_ADJ_KNK_CUS {p. 8304}	LV_ACIN {p. 1564}
LV_ACT_N_SP_IS_BAS_ EXT_ADJ {p. 7680}	LV_ACT_N_SP_IS_EXT_ ADJ {p. 7763}	LV_ACT_SA_EOL {p. 7763}	LV_AT {p. 654}

LV_CH_N_SP_IS {p. 1775}	LV_CS {p. 8394}	LV_DLY_N_SP_IS {p. 6710}	LV_DRI {p. 1302}
LV_ERR_FTL_MIN {p. 4762}	LV_FUP_LIH_L_PRS_ CTL_REQ {p. 4001}	LV_IS {p. 1720}	LV_N_SP_IS_LIH_ACT {p. 4216}
LV_N_SP_IS_POW_ACT {p. 8368}	LV_N_SP_IS_PWR_STAB {p. 8368}	LV_NT_SO2P_EXT_ADJ_ ACT {p. 3144}	LV_PL {p. 1720}
LV_PSTE_2_DISABLE {p. 6621}	LV_PSTE_3_DISABLE {p. 6621}	LV_PSTE_DISABLE {p. 6621}	LV_REQ_HEAT {p. 1567}
LV_ST_END {p. 1720}	LV_VAR_ACIN {p. 655}	LV_VAR_ARS {p. 655}	LV_VAR_PSTE_2 {p. 656}
LV_VAR_PSTE_3 {p. 656}	LV_VAR_TCT {p. 656}	N {p. 1525}	N_FAST {p. 1525}
N_SP_IS_BRAKE {p. 8212}	N_SP_IS_CH {p. 3564}	N_SP_IS_EXT_ADJ {p. 7763}	N_SP_IS_POIL_CTL {p. 8212}
N_SP_IS_POW_1 {p. 8212}	N_SP_IS_TCT_CAN {p. 1569}	N_SP_OFS_KWP {p. 7681}	OPM_AV {p. 8137}
STATE_PSTE_3_SRC {p. 1576}	T_AST {p. 1766}	TAM {p. 1579}	TCO {p. 1100}
TOIL {p. 8204}	TQ_LOSS {p. 8385}	VEL_ANG_PSTE {p. 1582}	VS {p. 1176}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ANG_EPS_ISC	V	0... 7FFFH	0... 1439.945815	0.043945	°STW
Minimum ANG_PSTE for N_SP_EPS					
C_ANG_PSTE_ISC	V	0... 7FFFH	0... 1439.945815	0.043945	°STW
Minimum ANG_PSTE for N_SP_PSTE					
C_DRI_VS_MIN_VB	V	0... FFH	0... 255	1	km/h
Minimum vehicle speed for activating battery charging in case LV_DRI = 1					
C_IGA_ADJ_HYS_N_SP_IS	V	0... 80H	-48 ...0	0.375	°CRK
Spark retard hysteresis for idle speed setpoint N_SP_IS_KNK					
C_IGA_ADJ_THD_N_SP_IS	V	0... 80H	-48 ...0	0.375	°CRK
Spark retard threshold for activating idle speed setpoint N_SP_IS_KNK					
C_N_DIF_CRLC	V	0... FFH	0... 0.99609375	0.00390625	-
Correlation factor for N_DIF_MMV calculation					
C_N_DIF_FAC	V	0... FFH	0... 0.99609375	0.00390625	-
Multiplicative factor for N_DIF_COR calculation					
C_N_DIF_MIN_MMV	V	F010... 0H	-4080 ...0	1	rpm
Minimum filtering constant					
C_N_SP_DEC_CS	V	1... FFH	0.0625... 15.9375	0.0625	rpm
Decrement engine speed setpoint for drive-off-support					
C_N_SP_DEC_IS_CH_DRI	V	1... FFH	0.0625... 15.9375	0.0625	rpm/10ms
Idle speed change limitation during catalyst heating and LV_DRI = 1					
C_N_SP_DEC_PL	V	1... FFH	0.0625... 15.9375	0.0625	rpm
Decrement idle speed setpoint for part load					


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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_SP_DEC_PSTE	V	1... FFH	0.0625... 15.9375	0.0625	rpm
C_N_SP_DEC_PSTE					
C_N_SP_HEAT_AT	V	0... 1FE0H	0... 8160	1	rpm
Idle speed at heater request, automatic transmission vehicle					
C_N_SP_HEAT_MT	V	0... 1FE0H	0... 8160	1	rpm
Idle speed at heater request, manual transmission vehicle					
C_N_SP_INC_CS	V	1... FFH	0.0625... 15.9375	0.0625	rpm
Increment engine speed setpoint for drive-off-support					
C_N_SP_INC_PL	V	1... FFH	0.0625... 15.9375	0.0625	rpm
Increment idle speed setpoint for part load					
C_N_SP_INC_PSTE	V	1... FFH	0.0625... 15.9375	0.0625	rpm
Increment engine speed setpoint for power steering					
C_N_SP_IS_ARS_AT	V	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint ARS, automatic transmission vehicle					
C_N_SP_IS_ARS_MT	V	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint ARS, manual transmission vehicle					
C_N_SP_IS_PSTE_2_AT	V	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint PSTE_2, automatic transmission vehicle					
C_N_SP_IS_PSTE_2_MT	V	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint PSTE_2, manual transmission vehicle					
C_N_SP_IS_PWR_STAB	V	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint for power supply stability					
C_N_SP_IS_PWR_STAB_DRI	V	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint for power supply stability and driving position engaged					
C_N_SP_IS_SA_EOL	V	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint during the "secondary air function end of line test"					
C_N_SP_LGRD_IS	V	1... FFH	0.0625... 15.9375	0.0625	rpm/10ms
Nominal idle speed change limitation					
C_N_SP_LGRD_IS_LIH	V	1... FFH	0.25... 63.75	0.25	rpm/10ms
Minimum filtering constant					
C_N_SP_OFS_KWP_MAX	V	0... 7FFFH	0... 32767	1	rpm
Upper threshold for tester offset					
C_N_SP_OFS_KWP_MIN	V	8000... FFFFH	-32768 ...-1	1	rpm
C_N_SP_OFS_KWP_MIN					
C_NT_SO2P_EXT_ADJ_ACT	V	0... 1FE0H	0... 8160	1	rpm
idle speed setpoints for SO2P in service					
C_T_ANG_DLY_N_SP_DEC_PSTE	V	0... FFFFH	0... 655.35	0.01	s
Delay time for decrement engine speed setpoint for power steering angle and velocity					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DLY_GRD_LIM	V	0... 7FFH	0... 20.47	0.01	s
Delay time of N_SP_IS gradient limitation					
C_T_VS_DLY_N_SP_DEC_PSTE	V	0... FFFFH	0... 655.35	0.01	s
Delay time for decrement engine speed setpoint for power steering vehicle speed					
C_TAM_HYS	V	0... 40H	0... 48	0.75	°C
Hysteresis for ambient temperature threshold					
C_TAM_N_SP_HEAT	V	0... FEH	-48... 142.5	0.75	°C
Ambient temperature threshold idle speed at heater request					
C_TAM_N_SP_IS_KNK	V	0... FEH	-48... 142.5	0.75	°C
Ambient temperature for N_SP_IS_KNK calculation					
C_TOIL_HYS_N_SP_IS	V	0... C8H	-40 ...160	1	°C
TOIL hysteresis for idle speed setpoint					
C_TOIL_THD_N_SP_IS	V	0... C8H	-40 ...160	1	°C
C_TOIL_THD_N_SP_IS					
C_VEL_ANG_EPS_ISC	V	0... 7FFFH	0... 1439.945815	0.043945	°STW/s
Minimum VEL_ANG_PSTE for N_SP_EPS					
C_VEL_ANG_PSTE_ISC	V	0... 7FFFH	0... 1439.945815	0.043945	°STW/s
Minimum VEL_ANG_PSTE for N_SP_PSTE					
C_VS_HYS_N_SP_CS	V	0... FFH	0... 255	1	km/h
Vehicle speed hysteresis for VS threshold drive-off-support					
C_VS_MAX_N_SP_CS	V	0... FFH	0... 255	1	km/h
Maximum vehicle speed for drive-off-support					
C_VS_MAX_N_SP_IS_ARS	V	0... FFH	0... 255	1	km/h
Maximum vehicle speed for N_SP_IS_ARS					
C_VS_MIN_N_SP_EPS	V	0... FFH	0... 255	1	km/h
Minimum vehicle speed threshold for N_SP_EPS					
C_VS_MIN_N_SP_IS_ARS	V	0... FFH	0... 255	1	km/h
Minimum vehicle speed for N_SP_IS_ARS					
C_VS_MIN_N_SP_PSTE	V	0... FFH	0... 255	1	km/h
Minimum vehicle speed threshold for N_SP_PSTE					
C_VS_MIN_N_SP_PSTE_2	V	0... FFH	0... 255	1	km/h
Minimum vehicle speed threshold for N_SP_PSTE_2					
ID_N_SP_IS_KNK_AT	V	0... 1FE0H	0... 8160	1	rpm
LDPM_IGA_N_SP_IS_KNK	4	0... 80H	-48 ...0	0.375	°CRK
Minimum idle speed for spark retard due to knocking with AT					
ID_N_SP_IS_KNK_MT	V	0... 1FE0H	0... 8160	1	rpm
LDPM_IGA_N_SP_IS_KNK	4	0... 80H	-48 ...0	0.375	°CRK
Minimum idle speed for spark retard due to knocking with MT					
IP_ACIN_N_SP_IS	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_N_SP_1	8	0... FEH	-48... 142.5	0.75	°C
Nominal idle speed with air conditioner switched on					
IP_DRI_ACIN_N_SP_IS	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_N_SP_1	8	0... FEH	-48... 142.5	0.75	°C
Nominal idle speed with DRIVE (A/T) engaged and air conditioner switched on					

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	Document key 10171571 SPE 000 AO	Pages Page 1125 of 8404	
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_DRI_N_SP_IS	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_N_SP_1	8	0... FEH	-48... 142.5	0.75	°C
Nominal idle speed with DRIVE (A/T) engaged					
IP_DRI_N_SP_IS_LIH	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_N_SP_1	8	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint in case of limp home and engaged drivetrain					
IP_FAC_N_SP_OFS_KWP	V	0... FFH	0... 0.99609375	0.00390625	-
LDPM_TCO_N_SP_1	8	0... FEH	-48... 142.5	0.75	°C
TCO factor for N_SP_OFS_KWP					
IP_N_MAX_TOL_ST	V	0... FFH	0... 8160	32	rpm
LDPM_TCO_9	9	0... FEH	-48... 142.5	0.75	°C
Top level end of start engine speed					
IP_N_SP_IS	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_1_ENSC	6	0... FEH	-48... 142.5	0.75	°C
Nominal idle speed without additional load on the engine					
IP_N_SP_IS_CS_OPM_1	V	0... 1FE0H	0... 8160	1	rpm
LDP_TOIL_IP_N_SP_IS_CS_OPM_1	8	0... C8H	-40 ...160	1	°C
Idle speed setpoint for drive-off-support with manual transmission in operation mode 1					
IP_N_SP_IS_CS_OPM_2	V	0... 1FE0H	0... 8160	1	rpm
LDP_TOIL_IP_N_SP_IS_CS_OPM_1	8	0... C8H	-40 ...160	1	°C
Idle speed setpoint for drive-off-support with manual transmission in operation mode 2					
IP_N_SP_IS_EPS	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_N_SP_IS_PSTE	6	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint for power steering variant EPS					
IP_N_SP_IS_LIH	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_N_SP_1	8	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint in case of limp home					
IP_N_SP_IS_PL_OPM_1	V	0... 1FE0H	0... 8160	1	rpm
LDP_N_N_SP_IS_PL_OPM_1	6	0... 1FE0H	0... 8160	1	rpm
LDP_TQ_LOSS_N_SP_IS_PL_OPM_1	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Nominal idle speed at PL in operation mode 1					
IP_N_SP_IS_PL_OPM_2	V	0... 1FE0H	0... 8160	1	rpm
LDP_N_N_SP_IS_PL_OPM_1	6	0... 1FE0H	0... 8160	1	rpm
LDP_TQ_LOSS_N_SP_IS_PL_OPM_1	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Nominal idle speed at PL in operation mode 2					
IP_N_SP_IS_PL_TCT_OPM_1	V	0... 1FE0H	0... 8160	1	rpm
LDP_N_N_SP_IS_PL_TCT_OPM_1	6	0... 1FE0H	0... 8160	1	rpm
LDP_TQ_LOSS_N_SP_IS_PL_TCT_OPM1	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Nominal idle speed at PL variant TCT in operation mode 1					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_N_SP_IS_PL_TCT_OPM_2	V	0... 1FE0H	0... 8160	1	rpm
LDP_N_N_SP_IS_PL_TCT_OPM_1	6	0... 1FE0H	0... 8160	1	rpm
LDP_TQ_LOSS_N_SP_IS_PL_TCT_OPM1	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Nominal idle speed at PL variant TCT in operation mode 2					
IP_N_SP_IS_PSTE	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_N_SP_IS_PSTE	6	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint for power steering					
IP_N_SP_IS_PSTE_2	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_N_SP_IS_PSTE	6	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint for power steering for VS >= C_VS_MIN_N_SP_PSTE_2					
IP_N_SP_IS_TOIL_AT	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TOIL_N_SP_IS_TOIL	4	0... C8H	-40 ...160	1	°C
Minimum idle speed for TOIL with AT					
IP_N_SP_IS_TOIL_MT	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TOIL_N_SP_IS_TOIL	4	0... C8H	-40 ...160	1	°C
Minimum idle speed for TOIL with MT					
IP_T_AST_MIN_N_SP_IS_CS	V	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_N_SP_1	8	0... FEH	-48... 142.5	0.75	°C
Minimum delay time after start for drive-off-support idle speed					
LC_FUP_FTL_MIN_IS_LIH_ENA	V	0... 1H	0 ...1	1	-
Enable the use of idle speed setpoint increase in case of fuel pressure or fuel tank min level error					
LC_IS_N_SP_CS_DIS	V	0... 1H	0 ...1	1	-
LC to switch on/off LV_IS condition for drive-off-support					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_N_DIF_MIN_CRLC	V	F010... 0H	-4080 ...0	1	rpm
Non calibrated correlation factor for N_DIF_MMV calculation					

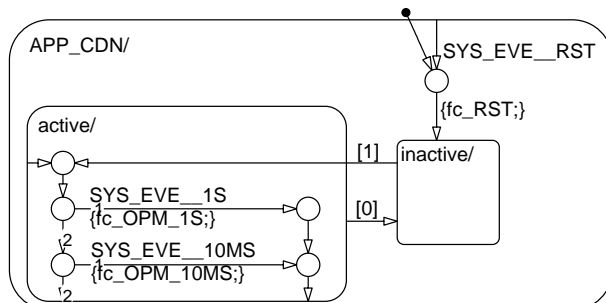
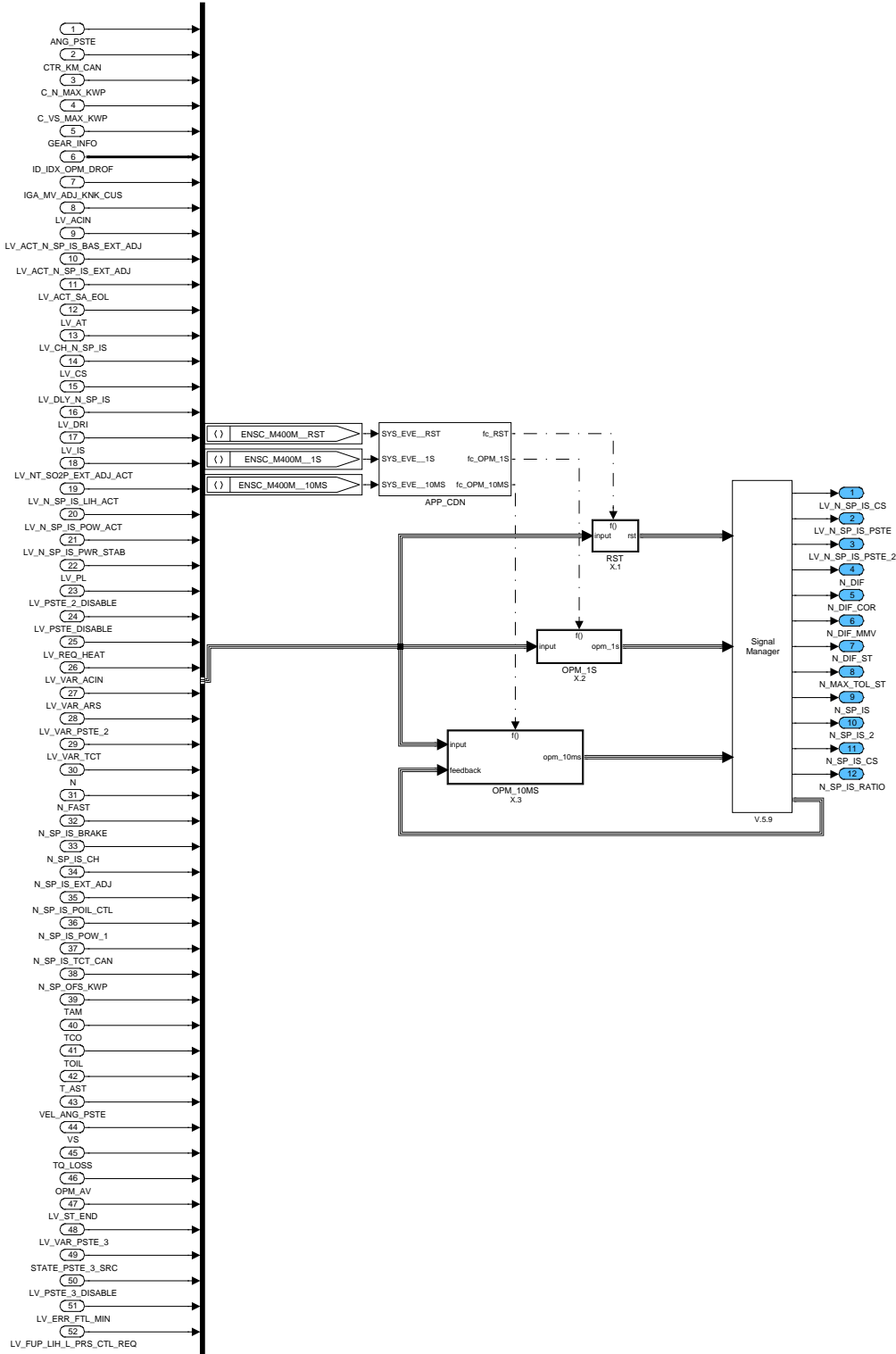
**General information:****Application conditions:**

Figure 4.6.1: :

Function description:


Formula section:



SDA\_SRS / SDA V 6.1.1 / 01-Mar-2011

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Figure 4.6.2: :

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### 4.6.1 Initialisation at system event reset

All output variable are initialised at system event reset.

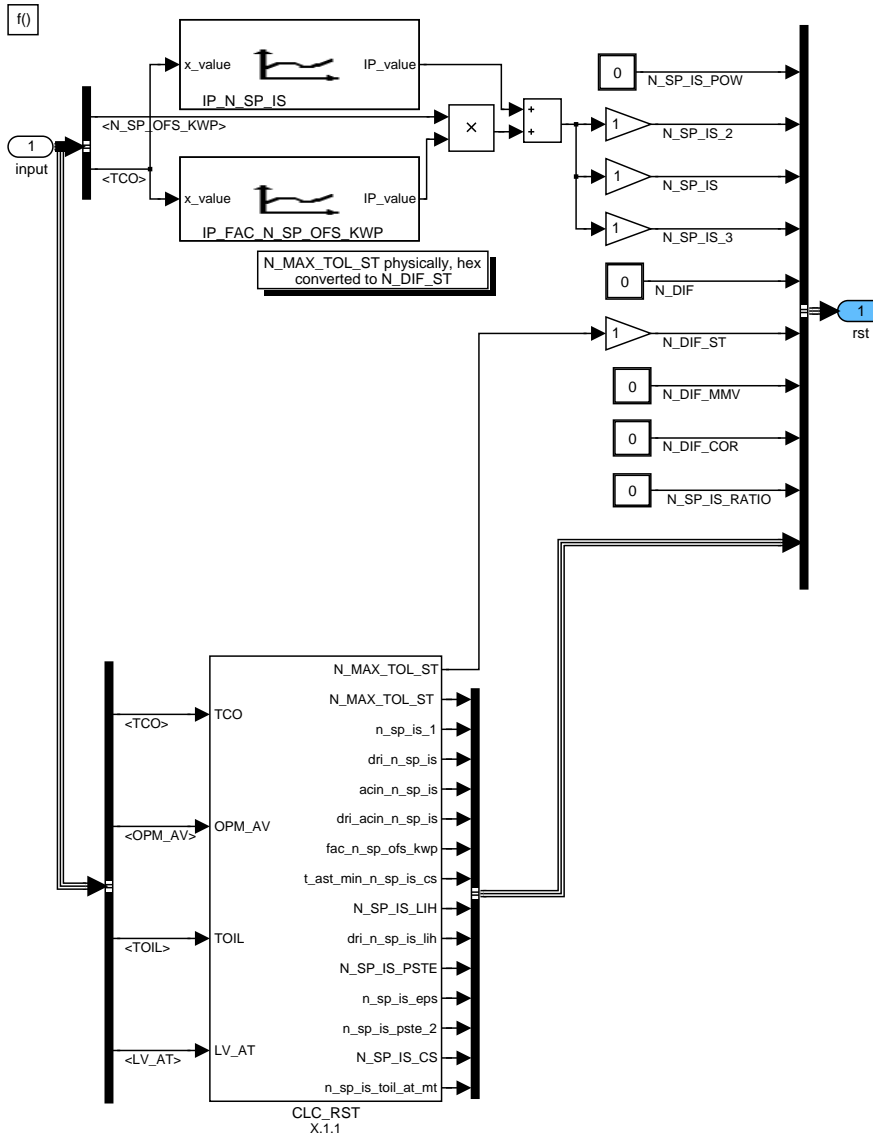


Figure 4.6.3: :

#### 4.6.1.1 Initialisation of temperature dependent variables.

All the temperature dependent variables are initialised here from corresponding IP maps and curves.

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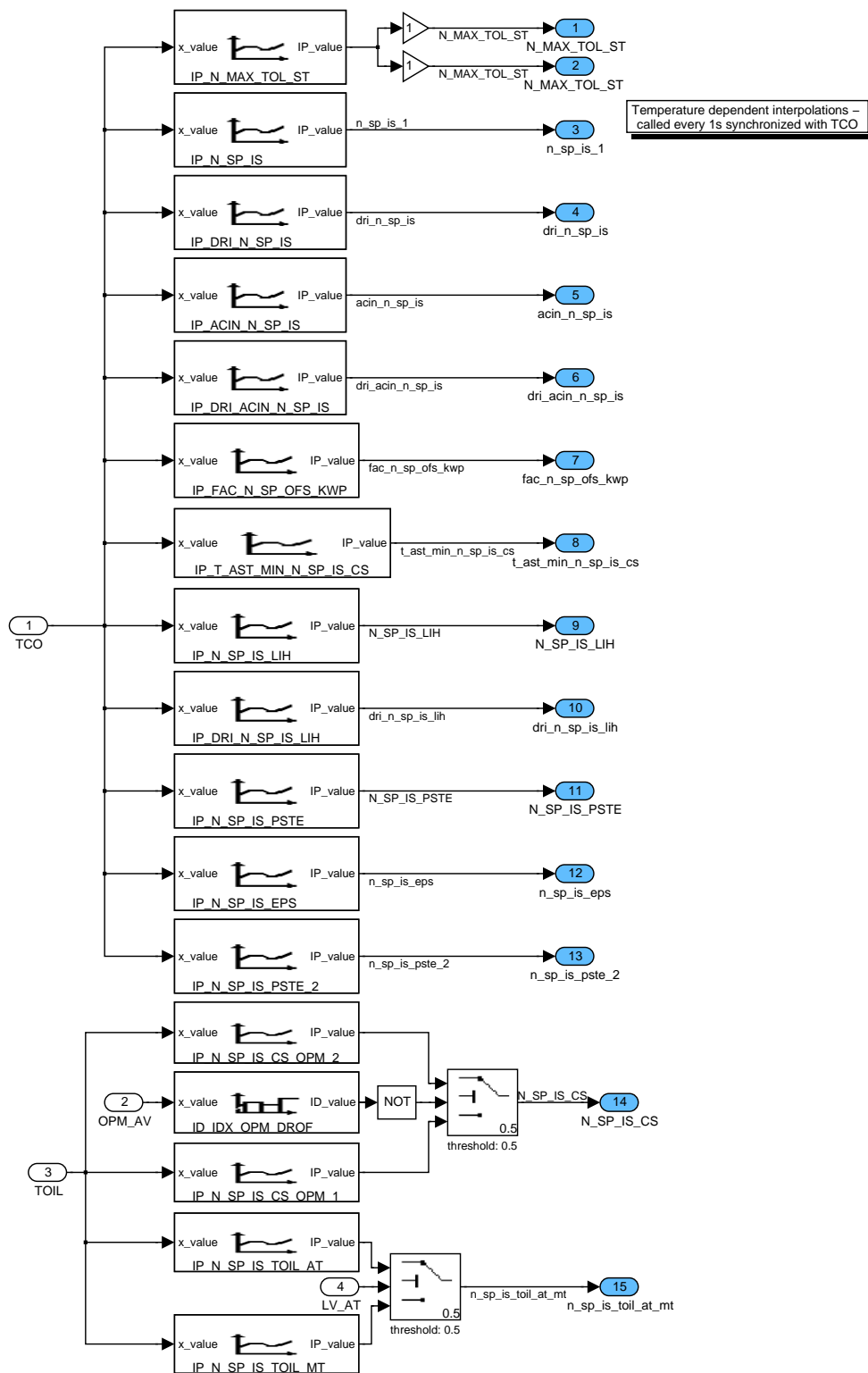


Figure 4.6.4: :

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## 4.6.2 Calculation at 1 second recurrence

### 4.6.2.1 Calculation of temperature dependent variables.

All the temperature dependent variables are calculated here from corresponding IP maps and curves.

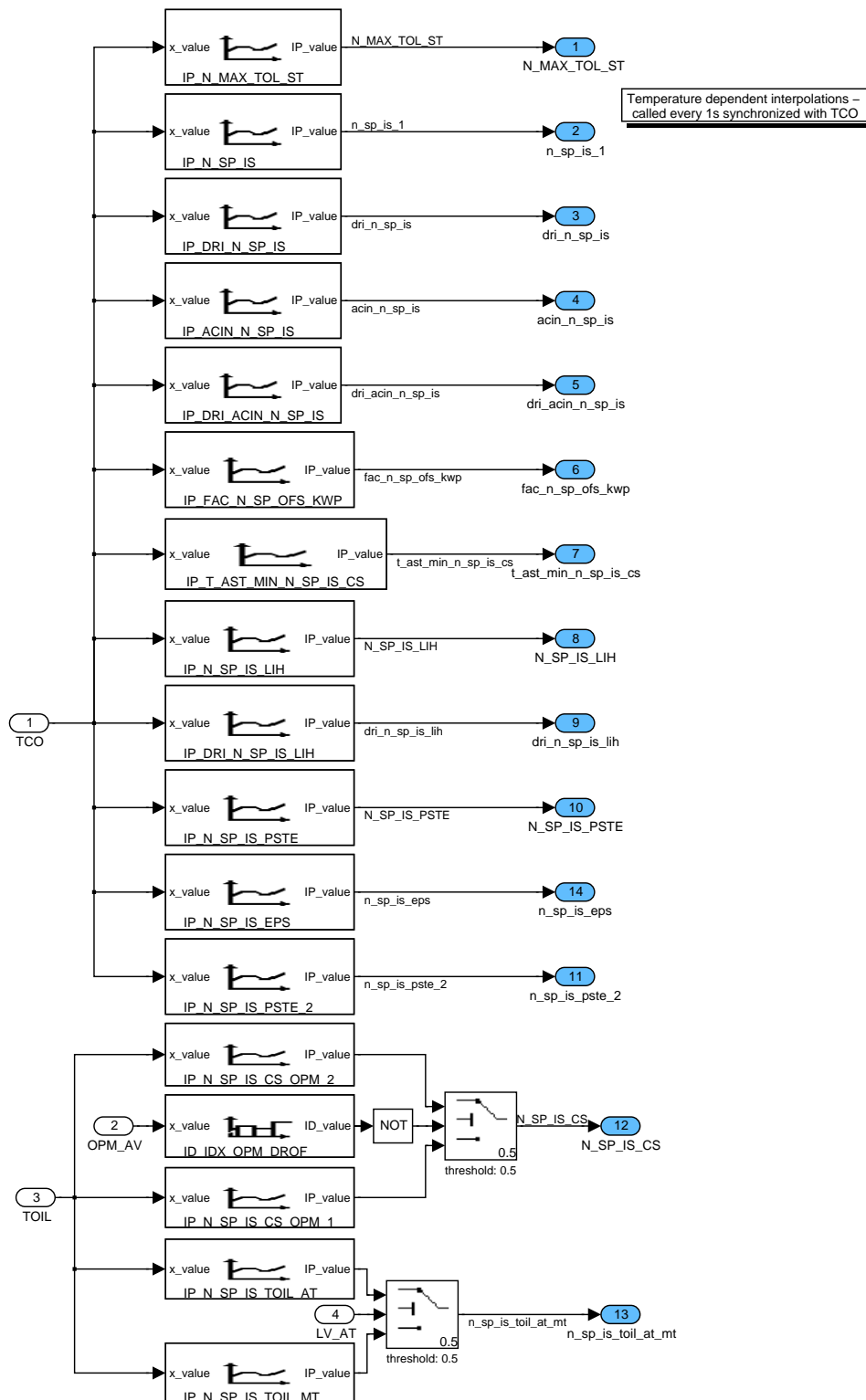


Figure 4.6.5: :

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## 4.6.3 Formula section.

### 4.6.3.1 Idle speed setpoint N\_SP\_IS

#### FUNCTION DESCRIPTION:

##### General information:

The input value LV\_DLY\_N\_SP\_IS (output from module Converter Torque) is derived from LV\_DRI including a tuneable delay time. If drive is engaged the converter torque is build up after a short delay time (about 400 ms). If the change in engine speed setpoint for drive engaged also is delayed the new setpoint can be adjusted more stable.

In general the transition from one idle speed setpoint to another is performed with adjustable change limitations. The only exception is: no change limitation before engine start has finished (LV\_ST\_END = 0). This is to ensure the desired engine speed setpoint immediately after start.

#### 4.6.3.1.1 Nominal idle speed with tester offset(Calculation of N\_SP\_IS\_2)

The nominal idle speed setpoint calculation takes into consideration air conditioning compressor ACC on/off, drivetrain engaged (LV\_DLY\_N\_SP\_IS) and offset by tester via KWP.

Table of nominal idle speed N\_SP\_IS\_1, dependant from ACC and drivetrain engaged:

LV_ACIN	LV_DLY_N_SP_IS	N_SP_IS_1
0	0	IP_N_SP_IS
0	1	IP_DRI_N_SP_IS
1	0	IP_ACIN_N_SP_IS
1	1	IP_DRI_ACIN_N_SP_IS

The tester offset is multiplied by a factor IP\_FAC\_N\_SP\_OFS\_KWP which is TCO dependant and limited by upper and lower thresholds.

N\_SP\_IS\_2 is calculated here depending upon logical variable LV\_ACIN and LV\_DLY\_N\_SP\_IS. Using these two variables the control input is generated using the lookup table. If both variable are zero then input from port 1 of multiport switch is passed, similarly the inputs at other ports are passed depending upon these two logical variable.

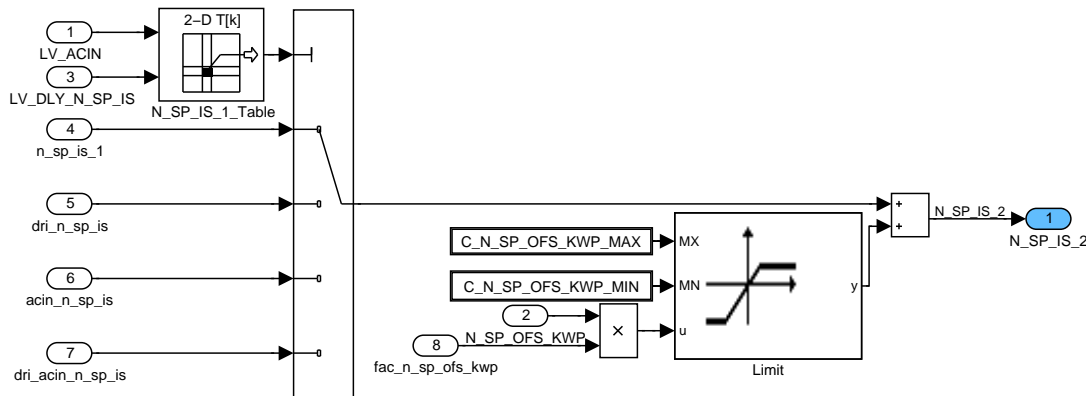


Figure 4.6.6: :

#### 4.6.3.1.2 Pre calculation and calculation of N\_SP\_IS

##### 4.6.3.1.2.1 Extraordinary engine speed setpoints(Calculation of first part of pre calculation.)

##### 4.6.3.1.2.1.1 Idle speed setpoint due to Power Management

The engine speed setpoint N\_SP\_IS\_POW\_1 from Power Management is used if LV\_N\_SP\_IS\_POW\_ACT = 1 and if it is the greatest of the speed setpoints entering the MAX-selection

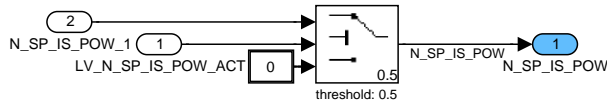


Figure 4.6.7: :

#### 4.6.3.1.2.1.2 Idle Speed setpoint required from heating control unit

The A/C-unit sets a requirement switch LV\_REQ\_HEAT to raise the idle speed in order to increase the heating power. If the vehicle is not equipped with A/C, LV\_REQ\_HEAT is made up with ambient temperature TAM. The idle speed setpoint C\_N\_SP\_HEAT\_MT/AT will be executed if LV\_REQ\_HEAT = 1 and if it is the greatest of the speed setpoints entering the MAX-selection

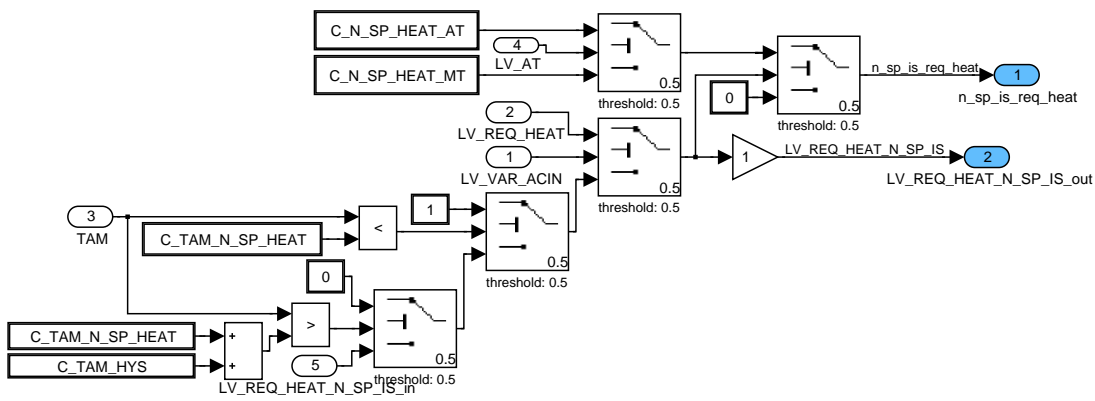


Figure 4.6.8: :

#### 4.6.3.1.2.1.3 Idle speed setpoint due to variant of power steering 2

The engine speed setpoint N\_SP\_IS\_VAR\_PSTE\_2 depends on learnt variant LV\_VAR\_PSTE\_2.

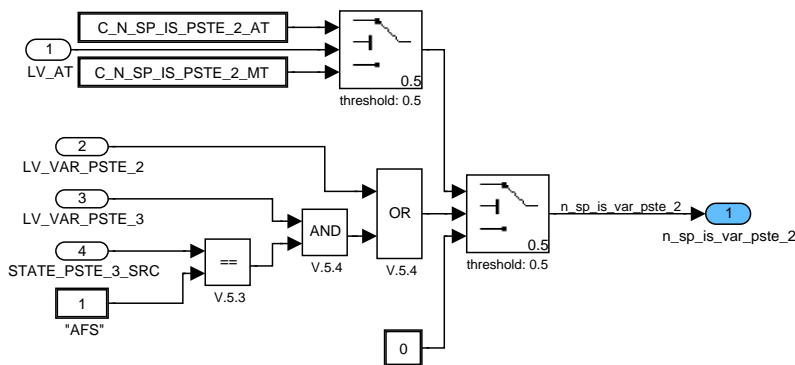


Figure 4.6.9: :

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### 4.6.3.1.2.1.4 Idle speed setpoint due to variant of ARS

The engine speed setpoint N\_SP\_IS\_ARS depends on learnt variant LV\_VAR\_ARS and vehicle speed.

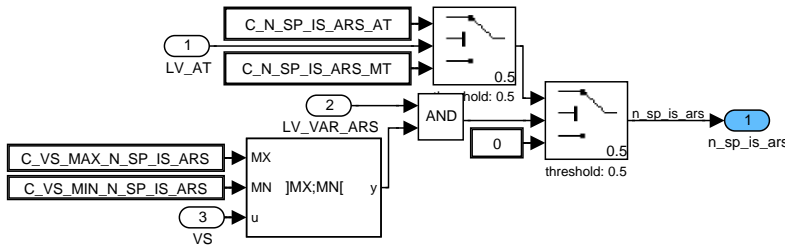


Figure 4.6.10: :

### 4.6.3.1.2.1.5 Idle Speed setpoint TOIL dependant

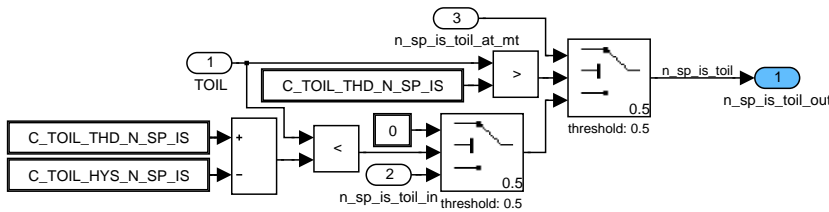


Figure 4.6.11: :

### 4.6.3.1.2.1.6 Idle Speed setpoint depending on average spark retard due to knocking

N\_SP\_IS takes care of the ignition spark retard due to knocking. Exceeding a calibrateable threshold an increased setpoint is active.

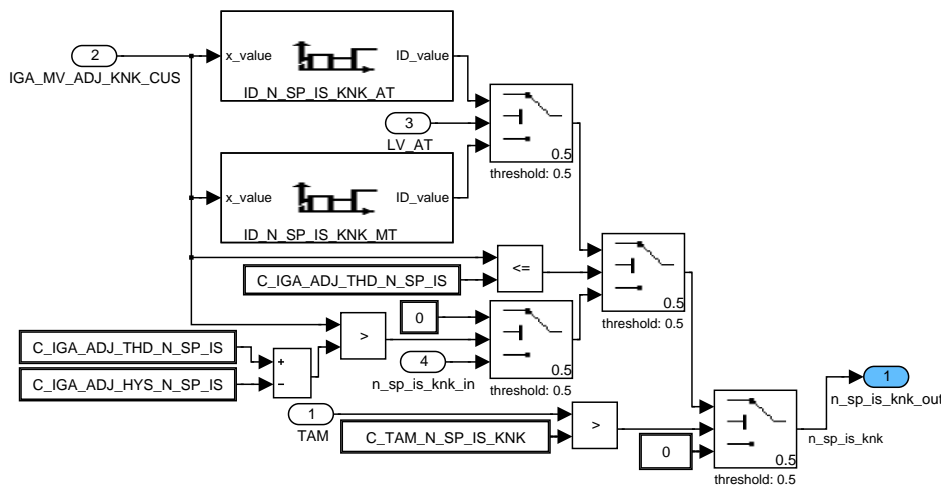


Figure 4.6.12: :

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### 4.6.3.1.2.1.7 Idle Speed setpoint at drive-off-support

Absolute engine speed setpoint dependant from TOIL and transmission variant, used under certain conditions where vehicle drive-off is expected and if it is the greatest of the speed setpoints entering the MAX-selection, see below. Individual gradient limitation C\_N\_SP\_INC/DEC\_CS.

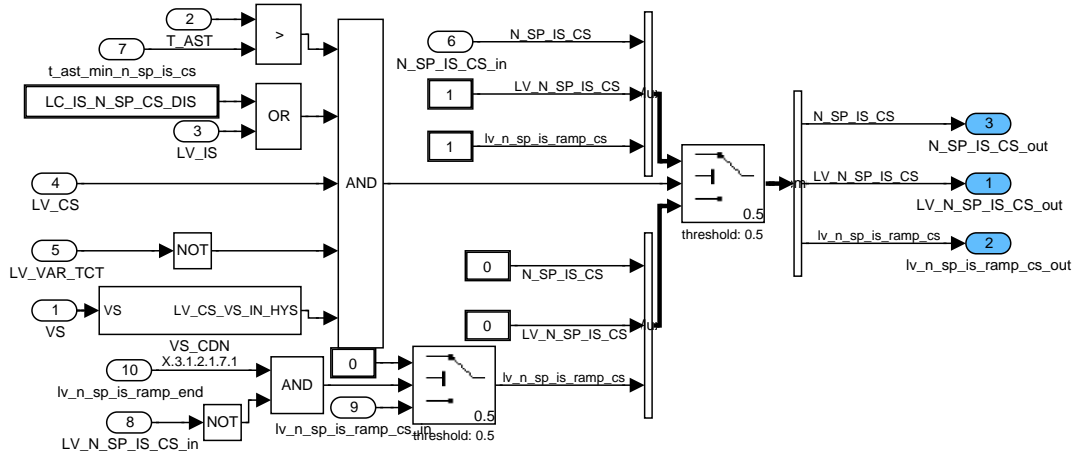


Figure 4.6.13: :

#### 4.6.3.1.2.1.7.1 Calculation of logical variable

If VS is less than difference of maximum vehicle speed for drive of support (C\_VS\_MAX\_N\_SP\_CS) and Vehicle speed hysteresis for VS threshold drive-off-support (C\_VS\_HYS\_N\_SP\_CS) then generated LV\_CS\_VS\_In\_HYS\_tmp is equal to 1 else if VS is greater than C\_VS\_MAX\_N\_SP\_CS then . LV\_CS\_VS\_In\_HYS\_tmp is set to 1 else it remains at old value.

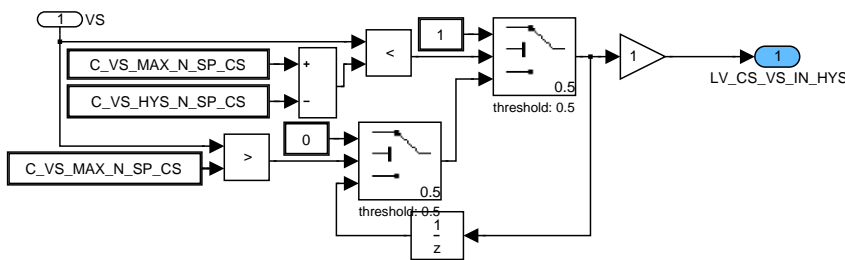


Figure 4.6.14: :

### 4.6.3.1.2.2 Extraordinary engine speed setpoints(Calculation of second part of pre calculation.)

#### 4.6.3.1.2.2.1 Idle Speed setpoint for power steering ( EPS /PSTE /PSTE\_2 )

Absolute engine speed setpoint dependant from steering angle and steering angle velocity, used under certain conditions. If it is the greatest of the speed setpoints entering the MAX-selection, see below. For power steering variant EPS and AFS (ident: PSTE).

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### 4.6.3.1.2.2.1.1 Idle speed setpoint for powersteering 1

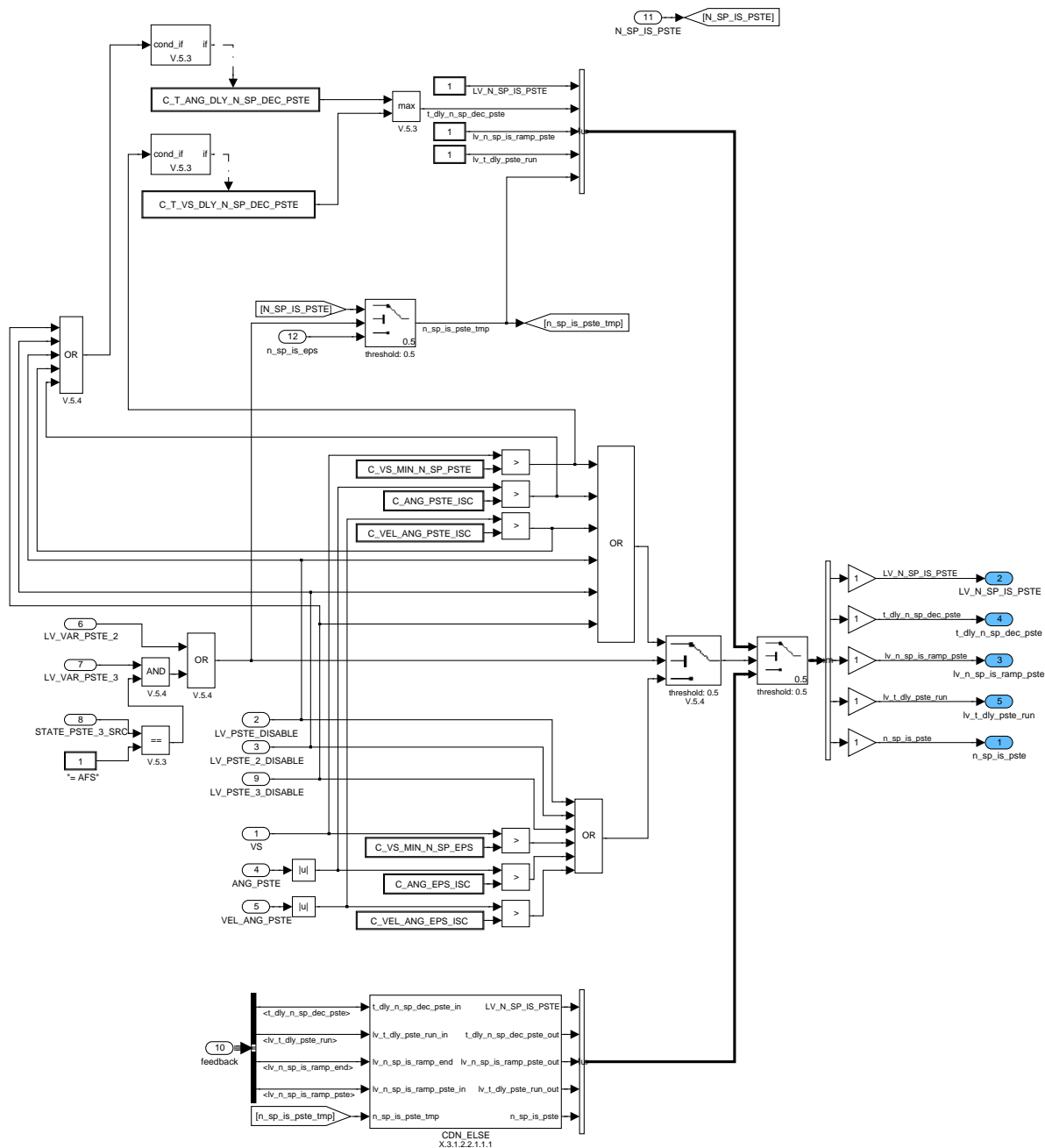


Figure 4.6.15: :

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4.6.3.1.2.2.1.1 Calculations when condition check fails.

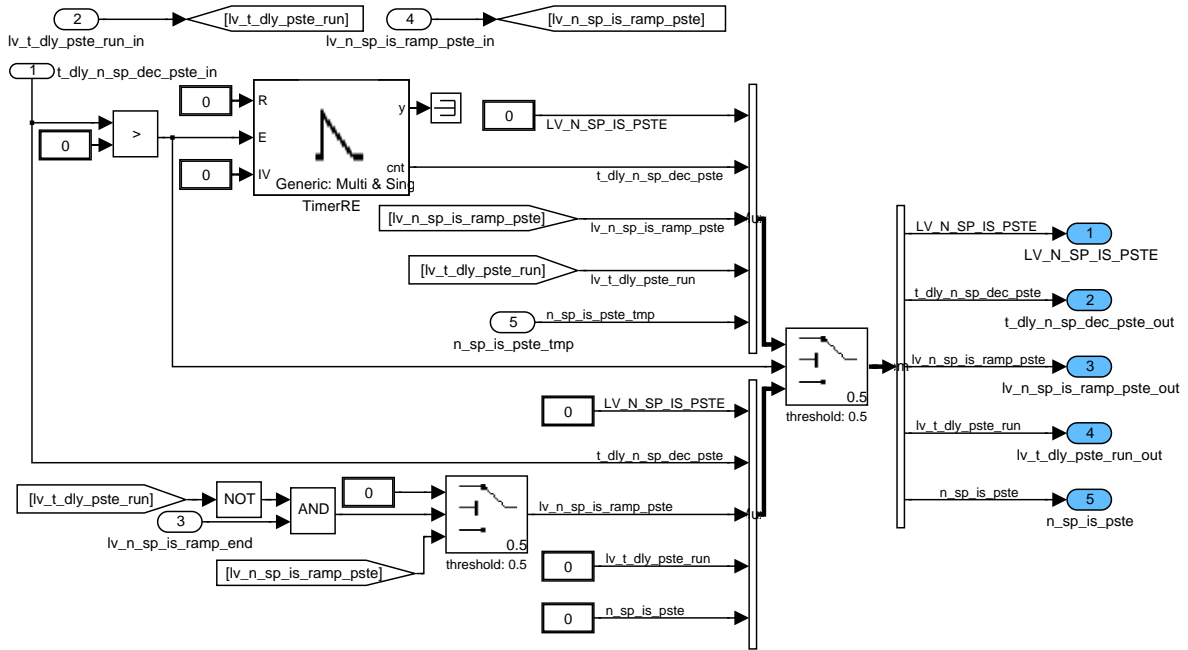


Figure 4.6.16: :

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### 4.6.3.1.2.2.1.2 Idle speed setpoint for powersteering 2

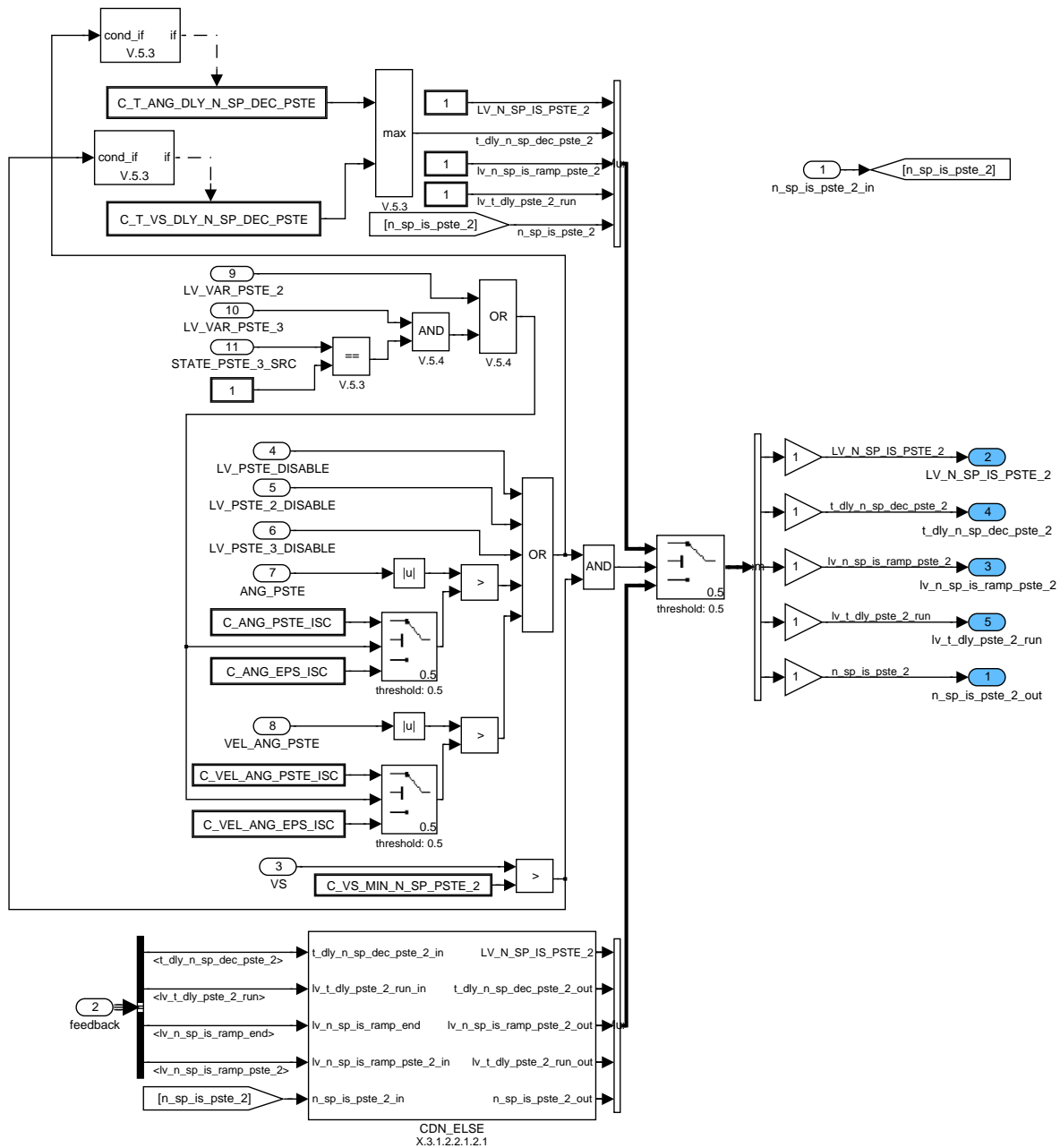


Figure 4.6.17: :

#### 4.6.3.1.2.2.1.2.1 Calculations when condition check fails.

Calculations when condition check fails.

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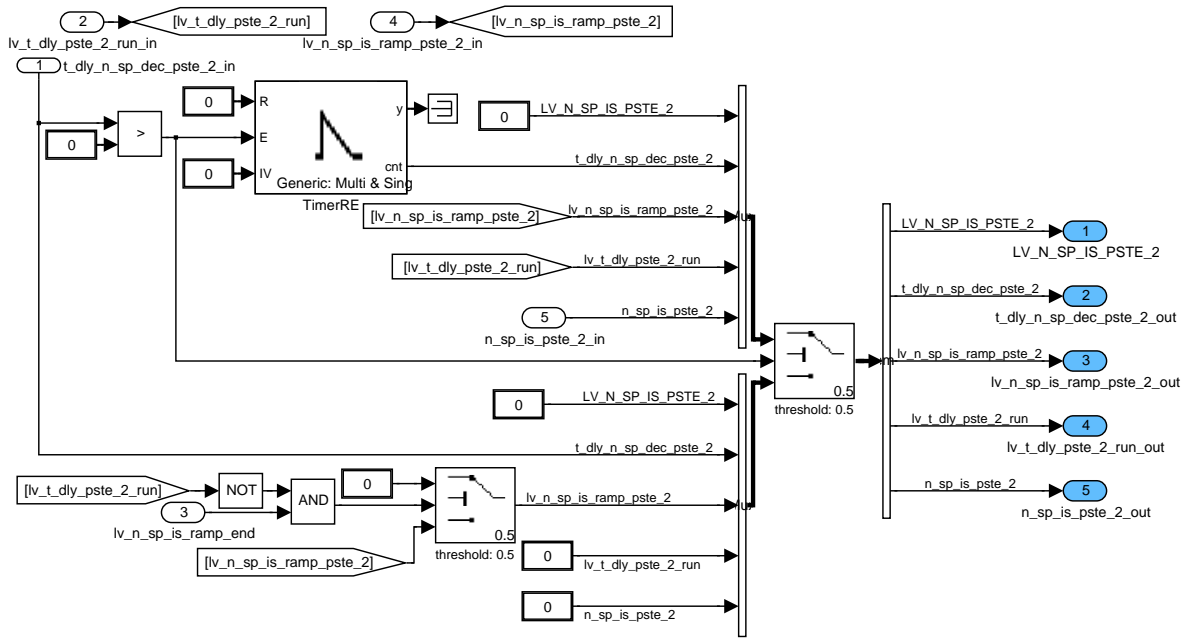


Figure 4.6.18: :

4.6.3.1.2.2.2 Idle Speed setpoint at part load (PL)

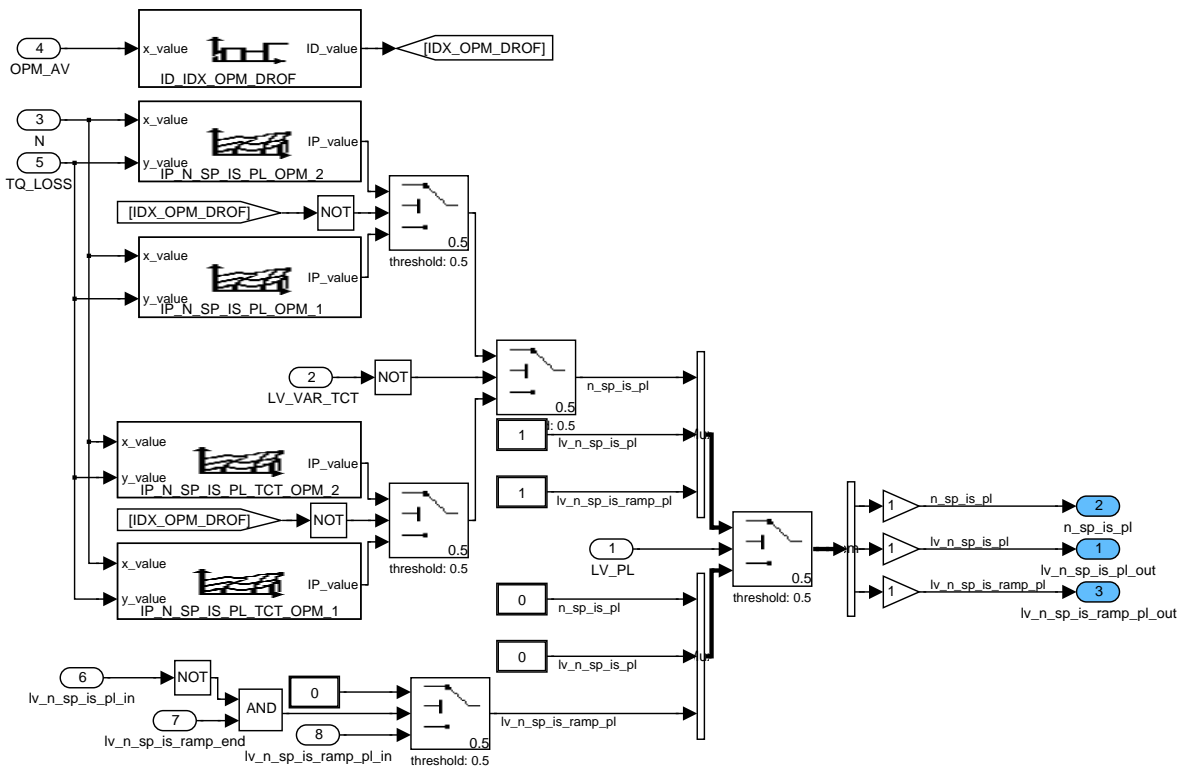


Figure 4.6.19: :

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#### 4.6.3.1.2.2.3 Idle Speed setpoint due to power management request for power supply stability

The engine speed setpoint  $N\_SP\_IS\_PWR\_STAB$  can be activated by the power supply stability request from the power management. The height of this setpoint depends on whether the driving position is engaged or not.

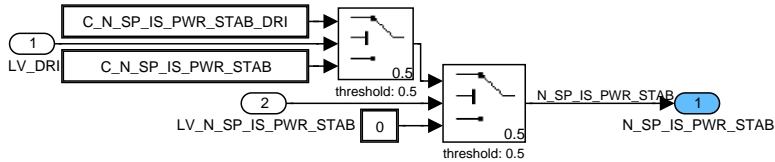


Figure 4.6.20: :

#### 4.6.3.1.2.2.4 Idle speed set point due to TCT(twin clutch transmission)

The engine speed setpoint  $N\_SP\_IS\_TCT\_CAN$  from TCT is transmitted via CAN and used as  $N\_SP\_IS\_TCT$  if  $LV\_VAR\_TCT = 1$  and if it is the greatest of the speed setpoints entering the MAX-selection.

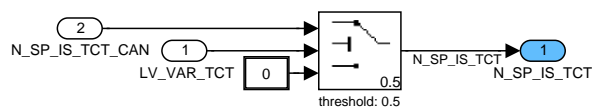


Figure 4.6.21: :

#### 4.6.3.1.2.3 Exceptional engine speed setpoint

There are 4 other cases which are not mentioned in above formula section. First is a function which allows to bypass the MAX-selection if a correspondingly command ( $LV\_ACT\_N\_SP\_IS\_BAS\_EXT\_ADJ$ ) was received via K-line. In this case,  $N\_SP\_IS\_3$  is set to the basis idle speed setpoint  $N\_SP\_IS\_2$ .

Second is a function which allows to bypass the MAX-selection if another correspondingly command ( $LV\_ACT\_N\_SP\_IS\_EXT\_ADJ$ ) was received via K-line. In this case,  $N\_SP\_IS\_3$  is set to the requested idle speed setpoint  $N\_SP\_IS\_EXT\_ADJ$ .

Third is an extra idle speed setpoint - $C\_N\_SP\_IS\_SA\_EOL$ - during the secondary air function end of line test. It is valid during  $LV\_ACT\_SA\_EOL = 1$ .

Fourth, a switch for activation of desulfatation,  $LV\_NT\_SO2P\_EXT\_ADJ\_ACT$  was introduced to increase  $N\_SP\_IS$  to 3000...4000 rpm.

4th case is limp home (highest priority). If PVS error and PVS limp home is requested ( $LV\_N\_SP\_IS\_LIH\_ACT = 1$ ) a different idle speed setpoint can be calibrated. So a higher vehicle dynamic as at nominal idle speed is possible.

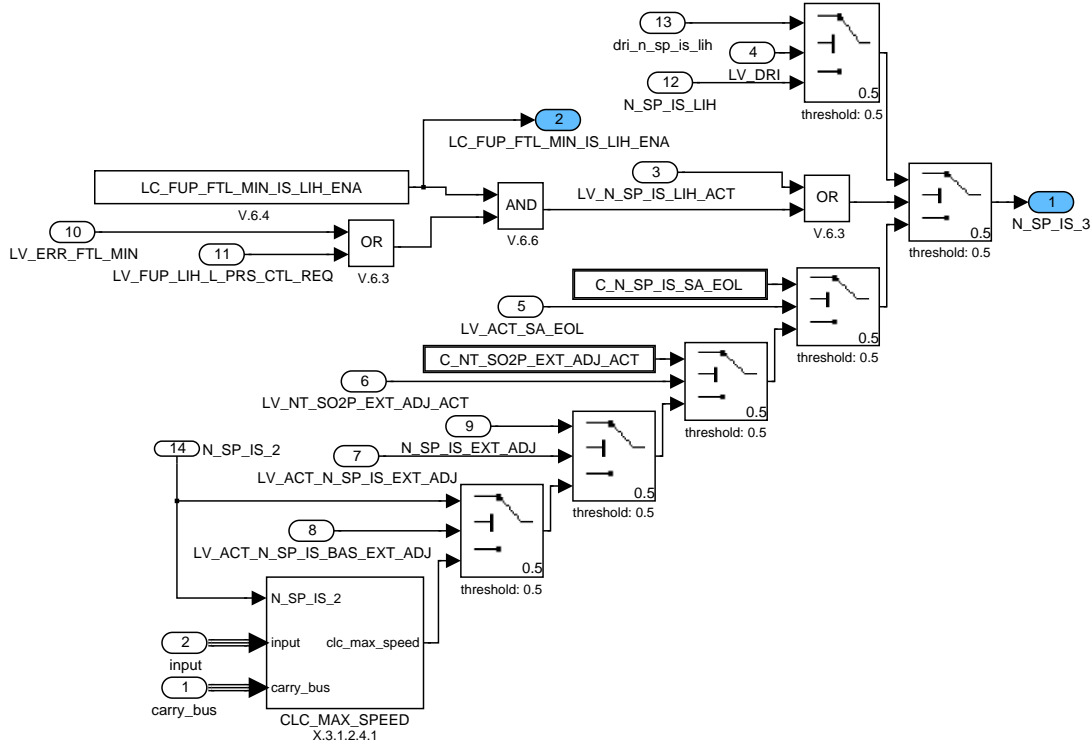


Figure 4.6.22: :

**4.6.3.1.2.3.1 Calculation of maximum speed from set of idle speed. calculated in pre calculation subsystem.**

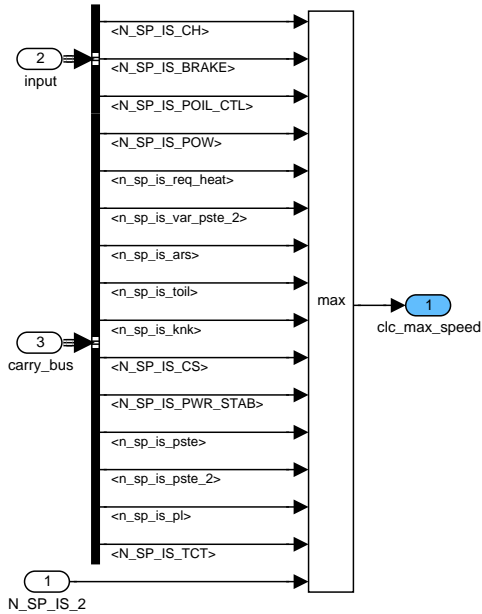


Figure 4.6.23: :

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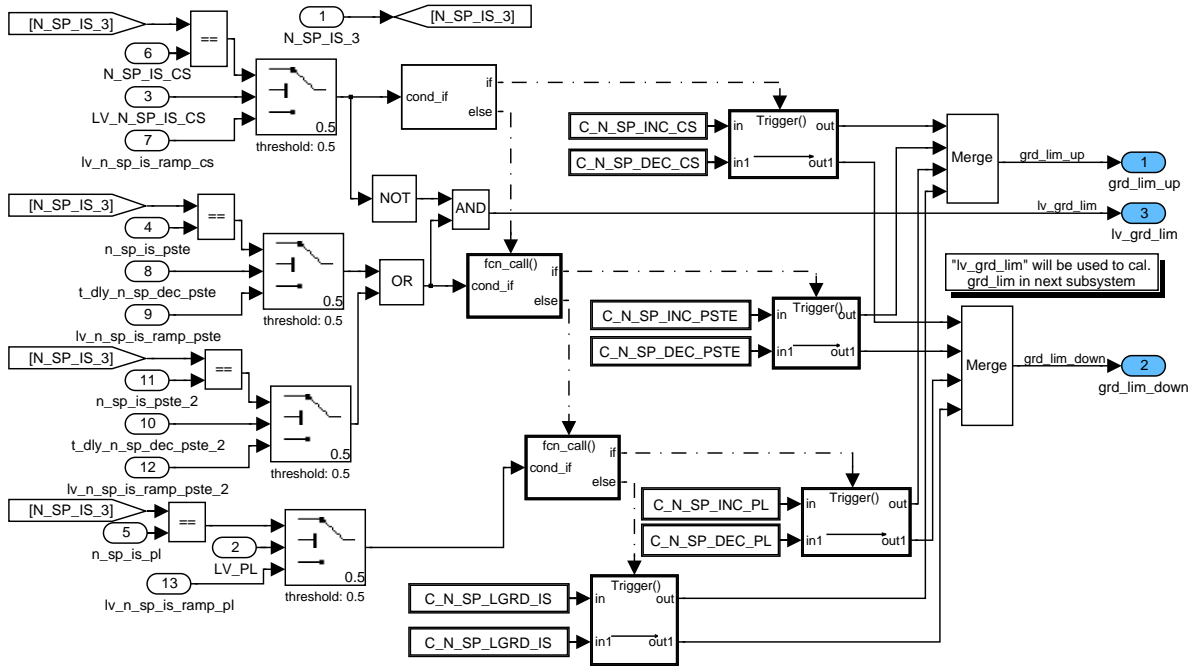


Figure 4.6.25: :

#### 4.6.3.1.4 Determination of N\_SP\_IS

During start and after end of start gradient limitation of N\_SP\_IS can be disabled by delay time C\_T\_DLY\_GRD\_LIM.

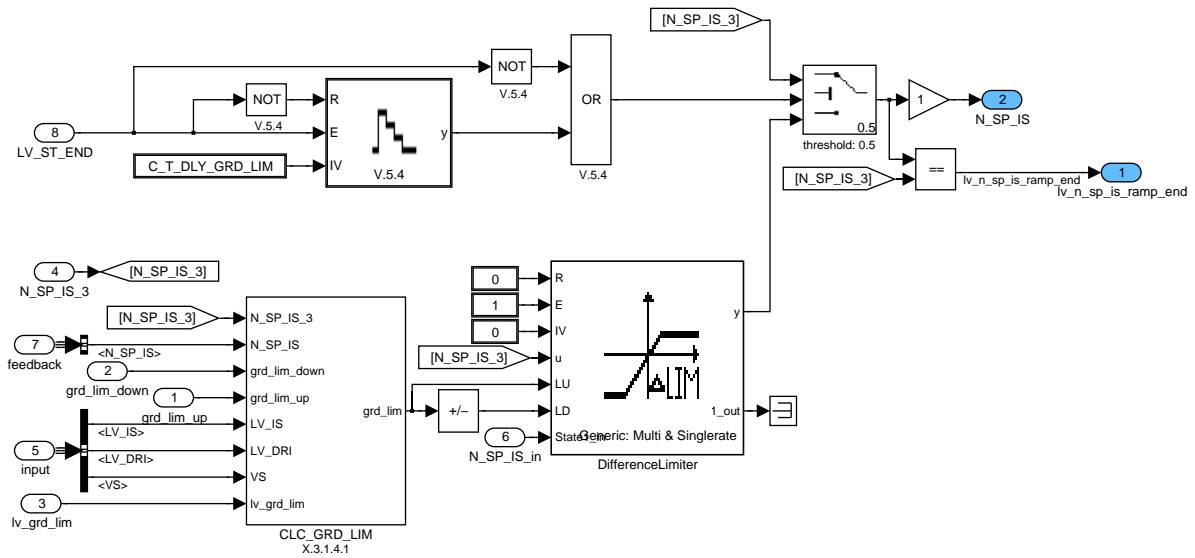


Figure 4.6.26: :

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#### 4.6.3.1.4.1 Calculation of optimal value of gradient limitation.

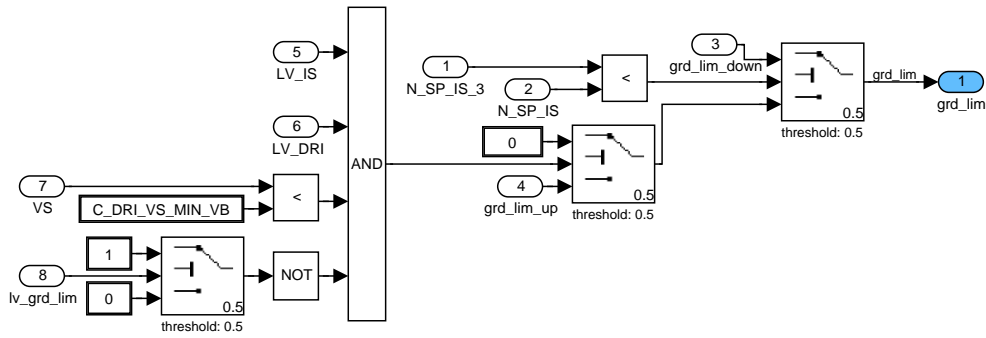


Figure 4.6.27: :

#### 4.6.3.1.5 Calculated engine speed setpoint ratio

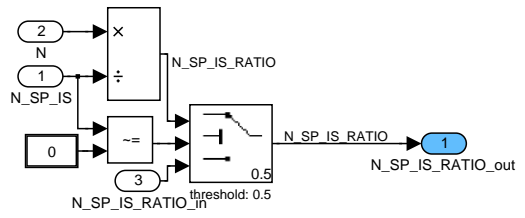


Figure 4.6.28: :

#### 4.6.3.2 Calculation of N\_DIF and N\_DIF\_ST

##### 4.6.3.2.1 Engine speed deviations N\_DIF, N\_DIF\_MMV, N\_DIF\_COR

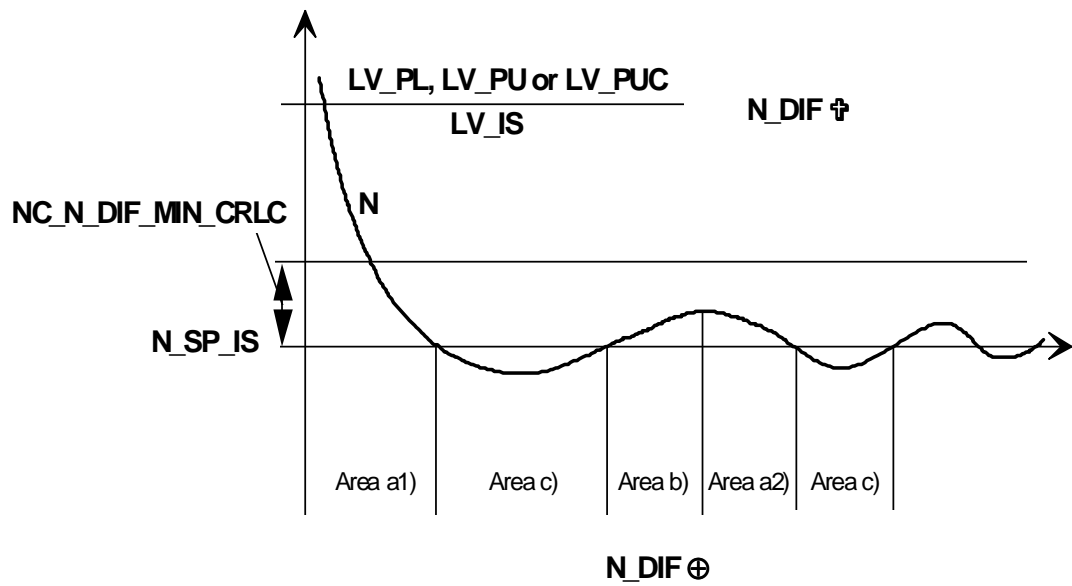


Figure 4.6.29: :

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N\_DIF\_MMV calculation:

After entry in Idle (LV\_IS=1), N\_DIF\_MMV is set to N\_DIF taking into account the limits defined below. Then the moving mean value is determined:

$$N\_DIF\_MMV(n) = N\_DIF\_MMV(n-1) + (N\_DIF - N\_DIF\_MMV(n-1)) * N\_DIF\_CRLC$$

The correlation constant C\_N\_DIF\_CRLC may assume 3 discrete values:

a1) Decreasing engine speed above nominal idle speed after entry in Idle (LV\_IS=1) and conditions b.) and c.) not previously met (or  $N\_DIF < NC\_N\_DIF\_MIN\_CRLC$ ):

$$(N\_DIF(n-3) < N\_DIF(n) \text{ and } N\_DIF(n) < 0)$$

$$N\_DIF\_CRLC = C\_N\_DIF\_CRLC \text{ (per adjustment)}$$

a2) Decreasing engine speed above nominal idle speed

$$\text{and } N\_DIF > NC\_N\_DIF\_MIN\_CRLC$$

and condition b.) previously fulfilled

$$N\_DIF\_CRLC = 1$$

b) Increasing engine speed above nominal idle speed

$$((N\_DIF(n-3) \geq N\_DIF(n) \text{ and } N\_DIF(n) < 0)$$

$$N\_DIF\_CRLC = 1$$

c) Engine speed below nominal idle speed after entry at idle and is still below idle speed

$$(N\_DIF(n) \geq 0)$$

$$N\_DIF\_CRLC = 0$$

Limits of N\_DIF\_MMV:

$$C\_N\_DIF\_MIN\_MMV ( N\_DIF\_MMV ( 0$$

N\_DIF\_COR calculation:

N\_DIF\_COR is relevant for the idle controller (idle-charge actuator and ignition timing):

$$N\_DIF\_COR = N\_DIF - N\_DIF\_MMV * C\_N\_DIF\_FAC$$

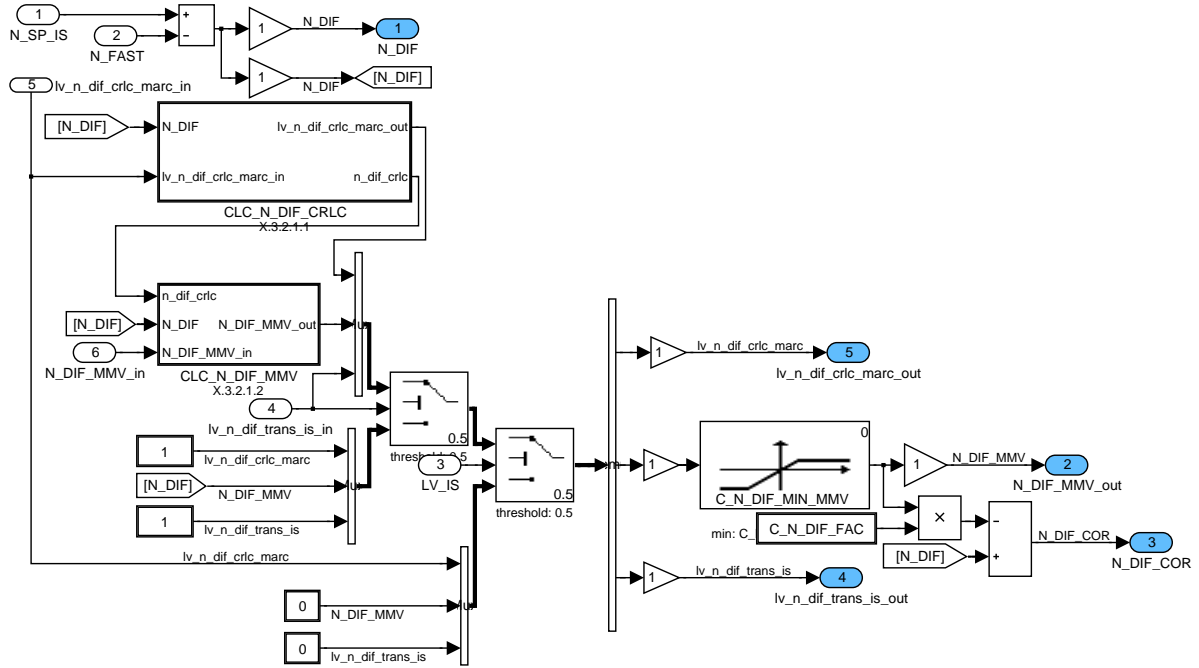


Figure 4.6.30: :

4.6.3.2.1.1 Determination of correlation factor

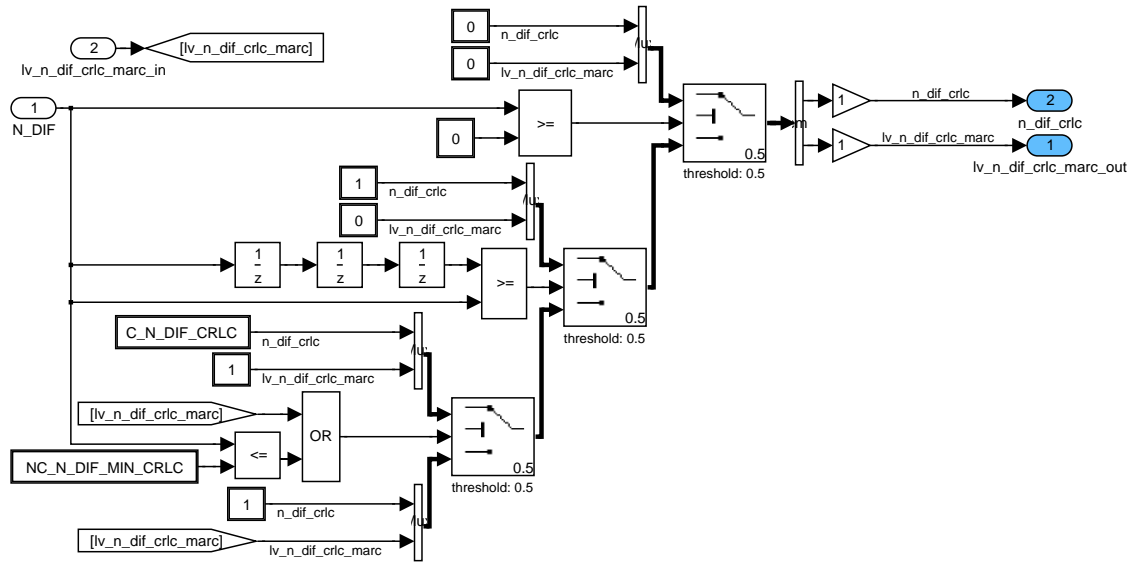


Figure 4.6.31: :

4.6.3.2.1.2 Calculation of N\_DIF\_MMV

N\_DIF\_MMV is determined here using low pass filter.

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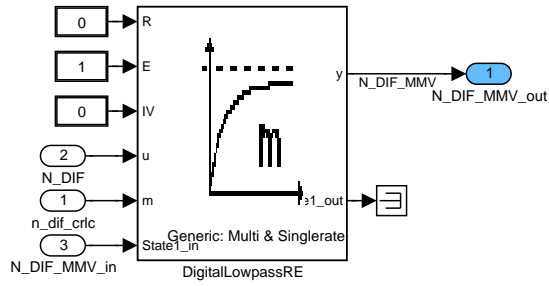


Figure 4.6.32: :

4.6.3.2.2 Engine speed deviation N\_DIF\_ST

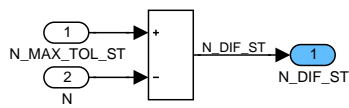


Figure 4.6.33: :

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## 4.7 Engine speed limit coordination

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_N_MAX_ETC_LIH	O/V	0... 1H	0 ...1	1	-
engine speed limitation (MTC or ETC_LIH) active					
LV_N_MAX_H	V	0... 1H	0 ...1	1	-
Boolean for increased engine speed limitation active					
LV_VS_MAX	O/V	0... 1H	0 ...1	1	-
Boolean for vehicle speed limitation active					
N_MAX_AT	-	0... 1FE0H	0... 8160	1	rpm
Engine speed limit for stopped AT-vehicle or at high vehicle speed					
N_MAX_DROF	-	0... 1FE0H	0... 8160	1	rpm
Engine speed limit in case of jump start					
N_MAX_EGY	-	0... 1FE0H	0... 8160	1	rpm
Engine speed limit in case of activated energy spare mode					
N_MAX_LIH_EGS	V	0... 1FE0H	0... 8160	1	rpm
Engine speed limit for AT in case of CAN error to EGS					
N_MAX_LIH_ETC	-	0... 1FE0H	0... 8160	1	rpm
Engine speed limit in case of throttle limp home required by throttle monitoring or ETC safety concept					
N_MAX_LIH_MTC	-	0... 1FE0H	0... 8160	1	rpm
Engine speed limit in case of MTC error					
N_MAX_LIH_PRS_OIL	V	0... 1FE0H	0... 8160	1	rpm
Engine speed limit for required oil pressure limp home mode					
N_MAX_MT	-	0... 1FE0H	0... 8160	1	rpm
Engine speed limit for stopped MT-vehicle					
N_MAX_THD	O/V	0... 1FE0H	0... 8160	1	rpm
Actual engine speed limit					
N_MAX_THD_1	O/V	0... 1FE0H	0... 8160	1	rpm
Actual engine speed limit depending on TOIL-orange area (BN2000)					
N_MAX_THD_2	O/V	0... 1FE0H	0... 8160	1	rpm
Actual engine speed limit depending on TOIL-red area (BN2000)					
N_MAX_THD_LIH	V	0... 1FE0H	0... 8160	1	rpm
Actual engine speed limit due to LIH					
N_MAX_VS_MAX	V	0... 1FE0H	0... 8160	1	rpm
Engine speed limit in case of vehicle speed limitation					
STATE_N_MAX_THD_LIH	O/V	0... 3H	0 ...3	1	-
Active engine speed reduction due to LIH (0..no reduce, 1..minor reduce, 2..major reduce)					
T_GEAR_VS_MAX	V	0... FFH	0... 25.5	0.1	s
Time since the last gear shift.					
VS_RATIO	V	0... FFFFH	0... 31.99951	488.299e-6	-
Ratio between vehicle speed limit and actual vehicle speed					

### Input data:

C_VS_MAX_0_DFT {p. 1158}	C_VS_MAX_1 {p. 1158}	C_VS_MAX_2 {p. 1158}	C_VS_MAX_3 {p. 1158}
CTR_KM_CAN {p. 1563}	GEAR {p. 1302}	LV_AT {p. 654}	LV_CS {p. 8394}
LV_ERR_ECU_CKS {p. 4232}	LV_ERR_ECU_RAM {p. 4232}	LV_ETCU_DISABLE_CAN {p. 6718}	LV_GP {p. 803}

LV_GS {p. 1565}	LV_INH_GP_SUP {p. 1566}	LV_MAF_BLS_DIAG {p. 4820}	LV_MTC_LIH_ACT {p. 4216}
LV_MTC_LIH_CUR_OFF {p. 4982}	LV_N_LIM_REQ_MON {p. 6877}	LV_N_LIM_REQ_RST_ CHK {p. 4230}	LV_N_MAX {p. 3779}
LV_ST_END {p. 1720}	LV_TPS_MTC_N_LIM {p. 4982}	LV_VAR_BN {p. 655}	LV_VAR_TCT {p. 656}
N {p. 1525}	N_LIH_PRS_OIL {p. 8218}	N_MAX_LIH_STATE_ CMB_S {p. 8218}	PV_AV {p. 1269}
STATE_EGY_MIN_KWP {p. 7483}	STATE_ETCU_PROG_ INFO {p. 1574}	STATE_GEAR_REV_AT_ AMT {p. 1302}	STATE_ST_TQ_LIM_GS {p. 1577}
T_AST {p. 1766}	TCO {p. 1100}	VS {p. 1176}	VS_MAX_SEL_EXT_REQ {p. 7683}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_KM_CAN_EGY_2_MAX	-	0... FFFFH	0... 655350	10	km
Maximum vehicle mileage to activate torque/engine speed-limitation due to energy spare mode 2 = "transport modus"					
C_N_MAX_DRI_RVL	-	0... 1FE0H	0... 8160	1	rpm
engine speed limit AT-vehicle in reverse gear					
C_N_MAX_EGY_1	-	0... 1FE0H	0... 8160	1	rpm
Engine speed limit in case of production energy spare mode					
C_N_MAX_EGY_2	-	0... 1FE0H	0... 8160	1	rpm
Engine speed limit in case of transportation energy spare mode					
C_N_MAX_EGY_3	-	0... 1FE0H	0... 8160	1	rpm
Engine speed limit in case of garage energy spare mode					
C_N_MAX_LIH_EGS_LGRD	-	0... 1FE0H	0... 8160	1	rpm
Limitation gradient for n_max during AT gear shift in case of CAN error to EGS					
C_N_MAX_MTC_LIH	-	0... 1FE0H	0... 8160	1	rpm
Engine speed limitation in case of fault detected by throttle monitoring or ETC safety concept					
C_N_MAX_PRS_OIL_ADD	-	0... 1FE0H	0... 8160	1	rpm
offset for engine speed limit for oil pressure limb home mode					
C_N_MAX_THD_LIH_H	-	0... 1FE0H	0... 8160	1	rpm
Higher engine speed limit threshold (classifies minor N_MAX reduction due to LIH)					
C_N_MAX_THD_LIH_L	-	0... 1FE0H	0... 8160	1	rpm
Lower engine speed limit threshold (classifies major N_MAX reduction due to LIH)					
C_N_MAX_THD_MIN	-	0... 1FE0H	0... 8160	1	rpm
Minimum allowed engine speed threshold					
C_T_AST_ETCU_CAN_VLD	-	0... FFFFH	0... 6553.5	0.1	s
Time after start limit, until ETCU_CAN is valid					
C_T_GEAR_VS_MAX_AT	-	0... FFH	0... 25.5	0.1	s
Time for calculating N_MAX_VS_MAX after a gear shift with AT.					
C_T_GEAR_VS_MAX_MT	-	0... FFH	0... 25.5	0.1	s
Time for calculating N_MAX_VS_MAX after a gear shift with MT.					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MAX_N_MAX_H_AT	-	0... FFH	0... 25.5	0.1	s
maximum time after exceeding the VS threshold, AT vehicle					
C_T_MAX_N_MAX_H_AT_MAN	-	0... FFH	0... 25.5	0.1	s
maximum time after exceeding the VS threshold, AT vehicle in 'M' (manual) mode					
C_T_MAX_N_MAX_H_MT	-	0... FFH	0... 25.5	0.1	s
maximum time after exceeding the VS threshold, MT vehicle					
C_VS_MAX_HYS	-	0... FFH	0... 255	1	km/h
Hysteresis of vehicle speed limitation					
C_VS_THD_N_MAX_H_AT	-	0... 7FFFH	0... 327.67	0.01	km/h
VS threshold for increased engine speed limit, AT vehicle					
C_VS_THD_N_MAX_H_AT_MAN	-	0... 7FFFH	0... 327.67	0.01	km/h
VS threshold for increased engine speed limit, AT vehicle in M (manual) mode					
C_VS_THD_N_MAX_H_MT	-	0... 7FFFH	0... 327.67	0.01	km/h
VS threshold for increased engine speed limit, MT vehicle					
ID_N_DEC_N_MAX_H_AT	-	0... 1FE0H	0... 8160	1	rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
stepwidth to basic engine speed limit, AT vehicle					
ID_N_DEC_N_MAX_H_AT_MAN	-	0... 1FE0H	0... 8160	1	rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
stepwidth to basic engine speed limit, AT vehicle in 'M' (manual) mode					
ID_N_DEC_N_MAX_H_MT	-	0... 1FE0H	0... 8160	1	rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
stepwidth to basic engine speed limit, MT vehicle					
ID_N_MAX_AT	-	0... 1FE0H	0... 8160	1	rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
basic engine speed limit AT-vehicle					
ID_N_MAX_AT_MAN	-	0... 1FE0H	0... 8160	1	rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
engine speed limit AT vehicle in 'M' (manual) mode					
ID_N_MAX_H_AT	-	0... 1FE0H	0... 8160	1	rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
increased engine speed limit AT-vehicle					
ID_N_MAX_H_AT_MAN	-	0... 1FE0H	0... 8160	1	rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
increased engine speed limit AT vehicle in 'M' (manual) mode					
ID_N_MAX_H_MT	-	0... 1FE0H	0... 8160	1	rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
increased engine speed limit MT-vehicle					
ID_N_MAX_MT	-	0... 1FE0H	0... 8160	1	rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
basic engine speed limit MT-vehicle					
ID_T_N_MAX_H_AT	-	0... FFFFH	0... 6553.5	0.1	s
LDPM_GEAR	9	0... FFH	0... 255	1	-
time for increased engine speed limit, AT vehicle					

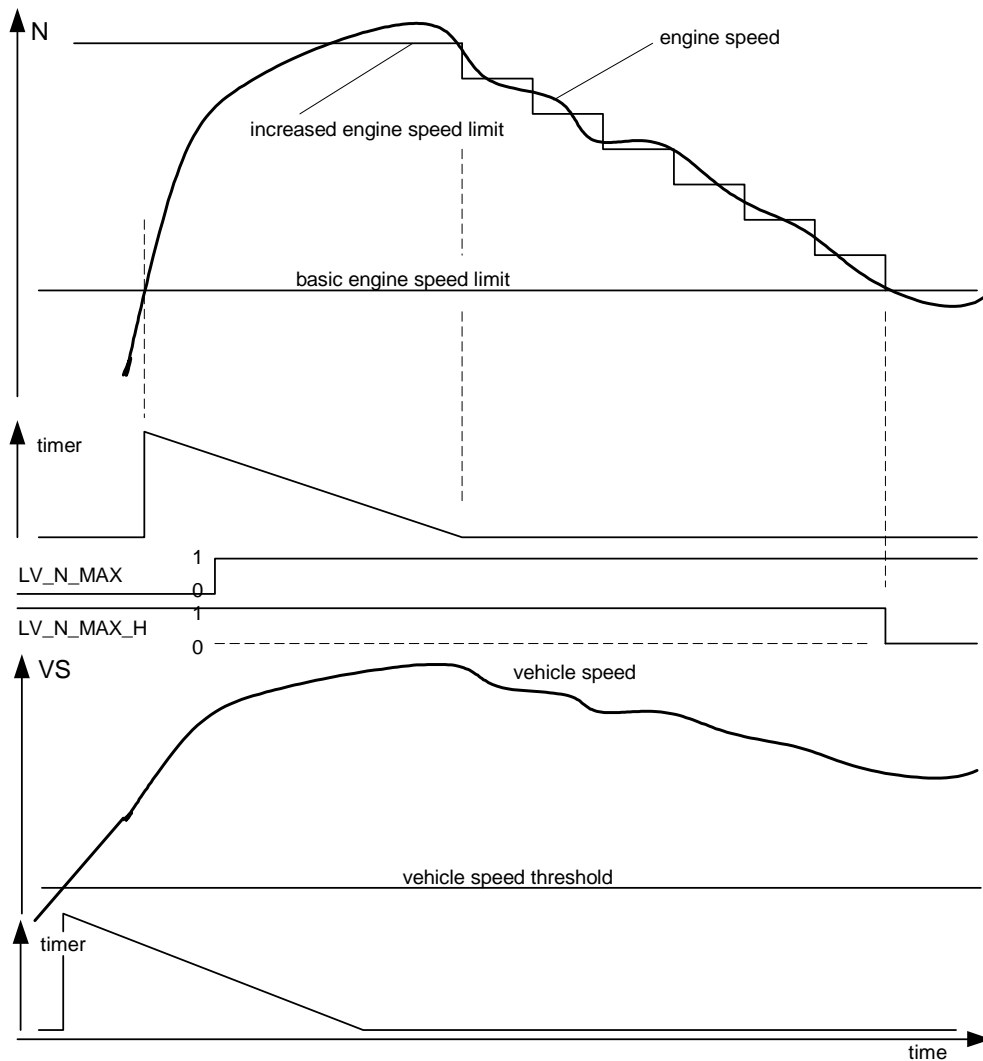
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_T_N_MAX_H_AT_MAN	-	0... FFFFH	0... 6553.5	0.1	s
LDPM_GEAR	9	0... FFH	0... 255	1	-
time for increased engine speed limit, AT vehicle in 'M' (manual) mode					
ID_T_N_MAX_H_MT	-	0... FFFFH	0... 6553.5	0.1	s
LDPM_GEAR	9	0... FFH	0... 255	1	-
time for increased engine speed limit, MT vehicle					
IP_N_MAX_1_TCO	-	0... 1FE0H	0... 8160	1	rpm
LDP_TCO_N_MAX_1	4	0... C8H	-40 ...160	1	°C
Engine speed limit (orange area) depending on TCO - BN2000					
IP_N_MAX_2_TCO	-	0... 1FE0H	0... 8160	1	rpm
LDP_TCO_N_MAX_2	4	0... C8H	-40 ...160	1	°C
Engine speed limit (orange area) depending on TCO - BN2000					
IP_N_MAX_DROF_VS	-	0... 1FE0H	0... 8160	1	rpm
LDP_VS_N_MAX_DROF	8	0... FFH	0... 255	1	km/h
Engine speed limit to avoid max torque at jump start					
IP_N_MAX_LIH_EGS	-	0... 1FE0H	0... 8160	1	rpm
LDP_VS__N_MAX	8	0... FFH	0... 255	1	km/h
Engine speed limit for AT in case of CAN error to EGS					
IP_N_MAX_MTC_CUR_OFF__PV_AV	-	0... 1FE0H	0... 8160	1	rpm
LDP_PV_AV__N_MAX_MTC_CUR_OFF	4	0... FFH	0... 99.60937	0.390625	%
Engine speed limit for limp home modus due to MTC error					
LC_N_MAX_VS_MAX_ACT	-	0... 1H	0 ...1	1	-
Switch to activate vs_max limitation over N_MAX_VS_MAX					
LC_VAR_ETCU_SPT_SWI	-	0... 1H	0 ...1	1	-
LC indicating version of AT or TCT transmission (0 = ETCU without sport switch, 1 = ETCU with sport switch)					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_N_REF_MAX	-	0... 1FE0H	0... 8160	1	rpm
Threshold for not active engine speed limitation, 8160rpm					

**FUNCTION DESCRIPTION:****General information:**

Several conditions can activate an engine speed limit. The actual engine speed limit is calculated as minimal selection of all requests.



Signal flow diagram

If the vehicle speed is below a threshold or exceeded this threshold not more than a calibrateable time before, an increased speed limit is valid for a short time (this is **not** true, if the transmission variant is AT and the reverse gear is engaged, i.e. if LV\_AT and STATE\_GEAR\_REV\_AT\_AMT = 1). So if the engine speed exceeds the basic engine speed limit while the time after VS exceeded C\_VS\_THD\_N\_MAX\_H\_xx is at the most C\_T\_MAX\_N\_MAX\_H\_xx, the increased engine speed limit is valid for a calibrateable time. After this time the valid limit is changed towards the basic engine speed limit via calibrateable steps. If C\_T\_MAX\_N\_MAX\_H\_xx is terminated without limitation being active (LV\_N\_MAX = 0), N\_MAX\_xx is set from increased speed limit to basic engine speed in one step.

A jump back to the increased engine speed limit is possible not before the engine speed limitation is finished (LV\_N\_MAX = 0). Furthermore the VS condition must be fulfilled (still or again). All the 4 parameters

- basic engine speed limit
- increased engine speed limit
- time for increased engine speed limit and
- stepwidth to basic engine speed limit

are separately calibrateable for the 3 vehicle variants

- automatic or twin clutch transmission
- manual transmission



- automatic manual transmission
- automatic of twin clutch transmission in manual mode 'M'

and dependant from the actual gear.

C\_VS\_THD\_N\_MAX\_H\_xx and C\_T\_MAX\_N\_MAX\_H\_xx are separately calibrateable for the 3 vehicle variants (xx = MT/AT).

Above a specific engine speed, the calculation of the stratified combustion mode is switched off. To enable a stratified limp home mode even when the stratified combustion mode calculation is switched off, the engine speed limitation N\_MAX\_LIH\_STATE\_CMB\_S is introduced to reactivate stratified mode calculation.

### Application conditions

**Initialisation:**

```

N_MAX_THD      = NC_N_REF_MAX ( = 8160 rpm )
N_MAX_THD_1    = 0
N_MAX_THD_2    = 0
LV_VS_MAX      = 0
N_MAX_THD_LIH  = NC_N_REF_MAX ( = 8160 rpm )
N_MAX_LIH_EGS  = NC_N_REF_MAX ( = 8160 rpm )
STATE_N_MAX_THD_LIH = 0
    
```

**Recurrence:** 100 ms

**Activation:** at every engine operating state

**Deactivation:** -

### Formula section:

a1) Basic engine speed limit :

Manual transmission vehicle

```

if      (LV_AT = 0 and LV_VAR_TCT = 0)
  Then    N_MAX_MT      = ID_N_MAX_MT
  Else    N_MAX_MT      = NC_N_REF_MAX
Endif
    
```


Automatic transmission or twin clutch transmission vehicle

```

if      (LV_AT = 1 or LV_VAR_TCT = 1)
  Then
    if      STATE_GEAR_REV_AT_AMT = 0
      then if [ (( STATE_ETCU_PROG_INFO=1 and LV_VAR_BN=0 ) or
                ( STATE_ETCU_PROG_INFO=2 and LV_VAR_BN=1 ) ) and
                LC_VAR_ETCU_SPT_SWI = 0 ] or
                [ LV_INH_GP_SUP = 1 and LC_VAR_ETCU_SPT_SWI = 1 ]
        Then    N_MAX_AT      = ID_N_MAX_AT_MAN
        else    N_MAX_AT      = ID_N_MAX_AT
        endif
      Else    N_MAX_AT      = C_N_MAX_DRI_RVL
    Endif
  Else    N_MAX_AT      = NC_N_REF_MAX
Endif
    
```

Remark: a change of the vehicle-(transmission-)type is done only during VS = 0 km/h.

a2) Parameters for increased engine speed limit :

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Parameter	Vehicle type *)	Value
VS-threshold	1)	C_VS_THD_N_MAX_H_MT
	3)	C_VS_THD_N_MAX_H_AT
	4)	C_VS_THD_N_MAX_H_AT_MAN
increased engine speed limit	1)	ID_N_MAX_H_MT
	3)	ID_N_MAX_H_AT
	4)	ID_N_MAX_H_AT_MAN
time before deceleration begins	1)	ID_T_N_MAX_H_MT
	3)	ID_T_N_MAX_H_AT
	4)	ID_T_N_MAX_H_AT_MAN
decrease stepwidth	1)	ID_N_DEC_N_MAX_H_MT
	3)	ID_N_DEC_N_MAX_H_AT
	4)	ID_N_DEC_N_MAX_H_AT_MAN

- \*) Vehicle types :
- 1) Manual transmission vehicle
  - 2) Automatic manual transmission vehicle
  - 3) Automatic/Twin clutch transmission vehicle
  - 4) Automatic/Twin clutch transmission vehicle in 'M' (manual) mode

Functionality (N\_MAX\_MT/AT = ...): see signal flow diagram above.

Status bit for increased engine speed limit:

```

if      ID_N_MAX_MT < N_MAX_MT < NC_N_REF_MAX
OR
  [ ID_N_MAX_AT < N_MAX_AT < NC_N_REF_MAX  and
    STATE_GEAR_REV_AT_AMT = 0  and
    { (((STATE_ETCU_PROG_INFO != 1  and  LV_VAR_BN = 0)  or
      (STATE_ETCU_PROG_INFO != 2  and  LV_VAR_BN = 1) )  and
      LC_VAR_ETCU_SPT_SWI = 0 )  or
      (LV_INH_GP_SUP = 0  and  LC_VAR_ETCU_SPT_SWI = 1) } ]
OR
  [ ID_N_MAX_AT_MAN < N_MAX_AT < NC_N_REF_MAX  and
    STATE_GEAR_REV_AT_AMT = 0  and
    { (((STATE_ETCU_PROG_INFO = 1  and  LV_VAR_BN = 0)  or
      (STATE_ETCU_PROG_INFO = 2  and  LV_VAR_BN = 1) )  and
      LC_VAR_ETCU_SPT_SWI = 0 )  or
      (LV_INH_GP_SUP = 1  and  LC_VAR_ETCU_SPT_SWI = 1) } ]
Then      LV_N_MAX_H = 1
Else      LV_N_MAX_H = 0
Endif

```

#### a4) Engine speed limit if limp home mode required by throttle monitoring

In case of limp home request from main throttle controller a lower engine speed limit should be active.

```

if      LV_N_LIM_REQ_MON == 1  or
  LV_TPS_MTC_N_LIM == 1  or
  LV_MTC_LIH_ACT == 1  or
  LV_N_LIM_REQ_RST_CHK == 1  or
  LV_MAF_BLS_DIAG == 1  or
  LV_ERR_ECU_CKS == 1  or
  LV_ERR_ECU_RAM == 1

```

```

Then          N_MAX_LIH_ETC =          C_N_MAX_MTC_LIH
Else          N_MAX_LIH_ETC =          NC_N_REF_MAX
Endif

```

a5) Engine speed limit if limp home mode only due to MTC error

```

If          LV_MTC_LIH_CUR_OFF ==          1
Then N_MAX_LIH_MTC          =          IP_N_MAX_MTC_CUR_OFF( PV_AV )
Else N_MAX_LIH_MTC =          NC_N_REF_MAX
Endif

```

```

If          N_MAX_LIH_MTC or N_MAX_LIH_ETC not NC_N_REF_MAX
Then LV_N_MAX_ETC_LIH = 1
Else LV_N_MAX_ETC_LIH = 0
Endif

```

a6) Engine speed limit for vehicle speed limitation

In case of vehicle speed limitation the engine speed limitation will be activated.

```

If (1)          LV_GP = 0
Then(1)
  If (2)          VS_MAX_SEL_EXT_REQ = 1
  Then(2)        VS_MAX = C_VS_MAX_1
  Else(2)
    If (3)          VS_MAX_SEL_EXT_REQ = 2
    Then(3)        VS_MAX = C_VS_MAX_2
    Else(3)
      If (4)          VS_MAX_SEL_EXT_REQ = 3
      Then(4)        VS_MAX = C_VS_MAX_3
      Else(4)        VS_MAX = C_VS_MAX_0_DFT
      Endif(4)
    Endif(3)
  Endif(2)
Else(1)          VS_MAX = 327.67
Endif(1)

```

```

VS_RATIO          =          VS_MAX / VS

```

```

If(1)          (VS_MAX < 327.67) AND LC_N_MAX_VS_MAX_ACT = 1
Then(1)
  If(2)          (VS_RATIO <= 1.0) ("Hysteresis")
  Then(2)        LV_VS_MAX = 1
  Else(2)
    If(3)          VS <= VS_MAX - C_VS_MAX_HYS
    Then(3)        LV_VS_MAX = 0
    Endif(3)
  Endif(2)
  If(4)          GEAR ≠ 0 and
                 GEAR ≠ GEAR_PREV_VS_MAX
  Then(4)        GEAR_PREV_VS_MAX = GEAR
                 LV_GEAR_SHIFT_VS_MAX = 1
  If(5) LV_AT = 1 or LV_VAR_TCT = 1
  Then(5) T_GEAR_VS_MAX = C_T_GEAR_VS_MAX_AT

```

```

        Else(5) T_GEAR_VS_MAX = C_T_GEAR_VS_MAX_MT
    Endif(5)
    Else(4) decrement T_GEAR_VS_MAX
        LV_GEAR_SHIFT_VS_MAX = 0
    Endif(4)

    If(6)      VS > VS_MAX - C_VS_MAX_HYS
        Then(6)
            If(7) [N_MAX_VS_MAX = NC_N_REF_MAX or LV_GEAR_SHIFT_VS_MAX = 1 or
                T_GEAR_VS_MAX ≠ 0] or
                ((LV_AT = 1 or LV_VAR_TCT = 1) and
                STATE_CC "Closed")
                Then(7)      N_MAX_VS_MAX = N * VS_RATIO,
                Else(7) N_MAX_VS_MAX remains
            Endif(7)
            Else(6)      N_MAX_VS_MAX = NC_N_REF_MAX
        Endif(6)

    Else(1)      {Engine speed limit for vehicle speed limitation deactivated
        LV_VS_MAX = 0
        N_MAX_VS_MAX = NC_N_REF_MAX }

    Endif(1)

```

a7) Engine speed limit for energy spare mode (production, transportation or garage mode)

```

IF      STATE_EGY_MIN_KWP = 1
then    N_MAX_EGY = C_N_MAX_EGY_1
elseif  STATE_EGY_MIN_KWP = 2          AND
        CTR_KM_CAN <= C_CTR_KM_CAN_EGY_2_MAX
then    N_MAX_EGY = C_N_MAX_EGY_2
elseif  STATE_EGY_MIN_KWP = 3
then    N_MAX_EGY = C_N_MAX_EGY_3
else    N_MAX_EGY = 1FE0H
ENDIF

```

a8) Engine speed limit in order to avoid a maximum torque in powertrain due to jump start

```

IF LV_CS = 1
then N_MAX_DROF = IP_N_MAX_DROF( VS )
else N_MAX_DROF = 1FE0H
ENDIF

```

a9) Engine speed limit in order to avoid overspeed in oil pressure limb home mode

```

N_MAX_LIH_PRS_OIL = N_LIH_PRS_OIL + C_N_MAX_PRS_OIL_ADD

```

a10) Engine speed limitation for automatic transmission in case of TCU - EGS limb home (CAN error)

```

IF      ( LV_ETCU_DISABLE_CAN == 1          AND
        LV_ST_END == 1          AND
        T_AST > C_T_AST_ETCU_CAN_VLD )    OR
        STATE_ST_TQ_LIM_GS == 1

```

```

THEN      N_MAX_LIH_EGS = IP_N_MAX_LIH_EGS (VS)
ELSE      N_MAX_LIH_EGS = N_MAX_LIH_EGS + C_N_MAX_LIH_EGS_LGRD
endif

```

*b) Selection of the currently active engine speed limit N\_MAX\_THD:*

The lowest active engine speed limitation is selected as input for the controller:

```

N_MAX_THD      =      max(      C_N_MAX_THD_MIN,
                               min(      N_MAX_MT,
                                         N_MAX_AMT,
                                         N_MAX_AT,
                                         N_MAX_LIH_ETC,
                                         N_MAX_LIH_MTC,
                                         N_MAX_VS_MAX,
                                         N_MAX_LIH_STATE_CMB_S,
                                         N_MAX_EGY,
                                         N_MAX_DROF,
                                         N_MAX_LIH_PRS_OIL,
                                         N_MAX_LIH_EGS )      )

```

*c1) Currently active engine speed limit (BN) depending on TCO N\_MAX\_THD\_1(orange area):*

```

N_MAX_THD_1      =      IP_N_MAX_1_TCO

```

*c2) Currently active engine speed limit (BN) depending on TCO N\_MAX\_THD\_2 (red area):*

```

N_MAX_THD_2      =      IP_N_MAX_2_TCO

```

*d) Selection of the currently active engine speed limit due to limp home N\_MAX\_THD\_LIH :*

The lowest active engine speed limitation caused by limp home is used for determination of the level of limitation (STATE\_N\_MAX\_THD\_LIH):

```

N_MAX_THD_LIH      =      min(      N_MAX_LIH_ETC,
                                   N_MAX_LIH_MTC,
                                   N_MAX_LIH_STATE_CMB_S,
                                   N_MAX_EGY,
                                   N_MAX_LIH_PRS_OIL)

```

```

If          N_MAX_THD_LIH < C_N_MAX_THD_LIH_L
Then        STATE_N_MAX_THD_LIH = 2           // major limitation of N due to
LIH
Else        If          N_MAX_THD_LIH < C_N_MAX_THD_LIH_H
               Then        STATE_N_MAX_THD_LIH = 1           // minor limitation of N due to
LIH
               Else        STATE_N_MAX_THD_LIH = 0           // no limitation of N due to LIH
               Endif
Endif

```

## 4.8 Vehicle speed limit calculation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
AC_VEH_MMV	O/V	8000... 7FFFH	-27.77088 ...27.770033	847.5e-6	m/s**2
Current Vehicle Acceleration - Filtered					
LV_VS_MAX_LIH_TCT_ACT	V	0... 1H	0 ...1	1	-
Vehicle speed maximum limphome for TCT					
VS_DIF_LIM	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	km/h
Vehicle speed deviation for speed limiter					
VS_MAX	O/V	0... 7FFFH	0... 327.67	0.01	km/h
Maximum allowed vehicle speed					
VS_PRED	O/V	0... 7FFFH	0... 327.67	0.01	km/h
Predicted Vehicle Speed for Speed Limitation					

### Input data:

AC_VEH {p. 797}	LV_GP {p. 803}	LV_IGK {p. 906}	LV_SWT_VMAX_ENA
N_VS {p. 806}	PV_AV {p. 1269}	VS_HIGH_RES {p. 811}	VS_MAX_LIH_TCT {p. 1582}
VS_MAX_SEL_EXT_REQ {p. 7683}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_AC_VEH_VS_MAX	V	0... FFFFH	0... 0.99998474121	15.2588e-6	-
PT1 filter constant for low pass filter					
C_PV_MIN_LIH_TCT_ACT	V	0... FFH	0... 99.609375	0.390625	%
Pedal value position minimum limphome for TCT					
C_VS_DIF_LIH_TCT_DEAC	V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed difference limphome for TCT					
C_VS_MAX_0_DFT	V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed limitation threshold 0 - default value					
C_VS_MAX_1	V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed limitation threshold 1					
C_VS_MAX_2	V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed limitation threshold 2					
C_VS_MAX_3	V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed limitation threshold 3					
C_VS_MAX_AMT	V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed limitation threshold - SSG					
C_VS_MAX_LIH_TCT_DEC	V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed maximum limphome for TCT decrement					
C_VS_MAX_LIH_TCT_INC	V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed maximum limphome for TCT increment					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VS_MAX_SWT_ENA	V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed limitation threshold for sweeping technology					
ID_T_VS_MAX_PRED	V	0... FFH	0... 7.96875	0.03125	s
LDPM_N_VS_VS_MAX	8	0... FFH	0... 255	1	rpm/(km/h)
Prediction time for predicted engine speed for automatic transmission					

### General information:

A filtered vehicle acceleration, AC\_VEH\_MMV is used to predict a future vehicle speed VS\_PRED. The vehicle speed limit, VS\_MAX is also determined at this point. For the fix limitation this limit will be given by the constant C\_VS\_MAX.

Another part is the calculation of the vehicle speed deviation which is an essential variable for the vehicle speed controller.

### Application conditions:

*Initialisation:* RST  
*Recurrence:* 100MS  
*Activation:* LV\_IGK==1  
*Deactivation:* if activation not true

### Function description:

### Formula section:

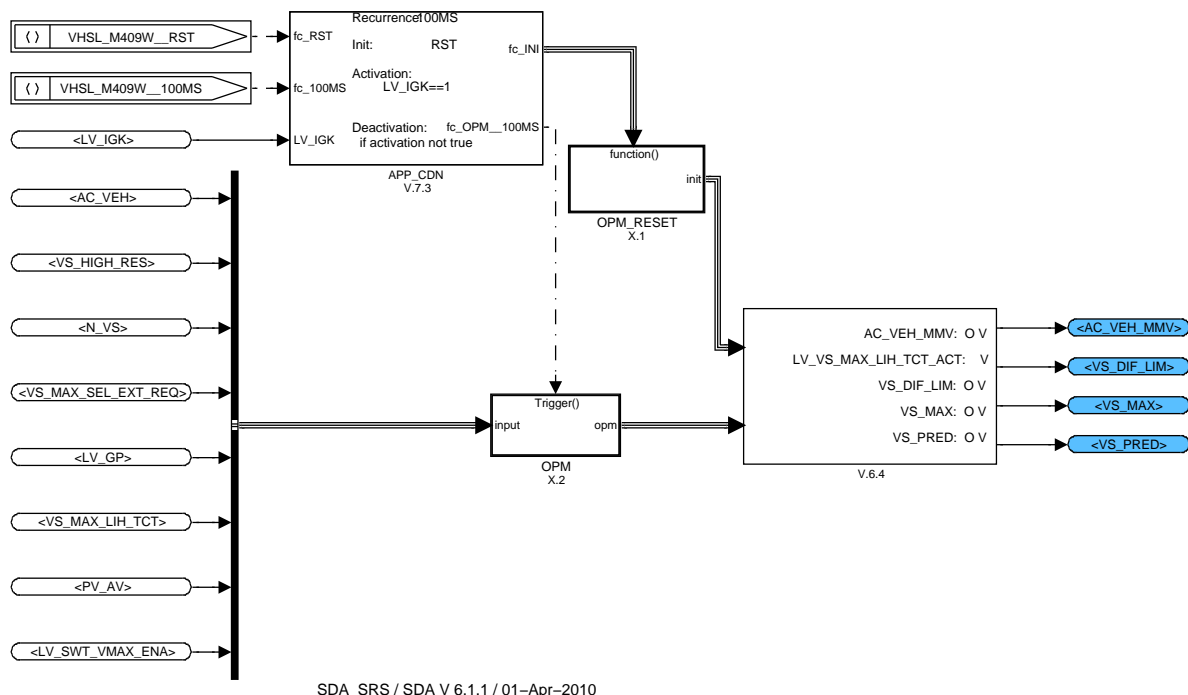


Figure 4.8.1: :

### 4.8.1 SUB FUNCTION: OPM\_RESET

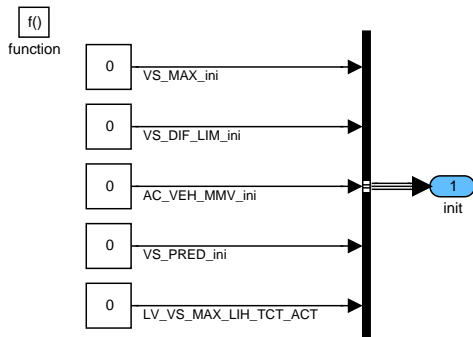


Figure 4.8.2: :

### Overview

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### 4.8.2 SUB FUNCTION: OPM\_100MS

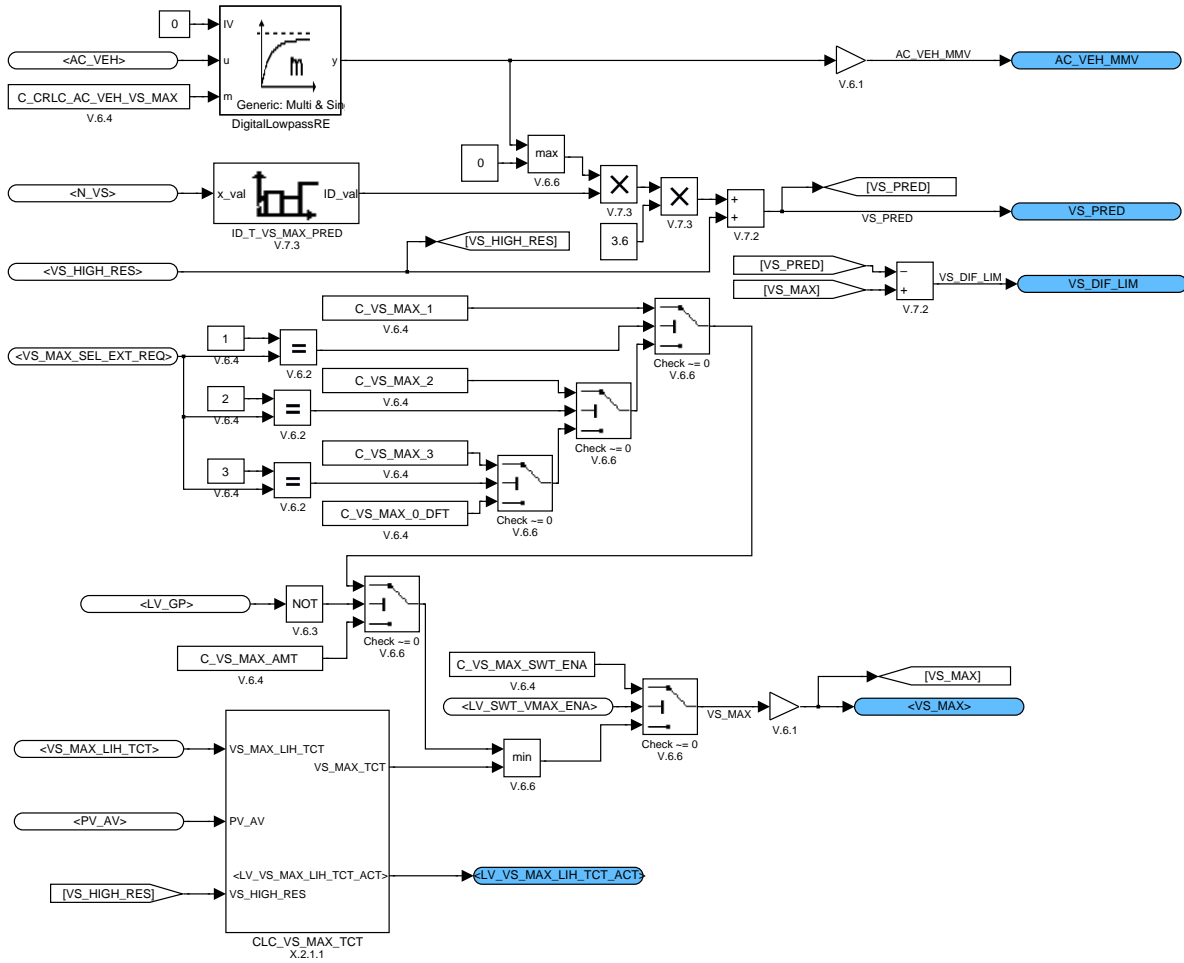



Figure 4.8.3: :

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 1161 of 8404</b>	
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### 4.8.2.1 Calculation of VS\_MAX\_TCT

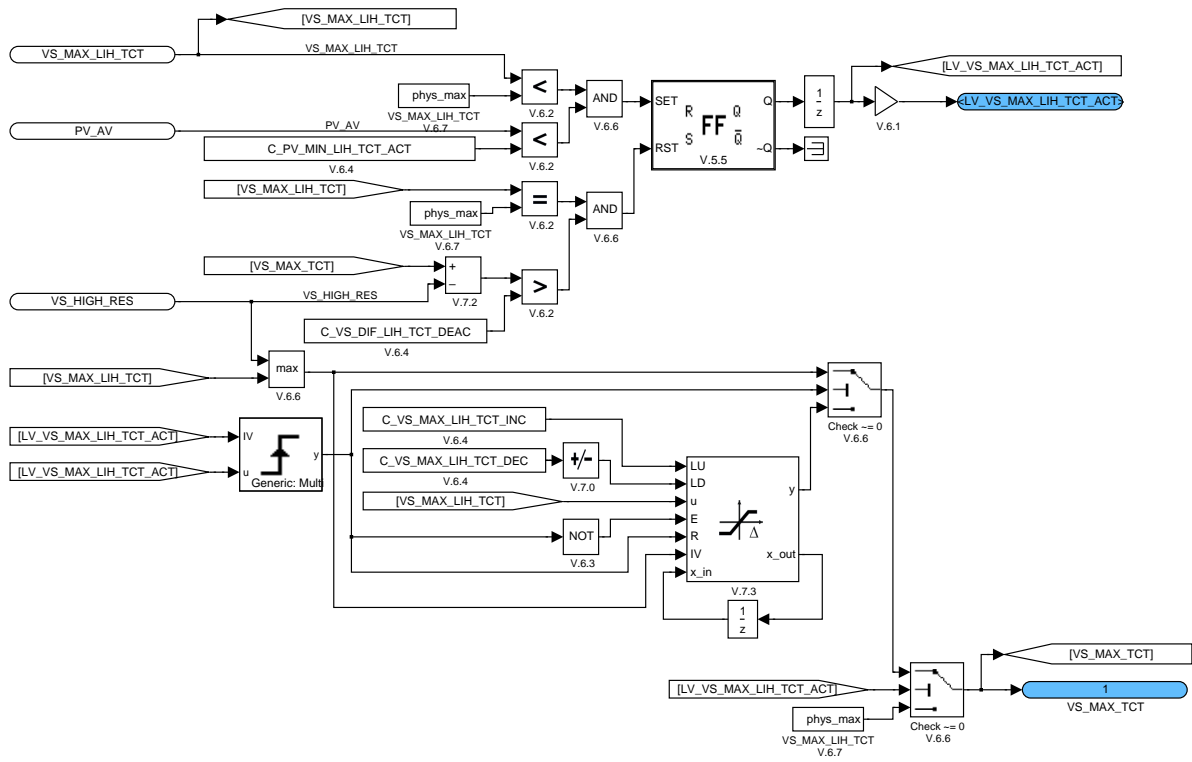



Figure 4.8.4: :

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
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## 4.9 Ambient pressure acquisition

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
AMP_COR	-	0... FFFFH	0... 5434	0.0829175	hPa
Corrected ambient pressure					
AMP_MES	O/V	0... FFFFH	0... 5434	0.0829175	hPa
valid ambient pressure					
AMP_RAW	V	0... FFFFH	0... 5434	0.0829175	hPa
ambient pressure raw value					
AMP_RAW_FRZ	-	0... FFFFH	0... 5434	0.0829175	hPa
Interim value for calculation of AMP_RAW substitute value					
AMP_RAW_NEW	-	0... FFFFH	0... 5434	0.0829175	hPa
Interim value for calculation of ambient pressure raw value					
AMP_SAE	O/V	0... FFH	0... 255	1	kPa
PID33 Ambient pressure					
CTR_SAMPLES	-	0... FFH	0... 255	1	-
counter for average determination					
FAC_AMP	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
factor of the ambient pressure related to the reference ambient pressure					
LV_AMP_GRD_MAX	V	0... 1H	0 ...1	1	-
ambient pressure maximum gradient exceeded					
SUM_AMP_RAW	-	0... FFFFFFFFH	0... 356128058	0.0829175	hPa
summarized ambient pressure raw value					
T_DLY_AMP_SUB	V	0... FFH	0... 25500	100	ms
Delay time before AMP_RAW value substitution					

### Input data:

C_V_AMP_MAX_DIAG {p. 4822}	C_V_AMP_MIN_DIAG {p. 4822}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}
LV_ERR_AMP_PLAUS_ CUS {p. 1061}	LV_ERR_PUT_EL {p. 4828}	LV_ERR_PUT_PLAUS {p. 1062}	LV_VAR_TCHA {p. 656}
MAF_KGH_MES {p. 1192}	PUT_MES_BAS {p. 1198}	STATE_ENG {p. 1720}	V_AMP {p. 831}
VS {p. 1176}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_CRLC	-	0... FFH	0... 0.99609	3.9063e-3	-
correlation value for the compensation of the noise signal of the ambient pressure signal					
C_AMP_HYS	-	0... FFFFH	0... 5434	0.0829175	hPa
maximum value between two acquired ambient pressure values					
C_AMP_REF	-	0... FFFFH	0... 5434	0.0829175	hPa
reference value of the ambient pressure					
C_FAC_AMP_MAX	-	0... FFFFH	0... 1.99996	30.5e-6	-
TOP for FAC_AMP					
C_FAC_AMP_MIN	-	0... FFFFH	0... 1.99996	30.5e-6	-
BOT for FAC_AMP					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_THD_AMP_SUB	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
MAF threshold for AMP_RAW value substitution					
C_T_DLY_AMP_SUB	-	0... FFH	0... 25500	100	ms
Delay time threshold for AMP_RAW value substitution					
IP_AMP_RAW_V_AMP	-	0... FFFFH	0... 5434	0.0829175	hPa
LDP_V_AMP_AMP_RAW	8	0... 3FFH	0 ...5	4.8876e-3	V
correlation table for the linearization of the ambient pressure value acquisition with motorola sensor					
IP_AMP_RAW_COR_VS	-	0... FFFFH	0... 5434	0.0829175	hPa
LDP_VS_AMP_RAW_COR	8	0... FFH	0... 255	1	km/h
correlation table for the linearization of the ambient pressure with the vehicle speed					

## FUNCTION DESCRIPTION:

### Application conditions

**Activation :** at every engine operating state

**Deactivation :** -

**Initialization :** At Reset:

```

If (1)          V_AMP < C_V_AMP_MIN_DIAG          or
                 V_AMP > C_V_AMP_MAX_DIAG
Then (1)        AMP_MES = C_AMP_REF
                 FAC_AMP = 1 (phys)
                 LV_AMP_GRD_MAX = 1
Else (1) If (2)                                LV_ERR_AMP = 0
                 Then (2)          AMP_RAW = IP_AMP_RAW_V_AMP
                 Else (2)          AMP_RAW = C_AMP_REF
                 Endif (2)
                 AMP_COR = AMP_RAW + IP_AMP_RAW_COR_VS
                 AMP_MES = AMP_COR // Calculated with first valid
measurement
                 value V_AMP //
                 FAC_AMP =          AMP_MES / C_AMP_REF // C_FAC_AMP_MIN

                 FAC_AMP          C_FAC_AMP_MAX //
                 LV_AMP_GRD_MAX = 0
Endif (1)
AMP_RAW_FRZ = C_AMP_REF

```

**Update rate:** 100 ms

**Formula section:**

```

AMP_SAE = IP_AMP_RAW__V_AMP //Conversion done is physical way, no initializa-
tion
If(1)          LV_ERR_AMP = 0          and
                LV_ERR_AMP_PLAUS = 0          and
LV_ERR_AMP_PLAUS_CUS = 0
Then(1)      If(2)          V_AMP < C_V_AMP_MIN_DIAG          or
                V_AMP > C_V_AMP_MAX_DIAG
                Then(2)      AMP_RAW(n) = AMP_RAW(n-1) // V_AMP out of range, keep last
valid
value //
                Else(2)      AMP_RAW_NEW = IP_AMP_RAW__V_AMP
If(3)          LV_AMP_GRD_MAX = 0          and
                AMP_RAW_NEW - AMP_RAW > C_AMP_HYS
                Then(3)      LV_AMP_GRD_MAX = 1
                AMP_RAW(n) = AMP_RAW(n-1) // Keep old value //
                Else(3)      AMP_RAW = AMP_RAW_NEW
                LV_AMP_GRD_MAX = 0
                Endif(3)

Else(1)      LV_AMP_GRD_MAX = 1
                If(2)          LV_VAR_TCHA = 0 // Qustion if there is a turbocharger and thus
also a PUT sensor //
                Then(2)      AMP_RAW = C_AMP_REF
                Else(2)      If(3)      LV_ERR_PUT_EL = 0          and
                LV_ERR_PUT_PLAUS = 0          and
                Then(3)      If(4)      MAF_KGH_MES <
C_MAF_THD_AMP_SUB          and
                STATE_ENG = 2          or
                STATE_ENG = 4          or
                STATE_ENG = 5
                Then(4)      T_DLY_AMP_SUB ++ // timer starts count-
ing,
no overflow allowed //
                If(5)          T_DLY_AMP_SUB >
C_T_DLY_AMP_SUB
                Then(5)      AMP_RAW = PUT_MES_BAS
                AMP_RAW_FRZ = PUT_MES_BAS

// Freeze last PUT_MES_BAS value //
                Else(5)      AMP_RAW = AMP_RAW_FRZ // Use last AMP_RAW_
FRZ (= PUT_MES_BAS) value at T_DLY_ERR_AMP > C_T_DLY_AMP_SUB conditions //
                Endif(5)

Else(4)      AMP_RAW = AMP_RAW_FRZ
T_DLY_AMP_SUB = 0
Endif(4)

                Else(3)      AMP_RAW = C_AMP_REF
                Endif(3)
Endif(2)

```

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**Endif(1)**

SUM\_AMP\_RAW = AMP\_RAW + SUM\_AMP\_RAW // summation of actual and preceding

amp\_raw values //

**If(1)** CTR\_SAMPLES < 9

**Then(1)** CTR\_SAMPLES ++

**Else(1)** AMP\_RAW\_NEW = SUM\_AMP\_RAW /10

AMP\_COR = AMP\_RAW\_NEW + IP\_AMP\_RAW\_COR\_VS

// Compensation of the back pressure of the vehicle, due to the vehicle speed //

AMP\_MES = AMP\_MES + (AMP\_COR - AMP\_MES) \* C\_AMP\_CRLC

// Suppression of the signal noise //

// Additionally the factor FAC\_AMP is calculated which is used in several

functions and limited by C\_FAC\_AMP\_MAX and C\_FAC\_AMP\_MIN //

C\_FAC\_AMP\_MIN FAC\_AMP C\_FAC\_AMP\_MAX

SUM\_AMP\_RAW = 0 // Clear counter //

CTR\_SAMPLES = 0 // Clear counter //

**Endif(1)**

## 4.10 Exhaust pipe variables

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MAF_FLOW_EX	O/V	0000... FFFFH	0... 2047.96875	0.03125	kg/h
air mass flow out of the exhaust manifold					
PRS_EX	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Pressure in the exhaust system					
PRS_EX_EGR	O/V	0000... FFFFH	0... 5434	0.083	hPa
Pressure in the exhaust system (for MAF_EGR-Calculation)					
PRS_EX_EGR_INC	O/V	0... FFFFH	0... 5434	0.0829	hPa
increase of exhaust pressure in comparison to ambient pressure (for MAF_EGR-Calculation)					
PRS_EX_INC	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Increase of exhaust pressure in comparison to ambient pressure					

### Input data:

AMP {p. 982}	LV_IGK {p. 906}	LV_RLY_MAIN {p. 3772}	MAF_CYL {p. 8277}
MFF_SP [NC_CBK_EX_NR] {p. 2151}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}
NC_MAF_FAC_CYL {p. 2889}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_PRS_EX_EGR_INC	V	0... FFFFH	0... 5434	0.0829	hPa
LDPM_MAF_FLOW_EGR	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
pressure increase in the exhaust pipe (for MAF_EGR-Calculation)					
IP_PRS_EX_INC	V	0... FFFFH	0... 5434	0.0829	hPa
LDPM_MAF_CYL_EX	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
pressure increase in the exhaust pipe					

### 4.10.1 Calculation of the exhaust manifold pressure PRS\_EX

#### FUNCTION DESCRIPTION:

There is an increase of the pressure in the exhaust pipe in comparison to the ambient pressure. The increase of the pressure is higher with increasing mass flow in the exhaust pipe. The cylinder mass air flow is direct proportional to the exhaust mass flow. Therefore the pressure increase in the exhaust pipe is a function of the cylinder mass flow.

The exhaust pressure PRS\_EX is a function of the ambient pressure and the increase of the pressure in the exhaust pipe, which is a function of the mass flow in the exhaust pipe.


#### Application conditions

**Initialisation:** *all = 0 at reset*

**Recurrence:** *1000ms*

**Activation:** *LV\_IGK = 0 -> 1*

**Deactivation:** *LV\_RLY\_MAIN = 1 -> 0 (also calculated in PWL phase)*


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**Formula section:**

$$\begin{aligned} \text{PRS\_EX\_INC} &= \text{IP\_PRS\_EX\_INC} (\text{MAF\_CYL}) \\ \text{PRS\_EX} &= \text{PRS\_EX\_INC} + \text{AMP} \end{aligned}$$

$$\begin{aligned} \text{MAF\_FLOW\_EX} &= \text{MAF\_CYL} / \text{NC\_CBK\_EX\_NR} + \\ &(\text{MFF\_SP}[\text{NC\_CBK\_EX\_NR} = 2] * \\ &\text{NC\_CYL\_NR} / \text{NC\_CBK\_EX\_NR} * \text{N} / \text{NC\_MAF\_FAC\_CYL}) - \\ &\text{MAF\_EGR} \end{aligned}$$

$$\begin{aligned} \text{PRS\_EX\_EGR\_INC} &= \text{IP\_PRS\_EX\_EGR\_INC} (\text{MAF\_FLOW\_EX}) \\ \text{PRS\_EX\_EGR} &= \text{PRS\_EX\_EGR\_INC} + \text{AMP} \end{aligned}$$

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## 4.11 Mass air flow throttle sensor variables

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_TPS_GAIN_ACT_1	O/V	0... 1H	0 ...1	1	-
Logical variable for TPS_AV based on amplified TPS 1					
LV_TPS_GRD_UP	O/V	0... 1H	0 ...1	1	-
Logical variable for throttle position gradient direction					
TPS_AV	O/V	0... 3FFFH	0... 119.5	0,0073	°TPS
Opening angle of the throttle valve					
TPS_AV_1	O/V	0... 3FFFH	0... 119.5	0,0073	°TPS
Opening angle of the throttle valve of TPS-Poti 1					
TPS_AV_2	O/V	0... 3FFFH	0... 119.5	0,0073	°TPS
Opening angle of the throttle valve of TPS-Poti 2					
TPS_AV_CTL	O/V	C000... 3FFFH	-119.5 ...119.5	0,0073	°TPS
Control opening angle of the throttle valve					
TPS_AV_CTL_1	O/V	C000... 3FFFH	-119.5 ...119.5	0,0073	°TPS
Control opening angle of the throttle valve of TPS-Poti 1					
TPS_AV_CTL_2	O/V	C000... 3FFFH	-119.5 ...119.5	0,0073	°TPS
Control opening angle of the throttle valve of TPS-Poti 2					
TPS_AV_CTL_GAIN_1	V	C000... 3FFFH	-119.5 ...119.5	0,0073	°TPS
Control opening angle of the throttle valve of amplified TPS-Poti 1					
TPS_AV_GAIN_1	V	0... 3FFFH	0... 119.5	0,0073	°TPS
Opening angle of the throttle valve of amplified TPS-Poti 1					
TPS_GRD	O/V	0... FFH	0... 2987.5	11.72	°TPS/s
Throttle position gradient, absolute value					
TPS_LIH	O/V	0... 3FFFH	0... 119.5	0,0073	°TPS
Limp home position of the throttle valve					
TPS_SEG	O/V	0... 3FFFH	0... 119.5	0.0073	°TPS
Segment synchronous measured throttle valve position					
TPS_SEG_1	O/V	0... 3FFFH	0... 119.5	0.0073	°TPS
Segment synchronous measured throttle valve position channel 1					
TPS_SEG_2	O/V	0... 3FFFH	0... 119.5	0.0073	°TPS
Segment synchronous measured throttle valve position channel 2					
TPS_SEG_GAIN_1	O/V	0... 3FFFH	0... 119.5	0.0073	°TPS
Segment synchronous measured throttle valve position amplified channel 1					
V_TPS_GAIN_BOL_ENA_1	V	0... 3FFH	0 ...5	0,0049	Volt
TPS1-voltage to switch from non-amplified to amplified sensor signal					
V_TPS_GAIN_TOL_ENA_1	V	0... 3FFH	0 ...5	0,0049	Volt
TPS1-voltage to switch from amplified to non-amplified sensor signal					

### Input data:

STATE_ETC_LIH {p. 4982}	STATE_TPS_DIAG {p. 4982}	TPS_AD_SLOP_GAIN_1 {p. 4951}	TPS_LIH_1 {p. 4952}
TPS_LIH_2 {p. 4952}	TPS_LIH_INI {p. 4952}	V_TPS_1 {p. 831}	V_TPS_2 {p. 831}
V_TPS_AD_EL_BOL_1 {p. 4952}	V_TPS_AD_EL_BOL_2 {p. 4952}	V_TPS_AD_LIH_1 {p. 4952}	V_TPS_AD_LIH_2 {p. 4952}
V_TPS_AD_OFS_GAIN_1 {p. 4952}	V_TPS_GAIN_1 {p. 986}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TPS_MAX	-	0... 3FFFH	0... 119.5	0,0073	°TPS
Maximum mechanical opening angle of the throttle valve in degree					
C_TPS_SLOP	-	0... FFFFH	0... 48	730e-6	°TPS/V
Nominal value of the slope of pots 1 and 2					
C_V_TPS_GAIN_GRD_MAX	-	0... 3FFH	0 ...5	0.0049	Volt
TPS voltage gradient limitation					
C_V_TPS_GRD_MAX	-	0... 3FFH	0 ...5	0.0049	Volt
TPS voltage gradient limitation					
C_V_TPS_HYS_GAIN_1	-	0... 3FFH	0 ...5	0.0049	Volt
Hysteresis treshold for switch amplified/non-amplified TPS1					
C_V_TPS_SWI_GAIN_1	-	0... 3FFH	0 ...5	0.0049	Volt
Offset on maximum nominal voltage for switch amplified/non-amplified TPS1					

**4.11.1 Standardization of the TPS-Voltage****FUNCTION DESCRIPTION:****General information:**

With the help of the determined adaptation values, the TPS-Position is standardized using the standard slope of the throttle position sensors C\_TPS\_SLOP.

For a better control of smaller opening angles the amplified poti 1 is used (TPS\_AV\_GAIN\_1).

To calculate the controller difference at the lower stop a control opening angle of the throttle value with positive/negative physical limits is needed (TPS\_AV\_CTL).

**Application conditions**

**Initialisation:**  $TPS\_LIH = TPS\_LIH\_INI$

**Recurrence:**  $5ms$

**Activation:** *at every operating state*

**Formula section:**

actual value 1& 2:

$$\begin{aligned} TPS\_AV\_1 &= (V\_TPS\_1\_FIL - V\_TPS\_AD\_EL\_BOL\_1) * C\_TPS\_SLOP \\ TPS\_AV\_2 &= (V\_TPS\_AD\_EL\_BOL\_2 - V\_TPS\_2\_FIL) * C\_TPS\_SLOP \end{aligned}$$

actual contol value 1& 2:

$$\begin{aligned} TPS\_AV\_CTL\_1 &= (V\_TPS\_1\_FIL - V\_TPS\_AD\_EL\_BOL\_1) * C\_TPS\_SLOP \\ TPS\_AV\_CTL\_2 &= (V\_TPS\_AD\_EL\_BOL\_2 - V\_TPS\_2\_FIL) * C\_TPS\_SLOP \end{aligned}$$

actual value: amplified poti 1:

$$TPS\_AV\_GAIN\_1 =$$

$$\left( \frac{V\_TPS\_GAIN\_1\_FIL - V\_TPS\_AD\_OFS\_GAIN\_1}{TPS\_AD\_SLOP\_GAIN\_1} - V\_TPS\_AD\_EL\_BOL\_1 \right) * C\_TPS\_SLOP$$

actual control value: amplified poti 1:

TPS\_AV\_CTL\_GAIN\_1 =

$$\left( \frac{V\_TPS\_GAIN\_1\_FIL - V\_TPS\_AD\_OFS\_GAIN\_1}{TPS\_AD\_SLOP\_GAIN\_1} - V\_TPS\_AD\_EL\_BOL\_1 \right) * C\_TPS\_SLOP$$

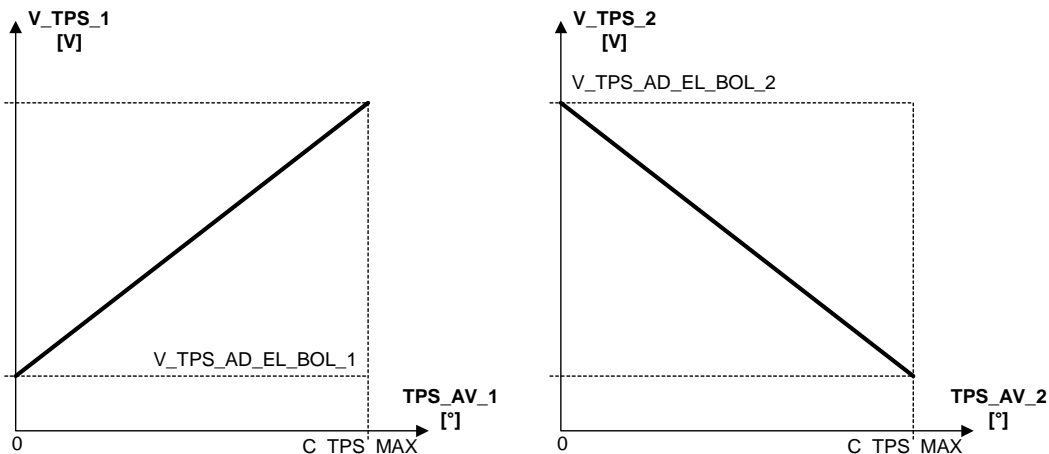


Figure 4.11.1: Standardization of the TPS-Voltage

## 4.11.2 Selection of actual value TPS\_AV /TPS\_AV\_CTL

### Description:

The selection of actual value TPS\_AV /TPS\_AV\_CTL depends on the hysteresis for amplified/non-amplified poti1 and the status of TPS/ETC diagnosis.

### Formula section:

Calculation hysteresis band:

$$V\_TPS\_GAIN\_TOL\_ENA\_1 = 5V / TPS\_AD\_SLOP\_GAIN\_1 - C\_V\_TPS\_SWI\_GAIN\_1$$


$$V\_TPS\_GAIN\_BOL\_ENA\_1 = V\_TPS\_GAIN\_TOL\_ENA\_1 - C\_V\_TPS\_HYS\_GAIN\_1$$

*Hysteresis for amplified/non-amplified poti 1:*

Hysteresis for use of amplified /non-amplified TPS 1:

```

if          V_TPS_1 < V_TPS_GAIN_BOL_ENA_1          and
              LV_TPS_GAIN_ACT_1 = 0
then       LV_TPS_GAIN_ACT_1 = 1
elseif     V_TPS_1 > V_TPS_GAIN_TOL_ENA_1          and
              LV_TPS_GAIN_ACT_1 = 1
  
```

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```

    then      LV_TPS_GAIN_ACT_1 = 0
  endif
endif

```

*Selection in errorfree case:*

TPS1 & TPS2 errorfree, no TPS plausibility error:

```

if          STATE_TPS_DIAG = TPS_NO_ERROR
then
    if      LV_TPS_GAIN_ACT_1 = 1
    inside operation range of amplified TPS1:
    then    TPS_AV      = TPS_AV_GAIN_1
           TPS_AV_CTL = TPS_AV_CTL_GAIN_1
           TPS_LIH    = TPS_LIH_1
    outside operation range of amplified TPS1:
    else    TPS_AV      = TPS_AV_1
           TPS_AV_CTL = TPS_AV_CTL_1
           TPS_LIH    = TPS_LIH_1
    endif
endif
endif

```

*Selection in error-cases:*

TPS1 & TPS2 erroneous or MTC without power:

```

if          STATE_TPS_DIAG = TPS_DBL_ERROR           or
           STATE_ETC_LIH = ETC_LIH_1                or
           STATE_ETC_LIH = ETC_LIH_2_REV           or
           STATE_ETC_LIH = ETC_LIH_2
then
  TPS_AV    = C_TPS_MAX
  TPS_LIH   = TPS_LIH_INI

```

TPS2 erroneous:

```

elseif     STATE_TPS_DIAG = TPS_LIH_1
then
    if      LV_TPS_GAIN_ACT_1 = 1
    inside operation range of amplified TPS1:
    then    TPS_AV      = TPS_AV_GAIN_1
           TPS_AV_CTL = TPS_AV_CTL_GAIN_1
           TPS_LIH    = TPS_LIH_1
    outside operation range of amplified TPS1:
    else    TPS_AV      = TPS_AV_1
           TPS_AV_CTL = TPS_AV_CTL_1
           TPS_LIH    = TPS_LIH_1
    endif

```

TPS1 erroneous:

```

elseif     STATE_TPS_DIAG = TPS_LIH_2
then
  TPS_AV    = TPS_AV_2
  TPS_AV_CTL = TPS_AV_CTL_2
  TPS_LIH   = TPS_LIH_2

```

TPS plausibility error:

```
elseif      STATE_TPS_DIAG = TPS_LIH_MAX
then        TPS_AV          = MAX(TPS_AV_1; TPS_AV_2)
            TPS_AV_CTL      = MAX(TPS_AV_CTL_1; TPS_AV_CTL_2)
            TPS_LIH         = TPS_LIH_INI
```

Endif

### 4.11.3 TPS gradient limitation

#### Description:

To eliminate eventually malfunctions the potentiometer values are verified by a gradient limitation. Is the difference between the old and new potentiometer voltage value exceeding the gradient threshold then keeps the old poti value. If by the next measuring the gradient limitation exceeded again, then the new poti value will adopt.

#### Formula section:

```
IF          V_TPS_Xn - V_TPS_Xn-1 > C_V_TPS_GRD_MAX
Then        V_TPS_X_FIL = V_TPS_Xn

Elseif      V_TPS_Xn - V_TPS_Xn-1 > C_V_TPS_GRD_MAX      and
            V_TPS_Xn-1 - V_TPS_Xn-2 > C_V_TPS_GRD_MAX

            Then        V_TPS_X_FIL = V_TPS_Xn
            Else        V_TPS_X_FIL = V_TPS_X_FILn-1

Endif

IF V_TPS_GAIN_1n - V_TPS_GAIN_1n-1 > C_V_TPS_GAIN_GRD_MAX
Then        V_TPS_GAIN_1_FILn = V_TPS_GAIN_1n
Elseif      V_TPS_GAIN_1n - V_TPS_GAIN_1n-1 > C_V_TPS_GAIN_GRD_MAX      and
            V_TPS_GAIN_1n-1 - V_TPS_GAIN_1n-2 > C_V_TPS_GAIN_GRD_MAX

            Then        V_TPS_GAIN_1_FILn = V_TPS_GAIN_1n
            Else        V_TPS_GAIN_1_FILn = V_TPS_GAIN_1_FILn-1

Endif
```


#### 4.11.3.1 Calculation of throttle position gradient: (TPS\_GRD)

#### Description:

The gradient is calculated as (absolute value of) difference from the actual throttle value and the throttle value i-4 (that is the throttle value which was actual 40ms before). Therefore the converted throttle values are written into a ring-buffer with 4 values.

#### Application conditions

Recurrence: 10ms

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**Formula section:**

$$\text{TPS\_GRD} = | (\text{TPS\_AVi} - \text{TPS\_AVi-4}) * 25 |$$

The throttle gradient direction is calculated as follows

```

if          (TPS_AVi - TPS_AVi-4) < 0
then       LV_TPS_GRD_UP = 0      (negative throttle gradient)
else       LV_TPS_GRD_UP = 1      (positive throttle gradient)
endif

```

**4.11.4 Segment synchronous throttle valve position: (TPS\_SEG)****Description:**

The segment synchronous TPS is needed as input for the intake manifold model. The calculation is carried out segment synchronously. With the help of the adaptation values the TPS-position is standardized to a range between 0° and C\_TPS\_MAX degree.

**Formula section:**

$$\text{TPS\_SEG\_1} = (\text{V\_TPS\_1} - \text{V\_TPS\_AD\_EL\_BOL\_1}) * \text{C\_TPS\_SLOP}$$

$$\text{TPS\_SEG\_2} = (\text{V\_TPS\_AD\_EL\_BOL\_2} - \text{V\_TPS\_2}) * \text{C\_TPS\_SLOP}$$

$$\text{TPS\_SEG\_GAIN\_1} =$$

$$\left( \frac{\text{V\_TPS\_GAIN\_1} - \text{TPS\_AD\_OFS\_GAIN\_1}}{\text{TPS\_AD\_SLOP\_GAIN\_1}} - \text{V\_TPS\_AD\_EL\_BOL\_1} \right) * \text{C\_TPS\_SLOP}$$

$$0^\circ \quad \text{TPS\_SEG\_x} \quad \text{C\_TPS\_MAX.}$$
*Selection in errorfree case:*

TPS1 & TPS2 errorfree, no TPS plausibility error:

```

if          STATE_TPS_DIAG = TPS_NO_ERROR
then
            if          LV_TPS_GAIN_ACT_1 = 1
                inside operation range of amplified TPS1:
            then       TPS_SEG = TPS_SEG_GAIN_1
                outside operation range of amplified TPS1:
            else       TPS_SEG = TPS_SEG_1
            endif

```

**endif**

*Selection in error-cases:*


TPS1 & TPS2 erroneous:

```

if          STATE_TPS_DIAG = TPS_DBL_ERROR
                STATE_ETC_LIH = ETC_LIH_1                or
                STATE_ETC_LIH = ETC_LIH_2_REV           or
                STATE_ETC_LIH = ETC_LIH_2
then       TPS_SEG = TPS_LIH_INI

```

TPS2 erroneous:

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```

elseif      STATE_TPS_DIAG = TPS_LIH_1
then
    if        LV_TPS_GAIN_ACT_1 = 1
    inside operation range of amplified TPS1:
    then      TPS_SEG          = TPS_SEG_GAIN_1
    outside operation range of amplified TPS1:
    else      TPS_SEG          = TPS_SEG_1
endif

```

TPS1 erroneous:

```

elseif      STATE_TPS_DIAG = TPS_LIH_2
then      TPS_SEG          = TPS_SEG_2


```

TPS plausibility error:

```

else      TPS_SEG          = MAX( TPS_SEG_1; TPS_SEG_2 )
endif

```

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## 4.12 Vehicle speed

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_VS_RUN	O/V	0... 1H	0 ...1	1	-
Vehicle is moving					
LV_VST	V	0... 1H	0 ...1	1	-
boolean for stopped vehicle					
T_ERR_VS_CAN	O/V	1... FFFFH	0.01... 655.35	0.01	s
timer after VS CAN error to set VS_FIL to 0					
VS	O/V	0... FFH	0... 255	1	km/h
Vehicle speed					
VS_EDGE_CTR_AV	V	0... FFFFH	0... 65535	1	-
actual value of vehicle speed tooth counter (free running counter)					
VS_EDGE_T_AV	O/V	0... FFFFFFFFH	0... 34359738.36	0.008	ms
actual timestamp of last tooth (free running timer)					
VS_EDGE_T_AV_DIF	V	0... FFFFFFFFH	0... 34359738.36	0.008	ms
actual timestamp difference					
VS_EDGE_T_AV_MAX	V	0... FFFFFFFFH	0... 34359738.36	0.008	ms
actual maximum timestamp of last tooth (free running timer)					
VS_FIL	O/V	0... FFFFH	0... 511.9921875	0.0078125	km/h
Filtered vehicle speed					
VS_H	O/V	0... FFFFH	0... 511.9921875	0.0078125	km/h
vehicle speed high range					
VS_SAE	O/V	0... FFH	0... 255	1	km/h
PID0D measured vehicle speed raw value					
VS_SENS	O/V	0... FFFFH	0... 511.9921875	0.0078125	km/h
vehicle speed calculated from vehicle speed sensor					
VS_SENS_GB	O/V	0... FFFFH	0... 511.9921875	0.0078125	km/h
vehicle speed signal by gearbox sensor					
VS_SENS_GRD	V	8000... 7FFFH	-256... 255.9921875	0.0078125	(km/h)/ 10ms
Vehicle speed gradient calculated from VS_SENS					

### Input data:

LV_ERR_BN_VS_TCS {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_N_WHEEL_FN_ LE {p. 5044}	LV_ERR_N_WHEEL_FN_ RI {p. 5044}
LV_ERR_N_WHEEL_RE_ LE {p. 5044}	LV_ERR_N_WHEEL_RE_ RI {p. 5044}	LV_ERR_TOUT_ASR_1 {p. 802}	LV_ERR_VS {p. 5021}
LV_ERR_VS_CAN {p. 1565}	LV_ERR_VS_PLAUS {p. 5021}	LV_VAR_ASR {p. 655}	N_GB_OUT {p. 1569}
N_WHEEL_RE_RI {p. 806}	RATIO_RAX	STATE_VEH_ROLL_CDN {p. 809}	VS_CAN {p. 1582}
WHEEL {p. 1582}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DIAM_WHEEL	V	0... FFFFH	0... 4095.9375	0.0625	mm
Wheeldiameter for speedcalculation if vehicle is on the roller test bench					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_VS_COM1	V	0... FFH	0... 1.9921875	0.0078125	-
Factor to adjust the VS_CAN-Signal from Flexray					
C_FAC_VS_FIL	V	0... FFH	0... 255	1	-
Filter factor					
C_T_ERR_VS_CAN	V	1... FFFFH	0.01... 655.35	0.01	s
Maximum time after VS CAN error to set VS_FIL to 0					
C_T_VST	V	1... 14H	10... 200	10	ms
Time delay for detection of vehicle stop					
C_VS_EDGE_SUM_MIN	V	1... FFH	1... 255	1	-
minimum number of wheel segments for evaluation of vehicle speed					
C_VS_FAC	V	0... 1000000H	0... 0.291271	17.3611e-9	m
Vehicle distance per segment					
C_VS_GB	V	0... FFFFH	0... 4095.9375	0.0625	mm
tire circumference					
C_VS_MIN_RUN	V	0... FFH	0... 255	1	km/h
vehicle speed threshold for running vehicle detection					
CLF_VS_SENS_ERR	V	1... FFH	1... 255	1	-
Calibration for selection of wheel sensor					

**Import actions:**

<b>ACTION_INFR_GetVsPulsStamp</b> (OUT<PRM_vs_edge_ctr_av>,OUT<PRM_vs_edge_t_av>,OUT<PRM_vs_edge_t_av_max>)
---

**General information****4.12.1 Calculation of Speed Signal VS****General information:**

Running vehicle is detected if vehicle speed  $VS \geq C\_VS\_MIN\_RUN$ .

**Application conditions:**

**Initialisation:**  $VS = 0 ; VS\_H = 0 ; LV\_VS\_RUN = 0 ;$


**Activation:** at every engine operating state

**Deactivation:** -

**Recurrence:** 10ms

**Function description:****Formula section:**

```
#IF (USE_L6 == ACTIVE) // Compiler switch to active VS-signal from Flexray
// Also means that LV_VAR_L6 = 1 switch to active VS-signal from Flexray
```

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```

#THEN
  If (2)    STATE_VEH_ROLL_CDN =4
  Then (2)  VS = VS_H = VS_FIL = VS_SENS
              = (C_DIAM_WHEEL / 2000) * N_WHEEL_RE_RI * 3.6
  Else (2)
    If    LV_ERR_VS_CAN =1
    Then  VS = VS_H = VS_FIL = VS_SENS = VS_SENS_GB
    Else  VS = VS_CAN * C_FAC_VS_COM1
              VS_H = VS_FIL = VS_SENS = WHEEL * C_FAC_VS_COM1
    Endif
#ELSE
  If    LV_ERR_VS_PLAUS = 1 // VS sensor error
  Then  VS = VS_FIL        VS_H = VS_FIL
  Else  VS = VS_SENS        VS_H = VS_SENS
  Endif
#ENDIF

If    VS ≥ C_VS_MIN_RUN
Then  LV_VS_RUN = 1
Else  LV_VS_RUN = 0
Endif

```

## 4.12.2 Filter of vehicle speed

### General information:

For the CAN signal WHEEL, a 1st order IIR filter is used for evaluating the vehicle speed for the CRU and the speed limitation. The jitter error of the input signal WHEEL is smaller than 1%. A jitters error smaller than 0.2% must be achieved for the control variable VS\_FIL with the filter. The frequency limit of the filter is approx.  $f_g = 0.80$  (Hz). Filtration of the speed signal is performed independently of the CRU mode with a 10ms time pattern.

### Application conditions:


**Initialisation:**            0 at reset

**Activation:**                LV\_VAR\_ASR = 1

**Deactivation:**              -

**Recurrence:**                10ms

### Function description:

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**Signal flow diagram:**

The structure of the filter is represented as follows:

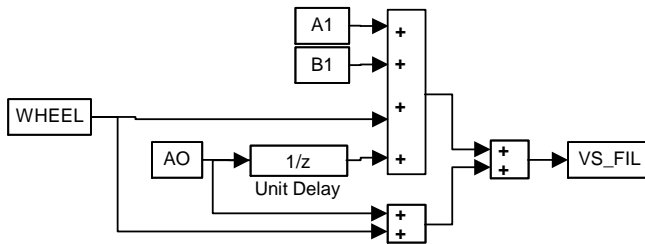


Figure 4.12.1:

$z^{-1}$  means a delay by one sampling time. The sampling time is  $T_{ab} = 10(\text{ms})$  and thus  $f_{ab} = 100 (\text{Hz})$ . At a quality  $Q = 1$ , the filter factors are calculated as:

**Formula section:**


$$A1 = A0 = \frac{1}{1 + W}; \quad B1 = -\frac{1 - W}{1 + W}; \quad \text{with } W = \frac{1}{\tan \frac{\pi}{Q}}; \quad W = C\_FAC\_VS\_FIL$$

Figure 4.12.2:

```
#IF (USE_L6 != ACTIVE) // Compiler switch to de-active VS-signal from Flexray
// Also means that LV_VAR_L6 = 0 switch to de-active VS-signal from Flexray
#THEN
    If LV_ERR_CAN_BOFF = 1 or
       LV_ERR_BN_VS_TCS = 1 or
       LV_ERR_TOUT_ASR_1 = 1
    Then
        VS_FIL = VS_SENS (converted)
    Else
        If LV_ERR_VS_CAN = 1
        Then
            T_ERR_VS_CAN decrements (Start value C_T_ERR_VS_CAN )
            If T_ERR_VS_CAN = 0
            Then
                VS_FIL = 0
            Else
                VS_FILn = VS_FILn-1
            Endif
        Else
            VS_FIL is calculated
            T_ERR_VS_CAN = 0
        Endif
    Endif
#Endif
```

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**4.12.3 Internal vehicle speed signal**

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**General information:**

A new edge is detected, if  $VS\_EDGE\_CTR\_AV_n \geq VS\_EDGE\_CTR\_AV_{n-10ms}$ . If  $(VS\_EDGE\_CTR\_AV_n - VS\_EDGE\_CTR\_AV_{n-x}) > C\_VS\_EDGE\_SUM\_MIN$  a new vehicle speed calculation is started. If during the time  $C\_T\_VST$  no changed edge is detected, the logical variable for stopped vehicle  $LV\_VST$  is set to 1 and  $VS\_SENS$  as well as  $VS\_SENS\_GRD$  are set to 0.

With the constant  $C\_VS\_FAC$  the adaption of the rolling circumference and the number of teeth per rotation is done.

**Application conditions:**

**Initialisation:**  
 $VS\_SENS = 0$   
 $VS\_SENS\_GRD = 0$   
 $LV\_VST = 1$

**Activation:**  
**#IF** (USE\_L6 != ACTIVE) //Compiler switch to de-active VS-signal from Flexray  
 // Also means that  $LV\_VAR\_L6 = 0$  switch to de-active VS-signal from Flexray

**Deactivation:** -

**Recurrence:** 10ms

**Function description:**

**Signal flow diagram:**

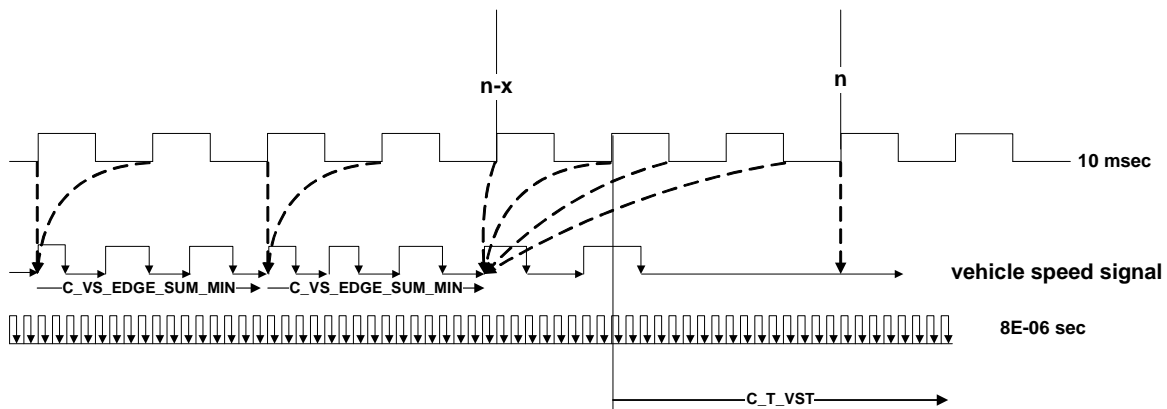



Figure 4.12.3:

**Formula section:**

$ACTION\_INFR\_GetVsPulsStamp(VS\_EDGE\_CTR\_AV, VS\_EDGE\_T\_AV, VS\_EDGE\_T\_AV\_MAX)$   
 $VS\_EDGE\_T\_AV\_DIF = VS\_EDGE\_T\_AV_n - VS\_EDGE\_T\_AV_{n-x}$

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```

IF VS_EDGE_T_AV_DIF < 0 // (Overflow)
THEN VS_EDGE_T_AV_DIF = VS_EDGE_T_AV_DIF + VS_EDGE_T_AV_MAX
ELSE VS_EDGE_T_AV_DIF = (VS_EDGE_T_AVn - VS_EDGE_T_AVn-x)
ENDIF

```

$C\_VS\_FAC = (\text{dynamic wheel circumference [m]} / (\text{number of teeth [-]}))$

$VS\_SENS = C\_VS\_FAC * (VS\_EDGE\_CTR\_AV_n - VS\_EDGE\_CTR\_AV_{n-x}) / VS\_EDGE\_T\_AV\_DIF$

$VS\_SENS\_GRD = (VS\_SENS_n - VS\_SENS_{n-x}) / VS\_EDGE\_T\_AV\_DIF$

#### 4.12.4 Internal vehicle speed signal by gearbox revolution speed sensor (only FlexRay)

##### General information:

This function is only for L6 (FlexRay) projects: Vehicle speed calculation using the gearbox output shaft revolution speed signal.

##### Application conditions:

**Initialisation:** VS\_SENS\_GB = 0

**Activation:** #IF (USE\_L6 == ACTIVE) // Compiler switch to active VS-signal from Flexray  
// Also means that LV\_VAR\_L6 = 1 switch to active VS-signal from Flexray

**Deactivation:** -

**Recurrence:** 10ms

##### Function description:

##### Formula section:

$VS\_SENS\_GB = (C\_VS\_GB * N\_GB\_OUT) / (RATIO\_RAX * 16666,7)$

C\_VS\_GB is the tire circumference in [mm]

#### 4.12.5 Error Handling

##### General information:

In case of an error in the vehicle speed the PID0D measured speed raw value should be updated. The relevant sensor errors can be selected using the calibration CLF\_VS\_SENS\_ERR.

##### Calibration Hint:

CLF_VS_SENS_ERR	Wheel sensor
1	Front left wheel
2	Front right wheel
4	Rear left wheel
8	Rear right wheel

### Application conditions:

**Initialisation:** VS\_SAE = 0

**Activation:** Always

**Deactivation:** Never

**Recurrence:** 10ms

### Function description:

### Formula section:

```

IF    LV_ERR_VS = 1 or
        (LV_ERR_N_WHEEL_FN_LE = 1 AND CLF_VS_SENS_ERR.bit0 = 1) OR
        (LV_ERR_N_WHEEL_FN_RI = 1 AND CLF_VS_SENS_ERR.bit1 = 1) OR
        (LV_ERR_N_WHEEL_RE_LE = 1 AND CLF_VS_SENS_ERR.bit2 = 1) OR
        (LV_ERR_N_WHEEL_RE_RI = 1 AND CLF_VS_SENS_ERR.bit3 = 1)
THEN  VS_SAE = FFH
ELSE  VS_SAE = VS
ENDIF

```

## 4.13 Distance counter

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DIST	O/V/S	00000000... H FFFFFFFFFH	0... 429496729500	-	m
Distance accumulation [100m]					
DIST_KWP	O/S	0... FFFFH	0... 524280	8	Km
Distance accumulation [8km]					

### Input data:

C_VS_FAC {p. 1177}	CTR_KM_CAN {p. 1563}	LV_ES {p. 1720}	VS_EDGE_CTR_AV {p. 1176}
--------------------	----------------------	-----------------	-----------------------------

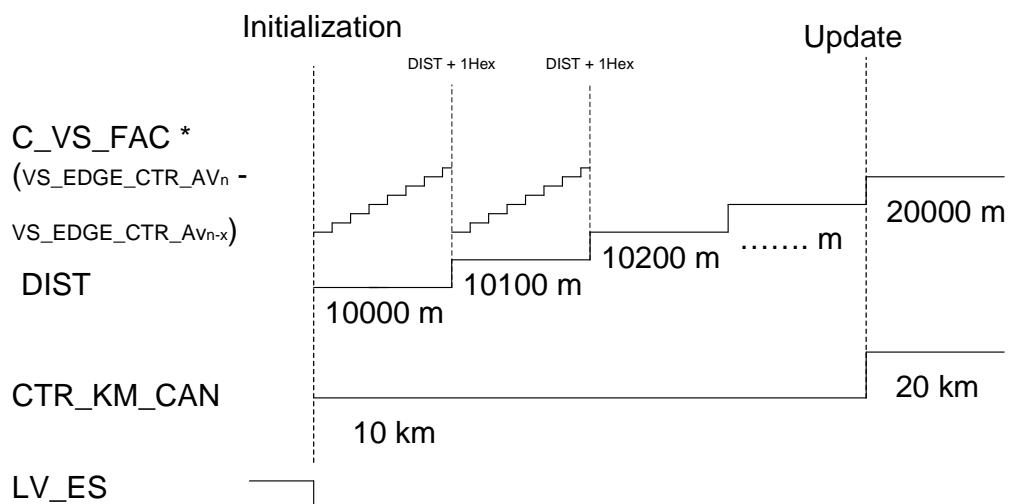
### FUNCTION DESCRIPTION:

#### General information:


This function is to accumulate the covered distance since the first vehicle start in resolution of 100m for EOBD propose. The information for updating of the calculation (CTR\_KM\_CAN, VS\_EDGE\_CTR\_AV) is sent by CAN.

#### Signal flow diagram:

## DIST calculation



### Application conditions

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**Initialisation:** *restored out of NVMY, first value = 0*  
**Recurrence:** *200ms*  
**Activation:** *LV\_ES = 0*

**Description:**

After activation DIST is restored out of NVMY and the calculation starts with ( C\_VS\_FAC \* VS\_EDGE\_CTR\_AVn - VS\_EDGE\_CTR\_AVn-x ) until DIST is incremented with 1Hex (100m).

This calculations is done until the next update of CTR\_KM\_CAN, then DIST is set to CTR\_KM\_CAN and the calculation starts from beginning.


If there is no update of CTR\_KM\_CAN (e.g. Timeout error), then the calculation remains active for this Driving cycle.

DIST\_KWP is calculated from DIST but different resolution for BMW diagnosis tool.

**Formula section:**

DIST: See signal flow diagramm  
 DIST\_KWP = DIST

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## 4.14 Battery voltage

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_VB_BN_DIAG	O/V	0... 1H	0 ...1	1	-
Boolean for battery voltage condition fulfilled for BN2000 diagnosis					
LV_CDN_VB_CAN_DIAG	O/V	0... 1H	0 ...1	1	-
Boolean for battery voltage condition fulfilled for CAN diagnosis					
LV_CDN_VB_CAN_TQ_DIAG	O/V	0... 1H	0 ...1	1	-
Boolean for battery voltage condition fulfilled for TQ_CAN-interfaces					
LV_CDN_VB_MIN_DIAG	O/V	0... 1H	0 ...1	1	-
Boolean for battery voltage condition fulfilled for remaining diagnosis					
LV_CDN_VB_OBD1	O/V	0... 1H	0 ...1	1	-
Boolean for battery voltage condition fulfilled for OBD diagnosis (=10V)					
LV_CDN_VB_OBD2	O/V	0... 1H	0 ...1	1	-
Boolean for battery voltage condition fulfilled for OBD-II diagnosis (=11V)					
LV_VB_JUMP	O/V	0... 1H	0 ...1	1	-
Logical value for detected overvoltage (jump start)					
V_IGK	O/V	0... FFH	0... 25.89843	0.1015625	V
Key - battery voltage					
VB	O/V	0... FFH	0... 25.89843	0.1015625	V
Relay - battery voltage					
VB_MMV	O/V	0... FFH	0... 25.89843	0.1015625	V
Moving mean value of battery voltage VB					
VB_SECU	V	0... FFH	0... 25.89843	0.1015625	V
Battery Voltage secured for dwell computation					

### Input data:

LV_IGK {p. 906}	V_IGK_MES {p. 847}	VB {p. 1185}	VB_MES {p. 845}
-----------------	--------------------	--------------	-----------------

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_VB	-	0... FFH	0... 0.99609	3.91e-3	-
Low pass filter correlation constant for VB_MMV					
C_T_MIN_CAN_DIAG	-	0... FFH	0... 2550	10	ms
VB-Time-condition for CAN diagnosis					
C_VB_MAX_OBD1	-	0... FFH	0... 25.89843	0.1015625	V
VB -threshold for maximum permissible battery voltage for OBD diagnosis					
C_VB_MAX_OBD2	-	0... FFH	0... 25.89843	0.1015625	V
VB -threshold for maximum permissible battery voltage for OBD2 diagnosis					
C_VB_MIN_BN_DIAG	-	0... FFH	0... 25.89843	0.1015625	V
Battery voltage threshold for BN2000 diagnosis					
C_VB_MIN_CAN_DIAG	-	0... FFH	0... 25.89843	0.1015625	V
Battery voltage threshold for CAN diagnosis					
C_VB_MIN_CAN_TQ_DIAG	-	0... FFH	0... 25.89843	0.1015625	V
Battery voltage threshold for CAN-TQ interface diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VB_MIN_DIAG	-	0... FFH	0... 25.89843	0.1015625	V
Battery voltage threshold for low voltage detection for remaining diagnosis					
C_VB_MIN_JUMP	-	0... FFH	0... 25.89843	0.1015625	V
VB -threshold for maximum permissible battery voltage					
C_VB_MIN_OBD1	-	0... FFH	0... 25.89843	0.1015625	V
VB -threshold for minimum permissible battery voltage for OBD diagnosis					
C_VB_MIN_OBD2	-	0... FFH	0... 25.89843	0.1015625	V
VB -threshold for minimum permissible battery voltage for OBD2 diagnosis					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_FAC_VB_RATIO	-	0... FFH	0... 1.99218	0.0078125	-
Factor to adapt the HEX-range to the range of 0 to 26 V					
NC_VB_SECU	-	0... FFH	0... 25.89843	0.1015625	V
Battery voltage offset (typical value = 1,02V)					

**4.14.1 Computation of VB****FUNCTION DESCRIPTION:****General information:**

The battery voltage (V\_IGK\_MES and VB\_MES (10 bit)) is measured up to 30V, 28V or 26V (means 0-5V at ADC), depending on the project-specific solution, but the range of VB (8 bit) remains 0-26 V. For the computation of VB in hex the correction factor NC\_FAC\_VB\_RATIO is necessary; its value depends on the project-specific battery voltage range. NC\_FAC\_VB\_RATIO is defined in the List of Configuration Datas . The following table shows how NC\_FAC\_VB\_RATIO is formed.

Measured battery voltage range (for example)	NC_FAC_VB_RATIO
0 ..... 26 V	26V / 26V
0 .. 28,8 V	28,8V / 26V
0 ..... 30 V	30V / 26V

**Application conditions**

**Activation:** *at reset*

**Initialisation:** VB = 0  
V\_IGK = 0


**Recurrence:** 10 ms

**Formula section:**

HEX calculation:

VB = (VB\_MES / 4) \* NC\_FAC\_VB\_RATIO

V\_IGK = (V\_IGK\_MES / 4) \* NC\_FAC\_VB\_RATIO

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VB relay:

```

If          VB_MES <= 26 Volt
Then       VB = (VB_MES / 4 ) * NC_FAC_VB_RATIO
Else       VB = 26 Volt           (FF hex)
Endif
    
```

VB key:

```

If          V_IGK_MES <= 26 Volt
Then       V_IGK = (V_IGK_MES / 4 ) * NC_FAC_VB_RATIO
Else       V_IGK = 26 Volt       (FF hex)
Endif
    
```

### 4.14.2 Secured battery voltage computation

#### Description:

A secured battery voltage value is a mix of VB and V\_IGK values which provides a safer battery voltage for functions especially in case of VB - relay wire to the ECU disconnection.

The accurate battery voltage value can be used for example for dwell computation in order to protect ignition coil and ECU ignition output stage against too long dwell time.

$VB\_SECU = \text{MAX}(VB, V\_IGK - NC\_VB\_SECU)$   
with  $VB\_SECU - NC\_VB\_SECU$  saturated to zero

### 4.14.3 Battery voltage conditions for diagnosis /jump start detection

#### FUNCTION DESCRIPTION:

#### General information:

Depending on VB there is a detection:

- Jump start
- Valid range for OBD1 diagnosis
- Valid range for OBD2 diagnosis
- Valid range for CAN diagnosis
- Valid range for BN2000 diagnosis
- Valid range for TQ-CAN interface diagnosis
- Valid range for remaining customer diagnosis


#### Application conditions

**Initialisation:**            *all 0*  
**Recurrence:**                *10ms*  
**Activation:**                 *at reset*

#### 4.14.3.1 Detection of overvoltage (Jump start)

#### Description:

The bit LV\_VB\_JUMP is used by functions which must not run when overvoltage is detected for example secondary air injection to prevent damages to the components.

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**Formula section:****Jump start detection:**

```

If           VB > C_VB_MIN_JUMP
Then        LV_VB_JUMP = 1
Else        LV_VB_JUMP = 0
Endif

```

**4.14.3.2 Battery voltage valid for OBD diagnosis****Description:**

Depending of OBD1/OBD2 there is a different flag for the valid VB range

**Formula section:****Valid range for OBD1 diagnosis:**

```

If           VB > C_VB_MIN_OBD1 and VB < C_VB_MAX_OBD1
Then        LV_CDN_VB_OBD1 = 1
Else        LV_CDN_VB_OBD1 = 0
Endif

```

**Valid range for OBD2 diagnosis:**

```

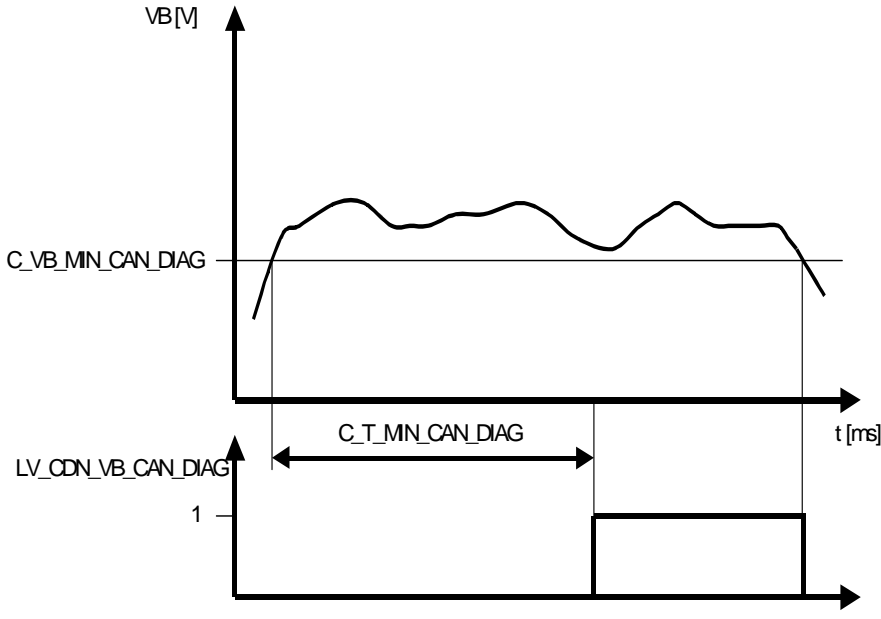
If           VB > C_VB_MIN_OBD2 and VB < C_VB_MAX_OBD2
Then        LV_CDN_VB_OBD2 = 1
Else        LV_CDN_VB_OBD2 = 0
Endif

```

**4.14.3.3 Minimum battery voltage detection for CAN diagnosis****Description:**

Due to low battery voltage CAN messages can be mutilated. So CAN timeout diagnosis is only done if battery voltage is valid for a minimum duration time.

**Signal flow diagram:**



**Formula section:**

Valid range for CAN diagnosis:

```

If      LV_IGK = 1      and
          VB > C_VB_MIN_CAN_DIAG      for
          time > C_T_MIN_CAN_DIAG
          (timer always started at every transition VB > C_VB_CAN_DIAG
           and at transition LV_IGK 0 -> 1)
Then   LV_CDN_VB_CAN_DIAG = 1
Else   LV_CDN_VB_CAN_DIAG = 0
Endif
    
```

**4.14.3.4 Minimum battery voltage detection for BN2000 diagnosis**

**Description:**

Due to low battery voltage BN2000 messages can be mutilated. So BN2000 timeout diagnosis is only done if battery voltage is valid for a minimum duration time.

**Signal flow diagram:**


**Formula section:**

Valid range for BN2000 diagnosis:

```

If      LV_IGK = 1      and
          VB > C_VB_MIN_BN_DIAG      for
          time > C_T_MIN_CAN_DIAG
          (timer always started at every transition VB > C_VB_BN_DIAG)
    
```

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```

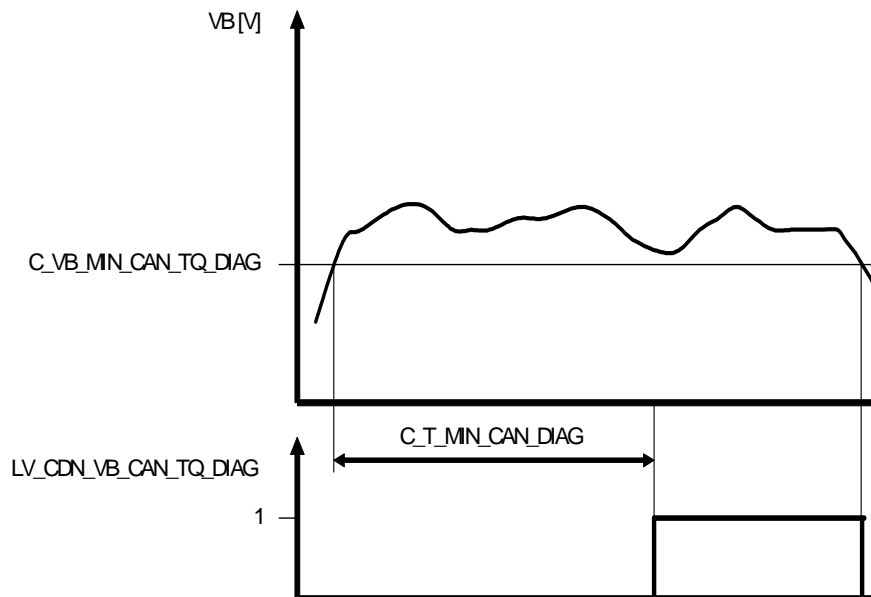
                and at transition LV_IGK 0 -> 1)
    Then        LV_CDN_VB_BN_DIAG = 1
    Else        LV_CDN_VB_BN_DIAG = 0
    Endif
    
```

#### 4.14.3.5 Minimum battery voltage detection for TQ\_CAN-interfaces

##### Description:

Due to low battery voltage CAN messages can be mutilated. So the TQ\_CAN-interfaces should only be enabled if battery voltage is valid for a minimum duration time.

##### Signal flow diagram:



##### Formula section:

Valid range for BN2000 diagnosis:

```

    If          LV_IGK = 1          and          for
                VB > C_VB_MIN_CAN_TQ_DIAG
                time > C_T_MIN_CAN_DIAG
                (timer always started at every transition VB > C_VB_MIN_CAN_TQ_DIAG
                 and at transition LV_IGK 0 -> 1)
    Then        LV_CDN_VB_CAN_TQ_DIAG = 1
    Else        LV_CDN_VB_CAN_TQ_DIAG = 0
    Endif
    
```

#### 4.14.3.6 Minimum Battery Voltage Detection for non OBD Diagnosis

**Description:**

The remaining diagnosis functions which are not covered by the above mentioned conditions are disabled below a separate threshold, which should be lower as OBD1/2 and CAN.

**Formula section:**

Valid range for non OBD diagnosis:

```

If                VB < C_VB_MIN_DIAG      or
                   LV_IGK = 0
Then             LV_CDN_VB_MIN_DIAG = 0
Else             LV_CDN_VB_MIN_DIAG = 1
Endif

```

**4.14.4 Moving average value for battery voltage**

A moving average value VB\_MMV is used in the chapter Engine speed setpoint calculation to define a minimum N\_SP\_IS in dependence of the battery voltage:

**Application conditions**

```

Activation:      at reset
Initialization: VB_MMV = 14 V
Recurrence:     10 ms

```

**Formula section:**

$$VB\_MMV_k = VB\_MMV_{k-1} + (VB_k - VB\_MMV_{k-1}) \cdot C\_CRLC\_VB.$$

## 4.15 Air mass flow sensor variables

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_MAF_PULS	O/V	0... 1H	0 ...1	1	-
Boolean for pulsation present					
MAF_KGH_MES	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Corrected mass air flow, measured per segment					
MAF_KGH_MES_BAS	O	0... FFFFH	0... 2047.96875	0.03125	kg/h
Raw air-mass flow measured (without correction, to be used for diagnosis only)					
MAF_KGH_MES_BAS_TCHA [NC_MAF_SENS_CONF]	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Raw air-mass flow up turbo charger measured (without correction, to be used for diagnosis only)					
MAF_KGH_MES_TCHA [NC_MAF_SENS_CONF]	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
corrected mass air flow up turbo charger, measured per segment					
MAF_MES	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Air-mass flow per segment					

### Input data:

LV_IGK {p. 906}	LV_VAR_TCHA {p. 656}	MAF {p. 8277}	MAF_FRQ_KGH_MES [NC_MAF_NR] {p. 834}
N {p. 1525}	NC_MAF_FAC_CYL {p. 2889}	PQ_SP {p. 8278}	STATE_ENG {p. 1720}
TIA {p. 1226}	TIA_TCHA {p. 1226}		


### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_PQ_SP_HYS_PULS	-	0... FFFFH	0... 0.99998	15.3e-6	-
Hysteresis for PQ-threshold for LV_MAF_PULS					
IP_FAC_MAF_KGH_COR	V	0... FFH	0... 1.99218	0.0078125	-
LDP_MAF_KGH_MES_BAS	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_TIA_IP_FAC_MAF_KGH_COR	6	0... FEH	-48... 142.5	0.75	°C
Correction for MAF_KGH_MES depending on raw signal and on intake air temperature					
IP_FAC_MAF_KGH_COR_FRQ	V	0... FFH	0... 1.99218	0.0078125	-
LDP_MAF_KGH_MES_BAS_TCHA_0	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_TIA_TCHA_IP_MAF_KGH_COR_FRQ	6	0... FEH	-48... 142.5	0.75	°C
Correction for MAF_KGH_MES_TCHA[0] depending on raw signal and on intake air temperature					
IP_PQ_SP_PULS	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_N_PQ_SP_PULS	6	0... 1FE0H	0... 8160	1	rpm
PQ-threshold for LV_MAF_PULS					

### 4.15.1 Air-mass flow acquisition MAF\_KGH\_MES

#### FUNCTION DESCRIPTION:

#### General information:

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For non turbo variant (N53) a frequency MAF sensor is used. For turbo variant (N54) a frequency MAF sensor (index [0]) is used. The analog MAF sensor (index [1]) is no longer used.

Frequency sensor: A correction is possible in order to take into consideration deviations of the measured mass air flow due to different installations of the air mass meter. This correction factor is dependant from MAF\_KGH\_MES\_BAS itself and of the air temperature.

### Application conditions

**Initialisation:** all 0 at reset **or** LV\_IGK 0->1

**Recurrence:** at STATE\_ENG: ST, IS, PL, PU and PUC segment synchronous  
at STATE\_ENG: ES  
1s

**Activation:** at all STATE\_ENG

**Deactivation:** -

### Formula section:

```

if      LV_VAR_TCHA = 0
then    // evaluation of frequency MAF sensor (N53)
          MAF_KGH_MES_BAS = MAF_FRQ_KGH_MES[0]
          MAF_KGH_MES = MAF_KGH_MES_BAS *
                    IP_FAC_MAF_KGH_COR(MAF_KGH_MES_BAS, TIA)
else    // evaluation of frequency MAF sensor (N54)
          MAF_KGH_MES_BAS = (MAF * N) / NC_MAF_FAC_CYL
          MAF_KGH_MES = MAF_KGH_MES_BAS
          MAF_KGH_MES_BAS_TCHA[0] = MAF_FRQ_KGH_MES[0]
          MAF_KGH_MES_TCHA[0] = MAF_KGH_MES_BAS_TCHA[0] *
                    IP_FAC_MAF_KGH_COR_FRQ(MAF_KGH_MES_BAS_TCHA[0], TIA_TCHA)
          // satisfaction layer interface of earlier analog MAF sensor (N54)//
          MAF_KGH_MES_TCHA[1] = 0
          MAF_KGH_MES_BAS_TCHA[1] = 0
endif

```

## 4.15.2 Air-mass Flow Acquisition MAF\_MES

### FUNCTION DESCRIPTION:


#### General information:

The air-mass MAF\_MES in mg/stroke is calculated from the measured air-mass flow MAF\_KGH\_MES and the engine speed N. The non calibratable constant NC\_MAF\_FAC\_CYL is inversly proportional to the number of cylinders, so the output MAF\_MES depends on the number of cylinders.

### Application conditions

**Initialisation:** all 0 at reset **or** LV\_IGK 0->1

**Recurrence:** at STATE\_ENG: ST, IS, PL, PU and PUC segment synchronous  
at STATE\_ENG: ES  
1s

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*Activation:* at all STATE\_ENG

*Deactivation:* -

#### Formula section:

**If** N = 0  
**Then** MAF\_MES = 0

**Else**  $MAF\_MES = \frac{MAF\_KGH\_MES}{N} * NC\_MAF\_FAC\_CYL$

**Endif**

### 4.15.3 Fade out of Mass Airflow Sensor

#### FUNCTION DESCRIPTION:

#### General information:

It is possible, that in some operating points of an engine the MAF sensor is unable to deliver the correct MAF value. Those operating points are displayed by LV\_MAF\_PULS = 1. This state will result in switching off the MAF feedback loop of the intake manifold model, so the load determination will be done like -/N-control.

#### Application conditions

**Initialisation:** all 0 at reset **or** LV\_IGK 0->1

**Recurrence:** at STATE\_ENG: ST, IS, PL, PU and PUC segment synchronous  
 at STATE\_ENG: ES  
 1s

*Activation:* at all STATE\_ENG

*Deactivation:* -

#### Formula section:

**If** PQ\_SP > IP\_PQ\_SP\_PULS  
**Then** LV\_MAF\_PULS = 1  
**Else** **If** PQ\_SP < IP\_PQ\_SP\_PULS - C\_PQ\_SP\_HYS\_PULS  
     **Then** LV\_MAF\_PULS = 0  
     **Else** LV\_MAF\_PULS remains unchanged  
**Endif**

**Endif**

## 4.16 Air mass flow variables

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MAF_DIF	O/V	8000... 7FFFH	-694.51059 ...694.4894	21.2e-3	mg/stk
Mass air flow difference per segment					
MAF_KGH	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Air-mass flow per segment in kg/h					
MAF_MMV	O/V	0... FFFFH	0... 1389	21.2e-3	mg/stk
MAF moving mean value					

### Input data:

LV_CLC_2SEG {p. 1825}	LV_CLC_2SEG_ENA {p. 1825}	LV_MAF_CONF	LV_MAF_CTL {p. 1211}
LV_MAP_CONF	LV_MAP_CTL	MAF {p. 8277}	MAF_KGH_FG_PRED {p. 8278}
MAF_KGH_MES {p. 1192}	MAF_MDL_MV {p. 8278}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_MMV_DIF_CRLC	-	0... FFH	0... 0.99609	3.91e-3	-
MAF moving mean value filtering factor					
C_MAF_MMV_HYS	-	0... 7FFFH	0... 694.4788	21.2e-3	mg/stk
Threshold for detecting raising MAF_MMV					

### Application conditions

**Initialisation:** *all outputs phys. 0 at reset*

**Recurrence:** *segment synchronous*

**Activation:** *LV\_CLC\_2SEG = 0*

**Deactivation:** *LV\_CLC\_2SEG = 1*

#### 4.16.1 Air-mass flow MAF\_KGH

### FUNCTION DESCRIPTION:

#### General information:


Depending on system configuration the air-mass flow MAF\_KGH is calculated. If no air-mass sensor is available or if the sensor diagnosis rejects the measured value (e.g. due to pulsation), a substitution value is assigned to MAF\_KGH.

#### Formula section:

```

if ( LV_MAF_CONF = 1 )      then
  if ( LV_MAF_CTL = 1 )    then
    MAF_KGH = MAF_KGH_MES

```

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```

else
  if ( LV_MAP_CONF = 1 ) then
    if ( LV_MAP_CTL = 1 ) then
      MAF_KGH = MAF_KGH_FG_PRED
    else
      MAF_KGH = MAF_MDL_MV
    endif
  else
    MAF_KGH = MAF_MDL_MV
  endif
endif
else
  MAF_KGH = MAF_KGH_FG_PRED
endif

```

## 4.16.2 Air-mass flow difference between two segments

### FUNCTION DESCRIPTION:

#### General information:

This function calculates the difference air-mass flow between two consecutive segments MAF\_DIF.

#### Formula section:

```

if LV_CLC_2SEG_ENA = 0
then MAF_DIF = MAFn - MAFn-1
else MAF_DIF = * (MAFn - MAFn-1)
endif

```

## 4.16.3 Air mass difference for rapidly falling load (MAF\_MMV )

### FUNCTION DESCRIPTION:

#### General information:

In the case of rapidly falling load, the transition to (LV\_PUC) can be accelerated in order to avoid an engine speed run-up, which is undesirable.


To trigger this function (see the following chapters: ignition, ignition angle correction for trailing throttle) some load conditions have to be fulfilled. For this reason, the value MAF\_MMV is calculated every segment from the corrected air mass MAF.

#### Formula section:

```

if MAF_DIF > C_MAF_MMV_HYS ( MAF_MMV for increasing air mass )
then MAF_MMV = MAF
else ( MAF_MMV for decreasing air mass )
  if LV_CLC_2SEG_ENA = 0
  then MAF_MMV = MAF_MMV + (MAF - MAF_MMV) * C_MAF_MMV_DIF_CRLC


```

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```

else           MAF_MMV = MAF_MMV + (MAF - MAF_MMV) * C_MAF_MMV_DIF_CRLC * 2
endif
endif

```

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## 4.17 Manifold air pressure sensor variables

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_MAP_SEG	O/V	0... 1H	0 ...1	1	-
Event segment, used to switch buffer					
LV_T_DLY_MAP_MES_AD	V	0... 1H	0 ...1	1	-
Logical value delay time for manifold evacuation is over					
MAP_DIP_MES_2SEG	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Intake manifold differential pressure mean value over two segments, model value in case of sensor error					
MAP_DIP_MES_BAS	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Intake manifold pressure per segment measured (differential pressure)					
MAP_DIP_MES_BAS_2SEG	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Intake manifold pressure per second segment measured (differential pressure)					
MAP_MES	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Intake manifold pressure per segment measured					
MAP_MES_BAS	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Intake manifold pressure per segment measured (raw value)					
MAP_MES_BAS_2SEG	V	0... FFFFH	0... 5434	0.0829175	hPa
Intake manifold pressure per second segment measured					
MAP_SAE	O/V	0... FFH	0... 255	1	kPa
Intake manifold pressure raw value for OBD					
PUT_MES_BAS	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Intake manifold pressure up throttle per segment measured					
PUT_MES_BAS_2SEG	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Intake manifold pressure up throttle per second segment measured					
TEMP_MAP_DIP_MDL	V	0... FEH	-48... 142.5	0.75	°C
Estimated temperature of manifold pressure sensor					
V_MAP	O/V	0... 400H	0 ...5	4.8828e-3	V
Voltage of the intake manifold pressure sensor (for diagnosis)					
V_MAP_AD	O/V/S	FE00... 200H	-2.5 ...2.5	4.8828e-3	V
Adapted voltage offset of manifold pressure sensor					
V_MAP_DIF	O/V	FE00... 200H	-2.5 ...2.5	4.8828e-3	V
Deviation to nominal output at differential pressure 0					
V_MAP_DIF_VLD	O/V	FE00... 200H	-2.5 ...2.5	4.8828e-3	V
Allowed sensor output deviation at differential pressure 0					
V_PUT	O/V	0... 400H	0 ...5	4.8828e-3	V
Voltage of the intake manifold pressure sensor up throttle					

### Input data:

AMP {p. 982}	ECU_STATE {p. 1091}	LV_ERR_MAP_DIP_SENS {p. 4824}	LV_ERR_PUT_EL {p. 4828}
LV_ES {p. 1720}	LV_VAR_TCHA {p. 656}	MAP {p. 8278}	MAP_CTR {p. 843}
MAP_CTR_1 {p. 843}	MAP_SUM_1 {p. 843}	N_32 {p. 1525}	PUT {p. 1209}
PUT_CTR {p. 843}	PUT_CTR_1 {p. 843}	PUT_SUM {p. 843}	PUT_SUM_1 {p. 843}
TAM {p. 1579}	TCO {p. 1100}	TCO_EX {p. 1045}	TIA {p. 1226}
TPS_AV {p. 1169}	VS_FIL {p. 1176}		


**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TEMP_MAP_DIP_TAM	-	0... FFH	0... 0.99609	3.9063e-3	-
Factor for TAM correction for MAP_DIP temperature model					
C_FAC_TEMP_MAP_DIP_TCO_EX	-	0... FFH	0... 0.99609	3.9063e-3	-
Factor for TCO_EX correction for MAP_DIP temperature model					
C_FAC_TEMP_MAP_DIP_TIA	-	0... FFH	0... 0.99609	3.9063e-3	-
Factor for TIA correction for MAP_DIP temperature model					
C_FAC_TEMP_V_MAP_AD	-	0... FFH	0... 0.99609	3.9063e-3	-
Factor on adaptation part at irregular temperature condition					
C_FAC_TEMP_V_MAP_SP_DIF_MAX	-	0... FFH	0... 1.99218	0.0078125	-
Factor on allowed sensor output deviation at stopped engine at irregular temperature condition					
C_FAC_V_MAP_AD	-	0... FFH	0... 0.99609	3.9063e-3	-
Part of sensor output deviation at stopped engine used for sensor characteristic adaptation					
C_N_MAP_PUT_CLC_SWI	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for switching between time and segment synchronous calculation					
C_NR_V_MAP_ACQ	-	0... FFH	0... 255	1	-
Number of acquisitions to build the mean value V_MAP_MV					
C_T_DLY_MAP_MES_AD	-	0... 3FFH	0... 10.23	0.01	s
Delay time after LV_ES detection before starting adaptation of sensor characteristic					
C_TEMP_MAP_DIP_MDL_FAC_MAX	-	0... FEH	-48... 142.5	0.75	°C
Upper TEMP_MAP_DIP_MDL temperature threshold to switch adaptation/diagnosis values					
C_TEMP_MAP_DIP_MDL_FAC_MIN	-	0... FEH	-48... 142.5	0.75	°C
Lower TEMP_MAP_DIP_MDL temperature threshold to switch adaptation/diagnosis values					
C_TPS_V_MAP_AD_MIN	-	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Minimum TPS to enable V_MAP adaptation					
C_V_MAP_AD_MAX	-	0... 200H	0... 2.5	4.8828e-3	V
Maximum absolute value of adapted voltage offset of manifold pressure sensor					
C_V_MAP_SP_AD	-	0... 200H	0... 2.5	4.8828e-3	V
Setpoint of MAP sensor output at stopped engine					
C_V_MAP_SP_DIF_MAX	-	FE00... 200H	-2.5 ...2.5	4.8828e-3	V
Allowed sensor output deviation at stopped engine at regular temperature condition					
IP_MAP_MES_BAS	-	0... FFFFH	0... 5434	0.0829175	hPa
LDP_V_MAP_MAP_MES_BAS	2	0... 400H	0 ...5	4.8828e-3	V
Conversion characteristic for MAP_DIP_MES_BAS					
IP_PUT_MES_BAS	-	0... FFFFH	0... 5434	0.0829175	hPa
LDP_V_PUT_PUT_MES_BAS	2	0... 400H	0 ...5	4.8828e-3	V
Conversion characteristic for PUT_MES_BAS					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_MAP_ABSV_REL_SWI	-	0... 1H	0 ...1	1	-
Switch for Calculation MAP_DIP_MES_BAS with measured absolute (1) or relative pressure (0)					
LC_PUT_ABSV_REL_SWI	-	0... 1H	0 ...1	1	-
Switch for Calculation PUT_MES_BAS with measured absolute (1) or relative pressure (0)					

**FUNCTION DESCRIPTION:****General information:**

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The raw value (voltage) MAP\_BAS (PUT\_BAS) is measured every 1 ms. The values (10 bit) are summed up in two alternating buffers, MAP\_SUM or MAP\_SUM\_1 (PUT\_SUM or PUT\_SUM\_1). The number of the values are counted in comparable buffers MAP\_CTR or MAP\_CTR\_1 (PUT\_CTR or PUT\_CTR\_1). This mechanism is necessary to synchronize the measurement and the calculation of MAP\_DIP\_MES\_BAS resp. PUT\_MES\_BAS (build mean value with a standardized range)

Depending on the logical variable LV\_MAP\_SEG one of the two buffers — MAP\_SUM or MAP\_SUM\_1 (PUT\_SUM or PUT\_SUM\_1) — and the respective counter — MAP\_CTR or MAP\_CTR\_1 (PUT\_CTR or PUT\_CTR\_1) — are selected for writing, the contents of the other buffer (counter) is used for calculations and diagnosis (after this buffer and the corresponding counter have been read they are cleared).

To avoid pressure sensor diagnosis errors during initialization of the ECU, the first measured value is mirrored from buffer MAP\_SUM into MAP\_SUM\_1 resp. PUT\_SUM into PUT\_SUM\_1 (also the counters). This ensures, that the sensor diagnosis gets reasonable values and doesn't detect a bad sensor due to zero values in the buffer.

MAP\_DIP/PUT\_MES\_BAS\_2SEG is introduced to get a smooth signal of MAP\_DIP\_MES\_BAS (filtering of possibly occurring pulsation of pressure).

### Signal flow diagram:

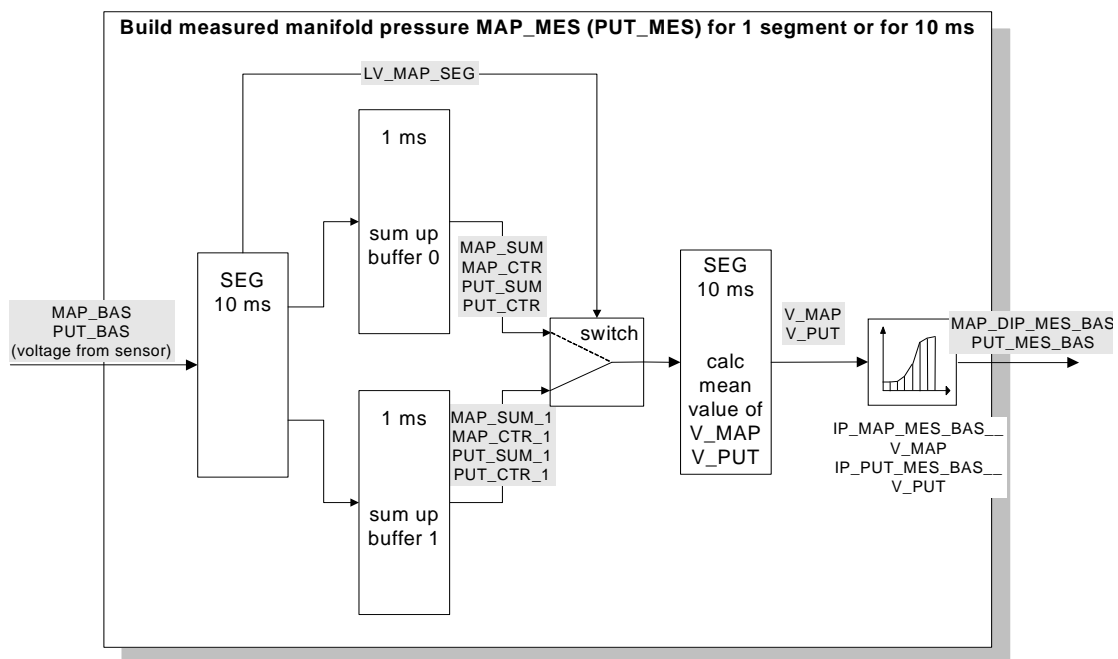


Figure 4.17.1: Signal flow during acquisition of manifold pressure MAP\_DIP\_MES\_BAS, PUT\_MES\_BAS

### Description:

The application SW toggles LV\_MAP\_SEG either at a period of 10 ms ( $N_{32} < C_{N\_MAP\_PUT\_CLC\_SWI}$ ) or at each segment ( $N_{32} \geq C_{N\_MAP\_PUT\_CLC\_SWI}$ ).

Because there are used two different MAP-sensors for pressure acquisition (relativ and absolute sensors) it is necessary to calculate the absolute value as input variable for the intake manifold modell.

### Application conditions

Initialisation: all: 0

except:



```

MAP_MES_BAS = AMP //
AMP must be initialized before MAP_MES_BAS_2SEG =
AMP // AMP must be initialized before
MAP_MES = AMP // AMP must be initialized
before

```

**Recurrence:** at N\_32 < C\_N\_MAP\_PUT\_CLC\_SWI all: 10ms  
at N\_32 >= C\_N\_MAP\_PUT\_CLC\_SWI all: segment

**Activation:** at every engine state

**Deactivation:** -

### Formula section:

Calculation of V\_MAP:

**If** LV\_MAP\_SEG = 1 **and**  
MAP\_CTR > 0

**Then**  $V\_MAP = \frac{MAP\_SUM}{MAP\_CTR} - V\_MAP\_AD$

**Else**

**If** LV\_MAP\_SEG = 0 **and**  
MAP\_CTR\_1 > 0

**Then**  $V\_MAP = \frac{MAP\_SUM\_1}{MAP\_CTR\_1} - V\_MAP\_AD$

**Endif**

**Endif**

Calculation of V\_MAP\_1:

**If** MAP\_CTR = 0 **and**  
MAP\_CTR\_1 = 0

**Then**  $V\_MAP\_1_n = V\_MAP\_1_{n-1}$

**Else**

**If** V\_MAP > 0

**Then**  $V\_MAP\_1 = \frac{(MAP\_SUM + MAP\_SUM\_1)}{(MAP\_CTR + MAP\_CTR\_1)} - V\_MAP\_AD$

**Else** V\_MAP\_1 = 0


**Endif**

**Endif**

If the selected counter is zero V\_MAP(\_1) and MAP(\_DIP)\_MES\_BAS(\_2SEG) remain unchanged.

Calculation of MAP\_MES\_BAS(\_2SEG) and MAP\_DIP\_MES\_BAS(\_2SEG):

V\_MAP (unit: V) has to be converted in MAP(\_DIP)\_MES\_BAS(\_2SEG) (unit: hPa)

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```

if LC_MAP_ABSV_REL_SWI = 1
then      (N54)
    MAP_MES_BAS = IP_MAP_MES_BAS(V_MAP)
    MAP_MES_BAS_2SEG = IP_MAP_MES_BAS(V_MAP_1)
    MAP_DIP_MES_BAS = AMP - MAP_MES_BAS
    MAP_DIP_MES_BAS_2SEG = AMP - MAP_MES_BAS_2SEG
else      (N53)
    MAP_DIP_MES_BAS = IP_MAP_MES_BAS(V_MAP)
    MAP_DIP_MES_BAS_2SEG = IP_MAP_MES_BAS(V_MAP_1)
    MAP_MES_BAS = AMP - MAP_DIP_MES_BAS
    MAP_MES_BAS_2SEG = AMP - MAP_DIP_MES_BAS_2SEG
endif
if      LV_ERR_MAP_DIP_SENS = 0
then    MAP_MES = MAP_MES_BAS
    MAP_DIP_MES_2SEG = MAP_DIP_MES_BAS_2SEG
else    MAP_MES = MAP      (model value)
    MAP_DIP_MES_2SEG = AMP - MAP (model value)
endif

```

Calculation of OBD relevant MAP\_SAE:

```
MAP_SAE = IP_MAP_MES_BAS(V_MAP)           //Conversion must be done in physical way
```

**Additional variables for LV\_VAR\_TCHA = 1 (turbo)**

Calculation of V\_PUT:

```

if      LV_MAP_SEG = 1           and
    PUT_CTR > 0

```

```

Then    V_PUT =  $\frac{PUT\_SUM}{PUT\_CTR}$ 

```

```

Else
    if      LV_MAP_SEG = 0           and
        PUT_CTR_1 > 0

```

```

Then    V_PUT =  $\frac{PUT\_SUM\_1}{PUT\_CTR\_1}$ 

```

**Endif**

**Endif**

If the selected counter is zero V\_PUT and PUT\_MES\_BAS stay unchanged.


Calculation of PUT\_MES\_BAS:

V\_PUT (unit: V) has to be converted in PUT\_MES\_BAS (unit: hPa)

```

if      LV_ERR_PUT_EL = 0

```

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```

Then      if      LC_PUT_ABSV_REL_SWI =1
           then    PUT_MES_BAS = IP_PUT_MES_BAS
           else    PUT_MES_BAS = AMP - IP_PUT_MES_BAS
           endif

```

```

Else      PUT_MES_BAS = PUT          (calculated from Model)
Endif

```

Calculation of V\_PUT\_1:

```

If        PUT_CTR = 0                and
           PUT_CTR_1 = 0

```

```

Then      V_PUT_1n = V_PUT_1n-1

```

```

Else

```

```

    If      V_PUT > 0

```

```

        Then      V_PUT_1 = (PUT_SUM + PUT_SUM_1) /
                           (PUT_CTR + PUT_CTR_1)

```

```

    Else      V_PUT_1 = 0

```

```

    Endif

```

```

Endif

```

Calculation of PUT\_MES\_BAS\_2SEG:

V\_PUT\_1 (unit: V) has to be converted into PUT\_MES\_BAS\_2SEG (unit: hPa)

```

If        LV_ERR_PUT_EL = 0

```

```

Then      if      LC_PUT_ABSV_REL_SWI = 1
           then    PUT_MES_BAS_2SEG = IP_PUT_MES_BAS
           else    PUT_MES_BAS_2SEG = AMP - IP_PUT_MES_BAS
           endif

```

```

Else      PUT_MES_BAS_2SEG = PUT          (calc. from Model)

```

```

Endif

```

### 4.17.1 Adaptation of sensor characteristic

#### FUNCTION DESCRIPTION:

#### General information:


If MAP is evaluated from a differential pressure sensor (MAP\_DIP), the sensor characteristic can be adapted due to the known differential pressure (0 hPa) when the engine doesn't run.

#### Application conditions

```

Initialisation:      V_MAP_AD from nonvolatile memory or = 0 V in case of memory
                    error or when the NVMY is reset
                    CTR_NR_V_MAP_ACQ = 0
                    LV_V_MAP_ACQ = 0

```

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```

T_DLY_MAP_MES_AD = 0
LV_T_DLY_MAP_MES_AD = 0
TEMP_MAP_DIP_MDL = TCO

```

```

V_MAP_SUM = 0 V
V_MAP_DIF = 0 V
V_MAP_DIF_VLD = C_V_MAP_SP_DIF_MAX

```

**Recurrence:**

```

10 ms
except TEMP_MAP_DIP_MDL : 500 ms

```

**Activation:**

```

ECU_STATE = PWL
LC_MAP_ABSV_REL_SWI = 0

```

```

TPS_AV ≥ C_TPS_V_MAP_AD_MIN
can be evacuated
VS_FIL = 0

```

**Deactivation:**

```

!Activation

```

**Formula section:**Estimation of MAP\_DIP sensor temperature

Done only as long as LV\_V\_MAP\_ACQ = 0 , every 500 ms

$$\text{TEMP\_MAP\_DIP\_MDL} = (((((\text{TCO} - \text{TCO\_EX}) * \text{C\_FAC\_TEMP\_MAP\_DIP\_TCO\_EX} + \text{TCO\_EX}) - \text{TIA}) * \text{C\_FAC\_TEMP\_MAP\_DIP\_TIA} + \text{TIA}) - \text{TAM}) * \text{C\_FAC\_TEMP\_MAP\_DIP\_TAM} + \text{TAM})$$

The following formulas are processed each recurrence in the same sequence as described here.

Delay collection of measurements until the manifold is evacuated

Done only as long as LV\_T\_DLY\_MAP\_MES\_AD = 0

```

if T_DLY_MAP_MES_AD < C_T_DLY_MAP_MES_AD
  then T_DLY_MAP_MES_AD++ //incremented by 10 ms
  else LV_T_DLY_MAP_MES_AD = 1
endif

```

Evaluation of a mean sensor output and of deviation to nominal output at differential pressure 0

Done only as long as LV\_V\_MAP\_ACQ = 0 **and** LV\_T\_DLY\_MAP\_MES\_AD = 1

```

if CTR_NR_V_MAP_ACQ < C_NR_V_MAP_ACQ
  then CTR_NR_V_MAP_ACQ++
        V_MAP_SUMn = V_MAP_SUMn-1 + V_MAP
  else V_MAP_MV = V_MAP_SUMn-1 / C_NR_V_MAP_ACQ
        V_MAP_DIF = V_MAP_MV - C_V_MAP_SP_AD
        LV_V_MAP_ACQ = 1
endif

```

Evaluation of allowed deviation and of the factor for the adaptation

Done only if LV\_V\_MAP\_ACQ = 1

```

if TEMP_MAP_DIP_MDL ≥ C_TEMP_MAP_DIP_MDL_FAC_MIN
    TEMP_MAP_DIP_MDL ≤ C_TEMP_MAP_DIP_MDL_FAC_MAX

```

```

then    V_MAP_DIF_VLD = C_V_MAP_SP_DIF_MAX
          FAC_V_MAP_AD = C_FAC_V_MAP_AD
else    V_MAP_DIF_VLD = C_V_MAP_SP_DIF_MAX *
          C_FAC_TEMP_V_MAP_SP_DIF_MAX
          FAC_V_MAP_AD = C_FAC_V_MAP_AD * C_FAC_TEMP_V_MAP_AD

```

**endif**

Calculation of the sensor characteristic adaptation value (voltage offset)


Done only if LV\_V\_MAP\_ACQ = 1

```

if    |V_MAP_DIF| ≤ V_MAP_DIF_VLD
then    V_MAP_AD = V_MAP_AD(old) + V_MAP_DIF * FAC_V_MAP_AD
          LV_V_MAP_ACQ = 0           //enables next adaptation loop
          CTR_NR_V_MAP_ACQ = 0
          V_MAP_SUM = 0
if    V_MAP_AD > C_V_MAP_AD_MAX
then    V_MAP_AD = C_V_MAP_AD_MAX
else
if    V_MAP_AD < -1 * C_V_MAP_AD_MAX
then    V_MAP_AD = -1 * C_V_MAP_AD_MAX
endif
endif

```

**endif**

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## 4.18 Volumetric efficiency

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_VOL_TEMP_COR	V	0... FFFFH	0... 1.99996	30.5e-6	-
Volumetric efficiency correction factor due to temperature effects					
EFF_VOL_TEMP_COR_MMV	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Filtered volumetric efficiency correction factor due to temperature effects					

### Input data:

LV_CLC_2SEG {p. 1825}	LV_CLC_2SEG_ENA {p. 1825}	MAF {p. 8277}	N_32 {p. 1525}
TCO {p. 1100}	TIA_IM {p. 984}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_STND	-	0... FEH	-48... 142.5	0.75	°C
Standard coolant temperature					
C_TCYL_STND	-	0... FEH	-48... 142.5	0.75	°C
Standard temperature in the cylinder					
C_TIA_IM_STND	-	0... FEH	-48... 142.5	0.75	°C
Standard intake air temperature					
IP_CRLC_EFF_VOL_TEMP_COR	-	0... FFH	0... 0.99609	3.91e-3	-
LDP_N_32_IP_CRLC_EFF_VOL_TEMP	6	0... FFH	0... 8160	32	rpm
Filter constant for volumetric efficiency correction					
IP_EFF_TCO_FAC_N_32_MAF	V	0... FFH	0... 0.99609	3.91e-3	-
LDPM_N_32_EFF_VOL_COR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF__EFF_VOL_COR	8	0... FFFFH	0... 1389	21.2e-3	mg/stk
Volumetric efficiency weighting factor versus cooling temperature					
IP_EFF_TIA_IM_FAC_N_32_MAF	V	0... FFH	0... 0.99609	3.91e-3	-
LDPM_N_32_EFF_VOL_COR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF__EFF_VOL_COR	8	0... FFFFH	0... 1389	21.2e-3	mg/stk
Volumetric efficiency weighting factor versus intake manifold gas temperature					

### General information:

Target of the temperature correction function is, to compensate the temperature influences onto the volumetric efficiency calculation. The air-mass flow into the cylinder is the product of the volume flow and the density of the air  $\dot{m} = A \cdot w \cdot \rho(T) = \dot{V} \cdot \rho(T)$ , where the density depends on the air-temperature. At low temperatures the air-density is much higher than at standard temperatures, therefore the air flowing into the cylinder at the same manifold pressure will increase. The basic volumetric efficiency usually is calibrated at standard temperatures of about 25 °C for intake air and about 90 °C for coolant temperature. To take into account the different density at operating points with other temperatures, the volumetric efficiency then has to be corrected.

Especially at speed-density systems, this temperature correction is essential, because the density of the air and therefore the air-mass flow strongly depend on the air temperature. This means all deviations from the temperatures at which the volumetric efficiency was calibrated will lead to a wrong air-mass flow value into the cylinder (e.g. wrong MAF value at cold starts without temperature corrections for a MAP system).

At systems equipped with an HFM sensor, the temperature correction is not as essential as for speed-density systems. Nevertheless, it is used to consider the heating of the air due to heat transfer from the warm intake duct to the air.

The compensation function is capable of taking into account deviations of coolant temperature and intake air temperature separately.

$$EFF\_VOL\_COR = \frac{273 + C\_TCYL\_STND}{273 + C\_TCYL\_STND + IP\_EFF\_TCO\_FAC \cdot (TCO - C\_TCO\_STND) + IP\_EFF\_TIA\_IM\_FAC \cdot (TIA\_IM - C\_TIA\_STND)}$$

### Signal flow diagram:

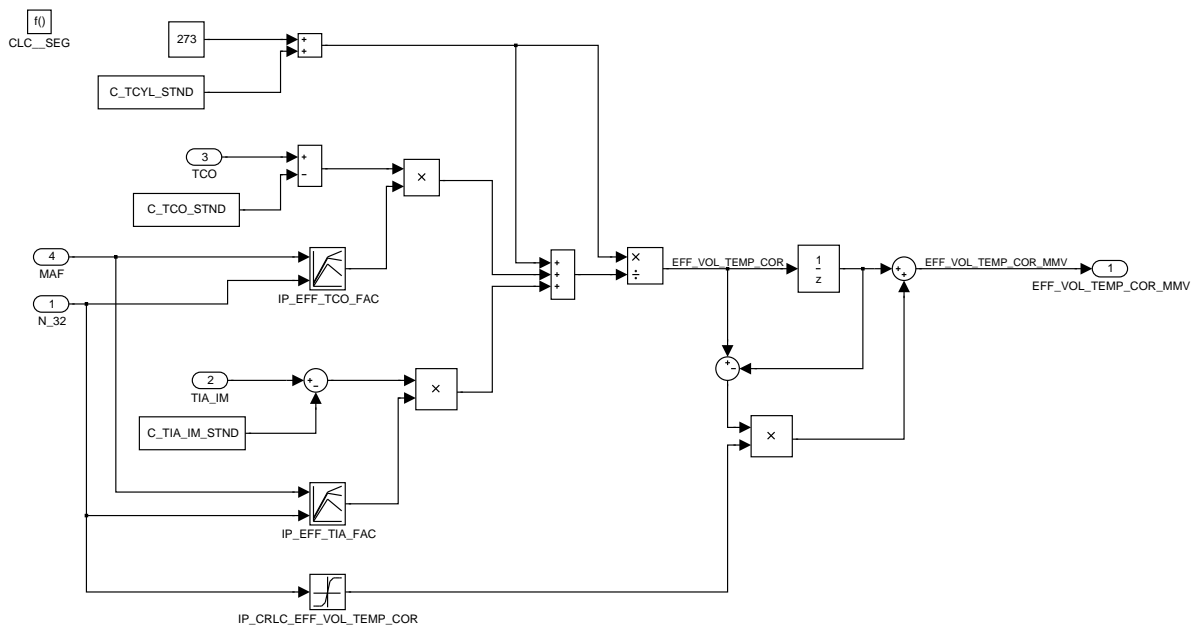


Figure 4.18.1: : Calculation algorithm for temperature correction

### Description:

The temperature correction factor `EFF_VOL_TEMP_COR` is the ratio between air temperature in the cylinder for standard conditions `TCYL` compared to air temperature in the cylinder for current `TCO`, `TIA_IM` and operating point. `TCO` and `TIA_IM` are compared to standard conditions and weighted by operating point.

### Application conditions

#### Initialisation:

at reset and engine running to stopped engine  
`EFF_VOL_TEMP_COR = 1`

Remark: The typical range of `EFF_VOL_TEMP_COR` is 0,8 to 1,5.

Activation: `LV_CLC_2SEG = 0`

*Deactivation:* LV\_CLC\_2SEG = 1  
*Recurrence:* segment synchronous

### Formula section:

$$\text{EFF\_VOL\_TEMP\_COR} = [ 273 + \text{C\_TCYL\_STND} ] / \\ [ 273 + \text{C\_TCYL\_STND} + \text{IP\_EFF\_TCO\_FAC} * (\text{TCO} - \text{C\_TCO\_STND}) + \\ \text{IP\_EFF\_TIA\_IM\_FAC} * (\text{TIA\_IM} - \text{C\_TIA\_IM\_STND}) ]$$


Changes in the operating point cause thermal inertia effects, which have to be taken into account. Filtering EFF\_VOL\_TEMP\_COR does this.

At first calculation EFF\_VOL\_TEMP\_COR\_MMV is = EFF\_VOL\_TEMP\_COR.

```

if      LV_CLC_2SEG_ENA = 0
then    EFF_VOL_TEMP_COR_MMVn = EFF_VOL_TEMP_COR_MMVn-1
          + ( EFF_VOL_TEMP_COR - EFF_VOL_TEMP_COR_MMVn-1 )
          * IP_CRLC_EFF_VOL_TEMP_COR
else    EFF_VOL_TEMP_COR_MMVn = EFF_VOL_TEMP_COR_MMVn-1
          + ( EFF_VOL_TEMP_COR - EFF_VOL_TEMP_COR_MMVn-1 )
          * 2 * IP_CRLC_EFF_VOL_TEMP_COR
endif

```

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## 4.19 Pressure decrease through the air cleaner

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
PUT	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Pressure upstream throttle					
PUT_MAX	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Maximum possible pressure upstream throttle					

### Input data:

AMP_AD {p. 982}	AMP_MDL {p. 982}	AMP_MES {p. 1163}	LV_CLC_2SEG {p. 1825}
LV_ERR_PUT_EL {p. 4828}	LV_ERR_PUT_PLAUS {p. 1062}	LV_ES {p. 1720}	LV_VAR_TCHA {p. 656}
MAF_CYL {p. 8277}	PUT_MES_BAS]		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_AMP_DEC	-	0... FFFFH	0... 5434	82.8999e-3	hPa
LDP_MAF_CYL_AMP_DEC	4	0... FFFFH	0... 2047.96875	0.03125	kg/h
Pressure decrease through the air cleaner					
LC_ENA_PUT_SUB_PLAUS_ERR	-	0... 1H	0 ...1	1	-
Switch to enable PUT substitution during PUT_PLAUS_ERR					

### FUNCTION DESCRIPTION:

#### General information:

With increasing air mass flow through the air cleaner there is a drop of pressure in the air cleaner in comparison to the ambient pressure.

#### Application conditions

**Initialisation:** PUT = AMP\_MES  
PUT\_MAX = AMP\_MES at ECU reset

**Activation:** LV\_CLC\_2SEG = 0

**Deactivation:** LV\_CLC\_2SEG = 1  
No pressure decrease will be calculated, if all elements of IP\_AMP\_DEC are 0.

**Recurrence:** LV\_ES = 10 ms  
LV\_ES = 0 segment synchronous

#### Formula section:

**If** LV\_VAR\_TCHA = 0  
**Then** PUT = AMP\_MDL - IP\_AMP\_DEC  
PUT\_MAX = AMP\_AD - IP\_AMP\_DEC  
**Else If** LV\_ERR\_PUT\_EL = 1 **or**  
( LV\_ERR\_PUT\_PLAUS = 1 **and**


```
LC_ENA_PUT_SUB_PLAUS_ERR = 1 )
```

```
Then PUT = AMP_MDL - IP_AMP_DEC
      PUT_MAX = AMP_AD - IP_AMP_DEC
```

```
Else PUT = PUT_MES_BAS
      PUT_MAX = AMP_AD - IP_AMP_DEC
```

```
Endif
```

```
Endif
```

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## 4.20 Intake manifold model (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_MAF_CTL	V	0... 1H	0 ...1	1	-
1: MAF controlled system					

### Input data:

ERR_SYM_LOAD_TPS_ PLAUS {p. 1052}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}	LV_ERR_MAF {p. 4815}	LV_MAF_PULS {p. 1192}
---	--	----------------------	-----------------------

### Application conditions

**Initialisation:**  $LV\_MAF\_CTL = 1$   
**Recurrence:**  $10\text{ ms}$   
**Activation:**  $every\ engine\ state$   
**Deactivation:**  $-$

### Formula section:

```

if
    or
    or
    [ LV_ERR_LOAD_TPS_PLAUS = 1
    ERR_SYM_LOAD_TPS_PLAUS = SYM_0 ]
and
then
    -/N-control: LV_MAF_CTL = 0
else
    MAF-control: LV_MAF_CTL = 1
endif

```

## 4.21 Intake manifold model

### Data definition:

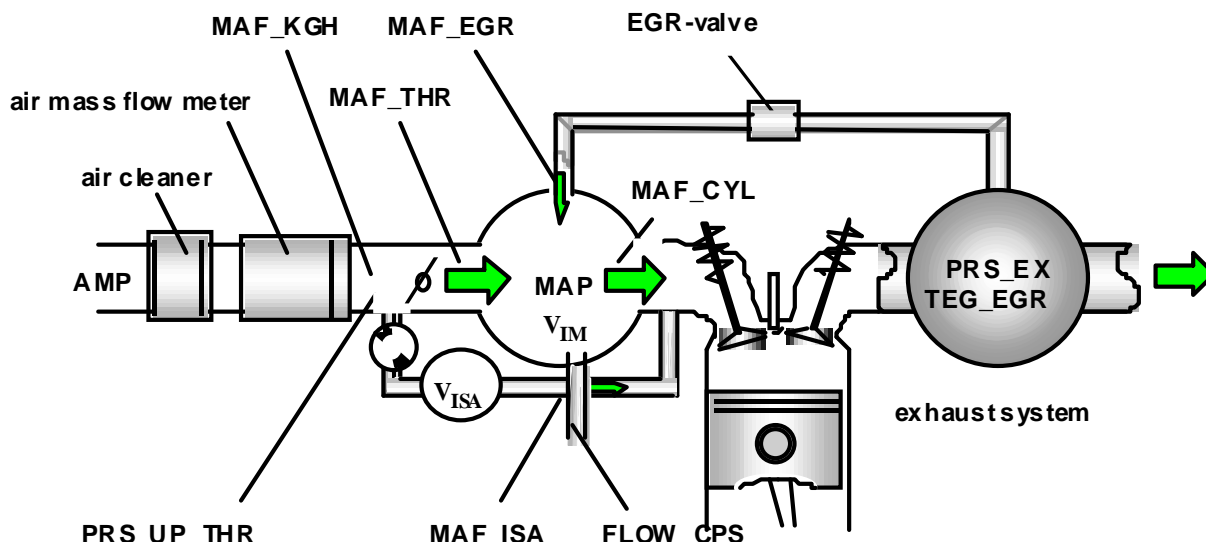
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_MAF_MAX	O/V	0... FFFFH	0 ...2	30.52e-6	-
ratio between MAF and MAF_MAX_COR					
MAF_FG_CYL	O/V	0000... FFFFH	0... 2047.96875	0.03125	kg/h
fresh air mass flow in the cylinder					
PQ_EGR	O/V	0000... FFFFH	0... 0.999985	15.2e-6	-
pressure quotient at the EGR - valve					

### Input data:

MAF_CYL {p. 8277}	MAF_EGR {p. 8278}	MAF_MAX_COR {p. 8278}	MAF_SP_TQI {p. 8390}
MAP {p. 8278}	PRS_EX_EGR {p. 1167}		

### General information:

The intake manifold model calculates the air mass flow at throttle, at idle speed actuator valve, the air mass flow into the cylinder and the pressure in the intake manifold. In case of



exhaust gas recirculation in addition the residual gas partial pressure and the fresh gas partial pressure are calculated. The calculation is done every segment due to charge determination for injection and ignition. Therefore it is necessary to scan the throttle- and idle speed actuator valve position also every segment.

### Signal flow diagram:

### Application conditions

**Recurrence:** *segment synchronous*

**Activation:** *at LV\_IGK = 1*

**Deactivation:** -

### 4.21.1 Calculation of the manifold pressure MAP

#### Application conditions

**Initialisation:** PQ\_EGR =0

#### Formula section:

$$PQ\_EGR_N = MAP_N / PRS\_EX\_EGR_N$$

### 4.21.2 Calculation of MAP\_FG

#### Application conditions

**Initialisation:** all 0 at Reset

#### Formula section:

*the air entering in the cylinder presently is given by :*

$$MAF\_FG\_CYL = MAF\_CYL - MAF\_EGR$$

### 4.21.3 Calculation of maximum possible mass air flow MAF\_MAX\_COR and the ratio between actual and maximum mass air flow FAC\_MAF\_MAX

#### Application conditions

**Initialisation:**

#### Formula section:

$$FAC\_MAF\_MAX = MAF\_SP\_TQI_N / MAF\_MAX\_COR_N$$

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## 4.22 Ambient air temperature calculation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TAM_ST	O/V	0... FEH	0... 142.5	0.75	°C
Ambient air temperature at Start					
TAM_STOP	O/V/S	0... FEH	0... 142.5	0.75	°C
Ambient air temperature at engine stop					

### Input data:

LV_ES {p. 1720}	LV_ST {p. 1720}	TAM {p. 1579}	
-----------------	-----------------	---------------	--

### Overview

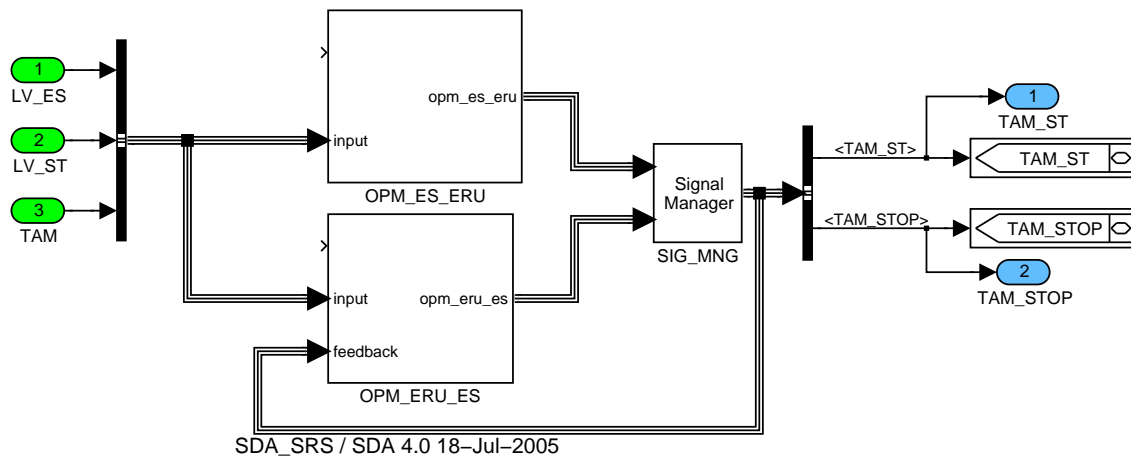


Figure 4.22.1: AIRT\_M4024

### 4.22.1 Calculation of ambient temperature at start(ES to ERU)

#### General information:

TAM is received via CAN (see chapter CANmessages).

TAM\_ST is determined at each transition from ES to ST.

#### Function Description

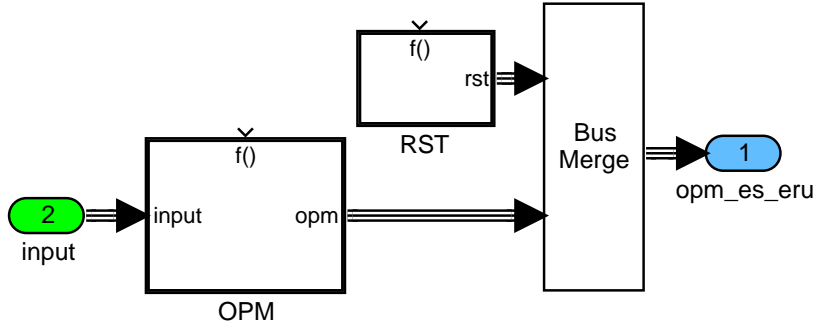


Figure 4.22.2: AIRT\_M4024/OPM\_ES\_ERU

### 4.22.1.1 Initialisation at reset

Initialisation of TAM\_ST to 0 at reset



Figure 4.22.3: AIRT\_M4024/OPM\_ES\_ERU/RST

### 4.22.1.2 Formula section

#### Aissgnment of TAM\_ST

TAM is assigned to TAM\_ST at start.

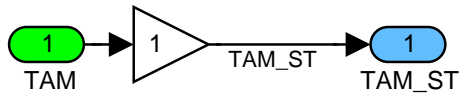


Figure 4.22.4: AIRT\_M4024/OPM\_ES\_ERU/OPM/CLC

## 4.22.2 Calculation of ambient temperature at Engine stop(ERU to ES)


General information:

TAM is received via CAN (see chapter CANmessages).

TAM\_STOP is determined at each transition from LV\_ES 0 > 1.

### Function Description

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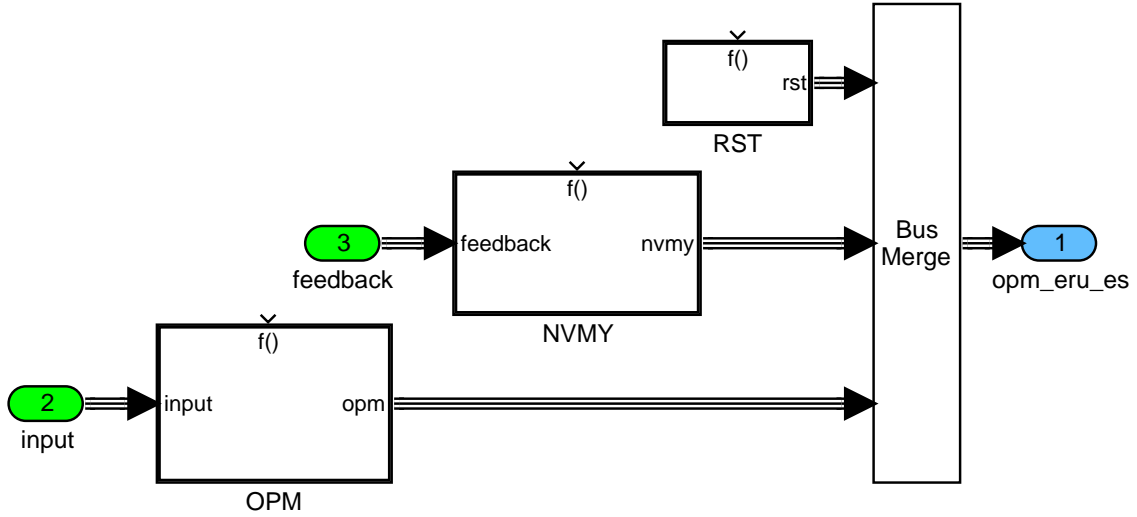


Figure 4.22.5: AIRT\_M4024/OPM\_ERU\_ES

4.22.2.1 At reset

Initialisation

Initialisation of TAM\_STOP to 0 at reset.



Figure 4.22.6: AIRT\_M4024/OPM\_ERU\_ES/RST/INI

4.22.2.2 Initialisations at non volatile memory system event(NVMY).

At system event NVMY the initialisation, restore and store action to and from the non volatile memory takes place.

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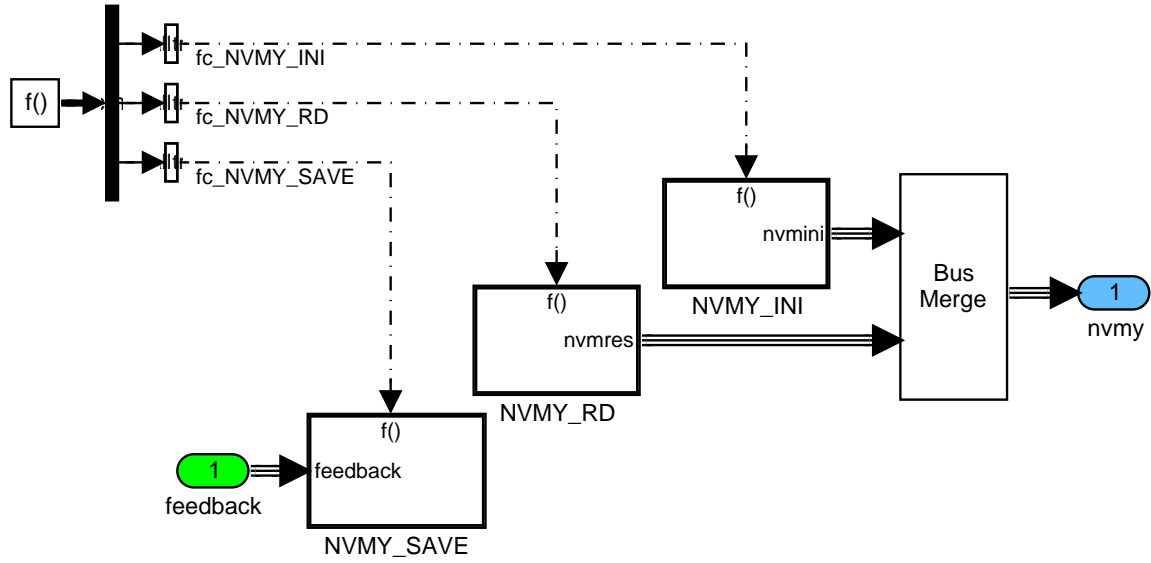


Figure 4.22.7: AIRT\_M4024/OPM\_ERU\_ES/NVMY

4.22.2.3 Formula section

Assignment to TAM\_STOP

TAM is assigned to TAM\_STOP



Figure 4.22.8: AIRT\_M4024/OPM\_ERU\_ES/OPM/CLC

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## 4.23 Coolant temperature (radiator outlet)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_INI_TCO_2	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) initialisation conditions					
TCO_1_2	O/V	80... 7FH	-96... 95.25	0.75	°C
Coolant temperature difference between the TCO- and the TCO_2 sensor					
TCO_2	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature (radiator outlet)					
TCO_2_MES	O/V	0... FEH	-48... 142.5	0.75	°C
Measured coolant temperature (radiator outlet)					
TCO_2_MES_ST	O/V	0... FEH	-48... 142.5	0.75	°C
Measured coolant temperature (radiator outlet) at start					
TCO_2_ST	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature (radiator outlet) at start					

### Input data:

LV_ERR_TCO_2 {p. 4572}	LV_ERR_TCO_2_PREL {p. 4572}	LV_ES {p. 1720}	LV_VAR_TCO_2 {p. 656}
NC_NR_TCO_SENS {p. 576}	TCO {p. 1100}	VP_TCO [NC_NR_TCO_SENS] {p. 1100}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_2_DIF_TCO	-	FFFFFF80... 7FH	-96... 95.25	0.75	°C
Temperature difference to the TCO-value in case of a coolant temperature (radiator outlet) failure					
C_TCO_2_MES_GRD_MAX	-	0... FEH	0... 190.5	0.75	°C
Maximum permissible temperature gradient for coolant temperature (radiator outlet) gradient monitoring					
C_TCO_2_SUB	-	0... FEH	-48... 142.5	0.75	°C
Substitute value for TCO_2 in case of no sensor is available					
IP_TCO_2_MES	-	0... FEH	-48... 142.5	0.75	°C
LDP_VP_TCO_2_IP_TCO_2_MES	16	0... 7FFFH	0... 4.999847412	153e-6	V
Linearization of the coolant temperature (radiator outlet) sensor voltage (VP_TCO[1]) for temperature acquisition					
LC_SWI_TCO_2_SUB	-	0... 1H	0 ...1	1	-
Minimum engine cooling temperature to activate the diagnosis condition					

## FUNCTION DESCRIPTION:

### General information:

The coolant temperature raw sensor voltage at radiator outlet is measured with use of an 10bit A/D converter by the ECU hardware. The software then is generating a modified sensor signal (VP\_TCO[1]), which is requested by the application software for further execution.

The modified sensor signal (VP\_TCO[1]) is converted into a measured temperature value at radiator outlet (TCO\_2\_MES) with use of a one-dimension interpolation table (IP\_TCO\_2\_MES).

If the sensor is not available (LV\_VAR\_TCO\_2 = 0) then TCO\_2 is set to an substitute value.

**Application conditions:**

See separate chapters:

**4.23.1 Coolant temperature (radiator outlet) gradient monitoring****FUNCTION DESCRIPTION:****General information:**

The measured coolant temperature at radiator outlet (TCO\_2\_MES) is monitored for not plausible gradients. It is checked if the temperature difference between the old and the new measured coolant temperature (TCO\_2\_MES) exceeds the permissible gradient C\_TCO\_2\_MES\_GRD\_MAX. In this case the old measured value remains unchanged. If the temperature difference between the measured coolant temperature values at radiator outlet is exceeding the permissible gradient again during the next measurement, the new measured value is transferred into the working memory. A measured value can be inhibited only if the gradient exceeded for one time (recurrence).

The monitoring of the coolant temperature (radiator outlet) gradient does not lead to failure entries. The only purpose is to extract implausible measured values (noise).

**Application conditions:**

*Initialisation at Reset:*

```
TCO_2_MES(n) = TCO_2_MES(n-1) = IP_TCO_2_MES
// acquisition of the coolant temperature (radiator outlet) measurement signal
```

*Recurrence:* 100 ms


*Activation:* at every engine operating state

*Deactivation:* -

**Formula section:**

```
If LV_VAR_TCO_2 = 1
then
  TCO_2_MES = IP_TCO_2_MES
  // VP_TCO[1] is used as input signal for the interpolation table IP_TCO_2_MES
  If |TCO_2_MES(n-1) - TCO_2_MES(n)| > C_TCO_2_MES_GRD_MAX
  then TCO_2_MES(n) = TCO_2_MES(n-1) (only one time!)
  else TCO_2_MES(n) = TCO_2_MES(n)
  endif
else
  If LC_SWI_TCO_2_SUB = 0
  then TCO_2_MES = TCO - C_TCO_2_DIF_TCO
  else TCO_2_MES = C_TCO_2_SUB
  endif
endif
```

**4.23.2 Coolant temperature (radiator outlet) acquisition**

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
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**Formula section:**

```

if (1)          LV_ERR_TCO_2 = 0
then (1)
    if (2)      LV_ERR_TCO_2_PREL = 0
    then (2)    TCO_2 = TCO_2_MES
    else (2)    TCO_2(n) = TCO_2(n-1)
    endif (2)
else (1)        TCO_2 = TCO - C_TCO_2_DIF_TCO
endif (1)

```

**4.23.3 Coolant temperature (radiator outlet) at engine start****FUNCTION DESCRIPTION:****General information:**

The coolant temperature (radiator outlet) and the measured coolant temperature at engine start (TCO\_2\_ST, TCO\_2\_MES\_ST) is determined as long as the engine operating state "Engine stop" is detected. During this time, TCO\_2\_ST is updated with the actual coolant temperature value at radiator outlet (TCO\_2) and TCO\_2\_MES\_ST is updated with the measured coolant temperature value at radiator outlet (TCO\_2\_MES).

**Application conditions**

**Initialisation at Reset:**      TCO\_2\_ST = TCO\_2\_MES  
    TCO\_2\_MES\_ST = TCO\_2\_MES

**Recurrence:**                      10 ms

**Activation:**                        LV\_ES = 1

**Deactivation:**                    LV\_ES = 0

**Formula section:**


```

TCO_2_ST = TCO_2
TCO_2_MES_ST = TCO_2_MES


```

**4.23.4 Temperature difference between the coolant temperature sensors****FUNCTION DESCRIPTION:****General information:**

The main coolant temperature sensor (TCO) is located next to the engine, while the second coolant temperature sensor (TCO\_2) is fixed at radiator outlet. The temperature difference between the coolant temperature values (TCO\_1\_2) is determined and used for further calibration issues. Only positive values for the coolant temperature difference are plausible at normal driving conditions.

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 1221 of 8404	
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**Application conditions****Initialisation at Reset:**       $TCO_{1\_2} = 95.25^{\circ}C$ **Recurrence:**                      *100 ms***Activation:**                        *at every engine operating state***Deactivation:**                    -**Formula section:** $TCO_{1\_2} = TCO - TCO_2$ 

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 1222 of 8404</b>	
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## 4.24 Oil temperature selection

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_TOIL_MAX	O/V/S	0... FFH	0... 255	1	-
event frequency counter					
DIST_TOIL_MAX	O/V/S	0... FFFFH	0... 524280	8	km
mileage at last warning threshold 1					
GEAR_TOIL_MAX	O/V/S	0... FFH	0... 255	1	-
GEAR at last warning threshold 1					
LV_CS_TOIL_MAX	O/V/S	0... 1H	0 ...1	1	-
clutch switch detection at last warning threshold 1					
LV_TOIL_THD_WARN_1	O/V	0... 1H	0 ...1	1	-
TOIL > warning threshold 1					
LV_TOIL_THD_WARN_2	O/V	0... 1H	0 ...1	1	-
TOIL > warning threshold 2					
N_TOIL_MAX	O/V/S	0... 1FE0H	0... 8160	1	rpm
N at last warning threshold 1					
PV_AV_TOIL_MAX	O/V/S	0... FFH	0... 99.6	0.39	%
PV_AV at last warning threshold 1					
TAM_TOIL_MAX	O/V/S	0... FEH	-48... 142.5	0.75	°C
ambient temperature at last warning threshold 1					
TCO_TOIL_MAX	O/V/S	0... FEH	-48... 142.5	0.75	°C
coolant temperature at last warning threshold 1					
TOIL_MAX_WARN	O/V/S	0... C8H	-40 ...160	1	°C
max. TOIL at last warning threshold 1					
TOIL_THD_TOIL_MAX	O/V/S	0... C8H	-40 ...160	1	°C
warning threshold 1					
TQI_AV_TOIL_MAX	O/V/S	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
indicated engine torque at last warning threshold 1					
VS_TOIL_MAX	O/V/S	0... FFH	0... 255	1	km/h
VS at last warning threshold 1					

### Input data:

C_TOIL_CHK_CTL_1 {p. 1223}	DIST_KWP {p. 1183}	GEAR {p. 1302}	LV_CS {p. 8394}
LV_IGK {p. 906}	LV_TOIL_THD_WARN_1 {p. 1223}	N {p. 1525}	PV_AV {p. 1269}
TAM {p. 1579}	TCO {p. 1100}	TOIL {p. 8204}	TQI_AV {p. 981}
VS {p. 1176}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TOIL_CHK_CTL_1	-	0... FFH	-40 ...215	1	°C
warning threshold 1 for TOIL overtemperature (appl. suggestion: 155°C)					
C_TOIL_CHK_CTL_2	-	0... FFH	-40 ...215	1	°C
warning threshold 2 for TOIL overtemperature (appl. suggestion: 158°C)					

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## 4.24.1 Oil overtemperature detection - Detection algorithm

### FUNCTION DESCRIPTION:

#### General information:

There are two thresholds for detecting a TOIL overtemperature. In case TOIL exceeds the first threshold a statusflag is set and a checkcontrol-message is sent, indicating that the TOIL is within the yellow area . If TOIL exceeds the second threshold a statusflag is set and a checkcontrol-message is set, indicating that the TOIL is within the red area .

The statusflags are reset if  $TOIL < threshold$ .

#### Application conditions

**Initialisation:** LV\_TOIL\_THD\_WARN\_i = 0 at reset

**Recurrence:** 1000ms

**Activation:** LV\_IGK = 1

#### Formula section:

Determination of LV\_TOIL\_THD\_WARN\_1:

```

IF          (TOIL > C_TOIL_CHK_CTL_1)
THEN      LV_TOIL_THD_WARN_1 = 1
ELSE      LV_TOIL_THD_WARN_1 = 0
ENDIF
    
```

Determination of LV\_TOIL\_THD\_WARN\_2:

```

IF          (TOIL > C_TOIL_CHK_CTL_2)
THEN      LV_TOIL_THD_WARN_2 = 1
ELSE      LV_TOIL_THD_WARN_2 = 0
ENDIF
    
```

## 4.24.2 Oil overtemperature detection - Environmental data

#### General information:

This function contains the environmental data, which should be stored in the nv-memory in case of detected oil overtemperature.

#### Application conditions

**Initialisation:** GEAR\_TMP = 0 at reset  
all xxx\_TOIL\_MAX - data restored out of NVMY

**Recurrence:** 1000 ms

**Activation:** LV\_IGK = 1



**Formula section:**

Determination of LV\_TOIL\_THD\_1:

```

IF                LV_TOIL_THD_WARN_1      =      1
THEN              CTR_TOIL_MAX            =      CTR_TOIL_MAX + 1      /* only once per
trigger */
IF                TOIL                    >      TOIL_MAX_WARN
THEN              TOIL_MAX_WARN           =      TOIL
VS_TOIL_MAX        =      VS
N_TOIL_MAX         =      N
GEAR_TOIL_MAX      =      GEAR_TMP
TQI_AV_TOIL_MAX    =      TQI_AV
TAM_TOIL_MAX       =      TAM
TCO_TOIL_MAX       =      TCO
DIST_TOIL_MAX      =      DIST_KWP
PV_AV_TOIL_MAX     =      PV_AV
LV_CS_TOIL_MAX     =      LV_CS
TOIL_THD_TOIL_MAX  =      C_TOIL_CHK_CTL_1

ENDIF
ENDIF
    
```

Determination of last used gear:

```

IF                (GEAR > 0)              /* in case of HS-Gearbox, GEAR = 0 if CS is
active */
THEN              GEAR_TMP                =      GEAR
ENDIF
    
```

## 4.25 Basic air temperature variables

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TIA	O/V	0... FEH	0... 142.5	0.75	°C
Intake air temperature					
TIA_MES	O/V	0... FEH	0... 142.5	0.75	°C
Intake air temperature raw value					
TIA_ST	O/V	0... FEH	0... 142.5	0.75	°C
Intake air temperature at ST					
TIA_SUB	O/V	0... FEH	0... 142.5	0.75	°C
Substitute value intake air temperature					
TIA_TCHA	O/V	0... FEH	0... 142.5	0.75	°C
Air temperature up turbo charger					
VP_TIA	O/V	0... 7FFFH	0... 4.99984741	15.25879e3	V
Voltage value of the intake air temperature sensor					
VP_TIA_TCHA	O/V	0... 7FFFH	0... 4.99984741	15.25879e3	V
Voltage for temperatur sensor up turbocharger					

### Input data:

C_VP_TIA_MAX_DIAG {p. 4195}	C_VP_TIA_MIN_DIAG {p. 4195}	LV_ERR_TCO {p. 4496}	LV_ERR_TIA {p. 4200}
LV_ERR_TIA_TCHA_UP {p. 4189}	LV_ST {p. 1720}	LV_VAR_TCHA {p. 656}	NC_CYL_NR {p. 1526}
TCO {p. 1100}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_DIAG	-	0... FEH	0... 142.5	0.75	°C
TCO threshold for switching TIA substitute					
C_TIA_GRD_MAX_DIAG	-	0... FEH	0... 190.5	0.75	°C/500ms
Maximum permissible gradient for TIA					
C_TIA_SUB_BOL	-	0... FEH	0... 142.5	0.75	°C
Lower TIA substitute value					
C_TIA_SUB_TOL	-	0... FEH	0... 142.5	0.75	°C
Upper TIA substitute value					
IP_TIA__VP_TIA	-	0... FEH	0... 142.5	0.75	°C
LDP_VP_TIA_TIA	16	0... 7FFFH	0... 4.99984741	15.25879e3	V
NTC characteristic					
IP_TIA_TCHA__VP_TIA_TCHA	-	0... FEH	0... 142.5	0.75	°C
LDP_VP_TIA_TCHA	16	0... 7FFFH	0... 4.99984741	15.25879e3	V
NTC characteristic up turbo charger					

### Import actions:

<b>ACTION_INFR_GetVpTia</b> (OUT<Vp_tia_sens>)
<b>ACTION_INFR_GetVpTiaTcha</b> (OUT<Vp_tia_tcha_sens>)

## Function description

### Function Description

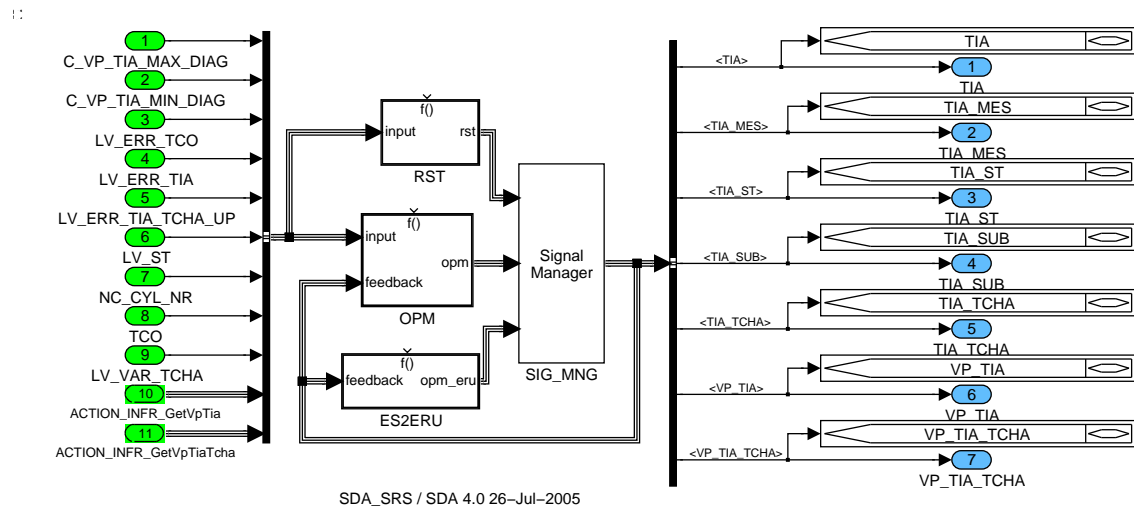


Figure 4.25.1: AIRT\_M4007

### 4.25.1 Temperature determination

General information:

The air temperatures are measured through an A/D converter.

The conversion into physical values is made through the nonlinear characteristic IP\_TIA\_\_VP\_TIA and IP\_TIA\_\_V\_TANS\_TCHA. In case of a present fault of the TIA sensor a substitute value will be used.

#### Calculation at reset

Calculation of TIA, TIA\_MES, VP\_TIA and VP\_TIA\_TCHA at reset

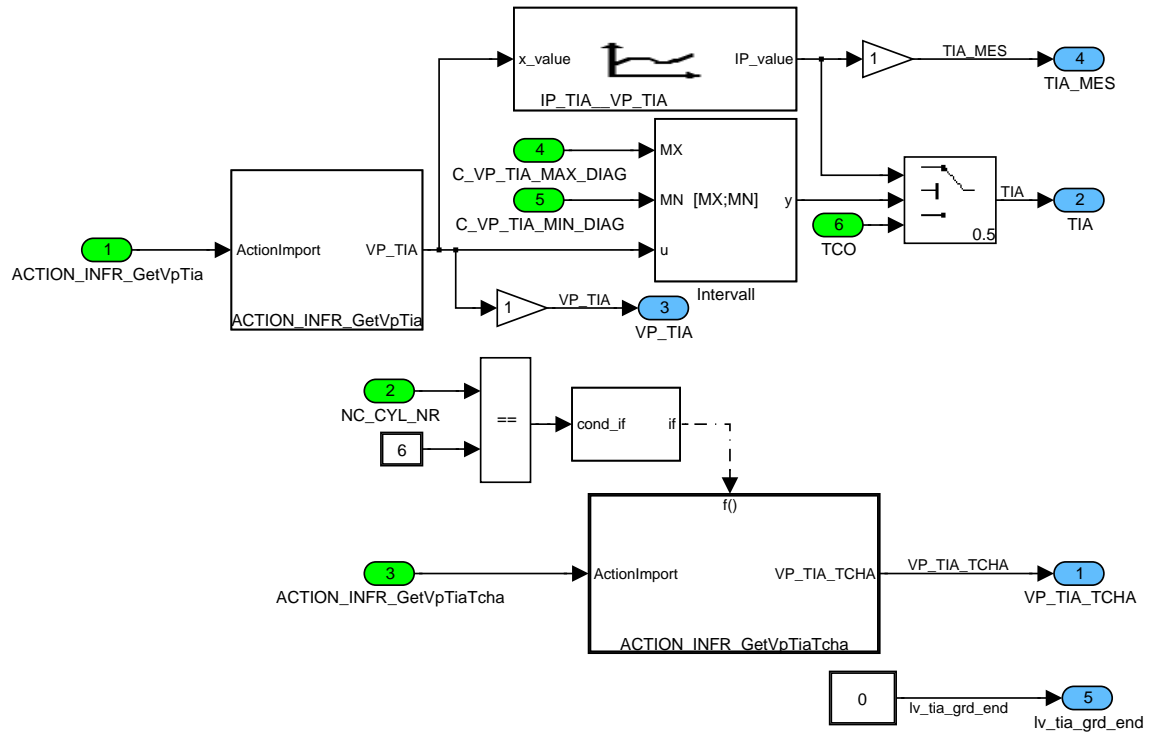


Figure 4.25.2: AIRT\_M4007/RST/CLC

### 4.25.2 Formula section

#### Calculation at 100ms recurrence

Calculation of TIA, TIA\_MES, TIA\_SUB, VP\_TIA and VP\_TIA\_TCHA

#### Action infrastructure outputs

The outputs of the air temperature sensor (VP\_TIA and VP\_TIA\_TCHA) are calculated here using action infrastructure.

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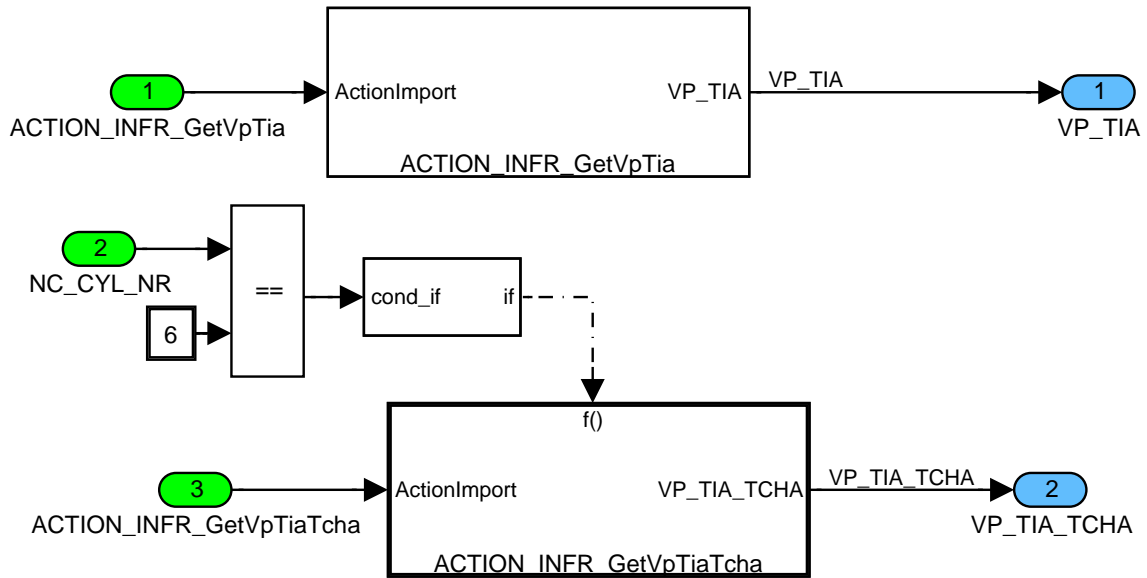


Figure 4.25.3: AIRT\_M4007/OPM/CLC/CLC\_1\_Vp\_TIA

**Determination of TIA , TIA\_TCHA, TIA\_MES and TIA\_SUB**

Calculation of TIA is done using TIA\_SUB, Output from temperature gradient monitoring scheme and old value of TIA .TIA\_TCHA is calculated using TIA and IP MAP.TIA\_MES is calculated from the IP table.

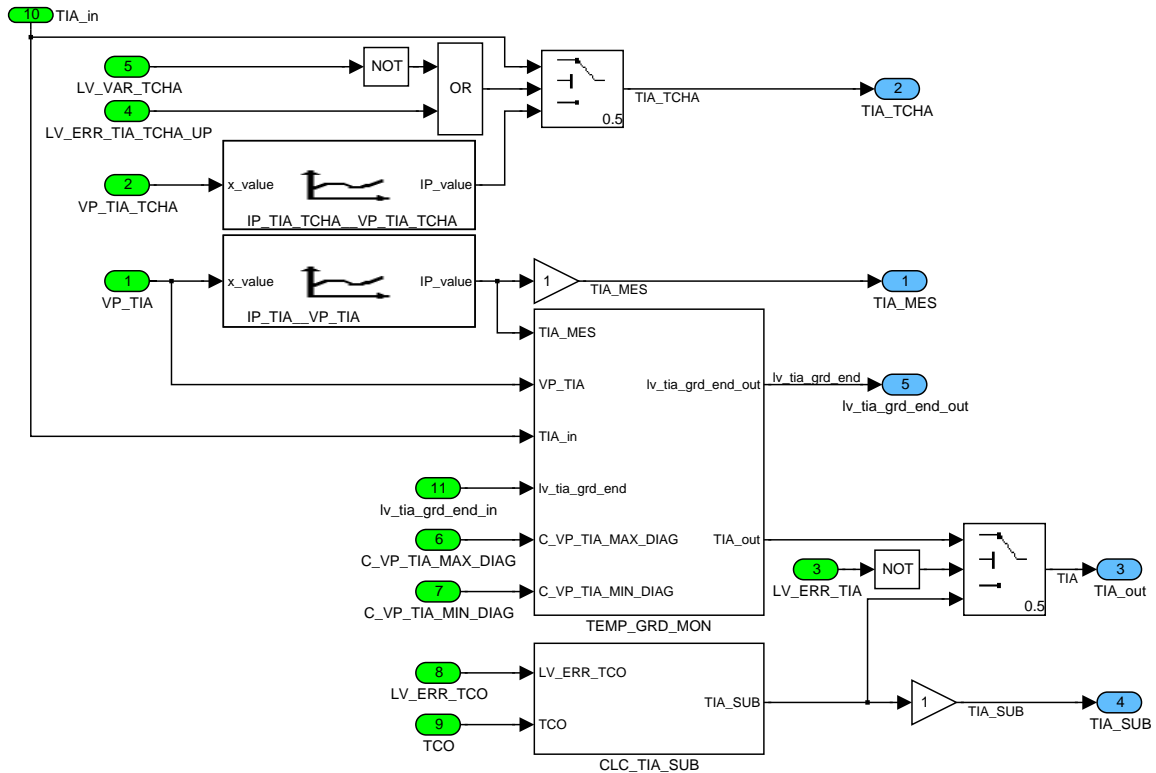



Figure 4.25.4: AIRT\_M4007/OPM/CLC/CLC\_2\_TIA\_ERR

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### Determination TIA\_SUB

TIA\_SUB is determined from lower TIA substitute value (C\_TIA\_SUB\_BOL) and upper TIA substitute value (C\_TIA\_SUB\_TOL).

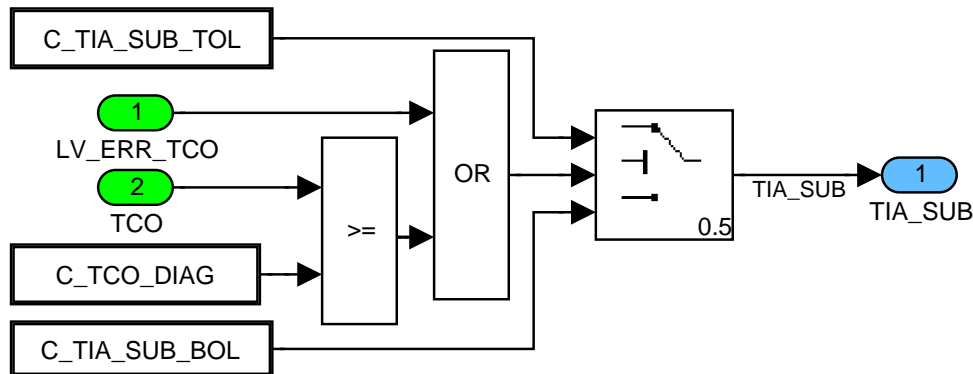


Figure 4.25.5: AIRT\_M4007/OPM/CLC/CLC\_2\_TIA\_ERR/CLC\_TIA\_SUB

### Temperature gradient monitoring

General information:

The temperature TIA is monitored for unplausible gradients. Previously there is a check that the measured value is within the permissible value range (see chapter Diagnosis). If yes, a check is made that the difference between the old and the new measured value exceeds the permissible gradient

C\_TIA\_GRD\_MAX\_DIAG for TIA.

If this is the case, then the old measured value remains unchanged. If it is determined once again at the next measurement that the maximum gradient was exceeded, then the new measured value is taken over into the working memory. A measured value can therefore only be masked out if the gradient was exceeded for the first time.

Gradient monitoring does not lead to any error storage, but serves only for masking out not plausible measured values (disturbances).

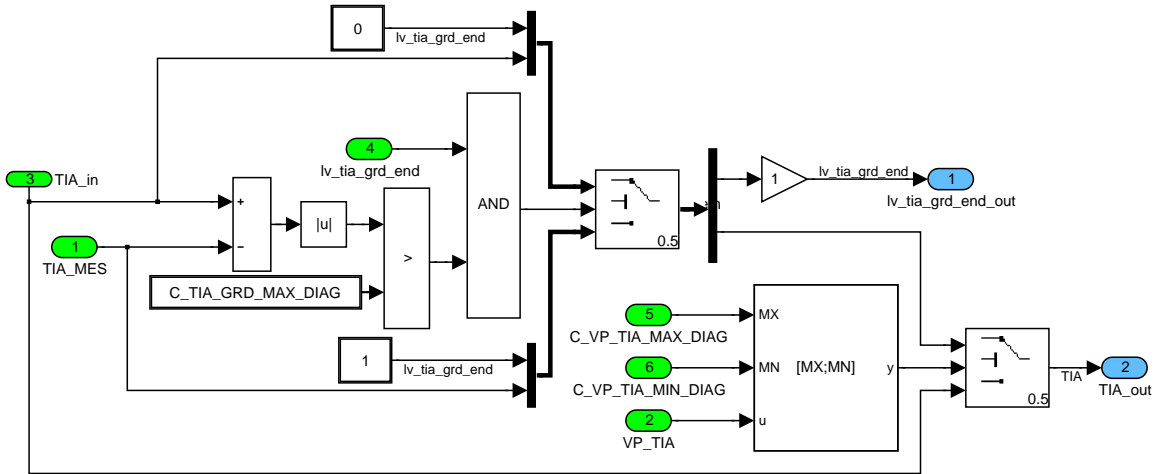


Figure 4.25.6: AIRT\_M4007/OPM/CLC/CLC\_2\_TIA\_ERR/TEMP\_GRD\_MON

### 4.25.3 Calculation at Engine stall to engine run event

#### Assignment of TIA to TIA\_ST

TIA is assigned to TIA\_ST

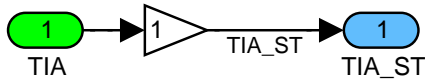


Figure 4.25.7: AIRT\_M4007/ES2ERU/OPM

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## 4.26 Fuel temperature

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_TFU_IV_ES	V	0... 1H	0 ...1	1	-
Flag for TFU_IV calculation after engine stop and before power latch active					
TEMP_DIF_TCO_TIA	O/V	0... FEH	-48... 142.5	0.75	°C
Temperature difference between TCO_EX and TCO or TIA and TCO					
TEMP_FUEL_RAIL_SUB	V	0... FEH	-48... 142.5	0.75	°C
Modeled fuel rail temperature depending from TCO and N					
TEMP_FUEL_RAIL_WALL	V	0... FEH	-48... 142.5	0.75	°C
Modeled fuel rail wall temperature					
TFU	O/V	0... FEH	-48... 142.5	0.75	°C
Fuel temperature					
TFU_ADD_FUEL_FLOW	V	0... FEH	-48... 142.5	0.75	°C
Fuel temperature increase /decrease due to fuel flow					
TFU_EFP	O/V	0... FEH	-48... 142.5	0.75	°C
Fuel temperature for the low pressure pump					
TFU_IV	O	0... FEH	-48... 142.5	0.75	°C
Injektor fuel temperature depending from TCO, N, MFF_SP, and EWP					
TFU_IV_ST	V	0... FEH	-48... 142.5	0.75	°C
Modeled injection valve temperature at engine start, depending on TCO, T_ES, TFU_IV_SUB_STOP and TEG_DYN_STOP					
TFU_IV_SUB	O/V	0... FEH	-48... 142.5	0.75	°C
Modeled injektor fuel temperature depending from TCO, N, MFF_SP, and EWP					
TFU_IV_SUB_BAS	V	0... FEH	-48... 142.5	0.75	°C
Modeled injector fuel temperature depending an TCO, IGA_AV and MFF_SP_MV					
TFU_IV_SUB_MV	V	0... FEH	-48... 142.5	0.75	°C
Modeled injector fuel temperature depending on TFU_IV_SUB_BAS and TEMP_CAPA_IV_MV					
TFU_IV_SUB_RAW	V	0... FEH	-48... 142.5	0.75	°C
Modeled injektor fuel temperature depending from TCO, N, MFF_SP, and EWP, raw-value after first low pass filter					
TFU_IV_SUB_STOP	O/V/S	0... FEH	-48... 142.5	0.75	°C
Modeled injection valve temperature TFU_IV at last engine stop, stored in NVMY					
TFU_LPF_TCO	V	0... FEH	-48... 142.5	0.75	°C
Modeled fuel temperature with low pass filter					
TFU_OFS_AIR	V	0... FEH	-48... 142.5	0.75	°C
Fuel temperature offset depending on ambient conditions					
TFU_RAW	V	0... FEH	-48... 142.5	0.75	°C
Modeled fuel temperature raw value					
TFU_SUB_STOP	O/V/S	0... FEH	-48... 142.5	0.75	°C
Modeled fuel temperature at last engine stop					

### Input data:

ECFPWM_ECF {p. 1045}	IGA_AV_MV_H_RNG {p. 1828}	LV_RUN_ENG {p. 1505}	LV_T_REL_CAN_REG {p. 1567}
MFF_SP_MV {p. 2151}	N {p. 1525}	N_REL_CWP {p. 4095}	T_AST {p. 1766}
T_ES {p. 1444}	TAM {p. 1579}	TCO {p. 1100}	TCO_EX {p. 1045}
TCO_ST {p. 1100}	TEG_DYN_STOP {p. 1039}	TEMP_CAPA_IV_MV {p. 2241}	VFF_MFF_SP_FUP_CTL {p. 3881}



VS_H {p. 1176}			
----------------	--	--	--

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FAC_TEMP_DIF_TCO_TIA	V	0... FFH	0... 0.99609375	3.90625e-3	-
Low pass filter correlation constant for difference of coolant temperature					
C_CRLC_FAC_TEMP_IV	V	0... FFH	0... 0.99609375	3.90625e-3	-
Low pass filter correlation constant for the injection valve temperature out of coolant temperature					
C_CRLC_FAC_VFF_MFF_SP_FUP_CTL	V	0... FFH	0... 0.99609375	3.90625e-3	-
Low pass filter correlation constant for the weighting factor of volume fuel flow through the injectors					
C_CRLC_FAC_VS_ECFPWM_ECF	V	0... FFH	0... 0.99609375	3.90625e-3	-
Low pass filter correlation constant for the weighting factor for air speed					
C_CRLC_TFU_IV_ES	V	0... FFFFH	0... 23.9996337891	366.211e-6	°C
Limited Gradient step for calculation of TFU_IV at engine stop before power latch or LV_IGK = 1 after engine stop					
C_T_AST_SWI_TFU_IV	V	0... FFFFH	0... 6553.5	0.1	s
Timer after start for activation of TEMP_CAPA_IV_MV based function					
C_T_TFU_CLC	V	1... FFH	1... 255	1	s
Time recurrence for TFU calculation					
C_T_TFU_IV_SUB_CLC	V	1... FFH	1... 255	1	s
Time recurrence for TFU_IV_SUB calculation					
C_T_TFU_IV_SUB_RAW_CLC	V	1... FFH	1... 255	1	s
Time recurrence for TFU_IV_SUB_RAW calculation					
C_TFU_EFP_OFS	V	0... FEH	-48... 142.5	0.75	°C
Offset for the modelling of the fuel temperature of the low pressure pump					
C_TFU_IV_SUB_LIM_DEC	V	0... FFFFH	0... 23.9996337891	366.211e-6	°C
Limited Gradient step for TFU_IV_SUB decrement					
C_TFU_IV_SUB_LIM_INC	V	0... FFFFH	0... 23.9996337891	366.211e-6	°C
Limited Gradient step for TFU_IV_SUB increment					
C_TFU_RAW_LIM_DEC	V	0... FFFFH	0... 23.9996337891	366.211e-6	°C
Limited Gradient step for TFU_RAW decrement					
C_TFU_RAW_LIM_INC	V	0... FFFFH	0... 23.9996337891	366.211e-6	°C
Limited Gradient step for TFU_RAW increment					
C_TFU_RAW_SWI_INI	V	0... AH	0... 10	1	-
Switch for initial value for gradient limitation of TFU_RAW after reset: 1 = 0hex (-48°C), 2 = TCO, 3 = TFU_LPF_TCO					
C_TFU_SUB_STOP_INI	V	0... FEH	-48... 142.5	0.75	°C
TFU_SUB_STOP initialisation value					
IP_CRLC_TFU_IV_SUB_VFF_MFF_SP	V	0... FFFFH	0... 0.999985	15.3186e-6	-
LDP_VFF_MFF_SP_IP_CRLC_TFU_IV	9	0... FFFFH	0... 255	3.89105e-3	l/h
Low pass filter correlation depending on VFF_MFF_SP_FUP_CTL					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_CRLC_TFU_T_AST_VFF_MFF_SP	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDP_T_AST_IP_CRLC_TFU_VFF_MFF	6	0... FFFFH	0... 65535	1	s
LDP_VFF_MFF_SP_FUP_CTL_IP_CRLC	6	0... FFFFH	0... 255	3.89105e-3	l/h
Weighting factor for correction of the fuel temperature					
IP_CRLC_VFF_MFF_TFU_IV_SUB_MV	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_VFF_MFF_SP_FUP_CTL	9	0... FFFFH	0... 255	3.89105e-3	l/h
Fading factor depending on VFF_MFF_SP_FUP_CTL					
IP_D_TIV_NORM_N_MFF_SP	V	0... FEH	-48... 142.5	0.75	°C
LDP_N_IP_D_TIV_NORM_N_MFF_SP	6	0... 1FE0H	0... 8160	1	rpm
LDP_MFF_SP_IP_D_TIV_NORM_N_MFF	4	0... FFFFH	0... 1389	0.0211948	mg
load-dependent temperatur differential to coolant temperature					
IP_FAC_T_ES	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_T_ES_IP_FAC_T_ES	9	0... FFFFH	0... 65535	1	min
Factor for correction of Engine off duration time					
IP_FAC_T_ES_TFU_IV	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_T_ES_IP_FAC_T_ES_TFU_IV	9	0... FFFFH	0... 65535	1	s
Factor for correction of Engine off duration time for TFU_IV_ST					
IP_FAC_TCO_TEMP_IV_COR	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_TCO_IP_FAC_TCO_TEMP_IV_COR	6	0... FEH	-48... 142.5	0.75	°C
Correction factor for correlation between TCO and injector temperature					
IP_FAC_TEG_T_ES_TEG_DYN_STOP	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_TEG_DYN_STOP_IP_FAC_TEG	6	0... 7FF0H	0... 2047	0.0625	°C
LDP_T_ES_IP_FAC_TEG_T_ES	6	0... FFFFH	0... 65535	1	min
Weighting factor for exhaust temperature					
IP_FAC_TEG_T_ES_TFU_IV	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_TEG_IP_FAC_TFU_IV	6	0... 7FF0H	0... 2047	0.0625	°C
LDP_T_ES_IP_FAC_TFU_IV	6	0... FFFFH	0... 65535	1	min
Weighting factor for exhaust temperature and engine off duration time for TFU_IV_ST					
IP_FAC_TEMP_IV_CWP_COR	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_N_IP_FAC_TEMP_IV_CWP_COR	6	0... FFH	0... 255	1	-
Factor for correlation between RPM of cooling water pump and injector temperature					
IP_FAC_TIV_EWP_COR	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_TIV_EWP_COR_IP_FAC_TIV_EWP	6	0... FFH	0... 255	1	-
Factor for correlation between RPM of electrical water pump and injector temperature					
IP_FAC_TIV_TCO_COR	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_TIV_TCO_COR_IP_FAC_TIV_TCO	6	0... FEH	-48... 142.5	0.75	°C
Factor for correlation between TCO and injector temperature					
IP_FAC_VFF_MFF_SP_FUP_CTL	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDPM_VFF_MFF_SP_FUP_CTL	9	0... FFFFH	0... 255	3.89105e-3	l/h
Factor for conversion of required fuel volume to cooling					
IP_FAC_VS_ECFPWM_ECF	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_VS_IP_FAC_VS_ECFPWM_ECF	6	0... FFFFH	0... 511.9921875	7.8125e-3	km/h

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_ECFPWM_ECF_IP_FAC	6	0... FFH	0... 99.609375	0.390625	%
Weighting factor for air speed					
IP_TAM_ADD_TFU_IV	V	0... FEH	-48... 142.5	0.75	°C
LDP_TAM_ADD_TFU_IV	8	0... FEH	-48... 142.5	0.75	°C
Correction of the influence of ambient temperatur on TFU_IV					
IP_TAM_ADD_TFU_RAW	V	0... FEH	-48... 142.5	0.75	°C
LDP_TAM_ADD_TFU_RAW	8	0... FEH	-48... 142.5	0.75	°C
Correction of the influence of ambient temperatur on TFU_RAW					
IP_TCO_TEMP_DIF_TCO_TIA	V	0... FEH	-48... 142.5	0.75	°C
LDP_TEMP_DIF_TCO_TIA_IP_TCO	6	0... FEH	-48... 142.5	0.75	°C
Factor for correction of the coolant temperature					
IP_TEMP_DIF_N_MFF_SP_IV	V	0... FEH	-48... 142.5	0.75	°C
LDP_N_IP_TEMP_DIF_IV	6	0... 1FE0H	0... 8160	1	rpm
LDP_MFF_SP_IP_TEMP_DIF_IV	4	0... FFH	0... 1389	5.4470588	mg/stk
load dependent injektor temperatur differential to coolant temperature					
IP_TEMP_OFS_IGA_MFF_SP	V	0... FEH	-48... 142.5	0.75	°C
LDP_IGA_IP_TEMP_OFS_MFF_SP	8	0... B40H	-90 ...90	0.0625	°CRK
LDP_MFF_SP_IP_TEMP_OFS_MFF_SP	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Temperature offset to TCO based on IGA_AV_MV and MFF_SP_MV					
LC_TCO_TFU_IV_SUB	V	0... 1H	0 ...1	1	-
Switch between TCO and TFU_IV_SUB for TFU_IV					
LC_TEMP_CAPA_TFU_IV_SWI	V	0... 1H	0 ...1	1	-
Switch between TEMP_CAPA based function (1) and TCO based function (0)					
LC_TEMP_FUEL_RAIL_WALL_TAM	V	0... 1H	0 ...1	1	-
Logical switch TEMP_FUEL_RAIL_WALL and TAM for TFU_RAW calculation					
LC_TFU_TIA_TCO_EX	V	0... 1H	0 ...1	1	-
Logical switch TIA and TCO_EX for TFU_OFS_AIR calculation					

### General information:

The temperature of the fuel has influence to the density and the volume of the fuel. This has consequences to several points of the function within the fuel supply aggregate and the injection timing. The influence is a lower efficiency of the pump and a influence on the injection valves due to higher temperature of different calculations of the fuel mass in the rail. Therefore two different temperature are modelled, TFU for the fuel pump control and TFU\_IV for the injection valve temperature

Both fuel temperatures are expected to depend mainly on the coolant temperature. Beyond this there is an influence of the fuel volume flow, the engine temperature, the ambient temperature, the vehicle speed and time since the last engine stop and the air temperature.


#### Application condition:

Activation: LV\_RUN\_ENG = 1;

Deactivation: At power latch;

Initialisation: At reset: TFU\_IV\_SUB\_RAW, TFU\_IV\_SUB, TFU\_IV, TFU, TFU\_RAW, TFU\_LPF\_TCO, TFU\_IV\_ST = TCO\_ST;

At I GK off to on:

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PT1 filter constant of TFU\_RAW = 0

local variables of gradient limiters tfu\_raw\_step\_clc and tfu\_iv\_sub\_step\_clc = 0

local counter for calculation delay of TFU values = 0

Recurrence: every 1S

Except the the following calculation:

TFU\_LPF\_CLC, TFU\_IV\_ST\_CLC Activation: LV\_T\_REL\_CAN\_REG = 1 and LV\_RUN\_ENG = 0 Recurrence: 100 ms

TFU\_INIT\_NO\_T\_REL\_CAN Activation: LV\_T\_REL\_CAN\_REG = 0 and LV\_RUN\_ENG = 0 Recurrence: 100 ms

TFU, which is calculated every C\_T\_TFU\_CLC and once at LV\_T\_REL\_CAN\_REG -> 1 change.

TFU\_IV\_SUB\_RAW, which is calculated every C\_T\_TFU\_IV\_SUB\_RAW\_CLC

TFU\_IV\_SUB, which is calculated every C\_T\_TFU\_IV\_SUB\_CLC

### Application conditions:

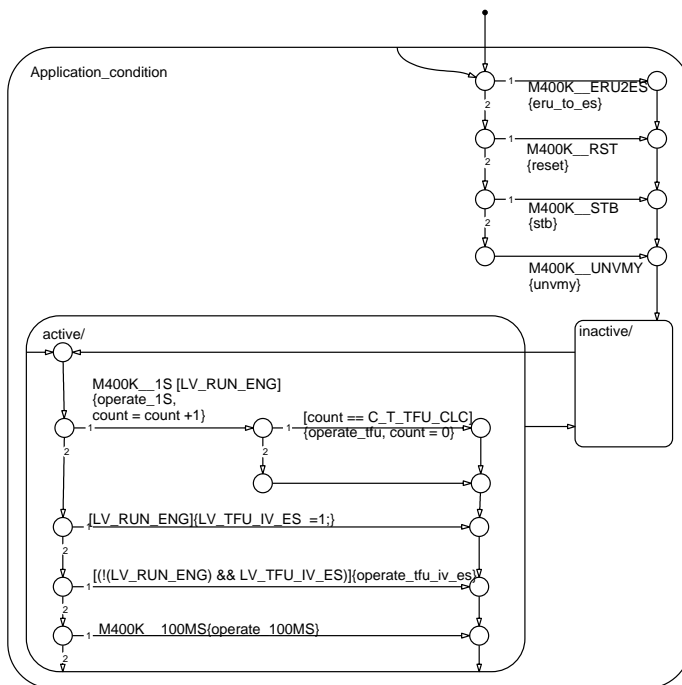


Figure 4.26.1: :

### Function description:

### Formula section:



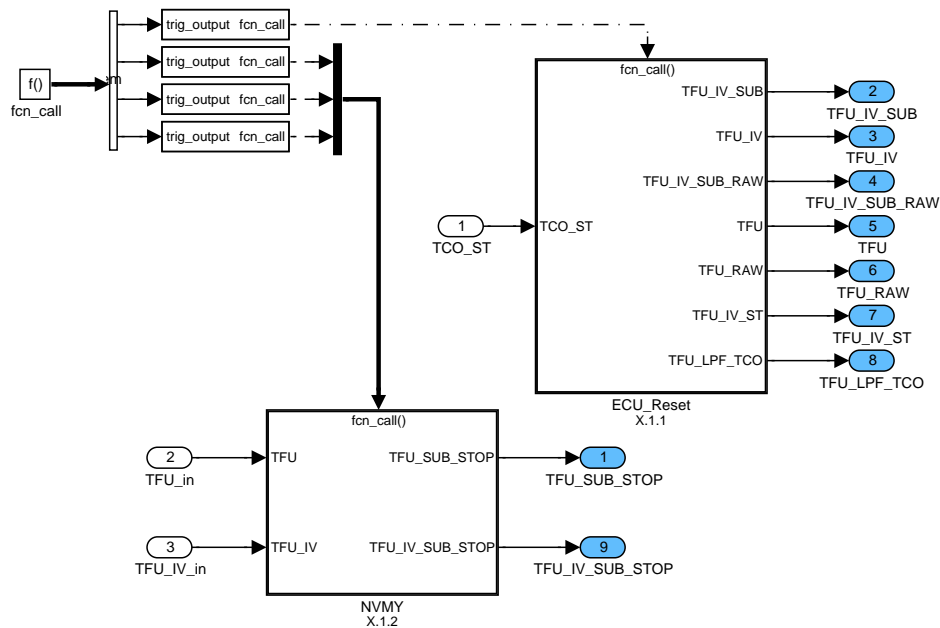


Figure 4.26.3: :

### 4.26.1.1 FUSL\_M400K/RST/ECU\_Reset

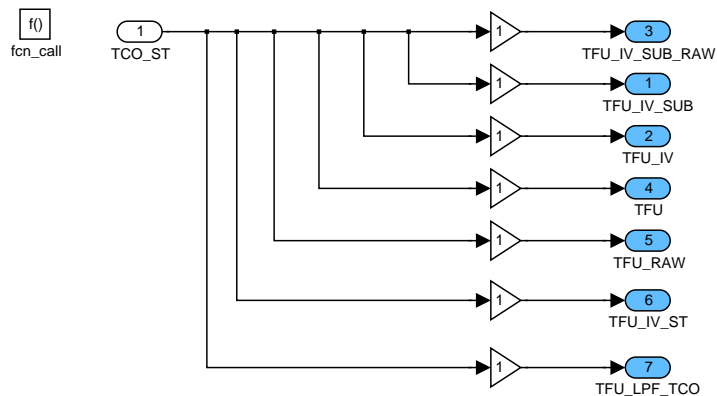



Figure 4.26.4: :

### 4.26.1.2 FUSL\_M400K/RST/NVMY

Overview of non volatile memory functions

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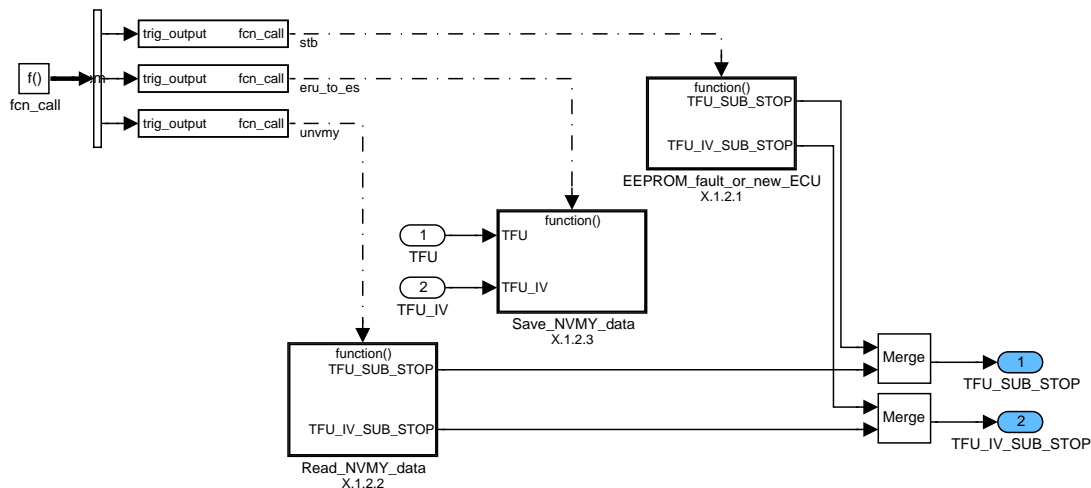


Figure 4.26.5: :

**4.26.1.2.1 FUSL\_M400K/RST/NVMY/EEPROM\_FAULT\_OR\_NEW\_ECU**

At EEPROM failure or by using a new ECU, no NVMY are available therefore this constant C\_TFU\_SUB\_STOP\_INI will be used as initial value.



Figure 4.26.6: :

**4.26.1.2.2 FUSL\_M400K/RST/NVMY/READ\_NVMY\_DATA**

Reading stored non volatile values from last engine run.

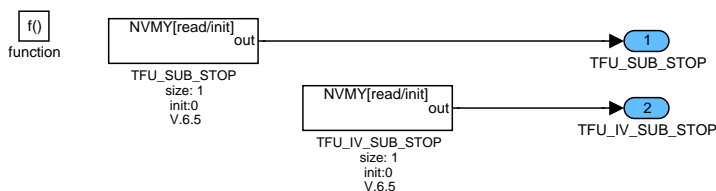


Figure 4.26.7: :

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### 4.26.1.2.3 FUSL\_M400K/RST/NVMY/Save\_NVMY\_data

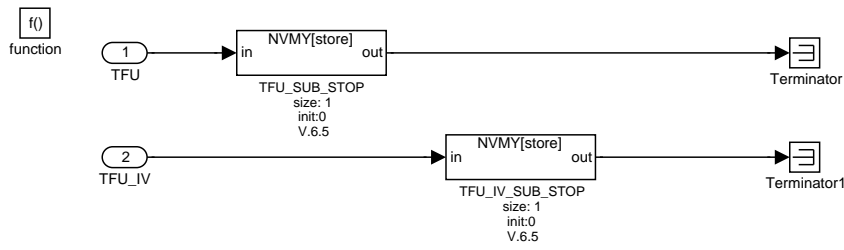



Figure 4.26.8: :

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### 4.26.2.1 FUSL\_M400K/Operate/Task\_100MS

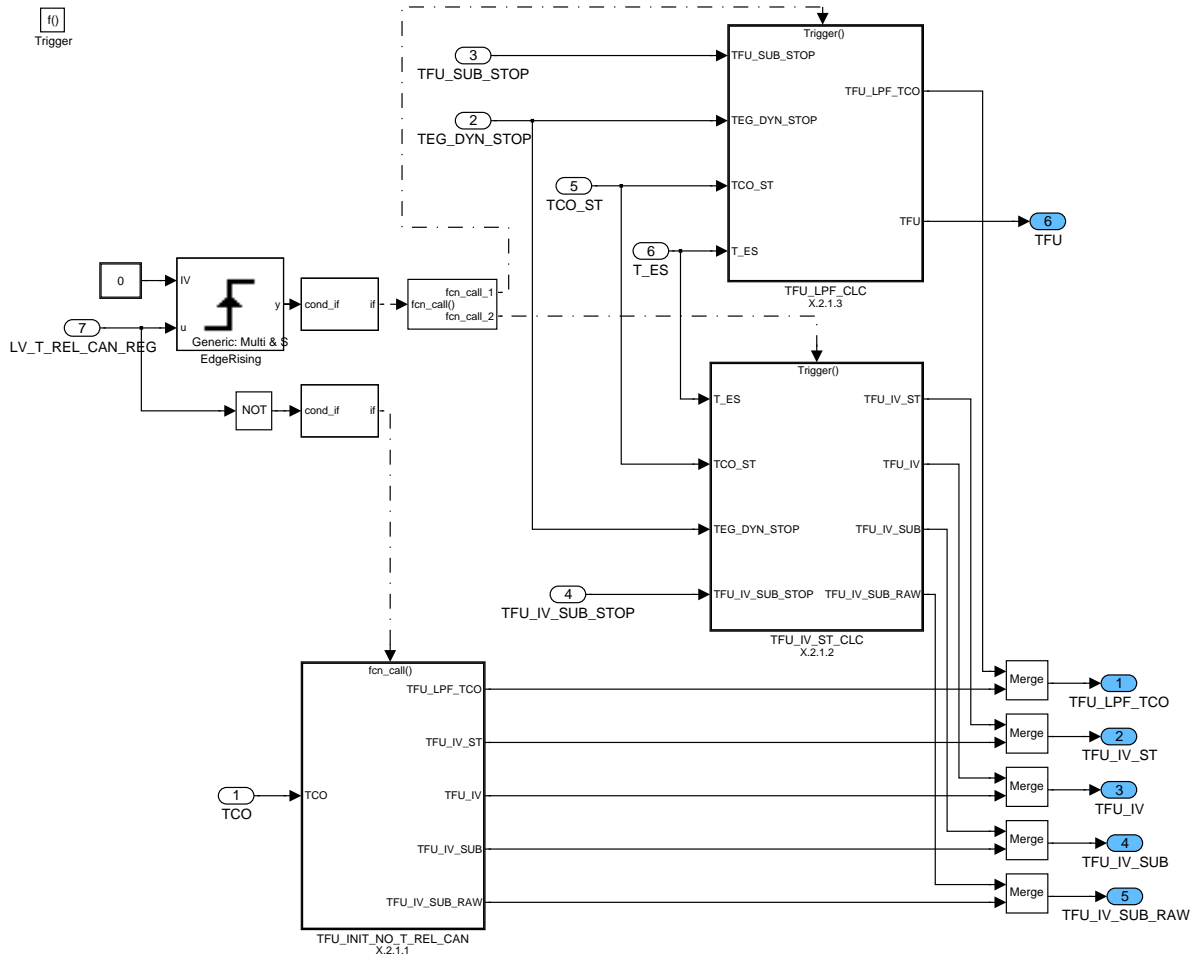


Figure 4.26.10: :

#### 4.26.2.1.1 FUSL\_M400K/Operate/Task\_100MS/TFU\_INIT\_NO\_T\_REL\_CAN

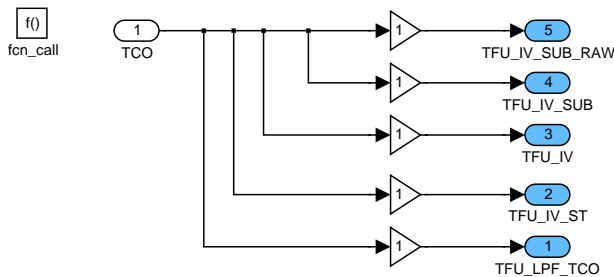


Figure 4.26.11: :

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### 4.26.2.1.2 FUSL\_M400K/Operate/Task\_100MS/TFU\_IV\_ST\_CLC

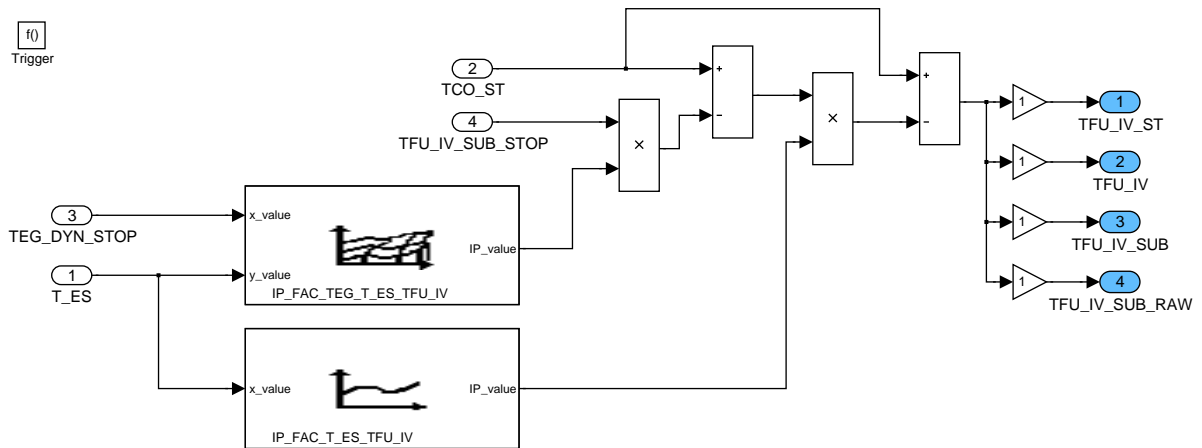


Figure 4.26.12: :

### 4.26.2.1.3 FUSL\_M400K/Operate/Task\_100MS/TFU\_LPF\_CLC

TFU is initialized with calculated TFU\_LPF\_TCO value at first LV\_T\_REL\_CAN\_REG change to true.

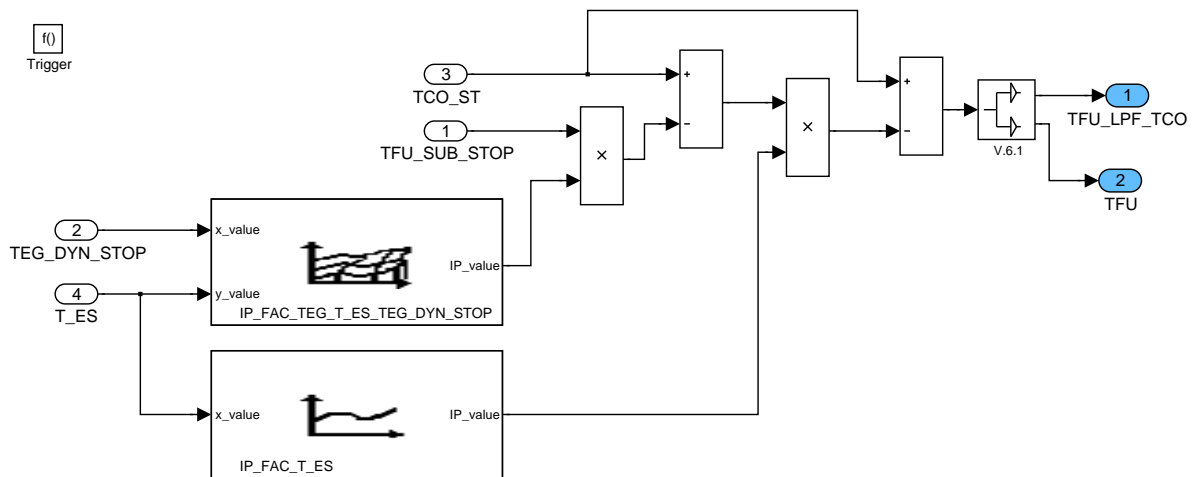


Figure 4.26.13: :

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### 4.26.2.2 FUSL\_M400K/OPERATE/TASK\_1S

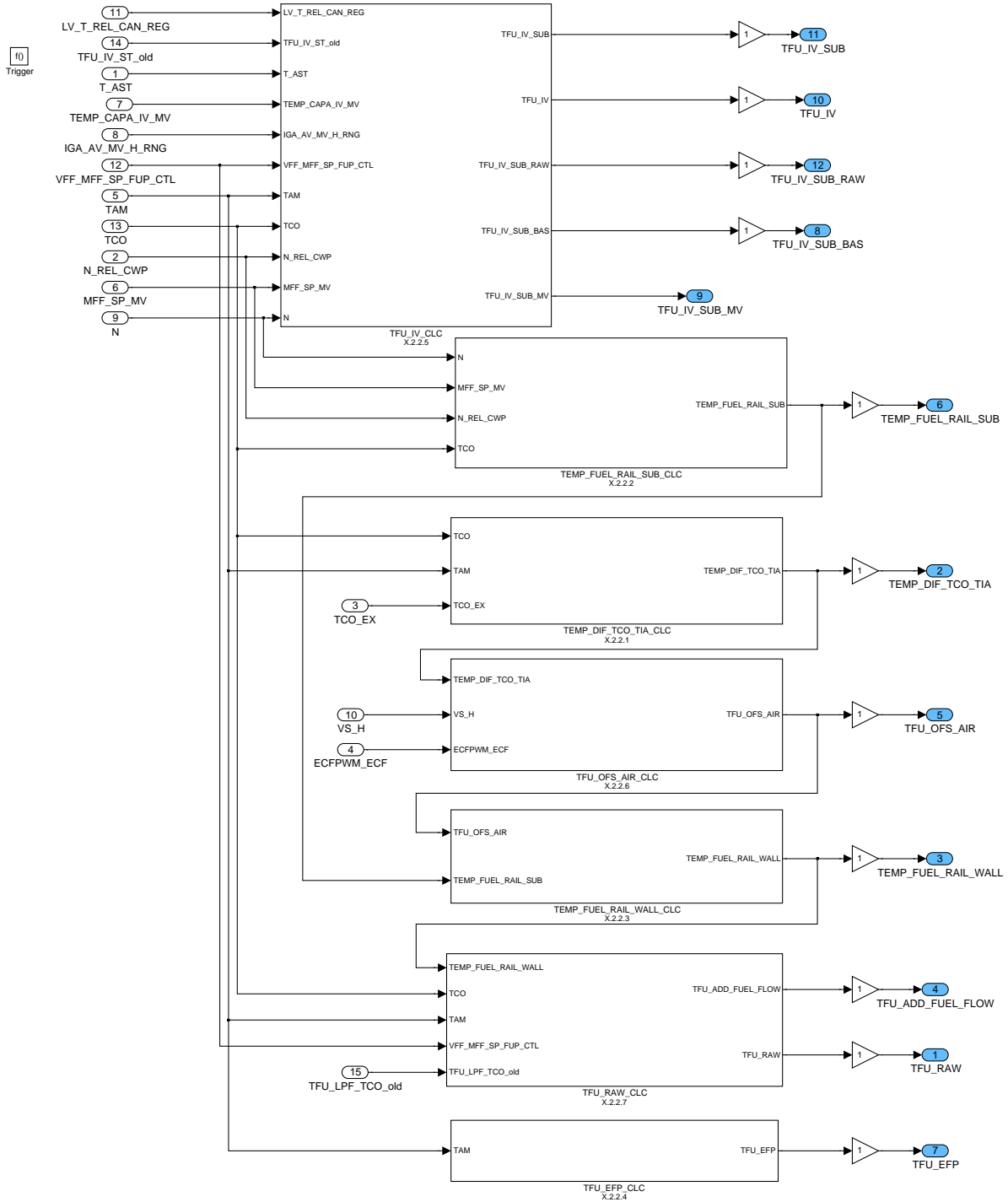


Figure 4.26.14: :

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4.26.2.2.1 FUSL\_M400K/Operate/Task\_1S/TEMP\_DIF\_TCO\_TIA\_CLC

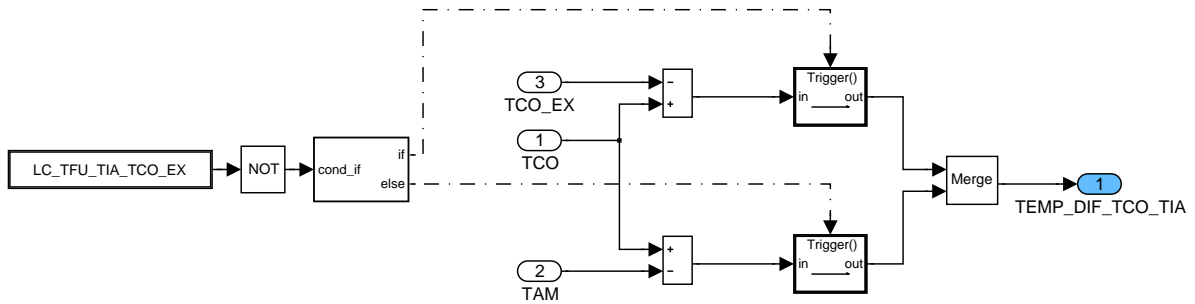


Figure 4.26.15: :

4.26.2.2.2 FUSL\_M400K/Operate/Task\_1S/TEMP\_FUEL\_RAIL\_SUB\_CLC

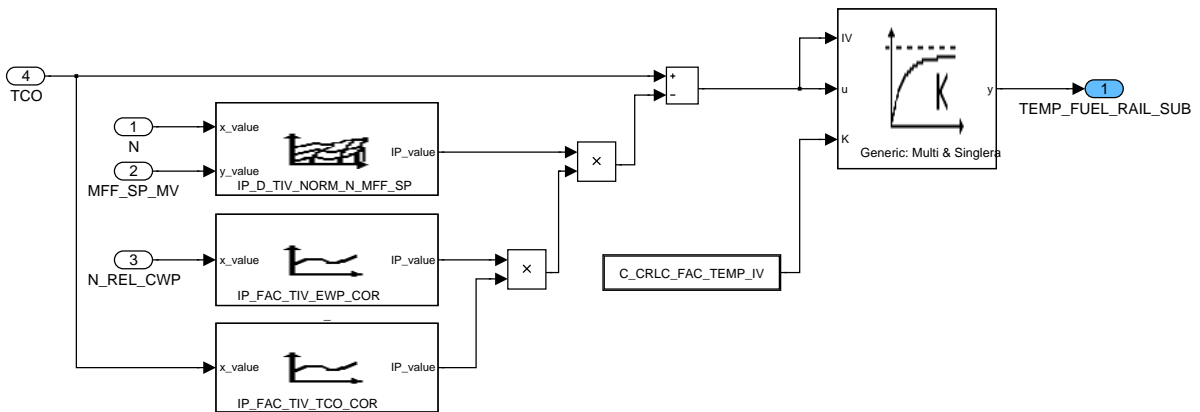


Figure 4.26.16: :

4.26.2.2.3 FUSL\_M400K/Operate/Task\_1S/TEMP\_FUEL\_RAIL\_WALL\_CLC

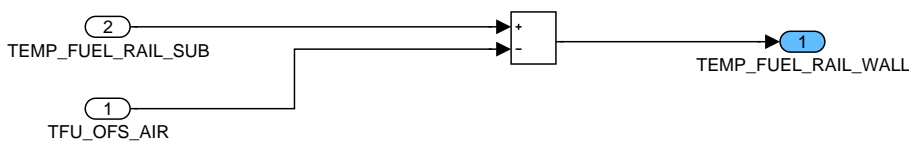


Figure 4.26.17: :

4.26.2.2.4 FUSL\_M400K/Operate/Task\_1S/TFU\_EFP\_CLC

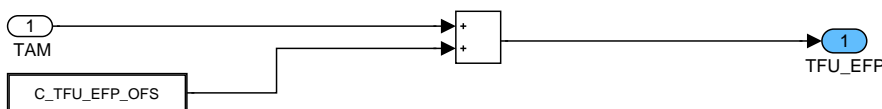



Figure 4.26.18: :

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#### 4.26.2.2.5 FUSL\_M400K/OPERATE/TASK\_1S/TFU\_IV\_CLC

For the calculation of the injection valve temperature, two functions are available, switchable by the logical constant LC\_TEMP\_CAPA\_TFU\_IV\_SWI.

1. - For TFU\_IV\_SUB\_MV a mixed temperature of the heating influence of the combustion chamber and the fuel temperature is calculated. The heating influence of the combustion chamber rests on TCO, MFF\_SP\_MV and ignition angle. The fuel temperature influence is described by TEMP\_CAPA\_IV\_MV (Temperature of the piezo stacks derived from their capacities).

With higher fuel flows through the injectors, the injector temperature is more influenced by the fuel temperature. The modeled injector temperature can be shifted by a fading factor based on the fuel flow to TEMP\_CAPA\_IV\_MV.

The heat up phase of the injector tip during start is faster than the heating of the fuel temperature. During start phase and short after start, the fading function between TEMP\_CAPA\_IV\_MV and TFU\_IV\_SUB\_RAW can be blocked for a certain time by using C\_T\_AST\_SWI\_TFU\_IV.

2. - The second function depends mainly on the coolant temperature, influenced by engine speed, the mass flow through the engine, the ambient temperature and the rpm of the cooling water pump.


The output TFU\_IV\_SUB\_RAW is filtered by a PT1 function. Because of the minimum resolution of the TFU values of 0,75°/digit, the input value of the PT1 is stored internal (not visible) and calculated with an finer resolution of 0,00036°/digit until it reaches the minimum digit.

By using C\_T\_TFU\_IV\_SUB\_RAW\_CLC or C\_T\_TFU\_IV\_SUB\_CLC the calculation recurrence of TFU\_IV\_SUB\_RAW (PT1 funktion) or TFU\_IV\_SUB (GradientLimiter) can be reduced.

The gradient limiters for rising and falling edge, C\_TFU\_IV\_SUB\_LIM\_DEC and C\_TFU\_IV\_SUB\_LIM\_INC have a finer resolution than TFU\_IV\_SUB. It takes several calculation cycles until TFU\_IV\_SUB changes. During this calculation cycles of TFU\_IV\_SUB a internal variable (not visible) is incremented or decremented depending on rising or failing gradient until it reaches the minimum digit of TFU\_IV\_SUB (0.75°C).

If the CAN values are not valid (LV\_T\_REL\_CAN\_REG = 0), TFU\_IV, TFU\_IV\_SUB and TFU\_IV\_SUB\_RAW = TCO.

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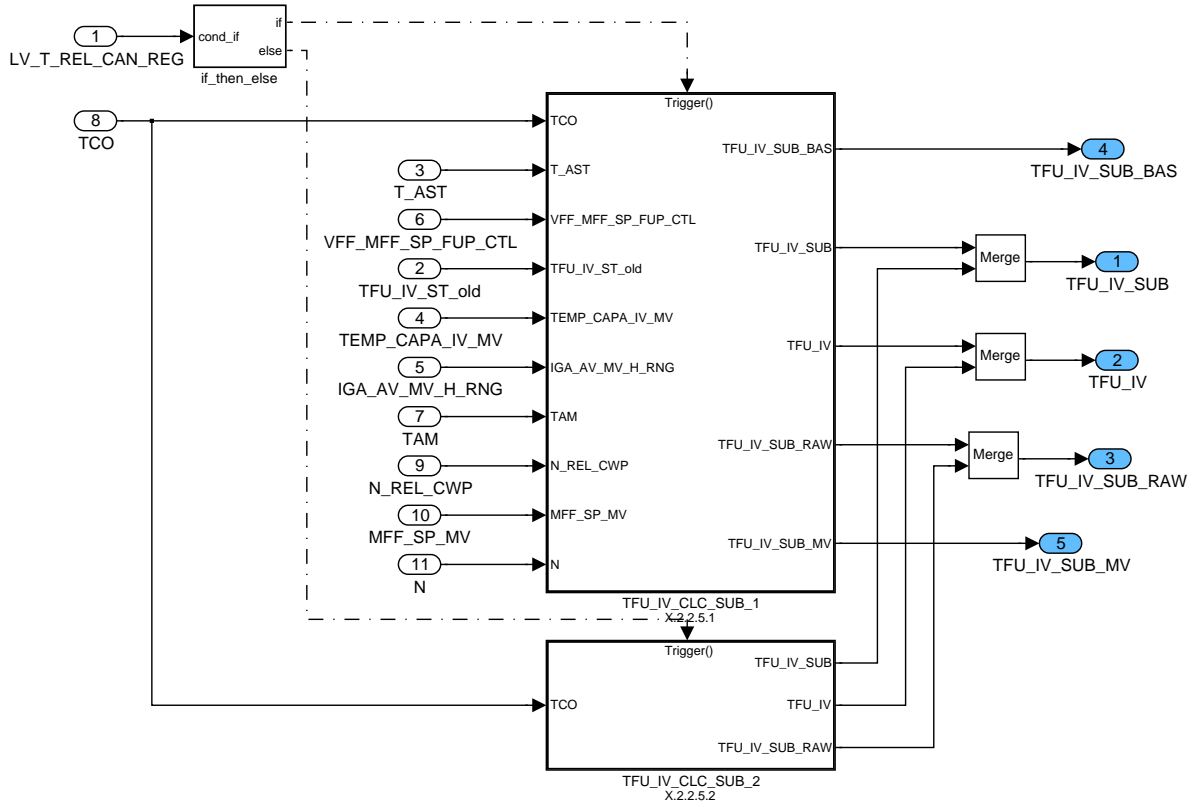


Figure 4.26.19: :

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### 4.26.2.2.5.1 FUSL\_M400K/OPERATE/TASK\_1S/TFU\_IV\_CLC/TFU\_IV\_CLC\_SUB\_1

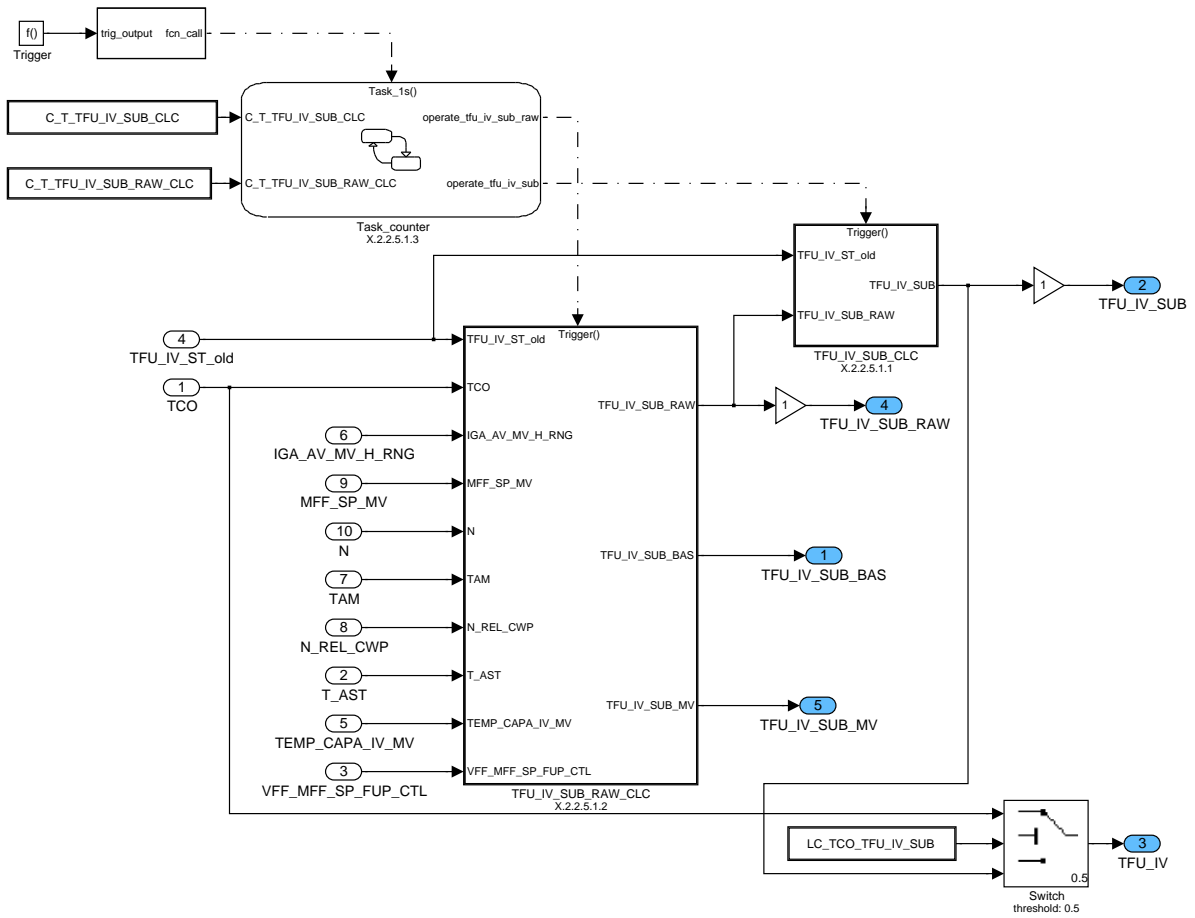


Figure 4.26.20: :

### 4.26.2.2.5.1.1 FUSL\_M400K/Operate/Task\_1S/TFU\_IV\_CLC/TFU\_IV\_CLC\_SUB\_1/TFU\_IV\_SUB\_CLC

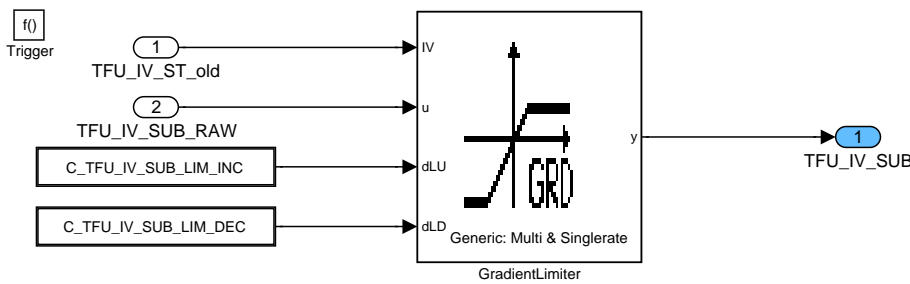


Figure 4.26.21: :

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### 4.26.2.2.5.1.2 FUSL\_M400K/Operate/Task\_1S/TFU\_IV\_CLC/TFU\_IV\_CLC\_SUB\_1/TFU\_IV\_SUB\_RAW\_CLC

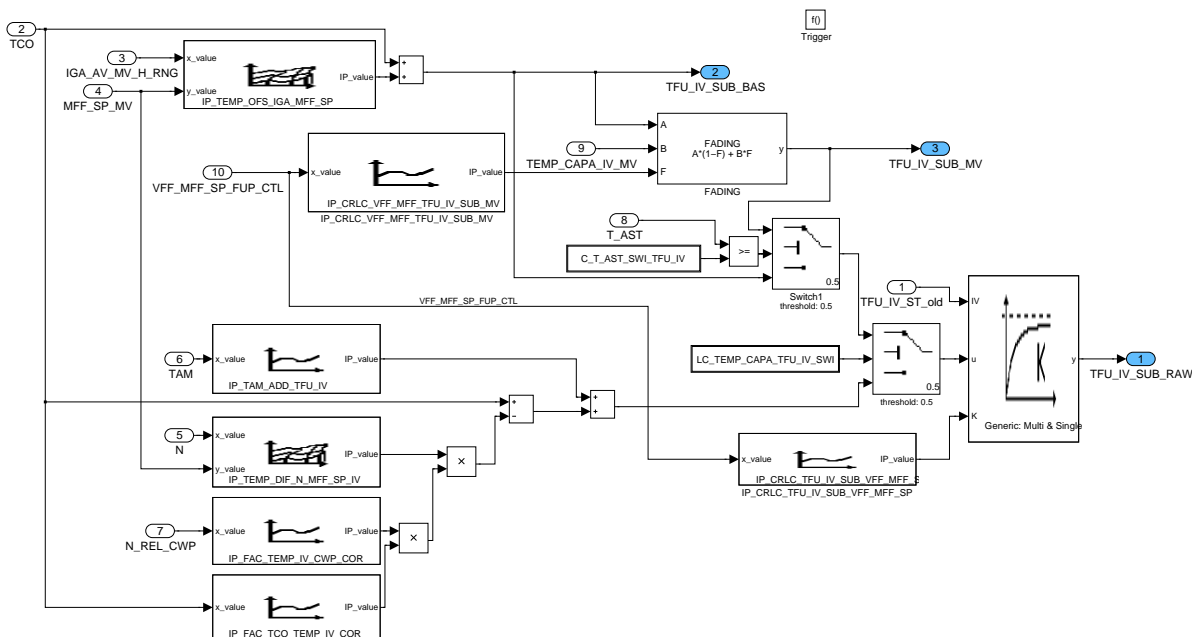


Figure 4.26.22: :

### 4.26.2.2.5.1.3 Task\_counter

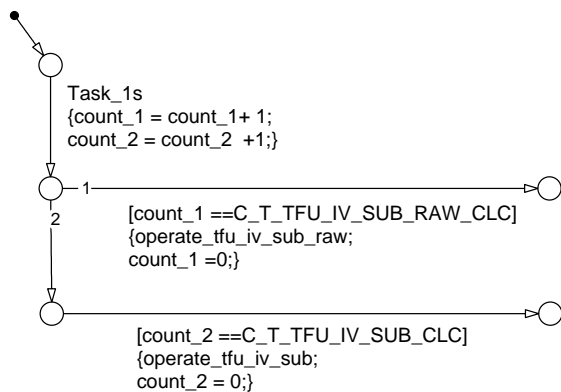


Figure 4.26.23: :

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#### 4.26.2.2.5.2 FUSL\_M400K/Operate/Task\_1S/TFU\_IV\_CLC/TFU\_IV\_CLC\_SUB\_2

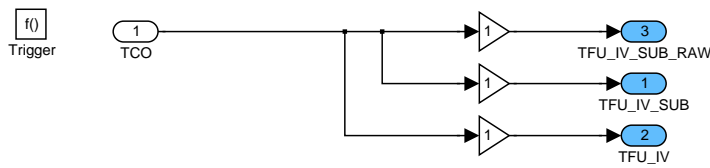


Figure 4.26.24: :

#### 4.26.2.2.6 FUSL\_M400K/OPERATE/TASK\_1S/TFU\_OFS\_AIR\_CLC

Calculation of ambient air influence on fuel temperature due to vehicle speed and electrical cooling fan.

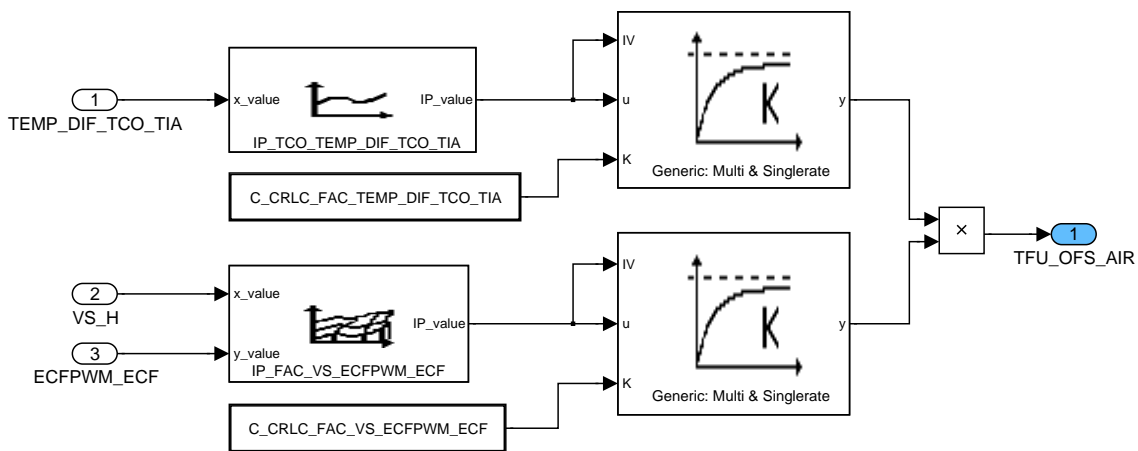


Figure 4.26.25: :

#### 4.26.2.2.7 FUSL\_M400K/OPERATE/TASK\_1S/TFU\_RAW\_CLC

The temperature TFU\_RAW is calculated from the fuel rail wall temperature reduced by the decrease of the temperature due to fuel flow through the fuel rail.

C\_TFU\_RAW\_LIM\_DEC and C\_TFU\_RAW\_LIM\_INC have a finer resolution than TFU\_RAW. It takes several calculation cycles (GradientLimiter) until TFU\_RAW changes. During this calculation cycles of TFU\_RAW the local variable tfu\_raw\_step\_clc is incremented or decremented depending on rising or failing gradient until it reaches the minimum digit of TFU\_RAW (0.75°C). After a step of TFU\_RAW the lasting value of tfu\_raw\_step\_clc will be used for the next calculation.

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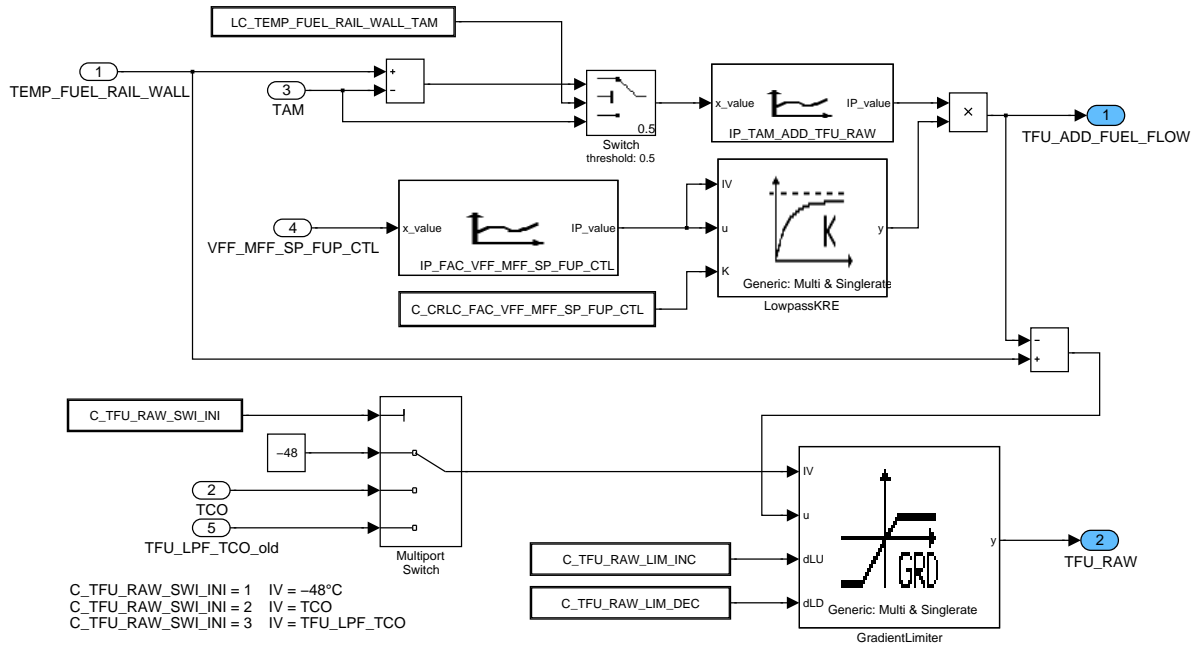


Figure 4.26.26: :

### 4.26.2.3 FUSL\_M400K/OPERATE/TFU\_CLC

Low pass filter of TFU\_RAW to TFU. The initial value TFU\_LPF\_TCO for the low pass filter depends on TCO, the exhaust gas temperature at engine stop, the engine of time and the fuel temperature at engine stop.

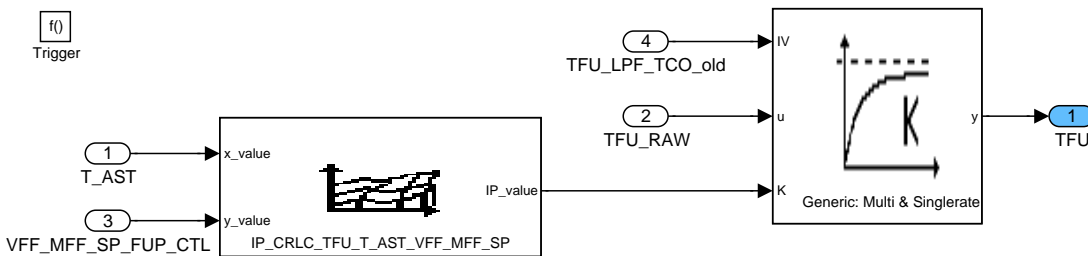


Figure 4.26.27: :

### 4.26.2.4 FUSL\_M400K/OPERATE/TASK\_TFU\_IV\_ES

At engine stop, a modelled injector temperature will be calculated based on TCO. Starting with the last modelled temperatures TFU\_IV\_SUB\_RAW, TFU\_IV\_SUB and TFU\_IV the values were incremented by the value C\_CRLC\_TFU\_IV\_ES until TCO is reached.

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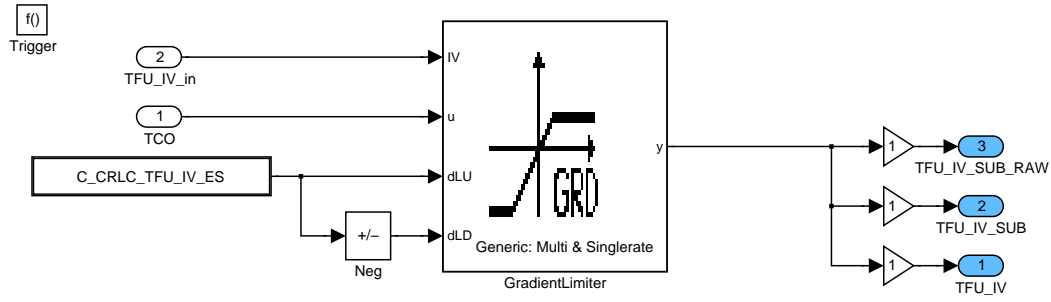



Figure 4.26.28: :

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## 4.27 Exhaust gas temperature

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TEG_PCAT_DOWN [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Exhaust gas temperature upstream of precat					
TEG_PCAT_DOWN_RAW	V	0... 7FFFH	0... 2047.9375	0.0625	K
Exhaust gas temp downstream of pre-catalyst, raw value i.e. not replaced by substitute value, wide range					
TEG_PCAT_DOWN_ST	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Exhaust gas temperature downstream of pre-catalyst at engine start					
TEG_PCAT_DOWN_WIDE_RNG	V	0... 7FFFH	0... 2047.9375	0.0625	K
Exhaust gas temperature downstream of pre-catalyst with wide range, unit: Kelvin					
TEG_PCAT_DOWN_WIDE_RNG_ST	O/V	0... 7FFFH	0... 2047.9375	0.0625	K
Exhaust gas temperature downstream of pre-catalyst at engine start with wide range, unit: Kelvin					
VP_TEG_PCAT_DOWN	O/V	0... 7FFFH	0... 4.99984	152.6e-6	V
Catalyst temperature sensor raw acquisition					

### Input data:

LV_ERR_PREL_TEG_PCAT_DOWN {p. 4713}	LV_ERR_TEG_PCAT_DOWN {p. 4713}	LV_IGK {p. 906}	MAF_KGH {p. 1195}
TEG_CAT_DOWN_MDL {p. 8236}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TEG_PCAT_DOWN_ADD_ERR	-	0... FFH	0... 510	2	°C
Additional offset on the temperature model in case of sensor error					
C_TEG_PCAT_DOWN_ST_INI	-	0... FFFFH	0... 1023.98437	0.015625	°C
Initialisation value of TEG_PCAT_DOWN_ST_i used in case of sensor error					
IP_TEG_VP_TEG	-	0... FFFFH	0... 1023.98437	0.015625	°C
LDP_VP_TEG_TEG	16	0... 7FFFH	0... 4.99984	152.6e-6	V
conversion table of exhaust gas temp.					
IP_TEG_WIDE_RNG_VP_TEG	-	0... FFFFH	0... 2047.96875	0.03125	K
LDP_VP_TEG_TEG_WIDE_RNG	8	0... 7FFFH	0... 4.99985	0.0001526	V
conversion table of exhaust gas temp. with extended range					

### Configuration data:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_TEG_SENS	-	1... 6H	1...6	1	-
number of exhaust gas temperature sensor in system					

### Import actions:

**ACTION\_INFR\_GetVpTeg** (IN<No Name available>,OUT<No Name available>)

### 4.27.1 Aquisition of VP\_TEG\_PCAT\_DOWN

**Sampling Rate:** Ta = 0.1sec

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### Application conditions

**Activation:** always calculated

**Deactivation:** -

#### Global configuration data

Data	Value
NC_NR_TEG_SENS	1

ACTION\_INFR\_GetVpTeg(1,VP\_TEG\_PCAT\_DOWN)

// all sensor values are imported and provided as output

## 4.27.2 Calculation of Exhaust Gas Temperatures

### General information:

The exhaust gas temperature sensor acquisition is suitable for single branch (only one exhaust bank) and twin branch exhaust lines (two exhaust banks).

For a twin branch exhaust line the exhaust gas temp. acquisition has the same structure for both exhaust lines. To differentiate variables and calibration data the **index i** is used:

**i = 1** refers to temp. sensor in the first branch of a twin branch exhaust line or the temp. sensor in a single branch exhaust line

**i = 2** refers to temp. sensor in the second branch of a twin branch exhaust line

This version is intended for an engine with a configuration that uses one temperature sensor. The exhaust gas temp. downstream of pre-cat.). TEG\_PCAT\_DOWN is used for the temperature modelling of the NOx catalyst monolith temperature (for GDI engine).

TEG\_PCAT\_DOWN\_ST is the exhaust gas temperature at engine start used for dew point calculation of the NOx catalyst.

As the range of TEG\_PCAT\_DOWN and TEG\_PCAT\_DOWN\_ST is limited to 0..1024°C, TEG\_PCAT\_DOWN\_WIDE\_RNG and TEG\_PCAT\_DOWN\_WIDE\_RNG\_ST are calculated in a similar manner with a range of 0..2048K (equals -273..1775°C) to provide information about subzero and very high temperatures.

**Sampling Rate:** Ta = 0.1sec

### Application conditions

**Activation:** Ignition on LV\_IGK = 1

**Deactivation:** Ignition off LV\_IGK = 0

### Initialisation:

At the transition LV\_IGK 0 -> 1 (including reset) TEG\_PCAT\_DOWN\_RAW is initialised with IP\_TEG\_WIDE\_RNG\_VP\_TEG(VP\_TEG\_PCAT\_DOWN). In that way the value TEG\_PCAT\_DOWN\_RAW is available for the module "Exhaust gas temperature sensor diagnosis (TEG)" to make the "Plausibility

check: Cold start". That is necessary since the module "Exhaust gas temperature sensor diagnosis (TEG)" must have been performed since a valid LV\_ERR\_PREL\_TEG\_PCAT\_DOWN is needed to determine TEG\_PCAT\_DOWN\_ST and TEG\_PCAT\_DOWN\_WIDE\_RNG\_ST.

At the first calculation of the module "Exhaust gas temperature" and at transition

LV\_ES 1 -> 0 TEG\_PCAT\_DOWN\_ST and TEG\_PCAT\_DOWN\_WIDE\_RNG\_ST are initialised:

```

If LV_ERR_PREL_TEG_PCAT_DOWN = 0
  Then
    TEG_PCAT_DOWN_ST = IP_TEG__VP_TEG(VP_TEG_PCAT_DOWN)
    TEG_PCAT_DOWN_WIDE_RNG_ST =
      IP_TEG_WIDE_RNG__VP_TEG(VP_TEG_PCAT_DOWN)
  Else
    TEG_PCAT_DOWN_ST = C_TEG_PCAT_DOWN_ST_INI
    TEG_PCAT_DOWN_WIDE_RNG_ST = TEG_PCAT_DOWN_ST
End

```

### **FUNCTION DESCRIPTION:**

The voltage VP\_TEG\_PCAT\_DOWN is converted with a linear interpolation to an exhaust gas temperature downstream of the pre-catalyst TEG\_PCAT\_DOWN / TEG\_PCAT\_DOWN\_WIDE\_RNG.

The logical variable LV\_ERR\_PREL\_TEG\_PCAT\_DOWN indicates a signal out of the specified range (short to ground or short to UB or line broken) or a not plausible temperature value. If active (LV\_ERR\_PREL\_TEG\_PCAT\_DOWN = 1), the last valid temperature value is frozen until the error is debounced (LV\_ERR\_TEG\_PCAT\_DOWN = 1) or until a valid temp. value is obtained again.

With debounced error (LV\_ERR\_TEG\_PCAT\_DOWN = 1) a substitute value TEG\_CAT\_DOWN\_MDL is assigned.

In normal operating mode (LV\_ERR\_PREL\_PCAT\_DOWN = 0 and LV\_ERR\_PCAT\_DOWN = 0) the temperature depends on the temperature sensor voltage via map.

### **Formula section:**

$$TEG\_PCAT\_DOWN\_RAW_N = IP\_TEG\_WIDE\_RNG\_VP\_TEG(VP\_TEG\_PCAT\_DOWN_N)$$

```
If LV_ERR_TEG_PCAT_DOWN = 1
```

```
Then
```

```
  TEG_PCAT_DOWN_1 = TEG_CAT_DOWN_MDL - C_TEG_PCAT_DOWN_ADD_ERR
```

```
  TEG_PCAT_DOWN_2 = TEG_PCAT_DOWN_1
```

```
  TEG_PCAT_DOWN_WIDE_RNG = TEG_PCAT_DOWN_1
```

```
Else
```

```
  If LV_ERR_PREL_TEG_PCAT_DOWN = 1
```

```
    Then
```

```
      TEG_PCAT_DOWN_1_N = TEG_PCAT_DOWN_1_{N-1}
```

```
      TEG_PCAT_DOWN_2_N = TEG_PCAT_DOWN_2_{N-1}
```

```
      TEG_PCAT_DOWN_WIDE_RNG_N = TEG_PCAT_DOWN_WIDE_RNG_{N-1}
```

```
    else
```


```
      TEG_PCAT_DOWN_1_N = IP_TEG__VP_TEG
```

```
      TEG_PCAT_DOWN_2_N = TEG_PCAT_DOWN_1_N
```

```
      TEG_PCAT_DOWN_WIDE_RNG_N = IP_TEG_WIDE_RNG__VP_TEG
```

```
    end
```

```
end
```

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## 4.28 ECU temperature

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_STC_TECU_1	O/V/S	0... FFFFFFFFH	0... 4294970000	1	-
statistic counter 1 for TECU monitoring					
CTR_STC_TECU_2	O/V/S	0... FFFFFFFFH	0... 4294970000	1	-
statistic counter 2 for TECU monitoring					
CTR_STC_TECU_3	O/V/S	0... FFFFFFFFH	0... 4294970000	1	-
statistic counter 3 for TECU monitoring					
CTR_STC_TECU_4	O/V/S	0... FFFFFFFFH	0... 4294970000	1	-
statistic counter 4 for TECU monitoring					
CTR_STC_TECU_5	O/V/S	0... FFFFFFFFH	0... 4294970000	1	-
statistic counter 5 for TECU monitoring					
CTR_STC_TECU_6	O/V/S	0... FFFFFFFFH	0... 4294970000	1	-
statistic counter 6 for TECU monitoring					
CTR_STC_TECU_7	O/V/S	0... FFFFFFFFH	0... 4294970000	1	-
statistic counter 7 for TECU monitoring					
CTR_STC_TECU_8	O/V/S	0... FFFFFFFFH	0... 4294970000	1	-
statistic counter 8 for TECU monitoring					
LV_V_TECU_VLD	O/V	0... 1H	0 ...1	1	-
Flag indicating that a valid VP_TECU value is available at MU					
TECU	O/V	0... FEH	0... 142.5	0.75	°C
ECU temperature					
TECU_MC	O/V	0... FEH	0... 142.5	0.75	°C
Microcontroller temperature					
V_TECU_MC	O/V	0... 7FFFH	0... 4.99984741	15.25879e3	V
Voltage of microcontroller temperature sensor					
VP_TECU	O/V	0... 7FFFH	0... 4.99984741	15.25879e3	V
Voltage of ECU temperature sensor					

### Input data:

LV_ERR_TECU {p. 4237}	LV_ES {p. 1720}	LV_IGK {p. 906}	TRT {p. 1504}
-----------------------	-----------------	-----------------	---------------

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TECU_SUB	-	0... FEH	0... 142.5	0.75	°C
TECU substitute value					
C_TECU_THD_1	-	0... FEH	0... 142.5	0.75	°C
ETCU threshold 1 (init. Value: 40°C)					
C_TECU_THD_2	-	0... FEH	0... 142.5	0.75	°C
ETCU threshold 2 (init. Value: 50°C)					
C_TECU_THD_3	-	0... FEH	0... 142.5	0.75	°C
ETCU threshold 3 (init. Value: 60°C)					
C_TECU_THD_4	-	0... FEH	0... 142.5	0.75	°C
ETCU threshold 4 (init. Value: 70°C)					
C_TECU_THD_5	-	0... FEH	0... 142.5	0.75	°C
ETCU threshold 5 (init. Value: 85°C)					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TECU_THD_6	-	0... FEH	0... 142.5	0.75	°C
ETCU threshold 6 (init. Value: 100°C)					
C_TECU_THD_7	-	0... FEH	0... 142.5	0.75	°C
ETCU threshold 7 (init. Value: 115°C)					
C_TRT_DIF_TECU	-	0... FFFFFFFFH	0... 119305	277.778e3	h
TRT difference for ETCU statistic (init. value: 0,08333h)					
IP_TECU	-	0... FEH	0... 142.5	0.75	°C
LDP_VP_TECU__TECU	16	0... 7FFFH	0... 4.99984	15.26e3	V
NTC characteristic					
LC_TECU_SWI	-	0... 1H	0 ...1	1	-
Selection of TECU source					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_TECU_MC_OFS	-	0... 7FFFH	0... 1023.97	0.03125	°C
Offset of conversion from voltage to temperature of microcontroller					
NC_TECU_MC_SLOP	-	0... FFFFH	0... 0.99998474	152.588e3	-
Slope of conversion from voltage to temperature of microcontroller					

**Import actions:**

<b>ACTION_INFR_GetVpTecu</b> (OUT<Vp_tecu_sens>)
<b>ACTION_INFR_GetVTecuMc</b> (OUT<V_tecu_mc_sens>)

**4.28.1 ECU temperature TECU:**

The ECU temperature is measured through an A/D converter. The software then is generating a modified sensor signal (VP\_TECU), which is requested by the application software for further execution.

The conversion into physical values is made through the nonlinear characteristic IP\_TECU. In case of a present fault of the TECU sensor a substitute value will be used.

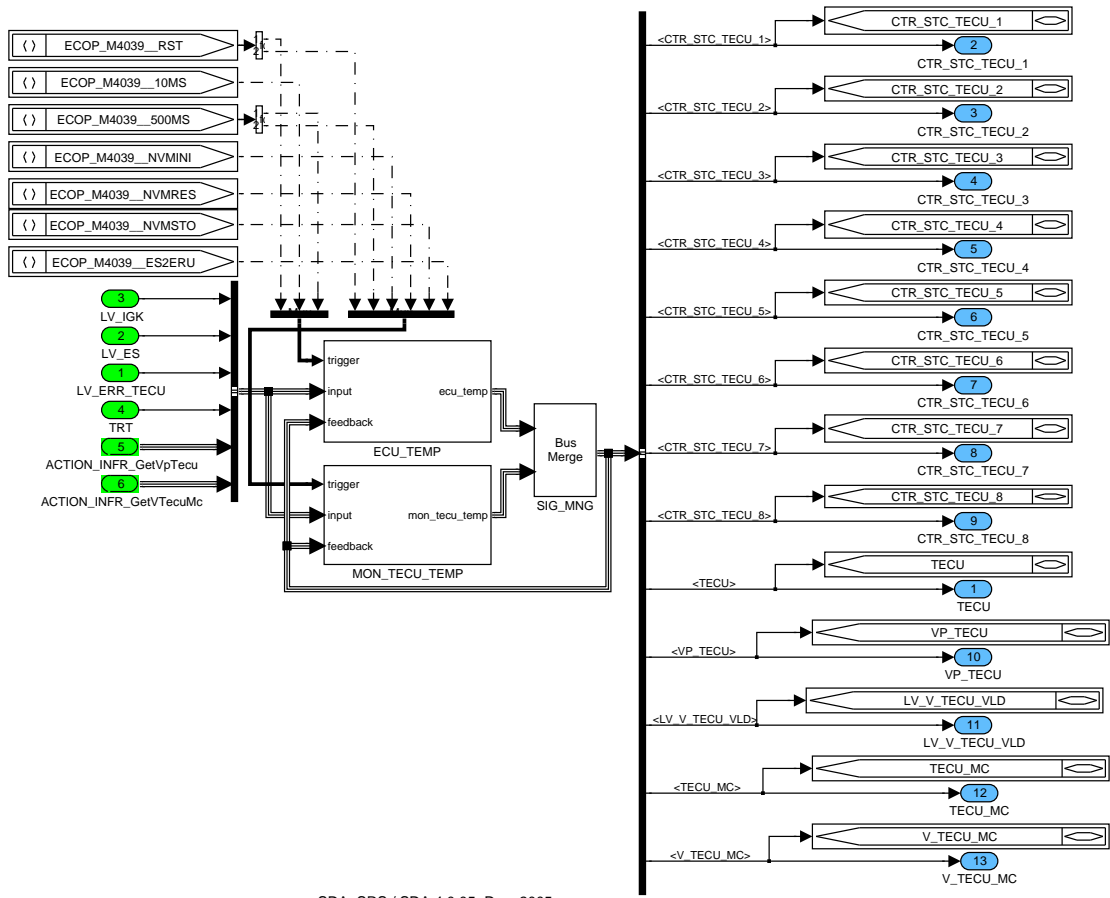
By request (LC\_TECU\_SWI) the source for the TECU calculation can switch between IP\_TECU(VP\_TECU) and TECU\_MC.

Here are listed the configuration data:

Data	Value
NC_TECU_MC_SLOP	190 °C/V *
NC_TECU_MC_OFS	231.9 °C

\*Note: For SW calculation purposes NC\_TECU\_MC\_SLOP = 0.028992584

**Function Description**



SDA\_SRS / SDA 4.0 05-Dec-2005

Figure 4.28.1: ECOP\_M4039

### 4.28.1.1 ECU Temperature Calculations

#### Determination of TECU\_MES in case of an/no TECU error

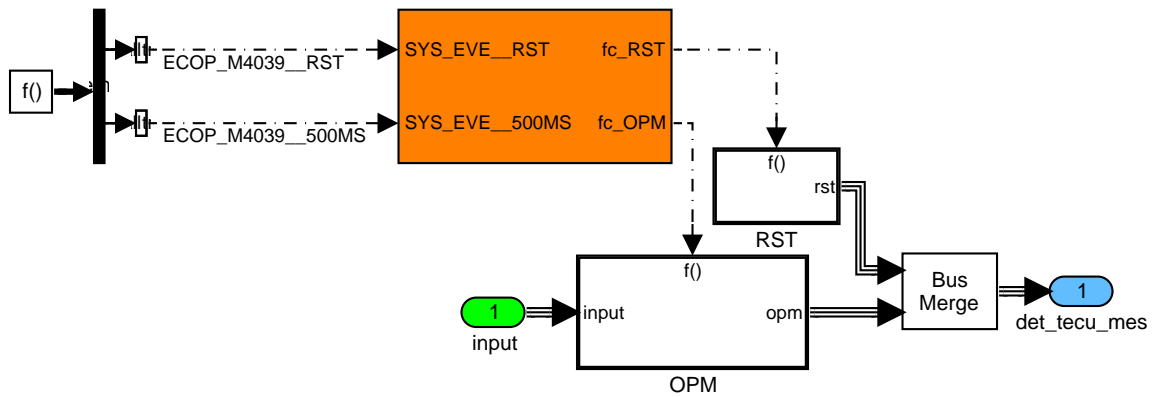



Figure 4.28.2: ECOP\_M4039/ECU\_TEMP/DET\_TECU\_MES

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**Application Condition**

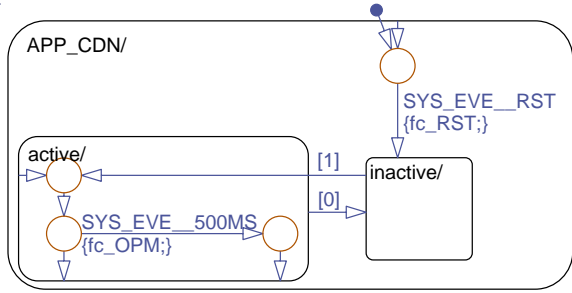


Figure 4.28.3: ECOP\_M4039/ECU\_TEMP/DET\_TECU\_MES/CHAPTER\_1/Chart

**Initialisation at "reset" event**

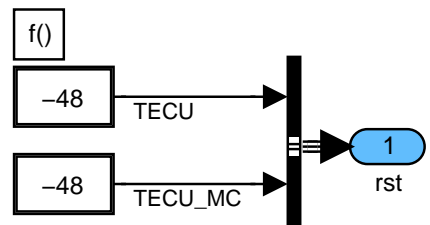


Figure 4.28.4: ECOP\_M4039/ECU\_TEMP/DET\_TECU\_MES/RST

**Formula Section**

**Calculation V\_TECU\_MC , VP\_TECU, TECU and TECU\_MC**

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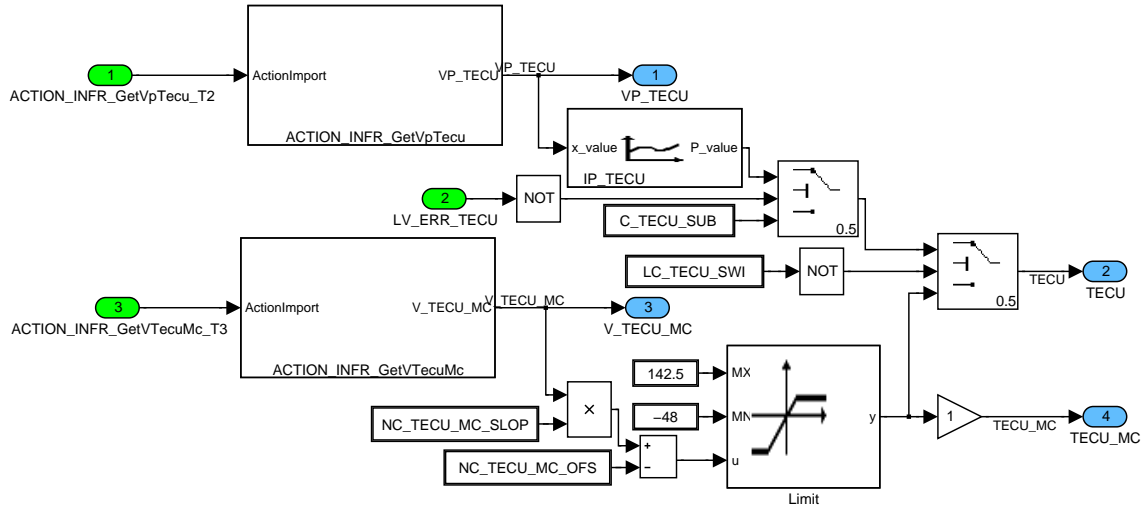


Figure 4.28.5: ECOP\_M4039/ECU\_TEMP/DET\_TECU\_MES/OPM/CLC

**Detection of valid value of V\_TECU (as an interface to VVL functionalites)**

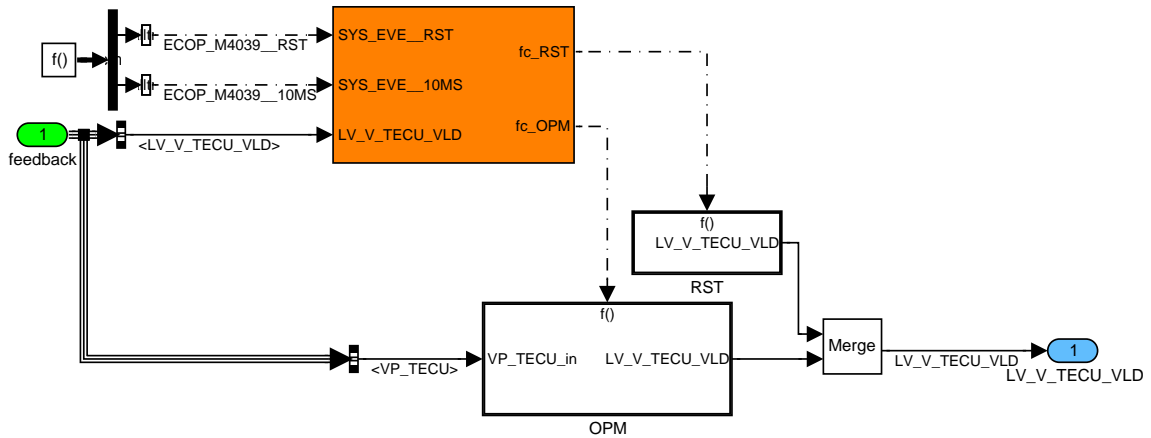


Figure 4.28.6: ECOP\_M4039/ECU\_TEMP/DET\_VLD\_V\_TECU

**Application condition**

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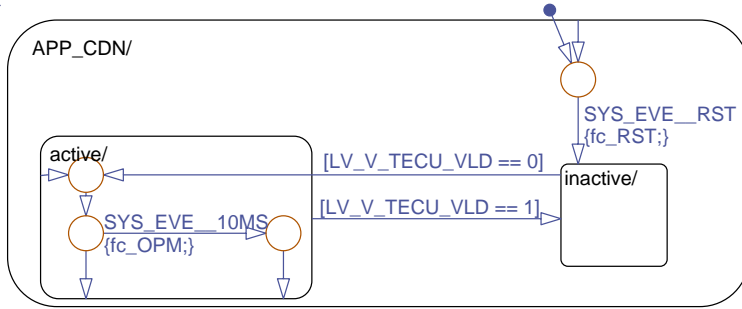


Figure 4.28.7: ECOP\_M4039/ECU\_TEMP/DET\_VLD\_V\_TECU/CHAPTER\_2/Chart

**Initialisation at "reset" event**



Figure 4.28.8: ECOP\_M4039/ECU\_TEMP/DET\_VLD\_V\_TECU/RST

**Formula Section : Calculation of LV\_V\_TECU\_VLD**

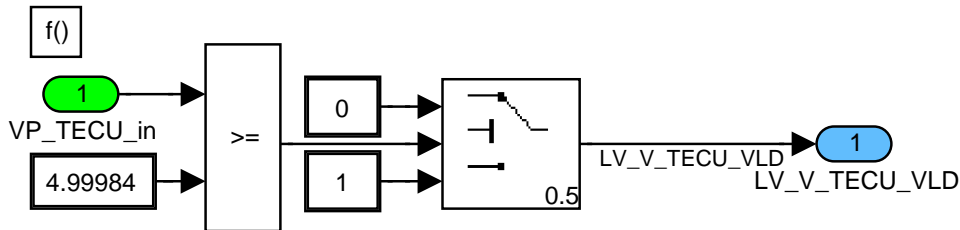


Figure 4.28.9: ECOP\_M4039/ECU\_TEMP/DET\_VLD\_V\_TECU/OPM

**4.28.1.2 Monitoring of the ECU - Temperature**

This function should provide a statistical statement, how often the ECU temperature is in a defined temperature band. After a calibratable time the ECU temperature will be checked in which temperature band is the ECU. Then, the corresponding counter is incremented.

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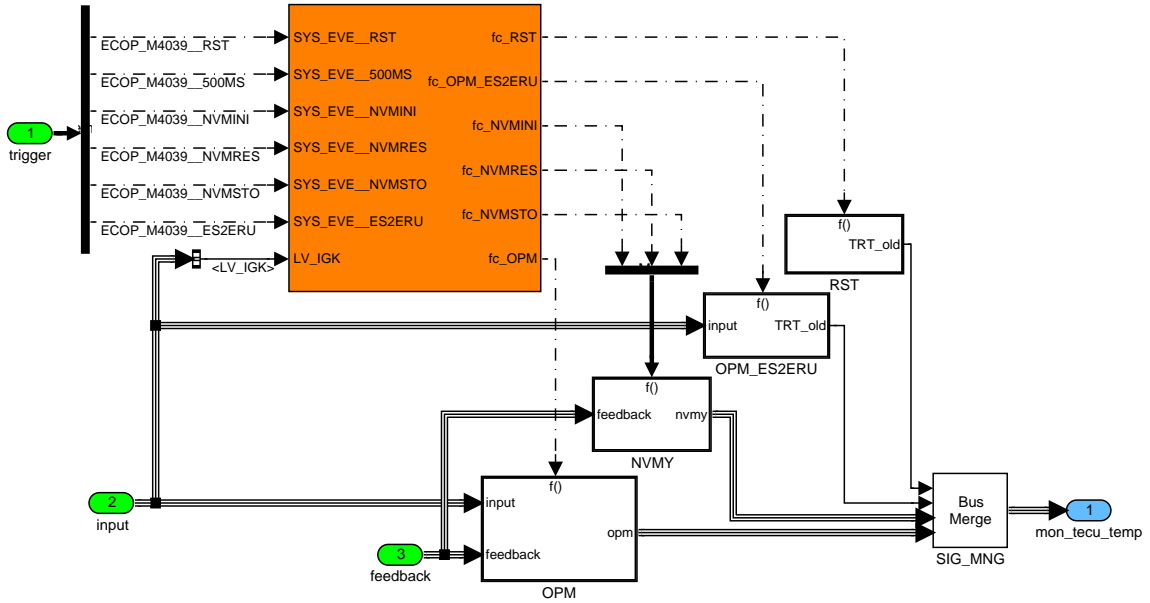


Figure 4.28.10: ECOP\_M4039/MON\_TECU\_TEMP

**Application condition**

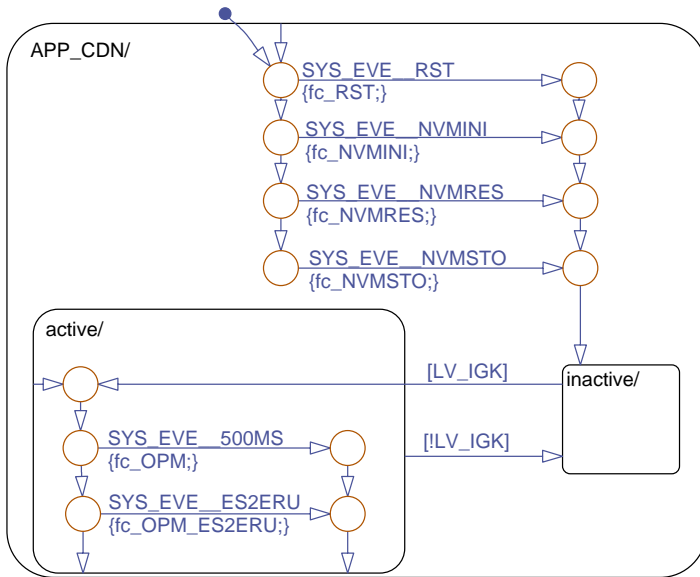


Figure 4.28.11: ECOP\_M4039/MON\_TECU\_TEMP/ECOP\_3/Chart

**Initialisation of TRT\_old**

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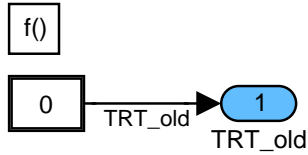


Figure 4.28.12: ECOP\_M4039/MON\_TECU\_TEMP/RST

**Initialisation at system event ES2ERU**

**Assignment of TRT to TRT\_old at system event ES2ERU**

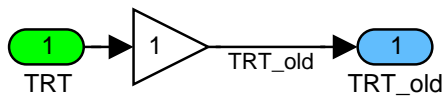


Figure 4.28.13: ECOP\_M4039/MON\_TECU\_TEMP/OPM\_ES2ERU/INI

**Initialisations at system events related to NVMY**

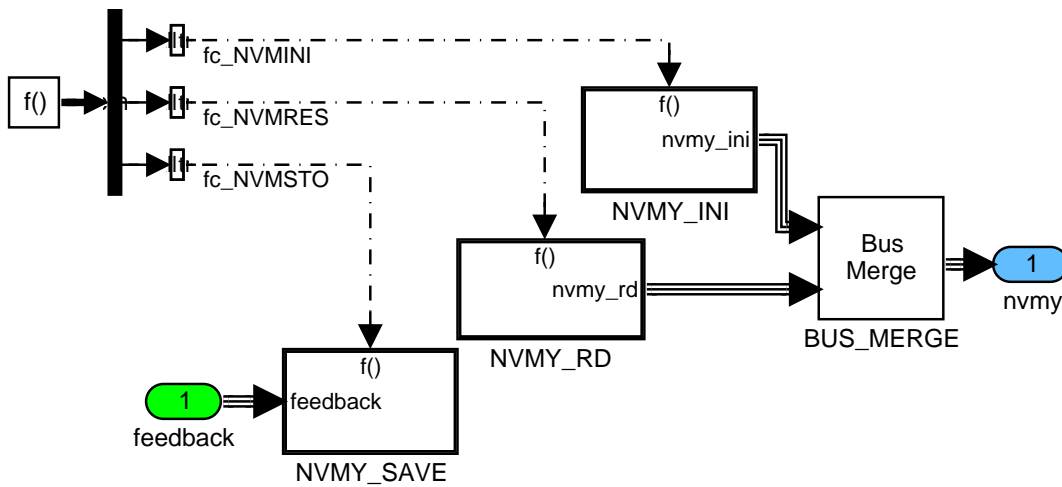



Figure 4.28.14: ECOP\_M4039/MON\_TECU\_TEMP/NVMY

**Formula Section**

**Condition check for the counter calculations**

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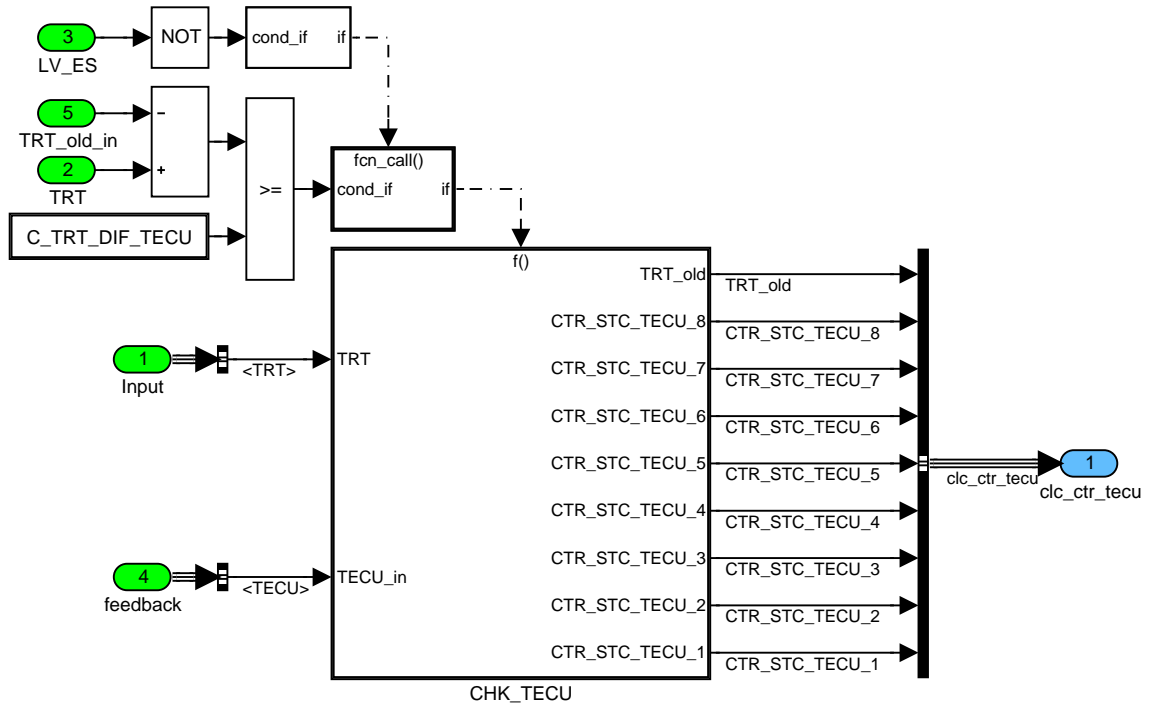


Figure 4.28.15: ECOP\_M4039/MON\_TECU\_TEMP/OPM/CLC\_CTR\_TECU

**Calculation of statistical counters**

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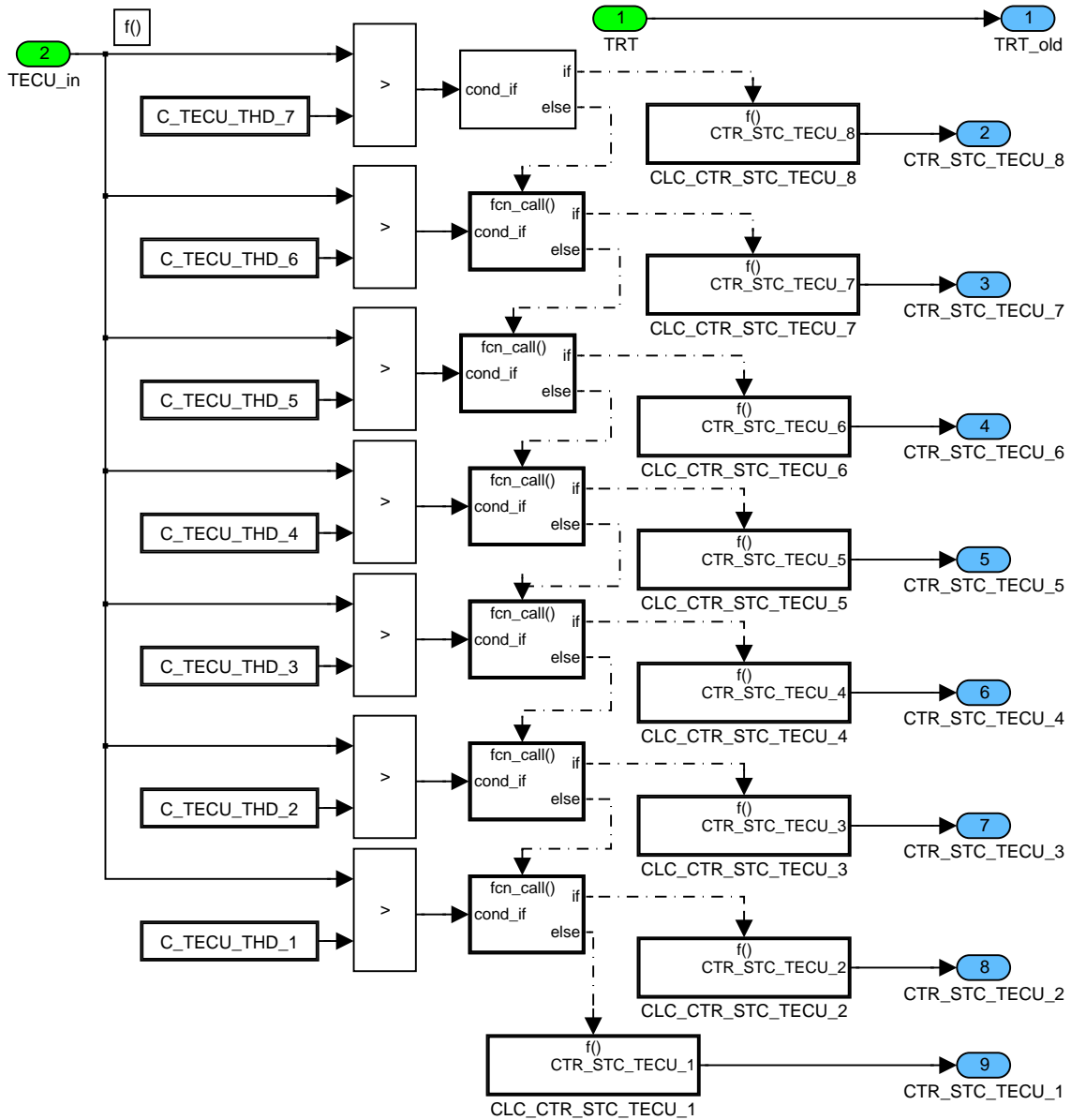


Figure 4.28.16: ECOP\_M4039/MON\_TECU\_TEMP/OPM/CLC\_CTR\_TECU/CHK\_TECU

### Calculation of statistical counter 8

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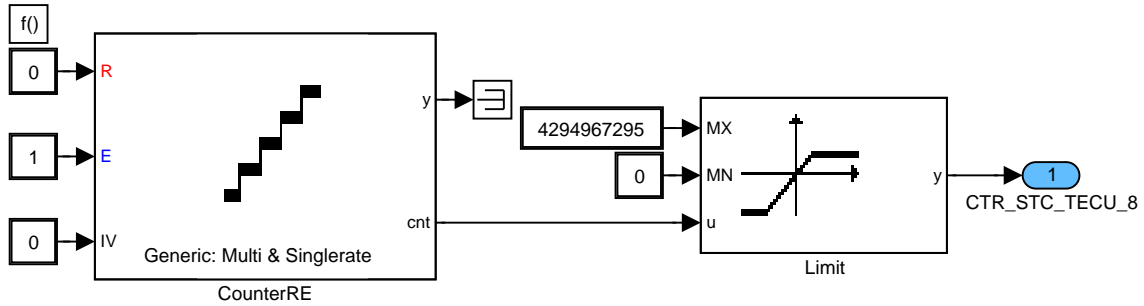


Figure 4.28.17:  
ECOP\_M4039/MON\_TECU\_TEMP/OPM/CLC\_CTR\_TECU/CHK\_TECU/CLC\_CTR\_STC\_TECU\_8

**Calculation of statistical counter 7**

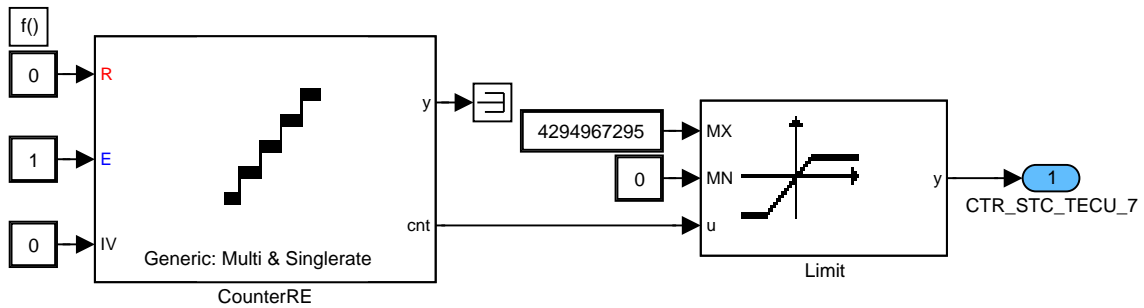


Figure 4.28.18:  
ECOP\_M4039/MON\_TECU\_TEMP/OPM/CLC\_CTR\_TECU/CHK\_TECU/CLC\_CTR\_STC\_TECU\_7

**Calculation of statistical counter 6**

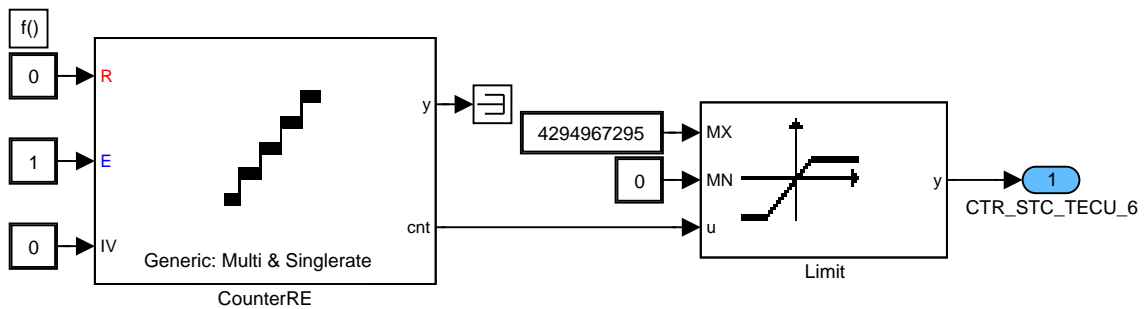


Figure 4.28.19:  
ECOP\_M4039/MON\_TECU\_TEMP/OPM/CLC\_CTR\_TECU/CHK\_TECU/CLC\_CTR\_STC\_TECU\_6

**Calculation of statistical counter 5**

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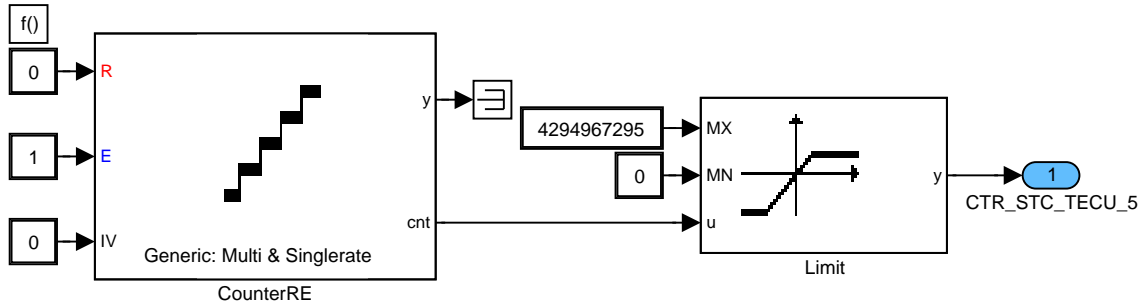


Figure 4.28.20:  
ECOP\_M4039/MON\_TECU\_TEMP/OPM/CLC\_CTR\_TECU/CHK\_TECU/CLC\_CTR\_STC\_TECU\_5

**Calculation of statistical counter 4**

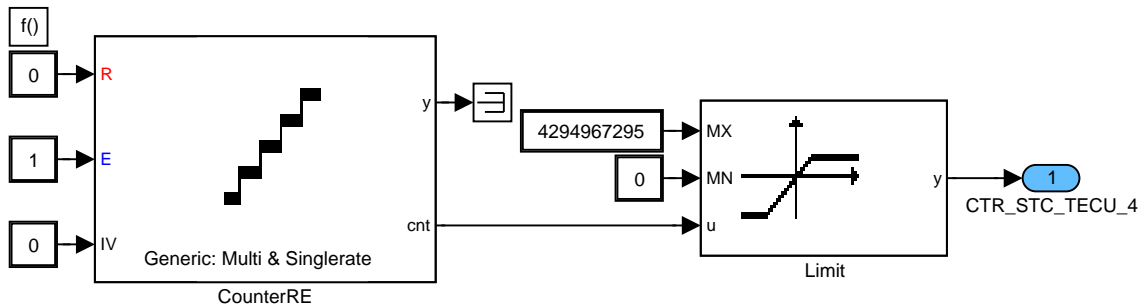


Figure 4.28.21:  
ECOP\_M4039/MON\_TECU\_TEMP/OPM/CLC\_CTR\_TECU/CHK\_TECU/CLC\_CTR\_STC\_TECU\_4

**Calculation of statistical counter 3**

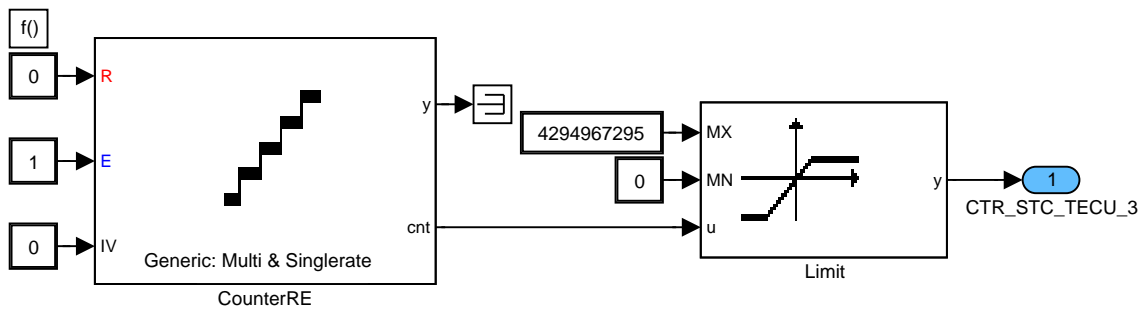


Figure 4.28.22:  
ECOP\_M4039/MON\_TECU\_TEMP/OPM/CLC\_CTR\_TECU/CHK\_TECU/CLC\_CTR\_STC\_TECU\_3

**Calculation of statistical counter 2**

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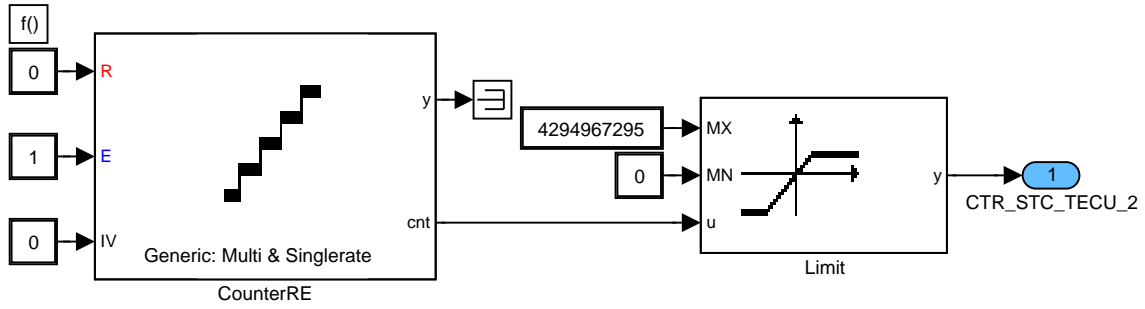


Figure 4.28.23:  
ECOP\_M4039/MON\_TECU\_TEMP/OPM/CLC\_CTR\_TECU/CHK\_TECU/CLC\_CTR\_STC\_TECU\_2

**Calculation of statistical counter 1**

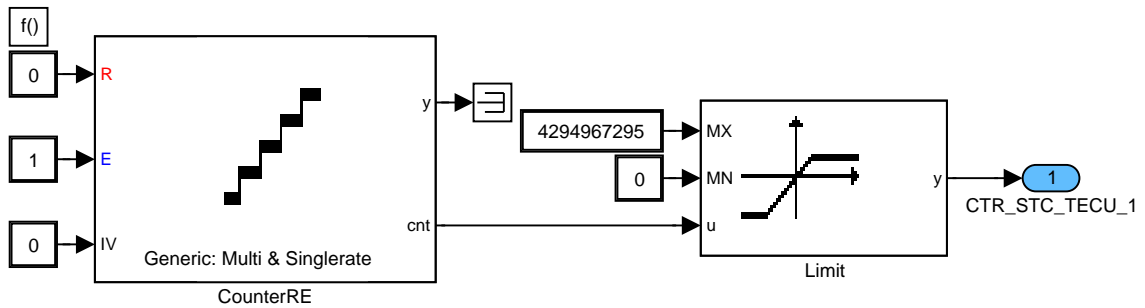


Figure 4.28.24:  
ECOP\_M4039/MON\_TECU\_TEMP/OPM/CLC\_CTR\_TECU/CHK\_TECU/CLC\_CTR\_STC\_TECU\_1

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## 4.29 Pedal value sensor variables

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_PV_BAS_COR	V	8000... 7FFFH	-1... 0.99996	30.5e-6	-
basic correction					
FAC_PV_COR	V	0... 7FFFH	0... 0.99996	30.5e-6	-
Summation of corrections					
FAC_PV_CS_COR	V	8000... 7FFFH	-1... 0.99996	30.5e-6	-
Starting correction					
FAC_PV_GS_COR	V	8000... 7FFFH	-1... 0.99996	30.5e-6	-
Gear shift correction					
LV_KD	O/V	0... 1H	0...1	1	-
Flag for Kick-Down-Recognition (internally recognized from both PVS-voltages)					
PV_AV	O/V	0... FFH	0... 99.60937	0.390625	%
Corrected pedal value interpretation					
PV_AV_1	O/V	0... FFH	0... 99.60937	0.390625	%
degree of activation of the accelerator pedal from PVS-channel 1					
PV_AV_2	O/V	0... FFH	0... 99.60937	0.390625	%
degree of activation of the accelerator pedal from PVS-channel 2					
PV_AV_GRD	O/V	0... FFH	-1250... 1240.23437	9.765625	%/s
Pedal value gradient					
PV_AV_RAW	O/V	0... FFH	0... 99.60937	0.390625	%
Global degree of activation of the gas pedal					
PV_CRU	O/V	0... FFH	0... 99.60937	0.390625	%
Pedal value interpretation of Cruise control					
PV_CRU_1	V	0... FFH	0... 99.60937	0.390625	%
Pedal value interpretation of Cruise control temporary					
PV_CRU_RAW	V	0... FFH	0... 99.60937	0.390625	%
Pedal value interpretation of Cruise control rawsignal					
PV_CUS	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Corrected pedal value interpretation with higher resolution for customer purpose					
PV_CUS_1	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
degree of activation of the accelerator pedal from PVS-channel 1 with higher resolution for customer purposes					
PV_CUS_2	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
degree of activation of the accelerator pedal from PVS-channel 2 with higher resolution for customer purposes					
PV_CUS_RAW	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Global degree of activation of the gas pedal with higher resolution for customer purpose					
PV_MAX	O/V	0... FFH	0... 99.60937	0.390625	%
Maximum selection of Pedal value interpretation					
V_PVS_FIL_1	V	0... 3FFFH	0... 4.99511	4.8828e-3	V
Filtered voltage of Pedal Value Sensor 1					
V_PVS_FIL_2	V	0... 3FFFH	0... 4.99511	4.8828e-3	V
Filtered voltage of Pedal Value Sensor 2					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**Input data:**

FAC_TQ_REQ_CRU {p. 6737}	FAC_TQ_REQ_DCC {p. 6737}	GEAR_INFO {p. 1564}	LC_RNG_L_MAN_AS {p. 6570}
LV_AT {p. 654}	LV_DET_NOT_PLAUS_ ACT {p. 4215}	LV_ERR_PVS_BLS_NOT_ PLAUS {p. 4216}	LV_IGK {p. 906}
LV_IM_CS_PN {p. 852}	LV_LDM_ENA {p. 6615}	LV_PVS_BLS_NOT_ PLAUS_ACT {p. 4216}	LV_RNG_L_REQ {p. 6570}
LV_VAR_BN_LDM {p. 655}	LV_VAR_DCC {p. 655}	LV_VAR_TCT {p. 656}	N {p. 1525}
N_32 {p. 1525}	N_DIF {p. 1122}	PV_AV_MAX_BRAKE_DET {p. 4216}	STATE_ETCU_CLU {p. 1573}
STATE_GEAR_REV_AT_ AMT {p. 1302}	STATE_GEAR_REV_CAN {p. 1574}	STATE_PVS_DIAG {p. 4216}	V_PVS_1 {p. 831}
V_PVS_2 {p. 831}	VS_FIL {p. 1176}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_PV_AV_BLS_NOT_PLAUS	-	0... FFH	0... 99.60937	0.390625	%
pedal position in case of an PV_AV/Brake implausibility					
C_PV_AV_BLS_NOT_PLAUS_HYS	-	0... FFH	0... 99.60937	0.390625	%
Hysteresis in case of an PV_AV/Brake implausibility					
C_PV_AV_BLS_NOT_PLAUS_LGRD	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Change limitation of pedal position in case of an PV_AV/Brake implausibility					
C_PV_GRD_LIH_MAX	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Max. (positive) pedal gradient in case of an error					
C_PVS_SLOP_1	-	0... FFH	0... 79.6875	0.3125	%/V
Slope value of the pedal value 1					
C_PVS_SLOP_2	-	0... FFH	0... 79.6875	0.3125	%/V
Slope value of the pedal value 2					
C_T_FAC_PV_CS_AT	-	1... FFFFH	0.01... 655.35	0.01	s
Timer switch off CS correction for AT					
C_T_FAC_PV_CS_MT	-	1... FFFFH	0.01... 655.35	0.01	s
Timer switch off CS correction for MT and TCT					
C_T_FAC_PV_GS	-	1... FFFFH	0.01... 655.35	0.01	s
Timer switch off GS correction					
C_THD_MAX_PV_AV	-	0... FFH	0... 99.60937	0.390625	%
Threshold for switching progression					
C_THD_MIN_PV_AV	-	0... FFH	0... 99.60937	0.390625	%
Threshold for switching progression					
C_V_PVS_HYS_FIL	-	0... FFH	0... 1.24511	4.8828e-3	V
Area of the dejitter-filters					
C_V_PVS_OFS_1	-	0... FFH	0... 1.24511	4.8828e-3	V
Offset of the pedal value 1					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_V_PVS_OFS_2	-	0... FFH	0... 1.24511	4.8828e-3	V
Offset of the pedal value 2					
C_V_PVS_THD_KD	-	0... FFH	0... 4.998	0.0195313	V
Pedal value to kick-down-recognition (Channel 1)					
C_V_PVS_THD_KD_HYS	-	0... FFH	0... 4.998	0.0195313	V
Hysteresis of kick down recognition Channel 1					
C_VS_MAX_FAC_PV_COR	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Starting or gear shift detection threshold					
C_VS_MAX_FAC_PV_COR_AT	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Starting or gear shift detection threshold for AT					
IP_FAC_PV_BAS_COR_AT	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N_PV_FAC_COR	6	0... 1FE0H	0... 8160	1	rpm
LDPM_PV_AV_RAW_PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Basic correction					
IP_FAC_PV_BAS_COR_AT_MAN	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N_PV_FAC_COR	6	0... 1FE0H	0... 8160	1	rpm
LDPM_PV_AV_RAW_PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Basic correction for AT in 'M' mode (manual)					
IP_FAC_PV_BAS_COR_AT_SPT	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N_PV_FAC_COR	6	0... 1FE0H	0... 8160	1	rpm
LDPM_PV_AV_RAW_PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Basic correction for AT in 'S' mode (sport)					
IP_FAC_PV_BAS_COR_GEAR_REV_AT	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_VS_FIL_PV_FAC_COR_GEAR_REV	6	0... FFFFH	0... 511.99218	0.0078125	km/h
Additive correction at reverse gear for AT					
IP_FAC_PV_BAS_COR_GEAR_REV_MT	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_VS_FIL_PV_FAC_COR_GEAR_REV	6	0... FFFFH	0... 511.99218	0.0078125	km/h
Additive correction at reverse gear for MT					
IP_FAC_PV_BAS_COR_GEAR_REV_TCT	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_VS_FIL_PV_FAC_COR_GEAR_REV	6	0... FFFFH	0... 511.99218	0.0078125	km/h
Additive correction at reverse gear for TCT					
IP_FAC_PV_BAS_COR_MT	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N_PV_FAC_COR	6	0... 1FE0H	0... 8160	1	rpm
LDPM_PV_AV_RAW_PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Basic correction					
IP_FAC_PV_BAS_COR_TCT	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N_PV_FAC_COR	6	0... 1FE0H	0... 8160	1	rpm
LDPM_PV_AV_RAW_PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Basic correction					
IP_FAC_PV_CS_COR_AT	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N_DIF_PV_FAC_COR	6	0... FFFFH	-32768 ...32767	1	rpm
LDPM_PV_AV_RAW_PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Clutch intervention correction					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_PV_CS_COR_AT_RNG_L	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N_DIF__PV_FAC_COR	6	0... FFFFH	-32768 ...32767	1	rpm
LDPM_PV_AV_RAW__PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Clutch intervention correction in low range mode					
IP_FAC_PV_CS_COR_MT	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N_DIF__PV_FAC_COR	6	0... FFFFH	-32768 ...32767	1	rpm
LDPM_PV_AV_RAW__PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Clutch intervention correction					
IP_FAC_PV_CS_COR_TCT	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N_DIF__PV_FAC_COR	6	0... FFFFH	-32768 ...32767	1	rpm
LDPM_PV_AV_RAW__PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Clutch intervention correction					
IP_FAC_PV_GS_COR_MT	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N__PV_FAC_COR	6	0... 1FE0H	0... 8160	1	rpm
LDPM_PV_AV_RAW__PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Gear shift intervention correction					
IP_FAC_PV_GS_COR_TCT	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N__PV_FAC_COR	6	0... 1FE0H	0... 8160	1	rpm
LDPM_PV_AV_RAW__PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Gear shift intervention correction					
IP_FAC_VS_PV_BAS_COR_AT	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_VS_FIL__PV_FAC_COR	8	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed correction					
IP_FAC_VS_PV_BAS_COR_AT_MAN	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_VS_FIL__PV_FAC_COR	8	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed correction for AT in 'M' mode (manual)					
IP_FAC_VS_PV_BAS_COR_AT_SPT	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_VS_FIL__PV_FAC_COR	8	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed correction for AT in 'S' mode (sport)					
IP_FAC_VS_PV_BAS_COR_MT	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_VS_FIL__PV_FAC_COR	8	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed correction					
IP_FAC_VS_PV_BAS_COR_TCT	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_VS_FIL__PV_FAC_COR	8	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed correction					
IP_FAC_VS_PV_GS_COR_MT	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_VS_FIL__PV_FAC_COR	8	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed correction					
IP_FAC_VS_PV_GS_COR_TCT	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_VS_FIL__PV_FAC_COR	8	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed correction					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_PV_CRU	V	0... FFH	0... 99.60937	0.390625	%
LDPM_N__FAC_TQ_REQ_DRIV	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_TQ_CRU_DCC	8	0... FFFFH	0... 1.99996	30.5e-6	-
Scaling factor for requested torque at clutch from driver					
IP_PV_CRU_RNG_L	V	0... FFH	0... 99.60937	0.390625	%
LDPM_N__FAC_TQ_REQ_DRIV	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_TQ_CRU_DCC	8	0... FFFFH	0... 1.99996	30.5e-6	-
Scaling factor for requested torque at clutch from driver in low range mode					
IP_PV_LIH_MAX	-	0... FFH	0... 99.60937	0.390625	%
LDP_N_32__PV_LIH_MAX	6	0... FFH	0... 8160	32	rpm
Max. pedal position in case of an error					

### General information:

The accelerator pedal value is determined by means of a two-channelled system (PVS: pedal value sensor). Upon operating the accelerator pedal, both independently supplied sensor channels supply a synchronized Voltage signal, which shows a definite Voltage-ratio (2:1). Both Voltage-signals are adapted to the supply Voltage of the potis in order to minimize measurement inaccuracy.

Plausibility unit monitors both output signals of the pedal sensor system as well as the supply Voltages and determine from this the state of the PVS's system (see chapter PVS diagnosis).

From the Voltages of both PVS-channels the Kick-Down operation is determined.

Dependent on the System State, the driver's demand is determined from the pedal activation values. In the case of a disturbed PVS-signal (ERR\_PVS 0), a selection of pedal values occurs from one of both PVS-channels and/or an output of zero.

Figure 1 shows a function overview of determination of the driver's demand.

### Signal flow diagram:

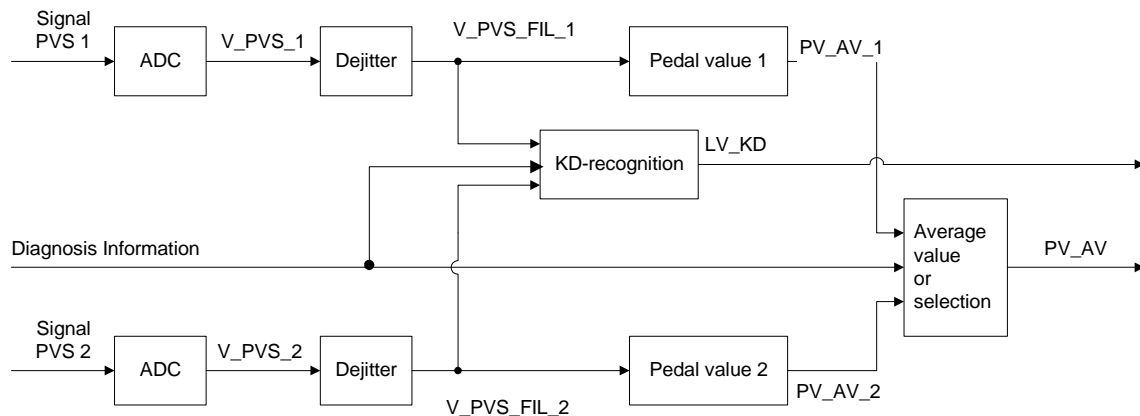


Figure 4.29.1: : Function overview of determination of the driver s demand

### Comment:

Since we are dealing with a two-channel system, the letter 'X' is used for either channel 1 or 2, in order to simplify the description. The letter 'Y' indicates the other respective channel.

**Application conditions:**

Recurrence: 10 ms

**4.29.1 Filtration of the PVS-values**

**FUNCTION DESCRIPTION:**

In order to maintain a stable driver's demand, the PVS-Voltage values need to be filtered. During the filtration, a hysteresis band is laid around the determined PVS-value (Width:  $2 * C\_V\_PVS\_HYS\_FIL$ ). The PVS-value is only changed when the current measurement value exceeds the limits of the hysteresis band. Thereby a jitter-free signal is produced, which actually hurries after the 'true' measurement value around the width of the hysteresis band. However, this signal reacts without hesitation to dynamic alterations of the driver's demand.

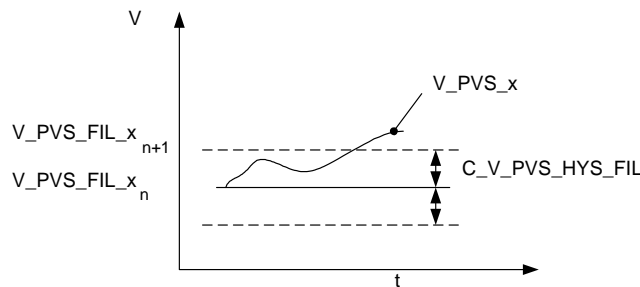


Figure 4.29.2: Filtration of PVS Voltage

**Formula section:**

**If**  $V\_PVS\_x_{(n)} > V\_PVS\_FIL\_x_{(n-1)} + C\_V\_PVS\_HYS\_FIL$  **or**  
 $V\_PVS\_x_{(n)} < V\_PVS\_FIL\_x_{(n-1)} - C\_V\_PVS\_HYS\_FIL$   
**Then**  $V\_PVS\_FIL\_X_{(n)} = V\_PVS\_x_{(n)}$   
**Else**  $V\_PVS\_FIL\_X_{(n)} = V\_PVS\_FIL\_X_{(n-1)}$

**4.29.2 Standardisation of the PVS-voltage value**

**FUNCTION DESCRIPTION:**

The pedal values are normalized by the determined producer values for the potentiometer slope  $C\_PVS\_SLOP$  and offset  $C\_PVS\_OFS$  in a range between 0% and 99,6%.

**Formula section:**

$$PV\_CUS\_x = PV\_AV\_x = (V\_PVS\_FIL\_x - C\_V\_PVS\_OFS\_x) * C\_PVS\_SLOP\_x$$

**Calibration hint:** in order to prevent the signal PVS 2 with it's worse resolution is selected for  $PV\_AV\_RAW$  (see following Value selection), the offset and slope for that sensor should be calibrated accordingly.  $PV\_AV\_2$  always should be a little higher than  $PV\_AV\_1$ . The difference should correspond to the usual occurring signal jitter which depends from the used sensor

**4.29.3 Value selection**

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 1274 of 8404	
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**FUNCTION DESCRIPTION:**

For an error-free system, the pedal value PV\_AV\_RAW (PV\_CUS\_RAW) is determined from minimum of both pedal values PV\_AV\_x (PV\_CUS\_x). In case of an error the selection depends on the PVS Diagnostic status. The restriction of the accelerator pedal value takes place at the limp home management.

In case of a not plausible accelerator-brake plausibility the driver demand is limited to C\_PVS\_BLS\_NOT\_PLAUS to defuse a clamp driver pedal.

**Application conditions**

**Initialisation:** 0  
**Recurrence:** 10ms  
**Activation:** LV\_IGK = 1  
**Deactivation:** LV\_IGK = 0, set PV\_AV\_RAW=0, PV\_CUS\_RAW=0

**Formula section:**

```

If(1) STATE_PVS_DIAG = PVS_NO_ERROR
Then(1) PV_AV_MIN = MIN ( PV_AV_1; PV_AV_2 )
          PV_CUS_MIN = MIN ( PV_CUS_1; PV_CUS_2 )
If(2) LV_PVS_BLS_NOT_PLAUS_ACT = 0 and
          LV_ERR_PVS_BLS_NOT_PLAUS = 0
Then(2) PV_AV_RAW = PV_AV_MIN
          PV_CUS_RAW = PV_CUS_MIN
Else(2)If(3) LV_DET_NOT_PLAUS_ACT = 1
Then(3) If(4) PV_AV_RAW > C_PV_AV_BLS_NOT_PLAUS
Then(4) PV_AV_RAWn = MIN ( PV_AV_MIN; PV_AV_RAWn-1 -
          C_PV_AV_BLS_NOT_PLAUS_LGRD )
          PV_CUS_RAWn = MIN ( PV_CUS_MIN; PV_CUS_RAWn-1 -
          C_PV_AV_BLS_NOT_PLAUS_LGRD )
Else(4) If(5) PV_AV_RAW ≥ PV_AV_MIN
Then(5) PV_AV_RAW = PV_AV_MIN
          PV_CUS_RAW = PV_CUS_MIN
Else(5) PV_AV_RAWn = PV_AV_RAWn-1
          PV_CUS_RAWn = PV_CUS_RAWn-1
Else(3)If(6) |PV_AV_RAWn-1-PV_AV_MIN>C_PV_AV_BLS_NOT_PLAUS_HYS
Then(6) If(7) PV_AV_RAWn-1 < PV_AV_MIN
Then(7) PV_AV_RAWn = PV_AV_RAWn-1 +
          C_PV_AV_BLS_NOT_PLAUS_LGRD
          PV_CUS_RAWn = PV_CUS_RAWn-1 +
          C_PV_AV_BLS_NOT_PLAUS_LGRD
Else(7) PV_AV_RAWn = PV_AV_MIN
          PV_CUS_RAWn = PV_CUS_MIN
Else(6) PV_AV_RAWn = PV_AV_MIN
          PV_CUS_RAWn = PV_CUS_MIN
Endif


```

In case of a present PVS error witch is not debounced yet, the pedal value is frozen in risen direction:

```

If STATE_PVS_DIAG = PVS_LIH_PRED and
      PV_AV_1 ≥ PV_AV_RAW
Then PV_AV_RAWn = PV_AV_RAWn-1

```

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```

    PV_CUS_RAWn = PV_CUS_RAWn-1
Else
    PV_AV_RAWn = PV_AV_1
    PV_CUS_RAWn = PV_CUS_1
Endif

If
    STATE_PVS_DIAG = PVS_LIH_MIN or PVS_LIH_1 or PVS_LIH_2
Then
    PV_AV_RAW and PV_CUS_RAW are limited upwards to IP_PV_LIH_MAX and
    the positive gradient is restricted to
    PV_AV_RAWn ≤ PV_AV_RAWn-1 + C_PV_GRD_LIH_MAX
    PV_CUS_RAWn ≤ PV_CUS_RAWn-1 + C_PV_GRD_LIH_MAX
Endif

If
    STATE_PVS_DIAG = PVS_LIH_MIN
Then
    PV_AV_RAW = Min (PV_AV_1, PV_AV_2)
    PV_CUS_RAW = Min (PV_CUS_1, PV_CUS_2)
Endif

If
    STATE_PVS_DIAG = PVS_LIH_1
Then
    PV_AV_RAW = PV_AV_1
    PV_CUS_RAW = PV_CUS_1
Endif

If
    STATE_PVS_DIAG = PVS_LIH_2
Then
    PV_AV_RAW = PV_AV_2
    PV_CUS_RAW = PV_CUS_2
Endif

If
    STATE_PVS_DIAG = PVS_DBL_ERROR or
    STATE_PVS_DIAG = PVS_LIH_1_PRE or
    STATE_PVS_DIAG = PVS_LIH_2_PRE or
    STATE_PVS_DIAG = PVS_LIH_BLS
Then
    PV_AV_RAW = 0
    PV_CUS_RAW = 0
Endif

```

#### 4.29.4 Driver progression correction

##### FUNCTION DESCRIPTION:

PV\_AV and PV\_CUS are the corrected driver interpretation and are used in the torque structure, CAN outputs and other functions.

The correction is a summation out of three parts, the basic, starting and gear shift correction.


##### Application conditions

**Initialisation:** 0

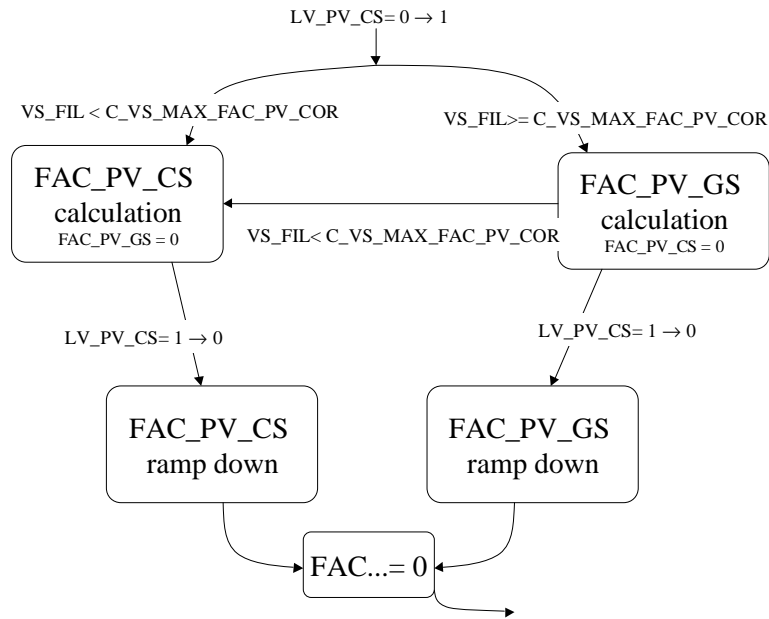
**Recurrence:** 10ms

**Activation:** LV\_IGK = 1

**Deactivation:** LV\_IGK = 0, set PV\_AV=0, PV\_CUS=0

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**Signal flow diagram:**



**Formula section:**

```

If(1) LV_AT = 1
    Then(1)
        If(2) GEAR_INFO = 1 and VS_FIL < C_VS_MAX_FAC_PV_COR_AT
            Then(2) LV_PV_CS = 1
            Else(2) LV_PV_CS = 0
            Endif(2)
        Endif(1)
    Elseif(1) LV_VAR_TCT = 1
        Then(3)
            If(4) STATE_ETCU_CLU = 03H (CLU_CLOSED)
                OR 04H (CLU_SLIP_CTRL) OR 05H (CLU_DYN_SLIP)
            Then(4) LV_PV_CS = 0
            Else(4) LV_PV_CS = 1
            Endif(4)
        Endif(3)
    Endif(1)


If LV_AT = 0 and LV_VAR_TCT = 0
then LV_PV_CS = LV_IM_CS_PN
Endif
    
```

**Basic correction:**

```

PV_AV = MIN ((PV_AV_RAW * (1 - FAC_PV_COR)); PV_AV_MAX_BRAKE_DET)
PV_CUS = MIN ((PV_CUS_RAW * (1 - FAC_PV_COR)); PV_AV_MAX_BRAKE_DET)
FAC_PV_COR = min(1 ; max(0 ; (FAC_PV_CS_COR + FAC_PV_GS_COR +
    
```

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FAC\_PV\_BAS\_COR)))

FAC\_PV\_COR has to be limited in the range between zero and one, so that no amplification of the raw value exists!

**Progression correction at drive off FAC\_PV\_CS\_COR:**

**Calculation by getting active Function LV\_PV\_CS = 0 to 1:**

```

If(1)      VS_FIL < C_VS_MAX_FAC_PV_COR
Then(1)   If(2)      LV_VAR_TCT = 1
              Then(2)   FAC_PV_CS_COR = IP_FAC_PV_CS_COR_TCT
              Else(2)   If(3)      LV_AT = 0
                          Then(3)   FAC_PV_CS_COR = IP_FAC_PV_CS_COR_MT
                          Else(3)   If(4)      LV_RNG_L_REQ = 1
                                      Then(4)   FAC_PV_CS_COR = IP_FAC_PV_CS_COR_
                                      AT_RNG_L
                                      Else(4)   FAC_PV_CS_COR = IP_FAC_PV_CS_COR_
                                      AT
                                      Endif(4)
                          Endif(3)
              Endif(2)
Else(1)   "see further definitions"
Endif(1)
    
```

**Calculation by active Function LV\_PV\_CS = 1:**

The calculation conditions remains from "Calculation by getting active Function:"

If there is a transition from VS\_FIL < C\_VS\_MAX\_FAC\_PV\_COR to

VS\_FIL ≥ C\_VS\_MAX\_FAC\_PV\_COR during active clutch, then the calculation remains as well as VS\_FIL < C\_VS\_MAX\_FAC\_PV\_COR fulfilled condition . FAC\_PV\_CS\_COR and FAC\_PV\_GS\_COR doesn't exists at the same time.

**Calculation triggered by leaving active Function LV\_PV\_CS = 1 to 0:**

At transition LV\_PV\_CS 1 to 0 then FAC\_PV\_CS\_COR is ramped down as followed:


- FAC\_PV\_CS\_COR is basically calculated like the active function.

```

If(1)      LV_PV_CS(n) = 0 and LV_PV_CS(n-1) = 1
Then(1)   If(2)      LV_AT = 1
              Then(2)   start decremented timer T_PV_CS_COR = C_T_FAC_PV_CS_AT

                          If(3)      LV_RNG_L_REQ = 1
                          Then(3)   FAC_PV_CS_COR =
                                      IP_FAC_PV_CS_COR_AT_RNG_L *
                                      T_PV_CS_COR / C_T_FAC_PV_CS_AT
                          Else(3)   FAC_PV_CS_COR =
                                      IP_FAC_PV_CS_COR_AT *
                                      T_PV_CS_COR / C_T_FAC_PV_CS_AT
                          Endif(3)
              Else(2)   start decremented timer T_PV_CS_COR = C_T_FAC_PV_CS_
              MT
    
```

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$$\text{FAC\_PV\_CS\_COR} = \text{IP\_FAC\_PV\_CS\_COR\_MT} * \frac{\text{T\_PV\_CS\_COR}}{\text{C\_T\_FAC\_PV\_CS\_MT}}$$

**Endif(2)**

Function is finished at T\_PV\_CS\_COR = 0.

**Endif(1)**

The progression correction is retriggered at detection of LV\_PV\_CS 0 to 1 during ramp.

**Progression correction at starting FAC\_PV\_GS\_COR (only MT or TCT):**

**Calculation by transition Function LV\_PV\_CS = 0 to 1:**

**IF(1)** VS\_FIL ≥ C\_VS\_MAX\_FAC\_PV\_COR

**Then (1)** FAC\_PV\_GS\_COR calculation see bellow

**Else (1)** FAC\_PV\_GS\_COR is not calculated FAC\_PV\_CS\_COR is calculated furthermore  
**endif**

**Calculation by active Function LV\_PV\_CS = 1:**

**IF(1)** VS\_FIL ≥ C\_VS\_MAX\_FAC\_PV\_COR

**Then(1) IF(2)** LV\_VAR\_TCT = 1

**Then(2)** FAC\_PV\_GS\_COR = IP\_FAC\_PV\_GS\_COR\_TCT \*

IP\_FAC\_VS\_PV\_GS\_COR\_TCT

**Else (2) IF(3)** LV\_AT = 0

**Then(3)** FAC\_PV\_GS\_COR = IP\_FAC\_PV\_GS\_COR\_MT \*

IP\_FAC\_VS\_PV\_GS\_COR\_MT

**Else(3)** FAC\_PV\_GS\_COR = 0

**Else(1)** FAC\_PV\_GS\_COR = 0

**Endif**

**Calculation leaving of the active function LV\_PV\_CS 1 to 0:**

At transition LV\_PV\_CS 1 to 0 then FAC\_PV\_GS\_COR is ramped down as followed:

- FAC\_PV\_GS\_COR is basically calculated like the active function.

**IF** LV\_PV\_CS<sub>(n)</sub> = 0 and LV\_PV\_CS<sub>(n-1)</sub> = 1

**Then** start decremented timer T\_PV\_GS\_COR = C\_T\_FAC\_PV\_GS

FAC\_PV\_GS\_COR = (IP\_FAC\_PV\_GS\_COR\_x \* IP\_FAC\_VS\_PV\_GS\_COR\_x) \*  
T\_PV\_GS\_COR / C\_T\_FAC\_PV\_GS

Function is finished at T\_PV\_GS\_COR = 0.

**Endif**

The progression correction is retriggered at detection of LV\_PV\_CS 0 to 1 during ramp.

**Progression correction general FAC\_PV\_BAS\_COR:**

Dependig on the type of gearbox and state of reverse gear the general correction is calculated. This correction depends from N, VS\_FIL and PV\_AV\_RAW.

**IF** STATE\_GEAR\_REV\_AT\_AMT = 1 or STATE\_GEAR\_REV\_CAN = 1

**Then** FAC\_PV\_BAS\_COR = IP\_FAC\_PV\_BAS\_COR\_x \* IP\_FAC\_VS\_PV\_BAS\_COR\_x  
+ IP\_FAC\_PV\_BAS\_COR\_GEAR\_REV\_y


**Else** FAC\_PV\_BAS\_COR = IP\_FAC\_PV\_BAS\_COR\_x \* IP\_FAC\_VS\_PV\_BAS\_COR\_x

**Endif**

**IF** LV\_VAR\_TCT = 1

**then** x = TCT

y = TCT

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```

else      if      LV_AT = 1
          then    y = AT
                (in first recurrence x is initialised with AT)
                Progression changed if mode of transmission is changed (AT_SPT... sport mode,
                AT_MAN...manual mode), changes become only valid if PV_AV is under or above
                a certain threshold to avoid jumps in PV_AV signal.
          if      [(STATE_ETCU_PROG_INFO = 2 and LV_VAR_BN = 1) or
                  (STATE_ETCU_PROG_INFO = 1 and LV_VAR_BN = 0)] and
                  [PV_AV < C_THD_MIN_PV_AV or
                  PV_AV > C_THD_MAX_PV_AV]
          Then    x = AT_MAN
          Elseif [(STATE_ETCU_PROG_INFO = 1 and LV_VAR_BN = 1) or
                  (STATE_ETCU_PROG_INFO = 2 and LV_VAR_BN = 0)] and
                  [PV_AV < C_THD_MIN_PV_AV or
                  PV_AV > C_THD_MAX_PV_AV]
          Then    x = AT_SPT
          Elseif [PV_AV < C_THD_MIN_PV_AV or
                  PV_AV > C_THD_MAX_PV_AV]
          Then    x = AT
                  Else    x = keep last
          endif
          else    x = MT
                  y = MT
          endif
endif

```

## 4.29.5 Kick-Down-Recognition

### FUNCTION DESCRIPTION:

The recognition of kick-down (LV\_KD) occurs, if the filtered pedal values (V\_PVS\_FIL\_1) of channel one is exceed the respective threshold values C\_V\_PVS\_THD\_KD\_x. Because of more jitters at Channel two only Channel one is used.

### Application conditions


**Initialisation:** 0  
**Recurrence:** 10ms  
**Activation:** LV\_IGK = 1  
**Deactivation:** LV\_IGK = 0, set LV\_KD=0

### Formula section:

```

If(1)      STATE_PVS_DIAG = PVS_NO_ERROR or
           STATE_PVS_DIAG = PVS_LIH_PRED
Then(1)
If(2)      V_PVS_FIL_1 > C_V_PVS_THD_KD and LV_KD = 0
Then(2)    LV_KD = 1
Else(2)
If (3)    V_PVS_FIL_1 < C_V_PVS_THD_KD - C_V_PVS_THD_KD_HYS and
LV_KD = 1

```

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```

Then(3)    LV_KD = 0
Else(3)    LV_KD = 1
Else(1)    LV_KD = 0
Endif
    
```

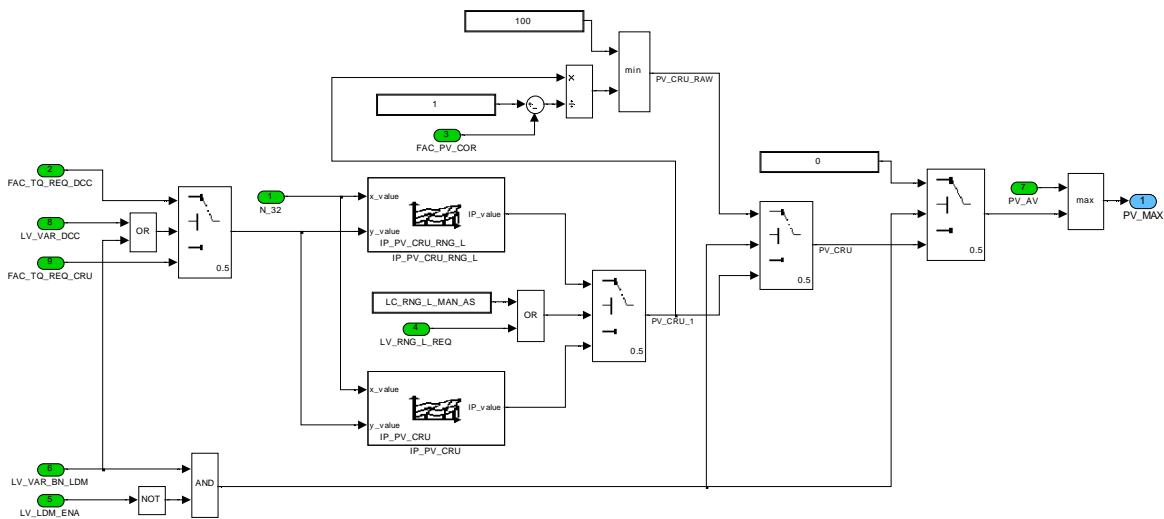
### 4.29.6 Selection of maximum pedal value

#### FUNCTION DESCRIPTION:

For CAN messages during cruise control and other functions the maximum selection between Pedal value and interpretation of cruise control charge request is needed.

The maps IP\_PV\_CRU\_RNG\_L and IP\_PV\_CRU have to be inverse maps of IP\_FAC\_TQ\_REQ\_RNG\_L and IP\_FAC\_TQ\_REQ\_DRIV.

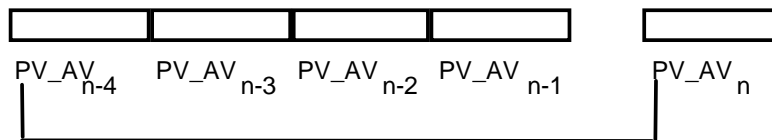
#### Signal flow diagram:



### 4.29.7 Calculation of PV\_AV gradient:

The PV\_AV gradient is calculated at intervals of 10 ms.

To this effect, the PV\_AV values are written into the ring buffer. Thus, the last four PV\_AV values are available in addition to the current PV\_AV value.




The PV\_AV gradient is based on a PV\_AV change over 40 ms.

The PV\_AV\_GRD reflects the gradient of the actual driver's demand prior to the corrections.

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$$PV\_AV\_GRD = (PV\_AVn - PV\_AVn-4) * 25$$

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## 4.30 Fuel pressure

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FUP	O/V	0... FFFFH	0... 347776	5.30672159	hPa
Fuel pressure					
FUP_H	O/V	0... FFFFH	0... 347776	5.30672159	hPa
Fuel pressure, high range					
FUP_MES	O/V	0... FFFFH	0... 347776	5.30672159	hPa
Measured fuel pressure					
FUP_MES_MMV	V	0... FFFFH	0... 347776	5.30672159	hPa
Measured mean value fuel pressure					
FUP_RNG_H	O/V	0... FFFFH	0... 255.99609375	0.00390625	MPa
Fuel pressure					
FUP_RNG_H_MES	O/V	0... FFFFH	0... 255.99609375	0.00390625	MPa
Measured fuel pressure					
LV_FUP_MES_LIH_REQ	V	0... 1H	0 ...1	1	-
Request for fuel pressure default value in case of error detection					
LV_FUP_SEG	O/V	0... 1H	0 ...1	1	-
Logical variable indicating the buffer to read the sensor voltage in BSW					
V_FUP_MV	O/V	0... 7FFFH	0... 4.9998474121093	152.587e-6	V
Mean value of the acquired sensor voltage					

### Input data:

CTR_V_FUP {p. 940}	CTR_V_FUP_1 {p. 940}	FUP_AD {p. 988}	FUP_EFP {p. 1290}
LC_FUP_EFP_AVL {p. 3801}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_FUP_LIH_L_PRS_ CTL_REQ {p. 4001}	LV_ST_END {p. 1720}	V_FUP_SUM {p. 940}	V_FUP_SUM_1 {p. 940}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUP_EFP_FUP_INI	V	0... FFFFH	0... 173888	2.65336079	hPa
Default value for fuel pressure initialisation by EFP system					
C_FUP_LIH_L_PRS_CRLC	V	0... FFH	0... 0.99609375	0.00390625	-
Correlation constant for the fuel pressure value at low pressure control limphome					
C_FUP_MES_CRLC	V	0... FFH	0... 0.99609375	0.00390625	-
Filter constant for the measured fuel pressure					
C_FUP_OFS_LIH_L_PRS_CTL_REQ	V	8000... 7FFFH	-173890 ...173884	5.30669108	hPa
Offset for FUP at low pressure control limphome					
IP_FUP_MES	V	0... FFFFH	0... 347776	5.30672159	hPa
LDP_V_FUP_MV_IP_FUP_MES	8	0... 7FFFH	0... 4.9998474121093	152.587e-6	V
Fuel pressure sensor linearisation table					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_MOD_FUP_MES_LIH_REQ	V	0... 1H	0 ...1	1	-
Defines, if fuel pressure substitute value request is based on low pressure limp home request (= 0) or based on fuel high pressure sensor errors (= 1)					

### General information:

The fuel pressure sensor is delivering a voltage signal corresponding to the fuel pressure in the rail. Out of this sensor voltage a fuel pressure value is calculated via linearisation table. An additional filter can be applied.

### Application conditions:

**Initialisation:** RST  
**Recurrence:** 10MS activated if LV\_ST\_END==0  
 SEG activated if LV\_ST\_END==1  
**Activation:** -  
**Deactivation:** never or if activation-condition of other event is true

### Function description:

### Formula section:

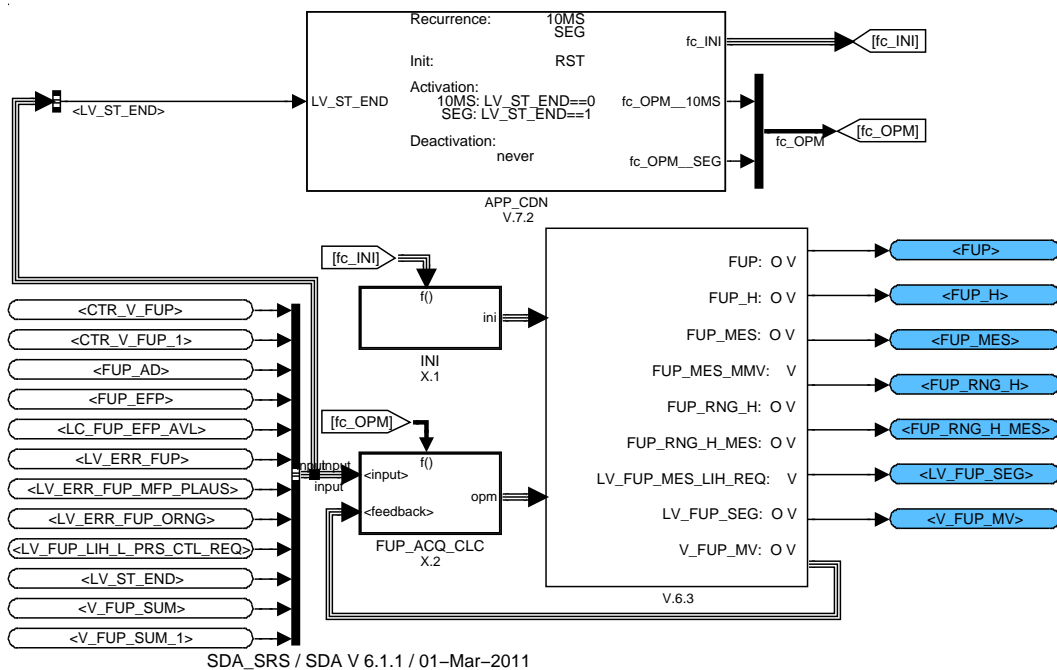


Figure 4.30.1: :

### 4.30.1 Initialisation function

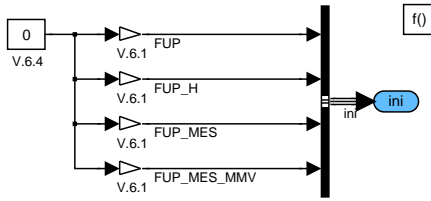


Figure 4.30.2: :

### Function description

The fuel pressure calculation is split into three parts.

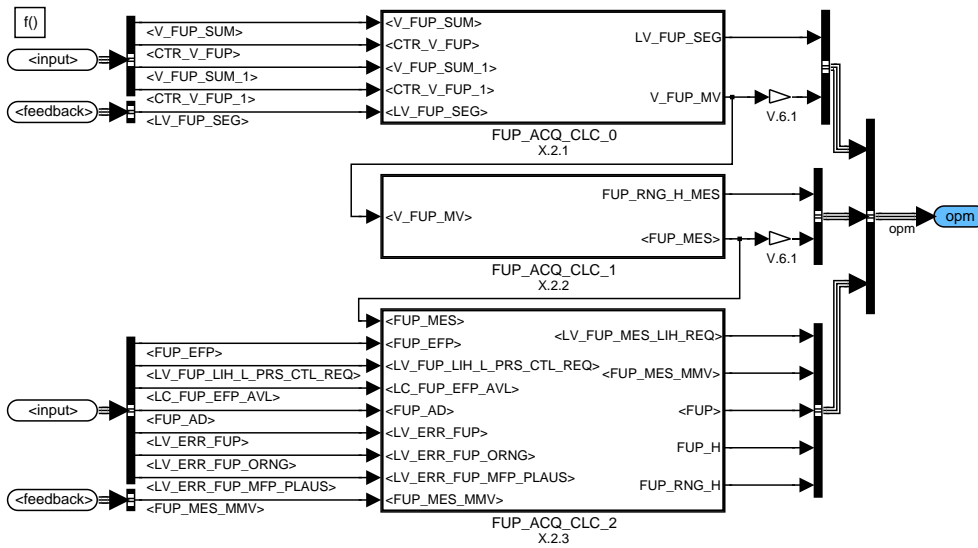


Figure 4.30.3: :

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### 4.30.2 Signal acquisition

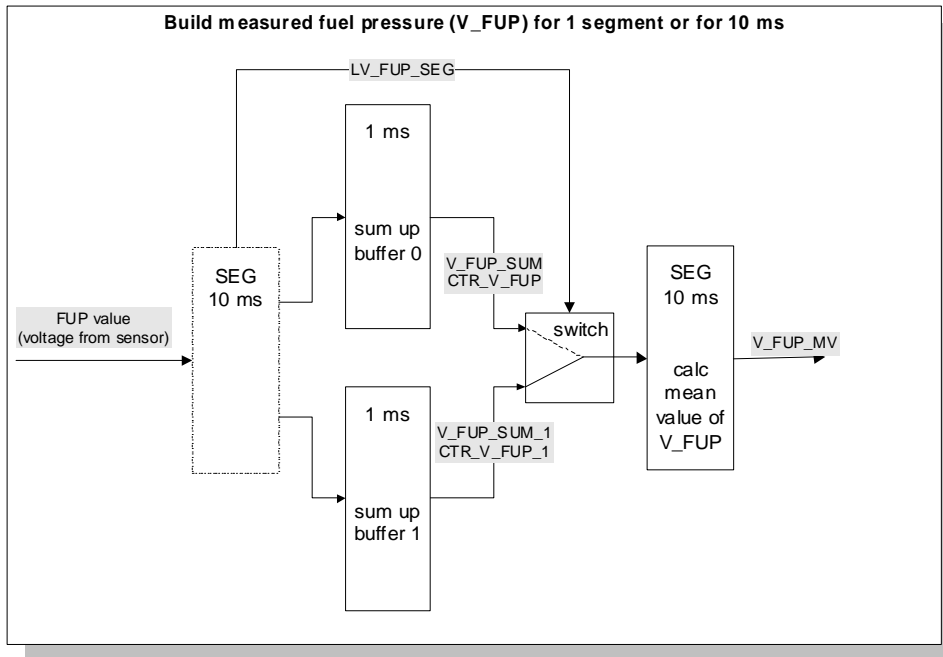


Figure 4.30.4: :


The raw value (voltage) for FUP is measured by continuous conversion every 1 ms. The values (10 bit) are summed up in two alternating buffers, SUM\_V\_FUP or SUM\_V\_FUP\_1. The numbers of values are counted in comparable buffers CTR\_FUP or CTR\_FUP\_1. This mechanism is necessary to synchronize the measurement and the calculation of FUP\_MES (build mean value with a standardized range) and will be done within BSW.

Depending on the logical variable LV\_FUP\_SEG one of the two buffers SUM\_V\_FUP or SUM\_V\_FUP\_1 and the respective counter CTR\_V\_FUP or CTR\_V\_FUP\_1 are selected for writing, the contents of the other buffer (counter) is used for calculations and diagnosis (after this buffer and the corresponding counter have been read they are cleared).

After having read out one buffer SUM\_V\_FUP or SUM\_V\_FUP\_1 the buffer has to be cleared as well as the corresponding counter CTR\_V\_FUP or CTR\_V\_FUP\_1.

A two-buffer-system is used to avoid incorrect FUP calculation.

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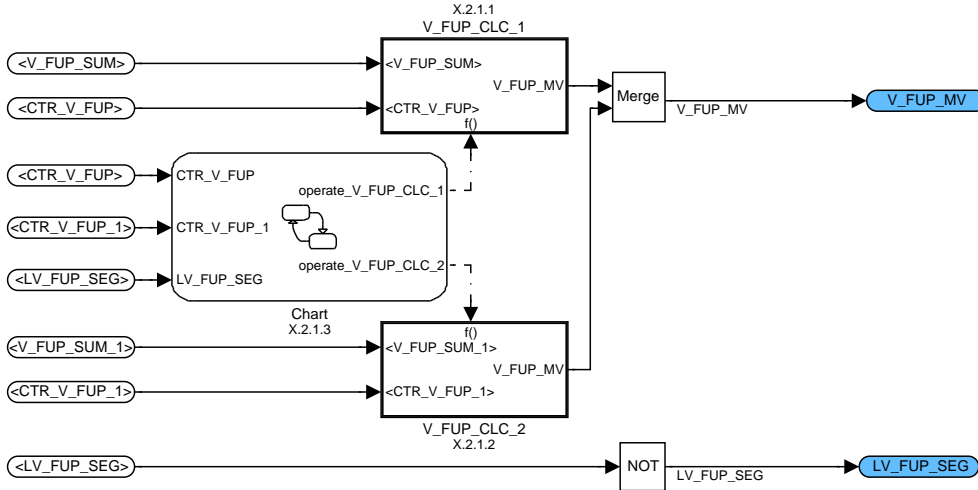


Figure 4.30.5: :

### 4.30.2.1 Chart

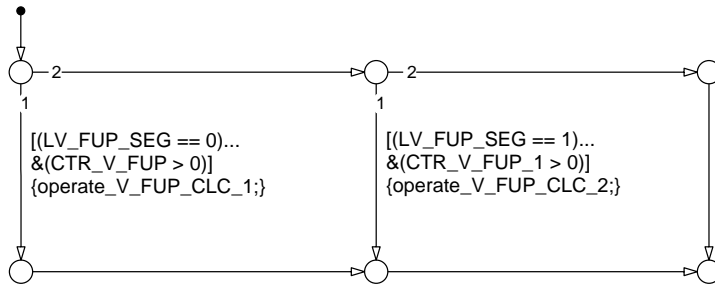


Figure 4.30.6: :

### 4.30.2.2 First calculation

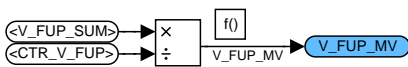


Figure 4.30.7: :

### 4.30.2.3 Second calculation

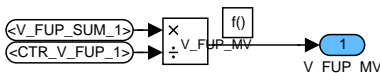


Figure 4.30.8: :

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### 4.30.3 Fuel pressure determination

The linearization table gives the relationship between the sensor signal and the fuel pressure. This data has to be delivered by the sensor supplier.

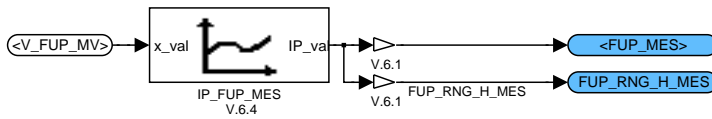


Figure 4.30.9: :

### 4.30.4 Coordination function for normal and LIH operation

The correlation constant gives the filter constant for the fuel pressure. This filtering could be necessary to get a more stable signal for the fuel pressure. If limp home is active and a low pressure sensor is available than the low pressure sensor value (FUP\_EFP) instead of the high pressure sensor value is mapped to FUP. This transition is filtered to avoid a big steps in FUP.

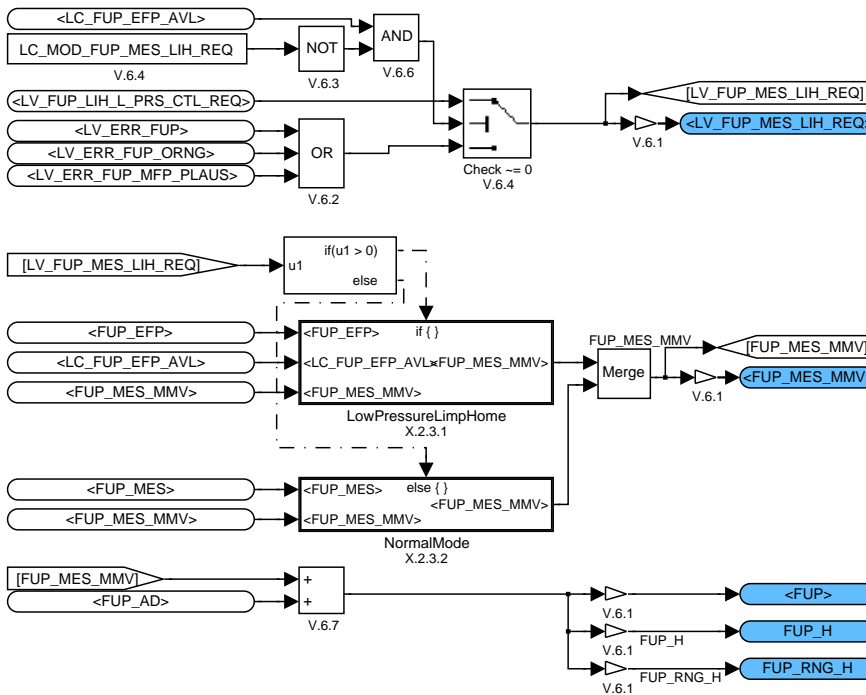


Figure 4.30.10: :

#### 4.30.4.1 Low pressure limp-home operation

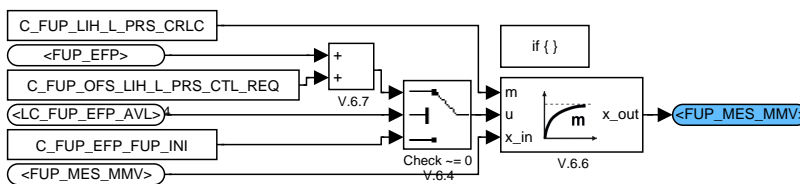



Figure 4.30.11: :

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### 4.30.4.2 Normal operation

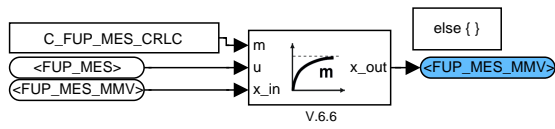



Figure 4.30.12: :

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## 4.31 Fuel pressure of low pressure pump

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FUP_EFP	O/V	0... FFFFH	0... 173888	2.6533608	hPa
Fuel pressure EFP					
FUP_EFP_CTR	-	0... FFFFH	0... 65535	1	-
Number of samples in buffer FUP_EFP_sum					
FUP_EFP_CTR_1	-	0... FFFFH	0... 65535	1	-
Number of samples in buffer FUP_EFP_sum_1					
FUP_EFP_MES	O/V	0... FFFFH	0... 173888	2.6533608	hPa
Measured Fuel pressure value in the feedline					
FUP_EFP_MMV	V	0... FFFFH	0... 173888	2.6533608	hPa
Mean fuel pressure value in the feedline					
FUP_EFP_SUM	-	0... FFFFFFFFH	0... 20971500	0.00488281	V
Accumulated low fuel pressure sensor measurements for segment number (2n 1), n=1,2,3,...					
FUP_EFP_SUM_1	-	0... FFFFFFFFH	0... 20971500	0.00488281	V
Accumulated low fuel pressure sensor measurements for segment number (2n), n=1,2,3,...					
LV_FUP_EFP_SEG	-	0... 1H	0 ...1	1	-
indicates if segment number is even or odd					
V_FUP_EFP	V	0... 7FFFH	0... 4.99984741	15.25879e3	V
Low fuel pressure EFP sensor raw acquisition					
V_FUP_EFP_MV	O/V	0... 7FFFH	0... 4.99984741	15.25879e3	V
Voltage of the low fuel pressure sensor (for diagnosis)					

### Input data:

ERR_SYM_FUP_EFP {p. 4733}	LV_ERR_FUP_EFP {p. 4733}	LV_ES {p. 1720}	
------------------------------	-----------------------------	-----------------	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUP_EFP_LIH	-	0... FFFFH	0... 173888	2.6533608	hPa
Limp home value for fuel pressure of low pressure circuit (opening pressure of safety valve)					
C_FUP_EFP_MES_CRLC	-	0... FFH	0... 0.99609375	0.00390625	-
Correlation constant for fuel pressure filter for the low pressure pump					
IP_FUP_EFP	-	0... FFFFH	0... 173888	2.6533608	hPa
LDP_V_FUP_EFP_IP_FUP_EFP	3	0... 7FFFH	0... 4.99984741	15.25879e3	V
Fuel pressure sensor linearisation table					

### 4.31.1 Fuel pressure acquisition of low pressure signal

The raw value (voltage) for FUP\_EFP is measured by continuous conversion every 1 ms. The values (10 bit) are summed up in two alternating buffers, FUP\_EFP\_SUM or FUP\_EFP\_SUM\_1. The numbers of values are counted in comparable buffers FUP\_EFP\_CTR or FUP\_EFP\_CTR\_1. This mechanism is necessary to synchronize the measurement and the calculation of FUP\_EFP\_MES (build mean value with a standardized range)

Depending on the logical variable LV\_FUP\_EFP\_SEG one of the two buffers FUP\_EFP\_SUM or FUP\_EFP\_SUM\_1 and the respective counter FUP\_EFP\_CTR or FUP\_EFP\_CTR\_1 are selected for writing, the contents of the other buffer (counter) is used for calculations and diagnosis (after this buffer and the corresponding counter have been read they are cleared).

After having read out one buffer FUP\_EFP\_SUM or FUP\_EFP\_SUM\_1 the buffer has to be cleared as well as the corresponding counter FUP\_EFP\_CTR or FUP\_EFP\_CTR\_1.

A twobuffersystem is used to avoid incorrect FUP\_EFP calculation.

The fuel pressure of the feedline is calculated by means of the fuel pressure sensor for the feedline. Additionally in case of sensor error a substitute value will be taken.

Use ACTION\_INFR\_GetVFupEfpSens(OUT <v\_fup\_efp>)

**Application Condition**

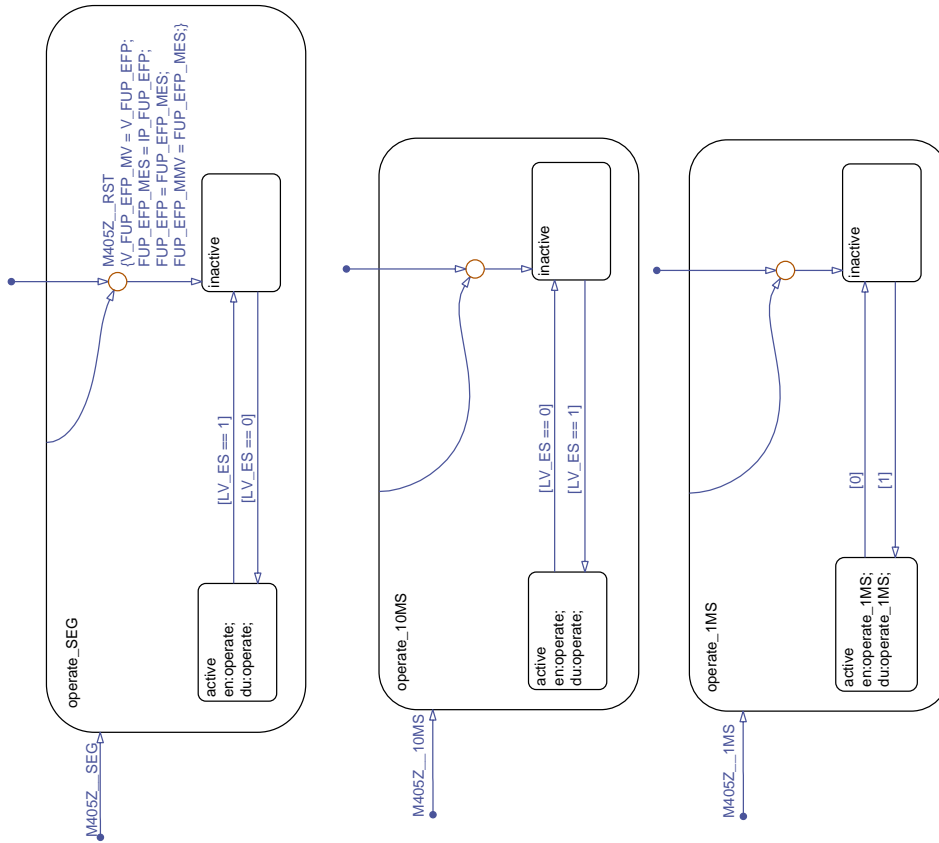
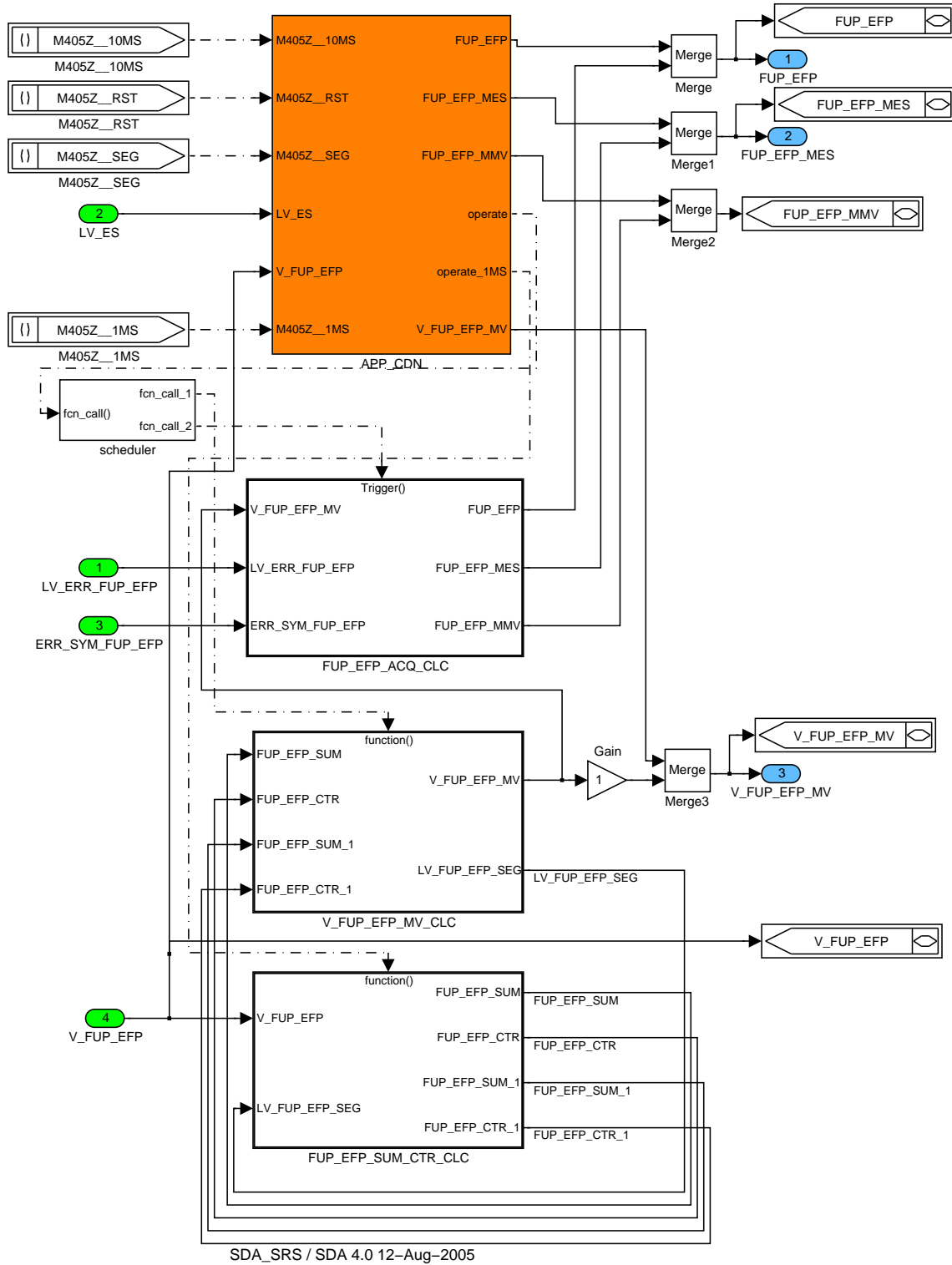


Figure 4.31.1: M405Z/APP\_CDN/Chart

**Function Description**

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Figure 4.31.2: M405Z

4.31.1.1 <HEADER MODULE="M405Z/V\_FUP\_EFP\_MV\_CLC">

Calculation of V\_FUP\_EFP\_MV.

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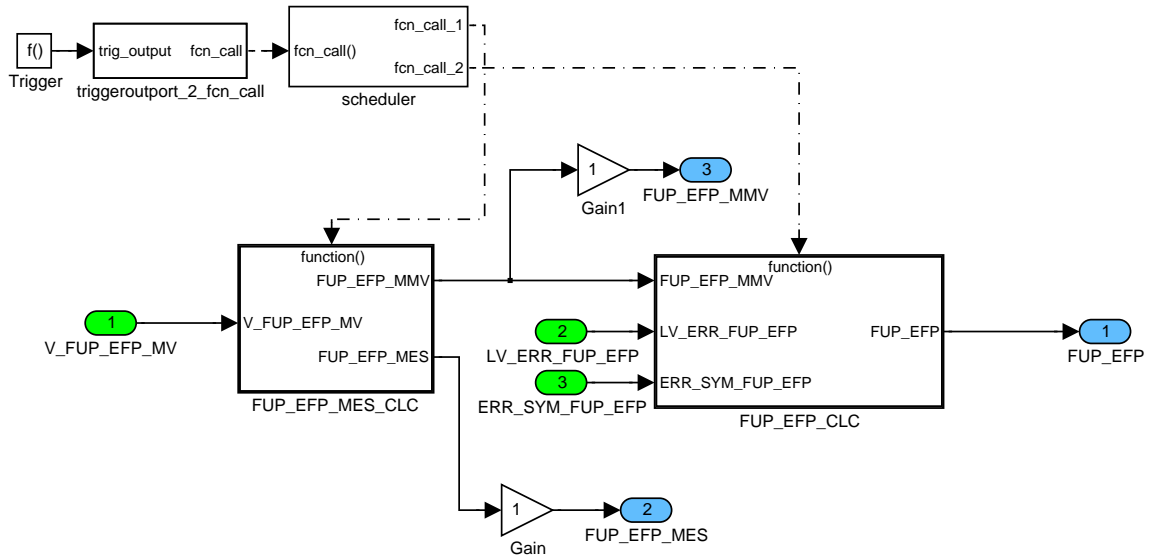


Figure 4.31.3: M405Z/FUP\_EFP\_ACQ\_CLC

**Fuel pressure of the electrical fuel pump calculation**

Depending on different failure bits the mean value of the fuel pressure sensor or a substitute value (opening point overpressure valve) is taken as FUP\_EFP.

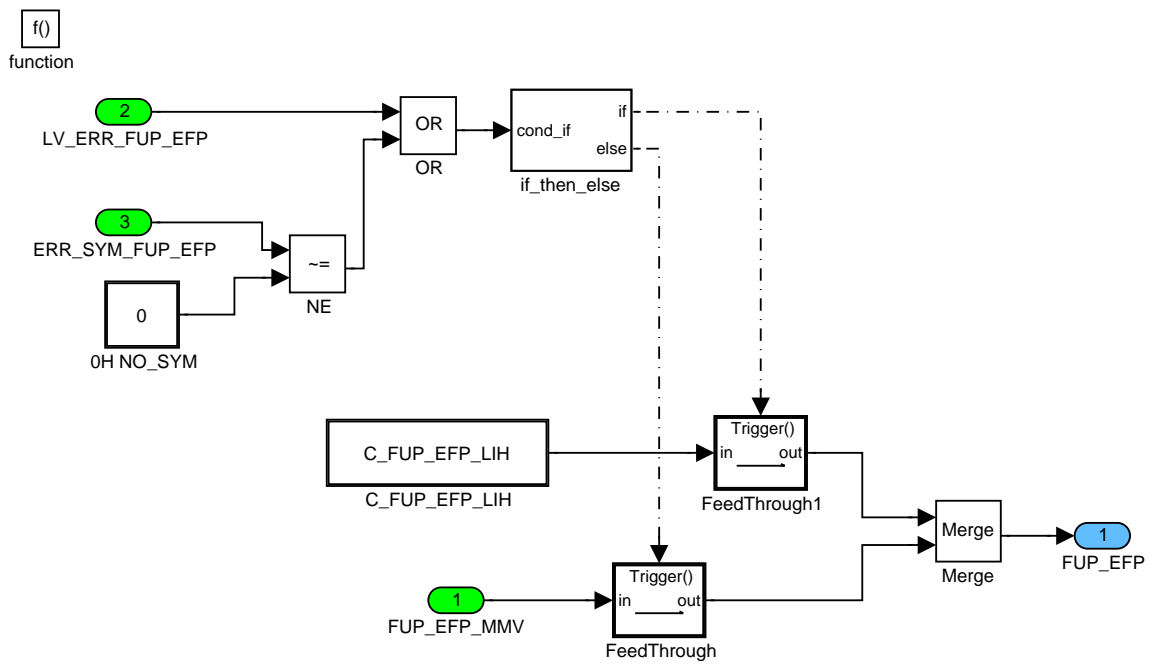



Figure 4.31.4: M405Z/FUP\_EFP\_ACQ\_CLC/FUP\_EFP\_CLC

**Sensor conversion**

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The sensor value is converted via calibrated curve into a measured value. This value is then filtered.

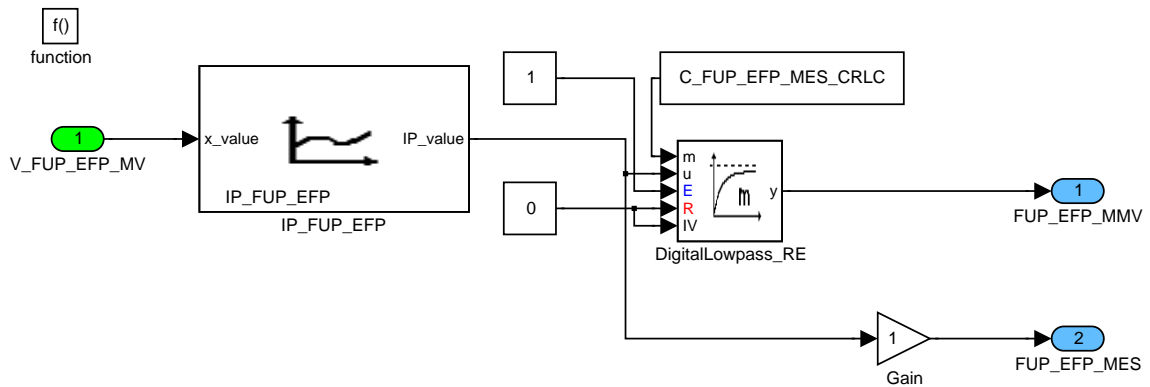
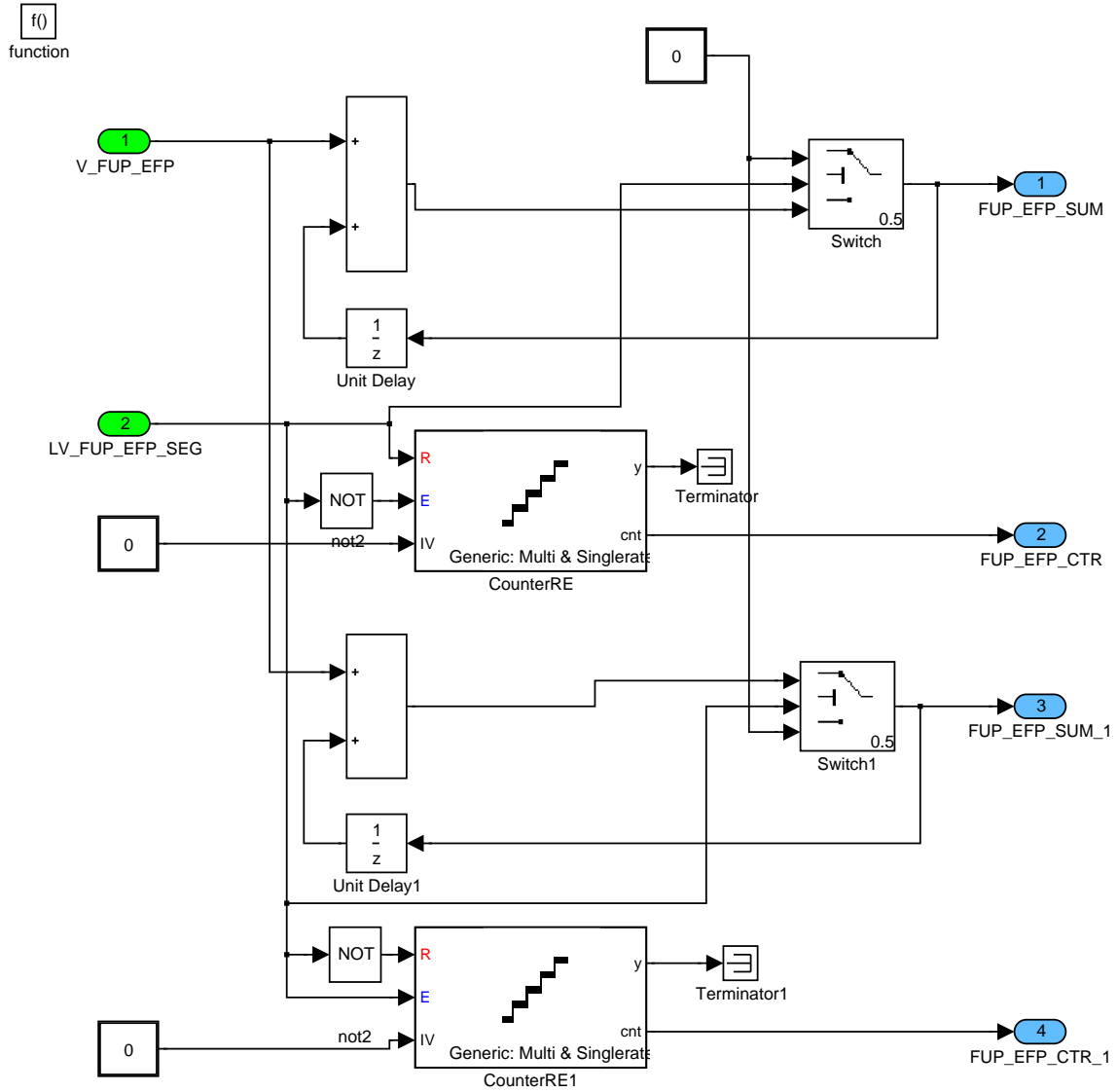


Figure 4.31.5: M405Z/FUP\_EFP\_ACQ\_CLC/FUP\_EFP\_MES\_CLC

#### 4.31.1.2 M405Z/FUP\_EFP\_SUM\_CTR\_CLC

Calculation of FUP\_EFP\_SUM, FUP\_EFP\_CTR, FUP\_EFP\_SUM\_1 and FUP\_EFP\_CTR\_1



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Figure 6 M405Z/  
FUP\_EFP\_SUM\_CTR\_CLC

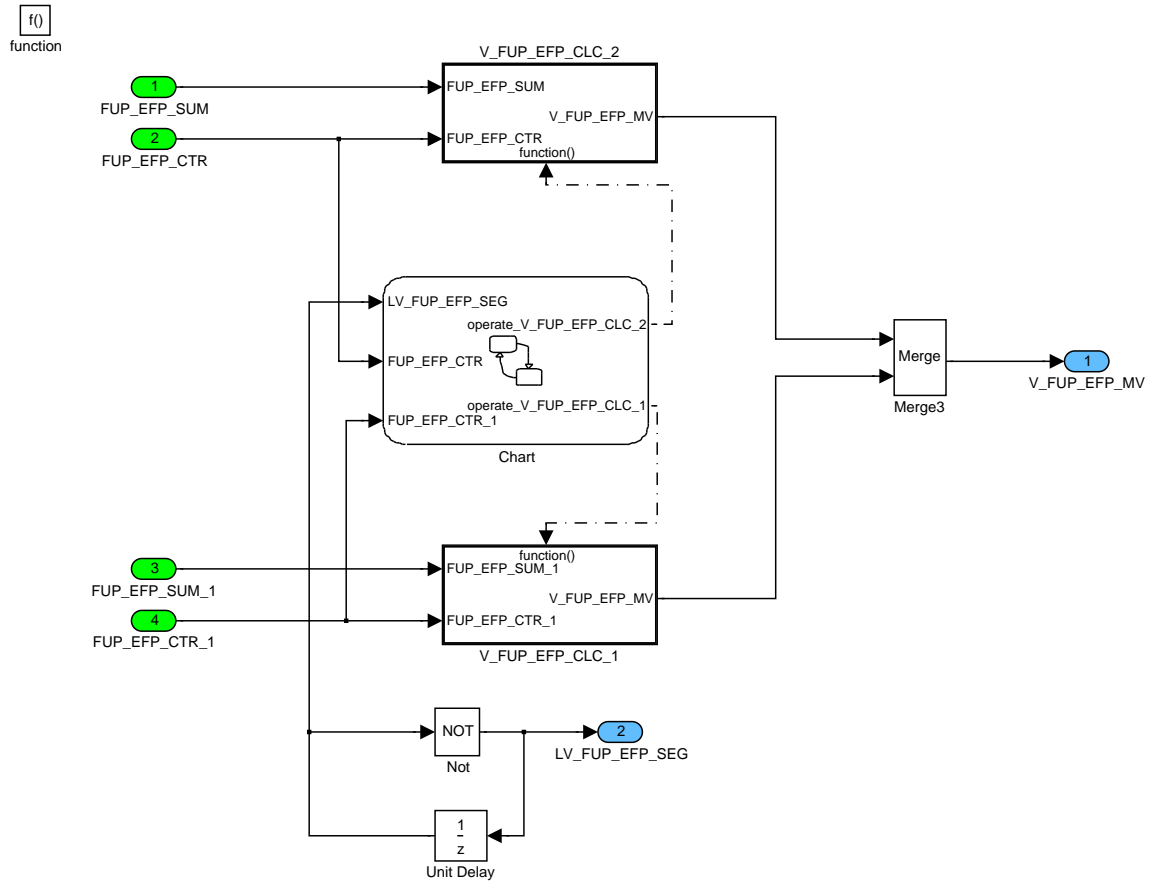


Figure 4.31.6: M405Z/V\_FUP\_EFP\_MV\_CLC

1.1.3 M405Z/V\_FUP\_EFP\_MV\_CLC/Chart

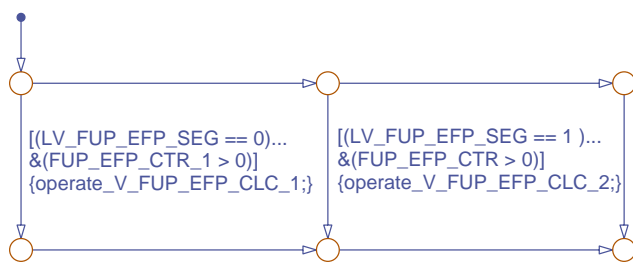


Figure 4.31.7: M405Z/V\_FUP\_EFP\_MV\_CLC/Chart

**M405Z/V\_FUP\_EFP\_MV\_CLC/V\_FUP\_EFP\_CLC\_1**

Calculation of V\_FUP\_EFP\_MV.

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f()  
function

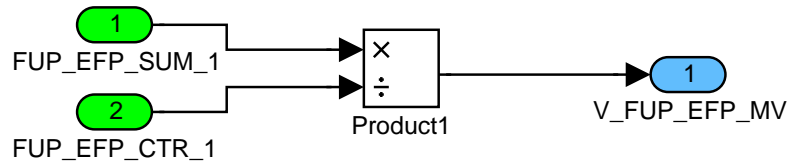


Figure 4.31.8: M405Z/V\_FUP\_EFP\_MV\_CLC/V\_FUP\_EFP\_CLC\_1

**M405Z/V\_FUP\_EFP\_MV\_CLC/V\_FUP\_EFP\_CLC\_2**

Calculation of V\_FUP\_EFP\_MV.

f()  
function

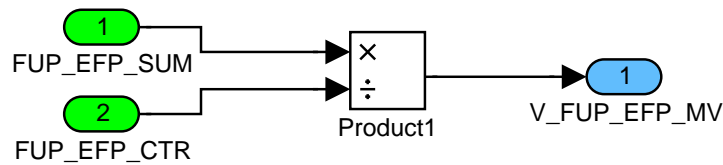



Figure 4.31.9: M405Z/V\_FUP\_EFP\_MV\_CLC/V\_FUP\_EFP\_CLC\_2

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## 4.32 Gear detection (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_INH_GS_IDC	V	0... FFH	0... 255	1	-
Counter for inhibiting gear-shift signal display					
GS_IDC_DISP	O/V	0... FFH	0... 255	1	-
Gear shift signal CAN - display type					
GS_IDC_GEAR	O/V	0... FFH	0... 255	1	-
Gear shift signal CAN - setpoint for gear					
LV_GS_DOWN_IDC_OFF	V	0... 1H	0 ...1	1	-
Gear shift down inhibited - CAN display off					
LV_GS_DOWN_IDC_OFF_1	V	0... 1H	0 ...1	1	-
Gear shift down 1 inhibited - CAN display off					
LV_GS_DOWN_IDC_OFF_2	V	0... 1H	0 ...1	1	-
Gear shift down 2 inhibited - CAN display off					
LV_GS_DOWN_IDC_OFF_3	V	0... 1H	0 ...1	1	-
Gear shift down 3 inhibited - CAN display off					
LV_GS_IDC_OFF	V	0... 1H	0 ...1	1	-
SPA not coded					
LV_INH_GS_IDC_1	V	0... 1H	0 ...1	1	-
Gear shift signal display 1 on CAN inhibited					
LV_INH_GS_IDC_2	V	0... 1H	0 ...1	1	-
Gear shift signal display 2 on CAN inhibited					

### Input data:

GEAR {p. 1302}	GS_IDC_DISP_RAW {p. 8285}	GS_IDC_GEAR_RAW {p. 8286}	LV_AT {p. 654}
LV_ERR_BN_VS_TCS {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_CRK {p. 4455}	LV_ERR_VS_CAN {p. 1565}
LV_ERR_VS_PLAUS {p. 5021}	LV_IGK {p. 906}	LV_MTC_CUR_OFF {p. 6565}	LV_VAR_AMT {p. 655}
LV_VAR_TCT {p. 656}	N {p. 1525}	VS {p. 1176}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_INH_GS_IDC_DEC	-	0... FFH	0... 255	1	-
Decrement for inhibiting gear-shift signal display					
C_CTR_INH_GS_IDC_INC	-	0... FFH	0... 255	1	-
Increment for inhibiting gear-shift signal display					
C_CTR_INH_GS_IDC_MAX	-	1... FFH	1... 255	1	-
Max. counter for inhibiting gear-shift signal display					
C_GS_DISP	-	0... FFH	0... 255	1	-
Constant for calibrating gear shift condition to be checked (up/down, etc.)					
C_GS_IDC_DISP_MAX	-	0... FFH	0... 255	1	-
Max-value for display type					
C_GS_IDC_DISP_SUB	-	0... FFH	0... 255	1	-
Default-value for display type					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_GS_IDC_GEAR_MAX	-	0... FFH	0... 255	1	-
Max-value for gear display					
C_GS_IDC_GEAR_SUB	-	0... FFH	0... 255	1	-
Default-value for gear display					
ID_GS_IDC_GEAR_MIN_1	-	0... FFH	0... 255	1	-
LDP_VS_ID_GS_IDC_GEAR_MIN_1	8	0... FFH	0... 255	1	km/h
Min. gear 1 depending on VS					
ID_GS_IDC_GEAR_MIN_2	-	0... FFH	0... 255	1	-
LDP_VS_ID_GS_IDC_GEAR_MIN_2	8	0... FFH	0... 255	1	km/h
Min. gear 2 depending on VS					
LC_GS_IDC_TCT_ENA	-	0... 1H	0 ...1	1	-
Enabling plausibility also for TCT					

### 4.32.1 Plausibility of gear shift setpoint displayed on CAN

#### FUNCTION DESCRIPTION:

#### General information:

The calculation of gear shift signal setpoint (output BMW-layer) is based on VS and N. Therefore the the gear shift signal setpoint should not be transmitted on CAN in case of VS-error, un-plausible N or limp home mode.

#### Application conditions

**Initialisation:** *all 0 at reset*

**Recurrence:** *100 ms*

**Activation:** LV\_IGK = 1    **and**  
 LV\_AT= 0                    **and**  
 LV\_VAR\_AMT = 0    **and**  
 (LV\_VAR\_TCT = 0                    **or**  
 LC\_GS\_IDC\_TCT\_ENA = 1)

#### Formula section:

##### Inhibition of gear shift down:

**if** GS\_IDC\_GEAR\_RAW <= GEAR                    **and**  
 GS\_IDC\_DISP\_RAW = C\_GS\_DISP                    **and**  
 GS\_IDC\_GEAR\_RAW != C\_GS\_IDC\_GEAR\_SUB

**Then** LV\_GS\_DOWN\_IDC\_OFF\_1 = 1


**Else** LV\_GS\_DOWN\_IDC\_OFF\_1 = 0

**Endif**

**if** GS\_IDC\_GEAR\_RAW < ID\_GS\_IDC\_GEAR\_MIN\_2 **and**  
 GS\_IDC\_GEAR\_RAW != C\_GS\_IDC\_GEAR\_SUB

**Then** LV\_GS\_DOWN\_IDC\_OFF\_2 = 1

**Else** LV\_GS\_DOWN\_IDC\_OFF\_2 = 0

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**Endif**

```

If      GS_IDC_GEAR_RAW < ID_GS_IDC_GEAR_MIN_1 and
          GS_IDC_DISP_RAW != C_GS_DISP           and
          GS_IDC_GEAR_RAW != C_GS_IDC_GEAR_SUB

```

```

Then   LV_GS_DOWN_IDC_OFF_3 = 1

```

```

Else   LV_GS_DOWN_IDC_OFF_3 = 0

```

**Endif**

```

If      LV_GS_DOWN_IDC_OFF_1 = 1   or
          LV_GS_DOWN_IDC_OFF_2 = 1   or
          LV_GS_DOWN_IDC_OFF_3 = 1

```

```

Then   LV_GS_DOWN_IDC_OFF = 1

```

```

Else   LV_GS_DOWN_IDC_OFF = 0

```

**Endif**

```

If      [B_spa_cist = 0           and           // no SPA coded,
          (GS_IDC_GEAR_RAW != C_GS_IDC_GEAR_SUB or // Spa_gang > 0
          GS_IDC_DISP_RAW != C_GS_IDC_DISP_SUB)] or // Spa_art > 0
          [GS_IDC_GEAR_RAW > C_GS_IDC_GEAR_MAX or // Spa_gang > max.
          GS_IDC_DISP_RAW > C_GS_IDC_DISP_MAX]    // Spa_art > max.

```

```

Then   LV_GS_IDC_OFF = 1

```

```

Else   LV_GS_IDC_OFF = 0

```

**Endif****General suppressing of gear shift setpoint:**

```

If      (LV_GS_DOWN_IDC_OFF = 1           OR
          LV_ERR_VS_CAN   = 1           OR // VS-CAN-signal not valid,
                                           // no debounced error, only
                                           // flag received via CAN
          LV_GS_IDC_OFF = 1)

```

```

Then   If      CTR_INH_GS_IDC < C_CTR_INH_GS_IDC_MAX
          Then   CTR_INH_GS_IDC = CTR_INH_GS_IDC + C_CTR_INH_GS_IDC_INC
          Else   LV_INH_GS_IDC_1 = 1
          Endif

```

```

Else   If      CTR_INH_GS_IDC > 0
          Then   CTR_INH_GS_IDC = CTR_INH_GS_IDC - C_CTR_INH_GS_IDC_DEC
          Else   LV_INH_GS_IDC_1 = 0
          Endif

```

**Endif**

```

If      LV_ERR_CRK = 1           OR // also transmitted on CAN for
          LV_MTC_CUR_OFF = 1       OR // N-signal invalid
          LV_ERR_VS_PLAUS = 1     OR // limp-home
          LV_ERR_BN_VS_TCS = 1    OR // VS-error (PIN)
          LV_ERR_CAN_BOFF = 1     OR // no VS-CAN-signal CAN12H
          LV_ERR_CAN_BOFF = 1     // CAN-bus-off

```

```

Then   LV_INH_GS_IDC_2 = 1


```

```

Else      LV_INH_GS_IDC_2 = 0
Endif

If        LV_INH_GS_IDC_1 = 1      or
         LV_INH_GS_IDC_2 = 1
Then     GS_IDC_GEAR = C_GS_IDC_GEAR_SUB
         GS_IDC_DISP = C_GS_IDC_DISP_SUB
Else     GS_IDC_GEAR = GS_IDC_GEAR_RAW
         GS_IDC_DISP = GS_IDC_DISP_RAW
Endif

```

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## 4.33 Gear ratio

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_GR	V	0... FFFFH	0... 1.999969	30.5175e-6	-
Factor for setpoint/actual reduction ratio of rear axle					
FAC_GR_MMV_AV	O/V/S	0... FFFFH	0... 1.999969	30.5175e-6	-
Rear axle ratio adaptation value					
GEAR	O/V	0... FFH	0... 255	1	-
Common gear, independent from AT or MT					
GEAR_EF	O/V	0... FFH	0... 255	1	-
Gear used for exhaust flap functionality					
GR_AT	O/V	0... FFH	0... 255	1	-
Automatic transmission gear					
GR_MT	O/V	0... FFH	0... 255	1	-
Manual transmission gear					
GR_RAX_AV	V	0... FFFFH	0... 255.99609375	0.00390625	-
Current rear axle ratio					
LV_DRI	O/V	0... 1H	0 ...1	1	-
Logical variable for engaged drive					
LV_RNG_L	O/V	0... 1H	0 ...1	1	-
Logical variable for engaged low range					
LV_RNG_L_AT	O/V	0... 1H	0 ...1	1	-
Logical variable for engaged low range AT					
N_MMV_GR_DET	-	0... 1FE0H	0... 8160	1	rpm
Filtered engine speed for gear ratio detection					
N_VS_RATIO	O/V	0... FFH	0... 255	1	rpm/(km/h)
engine speed /vehicle speed ratio, corrected by adaptation factor					
N_VS_RATIO_RAW	-	0... FFH	0... 255	1	rpm/(km/h)
Engine speed /vehicle speed ratio(raw value)					
STATE_GEAR_REV_AT_AMT	O/V	0... 1H	0 ...1	1	-
AT/AMT reverse gear (activ = 1, inactive = 0)					
VS_WHEEL	V	0... FFH	0... 255	1	km/h
Vehicle speed at wheel					

### Input data:

C_DIAM_WHEEL {p. 1176}	GEAR_INFO {p. 1564}	GR_SUB_MT {p. 798}	LC_AD_CLR_VAR {p. 528}
LV_AT {p. 654}	LV_CITY {p. 799}	LV_CS {p. 8394}	LV_ERR_BLS_PLAUS {p. 4209}
LV_ERR_BN_VS_TCS {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_CS {p. 5015}	LV_ERR_TOUT_ASR_1 {p. 802}
LV_ERR_VS {p. 5021}	LV_ES {p. 1720}	LV_ETCU_SPT_SWI {p. 1565}	LV_IM_BLS {p. 852}
LV_PUC {p. 1720}	LV_SOF_SWI_REQ {p. 3851}	LV_ST {p. 1720}	LV_VAR_ETCU_SPT {p. 656}

LV_VAR_TCT {p. 656}	N {p. 1525}	N_WHEEL_RE_LE {p. 806}	N_WHEEL_RE_RI {p. 806}
STATE_ETCU_PROG_INFO {p. 1574}	VS_H {p. 1176}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FAC_GR	V	0... FFH	0... 0.99609375	0.00390625	-
Correlation constant for adaptation of the rear axle					
C_CRLC_N_MMV_GR_DET	V	0... FFH	0... 0.99609375	0.00390625	-
Correlation constant for calculation of N_MMV_GR_DET filtered value					
C_CRLC_N_VS_RATIO_RAW	V	0... FFH	0... 0.99609375	0.00390625	-
Correlation constant for calculation of N_VS_RATIO filter value					
C_GR_RAX_SP	V	0... FFFFH	0... 255.99609375	0.00390625	-
Rear axle ratio of standard rear axle					
C_MIN_VS_RATIO	V	0... FFH	0... 255	1	km/h
Minimum engine speed for engine speed /vehicle speed ratio calculation					
C_N_VS_CRU_GEAR2_PUC_SP	V	0... FFH	0... 255	1	rpm/(km/h)
N/V/S ratio in case of PUC in 2nd gear with standard rear axle					
C_N_VS_CRU_GRD_FAC_GR_MAX	V	0... FFH	0... 255	1	rpm/(km/h)
Gradient of N/V/S ratio below which FAC_GR is adapted					
C_STATE_ETCU_PROG_INFO	V	0... FFH	0... 255	1	-
Manual switch for activating low range AT detection					
ID_GR_MT_N_VS_RATIO	V	0... FFH	0... 255	1	-
LDP_N_VS_RATIO_GR_MT	13	0... FFH	0... 255	1	rpm/(km/h)
Index table for Gear Ratio detection					
LC_N_VS_RATIO_N_WHL	V	0... 1H	0 ...1	1	-
Calculation of engine speed/vehicle speed ratio based on wheel speeds is selected when active, otherwise calculation based on engine speed and vehicle speed is selected					
LC_RNG_L	V	0... 1H	0 ...1	1	-
Manual switch for low range detection					

**General information**

Gear ratio calculation is depending on transmission type (manual or automatic). When manual transmission is detected and (LV\_AT == 0 & LV\_VAR\_TCT == 0), gear ratio is detected by using engine speed /vehicle speed ratio. In case of automatic transmission, gear ratio is detected by using the CAN-information of EGS. If LV\_VAR\_TCT = 1 then gear ratio is calculated versus CAN informations coming from DKG.

**Application conditions:****Initialisation:**


GR\_MT = 0 at [ LV\_ES = 1 or LV\_ST = 1 or LV\_CS = 1 ]

GR\_AT, LV\_DRI = 0 at [ LV\_ES = 1 or LV\_ST = 1 ]

FAC\_GR\_MMV\_AV = 1.0

when ECU is new or

when adaptation is reset by LC\_AD\_CLR\_VAR or

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```

when values of group VAR could not be read out from the non
volatile memory;
else: FAC_GR_MMV_AV is read back from non volatile memory

GEAR = 0
GEAR_EF = 0

N_MMV_GR_DET = N

if LC_N_VS_RATIO_N_WHL=1
then
N_VS_RATIO = N / (((N_WHEEL_RE_LE + N_WHEEL_RE_RI) / 2)
                    * C_DIAM_WHEEL) / (2000 / 3.6)
else
N_VS_RATIO = 255 rpm/ (km/ h)
endif

```

**Activation:** at all engine operating states except LV\_ES and LV\_ST .

**Deactivation:** at engine operating states LV\_ES and LV\_ST.

**Recurrence:** 10 ms **except** subchapter 1.1.1: 100 ms

### Function description:

### Formula section:

#### 4.33.1 Manual transmission (LV\_AT = 0 and LV\_VAR\_TCT = 0)

### Formula section:

Executed only if LV\_AT = 0 and LV\_VAR\_TCT = 0

```

if(1) [LV_ERR_VS = 1 and LV_ERR_CAN_BOFF = 1] or
[LV_ERR_VS = 1 and LV_ERR_BN_VS_TCS = 1] or
[LV_ERR_VS = 1 and LV_ERR_TOUT_ASR_1 = 1]
then(1) N_VS_RATIO = 0
GR_MT = GR_SUB_MT
else(1) N_MMV_GR_DETn = N_MMV_GR_DETn-1 +
+ C_CRCLC_N_MMV_GR_DET(N - N_MMV_GR_DETn-1)

N_WHEEL_RE_AV = (N_WHEEL_RE_LE + N_WHEEL_RE_RI) /2


VS_WHEEL = N_WHEEL_RE_AV * C_DIAM_WHEEL / (2000 /3.6)
// The resolution adaptation is 2000/(0.015625*0.0625*3.6)

N_VS_RATIO_RAW = N_MMV_GR_DET /VS_WHEEL

N_VS_RATIOn = N_VS_RATIOn-1 +
+ C_CRCLC_N_VS_RATIO_RAW(N_VS_RATIO_RAW - N_VS_RATIOn-1)

if(2) LC_N_VS_RATIO_N_WHL = 1

```

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```

then(2)
  if(3) VS_WHEEL > C_MIN_VS_RATIO
  then(3) N_VS_RATIO = N_VS_RATIOn
    if(4) LV_CS = 1
    then(4) GR_MT = 0
    else(4) GR_MT = ID_GR_MT__N_VS_RATIO
    endif(4)
  else(3) N_VS_RATIO = 255 rpm/(km/h)
    GR_MT = 0
  endif(3)
else(2)
  if(5) LV_CS = 0
  then(5)
    if(6) VS_H > C_MIN_VS_RATIO
    then(6) N_VS_RATIO = N /VS_H
    else(6) N_VS_RATIO = 255 rpm/(km/h)
    endif(6)
    GR_MT = ID_GR_MT__N_VS_RATIO
  else(5) N_VS_RATIO = 0
    GR_MT = 0
  endif(5)
endif(2)
endif(1)

LDP_N_VS_RATIO_GR_MT = N_VS_RATIOn /FAC_GR_MMV_AV

```

#### 4.33.1.1 Adaptation of different rear axle transmission ratios (only manual transmission)

Different rear axle ratios are used for the versions for different countries within the various vehicle series. The function aims at learning the rear axle ratio and to use it for correction for gear detection.

The gear detection is applied with the standard rear axle. Moreover, the standard reduction ratio is applied as fixed value. Moreover, the n/vs ratio used by the vehicle for driving in 2<sup>nd</sup> gear and trailing throttle fuel cut-off is applied.

##### Learning the new rear axle ratio

The adaptation of the rear axle ratio is only effected in 2<sup>nd</sup> gear and at trailing throttle fuel cut-off PUC. The quotient of the actual value and the setpoint of the n/vs ratio is used for calculation of the new rear axle ratio and the factor between the actual and setpoint reduction ratio.


The rear axle ratio is adapted via an adaptive correlation constant C\_CRLC\_FAC\_GR.

Moreover, FAC\_GR is biased with FAC\_GR\_MMV\_AV.

##### **Formula section:**

Executed only if (LV\_AT = 0 and LV\_VAR\_TCT = 0)

**if**            GEAR = 2                            **and**

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```

LV_PUC = 1           and
LV_CS = 0           and
LV_ERR_CS = 0       and
LV_IM_BLS = 0       and
LV_ERR_BLS_PLAUS = 0 and
|N_VS_RATIOn-1 - N_VS_RATIOn| < C_N_VS_CRU_GRD_FAC_GR_MAX
then Calculation of the rear axle ratio "ACTUAL to SETPOINT values - rear axle"
FAC_GR = N_VS_RATIO / C_N_VS_CRU_GEAR2_PUC_SP

Adaptation of the rear axle ratio:
FAC_GR_MMV_AVn = FAC_GR_MMV_AVn-1
                + C_CRLC_FAC_GR * (FAC_GR - FAC_GR_MMV_AVn-1)

Reduction ratio of the currently installed rear axle:
GR_RAX_AV = C_GR_RAX_SP * FAC_GR_MMV_AV
    
```

The calculated N\_VS\_RATIO ratio is continually divided by the current value of FAC\_GR\_MMV\_AV and the current multiplication result is used to obtain the correct gear from the value applied map ID\_GR\_MT\_N\_VS\_RATIO.

The adaptation value FAC\_GR\_MMV\_AV can be reset to 1 via the KWP command "delete variant".

### 4.33.2 Twin Clutch Transmission (LV\_VAR\_TCT = 1)

Gear ratio and LV\_DRI are calculated versus CAN informations coming from DKG.

#### Formula section:

Executed only if LV\_VAR\_TCT = 1

GR\_MT, LV\_DRI = f(GEAR\_INFO), see list below:

GEAR_INFO	Corresponding gear	GR_MT	LV_DRI
0H	neutral or park	0	0
1H	1st gear	1	1
2H	2nd gear	2	1
3H	3rd gear	3	1
4H	4th gear	4	1
5H	5th gear	5	1
6H	6th gear	6	1
7H	7th gear	7	1
AH	reverse gear	0	1

Figure 4.33.1:

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### 4.33.3 Automatic transmission (LV\_AT = 1)

Gear ratio and LV\_DRI are calculated versus CAN informations coming from EGS.

#### Formula section:

Executed only if LV\_AT = 1

GR\_AT, LV\_DRI = f(GEAR\_INFO), see list below:

GEAR_INFO	Corresponding gear	GR_AT	LV_DRI
0H	neutral or park	0	0
1H	1st gear	1	1
2H	2nd gear	2	1
3H	3rd gear	3	1
4H	4th gear	4	1
5H	5th gear	5	1
6H	6th gear	6	1
7H	7th gear	7	1
AH	reverse gear	0	1

Figure 4.33.2:

### 4.33.4 Information if the reverse gear (AT or TCT) is activ/inactiv :

#### Formula section:

```

if      (LV_AT = 1 or LV_VAR_TCT = 1)
          and   GEAR_INFO = AH
then    STATE_GEAR_REV_AT_AMT = 1
else    STATE_GEAR_REV_AT_AMT = 0
endif
    
```

### 4.33.5 Low range detection (LV\_RNG\_L, LV\_RNG\_L\_AT)

Depending on LC\_RNG\_L, the sport-switch and the LV\_RNG\_L\_AT-request from EGS, the bit LV\_RNG\_L will be activated.

Meaning of C\_STATE\_ETCU\_PROG\_INFO:

Bit	LV_RNG_L_AT will be set at condition:
0	AT / TCT in "S" / "DS" ("comfort transmission"; LV_VAR_ETCU_SPT=0)
1	AT / TCT in manual mode "M1 ... 6" ("comfort transmission"; LV_VAR_ETCU_SPT=0)
2	AT- / TCT-sport-switch in "S" / "DS" ("sport transmission"; LV_VAR_ETCU_SPT=1)
3	AT- / TCT-sport-switch in manual mode "M1 ... 6" ("sport transmission"; LV_VAR_ETCU_SPT=1)
4	Gearbox-sportswitch active and AT / TCT ("comfort transmission"; LV_VAR_ETCU_SPT=0)
5	Gearbox-sportswitch active and AT / TCT ("sport transmission"; LV_VAR_ETCU_SPT=1)
6	always with MT
7	not used

Figure 4.33.3:

**Formula section:**

**If**

AT/TCT "comfort" in "S-mode"

[STATE\_ETCU\_PROG\_INFO = 1H **and**  
LV\_VAR\_ETCU\_SPT = 0 **and**  
Bit 0 of C\_STATE\_ETCU\_PROG\_INFO is set] **or**

AT/TCT "comfort" in "M-mode"

[STATE\_ETCU\_PROG\_INFO = 2H **and**  
LV\_VAR\_ETCU\_SPT = 0 **and**  
Bit 1 of C\_STATE\_ETCU\_PROG\_INFO is set] **or**

AT/TCT "sport" in "S-mode"

[STATE\_ETCU\_PROG\_INFO = 1H **and**  
LV\_VAR\_ETCU\_SPT = 1 **and**  
Bit 2 of C\_STATE\_ETCU\_PROG\_INFO is set] **or**

AT/TCT "sport" in "M-mode"

[STATE\_ETCU\_PROG\_INFO = 2H **and**  
LV\_VAR\_ETCU\_SPT = 1 **and**  
Bit 3 of C\_STATE\_ETCU\_PROG\_INFO is set] **or**

AT/TCT "comfort" in "sport-mode-gearbox"

[LV\_VAR\_ETCU\_SPT = 0 **and**  
LV\_ETCU\_SPT\_SWI = 1 **and**  
Bit 4 of C\_STATE\_ETCU\_PROG\_INFO is set] **or**

AT/TCT "sport" in "sport-mode-gearbox"

[LV\_VAR\_ETCU\_SPT = 1 **and**  
LV\_ETCU\_SPT\_SWI = 1 **and**  
Bit 5 of C\_STATE\_ETCU\_PROG\_INFO is set] **or**

MT continious in "sport"-mode

[LV\_AT = 0 **and** LV\_VAR\_TCT = 0 **and**  
Bit 6 of C\_STATE\_ETCU\_PROG\_INFO is set]

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```

Then    LV_RNG_L_AT = 1
Else    LV_RNG_L_AT = 0
Endif

if      LC_RNG_L = 1           or    // request from application system
          LV_SOF_SWI_REQ = 1    or    // request from sport switch
          LV_RNG_L_AT = 1      // request from gearbox
then    LV_RNG_L = 1
else    LV_RNG_L = 0
endif

```

#### 4.33.6 Common Gear Ratio Independent from AT or MT ( GEAR )

##### Description:

At not stopped or starting engine, GEAR displays the actual gear ratio independent from transmission type.

##### Formula section:

```

if (1)    LV_ES = 0
           and LV_ST = 0
then (1)
           if (2)    LV_AT = 1
           then (2)    GEAR = GR_AT
           else (2)    GEAR = GR_MT
           endif (2)
else (1)    GEAR = 0
endif (1)

```

#### 4.33.7 Gear Ratio for exhaust flap functionality

##### Description:

For the exhaust flap function the detected gear shall not change during gear shift. For this purpose the variable GEAR\_EF is generated from GEAR.

##### Formula section:

```

if      LV_CS = 0
then    GEAR_EF = GEAR           no gear shift because clutch is closed
else    GEAR_EF = GEAR_EF       gear shift possible because open clutch, GEAR_EF remains
endif                                     unchanged

```

## 4.34 Drive train engaged

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DT	O/V	0... 1H	0 ...1	1	-
Logical variable drive train engaged					

### Input data:

GR_MT {p. 1302}	LV_AT {p. 654}	LV_CS {p. 8394}	LV_DRI {p. 1302}
LV_ES {p. 1720}	LV_VAR_TCT {p. 656}	VS {p. 1176}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VS_MIN_DT	-	0... FFH	0... 255	1	km/h
Threshold for vehicle running and drive-train closed detection					
LC_MOD_DT_TCT	-	0... 1H	0 ...1	1	-
Mode selection of drive train engaged detection for variant twin clutch transmission (0 = like MT; 1 = like AT)					

### General Information

#### General information:

Drive train engaged active (LV\_DT=1) means drive train is closed, engine torque is transmitted to the wheels and the vehicle is running ( VS >= C\_VS\_MIN\_DT).

The dependability to the vehicle-speed has different reason for AT and MT/AMT vehicle.

#### AT:

With engaged gear it s normally not necessary to have an aggressive idle-speed control. The only exception is a sudden breaking at slowly moving vehicle with engaged gear. In this case it s necessary to switch to the strong P\_D - parameter map of the idle-speed control to avoid idle-speed break-down.

#### MT:

At start of the vehicle without pushing the accelerator pedal it s necessary to switch as fast as possible to the smooth P\_D idle-speed control map to avoid vehicle jerking. Depending on slip of the clutch it may last too long until a gear-position determination is possible. Therefore in this case the switching from aggressive to the smooth P\_D map can happen even at slow vehicle speed.

Nevertheless the actualisation of LV\_DT is strongly depending on the update-rate of the input signal VS .

### Application Conditions

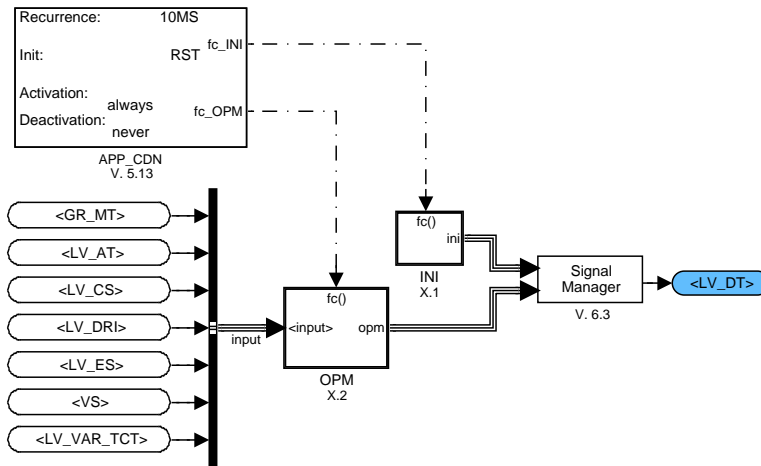
Initialization: RST

Recurrence: 10MS

Activation: always

Deactivation: never

### Function description




x SDA\_SRS / SDA V 5.2 30-Oct-2006

Figure 4.34.1: : Path: TRSM\_M400T

### 4.34.1 Initialisation at Reset

LV\_DT = 0

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### 4.34.2 Formula section

#### 4.34.2.1 Calculation of LV\_DT

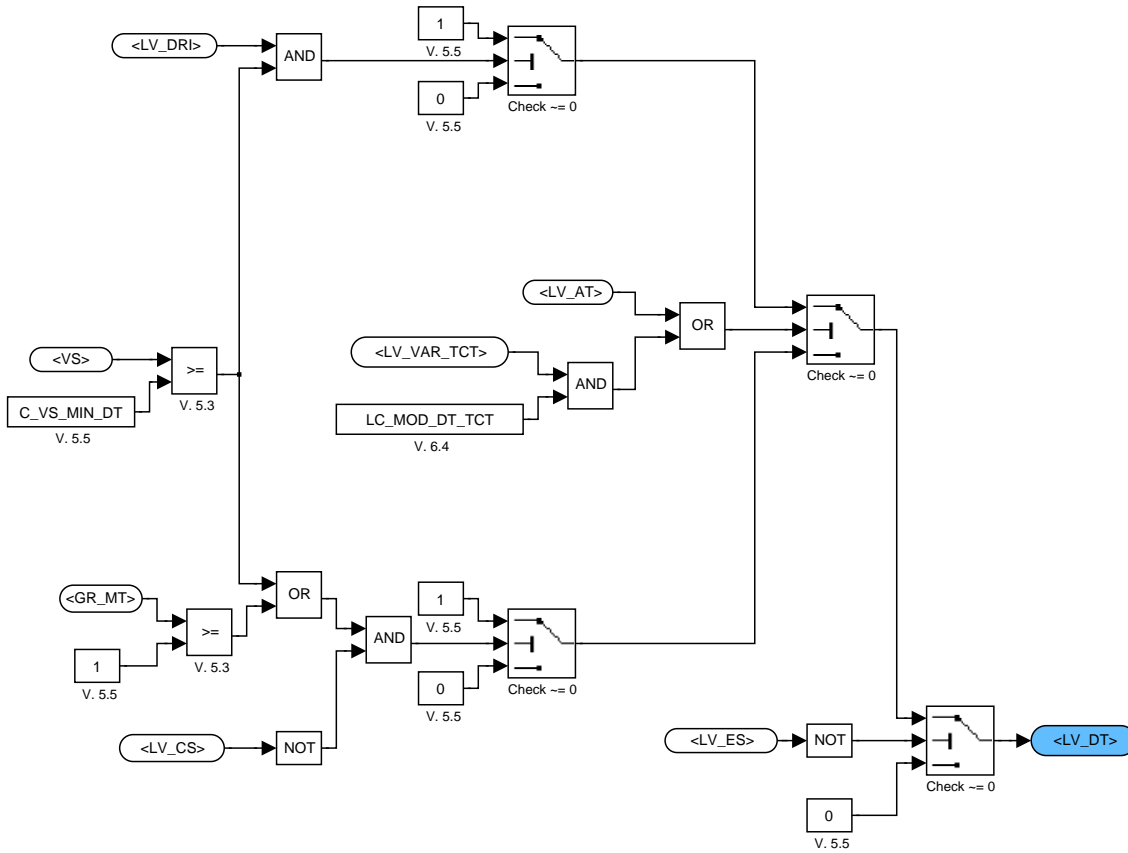


Figure 4.34.2: : Path: TRSM\_M400T/OPM/CLC\_LV\_DT

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## 4.35 O2 sensor (lin, up) SPI interface ASW - BSW

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LSL_IF_SPI_RST_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating general status of ATIC42 initialisation after RESET					
STATE_LSL_IF_CONF_SPI_WR [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Mapping of contents to be written to ATIC42 INIT_REG_1					
STATE_LSL_IF_SPI_WR [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Bit-field mapping of contents to be written to ATIC42 INIT_REG_1					

### Input data:

CTR_ERR_LSL_IF_SPI_WR [NC_CBK_EX_NR] {p. 955}	FRQ_R_IT_OSC_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 955}	FRQ_R_IT_OSC_LSL_IF_SPI_WR [NC_CBK_EX_NR] {p. 1320}	ICPLSL_LSL_IF [NC_CBK_EX_NR] {p. 2351}
LV_ICPLSL_ENA_LSL_IF [NC_CBK_EX_NR] {p. 2351}	LV_IPLSL_CTL_ENA_LSL_IF [NC_CBK_EX_NR] {p. 2351}	LV_LSL_ENA_LSL_IF [NC_CBK_EX_NR] {p. 1318}	LV_R_IT_CAL_ENA_LSL_IF [NC_CBK_EX_NR] {p. 1320}
LV_R_IT_OSC_ENA_LSL_IF [NC_CBK_EX_NR] {p. 1320}	LV_R_IT_SWI_RNG_LSL_IF [NC_CBK_EX_NR] {p. 1320}	LV_SWI_GAIN_LSL_IF [NC_CBK_EX_NR] {p. 2314}	LV_VLS_OFS_ADJ_ENA_LSL_IF [NC_CBK_EX_NR] {p. 2314}
NC_CBK_EX_NR {p. 1829}	STATE_LSL_IF_CONF_SPI_RD [NC_CBK_EX_NR] {p. 956}	STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 956}	T_DLY_DI_LSL_IF [NC_CBK_EX_NR] {p. 1318}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_LSL_IF_CONF_SPI_WR_INI	-	0... FFH	0... 255	1	-
Initialisation data of SPI register INIT_REG_2					
C_STATE_LSL_IF_SPI_WR_INI	-	0... FFH	0... 255	1	-
Initialisation data of SPI register INIT_REG_1					

## FUNCTION DESCRIPTION:

### General information:

This function shall describe the interface between application software (ASW) and the basic software (BSW) that helps to initialise and to configure the ATIC42.

Furthermore, the function shall collect information about the status of the initialisations performed by itself and by other application software and send out a general status of the initialisation via the flag LV\_LSL\_IF\_SPI\_RST\_END[i], which also indicates the readiness of the ATIC42.

The calculation shall be done for all exhaust cylinder banks.


For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

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### Description:

The function shall initialize the WRAF sensor interface **after RESET or upon erase of error management** by mirroring the contents of the calibration data C\_STATE\_LSL\_IF\_SPI\_WR\_INI into STATE\_LSL\_IF\_SPI\_WR[i] and C\_STATE\_LSL\_IF\_CONF\_SPI\_WR\_INI into the variable STATE\_LSL\_IF\_CONF\_SPI\_WR[i].

**Table 1:** Contents of the initialization variable C\_STATE\_LSL\_IF\_SPI\_WR\_INI

Bit	Bit Name	Meaning (value "1"/"0")
0	SWI_GAIN	IP gain 16 / 8
1	VLS_OFS_ADJ_ENA	IP offset measurement ON / OFF
2	ICPLSL_ENA	Enable / disable Icp
3	IPLSL_CTL_ENA	Enable / disable Ip control loop (2 <sup>nd</sup> silicon)
4	R_IT_CAL_ENA	Enable / disable Ri calibration
5	R_IT_OSC_ENA	Ri oscillator ON / OFF
6	LSL_ENA	Sensor enable / disable
7	R_IT_SWI_RNG	Ri measurement range 2 / range 1

After this the function shall bitwise compare the contents of STATE\_LSL\_IF\_SPI\_WR[i] and STATE\_LSL\_IF\_SPI\_RD[i], and of STATE\_LSL\_IF\_CONF\_SPI\_WR[i] and STATE\_LSL\_IF\_CONF\_SPI\_RD[i]. The function shall also check the initialization of the Ri-measurement frequency (done by the correspondent function) by bitwise comparing FRQ\_R\_IT\_OSC\_LSL\_IF\_SPI\_WR[i] with FRQ\_R\_IT\_OSC\_LSL\_IF\_SPI\_RD[i].

#### Remark:

For write validation procedure, sensor enable bit LV\_LSL\_IF\_LSL\_ENA\_i in the initialisation register is NOT considered because it is automatically reset by ATIC42 HW upon detection of an electrical sensor failure, regardless of the last transmitted SPI command. This asynchronous change in bit value assignment does not represent a communication error.

In addition, bit6 of FRQ\_R\_IT\_OSC\_LSL\_IF\_SPI\_xx[i] which represents the status of the Pin Selective Disabling feature shall also not be evaluated for SPI communication monitoring at present. Due to an ATIC42 HW error, command execution is performed but not monitored in ASIC response.

Additionally the actual value of error counter CTR\_ERR\_LSL\_IF\_SPI\_WR[i]<sub>(N)</sub> must be compared to its precedent value CTR\_ERR\_LSL\_IF\_SPI\_WR[i]<sub>(N-1)</sub>. If all comparisons show coincidence the flag LV\_LSL\_IF\_SPI\_RST\_END[i] is set to 1.

The BSW function is defined elsewhere (Basic inputs & outputs, WRAF sensor interface). The BSW essentially observes the interface byte for changes. Should a change occur due to an ASW function, the new information is sent to the ATIC42 and the write cycle is then verified.

The function shall collect information from 8 logical variables and map these to the single byte variable STATE\_LSL\_IF\_SPI\_WR[i], which then acts as an interface to the BSW. The bit-field mapping is depicted in the following Table 2 and Figure 1.

**Table 2:** Bit-field mapping of contents of STATE\_LSL\_IF\_SPI\_WR[i]



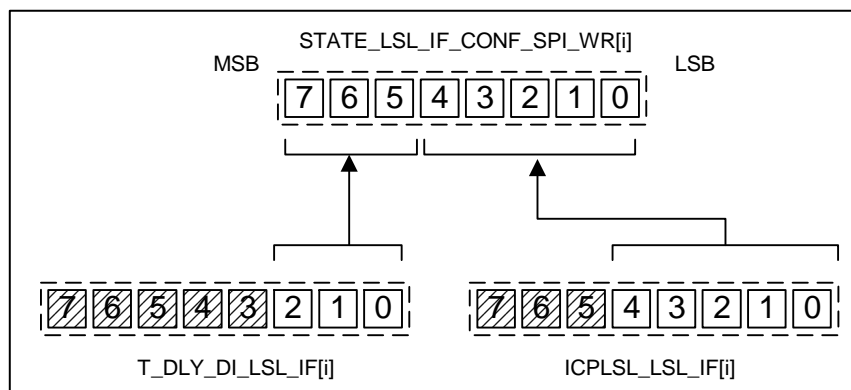


Figure 4.35.2: : Bit-field mapping of contents of STATE\_LSL\_IF\_CONF\_SPI\_WR[i]

### Application conditions

#### Initialization:

**After a RESET or upon erase of error management** the following initialization shall take place:

STATE\_LSL\_IF\_SPI\_WR[i] = C\_STATE\_LSL\_IF\_SPI\_WR\_INI

STATE\_LSL\_IF\_CONF\_SPI\_WR[i] = C\_STATE\_LSL\_IF\_CONF\_SPI\_WR\_INI

LV\_LSL\_IF\_SPI\_RST\_END[i] = 0.

**Store** CTR\_ERR\_LSL\_IF\_SPI\_WR<sub>i(N)</sub> - 1.

Counter content is decremented at function initialization prior to storage to ensure that BSW is executed once the least before LV\_LSL\_IF\_SPI\_RST\_END is set - and thus might falsely indicate execution of a successful write cycle for initialization. The simulated communication error (stored counter value differs from actual value) replaces time flow synchronization mechanism between ASW-BSW interface and

BSW function which are executed at same recurrence rate. This workaround assures that BSW is able to perform one write cycle minimum regardless of contents of ATIC42 initialization registers.

**Note:** after a successful initialization of the ATIC42 the flag LV\_LSL\_IF\_SPI\_RST\_END shall be activated.

*Recurrence:*

T\_SAMPLE = 10 ms.

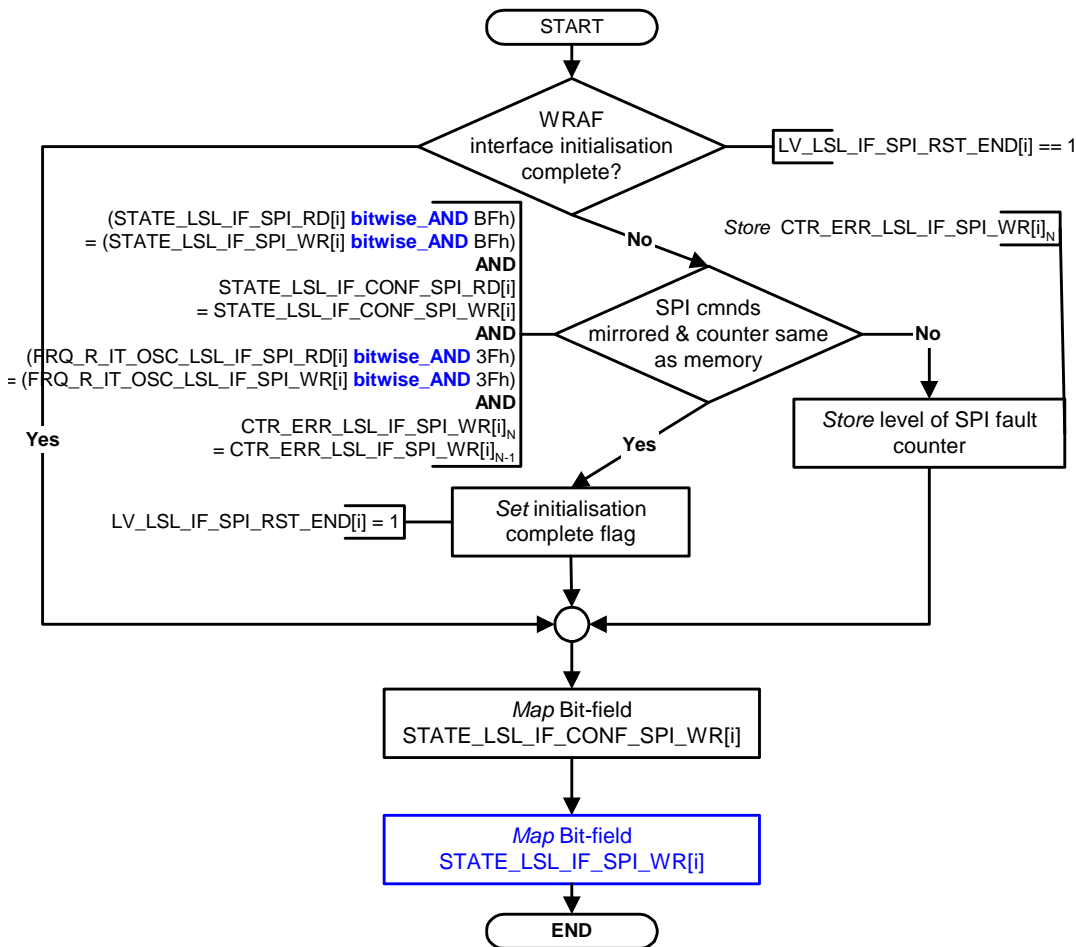
*Activation:*

In all Engine States

*Deactivation:*

--

**Formula section:**



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## 4.36 O2 sensor (lin, up) SPI interface ASW - BSW (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CTR_ERR_LSL_IF_SPI_MAN_INC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
BSW interface for manual increase of value of SPI communication error counter					
LV_LSL_ENA_LSL_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag to enable/disable WRAF sensor connection					
LV_LSL_IF_RST [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag to reset the ATIC42					
T_DLY_DI_LSL_IF [NC_CBK_EX_NR]	O/V	0... 7H	0 ...7	1	-
Configuration of the Sensor Protection Time					

### Input data:

LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_IGK {p. 906}	NC_CBK_EX_NR {p. 1829}
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### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DLY_DI_LSL_IF	V	0... 7H	0 ...7	1	-
Configuration of sensor protection time					
LC_CTR_ERR_LSL_IF_SPI_MAN_INC	V	0... 1H	0 ...1	1	-
Switch to manually increase value of SPI communication error counter within BSW					

### General information

Specification defines and initializes variables and boolean flags not defined and initialized elsewhere.

In case of an electric fault (incl. Open Circuit) which is detected by WRAF sensor electric diagnosis, sensor is decoupled as long as corresponding error flags are present.

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

### Description:

This function shall initialise the unused WRAF sensor interface flags.

Once OBDI sensor error is debounced ( LV\_ERR\_EL\_LSL\_UP[i] == 1 ), WRAF sensor is decoupled ( LV\_LSL\_ENA\_LSL\_IF [i] = 0 ) as long as error flag is present. Same action is taken once debounced OC failure is present ( LV\_ERR\_OC\_LSL\_UP[i] == 1 ).

The following configuration data shall be used:

C\_T\_DLY\_DI\_LSL\_IF = 010 = 2H (corresponds to 1ms)

**Application conditions:****Initialisation:**

The following variable initialisation shall take place *after RESET*.

```
T_DLY_DI_LSL_IF[i] = C_T_DLY_DI_LSL_IF
LV_LSL_IF_RST[i] = 0
LV_LSL_ENA_LSL_IF[i] = 1
```

The following variable initialisation shall take place at *LV\_IGK = 0 -> 1, or upon erase of error management*.

```
LV_LSL_ENA_LSL_IF[i] = 1
```

**NOTE:** *The logical variable LV\_LSL\_ENA\_LSL\_IF[i] is mapped in the interface byte STATE\_LSL\_IF\_SPI\_WR[i]. Its initialization shall be done according to the corresponding bit value of C\_STATE\_LSL\_IF\_SP\_WR\_INI in 'ATIC42 ASW<->BSW Interface', 4033. T\_DLY\_DI\_LSL\_IF[i] is mapped in the configuration byte STATE\_LSL\_IF\_CONF\_SPI\_WR[i].*

**Activation:**

In all engine states

**Deactivation:**

- -


**Recurrence:**

T\_SAMPLE = 10ms

**Function description:****Formula section:**

```
LV_CTR_ERR_LSL_IF_SPI_MAN_INC[i] = LC_CTR_ERR_LSL_IF_SPI_MAN_INC
```

```
IF      LV_IGK == 1
THEN IF  LV_ERR_EL_LSL_UP[i] == 1
OR      LV_ERR_OC_LSL_UP[i] == 1
THEN    LV_LSL_ENA_LSL_IF[i] = 0
ELSE    LV_LSL_ENA_LSL_IF[i] = 1
ENDIF
```

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## 4.37 O2 sensor (lin, up) element temperature determination

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_GAIN_H_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 23.9996	366e-6	-
High gain of oxygen sensor internal resistance determination circuit					
FAC_GAIN_L_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 23.9996	366e-6	-
Low gain of oxygen sensor internal resistance determination circuit					
FRQ_R_IT_OSC_LSL_IF_SPI_WR [NC_CBK_EX_NR]	O/V	0... 7FH	0... 127	1	-
Variable indicating coded information for requested Ri determination oscillator frequency					
LV_FAC_GAIN_H_VLD_R_IT_LS_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating measured high gain valid					
LV_FAC_GAIN_L_VLD_R_IT_LS_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating measured low gain valid					
LV_R_IT_CAL_ENA_LSL_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag requesting WRAF interface internal resistance adjust mode to be enabled					
LV_R_IT_OSC_ENA_LSL_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag requesting WRAF interface internal oscillator to be enabled					
LV_R_IT_REQ_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that conditions have been met and resistance determination requested					
LV_R_IT_SWI_RNG_LSL_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag requesting WRAF interface to select internal resistance gain (range)					
LV_TTIP_MES_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating validity of oxygen sensor ceramic temperature TTIP_MES_LS_UP					
LV_V_OFS_ADJ_VLD_R_IT_LS_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating offset in resistance adjust mode valid					
LV_V_OFS_MES_VLD_R_IT_LS_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating offset in resistance measurement mode valid					
LV_V_REF_VLD_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating internal resistance determination circuit references valid					
R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 16383.75	0.25	ohm
Oxygen sensor element internal resistance					




Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_TTIP_MES_LS_UP [NC_CBK_EX_NR]	V	0H 1H 2H 3H 4H	OFF MES_OFS ADJ_OFS ADJ_GAIN MES	-	-
State variable indicating current state of function					
T_DLY_R_IT_IPLSL_CTL_ACT [NC_CBK_EX_NR]	V	0... FFH	0... 2.55	0.01	s
Delay timer for freeze of Ri signal upon activation of Ip loop					
TCC_ERR_FAC_GAIN_H_R_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Counter incremented for every invalid high gain adjust measurement					
TCC_ERR_FAC_GAIN_L_R_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Counter incremented for every invalid low gain adjust measurement					
TCC_ERR_V_OFS_ADJ_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Counter incremented for every invalid offset voltage in resistance adjust mode					
TCC_ERR_V_OFS_MES_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Counter incremented for every invalid offset voltage in resistance measurement mode					
TCC_FAC_GAIN_H_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Counter incremented for every high gain adjust measurement					
TCC_FAC_GAIN_L_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Counter incremented for every low gain adjust measurement					
TCC_V_OFS_ADJ_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Counter incremented for every offset voltage in resistance adjust mode					
TCC_V_OFS_MES_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Counter incremented for every measured offset voltage in resistance measurement mode					
TTIP_MES_LS_UP [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Oxygen sensor ceramic temperature					
V_OFS_ADJ_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFCH	0... 4.99511	1.22e-3	V
Internal resistance determination circuit offset in resistance adjust mode					
V_OFS_MES_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFCH	0... 4.99511	1.22e-3	V
Internal resistance determination circuit offset in resistance measurement mode					

**Input data:**

CTR_ERR_LSL_IF_SPI_WR [NC_CBK_EX_NR] {p. 955}	FRQ_R_IT_OSC_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 955}	LV_IGK {p. 906}	LV_INH_TTIP_LS_UP [NC_CBK_EX_NR] {p. 1339}
LV_LS_UP_READY [NC_CBK_EX_NR] {p. 2335}	LV_LS_UP_READY_CDN [NC_CBK_EX_NR] {p. 2335}	LV_LS_UP_READY_RAW [NC_CBK_EX_NR] {p. 2335}	LV_LSH_UP_MAN_ACT [NC_CBK_EX_NR] {p. 2385}

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LV_LSL_DEAC [NC_CBK_EX_NR] {p. 955}	LV_LSL_IF_SPI_RST_END [NC_CBK_EX_NR] {p. 1313}	LV_LSL_OFS_ADJ_ACT [NC_CBK_EX_NR] {p. 2313}	NC_CBK_EX_NR {p. 1829}
STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 956}	V_TEMP_LS_UP [NC_CBK_EX_NR] {p. 967}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_GAIN_H_DIF_R_IT_LS_UP	-	0... FFFFH	0... 23.9996	366e-6	-
Maximum permitted deviation of measured FAC_GAIN_H_R_IT_LS_UP [NC_CBK_EX_NR] from nominal reference value					
C_FAC_GAIN_H_R_IT_LS_UP	-	0... FFFFH	0... 23.9996	366e-6	-
Reference high gain for internal resistance determination circuit					
C_FAC_GAIN_L_DIF_R_IT_LS_UP	-	0... FFFFH	0... 23.9996	366e-6	-
Maximum permitted deviation of measured FAC_GAIN_L_R_IT_LS_UP [NC_CBK_EX_NR] from nominal reference value					
C_FAC_GAIN_L_R_IT_LS_UP	-	0... FFFFH	0... 23.9996	366e-6	-
Reference low gain for internal resistance determination circuit					
C_FAC_GAIN_R_IT_LS_UP	-	0... FFFFH	0... 76.79882	1.17e-3	1/V
Factor used when determining high gain = $(C\_R\_IT\_REF\_LS\_UP + R5 + R6) / (5V * (R5 + R6))$					
C_FRQ_R_IT_OSC_LSL_IF	-	0... 7FH	0... 127	1	-
Coded information for Ri determination oscillator frequency					
C_R_IT_REF_LS_UP	-	0... FFFFH	0... 65535	1	ohm
Reference current pulse resistor for internal resistance determination circuit = $(R2 * R1) / (R2 + R1)$					
C_T_DLY_CLC_R_IT_LS_UP	-	0... FFH	0... 2.55	0.01	s
Delay required from switching from internal resistance adjust gain to measurement mode					
C_T_DLY_FAC_GAIN_R_IT_LS_UP	-	0... FFH	0... 2.55	0.01	s
Delay required from switching from internal resistance adjust offset to adjust gain mode					
C_T_DLY_OFS_ADJ_R_IT_LS_UP	-	0... FFH	0... 2.55	0.01	s
Delay required from switching from internal resistance measurement offset to adjust offset mode					
C_T_DLY_OFS_MES_R_IT_LS_UP	-	0... FFH	0... 2.55	0.01	s
Delay required from switching oscillator off or internal resistance measurement to measurement offset mode					
C_T_DLY_R_IT_IPLSL_CTL_ACT	-	0... FFH	0... 2.55	0.01	s
Delay time for freeze of Ri signal upon activation of Ip loop					
C_T_MAX_FAC_GAIN_R_IT_LS_UP	-	0... FFFFH	0... 655.35	0.01	s
Maximum permitted time for gain adjust measurement					
C_T_MAX_V_OFS_ADJ_R_IT_LS_UP	-	0... FFFFH	0... 655.35	0.01	s
Maximum permitted time for offset measurement in adjust mode					
C_T_MAX_V_OFS_MES_R_IT_LS_UP	-	0... FFFFH	0... 655.35	0.01	s
Maximum permitted time for offset measurement in measurement mode					
C_V_DIF_MAX_OFS_ADJ_R_IT_LS_UP	-	0... FFCH	0... 4.99511	1.22e-3	V
Maximum permitted deviation of V_OFS_ADJ_R_IT_LS_UP [NC_CBK_EX_NR] to nominal reference value					
C_V_DIF_MAX_OFS_MES_R_IT_LS_UP	-	0... FFCH	0... 4.99511	1.22e-3	V
Maximum permitted deviation of V_OFS_MES_R_IT_LS_UP [NC_CBK_EX_NR] to nominal reference value					
C_V_OFS_REF_R_IT_LS_UP	-	0... FFCH	0... 4.99511	1.22e-3	V
Reference offset voltage for internal resistance determination circuit					
IP_TTIP_MES_LS_UP	-	0... 7FFFH	0... 2047.9375	0.0625	°C

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_R_IT_LS_UP_IP_TTIP_LS_UP	8	0... FFFFH	0... 16383.75	0.25	ohm
Oxygen sensor temperature vs. internal resistance characteristic					
LC_R_RNG_REQ_LS_UP_LSL_IF	-	0... 1H	0 ...1	1	-
Boolean flag selecting internal resistance determination circuit gain when manual switching enabled					
LC_R_RNG_REQ_SWI_LS_UP_LSL_IF	-	0... 1H	0 ...1	1	-
Boolean flag enabling manual switching of internal resistance determination circuit gain					
LC_V_REF_R_IT_LS_UP	-	0... 1H	0 ...1	1	-
Boolean flag enabling internal resistance determination circuit reference measurement					

## FUNCTION DESCRIPTION:

### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

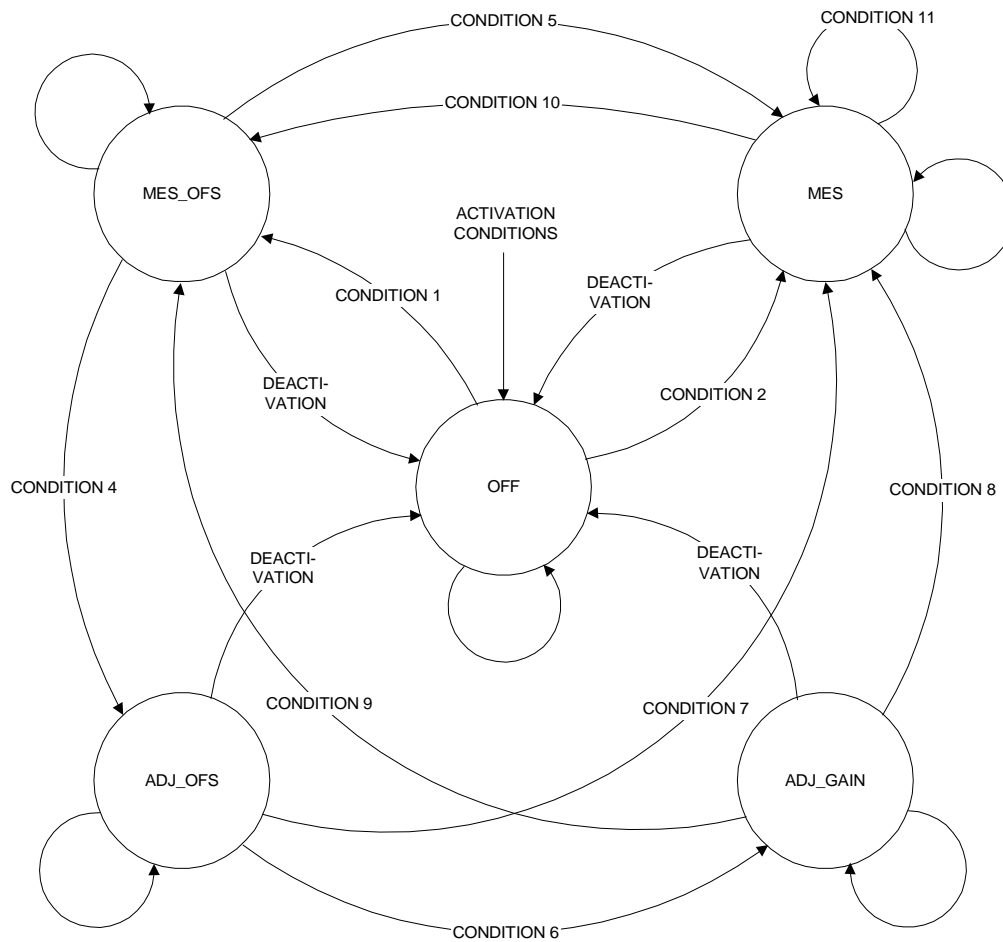
otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

The purpose of this function shall be to:

- Initialise the WRAF sensor interface with respect to all resistance determination parameters, i.e. switches and oscillator frequency.
- Switch between internal resistance ranges upon detection of operative readiness or when manually requested.
- Convert an acquired voltage (V\_TEMP\_LS\_UP[i]) into an oxygen sensor element ceramic temperature and internal resistance.
- Periodically measure the offset and gain of the internal resistance determination circuit in order to minimise errors in the measured resistance and therefore ceramic temperature determination.

### Signal flow diagram:




### Description:

The function, once activated, shall provide the ceramic tip temperature of the oxygen sensor every 100 ms derived from the measured internal resistance. This temperature may then be used for temperature control and diagnosis purposes. In order to increase the system accuracy, the equation linking the measured voltage (measure of internal resistance) to the internal resistance may be compensated for drifts in offset and gain of the measurement circuit. The compensation shall be carried out periodically, when triggered by the input variable LV\_LSL\_OFS\_ADJ\_ACT[i] being set and when switching between internal resistance ranges. This former condition ensures that the oscillator, used to measure the internal resistance, is off when the lambda output offset measurement is carried out. The latter condition ensures that the different gain associated with the different range is re-measured.

The offsets shall be measured in both the measurement mode (oxygen sensor attached to WRAF sensor interface) and adjustment mode (reference calibration resistor attached to WRAF sensor interface) by switching the oscillator off and measuring the voltage output of the circuit. The gain shall be measured by switching to the adjust mode and taking the voltage reading with the calibration resistor in place. With reading and the knowledge of the value of the calibration resistor, stimulus resistor and previously measured offset in adjustment mode, the function shall compute the gain. This gain value of the internal amplifier is the same for both adjustment mode and measurement mode. However, the offsets may differ from one another due to CM (common mode) errors in the internal amplifier and due to the differing potentials at the VN amplifier input in adjustment mode (VGND) and measurement mode (VGND + VS). Hence the gain is calculated with the adjustment mode offset and the measured internal resistance is calculated with the measurement offset.

The **initialisation** of the function output data variables shall be carried out as follows:

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- The SW initialisation of the WRAF sensor interface shall be carried out directly after a reset. FRQ\_R\_IT\_OSC\_LSL\_IF\_SPI\_WR[i] shall be set to C\_FRQ\_R\_IT\_OSC\_LSL\_IF. The ASW interface function shall then determine whether the WRAF sensor interface has been successfully initialised by comparing the information returned from the WRAF interface ASIC with the corresponding initialisation request. Once all initialisations have been completed, the flag LV\_LSL\_IF\_SPI\_RST\_END[i] is set indicating that the complete initialisation has been completed.
- The internal resistance R\_IT\_LS\_UP[i] shall be initialised to its maximum value and the ceramic temperature TTIP\_MES\_LS\_UP[i] to 0, i.e. cold sensor.
- The state machine shall be initialised to the OFF state and the temperature validity flag LV\_TTIP\_MES\_VLD\_LS\_UP[i] shall be reset.
- The validity flags, LV\_V\_REF\_VLD\_R\_IT\_LS\_UP[i], LV\_V\_OFS\_MES\_VLD\_R\_IT\_LS\_UP[i], LV\_V\_OFS\_ADJ\_VLD\_R\_IT\_LS\_UP[i], LV\_FAC\_GAIN\_H\_VLD\_R\_IT\_LS\_UP[i] & LV\_FAC\_GAIN\_L\_VLD\_R\_IT\_LS\_UP[i] shall be initialised dependent on the state of activation logical constant LC\_V\_REF\_R\_IT\_LS\_UP. Should the function be set to be active via this constant, then the flags shall be initialised with 0. Hence should the function be set to be inactive, the flags shall be set to 1, i.e. show that the offset and gain measurements are valid. This permits the function to be disabled via LC\_V\_REF\_R\_IT\_LS\_UP without affecting the functions that use the ceramic temperature information.
- The test cycle and frequency counters used to measure the number of reference measurements carried out (TCC\_...) and the number of reference measurements out of bounds (FRC\_...) shall be initialised after completion of engine start.
- The offset variables V\_OFS\_MES\_R\_IT\_LS\_UP[i] & V\_OFS\_ADJ\_R\_IT\_LS\_UP[i] and gain variables FAC\_GAIN\_H\_R\_IT\_LS\_UP[i] & FAC\_GAIN\_L\_R\_IT\_LS\_UP[i] shall be initialised with the appropriate C\_... constant.

Upon **deactivation** of the function, when the engine start flag is reset, the function shall indicate to other functions that the ceramic temperature is no longer valid by setting the STATE\_TTIP\_MES\_LS\_UP[i] to OFF, resetting the general validity flag LV\_TTIP\_MES\_VLD\_LS\_UP[i], the internal resistance measurement oscillator shall be switched off, the internal resistance measurement mode set to normal measurement mode and the resistance range shall be set the value LC\_R\_RNG\_REQ\_LS\_UP\_LSL\_IF.

The function shall be **activated** with LV\_IGK = 1, no inhibition bit set ( LV\_INH\_TTIP\_LS\_UP[i] == 1 ), no electrical OBD fault have been detected for the WRAF sensor which leads to sensor decoupling ( STATE\_LSL\_IF\_SPI\_RD[i] ( *bit* LSL\_ENA ) == 1 ), and either the raw or conditional operative readiness has been detected ( LV\_LS\_UP\_READY\_RAW[i] = 1 or LV\_LS\_UP\_READY\_CDN[i] = 1 ), or forced sensor pre-heating has been activated ( LV\_LSH\_UP\_MAN\_ACT[i] == 1 ).

It shall be **deactivated** for LV\_IGK = 0, at presence of function inhibition through corresponding application incidence, upon detection of an electrical OBD fault for the WRAF sensor resulting in sensor decoupling, or the raw and conditional operative readiness be reset together with passivated forced sensor pre-heating.


The validity of the ceramic temperature measurement shall be computed every recurrence and indicated by the Boolean flag LV\_V\_REF\_VLD\_R\_IT\_LS\_UP[i]. This flag shall be set when both offset measurements have been determined to be valid, as indicated by LV\_V\_OFS\_MES\_VLD\_R\_IT\_LS\_UP[i] and LV\_V\_OFS\_ADJ\_VLD\_R\_IT\_LS\_UP[i], and when the gain has been determined to be valid, as indicated by LV\_FAC\_GAIN\_H\_VLD\_R\_IT\_LS\_UP[i] or LV\_FAC\_GAIN\_L\_VLD\_R\_IT\_LS\_UP[i] depending on the selected resistance range (LV\_R\_IT\_SWI\_RNG\_LSL\_IF[i]).

The function shall be implemented as a state machine with five states. The state of the state machine shall be indicated by the variable STATE\_TTIP\_MES\_LS\_UP[i]. The state machine may be described as follows:

#### **STATE\_TTIP\_MES\_LS\_UP[i] = OFF**

**In state OFF**, the ceramic temperature validity flag LV\_TTIP\_MES\_VLD\_LS\_UP[i] shall be set to 0, indicating that the temperature shall not be used by other functions. The state machine may exit to one of either two states:

**Exit to measurement mode offset measurement, MES\_OFS:** Shall occur when the SPI interface has been determined to have been initialised via flag LV\_LSL\_IF\_SPI\_RST\_END[i] and should the cali-

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bration flag `LC_V_REF_R_IT_LS_UP` be set, thus permitting the calibration procedure to take place. Should these conditions be met, then `TIMER_1` & `TIMER_2` shall be reset, `TIMER_1` started. Additionally, the current value of the SPI fault counter `CTR_ERR_LSL_IF_SPI_WR[i]` shall be stored, the state `STATE_TTIP_MES_LS_UP[i]` set to `MES_OFS`, the oscillator switched off via `LV_R_IT_OSC_ENA_LSL_IF[i] = 0` and the measurement mode activated via `LV_R_IT_CAL_ENA_LSL_IF[i] = 0`.

**Exit to normal resistance measurement mode, MES:** Shall occur when the SPI interface has been determined to have been initialised via flag `LV_LSL_IF_SPI_RST_END[i]` and should the calibration flag `LC_V_REF_R_IT_LS_UP` be reset, thus preventing the calibration procedure from taking place. Should these conditions be met, then `TIMER_2` shall be reset, the current value of the SPI fault counter `CTR_ERR_LSL_IF_SPI_WR[i]` shall be stored, the state `STATE_TTIP_MES_LS_UP[i]` set to `MES`, the oscillator switched on via `LV_R_IT_OSC_ENA_LSL_IF[i] = 1` and the measurement mode activated via `LV_R_IT_CAL_ENA_LSL_IF[i] = 0`.

### **STATE\_TTIP\_MES\_LS\_UP[i] = MES\_OFS**

In state `MES_OFS`, the offset shall be determined as follows:

The function shall determine whether a fault in the SPI communication has occurred since the WRAF sensor interface control byte flags `LV_R_IT_OSC_ENA_LSL_IF[i]`, `LV_R_IT_CAL_ENA_LSL_IF[i]`, & `LV_R_IT_SWI_RNG_LSL_IF[i]` were programmed. This is facilitated by comparing the value of the SPI fault counter with the value stored prior to setting the flags. Additionally the status of the sensor coupling shall be determined. Should a communication fault have occurred either sending the information to the interface or should the information have changed in the interface control byte since programming, `CTR_ERR_LSL_IF_SPI_WR[i]` shall be incremented by the appropriate SPI communication function. This difference or the decoupling of the sensor, signalled by `LV_LSL_DEAC[i] = 1` or `STATE_LSL_IF_SP_RD[i].LSL_ENA = 0` shall cause the `TIMER_2` to be reset and the new value of the counter to be stored.

The SPI communication function operates an automatic retry strategy, thus if the desired contents could not be programmed or should the contents read back are not those programmed, then the SPI communication function shall continue to re-send the information until either it is successful or a debounced fault is recognised and further communication halted (check of `FRQ_R_IT_OSC_LSL_IF_SP_RD[i]`).

Should no SPI fault or decoupling of the sensor be determined to have occurred, the function shall verify that the desired contents have been programmed by reading the appropriate bits (`IT_OSC_ENA`, `R_LS_CAL_ENA` & `R_LS_RNG`) of the interface byte `STATE_LSL_IF_SP_RD[i]`. This byte mirrors the current contents of the WRAF sensor interface control byte. Due to the finite time that is required to program the WRAF sensor interface, the programming may not have taken place. In this instance the function shall await the next recurrence. If the programmed contents can be verified, the function shall wait until delay `C_T_DLY_OFS_MES_R_IT_LS_UP` has passed facilitated by `TIMER_2` and then take `4 V_TEMP_LS_UP[i]` samples over the current and next 3 recurrences.


The absolute difference between the average of the 4 samples and the constant `C_V_OFS_REF_R_IT_LS_UP` shall then be compared to `C_V_DIF_MAX_OFS_MES_R_IT_LS_UP` to determine whether the measured offset is in bounds. If this is the case, the appropriate validity flag `LV_V_OFS_MES_VLD_R_IT_LS_UP[i]` set. If not the case, the frequency counter `TCC_ERR_V_OFS_MES_R_IT_LS_UP[i]` shall be incremented, indicating a faulty offset measurement, and `LV_V_OFS_MES_VLD_R_IT_LS_UP[i]` shall be reset. `V_OFS_MES_R_IT_LS_UP[i]` shall take on the value of the average, within bounds or not.

Test cycle counter `TCC_V_OFS_MES_R_IT_LS_UP[i]` shall be incremented, indicating that another measurement mode offset measurement has been carried out.

The state machine may exit to one of either two states:

**Exit to adjustment mode offset measurement, ADJ\_OFS:** Shall occur when the offset measurement has been determined to have been completed. Should this condition be met, then the flag `LV_R_IT_CAL_ENA_LSL_IF[i]` shall be set, switching to adjust mode (calibration resistor), `TIMER_1` & `TIMER_2` shall be reset, `TIMER_1` started. Additionally, the current value of the SPI fault counter `CTR_ERR_LSL_IF_SPI_WR[i]` shall be stored and the state `STATE_TTIP_MES_LS_UP[i]` set to `ADJ_OFS`.

**Exit to normal resistance measurement mode, MES:** Shall occur when the time limit `C_T_MAX_V_OFS_MES_R_IT_LS_UP` has been determined to have been exceeded, facilitated by `TIMER_1`. This provides a time out to ensure that the function does not lock up should SPI communication faults continuously prevent the offset measurement from being completed. Should these conditions be met, then the

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oscillator shall be switched on by setting flag LV\_R\_IT\_CAL\_ENA\_LSL\_IF[i], *TIMER\_2* shall be reset, the current value of the SPI fault counter CTR\_ERR\_LSL\_IF\_SPI\_WR[i] shall be stored and the state STATE\_TTIP\_MES\_LS\_UP[i] set to MES.

### STATE\_TTIP\_MES\_LS\_UP[i] = ADJ\_OFS

In state **ADJ\_OFS**, the offset shall be determined by exactly the same method as described for state MES\_OFS, the only differences being:

- When checking that the programmed information has been correctly mirrored, bit STATE\_LSL\_IF\_SP\_RD[i].IT\_OSC\_ENA shall be 0, STATE\_LSL\_IF\_SP\_RD[i].R\_LS\_CAL\_ENA shall be 1 and STATE\_LSL\_IF\_SP\_RD[i].R\_LS\_RNG shall equal LV\_R\_IT\_SWI\_RNG\_LSL\_IF[i].
- The *TIMER\_2* delay shall be C\_T\_DLY\_OFS\_ADJ\_R\_IT\_LS\_UP.
- The absolute difference between the sample averages and constant C\_V\_OFS\_REF\_R\_IT\_LS\_UP shall be compared to C\_V\_DIF\_MAX\_OFS\_ADJ\_R\_IT\_LS\_UP.
- The adjustment mode offset variable shall be V\_OFS\_ADJ\_R\_IT\_LS\_UP[i], the validity flag shall be LV\_V\_OFS\_ADJ\_VLD\_R\_IT\_LS\_UP[i], the frequency counter TCC\_ERR\_V\_OFS\_ADJ\_R\_IT\_LS\_UP[i] and test cycle counter TCC\_V\_OFS\_ADJ\_R\_IT\_LS\_UP[i].

The state machine may exit to one of either two states:

**Exit to** adjustment mode gain measurement, **ADJ\_GAIN**: Shall occur when the offset measurement has been determined to have been completed and the lambda offset calibration has been completed, thus ensuring that the oscillator being off does not disturb the lambda output. Should these conditions be met, then the flag LV\_R\_IT\_OSC\_ENA\_LSL\_IF[i] shall be set, switching the oscillator on, *TIMER\_1* & *TIMER\_2* shall be reset and *TIMER\_1* started. Additionally, the current value of the SPI fault counter CTR\_ERR\_LSL\_IF\_SPI\_WR[i] shall be stored and the state STATE\_TTIP\_MES\_LS\_UP[i] set to ADJ\_GAIN.

**Exit to** normal resistance measurement mode, **MES**: Shall occur when the time limit C\_T\_MAX\_V\_OFS\_ADJ\_R\_IT\_LS\_UP has been determined to have been exceeded, facilitated by *TIMER\_1* providing a time out as described and the lambda output offset compensation has been completed as determined by LV\_LSL\_OFS\_ADJ\_ACT[i] = 0. Should these conditions be met, then the oscillator shall be switched on by setting flag LV\_R\_IT\_CAL\_ENA\_LSL\_IF[i], the mode set to measurement mode by resetting LV\_R\_IT\_CAL\_ENA\_LSL\_IF[i], *TIMER\_2* shall be reset, the current value of the SPI fault counter CTR\_ERR\_LSL\_IF\_SPI\_WR[i] shall be stored and the state STATE\_TTIP\_MES\_LS\_UP[i] set to MES.


### STATE\_TTIP\_MES\_LS\_UP[i] = ADJ\_GAIN

In state **ADJ\_GAIN**, the gain shall be determined by similarly to the method as described for state MES\_OFS, the only differences being:

- When checking that the programmed information has been correctly mirrored, bit STATE\_LSL\_IF\_SP\_RD[i].IT\_OSC\_ENA shall be 1, STATE\_LSL\_IF\_SP\_RD[i].R\_LS\_CAL\_ENA shall be 1 and STATE\_LSL\_IF\_SP\_RD[i].R\_LS\_RNG shall equal LV\_R\_IT\_SWI\_RNG\_LSL\_IF[i].
- The *TIMER\_2* delay shall be C\_T\_DLY\_FAC\_GAIN\_R\_IT\_LS\_UP.
- After having taken the 4 samples, the gain shall be computed using the equation in the formula section. The gain calculated and the constants used in the calculation shall depend on the selected resistance range.
- The absolute difference between the gain and constant C\_GAIN\_TEMP\_LS\_UP shall be compared to C\_GAIN\_TEMP\_LS\_UP\_DIF.
- The adjustment mode gain variable shall be FAC\_GAIN\_H\_R\_IT\_LS\_UP[i], the validity flag shall be LV\_FAC\_GAIN\_H\_VLD\_R\_IT\_LS\_UP[i], the frequency counter TCC\_ERR\_FAC\_GAIN\_H\_R\_IT\_LS\_UP[i] and test cycle counter TCC\_FAC\_GAIN\_H\_R\_IT\_LS\_UP[i] or FAC\_GAIN\_L\_R\_IT\_LS\_UP[i], the validity flag shall be LV\_FAC\_GAIN\_L\_VLD\_R\_IT\_LS\_UP[i], the frequency counter TCC\_ERR\_FAC\_GAIN\_L\_R\_IT\_LS\_UP[i] and test cycle counter TCC\_FAC\_GAIN\_L\_R\_IT\_LS\_UP[i] dependent on the selected resistance range (LV\_R\_IT\_SWI\_RNG\_LSL\_IF[i]).

The state machine may exit to one of either two states:

**Exit to** normal internal resistance measurement mode, **MES**: Shall occur when the gain measurement has been determined to have been successfully completed (LV\_V\_REF\_VLD\_R\_IT\_LS\_UP[i] = 1) or when the time limit C\_T\_MAX\_FAC\_GAIN\_R\_IT\_LS\_UP has been determined to have been exceeded,

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facilitated by *TIMER\_1* providing a time out as described previously. Should these conditions be met, then the mode shall be set to measurement mode by resetting *LV\_R\_IT\_CAL\_ENA\_LSL\_IF[i]*, *TIMER\_2* shall be reset, the current value of the SPI fault counter *CTR\_ERR\_LSL\_IF\_SPI\_WR[i]* shall be stored and the state *STATE\_TTIP\_MES\_LS\_UP[i]* set to *MES*.

**Exit to measurement mode offset measurement, *MES\_OFS*:** Shall occur should the gain measurement have been unsuccessfully completed (*LV\_V\_REF\_VLD\_R\_IT\_LS\_UP[i] = 0*) or if the lambda output offset compensation be requested (*LV\_LSL\_OFS\_ADJ\_ACT[i] = 1*). Should either of these conditions be met, then the oscillator shall be switched off via *LV\_R\_IT\_OSC\_ENA\_LSL\_IF[i] = 0* and the measurement mode activated via *LV\_R\_IT\_CAL\_ENA\_LSL\_IF[i] = 0*, *TIMER\_1* & *TIMER\_2* shall be reset, *TIMER\_1* started. Additionally, the current value of the SPI fault counter *CTR\_ERR\_LSL\_IF\_SPI\_WR[i]* shall be stored, the state *STATE\_TTIP\_MES\_LS\_UP[i]* set to *MES\_OFS*.

### ***STATE\_TTIP\_MES\_LS\_UP[i] = MES***

**In state *MES*,** the internal resistance shall be determined as follows:

The function shall determine whether a fault in the SPI communication or if the sensor has been decoupled as described previously. Should either of these conditions be true, the ceramic temperature validity flag *LV\_TTIP\_MES\_VLD\_LS\_UP[i]* shall be reset, thus suspending further use of the temperature information, *TIMER\_2* shall be reset and the new value of the counter to be stored.

Should no SPI fault or decoupling of the sensor be determined to have occurred, function checks for rising edge of ATIC42 pump current control enable bit. To avoid erroneous *Ri* readings due to electrical disturbance on *Ri* measurement circuit during *Ip* activation, *Ri* value is frozen for calibratable delay time *C\_T\_DLY\_R\_IT\_IPLSL\_CTL\_ACT* triggered by rising edge detection. Same holds true for falling edge. During signal freeze *LV\_TTIP\_MES\_VLD\_LS\_UP[i]* shall be reset.


Next the function shall verify that the desired control byte contents have been programmed by reading the appropriate bits (*IT\_OSC\_ENA = 1*, *R\_LS\_CAL\_ENA = 0*, *R\_LS\_RNG = LV\_R\_IT\_SWI\_RNG\_LSL\_IF[i]*) of the interface byte *STATE\_LSL\_IF\_SP\_RD*. If not the case the function shall await the next recurrence. If the programmed contents can be verified, the function shall wait until delay *C\_T\_DLY\_CLC\_R\_IT\_LS\_UP* has passed facilitated by *TIMER\_2* and then compute the internal resistance from the measurement mode offset, *V\_OFS\_MES\_R\_IT\_LS\_UP[i]*, the average of up to 8 *V\_TEMP\_LS\_UP[i]* samples, the value of the stimulus resistor, *C\_R\_IT\_REF\_LS\_UP* and dependent on the value of *LV\_R\_IT\_SWI\_RNG\_LSL\_IF[i]* either *FAC\_GAIN\_H\_R\_IT\_LS\_UP[i]* or *FAC\_GAIN\_L\_R\_IT\_LS\_UP[i]*.

The ceramic temperature validity flag *LV\_TTIP\_MES\_VLD\_LS\_UP[i]* shall be set and the ceramic temperature *TTIP\_MES\_LS\_UP[i]* shall be determined from the map *IP\_TTIP\_MES\_LS\_UP*.

The state machine may exit to one state:

**Exit to state, measurement mode offset measurement, *MES\_OFS*:** Shall occur should the calibration flag *LC\_V\_REF\_R\_IT\_LS\_UP* be set, thus permitting the calibration procedure to take place and either when the lambda offset correction has been determined to have been requested, *LV\_LSL\_OFS\_ADJ\_ACT[i] = 1* or should the operative readiness be detected or finally should a manual switching of the gain be requested. The non-operative readiness condition ensures that should any of the time-outs occur in the states *MES\_OFS*, *ADJ\_OFS* or *ADJ\_GAIN*, and the operative readiness not yet have been detected, then the function may restart the calibration process. Should these conditions be met, then, dependent on whether a manual range switch was requested, the resistance range shall be set to the Boolean constant *LC\_R\_RNG\_REQ\_LS\_UP\_LSL\_IF* or to the negation of *LV\_LS\_UP\_READY[i]*, the ceramic temperature validity flag *LV\_TTIP\_MES\_VLD\_LS\_UP[i]* shall be reset, the oscillator shall be switched off via *LV\_R\_IT\_OSC\_ENA\_LSL\_IF[i] = 0*, *TIMER\_1* & *TIMER\_2* shall be reset, *TIMER\_1* started. Additionally, the current value of the SPI fault counter *CTR\_ERR\_LSL\_IF\_SPI\_WR[i]* shall be stored, the state *STATE\_TTIP\_MES\_LS\_UP[i]* set to *MES\_OFS*.

Should the calibration flag *LC\_V\_REF\_R\_IT\_LS\_UP* be reset, thus disabling the calibration procedure to take place but the operative readiness be detected or should a manual switching of the gain be requested then, dependent on whether a manual range switch was requested, the resistance range shall be set to the Boolean constant *LC\_R\_RNG\_REQ\_LS\_UP\_LSL\_IF* or to the negation of *LV\_LS\_UP\_READY[i]*, the ceramic temperature validity flag *LV\_TTIP\_MES\_VLD\_LS\_UP[i]* shall be reset, *TIMER\_1* & *TIMER\_2* shall be reset, *TIMER\_1* started. Additionally, the current value of the SPI fault counter *CTR\_ERR\_LSL\_IF\_SPI\_WR[i]* shall be stored, but the state *STATE\_TTIP\_MES\_LS\_UP[i]* shall **remain in *MES***.

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In addition to the aforementioned state conditions, the state machine may **exit to state OFF** from all **other states**. This shall occur should the function be deactivated. In this case certain variables may be reset as described previously in the section regarding the initialisation.

#### Initialisation:

The following initialisation shall take place directly **after RESET**:

```
FRQ_R_IT_OSC_LSL_IF_SPI_WR[i] = C_FRQ_R_IT_OSC_LSL_IF
```

The following variable initialisation shall take place **after RESET, at LV\_IGK = 0 -> 1, or upon erase of error management**:

```
TTIP_MES_LS_UP[i] = 0
R_IT_LS_UP[i] = 16383.75 (i.e. FFFFH)
STATE_TTIP_MES_LS_UP[i] = OFF
LV_V_OFS_MES_VLD_R_IT_LS_UP[i] = ! LC_V_REF_R_IT_LS_UP
LV_V_OFS_ADJ_VLD_R_IT_LS_UP[i] = ! LC_V_REF_R_IT_LS_UP
LV_FAC_GAIN_H_VLD_R_IT_LS_UP[i] = ! LC_V_REF_R_IT_LS_UP
LV_FAC_GAIN_L_VLD_R_IT_LS_UP[i] = ! LC_V_REF_R_IT_LS_UP
LV_TTIP_MES_VLD_LS_UP[i] = 0
LV_V_REF_VLD_R_IT_LS_UP[i] = ! LC_V_REF_R_IT_LS_UP
TCC_V_OFS_MES_R_IT_LS_UP[i] = 0
TCC_V_OFS_ADJ_R_IT_LS_UP[i] = 0
TCC_FAC_GAIN_H_R_IT_LS_UP[i] = 0
TCC_FAC_GAIN_L_R_IT_LS_UP[i] = 0
TCC_ERR_V_OFS_MES_R_IT_LS_UP[i] = 0
TCC_ERR_V_OFS_ADJ_R_IT_LS_UP[i] = 0
TCC_ERR_FAC_GAIN_H_R_LS_UP[i] = 0
TCC_ERR_FAC_GAIN_L_R_LS_UP[i] = 0
V_OFS_MES_R_IT_LS_UP[i] = C_V_OFS_REF_R_IT_LS_UP
V_OFS_ADJ_R_IT_LS_UP[i] = C_V_OFS_REF_R_IT_LS_UP
FAC_GAIN_H_R_IT_LS_UP[i] = C_FAC_GAIN_H_R_IT_LS_UP
FAC_GAIN_L_R_IT_LS_UP[i] = C_FAC_GAIN_L_R_IT_LS_UP
LV_R_IT_REQ_LS_UP[i] = 0
T_DLY_R_IT_IPLSL_CTL_ACT[i] = 0
```

Reset internal timers TIMER\_1 & TIMER\_2

#### Recurrence:

The function shall run at a recurrence of 10 ms.


The computation of a new internal resistance value shall be carried out once every 100 ms provided the applicable conditions have been met.

#### Activation:

The functions *General validity of ceramic temperature measurement*, *Reset statistical counters after diagnosis completion* & *State Machine* shall be carried out according to the following conditions:

```
LV_INH_TTIP_LS_UP[i] == 0
```

```
and LV_IGK == 1
and STATE_LSL_IF_SPI_RD[i] ( bit LSL_ENA ) == 1
and ( LV_LS_UP_READY_RAW[i] == 1
or LV_LS_UP_READY_CDN[i] == 1
or LV_LSH_UP_MAN_ACT[i] == 1 )
```

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**Deactivation:**

```

LV_INH_TTIP_LS_UP[i] == 1
or      LV_IGK == 0
or      STATE_LSL_IF_SPI_RD[i] ( bit LSL_ENA ) == 0
or      ( LV_LS_UP_READY_RAW[i] == 0
and     LV_LS_UP_READY_CDN[i] == 0
and     LV_LSH_UP_MAN_ACT[i] == 0 )

```

The following variable initialisation shall take place upon deactivation:

```

STATE_TTIP_MES_LS_UP[i] = OFF
LV_TTIP_MES_VLD_LS_UP[i] = 0

```

In addition upon deactivation, the following variables shall be conditionally initialised:

```

if      LV_LSL_IF_SPI_RST_END[i] == 1
then    LV_R_IT_CAL_ENA_LSL_IF[i] = 0
          LV_R_IT_OSC_ENA_LSL_IF[i] = 0
          if      LC_R_RNG_REQ_SWI_LS_UP_LSL_IF == 1
          then    LV_R_IT_SWI_RNG_LSL_IF[i] = LC_R_RNG_REQ_LS_UP_LSL_IF
          else    LV_R_IT_SWI_RNG_LSL_IF[i] = ! LV_LS_UP_READY[i]
          endif
endif

```

**Formula section:**

*General validity of ceramic temperature measurement:*

```

if      LV_R_IT_SWI_RNG_LSL_IF[i] == 0
then    LV_V_REF_VLD_R_IT_LS_UP[i]
          = LV_V_OFS_MES_VLD_R_IT_LS_UP[i]
          & LV_V_OFS_ADJ_VLD_R_IT_LS_UP[i]
          & LV_FAC_GAIN_H_VLD_R_IT_LS_UP[i]
else    LV_V_REF_VLD_R_IT_LS_UP[i]
          = LV_V_OFS_MES_VLD_R_IT_LS_UP[i]
          & LV_V_OFS_ADJ_VLD_R_IT_LS_UP[i]
          & LV_FAC_GAIN_L_VLD_R_IT_LS_UP[i]
endif

```

**State Machine**

The state machine shall remain in its current state and carry out the actions specified to occur within that state once per recurrence unless otherwise specified. The state machine shall only move to another state when one of the conditions has been determined to be met.

**Notes:**

- 1. The priorities of the conditions to change between states shall be defined by the order in which these conditions are listed within the appropriate state as described below.**
- 2. TIMER\_1 & TIMER\_2 refer to SW internal variables. TIMER\_1 & TIMER\_2 are not visible output variables.**
- 3. The assignment store CTR\_ERR\_LSL\_IF\_SPI\_WR[i]<sub>N</sub> denotes that the current counter value shall be noted by the SW until the next assignment occurs.**


**STATE\_TTIP\_MES\_LS\_UP[i] = OFF**

*Actions:*

```

LV_TTIP_MES_VLD_LS_UP[i] = 0

```

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**Note: The above listed actions must be carried out at least once when the state has been entered for the first time or from any other state!**

Condition 1: OFF to MES\_OFS

LV\_LSL\_IF\_SPI\_RST\_END[i] = 1 &

LC\_V\_REF\_R\_IT\_LS\_UP = 1

Transition actions:

**Reset** TIMER\_1

**Start** TIMER\_1

**Reset** TIMER\_2

**Store** CTR\_ERR\_LSL\_IF\_SPI\_WR[i]<sub>N</sub>

STATE\_TTIP\_MES\_LS\_UP[i] = MES\_OFS

LV\_R\_IT\_OSC\_ENA\_LSL\_IF[i] = 0

LV\_R\_IT\_CAL\_ENA\_LSL\_IF[i] = 0

Condition 2: OFF to MES

LV\_LSL\_IF\_SPI\_RST\_END[i] = 1 &

LC\_V\_REF\_R\_IT\_LS\_UP = 0

Transition actions:

**Reset** TIMER\_2

**Store** CTR\_ERR\_LSL\_IF\_SPI\_WR[i]<sub>N</sub>


STATE\_TTIP\_MES\_LS\_UP[i] = MES

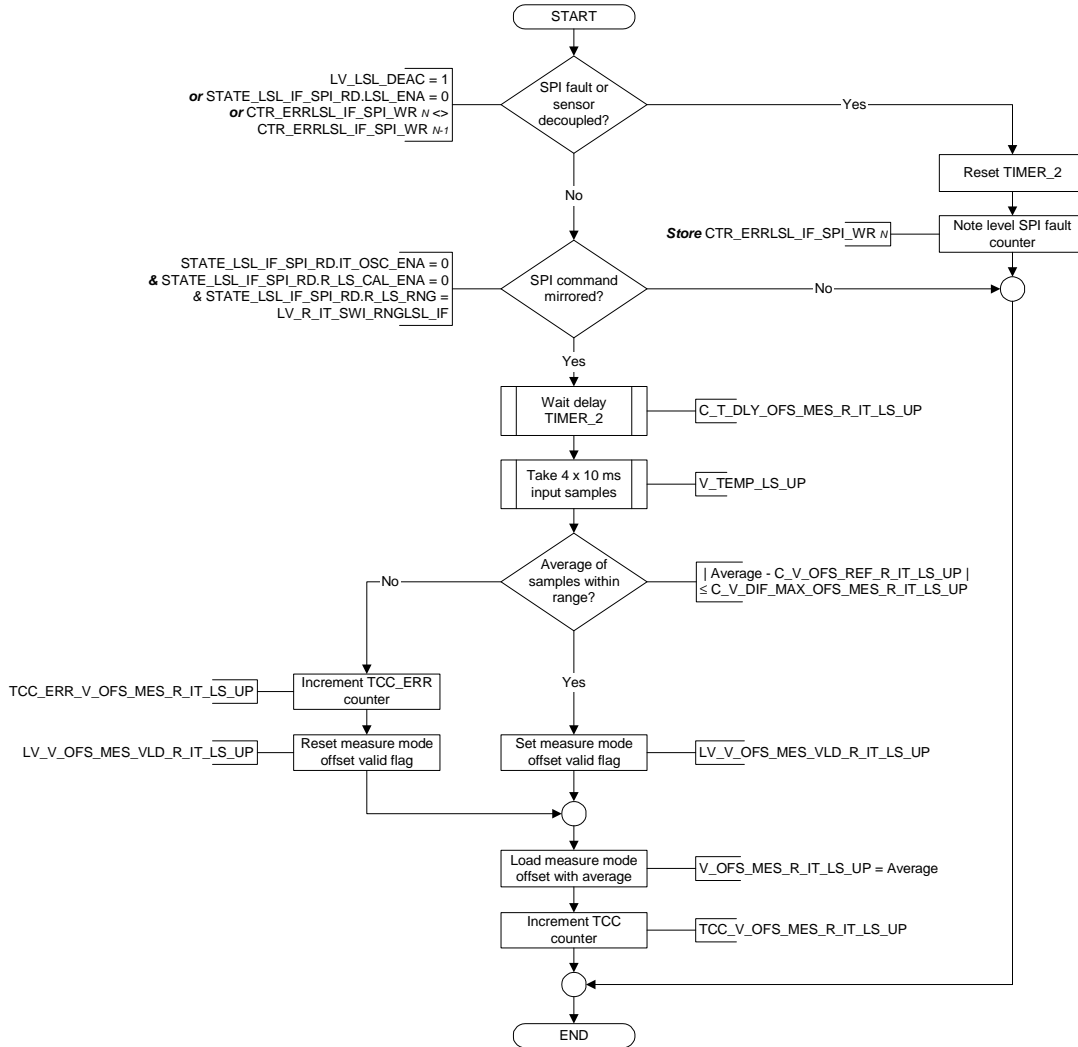
LV\_R\_IT\_OSC\_ENA\_LSL\_IF[i] = 1

LV\_R\_IT\_CAL\_ENA\_LSL\_IF[i] = 0

**STATE\_TTIP\_MES\_LS\_UP[i] = MES\_OFS**

Actions:

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**Note:** *TCC\_V\_OFS\_MES\_R\_IT\_LS\_UP[i]* & *TCC\_ERR\_V\_OFS\_MES\_R\_IT\_LS\_UP[i]* shall not be permitted to overflow.

Condition 4: *MES\_OFS* to *ADJ\_OFS*  
*MES\_OFS* procedure complete (valid or invalid)

Transition actions:

*LV\_R\_IT\_CAL\_ENA\_LSL\_IF[i]* = 1

**Reset** *TIMER\_1*

**Start** *TIMER\_1*

**Reset** *TIMER\_2*

**Store** *CTR\_ERR\_LSL\_IF\_SPI\_WR[i]<sub>N</sub>*

*STATE\_TTIP\_MES\_LS\_UP[i]* = *ADJ\_OFS*

Condition 5: *MES\_OFS* to *MES*

*TIMER\_1* *C\_T\_MAX\_V\_OFS\_MES\_R\_IT\_LS\_UP*

Transition actions:

*LV\_R\_IT\_OSC\_ENA\_LSL\_IF[i]* = 1


**Reset** *TIMER\_2*

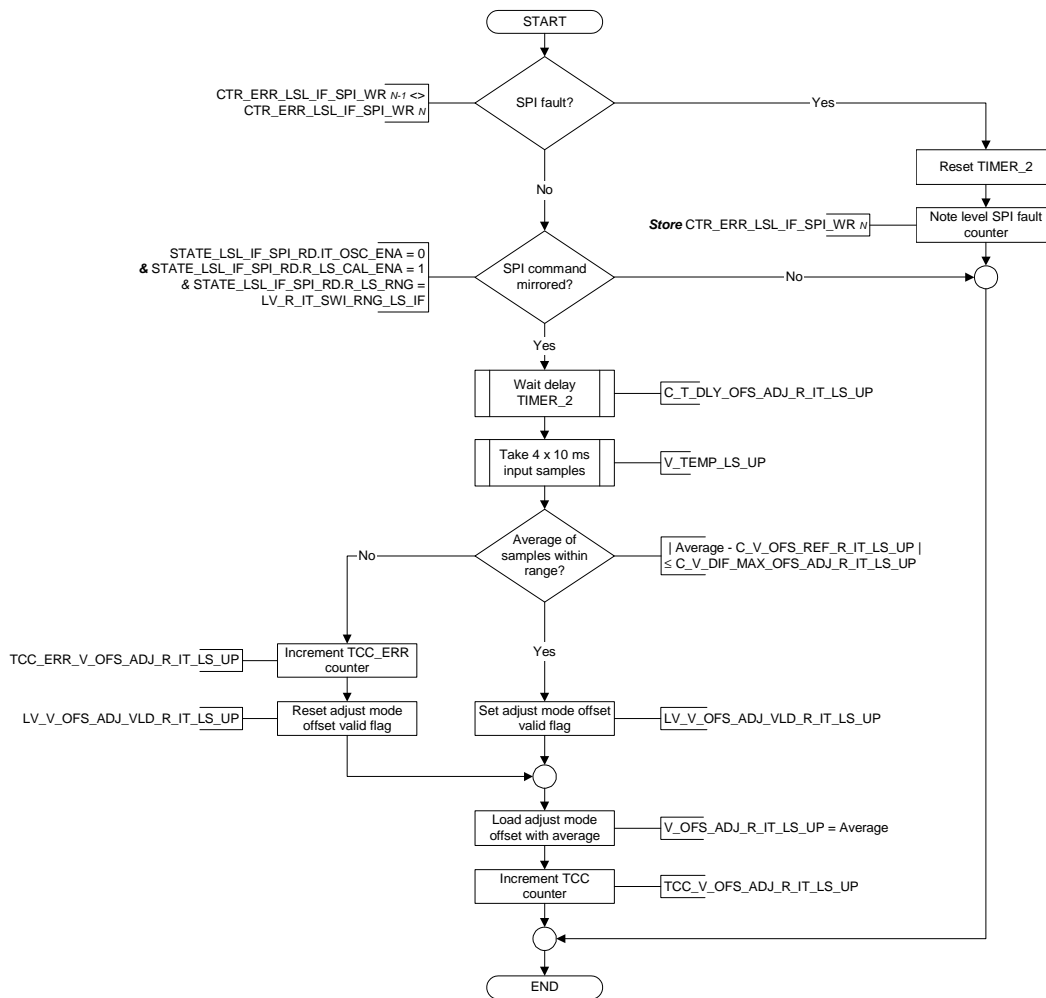
**Store** *CTR\_ERR\_LSL\_IF\_SPI\_WR[i]<sub>N</sub>*

*STATE\_TTIP\_MES\_LS\_UP[i]* = *MES*

***STATE\_TTIP\_MES\_LS\_UP[i]* = *ADJ\_OFS***

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**Actions:**

**Note:**  $TCC\_V\_OFS\_ADJ\_R\_IT\_LS\_UP[i]$  &  $TCC\_ERR\_V\_OFS\_ADJ\_R\_IT\_LS\_UP[i]$  shall not be permitted to overflow.

**Condition 6:**  $ADJ\_OFS$  to  $ADJ\_GAIN$

$ADJ\_OFS$  procedure complete (valid or invalid) &

$LV\_LSL\_OFS\_ADJ\_ACT[i] = 0$

**Transition actions:**

$LV\_R\_IT\_OSC\_ENA\_LSL\_IF[i] = 1$

**Reset**  $TIMER\_1$

**Start**  $TIMER\_1$

**Reset**  $TIMER\_2$

**Store**  $CTR\_ERR\_LSL\_IF\_SPI\_WR[i]_N$

$STATE\_TTIP\_MES\_LS\_UP[i] = ADJ\_GAIN$

**Condition 7:**  $ADJ\_OFS$  to  $MES$

$TIMER\_1$   $C\_T\_MAX\_V\_OFS\_ADJ\_R\_IT\_LS\_UP$  &

$LV\_LSL\_OFS\_ADJ\_ACT[i] = 0$

**Transition actions:**

$LV\_R\_IT\_OSC\_ENA\_LSL\_IF[i] = 1$

$LV\_R\_IT\_CAL\_ENA\_LSL\_IF[i] = 0$

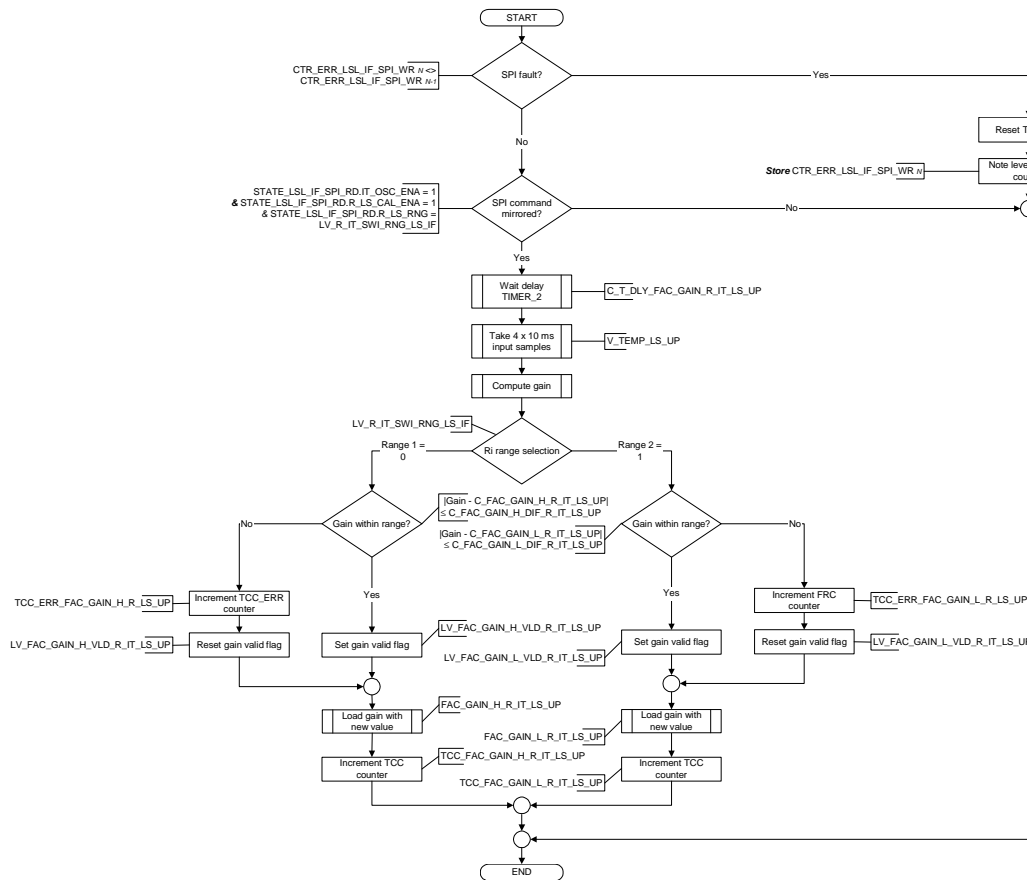
**Reset**  $TIMER\_2$

**Store**  $CTR\_ERR\_LSL\_IF\_SPI\_WR[i]_N$

STATE\_TTIP\_MES\_LS\_UP[i] = MES

STATE\_TTIP\_MES\_LS\_UP[i] = ADJ\_GAIN

Actions:



**Note:** *TCC\_FAC\_GAIN\_L\_R\_IT\_LS\_UP[i]*, *TCC\_ERR\_FAC\_GAIN\_L\_R\_LS\_UP[i]*, *TCC\_FAC\_GAIN\_H\_R\_IT\_LS\_UP[i]* & *TCC\_ERR\_FAC\_GAIN\_H\_R\_LS\_UP[i]* shall not be permitted to overflow.

Compute gain of internal resistance measurement circuit:

The gain shall be computed from the measurement circuit offset and the average of four (4) *V\_TEMP\_LS\_UP[i]* samples in the adjustment mode using the following formula:


```

if          LV_R_IT_SWI_RNG_LSL_IF[i] == 0
then       FAC_GAIN_H_R_IT_LS_UP[i]
              = ( AV( V_TEMP_LS_UP[i] ) - V_OFS_ADJ_R_IT_LS_UP[i] )
                * C_FAC_GAIN_R_IT_LS_UP
else       FAC_GAIN_L_R_IT_LS_UP[i]
              = ( AV( V_TEMP_LS_UP[i] ) - V_OFS_ADJ_R_IT_LS_UP[i] )
                * C_FAC_GAIN_R_IT_LS_UP
endif
  
```

Where  $AV( V\_TEMP\_LS\_UP[i] )$  is the average of the 4 previously samples taken at 10 ms intervals as shown in the appropriate flow chart.

**Note:** The difference in voltages ( $V\_TEMP\_LS\_UP[i] - V\_OFS\_ADJ\_R\_IT\_LS\_UP[i]$ ) shall be limited to 0 to prevent negative values.

Condition 9: ADJ\_GAIN to MES\_OFS

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LV\_LSL\_OFS\_ADJ\_ACT[i] = 1 **or**  
 (ADJ\_GAIN procedure complete &  
 LV\_V\_REF\_VLD\_R\_IT\_LS\_UP[i] = 0)

*Transition actions:*

LV\_R\_IT\_OSC\_ENA\_LSL\_IF[i] = 0

LV\_R\_IT\_CAL\_ENA\_LSL\_IF[i] = 0

**Reset** TIMER\_1

**Start** TIMER\_1

**Reset** TIMER\_2

**Store** CTR\_ERR\_LSL\_IF\_SPI\_WR[i]<sub>N</sub>

STATE\_TTIP\_MES\_LS\_UP[i] = MES\_OFS

*Condition 8: ADJ\_GAIN to MES*

TIMER\_1 C\_T\_MAX\_FAC\_GAIN\_R\_IT\_LS\_UP **or**

(ADJ\_GAIN procedure complete &

LV\_V\_REF\_VLD\_R\_IT\_LS\_UP[i] = 1)

*Transition actions:*

LV\_R\_IT\_CAL\_ENA\_LSL\_IF[i] = 0


**Reset** TIMER\_2

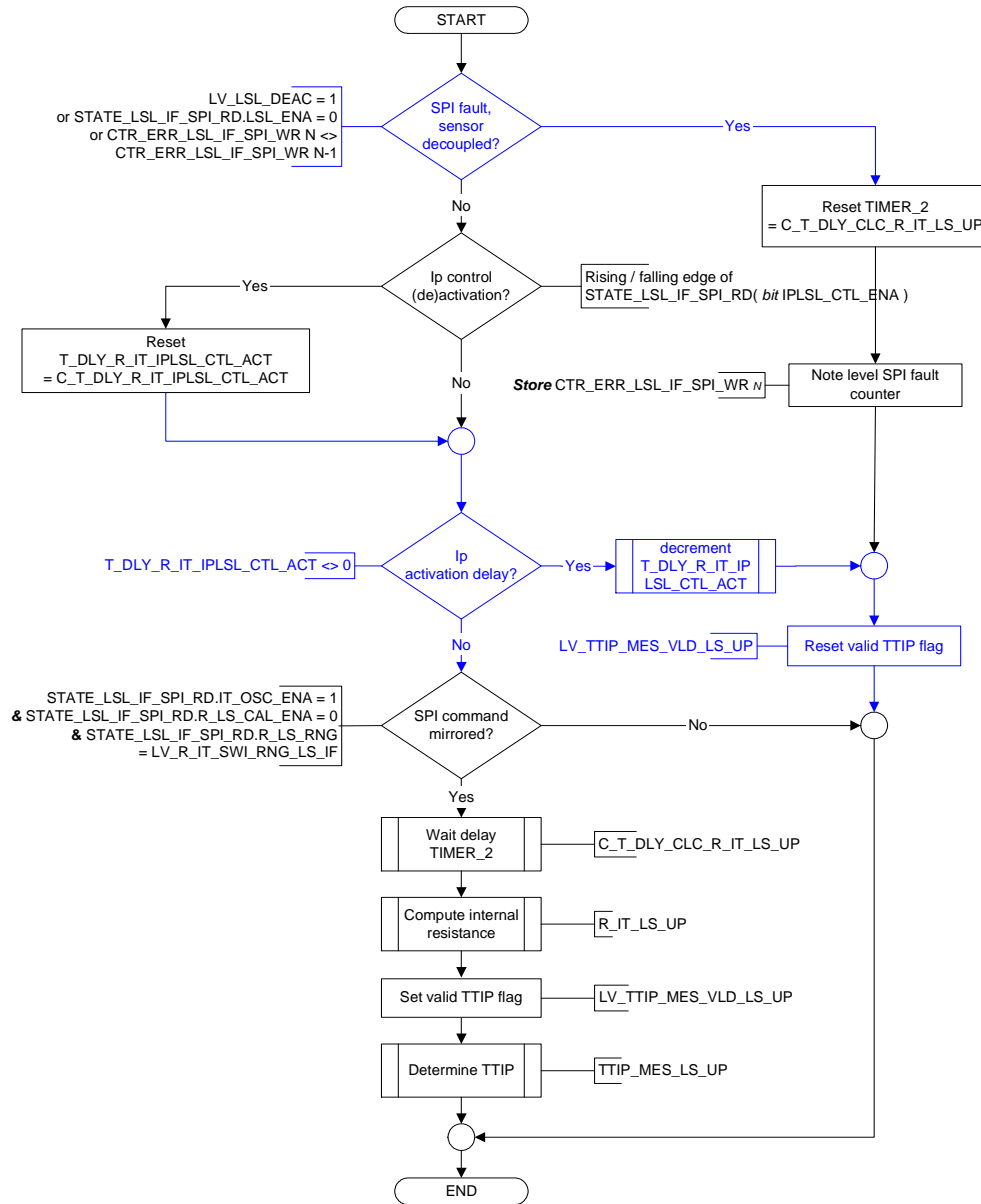
**Store** CTR\_ERR\_LSL\_IF\_SPI\_WR[i]<sub>N</sub>

STATE\_TTIP\_MES\_LS\_UP[i] = MES

**STATE\_TTIP\_MES\_LS\_UP[i] = MES**

*Actions:*

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### Compute internal resistance of oxygen sensor element: (Deviating recurrence, see above)

The internal resistance shall be computed from the offset voltage determined in the measurement mode with the oscillator off, the measurement circuit gain determined in the adjust mode and  $AV(V\_TEMP\_LS\_UP[i])$ . Once the active  $R_i$  determination conditions have been met as denoted above, the resistance shall be determined from the following formula.

**if**  $LV\_R\_IT\_SWI\_RNG\_LSL\_IF[i] == 0$   
**then**  $R\_IT\_LS\_UP[i] = C\_R\_IT\_REF\_LS\_UP$   
 $\quad * \{ AV(V\_TEMP\_LS\_UP[i]) - V\_OFS\_MES\_R\_IT\_LS\_UP[i] \}$   
 $\quad / \{ 5V * FAC\_GAIN\_H\_R\_IT\_LS\_UP[i] \}$   
 $\quad - ( AV(V\_TEMP\_LS\_UP[i]) - V\_OFS\_MES\_R\_IT\_LS\_UP[i] ) \}$   
**else**  $R\_IT\_LS\_UP[i] = C\_R\_IT\_REF\_LS\_UP$   
 $\quad * \{ AV(V\_TEMP\_LS\_UP[i]) - V\_OFS\_MES\_R\_IT\_LS\_UP[i] \}$   
 $\quad / \{ 5V * FAC\_GAIN\_L\_R\_IT\_LS\_UP[i] \}$   
 $\quad - ( AV(V\_TEMP\_LS\_UP[i]) - V\_OFS\_MES\_R\_IT\_LS\_UP[i] ) \}$



**endif**

Where  $AV(V\_TEMP\_LS\_UP[i])$  is either the average of the 8 previously samples taken at 10 ms intervals as shown in the appropriate flow chart or should the 100 ms task, in which the resistance is computed, be called before 8 samples could be taken then the latest  $V\_TEMP\_LS\_UP[i]$  value shall be used. Should the timing be such that no current  $V\_TEMP\_LS\_UP[i]$  are available then the resistance and hence ceramic temperature shall be calculated in the next 100 ms recurrence. Additionally, in this instance  $LV\_TTIP\_MES\_VLD\_LS\_UP[i]$  would remain reset until the next recurrence.

**Note: The difference in voltages ( $V\_TEMP\_LS\_UP[i] - V\_OFS\_MES\_R\_IT\_LS\_UP[i]$ ) shall be limited to 0 to prevent negative values.**

Should internal resistance determination be suspended due to an adjustment measurement request, the value  $R\_IT\_LS\_UP[i]$  shall be maintained at the value computed prior to suspension but the variable(s) used to compute the average shall be reinitialised.

*Determine ceramic temperature from mapped characteristic oxygen sensor element temperature vs. internal resistance:*

$TTIP\_MES\_LS\_UP[i] = IP\_TTIP\_MES\_LS\_UP (R\_IT\_LS\_UP[i])$

*Condition 10: MES to MES\_OFS*

$LC\_V\_REF\_R\_IT\_LS\_UP = 1 \ \&$

$(LV\_LSL\_OFS\_ADJ\_ACT[i] = 1 \ \text{or}$

$LV\_LS\_UP\_READY[i] \ \text{transition } 0 \ 1 \ \text{or}$

$LC\_R\_RNG\_REQ\_SWI\_LS\_UP\_LSL\_IF \ \text{transition } 0 \ 1)$

*Transition actions:*

**if**  $(LC\_R\_RNG\_REQ\_SWI\_LS\_UP\_LSL\_IF = 1)$

**then**

$LV\_R\_IT\_SWI\_RNG\_LSL\_IF[i] = LC\_R\_RNG\_REQ\_LS\_UP\_LSL\_IF$

**else**

$LV\_R\_IT\_SWI\_RNG\_LSL\_IF[i] = ! LV\_LS\_UP\_READY[i]$

**endif.**

$LV\_TTIP\_MES\_VLD\_LS\_UP[i] = 0$

$LV\_R\_IT\_OSC\_ENA\_LSL\_IF[i] = 0$

**Reset** *TIMER\_1*

**Start** *TIMER\_1*

**Reset** *TIMER\_2*

**Store**  $CTR\_ERR\_LSL\_IF\_SPI\_WR[i]_N$

$STATE\_TTIP\_MES\_LS\_UP[i] = MES\_OFS$

*Condition 11: MES to MES*

$LC\_V\_REF\_R\_IT\_LS\_UP = 0 \ \&$

$(LV\_LS\_UP\_READY[i] \ \text{transition } 0 \ 1 \ \text{or}$

$LC\_R\_RNG\_REQ\_SWI\_LS\_UP\_LSL\_IF \ \text{transition } 0 \ 1)$

*Transition actions:*

**if**  $(LC\_R\_RNG\_REQ\_SWI\_LS\_UP\_LSL\_IF = 1)$

**then**

$LV\_R\_IT\_SWI\_RNG\_LSL\_IF[i] = LC\_R\_RNG\_REQ\_LS\_UP\_LSL\_IF$

**else**

$LV\_R\_IT\_SWI\_RNG\_LSL\_IF[i] = ! LV\_LS\_UP\_READY[i]$

**endif.**


$LV\_TTIP\_MES\_VLD\_LS\_UP[i] = 0$

**Reset** *TIMER\_2*

**Store**  $CTR\_ERR\_LSL\_IF\_SPI\_WR[i]_N$

**Additional variable /constant definitions**

$FRQ\_R\_IT\_OSC\_LSL\_IF\_SPI\_WR[i]$  and  $C\_FRQ\_R\_IT\_OSC\_LSL\_IF$  shall be defined as follows:

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<b>Bit 7</b>	<b>Bit 6</b>	<b>Bit 5</b>	<b>Bit 4</b>	<b>Bit 3</b>	<b>Bit 2</b>	<b>Bit 1</b>	<b>Bit 0</b>
X	D6	D5	D4	D3	D2	D1	D0

Where:

X denotes don't care

D0 through D5 denotes the 6 bit coded oscillator frequency information. A value of 00H represents 2.0 kHz and each step 125 Hz. Hence 3F represents 9.875 kHz.

D6 denotes the bit used to selectively disable pins inside of the protection time under fault conditions. 0 pins will be decoupled after the protection time has passed. 1 the pin at which the fault is detected will immediately be decoupled, i.e. inside the protection time before the remaining pins are decoupled after the passing of the protection time.

## 4.38 O2 sensor (lin, up) element temperature determination (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_TTIP_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that upstream oxygen sensor ceramic temperature determination shall be inhibited					

### Input data:

LV_DIAG_OC_IF_OSC_DI_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ES {p. 1720}	LV_ST_END {p. 1720}	NC_CBK_EX_NR {p. 1829}
STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 956}			

### FUNCTION DESCRIPTION:

#### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

The Boolean flag LV\_INH\_TTIP\_LS\_UP[i] shall indicate whether the upstream oxygen sensor ceramic temperature determination shall be permitted to take place. When set, no temperature determination shall take place.

#### Description:

#### Application conditions:

##### Initialisation:

The following initialisation shall be carried out after RESET and upon leaving the engine state Engine Stop (LV\_ES).

LV\_INH\_TTIP\_LS\_UP[i] = 0

Recurrence: 1s

##### Activation:

LV\_ST\_END == 1

##### Deactivation:

LV\_ST\_END == 0


#### Formula section:

**if** LV\_DIAG\_OC\_IF\_OSC\_DI\_LSL\_UP[i] == 1  
**or** STATE\_LSL\_IF\_SPI\_RD[i] *bit* LSL\_ENA == 0

```

then      LV_INH_TTIP_LS_UP[i] = 1
else      LV_INH_TTIP_LS_UP[i] = 0
endif

```

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## 4.39 O2 sensor (lin, up) basic signal processing

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_VLS_UP_INIT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the buffer initialisation after switching between Gain 16 & Gain 8 values of WRAF Controller or after Offset adjustment of WRAF sensor					
LV_VLS_UP_VLD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating whether clipping of the WRAF sensor signal is taking place (1 No clipping, 0 clipping)					
NR_BUF_SAMPLE [NC_NR_BUF_SAMPLE_LEN][NC_CBK_EX_NR]	-	0... FFH	0... 255	1	-
Ring buffer for saving the number of samples taken for intermediate sum.					
NR_SAMPLE_1_SUM	V	0... FFH	0... 255	1	-
Number of samples taken for Intermediate Sum 1					
NR_SAMPLE_2_SUM	V	0... FFH	0... 255	1	-
Number of samples taken for Intermediate Sum 2					
NR_SAMPLE_TOT_MV [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Total number of samples taken for mean value calculation					
NR_VALUE_BUF_SAMPLE	V	0... FFH	0... 255	1	-
Number of values to be taken from NR_BUF_SAMPLE for mean value calculation					
NR_VALUE_BUF_SUM	V	0... FFH	0... 255	1	-
Number of values to be taken from VLS_BUF_SUM for mean value calculation					
NR_VLS_UP_BUF_IDX [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Index for the ring buffer NR_BUF_SAMPLE					
NR_VLS_UP_RAW_BUF_IDX	V	0... FFH	0... 255	1	-
Index for the ring buffer VLS_UP_RAW_BUF as well as the Counter to trigger the mean value calculation of WRAF sensor signal					
NR_VLS_UP_RAW_SAMPLE_MV	V	0... FFH	0... 255	1	-
Total number of samples required for mean value calculation					
STATE_LSL_IF_SPI_RD_OLD [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
past initialization status register information for WRAF controller					
STATE_LSL_IF_SPI_WR_OLD [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
past initialization write status register information for WRAF controller					
T_DLY_VLS_UP_INIT [NC_CBK_EX_NR]	V	0... FFH	0... 2.55	0.01	s
reset timer for LV_VLS_UP_INIT					
T_SEG_LEN	V	0... FFH	0... 0.255	0.001	s
Actual segment time measured in msec					
VLS_BUF_SUM [NC_NR_BUF_SUM_LEN][NC_CBK_EX_NR]	-	0... FFFFH	0... 319.995117	0.00488281	V
Ring buffer for saving the intermediate sums of raw sensor signal					
VLS_UP [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.99511719	0.00488281	V
Upstream oxygen sensor voltage Bank 1					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VLS_UP_10_RAW [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.99511719	0.00488281	V
Raw value of WRAF sensor voltage signal Recurrence 10.0 msec					
VLS_UP_INTER_1_SUM [NC_CBK_EX_NR]	V	0... FFFFH	0... 319.995117	0.00488281	V
Intermediate sum 1					
VLS_UP_INTER_2_SUM [NC_CBK_EX_NR]	V	0... FFFFH	0... 319.995117	0.00488281	V
Intermediate sum 2					
VLS_UP_MV [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511719	0.00488281	V
Mean value of Upstream Oxygen sensor voltage					
VLS_UP_RAW_BUF [NC_NR_RAW_BUF_LEN][NC_CBK_EX_NR]	-	0... 3FFH	0... 4.99511719	0.00488281	V
Ring Buffer for storing the raw signal of WRAF sensor every 1 msec					
VLS_UP_TOT_SUM_MV [NC_CBK_EX_NR]	V	0... FFFFFFFFH	0... 20971500	0.00488281	V
Total sum of raw signal voltages taken for mean value calculation					

**Input data:**

LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}	N {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}
STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 956}	STATE_LSL_IF_SPI_WR [NC_CBK_EX_NR] {p. 1313}	VLS_UP_RAW [NC_CBK_EX_NR] {p. 967}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_MAX_VLS_UP_MV	-	0... 1FE0H	0... 8160	1	rpm
Maximum engine speed threshold for calculating mean value (background : save CPU load)					
C_T_DLY_VLS_UP_INIT	-	1... FFH	0.01 ...2.55	0.01	s
reset timer for LV_VLS_UP_INIT, Initial value = 1					
C_T_DLY_VLS_UP_INIT_MAX	-	1... FFH	0.01 ...2.55	0.01	s
initial value for delay timer in case of gain switching or offset adjustment					
C_VLS_UP_THD_BOL	-	0... 3FFH	0... 4.995117	0.00488281	V
Lower voltage threshold for WRAF sensor signal					
C_VLS_UP_THD_TOL	-	0... 3FFH	0... 4.995117	0.00488281	V
Upper voltage threshold for WRAF sensor signal					
LC_VLS_UP_MV_ON	-	0... 1H	0...1	1	-
Calibration flag to switch between raw value and filtered value (1 filtered, 0 raw)					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_FAC_10_SAMPLE	-	0... FFH	0... 255	1	-
Factor for multiplication, if segment time is less than NC_T_SEG_LEN_MIN					
NC_FAC_5_SAMPLE	-	0... FFH	0... 255	1	-
Factor for multiplication, if segment time is less than 5 msec					
NC_N_MIN_VLS_UP_MV	-	0... 1FE0H	0... 8160	1	rpm
Minimum engine speed threshold for calculating the mean value					
NC_NR_BUF_SAMPLE_LEN	-	0... FFH	0... 255	1	-
Buffer size for storing the number of samples taken for intermediate sum 1 (for minimum speed of 500 RPM)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_BUF_SUM_LEN	-	0... FFH	0... 255	1	-
Buffer size for storing the intermediate sums of sensor signal every 10 ms (for minimum speed of 500 RPM)					
NC_NR_RAW_BUF_LEN	-	0... FFH	0... 255	1	-
Ring buffer size for storing the raw sensor signal every 1 msec					
NC_T_SEG_LEN_MIN	-	0... FFH	0... 0.255	0.001	s
Minimum segment time required for mean value calculation					

### 4.39.1 EGCP\_SIGCVLSL3

The WRAF sensor  $s$  signal is influenced by the pressure fluctuations in the exhaust manifold. The dynamic pressure peaks in exhaust gas results in momentary increase of oxygen concentration inside the reference cell of WRAF sensor & the same is reflected at the sensor output signal. Pressure fluctuation comes mainly from segment timing, quick open & close of exhaust valve, misfiring and may be some other parameter. Out of all these most dominant influence comes from segment timing. To remove segment timing influence from the signal a mean value is evaluated.

The calculation shall be done for all exhaust cylinder banks.

NC\_CBK\_EX\_NR defines the number of exhaust banks. For vector elements, the variable extension  $_i$  is used in the model instead of  $[i]$  as found in the textual description.

To evaluate segment synchronous mean value, the raw voltage signal is captured every 1 ms (from BSW) and stored in a ring buffer. The size of this ring buffer is defined by NC\_NR\_RAW\_BUF\_LEN and it is **fixed** at 10. All other calculations in this function is triggered soon after the 10<sup>th</sup> value is written in to the buffer. The segment time in msec is calculated every 10 ms.

In order to save the memory space, 2 intermediate sums is built out of the earlier 10 values and stored in a second ring buffer. At the same time, the number of samples taken for first intermediate sum calculation is stored in the third ring buffer. The number of samples required for mean value as well as intermediate sums is calculated dynamically based on the segment time.

The final mean value is calculated by reading the buffers filled with intermediate sums and corresponding number of samples. The values are filled in all the three ring buffers from bottom to top.

It is possible to switch off this function using the switch LC\_VLS\_UP\_MV\_ON, in which case only the raw sensor signal is delivered at 10 ms recurrence.


The ring buffer size for storing the intermediate sums and number of samples is calculated for a minimum engine speed of 500 rpm ( Engine having 4 cyl and 2 exhaust bank - worst case). Hence the default values are

NC\_N\_MIN\_VLS\_UP\_MV = 500 rpm

NC\_NR\_BUF\_SAMPLE\_LEN = 12

NC\_NR\_BUF\_SUM\_LEN = 2 \* NC\_NR\_BUF\_SAMPLE\_LEN = 24

#### Application Condition

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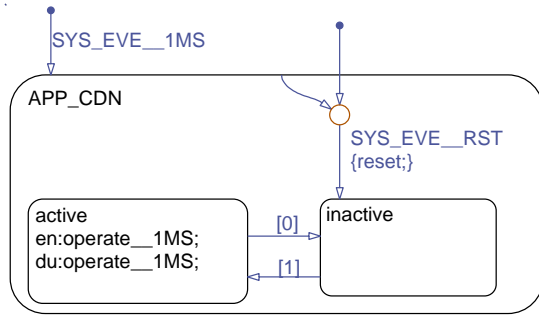
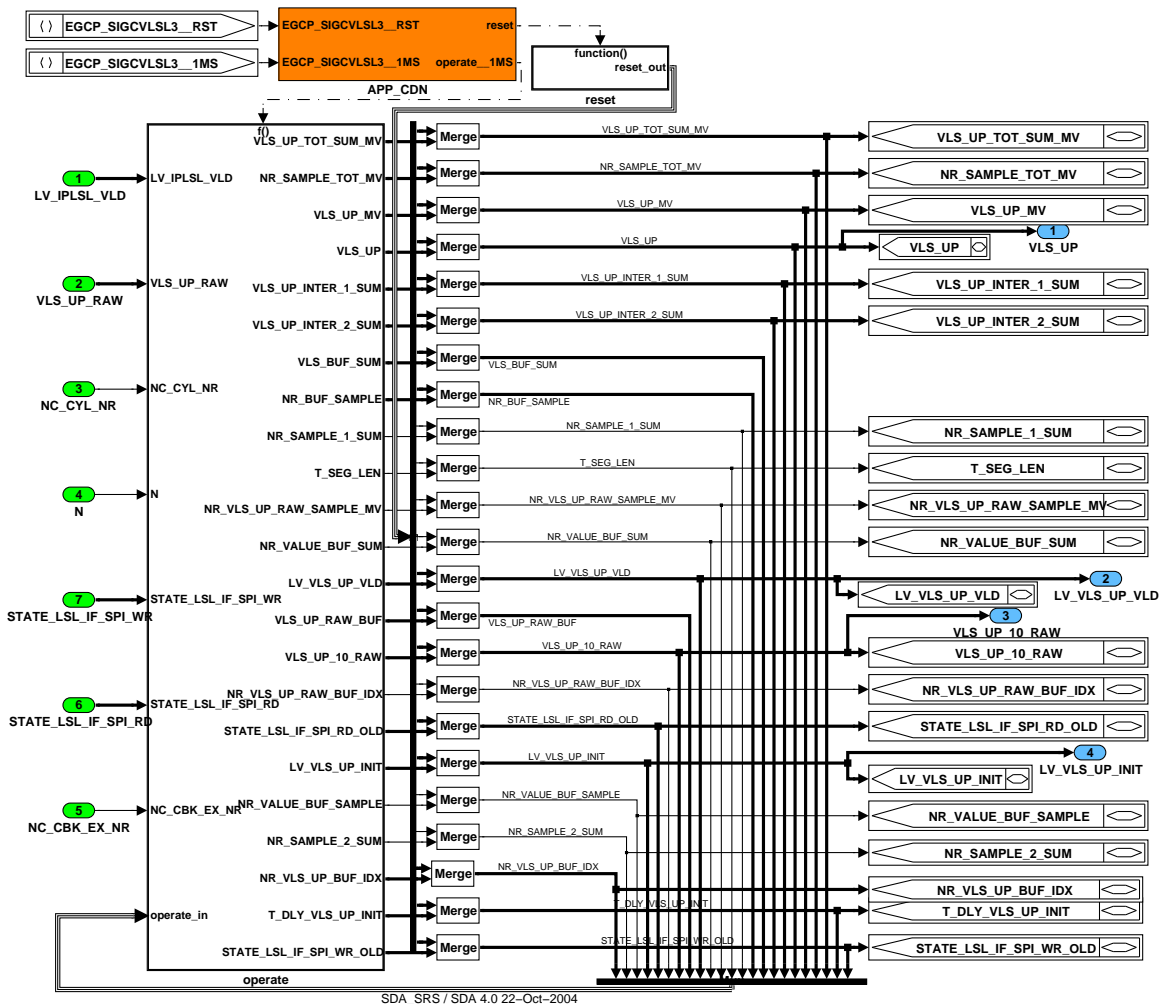


Figure 4.39.1: EGCP\_SIGCVLSL3/APP\_CDN/Chart

**Function Description**



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Figure 4.39.2: EGCP\_SIGCVLSL3



### 4.39.1.1 SUBFUNCTION: operate

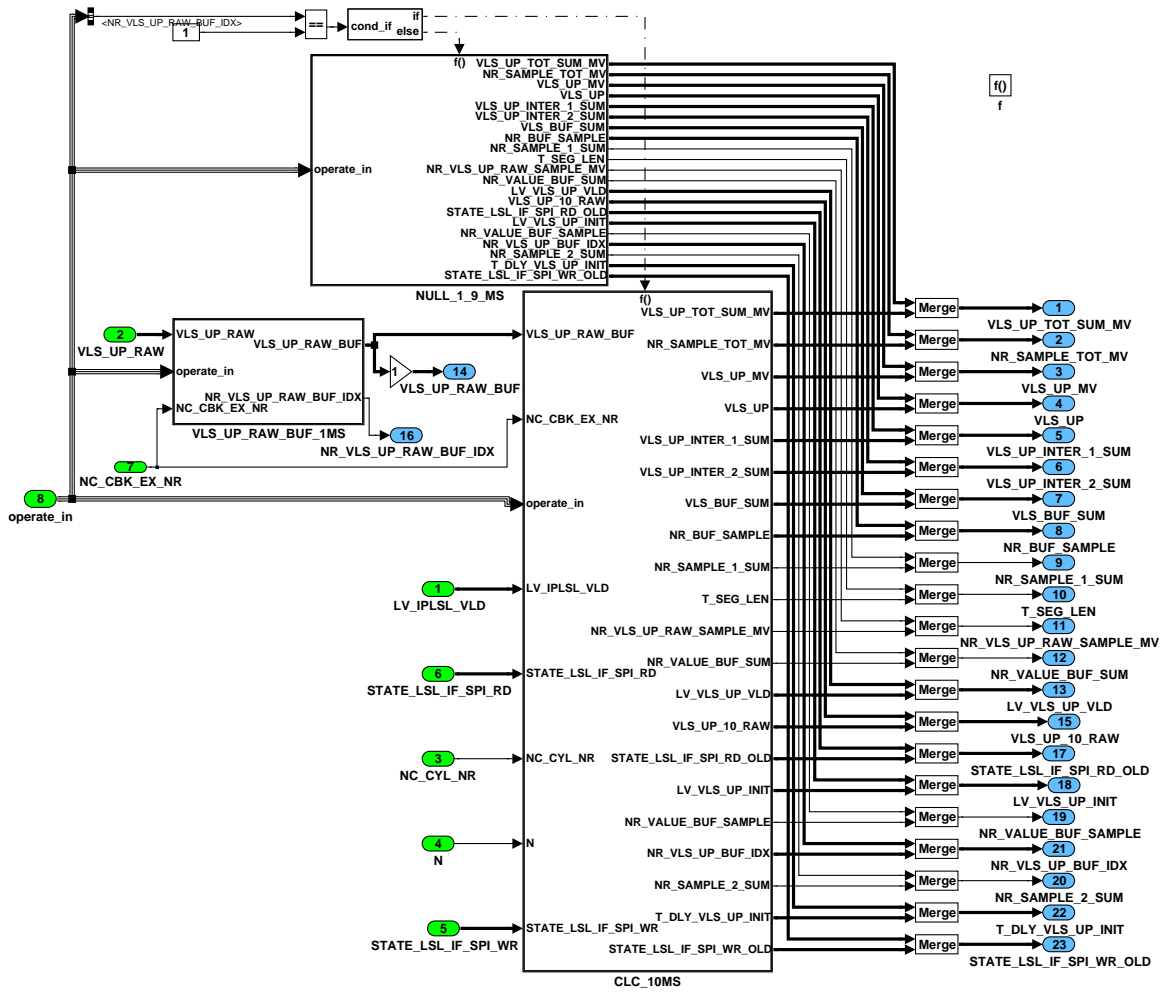


Figure 4.39.3: EGCP\_SIGCVLSL3/operate

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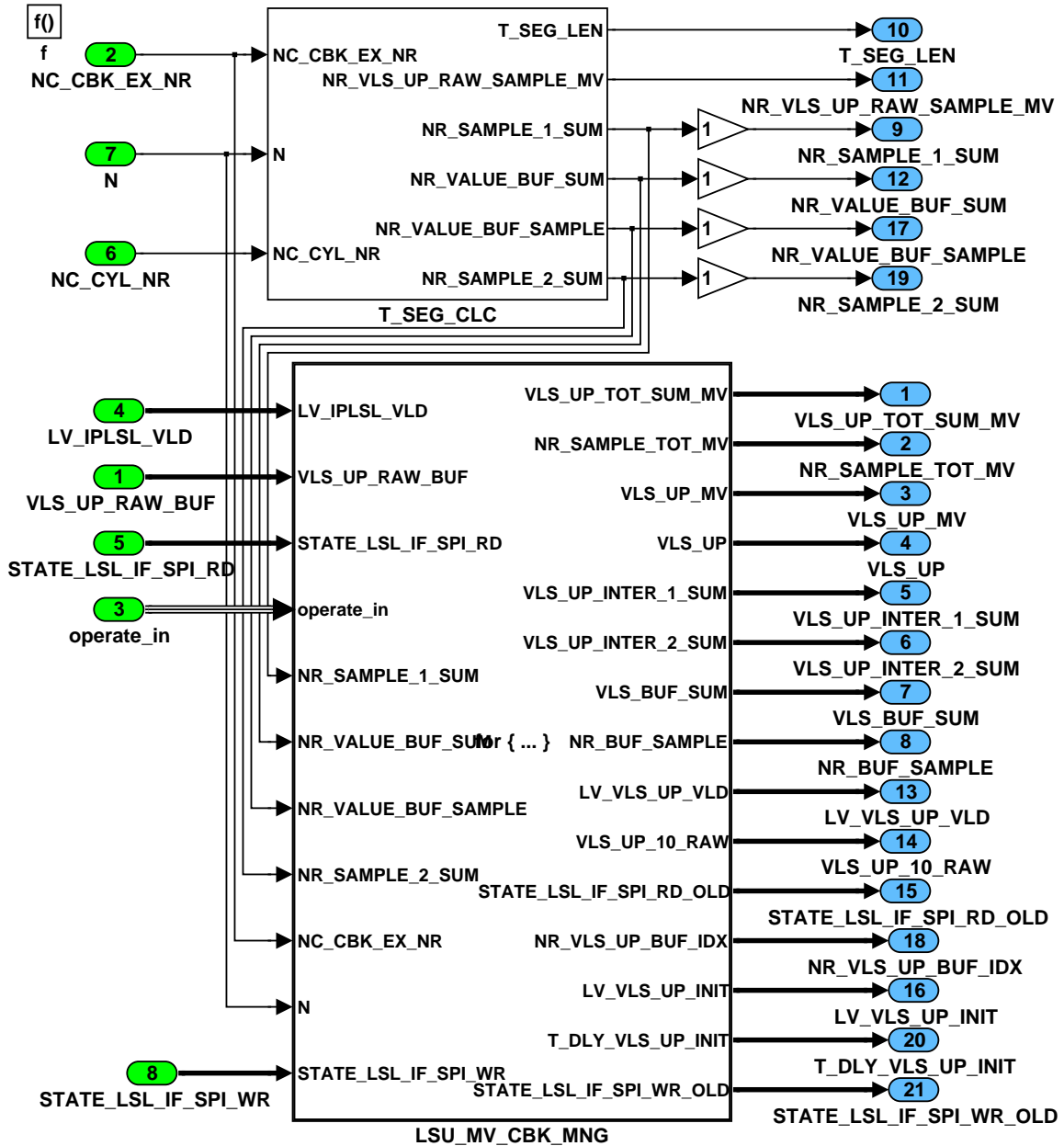


Figure 4.39.4: EGCP\_SIGCVLSL3/operate/CLC\_10MS

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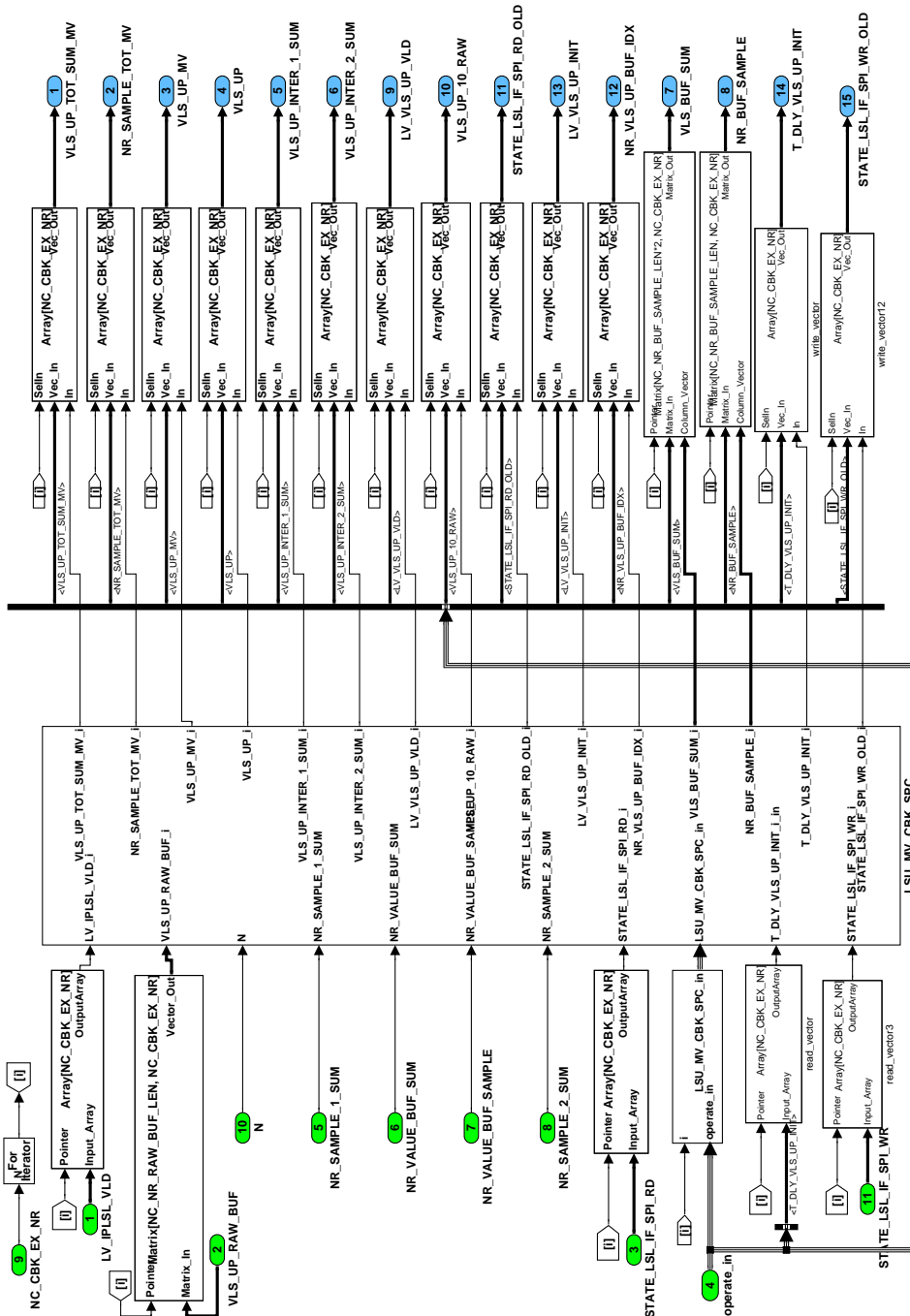



Figure 4.39.5: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG

### Re initialisation of buffers

The raw signal voltage is always compared with limiting values and clipped if any. Accordingly the flag LV\_VLS\_UP\_VLD is set.

The bit LV\_VLS\_UP\_INIT is set to 1 whenever any one of the 2 LSBs of STATE\_LSL\_IF\_SPI\_WR toggles. T\_DLY\_VLS\_UP\_INIT is initialized to calibration value whenever any one of the 2 LSBs of STATE\_LSL\_IF\_SPI\_WR toggles. The bit LV\_VLS\_UP\_INIT reset to 0 after expiry of timer T\_DLY\_VLS\_UP\_INIT.

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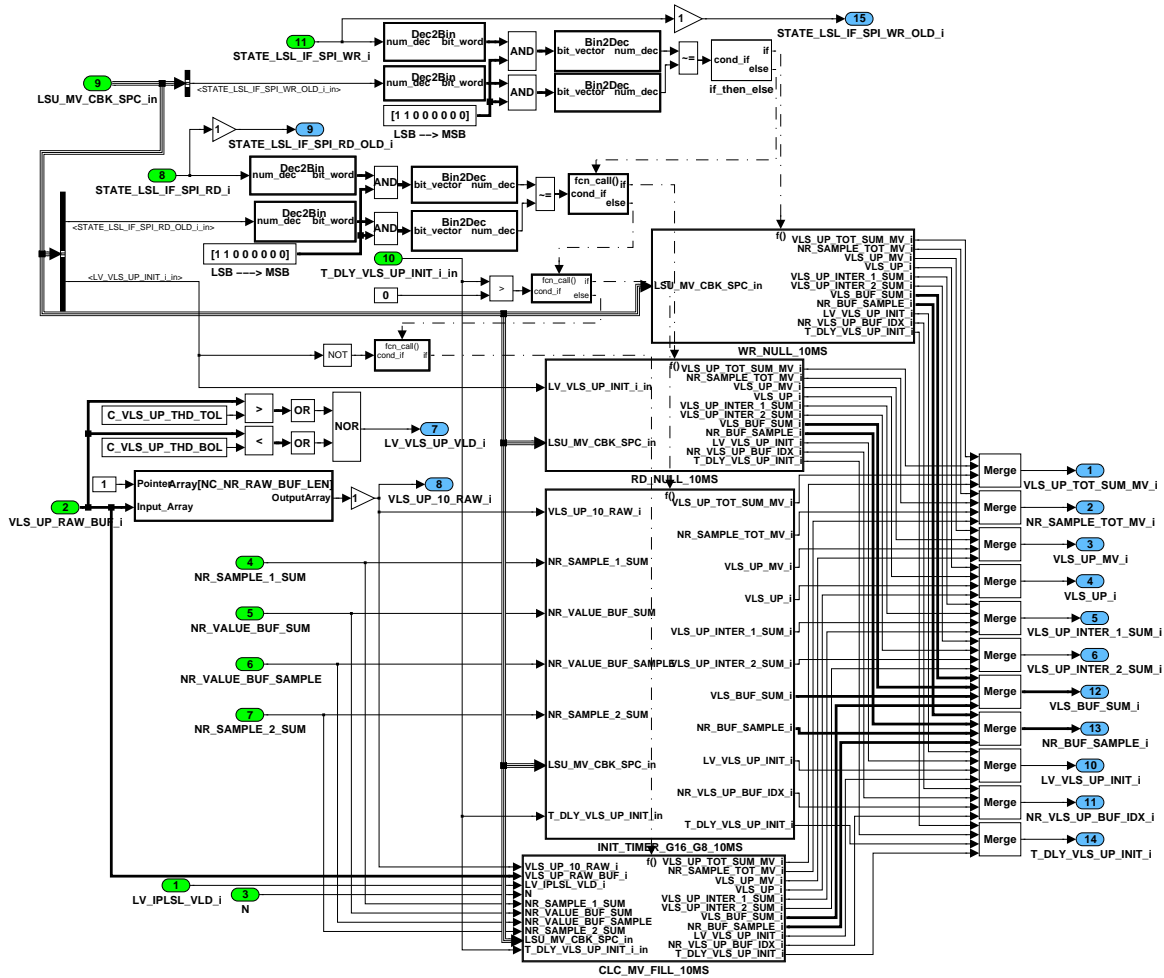


Figure 4.39.6: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC

### Filling ring buffers with current values

During engine starting, the buffers are filled with current sensor values till the conditions for mean value calculation are fulfilled. In this case, VLS\_UP would be same as VLS\_UP\_10\_RAW (every 10<sup>th</sup> raw signal value stored in VLS\_UP\_RAW\_BUF).

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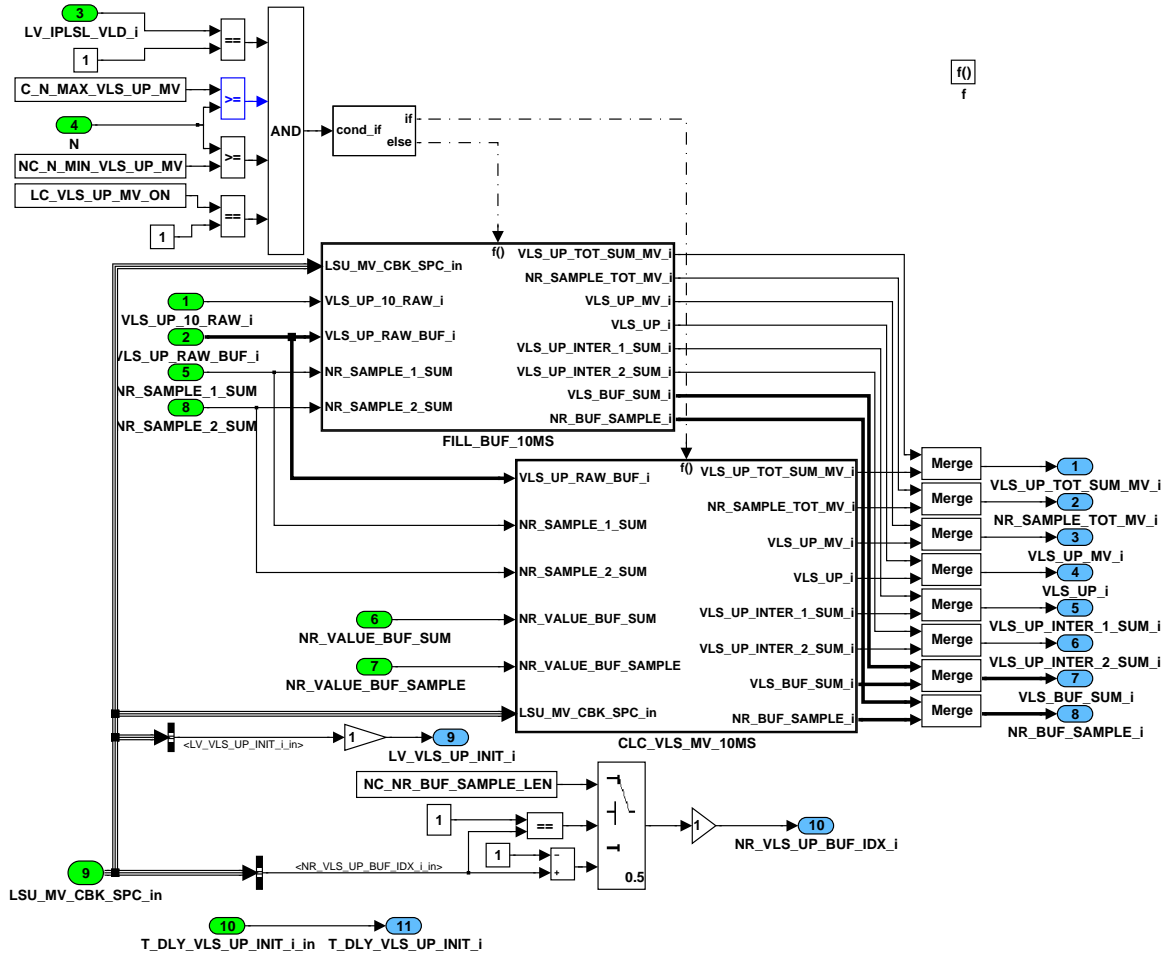


Figure 4.39.7: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/CLC\_MV\_FILL\_10MS

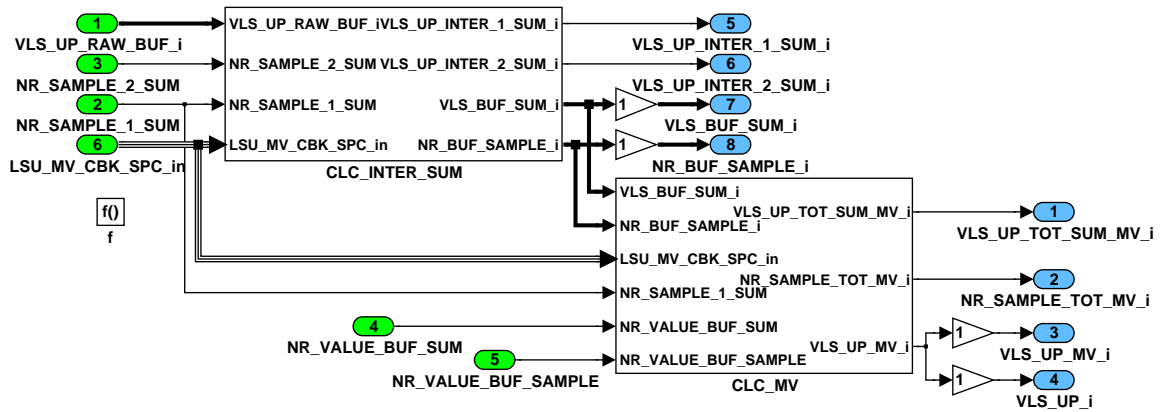


Figure 4.39.8: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/CLC\_MV\_FILL\_10MS/CLC\_VLS\_MV\_10MS

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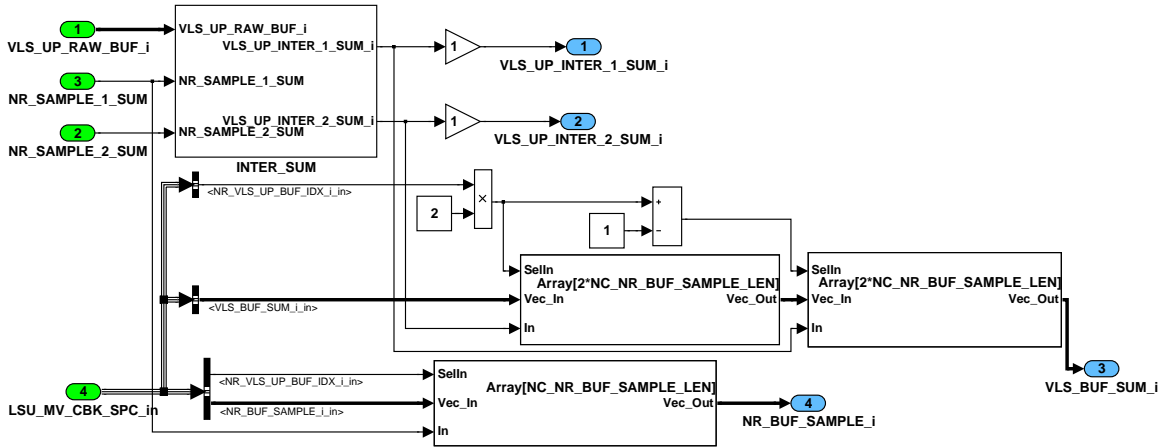


Figure 4.39.9: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/CLC\_MV\_FILL\_10MS/CLC\_VLS\_MV\_10MS/CLC\_INTER\_SUM

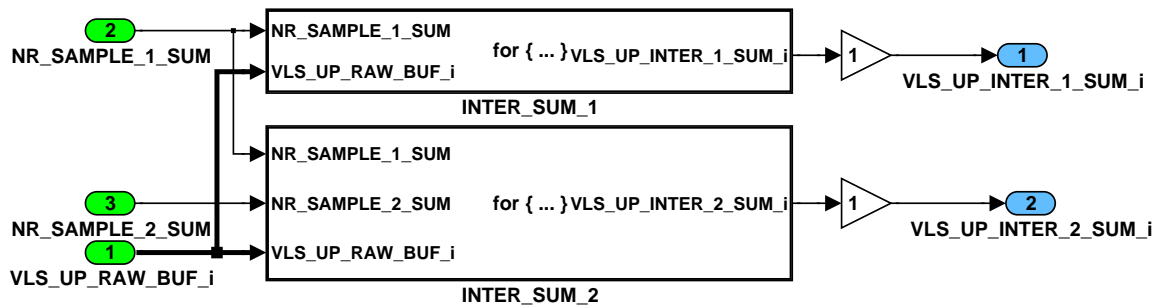


Figure 4.39.10: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/CLC\_MV\_FILL\_10MS/CLC\_VLS\_MV\_10MS/CLC\_INTER\_SUM/INTER\_SUM

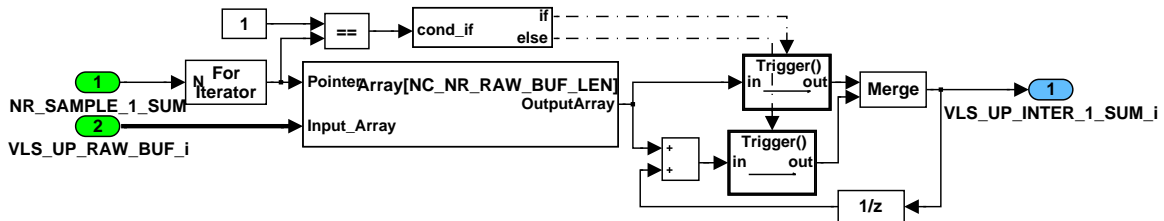


Figure 4.39.11: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/CLC\_MV\_FILL\_10MS/CLC\_VLS\_MV\_10MS/CLC\_INTER\_SUM/INTER\_SUM/INTER\_SUM\_1

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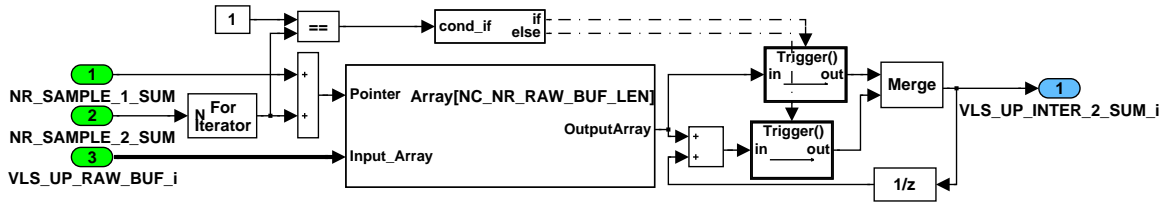


Figure 4.39.12: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/CLC\_MV\_FILL\_10MS/CLC\_VLS\_MV\_10MS/CLC\_INTER\_SUM/INTER\_SUM/INTER\_SUM\_2

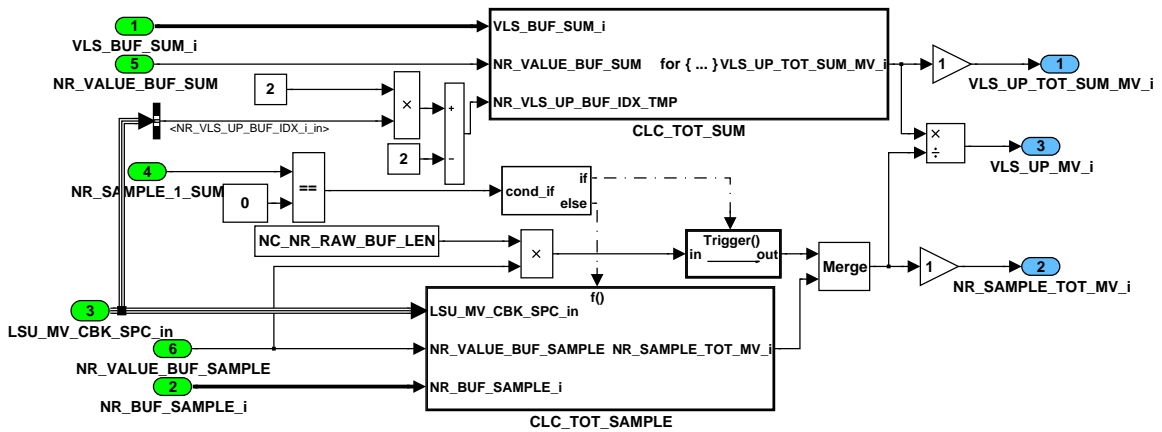


Figure 4.39.13: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/CLC\_MV\_FILL\_10MS/CLC\_VLS\_MV\_10MS/CLC\_MV

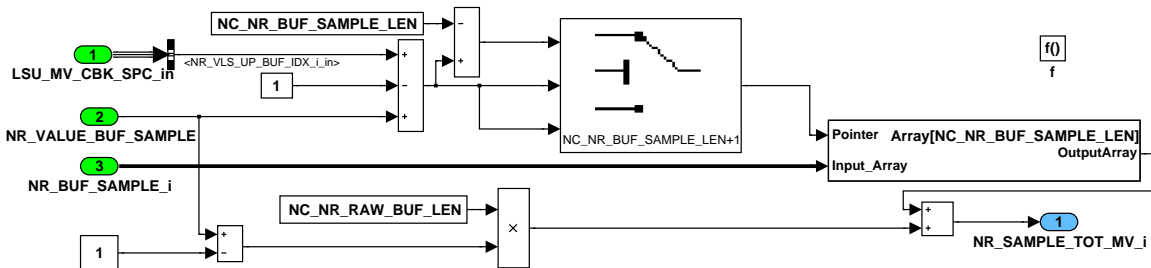


Figure 4.39.14: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/CLC\_MV\_FILL\_10MS/CLC\_VLS\_MV\_10MS/CLC\_MV/CLC\_TOT\_SAMPLE

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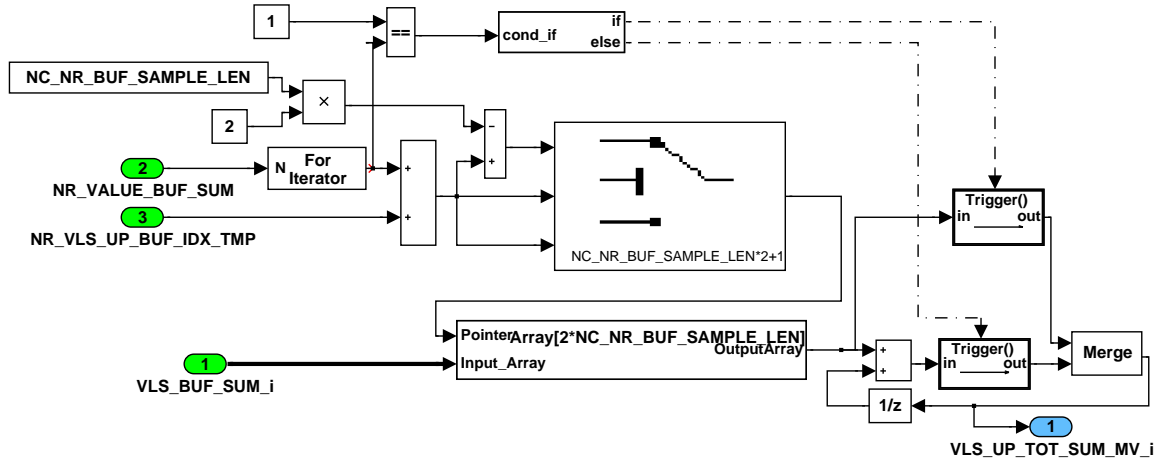


Figure 4.39.15: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/CLC\_MV\_FILL\_10MS/CLC\_VLS\_MV\_10MS/CLC\_MV/CLC\_TOT\_SUM

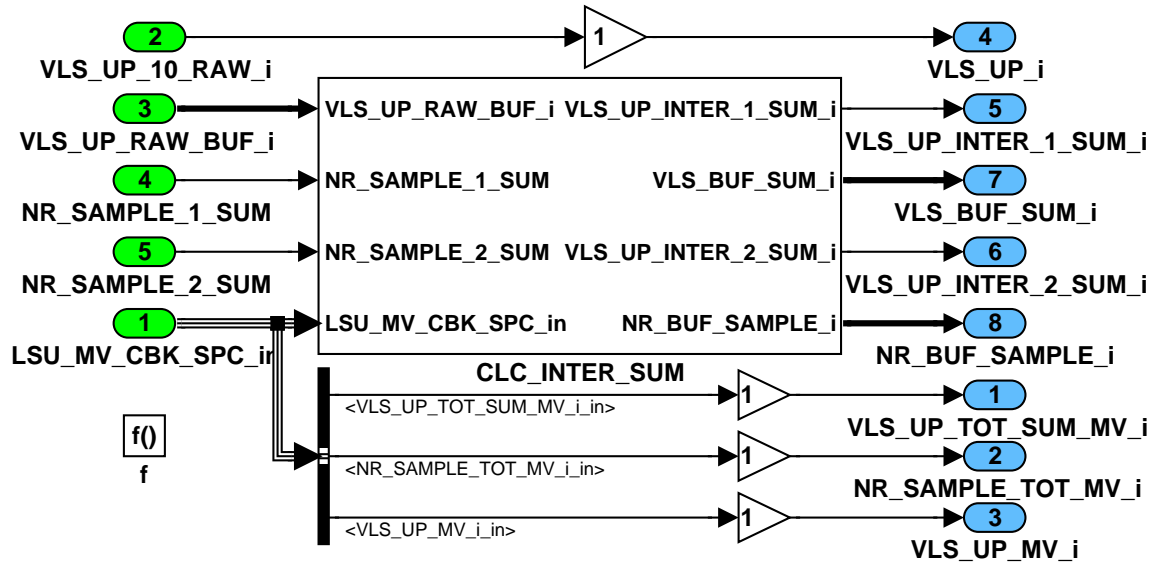


Figure 4.39.16: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/CLC\_MV\_FILL\_10MS/FILL\_BUF\_10MS

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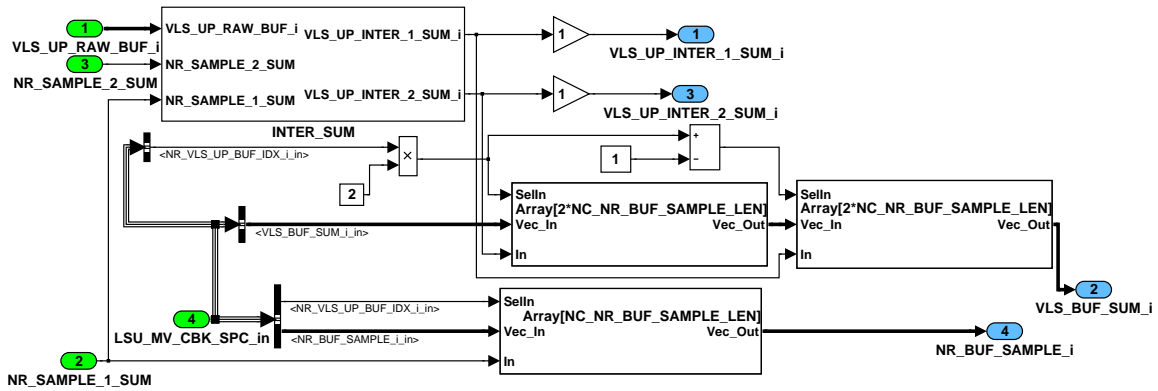


Figure 4.39.17: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/CLC\_MV\_FILL\_10MS/FILL\_BUF\_10MS/CLC\_INTER\_SUM

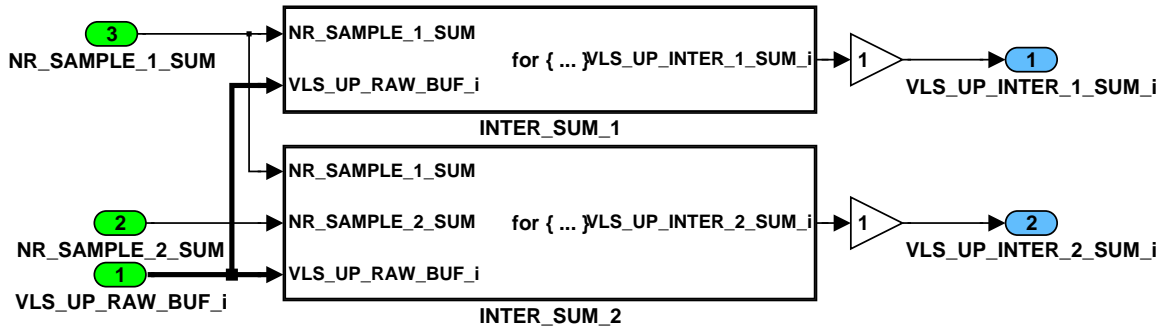


Figure 4.39.18: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/CLC\_MV\_FILL\_10MS/FILL\_BUF\_10MS/CLC\_INTER\_SUM/INTER\_SUM

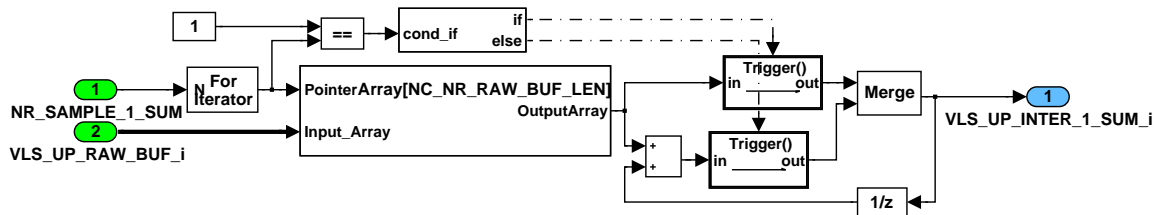


Figure 4.39.19: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/CLC\_MV\_FILL\_10MS/FILL\_BUF\_10MS/CLC\_INTER\_SUM/INTER\_SUM/INTER\_SUM\_1

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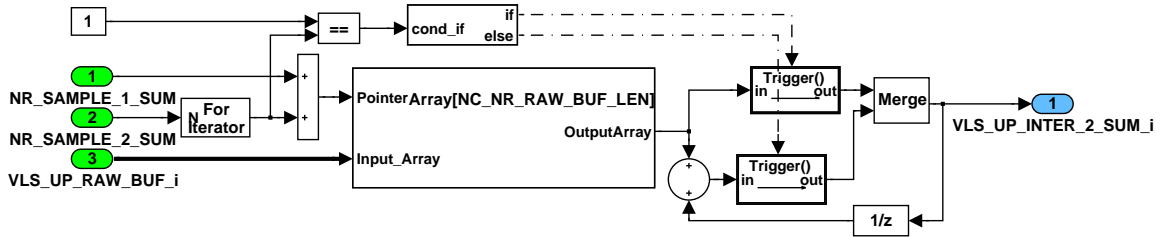


Figure 4.39.20: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/CLC\_MV\_FILL\_10MS/FILL\_BUF\_10MS/CLC\_INTER\_SUM/INTER\_SUM/INTER\_SUM\_2

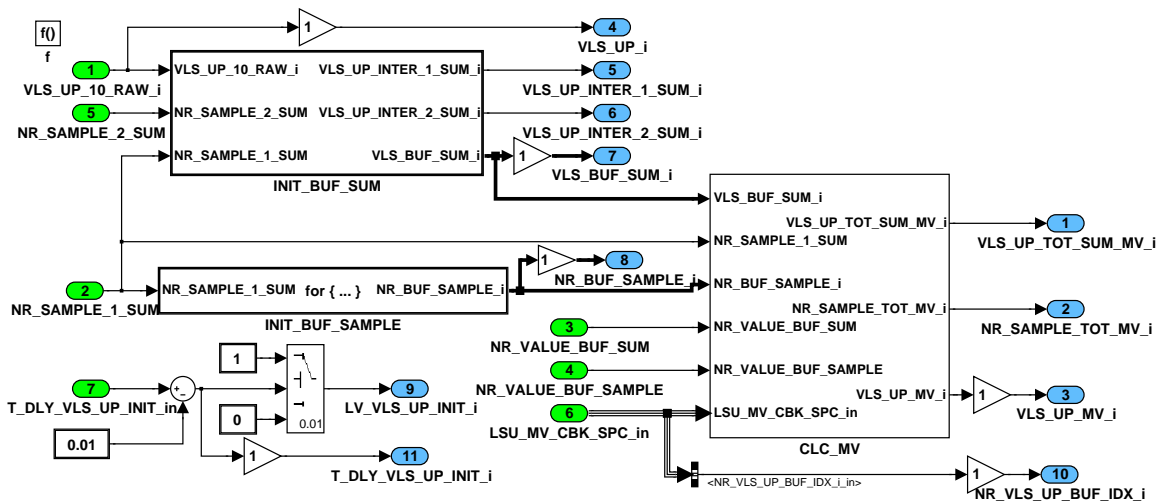


Figure 4.39.21: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/INIT\_TIMER\_G16\_G8\_10MS

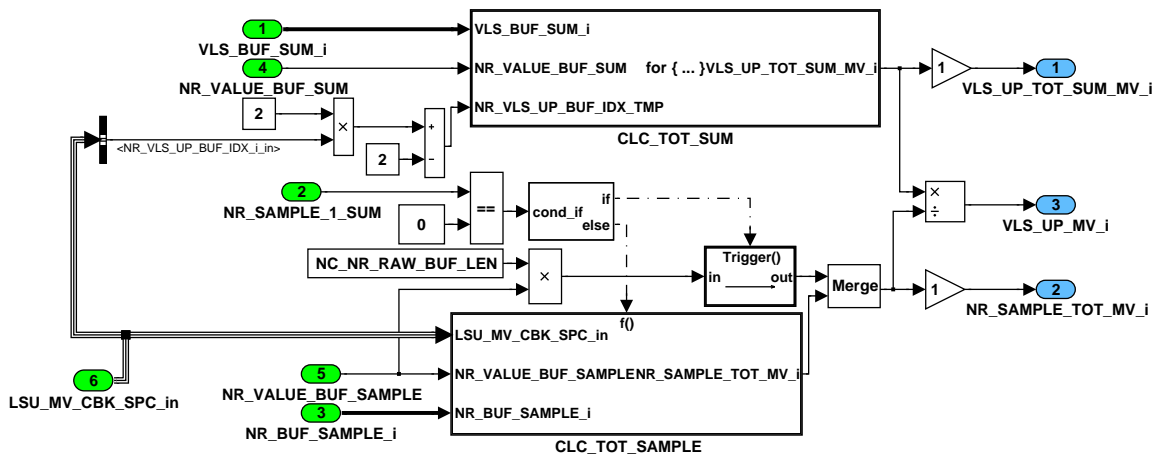


Figure 4.39.22: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/INIT\_TIMER\_G16\_G8\_10MS/CLC\_MV

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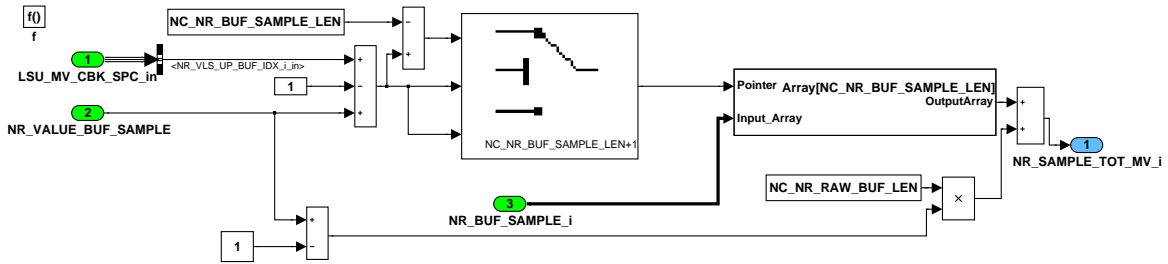


Figure 4.39.23: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/INIT\_TIMER\_G16\_G8\_10MS/CLC\_MV/CLC\_TOT\_SAMPLE

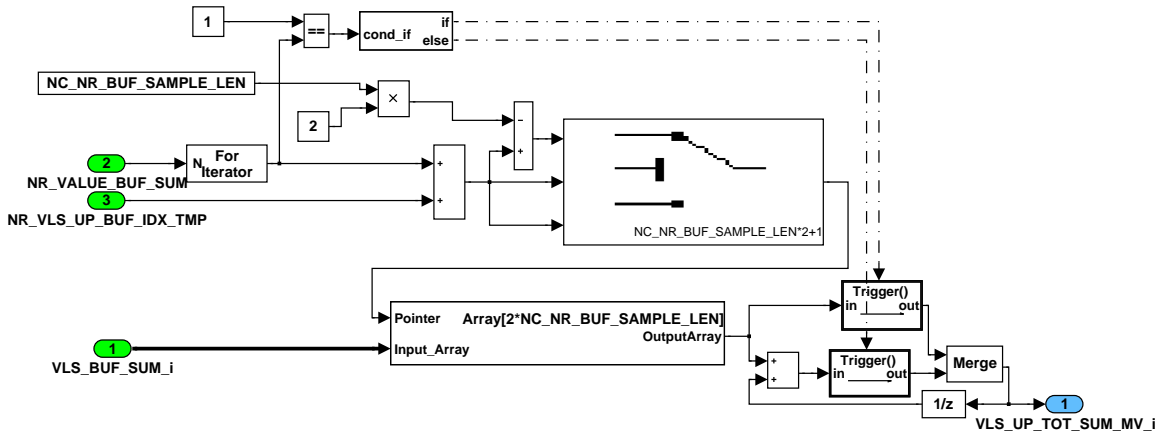


Figure 4.39.24: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/INIT\_TIMER\_G16\_G8\_10MS/CLC\_MV/CLC\_TOT\_SUM

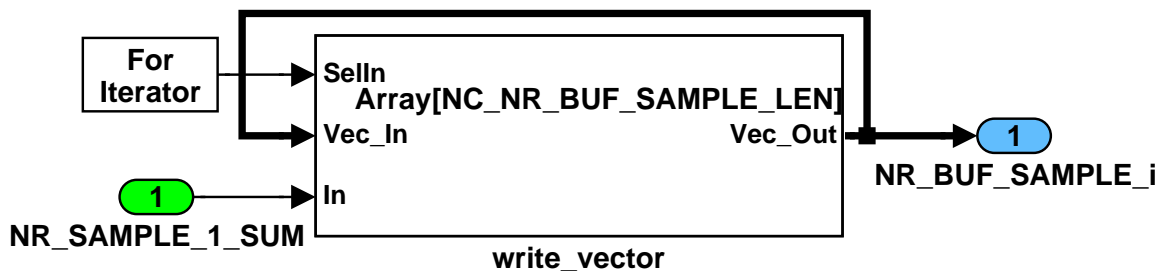


Figure 4.39.25: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/INIT\_TIMER\_G16\_G8\_10MS/INIT\_BUF\_SAMPLE

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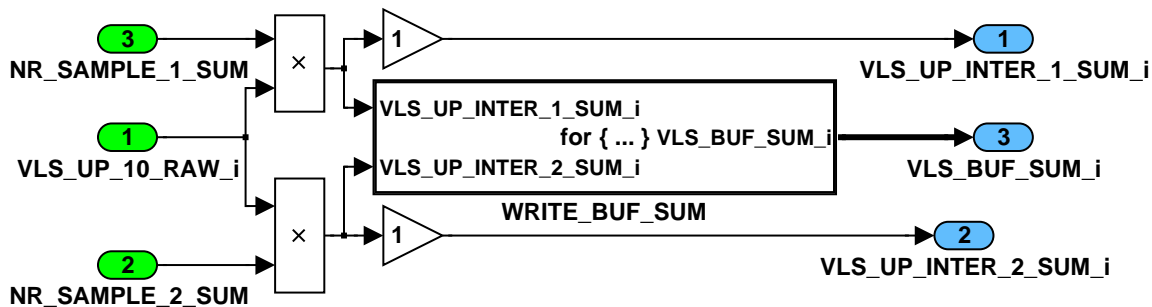


Figure 4.39.26: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/INIT\_TIMER\_G16\_G8\_10MS/INIT\_BUF\_SUM

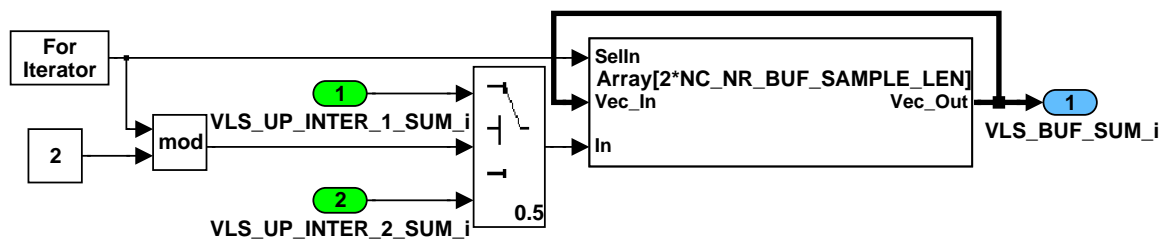


Figure 4.39.27: EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/INIT\_TIMER\_G16\_G8\_10MS/INIT\_BUF\_SUM/WRITE\_BUF\_SUM

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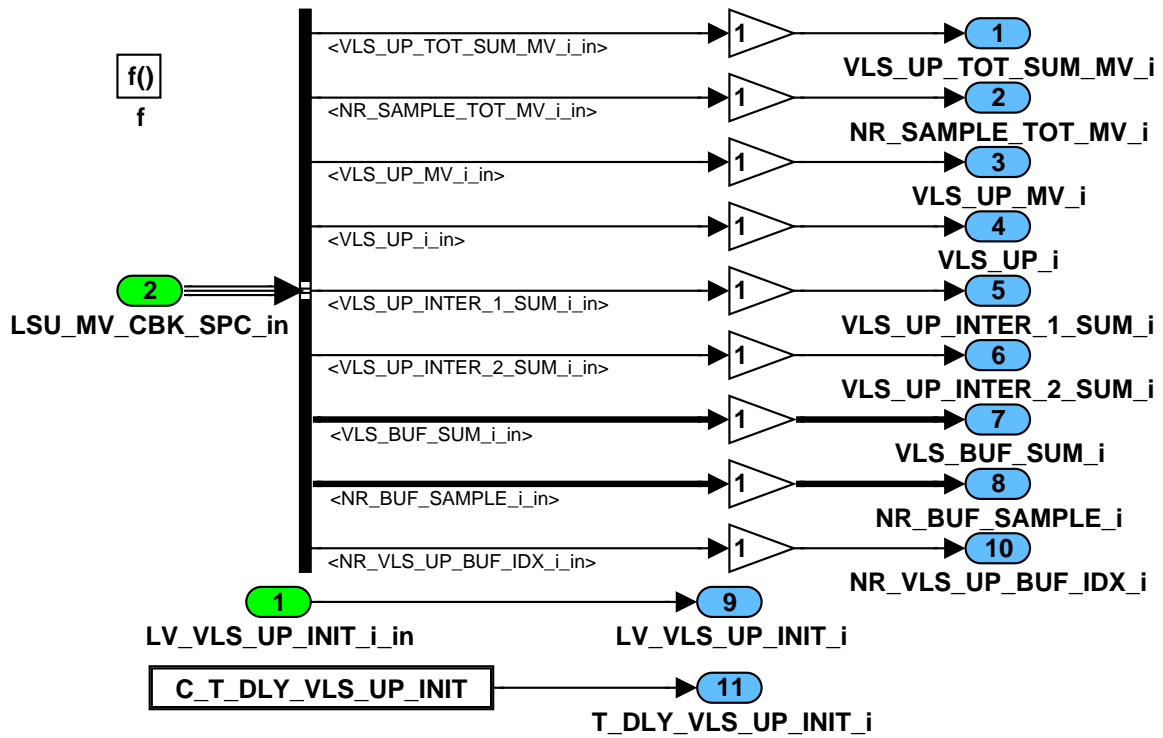


Figure 4.39.28:  
EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/RD\_NULL\_10MS

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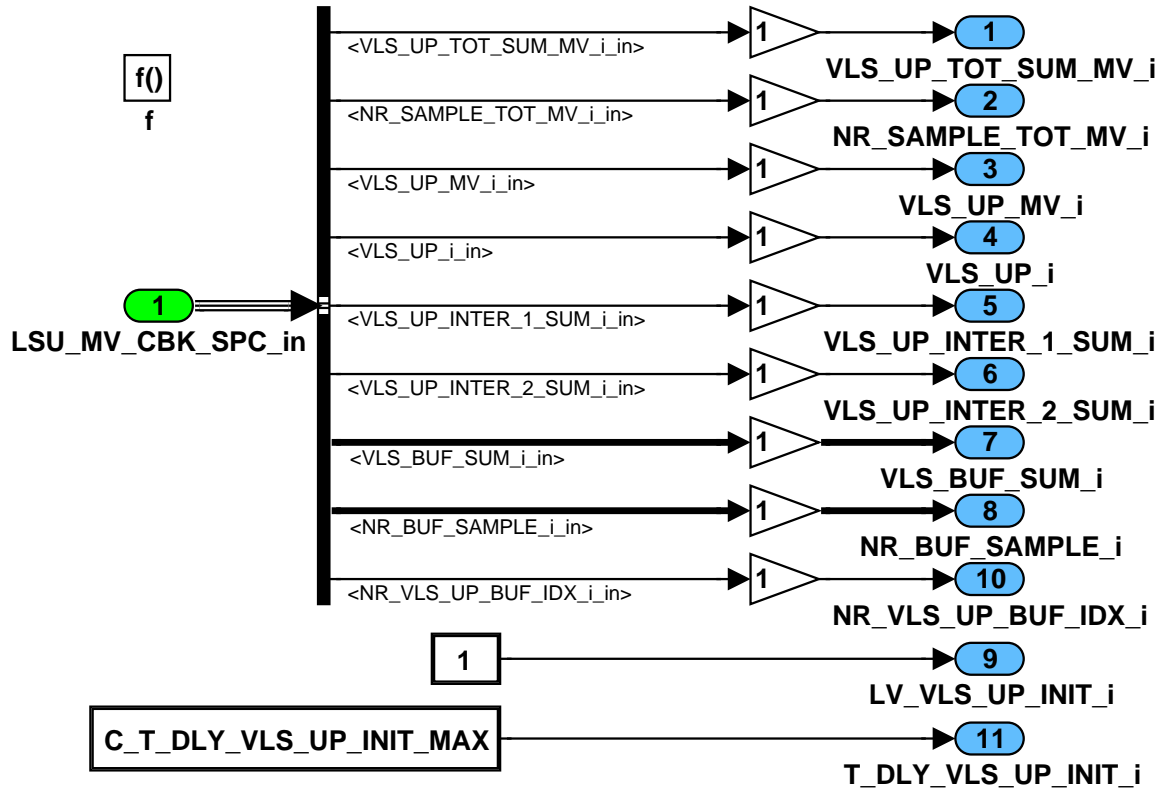


Figure 4.39.29:  
EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_CBK\_SPC/WR\_NULL\_10MS

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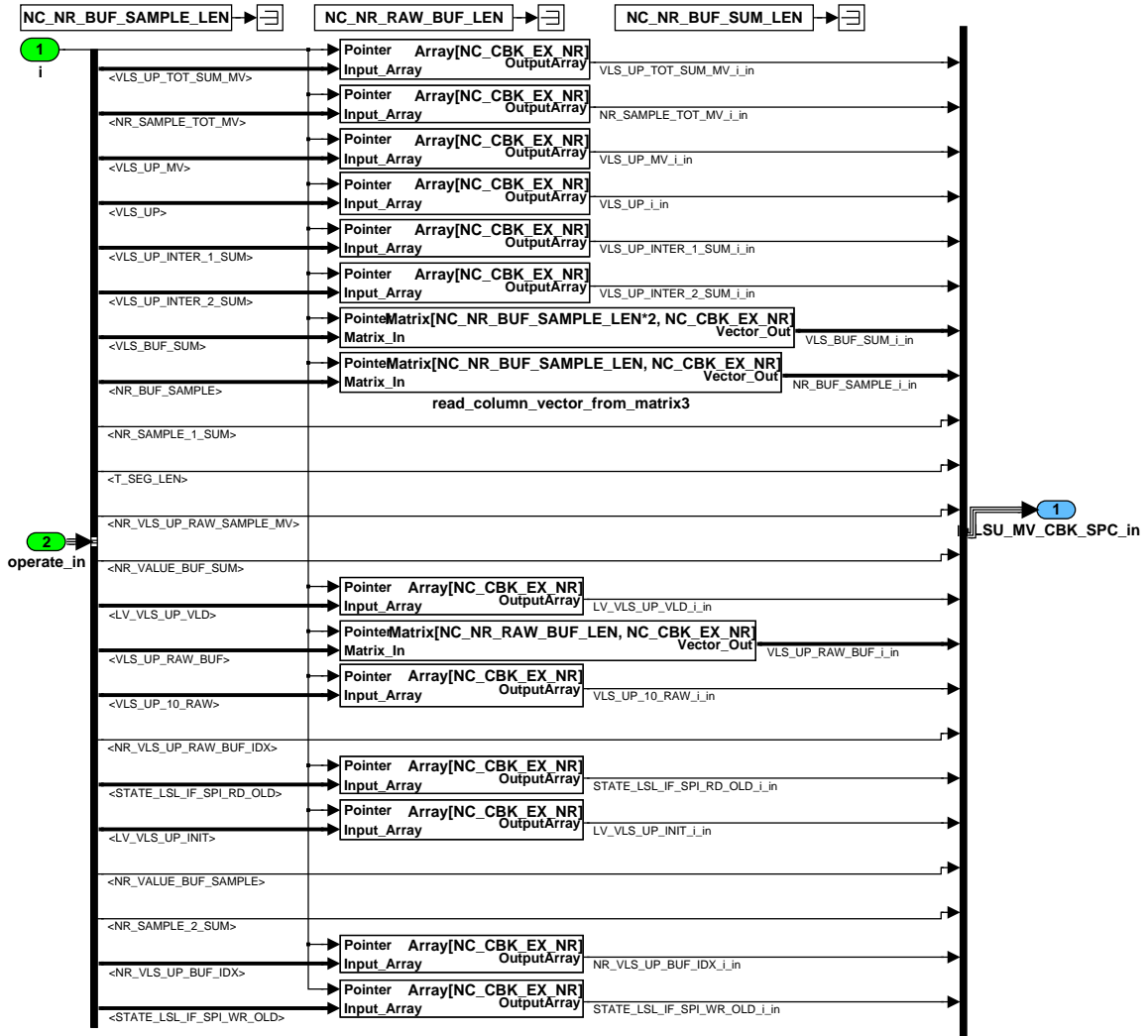


Figure 4.39.30:  
EGCP\_SIGCVLSL3/operate/CLC\_10MS/LSU\_MV\_CBK\_MNG/LSU\_MV\_SIG\_CBK\_MNG

**Calculation of segment time and number of samples for mean value**

The segment time will be calculated after every 10<sup>th</sup> raw signal value is written in to the buffer. The number of samples required for mean value calculation depend on the segment time. The minimum segment time is fixed using NC\_T\_SEG\_LEN\_MIN. If the measured segment time is less than the minimum, then number of samples will be calculated by corresponding multiplication factors.

The default values are

NC\_T\_SEG\_LEN\_MIN = 0.01 s

NC\_FAC\_10\_SAMPLE = 2

NC\_FAC\_5\_SAMPLE = 4

2 \* 60 \* 1000 \* no\_of\_cyl\_bank

T\_SEG\_LEN = (ms)

N\_in\_rpm \* no\_of\_cyl

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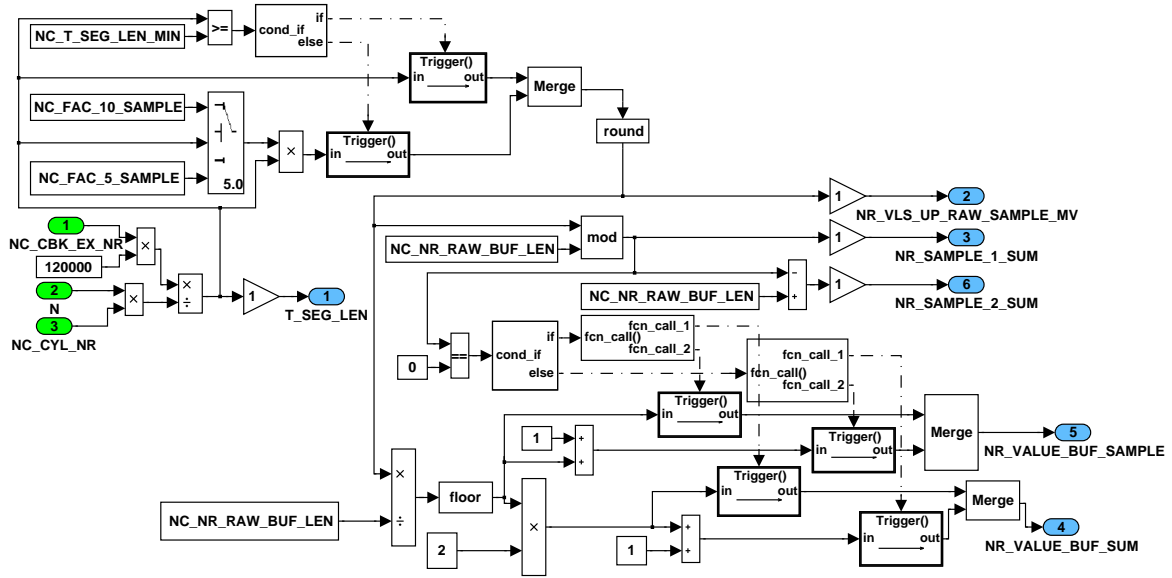


Figure 4.39.31: EGCP\_SIGCVLSL3/operate/CLC\_10MS/T\_SEG\_CLC

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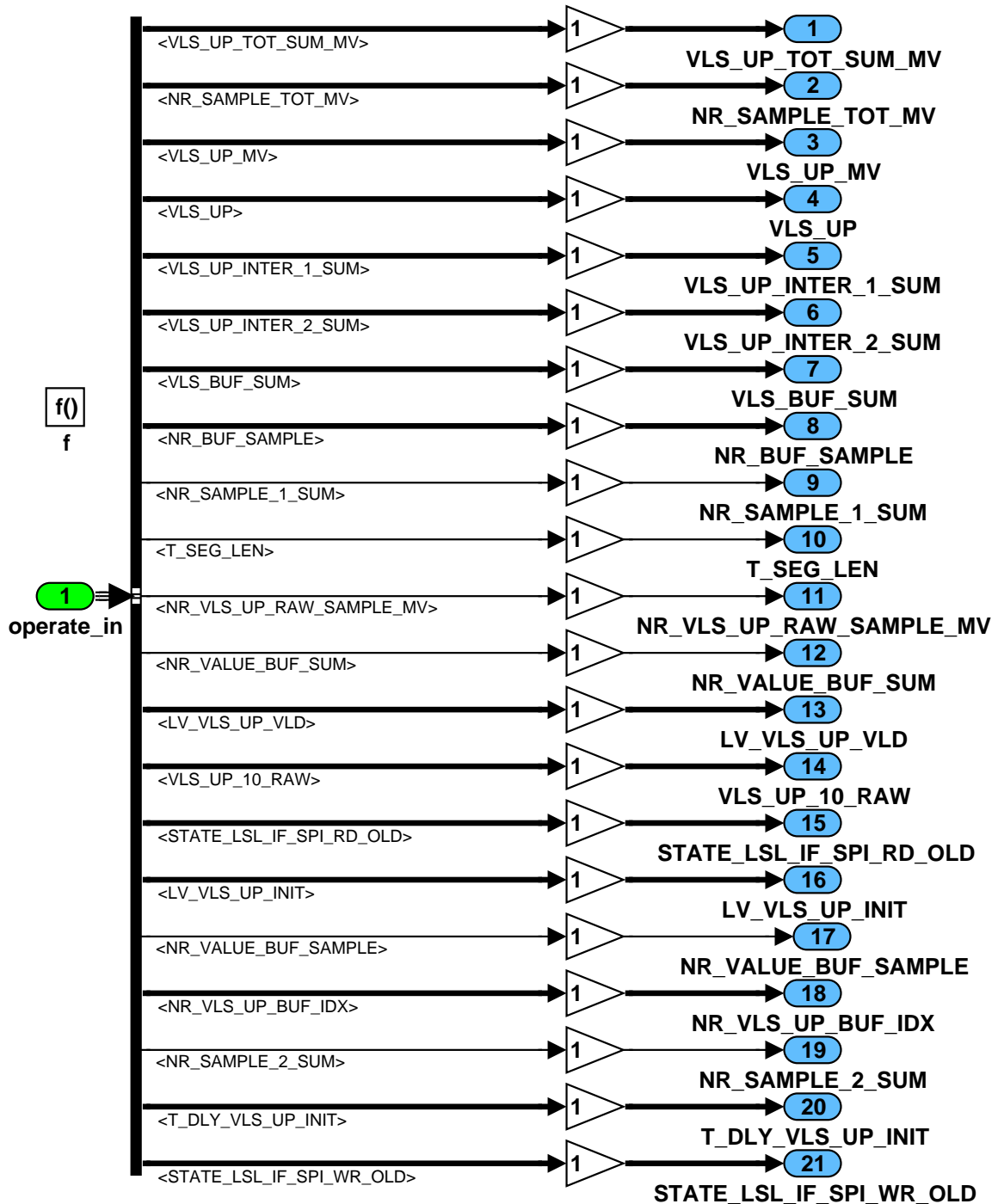


Figure 4.39.32: EGCP\_SIGCVLSL3/operate/NULL\_1\_9\_MS

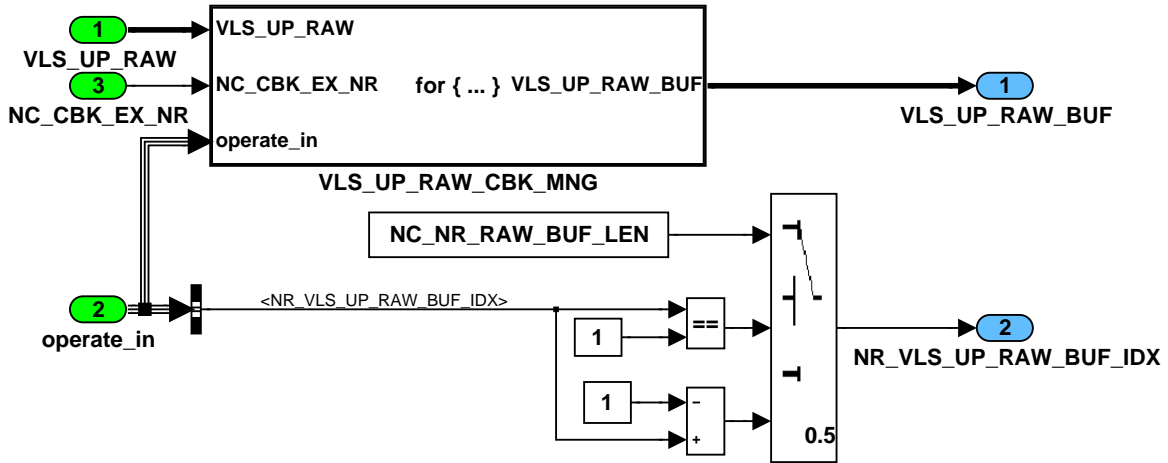


Figure 4.39.33: EGCP\_SIGCVLSL3/operate/VLS\_UP\_RAW\_BUF\_1MS

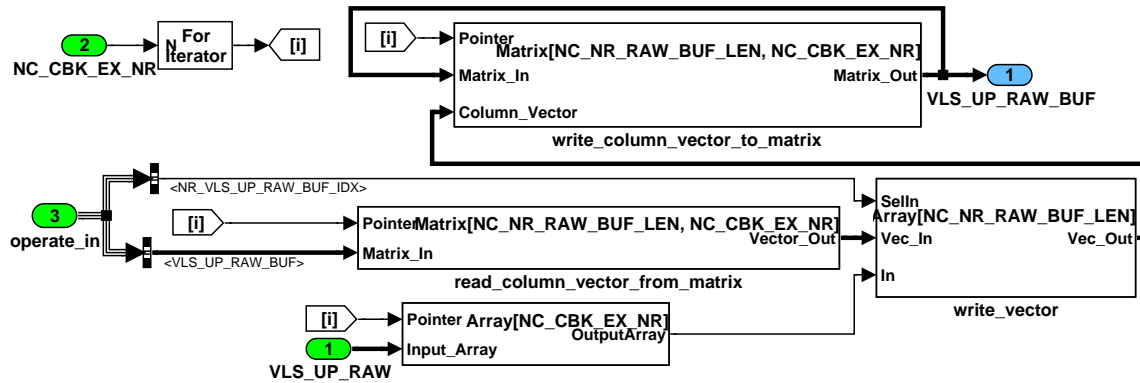


Figure 4.39.34: EGCP\_SIGCVLSL3/operate/VLS\_UP\_RAW\_BUF\_1MS/VLS\_UP\_RAW\_CBK\_MNG

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### 4.39.1.2 SUBFUNCTION: reset

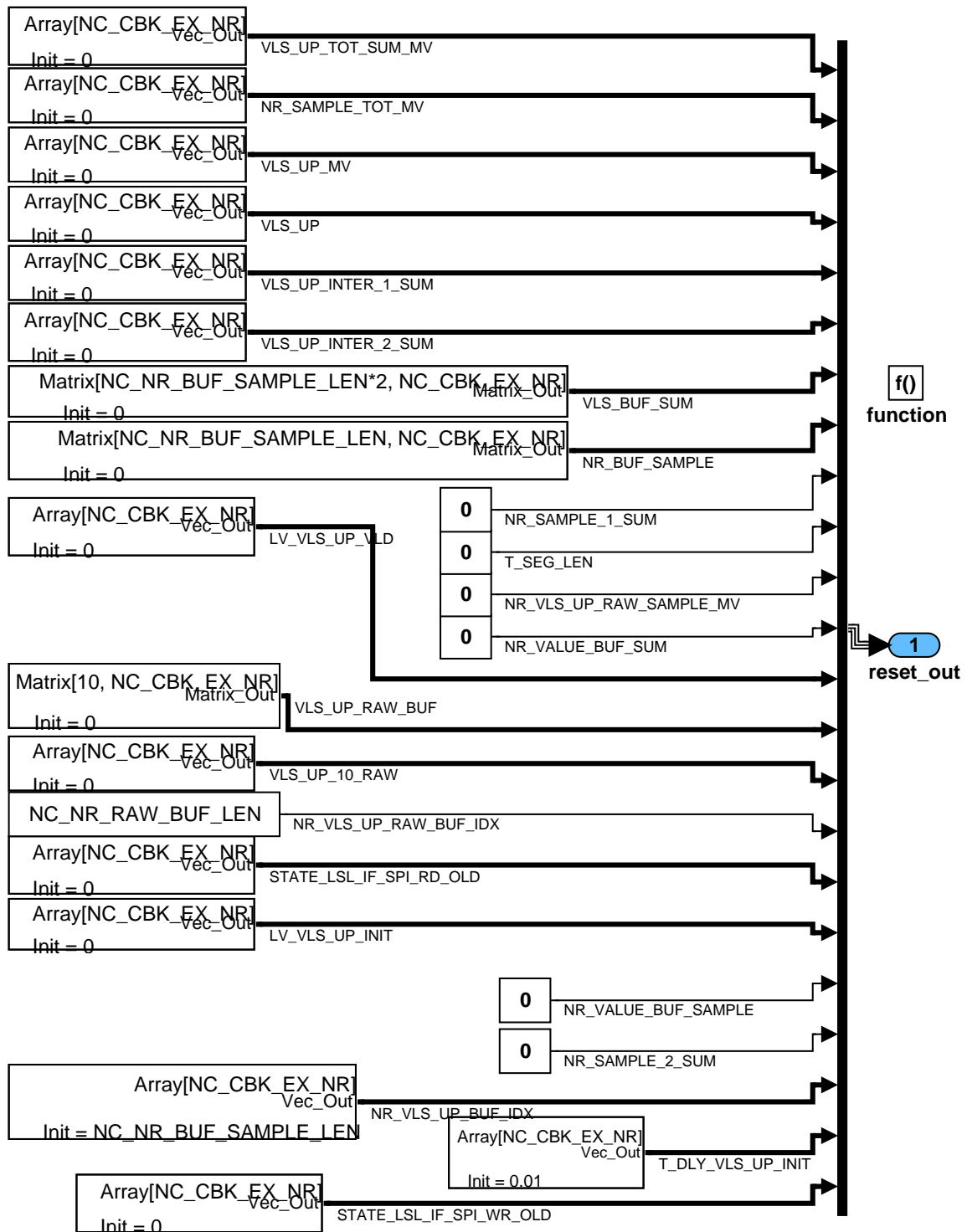


Figure 4.39.35: EGCP\_SIGCVLSL3/reset

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## 4.40 O2 sensor (bin, down) element temperature determination

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CYCNR_R_IT_LS_DOWN_VLD [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Handshake counter indicating the number of valid resistance values determined since initial activation					
FAC_T_VLS_DOWN_MMV_DRV1 [NC_CBK_EX_NR]	V	0... FFH	0... 63.75	0.25	-
Multiplicative factor modifies DRV1_VLS_DOWN_MMV_MIN_THD dependent on T_VLS_CYC_AFL_HLD					
FAC_T_VLS_DOWN_MMV_DRV1_ABS [NC_CBK_EX_NR]	V	0... FFH	0... 15.9375	0.0625	-
Multiplicative factor modifies C_VLS_DOWN_MMV_DRV1_ABS_MAX dependent on T_VLS_CYC_AFL_HLD					
LV_R_IT_DET_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating that resistance has already been determined (lock out)					
LV_R_IT_REQ_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that conditions have been met and resistance determination requested					
LV_VLS_DOWN_DRV1_CDN_R_LS [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating that low gradient condition met					
LV_VLS_DOWN_RNG_CDN_R_LS [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating that VLS_DOWN at low gradient condition met					
POW_MMV_LSH_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 84.49871	1.2894e-3	W
Moving mean value of downstream oxygen sensor heater power					
R_IT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	Ohm
Internal resistance of downstream oxygen sensor (Released)					
R_IT_MDL_LS_DOWN_NEW [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	Ohm
Internal resistance of downstream oxygen sensor (Modelled for new sensor)					
R_IT_MES_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	Ohm
Internal resistance of downstream oxygen sensor (Measured)					
T_AFL_CYC_HLD_R_IT_LS_DOWN [NC_CBK_EX_NR]	V	0... FFH	0... 2.55	0.01	s
Lean mixture cycle time (measured upstream), held until next threshold crossing downstream					
T_SAMPLE_R_IT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 655.35	0.01	s
Time measured between internal resistance samples					
TTIP_MES_BOL_LS_DOWN [NC_CBK_EX_NR]	V	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Downstream oxygen sensor ceramic temperature, Lower limit, Unfiltered					
TTIP_MES_BOL_MMV_LS_DOWN [NC_CBK_EX_NR]	V	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Downstream oxygen sensor ceramic temperature, Lower limit, Filtered					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TTIP_MES_LS_DOWN [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Downstream oxygen sensor ceramic temperature					
TTIP_MES_TOL_LS_DOWN [NC_CBK_EX_NR]	V	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Downstream oxygen sensor ceramic temperature, Upper limit, Unfiltered					
TTIP_MES_TOL_MMV_LS_DOWN [NC_CBK_EX_NR]	V	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Downstream oxygen sensor ceramic temperature, Upper limit, Filtered					
TTIP_REF_MDL_MMV_LS_DOWN [NC_CBK_EX_NR]	V	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Reference of downstream oxygen sensor ceramic temperature (Modelled for new sensor)					
VLS_DOWN_CUR_PUMP_OFF [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511	4.8828e-3	V
Downstream oxygen sensor voltage prior to switching on pump current switch					
VLS_DOWN_CUR_PUMP_ON [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511	4.8828e-3	V
Downstream oxygen sensor voltage C_T_CUR_PUMP_ON_LS_DOWN after switching on pump current switch					
VLS_DOWN_MMV_DRV1_THD_MAX [NC_CBK_EX_NR]	V	8000... 7FFFH	-2.5... 2.4999	76.3e-6	V/10ms
Upper variable VLS_DOWN gradient threshold					
VLS_DOWN_MMV_DRV1_THD_MIN [NC_CBK_EX_NR]	V	8000... 7FFFH	-2.5... 2.4999	76.3e-6	V/10ms
Lower variable VLS_DOWN gradient threshold					
VP_LS_DOWN_TMP	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Temporary VLS_DOWN measurement from ADC for conversion to range required in EGCP					

**Input data:**

CTR_AFL_CYC [NC_CBK_EX_NR] {p. 2439}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_ES {p. 1720}	LV_INH_R_IT_LS_DOWN [NC_CBK_EX_NR] {p. 1379}
LV_ST_END {p. 1720}	LV_VLS_DOWN_MMV_ACT [NC_CBK_EX_NR] {p. 2409}	LV_VLS_DOWN_MMV_LIM [NC_CBK_EX_NR] {p. 2409}	MAF_KGH {p. 1195}
NC_CBK_EX_NR {p. 1829}	STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}	T_AFL_CYC_HLD [NC_CBK_EX_NR] {p. 2439}	TEG_DYN_LS_DOWN [NC_CBK_EX_NR] {p. 1007}
V_EFC_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_DOWN_BOL [NC_CBK_EX_NR] {p. 2409}	VLS_DOWN_DRV1_ABS_MAX [NC_CBK_EX_NR] {p. 2409}
VLS_DOWN_DRV1_MMV [NC_CBK_EX_NR] {p. 2409}	VLS_DOWN_DRV1_MMV_MIN [NC_CBK_EX_NR] {p. 2409}	VLS_DOWN_MMV_MAX [NC_CBK_EX_NR] {p. 2409}	VLS_DOWN_MMV_MIN [NC_CBK_EX_NR] {p. 2409}
VLS_DOWN_TOL [NC_CBK_EX_NR] {p. 2409}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_POW_MMV_LSH_DOWN	-	0... FFH	0... 0.99609	3.91e-3	-
Correlation (filter) constant for moving mean value of downstream heater power					
C_CRLC_TTIP_FALL_R_IT_LS_DOWN	-	0... FFH	0... 0.99609	3.91e-3	1/s
Correlation (filter) constant for falling ceramic temperature, limit calculation					
C_CRLC_TTIP_RISE_R_IT_LS_DOWN	-	0... FFH	0... 0.99609	3.91e-3	1/s
Correlation (filter) constant for rising ceramic temperature, limit calculation					
C_CTR_AFL_CYC_MIN_RI_IT_LS_DOWN	-	0... FFFFH	0... 65535	1	-
Min. no. AF cycles post lambda controller activation to permit use of T_VLS_CYC_AFL_HLD dependency					
C_FAC_R_IT_ERR_NEG_LS_DOWN	-	0... FFH	0... 0.99609	3.91e-3	-
Internal resistance measurement negative error (i.e. 100% to 0%)					
C_FAC_R_IT_ERR_POS_LS_DOWN	-	0... FFH	0... 0.99609	3.91e-3	-
Internal resistance measurement positive error (i.e. 0% to 100%)					
C_FAC_VLS_DOWN_MMV_DRV1_THD	-	0... FFH	0... 1.99218	0.0078125	-
Multiplicative factor used to weight gradient thresholds dependent on VLS_DOWN_MMV_xxx[NC_CBK_EX_NR] amplitude					
C_FAC_VLS_DOWN_MMV_DRV1_THD_MIN	-	0... FFH	0... 0.99609	3.91e-3	-
Hysteresis factor of DRV1_VLS_DOWN_MMV_MIN governing limiting of DRV1_VLS_DOWN_MMV_MIN_THD					
C_MAF_KGH_MAX_R_IT_LS_DOWN	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Maximum MAF_KGH threshold for activation of internal resistance determination					
C_T_CUR_PUMP_OFF_LS_DOWN	-	0... FFFFH	0... 655.35	0.01	s
Minimum delay between consecutive pump current activation					
C_T_CUR_PUMP_ON_LS_DOWN	-	0... 8H	0... 0.008	0.001	s
Duration for pump current active					
C_T_DLY_CUR_PUMP_LS_DOWN	-	0... FFH	0... 0.255	0.001	s
Duration in which VLS_DOWN[NC_CBK_EX_NR] signal masked directly after Ri determination					
C_TEG_MIN_CUR_PUMP_ON_LS_DOWN	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Temperature threshold for the activation of sensor pumping					
C_VLS_DOWN_MMV_DRV1_ABS_MAX	-	0... FFFFH	0... 4.99992	76.3e-6	V/10ms
Threshold for absolute maximum 1st derivative of VLS_DOWN[NC_CBK_EX_NR] signal for Ri determination					
C_VLS_DOWN_MMV_DRV1_THD_MAX	-	8000... 7FFFH	-2.5... 2.4999	76.3e-6	V/10ms
Maximum threshold for mean 1st derivative of VLS_DOWN[NC_CBK_EX_NR] signal for Ri determination					
C_VLS_DOWN_MMV_DRV1_THD_MIN	-	8000... 7FFFH	-2.5... 2.4999	76.3e-6	V/10ms
Minimum threshold for mean 1st derivative of VLS_DOWN[NC_CBK_EX_NR] signal for Ri determination					
C_VLS_DOWN_MMV_MIN_RNG_BOL_R_IT	-	0... FFFFH	0... 4.99992	76.3e-6	V
Permitted range of VLS_DOWN[NC_CBK_EX_NR] below VLS_DOWN_MMV_MIN[NC_CBK_EX_NR] at low gradient for Ri determination					
C_VLS_DOWN_MMV_MIN_RNG_TOL_R_IT	-	0... FFFFH	0... 4.99992	76.3e-6	V
Permitted range of VLS_DOWN[NC_CBK_EX_NR] above VLS_DOWN_MMV_MIN[NC_CBK_EX_NR] at low gradient for Ri determination					
C_VLS_HYS_R_IT_LS_DOWN	-	0... 3FFFH	0... 4.99511	4.88e-3	V
Voltage hysteresis for evaluation if VLS_DOWN[i] shall be masked after Ri determination					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_CRCLC_TTIP_REF_MDL_LS_DOWN	-	0... FFH	0... 0.99609	3.91e-3	-
LDPM_MAF_KGH_1_EGCP	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
Correlation map for calculation of reference downstream tip temperature (modelled for new sensor)					
IP_FAC_T_DRV1_VLS_DOWN_MMV	-	0... FFH	0... 63.75	0.25	-
LDPM_T_AFL_CYC_HLD_1_EGCP	8	0... FFH	0... 2.55	0.01	s
Multiplicative factor modifies DRV1_VLS_DOWN_MMV_MIN_THD dependent on T_VLS_CYC_AFL_HLD					
IP_FAC_T_VLS_DOWN_MMV_DRV1_ABS	-	0... FFH	0... 15.9375	0.0625	-
LDPM_T_AFL_CYC_HLD_1_EGCP	8	0... FFH	0... 2.55	0.01	s
Multiplicative factor modifies C_VLS_DOWN_MMV_DRV1_ABS_MAX dependent on T_VLS_CYC_AFL_HLD					
IP_R_IT_MDL_LS_DOWN_NEW	V	0... FFFFH	0... 65535	1	ohm
LDP_POW_MMV_LSH_DOWN_IP_LS_DOWN	8	0... FFFFH	0... 84.49871	1.2894e-3	W
LDP_TTIP_REF_MDL_MMV_LS_DOWN_R	8	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Internal resistance of a new downstream oxygen sensor (modelled)					
IP_TTIP_MES_LS_DOWN	-	0... 7FFFH	0... 2047.9375	0.0625	°C
LDP_R_IT_MES_LS_DOWN_IP_LS_DOWN	8	0... FFFFH	0... 65535	1	ohm
Oxygen sensor temperature vs. internal resistance characteristic					
LC_R_IT_LS_DOWN_PUC_ACT	-	0... 1H	0 ...1	1	-
Switch to activate Ri-measurement regardless activation conditions. For test purpose only !					
LC_R_IT_VLD_INH_LS_DOWN	-	0... 1H	0 ...1	1	-
Boolean flag inhibiting internal resistance determination validity function					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_FAC_R_REF_LS_DOWN	-	0... FFFFH	0... 3.99993	61e-6	-
Pump current limiting to pull down resistance ratio (RPump/R2)					
NC_R_REF_LS_DOWN	-	0... FFFFH	0... 65535	1	ohm
Reference resistance for pump current (RPump)					
NC_VLS_DOWN_CUR_PUMP_REF	-	0... 3FFH	0... 4.99511	4.88e-3	V
Reference voltage value (4.82 V)					

**Import actions:**

<b>ACTION_INFR_GetVAdcLsDown</b> (IN<i>,OUT<v_adc>)
<b>ACTION_INFR_SetCmdLsDown</b> (IN<i>,IN<lv_swi_ls_down>)


**FUNCTION DESCRIPTION:****General information:**

The function shall provide the output variable R\_IT\_LS\_DOWN[i], the internal resistance of the oxygen sensor. The resistance is dependent on the operating temperature of the sensor and may be used for oxygen sensor diagnosis.

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

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$i = 2$ , for exhaust cylinder bank 2  
 otherwise (NC\_CBK\_EX\_NR = 1)  
 $i = 1$ , for single exhaust cylinder bank.

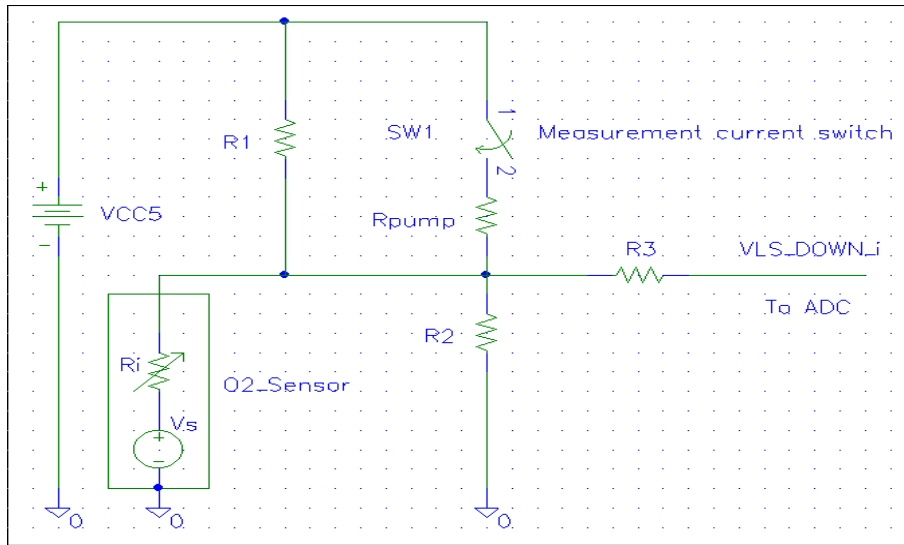


Figure 4.40.1: Simplified measurement circuit schematic, Internal resistance determination

**Signal flow diagram:**



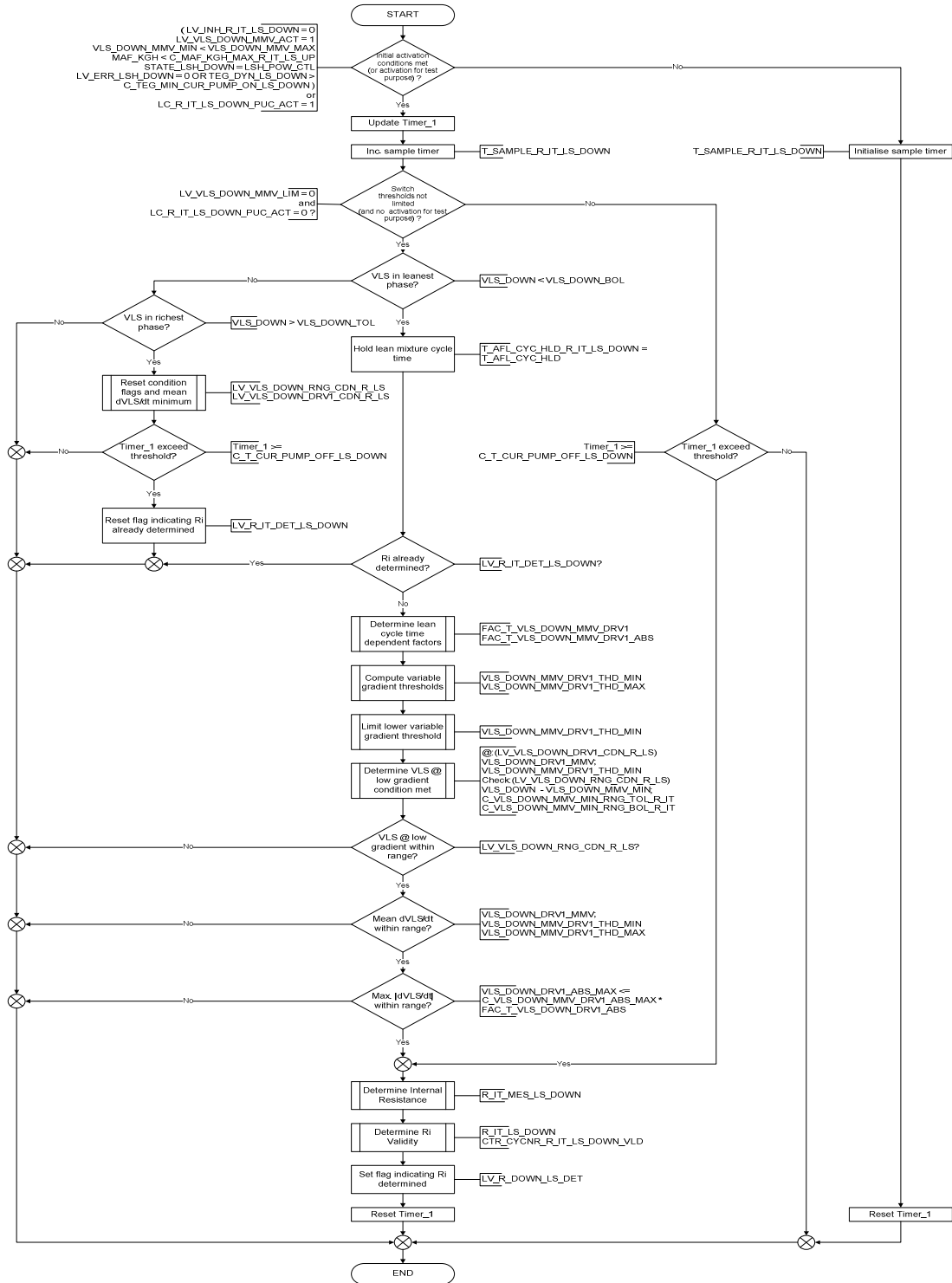



Figure 4.40.2: Function flow chart, Internal resistance determination

**Description:**

The internal resistance of the oxygen sensor shall be determined by use of the oxygen sensor interface circuit *Figure 1* (Capacitors not shown). The internal resistance provides information as to the tip

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temperature of the sensor and may be used for diagnosis purposes and operative readiness determination.

Under normal conditions, the switch SW1 shall be open and the oxygen sensor signal voltage (VLS\_DOWN[i]) is measured by the microcontroller.

The potential divider (resistors  $R_1$  &  $R_2$ ) shall be permit the operation readiness of the oxygen sensor to be determined and enable electrical fault conditions to be detected.

Periodically, for a limited amount of time, the switch SW1 shall be closed and a voltage of approx. 4.8 V connected through resistor  $R_{pump}$  to the oxygen sensor signal connection. This shall cause current to flow into the sensor and through the internal resistance  $R_i$ , thereby pumping the sensor. The resultant voltage acquired at the microcontroller input shall permit the internal resistance of the sensor to be calculated by use of a formula shown in the formula section below.

Prior to permitting the determination of the internal resistance, a number of conditions shall be determined to be met:

The initial activation conditions shall require that: No function inhibit is requested (LV\_INH\_R\_IT\_LS\_DOWN[i] = 0); Delay since deactivation since last overrun fuel cut-off passed (LV\_VLS\_DOWN\_MMV\_ACT[i]); The initial post initialisation transients have passed for the VLS\_DOWN\_MMV\_XXX[i] inputs (VLS\_DOWN\_MMV\_MIN[i] < VLS\_DOWN\_MMV\_MAX[i]); The engine load threshold has not been exceeded (MAF\_KGH < C\_MAF\_KGH\_MAX\_R\_IT\_LS\_DOWN); The oxygen sensor heater state LSH\_POW\_CTL has been reached; No heater OBDI error has been detected in the relevant heater driver (LV\_ERR\_LSH\_DOWN[i]) or should a heater driver fault have been detected, the modelled exhaust gas temperature at downstream sensor position TEG\_DYN\_LS\_DOWN[i] shall exceed the threshold C\_TEG\_MIN\_CUR\_PUMP\_ON\_LS\_DOWN.

With the switch LC\_R\_IT\_LS\_DOWN\_PUC\_ACT the initial activation conditions can be ignored, and Ri-determination is activated. Bypass of initial activation conditions is allowed for test purpose only. For serial calibration LC\_R\_IT\_LS\_DOWN\_PUC\_ACT has to be set to 0 !


Once the above conditions have been met, an internal timer (TIMER\_1) shall be started and timer T\_SAMPLE\_R\_IT\_LS\_DOWN[i] shall be updated. The latter timer shall be initialised with its maximum value of 655.35 s. This ensures that the temperature limits for the validity function are correctly initialised. The further procedure shall depend on the status of the oxygen sensor signal, as determined by LV\_VLS\_DOWN\_MMV\_LIM (Again, with LC\_R\_IT\_LS\_DOWN\_PUC\_ACT this condition can be forced to be fulfilled). Should the VLS\_DOWN\_MMV\_XXX[i] signals be limited, i.e. no or little oxygen sensor amplitude is present, the function shall determine the internal resistance every (C\_T\_CUR\_PUMP\_OFF\_LS\_DOWN + C\_T\_CUR\_PUMP\_ON\_LS\_DOWN + C\_T\_DLY\_CUR\_PUMP\_LS\_DOWN). Otherwise the oxygen sensor signal shall be determined to have significant amplitude and the internal resistance determination shall only be carried out in lean phases where the oxygen sensor signal is relatively flat and stable. This is achieved by the following conditions:

If the oxygen sensor signal is lean (VLS\_DOWN[i] < VLS\_DOWN\_BOL[i]) and neither the resistance determination has been carried out yet in this lean phase nor the determination be locked out due to the minimum off time (LV\_R\_IT\_DET\_LS\_DOWN[i] = 0) then the function shall determine the lean cycle time dependent factors FAC\_T\_VLS\_DOWN\_MMV\_DRV1[i] & FAC\_T\_VLS\_DOWN\_MMV\_DRV1\_ABS[i] from the appropriate maps IP\_FAC\_T\_DRV1\_VLS\_DOWN\_MMV & IP\_FAC\_T\_VLS\_DOWN\_MMV\_DRV1\_ABS respectively. These factors shall be dependent on the held lean cycle time from the previous lean cycle (T\_AFL\_CYC\_HLD\_R\_IT\_LS\_DOWN[i]). Should the cycle time decrease then it is intended that the factors shall increase and vice versa.

The thresholds for the gradient condition shall then be computed. These thresholds (VLS\_DOWN\_MMV\_DRV1\_THD\_MAX[i] & VLS\_DOWN\_MMV\_DRV1\_THD\_MIN[i]) are directly proportional to the amplitude of the difference between VLS\_DOWN\_MMV\_XXX[i] signals. Furthermore, VLS\_DOWN\_MMV\_DRV1\_THD\_MIN[i] shall be modified by factor FAC\_T\_VLS\_DOWN\_MMV\_DRV1[i]. The factor FAC\_T\_VLS\_DOWN\_MMV\_DRV1[i] shall be set to 1 unless C\_CTR\_AFL\_CYC\_MIN\_RI\_IT\_LS\_DOWN AF cycles have passed since the last lambda controller activation, as counted by CTR\_AFL\_CYC[i]. This ensures that T\_AFL\_CYC\_HLD\_R\_IT\_LS\_DOWN[i] is valid.

The variable threshold VLS\_DOWN\_MMV\_DRV1\_THD\_MIN[i] shall be limited so that its value is not less than that of VLS\_DOWN\_DRV1\_MMV\_MIN[i] \* C\_FAC\_VLS\_DOWN\_MMV\_DRV1\_THD\_MIN.

The function shall then wait for the oxygen sensor signal gradient to exceed the minimum threshold (VLS\_DOWN\_DRV1\_MMV[i] VLS\_DOWN\_MMV\_DRV1\_THD\_MIN[i]) and then determine whether the absolute oxygen sensor signal voltage is within a particular range of the VLS\_DOWN\_MMV\_MIN[i] sig-

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nal ( $VLS\_DOWN\_MMV\_MIN[i] - C\_VLS\_DOWN\_MMV\_MIN\_RNG\_BOL\_R\_IT$   $VLS\_DOWN[i]$   $VLS\_DOWN\_MMV\_MIN[i] + C\_VLS\_DOWN\_MMV\_MIN\_RNG\_TOL\_R\_IT$ ). If this is the case, the  $VLS\_DOWN[i]$  shall be considered to be consistent with previous lean phase amplitudes and resistance determination may be carried out. This condition shall only be carried out once per lean phase. i.e. at transition from rich to lean. The fulfilment of the gradient condition is indicated by  $LV\_VLS\_DOWN\_DRV1\_CDN\_R\_LS[i]$  and the fulfilment of the range condition by  $LV\_VLS\_DOWN\_RNG\_CDN\_R\_LS[i]$ .

If the range condition has been met, the gradient is in a particular range ( $VLS\_DOWN\_MMV\_DRV1\_THD\_MIN[i]$   $VLS\_DOWN\_DRV1\_MMV[i]$   $VLS\_DOWN\_MMV\_DRV1\_THD\_MAX[i]$ ) and the oxygen sensor signal is determined to be stable in the short term ( $VLS\_DOWN\_DRV1\_ABS\_MAX[i]$   $C\_VLS\_DOWN\_MMV\_DRV1\_ABS\_MAX * FAC\_T\_VLS\_DOWN\_MMV\_DRV1\_ABS[i]$ ) then resistance determination is requested ( $LV\_R\_IT\_REQ\_LS\_DOWN[i] = 1$ ). The factor  $FAC\_T\_VLS\_DOWN\_MMV\_DRV1\_ABS[i]$  shall be set to 1 unless  $C\_CTR\_AFL\_CYC\_MIN\_RI\_IT\_LS\_DOWN$  AF cycles have passed since the last lambda controller activation, as counted by  $CTR\_AFL\_CYC[i]$ . This ensures that  $T\_AFL\_CYC\_HLD\_R\_IT\_LS\_DOWN[i]$  is valid.

Once internal resistance determination has been requested, the Basic SW shall take a single  $VLS\_DOWN[i]$  sample and store as  $VLS\_DOWN\_CUR\_PUMP\_OFF[i]$ . SW1 shall be switched ON, at time  $C\_T\_CUR\_PUMP\_ON\_LS\_DOWN[i]$  and the  $VLS\_DOWN[i]$  shall be masked. A second oxygen sensor signal voltage sample shall be taken and stored as  $VLS\_DOWN\_CUR\_PUMP\_ON[i]$ . SW1 shall then be switched OFF and masking shall continue for a time  $C\_T\_DLY\_CUR\_PUMP\_LS\_DOWN$ , after which the  $VLS\_DOWN[i]$  shall return to normal following of the oxygen sensor signal voltage. Masking shall be discontinued if the oxygen sensor signal voltage exceeds  $VLS\_DOWN\_CUR\_PUMP\_ON[i] + C\_VLS\_HYS\_R\_IT\_LS\_DOWN$  during the time  $C\_T\_DLY\_CUR\_PUMP\_LS\_DOWN$  after switching off SW1. Adding the voltage hysteresis shall prevent the function to discard lambda sensor voltage masking if the first  $VLS\_DOWN[i]$  value after switching off the pump current is larger than the last  $VLS\_DOWN[i]$  value while pumping due to signal noise.

The internal resistance  $R\_IT\_MES\_LS\_DOWN[i]$  shall be determined using the formula stated with the main variables being oxygen sensor voltage prior to pumping,  $VLS\_DOWN\_CUR\_PUMP\_OFF[i]$ , and signal voltage during pumping,  $VLS\_DOWN\_CUR\_PUMP\_ON[i]$ .


The internal resistance shall be calculated every time the oxygen sensor is pumped. For each new resistance value detected, a counter  $CTR\_CYCNR\_R\_IT\_LS\_DOWN\_VLD[i]$  shall be incremented to indicate to other functions that a new resistance value is available.

**NOTE: During the time where SW1 is switched on, ( $LV\_R\_IT\_REQ\_LS\_DOWN[i]=1$ ) the output voltage of the oxygen sensor ( $VLS\_DOWN[i]$ ) does not represent the true A/F ratio and is therefore invalid and shall not be used as such. The basic software shall mask the response of the sensor to pumping by keeping the voltage constant during this time by using the last  $VLS\_DOWN[i]$  sample prior to activating SW1.**

The internal resistance shall be calculated every time the oxygen sensor is pumped. For each new resistance value detected, the validity of the resistance shall be checked:

Should the validity function not be inhibited ( $LC\_R\_IT\_VLD\_INH\_LS\_DOWN = 0$ ), then the tip temperature of the ceramic shall be determined from a map.  $TTIP\_MES\_LS\_DOWN[i]$  represents the nominal temperature,  $TTIP\_MES\_TOL\_LS\_DOWN[i]$  represents the maximum temperature ( $R\_IT\_MES\_LS\_DOWN[i] * (1 - C\_FAC\_R\_IT\_ERR\_NEG\_LS\_DOWN)$ ), i.e. temperature for resistance with negative measurement error and  $TTIP\_MES\_BOL\_LS\_DOWN[i]$  represents the minimum temperature ( $R\_IT\_MES\_LS\_DOWN[i] * (1 + C\_FAC\_R\_IT\_ERR\_NEG\_LS\_DOWN)$ ), i.e. temperature for resistance with positive measurement error. A low pass filter shall then be applied to the upper and lower temperature limits to represent the maximum possible temperature gradient between resistance samples. Dependent on the direction of change of resistance between two measurements, either constant  $C\_CRLC\_TTIP\_RISE\_R\_IT\_LS\_DOWN$  (rising temp.) or  $C\_CRLC\_TTIP\_FALL\_R\_IT\_LS\_DOWN$  (falling temp.) shall be applicable. The final filter constant used, limited to a maximum of 1, shall be the aforementioned constant multiplied by the time between resistance samples ( $T\_SAMPLE\_R\_IT\_LS\_DOWN[i]$ ). This shall be to compensate for the irregular sample time.

Should then the ceramic tip temperature fall within the temperature limit bounds, the measured resistance shall be considered to be valid, shall be passed to the output variable  $R\_IT\_LS\_DOWN[i]$ , the counter  $CTR\_CYCNR\_R\_IT\_LS\_DOWN\_VLD[i]$  shall be incremented to indicate to other functions that a new resistance value is available and the  $T\_SAMPLE\_R\_IT\_LS\_DOWN[i]$  shall be reset. If the above

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temperature condition is not met, R\_IT\_LS\_DOWN[i] shall be maintained at its last value and the filtered temperature limits shall be reset to their previous values, i.e. the resistance value shall be ignored.

Should the validity function be inhibited then for each new resistance the R\_IT\_MES\_LS\_DOWN[i] shall be passed to R\_IT\_LS\_DOWN[i] and the counter CTR\_CYCNR\_R\_IT\_LS\_DOWN\_VLD[i] shall be incremented.

In the case of significant oxygen sensor amplitude (LV\_VLS\_DOWN\_MMV\_LIM = 0) and the sensor signal be in the rich phase (VLS\_DOWN[i] > VLS\_DOWN\_TOL[i]), the flags LV\_VLS\_DOWN\_RNG\_CDN\_R\_LS[i] & LV\_VLS\_DOWN\_DRV1\_CDN\_R\_LS[i] shall be reset. Furthermore, if these conditions have been met and the timer *TIMER\_1* exceeds C\_T\_CUR\_PUMP\_OFF\_LS\_DOWN then LV\_R\_IT\_DET\_LS\_DOWN[i] shall be reset, thereby permitting the internal resistance to be determined in the next cycle should the appropriate conditions be met.

For reference reasons of OBD II diagnosis the value R\_IT\_MDL\_LS\_DOWN\_NEW[i] is calculated out of heating power, exhaust gas temperature and MAF\_KGH.

### Application conditions

**Recurrence:**  $T\_SAMPLE\_1 = 10 \text{ ms}$

The function shall be carried out once every 10 ms. The internal resistance value shall only be calculated after pumping the oxygen sensor. See recurrence there. Reference internal resistance shall be calculated with recurrence 1 s.

*Initialisation:*

at reset:


```
ACTION_INFR_SetCmdLsDown(
    IN      i
    IN      0)
```

The following initialisation shall be carried out after a RESET and upon leaving the engine state Engine Stop (LV\_ES).

```
R_IT_LS_DOWN[i] = 65535
R_IT_MES_LS_DOWN[i] = 65535
R_IT_MDL_LS_DOWN_NEW[i] = 65535
POW_MMV_LSH_DOWN[i] = 0
VLS_DOWN_CUR_PUMP_ON[i] = 0
VLS_DOWN_CUR_PUMP_OFF[i] = 0
CTR_CYCNR_R_IT_LS_DOWN_VLD[i] = 0
LV_VLS_DOWN_DRV1_CDN_R_LS[i] = 0
LV_VLS_DOWN_RNG_CDN_R_LS[i] = 0
LV_R_IT_REQ_LS_DOWN[i] = 0
LV_R_IT_DET_LS_DOWN[i] = 0
VLS_DOWN_MMV_DRV1_THD_MIN[i] = 0
VLS_DOWN_MMV_DRV1_THD_MAX[i] = 0
T_AFL_CYC_HLD_R_IT_LS_DOWN[i] = 0
FAC_T_VLS_DOWN_MMV_DRV1[i] = 0
FAC_T_VLS_DOWN_MMV_DRV1_ABS[i] = 0
TTIP_REF_MDL_MMV_LS_DOWN[i] = 0
TTIP_MES_LS_DOWN[i] = 0
TTIP_MES_TOL_LS_DOWN[i] = 0
TTIP_MES_BOL_LS_DOWN[i] = 0
TTIP_MES_TOL_MMV_LS_DOWN[i] = 0
TTIP_MES_BOL_MMV_LS_DOWN[i] = 0
T_SAMPLE_R_IT_LS_DOWN[i] = 655.35
```

**NOTE: All N-1 variables shall also be initialised to the associated value specified above.**

*Activation /Deactivation:*

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```

if      LV_ST_END = 1
then    Function activated
else    Function deactivated
endif

```

### Formula section:


```

if      [ LV_INH_R_IT_LS_DOWN[i] = 0
and      LV_VLS_DOWN_MMV_ACT[i] = 1
and      VLS_DOWN_MMV_MIN[i] < VLS_DOWN_MMV_MAX[i]
and      MAF_KGH < C_MAF_KGH_MAX_R_IT_LS_DOWN
and      STATE_LSH_DOWN[i] = "LSH_POW_CTL"
and      (LV_ERR_LSH_DOWN[i] = 0
or      TEG_DYN_LS_DOWN[i] > C_TEG_MIN_CUR_PUMP_ON_LS_DOWN ) ]
or      LC_R_IT_LS_DOWN_PUC_ACT = 1
then    Update TIMER_1
          Increment T_SAMPLE_R_IT_LS_DOWN[i]
if      LV_R_IT_REQ_LS_DOWN[i] = 0
then    if      LV_VLS_DOWN_MMV_LIM[i] = 0
          and      LC_R_IT_LS_DOWN_PUC_ACT = 0
          then    if      VLS_DOWN[i] < VLS_DOWN_BOL[i]
          then    T_AFL_CYC_HLD_R_IT_LS_DOWN[i] =
          T_AFL_CYC_HLD[i]
          if      LV_R_IT_DET_LS_DOWN[i] = 0
          then    "Determine lean cycle time dependent factors"
          "Compute variable gradient thresholds"
          "Limit lower variable gradient threshold"
          "Determine VLS_DOWN at low gradient condition met"
          if      LV_VLS_DOWN_RNG_CDN_R_LS[i] = 1
          and      VLS_DOWN_DRV1_MMV[i]
          VLS_DOWN_MMV_DRV1_THD_MIN[i]
          and      VLS_DOWN_DRV1_MMV[i]
          VLS_DOWN_MMV_DRV1_THD_MAX[i]
          and      VLS_DOWN_DRV1_ABS_MAX[i]
          C_VLS_DOWN_MMV_DRV1_ABS_MAX *
          FAC_T_VLS_DOWN_MMV_DRV1_ABS[i])
          then    LV_R_IT_REQ_LS_DOWN[i] = 1
          VLS_DOWN_CUR_PUMP_OFF[i] = VLS_DOWN[i]

          Switch SW1 ON
          "Determine internal resistance" started
          ACTION_INFR_SetCmdLsDown(
              IN      i
              IN      1)

          endif
        endif
      else    if      VLS_DOWN[i] > VLS_DOWN_TOL[i]
      then    LV_VLS_DOWN_RNG_CDN_R_LS[i] = 0
      LV_VLS_DOWN_DRV1_CDN_R_LS[i] = 0
      if      TIMER_1
      C_T_CUR_PUMP_OFF_LS_DOWN

```

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```

                                then      LV_R_IT_DET_LS_DOWN[i] = 0
                                endif
                            endif
                    endif
                    else      If      (TIMER_1 C_T_CUR_PUMP_OFF_LS_DOWN)
                                then      LV_R_IT_REQ_LS_DOWN[i] = 1
                                VLS_DOWN_CUR_PUMP_OFF[i] = VLS_DOWN[i]
                                Switch SW1 ON
                                "Determine internal resistance" started
                                ACTION_INFR_SetCmdLsDown(
                                    IN      i
                                    IN      1)
                                endif
                            endif
                    endif
                If      LV_R_IT_REQ_LS_DOWN[i] = 1 -> 0
                then      "Calculation of Internal resistance"
                    LV_R_IT_DET_LS_DOWN[i] = 1
                    Reset TIMER_1
                endif
            else      Reset TIMER_1
                    T_SAMPLE_R_IT_LS_DOWN[i] = 655.35 (i.e. FFFFH)
                    LV_R_IT_DET_LS_DOWN[i] = 0
                    LV_VLS_DOWN_DRV1_CDN_R_LS[i] = 0
                    LV_VLS_DOWN_RNG_CDN_R_LS[i] = 0
            endif
        "Calculation of internal resistance reference"
    
```

**NOTES:**

1. **TIMER\_1** refers to a SW internal timer and not a visible output data variable.
2. **T\_SAMPLE\_R\_LS\_DOWN[i]** shall not be permitted to overflow. When the specified maximum value has been reached, this shall be held until the timer is reset by the function.

*Calculation of internal resistance reference:*

% This calculation is carried out with the recurrence: T\_SAMPLE\_2 = 1 s.

$$POW\_MMV\_LSH\_DOWN[i]_n = POW\_MMV\_LSH\_DOWN[i]_{n-1} * (1 - C\_CRLC\_POW\_MMV\_LSH\_DOWN) + C\_CRLC\_POW\_MMV\_LSH\_DOWN * V\_EFC\_LSH\_DOWN[i]^2 * T\_SAMPLE\_2 * [W/(s*V^2)]$$


$$TTIP\_REF\_MDL\_MMV\_LS\_DOWN[i]_n = TTIP\_REF\_MDL\_MMV\_LS\_DOWN[i]_{n-1} * (1 - IP\_CRLC\_TTIP\_REF\_MDL\_LS\_DOWN) + IP\_CRLC\_TTIP\_REF\_MDL\_LS\_DOWN * TEG\_DYN\_LS\_DOWN[i]$$

% IP (MAF\_KGH)

$$R\_IT\_MDL\_LS\_DOWN\_NEW[i] = IP\_R\_IT\_MDL\_LS\_DOWN\_NEW * IP (POW\_MMV\_LSH\_DOWN[i]; TTIP\_REF\_MDL\_MMV\_LS\_DOWN[i])$$
*Determine lean cycle time dependent factors:*

```

If      (CTR_AFL_CYC[i] C_CTR_AFL_CYC_MIN_RI_IT_LS_DOWN)
then    FAC_T_VLS_DOWN_MMV_DRV1[i] =
        IP_FAC_T_DRV1_VLS_DOWN_MMV (T_AFL_CYC_HLD_R_IT_LS_DOWN[i])
        FAC_T_VLS_DOWN_MMV_DRV1_ABS[i] =
        IP_FAC_T_VLS_DOWN_MMV_DRV1_ABS (T_AFL_CYC_HLD_R_IT_LS_DOWN[i])
else    FAC_T_VLS_DOWN_MMV_DRV1[i] = 1
        FAC_T_VLS_DOWN_MMV_DRV1_ABS[i] = 1
    
```

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**endif.**

*Compute variable gradient thresholds:*

```
VLS_DOWN_MMV_DRV1_THD_MAX[i] = C_VLS_DOWN_MMV_DRV1_
THD_MAX *
```

```
    C_FAC_VLS_DOWN_MMV_DRV1_THD *
    (VLS_DOWN_MMV_MAX[i] -
    VLS_DOWN_MMV_MIN[i])
```

```
VLS_DOWN_MMV_DRV1_THD_MIN[i] = C_VLS_DOWN_MMV_DRV1_
THD_MIN *
```

```
    C_FAC_VLS_DOWN_MMV_DRV1_THD *
    (VLS_DOWN_MMV_MAX[i] -
    VLS_DOWN_MMV_MIN[i]) *
    FAC_T_VLS_DOWN_MMV_DRV1[i]
```

*Limit lower variable gradient threshold:*

```
VLS_DOWN_MMV_DRV1_THD_MIN[i] = MAX( VLS_DOWN_MMV_DRV1_
THD_MIN[i],
```

```
    VLS_DOWN_DRV1_MMV_MIN[i] *
    C_FAC_VLS_DOWN_MMV_DRV1_THD_MIN)
```

*Determine VLS\_DOWN at low gradient condition met:*

```
if (LV_VLS_DOWN_DRV1_CDN_R_LS[i] = 0) &
    (VLS_DOWN_DRV1_MMV[i] VLS_DOWN_MMV_DRV1_THD_MIN[i])
```

```
then LV_VLS_DOWN_DRV1_CDN_R_LS[i] = 1
```

```
    if (VLS_DOWN[i]
        (VLS_DOWN_MMV_MIN[i] + C_VLS_DOWN_MMV_MIN_RNG_TOL_R_IT) ) &
        (VLS_DOWN[i]
        (VLS_DOWN_MMV_MIN[i] - C_VLS_DOWN_MMV_MIN_RNG_BOL_R_IT) )
```

```
    then LV_VLS_DOWN_RNG_CDN_R_LS[i] = 1
```

```
    else LV_VLS_DOWN_RNG_CDN_R_LS[i] = 0
```

```
    endif
```

**endif.**


**NOTE: VLS\_DOWN\_MMV\_MIN[i] + C\_VLS\_DOWN\_MMV\_MIN\_RNG\_TOL\_R\_IT shall not cause an overflow and VLS\_DOWN\_MMV\_MIN[i] - C\_VLS\_DOWN\_MMV\_MIN\_RNG\_BOL\_R\_IT shall not cause an underflow.**

*Determine internal resistance:*

Recurrence: T\_SAMPLE\_3 = 1 ms

```
if LV_R_IT_REQ_LS_DOWN[i] = 1
```

```
then
```

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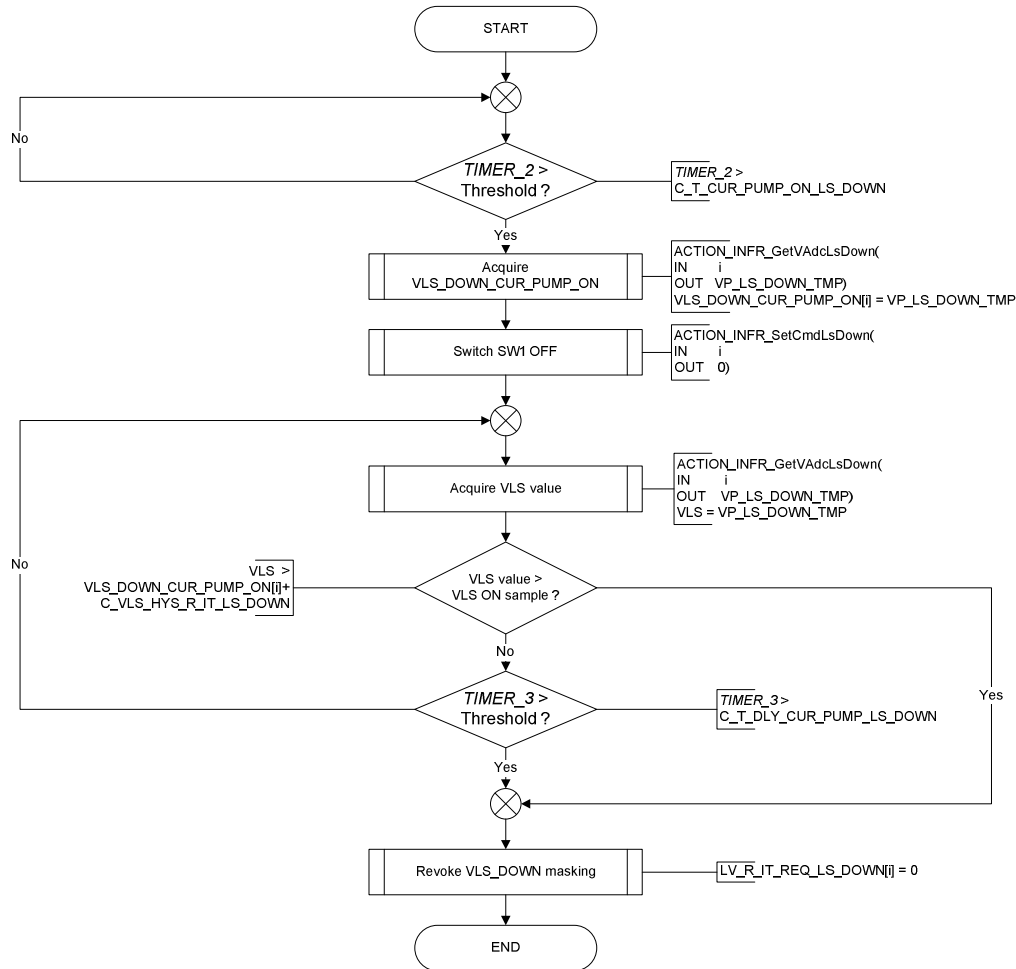


Figure 4.40.3: Function flow chart, Internal resistance determination

**endif***Calculation of Internal resistance:*

The internal resistance shall be determined as follows:

$$R_{IT\_MES\_LS\_DOWN}[i] = NC\_R\_REF\_LS\_DOWN * (VLS\_DOWN\_CUR\_PUMP\_ON[i] - VLS\_DOWN\_CUR\_PUMP\_OFF[i]) / \{NC\_VLS\_DOWN\_CUR\_PUMP\_REF - (VLS\_DOWN\_CUR\_PUMP\_ON[i] - VLS\_DOWN\_CUR\_PUMP\_OFF[i]) * NC\_FAC\_R\_REF\_LS\_DOWN - VLS\_DOWN\_CUR\_PUMP\_ON[i]\}$$

*Determine internal resistance validity:*

The following function shall be carried once out for every new resistance value determined.





Figure 4.40.4: Function flow chart, Internal resistance validity determination

If (LC\_R\_IT\_VLD\_INH\_LS\_DOWN = 0)

then

TTIP\_MES\_LS\_DOWN[i] = IP\_TTIP\_MES\_LS\_DOWN (R\_IT\_MES\_LS\_DOWN[i])  
 TTIP\_MES\_TOL\_LS\_DOWN[i] = IP\_TTIP\_MES\_LS\_DOWN (R\_IT\_MES\_LS\_DOWN[i] \*  
 (1 - C\_FAC\_R\_IT\_ERR\_NEG\_LS\_DOWN))  
 TTIP\_MES\_BOL\_LS\_DOWN[i] = IP\_TTIP\_MES\_LS\_DOWN (R\_IT\_MES\_LS\_DOWN[i] \*  
 (1 + C\_FAC\_R\_IT\_ERR\_POS\_LS\_DOWN))

If (R\_IT\_MES\_LS\_DOWN[i]<sub>N</sub> > R\_IT\_MES\_LS\_DOWN[i]<sub>N-1</sub>)

then

TTIP\_MES\_TOL\_MMV\_LS\_DOWN[i]<sub>N</sub> = TTIP\_MES\_TOL\_MMV\_LS\_DOWN[i]<sub>N-1</sub> +  
 (TTIP\_MES\_TOL\_LS\_DOWN[i] - TTIP\_MES\_TOL\_MMV\_LS\_DOWN[i]<sub>N-1</sub>) \*  
 MIN(1, C\_CRLC\_TTIP\_FALL\_R\_IT\_LS\_DOWN \* T\_SAMPLE\_R\_IT\_LS\_DOWN[i])  
 TTIP\_MES\_BOL\_MMV\_LS\_DOWN[i]<sub>N</sub> = TTIP\_MES\_BOL\_MMV\_LS\_DOWN[i]<sub>N-1</sub> +  
 (TTIP\_MES\_BOL\_LS\_DOWN[i] - TTIP\_MES\_BOL\_MMV\_LS\_DOWN[i]<sub>N-1</sub>) \*  
 MIN(1, C\_CRLC\_TTIP\_FALL\_R\_IT\_LS\_DOWN \* T\_SAMPLE\_R\_IT\_LS\_DOWN[i])

else

TTIP\_MES\_TOL\_MMV\_LS\_DOWN[i]<sub>N</sub> = TTIP\_MES\_TOL\_MMV\_LS\_DOWN[i]<sub>N-1</sub> +  
 (TTIP\_MES\_TOL\_LS\_DOWN[i] - TTIP\_MES\_TOL\_MMV\_LS\_DOWN[i]<sub>N-1</sub>) \*

```


MIN(1, C_CRLC_TTIP_RISE_R_IT_LS_DOWN * T_SAMPLE_R_IT_LS_DOWN[i])
TTIP_MES_BOL_MMV_LS_DOWN[i]N = TTIP_MES_BOL_MMV_LS_DOWN[i]N-1 +
(TTIP_MES_BOL_LS_DOWN[i] - TTIP_MES_BOL_MMV_LS_DOWN[i]N-1) *
MIN(1, C_CRLC_TTIP_RISE_R_IT_LS_DOWN * T_SAMPLE_R_IT_LS_DOWN[i])
endif
If ((TTIP_MES_LS_DOWN[i] TTIP_MES_TOL_MMV_LS_DOWN[i]) &
(TTIP_MES_LS_DOWN[i] TTIP_MES_BOL_MMV_LS_DOWN[i]))
then
R_IT_LS_DOWN[i] = R_IT_MES_LS_DOWN[i]N
Increment CTR_CYCNR_R_IT_LS_DOWN_VLD[i]
Reset T_SAMPLE_R_IT_LS_DOWN[i]
TTIP_MES_TOL_MMV_LS_DOWN[i]N-1 = TTIP_MES_TOL_MMV_LS_DOWN[i]N
TTIP_MES_BOL_MMV_LS_DOWN[i]N-1 = TTIP_MES_BOL_MMV_LS_DOWN[i]N
else
R_IT_LS_DOWN[i]N = R_IT_LS_DOWN[i]N-1
TTIP_MES_TOL_MMV_LS_DOWN[i]N = TTIP_MES_TOL_MMV_LS_DOWN[i]N-1
TTIP_MES_BOL_MMV_LS_DOWN[i]N = TTIP_MES_BOL_MMV_LS_DOWN[i]N-1
endif
R_IT_MES_LS_DOWN[i]N-1 = R_IT_MES_LS_DOWN[i]N
else
R_IT_LS_DOWN[i] = R_IT_MES_LS_DOWN[i]N
Increment CTR_CYCNR_R_IT_LS_DOWN_VLD[i]

```

**endif.**

**NOTES:**

1. **The difference (VLS\_DOWN\_CUR\_PUMP\_ON[i] - VLS\_DOWN\_CUR\_PUMP\_OFF[i]) shall be limited to 0 for negative values as the voltage during pumping should be greater than that without.**
2. **If the incrementation would cause the counter CTR\_CYCNR\_R\_IT\_LS\_DOWN\_VLD[i] to overflow then the counter shall be reset to 0.**
3. **The basic software (BSW) shall mask the VLS\_DOWN[i] signal during resistance determination by retaining the value of the last sample prior to activating the resistance determination. This shall be indicated by setting LV\_R\_IT\_REQ\_LS\_DOWN[i]. Upon revoking the masking the last oxygen sensor signal voltage VLS value determined by the BSW shall be used for the VLS\_DOWN[i] signal and LV\_R\_IT\_REQ\_LS\_DOWN[i] shall be reset.**
4. **Should C\_T\_CUR\_PUMP\_ON\_LS\_DOWN = 0, SW1 shall not be activated.**

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## 4.41 O2 sensor (bin, down) element temperature determination (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_R_IT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that downstream sensor internal resistance determination shall be inhibited when set					

### Input data:

LV_ES {p. 1720}	LV_VAR_LSH_DOWN {p. 656}	NC_CBK_EX_NR {p. 1829}	TCO {p. 1100}
-----------------	-----------------------------	------------------------	---------------

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_CUR_ON_LS_DOWN_MIN	-	0... FEH	-48... 142.5	0.75	°C
TCO threshold for detection of R_IT_LS_DOWN					

## FUNCTION DESCRIPTION:

### General information:

The calculation shall be done for all exhaust cylinder banks.

The Boolean flag(s) LV\_INH\_R\_IT\_LS\_DOWN[NC\_CBK\_EX\_NR] shall indicate whether the downstream oxygen sensor internal resistance determination shall be permitted to take place. When set, no resistance determination shall take place.

### Application conditions

**Initialisation:** The following initialisation shall be carried out upon leaving the engine

```
state Engine Stop (LV_ES).
LV_INH_R_IT_LS_DOWN[NC_CBK_EX_NR] = 0
```

**Recurrence:** 1s

**Activation:** at every engine operating state

**Deactivation:** -

### Formula section:


```
If      LV_VAR_LSH_DOWN = 1 and TCO > C_TCO_CUR_ON_LS_DOWN_MIN
then    LV_INH_R_IT_LS_DOWN[NC_CBK_EX_NR] = 0
else    LV_INH_R_IT_LS_DOWN[NC_CBK_EX_NR] = 1
endif
```

## 4.42 NOx sensor interface

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_NS [NC_NOX_SENS_CONF]	O/V	0... FFH	0... 255	1	-
NOx sensor failure byte					
LAMB_NOX_SENS [NC_NOX_SENS_CONF]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda value, measured by NOx sensor					
LAMB_NOX_SENS_DIAG [NC_NOX_SENS_CONF]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda value for diagnosis functions, measured by NOx sensor					
LAMB_NS_DIAG_GRD_OSC [NC_NOX_SENS_CONF]	V	8000... 7FFFH	-32... 31.99902	976.599e-6	-
Gradient of NOx sensor lambda signal for detection of NOx signal oscillations					
LAMB_NS_DIAG_OLD_OSC [NC_NOX_SENS_CONF]	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Old value of NOx sensor lambda signal for detection of NOx signal oscillations					
LV_NOX_SENS_LAMB_AUTH [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the Lambda signal has be reached the valid state after start					
LV_NOX_SENS_LAMB_DIAG_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the Lambda signal is valid for use into the diagnosis functions					
LV_NOX_SENS_LAMB_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the Lambda signal is valid					
LV_NOX_SENS_NOX_AUTH [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the NOx signal has be reached the valid state after the start					
LV_NOX_SENS_NOX_DIAG_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the NOx signal is valid for use into the diagnosis functions					
LV_NOX_SENS_NOX_MDL_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the NOx signal is valid for use. The state "valid" is debounced present.					
LV_NOX_SENS_NOX_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the NOx signal is valid					
LV_NOX_SENS_VLS_AUTH [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the binary O2 signal has be reached the state "valid" after start					
LV_NOX_SENS_VLS_DIAG_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the binary O2 signal is valid for use into the diagnosis functions					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_NOX_SENS_VLS_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the binary O2 signal is valid					
LV_NS_SHIFT_DIAG_ERR [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Sensor self diagnosis result from NOx sensor					
NOX_NOX_SENS [NC_NOX_SENS_CONF]	O/V	FF9C... 05DCH	-100 ...1500	1	ppm
NOx concentration value, measured by NOx-Sensor					
NOX_NOX_SENS_DIAG [NC_NOX_SENS_CONF]	O/V	FF9C... 05DCH	-100 ...1500	1	ppm
NOx concentration value for diagnosis functions, measured by NOx-Sensor					
NOX_NOX_SENS_DIAG_H_RES [NC_NOX_SENS_CONF]	-	FF9C0000... 05DC0000H	-100 ...1500	1/0x10000	ppm
32bit variable of NOX_NOX_SENS_DIAG_i for internal use only					
NOX_NOX_SENS_H_RES [NC_NOX_SENS_CONF]	-	FF9C0000... 05DC0000H	-100 ...1500	1/0x10000	ppm
32bit variable of NOX_NOX_SENS_i for internal use only					
NOX_SENS_TEMP [NC_NOX_SENS_CONF]	O/V	0... 3H	0 ...3	1	-
Indicator for state of sensor heater management					
STATE_ENG_OLD_OSC	-	0H 1H 2H 3H 4H 5H	ES ST IS PL PU PUC	-	-
Old value of engine operating state for detection of NOx signal oscillations					
STATE_NOX_OLD_OSC	-	0H 1H 2H 3H 4H 5H	PASSIV LOAD REGENERATION WAIT STOP WARMUP	-	-
Old value of NOx catalyst state for detection of NOx signal oscillations					
STATE_NS [NC_NOX_SENS_CONF]	O/V	0... FFH	0... 255	1	-
NOx sensor state					
T_NOX_NS_OSC [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 655.35	0.01	s
Time since last reason for an oscillation of NOx signal was detected					
T_NOX_SENS_LAMB_HLD [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 655.35	0.01	s
Timer for hold of last valid Lambda signal value					
T_NOX_SENS_NOX_HLD [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 655.35	0.01	s
Timer for hold of last valid NOx signal value					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_NOX_SENS_NOX_MDL [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 655.35	0.01	s
Timer for debounce of signal state "valid" after re-entry into state "valid"					
T_NOX_SENS_PWR [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 655.35	0.01	s
Timer for debounce of NOx sensor power supply failures					
T_NOX_SENS_VLS_HLD [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 655.35	0.01	s
Timer for hold of last valid binary O2 signal value					
VLS_NOX_SENS [NC_NOX_SENS_CONF]	O/V	0... 578H	-200 ...1200	1	mV
Binary O2 signal voltage, raw value, measured by NOx sensor					
VLS_NOX_SENS_DIAG [NC_NOX_SENS_CONF]	O/V	0... 578H	-200 ...1200	1	mV
Binary O2 signal voltage for diagnosis functions, raw value, measured by NOx sensor					

**Input data:**

C_STATE_NS_MASK_MODE_1 {p. 1400}	C_STATE_NS_MASK_MODE_2 {p. 1400}	C_STATE_NS_MASK_MODE_5 {p. 1400}	CAN_ERR_NOX_SENS [NC_NOX_SENS_CONF] {p. 1398}
CAN_LAMB_NOX_SENS [NC_NOX_SENS_CONF] {p. 1398}	CAN_NOX_NOX_SENS [NC_NOX_SENS_CONF] {p. 1398}	CAN_STATE_DIAG_NS [NC_NOX_SENS_CONF] {p. 1398}	CAN_STATE_NOX_SENS [NC_NOX_SENS_CONF] {p. 1398}
CAN_STATE_NS_TMP [NC_NOX_SENS_CONF] {p. 1398}	CAN_VLS_NOX_SENS [NC_NOX_SENS_CONF] {p. 1399}	LAMB_NS_DIAG [NC_NOX_SENS_CONF] {p. 991}	LV_CAN_TEMP_MIN_THD [NC_NOX_SENS_CONF] {p. 1399}
LV_ERR_NS_CAN_BOFF {p. 991}	LV_ERR_NS_CAN_MSG_LOST [NC_NOX_SENS_CONF] {p. 991}	LV_IGK {p. 906}	NC_NOX_SENS_CONF {p. 643}
NOX_SENS_TEMP [NC_NOX_SENS_CONF] {p. 1381}	STATE_ENG {p. 1720}	STATE_NOX {p. 2986}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_NOX_NOX_SENS	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for 1st NOx signal filter					
C_CRLC_NOX_NOX_SENS_DIAG	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for 2nd NOx signal filter					
C_ERR_NOX_SENS [NC_NOX_SENS_CONF]	-	0... FFH	0... 255	1	-
Manual value for error byte					
C_LAMB_NOX_SENS [NC_NOX_SENS_CONF]	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Manual Lambda value					
C_LAMB_NS_GRD_MAX_OSC	-	0... 7FFFH	0... 31.99902	976.599e-6	-
NOx signal oscillations will be detected if gradient of NOx sensor lambda signal is higher than this value					
C_LAMB_NS_GRD_MIN_OSC	-	8000... 0H	-32 ...0	976.599e-6	-
NOx signal oscillations will be detected if gradient of NOx sensor lambda signal is lower than this negative value					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NOX_NOX_SENS [NC_NOX_SENS_CONF]	-	FF9C... 05DCH	-100 ...1500	1	ppm
Manual NOx concentration value					
C_STATE_DIAG_NS_MAN [NC_NOX_SENS_CONF]	-	0... FFH	0... 255	1	-
Switch for manual set of NOx sensor self diagnosis state					
C_STATE_LAMB_NS_MASK	-	0... FFH	0... 255	1	-
Bit-mask for detection of valid Lambda signal from NOx sensor					
C_STATE_NOX_NS_MASK	-	0... FFH	0... 255	1	-
Bit-mask for detection of valid NOx signal from NOx sensor					
C_STATE_VLS_NS_MASK	-	0... FFH	0... 255	1	-
Bit-mask for detection of valid Binary O2 signal from NOx sensor					
C_T_NOX_SENS_LAMB_AUTH	-	0... FFFFH	0... 655.35	0.01	s
Minimum time of Lambda signal readiness to set the authorisation bit					
C_T_NOX_SENS_LAMB_HLD	-	0... FFFFH	0... 655.35	0.01	s
Maximum time of hold the last valid Lambda signal value					
C_T_NOX_SENS_NOX_AUTH	-	0... FFFFH	0... 655.35	0.01	s
Minimum time of full NOx sensor readiness to set the NOx signal authorisation bit					
C_T_NOX_SENS_NOX_HLD	-	0... FFFFH	0... 655.35	0.01	s
Maximum time of hold the last valid NOx signal value					
C_T_NOX_SENS_NOX_MDL	-	0... FFFFH	0... 655.35	0.01	s
Minimum NOx signal "valid" time for set of model "valid" bit					
C_T_NOX_SENS_PWR_HLD	-	0... FFFFH	0... 655.35	0.01	s
Debounce time for NOx sensor power supply failures					
C_T_NOX_SENS_VLS_AUTH	-	0... FFFFH	0... 655.35	0.01	s
Minimum time of binary O2 signal readiness to set the authorisation bit					
C_T_NOX_SENS_VLS_HLD	-	0... FFFFH	0... 655.35	0.01	s
Maximum time of hold the last valid binary O2 signal value					
C_VLS_NOX_SENS [NC_NOX_SENS_CONF]	-	0... 578H	-200 ...1200	1	mV
Manual binary O2 value					
LC_NOX_SENS_ERR_MAN [NC_NOX_SENS_CONF]	-	0... 1H	0 ...1	1	-
Manual setting of error byte on/off					
LC_NOX_SENS_LAMB_MAN [NC_NOX_SENS_CONF]	-	0... 1H	0 ...1	1	-
Manual setting of Lambda value on/off					
LC_NOX_SENS_LAMB_VLD [NC_NOX_SENS_CONF]	-	0... 1H	0 ...1	1	-
Permanently authorisation Lambda signal on/off					
LC_NOX_SENS_NOX_MAN [NC_NOX_SENS_CONF]	-	0... 1H	0 ...1	1	-
Manual setting of NOx concentration value on/off					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_NOX_SENS_NOX_VLD [NC_NOX_SENS_CONF]	-	0... 1H	0 ...1	1	-
Permanently authorisation NOx signal on/off					
LC_NOX_SENS_VLS_MAN [NC_NOX_SENS_CONF]	-	0... 1H	0 ...1	1	-
Manual setting of binary O2 value on/off					
LC_NOX_SENS_VLS_VLD [NC_NOX_SENS_CONF]	-	0... 1H	0 ...1	1	-
Permanently authorisation binary O2 signal on/off					
LC_STATE_ENG_CHG_OSC	-	0... 1H	0 ...1	1	-
Enable observation of changes of STATE_ENG for detection of NOx signal oscillations					
LC_STATE_NOX_CHG_OSC	-	0... 1H	0 ...1	1	-
Enable observation of changes of STATE_NOX for detection of NOx signal oscillations					

### FUNCTION DESCRIPTION:

#### General information:

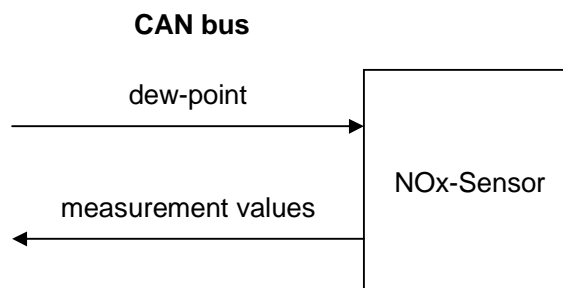
The number of NOx sensors in the system is defined by NC\_NOX\_SENS\_CONF. The value of NC\_NOX\_SENS\_CONF is to set within the project specific module List of Configuration Data .

```

if      NC_NOX_SENS_CONF = 0
then    the system contains no NOx sensor
           nothing is to calculate, no NOx sensor variables are declared
else    if      NC_NOX_SENS_CONF = 1
           then    the system contains 1 NOx sensor
                   all NOx sensor variables are xxx_1 (i = 1)
           else    if      NC_NOX_SENS_CONF = 2
           then    the system contains 2 NOx sensors
                   all NOx sensor variables for exhaust line 1 are xxx_1 (i = 1)
                   all NOx sensor variables for exhaust line 2 are xxx_2 (i = 2)
           endif
           endif
endif

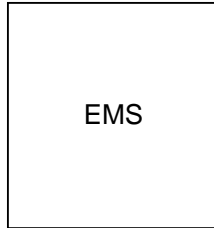
```

The NOx sensor Interface handles the variables and CAN messages for the use of NOx sensor into the EMS.



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The EMS sends the dew point to the NOx sensor and receives measurement values and sensor status information from the NOx sensor via CAN bus. The CAN message structure and the CAN message IDs are defined project specific, e.g. at module NOx sensor Interface (Application Incidences). The dew point handling is also performed in a project specific module, e.g. at module NOx sensor Interface (Application Incidences).

**Description:**

The NOx sensor sends messages with actual measurement values, sensor status and a failure byte to the EMS.

The information from the NOx sensor status byte are combined with the CAN bus failure information to the signal valid indicators. These CAN bus failures are lost message from the NOx sensor and the state CAN busoff.

**Application conditions**

- Recurrence:** 10 ms
- Activation:** LV\_IGK = 1
- Deactivation:** LV\_IGK = 0

**4.42.1 NOx concentration signal**

**FUNCTION DESCRIPTION:**

**General information:**

The EMS receives the NOx concentration signal from the NOx sensor by CAN. After that the NOx concentration signal is evaluated by NOx sensor status information and filtered within the EMS.

**Description:**

The NOx output signal NOX\_NOX\_SENS\_DIAG\_i is used for the NOx sensor diagnosis functions. It is generated by filter of CAN\_NOX\_NOX\_SENS\_i, which is received from the NOx sensor.

The NOx output signal NOX\_NOX\_SENS\_i is used for the NOx catalyst control functions. It is generated by filter of CAN\_NOX\_NOX\_SENS\_i after an analysis of sensor status information CAN\_STATE\_NOX\_SENS\_i. A new NOX\_NOX\_SENS\_i value is calculated if no CAN bus error is occurred and CAN\_STATE\_NOX\_SENS\_i indicates full sensor readiness by CAN\_STATE\_NOX\_SENS\_i = 1EH. All other bits of CAN\_STATE\_NOX\_SENS\_i have no relevance for full readiness. So the system is authorised to use the NOx signal.

The bit LV\_NOX\_SENS\_NOX\_AUTH\_i is set to 1 after the NOx sensor was uninterrupted full ready for at least C\_T\_NOX\_SENS\_NOX\_AUTH. LV\_NOX\_SENS\_NOX\_AUTH\_i is reset to 0 when the temperature of NOx sensor element is out of control range and the power supply of NOx sensor is out of specified range (bit PWR\_OK of NOX\_SENS\_TEMP\_i = 0) or when the engine is stopped or when the

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NOx sensor dew point is reset. This is necessary in order to deactivate the NOx sensor OBD II diagnosis functions.

The variable LV\_NOX\_SENS\_NOX\_DIAG\_VLD\_i is reset to 0 every time when the sensor loses the full readiness. So the diagnosis functions are informed in order to exclude a wrong diagnosis. At the same time starts the timer T\_NOX\_SENS\_NOX\_HLD\_i. It runs up to the maximum value. An overflow is not allowed. The timer is stopped and reset, when the sensor reaches its full readiness.

The variable LV\_NOX\_SENS\_NOX\_MDL\_VLD\_i is used in the module NOx catalyst model controller. The variable LV\_NOX\_SENS\_NOX\_MDL\_VLD\_i informs this module about the NOx signal state. It is reset to 0 every time when the sensor loses the full readiness. It is set to 1 after the NOx signal was valid for the time C\_T\_NOX\_SENS\_NOX\_MDL.

Note! The timer T\_NOX\_SENS\_NOX\_MDL\_i runs up to the maximum value. An overflow is not allowed.

If the permanently authorisation of NOx signal is activated by LC\_NOX\_SENS\_NOX\_VLD\_i = 1 and LV\_NOX\_SENS\_NOX\_AUTH\_i = 1 then it is allowed to calculate a new NOX\_NOX\_SENS\_i value without full sensor readiness. The variable LV\_NOX\_SENS\_NOX\_VLD\_i is set to 1 so that the system is authorised to use the NOx signal. After the engine start the permanently authorisation of NOx signal is blocked up to the use of sensor signals is allowed by LV\_NOX\_SENS\_NOX\_AUTH\_i = 1. Then the calculation of NOX\_NOX\_SENS\_i values is started.

When the sensor loses its full readiness the last valid NOx signal value NOX\_NOX\_SENS\_i and LV\_NOX\_SENS\_NOX\_VLD\_i are held up to the time C\_T\_NOX\_SENS\_NOX\_HLD is passed. After that the NOx signal NOX\_NOX\_SENS\_i is set to C\_NOX\_NOX\_SENS\_i and LV\_NOX\_SENS\_NOX\_VLD\_i is reset.

If the manual setting of NOx values is active LC\_NOX\_SENS\_NOX\_MAN\_i = 1 then NOX\_NOX\_SENS\_DIAG\_i and NOX\_NOX\_SENS\_i are set to C\_NOX\_NOX\_SENS\_i, LV\_NOX\_SENS\_NOX\_VLD\_i is set to 1 and LV\_NOX\_SENS\_NOX\_DIAG\_VLD\_i is reset.

The calculation of NOX\_NOX\_SENS\_i and NOX\_NOX\_SENS\_DIAG\_i shall be done with an internal resolution of 32 bit.

### Application conditions

#### Initialisation:


```

at reset, at LV_IGK = 1 -> 0:
NOX_NOX_SENS_i = C_NOX_NOX_SENS_i
NOX_NOX_SENS_DIAG_i = C_NOX_NOX_SENS_i
LV_NOX_SENS_NOX_VLD_i = 0
LV_NOX_SENS_NOX_DIAG_VLD_i = 0
LV_NOX_SENS_NOX_AUTH_i = 0
LV_NOX_SENS_NOX_MDL_VLD_i = 0
T_NOX_SENS_NOX_HLD_i = 0
T_NOX_SENS_NOX_MDL_i = 0
    
```

#### Formula section:

```

If(1)                                     LC_NOX_SENS_NOX_MAN_i = 0      AND
      LV_CAN_TEMP_MIN_THD_i = 1              AND
      CAN_STATE_NS_TMP[i] = C_STATE_NS_MASK_MODE_2
then(1)
      if(2)                                  LV_ERR_NS_CAN_MSG_LOST[i] = 0      AND
      LV_ERR_NS_CAN_BOFF = 0                  AND
      ( CAN_STATE_NOX_SENS[i] bitwise AND
        C_STATE_NOX_NS_MASK ) = C_STATE_NOX_NS_MASK
      then(2)
    
```

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```

if(3)                                LV_NOX_SENS_NOX_AUTH_i
= 1
then(3)    T_NOX_SENS_NOX_HLD_i = 0
            LV_NOX_SENS_NOX_DIAG_VLD_i = 1
            LV_NOX_SENS_NOX_VLD_i = 1
            increment T_NOX_SENS_NOX_MDL_i
if(4)      T_NOX_SENS_NOX_MDL_i >= C_T_NOX_SENS_NOX_MDL

            then(4)    LV_NOX_SENS_NOX_MDL_VLD_i = 1
            endif(4)
else(3)    increment T_NOX_SENS_NOX_HLD_i
if(5)      T_NOX_SENS_NOX_HLD_i >= C_T_NOX_SENS_NOX_AUTH

            then(5)    LV_NOX_SENS_NOX_AUTH_i = 1
                    LV_NOX_SENS_NOX_VLD_i = 1
                    LV_NOX_SENS_NOX_DIAG_VLD_i = 1
            endif(5)
endif(3)
if(6)                                LV_NOX_SENS_NOX_DIAG_VLD_i
i(n-1) = 0                                AND
            LV_NOX_SENS_NOX_DIAG_VLD_i(n) = 1
then(6)    NOX_NOX_SENS_i(n) =
            CAN_NOX_NOX_SENS_i * C_CRLC_NOX_NOX_SENS
+
            NOX_NOX_SENS_DIAG_i(n-1) * (1 - C_CRLC_NOX_NOX_
SENS)
else(6)    NOX_NOX_SENS_i(n) =
            CAN_NOX_NOX_SENS_i * C_CRLC_NOX_NOX_SENS
+
            NOX_NOX_SENS_i(n-1) * (1 - C_CRLC_NOX_NOX_SENS)

endif(6)
else(2)    LV_NOX_SENS_NOX_DIAG_VLD_i = 0
            T_NOX_SENS_NOX_MDL_i = 0
            LV_NOX_SENS_NOX_MDL_VLD_i = 0
if(7)                                LV_NOX_SENS_NOX_AUTH_i
= 1
then(7)    increment T_NOX_SENS_NOX_HLD_i
else(7)    T_NOX_SENS_NOX_HLD_i = 0
            NOX_NOX_SENS_i = C_NOX_NOX_SENS_i
            LV_NOX_SENS_NOX_VLD_i = 0

endif(7)
if(8)                                LC_NOX_SENS_NOX_VLD_i =
1                                AND
            LV_NOX_SENS_NOX_AUTH_i = 1
then(8)    NOX_NOX_SENS_i(n) =
            CAN_NOX_NOX_SENS_i * C_CRLC_NOX_NOX_SENS
+
            NOX_NOX_SENS_i(n-1) * (1 - C_CRLC_NOX_NOX_SENS)

            LV_NOX_SENS_NOX_VLD_i = 1
else(8)
if(9)      T_NOX_SENS_NOX_HLD_i >= C_T_NOX_SENS_NOX_HLD

```

```

                then(9)          NOX_NOX_SENS_i = C_NOX_NOX_SENS_i
                                LV_NOX_SENS_NOX_VLD_i = 0
                endif(9)
            endif(8)
        endif(2)
    if(10)                    ( LV_NOX_SENS_NOX_AUTH_i = 1
                                LV_NOX_SENS_NOX_DIAG_VLD_i = 0
                                AND
                                Bit PWR_OK of NOX_SENS_TEMP_i = 0 )
        then(10)              NOX_NOX_SENS_i = C_NOX_NOX_SENS_i
                                NOX_NOX_SENS_DIAG_i = C_NOX_NOX_SENS_i
                                LV_NOX_SENS_NOX_VLD_i = LC_NOX_SENS_NOX_MAN_i
                                LV_NOX_SENS_NOX_DIAG_VLD_i = 0
                                LV_NOX_SENS_NOX_AUTH_i = LC_NOX_SENS_NOX_MAN_i
                                LV_NOX_SENS_NOX_MDL_VLD_i = 0
                                T_NOX_SENS_NOX_HLD_i = 0
                                T_NOX_SENS_NOX_MDL_i = 0
        else(10)              NOX_NOX_SENS_DIAG_i(n) =
                                CAN_NOX_NOX_SENS_i * C_CRLC_NOX_NOX_SENS_DIAG +
                                NOX_NOX_SENS_DIAG_i(n-1) * (1 - C_CRLC_NOX_NOX_SENS_
                                DIAG)
        endif(10)
    else(1)                  NOX_NOX_SENS_i = C_NOX_NOX_SENS_i
                                NOX_NOX_SENS_DIAG_i = C_NOX_NOX_SENS_i
                                LV_NOX_SENS_NOX_VLD_i = LC_NOX_SENS_NOX_MAN_i
                                LV_NOX_SENS_NOX_DIAG_VLD_i = 0
                                LV_NOX_SENS_NOX_AUTH_i = LC_NOX_SENS_NOX_MAN_i
                                LV_NOX_SENS_NOX_MDL_VLD_i = 0
                                T_NOX_SENS_NOX_HLD_i = 0
                                T_NOX_SENS_NOX_MDL_i = 0
    endif(1)

```

### Prediction of NOx signal oscillations

LAMB\_NS\_DIAG\_GRD\_OSC\_i = LAMB\_NS\_DIAG\_i - LAMB\_NS\_DIAG\_OLD\_OSC\_i

```


If(11) ( LC_STATE_NOX_CHG_OSC AND
            STATE_NOX != STATE_NOX_OLD_OSC )
            OR
            ( LC_STATE_ENG_CHG_OSC AND
            STATE_ENG != STATE_ENG_OLD_OSC )
            OR
            LAMB_NS_DIAG_GRD_OSC_i > C_LAMB_NS_GRD_MAX_OSC
            OR
            LAMB_NS_DIAG_GRD_OSC_i < C_LAMB_NS_GRD_MIN_OSC
Then(11)    T_NOX_NS_OSC_i = 0
Else(11)    increment T_NOX_NS_OSC_i      (10ms)
Endif(11)

```

LAMB\_NS\_DIAG\_OLD\_OSC\_i = LAMB\_NS\_DIAG\_i  
 STATE\_NOX\_OLD\_OSC = STATE\_NOX  
 STATE\_ENG\_OLD\_OSC = STATE\_ENG

### 4.42.2 Lambda signal

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## FUNCTION DESCRIPTION:

### General information:

The EMS receives the Lambda signal from the NOx sensor by CAN. The Lambda signal is issued in the kind of 1000/. The 1000/ value was chosen for an easy data transmission by CAN.

### Description:

The Lambda signal CAN\_LAMB\_NOX\_SENS\_i, which is received from the NOx sensor, is converted from 1000/ value to and then it is stored at LAMB\_NOX\_SENS\_DIAG\_i. After that the Lambda signal is evaluated by the sensor status CAN\_STATE\_NOX\_SENS\_i.

The value of LAMB\_NOX\_SENS\_DIAG\_i is copied to LAMB\_NOX\_SENS\_i if no CAN bus error is occurred and CAN\_STATE\_NOX\_SENS\_i indicates at least level 2 sensor readiness by CAN\_STATE\_NOX\_SENS\_i = 0EH. For level 2 sensor readiness must be checked the bits B1, B2, B3 and B6 of CAN\_STATE\_NOX\_SENS\_i. All other bits of CAN\_STATE\_NOX\_SENS\_i have no relevance for level 2 readiness. At the same time the variables LV\_NOX\_SENS\_LAMB\_VLD\_i and LV\_NOX\_SENS\_LAMB\_DIAG\_VLD\_i are set to 1. So the system is authorised to use the Lambda signal.

The variable LV\_NOX\_SENS\_LAMB\_DIAG\_VLD\_i is reset to 0 every time when the sensor loses the level 2 readiness. So the diagnosis functions are informed in order to exclude a wrong diagnosis. At the same time starts the timer T\_NOX\_SENS\_LAMB\_HLD\_i. It runs up to the maximum value. An overflow is not allowed. The timer is stopped and reset, when the sensor reaches the level 2 readiness.

If the permanently authorisation of Lambda signal is activated by LC\_NOX\_SENS\_LAMB\_VLD\_i = 1 and LV\_NOX\_SENS\_NOX\_AUTH\_i = 1 then it is allowed to pass the Lambda signal to LAMB\_NOX\_SENS\_i without level 2 sensor readiness. The variable LV\_NOX\_SENS\_LAMB\_VLD\_i is set to 1 so that the system is authorised to use the Lambda signal. After the engine start the permanently authorisation of Lambda signal is blocked up to LV\_NOX\_SENS\_LAMB\_AUTH\_i = 1. Then the Lambda signal values are passed to LAMB\_NOX\_SENS\_i.

When the sensor loses the level 2 readiness the last valid Lambda signal value LAMB\_NOX\_SENS\_i and LV\_NOX\_SENS\_LAMB\_VLD\_i are held up to the time C\_T\_NOX\_SENS\_LAMB\_HLD is passed. After that the Lambda signal LAMB\_NOX\_SENS\_i is set to C\_LAMB\_NOX\_SENS\_i and LV\_NOX\_SENS\_LAMB\_VLD\_i is reset.

If the manual setting of Lambda values is active (LC\_NOX\_SENS\_LAMB\_MAN\_i = 1) then LAMB\_NOX\_SENS\_DIAG\_i and LAMB\_NOX\_SENS\_i are set to C\_LAMB\_NOX\_SENS\_i, LV\_NOX\_SENS\_LAMB\_VLD\_i is set to 1 and LV\_NOX\_SENS\_LAMB\_DIAG\_VLD\_i is reset.

### Application conditions

#### **Initialisation:**


at reset, at LV\_IGK = 1 -> 0:

```

LAMB_NOX_SENS_DIAG_i = C_LAMB_NOX_SENS_i
LAMB_NOX_SENS_i = C_LAMB_NOX_SENS_i
LV_NOX_SENS_LAMB_VLD_i = 0
LV_NOX_SENS_LAMB_DIAG_VLD_i = 0
LV_NOX_SENS_LAMB_AUTH_i = 0
T_NOX_SENS_LAMB_HLD_i = 0
    
```

### Formula section:

if(1) LC\_NOX\_SENS\_LAMB\_MAN\_i = 0 **AND**  
**AND**  
 LV\_CAN\_TEMP\_MIN\_THD\_i = 1  
 ( CAN\_STATE\_NS\_TMP[i] = C\_STATE\_NS\_MASK\_MODE\_1  
 CAN\_STATE\_NS\_TMP[i] = C\_STATE\_NS\_MASK\_MODE\_2  
 CAN\_STATE\_NS\_TMP[i] = C\_STATE\_NS\_MASK\_MODE\_5 )

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```

then(1)    LAMB_NOX_SENS_DIAG_i = 1000 / CAN_LAMB_NOX_SENS_i
if(2)      LV_ERR_NS_CAN_MSG_LOST[i] = 0 AND

    LV_ERR_NS_CAN_BOFF = 0 AND
    ( CAN_STATE_NOX_SENS[i] bitwise AND
      C_STATE_LAMB_NS_MASK ) = C_STATE_LAMB_NS_MASK

then(2)    LAMB_NOX_SENS_i = LAMB_NOX_SENS_DIAG_i
if(3)      LV_NOX_SENS_LAMB_AUTH_
i = 1
then(3)    LV_NOX_SENS_LAMB_VLD_i = 1
    LV_NOX_SENS_LAMB_DIAG_VLD_i = 1
    T_NOX_SENS_LAMB_HLD_i = 0
else(3)    increment T_NOX_SENS_LAMB_HLD_i
if(4)      T_NOX_SENS_LAMB_HLD_i >= C_T_NOX_SENS_LAMB_
AUTH
then(4)    LV_NOX_SENS_LAMB_AUTH_i = 1
    LV_NOX_SENS_LAMB_VLD_i = 1
    LV_NOX_SENS_LAMB_DIAG_VLD_i = 1
endif(4)
endif(3)
else(2)
if(5)      LV_NOX_SENS_LAMB_AUTH_i = 1
then(5)
if(6)      Bit PWR_OK of
NOX_SENS_TEMP_i = 1
then(6)    LV_NOX_SENS_LAMB_DIAG_VLD_i = 0
    increment T_NOX_SENS_LAMB_HLD_i
if(7)      LC_NOX_
SENS_LAMB_VLD_i = 1
then(7)    LAMB_NOX_SENS_i = LAMB_NOX_SENS_DIAG_
i
    LV_NOX_SENS_LAMB_VLD_i = 1
else(7)
if(8)      T_NOX_
SENS_LAMB_HLD_i >=
    C_T_
NOX_SENS_LAMB_HLD
then(8)    LAMB_NOX_SENS_i = C_LAMB_NOX_
SENS_i
    LV_NOX_SENS_LAMB_VLD_i = 0
endif(8)
endif(7)
else(6)
    LAMB_NOX_SENS_i = C_LAMB_NOX_SENS_i
    LAMB_NOX_SENS_DIAG_i = C_LAMB_NOX_SENS_i
    LV_NOX_SENS_LAMB_VLD_i = LC_NOX_SENS_LAMB_MAN_i
    LV_NOX_SENS_LAMB_DIAG_VLD_i = 0
    LV_NOX_SENS_LAMB_AUTH_i = LC_NOX_SENS_LAMB_MAN_
i
    T_NOX_SENS_LAMB_HLD_i = 0
endif(6)
else(5)    LAMB_NOX_SENS_i = C_LAMB_NOX_SENS_i
    LAMB_NOX_SENS_DIAG_i = C_LAMB_NOX_SENS_i
    LV_NOX_SENS_LAMB_VLD_i = LC_NOX_SENS_LAMB_MAN_i

```

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```

LV_NOX_SENS_LAMB_DIAG_VLD_i = 0
LV_NOX_SENS_LAMB_AUTH_i = LC_NOX_SENS_LAMB_MAN_i
T_NOX_SENS_LAMB_HLD_i = 0
endif(5)
endif(2)
else(1)
LAMB_NOX_SENS_i = C_LAMB_NOX_SENS_i
LAMB_NOX_SENS_DIAG_i = C_LAMB_NOX_SENS_i
LV_NOX_SENS_LAMB_VLD_i = LC_NOX_SENS_LAMB_MAN_i
LV_NOX_SENS_LAMB_DIAG_VLD_i = 0
LV_NOX_SENS_LAMB_AUTH_i = LC_NOX_SENS_LAMB_MAN_i
T_NOX_SENS_LAMB_HLD_i = 0
endif(1)

```

### 4.42.3 Binary O2 signal

#### FUNCTION DESCRIPTION:

##### General information:

The EMS receives the binary O2 signal from the NOx sensor by CAN. The principle characteristic of the NOx sensor s binary signal is the same as of a binary O2 sensor.

##### Description:

The binary O2 signal CAN\_VLS\_NOX\_SENS\_i, which is received from the NOx sensor, is copied to VLS\_NOX\_SENS\_DIAG\_i. After that the binary O2 signal is evaluated by the sensor status CAN\_STATE\_NOX\_SENS\_i.

The value of CAN\_VLS\_NOX\_SENS\_i is copied to VLS\_NOX\_SENS\_i if no CAN bus error is occurred and CAN\_STATE\_NOX\_SENS\_i indicates at least level 2 sensor readiness by CAN\_STATE\_NOX\_SENS\_i = 0EH. For level 2 sensor readiness must be checked the bits B1, B2, B3 and B6 of CAN\_STATE\_NOX\_SENS\_i. All other bits of CAN\_STATE\_NOX\_SENS\_i have no relevance for level 2 readiness. At the same time the variables LV\_NOX\_SENS\_VLS\_VLD\_i and LV\_NOX\_SENS\_VLS\_DIAG\_VLD\_i are set to 1. So the system is authorised to use the binary O2 signal.

The variable LV\_NOX\_SENS\_VLS\_DIAG\_VLD\_i is reset to 0 every time when the sensor loses the level 2 readiness. So the diagnosis functions are informed in order to exclude a wrong diagnosis. At the same time starts the timer T\_NOX\_SENS\_VLS\_HLD\_i. It runs up to the maximum value. An overflow is not allowed. The timer is stopped and reset, when the sensor reaches the level 2 readiness.


If the permanently authorisation of binary O2 signal is activated by LC\_NOX\_SENS\_VLS\_VLD\_i = 1 and LV\_NOX\_SENS\_NOX\_AUTH\_i = 1 then it is allowed to pass the binary O2 signal to VLS\_NOX\_SENS\_i without level 2 sensor readiness. The variable LV\_NOX\_SENS\_VLS\_VLD\_i is set to 1 so that the system is authorised to use the binary O2 signal. After the engine start the permanently authorisation of binary O2 signal is blocked up to LV\_NOX\_SENS\_VLS\_AUTH\_i = 1. Then the binary O2 signal values are passed to VLS\_NOX\_SENS\_i.

When the sensor loses the level 2 readiness the last valid binary O2 signal value VLS\_NOX\_SENS\_i and LV\_NOX\_SENS\_VLS\_VLD\_i are held up to the time C\_T\_NOX\_SENS\_VLS\_HLD is passed. After that the binary O2 signal VLS\_NOX\_SENS\_i is set to C\_VLS\_NOX\_SENS\_i and LV\_NOX\_SENS\_VLS\_VLD\_i is reset.

If the manual setting of binary O2 values is active LC\_NOX\_SENS\_VLS\_MAN\_i = 1 then VLS\_NOX\_SENS\_DIAG\_i and VLS\_NOX\_SENS\_i are set to C\_VLS\_NOX\_SENS\_i, LV\_NOX\_SENS\_VLS\_VLD\_i is set to 1 and LV\_NOX\_SENS\_VLS\_DIAG\_VLD\_i is reset.

##### Application conditions

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```

                                then(8)                                VLS_NOX_
                                SENS_i = C_VLS_NOX_SENS_i
                                LV_NOX_SENS_VLS_VLD_i = 0
                                endif(8)
                                endif(7)
                                else(6)                                VLS_NOX_SENS_i = C_VLS_NOX_SENS_i
                                VLS_NOX_SENS_DIAG_i = C_VLS_NOX_SENS_i
                                LV_NOX_SENS_VLS_VLD_i = LC_NOX_SENS_VLS_MAN_i
                                LV_NOX_SENS_VLS_DIAG_VLD_i = 0
                                LV_NOX_SENS_VLS_AUTH_i = LC_NOX_SENS_VLS_MAN_
                                i
                                T_NOX_SENS_VLS_HLD_i = 0
                                endif(6)
                                else(5)                                VLS_NOX_SENS_i = C_VLS_NOX_SENS_i
                                VLS_NOX_SENS_DIAG_i = C_VLS_NOX_SENS_i
                                LV_NOX_SENS_VLS_VLD_i = LC_NOX_SENS_VLS_MAN_i
                                LV_NOX_SENS_VLS_DIAG_VLD_i = 0
                                LV_NOX_SENS_VLS_AUTH_i = LC_NOX_SENS_VLS_MAN_i
                                T_NOX_SENS_VLS_HLD_i = 0
                                endif(5)
                                endif(2)
                                else(1)                                VLS_NOX_SENS_i = C_VLS_NOX_SENS_i
                                VLS_NOX_SENS_DIAG_i = C_VLS_NOX_SENS_i
                                LV_NOX_SENS_VLS_VLD_i = LC_NOX_SENS_VLS_MAN_i
                                LV_NOX_SENS_VLS_DIAG_VLD_i = 0
                                LV_NOX_SENS_VLS_AUTH_i = LC_NOX_SENS_VLS_MAN_i
                                T_NOX_SENS_VLS_HLD_i = 0
                                endif(1)

```

#### 4.42.4 NOx sensor errors

##### FUNCTION DESCRIPTION:

##### General information:

The NOx sensor monitors the connection between the NOx sensor interface unit and the sensor element. The sensor interface is able to detect open wires and short circuits between the sensor connection wires.

The NOx sensor sends the monitoring result together with the measurement data as failure byte to the EMS. The EMS uses this failure byte for the NOx sensor diagnosis.


##### Description:

The NOx sensor's failure byte is valid, if no CAN bus error is occurred. In this case the failure byte CAN\_ERR\_NOX\_SENS\_i is copied to the variable ERR\_NS[i], so that it can be evaluated by the NOx sensor diagnosis function. Otherwise the variable ERR\_NS[i] is reset.

If the manual setting of error byte is active LC\_NOX\_SENS\_ERR\_MAN\_i = 1 then ERR\_NS[i] is set to C\_ERR\_NOX\_SENS\_i.

##### Application conditions

**Initialisation:** *at reset, at LV\_IGK = 1 -> 0:* *ERR\_NS[i] = 0*

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**Formula section:**

```

if      LC_NOX_SENS_ERR_MAN_i = 0
then
    if          LV_ERR_NS_CAN_MSG_LOST[i] = 0
        LV_ERR_NS_CAN_BOFF = 0
        then    ERR_NS[i] = CAN_ERR_NOX_SENS_i
        else    ERR_NS[i] = 0
        endif
    else      ERR_NS[i] = C_ERR_NOX_SENS_i
endif
    
```

**4.42.5 Sensor temperature**

**FUNCTION DESCRIPTION:**

**General information:**

The NOx sensor interface unit controls the temperature of the sensor element. The state of the temperature control is transmitted to the EMS by the status byte.

The NOx sensor observes its power supply voltage. If the power supply voltage is in the range MIN < voltage < MAX then the bit B0 of CAN\_STATE\_NOX\_SENS\_i is 0.

In the case of voltage < MIN (specification value of sensor) it is possible that the sensor can not control the correct sensor element temperature. Because of this the sensor loses the readiness. The possible reasons of undervoltage are a to low battery voltage or a high voltage drop over the power supply wire (e.g. connector problem).

In the case of voltage > MAX (specification value of sensor) the sensor is shut down up to the power supply voltage is again in the allowed range (self-protection mode).

At both cases the NOx sensor diagnosis functions must be deactivated in order to prevent wrong diagnoses.

**Description:**

The state of sensor temperature control and the state of sensor power supply voltage are indicated by bits of NOX\_SENS\_TEMP\_i. The meaning of each bit of NOX\_SENS\_TEMP\_i is described at the table below.

NOX_SENS_TEMP_i	Description
Bit B0 ... TEMP_OK	Sensor temperature is ok.
Bit B1 ... PWR_OK	Sensor power supply is ok.
Bit B2	not used
Bit B3	not used
Bit B4	not used
Bit B5	not used
Bit B6	not used
Bit B7	not used

The sensor temperature is valid if no CAN bus error is occurred and the status byte CAN\_STATE\_NOX\_SENS\_i indicates level 1 readiness.

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```

endif
else
  case selection on C_STATE_DIAG_NS_MAN[i]:
    case:      C_STATE_DIAG_NS_MAN[i] = 1
                Sensor self diagnosis is running.
                STATE_NS[i] = 1
                LV_NS_SHIFT_DIAG_ERR[i](n) = LV_NS_SHIFT_DIAG_ERR[i](n-1)


    case:      C_STATE_DIAG_NS_MAN[i] = 2
                Sensor self diagnosis was aborted.
                Sensor is returning to normal operation mode.
                STATE_NS[i] = 2
                LV_NS_SHIFT_DIAG_ERR[i](n) = LV_NS_SHIFT_DIAG_ERR[i](n-1)

    case:      C_STATE_DIAG_NS_MAN[i] = 3
                Sensor self diagnosis was completed. Result: "Sensor is ok".
                Sensor is returning to normal operation mode.
                STATE_NS[i] = 3
                LV_NS_SHIFT_DIAG_ERR[i] = 0

    case:      C_STATE_DIAG_NS_MAN[i] = 4
                Sensor self diagnosis was completed. Result: "Sensor is faulty".
                Sensor is returning to normal operation mode.
                STATE_NS[i] = 3
                LV_NS_SHIFT_DIAG_ERR[i] = 1

    default:
                Sensor self diagnosis is "off".
                STATE_NS[i] = 0
                LV_NS_SHIFT_DIAG_ERR[i](n) = LV_NS_SHIFT_DIAG_ERR[i](n-1)
  end case selection
endif

```

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## 4.43 NOx sensor interface (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CAN_ERR_NOX_SENS [NC_NOX_SENS_CONF]	O/V	0... FFH	0... 255	1	-
NOx sensor error byte					
CAN_HW_NS [NC_NOX_SENS_CONF]	O/V	0... FFH	0... 255	1	-
NOx sensor hardware version number					
CAN_LAMB_NOX_SENS [NC_NOX_SENS_CONF]	O/V	0... 0604H	0... 1540	1	-
Lambda value as [1000/Lambda], measured by NOx sensor					
CAN_NOX_DIAG_NS [NC_NOX_SENS_CONF]	O/V	8000... 7FFFH	-32768 ...32767	1	-
NOx signal - Diagnosis value					
CAN_NOX_NOX_SENS [NC_NOX_SENS_CONF]	O/V	FF9C... 05DCH	-100 ...1500	1	ppm
NOx concentration value, measured by NOx sensor					
CAN_NOX_REF_NS [NC_NOX_SENS_CONF]	O/V	8000... 7FFFH	-32768 ...32767	1	-
NOx signal - Diagnosis reference value					
CAN_R_RATIO_NOX_SENS [NC_NOX_SENS_CONF]	O/V	8000... 7FFFH	-32768 ...32767	1	-
Sensor element temperature depended resistance ratio as 1000 * R/R25					
CAN_STATE_DIAG_NS [NC_NOX_SENS_CONF]	O/V	0... FFH	0... 255	1	-
NOx sensor self diagnosis state					
CAN_STATE_NOX_SENS [NC_NOX_SENS_CONF]	O/V	0... FFH	0... 255	1	-
NOx sensor status byte					
CAN_STATE_NS_DIAG_REQ [NC_NOX_SENS_CONF]	O/V	0... FH	0... 15	1	-
Request to NOx sensor for doing a sensor self diagnosis					
CAN_STATE_NS_TMP [NC_NOX_SENS_CONF]	O/V	0... FFH	0... 255	1	-
NOx sensor state - Temporary signal for sensor mode switching					
CAN_SW_NS [NC_NOX_SENS_CONF]	O/V	0... FFH	0... 255	1	-
NOx sensor software version number					
CAN_TMP_BYTE_1 [NC_NOX_SENS_CONF]	-	0... FFH	0... 255	1	-
Temporary signal from CAN message buffer - byte 1					
CAN_TMP_BYTE_2 [NC_NOX_SENS_CONF]	-	0... FFH	0... 255	1	-
Temporary signal from CAN message buffer - byte 2					
CAN_TMP_BYTE_3 [NC_NOX_SENS_CONF]	-	0... FFH	0... 255	1	-
Temporary signal from CAN message buffer - byte 3					
CAN_TMP_BYTE_4 [NC_NOX_SENS_CONF]	-	0... FFH	0... 255	1	-
Temporary signal from CAN message buffer - byte 4					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CAN_TMP_BYTE_5 [NC_NOX_SENS_CONF]	-	0... FFH	0... 255	1	-
Temporary signal from CAN message buffer - byte 5					
CAN_TMP_BYTE_6 [NC_NOX_SENS_CONF]	-	0... FFH	0... 255	1	-
Temporary signal from CAN message buffer - byte 6					
CAN_TMP_BYTE_8 [NC_NOX_SENS_CONF]	-	0... FFH	0... 255	1	-
Temporary signal from CAN message buffer - byte 8					
CAN_TMP_WORD_1 [NC_NOX_SENS_CONF]	V	8000... 7FFFH	-32768 ...32767	1	-
Temporary signal from CAN message buffer - word 1					
CAN_VLS_NOX_SENS [NC_NOX_SENS_CONF]	O/V	0... 578H	-200 ...1200	1	mV
Binary O2 signal voltage, raw value, measured by NOx sensor					
LV_CAN_TEMP_MIN_THD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor dew point					
LV_MDL_TEMP_MIN_THD [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Temperature model has reached the dew point for NOx sensor					
LV_NS_VERS_REQ_1 [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Request to NOx sensor for transmission of sensor identification data					
LV_NS_VERS_REQ_2 [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Selection of NOx sensor identification data part 1 or 2					

**Input data:**

CAN_HW_NS [NC_NOX_SENS_CONF] {p. 1398}	CAN_R_RATIO_NOX_SENS [NC_NOX_SENS_CONF] {p. 1398}	CAN_STATE_NS_DIAG_REQ [NC_NOX_SENS_CONF] {p. 1398}	LV_CAN_TEMP_MIN_THD [NC_NOX_SENS_CONF] {p. 1399}
LV_DIAG_REQ_NS_SHIFT [NC_NOX_SENS_CONF] {p. 6426}	LV_IGK {p. 906}	LV_NS_VERS_REQ_1 [NC_NOX_SENS_CONF] {p. 1399}	LV_NS_VERS_REQ_2 [NC_NOX_SENS_CONF] {p. 1399}
LV_TNT_MIN_THD_2 {p. 3181}	NC_NOX_SENS_CONF {p. 643}	STATE_NS_VERS [NC_NOX_SENS_CONF] {p. 6313}	T_AST_SAE {p. 1766}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CAN_STATE_NS_TMP_MASK	-	0... FFH	0... 255	1	-
Base bit-mask for selection of NOx sensor mode					
C_R_RATIO_NOX_SENS_MIN	-	8000... 7FFFH	-32768 ...32767	1	-
Minimum sensor element temperature for set of dew point ahead of temperature model					
C_STATE_DIAG_NS_REF	-	0... FFH	0... 255	1	-
Configuration label for distinction between "Diagnosis reference value" and "Diagnosis value"					
C_STATE_NS_DIAG_REQ_MASK_A	-	0... FH	0... 15	1	-
Bit-Mask "A" for request of NOx sensor self diagnosis ("A" ... at Lambda=1.0 conditions)					
C_STATE_NS_DIAG_REQ_MASK_OFF	-	0... FH	0... 15	1	-
Bit-Mask for NOx sensor self diagnosis request "OFF"					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_NS_MASK_MODE_1	-	0... FFH	0... 255	1	-
Bit-mask for detection of NOx sensor data transfer mode 1 - Wait on dew point					
C_STATE_NS_MASK_MODE_2	-	0... FFH	0... 255	1	-
Bit-mask for detection of NOx sensor data transfer mode 2 - Measuring					
C_STATE_NS_MASK_MODE_3_A	-	0... FFH	0... 255	1	-
Bit-mask "A" for detection of NOx sensor data transfer mode 3 - Sensor identification data, part 1					
C_STATE_NS_MASK_MODE_3_B	-	0... FFH	0... 255	1	-
Bit-mask "B" for detection of NOx sensor data transfer mode 3 - Sensor identification data, part 1					
C_STATE_NS_MASK_MODE_4_A	-	0... FFH	0... 255	1	-
Bit-mask "A" for detection of NOx sensor data transfer mode 4 - Sensor identification data, part 2					
C_STATE_NS_MASK_MODE_4_B	-	0... FFH	0... 255	1	-
Bit-mask "B" for detection of NOx sensor data transfer mode 4 - Sensor identification data, part 2					
C_STATE_NS_MASK_MODE_5	-	0... FFH	0... 255	1	-
Bit-mask for detection of NOx sensor data transfer mode 5 - Sensor self diagnosis					
C_STATE_NS_VERS_REQ_CAN_MAN	-	0... 2H	0 ...2	1	-
Manual set of request for read out of NOx sensor identification data					
C_STATE_NS_VERS_REQ_MASK_1	-	0... FFH	0... 255	1	-
STATE_NS_VERS bit-mask for request of NOx sensor identification data part 1					
C_STATE_NS_VERS_REQ_MASK_2	-	0... FFH	0... 255	1	-
STATE_NS_VERS bit-mask for request of NOx sensor identification data part 2					
C_T_AST_CAN_HW_NS_MAX	-	0... FFFFH	0... 65535	1	s
Maximum engine running time for receiving of NOx sensor hardware information					
C_T_RUN_DIAG_NS_SHIFT	-	0... FFH	0... 25.5	0.1	s
NOx sensor self diagnosis run-in time					
LC_CAN_R_RATIO_NOX_SENS_CONT	-	0... 1H	0 ...1	1	-
CAN_R_RATIO_NOX_SENS calculation mode selection; 0..."follow-up" pointer; 1...continuous					
LC_NOX_SENS_2	-	0... 1H	0 ...1	1	-
NOx sensor of exhaust line 2 exists (yes/no)					

### General information:

The number of NOx sensors in the system is defined by NC\_NOX\_SENS\_CONF.

**if** NC\_NOX\_SENS\_CONF = 0

**then** The system contains no NOx sensor  
no output variables shall be generated

**else**

**if** NC\_NOX\_SENS\_CONF = 1

**then** The system contains one NOx sensor  
i = 1 ... all NOx sensor variables are xxx[i = 1]

**else**

**if** NC\_NOX\_SENS\_CONF = 2

**then** The system contains two NOx sensors  
i = 1 ... the NOx sensor variables for exhaust line 1 are xxx[i = 1]  
i = 2 ... the NOx sensor variables for exhaust line 2 are xxx[i = 2]

**endif**

**endif**

**endif**

### 4.43.1 NOx sensor activation data

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## FUNCTION DESCRIPTION:

### General information:

This chapter is used as interface between the variables on the CAN bus and the system variables. The NOx sensor needs from the EMS the information, that the dew point is passed. This information is necessary for the heater management of the NOx sensor. It protects the NOx sensor in order to avoid damages by water splash of condense water in the exhaust system. The dew point recognition is performed in the NOx catalyst monolith temperature model .  
If the NOx sensor has been received the dew point from the EMS, then the heater management warms up the sensor on the normal operating temperature.

### Description:

The dew point flag for the NOx sensor LV\_CAN\_TEMP\_MIN\_THD\_i is set, if the dew point, which is calculated by the NOx catalyst monolith temperature model, is reached or if the NOx sensor's ceramic (sensor element) was sufficiently heated up by exhaust gas. The detection of sufficient sensor element heating uses a temperature dependent resistance ratio signal, which is sent by the NOx sensor while the NOx sensor is waiting for the dew point.

The resistance ratio signal is sent instead of the NOx signal. This resistance ratio signal represents the momentary temperature of sensor element. It is defined as:

$$CAN\_R\_RATIO\_NOX\_SENS\_i = \frac{R}{R_{25}} = 911 \cdot (1 + \alpha \cdot T + \beta \cdot T^2)$$

$\alpha$  ... material constant,  $\alpha = 3.92 \cdot 10^{-3} \text{ K}^{-1}$   
 ... material constant,  $\beta = -0.6 \cdot 10^{-6} \text{ K}^{-2}$   
 T ... temperature of sensor element [ $^{\circ}\text{C}$ ]

The scope of dew point detection by sensor element temperature is an earlier set of dew point in comparison with the dew point set by NOx catalyst monolith temperature model.

The dew point is detected by sensor element temperature when the resistance ratio signal from the NOx sensor exceeds the threshold C\_R\_RATIO\_NOX\_SENS\_MIN. The set of dew point by sensor element temperature is allowed only 1x after engine start. A reset of dew point is possible by the NOx catalyst temperature model within a driving cycle (e.g. very long pull fuel cutoff phase). In this case the sensor temperature condition has not the right to set the dew point again. Hence the resistance ratio signal is set to maximum value after the dew point was reached the 1<sup>st</sup> time within a driving cycle and is reset to "0" at every engine start.

### **Calibration hints:**

A typical sensor element temperature threshold for set of dew point is:

$$T \text{ } 300^{\circ}\text{C} \Rightarrow C\_R\_RATIO\_NOX\_SENS\_MIN = 1936$$

Other values for C\_R\_RATIO\_NOX\_SENS\_MIN can be calculated by use of definition equation (see above).


This function can be switched off by calibration

$$C\_R\_RATIO\_NOX\_SENS\_MIN = \text{maximum value (7FFFH or 32767)}$$

### Application conditions

#### **Initialisation:**

at reset:  
 LV\_CAN\_TEMP\_MIN\_THD\_i = 0  
 LV\_MDL\_TEMP\_MIN\_THD\_i = 0

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```

CAN_STATE_NS_DIAG_REQ[i] = 0
LV_NS_VERS_REQ_1[i] = 0
LV_NS_VERS_REQ_2[i] = 0

```

**Recurrence:** *corresponding to EMS send message with CAN-ID = 140H*

**Activation:** *after reset, at every engine state*

**Deactivation:** -

**Formula section:**

```

if
then
    if
    then
        LV_CAN_TEMP_MIN_THD_i = 1
        LV_MDL_TEMP_MIN_THD_i = 1
    else
        if
        THD_i = 0
        AND
        CAN_R_RATIO_NOX_SENS_i > C_R_RATIO_NOX_SENS_MIN
        then
            LV_CAN_TEMP_MIN_THD_i = 1
        else
            LV_CAN_TEMP_MIN_THD_i = 0
        endif
    endif
    if
        LV_DIAG_REQ_NS_SHIFT[i] = 1
    AND
    LV_CAN_TEMP_MIN_THD[i] = 1
    then
        CAN_STATE_NS_DIAG_REQ[i] = C_STATE_NS_DIAG_REQ_MASK_A
    else
        CAN_STATE_NS_DIAG_REQ[i] = C_STATE_NS_DIAG_REQ_MASK_OFF
    endif
endif
else
    LV_CAN_TEMP_MIN_THD_i = 0
    LV_MDL_TEMP_MIN_THD_i = 0
    CAN_STATE_NS_DIAG_REQ[i] = C_STATE_NS_DIAG_REQ_MASK_OFF
endif
if
then
    C_STATE_NS_VERS_REQ_CAN_MAN > 0
    Manual controlled set of request for NOx sensor identification data
    case selection on C_STATE_NS_VERS_REQ_CAN_MAN:
    case:
        C_STATE_NS_VERS_REQ_CAN_MAN = 1
        Sensor identification data, part 1 are requested
        LV_NS_VERS_REQ_1[i] = 1
        LV_NS_VERS_REQ_2[i] = 0
    case:
        C_STATE_NS_VERS_REQ_CAN_MAN = 2
        Sensor identification data, part 2 are requested
        LV_NS_VERS_REQ_1[i] = 1
        LV_NS_VERS_REQ_2[i] = 1
    default:
        No sensor identification data are requested
        LV_NS_VERS_REQ_1[i] = 0
        LV_NS_VERS_REQ_2[i] = 0

```

**end case selection**

```

else      Regular controlled set of request for NOx sensor identification data
if        CAN_HW_NS[i] > 0 OR T_AST_SAE >= C_T_AST_CAN_HW_NS_MAX
then
    case selection on STATE_NS_VERS[i]:
        case:      STATE_NS_VERS[i] = C_STATE_NS_VERS_REQ_MASK_1
                   Sensor identification data, part 1 are requested
                   LV_NS_VERS_REQ_1[i] = 1
                   LV_NS_VERS_REQ_2[i] = 0
        case:      STATE_NS_VERS[i] = C_STATE_NS_VERS_REQ_MASK_2
                   Sensor identification data, part 2 are requested
                   LV_NS_VERS_REQ_1[i] = 1
                   LV_NS_VERS_REQ_2[i] = 1
        default:
                   No sensor identification data are requested
                   LV_NS_VERS_REQ_1[i] = 0
                   LV_NS_VERS_REQ_2[i] = 0
    end case selection
else      Sensor identification data, part 2 are requested until received or time out
    LV_NS_VERS_REQ_1[i] = 1
    LV_NS_VERS_REQ_2[i] = 1
endif
endif

```

**4.43.2 CAN Protocol**

**General information:**

The following control units participate to CAN-communication:

- EMS: Engine management system
- NOX1: NOx sensor on exhaust line 1
- NOX2: NOx sensor on exhaust line 2

CAN communication is based on messages. A message is defined at the identifier number. Valid identifier numbers are numbers from 1 to 1023 (short identifier). Messages with lower identifier number have higher priority. The length of a message can vary from 1 to 8 bytes.

- Baudrate: 500 kBaud
- Data format: Motorola

The NOx sensor in exhaust line 1 sends its measurement values on CAN Messages with the ID = 130H. The NOx sensor in exhaust line 2 sends its measurement values on CAN Messages with the ID = 135H.

The NOx sensors in all exhaust lines receive the dew point on the CAN Message with the ID = 140H.


**4.43.2.1 Send messages by EMS**

**4.43.2.1.1 ID = 140H - NOx sensor dew point**

**General information:**

**ATTENTION!!!**

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The CAN message description in this function specification is **for information only!** It is not included within NOx sensor component change management!

This message transfers the dew point and special operation mode requests from the EMS to all NOx sensors within the system. The sending of this message is permanently active.

**Description:**

The calibration value NOx sensor self diagnosis run-in time C\_T\_RUN\_DIAG\_NS\_SHIFT allows to overwrite the NOx sensor internal default value of this parameter. For a explanation of NOx sensor self diagnosis, its parameters and effects contact the NOx sensor supplier or see NOx sensor component specification.

**Calibration hint:**

It is strongly recommended to use the NOx sensor internal default value of this parameter. Hence use the According to the definitions into the NOx sensor component specification for project MSD80, the following calibration is recommended:

1. activation of functionality:  
C\_T\_RUN\_DIAG\_NS\_SHIFT > 0.0 s
2. deactivation of functionality (use of NOx sensor internal default value):  
C\_T\_RUN\_DIAG\_NS\_SHIFT = 0.0 s

**Application conditions**

- Initialisation:** -
- Recurrence:** 100ms
- Activation:** after reset
- Deactivation:** -

**Formula section:**

**CAN Frame and Signal Definitions:**

ID = 140H, base time = 100ms - NOx sensor dew point								
Bit:	7	6	5	4	3	2	1	0
	MSB							LSB
Byte:					Sensor identification request 1 for sensor ID=130H		Sensor identification request 2 for sensor ID=130H	
0	Dew point for sensor ID=130H	0	0	0	0	0	0	0
1	Dew point for sensor ID=135H	0	0	0	Sensor identification request 1 for sensor ID=135H	0	Sensor identification request 2 for sensor ID=135H	0
2	0	0	0	0	Diagnosis request for sensor ID=130H			
3	0	0	0	0	Diagnosis request for sensor ID=135H			
4	Diagnosis run-in time							
5	00H							
6	00H							
7	00H							

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ID	Signal	Hex Range	Phys. Range	Resolution	Unit	Init Value	Default Value
140H	Dew point for sensor ID=130H & 135H	0...1H	0...1	1	[-]	0	0
140H	Sensor identification request 1 for sensor ID=130H & 135H	0...1H	0...1	1	[-]	0	0
140H	Sensor identification request 2 for sensor ID=130H & 135H	0...1H	0...1	1	[-]	0	0
140H	Diagnosis request for sensor ID=130H & 135H	0...FH	0...15	1	[-]	0	0
140H	Diagnosis run-in time	0...FFH	0.0...25.5	0.1	[s]	0	0


ID	Signal	Signal value	Description
140H	Dew point for sensor ID=130H & 135H	0	Dew point is not reached
		1	Dew point is reached
140H	Sensor identification request 1 for sensor ID=130H & 135H	0	No request
		1	Request for sensor identification data
140H	Sensor identification request 2 for sensor ID=130H & 135H	0	Request for part 1 of sensor identification data
		1	Request for part 2 of sensor identification data
140H	Diagnosis request for sensor ID=130H & 135H	0H (0000b)	No request, sensor self diagnosis = "off"
		1H (0001b)	Conditions for sensor self diagnosis at $\lambda=1.0$ present
		2H (0010b)	Conditions for sensor self diagnosis at pull fuel cutoff (Schub) present
		4H (0100b)	Conditions for sensor self diagnosis at $\lambda=xxx$ present
		8H (1000b)	Conditions for sensor self diagnosis at $\lambda=xxx$ present
	other values	Other values are not defined. => Hence they are not allowed.	
140H	Diagnosis run-in time	0.0 s	No diagnosis run-in time change request from EMS. Use sensor internal value (default value).
		0.1...25.5 s	Diagnosis run-in time from EMS

ID	Signal	ECU signal variable name
140H	Dew point for sensor ID=130H	LV_CAN_TEMP_MIN_THD[1]
140H	Dew point for sensor ID=135H	LV_CAN_TEMP_MIN_THD[2] <sup>5)</sup>
140H	Sensor identification request 1 for sensor ID=130H	LV_NS_VERS_REQ_1[1]
140H	Sensor identification request 2 for sensor ID=130H	LV_NS_VERS_REQ_2[1]
140H	Sensor identification request 1 for sensor ID=135H	LV_NS_VERS_REQ_1[2] <sup>5)</sup>
140H	Sensor identification request 2 for sensor ID=135H	LV_NS_VERS_REQ_2[2] <sup>5)</sup>
140H	Diagnosis request for sensor ID=130H	CAN_STATE_NS_DIAG_REQ[1]
140H	Diagnosis request for sensor ID=135H	CAN_STATE_NS_DIAG_REQ[2] <sup>5)</sup>
140H	Diagnosis run-in time	C_T_RUN_DIAG_NS_SHIFT

<sup>5)</sup> If NC\_NOX\_SENS\_CONF = 1 then use the i = 1 variables instead of i = 2 variables.

#### 4.43.2.2 Received messages by EMS

##### General information:

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For all received messages are applicable:

```

if                                LV_IGK = 0 OR
    lost message error of a particular message is detected
then
    if                                default values for this message are defined
    then                                the default values are used
    else                                the previous values of this message are used
    endif
else                                the received message values are used
endif
    
```

### Description:

The NOx sensor transmits different signals, which can identified by the "Sensor status" signal. Detailed information are included into the next section with the CAN message description.

### **ATTENTION!!!**

The CAN message description in this function specification is **for information only!** It is not included within NOx sensor component change management!

### **Calibration hint:**

According to the definitions into the NOx sensor component specification for project MSD80, the following calibration is recommended:

C_CAN_STATE_NS_TMP_MASK (decimal)	= 1110 0000b = E0H =
C_STATE_NS_MASK_MODE_1 (decimal)	= 0100 0000b = 40H =
C_STATE_NS_MASK_MODE_2 (decimal)	= 0000 0000b = 00H =
C_STATE_NS_MASK_MODE_3_A (decimal)	= 1000 0000b = 80H =
C_STATE_NS_MASK_MODE_3_B (decimal)	= 1100 0000b = C0H =
C_STATE_NS_MASK_MODE_4_A (decimal)	= 1010 0000b = A0H =
C_STATE_NS_MASK_MODE_4_B (decimal)	= 1110 0000b = E0H =
C_STATE_NS_MASK_MODE_5 (decimal)	= 0010 0000b = 20H =

A functionality can be deactivated by mode mask calibration of 0FH.

### Application conditions

**Initialisation:** at reset:  
 CAN\_R\_RATIO\_NOX\_SENS[i] = 0  
 CAN\_STATE\_NS\_TMP[i] = 0  
 CAN\_SW\_NS[i] = 0  
 CAN\_HW\_NS[i] = 0  
 CAN\_STATE\_DIAG\_NS[i] = 0  
 CAN\_NOX\_REF\_NS[i] = 0  
 CAN\_NOX\_DIAG\_NS[i] = 0

**Recurrence:** 10ms

**Activation:** after reset, at every engine state

**Deactivation:** -

**Formula section:**

*Signals, which are to copy from CAN message buffer without any condition*

CAN\_STATE\_NOX\_SENS[i] = CAN Message buffer "Sensor status"  
 CAN\_STATE\_NS\_TMP[i] = CAN\_STATE\_NOX\_SENS[i] **bit-wise AND**  
 C\_CAN\_STATE\_NS\_TMP\_MASK

**case selection on CAN\_STATE\_NS\_TMP[i]:**

**case 1:** CAN\_STATE\_NS\_TMP[i] = C\_STATE\_NS\_MASK\_  
 MODE\_1

*Mode 1 - Wait on dew point (Mask: 010x xxxx)*

*Resistance ratio was received*

CAN\_NOX\_NOX\_SENS[i] = 0

**if** CAN\_R\_RATIO\_NOX\_SENS[i](n-

1) < CAN\_TMP\_WORD\_1[i] **OR**

LC\_CAN\_R\_RATIO\_NOX\_SENS\_CONT = 1

**then** CAN\_R\_RATIO\_NOX\_SENS[i] = CAN\_TMP\_WORD\_1[i]

**else** *Resistance ratio remains unchanged*

CAN\_R\_RATIO\_NOX\_SENS[i](n) = CAN\_R\_RATIO\_NOX\_SENS[i](n-1)

**endif**

CAN\_ERR\_NOX\_SENS[i] = CAN\_TMP\_BYTE\_8[i]

*Signals, which are to copy from CAN message buffer*

CAN\_LAMB\_NOX\_SENS[i] = CAN Message buffer "Lambda signal" \*

CAN\_VLS\_NOX\_SENS[i] = CAN Message buffer "Binary O2 signal" \*

\*...The CAN Message buffer value has to read out as **signed integer** value!

*Frozen signals (nothing is to do)*

CAN\_SW\_NS[i](n) = CAN\_SW\_NS[i](n-1)

CAN\_HW\_NS[i](n) = CAN\_HW\_NS[i](n-1)

CAN\_STATE\_DIAG\_NS[i](n) = CAN\_STATE\_DIAG\_NS[i](n-1)

CAN\_NOX\_REF\_NS[i](n) = CAN\_NOX\_REF\_NS[i](n-1)

CAN\_NOX\_DIAG\_NS[i](n) = CAN\_NOX\_DIAG\_NS[i](n-1)

**case 2:** CAN\_STATE\_NS\_TMP[i] = C\_STATE\_NS\_MASK\_  
 MODE\_2

*Mode 2 - Measuring (Mask: 000x xxxx)*

*NOx signal and error signal were received*

CAN\_NOX\_NOX\_SENS[i] = CAN\_TMP\_WORD\_1[i]

CAN\_ERR\_NOX\_SENS[i] = CAN\_TMP\_BYTE\_8[i]

*Signals, which are to copy from CAN message buffer*

CAN\_LAMB\_NOX\_SENS[i] = CAN Message buffer "Lambda signal" \*

CAN\_VLS\_NOX\_SENS[i] = CAN Message buffer "Binary O2 signal" \*

\*...The CAN Message buffer value has to read out as **signed integer** value!

*Frozen signals (nothing is to do)*

CAN\_R\_RATIO\_NOX\_SENS[i](n) = CAN\_R\_RATIO\_NOX\_SENS[i](n-1)

CAN\_SW\_NS[i](n) = CAN\_SW\_NS[i](n-1)

CAN\_HW\_NS[i](n) = CAN\_HW\_NS[i](n-1)

CAN\_STATE\_DIAG\_NS[i](n) = CAN\_STATE\_DIAG\_NS[i](n-1)

CAN\_NOX\_REF\_NS[i](n) = CAN\_NOX\_REF\_NS[i](n-1)

CAN\_NOX\_DIAG\_NS[i](n) = CAN\_NOX\_DIAG\_NS[i](n-1)



**case 3:** CAN\_STATE\_NS\_TMP[i] = C\_STATE\_NS\_MASK\_  
MODE\_3\_A OR

CAN\_STATE\_NS\_TMP[i] = C\_STATE\_NS\_MASK\_MODE\_3\_B  
Mode 3 - Sensor identification data, part 1 (Mask: 1x0x xxxx -> 100... or 110...)  
Sensor identification data, part 1 was received  
- part number data are ignored  
- software version is recorded  
CAN\_SW\_NS[i] = CAN\_TMP\_BYTE\_8[i]

Signals, which are to copy from CAN message buffer  
--

Frozen signals (nothing is to do)

CAN\_NOX\_NOX\_SENS[i](n) = CAN\_NOX\_NOX\_SENS[i](n-1)  
CAN\_LAMB\_NOX\_SENS[i](n) = CAN\_LAMB\_NOX\_SENS[i](n-1)  
CAN\_VLS\_NOX\_SENS[i](n) = CAN\_VLS\_NOX\_SENS[i](n-1)  
CAN\_ERR\_NOX\_SENS[i](n) = CAN\_ERR\_NOX\_SENS[i](n-1)  
CAN\_R\_RATIO\_NOX\_SENS[i](n) = CAN\_R\_RATIO\_NOX\_SENS[i](n-1)  
CAN\_HW\_NS[i](n) = CAN\_HW\_NS[i](n-1)  
CAN\_STATE\_DIAG\_NS[i](n) = CAN\_STATE\_DIAG\_NS[i](n-1)  
CAN\_NOX\_REF\_NS[i](n) = CAN\_NOX\_REF\_NS[i](n-1)  
CAN\_NOX\_DIAG\_NS[i](n) = CAN\_NOX\_DIAG\_NS[i](n-1)

**case 4:** CAN\_STATE\_NS\_TMP[i] = C\_STATE\_NS\_MASK\_  
MODE\_4\_A OR

CAN\_STATE\_NS\_TMP[i] = C\_STATE\_NS\_MASK\_MODE\_4\_B  
Mode 4 - Sensor identification data, part 2 (Mask: 1x1x xxxx -> 101... or 111...)  
Sensor identification data, part 2 was received  
- parameter list data is ignored  
- individual part number data are ignored  
- quality status is recorded  
CAN\_HW\_NS[i] = CAN\_TMP\_BYTE\_8[i]


Signals, which are to copy from CAN message buffer  
--

Frozen signals (nothing is to do)

CAN\_NOX\_NOX\_SENS[i](n) = CAN\_NOX\_NOX\_SENS[i](n-1)  
CAN\_LAMB\_NOX\_SENS[i](n) = CAN\_LAMB\_NOX\_SENS[i](n-1)  
CAN\_VLS\_NOX\_SENS[i](n) = CAN\_VLS\_NOX\_SENS[i](n-1)  
CAN\_ERR\_NOX\_SENS[i](n) = CAN\_ERR\_NOX\_SENS[i](n-1)  
CAN\_R\_RATIO\_NOX\_SENS[i](n) = CAN\_R\_RATIO\_NOX\_SENS[i](n-1)  
CAN\_SW\_NS[i](n) = CAN\_SW\_NS[i](n-1)  
CAN\_STATE\_DIAG\_NS[i](n) = CAN\_STATE\_DIAG\_NS[i](n-1)  
CAN\_NOX\_REF\_NS[i](n) = CAN\_NOX\_REF\_NS[i](n-1)  
CAN\_NOX\_DIAG\_NS[i](n) = CAN\_NOX\_DIAG\_NS[i](n-1)

**case 5:** CAN\_STATE\_NS\_TMP[i] = C\_STATE\_NS\_MASK\_  
MODE\_5

Mode 5 - Sensor self diagnosis (Mask: 001x xxxx)

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```

Diagnosis signals were received
CAN_STATE_DIAG_NS[i] = CAN_TMP_BYTE_8[i]
if      CAN_STATE_DIAG_NS[i] <= C_STATE_DIAG_NS_REF
  then  Diagnosis reference value was received
        CAN_NOX_REF_NS[i] = CAN_TMP_WORD_1[i]
  else  Diagnosis value was received
        CAN_NOX_DIAG_NS[i] = CAN_TMP_WORD_1[i]
endif

Signals, which are to copy from CAN message buffer
CAN_LAMB_NOX_SENS[i] = CAN Message buffer "Lambda signal" *
CAN_VLS_NOX_SENS[i] = CAN Message buffer "Binary O2 signal" *
*...The CAN Message buffer value has to read out as signed integer value!
    
```

```

Frozen signals (nothing is to do)
CAN_NOX_NOX_SENS[i](n) = CAN_NOX_NOX_SENS[i](n-1)
CAN_ERR_NOX_SENS[i](n) = CAN_ERR_NOX_SENS[i](n-1)
CAN_R_RATIO_NOX_SENS[i](n) = CAN_R_RATIO_NOX_SENS[i](n-1)
CAN_SW_NS[i](n) = CAN_SW_NS[i](n-1)
CAN_HW_NS[i](n) = CAN_HW_NS[i](n-1)
    
```

**default case:**

*This part is reached in case of wrong system calibration or at receive of not allowed "Sensor status" signal combination - Mask 011x xxxx.  
Nothing is done in this case. All signals are frozen.*

```

Frozen signals (nothing is to do)
CAN_NOX_NOX_SENS[i](n) = CAN_NOX_NOX_SENS[i](n-1)
CAN_LAMB_NOX_SENS[i](n) = CAN_LAMB_NOX_SENS[i](n-1)
CAN_VLS_NOX_SENS[i](n) = CAN_VLS_NOX_SENS[i](n-1)
CAN_ERR_NOX_SENS[i](n) = CAN_ERR_NOX_SENS[i](n-1)
CAN_R_RATIO_NOX_SENS[i](n) = CAN_R_RATIO_NOX_SENS[i](n-1)
CAN_SW_NS[i](n) = CAN_SW_NS[i](n-1)
CAN_HW_NS[i](n) = CAN_HW_NS[i](n-1)
CAN_STATE_DIAG_NS[i](n) = CAN_STATE_DIAG_NS[i](n-1)
CAN_NOX_REF_NS[i](n) = CAN_NOX_REF_NS[i](n-1)
CAN_NOX_DIAG_NS[i](n) = CAN_NOX_DIAG_NS[i](n-1)
    
```

**end case selection**

**4.43.2.3 ID = 130H - NOx sensor 1 data and ID = 135H - NOx sensor 2 data**

**General information:**

**ATTENTION!!!**


The CAN message description in this function specification is **for information only!** It is not included within NOx sensor component change management!

This messages transfers the measurement data, diagnosis data and sensor identification data from the NOx sensor 1 and NOx sensor 2 to the EMS.

The message content depends on sensor operation mode. It exists following sensor operation modes:

- Mode 1 - Wait on dew point
- Mode 2 - Measuring
- Mode 3 - Sensor identification data, part 1

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- Mode 4 - Sensor identification data, part 2
- Mode 5 - Sensor self diagnosis

The sensor indicates its operation mode by the signal "Sensor status" which is included within each transmitted message.

### Formula section:

### CAN Frame and Signal Definitions:

**Mode 1 - Wait on dew point:**  
**sensor status: 0 1 0 x x x x x (b)**

**Sen-**

ID = 130H, base time = 10ms - NOx sensor 1 data ID = 135H, base time = 10ms - NOx sensor 2 data								
Bit:	7	6	5	4	3	2	1	0
	MSB							LSB
Byte:								
0	Resistance ratio signal, High byte							
1	Resistance ratio signal, Low byte							
2	Lambda signal, High byte							
3	Lambda signal, Low byte							
4	Binary O2 signal voltage, High byte							
5	Binary O2 signal voltage, Low byte							
6	Sensor status							
7	Error status							

ID	Signal	Hex Range	Phys. Range	Resolution	Unit	Init Value	Default Value
130H, 135H	Resistance ratio	8000H... 7FFFH	-32768... 32767	1	[-]	00H	
130H, 135H	Lambda signal	8000H... 7FFFH	-32768... 32767	1	[-]	00H	
130H, 135H	Binary O2 signal	8000H... 7FFFH	-32968... 32567	1	[mV]	00H	
130H, 135H	Sensor status <sup>1)</sup>	0...FFH	0...255	1	[-]	01H	01H
130H, 135H	Error status <sup>2)</sup>	0...FFH	0...255	1	[-]	0	0

NOx Sensor 1 - NC\_NOX\_SENS\_CONF >= 1

ID	Signal	ECU signal variable name
130H	Resistance ratio	CAN_TMP_WORD_1[1]
130H	Lambda signal	CAN_LAMB_NOX_SENS[1]
130H	Binary O2 signal	CAN_VLS_NOX_SENS[1]
130H	Sensor status <sup>1)</sup>	CAN_STATE_NOX_SENS[1]
130H	Error status <sup>2)</sup>	CAN_TMP_BYTE_8[1]

NOx Sensor 2 - NC\_NOX\_SENS\_CONF = 2

ID	Signal	ECU signal variable name
135H	Resistance ratio	CAN_TMP_WORD_1[2]
135H	Lambda signal	CAN_LAMB_NOX_SENS[2]
135H	Binary O2 signal	CAN_VLS_NOX_SENS[2]
135H	Sensor status <sup>1)</sup>	CAN_STATE_NOX_SENS[2]
135H	Error status <sup>2)</sup>	CAN_TMP_BYTE_8[2]

**Mode 2 - Measuring:****Sensor****status: 0 0 0 x x x x (b)**

ID = 130H, base time = 10ms - NOx sensor 1 data ID = 135H, base time = 10ms - NOx sensor 2 data							
Bit:	7 MSB	6	5	4	3	2	1 0 LSB
Byte:							
0	NOx signal, High byte						
1	NOx signal, Low byte						
2	Lambda signal, High byte						
3	Lambda signal, Low byte						
4	Binary O2 signal voltage, High byte						
5	Binary O2 signal voltage, Low byte						
6	Sensor status						
7	Error status						

ID	Signal	Hex Range	Phys. Range	Resolution	Unit	Init Value	Default Value
130H, 135H	NOx signal	8000H... 7FFFH	-32768... 32767	1	[ppm]	00H	
130H, 135H	Lambda signal	8000H... 7FFFH	-32768... 32767	1	[-]	00H	
130H, 135H	Binary O2 signal	8000H... 7FFFH	-32968... 32567	1	[mV]	00H	
130H, 135H	Sensor status <sup>1)</sup>	0...FFH	0...255	1	[-]	01H	01H
130H, 135H	Error status <sup>2)</sup>	0...FFH	0...255	1	[-]	0	0

**NOx Sensor 1 - NC\_NOX\_SENS\_CONF >= 1**

ID	Signal	ECU signal variable name
130H	NOx signal	CAN_TMP_WORD_1[1]
130H	Lambda signal	CAN_LAMB_NOX_SENS[1]
130H	Binary O2 signal	CAN_VLS_NOX_SENS[1]
130H	Sensor status <sup>1)</sup>	CAN_STATE_NOX_SENS[1]
130H	Error status <sup>2)</sup>	CAN_TMP_BYTE_8[1]

**NOx Sensor 2 - NC\_NOX\_SENS\_CONF = 2**

ID	Signal	ECU signal variable name
135H	NOx signal	CAN_TMP_WORD_1[2]
135H	Lambda signal	CAN_LAMB_NOX_SENS[2]
135H	Binary O2 signal	CAN_VLS_NOX_SENS[2]
135H	Sensor status <sup>1)</sup>	CAN_STATE_NOX_SENS[2]
135H	Error status <sup>2)</sup>	CAN_TMP_BYTE_8[2]

**Mode 3 - Sensor identification data, part 1:**

sensor status: 1 x 0 x x x x x (b)

ID = 130H, base time = 10ms - NOx sensor 1 data ID = 135H, base time = 10ms - NOx sensor 2 data								
Bit:	7	6	5	4	3	2	1	0
	MSB							LSB
Byte:								
0	Part number, byte 1 (MSB), (BCD coded)							
1	Part number, byte 2, (BCD coded)							
2	Part number, byte 3, (BCD coded)							
3	Part number, byte 4, (BCD coded)							
4	Part number, byte 5, (BCD coded)							
5	Part number, byte 6 (LSB), (BCD coded)							
6	Sensor status							
7	Software version							

ID	Signal	Hex Range	Phys. Range	Resolution	Unit	Init Value	Default Value
130H, 135H	Part number, byte 1 (MSB)	0... FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Part number, byte 2	0...FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Part number, byte 3	0...FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Part number, byte 4	0...FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Part number, byte 5	0...FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Part number, byte 6 (LSB)	0...FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Sensor status <sup>1)</sup>	0...FFH	0...255	1	[-]	01H	01H
130H, 135H	Software version	0...FFH	0...255	1	[-]	0	0

NOx Sensor 1 - NC\_NOX\_SENS\_CONF >= 1

ID	Signal	ECU signal variable name
130H	Part number, byte 1 (MSB)	CAN_TMP_BYTE_1[1]
130H	Part number, byte 2	CAN_TMP_BYTE_2[1]
130H	Part number, byte 3	CAN_TMP_BYTE_3[1]
130H	Part number, byte 4	CAN_TMP_BYTE_4[1]
130H	Part number, byte 5	CAN_TMP_BYTE_5[1]
130H	Part number, byte 6 (LSB)	CAN_TMP_BYTE_6[1]
130H	Sensor status <sup>1)</sup>	CAN_STATE_NOX_SENS[1]
130H	Software version	CAN_TMP_BYTE_8[1]

NOx Sensor 2 - NC\_NOX\_SENS\_CONF = 2

ID	Signal	ECU signal variable name
135H	Part number, byte 1 (MSB)	CAN_TMP_BYTE_1[2]
135H	Part number, byte 2	CAN_TMP_BYTE_2[2]
135H	Part number, byte 3	CAN_TMP_BYTE_3[2]
135H	Part number, byte 4	CAN_TMP_BYTE_4[2]
135H	Part number, byte 5	CAN_TMP_BYTE_5[2]
135H	Part number, byte 6 (LSB)	CAN_TMP_BYTE_6[2]
135H	Sensor status <sup>1)</sup>	CAN_STATE_NOX_SENS[2]
135H	Software version	CAN_TMP_BYTE_8[2]

Mode 4 - Sensor identification data, part 2:

sensor status: 1 x 1 x x x x (b)

ID = 130H, base time = 10ms - NOx sensor 1 data								
ID = 135H, base time = 10ms - NOx sensor 2 data								
Bit:	7	6	5	4	3	2	1	0
	MSB							LSB
Byte:								
0	Parameter list (BCD coded)							
1	Individual part number, byte 1 - year (BCD coded)							
2	Individual part number, byte 2 - month (BCD coded)							
3	Individual part number, byte 3 - day (BCD coded)							
4	Individual part number, byte 4 - number 1 (MSB), (BCD coded)							
5	Individual part number, byte 5 - number 2 (LSB), (BCD coded)							
6	Sensor status							
7	Quality status, (BCD coded)							

ID	Signal	Hex Range	Phys. Range	Resolution	Unit	Init Value	Default Value
130H, 135H	Parameter list	0... FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Individual part number, byte 1 - year	0...FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Individual part number, byte 2 - month	0...FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Individual part number, byte 3 - day	0...FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Individual part number, byte 4 - number 1 (MSB)	0...FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Individual part number, byte 5 - number 2 (LSB)	0...FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Sensor status <sup>1)</sup>	0...FFH	0...255	1	[-]	01H	01H
130H, 135H	Quality status	0...FFH	0...99 (BCD coded)	1	[-]	0	0

## NOx Sensor 1 - NC\_NOX\_SENS\_CONF &gt;= 1

ID	Signal	ECU signal variable name
130H	Parameter list	CAN_TMP_BYTE_1[1]
130H	Individual part number, byte 1 - year	CAN_TMP_BYTE_2[1]
130H	Individual part number, byte 2 - month	CAN_TMP_BYTE_3[1]
130H	Individual part number, byte 3 - day	CAN_TMP_BYTE_4[1]
130H	Individual part number, byte 4 - number 1 (MSB)	CAN_TMP_BYTE_5[1]
130H	Individual part number, byte 5 - number 2 (LSB)	CAN_TMP_BYTE_6[1]
130H	Sensor status <sup>1)</sup>	CAN_STATE_NOX_SENS[1]
130H	Quality status	CAN_TMP_BYTE_8[1]

## NOx Sensor 2 - NC\_NOX\_SENS\_CONF = 2

ID	Signal	ECU signal variable name
135H	Parameter list	CAN_TMP_BYTE_1[2]
135H	Individual part number, byte 1 - year	CAN_TMP_BYTE_2[2]
135H	Individual part number, byte 2 - month	CAN_TMP_BYTE_3[2]
135H	Individual part number, byte 3 - day	CAN_TMP_BYTE_4[2]
135H	Individual part number, byte 4 - number 1 (MSB)	CAN_TMP_BYTE_5[2]
135H	Individual part number, byte 5 - number 2 (LSB)	CAN_TMP_BYTE_6[2]
135H	Sensor status <sup>1)</sup>	CAN_STATE_NOX_SENS[2]
135H	Quality status	CAN_TMP_BYTE_8[2]

**Mode 5 - Sensor self diagnosis:**  
**sensor status: 0 0 1 x x x x x (b)**

Sen-

ID = 130H, base time = 10ms - NOx sensor 1 data ID = 135H, base time = 10ms - NOx sensor 2 data								
Bit:	7	6	5	4	3	2	1	0
	MSB							LSB
Byte:								
0	Diagnosis signal, High byte							
1	Diagnosis signal, Low byte							
2	Lambda signal, High byte							
3	Lambda signal, Low byte							
4	Binary O2 signal voltage, High byte							
5	Binary O2 signal voltage, Low byte							
6	Sensor status							
7	Diagnosis status							

ID	Signal	Hex Range	Phys. Range	Resolution	Unit	Init Value	Default Value
130H, 135H	Diagnosis signal <sup>4)</sup> - Diagnosis reference value - Diagnosis value	8000H... 7FFFH	-32768... 32767	1	[-]	00H	
130H, 135H	Lambda signal	8000H... 7FFFH	-32768... 32767	1	[-]	00H	
130H, 135H	Binary O2 signal	8000H... 7FFFH	-32968... 32567	1	[mV]	00H	
130H, 135H	Sensor status <sup>1)</sup>	0...FFH	0...255	1	[-]	01H	01H
130H, 135H	Diagnosis status <sup>3)</sup>	0...FFH	0...255	1	[-]	0	0

## NOx Sensor 1 - NC\_NOX\_SENS\_CONF &gt;= 1

ID	Signal	ECU signal variable name
130H	Diagnosis signal <sup>4)</sup>	CAN_TMP_WORD_1[1]
130H	Lambda signal	CAN_LAMB_NOX_SENS[1]
130H	Binary O2 signal	CAN_VLS_NOX_SENS[1]
130H	Sensor status <sup>1)</sup>	CAN_STATE_NOX_SENS[1]
130H	Diagnosis status <sup>3)</sup>	CAN_TMP_BYTE_8[1]

## NOx Sensor 2 - NC\_NOX\_SENS\_CONF = 2

ID	Signal	ECU signal variable name
135H	Diagnosis signal <sup>4)</sup>	CAN_TMP_WORD_1[2]
135H	Lambda signal	CAN_LAMB_NOX_SENS[2]
135H	Binary O2 signal	CAN_VLS_NOX_SENS[2]
135H	Sensor status <sup>1)</sup>	CAN_STATE_NOX_SENS[2]
135H	Diagnosis status <sup>3)</sup>	CAN_TMP_BYTE_8[2]


1) The following table describes the meaning of byte "Sensor status":

Byte: "Sensor status"								Function
B7	B6	B5	B4	B3	B2	B1	B0	
							X	Power supply bit. 0 ... 11.5V ≤ VB ≤ 15.5V 1 ... VB < 11.5V or VB > 15.5V VB...battery voltage measured by NOx sensor ECU inside of NOx sensor ECU
						X		Sensor temperature indication bit. 0 ... Sensor temperature is not ok (out of operating range) 1 ... Sensor temperature is ok (within operating range)
					X			Ip1 ready indication bit. 0 ... not ok (out of operating range) 1 ... ok (within operating range)
				X				Ip0 ready indication bit. 0 ... not ok (out of operating range) 1 ... ok (within operating range)
			X					Ip2 ready indication bit. 0 ... not ok (out of operating range) 1 ... ok (within operating range)
		X						Mode switch for read out of sensor identification data and sensor self diagnosis mode For details see NOx sensor specification. Bit B7 = 0: 0 ... Normal sensor operation mode 1 ... Sensor self diagnosis mode Bit B7 = 1 (sensor identification data read out mode): 0 ... Sensor transmits sensor identification data part 1 1 ... Sensor transmits sensor identification data part 2
	X							Dew point bit. 0 ... Sensor has received dew point Byte 1 and 2 contains NOx signal. 1 ... Sensor is waiting for dew point Byte 1 and 2 contains resistance ratio.
X								Mode switch for read out of sensor identification data. For details see NOx sensor specification. 0 = normal sensor operation or sensor self diagnosis mode 1 = sensor identification data read out mode
								<b>Important combinations:</b>
0	0	0	0	0	0	0	0	0 (00H): NOx sensor is not yet active.
0	1	0	0	0	0	0	0	64 (40H): NOx sensor is waiting for dew point.
0	0	0	0	0	0	0	1	1 (01H): NOx sensor can not reach any readiness level because of power supply problem
0	0	0	0	0	0	1	0	2 (02H): NOx sensor readiness is level 1. Temperature is ok.
0	0	0	0	1	1	1	0	14 (0EH): NOx sensor readiness is level 2. Lambda and binary O2 signal are valid.
0	0	0	1	1	1	1	0	30 (1EH): NOx sensor has full readiness. NOx, Lambda and binary O2 signals are valid.
0	0	0	1	1	1	1	1	31 (1FH): NOx sensor has full readiness. All signals are valid. But a power supply problem is present.

2) The following table describes the meaning of byte "Error status":

Byte: "Error status"								Function
B7	B6	B5	B4	B3	B2	B1	B0	
0	0	0	0	0	0	0	0	NOx sensor no failure
							X	NOx sensor error 1, Open wire at heater
						X		NOx sensor error 2, Open wire at NOx function
					X			NOx sensor error 3, Open wire at Lambda function
			X					NOx sensor error 4, Open wire at binary O2 function
		X						NOx sensor error 5, Short circuit at heater
	X							NOx sensor error 6, Short circuit at NOx function
								NOx sensor error 7, Short circuit at Lambda function
X								NOx sensor error 8, Short circuit at binary O2 function

3) The following table describes the meaning of byte "Diagnosis status":

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Byte: "Diagnosis status"	
Value	Function
0 (00H)	Sensor self diagnosis is running
1 (01H)	Sensor self diagnosis was aborted. Sensor is returning to normal operation mode.
2 (02H)	Sensor self diagnosis was completed. Result: "Sensor is ok". Sensor is returning to normal operation mode.
3 (03H)	Sensor self diagnosis was completed. Result: "Sensor is faulty". Sensor is returning to normal operation mode.
other values	Other values are not defined yet.

4) The following table describes the meaning of byte "Diagnosis signal":

Byte: "Diagnosis status"		Byte: "Diagnosis signal"	
Value	Function	Signal	ECU signal variable name
0 (00H)	Diagnosis runs	Diagnosis reference value	CAN_NOX_REF_NS[i]
1 (01H)	Diagnosis aborted	Diagnosis reference value	CAN_NOX_REF_NS[i]
2 (02H)	Diagnosis completed	Diagnosis value	CAN_NOX_DIAG_NS[i]
3 (03H)	Diagnosis completed	Diagnosis value	CAN_NOX_DIAG_NS[i]
other values	not defined	not defined	not defined

#### 4.43.2.3.1 Selection of NOx sensor configuration

##### General information:

The EMS system MSD80 is designed for various exhaust gas system configurations (e.g. N43UL - 1 branch system, N43OL - Y system with 1 NOx catalyst, N53 - Y system with 2 NOx catalysts, N53 development samples - full 2 branch system). Hence the adjusted value of NC\_NOX\_SENS\_CONF (number of NOx sensors within the system) does not correspond always correctly with the number of really necessary or really used NOx sensors. Therefore NC\_NOX\_SENS\_CONF is adjusted mostly on 2 NOx sensors even if only 1 NOx sensor is really necessary or really used.

example: MSD80 - N53

1. full 2 branch system with 2 NOx sensors:

NC\_NOX\_SENS\_CONF has to be adjusted to 2.

2. Y system with 2 NOx catalysts and 1 NOx sensor:

NC\_NOX\_SENS\_CONF should be adjusted to 1 but is adjusted to 2 because it is the same software like as for full 2 branch system.


So that these different exhaust system configurations can be handled with 1 ECU software it was implemented a functionality for copying of NOx sensor signals from line  $i = 1$  to line  $i = 2$ .

##### Application conditions

<b>Initialisation:</b>	-
<b>Recurrence:</b>	10ms
<b>Activation:</b>	after reset
<b>Deactivation:</b>	-

##### Formula section:


**if** NC\_NOX\_SENS\_CONF = 2  
**then**

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```

if      LC_NOX_SENS_2 = 0
then
    CAN_NOX_NOX_SENS_2 = CAN_NOX_NOX_SENS_1
    CAN_LAMB_NOX_SENS_2 = CAN_LAMB_NOX_SENS_1
    CAN_VLS_NOX_SENS_2 = CAN_VLS_NOX_SENS_1
    CAN_STATE_NOX_SENS_2 = CAN_STATE_NOX_SENS_1
    CAN_ERR_NOX_SENS_2 = CAN_ERR_NOX_SENS_1
else
    CAN_NOX_NOX_SENS_2 = CAN message data from ID=135H
    CAN_LAMB_NOX_SENS_2 = CAN message data from ID=135H
    CAN_VLS_NOX_SENS_2 = CAN message data from ID=135H
    CAN_STATE_NOX_SENS_2 = CAN message data from ID=135H
    CAN_ERR_NOX_SENS_2 = CAN message data from ID=135H
endif
endif

```

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## 4.44 Clutch switch

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CS_CUS	O/V	0... 1H	0 ...1	1	-
Boolean for clutch switch detection					

### Input data:

LV_AT {p. 654}	LV_IM_CS_PN {p. 852}	LV_VAR_TCT {p. 656}	STATE_ETCU_CLU {p. 1573}
----------------	----------------------	---------------------	-----------------------------

### General information:

Clutch switch detection is required for function management at transient conditions. It's only necessary for cars with manual transmission.

At determination of the 'real' clutch-switch closing (LV\_IM\_CS\_PN=1) LV\_CS\_CUS resets at change of LV\_IM\_CS\_PN from 1 → 0 or STATE\_ETCU\_CLU 03H/4H/5H.

### Application conditions

**Activation:** LV\_AT = 0

**Deactivation :** LV\_AT = 1

**Initialisation:**

```

if LV_AT=0 and LV_VAR_TCT = 0
  then LV_CS_CUS = LV_IM_CS_PN
  time recurrency : 10ms
endif

```

### Formula section:

```

if LV_VAR_TCT = 0
  then LV_CS_CUS = LV_IM_CS_PN
  elseif STATE_ETCU_CLU = 3H or 4H or 5H
    then LV_CS_CUS = 0
    else LV_CS_CUS = 1
  endif
endif

```

## 4.45 Power steering acquisition

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ANG_PSTE_END_LE_AD	O/V/S	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW
relative steering wheel sensor left side adaptation					
ANG_PSTE_END_RI_AD	O/V/S	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW
relative steering wheel sensor angle right					
ANG_PSTE_STND	O/V	8000... 7FFFH	-100... 99.9969482422	3.05176e-3	%
Relative steering wheel sensor angle					
LV_STG_RI_ACT	V	0... 1H	0 ...1	1	-
LV indicating steering active (direction: 1 = right , 0 = left)					
LV_VEL_ANG_PSTE_MIN_DET	V	0... 1H	0 ...1	1	-
LV indicating "released" steering wheel					
T_VEL_ANG_PSTE	V	0... FFH	0... 2.55	0.01	s
Time for detecting "released" steering wheel					
VEL_ANG_PSTE_COR	O/V	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
Filtered steering-wheel-angle velocity					
VEL_ANG_PSTE_MMV	V	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
moving mean value of steering-wheel-angle velocity					

### Input data:

ANG_PSTE {p. 1561}	LV_ERR_ANG_PSTE_CAN {p. 1565}	LV_IGK {p. 906}	VEL_ANG_PSTE {p. 1582}
VS {p. 1176}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ANG_PSTE_AD_LGRD	-	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW
ANG_PSTE_AD incrementation					
C_ANG_PSTE_END_DIF	-	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW
cal. difference between ANG_PSTE_END_LE/RI_AD out of NVMY and init-value (at reset)					
C_ANG_PSTE_END_LE_INI	-	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW
initialisation value left ANG_PSTE_STND (positiv)					
C_ANG_PSTE_END_RI_INI	-	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW
initialisation value right ANG_PSTE_STND (negativ)					
C_CRLC_VEL_ANG_PSTE	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlation constant for steering wheel angle velocity					
C_T_ANG_PSTE_AD	-	0... FFFFH	0... 655.35	0.01	s
Time during which adaptation of steering wheel angle is inhibited					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_VEL_ANG_PSTE	-	0... FFH	0... 2.55	0.01	s
Time for detecting "released" steering wheel					
C_VEL_ANG_PSTE_MAX_AD	-	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
VEL_ANG_PSTE-threshold for adaptation of steering wheel angle					
C_VEL_ANG_PSTE_MIN_1	-	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
Minimum threshold VEL_ANG_PSTE_MMV for detection of steering active					
C_VEL_ANG_PSTE_MIN_2	-	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
Minimum threshold VEL_ANG_PSTE_MMV for detection of "released" steering wheel					
C_VS_PSTE	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for power steering					
LC_VEL_ANG_PSTE_COR	-	0... 1H	0 ...1	1	-
Calculation of VEL_ANG_PSTE_COR depending on steering wheel state					

## General Information

### Application Conditions

Initialization: RST, NVMINI, NVMRES, NVMSTO

Recurrence: 10MS

Activation: LV\_IGK==1

Deactivation: LV\_IGK==0

### Function description

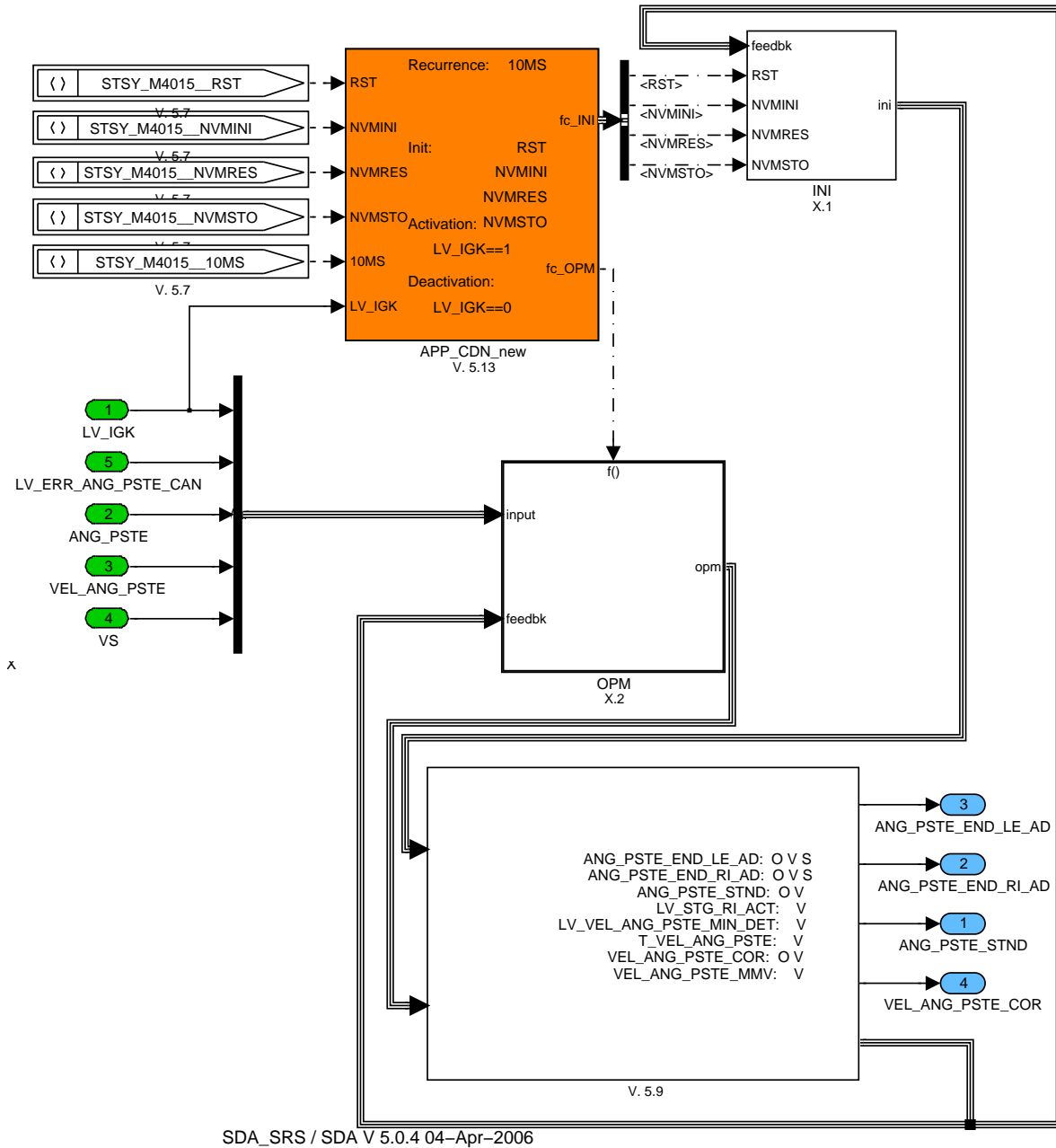



Figure 4.45.1: : Path: STSY\_M4015

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### 4.45.1 Initialisation

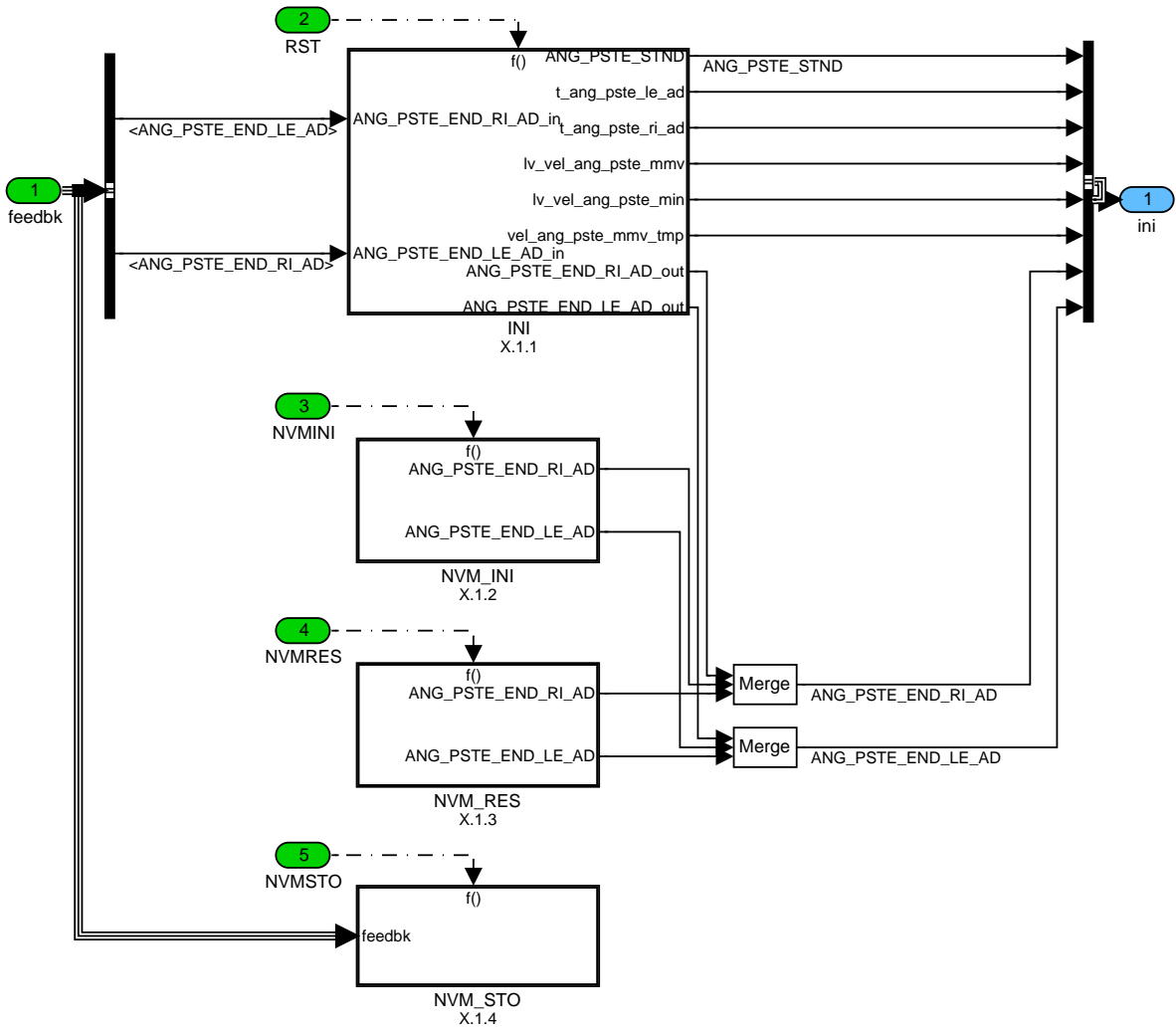


Figure 4.45.2: : Path: STSY\_M4015/INI

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### 4.45.1.1 Initialisation at reset

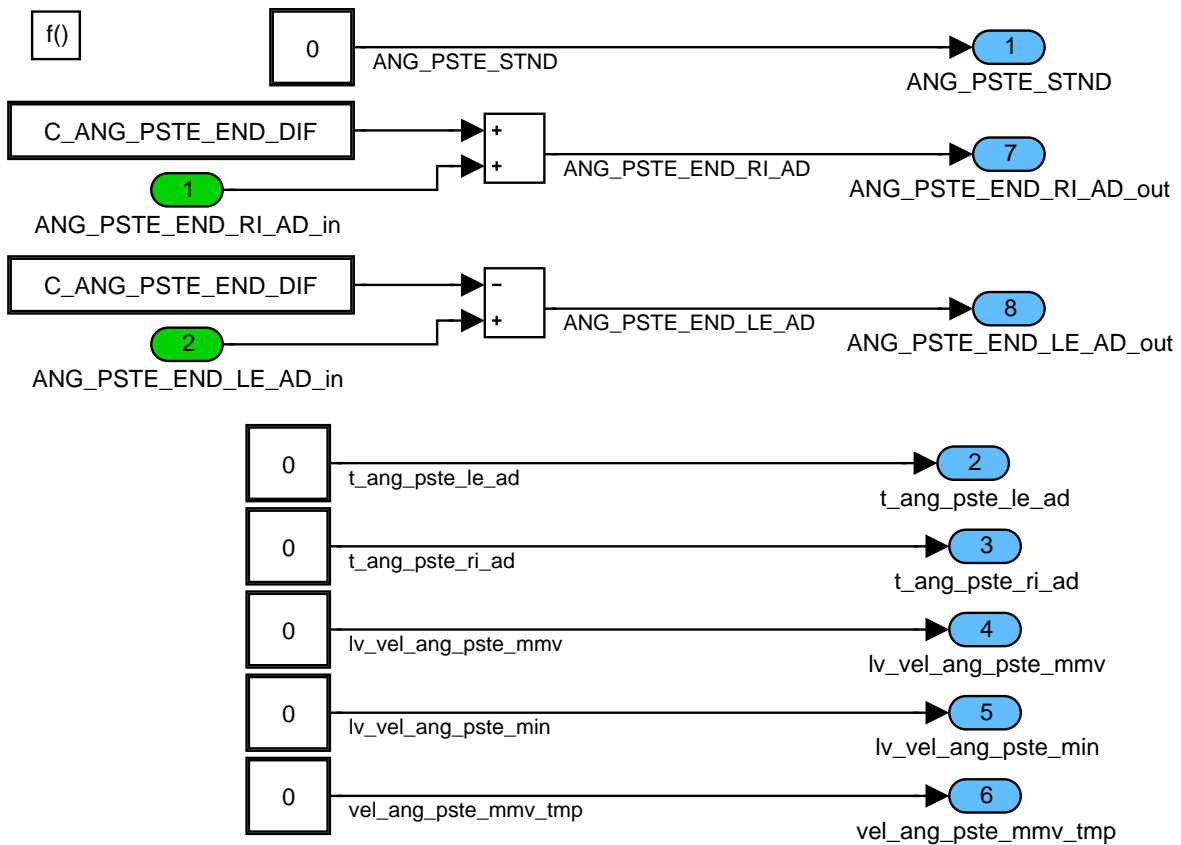


Figure 4.45.3: : Path: STSY\_M4015/INI/INI

### 4.45.1.2 Initialisation at NVMY

In case of new ECU or if reading non-volatile memory not possible

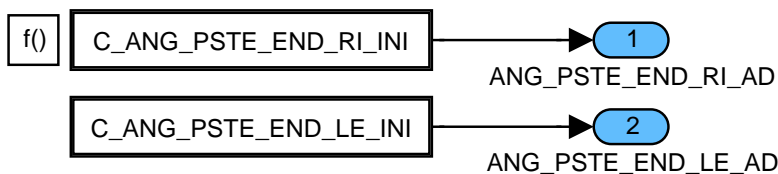


Figure 4.45.4: : Path: STSY\_M4015/INI/NVM\_INI



### 4.45.1.3 Restore of NVMY variable

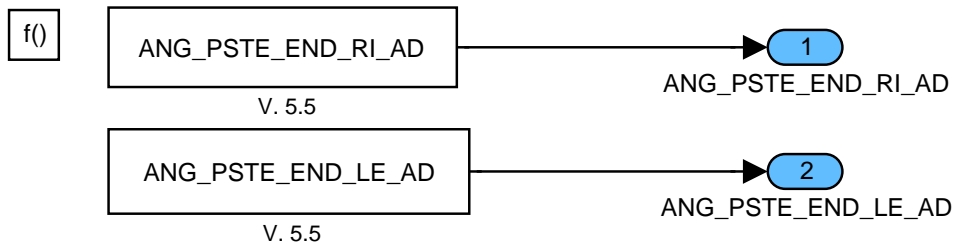


Figure 4.45.5: : Path: STSY\_M4015/INI/NVM\_RES

### 4.45.1.4 Storing of NVMY variable

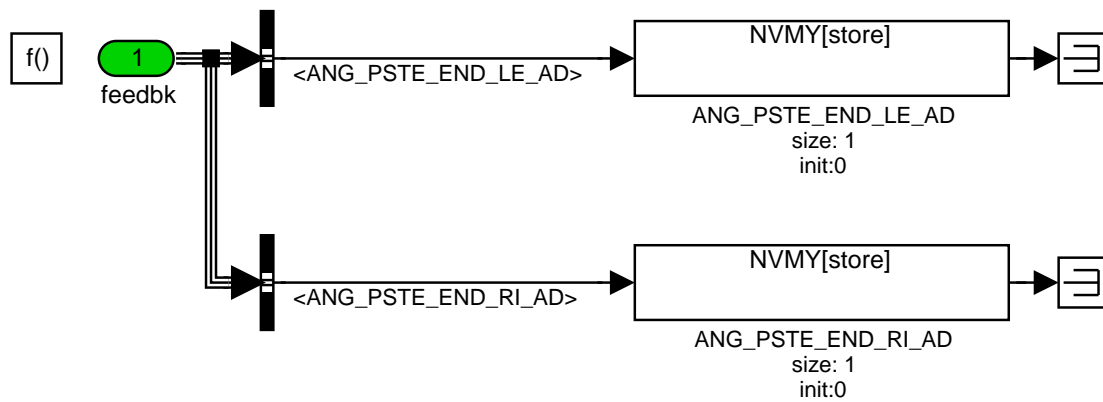


Figure 4.45.6: : Path: STSY\_M4015/INI/NVM\_STO

### 4.45.2 Function overview

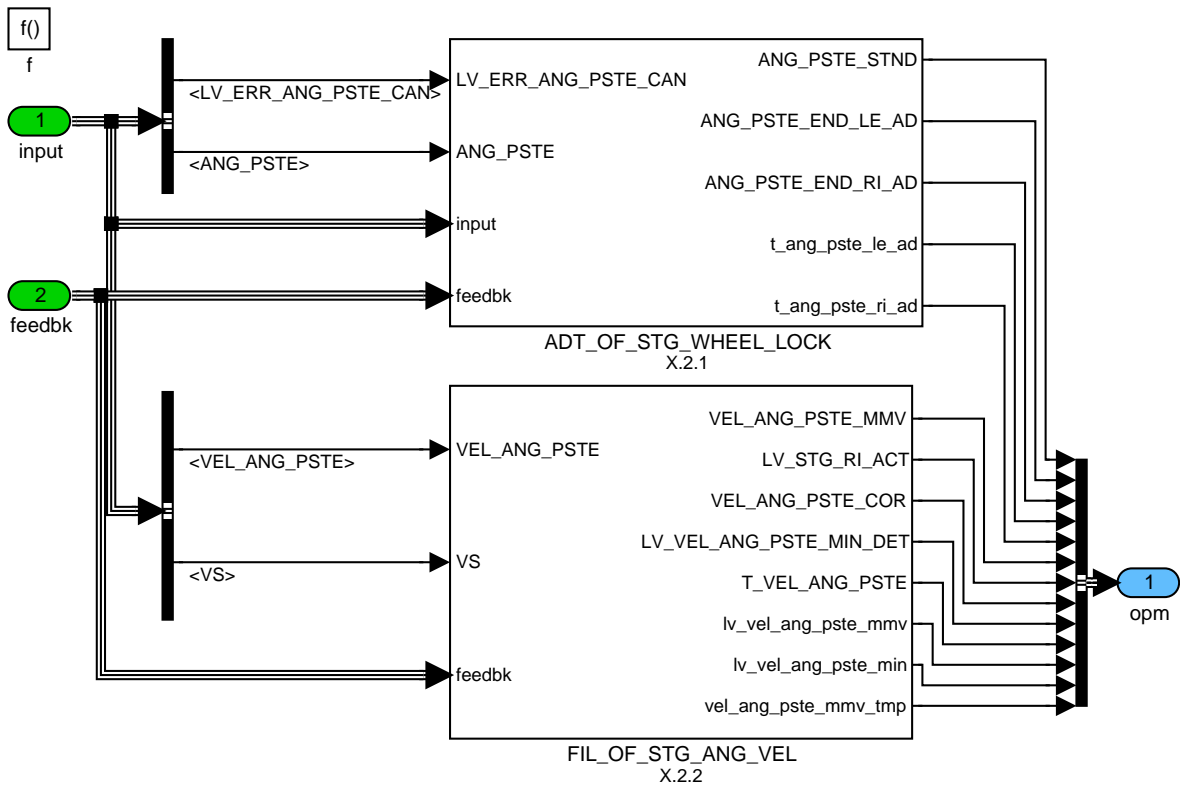


Figure 4.45.7: : Path: STSY\_M4015/OPM

#### 4.45.2.1 Adaptation of steering wheel lock

General information:

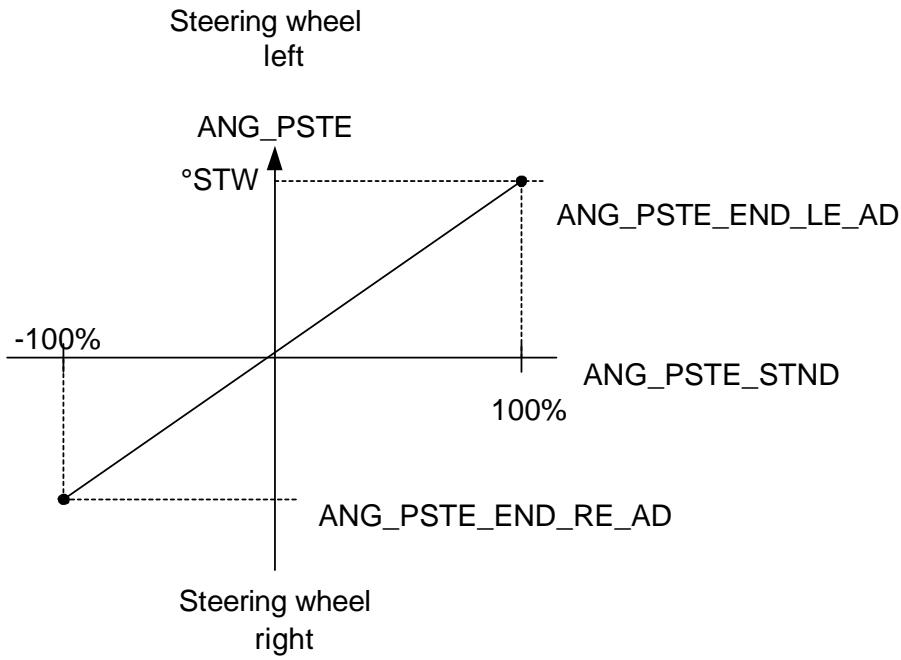
This module contains the calculation of the relative steering wheel sensor (ANG\_PSTE\_STND) and relating adaptations (ANG\_PSTE\_END\_RI\_AD, ANG\_PSTE\_END\_LE\_AD) depending on the steering wheel angle ANG\_PSTE received via CAN.

To enable a new adaptation of the steering wheel angles after every reset, the values ANG\_PSTE\_END\_LE/\_RI\_AD should be initialised as follows:

the adaptation values restored out of the non-volatile memory minus a calibratable constant.

Signal flow diagram:


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Application hint:

to ensure a proper adaptation of ANG\_PSTE\_END\_LE/RI please note that the range of the adaptation incrementation should be calibrated within the following range  
 $C\_ANG\_PSTE\_AD\_LGRD = 0.1 \text{ } ^\circ\text{STW} \dots 1.5 \text{ } ^\circ\text{STW}$

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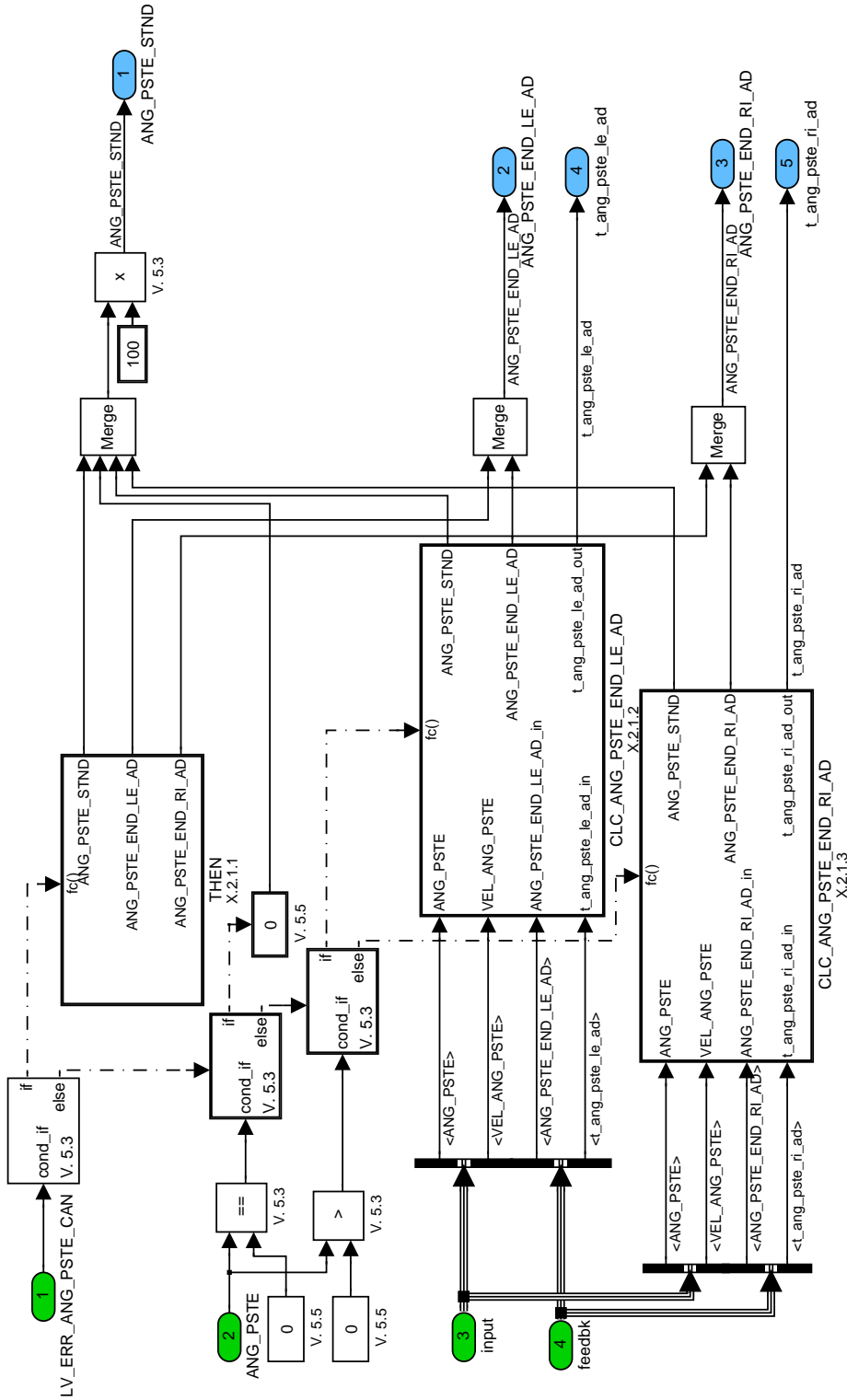



Figure 4.45.8: : Path: STSY\_M4015/OPM/ADT\_OF\_STG\_WHEEL\_LOCK

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### 4.45.2.1.1 Initialisation for variables

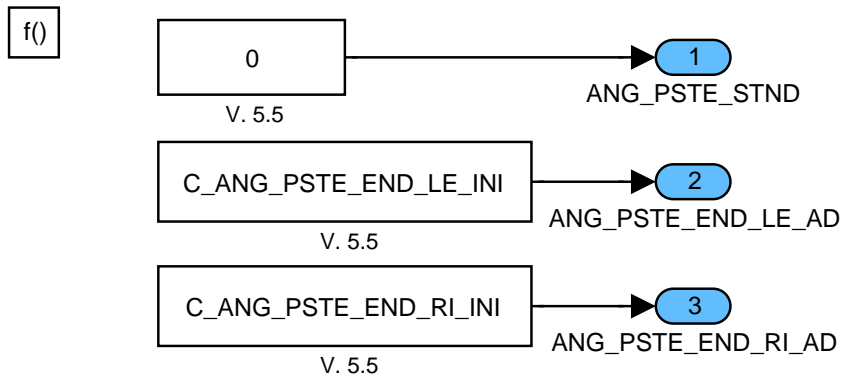



Figure 4.45.9: : Path: STSY\_M4015/OPM/ADT\_OF\_STG\_WHEEL\_LOCK/THEN

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### 4.45.2.1.2.1 Calculation of ANG\_PSTE\_END\_LE\_AD

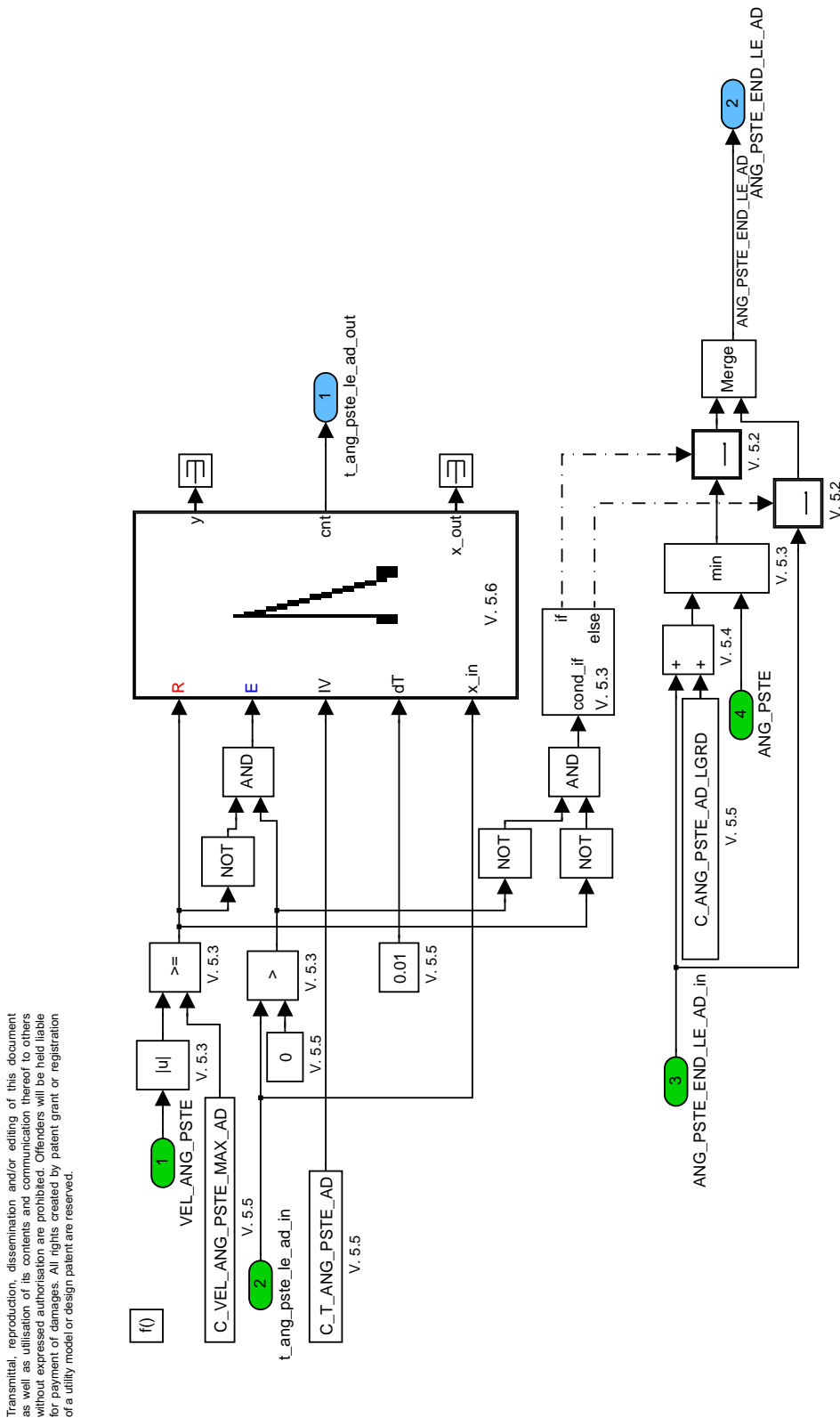



Figure 4.45.11: : Path:  
STSY\_M4015/OPM/ADT\_OF\_STG\_WHEEL\_LOCK/CLC\_ANG\_PSTE\_END\_LE\_AD/THEN

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### 4.45.2.1.3.1 Calculation of ANG\_PSTE\_END\_LE\_AD

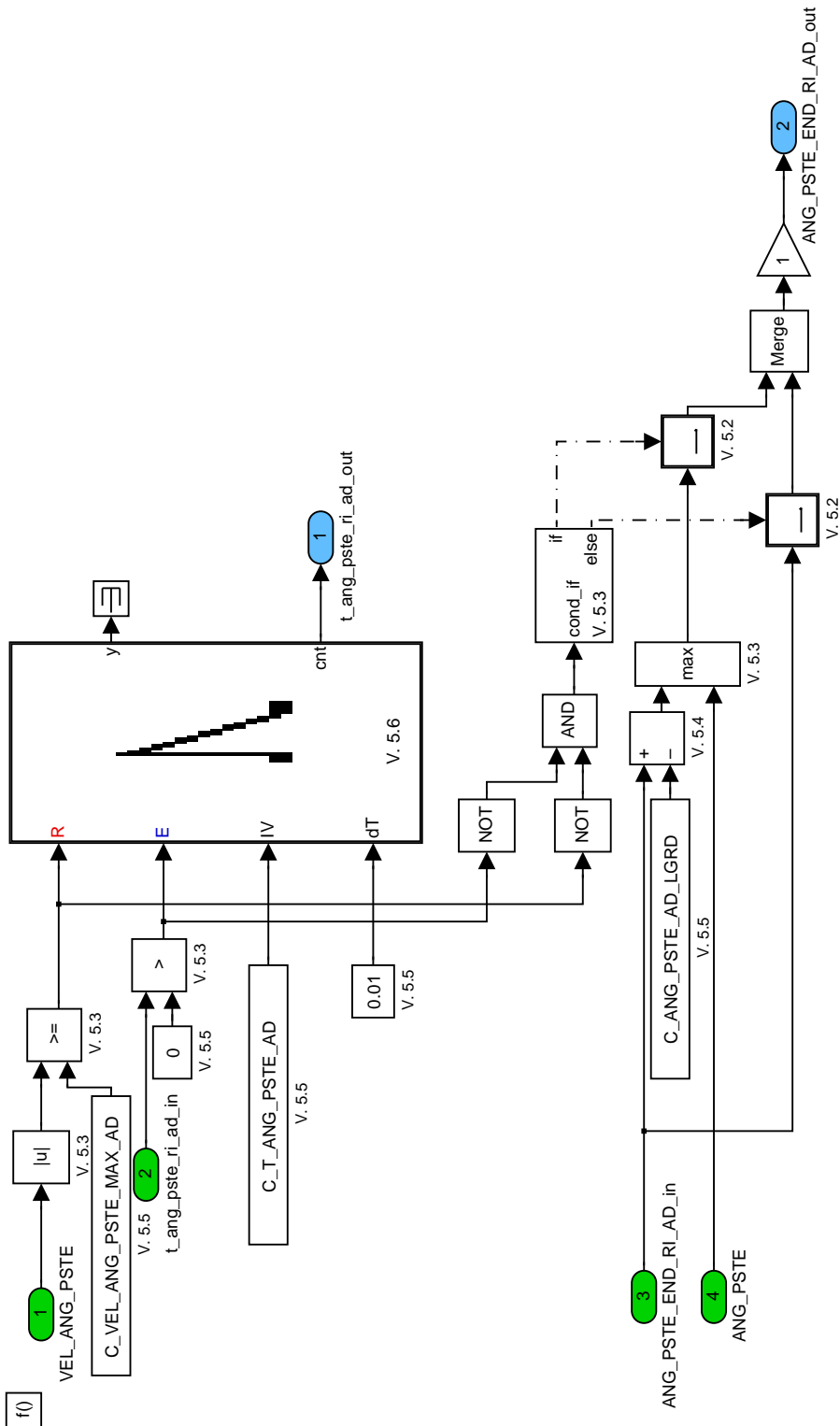



Figure 4.45.13: : Path:  
STSY\_M4015/OPM/ADT\_OF\_STG\_WHEEL\_LOCK/CLC\_ANG\_PSTE\_END\_RI\_AD/THEN

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### 4.45.2.2 Filtering of steering wheel angle velocity

General information:

This module contains the filtering of the steering-wheel angle velocity as well as the detection of the steering direction change and the state of the steering wheel (steering wheel: released or held tight). It is used as an input for the torque loss for power-steering-calculation: if the steering-wheel is held tight the providing of a torque loss for power-steering is necessary; whereas if the steering-wheel is released only the torque (Schleppmoment) of the power-steering pump itself is sufficient.

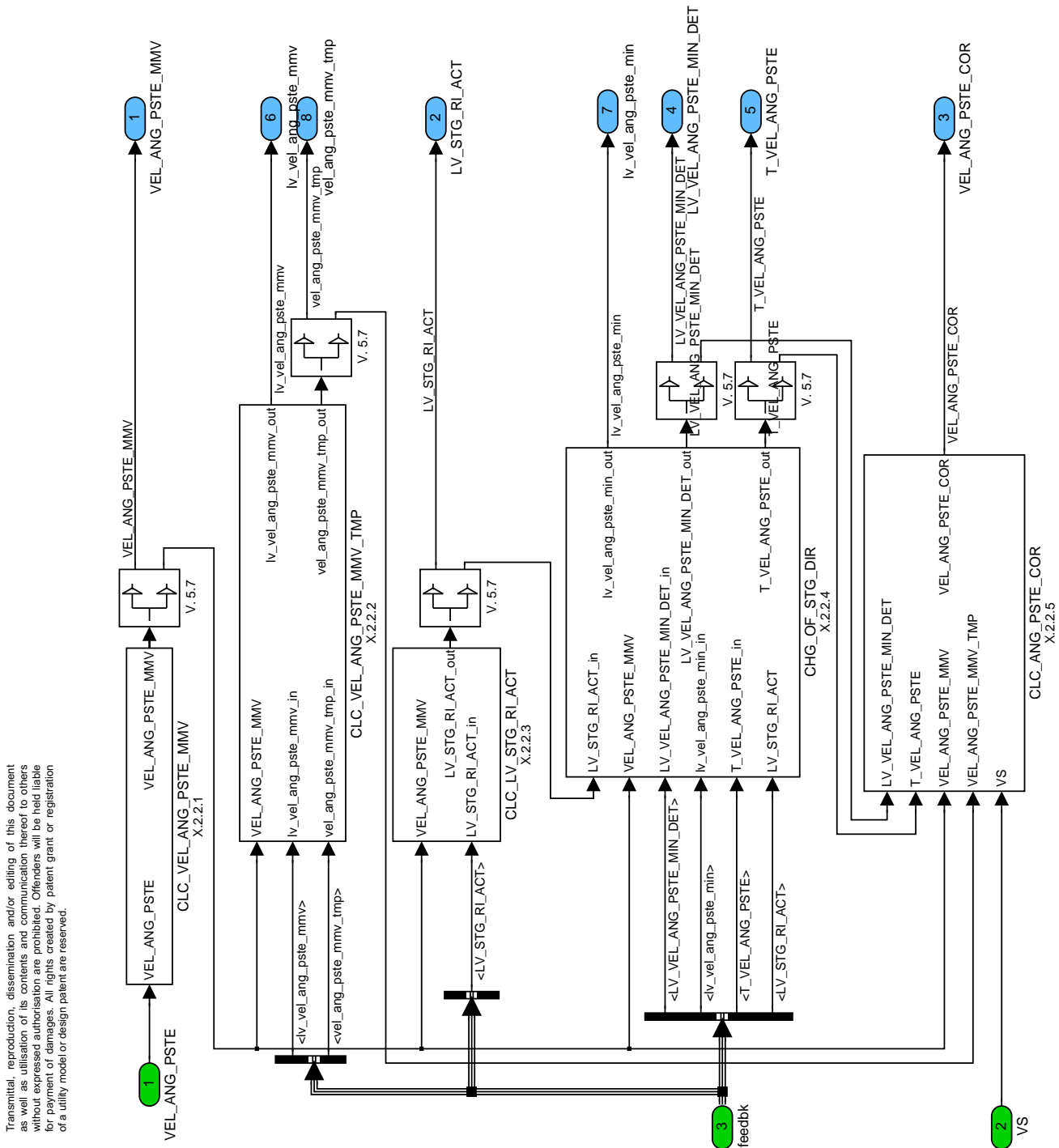


Figure 4.45.14: Path: STSY\_M4015/OPM/FIL\_OF\_STG\_ANG\_VEL

4.45.2.2.1 Moving mean value VEL\_ANG\_PSTE\_MMV:

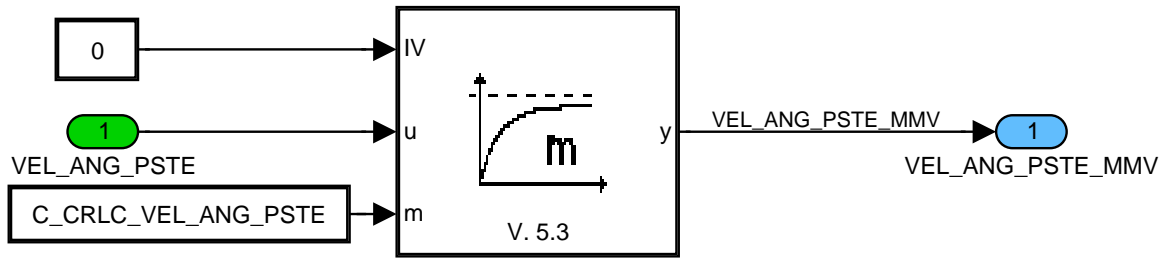

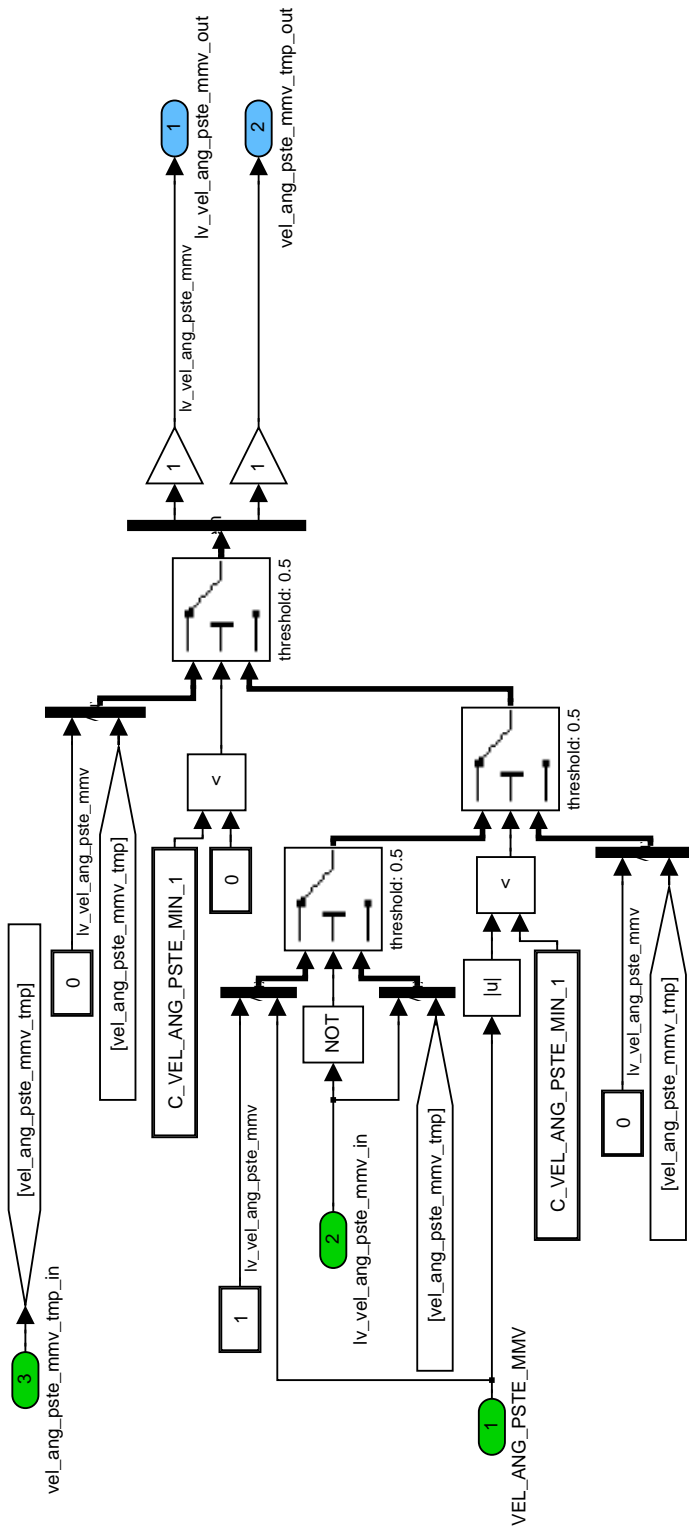


Figure 4.45.15: : Path: STSY\_M4015/OPM/FIL\_OF\_STG\_ANG\_VEL/CLC\_VEL\_ANG\_PSTE\_MMV

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### 4.45.2.2.2 Temporary moving mean value VEL\_ANG\_PSTE\_MMV\_TMP:



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Figure 4.45.16: : Path:  
STSY\_M4015/OPM/FIL\_OF\_STG\_ANG\_VEL/CLC\_VEL\_ANG\_PSTE\_MMV\_TMP

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### 4.45.2.2.3 Recognition of steering-direction:

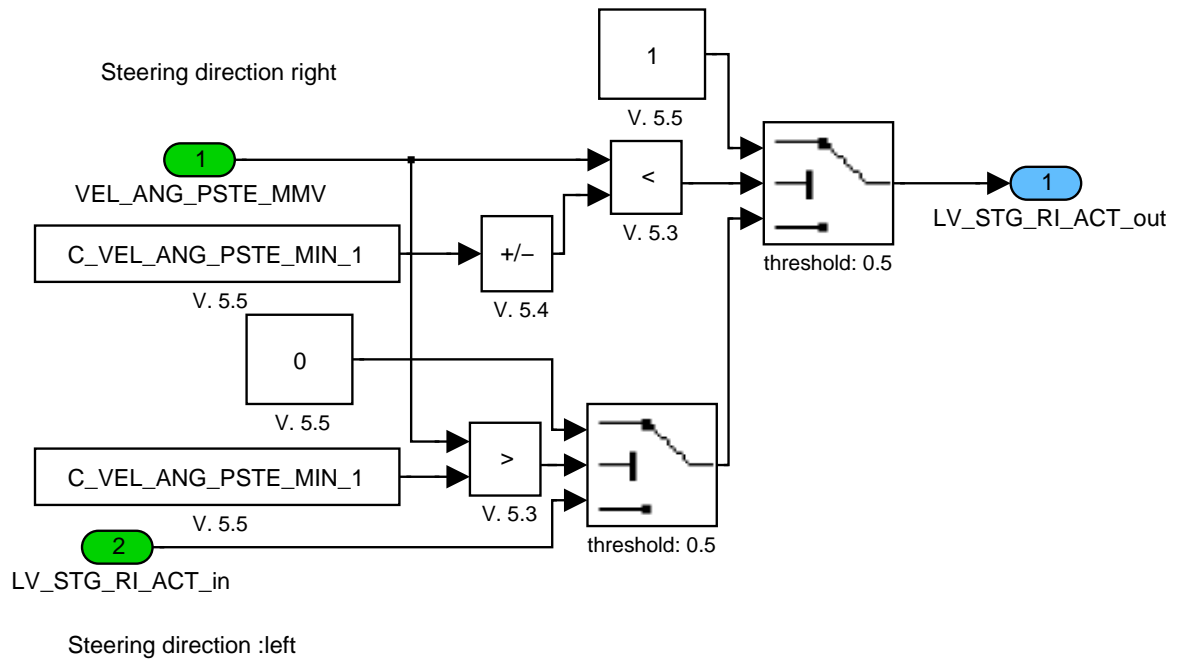
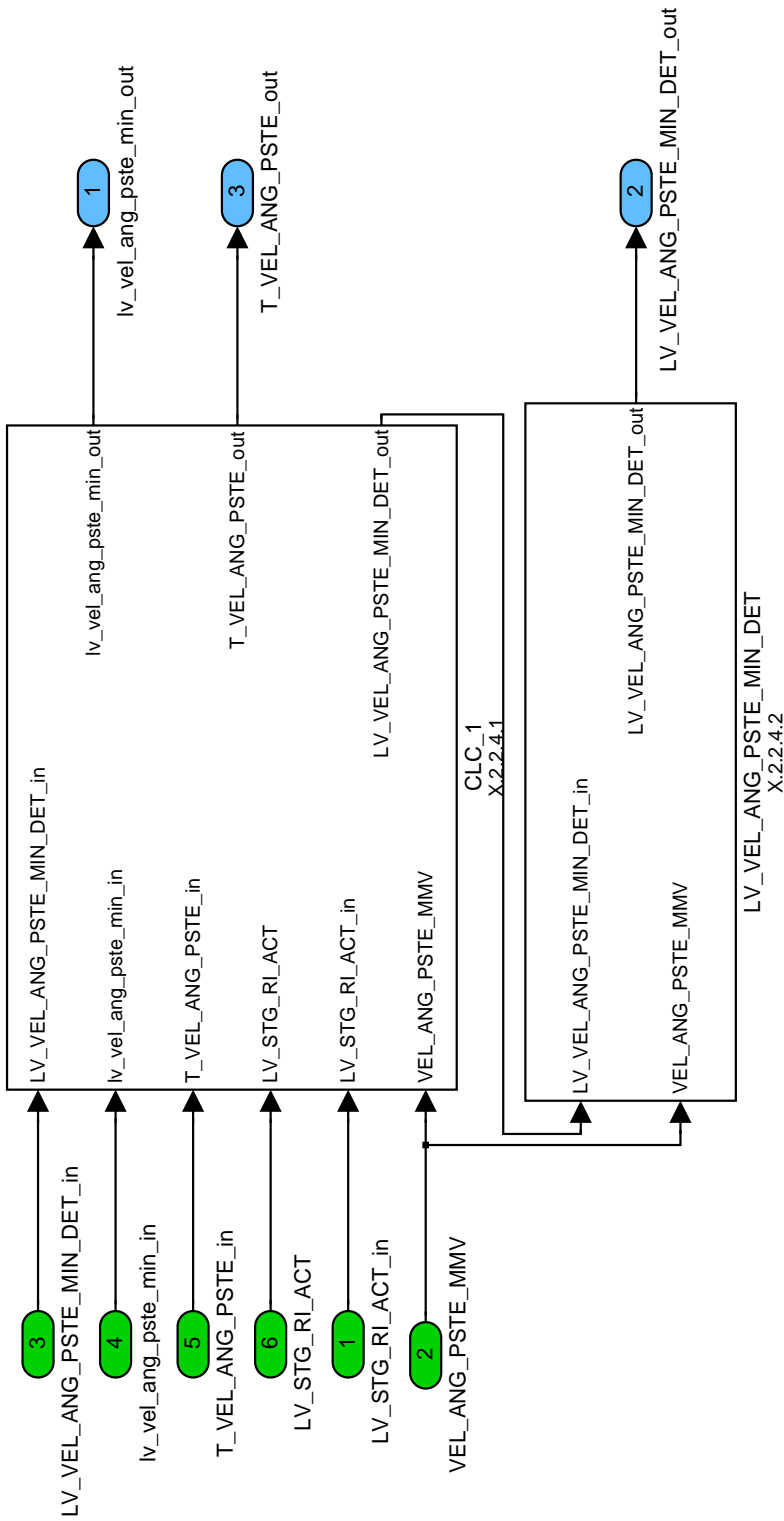


Figure 4.45.17: : Path: STSY\_M4015/OPM/FIL\_OF\_STG\_ANG\_VEL/CLC\_LV\_STG\_RI\_ACT


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#### 4.45.2.2.4 Change of steering direction:

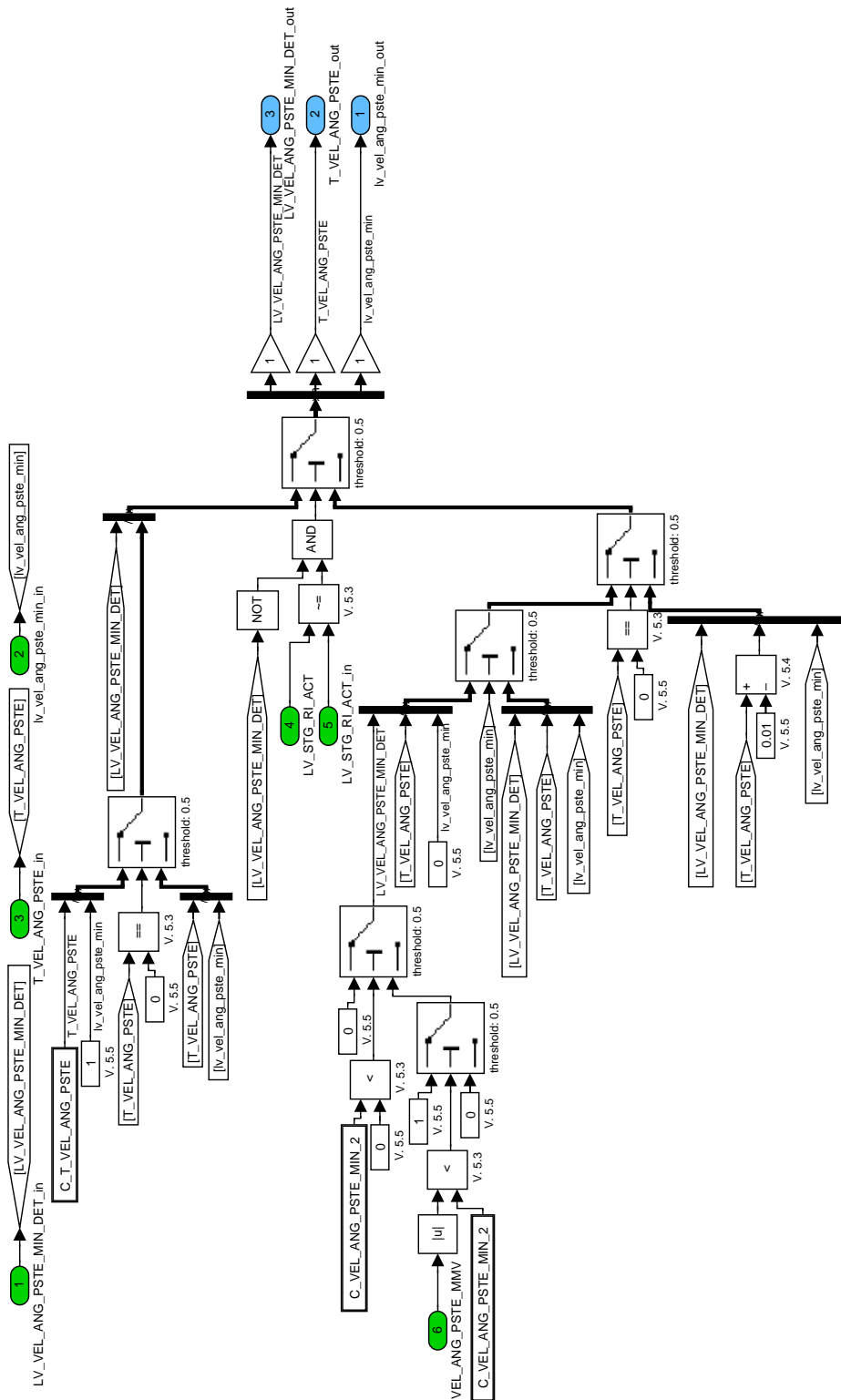


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Figure 4.45.18: : Path: STSY\_M4015/OPM/FIL\_OF\_STG\_ANG\_VEL/CHG\_OF\_STG\_DIR

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### 4.45.2.2.4.1 Calculation of T\_VEL\_ANG\_PSTE



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Figure 4.45.19: Path: STSY\_M4015/OPM/FIL\_OF\_STG\_ANG\_VEL/CHG\_OF\_STG\_DIR/CLC\_1

### 4.45.2.2.4.2 Calculation of LV\_VEL\_ANG\_PSTE\_MIN\_DET

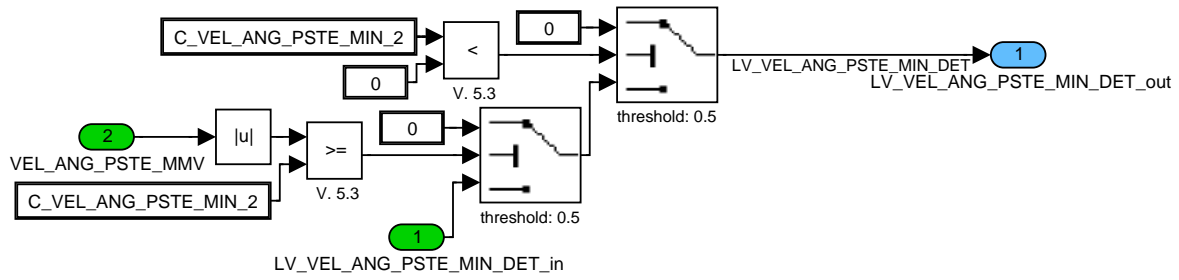



Figure 4.45.20: : Path:  
STSY\_M4015/OPM/FIL\_OF\_STG\_ANG\_VEL/CHG\_OF\_STG\_DIR/LV\_VEL\_ANG\_PSTE\_MIN\_DET

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## 4.46 Detection of driver request passive

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CT	O/V	0... 1H	0 ...1	1	-
Logical variable for detecting driver request passive					

### Input data:

FAC_TQ_REQ_CLU_LDM {p. 6706}	LV_MTC_CUR_OFF {p. 6565}	N_32 {p. 1525}	
---------------------------------	-----------------------------	----------------	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQ_REQ_CLU_IS_HYS	-	0... FFFFH	0... 1.99996	30.5e-6	-
Hysteresis on threshold on FAC_TQ_REQ_CLU for IS detection					
IP_FAC_TQ_REQ_CLU_IS_N_32	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_N_32_FAC_TQ_REQ_CLU_IS	0	1... FFH	32... 8160	32	rpm
Threshold on FAC_TQ_REQ_CLU for IS detection					

### General information:

The detection of LV\_CT = 0 (no torque request from driver or cruise control or LDM) is done by evaluating the torque scaling factor FAC\_TQ\_REQ\_CLU\_LDM (driver /cruise /LDM).

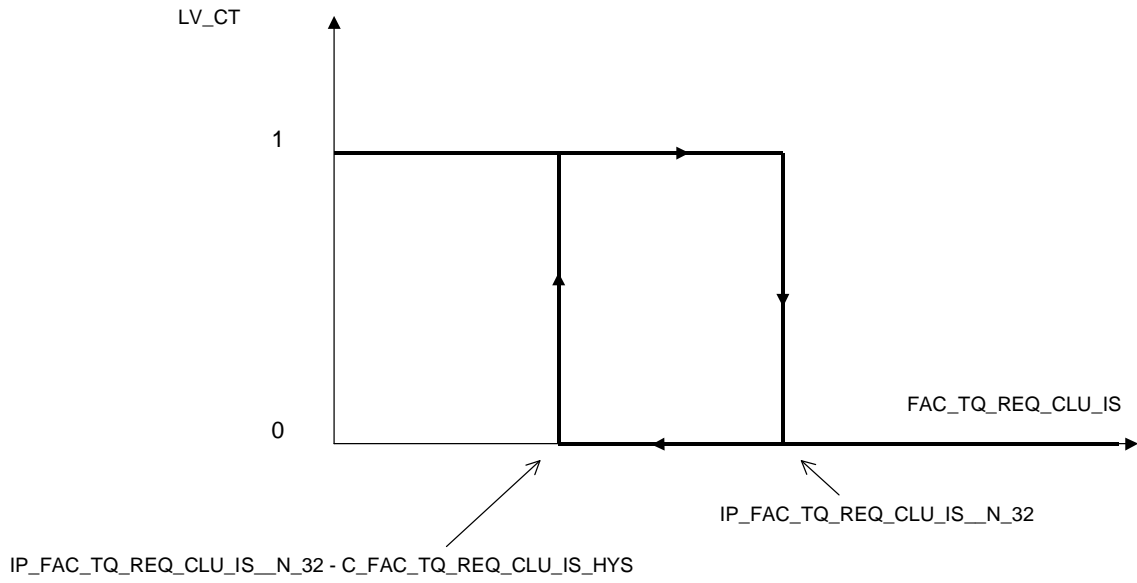
In case of LV\_MTC\_CUR\_OFF = 1 (no more throttle control), the throttle will remain in the fixed limp home position, which is around 8° (depending on the used throttle); this is a part load position (LV\_CT=0). All torque requests can only be realized by spark advance interaction or single cylinder cut off coordination. For this purpose the driver passive detection is deactivated (LV\_CT=0).

### Formula section:


```

If          LV_MTC_CUR_OFF = 1
Then       LV_CT = 0
Else       if          LV_CT = 1
           Then       if          FAC_TQ_REQ_CLU_LDM IP_FAC_TQ_REQ_CLU_IS__N_
32          Then       LV_CT = 0
           Endif
           Else       if          (FAC_TQ_REQ_CLU_LDM IP_FAC_TQ_REQ_CLU_IS__
N_32
- C_FAC_TQ_REQ_CLU_IS_HYS )
           Then       LV_CT = 1
           Endif
           Endif
Endif

```



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## 4.47 Engine off duration

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ST_END_T_ES	V	0... 1H	0 ...1	1	-
Flag used to allow T_REL_CAN_ES setting when engine stops					
T_ES	O/V	0... FFFFH	0... 65535	1	min
Engine off duration time					
T_ES_2	O/V	0... FFFFH	0... 65535	1	s
Engine off duration time in second					
T_ES_CUS	O/V	0... FFFFH	0... 65535	1	min
Engine off duration time for customer - value holds while engine is running					
T_REL_CAN_ES	V/S	0... FFFFFFFFH	0... 4294967295	1	min
Time counter value at the start of engine off phase					
T_REL_CAN_ES_2	V/S	0... FFFFFFFFH	0... 4294967295	1	s
Time counter value at the end of start of engine off phase					
T_REL_CAN_ST	V	0... FFFFFFFFH	0... 4294967295	1	min
Time counter value at the end of engine off phase					
T_REL_CAN_ST_2	V	0... FFFFFFFFH	0... 4294967295	1	s
Time counter value at the end of engine off phase					

### Input data:

LV_ERR_T_ES {p. 4466}	LV_ERR_T_ES_TCO_ FAST {p. 4466}	LV_ERR_T_ES_TCO_ SLOW {p. 4466}	LV_ES {p. 1720}
LV_IGK {p. 906}	LV_ST_END {p. 1720}	LV_T_REL_CAN_REG {p. 1567}	T_REL_CAN {p. 1579}
T_REL_CAN_2 {p. 1579}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_ES_SUB	-	0... FFFFH	0... 65535	1	min
substitute value of T_ES					
C_T_REL_CAN_ST_2_MAN	-	0... FFFFFFFFH	0... 4294967295	1	s
Manual value for T_REL_CAN_ST_2 in seconds					
LC_T_REL_CAN_ST_MAN	-	0... 1H	0 ...1	1	-
Switch to enable manual setting of T_REL_CAN_ST and T_REL_CAN_ST_2					

### FUNCTION DESCRIPTION:

The time T\_ES describes the engine off duration time. For this the relative time counter of CAN Message XXXX is evaluated. This counter is incremented every minute by 1 Hex.

At the transition into the Engine State LV\_ES the last valid Value of T\_REL\_CAN is hand over to the non-volatile memory as T\_REL\_CAN\_ES.

As soon as the condition LV\_ES and LV\_IGK = 1 is recognised the Value of T\_REL\_CAN is hand over to T\_REL\_CAN\_ST and will be updated every minute until the State LV\_ES is leaving.

As soon as T\_REL\_CAN\_ST is present the Time T\_ES is calculated and will be updated every minute until the State LV\_ES is leaving too.

The time T\_ES\_2 calculated in every second. This is needed for the calculation of restart factor of the mass fuel flow (fac\_st\_rest). Similar to T\_ES, as soon as T\_REL\_CAN\_ST\_2 is present the Time T\_ES\_2 is calculated and will be updated every second until the State LV\_ES is leaving too.

**General information:**

The engine off duration time will be used mainly in temperature critical functions like injection and dew point recognition

**Application conditions:**

*Initialization at reset:*

```
T_ES = 0
T_ES_2 = 0
T_REL_CAN_ES_2 = 0 (out of NVMY)
T_REL_CAN_ST_2 = 0
T_REL_CAN_ES = 0 (out of NVMY)
T_REL_CAN_ST = 0
LV_ST_END_T_ES = 0
T_ES_CUS = 0
```

*Recurrence:* 100ms  
*Activation:* always


**Formula section:**

```
If(1) (LV_T_REL_CAN_REG = 1 and
LV_ST_END_T_ES = 1 and
LV_ES_n = 1 and LV_ES_{n-1} = 0) //When the transition to engine stop is
recognized, then the timers at the start of the engine off phase are set//
Then(1) T_REL_CAN_ES = T_REL_CAN (non volatile)
LV_ST_END_T_ES = 0
T_REL_CAN_ES_2 = T_REL_CAN_2 (non volatile)
Endif(1)
```

**Calculation of T\_ES:**

```
If(1) LV_ST_END = 0
Then (1)
If (2) LV_ERR_T_ES = 0 and
LV_ERR_T_ES_TCO_SLOW = 0 and
LV_ERR_T_ES_TCO_FAST = 0
Then (2)
If (3) LC_T_REL_CAN_ST_MAN = 1 // flag for testing
Then(3) T_REL_CAN_ST = (C_T_REL_CAN_ST_2_MAN / 60)
Else(3) T_REL_CAN_ST = T_REL_CAN
EndIf(3)
T_ES = T_REL_CAN_ST - T_REL_CAN_ES
Else(2) T_ES = C_T_ES_SUB
Endif (2)
Else(1) T_ES = 0
LV_ST_END_T_ES = 1
Endif (1)
```

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**Calculation of T\_ES\_2:**

```

If(1)          LV_ST_END = 0
Then (1)
    If (2)          LV_ERR_T_ES = 0           and
                    LV_ERR_T_ES_TCO_SLOW = 0       and
                    LV_ERR_T_ES_TCO_FAST = 0
    Then (2)
        If (3)          LC_T_REL_CAN_ST_MAN = 1     // flag for testing
        Then(3) T_REL_CAN_ST_2 = C_T_REL_CAN_ST_2_MAN
        Else(3) T_REL_CAN_ST_2 = T_REL_CAN_2
        EndIf(3)
                    T_ES_2 = T_REL_CAN_ST_2 - T_REL_CAN_ES_2
    Else(2)          T_ES_2 = C_T_ES_SUB * 60
    Endif (2)
Else(1)          T_ES_2 = 0
Endif (1)
    
```

**Calculation of T\_ES\_CUS:**

*//Remark: T\_ES\_CUS must be calculated after T\_ES is calculated!*

```

If (1)          LV_ST_END = 0
Then (1)          T_ES_CUS = T_ES
Else (1)          //engine has started//
    if(2)          LV_ERR_T_ES = 1           or
                    LV_ERR_T_ES_TCO_SLOW = 1       or
                    LV_ERR_T_ES_TCO_FAST = 1
    Then(2)          T_ES_CUS = C_T_ES_SUB //if T_ES error is detected, then T_ES_CUS is
                    set to the substitute value//
    Else(2)          T_ES_CUSn = T_ES_CUSn-1//if no error detected, then T_ES_CUS remains con-
                    stant, equal to the value of T_ES before the engine started//
    Endif(2)
Endif(1)
    
```

## 4.48 Engine roughness segment time correction

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ENA_SEG_T_MES	O/V	0... 1H	0 ...1	1	-
Engine roughness segment time validity flag					
SEG_AD_COR_ER	V	8000... 7FFFH	-7.8125 ...7.81226	238.4e-6	°/oo
ER segment adaptive values correction versus engine speed (for each segment)					
SEG_NR_MES	O/V	0... 7H	0 ...7	1	-
Phasing reference of ER segment acquisition					
SEG_T_COR	O/V	0... FFFFH	0... 65535	1	µs
Current ER corrected segment time					
SEG_T_COR_BUF [NC_SIZE_SEG_T_COR_BUF]	O	0... FFFFH	0... 65535	1	µs
ER corrected segment times buffer (after adaptation)					
SEG_T_MES	V	0... FFFFH	0... 65535	1	µs
Engine roughness raw segment time relative to former TDC					
SEG_T_MES_CYL [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	µs
Buffer of cylinder engine roughness raw segment times					

### Input data:

LV_AT {p. 654}	LV_ENA_SEG_T_MES {p. 1447}	LV_ERR_CRK {p. 4455}	LV_INH_MIS_CRK {p. 4432}
LV_LIH_ERR_CRK {p. 1505}	LV_SYN_ENG {p. 1506}	N_32 {p. 1525}	NC_CYL_NR {p. 1526}
SEG_AD_COR_ER {p. 1447}	SEG_AD_MMV_ER [NC_CYL_NR] {p. 1474}	SEG_NR {p. 1525}	SEG_NR_MES {p. 1447}
SEG_T_MES {p. 1447}	T_SEG_ER {p. 853}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_SEG_T_MES_MAX	-	0... FFFFH	0... 65535	1	µs
ER maximum valid segment time					
C_SEG_T_MES_MIN	-	0... FFFFH	0... 65535	1	µs
ER minimum valid segment time					
IP_SEG_AD_COR_ER_AT_1	-	0... FFFFH	-7.8125 ...7.81226	238.4e-6	°/oo
LDPM_N_32_6_ENRD	6	0... FFH	0... 8160	32	rpm
Adaptive value correction versus engine speed in AT for segment 1					
IP_SEG_AD_COR_ER_AT_2	-	0... FFFFH	-7.8125 ...7.81226	238.4e-6	°/oo
LDPM_N_32_6_ENRD	6	0... FFH	0... 8160	32	rpm
Adaptive value correction versus engine speed in AT for segment 2					
IP_SEG_AD_COR_ER_AT_3	-	0... FFFFH	-7.8125 ...7.81226	238.4e-6	°/oo
LDPM_N_32_6_ENRD	6	0... FFH	0... 8160	32	rpm
Adaptive value correction versus engine speed in AT for segment 3					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_SEG_AD_COR_ER_AT_4	-	0... FFFFH	-7.8125 ...7.81226	238.4e-6	°/oo
LDPM_N_32_6_ENRD	6	0... FFH	0... 8160	32	rpm
Adaptive value correction versus engine speed in AT for segment 4					
IP_SEG_AD_COR_ER_MT_1	-	0... FFFFH	-7.8125 ...7.81226	238.4e-6	°/oo
LDPM_N_32_1_ENRD	6	0... FFH	0... 8160	32	rpm
Adaptive value correction versus engine speed in MT for segment 1					
IP_SEG_AD_COR_ER_MT_2	-	0... FFFFH	-7.8125 ...7.81226	238.4e-6	°/oo
LDPM_N_32_1_ENRD	6	0... FFH	0... 8160	32	rpm
Adaptive value correction versus engine speed in MT for segment 2					
IP_SEG_AD_COR_ER_MT_3	-	0... FFFFH	-7.8125 ...7.81226	238.4e-6	°/oo
LDPM_N_32_1_ENRD	6	0... FFH	0... 8160	32	rpm
Adaptive value correction versus engine speed in MT for segment 3					
IP_SEG_AD_COR_ER_MT_4	-	0... FFFFH	-7.8125 ...7.81226	238.4e-6	°/oo
LDPM_N_32_1_ENRD	6	0... FFH	0... 8160	32	rpm
Adaptive value correction versus engine speed in MT for segment 4					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_SEG_DLY_ER_MES	-	0... 2H	0 ...2	1	-
Delay between ER segment and Cylinder measured segment					
NC_SIZE_SEG_T_COR_BUF	-	0... FFH	0... 255	1	-
Size of the array of engine roughness corrected segment times					

**4.48.1 Phasing reference for the acquisition of engine roughness segment time****FUNCTION DESCRIPTION:**

The ER segments provided by the aggregate ENSD, are used to observe in-cylinder combustion effects on crankshaft. The cylinder x combustion is located between cylinder X tdc and cylinder X+1 tdc. Consequently, at X+1 tdc, the T\_SEG\_ER obtained is relative to cylinder X combustion, a delay of 1 tdc between SEG\_NR value at cylinder observed ( $NC\_SEG\_DLY\_ER\_MES=1$ ).

Exceptionally, if the segment is located after ER segment, this delay must be cancelled ( $NC\_SEG\_DLY\_ER\_MES=0$ ), because in such case the phasing reference SEG\_NR is updated after T\_SEG\_ER acquisition.


SEG\_NR\_MES, the ER segments phasing reference, will be used to identify which cylinder is observed with the current engine roughness segment, it's particularly useful for ER segment adaptive values identification.

**Application conditions**

**Initialisation:** *at ECU reset, Engine Stop Or Deactivation event*  
 $SEG\_NR\_MES = 0$

**Recurrence:** *Segment*

**Activation:**  $LV\_SYN\_ENG = 1$

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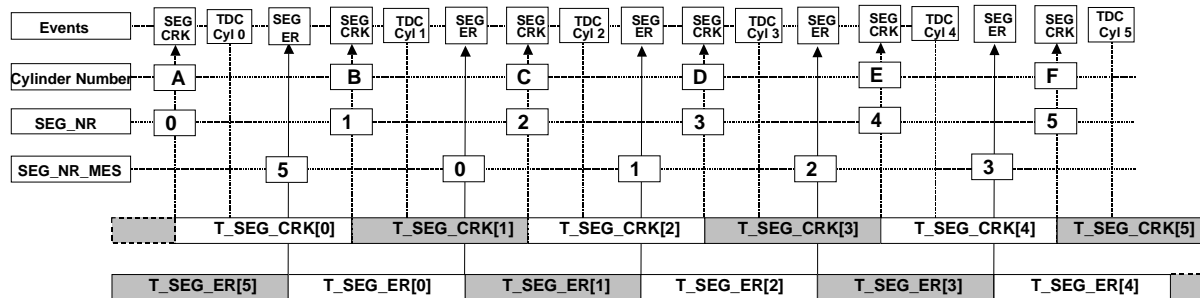


**Deactivation:**  $LV\_SYN\_ENG = 0$

### Formula section:

$$SEG\_NR\_MES = ( SEG\_NR - NC\_SEG\_DLY\_ER\_MES ) \% NC\_CYL\_NR$$

### Implant scheme:



6 Cylinder Engine Example :  $NC\_SEG\_DLY\_ER\_MES = 1$

## 4.48.2 Engine roughness segment time acquisition and control

### General information:

Here's described the segment time buffers management & control

ER current raw segment time:

$T\_SEG\_ER$  (input from ENSD)

Coming directly from the ENSD aggregate and update at each ER segment task according ER segment counter ( $SEG\_NR\_MES$ ).

Actual ER segment time sample is considered **invalid** if :

- Engine synchronisation is disable ( $LV\_SYN\_ENG = 0$ )
- When on one crankshaft revolution at least one tooth less or more has been detected ( $LV\_INH\_MIS\_CRK = 1$  before antibounce counter),
- When the crahshaft error or limp home is activated ( $LV\_ERR\_CRK = 1$  or  $LV\_LIH\_ERR\_CRK = 1$ )
- $SEG\_T\_MES$  obtained exceeds a defined valid range ( $C\_SEG\_T\_MES\_MIN$  &  $C\_SEG\_T\_MES\_MAX$ )

Cylinder ER raw segment times:

$SEG\_T\_MES$  &  $SEG\_T\_MES\_CYL[NC\_CYL\_NR]$  (outputs)

This is a buffer where  $T\_SEG\_ER$  values (after data casting) are stored according  $SEG\_NR\_MES$  counter. It allows having a memory of raw ER segments on a complete engine cycle. These values will be used by the ER adaptive learning process.

### Application conditions

**Initialisation:** at ECU reset, Engine Stop **Or** Deactivation event

$SEG\_T\_MES = FFFFH$

For  $x = 0 \dots NC\_CYL\_NR-1$

```
SEG_T_MES_CYL[x] = FFFFH
```

**EndFor**

```
LV_ENA_SEG_T_MES = 0
```

```
Recurrence:      Segment
```

```
Activation:       LV_SYN_ENG = 1
```

```
Deactivation:    LV_SYN_ENG = 0
```

**Formula section:**

```
SEG_T_MES = T_SEG_ER // physical equivalence conversion
```

```
If LV_SYN_ENG = 0
```

```
Or SEG_T_MES > C_SEG_T_MES_MAX
```

```
Or SEG_T_MES < C_SEG_T_MES_MIN
```

```
Or LV_INH_MIS_CRK = 1
```

```
Or LV_ERR_CRK = 1
```

```
Or LV_LIH_ERR_CRK = 1
```

```
Then LV_ENA_SEG_T_MES = 0
```

```
SEG_T_MES = FFFFH
```

```
Else LV_ENA_SEG_T_MES = 1
```

**EndIf**

```
SEG_T_MES_CYL[SEG_NR_MES] = SEG_T_MES
```

**4.48.2.1 Correction of the engine roughness segment adaptive values****FUNCTION DESCRIPTION:****General information:**

Due to crankshaft flexion appearance at high engine speed that decreases the misfire detection efficiency, an open-loop adaptive correction value depending on engine speed for each cylinder can be introduced per type of transmission.

A correction can be applied only for each singular segment of the flywheel.

**Application conditions**

**Initialisation:** *at ECU reset, Engine Stop Or Deactivation event*  
 SEG\_AD\_COR\_ER = 0


**Recurrence:** *Segment*

**Activation:** *LV\_ENA\_SEG\_T\_MES = 1*

**Deactivation:** *LV\_ENA\_SEG\_T\_MES = 0*

**Formula section:**

SEG\_AD\_COR\_ER is updated according the following table (*function of NC\_CYL\_NR and the current value of SEG\_NR\_MES*)

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SEG_NR_MES	NC_CYL_NR = 3	NC_CYL_NR = 4	NC_CYL_NR = 5	NC_CYL_NR = 6	NC_CYL_NR = 8
0	SEG_AD_COR_ER = 0				
1	SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_1(N_32)				
2	SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_2(N_32)	SEG_AD_COR_ER = 0	SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_2(N_32)	SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_2(N_32)	SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_2(N_32)
3		SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_1(N_32)	SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_3(N_32)	SEG_AD_COR_ER = 0	SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_3(N_32)
4			SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_4(N_32)	SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_1(N_32)	SEG_AD_COR_ER = 0
5				SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_2(N_32)	SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_1(N_32)
6					SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_2(N_32)
7					SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_3(N_32)

*\_xT stands for \_AT if LV\_AT = 1 else stands for \_MT*

### 4.48.3 Engine roughness segment time correction

#### FUNCTION DESCRIPTION:

##### General information:

The prerequisite for a reliable engine roughness evaluation is an accurate ER segment time measurement.

As the crankshaft flywheel teeth are subject to manufacturing tolerances, geometrical run-out and off-center installation which result in angles modulation, consequently the measured raw segment periods aren't similar and have systematic inaccuracies regarding other segments.

As these inaccuracies are systematic, they can be "learned" by an adaptive process during fuel cut-off periods and used for ER segment time correction. This adaptive process is described in the module : Engine roughness adaptive learning process.

ER segment adaptive values: SEG\_AD\_MMV\_ER[NC\_CYL\_NR] (inputs)

ER adaptive values are stored according SEG\_NR\_MES counter. These adaptive values are obtained and updated by the ER segment adaptive values learning process. There's one ER segment adaptive value per engine cylinder.

*Remark: The SEG\_AD\_MMV\_ER\_x are stored in ECU non-volatile memory.*

ER current corrected segment time: SEG\_T\_COR (output)

This value is the current result of the ER segment correction process obtained with T\_SEG\_ER as input.

ER corrected segment times buffer: SEG\_T\_COR\_BUF[NC\_SIZE\_SEG\_T\_COR\_BUF] (outputs)

This is a buffer where are stored SEG\_T\_COR values (ER corrected segment time current value) who are needed for ER calculation.

SEG\_T\_COR is stored according a FIFO management (first in, first out).

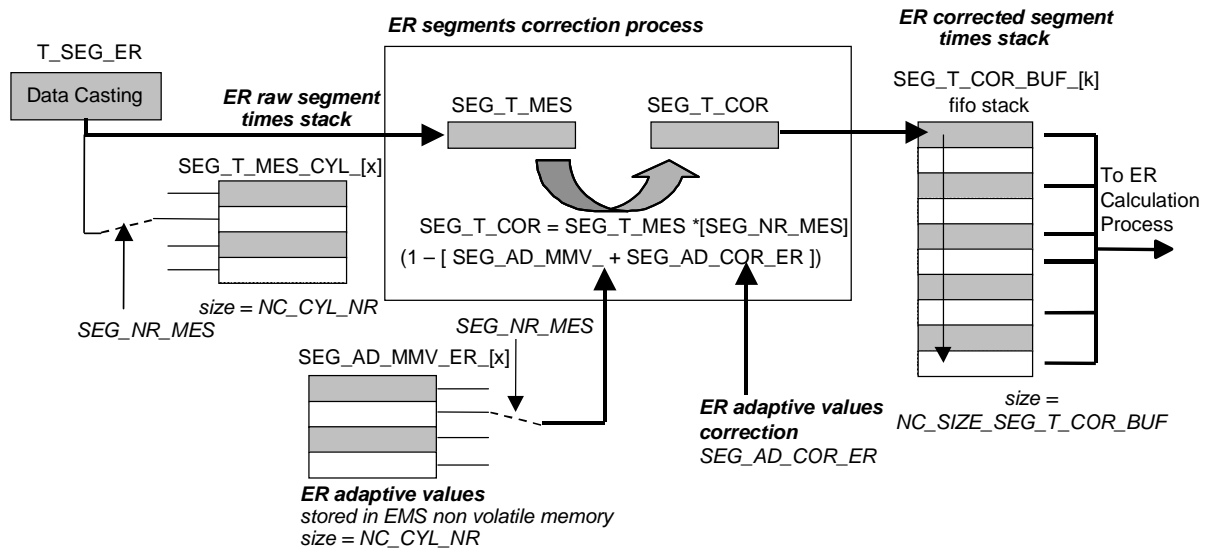
*SEG\_T\_COR\_BUF buffer size depends on engine type:*

NC\_SIZE\_SEG\_T\_COR\_BUF = 11 segment time samples for a 5 cylinder engine

NC\_SIZE\_SEG\_T\_COR\_BUF = 9 segment time samples for 4 & 8 cylinder engine

NC\_SIZE\_SEG\_T\_COR\_BUF = 7 segment time samples for 3 & 6 cylinder engine

*This size NC\_SIZE\_SEG\_T\_COR\_BUF is determined by the ER sample number required by ER calculation according engine type.*



### Application conditions

**Initialisation:** at ECU reset, Engine Stop **Or** Deactivation event

SEG\_T\_COR = FFFFH

**For** k = 0 to NC\_SIZE\_SEG\_T\_COR\_BUF-1  
SEG\_T\_COR\_BUF[k] = FFFFH

**EndFor**

**Recurrence:** Segment

**Activation:** LV\_SYN\_ENG = 1

**Deactivation:** LV\_SYN\_ENG = 0

### Formula section:

**If**(1) LV\_ENA\_SEG\_T\_MES = 0

**Then**(1) SEG\_T\_COR = FFFFH

**For**(2)k = 0 to NC\_SIZE\_SEG\_T\_COR\_BUF-1  
SEG\_T\_COR\_BUF[k] = FFFFH

**EndFor**(2)

**Else**(1) SEG\_T\_COR =  
SEG\_T\_MES \* (1 - [SEG\_AD\_MMV\_ER[SEG\_NR\_MES] + SEG\_AD\_COR\_ER])

**For**(2)k : 1 to NC\_SIZE\_SEG\_T\_COR\_BUF-1

SEG\_T\_COR\_BUF[k] is managed as a FIFO stack (SEG\_T\_COR\_BUF last value is lost)

**EndFor**(2)

SEG\_T\_COR\_BUF[0] = SEG\_T\_COR

**EndIf**(1)

**Where:**

SEG\_T\_MES : Current uncorrected ER segment time after data casting

SEG\_T\_COR : Current ER corrected segment time


SEG\_AD\_MMV\_ER[SEG\_NR\_MES] :

ER segment adaptive value corresponding to current T\_SEG\_ER phasing

SEG\_AD\_COR\_ER :

*Adaptive value correction versus engine speed corresponding to current T\_SEG\_  
ER phasing*

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## 4.49 Engine roughness calculation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRLC_DRV2_ER	V	0... FFH	0... 0.99609	3.9063e-3	-
Correlation factor for engine roughness curvature component calculation					
DRV0_ER	O/V	7FFFFFFFH 80000000... H	2147483647 -2147483648...	-	µs
Engine roughness static component					
DRV1_ER	O/V	8000... 7FFFH	-32768 ...32767	1	µs
Engine roughness dynamic component					
DRV2_ER	V	0... FFFFH	0... 65535	1	µs
Engine roughness curvature component					
DRV2_MMV_ER	V	0... FFFFH	0... 65535	1	µs
Averaged engine roughness curvature component					
ER	O/V	8000... 7FFFH	-32768 ...32767	1	µs
Engine roughness					
ER_CYL [NC_CYL_NR]	V	8000... 7FFFH	-32768 ...32767	1	µs
Cylinder normalised engine roughness values					
ER_RAW	O/V	8000... 7FFFH	-32768 ...32767	1	µs
Engine roughness without curvature component					
ER_STND	O/V	8000... 7FFFH	-32768 ...32767	1	-
Normalised engine roughness					
ER_STND_CYL [NC_CYL_NR]	V	8000... 7FFFH	-32768 ...32767	1	-
Cylinder normalised engine roughness values					
FAC_ADD_ER [NC_CYL_NR]	V	8000... 7FFFH	-32768 ...32767	1	µs
ER additive correction components					
FAC_DRV2_ER	V	0... 3FCH	0 ...4	3.9216e-3	-
Weighting factor for engine roughness curvative component calculation (correction amount)					
FAC_GAIN_ER [NC_CYL_NR]	V	0... 1FFH	0... 1.99609	3.9063e-3	-
ER multiplicative correction components					
LV_ENA_ER	O/V	0... 1H	0 ...1	1	-
Engine roughness valid calculation control flag					
SEG_NR_ER	O/V	0... 7H	0 ...7	1	-
ER segment counter for segment identification (0 ... NC_CYL_NR - 1)					

### Input data:

C_SEG_DLY_ER {p. 1455}	CTR_T_ZDLY_MIS {p. 6225}	LOAD_MIS {p. 6213}	LV_AT {p. 654}
LV_ENA_ER {p. 1454}	LV_ENA_SEG_T_MES {p. 1447}	LV_IS {p. 1720}	LV_SYN_ENG {p. 1506}
LV_VAR_TCT {p. 656}	N {p. 1525}	N_32 {p. 1525}	NC_CYL_NR {p. 1526}
SEG_NR {p. 1525}	SEG_T_COR {p. 1447}	SEG_T_COR_BUF [NC_ SIZE_SEG_T_COR_BUF] {p. 1447}	TCO {p. 1100}
THD_AD_ER {p. 1474}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_DRV2_ZDLY_ER	-	0... FFH	0... 0.99609	3.9062e-3	-
Correlation factor for engine roughness curvature component calculation after start					
C_FAC_SCA_ER_STND	-	0... FFH	0... 255	1	-
Scaling factor used for normalised engine roughness calculation					
C_N_32_MAX_DRV2_ER_IS	-	0... FFH	0... 8160	32	rpm
Maximum engine speed to apply DRV2 specific weighting factor in idle speed					
C_N_MAX_ER	-	0... 1FE0H	0... 8160	1	rpm
maximum engine speed for engine roughness calculation					
C_N_MAX_ER_STND	-	0... 1FE0H	0... 8160	1	rpm
Maximum engine speed to compute normalised engine roughness					
C_N_MIN_ER	-	0... 1FE0H	0... 8160	1	rpm
minimum engine speed for engine roughness calculation					
C_SEG_DLY_ER	-	0... CH	0... 12	1	-
Delay of ER segment reference					
C_T_DRV2_ZDLY_ER	-	0... FFFFH	0... 655.35	0.01	s
Delay for specific curvative component calculation during after start					
IP_CRLC_DRV2_ER_AT	-	0... FFH	0... 0.99609	3.9062e-3	-
LDP_N_32_IP_CRLC_DRV2_ER_AT	4	0... FFH	0... 8160	32	rpm
Correlation factor for engine roughness curvature component calculation (correction duration) - AT vehicle					
IP_CRLC_DRV2_ER_MT	-	0... FFH	0... 0.99609	3.9062e-3	-
LDP_N_32_IP_CRLC_DRV2_ER_MT	4	0... FFH	0... 8160	32	rpm
Correlation factor for engine roughness curvature component calculation (correction duration) - MT vehicle					
IP_CRLC_DRV2_ER_TCT	-	0... FFH	0... 0.99609	3.9062e-3	-
LDP_N_32_IP_CRLC_DRV2_ER_TCT	4	0... FFH	0... 8160	32	rpm
Correlation factor for engine roughness curvature component calculation (correction duration) - TCT vehicle					
IP_FAC_ADD_ER_AT [NC_CYL_NR]	V	0... FFFFH	-32768 ...32767	1	µs
LDPM_N_32_5_ENRD [NC_CYL_NR]	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_IP_FAC_ADD_ER_AT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER cylinder x additive segment-dependent factor for torsion correction with AT					
IP_FAC_ADD_ER_MT [NC_CYL_NR]	V	0... FFFFH	-32768 ...32767	1	µs
LDPM_N_32_3_ENRD [NC_CYL_NR]	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_IP_FAC_ADD_ER_MT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER cylinder x additive segment-dependent factor for torsion correction with MT					
IP_FAC_ADD_ER_TCT [NC_CYL_NR]	V	0... FFFFH	-32768 ...32767	1	µs
LDP_N_32_8_ENRD [NC_CYL_NR]	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_IP_FAC_ADD_ER_TCT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER cylinder x additive segment-dependent factor for torsion correction with TCT					
IP_FAC_DRV2_ER_AT	V	0... 3FCH	0 ...4	3.9216e-3	-
LDP_N_32_IP_FAC_N_DRV2_ER_AT	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_MIS_IP_FAC_DRV2_ER_AT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for DRV2 component calculation - AT vehicle					
IP_FAC_DRV2_ER_IS_AT	V	0... 3FCH	0 ...4	3.9216e-3	-
LDP_N_IP_FAC_N_DRV2_ER_IS_AT	4	0... 1FE0H	0... 8160	1	rpm

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_LOAD_IP_FAC_DRV2_ER_IS_AT	4	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for DRV2 component calculation - AT vehicle in idle speed					
IP_FAC_DRV2_ER_IS_MT	V	0... 3FCH	0 ...4	3.9216e-3	-
LDP_N_IP_FAC_N_DRV2_ER_IS_MT	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_FAC_DRV2_ER_IS_MT	4	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for DRV2 component calculation - MT vehicle in idle speed					
IP_FAC_DRV2_ER_IS_TCT	V	0... 3FCH	0 ...4	3.9216e-3	-
LDP_N_IP_FAC_N_DRV2_ER_IS_TCT	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_FAC_DRV2_ER_IS_TCT	4	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for DRV2 component calculation - TCT vehicle in idle speed					
IP_FAC_DRV2_ER_MT	V	0... 3FCH	0 ...4	3.9216e-3	-
LDP_N_32_IP_FAC_N_DRV2_ER_MT	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_MIS_IP_FAC_DRV2_ER_MT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for DRV2 component calculation - MT vehicle					
IP_FAC_DRV2_ER_TCT	V	0... 3FCH	0 ...4	3.9216e-3	-
LDP_N_32_IP_FAC_N_DRV2_ER_TCT	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_MIS_IP_FAC_DRV2_ER_TCT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for DRV2 component calculation - TCT vehicle					
IP_FAC_DRV2_ZDLY_ER	-	0... 3FCH	0 ...4	3.9216e-3	-
LDP_TCO_IP_FAC_DRV2_ZDLY_ER	6	0... FEH	-48... 142.5	0.75	°C
Weighting factor for engine roughness curvative component calculation (correction amount) after start					
IP_FAC_GAIN_ER_AT [NC_CYL_NR]	-	0... 1FFH	0... 1.99609	3.9063e-3	-
LDPM_N_32_4_ENRD [NC_CYL_NR]	6	0... FFH	0... 8160	32	rpm
ER cylinder x multiplicative segment-dependent factor for torsion correction with AT					
IP_FAC_GAIN_ER_MT [NC_CYL_NR]	-	0... 1FFH	0... 1.99609	3.9063e-3	-
LDPM_N_32_2_ENRD [NC_CYL_NR]	6	0... FFH	0... 8160	32	rpm
ER cylinder x multiplicative segment-dependent factor for torsion correction with MT					
IP_FAC_GAIN_ER_TCT [NC_CYL_NR]	-	0... 1FFH	0... 1.99609	3.9063e-3	-
LDP_N_32_7_ENRD [NC_CYL_NR]	6	0... FFH	0... 8160	32	rpm
ER cylinder x multiplicative segment-dependent factor for torsion correction with TCT					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_CONF_GAIN_ADD_ER	-	0... 1H	0 ...1	1	-
ER multiplicative and additive correction enable					

**General information**

The engine roughness index (ER) is a system variable relative to crankshaft segments behaviour. This index is mainly used by the misfire monitoring & algorithms dedicated to combustion process control. Integration version for 3,4,5,6 & 8 cylinder engines.

The engine roughness system variable is calculated each ER window end occurrence, every time the engine is running & synchronised.

**4.49.1 Engine roughness segment reference**

Due to engine roughness definition, there is a delay of C\_SEG\_DLY\_ER segments between ER actual value and the segment that was observed by this ER value.

SEG\_NR\_ER will be used to identify which cylinder is observed with the engine roughness system variable, it's particularly useful for misfire cylinder identification.



The segment counter SEG\_NR\_ER with the limit 0...(NC\_CYL\_NR - 1) is incremented in the same way as the common segment counter SEG\_NR.

**Application conditions**

- Initialisation:** *at ECU reset, Engine Stop Or Deactivation condition event*  
SEG\_NR\_ER = 0
- Recurrence:** *Segment*
- Activation:** *LV\_SYN\_ENG = 1*
- Deactivation:** *LV\_SYN\_ENG = 0*

**Formula section:**

$$SEG\_NR\_ER = (SEG\_NR + 2 * NC\_CYL\_NR - C\_SEG\_DLY\_ER) \% NC\_CYL\_NR$$

**4.49.2 Engine roughness segments control process**

**Description:**

All ER components calculations are based on corrected segment time acquisitions buffer values SEG\_T\_COR\_BUF.

As soon as an invalid segment has been detected during acquisition process (LV\_ENA\_SEG\_T\_MES = 0) or segment adaptive calculation, ER calculation & misfire detection have to be disabled (LV\_ENA\_ER = 0).

**Application conditions**

- Initialisation:** *at ECU reset, Engine Stop Or Deactivation condition event*  
LV\_ENA\_ER = 0
- Recurrence:** *Segment*

**Activation:**

Engine roughness calculation is executed only if:

NC\_SIZE\_SEG\_T\_COR\_BUF consecutive valid ER segment times have been acquired & stored in SEG\_T\_COR\_BUF buffer.

"Valid" stands for:

LV\_ENA\_SEG\_T\_MES = 1 on NC\_SIZE\_SEG\_T\_COR\_BUF consecutive ER segments

**And** no ER components calculation overflow on current segment (*DRV0, DRV1, DRV2 and ER components*)

**And** N <= C\_N\_MAX\_ER


**And** N >= C\_N\_MIN\_ER

*In this case:*

ER components are calculated as described below.

LV\_ENA\_ER = 1 (*if no overflow occurs during ER components calculation*)

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### Deactivation:

Engine roughness calculation is stopped & initialised when at least one of the NC\_SIZE\_SEG\_T\_COR\_BUF consecutive segment times have been acquired & stored in SEG\_T\_COR\_BUF buffer have been detected invalid.

"Invalid" stands for:

LV\_ENA\_SEG\_T\_MES = 0 at least one time on NC\_SIZE\_SEG\_T\_COR\_BUF consecutive ER segments

Or at least one calculation overflow occurs one of ER components (*DRV0, DRV1, DRV2 or ER component*) on current segment.

Or  $N > C\_N\_MAX\_ER$

Or  $N < C\_N\_MIN\_ER$

In that case :

LV\_ENA\_ER = 0

ER components are initialised to 0

### 4.49.3 Cylinder specific engine roughness components correction

#IF NLC\_CONF\_GAIN\_ADD\_ER = 1

#### FUNCTION DESCRIPTION:

#### General information:

The misfire detection based on ER index can be complicated by the torsional/flexion vibrations especially with multiple cylinder engines with a long crankshaft. This affects on misfire detection efficiency, especially at high engine speed.

To balance this phenomenon, after segment timing correction with ER adaptive values (*see ER segment correction process*), an irregular operation is determined from the measured cylinder segment times, cylinder specific additive and multiplicative corrections are applied on the raw engine roughness value (*ER\_RAW*).

FAC\_ADD\_ER[NC\_CYL\_NR] and FAC\_GAIN\_ER[NC\_CYL\_NR] correction coefficients are based on calibration tables specific to each cylinder and to transmission type (MT/AT).

#### Application conditions

**Initialisation:** at ECU reset, at Engine Stop **Or** on Deactivation condition event

**For** x = 0 to NC\_CYL\_NR-1

FAC\_GAIN\_ER[x] = 1

FAC\_ADD\_ER[x] = 0

**EndFor**

**Recurrence:** Segment

**Activation:** LV\_ENA\_ER = 1


**Deactivation:** LV\_ENA\_ER = 0

#### Formula section:

**If(1)** LV\_AT = 1

**Then(1)**

XX= AT

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```

Elseif(2)   LV_VAR_TCT = 1
             Then(2)
             XX= TCT
             Else(2)
             XX= MT
             Endif(2)
Endif(1)
    
```

```

FAC_GAIN_ER[SEG_NR_ER] = IP_FAC_GAIN_ER_xx[SEG_NR_ER](N_32)
FAC_ADD_ER[SEG_NR_ER] = IP_FAC_ADD_ER_xx[SEG_NR_ER](N_32,LOAD_MIS)
#ENDIF
    
```

#### 4.49.4 Engine roughness DRV2 components filter & gain determination

##### FUNCTION DESCRIPTION:

This function allows to determinate the coefficients relative to DRV2 components of the engine roughness, according different configurations:

If used (*see project/customer legal requirements concerning misfire monitoring after engine start*), during zero delay misfire monitoring activation period, specific gain & filter coefficient can be apply to DRV2 component to be able to detect misfire just after engine start (*dynamic correction modified*).

Else, FAC\_DRV2\_ER & CRLC\_DRV2\_ER are defined according transmission type (AT/MT).

##### Application conditions

**Initialisation:**                    *at ECU reset, at Engine Stop Or on Deactivation condition event*

```

FAC_DRV2_ER = IP_FAC_DRV2_ZDLY_ER(TCO)
CRLC_DRV2_ER = C_CRLC_DRV2_ZDLY_ER
    
```

**Recurrence:**                        *Segment*

**Activation:**                        *LV\_ENA\_ER = 1*

**Deactivation:**                      *LV\_ENA\_ER = 0*

##### Formula section:

**If(1)** LV\_AT = 1

**Then(1)**

XX= AT

**Elseif(2)** LV\_VAR\_TCT = 1

**Then(2)**

XX= TCT

**Else(2)**

XX= MT

**Endif(2)**


**Endif(1)**

**If(1)** CTR\_T\_ZDLY\_MIS > C\_T\_DRV2\_ZDLY\_ER

**Then(1)**     *// Zero delay misfire monitoring activation period*

FAC\_DRV2\_ER = IP\_FAC\_DRV2\_ZDLY\_ER(TCO)

CRLC\_DRV2\_ER = C\_CRLC\_DRV2\_ZDLY\_ER

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**Elseif(2)**

```

If(3)    LV_IS = 1    And    N_32 < C_N_32_MAX_DRV2_ER_IS
Then(3)    FAC_DRV2_ER = IP_FAC_DRV2_ER_IS_xx(N, LOAD_MIS)
Else(3)    FAC_DRV2_ER = IP_FAC_DRV2_ER_xx (N_32, LOAD_MIS)
EndIf(3)
        CRLC_DRV2_ER = IP_CRLC_DRV2_ER_xx (N_32)
    
```

**EndIf(2)**

**EndIf(1)**

### 4.49.5 Engine roughness components calculation

**General information:**

The engine roughness calculation needs three individual components: a static component (DRV0\_ER), a dynamic component (DRV1\_ER) and a curvature component (DRV2\_ER). These component definitions are specific to the engine cylinder number (see following related subchapters).

DRV2\_MMV\_ER is the filtered curvature component correction (DRV2\_ER) who allows adding an artificial positive offset on ER value in case of dynamic curvature effects. This feature had a safety effect against wrong detection in case of segment oscillations.

ER\_RAW is the engine roughness value without curvature component (DRV2\_MMV\_ER), used by cylinder balancing and engine warm up monitoring modules.

**Application conditions**

**Initialisation:** *at ECU reset, at Engine Stop Or on Deactivation condition event*

```

DRV0_ER = 0
DRV1_ER = 0
DRV2_ER = 0
DRV2_MMV_ER = 0
ER_RAW = 0
    
```

**Recurrence:** *Segment*

**Activation:** *LV\_ENA\_ER = 1*

**Deactivation:** *LV\_ENA\_ER = 0*

**Formula section:**

Engine roughness static component:

$DRV0\_ER(n) = NC\_CYL\_NR * [ SEG\_T\_COR(n) - SEG\_T\_COR(n+1) ]$

Engine roughness dynamic and curvature components:

DRV1\_ER and DRV2\_ER components are engine type specific.

**3 Cylinder Engine**

**#If NC\_CYL\_NR = 3**

DRV1\_ER(n) = SEG\_T\_COR(n-2) - SEG\_T\_COR(n+1)

DRV2\_ER(n) = FAC\_DRV2\_ER \*

max(0,[SEG\_T\_COR(n-3) - SEG\_T\_COR(n)] - [SEG\_T\_COR(n) - SEG\_T\_COR(n+3)])

**#EndIf**

**4 or 8 Cylinder Engine**


**#If NC\_CYL\_NR = 4 or 8**

DRV1\_ER (n) = SEG\_T\_COR(n-2) - SEG\_T\_COR(n+2)

DRV2\_ER (n) = FAC\_DRV2\_ER \*

max(0,[SEG\_T\_COR(n-4) - SEG\_T\_COR(n)] - [SEG\_T\_COR(n) - SEG\_T\_COR(n+4)])

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**#Endlf**

**5 Cylinder Engine**

**#If NC\_CYL\_NR = 5**

$$\text{DRV1\_ER}(n) = \text{SEG\_T\_COR}(n-2) - \text{SEG\_T\_COR}(n+3)$$

$$\text{DRV2\_ER}(n) = \text{FAC\_DRV2\_ER} *$$

$$\text{max}(0, [\text{SEG\_T\_COR}(n-5) - \text{SEG\_T\_COR}(n)] - [\text{SEG\_T\_COR}(n) - \text{SEG\_T\_COR}(n+5)])$$

**#Endlf**

**6 Cylinder Engine**

**#If NC\_CYL\_NR = 6**

$$\text{DRV1\_ER}(n) = \text{SEG\_T\_COR}(n-3) - \text{SEG\_T\_COR}(n+3)$$


$$\text{DRV2\_ER}(n) = \text{FAC\_DRV2\_ER} *$$

$$\text{max}(0, [\text{SEG\_T\_COR}(n-3) - \text{SEG\_T\_COR}(n)] - [\text{SEG\_T\_COR}(n) - \text{SEG\_T\_COR}(n+3)])$$

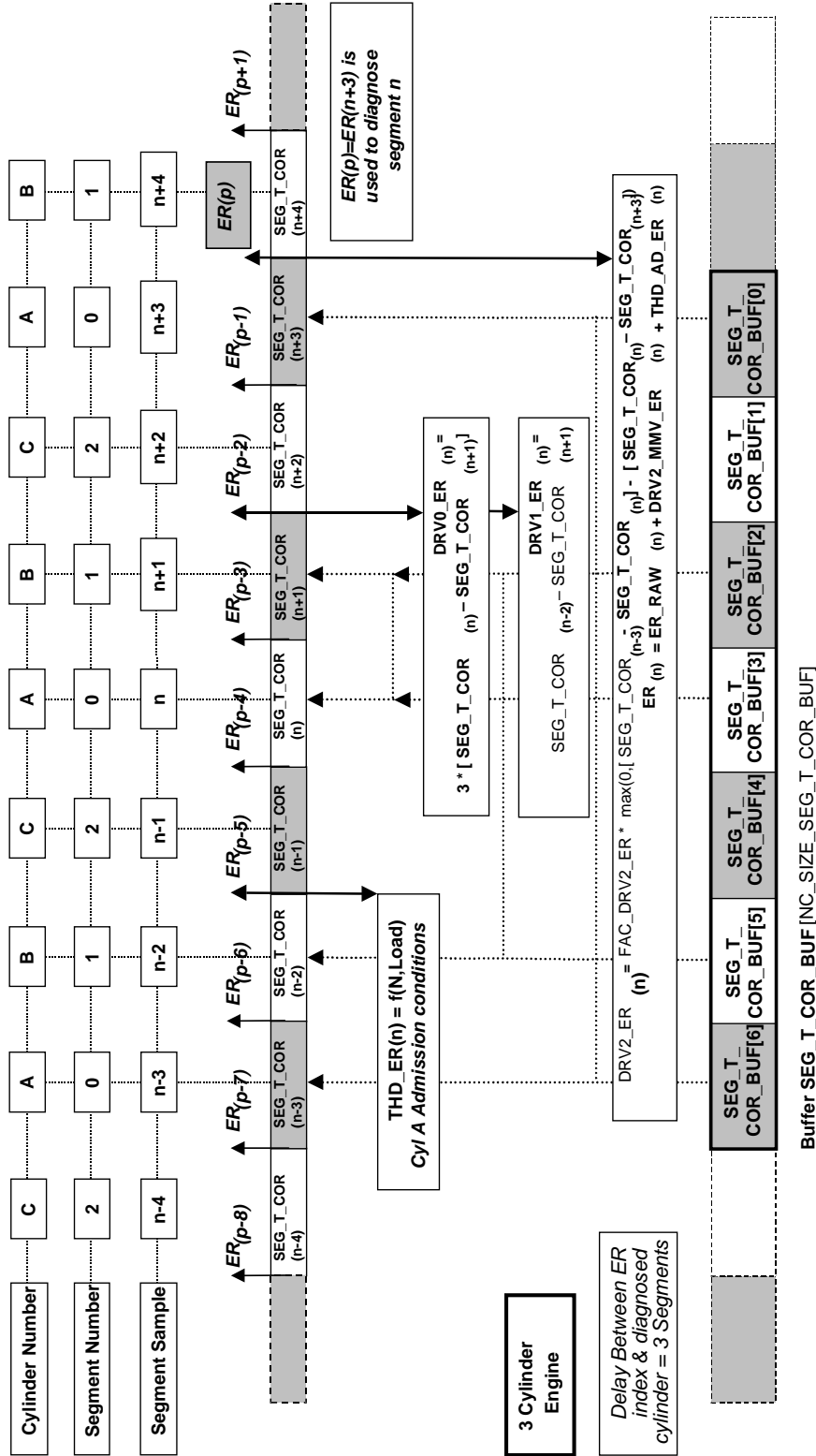
**#Endlf**

**Implant scheme for 3 cylinder engine:**

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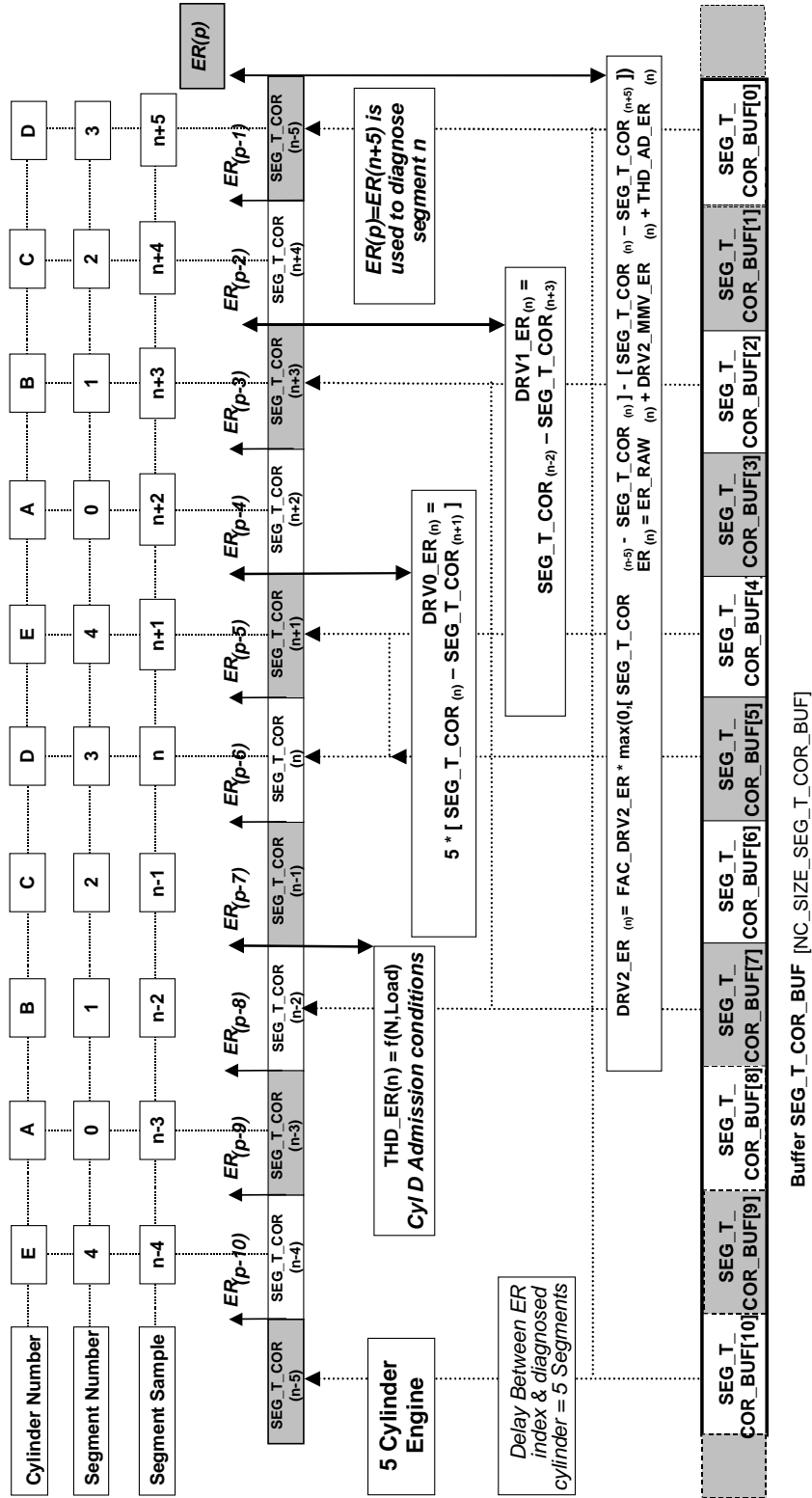
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**Implant scheme for 4 cylinder engine:**



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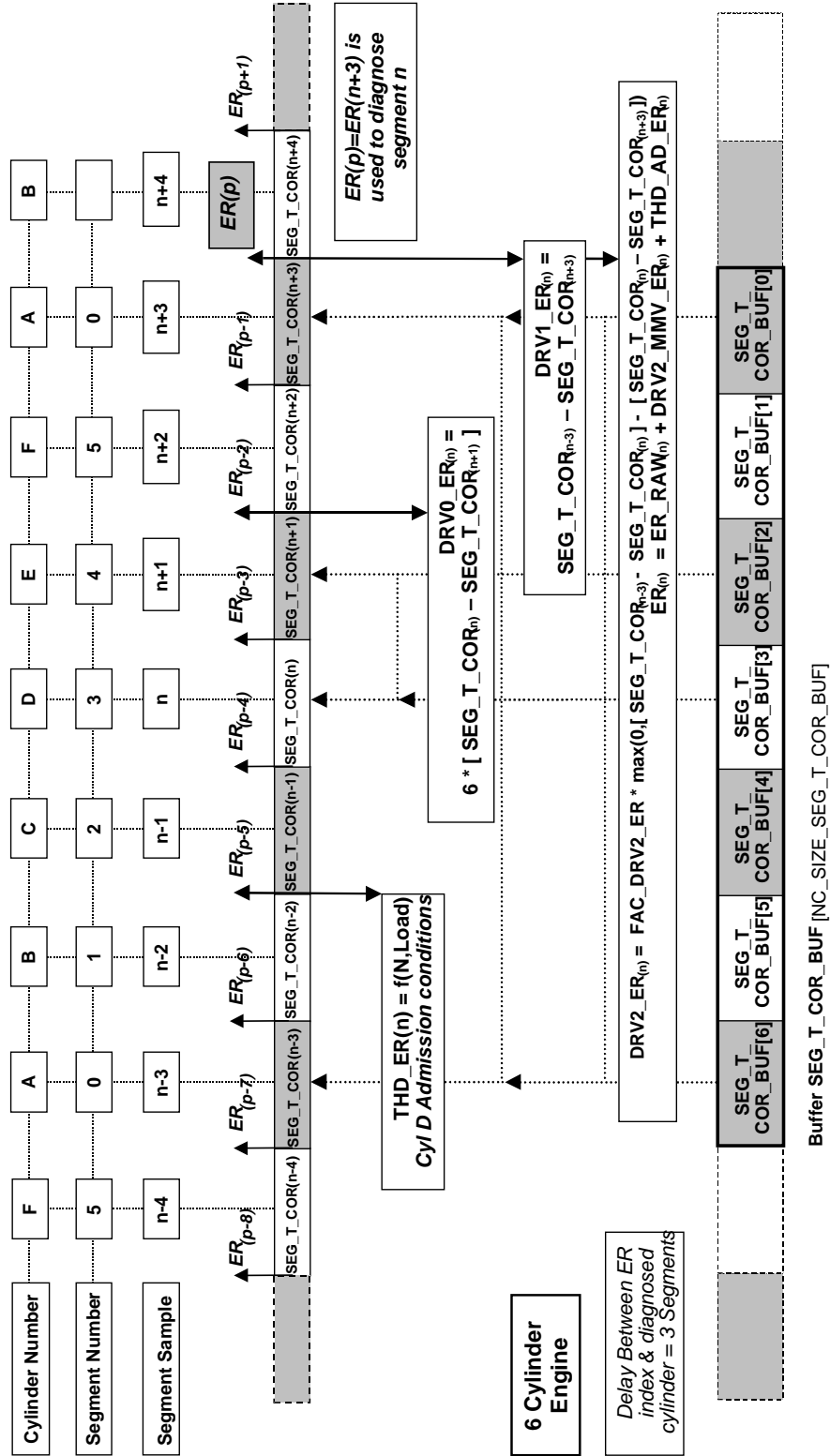


**Implant scheme for 6 cylinder engine:**

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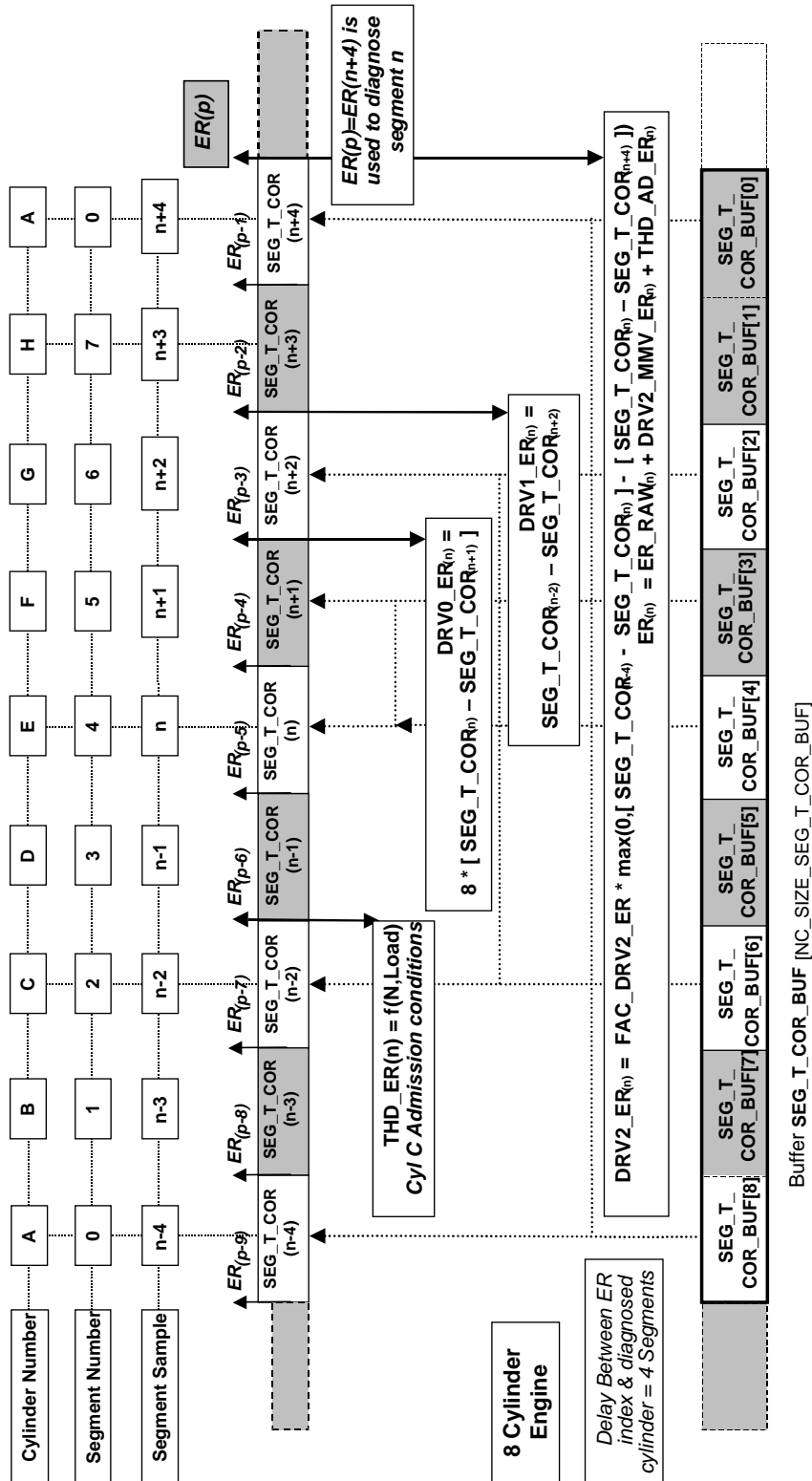


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**Implant scheme for 8 cylinder engine:**

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Engine roughness filtered curvature component:

$$DRV2\_MMV\_ER(n) = DRV2\_MMV\_ER(n-1) + CRLC\_DRV2\_ER * (DRV2\_ER(n) - DRV2\_MMV\_ER(n-1))$$

Engine roughness value without curvature component:

**#if NLC\_CONF\_GAIN\_ADD\_ER = 1**

```

ER_RAW = FAC_GAIN_ER[SEG_NR_ER] *
          (DRV0_ER - DRV1_ER - FAC_ADD_ER[SEG_NR_ER])
#Else
ER_RAW = DRV0_ER - DRV1_ER
#EndIf

```

#### 4.49.6 Engine roughness values determination

##### Description:

ER is the complete engine roughness value including all ER components (DRV0\_ER, DRV1\_ER & DRV2\_MMV\_ER), specified & used by misfire detection module.

ER\_STND is the normalised engine roughness value versus engine speed that could be amplified by a gain C\_FAC\_SCA\_ER\_STND. This is the nominal engine roughness value divided by the corresponding cubic corrected ER segment time (SEG\_T\_COR\_BUF[C\_SEG\_DLY\_ER])<sup>3</sup>. The cubic segment time is calculated by using a mantisse and an exponent.

ER & ER\_STND calculation formula are generic to all engine type.

A positive offset (THD\_AD\_ER) is added to ER components as long as the ER adaptive learning process hasn't been executed. This, in a way to avoid wrong misfire detection in engine operation areas where crankshaft decelerations due to a misfire are very close to ER noise due to the flywheel mechanical tolerances.

This offset decreases as the ER adaptive learning progress. At the end of the learning process, this offset is null (*see next chapter ER adaptive values learning process for more informations*).

Once the ER fast adaptive learning stage has been executed, these flywheel mechanical tolerances are sufficiently reduced to able to detect misfire in full legal range without adding a positive offset.

ER\_CYL\_x and ER\_STND\_CYL\_x are the engine roughness values obtained for corresponding cylinder x, these values are switched according SEG\_NR\_ER segment reference.

##### Application conditions

**Initialisation:** *at ECU reset, at Engine Stop Or on Deactivation condition event*

```

ER = 0
ER_STND = 0
For x = 0 to NC_CYL_NR-1
ER_CYL[x] = 0
ER_STND_CYL[x] = 0
EndFor

```

**Recurrence:** *Segment*

**Activation:** *LV\_ENA\_ER = 1*

**Deactivation:** *LV\_ENA\_ER = 0*

##### Formula section:

###### Engine roughness:

```

ER = ER_RAW + DRV2_MMV_ER + THD_AD_ER
ER_CYL[SEG_NR_ER] = ER

```

###### Normalised Engine roughness versus engine speed:


**If** N < C\_N\_MAX\_ER\_STND

**Then**

```

ER_STND = ER / (SEG_T_COR_BUF[C_SEG_DLY_ER] )3 * 2(16+C_FAC_SCA_ER_STND)
ER_STND_CYL[SEG_NR_ER] = ER_STND

```

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**Else**

```
ER_STND = 0
```

```
ER_STND_CYL[SEG_NR_ER] = 0
```

**EndIf**

*Note: if  $C\_SEG\_DLY\_ER \geq NC\_SIZE\_SEG\_T\_COR\_BUF$ ,  $SEG\_T\_COR\_BUF[C\_SEG\_DLY\_ER]$  data is limited to the last cell of the buffer.*

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## 4.50 Engine roughness calculation (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ER_AV_QUO	V	0... FFH	0... 2.55	0.01	-
Quotient of ER/THD_ER (to simplify calibration and testing)					
LV_INH_APP_ER_AD	O/V	0... 1H	0 ...1	1	-
ER segment adaptive process inhibition flag relative application specific conditions					
LV_INH_OBD_ER_AD	O/V	0... 1H	0 ...1	1	-
ER segment adaptive process inhibition flag.					
LV_REQ_SEG_AD_MMV_ER_APP	O/V	0... 1H	0 ...1	1	-
Flag indicating request to reload stored segment adaptive values					
LV_SEG_AD_RST_ER_EOL	O/V	0... 1H	0 ...1	1	-
EOL specific request to reset ER segment adaptive values					
SEG_AD_MMV_ER_APP [NC_CYL_NR]	O/V	8000... 7FFFH	-7.8125 ...7.8123	0.000238	
ER filtered adaptive values used for reload (for each segment) if segment adaptive process not valid					

### Input data:

ER {p. 1454}	GR_AT {p. 1302}	GR_MT {p. 1302}	LV_AT {p. 654}
LV_ENA_ER {p. 1454}	LV_ENA_SEG_T_MES {p. 1447}	LV_EOL_OBD {p. 800}	LV_ERR_CPS {p. 1001}
LV_ERR_CRK {p. 4455}	LV_ERR_DIAGCPS {p. 5926}	LV_ES {p. 1720}	LV_REQ_INH_MIS {p. 6225}
LV_REQ_SEG_AD_RST_ EOL {p. 804}	LV_ST {p. 1720}	LV_SYN_ENG {p. 1506}	STATE_ERR_IV {p. 4803}
THD_ER {p. 6276}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_GR_INH_ER_AD_AT	-	0... FFH	0... 255	1	-
Bitfield used to inhibit engine roughness adaptive according current AT gear ratio (Gear corresponding bit = 1, ER_AD inhibited)					
C_GR_INH_ER_AD_MT	-	0... FFH	0... 255	1	-
Bitfield used to inhibit engine roughness adaptive according current MT gear ratio (Gear corresponding bit = 1, ER_AD inhibited)					
LC_SEG_AD_RST_ENA_EOL	-	0... 1H	0 ...1	1	-
Specific EOL request enable flag to reset ER segment adaptive values & learning process					


### 4.50.1 Inhibition of engine roughness adaptive process - Application specific

#### FUNCTION DESCRIPTION:

Engine roughness segments adaptive process is inhibited when one of the following system conditions occurs. See application specific accessories that could have an impact on the transmission behaviour (CVT, Automatic gear shifting, specific gear ratios...).

#### Application conditions

**Initialisation:** at ECU reset and engine Stop:

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```

LV_INH_APP_ER_AD = 0
at ECU reset:
LV_REQ_SEG_AD_MMV_ER_APP = 0
SEG_AD_MMV_ER_APP [NC_CYL_NR] = 0

```

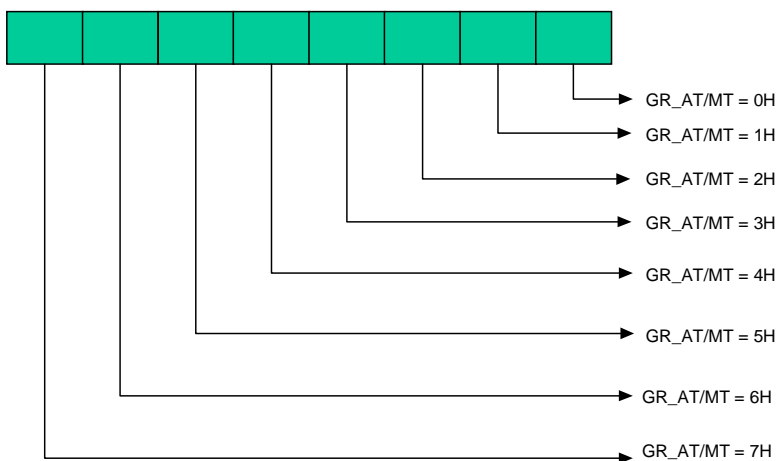
**Update rate:** *Engine roughness segment*

**Activation:** *LV\_ENA\_SEG\_T\_MES = 1*

**Deactivation:** *LV\_ENA\_SEG\_T\_MES = 0*

### Diagram:

Bit-position within C\_GR\_INH\_ER\_AD\_MT/AT



**Example:** Inhibition should be in 1st gear and 2nd gear: => C\_GR\_INH\_ER\_AD\_MT/AT = 6H

### Formula section:

```

If      (LV_AT = 1 And C_GR_INH_ER_AD_AT[GR_AT] = 1)
Or      ( LV_AT = 0 And C_GR_INH_ER_AD_MT[GR_MT] = 1)
Then    LV_INH_APP_ER_AD = 1
Else    LV_INH_APP_ER_AD = 0
EndIf

```

## 4.50.2 ER segment adaptive process inhibition related to OBDI diagnosis

### General information:

ER segment adaptive process is inhibited when one of the mentioned OBD I errors occurs.

### Application conditions

**Initialization:** *0 at reset*

**Update rate:** *Engine roughness segment*

**Activation:** *LV\_SYN\_ENG = 1*

**Deactivation:** *LV\_SYN\_ENG = 0*

**Formula section:**

```

If          STATE_ERR_IV <> 0           or
              LV_ERR_CPS = 1             or
              LV_ERR_DIAGCPS = 1        or
              LV_ERR_CRK = 1

Then       LV_INH_OBD_ER_AD = 1
Else       LV_INH_OBD_ER_AD = 0
Endif
    
```

**4.50.3 End of line & After sale service request to reset ER segment adaptive values**

**General information:**

During end of line plant and/or for After sale services, a request is generated via communication protocol, to reset ER segment adaptive values & learning process (see *project communication protocol*).

**Application conditions**

```

Initialization:      0 at reset
Update rate:        Engine roughness segment
Activation:         LV_ENA_SEG_T_MES = 1
Deactivation:      LV_ENA_SEG_T_MES = 0
    
```

**Formula section:**

```

If  LV_EOL_OBD = 1           // OBD end of line process request
      And  LC_SEG_AD_RST_ENA_EOL = 1
      And  LV_REQ_SEG_AD_RST_EOL = 1
           // EOL request to reset segment adaptive values
Then  LV_SEG_AD_RST_ER_EOL = 1
Else  LV_SEG_AD_RST_ER_EOL = 0
Endif
    
```

**4.50.4 Normalised engine roughness quotient for calibration**

**FUNCTION DESCRIPTION:**

**General information:**


To simplify the calibration, testing and controlling of the misfire function the variable ER\_AV\_QUO is defined.

**Application conditions**

```

Initialisation:      ER_AV_QUO = 0 at reset
Recurrence:         updated every segment
    
```

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**Activation:**  $LV\_ENA\_ER = 1$


**Deactivation:**  $LV\_ENA\_ER = 0$

**Formula section:**

```

If      LV_ES      = 1  or
          LV_ST      = 1  or
          LV_REQ_INH_MIS = 1  or
          ER > 0
Then    ER_AV_QUO      = 0
Else    ER_AV_QUO      = ER / THD_ER
Endif

```

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## 4.51 Engine roughness adaptive learning process

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRLC_SEG_AD_ER	V	0... FFFFH	0... 0.99998	15.3e-6	-
ER segment adaptive values filtering coefficient					
CTR_SEG_AD_ER	V/S	0... FFFFH	0... 65535	1	-
Counter of ER segment adaptation learning process					
DELTA_CRK_DIF_MAX_ER	V/S	0... FFFFH	0... 999.98474	15.3e-3	%oo
Limitation of adaptation range (mech. Tolerance)					
LV_INH_ACC_ER_AD	V	0... 1H	0 ...1	1	-
ER adaptive process fade out request flag due to Air conditioner activation					
LV_INH_LOAD_GRD_MAX_ER_AD	V	0... 1H	0 ...1	1	-
ER adaptive process fade out request flag due to engine load transient condition					
LV_INH_MAF_DIF_ER_AD	V	0... 1H	0 ...1	1	-
ER adaptive process fade out request flag due to MAF transient condition					
LV_INH_TPS_GRD_ER_AD	V	0... 1H	0 ...1	1	-
ER adaptive process fade out request flag due to TPS transient condition					
LV_SEG_AD_AVL_ER	O/V/S	0... 1H	0 ...1	1	-
Segment adaptation process state : no adaptive process executed (=0) fast adaptive process achieved (=1)					
LV_SEG_AD_DIF_MAX_ER	O/V	0... 1H	0 ...1	1	-
Maximum ER adaptive values difference on same physical segment					
LV_SEG_AD_ER	O/V	0... 1H	0 ...1	1	-
ER segment adaptation process enable					
LV_SEG_AD_FDOUT_ER	V	0... 1H	0 ...1	1	-
Boolean for segment adaptation fade out condition					
LV_SEG_AD_FDOUT_ER_EOL	V	0... 1H	0 ...1	1	-
EOL specific request for ER segment adaptive learning process					
LV_SEG_AD_LIM_ER	O/V/S	0... 1H	0 ...1	1	-
ER filtered adaptive values out of range					
LV_SEG_AD_RAW_ER	V	0... 1H	0 ...1	1	-
ER segment adaptation process monitoring enable					
SEG_AD_DIF_ER_0	V	0... 7FFFH	0... 7.81226	237.999e-6	%oo
ER adaptive values difference on same physical segment (Segment 0 & Identical)					
SEG_AD_DIF_ER_1	V	0... 7FFFH	0... 7.81226	237.999e-6	%oo
ER adaptive values difference on same physical segment (Segment 1 & Identical)					
SEG_AD_DIF_ER_2	V	0... 7FFFH	0... 7.81226	237.999e-6	%oo
ER adaptive values difference on same physical segment (Segment 2 & Identical)					
SEG_AD_DIF_ER_3	V	0... 7FFFH	0... 7.81226	237.999e-6	%oo
ER adaptive values difference on same physical segment (Segment 3 & Identical)					
SEG_AD_FDOUT_ER_CDN	V	0... FFH	0... 255	1	-
Segment adaptation fade out conditions carrier byte (before masking)					
SEG_AD_FDOUT_ER_CDN_NR	V	0... 8H	0 ...8	1	-
Segment adaptation fade out conditions number (after masking)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
SEG_AD_MMV_ER [NC_CYL_NR]	O/V/S	8000... 7FFFH	-7.8125 ...7.81226	237.999e-6	°/oo
ER filtered adaptive values used for learning process (for each segment)					
SEG_AD_RAW_MMV_ER [NC_CYL_NR]	V	8000... 7FFFH	-7.8125 ...7.81226	237.999e-6	°/oo
ER filtered adaptive values used for learning process monitoring (for each segment)					
THD_AD_ER	O/V	0... FFFFH	0... 65535	1	µs
Engine roughness threshold correction factor during segment adaptation learning process.					

**Input data:**

CRLC_SEG_AD_ER {p. 1473}	CTR_SEG_AD_ER {p. 1473}	DRV1_ER {p. 1454}	LOAD_GRD_MIS {p. 6213}
LOAD_MIS {p. 6213}	LV_ACCOUT_RLY {p. 3589}	LV_AT {p. 654}	LV_ENA_ER {p. 1454}
LV_ENA_SEG_T_MES {p. 1447}	LV_EOL_OBD {p. 800}	LV_INH_APP_ER_AD {p. 1469}	LV_INH_OBD_ER_AD {p. 1469}
LV_INJ_CUT {p. 2295}	LV_REQ_SEG_AD_MMV_ER_APP {p. 1469}	LV_SEG_AD_AVL_ER {p. 1473}	LV_SEG_AD_DIF_MAX_ER {p. 1473}
LV_SEG_AD_ER {p. 1473}	LV_SEG_AD_FDOUT_ER {p. 1473}	LV_SEG_AD_FDOUT_ER_EOL {p. 1473}	LV_SEG_AD_LIM_ER {p. 1473}
LV_SEG_AD_RAW_ER {p. 1473}	LV_SEG_AD_RST_ER_EOL {p. 1469}	LV_STATE_RR {p. 6301}	LV_VAR_TCT {p. 656}
MAF {p. 8277}	MAF_DIF {p. 1195}	N_32 {p. 1525}	NC_CYL_NR {p. 1526}
SEG_AD_MMV_ER_APP [NC_CYL_NR] {p. 1469}	SEG_AD_RAW_MMV_ER [NC_CYL_NR] {p. 1474}	SEG_NR_MES {p. 1447}	SEG_T_COR {p. 1447}
SEG_T_MES_CYL [NC_CYL_NR] {p. 1447}	TPS_AV {p. 1169}	TPS_GRD {p. 1169}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRK_DIF_MAX_ER	-	0... 1FFFH	0... 7.79724	0.0152588	°/oo
Limitation of ER adaptation range (mechanical tolerance)					
C_CRLC_FAST_SEG_AD_ER	-	0... FFFFH	0... 0.99998	15.3e-6	-
Fast ER segment adaptive values filtering coefficient (fast learning phase)					
C_CRLC_FAST_SEG_AD_ER_TCT	-	0... FFFFH	0... 0.99998	15.3e-6	-
Fast ER segment adaptive values filtering coefficient (fast learning phase - TCT vehicle)					
C_CRLC_SEG_AD_ER	-	0... FFFFH	0... 0.99998	15.3e-6	-
Nominal ER segment adaptive values filtering coefficient					
C_CRLC_SEG_AD_ER_EOL	-	0... FFFFH	0... 0.99998	15.3e-6	-
EOL specific filtering coefficient for ER segment adaptive values learning process					
C_CRLC_SEG_AD_ER_TCT	-	0... FFFFH	0... 0.99998	15.3e-6	-
Nominal ER segment adaptive values filtering coefficient (TCT vehicle)					
C_CRLC_SEG_AD_RAW_ER	-	0... FFFFH	0... 0.99998	15.3e-6	-
Filter coefficient for ER segment adaptive values monitoring					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DRV1_MAX_SEG_AD_ER	-	0... 7FFFH	0... 32767	1	µs
Maximum value of DRV1_ER (dynamic part of engine roughness) for crankshaft target wheel learning.					
C_DRV1_MAX_SEG_AD_ER_EOL	-	0... 7FFFH	0... 32767	1	µs
Maximum value of DRV1_ER (dynamic part of engine roughness) for crankshaft target wheel learning for EOL request mode					
C_MASK_SEG_AD_FDOUT_ER	-	0... FFH	0... 255	1	-
Configuration mask for SEG_AD_FDOUT_ER_CDN fade out carrier structure					
C_N_MAX_SEG_AD_ER_AT	-	0... FFH	0... 8160	32	rpm
Maximum engine speed threshold for crankshaft target wheel learning with AT					
C_N_MAX_SEG_AD_ER_EOL_AT	-	0... FFH	0... 8160	32	rpm
Maximum engine speed threshold for crankshaft target wheel learning for EOL request mode in AT					
C_N_MAX_SEG_AD_ER_EOL_MT	-	0... FFH	0... 8160	32	rpm
Maximum engine speed threshold for crankshaft target wheel learning for EOL request mode in MT					
C_N_MAX_SEG_AD_ER_EOL_TCT	-	0... FFH	0... 8160	32	rpm
Maximum engine speed threshold for crankshaft target wheel learning for EOL request mode in TCT					
C_N_MAX_SEG_AD_ER_MT	-	0... FFH	0... 8160	32	rpm
Maximum engine speed threshold for crankshaft target wheel learning with MT					
C_N_MAX_SEG_AD_ER_TCT	-	0... FFH	0... 8160	32	rpm
Maximum engine speed threshold for crankshaft target wheel learning with TCT					
C_N_MIN_SEG_AD_ER_AT	-	0... FFH	0... 8160	32	rpm
Minimum engine speed threshold for crankshaft target wheel learning with AT					
C_N_MIN_SEG_AD_ER_EOL_AT	-	0... FFH	0... 8160	32	rpm
Minimum engine speed threshold for crankshaft target wheel learning for EOL request mode in AT					
C_N_MIN_SEG_AD_ER_EOL_MT	-	0... FFH	0... 8160	32	rpm
Minimum engine speed threshold for crankshaft target wheel learning for EOL request mode in MT					
C_N_MIN_SEG_AD_ER_EOL_TCT	-	0... FFH	0... 8160	32	rpm
Minimum engine speed threshold for crankshaft target wheel learning for EOL request mode in TCT					
C_N_MIN_SEG_AD_ER_MT	-	0... FFH	0... 8160	32	rpm
Minimum engine speed threshold for crankshaft target wheel learning with MT					
C_N_MIN_SEG_AD_ER_TCT	-	0... FFH	0... 8160	32	rpm
Minimum engine speed threshold for crankshaft target wheel learning with TCT					
C_N_SEG_T_AD_RAW_MAX_ER	-	0... FFH	0... 8160	32	rpm
Maximum engine speed threshold for crankshaft target wheel monitoring					
C_N_SEG_T_AD_RAW_MIN_ER	-	0... FFH	0... 8160	32	rpm
Minimum engine speed threshold for crankshaft target wheel monitoring					
C_NR_SEG_AD_ACT_MIN_ER	-	0... FFH	0... 255	1	-
Minimum segments number in fuel cut-off mode before triggering ER segment adaptive learning process					
C_NR_SEG_AD_ACT_MIN_ER_EOL	-	0... FFH	0... 255	1	-
Minimum segments number in fuel cut-off mode before triggering ER segment adaptive learning process for EOL request mode					
C_NR_SEG_AD_AVL_ER	-	0... FFH	0... 255	1	-
Segments number to achieve the first adaptive process phase					
C_NR_SEG_DRV1_MIN_ER	-	0... FFH	0... 255	1	-
Minimum number of segments for engine roughness dynamic part					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NR_SEG_DRV1_MIN_ER_EOL	-	0... FFFH	0... 255	1	-
Minimum number of segments for engine roughness dynamic part for EOL request mode					
C_SEG_AD_DIF_MAX_ER	-	0... 7FFFH	0... 7.81226	237.999e-6	°/oo
Maximum range for difference between same physical segment adaptive values					
C_SEG_AD_MAX_ER	-	0... 7FFFH	0... 7.81226	237.999e-6	°/oo
Limitation of ER segment adaptation range (mechanical tolerance).					
C_T_ACCOUT_DLY_ER_AD	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when air-conditioning compressor has been switched on or off					
C_T_LOAD_GRD_DLY_ER_AD	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when maximum actual torque gradient has been detected.					
C_T_MAF_DIF_DLY_ER_AD	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when maximum air-mass gradient has been detected.					
C_T_TPS_GRD_DLY_ER_AD	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when maximum throttle gradient has been detected.					
IP_LOAD_GRD_ER_AD	-	0... 7FFFH	0... 99.99694	3.05e-3	%
LDP_LOAD_MIS_IP_LOAD_GRD_ER_AD	6	0... 7FFFH	0... 99.99694	3.05e-3	%
Maximum actual torque gradient fade out condition.					
IP_MAF_DIF_MAX_ER_AD	-	0... FFFFH	0... 1389	21.2e-3	mg/stk
LDP_MAF_IP_MAF_DIF_MAX_ER_AD	6	0... FFFFH	0... 1389	21.2e-3	mg/stk
Maximum air-mass gradient per SEG for fade out condition.					
IP_TPS_GRD_MAX_ER_AD	-	0... FFFH	0... 2987.5	11.7156863	°TPS/s
LDP_TPS_AV_IP_TPS_GRD_MAX_ER	6	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Maximum throttle gradient threshold for fade out condition.					
LC_SEG_AD_ER_REQ_EOL	-	0... 1H	0 ...1	1	-
Specific EOL request enable flag for ER segment adaptive value learning process					
LC_SEG_AD_LIM_REAC_ER	-	0... 1H	0 ...1	1	-
Reactivation of the ER segment adaptation range check at each learning phase					

### General information:

To reduce systematic noises generated by target wheel mechanical tolerances, an adaptive learning process is required to improve the signal noise ratio on engine roughness variable and to avoid wrong misfire detection at high engine speed /low load.

ER segment adaptive values learning process is based on ER segments timing observation according a geometrical reference (ER segment time 0, SEG\_NR\_MES = 0).

During an engine deceleration in fuel cut-off mode on all cylinders (LV\_INJ\_CUT, no engine combustion influences), due to crankshaft inertia, engine speed can be considered in a short horizon as constant, thus on one engine cycle (720°Crk) timing dissimilarities between segment reference and others will be observed. For longer horizon observation, a deceleration is applied according current segment position in the engine cycle.

When all adaptation conditions fulfilled (smooth deceleration in fuel cut-off conditions), an adaptive values learning process is performed every **720° crank angle**, starting with **segment 0** (*adaptive process reference*).

If there is no cylinder specific mechanical damage or crankshaft torsion/flexion, the adaptation values for cylinders with the same mechanical segment will be approximately identical:

3 cylinder engine	4 cylinder engine	5 cylinder engine	6 cylinder engine	8 cylinder engine
SEG_AD_ER_0 (geometrically singular)	SEG_AD_ER_0 ≡ SEG_AD_ER_2	SEG_AD_ER_0 (geometrically singular)	SEG_AD_ER_0 ≡ SEG_AD_ER_3	SEG_AD_ER_0 ≡ SEG_AD_ER_4
SEG_AD_ER_1 (geometrically singular)	SEG_AD_ER_1 ≡ SEG_AD_ER_3	SEG_AD_ER_1 (geometrically singular)	SEG_AD_ER_1 ≡ SEG_AD_ER_4	SEG_AD_ER_1 ≡ SEG_AD_ER_5
SEG_AD_ER_2 (geometrically singular)		SEG_AD_ER_2 (geometrically singular)	SEG_AD_ER_2 ≡ SEG_AD_ER_5	SEG_AD_ER_2 ≡ SEG_AD_ER_6
		SEG_AD_ER_3 (geometrically singular)		SEG_AD_ER_3 ≡ SEG_AD_ER_7
		SEG_AD_ER_4 (geometrically singular)		
Segments length : 240°Crk	Segments length : 180°Crk	Segments length : 144°Crk	Segments length : 120°Crk	Segments length : 90°Crk

### 4.51.1 Fade out conditions of engine roughness segment adaptive process

#### FUNCTION DESCRIPTION:

##### Description:

LV\_SEG\_AD\_FDOUT\_ER combines all system conditions to generate a fade out condition as input for the generic segment adaptation process.

Update rate: segment occurrence for conditions & data process  
10ms for free running decouplers

##### Application conditions

**Activation:** LV\_ENA\_SEG\_T\_MES = 1

**Deactivation:** LV\_ENA\_SEG\_T\_MES = 0

**Action on deactivation event Or ECU reset:**

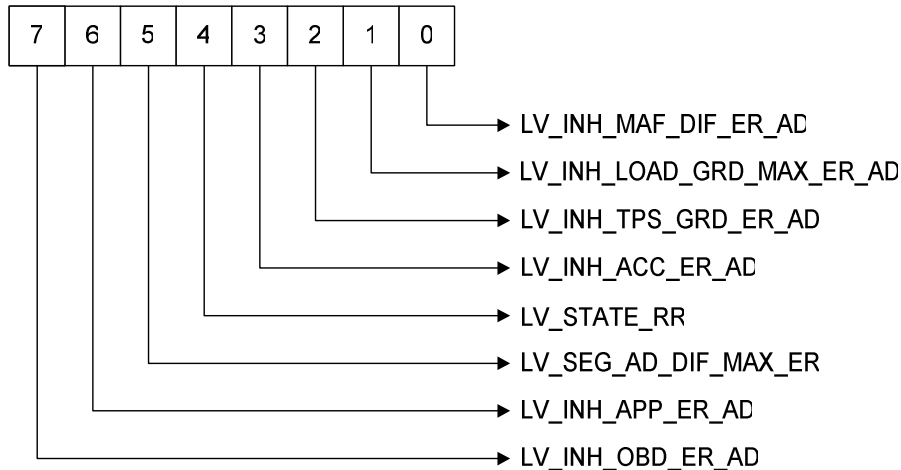
LV\_SEG\_AD\_FDOUT\_ER = 1

SEG\_AD\_FDOUT\_ER\_CDN = 0xFF

SEG\_AD\_FDOUT\_ER\_CDN\_NR = 8

##### Definition of segment adaptation fade out conditions carrier:

**SEG\_AD\_FDOUT\_ER\_CDN** : Carrier used for fade-out conditions merge



### 4.51.1.1 Configurable Fade-out Management

#### Application conditions:

The Fade out management of the segment adaptive process can be configured with a bitfield mask calibration that allow to take in account or not some conditions set in the carrier.

If the corresponding bit in the SEG\_AD\_FDOUT\_ER\_CDN carrier structure is set to 0 in C\_MASK\_SEG\_AD\_FDOUT\_ER calibration, then the corresponding condition will not fade-out the segment adaptive process via LV\_SEG\_AD\_FDOUT\_ER.

The number of fade-out conditions not masked by this calibration is set in SEG\_AD\_FDOUT\_ER\_CDN\_NR.

#### Formula section:

```
SEG_AD_FDOUT_ER_CDN_NR =
    sum (SEG_AD_FDOUT_ER_CDN & C_MASK_SEG_AD_FDOUT_ER)
    ! (bitfield operation) !
```

```
If   SEG_AD_FDOUT_ER_CDN_NR ≠ 0
Then  LV_SEG_AD_FDOUT_ER = 1
Else  LV_SEG_AD_FDOUT_ER = 0
EndIf
```

### 4.51.1.2 Maximum air-mass gradient

Due to trailing throttle /acceleration transition problems it is necessary to disable ER segment learning process for a short period when the air-mass gradient per segment exceeds a calibration value.

#### Application conditions:

ER segment adaptation is disabled while the absolute of the air-mass gradient exceeds the value mentioned below:

After the last triggering of this segment adaptation is suppressed for a period of C\_T\_MAF\_DIF\_DLY\_ER\_AD.

**Formula section:**

**If** |MAF\_DIF| > IP\_MAF\_DIF\_MAX\_ER\_AD(MAF)

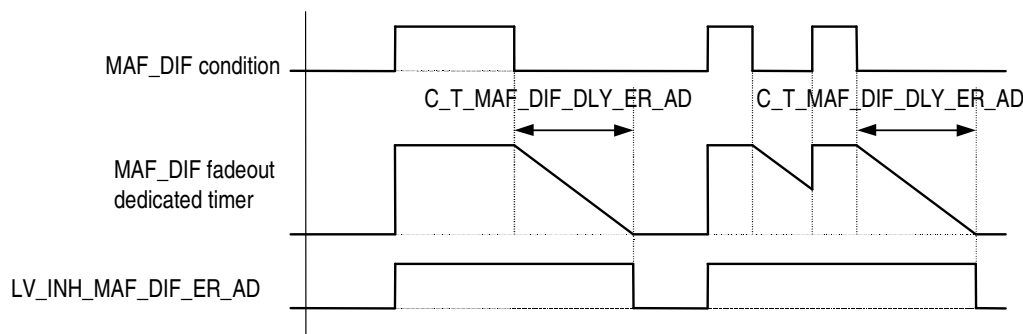
**Then**

After condition rising edge triggering, LV\_INH\_MAF\_DIF\_ER\_AD flag is set to 1 as long as condition is true.

After condition falling edge triggering, LV\_INH\_MAF\_DIF\_ER\_AD flag is hold to 1 for a period of C\_T\_MAF\_DIF\_DLY\_ER\_AD.

**Endif**

**Fade out behaviour summary:**



**4.51.1.3 Maximum actual load gradient**

Due to general intervention of the torque model it's necessary to disable ER segment adaptation for a short period when the actual torque gradient exceeds a calibration value.

**Application conditions:**

ER segment adaptation is disabled while the absolute of the torque gradient - here LOAD\_GRD\_MIS the reference for Misfire detection process - exceeds the value mentioned below.

After the last triggering of this segment adaptation is suppressed for a period of C\_T\_LOAD\_GRD\_DLY\_ER\_AD.

**Formula section:**

**If** LOAD\_GRD\_MIS > IP\_LOAD\_GRD\_ER\_AD(LOAD\_MIS)

**Then**


After condition rising edge triggering, LV\_INH\_LOAD\_GRD\_MAX\_ER\_AD flag is set to 1 as long as condition is true.

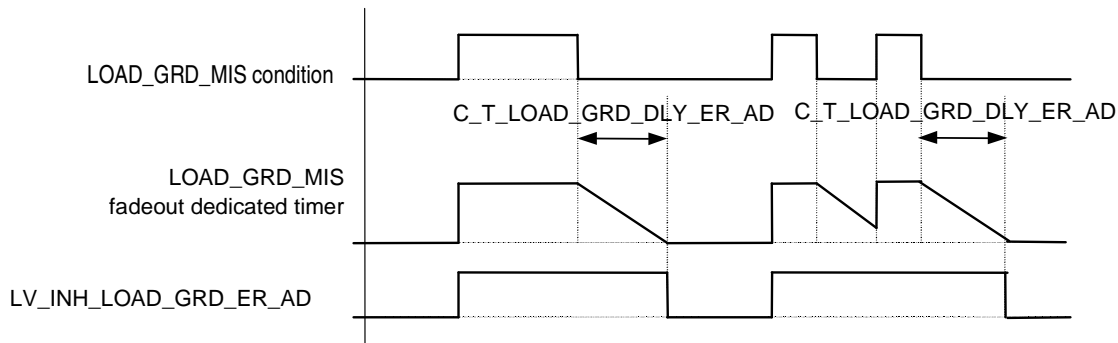
After condition falling edge triggering, LV\_INH\_LOAD\_GRD\_MAX\_ER\_AD flag is hold to 1 for a period of C\_T\_LOAD\_GRD\_DLY\_ER\_AD.

**Endif**

**Fade out behaviour summary:**

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#### 4.51.1.4 Maximum throttle gradient

Due to trailing throttle /acceleration transient problems at low load it is necessary to disable ER segment adaptation for a short period when the throttle gradient exceeds a calibration value.

##### Application conditions:

ER segment adaptation is disabled while the throttle position gradient exceeds the value mentioned below.

After the last triggering of this segment adaptation is suppressed for a period of C\_T\_TPS\_GRD\_DLY\_ER\_AD.

##### Formula section:

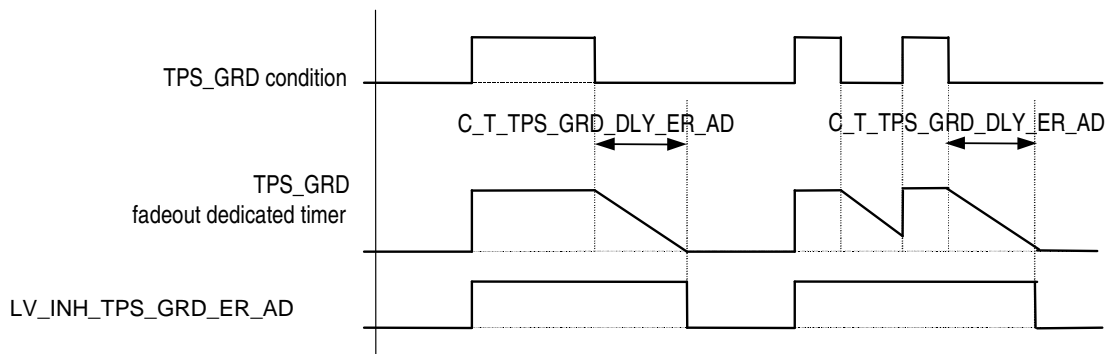
**If**  $TPS\_GRD > IP\_TPS\_GRD\_MAX\_ER\_AD(TP\_AV)$

**Then**

After condition rising edge triggering, LV\_INH\_TPS\_GRD\_ER\_AD flag is set to 1 as long as condition is true.

After condition falling edge triggering, LV\_INH\_TPS\_GRD\_ER\_AD flag is hold to 1 for a period of C\_T\_TPS\_GRD\_DLY\_ER\_AD.

**Endif**




#### 4.51.1.5 Air - conditioning compressor activation

When the air - conditioning compressor is switched on, an additional load is briefly applied to the engine.

This load jump can cause an ER segment period jump and crankshaft vibration.

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**Application conditions:**

Engine roughness segment adaptation can be suppressed for the applicable constant period C\_T\_ACCOUT\_DLY\_ER\_AD, starting if the air - conditioning compressor is switched on or off (LV\_ACCOUT\_RLY changes from 0 to 1 or from 1 to 0), during this period LV\_INH\_ACC\_ER\_AD is set to 1.

**Formula section:**

```

If   LV_ACCOUT_RLY = 0 → 1
Or   LV_ACCOUT_RLY = 1 → 0
Then LV_INH_ACC_ER_AD is set to 1 during C_T_ACCOUT_DLY_ER_AD
Endif

```

**4.51.1.6 Rough road condition active**

Due to possible feedback from the driven wheels to the crankshaft it is necessary to fade out. ER segment adaptation when rough road condition is active (LV\_STATE\_RR = 1).

**4.51.1.7 Engine roughness adaptive values on the same physical segment out of range**

Due to possible feedback from Dual Mass Flywheel oscillations (*see transmission/crankshaft design*) in adaptive process engine speed range, fluctuations on ER adaptive values of identical physical segments can induce dissimilarity in ER segment correction. LV\_SEG\_AD\_DIF\_MAX\_ER indicates that the engine roughness adaptive values difference on the same physical segment is out of range.

This flag is produced in the following chapter called: Engine roughness adaptive values difference on the same physical segment out of range.

**4.51.1.8 Application specific inhibition request for engine roughness adaptive process**

Due to possible accessories triggering specific to the application (CVT shifts...), an inhibition of the engine roughness adaptive process can be applied.

The inhibition is applied when LV\_INH\_APP\_ER\_AD = 1.

**4.51.1.9 Inhibition request for engine roughness adaptive process linked to OBD errors**

Due to possible troubles induced by OBD I sensors errors (CAM, CRK...), the engine roughness adaptive process can be inhibited by the flag LV\_INH\_OBD\_ER\_AD.

The inhibition is applied when LV\_INH\_OBD\_ER\_AD = 1.

**4.51.2 End of line specific request for ER segment adaptive values learning process****General information:**

During end of line plant, specific conditions to activate ER adaptive process can be used. If OBD end of line process occurs, this request has priority on nominal conditions.

**Update rate:** ER segment occurrence


**Application conditions**

**Activation:** LV\_ENA\_SEG\_T\_MES = 1

**Deactivation:** LV\_ENA\_SEG\_T\_MES = 0

**Action on deactivation event Or ECU reset:**

LV\_SEG\_AD\_FDOUT\_ER\_EOL = 1

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**Description:**

```

If   LV_EOL_OBD = 1           // OBD end of line process request
      And   LV_INJ_CUT = 1 (all cylinders shut-off) during last C_NR_SEG_AD_ACT_MIN_ER_EOL
      segments since last SEG_NR_MES = 0
      And   {
            [ LV_AT = 1   And   N_32 < C_N_MAX_SEG_AD_ER_EOL_AT
              And   N_32 > C_N_MIN_SEG_AD_ER_EOL_AT ]
            Or   [ LV_AT = 0   And   N_32 < C_N_MAX_SEG_AD_ER_EOL_MT
              And   LV_VAR_TCT = 0   And   N_32 > C_N_MIN_SEG_AD_ER_EOL_
MT ]
            Or   [ LV_AT = 0   And   N_32 < C_N_MAX_SEG_AD_ER_
EOL_TCT
              And   LV_VAR_TCT = 1   And   N_32 > C_N_MIN_SEG_AD_ER_EOL_
TCT ] }

      And   DRV1_ER < C_DRV1_MAX_SEG_AD_ER_EOL during
NR_SEG_DRV1_MIN_ER_EOL segments
      And   LC_SEG_AD_ER_REQ_EOL = 1
Then      // Request in specific EOL range for segment adaptive process
            LV_SEG_AD_FDOUT_ER_EOL = 0
Else      // No specific request
            LV_SEG_AD_FDOUT_ER_EOL = 1
EndIf
    
```

**4.51.3 Engine roughness adaptive learning process management**

**Description:**

The adaptive process is managed in two phases:

- A fast adaptive process for end of line procedures (EOL), who allow a fast convergence to ER flywheel adaptive values.
- At the end of the fast adaptive process, a slow adaptive process who will monitor ER adaptive values during the engine lifetime.

An end of line specific filtering mode, to be used on EOL or special service request.

At the beginning of the segment adaptation learning process, it is necessary to upper the engine roughness value with an additional offset (THD\_AD\_ER), depending on the target wheel tolerances to be exceeded.

For instance, a flywheel with a ± 0.3°Crk mechanical tolerance on the ER segment corresponds to following segment drift:

Engine Type	ER Segment length	Induced Drift with ± 0.3°Crk tolerance on ER segment
3 cyl engine	240°Crk	2.5‰
4 cyl engine	180°Crk	3.33‰
5 cyl engine	144°Crk	4.17‰
6 cyl engine	120°Crk	5‰
8 cyl engine	90°Crk	6.68‰

The value by which the ER is increased at the beginning is gradually reduced to zero in a linear way until the 95% correction is obtained.

This number of steps is controlled by an internal adaptation counter CTR\_SEG\_AD\_ER.

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### 4.51.3.1 Engine roughness adaptive learning process

#### First time initialisation :

The ER segment adaptive values learning process is initialised when :

- ECU is initialised for the first time (*flash memory formatting*)
- A loss of adaptation values has been detected (*flash memory corrupted*).
- A specific external tool request occurs (*use of LV\_SEG\_AD\_RST\_ER\_EOL*)

**// ER segment adaptive process control variables reseted**

CTR\_SEG\_AD\_ER = 0

DELTA\_CRK\_DIF\_MAX\_ER = NC\_CYL\_NR \* 4 \* C\_CRK\_DIF\_MAX\_ER

LV\_SEG\_AD\_AVL\_ER = 0

**Update rate:** ER segment task, every engine cycle when SEG\_NR\_MES = 0 ;  
SEG\_T\_MES\_0 segment acquired.

#### Application conditions:

*Activation/Deactivation: (based on LV\_SEG\_AD\_RAW\_ER evaluation)*

*// Raw adaptive value monitoring activation*

```

If   LV_INJ_CUT = 1           // All cylinders shut-off
      And   N_32 < C_N_SEG_T_AD_RAW_MAX_ER
      And   N_32 > C_N_SEG_T_AD_RAW_MIN_ER
      And   LV_ENA_SEG_T_MES = 1
Then  LV_SEG_AD_RAW_ER = 1
Else  LV_SEG_AD_RAW_ER = 0
        LV_SEG_AD_ER = 0

```

**Endlf**


#### Formula section:

*// Adaptive value learning process activation*

```

If(1) LV_SEG_AD_FDOUT_ER = 0
      And [ ( LV_INJ_CUT = 1 (all cylinders shut-off) during last
              C_NR_SEG_AD_ACT_MIN_ER segments since last SEG_NR_MES = 0 )
            And { [ LV_AT = 1 And N_32 < C_N_MAX_SEG_AD_ER_AT
                    And N_32 > C_N_MIN_SEG_AD_ER_AT ]
                  Or
                    [ LV_AT = 0 And N_32 < C_N_MAX_SEG_AD_ER_TCT
                      And LV_VAR_TCT = 1 And N_32 > C_N_MIN_SEG_AD_ER_TCT ]
                  }
            Or
              [ LV_AT = 0 And N_32 < C_N_MAX_SEG_AD_ER_MT
                And LV_VAR_TCT = 0 And N_32 > C_N_MIN_SEG_AD_ER_MT ]
            ]
      And   DRV1_ER < C_DRV1_MAX_SEG_AD_ER during
      NR_SEG_DRV1_MIN_ER segments )
      Or   LV_SEG_AD_FDOUT_ER_EOL = 0 ]
Then(1)  LV_SEG_AD_ER = 1 // ER adaptive learning process enable
      If(2)  LV_SEG_AD_AVL_ER = 0
      Then (2) // First adaptive process phase
      If(3)  LV_SEG_AD_FDOUT_ER_EOL = 0

```

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```

Then(3)      CRLC_SEG_AD_ER = C_CRLC_SEG_AD_ER_EOL
Else(3)
  If(4)      LV_VAR_TCT = 0
  Then(4)
    CRLC_SEG_AD_ER = C_CRLC_FAST_SEG_AD_ER
  Else(4)
    CRLC_SEG_AD_ER = C_CRLC_FAST_SEG_AD_ER_TCT
  EndIf(4)
EndIf(3)
  DELTA_CRK_DIF_MAX_ER(n) = DELTA_CRK_DIF_MAX_ER(n-1)
    - "NC_CYL_NR * 4 * C_CRK_DIF_MAX_ER * CRLC_SEG_AD_ER
    3
  CTR_SEG_AD_ER = CTR_SEG_AD_ER + 1      (with saturation to max value)
If(3)      CTR_SEG_AD_ER C_NR_SEG_AD_AVL_ER
Then(3)    LV_SEG_AD_AVL_ER = 1      // First adaptive process phase achieved
EndIf(3)
Else(2)    // Engine lifetime adaptive process phase
  CTR_SEG_AD_ER = CTR_SEG_AD_ER + 1      (with saturation to max value)
If(2)    LV_SEG_AD_FDOUT_ER_EOL = 0
  Then(2)  CRLC_SEG_AD_ER = C_CRLC_SEG_AD_ER_EOL
Else(2)
  If(4)    LV_VAR_TCT = 0
  Then(4)
    CRLC_SEG_AD_ER = C_CRLC_SEG_AD_ER
  Else(4)
    CRLC_SEG_AD_ER = C_CRLC_SEG_AD_ER_TCT
  EndIf(4)
EndIf(2)

EndIf(1)
Else(1)    LV_SEG_AD_ER = 0              // ER adaptive learning process disable
EndIf(1)

```

### 4.51.3.2 Engine roughness offset during first adaptive process phase

**Update rate:** ER segment task

#### Application conditions

**Activation:**  $LV\_ENA\_ER = 1$

**Deactivation:**  $LV\_ENA\_ER = 0$

**Action on deactivation condition Or ECU reset :**  $THD\_AD\_ER = 0$

#### Formula section:


**If**  $LV\_SEG\_AD\_AVL\_ER = 0$

**Then** // The ER offset factor  $THD\_AD\_ER$  is decreased via  $DELTA\_CRK\_DIF\_MAX\_ER$  value

$THD\_AD\_ER = DELTA\_CRK\_DIF\_MAX\_ER * SEG\_T\_COR$

**Else**  $THD\_AD\_ER = 0$

**EndIf**

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## 4.51.4 Engine roughness adaptive values calculation & filtering

### FUNCTION DESCRIPTION:

This function allows to determinate the coefficients for ER segment adaptive values filters used in the learning process. Three different stages can be differentiate :

- Nominal ER segment adaptive values filtering mode, used to monitor adaptive values during engine lifetime.
- Fast ER segment adaptive values filtering mode, used to quickly obtain valid adaptive values when the EMS is new.
- EOL specific filtering mode, to be used on EOL or special service request.

LV\_SEG\_AD\_LIM\_ER is set if at least one SEG\_AD\_MMV\_ER\_x value exceeds C\_SEG\_AD\_MAX\_ER.

### First time initialisation :

The ER segment adaptive values learning process is initialised when :

- ECU is initialised for the first time (*flash memory formatting*)
- A loss of adaptation values has been detected (*flash memory corrupted*).
- A specific external tool request occurs (*use of LV\_SEG\_AD\_RST\_ER\_EOL defined in Application Incidences file*)

### **// ER segment adaptive values reseted**

```
For x = 0 ... [NC_CYL_NR-1]
    SEG_AD_MMV_ER[x] = 0
EndFor
LV_SEG_AD_LIM_ER = 0
```

### Initialisation at ECU reset:

```
For x = 0...(NC_CYL_NR - 1)
    SEG_AD_RAW_MMV_ER[x] = SEG_AD_MMV_ER[x]
EndFor
```

**Update rate:** ER segment occurrence

### Application conditions:

This process is executed every engine cycle when SEG\_T\_MES\_0 (reference segment) is acquired and when the monitoring of the adaptive learning process is active

**Activation:** LV\_SEG\_AD\_RAW\_ER = 1

*Process on activation transient:*

**If** LC\_SEG\_AD\_LIM\_REAC\_ER = 1 // *reactivation of the adaptive values range check*

**Then** LV\_SEG\_AD\_LIM\_ER = 0

**Else** No Operation

**EndIf**

**Deactivation:** LV\_SEG\_AD\_RAW\_ER = 0

**Formula section:** *Temporary data are in italic*


**For(1) x = 0 ... to ... [NC\_CYL\_NR-1]**

*Deceleration correction factor (temporary data):*

*FAC\_DECE\_SEG\_AD\_ER[x] =*

*(x / NC\_CYL\_NR) \* (SEG\_T\_MES\_CYL[0] - SEG\_T\_MES\_CYL[0]\_prev)*

Raw adaptive values:

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$$SEG\_AD\_ER[x] = \frac{[ (SEG\_T\_MES\_CYL[x] - SEG\_T\_MES\_CYL[0]_{prev}) - FAC\_DECE\_SEG\_AD\_ER[x] ]}{SEG\_T\_MES\_CYL[0]_{prev}}$$

Engine roughness adaptive values filtering for monitoring and learning process:

```

SEG_AD_RAW_MMV_ER[x]i = SEG_AD_RAW_MMV_ER[x]i-1 +
  C_CRLC_SEG_AD_RAW_ER * (SEG_AD_ER[x]i - SEG_AD_RAW_MMV_ER[x]i-1)
If(2)   LV_SEG_AD_ER = 1
Then(2)   If(3)           CTR_SEG_AD_ER = 1
Then(3)   SEG_AD_MMV_ER[x]i = SEG_AD_ER[x]i
Else(3)   SEG_AD_MMV_ER[x]i = SEG_AD_MMV_ER[x]i-1 +
  CRLC_SEG_AD_ER * [SEG_AD_ER[x]i - SEG_AD_MMV_ER[x]i-1]
EndIf(3)
Engine roughness adaptive values out of range check:
If(3)   |SEG_AD_MMV_ER[x]| >= C_SEG_AD_MAX_ER
Then(3)   LV_SEG_AD_LIM_ER = 1
EndIf(3)

```

**EndIf**(2)

```

If(2)   LV_SEG_AD_ER = 1 → 0
And    LV_SEG_AD_AVL_ER = 1
        //no risk because THD_AD_ER = 0, CTR_SEG_AD_ER no more
used

```

```

And    LV_REQ_SEG_AD_MMV_ER_APP = 1
Then(2)   SEG_AD_MMV_ER[x] = SEG_AD_MMV_ER_APP[x]
          LV_SEG_AD_LIM_ER = 0

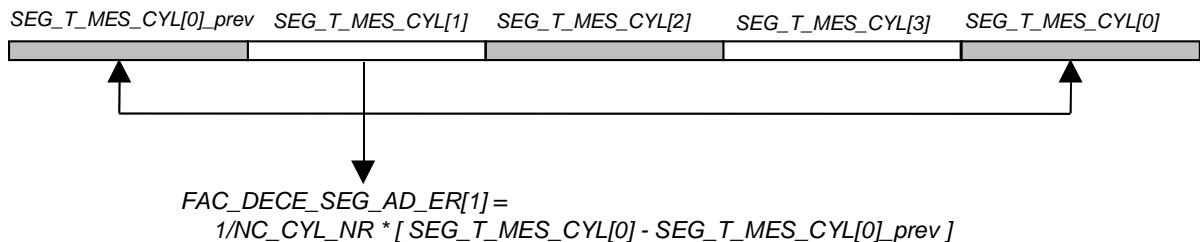
```

**EndIf**(2)

**EndFor**(1)


where:

SEG\_AD\_ER[x] : raw adaptive value for logical segment x, temporary data  
 FAC\_DECE\_SEG\_AD\_ER[x] : deceleration correction factor, temporary data  
 SEG\_AD\_RAW\_MMV\_ER[x] : fast filtered adaptive value for logical segment x  
 SEG\_AD\_MMV\_ER[x] : filtered adaptive value for logical segment x  
 SEG\_T\_MES\_CYL[0]<sub>prev</sub> : raw segment period of reference segment (SEG\_NR\_MES=0), on previous engine cycle, temporary data, oldest value  
 SEG\_T\_MES\_CYL[0] : raw segment period of reference segment (SEG\_NR\_MES=0) after NC\_CYL\_NR segments (720° crank angle), newest value



#### 4.51.5 Engine roughness adaptive values difference on the same physical segment out of range

**General information:**

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
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Due to possible feedback from Dual Mass Flywheel oscillations (see *transmission/crankshaft design*) in adaptive process engine speed range, fluctuations on ER adaptive values of identical physical segments can induce dissimilarity in ER segment correction.

If difference between identical physical segments ER fast filtered adaptive values exceeds a calibratable gap, a fade out is applied.

ER identical physical segments adaptive value differences are evaluated each 720°Crk, for that this process is executed every engine cycle when SEG\_T\_MES\_0 (SEG\_NR\_MES = 0) is acquired and when the adaptive monitoring process is active.

**Update rate:** ER segment occurrence,

### Application conditions

**Activation:** SEG\_NR\_MES = 0  
**And** LV\_SEG\_AD\_RAW\_ER = 1

**Deactivation:** SEG\_NR\_MES != 0  
**Or** LV\_SEG\_AD\_RAW\_ER = 0

**Initialisation :** on ECU reset:  
 LV\_SEG\_AD\_DIF\_MAX\_ER = 0  
**#If** NC\_CYL\_NR = 4, 6 or 8  
 SEG\_AD\_DIF\_ER\_0 = 0  
 SEG\_AD\_DIF\_ER\_1 = 0  
**#EndIf**  
**#If** NC\_CYL\_NR = 6 or 8  
 SEG\_AD\_DIF\_ER\_2 = 0  
**#EndIf**  
**#If** NC\_CYL\_NR = 8  
 SEG\_AD\_DIF\_ER\_3 = 0  
**#EndIf**

### Formula section:

**#If** NC\_CYL\_NR = 3 Or NC\_CYL\_NR = 5  
 LV\_SEG\_AD\_DIF\_MAX\_ER = 0

**#Endif**

**#if** NC\_CYL\_NR = 4

SEG\_AD\_DIF\_ER\_0 = | SEG\_AD\_RAW\_MMV\_ER\_0 - SEG\_AD\_RAW\_MMV\_ER\_2 |  
 SEG\_AD\_DIF\_ER\_1 = | SEG\_AD\_RAW\_MMV\_ER\_1 - SEG\_AD\_RAW\_MMV\_ER\_3 |

**If** SEG\_AD\_DIF\_ER\_0 >= C\_SEG\_AD\_DIF\_MAX\_ER  
**Or** SEG\_AD\_DIF\_ER\_1 >= C\_SEG\_AD\_DIF\_MAX\_ER

**Then** LV\_SEG\_AD\_DIF\_MAX\_ER = 1

**Else** LV\_SEG\_AD\_DIF\_MAX\_ER = 0

**Endif**

**#Endif**

**#if** NC\_CYL\_NR = 6


SEG\_AD\_DIF\_ER\_0 = | SEG\_AD\_RAW\_MMV\_ER\_0 - SEG\_AD\_RAW\_MMV\_ER\_3 |  
 SEG\_AD\_DIF\_ER\_1 = | SEG\_AD\_RAW\_MMV\_ER\_1 - SEG\_AD\_RAW\_MMV\_ER\_4 |  
 SEG\_AD\_DIF\_ER\_2 = | SEG\_AD\_RAW\_MMV\_ER\_2 - SEG\_AD\_RAW\_MMV\_ER\_5 |

**If** SEG\_AD\_DIF\_ER\_0 >= C\_SEG\_AD\_DIF\_MAX\_ER  
**Or** SEG\_AD\_DIF\_ER\_1 >= C\_SEG\_AD\_DIF\_MAX\_ER  
**Or** SEG\_AD\_DIF\_ER\_2 >= C\_SEG\_AD\_DIF\_MAX\_ER

**Then** LV\_SEG\_AD\_DIF\_MAX\_ER = 1

**Else** LV\_SEG\_AD\_DIF\_MAX\_ER = 0

**Endif**

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**#Endif**

**#if NC\_CYL\_NR = 8**

SEG\_AD\_DIF\_ER\_0 = | SEG\_AD\_RAW\_MMV\_ER\_0 - SEG\_AD\_RAW\_MMV\_ER\_4 |

SEG\_AD\_DIF\_ER\_1 = | SEG\_AD\_RAW\_MMV\_ER\_1 - SEG\_AD\_RAW\_MMV\_ER\_5 |

SEG\_AD\_DIF\_ER\_2 = | SEG\_AD\_RAW\_MMV\_ER\_2 - SEG\_AD\_RAW\_MMV\_ER\_6 |

SEG\_AD\_DIF\_ER\_3 = | SEG\_AD\_RAW\_MMV\_ER\_3 - SEG\_AD\_RAW\_MMV\_ER\_7 |

**If** SEG\_AD\_DIF\_ER\_0 >= C\_SEG\_AD\_DIF\_MAX\_ER

**Or** SEG\_AD\_DIF\_ER\_1 >= C\_SEG\_AD\_DIF\_MAX\_ER

**Or** SEG\_AD\_DIF\_ER\_2 >= C\_SEG\_AD\_DIF\_MAX\_ER


**Or** SEG\_AD\_DIF\_ER\_3 >= C\_SEG\_AD\_DIF\_MAX\_ER

**Then** LV\_SEG\_AD\_DIF\_MAX\_ER = 1

**Else** LV\_SEG\_AD\_DIF\_MAX\_ER = 0

**Endif**

**#Endif**

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## 4.52 Engine roughness signal preparation for cylinder balancing

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DLY_DRV1_STND_BAL	V	0... FFFFH	0... 65535	1	-
Segment delay counter for acceleration fade out of cylinder balancing					
DLY_DRV1_STND_BAL	V	0... FFFFH	0... 65535	1	-
Segment delay for acceleration fade out of cylinder balancing					
DRV1_STND_BAL	V	8000... 7FFFH	-325.78 ...325.77	0.00994202	1/s**2
Standardized acceleration component of the ER value					
ER_STD_BAL [NC_CYL_NR]	V	8000... 7FFFH	-325.78 ...325.77	0.00994202	1/s**2
Standard deviation of the engine roughness					
ER_STD_DIF_BAL	V	8000... 7FFFH	-325.78 ...325.77	0.00994202	1/s**2
Difference of the filtered normalized and normalized engine roughness values for calc. of the standard deviation					
ER_STD_MMV_BAL [NC_CYL_NR]	O/V/S	8000... 7FFFH	-325.78 ...325.77	0.00994202	1/s**2
Filtered standard deviation of the engine roughness					
ER_STND_BAL	V	8000... 7FFFH	-325.78 ...325.77	0.00994202	1/s**2
Normalized cylinder selective engine roughness values					
ER_STND_FIL_BAL	V	8000... 7FFFH	-325.78 ...325.77	0.00994202	1/s**2
Normalized cylinder selective engine roughness values after median filter					
ER_STND_MMV_BAL [NC_CYL_NR]	O/V/S	8000... 7FFFH	-325.78 ...325.77	0.00994202	1/s**2
Filtered normalized cylinder selective engine roughness values					
ER_STND_MMV_DIF_BAL [NC_CYL_NR]	O/V	8000... 7FFFH	-325.78 ...325.77	0.00994202	1/s**2
Difference of filtered normalized and average engine roughness value					
ER_STND_MMV_MV_BAL	V	8000... 7FFFH	-325.78 ...325.77	0.00994202	1/s**2
Mean value of all engine roughness values of the last [NC_CYL_NR] segments					
ER_STND_MMV_STD_BAL [NC_CYL_NR]	O/V/S	8000... 7FFFH	-325.78 ...325.77	0.00994202	1/s**2
Filtered normalized engine roughness values for calculation of the standard deviation					
LV_DRV1_STND_BAL_FDOUT	O/V	0... 1H	0 ...1	1	-
Flag for acceleration fade out of cylinder balancing					

### Input data:

DRV1_ER {p. 1454}	ER {p. 1454}	LV_DRV1_ER_BAL_ACT {p. 4022}	LV_ER_STND_ER_BAL_ ACT {p. 4022}
N_32 {p. 1525}	NC_CYL_NR {p. 1526}	SEG_NR_ER {p. 1454}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_ER_STD_BAL	-	0... FFH	0... 0.99609307	0.00390625	-
Correlation constant for ER_STND_FIL_BAL value filter for standard deviation					
C_CRLC_ER_STD_MMV_BAL	-	0... FFH	0... 0.99609307	0.00390625	-
Correlation constant for ER_STD_BAL value filter					
C_CRLC_ER_STND_BAL	-	0... FFH	0... 0.99609307	0.00390625	-
Correlation constant for ER_STND_FIL_BAL value filter					
C_CTR_DLY_DRV1_STND_BAL_DEC	-	0... FFH	0... 255	1	-
Segment delay counter decrement value					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_ER_STD_NEG_BAL	-	0... FFH	0... 0.99609307	0.00390625	-
Weighting factor for negative ER_STD_DIF_BAL values					
C_FAC_ER_STD_POS_BAL	-	0... FFH	0... 0.99609307	0.00390625	-
Weighting factor for positive ER_STD_DIF_BAL values					
IP_DLY_DRV1_STND_BAL	-	0... FFFFH	0... 65535	1	-
LDP_DRV1_STND_BAL_IP_DLY_BAL	8	0... FFFFH	-325.78 ...325.77	0.0099313	1/s**2
Segment delay counter start value					

### General information:

Attention - This specification version (402U01) is only valid for software variants which are providing the input variables ER and DRV1\_ER as 16 bit values.

The engine roughness signal ER as well as the dynamic part of the engine roughness signal DRV1\_ER are used as basis for the calculation of the input signal for the cylinder balancing control functions. The calculations are kept cylinder individual corresponding on the actual segment number SEG\_NR\_ER.

The module "Engine roughness signal preparation for cylinder balancing" is divided in two separate chapters. Within the first part the calculation of the input signals for the cylinder balancing controller is done, while the second part is providing fade out conditions while cylinder balancing has to be interrupted.

### Application Condition

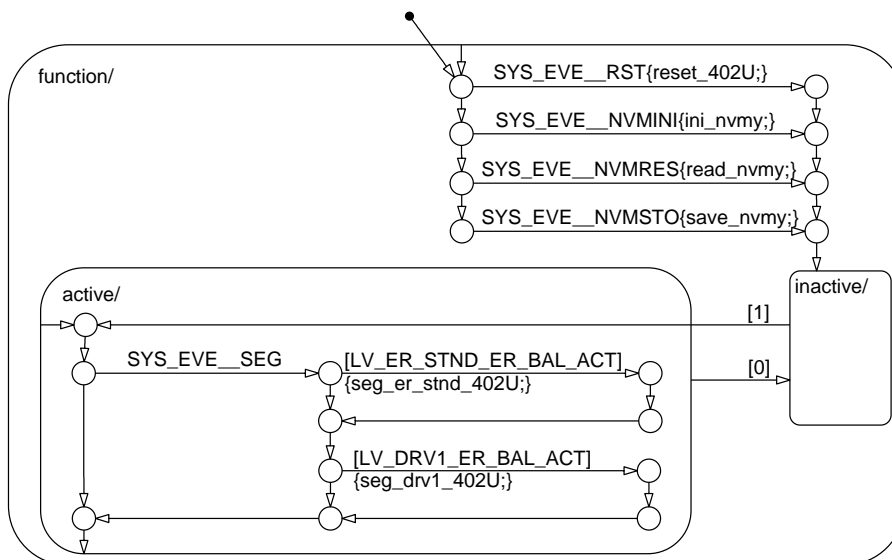



Figure 4.52.1: CYBL\_SIGNAL/APP\_CDN/Chart

### Function Description

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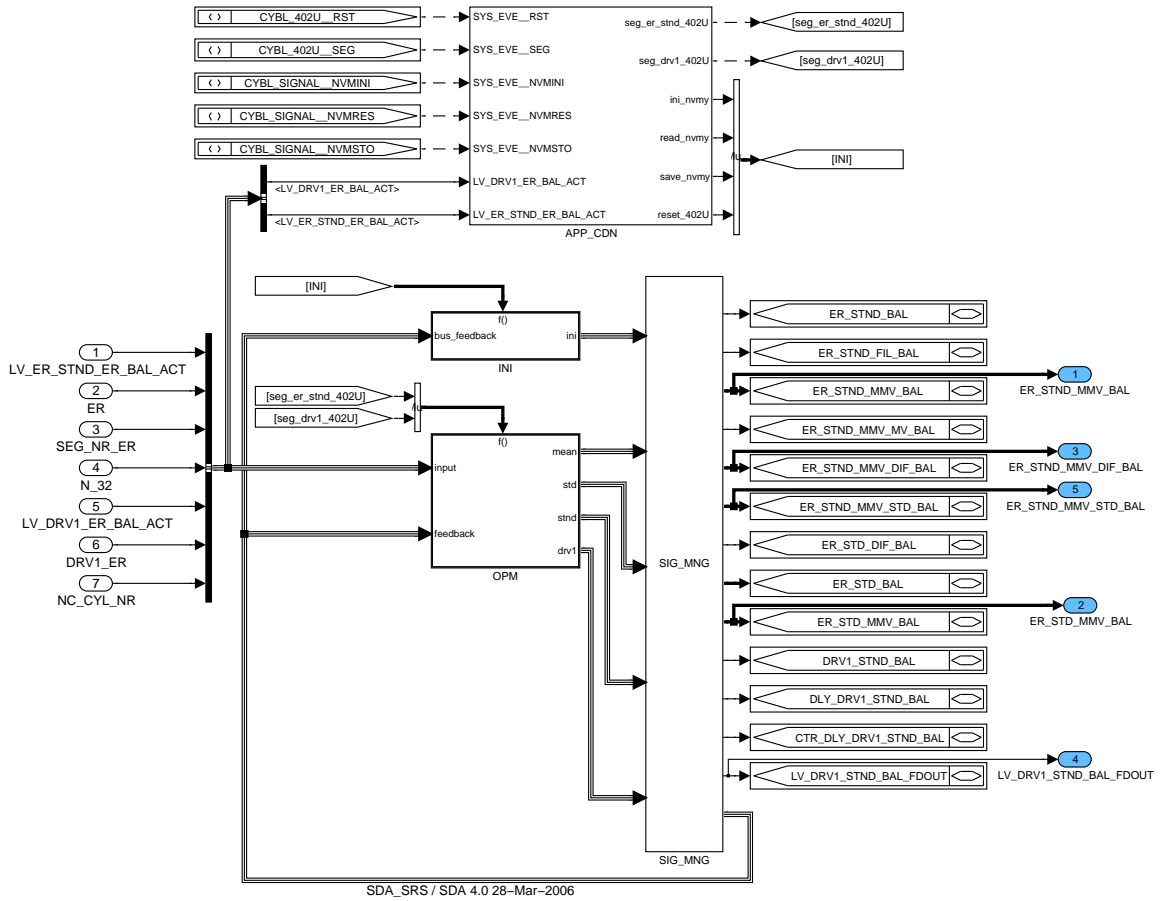


Figure 4.52.2: CYBL\_SIGNAL

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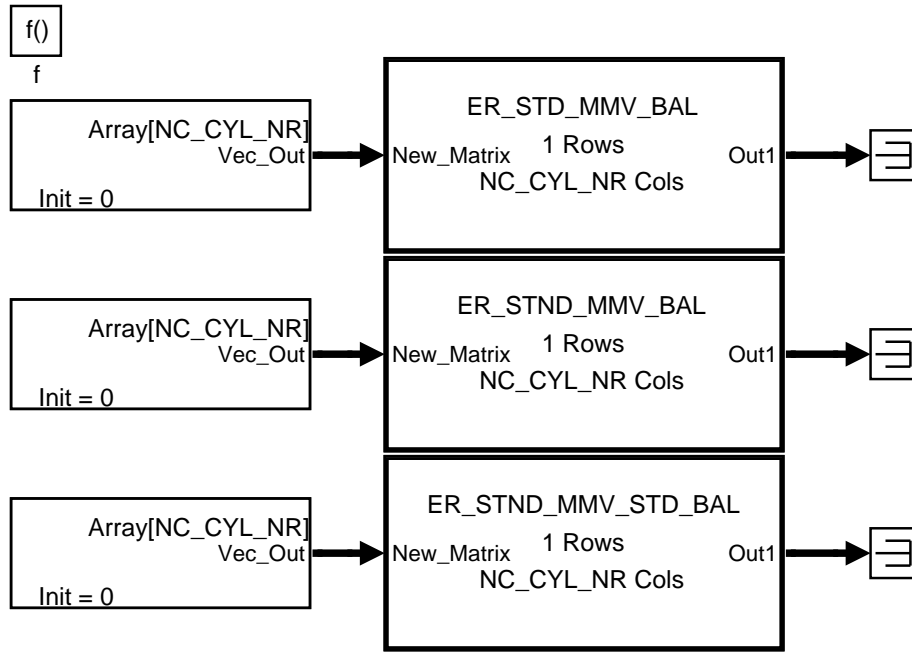


Figure 4.52.4: CYBL\_SIGNAL/INI/NVMYINI

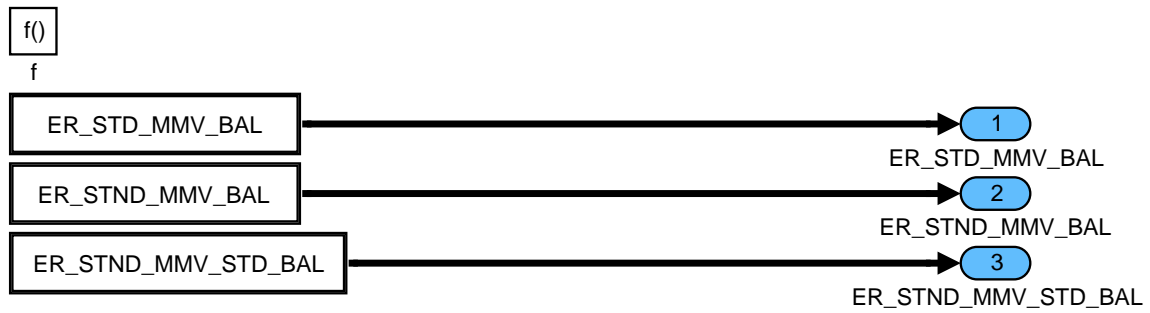


Figure 4.52.5: CYBL\_SIGNAL/INI/NVMYRES

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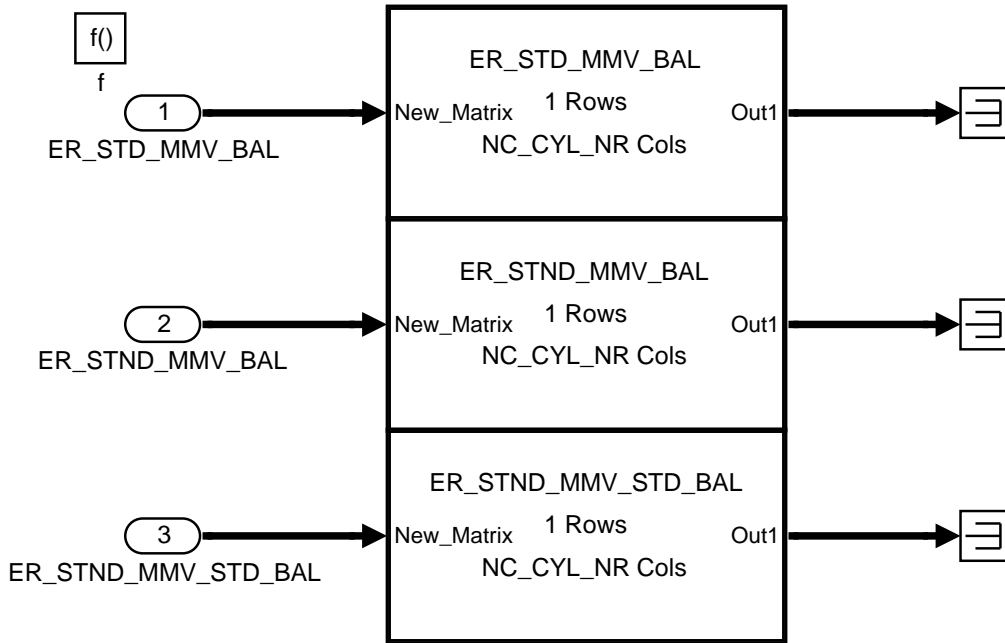


Figure 4.52.6: CYBL\_SIGNAL/INI/NMVYSTO

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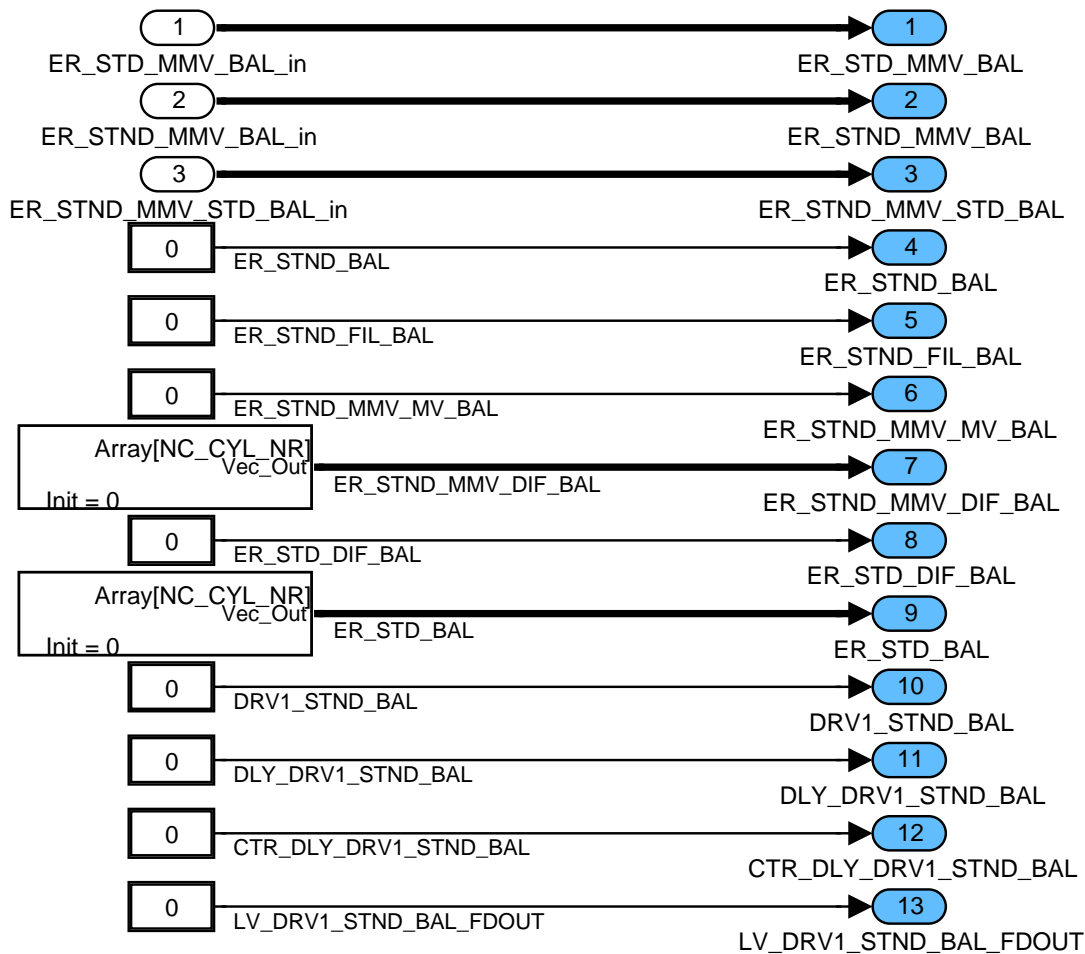


Figure 4.52.7: CYBL\_SIGNAL/INI/RST

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### 4.52.2 Calculation of OPR\_ER\_STND and OPR\_DRV1 - tasks

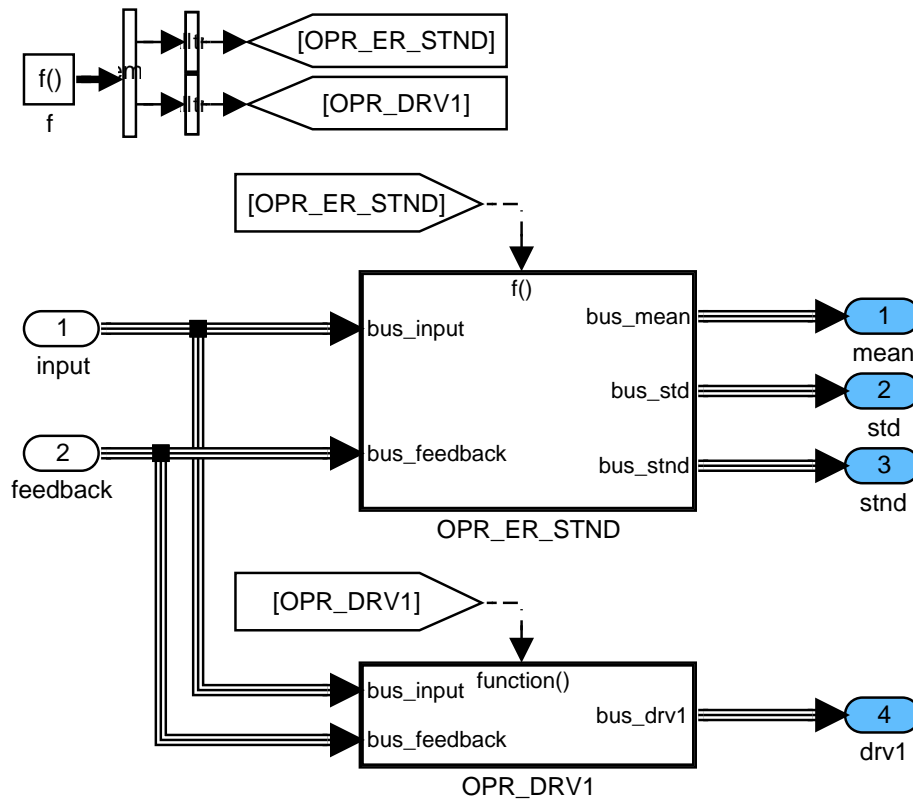


Figure 4.52.8: CYBL\_SIGNAL/OPM

#### Input signals for cylinder balancing adaptation functions

The ER values are used to calculate normalized cylinder selective engine roughness values ER\_STND\_BAL. After normalization (multiplication by  $N_{32}^3$ ), the cylinder selective values are filtered by a Median Filter and a PT1-Filter.

In addition, moving mean values are built (ER\_STND\_MMV\_STD\_BAL[SEG\_NR\_ER]) for the calculation of cylinder specific standard deviations (ER\_STD\_BAL[SEG\_NR\_ER]).


The standard deviation ER\_STD\_DIF\_BAL is calculated by subtracting the moving mean values ER\_STND\_MMV\_STD\_BAL[SEG\_NR\_ER] from the ER\_STND\_BAL values.

The resulting difference ER\_STD\_DIF\_BAL is multiplied with a weighting factor for negative and positive values (C\_FAC\_ER\_STD\_NEG/POS\_BAL). Afterwards a moving mean value is calculated based on this weighted signal.

To allow a cylinder specific adaptation via the engine roughness, a specific signal has to be created for each cylinder. Therefore, from the variable ER\_STND\_MMV\_BAL[SEG\_NR\_ER] the value ER\_STND\_MMV\_MV\_BAL (average value of all cylinder specific moving mean values) is subtracted.

The values ER\_STD\_MMV\_BAL[SEG\_NR\_ER], ER\_STND\_MMV\_BAL[SEG\_NR\_ER] and ER\_STND\_MMV\_STD\_BAL[SEG\_NR\_ER] are stored in the non-volatile memory (NVMY) and used for initialization issues at next engine run.

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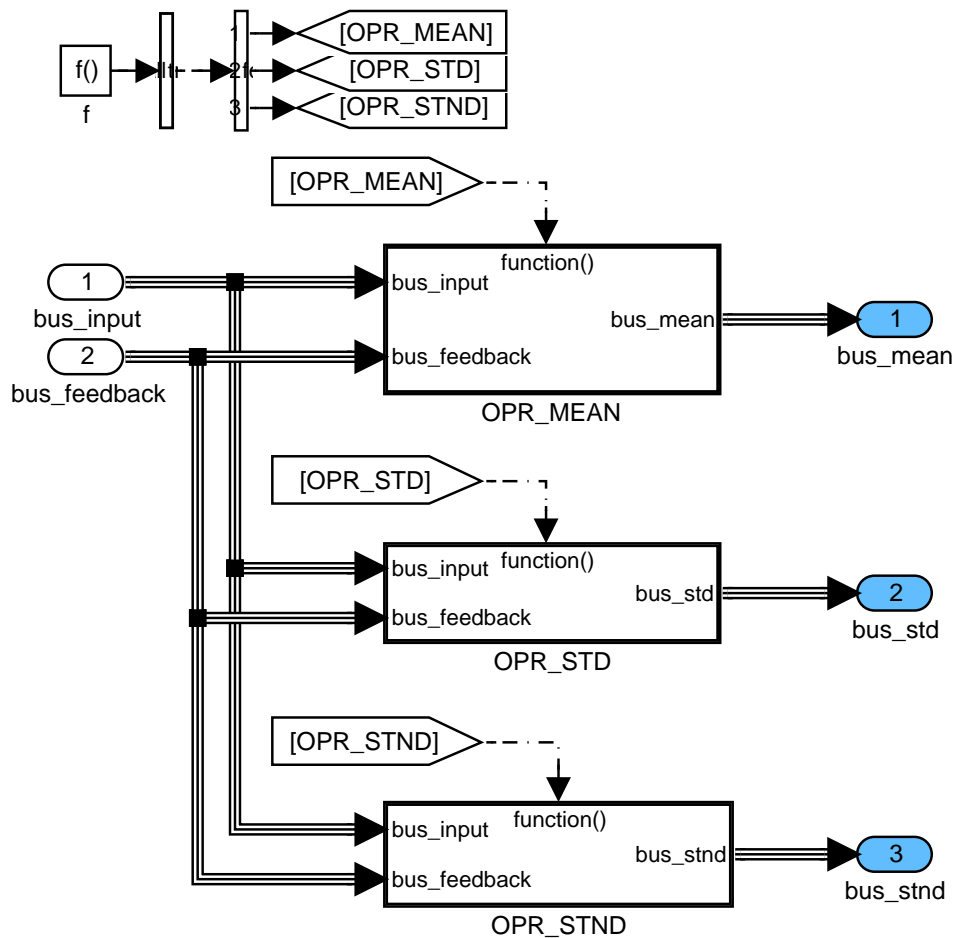


Figure 4.52.9: CYBL\_SIGNAL/OPM/OPR\_ER\_STND

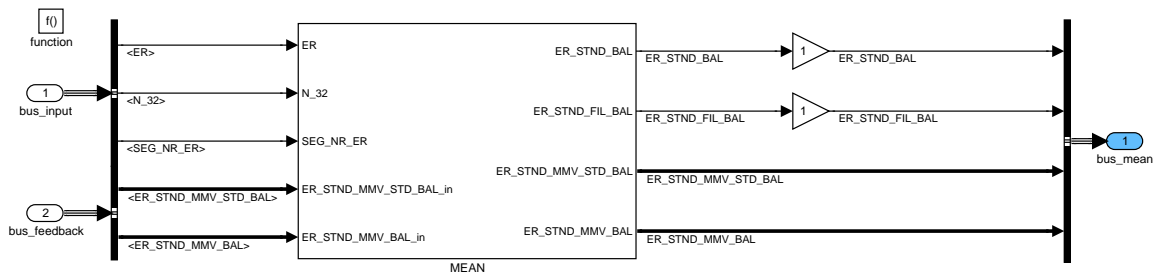


Figure 4.52.10: CYBL\_SIGNAL/OPM/OPR\_ER\_STND/OPR\_MEAN

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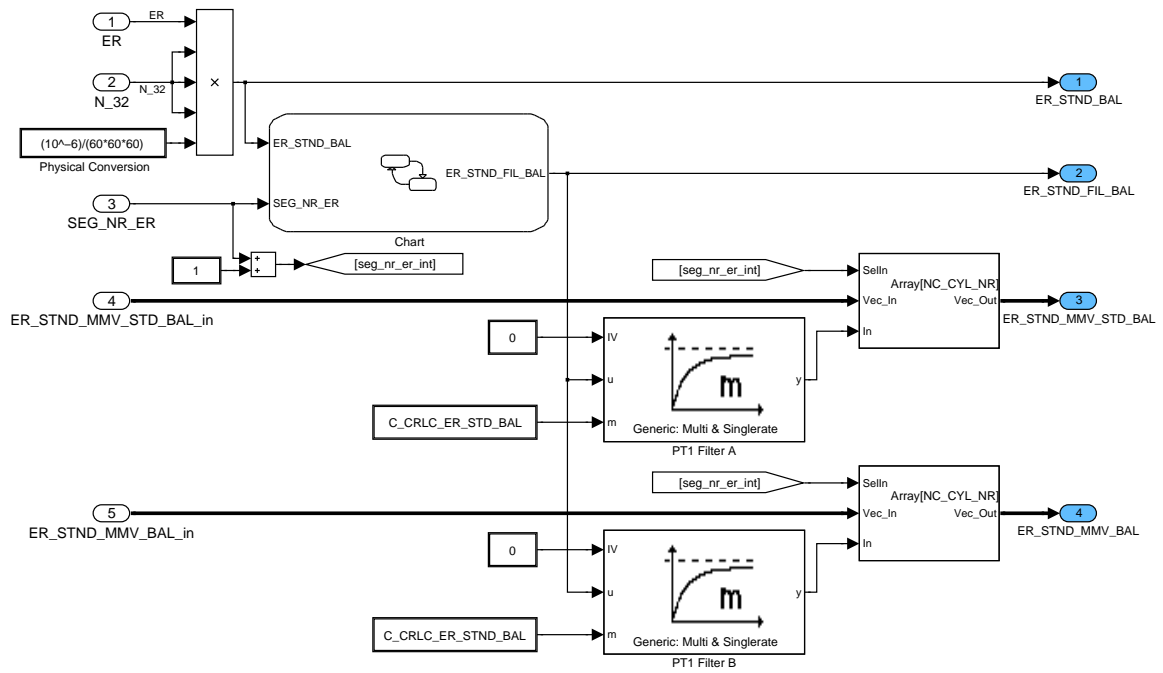


Figure 4.52.11: CYBL\_SIGNAL/OPM/OPR\_ER\_STND/OPR\_MEAN/MEAN

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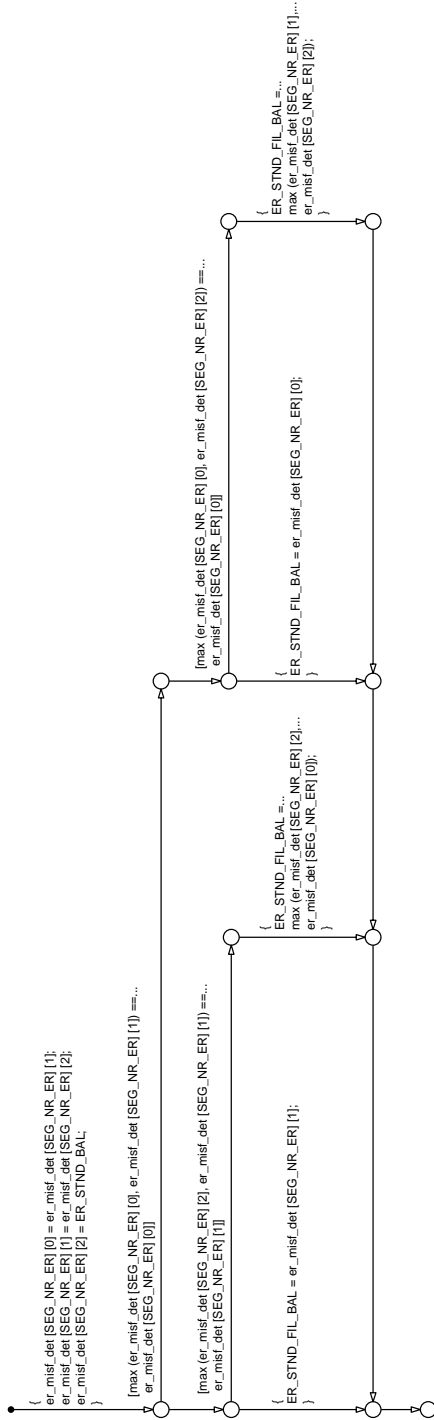



Figure 4.52.12: CYBL\_SIGNAL/OPM/OPR\_ER\_STND/OPR\_MEAN/MEAN/Chart

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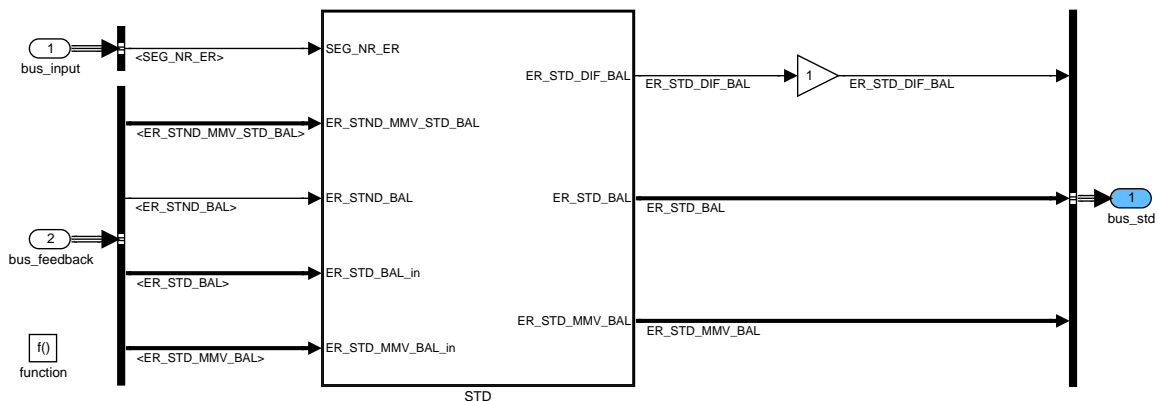


Figure 4.52.13: CYBL\_SIGNAL/OPM/OPR\_ER\_STND/OPR\_STD

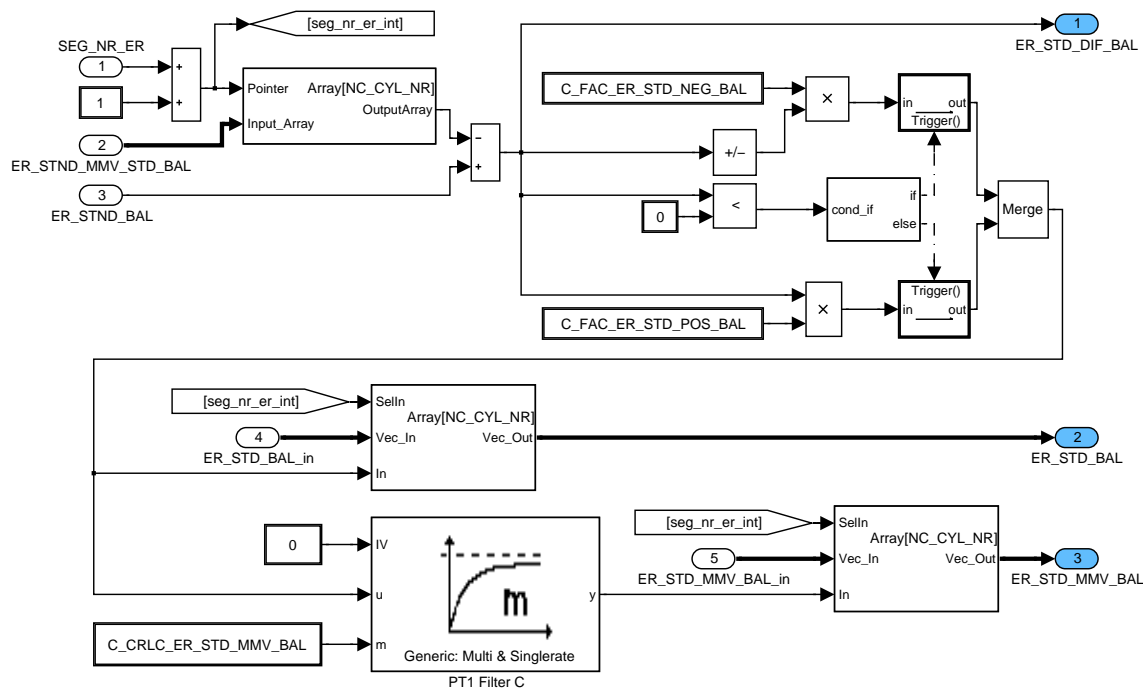


Figure 4.52.14: CYBL\_SIGNAL/OPM/OPR\_ER\_STND/OPR\_STD/STD

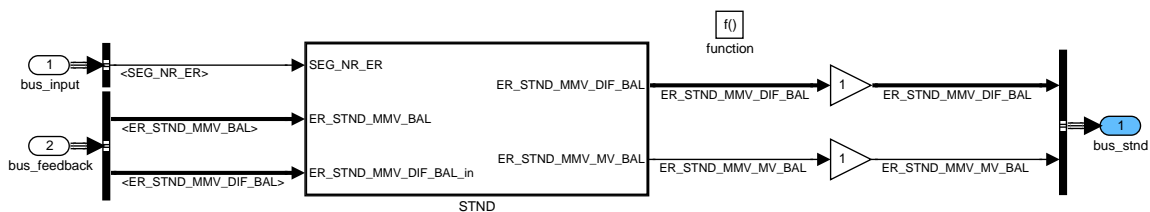


Figure 4.52.15: CYBL\_SIGNAL/OPM/OPR\_ER\_STND/OPR\_STND

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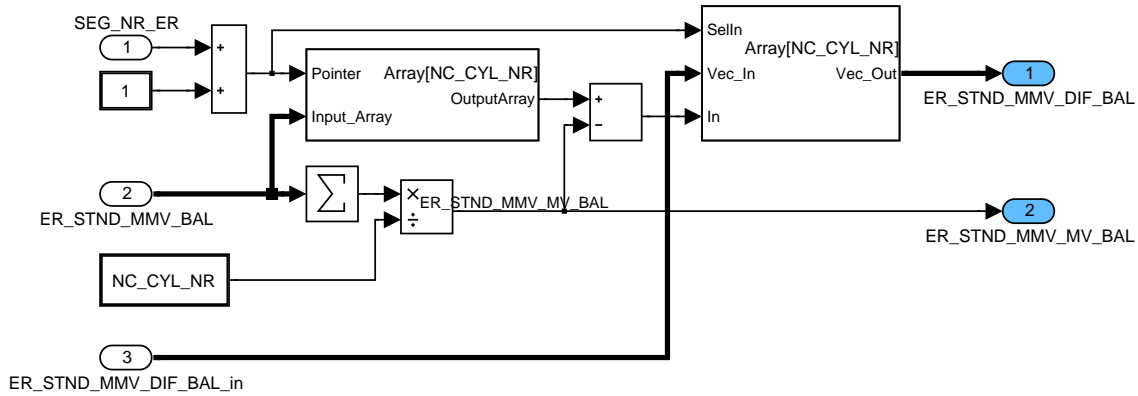


Figure 4.52.16: CYBL\_SIGNAL/OPM/OPR\_ER\_STND/OPR\_STND/STND

**Calculation of cylinder balancing acceleration fade out conditions**

Multiplying the dynamic component (DRV1\_ER) part of the engine roughness calculation with the engine speed by the power of three normalizes the signal. The defined signal is reproducing the engine acceleration in numbers. If the acceleration is quite high or low, in case of speeding up or down, the cylinder balancing adaptation is stopped for a certain number of segments. The number of segments are stored in a counter, which is counting back to zero in certain steps as mentioned in the signal flow diagram.

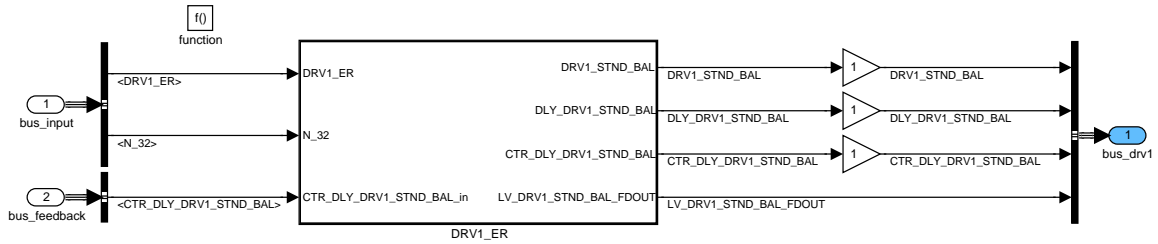


Figure 4.52.17: CYBL\_SIGNAL/OPM/OPR\_DRV1

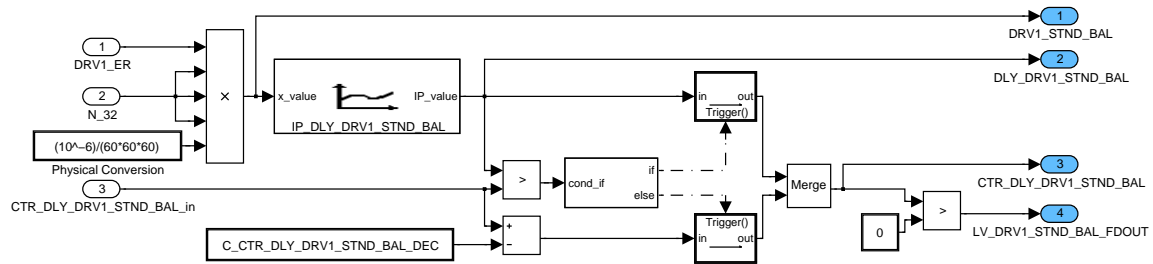


Figure 4.52.18: CYBL\_SIGNAL/OPM/OPR\_DRV1/DRV1\_ER

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### 4.52.3 SUBFUNCTION: SIG\_MNG

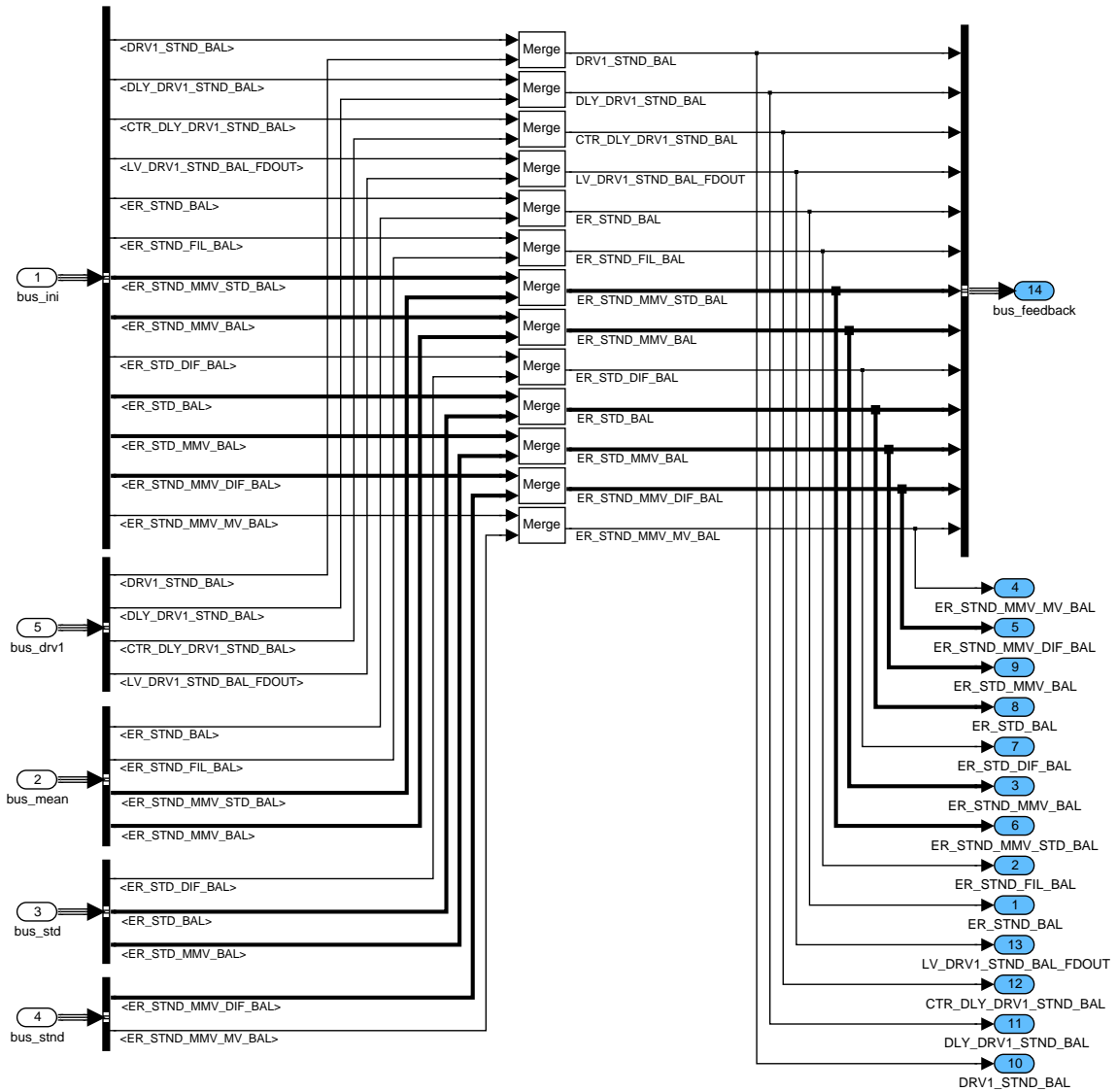


Figure 4.52.19: CYBL\_SIGNAL/SIG\_MNG

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## 4.53 Emission related variables definition

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VLS_DOWN_MAX_DC [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Max Voltage Value in a DC					
VLS_DOWN_MIN_DC [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Min Voltage Value in a DC					

### Input data:

LV_DC {p. 5746}	LV_END_DIAG_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_END_DIAG_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}
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### 4.53.1 Calculation of minimum /maximum downstream lambda sensor voltage for service \$06

#### FUNCTION DESCRIPTION:

VLS\_DOWN\_MIN/MAX\_DC[NC\_CBK\_EX\_NR] are used for OBD communication (MODE 06h), indicating the maximum/minimum downstream voltage to check if sensors are not aged or damaged. Once the electrical diagnosis (SCP and SCG) of the downstream lambda sensors has been completed in a driving cycle, VLS\_DOWN\_MIN/MAX\_DC [NC\_CBK\_EX\_NR] are updated respectively by VLS\_DOWN[NC\_CBK\_EX\_NR].

#### Application conditions

**Initialisation:** VLS\_DOWN\_MIN\_DC [NC\_CBK\_EX\_NR] = 0.425 [V]  
VLS\_DOWN\_MAX\_DC [NC\_CBK\_EX\_NR] = 0.425 [V]  
at reset **or** clearing FMY **or** LV\_DC 0->1

**Recurrence:** 100ms

**Activation:** LV\_DC = 1

#### Formula section:

```

IF          LV_END_DIAG_SCG_LS_DOWN[NC_CBK_EX_NR] =1  AND
              VLS_DOWN[NC_CBK_EX_NR] < VLS_DOWN_MIN_DC[NC_CBK_EX_NR]
THEN       VLS_DOWN_MIN_DC[NC_CBK_EX_NR] = VLS_DOWN[NC_CBK_EX_NR]
ENDIF
IF          LV_END_DIAG_SCP_LS_DOWN[NC_CBK_EX_NR] =1 AND
              VLS_DOWN[NC_CBK_EX_NR] > VLS_DOWN_MAX_DC[NC_CBK_EX_NR]
THEN       VLS_DOWN_MAX_DC[NC_CBK_EX_NR] = VLS_DOWN[NC_CBK_EX_NR]
ENDIF
    
```

## 4.54 Runtime counters

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TRT	O/V/S	0... FFFFFFFFH	0... 119304.64708	27.7999e-6	h
Total running time					

### Input data:

LV_ES {p. 1720}	LV_IGK {p. 906}		
-----------------	-----------------	--	--

### Function description:

The total running time is incremented by 100ms each if the conditions "ignition key ON" and "engine running" has been detected.

The total running time is saved in the non-volatile memory at the end of the driving cycle.

### Formula section:

```

IF          LV_IGK = 1      UND    LV_ES = 0
THEN       TRT = TRT + 2,7778e-5h
ELSE       TRT = TRT
    
```



## 4.55 Engine position control

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_VLD_CAM_SYN_CRK	V	0... FFH	0... 255	1	-
Counter for validation of camshaft signal for crankshaft synchronization					
LV_ACT_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Selfsynchronisation activated on exhaust camshaft i					
LV_ACT_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Selfsynchronisation activated on intake camshaft i					
LV_ACT_CRK	O/V	0... 1H	0 ...1	1	-
Crankshaft acquisition active					
LV_ACT_LIH_CRK_CAM_EX [NC_NR_CAM_CBK]	V	0... 1H	0 ...1	1	-
Crankshaft limp-home operating mode activated on exhaust camshaft i					
LV_ACT_LIH_CRK_CAM_IN [NC_NR_CAM_CBK]	V	0... 1H	0 ...1	1	-
Crankshaft limp-home operating mode activated on intake camshaft i					
LV_ACT_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Crankshaft synchronization operating mode activated on exhaust camshaft i					
LV_ACT_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Crankshaft synchronization operating mode activated on intake camshaft i					
LV_CRK_MISS_RUN_ENG	O/V	0... 1H	0 ...1	1	-
Boolean information engine running after engine stop request					
LV_ENG_BACK_CFM	O/V	0... 1H	0 ...1	1	-
Engine backwards rotation confirmed					
LV_ENG_BACK_DET	O/V	0... 1H	0 ...1	1	-
Engine backwards rotation detected					
LV_ERR_CAM	O/V	0... 1H	0 ...1	1	-
Failure on all camshaft sensor signals in normal mode					
LV_ERR_LIH_CRK_CAM	V	0... 1H	0 ...1	1	-
No more camshaft sensor signals available for crankshaft limp-home mode					
LV_FIRST_VLD_TOOTH	O/V	0... 1H	0 ...1	1	-
First tooth detected after engine stop					
LV_LIH_ERR_CAM	V	0... 1H	0 ...1	1	-
Camshaft limp-home mode (failure on all camshaft sensors)					
LV_LIH_ERR_CRK	O/V	0... 1H	0 ...1	1	-
Crankshaft limp-home mode (crankshaft sensor failure)					
LV_RUN_ENG	O/V	0... 1H	0 ...1	1	-
Engine running					
LV_STOP_ENG	O	0... 1H	0 ...1	1	-
Boolean information for engine stop request					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_SYN_ENG	O/V	0... 1H	0 ...1	1	-
Boolean information for engine synchronization completed.					
LV_SYN_VLD	O/V	0... 1H	0 ...1	1	-
Engine synchronization validated					
PSN_ENG_CAM_LIH_CRK	O	0... 2CFFH	0... 719.9375	0.0625	°CRK
Engine position in crankshaft limp-home mode					
PSN_ENG_CRK	O	0... 2CFFH	0... 719.9375	0.0625	°CRK
Engine position from crankshaft					
ST_EPM	-	0... 8H	0 ...8	1	-
Engine position manager state					

**Input data:**

C_DYW_CAM_CRK_SYN_ADC_EX {p. 873}	C_DYW_CAM_CRK_SYN_ADC_IN {p. 873}	C_DYW_CAM_CRK_SYN_RTD_EX {p. 873}	C_DYW_CAM_CRK_SYN_RTD_IN {p. 873}
C_N_NOT_REST {p. 4456}	IDX_EDGE_CAM_EX [NC_NR_CAM_CBK] {p. 871}	IDX_EDGE_CAM_IN [NC_NR_CAM_CBK] {p. 871}	LC_ENG_BACK_INH {p. 4457}
LV_CAM_LIH_EXT_ENA {p. 1717}	LV_CAM_STOP_EX [NC_NR_CAM_CBK] {p. 871}	LV_CAM_STOP_IN [NC_NR_CAM_CBK] {p. 871}	LV_CAM_SYN_CRK {p. 871}
LV_CRK_FIRST_VLD_TOOTH {p. 853}	LV_CRK_MISS_TOOTH {p. 853}	LV_CRK_RUN {p. 853}	LV_CRK_STOP {p. 853}
LV_CRK_SYN {p. 853}	LV_ERR_CAM_EX [NC_NR_CAM_CBK] {p. 4455}	LV_ERR_CAM_IN [NC_NR_CAM_CBK] {p. 4455}	LV_ERR_CRK {p. 4455}
LV_IGK {p. 906}	LV_LOST_SYN_CRK {p. 853}	LV_ORNG_CAM_SYN_CRK {p. 871}	LV_ORNG_RATIO_CAM_EX [NC_NR_CAM_CBK] {p. 871}
LV_ORNG_RATIO_CAM_IN [NC_NR_CAM_CBK] {p. 871}	LV_SEG_NR_UPD_REQ {p. 1717}	LV_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 872}	LV_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 872}
LV_SYN_VLD_CAM_LIH {p. 1717}	N {p. 1525}	N_TOOTH {p. 1525}	NC_ACT_CAM_EDGE_LIH {p. 874}
NC_ACT_CAM_EDGE_SYN {p. 874}	NC_NR_TOOTH {p. 854}	NC_OFS_TDC0_REF_CRK {p. 854}	NC_PSN_EDGE_CAM_EX [NC_NR_EDGE_CAM_EX] [NC_NR_CAM_CBK] {p. 874}
NC_PSN_EDGE_CAM_IN [NC_NR_EDGE_CAM_IN] [NC_NR_CAM_CBK] {p. 874}	PSN_EDGE_AD_CAM_EX [NC_NR_EDGE_CAM_EX] [NC_NR_CAM_CBK] {p. 1534}	PSN_EDGE_AD_CAM_IN [NC_NR_EDGE_CAM_IN] [NC_NR_CAM_CBK] {p. 1534}	PSN_ENG_CRK_OFS {p. 872}
PSN_ENG_ENSD {p. 1525}	PSN_ENG_SYN_CAM_MIN {p. 872}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DLY_STOP_ENG	-	0... FFH	0... 2550	10	ms
Delay time for engine running after engine stop request					
ID_NR_VLD_CAM_SYN_CRK	-	0... FFH	0... 255	1	-
LDP_N_ID_NR_VLD_CAM_SYN_CRK	2	0... 1FE0H	0... 8160	1	rpm
Number of camshaft signal edges to validate cam/crk synchronization					
LC_INH_LIH_CAM	-	0... 1H	0 ...1	1	-
Inhibition of camshaft limp-home mode					
LC_INH_LIH_CRK	-	0... 1H	0 ...1	1	-
Inhibition of crankshaft limp-home mode					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_CAM_CBK	-	1... 2H	1 ...2	1	-
Camshaft sensor(s) present on one or two cylinder banks					
NC_PRI_LIH_CAM_CBK	-	1... 2H	1 ...2	1	-
Priority for limp-home mode on camshaft sensor(s) of cylinder bank 1 or 2					
NC_PRI_LIH_CAM_IN	-	0... 1H	0 ...1	1	-
Priority for limp-home mode on intake camshaft sensor(s)					
NC_PRI_SYN_CAM_CBK	-	1... 2H	1 ...2	1	-
Priority for synchronization on camshaft sensor(s) of cylinder bank 1 or 2					
NC_PRI_SYN_CAM_IN	-	0... 1H	0 ...1	1	-
Priority for synchronization mode on intake camshaft sensor(s)					
NLC_CAM_EX	-	0... 1H	0 ...1	1	-
Exhaust camshaft sensor(s) present in the system					
NLC_CAM_IN	-	0... 1H	0 ...1	1	-
Intake camshaft sensor(s) present in the system					
NLC_LIH_CAM_EX	-	0... 1H	0 ...1	1	-
Exhaust camshaft sensor(s) available for crankshaft limp-home					
NLC_LIH_CAM_IN	-	0... 1H	0 ...1	1	-
Intake camshaft sensor(s) available for crankshaft limp-home					

**FUNCTION DESCRIPTION:****General information:**


The Engine Position Manager provides a summary of camshaft and crankshaft synchronization status information to the system. It sets the operating modes of camshaft and crankshaft acquisition depending on synchronization status, availability, and detected failures. The signal source for engine position will be selected based on the activated operating mode.

Camshaft and crankshaft signal acquisition will be set passive for a calibrated delay after key-off has been detected at low engine speed, and for another calibrated delay after a loss of synchronization at low engine speed. This avoids wrong injection, ignition and diagnosis with backward rotation after rapid key-off/on or stalling.

$i = 1 \dots NC\_NR\_CAM\_CBK$

$z = 0 \dots NC\_NR\_EDGE\_CAM\_IN/EX$

**Description:**

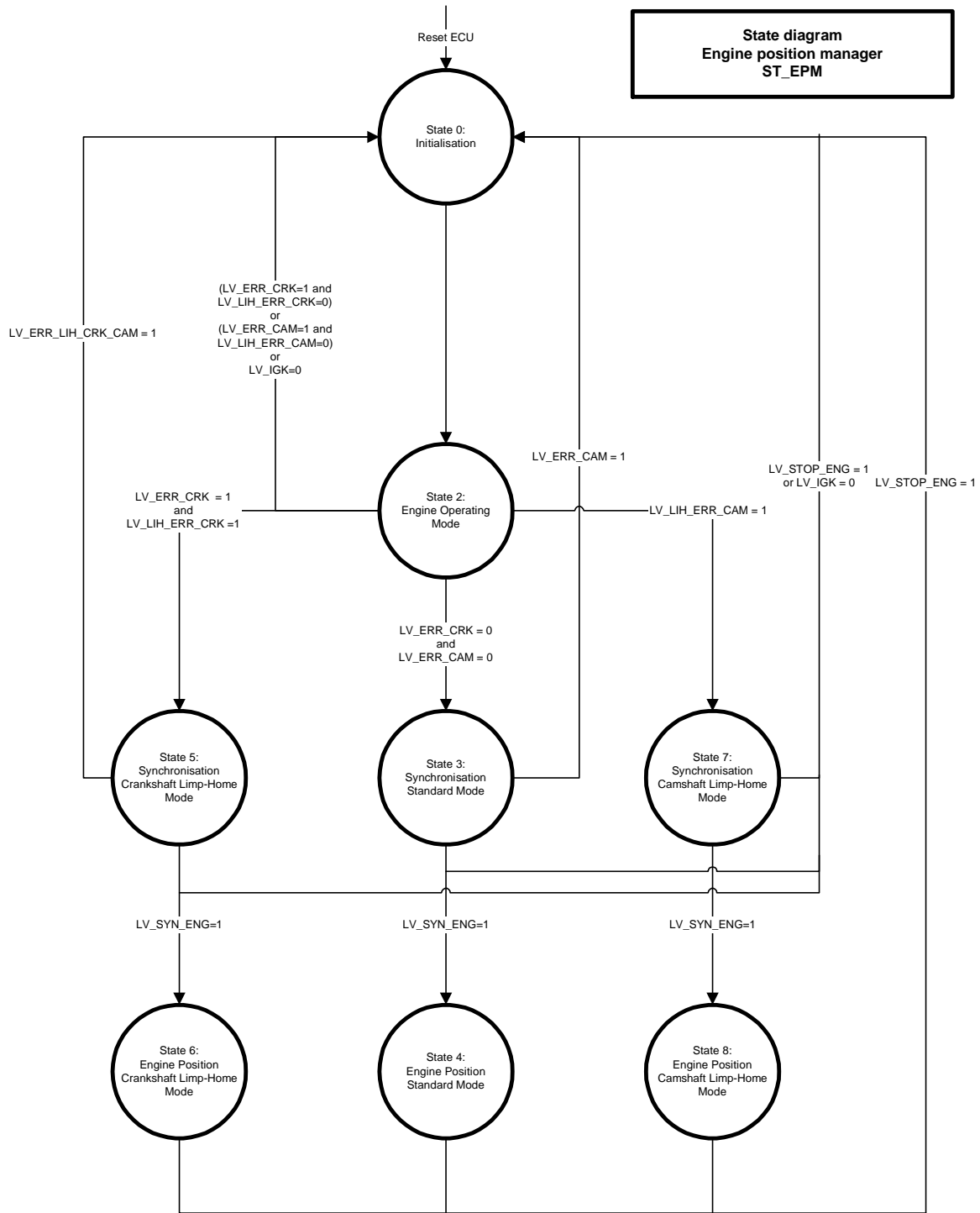
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Engine synchronized (LV_SYN_ENG)	Yes (LV_SYN_ENG = 1)	No (LV_SYN_ENG = 0)
Crankshaft sensor available (LV_ERR_CRK = 0) At least one camshaft sensor available (LV_ERR_CAM = 0)	<u>Standard Mode:</u> Engine position and speed calculation with crankshaft sensor signal	<u>Standard Mode</u> Engine synchronisation with camshaft and crankshaft sensor information
Crankshaft sensor available (LV_ERR_CRK = 0) Failure on <b>all</b> Camshaft sensors (LV_ERR_CAM = 1)	<u>Limp home Cam:</u> Engine position and speed calculation with crankshaft sensor signal	<u>Limp home Cam:</u> Engine synchronisation without camshaft sensor information
Crankshaft sensor failure (LV_ERR_CRK = 1) At least one camshaft sensors available for crank limp-home (LV_ERR_LIH_CRK_CAM = 0)	<u>Limp home Crank:</u> Engine position and speed calculation without crankshaft sensor signal.	<u>Limp home Crank:</u> Engine synchronisation without crankshaft sensor information
Crankshaft sensor failure (LV_ERR_CRK = 1) Failure on <b>all</b> Camshaft sensors available for crank limp-home (LV_ERR_LIH_CRK_CAM = 1)		<u>Engine synchronisation fiasco:</u> Engine cannot be synchronized

### Application conditions

**Recurrence:** 10 ms

#### 4.55.1 State flow diagram



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**Initialisation:**

LV\_ERR\_CAM is reset at 0 to 1 transition of LV\_IGK

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LV\_CRK\_MISS\_RUN\_ENG is reset and timer C\_T\_DLY\_STOP\_ENG stopped at 1 to 0 transition of LV\_IGK

### **Formula section:**

#### **State 0 : Initialisation**

Initialization of output data and deactivation of all state flow diagrams.

#### *Input conditions:*

External event: ECU Reset  
 From state 2: (LV\_ERR\_CRK = 1 And LV\_LIH\_ERR\_CRK = 0)  
 Or  
 (LV\_ERR\_CAM = 1 And LV\_LIH\_ERR\_CAM = 0)  
 Or  
 LV\_IGK = 0  
 From state 3: LV\_ERR\_CAM = 1  
 From state 5: LV\_ERR\_LIH\_CRK\_CAM = 1  
 From state 3,5,7: LV\_STOP\_ENG = 1  
 Or  
 LV\_IGK = 0  
 From state 4,6,8: LV\_STOP\_ENG = 1

#### *Output conditions:*

To State 2 : End of initialisation

#### *Action in the state:*

LV\_STOP\_ENG = 1  
 LV\_FIRST\_VLD\_TOOTH = 0  
 LV\_RUN\_ENG = 0  
 LV\_SYN\_ENG = 0  
 LV\_SYN\_VLD = 0  
 PSN\_ENG\_CRK = PSN\_ENG\_CAM\_LIH\_CRK = 0  
 CTR\_VLD\_CAM\_SYN\_CRK = 0  
 LV\_LIH\_ERR\_CRK = 0  
 LV\_LIH\_ERR\_CAM = 0  
 LV\_ERR\_LIH\_CRK\_CAM = 0

Deactivation of Crankshaft self-synchronisation:

LV\_ACT\_CRK = 0

Deactivation of Camshaft self-synchronisation for all camshaft signals:

LV\_ACT\_CAM\_IN(EX)[i] = 0

Deactivation of Camshaft/Crankshaft synchronisation for all camshaft signals:

LV\_ACT\_SYN\_CRK\_CAM\_IN(EX)[i] = 0

Deactivation of limp-home mode for all camshaft signals:

LV\_ACT\_LIH\_CRK\_CAM\_IN(EX)[i] = 0

Deactivation of synchronization determination in camshaft limp home

LV\_CAM\_LIH\_EXT\_ENA = 0

LV\_SYN\_VLD\_CAM\_LIH = 0

LV\_SEG\_NR\_UPD\_REQ = 0

## Deactivation of synchronization validation in camshaft limp home

*Transition action:*

None

State 2 : Engine Operating Mode

Select engine operating mode in function of diagnostic information and limp home status.

*Input conditions:*

From State 0: End of initialisation

*Output conditions:*

To state 0: (LV\_ERR\_CRK = 1 And  
 (LC\_INH\_LIH\_CRK = 1 Or LV\_ERR\_LIH\_CRK\_CAM = 1))  
 Or  
 (LV\_ERR\_CAM = 1 And  
 LC\_INH\_LIH\_CAM = 1 And LV\_ERR\_CRK = 0)  
 Or  
 LV\_IGK = 0

To state 3: LV\_ERR\_CRK = 0 And LV\_ERR\_CAM = 0  
 To state 5: LV\_LIH\_ERR\_CRK = 1 And LV\_ERR\_CRK = 1  
 To state 7: LV\_LIH\_ERR\_CAM = 1

*Action in the state:*

```

If      LV_ERR_CRK = 1
Then    If      LC_INH_LIH_CRK = 0
           And    LV_ERR_LIH_CRK_CAM = 0
           Then    Select Crankshaft limp-home mode
                   LV_LIH_ERR_CRK = 1
           Else    Crankshaft limp-home not possible
           Endif
Else    If      LV_ERR_CAM = 1
           And    LC_INH_LIH_CAM = 0
           Then    Select Camshaft limp-home mode
                   LV_LIH_ERR_CAM = 1
           Else    Camshaft limp-home not possible
           Endif
Endif

```

*Transition action:*

To state 3,5,7: LV\_STOP\_ENG = 0

To state 3:

Activation of Crankshaft self-synchronisation:

LV\_ACT\_CRK = 1

Activation of Camshaft self-synchronisation for all camshaft signals:

LV\_ACT\_CAM\_IN(EX)[i] = 1

*Activation of camshaft selection for synchronisation ()*

Activation of Camshaft/Crankshaft synchronisation for the selected camshaft signal.

To state 5:

Activation of Camshaft self-synchronisation for all the camshaft signals:

LV\_ACT\_CAM\_IN(EX)[i] = 1  
*Activation of camshaft selection for limp-home ()*

To state 7:           Activation of Camshaft self-synchronisation for all the camshaft signals:

LV\_ACT\_CAM\_IN(EX)[i] = 1  
 Activation of Crankshaft self-synchronisation:  
 LV\_ACT\_CRK = 1

### State 3 : Synchronisation Standard Mode

Engine synchronisation with camshaft and crankshaft sensor information.

#### *Input conditions:*

From state 2:                   LV\_ERR\_CRK = 0 And LV\_ERR\_CAM = 0

#### *Output conditions:*

To state 0:                   LV\_STOP\_ENG = 1  
                                   Or  
                                   LV\_IGK = 0  
                                   Or  
                                   LV\_ERR\_CAM = 1

To state 4:                   LV\_SYN\_ENG = 1

#### *Action in the state:*

LV\_FIRST\_VLD\_TOOTH = LV\_CRK\_FIRST\_VLD\_TOOTH  
 LV\_RUN\_ENG = LV\_CRK\_RUN  
*Activation of calculation of PSN\_ENG\_CRK in standard mode()*  
**If**           LV\_FIRST\_VLD\_TOOTH = 1  
**Then**        *Activation of synchronization validation ()*  
**End if**  
*Activation of engine position calculation standard mode ()*  
*Activation of Camshaft self-synchronisation reactivation ()*  
*Activation of engine stop detection ()*

**If**           LV\_RUN\_ENG = 1  
**Then**        Activation of engine speed calculation  
**Endif**

On 0 to 1 transition of LV\_CAM\_SYN\_CRK:

**If**           LV\_ERR\_CAM\_IN(EX)[i] = 0  
                                   For all available camshaft sensors  
**Then**        *Activation of fast synchronization ()*  
**Else**        *Activation of slow synchronization ()*  
**Endif**

#### *Transition action:*

To state 4:                   LV\_CRK\_MISS\_RUN\_ENG = 0  
                                   Stop timer C\_T\_DLY\_STOP\_ENG

### State 4 : Engine Position Standard Mode



Engine position and speed calculation with crankshaft sensor signal.

*Input conditions:*

From state 3: LV\_SYN\_ENG = 1

*Output conditions:*

To state 0: LV\_STOP\_ENG = 1

*Action in the state:*

*Reactivation of Camshaft self-synchronisation ()*  
*Activation of engine position calculation standard mode ()*  
*Activation of segment period calculation ()*  
*Activation of speed gradient calculation ()*  
*Activation of crankshaft sensor phase angle correction ()*  
*Activation of engine stop detection ()*

**If** LV\_SYN\_VLD = 1  
**Then** Activation of Camshaft adaptation and position output ()  
**Endif**  
 Activation of Engine backwards rotation detection ()

*Transition action:*

To state 0: **If** C\_T\_DLY\_STOP\_ENG > 0  
 And LV\_IGK = 1  
 And LV\_CRK\_MISS\_RUN\_ENG = 0  
**Then** LV\_CRK\_MISS\_RUN\_ENG = 1  
 Start timer C\_T\_DLY\_STOP\_ENG  
 Reset LV\_CRK\_MISS\_RUN\_ENG after timer has elapsed  
**Endif**

State 5 : Synchronisation Crankshaft Limp-Home Mode

Engine synchronisation without crankshaft sensor signal.

*Input conditions:*

From state 2: LV\_LIH\_ERR\_CRK = 1  
 And  
 LV\_ERR\_CRK = 1


*Output conditions:*

To state 0: LV\_STOP\_ENG = 1  
 Or  
 LV\_IGK = 0  
 Or  
 LV\_ERR\_LIH\_CRK\_CAM = 1  
 To state 6: LV\_SYN\_ENG=1

*Action in the state:*

*Activation of crankshaft limp-home synchronization() for the selected camshaft signal*  
*Activation of calculation of PSN\_ENG\_CAM\_LIH\_CRK()*

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Activation of engine position calculation crankshaft limp-home mode  
*Reactivation of Camshaft self-synchronisation ()*  
*Activation of engine stop detection ()*

```

If      LV_RUN_ENG = 1
Then    Activation of engine speed calculation
Endif

```

*Transition action:*

To state 6:                   LV\_CRK\_MISS\_RUN\_ENG = 0  
                                   Stop timer C\_T\_DLY\_STOP\_ENG

### State 6 : Engine Position Crankshaft Limp-Home Mode

Engine position and speed calculation without crankshaft sensor signal.

*Input conditions:*

From state 5:                   LV\_SYN\_ENG = 1

*Output conditions:*

To state 0:                   LV\_STOP\_ENG = 1

*Action in the state:*

Activation of engine position calculation crankshaft limp-home mode  
*Activation of Camshaft self-synchronisation reactivation ()*  
 Activation of segment period calculation  
 Activation of speed gradient calculation  
*Activation of engine stop detection ()*

*Transition action:*

```

To state 0:                   If      C_T_DLY_STOP_ENG > 0
                           And LV_IGK = 1
                           And LV_CRK_MISS_RUN_ENG = 0
Then    LV_CRK_MISS_RUN_ENG = 1
                           Start timer C_T_DLY_STOP_ENG
                           Reset LV_CRK_MISS_RUN_ENG after timer has elapsed
Endif

```

### State 7 : Synchronisation Camshaft Limp-Home Mode

Engine synchronisation without camshaft sensor signal.

*Input conditions:*

From state 2:                   LV\_LIH\_ERR\_CAM = 1

*Output conditions:*

To state 0:                   LV\_STOP\_ENG = 1

Or

LV\_IGK = 0

To state 8:                   LV\_SYN\_ENG = 1

*Action in the state:*

*Activation of camshaft limp-home synchronization()*  
 LV\_FIRST\_VLD\_TOOTH = LV\_CRK\_FIRST\_VLD\_TOOTH  
 LV\_RUN\_ENG = LV\_CRK\_RUN  
*Activation of calculation of PSN\_ENG\_CRK in camshaft limp-home mode()*  
  
 Activation of engine position calculation standard mode  
*Activation of engine stop detection ()*

**If** LV\_RUN\_ENG = 1  
**Then** Activation of engine speed calculation  
**Endif**

*Transition action:*

To state 8: LV\_CRK\_MISS\_RUN\_ENG = 0  
 Stop timer C\_T\_DLY\_STOP\_ENG

State 8 : Engine Position Camshaft Limp-Home Mode

Engine position and speed calculation without camshaft sensor signal.

*Input conditions:*

From state 7: LV\_SYN\_ENG = 1

*Output conditions:*

To state 0: LV\_STOP\_ENG = 1

*Action in the state:*

Activation of Synchronization determination in camshaft limp home()  
 Activation of Synchronization validation in camshaft limp home()  
*Reactivation of Camshaft self-synchronisation ()*  
 Activation of PSN\_ENG\_CRK correction in camshaft limp home()  
 Activation of engine position calculation standard mode  
 Activation of segment period calculation  
 Activation of segment number correction in camshaft limp home()  
 Activation of speed gradient calculation  
 Activation of crankshaft sensor phase angle correction  
*Activation of engine stop detection ()*  
*Activation of Engine backwards rotation detection ()*

*Transition action:*

To state 0: **If** C\_T\_DLY\_STOP\_ENG > 0  
 And LV\_IGK = 1  
 And LV\_CRK\_MISS\_RUN\_ENG = 0  
**Then** LV\_CRK\_MISS\_RUN\_ENG = 1  
 Start timer C\_T\_DLY\_STOP\_ENG  
 Reset LV\_CRK\_MISS\_RUN\_ENG after timer has elapsed  
**Endif**

## 4.55.2 Definition of the sub-function tasks

### 4.55.2.1 Fast Engine synchronization

#### General information:

Fast engine synchronization is in charge to synchronize as soon as the crankshaft signal acquisition is synchronized and a camshaft signal information is available on the selected camshaft.

#### Application conditions

**Recurrence:** on 0 to 1 transition of LV\_CAM\_SYN\_CRK

#### Formula section:

```
If          LV_CAM_SYN_CRK = 1
Then       LV_SYN_ENG = 1
Endif
```

### 4.55.2.2 Slow Engine synchronization

#### General information:

Slow engine synchronization is activated when a failure was detected on at least one camshaft sensor. The engine is synchronized as soon as a number of calibratable camshaft edges has occurred (engine synchronized when synchronization is validated). This avoids multiple injection and ignition events with wrong synchronization.

#### Application conditions

**Recurrence:** at every active camshaft edge and on 0 to 1 transition of LV\_CAM\_SYN\_CRK

*The active camshaft edge for synchronization is defined by NC\_ACT\_CAM\_EDGE\_SYN.*

#### Formula section:

The engine speed value used to calculate NR\_VLD\_CAM\_SYN\_CRK is the one determined at transition from 0 to 1 of LV\_CAM\_SYN\_CRK (see Synchronization validation)

```
If          LV_CAM_SYN_CRK = 1
Then       If      CTR_VLD_CAM_SYN_CRK > NR_VLD_CAM_SYN_CRK
           Then    LV_SYN_ENG = 1
           Endif
Endif
```

**Remark:** CTR\_VLD\_CAM\_SYN\_CRK is incremented in "synchronization validation ()" function

### 4.55.2.3 Crankshaft limp-home synchronization

#### General information:

Only the informations of the selected camshaft signal is used to perform the engine synchronization.

i = 1...NC\_NR\_CAM\_CBK                      z = 0...NC\_NR\_EDGE\_CAM\_IN/EX

### Application conditions

**Recurrence:** at every camshaft edge

### Formula section:

```

If      LV_SYN_CAM_IN(EX)[i] = 1 for the selected camshaft signal
Then    LV_FIRST_VLD_TOOTH = 1
           LV_RUN_ENG = 1
           LV_SYN_ENG = 1
    
```

**Endif**

### 4.55.2.4 Camshaft limp-home synchronization

#### General information:

No camshaft signals are available for the Crank/Cam synchronization so the engine synchronization is performed as soon as the crankshaft is synchronized (the engine revolution can not be identified so a default value is used).

### Application conditions

**Recurrence:** at every reference gap

### Formula section:

```

If      LV_CRK_SYN = 1
Then    LV_SYN_ENG = 1
Endif
    
```

### 4.55.2.5 Synchronisation validation

#### General information:

Synchronisation is validated as soon as a number of calibratable camshaft edges has occurred. During validation phase, the angular distance between cam/crk events is checked. Engine synchronisation is reset if one of the tests fails.

$i = 1 \dots NC\_NR\_CAM\_CBK$                        $z = 0 \dots NC\_NR\_EDGE\_CAM\_IN/EX$

### Application conditions

**Recurrence:** at every active camshaft edge and on 0 to 1 transition of LV\_CAM\_SYN\_CRK as long as LV\_SYN\_VLD = 0


*The active camshaft edge for synchronization is defined by NC\_ACT\_CAM\_EDGE\_SYN.*

### Formula section:

At transition from 0 to 1 of LV\_CAM\_SYN\_CRK,  $NR\_VLD\_CAM\_SYN\_CRK = ID\_NR\_VLD\_CAM\_SYN\_CRK$ .

Increment CTR\_VLD\_CAM\_SYN\_CRK

**If** LV\_CAM\_SYN\_CRK = 1

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	NC_PRI_SYN_CAM_CBK = 1	NC_PRI_SYN_CAM_CBK = 2
NC_PRI_SYN_CAM_IN = 0	CAM_EX_1 CAM_EX_2 CAM_IN_1 CAM_IN_2	CAM_EX_2 CAM_EX_1 CAM_IN_2 CAM_IN_1
NC_PRI_SYN_CAM_IN = 1	CAM_IN_1 CAM_IN_2 CAM_EX_1 CAM_EX_2	CAM_IN_2 CAM_IN_1 CAM_EX_2 CAM_EX_1

The first camshaft sensor in the above list which fulfills the following conditions is selected:

- physically present in the system (configuration data NLC\_CAM\_IN, NLC\_CAM\_EX and NC\_NR\_CAM\_CBK)
- no failure reported on it (LV\_ERR\_CAM\_IN(EX)[i] = 0)

The crankshaft synchronization mode is activated on one camshaft signal by setting LV\_ACT\_SYN\_CRK\_CAM\_IN(EX)[i] for the selected camshaft.

LV\_ERR\_CAM is set if all available camshaft sensors report an error.

#### 4.55.2.8 Camshaft Selection for limp-home

##### General information:

Target wheels on intake and exhaust camshafts may be different, and not all may be useable for limp-home. The availability of camshaft sensors for limp-home is given by NLC\_LIH\_CAM\_IN(EX) and NC\_NR\_CAM\_CBK. A camshaft signal can only be selected if no error is detected on the respective camshaft (LV\_ERR\_CAM\_IN(EX)[i] = 0).

$i = 1 \dots NC\_NR\_CAM\_CBK$

$z = 0 \dots NC\_NR\_EDGE\_CAM\_IN/EX$

##### Formula section:

The selection order is given by the following table:

	NC_PRI_LIH_CAM_CBK = 1	NC_PRI_LIH_CAM_CBK = 2
NC_PRI_LIH_CAM_IN = 0	CAM_EX_1 CAM_EX_2 CAM_IN_1 CAM_IN_2	CAM_EX_2 CAM_EX_1 CAM_IN_2 CAM_IN_1
NC_PRI_LIH_CAM_IN = 1	CAM_IN_1 CAM_IN_2 CAM_EX_1 CAM_EX_2	CAM_IN_2 CAM_IN_1 CAM_EX_2 CAM_EX_1

The first camshaft sensor in the above list which fulfills the following conditions is selected:

- physically present in the system (configuration data NLC\_CAM\_IN, NLC\_CAM\_EX\_IN and NC\_NR\_CAM\_CBK)
- no failure reported on it (LV\_ERR\_CAM\_IN(EX)[i] = 0)
- available for crankshaft limp-home (NLC\_LIH\_CAM\_IN = 1 or NLC\_LIH\_CAM\_EX = 1)

The crankshaft limp-home mode is activated on one camshaft signal by setting LV\_ACT\_LIH\_CRK\_CAM\_IN(EX)[i] for the selected camshaft.

LV\_ERR\_LIH\_CRK\_CAM is set if no more camshaft sensors is available.

#### 4.55.2.9 Engine stop detection

##### Application conditions

**Recurrence:** 10ms

##### Formula section:

LV\_STOP\_ENG is set if one of the conditions in the table below are met:

In Standard mode (States 3 and 4)	In Camshaft limp-home mode (States 7 and 8)	In Crankshaft limp-home mode (States 5 and 6)	In Engine position Standard and Camshaft limp-home mode (States 4 and 8)
LV_CRK_STOP = 1	LV_CRK_STOP = 1	LV_CAM_STOP_IN(EX) [i] = 1 for the selected camshaft signal	LV_ENG_BACK_CFM switches from 0 to 1
LV_ORNG_CAM_SYN_CRK = 1 (*)			
LV_ERR_CRK = 1 And LC_INH_LIH_CRK = 0			

(\*) This information is available as long as LV\_SYN\_VLD = 0.

#### 4.55.2.10 Camshaft self-synchronisation reactivation

##### General information:

When the self-synchronization of a camshaft signal goes to the fiasco state (LV\_CAM\_STOP\_IN(EX)[i] = 1), the self-synchronization on this camshaft signal will be reactivated as soon as possible. If this camshaft is selected for the synchronization in crankshaft limp-home mode an engine stop is detected (by *engine stop detection()* sub-function task) and a new synchronization is restarted.

i = 1...NC\_NR\_CAM\_CBK

z = 0...NC\_NR\_EDGE\_CAM\_IN/EX

##### Application conditions

**Recurrence:** 10ms

##### Formula section:

For all available camshaft signal sensors:

**If** LV\_CAM\_STOP\_IN(EX)[i] = 1



**And**           LV\_ACT\_LIH\_CRK\_CAM\_IN(EX)[i] = 0  
**Then**           Activation of Camshaft self-synchronisation for this camshaft signal  
**Endif**

#### 4.55.2.11 Calculation of PSN\_ENG\_CRK in standard mode()

##### General information:

##### Formula section:

Before synchronization (LV\_SYN\_ENG = 0):

Truth table					
LV_CRK_SYN n	0	1			
LV_CRK_SYN n-1	0	0			1
LV_CAM_SYN_CRK n	0	0	1	0	1
LV_CAM_SYN_CRK n-1	0	0	0	0	0
Engine position action	1	2	3	4	5

##### **Action 1:**

PSN\_ENG\_CRK = PSN\_ENG\_SYN\_CAM\_MIN

##### **Action 2:**

PSN\_ENG\_CRK = PSN\_ENG\_SYN\_CAM\_MIN  
 PSN\_ENG\_CRK\_GAP = 360° - NC\_OFS\_TDC0\_REF\_CRK

##### **Action 3:**

PSN\_ENG\_CRK = 360° - NC\_OFS\_TDC0\_REF\_CRK + PSN\_ENG\_CRK\_OFS

##### **Action 4:**

PSN\_ENG\_CRK = PSN\_ENG\_SYN\_CAM\_MIN  
 PSN\_ENG\_CRK\_GAP n = PSN\_ENG\_CRK\_GAP n-1 + (360°/NC\_NR\_TOOTH)

##### **Action 5:**

PSN\_ENG\_CRK = PSN\_ENG\_CRK\_GAP + PSN\_ENG\_CRK\_OFS

After the synchronization (LV\_SYN\_ENG = 1):

PSN\_ENG\_CRK is incremented on the tooth signal and jitter from 0 to 720°.

#### 4.55.2.12 Calculation of PSN\_ENG\_CRK in camshaft limp-home mode()

##### General information:

**Formula section:**

Before synchronization (LV\_SYN\_ENG = 0):

Truth table		
LV_CRK_SYN n	0	1
LV_CRK_SYN n-1	0	0
Engine position action	1	2

**Action 1:**

PSN\_ENG\_CRK is incremented on the tooth signal and jitter from 0 to 360°

**Action 2:**

PSN\_ENG\_CRK = 720° - NC\_OFS\_TDC0\_REF\_CRK

After the synchronization (LV\_SYN\_ENG = 1):

PSN\_ENG\_CRK is incremented on the tooth signal and jitter from 0 to 720°

**4.55.2.13 PSN\_ENG\_CRK correction in camshaft limp-home()**

**General information:**

This function updates PSN\_ENG\_CRK depending on synchronization determination test result in camshaft limp home.

**Application conditions**

- Initialisation:** *none*
- Recurrence:** *none*
- Activation:** *LV\_SEG\_NR\_UPD\_REQ = 1*
- Deactivation:** *LV\_SEG\_NR\_UPD\_REQ = 0*

**Formula section:**

PSN\_ENG\_CRK = PSN\_ENG\_CRK + (360°CRK /NC\_NR\_GAP)

**4.55.2.14 Calculation of PSN\_ENG\_CAM\_LIH\_CRK()**

**General information:**

The purpose of this function is to provide engine position during crankshaft limp-home. In crankshaft limp-home, the engine position is calculated from the camshaft sensor selected by LV\_ACT\_LIH\_CRK\_CAM\_IN(EX)[i].

$i = 1 \dots NC\_NR\_CAM\_CBK$                        $z = 0 \dots NC\_NR\_EDGE\_CAM\_IN/EX$

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### Application conditions

**Initialization:** PSN\_ENG\_CAM\_LIH\_CRK = 0  
**Recurrence:** every camshaft signal edge  
**Activation:** LV\_SYN\_ENG = 1  
**Deactivation:** LV\_SYN\_ENG = 0

### Formula section:

For  $z = \text{IDX\_EDGE\_CAM\_IN(EX)[i]}$  and the camshaft sensor selected for crankshaft limp home by  $\text{LV\_ACT\_LIH\_CRK\_CAM\_IN(EX)[i]}$ :

```

If                z is a falling camshaft signal edge
Then             If                NC_ACT_CAM_EDGE_LIH = 1
                                Or
                                NC_ACT_CAM_EDGE_LIH = 3
                                Then         PSN_ENG_CAM_LIH_CRK = NC_PSN_EDGE_CAM_IN(EX)[z][i] +
                                                Average value of PSN_EDGE_AD_CAM_IN(EX)[z][i] for all falling camshaft
                                                signal edges
                                Else         no update of PSN_ENG_CAM_LIH_CRK
                                Endif
Else             If                NC_ACT_CAM_EDGE_LIH = 2
                                Or
                                NC_ACT_CAM_EDGE_LIH = 3
                                Then         PSN_ENG_CAM_LIH_CRK = NC_PSN_EDGE_CAM_IN(EX)[z][i] +
                                                Average value of PSN_EDGE_AD_CAM_IN(EX)[z][i] for all rising camshaft
                                                signal edges
                                Else         no update of PSN_ENG_CAM_LIH_CRK
                                Endif
End

```

### 4.55.2.15 Engine backwards rotation detection ()

#### General information:

The aim of this function is to detect a change in the direction of engine rotation which would lead to a false crankshaft teeth counter value and thus to a wrong timing for injection and/or ignition events. This could occur at low engine speed with hard compression phases.

This functionality gets a lower performance if camshaft target wheel is symmetrical as only the tests on crankshaft signal can be done (Action 1 and Test 2).

$i = 1 \dots \text{NC\_NR\_CAM\_CBK}$                        $z = 0 \dots \text{NC\_NR\_EDGE\_CAM\_IN/EX}$

### Application conditions

**Initialisation:** at reset or engine stalling (LV\_STOP\_ENG transition from 0 to 1)  
 LV\_ENG\_BACK\_DET = 0  
 LV\_ENG\_BACK\_CFM = 0

**Recurrence:** 10ms and every camshaft edge (for all camshaft sensors) and every reference gap and at engine stalling (LV\_STOP\_ENG transition from 0 to 1)

**Activation:** LC\_ENG\_BACK\_INH = 0

*Deactivation:* when application conditions are not fulfilled

**Formula section:**

```

If          ( N_TOOTH < C_N_NOT_REST And LV_CRK_MISS_TOOTH = 1 )
              or LV_ENG_BACK_DET = 1
Then       LV_ENG_BACK_DET = 1
              Activation of Engine backwards rotation confirmation ( )
Else       LV_ENG_BACK_DET = 0
              LV_ENG_BACK_CFM = 0
End
LV_CRK_MISS_TOOTH is reset after reading.
    
```

Engine backwards rotation confirmation ( ):

The following table shows the test or action to perform in function of the current event. The event is a detection of a camshaft edge (CAM) or a detection of reference gap (GAP) or an engine stall (Engine stall).

Event	GAP	Engine stall	CAM
Test / Action	Action 1	Test 2	Test 3

Action 1:

This event means that the reference gap has been detected at the expected position (the number of teeth between 2 gaps is correct) and thus that engine backwards rotation is not confirmed.

LV\_ENG\_BACK\_DET = 0

Test 2:

This event means that the number of teeth between 2 gaps is not correct due to engine backwards rotation which is thus confirmed.

```

If          LV_LOST_SYN_CRK = 1
Then       LV_ENG_BACK_CFM = 1
    
```


Test 3:

This test is only done on the camshaft signal that generated the event. It checks whether camshaft signal position is correct versus crankshaft signal or versus previous camshaft signal. If not, engine backwards rotation is confirmed.

```

If          LV_ERR_CAM_IN(EX)[i] = 0
Then       if {
              ( LV_SYN_CAM_IN(EX)[i] = 1          'z value, which represents camshaft edge
              number, is know as camshaft is self-synchronized
              And
              ( PSN_ENG_ENSD = NC_PSN_EDGE_CAM_IN(EX)[z][i] - C_DYW_CAM_CRK_
              SYN_ADC_IN(EX)
              Or PSN_ENG_ENSD = NC_PSN_EDGE_CAM_IN(EX)[z][i] + C_DYW_CAM_CRK_
              SYN_RTD_IN(EX) ) )
              Or
              LV_ORNG_RATIO_CAM_IN(EX)[i] = 1 }
Then       LV_ENG_BACK_CFM = 1
Else       if LV_SYN_CAM_IN(EX)[i] = 1
              Then LV_ENG_BACK_DET = 0
              End
End
End
    
```

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## 4.56 Engine position and speed calculation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
N	O/V	0... 1FE0H	0... 8160	1	rpm
Engine speed - resolution 1 rpm					
N_32	O/V	0... FFH	0... 8160	32	rpm
Engine speed -Resolution 32 rpm					
N_CRK_WIN	-	0... 1FE0H	0... 8160	1	rpm
Engine speed on crankshaft tooth window at end of segment					
N_FAST	O/V	0... 1FE0H	0... 8160	1	rpm
Fast engine speed					
N_GRD	O/V	80... 7FH	-4096 ...4064	32	rpm/s
Engine speed gradient					
N_GRD_H_RES	O/V	F000... 0FFFH	-4096 ...4095	1	rpm/s
High resolution engine speed gradient					
N_MMV	O/V	0... 1FE0H	0... 8160	1	rpm
Engine Speed moving mean value					
N_TOOTH	O/V	0... 1FE0H	0... 8160	1	rpm
Engine Speed calculated on last crankshaft tooth period (update rate 10ms)					
PSN_ENG	O	0... 780H	0... 720	0.375	°CRK
Exported engine position					
PSN_ENG_ENSD	O	0... 2CFFH	0... 719.9375	0.0625	°CRK
Actual engine position in fine resolution					
PSN_ENG_SYN_MAX	O/V	0... 780H	0... 720	0.375	°CRK
Maximum engine position during crankshaft synchronization phase.					
PSN_ENG_SYN_MIN	O/V	0... 780H	0... 720	0.375	°CRK
Minimum engine position during crankshaft synchronization phase.					
SEG_CTR	O/V	0... FFFFH	0... 65535	1	-
Continuous segment counter (saturated at maximum value)					
SEG_NR	O/V	0... 7H	0 ...7	1	-
Actual segment number (from 0 to NC_CYL_NR-1)					
T_REV_AV	-	0... 7FFFFFFH	0... 1.9965	237.999e-9	s
Actual revolution time					
T_REV_PREV	-	0... 7FFFFFFH	0... 1.9965	237.999e-9	s
Previous revolution time					
T_SEG_AV	O/V	0... FFFFH	0... 0.26214	0.000004	s
Segment period (saturated at low engine speed).					
T_SEG_HALF_AV	O/V	0... FFFFH	0... 0.26214	0.000004	s
Exported half-segment period					

### Input data:

LV_CRK_SYN {p. 853}	LV_RUN_ENG {p. 1505}	LV_SEG_NR_UPD_REQ {p. 1717}	LV_STOP_ENG {p. 1505}
NC_CRK_WIN_SEG_LEN {p. 854}	NC_NR_TOOTH {p. 854}	NC_PSN_SEG_TDC_REF {p. 854}	PSN_ENG_CAM_LIH_CRK {p. 1506}
PSN_ENG_CRK {p. 1506}	PSN_ENG_SYN_CAM_ MAX {p. 872}	PSN_ENG_SYN_CAM_ MIN {p. 872}	T_CRK_WIN_ENSD {p. 853}

T_SEG_ENSD {p. 853}	T_SEG_HALF_ENSD {p. 853}	T_TOOTH {p. 853}	
---------------------	-----------------------------	------------------	--

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_N_FAST	-	0... FFH	0... 0.99609	3.91e-3	-
Factor for fast engine speed prediction					
C_N_FAST_SWI	-	0... 4H	0 ...4	1	-
Switch case choice for N_FAST calculation mode					
C_N_TOOTH_END	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for N_TOOTH calculation at engine start					
ID_CRK_PHA_COR	-	0... FFH	0... 15.9375	0.0625	°CRK
LDP_N_32_ID_CRK_PHA_COR	16	0... FFH	0... 8160	32	rpm
Table for crankshaft transmitter phase offset correction					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CYL_NR	-	1... 8H	1 ...8	1	-
count of cylinder					

**FUNCTION DESCRIPTION:**

At engine stalling (LV\_STOP\_ENG 0 to 1), all output data are set to initialization value.

**4.56.1 Engine Position Calculation Standard Mode****General information:**

The function provides output values for engine position in standard operating mode.

**Application conditions**

**Initialisation:** PSN\_ENG =PSN\_ENG\_ENSD = 0

**Recurrence:** every update of the corresponding input values


**Formula section:**

PSN\_ENG = PSN\_ENG\_ENSD (resolution conversion)  
 PSN\_ENG\_ENSD = PSN\_ENG\_CRK + ID\_CRK\_PHA\_COR  
 PSN\_ENG\_SYN\_MIN = PSN\_ENG\_SYN\_CAM\_MIN  
 PSN\_ENG\_SYN\_MAX = PSN\_ENG\_SYN\_CAM\_MAX

The resolution of variables that are exported outside the aggregate is different from the resolution used internally!

**4.56.2 Engine Position Calculation Crankshaft Limp-Home Mode****General information:**

The function provides output values for engine position in crankshaft limp-home mode.

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### Application conditions

**Initialisation:** PSN\_ENG =PSN\_ENG\_ENSD = 0

**Recurrence:** every update of the corresponding input values

### Formula section:

PSN\_ENG = PSN\_ENG\_ENSD (resolution conversion)

PSN\_ENG\_ENSD = PSN\_ENG\_CAM\_LIH\_CRK

PSN\_ENG\_SYN\_MIN = PSN\_ENG\_SYN\_CAM\_MIN

PSN\_ENG\_SYN\_MAX = PSN\_ENG\_SYN\_CAM\_MAX

The resolution of variables that are exported outside the aggregate is different from the resolution used internally!

## 4.56.3 Segment Period Calculation

### General information:

The function provides output values for the segment period.

The engine cycle is divided into a number of TDC periods corresponding to the number of cylinders NC\_CYL\_NR. The corresponding time intervals T\_SEG\_AV are measured between tooth events located NC\_PSN\_SEG\_TDC\_REF degrees before each TDC.

The segment number SEG\_NR indicates the number of the cylinder that will be next in the firing order. A control signal is generated to trigger execution of segment synchronous tasks.

### Application conditions

**Initialisation:** T\_SEG\_AV is set to the maximum value  
SEG\_CTR = 0  
SEG\_NR = 0

**Activation:** LV\_RUN\_ENG = 1

**Recurrence :** when LV\_RUN\_ENG is set  
And when LV\_CRK\_SYN is set  
And every segment trigger

### Formula section:

T\_SEG\_AV = T\_SEG\_ENSD saturated to maximum value at low speed.

At engine synchronization, SEG\_NR is initialized with current segment number.

SEG\_CTR is incremented at every segment.

## 4.56.4 Segment number correction in camshaft limp home

### General information:

This function updates SEG\_NR value in camshaft limp home mode depending on synchronization determination test result.

### Application conditions

**Initialisation:** *none*  
**Recurrence:** *none*  
**Activation:**  $LV\_SEG\_NR\_UPD\_REQ = 1$   
**Deactivation:**  $LV\_SEG\_NR\_UPD\_REQ = 0$

### Formula section:

$SEG\_NR = SEG\_NR + NC\_CYL\_NR / (2 * NC\_NR\_GAP)$

## 4.56.5 Engine speed N, N<sub>32</sub>, N<sub>MMV</sub>

### General information:

The engine speed is determined in each segment from the segment period T<sub>SEG\_ENSD</sub>.

### Application conditions:

**Activation:** LV\_RUN\_ENG = 1  
**Recurrence:** when LV\_RUN\_ENG is set  
 And when LV\_CRK\_SYN is set  
 And every segment trigger

### Formula section:

$$N = \frac{2 * 60}{NC\_CYL\_NR * T\_SEG\_ENSD} \text{ for } T\_SEG\_ENSD \text{ in s}$$

N<sub>32</sub> = N in resolution 32 rpm

Before synchronization and at synchronization, one engine speed is output at the moment when crankshaft rotation is validated. The output value will be calculated from the most recent tooth period (see Segment Period Calculation)

N<sub>MMV</sub> is the moving mean value calculated on the last 720° CRK:

$$N\_MMV = \frac{N_n + N_{n-1} + \dots + N_{n-NC\_CYL\_NR}}{NC\_CYL\_NR}$$

Before engine synchronisation N<sub>MMV</sub> = N. After engine synchronisation and before the first engine cycle is completed, N<sub>MMV</sub> is calculated as the mean value of the most recent segments of this cycle.

Set N<sub>FAST</sub> to N if no fast engine speed calculation is required.

**If** C\_N\_FAST\_SWI = 0  
**Then** N\_FAST = N  
**Endif**



## 4.56.6 Fast Engine speed based on last tooth period

### General information:

Provide engine speed calculated every 10ms on the last crankshaft tooth period during cranking, synchronisation and start phase. Calculation is done until speed threshold is reached.

If, during running, Engine speed becomes lower than this threshold, this calculation is started again

In the formula after, T\_TOOTH in s is the time for the last crankshaft tooth period, acquired in BSW just before the 10ms trigger event used for update rate of N\_TOOTH here.

### Application conditions:

*Initialisation:* N\_TOOTH = 0  
*Recurrence :* 10ms  
*Activation:* LV\_RUN\_ENG = 1

*Deactivation:* LV\_RUN\_ENG = 0

### Formula section:

```

If          N_32 <= C_N_TOOTH_END
Then       N_TOOTH = 60 / (NC_NR_TOOTH * T_TOOTH)
Endif
If          C_N_FAST_SWI = 1
Then       N_FAST = N_TOOTH
Endif
    
```

## 4.56.7 Fast Engine Speed based on Half-Segment Period Calculation

### General information:

This function provides fast engine speed based on half-segment period.

### Application conditions

*Initialisation:* T\_SEG\_HALF\_AV is set to the maximum value  
*Recurrence:* before synchronization: once at transition from LV\_RUN\_ENG from 0 to 1  
 after synchronization: every segment trigger **and** segment trigger  
*Activation:* LV\_RUN\_ENG = 1

### Formula section:

```

If          C_N_FAST_SWI = 2
Then       N_FAST =  $\frac{60}{NC\_CYL\_NR * T\_SEG\_HALF\_ENSD}$ 
    
```

**Endif**

T\_SEG\_HALF\_AV = T\_SEG\_HALF\_ENSD saturated to maximum value at low speed.

## 4.56.8 Fast Engine Speed based on Crankshaft Tooth Window

### General information:

This function provides fast engine speed output based on a crankshaft window at the end of each segment. Updated every segment

### Application conditions

**Initialisation:** N\_FAST = 0  
**Recurrence :** every segment trigger  
**Activation:** LV\_RUN\_ENG = 1  
**And**  
 ( C\_N\_FAST\_SWI = 3 **Or** C\_N\_FAST\_SWI = 4 )  
**Deactivation:** C\_N\_FAST\_SWI <> 3 **And** C\_N\_FAST\_SWI <> 4

### Formula section:

$$N\_CRK\_WIN = \frac{60}{T\_CRK\_WIN\_ENSD} \frac{NC\_CRK\_WIN\_SEG\_LEN}{360^\circ CRK}$$

**If** C\_N\_FAST\_SWI = 3  
**Then** N\_FAST = N + C\_FAC\_N\_FAST \* (N\_CRK\_WIN n - N\_CRK\_WIN n-1)  
**Endif**  
**If** C\_N\_FAST\_SWI = 4  
**Then** N\_FAST = N + C\_FAC\_N\_FAST \* (N n - N\_CRK\_WIN n-1)  
**Endif**

## 4.56.9 Engine speed gradient N\_GRD, N\_GRD\_H\_RES

### General information:

The engine speed gradient is the acceleration of the crankshaft in rpm/s. For engines with an even number of cylinders (2...8), the gradient is calculated from the duration of the most recent engine revolution, and the duration of the previous engine revolution. With this calculation, the gradient is free from errors due to mechanical tolerances of the crankshaft target wheel.

For three-cylinder engines, the gradient is calculated from the most recent segment time, and the segment time before. Errors from mechanical tolerances of the crankshaft target wheel are not corrected, but are supposed to have a minor effect due to the greater angle of the segments.

Application recurrence: every segment trigger

### Formula section:


For even cylinder numbers, the duration of the most recent engine revolution is the sum of the most recent NC\_CYL\_NR/2 segment times. For e.g. a four-cylinder engine, this is:

$$T\_REV\_AV = T\_SEG\_ENSDn + T\_SEG\_ENSDn-1$$

The duration of the previous engine revolution is for the example of a four-cylinder engine:

$$T\_REV\_PREV = T\_SEG\_ENSDn-2 + T\_SEG\_ENSDn-3$$

N\_GRD calculation:

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N\_GRD\_H\_RES =

$$\frac{60 * (T\_REV\_PREV - T\_REV\_AV)}{T\_REV\_PREV * T\_REV\_AV * 0.5 * (T\_REV\_PREV + T\_REV\_AV)}$$

for T\_REV\_AV and T\_REV\_PREV in s

N\_GRD = N\_GRD\_H\_RES in resolution 32 rpm/s.

The resolution of the segment time introduces an error into the calculation of the engine speed gradient, depending on engine speed.

For a timer resolution of 0.25µs, a difference of 1 timer tick between T\_REV\_AV and T\_REV\_PREV corresponds to:

0.015 rpm/s at 600 rpm  
and 15 rpm/s at 6000 rpm

For three-cylinder engines, the gradient is calculated as follows:

N\_GRD\_H\_RES =

$$\frac{2 * 60 * (T\_SEG\_ENSD_{n-1} - T\_SEG\_ENSD_n)}{3 * T\_SEG\_ENSD_{n-1} * T\_SEG\_ENSD_n * 0.5 * (T\_SEG\_ENSD_{n-1} + T\_SEG\_ENSD_n)}$$

N\_GRD = N\_GRD\_H\_RES in resolution 32 rpm/s.

The resolution of the segment time introduces an error into the calculation of the engine speed gradient, depending on engine speed.

A difference of 1 timer tick between T\_SEG\_ENSDn and T\_SEG\_ENSDn-1 corresponds to:

0.51 rpm/s at 600 rpm  
and 51 rpm/s at 6000 rpm

## 4.56.10 Crankshaft Sensor Phase Angle Correction

### General information:

The sensor phase angle is defined as the rotation angle of the target wheel between the mechanical reference and the electrical reference for a tooth of the target wheel.

The mechanical reference in the target wheel drawing usually is the trailing edge of a tooth in the defined rotation direction. The mechanical reference position is reached when the center of the sensor is aligned to that angular reference.

The electrical reference may be on the falling or on the rising edge of the sensor output signal, see active edge definition in the acquisition of crankshaft signal. The reference position is reached when the sensor output signal switches (for active sensors) respectively has its zero crossing (for VR sensors).


A retard of the electrical reference relative to the mechanical edge is defined as a positive phase angle. With most sensors, the signal edge is generated at the center of each tooth at low speed. At high speed the signal edge may be retarded.

The typical phase angle ID\_CRK\_PHA\_COR (at typical air gap and operating temperature) of the used sensor/target wheel combination is calibrated in a table versus engine speed. The value corresponding to the actual engine speed is added to the actual engine position delivered from crankshaft acquisition, in order to obtain a corrected engine position (see position calculation in the first chapter of this specification).


### Application conditions:

**Recurrence:** every segment trigger

**Activation:** LV\_CRK\_SYN = 1

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*Deactivation:*            LV\_CRK\_SYN = 0

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## 4.57 Camshaft adaptation and position output

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CAM_PSN_LST_REF_AD_EX [NC_NR_CAM_CBK]	O/V	0... 3FFH	-32... 31.9375	0.0625	°CRK
Adapted exhaust camshaft i signal position after last correct reference adaptation					
CAM_PSN_LST_REF_AD_IN [NC_NR_CAM_CBK]	O/V	0... 3FFH	-32... 31.9375	0.0625	°CRK
Adapted intake camshaft i signal position after last correct reference adaptation					
CTR_REV_AD_REF_CAM_EX [NC_NR_CAM_CBK]	V	0... FFH	0... 255	1	-
Exhaust camshaft reference position adaptation revolution counter					
CTR_REV_AD_REF_CAM_IN [NC_NR_CAM_CBK]	V	0... FFH	0... 255	1	-
Intake camshaft reference position adaptation revolution counter					
LV_AD_END_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Exhaust camshaft reference position adaptation successful					
LV_AD_END_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Intake camshaft reference position adaptation successful					
LV_CAM_AD_PWL_NOT_SAVE_EX [NC_NR_CAM_CBK]	-	0... 1H	0 ...1	1	-
Camshaft adaptive values storage in NVMY not allowed, for exhaust i					
LV_CAM_AD_PWL_NOT_SAVE_IN [NC_NR_CAM_CBK]	-	0... 1H	0 ...1	1	-
Camshaft adaptive values storage in NVMY not allowed, for intake i					
LV_CAM_AD_SAVE_EX [NC_NR_CAM_CBK]	O/V/S	0... 1H	0 ...1	1	-
Confirmation that adaptative values at exhaust i have already been stored					
LV_CAM_AD_SAVE_IN [NC_NR_CAM_CBK]	O/V/S	0... 1H	0 ...1	1	-
Confirmation that adaptative values at intake i have already been stored					
LV_TOOTH_OFF_DET_ENA_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Confirmation that a reference adaptation occurred after the very first one, to allow the one_tooth_off detection (exhaust i)					
LV_TOOTH_OFF_DET_ENA_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Confirmation that a reference adaptation occurred after the very first one, to allow the one_tooth_off detection (intake i)					
PSN_AD_CAM_EX [NC_NR_CAM_CBK]	O/V	0... FFH	-48... 47.625	0.375	°CRK
Adapted exhaust camshaft position relative to designed passive position					
PSN_AD_CAM_IN [NC_NR_CAM_CBK]	O/V	0... FFH	-48... 47.625	0.375	°CRK
Adapted intake camshaft position relative to designed passive position					
PSN_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1FFH	-96... 95.625	0.375	°CRK
Actual exhaust camshaft position relative to adapted passive position					
PSN_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1FFH	-96... 95.625	0.375	°CRK
Actual intake camshaft position relative to adapted passive position					
PSN_DIF_EDGE_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 780H	0... 720	0.375	°CRK
Crankshaft angle between the previous and the current exhaust camshaft i position determination					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
PSN_DIF_EDGE_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 780H	0... 720	0.375	°CRK
Crankshaft angle between the previous and the current intake camshaft position determination					
PSN_EDGE_AD_CAM_EX [NC_NR_EDGE_CAM_EX][NC_NR_CAM_CBK]	O/V/S	0... 3FFH	-32... 31.9375	0.0625	°CRK
Adapted exhaust camshaft i signal edge z position					
PSN_EDGE_AD_CAM_IN [NC_NR_EDGE_CAM_IN][NC_NR_CAM_CBK]	O/V/S	0... 3FFH	-32... 31.9375	0.0625	°CRK
Adapted intake camshaft i signal edge z position					
PSN_EDGE_CAM_EX [NC_NR_EDGE_CAM_EX][NC_NR_CAM_CBK]	O	0... FFFH	-128... 127.9375	0.0625	°CRK
Actual exhaust camshaft position relative to adapted passive position at signal edge index z					
PSN_EDGE_CAM_IN [NC_NR_EDGE_CAM_IN][NC_NR_CAM_CBK]	O	0... FFFH	-128... 127.9375	0.0625	°CRK
Actual intake camshaft position relative to adapted passive position at signal edge index z					
PSN_ENG_CAM_EX [NC_NR_CAM_CBK]	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Engine position at the last exhaust camshaft i edge					
PSN_ENG_CAM_IN [NC_NR_CAM_CBK]	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Engine position at the last intake camshaft i edge					
T_DIF_EDGE_CAM_EX [NC_NR_CAM_CBK]	O/V	0... FFFFFFFFH	0... 17179.86918	0.000004	s
Time between the previous and current camshaft signal edge					
T_DIF_EDGE_CAM_IN [NC_NR_CAM_CBK]	O/V	0... FFFFFFFFH	0... 17179.86918	0.000004	s
Time between the previous and current camshaft signal edge					

**Input data:**

C_TOL_REF_CRK_CAM_EX {p. 4422}	C_TOL_REF_CRK_CAM_IN {p. 4422}	IDX_EDGE_CAM_EX [NC_NR_CAM_CBK] {p. 871}	IDX_EDGE_CAM_IN [NC_NR_CAM_CBK] {p. 871}
LC_NOT_ADJ_CAM_IVVT_EX [NC_NR_CBK_IVVT] {p. 8400}	LC_NOT_ADJ_CAM_IVVT_IN [NC_NR_CBK_IVVT] {p. 8400}	LV_DI_AD_REF_CAM_IVVT_EX {p. 8399}	LV_DI_AD_REF_CAM_IVVT_IN {p. 8399}
LV_SYN_VLD {p. 1506}	LV_VLD_PSN_CAM_EX [NC_NR_CAM_CBK] {p. 872}	LV_VLD_PSN_CAM_IN [NC_NR_CAM_CBK] {p. 872}	N_32 {p. 1525}
NC_NR_EDGE_CAM_EX {p. 874}	NC_NR_EDGE_CAM_IN {p. 874}	NC_PSN_EDGE_CAM_EX [NC_NR_EDGE_CAM_EX][NC_NR_CAM_CBK] {p. 874}	NC_PSN_EDGE_CAM_IN [NC_NR_EDGE_CAM_IN][NC_NR_CAM_CBK] {p. 874}
NLC_IVVT_EX {p. 8400}	NLC_IVVT_IN {p. 8401}	PSN_ENG_ENSD {p. 1525}	T_SEG_CAM_EX [NC_NR_CAM_CBK] {p. 872}
T_SEG_CAM_IN [NC_NR_CAM_CBK] {p. 873}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_AD_CAM_EX	-	0... FFH	0... 0.99609	3.9063e-3	-
Averaging constant for continuous adaptation					
C_CRLC_AD_CAM_IN	-	0... FFH	0... 0.99609	3.9063e-3	-
Averaging constant for continuous adaptation					
C_CRLC_AD_REF_CAM_EX	-	0... FFH	0... 0.99609	3.9063e-3	-
Averaging constant for reference position adaptation					
C_CRLC_AD_REF_CAM_IN	-	0... FFH	0... 0.99609	3.9063e-3	-
Averaging constant for reference position adaptation					
C_GRD_AD_MAX_CAM_EX	-	0... FFH	0... 15.9375	0.0625	°CRK
Max. permissible drift of reference edge position for continuous adaptation					
C_GRD_AD_MAX_CAM_IN	-	0... FFH	0... 15.9375	0.0625	°CRK
Max. permissible drift of reference edge position for continuous adaptation					
C_GRD_AD_REF_MAX_CAM_EX	-	0... FFH	0... 15.9375	0.0625	°CRK
Max. permissible drift of reference edge position for reference position adaptation					
C_GRD_AD_REF_MAX_CAM_IN	-	0... FFH	0... 15.9375	0.0625	°CRK
Max. permissible drift of reference edge position for reference position adaptation					
C_NR_REV_AD_REF_CAM_EX	-	0... FFH	0... 255	1	-
Number of camshaft revolutions for reference position adaptation					
C_NR_REV_AD_REF_CAM_IN	-	0... FFH	0... 255	1	-
Number of camshaft revolutions for reference position adaptation					
C_TOL_TOOTH_OFF_CAM_EX	-	0... 1FFH	0... 31.9375	0.0625	°CRK
Reference position tolerance for tooth off detection for exhaust camshaft					
C_TOL_TOOTH_OFF_CAM_IN	-	0... 1FFH	0... 31.9375	0.0625	°CRK
Reference position tolerance for tooth off detection for intake camshaft					
ID_CAM_PHA_COR	-	0... 5FFH	-48... 47.9375	0.0625	°CRK
LDP_N_32_ID_CAM_PHA_COR	16	0... FFH	0... 8160	32	rpm
Table for camshaft transmitter phase offset correction					

**FUNCTION DESCRIPTION:****General information:**


The function provides a feedback about the actual camshaft position relative to the engine position measured with the crankshaft sensor. The signals of one, two or four camshaft sensors are treated (intake and/or exhaust camshaft on one or two cylinder banks).

The actual engine position is captured with every camshaft signal edge. The camshaft position is calculated as the difference between the captured engine position, and the engine position measured on the respective camshaft. The difference may be due to tolerances, or due to an intentional displacement by a camshaft phasing system (VVTI).

Two different adaptive learning algorithms eliminate the tolerances, in order to measure exactly the VVTI displacement.

The reference position adaptation is done for all signal edges. It is performed on all intake camshafts as long as LV\_DI\_AD\_REF\_CAM\_IVVT\_IN = 0. It is performed on all exhaust camshafts as long as LV\_DI\_AD\_REF\_CAM\_IVVT\_EX = 0. The camshafts are then situated in their respective VVTI passive positions. After the completion of the adaptation LV\_AD\_END\_CAM\_IN(EX)[i] is set and PSN\_AD\_CAM\_IN(EX)[i] is calculated as the mean value of all adapted signal edges. The reference edge has the index 1. It is the first electrical falling edge of the camshaft signal after TDC0.

The position of other signal edges is adapted continuously relative to the reference signal edge, in order to always deliver a coherent position information.

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Both adaptation algorithms are performed only at a limited dynamic variation of the camshaft position measured at the reference edge.

The logical calibration bit `LC_NOT_ADJ_CAM_IVVT_IN(EX)[i]` is set if the VVTI system is inhibited on the corresponding camshafts. The respective camshafts will be treated like being constantly in the VVTI passive position. If an engine has more camshaft sensors than VVTI actuators, then `NLC_IVVT_IN(EX) = 0` indicates that VVTI is not existing on intake or on exhaust camshafts.

### 4.57.1 Engine Position Determination from Camshaft signal

#### General information:

As soon as camshaft is self-synchronized, the actual engine position is calculated at every camshaft signal edge from theoretical position plus adaptation value for the actual signal edge index.

$i = 1 \dots NC\_NR\_CAM\_CBK$                        $z = 0 \dots NC\_NR\_EDGE\_CAM\_IN/EX$

#### Description:

*Recurrence :*                      every CAM active edge

#### Formula section:

for  $z = IDX\_EDGE\_CAM\_IN(EX)[i]$   
 $PSN\_ENG\_CAM\_IN(EX)[i] (n) = NC\_PSN\_EDGE\_CAM\_IN(EX)[z][i] + PSN\_EDGE\_AD\_CAM\_IN(EX)[z][i] (n-1) + ID\_CAM\_PHA\_COR$

### 4.57.2 Camshaft Position Output

#### Application conditions:

##### *Activation:*

$LV\_VLD\_PSN\_CAM\_IN(EX)[i] = 1$  And  $LV\_SYN\_VLD = 1$

*Recurrence:*                      every update of  $IDX\_EDGE\_CAM\_IN(EX)[i]$

##### *Initialization:*

$PSN\_CAM\_IN(EX)[i] = 0$

$PSN\_EDGE\_CAM\_IN(EX)[z][i] = 0$


#### Formula section:

for  $z = IDX\_EDGE\_CAM\_IN(EX)[i]$   
 $PSN\_EDGE\_CAM\_IN(EX)[z][i] = PSN\_ENG\_ENSD - PSN\_ENG\_CAM\_IN(EX)[i]$   
 In the following calculations, the resolution has to be converted:  
 $PSN\_CAM\_IN(EX)[i] = PSN\_EDGE\_CAM\_IN(EX)[z][i]$   
 $PSN\_DIF\_EDGE\_CAM\_IN(EX)[i] = PSN\_ENG\_ENSD (n) - PSN\_ENG\_ENSD (n-1)$   
 $T\_DIF\_EDGE\_CAM\_IN(EX)[i] = T\_SEG\_CAM\_IN(EX)[i]$

### 4.57.3 Camshaft Position Adaptation

#### 4.57.3.1 Reference Position Adaptation

#### General information:

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The reference position adaptation is done whenever it is not disabled by the corresponding flag from VVTI, or if there is no VVTI on that camshaft, and if the condition for limited dynamic variation of the camshaft position is true. A flag is set to signal successful adaptation.

The flag is reset when the adaptation inhibit conditions become false.

**If** LV\_DI\_AD\_REF\_CAM\_IVVT\_IN(EX) = 1  
**Then** LV\_AD\_END\_CAM\_IN(EX)[i] = 0

The camshaft position output value should be zero in VVTI passive position. At each occurrence of the reference camshaft signal edge, a portion of the position deviation is added to the previous adaptation value, as long as adaptation conditions are true, this is done for all the camshaft signal edges.

If the conditions stay true for a number of revolutions, then the flag for successful end of adaptation is set (LV\_AD\_END\_CAM\_IN(EX)[i] = 1).

i = 1...NC\_NR\_CAM\_CBK                      z = 0...NC\_NR\_EDGE\_CAM\_IN/EX

### **Application conditions:**

#### *Activation:*

LV\_VLD\_PSN\_CAM\_IN(EX)\_I = 1 **And** LV\_SYN\_VLD = 1

#### **And**

LV\_DI\_AD\_REF\_CAM\_IVVT\_IN(EX) = 0 **Or** LC\_NOT\_ADJ\_CAM\_IVVT\_IN(EX)[i] = 1 **Or** NLC\_IVVT\_IN(EX) = 0

*Recurrence:*                      every reference camshaft signal edge (IDX\_EDGE\_CAM\_IN(EX)[i] = 1)

#### *Initialization:*

LV\_AD\_END\_CAM\_IN(EX)[i] = 0

CTR\_REV\_AD\_REF\_CAM\_IN(EX)[i] = 0

PSN\_EDGE\_AD\_CAM\_IN(EX)[z][i] from saved value in NVMY (if adaptation value has never been learned or if the stored value could not be read, PSN\_EDGE\_AD\_CAM\_IN(EX)[z][i] are initialized to 0)

PSN\_AD\_CAM\_IN(EX)[i] = Sum ( PSN\_EDGE\_AD\_CAM\_IN(EX)[z][i]  
for z = 1...NC\_NR\_EDGE\_CAM\_IN(EX) ) /NC\_NR\_EDGE\_CAM\_IN(EX)  
(resolution conversion)

LV\_CAM\_AD\_SAVE\_IN(EX)[i] from saved value in NVMY (if adaptation value has never been learned or if the stored value could not be read, LV\_CAM\_AD\_SAVE\_IN(EX)[i] is initialized to 0)

PSN\_EDGE\_AD\_CAM\_IN(EX)[z][i] and LV\_CAM\_AD\_SAVE\_IN(EX)[i] shall be saved in NVMY only if: LV\_CAM\_AD\_PWL\_NOT\_SAVE\_IN(EX)[i] = 0 (otherwise the last stored values, which have been stored after last driving cycle without error, shall not be changed)

At reset: CAM\_PSN\_LST\_REF\_AD\_IN(EX)[i] = PSN\_EDGE\_AD\_CAM\_IN(EX)[1][i]

(All these adaptive values has to be reset in case of cam/crk mechanical change (Chain change, camshaft sensor change...))

### **Formula section:**

**If** |PSN\_EDGE\_CAM\_IN(EX)[1][i] (n) - PSN\_EDGE\_CAM\_IN(EX)[1][i] (n-1)| < C\_GRD\_AD\_REF\_MAX\_CAM\_IN(EX)

**Then** increment CTR\_REV\_AD\_REF\_CAM\_IN(EX)[i]

The adaptation values are calculated for all indexes (for z = 1...NC\_NR\_EDGE\_CAM\_IN(EX))


PSN\_EDGE\_AD\_CAM\_IN(EX)[z][i] (n) = PSN\_EDGE\_AD\_CAM\_IN(EX)[z][i] (n-1) + C\_CRLC\_AD\_REF\_CAM\_IN(EX) \* PSN\_EDGE\_CAM\_IN(EX)[z][i]

**Else** CTR\_REV\_AD\_REF\_CAM\_IN(EX)[i] = 0

**Endif**

**If** CTR\_REV\_AD\_REF\_CAM\_IN(EX)[i] >= C\_NR\_REV\_AD\_REF\_CAM\_IN(EX)

**Then** CTR\_REV\_AD\_REF\_CAM\_IN(EX)[i] = 0

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```

PSN_AD_CAM_IN(EX)[i] = Sum ( PSN_EDGE_AD_CAM_IN(EX)[z][i]
for z = 1...NC_NR_EDGE_CAM_IN(EX) ) /NC_NR_EDGE_CAM_IN(EX)
(resolution conversion)
If      LV_CAM_AD_SAVE_IN(EX)[i] = 1
Then    If      |CAM_PSN_LST_REF_AD_IN(EX)[i] - PSN_EDGE_AD_CAM_IN(EX)[1][i]|
< C_TOL_TOOTH_OFF_CAM_IN(EX)
          Then    CAM_PSN_LST_REF_AD_IN(EX)[i] = PSN_EDGE_AD_CAM_IN(EX)[1][i]

          Else    nothing
          Endif
          LV_TOOTH_OFF_DET_ENA_IN(EX)[i] = 1 (to allow the ONE_TOOTH_OFF di-
agnosis only if a reference adaptation has been done after the very first one)
Else    If      C_TOL_TOOTH_OFF_CAM_IN(EX) <> 0
          Then    CAM_PSN_LST_REF_AD_IN(EX)[i] = PSN_EDGE_AD_CAM_IN(EX)[1][i]

                  LV_CAM_AD_SAVE_IN(EX)[i] = 1 (set at the end of the very first reference
adaptation)
          Else    nothing
          Endif
Endif
LV_AD_END_CAM_IN(EX)[i] = 1
Else
LV_TOOTH_OFF_DET_ENA_IN(EX)[i] = 0
Endif

If      LV_DI_AD_REF_CAM_IVVT_IN(EX) = 1
Then    CTR_REV_AD_REF_CAM_IN(EX)[i] = 0
Endif

```

### 4.57.3.2 Continuous Edge Position Adaptation

The continuous position adaptation is enabled at a limited dynamic variation of the camshaft position measured at the reference signal edge.

The difference of the actual camshaft position measured at the reference edge, and the actual camshaft position measured at any other signal edge, is calculated once per camshaft revolution. That difference is multiplied with a coefficient ( $\ll 1$ ) and added to the previous adaptation value to form the new adaptation value, which is applied in the following camshaft revolution. This way the camshaft position output value calculated at any signal edges will approach the camshaft position output value calculated at the reference signal edge.

#### Application conditions:

##### *Activation:*

LV\_VLD\_PSN\_CAM\_IN[i] = 1 **And** LV\_SYN\_VLD = 1


##### **And**

LV\_DI\_AD\_REF\_CAM\_IVVT\_IN(EX) = 1 **And** LC\_NOT\_ADJ\_CAM\_IVVT\_IN(EX)[i] = 0 **And** NLC\_IVVT\_IN(EX) = 1

*Recurrence:* every reference camshaft signal edge (IDX\_EDGE\_CAM\_IN(EX)[i] = 1)

##### *Initialization:*

PSN\_EDGE\_AD\_CAM\_IN(EX)[z][i] from saved value in NVMY (if adaptation value has never been learned or if the stored value could not be read, PSN\_EDGE\_AD\_CAM\_IN(EX)[z][i] is initialized to 0)

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PSN\_EDGE\_AD\_CAM\_IN(EX)[z][i] and LV\_CAM\_AD\_SAVE\_IN(EX)[i] shall be saved in NVMY only if: LV\_CAM\_AD\_PWL\_NOT\_SAVE\_IN(EX)[i] = 0 (otherwise the last stored values, which have been stored after last driving cycle without error, shall not be changed)

#### **Formula section:**

For the following equations, the index z of the camshaft signal edges equals IDX\_EDGE\_CAM\_IN(EX)[i] (z=1 for reference edge). The adaptation values are calculated for all indexes from 2 to NC\_NR\_EDGE\_CAM\_IN(EX).

```

If      |PSN_EDGE_CAM_IN(EX)[1][i] (n) - PSN_EDGE_CAM_IN(EX)[1][i] (n-1)| <
          C_GRD_AD_MAX_CAM_IN(EX)
Then    PSN_EDGE_AD_CAM_IN(EX)[z][i] (n)      =
          PSN_EDGE_AD_CAM_IN(EX)[z][i] (n-1) + C_CRLC_AD_CAM_IN(EX) *
          (PSN_EDGE_CAM_IN(EX)[z][i] - PSN_EDGE_CAM_IN(EX)[1][i])

```

**Endif**

#### **4.57.3.3 Reference adaptive values save authorization at Powerlatch**

Before saving the adaptive values in NVMY during PWL, it is important to check if they are correct. Even if the REF\_CRK\_CAM error is not set, the calculated adaptive values can be wrong (for example, the error flag could have been reset on a quick key 0 to 1 transition).

#### **Application conditions:**

*Activation:*

ECU\_STATE = PWL

*Recurrence:* once during PWL, for all camshaft edges of all present camshaft sensors, before saving the NVMY adaptive values

*Initialization:*

LV\_CAM\_AD\_PWL\_NOT\_SAVE\_IN(EX)[i] = 0


#### **Formula section:**

```

If      PSN_EDGE_AD_CAM_IN(EX)[z][i] < - C_TOL_REF_CRK_CAM_IN(EX)
or      PSN_EDGE_AD_CAM_IN(EX)[z][i] > C_TOL_REF_CRK_CAM_IN(EX)
Then    LV_CAM_AD_PWL_NOT_SAVE_IN(EX)[i] = 1
Else
if      LV_CAM_AD_SAVE_IN(EX)[i] = 1
          And
          CAM_PSN_LST_REF_AD_IN(EX)[i] <> PSN_EDGE_AD_CAM_IN(EX)[1][i]
          And
          C_TOL_TOOTH_OFF_CAM_IN(EX) <> 0
          Then    LV_CAM_AD_PWL_NOT_SAVE_IN(EX)[i] = 1
          Else    nothing, (if LV_CAM_AD_PWL_NOT_SAVE_IN(EX)[i] has been set to 1 due to
          anyone of the camshaft edges, it must stay to 1 and the adaptive will not be saved. Contrary,
          if all the camshaft edges are correct, adaptive values can be saved, LV_CAM_AD_PWL_NOT_
          SAVE_IN(EX)[i] must stay at 0)
Endif
Endif

```

**Endif**

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## 4.58 Evaporative emission control variables

### Data definition:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LAM_CP_DYW	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
FAC_LAM_CP average value for dynamic window					
LAMB_SP_S_DYW_CP	V	0... 7FFFH	0... 31.99902	976.599e-6	-
LAMB_SP_S average value for dynamic window					
LV_CP_CAT_PURGE	O/V	0... 1H	0 ...1	1	-
Catalyst purge activated					
LV_CP_CAT_PURGE_AFL	O/V	0... 1H	0 ...1	1	-
Catalyst purge AFL activated					
LV_CP_CDN_MIN_PURGE_FAST	O/V	0... 1H	0 ...1	1	-
flag for usage of CL-model; =1: MIN_PURGE forced, no CL-mdl usage possible					
LV_CP_CLOSE_REQ	O/V	0... 1H	0 ...1	1	-
Request to close the CPS valve					
LV_CP_CMU_CMB	O/V	0... 1H	0 ...1	1	-
Commutation combustion active					
LV_CP_DYW	O/V	0... 1H	0 ...1	1	-
Dynamic window for canister purge					
LV_CP_PU	V	0... 1H	0 ...1	1	-
Flag to interrupt the purge in PU mode					
LV_CP_PUC	V	0... 1H	0 ...1	1	-
CP interruption due to engine state PUC					
LV_CP_WIN	V	0... 1H	0 ...1	1	-
Engine operation within CP window (n & maf)					
LV_LAM_LIM_CP	V	0... 1H	0 ...1	1	-
Lambda controller reached limits (defined in lambda controller module)					
LV_LAM_OUT_CP	V	0... 1H	0 ...1	1	-
Lambda controller reached limits (defined in this module)					
LV_N_MAX_CP	O/V	0... 1H	0 ...1	1	-
Maximum engine speed for canister purge calculations limit reached					
MAF_DYW_CP	V	0... FFFFH	0... 1389	0.0211948	mg/stk
MAF average value for dynamic window					
N_DYW_CP	V	0... 1FE0H	0... 8160	1	rpm
N average value for dynamic window					
PRS_CPS	O/V	8000... 7FFFH	-2717.04 ...2716.96	0.0829175	hPa
Pressure difference environment over CP line					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_CDN_CP	O/V	0H	NO_CDN	-	-
		1H	CDN_NO_PURGE		
		2H	CDN_MIN_PURGE		
		3H	CDN_RAMP_OPEN		
		4H	CDN_RAMP_FAST		
5H	CDN_NO_FAST				
Activation conditions for evaporative emission control function					
T_DLY_CAT_PURGE_CP_AFL_TMP	-	0... FFFFH	0... 6553.5	0.1	s
timer for LV_CP_CAT_PURGE_AFL calculation					
T_DLY_CAT_PURGE_CP_TMP	-	0... FFFFH	0... 6553.5	0.1	s
timer for LV_CP_CAT_PURGE calculation					
T_DLY_CMU_CP_TMP	-	0... FFFFH	0... 6553.5	0.1	s
timer for LV_CP_CMU_CMB calculation					
T_DLY_CP_PU_TMP	-	0... FFFFH	0... 6553.5	0.1	s
timer for LV_CP_PU calculation					
T_DLY_CP_PUC_TMP	-	0... FFFFH	0... 6553.5	0.1	s
timer for LV_CP_PUC calculation					
T_DLY_DYW_CP	-	0... FFFFH	0... 1310.7	0.02	s
timer for LV_CP_DYW calculation					
T_DLY_LAM_LIM_CP_TMP	-	0... FFFFH	0... 6553.5	0.1	s
timer for LV_LAM_LIM_CP calculation					
T_DLY_LAM_OUT_CP_TMP	-	0... FFFFH	0... 6553.5	0.1	s
timer for LV_LAM_OUT_CP calculation					
TQI_DYW_CP	V	0... 7FFFH	0... 1023.97	0.03125	Nm
TQI_SP_S average value for dynamic window					

## Input data:

AMP {p. 982}	FAC_LAM_CP {p. 3698}	FAC_LAM_MV_MMV_CP [NC_CBK_EX_NR] {p. 2462}	LAMB_SP_S {p. 1820}
LV_CAT_PURGE_REQ_POST_AFL [NC_NT_NR] {p. 2982}	LV_CL_MDL_END_CAT_PURGE {p. 3728}	LV_CMB_TRAN_ACT {p. 799}	LV_CP_CLL {p. 3636}
LV_CP_CLOSE_1 {p. 3679}	LV_CP_CLOSE_2 {p. 3679}	LV_CP_CLOSE_3 {p. 3679}	LV_CP_DYW_EXT {p. 3679}
LV_FAC_LAM_LIM_MAX [NC_CBK_EX_NR] {p. 2463}	LV_FAC_LAM_LIM_MIN [NC_CBK_EX_NR] {p. 2463}	LV_FCUT_IND {p. 2295}	LV_HOM_ACT {p. 8136}
LV_INH_CP {p. 3679}	LV_INH_CP_CLL {p. 3679}	LV_INH_CP_FAST {p. 3679}	LV_IS {p. 1720}
LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}	LV_LAM_STOP_SHO_PER [NC_CBK_EX_NR] {p. 2448}	LV_LDC_LAM_AD [NC_CBK_EX_NR] {p. 2721}

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LV_NT_RGN_REQ {p. 996}	LV_PU {p. 1720}	LV_PUC {p. 1720}	MAF {p. 8277}
MAP {p. 8278}	N {p. 1525}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}
PRS_CPS_EXT {p. 3680}	STATE_CLL_DEAC_CP {p. 3637}	STATE_CP {p. 3637}	STATE_LOCK_CP {p. 3638}
T_AST {p. 1766}	T_DLY_MAX_CP {p. 3638}	TCO {p. 1100}	TIA_THR {p. 984}
TQI_SP_S {p. 8391}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_LAM_DYW_CP	-	0... FFH	0... 0.99609	3.9063e-3	-
Filter constant for limited dynamics calculation on lambda controller controller in non-normal purge					
C_CRLC_LAMB_SP_S_DYW_CP	-	0... FFH	0... 0.99609	3.9063e-3	-
Filter constant for limited dynamics calculation on lambda setpoint in stratified					
C_CRLC_MAF_DYW_CP	-	0... FFH	0... 0.99609	3.9063e-3	-
Filter constant for limited dynamics calculation on MAF					
C_CRLC_N_DYW_CP	-	0... FFH	0... 0.99609	3.9063e-3	-
Filter constant for limited dynamics calculation on engine speed					
C_CRLC_TQI_DYW_CP_1	-	0... FFH	0... 0.99609	3.9063e-3	-
Filter constant for limited dynamics calculation on tqi_sp in stratified					
C_CRLC_TQI_DYW_CP_2	-	0... FFH	0... 0.99609	3.9063e-3	-
Filter constant for limited dynamics calculation on tqi_sp in stratified for RampOpenFast and MaxPurge					
C_DLY_N_MAF_DYW_CP	-	0... FFFFH	0... 1310.7	0.02	s
Time delay to have stabilization condition					
C_DLY_N_TQI_DYW_CP_1	-	0... FFFFH	0... 1310.7	0.02	s
Time delay to have stabilization condition for RampOpen					
C_DLY_N_TQI_DYW_CP_2	-	0... FFFFH	0... 1310.7	0.02	s
Time delay to have stabilization condition for RampOpenFast and MaxPurge					
C_FAC_LAM_CP_BOL	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Limit on FAC_LAM_CP value to start RAMP_OPEN					
C_FAC_LAM_CP_DYW	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Dynamic window value on FAC_LAM_CP					
C_FAC_LAM_CP_TOL	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Limit on FAC_LAM_CP value to start RAMP_OPEN					
C_LAMB_SP_S_CP_BOL	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Bottom limit on the LAMB_SP_S value					
C_LAMB_SP_S_CP_TOL	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Top limit on the LAMB_SP_S value					
C_LAMB_SP_S_DYW_CP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Dynamic window on LAMB_SP_S value					
C_MAF_CP_BOL_HYS	-	0... FFH	0... 1389	5.4470588	mg/stk
Hysteresis for minimum mass air flow limit for activation of the RAMP_OPEN operation (homogeneous)					
C_MAF_DYW_CP	-	0... FFFFH	0... 1389	0.0211948	mg/stk
MAF window for limited dynamics					
C_N_2_CP_BOL	-	0... FFH	0... 8160	32	rpm
Minimum speed limit for activation of the RAMP_OPEN operation (stratified)					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_2_CP_TOL	-	0... FFH	0... 8160	32	rpm
Maximum speed limit for activation of the RAMP_OPEN operation (stratified)					
C_N_2_DYW_CP	-	0... 1FE0H	0... 8160	1	rpm
engine speed window for limited dynamics					
C_N_CP_BOL	-	0... FFH	0... 8160	32	rpm
Minimum speed limit for activation of the RAMP_OPEN operation (homogeneous)					
C_N_CP_TOL	-	0... FFH	0... 8160	32	rpm
Maximum speed limit for activation of the RAMP_OPEN operation (homogeneous)					
C_N_DYW_CP	-	0... 1FE0H	0... 8160	1	rpm
engine speed window for limited dynamics					
C_N_HYS_MAX_CP	-	0... FFH	0... 8160	32	rpm
Hysteresis value for canister purge calculations (CPU load reduction)					
C_N_MAX_CP	-	0... FFH	0... 8160	32	rpm
Maximum engine speed value for canister purge calculations (CPU load reduction)					
C_PRS_MAX_CPS	-	8000... 7FFFH	-2717.04 ...2716.96	0.0829175	hPa
Pressure difference limit (environment-intake manifold) for activation of the canister purge					
C_PRS_MAX_CPS_2	-	8000... 7FFFH	-2717.04 ...2716.96	0.0829175	hPa
Pressure difference limit (environment-intake manifold) for direct switch to NO_PURGE (no ramp)					
C_T_DLY_CAT_PURGE_AFL_CP	-	1... FFFFH	0.1... 6553.5	0.1	s
Delay time at start cathalyst purge AFL					
C_T_DLY_CAT_PURGE_CP	-	1... FFFFH	0.1... 6553.5	0.1	s
Delay time after cathalyst purge					
C_T_DLY_LAM_CP	-	1... FFFFH	1... 65535	1	s
Delay on lambda control stabilization to restart RAMP_OPEN					
C_T_DLY_PU_CPS	-	1... FFFFH	0.1... 6553.5	0.1	s
CPS interrupt time during PU					
C_T_DLY_PUC_CP	-	1... FFFFH	0.1... 6553.5	0.1	s
caniser purge interrupt time after PUC					
C_T_LAM_LIM_CP	-	0... FFFFH	0... 6553.5	0.1	s
Additional time to stay in MIN_PURGE after LV_FAC_LAM_LIM_XXX					
C_TIA_MIN_CP	-	0... FEH	-48... 142.5	0.75	°C
Minimum intake air temperature for closing of the CPS					
C_TQI_CP_BOL_HYS	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Hysteresis for minimum mass air flow limit for activation of the RAMP_OPEN operation (homogeneous)					
C_TQI_DYW_CP	-	0... 7FFFH	0... 1023.97	0.03125	Nm
Dynamic window value on TQI_SP_S					
IP_MAF_CP_BOL	-	0... FFH	0... 1389	5.4470588	mg/stk
LDPM_N_32_3_EVAC	8	0... FFH	0... 8160	32	rpm
Minimum mass air flow limit for activation of the RAMP_OPEN operation (homogeneous)					
IP_MAF_CP_TOL	-	0... FFH	0... 1389	5.4470588	mg/stk
LDPM_N_32_3_EVAC	8	0... FFH	0... 8160	32	rpm
Maximum mass air flow limit for activation of the RAMP_OPEN operation (homogeneous)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_T_DLY_CMU_CPS	-	0... FFFFH	0... 6553.5	0.1	s
LDP_N_32_IP_T_DLY_CMU_CPS	6	0... FFH	0... 8160	32	rpm
Stabilization delay on lambda regulation after commutation					
IP_TQI_CP_BOL	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_N_32_3_EVAC	8	0... FFH	0... 8160	32	rpm
Minimum torque limit for sctivation of the RAMP_OPEN operation (stratified)					
IP_TQI_CP_TOL	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_N_32_3_EVAC	8	0... FFH	0... 8160	32	rpm
Maximum torque limit for sctivation of the RAMP_OPEN operation (stratified)					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_CDN_CP_MAN	-	0H	NO_CDN	-	-
		1H	CDN_NO_PURGE		
		2H	CDN_MIN_PURGE		
		3H	CDN_RAMP_OPEN		
		4H	CDN_RAMP_FAST		
manual selection of STATE_CDN_CP					
C_STATE_LAM_LIM_CP	-	0H	NONE	-	-
		1H	NO_PURGE		
		2H	MIN_PURGE		
state to be forced if lambda control limitation reached					
C_STATE_WIN_CP_NOT	-	0H	NONE	-	-
		1H	NO_PURGE		
		2H	MIN_PURGE		
state to be forced if engine operation outside CP window					
LC_CP_CAT_PURGE_AFL_ACT	-	0... 1H	0 ...1	1	-
Canister purge AFL in closed loop with CL-Model					
LC_CP_CAT_PURGE_OFF	-	0... 1H	0 ...1	1	-
Canister purge off during catalyst purge					
LC_CP_CAT_PURGE_OPL	-	0... 1H	0 ...1	1	-
Canister purge in open loop during cathalyst purge					
LC_CP_CLL_INH_MAN	-	0... 1H	0 ...1	1	-
switch for deactivation of closed loop canister purge ("normal purge")					
LC_CP_CLL_S_INH	-	0... 1H	0 ...1	1	-
Selection of MIN_PURGE during stratified mode (=1)					
LC_CP_DYW_CLC_ENA	-	0... 1H	0 ...1	1	-
1: calculation of dynamic window conditions					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_CP_DYW_CLC_MAX_ENA	-	0... 1H	0 ...1	1	-
1: calculate lim.dynamics /lambda contr.limits etc. also with n_max_cp exceeded					
LC_CP_DYW_LAM_AD	-	0... 1H	0 ...1	1	-
1: use the limited dynamics flag of the lambda adaptation (common flag lamb ad /cp)					
LC_CP_INH_MAN	-	0... 1H	0 ...1	1	-
switch for deactivation of canister purge and force NO_PURGE					
LC_LAM_DYW_CP_INI_DEAC	-	0... 1H	0 ...1	1	-
1: deactivate dynamic window on lambda control at deactivated normal purge					
LC_PRS_CPS_EXT	-	0... 1H	0 ...1	1	-
switch to use externally calculated value for PRS_CPS					
LC_STATE_CDN_CP_MAN	-	0... 1H	0 ...1	1	-
switch to activate test mode // manual setting of STATE_CDN_CP					

Input data table order: External inputs - Inputs from other EVAC modules

(If the system includes an OBD sequencer, LV\_CP\_CLOSE\_CP\_x will be imported from outside the EVAC aggregate, if the system does not include an OBD sequencer, the flags will be provide within the aggregate (within the appl.inc. module))

### General information:

--

### Application conditions

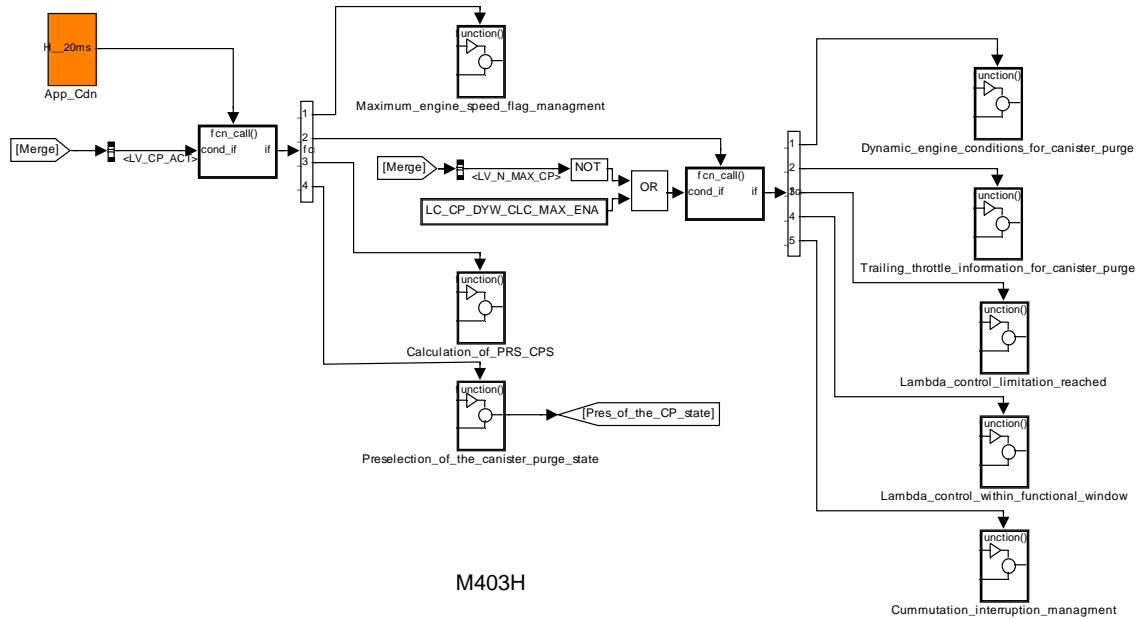
**Initialisation:** --

**Recurrence:** 20 ms

**Activation:** --

**Deactivation:** --

### Signal flow diagram:



M403H

### Formula section:

```

if    LV_CP_ACT = 1
then call "Maximum engine speed flag management"
      if    [ LV_N_MAX_CP = 0
      or    LC_CP_DYW_CLC_MAX_ENA = 1 ]
      then call "Dynamic engine conditions for canister purge"
            call "Trailing throttle information for canister purge"
            call "Canister purge prohibition after "trailing fuel cut off"
            call "Lambda control limitation reached"
            call "Lambda control within functional window"
            call "Commutation interruption management"
            call "Catalyst purge interruption management"
      endif
      call "Calculation of PRS_CPS"
      call "Preselection of the canister purge state"
end

```

### 4.58.1 Maximum engine speed flag management

#### General information:

When the CPU load is critical it is possible to disable some of the canister purge calculations when the engine speed is above a threshold.

#### Application conditions

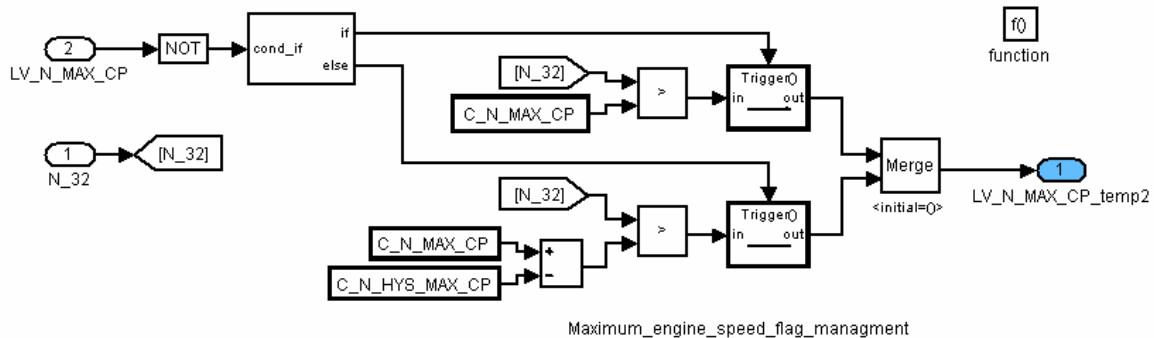
**Initialisation:** at RST or IGKON  
LV\_N\_MAX\_CP = 0

**Recurrence:** called by superior block

**Activation:** *called by superior block*

**Deactivation:** - -

### Signal flow diagram:



### Formula section:

```

if    LV_N_MAX_CP = 0
then  LV_N_MAX_CP = [ N_32 > C_N_MAX_CP ]
else  LV_N_MAX_CP = [ N_32 > C_N_MAX_CP - C_N_HYS_MAX_CP ]
endif
end

```

## 4.58.2 Dynamic engine conditions for canister purge

### General information:

The limited dynamic condition for a variable exist if the current value stays inside a tolerance window. If the values of n & maf (homogeneous) resp. n, tqi\_sp\_s and lamb\_sp\_s (stratified) stay within a window around the moving mean value of this variable for a certain time, limited dynamic is detected. C\_FAC\_LAM\_CP\_DYW should be always greater than C\_FAC\_LAM\_DIF\_MAX\_CP.

### Application conditions

**Initialisation:** at RST or IGKON

```

N_DYW_CP      = 0
MAF_DYW_CP    = 0
TQI_DYW_CP    = 0
LAMB_SP_S_DYW_CP = 0
FAC_LAM_CP_DYW  = 0
T_DLY_DYW_CP  = 0

```

**Recurrence:** *called by superior bloc*

**Activation:** *called by superior block*

**Deactivation:** - -

**Formula section:**

```

if    LC_CP_DYW_CLC_ENA    = 1
and   LC_CP_CLL_INH_MAN    = 0
then  call  "Dynamic window calculation"
        else  LV_CP_DYW = 1
endif
if    LC_CP_DYW_LAM_AD = 1          // use dyw flag from lambda adaptation
then  LV_CP_DYW = [LV_CP_DYW and LV_LDC_LAM_AD [1] and LV_LDC_LAM_AD [2]]
endif
end

```

**4.58.2.1 Dynamic window calculation**

```

if    [    LV_HOM_ACT = 1          // limited dynamic cond. for homogeneous operation
and   abs (N_DYW_CP    - N)        < C_N_DYW_CP
and   abs (MAF_DYW_CP  - MAF)      < C_MAF_DYW_CP
and   abs (FAC_LAM_CP_DYW - FAC_LAM_CP) < C_FAC_LAM_CP_DYW]
or    [    LV_HOM_ACT = 0          // limited dynamic conditions for stratified operation
and   abs (N_DYW_CP    - N)        < C_N_2_DYW_CP
and   abs (TQI_DYW_CP  - TQI_SP_S)  < C_TQI_DYW_CP
and   abs (LAMB_SP_S_DYW_CP - LAMB_SP_S) < C_LAMB_SP_S_DYW_CP ]
then  call  "Timer and MMV calculation" // LDC fulfilled
else  call  "Timer and MMV init"       // LDC not fulfilled
endif
LV_CP_DYW =
    [ T_DLY_DYW_CP = 0
and  LV_CP_DYW_EXT = 1 ]          // external dyn.win.flag from appl.inc. module
end

```

**4.58.2.2 Timer and MMV calculation**

```

N_DYW_CPn = N_DYW_CPn-1 + (N - N_DYW_CPn-1) * C_CRLC_N_DYW_CP
if LV_HOM_ACT = 1
    MAF_DYW_CPn = MAF_DYW_CPn-1 +
    (MAF - MAF_DYW_CPn-1) * C_CRLC_MAF_DYW_CP
    if LV_CP_CLL = 1          // no ldc on lambda controller in normal purge
    or [STATE_CLL_DEAC_CP ≠ CP_NO_DEAC and LC_LAM_DYW_CP_INI_DEAC = 1]
    then FAC_LAM_CP_DYW = FAC_LAM_CP
    else FAC_LAM_CP_DYWn = FAC_LAM_CP_DYWn-1 +
    (FAC_LAM_CP - FAC_LAM_CP_DYWn-1) * C_CRLC_LAM_DYW_CP
    endif
else
    if (STATE_CP = RAMP_OPEN_FAST or STATE_CP = MAX_PURGE
    or STATE_CLL_DEAC_CP = MAX_PURGE_DEAC
    or STATE_CLL_DEAC_CP = RAMP_FAST_DEAC
    or T_DLY_MAX_CP > 0 )
    then TQI_DYW_CPn = TQI_DYW_CPn-1 +
    (TQI_SP_S - TQI_DYW_CPn-1) * C_CRLC_TQI_DYW_CP_2
    else TQI_DYW_CPn = TQI_DYW_CPn-1 +
    (TQI_SP_S - TQI_DYW_CPn-1) * C_CRLC_TQI_DYW_CP_1
    endif
    LAMB_SP_S_DYW_CPn = LAMB_SP_S_DYW_CPn-1 +
    (LAMB_SP_S - LAMB_SP_S_DYW_CPn-1) * C_CRLC_LAMB_SP_S_DYW_CP

```

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**endif**

T\_DLY\_DYW\_CP = max (0, T\_DLY\_DYW\_CP - TA) // timer decrementation

**end**

#### 4.58.2.3 Timer and MMV init

N\_DYW\_CP = N

**if** LV\_HOM\_ACT = 1

MAF\_DYW\_CP = MAF

FAC\_LAM\_CP\_DYW = FAC\_LAM\_CP

T\_DLY\_DYW\_CP = C\_DLY\_N\_MAF\_DYW\_CP

**else**

TQI\_DYW\_CP = TQI\_SP\_S

LAMB\_SP\_S\_DYW\_CP = LAMB\_SP\_S

**if** (STATE\_CP = RAMP\_OPEN\_FAST **or** STATE\_CP = MAX\_PURGE

**or** STATE\_CLL\_DEAC\_CP = MAX\_PURGE\_DEAC

**or** STATE\_CLL\_DEAC\_CP = RAMP\_FAST\_DEAC

**or** T\_DLY\_MAX\_CP > 0)

**then** T\_DLY\_DYW\_CP = C\_DLY\_N\_TQI\_DYW\_CP\_2

**else** T\_DLY\_DYW\_CP = C\_DLY\_N\_TQI\_DYW\_CP\_1

**endif**

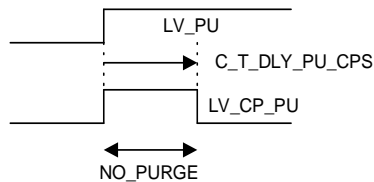
**endif**

**end**

### 4.58.3 Trailing throttle information for canister purge

#### General information:

In case of trailing throttle condition LV\_PU, the fuel coming from the purge could be important compared to the fuel injected. To prevent any malfunction we need to close immediatly the purge valve during a delay C\_T\_DLY\_PU\_CPS. During this time the flag LV\_CP\_PU is set to 1.



#### Application conditions

**Initialisation:**

at RST or IGKON

LV\_CP\_PU = 0

T\_DLY\_CP\_PU\_TMP = 0

**Recurrence:**

*called by superior block*

**Activation:**

*called by superior block*

**Deactivation:**

--

**Formula section:**

```

if    LV_PU 0 1
then  T_DLY_CP_PU_TMP = C_T_DLY_PU_CPS
else  T_DLY_CP_PU_TMP = max (0, T_DLY_CP_PU_TMP - TA)
endif
LV_CP_PU = [T_DLY_CP_PU_TMP > 0 ]
end
    
```

**4.58.4 Canister purge prohibition after "trailing fuel cut off"**

After a fuel cut off phase (PUC) the engine needs a certain time to stabilize the air fuel ratio. During this phase the lambda controller has a deviation. To prevent that this deviation has an influence on the CL calculation, canister purge will be disabled after a PUC phase.

**Application conditions**

**Initialisation:** at RST or IGKON  
                   LV\_CP\_PUC = 0  
                   T\_DLY\_CP\_PUC\_TMP = 0

**Recurrence:** called by superior block

**Activation:** called by superior block

**Deactivation:** - -

**Formula section:**

```

if    LV_PUC = 1
then  T_DLY_CP_PUC_TMP = C_T_DLY_PUC_CP
else  T_DLY_CP_PUC_TMP = max (0, T_DLY_CP_PUC_TMP - TA)
endif
LV_CP_PUC = [T_DLY_CP_PUC_TMP > 0 ]
end
    
```

**4.58.5 Lambda control limitation reached**

**General information:**

When the lambda control reaches a minimum or maximum value, the information LV\_FAC\_LAM\_LIM\_MIN resp. LV\_FAC\_LAM\_LIM\_MAX is set. As soon as the lambda control value is again in its limits, the bit information is reset. In order to memorize this information and to wait for a lambda control value stabilized, an information is managed LV\_LAM\_LIM\_CP.

This value is set to TRUE as long as any lambda control limit is exceeded and reset after a delay C\_T\_LAM\_LIM\_CP after the lambda control is within its limits again.


**Application conditions**

**Initialisation:** at RST or IGKON  
                   LV\_LAM\_LIM\_CP = 0  
                   T\_DLY\_LAM\_LIM\_CP\_TMP = 0  
                   **Recurrence:** called by superior block

**Activation:** called by superior block

**Deactivation:** - -

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**Formula section:**

```

if   LV_FAC_LAM_LIM_MIN [i]   = 1           at least one bench
or   LV_FAC_LAM_LIM_MAX [i]   = 1           at least one bench
then T_DLY_LAM_LIM_CP_TMP     = C_T_LAM_LIM_CP
else T_DLY_LAM_LIM_CP_TMP     = max (0, T_DLY_LAM_LIM_CP_TMP - TA)
endif
LV_LAM_LIM_CP = [T_DLY_LAM_LIM_CP_TMP > 0 ]
end

```

**4.58.6 Lambda control within functional window****General information:**

Parallel to the observation of lambda control limits using the flags LV\_FAC\_LAM\_LIM\_MIN and LV\_FAC\_LAM\_LIM\_MAX coming from the lambda controller, the canister purge strategy provides two independent limits C\_FAC\_LAM\_CP\_BOL & C\_FAC\_LAM\_CP\_TOL.

As long as at least one lambda controller is not running in a window defined by [C\_FAC\_LAM\_CP\_BOL, C\_FAC\_LAM\_CP\_TOL] an information is set to TRUE and reset after a delay C\_T\_DLY\_LAM\_CP after all lambda controllers are within [C\_FAC\_LAM\_CP\_BOL, C\_FAC\_LAM\_CP\_TOL] again.

**Application conditions**

**Initialisation:** at RST or IGKON  
                   LV\_LAM\_OUT\_CP = 0  
                   T\_DLY\_LAM\_OUT\_CP\_TMP = 0

**Recurrence:** called by superior block

**Activation:** called by superior block

**Deactivation:** - -

**Formula section:**


```

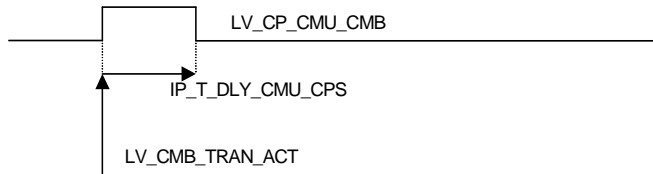
if   FAC_LAM_MV_MMV_CP [i] <= C_FAC_LAM_CP_BOL           at least one bench
or   FAC_LAM_MV_MMV_CP [i] >= C_FAC_LAM_CP_TOL           at least one bench
then T_DLY_LAM_OUT_CP_TMP = C_T_DLY_LAM_CP
else T_DLY_LAM_OUT_CP_TMP = max (0, T_DLY_LAM_OUT_CP_TMP - TA)
endif
LV_LAM_OUT_CP = [T_DLY_LAM_OUT_CP_TMP > 0 ]
end

```

**4.58.7 Commutation interruption management****General information:**

Before a combustion commutation, the CPS valve may be closed to purge the intake manifold. A delay will be added to wait for lambda stabilisation and manifold purge. During the commutation the evaporative emission control is in state NO\_PURGE

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### Application conditions

**Initialisation:** at RST or IGKON  
 $LV\_CP\_CMU\_CMB = 0$   
 $T\_DLY\_CMU\_CP\_TMP = 0$

**Recurrence:** called by superior block

**Activation:** called by superior block

**Deactivation:** - -

### Formula section:

```

if LV_CMB_TRAN_ACT
then T_DLY_CMU_CP_TMP = IP_T_DLY_CMU_CPS (N_32)
else T_DLY_CMU_CP_TMP = max (0, T_DLY_CMU_CP_TMP - TA)
endif
LV_CP_CMU_CMB = [T_DLY_CMU_CP_TMP > 0]
end
  
```

## 4.58.8 Catalyst purge interruption management

### General information:

During NO<sub>x</sub> regeneration of the catalyst and a time delay after that, the canister purge can be set configurable to off, open loop or closed loop.

### Application conditions

**Initialisation:** at RST or IGKON  
 $LV\_CP\_CAT\_PURGE = 0$   
 $T\_DLY\_CAT\_PURGE\_CP\_TMP = 0$

**Recurrence:** called by superior block

**Activation:** called by superior block

**Deactivation:** - -



**Formula section:**

```

if    LV_HOM_ACT = 1
      and [LV_NT_RGN_REQ
      or    (LV_CAT_PURGE_REQ_POST_AFL[i]           // at least one of these flags
            and LC_CP_CAT_PURGE_AFL_ACT)]
then T_DLY_CAT_PURGE_CP_TMP = C_T_DLY_CAT_PURGE_CP
else T_DLY_CAT_PURGE_CP_TMP = max (0, T_DLY_CAT_PURGE_CP_TMP - TA)
endif
LV_CP_CAT_PURGE = [T_DLY_CAT_PURGE_CP_TMP > 0 ]
end

if    [LV_HOM_ACT = 1
      and LV_CAT_PURGE_REQ_POST_AFL[i] transition 0 -> 1 // at least one of these flags
then T_DLY_CAT_PURGE_CP_AFL_TMP = C_T_DLY_CAT_PURGE_AFL_CP
else T_DLY_CAT_PURGE_CP_AFL_TMP
      = max (0, T_DLY_CAT_PURGE_CP_AFL_TMP - TA)
endif
LV_CP_CAT_PURGE_AFL = [T_DLY_CAT_PURGE_CP_AFL_TMP > 0 ]
end

```

**4.58.9 Calculation of PRS\_CPS**

**General information:**

PRS\_CPS is the pressure drop over the CP system, i.e. the difference between ambient air pressure and intake manifold pressure

**Application conditions**

**Initialisation:** at RST or IGKON  
PRS\_CPS = 0

**Recurrence:** called by superior block

**Activation:** called by superior block

**Deactivation:** - -

**Formula section:**

```

if    LC_PRS_CPS_EXT
then PRS_CPS = PRS_CPS_EXT
else PRS_CPS = AMP - MAP
end


```

**4.58.10 Preselection of the canister purge state**

**General information:**

After activation of the function (LV\_CP\_ACT=1) there is a continuous check of the activation conditions.

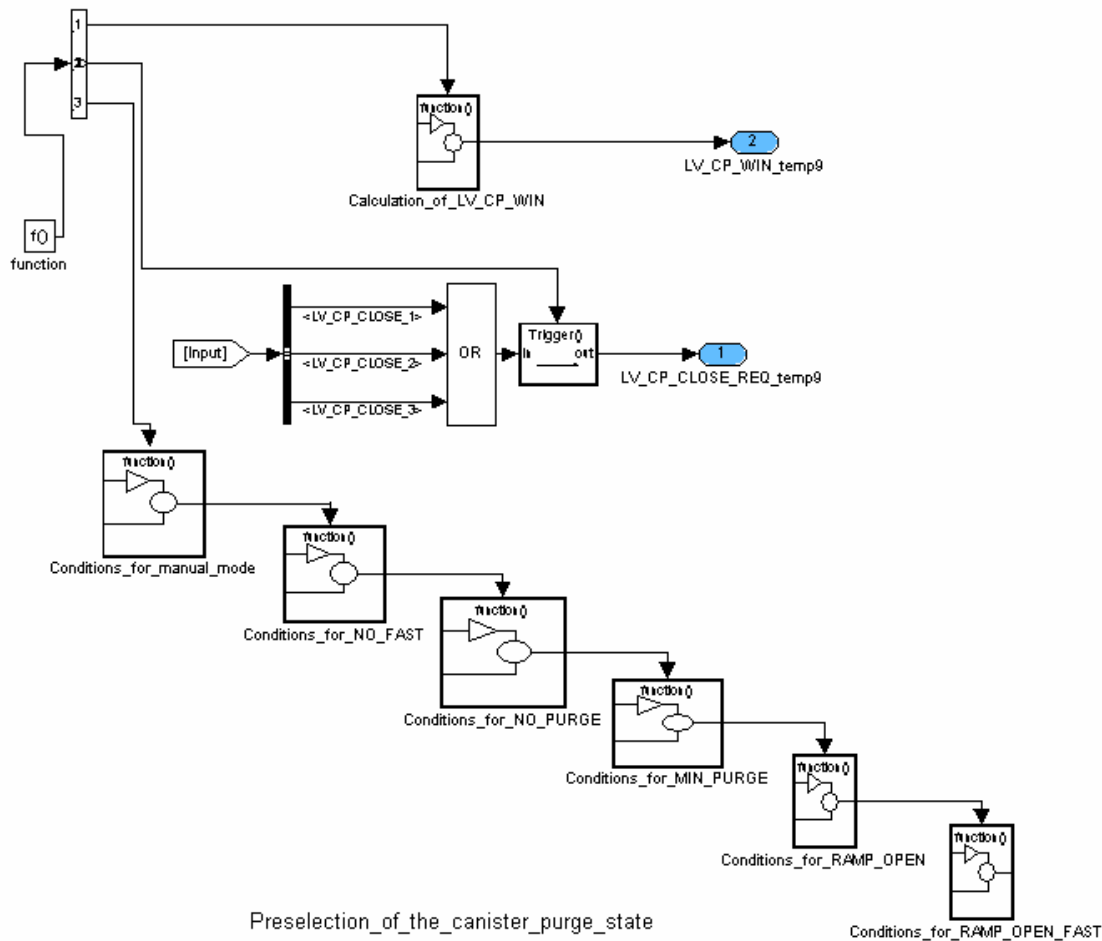
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## Application conditions

- Initialisation:** at RST or IGKON  
all the values are set to zero.
- Recurrence:** called by superior block
- Activation:** called by superior block
- Deactivation:** - -

## Signal flow diagram:



## Formula section:

```

if LV_HOM_ACT = 1
then if LV_CP_WIN = 1
    then LV_CP_WIN = // Engine operation window for CP, hom.
        [ N_32 > C_N_CP_BOL
        and N_32 < C_N_CP_TOL
        and MAF > [ IP_MAF_CP_BOL (N_32) - C_MAF_CP_BOL_HYS ]
        and MAF < IP_MAF_CP_TOL (N_32)]
  
```

```

else LV_CP_WIN = // Engine operation window for CP, hom.
  [ N_32 > C_N_CP_BOL
    and N_32 < C_N_CP_TOL
    and MAF > [ IP_MAF_CP_BOL (N_32) + C_MAF_CP_BOL_HYS ]
    and MAF < IP_MAF_CP_TOL (N_32)]
endif
else if LV_CP_WIN = 1
then LV_CP_WIN = // Engine operation window for CP, strat.
  [ N_32 > C_N_2_CP_BOL
    and N_32 < C_N_2_CP_TOL
    and TQI_SP_S > [ IP_TQI_CP_BOL (N_32) - C_TQI_CP_BOL_HYS ]
    and TQI_SP_S < IP_TQI_CP_TOL (N_32)]
else LV_CP_WIN = // Engine operation window for CP, strat.
  [ N_32 > C_N_2_CP_BOL
    and N_32 < C_N_2_CP_TOL
    and TQI_SP_S > [ IP_TQI_CP_BOL (N_32) + C_TQI_CP_BOL_HYS ]
    and TQI_SP_S < IP_TQI_CP_TOL (N_32)]
endif
endif

```

```

LV_CP_CLOSE_REQ =
[ LV_CP_CLOSE_1 // request to close CPS with high speed
or LV_CP_CLOSE_2 // request to close CPS with medium speed
or LV_CP_CLOSE_3 // request to close CPS with normal speed

```

#### Conditions for manual mode:

- Test mode activated  
(LC\_STATE\_CDN\_CP\_MAN = 1)  
// in this case the conditions below are no more checked  
STATE\_CDN\_CP = C\_STATE\_CDN\_CP\_MAN

#### Conditions for immediate switch to NO\_PURGE (without ramp):

- Fuel cut off active  
(LV\_FCUT\_IND = 1) **or**
- Trailing throttle operation started  
(LV\_CP\_PU = 1) **or**
- Prohibition after PUC  
(LV\_CP\_PUC = 1) **or**
- Deactivation due to high engine speed /CPU load  
(LV\_N\_MAX\_CP = 1) **or**
- Difference pressure intake manifold-environment below threshold  
(relevant for supercharger engine or high engine load)  
(PRS\_CPS < C\_PRS\_MAX\_CPS\_2) **or**
- Request for fast closing from appl.inc. module  
(LV\_INH\_CP\_FAST = 1)  
STATE\_CDN\_CP = CDN\_NO\_FAST

#### Conditions for NO\_PURGE:

- (closing of the CPS required)
- Conditions for NO\_FAST are not fulfilled **and**
  - {canister purge manually forced to NO\_PURGE  
(LC\_CP\_INH\_MAN=1) **or**

3. Application incidences flag to inhibit canister purge and switch to NO\_PURGE  
(LV\_INH\_CP=1) or
4. NO\_PURGE locked for a certain time by EVAC control  
(STATE\_LOCK\_CP = NO\_PURGE) or
5. Request to close CPS from OBD2 sequenceur  
(LV\_CP\_CLOSE\_REQ=1) or
6. Difference pressure intake manifold-environment below threshold  
(relevant for supercharger engine)  
(PRS\_CPS < C\_PRS\_MAX\_CPS) or
7. Idle speed active and ambient air temperature below threshold  
(acoustic problems with the CPS at low ambient temperatures)  
[(LV\_IS=1) **and** (TIA\_THR < C\_TIA\_MIN\_CP)] or
8. Combustion commutation and stabilization  
(LV\_CP\_CMU\_CMB=1) or
9. Engine operation point outside CP window and NO\_PURGE selected for this event  
[(LV\_CP\_WIN = 0) **and** (C\_STATE\_WIN\_CP\_NOT = NO\_PURGE)] or
  1. Lambda controller reached limits and no purge state is desired  
[(LV\_LAM\_LIM\_CP = 1) **and** (C\_STATE\_LAM\_LIM\_CP = NO\_PURGE)] or
11. Catalyst purge requests state NoPurge  
[(LV\_CP\_CAT\_PURGE = 1  
and (LC\_CP\_CAT\_PURGE\_OFF = 1 or LV\_CL\_MDL\_END\_CAT\_PURGE = 1)] or  
[LV\_CP\_CAT\_PURGE\_AFL = 1]

STATE\_CDN\_CP = CDN\_NO\_PURGE


#### Conditions for MIN\_PURGE:

1. "hard" conditions for MIN\_PURGE:

The "hard" conditions for MIN\_PURGE force MIN\_PURGE, i.e. no usage of the canister load model is possible.

LV\_CP\_CDN\_MIN\_PURGE\_FAST =

1. {closed loop canister purge ("normal puge") manually deactivated  
(LC\_CP\_CLL\_INH\_MAN=1) or
2. Application incidences flag to inhibit normal purge and switch to MIN\_PURGE  
(LV\_INH\_CP\_CLL=1) or
3. MIN\_PURGE locked for a certain time by EVAC control  
(STATE\_LOCK\_CP = MIN\_PURGE) or
4. Trailing throttle  
(LV\_PU = 1) or
5. Switch for not allowing NORMAL\_PURGE in stratified set  
(LV\_HOM\_ACT=0 **and** LC\_CP\_CLL\_S\_INH=1) or
6. Engine operation point outside CP window and MIN\_PURGE selected for this event  
[(LV\_CP\_WIN = 0) **and** (C\_STATE\_WIN\_CP\_NOT = MIN\_PURGE)] or
7. Catalyst purge requests open loop  
[(LV\_CP\_CAT\_PURGE = 1) **and** (LC\_CP\_CAT\_PURGE\_OPL = 1)]
  1. combination of all conditions for MIN\_PURGE:
    1. Conditions for NO\_FAST are not fulfilled and
    2. Conditions for NO\_PURGE are not fulfilled and
    3. [ Any of the "hard" conditions for MIN\_PURGE is given (LV\_  
CP\_CDN\_MIN\_PURGE\_FAST = 1) or
    4. Lambda control in open-loop state in homogeneous mode  
(LV\_HOM\_ACT=1 **and** LV\_LAM\_LSCL[i] = 0)

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- (at least one bank) **or**
5. Lambda control stopped in homogeneous mode  
(LV\_HOM\_ACT=1 **and** LV\_LAM\_STOP[i] = 1 **and** LV\_LAM\_STOP\_SHO\_PER[i] = 0)  
(at least one bank, both conditions has to be true for one bank) **or**
  6. Lambda controller reached limits and min purge state is desired  
[(LV\_LAM\_LIM\_CP=1) **and** (C\_STATE\_LAM\_LIM\_CP = MIN\_PURGE)]  
STATE\_CDN\_CP = CDN\_MIN\_PURGE

#### Conditions for RAMP\_OPEN:

1. Conditions for NO\_FAST are not fulfilled **and**
2. Conditions for NO\_PURGE are not fulfilled **and**
3. Conditions for MIN\_PURGE are not fulfilled **and**
4. Limited dynamics for canister purge fulfilled  
(LV\_CP\_DYW=1) **and**
5. [ Lambda control in defined limits in homogeneous mode  
(LV\_HOM\_ACT=1 **and** LV\_LAM\_OUT\_CP=0) **or**
6. Lambda setpoint within defined limits in stratified mode  
[LV\_HOM\_ACT=0 **and** (C\_LAMB\_SP\_S\_CP\_BOL < LAMB\_SP\_S < C\_LAMB\_SP\_S\_CP\_TOL ) ]  
**and**
7. Engine operation within CP window (LV\_CP\_WIN = 1)  
STATE\_CDN\_CP = CDN\_RAMP\_OPEN

#### Conditions for RAMP\_OPEN\_FAST :

1. Conditions for NO\_FAST are not fulfilled **and**
  2. Conditions for NO\_PURGE are not fulfilled **and**
  3. Conditions for MIN\_PURGE are not fulfilled **and**
  4. Limited dynamics for canister purge fulfilled  
(LV\_CP\_DYW=1) **and**
  5. [ Lambda control in defined limits in homogeneous mode  
(LV\_HOM\_ACT=1 **and** LV\_LAM\_OUT\_CP=0) **or**
  6. Lambda setpoint within defined limits in stratified mode  
[LV\_HOM\_ACT=0 **and** (C\_LAMB\_SP\_S\_CP\_BOL < LAMB\_SP\_S < C\_LAMB\_SP\_S\_CP\_TOL ) ]  
**and**
- STATE\_CDN\_CP = CDN\_RAMP\_FAST

(the only difference between conditions for RAMP\_OPEN and for RAMP\_OPEN\_FAST is the engine operation window.)


if none of the above conditions are fulfilled

STATE\_CDN\_CP = NO\_CDN

The calculation of STATE\_CDN\_CP is done in the following order:

```


if           Conditions for manual mode fulfilled
then        STATE_CDN_CP = C_STATE_CDN_CP_MAN
elseif      Conditions for NO_FAST fulfilled
then        STATE_CDN_CP = CDN_NO_FAST
elseif      Conditions for NO_PURGE fulfilled
then        STATE_CDN_CP = CDN_NO_PURGE
elseif      Conditions for MIN_PURGE fulfilled
then        STATE_CDN_CP = CDN_MIN_PURGE
elseif      Conditions for RAMP_OPEN fulfilled
then        STATE_CDN_CP = CDN_RAMP_OPEN
elseif      Conditions for RAMP_OPEN_FAST fulfilled
  
```

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```

then      STATE_CDN_CP = CDN_RAMP_FAST
else      STATE_CDN_CP = NO_CDN
endif
end

```

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## 4.59 Multiplexed variable definition

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA_IGC_0_5_H_RNG	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Ignition angle applied on the respective cylinder (0 to 5)					
IGA_KNK_0_5	V	0... 80H	-48 ...0	0.375	°CRK
Spark retard due to knocking combustion of the respective cylinder (0 to 5)					
KNK_THD_0_5	V	0... FFH	0... 4.998	19.5e-3	V
Knock threshold of the respective cylinder (0 to 5)					
KNKS_0_5	V	0... FFFFH	0... 4.99992	76.3e-6	V
Knock control signal of the respective cylinder (0 to 5)					
KNKS_REL_NL_0_5	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
Relative knock value					
NL_0_5	V	0... FFFFH	0... 4.99992	76.3e-6	V
Noise level of the respective cylinder (0 to 5)					
TI_1_HOM_0_5	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, homogeneous mode, first pulse (0 to 5)					
TI_1_S_0_5	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, stratified mode, first pulse (0 to 5)					
TI_2_HOM_0_5	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, homogeneous mode, second pulse (0 to 5)					
TI_2_S_0_5	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, stratified mode, second pulse (0 to 5)					

### Input data:

C_IGA_INI_H_RNG {p. 1829}	C_KNK_THD_MAX {p. 1963}	IGA_IGC_H_RNG [NC_CYL_NR] {p. 1876}	IGA_KNK [NC_CYL_NR] {p. 1960}
KNK_THD [NC_CYL_NR] {p. 1960}	KNKS [NC_CYL_NR] {p. 849}	KNKS_REL_NL [NC_CYL_NR] {p. 849}	NL [NC_CYL_NR] {p. 1962}
TI_1_HOM [NC_CYL_NR] {p. 2002}	TI_1_S [NC_CYL_NR] {p. 2003}	TI_2_HOM [NC_CYL_NR] {p. 2003}	TI_2_S [NC_CYL_NR] {p. 2003}

### FUNCTION DESCRIPTION:


#### General information:

The purpose of introducing multiplexed segment-synchronous variables is to be able to watch several online-values (segment-synchronous) via only one variable during calibration. This way the number of used online-variables can be reduced during measurements while still having the possibility to measure the data of all cylinders.

#### Description:

E.g.: The variable IGA\_0\_5 shows the ignition angle of the currently firing cylinder as online-output-data by writing the different succeeding IGA-values (firing order) into the respective segments of the variable.

#### Application conditions

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**Initialisation:**

```
IGA_IGC_0_5_H_RNG = C_IGA_INI _H_RNG
KNK_THD_0_5 = 5V at reset and engine running to engine stop
IGA_KNK_0_5 initialised as IGA_KNK_x
KNKS_0_5 initialised as KNKS_x
NL_0_5 = C_KNK_THD_MAX at reset or engine running to engine
stop
TI_1/ 2_HOM/ S_0_5 = 0 ms
KNKS_REL_NL_0_5 = initialised as KNKS_REL_NL_x
```

**Recurrence:**

*(update rate) every segment*


**Activation:**

*every engine operating state*

*Deactivation: - - - -*

**Formula section:**

```
IGA_IGC_0_5_H_RNG:      IGA_IGCH_RNG of cylinder x = value segment x
IGA_KNK_0_5:            IGA_KNK of cylinder x = value segment x
KNK_THD_0_5:           KNK_THD of cylinder x = value segment x
KNKS_0_5:              KNKS of cylinder x = value segment x
NL_0_5:                NL of cylinder x = segment x
TI_1_HOM_0_5:          calculated out of TI_1_HOM[NC_CLY_NR]
TI_2_HOM_0_5:          calculated out of TI_2_HOM[NC_CLY_NR]
TI_1_S_0_5:            calculated out of TI_1_S[NC_CLY_NR]
TI_2_S_0_5:            calculated out of TI_2_S[NC_CLY_NR]
KNKS_REL_NL_0_5:      KNKS_REL_NL x = segment x
```

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## 4.60 CAN messages engine management system

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
AC_VEH_LGT_TCS	O/V	8010... 7FF0H	-51.175 ...51.175	0.0015625	m/s**2
Vehicle acceleration longitudinal					
AC_VEH_TRV_TCS	O/V	8010... 7FF0H	-51.175 ...51.175	0.0015625	m/s**2
Vehicle acceleration transversal					
AC_WHEEL_PBR	O/V	10... FFF0H	-51.175 ...51.175	0.0015625	m/s**2
request deceleration wheel torque EMF electromechanic park brake (PBR)					
AMP_CAN	-	0... FEH	598... 1106	2	hPa
AMP (converted for CAN)					
ANG_PSTE	O/V	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW
Steering wheel sensor angle					
BRAKE_PRS	O/V	0... FFH	0... 255	1	bar
Brake pressure					
CC_ID	O/V	0... FFFFH	0... 65535	1	-
Checkcontrol ID					
CKS_CAN_CAS	O/V	0... FH	0... 15	1	-
check sum CAS from CAN					
CKS_CAN_ETCU	O/V	0... FFH	0... 255	1	-
checksum ETCU from CAN					
CKS_CAN_ETCU_3	O/V	0... FFH	0... 255	1	-
check sum ETCU_3 from CAN					
CKS_CAN_LDM	O/V	0... FFH	0... 255	1	-
Checksum LDM from CAN					
CKS_CAN_MSW	O/V	0... FFH	0... 255	1	-
Checksum MSW - SZL					
CKS_CAN_PBR	O/V	0... FFH	0... 255	1	-
checksum PBR from CAN					
CKS_CAN_REQ_PBR	O/V	0... FFH	0... 255	1	-
checksum REQ_PBR from CAN					
CKS_CAN_TQ_AMT	O/V	0... FFH	0... 255	1	-
check sum TQ_AMT from CAN					
CKS_CAN_TQ_DCC	O/V	0... FFH	0... 255	1	-
Checksum TQ_DCC from CAN					
CKS_CAN_TQ_ETCU	O/V	0... FFH	0... 255	1	-
check sum TQ_ETCU from CAN					
CKS_CAN_TQ_PBR	O/V	0... FFH	0... 255	1	-
Checksum AC_WHEEL_PBR					
CKS_CAN_TQ_PSTE_2	O/V	0... FFH	0... 255	1	-
Checksum TQ_PSTE_2 from CAN					
CKS_CAN_TQ_PSTE_3	O/V	0... FFH	0... 255	1	-
Check sum TQ_PSTE_3					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CKS_CAN_TQ_TCS	O/V	0... FFH	0... 255	1	-
check sum traction control system TQ_TCS from CAN					
CKS_CAN_TQ_TCT	O/V	0... FFH	0... 255	1	-
checksum TQ_TCT from CAN					
CKS_CAN_VEH_MOD	O/V	0... FH	0... 15	1	-
check sum VEH_MOD from CAN					
CKS_CLC_CAS	O/V	0... FH	0... 15	1	-
Check sum CAS					
CKS_CLC_ECU1	O/V	0... FFH	0... 255	1	-
Check sum ECU 1					
CKS_CLC_ECU2	O/V	0... FFH	0... 255	1	-
Check sum ECU 2					
CKS_CLC_ECU3	O/V	0... FFH	0... 255	1	-
Check sum ECU 3					
CKS_CLC_ETCU	O/V	0... FFH	0... 255	1	-
Checksum ETCU					
CKS_CLC_ETCU_3	O/V	0... FFH	0... 255	1	-
Checksum ETCU_3					
CKS_CLC_GS_IDC	O/V	0... FFH	0... 255	1	-
Checksum GS_IDC (gear shift indication)					
CKS_CLC_LDM	O/V	0... FFH	0... 255	1	-
Check sum LDM					
CKS_CLC_MSW	O/V	0... FFH	0... 255	1	-
Check sum CRU (SZL)					
CKS_CLC_PBR	O/V	0... FFH	0... 255	1	-
Checksum PBR					
CKS_CLC_REQ_PBR	O/V	0... FFH	0... 255	1	-
Checksum REQ_PBR					
CKS_CLC_TQ_AMT	O/V	0... FFH	0... 255	1	-
Check sum TQ_AMT					
CKS_CLC_TQ_DCC	O/V	0... FFH	0... 255	1	-
Check sum TQ_DCC					
CKS_CLC_TQ_ETCU	O/V	0... FFH	0... 255	1	-
Check sum TQ_ETCU					
CKS_CLC_TQ_PBR	O/V	0... FFH	0... 255	1	-
Check sum AC_WHEEL_PBR					
CKS_CLC_TQ_PSTE_2	O/V	0... FFH	0... 255	1	-
Check sum TQ_PSTE_2					
CKS_CLC_TQ_PSTE_3	O/V	0... FFH	0... 255	1	-
Check sum EHB3 (PSTE 3)					
CKS_CLC_TQ_TCS	O/V	0... FFH	0... 255	1	-
Check sum TQ_TCS					
CKS_CLC_TQ_TCT	O/V	0... FFH	0... 255	1	-
Checksum TQ_TCT					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CKS_CLC_TQ_WHEEL_1	O/V	0... FFH	0... 255	1	-
Check sum TQ_WHEEL_1					
CKS_CLC_TQ_WHEEL_2	O/V	0... FFH	0... 255	1	-
Check sum TQ_WHEEL_2					
CKS_CLC_VEH_MOD	O/V	0... FFH	0... 255	1	-
Check sum VEH_MOD (CAS)					
CTL_SHIFT_LOCK_CAN	O/V	0... 3H	0 ...3	1	-
Control shift-lock					
CTR_DLY_MSG_OIL	V	0... FFH	0... 255	1	-
CTR for delay of oil-message					
CTR_FTL_LE_NOT_VLD	V	0... FFH	0... 255	1	-
Counter for messages with invalid FTL_LE-value					
CTR_FTL_NOT_VLD	V	0... FFH	0... 255	1	-
Counter for messages with invalid FTL-value					
CTR_FTL_RI_NOT_VLD	V	0... FFH	0... 255	1	-
Counter for messages with invalid FTL_RI-value					
CTR_IMOB_RESP_RCV_CAN	O	0... FFH	0... 255	1	-
CAS-response					
CTR_KM_BN	O/V	0... FFFFFFFH	0... 16777215	1	km
vehicle kilometer BN reading from Kombi - for OBD					
CTR_KM_CAN	O/V/S	0... FFFFH	0... 655350	10	km
vehicle kilometer reading from Kombi					
CTR_RST_BOS_RST	O/V	0... FFH	0... 255	1	-
reset BOS service counter reset					
CTR_STATE_ERR_CAN	-	0... FFH	0... 255	1	-
Timeout counter for service message OBD diagnosis					
CTR_TOUT_N_ECF_CAN	O/V	0... FFH	0... 255	1	-
Counter for timeout-detection ext. ECF-request					
CUR_ENG_EFP	O/V	0... FFH	0... 25.5	0.1	A
Engine current of the EFP					
CUR_SC_MAX_CAN	O/V/S	0... FFH	0... 2550	10	A
Maximum short-current (vehicle-specific)					
CUR_SC_MIN_CAN	O/V/S	0... FFH	0... 2550	10	A
Minimum short-current (vehicle-specific)					
CUR_WKU_CAN	O/V/S	0... FFH	0... 0.255	0.001	A
Quiescent-current (vehicle-specific)					
CYC_CTR_CC	O	0... FFH	0... 255	1	-
Checkcontrol counter					
CYC_CTR_CC_SAVE	O	0... FFH	0... 255	1	-
Checkcontrol counter buffer					
dm_ab_fws	O	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Fahrwiderstand (Moment zur Bergkompensation)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ECF_REQ_EXT	V	0... FFH	0... 255	1	-
Ext. ECU (AFS, EPS) requiring ECF speed					
FAC_GB_GAIN	O/V	0... FFFFH	0... 8191.875	0.125	1/m
gearbox-drive-train gain					
FAC_IS_INC_REQ	O/V	0... FFH	0... 255	1	-
Request IS-increase					
FAC_POW_MNG_VST_CNS [15]	O/V/S	0... FFH	0... 255	1	-
Powermanagement Standverbraucher					
FTL	O/V	0... 7FH	0... 127	1	l
Fuel tank level					
FTL_LE	O/V	0... 7FH	0... 127	1	l
Fuel tank level left					
FTL_RI	O/V	0... 7FH	0... 127	1	l
Fuel tank level right					
GEAR_INFO	O/V	0... FH	0... 15	1	-
gear information from EGS-ECU					
HEAT_REQ_PERC	O/V	0... C8H	0... 100	0.5	%
heat-flow request air-conditioning					
IDX_BAT_CAN	O/V/S	0... FFH	0... 255	1	-
implemented battery					
IMOB_RCV_RESP_CAN [_x]	O		-	-	-
CAS-response					
ipm_typ_fp	O	0... FFH	0... 255	1	-
IPM-Fahrertyp zur Beeinflussung der Pedalauswertung					
ipm_typ_mdkw	O	0... FFH	0... 255	1	-
IPM-Fahrertyp zur Beeinflussung der Soll-Momentenbestimmung					
LV_ACCIN	O/V	0... 1H	0 ...1	1	-
logical variable ACC request					
LV_ACIN	O/V	0... 1H	0 ...1	1	-
logical variable ACC readiness					
LV_AMT_ES	O/V	0... 1H	0 ...1	1	-
LV indicating engine stop via CAN					
LV_AMT_LIH_CAN	O/V	0... 1H	0 ...1	1	-
Logical variable AMT intervention limp home					
LV_CC_ID_BENCH	-	0... 1H	0 ...1	1	-
Bit indicating if the sending condition of CC test message true					
LV_CC_ID_TRA	-	0... 1H	0 ...1	1	-
Bit indicating if the sending condition of CC TRA message true					
LV_CC_ID_XX	-	0... 1H	0 ...1	1	-
LV indicating if the sending conditions of CC-messages are true due to present (1) or healed (0) error					
LV_CC_TEST_BENCH_ACT	V	0... 1H	0 ...1	1	-
Checkcontrol test bench active					
LV_CFT_MOD_PBR	O/V	0... 1H	0 ...1	1	-
Bit indicating comfort mode of parking brake (get from CAN)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CS_2	O/V	0... 1H	0 ...1	1	-
Clutch switch 2 information					
LV_CTOP	O/V	0... 1H	0 ...1	1	-
State convertible top: 0 = closed, 1 = open					
LV_DCC_LIH_CAN	O/V	0... 1H	0 ...1	1	-
LV indicating DCC intervention limp home					
LV_DCC_OFF_ACK	O/V	0... 1H	0 ...1	1	-
Acknowledge bit for switch-off DCC					
LV_DCC_PUC_INH	O/V	0... 1H	0 ...1	1	-
inhibition of PUC required by DCC					
LV_DRIV_DOOR_OPEN	O/V	0... 1H	0 ...1	1	-
Driver door open					
LV_ECRAS_CTL_CAN_1	O/V	0... 1H	0 ...1	1	-
ECRAS control via CAN step 1					
LV_ECRAS_CTL_CAN_2	O/V	0... 1H	0 ...1	1	-
ECRAS control via CAN step 2					
LV_EFP_OFF_EXT_ADJ_CAN	O/V	0... 1H	0 ...1	1	-
Switch OFF of EFP via CAN (tester diagnosis)					
LV_EFP_ON_EXT_ADJ_CAN	O/V	0... 1H	0 ...1	1	-
Switch ON of EFP via CAN (tester diagnosis)					
LV_ERR_ANG_PSTE_CAN	O/V	0... 1H	0 ...1	1	-
Interface bit for TQ_LOSS_PSTE calculation in case of error via CAN					
LV_ERR_TQ_LOSS_ARS_AV_CAN	O/V	0... 1H	0 ...1	1	-
interface bit for TQ_LOSS_ARS calculation in case of error via CAN					
LV_ERR_TQ_LOSS_ARS_SP_CAN	O/V	0... 1H	0 ...1	1	-
interface bit for TQ_LOSS_ARS calculation in case of error via CAN					
LV_ERR_VS_CAN	O/V	0... 1H	0 ...1	1	-
Logical variable for VS_CAN error					
LV_ETCU_LIH_CAN	O/V	0... 1H	0 ...1	1	-
logical variable ETCU gear shift intervention limp home					
LV_ETCU_SPT_SWI	O/V	0... 1H	0 ...1	1	-
Sport mode set in gearbox					
LV_FTL_CAN_ERR	O/V	0... 1H	0 ...1	1	-
Logical value erroneous fuel tank level signal					
LV_FTL_LE_CAN_ERR	O/V	0... 1H	0 ...1	1	-
Logical value erroneous fuel tank level (left) signal					
LV_FTL_OBD_INH_L	O/V	0... 1H	0 ...1	1	-
logical variable fuel reserve					
LV_FTL_RI_CAN_ERR	O/V	0... 1H	0 ...1	1	-
Logical value erroneous fuel tank level (right) signal					
LV_FTL_TOT_CAN_ERR	O/V	0... 1H	0 ...1	1	-
logical value erroneous fuel tank level signal total FTL					
LV_GS	O/V	0... 1H	0 ...1	1	-
LV indicating active gear shift (get from transmission)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_GS_IDC_LDM	O/V	0... 1H	0 ...1	1	-
Request gear shift indication for LDM (gear shift down)					
LV_HOOD_OPEN	O/V	0... 1H	0 ...1	1	-
Engine hood open					
LV_INH_GP_SUP	O/V	0... 1H	0 ...1	1	-
Bit indicating inhibition of shift up for gearbox protection (info get from ETCU)					
LV_KEY_AUX	O/V	0... 1H	0 ...1	1	-
status Kl. R					
LV_KEY_VLD	O/V	0... 1H	0 ...1	1	-
Valid key recognized - CAS					
LV_KEY_VLD_MSG_FAILED	O/V	0... 1H	0 ...1	1	-
Valid key message failed - CAS					
LV_LDM_CAN_INI	O/V	0... 1H	0 ...1	1	-
Ini-values sent via CAN					
LV_LDM_LIH_CAN	O/V	0... 1H	0 ...1	1	-
LDM LIH via CAN					
LV_LEVEL_IS	O/V	0... 1H	0 ...1	1	-
Status switch level rpm					
LV_LTG_HDLP_L_ON	O/V	0... 1H	0 ...1	1	-
State low beam: 0 off, 1 on					
LV_LTG_INL_ON	O/V	0... 1H	0 ...1	1	-
State interior lighting: 0 off, 1 on					
LV_MIL_CAN	O/V	0... 1H	0 ...1	1	-
Boolean indicating MIL					
LV_MIL_CAN_1	-	0... 1H	0 ...1	1	-
Auxiliary bit for LV_MIL CC-messages					
LV_MIL_FLL	O/V	0... 1H	0 ...1	1	-
bit for MIL flash light					
LV_MIL_REQ_ETCU	O/V	0... 1H	0 ...1	1	-
Bit indicating MIL request from transmission control unit					
LV_MSG_PROG_STEP_CRU	O/V	0... 1H	0 ...1	1	-
Message of "Programmierung Stufentempomat" received					
LV_N_DISP_DYN	O/V	0... 1H	0 ...1	1	-
Bit indicating request to calculate dynamisation of N for display in ICL (Kombi)					
LV_N_SP_TCT	O/V	0... 1H	0 ...1	1	-
LV indicating valid Target N during TCT-intervention (N-regulation active)					
LV_N_SP_TCT_REQ	O/V	0... 1H	0 ...1	1	-
LV indicating N-regulation requested by DKG					
LV_NO_VECH_REQ	O	0... 1H	0 ...1	1	-
Bit indicating, that service "Anfrage: Fahrgestellnummer" has to be sent					
LV_OBD_SCAN_REQ	V	0... 1H	0 ...1	1	-
Bit indicating that OBD tester is connected and has send request once					
LV_OBD_TAM_RCV	V	0... 1H	0 ...1	1	-
ambient temperature sensor data for OBD received					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_PLAUS_ASR_CTL	O/V	0... 1H	0 ...1	1	-
logical variable for ASR intervention is active					
LV_PLAUS_ESP_CTL	O/V	0... 1H	0 ...1	1	-
logical variable for DSC intervention is active					
LV_POW_CLAS_VEH_CAN_RCV	O/V	0... 1H	0 ...1	1	-
Status vehicle power class received via CAN					
LV_PSTE_2_ERR	O/V	0... 1H	0 ...1	1	-
LV indicating AFS error (sent by AFS via CAN)					
LV_PSTE_3_INTV	O/V	0... 1H	0 ...1	1	-
PSTE 3 (EHB3) torque intervention active					
LV_PUMP_AMT_ON	O/V	0... 1H	0 ...1	1	-
LV indicating status of hydraulic pump - AMT					
LV_REQ_ACK_IGK_OFF	V	0... 1H	0 ...1	1	-
intermediate state for CAN message control of ACK_IGK_OFF					
LV_REQ_HEAT	O/V	0... 1H	0 ...1	1	-
LV increased heater power request					
LV_REQ_PWL_DMTL_SND	O/V	0... 1H	0 ...1	1	-
Bit indicating power latch time for DMTL requested via CAN					
LV_REQ_TCO_L	O/V	0... 1H	0 ...1	1	-
LV requirement for low coolant temperature					
LV_RLY_ST_CAN	O/V	0... 1H	0 ...1	1	-
status starter relay					
LV_SEND_CC_ID_BENCH	-	0... 1H	0 ...1	1	-
Bit indicating sending of CC test message					
LV_SEND_CC_ID_TRA	-	0... 1H	0 ...1	1	-
Bit indicating sending of CC TRA message					
LV_SEND_CC_ID_XX	-	0... 1H	0 ...1	1	-
LV indicating the CC-message which conditions for sending are fulfilled					
LV_STATE_ERR_CAN_ACT	-	0... 1H	0 ...1	1	-
OBD sensor diagnosis message received at least once					
LV_STATE_ERR_CAN_RCV	-	0... 1H	0 ...1	1	-
OBD sensor diagnosis message received cyclic					
LV_STATE_ERR_CAN_TOUT	O/V	0... 1H	0 ...1	1	-
Timeout detected of service message OBD diagnosis					
LV_STATE_TRL	O/V	0... 1H	0 ...1	1	-
State trailer: 0 off, 1 on					
LV_T_REL_CAN_REG	O/V	0... 1H	0 ...1	1	-
T_REL_CAN receiving of INSTR2 message					
LV_TAM_CAN_ERR	O/V	0... 1H	0 ...1	1	-
TAM-failure present					
LV_TCS_CTL_ACT	O/V	0... 1H	0 ...1	1	-
Bit indicating active chassis control functions					
LV_TCS_LIH_CAN	O/V	0... 1H	0 ...1	1	-
logical variable traction control system limp home					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_TCT_ES	O/V	0... 1H	0 ...1	1	-
LV indicating ES requested by DKG					
LV_TCT_LIH_CAN	O/V	0... 1H	0 ...1	1	-
logical variable TCT gear shift intervention limp home					
LV_TQ_AMT_DEC_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable indicating torque decrease due to AMT intervention					
LV_TQ_AMT_INC_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable indicating torque increase due to AMT intervention					
LV_TQ_ASR_REQ	O/V	0... 1H	0 ...1	1	-
logical variable ASR intervention required					
LV_TQ_DCC_INC_REQ	O/V	0... 1H	0 ...1	1	-
LV indicating torque increase required by DCC					
LV_TQ_GS_DEC_REQ	O/V	0... 1H	0 ...1	1	-
LV indicating TQ decrease requested by transmission					
LV_TQ_GS_INC_REQ	O/V	0... 1H	0 ...1	1	-
LV indicating TQ increase requested by transmission					
LV_TQ_MSR_REQ	O/V	0... 1H	0 ...1	1	-
logical variable MSR intervention required					
LV_TQ_PSTE_3_CAN_DI	O/V	0... 1H	0 ...1	1	-
PSTE 3 (EHB3) torque request via CAN disabled					
LV_TQ_PSTE_3_CAN_ENA	O/V	0... 1H	0 ...1	1	-
PSTE 3 (EHB3) torque request via CAN enabled					
LV_TQ_PSTE_3_CAN_LIH	O/V	0... 1H	0 ...1	1	-
PSTE 3 (EHB3) torque request via CAN in limp home					
LV_TQ_WHEEL_LDM_BN_ERR	O/V	0... 1H	0 ...1	1	-
LV indicating torque request by ldm invalid					
LV_TQ_WHEEL_LDM_REQ	O/V	0... 1H	0 ...1	1	-
LDM requested via CAN					
LV_VAR_VEH_MOD	O/V	0... 1H	0 ...1	1	-
auxiliary bit for activation of BN-Diag					
LV_WAL_1_CAN	O/V	0... 1H	0 ...1	1	-
Boolean indicating WAL_1					
LV_WHEEL_CAN_FN_LE_ERR	O/V	0... 1H	0 ...1	1	-
Logical variable for error on CAN wheel front left signal					
LV_WHEEL_CAN_FN_RI_ERR	O/V	0... 1H	0 ...1	1	-
Logical variable for error on CAN wheel front right signal					
LV_WHEEL_CAN_RE_LE_ERR	O/V	0... 1H	0 ...1	1	-
Logical variable for error on CAN wheel rear left signal					
LV_WHEEL_CAN_RE_RI_ERR	O/V	0... 1H	0 ...1	1	-
Logical variable for error on CAN wheel rear right signal					
N_CAN	-	0... 7F80H	0... 8160	0.25	rpm
engine speed ( converted for BN 2000)					
N_ECF	O/V	0... FH	0... 15	1	-
Setpoint step of electric cooling fan speed					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
N_ECF_CAN	O/V	0... FFH	0... 99.60937	0.390625	%
relative desired ECF speed from ext. ECU (AFS, EPS)					
N_ECF_CAN_2	V	0... FFH	0... 99.60937	0.390625	%
relative desired ECF speed from ext. ECU (AFS, EPS)					
N_EFP_AV	O/V	0... FFH	0... 12750	50	rpm
Engine speed of the EFP					
N_GB	O/V	0... FFEH	0... 8191.75	0.125	rpm
Input shaft speed turbine/gearbox (AT)					
N_GB_OUT	O/V	0... FFFFH	-32768 ...32767	1	rpm
Output speed drive train gearbox					
N_MAX_AMT_CAN	O/V	0... 1FE0H	0... 8160	1	rpm
Engine speed limit AMT via CAN					
N_MAX_THD_1_CAN	-	0... FFH	0... 12750	50	rpm
Actual engine speed limit orange engine speed area (converted for CAN)					
N_MAX_THD_2_CAN	-	0... FFH	0... 12750	50	rpm
Actual engine speed limit red engine speed area (converted for CAN)					
N_SP_IS_TCT_CAN	O/V	0... 1FE0H	0... 8160	1	rpm
Target N_SP_IS requested during TCT-intervention					
N_SP_TCT	O/V	0... 1FE0H	0... 8160	1	rpm
Target N during TCT-intervention (N-regulation active)					
NR_VS_CRU_IF	O/V	0... FH	0... 15	1	-
Current vehicle speed step via CAN					
OBD_TAM	O/V	0... FFH	-40 ...215	1	°C
Ambient air temperature SAE J1979					
PV_LDM_REQ_CAN	-	0... 1000H	0... 100	0.0244141	%
pedal value requested from LDM ( converted for BN 2000)					
PV_MAX_CAN	-	0... FEH	0... 99.21875	0.390625	%
maximum selection pedal value ( converted for BN 2000)					
QOIL_DS_RST_CAN_1_5	O/V	8000... 7FFFH	-32768 ...32767	1	-
Restlauleistung_BOS_Rückstellung_1					
QOIL_DS_RST_CAN_2_1	O/V	0... FFH	0... 255	1	-
ID2_BOS_resetting_2					
QOIL_DS_RST_CAN_2_2	O/V	0... FFFFH	0... 65535	1	-
ID_function_BOS_resetting_2					
QOIL_DS_RST_CAN_2_3	O/V	0... FFH	0... 255000	1000	km
Prognose_Intervall_Weg_BOS_Rückstellung_2					
QOIL_DS_RST_CAN_2_4	O/V	0... FFH	0... 255	1	-
Zieltermin_Monat_BOS_Rückstellung_2					
QOIL_DS_RST_CAN_2_5	O/V	0... FFH	0... 255	1	-
Zieltermin_Jahr_BOS_Rückstellung_2					
QOIL_DS_RST_CAN_2_6	O/V	0... FFH	0... 255	1	-
Prognose_Intervall_Zeit_BOS_Rückstellung_2					
STATE_ACIN_CAN	O/V	0... 7H	0 ...7	1	-
state air-conditioning request signal CAN					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_ACK_IGK_OFF	O/V	0... 3H	0 ...3	1	-
Ignition off request from CAS acknowledged					
STATE_AMT	O/V	0H 1H 2H 3H 7H	NO_INTERV TORQUE_DEC N_REGUL TORQUE_INC INVALID_ SIGNAL	-	-
Status shift-process AMT via CAN					
STATE_AMT_INTV	O/V	0H 1H 2H 3H	NO_INTV TQ_INC TQ_DEC LOCKED	-	-
status torque target AMT via CAN					
STATE_AMT_OBD	O/V	0H 2H 4H 6H 8H AH CH EH FH	MIL_OFF MIL_OFF MIL_ON MIL_ON MIL_FLL MIL_FLL IDLE INI_VALUE INVALID_ SIGNAL	-	-
Status OBD gearbox					
STATE_AMT_OBD_ERR	O/V	0H 1H 2H	NO_OBD_ ERROR OBD_ERROR INVALID_ SIGNAL	-	-
Status OBD-relevant error - AMT					
STATE_ARS_CAN	O/V	0H 1H 3H	INACTIVE ACTIVE INVALID_ SIGNAL	-	-
status anti roll stabilization via CAN					
STATE_AVL_BOS_RST	O/V	0... FFH	0... 255	1	-
availability_BOS_resetting					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_BN_MSW	O/V	0H	NO_ACTION	-	-
		1H	TIP_PRE		
		2H	PRESS_PRE		
		4H	TIP_POST		
		8H	PRESS_POST		
		10H	TIP_UP_		
			DOWN		
		40H	TIP_AXIAL		
		41H	TIP_AXIAL		
		42H	TIP_AXIAL		
44H	TIP_POST				
48H	PRESS_POST				
50H	TIP_UP_				
	DOWN				
7FH	INVALID_				
		SIGNAL			
Status MSW BN (CAN)					
STATE_BRAKE_PRS	O/V	0... 3H	0 ...3	1	-
status brake pressure via CAN					
STATE_CC	O/V	0H	OPEN	-	-
		1H	CONTROLLED		
		2H	CLOSED		
		3H	NOT_DEFINED		
State of converter clutch (CC)					
STATE_CC_KEY	V	0... FH	0... 15	1	-
CC-message transmission-condition ID xx					
STATE_CC_TEST_BENCH_OBD_1	-	0... FFH	0... 255	1	-
Bit coded readiness 1 for CC test bench					
STATE_CC_TEST_BENCH_OBD_2	-	0... FFH	0... 255	1	-
Bit coded readiness 2 for CC test bench					
STATE_CLU_AMT	O/V	0H	CLU_OPEN	-	-
		1H	CREEPING		
		2H	DRIVE_OFF		
		3H	CLU_CLOSED		
		7H	INVALID_		
		SIGNAL			
Status shift-process AMT via CAN					
STATE_CRU_BN	V	0... 7H	0 ...7	1	-
Status of Cruise Control for BN-CAN					
STATE_CUS_LDM_CAN	O/V	0... FFFFH	0... 65535	1	-
auxiliary state for LDM test required by customer					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_DCC	O/V	0H	INACTIVE	-	-
		1H	STAND_BY		
		2H	NORMAL		
		3H	RESERVE		
		4H	BRAKE_		
		5H	ACTIVE		
		6H	DRIVER_		
7H	ACTIVE				
RESERVE					
INVALID_					
SIGNAL					
Status DCC					
STATE_DCC_CTL	O/V	0... 7H	0 ...7	1	-
Status DCC control					
STATE_DCC_INTV	O/V	0H	NO_INTER-	-	-
		1H	VENTION		
		2H	TORQUE_		
		3H	INCREASE		
INVALID_					
SIGNAL					
INVALID_					
SIGNAL					
status torque target DCC via CAN interface					
STATE_DCC_OFF_REQ	O/V	0H	RESERVED	-	-
		1H	SYS_OFF		
		2H	SYS_OK		
		3H	INVALID_		
SIGNAL					
status switch-off DCC					
STATE_DCC_PUC_INH	O/V	0H	NO_REQUEST	-	-
		1H	INHIBIT_PUC		
		3H	INVALID_		
SIGNAL					
status request PUC-inhibition via CAN interface - DCC					
STATE_DHL_CTL	O/V	0... FH	0... 15	1	-
status of hill descent control function					
STATE_DI_PUC	O/V	0H	NO_REQUEST	-	-
		1H	DISABLE_PUC		
		3H	INVALID_		
SIGNAL					
state disable pull cut off					


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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_DIAG_EFP	O/V	0... FFH	0... 255	1	-
Diagnosis state of the CAN-EFP					
STATE_EFP_CAN	O/V	0... 3H	0 ...3	1	-
EFP - state for EOL and ASA diagnosis					
STATE_EFP_CRASH_CAN	O/V	0... 3H	0 ...3	1	-
Request for switch off fuel pump after crash					
STATE_EFP_CTL	O/V	0... 3H	0 ...3	1	-
State which EFP-control is active					
STATE_EFP_CTL_ECU	O/V	0... FFH	0... 255	1	-
State EFP-control CAN					
STATE_ERR_SYM_FTL_LE_CAN	O/V	0H 1H 2H 4H	NO_SYM SCP SCG OL	-	-
Error symptom for left fuel tank level sensor get via CAN					
STATE_ERR_SYM_FTL_RI_CAN	O/V	0H 1H 2H 4H	NO_SYM SCP SCG OL	-	-
Error symptom for right fuel tank level sensor get via CAN					
STATE_ERR_SYM_TAM_CAN	O/V	0H 1H 2H 4H	NO_SYM SCP SCG OL	-	-
Error symptom for TAM sensor get via CAN					
STATE_ETCU_CLU	O/V	0H 1H 2H 3H 4H 5H 6H 7HH	CLU_OPEN CREEPING DRIVE_OFF CLU_CLOSED CTL_SLIP DRIVE_ DYNAMIC UNUSED INVALID_ SIGNAL	-	-
State gearbox for starting-clutch					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_ETCU_INTV	O/V	0H 1H 2H 3H	NO_INTV TQ_INC TQ_DEC LOCKED	-	-
status torque target ETCU system via CAN					
STATE_ETCU_OBD	O/V	0H 2H 4H 6H 8H AH CH EH FH	MIL_OFF MIL_OFF MIL_ON MIL_ON MIL_FLL MIL_FLL IDLE INI_VALUE INVALID_ SIGNAL	-	-
status OBD gearbox					
STATE_ETCU_OBD_ERR	O/V	0H 1H 2H	NO_OBD_ ERROR OBD_ERROR INVALID_ SIGNAL	-	-
state OBD error					
STATE_ETCU_PROG_INFO	O/V	0... FH	0... 15	1	-
State mode ETCU					
STATE_ETCU_SPT_SWI	O/V	0... 3H	0 ...3	1	-
Status if gearbox has built in sport switch					
STATE_EXT_POW_CNS	O/V	0... C8H	0... 100	0.5	%
State power consumption (Sonderverbraucher)					
STATE_GAP_MSW	-	0... 3H	0 ...3	1	-
Status MSW BN (CAN)					
STATE_GEAR_REV_CAN	O/V	0... 1H	0 ...1	1	-
State reverse gear: 0 inactive, 1 active					
STATE_HLD_PBR	O/V	0... 3H	0 ...3	1	-
State of holding vehicle with parking brake (get from CAN)					
STATE_ID_FCT_BOS_RST	O/V	0... FFFFH	0... 65535	1	-
ID_function_BOS_resetting					
STATE_ID2_BOS_RST	O/V	0... FFH	0... 255	1	-
ID2_BOS_resetting					
STATE_IF_ICL_BN_MSW	O/V	0... 7H	0 ...7	1	-
status interface ICL/cruise control					
STATE_IGK_CAN	O/V	0H 1H 2H	IGK_OFF IGK_ON INVALID_ SIGNAL	-	-
status ignition key via CAN					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_IGK_HW	O/V	0... 3H	0 ...3	1	-
status ignition key (HW) via CAN					
STATE_LDM	O/V	0... FH	0... 15	1	-
state ldm					
STATE_LDM_INTV	O/V	0... 3H	0 ...3	1	-
state ldm					
STATE_MAX_AC_ST	O/V	0H 1H 2H 3HH	NO_RACE_ST RACE_ST_ ACT RACE_ST_ PREP INVALID_ SIGNAL	-	-
Status of race start (maximum acceleration at start)					
STATE_MOD_GB	O/V	0H 1H 2H 3H 7H	SSC_SBC_ OFF SSC_ON SBC_ON SSC_SBC_ON INVALID_ SIGNAL	-	-
State mode gearbox : SSC (Sleeping Starter Clutch), SBC (Stand By Control)					
STATE_OBD_CYC_BN	O/V	0... 3FH	0... 63	1	-
OBD cycle state new definition					
STATE_PBR	O/V	0... FH	0... 15	1	-
State of the parking brake (get from CAN)					
STATE_PBR_ACT	O/V	0... FH	0... 15	1	-
Status actuator EMF (electromechanic park brake PBR)					
STATE_PBR_ACT_QLY	O/V	0... FH	0... 15	1	-
Qualifier Status actuator EMF (electromechanic park brake PBR)					
STATE_POW_CLAS_VEH	O/V	0... 3H	0 ...3	1	-
status vehicle power class via CAN					
STATE_PSTE_2_INTV	O/V	0H 1H 2H 3H	NO_INTV TQ_INC TQ_DEC INVALID_ SIGNAL	-	-
status torque target PSTE_2 via CAN interface					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_PSTE_3_ERR	O/V	0H 1H 2H 3H 4H 5H 6H 7HH	NO_ERROR NO_SENSOR SENSOR_ ERROR SENSOR_ AND_MODEL_ ERROR SENSOR_ ERROR_TEMP SENSOR_ AND_MODEL_ ERROR_TEMP NOT_USED SIGNAL_ INVALID	-	-
Error state of PSTE 3 (EHB3)					
STATE_PSTE_3_INTV	O/V	0H 1H 2H 3HH	RESERVED NO_INTER- VENTION INTERVEN- TION_ACTIVE INVALID_SIG- NAL	-	-
state of PSTE 3 (EHB3) torque intervention					
STATE_PSTE_3_SRC	O/V	0H 1H 2H 3H 4HH	NORMAL_ STEERING AFS EPS RESERVED INVALID_ SIGNAL	-	-
Source of torque request due to steering					
STATE_SENS_ANG_PSTE	O/V	0... 7H	0 ...7	1	-
Status of steering wheel sensor					
STATE_SP_DYN_WHEEL	O/V	0... FFH	0... 255	1	-
state follow dynamic					
STATE_SPT_SWI	O/V	0... 3H	0 ...3	1	-
State of sport switch					
STATE_ST_TQ_LIM_AMT	O/V	0H 1H 3H	NO_INTV INTV INVALID_ SIGNAL	-	-
State starting torque limitation AMT					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_ST_TQ_LIM_GS	O/V	0H 1H 3H	NO_INTV INTV INVALID_ SIGNAL	-	-
State starting torque limitation					
STATE_SWL_OFF_VB	O/V	0... 3H	0 ...3	1	-
state switch off battery voltage (kl30)					
STATE_TCS_CAN	O/V	0H 1H 2H 4H 6H 7H	VALID PASSIVE DEFECT TRACTION_ MODE UNDERVOLTAGE INVALID_ SIGNAL	-	-
status traction control system via CAN					
STATE_TCS_CTL	O/V	0H 1H 2H 4H 8H 10H 20H 40H FEH FFHH	NO_CONTROL ABS_ CONTROL ASR_ CONTROL TCS_ CONTROL HBA_ CONTROL MSR_ CONTROL EBV_ CONTROL DYNO_ACTIVE MULTI_ CONTROL SIGNAL_ INVALID	-	-
status closed-loop-control via CAN					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_TCS_DECE	O/V	0H	NO_INTV	-	-
		1H	DCC_INTV_OK		
		2H	EMF_INTV_OK		
		3H	HBA_INTV_OK		
		15H	INVALID_ SIGNAL		
status deceleration (actual value) via CAN					
STATE_TCS_INTV	O/V	0H	NO_INTV	-	-
		1H	MSR_INTV		
		2H	ASR_INTV		
		3H	INTERFACE_ LOCKED		
status traction control system via CAN					
STATE_TCT_INTV	O/V	0H	NO_INTV	-	-
		2H	CREEP TCT_ INTV_DEC		
		3H	TCT_INTV_INC		
		4H	N_ REGULATION		
		6H	TQ_DEC		
		CH	TCT_ES		
		FHH	INVALID		
status torque target TCT system via CAN					
STATE_TEMP_GB	O/V	0H	NO_REQUEST	-	-
		1H	ACTIVE_ STEP_1		
		2H	ACTIVE_ STEP_2		
		3H	INVALID_ SIGNAL		
State overtemperature gearbox (AT) - request for cooling (overheating protection) via ECT/ECF					
STATE_TQ_WHEEL_PBR_QLY	O/V	0... FH	0... 15	1	-
Qualifier Status actuator EMF (electromechanic park brake PBR)					
STATE_VEH_CNS [10]	O/V	0... FFH	0... 255	1	-
State vehicle consumer (Verbraucherstatus)					
STATE_VEH_CNS_FCT	O/V	0... 3H	0 ...3	1	-
State functionality of vehicle consumer					
STATE_VEH_MOD	O/V	0... FH	0... 15	1	-
vehicle mode					
STATE_VS_ICL_DISP	O/V	0H	KM/H	-	-
		1H	MPH		
		3H	INVALID_ SIGNAL		
status scaling of speedometer (displayed vehicle speed)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_WAL_CAN	V	0H 1H 2H 3H	OFF YELLOW INVALID_ SIGNAL INVALID_ SIGNAL	-	-
logical variable fuel reserve					
T_CAN	O/V	0... FFFFH	0... 65535	1	d
day counter absolute (counts the days at sufficient mains voltage )					
T_CLK_ICL_DISP_1	O/V	0... FFH	0... 255	1	-
Display of date (day)					
T_CLK_ICL_DISP_2	O/V	0... FFH	0... 255	1	-
Display of date (month)					
T_CLK_ICL_DISP_3	O/V	0... FFFFH	0... 65535	1	-
Display of date (year)					
T_CTR_REL_CAN	V	0... FFFFFFFFH	0... 4294967295	1	s
relative time counter (reset at Kl. 30 OFF), E65					
T_CTR_SWI_OFF_VB	O/V	0... FFH	0... 255	1	s
shutdown counter battery-main-switch					
T_ERR_N_ENG	V	0... FFH	0... 2.55	0.01	s
Timer for sending RPM_ENG_ERR true or false without debounced CRK error					
T_INH_ACK_IGK_OFF	V	0... FFH	0... 2.55	0.01	s
Timer for recognition if ignition off acknowledge is allowed					
T_REL_CAN	O/V	0... FFFFFFFFH	0... 4294967295	1	min
Relative time counter					
T_REL_CAN_2	O/V	0... FFFFFFFFH	0... 4294967295	1	s
Relative time counter, resolution in seconds					
TAM	O/V	0... FEH	-48... 142.5	0.75	°C
Ambient temperature					
TCC_CAN_ARS	O/V	0... EH	0... 14	1	-
free running test cycle counter ARS (alive counter)					
TCC_CAN_CAS	O/V	0... EH	0... 14	1	-
free running test cycle counter CAS (alive counter)					
TCC_CAN_DISP_ECU	V	0... EH	0... 14	1	-
free running test cycle counter					
TCC_CAN_ECU	V	0... EH	0... 14	1	-
free running test cycle counter ECU1 (alive counter)					
TCC_CAN_ECU1	V	0... EH	0... 14	1	-
free running test cycle counter ECU1 (alive counter)					
TCC_CAN_ECU2	V	0... EH	0... 14	1	-
free running test cycle counter ECU2 (alive counter)					
TCC_CAN_ECU3	V	0... EH	0... 14	1	-
free running test cycle counter ECU3 (alive counter)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TCC_CAN_ETCU	O/V	0... FH	0... 15	1	-
free running test cycle counter ETCU (alive counter)					
TCC_CAN_ETCU_3	O/V	0... FH	0... 15	1	-
free running test cycle counter ETCU_3 (alive counter)					
TCC_CAN_GS_IDC	V	0... EH	0... 14	1	-
free running test cycle counter					
TCC_CAN_ICL	O/V	0... EH	0... 14	1	-
free running test cycle counter instrument cluster (alive counter)					
TCC_CAN_LDM	O/V	0... FH	0... 15	1	-
free running test cycle counter TQ_DCC (alive counter)					
TCC_CAN_MSW	O/V	0... EH	0... 14	1	-
Alive counter MSW - SZL					
TCC_CAN_PBR	O/V	0... FH	0... 15	1	-
free running test cycle counter PBR (alive counter)					
TCC_CAN_REQ_PBR	O/V	0... FH	0... 15	1	-
free running test cycle counter REQ_PBR (alive counter)					
TCC_CAN_TQ_AMT	O/V	0... EH	0... 14	1	-
free running test cycle counter TQ_AMT (alive counter)					
TCC_CAN_TQ_DCC	O/V	0... EH	0... 14	1	-
free running test cycle counter TQ_DCC (alive counter)					
TCC_CAN_TQ_ETCU	O/V	0... EH	0... 14	1	-
free running test cycle counter TQ_ETCU (alive counter)					
TCC_CAN_TQ_PBR	V	0... EH	0... 14	1	-
Alive counter TQ_PBR					
TCC_CAN_TQ_PSTE_2	O/V	0... EH	0... 14	1	-
free running test cycle counter TQ_PSTE_2 (alive counter)					
TCC_CAN_TQ_PSTE_3	V	0... EH	0... 14	1	-
free running test cycle counter PSTE_3 (alive counter)					
TCC_CAN_TQ_TCS	O/V	0... EH	0... 14	1	-
free running test cycle counter TQ_TCS (alive counter)					
TCC_CAN_TQ_TCT	O/V	0... FH	0... 15	1	-
free running test cycle counter TQ_TCT (alive counter)					
TCC_CAN_VEH_MOD	O/V	0... EH	0... 14	1	-
free running test cycle counter VEH_MOD (alive counter)					
TEMP_GB	O/V	0... FFH	-40 ...215	1	°C
Temperature gearbox (AT) - request for cooling (overheating protection) via ECF					
TOIL_CAN	-	0... FFH	-48 ...207	1	°C
Oil temperature ( converted for BN 2000)					
TQ_ACCIN_CAN	O/V	0... FFH	0... 127.5	0.5	Nm
ACC-torque from CAN					
TQ_AMT_FAST_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque target (fast) for AMT via CAN interface					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_AMT_SLOW_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque target (slow) for AMT via CAN interface					
TQ_CONV_CAN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
converter torque from ETCU					
TQ_DCC_FAST_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque target (fast) for DCC via CAN interface					
TQ_DCC_SLOW_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque target (slow) for DCC via CAN interface					
TQ_EMS_BN	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
actual engine torque - driver s choice (converted for BN)					
TQ_GS_FAST_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque target (fast) for GS via CAN interface					
TQ_GS_SLOW_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque target (slow) for GS via CAN interface					
TQ_LOSS_ARS_AV_CAN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque loss actual value ARS from CAN					
TQ_LOSS_ARS_SP_CAN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque loss setpoint ARS from CAN					
TQ_LOSS_PSTE_2_AV_CAN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque loss actual value PSTE_2 from CAN					
TQ_LOSS_PSTE_2_SP_CAN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque loss setpoint PSTE_2 from CAN					
TQ_LOSS_PSTE_3_AV_CAN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
actual torque value for steering					
TQ_LOSS_PSTE_3_SP_CAN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
setpoint torque value for steering					
TQ_MAF	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
actual engine torque - spare, positive					
TQ_MAX_ACC_CAN	V	0... FFH	0... 127.5	0.5	Nm
air-conditioning-compressor limited torque after switch on					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_TCS_FAST_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque target (fast) due to TCS via CAN					
TQ_TCS_SLOW_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque target (slow) due to TCS via CAN					
TQ_TCT_CAN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque clutch for TCT via CAN interface					
TQ_WHEEL_LDM_BN	O/V	8000... 7FFFH	-32768 ...32767	1	Nm
Torque request by ldm					
TQI_MAF	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Indicated engine torque after charging interventions (converted for CAN)					
V_ENG_EFP	O/V	0... FFH	5... 30.5	0.1	V
Engine voltage of the EFP					
V_GEN_TAR	O/V	0... FFH	10.6... 16.975	0.025	V
target generator voltage					
VB_EFP	O/V	0... FFH	5... 30.5	0.1	V
VB measured by EFP					
VEH_KEY_NR	O/V	0... FH	0... 15	1	-
vehicle key number					
VEL_ANG_PSTE	O/V	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
Steering wheel sensor velocity					
VIN_CAN [NC_VIN_CAN_LEN]	O/V	0	ASCII	1	-
VIN received on CAN from CAS ( ASCII coded string )					
VIN_CAN [NC_VIN_CAN_LEN]	O/V	0	ASCII	1	-
VIN received over CAN					
VS_CAN	O/V	0... FFH	0... 255	1	km/h
Vehicle speed signal from CAN					
VS_ICL_DISP	O/V	0... FFEH	0... 409.4	0.1	km/h
displayed vehicle speed (speedometer)					
VS_MAX_LIH_TCT	O/V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed limitation from TCT gear box in case of limp home					
VS_STEP_IF_1	O/V	0... FFEH	0... 409.4	0.1	km/h
Vehicle speed step from CAN					
VS_STEP_IF_2	O/V	0... FFEH	0... 409.4	0.1	km/h
Vehicle speed step from CAN					
VS_STEP_IF_3	O/V	0... FFEH	0... 409.4	0.1	km/h
Vehicle speed step from CAN					
WHEEL	O/V	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed signal from CAN for cruise control					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
WHEEL_CAN_FN_LE	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	km/h
Wheel speed front left via CAN					
WHEEL_CAN_FN_RI	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	km/h
Wheel speed front right via CAN					
WHEEL_CAN_RE_LE	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	km/h
Wheel speed rear left via CAN					
WHEEL_CAN_RE_RI	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	km/h
Wheel speed rear right via CAN					

**Input data:**

AMP {p. 982}	B_ccbfnach {p. 8342}	B_ccbttdfk {p. 8342}	B_ccpmerr {p. 8342}
B_ccprio {p. 8342}	B_ccruhver {p. 8342}	B_notafu {p. 8345}	B_poel_gelb {p. 8346}
Bostoken {p. 8155}	C_T_DMTL_MAX {p. 5974}	CONF_SOF_SWI {p. 654}	CONF_SWI_EFP_OUT {p. 654}
CTR_CDN_OBD_RBM {p. 5858}	CTR_ERR_DYN_NR {p. 5767}	CUR_GEN {p. 8368}	CUR_RNG_CTL {p. 8285}
DIST {p. 1183}	DIST_RESI_OIL {p. 8202}	DIST_RESI_OIL_KM {p. 8202}	ECU_STATE {p. 1091}
EFF_IGA_AV_CAN {p. 1845}	EFF_IGA_BAS_COR {p. 1845}	EFF_LAMB_AV {p. 8379}	EFF_LAMB_BAS_COR {p. 8379}
EFF_SCC_AV_CAN {p. 6665}	EFPPWM_CAN {p. 988}	ERR_SYM_BN_ARS {p. 4860}	ERR_SYM_BN_TQ_DCC {p. 4864}
ERR_SYM_BN_TQ_ETCU {p. 4864}	ERR_SYM_BN_TQ_TCS {p. 4865}	ERR_SYM_BN_TQ_TCT {p. 4865}	ERR_SYM_FTL_LE_CAN {p. 4745}
ERR_SYM_FTL_RI_CAN {p. 4745}	FCO {p. 3846}	GS_IDC_DISP {p. 1298}	GS_IDC_GEAR {p. 1298}
Id_bosrtak {p. 8159}	idbosmsg {p. 8202}	idfbosmg_w {p. 8286}	IMOB_TRM_CHAL [x]
LC_ETCU_FRF {p. 5010}	LC_IGK_OFF_ACK {p. 3772}	LOAD_CLC {p. 5801}	LV_ACCOUT_RLY {p. 3589}
LV_ACT_MIL_EXT_ADJ {p. 7432}	LV_ACT_N_SP_IS_EXT_ ADJ {p. 7763}	LV_ACT_WAL_1_EXT_ADJ {p. 7433}	LV_AT {p. 654}
LV_CAN_SND_MSG_ PWR_MNG_0 {p. 8286}	LV_CAN_SND_MSG_ PWR_MNG_1 {p. 8286}	LV_CHK_FUC_OPEN_CAN {p. 5918}	LV_CRU_ACT_INH {p. 7227}
LV_CRU_DISP_HUD {p. 7201}	LV_CRU_MAIN_SWI {p. 7220}	LV_CRU_OFF_IRR {p. 7227}	LV_DC_PERM {p. 5746}
LV_DC_RBM {p. 5858}	LV_DCC_OFF_ECU {p. 5051}	LV_ERR_ACK_IGK_OFF {p. 4939}	LV_ERR_AMP {p. 4822}
LV_ERR_BLS_PLAUS {p. 4209}	LV_ERR_BN_ARS {p. 4869}	LV_ERR_BN_CDN_DOOR {p. 4869}	LV_ERR_BN_DHL_CTL {p. 4869}
LV_ERR_BN_EFP {p. 4869}	LV_ERR_BN_ETCU_2 {p. 4870}	LV_ERR_BN_ETCU_3 {p. 4870}	LV_ERR_BN_GEAR_REV {p. 4870}
LV_ERR_BN_LTG_HDLP_ L {p. 4870}	LV_ERR_BN_PBR {p. 4870}	LV_ERR_BN_REQ_PBR {p. 4870}	LV_ERR_BN_STAT_TCT {p. 4870}

LV_ERR_BN_T_CLK {p. 4870}	LV_ERR_BN_TQ_DCC {p. 4870}	LV_ERR_BN_TQ_ETCU {p. 4871}	LV_ERR_BN_TQ_PBR {p. 4871}
LV_ERR_BN_TQ_PSTE_3 {p. 4871}	LV_ERR_BN_TQ_TCS {p. 4871}	LV_ERR_BN_TQ_TCT {p. 4871}	LV_ERR_BN_TRL {p. 4871}
LV_ERR_BN_WHEEL_ CAN {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_CRK {p. 4455}	LV_ERR_EGY_MIN_2 {p. 4926}
LV_ERR_FTL_LE_CAN {p. 4745}	LV_ERR_FTL_RI_CAN {p. 4745}	LV_ERR_LDM_INH_MON {p. 6983}	LV_ERR_QOIL_SENS {p. 1062}
LV_ERR_STST {p. 8220}	LV_ERR_TAM_PLAUS {p. 5076}	LV_ERR_TCO {p. 4496}	LV_ERR_TOUT_ICL_7 {p. 802}
LV_ERR_VS {p. 5021}	LV_ES {p. 1720}	LV_FUC_CAN {p. 5966}	LV_GS_DOWN {p. 8286}
LV_GS_UP {p. 8286}	LV_IGK {p. 906}	LV_IM_BLS {p. 852}	LV_IM_BTS {p. 852}
LV_IM_CS_PN {p. 852}	LV_INH_STST_CDN {p. 8286}	LV_IS {p. 1720}	LV_KD {p. 1269}
LV_LDM_OFF_ECU {p. 5054}	LV_LIH_COC_ON {p. 8225}	LV_MIL {p. 5827}	LV_MIL_ACT_REQ {p. 5840}
LV_MIL_EXT_ADJ	LV_MIS_STATE_A {p. 6238}	LV_OBD_SCAN_REQ {p. 1566}	LV_OIL_CNS_WARN_1 {p. 8286}
LV_OIL_CNS_WARN_2 {p. 8287}	LV_POIL_SWI {p. 903}	LV_POW_CLAS_VEH_ CAN_REQ {p. 4945}	LV_PROG_STEP_1 {p. 7201}
LV_PUC {p. 1720}	LV_REQ_PWL_DMTL {p. 5967}	LV_ST {p. 1720}	LV_ST_END {p. 1720}
LV_STEP_ON_ICL {p. 7201}	LV_STST_ST_REQ_CUS {p. 8220}	LV_TEMP_ENG_WARN_1 {p. 8225}	LV_TEMP_ENG_WARN_2 {p. 8225}
LV_TEMP_ENG_WARN_3 {p. 8225}	LV_TQ_MAX_ARS {p. 6650}	LV_VAR_AMT {p. 655}	LV_VAR_ARS {p. 655}
LV_VAR_ASR {p. 655}	LV_VAR_BN_EFP {p. 655}	LV_VAR_DCC {p. 655}	LV_VAR_ECRAS_DOWN {p. 4515}
LV_VAR_ECRAS_UP {p. 655}	LV_VAR_ETCU {p. 655}	LV_VAR_ETCU_3 {p. 655}	LV_VAR_ICL {p. 656}
LV_VAR_PBR {p. 656}	LV_VAR_STST {p. 805}	LV_VAR_TCT {p. 656}	LV_VAR_TQ_PBR {p. 656}
LV_VAR_VEH {p. 656}	LV_VS_RUN {p. 1176}	LV_WAL_1 {p. 5827}	LV_WAL_1_EXT_ADJ {p. 7435}
LV_WAL_ST {p. 5827}	LV_WUP {p. 1775}	LV_WUP_CAN {p. 1766}	Md_rad_ksoll {p. 8160}
N_32 {p. 1525}	N_DISP_DYN {p. 8287}	N_MAX_THD_1 {p. 1148}	N_MAX_THD_2 {p. 1148}
N_REL_CWP {p. 4095}	N_SP_IS {p. 1122}	N_ST_POW_MOD {p. 8368}	NR_VS_CRU {p. 7201}
OBD_TPS_1 {p. 5801}	OPM_AV {p. 8137}	POW_CTL_PARK_CNS {p. 8288}	POW_CTL_PRI_PEAK_ RED {p. 8288}
POW_CTL_PRI_PEAK_ RED_CFT {p. 8288}	POW_CTL_PWR_CNS_1 {p. 8288}	POW_CTL_PWR_CNS_2 {p. 8288}	POW_REL_ALTER_CLC {p. 8368}




PV_AV {p. 1269}	PV_MAX {p. 1269}	PWM_VALUE_HIV_PERC {p. 807}	QOIL_DS_CAN_2_1 {p. 8203}
QOIL_DS_CAN_2_2 {p. 8203}	QOIL_DS_CAN_2_3 {p. 8203}	QOIL_DS_CAN_2_4 {p. 8203}	QOIL_DS_CAN_2_5 {p. 8203}
QOIL_DS_CAN_2_6 {p. 8203}	Qv_out_m {p. 8166}	Qv_quali_m {p. 8167}	Qv_td1 {p. 8167}
Qvc_status_3 {p. 8167}	Qvc_status_4 {p. 8167}	rqpcos {p. 8288}	selspcos {p. 8288}
SF_TQD {p. 6741}	st_ldstgen {p. 8289}	STATE_ALTER {p. 8368}	STATE_COC {p. 8225}
STATE_CRU {p. 7227}	STATE_CRU_CAN {p. 7227}	STATE_CUR_ENG_CNS {p. 8369}	STATE_CUT_OFF_DT {p. 807}
STATE_DIAG_GS {p. 5010}	STATE_ENGG_POS {p. 8289}	STATE_INI_DT {p. 808}	STATE_LOIL {p. 8203}
STATE_MIL {p. 5827}	STATE_MIL_ON_DIS_ EXT_REQ {p. 7683}	STATE_N_MAX_THD_LIH {p. 1148}	STATE_OIL_AVL {p. 8203}
STATE_OIL_REQ {p. 8203}	STATE_READY_OBD_1 {p. 5881}	STATE_READY_OBD_2 {p. 5881}	STATE_SPT_DISP_CAN {p. 8289}
STATE_SPT_ECU_CAN {p. 8290}	STATE_SPT_ESP_CAN {p. 8290}	STATE_SPT_MOD_GB {p. 8290}	STATE_SPT_STEP_GB {p. 8290}
STATE_TQ_DCC {p. 6737}	STATE_TQ_LDM {p. 6737}	STATE_TQ_WHEEL {p. 8290}	stpcos {p. 8290}
T_PWL {p. 3776}	T_WAKE_UP_ON {p. 906}	TCO {p. 1100}	TIA {p. 1226}
TOIL {p. 8204}	TQ_ASR_FAST_DEC_BN {p. 1710}	TQ_AV {p. 6656}	TQ_ECU_ETCU {p. 8290}
TQ_LOSS {p. 8385}	TQ_MAX_ACC {p. 8290}	TQ_MAX_CLU {p. 8380}	TQ_MAX_WHEEL {p. 8290}
TQ_MIN_WHEEL_L {p. 8290}	TQ_WHEEL {p. 8291}	TQI_DCC_FAST_INC {p. 6731}	TQI_EMS {p. 8391}
TQI_REF_IGA_MIN_LAMB {p. 6661}	TQI_REF_MAX {p. 8380}	TQI_SP_CAN {p. 8391}	ulev {p. 8179}
VB_POW_MNG {p. 8369}	VFF_EFP {p. 989}	VS {p. 1176}	VS_SP_DRIV_CRU_CAN {p. 7201}
VS_STEP_CAN_1 {p. 7201}	VS_STEP_CAN_2 {p. 7201}	VS_STEP_CAN_3 {p. 7201}	zrbosmld {p. 8204}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CC_ID_TEST_BENCH	-	0... FFFFH	0... 65535	1	-
Checkcontrol ID for test message					
C_CC_ID_TRA	-	0... FFFFH	0... 65535	1	-
Checkcontrol ID for TRA message					
C_CC_MESS	-	0... FFH	0... 255	1	-
ID2 check-control message standard ID2_CC_MESS_STD (Standard CC-report: 40H)					
C_CTR_DLY_MSG_OIL	-	0... FFH	0... 255	1	-
counter for transmitting Layer-values after Kl.15 on					
C_CTR_ERR_DYN_CC_TEST_BENCH	-	0... FFH	0... 255	1	-
Threshold for number of failures stored in dynamic memory					
C_CTR_FTL_NOT_VLD	-	0... FFH	0... 255	1	-
Counter threshold for messages with invalid FTL_XX-value					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_LDM_CAN_INI	-	0... FFH	0... 255	1	-
Counter for sending ini-value of ST_INTF_PT					
C_CTR_TOUT_N_ECF_CAN	-	0... FFH	0... 255	1	-
Threshold for counter timeout-detection ext. ECF-request					
C_CTR_TOUT_STATE_ERR_CAN	-	0... FFH	0... 255	1	-
Threshold for counter timeout-detection of OBD diagnosis service message					
C_ICL_DISP_FRQ	-	0... 3H	0 ...3	1	-
calibratable constant for display messages on ICL					
C_N_32_THD_CC_POIL_SWI	-	0... FFH	0... 8160	32	rpm
N_32-Threshold for activating CC-message LV_POIL_SWI					
C_N_DISP_DYN_ENA	-	0... 2H	0 ...2	1	-
Condition for sending DISP_RPM_ENG on CAN (0...message not sent, 1...=N_DISP_DYN, 2...=N_CAN)					
C_N_ECF_CAN	-	0... FFH	0... 99.60937	0.390625	%
Default value for ECF-request					
C_N_SP_IS_THD_CAN	-	0... 1FE0H	0... 8160	1	rpm
Engine speed setpoint threshold for reconition of ST_SW_LEV_RPM condition					
C_STATE_CC_ID_BENCH	-	0... FH	0... 15	1	-
sending-condition for CC- test - message					
C_STATE_CC_ID_TRA	-	0... FH	0... 15	1	-
sending-condition for CC-message					
C_STATE_CC_ID_xx	-	0... FH	0... 15	1	-
sending-condition for CC-message (e.g. LV_IGK, LV_KEY_AUX, etc.)					
C_STATE_CC_TEST_BENCH	-	0... FFH	0... 255	1	-
Bit coded trigger conditions for activating Checkcontrol test bench					
C_STATE_CC_TEST_BENCH_OBD_1	-	0... FFH	0... 255	1	-
Bit coded readiness code status 1 threshold for CC bench mode					
C_STATE_CC_TEST_BENCH_OBD_2	-	0... FFH	0... 255	1	-
Bit coded readiness code status 2 threshold for CC bench mode					
C_STATE_CC_TEST_MASK_OBD_1	-	0... FFH	0... 255	1	-
Bit mask for readiness code completion status 1					
C_STATE_CC_TEST_MASK_OBD_2	-	0... FFH	0... 255	1	-
Bit mask for readiness code completion status 2					
C_STATE_COC_MAX_CC_TEST_BENCH	-	0... FFH	0... 255	1	-
maximum state of coolant circuit management for CC test bench					
C_STATE_COC_MIN_CC_TEST_BENCH	-	0... FFH	0... 255	1	-
minimum state of coolant circuit management for CC test bench					
C_STATE_LOIL_SUB	-	0... FFH	0... 255	1	s
Default value for transmitting layer-values					
C_STATE_OPM_MAX_CC_TEST_BENCH	-	0... 8H	0 ...8	1	-
maximum trigger threshold (OPM_AV) for CC bench mode					
C_STATE_OPM_MIN_CC_TEST_BENCH	-	0... 8H	0 ...8	1	-
minimum trigger threshold (OPM_AV) for CC bench mode					
C_T_CTR_SWI_OFF_VB_MIN	-	0... FFH	0... 255	1	s
Threshold shutdown counter battery-main-switch					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_CYC_CAN_ECU_2	-	0... FFH	10... 2560	10	ms
Constant for cycle time of output CAN-message "TORQUE_2" (default = 10ms)					
C_T_CYC_DISP_ICL_CAN	-	0... FH	0... 15	1	s
recurrence for transmission of check control message (appl. suggestion: 10 s)					
C_T_DLY_ERR_PSTE	-	0... FFH	0... 2.55	0.01	s
Time delay threshold to suppress error steering angle					
C_T_MAX_INH_ACK_IGK_OFF	-	0... FFH	0... 2.55	0.01	s
threshold to allow igk off acknowledge					
C_TAM_MAN_AS	-	0... FEH	-48... 142.5	0.75	°C
Ambient temperature TAM by application system					
C_TAM_SUB	-	0... FEH	-48... 142.5	0.75	°C
Substitute TAM-temperature in case of TAM-failure					
C_TEMP_GB_SUB	-	0... FFH	-40 ...215	1	°C
Default temperature for automatic gearbox in case of error TEMP_GB					
C_TQ_ACCIN	-	0... FFH	0... 127.5	0.5	Nm
Minimum torque ACCIN					
C_TQ_MAX_ACC	-	0... FFH	0... 127.5	0.5	Nm
air-conditioning-compressor limit torque after switch on					
C_V_SP_GEN	-	0... FFH	10.6... 16.975	0.025	V
Generator voltage (substitute value in case of invalid signal from CAN)					
IP_T_DLY_POIL_SWI_CAN_TOIL	-	0... FFFFH	0... 6553.5	0.1	s
LDP_TOIL__T_DLY_POIL_SWI_CAN	6	0... C8H	-40 ...160	1	°C
Delay-time for first activation of CC-message LV_POIL_SWI					
LC_CC_TEST_BENCH	-	0... 1H	0 ...1	1	-
LC for enabling CC test bench					
LC_ENA_CC_MIL_1	-	0... 1H	0 ...1	1	-
LC for enabling MIL_1 checkcontrol-message					
LC_ENA_REQ_PWL_DMTL_CAN	-	0... 1H	0 ...1	1	-
Switch to enable requests to get additional poweredge time for DMTL via CAN (only relevant for E70)					
LC_MSR_BN	-	0... 1H	0 ...1	1	-
LC for allowing MSR-intervention in case of TQ_TCS_FAST_BN <> TQ_TCS_SLOW_BN by DSC					
LC_PSTE_3_SUB_ENA	-	0... 1H	0 ...1	1	-
Enable substitute values for PSTE_3 interface					
LC_SND_MSG_OIL_KEY_AUX	-	0... 1H	0 ...1	1	-
LC for transmitting Layer-values independent of KI.15					
LC_TAM_MAN_AS	-	0... 1H	0 ...1	1	-
Logical constant switch TAM from CAN or application system					
LC_TQI_MAF_MAN	-		-	-	-
Logical constant to switch between two paths of the TQI_MAF calculation					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MAX_ERR_N_ENG	-	0... FFH	0... 2.55	0.01	s
Threshold for sending RPM_ENG_ERR true or false without debounced CRK error					
LC_EFPPWM_CTL	-	0... 1H	0 ...1	1	-
Switch between PT-CAN definition and EKP Ctl functionality					
NC_VIN_CAN_LEN	-	0... FFH	0... 255	1	-
Length of VIN message over CAN					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
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### Action definition

ACTION_COMM_SEND_CHAL_CAN_TRIG ()	Mode: O
-	


ACTION_INTC_NO_VECH_REQ ()	Mode: O
When this action is called the service "Anfrage:Fahregestellnummer" is requested.	

### General information:

The basis of this CAN communication is the specification for "BN 2000" integration revision 6.3.0 (E65) and 4.1.0 (E60). All messages are transmitted as a complete frame, that means every label which is not defined will be transmitted with its "invalid" value (not initialization value!!).

The network management is done by the standard core, so it isn't described in that document.

The allocation of the messages to the two CAN- controller follows the BMW- Excel- Sheet Verteilung\_CAN\_Kanäle\_2CANController.xls from 25-06-2003. The messages which are according to this sheet transmitted in channel 0 ... 13, Basic 1 and Basic 2 are sent via CAN- controller 1. The messages in channel 14 ... 27, Basic 3 and Basic 4 are sent via CAN- controller 2.

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### 4.60.1 Input messages overview

message / identifier	BN2000 definition	ECU definition
<b>ACC-Modul</b>	<b>adaptive cruise control</b>	
<b>DREHMOMENT_ANF_ACC</b>	ST_TORQ_CLCTR_ACC	STATE_DCC_CTL
	ST_ACC_MOD_DME	STATE_DCC
	ST_ACC_SWO_SYS_DME	STATE_DCC_OFF_REQ
	CHKSM_TORQ_ACC	CKS_CAN_TQ_DCC
	ALIV_TORQ_ACC	TCC_CAN_TQ_DCC
	TORQ_TAR_ACC	TQ_DCC_FAST_BN
	TORQ_TAR_ADJR_POS_ACC	TQ_DCC_SLOW_BN
	ST_TORQ_TAR_ACC	STATE_DCC_INTV
	RQ_PREV_INFS_ACC	STATE_DCC_PUC_INH
<b>ARS-Modul</b>	<b>anti roll stabilization</b>	<b>ARS (anti roll stabilization)</b>
<b>STAT_ARS</b>	ALIV_COU_ARS	TCC_CAN_ARS
	ST_CLCTR_ARS	STATE_ARS_CAN
	TORQ_TAR_ARS	TQ_LOSS_ARS_SP_CAN
	TORQ_AVL_ARS	TQ_LOSS_ARS_AV_CAN
<b>AFS-Modul</b>	<b>active front steering</b>	<b>PSTE_2 (power steering 2)</b>
<b>DREHMOMENT_ANF_AFS</b>	ALIV_COU_AFS	TCC_CAN_TQ_PSTE_2
	CHKSM_TORQ_AFS	CKS_CAN_TQ_PSTE_2
	ST_TORQ_TAR_AFS	STATE_PSTE_2_INTV
	TORQ_TAR_AFS	TQ_LOSS_PSTE_2_SP_CAN
	TORQ_AVL_AFS	TQ_LOSS_PSTE_2_AV_CAN
	ST_RQ_TORQ_AFS_ERR	LV_PSTE_2_ERR
<b>CAS</b>	<b>car access system</b>	
<b>FAHRGESTELLNUMMER</b>	NO_VECH_x	VIN_CAN[NC_VIN_CAN_LEN]
<b>KLEMMENSTATUS</b>	ST_KL_R	LV_KEY_AUX
	ST_KL_15	STATE_IGK_CAN
	ST_KL_50	LV_RLY_ST_CAN
	NO_KEY	VEH_KEY_NR
	ST_STCD_PENG_MSA	LV_CS_2
	ST_KL_15_HW	STATE_IGK_HW (STATE_ACK_IGK_OFF)
	ALIV_KL	TCC_CAN_CAS
	CHKSM_KL	CKS_CAN_CAS
	ST_KEY_VLD	LV_KEY_VLD
<b>CODIERUNG_PM</b>	I_SC_MAX_VEH	CUR_SC_MAX_CAN
	I_SC_MIN_VEH	CUR_SC_MIN_CAN
	QC_VEH	CUR_WKU_CAN
	CLAS_BT	IDX_BAT_CAN
<b>FAHRZEUGTYP</b>	TYP_VEH	Not in use yet
	TYP_BODY	Not in use yet
	QUAN_CYL	Not in use yet
	QUAN_GR	Not in use yet
	TYP_ENG	Not in use yet
	TYP_STE	Not in use yet
	TYP_GRB	Not in use yet


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	CLAS_PWR	STATE_POW_CLAS_VEH
	TYP_CNT	Not in use yet
	TYP_CAPA	Not in use yet
<b>STAT_ZV_KLAPPEN</b>	ST_DSW_DRD	LV_DRIV_DOOR_OPEN
	ST_CT_BON	LV_HOOD_OPEN
<b>Response from CAS</b>	See formula section	See formula section
<b>SZM</b>		
<b>FAHRZEUGMODUS</b>	MOD_VEH	STATE_VEH_MOD
	ALIV_MOD_VEH	TCC_CAN_VEH_MOD
	CHKSM_MOD_VEH	CKS_CAN_VEH_MOD
<b>CTR_CRASH_SWO_EKP</b>	CTR_CRASH_SWO_EKP	STATE_EFP_CRASH_CAN
<b>DSC-Modul</b>		<b>TCS (traction control system)</b>
<b>DREHMOMENT_ANF_DSC</b>	CHKSM_TORQ_DSC	CKS_CAN_TQ_TCS
	ALIV_TORQ_DSC	TCC_CAN_TQ_TCS
	TORQ_TAR_DSC	TQ_TCS_FAST_BN
	TORQ_TAR_ADJR_POS_DSC	TQ_TCS_SLOW_BN
	ST_TORQ_TAR_DSC	STATE_TCS_INTV (LV_TQ_ASR_REQ, LV_TQ_MSR_REQ, LV_TCS_LIH_CAN)
<b>GESCHWINDIGKEIT</b>	V_VEH	VS_CAN, WHEEL
	ACLN_VEH_LN_DSC	AC_VEH_LGT_TCS
	ACLN_VEH_ACRO_DSC	AC_VEH_TRV_TCS
<b>GESCHWINDIGKEIT_RAD</b>	V_WHL_FLH	not in use → CAN11H
	V_WHL_FRH	not in use → CAN11H
	V_WHL_RLH	not in use → CAN11H
	V_WHL_RRH	not in use → CAN11H
<b>STAT_DSC</b>	ST_CLCTR	STATE_TCS_CTL (LV_PLAUS_ASR_CTL, LV_PLAUS_ESP_CTL, LV_TCS_CTL_ACT)
	ST_DSC	STATE_TCS_CAN
	ST_DCRN_AVL	STATE_TCS_DECE
	ST_BRP	STATE_BRAKE_PRS
	BRP	BRAKE_PRS
<b>EGS-Modul</b>	<b>elektr. Getriebesteuerung</b>	<b>ETCU (electronic transmission control unit)</b>
<b>DREHMOMENT_ANF_EGS</b>	CHKSM_TORQ_EGS	CKS_CAN_TQ_ETCU
	ALIV_TORQ_EGS	TCC_CAN_TQ_ETCU
	TORQ_TAR_EGS	TQ_GS_FAST_BN
	TORQ_TAR_ADJR_POS_EGS	TQ_GS_SLOW_BN
	ST_TORQ_TAR_EGS	STATE_ETCU_INTV (LV_TQ_GS_INC_REQ, LV_TQ_GS_DEC_REQ, LV_ETCU_LIH_CAN)
	ST_OBD_GRB	STATE_ETCU_OBD
	ST_OBD_ERR_GRB	STATE_ETCU_OBD_ERR
	ST_LIM_STORQ	STATE_ST_TQ_LIM_GS

	TORQ_DRAW_GRB	TQ_CONV_CAN
	TEMP_GRB	TEMP_GB
	ST_OTMP_GRB	STATE_TEMP_GB
<b>SSG-Modul</b>	<b>sequentielles Schaltgetriebe</b>	<b>AMT (automated manual transmission)</b>
<b>DREHMOMENT_ANF_SSG</b>	CHKSM TORQ_SSG	CKS_CAN_TQ_AMT
	ALIV_TORQ_SSG	TCC_CAN_TQ_AMT
	TORQ_TAR_SSG	TQ_AMT_FAST_BN
	TORQ_TAR_ADJR_POS_SSG	TQ_AMT_SLOW_BN
	ST_TORQ_TAR_SSG	STATE_AMT_INTV (LV_TQ_AMT_INC_REQ, LV_TQ_AMT_DEC_REQ, LV_AMT_LIH_CAN)
	ST_OBD_GRB_SSG	STATE_AMT_OBD
	ST_OBD_ERR_GRB_SSG	STATE_AMT_OBD_ERR
	ST_LIM_STORQ_SSG	STATE_ST_TQ_LIM_AMT
	ST_SHPS_SSG	STATE_AMT
	ST_CLT_SSG	STATE_CLU_AMT
	RQ_Motorstop	LV_AMT_ES
	LIM_RPM_ENG	N_MAX_AMT_CAN
	ST_GRLV_ACV	LV_GS
<b>DKG-Modul (TCT)</b>	<b>Doppelkupplungagetriebe</b>	<b>TCT (twin clutch transmission)</b>
<b>DREHMOMENT_ANF_DKG</b>	CHKSM TORQ_DKG	CKS_CAN_TQ_TCT
	ALIV_TORQ_DKG	TCC_CAN_TQ_TCT
	TORQ_TAR_DKG	TQ_GS_FAST_BN
	TORQ_TAR_ADJR_POS_DKG	TQ_GS_SLOW_BN
	ST_MOD_DKG	STATE_TCT_INTV (LV_TQ_GS_INC_REQ, LV_TQ_GS_DEC_REQ, LV_TCT_LIH_CAN, LV_TCT_ES, LV_N_SP_TCT_REQ)
	TORQ_CLT_DKG	TQ_TCT_CAN
	RPM_TAR_ENG_DKG	N_SP_TCT (LV_N_SP_TCT)
<b>ST_DKG</b>	RQ_AUXWP	Not used
	ST_OTMP_DKG	STATE_TEMP_GB
	TEMP_DKG	TEMP_GB
<b>Transmission units</b>	<b>Getriebeinformationen</b>	<b>Transmission data</b>
<b>GETRIEBEDATEN</b>		
	ST_GR_GRB	GEAR_INFO
	GRDT_REIN	FAC_GB_GAIN
only EGS (LV_AT) ->	ST_CCLT	STATE_CC
only EGS (LV_AT) ->	ST_MOD_GRB	STATE_MOD_GB
only SSG (LV_VAR_AMT) ->	ST_HYPP_ACV	LV_PUMP_AMT_ON
only DKG or EGS (LV_VAR_TCT or LV_AT) ->	ST_GRLV_ACV	LV_GS
only DKG (LV_VAR_TCT) ->	ST_RSTA	STATE_MAX_AC_ST
<b>GETRIEBEDATEN_2</b>		

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	RPM_GRB_TURB	N_GB
	ST_RCOG_FSHUP	LV_INH_GP_SUP
only DKG (LV_VAR_TCT) ->	RQ_BST_RPM_IDLG	N_SP_IS_TCT_CAN
only DKG (LV_VAR_TCT) ->	ST_STCLT	STATE_ETCU_CLU
	RPM_GRB_NEGL_2	N_GB_OUT
	RQ_GRB_DYNS_DISP_RPM_ENG	LV_N_DISP_DYN
	ST_GRB_SW	STATE_ETCU_SPT_SWI
<b>GETRIEBEDATEN_3</b>		
	TORQ_DVCH_RISE	dm_ab_fws
	IDX_ACPD	ipm_typ_fp
	IDX_TORQ_FIL	ipm_typ_mdkw
only DKG (LV_VAR_TCT) ->	RQ_MIL_GRB	LV_MIL_REQ_ETCU
only DKG (LV_VAR_TCT) ->	LIM_MAX_V_GRB_EMMOD	VS_MAX_LIH_TCT
<b>ANZEIGE_GETRIEBEDATEN</b>		
	CTR_DISP_PRG_GRB	STATE_ETCU_PROG_INFO
	CTR_DISP_SPMOD_GRB	LV_ETCU_SPT_SWI
<b>IHKA</b>		
<b>WAERMESTROM_KLIMA</b>	HTFL_RQ_AIC	HEAT_REQ_PERC
	HTFL_ST_AIC	not in use, value initialised FFh
	TORQ_TAR_ACCM	TQ_ACCIN_CAN
	CTR_EFAN_AIC	N_ECF
	CTR_AIC_SPFN	LV_REQ_HEAT , LV_REQ_TCO_L
	CTR_CLMP	LV_REQ_TCO_L
	CTR_AIC_RDI	STATE_ACIN_CAN
	ST_PWR_SPCOS	STATE_EXT_POW_CNS
	CTR_FAN_FLAP	LV_ECRAS_CTL_CAN_1/_2
<b>Kombi</b>		
<b>A_TEMP_RELATIVZEIT</b>	TEMP_EX	TAM
	T_SEC_COU_REL	T_CTR_REL_CAN (E65) bzw. T_REL_CAN (E60), T_REL_CAN_2
	T_DAY_COU_ABSL	T_CAN
<b>BOS_RUECKSTELLUNG</b>	ID2_BOS_RSTG	STATE_ID2_BOS_RST
	ID_FN_BOS_RSTG	STATE_ID_FCT_BOS_RST
	AVAI_BOS_RSTG	STATE_AVL_BOS_RST
	COU_RSTG_BOS_RSTG	CTR_RST_BOS_RST
	RMMI_BOS_RSTG	QOIL_DS_RST_CAN_1_5
<b>BOS_RUECKSTELLUNG_2</b>	ID2_BOS_RSTG_2	QOIL_DS_RST_CAN_2_1
	ID_FN_BOS_RSTG_2	QOIL_DS_RST_CAN_2_2
	FRC_INTM_WAY_BOS_RSTG_2	QOIL_DS_RST_CAN_2_3
	TARD_MON_BOS_RSTG_2	QOIL_DS_RST_CAN_2_4
	TARD_YR_BOS_RSTG_2	QOIL_DS_RST_CAN_2_5
	FRC_INTM_T_BOS_RSTG_2	QOIL_DS_RST_CAN_2_6
<b>KILOMETERSTAND</b>	MILE_KM	CTR_KM_CAN



	FLLV_FUTA	FTL
	FLLV_FUTA_LH	FTL_LE
	FLLV_FUTA_RH	FTL_RI
	ST_FLLV_FUTA_SPAR	LV_FTL_OBD_INH_L
	RNG	not defined
<b>STAT_KOMBI</b>	V_VEH_SPDM	VS_ICL_DISP
	ST_UN_V_SPDM	STATE_VS_ICL_DISP
	ST_INTF_CCTRA_KI	STATE_IF_ICL_BN_MSW
	ALIV_COU_KI	TCC_CAN_ICL
	ST_WALI_ENG	STATE_WAL_CAN
<b>UHRZEIT_DATUM</b>	DISP_HR	Not in use yet
	DISP_MN	Not in use yet
	DISP_SEC	Not in use yet
	DISP_DATE_DAY	T_CLK_ICL_DISP_1
	DISP_DATE_WDAY	Not in use yet
	DISP_DATE_MON	T_CLK_ICL_DISP_2
	DISP_DATE_YR	T_CLK_ICL_DISP_3
	ST_DISP_CTI_DATE	Not in use yet
<b>LDM</b>	<b>Längsdynamikmodul</b>	
<b>Anforderung Radmoment Antriebsstrang</b>	Byte 7 + Byte 6	STATE_CUS_LDM_CAN
	FOLDYN_WMOM_PT_TAR	STATE_DI_PUC
	ST_DRASY_PT	STATE_LDM
	WMOM_PT_TAR	TQ_WHEEL_LDM_BN
	WMOM_PT_ENBL	STATE_LDM_INTV
	FOLDYN_WMOM_PT_TAR	STATE_SP_DYN_WHEEL
	ALIV_RQ_WMOM_PT	TCC_CAN_LDM
	CHKSM_RQ_WMOM_PT	CKS_CAN_LDM
	RQ_GSI_CLCTR_LN	LV_GS_IDC_LDM
<b>Power-Modul</b>		
<b>POWERMGMT_BATTERIESPANNUNG</b>	ST_BTSW	see <b>2.8 Power-Modul</b>
	ST_SWO_KL_30	STATE_SWI_OFF_VB
	SDWN_COU_BTSW	T_CTR_SWI_OFF_VB
	T_SEC_COU_REL_RED	T_REL_CAN (E65) T_REL_CAN_2 (E65)
<b>POWERMGMT LADESPANNUNG</b>	CTR_GEN_U_TAR	V_GEN_TAR
	RPM_IDLG_SPEC	FAC_IS_INC_REQ
	TEMP_BT	not defined
<b>SZ-Lenksäule</b>		
<b>BEDIENUNG_TEMPOMAT</b>	CHKSM_CCTR	CKS_CAN_MSW
	ALIV_CCTR	TCC_CAN_MSW
	OP_PUBU_CCTR_ACC	STATE_BN_MSW
	OP_GAPC_ACC	STATE_GAP_MSW
<b>LENKRADWINKEL</b>		
	STWA	ANG_PSTE
	STWA_V	VEL_ANG_PSTE


	STWA_ERR	STATE_SENS_ANG_PSTE
<b>K_CAN: LM</b>		
<b>STAT_GANG_RUECKWAE RTS</b>	ST_GR_BAC	STATE_GEAR_REV_CAN
<b>LAMPENZUSTAND</b>	ST_DIPB	LV_LTG_HDLP_L_ON
<b>CTR_LICHT</b>	CTR_ITLI	LV_LTG_INL_ON
<b>STAT_ANHAENGER</b>	ST_TRAI	LV_STATE_TRL
<b>STAT_VERDECK_CABRIO</b>	ST_PO_FLDT_CAB	LV_CTOP
<b>EKP</b>		
<b>STAT_EKP</b>	ST_DIAG_FU_PP_EL	STATE_DIAG_EFP
	ST_FU_PP_EL	STATE_EFP_CAN
	U_ENG_FU_PP_EL	V_ENG_EFP
	I_ENG_FU_PP_EL	CUR_ENG_EFP
	RPM_AVL_FU_PP_EL	N_EFP_AV
	U_KL_30_FU_PP_EL	VB_EFP
	FLQUAN_TAR_FU_PP_EL	not defined yet
	SETQ_FU_PP_EL	not defined yet
	ST_FU_CLCTR_FU_PP_EL	STATE_EFP_CTL
<b>K_CAN: CCC_GW, M_ASK</b>		
<b>PRGG_CCTR</b>	IDX_NO_PRGG_CCTR	NR_VS_CRU_IF
	V_PRGG_CCTR_IDX_NO_1	VS_STEP_IF_1
	V_PRGG_CCTR_IDX_NO_2	VS_STEP_IF_2
	V_PRGG_CCTR_IDX_NO_3	VS_STEP_IF_3
<b>K_CAN</b>		
<b>PM_STANDVERBRAUCHE R</b>	ID_FN_PWGM	FAC_POW_MNG_VST_CNS, formula section
	ST_PCOS_PWGM	FAC_POW_MNG_VST_CNS, formula section
<b>VERBRAUCHERSTATUS</b>	ID_FN_COS	STATE_VEH_CNS[10], see formula section
	ST_FN_COS	STATE_VEH_CNS_FCT, see formula section
<b>ANFORDERUNG_ELUEFT ER</b>		see formula section
<b>OBD Sensor Diagnosestatus</b>		see formula section
<b>EHB3</b>		
<b>DREHMOMENT_ANF_STE</b>	CHKSM_TORQ_STE	CKS_CAN_TQ_PSTE_3
	ALIV_TORQ_STE	TCC_CAN_TQ_PSTE_3
	SRC_RQ_TORQ_STE	STATE_PSTE_3_SCR
	TORQ_AVL_STE	TQ_LOSS_PSTE_3_AV_CAN
	TORQ_TAR_STE	TQ_LOSS_PSTE_3_SP_CAN
	ST_TORQ_TAR_STE	STATE_PSTE_3_INTV ( LV_PSTE_3_INTV)
	ST_RQ_TORQ_STE_ERR	STATE_PSTE_3_ERR (LV_TQ_ PSTE_3_CAN_ENA LV_TQ_ PSTE_3_CAN_LIH LV_TQ_ PSTE_3_CAN_DI)

<b>EMF (PBR)</b>		
STELLANF_EMF	ST_HYD_RETA_2	STATE_HLD_PBR
	ST_CFFU_EMF_2	LV_CFT_MOD_PBR
STATUS_EMF	ST_EMF_LOCA_2	STATE_PBR
ST_RQ_EMF	ST_ACT_EMF	STATE_PBR_ACT
	QU_ST_ACT_EMF	STATE_PBR_ACT_QLY
	RQ_DCRN_EMF	AC_WHEEL_PBR
	QU_RQ_DCRN	STATE_TQ_WHEEL_PBR_QLY
	ALIV_ST_RQ_EMF	TCC_CAN_TQ_PBR
	CHKSM_ST_RQ_EMF	CKS_CAN_TQ_PBR
	SAFG_RQ_WMOM_EMF	not used
<b>DXC</b>		
SOLL_MOM_ANF	ST_HDC_FN	STATE_DHL_CTL
<b>BEDIENUNG_MDRV</b>		
Signals see according chapter		
<b>FAHRGESTELLNUMMER</b>		
	NO_VECH	VIN_CAN

## 4.60.2 Output messages overview

message / identifier	BN2000 definition	ECU definition
<b>DME1</b>		
<b>ANFRAGE</b>	ID2_INQY	see chapter 3
	ID_FN_INQY	see chapter 3
<b>DISP_CC_MSG_EXT</b>	ID2_CC_MESS_EXT	not defined
	NO_CC_MESS_EXT	not defined
	ST_CC_MESS_EXT	not defined
	TRANF_CC_MESS_EXT	not defined
	ST_IDC_CCLK_CC_MESS_EXT	not defined
	NO_FRM_CC_MESS_EXT	not defined
	QUAN_FRM_CC_MESS_EXT	not defined
	UTDT_CC_MESS	not defined
<b>DISP_CC_MSG</b>	ID2_CC_MESS_STD	01000000b
	NO_CC_MESS_STD	depending on dif. condition
	ST_CC_MESS_STD	depending on dif. condition
	TRANF_CC_MESS_STD	C_T_CYC_DISP_ICL_CAN
	ST_IDC_CCLK_CC_MESS_STD	C_ICL_DISP_FRQ
<b>BOS_MELDUNG</b>	ID2_BOS_MESS	idbosmsg
	ID_FN_BOS_MESS	idfbosmg_w
	RMMI_BOS	DIST_RESI_OIL
	ST_UN_BOS	DIST_RESI_OIL_KM
	AVAI_BOS_MESS	STATE_OIL_AVL
	COU_RSTG_BOS_MESS	zrbosmld
<b>BOS_MELDUNG_2</b>	ID2_BOS_MESS_2	QOIL_DS_CAN_2_1
	ID_FN_BOS_MESS_2	QOIL_DS_CAN_2_2
	FRC_INTM_WAY_BOS_MESS_2	QOIL_DS_CAN_2_3
	TARD_YR_BOS_MESS_2	QOIL_DS_CAN_2_4
	TARD_MON_BOS_MESS_2	QOIL_DS_CAN_2_5
	FRC_INTM_T_BOS_MESS_2	QOIL_DS_CAN_2_6
<b>TORQUE_1</b>	CHKSM_TORQ_1_DME	CKS_CLC_ECU1
	ALIV_TORQ_1_DME	TCC_CAN_ECU1
	TORQ_AVL	TQ_AV (converted for BN)
	ST_TORQ_AVL	SF_TQD, LV_DI_TQ_REQ_CAN_MPI_G DI
	TORQ_AVL_DMEE	TQ_ECU_ETCU
	ST_SW_CLT	LV_IM_CS_PN
	ST_DMEA_SWO	LV_DCC_OFF_ECU
	RCPT_ACC_SWO_SYS_DME	LV_DCC_OFF_ACK
	ST_RCPT_ENG_ACC	STATE_TQ_INTV_DCC
	ST_RCPT_ENG_ARS	STATE_TQ_INTV_ARS
	ST_RCPT_ENG_DSC	STATE_TQ_INTV_TCS
	ST_RCPT_ENG_EGS	STATE_TQ_INTV_ETCU, STATE_TQ_INTV_AMT, STATE_TQ_INTV_TCT
	ST_OBD_CTFN_GRB	STATE_DIAG_GS
	ST_CT_BRPD_DME	BLS-/BTS-conditions

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<b>TORQUE_2</b>	CHKSM_TORQ_2_DME	CKS_CLC_ECU2
	ALIV_TORQ_2_DME	TCC_CAN_ECU2
	ST_SW_LEV_RPM	N_SP_IS-conditions
	ST_INFS	LV_PUC
	TORQ_AVL_MIN	TQ_LOSS (converted for BN)
	TORQ_AVL_MAX	TQ_MAX_CLU (converted for BN)
	TORQ_AVL_SPAR_NEG	TQ_REF_IGA_MIN_LAMB (converted for BN)
	TORQ_AVL_SPAR_POS	TQ_MAF (converted for BN)
<b>TORQUE_3</b>	CHKSM_TORQ_3_DME	CKS_CLC_ECU3
	ALIV_TORQ_3_DME	TCC_CAN_ECU3
	TORQ_DVCH	TQ_EMS_BN
	ANG_ACPD	PV_MAX_CAN
	RPM_ENG	N_CAN
	RPM_ENG_ERR	LV_ERR_CRK
	ST_IDLG_ENG	! LV_IS
	ST_CLCTR_V	STATE_CRU_CAN, STATE_TQ_DCC, STATE_TQ_LDM
	RQAM_FU	VFF_EFP / EFPPWM_CAN
<b>ENGINE_RPM</b>	RPM_TEMP_DOM_1	N_MAX_THD_1_CAN
	RPM_TEMP_DOM_2	N_MAX_THD_2_CAN
<b>ENGINE_1</b>	TEMP_ENG	TCO (converted)
	TEMP_EOI	TOIL_CAN
	ALIV_COU_DME	TCC_CAN_ECU
	ST_ENG_RUN	LV_ES and LV_ST conditions
	ST_SW_WAUP	LV_WUP_CAN; LV_LIH_COC_ON
	AIP_ENG	AMP_CAN
	IJV_FU	FCO (like CAN11h)
	CTR_SLCK	CTL_SHIFT_LOCK_CAN
	ST_SW_CLT	LV_IM_CS_PN
	RDUC_DOCTR_RPM	STATE_N_MAX_THD_LIH
	RPM_IDLG_TAR	N_SP_IS
	ST_RBMCYC	LV_DC_RBM (see formula)
<b>ENGINE_2</b>	RQ_STASS	B_notafu
<b>GESCHWINDIGKEIT_TEMPOMAT</b>	V_CLCTR_CCTR	VS_SP_DRIV_CRU_CAN
	ST_V_CLCTR_CCTR	depending on conditions
	CTR_DISP_CCTR	LV_STEP_ON_ICL
	CTR_DISP_CCTR_HUD	LV_CRU_DISP_HUD
	RCPT_ACTVN_CCTR_DR	LV_CRU_ACT_INH
	IDX_NO	NR_VS_CRU
	V_CCTR_IDX_NO_1	VS_STEP_CAN_1
	V_CCTR_IDX_NO_2	VS_STEP_CAN_2
	V_CCTR_IDX_NO_3	VS_STEP_CAN_3
<b>WAERMESTROM_MOTOR</b>	HTFL_RQ_DME	FFh

	HTFL_ST_DME	N_REL_CWP
	ACCM_LIM_TORQ	TQ_MAX_ACC_CAN
	ST_CRAW_ENG	STATE_CUR_ENG_CNS
	ST_I_GEN	CUR_GEN
	ST_GEN	STATE_ALTER
	ST_LDST_GEN	st_ldstgen
	CTR_APE_WV	PWM_VALUE_HIV_PERC
	LDST_GEN	POW_REL_ALTER_CLC
<b>POWERMANAGEMENT_B ATTERIESPANNUNG</b> (in case of E60, LV_VAR_VEH = 0)	T_SEC_COU_REL_RED	invalid value: FFFFFFFH
	SDWN_COU_BTSW	invalid value: FFH
	ST_SWO_KL_30	invalid value: 11b = 3H
	ST_COS_SWO	invalid value: 11b = 3H
	ST_HT_RSCR	invalid value: 11b = 3H
	ST_PCOS	stpcos
	CTR_PRED_PRIO_CF	POW_CTL_PRI_PEAK_RED_CFT
	CTR_PRED_PRIO	POW_CTL_PRI_PEAK_RED
	ST_SW_DSTB	invalid value: 11b = 3H
	ST_BTSW	invalid value: 11b = 3H
	U_BT	VB_POW_MNG
	ACKM_RQ_SWO_KL_15	STATE_ACK_IGK_OFF
<b>POWERMANAGEMENT_V ERBRAUCHERSTEUERUNG</b> (in case of E60, LV_VAR_VEH = 0)	CTR_PCOS	POW_CTL_PARK_CNS
	RQ_PCOS	rqpcos
	CTR_CBR	CUR_RNG_CTL
	CTR_PWR_COS	POW_CTL_PWR_CNS_1
	CTR_PWR_SPCOS	POW_CTL_PWR_CNS_2
	SLCTN_SPCOS	selspcos
	ULEV	ulev
<b>Radmoment Antriebsstrang 1</b>	ST_PENG	STATE_ENGG_POS
	ANG_ACPD_TAR	PV_LDM_REQ_CAN
	WMOM_PT_AVL	TQ_WHEEL
	ANG_ACPD_REAL	PV_AV
	ALIV_WMOM_PT_1	TCC_CAN_TQ_WHEEL_1
	CHKSM_WMOM_PT_1	CKS_CLC_TQ_WHEEL_1
<b>Radmoment Antriebsstrang 2</b>	WMOM_PT_MAX	TQ_MAX_WHEEL
	WMOM_PT_MIN_LOW	TQ_MIN_WHEEL_L
	WMOM_PT_MAX	TQ_MAX_WHEEL
	ST_PT_INIT	LV_LDM_OFF, LV_LDM_OFF_ECU

	ALIV_WMOM_PT_2	TCC_CAN_TQ_WHEEL_2
	CHKSM_WMOM_PT_2	CKS_CLC_TQ_WHEEL_2
<b>Challenge to CAS</b>	See formula section	See formula section
<b>Status EKP</b>	ST_FU_CLCTR_DME	STATE_EFP_CTL_ECU
<b>OBD_DT_MOTOR</b>	PO_THVA_ENG	OBD_TPS_1
	CALCVL_LD_ENG	LOAD_CLC
	ST_PFC_CYC	STATE_PFC_CYC_BN
<b>ST_BATT</b>	CND_BT	Qv_out_m
	CND_BT_ACCY	Qv_quali_m
	CND_BT_CHNG	Qvc_status_4
	CND_BT_T	Qv_td
	ST_CND_BT	Qvc_status_3
<b>DISP_GSI</b>	ALIV_DISP_GSI	TCC_CAN_GS_IDC
	DISP_TARG	Spa_gang
	DISP_GSI	Spa_art
	CHKSM_DISP_GSI	CKS_CLC_GS_IDC
<b>DISP_ENGDAT</b>	ALIV_DISP_ENGDAT	TCC_CAN_DISP_ECU
	DISP_RPM_ENG	N_DISP_DYN
<b>ST_MDRV</b>	Signals see accoring chapter	
<b>DME2</b>		

### 4.60.3 Enable conditions for BN 2000 diagnosis

#### General information:

The CAN diagnosis for BN input messages is only to be enabled if the variant has been recognized. In case of a modul (e.g. TCS) which is not a variant but implemented in every vehicle the diagnosis is always enabled.

If BN diagnosis for message XXX is enabled (conditions see table below) then the conditions for activating the BN diagnosis have to be checked: only if LV\_CDN\_DIAG\_BN\_XXX =1 then the BN diagnosis is to be activated. For activation conditions see Chapter BN2000 diagnosis .

In the following the input messages, their keywords, the symptoms which have to be detected (timeout, alive, checksum) and the enable conditions for each diagnosis are described.

The XXX in the Chapter BN2000 diagnosis have to be replaced by the respective keyword in the table below.

As soon as an TOUT/CKS/TCC-symptom is detected the last CAN-signals of the corresponding message are freezed until the LV\_ERR\_BN\_xxx is debounced, no more new values are taken over. After the LV\_ERR\_BN\_xxx is debounced the signals are set to default-values.

The diagnosis of the symptoms TOUT/CKS/TCC can be inhibited by setting the corresponding calibration constant C\_CTR\_DIAG\_TOUT/CKS/TCC\_CAN\_MAX\_xxx to 0. In this case the CAN-signals will be taken over.

#### Table of BN input messages

message / identifier	Keyword for BN-diagnosis (XXX):	Enable conditions for BN-diagnosis:	Diagnosis of symptoms:
<b>ACC-Modul</b>	<b>(Distance Cruise Control)</b>		
<b>DREHMOMENT_ANF_ACC</b>	<b>TQ_DCC</b>	<b>LV_VAR_DCC = 1</b>	<b>TCC_CAN_TQ_DCC</b>
			<b>CKS_CAN_TQ_DCC</b>
			<b>Timeout TQ_DCC</b>
<b>ARS-Modul</b>	<b>(Anti-roll-stabilisation)</b>		
<b>STAT_ARS</b>	<b>ARS</b>	<b>LV_VAR_ARS = 1</b>	<b>TCC_CAN_ARS</b>
			<b>Timeout ARS</b>
<b>AFS-Modul</b>	<b>(Active Front Steering)</b>		
<b>DREHMOMENT_ANF_ACC</b>	<b>TQ_PSTE_2</b>	<b>LV_VAR_PSTE_2 = 1</b>	<b>TCC_CAN_TQ_PSTE_2</b>
			<b>CKS_CAN_TQ_PSTE_2</b>
			<b>Timeout TQ_PSTE_2</b>
<b>EHB3-Modul</b>	<b>(Electric Power Steering)</b>		
<b>DREHMOMENT_ANF_STE</b>	<b>TQ_PSTE_3</b>	<b>LV_VAR_PSTE_3 = 1</b>	<b>TCC_CAN_TQ_PSTE_3</b>
			<b>CKS_CAN_TQ_PSTE_3</b>
			<b>Timeout TQ_PSTE_3</b>
<b>CAS</b>	<b>(Car-access-system)</b>		
<b>KLEMMENSTATUS</b>	<b>CAS</b>	<b>always enabled</b>	<b>TCC_CAN_CAS</b>
			<b>CKS_CAN_CAS</b>
			<b>Timeout CAS</b>
<b>FAHRZEUGMODUS</b>	<b>VEH_MOD</b>	<b>LV_VAR_VEH_MOD = 1</b>	<b>TCC_CAN_VEH_MOD</b>
			<b>CKS_CAN_VEH_MOD</b>
			<b>Timeout VEH_MOD</b>
<b>STAT_ZV_KLAPPEN</b>	<b>CDN_DOOR</b>	<b>always enabled</b>	<b>Timeout CDN_DOOR</b>
<b>DSC-Modul</b>	<b>(Traction-control-system)</b>		
<b>DREHMOMENT_ANF_DSC</b>	<b>TQ_TCS</b>	<b>always enabled</b>	<b>TCC_CAN_TQ_TCS</b>
			<b>CKS_CAN_TQ_TCS</b>
			<b>Timeout TQ_TCS</b>
<b>GESCHWINDIGKEIT</b>	<b>VS_TCS</b>	<b>always enabled</b>	<b>Timeout VS_TCS</b>
<b>GESCHWINDIGKEIT_RAD</b>		<b>not in use</b>	<b>-----</b>
<b>STAT_DSC</b>	<b>TCS</b>	<b>always enabled</b>	<b>Timeout TCS</b>
<b>EGS-Modul</b>			
<b>DREHMOMENT_ANF_EGS</b>	<b>TQ_ETCU</b>	<b>LV_AT = 1</b>	<b>TCC_CAN_TQ_ETCU</b>
			<b>CKS_CAN_TQ_ETCU</b>
			<b>Timeout TQ_ETCU</b>



<b>SSG-Modul</b>			
<b>DREHMOMENT_ANF_SSG</b>	<b>TQ_AMT</b>	LV_VAR_AMT = 1	TCC_CAN_TQ_AMT
			CKS_CAN_TQ_AMT
			Timeout TQ_AMT
<b>DKG-Modul</b>			
<b>DREHMOMENT_ANF_DKG</b>	<b>TQ_TCT</b>	LV_VAR_TCT = 1	TCC_CAN_TQ_TCT
			CKS_CAN_TQ_TCT
			Timeout TQ_TCT
<b>ST_DKG</b>	<b>STAT_TCT</b>	LV_VAR_TCT = 1	Timeout STAT_TCT
<b>Transmission units</b>			
<b>GETRIEBEDATEN</b>	<b>ETCU</b>	LV_VAR_ETCU = 1	TCC_CAN_ETCU
			CKS_CAN_ETCU
			Timeout ETCU
<b>GETRIEBEDATEN_2</b>	<b>ETCU_2</b>	LV_AT = 1 or LV_VAR_TCT = 1	Timeout ETCU_2
<b>GETRIEBEDATEN_3</b>	<b>ETCU_3</b>	LV_VAR_ETCU_3	TCC_CAN_ETCU_3
			CKS_CAN_ETCU_3
			Timeout ETCU_3
<b>ANZEIGE_GETRIEBEDATEN</b>	<b>ETCU_DISP</b>	LV_AT = 1 or LV_VAR_TCT = 1	Timeout ETCU_DISP
<b>IHKA</b>			
<b>WAERMESTROM_KLIMA</b>	<b>ACC</b>	LV_VAR_ACIN = 1	Timeout ACC
<b>Kombi</b>			
<b>A_TEMP_RELATIVZEIT</b>	<b>T_ICL</b>	LV_VAR_ICL = 1	Timeout T_ICL
<b>BOS_RUECKSTELLUNG</b>			
<b>KILOMETERSTAND</b>	<b>KM_ICL</b>	LV_VAR_ICL = 1	Timeout KM_ICL
<b>STAT_KOMBI</b>	<b>ICL</b>	LV_VAR_ICL = 1	TCC_CAN_ICL
			Timeout ICL
<b>UHRZEIT_DATUM</b>	<b>T_CLK</b>	LV_VAR_ICL = 1	Timeout T_CLK
<b>Power-Modul</b>			
<b>POWERMGMT_BATTERIESPANNUNG</b>	<b>POW_VB</b>	LV_VAR_VEH = 1	Timeout POW_VB
<b>POWERMGMT_LADESPANNUNG</b>	<b>POW_GEN</b>	LV_VAR_VEH = 1	Timeout POW_GEN
<b>SZ-Lenksäule</b>			
<b>BEDIENUNG_TEMPOMAT</b>	<b>MSW</b>	LV_VAR_BN_MSW = 1	TCC_CAN_MSW
			CKS_CAN_MSW
			Timeout MSW
<b>LENKRADWINKEL</b>	<b>ANG_PSTE</b>	LV_VAR_PSTE = 1	Timeout ANG_PSTE
<b>SZM</b>			
<b>Steuerung Crashabschaltung EKP</b>	<b>EFP_CRASH</b>	LV_VAR_EFP_CRASH = 1	Timeout EFP_CRASH
<b>EKP</b>			
<b>STAT_EKP</b>	<b>EFP</b>	LV_VAR_BN_EFP = 1	Timeout EFP
<b>K_CAN: LM</b>			
<b>STAT_GANG_RUECKWAE RTS</b>	<b>GEAR_REV</b>	LV_VAR_BN_GEAR_R EV = 1	Timeout GEAR_REV
<b>LAMPENZUSTAND</b>	<b>LTG_HDLP</b>	LV_VAR_BN_LTG_HDL	Timeout LTG_HDLP_L

	<b>L</b>	<b>P_L = 1</b>	
<b>STAT_ANHAENGER</b>	<b>TRL</b>	<b>LV_VAR_BN_TRL = 1</b>	<b>Timeout TRL</b>
<b>LDM</b>			
<b>Anforderung Radmoment Antriebsstrang</b>	<b>LDM</b>	<b>LV_VAR_BN_LDM = 1</b>	<b>TCC_CAN_LDM</b>
			<b>CKS_CAN_LDM</b>
			<b>Timeout LDM</b>
<b>EMF-Modul</b>	<b>(Electric mechanical park brake)</b>		
<b>STELLANF_EMF</b>	<b>REQ_PBR</b>	<b>LV_VAR_PBR = 1</b>	<b>TCC_CAN_REQ_PBR</b>
			<b>CKS_CAN_REQ_PBR</b>
			<b>Timeout REQ_PBR</b>
<b>STATUS_EMF</b>	<b>PBR</b>	<b>LV_VAR_PBR = 1</b>	<b>TCC_CAN_PBR</b>
			<b>CKS_CAN_PBR</b>
			<b>Timeout PBR</b>
<b>ST_RQ_EMF</b>	<b>TQ_PBR</b>	<b>LV_VAR_TQ_PBR = 1</b>	<b>Timeout TQ_PBR</b> <b>TCC_CAN_TQ_PBR</b> <b>CKS_CAN_TQ_PBR</b>
<b>DXC-Modul</b>	<b>(4 wheel drive ECU)</b>		
<b>SOLL_MOM_ANF</b>	<b>DHL_CTL</b>	<b>LV_VAR_4WD = 1</b>	<b>Timeout DHL_CTL</b>

#### 4.60.4 Input messages

##### General information:

The handling of default-values in case of a CAN-error is as follows: if one of the symptoms (timeout, alive or checksum) is detected the last received value should be frozen until the error is debounced. After debounce the respective default-value should be used until rebound.

##### 4.60.4.1 ACC-Modul

##### Formula section:

##### DREHMOMENT\_ANF\_ACC:

**IF**  $LV\_ERR\_BN\_TQ\_DCC = 0$  **AND**  
 $LV\_ERR\_CAN\_BOFF = 0$

**THEN** // checksum\_torque\_ACC:  
 $CKS\_CAN\_TQ\_DCC = CHKSM\_TORQ\_ACC$

// alive\_torque\_ACC:  
 $TCC\_CAN\_TQ\_DCC = ALIV\_TORQ\_ACC$

// Torque\_target\_ACC:  
 $TQ\_DCC\_FAST\_BN = TORQ\_TAR\_ACC$

// Torque\_target\_adjustment-range\_positive\_ACC:  
 $TQ\_DCC\_SLOW\_BN = TORQ\_TAR\_ADJR\_POS\_ACC$

*// state ACC-intervention:*

```

if          ST_TORQ_TAR_ACC      = 00H
then          STATE_DCC_INTV      =NO_INTERVENTION
              LV_TQ_DCC_INC_REQ    = 0
elseif       ST_TORQ_TAR_ACC      = 01H
then          STATE_DCC_INTV      =TORQUE_INCREASE
              LV_TQ_DCC_INC_REQ    = 1
else          LV_TQ_DCC_INC_REQ    = 0
              endif
elseif       ST_TORQ_TAR_ACC      = 02H      or
              ST_TORQ_TAR_DCC      = 03H
then          STATE_DCC_INTV      =INVALID_SIGNAL
              LV_DCC_LIH_CAN        = 1
else          LV_DCC_LIH_CAN        = 0
endif
    
```

*// request\_prevention\_over-run-fuel-shutoff:*

```

IF          STATE_DCC_PUC_INH    =    01H
THEN          LV_DCC_PUC_INH      =    1
ELSE          LV_DCC_PUC_INH      =    0
ENDIF
    
```

STATE\_DCC\_PUC\_INH = RQ\_PREV\_INFIS\_ACC

*// status\_ACC\_switch-off\_system\_DME:*

```

IF          STATE_DCC_OFF_REQ    =    01H
THEN          LV_DCC_OFF_ACK      =    1
ELSE          LV_DCC_OFF_ACK      =    0
ENDIF
    
```

STATE\_DCC\_OFF\_REQ = ST\_ACC\_SWO\_SYS\_DME

*// status\_ACC\_mode\_DME:*

```

IF          ST_ACC_MOD_DME      =    00H
THEN          STATE_DCC          =    INACTIV
ELSEIF       ST_ACC_MOD_DME      =    01H
THEN          STATE_DCC          =    STAND_BY
ELSEIF       ST_ACC_MOD_DME      =    02H
THEN          STATE_DCC          =    NORMAL
ELSEIF       ST_ACC_MOD_DME      =    03H
THEN          STATE_DCC          =    RESERVE
ELSEIF       ST_ACC_MOD_DME      =    04H
THEN          STATE_DCC          =    BRAKE_ACTIVE
ELSEIF       ST_ACC_MOD_DME      =    05H
THEN          STATE_DCC          =    DRIVER_ACTIVE
ELSEIF       ST_ACC_MOD_DME      =    06H
THEN          STATE_DCC          =    RESERVE
ELSEIF       ST_ACC_MOD_DME      =    07H
THEN          STATE_DCC          =    INVALID_SIGNAL
    
```

**ENDIF**

```

// status_torque_control_ACC:
STATE_DCC_CTL          = ST_TORQ_CLCTR_ACC

ELSE // checksum_torque_ACC:
CKS_CAN_TQ_DCC         = FFH

// alive_torque_ACC:
TCC_CAN_TQ_DCC         = FH

// Torque_target_ACC:
TQ_DCC_FAST_BN         = 8000H

// Torque_target_adjustment-range_posistive_ACC:
TQ_DCC_SLOW_BN         = 8000H

// state_ACC-intervention:
STATE_DCC_INTV          = 3H
LV_TQ_DCC_INC_REQ       = 0
LV_DCC_LIH_CAN          = 1

// request_prevention_over-run-fuel-shutoff:
STATE_DCC_PUC_INH = 0H
LV_DCC_PUC_INH          = 0

// status_ACC_switch-off_system_DME:
STATE_DCC_OFF_REQ       = 03H
LV_DCC_OFF_ACK          = 0

// status_ACC_mode_DME:
STATE_DCC               = 0H

// status_torque_control_ACC:
STATE_DCC_CTL           = 7H // invalid signal
    
```

**ENDIF**


**4.60.4.2 ARS-Modul**

**Formula section:**

```

STAT_ARS
IF LV_ERR_BN_ARS = 0 AND
LV_ERR_CAN_BOFF = 0
THEN // free running test cycle counter anti roll stabilization :
TCC_CAN_ARS = ALIV_COU_ARS
    
```

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```

// status anti roll stabilization :
if      ST_CLCTR_ARS      =      00b
then    STATE_ARS_CAN    =      INACTIVE
elseif  ST_CLCTR_ARS      =      01b
then    STATE_ARS_CAN    =      ACTIVE
else    STATE_ARS_CAN    =      INVALID_SIGNAL
endif

// target value torque loss ARS :
TQ_LOSS_ARS_SP_CAN      =      TORQ_TAR_ARS (converted from BN 2000)

IF      TORQ_TAR_ARS      = FFH
THEN    LV_ERR_TQ_LOSS_ARS_SP_CAN = 1
ELSE    LV_ERR_TQ_LOSS_ARS_SP_CAN = 0
ENDIF

// actual value torque loss ARS :
TQ_LOSS_ARS_AV_CAN      =      TORQ_AVL_ARS (converted from BN 2000)

IF      TORQ_AVL_ARS      = FFH
THEN    LV_ERR_TQ_LOSS_ARS_AV_CAN = 1
ELSE    LV_ERR_TQ_LOSS_ARS_AV_CAN = 0
ENDIF
ELSE    // free running test cycle counter anti roll stabilization :
TCC_CAN_ARS      =      FH

// status anti roll stabilization :
STATE_ARS_CAN      =      3H

// target value torque loss ARS :
TQ_LOSS_ARS_SP_CAN      =      8000H
LV_ERR_TQ_LOSS_ARS_SP_CAN = 1

// actual value torque loss ARS :
TQ_LOSS_ARS_AV_CAN      =      8000H
LV_ERR_TQ_LOSS_ARS_AV_CAN = 1
ENDIF

```

#### 4.60.4.3 AFS-Modul

##### Formula section:

##### DREHMOMENT\_ANF\_AFS:

```

IF      LV_ERR_BN_TQ_PSTE_2 = 0      AND
        LV_ERR_CAN_BOFF = 0
THEN    // checksum_torque_AFS:

CKS_CAN_TQ_PSTE_2      =      CHKSM_TORQ_AFS

```

*// alive\_torque\_AFS:*

TCC\_CAN\_TQ\_PSTE\_2 = ALIV\_TORQ\_AFS

*// target value torque loss AFS :*

TQ\_LOSS\_PSTE\_2\_SP\_CAN = TORQ\_TAR\_AFS (converted from BN 2000)

*// actual value torque loss AFS :*

TQ\_LOSS\_PSTE\_2\_AV\_CAN = TORQ\_AVL\_AFS (converted from BN 2000)

*// state AFS-intervention:*

```

if      ST_TORQ_TAR_AFS      = 00H
then    STATE_PSTE_2_INTV    =NO_INTERVENTION
elseif  ST_TORQ_TAR_AFS      = 01H
then    STATE_PSTE_2_INTV    =TORQUE_INCREASE
elseif  ST_TORQ_TAR_AFS      = 02H
then    STATE_PSTE_2_INTV    =TORQUE_DECREASE
elseif  ST_TORQ_TAR_AFS      = 03H
then    STATE_PSTE_2_INTV    =INVALID_SIGNAL
endif

```

```

if      ST_RQ_TORQ_AFS_ERR    = 02H      or
          ST_RQ_TORQ_AFS_ERR    = 04H
then    LV_PSTE_2_ERR = 1
else    LV_PSTE_2_ERR = 0
endif

```

**ELSE**      *// checksum\_torque\_AFS:*

CKS\_CAN\_TQ\_PSTE\_2 = FFH

*// alive\_torque\_AFS:*

TCC\_CAN\_TQ\_PSTE\_2 = FH

*// target value torque loss AFS :*

TQ\_LOSS\_PSTE\_2\_SP\_CAN = 8000H

*// actual value torque loss AFS :*

TQ\_LOSS\_PSTE\_2\_AV\_CAN = 8000H

*// state AFS-intervention:*

```

STATE_PSTE_2_INTV      =3H
LV_PSTE_2_ERR = 1
ENDIF

```

#### 4.60.4.4 CAS (car access system)

##### Formula section:

**Part calculated with 10ms recurrence (at every engine state):**

```

If          LV_STST_ST_REQ_CUS = 1
Then       T_INH_ACK_IGK_OFF = 0 s
Else       increment T_INH_ACK_IGK_OFF    (until max reached)
Endif
    
```

##### **KLEMMENSTATUS:**

```

IF          LV_ERR_BN_CAS = 0                AND
              LV_ERR_CAN_BOFF = 0
THEN       // status_klemme_R:
if         ST_KL_R = 01H
then       LV_KEY_AUX = 1
else       LV_KEY_AUX = 0
endif

// status klemme 15 :
if         ST_KL_15 = 00b
then       STATE_IGK_CAN = IGK_OFF
elseif    ST_KL_15 = 01b
then       STATE_IGK_CAN = IGK_ON
else       STATE_IGK_CAN = INVALID_SIGNAL
endif

//status positive engagement clutch:
If         ST_STCD_PENG_MSA = 1
Then       LV_CS_2 = 1
Else       LV_CS_2 = 0
Endif

// status klemme 15 HW :
If         ST_KL_15_HW = 3H
Then       STATE_IGK_HW = 2
Else       STATE_IGK_HW = ST_KL_15_HW
Endif

If         STATE_IGK_HW 2->1
Then       LV_REQ_ACK_IGK_OFF =1
Else       If         STATE_IGK_HW != 1
Then       LV_REQ_ACK_IGK_OFF =0
Else // do nothing
Endif
Endif

// status if IGK-off request from CAS can be acknowledged:
// hint: LC_IGK_OFF_ACK active = 1
If         LC_IGK_OFF_ACK = 1                and
              LV_REQ_ACK_IGK_OFF = 1          and
              VS = 0 km/h                      and
    
```

```

        LV_ERR_VS          = 0          and
        ECU_STATE          = ENG_STOP   and
LV_STST_ST_REQ_CUS = 0          and
LV_OBD_SCAN_REQ = 0          and          //see NOTE be-
low
        T_INH_ACK_IGK_OFF >= C_T_MAX_INH_ACK_IGK_OFF
Then          STATE_ACK_IGK_OFF= 1
Else          STATE_ACK_IGK_OFF= 0
Endif

```

**NOTE :** Bit LV\_OBD\_SCAN\_REQ is supplied via network layer. Purpose of this part is to make sure that KI15 will be deactivated only by pressing START/STOP button once OBD scan tool has been connected to vehicle and one of the messages in table below was sent. Switching off KL15 by power management is not possible in this state.

Requirements for LV\_OBD\_SCAN\_REQ :

- is initialised with "0" at reset
- after disconnecting OBD scan tool KI15 can be switched off by pressing START/STOP button.
- is set when OBD scan tool is connected to vehicle can and one of the messages listed in table has been sent successfully once.

CAN identifier (hex)	Description
7DF	CAN identifier for functionally addressed request messages sent by the external test equipment.
7E0	Physical request CAN identifier from the external test equipment to ECU #1
7E1	Physical request CAN identifier from the external test equipment to ECU #2
7E2	Physical request CAN identifier from the external test equipment to ECU #3
7E3	Physical request CAN identifier from the external test equipment to ECU #4
7E4	Physical request CAN identifier from the external test equipment to ECU #5
7E5	Physical request CAN identifier from the external test equipment to ECU #6
7E6	Physical request CAN identifier from the external test equipment to ECU #7
7E7	Physical request CAN identifier from the external test equipment to ECU #8

```

// status_klemme_50:
if          ST_KL_50          = 01H
then       LV_RLY_ST_CAN      = 1
else       LV_RLY_ST_CAN      = 0
endif

```

```

// key number :
VEH_KEY_NR   =          NO_KEY

```

```

// checksum_klemme CAS :
CKS_CAN_CAS  =          CHKSM_KL

```

```

// alive_klemme CAS :
TCC_CAN_CAS  =          ALIV_KL

```

```

// status_key_valid:
LV_KEY_VLD_MSG_FAILED = 0
If(1)          ST_KEY_VLD = 01H
Then(1)       LV_KEY_VLD = 1

```



```

Else(1)      if(2)          ST_KEY_VLD          = 00H
              Then(2)       LV_KEY_VLD          = 0
              Else(2)       LV_KEY_VLD          = 0
                              LV_KEY_VLD_MSG_FAILED = 1
              Endif(2)
Endif(1)

```

```

ELSE        // checksum_klemme CAS :
            CKS_CAN_CAS      =          FH
            // alive_klemme CAS :
            TCC_CAN_CAS      =          FH
            // status klemme 15 HW :
            STATE_IGK_HW     = 2H
            // status_key_valid:
            LV_KEY_VLD       = 0
            LV_KEY_VLD_MSG_FAILED = 1
            //status positive engagement clutch:
            LV_CS_2 = 0
            // status if IGK-off request from CAS can be acknowledged:
            STATE_ACK_IGK_OFF= 0
ENDIF

```

### CODIERUNG\_PM

*current\_short-circuit\_maximum\_vehicle:*  
 CUR\_SC\_MAX\_CAN = I\_SC\_MAX\_VEH

*current\_short-circuit\_minimum\_vehicle:*  
 CUR\_SC\_MIN\_CAN = I\_SC\_MIN\_VEH

*quiescent-current\_vehicle:*  
 CUR\_WKU\_CAN = QC\_VEH

*class\_battery:*  
 IDX\_BAT\_CAN = CLAS\_BT

### Fahrzeugtyp


*Class\_power*  
 STATE\_POW\_CLAS\_VEH = CLAS\_PWR  
*message Fahrzeugtyp is received :*  
 LV\_POW\_CLAS\_VEH\_CAN\_RCV = 1

### STAT\_ZV\_KLAPPEN

```

IF          LV_ERR_BN_CDN_DOOR = 0          AND
            LV_ERR_CAN_BOFF = 0
THEN
            // status_door-switch_DRD
            If          ST_DSW_DRD = 00 h
            then       LV_DRIV_DOOR_OPEN = 0
            else       LV_DRIV_DOOR_OPEN = 1

```

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```

endif
// status_contact_bonnet
If      ST_CT_BON = 00 h
then    LV_HOOD_OPEN = 0
else    LV_HOOD_OPEN = 1
endif

ELSE

LV_DRIV_DOOR_OPEN = 1
LV_HOOD_OPEN = 1

ENDIF

```

### Response CAS (EWS):

#### Frame 1:

ID a see LH EWS

IMOB\_RCV\_RESP\_CAN\_x

CTR\_IMOB\_RESP\_RCV\_CAN = CTR\_IMOB\_RESP\_RCV\_CAN or 0x1

#### Frame 2:

ID b see LH EWS

IMOB\_RCV\_RESP\_CAN\_x

CTR\_IMOB\_RESP\_RCV\_CAN = CTR\_IMOB\_RESP\_RCV\_CAN or 0x2

### 4.60.4.5 SZM

#### FAHHRZEUGMODUS

```

IF      LV_ERR_BN_VEH_MOD = 0      AND
        LV_ERR_CAN_BOFF = 0
THEN    // mode_vehicle:
STATE_VEH_MOD      =      MOD_VEH

```

#### // checksum\_mode\_vehicle:

```

CKS_CAN_VEH_MOD      =      CHKSM_MOD_VEH

```

#### // alive\_mode\_vehicle:

```

TCC_CAN_VEH_MOD      =      ALIV_MOD_VEH

```

#### // enable conditions for BN-Diag VEH\_MOD :

```

IF      CONF_SOF_SWI      = 1
THEN    LV_VAR_VEH_MOD      = 1
ELSE    LV_VAR_VEH_MOD      = 0
ENDIF
ELSE    // mode_vehicle:
STATE_VEH_MOD      =      1

```

#### // checksum\_mode\_vehicle:

```

CKS_CAN_VEH_MOD      =      FFH


```

#### // alive\_mode\_vehicle:

```

TCC_CAN_VEH_MOD      =      FH

```

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**ENDIF**

**CTR\_CRASH\_SWO\_EKP**

*control\_crash\_switch-off\_EKP:*

```

IF                LV_ERR_BN_EFP_CRASH = 0          and
                   LV_ERR_CAN_BOFF = 0
THEN              IF          CTR_CR_SWO_EKP = AH
                   THEN          STATE_EFP_CRASH_CAN = 2H
                   ELSE          STATE_EFP_CRASH_CAN = 0H
                   ENDIF
ELSE              STATE_EFP_CRASH_CAN = FFH
ENDIF
    
```

**4.60.4.6 DSC-Modul**

Formula section:

**DREHMOMENT\_ANF\_DSC**

```

IF                LV_ERR_BN_TQ_TCS = 0          AND
                   LV_ERR_CAN_BOFF = 0
THEN              // checksum_torque_DSC:
                   CKS_CAN_TQ_TCS      =   CHKSM_TORQ_DSC

                   // free running test cycle counter TCS :
                   TCC_CAN_TQ_TCS      =   ALIV_TORQ_DSC

                   // Torque_target_DSC:
                   TQ_TCS_FAST_BN      =   TORQ_TAR_DSC

                   // Torque_target_adjustment-range_posistive_DSC:
                   IF          LV_TQ_MSR_REQ = 1          AND
                   LC_MSR_BN = 1
                   THEN      TQ_TCS_SLOW_BN = TQ_TCS_FAST_BN
                   ELSE      TQ_TCS_SLOW_BN = TORQ_TAR_ADJR_POS_TCS
                   ENDIF
    
```

*// state TCS-intervention :*

```

if                ST_TORQ_TAR_DSC      =           00b
then              STATE_TCS_INTV      =           NO_INTERVENTION
elseif           ST_TORQ_TAR_DSC      =           01b
                   then              STATE_TCS_INTV      =           MSR_INTERVENTION
                   LV_TQ_MSR_REQ = 1
                   else              LV_TQ_MSR_REQ = 0
                   endif
elseif           ST_TORQ_TAR_DSC      =           10b
                   then              STATE_TCS_INTV      =           ASR_INTERVENTION
                   LV_TQ_ASR_REQ = 1
                   else              LV_TQ_ASR_REQ = 0
                   endif
elseif           ST_TORQ_TAR_DSC      =           11b
    
```

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```

then      STATE_TCS_INTV          =      INTERFACE_LOCKED
          LV_TCS_LIH_CAN = 1
else      LV_TCS_LIH_CAN = 0
endif

endif
ELSE      // checksum_torque_DSC:
          CKS_CAN_TQ_TCS          =      FFH

          // free running test cycle counter TCS :
          TCC_CAN_TQ_TCS          =      FH

          // Torque_target_DSC:
          TQ_TCS_FAST_BN          =      8000H

          // Torque_target_adjustment-range_posistive_DSC:
          TQ_TCS_SLOW_BN =      8000H

          // state TCS-intervention :
          STATE_TCS_INTV          =      3H
          LV_TCS_LIH_CAN          =      1
          LV_TQ_MSR_REQ           =      0
          LV_TQ_ASR_REQ           =      0

ENDIF

```

**Geschwindigkeit:**

```

IF      LV_ERR_BN_VS_TCS = 0      AND
        LV_ERR_CAN_BOFF = 0

THEN    //speed_vehicle:
        VS_CAN          =      V_VEH      (converted from BN2000)
        WHEEL          =      V_VEH      (converted from BN2000)

        IF      V_VEH          =      FFFH
        THEN    LV_ERR_VS_CAN = 1
        ELSE    LV_ERR_VS_CAN = 0
        ENDIF

        // acceleration_vehicle_longitudinal_DSC:
        IF      ACLN_VEH_LN_DSC =      800H      //Signal invalid
        THEN    AC_VEH_LGT_TCS          =      0 m/s**2
        ELSE    AC_VEH_LGT_TCS          =      ACLN_VEH_LN_DSC
                (converted from BN2000)
        ENDIF

        // acceleration_vehicle_across_DSC:
        IF      ACLN_VEH_ACRO_DSC =      800H      //Signal invalid
        THEN    AC_VEH_TRV_TCS          =      0 m/s**2
        ELSE    AC_VEH_TRV_TCS          =      ACLN_VEH_ACRO_DSC
                (converted from BN2000)
        ENDIF

```

```

ELSE      //speed_vehicle:
VS_CAN    =      FFH
WHEEL     =      FFFFH
LV_ERR_VS_CAN = 1

// acceleration_vehicle_longitudinal_DSC:
AC_VEH_LGT_TCS      =      0 m/s**2

// acceleration_vehicle_across_DSC:
AC_VEH_TRV_TCS      =      0 m/s**2

ENDIF

```

### ***Geschwindigkeit\_Rad:***

This message will not be read into internal variables and evaluated as for rough road detection the function of CAN11h will be used.

### **STAT\_DSC:**

```

IF          LV_ERR_BN_TCS = 0      AND
           LV_ERR_CAN_BOFF = 0


THEN      // status close-loop-control via CAN:
if        ST_CLCTR      = 0000 0000b
then      STATE_TCS_CTL = NO_CONTROL
elseif    ST_CLCTR      = 0000 0001b
then      STATE_TCS_CTL = ABS_CONTROL
elseif    ST_CLCTR      = 0000 0010b
then      STATE_TCS_CTL = ASR_CONTROL
elseif    ST_CLCTR      = 0000 0100b
then      STATE_TCS_CTL = TCS_CONTROL
elseif    ST_CLCTR      = 0000 1000b
then      STATE_TCS_CTL = HBA_CONTROL
elseif    ST_CLCTR      = 0001 0000b
then      STATE_TCS_CTL = MSR_CONTROL
elseif    ST_CLCTR      = 0010 0000b
then      STATE_TCS_CTL = EBV_CONTROL
elseif    ST_CLCTR      = 0100 0000b
then      STATE_TCS_CTL = DYNO_ACTIVE
elseif    ST_CLCTR      = 1111 1111b
then      STATE_TCS_CTL = SIGNAL_INVALID
else      STATE_TCS_CTL = MULTI_CONTROL
endif

IF          ST_CLCTR != 1111 1111b      AND
(ST_CLCTR[Bit 0] = 1 OR //ABS_CONTROL
 ST_CLCTR[Bit 1] = 1 OR //ASR_CONTROL
 ST_CLCTR[Bit 4] = 1) //MSR_CONTROL

THEN      LV_PLAUS_ASR_CTL = 1
ELSE      LV_PLAUS_ASR_CTL = 0
ENDIF

IF          ST_CLCTR != 1111 1111b      AND

```

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```

        ST_CLCTR[Bit 2] = 1           // DSC/TCS_CONTROL
THEN    LV_PLAUS_ESP_CTL = 1
ELSE    LV_PLAUS_ESP_CTL = 0
ENDIF

// chassis control function active:
IF      ST_CLCTR != 1111 1111b      AND
(ST_CLCTR[Bit 0] = 1 OR           // ABS_CONTROL
 ST_CLCTR[Bit 1] = 1 OR           // ASR_CONTROL
 ST_CLCTR[Bit 2] = 1 OR           // DSC_CONTROL
 ST_CLCTR[Bit 3] = 1)            // HBA_CONTROL
THEN    LV_TCS_CTL_ACT = 1
ELSE    LV_TCS_CTL_ACT = 0
ENDIF

// status traction control system via CAN :
if      ST_DSC = 000b
then    STATE_TCS_CAN = VALID
elseif ST_DSC = 001b
then    STATE_TCS_CAN = PASSIV
elseif ST_DSC = 010b
then    STATE_TCS_CAN = DEFECTIVE
elseif ST_DSC = 100b
then    STATE_TCS_CAN = TRACTION_MODE
elseif ST_DSC = 110 b
then    STATE_TCS_CAN = UNDERVOLTAGE_TCS
elseif ST_DSC = 111b
then    STATE_TCS_CAN = INVALID_SIGNAL
endif

// ST_DSC - status deceleration actual-value:
if      ST_DCRN_AVL = 0H
then    STATE_TCS_DECE = NO_INTERVENTION
elseif ST_DCRN_AVL = 1H
then    STATE_TCS_DECE = DCC_INTV_ACCEPTED
elseif ST_DCRN_AVL = 2H
then    STATE_TCS_DECE = EMF_INTV_ACCEPTED
elseif ST_DCRN_AVL = 3H
then    STATE_TCS_DECE = HBA_INTV_ACCEPTED
elseif ST_DCRN_AVL = FH
then    STATE_TCS_DECE = SIGNAL_INVALID
endif

// status brake-pressure:
STATE_BRAKE_PRS = ST_BRP

// brake-pressure:
BRAKE_PRS = BRP
ELSE
    // status close-loop-control via CAN:
    STATE_TCS_CTL = 0H

```

```

LV_PLAUS_ASR_CTL = 0
LV_PLAUS_ESP_CTL = 0

//status chassis control functions
LV_TCS_CTL_ACT = 0

// status traction control system via CAN :
STATE_TCS_CAN   =   7H

// ST_DSC - status deceleration actual-value:
STATE_TCS_DECE  =   0H

// status brake-pressure:
STATE_BRAKE_PRS   =   2H

// brake-pressure:
BRAKE_PRS        =   FFH

```

**ENDIF**

#### 4.60.4.7 EGS-Modul


##### Formula section:

##### **DREHMOMENT\_ANF\_EGS**

```

IF(1)      LV_ERR_BN_TQ_ETCU = 0           AND
             LV_ERR_CAN_BOFF = 0
THEN(1)   // Checksum ETCU:
             CKS_CAN_TQ_ETCU      =      CHKSM_TORQ_EGS
             // Alive-Counter ETCU:
             TCC_CAN_TQ_ETCU      =      ALIV_TORQ_EGS
             // Torque_target _EGS:
             TQ_GS_FAST_BN        =      TORQ_TAR_EGS
             // Torque_target_adjustment-range_posistive _EGS:
             TQ_GS_SLOW_BN        =      TORQ_TAR_ADJR_POS_EGS
             // state ETCU-intervention :
             if      ST_TORQ_TAR_EGS      =      00H
             then    STATE_ETCU_INTV      =      NO_INTERVENTION
             elseif  ST_TORQ_TAR_EGS      =      01H
                 then    STATE_ETCU_INTV      =      TORQUE_INCREASE
                 LV_TQ_GS_INC_REQ = 1
                 LV_TQ_GS_DEC_REQ = 0
             else
                 LV_TQ_GS_INC_REQ = 1
                 LV_TQ_GS_DEC_REQ = 0
             endif
             elseif  ST_TORQ_TAR_EGS      =      02H
                 then    STATE_ETCU_INTV      =      TORQUE_DECREASE
                 LV_TQ_GS_DEC_REQ = 1
                 LV_TQ_GS_INC_REQ = 0
             else
                 LV_TQ_GS_DEC_REQ = 1
                 LV_TQ_GS_INC_REQ = 0
             endif
             elseif  ST_TORQ_TAR_EGS      =      03H
                 then    STATE_ETCU_INTV      =      INTERFACE_LOCKED

```

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```

                LV_ETCU_LIH_CAN = 1
            else
                LV_ETCU_LIH_CAN = 0
            endif

endif

// status_OBD_gearbox ST_OBD_GRB:
IF
    ST_OBD_GRB = 00H
THEN
    STATE_ETCU_OBD = MIL_OFF
ELSEIF
    ST_OBD_GRB = 02H
THEN
    STATE_ETCU_OBD = MIL_OFF
ELSEIF
    ST_OBD_GRB = 04H
THEN
    STATE_ETCU_OBD = MIL_ON
ELSEIF
    ST_OBD_GRB = 06H
THEN
    STATE_ETCU_OBD = MIL_ON
ELSEIF
    ST_OBD_GRB = 08H
THEN
    STATE_ETCU_OBD = MIL_FLL
ELSEIF
    ST_OBD_GRB = 0AH
THEN
    STATE_ETCU_OBD = MIL_FLL
ELSEIF
    ST_OBD_GRB = 0CH
THEN
    STATE_ETCU_OBD = IDLE
ELSEIF
    ST_OBD_GRB = 0EH
THEN
    STATE_ETCU_OBD = INI_VALUE
ELSEIF
    ST_OBD_GRB = 0FH
THEN
    STATE_ETCU_OBD = INVALID_SIGNAL
ENDIF

```

```

// status_OBD_error_gearbox:
IF
    ST_OBD_ERR_GRB = 00H
THEN
    STATE_ETCU_OBD_ERR = NO_OBD_ERROR
ELSEIF
    ST_OBD_ERR_GRB = 01H
THEN
    STATE_ETCU_OBD_ERR = OBD_ERROR
ELSEIF
    ST_OBD_ERR_GRB = 02H
THEN
    STATE_ETCU_OBD_ERR = INVALID_SIGNAL
ENDIF

```

```

// Status starting torque limitation:
IF
    ST_LIM_STORQ = 00H
THEN
    STATE_ST_TQ_LIM_GS = NO_INTERVENTION
ELSEIF
    ST_LIM_STORQ = 01H
THEN
    STATE_ST_TQ_LIM_GS = INTERVENTION
ELSEIF
    ST_LIM_STORQ = 02H
THEN
    STATE_ST_TQ_LIM_GS = INVALID_SIGNAL
ENDIF

```

```

// Torque_draw gearbox:
if
    TORQ_DRAW_GRB = FFH
then
    TQ_CONV_CAN = 0 Nm
else
    TQ_CONV_CAN = TORQ_DRAW_GRB
endif

```

```

// Temperature gearbox:
IF
    LV_AT = 1
THEN
    IF
        TEMP_GRB = FFH

```



```

        THEN      TEMP_GB      = C_TEMP_GB_SUB
        ELSE      TEMP_GB      = TEMP_GRB
        ENDIF
ELSE      TEMP_GB      = -40 °C
ENDIF

// Status_overtemperature_gearbox:
IF      LV_AT = 1
THEN    IF      ST_OTMP_GRB      = 00b
        THEN    STATE_TEMP_GB      = NO_REQUEST
        ELSEIF  ST_OTMP_GRB      = 01b
        THEN    STATE_TEMP_GB      = ACTIVE_STEP_1
        ELSEIF  ST_OTMP_GRB      = 10b
        THEN    STATE_TEMP_GB      = ACTIVE_STEP_2
        ELSEIF  ST_OTMP_GRB      = 11b
        THEN    STATE_TEMP_GB      = INVALID_SIGNAL
        ENDIF
ELSE    STATE_TEMP_GB = NO_REQUEST
ENDIF

ELSE(1) // Checksum ETCU:
CKS_CAN_TQ_ETCU      =      FFH

// Alive-Counter ETCU:
TCC_CAN_TQ_ETCU      =      FH

// Torque_target_EGS:
TQ_GS_FAST_BN      =      8000H

// Torque_target_adjustment-range_posistive_EGS:
TQ_GS_SLOW_BN      =      8000H

// state ETCU-intervention :
STATE_ETCU_INTV      =      3H
LV_ETCU_LIH_CAN      =      1
LV_TQ_GS_INC_REQ      =      0
LV_TQ_GS_DEC_REQ      =      0

// status_OBD_gearbox ST_OBD_GRB:
STATE_ETCU_OBD      =      EH


// status_OBD_error_gearbox:
STATE_ETCU_OBD_ERR      =      3H

// Status starting torque limitation:
STATE_ST_TQ_LIM_GS      = INVALID_SIGNAL (3H)

// Torque_draw_gearbox:
TQ_CONV_CAN      = 0 Nm

// Temperature gearbox:
TEMP_GB      = 0H

```

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```
// Status_overttemperature_gearbox:
STATE_TEMP_GB = 0H
```

```
ENDIF(1)
```

#### 4.60.4.8 SSG-Modul

##### Formula section:

##### DREHMOMENT\_ANF\_SSG

```
IF          LV_ERR_BN_TQ_AMT = 0          AND
           LV_ERR_CAN_BOFF = 0
```

```
THEN      // Checksum TQ_AMT:
CKS_CAN_TQ_AMT      =      CHKSM_TORQ_SSG
```

```
// Alive-Counter TQ_AMT:
TCC_CAN_TQ_AMT      =      ALIV_TORQ_SSG
```

```
// Torque_target_SSG:
TQ_AMT_FAST_BN      =      TORQ_TAR_SSG
```

```
// Torque_target_adjustment-range_positive:
TQ_AMT_SLOW_BN      =      TORQ_TAR_ADJR_POS_SSG
```

```
// state ETCU-intervention STATE_AMT_INTV:
```

```
if          ST_TORQ_TAR_SSG      = 00H
then        STATE_AMT_INTV      =NO_INTERVENTION
elseif     ST_TORQ_TAR_SSG      = 01H
           then STATE_AMT_INTV      =TORQUE_INCREASE
           LV_TQ_AMT_INC_REQ = 1
else        LV_TQ_AMT_INC_REQ = 0
endif
elseif     ST_TORQ_TAR_SSG      = 02H
           then STATE_AMT_INTV      =TORQUE_DECREASE
           LV_TQ_AMT_DEC_REQ = 1
else        LV_TQ_AMT_DEC_REQ = 0
endif
elseif     ST_TORQ_TAR_SSG      = 03H
           then STATE_AMT_INTV      =INTERFACE_LOCKED
           LV_AMT_LIH_CAN = 1
else        LV_AMT_LIH_CAN = 0
endif
endif
```

```
// status_OBD_gearbox ST_OBD_GRB_SSG:
```

```
IF          ST_OBD_GRB_SSG      =      00H
THEN        STATE_AMT_OBD      =      MIL_OFF
ELSEIF     ST_OBD_GRB_SSG      =      02H
THEN        STATE_AMT_OBD      =      MIL_OFF
ELSEIF     ST_OBD_GRB_SSG      =      04H
THEN        STATE_AMT_OBD      =      MIL_ON
```

```

ELSEIF ST_OBD_GRB_SSG = 06H
THEN STATE_AMT_OBD = MIL_ON
ELSEIF ST_OBD_GRB_SSG = 08H
THEN STATE_AMT_OBD = MIL_FLL
ELSEIF ST_OBD_GRB_SSG = 0AH
THEN STATE_AMT_OBD = MIL_FLL
ELSEIF ST_OBD_GRB_SSG = 0CH
THEN STATE_AMT_OBD = IDLE
ELSEIF ST_OBD_GRB_SSG = 0EH
THEN STATE_AMT_OBD = INI_VALUE
ELSEIF ST_OBD_GRB_SSG = 0FH
THEN STATE_AMT_OBD = INVALID_SIGNAL
ENDIF

```

*// status\_OBD\_error\_gearbox ST\_OBD\_ERR\_GRB\_SSG:*

```

IF ST_OBD_ERR_GRB_SSG = 00H
THEN STATE_AMT_OBD_ERR = NO_OBD_ERROR
ELSEIF ST_OBD_ERR_GRB_SSG = 01H
THEN STATE_AMT_OBD_ERR = OBD_ERROR
ELSE STATE_AMT_OBD_ERR = INVALID_SIGNAL
ENDIF

```

*// Status starting torque limitation:*

```

IF ST_LIM_STORQ_SSG = 00H
THEN STATE_ST_TQ_LIM_AMT = NO_INTERVENTION
ELSEIF ST_LIM_STORQ_SSG = 01H
THEN STATE_ST_TQ_LIM_AMT = INTERVENTION
ELSE STATE_ST_TQ_LIM_AMT = INVALID_SIGNAL
ENDIF

```

*// Status shift-process SSG:*

```

IF ST_SHPS_SSG = 00H
THEN STATE_AMT = NO_INTERVENTION
ELSEIF ST_SHPS_SSG = 01H
THEN STATE_AMT = TORQUE_DECREASE
ELSEIF ST_SHPS_SSG = 02H
THEN STATE_AMT = N_REGULATION
ELSEIF ST_SHPS_SSG = 03H
THEN STATE_AMT = TORQUE_INCREASE
ELSEIF ST_SHPS_SSG = 07H
THEN STATE_AMT = INVALID_SIGNAL
ENDIF

```

*// Status clutch SSG:*

```

IF ST_CLT_SSG = 00H
THEN STATE_CLU_AMT = CLU_OPEN
ELSEIF ST_CLT_SSG = 01H
THEN STATE_CLU_AMT = CREEPING
ELSEIF ST_CLT_SSG = 02H
THEN STATE_CLU_AMT = DRIVE_OFF
ELSEIF ST_CLT_SSG = 03H
THEN STATE_CLU_AMT = CLU_CLOSED

```

```

ELSEIF      ST_CLT_SSG      = 07H
THEN        STATE_CLU_AMT    = INVALID_SIGNAL
ENDIF

```

*// Request engine-stop:*

```

IF          RQ_MOTORSTOP = 01H
THEN        LV_AMT_ES = 1
ELSE        LV_AMT_ES = 0
ENDIF

```

*// Limit\_RPM\_engine:*

```

N_MAX_AMT_CAN      =      LIM_RPM_ENG
(converted from BN2000)

```

*// Status gear-shift SSG:*

```

IF          ST_GRLV_ACV = 01H
THEN        LV_GS = 1
ELSE        LV_GS = 0
ENDIF

```

*ELSE // Checksum TQ\_AMT:*

```

CKS_CAN_TQ_AMT      =      FFH

```

*// Alive-Counter TQ\_AMT:*

```

TCC_CAN_TQ_AMT      =      FH

```

*// Torque\_target\_SSG:*

```

TQ_AMT_FAST_BN      =      8000H

```

*// Torque\_target\_adjustment-range\_positive:*

```

TQ_AMT_SLOW_BN      =      8000H

```

*// state ETCU-intervention STATE\_AMT\_INTV:*

```

STATE_AMT_INTV      =3H
LV_AMT_LIH_CAN      = 1
LV_TQ_AMT_INC_REQ   = 0
LV_TQ_AMT_DEC_REQ   = 0

```

*// status\_OBD\_gearbox ST\_OBD\_GRB\_SSG:*

```

STATE_AMT_OBD      =      EH

```

*// status\_OBD\_error\_gearbox ST\_OBD\_ERR\_GRB\_SSG:*

```

STATE_AMT_OBD_ERR   = INVALID_SIGNAL (2)

```

*// Status starting torque limitation:*

```

STATE_ST_TQ_LIM_AMT = INVALID_SIGNAL (3H)

```

*// Status shift-process SSG:*

```

STATE_AMT           = 0

```

*// Status clutch SSG:*

```

STATE_CLU_AMT      = 0

```

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```
// Request engine-stop:
LV_AMT_ES = 0
```

```
// Limit_RPM_engine:
N_MAX_AMT_CAN      =      0H
```

```
// Status gear-shift SSG:
LV_GS = 0
ENDIF
```

#### 4.60.4.9 DKG-Modul (TCT)

DREHMOMENT\_ANF\_DKG (ID = B8h)

##### Application conditions

**Initialisation:**            *all 0*

**Recurrence:**            *message received with recurrence 10ms (tmin = 9ms, tmax = 11ms)*

**Activation:**            *LV\_VAR\_TCT = 1*

##### Formula section:

```
IF(1)      LV_ERR_BN_TQ_TCT = 0                AND
           LV_ERR_CAN_BOFF = 0

THEN(1)

// Checksum TCT:
CKS_CAN_TQ_TCT      =      CHKSM_TORQ_DKG
// Alive-Counter TCT:
TCC_CAN_TQ_TCT      =      ALIV_TORQ_DKG
// Torque_target_TCT:
TQ_GS_FAST_BN      =      TORQ_TAR_DKG                (con-
verted)
// Torque_target_adjustment-range_posistive_TCT:
TQ_GS_SLOW_BN      =      TORQ_TAR_ADJR_POS_DKG      (converted)

// state TCT-mode :
LV_TQ_GS_INC_REQ = 0
LV_TQ_GS_DEC_REQ = 0
LV_TCT_LIH_CAN = 0
LV_TCT_ES      = 0
LV_N_SP_TCT_REQ = 0
if      ST_MOD_DKG                =      00H
then    STATE_TCT_INTV            =      NO_INTERVENTION
elseif  ST_MOD_DKG                =      02H
then    STATE_TCT_INTV            =      CREEP
elseif  ST_MOD_DKG                =      03H
then    STATE_TCT_INTV            =      TCT_INTV_DEC
LV_TQ_GS_DEC_REQ = 1
elseif  ST_MOD_DKG                =      04H
then    STATE_TCT_INTV            =      TCT_INTV_INC
LV_TQ_GS_INC_REQ = 1
```

```

elseif    ST_MOD_DKG                =    06H
then      STATE_TCT_INTV            =    N_REGULATION
LV_N_SP_TCT_REQ = 1
elseif    ST_MOD_DKG                =    0CH
then      STATE_TCT_INTV            =    TQ_DEC
elseif    ST_MOD_DKG                =    0DH
then      STATE_TCT_INTV            =    TCT_ES
LV_TCT_ES    = 1
elseif    ST_MOD_DKG                =    0FH
then      STATE_TCT_INTV            =    INVALID
LV_TCT_LIH_CAN = 1
endif

//torque_clutch_DKG:
IF        TORQ_CLT_DKG              = FFFH
THEN      TQ_TCT_CAN = 0 Nm
ELSE      TQ_TCT_CAN = MAX (0 Nm; TORQ_CLT_DKG)    (converted)
ENDIF

//RPM_target_engine_DKG:
If        RPM_TAR_ENG_DKG != FFFH
Then      N_SP_TCT = RPM_TAR_ENG_DKG    (converted)

LV_N_SP_TCT = LV_N_SP_TCT_REQ
Else      N_SP_TCT = 0
LV_N_SP_TCT = 0
Endif

// status_OBD_gearbox ST_OBD_GRB:
STATE_ETCU_OBD    =    EH

// status_OBD_error_gearbox:
STATE_ETCU_OBD_ERR    =    3H

// Status starting torque limitation:
STATE_ST_TQ_LIM_GS    =    INVALID_SIGNAL    (3H)

// Torque_draw gearbox:
TQ_CONV_CAN    = 0 Nm

ELSE(1)


// Checksum ETCU:
CKS_CAN_TQ_TCT    =    FFH

// Alive-Counter ETCU:
TCC_CAN_TQ_TCT    =    FH

// Torque_target_EGS:
TQ_GS_FAST_BN    =    8000H

// Torque_target_adjustment-range_posistive_EGS:
TQ_GS_SLOW_BN    =    8000H

```

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```

// state ETCU-intervention :
STATE_TCT_INTV          =      FH
LV_TCT_LIH_CAN          =      1
LV_TQ_GS_INC_REQ       =      0
LV_TQ_GS_DEC_REQ       =      0
LV_TCT_ES               =      0
LV_N_SP_TCT_REQ        =      0

// torque_clutch_DKG:
TQ_TCT_CAN              =      0H

//RPM_target_engine_DKG:
N_SP_TCT = 0H
LV_N_SP_TCT = 0

// status_OBD_gearbox ST_OBD_GRB:
STATE_ETCU_OBD          =      EH

// status_OBD_error_gearbox:
STATE_ETCU_OBD_ERR      =      3H

// Status starting torque limitation:
STATE_ST_TQ_LIM_GS      =  INVALID_SIGNAL (3H)

// Torque_draw gearbox:
TQ_CONV_CAN             = 0 Nm

```

**ENDIF (1)**

**ST\_DKG ( Status DKG) (ID =37D h)**

### Application conditions

**Initialisation:** *at reset TEMP\_GB = -40 °C, STATE\_TEMP\_GB = NO\_REQUEST*

**Recurrence:** *1 s (tmin=0.9s, tmax=1.1s)*

**Activation:** *LV\_VAR\_TCT = 1*

### Formula section:

```

:
IF          LV_ERR_CAN_BOFF = 0 AND
              LV_ERR_BN_STAT_TCT = 0
THEN
              // Temperature gearbox:
              IF          TEMP_DKG = FFH
              THEN          TEMP_GB      = C_TEMP_GB_SUB
ELSE          TEMP_GB      = TEMP_DKG
ENDIF


```

*// Status\_Overtemperature\_gearbox:*

```

IF          ST_OTMP_DKG      = 00b

```

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```

        THEN      STATE_TEMP_GB      = NO_REQUEST
        Elseif    ST_OTMP_DKG        = 01b
        THEN      STATE_TEMP_GB      = ACTIVE_STEP_1
        Elseif    ST_OTMP_DKG        = 10b
        THEN      STATE_TEMP_GB      = ACTIVE_STEP_2
        Elseif    ST_OTMP_DKG        = 11b
        THEN      STATE_TEMP_GB      = INVALID_SIGNAL
    ENDIF

ELSE      setting default values:
        TEMP_GB      = -40 °C
        STATE_TEMP_GB      = NO_REQUEST
ENDIF

```

#### 4.60.4.10 Transmission Data ( from EGS, SSG or DKG)

##### GETRIEBEDATEN (ID = BAh)

##### Application conditions

**Initialisation:**        *all 0*

**Recurrence:**        *message received with recurrence 20ms (tmin = 19ms, tmax = 21ms)*

**Activation:**        *LV\_VAR\_ETCU = 1*

##### Formula section:

```

IF      LV_ERR_BN_ETCU = 0      AND
        LV_ERR_CAN_BOFF = 0

THEN    // checksum ETCU :
        CKS_CAN_ETCU = CHKSM_GRB
        // Alive counter ETCU:
        TCC_CAN_ETCU = ALIV_GRB

        // target gear information from ETCU :
        if      ST_GR_GRB      = 0000b      (reserve)
            or   ST_GR_GRB      = 0001b      (Neutral)
            or   ST_GR_GRB      = 0011b      (Park)
            or   ST_GR_GRB      = 1111b      (invalid signal)

        then    GEAR_INFO      = 00H
        elseif  ST_GR_GRB      = 0101b      (1.gear)
        then    GEAR_INFO      = 01H
        elseif  ST_GR_GRB      = 0110b      (2.gear)
        then    GEAR_INFO      = 02H
        elseif  ST_GR_GRB      = 0111b      (3.gear)
        then    GEAR_INFO      = 03H
        elseif  ST_GR_GRB      = 1000b      (4.gear)
        then    GEAR_INFO      = 04H
        elseif  ST_GR_GRB      = 1001b      (5.gear)
        then    GEAR_INFO      = 05H

```



```

elseif    ST_GR_GRB      = 1010b      (6.gear)
then      GEAR_INFO      = 06H
elseif    ST_GR_GRB      = 1011b      (7.gear)
then      GEAR_INFO      = 07H
elseif    ST_GR_GRB      = 0010b      (reverse gear)
then      GEAR_INFO      = 0AH
endif

```

*//gearbox-drive-train\_reinforcement:*

```

If        GRDT_REIN      <      FFEH
Then      FAC_GB_GAIN    = GRDT_REIN
Else      FAC_GB_GAIN    = 00H
Endif

```

*//data sent only by EGS (LV\_AT):*

```

IF        LV_AT = 1
THEN

```

*// Status\_torque-converter-lockup-clutch:*

```

IF          ST_CCLT      = 0H
THEN          STATE_CC      = CC open
ELSEIF      ST_CCLT      = 1H
THEN          STATE_CC      = CC controlled
ELSEIF      ST_CCLT      = 02H
THEN          STATE_CC      = CC closed
ELSEIF      ST_CCLT      = 03H
THEN          STATE_CC      = Signal invalid
ENDIF

```

*// Status\_mode\_gearbox:*

```

IF          ST_MOD_GRB    = 00H
THEN          STATE_MOD_GB  = SSC_SBC_OFF
ELSEIF      ST_MOD_GRB    = 01H
THEN          STATE_MOD_GB  = SSC_ON
ELSEIF      ST_MOD_GRB    = 02H
THEN          STATE_MOD_GB  = SBC_ON
ELSEIF      ST_MOD_GRB    = 03H
THEN          STATE_MOD_GB  = SSC_SBC_ON
ELSEIF      ST_MOD_GRB    = 07H
THEN          STATE_MOD_GB  = INVALID SIGNAL
ENDIF

```

**ENDIF**

*//data sent only by SSG (LV\_VAR\_AMT):*

```

IF          LV_VAR_AMT = 1
THEN

```

*// Status\_hydraulic-pump\_active ST\_HYPP\_ACV:*

```

IF          ST_HYPP_ACV    = 1
THEN          LV_PUMP_AMT_ON = 1
ELSE          LV_PUMP_AMT_ON = 0
ENDIF

```

**ENDIF**

```
//data received from DKG or EGS (LV_VAR_TCT or LV_AT):
```

```
IF      LV_VAR_TCT = 1 or LV_AT = 1
THEN
    // Status gear-shift:
    IF      ST_GRLV_ACV = 01H
    THEN    LV_GS = 1
    ELSE    LV_GS = 0
    ENDIF
ENDIF
```

```
//data sent only by DKG (LV_VAR_TCT):
```

```
IF      LV_VAR_TCT = 1
THEN
    // status race start:
    STATE_MAX_AC_ST = ST_RSTA
ENDIF
```

**ELSE**

```
// target gear information from ETCU :
GEAR_INFO      = 00H
```

```
//gearbox-drive-train_reinforcement:
FAC_GB_GAIN     = 00H
```

```
// Status_torque-converter-lockup-clutch:
STATE_CC        = 3H
```

```
// Status_mode_gearbox:
STATE_MOD_GB    = 07H
```

```
// Status_hydraulic-pump_active ST_HYPP_ACV:
LV_PUMP_AMT_ON = 0
```

```
IF      LV_VAR_TCT = 1 or LV_AT = 1
THEN
    // Status gear-shift EGS:
    LV_GS = 0
ENDIF
```

```
IF      LV_VAR_TCT = 1
THEN
    // Status race start:
    STATE_MAX_AC_ST = 11b
ENDIF
```

```
// checksum ETCU :
CKS_CAN_ETCU = FFH
// Alive counter ETCU:
TCC_CAN_ETCU = FH
```

**ENDIF**

**GETRIEBEDATEN 2 (ID = 1A2h)****Application conditions****Initialisation:** *all 0***Recurrence:** *message received with recurrence 20ms (tmin = 19ms, tmax = 21ms)***Activation:** *LV\_VAR\_TCT = 1 or LV\_AT = 1***Formula section:**

```

If          LV_ERR_CAN_BOFF = 0 and
              LV_ERR_BN_ETCU_2 = 0
Then       //RPM_gearbox_turbine:
              N_GB          = RPM_GRB_TURB

              //data sent only by DKG (LV_VAR_TCT):
IF         LV_VAR_TCT = 1
              THEN
                // request_boost_RPM_idling:
                if      RQ_BST_RPM_IDLG      !=      FFH
                Then    N_SP_IS_TCT_CAN      =      RQ_BST_RPM_IDLG
                Else    N_SP_IS_TCT_CAN      =      0
                Endif
                // Status_starting_clutch:
                STATE_ETCU_CLU = ST_STCLT
              ENDIF

              //status if forced-shift up is active in actual gear shift mode:
IF         ST_RCOG_FSHUP = 0
THEN       LV_INH_GP_SUP = 0
ELSE       LV_INH_GP_SUP = 1
ENDIF

              //RPM_at_gearbox_output /drivetrain turbine:
              N_GB_OUT = RPM_GRB_NEGL_2          (converted)

              //request dynamisation of engine-rpm signal for display (kombi) :
IF         RQ_GRB_DYNS_DISP_RPM_ENG = 01b
THEN       LV_N_DISP_DYN = 1
ELSE       LV_N_DISP_DYN = 0
ENDIF

              //status of gearbox sport switch:
              STATE_ETCU_SPT_SWI = ST_GRB_SSW

Else

              // request_boost_RPM_idling:
              N_SP_IS_TCT_CAN          = 0H

              //RPM_gearbox_turbine:

```

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```

N_GB          = 0
// Status_starting_clutch:
STATE_ETCU_CLU          = 0
//status if forced-shift up is active in actual gear shift mode:
LV_INH_GP_SUP = 1
//RPM_at_gearbox_output /drivetrain turbine:
N_GB_OUT = 0 rpm
//request dynamisation of engine-rpm signal for display (kombi) :
LV_N_DISP_DYN = 0
//status of gearbox sport switch:
STATE_ETCU_SPT_SWI = 3H

```

**ENDIF**

### GETRIEBEDATEN 3 (ID = 3B1h):

#### Application conditions

**Initialisation:** all 0  
except: VS\_MAX\_LIH\_TCT = 7FFFH

**Recurrence:** message received with recurrence 100ms (tmin = 90ms, tmax = 110ms) and event triggered (tmin=50ms)


**Activation:** LV\_VAR\_ETCU\_3 = 1

#### Formula section:

```

If          LV_ERR_CAN_BOFF = 1          or
              LV_ERR_BN_ETCU_3 = 1
Then       TCC_CAN_ETCU_3      = FH
              CKS_CAN_ETCU_3      = FFH
              ipm_typ_fp           = 0
              ipm_typ_mdkw        = 0
              dm_ab_fws           = -32768 Nm
              //data sent only by DKG (LV_VAR_TCT):
IF         LV_VAR_TCT = 1
              THEN
                  LV_MIL_REQ_ETCU      = 0
                  VS_MAX_LIH_TCT      = 7FFFH
              ENDIF
Else       // Checksum ETCU:
              CKS_CAN_ETCU_3          = CHKSM_GRB_3
              // Alive-Counter ETCU:
              TCC_CAN_ETCU_3          = ALIV_GRB_3
              if          IDX_ACPD > 5H // not defined and invalid case
              then       ipm_typ_fp      = 0
              else       ipm_typ_fp      = IDX_ACPD
              endif
              if          IDX_TORQ_FIL > 5H // not defined and invalid case
              then       ipm_typ_mdkw = 0
              else       ipm_typ_mdkw = IDX_TORQ_FIL
              endif
              if          TORQ_DVCH_RISE = FFFH // invalid case

```

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```

then      dm_ab_fws      = -32768 Nm
else      dm_ab_fws      = TORQ_DVCH_RISE (converted from BN)
endif
//data sent only by DKG (LV_VAR_TCT):
IF       LV_VAR_TCT = 1
THEN
    // bit requesting Mil illumination by transmission control unit:
    if      RQ_MIL_GRB = 1H
        then    LV_MIL_REQ_ETCU = 0
        else    if      RQ_MIL_GRB = 2H
            then    LV_MIL_REQ_ETCU = 1
            endif
        endif
    //limitation maximum speed gearbox limp home:
    if      LIM_MAX_V_GRB_EMMOD = 3FH // invalid case
    then    VS_MAX_LIH_TCT = 7FFFH
    else    VS_MAX_LIH_TCT = LIM_MAX_V_GRB_EMMOD (converted from
    BN)
    endif
ENDIF

```

**Endif**

#### ANZEIGE GETRIEBEDATEN (ID = 1D2h):

#### Application conditions

**Initialisation:** all 0

**Recurrence:** message received with recurrence 200ms (tmin = 90ms, tmax = 110ms) and event triggered (tmin=50ms)

**Activation:** LV\_AT = 1 **or** LV\_VAR\_TCT

#### Formula section:

```


If          LV_ERR_CAN_BOFF      = 1      or
              LV_ERR_BN_ETCU_DISP = 1
Then        STATE_ETCU_PROG_INFO = FH
              LV_ETCU_SPT_SWI = 0
Else        STATE_ETCU_PROG_INFO = CTR_DISP_PRG_GRB
              //control display sport mode gearbox:
IF          CTR_DISP_SPMOD_GRB = 1H
    Then      LV_ETCU_SPT_SWI = 1
    Else      LV_ETCU_SPT_SWI = 0
    Endif

```

**Endif**

#### 4.60.4.11 IHKA

#### Formula section:

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**WAERMESTROM\_KLIMA**

```

IF          LV_ERR_BN_ACC = 0          AND
              LV_ERR_CAN_BOFF = 0
THEN        // torque target air-conditioning-compressor:

if          TORQ_TAR_ACCM              <      C_TQ_ACCIN
then        TQ_ACCIN_CAN                =      0
else        TQ_ACCIN_CAN                =      TORQ_TAR_ACCM
endif

// logical variable ACC request LV_ACCIN :
if          STATE_ACIN_CAN              >      0
then        LV_ACCIN = 1
else        LV_ACCIN = 0
endif

// control electric-fan air-conditioning:
if          CTR_EFAN_AIC                =      ! 0FH
then        N_ECF                       =      CTR_EFAN_AIC
else        N_ECF                       =      0
endif


// control air-conditioning_special-function /control_cooling-map-system:
IF          CTR_AIC_SPFN                = 01H
THEN        LV_REQ_HEAT                  = 1
ELSE        LV_REQ_HEAT                  = 0
ENDIF

IF          CTR_AIC_SPFN                = 02H          OR
              CTR_CLMP                    = 01H
THEN        LV_REQ_TCO_L                  = 1
ELSE        LV_REQ_TCO_L                  = 0
ENDIF

// control air-conditioning readiness:
STATE_ACIN_CAN = CTR_AIC_RDI
IF          STATE_ACIN_CAN = 0
  THEN      LV_ACIN = 0
ELSEIF    STATE_ACIN_CAN = 2H          OR
              STATE_ACIN_CAN = 4H
  THEN      LV_ACIN = 1
ELSEIF    STATE_ACIN_CAN = 1H          AND
              LV_IS = 1
  THEN      IF          LV_ACIN = 0
                THEN      LV_ACIN = 0
                ELSE      LV_ACIN = 1 until LV_IS <> 1
            ENDIF
ELSEIF    STATE_ACIN_CAN = 7H
  THEN      freeze value of LV_ACIN (until STATE_ACIN <> 7H)
ENDIF

//heat-flow_request_air-conditioning:

```

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```

if      HTFL_RQ_AIC      =      FFh
then    HEAT_REQ_PERC   =      0
else    HEAT_REQ_PERC   =      HTFL_RQ_AIC
endif

```

```

//state_power_special-consumer:
if      ST_PWR_SPCOS    =      FFH
then    STATE_EXT_POW_CNS = 0
else    STATE_EXT_POW_CNS = ST_PWR_SPCOS
endif

```

```

// control_fan_flap:
LV_ECRAS_CTL_CAN_1 = Bit 0 of CTR_FAN_FLAP
LV_ECRAS_CTL_CAN_2 = Bit 1 of CTR_FAN_FLAP

```

```

ELSE    //torque target air-conditioning-compressor:
          TQ_ACCIN_CAN    =      0H
          LV_ACCIN = 0

```

```

// control electric-fan air-conditioning:
N_ECF      =      0

```

```

// control air-conditioning_special-function /control_cooling-map-system:
LV_REQ_HEAT      = 0
LV_REQ_TCO_L     = 0

```

```

// control air-conditioning readiness:
STATE_ACIN_CAN = 7H
LV_ACIN = 0

```

```

//heat-flow_request_air-conditioning:
HEAT_REQ_PERC      =      0

```

```

//state_power_special-consumer:
STATE_EXT_POW_CNS = 0

```

```

// control_fan_flap:
LV_ECRAS_CTL_CAN_1 = 1
LV_ECRAS_CTL_CAN_2 = 1
endif

```

#### **Not in use:**

**The following messages are not in use by the IHKA. Therefore the values are initialised with FFh and the messages are not evaluated.**


```

heat-flow_status_air-conditioning:
HTFL_ST_AIC = FFh

```

#### **4.60.4.12 Kombi**

#### **Application conditions**

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**Initialisation:**                    *at reset:*                    *TAM = TIA*

**Formula section:**

**A\_TEMP\_RELATIVZEIT**

*Ambient temperature TAM:*

**IF** (0)                    *LV\_VAR\_ICL = 1*

**THEN** (0)

**if** (1)                    *LC\_TAM\_MAN\_AS = 0*

**then** (1)

**if** (2)                    *TEMP\_EX = FFH*                    **OR**  
                               *LV\_ERR\_BN\_T\_ICL = 1*                    **OR**                    (*TAM-failure*)  
                               *LV\_ERR\_CAN\_BOFF = 1*

**then** (2)

**if** (3)                    *TAM-failure was not present the recurrence before*

**then** (3) *TAM<sub>n</sub> = TAM<sub>n-1</sub>*                    (*last valid TAM remains*)

*LV\_TAM\_CAN\_ERR = 1*

**else** (3)                    *TAM = C\_TAM\_SUB*                    (*TAM-failure present*)

*TAM\_CAN\_ERR = 1*                    (*since ECU initialisation*)

**endif** (3)

**else** (2)                    *LV\_TAM\_CAN\_ERR = 0*

**if** (4)                    *LV\_ERR\_TAM\_PLAUS = 1*

**then** (4)                    *TAM = C\_TAM\_SUB*

**else** (4)                    *TAM = TEMP\_EX*                    (*CAN*)

**endif** (4)

**endif** (2)

**else** (1)                    *TAM = C\_TAM\_MAN\_AS*                    (*application system*)

**endif** (1)

**IF**                    *LV\_ERR\_BN\_T\_ICL = 0*                    **AND**

*LV\_ERR\_CAN\_BOFF = 0*

**THEN**                    *T\_CTR\_REL\_CAN = T\_SEC\_COU\_REL*                    // for E65 only

*T\_CAN = T\_DAY\_COU\_ABSL*

**ELSE**                    *T\_CTR\_REL\_CAN = T\_REL\_CAN* converted                    // for E65 only

*T\_CAN = FFFFF*

**ENDIF**

**ELSE** (0)                    do nothing

**ENDIF** (0)

**BOS\_RUECKSTELLUNG + BOS\_RUECKSTELLUNG\_2**

*//detection if messages were used and reset of STATE\_ID\_FCT\_BOS\_RST and QOIL\_DS\_RST\_CAN\_2\_2: this part has to be calculated every 100ms:*

**if**                    *LV\_ERR\_CAN\_BOFF = 0*                    **and**

*ld\_bosrtak = STATE\_ID\_FCT\_BOS\_RST*                    **and**

*ld\_bosrtak > 0*

**then**                    *STATE\_ID\_FCT\_BOS\_RST = 0*

*QOIL\_DS\_RST\_CAN\_2\_2 = 0*



**endif**

**BOS\_RUECKSTELLUNG**

```

IF                LV_ERR_CAN_BOFF                = 0
THEN              if new message received BOS_RUECKSTELLUNG
                    then      STATE_ID2_BOS_RST                = ID2_BOS_RSTG
                                STATE_ID_FCT_BOS_RST            = ID_FN_BOS_RSTG
                                STATE_AVL_BOS_RST                = AVAI_BOS_RSTG
                                CTR_RST_BOS_RST                  = COU_RSTG_BOS_RSTG
                                QOIL_DS_RST_CAN_1_5              = RMMI_BOS_RSTG
                    else      variables unchanged
                    endif
ELSE              STATE_ID2_BOS_RST                = FFH
                                STATE_ID_FCT_BOS_RST            = FFFFH
                                STATE_AVL_BOS_RST                = FFH
                                CTR_RST_BOS_RST                  = FFH
                                QOIL_DS_RST_CAN_1_5              = 8000H

```

**ENDIF**

**BOS\_RUECKSTELLUNG\_2**

```

IF                LV_ERR_CAN_BOFF                = 0
THEN              if new message received BOS_RUECKSTELLUNG_2
                    then      QOIL_DS_RST_CAN_2_1              = ID2_BOS_RSTG_2
                                QOIL_DS_RST_CAN_2_2              = ID_FN_BOS_RSTG_2
                                QOIL_DS_RST_CAN_2_3              = FRC_INTM_WAY_BOS_RSTG_2
                                QOIL_DS_RST_CAN_2_4              = TARD_MON_BOS_RSTG_2
                                QOIL_DS_RST_CAN_2_5              = TARD_YR_BOS_RSTG_2
                                QOIL_DS_RST_CAN_2_6              = FRC_INTM_T_BOS_RSTG_2
                    else      variables unchanged
                    endif
ELSE              QOIL_DS_RST_CAN_2_1              = FFH
                                QOIL_DS_RST_CAN_2_2              = FFFFH
                                QOIL_DS_RST_CAN_2_3              = FFH
                                QOIL_DS_RST_CAN_2_4              = FH
                                QOIL_DS_RST_CAN_2_5              = FFH
                                QOIL_DS_RST_CAN_2_6              = FFH

```

**ENDIF**

**KILOMETERSTAND**


```

IF                LV_ERR_BN_KM_ICL = 0                AND
                    LV_ERR_CAN_BOFF = 0

THEN              // mileage_kilometre
                    if      MILE_KM = FFFFFFFH
                    then    CTR_KM_CAN = DIST
                    elseif  MILE_KM < 655350 km (9FFF6H)
                    then    CTR_KM_CAN = MILE_KM
                    else    CTR_KM_CAN = 655340 km (FFFEH)
                    endif

```

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```
// Kilometerstand - BN (1km-Auflösung)
if          MILE_KM < 16777215
then       CTR_KM_BN = MILE_KM
else       CTR_KM_BN = 16777214 (FFFFFFH)
endif

if         LV_IGK = 1
then
  // fluid-level_fuel-tank:
  if       FLLV_FUTA < 7FH
  then     FTL = FLLV_FUTA          and       LV_FTL_TOT_CAN_ERR = 0
           CTR_FTL_NOT_VLD = 0
  elseif   7FH ≤ FLLV_FUTA < FFH
  then     FTL = 126I              and       LV_FTL_TOT_CAN_ERR = 0
           CTR_FTL_NOT_VLD = 0
  elseif   FLLV_FUTA = FFH
  then     if       CTR_FTL_NOT_VLD ≥ C_CTR_FTL_NOT_VLD
  then     FTL = 0          and       LV_FTL_TOT_CAN_ERR = 1
  else     CTR_FTL_NOT_VLD = ++
           keep last value
  endif
  endif
endif
else     keep last value
endif

fluid-level_fuel-tank_left-hand:
if       LV_IGK = 1
then
  if       FLLV_FUTA_LH < 7FH
  then     FTL_LE = FLLV_FUTA_LH  and LV_FTL_LE_CAN_ERR = 0
           CTR_FTL_LE_NOT_VLD = 0
  elseif   7FH ≤ FLLV_FUTA_LE < FFH
  then     FTL_LE = 62I          and       LV_FTL_LE_CAN_ERR = 0
           CTR_FTL_LE_NOT_VLD = 0
  elseif   FLLV_FUTA_LE = FFH
  then     if       CTR_FTL_LE_NOT_VLD ≥ C_CTR_FTL_NOT_VLD
  then     FTL_LE = 0          and       LV_FTL_LE_CAN_ERR = 1
  else     CTR_FTL_LE_NOT_VLD = ++
           keep last value
  endif
  endif
endif
else     keep last value
endif

fluid-level_fuel-tank_right-hand:
if       LV_IGK = 1
then
  if       FLLV_FUTA_RH < 7FH
  then     FTL_RI = FLLV_FUTA_RH  and       LV_FTL_RI_CAN_ERR = 0
           CTR_FTL_RI_NOT_VLD = 0
  elseif   7FH ≤ FLLV_FUTA_RH < FFH
  then     FTL_RI = 62I          and       LV_FTL_RI_CAN_ERR = 0
  endif
endif
```

```

        CTR_FTL_RI_NOT_VLD = 0
    elseif      FLLV_FUTA_RH = FFH
then if      CTR_FTL_RI_NOT_VLD >= C_CTR_FTL_NOT_VLD
    then      FTL_RI = 0      and      LV_FTL_RI_CAN_ERR = 1
    else      CTR_FTL_RI_NOT_VLD = ++
              keep last value
    endif
endif
else      keep last value
endif

```

*status fluid-level fuel-tank spare :*

```

if      ST_FLLV_FUTA_SPAR = 01b
    or   ST_FLLV_FUTA_SPAR = 10b
    or   ST_FLLV_FUTA_SPAR = 11b
then    LV_FTL_OBD_INH_L = 1
else    LV_FTL_OBD_INH_L = 0
endif

```

**ELSE**

```

// mileage_kilometre
CTR_KM_CAN = DIST

```

*// fluid-level\_fuel-tank:*

```

FTL = 0      and      LV_FTL_CAN_ERR = 1
LV_FTL_TOT_CAN_ERR = 1

```

*fluid-level\_fuel-tank\_left-hand:*

```

FTL_LE = 0      and      LV_FTL_LE_CAN_ERR = 1

```

*fluid-level\_fuel-tank\_right-hand:*

```

FTL_RI = 0      and      LV_FTL_RI_CAN_ERR = 1

```

*status fluid-level fuel-tank spare :*

```

LV_FTL_OBD_INH_L = 0

```

**ENDIF**

*//setting of LV\_FTL\_LE\_CAN\_ERR in dependency of LV\_ERR\_xxx*

```

if      LV_FTL_LE_CAN_ERR = 0 and
    [(LV_ERR_FTL_LE_CAN = 1 and ERR_SYM_FTL_LE_CAN != SYM_3 and
    ERR_SYM_FTL_LE_CAN != NO_SYM)
    or (LV_ERR_TOUT_ICL_7 = 1 or LV_STATE_ERR_CAN_TOUT = 1 )]
Then    LV_FTL_LE_CAN_ERR = 1
Endif

```

*//setting of LV\_FTL\_RI\_CAN\_ERR in dependency of LV\_ERR\_xxx*

```

if      LV_FTL_RI_CAN_ERR = 0 and
    [(LV_ERR_FTL_RI_CAN = 1 and ERR_SYM_FTL_RI_CAN != SYM_3 and
    ERR_SYM_FTL_RI_CAN != NO_SYM)
    or (LV_ERR_TOUT_ICL_7 = 1 or LV_STATE_ERR_CAN_TOUT = 1 )]
Then    LV_FTL_RI_CAN_ERR = 1
Endif

```

```

If          LV_FTL_TOT_CAN_ERR = 1          or
              LV_FTL_LE_CAN_ERR = 1          or
              LV_FTL_RI_CAN_ERR = 1
Then       LV_FTL_CAN_ERR = 1
Else       LV_FTL_CAN_ERR = 0
Endif

```

**STAT\_KOMBI**

```

IF          LV_ERR_BN_ICL = 0              AND
              LV_ERR_CAN_BOFF = 0
THEN       // speed_vehicle_speedometer:
VS_ICL_DISP      =          V_VEH_SPDM

```

```

// status_unit-of-measurement_speed_speedometer:
STATE_VS_ICL_DISP      =          ST_UN_V_SPDM

```

```

// status_interface_cruise-control:
STATE_IF_ICL_BN_MSW    =          ST_INTF_CCTRA_KI

```

```

// alive_ICL:
TCC_CAN_ICL           =          ALIV_COU_KI

```

```

STATE_WAL_CAN         =          ST_WALI_ENG

```

```

ELSE       // speed_vehicle_speedometer:
VS_ICL_DISP           =          FFFH

```

```

// status_unit-of-measurement_speed_speedometer:
STATE_VS_ICL_DISP     =          3H

```

```

// status_interface_cruise-control:
STATE_IF_ICL_BN_MSW   =          1H

```

```

// alive_ICL:
TCC_CAN_ICL           =          FH

```

```

STATE_WAL_CAN         =          3H


```

**UHRZEIT\_DATUM**

```

IF          LV_ERR_BN_T_CLK = 0              AND
              LV_ERR_CAN_BOFF = 0
THEN       // display day:
              IF          0 < DISP_DATE_DAY < 32
              THEN       T_CLK_ICL_DISP_1 = DISP_DATE_DAY
              ELSE       T_CLK_ICL_DISP_1 = 255
              ENDIF
              // display month:
              IF          0 < DISP_DATE_MON < 13
              THEN       T_CLK_ICL_DISP_2 = DISP_DATE_DAY
              ELSE       T_CLK_ICL_DISP_2 = 255

```

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```

ENDIF
// display year:
IF      0 < DISP_DATE_YR < 65535
THEN    T_CLK_ICL_DISP_3 = DISP_DATE_YR
ELSE    T_CLK_ICL_DISP_3 = 65535
ENDIF

ELSE    T_CLK_ICL_DISP_1 = 255
          T_CLK_ICL_DISP_2 = 255
          T_CLK_ICL_DISP_3 = 65535

ENDIF

```

#### 4.60.4.13 LDM

##### Formula section:

Anforderung Radmoment Antriebsstrang:

```

IF      LV_ERR_BN_LDM      = 0      AND
          LV_ERR_CAN_BOFF   = 0

THEN    // checksum LDM:
          CKS_CAN_LDM       =      CHKSM_RQ_WMOM_PT
          // alive LDM:
          TCC_CAN_LDM       =      ALIV_RQ_WMOM_PT
          // follow-dynamic_wheel-moment_power-train_target:
          STATE_SP_DYN_WHEEL = FOLDYN_WMOM_PT_TAR (Bit 0 ... Bit 3)
          // request_prevention_inertia-fuel-shutoff:
          STATE_DI_PUC      =      FOLDYN_WMOM_PT_TAR (Bit 0)
          // wheel-moment_power-train_target:
if      WMOM_PT_TAR = FFFFH
Then    LV_TQ_WHEEL_LDM_BN_ERR = 1
          TQ_WHEEL_LDM_BN      =      - 32000 Nm
Else    LV_TQ_WHEEL_LDM_BN_ERR = 0
          if      WMOM_PT_TAR <= 32000 Nm
          then    TQ_WHEEL_LDM_BN      =      WMOM_PT_TAR
          else    TQ_WHEEL_LDM_BN      =      32000 Nm
          endif

Endif
          // status_driver-assistance-system_powertrain:
          STATE_LDM          =      ST_DRASY_PT
          // Wheel-moment power-train enable:
          STATE_LDM_INTV     =      WMOM_PT_ENBL
if      STATE_LDM_INTV = 0
Then    LV_TQ_WHEEL_LDM_REQ = 0
          LV_LDM_LIH_CAN = 0
Elseif STATE_LDM_INTV = 1
Then    LV_TQ_WHEEL_LDM_REQ = 1
          LV_LDM_LIH_CAN = 0
Else    LV_TQ_WHEEL_LDM_REQ = 0
          LV_LDM_LIH_CAN = 1

Endif

```

```

//request gear shift indicator for LDM:
If      RQ_GSI_CLCTR_LN = 1
Then    LV_GS_IDC_LDM = 1
Else    LV_GS_IDC_LDM = 0
Endif

ELSE    // checksum LDM:
          CKS_CAN_LDM      =      FFh
// alive LDM:
TCC_CAN_LDM      =      Fh
// follow-dynamic_wheel-moment_power-train_target:
STATE_SP_DYN_WHEEL      =      Fh
// wheel-moment_power-train_target:
TQ_WHEEL_LDM_BN      =      -32000 Nm
LV_TQ_WHEEL_LDM_BN_ERR = 0
// Wheel-moment power-train enable:
STATE_LDM_INTV      =      3H
LV_TQ_WHEEL_LDM_REQ = 0
LV_LDM_LIH_CAN = 1
// request_prevention_inertia-fuel-shutoff:
STATE_DI_PUC      =      0H (nur Auswertung Bit 3)
// status_driver-assistance-system_powertrain:
STATE_LDM      =      FH
// auxiliary bytes for LDM test required by customer:
STATE_CUS_LDM_CAN =      FFFFh
//request gear shift indicator for LDM:
LV_GS_IDC_LDM = 0

ENDIF

```

#### 4.60.4.14 Power-Modul

##### Application conditions

**Initialisation:**  $V\_GEN\_TAR = C\_V\_SP\_GEN$  (valid for BN2000 **and** CAN11H)

##### Formula section:

##### **POWERMGMT\_BATTERIESPANNUNG**

*status\_battery-main-switch:*

The signal cannot be evaluated as it is transmitted only after transition KL30 ON OFF.

*status\_switch-off\_klemme\_30:*

STATE\_SWI\_OFF\_VB = ST\_SWO\_KL\_30

The signal is only to be read into the internal variable STATE\_SWI\_OFF\_VB but not evaluated.

*shutdown counter battery-main-switch :*


**if**  $LV\_IGK = 0$  **and**  $VS = 0$  **and**  $LV\_ES = 1$  ( engine stopped )

**then if** SDWN\_COU\_BTSW = FFH

**then** T\_CTR\_SWI\_OFF\_VB = 254

**else** T\_CTR\_SWI\_OFF\_VB = SDWN\_COU\_BTSW

**if**  $T\_CTR\_SWI\_OFF\_VB \leq C\_T\_CTR\_SWI\_OFF\_VB\_MIN$  **and**

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```

                                PWL is active (before NM)
then          shut down operating system
endif
endif
else          T_CTR_SWI_OFF_VB = 254
endif

time second counter relative Redundant :
IF            LV_ERR_CAN_BOFF = 0
THEN         IF            LV_VAR_VEH = 1           // E65
                THEN         IF            LV_ERR_BN_POW_VB = 0
                            THEN         T_REL_CAN = T_SEC_COU_REL_Redundant ( converted)
                                    //from Powermodul, message POWERMGMT_BATTERIESPANNUNG
                                    T_REL_CAN_2 = T_SEC_COU_REL_Redundant
                                    //setting bit indicating t_rel_can received:
                                    LV_T_REL_CAN_REG = 1
                            ELSEIF       LV_ERR_BN_T_ICL = 0
                                    THEN         T_REL_CAN = T_SEC_COU_REL (converted)
                                    T_REL_CAN_2 = T_SEC_COU_REL
                                    ELSE         T_REL_CAN = 0
                                                T_REL_CAN_2 = 0
                            ENDIF
                ELSEIF       LV_VAR_VEH = 0           // E60
                THEN         IF            LV_ERR_BN_T_ICL = 0
                            THEN         T_REL_CAN = T_SEC_COU_REL (converted)
                                    T_REL_CAN_2 = T_SEC_COU_REL
                                    // from Kombi, message A_TEMP_RELATIVZEIT
                                    //setting bit indicating t_rel_can received:
                                    LV_T_REL_CAN_REG = 1
                            ELSE         T_REL_CAN = 0
                                                T_REL_CAN_2 = 0
                            ENDIF
                ENDIF
ELSE         T_REL_CAN = 0
                T_REL_CAN_2 = 0
ENDIF

```

### POWERMGMT\_LADESPANNUNG

```

IF            LV_ERR_BN_POW_GEN = 0           AND
                LV_ERR_CAN_BOFF = 0
THEN         // Control_generator_voltage_target:
if          CTR_GEN_U_TAR = FFH
then        V_GEN_TAR = C_V_SP_GEN
else        V_GEN_TAR = CTR_GEN_U_TAR ( converted)
endif


```

### RPM\_idling\_specification:

```

if          RPM_IDLG_SPEC = 3H
then        FAC_IS_INC_REQ = 0
else        FAC_IS_INC_REQ = RPM_IDLG_SPEC

```

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**endif**

**ELSE** // Control\_generator\_voltage\_target:  
V\_GEN\_TAR = C\_V\_SP\_GEN

*RPM\_idling\_specification:*

FAC\_IS\_INC\_REQ = 0

**ENDIF**

#### 4.60.4.15 SZ-Lenksäule

##### Formula section:

##### ***LENKRADWINKEL (Sender SZL/E65, DSC/E60)***

```

IF          ( LV_IGK = 0 AND LV_ES = 1 )                                OR
              (LV_IGK = 1 AND T_WAKE_UP_ON < C_T_DLY_ERR_PSTE)           OR
              (ECU_STATE = 'Wake_up' AND T_PWL < C_T_DLY_ERR_PSTE)
THEN      ANG_PSTE = 0°
              LV_ERR_ANG_PSTE_CAN = 0
              STATE_SENS_ANG_PSTE = 0H
              VEL_ANG_PSTE = 0°/s
ELSE      IF          LV_ERR_BN_ANG_PSTE = 0 AND
              LV_ERR_CAN_BOFF = 0
THEN      IF          STWA_ERR = 1
              THEN      ANG_PSTE = 0°
              VEL_ANG_PSTE = 0°/s
              LV_ERR_ANG_PSTE_CAN = 0
              STATE_SENS_ANG_PSTE = 0H
              ELSE      IF          STWA = 8000H or STWA_ERR >= 1
              THEN      ANG_PSTE = 0
              LV_ERR_ANG_PSTE_CAN = 1
              VEL_ANG_PSTE = 0°/s
              ELSE      ANG_PSTE = STWA
              LV_ERR_ANG_PSTE_CAN = 0
              VEL_ANG_PSTE = STWA_V
              ENDIF
              STATE_SENS_ANG_PSTE = STWA_ERR
              ENDIF
ELSE      ANG_PSTE = 0°
              LV_ERR_ANG_PSTE_CAN = 1
              STATE_SENS_ANG_PSTE = 3H
              VEL_ANG_PSTE = 0°/s
ENDIF
ENDIF
    
```

##### ***BEDIENUNG\_TEMPOMAT***

```

IF          LV_ERR_BN_MSW          = 0          AND
              LV_ERR_CAN_BOFF       = 0
THEN      CKS_CAN_MSW = CHKSM_CCTR
    
```



TCC\_CAN\_MSW = ALIV\_CCTR

```

IF          OP_PUBU_CCTR_ACC      = 00H
THEN       STATE_BN_MSW          = NO_ACTION
ELSEIF     OP_PUBU_CCTR_ACC      = 10H          OR
            OP_PUBU_CCTR_ACC      = 50H
THEN       STATE_BN_MSW          = TIP_UP or DOWN    // OFF
ELSEIF     OP_PUBU_CCTR_ACC      = 04H          OR
            OP_PUBU_CCTR_ACC      = 44H
THEN       STATE_BN_MSW          = TIP_POST
ELSEIF     OP_PUBU_CCTR_ACC      = 08H
            OP_PUBU_CCTR_ACC      = 48H
THEN       STATE_BN_MSW          = PRESS_POST
ELSEIF     OP_PUBU_CCTR_ACC      = 40H          OR
            OP_PUBU_CCTR_ACC      = 41H          OR
            OP_PUBU_CCTR_ACC      = 42H
THEN       STATE_BN_MSW          = TIP_AXIAL
ELSEIF     OP_PUBU_CCTR_ACC      = 01H
THEN       STATE_BN_MSW          = TIP_PRE
ELSEIF     OP_PUBU_CCTR_ACC      = 02H
THEN       STATE_BN_MSW          = PRESS_PRE
ELSEIF     OP_PUBU_CCTR_ACC      = 7F
THEN       STATE_BN_MSW          = INVALID SIGNAL
ENDIF

```

STATE\_GAP\_MSW = OP\_GAPC\_ACC // this variable will only be used for the  
checksum-calculation of the message Bedienung Tempomat

```

ELSE      CKS_CAN_MSW          = FFH
            TCC_CAN_MSW          = FH
            STATE_BN_MSW         = 0H
ENDIF

```

#### 4.60.4.16 K\_CAN: LM

##### Formula section:

##### **STATUS\_GANG\_RÜCKWÄRTS**

```

IF          LV_ERR_CAN_BOFF = 0          and
            LV_ERR_BN_GEAR_REV = 0
THEN       if          ST_GR_BAC = 2H
then       STATE_GEAR_REV_CAN = 1
else       STATE_GEAR_REV_CAN = 0
endif
ELSE       STATE_GEAR_REV_CAN = 0
ENDIF

```

##### **LAMPENZUSTAND**

```

IF          LV_ERR_CAN_BOFF = 0          and
            LV_ERR_BN_LTG_HDLP_L = 0
THEN       if          ST_DIPB = 1
then       LV_LTG_HDLP_L_ON = 1

```

```

else      LV_LTG_HDLP_L_ON = 0
endif
ELSE      LV_LTG_HDLP_L_ON = 0
ENDIF

```

### CTR\_LICHT

```

IF          LV_ERR_CAN_BOFF = 0
THEN      if      CTR_ITLI = 1
then      LV_LTG_INL_ON = 1
else      LV_LTG_INL_ON = 0
endif
ELSE      LV_LTG_INL_ON = 0
ENDIF

```

### STAT\_ANHÄNGER

```

IF          LV_ERR_CAN_BOFF = 0      AND
          LV_ERR_BN_TRL = 0      AND
          ST_TRAI < 2
THEN      LV_STATE_TRL = ST_TRAI
ELSE      LV_STATE_TRL = 0
ENDIF

```

### STAT\_VERDECK\_CABRIO ( 27EH )

#### General information:

The state of the cabrio top must be available in the ECU For handling of the sound flap.

#### Application conditions

**Initialisation:** *at reset LV\_CTOP = 0*

**Recurrence:** *message received event triggered (tmin=100ms)*


**Activation:** *every engine state*

#### Formula section:

```

IF          LV_ERR_CAN_BOFF = 0
THEN      setting LV_CTOP:
          if      ST_PO_FLDT_CAB = 0
          OR ST_PO_FLDT_CAB = 4
          OR ST_PO_FLDT_CAB = 7
          Then      LV_CTOP = 0
          Elseif    ST_PO_FLDT_CAB = 1
          OR  ST_PO_FLDT_CAB = 2
          OR  ST_PO_FLDT_CAB = 3
          Then      LV_CTOP = 1
          Endif
ELSE      setting default value:
          LV_CTOP = 0
ENDIF

```

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#### 4.60.4.17 EKP

##### General information:

In case of LV\_VAR\_BN\_EFP = 1 (e.g. LEVII-vehicles) the EKP sends its data concerning the DME interface on the PT-CAN, message ID = 335h.

##### Application conditions

**Initialisation:** at reset and LV\_IGK = 1:  
 LV\_EFP\_ON\_EXT\_ADJ\_CAN = 0H  
 LV\_EFP\_OFF\_EXT\_ADJ\_CAN = 0H  
 STATE\_DIAG\_EFP = FFH  
 STATE\_EFP\_CAN = 0H  
 V\_ENG\_EFP = 5V  
 CUR\_ENG\_EFP = 0A  
 N\_EFP\_AV = 0 rpm  
 VB\_EFP = 5V  
 STATE\_EFP\_CTL = 3H

**Recurrence:** 1 s **or** Event controlled

**Activation:** LV\_IGK = 1 and LV\_VAR\_BN\_EFP = 1

##### Formula section:


```

If      LV_ERR_BN_EFP = 0      AND
          LV_ERR_CAN_BOFF = 0
Then    STATE_DIAG_EFP      =      ST_DIAG_FU_PP_EL
          STATE_EFP_CAN        =      ST_FU_PP_EL
          V_ENG_EFP            =      U_ENG_FU_PP_EL
          CUR_ENG_EFP          =      I_ENG_FU_PP_EL
          N_EFP_AV             =      RPM_AVL_FU_PP_EL
          VB_EFP               =      U_KL_30_FU_PP_EL
          STATE_EFP_CTL        =      ST_FU_CLCTR_FU_PP_EL
Else    STATE_DIAG_EFP      =      FFH
          STATE_EFP_CAN        =      0H
          V_ENG_EFP            =      5V
          CUR_ENG_EFP          =      0A
          N_EFP_AV             =      0 rpm
          VB_EFP               =      5V
          STATE_EFP_CTL        =      3H
Endif
    
```

```

If      STATE_EFP_CAN = 1
Then    LV_EFP_ON_EXT_ADJ_CAN = 1
LV_EFP_OFF_EXT_ADJ_CAN = 0
Else if STATE_EFP_CAN = 2
Then    LV_EFP_ON_EXT_ADJ_CAN = 0
LV_EFP_OFF_EXT_ADJ_CAN = 1
Else    LV_EFP_ON_EXT_ADJ_CAN = 0
LV_EFP_OFF_EXT_ADJ_CAN = 0
Endif
Endif
    
```

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#### 4.60.4.18 K\_CAN: CCC\_GW, M\_ASK

##### General information:

##### Application conditions

##### Initialisation:

**Recurrence:** *event controlled*

**Activation:** *LV\_IGK = 1*

##### Formula section:

##### Programmierung Stufentempomat:

*handshake with stepped cruise-control function:*

```
IF          message Programmierung Stufentempomat has been received
THEN      LV_MSG_PROG_STEP_CRU = 1
input for stepped cruise control-function
resetting of bit through stepped cruise control function
ENDIF
```

*index\_number\_programming\_cruise-control*  
NR\_VS\_CRU\_IF = IDX\_NO\_PRGG\_CCTR

*speed\_programming\_cruise-control\_index\_number\_1*  
VS\_STEP\_IF\_1 = V\_PRGG\_CCTR\_IDX\_NO\_1

*speed\_programming\_cruise-control\_index\_number\_2*  
VS\_STEP\_IF\_2 = V\_PRGG\_CCTR\_IDX\_NO\_2

*speed\_programming\_cruise-control\_index\_number\_3*  
VS\_STEP\_IF\_3 = V\_PRGG\_CCTR\_IDX\_NO\_3

#### 4.60.4.19 K\_CAN/PT-CAN

##### Application conditions

**Initialisation:** *at LV\_IGK 0 - -> 1:*

```

FAC_POW_MNG_VST_CNS (index 0) = 255,
FAC_POW_MNG_VST_CNS (index i) = 0
at reset      N_ECF_CAN = 0 %
              N_ECF_CAN_2 = 0 %
              ECF_REQ_EXT = 0
```

**Activation:** *Powermanagement\_Standverbraucher : LV\_IGK = 1*  
*Anforderung\_E-Lüfter: bus\_active*


##### DIENSTENACHRICHTEN:

##### Powermanagement\_Standverbraucher

IF ID2 = 08H

THEN Dienstnachricht Powermanagement\_Standverbraucher

ENDIF

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```

IF          ST_PCOS_PWMG = ON           // Status Standverbraucher PM
THEN
  IF        FAC_POW_MNG_VST_CNS (index 0) = 255
  THEN      FAC_POW_MNG_VST_CNS (index 0) = SV-ID
  ELSE      IF        FAC_POW_MNG_VST_CNS (index i) = SV-ID
            THEN      no action           // SV already in list
            ENDIF
  ELSE      IF        FAC_POW_MNG_VST_CNS (index i) = 0
            THEN      FAC_POW_MNG_VST_CNS (index i) = SV-ID
                    // free position found
            ENDIF
  ENDIF
ELSE        IF        ST_PCOS_PWMG = OFF           // Status Standverbraucher PM
THEN        IF        FAC_POW_MNG_VST_CNS (index i) = SV-ID
            THEN      FAC_POW_MNG_VST_CNS (index i) = 0           // SV
                    found, delete from list
            ENDIF
            IF        FAC_POW_MNG_VST_CNS (index i) = 0
            THEN      FAC_POW_MNG_VST_CNS (index 0) = 255
            ENDIF
        ENDIF
ENDIF

```

Standverbraucher (SV)	SV-ID (ID_FN_PWM G)
Anhängerlicht	1
Bordmonitor (MMI)	2
Diebstahlwarnanlage	3
Licht	4
Standheizten	5
Standlüften	6
Getriebe	7
Restwärme	8
Telefon (ECE)	9
Telefon (USA)	10
Standklimatisierung	11
APU	12
Frontscheibenheizung	13

### Verbraucherstatus

```

IF          ID2 = 6EH
THEN        Dienstenachricht Verbrauchersstatus
ENDIF

```

```

STATE_VEH_CNS[10] = ID_FN_COS
STATE_VEH_CNS_FCT = ST_FN_COS

```

Bit 0	Bit 1	Status
0	0	Verbraucherfunktion aus
0	1	Verbraucherfunktion ein
1	0	Ungültiger Zustand
1	1	Signal ungültig

Byte	Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
Byte 1	V0	V0	V1	V1	V2	V2	V3	V3
Byte 2	V4	V4	V5	V5	V6	V6	V7	V7
Byte 3	V8	V8	V9	V9	V10	V10	V11	V11
Byte 4	V12	V12	V13	V13	V14	V14	V15	V15
Byte 5	V16	V16	V17	V17	V18	V18	V19	V19
Byte 6	V20	V20	V21	V21	V22	V22	V23	V23
Byte 7	V24	V24	V25	V25	V26	V26	V27	V27
Byte 8	V28	V28	V29	V29	V30	V30	V31	V31
Byte 9	V32	V32	V33	V33	V34	V34	V35	V35
Byte 10	V36	V36	V37	V37	V38	V38	V39	V39

### Anforderung\_E-Lüfter

```

IF          ID2_RQ_STG_EFAN = 15h
// Dienstenachricht Anforderung E-Lüfter
THEN
  LV_N_ECF_CAN_ACT = 1
//Dienstenachricht E-Lüfter zum 1. Mal angefordert
  LV_N_ECF_CAN_RCV = 1
//Dienstenachricht zyklisch erhalten (1s-Raster)
  IF ((ID_FN_RQ_STG_EFAN != FFH) AND (RQ_STG_EFAN != FH))
  THEN      N_ECF_CAN_2 = RQ_STG_EFAN           //conversion from CAN
            ECF_REQ_EXT = ID_FN_RQ_STG_EFAN
            //anforderndes Steuergerät
  IF      RQ_STG_EFAN = 0
  THEN    LV_N_ECF_CAN_ACT = 0
            //Anforderung E-Lüfter zurückgenommen
  ENDIF
  ELSE    If      (ID_FN_RQ_STG_EFAN != FFH)
  Then    N_ECF_CAN_2 = C_N_ECF_CAN
  Else    N_ECF_CAN_2 = 0
  Endif
            ECF_REQ_EXT = 0
  ENDIF
ENDIF
ENDIF

```

### Monitoring of Anforderung\_E-Lüfter (cyclic transmission, 1s):

```

IF          LV_N_ECF_CAN_ACT = 1
// Dienstenachricht Anforderung E-Lüfter wird angefordert
THEN
  IF      LV_N_ECF_CAN_RCV = 1
//Dienstenachricht E-Lüfter wird zyklisch erhalten
  THEN    CTR_TOUT_N_ECF_CAN = 0
            LV_N_ECF_CAN_RCV = 0
  ELSE    IF      CTR_TOUT_N_ECF_CAN >= C_CTR_TOUT_N_ECF_
CAN
  THEN    N_ECF_CAN_2 = C_N_ECF_CAN
            ECF_REQ_EXT = 0
  ELSE    CTR_TOUT_N_ECF_CAN ++
  ENDIF
  ENDIF
ENDIF
ENDIF

```

*//setting of N\_ECF\_CAN (add. check if component protection necessary): This part has to be calculated with recurrence of 1s (independent on message received or not)*

```

If          [LV_ERR_CAN_BOFF = 1 or LV_ERR_BN_TQ_PSTE_3 = 1]          and
              [LV_VAR_ECRAS_UP = 1 or LV_VAR_ECRAS_DOWN = 1]
Then       // setting of min value for component protection:
              N_ECF_CAN =MAX(N_ECF_CAN_2,C_N_ECF_CAN)
Else       // setting value like requested by CAN message (Anforderung E-Lüfter):
              N_ECF_CAN = N_ECF_CAN_2
Endif

```

### OBD Sensor Diagnosestatus (condition based service)

#### Application conditions

```

Initialisation:      ODB_TAM = TAM (has to be initialised after TAM initialisation),
                        all other = 0
Recurrence:        10s
Activation:        LV_IGK = 1

```


#### Formula section:

```

IF          ID2 = 8CH          //Dienstnachricht OBD Sensor Diagnosestatus
THEN
  LV_STATE_ERR_CAN_ACT = 1
  //Dienstnachricht OBD Sensor Diagnosestatus zum 1. Mal angefordert
  LV_STATE_ERR_CAN_RCV = 1
  //Dienstnachricht zyklisch erhalten (10s-Raster)
if          ID_OBD_SEN = 0H
  Then       // get symptom of TAM sensor
    if        ERR_OBD_SEN_1 = 1H
      then    // short circuit to ground
              STATE_ERR_SYM_TAM_CAN = SCG
      elseif  ERR_OBD_SEN_1 = 2H
      then    // short circuit to vbatt (plus) or open line (can't be distinguished)
              STATE_ERR_SYM_TAM_CAN = SCP
    else     STATE_ERR_SYM_TAM_CAN = NO_SYM
    endif
    // get raw value of TAM for OBD:
    OBD_TAM =RWDT_OBD_SEN_1
              (converted. -> OBD_TAM = [hex] /2 - 40° C )
    // TAM value received:
    LV_OBD_TAM_RCV = 1

  Elseif    ID_OBD_SEN = 1H
  Then     // get symptom of FTL_RI sensor
    if      ERR_OBD_SEN_2 = 1H
      then  // short circuit to ground
              STATE_ERR_SYM_FTL_RI_CAN = SCG
      elseif ERR_OBD_SEN_2 = 2H
      then  // short circuit to vbatt (plus) or open line (can't be distinguished)

```

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```

        STATE_ERR_SYM_FTL_RI_CAN = SCP
    else
        STATE_ERR_SYM_FTL_RI_CAN = NO_SYM
    endif
// get symptom of FTL_LE sensor
if
    ERR_OBD_SEN_1 = 1H
    then
        // short circuit to ground
        STATE_ERR_SYM_FTL_LE_CAN = SCG
    elseif
        ERR_OBD_SEN_1 = 2H
    then
        // short circuit to vbatt (plus) or open line (can't be distinguished)
        STATE_ERR_SYM_FTL_LE_CAN = SCP
    else
        STATE_ERR_SYM_FTL_LE_CAN = NO_SYM
    endif
Else
    no changes
Endif
ENDIF

```

#### Monitoring of Dienstenachricht OBD Diagnosestatus (cyclic transmission, 10s):

```

IF
    LV_STATE_ERR_CAN_ACT = 1
// Dienstenachricht OBD Diagnosestatus wird angefordert
THEN
    IF
        LV_STATE_ERR_CAN_RCV = 1
        //Dienstenachricht OBD Diagnosestatus wird zyklisch erhalten
        THEN
            CTR_STATE_ERR_CAN = 0
            LV_STATE_ERR_CAN_RCV = 0
            LV_STATE_ERR_CAN_TOUT = 0
        ELSE
            IF
                CTR_STATE_ERR_CAN >= C_CTR_TOUT_STATE_ERR_CAN
                THEN
                    LV_STATE_ERR_CAN_TOUT = 1
                    STATE_ERR_SYM_FTL_LE_CAN = NO_SYM
                    STATE_ERR_SYM_FTL_RI_CAN = NO_SYM
                    STATE_ERR_SYM_TAM_CAN = NO_SYM
                ELSE
                    CTR_STATE_ERR_CAN ++
                ENDIF
            ENDIF
        ENDIF
    ENDIF
ENDIF

```

#### Application conditions

**Recurrence:** *1s*

**Activation:** *at every engine state*

*//setting of OBD\_TAM if message not received yet (after reset a time gap up to 10s until first receive of message is possible). This part has to be calculated with recurrence of 1s (independent on message received or not):*

```

If
    LV_OBD_TAM_RCV = 0
Then
    // setting of OBD_TAM = TAM for initialisation:
    OBD_TAM = TAM      (converted)
Else
    do nothing
Endif

```

#### 4.60.4.20 EHB3 - DREHMOMENT\_ANF\_STE



**Formula section:**

**DREHMOMENT\_ANF\_STE:**

```

IF(1)      LV_ERR_BN_TQ_PSTE_3 = 0      AND
              LV_ERR_CAN_BOFF = 0

THEN(1)
// checksum_torque_STE:
CKS_CAN_TQ_PSTE_3      = CHKSM_TORQ_STE
    
```

```

// alive_torque_STE:
TCC_CAN_TQ_PSTE_3      = ALIV_TORQ_STE
    
```

```

// source torque_STE
if          SRC_RQ_TORQ_STE = 0H
then        STATE_PSTE_3_SRC = NORMAL_STEERING
elseif     SRC_RQ_TORQ_STE = 1H
then        STATE_PSTE_3_SRC = AFS
elseif     SRC_RQ_TORQ_STE = 2H
then        STATE_PSTE_3_SRC = EPS
elseif     SRC_RQ_TORQ_STE = 4H
then        STATE_PSTE_3_SRC = RESERVED
elseif     SRC_RQ_TORQ_STE = FH
then        STATE_PSTE_3_SRC = INVALID_SIGNAL
endif
    
```

```

if (2) STATE_PSTE_3_SRC = AFS AND LC_PSTE_3_SUB_ENA = 1
then
    TQ_LOSS_PSTE_3_AV_CAN = 0
    TQ_LOSS_PSTE_3_SP_CAN = 0
    STATE_PSTE_3_INTV = 2
    LV_PSTE_3_INTV = 1
    STATE_PSTE_3_ERR = 0
    LV_TQ_PSTE_3_CAN_ENA = 1
    LV_TQ_PSTE_3_CAN_LIH = 0
    LV_TQ_PSTE_3_CAN_DI = 0
else (2)
    
```

```

// actual value torque loss STE :
if          TORQ_AVL_STE = FFH
then        TQ_LOSS_PSTE_3_AV_CAN = 8000H
else        TQ_LOSS_PSTE_3_AV_CAN = TORQ_AVL_STE (converted from BN 2000)
endif
    
```

```

// target value torque loss STE
if          TORQ_TAR_STE = FFH
then        TQ_LOSS_PSTE_3_SP_CAN = 8000H
else        TQ_LOSS_PSTE_3_SP_CAN = TORQ_TAR_STE (converted from BN 2000)
endif
    
```

```

// state STE-intervention:
STATE_PSTE_3_INTV = ST_TORQ_TAR_STE
    
```

```

if          STATE_PSTE_3_INTV = 02H
then       LV_PSTE_3_INTV      = 1
else       LV_PSTE_3_INTV      = 0
endif

```

```

// state torque_STE_error
STATE_PSTE_3_ERR = ST_RQ_TORQ_STE_ERR

```

```

if          STATE_PSTE_3_ERR = 00H
then       LV_TQ_PSTE_3_CAN_ENA = 1
else       LV_TQ_PSTE_3_CAN_ENA = 0
endif

```

```

if          STATE_PSTE_3_ERR = 01H or
             STATE_PSTE_3_ERR = 02H or
             STATE_PSTE_3_ERR = 04H
then       LV_TQ_PSTE_3_CAN_LIH = 1
else       LV_TQ_PSTE_3_CAN_LIH = 0
endif

```

```

if          STATE_PSTE_3_ERR = 03H or
             STATE_PSTE_3_ERR = 05H or
             STATE_PSTE_3_ERR = 06H or
             STATE_PSTE_3_ERR = 07H
then       LV_TQ_PSTE_3_CAN_DI = 1
else       LV_TQ_PSTE_3_CAN_DI = 0
endif

```

**Endif(2)**

**ELSE(1)** // substitute values\_STE:

```

// checksum_torque_STE
CKS_CAN_TQ_PSTE_3      = FFH

```

```

// alive_torque_STE:
TCC_CAN_TQ_PSTE_3      = FH

```

```

// source torque_STE
STATE_PSTE_3_SRC      = 4H

```

```

// actual value torque loss STE :
TQ_LOSS_PSTE_3_AV_CAN = 8000H

```

```

// target value torque loss STE :
TQ_LOSS_PSTE_3_SP_CAN = 8000H

```

```


// state STE-intervention:
STATE_PSTE_3_INTV     = 3H
LV_PSTE_3_INTV        = 0H

```

```

// state torque_STE_error

```

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```

STATE_PSTE_3_ERR          = 7H
LV_TQ_PSTE_3_CAN_ENA     = 0H
LV_TQ_PSTE_3_CAN_LIH     = 0H
LV_TQ_PSTE_3_CAN_DI      = 1H

```

**ENDIF(1)**

#### 4.60.4.21 EMF Modul (PBR) electromechanic park brake

**STELLANF\_EMF**

**Formula section:**

```

IF                LV_ERR_BN_REQ_PBR = 0                AND
                   LV_ERR_CAN_BOFF = 0

THEN

    // checksum:
    CKS_CAN_REQ_PBR = CHKSM_PRQ_EMF
    // alive counter:
    TCC_CAN_REQ_PBR = ALIV_PRQ_EMF
    // status indicating holding of vehicle with parking brake
    STATE_HLD_PBR = ST_HYD_RETA_2
    // comfort mode of parking brake
    If              ST_CFFU_EMF_2 < 2H
    Then            LV_CFT_MOD_PBR = ST_CFFU_EMF_2
    Else            LV_CFT_MOD_PBR = 0
    Endif

ELSE              // substitute values:

    // checksum
    CKS_CAN_REQ_PBR          = FFH
    // alive_counter:
    TCC_CAN_REQ_PBR          = FH
    // status indicating holding of vehicle with parking brake
    STATE_HLD_PBR = 3H
    // comfort mode of parking brake
    LV_CFT_MOD_PBR = 0

ENDIF

```

**STATUS\_EMF**

**Formula section:**


```

IF                LV_ERR_BN_PBR = 0                AND
                   LV_ERR_CAN_BOFF = 0

THEN

    // checksum:
    CKS_CAN_PBR              = CHKSM_ST_EMF
    // alive counter:
    TCC_CAN_PBR              = ALIV_COU_EMF_2

```

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```
//status of parking brake
STATE_PBR = ST_EMF_LOCA_2
```

```
ELSE      // substitute values
           // checksum
           CKS_CAN_PBR      = FFH
           // alive_counter:
           TCC_CAN_PBR      = FH
           //status of parking brake
           STATE_PBR = FH

ENDIF
```

**ST\_RQ\_EMF ( Status Anforderung EMF) (ID =1FDH)**

### Application conditions

```
Initialisation:      at reset all 0
Recurrence:        40 ms (tmin=36 ms, tmax=44 ms)
Activation:        LV_VAR_TQ_PBR = 1
```

### Formula section:

```
IF          LV_ERR_CAN_BOFF = 0 AND
             LV_ERR_BN_TQ_PBR = 0

THEN

           // Checksum:
           CKS_CAN_TQ_PBR      = CHKSM_ST_RQ_EMF
           // Alive-Counter:
           TCC_CAN_TQ_PBR      = ALIV_ST_RQ_EMF
           // status actuator EMF:
           STATE_PBR_ACT       = ST_ACT_EMF
           STATE_PBR_ACT_QLY    = QU_ST_ACT_EMF
           // request deceleration EMF:
           AC_WHEEL_PBR        = RQ_DCRN_EMF      (converted)
           STATE_TQ_WHEEL_PBR_QLY = QU_RQ_DCRN

ELSE       //setting default values:
           STATE_PBR_ACT       = FH
           STATE_PBR_ACT_QLY    = FH
           AC_WHEEL_PBR        = 0 m/s**2
           STATE_TQ_WHEEL_PBR_QLY = FH
           TCC_CAN_TQ_PBR      = FH
           CKS_CAN_TQ_PBR      = FFH


ENDIF
```

### **4.60.4.22 DXC - SOLL\_MOM\_ANF ( Status hill descent control - HDC)**

### Formula section:

```
IF          LV_ERR_BN_DHL_CTL = 0           AND
             LV_ERR_CAN_BOFF = 0

THEN
```

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```

//status of hill descent control:
STATE_DHL_CTL = ST_HDC_FN
ELSE
//default value:
STATE_DHL_CTL = Fh
ENDIF

```

#### 4.60.4.23 FAHRGESTELLNUMMER (Vehicle Identification Number, ID = 380 hex)

Bit7      Bit6      Bit5      Bit4      Bit3      Bit2      Bit1      Bit0

Figure 4.60.1: Byte6

Byte6      NO\_VECH\_7 -> **VIN\_CAN[6]**

Figure 4.60.2: Byte5

Byte5      NO\_VECH\_6 -> **VIN\_CAN[5]**

Figure 4.60.3: Byte4

Byte4      NO\_VECH\_5 -> **VIN\_CAN[4]**

Figure 4.60.4: Byte3

Byte3      NO\_VECH\_4 -> **VIN\_CAN[3]**

Figure 4.60.5: Byte2

Byte2      NO\_VECH\_3 -> **VIN\_CAN[2]**

Figure 4.60.6: Byte1

Byte1      NO\_VECH\_2 -> **VIN\_CAN[1]**

Figure 4.60.7: Byte0

Byte0      NO\_VECH\_1 -> **VIN\_CAN[0]**


Figure 4.60.8: Signals

Signals	Range	Conversion	Invalid-case
NO_VECH_x	0..FFh	ASCII	FFh

### Application conditions

**Initialisation:**      *all zero at Reset*

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**Recurrence:**                    *Event triggered:*                    *Debounce time = 200ms*  
**Activation:**                    *Bus active*

**Formula section:**

*/\* NO\_VECH\_7 = least significant digit of vehicle identification number (Fahrgestellnummer)  
 NC\_VIN\_CAN\_LEN = 7*

VIN\_CAN [0]                    =                    NO\_VECH\_1  
 VIN\_CAN [1]                    =                    NO\_VECH\_2  
 VIN\_CAN [2]                    =                    NO\_VECH\_3  
 VIN\_CAN [3]                    =                    NO\_VECH\_4  
 VIN\_CAN [4]                    =                    NO\_VECH\_5  
 VIN\_CAN [5]                    =                    NO\_VECH\_6  
 VIN\_CAN [6]                    =                    NO\_VECH\_7

**Checksum calculation:**


No checksum calculation

No diagnosis possible -> message received only event triggered

**# IF ( NC\_SPORT\_SZL != 0 )                    // Compiler switch for deactivation of functionality**

#### 4.60.4.24 BEDIENUNG\_MDRV (MDRIVE switch, ID = 1D9 hex)

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	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte2					ALIV_COU_OP_PUBU_MDRV			
Byte1	OP_PUBU_MDRV							
Byte0	OP_PUBU_MDRV_COMP							

Figure 4.60.9: Signals

Signals	Range	Conversion	Invalid-case
ALIV_COU_OP_PUBU_MDRV	<b>0..Eh</b>	-	<b>Fh</b>
OP_PUBU_MDRV	<b>0..1</b>	-	<b>3h</b>
OP_PUBU_MDRV_COMP	<b>0..3</b>	-	<b>3h</b>

### Application conditions

**Initialisation:** *all zero at Reset*

**Recurrence:** 1s  
Event triggered: Debounce time = 100ms

**Activation:** *LV\_VAR\_SPT\_SWI = 1*

### Formula section:

*// Alive-Counter:*

TCC\_CAN\_SPT\_SWI = ALIV\_COU\_OP\_PUBU\_MDRV

**IF** LV\_ERR\_BN\_SPT\_SWI = 0 **AND**  
LV\_ERR\_CAN\_BOFF = 0

**THEN**

*// only read signal if OP\_POBU\_MDRV\_COMP is the complement (= bitwise  
// inverted value) of OP\_PUBU\_MDRV*

**IF** OP\_POBU\_MDRV\_COMP = (~OP\_PUBU\_MDRV)

**THEN** STATE\_SPT\_SWI = OP\_PUBU\_MDRV

**ELSE** STATE\_SPT\_SWI = 0 **ENDIF**

**ELSE**

STATE\_SPT\_SWI = 0

**ENDIF**

**#ENDIF**

### 4.60.4.25 FAHRGESTELLNUMMER (Vehicle Identification Number, ID = 380 hex)

Bit7 Bit6 Bit5 Bit4 Bit3 Bit2 Bit1 Bit0

Figure 4.60.10: Byte6

Byte6 NO\_VECH\_7 -> **VIN\_CAN[6]**

Figure 4.60.11: Byte5



Byte5 NO\_VECH\_6 -> VIN\_CAN[5]

Figure 4.60.12: Byte4

Byte4 NO\_VECH\_5 -> VIN\_CAN[4]

Figure 4.60.13: Byte3

Byte3 NO\_VECH\_4 -> VIN\_CAN[3]

Figure 4.60.14: Byte2

Byte2 NO\_VECH\_3 -> VIN\_CAN[2]

Figure 4.60.15: Byte1

Byte1 NO\_VECH\_2 -> VIN\_CAN[1]

Figure 4.60.16: Byte0

Byte0 NO\_VECH\_1 -> VIN\_CAN[0]

Figure 4.60.17: Signals

Signals	Range	Conversion	Invalid-case
NO_VECH_x	0..FFh	ASCII	FFh

### Application conditions

**Initialisation:** *all zero at Reset*

**Recurrence:** *Event triggered:                      Debounce time = 200ms*

**Activation:** *Bus active*


### Formula section:

/\* NO\_VECH\_7 = least significant digit of vehicle identification number (Fahrge  
stellnummer)

NC\_VIN\_CAN\_LEN = 7

VIN\_CAN [0]        =       NO\_VECH\_1  
VIN\_CAN [1]        =       NO\_VECH\_2  
VIN\_CAN [2]        =       NO\_VECH\_3  
VIN\_CAN [3]        =       NO\_VECH\_4  
VIN\_CAN [4]        =       NO\_VECH\_5  
VIN\_CAN [5]        =       NO\_VECH\_6  
VIN\_CAN [6]        =       NO\_VECH\_7

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**Checksum calculation:**

No checksum calculation  
No diagnosis possible -> message received only event triggered

**4.60.4.26 GESCHWINDIGKEIT\_RAD (CAN-ID = CE hex)**

Bit7      Bit6      Bit5      Bit4      Bit3      Bit2      Bit1      Bit0

Figure 4.60.18: Byte7

Byte7      V\_WHL\_RRH

Figure 4.60.19: Byte6

Byte6      V\_WHL\_RRH

Figure 4.60.20: Byte5

Byte5      V\_WHL\_RLH

Figure 4.60.21: Byte4

Byte4      V\_WHL\_RLH

Figure 4.60.22: Byte3

Byte3      V\_WHL\_FRH

Figure 4.60.23: Byte2

Byte2      V\_WHL\_FRH

Figure 4.60.24: Byte1


Byte1      V\_WHL\_FLH

Figure 4.60.25: Byte0

Byte0      V\_WHL\_FLH

**Application conditions**

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**Initialisation:**            **at reset all 0**

**Recurrence:**             **20ms (tmin = 18ms, tmax = 22ms)**

**Activation:**             **at every engine state**

#### Formula section:

```

IF                   LV_ERR_BN_WHEEL_CAN = 0           AND
                      LV_ERR_CAN_BOFF = 0

THEN

    // speed_wheel_RLH
    WHEEL_CAN_RE_LE = V_WHL_RLH (converted from BN2000)
    If                V_WHL_RLH = 8000 h
    then LV_WHEEL_CAN_RE_LE_ERR = 1
    else LV_WHEEL_CAN_RE_LE_ERR = 0
    endif

    // speed_wheel_RRH
    WHEEL_CAN_RE_RI = V_WHL_RRH (converted from BN2000)
    If V_WHL_RRH = 8000 h
    then LV_WHEEL_CAN_RE_RI_ERR = 1
    else LV_WHEEL_CAN_RE_RI_ERR = 0
    endif

    // speed_wheel_FLH
    WHEEL_CAN_FN_LE = V_WHL_FLH (converted from BN2000)
    If                V_WHL_FLH = 8000 h
    then LV_WHEEL_CAN_FN_LE_ERR = 1
    else LV_WHEEL_CAN_FN_LE_ERR = 0
    endif

    // speed_wheel_FRH
    WHEEL_CAN_FN_RI = V_WHL_FRH (converted from BN2000)
    If V_WHL_FRH = 8000 h
    then LV_WHEEL_CAN_FN_RI_ERR = 1
    else LV_WHEEL_CAN_FN_RI_ERR = 0
    endif

```

```

ELSE

    // speed_wheel_RLH
    WHEEL_CAN_RE_LE = 8000 h
    // speed_wheel_RRH
    WHEEL_CAN_RE_RI = 8000 h
    // speed_wheel_FLH
    WHEEL_CAN_FN_LE = 8000 h
    // speed_wheel_FRH
    WHEEL_CAN_FN_RI = 8000 h


```

**ENDIF**

### 4.60.5 Output messages of the DME to the CAN bus

#### Application conditions

**Initialisation:**            N\_MAX\_THD\_1\_CAN = 0 at reset

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```

N_MAX_THD_2_CAN = 0          at reset
STATE_TQ_INTV_DCC = 0H
LV_POW_CLAS_VEH_CAN_RCV = 0 at transition LV_IGK 1 - -> 0
CTR_LDM_CAN_INI = 0          at reset
LV_ENG_RUN_CAN = 0           at reset
LV_LDM_CAN_INI = 1           at reset
STATE_EFP_CTL_ECU = 03H     at reset
T_ERR_N_ENG = 0 s           at reset

```

**Recurrence:**

```

TORQUE_1 = 10 ms
TORQUE_2 = C_T_CYC_CAN_ECU_2
BOS_MELDUNG:
at transition LV_IGK and at signal change (time for debounce
is 1 s) or at transition of Bostoken form 0 -> !0 (time for
debounce is 1 s)
BOS_MELDUNG_2:
at transition LV_IGK and at signal change of either BOS_MELDUNG
or BOS_MELDUNG_2 (time for debounce is 1 s) or at transition
of
Bostoken form 0 -> !0 (time for debounce is 1 s)
Status Kraftstoffregelung DME:
General: 10s
at transition LV_IGK and at signal change (time for debounce
is 160ms);
at transition LV_IGK 0 1 the message has to be sent 3
times,
recurrency 160ms
ENGINE_1 = 100 ms
ENGINE_2: cyclic = 1s and at signal change (tmin = 50
ms)
ENGINE_RPM = 1 s

```

```

POWERMANAGEMENT_BATTERIESPANNUNG
always when LV_CAN_SND_MSG_PWR_MNG_1 is set
(recurrency of LV_CAN_SND_MSG_PWR_MNG_1 is 100ms)
reset LV_CAN_SND_MSG_PWR_MNG_1 after the message is sent
POWERMANAGEMENT_VERBRAUCHERSTEUERUNG
always when LV_CAN_SND_MSG_PWR_MNG_0 is set
(recurrency of LV_CAN_SND_MSG_PWR_MNG_0 is 100ms)
reset LV_CAN_SND_MSG_PWR_MNG_0 after the message is sent
GESCHWINDIGKEIT_TEMPOMAT
cyclic: 200ms; event triggered: min. time for sending 100ms
RADMOM_PT_1 and RADMOM_PT_2 = 20 ms
ELEKTRONISCHER MOTORÖLMESSTAB
cyclic: 10 s, event triggered (at transition KL.R off - ->
on and at signal change): min. time for sending 100ms and
on request
WAERMESTROM_MOTOR:
Cyclic: 1000ms, event-triggered, min. time 10 ms
OBD_DT_MOTOR: cyclic 1000ms
ST_BATT: event triggered at signal change (tmin = 200 ms) ->
the message has to be sent 3 times with recurrence 160ms
DISP_GSI: 100ms (tmin = 90ms, tmax = 110ms)
DISP_ENGDAT: 100ms (tmin=90ms, tmax=110ms)

```

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**Activation:**

```

POWERMANAGEMENT_BATTERIESPANNUNG AND
POWERMANAGEMENT_VERBRAUCHERSTEUERUNG
only if LV_VAR_VEH = 0 (E60)
GESCHWINDIGKEIT_TEMPOMAT at Kl.15 on and LV_VAR_DCC =
0
and LV_VAR_BN_LDM = 0
RADMOM_PT_1 and RADMOM_PT_2 only if LV_VAR_BN_LDM = 1
ELEKTRONISCHER MOTORÖLMESSSTAB at bus_active (always)
Status Kraftstoffregelung DME: Kl. 15 on
OBD_DT_MOTOR: LV_IGK = 1 and
LC_ETCU_FRF = 0 and
(LV_AT = 1 or LV_VAR_TCT =1)
ST_BATT: LV_IGK = 1
DISP_GSI: LV_IGK = 1
ENGINE_2: LV_IGK = 1
DISP_ENGDAT: C_N_DISP_DYN_ENA != 0

```

**Deactivation:**

```

GESCHWINDIGKEIT_TEMPOMAT at Kl.15 off
ELEKTRONISCHER MOTORÖLMESSSTAB at Kl.15 off
Status Kraftstoffregelung DME: Kl. 15 off
DISP_GSI: LV_IGK = 0
DISP_ENGDAT: C_N_DISP_DYN_ENA = 0

```

### Formula section:

#### 4.60.5.1 DME1

#### 4.60.5.2 Anfrage

*requested by DME:*

```

IF B_codierpm = 1
THEN Anfrage: Codierung Powermanagement is requested by DME from CAS
ID 395H // (recurrency 5 sec)
ENDIF

IF LV_POW_CLAS_VEH_CAN_REQ 0->1
THEN Anfrage: Fahrzeugtyp is requested by DME from CAS
ID 388H // once per trigger
ENDIF

IF LV_NO_VECH_REQ = 1 // recurrence 10ms
THEN Anfrage: Fahrgestellnummer is requested by DME from CAS
ID 380H
LV_NO_VECH_REQ = 0 // reset trigger after sending

```

### Description for actions:

<b>ACTION_INTC_NO_VECH_REQ()</b>					
When this action is called the service "Anfrage:Fahrgestellnummer" is requested.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
-	-	-	-	-	-
-	-	-	-	-	-

## FUNCTION DESCRIPTION:

LV\_NO\_VECH\_REQ = 1

*requested from DME by other STG:*

```

IF          ID2_INQY      =      1

THEN       IF          ID_FB_INQY = 897 dez// please note : motorola-format

                THEN          Anfrage: Elektronischer Ölmeßstab  is requested from DME
                By STG (ID 580 + STG)
                - -> description of message see 3.1.2
                ELSE       IF          ID_FN_INQY      =      910 dez
                // please note that the positions of high byte
                and low byte are changed (Intel-format)

                        THEN          Anfrage: Startdrehzahl  is requested from DME
                        by STG  (ID 580H + STG)
                        RPM_ENG_STA = N_ST_POW_MOD  (converted)

                ENDIF
ENDIF
ENDIF

```

### 4.60.5.3 Elektronischer Ölmeßstab

Please note: this message is sent:

- cyclic
- event-triggered
- on request (see 3.1.1)

```

if  LV_IGK = 0
    Then  CTR_DLY_MSG_OIL = 0
    Else  if  CTR_DLY_MSG_OIL < C_CTR_DLY_MSG_OIL
        Then  CTR_DLY_MSG_OIL ++
        Endif
    Endif

if  CTR_DLY_MSG_OIL >= C_CTR_DLY_MSG_OIL or
    LC_SND_MSG_OIL_KEY_AUX = 1
    Then  RECM_RFLV_EOI = STATE_OIL_REQ
        if  STATE_LOIL = 0
            Then  FLLV_EOI = C_STATE_LOIL_SUB
            Else  FLLV_EOI = STATE_LOIL
            Endif
        Else  FLLV_EOI = C_STATE_LOIL_SUB
            RECM_RFLV_EOI = 0
        Endif

```

### 4.60.5.4 BOS\_MELDUNG

```

ID2_BOS_MESS      =      idbosmsg
ID_FN_BOS_MESS    =      idfbosmg_w
RMMI_BOS          =      DIST_RESI_OIL
ST_UN_BOS         =      DIST_RESI_OIL_KM
AVAI_BOS_MESS     =      STATE_OIL_AVL

```

COU\_RSTG\_BOS\_MESS = zrbosmld

#### 4.60.5.5 BOS\_MELDUNG\_2

ID2\_BOS\_MESS\_2 = QOIL\_DS\_CAN\_2\_1  
 ID\_FN\_BOS\_MESS\_2 = QOIL\_DS\_CAN\_2\_2  
 FRC\_INTM\_WAY\_BOS\_MESS\_2 = QOIL\_DS\_CAN\_2\_3  
 TARD\_YR\_BOS\_MESS\_2 = QOIL\_DS\_CAN\_2\_4  
 TARD\_MON\_BOS\_MESS\_2 = QOIL\_DS\_CAN\_2\_5  
 FRC\_INTM\_T\_BOS\_MESS\_2 = QOIL\_DS\_CAN\_2\_6

#### 4.60.5.6 TORQUE\_1

*check control torque\_1 DME :*

CHKSM\_TORQ\_1\_DME = CKS\_CLC\_ECU1

*alive counter torque\_1 DME :*

ALIV\_TORQ\_1\_DME = TCC\_CAN\_ECU1  
 TCC\_CAN\_ECU1<sub>N</sub> = TCC\_CAN\_ECU1<sub>N-1</sub> + 10 ms

*torque actual-value:*

TORQ\_AVL = TQ\_AV (converted for BN2000)

*status torque actual-value:*

**If** SF\_TQD = 3 **or**  
 LV\_DI\_TQ\_REQ\_CAN\_MPI\_GDI = 1  
**Then** ST\_TORQ\_AVL = 3  
**Else** ST\_TORQ\_AVL = SF\_TQD  
**Endif**

TORQ\_AVL\_DMEE = TQ\_ECU\_ETCU (converted for BN2000)

*TQI\_MAF:*

**IF** LC\_TQI\_MAF\_MAN = 1  
**Then** TQI\_MAF = TQI\_SP\_CAN  
**Else** TQI\_MAF = TQI\_REF \* EFF\_IGA\_AV\_CAN \* EFF\_SCC\_AV\_CAN \*  
 EFF\_LAMB\_AV  
**Endif**

**Endif**

*calculation of TQ\_MAF:*

TQ\_MAF = TQI\_MAF + TQ\_LOSS

*Status\_switch\_clutch:*

**IF** LV\_AT = 1 **OR** LV\_VAR\_AMT = 1  
**THEN** ST\_SW\_CLT = 3H  
**ELSE** ST\_SW\_CLT = LV\_IM\_CS\_PN  
**ENDIF**

*status DME/ACC switch-off:*

**IF** LV\_DCC\_OFF\_ECU = 0  
**THEN** ST\_DMEA\_SWO = 0H  
**ELSE** ST\_DMEA\_SWO = 1H  
**ENDIF**

*receipt\_ACC\_switch-off\_system\_DME:*

```

IF          LV_DCC_OFF_ACK          =      0
THEN       RCPT_ACC_SWO_SYS_DME     =      0H
ELSE       RCPT_ACC_SWO_SYS_DME     =      1H
ENDIF

```

*status\_receipt\_engine\_ACC:*

```

IF          LV_VAR_DCC              =      0
THEN       STATE_TQ_INTV_DCC        =      3H
ELSEIF     LV_ERR_BN_TQ_DCC         =      0
THEN       STATE_TQ_INTV_DCC        =      0H
ELSEIF     ERR_SYM_BN_TQ_DCC        =      SYM_1      OR
            ERR_SYM_BN_TQ_DCC        =      SYM_3
THEN       STATE_TQ_INTV_DCC        =      1H
ELSEIF     ERR_SYM_BN_TQ_DCC        =      SYM_2
THEN       STATE_TQ_INTV_DCC        =      2H
ENDIF

```

ST\_RCPT\_ENG\_ACC = STATE\_TQ\_INTV\_DCC

*status\_receipt\_engine\_ARS:*

```

IF          LV_VAR_ARS              =      0
THEN       STATE_TQ_INTV_ARS        =      3H
ELSEIF     LV_ERR_BN_ARS            =      0
THEN       IF          LV_TQ_MAX_ARS          =      1
            THEN       STATE_TQ_INTV_ARS        =      1H
            ELSE       STATE_TQ_INTV_ARS        =      0H
            ENDIF
ELSEIF     ERR_SYM_BN_ARS            =      SYM_1      OR
            ERR_SYM_BN_ARS            =      SYM_3      OR
            LV_TQ_MAX_ARS              =      1
THEN       STATE_TQ_INTV_ARS        =      1H
ELSEIF     LV_ERR_BN_ARS            =      1      AND
            ERR_SYM_BN_ARS            =      SYM_2
THEN       STATE_TQ_INTV_ARS        =      2H
ENDIF

```

ST\_RCPT\_ENG\_ARS = STATE\_TQ\_INTV\_ARS

*status\_receipt\_engine\_DSC:*

```

IF          LV_VAR_ASR              =      0
THEN       STATE_TQ_INTV_TCS        =      3H
ELSEIF     LV_ERR_BN_TQ_TCS         =      0
THEN       STATE_TQ_INTV_TCS        =      0H
ELSEIF     ERR_SYM_BN_TQ_TCS        =      SYM_1      OR
            ERR_SYM_BN_TQ_TCS        =      SYM_3
THEN       STATE_TQ_INTV_TCS        =      1H
ELSEIF     ERR_SYM_BN_TQ_TCS        =      SYM_2      OR
THEN       STATE_TQ_INTV_TCS        =      2H
ENDIF

```

ST\_RCPT\_ENG\_DSC = STATE\_TQ\_INTV\_TCS



*status\_receipt\_engine\_EGS/SSG/TCT:*

```

IF          LV_AT          =      1
THEN       ST_RCPT_ENG_EGS    =      STATE_TQ_INTV_ETCU
ELSEIF     LV_VAR_AMT      =      1
THEN       ST_RCPT_ENG_EGS    =      STATE_TQ_INTV_AMT
ELSEIF     LV_VAR_TCT       =      1
THEN       ST_RCPT_ENG_EGS    =      STATE_TQ_INTV_TCT
ENDIF

```

```

IF          LV_AT          =      0
THEN       STATE_TQ_INTV_ETCU =      3H
ELSEIF     LV_ERR_BN_TQ_ETCU =      0
THEN       STATE_TQ_INTV_ETCU =      0H
ELSEIF     ERR_SYM_BN_TQ_ETCU =      SYM_1      OR
             ERR_SYM_BN_TQ_ETCU =      SYM_3
THEN       STATE_TQ_INTV_ETCU =      1H
ELSEIF     LV_ERR_BN_TQ_ETCU =      1      AND
             ERR_SYM_BN_TQ_ETCU =      SYM_2      OR
THEN       STATE_TQ_INTV_ETCU =      2H
ENDIF

```

```

IF          LV_VAR_AMT      =      0
THEN       STATE_TQ_INTV_AMT  =      3H
ELSEIF     STATE_ERR_AMT_CAN =      0H
THEN       STATE_TQ_INTV_AMT  =      0H
ELSEIF     STATE_ERR_AMT_CAN =      2H      OR
             STATE_ERR_AMT_CAN =      3H      OR
THEN       STATE_TQ_INTV_AMT  =      1H
ELSEIF     STATE_ERR_AMT_CAN =      1H
THEN       STATE_TQ_INTV_AMT  =      2H
ELSE       STATE_TQ_INTV_AMT  =      3H
ENDIF

```

```

IF          LV_VAR_TCT       =      0
THEN       STATE_TQ_INTV_TCT  =      3H
ELSEIF     LV_ERR_BN_TQ_TCT  =      0
THEN       STATE_TQ_INTV_TCT  =      0H
ELSEIF     ERR_SYM_BN_TQ_TCT  =      SYM_1      OR
             ERR_SYM_BN_TQ_TCT  =      SYM_3
THEN       STATE_TQ_INTV_TCT  =      1H
ELSEIF     LV_ERR_BN_TQ_TCT  =      1      AND
             ERR_SYM_BN_TQ_TCT  =      SYM_2
THEN       STATE_TQ_INTV_TCT  =      2H
ENDIF

```

*status\_OBD\_control-function\_gearbox ST\_OBD\_CTFN\_GRB:*

```
ST_OBD_CTFN_GRB = STATE_DIAG_GS
```

*status\_contact\_brake-pedal\_DME:*

```

if          LV_ERR_BLS_PLAUS          =      1
then       ST_CT_BRPD_DME            =      111b
elseif     LV_IM_BTS                 = 0    and    LV_IM_BLS          = 0
then       ST_CT_BRPD_DME            =      000b
elseif     LV_IM_BTS                 = 1    and    LV_IM_BLS          = 0
then       ST_CT_BRPD_DME            =      010b
elseif     LV_IM_BTS                 = 0    and    LV_IM_BLS          = 1
then       ST_CT_BRPD_DME            =      001b
else       ST_CT_BRPD_DME            =      011b
endif

```

#### 4.60.5.7 TORQUE\_2

*checksum\_torque\_2\_DME:*

```
CHKSM_TORQ_2_DME      =      CKS_CLC_ECU2
```

*status\_over-run-fuel-shutoff:*

```

IF          LV_PUC=0                and    LV_TQ_DCC_INC_REQ=1        and
              TQI_DCC_FAST_INC < TQI_REF_IGA_MIN_LAMB
Then       ST_INFS =02H
else       ST_INFS = LV_PUC
endif

```

*alive counter torque\_2 DME :*

```

ALIV_TORQ_2_DME      =      TCC_CAN_ECU2
TCC_CAN_ECU2N      = T      CC_CAN_ECU2N-1 + 10 ms

```

*status\_switch\_level\_RPM:*

```

if          N_SP_IS                 >      C_N_SP_IS_THD_CAN
then       ST_SW_LEV_RPM            =      00b
              LV_LEVEL_IS           =      0
else       ST_SW_LEV_RPM            =      01b
              LV_LEVEL_IS           =      1
endif

```

*torque\_actual-value\_minimum:*

```
TORQ_AVL_MIN      =      TQ_LOSS      (converted for BN2000)
```

*torque\_actual-value\_maximum:*

```
TORQ_AVL_MAX      =      TQ_MAX_CLU   (converted for BN2000)
```

*torque\_actual-value\_spare\_negative:*

```

TORQ_AVL_SPAR_NEG =      TQ_REF_IGA_MIN_LAMB      (converted for BN2000)
TQ_REF_IGA_MIN_LAMB =      TQI_REF_IGA_MIN_LAMB + TQ_LOSS

```

*torque\_actual-value\_spare\_positive:*

```
TORQ_AVL_SPAR_POS      =      TQ_MAF      (converted for BN2000)
```

#### 4.60.5.8 TORQUE\_3

*checksum\_torque\_3\_DME:*

```
CHKSM_TORQ_3_DME      =      CKS_CLC_ECU3
```

*alive counter torque\_2 DME :*

```
ALIV_TORQ_3_DME      =      TCC_CAN_ECU3
TCC_CAN_ECU3N      =      TCC_CAN_ECU3N-1 + 10 ms
```

*torque\_driver's-choice:*

```
TORQ_DVCH           =      TQ_EMS_BN (converted)
TQ_EMS_BN           =      TQ_LOSS + MIN [MAX(TQI_EMS;TQI_DCC_FAST_INC);
                                TQI_REF_MAX*EFF_IGA_BAS_COR]
```

*angle\_accelerator-pedal:*

```
PV_MAX_CAN         =      PV_MAX (converted)
```

```
If          PV_MAX_CAN <      FFH
Then       ANG_ACPD      =      PV_MAX_CAN
Else       ANG_ACPD      =      FEH
Endif
```

*// save "engine should run-status" without need of ENSD*

```
If          LV_ST_END = 1
Then       LV_ENG_RUN_CAN = 1
                T_ERR_N_ENG = 0 s
Else       If          ECU_STATE = PWL
                Then       LV_ENG_RUN_CAN = 0
                Endif
Endif
```

*RPM\_engine and RPM\_engine\_error:*

```
If          N > 0
Then       N_CAN = N      (converted)
                RPM_ENG_ERR = LV_ERR_CRK
Else       if          (LV_ENG_RUN_CAN = 1 AND LV_STALL=0)
                Then       if (T_ERR_N_ENG >= C_T_MAX_ERR_N_ENG) and LV_ERR_CRK=0
                        then       LV_ENG_RUN_CAN = 0
                                    T_ERR_N_ENG = 0 s
                                    N_CAN = 0
                                    RPM_ENG_ERR = 00H
                        else       T_ERR_N_ENG = T_ERR_N_ENG + 0,01 s
                                    N_CAN = FFFFH          // CRK error active but not de-
bounced
                                    RPM_ENG_ERR = 01H          // RPM_ENG=FFFFH RPM_ENG_ERR=1
                        endif
                Else       N_CAN = 0
                RPM_ENG_ERR = LV_ERR_CRK
                Endif
Endif
RPM_ENG      =      N_CAN
```

*status\_idling\_engine:*

```
ST_IDLG_ENG      =      ! LV_IS
```

*status closed-loop-control speed:*

```
IF      STATE_CRU_CAN      = 7H      // DEC
THEN    STATE_CRU_BN      = 4H
ELSEIF  STATE_CRU_CAN      = 1H      // CONST/TIP
THEN    STATE_CRU_BN      = 5H
ELSEIF  STATE_CRU_CAN      = 3H      // RES
THEN    STATE_CRU_BN      = 6H
ELSEIF  STATE_CRU_CAN      = 5H      // SET_ACC
THEN    STATE_CRU_BN      = 7H
ELSEIF  (STATE_CRU_CAN      = 0H      AND      //PASSIVE
        PV_AV      = 0%)
THEN    STATE_CRU_BN      = 8H
ELSEIF  (STATE_CRU_CAN      = 0H      AND      //PASSIVE
        PV_AV      <> 0%)
THEN    STATE_CRU_BN      = 9H
ENDIF
```

```
if      LV_MTC_CUR_OFF      = 1
then    ST_CLCTR_V      = FH
elseif  LV_KD = 1
then    ST_CLCTR_V      = 0BH
elseif  LV_VAR_DCC = 1
then    ST_CLCTR_V      = STATE_TQ_DCC
elseif  LV_VAR_BN_LDM = 1
then    ST_CLCTR_V      = STATE_TQ_LDM
else    ST_CLCTR_V      = STATE_CRU_BN
endif
```

*Required\_amount\_of\_fuel:*

```
IF      CONF_SWI_EFP_OUT      =      !1
THEN    IF      LC_EFPPWM_CTL = 0
        THEN    RQAM_FU      =      VFF_EFP
        ELSE    RQAM_FU      =      EFPPWM_CAN
ENDIF
```

#### 4.60.5.9 ENGINE\_RPM

*actual engine speed limit (orange area) depending on TCO:*

```
IF      N_MAX_THD_1      >      N_MAX_THD_1_CAN
THEN    N_MAX_THD_1_CAN      =      N_MAX_THD_1
ENDIF
RPM_TEMP_DOM_1      =      N_MAX_THD_1_CAN
```

```
IF      LV_ERR_TCO      = 0
THEN    RPM_TEMP_DOM_1 = N_MAX_THD_1_CAN
ELSE    RPM_TEMP_DOM_1 = FFH
```

**ENDIF**

*actual engine speed limit (red area) depending on TCO:*

```

IF          N_MAX_THD_2          >      N_MAX_THD_2_CAN
THEN       N_MAX_THD_2_CAN      =      N_MAX_THD_2
ENDIF

```

```

IF          LV_ERR_TCO          = 0
THEN       RPM_TEMP_DOM_2 = N_MAX_THD_2_CAN
ELSE       RPM_TEMP_DOM_2 = FFH
ENDIF

```

**4.60.5.10 ENGINE\_1**

*temperature engine :*

```

if          LV_ERR_TCO          = 1
then       TEMP_ENG            = FFH
else       TEMP_ENG            = TCO ( converted)
endif

```

*alive counter DME :*

```

ALIV_COU_DMEN      =      TCC_CAN_ECU
TCC_CAN_ECUN      =      TCC_CAN_ECUN-1 + 200 ms

```

*temperature engine oil :*

```

TOIL_CAN      =      TOIL          ( converted)
if          LV_ERR_QOIL_SENS = 1      and
              ( ERR_SYM_QOIL_SENS = SYM_0 or
                ERR_SYM_QOIL_SENS = SYM_2 )
then       TEMP_EOI            = FFH
else       TEMP_EOI            = TOIL_CAN
endif

```

*status engine run :*

```

if          LV_ES = 1
then       ST_ENG_RUN = 00b
elseif     LV_ST = 1
then       ST_ENG_RUN = 01b
elseif     LV_ES = 0
and       LV_ST = 0
then       ST_ENG_RUN = 10b
endif

```

*status switch warm-up ST\_SW\_WAUP :*

```

if          LV_LIH_COC_ON          =      1
then       ST_SW_WAUP              =      10b
elseif     LV_WUP_CAN              =      0
then       ST_SW_WAUP              =      00b
else       ST_SW_WAUP              =      01b
endif

```

*air-pressure engine AIP\_ENG :*

```

AMP_CAN      =      AMP_MES

```

```

if          LV_ERR_AMP      =      1
then       AIP_ENG         =      FFH
else       AIP_ENG         =      AMP_CAN
endif
    
```

*Injection-volume\_fuel:*  
 IJV\_FU = FCO (like CAN11h)

*Control\_shift-lock:*

```

IF          (LV_ACT_N_SP_IS_EXT_ADJ      = 1      AND
              LV_IS      = 1      AND
              VS      = 0
THEN       CTL_SHIFT_LOCK_CAN = 10b      intervention
ELSE       CTL_SHIFT_LOCK_CAN = 01b      no intervention (default)
ENDIF
    CTR_SLCK      =      CTL_SHIFT_LOCK_CAN
    
```

*Active engine speed limit in case of limp home:*  
 RDUC\_DOCTR\_RPM = STATE\_N\_MAX\_THD\_LIH

*RPM\_idling\_target:*  
 RPM\_IDLG\_TAR = N\_SP\_IS

*Status\_rbm-cycle:*

```

IF          LV_DC_RBM = 1
THEN       ST_RBMCYC = 10b
ELSE       ST_RBMCYC = 00b
ENDIF
    
```

#### 4.60.5.11 ENGINE\_2 (Motordaten 2, ID=383h)

*Request starting assistance:*

```

if          B_notafu = 0
then       RQ_STASS = 0
else       RQ_STASS = 1
endif
    
```

#### 4.60.5.12 GESCHWINDIGKEIT\_TEMPOMAT


*speed\_closed-loop-control\_cruise-control:*  
 V\_CLCTR\_CCTR = VS\_SP\_DRIV\_CRU\_CAN

*status\_speed\_closed-loop-control\_cruise-control ST\_V\_CLCTR\_CCTR:*

```

IF          LV_PROG_STEP_1      =      0
THEN       IF          LV_CRU_MAIN_SWI      =      0
THEN       ST_V_CLCTR_CCTR      = 00H      "Off"
ELSE       IF          STATE_CRU      =      "PASSIVE"
THEN       ST_V_CLCTR_CCTR = 01H      "inactive"
ELSE       ST_V_CLCTR_CCTR = 02H      "active"
ENDIF
ENDIF
ELSE       ST_V_CLCTR_CCTR = 01H      "inactive"
ENDIF
    
```

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*control\_display\_cruise-control:*

CTR\_DISP\_CCTR = LV\_STEP\_ON\_ICL

*control\_display\_cruise-control\_HUD:*

CTR\_DISP\_CCTR\_HUD = LV\_CRU\_DISP\_HUD

*receipt\_activation\_cruise-control\_DR:*

RCPT\_ACTVN\_CCTR\_DR = LV\_CRU\_ACT\_INH

*index\_number:*

IDX\_NO = NR\_VS\_CRU

*speed\_cruise-control\_index\_number\_i :*

V\_CCTR\_IDX\_NO\_i = VS\_STEP\_CAN\_i (i = 1,2,3)

#### 4.60.5.13 WAERMESTROM\_MOTOR

*air-conditioning-compressor\_limit\_torque:*

**IF** LV\_ACCOUT\_RLY = 0

**THEN** TQ\_MAX\_ACC\_CAN = 0

**ELSE** TQ\_MAX\_ACC\_CAN = min(TQ\_MAX\_ACC, C\_TQ\_MAX\_ACC)

**ENDIF**

ACCM\_LIM\_TORQ = TQ\_MAX\_ACC\_CAN

*heat-flow\_request\_DME:*

HTFL\_RQ\_DME = FFh

*heat-flow\_status\_DME:*

HTFL\_ST\_DME = N\_REL\_CWP

*status\_current-raw\_engine:*

ST\_CRAW\_ENG = STATE\_CUR\_ENG\_CNS

*status\_current\_generator:*

ST\_I\_GEN = CUR\_GEN

*status\_generator:*

ST\_GEN = STATE\_ALTER

*status\_load-state\_generator:*

ST\_LDST\_GEN = st\_ldstgen

*control\_aperture\_water-valve:*

CTR\_APE\_WV = PWM\_VALUE\_HIV\_PERC

*load-state\_generator:*

LDST\_GEN = POW\_REL\_ALTER\_CLC

#### 4.60.5.14 POWERMANAGEMENT\_BATTERIESPANNUNG

(in case of E60, LV\_VAR\_VEH = 0)

```

T_SEC_COU_REL_RED      =      FFFFFFFH
SDWN_COU_BTSW         =      FFH
ST_SWO_KL_30          =      3H
ST_COS_SWO             =      3H
ST_HT_RSCR            =      3H
ST_PCOS               =      stpcos
CTR_PRED_PRIO_CF      =      POW_CTL_PRI_PEAK_RED_CFT
CTR_PRED_PRIO         =      POW_CTL_PRI_PEAK_RED
ST_SW_DSTB            =      3H
ST_BTSW               =      3H
U_BT                  =      VB_POW_MNG
if          LV_ERR_ACK_IGK_OFF = 1
then       ACKM_RQ_SWO_KL_15 = 0
else       ACKM_RQ_SWO_KL_15 = STATE_ACK_IGK_OFF
endif

```

#### 4.60.5.15 POWERMANAGEMENT\_VERBRAUCHERSTEUERUNG

(in case of E60, LV\_VAR\_VEH = 0)

```

CTR_PCOS              =      POW_CTL_PARK_CNS
RQ_PCOS               =      rqpcos
CTR_CBR               =      CUR_RNG_CTL
CTR_PWR_COS           =      POW_CTL_PWR_CNS_1
CTR_PWR_SPCOS         =      POW_CTL_PWR_CNS_2
SLCTN_SPCOS           =      selspcos
ULEV                  =      ulev

```

#### 4.60.5.16 Radmoment Antriebsstrang 1

```

CHKSM_WMOM_PT_1      =      CKS_CLC_TQ_WHEEL_1

ALIV_WMOM_PT_1       =      TCC_CAN_TQ_WHEEL_1
TCC_CAN_TQ_WHEEL_1_N =      TCC_CAN_TQ_WHEEL_1_{N-1} + 20 ms

ST_PENG              =      STATE_ENGG_POS
WMOM_PT_AVL          =      TQ_WHEEL

IF          LV_TQ_WHEEL_LDM_BN_ERR = 1
THEN       PV_LDM_REQ_CAN = FFFH
ELSE       PV_LDM_REQ_CAN = PV_CRU (converted)
ENDIF

ANG_ACPD_TAR         =      PV_LDM_REQ_CAN

ANG_ACPD_REAL        =      PV_AV

IF          CTR_LDM_CAN_INI >= C_CTR_LDM_CAN_INI
Then       ST_INTF_PT = 0
              LV_LDM_CAN_INI = 0
if         LV_LDM_OFF_ECU = 1      or
              LV_ERR_LDM_INH_MON = 1

```



```

Then      Bit 1 of ST_INTF_PT is set to 1
Else      Bit 1 of ST_INTF_PT is reset to 0
Endif

If        LV_LDM_OFF = 1
Then      Bit 0 of ST_INTF_PT is set to 1
Else      Bit 0 of ST_INTF_PT is reset to 0
Endif
Else      Bit 0, Bit 1, Bit 2 and Bit 3 of ST_INTF_PT are set, Bit 4 is reset to 0
           // ST_INTF_PT = FH
if        LV_IGK = 1
then      CTR_LDM_CAN_INI ++
           //incremented with cyclic transmission of message
endif
Endif

```

#### 4.60.5.17 Radmoment Antriebsstrang 2

```

CHKSM_WMOM_PT_2          =      CKS_CLC_TQ_WHEEL_2

ALIV_WMOM_PT_2          =      TCC_CAN_TQ_WHEEL_2
TCC_CAN_TQ_WHEEL_2N    =      TCC_CAN_TQ_WHEEL_2N-1 + 20 ms

WMOM_PT_MAX             =      TQ_MAX_WHEEL
WMOM_PT_MIN_LOW        =      TQ_MIN_WHEEL_L
WMOM_PT_COODT_TAR      =      Md_rad_ksoll      (converted to BN! see LH )

```

#### 4.60.5.18 Challenge to CAS (EWS):

*The frame n+1 will only be send if the frame n has be confirmed by the can-driver*

*Frame 1:*

ID c see LH EWS  
 IMOB\_TRM\_CHAL\_x

*Frame 2:*

ID d see LH EWS  
 IMOB\_TRM\_CHAL\_x

*Frame 3:*

ID e see LH EWS  
 IMOB\_TRM\_CHAL\_x

#### **ACTION\_COMM\_SEND\_CHAL\_CAN\_TRIG() :**

```

ctr_imob_resp_rcv_can = 0      (delete receive-counter)
Start Transmission

```

#### 4.60.5.19 Status Kraftstoffregelung DME

*status\_fuel\_closed-loop-control\_DME:*

```

IF          LC_EFPWM_CTL          =      0
THEN        STATE_EFP_CTL_ECU = 01H
ELSE        STATE_EFP_CTL_ECU = 02H
ENDIF
ST_FU_CLCTR_DME = STATE_EFP_CTL_ECU

```

### 4.60.5.20 OBD\_DT\_MOTOR (OBD Daten Motor)

Message Layout:

Bit7      Bit6      Bit5      Bit4      Bit3      Bit2      Bit1      Bit0

Figure 4.60.26: Byte2



Figure 4.60.27: Byte1



Figure 4.60.28: Byte0



*Position of throttle valve (converted from 0...FFh -> 0...FEh):*

```

if          OBD_TPS_1 > 7Fh
then       PO_THVA_ENG = OBD_TPS_1 - 1h    (shift for conversion)
else       PO_THVA_ENG = OBD_TPS_1
endif
    
```

*Calculated value for engine load (converted from 0...FFh -> 0...FEh):*

```

if          LOAD_CLC > 7Fh
then       CALCVL_LD_ENG      = LOAD_CLC - 1h    (shift for conversion)
else       CALCVL_LD_ENG      = LOAD_CLC
endif
    
```

*State PFC-Cycle*

```

If          LV_DC_PERM = 0
Then       STATE_OBD_CYC_BN = 0 0 (bin)           // 'Kein PFC-Zyklus',
Else       STATE_OBD_CYC_BN = 0 1 (bin)           // 'PFC-Zyklus erfüllt'
Endif
    
```

ST\_PFC\_CYC      = STATE\_OBD\_CYC\_BN

### 4.60.5.21 ST\_BATT (Status Batterie - ID:38Bh)

*Condition battery:*

CND\_BT = Qv\_out\_m      // converted -> Ph = 2 \* [hex] %

*Condition battery accuracy:*

CND\_BT\_ACCY = Qv\_quali\_m      // converted -> Ph = 2 \* [hex] %

*Condition battery change:*

CND\_BT\_CHNG = Qvc\_status\_4      // converted -> Ph = 2 \* [hex] - 128

*Condition battery time (resolution 4 h, Qv\_td -> resolution 1h):*

```

If           Qv_td1 /4 < 255
Then        CND_BT_T = Qv_td1 /4           //residue not used
Else        CND_BT_T = FEh
Endif
    
```

*Status condition battery:*

```

If           Qvc_status_3 < FH
Then        ST_CND_BT = Qvc_status_3
Else        ST_CND_BT = 1
Endif
    
```

#### 4.60.5.22 DISP\_GSI (Anzeige Schalthinweis - ID:2F3h)

##### Formula section:

*alive counter display gear shift indication :*

```

ALIV_DISP_GSI           = TCC_CAN_GS_IDC
TCC_CAN_GC_IDCn       = TCC_CAN_GS_IDCn-1 + 1
    
```

*display target gear:*

```

DISP_TARG           =           GS_IDC_GEAR           (copy lowest 4 bit)
    
```

*display gear shift indication :*

```

DISP_GSI           =           GS_IDC_DISP           (copy lowest 2 bit)
    
```

*Checksum for gear shift indication :*

```

CHKSM_DISP_GSI     =           CKS_CLC_GS_IDC
    
```

#### 4.60.5.23 DISP\_ENGDAT (Anzeige Motordaten - ID:175h)

*alive counter display gear shift indication :*

```

ALIV_DISP_ENGDAT    = TCC_CAN_DISP_ECU
TCC_CAN_DISP_ECUn  = TCC_CAN_DISP_ECUn-1 + 1
    
```

*display rpm of engine:*

```

If           C_N_DISP_DYN_ENA = 1
Then        DISP_RPM_ENG           =           N_DISP_DYN
Else        DISP_RPM_ENG           =           N_CAN
Endif
    
```

#### 4.60.5.24 Dienste - Anforderung Bus/Teilnetz (ID2 = 12/Ch)

##### General information:

This message is sent to guarantee a defined PWL time for DMTL-diagnosis. The maximum power latch time is requested only once per driving cycle. This Function is only necessary for vehicle platforms which have a switched Klemme 30 by CAS. Message Layout:

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte7								
Byte6								
Byte5	DUR_FLLUPT							
Byte4	ST_LAW_RQ				ST_RQ_BUS			
Byte3	ID_RQ_BUS							
Byte2	ID_FN_RQ_BUS							
Byte1	ID_FN_RQ_BUS							
Byte0	12-Anforderung Bus/Teilnetz							

### Application conditions

**Initialisation:** `LV_REQ_PWL_DMTL_SND = 0` at reset or `LV_IGK 0->1`

**Recurrence:** event triggered ( $t_{min}=100ms$ , sent 3 times with recurrence 160ms)  
-> see formula section

**Activation:** `LC_ENA_REQ_PWL_DMTL_CAN = 1`

### Formula section:

**If** `LV_REQ_PWL_DMTL = 0 -> 1` **and** `LV_REQ_PWL_DMTL_SND = 0`  
**Then** send message 3 times with recurrence 160ms (as described below)

```
//ID_function_request_bus : tank leakage diagnosis:
ID_FN_RQ_BUS      = 110h
//request bus "Klemme 30g":
ID_RQ_BUS         = 50
// status of request bus : activation:
ST_RQ_BUS         = 0
// request due to law:
ST_LAW_RQ         = 1
// requested powerledge time (converted and limited):
DUR_FLLUPT       = C_T_DMTL_MAX
(DUR_FLLPT = 0 ... 254 min, (PH) = (HEX) [min])
If sending finished
Then LV_REQ_PWL_DMTL_SND = 1
Endif
```


**Endif**

**# IF ( NC\_SPORT\_SZL != 0 )** // Compiler switch for deactivation of functionality

#### 4.60.5.25 ST\_MDRV (status MDRIVE, ID = 399 hex)

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	
Byte5		unused					unused		
Byte4	unused			CTR_DISP_MDRV		unused			
Byte3	unused				unused				
Byte2	ST_MDRV_CHC_ENG				ST_MDRV_STG_GRB				
Byte1	ST_MDRV_MOD_GRB			ST_MDRV_DSC			unused		
Byte0	ALIV_ST_MDRV				CHKSM_ST_MDRV				

Figure 4.60.29: Signal

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
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Signal	Range	Conversion	Invalid-case
CHKSM_ST_MDRV	0..15	-	-
ALIV_ST_MDRV	0..Eh	-	Fh
ST_MDRV_DSC	0..111b	000 Keine Änderung 001 DSC AUS 010 DSC EIN 100 DSC EIN Sport 101 DTC EIN M-Track-Mode 111 Signal ungültig	111b
ST_MDRV_MOD_GRB	0..7h	000: Keine Änderung 001: Automatik 010: Sequentiell 111: Signal ungültig	111b
ST_MDRV_STG_GRB	0..15h	0: Keine Änderung 1..6: Stufe 1..6 15: Signal ungültig	1111b
ST_MDRV_CHC_ENG	0..15h	0: keine Änderung 1: Kennlinie 1 2: Kennlinie 2 15: Signal ungültig	1111b
CTR_DISP_MDRV	0..3h	00 M-Drive-Anzeige AUS 01 M-Drive-Anzeige EIN 10 M-Drive-Anzeige EIN, BLINKEN 11 Signal ungültig	3h

## Application conditions

**Initialisation:** *all zero at Reset*

**Recurrence:**

- 10s (tmin = 9s, tmax = 11s)
- at signalchange (tmin = 160 ms)
- 3 times when LV\_IGK 1- ->0 (tmin = 160 ms)

**Activation:** *LV\_VAR\_SPT\_SWI = 1*

## Formula section:

```
CTR_DISP_MDRV      = STATE_SPT_DISP_CAN      ///copy lowest bits
ST_MDRV_DSC        = STATE_SPT_ESP_CAN      ///copy lowest bits
ST_MDRV_CHC_ENG    = STATE_SPT_ECU_CAN      ///copy lowest bits
ST_MDRV_MOD_GRB    = STATE_SPT_MOD_GB       ///copy lowest bits
ST_MDRV_STG_GRB    = STATE_SPT_STEP_GB      ///copy lowest bits
```

Checksum and alive counter calculation:


```
ALIV_ST_MDRVN      = ALIV_ST_MDRVN-1 + 1
CHKSM_ST_MDRV      = CRC_CLC_CAN_STMDRV      (Standart 4bit checksum)
```

**# ENDIF**

## 4.60.6 Checkcontrol- Messages

### General Information:

Activation: *LV\_KEY\_AUX = 1 OR LV\_IGK = 1*  
Update rate: *100ms*  
Initialisation: *at reset or at transition KL.15 0 -> 1 :*  
*LV\_CC\_POIL\_SWI\_INH = 1*

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```

        LV_CC_TEST_BENCH_ACT = 0
    at LV_ST_END = 0 -> 1:
        T_DLY_POIL_SWI_CAN = IP_T_DLY_POIL_SWI_CAN__TOIL
    at reset:
        CYC_CTR_CC                = 0
        LV_CC_ID_XX                = 0
        LV_SEND_CC_ID_XX          = 0
        LV_CC_ID_BENCH            = 0
        LV_SEND_CC_ID_BENCH      = 0
        CC_ID = 0
    at deactivation:
        LV_MIL_CAN_1              = 0
        LV_MIL_CAN_1n-1          = 0
        LV_CC_ID_34               = 0
        LV_SEND_CC_ID_34          = 0

```

### Formula section:

*conditions for sending of CC-messages:*

--> to be calculated only in 100ms recurrency:

```

if                (LV_ES = 0)
then             STATE_CC_KEY = 3          // Motor läuft
else             if                (LV_IGK = 1)
then             STATE_CC_KEY = 2          // Kl. 15 an
else             if                (LV_KEY_AUX = 1)
then             STATE_CC_KEY = 1          // Kl. R an
else             STATE_CC_KEY = 0
endif
endif

```

*// Auxiliary bit for suppressing EML during predrive-check:*

--> to be calculated only in 500ms recurrency

```

if                LV_WAL_1_EXT_ADJ = 1
then             LV_WAL_1_CAN = LV_ACT_WAL_1_EXT_ADJ
elseif          (LV_WAL_ST = 1)          //predrive check active
then             LV_WAL_1_CAN = 0;
else             LV_WAL_1_CAN = LV_WAL_1
endif

if                LV_MIL_EXT_ADJ = 1
then             LV_MIL_CAN = LV_ACT_MIL_EXT_ADJ
else             LV_MIL_CAN = LV_MIL
endif

```

// Auxiliary bit for MIL-Lamp only (or flash) CC-message:

```
--> to be calculated only in 500ms recurrency
if STATE_MIL_ON_DIS_EXT_REQ = 02h or LC_ENA_CC_MIL_1 = 0
    //MIL-OFF by coding or calibration
then LV_MIL_CAN_1 = 0
elseif LV_MIL_EXT_ADJ = 1 // external adjustment by tester
then LV_MIL_CAN_1 = LV_ACT_MIL_EXT_ADJ
elseif STATE_MIL = 2
    then if STATE_MIL N-1 <> 2
        then LV_MIL_CAN_1 = 0
        else LV_MIL_CAN_1 = 1
        endif
    else if [LV_MIL = 1 and
        ( LV_WAL_ST = 1 or STATE_MIL = 1 or LV_MIL_ACT_REQ = 1)]
        then LV_MIL_CAN_1 = 1
        else LV_MIL_CAN_1 = 0
        endif
    endif
endif
```

//Auxiliary bit for FUC CC-message:

```
--> to be calculated only in 500ms recurrency
if LV_FUC_CAN = 1 or
    LV_CHK_FUC_OPEN_CAN = 1
then LV_FUC_CAN_BN = 1
else LV_FUC_CAN_BN = 0
endif
```

//Auxiliary bit for BLS defect CC-message:

```
--> to be calculated only in 500ms recurrency
if (VAR_VEH = PL2 & &
    LV_ERR_BLS_PLAUS = 1)
then LV_BLS_PLAUS_CAN = 1
else LV_BLS_PLAUS_CAN = 0
endif
```

// activation of Bench mode

```
--> to be calculated in 100ms recurrency:
if (LC_CC_TEST_BENCH = 1)
then STATE_CC_TEST_BENCH_OBD_1 = STATE_READY_OBD_1 nor
    C_STATE_CC_TEST_MASK_OBD_1 // (bitweise Verknüpfung)
    STATE_CC_TEST_BENCH_OBD_2 = STATE_READY_OBD_2 nor C_STATE_CC_TEST_
    MASK_OBD_2 // (bitweise Verknüpfung)
    if [(C_STATE_CC_TEST_BENCH [Bit 0] = 1) and
        (CTR_ERR_DYN_NR >= C_CTR_ERR_DYN_CC_TEST_BENCH)] or
        [(C_STATE_CC_TEST_BENCH [Bit 1] = 1) and
```



```

        (OPM_AV >= C_STATE_OPM_MIN_CC_TEST_BENCH) and
        (OPM_AV <= C_STATE_OPM_MAX_CC_TEST_BENCH)]           or
    [(C_STATE_CC_TEST_BENCH [Bit 2] = 1) and
     (STATE_COC >= C_STATE_COC_MIN_CC_TEST_BENCH) and
     (STATE_COC <= C_STATE_COC_MAX_CC_TEST_BENCH)]         or
    [(C_STATE_CC_TEST_BENCH [Bit 3] = 1) and
     (CTR_CDN_OBD_RBM > CTR_CDN_OBD_RBMn-1)]               or
    [(C_STATE_CC_TEST_BENCH [Bit 4] = 1) and
     (LV_WUP = 0)]                                         or
    [(C_STATE_CC_TEST_BENCH [Bit 5] = 1) and
     (STATE_CC_TEST_BENCH_OBD_1 =
      C_STATE_CC_TEST_BENCH_OBD_1           or
      STATE_CC_TEST_BENCH_OBD_2 =
      C_STATE_CC_TEST_BENCH_OBD_2 )]
    then          LV_CC_TEST_BENCH_ACT = 1
    else          LV_CC_TEST_BENCH_ACT = 0

endif
else
endif
LV_CC_TEST_BENCH_ACT = 0
endif

```

*// Auxiliary bit and transmission for CC message low oil pressure :*

--> to be calculated only in 100ms recurrency:

```

If          N_32          > C_N_32_THD_CC_POIL_SWI      AND
              LV_ST_END = 1
Then   if          T_DLY_POIL_SWI_CAN          >          0
          then      T_DLY_POIL_SWI_CAN          =          T_DLY_POIL_SWI_CAN - 100 ms
          else      LV_CC_POIL_SWI_INH          =          0
          endif
          else      LV_CC_POIL_SWI_INH = 1
          endif

```

--> to be calculated only in 500ms recurrency:

```

If          LV_CC_POIL_SWI_INH = 0                    and
              LV_POIL_SWI          = 0                    // oil-pressure low
then      LV_POIL_SWI_CAN          = 1
else      LV_POIL_SWI_CAN          = 0
endif

```

*// Auxiliary bit and transmission for CC message TRA-mode :*

• to be calculated only in 500ms recurrency:

```

If          LV_ERR_EGY_MIN_2 = 1                    // transportation mode
          then      LV_TRA_MODE_CAN = 1
          else      LV_TRA_MODE_CAN = 0
          endif

```

*// If an error occurs CC-message has to be activated*

*// If an error already exists and a new error occurs the actual*

*// counter has to be stopped and the new error has to be transmitted first*

```
// before the old error is transmitted again
```

```
if (CYC_CTR_CC % 5 = 0 ) // to be calculated only in 500ms recur-
rency
```

```
// CC-message MIL-flash-light:
```

```
if (LV_MIL_CAN_1 != LV_MIL_CAN_1n-1
&& STATE_CC_KEY >= C_STATE_CC_ID_34)
```

```
then CYC_CTR_CC_SAVE = CYC_CTR_CC
```

```
CYC_CTR_CC = 0
```

```
LV_SEND_CC_ID_34 = true
```

```
if (LV_MIL_CAN_1 = 1 )
```

```
then LV_CC_ID_34 = true
```

```
elseif (LV_MIL_CAN_1 = 0 )
```

```
then LV_CC_ID_34 = false
```

```
endif
```

```
LV_EVE_CC_MSG = 1
```

```
// CC-message Misfire B:
```

```
elseif (LV_MIS_STATE_A != LV_MIS_STATE_An-1
&& STATE_CC_KEY >= C_STATE_CC_ID_33)
```

```
then CYC_CTR_CC_SAVE = CYC_CTR_CC
```

```
CYC_CTR_CC = 5
```

```
LV_SEND_CC_ID_33 = true
```

```
if (LV_MIS_STATE_A = 1 )
```

```
then LV_CC_ID_33 = true
```

```
elseif (LV_MIS_STATE_A = 0 )
```

```
then LV_CC_ID_33 = false
```

```
endif
```

```
LV_EVE_CC_MSG = 1
```

```
// CC-message Engine temperature (warning 1)
```

```
elseif (LV_TEMP_ENG_WARN_1 != LV_TEMP_ENG_WARN_1n-1
&& STATE_CC_KEY >= C_STATE_CC_ID_257)
```

```
// only at transition
```

```
// nur Übergang beachten
```

```
then CYC_CTR_CC_SAVE = CYC_CTR_CC
```

```
CYC_CTR_CC = 10
```

```
LV_SEND_CC_ID_257 = true
```

```
if (LV_TEMP_ENG_WARN_1 = 1 )
```

```
then LV_CC_ID_257 = true
```

```
elseif (LV_TEMP_ENG_WARN_1 = 0 )
```

```
then LV_CC_ID_257 = false
```

```
endif
```

```
LV_EVE_CC_MSG = 1
```

```
// CC message Engine temperature (warning 2) :
```

```
if (LV_TEMP_ENG_WARN_2 != LV_TEMP_ENG_WARN_2n-1
&& STATE_CC_KEY >= C_STATE_CC_ID_39)
```


```
// only at transition
```

```
// only at transition
```

```
then CYC_CTR_CC_SAVE = CYC_CTR_CC
```

```
CYC_CTR_CC = 15
```

```
LV_SEND_CC_ID_39 = true
```

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```

if    (LV_TEMP_ENG_WARN_2 = 1 )
then  LV_CC_ID_39 = true
elseif (LV_TEMP_ENG_WARN_2 = 0 )
then  LV_CC_ID_39 = false
endif
      LV_EVE_CC_MSG = 1

```

*// CC\_message low oil pressure :*

```

elseif (LV_POIL_SWI_CAN != LV_POIL_SWI_CANn-1
      && STATE_CC_KEY >= C_STATE_CC_ID_212)
then   CYC_CTR_CC_SAVE = CYC_CTR_CC
      CYC_CTR_CC = 20
      LV_SEND_CC_ID_212 = true
if    (LV_POIL_SWI_CAN= 1)
then  LV_CC_ID_212 = true
else  LV_CC_ID_212 = false
      endif
      LV_EVE_CC_MSG = 1

```

*// CC\_message STATE ALTER:*

```

elseif (STATE_ALTER != STATE_ALTERn-1
      && STATE_CC_KEY >= C_STATE_CC_ID_213)
then   CYC_CTR_CC_SAVE = CYC_CTR_CC
      CYC_CTR_CC = 25
      LV_SEND_CC_ID_213= true
if    (STATE_ALTER= 02H)
then  LV_CC_ID_213 = true
elseif (STATE_ALTER = ! 02H )
then  LV_CC_ID_213 = false
      endif
      LV_EVE_CC_MSG = 1

```

*// CC\_message CRU OFF IRR:*

```

elseif (LV_CRU_OFF_IRR!= LV_CRU_OFF_IRRn-1
      && STATE_CC_KEY >= C_STATE_CC_ID_26)
then   CYC_CTR_CC_SAVE = CYC_CTR_CC
      CYC_CTR_CC = 30
      LV_SEND_CC_ID_26 = true
if    (LV_CRU_OFF_IRR= 1 )
      LV_CC_ID_26 = true
elseif (LV_CRU_OFF_IRR= 0 )
then  LV_CC_ID_26 = false
endif
      LV_EVE_CC_MSG = 1


```

*// CC\_message oil level below minimum :*

```

elseif (LV_OIL_CNS_WARN_2!= LV_OIL_CNS_WARN_2n-1
      && STATE_CC_KEY >= C_STATE_CC_ID_28)
then   CYC_CTR_CC_SAVE = CYC_CTR_CC
      CYC_CTR_CC = 35
      LV_SEND_CC_ID_28 = true
if    (LV_OIL_CNS_WARN_2= 1 )

```

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```

then    LV_CC_ID_28 = true
elseif  (LV_OIL_CNS_WARN_2= 0 )
then    LV_CC_ID_28 = false
endif
        LV_EVE_CC_MSG = 1

```

*// CC\_message EML:*

```

elseif  (LV_WAL_1_CAN != LV_WAL_1_CANn-1
          && STATE_CC_KEY >= C_STATE_CC_ID_29)
then    CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 40
        LV_SEND_CC_ID_29 = true
        if   (LV_WAL_1_CAN= 1 )
        then  LV_CC_ID_29 = true
        elseif (LV_WAL_1_CAN= 0 )
        then  LV_CC_ID_29 = false
        endif
        LV_EVE_CC_MSG = 1

```

*// CC\_message "transportation mode":*

```

elseif  (LV_TRA_MODE_CAN != LV_TRA_MODE_CANn-1
          && STATE_CC_KEY >= C_STATE_CC_ID_TRA)
then    CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = -
        LV_SEND_CC_ID_TRA = true
        if   (LV_TRA_MODE_CAN = 1 )
        then  LV_CC_ID_TRA = true
        elseif (LV_TRA_MODE_CAN = 0 )
        then  LV_CC_ID_TRA = false
        endif
        LV_EVE_CC_MSG = 1

```

*// CC\_message Zwangsschaltung aktiv :*

```

elseif  (LV_LIH_COC_ON!= LV_LIH_COC_ONn-1
          && STATE_CC_KEY >= C_STATE_CC_ID_155)
then    CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 50
        LV_SEND_CC_ID_155 = true
        if   (LV_LIH_COC_ON= 1 )
        then  LV_CC_ID_155 = true
        elseif (LV_LIH_COC_ON= 0 )
        then  LV_CC_ID_155 = false
        endif
        LV_EVE_CC_MSG = 1


```

*// CC\_message oil level at minimum :*

```

elseif  (LV_OIL_CNS_WARN_1!= LV_OIL_CNS_WARN_1n-1
          && STATE_CC_KEY >= C_STATE_CC_ID_27)
then    CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 55

```

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```

LV_SEND_CC_ID_27 = true
if    (LV_OIL_CNS_WARN_1= 1 )
then  LV_CC_ID_27 = true
elseif (LV_OIL_CNS_WARN_1= 0 )
then  LV_CC_ID_27 = false
endif
      LV_EVE_CC_MSG = 1

```

*// CC\_message close filler cap :*

```

elseif  ( LV_FUC_CAN_BN!= LV_FUC_CAN_BNn-1
          && STATE_CC_KEY >= C_STATE_CC_ID_32)
then    CYC_CTR_CC_SAVE = CYC_CTR_CC
          CYC_CTR_CC = 60
          LV_SEND_CC_ID_32 = true
if      ( LV_FUC_CAN_BN= 1 )
then    LV_CC_ID_32 = true
elseif  ( LV_FUC_CAN_BN = 0 )
then    LV_CC_ID_32 = false
endif
          LV_EVE_CC_MSG = 1

```

*// CC\_message error oil level sensor :*

```

elseif  ( LV_ERR_QOIL_SENS!= LV_ERR_QOIL_SENSn-1
          && STATE_CC_KEY >= C_STATE_CC_ID_182)
then    CYC_CTR_CC_SAVE = CYC_CTR_CC
          CYC_CTR_CC = 65
          LV_SEND_CC_ID_182 = true
if      ( LV_ERR_QOIL_SENS= 1 )
then    LV_CC_ID_182 = true
elseif  ( LV_ERR_QOIL_SENS = 0 )
then    LV_CC_ID_182 = false
endif
          LV_EVE_CC_MSG = 1

```

*// CC\_message reload 12V-battery :*

```

elseif  ( B_ccbtnach!= B_ccbtnachn-1
          && STATE_CC_KEY >= C_STATE_CC_ID_229)
then    CYC_CTR_CC_SAVE = CYC_CTR_CC
          CYC_CTR_CC = 70
          LV_SEND_CC_ID_229 = true
if      ( B_ccbtnach= 1 )
then    LV_CC_ID_229 = true
elseif  ( B_ccbtnach = 0 )
then    LV_CC_ID_229 = false
endif
          LV_EVE_CC_MSG = 1

```

*// CC\_message no battery monitoring :*

```

elseif  ( B_ccpmerr!= B_ccpmerrn-1
          && STATE_CC_KEY >= C_STATE_CC_ID_247)
then    CYC_CTR_CC_SAVE = CYC_CTR_CC
          CYC_CTR_CC = 75

```

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```

LV_SEND_CC_ID_247 = true
if    ( B_ccpmerr= 1 )
then  LV_CC_ID_247 = true
elseif ( B_ccpmerr = 0 )
then  LV_CC_ID_247 = false
endif
LV_EVE_CC_MSG = 1

```

*// CC\_message stand-by-current error :*

```

elseif    ( B_ccruhver!= B_ccruhvern-1
            && STATE_CC_KEY >= C_STATE_CC_ID_220)
then     CYC_CTR_CC_SAVE = CYC_CTR_CC
          CYC_CTR_CC = 80
          LV_SEND_CC_ID_220 = true
if      ( B_ccruhver= 1 )
then    LV_CC_ID_220 = true
elseif  ( B_ccruhver = 0 )
then    LV_CC_ID_220 = false
endif
LV_EVE_CC_MSG = 1

```

*// CC\_message check battery :*

```

elseif    ( B_ccbttdfk!= B_ccbttdfkn-1
            && STATE_CC_KEY >= C_STATE_CC_ID_304)
then     CYC_CTR_CC_SAVE = CYC_CTR_CC
          CYC_CTR_CC = 85
          LV_SEND_CC_ID_304 = true
if      ( B_ccbttdfk= 1 )
then    LV_CC_ID_304 = true
elseif  ( B_ccbttdfk = 0 )
then    LV_CC_ID_304 = false
endif
LV_EVE_CC_MSG = 1

```

*// CC\_message check battery contacts :*

```

elseif    ( B_ccbttknt!= B_ccbttkntn-1
            && STATE_CC_KEY >= C_STATE_CC_ID_305)
then     CYC_CTR_CC_SAVE = CYC_CTR_CC
          CYC_CTR_CC = 90
          LV_SEND_CC_ID_305 = true
if      ( B_ccbttknt= 1 )
then    LV_CC_ID_305 = true
elseif  ( B_ccbttknt = 0 )
then    LV_CC_ID_305 = false
endif
LV_EVE_CC_MSG = 1


```

*// CC\_message consumer switch off :*

```

elseif    ( B_ccprio!= B_ccprion-1
            && STATE_CC_KEY >= C_STATE_CC_ID_306)
then     CYC_CTR_CC_SAVE = CYC_CTR_CC
          CYC_CTR_CC = 95

```

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```

LV_SEND_CC_ID_306 = true
if    ( B_ccprio= 1 )
then  LV_CC_ID_306 = true
elseif ( B_ccprio = 0 )
then  LV_CC_ID_306 = false
endif
LV_EVE_CC_MSG = 1

```

*// CC\_message brake light switch defect :*

```

elseif ( LV_BLS_PLAUS_CAN != LV_BLS_PLAUS_CANn-1
        && STATE_CC_KEY >= C_STATE_CC_ID_148)
then   CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 100
        LV_SEND_CC_ID_148 = true
if    ( LV_BLS_PLAUS_CAN= 1 )
then  LV_CC_ID_148 = true
elseif ( LV_BLS_PLAUS_CAN = 0 )
then  LV_CC_ID_148 = false
endif
LV_EVE_CC_MSG = 1

```

*// CC\_message gear-shift up :*

```

elseif ( LV_GS_UP != LV_GS_UPn-1
        && STATE_CC_KEY >= C_STATE_CC_ID_276)
then   CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 105
        LV_SEND_CC_ID_276 = true
if    ( LV_GS_UP= 1 )
then  LV_CC_ID_276 = true
elseif ( LV_GS_UP = 0 )
then  LV_CC_ID_276 = false
endif
LV_EVE_CC_MSG = 1

```

*// CC\_message gear-shift down :*

```

elseif ( LV_GS_DOWN != LV_GS_DOWNn-1
        && STATE_CC_KEY >= C_STATE_CC_ID_278)
then   CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 110
        LV_SEND_CC_ID_278 = true
if    ( LV_GS_DOWN= 1 )
then  LV_CC_ID_278 = true
elseif ( LV_GS_DOWN = 0 )
then  LV_CC_ID_278 = false
endif
LV_EVE_CC_MSG = 1


```

*// CC\_message request for gear-shift up (temperature warning 3) :*

```

elseif ( LV_TEMP_ENG_WARN_3 != LV_TEMP_ENG_WARN_3n-1
        && STATE_CC_KEY >= C_STATE_CC_ID_367)
then   CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 115

```

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```

LV_SEND_CC_ID_367 = true
if    ( LV_TEMP_ENG_WARN_3= 1 )
then  LV_CC_ID_367 = true
elseif (LV_TEMP_ENG_WARN_3 = 0 )
then  LV_CC_ID_367 = false
endif
LV_EVE_CC_MSG = 1

```

*// CC\_message "MSA failure":*

```

elseif ( LV_ERR_STST != LV_ERR_STSTn-1
&& STATE_CC_KEY >= C_STATE_CC_ID_397
&& LV_VAR_STST = 1)
then   CYC_CTR_CC_SAVE = CYC_CTR_CC
CYC_CTR_CC = 120
LV_SEND_CC_ID_397 = true
if    (LV_ERR_STST = 1 )
then  LV_CC_ID_397 = true
elseif (LV_ERR_STST = 0 )
then  LV_CC_ID_397 = false
endif
LV_EVE_CC_MSG = 1

```

*// CC\_message "oil pressure lamp - yellow":*

```

elseif ( B_poel_gelb != B_poel_gelbn-1
&& STATE_CC_KEY >= C_STATE_CC_ID_427)
then   CYC_CTR_CC_SAVE = CYC_CTR_CC
CYC_CTR_CC = 125
LV_SEND_CC_ID_427 = true
if    (B_poel_gelb = 1 )
then  LV_CC_ID_427 = true
elseif (B_poel_gelb = 0 )
then  LV_CC_ID_427 = false
endif
LV_EVE_CC_MSG = 1

```

*// CC\_message "condition MSA deactivated":*

```

elseif ( LV_INH_STST_CDN != LV_INH_STST_CDNn-1
&& STATE_CC_KEY >= C_STATE_CC_ID_-0
&& LV_VAR_STST = 1)
then   CYC_CTR_CC_SAVE = CYC_CTR_CC
CYC_CTR_CC = 130
LV_SEND_CC_ID_-0 = true
if    (LV_INH_STST_CDN = 1 )
then  LV_CC_ID_-0 = true
elseif (LV_INH_STST_CDN = 0 )
then  LV_CC_ID_-0 = false
endif
LV_EVE_CC_MSG = 1


```

*// CC\_testmessage (bench mode):*

```

elseif ( LV_CC_TEST_BENCH_ACT != LV_CC_TEST_BENCH_ACTn-1
&& STATE_CC_KEY >= C_STATE_CC_ID_BENCH)

```

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```

then    CYC_CTR_CC_SAVE = CYC_CTR_CC
          CYC_CTR_CC = 135
          LV_SEND_CC_ID_BENCH = true
if      (LV_CC_TEST_BENCH_ACT = 1 )
then    LV_CC_ID_BENCH = true
elseif  (LV_CC_TEST_BENCH_ACT = 0 )
then    LV_CC_ID_BENCH = false
endif
          LV_EVE_CC_MSG = 1
endif
endif

// If an error is present the corresponding CC-message is transmitted depending on the
// counter value. Due to the 100ms-recurrency and the calculation-steps of 5 it is secured that
// the messages are only transmitted with a recurrency of 500ms
if      ( CYC_CTR_CC = 0 & & LV_SEND_CC_ID_34 = True )
then    CC_ID = 34
          if      ( STATE_MIL = 2 )                // MIL flash light requested

          then    LV_MIL_FLL = true                //Activation MIL flash light
          else    LV_MIL_FLL = false              // MIL: no flash light
          endif
          ST_CC_MESS_STD = LV_CC_ID_34

elseif  ( CYC_CTR_CC = 5 & & LV_SEND_CC_ID_33 = True )
then    CC_ID = 33
          LV_MIL_FLL = false
          ST_CC_MESS_STD = LV_CC_ID_33

elseif  ( CYC_CTR_CC = 10 & & LV_SEND_CC_ID_257 = True )
then    CC_ID = 257
          LV_MIL_FLL = false
          ST_CC_MESS_STD = LV_CC_ID_257


elseif  ( CYC_CTR_CC = 15 & & LV_SEND_CC_ID_39 = True )
then    CC_ID = 39
          LV_MIL_FLL = false
          ST_CC_MESS_STD = LV_CC_ID_39

elseif  ( CYC_CTR_CC = 20 & & LV_SEND_CC_ID_212 = True )
then    CC_ID = 212
          LV_MIL_FLL = false
          ST_CC_MESS_STD = LV_CC_ID_212

elseif  ( CYC_CTR_CC = 25 & & LV_SEND_CC_ID_213 = True )
then    CC_ID = 213
          LV_MIL_FLL = false
          ST_CC_MESS_STD = LV_CC_ID_213

elseif  ( CYC_CTR_CC = 30 & & LV_SEND_CC_ID_26 = True )
then    CC_ID = 26

```

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```

LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_26

elseif      ( CYC_CTR_CC = 35 & & LV_SEND_CC_ID_28 = True )
then        CC_ID = 28
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_28

elseif      ( CYC_CTR_CC = 40 & & LV_SEND_CC_ID_29 = True )
then        CC_ID = 29
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_29

elseif      ( CYC_CTR_CC == - & & LV_SEND_CC_ID_TRA == True )
then        CC_ID = C_CC_ID_TRA
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_TRA

elseif      ( CYC_CTR_CC = 50 & & LV_SEND_CC_ID_155 = True )
then        CC_ID = 155
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_155

elseif      ( CYC_CTR_CC = 55 & & LV_SEND_CC_ID_27 = True )
then        CC_ID = 27
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_27

elseif      ( CYC_CTR_CC = 60 & & LV_SEND_CC_ID_32 = True )
then        CC_ID = 32
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_32


elseif      ( CYC_CTR_CC = 65 & & LV_SEND_CC_ID_182 = True )
then        CC_ID = 182
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_182

elseif      ( CYC_CTR_CC = 70 & & LV_SEND_CC_ID_229 = True )
then        CC_ID = 229
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_229

elseif      ( CYC_CTR_CC = 75 & & LV_SEND_CC_ID_247 = True )
then        CC_ID = 247
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_247

elseif      ( CYC_CTR_CC = 80 & & LV_SEND_CC_ID_220 = True )
then        CC_ID = 220
LV_MIL_FLL = false

```

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```

ST_CC_MESS_STD = LV_CC_ID_220

elseif      ( CYC_CTR_CC = 85 & & LV_SEND_CC_ID_304 = True )
then        CC_ID = 304
             LV_MIL_FLL = false
             ST_CC_MESS_STD = LV_CC_ID_304

elseif      ( CYC_CTR_CC = 90 & & LV_SEND_CC_ID_305 = True )
then        CC_ID = 305
             LV_MIL_FLL = false
             ST_CC_MESS_STD = LV_CC_ID_305

elseif      ( CYC_CTR_CC = 95 & & LV_SEND_CC_ID_306 = True )
then        CC_ID = 306
             LV_MIL_FLL = false
             ST_CC_MESS_STD = LV_CC_ID_306

elseif      ( CYC_CTR_CC = 100 & & LV_SEND_CC_ID_148 = True )
then        CC_ID = 148
             LV_MIL_FLL = false
             ST_CC_MESS_STD = LV_CC_ID_148

elseif      ( CYC_CTR_CC = 105 & & LV_SEND_CC_ID_276 = True )
then        CC_ID = 276
             LV_MIL_FLL = false
             ST_CC_MESS_STD = LV_CC_ID_276

elseif      ( CYC_CTR_CC = 110 & & LV_SEND_CC_ID_278 = True )
then        CC_ID = 278
             LV_MIL_FLL = false
             ST_CC_MESS_STD = LV_CC_ID_278

elseif      ( CYC_CTR_CC = 115 & & LV_SEND_CC_ID_367 = True )
then        CC_ID = 367
             LV_MIL_FLL = false
             ST_CC_MESS_STD = LV_CC_ID_367

elseif      ( CYC_CTR_CC = 120 & & LV_SEND_CC_ID_397 = True )
then        CC_ID = 397
             LV_MIL_FLL = false
             ST_CC_MESS_STD = LV_CC_ID_397

elseif      ( CYC_CTR_CC = 125 & & LV_SEND_CC_ID_427 = True )
then        CC_ID = 427
             LV_MIL_FLL = false
             ST_CC_MESS_STD = LV_CC_ID_427

elseif      ( CYC_CTR_CC = 130 & & LV_SEND_CC_ID_-0 = True )
then        CC_ID = -0
             LV_MIL_FLL = false
             ST_CC_MESS_STD = LV_CC_ID_-0

```

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```

elseif      ( CYC_CTR_CC = 135 & & LV_SEND_CC_ID_BENCH = True )
then        CC_ID = C_CC_ID_TEST_BENCH
              LV_MIL_FLL = false
              ST_CC_MESS_STD = LV_CC_ID_BENCH

else        CC_ID = 0

endif

If          (LV_SEND_CC_ID_26 = True || ..... || LV_SEND_CC_ID_-0 || LV_SEND_CC_ID_BENCH
= True || LV_SEND_CC_ID_TRA == True )
Then       ID2_CC_MESS_STD = C_CC_MESS
              NO_CC_MESS_STD = CC_ID
              // ST_CC_MESS_STD see above
              TRANF_CC_MESS_STD = C_T_CYC_DISP_ICL_CAN
If         LV_MIL_FLL = 1
              ST_IDC_CCLK_CC_MESS_STD = C_ICL_DISP_FRQ
else       ST_IDC_CCLK_CC_MESS_STD = 00H
endif
              CAN_SendMessage()

endif

if         LV_EVE_CC_MSG = 1
then       CYC_CTR_CC = CYC_CTR_CC_SAVE
              if      (CYC_CTR_CC >= 5)
              then    CYC_CTR_CC = CYC_CTR_CC - 4
              else    CYC_CTR_CC = 136
              endif
else       if      CYC_CTR_CC < 140
              then    CYC_CTR_CC++
              else    CYC_CTR_CC = 0
              endif

endif
    
```

*status indicate-direction frequency check-control message standard :*

C\_ICL\_DISP\_FRQ            name

00H	"Kein Blinken"
01H	"Langsames Blinken"
02H	"Schnelles Blinken"
03H	"Signal ungültig"

// If an error is not present any longer, the transmission-request of the corresponding  
// CC-message has to be reset to 0.

```


if          LV_MIL_CAN_1 != LV_MIL_CAN_1n-1
              & & STATE_CC_KEY >= C_STATE_CC_ID_34
then       if    LV_MIL_CAN_1n-1 = 1
              then  LV_SEND_CC_ID_34            =            false
              endif
              LV_MIL_CAN_1n-1 = LV_MIL_CAN_1
    
```

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```

elseif          LV_MIS_STATE_A!= LV_MIS_STATE_A  $n-1$ 
                  & & STATE_CC_KEY >= C_STATE_CC_ID_33
then            if    LV_MIS_STATE_A  $n-1$  = 1
then            LV_SEND_CC_ID_33          =          false
                  endif
                  LV_MIS_STATE_A  $n-1$  = LV_MIS_STATE_A
elseif          LV_TEMP_ENG_WARN_1!= LV_TEMP_ENG_WARN_1  $n-1$ 
                  & & STATE_CC_KEY >= C_STATE_CC_ID_257
then            if    LV_TEMP_ENG_WARN_1  $n-1$  = 1
then            LV_SEND_CC_ID_257        =          false
                  endif
                  LV_TEMP_ENG_WARN_1  $n-1$  = LV_TEMP_ENG_WARN_1
elseif          LV_TEMP_ENG_WARN_2!= LV_TEMP_ENG_WARN_2  $n-1$ 
                  & & STATE_CC_KEY >= C_STATE_CC_ID_39
then            if    LV_TEMP_ENG_WARN_2  $n-1$  = 1
then            LV_SEND_CC_ID_39         =          false
                  endif
                  LV_TEMP_ENG_WARN_2  $n-1$  = LV_TEMP_ENG_WARN_2
elseif          LV_POIL_SWI_CAN!= LV_POIL_SWI_CAN  $n-1$ 
                  & & STATE_CC_KEY >= C_STATE_CC_ID_212
then            if    LV_POIL_SWI_CAN  $n-1$  = 1
then            LV_SEND_CC_ID_212        =          false
                  endif
                  LV_POIL_SWI_CAN  $n-1$  = LV_POIL_SWI_CAN
elseif          STATE_ALTER != STATE_ALTER  $n-1$ 
                  & & STATE_CC_KEY >= C_STATE_CC_ID_213
then            if    STATE_ALTER  $n-1$  = 1
then            LV_SEND_CC_ID_213        =          false
                  endif
                  STATE_ALTER  $n-1$  = STATE_ALTER
elseif          LV_CRU_OFF_IRR != LV_CRU_OFF_IRR  $n-1$ 
                  & & STATE_CC_KEY >= C_STATE_CC_ID_26
then            if    LV_CRU_OFF_IRR  $n-1$  = 1
then            LV_SEND_CC_ID_26         =          false
                  endif
                  LV_CRU_OFF_IRR  $n-1$  = LV_CRU_OFF_IRR
elseif          LV_OIL_CNS_WARN_2!= LV_OIL_CNS_WARN_2  $n-1$ 
                  & & STATE_CC_KEY >= C_STATE_CC_ID_28
then            if    LV_OIL_CNS_WARN_2  $n-1$  = 1
then            LV_SEND_CC_ID_28         =          false
                  endif
                  LV_OIL_CNS_WARN_2  $n-1$  = LV_OIL_CNS_WARN_2
elseif          LV_WAL_1_CAN != LV_WAL_1_CAN  $n-1$ 
                  & & STATE_CC_KEY >= C_STATE_CC_ID_29
then            if    LV_WAL_1_CAN  $n-1$  = 1
then            LV_SEND_CC_ID_29         =          false
                  endif
                  LV_WAL_1_CAN  $n-1$  = LV_WAL_1_CAN
elseif          LV_TRA_MODE_CAN != LV_TRA_MODE_CAN  $n-1$ 
                  & & STATE_CC_KEY >= C_STATE_CC_ID_TRA
then            if    LV_TRA_MODE_CAN  $n-1$  = 1
then            LV_SEND_CC_ID_TRA        =          false


```

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```

        endif
LV_TRA_MODE_CANn-1 = LV_TRA_MODE_CAN
elseif
    LV_LIH_COC_ON != LV_LIH_COC_ONn-1
    && STATE_CC_KEY >= C_STATE_CC_ID_155
    then
        if LV_LIH_COC_ONn-1 = 1
        then LV_SEND_CC_ID_155 = false
        endif
LV_LIH_COC_ONn-1 = LV_LIH_COC_ON
elseif
    LV_OIL_CNS_WARN_1 != LV_OIL_CNS_WARN_1n-1
    && STATE_CC_KEY >= C_STATE_CC_ID_27
    then
        if LV_OIL_CNS_WARN_1n-1 = 1
        then LV_SEND_CC_ID_27 = false
        endif
LV_OIL_CNS_WARN_1n-1 = LV_OIL_CNS_WARN_1
elseif
    LV_FUC_CAN_BN != LV_FUC_CAN_BNn-1
    && STATE_CC_KEY >= C_STATE_CC_ID_32
    then
        if LV_FUC_CAN_BNn-1 = 1
        then LV_SEND_CC_ID_32 = false
        endif
LV_FUC_CAN_BNn-1 = LV_FUC_CAN_BN
elseif
    LV_ERR_QOIL_SENS != LV_ERR_QOIL_SENSn-1
    && STATE_CC_KEY >= C_STATE_CC_ID_182
    then
        if LV_ERR_QOIL_SENSn-1 = 1
        then LV_SEND_CC_ID_182 = false
        endif
LV_ERR_QOIL_SENSn-1 = LV_ERR_QOIL_SENS
elseif
    B_ccbtnach != B_ccbtnachn-1
    && STATE_CC_KEY >= C_STATE_CC_ID_229
    then
        if B_ccbtnachn-1 = 1
        then LV_SEND_CC_ID_229 = false
        endif
B_ccbtnachn-1 = B_ccbtnach
elseif
    B_ccpmerr != B_ccpmerrn-1
    && STATE_CC_KEY >= C_STATE_CC_ID_247
    then
        if B_ccpmerrn-1 = 1
        then LV_SEND_CC_ID_247 = false
        endif
B_ccpmerrn-1 = B_ccpmerr
elseif
    B_ccruhver != B_ccruhvern-1
    && STATE_CC_KEY >= C_STATE_CC_ID_220
    then
        if B_ccruhvern-1 = 1
        then LV_SEND_CC_ID_220 = false
        endif
B_ccruhvern-1 = B_ccruhver
elseif
    B_ccbttdfk != B_ccbttdfkn-1
    && STATE_CC_KEY >= C_STATE_CC_ID_304
    then
        if B_ccbttdfkn-1 = 1
        then LV_SEND_CC_ID_304 = false
        endif
B_ccbttdfkn-1 = B_ccbttdfk
elseif
    B_ccbttknt != B_ccbttkntn-1
    && STATE_CC_KEY >= C_STATE_CC_ID_305


```

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```

then    if    B_ccbttkntn-1 = 1
           then    LV_SEND_CC_ID_305      =      false
           endif
           B_ccbttkntn-1 = B_ccbttknt
elseif    B_ccprio != B_ccprion-1
           && STATE_CC_KEY >= C_STATE_CC_ID_306
           then    if    B_ccprion-1 = 1
           then    LV_SEND_CC_ID_306      =      false
           endif
           B_ccprion-1 = B_ccprio
elseif    LV_BLS_PLAUS_CAN != LV_BLS_PLAUS_CANn-1
           && STATE_CC_KEY >= C_STATE_CC_ID_148
           then    if    LV_BLS_PLAUS_CANn-1 = 1
           then    LV_SEND_CC_ID_148      =      false
           endif
           LV_BLS_PLAUS_CANn-1 = LV_BLS_PLAUS_CAN
elseif    LV_GS_UP != LV_GS_UPn-1
           && STATE_CC_KEY >= C_STATE_CC_ID_276
           then    if    LV_GS_UPn-1 = 1
           then    LV_SEND_CC_ID_276      =      false
           endif
           LV_GS_UPn-1 = LV_GS_UP
elseif    LV_GS_DOWN != LV_GS_DOWNn-1
           && STATE_CC_KEY >= C_STATE_CC_ID_278
           then    if    LV_GS_DOWNn-1 = 1
           then    LV_SEND_CC_ID_278      =      false
           endif
           LV_GS_DOWNn-1 = LV_GS_DOWN
elseif    LV_TEMP_ENG_WARN_3 != LV_TEMP_ENG_WARN_3n-1
           && STATE_CC_KEY >= C_STATE_CC_ID_367
           then    if    LV_TEMP_ENG_WARN_3n-1 = 1
           then    LV_SEND_CC_ID_367      =      false
           endif
           LV_TEMP_ENG_WARN_3n-1 = LV_TEMP_ENG_WARN_3
elseif    LV_ERR_STST != LV_ERR_STSTn-1
           && STATE_CC_KEY >= C_STATE_CC_ID_397
           then    if    LV_ERR_STSTn-1 = 1
           then    LV_SEND_CC_ID_397      =      false
           endif
           LV_ERR_STSTn-1 = LV_ERR_STST
elseif    B_poel_gelb != B_poel_gelbn-1
           && STATE_CC_KEY >= C_STATE_CC_ID_427
           then    if    B_poel_gelbn-1 = 1
           then    LV_SEND_CC_ID_427      =      false
           endif
           B_poel_gelbn-1 = B_poel_gelb
elseif    LV_INH_STST_CDN != LV_INH_STST_CDNn-1
           && STATE_CC_KEY >= C_STATE_CC_ID_-0
           then    if    LV_INH_STST_CDNn-1 = 1
           then    LV_SEND_CC_ID_-0      =      false
           endif
           LV_INH_STST_CDNn-1 = LV_INH_STST_CDN

```

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```

elseif          LV_CC_TEST_BENCH_ACT != LV_CC_TEST_BENCH_ACTn-1
                  && STATE_CC_KEY >= C_STATE_CC_ID_BENCH
then    if    LV_CC_TEST_BENCH_ACTn-1 = 1
then          LV_SEND_CC_ID_BENCH      =      false
                  endif
                  LV_CC_TEST_BENCH_ACTn-1 = LV_CC_TEST_BENCH

```

**endif**

C\_STATE\_CC\_ID\_xxx = 0, 1, 2 oder 3

- 1 = CC ab Kl.R senden
- 2 = CC ab Kl.15 senden
- 3 = CC ab Motor läuft senden
- ...
- FH = CC nie senden

### 4.60.7 Check Sum Calculation

#### FUNCTION DESCRIPTION:

The check sum calculation is additional to the "alive counter" a further possibility to supervise the data transmitted via CAN. From all safety relevant controllers, the ECU included, a check sum over all sent data including his own CAN-ID (11 bit) is calculated and sent together with the data frame. The receiver of the data frame can calculate the check sum over the received data and compare it with the received check sum. If both check sums are not the same a transmission error occurred. For check sum calculation see newest BN 2000 specification.

The check sums CKS\_CLC\_TQ\_DCC, CKS\_CLC\_CAS, CKS\_CLC\_TQ\_TCS, CKS\_CLC\_TQ\_ETCU, CKS\_CLC\_TQ\_AMT, CKS\_CLC\_MSW, CKS\_CLC\_LDM, CKS\_CLC\_TQ\_PSTE\_3, CKS\_CLC\_PBR, CKS\_CLC\_ETCU, CKS\_CLC\_TQ\_TCT, CKS\_CLC\_TQ\_PBR are calculated with received data (see description below).

CKS\_CLC\_ECU1, CKS\_CLC\_ECU2 and CKS\_CLC\_ECU3, CKS\_CLC\_TQ\_WHEEL\_1, CKS\_CLC\_TQ\_WHEEL\_2, CKS\_CLC\_GS\_IDC are calculated with sent data from ECU.

#### Formula section:

##### **Check sum ECU1**

CKS\_CLC\_ECU1  
Torque\_1 - ID A8H

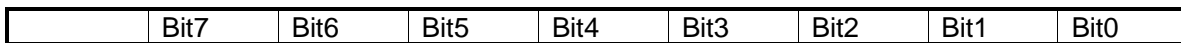


Figure 4.60.30: Byte7



Figure 4.60.31: Byte6

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Byte6	ST_RCPT_ENG_ EGS	ST_RCPT_ENG_ DSC	ST_RCPT_ENG_ ARS	ST_RCPT_ENG_A CC
-------	---------------------	---------------------	---------------------	---------------------

Figure 4.60.32: Byte5

Byte5	RCPT_ACC_SWO_ SYS_DME	ST_DMEA_SWO	ST_RTIR	ST_SW_CLT
-------	--------------------------	-------------	---------	-----------

Figure 4.60.33: Byte4

Byte4	TORQ_AVL_DMEE
-------	---------------

Figure 4.60.34: Byte3

Byte3	TORQ_AVL_DMEE	ST_TORQ_AVL
-------	---------------	-------------

Figure 4.60.35: Byte2

Byte2	TORQ_AVL
-------	----------

Figure 4.60.36: Byte1

Byte1	TORQ_AVL	ALIV_TORQ_1_DME
-------	----------	-----------------

Figure 4.60.37: Byte0

Byte0	CHKSM_TORQ_1_DME
-------	------------------

### Check sum ECU2

CKS\_CLC\_ECU2

Torque\_2 - IDA9H

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
--	------	------	------	------	------	------	------	------

Figure 4.60.38: Byte7

Byte7	TORQ_AVL_SPAR_POS
-------	-------------------

Figure 4.60.39: Byte6

Byte6	TORQ_AVL_SPAR_POS	TORQ_AVL_SPAR_NEG
-------	-------------------	-------------------

Figure 4.60.40: Byte5

Byte5	TORQ_AVL_SPAR_NEG
-------	-------------------

Figure 4.60.41: Byte4

Byte4	TORQ_AVL_MAX
-------	--------------

Figure 4.60.42: Byte3

Byte3	TORQ_AVL_MAX	TORQ_AVL_MIN
-------	--------------	--------------

Figure 4.60.43: Byte2

Byte2	TORQ_AVL_MIN
-------	--------------

Figure 4.60.44: Byte1

Byte1	ST_INFS	ST_SW_LEV_RP M	ALIV_TORQ_2_DME
-------	---------	-------------------	-----------------

Figure 4.60.45: Byte0

Byte0	CHKSM_TORQ_2_DME
-------	------------------

**Check sum ECU3**

CKS\_CLC\_ECU3

Torque\_3 - ID AAH

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
--	------	------	------	------	------	------	------	------

Figure 4.60.46: Byte7

Byte7	RQAM_FU
-------	---------

Figure 4.60.47: Byte6

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Figure 4.60.48: Byte5



Figure 4.60.49: Byte4



Figure 4.60.50: Byte3



Figure 4.60.51: Byte2



Figure 4.60.52: Byte1



Figure 4.60.53: Byte0



**Check sum TQ\_WHEEL\_1**

CKS\_CLC\_TQ\_WHEEL\_1

RADMOM\_PT\_1 - ID B4H

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
------	------	------	------	------	------	------	------

Figure 4.60.54: Byte7



Figure 4.60.55: Byte6

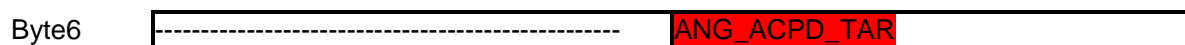


Figure 4.60.56: Byte5

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Byte5 ANG\_ACPD\_TAR

Figure 4.60.57: Byte4

Byte4 WMOM\_PT\_AVL

Figure 4.60.58: Byte3

Byte3 WMOM\_PT\_AVL

Figure 4.60.59: Byte2

Byte2 ANG\_ACPD\_REAL

Figure 4.60.60: Byte1

Byte1 ANG\_ACPD\_REAL | ALIV\_WMOM\_PT\_1

Figure 4.60.61: Byte0

Byte0 CHKSM\_WMOM\_PT\_1

**Check sum TQ\_WHEEL\_2**

CKS\_CLC\_TQ\_WHEEL\_2

RADMOM\_PT\_2 - ID ACH

Bit7      Bit6      Bit5      Bit4      Bit3      Bit2      Bit1      Bit0

Figure 4.60.62: Byte7

Byte7 WMOM\_PT\_MAX

Figure 4.60.63: Byte6

Byte6 WMOM\_PT\_MAX

Figure 4.60.64: Byte5

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	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte5	ST_TORQ_CTRL_ACC			ST_ACC_MOD_DME			ST_ACC_SWO_S YS_DME	
Byte4	RQ_PREV_INFS_ ACC		ST_TORQ_TAR_ ACC		TORQ_TAR_ADJR_POS_ACC			
Byte3	TORQ_TAR_ADJR_POS_ACC							
Byte2	TORQ_TAR_ACC							
Byte1	TORQ_TAR_ACC				ALIV_TORQ_ACC			
Byte0	CHKSM_TORQ_ACC							

**Check sum TQ\_PSTE\_2 (AFS)**

CKS\_CLC\_TQ\_PSTE\_2

DREHMOMENT\_ANF\_AFS - ID B9H

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte5					ST_RQ_TORQ_AFS_ERR			
Byte4			ST_TORQ_TAR_A FS		TORQ_TAR_AFS			
Byte3	TORQ_TAR_AFS							
Byte2	TORQ_AVL_AFS							
Byte1	TORQ_AVL_AFS				ALIV_TORQ_AFS			
Byte0	CHKSM_TORQ_AFS							

**Check sum CAS :**

CKS\_CLC\_CAS

KLEMMENSTATUS - ID 130H

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 4	CHKSM_KL				ALIV_KL			
Byte 3	ST_KL15_HW							
Byte 2	ST_STCD_PENG_MSA							
Byte 1					NO_KEY			
Byte 0	ST_KEY_VLD		ST_KL_50		ST_KL_15		ST_KL_R	

**Check sum TQ\_TCS :**

CKS\_CLC\_TQ\_TCS

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DREHMOMENT\_ANF\_DSC - ID B6H

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 4			ST_TORQ_TAR_DS		TORQ_TAR_ADJR_POS_DSC			
			C					
Byte 3	TORQ_TAR_ADJR_POS_DSC							
Byte 2	TORQ_TAR_DSC							
Byte 1	TORQ_TAR_DSC				ALIV_TORQ_DSC			
Byte 0	CHKSM_TORQ_DSC							

**Check sum TQ\_ETCU :**

CKS\_CLC\_TQ\_ETCU

DREHMOMENT\_ANF\_EGS - ID B5H

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 7	TEMP_GRB							
Byte 6	TORQ_DRAW_GRB							
Byte 5	ST_LIM_STORQ		ST_OBD_ERR_GRB		ST_OBD_GRB			
Byte 4	ST_OTMP_GRB		ST_TORQ_TAR_EG		TORQ_TAR_ADJR_POS_EGS			
			S					
Byte 3	TORQ_TAR_ADJR_POS_EGS							
Byte 2	TORQ_TAR_EGS							
Byte 1	TORQ_TAR_EGS				ALIV_TORQ_EGS			
Byte 0	CHKSM_TORQ_EGS							

**Check sum TQ\_AMT :**

CKS\_CLC\_TQ\_AMT

DREHMOMENT\_ANF\_SSG - ID BDH

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte7	LIM_RPM_ENG							
Byte6	RQ_Motorstop		ST_CLT_SSG			ST_SHPS_SSG		
Byte5	ST_LIM_STORQ_		ST_OBD_ERR_G		ST_OBD_GRB_SSG			
	SSG		RB_SSG					
Byte4			ST_TORQ_TAR_		TORQ_TAR_ADJR_POS_SSG			
			SSG					
Byte3	TORQ_TAR_ADJR_POS_SSG							
Byte2	TORQ_TAR_SSG							
Byte1	TORQ_TAR_SSG				ALIV_TORQ_SSG			
Byte0	CHKSM_TORQ_SSG							

**Check sum MSW (SZL)**

CKS\_CLC\_MSW

BEDIENUNG\_TEMPOMAT - ID 194H

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0

Figure 4.60.72: Byte3

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Figure 4.60.73: Byte2



Figure 4.60.74: Byte1



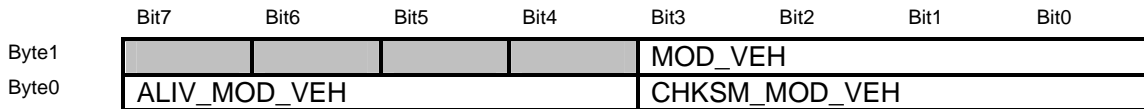
Figure 4.60.75: Byte0



**Check sum VEH\_MOD (CAS)**

CKS\_CLC\_VEH\_MOD

VEH\_MOD - ID 315H



**Check sum LDM**

CKS\_CLC\_LDM

ANF\_RADMOM\_PT - ID BFH



Figure 4.60.76: Byte4



Figure 4.60.77: Byte3



Figure 4.60.78: Byte2



Figure 4.60.79: Byte1

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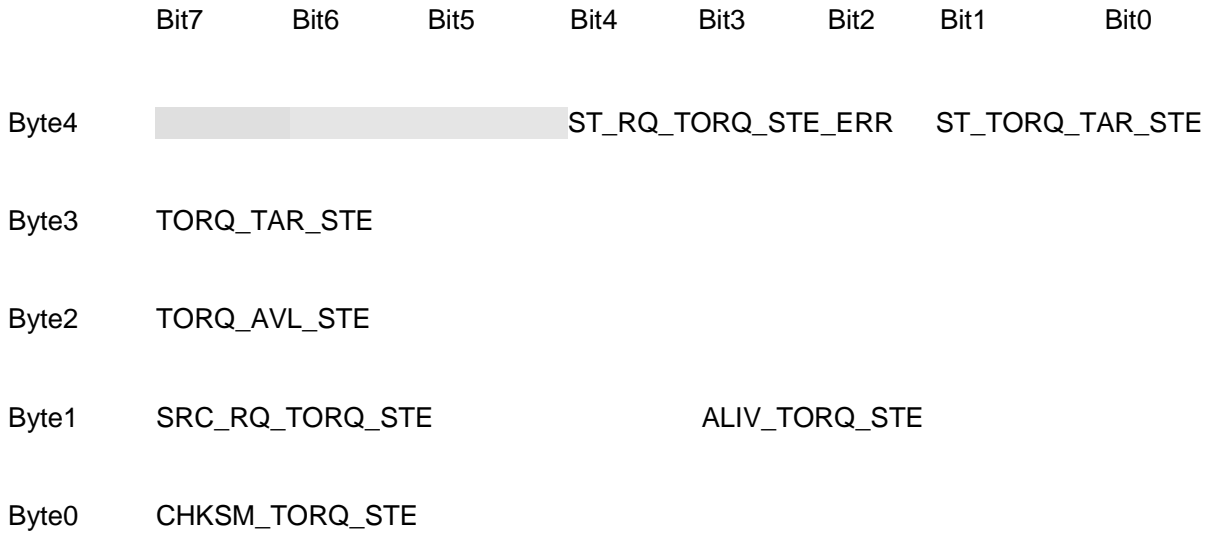


Byte1 FOLDYN\_WMOM\_PT\_TAR ALIV\_RQ\_WMOM\_PT

Figure 4.60.80: Byte0

Byte0 CHKSM\_RQ\_WMOM\_PT

**Check sum EHB3 (TQ\_PSTE\_3)**  
CKS\_CLC\_TQ\_PSTE\_3  
DREHMOMENT\_ANF\_STE - ID B1H



**Check sum ETCU\_3**  
CKS\_CLC\_ETCU\_3  
GETRIEBEDATEN\_3 - ID 3B1H



Figure 4.60.81: Byte5

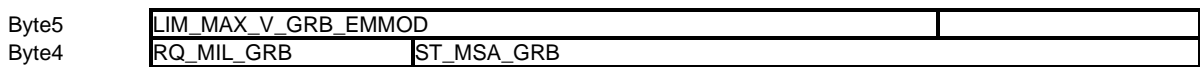


Figure 4.60.82: Byte3

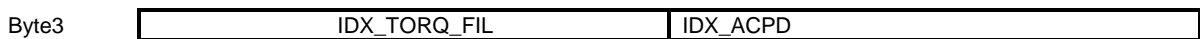


Figure 4.60.83: Byte2

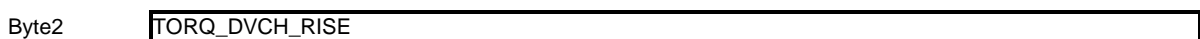


Figure 4.60.84: Byte1

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Figure 4.60.85: Byte0



**Check sum REQ\_PBR**  
CKS\_CLC\_REQ\_PBR  
STELLANF\_EMF - ID 1A7H

Bit7      Bit6      Bit5      Bit4      Bit3      Bit2      Bit1      Bit0

Figure 4.60.86: Byte3

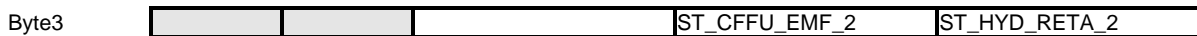


Figure 4.60.87: Byte2



Figure 4.60.88: Byte1



Figure 4.60.89: Byte0



**Check sum PBR**  
CKS\_CLC\_PBR  
STATUS\_EMF - ID 201H

Bit7      Bit6      Bit5      Bit4      Bit3      Bit2      Bit1      Bit0

Figure 4.60.90: Byte3



Figure 4.60.91: Byte2

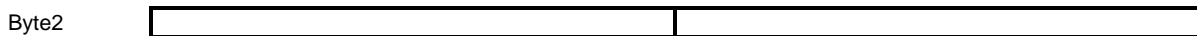


Figure 4.60.92: Byte1

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Figure 4.60.93: Byte0



**Check sum ETCU**

CKS\_CLC\_ETCU

GETRIEBEDATEN - ID BAH

Bit7      Bit6      Bit5      Bit4      Bit3      Bit2      Bit1      Bit0

Figure 4.60.94: Byte7



Figure 4.60.95: Byte6



Figure 4.60.96: Byte5



Figure 4.60.97: Byte4



Figure 4.60.98: Byte3



Figure 4.60.99: Byte2

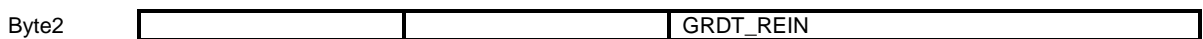


Figure 4.60.100: Byte1

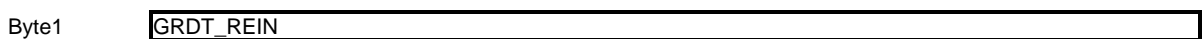


Figure 4.60.101: Byte0

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**Check sum TQ\_TCT**

CKS\_CLC\_TQ\_TCT

DREHMOMENT\_ANF\_DKG - ID B8H

Bit7      Bit6      Bit5      Bit4      Bit3      Bit2      Bit1      Bit0

Figure 4.60.102: Byte7



Figure 4.60.103: Byte6



Figure 4.60.104: Byte5



Figure 4.60.105: Byte4



Figure 4.60.106: Byte3



Figure 4.60.107: Byte2



Figure 4.60.108: Byte1



Figure 4.60.109: Byte0



**Check sum ST\_RQ\_EMF**

CKS\_CLC\_TQ\_PBR

ST\_RQ\_EMF - ID 1FDH

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Bit7      Bit6      Bit5      Bit4      Bit3      Bit2      Bit1      Bit0

Figure 4.60.110: Byte5

Byte5      ST\_ACT\_EMF      QU\_ST\_ACT\_EMF

Figure 4.60.111: Byte4

Byte4      SAFG\_RQ\_WMOM\_EMF

Figure 4.60.112: Byte3

Byte3      RQ\_DCRN\_EMF

Figure 4.60.113: Byte2

Byte2      RQ\_DCRN\_EMF

Figure 4.60.114: Byte1

Byte1      QU\_RQ\_DCRN\_EMF      ALIV\_ST\_RQ\_EMF

Figure 4.60.115: Byte0

Byte0      CHKSM\_ST\_RQ\_EMF

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## 4.61 CAN messages engine management system (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_SYM_TQ_DCC_CS	O/V	0... 1H	0 ...1	1	-
Logical bit for TQ_REQ_CAN error due to DCC torque intervention clutch switch					
T_TQ_DCC_CS	V	0... FFH	0... 2.55	0.01	s
Time of clutch switch intervention during DCC active					
TQ_AMT_FAST_DEC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
fast torque decreased intervention due to AMT					
TQ_AMT_FAST_INC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
fast torque increased intervention due to AMT					
TQ_AMT_SLOW_DEC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
slow torque decreased intervention due to AMT					
TQ_AMT_SLOW_INC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
slow torque increased intervention due to AMT					
TQ_ASR_FAST_DEC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
fast torque decreased intervention due to TCS					
TQ_ASR_SLOW_DEC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
slow torque decreased intervention due to TCS					
TQ_DCC_FAST_INC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
fast torque increased intervention due to DCC					
TQ_DCC_SLOW_INC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
slow torque increased intervention due to DCC					
TQ_GS_FAST_DEC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
fast torque decreased intervention due to GS					
TQ_GS_FAST_INC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
fast torque increased intervention due to GS					
TQ_GS_SLOW_DEC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
slow torque decreased intervention due to GS					
TQ_GS_SLOW_INC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
slow torque increased intervention due to GS					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_MSR_FAST_INC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
fast torque increased intervention due to TCS					
TQ_MSR_SLOW_INC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
slow torque increased intervention due to TCS					
TQ_WHEEL_LDM_INC_DEC_BN	O/V	8000... 7FFFH	-32768 ...32767	1	Nm
torque increased intervention due to LDM					


**Input data:**

LV_AMT_LIH_CAN {p. 1564}	LV_AT {p. 654}	LV_DCC_LIH_CAN {p. 1565}	LV_ETCU_LIH_CAN {p. 1565}
LV_IGK {p. 906}	LV_IM_CS_PN {p. 852}	LV_TCT_LIH_CAN {p. 1568}	LV_TQ_AMT_DEC_REQ {p. 1568}
LV_TQ_AMT_INC_REQ {p. 1568}	LV_TQ_ASR_REQ {p. 1568}	LV_TQ_DCC_INC_REQ {p. 1568}	LV_TQ_GS_DEC_REQ {p. 1568}
LV_TQ_GS_INC_REQ {p. 1568}	LV_TQ_MSR_REQ {p. 1568}	LV_TQ_WHEEL_LDM_BN_ ERR {p. 1568}	LV_TQ_WHEEL_LDM_ REQ {p. 1568}
LV_VAR_AMT {p. 655}	LV_VAR_BN {p. 655}	LV_VAR_BN_LDM {p. 655}	LV_VAR_TCT {p. 656}
N {p. 1525}	STATE_AMT_INTV {p. 1570}	STATE_DCC_CTL {p. 1572}	STATE_DCC_INTV {p. 1572}
STATE_ETCU_INTV {p. 1574}	STATE_TCS_INTV {p. 1578}	STATE_TCT_INTV {p. 1578}	TQ_AMT_FAST_BN {p. 1580}
TQ_AMT_SLOW_BN {p. 1581}	TQ_DCC_FAST_BN {p. 1581}	TQ_DCC_SLOW_BN {p. 1581}	TQ_GS_FAST_BN {p. 1581}
TQ_GS_SLOW_BN {p. 1581}	TQ_TCS_FAST_BN {p. 1582}	TQ_TCS_SLOW_BN {p. 1582}	TQ_WHEEL_LDM_BN {p. 1582}

**Calibration data:**

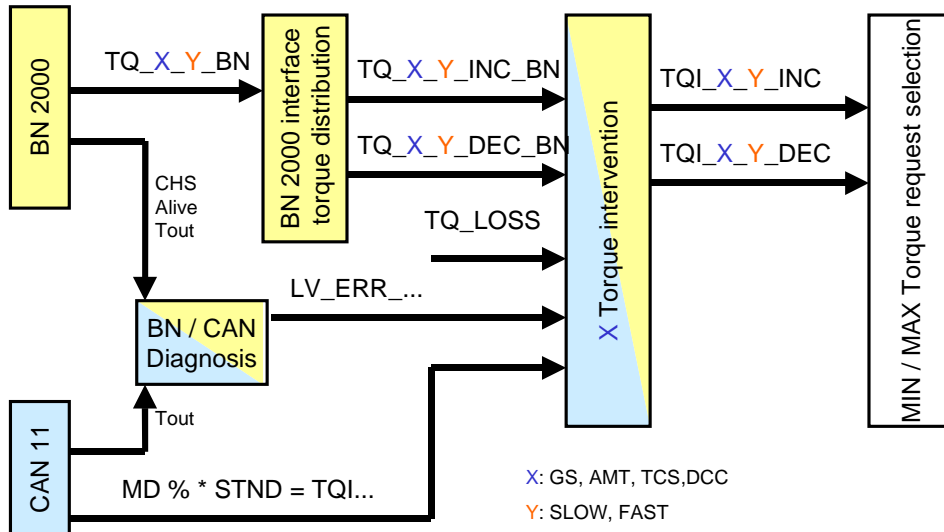
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_TQ_DCC_CS_DEC	-	0... FFH	0... 0.99609	3.9063e-3	-
Correlation constant for decrement TQ_DCC_CS intervention					
C_CRLC_TQ_DCC_CS_INC	-	0... FFH	0... 0.99609	3.9063e-3	-
Correlation constant for increment TQ_DCC_CS intervention					
C_THD_T_TQ_DCC_CS	-	0... FFH	0... 2.55	0.01	s
Threshold for maximum allowed torque intervention concerning clutch switch					
IP_TQ_DCC_CS	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_TQ_DCC_CS	6	0... 1FE0H	0... 8160	1	rpm
Intended DCC torque during clutch switch on					
LC_ENA_TQ_DCC_CS	-	0... 1H	0 ...1	1	-
Logical constant to set the TQ_DCC_CS intervention active					

**FUNCTION DESCRIPTION:****General information:**

Released by Tetenborn Frank		Date 2013-02-13	File 17409501.00A
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 1711 of 8404	
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Some functions of BN 2000 contain a torque request. For the torque structure interfaces it's necessary to define the direction of torque request as increased or decreased. The BN delivers just one torque request and an additional direction information bit. This module combines the direction information bit of BN with the torque request and supported the torque structure interfaces.

**Signal flow diagram:**



**Application conditions**

**Initialisation:**

$TQ\_X\_FAST\_DEC\_BN = 1023.97Nm$   
 $TQ\_X\_SLOW\_DEC\_BN = 1023.97Nm$   
 $TQ\_X\_FAST\_INC\_BN = -1024 Nm$   
 $TQ\_X\_SLOW\_INC\_BN = -1024 Nm$   
 $TQ\_WHEEL\_LDM\_INC\_DEC\_BN = -32000 Nm$   
 $LV\_RST\_T\_TQ\_DCC\_CS = 1$   
 $T\_TQ\_DCC\_CS = 0$   
 $LV\_ERR\_SYM\_TQ\_DCC\_CS = 0$

**Recurrence:**

10ms

**Activation:**

$LV\_VAR\_BN = 1$  and  $LV\_IGK = 1$

**Description:**

INDEX	Functionality				
Customer	EGS	DSC	SSG	ACC	LDM
Y	ETCU	TCS	AMT	DCC	LDM
X_INC	GS_INC	MSR	AMT_INC	DCC_INC	LDM_INC _DEC
X_DEC	GS_DEC	ASR	AMT_DEC	-	-
Z	GS	TCS	AMT	DCC	LDM

(The DCC function delivers only an increased Torque request. By using this template the initialisation of LV\_TQ\_DCC\_DEC\_REQ with 0 is necessary.) Beside of this, it is necessary that under defined conditions the torque request of the DCC is controlled by the ECU.

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**Formula section:**Torque CAN selection for intervention :

```

if          STATE_Y_INTV = NO_INTERVENTION (00H)
or          LV_Y_LIH_CAN = 1
or          TQ_Z_FAST_BN = -1024 Nm
or          TQ_Z_SLOW_BN = -1024 Nm
then        TQ_X_FAST_DEC_BN = 1023.97 Nm
              TQ_X_SLOW_DEC_BN = 1023.97 Nm
              TQ_X_FAST_INC_BN = -1024 Nm
              TQ_X_SLOW_INC_BN = -1024 Nm
elseif     LV_TQ_X_INC_REQ          (X_INC-intervention)
then       TQ_X_FAST_DEC_BN = 1023.97 Nm
              TQ_X_SLOW_DEC_BN = 1023.97 Nm
              TQ_X_FAST_INC_BN = TQ_Z_FAST_BN (converted)
              TQ_X_SLOW_INC_BN = TQ_Z_SLOW_BN (converted)
elseif     LV_TQ_X_DEC_REQ          (X_DEC-intervention)
then       TQ_X_FAST_DEC_BN = TQ_Z_FAST_BN (converted)
              TQ_X_SLOW_DEC_BN = TQ_Z_SLOW_BN (converted)
              TQ_X_FAST_INC_BN = -1024 Nm
              TQ_X_SLOW_INC_BN = -1024 Nm
endif
endif
endif

```

DCC Torque CAN selection for intervention

```

if(1)      STATE_DCC_INTV = NO_INTERVENTION (00H)
or         LV_DCC_LIH_CAN = 1
or         TQ_DCC_FAST_BN = -1024 Nm
or         TQ_DCC_SLOW_BN = -1024 Nm
then(1)    TQ_DCC_FAST_DEC_BN = 1023.97 Nm
              TQ_DCC_SLOW_DEC_BN = 1023.97 Nm
              TQ_DCC_FAST_INC_BN = -1024 Nm
              TQ_DCC_SLOW_INC_BN = -1024 Nm
              LV_RST_T_TQ_DCC_CS = 1
              LV_ERR_SYM_TQ_DCC_CS = 0
Else(1) if(2) LV_TQ_DCC_INC_REQ = 1
Then(2) If(3)          (LV_AT = 0 and LV_VAR_AMT = 0 and LV_VAR_TCT = 0)
and
              LC_ENA_TQ_DCC_CS = 1
Then(3) if(4)          LV_IM_CS_PN = 1 and
              (STATE_DCC_CTL = 0 H or
              STATE_DCC_CTL = 2 H) and
              LV_ERR_SYM_TQ_DCC_CS = 0
Then(4) TQ_DCC_FAST_INC_BN = TQ_DCC_FAST_INC_BN(n-1) +
              C_CRLC_TQ_DCC_CS_DEC * (IP_TQ_DCC_CS -
              TQ_DCC_FAST_INC_BN(n-1))
              TQ_DCC_SLOW_INC_BN = TQ_DCC_SLOW_INC_BN(n-1)

```

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
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```

+ C_CRLC_TQ_DCC_CS_DEC * (IP_TQ_DCC_CS -
  TQ_DCC_SLOW_INC_BN(n-1))
If(4') LV_RST_T_TQ_DCC_CS = 1
Then(4') T_TQ_DCC_CS = 0
  LV_RST_T_TQ_DCC_CS = 0
Else(4') T_TQ_DCC_CS = T_TQ_DCC_CS + 10

ms

If(4'') T_TQ_DCC_CS > C_THD_T_TQ_DCC_CS
Then(4'') LV_ERR_SYM_TQ_DCC_CS = 1
Else(4'') LV_ERR_SYM_TQ_DCC_CS = 0
Endif(4'')
Endif(4')
Else(4) TQ_DCC_FAST_INC_BN =
  TQ_DCC_FAST_INC_BN(n-1) +
  C_CRLC_TQ_DCC_CS_INC * (TQ_DCC_FAST_BN(n) -
  TQ_DCC_FAST_INC_BN(n-1))
  TQ_DCC_SLOW_INC_BN = TQ_DCC_SLOW_INC_BN(n-1) +
  C_CRLC_TQ_DCC_CS_INC * (TQ_DCC_SLOW_BN(n) -
  TQ_DCC_SLOW_INC_BN(n-1))
  LV_RST_T_TQ_DCC_CS = 1
Endif(4)
Else(3) TQ_DCC_FAST_INC_BN = TQ_DCC_FAST_BN (converted)
  TQ_DCC_SLOW_INC_BN = TQ_DCC_SLOW_BN (converted)
  TQ_DCC_FAST_DEC_BN = 1023.97 Nm
  TQ_DCC_SLOW_DEC_BN = 1023.97 Nm
  LV_ERR_SYM_TQ_DCC_CS = 0
Endif(3)
Then(2) TQ_DCC_FAST_DEC_BN = 1023.97 Nm
  TQ_DCC_SLOW_DEC_BN = 1023.97 Nm
  TQ_DCC_FAST_INC_BN = TQ_DCC_FAST_BN (converted)
  TQ_DCC_SLOW_INC_BN = TQ_DCC_SLOW_BN (converted)
  LV_RST_T_TQ_DCC_CS = 1
  LV_ERR_SYM_TQ_DCC_CS = 0
Endif(2)
Endif(1)

```

LDM Torque CAN selection for intervention

```

If(1) LV_TQ_WHEEL_LDM_REQ = 1 and
  LV_TQ_WHEEL_LDM_BN_ERR = 0
then(1) TQ_WHEEL_LDM_INC_DEC_BN = TQ_WHEEL_LDM_BN
Else(1) TQ_WHEEL_LDM_INC_DEC_BN = -32000 Nm
Endif(1)

```

DKG Torque CAN selection for intervention :

```


If STATE_TCT_INTV = NO_INTERVENTION (00H)
or LV_TCT_LIH_CAN = 1
or TQ_GS_FAST_BN = -1024 Nm
or TQ_GS_SLOW_BN = -1024 Nm
then TQ_GS_FAST_DEC_BN = 1023.97 Nm
  TQ_GS_SLOW_DEC_BN = 1023.97 Nm

```

```

    TQ_GS_FAST_INC_BN = -1024 Nm
    TQ_GS_SLOW_INC_BN = -1024 Nm
elseif LV_TQ_GS_INC_REQ = 1
    then TQ_GS_FAST_DEC_BN = 1023.97 Nm
        TQ_GS_SLOW_DEC_BN = 1023.97 Nm
        TQ_GS_FAST_INC_BN = TQ_GS_FAST_BN (converted)
        TQ_GS_SLOW_INC_BN = TQ_GS_SLOW_BN (converted)
    elseif LV_TQ_GS_DEC_REQ = 1
        then TQ_GS_FAST_DEC_BN = TQ_GS_FAST_BN (converted)
            TQ_GS_SLOW_DEC_BN = TQ_GS_SLOW_BN (converted)
            TQ_GS_FAST_INC_BN = -1024 Nm
            TQ_GS_SLOW_INC_BN = -1024 Nm
        endif
    endif
endif
endif
endif

```

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 1715 of 8404</b>	
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## 4.62 CAN messages gateway

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STMIN_ECU	-	0... FFH	0... 255	1	ms
STMIN for gateway from EGS to tester					

### Description:

ECU is in case of 11hex gateway between EGS on PT-CAN and Tester on Lo-CAN (e.g reprogramming via tester). The table below describes the way of routing the named diagnosis messages. Routing by hardware means that the controller is used (no application software involved). Routing by software means that the related message is received and if necessary modified and than sent to designated receiver (e.g. tester).

Messages	ID	Routing by ..	Sent from..	Sent to..
Diagnosis-Messages	6F0-6FF	Hardware	Tester	EGS
Diagnosis-Messages	618	Software	EGS	Tester

### Formula section:

Rule for software routing:

receive message (buffer byte 0-7)

```

If                byte 1 of received message == 30hex           (FlowControl)
Then             if      byte 3 of received message < C_STMIN_ECU   (STMIN)
                    Then      byte 3 = C_STMIN_ECU
                    Endif
Endif
    
```

**Endif**

send message (buffer byte 0-7)

## 4.63 Synchronisation determination in camshaft limp home

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CAM_LIH_EXT_ENA	O/V	0... 1H	0 ...1	1	-
Camshaft limp home with external help enabled					
LV_SEG_NR_UPD_REQ	O/V	0... 1H	0 ...1	1	-
SEG_NR update request					
LV_SYN_VLD_CAM_LIH	O/V	0... 1H	0 ...1	1	-
Engine synchronization determined in camshaft limp home mode					

### Input data:

INH_INJ {p. 2295}	LV_VS_RUN {p. 1176}	N {p. 1525}	N_GRD {p. 1525}
NC_CAM_LIH_SWI {p. 638}	SEG_CTR {p. 1525}	SEG_NR {p. 1525}	TCO_CMN {p. 642}
VB_CMN {p. 642}			

### FUNCTION DESCRIPTION:

#### General information:

This functions aims at initializing the variables used by ENSD or others aggregates in case no camshaft limp home method has been selected.

#### Description:

#### Application conditions

<b>Initialisation:</b>	<i>none</i>
<b>Recurrence:</b>	<i>at reset</i>
<b>Activation:</b>	<i>NC_CAM_LIH_SWI = None</i>
<b>Deactivation:</b>	<i>NC_CAM_LIH_SWI None</i>


#### Formula section:

LV\_SYN\_VLD\_CAM\_LIH = 0  
 LV\_CAM\_LIH\_EXT\_ENA = 0  
 LV\_SEG\_NR\_UPD\_REQ = 0

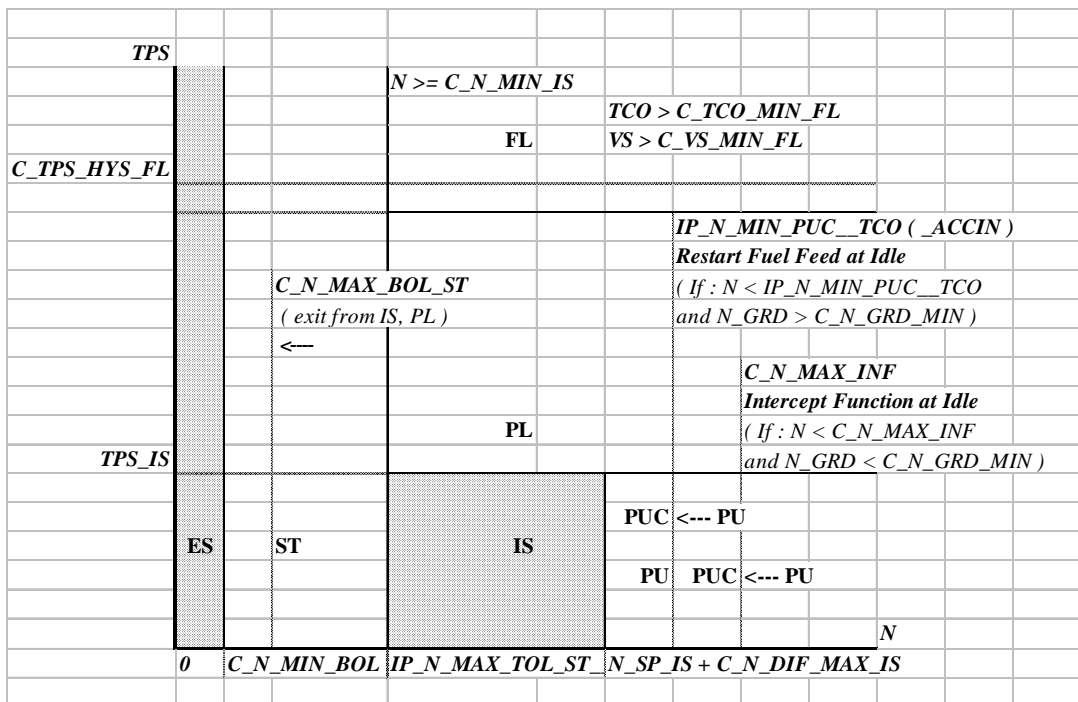
Remark: as this module is only a stub, N, N\_GRD, SEG\_CTR, LV\_VS\_RUN, INH\_INJ, TCO\_CMN, VB\_CMN and SEG\_NR are not used.

# 5 - Engine operating states

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Released by <b>Tettenborn Frank</b>		Date <b>2013-02-13</b>	File <b>30407201.00B</b>
	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 1718 of 8404</b>	
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# 5.1 General drawing



- LV\_ES : Engine Stopped
- LV\_ST : Start
- LV\_IS : Idle Speed
- LV\_PL : Part Load
- LV\_PU : Trailing Throttle
- LV\_PUC : Trailing Throttle Fuel Cut Off

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## 5.2 Basic operating states

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CS_PUC	V	0... 1H	0 ...1	1	-
Clutch switch information including AMT					
LV_ES	O/V	0... 1H	0 ...1	1	-
Engine operating state "Engine stopped"					
LV_IGA_MIN_PUC	O/V	0... 1H	0 ...1	1	-
conditions for IGA_MIN_PUC					
LV_IS	O/V	0... 1H	0 ...1	1	-
Engine operating state "Idle Speed"					
LV_PL	O/V	0... 1H	0 ...1	1	-
Engine operating state "Part Load"					
LV_PU	O/V	0... 1H	0 ...1	1	-
Engine operating state "Trailing throttle"					
LV_PUC	O/V	0... 1H	0 ...1	1	-
Engine operating state "trailing throttle fuel cut off "					
LV_PUC_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable trailing throttle fuel cut off request					
LV_ST	O/V	0... 1H	0 ...1	1	-
Engine operating state "Start"					
LV_ST_END	O/V	0... 1H	0 ...1	1	-
Engine operating state "Start" not active					
N_HYS_ACT_PUC	V	0... FFH	0... 8160	32	rpm
Actual effective engine speed hysteresis for LV_PUC					
N_HYS_MIN_PUC	V	0... FFH	0... 8160	32	rpm
Minimum engine speed hysteresis for LV_PUC					
N_MIN_PUC	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for the activation of LV_PUC.					
STATE_ENG	V	0H 1H 2H 3H 4H 5H	ES ST IS PL PU PUC	-	-
engine operating state					
T_IS	O/V	0... FFFFH	0... 655.35	0.01	s
Time since the activation of the state idle speed.					
T_PU	O/V	0... FFFFH	0... 655.35	0.01	s
Time elapsed into LV_PU					

### Input data:

C_N_DIF_FAC {p. 1123}	C_N_GRD_MIN {p. 1759}	CYC_CAST {p. 1766}	GR_AT {p. 1302}
GR_MT {p. 1302}	IP_N_MAX_INF {p. 1760}	LV_ACCOUT_RLY {p. 3589}	LV_AT {p. 654}
LV_CS {p. 8394}	LV_CT {p. 1442}	LV_DCC_INC_ACT {p. 6731}	LV_DCC_PUC_INH {p. 1565}



LV_DT {p. 1310}	LV_ETCU_PUC_REQ {p. 8209}	LV_GS_INC_ACT {p. 6718}	LV_INF {p. 1759}
LV_INH_PUC_CUS {p. 8209}	LV_LDM_PUC_INH {p. 6615}	LV_MSR_ACT {p. 6741}	LV_PUC_INH_TEMP_CAT {p. 8233}
LV_PUC_LOCK_TNT {p. 8199}	LV_PUC_SA_INH {p. 804}	LV_RGN_NT_REQ {p. 2983}	LV_RNG_L_REQ {p. 6570}
LV_S_ACT {p. 8137}	LV_TQI_BOL_SET {p. 8379}	LV_TQI_BOL_SET_S {p. 805}	LV_VAR_TCT {p. 656}
N {p. 1525}	N_32 {p. 1525}	N_DIF_MMV {p. 1122}	N_GRD {p. 1525}
N_MAX_TOL_ST {p. 1122}	N_SP_IS {p. 1122}	NC_N_MIN {p. 854}	OPM_AV {p. 8137}
STATE_ETCU_CLU {p. 1573}	STATE_TCT_INTV {p. 1578}	T_AST {p. 1766}	TCO {p. 1100}
TQ_LOSS_ADD {p. 8385}	TQ_LOSS_ARS_SP_CAN {p. 1581}	TQ_LOSS_PSTE_2_SP_ CAN {p. 1581}	VS {p. 1176}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CLC_STATE_ETCU_CLU	-	0... FFH	0... 255	1	-
Constant to define closed clutch depending on shift-process TCT via CAN					
C_CYCNR_HYS_PUC	-	0... FFFFH	0... 65535	1	°CRK
Cycle counter to reset the LV_PUC engine speed hysteresis					
C_CYCNR_HYS_PUC_ST	-	0... FFFFH	0... 65535	1	°CRK
Cycle counter to reset the LV_PUC engine speed hysteresis in cold condition					
C_N_DIF_AST	-	0... 1FE0H	0... 8160	1	rpm
Additional engine speed hysteresis to avoid "LV_PU" direct after start					
C_N_DIF_MAX_HYS_IS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hys. for transition to IS with stopped car					
C_N_DIF_MAX_HYS_PUC	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hys. for transition PU to PUC					
C_N_MAX_BOL_ST	-	0... FFH	0... 8160	32	rpm
Engine speed threshold to detect LV_ST or LV_PL from LV_IS					
C_T_MAX_PU	-	0... FFFFH	0... 655.35	0.01	s
Maximum delay time of PUC activation after entry of PU					
C_T_MIN_PU_MSR	-	0... FFFFH	0... 655.35	0.01	s
Minimum delay time of PUC activation after MSR					
C_T_MIN_PU_RNG_L	-	0... FFFFH	0... 655.35	0.01	s
Minimum delay time of PUC activation after entry of PU for LV_RNG_L_REQ = 1					
C_T_MIN_PU_VS	-	0... FFFFH	0... 655.35	0.01	s
Minimum delay time of PUC activation after entry of PU					
C_T_MIN_PU_VS_CS	-	0... FFFFH	0... 655.35	0.01	s
Minimum delay time for entry PUC due to clutch switch for MT					
C_T_N_DIF_AST	-	0... FFFFH	0... 6553.5	0.1	s
Time after start where C_N_DIF_AST is additional calculated to engine speed hysteresis					
C_TCO_MIN_PUC_ST	-	0... FEH	-48... 142.5	0.75	°C
Coolant temperature to select the LV_PUC engine speed hysteresis					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VS_MIN_PU	-	0... FFH	0... 255	1	km/h
minimum vehicle speed of IGA_Min of PU					
C_VS_PU_CS_MAX	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed for delayed PUC due to clutch switch for MT					
C_VS_PU_CS_MIN	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed for delayed PUC due to clutch switch for MT					
ID_N_HYS_MAX_PUC__GR_AT	-	0... FFH	0... 8160	32	rpm
LDPM_GR_AT_3	9	0... FFH	0... 255	1	-
Engine speed hysteresis set entering LV_PUC					
ID_N_HYS_MAX_PUC__GR_MT	-	0... FFH	0... 8160	32	rpm
LDPM_GR_MT_3	9	0... FFH	0... 255	1	-
Engine speed hysteresis set entering LV_PUC for MT transmissions					
ID_N_HYS_MIN_PUC__GR_AT	V	0... FFH	0... 8160	32	rpm
LDPM_GR_AT_3	9	0... FFH	0... 255	1	-
LDPM_VS	4	0... FFH	0... 255	1	km/h
Engine speed hysteresis reset when C_CYCNR_HYS_PUC_xx achieved					
ID_N_HYS_MIN_PUC__GR_MT	V	0... FFH	0... 8160	32	rpm
LDPM_GR_MT_3	9	0... FFH	0... 255	1	-
LDPM_VS	4	0... FFH	0... 255	1	km/h
Engine speed hysteresis reset when C_CYCNR_HYS_PUC_xx achieved					
ID_N_HYS_PUC_ST__GR_AT	-	0... FFH	0... 8160	32	rpm
LDPM_GR_AT_3	9	0... FFH	0... 255	1	-
Engine speed hysteresis set entering LV_PUC in cold condition for AT transmission					
ID_N_HYS_PUC_ST__GR_MT	-	0... FFH	0... 8160	32	rpm
LDPM_GR_MT_3	9	0... FFH	0... 255	1	-
Engine speed hysteresis set entering LV_PUC in cold condition for MT transmission.					
IP_CYC_CAST__TCO	-	0... FFFFH	0... 65535	1	-
LDPM_TCO_9	9	0... FEH	-48... 142.5	0.75	°C
Cycle counter to define the duration of the start phase characterised by LV_ST					
IP_N_ACCOUT_MIN_PUC__TCO__GR_AT	V	0... FFH	0... 8160	32	rpm
LDPM_TCO_1_6	6	0... FEH	-48... 142.5	0.75	°C
LDPM_GR_AT_3	9	0... FFH	0... 255	1	-
LV_PUC engine speed threshold with air conditioned compressor active					
IP_N_ACCOUT_MIN_PUC__TCO__GR_MT	V	0... FFH	0... 8160	32	rpm
LDPM_TCO_1_6	6	0... FEH	-48... 142.5	0.75	°C
LDPM_GR_MT_3	9	0... FFH	0... 255	1	-
LV_PUC engine speed threshold with air conditioning compressor active					
IP_N_DIF_MAX_IS	-	0... 1FE0H	0... 8160	1	rpm
LDP_N_GRD_N_DIF_MAX_IS	6	0... FFH	-4096 ...4064	32	rpm/s
Engine speed hysteresis before "Idle Speed" (LV_IS)					
IP_N_MIN_PUC__TCO__GR_AT	V	0... FFH	0... 8160	32	rpm
LDPM_TCO_1_6	6	0... FEH	-48... 142.5	0.75	°C

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_GR_AT_3	9	0... FFH	0... 255	1	-
LV_PUC engine speed threshold					
IP_N_MIN_PUC__TCO__GR_MT	V	0... FFH	0... 8160	32	rpm
LDPM_TCO_1_6	6	0... FEH	-48... 142.5	0.75	°C
LDPM_GR_MT_3	9	0... FFH	0... 255	1	-
LV_PUC engine speed threshold					
IP_N_MIN_PUC_ADD	-	0... FFH	0... 8160	32	rpm
LDP_TQ_LOSS_ADD__PUC	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Additive term for reactivation engine speed					
IP_N_MIN_PUC_ADD_ARS	-	0... FFH	0... 8160	32	rpm
LDP_TQ_LOSS_ARS_SP_CAN_PUC	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Additive term for reactivation engine speed					
IP_N_MIN_PUC_ADD_PSTE_2	-	0... FFH	0... 8160	32	rpm
LDP_TQ_LOSS_PSTE_2_SP_CAN_PUC	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Additive term for reactivation engine speed					
IP_T_MIN_PU__N__TCO	V	0... FFFFH	0... 655.35	0.01	s
LDP_N__T_MIN_PU	8	0... 1FE0H	0... 8160	1	rpm
LDP_TCO__T_MIN_PU	6	0... FEH	-48... 142.5	0.75	°C
Minimum delay time of PUC activation					
IP_T_MIN_PU_HOM	-	0... FFFFH	0... 655.35	0.01	s
LDPM_N__T_MIN_PU_OPM	3	0... 1FE0H	0... 8160	1	rpm
Minimum delay time of PUC activation after entry of PU in homogenous mode					
IP_T_MIN_PU_RNG_L__N__TCO	V	0... FFFFH	0... 655.35	0.01	s
LDP_N__T_MIN_PU	8	0... 1FE0H	0... 8160	1	rpm
LDP_TCO__T_MIN_PU	6	0... FEH	-48... 142.5	0.75	°C
Minimum delay time of PUC activation					
IP_T_MIN_PU_S	-	0... FFFFH	0... 655.35	0.01	s
LDPM_N__T_MIN_PU_OPM	3	0... 1FE0H	0... 8160	1	rpm
Minimum delay time of PUC activation after entry of PU in s mode					
LC_INH_DT_PU	-	0... 1H	0 ...1	1	-
Manual inhibition bit for deactivation drivetrain impact for controlling transition to PUC					
LC_INH_PUC_NT_REQ	-	0... 1H	0 ...1	1	-
Manual switch to inhibit PUC due to regeneration request of NOx management					
LC_N_HYS_CYL_CUT_OFF_AT_CONF	-	0... 1H	0 ...1	1	-
Logical constant for premature reset to minimum engine speed hysteresis, vehicle with automatic transmission					
LC_N_HYS_CYL_CUT_OFF_MT_CONF	-	0... 1H	0 ...1	1	-
Logical constant for premature reset to minimum engine speed hysteresis, vehicle with manual transmission					

### General information:

From the 6 different basic operating states only 1 can be active at the same time. So this function can be realised as a state machine. This specification describes the transition conditions.


### Application conditions:

Released by Tetenborn Frank		Date 2013-02-13	File 43500202.00F
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 1723 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

*Initialisation:* RST, ERU2ES, ES2ERU  
*Recurrence:* 10MS, SEG  
*Activation:* 10MS: always  
 SEG: always  
*Deactivation:* never

### Function description:

### Formula section:

Released by Tettenborn Frank		Date 2013-02-13	File 43500202.00F
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 1724 of 8404	
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LV\_ES is the operating state which is set during ECU initialisation.

The engine operating state Engine Stopped (LV\_ES) is characterized by  $N_{32} < NC_{N\_MIN}$ . In this engine operating state, the functions are assigned to initialisation values.

The entire scope of diagnosis and actuator control is accessible.

### 5.2.1.1 Initilisation of Variables at Reset

LV\_ES is the operating state which is set during ECU initialisation

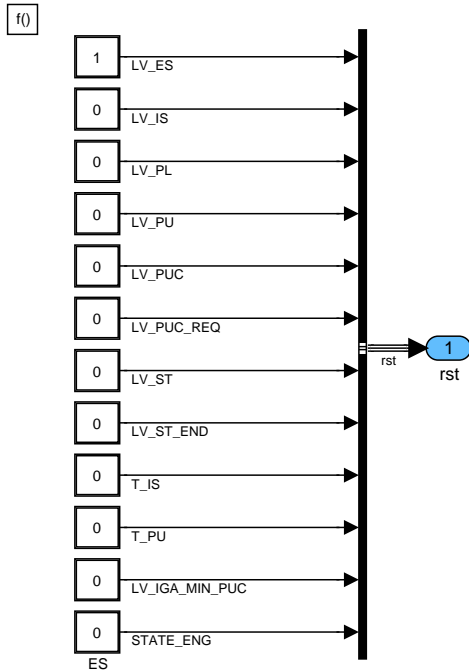


Figure 5.2.2: :

### 5.2.1.2 Initilisation of Variables at ERU2ES Event

The initialization of variables are done at ERU2ES event

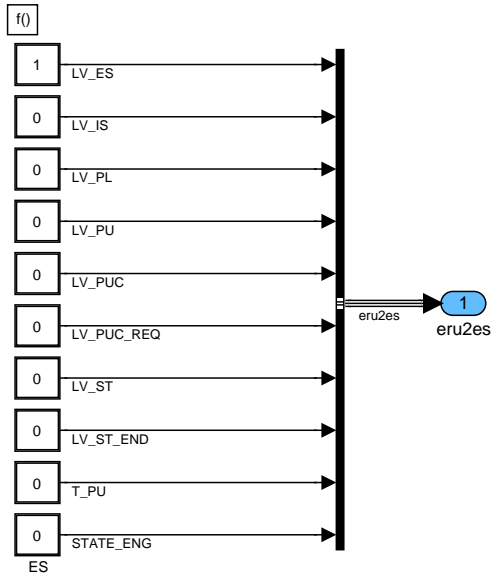


Figure 5.2.3: :

### 5.2.1.3 Initialization of Variables at ES2ERU

The initialization of variables are done at ES2ERU event

#### 5.2.1.3.1 Initialization of N\_HYS\_PUC

The trigger for the calculation of N\_HYS\_PUC

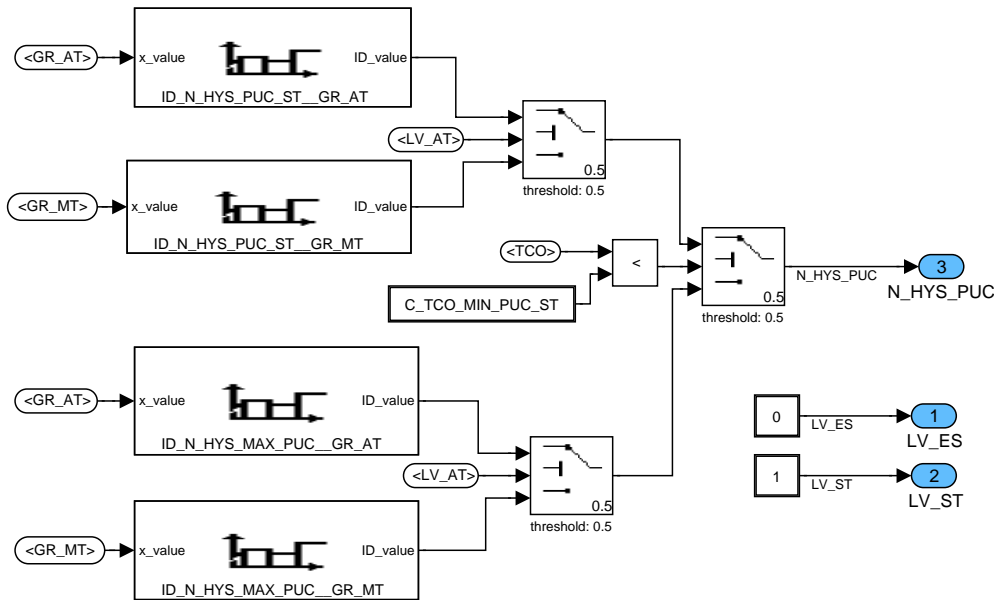


Figure 5.2.4: :

## 5.2.2 Formula Section

All the variables are calculated under 10 MS and SEG recurrence

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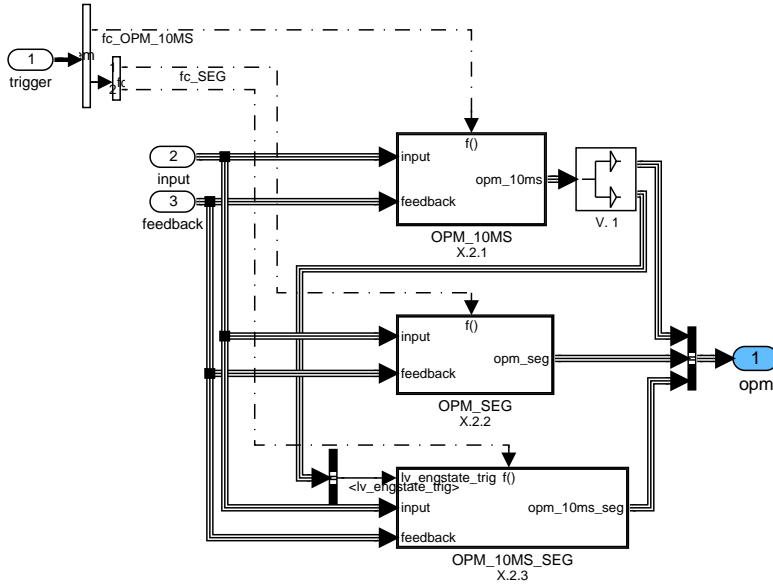


Figure 5.2.5: :

### 5.2.2.1 Formula Section for 10 ms Recurrence

The timer values are calculated in this block at 10 ms recurrence.

#### 5.2.2.1.1 Calculation of Timer T\_IS

The timer is calculated in this subchapter

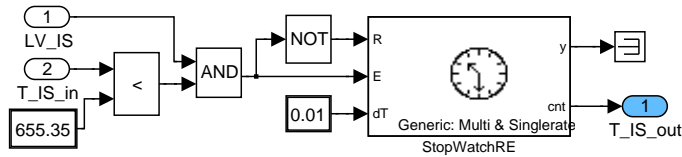


Figure 5.2.6: :

#### 5.2.2.1.2 Activation of the timer T\_PU:

Timer T\_PU is calculated in this block

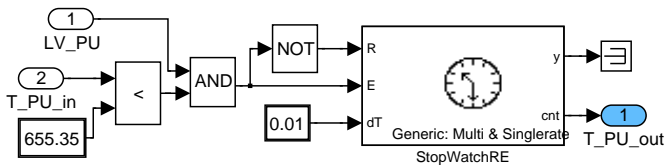


Figure 5.2.7: :

#### 5.2.2.1.3 Calculation of T\_PU\_MSR

This block computes T\_PU\_MSR

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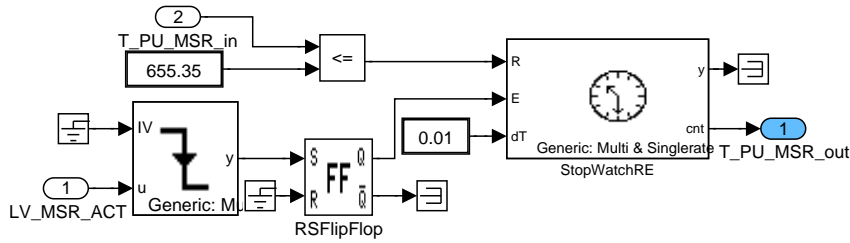


Figure 5.2.8: :

**5.2.2.1.4 Set engine state trigger flag**

lv\_engstate\_trig is set to 1

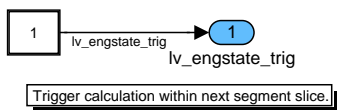


Figure 5.2.9: :

**5.2.2.2 Calculation of speed for segment recurrence**

N\_HYS\_PUC is calculated.

**5.2.2.2.1 Calculation of Flag**

N\_HYS\_PUC is calculated by checking the values of LV\_PUC flag.

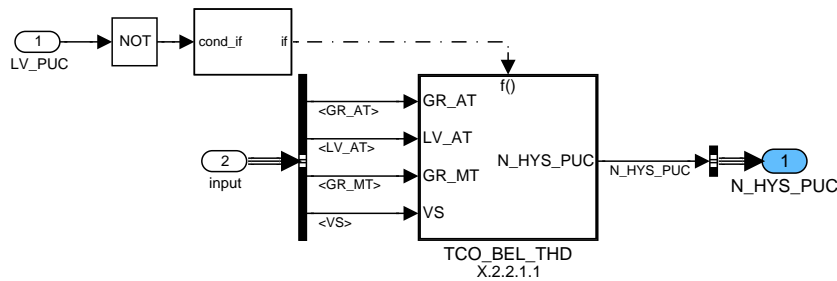


Figure 5.2.10: :

**5.2.2.2.1.1 Calculation of N\_HYS\_PUC**

N\_HYS\_PUC is calculated in this block.

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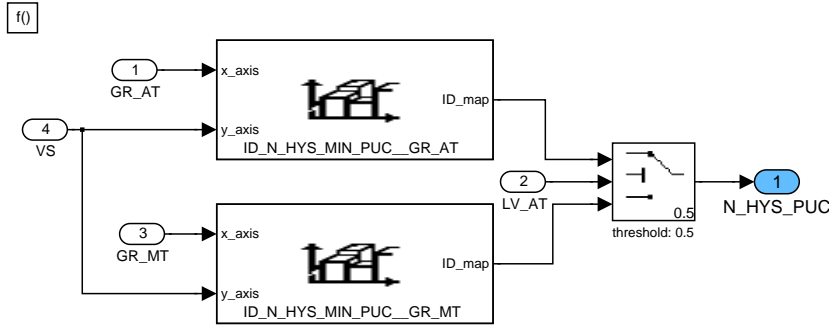


Figure 5.2.11: :

### 5.2.2.3 Calculation of engine state every segment synchronized with 10ms slice

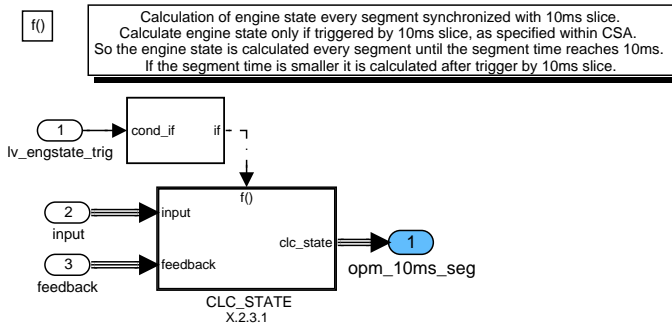


Figure 5.2.12: :

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5.2.2.3.1 Calculation at 10 MS and SEGMENT recurrence

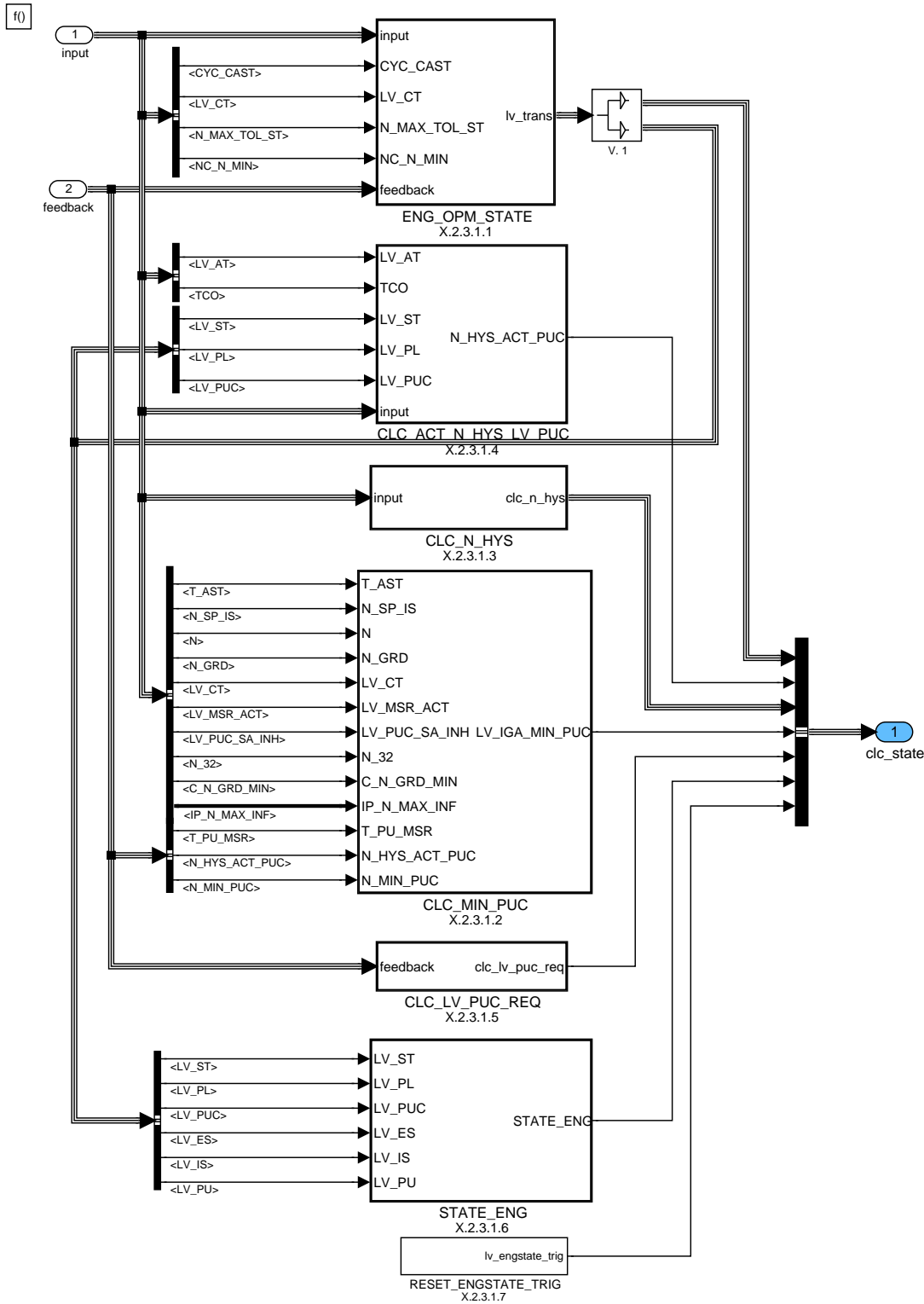


Figure 5.2.13: :

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### 5.2.2.3.1.1 Calculation of Engine States

The State variables are calculated.

Additional calculation of LV\_ST\_END: The engine operating state Start (LV\_ST) (cold start and hot start) is detected from all engine operating states via means of engine speed. The boolean LV\_ST\_END displays the transition from start to running engine .

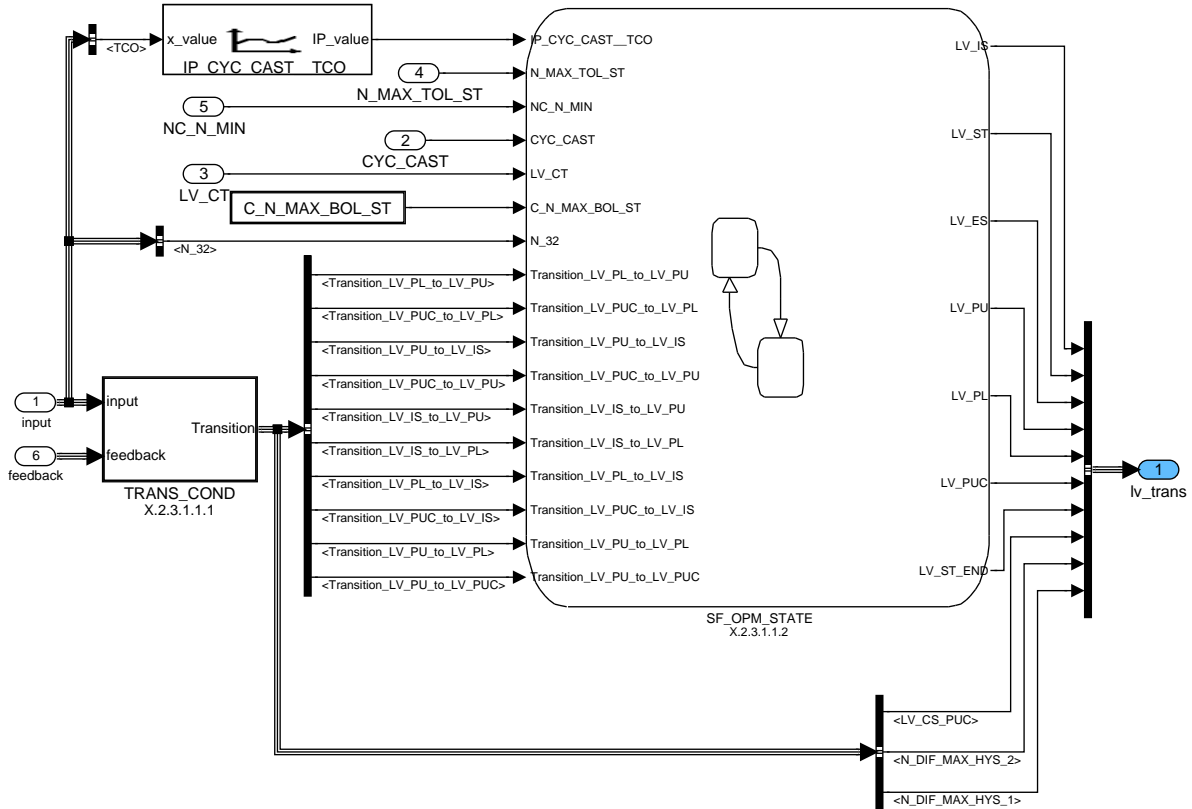


Figure 5.2.14: :

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### 5.2.2.3.1.1.1 Boolean condition calculations for Stateflow

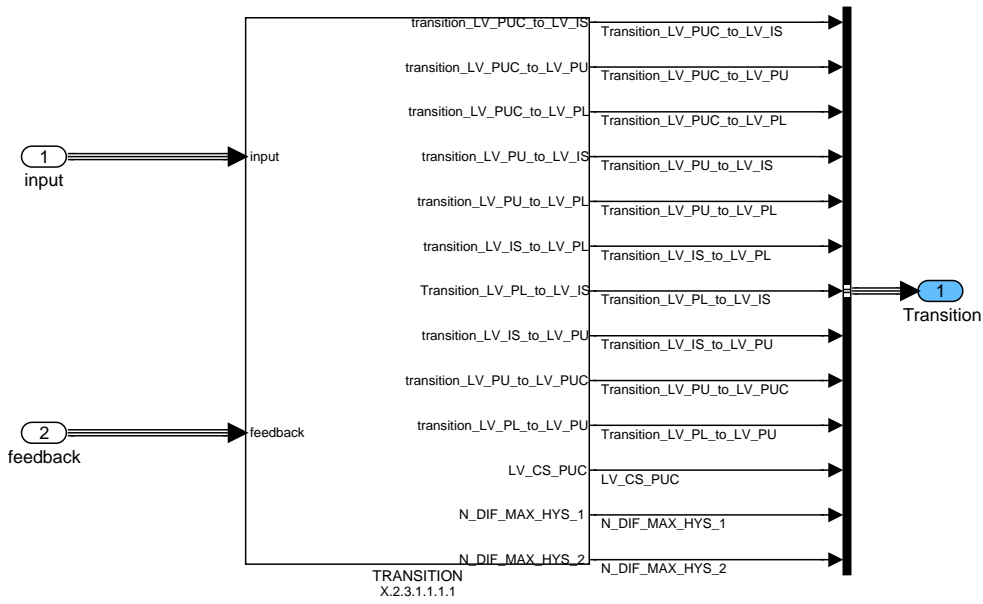


Figure 5.2.15: :

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### 5.2.2.3.1.1.1.1 Calculation of Engine Transition Conditions

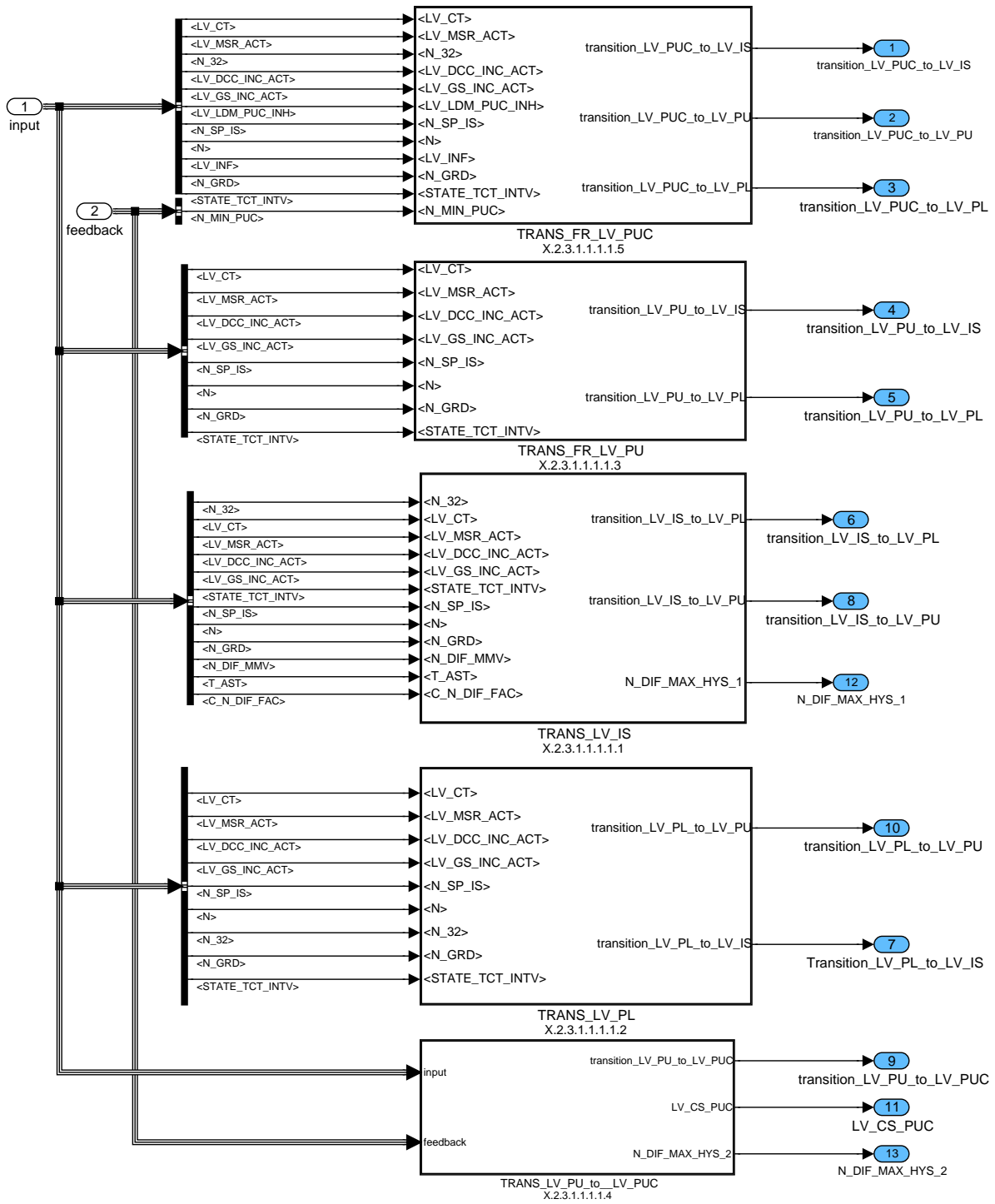


Figure 5.2.16: :

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5.2.2.3.1.1.1.1 Calculation of Transition Condition

Engine operating state : Idle Speed (LV\_IS) The Transition condition for various To facilitate this documentation, N\_SP\_IS and N\_DIF\_MMV are described in the chapter System Variables . The following states are calculated in this part

Exit to LV\_PL : Part Load, Exit to LV\_PU : Trailing Throttle states are calculated below.

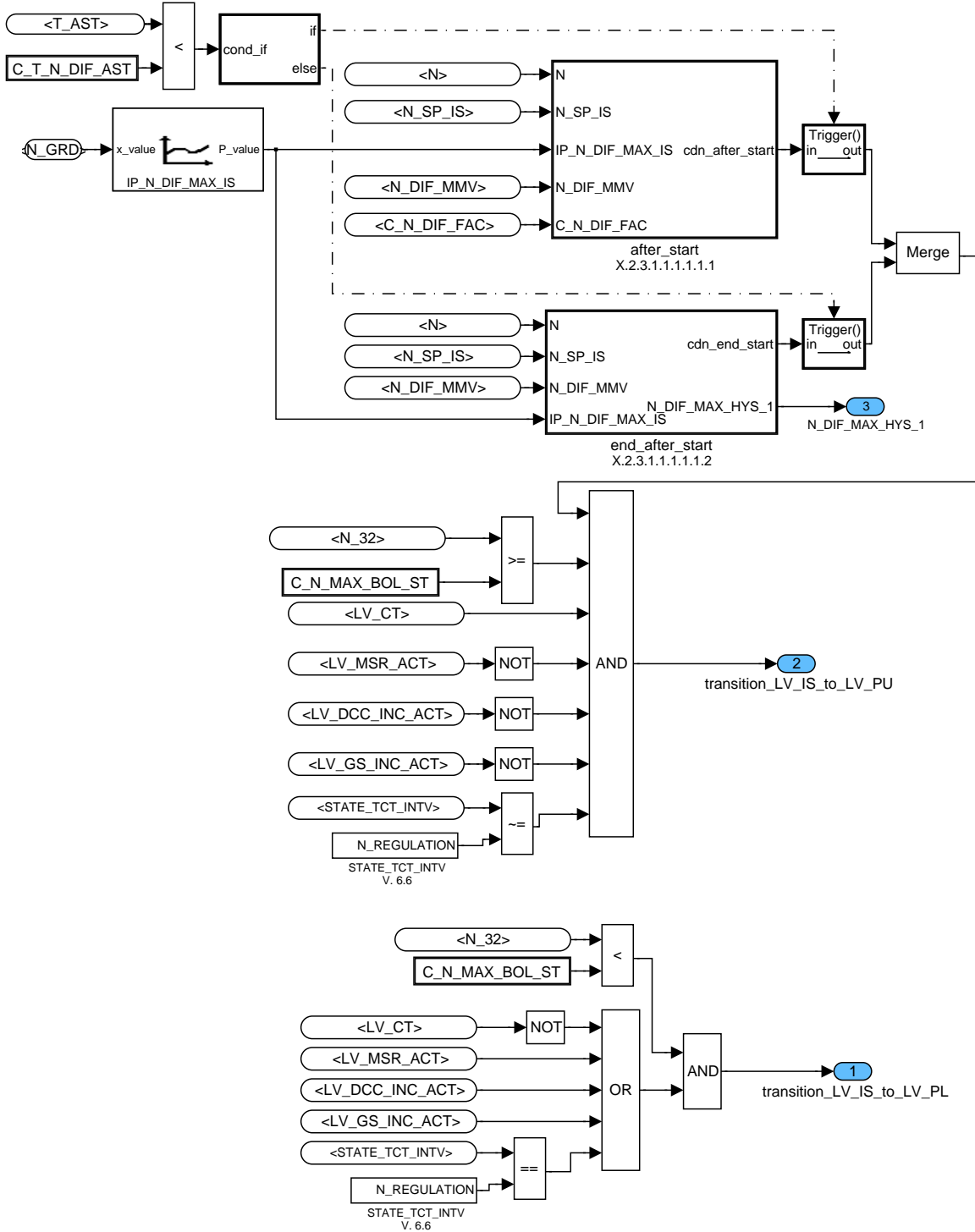


Figure 5.2.17: :

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**5.2.2.3.1.1.1.1.1 Condition 1**

This condition represents AFTER START

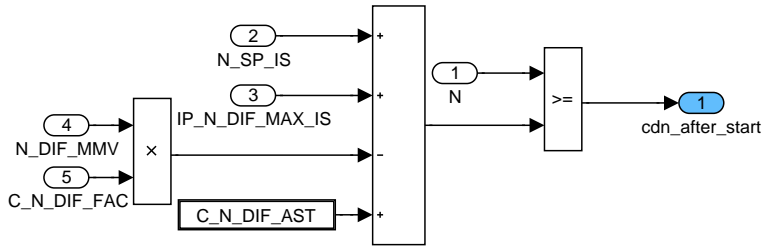


Figure 5.2.18: :

**5.2.2.3.1.1.1.1.2 Condition 2**

This condition represents END AFTER START

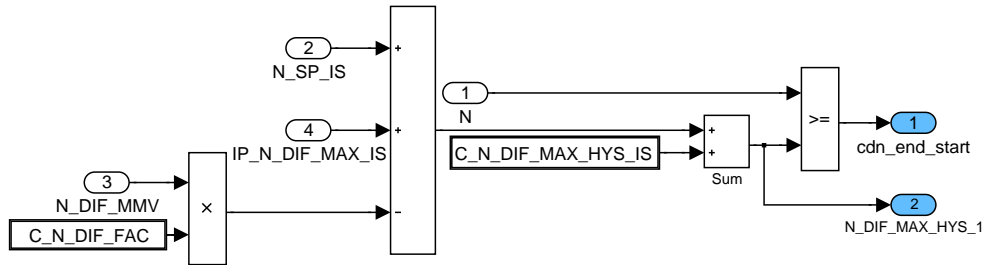


Figure 5.2.19: :

**5.2.2.3.1.1.1.2 Engine operating state : "Part Load" (LV\_PL)**

To facilitate this documentation, N\_SP\_IS is described in the chapter System Variables . The following states are calculated in this subchapter Exit to LV\_IS : Idle Speed, Exit to LV\_PU : Trailing Throttle.

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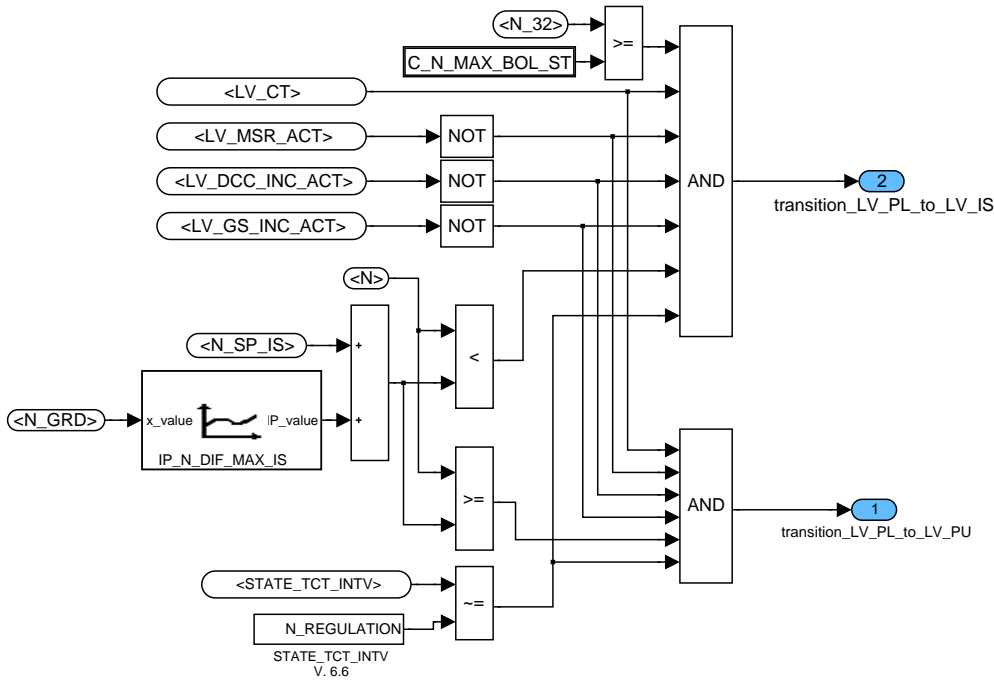


Figure 5.2.20: :

### 5.2.2.3.1.1.1.3 Engine operating state : "Trailing Throttle" (LV\_PU)

To facilitate this documentation, N\_GRD and N\_SP\_IS are described in the chapter System Variables . The following state transitions are calculated - Exit to LV\_PL : Part Load, Exit to LV\_IS : Idle Speed

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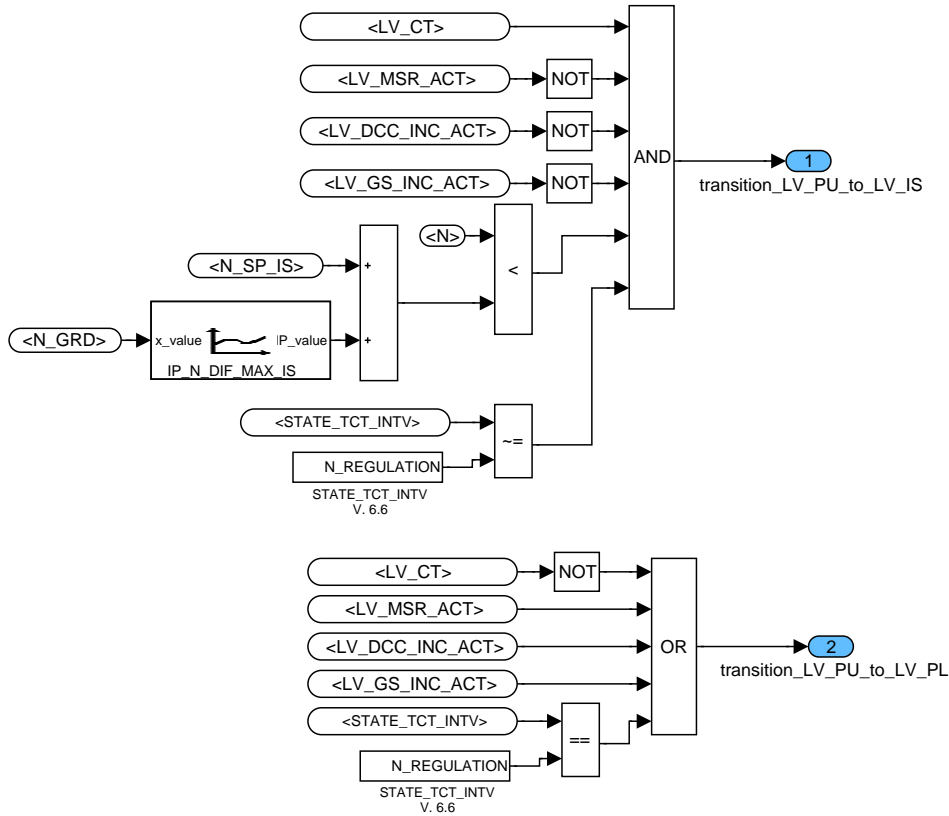


Figure 5.2.21: :

**5.2.2.3.1.1.1.4 Exit to LV\_PUC : Trailing Throttle Fuel Cut Off**

After active MSR function a delay time for entrance into PUC is started to suppress a jittering of MSR function.

T\_PU\_MSR started at LV\_MSR\_ACT 1 to 0

In order to avoid a sudden entry in PUC especially for TCT variant the flag LV\_CS\_PUC in dependence of STATE\_ETCU\_CLU is defined. The driveability in stop and go conditions is improved by using a delayed clutch switch for entry in PUC.

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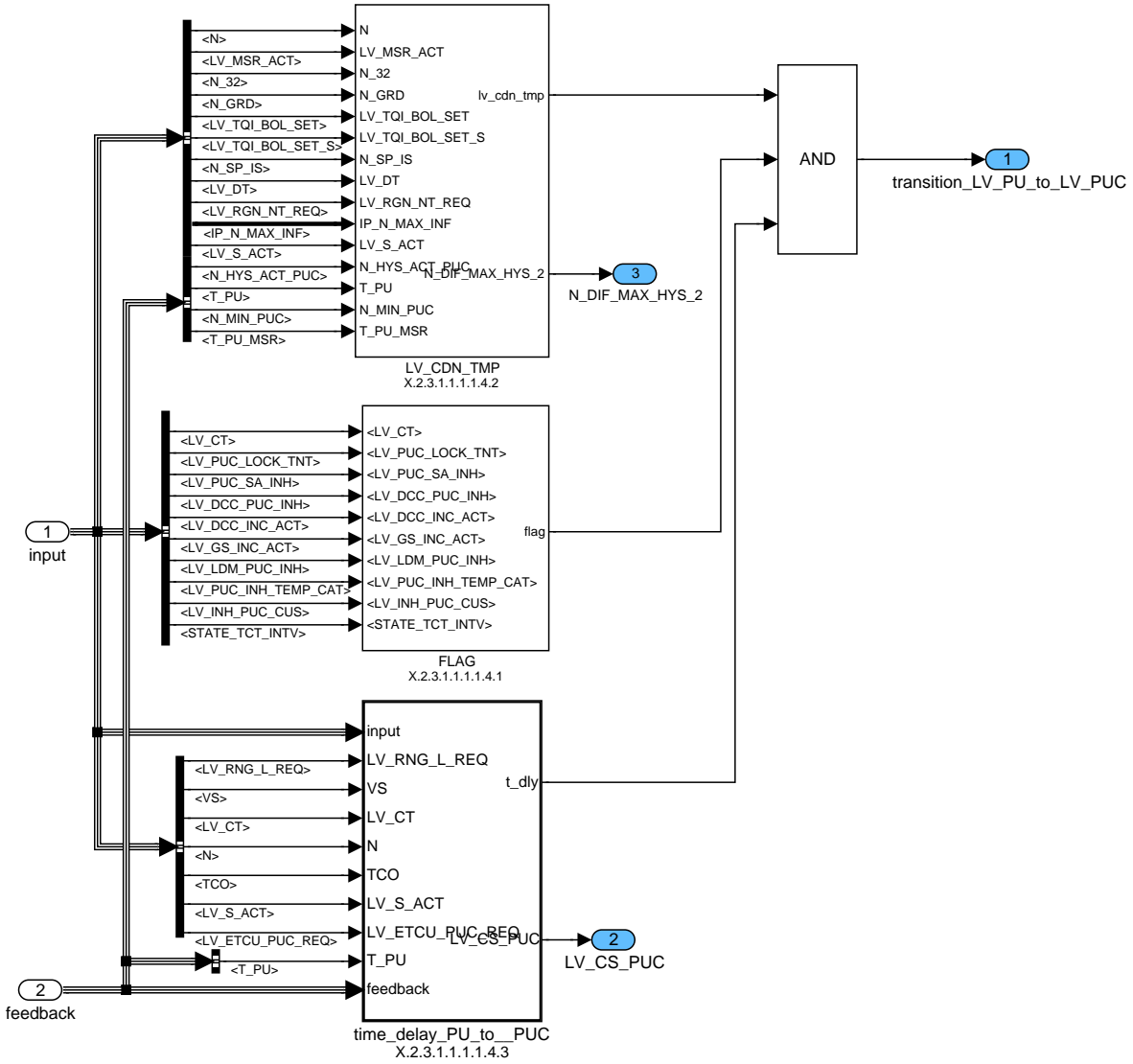


Figure 5.2.22: :

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### 5.2.2.3.1.1.1.4.1 Calculation of Flag

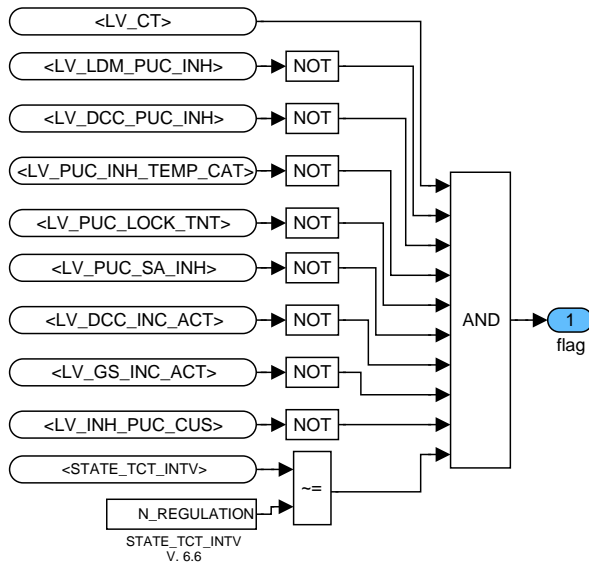


Figure 5.2.23: :

### 5.2.2.3.1.1.1.4.2 Calculation of lv\_cdn\_tmp

In order to avoid a sudden entry in PUC especially for TCT variant the flag LV\_CS\_PUC in dependence of STATE\_ETCU\_CLU is defined. The driveability in stop and go conditions is improved by using a delayed clutch switch for entry in PUC.

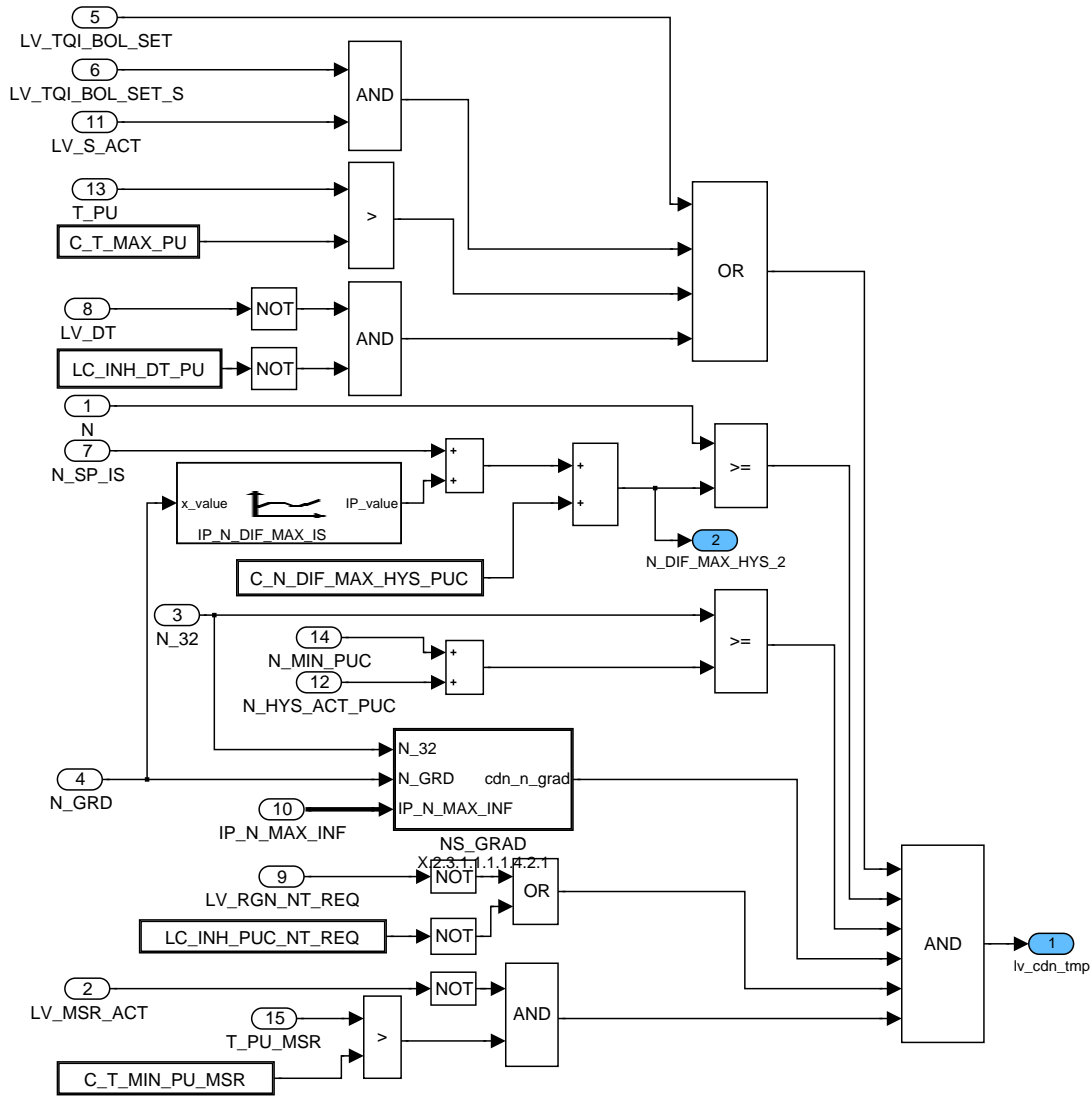


Figure 5.2.24: :

### 5.2.2.3.1.1.1.4.2.1 Calculation of N\_GRD

The following condition is satisfied in this block  
 N\_GRD ( C\_N\_GRD\_MIN (only if N\_32 < IP\_N\_MAX\_INF)

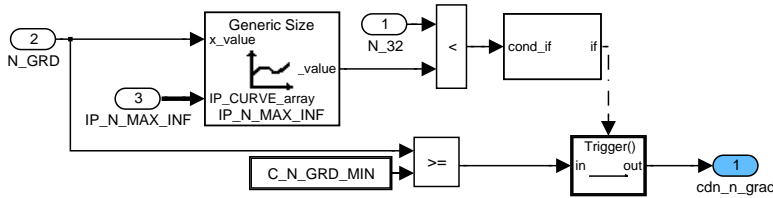


Figure 5.2.25: :

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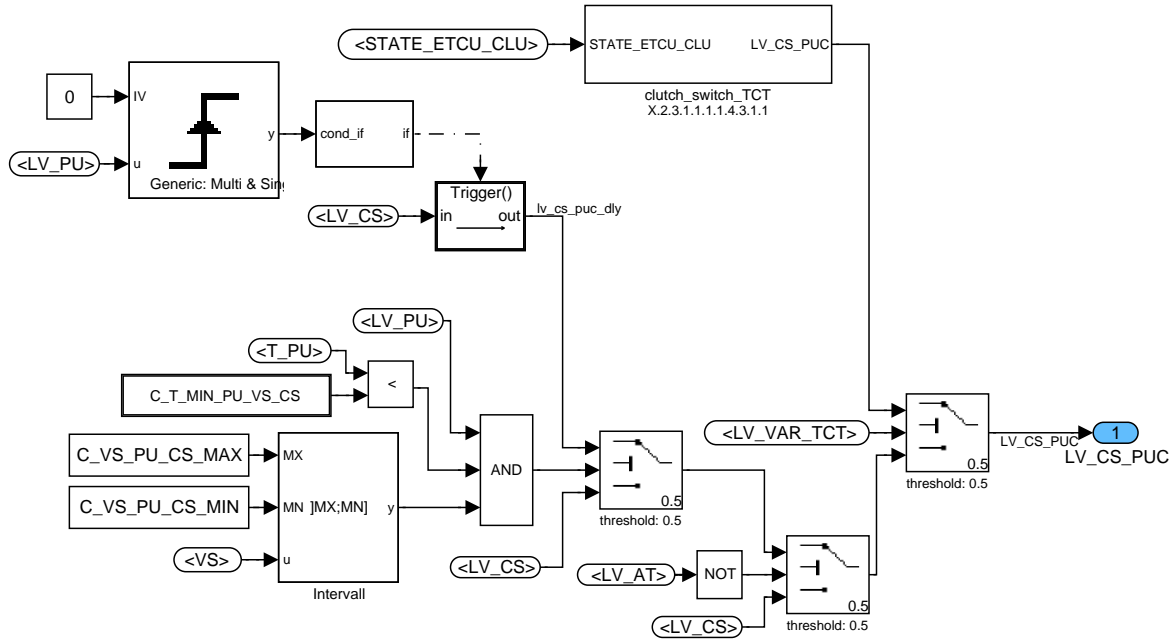


Figure 5.2.27: :

### 5.2.2.3.1.1.1.4.3.2 Bit Wise Operator

LV\_CS\_PUC\_RAW is calculated in this block for the gearbox variant twin clutch transmission

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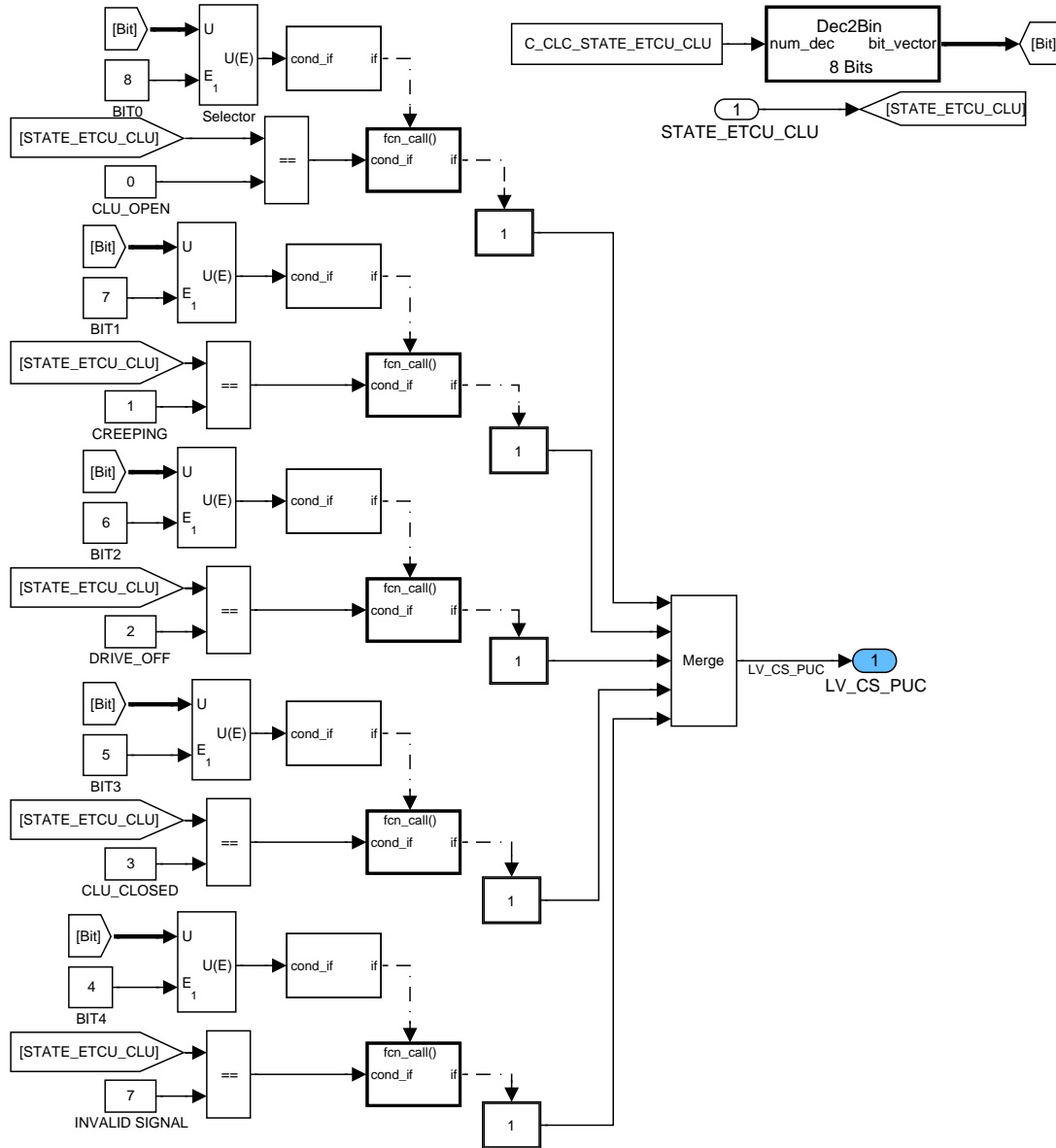


Figure 5.2.28: :

5.2.2.3.1.1.1.5 Calculation of Transition from LV\_PUC

The following transitions are involved in LV\_PUC state- Exit to LV\_IS : Idle Speed, Exit to LV\_PU : Trailing Throttle, Exit to LV\_PL: Part Load

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### 5.2.2.3.1.1.2 SF\_OPM\_STATE

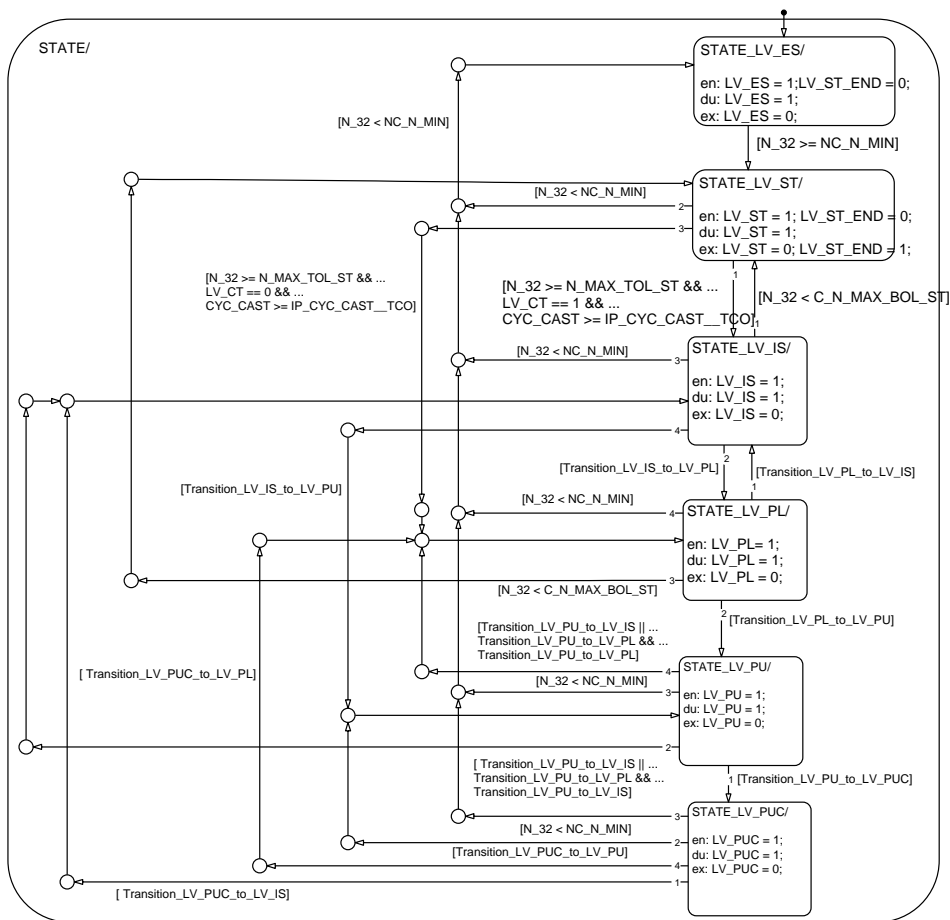


Figure 5.2.30: :

### 5.2.2.3.1.2 Conditions for minimum ignition angle PUC:

LV\_IGA\_MIN\_PUC is calculated in this sub block

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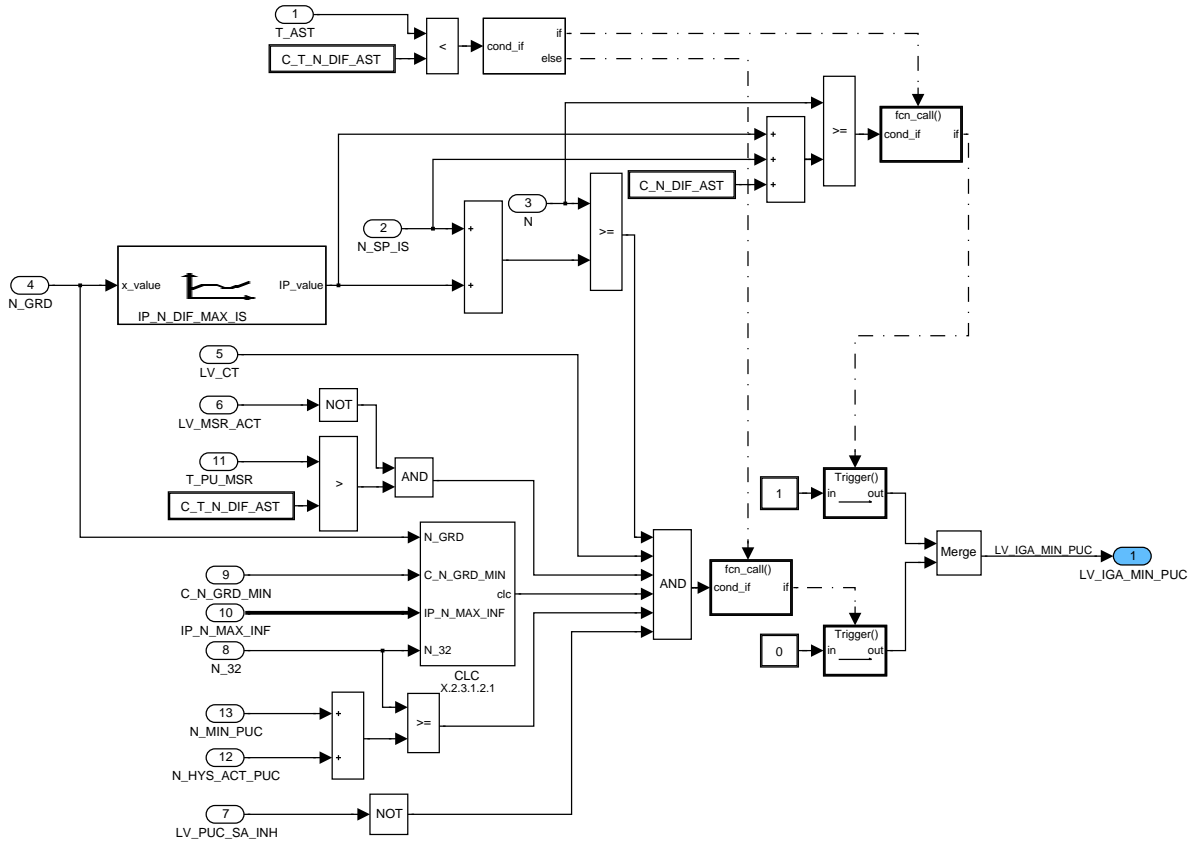


Figure 5.2.31: :

**5.2.2.3.1.2.1 N\_GRD and C\_N\_GRD\_MIN - -Check**

The flag is set if and only if  $N_{32} < IP_{N\_MAX\_INF}$

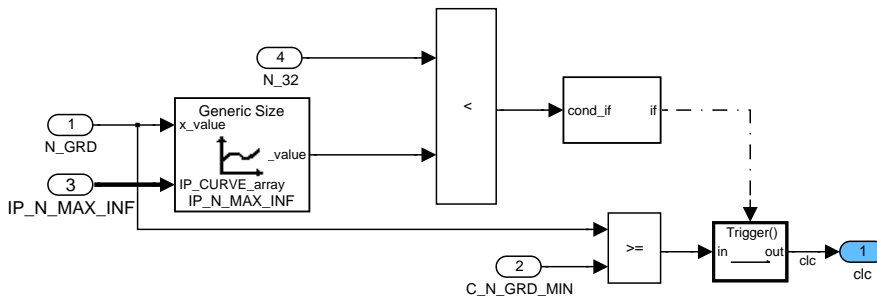


Figure 5.2.32: :

**5.2.2.3.1.3 Calculation of N\_HYS variables**

To facilitate this documentation,  $N_{SP\_IS}$  is described in the chapter System Variables .  
 To facilitate this documentation,  $N_{SP\_IS}$  is described in the chapter System Variables .  
 The engine speed threshold for termination of PUC (reactivation of injection at decreasing engine speed) is the reactivation engine speed  $N_{MIN\_PUC}$ . It is dependant from TCO, gear ratio, vehicle type (trans-

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mission) and TQ\_LOSS\_ADD (additional torque losses). ARS and PSTE torque request maps remain preserved to keep the opportunity of separate treatment.

Function 'LV\_PUC Hysteresis':

To avoid toggling PUC <- -> PU or PUC <- -> IS there is a hysteresis for the engine speed threshold which determines this transition. Transition from PUC when  $N < \text{threshold}$  ( $N\_MIN\_PUC$ ); transition to PUC when  $N > \text{threshold} + \text{hysteresis}$  ( $N\_MIN\_PUC + N\_HYS\_ACT\_PUC$ ).

When entering Trailing Throttle Fuel Cut Off (LV\_PUC), the engine speed hysteresis is set to a larger value,  $ID\_N\_HYS\_MAX\_PUC\_GR\_xx$  ( $xx = MT, AT$ ), and a cycle counter is loaded with an adjustable number,  $C\_CYCNR\_HYS\_PUC$ . The cycle counter is decremented once per program cycle in any engine operating state except 'Trailing Throttle Fuel Cut Off' (LV\_PUC).

When the counter has reached its lower limit 0, the engine speed hysteresis is reset to the value  $ID\_N\_HYS\_MIN\_PUC\_GR\_xx$ . This value depends on gear  $GR\_xx$  and vehicle speed  $VS$  and is the minimum engine speed hysteresis for LV\_PUC. The hysteresis is reset to this minimum value also, if during counter decrementation the engine operating state changes to partload and this reset is enabled by calibration switch  $LC\_N\_HYS\_CYL\_CUT\_OFF\_xx\_CONF$ .

If the coolant temperature is below the threshold  $C\_TCO\_MIN\_PUC\_ST$  when the engine is started, then the engine speed hysteresis for the detection of LV\_PUC is increased to an adjustable value  $ID\_N\_HYS\_PUC\_ST\_GR\_xx$ , for an adjustable number of cycles  $C\_CYCNR\_HYS\_PUC\_ST$ . This results in faster catalyst heat-up during trailing throttle operation.

For the customer request  $LV\_INH\_PUC\_CUS = 1$ , the engine operating state LV\_PUC is inhibited.

Description:

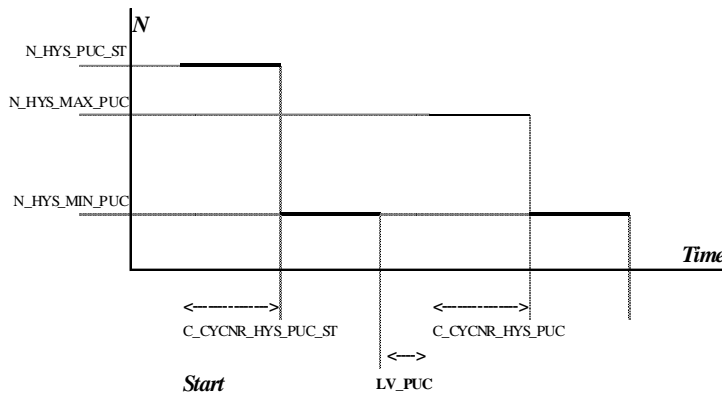



Figure 5.2.33: :  
Figure 1: overview N hysteresis for PUC versus time

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	Document key 10171571 SPE 000 AO	Pages Page 1748 of 8404	
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**5.2.2.3.1.3.1 Engine operating state : "Trailing Throttle Fuel Cut Off" (LV\_PUC)**

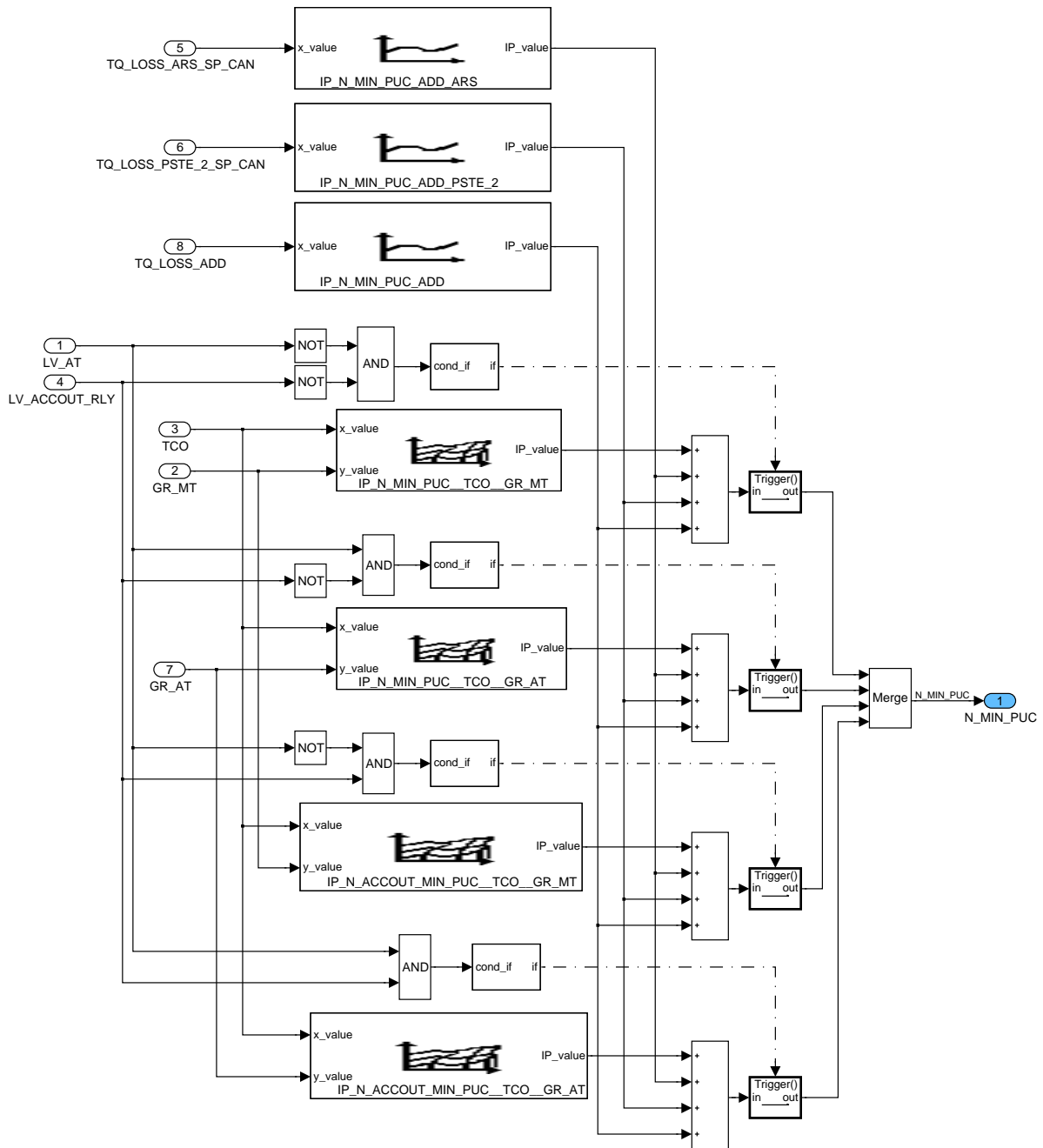


Figure 5.2.34: :

**5.2.2.3.1.3.2 Calculation of minimum engine speed hysteresis for LV\_PUC:**

Calculation of N\_HYS\_MIN\_PUC

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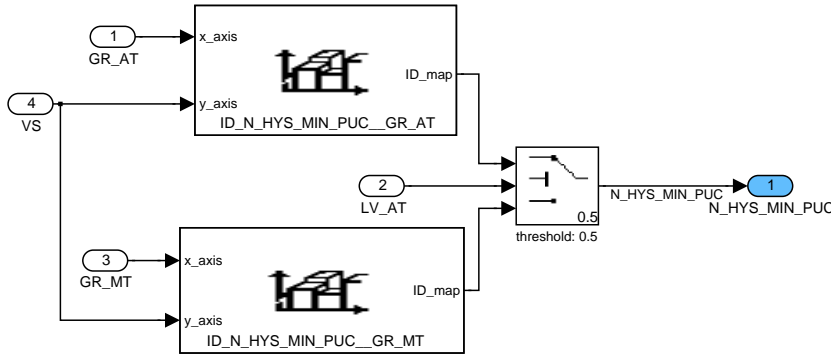


Figure 5.2.35: :

### 5.2.2.3.1.4 Calculation of actual effective engine speed hysteresis for LV\_PUC

N\_HYS\_ACT\_PUC is calculated in this block.

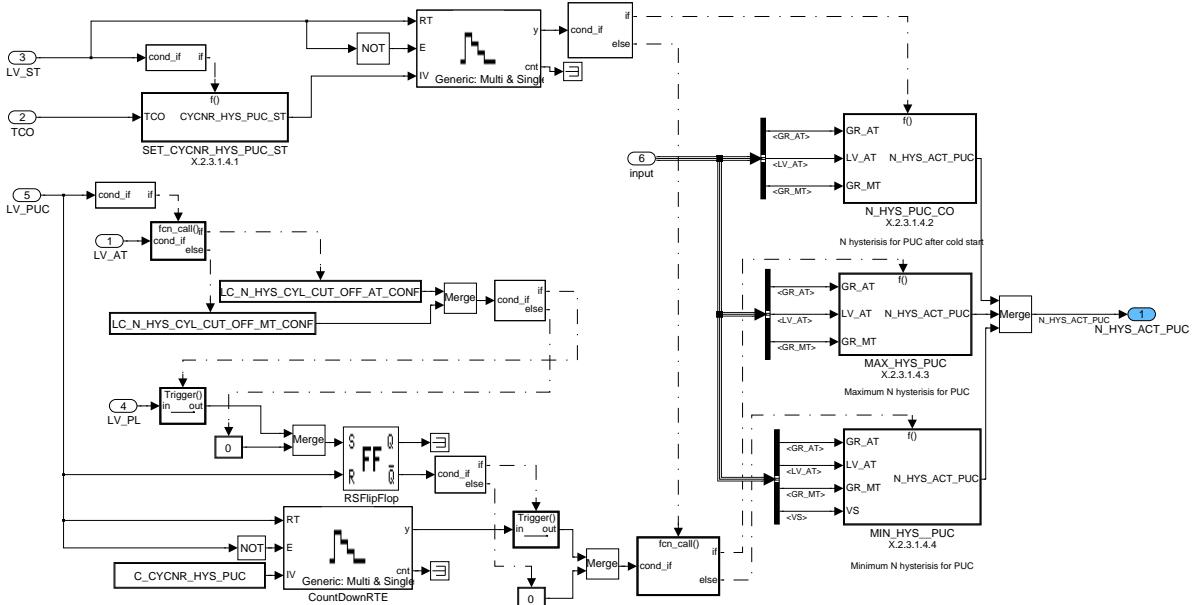


Figure 5.2.36: :

#### 5.2.2.3.1.4.1 SET\_CYCNR\_HYS\_PUC\_ST

CYCNR\_HYS\_PUC\_ST is set.

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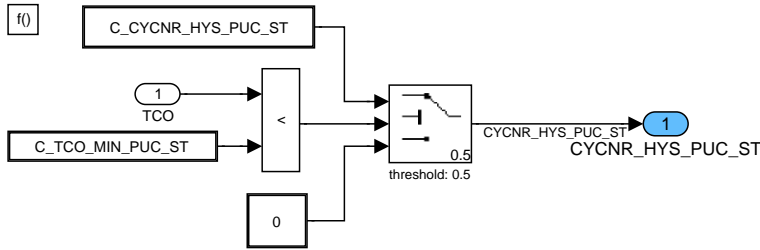


Figure 5.2.37: :

**5.2.2.3.1.4.2 Calculation at Coldstart**

N\_HYS\_ACT\_PUC is calculated in this block

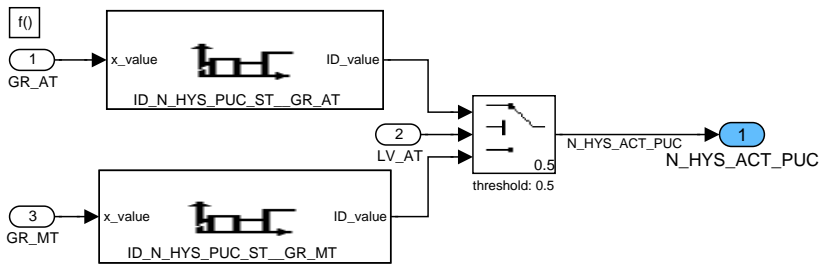


Figure 5.2.38: :

**5.2.2.3.1.4.3 Maximum Speed Hysteresis for PUC**

N\_HYS\_ACT\_PUC is calculated in this block.

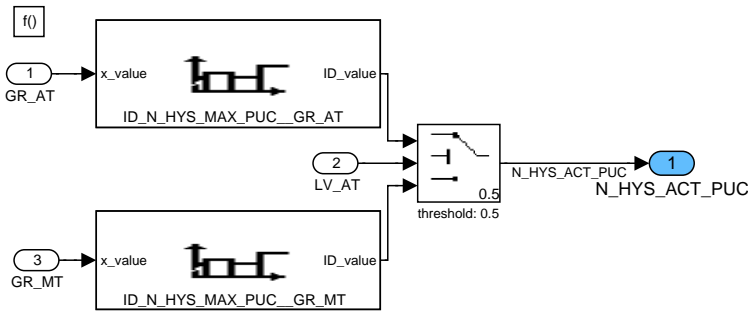


Figure 5.2.39: :

**5.2.2.3.1.4.4 Minimum Speed Hysteresis for PUC**

N\_HYS\_ACT\_PUC is calculated in this block.

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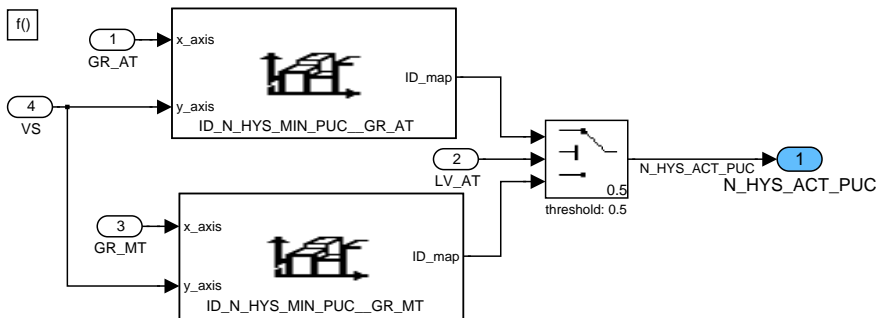


Figure 5.2.40: :

**5.2.2.3.1.5 Logical variable trailing throttle fuel cut-off request LV\_PUC\_REQ**

LV\_PUC\_REQ is set at trailing throttle conditions. It is evaluated in the module Minimum torque at clutch .

**5.2.2.3.1.5.1 No title given**

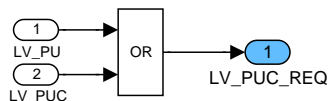


Figure 5.2.41: :

**5.2.2.3.1.6 Engine operating state : "Status byte" (STATE\_ENG)**

The status-byte STATE\_ENG gives a quick overview of the engine operating state for e.g. calibration.

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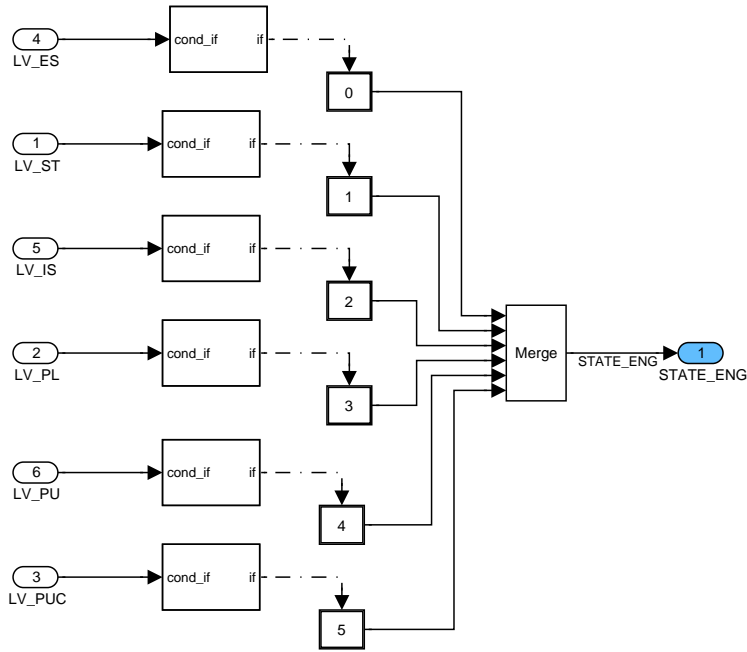


Figure 5.2.42: :

### 5.2.2.3.1.7 Reset engine state trigger flag

lv\_engstate\_trig is reset to 0.

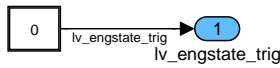


Figure 5.2.43: :

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## 5.3 Administration of calculation optimization

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CBK_EX_NR_ST_CLC	O/V	0... 1H	1 ...2	1	-
Start number of exhaust bank for calculations					
CTR_CBK_EX_NR_STOP_CLC	O/V	0... 1H	1 ...2	1	-
Stop number of exhaust bank for calculations					
CTR_CBK_IN_NR_ST_CLC	O/V	0... 1H	1 ...2	1	-
Start number of intake bank for calculations					
CTR_CBK_IN_NR_STOP_CLC	O/V	0... 1H	1 ...2	1	-
Stop number of intake bank for calculations					
CTR_CYL_NR_ST_CLC	O/V	0... 7H	0 ...7	1	-
Number of first cylinder in calculation order					
CTR_CYL_NR_STOP_CLC	O/V	0... 7H	0 ...7	1	-
Number of last cylinder in calculation order					
STATE_CLC_RED	O/V	0... FFH	0... 255	1	-
Calculation reduction state for runtime optimization					

### Input data:

LV_ST_END {p. 1720}	N_32 {p. 1525}	NC_CYL_NR {p. 1526}	NC_IN_REF {p. 812}
NC_LAMB_REF [NC_CYL_NR] {p. 812}	SEG_NR {p. 1525}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_CTR_CYL_NR_CLC	-	0... 7H	0 ...7	1	-
LDP_SEG_NR_ID_CTR_CYL_NR_CLC	NC_ CYL_ NR	0... 7H	0 ...7	1	-
Cylinderandsegmentrelationforruntime-reduction					
C_N_32_THD_CLC_RED	1	0... FFH	0... 8160	32	rpm
Enginespeedthresholdforactivationofruntime-reduction					
C_N_32_HYS_CLC_RED	1	0... 3FH	0... 2016	32	rpm
Enginespeedhysteresisfordeactivationofruntime-reduction					
C_SEG_NR_ST_CLC_RED	1	0... 7H	0 ...7	1	-
Startsegmentnumberforruntime-reductionactivation					
Start segment number for runtime reduction activation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_STATE_CLC_RED_ACT	-	0... FFH	0... 255	1	-
Constant defined to indicate that calculation reduction is active					
NC_STATE_CLC_RED_CLC_DEAC	-	0... FFH	0... 255	1	-
Constant defined to indicate that the calculation of a module has not been done at next activation call					
NC_STATE_CLC_RED_MASK_1	-	0... FFH	0... 255	1	-
Mask to isolate calculation recurrence information					
NC_STATE_CLC_RED_MASK_2	-	0... FFH	0... 255	1	-
Mask to isolate activation information					
NC_STATE_CLC_RED_SEG_05	-	0... FFH	0... 255	1	-
Constant defined to indicate that the calculation of a module is done twice per segment					
NC_STATE_CLC_RED_SEG_1	-	0... FFH	0... 255	1	-
Constant defined to indicate that the calculation of a module is done on every segment					
NC_STATE_CLC_RED_SEG_2	-	0... FFH	0... 255	1	-
Constant defined to indicate that the calculation of a module is done on every second segment					
NC_STATE_CLC_RED_SEG_4	-	0... FFH	0... 255	1	-
Constant defined to indicate that the calculation of a module is done on every fourth segment					

**FUNCTION DESCRIPTION:**General information:

This module is used for administration of runtime reduction and calculation optimization steps.

Pay Attention! This module has to be placed in the operating system immediately after the calculation of N\_32 and SEG\_NR, which are calculated by the ENSD aggregate. All aggregates, which are affected by calculation optimization, have to be calculated afterwards.

**5.3.1 Runtime reduction****Application conditions**

**Activation :** *every engine state*

**Deactivation :** -

**Initialization:**

```

at reset: STATE_CLC_RED = NC_STATE_CLC_RED_SEG_1
CTR_CYL_NR_ST_CLC = 0
CTR_CYL_NR_STOP_CLC = (NC_CYL_NR - 1)
CTR_CBK_IN_NR_ST_CLC = 1 (physical meaning)
CTR_CBK_IN_NR_STOP_CLC = NC_CBK_IN_NR
CTR_CBK_EX_NR_ST_CLC = 1 (physical meaning)
CTR_CBK_EX_NR_STOP_CLC = NC_CBK_EX_NR

```

**Recurrence :**

```

LV_ST_END = 0: 10 ms
LV_ST_END = 1: segment synchronous

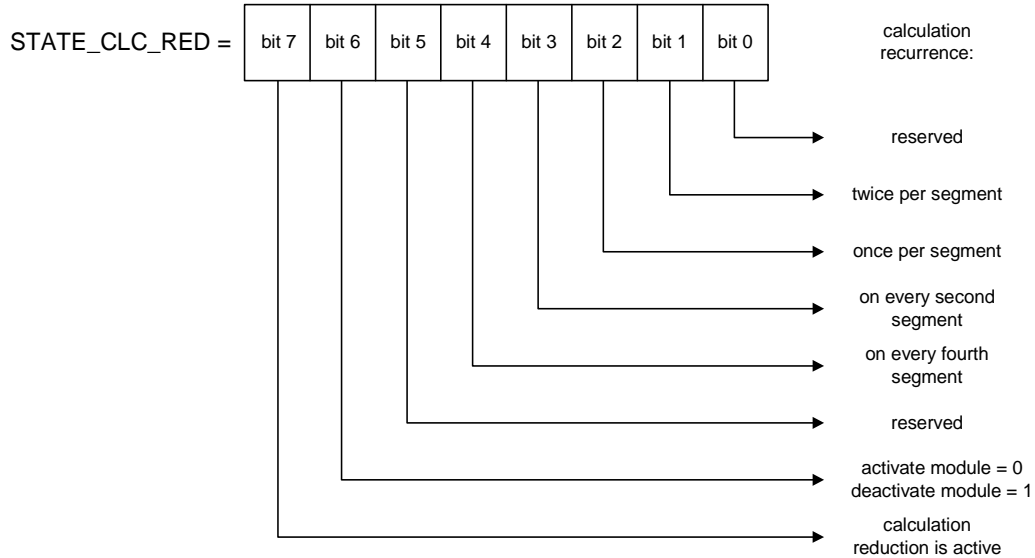
```

This chapter describes runtime reduction steps. First step is to reduce cylinder dependent calculations from all cylinders to one cylinder, dependent on the engine speed. An additional step is to reduce bank dependent calculations to the intake or exhaust bank, which is allocated to the related cylinder by NC\_IN\_REF and NC\_LAMB\_REF.

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	Document key 10171571 SPE 000 AO	Pages Page 1755 of 8404	
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## Formula Section :

### 5.3.1.1 Definition of STATE\_CLC\_RED



#### 5.3.1.1.1 Definitions of the non calibrateable constants to generate STATE\_CLC\_RED

NC_STATE_CLC_RED_SEG_05	= 0x02H
NC_STATE_CLC_RED_SEG_1	= 0x04H
NC_STATE_CLC_RED_SEG_2	= 0x08H
NC_STATE_CLC_RED_SEG_4	= 0x10H
NC_STATE_CLC_RED_CLC_DEAC	= 0x40H
NC_STATE_CLC_RED_ACT	= 0x80H
NC_STATE_CLC_RED_MASK_1	= 0x1EH
NC_STATE_CLC_RED_MASK_2	= 0xC0H

#### 5.3.1.2 Check runtime reduction activation conditions

(1) IF (STATE\_CLC\_RED AND NC\_STATE\_CLC\_RED\_ACT) = 0 ... bitwise

AND

N\_32 > C\_N\_32\_THD\_CLC\_RED

AND

SEG\_NR = C\_SEG\_NR\_ST\_CLC\_RED

(1) THEN (runtime reduction has to be activated)

STATE\_CLC\_RED =

OR

NC\_STATE\_CLC\_RED\_ACT

NC\_STATE\_CLC\_RED\_SEG\_2

...

bitwise

(1) ELSE

(2) IF (STATE\_CLC\_RED AND NC\_STATE\_CLC\_RED\_ACT) =

bitwise NC\_STATE\_CLC\_RED\_ACT

AND

```

N_32 < (C_N_32_THD_CLC_RED - C_N_32_HYS_CLC_RED)
AND
SEG_NR = C_SEG_NR_ST_CLC_RED
(2) THEN
STATE_CLC_RED = NC_STATE_CLC_RED_SEG_1
(runtime reduction will be deactivated)
(2) ENDIF
(1) ENDIF

```

### 5.3.1.3 Determine cylinder and bank numbers for follow up calculations

```

(3) IF (STATE_CLC_RED AND NC_STATE_CLC_RED_ACT) = ... bitwise NC_STATE_CLC_RED_ACT
(3) THEN
STATE_CLC_RED = STATE_CLC_RED
                ExOR NC_STATE_CLC_RED_CLC_DEAC ... bitwise

CTR_CYL_NR_ST_CLC = ID_CTR_CYL_NR_CLC
(SEG_NR is input data for ID_CTR_CYL_NR_CLC)
CTR_CYL_NR_STOP_CLC = CTR_CYL_NR_ST_CLC
(4) IF Bit related to cylinder CTR_CYL_NR_ST_CLC of NC_IN_REF = 1
(4) THEN
CTR_CBK_IN_NR_ST_CLC = 2 (physical meaning)
CTR_CBK_IN_NR_STOP_CLC = 2 (physical meaning)
(4) ELSE
CTR_CBK_IN_NR_ST_CLC = 1 (physical meaning)
CTR_CBK_IN_NR_STOP_CLC = 1 (physical meaning)
(4) ENDIF
(5) IF Bit related to cylinder CTR_CYL_NR_ST_CLC of NC_LAMB_REF = 1
(5) THEN
CTR_CBK_EX_NR_ST_CLC = 2 (physical meaning)
CTR_CBK_EX_NR_STOP_CLC = 2 (physical meaning)
(5) ELSE
CTR_CBK_EX_NR_ST_CLC = 1 (physical meaning)
CTR_CBK_EX_NR_STOP_CLC = 1 (physical meaning)
(5) ENDIF
(3) ELSE
CTR_CYL_NR_ST_CLC = 0
CTR_CYL_NR_STOP_CLC = (NC_CYL_NR - 1)
CTR_CBK_IN_NR_ST_CLC = 1 (physical meaning)
CTR_CBK_IN_NR_STOP_CLC = NC_CBK_IN_NR (physical meaning)
CTR_CBK_EX_NR_ST_CLC = 1 (physical meaning)
CTR_CBK_EX_NR_STOP_CLC = NC_CBK_EX_NR (physical meaning)
(3) ENDIF

```

#### Application hint

ID\_CTR\_CYL\_NR\_CLC describe the cylinder number, which will be calculated exclusive on the segment with the number SEG\_NR, even if the runtime reduction is active. Therefore you have to specify the segment cylinder relation here proper to your engine type.

For example (8 cyl. engine):

SEG_NR Segment number	ID_CTR_CYL_NR_CLC Exclusive calculated cylinder
0	3
1	4
2	5
3	6
4	7
5	0
6	1
7	2

Note that the related intake and exhaust banks will be calculated automatically by NC\_IN\_REF and NC\_LAMB\_REF.

## 5.4 Basic functions

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_FL	O/V	0... 1H	0 ...1	1	-
Basic function FL					
LV_FL_RAW	O/V	0... 1H	0 ...1	1	-
LV condition pedal value is fulfilled					
LV_INF	O/V	0... 1H	0 ...1	1	-
Basic function " Intercept "					

### Input data:

CL_MMV {p. 3698}	FAC_TQ_REQ_DRIV {p. 6570}	LOAD_THD_FL {p. 8390}	LV_AT {p. 654}
LV_CT {p. 1442}	LV_IS {p. 1720}	LV_PU {p. 1720}	LV_PUC {p. 1720}
LV_TI_LIM_ACT {p. 8270}	LV_TQ_LIM_INTV {p. 6692}	N {p. 1525}	N_32 {p. 1525}
N_GRD {p. 1525}	N_SP_IS {p. 1122}	STATE_ETC_LIH {p. 4982}	STATE_TPS_DIAG {p. 4982}
T_AST {p. 1766}	T_MIN_D_ISA	TCO {p. 1100}	VS {p. 1176}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_MMV_THD_FL	-	0... FFFFH	0 ...2	30.5e-6	-
threshold for high canister load					
C_FAC_TQ_REQ_FL_HYS	-	0... FFFFH	0... 1.999969	30.518e-6	-
Hysteresis for driver wish threshold for Full load recognition					
C_LOAD_THD_FL_HYS	-	0... FFFFH	0... 3.99993897	0.000061	-
Hysteresis for load threshold for Full load recognition					
C_N_GRD_MIN	-	80... 00H	-4096 ...0	32	min-1/s
engine speed gradient threshold for activating the intercept function					
C_N_MAX_FL_DLY	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for Full load recognition					
C_N_MIN_CP_FL	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for FL at high canister purge load					
C_N_MIN_FL	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for FL					
C_N_MIN_FL_DLY	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for Full load recognition					
C_T_MAX_FL_DLY	-	0... FFFFH	0... 6553.5	0,1	s
Time after Start- Threshold value for Full load recognition					
C_T_MIN_FL_DLY	-	0... FFFFH	0... 6553.5	0,1	s
Time after Start- Threshold for Full load recognition					
C_T_TI_DLY_FL_1	-	0... FFFFH	0... 655.35	0,01	s
Delay time Full load					
C_T_TI_DLY_FL_2	-	0... FFFFH	0... 655.35	0,01	s
Delay time Full load					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_TI_DLY_FL_AT_1	-	0... FFFFH	0... 655.35	0,01	s
Delay time Full load t AT					
C_T_TI_DLY_FL_AT_2	-	0... FFFFH	0... 655.35	0,01	s
Delay time Full load AT					
C_TCO_MIN_FL	-	0... FEH	-48... 142.5	0.75	°C
Minimum temperature for FL					
C_VS_MIN_FL	-	0... FFH	0... 255	1	km/h
Minimum velocity for FL					
IP_FAC_TQ_REQ_DRIV_FL	-	0... FFFFH	0... 1.999969	30.518e-6	-
LDPM_N_2_3	16	0... 1FE0H	0... 8160	1	rpm
Driver wish threshold for Full load recognition					
IP_LOAD_THD_FL	-	0... FFFFH	0... 3.99993897	0.000061	-
LDPM_N_2_3	16	0... 1FE0H	0... 8160	1	rpm
Load threshold for Full load recognition					
IP_N_MAX_INF	-	0... FFH	0... 8160	32	min-1
LDP_N_GRD_N_MAX_INF	6	80... 00H	-4096 ...0	32	min-1/s
Maximum engine speed for intercept function					

## 5.4.1 Full Load: (LV\_FL)

### FUNCTION DESCRIPTION:

#### General information:

Main parameter for full load is an engine speed dependent load threshold. Additional parameters to disable full load are several failure conditions, coolant temperature, engine speed and vehicle speed. After fulfillment of all other conditions, the state LV\_FL can be suppressed for a certain time.

### Application conditions

**Activation :** at every engine operating state

**Deactivation :** -

**Initialization :** LV\_FL and LV\_FL\_RAW = 0  
LV\_FL\_1 and LV\_FL\_2 and LV\_FL\_3 = 0

**Update rate :** 10 ms

### Formula section:

#### Intermediary values:

check pedal value for full load request, including hysteresis:

```

if FAC_TQ_REQ_DRIV IP_FAC_TQ_REQ_DRIV_FL
then LV_FL_1 = 1
else
if FAC_TQ_REQ_DRIV < IP_FAC_TQ_REQ_DRIV_FL - C_FAC_TQ_REQ_FL_HYS
then LV_FL_1 = 0
else LV_FL_1 remains unchanged
endif
endif

```



check requested torque setpoint for full load request, including hysteresis:

```

if   LOAD_THD_FL  IP_LOAD_THD_FL
  then  LV_FL_2 = 1
  else
    if   LOAD_THD_FL < IP_LOAD_THD_FL - C_LOAD_THD_FL_HYS
      then  LV_FL_2 = 0
      else   LV_FL_2 remains unchanged
    endif
  endif

```

check conditions that prevent full load:

```

if   LV_CT = 1
  STATE_ETC_LIH  ETC_NO_LIH  and  STATE_ETC_LIH  ETC_LIH_1  or
  STATE_TPS_DIAG  TPS_LIH_MAX  or
  LV_TI_LIM_ACT = 1  or
  LV_TQ_LIM_INTV = 1
  then  LV_FL_3 = 0
  else   LV_FL_3 = 1
endif

```

```

if   LV_FL_1 = 1  and  LV_FL_2 = 1  and  LV_FL_3 = 1  and
  TCO  C_TCO_MIN_FL
  then  LV_FL_RAW = 1
  else   LV_FL_RAW = 0
endif

```

Full load recognition:

```

if   LV_FL_RAW = 1
  then
    check engine/vehicle conditions for full load:
    if   ( CL_MMV  C_CL_MMV_THD_FL  and
      N_32  C_N_MIN_FL  and
      VS  C_VS_MIN_FL )  at least one time since reset  or
      ( CL_MMV >  C_CL_MMV_THD_FL  and
      N_32  C_N_MIN_CP_FL  and
      VS  C_VS_MIN_FL )  at least one time since reset
    then  start timer T_TI_DLY_FL if not yet started
      check full load time delay:
      if C_N_MIN_FL_DLY  N_32 < C_N_MAX_FL_DLY  and
        C_T_MIN_FL_DLY  T_AST < C_T_MAX_FL_DLY
        then
          if   T_TI_DLY_FL > C_T_TI_DLY_FL(AT)_2  (LV_AT = 0/1)
            then  LV_FL = 1
          endif
        else
          if   T_TI_DLY_FL > C_T_TI_DLY_FL(AT)_1  (LV_AT = 0/1)
            then  LV_FL = 1
          endif
        endif
      endif

```

```

        increment timer T_TI_DLY_FL
    else    reset timer T_TI_DLY_FL
           LV_FL = 0
    endif
else      LV_FL      = 0
endif
    
```

## 5.4.2 Intercept function : (LV\_INF)

### FUNCTION DESCRIPTION:

#### General information:

In the engine operating states trailing throttle (LV\_PU) or trailing throttle fuel cut off (LV\_PUC), the **intercept function (LV\_INF)** can be enabled below an engine speed threshold IP\_N\_MAX\_INF.

For this purpose, the engine speed gradient N\_GRD is monitored.

If the negative engine speed gradient exceeds the adjustable constant C\_N\_GRD\_MIN during trailing throttle fuel cut off the injection will be reactivated to counteract the high negative engine speed gradient.

### Application conditions

**Activation :** at every engine operating state

**Initialization :** LV\_INF = 0

**Update rate :** every segment

### Formula section:

```

if          LV_CT          = 1          and
              N_32          < IP_N_MAX_INF and
              N_GRD        < C_N_GRD_MIN
then       LV_INF          = 1
else       LV_INF          = 0
    
```

## 5.5 Auxiliary functions

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
OPM_EXT_REQ	O/V	0... FFFFH	0... 65535	1	-
Operation mode request from tester					
OPM_EXT_REQ_TMP	-	0... FFFFH	0... 65535	1	-
Operation mode request from tester without EOL request					

### Input data:

LV_ACT_VLS_EOL_EXT_ADJ {p. 7763}	LV_IGK {p. 906}	STATE_HOM_AFS_REQ_EXT_ADJ {p. 7683}	
-------------------------------------	-----------------	--	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_OPM_EXT_REQ_1	-	0... FFFFH	0... 65535	1	-
Constant 1 for operation mode request from tester					
C_OPM_EXT_REQ_2	-	0... FFFFH	0... 65535	1	-
Constant 2 for operation mode request from tester					
C_OPM_EXT_REQ_3	-	0... FFFFH	0... 65535	1	-
Constant 3 for operation mode request from tester					
C_OPM_EXT_REQ_4	-	0... FFFFH	0... 65535	1	-
Constant 4 for operation mode request from tester					
C_OPM_EXT_REQ_5	-	0... FFFFH	0... 65535	1	-
Constant 5 for operation mode request from tester					
C_OPM_EXT_REQ_6	-	0... FFFFH	0... 65535	1	-
Constant 6 for operation mode request from tester					
C_OPM_EXT_REQ_7	-	0... FFFFH	0... 65535	1	-
Constant 7 for operation mode request from tester					
C_OPM_EXT_REQ_8	-	0... FFFFH	0... 65535	1	-
Constant 8 for operation mode request from tester					
C_OPM_EXT_REQ_VLS_EOL	-	0... FFFFH	0... 65535	1	-
Constant for operation mode request from tester (end of line test)					

### FUNCTION DESCRIPTION:

#### General Information:

Via tester an operation mode (e.g. homogenous) can be requested. This is necessary e.g. for end of line tests. This information is used in this module, to switch between several calibratable operation modes. The generated information word OPM\_EXT\_REQ is send to the customer software via layer.

### Application Condition

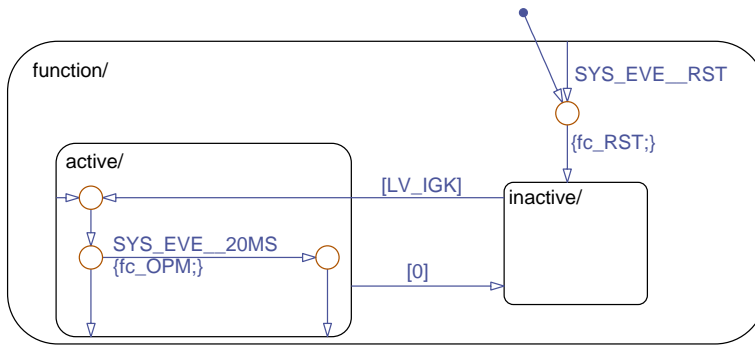


Figure 5.5.1: ENOS\_M5004/APP\_CDN/Chart

**Function Description**

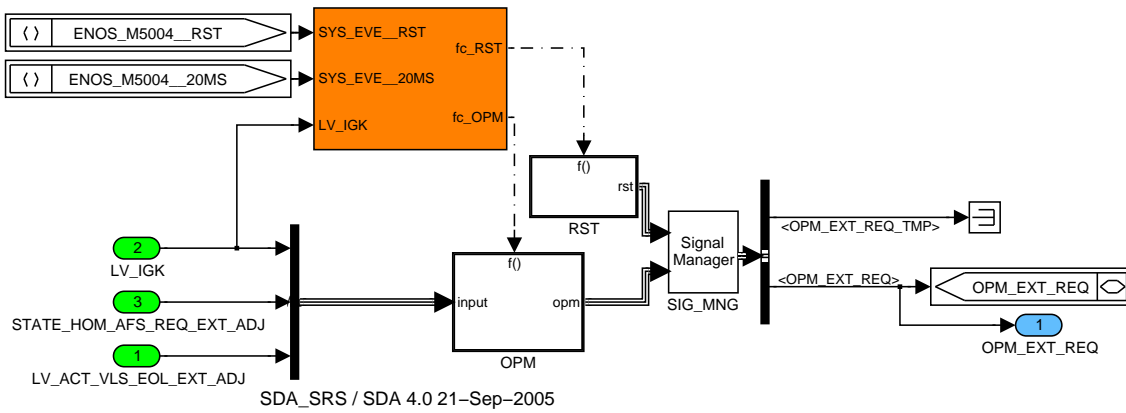


Figure 5.5.2: ENOS\_M5004

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### 5.5.1 Initialization

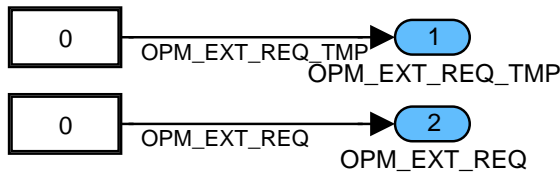


Figure 5.5.3: ENOS\_M5004/RST/INI

### 5.5.2 Formula section

#### Calculation

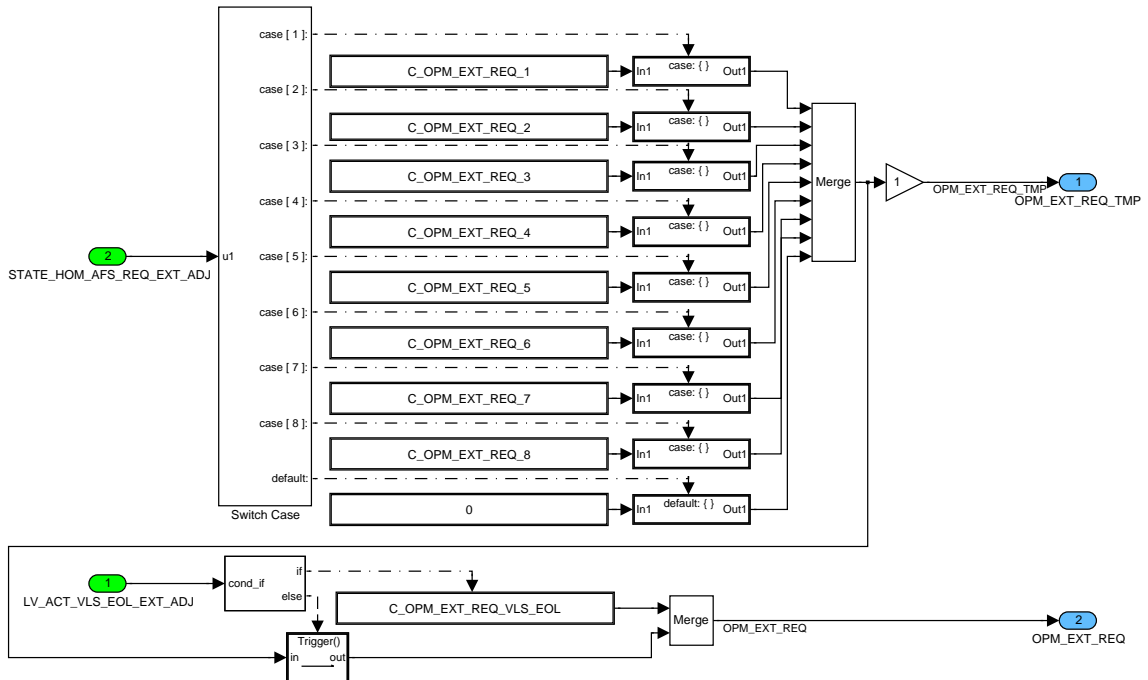


Figure 5.5.4: ENOS\_M5004/OPM/CLC\_OPM\_EXT\_REQ

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## 5.6 Auxiliary start functions

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_N_WIN_STALL	V	0... FFH	0... 255	1	-
Number of events inside the STALL rpm range					
CYC_CAST	O/V	0... FFFFH	0... 65535	1	-
Cycle counter at start and after start					
LV_AST	O/V	0... 1H	0 ...1	1	-
Auxiliary function "After-start"					
LV_REST	O/V	0... 1H	0 ...1	1	-
Auxiliary function "Re-start"					
LV_ST_ES	O/V	0... 1H	0 ...1	1	-
Detection of engine start break off (passive /active)					
LV_STALL	O/V/S	0... 1H	0 ...1	1	-
Auxiliary function "Engine Stall detected"					
LV_WUP_CAN	O/V	0... 1H	0 ...1	1	-
0 = catalyst hating/warm up - 1 = engine at operating temperature					
T_AST	O/V	0... FFFFH	0... 6553.5	0.1	s
Time after start					
T_AST_DIAG	O/V	0... FFFFH	0... 32767.5	0.5	s
After start time for common sensor diagnosis					
T_AST_REST	O/V/S	0... FFFFH	0... 6553.5	0.1	s
After start time for re-start					
T_AST_SAE	O/V	0... FFFFH	0... 65535	1	s
PID1F Cumulated time since engine start					
T_ST_ES	V	1... FFFFH	0.1... 6553.5	0.1	s
Time after transition from LV_ST to LV_ES					
TCO_REST	V/S	0... FEH	-48... 142.5	0.75	°C
Coolant temperature, stored to detect a re-start					

### Input data:

LV_AST_END {p. 2100}	LV_DC {p. 5746}	LV_ES {p. 1720}	LV_IGK {p. 906}
LV_IS {p. 1720}	LV_PL {p. 1720}	LV_ST {p. 1720}	LV_ST_END {p. 1720}
N_32 {p. 1525}	N_TOOTH_CUS {p. 1042}	TCO {p. 1100}	TL_CAST {p. 2100}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_N_WIN_STALL	-	0... FFH	0... 255	1	-
Counter of N true events					
C_CYC_CAST_MAX_ST_ES	-	0... FFFFH	0... 65535	1	-
Max value of CYC_CAST for the beginning of incrementation if LV_ST_ES is set					
C_CYC_CAST_MIN_ST_ES	-	0... FFFFH	0... 65535	1	-
Min value of CYC_CAST for the detection of LV_ST_ES					
C_N_MAX_CDN_STALL	-	0... 1FE0H	0... 8160	1	rpm
Engine-speed threshold for deactivation of stalling detection					
C_T_MAX_REST	-	1... FFH	1... 255	1	s
Time delay after switching on from LV_ST to detect LV_REST					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MIN_ECU_REST	-	1... FFFFH	0.1... 6553.5	0.1	s
Time threshold to detect new start after start-break off.					
C_TCO_DIF_MAX_REST	-	0... 50H	0... 60	0.75	°C
Coolant temperature threshold to detect LV_REST					
C_TCO_SWI_WUP	-	0... FEH	-48... 142.5	0.75	°C
TCO condition for setting LV_WUP_CAN					
IP_N_BOL_STALL	-	0... 1FE0H	0... 8160	1	rpm
LPDM_TCO__N_STALL	9	0... FEH	-48... 142.5	0.75	°C
Minimum engine speed for engine stalling detection					
IP_N_TOL_STALL	-	0... 1FE0H	0... 8160	1	rpm
LPDM_TCO__N_STALL	9	0... FEH	-48... 142.5	0.75	°C
Maximum engine speed for engine stalling detection					
IP_T_AST_SWI_WUP__CTR_KM_CAN	-	0... FFFFH	0... 6553.5	0.1	s
LPDM_CTR_KM_CAN	4	0... FFFE H	0... 655340	10	km
Time condition for setting LV_WUP_CAN					

## 5.6.1 Cycle counter CYC\_CAST

### FUNCTION DESCRIPTION:

#### General information:

1. CYC\_CAST shows the number of 120°crk cycles that have elapsed during the actual start phase (LV\_ST=1). The start value is either zero or limited by the constant C\_CYC\_CAST\_MAX\_ST\_ES (if start break off was detected).
2. During actual after start phase (LV\_AST from 0 to 1), the counter is reseted and restarts counting the number of cycles after start. When LV\_AST is finished CYC\_CAST remains at its last value.

#### Application conditions

**Activation:**  $LV\_ST = 1$  or  $LV\_AST = 1$

**Deactivation:**  $LV\_ST = 0$  and  $LV\_AST = 0$

**Initialization:**  $CYC\_CAST = 0$  at ECU-reset

**Recurrence:** Every TDC


#### Formula section:

```

if      LV_AST 0 => 1
then    CYC_CAST = 0
else if LV_ST or LV_AST is 1 and CYC_CAST < 65535
then    CYC_CASTn = CYC_CASTn-1 + 1
else    CYC_CASTn = CYC_CASTn-1
if      LV_ST_ES = 1
then if CYC_CAST > C_CYC_CAST_MAX_ST_ES
then    CYC_CAST = C_CYC_CAST_MAX_ST_ES

endif
endif

```

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## 5.6.2 Start Break off LV\_ST\_ES

### Description:

#### Activation:

For engine stall during start phase, i.e. transition from LV\_ST to LV\_ES before N\_32 reaching IP\_N\_MAX\_TOL\_ST\_TCO, the flag **LV\_ST\_ES** is set to 1, if LV\_ST was active for a minimum number of cycles C\_CYC\_CAST\_MIN\_ST\_ES. (Hint: At the same time the counter CYC\_CAST will be frozen to its actual value).

#### Deactivation and application:

Case 1 (start after C\_T\_MIN\_ECU\_REST elapsed or powerlatch ended):

A timer T\_ST\_ES is started at the transition from LV\_ST to LV\_ES. If the timer elapses before a new start takes place (T\_ST\_ES < C\_T\_MIN\_ECU\_REST), LV\_ST\_ES is reset and CYC\_CAST is set to zero in the next start.

### Application conditions

**Initialisation:**  $T_{ST\_ES} = 0$  at ECU reset

**Recurrence:** 100 ms

### Formula section:

```

If          transition LV_ST → LV_ES
and         LV_ST_END = 0                ; eng.op.state Start not left
and         CYC_CAST < C_CYC_CAST_MIN_ST_ES
then        LV_ST_ES = 1
endif
    
```

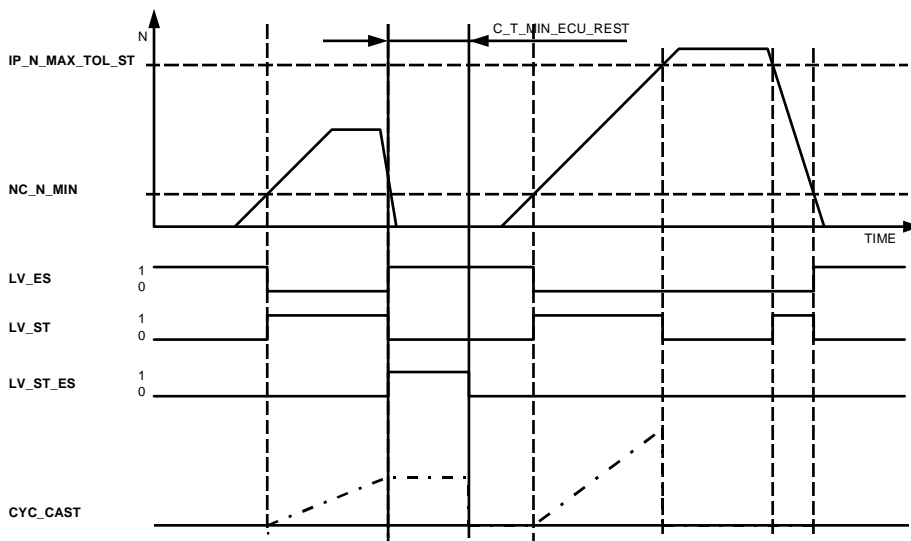
```

If          LV_AST 0 => 1
and         LV_ST 1 => 0
or          T_ST_ES < C_T_MIN_ECU_REST
then        LV_ST_ES = 0
endif
    
```

```

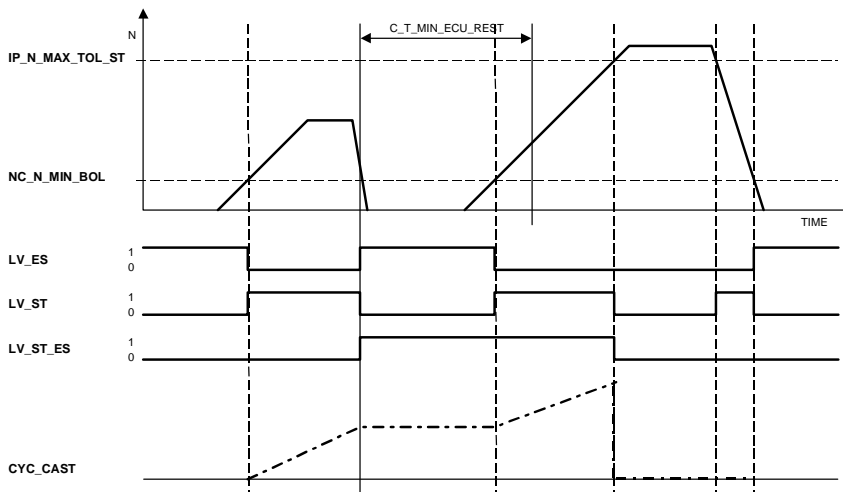
If          LV_ST_ES = 1    and    LV_ES=1
then        T_ST_ESn = T_ES_STn-1 + 1
    If        T_ST_ES >= C_T_MIN_ECU_REST
    then      LV_ST_ES = 0
    endif      CYC_CAST = 0
    endif
else        T_ST_ES = 0
endif
    
```





Case 2 (start within  $C\_T\_MIN\_ECU\_REST$ ):


If a new start takes place before the timer has elapsed ( $T\_ST\_ES < C\_T\_MIN\_ECU\_REST$ ),  $LV\_ST\_ES$  remains set until the engine operation state start is exited to part load or idle, In this case the counter  $CYC\_CAST$  starts with the previous frozen  $CYC\_CAST$ -value *limited to a adjustable maximum value (see definition of  $CYC\_CAST$ )*.



**Remark :**

If  $C\_T\_MIN\_ECU\_REST > C\_T\_MAX\_ECU$  (power latch time) and powerlatch-phase ended the value of  $CYC\_CAST$  is reseted to zero for the next engine start after "start break off"-event.

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### 5.6.3 Restart function detection ( LV\_REST )

#### FUNCTION DESCRIPTION:

#### General information:

The re-start function is requested as an injection time correction during start.

- If the CAN clock timing is available LV\_T\_REL\_CAN\_REG=1 the re-start factor is calculated by TCO\_STOP, T\_AST\_REST and T\_ES (see “Fuel mass setpoint and pre-injection time calculation”).
- If the CAN clock timing is not available LV\_T\_REL\_CAN\_REG=0 the re-start factor is calculated as a substitute from IP\_TI\_ST\_REST.

#### Application conditions:

##### Activation:

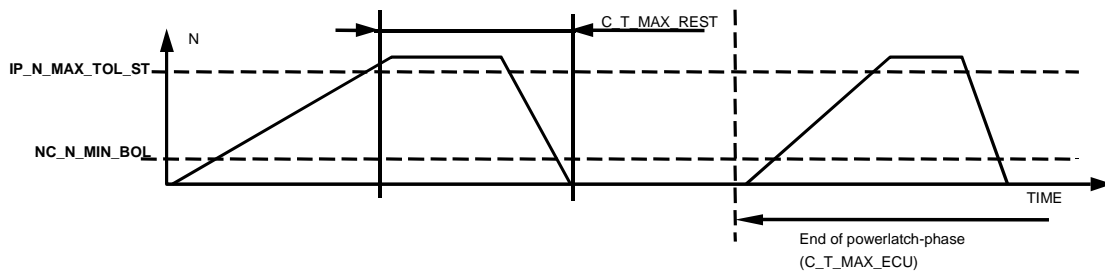
After transition from engine start (LV\_ST = 1) to engine stop (LV\_ES = 1) LV\_REST is checked to the end of the powerlatch-phase. As the engine was operated in part load or idle before engine stop, the next start is considered as a restart if following conditions are fulfilled:

**if** TCO\_REST < FFH (no flash-error)  
**and** TCO > TCO\_REST - C\_TCO\_DIF\_MAX\_REST

**then** LV\_REST = 1  
**else** LV\_REST = 0

Therefore the restart-flag LV\_REST is set to 1 before the next start, if the start happens before the end of the powerlatch-phase and the coolant temperature did not drop too much.

The calculation of start injection time deactivation factor will start with CYC\_CAST = 0.



##### Deactivation:

A counter T\_AST is started at transition LV\_ST → ( LV\_IS or LV\_PL ).


If the engine operating state engine stopped (LV\_ES) is detected before the counter has reached its maximum value C\_T\_MAX\_REST, the related coolant temperature is stored :  
(TCO → TCO\_REST ) in a non volatile memory.

Recurrence: segment

### 5.6.4 Engine stall detection LV\_STALL

#### General information:

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Engine stall detection is used for injection and CRK diagnosis.

If engine is stopped with ignition-key-on there are two different possibilities:

- Engine is stalling
- CRK error is active

In order to detect a real engine stalling the engine speed value  $N\_TOOTH\_CUS$  is monitored. The reason for monitoring  $N\_TOOTH\_CUS$  instead of  $N$  is that  $N\_TOOTH\_CUS$  is calculated with a recurrency of 10ms, whereas  $N$  is calculated segment-synchronous. With engine-speed-values of  $< 1500$  rpm the segment-time increases, the resulting update-rate of  $N$  is not precise enough for the different cases of engine-stall-detection.

If a CRK error occurs  $N\_TOOTH\_CUS$  is set to 0. If the engine is stalling  $N\_TOOTH\_CUS$  is passing a defined stalling-window.

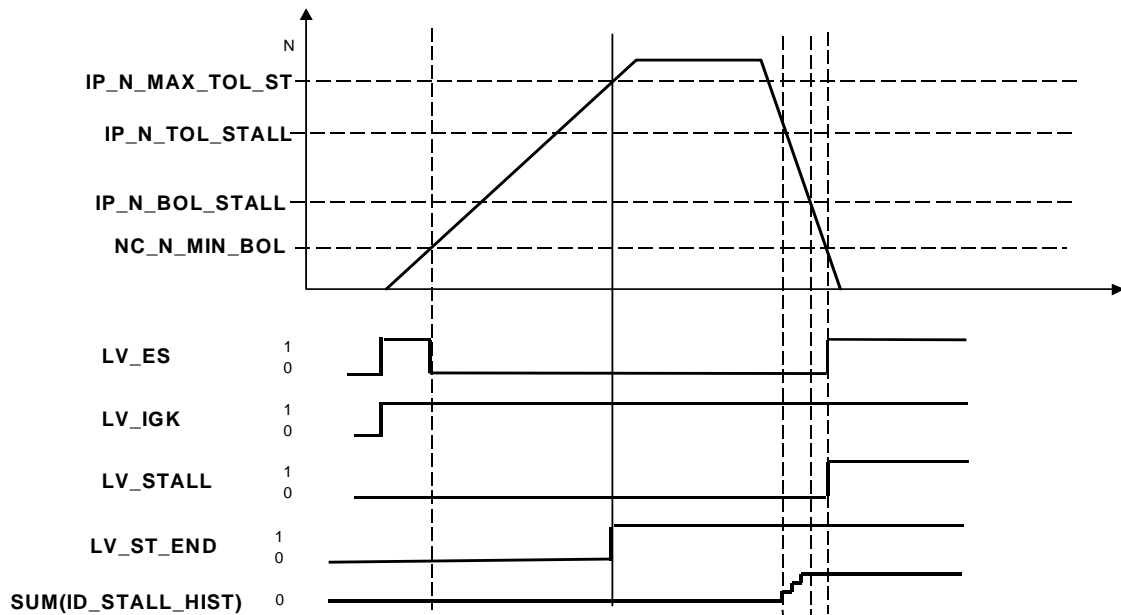
**Description:**

ID\_STALL\_HIS is a buffer for the 32 last update rates (= 320ms History).

If  $N\_TOOTH\_CUS$  is between  $IP\_N\_TOL/BOL\_STALL$  then the value in the buffer is set to 1 (=true-event).

After transition from engine running ( $LV\_ST\_END = 1$ ) to engine stop ( $LV\_ES = 1$ ) with **turned on ignition** ( $LV\_IGK = 1$ ), it is checked if the sum of true-events in the buffer is bigger then a stalling - threshold.

**Signal flow diagram:**




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**Application conditions**

**Initialisation:**  $LV\_STALL$  is restored out of NVMY

**Recurrence:** 10ms

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**Activation:**  $N\_TOOTH\_CUS < C\_N\_MAX\_CDN\_STALL$  **and**  $LV\_ST\_END = 1$

**Formula section:**

Reset of event-counter and ring-buffer after activation:

ID\_STALL\_HIS = 0  
CTR\_N\_WIN\_STALL = 0

Caclulation of LV\_STALL:

```

if      IP_N_BOL_STALL < N_TOOTH_CUS < IP_N_TOL_STALL
then    ID_STALL_HIS = 1
        CTR_N_WIN_STALL ++           (stop ++ if FFH is reached)
else    ID_STALL_HIS = 0
        CTR_N_WIN_STALL = 0
endif

```

```

If      LV_ES 0 => 1
and    LV_ST_END = 1
and    LV_IGK = 1
and    SUM( ID_STALL_HIS ) > C_CTR_N_WIN_STALL
then    LV_STALL = 1
endif

```

Reset LV\_STALL

```

if      LV_ST_END 0 => 1
then    LV_STALL = 0
endif

```

**5.6.5 After-Start function : (LV\_AST)**

**FUNCTION DESCRIPTION:**

**General information:**

The after-start function serves to supply the extra injection quantity required after start by the cold walls of the combustion chamber.

The after-start function (**LV\_AST**) is requested whenever the engine exits the operating state start (LV\_ST) and is executed simultaneously with other engine operating states, except engine stopped (LV\_ES) and start (LV\_ST).


The value of T\_AST when engine stopped (LV\_ES=1) - after LV\_ST\_END = 1 has reached once - detected is transfered in T\_AST\_REST and safed in the non volatile memory at the end of the powerlatch - phase.

The variable T\_AST indicates the time after leaving start-state. After reaching it's maximum value, T\_AST is frozen. Reset occurs with every new start (Transition from LV\_ST = 0 to 1).

T\_AST\_DIAG is calculated from T\_AST to satisfy OBD requirements: recurrency must be 500ms for input signal aquisition/diagnosis.

**Application conditions:**

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**Activation:**

The state **LV\_AST** is activated as soon as the engine operating state start (LV\_ST) is exited to go to the engine operating states idle speed (LV\_IS) or part load (LV\_PL).

**Deactivation:**

TI\_CAST = 0 (refer to Chapter : " Injection ").

**Recurrence:**

Segment (LV\_AST), 100ms (T\_AST/T\_AST\_REST), 500ms (T\_AST\_DIAG)

**Formula section:**

**If** LV\_ES = 0 **AND** LV\_ST = 0  
**then**

**if** T\_AST < max. Value  
**then** increment T\_AST  
**endif**

**endif**

T\_AST\_DIAG = T\_AST (physical meaning)

**If** LV\_ES = 1 **or** LV\_ST = 1 **or** LV\_AST\_END = 1

**Then** LV\_AST = 0

**Else** LV\_AST = 1

**Endif**

**If** LV\_ST\_END<sub>n</sub> = 0 **and** LV\_ST\_END<sub>n-1</sub> = 1000 **and**  
LV\_ES<sub>n</sub> = 1 **and** LV\_ES<sub>n-1</sub> = 0

**Then** T\_AST\_REST = T\_AST

**Endif**

**5.6.6 State warm up**

**FUNCTION DESCRIPTION:**

**General information:**

Calculation of state warm up. When end of warm up phase and catalyst heating is detected, LV\_WUP\_CAN is set to 1.

**Application conditions**

**Initialisation:** 0

**Recurrence:** 100 ms


**Formula section:**

**IF** T\_AST > IP\_T\_AST\_SWI\_WUP\_\_CTR\_KM\_CAN **or**  
TCO > C\_TCO\_SWI\_WUP

**THEN** LV\_WUP\_CAN = 1 (catalyst heating ended indication, engine at operating temperature)

**ELSE** LV\_WUP\_CAN = 0

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## 5.6.7 Cumulated time since engine start for OBD scan tool (PID1F)

### FUNCTION DESCRIPTION:

#### General information:

Time after start is needed for OBD scan tool (PID1F)

#### Application conditions

**Initialisation:** at reset or transition LV\_DC = 1->0 set T\_AST\_SAE = 0 s


**Recurrence:** 1s

**Activation:** LV\_ST\_END = 1

**Deactivation:** LV\_ST\_END = 0

#### Formula section:

$T\_AST\_SAEn = T\_AST\_SAEn-1 + 1s$

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## 5.7 Catalyst heating functions

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CH_N_SP_IS	O/V	0... 1H	0 ...1	1	-
Catalyst Heating Function "increased idle speed setpoint"					
LV_TI_CH	O/V	0... 1H	0 ...1	1	-
Catalyst Heating Function "lean injection"					
LV_WUP	O/V	0... 1H	0 ...1	1	-
Warm up functions active					

### Input data:

LV_ES {p. 1720}	STATE_CH {p. 1777}	TI_WUP_1_ADD {p. 2109}	
-----------------	--------------------	------------------------	--

### 5.7.1 Catalyst Heating functions

#### General information:

Logical catalyst heating variables that have been used up to now are set depending on STATE\_CH.

#### Application conditions

**Initialisation:** *all outputs = 0 at ECU initialization*  
**Recurrence:** *100 ms*  
**Activation:** *at every engine operating state*  
**Deactivation:** -

#### Formula section:

```

If STATE_CH = 1
  Then
    LV_TI_CH = 1
  Else
    LV_TI_CH = 0
  Endif

IF STATE_CH = 1 OR 2
  Then
    LV_CH_N_SP_IS = 1
  Else
    LV_CH_N_SP_IS = 0
  endif
    
```

### 5.7.2 Warm-up function : (LV\_WUP)

#### FUNCTION DESCRIPTION:

**General information:**

The injection is corrected with the warm-up enrichment.  
The states warm-up (LV\_WUP) and catalyst heating (LV\_TI\_CH) are used parallel.

**Application conditions**


**Initialisation :** LV\_WUP = 1  
**Recurrence :** once per segment (720 °crk / NC\_CYL\_NR)  
**Activation :** at all engine operating states  
**Deactivation :** TI\_WUP\_1\_ADD = 0 (refer to chapter : " Injection "). Is activated again at STATE\_ENG = LV\_ES

**Formula section:**

```
if LV_ES = 1
  then LV_WUP = 1
endif

if LV_WUP = 1
  then if TI_WUP_1_ADD > 0
        then LV_WUP unchanged (stays at value 1)
        else LV_WUP = 0
      endif
  else LV_WUP unchanged (stays at value 0)
endif
```

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## 5.8 Catalyst heating coordination

### Data definition:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CH_AST_CDN	V	0... 1H	0 ...1	1	-
Indicates if conditions for after start catalyst heating are fulfilled					
LV_CH_L_CDN	V	0... 1H	0 ...1	1	-
Indicates if conditions for low load catalyst heating are fulfilled					
LV_CH_L_RGN	O/V	0... 1H	0 ...1	1	-
Low load catalyst heating for NOx-trap - heating after regeneration is active					
LV_CH_SO2P_CDN	V	0... 1H	0 ...1	1	-
Indicator for conditions of desulfation catalyst heating					
STATE_CH	O/V	0H 1H 2H 3H	CH_OFF CH_AST CH_L_LOAD CH_SO2P	-	-
State of catalyst heating					
TEMP_CAT_DIF_CH_L	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	K
Difference between actual catalyst temperature and deactivation threshold for low load CH					
TNT_DIF_CH_L	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	K
Difference between actual NOx-trap-temperature and deactivation threshold for low load CH					
TNT_MDL_L_COR_CH_L	V	0... FFFFH	0... 1023.984375	0.015625	°C
Lowest NOx-Trap temperature - adapted for low load catalyst heating activation					
TQI_REQ_FAST_FIL_CH_SO2P	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Filtered torque request (fast path) for desulfation catalyst heating activation					
VS_FIL_CH_SO2P	V	0... FFH	0... 255	1	km/h
Filtered vehicle speed					

### Input data:

CTR_KM_CAN {p. 1563}	FTL {p. 1564}	LV_CH_AST_ENA {p. 1789}	LV_CH_AST_REQ_TCHA_DIAG {p. 8232}
LV_CH_L_ENA {p. 1789}	LV_HOM_ACT {p. 8136}	LV_NT_RGN_REQ {p. 996}	LV_NT_SO2P_EXT_ADJ_ACT {p. 3144}
LV_SO2P_REQ_2 {p. 3073}	LV_ST_END {p. 1720}	LV_STATE_CH_SO2P_ENA {p. 1789}	N_32 {p. 1525}
NT_AGI {p. 3073}	T_AST_COR_CH {p. 1801}	T_ES_CUS {p. 1444}	TCO {p. 1100}
TCO_ST {p. 1100}	TEMP_CAT {p. 8237}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	TNT_MDL_H {p. 8237}
TNT_MDL_L {p. 8237}	TQI_REQ_FAST {p. 8391}	VS {p. 1176}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQI_FIL_CH_SO2P	-	0... FFFFH	0 ...1	15.259e-6	-
Correlation factor to filter the requested torque					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_VS_FIL_CH_SO2P	-	0... FFFFH	0 ...1	15.259e-6	-
Correlation factor to filter the vehicle speed					
C_FTL_HYS_CH_SO2P	-	0... 7FH	0... 127	1	l
Hysteresis of fuel tank level threshold for deactivation of desulfation catalyst heating					
C_FTL_MIN_CH_SO2P	-	0... 7FH	0... 127	1	l
Minimum fuel tank level, deactivates desulfation catalyst heating					
C_N_32_MIN_NT_SO2P_EXT_ADJ_CH	-	0... FFH	0... 8160	32	rpm
Minimum engine speed to start catalyst heating for desulfation, activated by external adjustment					
C_N_32_THD_CH_L_OFF	-	0... FFH	0... 8160	32	rpm
Threshold of engine speed that disables CH_L					
C_N_32_THD_CH_L_ON	-	0... FFH	0... 8160	32	rpm
Threshold of engine speed that enables CH_L					
C_STATE_CH_MAN	-	0H 1H 2H 3H	CH_OFF CH_AST CH_L_LOAD CH_SO2P	-	-
Manual setting of state of cat. heating					
C_T_MAX_CH_L_RGN	-	0... FFFFH	0... 6553.5	0.1	s
Maximum duration of low load heating after regeneration phase					
C_TCO_HYS_CH_SO2P	-	0... FEH	-48... 142.5	0.75	°C
Hysteresis of coolant temperature threshold for activation of catalyst heating for desulfation					
C_TCO_MIN_CH_SO2P	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature for activation of catalyst heating for desulfation					
C_TEMP_CAT_DYN_MDL_THD_CH_SO2P	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Threshold of catalyst temperature for desulfation catalyst heating					
C_TEMP_CAT_MAX_CH_AST	-	0... FFFFH	-33... 990.984375	0.015625	°C
Threshold of catalyst temperature for catalyst heating after start					
C_TEMP_CAT_THD_CH_L_HOM_ON	-	0... FFFFH	-33... 990.984375	0.015625	°C
Threshold of catalyst temperature for homogeneous CH_L					
C_TEMP_CAT_THD_CH_L_OFF	-	0... FFFFH	-33... 990.984375	0.015625	°C
Threshold of catalyst temperature for deactivation of low load CH					
C_TEMP_CAT_THD_CH_L_S_ON	-	0... FFFFH	-33... 990.984375	0.015625	°C
Threshold of catalyst temperature for stratified CH_L					
C_TNT_HYS_CH_L_RGN	-	8000... 7FFFH	-512... 511.984375	0.015625	°C
Hysteresis for activation of low load catalyst heating for heating after regeneration					
C_TNT_MAX_CH_AST	-	0... FFFFH	0... 1023.984375	0.015625	°C
Maximum nox trap temperature for catalyst heating after start					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TNT_MAX_CH_SO2P	-	0... FFFFH	0... 1023.984375	0.015625	°C
Maximum temperature of TNT for desulfation catalyst heating					
C_TNT_MIN_CH_L_RGN	-	0... FFFFH	0... 1023.984375	0.015625	°C
Minimum NOx-Trap temperature for activation of low load catalyst heating for heating after regeneration					
C_TNT_MIN_CH_SO2P	-	0... FFFFH	0... 1023.984375	0.015625	°C
Minimum temperature of TNT for desulfation catalyst heating					
C_TNT_THD_CH_L_HOM_ON	-	0... FFFFH	0... 1023.984375	0.015625	°C
Threshold NOx-trap-temperature that activates CH in homogeneous					
C_TNT_THD_CH_L_OFF	-	0... FFFFH	0... 1023.984375	0.015625	°C
Threshold NOx-trap-temperature that deactivates CH in stratified and homogeneous					
C_TNT_THD_CH_L_RGN	-	0... FFFFH	0... 1023.984375	0.015625	°C
If NOx-Trap temperature falls below this threshold low load catalyst heating for heating after regeneration is activated					
C_TNT_THD_CH_L_S_ON	-	0... FFFFH	0... 1023.984375	0.015625	°C
Threshold NOx-trap-temperature that activates CH in stratified					
C_TQI_REQ_FAST_THD_CH_L_OFF	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Threshold of TQI_REQ_FAST that disables CH_L					
C_TQI_REQ_FAST_THD_CH_L_ON	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Threshold of TQI_REQ_FAST that enables CH_L					
C_TQI_THD_CH_SO2P	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Threshold of requested torque to activate desulfation catalyst heating					
C_VS_MAX_CH_AST	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for after start catalyst heating					
C_VS_THD_CH_SO2P	-	0... FFH	0... 255	1	km/h
threshold of vehicle speed to activate desulfation catalyst heating					
IP_T_AST_THD_CH_AST	V	0... FFFFH	0... 6553.5	0.1	s
LDP_TCO_ST_IP_T_AST_THD_CH_AST	8	0... FEH	-48... 142.5	0.75	°C
LDPM_CTR_KM_CAN_1_EXTC	4	0... FFFFH	0... 655350	10	km
Threshold of time after start for catalyst heating after start					
IP_T_ES_THD_CH_AST	-	0... FFFFH	0... 65535	1	min
LDP_TCO_ST_IP_T_ES_THD_CH_AST	8	0... FEH	-48... 142.5	0.75	°C
Threshold of engine off duration time which stops catalyst heating after start					
IP_TNT_ADD_CH_L_NT_AGI	-	0... FFFFH	-1024... 1023.96875	0.03125	K
LDP_NT_AGI_IP_TNT_ADD_CH_L	4	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Additive temperature value on low-load-catalyst-heating-activation-thresholds					
IP_TQI_REQ_FAST_THD_CH_L_RGN	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_IP_TQI_REQ_CH_L_RGN	4	0... FFH	0... 8160	32	rpm
Torque - threshold to deactivate low load catalyst heating after regeneration					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_STATE_CH_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of state of cat. heating					

**General Information**

This module has to be calculated before any other catalyst heating module. In this module the decision is made if catalyst heating after start, in low load or for desulfation is active. STATE\_CH indicates the actual status and triggers other modules.

**Application Conditions**

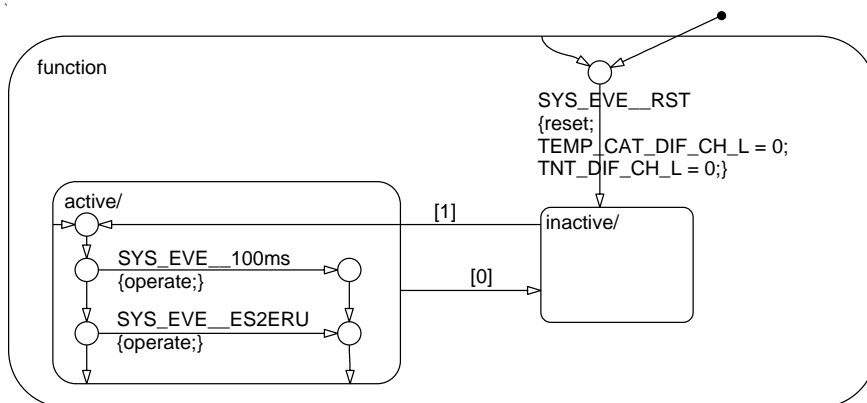


Figure 5.8.1: : Path: EXTC\_ISPCLCHC0/APP\_CDN/Chart

**Function description**

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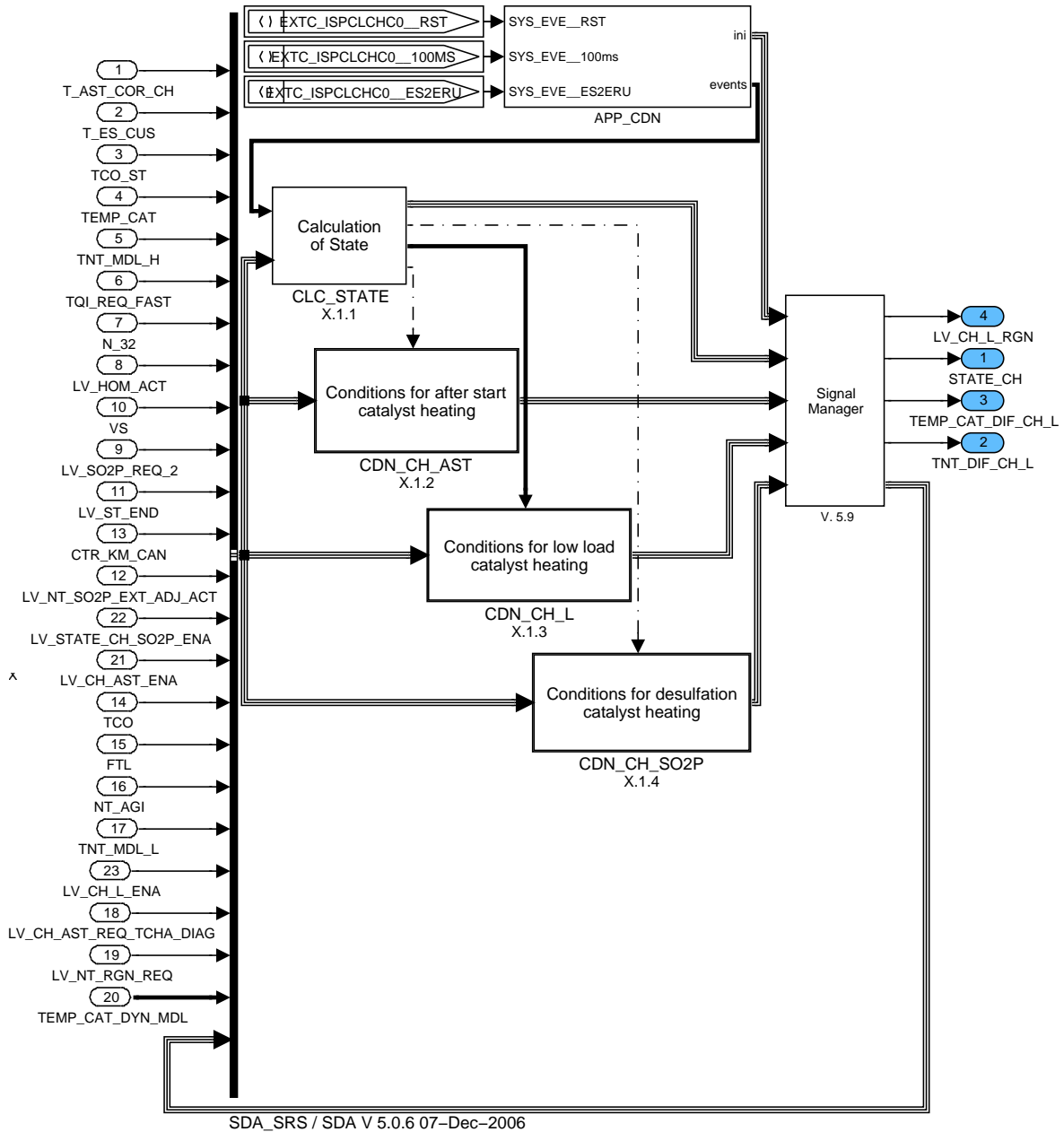


Figure 5.8.2: : Path: EXTC\_ISPCLCHC0

## 5.8.1 State machine

### 5.8.1.1 State machine - Subsystem

The conditions for activation of several catalyst heating measures are not calculated if another measure is active see stateflow chart.

With to LC\_STATE\_CH\_MAN\_ACT it is possible to switch STATE\_CH manually.

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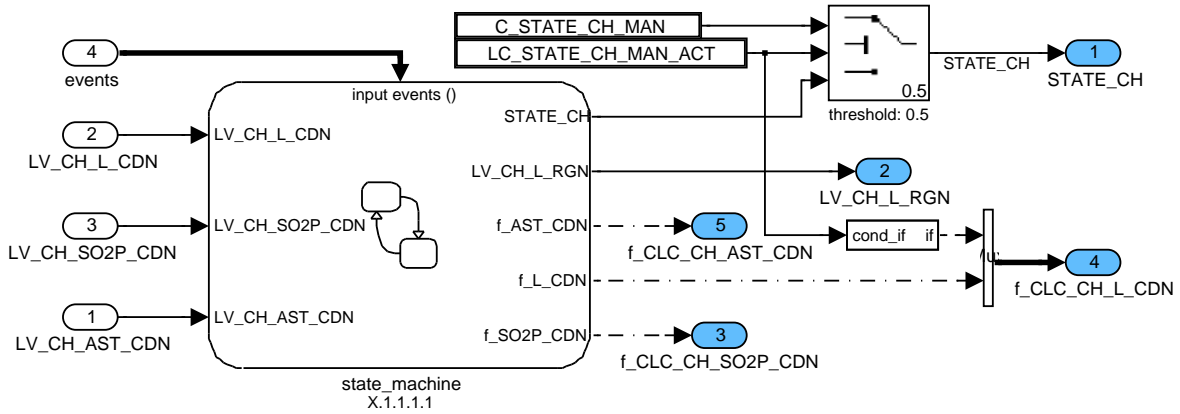


Figure 5.8.3: : Path: EXTC\_ISPCLCHC0/CLC\_STATE/SUB

### 5.8.1.1.1 state\_machine

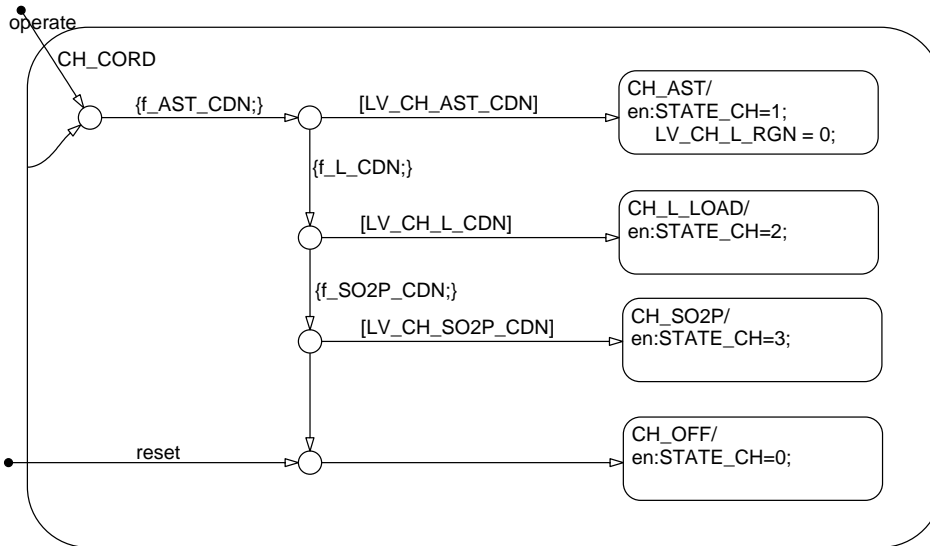


Figure 5.8.4: : Path: EXTC\_ISPCLCHC0/CLC\_STATE/SUB/state\_machine

## 5.8.2 Conditions for after start heating

### 5.8.2.1 Conditions for after start heating - Subsystem

T\_ES\_CUS is the time with stopped engine. If one of the conditions stops catalyst heating, it only can be re-activated after next start.

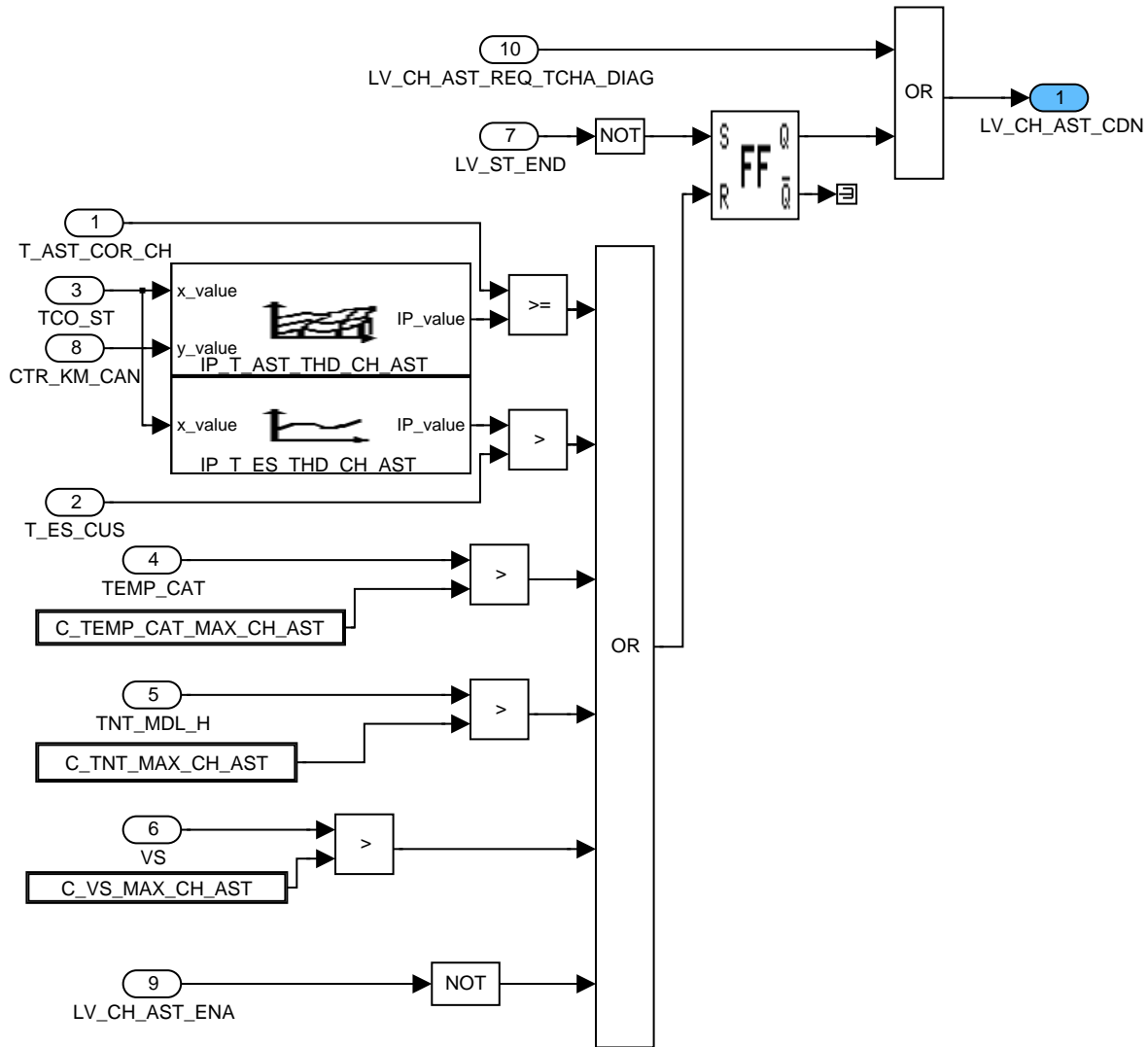


Figure 5.8.5: Path: EXTC\_ISPCLCHC0/CDN\_CH\_AST/SUB

## 5.8.3 Conditions for low load heating

### 5.8.3.1 Conditions for low load heating - Subsystem

TNT\_MDL\_L can be adjusted depending on NOx-trap aging.

Low load catalyst heating can be activated due to low temperatures in NOx-Trap or Pre-catalyst ('CH\_L\_CDN') or after regeneration of NOx-trap. In 2nd case the lambda-split function is activated (LV\_CH\_L\_RGN = 1).

The differences between the actual temperatures and the thresholds TNT\_DIF\_CH\_L and TEMP\_CAT\_DIF\_CH\_L are used as mapinputs in the setpoint calculation modules e.g. for torque reserve.

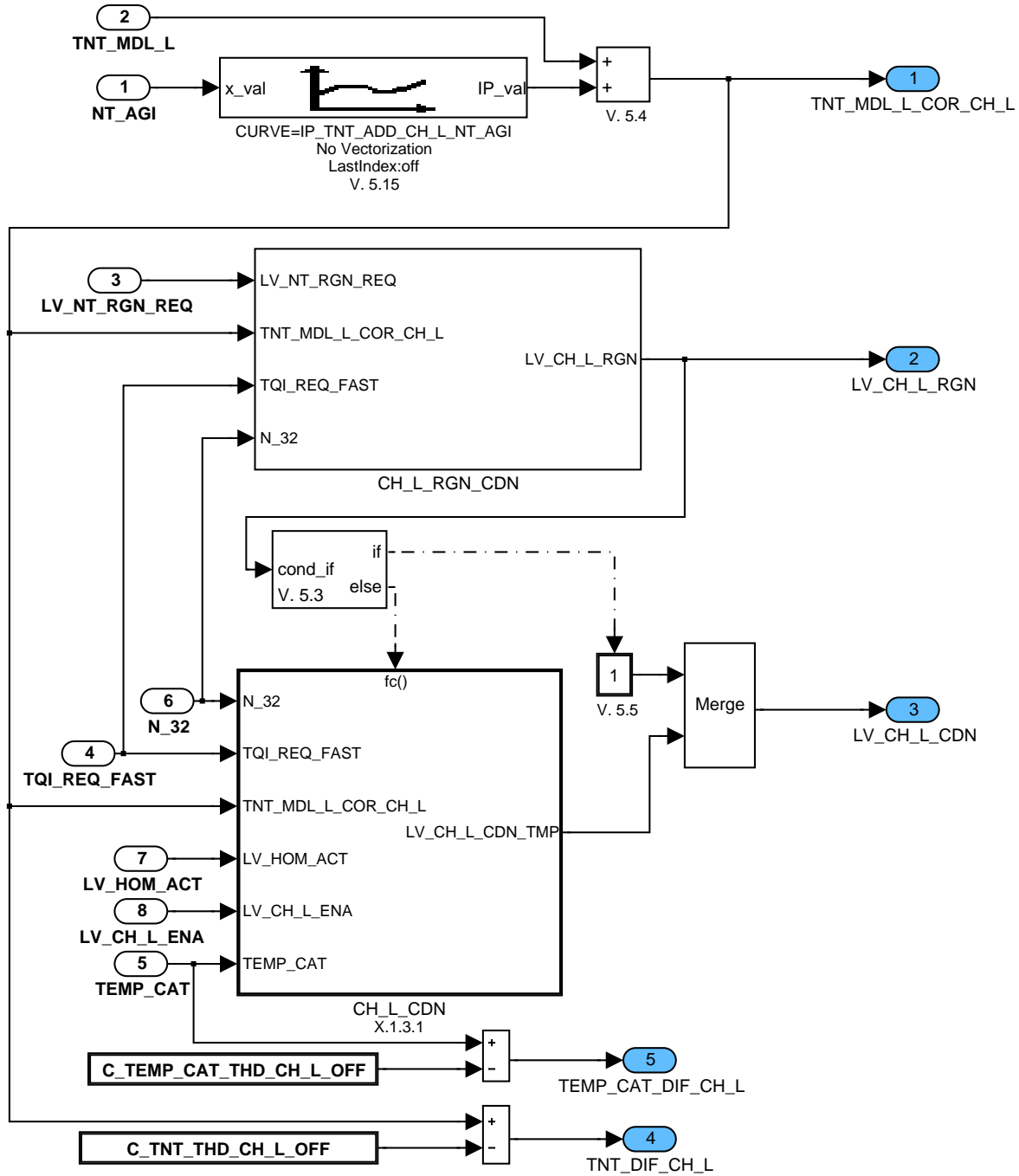


Figure 5.8.6: : Path: EXTC\_ISPCLCHC0/CDN\_CH\_L/SUB

### 5.8.3.1.1 Conditions for low load heating - Subsystem

For torque, engine speed and temperature there are each two thresholds for hysteresis application. For homogenous and stratified mode there are several activation thresholds for catalyst temperature. Attention: In low load catalyst heating one measure is to request homogeneous mode at too low temperatures! (See "Catalyst heating low load strategy"). These temperature thresholds have to be calibrated cohesive.

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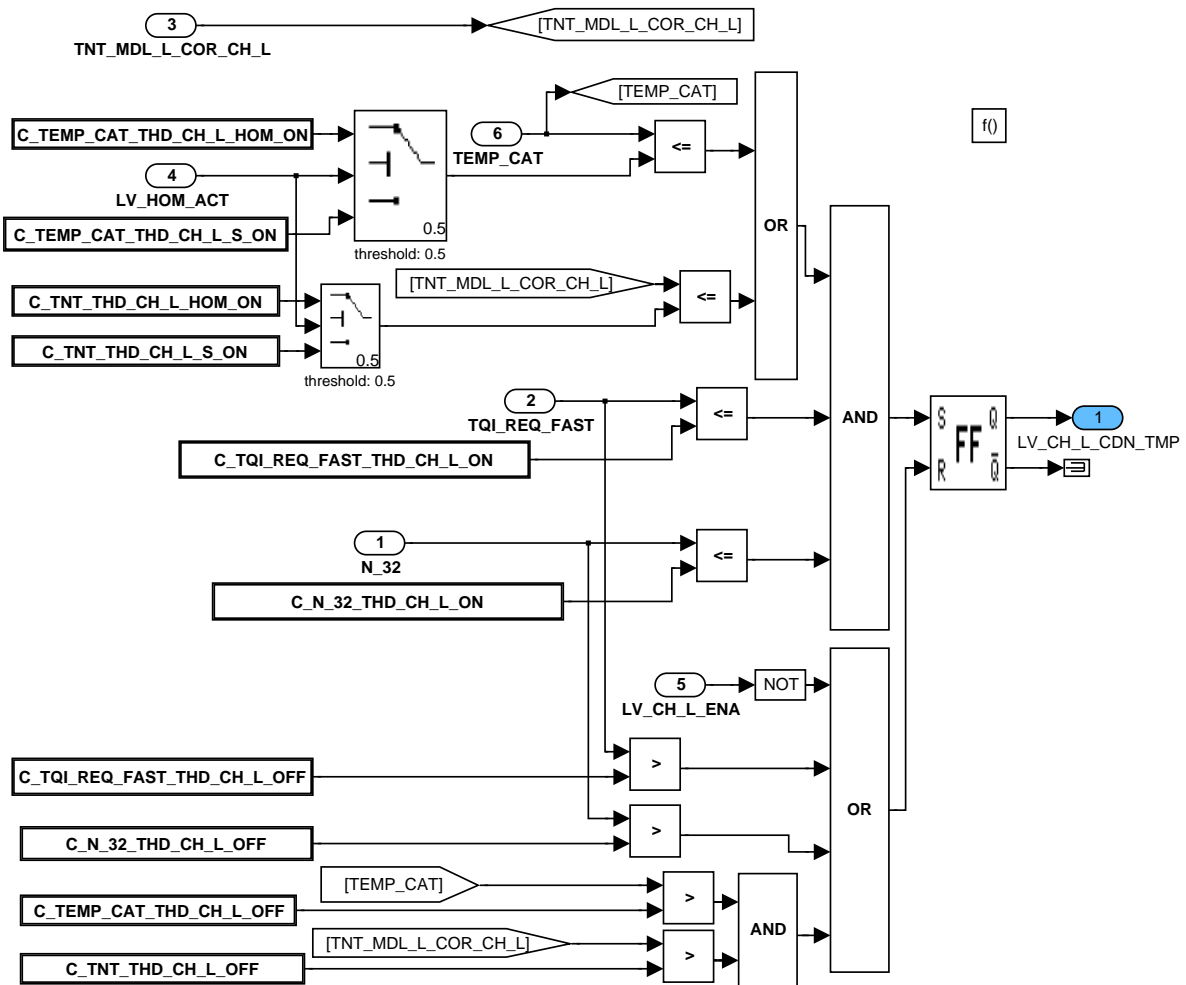


Figure 5.8.7: : Path: EXTC\_ISPCLCHC0/CDN\_CH\_L/SUB/CH\_L\_CDN

### 5.8.3.1.2 Conditions for low load heating after regeneratin (lambda split function)

LV\_NT\_RGN\_REQ is 1 at active regeneration. The function can be deactivated depending on load-, temperature- or time threshold.

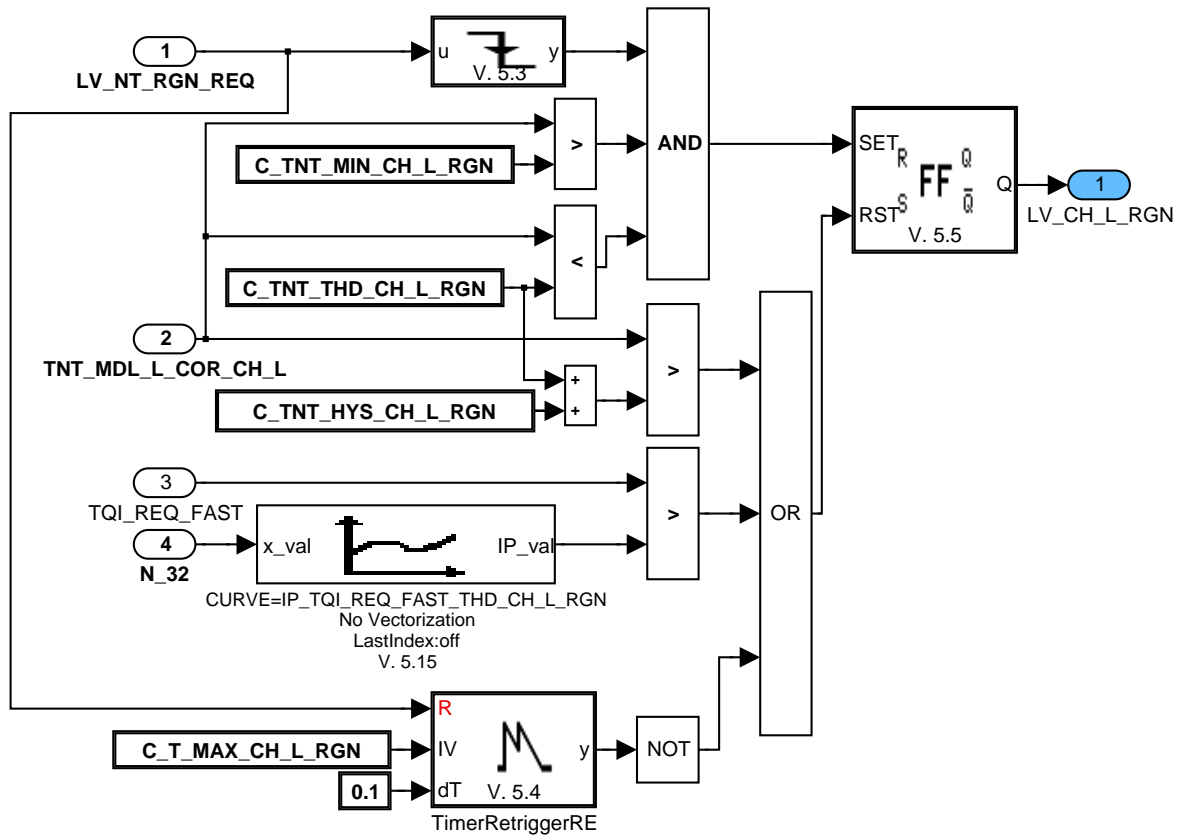


Figure 5.8.8: : Path: EXTC\_ISPCLCHC0/CDN\_CH\_L/SUB/CH\_L\_RGN\_CDN

### 5.8.4 Conditions for desulfation catalyst heating

#### 5.8.4.1 Conditions for desulfation catalyst heating - 1st part

Vehicle speed and requested torque are filtered to avoid often on and off switching. TCO and FTL thresholds can only be re-set at engine off.

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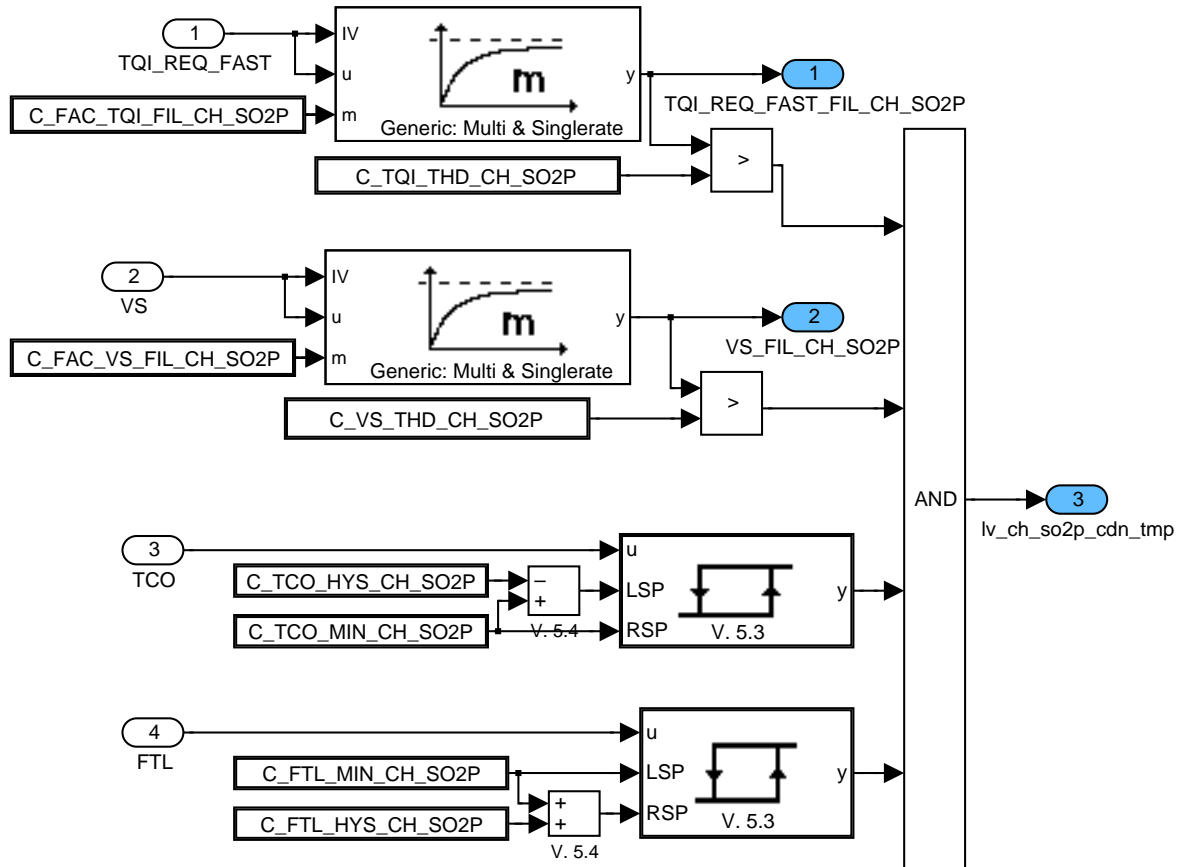


Figure 5.8.9: : Path: EXTC\_ISPCLCHC0/CDN\_CH\_SO2P/SUB\_1

### 5.8.4.2 Conditions for desulfation catalyst heating - 2nd part

LV\_SO2P\_REQ\_2 indicates that catalyst heating is necessary due to imperatively desulfation.

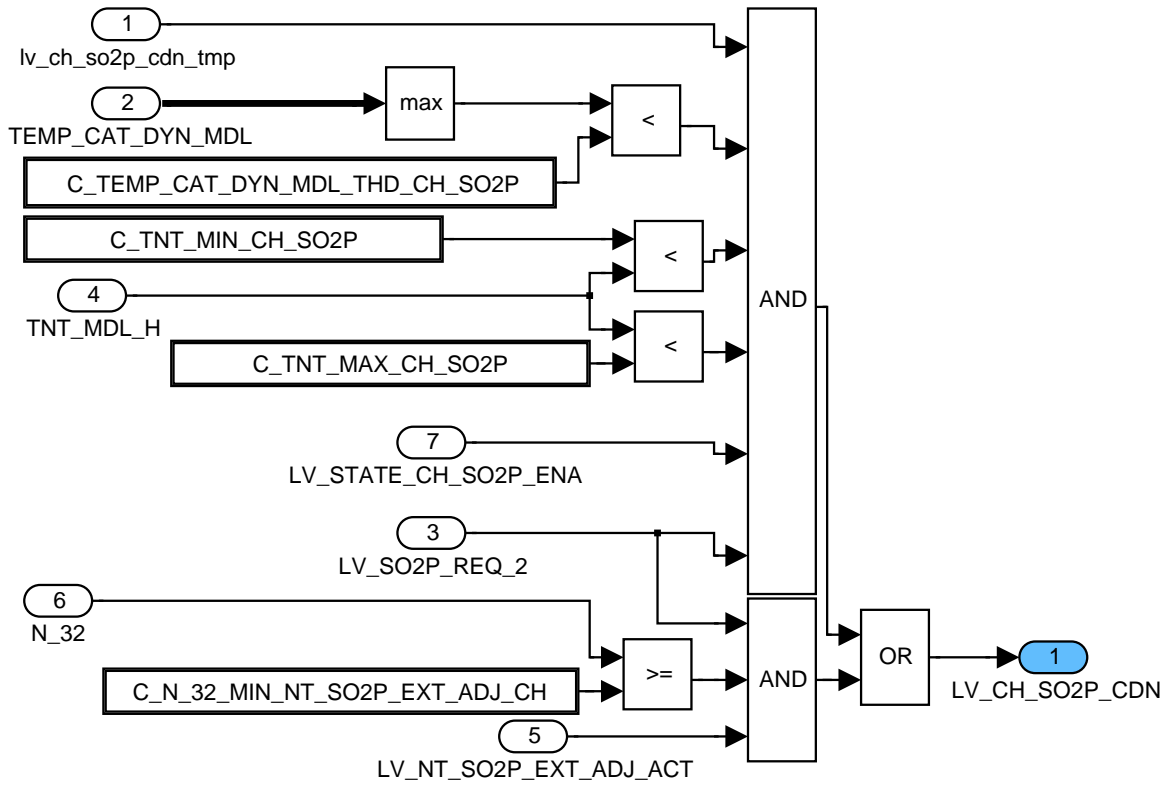


Figure 5.8.10: : Path: EXTC\_ISPCLCHC0/CDN\_CH\_SO2P/SUB\_2

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## 5.9 Catalyst heating coordination (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CH_SO2P	O/V/S	0... FFH	0... 255	1	-
Counter of not effectual trials to heat the NOx - Trap for desulfation					
CTR_KM_CH_SO2P_INH	O/V/S	0... FFFFH	0... 655350	10	km
Mileage at inhibition of catalyst heating for desulfation due to CTR_CH_SO2P or T_CH_SO2P_ACT					
CTR_KM_SO2P_END	O/V/S	0... FFFFH	0... 655350	10	km
Mileage at last successful desulfation					
DIST_CH_SO2P_INH	O/V	0... FFFFH	0... 655350	10	km
Km - counter since inhibition of catalyst heating for desulfation due to CTR_CH_SO2P or T_CH_SO2P_ACT					
DIST_SO2P_END	O/V	0... FFFFH	0... 655350	10	km
Km - counter since last end of desulfation					
LV_CH_AST_ENA	O/V	0... 1H	0 ...1	1	-
indicates if after start catalyst heating is enabled					
LV_CH_L_ENA	O/V	0... 1H	0 ...1	1	-
Inhibition of catalyst heating in low load					
LV_CTR_KM_CH_SO2P_INH	V	0... 1H	0 ...1	1	-
Start of mileage counter CTR_KM_CH_SO2P_INH					
LV_STATE_CH_SO2P_ENA	O/V	0... 1H	0 ...1	1	-
Catalyst heating for desulfation is enabled					
T_CH_SO2P_ACT	O/V/S	0... FFFFH	0... 6553.5	0.1	s
Time with active catalyst heating for desulfation without active desulfation					

### Input data:

C_TNT_SP_CH_SO2P {p. 1814}	CTR_KM_CAN {p. 1563}	LV_CH {p. 8232}	LV_CH_INH {p. 8232}
LV_CH_SO2P_WOUT_LIM {p. 3144}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_IV [NC_CYL_NR] {p. 4802}
LV_ERR_LOAD_TPS_ PLAUS {p. 1062}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_TEG_PCAT_ DOWN {p. 4713}
LV_SO2P_REQ {p. 3129}	LV_SO2P_REQ_2 {p. 3073}	NC_CYL_NR {p. 1526}	NT_AGI_SUL {p. 3073}
STATE_CH {p. 1777}	T_AST_DC_CON {p. 809}	TNT_MDL_MV {p. 8237}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_CH_SO2P_MAX	V	0... FFH	0... 255	1	-
Maximum allowed heating activations within calibratable km - distance					
C_DIST_CH_SO2P_INH_MAX	V	0... FFFFH	0... 655350	10	km
Maximum km-counter since inhibition of catalyst heating for desulfation - to allow heating again					
C_DIST_SO2P_END_MIN	V	0... FFFFH	0... 655350	10	km
Minimum km since last desulfation to activate catalyst heating for desulfation					
C_T_AST_MAX_CH_AST	V	0... FFFFH	0... 6553.5	0.1	s
Maximum time after start to activate catalyst heating after start					
C_T_CH_SO2P_ACT_MAX	V	0... FFFFH	0... 6553.5	0.1	s
Maximum heating time without activation of desulfation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TNT_DELTA_MAX_CH_SO2P	V	0... FFFFH	0... 1023.984375	0.015625	°C
LDP_NT_AGI_SUL_IP_TNT_CH_SO2P	6	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Permissible temperature difference to be bridged					

### General information:


In this module additional conditions for catalyst heating for desulfation of NOx Trap are defined.

### Application conditions:

*Initialisation:* RST, NVMINI, NVMRES, NVMSTO, IGKON  
*Recurrence:* 100MS  
*Activation:* always  
*Deactivation:* never

### Function description:

### Formula section:

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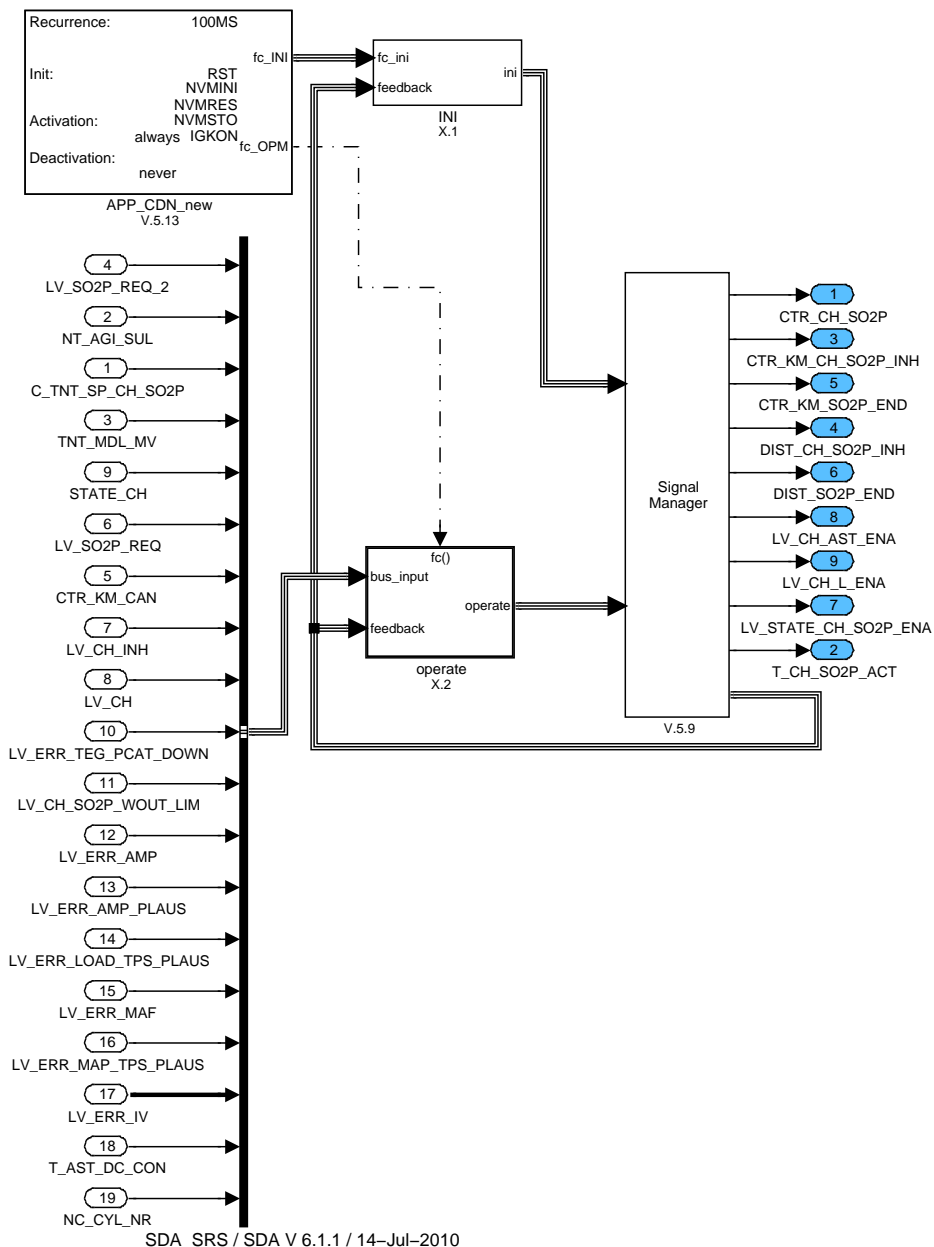


Figure 5.9.1: :

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## 5.9.1 Initialisation /NVMY - Handling

### 5.9.1.1 Initialisation at reset

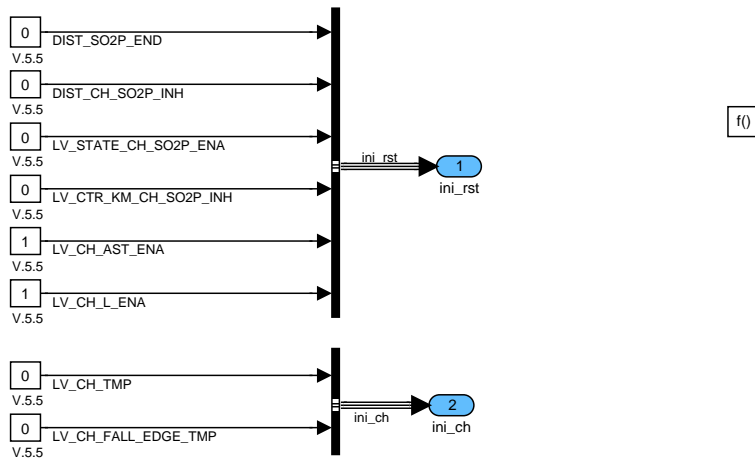


Figure 5.9.2: :

### 5.9.1.2 Initialisation at ignition key on

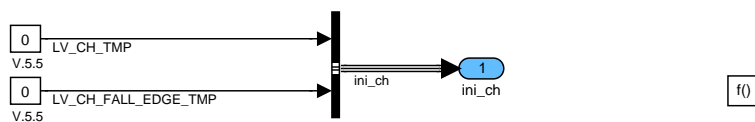


Figure 5.9.3: :

## 5.9.2 Operate Subsystem

### 5.9.2.1 Conditions for desulfation - catalyst heating

LV\_CTR\_KM\_CH\_SO2P\_INH\_INI starts the kilometre counter DIST\_CH\_SO2P\_INH.



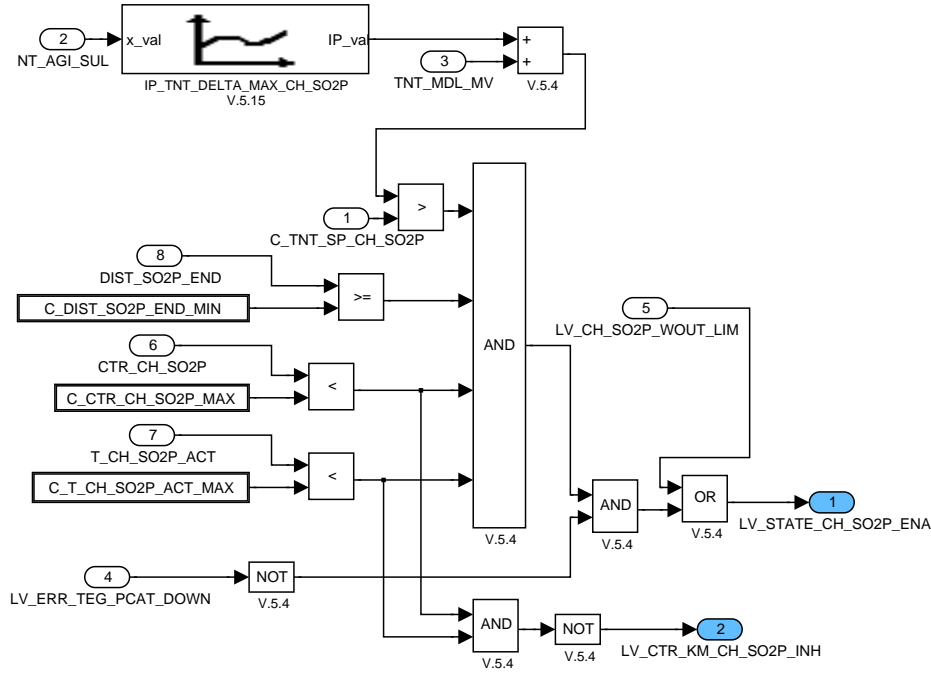



Figure 5.9.4: :

### 5.9.2.2 Calculation of timer and counter - for desulfation catalyst heating

CTR\_CH\_SO2P counts the ineffective tryings to heat up the catalyst. T\_CH\_SO2P\_ACT is the time, the catalyst is heated without started desulfation (temperature for desulfation not reached).DIST\_SO2P\_END are the kilometres that have been driven since the last successful desulfation. DIST\_CH\_SO2P\_INH are the kilometres that have been driven since the time- or counter-threshold was reached. After C\_DIST\_CH\_SO2P\_INH\_MAX is reached, the timer and the counter are initialized and the catalyst is heated again.

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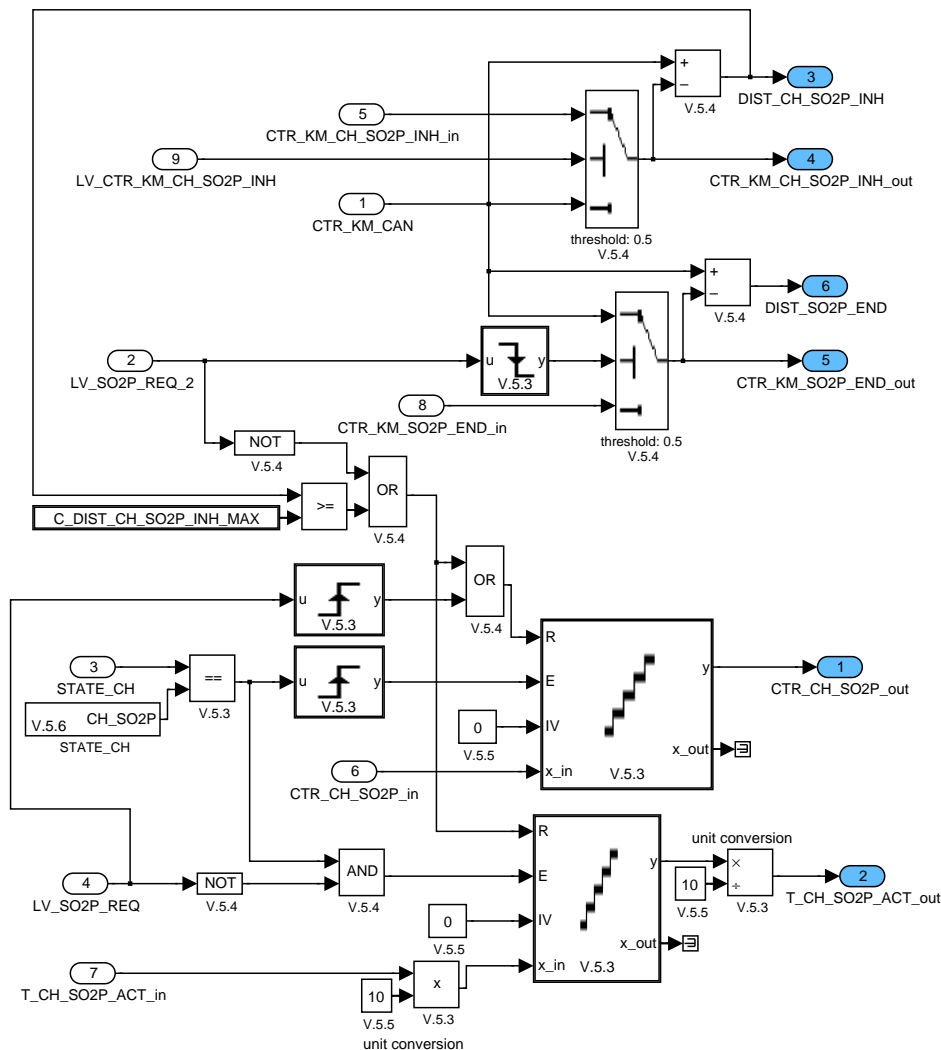



Figure 5.9.5: :

### 5.9.2.3 External conditions for after start catalyst heating

LV\_CH\_AST\_INH\_OPM and LV\_CH\_AST\_INH\_OPM are set to 0 at system event ignition key on.

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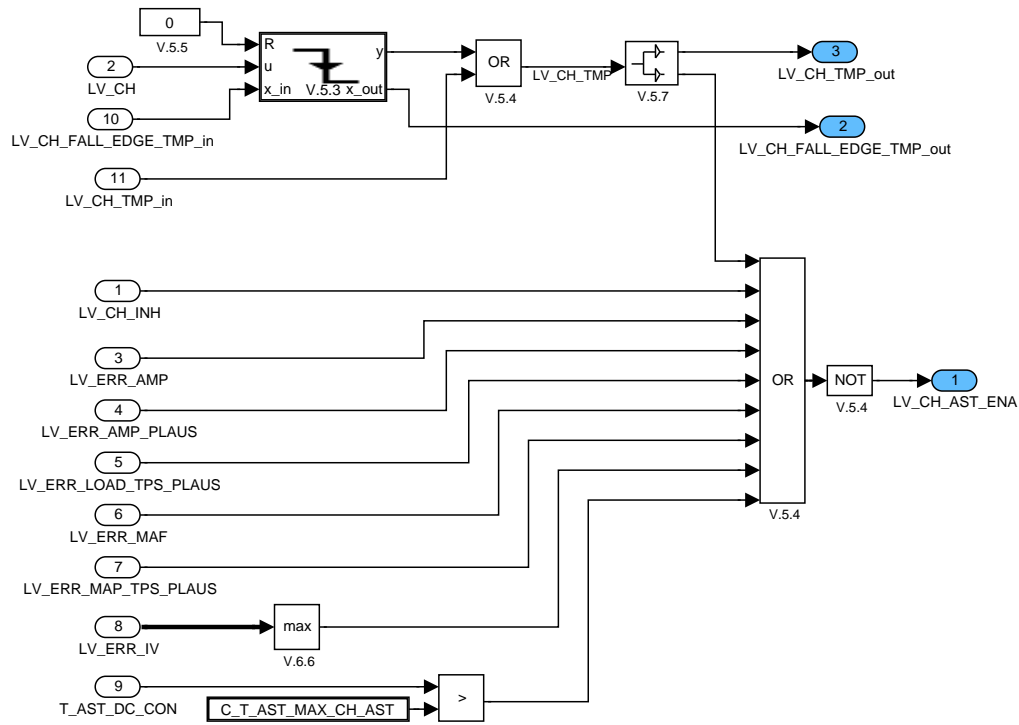


Figure 5.9.6: :

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## 5.10 Catalyst heating strategy

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NR_PRI_CH_MOD	O/V	80... 7FH	-128 ...127	1	-
Priority of catalyst heating strategy					
NR_PRI_CH_MOD_REQ	O	80... 7FH	-128 ...127	1	-
Priority of requested catalyst heating strategy					
STATE_CH_MOD	O/V	0H 1H 2H 3H 4H	CH_MOD_OFF CH_MOD_ HOM CH_MOD_ MPLH CH_MOD_ MPLP CH_MOD_ HOMS	-	-
Catalyst heating strategy					
STATE_CH_MOD_REQ	O	0H 1H 2H 3H 4H	CH_MOD_OFF CH_MOD_ HOM CH_MOD_ MPLH CH_MOD_ MPLP CH_MOD_ HOMS	-	-
Requested CH-strategy (combustion mode) for catalyst heating					


### Input data:

LV_CH_AST_REQ_TCHA_DIAG {p. 8232}	LV_DLY_CH_MOD_REQ_SO2P_HOM {p. 1813}	NR_PRI_CH_MOD_REQ_L {p. 1809}	STATE_CH {p. 1777}
STATE_CH_MOD_AST {p. 1801}	STATE_CH_MOD_L {p. 1809}	STATE_CH_MOD_REQ_AST {p. 1801}	STATE_CH_MOD_REQ_L {p. 1809}
STATE_CH_MOD_REQ_SO2P {p. 1813}	STATE_CH_MOD_SO2P {p. 1813}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NR_PRI_CH_MOD	-	80... 7FH	-128 ...127	1	-
Priority of catalyst heating strategy					
C_NR_PRI_CH_MOD_REQ	-	80... 7FH	-128 ...127	1	-
Priority of requested catalyst heating strategy					
C_NR_PRI_CH_MOD_REQ_TCHA_DIAG	-	80... 7FH	-128 ...127	1	-
Priority of requested strategy - at activated catalyst heating function for turbo charger diagnosis					

### General Information

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This modul merges the STATE\_.. values from after start and low load catalyst heating.

**Application Conditions**

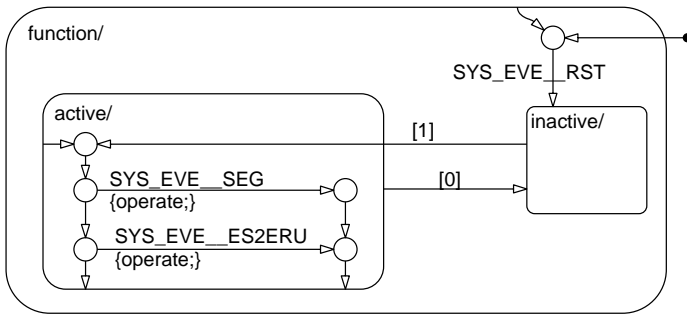

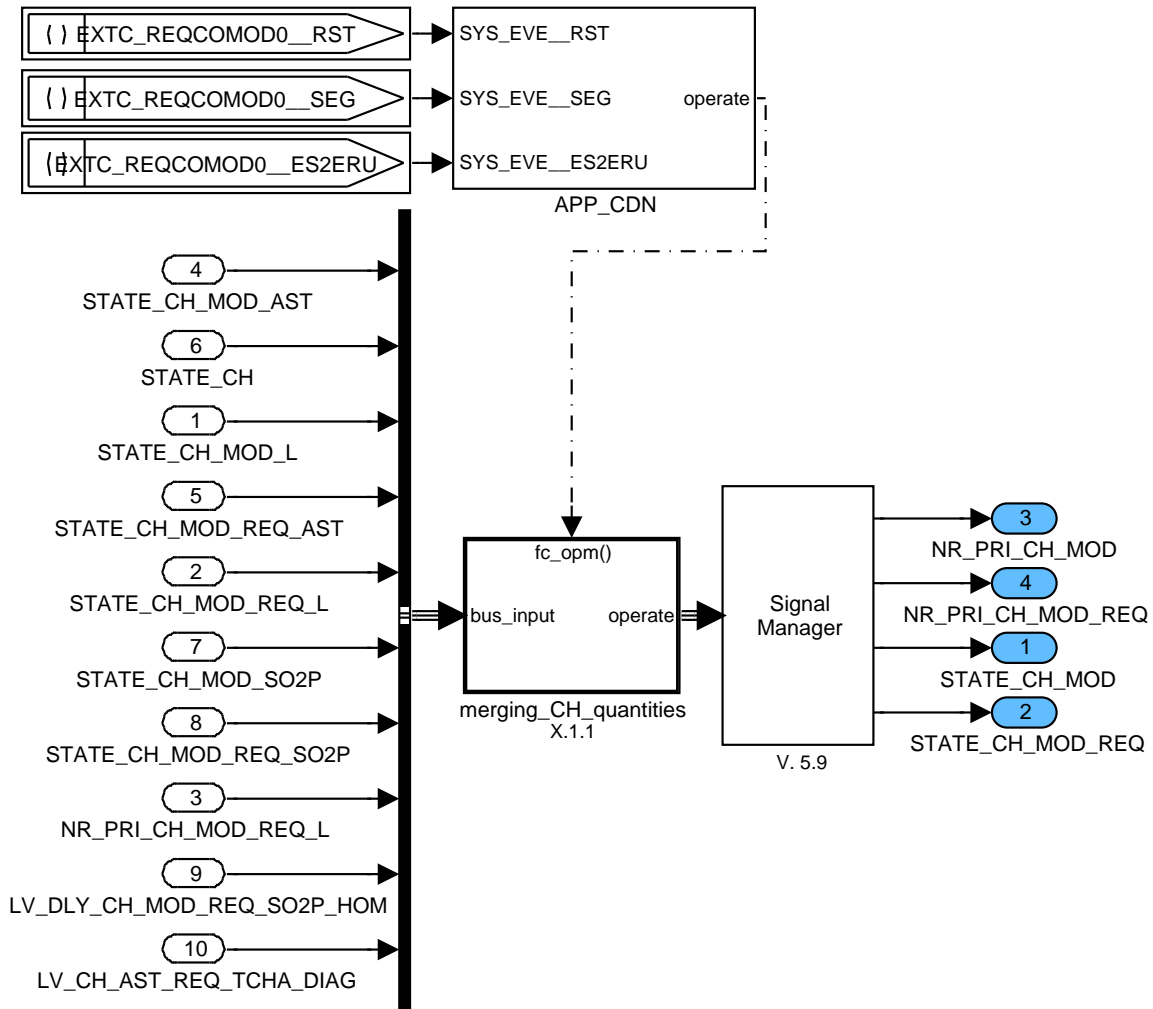


Figure 5.10.1: : Path: EXTC\_REQCOMOD0/APP\_CDN/Chart

**Function description**

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Figure 5.10.2: : Path: EXTC\_REQCOMOD0

## 5.10.1 Operate Subsystem

### 5.10.1.1 Generation of STATE\_CH\_MOD

STATE\_CH indicates the actual active catalyst heating state CH\_AST, CH\_L\_LOAD or CH\_SO2P. STATE\_CH\_MOD is set to the corresponding value.

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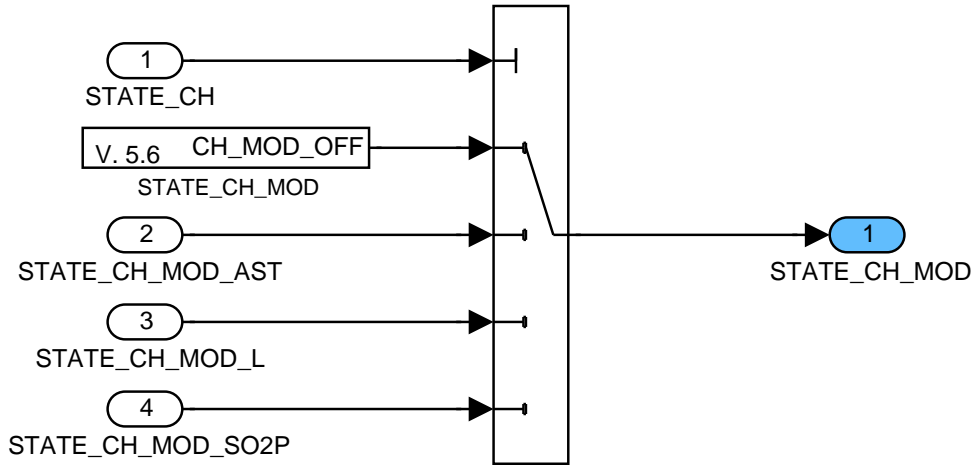


Figure 5.10.3: : Path: EXTC\_REQCOMOD0/merging\_CH\_quantities/CLC\_STATE\_CH\_MOD

### 5.10.1.2 Generation of STATE\_CH\_MOD\_REQ

Same procedere as for STATE\_CH\_MOD. At LV\_DLY\_CH\_MOD\_REQ\_SO2P\_HOM = 1, it is possible that STATE\_CH\_MOD\_REQ requests homogeneous mode although STATE\_CH is CH\_OFF. At LV\_CH\_AST\_REQ\_TCHA\_DIAG = 1, MPLH is requested.

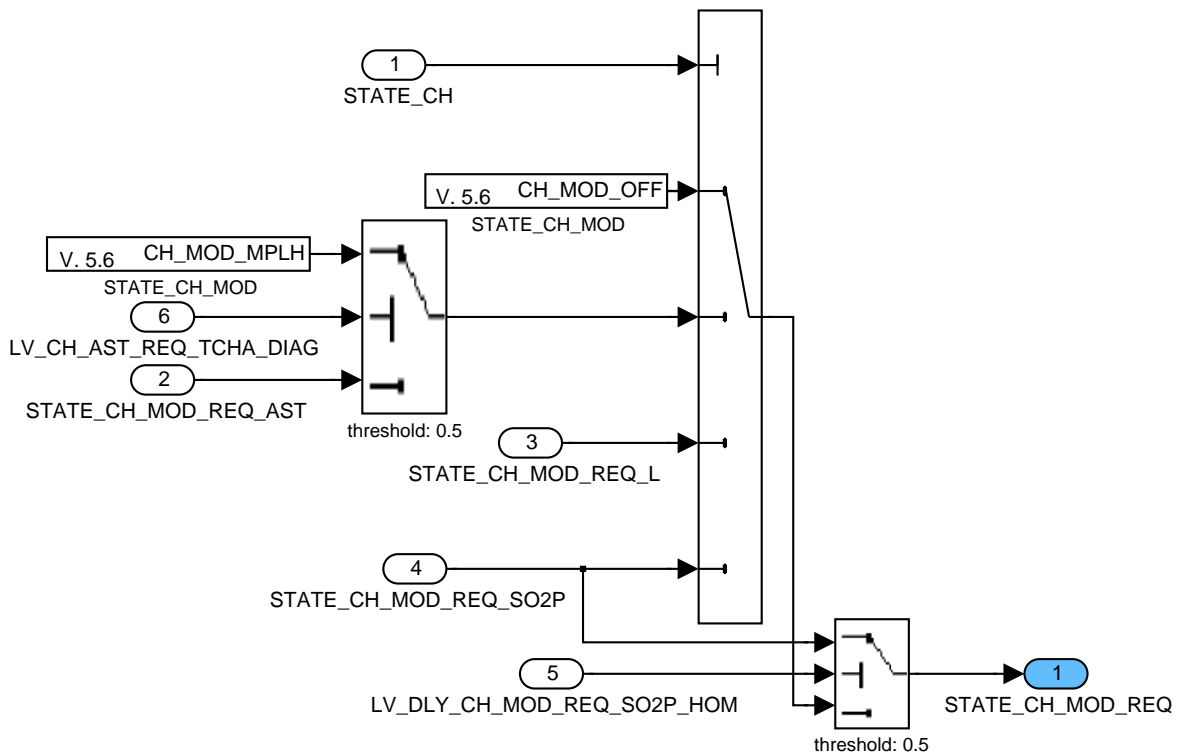



Figure 5.10.4: : Path: EXTC\_REQCOMOD0/merging\_CH\_quantities/CLC\_STATE\_CH\_MOD\_REQ

### 5.10.1.3 Generation of priority for operation mode requests

At active turbo diagnosis a separate value is used.

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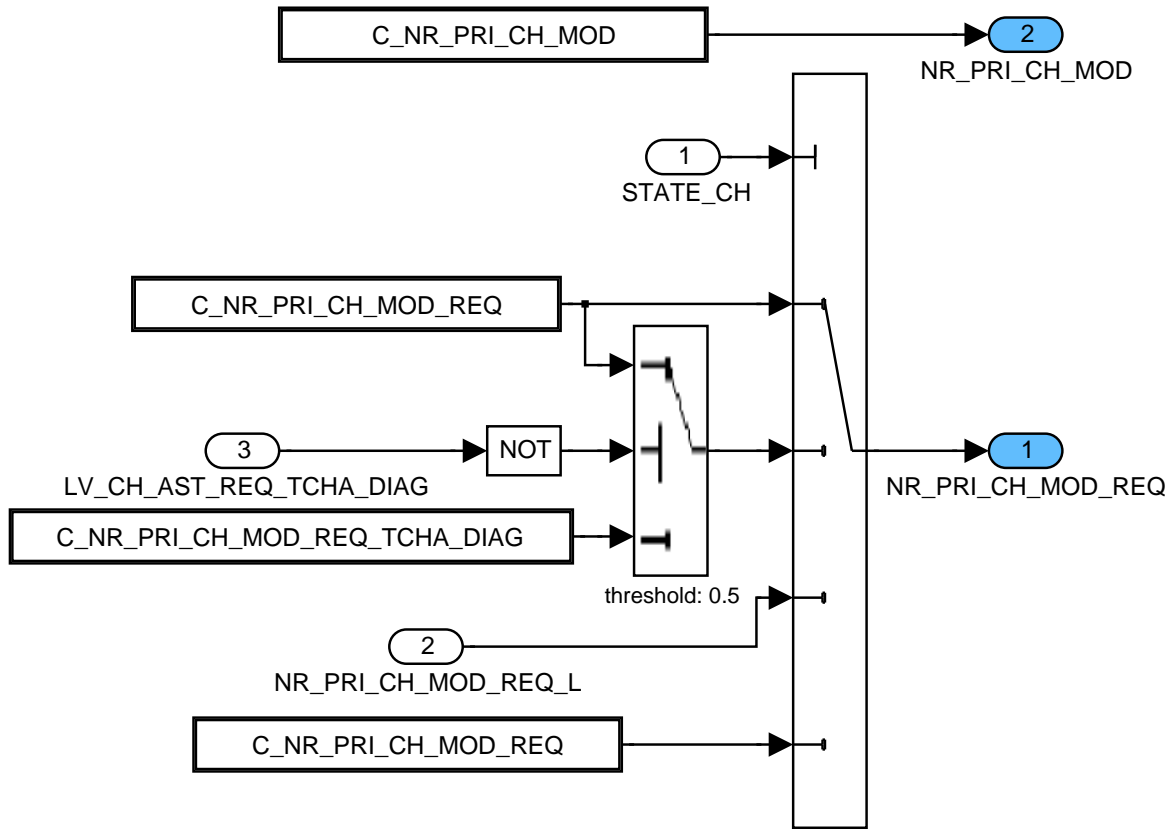


Figure 5.10.5: : Path: EXTC\_REQCOMOD0/merging\_CH\_quantities/CLC\_NR\_PRI

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## 5.11 Catalyst heating after start strategy

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CH_AST_MPLH_CDN	V	0... 1H	0 ...1	1	-
Indicates if conditions for after start catalyst heating with multiple injection in homogenous are fulfilled					
LV_CH_AST_MPLP_CDN	V	0... 1H	0 ...1	1	-
Indicates if conditions for after start catalyst heating with post injection in stratified are fulfilled					
STATE_CH_MOD_AST	O/V	0H 1H 2H 3H 4H	CH_MOD_OFF CH_MOD_ HOM CH_MOD_ MPLH CH_MOD_ MPLP CH_MOD_ HOMS	-	-
Catalyst heating strategy					
STATE_CH_MOD_REQ_AST	O/V	0H 1H 2H 3H 4H	CH_MOD_OFF CH_MOD_ HOM CH_MOD_ MPLH CH_MOD_ MPLP CH_MOD_ HOMS	-	-
Requested CH-strategy (combustion mode) for after start catalyst heating					
T_AST_COR_CH	O/V	0... FFFFH	0... 6553.5	0.1	s
Catalyst age depending correction of T_AST for after start catalyst heating					

### Input data:

CTR_KM_CAN {p. 1563}	LV_ES {p. 1720}	LV_HOM_ACT {p. 8136}	LV_HOM_ENA {p. 8136}
LV_HOMS_ACT {p. 8269}	LV_MPLH_ACT {p. 8269}	LV_MPLP_ACT {p. 8270}	LV_S_ACT {p. 8137}
LV_S_ENA {p. 8137}	LV_ST_END {p. 1720}	N_32 {p. 1525}	PV {p. 978}
STATE_CH {p. 1777}	T_AST {p. 1766}	TCO_ST {p. 1100}	TQI_REQ_FAST {p. 8391}
VS {p. 1176}			

### Calibration data:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CH_MOD_MAN	-	0H 1H 2H 3H 4H	CH_MOD_OFF CH_MOD_ HOM CH_MOD_ MPLH CH_MOD_ MPLP CH_MOD_ HOMS	-	-
Manual setting of catalyst heating strategy					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_MAX_MPLH_CH_AST	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for after start catalyst heating in homogeneous mode with split injection					
C_N_MAX_MPLP_CH_AST	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for after start catalyst heating in stratified mode with post injection					
C_N_MIN_MPLH_CH_AST	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for after start catalyst heating in homogeneous mode with split injection					
C_N_MIN_MPLP_CH_AST	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for after start catalyst heating in stratified mode with post injection					
C_T_MIN_PV_THD_MPLH_CH_DEAC	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time to deactivate MPLH_CH after exceeded pedal value					
C_TQI_MAX_MPLP_CH_AST	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum of indicated torque request for after start catalyst heating with post injection					
C_TQI_MIN_MPLP_CH_AST	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Minimum of indicated torque request for after start catalyst heating with post injection					
C_VS_MAX_MPLP_CH_AST	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed for post injection during after start catalyst heating					
ID_CH_MOD_BAS	V	0... 3H	0 ...3	1	-
LDPM_T_AST_COR_CH_1_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDP_TCO_ST_ID_CH_MOD_BAS	8	0... FEH	-48... 142.5	0.75	°C
Basic catalyst heating strategy					
IP_PV_THD_MPLH_CH_AST	-	0... 3FFFH	0... 99.90234375	0.0976563	%
LDP_TCO_ST_IP_PV_THD_MPLH_CH	8	0... FEH	-48... 142.5	0.75	°C
Pedal value threshold for multiple injection in homogeneous for after start catalyst heating					
IP_T_AST_COR_CH	-	0... FFFFH	0... 6553.5	0.1	s
LDP_CTR_KM_CAN_IP_T_AST_COR_CH	6	0... FFFFH	0... 655350	10	km
Catalyst age (in fact driven km) corrected time after start for after start catalyst heating					
LC_CH_MOD_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of catalyst heating strategy					

## General Information

The engine states during catalyst heating can be homogeneous (HOM), homogeneous with multiple injection (MPLH), stratified with post injection (MPLP) and homogeneous-stratified (HOMS). STATE\_CH\_MOD\_AST, generated in this module, contains the information which catalyst heating strategy is active and is used for CH-setpoint calculation (for example fuel mass setpoint or lambda). Further the request which combustion mode is the most efficient for catalyst heating is generated in this module.

## Application Conditions

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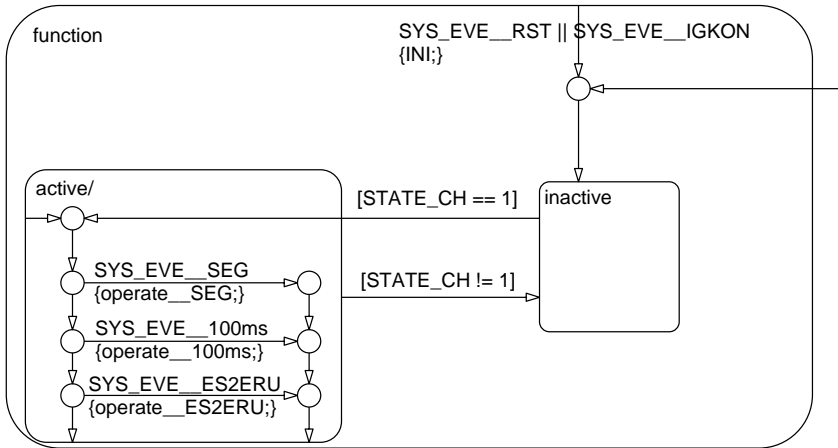



Figure 5.11.1: : Path: EXTC\_ISPCLMODAS0/APP\_CDN/Chart

**Function description**

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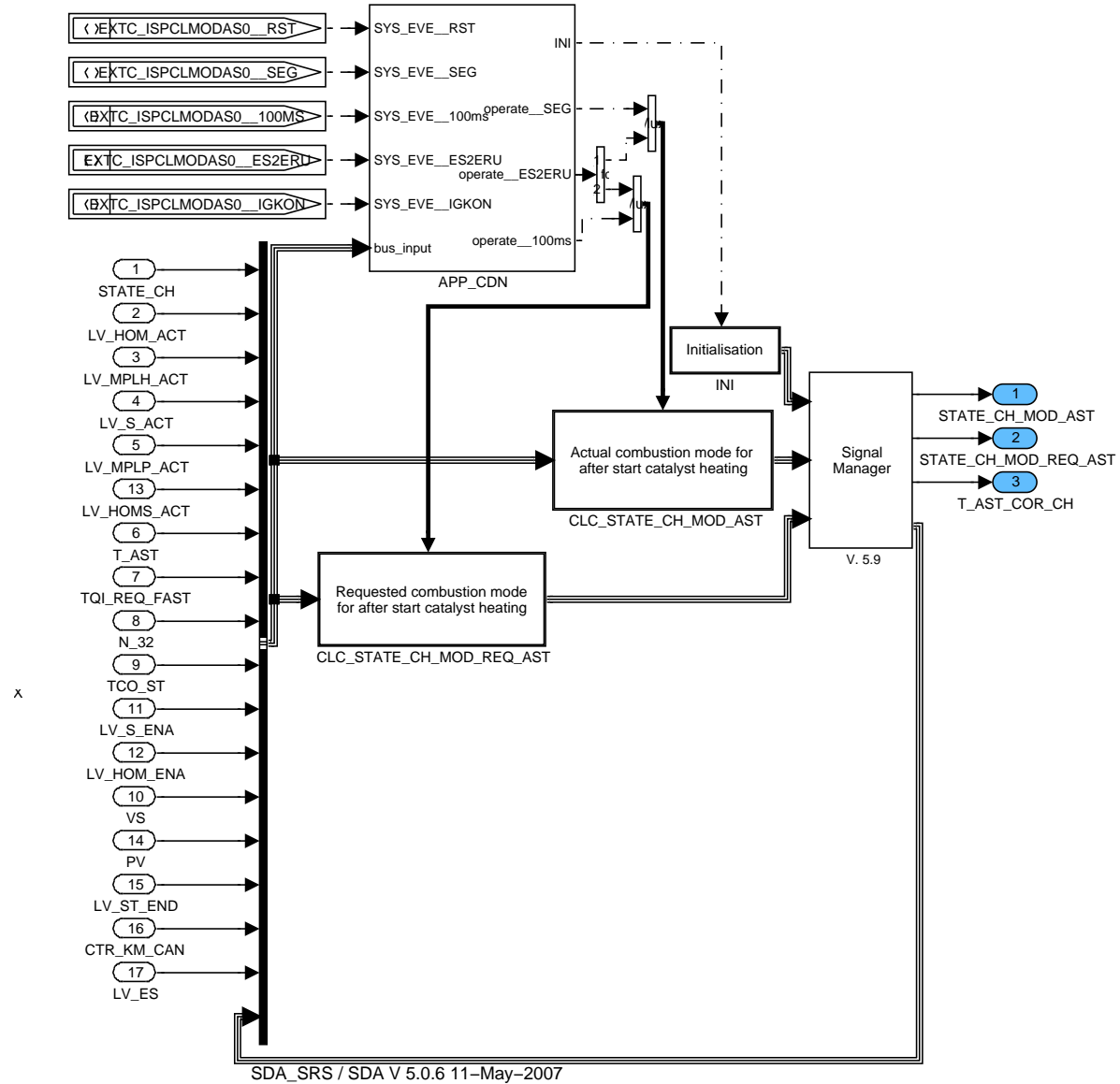


Figure 5.11.2: : Path: EXTC\_ISPCLMODAS0

### 5.11.1 Initialisation

#### 5.11.1.1 No title given

The outputs are initialised at reset and function deactivation.

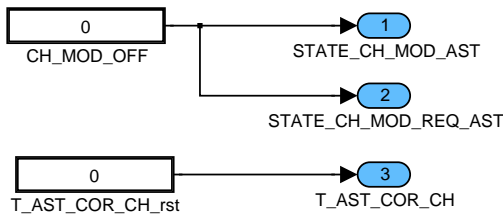


Figure 5.11.3: : Path: EXTC\_ISPCLMODAS0/INI/SUB

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## 5.11.2 Actual combustion mode for after start catalyst heating

### 5.11.2.1 No title given

STATE\_CH\_MOD\_AST is set according to the bit-variables that show the actual mode (HOM, MPLH, HOMS or MPLP). If no mode is requested for catalyst heating (STATE\_CH\_MOD\_REQ\_AST = 0) also the actual mode is set to 0. It is also possible to set STATE\_CH\_MOD\_AST manually.

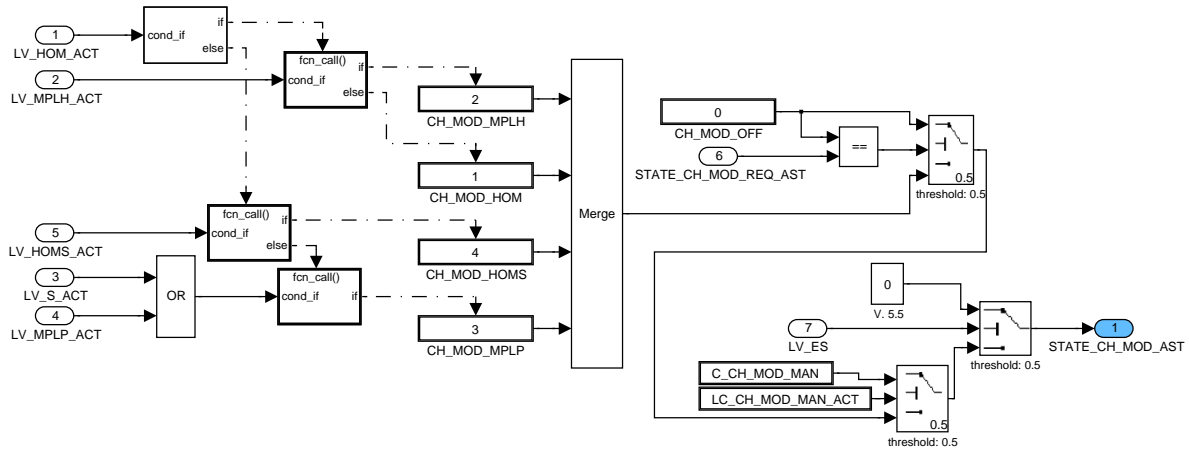


Figure 5.11.4: : Path: EXTC\_ISPCLMODAS0/CLC\_STATE\_CH\_MOD\_AST/SUB

## 5.11.3 Requested combustion mode for catalyst heating

### 5.11.3.1 No title given

ID\_CH\_MOD\_BAS contains the strategy-order for catalyst heating.

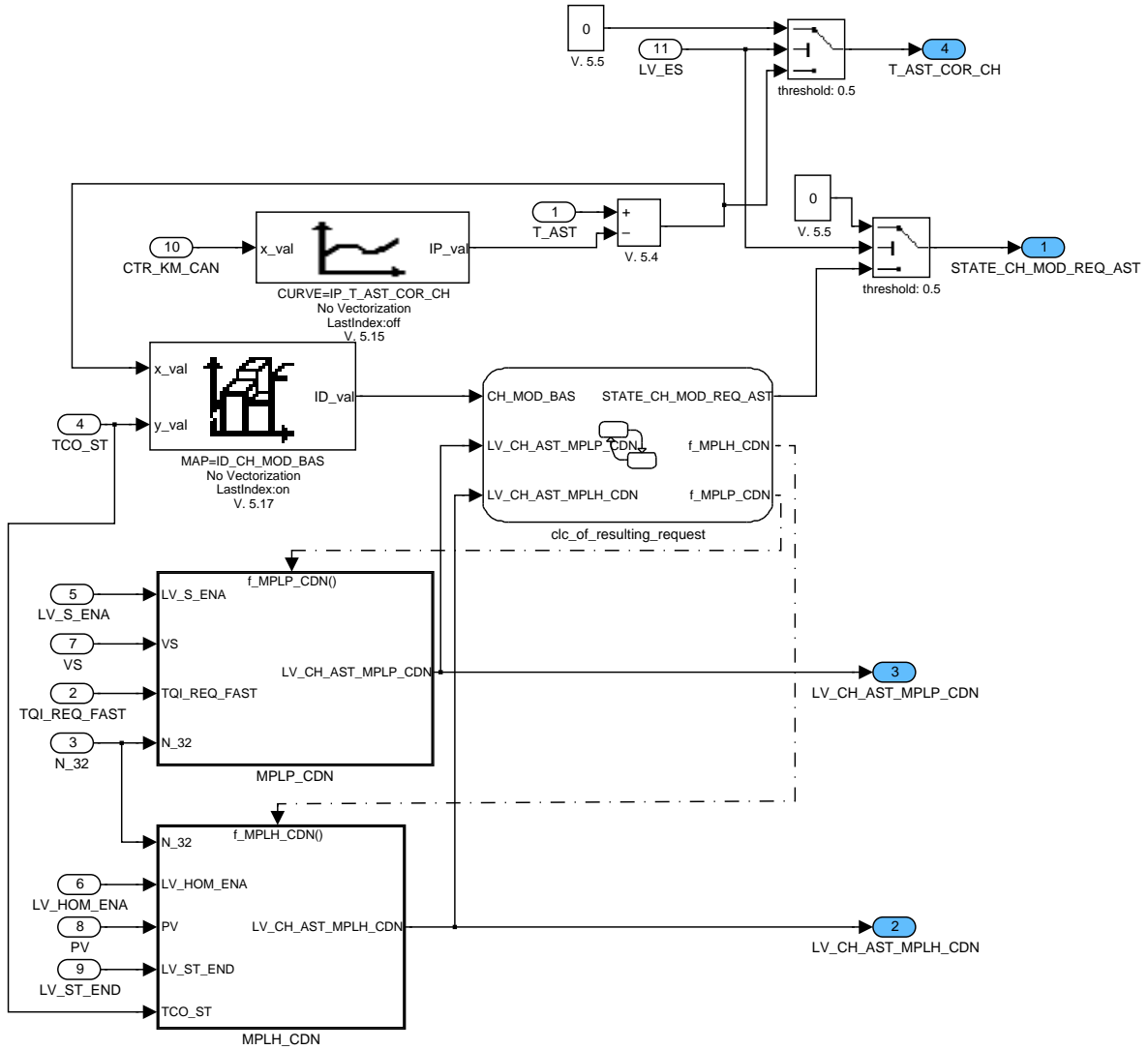
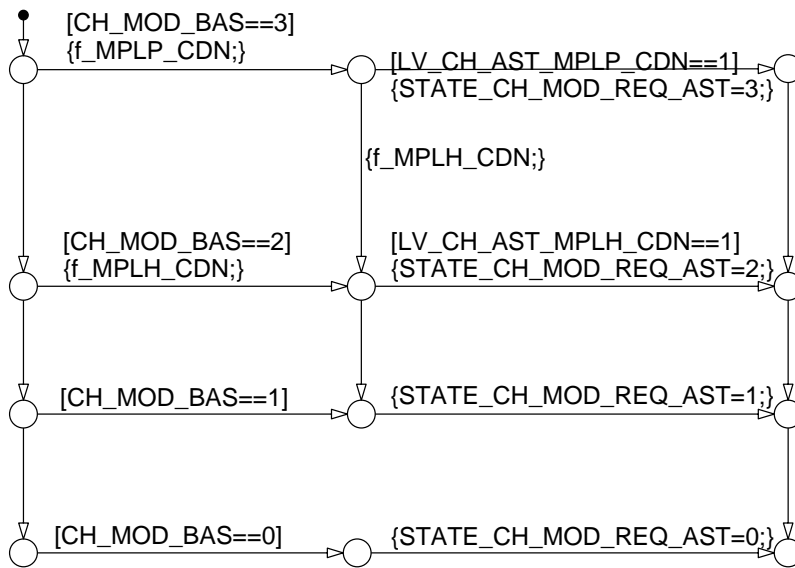


Figure 5.11.5: : Path: EXTC\_ISPCLMODAS0/CLC\_STATE\_CH\_MOD\_REQ\_AST/SUB

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### 5.11.3.1.1 clc\_of\_resulting\_request



Via function-call (e.g. f\_MPLP\_CDN) some conditions for the "optimal" combustion mode CH\_MOD\_BAS are checked. If this conditions (s. next subsystems) are not fulfilled, the next mode of the priority-order MPLP-MPLH-HOM is checked.

Figure 5.11.6: : Path: EXTC\_ISPCLMODAS0/CLC\_STATE\_CH\_MOD\_REQ\_AST/SUB/clc\_of\_resulting\_request

### 5.11.3.1.2 Conditions for homogenous mode with multiple injection

LV\_CH\_AST\_MPLH\_CDN indicates if conditions for MPLH for catalyst heating are fulfilled. It is set to 0 if the engine speed is not in-between a calibratable range, LV\_HOM\_ENA is 0 or the pedal value exceeds C\_PV\_MAX\_MPLH\_CH for a certain time (C\_T\_MIN\_PV\_THD\_MPLH\_CH\_DEAC). The bit LV\_CH\_AST\_MPLH\_CDN can only be set to 1 again after next engine start.

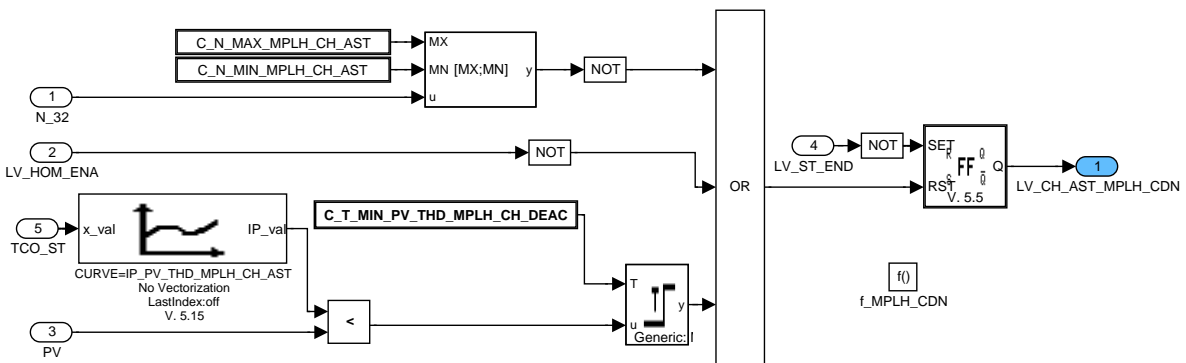


Figure 5.11.7: : Path: EXTC\_ISPCLMODAS0/CLC\_STATE\_CH\_MOD\_REQ\_AST/SUB/MPLH\_CDN

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### 5.11.3.1.3 Conditions for stratified mode

For stratified mode with post injection the torque request and the engine speed has to be in-between a calibratable range, the vehicle speed must be below a limit and LV\_S\_ENA must indicate that stratified mode is enabled.

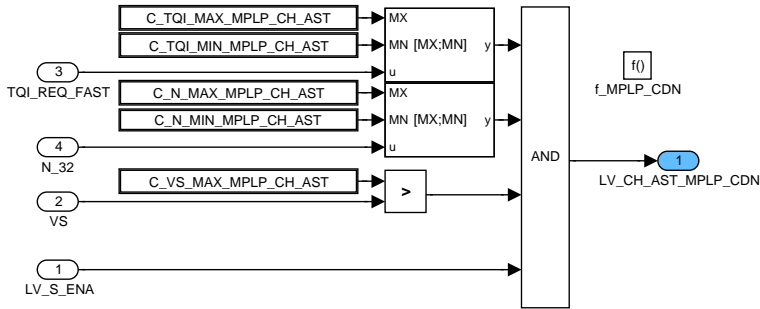


Figure 5.11.8: : Path: EXTC\_ISPCLMODAS0/CLC\_STATE\_CH\_MOD\_REQ\_AST/SUB/MPLP\_CDN

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## 5.12 Catalyst heating low load strategy

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NR_PRI_CH_MOD_REQ_L	O/V	80... 7FH	0... 127	1	-
Priority of requested catalyst heating strategy for low load catalyst heating					
STATE_CH_MOD_L	O/V	0H 1H 2H 3H 4H	CH_MOD_OFF CH_MOD_ HOM CH_MOD_ MPLH CH_MOD_ MPLP CH_MOD_ HOMS	-	-
Catalyst heating strategy for low load heating					
STATE_CH_MOD_REQ_L	O/V	0H 1H 2H 3H 4H	CH_MOD_OFF CH_MOD_ HOM CH_MOD_ MPLH CH_MOD_ MPLP CH_MOD_ HOMS	-	-
Requested CH strategy (combustion mode) for low load catalyst heating					

### Input data:

C_CH_MOD_MAN {p. 1801}	LC_CH_MOD_MAN_ACT {p. 1802}	LV_HOMS_ACT {p. 8269}	LV_MPLP_ACT {p. 8270}
LV_S_ACT {p. 8137}	STATE_CH {p. 1777}	TEMP_CAT {p. 8237}	TNT_MDL_H {p. 8237}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NR_PRI_CH_MOD_REQ_L_ACT	-	80... 7FH	0... 127	1	-
Priority of requested catalyst heating strategy for switching to homogeneous mode					
C_NR_PRI_CH_MOD_REQ_L_PAS	-	80... 7FH	0... 127	1	-
Priority of passive requested catalyst heating strategy in low load catalyst heating					
C_TEMP_CAT_MIN_SWI_HOM_CH_L	-	0... FFFFH	0... 990.984375	0.015625	°C
Below this catalyst temperature the homogeneous mode is requested for low load catalyst heating					
C_TEMP_CAT_MIN_SWI_HOMS_CH_L	-	0... FFFFH	0... 990.984375	0.015625	°C
Below this catalyst temperature the homogeneous stratified mode is requested for low load catalyst heating					
C_TEMP_HYS_SWI_HOM_CH_L	-	0... FFFFH	0... 1023.98	0.015625	°C
Hysteresis of temperature threshold for switching in homogenous mode in low load catalyst heating					
C_TEMP_HYS_SWI_HOMS_CH_L	-	0... FFFFH	0... 1023.98	0.015625	°C
Hysteresis of temperature threshold for switching in homogenous stratified mode in low load catalyst heating					
C_TNT_MIN_SWI_HOM_CH_L	-	0... FFFFH	0... 1023.98	0.015625	°C
Below this NOx trap temperature the homogeneous mode is requested for low load catalyst heating					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TNT_MIN_SWI_HOMS_CH_L	-	0... FFFFH	0... 1023.98	0.015625	°C
Below this NOx trap temperature the homogeneous stratified mode is requested for low load catalyst heating					

**General information**

This module has to be calculated after Catalyst heating coordination and Catalyst heating after start strategy and before any other catalyst heating module.

The output STATE\_CH\_MOD\_L will be merged in Catalyst heating strategy into STATE\_CH\_MOD. This value is used to trigger setpoint calculation modules. STATE\_CH\_MOD\_REQ\_L will be merged into STATE\_CH\_MOD\_REQ.

**Application Condition**

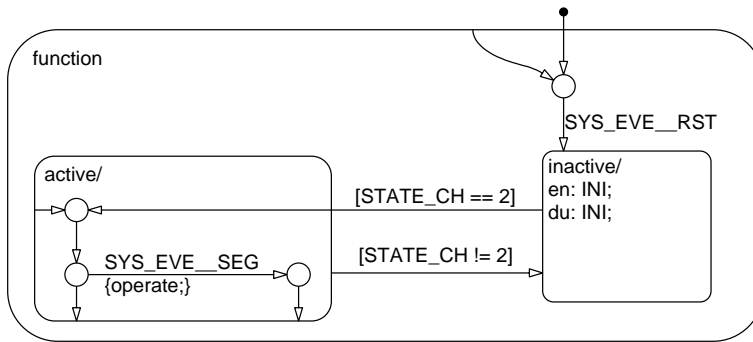


Figure 5.12.1: EXTC\_ISPCLmodII0/APP\_CDN/Chart

**Function Description**

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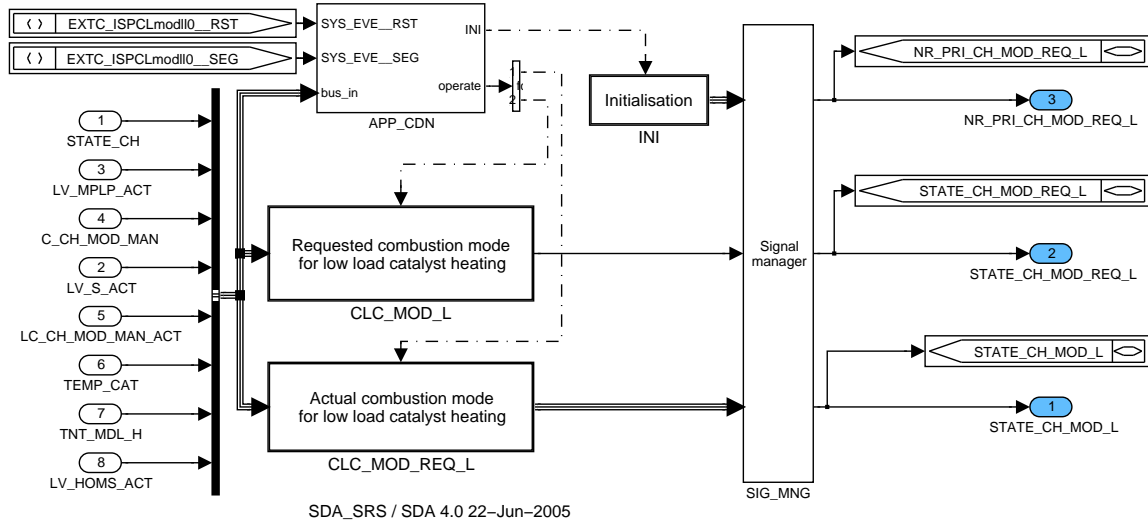


Figure 5.12.2: EXTC\_ISPCLmodII0

### 5.12.1 Initialization

All outputs are set to 0 at reset and deactivated function.

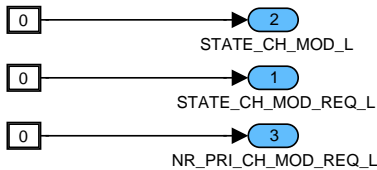


Figure 5.12.3: EXTC\_ISPCLmodII0/INI/INI\_SUB

### 5.12.2 Actual combustion mode for low load catalyst heating

Depending on the actual active combustion mode, STATE\_CH\_MOD\_L is set to HOMS, MPLP or HOM. With (L)C\_CH\_MOD\_MAN(\_ACT) it is possible to set it manually.

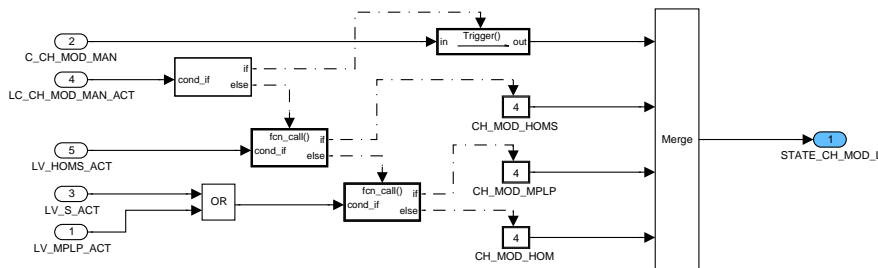


Figure 5.12.4: EXTC\_ISPCLmodII0/CLC\_MOD\_L/CLC\_MOD\_L\_SUB

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### 5.12.3 Requested combustion mode for low load catalyst heating

If catalyst or NOxTrap temperature falls below C\_TEMP\_CAT\_MIN\_SWI\_HOMS\_CH\_L or C\_TNT\_MIN\_SWI\_HOMS\_CH\_L the HOMS - mode is requested to inhibit that the catalyst cools down under the working temperature. If one of the temperatures falls even below C\_TEMP\_CAT\_MIN\_SWI\_HOM\_CH\_L or C\_TNT\_MIN\_SWI\_HOM\_CH\_L homogenous mode is requested. NR\_PRI\_CH\_MOD\_REQ\_L is increased via C\_NR\_PRI\_CH\_MOD\_REQ\_L\_ACT if the request shall be active.

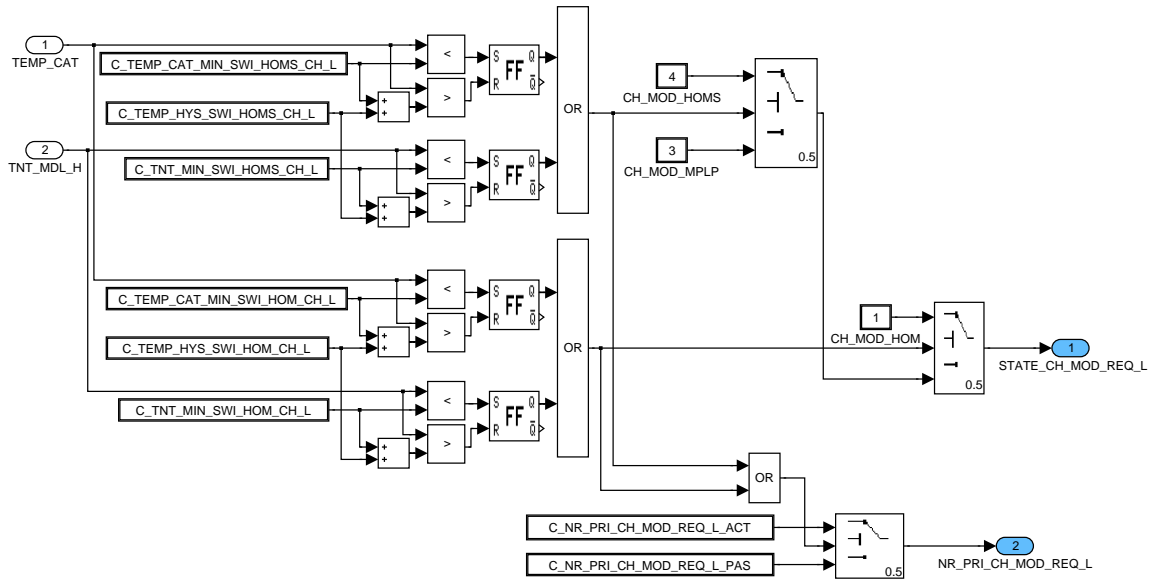


Figure 5.12.5: EXTC\_ISPCLmodII0/CLC\_MOD\_REQ\_L/CLC\_MOD\_REQ\_L\_SUB

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## 5.13 Catalyst heating for desulfation strategy

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DLY_CH_MOD_REQ_SO2P_HOM	O/V	0... 1H	0 ...1	1	-
Indicates if homogeneous mode is requested after active desulfation catalyst heating					
STATE_CH_MOD_REQ_SO2P	O/V	0H 1H 2H 3H 4H	CH_MOD_OFF CH_MOD_ HOM CH_MOD_ MPLH CH_MOD_ MPLP CH_MOD_ HOMS	-	-
Requested CH-strategy (combustion mode) for desulfation catalyst heating					
STATE_CH_MOD_SO2P	O/V	0H 1H 2H 3H 4H	CH_MOD_OFF CH_MOD_ HOM CH_MOD_ MPLH CH_MOD_ MPLP CH_MOD_ HOMS	-	-
Catalyst heating strategy for desulfation catalyst heating					
TNT_DIF_CH_SO2P	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	K
Difference between desulfation setpoint and actual value of TNT					


### Input data:

LV_MPLH_ACT {p. 8269}	LV_NT_SO2P_EXT_ADJ_ ACT {p. 3144}	LV_S_ACT {p. 8137}	LV_STATE_CH_SO2P_ ENA {p. 1789}
MAF {p. 8277}	N_32 {p. 1525}	STATE_CH {p. 1777}	TNT_MDL_L {p. 8237}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_SO2P_ACT_HYS	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass air flow hysteresis to avoid toggle of switch over the SO2P heating request					
C_N_32_SO2P_ACT_HYS	-	0... FFH	0... 8160	32	rpm
Engine speed hysteresis to avoid toggle of switch over the SO2P heating request					
C_STATE_CH_MOD_SO2P_MAN	-	0H 1H 2H	CH_MOD_OFF CH_MOD_ HOM CH_MOD_ MPLH	-	-
Manual setting of catalyst heating strategy for desulfation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DLY_STATE_CH_MOD_REQ_SO2P	-	0... FFFFH	0... 6553.5	0.1	s
Time to request homogeneous mode after deactivation of desulfation catalyst heating					
C_TNT_SP_CH_SO2P	-	0... FFFFH	0... 1023.984375	0.015625	°C
Setpoint of TNT for desulfation catalyst heating					
C_TNT_SP_CH_SO2P_EXT_ADJ	-	0... FFFFH	0... 1023.984375	0.015625	°C
Setpoint of TNT for desulfation catalyst heating activated by external adjustment					
ID_STATE_CH_MOD_REQ_SO2P	V	0... 2H	0 ...2	1	-
LDP_N_32_ID_CH_MOD_REQ_SO2P	6	0... FFH	0... 8160	32	rpm
LDP_MAF_ID_CH_MOD_REQ_SO2P	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Requested combustion mode for desulfation catalyst heating					
LC_STATE_CH_MOD_SO2P_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of catalyst heating strategy for desulfation					

## General Information

This module has to be calculated after Catalyst heating coordination , Catalyst heating after start strategy , Catalyst heating low load strategy and before any other catalyst heating module.

The engine states during catalyst heating for desulfation can be homogeneous (HOM) and homogeneous with multiple injection (MPLH). STATE\_CH\_MOD\_SO2P, generated in this module, contains the information which catalyst heating strategy is active and is used for CH-setpoint calculation (for example fuel mass setpoint or lambda). It will be merged in Catalyst heating strategy into STATE\_CH\_MOD. STATE\_CH\_MOD\_REQ\_SO2P will be merged into STATE\_CH\_MOD\_REQ. Further a request is generated that contains the most efficient combustion mode for desulfation catalyst heating.

## Application Conditions

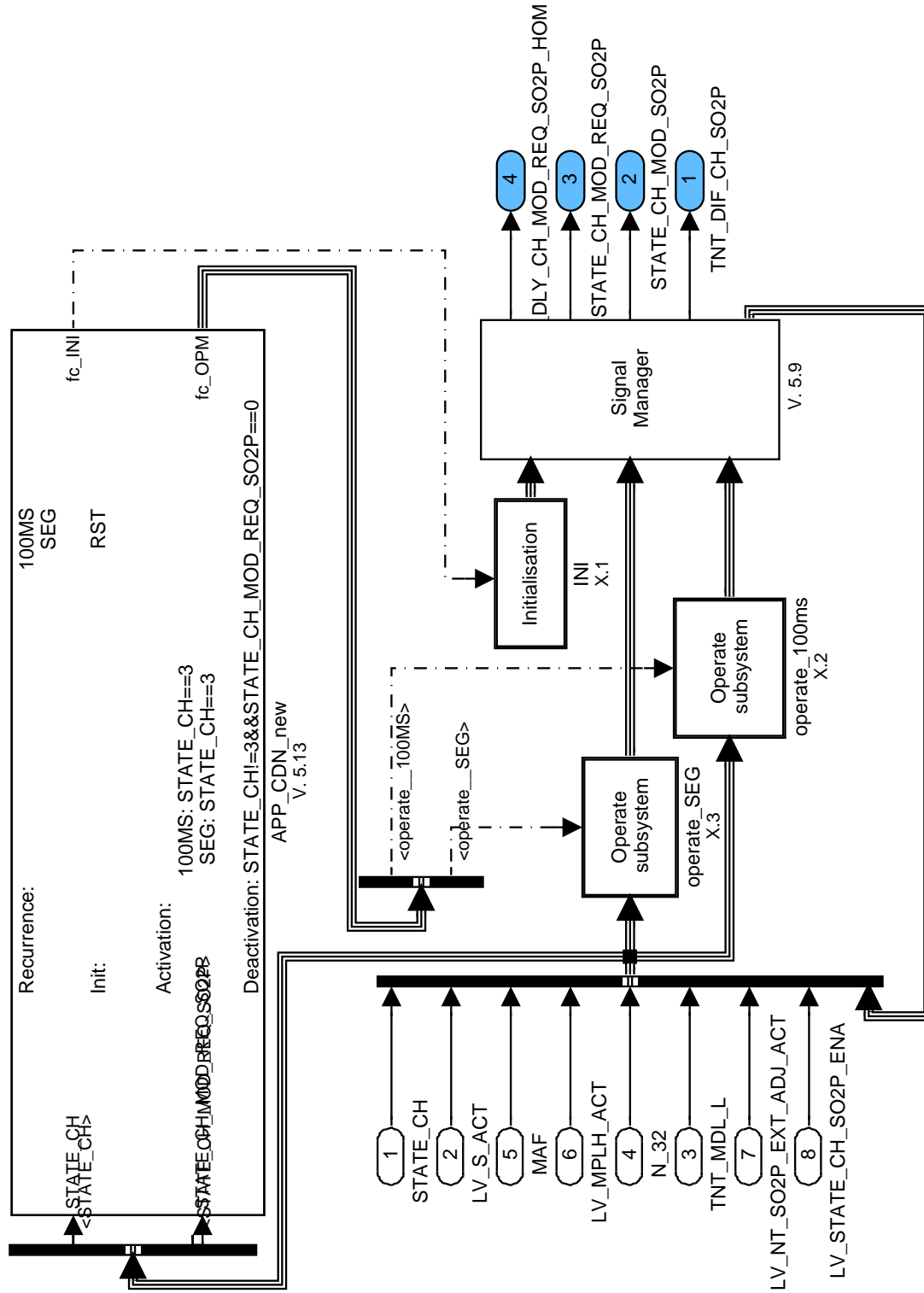
Initialization: RST

Activation: 100MS: STATE\_CH == 3

SEG: STATE\_CH == 3

Deactivation: STATE\_CH != 3 & STATE\_CH\_MOD\_REQ\_SO2P == 0

## Function description




SDA\_SRS / SDA V 5.0.6 15-Mar-2007

x

Figure 5.13.1: Path: EXTC\_ISPCLMODS00

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## 5.13.1 Initialisation

### 5.13.1.1 Initialisation - Subsystem

The outputs are initialised at reset and function deactivation.

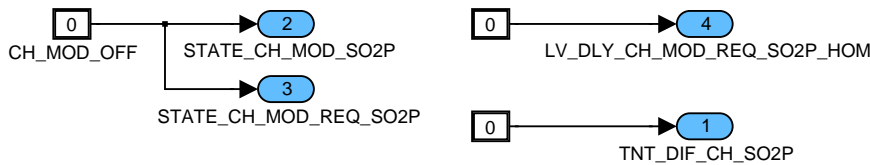


Figure 5.13.2: : Path: EXTC\_ISPCLMODSO0/INI/SUB

## 5.13.2 100 ms - Task

### 5.13.2.1 100 ms - Task - Subsystem

At deactivation of desulfation catalyst heating due to torque or vehicle speed threshold ( $STATE\_CH == 0$  and  $LV\_STATE\_CH\_SO2P\_ENA=1$ ) there is the possibility to request homogenous mode for a calibratable time.

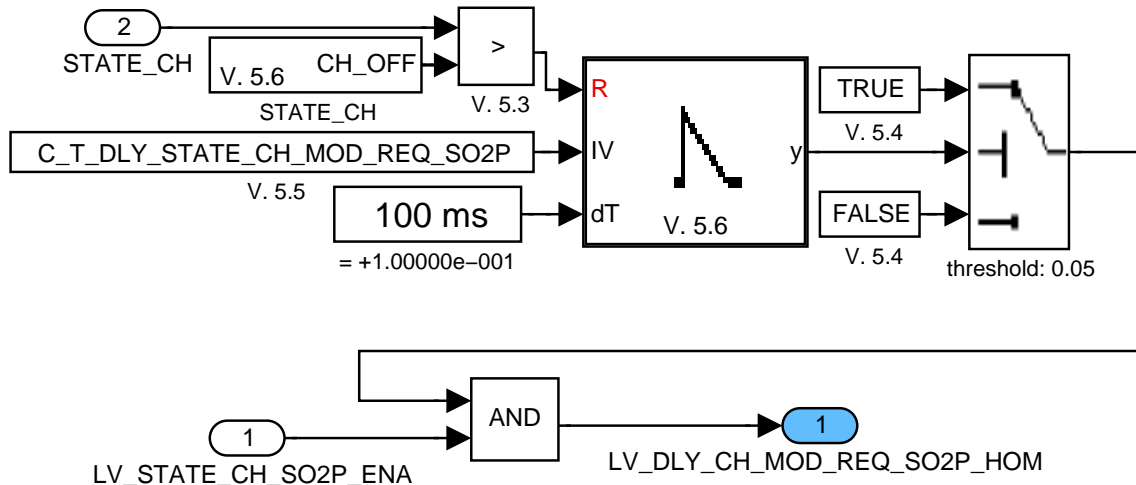


Figure 5.13.3: : Path: EXTC\_ISPCLMODSO0/operate\_100ms/SUB

## 5.13.3 Segment synchronous task

### 5.13.3.1 Segment synchronous task - Subsystem

TNT\_DIF\_CH\_SO2P is the difference between the NOx-trap temperature setpoint and the actual value. It is negative if there is necessity to heat. The ID and the calibration data for manual setting have other physical meaning as the output of the spec because for catalyst heating for desulfation only HOM and MPLH can be used.



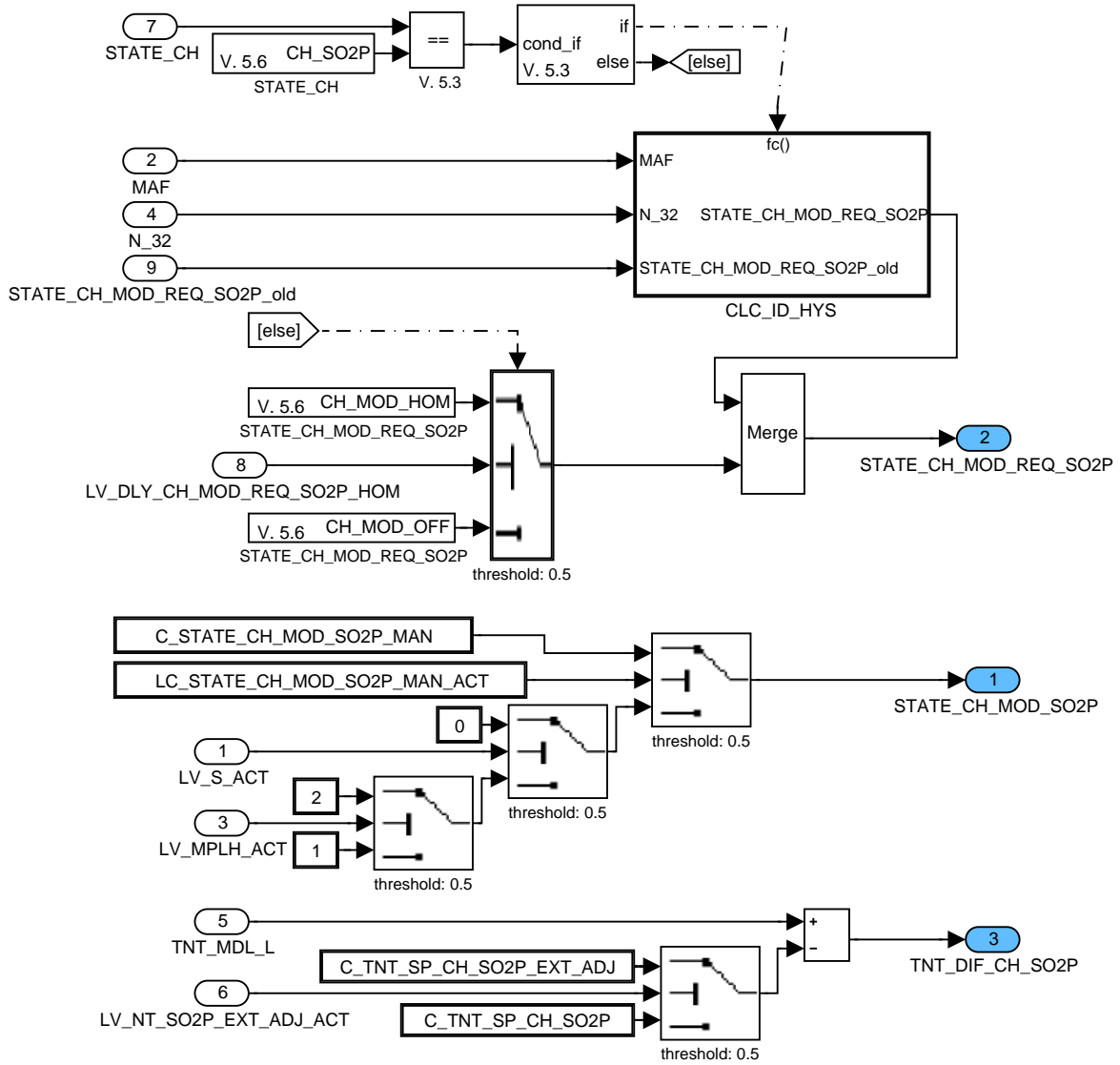


Figure 5.13.4: : Path: EXTC\_ISPCLMODSO0/operate\_SEG/SUB

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### 5.13.3.1.1 EXTC\_ISPCLMODSO0/OPERATE\_SEG/SUB/CLC\_ID\_HYS

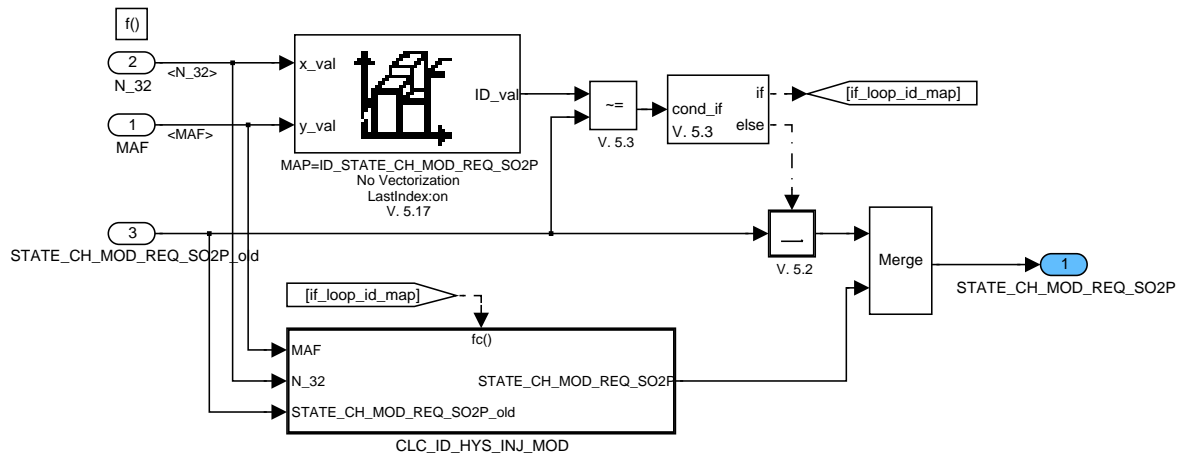


Figure 5.13.5: : Path: EXTC\_ISPCLMODSO0/operate\_SEG/SUB/CLC\_ID\_HYS

#### 5.13.3.1.1.1 Change of injection mode

The basic for the changing of the injection mode is the hysteresis of N\_32 and MAF to avoid the toggle between the injection modes. The actual values of N\_32 and MAF are detected by the corresponding breakpoints. These indexes are going to the map ID\_STATE\_CH\_MOD\_REQ\_SO2P. The hysteresis is calculated with the value of the corresponding breakpoint and the calibration constant. The changing of the injection mode is only possible after reaching the maximum threshold of the hysteresis. Example: Actual engine speed is 3000rpm. Corresponding breakpoint is 1632rpm. Calibration value is 200rpm. Result of the hysteresis is 1632rpm + 200rpm = 1832rpm. The calculation of MAF is the same.



## 5.14 Lambda testing for stratified mode

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_SP_S	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda setpoint for stratified mode					
LAMB_SP_S_RAW	V	0... 7FFFH	0... 31.99902	976.599e-6	-
Raw value lambda setpoint for stratified mode					

### Input data:

LAMB_SP_S_EXT {p. 8136}	LV_S_CLC {p. 1822}	MAF_SP_S {p. 805}	MFF_CP {p. 3700}
MFF_SP_S {p. 8243}	N_32 {p. 1525}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_LAMB_SP_S	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation filter constant for LAMB_SP_S filtering					
C_FAC_LAMB_AFS	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Air fuel stoichiometric factor (typical value 14.71)					
C_LAMB_SP_S_INI	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Initialization value for LAMB_SP_S after reset.					
LC_LAMB_SP_S_RAW_EXT	-	0... 1H	0...1	1	-
Switch between Layer and internal calculation of LAMB_SP_S					

## FUNCTION DESCRIPTION:

### General information:

The lambda LAMB\_SP\_S in stratified has to be limited to a minimum lambda value. If the lambda setpoint LAMB\_SP\_S is below the minimum threshold LAMB\_MIN\_S then the stratified combustion is not authorized.

### Description:

### Application conditions

**Activation:**  $LV\_S\_CLC = 1$

**Deactivation:**  $LV\_S\_CLC = 0$

**Initialization:** at reset:  
 $LAMB\_SP\_S(n-1) = C\_LAMB\_SP\_S\_INI$   
 at the transition of LV\_S\_CLC from 0 to 1:  
 LAMB\_SP\_S\_RAW has to be calculated for the initialization.  
 $LAMB\_SP\_S(n-1) = LAMB\_SP\_S\_RAW.$


**Update rate:** 10 ms

**Formula section:**

```

IF          LC_LAMB_SP_S_RAW_EXT = 0
Then       LAMB_SP_S_RAW      =
          MAF_SP_S /(C_FAC_LAMB_AFS * (MFF_SP_S + MFF_CP))
ELSE      LAMB_SP_S_RAW      = LAMB_SP_S_EXT ("from Layer")
endif
LAMB_SP_S(n) =
C_CRLC_LAMB_SP_S * (LAMB_SP_S_RAW - LAMB_SP_S(n-1)) + LAMB_SP_S(n-1)

```

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## 5.15 Combustion state manager (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_AFL_CLC	O/V		-	-	-
Logical variable for the deactivation of all AFL- mode relevant modules.					
LV_INH_AFL	O/V		-	-	-
Inhibit of AFL mode due to project specific requests.					
LV_INH_S	O/V		-	-	-
Inhibit of stratified mode due to project specific requests.					
LV_S_CLC	O/V		-	-	-
Logical variable for the deactivation of all stratified mode relevant modules.					

### Input data:

LV_BRAKE_REQ {p. 799}	LV_ERR_EGR {p. 801}	LV_ERR_FPS {p. 801}	LV_ERR_NOX_SENS_ CAN_BOFF {p. 991}
LV_ERR_PORT [NC_PORTPWM] {p. 801}	LV_FPAPWM_DIAG_AFS_ REQ {p. 803}	LV_INH_S_MAN {p. 803}	LV_MIS_STATE_A {p. 6238}
LV_MIS_STATE_B {p. 6238}	LV_SAWUP {p. 804}	LV_TEMP_BOL {p. 805}	N_32 {p. 1525}
STATE_CMB_CTL {p. 8137}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_AFL_CLC	-	0... FFH	0... 8160	32	rpm
Engine speed limit for the deactivation of the AFL mode related modules.					
C_N_AFL_CLC_HYS	-	0... FFH	0... 8160	32	rpm
Engine speed hysteresis for the deactivation of the AFL mode related modules.					
C_N_S_CLC	-	0... FFH	0... 8160	32	rpm
Engine speed limit for the deactivation of the stratified mode related modules.					
C_N_S_CLC_HYS	-	0... FFH	0... 8160	32	rpm
Engine speed hysteresis for the deactivation of the stratified mode related modules.					


### FUNCTION DESCRIPTION:

There are several project specific requests to inhibit the stratified and AFL mode. Within this function all these requests lead to the bits LV\_INH\_S and LV\_INH\_AFL to simplify the combustion manager.

To reduce the processor load all stratified mode related modules shall no longer be calculated, if LV\_S\_CLC = 0. All AFL-mode relevant modules including the combustion manager shall no longer be calculated, if LV\_AFL\_CLC = 0.

### Application conditions

**Initialisation:** at reset: LV\_INH\_S = 1  
LV\_INH\_AFL = 1  
LV\_S\_CLC = 1  
LV\_AFL\_CLC = 1

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**Recurrence:** 10 ms

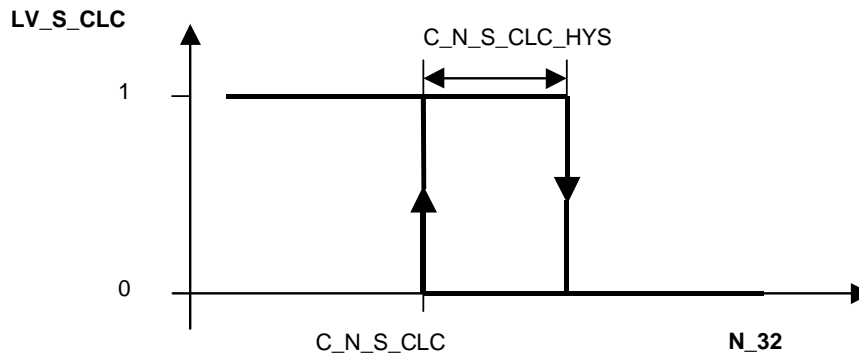
**Activation:** every engine state

**Deactivation:** -

**Formula section:**

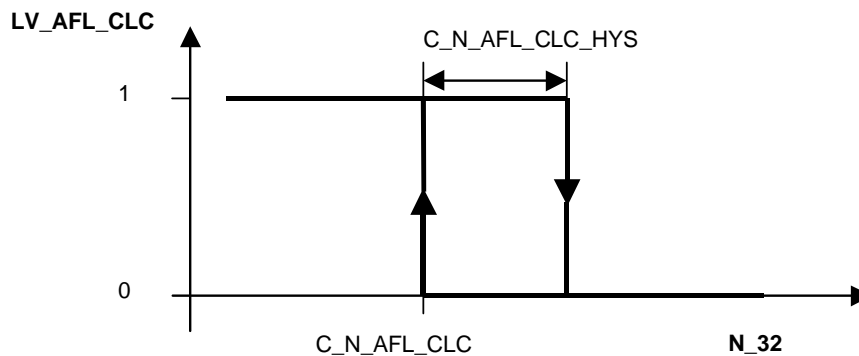
**Definition of LV\_S\_CLC:**

This calculation will only be done if the STATE\_CMB\_CTL = HOM\_AFS.



**Definition of LV\_AFL\_CLC:**

This calculation will only be done if the STATE\_CMB\_CTL = HOM\_AFS.



**IF** LV\_INH\_S\_MAN or  
 LV\_MIS\_STATE\_A or  
 LV\_MIS\_STATE\_B or  
 LV\_ERR\_PORT or  
 LV\_ERR\_EGR or  
 LV\_ERR\_NOX\_SENS\_CAN\_BOFF or  
 LV\_ERR\_FPS or  
 LV\_ERR\_NOX\_SENS\_CAN\_MSG\_LOST\_i or  
 LV\_SAWUP or  
 LV\_FPAPWM\_DIAG\_AFS\_REQ or  
 LV\_BRAKE\_REQ or  
 LV\_TEMP\_BOL or  
**Not** LV\_S\_CLC or


**Then** LV\_INH\_S = 1  
**Else** LV\_INH\_S = 0

**IF** LV\_MIS\_STATE\_A or  
 LV\_MIS\_STATE\_B or  
 LV\_ERR\_PORT or  
 LV\_ERR\_EGR or  
 LV\_ERR\_NOX\_SENS\_CAN\_BOFF or  
 LV\_ERR\_FPS or  
 LV\_ERR\_NOX\_SENS\_CAN\_MSG\_LOST\_i or  
 LV\_SAWUP or  
 LV\_FPAPWM\_DIAG\_AFS\_REQ or  
 LV\_BRAKE\_REQ or  
 LV\_TEMP\_BOL or  
**Not** LV\_AFL\_CLC or  
**Then** LV\_INH\_AFL = 1  
**Else** LV\_INH\_AFL = 0

### 5.15.1 Variables of Non implemented Functions for combustion management

Initialisation:

NT\_AGI\_S\_RED = 0 (if functionality is not implemented yet)  
 LV\_NT\_STC\_MAX\_ACT = 0 (if functionality is not implemented yet)  
 LV\_PUC\_INH\_TEMP\_CAT = 0 (if functionality is not implemented yet)  
 MFF\_CP = 0 mg/stk (if functionality is not implemented yet)

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## 5.16 Run time optimization by recurrency switch

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CLC_2SEG	O/V	0... 1H	0 ...1	1	-
Toggle-Bit for activation/deactivation of the segment synchronously calculation					
LV_CLC_2SEG_ENA	O/V	0... 1H	0 ...1	1	-
Activation flag for correction modes for non segment synchronously calculation					

### Input data:

N_32 {p. 1525}			
----------------	--	--	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_SEG_2_ENA	V	0... FFH	0... 8160	32	rpm
engine speed threshold for the activation of the calculation recurrence change to every second segment					

### General information

At a high engine speed, run time problems may occur. Overstepping a certain engine speed threshold, the Toggle-Bit created in this module can evoke modules calculated segment synchronously to switch to a recurrency of every second segment.

### Application conditions:

**Initialisation:** LV\_CLC\_2SEG = 0; LV\_CLC\_2SEG\_ENA = 0

**Activation:** every other engine state

**Deactivation:** engine stopped or engine start detected: LV\_ES = 1 or LV\_ST = 1

**Recurrence:** every segment

### Function description:

#### Formula section:

##### Activation of Toggle-Bit:

As soon as the engine speed exceeds a threshold C\_N\_SEG\_2\_ENA, the Toggle-Bit LV\_CLC\_2SEG gets activated and changes its value from zero to one the next segment and back to zero again the subsequent segment.

##### Activation of Correction-Bit:

At the same time, the bit LV\_CLC\_2SEG\_ENA is set to one. This bit enables calculation corrections in files that use a segment counter or have to be corrected by any other influences caused by a calculation recurrence only every second segment.


##### Deactivation:

The deactivation of both bits is done as soon as the engine speed threshold is underspent again.

```


if N_32 > C_N_SEG_2_ENA
then   LV_CLC_2SEG_ENA   = 1
        LV_CLC_2SEG      = 0 → 1 → 0 → 1 → 0 → 1 → 0 → ... (toggling)
else   LV_CLC_2SEG_ENA = 0
        LV_CLC_2SEG      = 0
endif

```

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# 6 - Ignition

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## 6.1 Ignition angle general

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA [NC_CYL_NR]	O/V	0... FFH	0... 60	0.375	°CRK
Basic ignition angle application correction and knock control included					
IGA_AV_H_RNG [NC_CYL_NR]	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
Homogeneous ignition angle in wide range applied on cylinder x					
IGA_AV_H_RNG_1 [NC_CYL_NR]	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
Intermediate ignition angle in wide range till gradient limitation after start is terminated					
IGA_AV_H_RNG_HOMS [NC_CYL_NR]	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
Homogeneous ignition angle in wide range applied on cylinder x					
IGA_AV_H_RNG_S [NC_CYL_NR]	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
homogeneous ignition angle in high range applied on cylinder x					
IGA_AV_MV_CAN_H_RNG	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
Mean value of actual ignition angle in wide range					
IGA_AV_MV_CBK_H_RNG [NC_CBK_EX_NR]	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
Mean value of actual ignition angle bank selective in wide range					
IGA_AV_MV_H_RNG	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
Mean value of actual ignition angle in wide range					
IGA_MIN_CBK_H_RNG [NC_CBK_EX_NR]	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
Minimum ignition angle in wide range bank selective					
IGA_MIN_H_RNG	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
Minimum ignition angle in wide range					
IGA_SP_MAX_1_CAN_H_RNG	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
Maximum ignition angle depending on torque intervention in wide range					
IGA_SP_MAX_1_CBK_H_RNG [NC_CBK_EX_NR]	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
Maximum ignition angle depending on torque intervention in wide range bank selective					
IGA_WOUT_KNK [NC_CYL_NR]	O/V	0... FFH	0... 60	0.375	°CRK
Actual ignition angle (incl. application corrections without knock interception)					
LV_IGA_GRD_ACT	O/V	0... 1H	0 ...1	1	-
Flag for ignition angle gradient limitation out of start active					

### Input data:

IGA_ADD_CMB_CTL [NC_CYL_NR] {p. 8266}	IGA_ADJ_KNK [NC_CYL_NR] {p. 1960}	IGA_AV_H_RNG_HOMS_1 [NC_CYL_NR] {p. 8266}	IGA_AV_H_RNG_S_1 [NC_CYL_NR] {p. 8266}
IGA_BAS_COR_CBK [NC_CBK_EX_NR] {p. 8266}	IGA_DIF_MIN_H_RNG {p. 1925}	IGA_IS_TQ_KNK {p. 8304}	IGA_REF_COR_CBK [NC_CBK_EX_NR] {p. 8266}
IGA_SP_CBK_CAN_H_RNG [NC_CBK_EX_NR] {p. 1948}	IGA_SP_CBK_H_RNG [NC_CBK_EX_NR] {p. 1948}	IGA_ST {p. 1912}	IGA_TRA_KNK {p. 798}
LV_ES {p. 1720}	LV_N_MAX_ETC_LIH {p. 1148}	LV_ST {p. 1720}	N {p. 1525}
TCO {p. 1100}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_IGA_AS	-	80... 7FH	0... 47.625	0.375	°CRK
Spark retard by application system global					
C_IGA_AS_CYL [NC_CYL_NR]	-	80... 7FH	0... 47.625	0.375	°CRK
Spark retard by application system cylinderindividual					
C_IGA_INI_H_RNG	-	FA60... 5A0H	0... 90	0.0625	°CRK
Init value for ignition angle in wide range					
C_IGA_MAN_H_RNG	-	FA60... 5A0H	0... 90	0.0625	°CRK
Absolute spark retard input by application system in wide range					
C_IGA_MIN_ETC_LIH	-	0... FFH	0... 60	0.375	°CRK
Absolute possible spark retard at ETC LIH					
C_N_MAX_IGA_10MS_CLC	-	0... 1FE0H	0... 8160	1	rpm
Max. engine speed threshold above which the 10ms tasks are deactivated					
IP_IGA_LGRD_AST	-	0... FFH	0... 95.625	0.375	°CRK
LDPM_TCO_1_IGSP	8	0... FEH	0... 142.5	0.75	°C
Gradient limitation IGA after start phase					
LC_IGA_MAN	-	0... 1H	0 ...1	1	-
Switch for absolute spark retard input by application system					
LC_IGA_ST_ENA	-	0... 1H	0 ...1	1	-
Logical constant for separated start ignition angle					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CBK_EX_NR	-	1... 4H	1 ...4	1	-
Number of exhaust cylinder banks					
NC_CYL_NR	-	1... 8H	1 ...8	1	-
count of cylinder					

**6.1.1 IGSP\_M6001****General information:**

This module coordinates different ignition angle requests and calculates the ignition angles IGA\_AV\_H\_RNG[x] and IGA\_AV\_H\_RNG\_S[x].

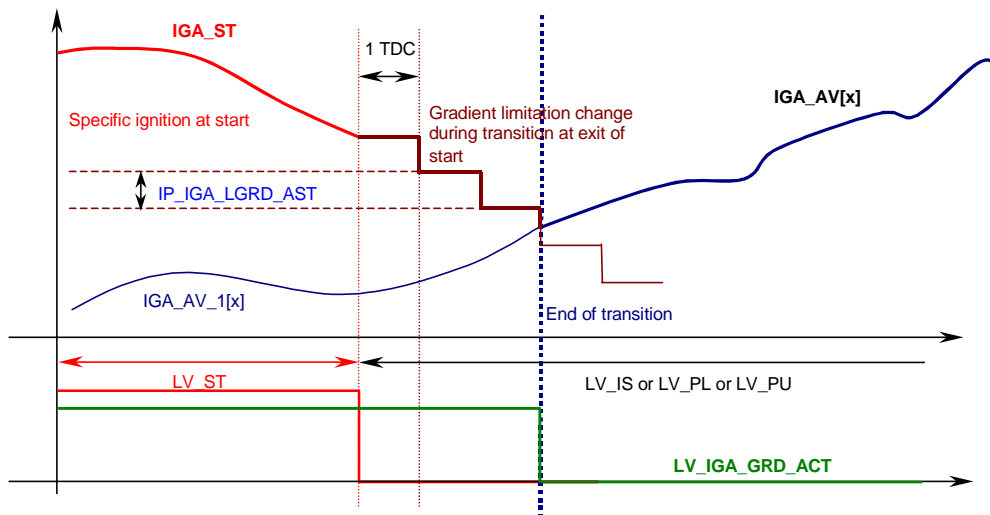
IGA\_SP is the output from the torque management functions to realize the torque setpoint. IGA\_SP is limited to IGA\_MIN the minimum ignition angle which can be applied to the engine.

IGA\_BAS\_COR is the corrected basic igniton angle which is realized normally if no other requests like knock control or torque requests (via IGA\_SP) requires a retarded ignition angle.

The reference ignition angle IGA\_REF\_COR is a theoretical ignition angle at maximum engine torque. It is the reference value to all ignition angles to calculate the ignition angle differences (IGA\_DIF\_XXX) for the calculation of EFF\_IGA\_XXX values.

According to application choice (through logical application incidence flag LC\_IGA\_ST\_ENA) the ignition angle during start phase is not managed through the torque but by the specific value IGA\_ST. In this case, the corresponding ignition efficiencies are set to 1. At the end of start phase the transition from IGA\_ST to the set point ignition delivered by torque calculation IGA\_AV\_1[x] is approached through a gradient limitation (the ignition gradient step is calibrateable).

This module delivers the homogeneous ignition angle IGA\_AV\_H\_RNG[x] and the stratified ignition angle IGA\_AV\_H\_RNG\_S[x] for the MSD70 project in IGRE. For the MSV70, the stratified ignition angle is a copy of the homogeneous one. Therefore, this HOM /S switch is also visible in MSV70, but effectiv.



Picture: example for transition after start with IGA gradient limitation

Application conditions:

Initialisation: IGA\_AV\_H\_RNG[x] = C\_IGA\_INI\_H\_RNG at reset  
 IGA\_MIN = 90 °crk at reset  
 LV\_IGA\_GRD\_ACT = 0 at engine stalling

Recurrence: every 10 ms and every TDC

Activation: at every engine operating state

Deactivation:

**Application Condition**

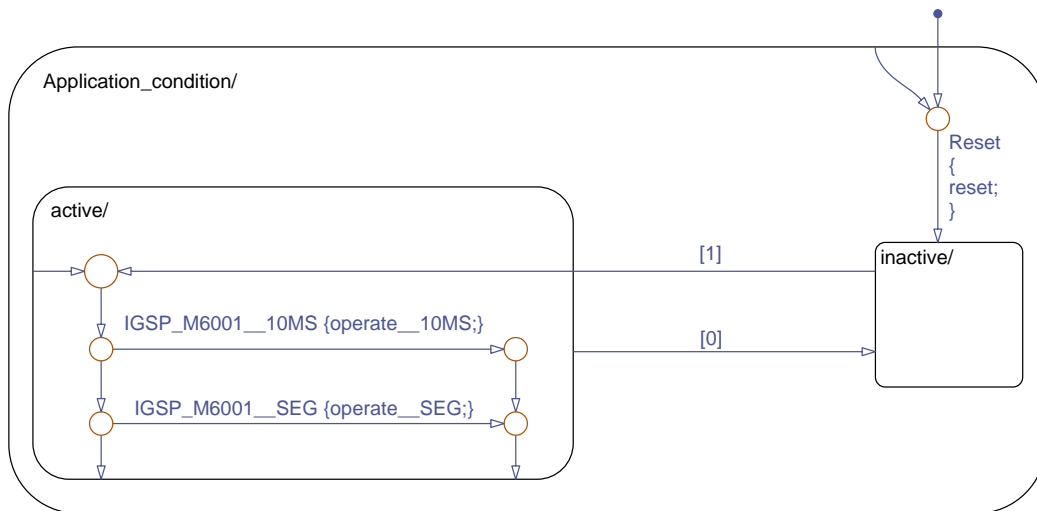


Figure 6.1.1: IGSP\_M6001/APP\_CDN/APPCND

**Function Description**

Released by Tettenborn Frank		Date 2013-02-13	File 43600104.00E
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 1830 of 8404	
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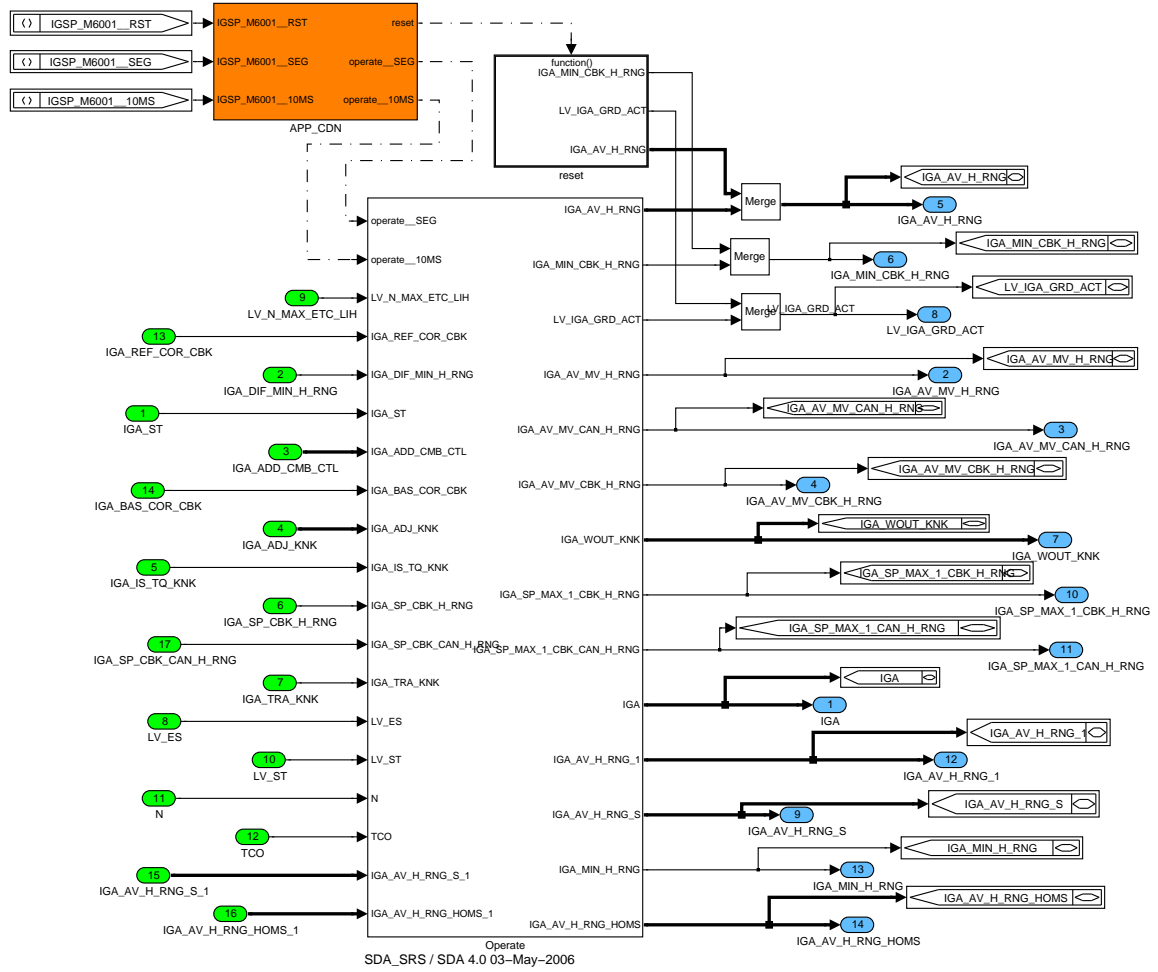


Figure 6.1.2: IGSP\_M6001

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### 6.1.1.1 SUBFUNCTION: Operate

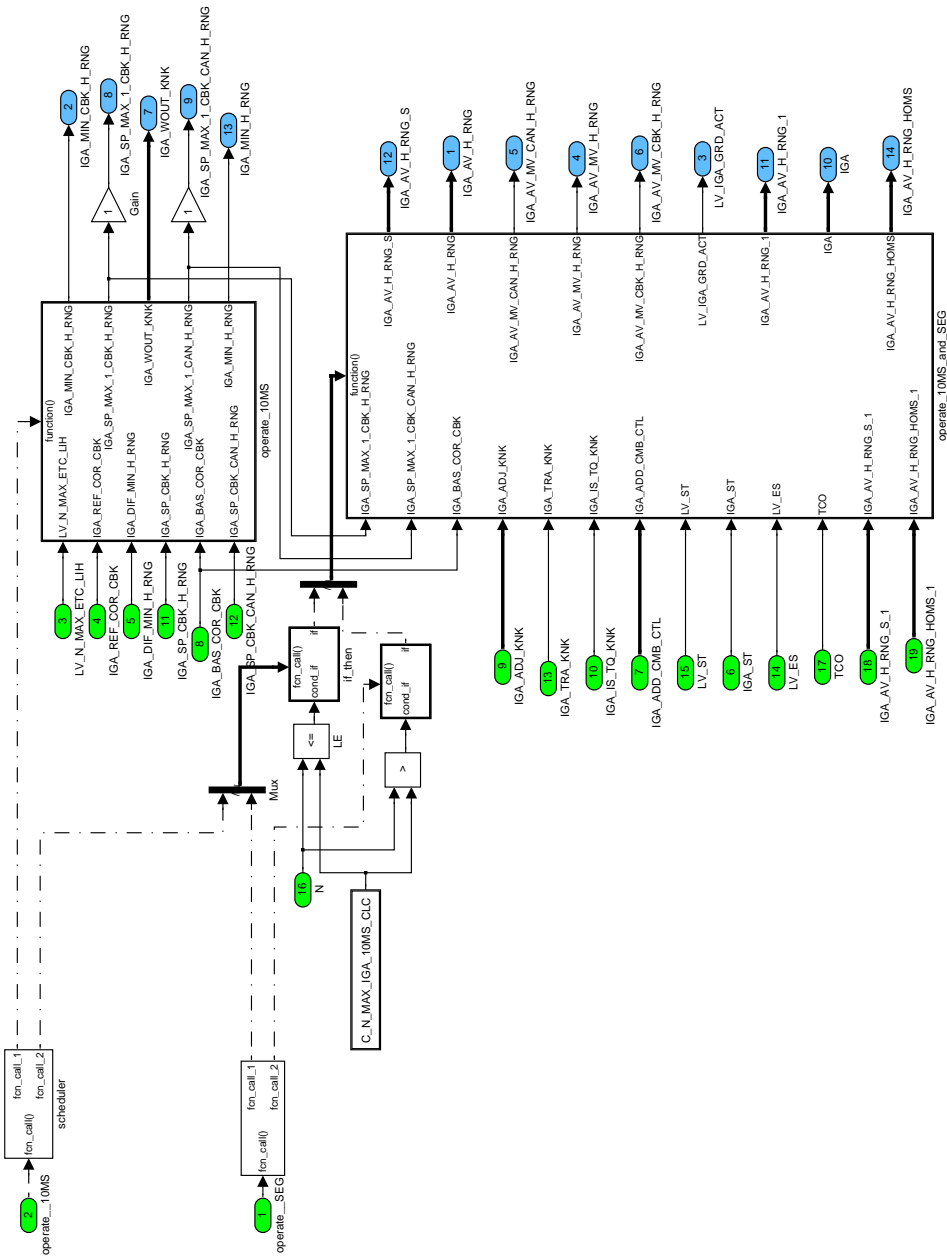


Figure 6.1.3: IGSP\_M6001/Operate

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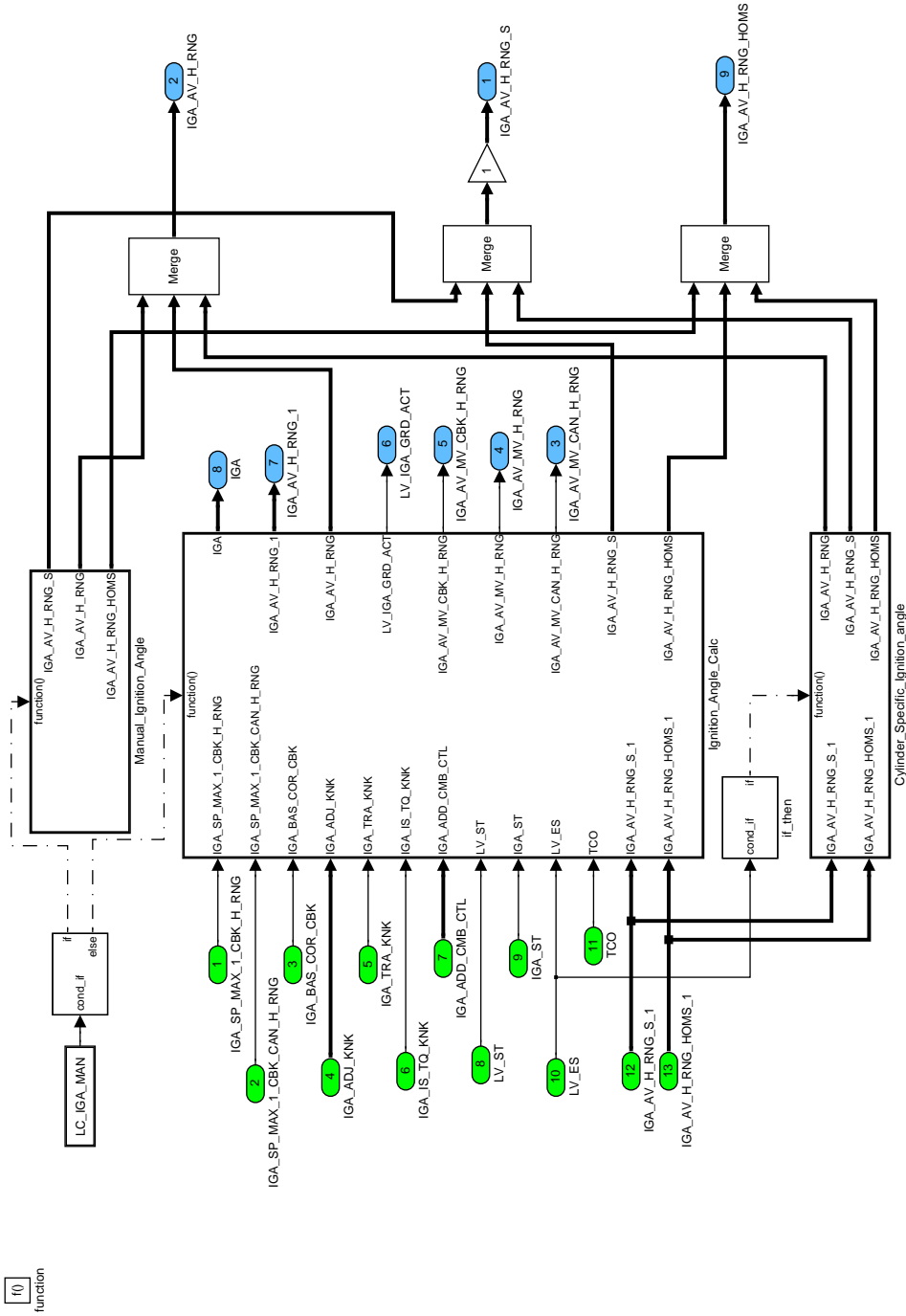


Figure 6.1.6: IGSP\_M6001/Operate/operate\_10MS\_and\_SEG

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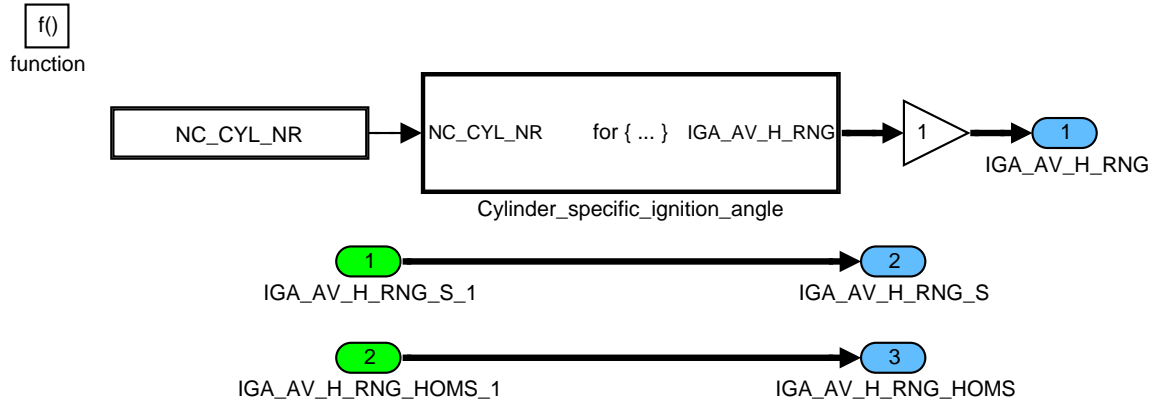


Figure 6.1.7: IGSP\_M6001/Operate/operate\_10MS\_and\_SEG/Cylinder\_Specific\_Ignition\_angle

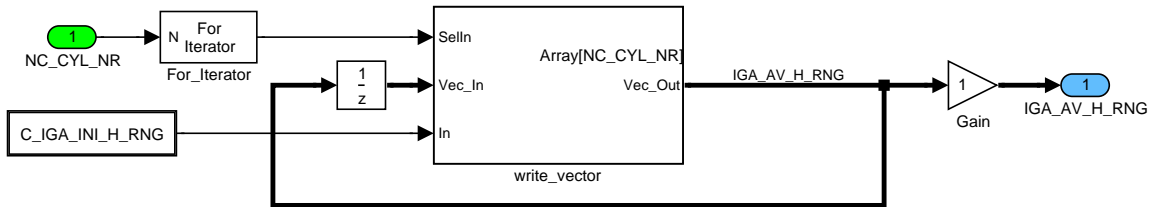


Figure 6.1.8: IGSP\_M6001/Operate/operate\_10MS\_and\_SEG/Cylinder\_Specific\_Ignition\_angle/  
Cylinder\_specific\_ignition\_angle

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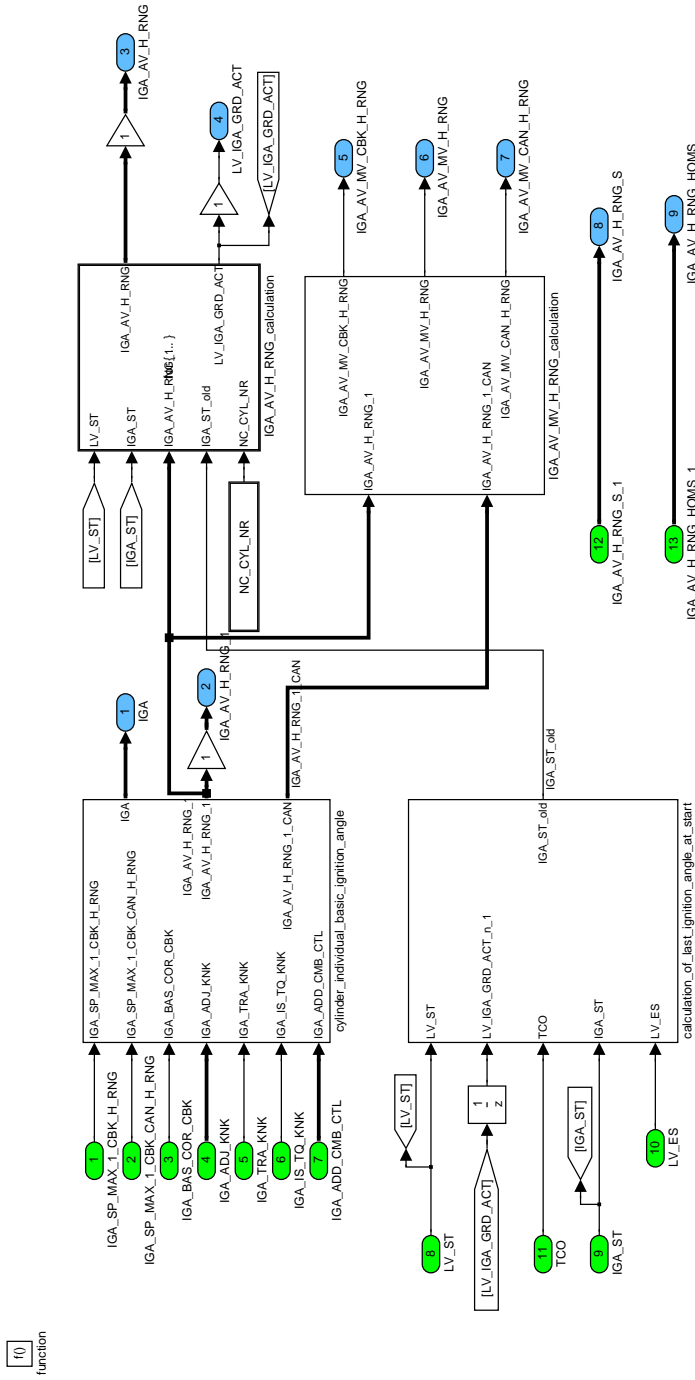


Figure 6.1.9: IGSP\_M6001/Operate/operate\_10MS\_and\_SEG/Ignition\_Angle\_Calc

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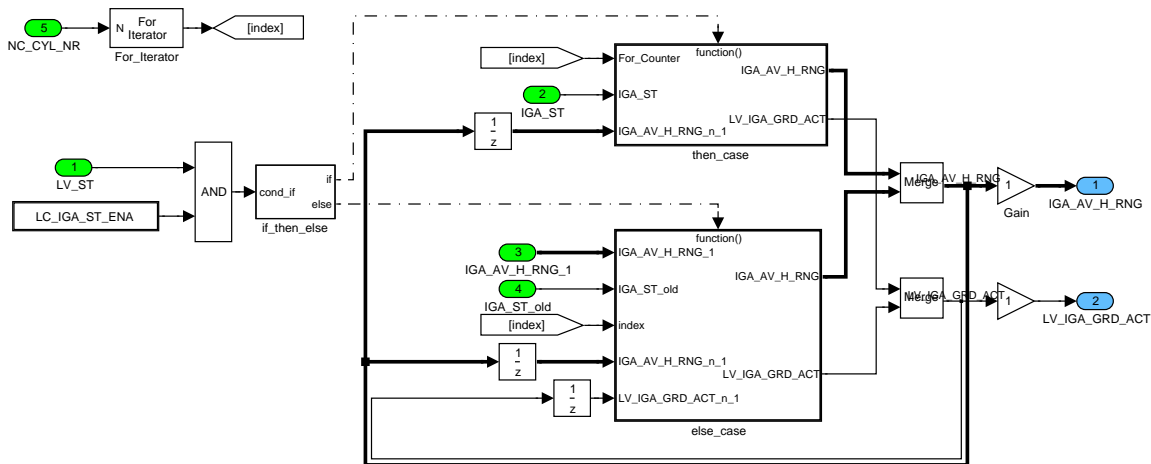


Figure 6.1.10: IGSP\_M6001/Operate/operate\_10MS\_and\_SEG/ignition\_Angle\_Calc/IGA\_AV\_H\_RNG\_calculation

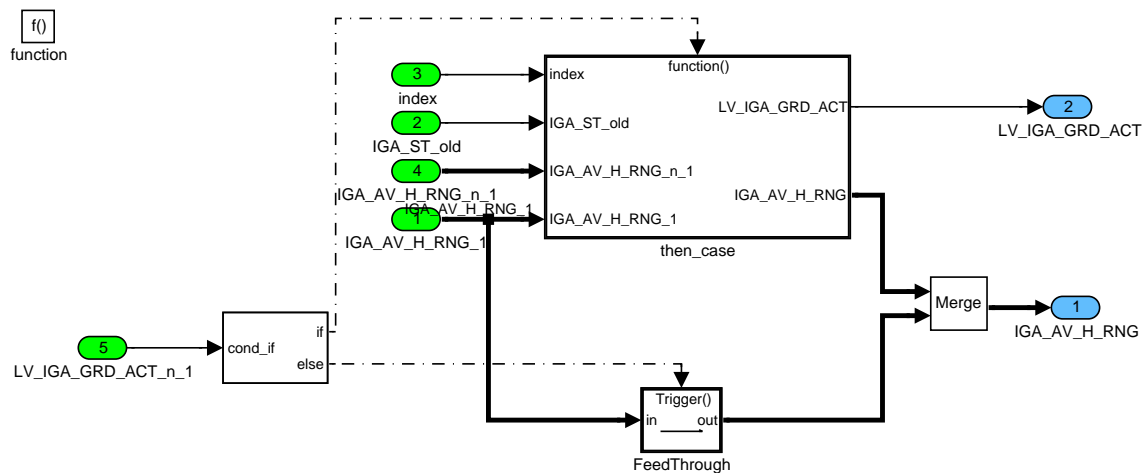


Figure 6.1.11: IGSP\_M6001/Operate/operate\_10MS\_and\_SEG/ignition\_Angle\_Calc/IGA\_AV\_H\_RNG\_calculation/else\_case

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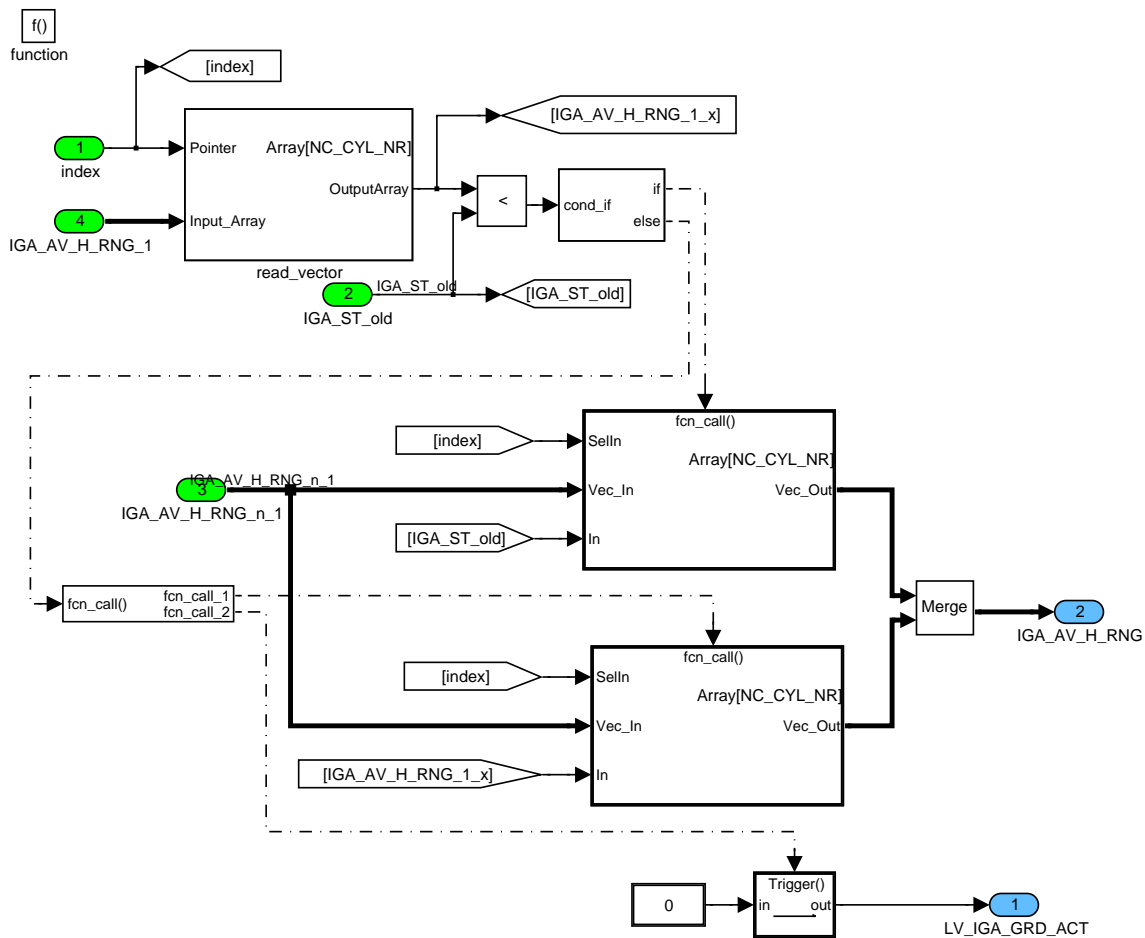


Figure 6.1.12: IGSP\_M6001/Operate/operate\_10MS\_and\_SEG/Ignition\_Angle\_Calc/I  
IGA\_AV\_H\_RNG\_calculation/else\_case/then\_case

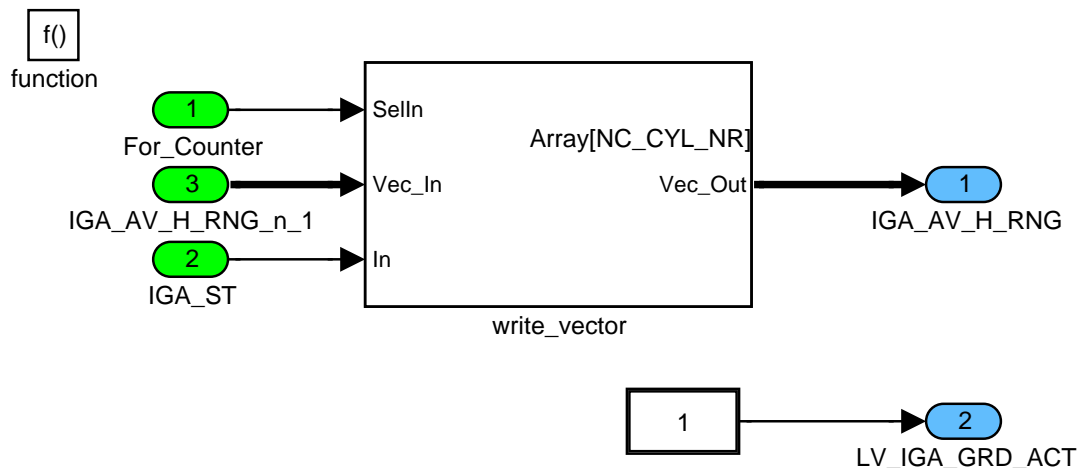


Figure 6.1.13: IGSP\_M6001/Operate/operate\_10MS\_and\_SEG/Ignition\_Angle\_Calc/I  
IGA\_AV\_H\_RNG\_calculation/then\_case

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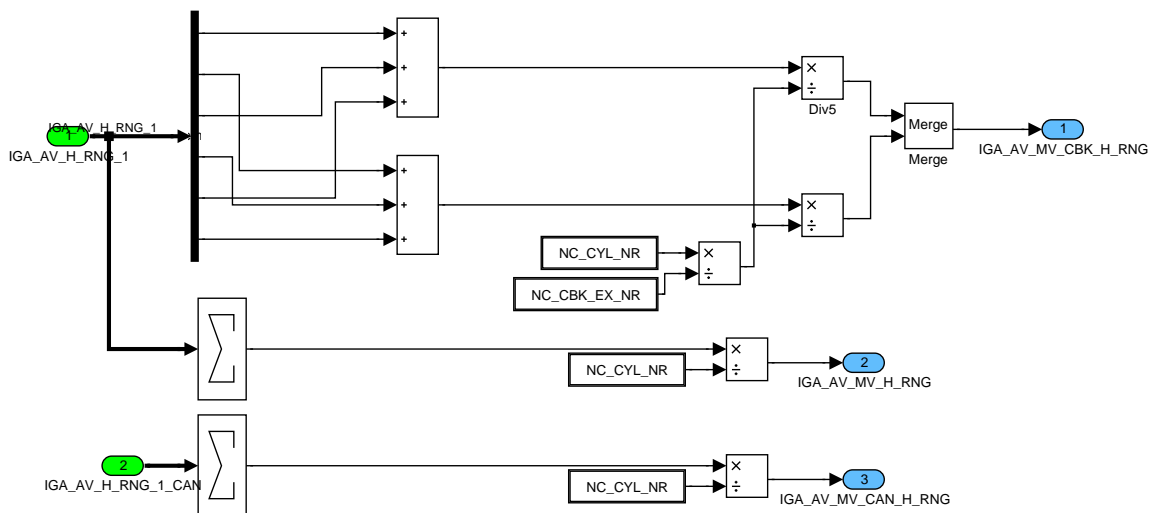


Figure 6.1.14: IGSP\_M6001/Operate/operate\_10MS\_and\_SEG/Ignition\_Angle\_Calc/ IGA\_AV\_MV\_H\_RNG\_calculation

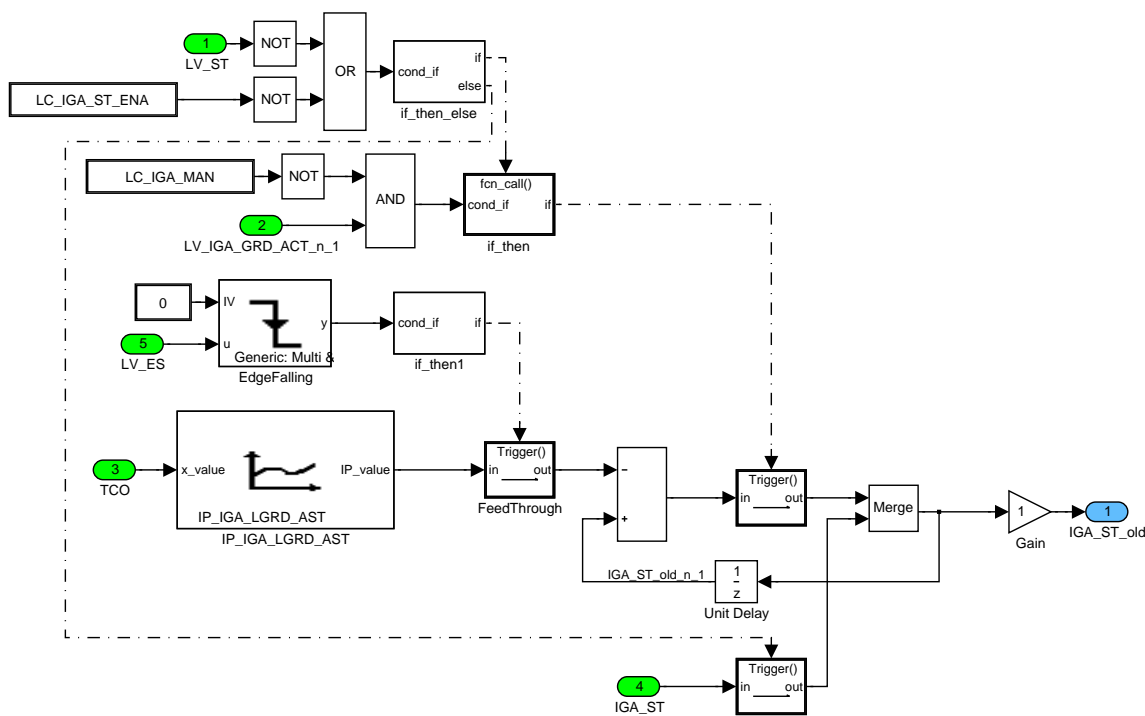


Figure 6.1.15: IGSP\_M6001/Operate/operate\_10MS\_and\_SEG/Ignition\_Angle\_Calc/ calculation\_of\_last\_ignition\_angle\_at\_start

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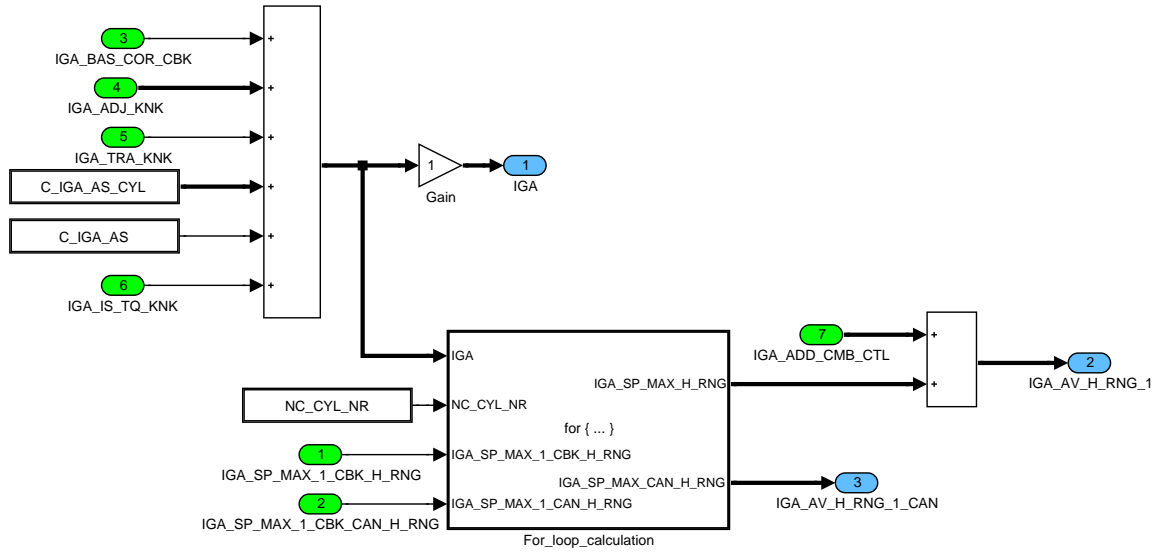


Figure 6.1.16: IGSP\_M6001/Operate/operate\_10MS\_and\_SEG/ignition\_angle\_calc/cylinder\_individual\_basic\_ignition\_angle

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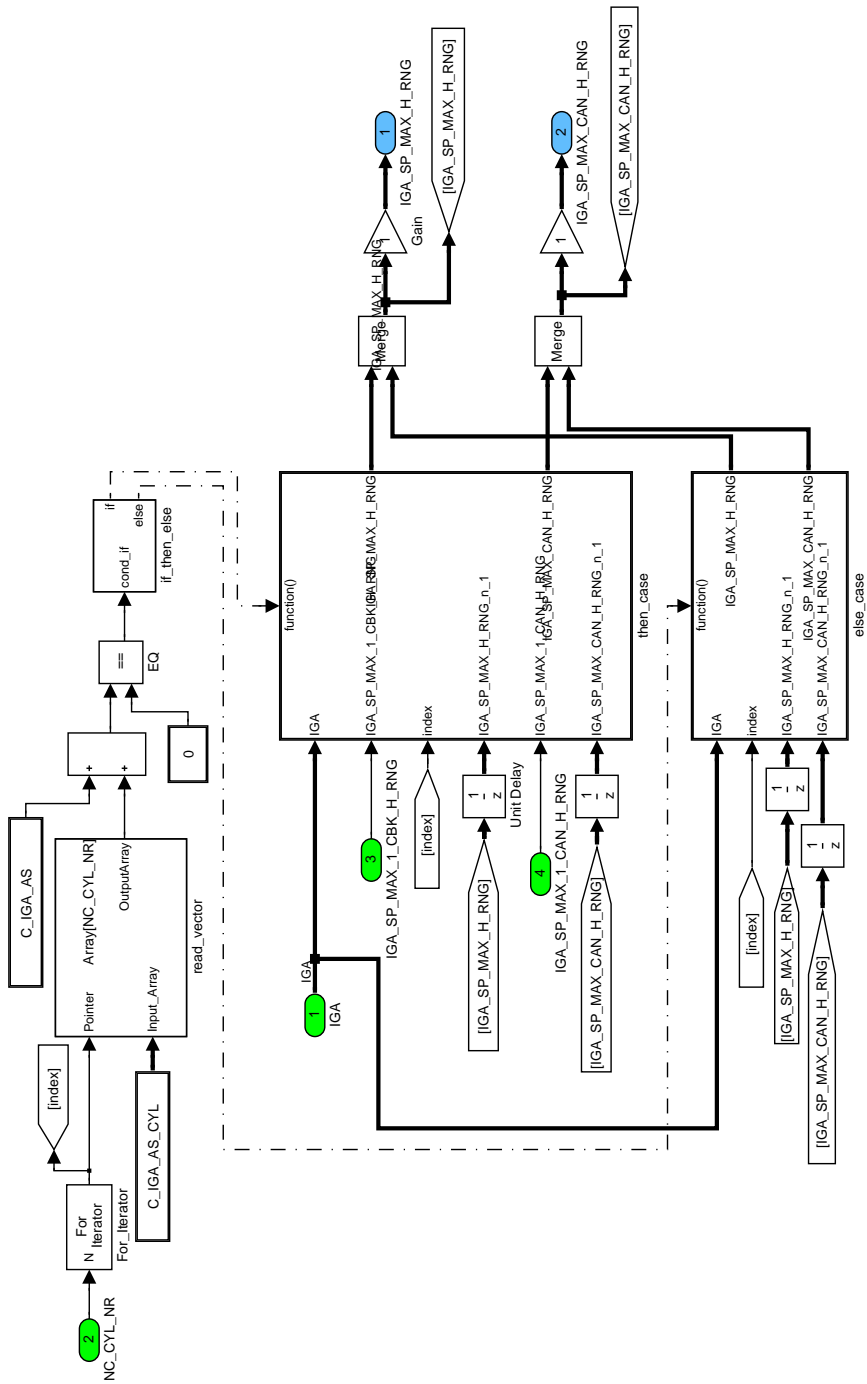


Figure 6.1.17: IGSP\_M6001/Operate/operate\_10MS\_and\_SEG/Ignition\_Angle\_Calc/cylinder\_individual\_basic\_ignition\_angle/For\_loop\_calculation

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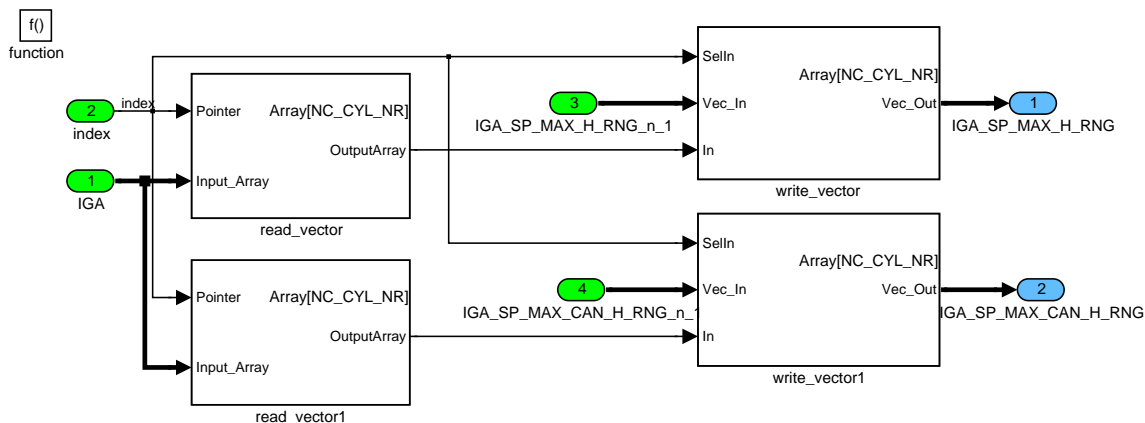


Figure 6.1.18: IGSP\_M6001/Operate/operate\_10MS\_and\_SEG/Ignition\_Angle\_Calc/cylinder\_individual\_basic\_ignition\_angle/For\_loop\_calculation/else\_case

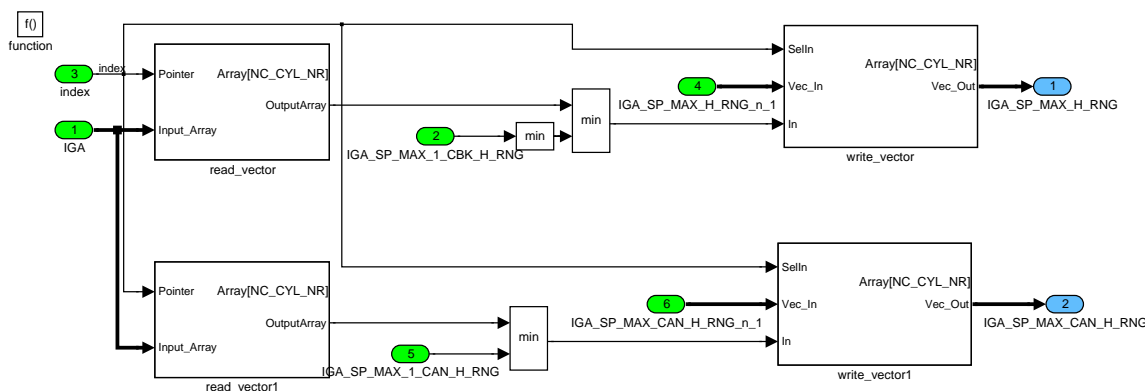


Figure 6.1.19: IGSP\_M6001/Operate/operate\_10MS\_and\_SEG/Ignition\_Angle\_Calc/cylinder\_individual\_basic\_ignition\_angle/For\_loop\_calculation/then\_case

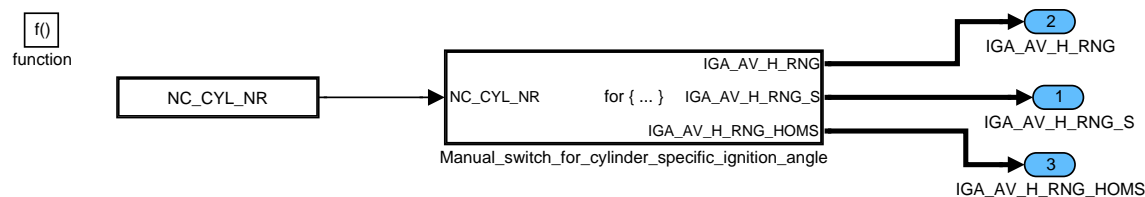


Figure 6.1.20: IGSP\_M6001/Operate/operate\_10MS\_and\_SEG/Manual\_Ignition\_Angle

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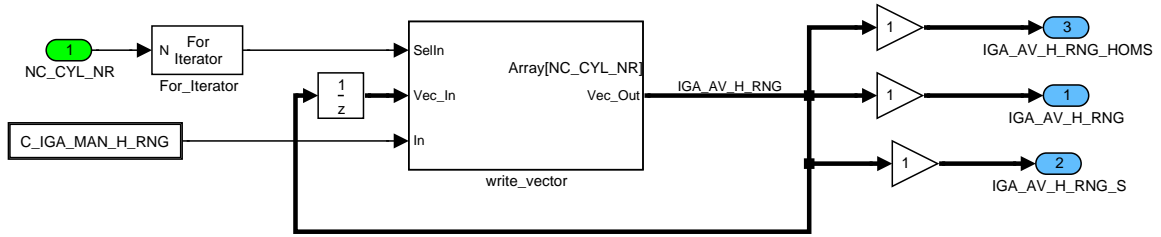


Figure 6.1.21: IGSP\_M6001/Operate/operate\_10MS\_and\_SEG/Manual\_Ignition\_Angle/Manual\_switch\_for\_cylinder\_specific\_ignition\_angle

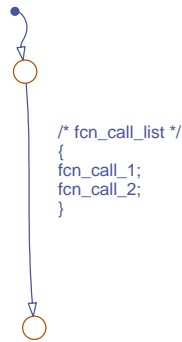



Figure 6.1.22: IGSP\_M6001/Operate/scheduler2/module\_scheduler

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 1843 of 8404</b>	
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### 6.1.1.2 SUBFUNCTION: reset

f()  
function

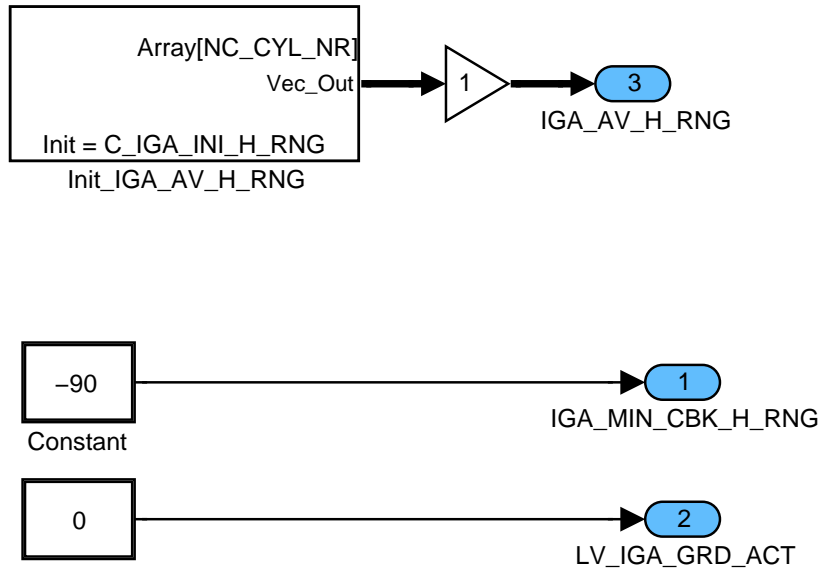


Figure 6.1.23: IGSP\_M6001/reset

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## 6.2 Ignition angle efficiency

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_IGA_AV	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
Ignition efficiency actual ignition angle bank selective					
EFF_IGA_AV_CAN	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
Ignition efficiency actual ignition angle for CAN					
EFF_IGA_AV_CBK [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
Ignition efficiency actual ignition angle bank selective					
EFF_IGA_BAS_COR	O/V	0... FFFFH	0... 1.999969	305.176e3	-
Ignition efficiency basic ignition angle					
EFF_IGA_BAS_COR_CBK [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
Ignition efficiency basic ignition angle (Bank selective)					
EFF_IGA_BAS_COR_KNK_FIL	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
Ignition efficiency referenced to IGA_BAS_COR_KNK_FIL					
EFF_IGA_MIN	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
Ignition efficiency minimum ignition angle					
EFF_IGA_MIN_TEG	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
possible ignition efficiency minimum according to the exhaust gas temperature					
EFF_IGA_SEG_AV	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
Ignition efficiency actual ignition angle segment synchronous					
FAC_EFF_IGA	O/V	0... FFH	0... 11.22	0.044	-
Factor for basic ignition efficiency correction depending on engine operation mode					
FAC_EFF_IGA_CH_COR	O/V	0... FFH	0... 11.22	0.044	-
Factor for basic ignition efficiency correction depending on engine operation mode					
IGA_BAS_COR_KNK_ADD	V	0... FFH	0... 60	0.375	°CRK
Basic corrected ignition angle knock mean value IGA_MV_ADJ_KNK included					
IGA_BAS_COR_KNK_FIL_CBK [NC_CBK_EX_NR]	V	0... FFH	0... 60	0.375	°CRK
Corrected basic ignition angle with mean knock correction bank selective					
IGA_DIF_AV_CAN_H_RNG	V	0... B40H	0 ...0	0.0625	°CRK
Difference of actual ignition angle to reference ignition angle for CAN					
IGA_DIF_AV_CBK_H_RNG [NC_CBK_EX_NR]	V	0... B40H	0 ...0	0.0625	°CRK
Difference of actual ignition angle to reference ignition angle bank selective					
IGA_DIF_AV_H_RNG	V	0... B40H	0 ...0	0.0625	°CRK
Difference of actual ignition angle to reference ignition angle					
IGA_DIF_BAS_CBK [NC_CBK_EX_NR]	V	0... FFH	0 ...0	0.375	°CRK
Difference of basic ignition angle to reference ignition angle bank selective					
IGA_DIF_BAS_KNK_FIL	O/V	0... FFH	0 ...0	0.375	°CRK
Difference of IGA_BAS_COR_KNK_FIL to reference ignition angle					
IGA_DIF_SEG_AV_H_RNG	V	0... B40H	0 ...0	0.0625	°CRK
Difference of actual ignition angle to reference ignition angle segment synchronous					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA_MV_KNK_FIL	V	80... 7FH	0... 47.625	0.375	°CRK
Filtered mean knock correction					

**Input data:**

FAC_CAM_CH {p. 8379}	FAC_EFF_IGA_CH {p. 8379}	FAC_EFF_IGA_SCAV {p. 8379}	FAC_EFF_IGA_SECU {p. 8379}
FAC_IGA_OPM_SEL {p. 8266}	FAC_MAF_REL {p. 8277}	IGA_AV_MV_CAN_H_RNG {p. 1828}	IGA_AV_MV_CBK_H_RNG [NC_CBK_EX_NR] {p. 1828}
IGA_AV_MV_H_RNG {p. 1828}	IGA_BAS_COR_CBK [NC_CBK_EX_NR] {p. 8266}	IGA_DIF_MIN_H_RNG {p. 1925}	IGA_DIF_MIN_TEG_H_RNG {p. 1939}
IGA_MV_CBK_ADJ_KNK [NC_CBK_EX_NR] {p. 1960}	IGA_REF_COR_CBK [NC_CBK_EX_NR] {p. 8266}	LC_IGA_ST_ENA {p. 1829}	LV_IS {p. 1720}
LV_ST {p. 1720}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_IGA_KNK	-	0... FFH	0... 0.99609375	0.00390625	-
Correlation constant knock correction filter					
IP_EFF_IGA	-	0... 4E20H	0... 100	0.005	%
LDP_IGA_DIF_IP_EFF_IGA	16	0... B40H	0 ...0	0.0625	°CRK
Basic Ignition Angle Efficiency					
IP_FAC_EFF_IGA_CH_COLD_IS_OPM_1	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_8_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_5_TQDR	10	0... BB8H	0... 300	0.1	%
Factor for catalyst heating cold engine during IS in normal mode					
IP_FAC_EFF_IGA_CH_COLD_IS_OPM_2	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_9_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_6_TQDR	10	0... BB8H	0... 300	0.1	%
Factor for catalyst heating cold engine during IS in throttled mode					
IP_FAC_EFF_IGA_CH_COLD_OPM_1	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_13_TQDR	12	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_1_TQDR	10	0... BB8H	0... 300	0.1	%
Factor for catalyst heating cold engine in normal mode					
IP_FAC_EFF_IGA_CH_COLD_OPM_2	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_16_TQDR	12	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_2_TQDR	10	0... BB8H	0... 300	0.1	%
Factor for catalyst heating cold engine in throttled mode					
IP_FAC_EFF_IGA_CH_IS_OPM_1	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_8_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_5_TQDR	10	0... BB8H	0... 300	0.1	%
Factor for catalyst heating warm engine during IS in normal mode					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_EFF_IGA_CH_IS_OPM_2	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_9_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_6_TQDR	10	0... BB8H	0... 300	0.1	%
Factor for catalyst heating warm engine during IS in throttled mode					
IP_FAC_EFF_IGA_CH_OPM_1	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_2_TQDR	12	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_1_TQDR	10	0... BB8H	0... 300	0.1	%
Factor for catalyst heating warm engine in normal mode					
IP_FAC_EFF_IGA_CH_OPM_2	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_11_TQDR	12	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_2_TQDR	10	0... BB8H	0... 300	0.1	%
Factor for catalyst heating warm engine in throttled mode					
IP_FAC_EFF_IGA_COLD_IS_OPM_1	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_21_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_11_TQDR	10	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency depending on cold engine, IS, and engine operation mode 1					
IP_FAC_EFF_IGA_COLD_IS_OPM_2	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_22_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_12_TQDR	8	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency depending on cold engine, IS, and engine operation mode 2					
IP_FAC_EFF_IGA_COLD_OPM_1	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_19_TQDR	12	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_9_TQDR	10	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency depending on cold engine and engine operation mode 1					
IP_FAC_EFF_IGA_COLD_OPM_2	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_20_TQDR	12	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_10_TQDR	10	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency depending on cold engine and engine operation mode 2					
IP_FAC_EFF_IGA_COLD_SCAV_OPM_1	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_23_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_13_TQDR	8	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency for cold engine regarding scavenging operation (OPM 1)					
IP_FAC_EFF_IGA_COLD_SCAV_OPM_2	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_24_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_14_TQDR	8	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency for cold engine regarding scavenging operation (OPM 2)					
IP_FAC_EFF_IGA_IS_OPM_1	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_17_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_7_TQDR	10	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency depending on engine in IS mode operation mode 1					
IP_FAC_EFF_IGA_IS_OPM_2	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_18_TQDR	8	0... FFH	0... 8160	32	rpm

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_FAC_MAF_REL_8_TQDR	10	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency depending on engine in IS mode operation mode 2					
IP_FAC_EFF_IGA_OPM_1	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_10_TQDR	20	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_3_TQDR	16	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency depending on engine operation mode 1					
IP_FAC_EFF_IGA_OPM_2	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_12_TQDR	20	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_4_TQDR	16	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency depending on engine operation mode 2					
IP_FAC_EFF_IGA_SCAV_OPM_1	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_23_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_13_TQDR	8	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency regarding scavenging operation (OPM 1)					
IP_FAC_EFF_IGA_SCAV_OPM_2	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_24_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_14_TQDR	8	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency regarding scavenging operation (OPM 2)					

## 6.2.1 Ignition angle efficiency

The ignition efficiency values EFF\_IGA\_AV (actual efficiency), EFF\_IGA\_BAS\_COR (basic efficiency), EFF\_IGA\_BAS\_COR\_KNK\_FIL (efficiency with mean knock correction) and EFF\_IGA\_MIN (minimum efficiency due to IGA\_MIN) provide the link from an ignition angle to a torque efficiency. They are used in different torque modules to calculate the actual indicated engine torque, basic indicated engine torque values or the minimum indicated engine torque.

The efficiency calculation follows always the same strategy:

calculation of all specific delta ignition angle IGA\_DIF...

calculation of efficiencies using engine mode depending function "EFF\_IGA(IGA\_DIF...)".

### Application Condition



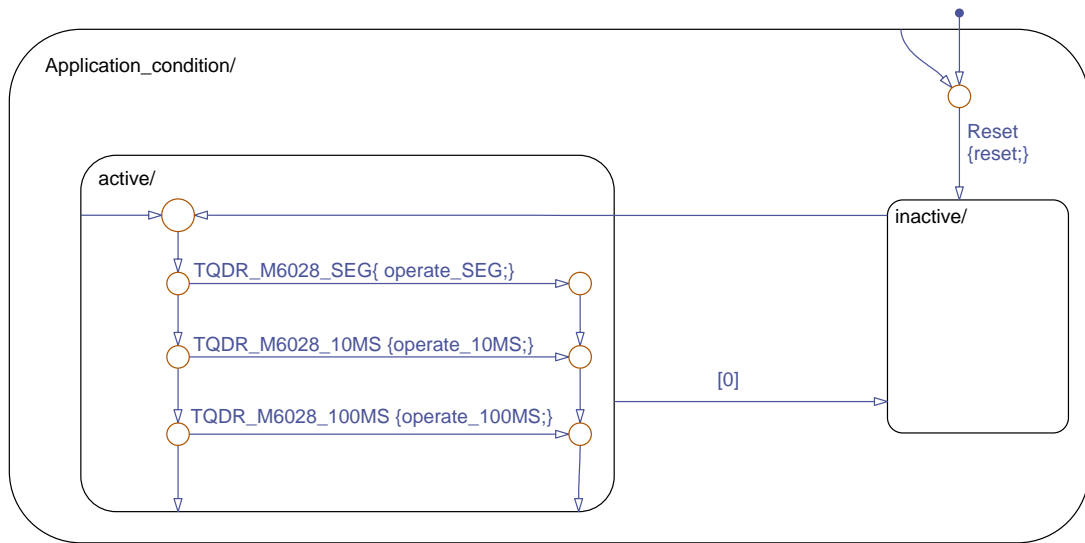

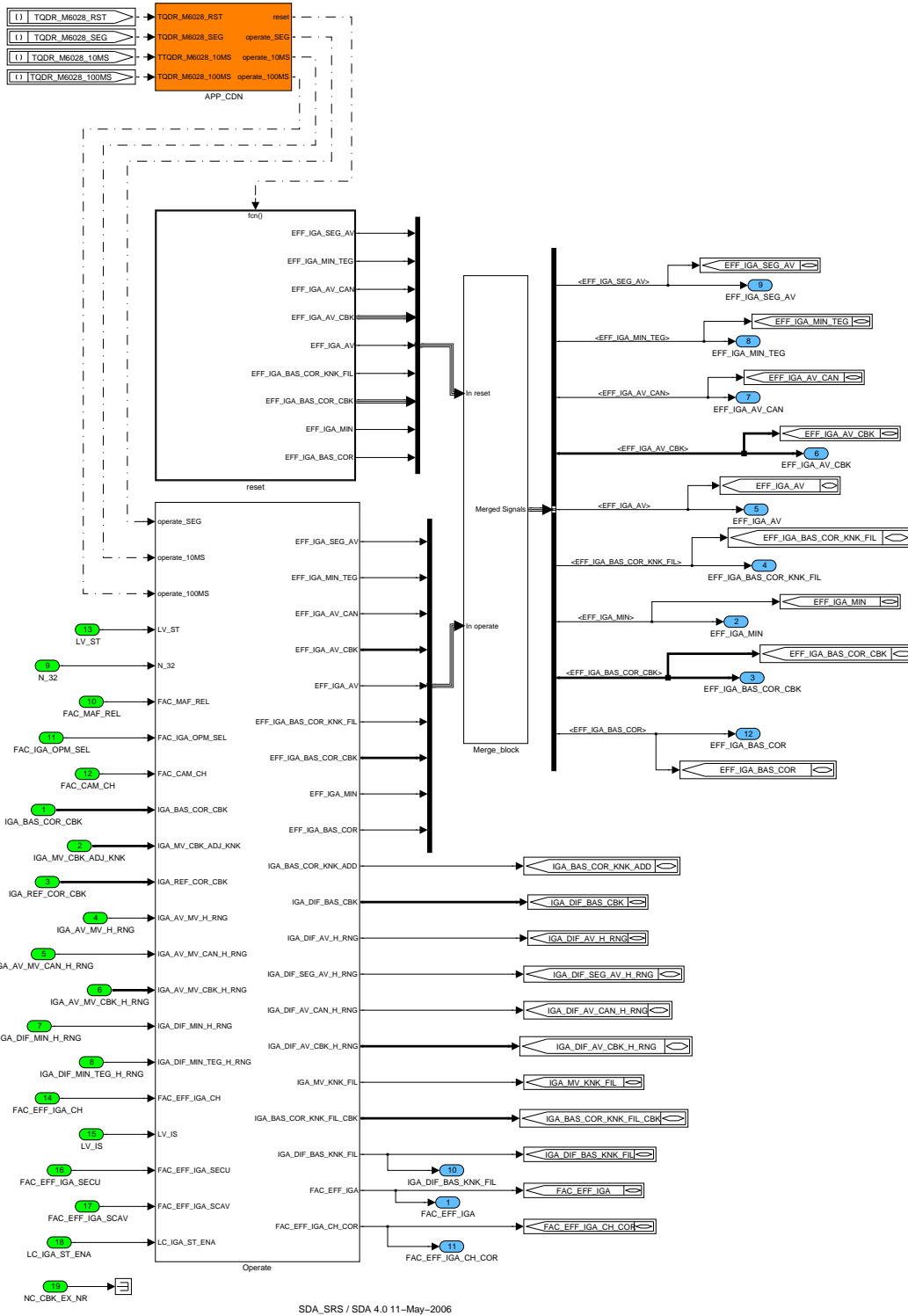


Figure 6.2.1: TQDR\_M6028/APP\_CDN/APPCND

**Function Description**

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Figure 6.2.2: TQDR\_M6028

### 6.2.1.1 RESET

Resetting efficiencies.

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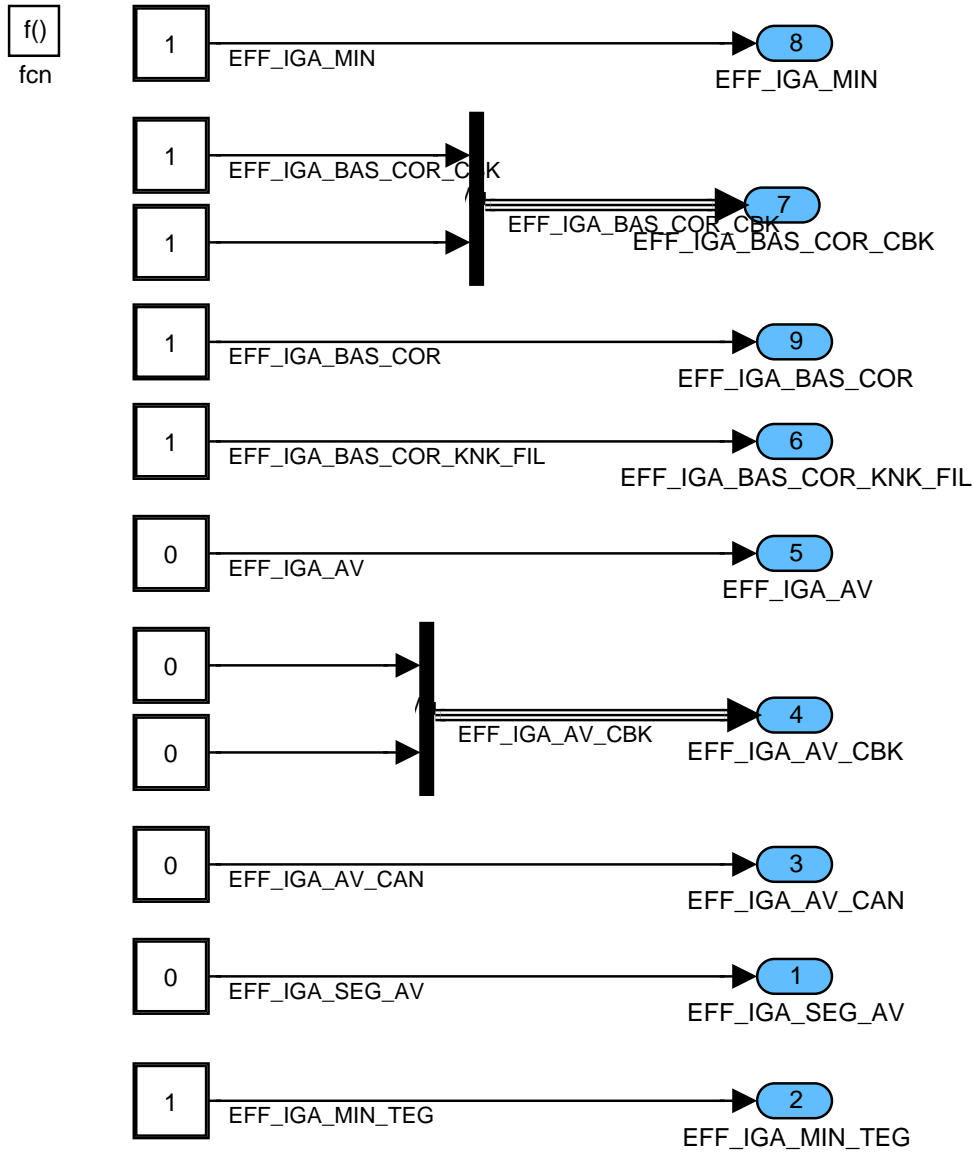


Figure 6.2.3: TQDR\_M6028/reset

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### 6.2.1.2 OPERATE

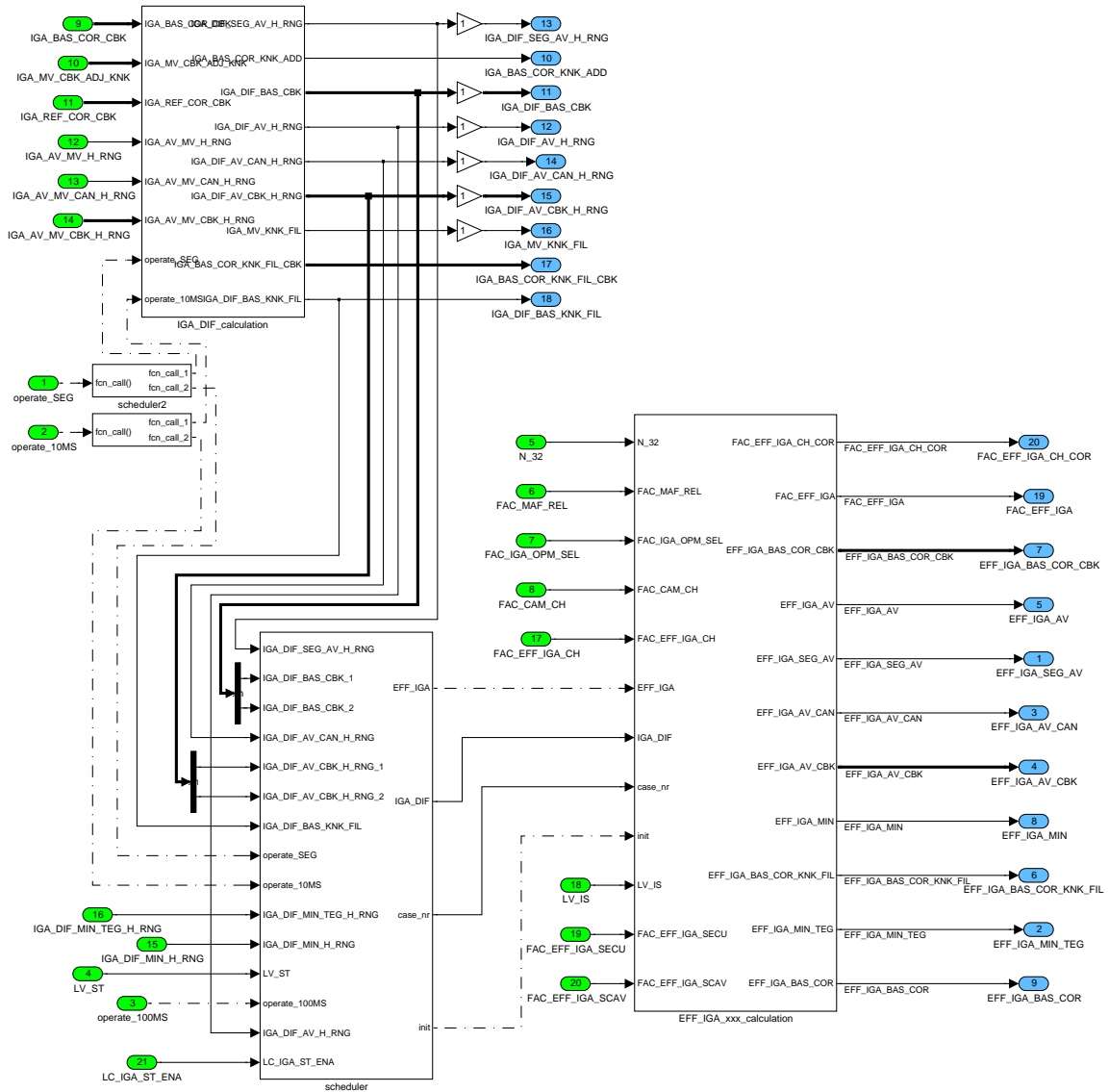


Figure 6.2.4: TQDR\_M6028/Operate

### IGA\_DIF\_CALCULATION

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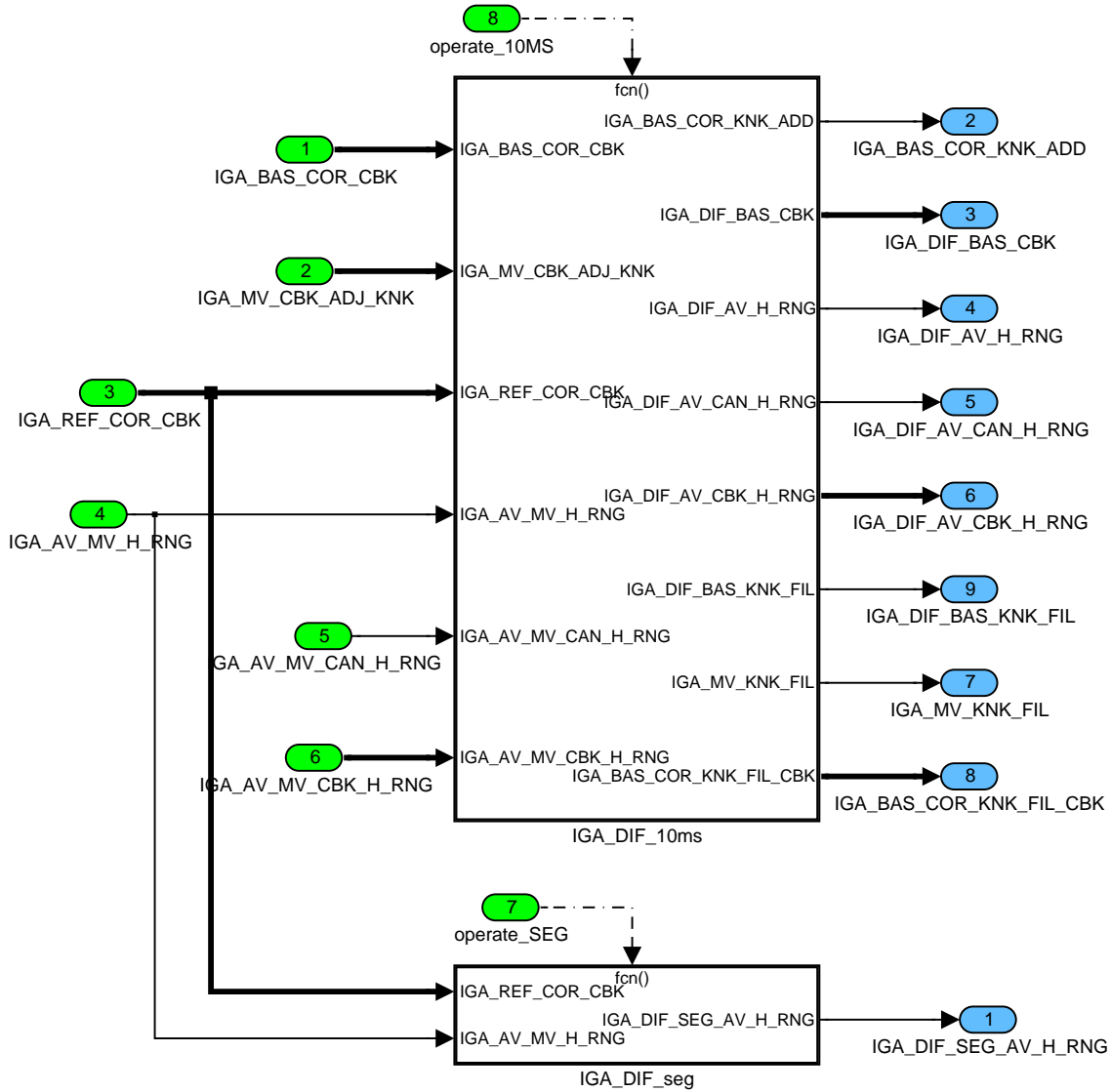


Figure 6.2.5: TQDR\_M6028/Operate/IGA\_DIF\_calculation

**IGA\_DIF\_10MS**

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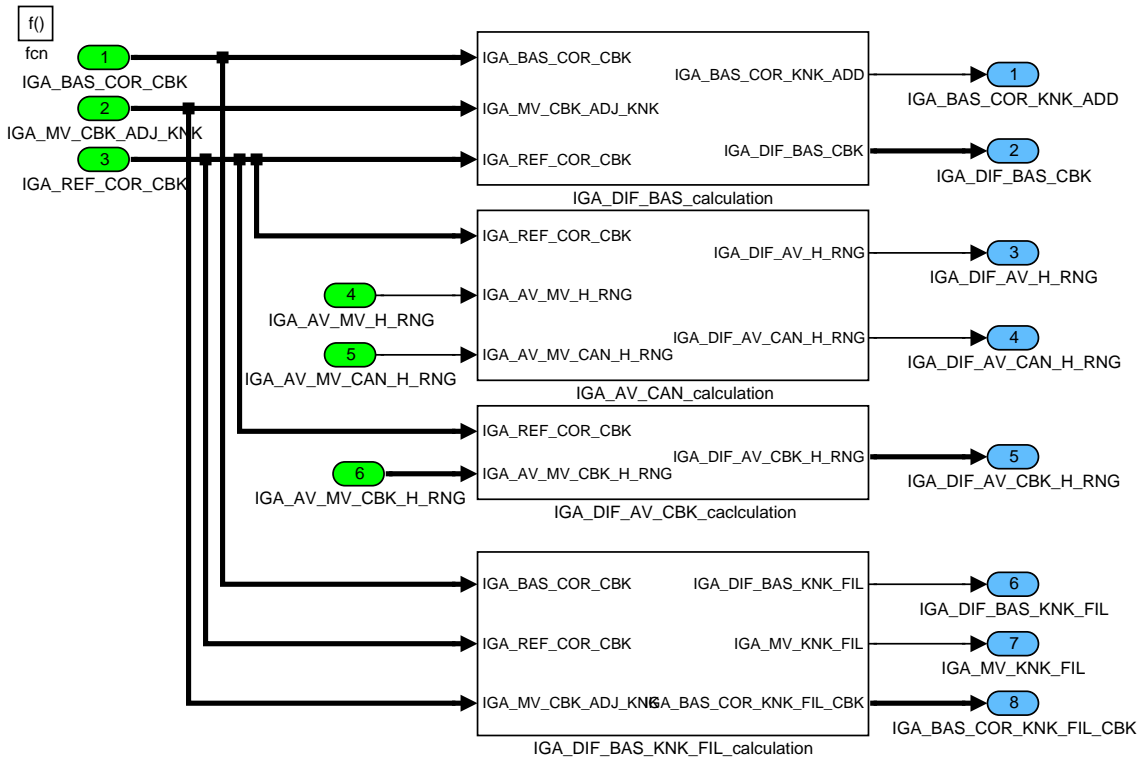


Figure 6.2.6: TQDR\_M6028/Operate/IGA\_DIF\_calculation/IGA\_DIF\_10ms

**IGA\_DIF\_BAS\_CALCULATION**

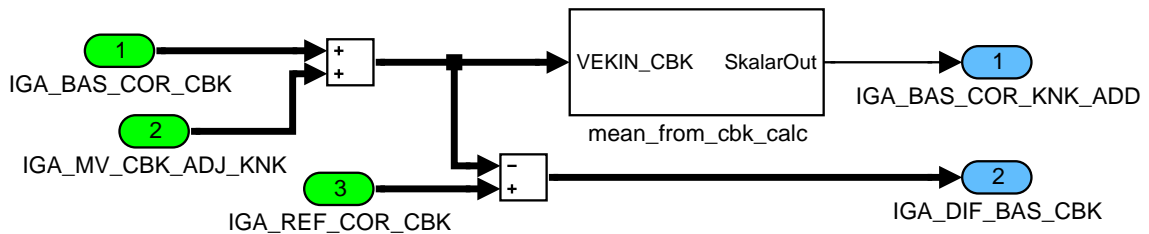


Figure 6.2.7: TQDR\_M6028/Operate/IGA\_DIF\_calculation/IGA\_DIF\_10ms/IGA\_DIF\_BAS\_calculation

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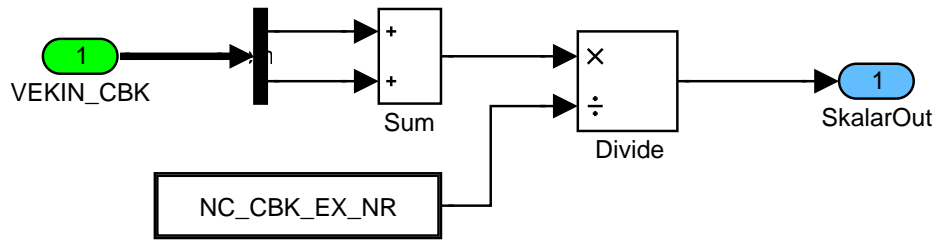


Figure 6.2.8: TQDR\_M6028/Operate/IGA\_DIF\_calculation/IGA\_DIF\_10ms/IGA\_DIF\_BAS\_calculation/mean\_from\_cbk\_calc

**IGA\_AV\_CAN\_CALCULATION**

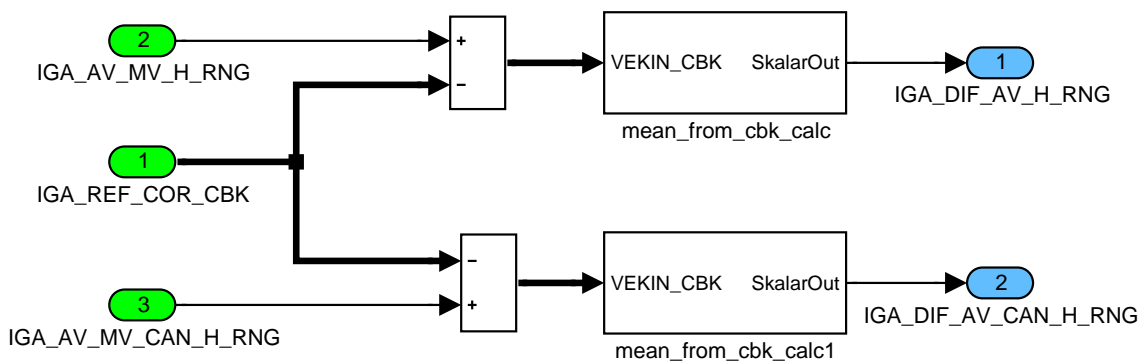


Figure 6.2.9: TQDR\_M6028/Operate/IGA\_DIF\_calculation/IGA\_DIF\_10ms/IGA\_AV\_CAN\_calculation

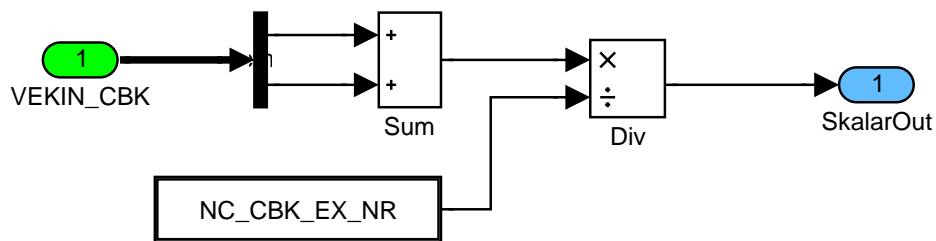


Figure 6.2.10: TQDR\_M6028/Operate/IGA\_DIF\_calculation/IGA\_DIF\_10ms/IGA\_AV\_CAN\_calculation/mean\_from\_cbk\_calc

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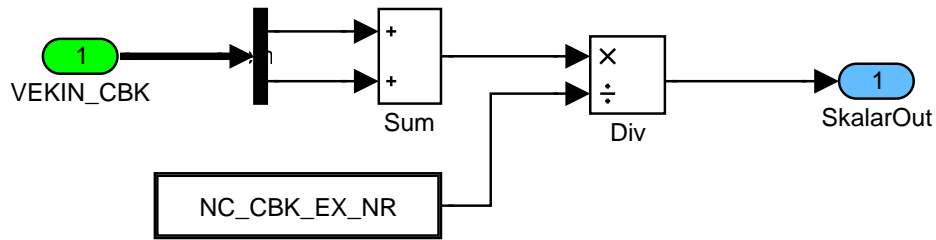


Figure 6.2.11: TQDR\_M6028/Operate/IGA\_DIF\_calculation/IGA\_DIF\_10ms/IGA\_AV\_CAN\_calculation/mean\_from\_cbk\_calc1

**IGA\_DIF\_AV\_CBK\_CACLCULATION**

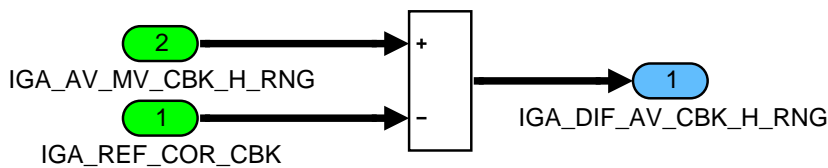


Figure 6.2.12: TQDR\_M6028/Operate/IGA\_DIF\_calculation/IGA\_DIF\_10ms/IGA\_DIF\_AV\_CBK\_caculation

**IGA\_DIF\_BAS\_KNK\_FIL\_CALCULATION**

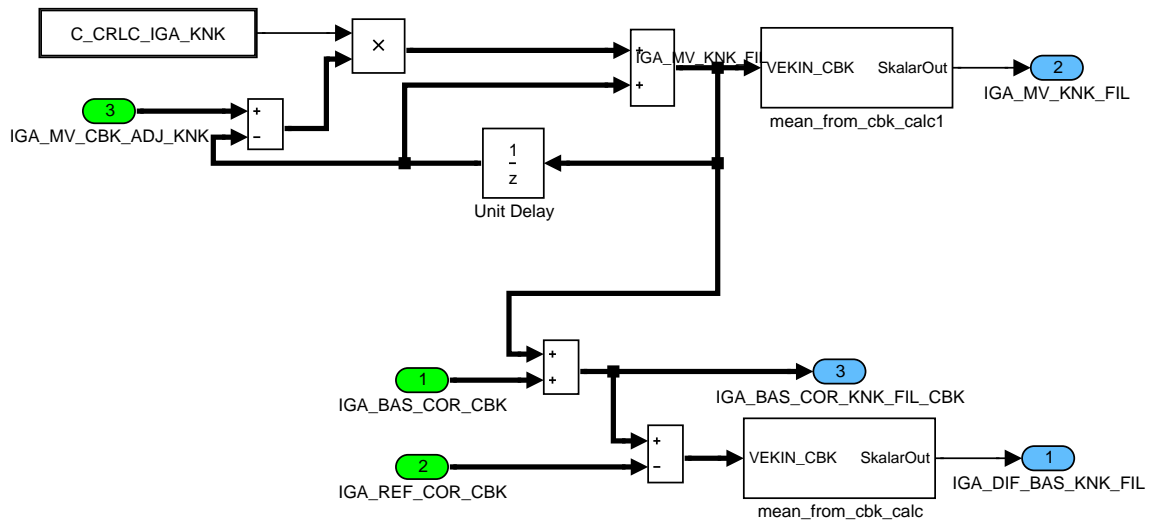


Figure 6.2.13: TQDR\_M6028/Operate/IGA\_DIF\_calculation/IGA\_DIF\_10ms/IGA\_DIF\_BAS\_KNK\_FIL\_calculation

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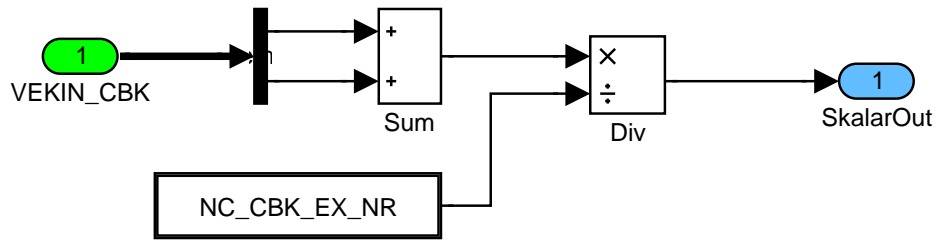


Figure 6.2.14: TQDR\_M6028/Operate/IGA\_DIF\_calculation/IGA\_DIF\_10ms/  
IGA\_DIF\_BAS\_KNK\_FIL\_calculation/mean\_from\_cbk\_calc

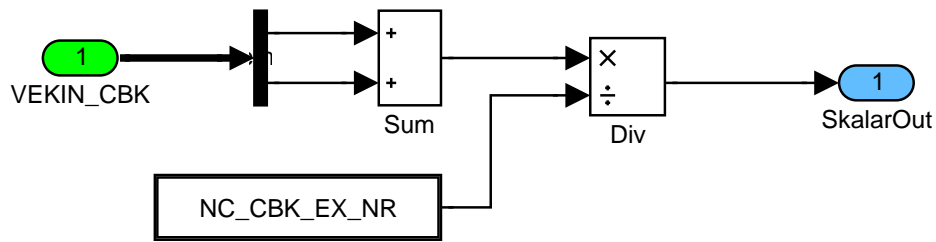


Figure 6.2.15: TQDR\_M6028/Operate/IGA\_DIF\_calculation/IGA\_DIF\_10ms/  
IGA\_DIF\_BAS\_KNK\_FIL\_calculation/mean\_from\_cbk\_calc1

**IGA\_DIF\_SEG**

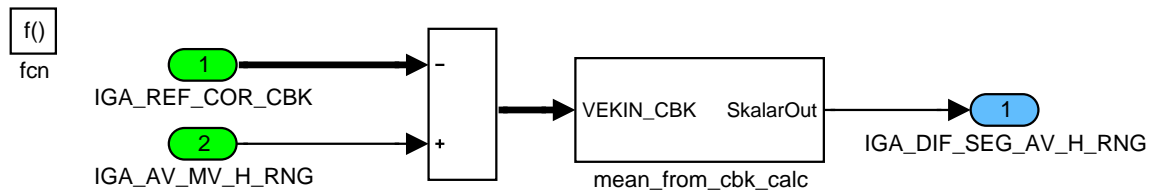


Figure 6.2.16: TQDR\_M6028/Operate/IGA\_DIF\_calculation/IGA\_DIF\_seg

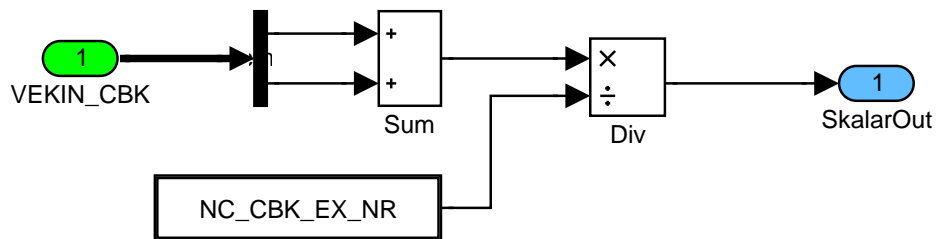


Figure 6.2.17: TQDR\_M6028/Operate/IGA\_DIF\_calculation/IGA\_DIF\_seg/mean\_from\_cbk\_calc

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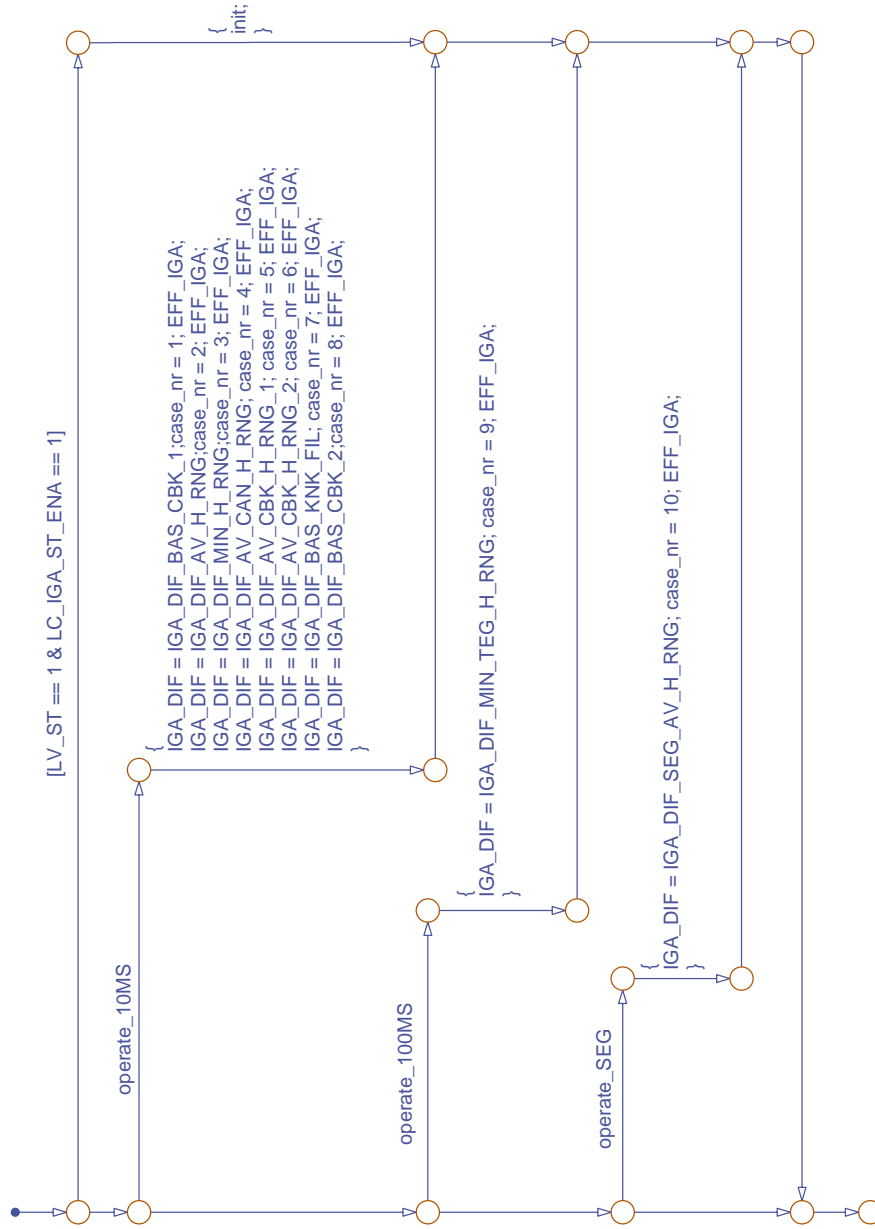



Figure 6.2.18: TQDR\_M6028/Operate/scheduler/scheduler

**EFF\_IGA\_XXX\_CALCULATION**

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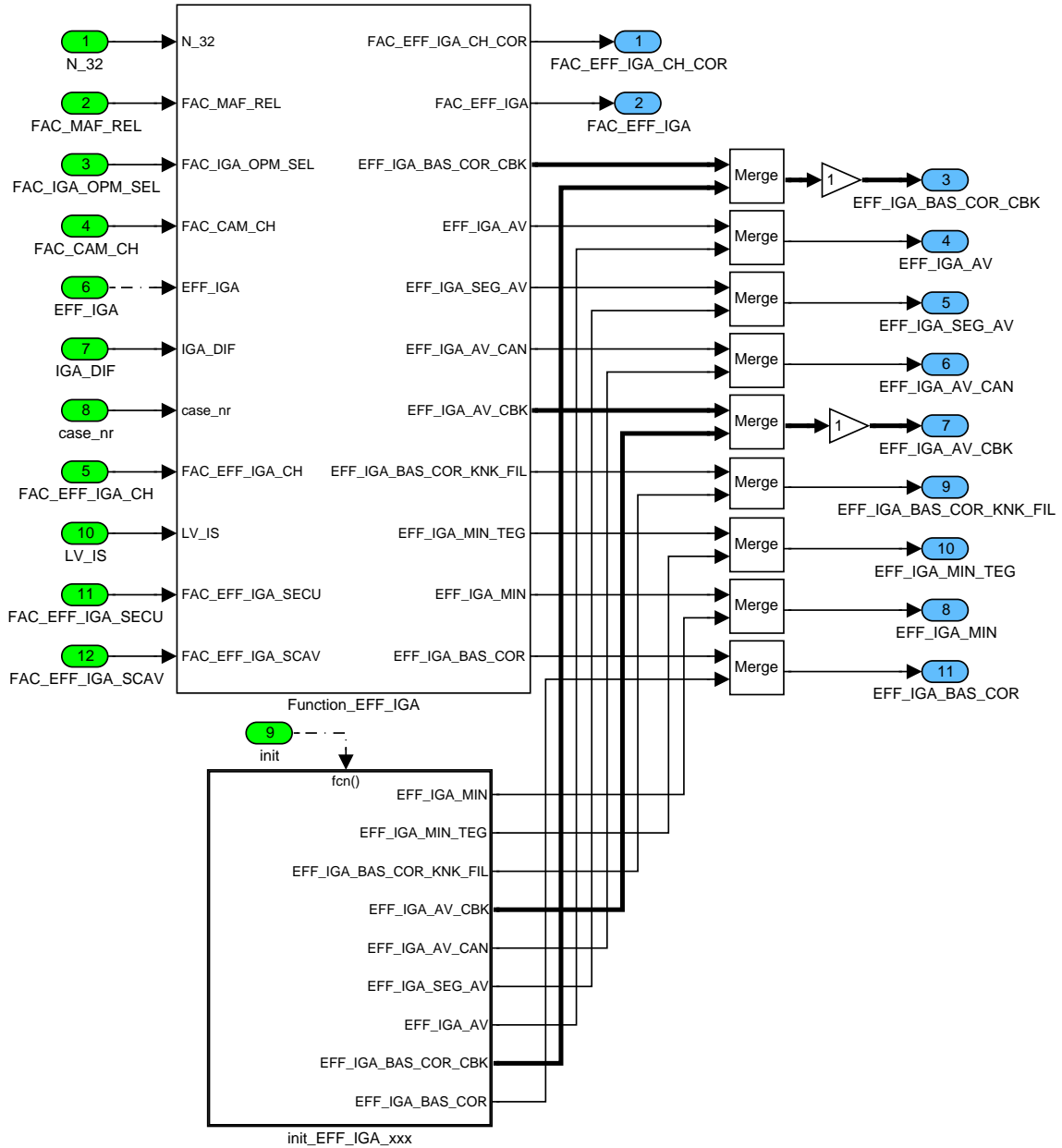


Figure 6.2.19: TQDR\_M6028/Operate/EFF\_IGA\_xxx\_calculation

**INIT\_EFF\_IGA\_XXX**

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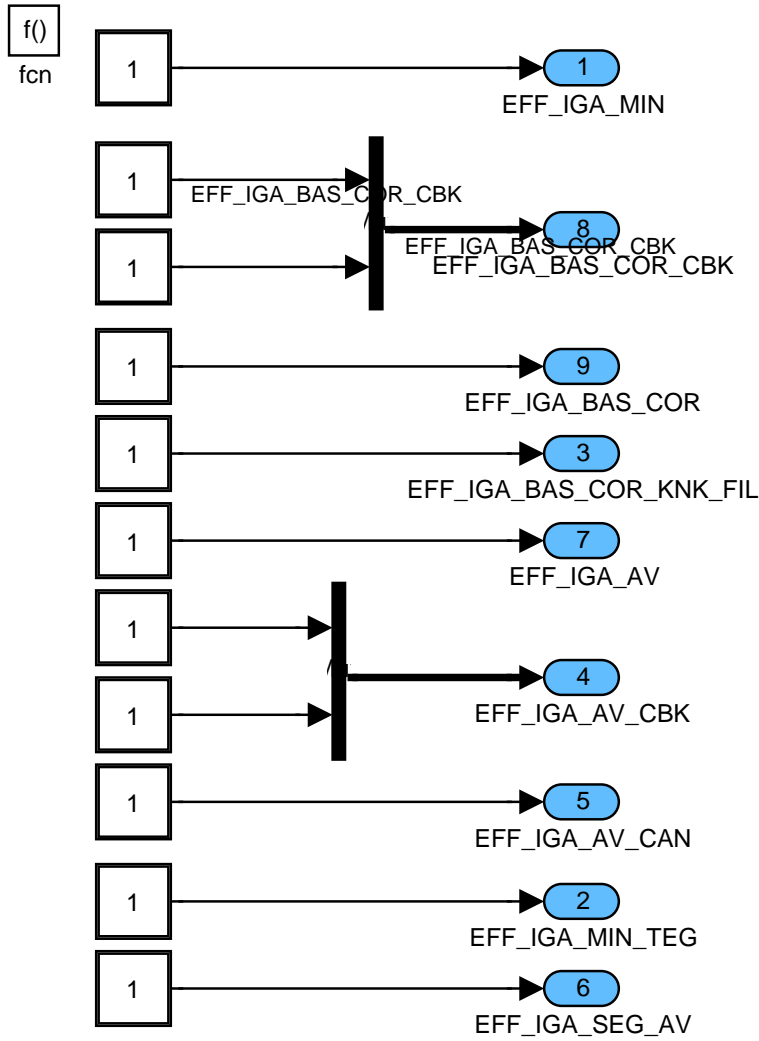


Figure 6.2.20: TQDR\_M6028/Operate/EFF\_IGA\_xxx\_calculation/init\_EFF\_IGA\_xxx

**FUNCTION EFF\_IGA**

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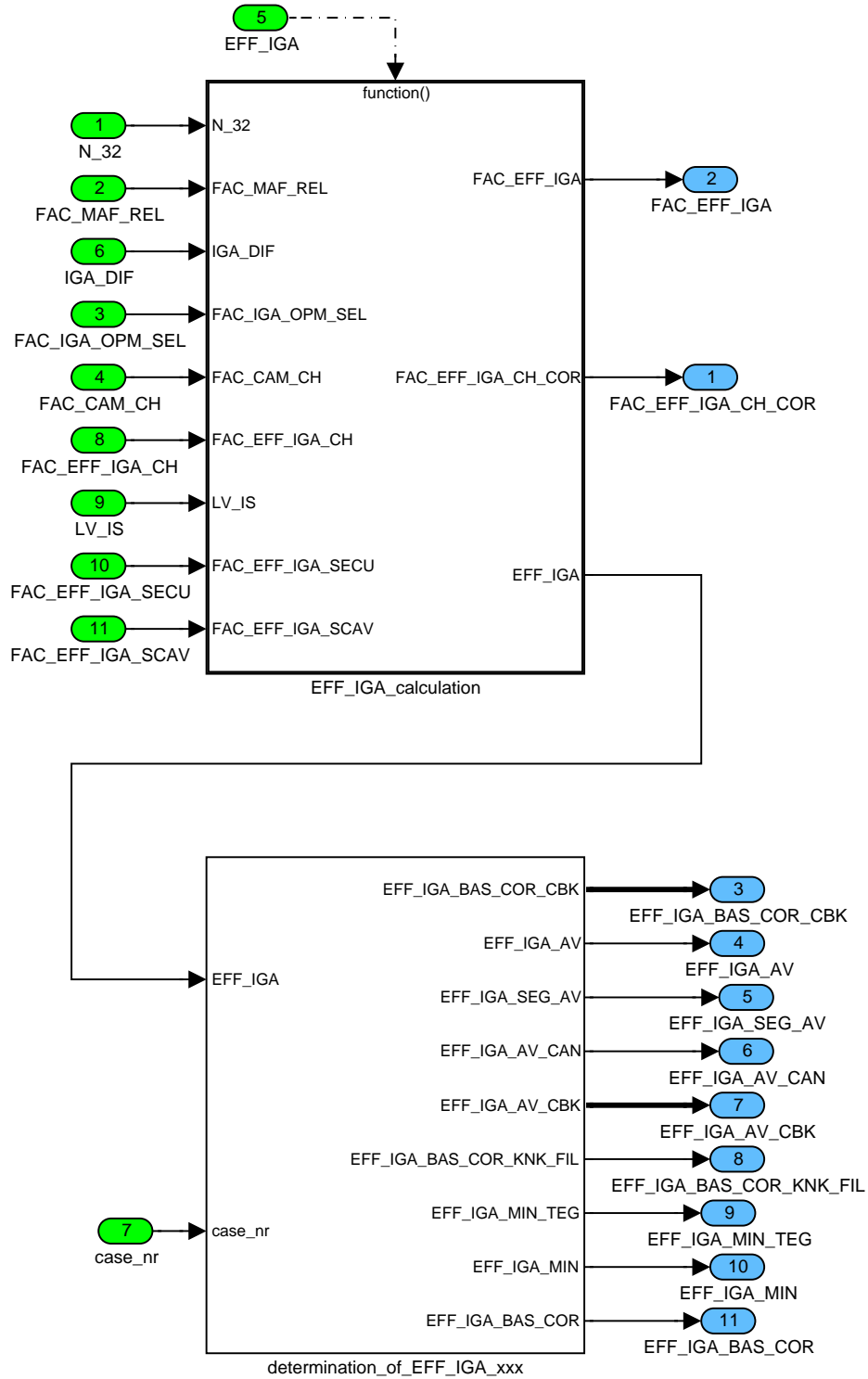


Figure 6.2.21: TQDR\_M6028/Operate/EFF\_IGA\_xxx\_calculation/Function\_EFF\_IGA

**EFF\_IGA\_CALCULATION**

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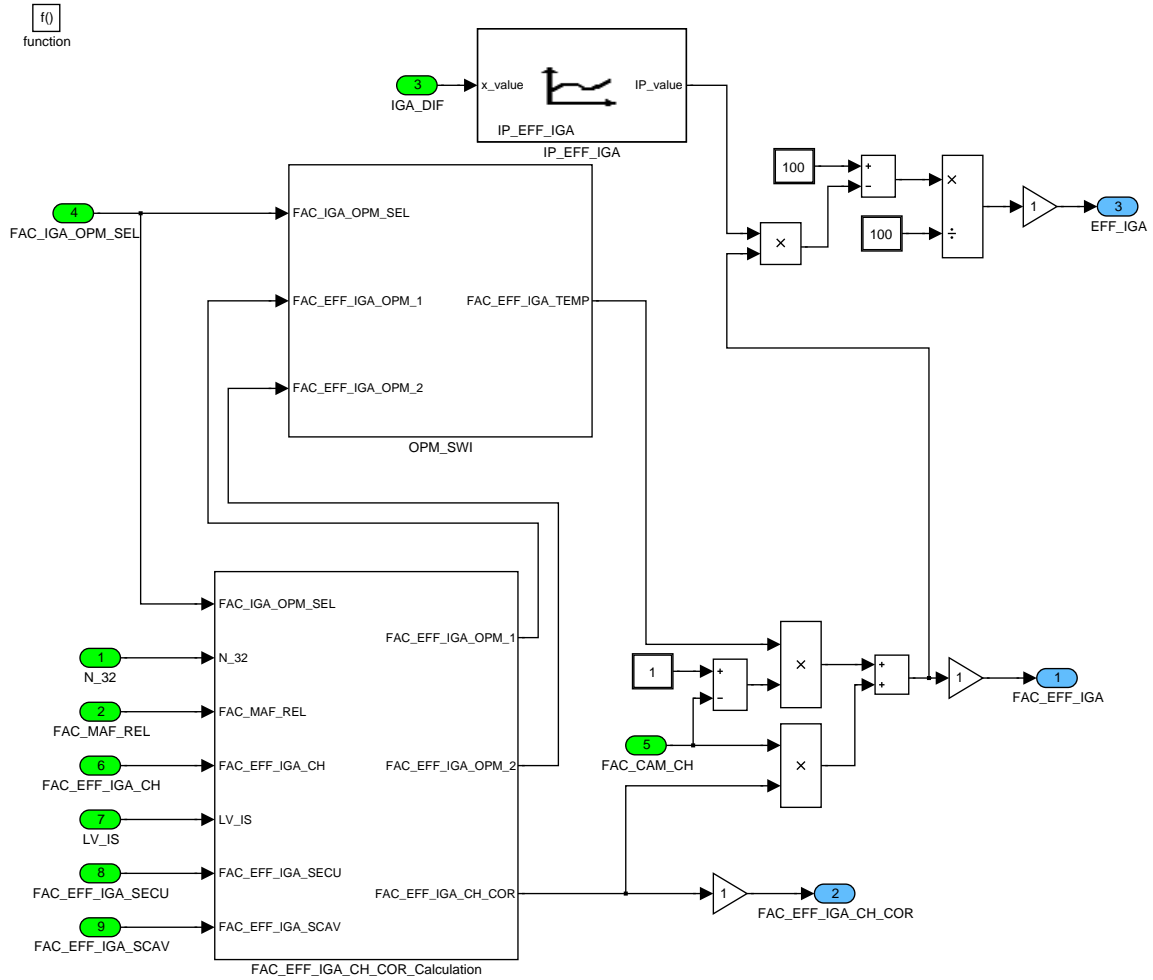


Figure 6.2.22: TQDR\_M6028/Operate/EFF\_IGA\_xxx\_calculation/Function\_EFF\_IGA/EFF\_IGA\_calculation

**FAC EFF IGA CH COR CALCULATION**

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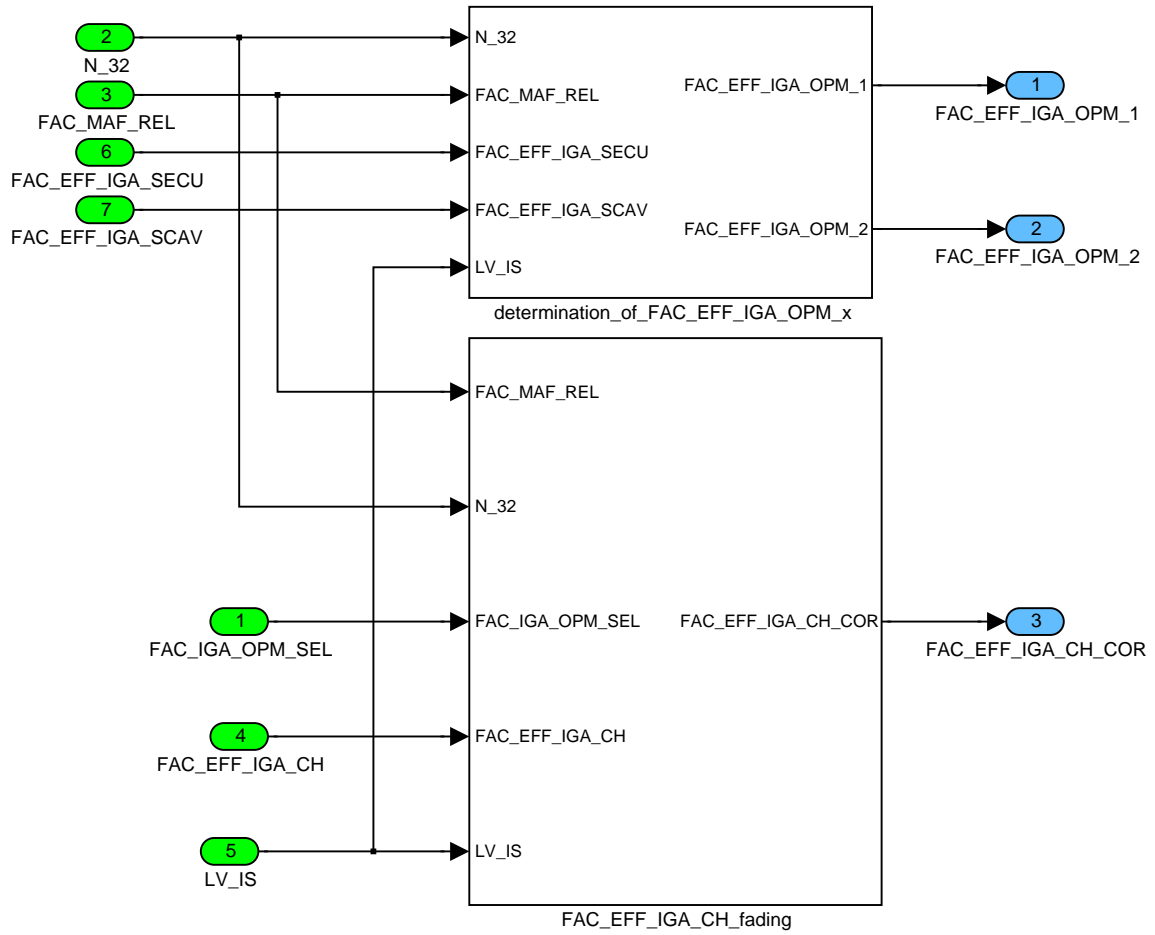



Figure 6.2.23: TQDR\_M6028/Operate/EFF\_IGA\_xxx\_calculation/Function\_EFF\_IGA/EFF\_IGA\_calculation/FAC\_EFF\_IGA\_CH\_COR\_Calculation

**DETERMINATION\_OF\_FAC\_EFF\_IGA\_OPM\_X**

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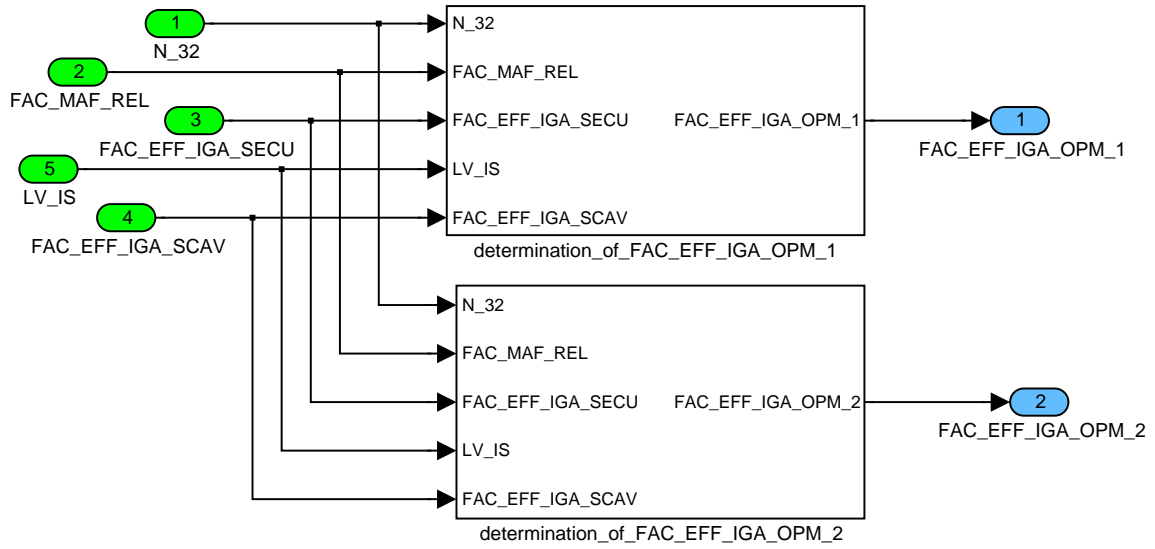



Figure 6.2.24: TQDR\_M6028/Operate/EFF\_IGA\_xxx\_calculation/Function\_EFF\_IGA/  
EFF\_IGA\_calculation/FAC\_EFF\_IGA\_CH\_COR\_Calculation/determination\_of\_FAC\_EFF\_IGA\_OPM\_x

**DETERMINATION\_OF\_FAC\_EFF\_IGA\_OPM\_1**

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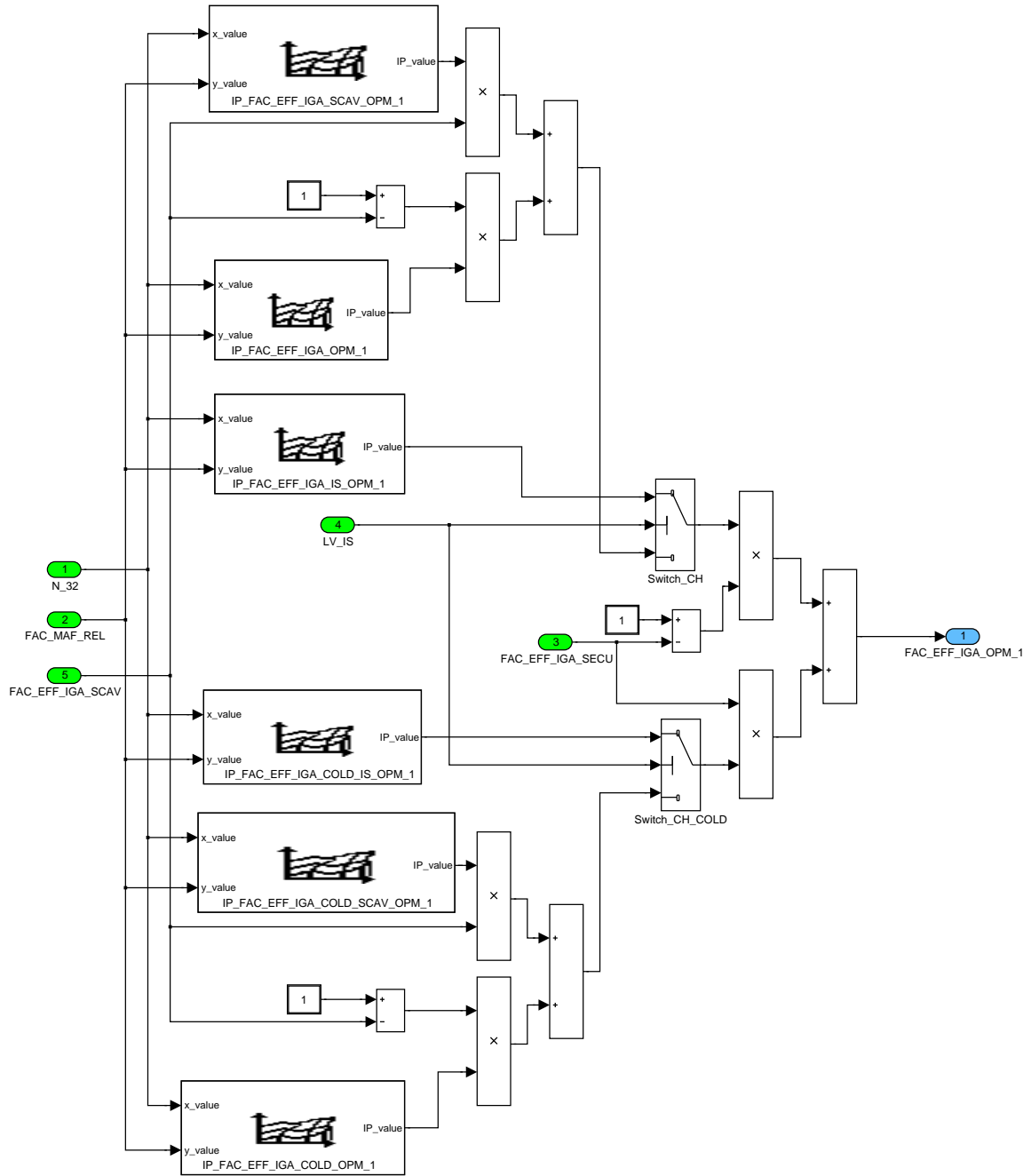


Figure 6.2.25: TQDR\_M6028/Operate/EFF\_IGA\_xxx\_calculation/Function\_EFF\_IGA/EFF\_IGA\_calculation/FAC\_EFF\_IGA\_CH\_COR\_Calculation/determination\_of\_FAC\_EFF\_IGA\_OPM\_x/determination\_of\_FAC\_EFF\_IGA\_OPM\_1

**DETERMINATION OF FAC EFF IGA OPM 2**

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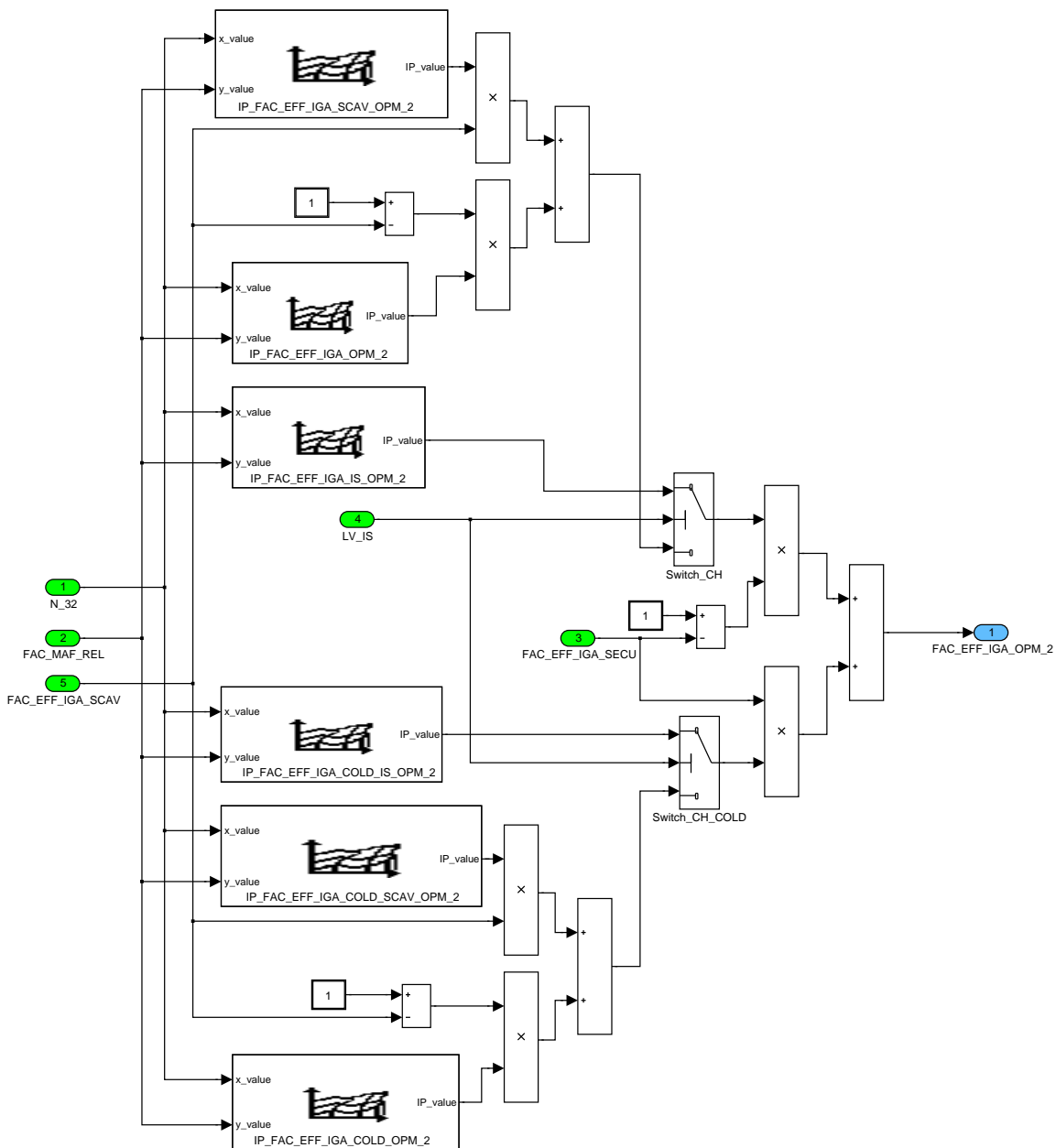


Figure 6.2.26: TQDR\_M6028/Operate/EFF\_IGA\_xxx\_calculation/Function\_EFF\_IGA/EFF\_IGA\_calculation/FAC\_EFF\_IGA\_CH\_COR\_Calculation/determination\_of\_FAC\_EFF\_IGA\_OPM\_x/determination\_of\_FAC\_EFF\_IGA\_OPM\_2

**FAC EFF IGA CH FADING**

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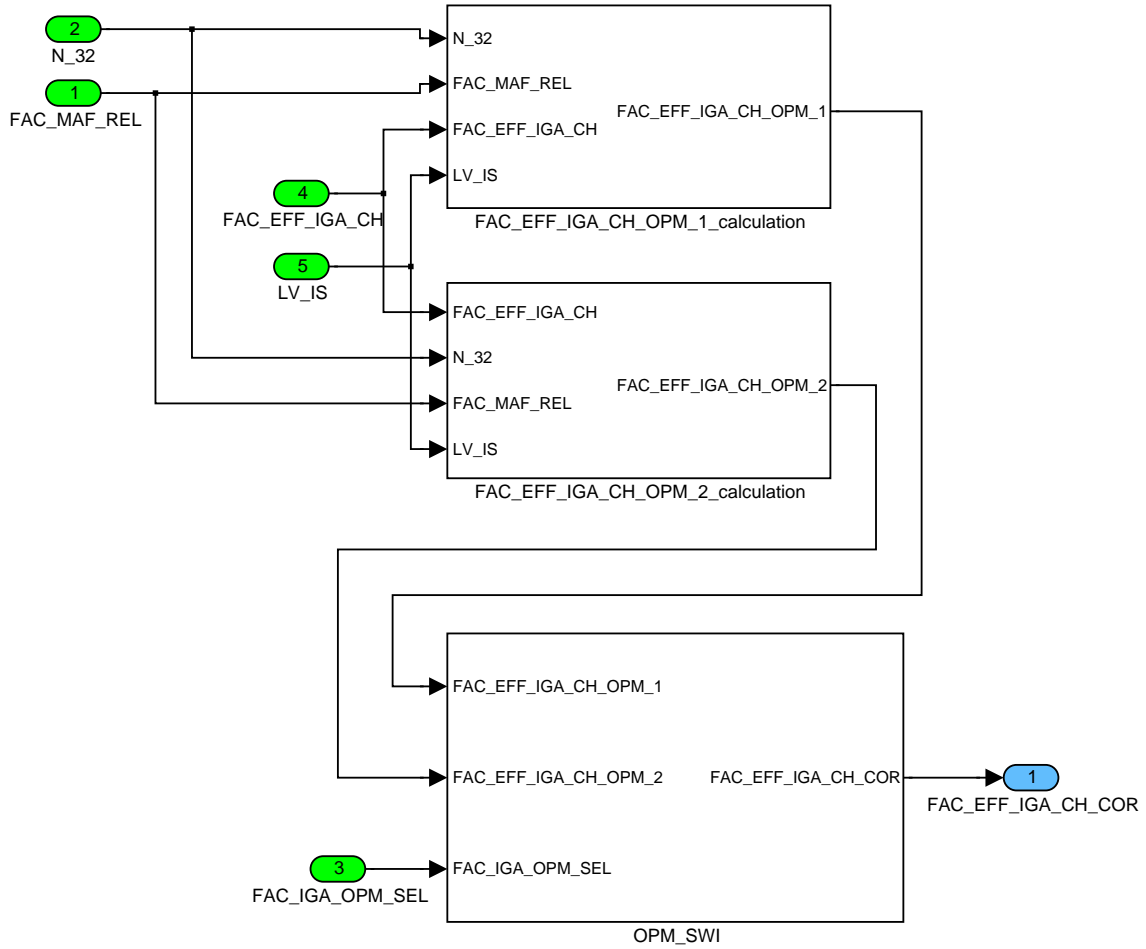


Figure 6.2.27: TQDR\_M6028/Operate/EFF\_IGA\_xxx\_calculation/Function\_EFF\_IGA/  
EFF\_IGA\_calculation/FAC\_EFF\_IGA\_CH\_COR\_Calculation/FAC\_EFF\_IGA\_CH\_fading

**FAC\_EFF\_IGA\_CH\_OPM\_1\_CALCULATION**

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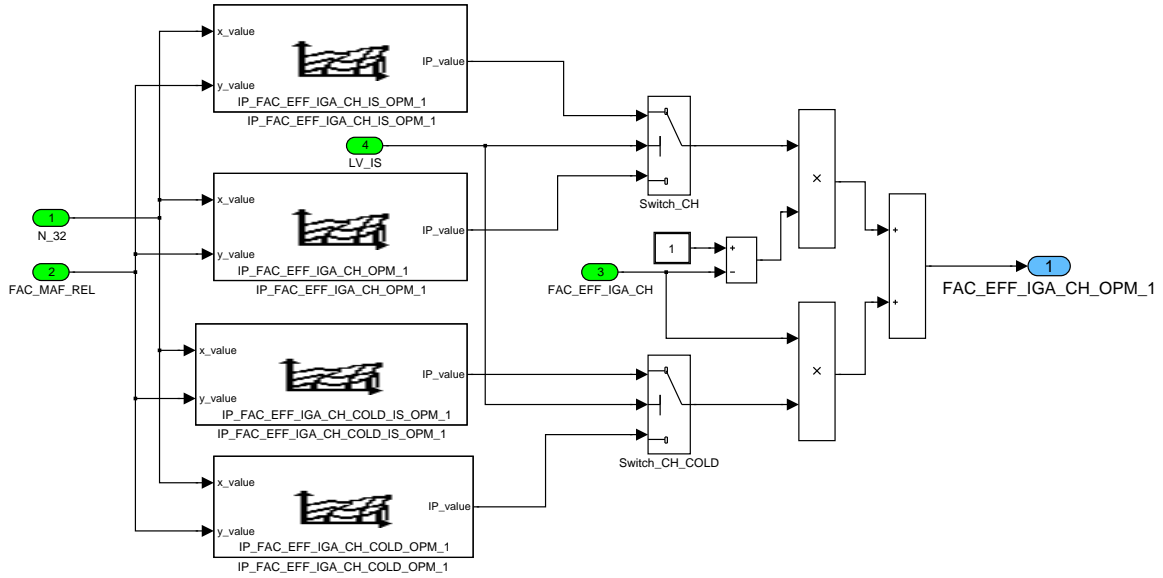


Figure 6.2.28: TQDR\_M6028/Operate/EFF\_IGA\_xxx\_calculation/Function\_EFF\_IGA/EFF\_IGA\_calculation/FAC\_EFF\_IGA\_CH\_COR\_Calculation/FAC\_EFF\_IGA\_CH\_fading/FAC\_EFF\_IGA\_CH\_OPM\_1\_calculation

**FAC\_EFF\_IGA\_CH\_OPM\_2\_CALCULATION**

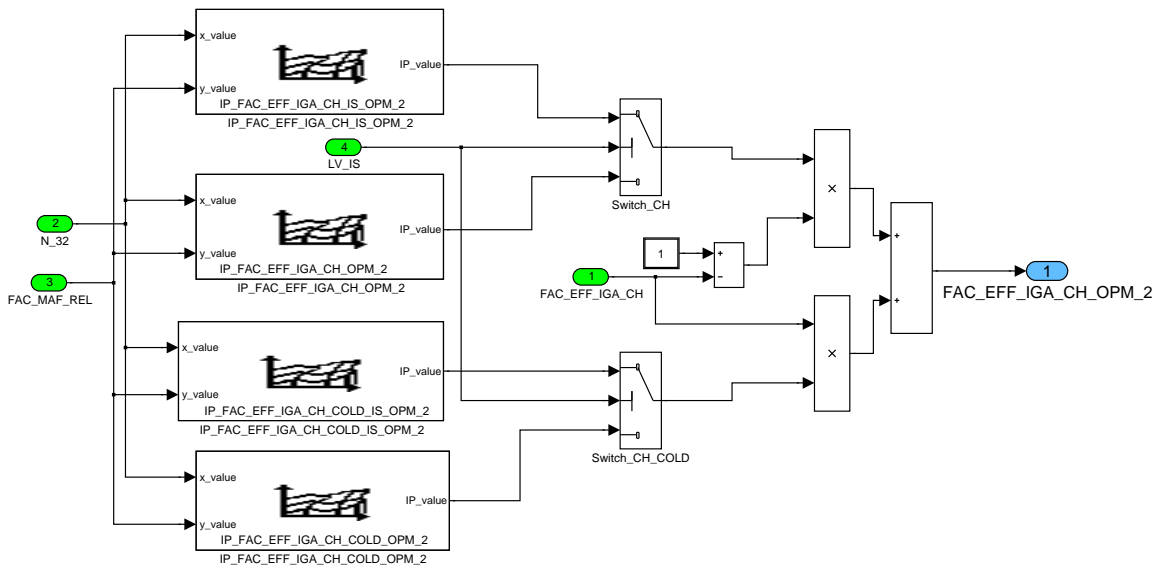


Figure 6.2.29: TQDR\_M6028/Operate/EFF\_IGA\_xxx\_calculation/Function\_EFF\_IGA/EFF\_IGA\_calculation/FAC\_EFF\_IGA\_CH\_COR\_Calculation/FAC\_EFF\_IGA\_CH\_fading/FAC\_EFF\_IGA\_CH\_OPM\_2\_calculation

**OPM\_SWI**

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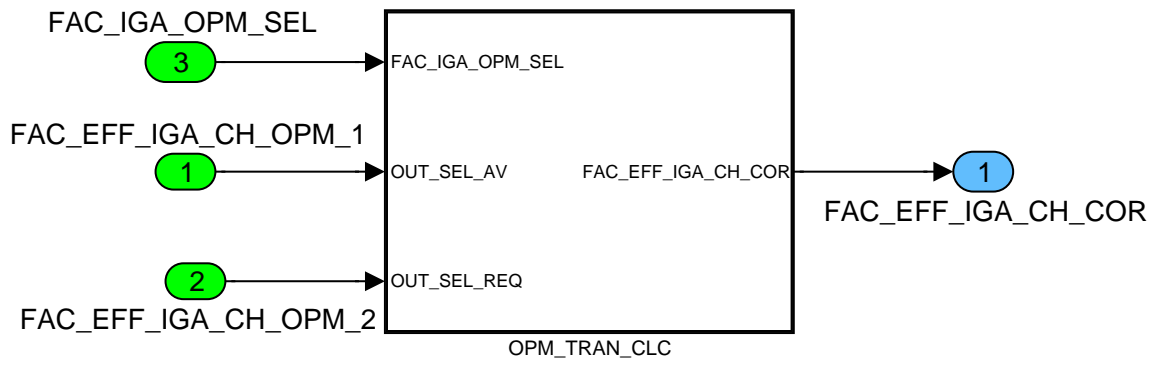


Figure 6.2.30: TQDR\_M6028/Operate/EFF\_IGA\_xxx\_calculation/Function\_EFF\_IGA/  
EFF\_IGA\_calculation/FAC\_EFF\_IGA\_CH\_COR\_Calculation/FAC\_EFF\_IGA\_CH\_fading/OPM\_SWI

**OPM\_TRAN\_CLC**

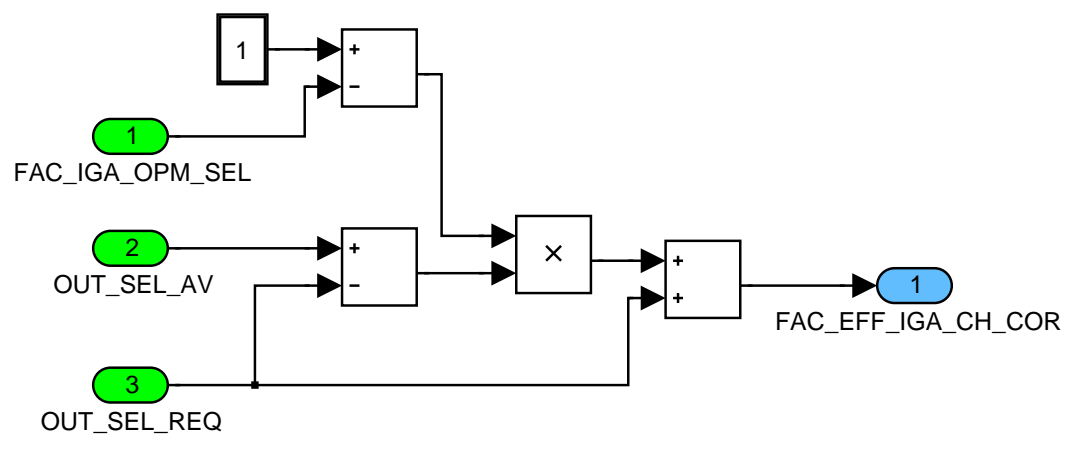


Figure 6.2.31:  
TQDR\_M6028/Operate/EFF\_IGA\_xxx\_calculation/Function\_EFF\_IGA/EFF\_IGA\_calculation/  
FAC\_EFF\_IGA\_CH\_COR\_Calculation/FAC\_EFF\_IGA\_CH\_fading/OPM\_SWI/OPM\_TRAN\_CLC

**OPM\_SWI**

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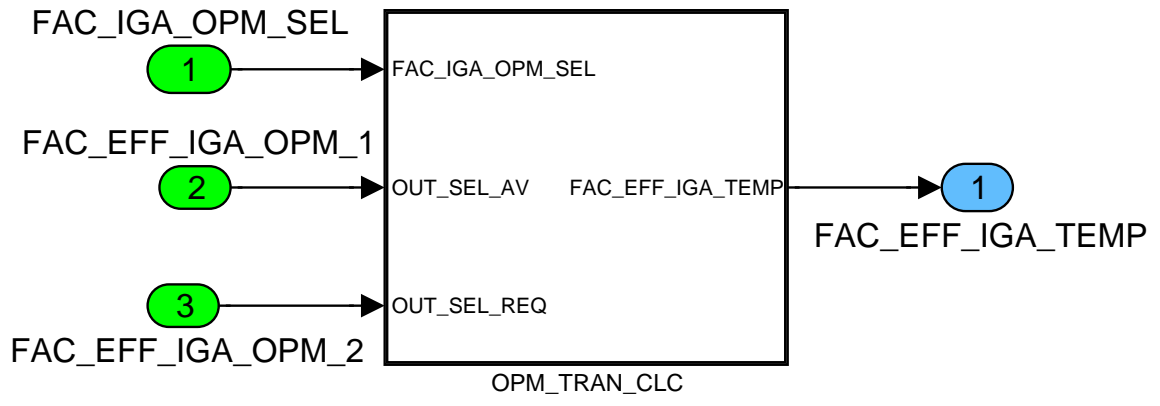


Figure 6.2.32: TQDR\_M6028/Operate/EFF\_IGA\_xxx\_calculation/Function\_EFF\_IGA/  
EFF\_IGA\_calculation/OPM\_SWI

**OPM\_TRAN\_CLC**

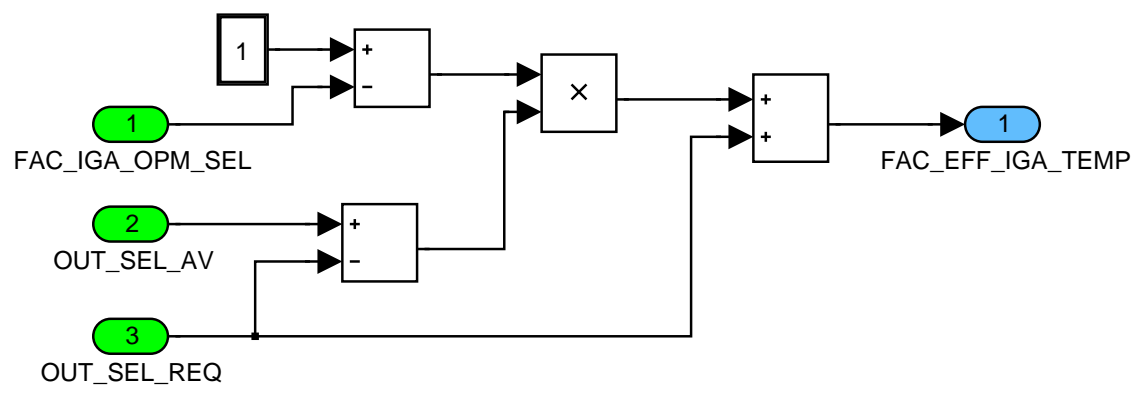
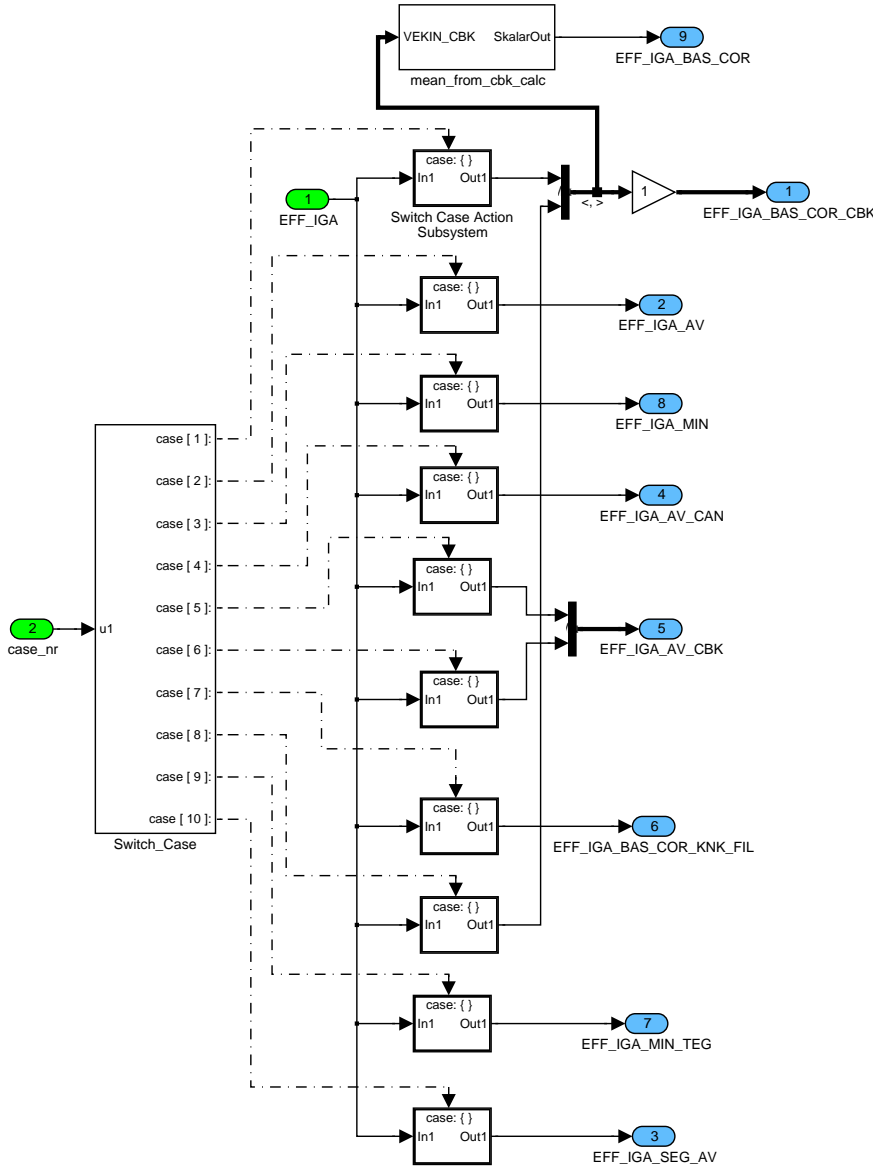


Figure 6.2.33: TQDR\_M6028/Operate/EFF\_IGA\_xxx\_calculation/Function\_EFF\_IGA/  
EFF\_IGA\_calculation/OPM\_SWI/OPM\_TRAN\_CLC

**FUNCTION\_EFF\_IGA/DETERMINATION\_OF\_EFF\_IGA\_XXX**

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Case 1,8: EFF\_IGA\_BAS\_COR\_CBK[i] = function call EFF\_IGA (IGA\_DIF\_BAS\_CBK[i])  
 Case 2: EFF\_IGA\_AV = function call EFF\_IGA (IGA\_DIF\_AV\_H\_RNG)  
 Case 3: EFF\_IGA\_MIN = function call EFF\_IGA (IGA\_DIF\_MIN\_H\_RNG)  
 Case 4: EFF\_IGA\_AV\_CAN = function call EFF\_IGA (IGA\_DIF\_AV\_CAN\_H\_RNG)  
 Case 5,6: EFF\_IGA\_AV[i] = function call EFF\_IGA (IGA\_DIF\_AV\_H\_RNG[i])  
 Case 7: EFF\_IGA\_BAS\_COR\_KNK\_FIL = function call EFF\_IGA (IGA\_DIF\_BAS\_KNK\_FIL\_CBK)  
 Case 9: EFF\_IGA\_MIN\_TEG = function call EFF\_IGA (IGA\_DIF\_MIN\_TEG\_H\_RNG)  
 Case 10: EFF\_IGA\_SEG\_AV = function call EFF\_IGA (IGA\_DIF\_SEG\_AV)

Figure 6.2.34:  
 TQDR\_M6028/Operate/EFF\_IGA\_xxx\_calculation/Function\_EFF\_IGA/determination\_of\_EFF\_IGA\_xxx

### 6.2.1.3 MERGE BLOCK

Signals merged from states reset and operate.

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 1871 of 8404	
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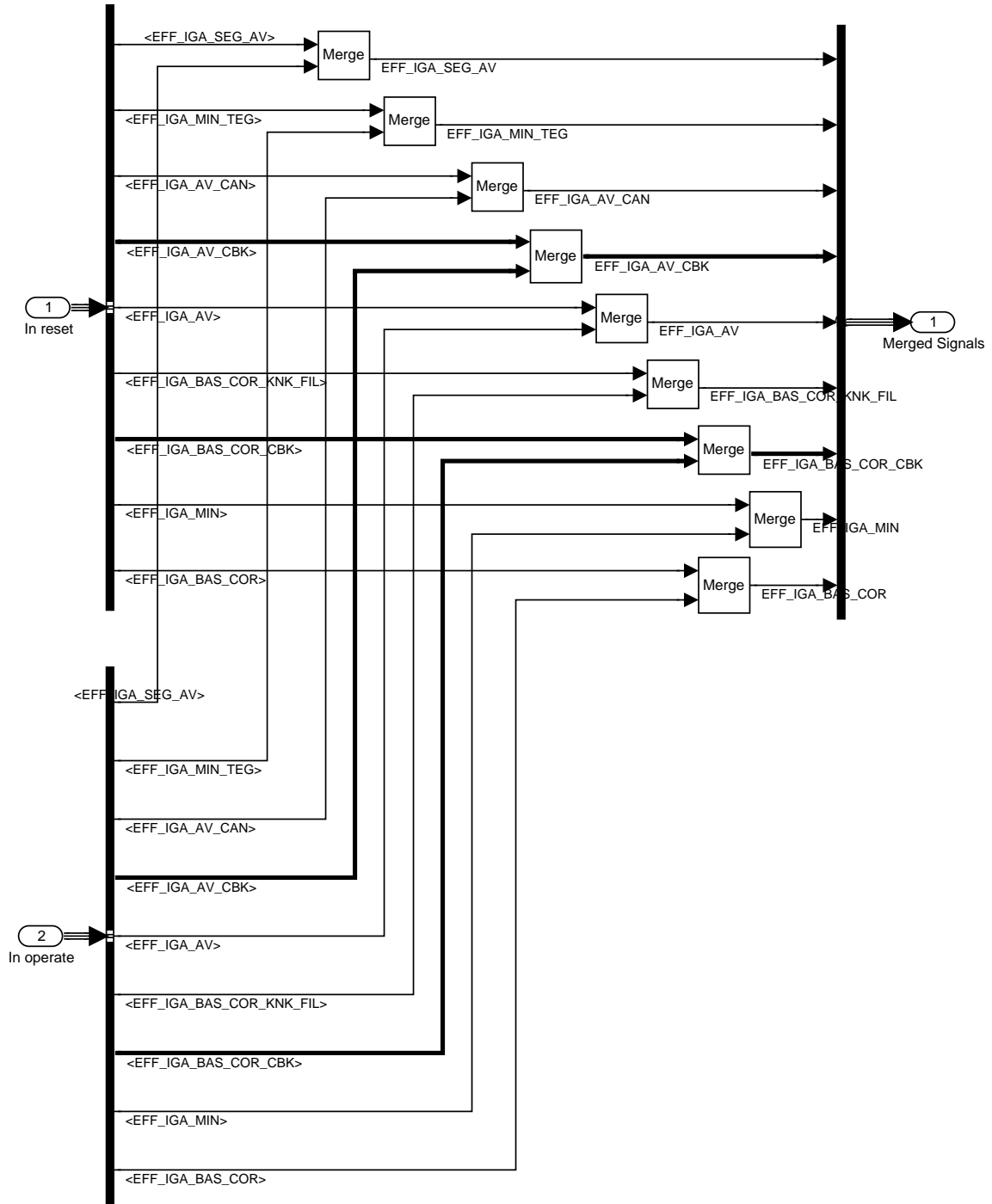


Figure 6.2.35: TQDR\_M6028/Merge\_block

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## 6.3 Dwell time period

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TD	O/V	0... FFFFH	0... 262.14	0,004	ms
Dwell time					

### Input data:

C_TD_S_AS {p. 1875}	IP_TD_S {p. 1875}	LV_HOM_RUN {p. 8136}	LV_TD_AD_H {p. 937}
N_32 {p. 1525}	TD_FAC {p. 1874}	VB {p. 1185}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TD_AS	-	F800... 7F0H	-8.192 ...8.128	0,004	ms
Dwell time offset usual value: 0 ms					
C_TD_INI	-	0... FFFFH	0... 262.14	0,004	ms
initial value for dwell time control (typ. Value 3ms for standart coils and <2ms for pencil coils)					
IP_TD	V	0... FFFFH	0... 262.14	0,004	ms
LDPM_VB_1_IGRE	8	0... FFH	0... 26	0,102	V
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Dwell time correction versus battery voltage and engine speed					

### 6.3.1 Dwell time calculation

#### FUNCTION DESCRIPTION:

The dwell time raw value calculation is based on the simulation done by the HW-group. At any time an adaptation or correction factor has to be multiplied or added in this chapter.

The dwell time open-loop control value is stored in terms of a battery voltage and engine speed related characteristics.

#### Application conditions

**Initialisation:**  $TD = C\_TD\_INI$  at reset

**Recurrence:**  $10\text{ ms}$

**Activation:** at every engine state **if**  $LV\_HOM\_RUN = 1$

#### Formula section

**If**  $LV\_TD\_AD\_H == 1$   
**Then**  $TD = IP\_TD\_S(VB, N\_32) * TD\_FAC + C\_TD\_S\_AS$   
**Else**  $TD = IP\_TD(VB, N\_32) * TD\_FAC + C\_TD\_AS$   
**Endif**

## 6.4 Dwell time factor calculation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TD_FAC	O/V	0... FFH	0... 1.99218	0.0078125	-
Basic dwell time factor					
TD_FAC_TCO	V	1... FFH	0.00781 ...1.99218	0.0078125	-
Adjustment factor with TCO dependence					

### Input data:

TCO {p. 1100}			
---------------	--	--	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TD_FAC_TCO	-	1... FFH	0.00781 ...1.99218	0.0078125	-
LDPM_TCO_TD_FAC	8	0... FEH	-48... 142.5	0.75	°C
Adjustment Factor for dwell time					

### FUNCTION DESCRIPTION:

#### General information:

The output data could be only TD\_FAC. All other factors should be only visible values.

The dwell time factor regroups all adjustment factors as coil temperature factor or a boost factor for start. Here the boost factor is not taken into account as we use for MSD8X project an adaptation of Dwell Time at high current target at start.

**Initialisation :** at reset  
                             TD\_FAC = 1  
                                     TD\_FAC\_TCO = 1  
                             Recurrence: 10 ms

#### Formula section:

TD\_FAC\_TCO = IP\_TD\_FAC\_TCO  
 TD\_FAC = TD\_FAC\_TCO

## 6.5 Dwell time period for stratified mode

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TD_S	O/V	0... FFFFH	0... 262.14	0,004	ms
Dwell time for stratified mode					

### Input data:

LDPM_N_32_1_IGRE	LDPM_VB_1_IGRE	LV_S_RUN {p. 8137}	N_32 {p. 1525}
TD_FAC {p. 1874}	VB {p. 1185}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TD_S_AS	-	F800... 7F0H	-8.192 ...8.128	0.004	ms
Application intervention for stratified mode (typ. Value : 0 ms)					
C_TD_S_INI	-	0... FFFF H	0... 262.14	0.004	ms
Init. value for dwell time control (same for homogeneous and stratified mode)					
IP_TD_S	V	0... FFFFH	0... 262.14	0,004	ms
LDPM_VB_1_IGRE	8	0... FFH	0... 26	0,102	V
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Dwell time correction versus battery voltage and engine speed for stratified mode					

### FUNCTION DESCRIPTION:

The following function is similar to the dwell time calculation for homogeneous combustion. Only the calibration data should be adapted to stratified combustion.

The dwell time value calculation is based on the simulation done by the HW-group. The dwell time open-loop control value is stored in terms of a battery voltage-related characteristic.

### Application conditions

**Initialisation:**  $TD_S = C\_TD\_S\_INI$  at reset

**Recurrence:**  $10\text{ ms}$

**Activation:**  $LV\_S\_RUN = 1$

**Deactivation:**  $LV\_S\_RUN = 0$

### Formula section:

$$TD\_S = IP\_TD\_S(VB, N\_32) * TD\_FAC + C\_TD\_S\_AS$$

## 6.6 Dwell time and ignition angle switches for different combustion modes

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA_IGC_H_RNG [NC_CYL_NR]	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Ignition angle (high range) at cylinder x					
TD_FAC_MAX_TMP	-	1... FFH	1... 255	1/128	-
Maximal dwell time control					
TD_FAC_MIN_TMP	-	1... FFH	1... 255	1/128	-
Minimal dwell time control					
TD_IGC [NC_CYL_NR]	O/V	0... FFFFH	0... 262.14	0,004	ms
Dwell time duration					
TD_IGC_ACT_MAX	-	0... FFFFH	0... 262.14	0,004	ms
Maximal Dwell time duration					
TD_IGC_ACT_MIN	-	0... FFFFH	0... 262.14	0,004	ms
Minimal Dwell time duration					
TD_LIM_MAX	O/V	0... FFFFH	0... 262.14	0,004	ms
Maximum dwell time allowed					

### Input data:

IGA_AV_H_RNG [NC_CYL_NR] {p. 1828}	IGA_IGC_H_RNG_ACT [NC_CYL_NR] {p. 2037}	IGC_EXT_ADJ [NC_CYL_NR]	INJ_MOD [NC_CYL_NR] {p. 2037}
INJ_MOD_SP [NC_CYL_NR] {p. 3328}	LV_ES {p. 1720}	LV_FIRST_VLD_TOOTH {p. 1505}	LV_IGC_EXT_ADJ [NC_CYL_NR]
LV_IGK {p. 906}	LV_IGN_INJ_SYN_DEAC {p. 8269}	LV_INH_IGC [NC_CYL_NR] {p. 4773}	LV_ST_END {p. 1720}
NC_CYL_NR {p. 1526}	NC_INJ_MOD_HOM {p. 2045}	NC_INJ_MOD_MASK_1 {p. 2045}	NC_TD_LIM_MAX_H {p. 1876}
NC_TD_LIM_MAX_L {p. 1876}	NC_TD_LIM_MIN {p. 1877}	TD {p. 1873}	TD_AD [NC_CYL_NR] {p. 932}
TD_FAC_MAX {p. 917}	TD_FAC_MIN {p. 917}	TD_IGC_ACT [NC_CYL_NR] {p. 2040}	TD_S {p. 1875}
VB {p. 1185}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VB_TD_MAX_LIM_H	-	0... FFH	0... 26	0.102	V
High battery voltage threshold above which we apply NC_TD_LIM_MAX_H for maximum dwell time					
C_VB_TD_MAX_LIM_L	-	0... FFH	0... 26	0.102	V
Low battery voltage threshold below which we apply NC_TD_LIM_MAX_L for maximum dwell time					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_TD_LIM_MAX_H	-	0... FFFFH	0... 262.14	0.004	ms
NC_TD_LIM_MAX_H - Typical value 20 ms					
NC_TD_LIM_MAX_L	-	0... FFFFH	0... 262.14	0.004	ms
NC_TD_LIM_MAX_L - Typical value 10 ms					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_TD_LIM_MIN	-	0... FFFFH	0... 262.14	0.004	ms
NC_TD_LIM_MIN (Typical value 1 ms)					

<b>ACTION_INFR_SetIgnDwell (IN &lt;&gt;, IN &lt;&gt;, IN &lt;&gt;, IN &lt;&gt;)</b>
<b>ACTION_INFR_SetIgnAngle (IN &lt;&gt;, IN &lt;&gt;)</b>
<b>ACTION_INFR_SetIgcDwellTest (IN &lt;&gt;, IN &lt;&gt;)</b>
<b>ACTION_INJR_IgnUpdate (IN &lt;&gt;, IN &lt;&gt;)</b>

### Exported action:

<b>ACTION_IGRE_SendTrigForIgnUpd (IN &lt;PRM_STATE_IGN_UPD_ENA&gt;)</b>
This action allows INJR to trig IGRE for updating its ignition parameter to its driver according to the designating cylinders specified by action parameter.

### Description for action:

<b>ACTION_IGRE_SendTrigForIgnUpd (IN &lt;PRM_STATE_IGN_UPD_ENA&gt;)</b>					
This action allows INJR to trig IGRE for updating its ignition parameter to its driver according to the designating cylinders specified by action parameter.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_STATE_IGN_UPD_ENA	IN	0...FF	0...255	1	-
Bitmap to enable/disable ignition update calculations.					

### Formula section For ACTION\_IGRE\_SendTrigForIgnUpd:

TD\_IGC\_ACT\_MAX = 0 ms

TD\_IGC\_ACT\_MIN = 262.14 ms

For x = 0 to NC\_CYL\_NR - 1

TD\_IGC\_ACT\_MAX = max (TD\_IGC\_ACT[x], TD\_IGC\_ACT\_MAX)

TD\_IGC\_ACT\_MIN = min (TD\_IGC\_ACT[x], TD\_IGC\_ACT\_MIN)

Endfor

TD\_FAC\_MAX\_TMP = min (TD\_LIM\_MAX / TD\_IGC\_ACT\_MAX, TD\_FAC\_MAX)

TD\_FAC\_MIN\_TMP = max (NC\_TD\_LIM\_MIN / TD\_IGC\_ACT\_MIN, TD\_FAC\_MIN)

TD\_IGC[x] = TD\_IGC\_ACT[x]

IGA\_IGC\_H\_RNG[x] = IGA\_IGC\_H\_RNG\_ACT[x]

For x = 0 to NC\_CYL\_NR - 1

Set ignition parameters if newly calculated:

If bit x of PRM\_STATE\_IGN\_UPD\_ENA == 1

Then

**ACTION\_INFR\_SetIgnDwell (x, TD\_FAC\_MIN\_TMP, TD\_IGC[x],**

**FAC\_MAX\_TMP)**

**ACTION\_INFR\_SetIgnAngle (x, IGA\_IGC\_H\_RNG[x])**

Endif

Endfor

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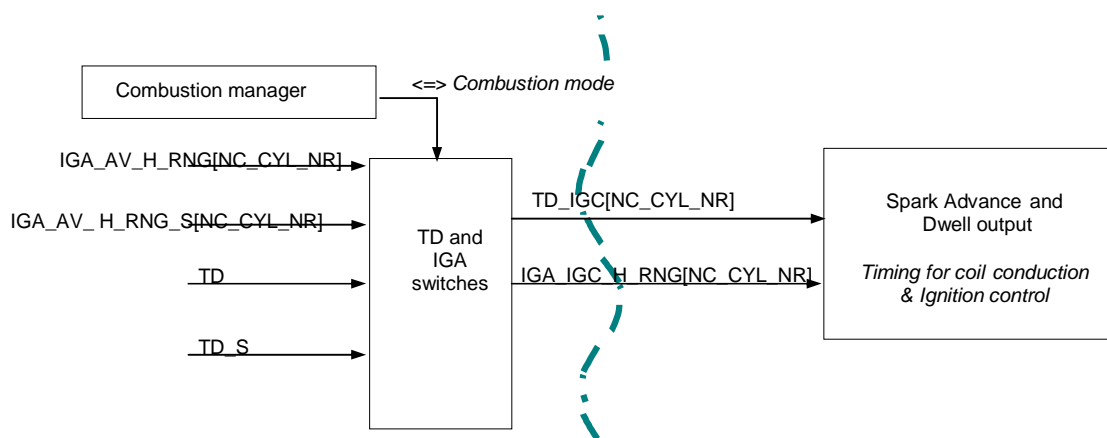
## FUNCTION DESCRIPTION:

This module should cover all necessary switches between the different dwell times and ignition angles to ensure two outputs, TD\_IGC[NC\_CYL\_NR] and IGA\_IGC\_H\_RNG[NC\_CYL\_NR].

**Initialisation:** at reset  
 $TD\_IGC[NC\_CYL\_NR] = TD + TD\_AD[NC\_CYL\_NR]$   
 $IGA\_IGC\_H\_RNG[NC\_CYL\_NR] = IGA\_AV\_H\_RNG[NC\_CYL\_NR]$

**For**  $x = 0$  **to**  $NC\_CYL\_NR - 1$   
**ACTION\_INFR\_SetIgnDwell**( $x, TD\_FAC\_MIN, TD\_IGC[x], TD\_FAC\_MAX$ )  
**ACTION\_INFR\_SetIgnAngle**( $x, IGA\_IGC\_H\_RNG[x]$ )  
**Endfor**

## Signal flow diagram:



## Choice between homogeneous inputs and stratified inputs

The switch between homogeneous and stratified combustion mode could not be realised between TD\_ON[NC\_CYL\_NR] and TD\_OFF[NC\_CYL\_NR].

Switching is only possible if there's no action on the cylinder.

The switch has to be synchronised with the injection switch. The combustion manager managed by INJR does this synchronisation. The switch has to work per cylinder. Some inputs on this signal flow diagram are in fact use by the synchronization module of INJR.

### 6.6.1 Update of Ignition angle if homogeneous mode is selected

#### Application conditions

**Activation:**  $LV\_ST\_END = 1$ : Engine synchronized

**Recurrence:** 10ms

#### Formula section:

**For**  $x = 0$  **to**  $NC\_CYL\_NR - 1$

**If**  $INJ\_MOD[x] == 'SNGH'$  **And**  $INJ\_MOD\_SP[x] == 'SNGH'$   
**Or**  $[INJ\_MOD[x] == 'MPLH'$  **And**  $INJ\_MOD\_SP[x] == 'MPLH'$  **And**  $LV\_IGN\_INJ\_SYN\_DEAC = 1$  ]

```

Or      [ INJ_MOD[x] == 'MPLH+PLS3' And INJ_MOD_SP[x] == 'MPLH+PLS3' And LV_
IGN_INJ_SYN_DEAC = 1 ]
Then    IGA_IGC_H_RNG[x] = IGA_AV_H_RNG[x]
        ACTION_INJR_IgnUpdate (x, IGA_IGC_H_RNG[x])
        ACTION_INFR_SetIgnAngle (x, IGA_IGC_H_RNG_ACT[x])
Endif
Endfor

```

## 6.6.2 TD\_LIM\_MAX calculation

### Application conditions

**Activation:** Engine synchronized  
**Recurrence:** 10ms  
**Initialisation:** at reset

### Formula section:

```

If      VB < C_VB_TD_MAX_LIM_L
Then    TD_LIM_MAX = NC_TD_LIM_MAX_H
Endif

```

```

If      VB > C_VB_TD_MAX_LIM_H
Then    TD_LIM_MAX = NC_TD_LIM_MAX_L
Endif

```

**In every case:**  $TD\_IGC[x] * TD\_FAC\_MAX \leq TD\_LIM\_MAX$   
 $TD\_IGC[x] * TD\_FAC\_MIN \geq NC\_TD\_LIM\_MIN$

NC\_TD\_LIM\_MIN is defined for dwell time protection in case of advance ignition changes during the dwell time application. If the dwell time is equal to this minimal limit value, the advance ignition could be not guaranteed

NC\_TD\_LIM\_MAX is defined for the maximum dwell time in case of advance ignition changes during the dwell time application. If the dwell time is equal to this maximal limit value, the advance ignition could be not guaranteed

**Note:** In any case, TD\_FAC\_MIN has to be smaller than 1 and TD\_FAC\_MAX greater than one to be sure to respect the requested dwell and avoid inconsistencies

care has to be taken with the setting of NC\_TD\_LIM\_MAX\_L and NC\_TD\_LIM\_MAX\_H in order to avoid Dwell Time /coil charging recovery:

Dwell time can start at the earliest at 288°CRK before the TDC.

NC\_TD\_LIM\_MAX\_L and NC\_TD\_LIM\_MAX\_H should be tuned in consequence to respect coil charging time no recovery and coil capacity

$$TD\_MAX = \min(TD\_IGC[x] * TD\_FAC\_MAX, TD\_LIM\_MAX)$$

$$TD\_MIN = \max(TD\_IGC[x] * TD\_FAC\_MIN, NC\_TD\_LIM\_MIN)$$


## 6.6.3 Dwell time switch Ignition Actuator Tests Diagnosis

### Application conditions

```

Activation:      [ LV_ES = 1 // Actuator tests activation
                    and   LV_IGK = 1
                    and   LV_FIRST_VLD_TOOTH = 0
                    and   LV_INH_IGC[x] = 0

```

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```

and          at least one LV_IGC_EXT_ADJ[x] = 1]
Deactivation: [ LV_ES = 0          // Actuator tests deactivation
or          LV_IGK          = 0
or          LV_FIRST_VLD_TOOTH = 1
or          LV_INH_IGC[x] = 1
or          at least one LV_IGC_EXT_ADJ[x] = 0]
Recurrence: On transition of IGC_EXT_ADJ[x] from 0 to 1

```

### System description:

For ignition coil actuator tests purpose, the Dwell Time has to be applied and transmitted to BSW via action. A specific service is used for those tests purposes.

### Formula section:

```

If (INJ_MOD[x] & NC_INJ_MOD_MASK_1) != NC_INJ_MOD_HOM // Stratified mode for cyl. _x
Then TD_IGC[x] = TD_S
Else TD_IGC[x] = TD
Endif

For x = 0 to NC_CYL_NR - 1
  If LV_IGC_EXT_ADJ[x] = 1
    Then On transition of IGC_EXT_ADJ[x] from 0 to 1
      And LV_FIRST_VLD_TOOTH = 0
      ACTION_INFR_SetIgcDwellTest(x,TD_IGC[x])
    Elseif LV_FIRST_VLD_TOOTH = 1
      ACTION_INFR_SetIgcDwellTest(x,0) // immediate cut of tests on engine
  running
Endif
EndFor

```



## 6.7 Ignition with multiple spark

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGN_MPL_NR [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
Number of ignition sparks					
T_CTR_TD_MPL	V	0... FFFFH	0... 6553.5	0,1	s
Maintenance Time of Multiple Spark activation before Out Case					
TD_MPL	O/V	0... FFFFH	0... 262.14	0,004	ms
Dwell time for multiple spark (for 2 <sup>nd</sup> and others MPL sparks)					
TD_MPL_1	O/V	0... FFFFH	0... 262.14	0,004	ms
Dwell time for 1 <sup>st</sup> multiple spark (e.g. 1 <sup>st</sup> spark after main spark)					
TD_MPL_1_DLY	O/V	0... FFFFH	0... 262.14	0,004	ms
Dwell time interruption between main spark and 1 <sup>st</sup> MPL spark					
TD_MPL_DLY	O/V	0... FFFFH	0... 262.14	0,004	ms
Dwell time interruption between MPL sparks (except between main and 1 <sup>st</sup> MPL spark)					

### Input data:

INJ_MOD [NC_CYL_NR] {p. 2037}	INJ_MOD_MPL {p. 1896}	LDPM_N_32_1_IGRE	LDPM_VB_1_IGRE
LV_ES {p. 1720}	LV_FL {p. 1759}	LV_INH_TD_MPL {p. 1896}	LV_IS {p. 1720}
LV_PL {p. 1720}	LV_PU {p. 1720}	LV_PUC {p. 1720}	LV_ST {p. 1720}
LV_TD_MPL_SPC_IGN_ ACT {p. 1896}	N_32 {p. 1525}	NC_CYL_NR {p. 1526}	NC_INJ_MOD_HOM {p. 2045}
NC_INJ_MOD_MASK_1 {p. 2045}	NR_MPL_CYL_IGN [NC_CYL_NR] {p. 1896}	TCO {p. 1100}	TEMP_MDL_IGC {p. 1896}
VB {p. 1185}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_MAX_MPL_IS	-	0... FFH	0... 8160	32	rpm
Engine speed max for ignition with multiple spark at idle					
C_N_MAX_MPL_PL_PU_FL	-	0... FFH	0... 8160	32	rpm
Engine speed max for ignition with multiple spark at Run					
C_N_MAX_MPL_PUC	-	0... FFH	0... 8160	32	rpm
Engine speed max for ignition with multiple spark at Fuel cut off					
C_N_MAX_MPL_ST	-	0... FFH	0... 8160	32	rpm
Engine speed max for ignition with multiple spark at Start					
C_N_MIN_MPL_IS	-	0... FFH	0... 8160	32	rpm
Engine speed min for ignition with multiple spark at Idle					
C_N_MIN_MPL_PL_PU_FL	-	0... FFH	0... 8160	32	rpm
Engine speed min for ignition with multiple spark at Run					
C_N_MIN_MPL_PUC	-	0... FFH	0... 8160	32	rpm
Engine speed min for ignition with multiple spark at fuel cut off					
C_N_MIN_MPL_ST	-	0... FFH	0... 8160	32	rpm
Engine speed min for ignition with multiple spark at Start					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_CTR_TD_MPL	-	0... FFFFH	0... 655.35	0,01	s
Maintenance Time of Multiple Spark activation before Out Case					
C_T_CTR_TD_MPL_AST	-	0... FFFFH	0... 655.35	0,01	s
Maintenance Time of Multiple Spark activation before Out Case and for the After Start phase					
C_TCO_MAX_MPL_IS	-	0... FEH	-48... 142.5	0.75	°C
Max. Coolant Temp. to have multiple spark at Idle speed					
C_TCO_MAX_MPL_PL_PU_FL	-	0... FEH	-48... 142.5	0.75	°C
Max. Coolant Temp. to have multiple spark at Run					
C_TCO_MAX_MPL_PUC	-	0... FEH	-48... 142.5	0.75	°C
Max. Coolant Temp. To have multiple spark at fuel cut off					
C_TCO_MAX_MPL_ST	-	0... FEH	-48... 142.5	0.75	°C
Max. Coolant Temp. to have multiple spark at start					
C_TD_MPL_MAN	-	0... 1H	0 ...1	1	-
Manual activation of the MPL					
C_TEMP_MDL_IGC_HYS	-	0... FFH	-40 ...215	1	°C
Estimated coil temperature minimum threshold					
C_TEMP_MDL_IGC_MAX	-	0... FFH	-40 ...215	1	°C
estimated coil temperature maximum threshold					
C_VB_MAX_MPL_IS	-	0... FFH	0... 26	0.102	V
Max. Battery voltage to have multiple spark (requested value 16V) at idle speed					
C_VB_MAX_MPL_PL_PU_FL	-	0... FFH	0... 26	0.102	V
Max. Battery voltage to have multiple spark (requested value 16V) at Run					
C_VB_MAX_MPL_PUC	-	0... FFH	0... 26	0.102	V
Max. Battery voltage to have multiple spark (requested value 16V) at fuel cut off					
C_VB_MAX_MPL_ST	-	0... FFH	0... 26	0.102	V
Max. Battery voltage to have multiple spark (requested value 16V) at start					
IP_FAC_TCO_NR_MPL	-	0... 50H	0 ...8	0.1	-
LDPM_TCO_1_IGRE	8	0... FEH	-48... 142.5	0.75	°C
TCO factor used to calculate multiple spark number in homogeneous mode					
IP_FAC_TCO_NR_MPL_S	-	0... 50H	0 ...8	0.1	-
LDPM_TCO_1_IGRE	8	0... FEH	-48... 142.5	0.75	°C
TCO factor used to calculate multiple spark number in stratified mode					
IP_FAC_TEMP_MDL_IGC_NR_MPL	-	0... 50H	0 ...8	0.1	-
LDPM_TEMP_MDL_IGC_1_IGRE	8	0... FFH	-40 ...215	1	°C
estimated coil temperature factor used to calculate multiple spark number in homogeneous mode					
IP_FAC_TEMP_MDL_IGC_NR_MPL_S	-	0... 50H	0 ...8	0.1	-
LDPM_TEMP_MDL_IGC_1_IGRE	8	0... FFH	-40 ...215	1	°C
estimated coil temperature factor used to calculate multiple spark number in stratified mode					
IP_NR_MPL	V	0... FFH	0... 255	1	-
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_MV_1_IGRE	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Number of successive ignition sparks depending on engine speed and mass fuel in homogeneous mode					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_NR_MPL_S	V	0... FFH	0... 255	1	-
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	Rpm
LDPM_MFF_SP_MV_1_IGRE	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Number of successive ignition sparks depending on engine speed and mass fuel in stratified mode					
IP_TD_MPL	-	0... FFFFH	0... 262.14	0,004	ms
LDPM_VB_1_IGRE	8	0... FFH	0... 26	0.102	V
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Dwell time for multiple spark in homogeneous mode confirmed					
IP_TD_MPL_1	V	0... FFFFH	0... 262.14	0,004	ms
LDPM_VB_1_IGRE	8	0... FFH	0... 26	0.102	V
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Dwell time for 1 <sup>st</sup> multiple spark in homogeneous mode confirmed					
IP_TD_MPL_1_S	V	0... FFFFH	0... 262.14	0,004	ms
LDPM_VB_1_IGRE	8	0... FFH	0... 26	0.102	V
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Dwell time for 1 <sup>st</sup> multiple spark in stratified mode confirmed					
IP_TD_MPL_S	-	0... FFFFH	0... 262.14	0,004	ms
LDPM_VB_1_IGRE	8	0... FFH	0... 26	0.102	V
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Dwell time for multiple spark in stratified mode confirmed					
IP_TD_T_MPL	-	0... FFFFH	0... 262.14	0,004	ms
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Minimum time between two ignition (normal value 150µs) in homogeneous mode					
IP_TD_T_MPL_1	V	0... FFFFH	0... 262.14	0,004	ms
LDPM_VB_1_IGRE	8	0... FFH	0... 26	0.102	V
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Time delay between mains spark and start of ign coil drive for 1 <sup>st</sup> MPL spark (homogeneous mode confirmed)					
IP_TD_T_MPL_1_S	V	0... FFFFH	0... 262.14	0,004	ms
LDPM_VB_1_IGRE	8	0... FFH	0... 26	0.102	V
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Time delay between main spark and start of ign coil drive for 1 <sup>st</sup> MPL spark (stratified mode confirmed)					
IP_TD_T_MPL_S	-	0... FFFFH	0... 262.14	0,004	ms
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Minimum time between two ignition (normal value 150µs) in stratified mode					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_MAX_IGN_MPL_NR	-	0... FFH	0... 255	1	-
Maximum multiple spark - Typical value for debug:7					
NC_MPL_IGN_H_RNG_CRK_MAX	-	0... 12C0H	0... 300	0.0625	°CRK
Maximum ignition angle after TDC to start TD_MPL (normal value 12 to 18 °CRK)					
NC_MPL_T_MAX	-	0... FFFFH	0... 262.14	0.004	ms
Maximum time duration of Multiple Spark (Normal value 60 ms)					

**Import actions:**

Continued on next page

**ACTION\_INFR\_SetIgnMpl** (IN<No Name available>,IN<No Name available>,IN<No Name available>,IN<No Name available>,IN<No Name available>,IN<No Name available>)

### 6.7.1 Calculation of parameters for multiple spark

#### FUNCTION DESCRIPTION:

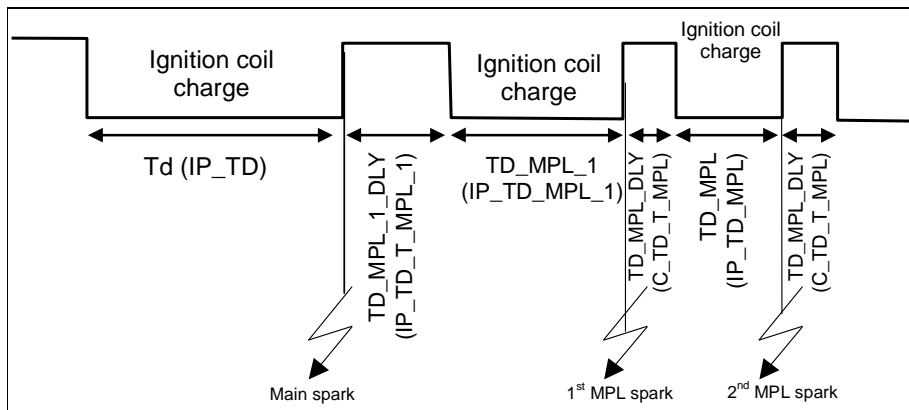
With this function several subsequent sparks could be created. The delay time to create a spark and the time to reload the coil are defined in tables depending on battery voltage and on engine speed.

At start and for the following application conditions, the ignition is controlled by means of multiple sparks.

After an adjustable combustion period, the ignition coil is loaded with a specific dwell time to create successive sparks. The number of successive sparks is defined as IGN\_MPL\_NR.

The multiple sparks ignition can also be activated by the input flag LV\_TD\_MPL\_SPC\_IGN\_ACT. In this case, the 1<sup>st</sup> MPL spark (e.g. the first spark after the main spark) is controlled by specific calibration data IP\_TD\_MPL\_1 and IP\_TD\_T\_MPL\_1 (see the picture below for more explanation).

If LV\_TD\_MPL\_SPC\_IGN\_ACT is inactive, the 1<sup>st</sup> MPL spark takes the same parameters than the other MPL sparks.



The MPL Sparks are maintained during a time (C\_T\_CTR\_TD\_MPL\_AST or C\_T\_CTR\_TD\_MPL) after the end of the activation condition, before exiting this MPL procedure (*Application Multiple Spark Maintenance for a time before Exit Case*)

We use an estimated coil temperature to limit the number of multiple sparks and then protect ignition coil.

We also increase the number of multiple sparks in case of misfiring.

Priority is given to the protection of ignition coil, according to the estimated temperature coil compared to a maximum value: C\_TEMP\_MDL\_IGC\_MAX.

#### Application conditions

##### Initialisation:

```

IGN_MPL_NR = 0
TD_MPL      = 0
TD_MPL_1    = 0
TD_MPL_DLY  = 0
TD_MPL_1_DLY = 0
T_CTR_TD_MPL = 0
    
```

*At reset and in deactivation condition*

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	Document key 10171571 SPE 000 AO	Pages Page 1884 of 8404	
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**Recurrence:** 10 ms

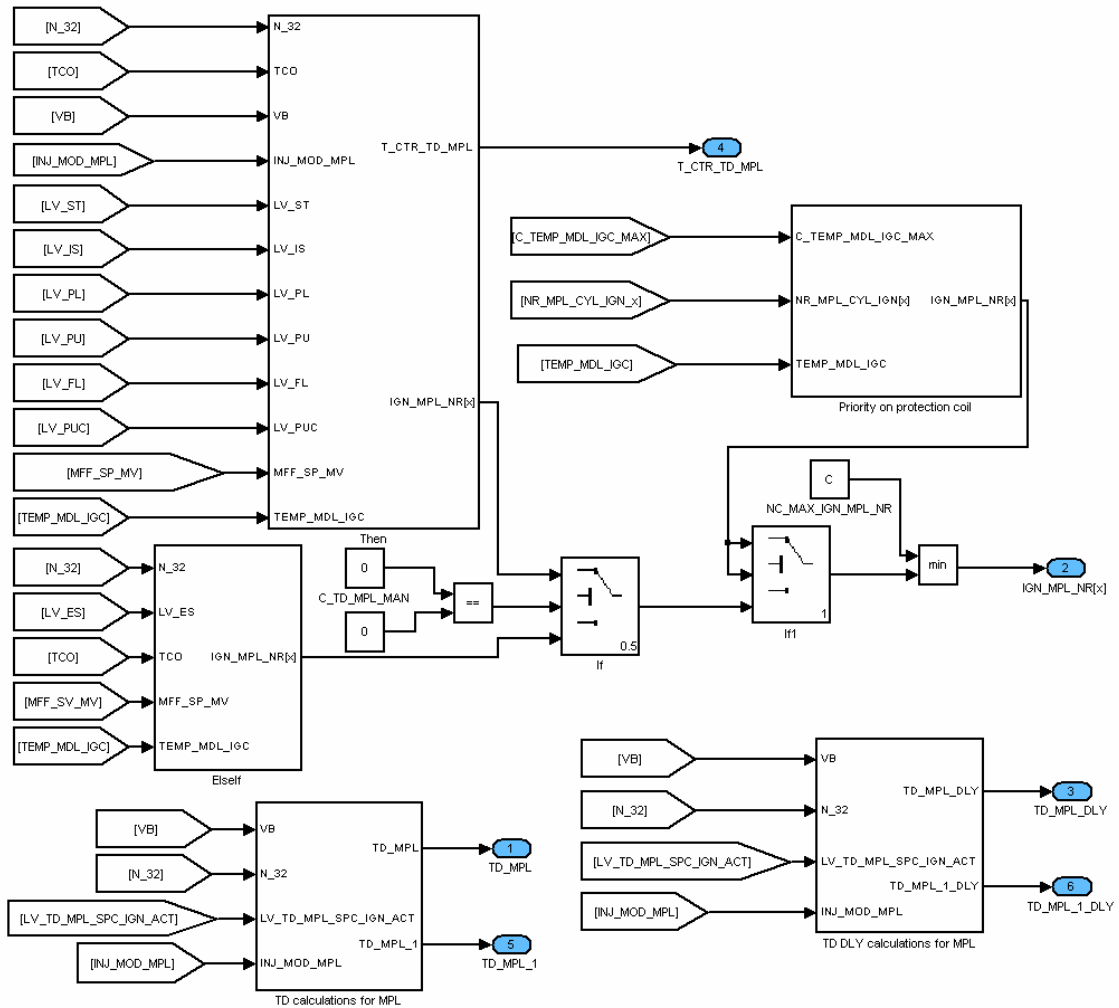
Activation:

LV\_INH\_TD\_MPL = 0

**Deactivation:**

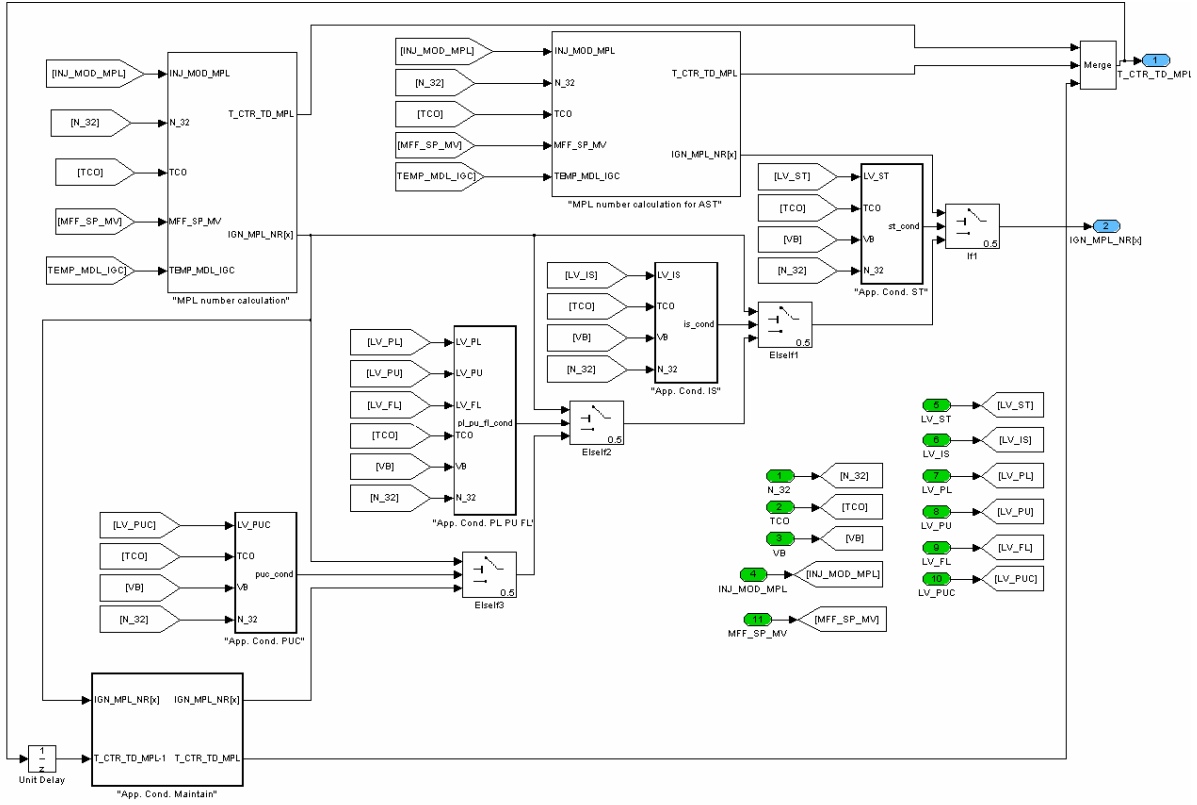
LV\_INH\_TD\_MPL = 1

**Formula section:**



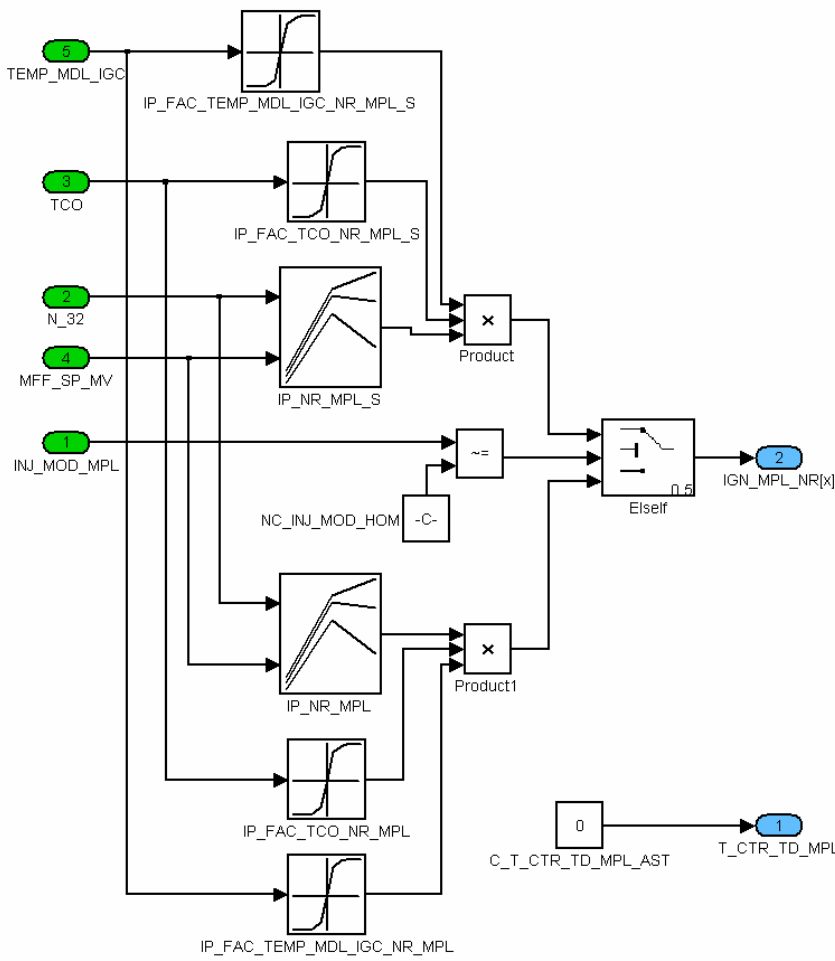
**IGRE\_TD\_MPL**

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*iGRE\_TD\_MPL / Then*

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IGRE\_TD\_MPL / Then / MPL number calculation for AST

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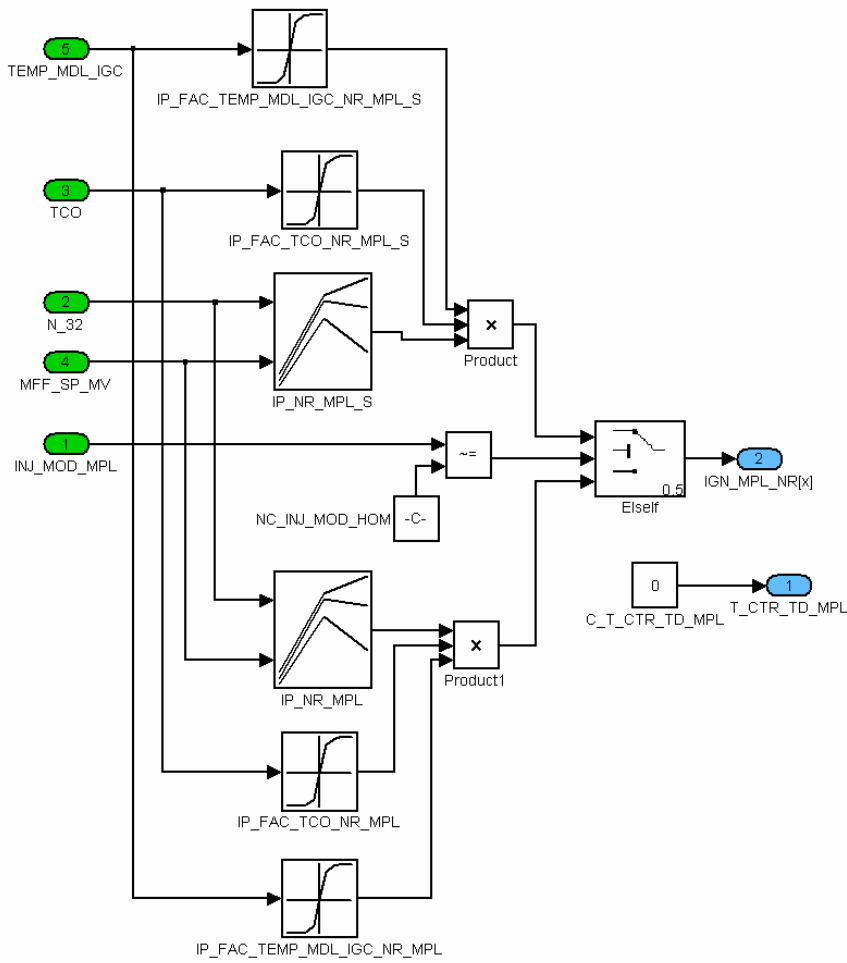


Figure 6.7.1: IGRE\_TD\_MPL /Then /MPL number calculation

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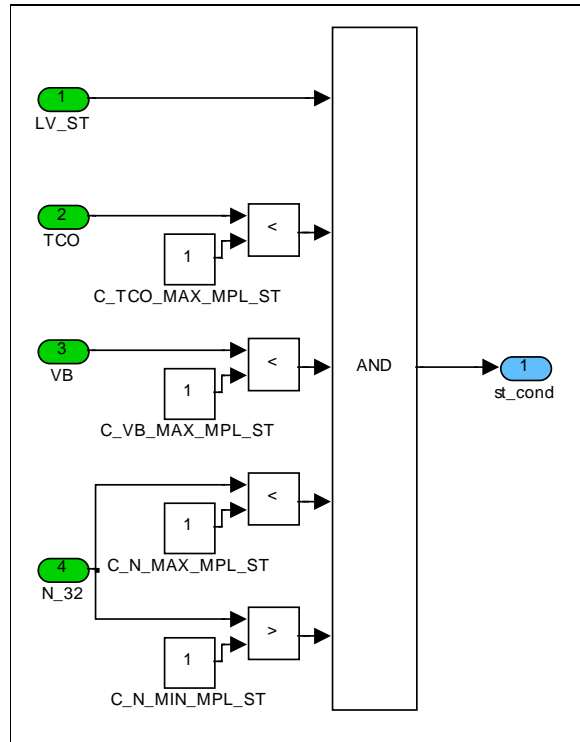


Figure 6.7.2: IGRE\_TD\_MPL /Then /App. Cond. ST

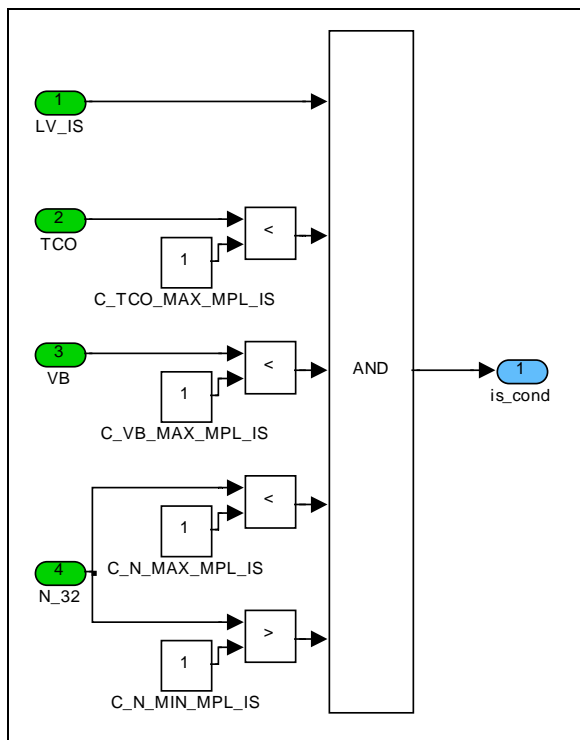


Figure 6.7.3: IGRE\_TD\_MPL /Then /App. Cond. IS

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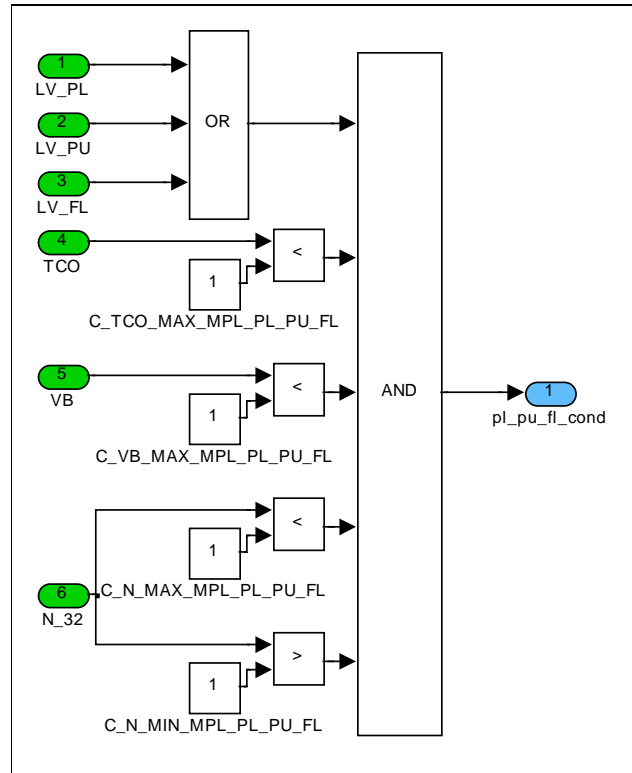


Figure 6.7.4: IGRE\_TD\_MPL /Then /App. Cond. PL PU FL

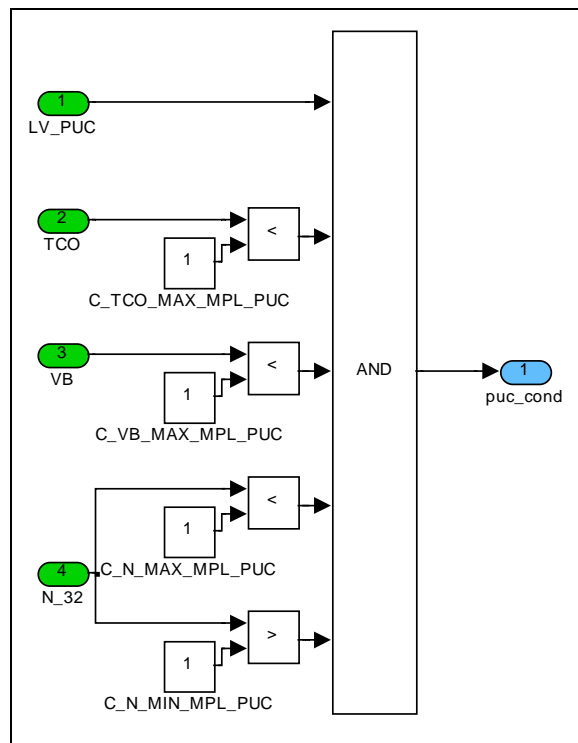


Figure 6.7.5: IGRE\_TD\_MPL /Then /App. Cond. PUC

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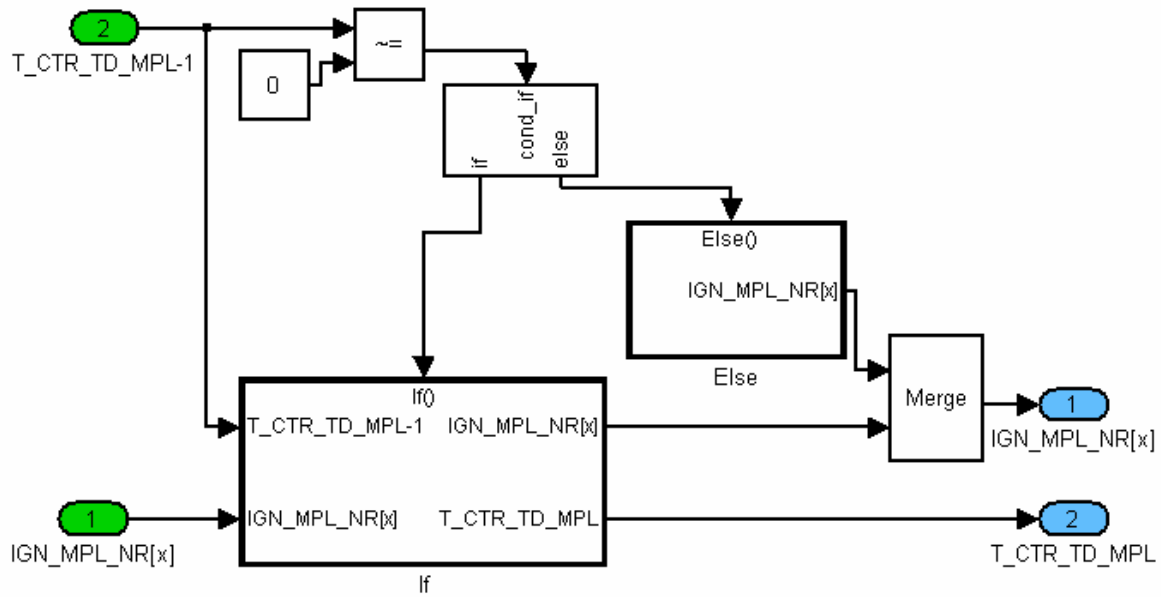


Figure 6.7.6: IGRE\_TD\_MPL /Then /App. Cond. Maintain

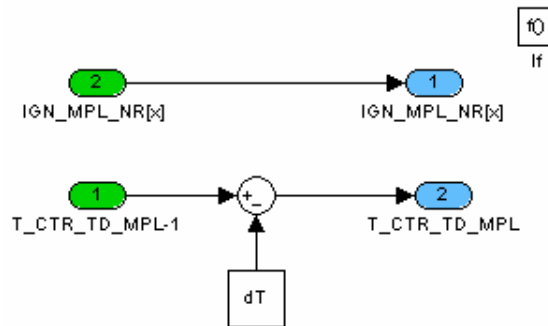


Figure 6.7.7: IGRE\_TD\_MPL /Then /App. Cond. Maintain /If

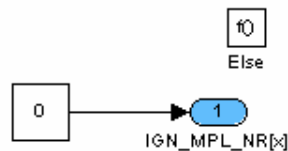


Figure 6.7.8: IGRE\_TD\_MPL /Then /App. Cond. Maintain /Else

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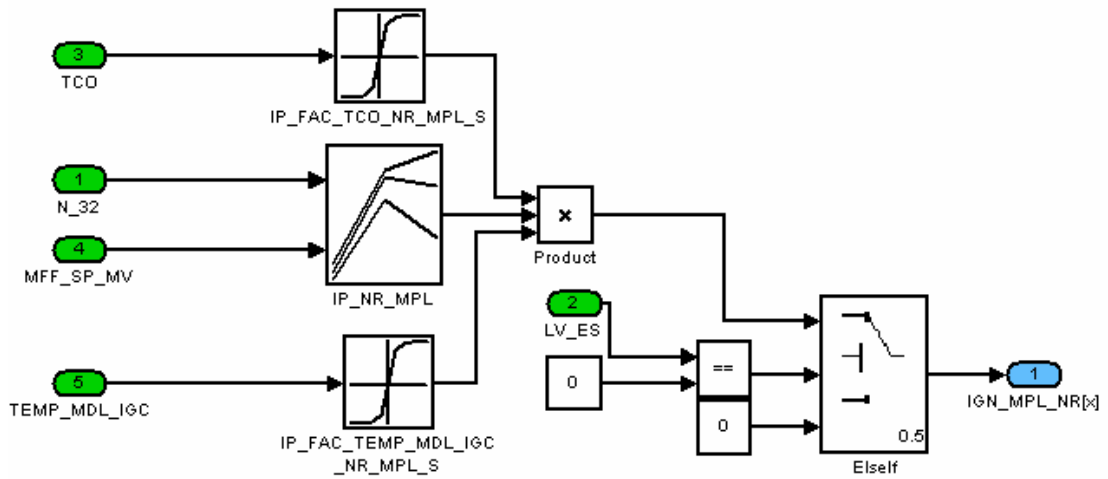



Figure 6.7.9: IGRE\_TD\_MPL /Elself

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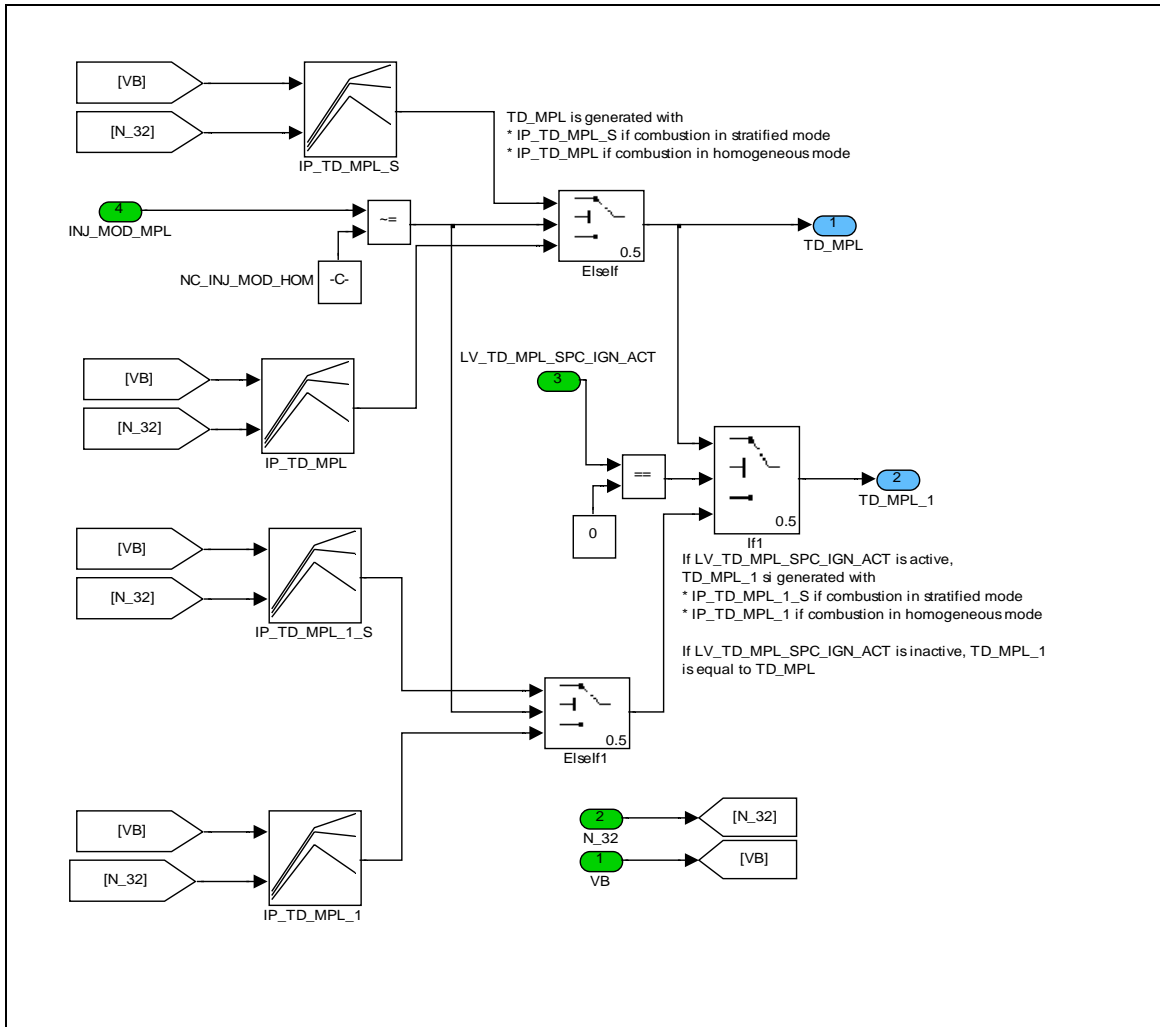


Figure 6.7.10: IGRD\_TD\_MPL /TD calculations for MPL

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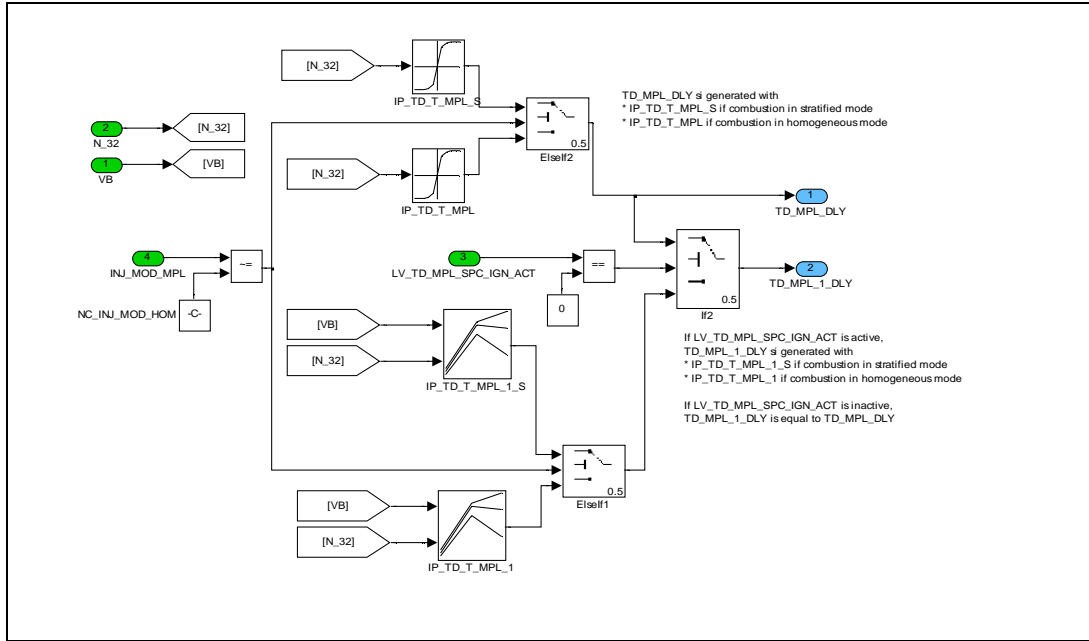


Figure 6.7.11: IGRE\_TD\_MPL /TD DLY calculations for MPL

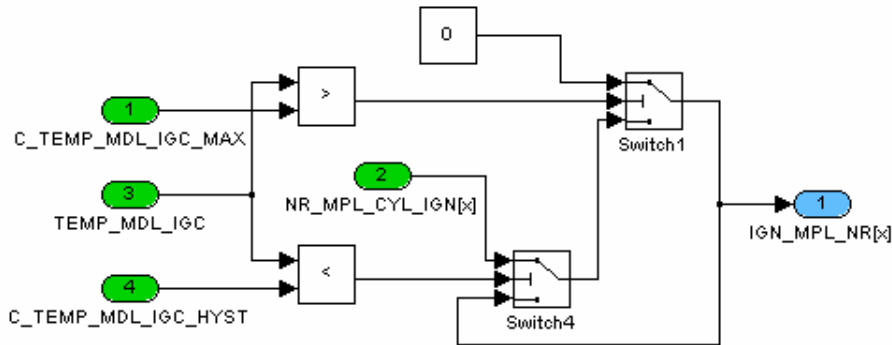


Figure 6.7.12: Priority on protection coil

## 6.7.2 Settings of multiple spark parameters

### Application conditions


#### Initialisation:

*At reset*  
**ACTION\_INFR\_SetIgnMpl** (x, TD\_MPL\_1, TD\_MPL, TD\_MPL\_1\_DLY, TD\_MPL\_DLY, IGN\_MPL\_NR[x])


#### Recurrence:

10 ms

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**Formula section:****For** x = 0 **to** NC\_CYL\_NR - 1**ACTION\_INFR\_SetIgnMpl** (x, TD\_MPL\_1, TD\_MPL, TD\_MPL\_1\_DLY, TD\_MPL\_DLY,  
IGN\_MPL\_NR[x])**EndFor**

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## 6.8 Ignition with multiple spark (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EGY_COLD_IGC	O/V	0... FFFFH	0... 6553.5	0.1	W
Lost energy in the ignition coils because of cooling					
EGY_HEAT_IGC	O/V	0... FFFFH	0... 6553.5	0.1	W
Ignition energy of the ignition coils					
EGY_HEAT_IGC_HOM	O/V	0... FFFFH	0... 6553.5	0.1	W
Ignition energy of the ignition coils in homogeneous mode					
EGY_HEAT_IGC_S	O/V	0... FFFFH	0... 6553.5	0.1	W
Ignition energy of the ignition coils in stratified mode					
INJ_MOD_MPL	O/V	0... FFH	0... 255	1	-
Variable indicating if combustion mode is considered as homogeneous or stratified					
LV_INH_TD_MPL	O/V	0... 1H	0 ...1	1	-
Inhibition for multiple spark					
LV_TD_MPL_SPC_IGN_ACT	O/V	0... 1H	0 ...1	1	-
Activation of the 2° ignition event using modified extended MPL					
NR_MPL_CYL_IGN [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
Number of MPL for selected cylinder by BMW layer word label in homogeneous mode					
TEMP_COOL	V	0... FFH	-40 ...215	1	°C
Cooling temperature of ignition coils					
TEMP_MDL_IGC	O/V/S	0... FFH	-40 ...215	1	°C
Estimated coil temperature					

### Input data:

IGN_MPL_NR [NC_CYL_NR] {p. 1881}	INJ_MOD [NC_CYL_NR] {p. 2037}	LV_TD_AD_H {p. 937}	N_32 {p. 1525}
NC_CYL_NR {p. 1526}	STATE_MPL_CYL_IGN {p. 8264}	TAM {p. 1579}	TCO {p. 1100}
TECU {p. 1256}	TOIL {p. 8204}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ALFA_A_IGC	-	0... 3E8H	0 ...1	1e-3	W/K
Product of heat-transfer-coefficient and area of the ignition coils					
C_CP_M_IGC	-	0... 2710H	0... 1000	0.1	J/K
Product of heat-capacity and mass of ignition coils					
C_N_MAX_MPL_SPC_IGN_ACT	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for 2° ignition event activation					
C_TCO_STE	-	0... FEH	-48... 142.5	0.75	°C
Minimum threshold for calculation of temperature model					
C_TECU_MAX_IGN_MPL	-	0... FEH	-48... 142.5	0.75	°C
TECU threshold to disable multiple spark activation					
C_TEMP_COOL_INI	-	0... FFH	-40 ...215	1	°C
Initialisation of ignition coils cooling temperature					
C_TEMP_GRD	-	0... 320H	0 ...8	0.01	-
Temperature gradient in integrator-block					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TEMP_MDL_IGC_HYS_MAX	-	0... FFH	-40 ...215	1	°C
Estimated coil temperature maximum threshold					
C_TEMP_MDL_IGC_HYS_MIN	-	0... FFH	-40 ...215	1	°C
Estimated coil temperature minimum threshold					
C_TEMP_MDL_IGC_INI	-	0... FFH	-40 ...215	1	°C
initialization-value for temperature model					
C_TEMP_MDL_IGC_INT_MAX	-	0... FFH	-40 ...215	1	°C
Integrator maximum limit of coil model-temperature					
C_TEMP_MDL_IGC_INT_MIN	-	0... FFH	-40 ...215	1	°C
Integrator minimum limit of coil model-temperature					
C_TOIL_IGC_MAX	-	0... C8H	-40 ...160	1	°C
Maximum threshold for oil temperature					
C_TOIL_IGC_MIN	-	0... C8H	-40 ...160	1	°C
Threshold for TOIL					
ID_NR_IGN_MPL	-	0... FFH	0... 255	1	-
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Number of successive ignition sparks in homogeneous mode if misfiring is detected					
ID_NR_IGN_MPL_S	-	0... FFH	0... 255	1	-
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Number of successive ignition sparks in stratified mode if misfiring is detected					
IP_EFF_IGC	-	0... 7FH	0... 1.984375	0.015625	-
LDP_TEMP_MDL_IGC_IP_EFF_IGC	6	0... FFH	-40 ...215	1	°C
Efficiency of ignition coils depending on model temperature					
IP_EGY_IGC_HOM	V	0... FFFFH	0... 6553.5	0.1	W
LDPM_IGN_MPL_NR_IP_EGY_IGC	8	0... FFH	0... 255	1	-
LDPM_N_32	8	0... FFH	0... 8160	32	rpm
ignition energy in homogeneous mode					
IP_EGY_IGC_S	V	0... FFFFH	0... 6553.5	0.1	W
LDPM_IGN_MPL_NR_IP_EGY_IGC	8	0... FFH	0... 255	1	-
LDPM_N_32	8	0... FFH	0... 8160	32	rpm
ignition energy in stratified mode					
IP_TAM_COR	-	0... FE00H	-48... 142.5	2.92969e-3	°C
LDP_TAM_IP_TAM_COR	6	0... FEH	-48... 142.5	0.75	°C
Temperature correction due to ambient temperature influence					
LC_TD_MPL_SPC_IGN_ACT	-	0... 1H	0 ...1	1	-
Calibration for activation control of 2° ignition event using modified extended MPL to switch off					
LC_TEMP_IGC_VAR	-	0... 1H	0 ...1	1	-
Switch between TOIL and TCO for TEMP_COOL					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_INJ_MOD_HOM	-	0... FFH	0... 255	1	-
NC_INJ_MOD_HOM					
NC_INJ_MOD_MASK_1	-	0... FFH	0... 255	1	-
Mask					
NC_INJ_MOD_S	-	0... FFH	0... 255	1	-
Constant defined to indicate stratified mode					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

## General Information

### Application Conditions

Initialization: RST, NVMINI, NVMSTO, NVMRES

Recurrence: 100MS if alwayselse 10MS


Activation: 100MS: always

10MS: always

Deactivation: never

Additionally Activation of one event deactivates others

### Function description

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 1898 of 8404</b>	
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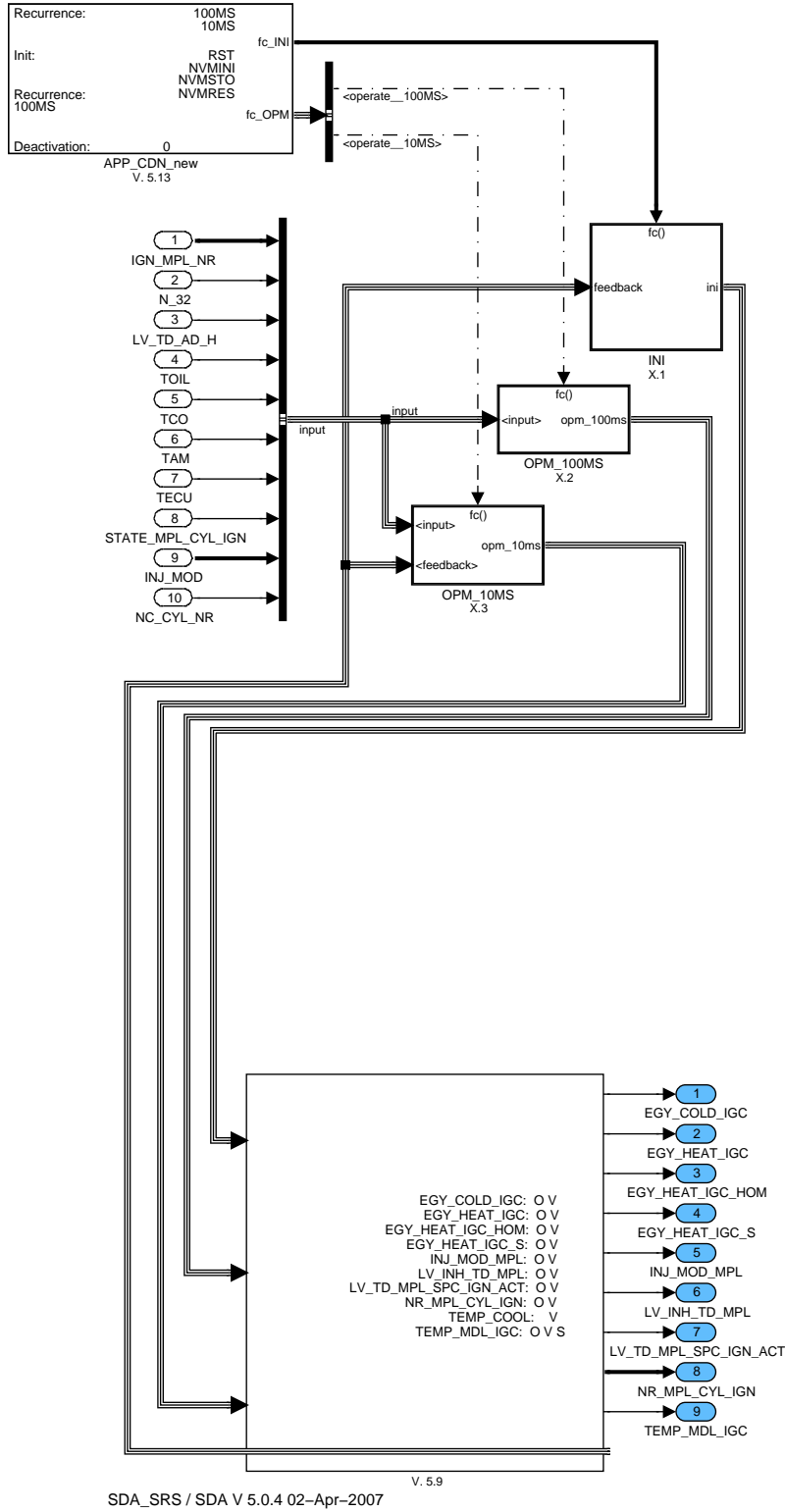



Figure 6.8.1: : Path: IGRE\_M602J

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## 6.8.1 Initialization

### 6.8.1.1 Initialization of TEMP\_MDL\_IGC in non-volatile-memory

The last calculated value of TEMP\_MDL\_IGC shall be stored.

#### 6.8.1.1.1 Initialization of TEMP\_MDL\_IGC

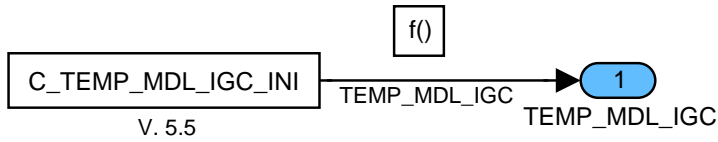


Figure 6.8.2: : Path: IGRE\_M602J/INI/NVMY/INI\_NVMY

#### 6.8.1.1.2 Initialization of TEMP\_MDL\_IGC out of NVMY

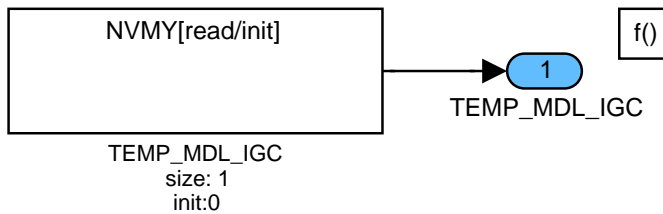


Figure 6.8.3: : Path: IGRE\_M602J/INI/NVMY/RD\_NVMY

#### 6.8.1.1.3 Storing of TEMP\_MDL\_IGC in NVMY

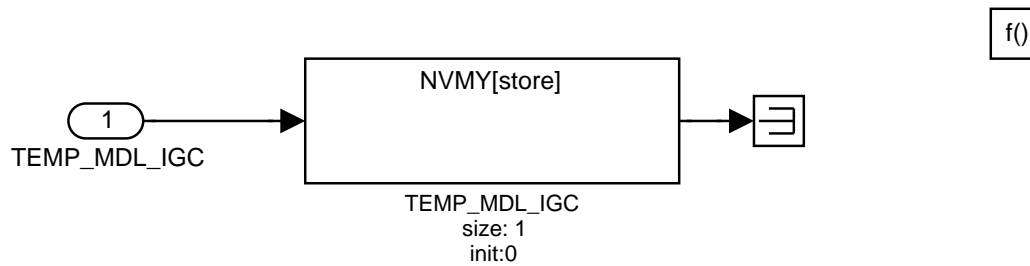


Figure 6.8.4: : Path: IGRE\_M602J/INI/NVMY/SAVE\_NVMY

### 6.8.1.2 Initialization values

Initialization

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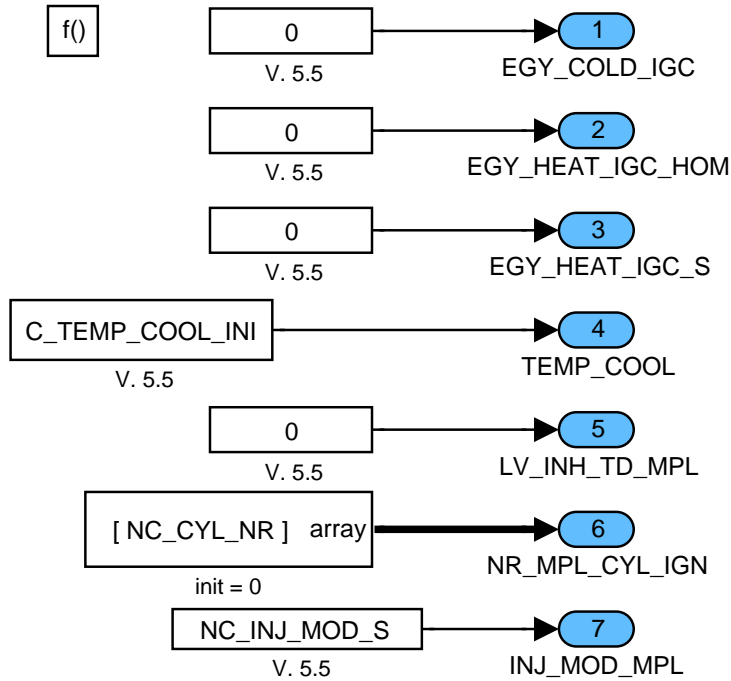


Figure 6.8.5: : Path: IGRM\_M602J/INI/RST

### 6.8.2 Recurrence 100ms

#### 6.8.2.1 Calculation of cooling temperature for temperature model (recurrence 100ms)

The cooling temperature is calculated as the sum of the influence of the ambient temperature and TOIL or TCO. The customer wants the LC to choose between TOIL and TCO because he is not sure which one is correct. In a future version the selection will be removed.

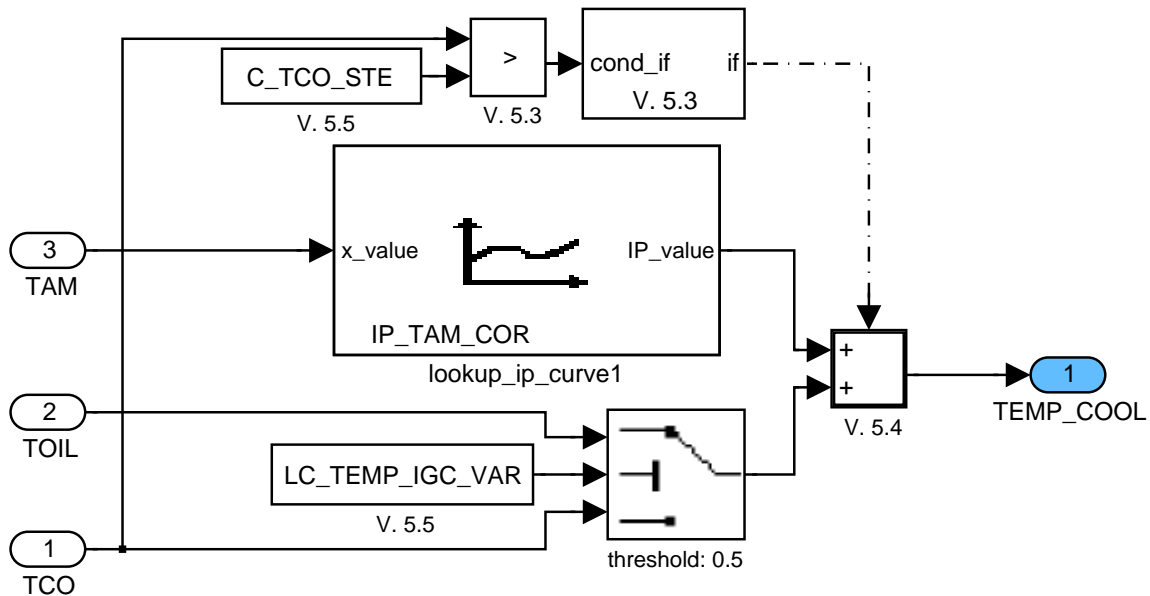


Figure 6.8.6: : Path: IGRM\_M602J/OPM\_100MS/TEMP

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## 6.8.3 Recurrence 10ms

### 6.8.3.1 Temperature Model for Ignition Coils (recurrence 10ms)

The function shall only be calculated when the activation-condition  $TCO > C\_TCO\_STE$  is fulfilled.

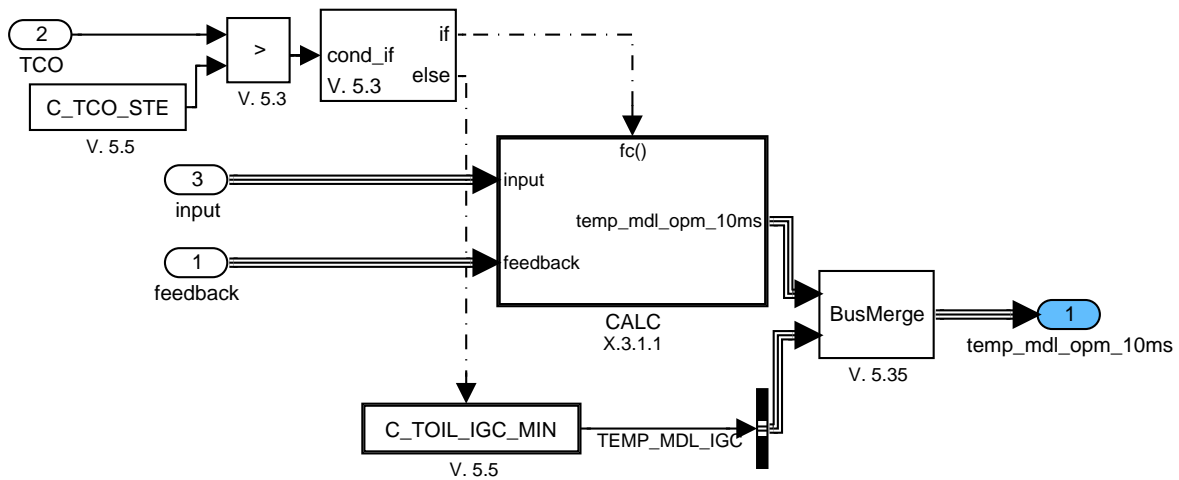


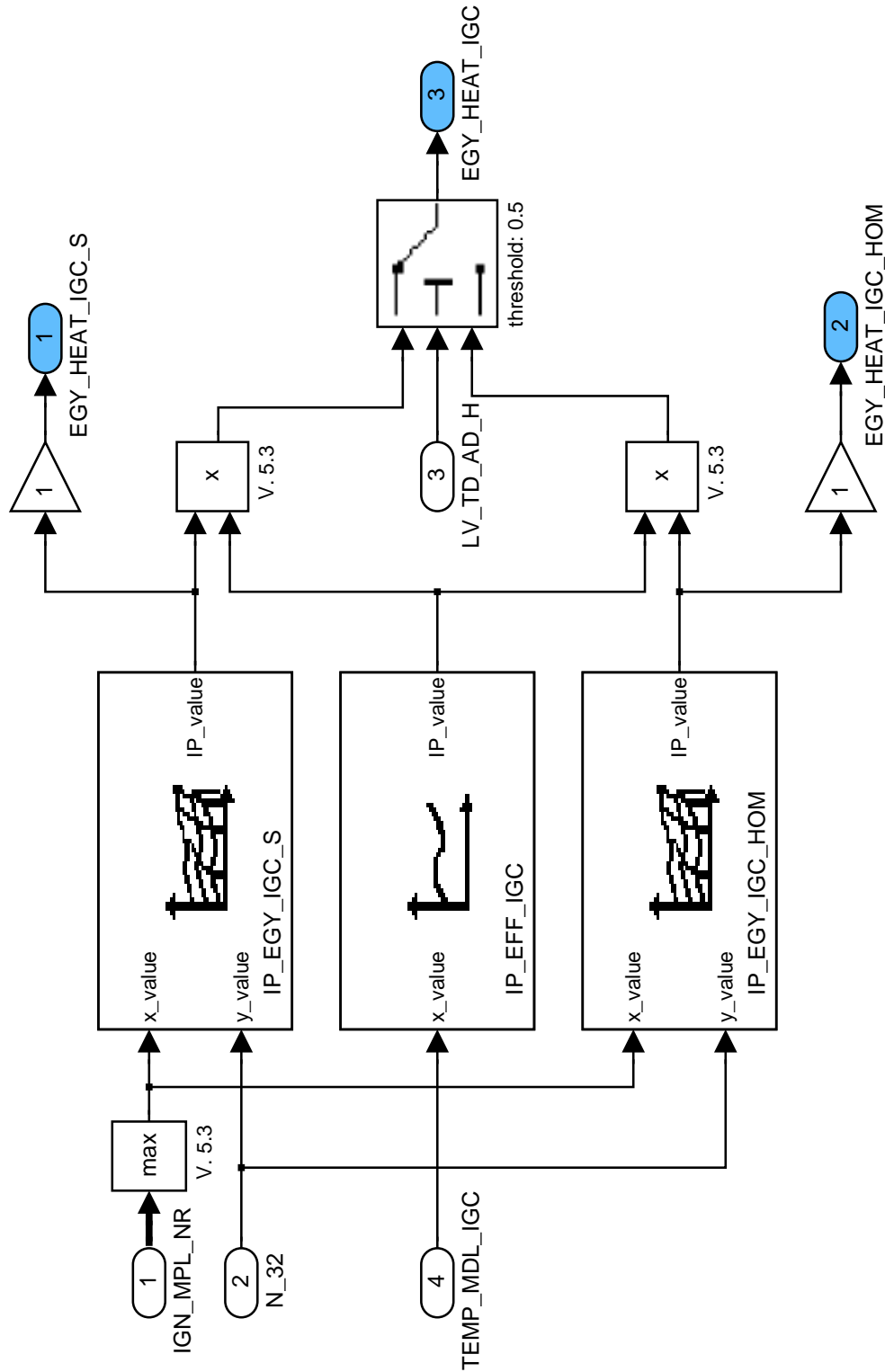
Figure 6.8.7: : Path: IGRE\_M602J/OPM\_10MS/CALC\_TEMP\_MDL

#### 6.8.3.1.1 Calculation overview for Temperature-Model of Ignition-Coils

No Calculation


##### 6.8.3.1.1.1 Energy of ignition-coils in homogeneous and stratified mode

As a fundamental of the ignition-coil model the heat-energy of the ignition-coils is calculated. It can differentiate between the homogenous and stratified mode.




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Figure 6.8.8: : Path: IGRM\_M602J/OPM\_10MS/CALC\_TEMP\_MDL/CALC/EGY\_HEAT

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### 6.8.3.1.1.2 Calculation of model-temperature

The model temperature of the ignition coils gets calculated in this function. Based on the heat-energy, the cooling temperature, and the last calculated model temperature the cooling-energy and the new model temperature get calculated.  $C\_ALFA\_A\_IGC$  is the product of the heat-transfer-coefficient and the area of the coils and  $C\_CP\_M\_IGC$  the product of the heat-capacity and the mass of the coils. The integrator-block generates the temperature.

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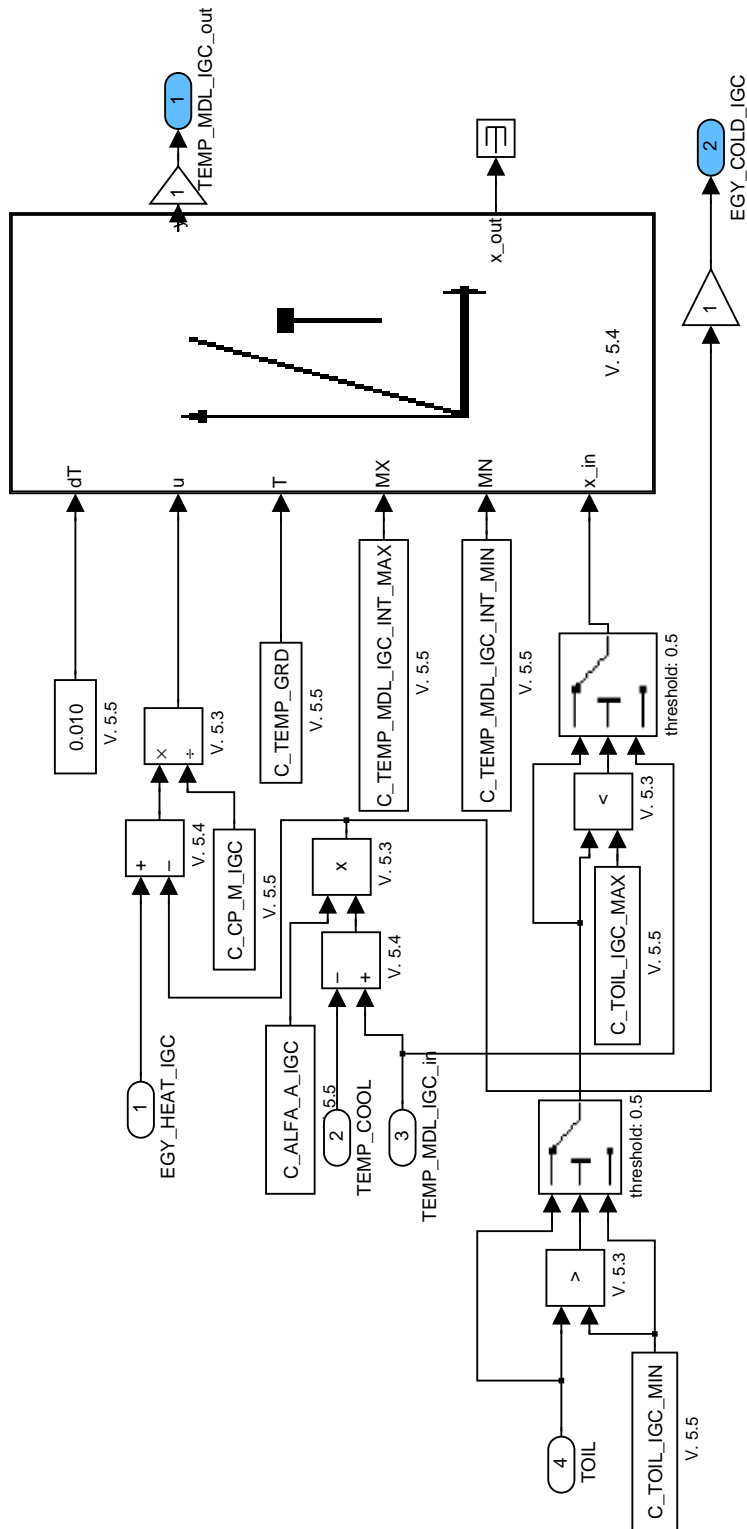



Figure 6.8.9: Path: IGRM\_M602J/OPM\_10MS/CALC\_TEMP\_MDL/CALC/TEMP\_IGC

### 6.8.3.2 Deactivation of multiple spark on ECU temperature threshold

The purpose of this function is to deactivate the multiple sparks above an ECU temperature threshold in order to decrease heat dissipation due to multiple sparks.

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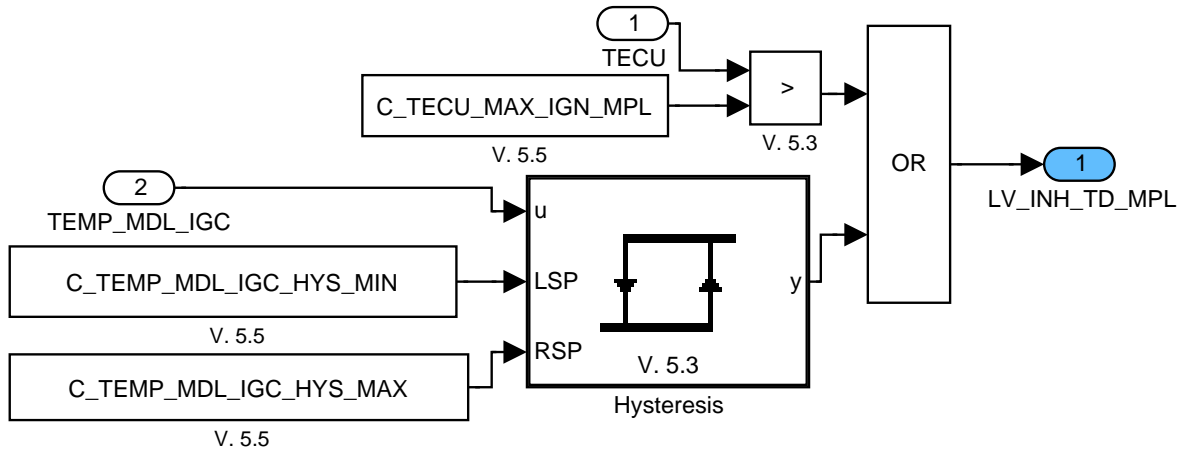


Figure 6.8.10: : Path: IGRM\_M602J/OPM\_10MS/TEMP\_MPL\_DEAC

### 6.8.3.3 Extended Multiple Spark function Activation

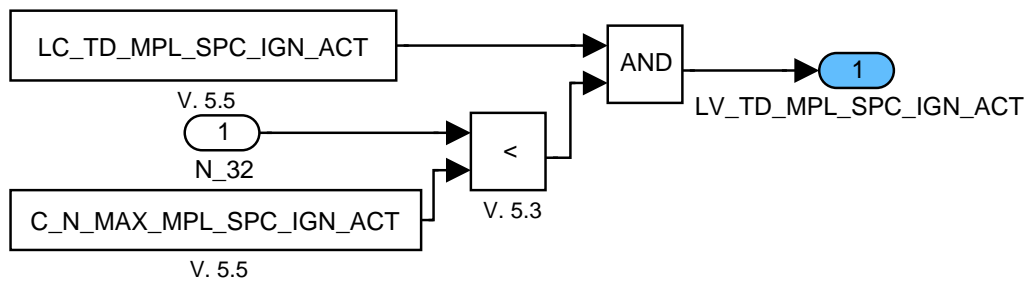


Figure 6.8.11: : Path: IGRM\_M602J/OPM\_10MS/MPL\_SPC\_IGN\_ACT

### 6.8.3.4 Individual raise of Multiple Spark in case of misfiring

The purpose of this function is to set a calibrated number of multiple spark on a specific cylinder in case of misfiring.

The selection of cylinder is done by a word: STATE\_MPL\_CYL\_IGN. Each bit codes a cylinder, the first cylinder is code by the lowest bit. If the bit is set to 1, there is misfiring and we set the number of MPL for this cylinder to a calibrated value. If it's set to 0, the number of MPL in this specifications will be set to 0 and will be replace in the generic specifications by an appropriate value based on a interpolation table depending on engine speed and battery voltage.

#### 6.8.3.4.1 Set INJ\_MOD\_MPL to NC\_INJ\_MOD\_S

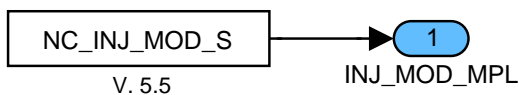


Figure 6.8.12: : Path: IGRM\_M602J/OPM\_10MS/INJ\_MOD\_MPL/SET\_NC\_INJ\_MOD\_S

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### 6.8.3.4.2 FOR-Loop for calculation for every cylinder

The calculation shall be done for every cylinder.

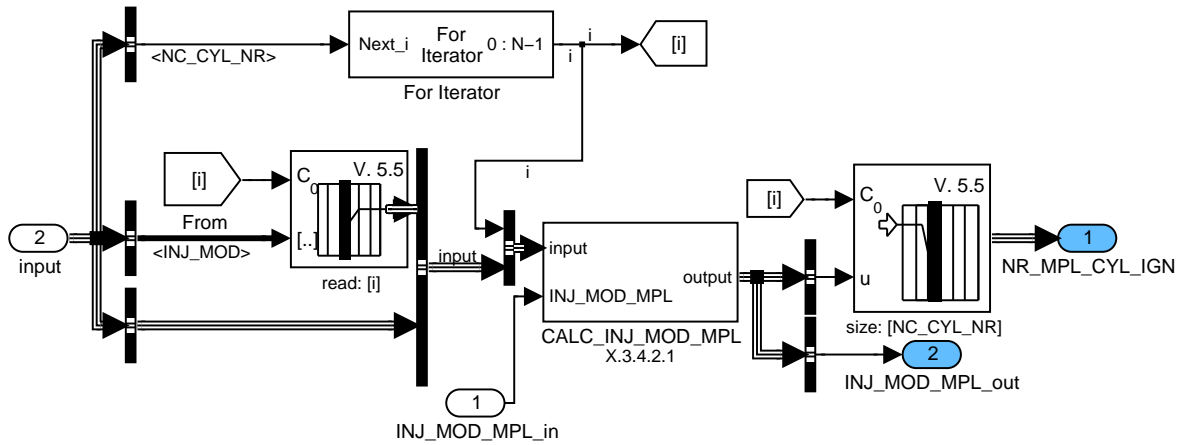



Figure 6.8.13: : Path: IGR\_M602J/OPM\_10MS/INJ\_MOD\_MPL/FOR\_INJ\_MOD\_MPL

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6.8.3.4.2.1 Calculation-Subsystem in FOR-Loop

6.8.3.4.2.1.1 Calculation of Injection-Mode and Number of Multiple sparks

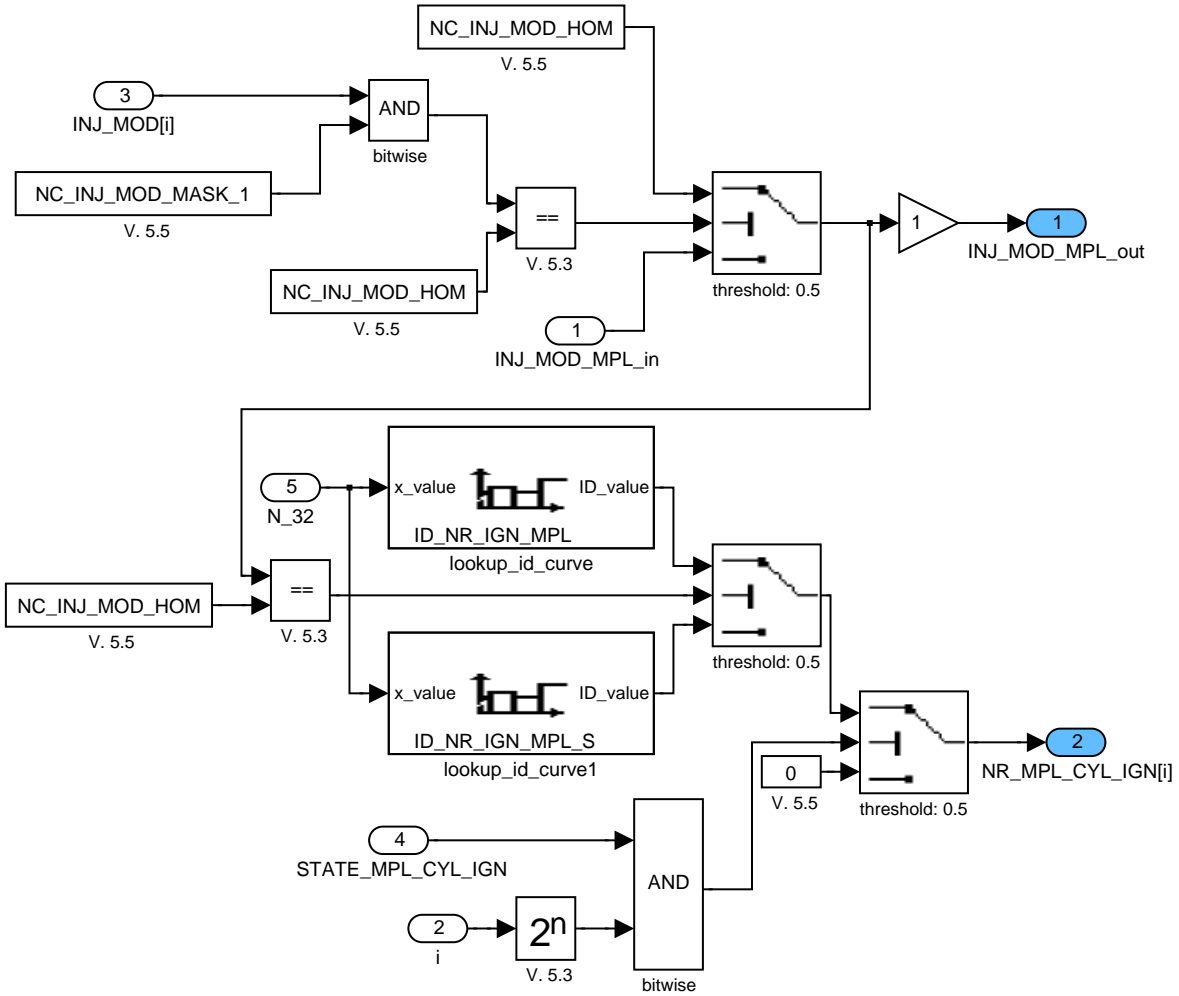


Figure 6.8.14: : Path: IGRE\_M602J/OPM\_10MS/INJ\_MOD\_MPL/FOR\_INJ\_MOD\_MPL/CALC\_INJ\_MOD\_MPL/CALC

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## 6.9 Ignition activation control

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CYCNR_IGA_ES	V	0... FH	0... 15	1	-
Counter for number of cycles for which ignition is maintained after detection of LV_IGK= 0 or LV_STST_STOP_REQ= 1					
INH_IGC	V	0... FFH	0... 255	1	-
Inhibition of selected cylinder					

### Input data:

INH_IGC_MIS_GEN {p. 7194}	LV_FIRST_VLD_TOOTH {p. 1505}	LV_IGK {p. 906}	LV_IGN_INJ_LOCK_REQ {p. 4455}
LV_INH_IGC [NC_CYL_NR] {p. 4773}	LV_LOCK_IMOB	LV_ST_END {p. 1720}	LV_STST_STOP_REQ {p. 805}
LV_SYN_ENG {p. 1506}	NC_CYL_NR {p. 1526}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CYCNR_IGA_ES	-	0... FH	0... 15	1	-
Number of cycles for which ignition is maintained after detection of LV_IGK = 0					

### Import actions:

ACTION_INFR_SetIgnEnable (IN<No Name available>,IN<No Name available>)
--

### 6.9.1 Normal Mode Activation

#### FUNCTION DESCRIPTION:

As there could be different possibilities to deactivate the ignition system an **OR-Junction** is done in this chapter. The output of this or-junction has to be INH\_IGC.

The Inputs can come from the ignition diagnosis, from the injection chapter, from the Misfire Generator or from any other function requesting ignition cut-off.

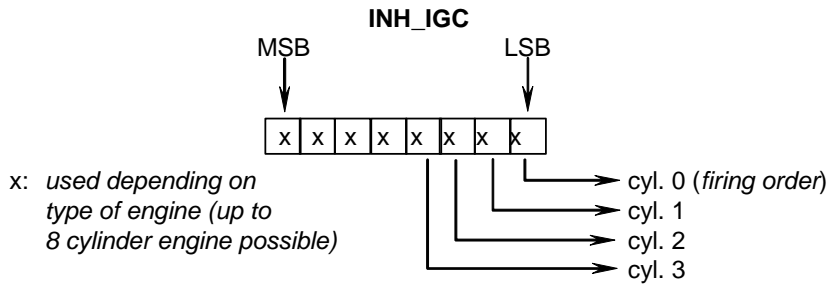
#### Application conditions

<b>Initialisation:</b>	at reset
<b>Recurrence:</b>	if LV_ST_END = 1 and LV_IGN_INJ_LOCK_REQ = 0: segment synchronous (every TDC) if LV_ST_END = 0 or LV_IGN_INJ_LOCK_REQ = 1: 10 ms
<b>Activation:</b>	LV_SYN_ENG = 1
<b>Deactivation:</b>	LV_SYN_ENG = 0

#### Formula section:

### Output driver deactivation

The decision to inhibit an ignition stage is taken for each output before the turn on at TD\_ON[x]. This means that no Disable /cut-off can be set on a coil while charging  
INH\_IGC is the bit wise OR of all inputs requesting an ignition cut-off.  
LV\_INH\_IGC[x] sets the INH\_IGC for the corresponding cylinder to 1.  
When one bit within INH\_IGC is set to 1, the corresponding ignition output is performed as soon as possible. The ignition output remains inhibited while the INH\_IGC is unchanged.



- Calculation of CTR\_CYCNR\_IGA\_ES

```

IF (LV_IGKn = 0 and LV_IGKn-1 = 1)
  or (LV_STST_STOP_REQn = 1 and LV_STST_STOP_REQn-1 = 0)
  THEN CTR_CYCNR_IGA_ESn = C_CYCNR_IGA_ES
ELSE IF (LV_IGKn = 0 and LV_IGKn-1 = 0)
  or (LV_STST_STOP_REQn = 1 and LV_STST_STOP_REQn-1 = 1)
  THEN CTR_CYCNR_IGA_ESn = CTR_CYCNR_IGA_ESn-1 - 1
  ELSE CTR_CYCNR_IGA_ESn = CTR_CYCNR_IGA_ESn-1
ENDIF
  
```

ENDIF

- Inhibition for ignition system of cylinder x

```

IF LV_LOCK_IMOB = 1
  or LV_IGN_INJ_LOCK_REQ = 1
  or LV_FIRST_VLD_TOOTH = 0
  or (CTR_CYCNR_IGA_ES = 0 and LV_IGK = 0)
  or (CTR_CYCNR_IGA_ES = 0 and LV_STST_STOP_REQ = 1)
  THEN INH_IGC = 2NC_CYL_NR - 1 (ignitions on all the cylinders are inhibited)
ELSE
  FOR x = 0 to NC_CYL_NR-1
    IF LV_INH_IGC[x] = 1
      or bit x of INH_IGC_MIS_GEN = 1
      THEN the corresponding bit /Cylinder x of INH_IGC is set to 1
      ELSE the corresponding bit /Cylinder x of INH_IGC is set to 0
    ENDIF
  ENDFOR
ENDIF
  
```


**ENDIF**

```
FOR   x = 0 to NC_CYL_NR-1
        ACTION_INFR_SetIgnEnable(x, not(corresponding bit x of INH_IGC))
ENDFOR
```

**Note:**

1. For DI engine it is strongly recommended to enable Ignition only after Validated synchronisation, *ie.* activation of this function on LV\_SYN\_VLD = 1 only instead of LV\_SYN\_ENG
2. No deactivation is possible on a charging coil, *ie.* after TD\_ON[x] event: if Dwell Time has started on a stage, this charging will be elapsed to its end  
Refer to module 200X for more details

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## 6.10 Basic ignition angle at start

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA_ST	O/V	0... FFH	0... 60	0.375	°CRK
Basic ignition angle at start					
LV_ANG_PSN_ENG_REL_TMP	V	0... 1H	0 ...1	1	-
The first ITDC is reached in case of MSA start					
LV_IGA_ST_PSN_ENG_COR_STST	V	0... 1H	0 ...1	1	-
IGA_ST correction for MSA start is active					

### Input data:

AMP {p. 982}	CYC_ST {p. 797}	LV_ES {p. 1720}	LV_IGA_ST_OPM_SEL {p. 8266}
LV_ST {p. 1720}	LV_STST_ST_REQ {p. 804}	LV_SYN_ENG {p. 1506}	N {p. 1525}
PSN_ENG_REL {p. 807}	PSN_ENG_REL_ST {p. 807}	TCO {p. 1100}	TIA {p. 1226}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ANG_PSN_ENG_REL_STST	-	0... 780H	0... 720	0.375	°CRK
Relative engine position threshold for deactivation of additive ignition angle correction (default 120 °CRK) [Attention: PSN_ENG_REL = 180...0,375°CRK]					
IP_IGA_ST_AMP_COR_OPM_1	-	0... FFH	0... 47.625	0.375	°CRK
LDPM_AMP_1_IGA_ST	6	0... FFFFH	0... 5434	0.08291752	hPa
Ambient pressure correction of the basic ignition angle at start at operation mode 1					
IP_IGA_ST_AMP_COR_OPM_2	-	0... FFH	0... 47.625	0.375	°CRK
LDPM_AMP_1_IGA_ST	6	0... FFFFH	0... 5434	0.08291752	hPa
Ambient pressure correction of the basic ignition angle at start at operation mode 2					
IP_IGA_ST_BAS_OPM_1	-	0... FFH	0... 60	0.375	°CRK
LDPM_N_1_IGA_ST	6	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_1_IGSP	8	0... FEH	0... 142.5	0.75	°C
Basic ignition angle at start at operation mode 1					
IP_IGA_ST_BAS_OPM_2	-	0... FFH	0... 60	0.375	°CRK
LDPM_N_1_IGA_ST	6	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_1_IGSP	8	0... FEH	0... 142.5	0.75	°C
Basic ignition angle at start at operation mode 2					
IP_IGA_ST_CYC_ST_COR_OPM_1	-	0... FFH	0... 47.625	0.375	°CRK
LDPM_CYC_1_IGA_ST	6	0... FFH	0... 255	1	-
LDPM_TCO_1_IGSP	8	0... FEH	0... 142.5	0.75	°C
Correction of the basic ignition angle at start dependen on the start cycle counter at operation mode 1					
IP_IGA_ST_CYC_ST_COR_OPM_2	-	0... FFH	0... 47.625	0.375	°CRK
LDPM_CYC_1_IGA_ST	6	0... FFH	0... 255	1	-
LDPM_TCO_1_IGSP	8	0... FEH	0... 142.5	0.75	°C
Correction of the basic ignition angle at start dependen on the start cycle counter at operation mode 2					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_IGA_ST_PSN_ENG_COR_STST	-	0... FFH	0... 47.625	0.375	°CRK
LDP_ANG_PSN_ENG_REL_ST	6	0... 780H	0... 720	0.375	°CRK
Relative engine stop position correction additive to IGA_ST for the first ignition at MSA start					
IP_IGA_ST_TIA_COR_OPM_1	-	0... FFH	0... 47.625	0.375	°CRK
LDPM_TIA_1_IGA_ST	6	0... FEH	0... 142.5	0.75	°C
Ambient pressure correction of the basic ignition angle at start at operation mode 1					
IP_IGA_ST_TIA_COR_OPM_2	-	0... FFH	0... 47.625	0.375	°CRK
LDPM_TIA_1_IGA_ST	6	0... FEH	0... 142.5	0.75	°C
Ambient pressure correction of the basic ignition angle at start at operation mode 2					

### 6.10.1 IGSP\_M6004

#### FUNCTION DESCRIPTION:

##### General information:

The ignition angle at start is basically dependent on the engine speed N and coolant temperature TCO determined by the map IP\_IGA\_ST\_BAS. Additionally a map dependent on the ambient pressure AMP corrects this basic ignition angle. To avoid backfiring due to the fast increase of the combustion chamber temperature a second correction dependent on the cycle counter CYC\_ST and the coolant temperature is added. A further map considers influences of the intake air temperature TIA.

The switch LV\_IGA\_ST\_OPM\_SEL is used to determine if either the basic ignition angle at start for operation mode 1 or the basic ignition angle at start for operation mode 2 is calculated.

In case of MSA start (engine start stop automatic) there is an additive correction dependent on the relative engine position PSN\_ENG\_REL\_ST for the first ignition.

##### Application conditions :

**Activation :** LV\_ST = 1 or (LV\_ES = 1 and LV\_SYN\_ENG = 1)  
**Deactivation :** LV\_ST = 0 and (LV\_ES = 0 or LV\_SYN\_ENG = 0)  
**Update rate :** every 10 ms and every TDC  
**Initialisation:** at reset : IGA\_ST = 0  
 LV\_IGA\_ST\_PSN\_ENG\_COR\_STST = 0  
 LV\_PSN\_ENG\_REL\_TMP = 0

**Remark:** if LV\_IGA\_ST\_OPM\_SEL = 1 only the upper part has to be executed (IP...OPM\_2), else only the lower part has to be executed (IP...OPM\_1).

#### Application Condition

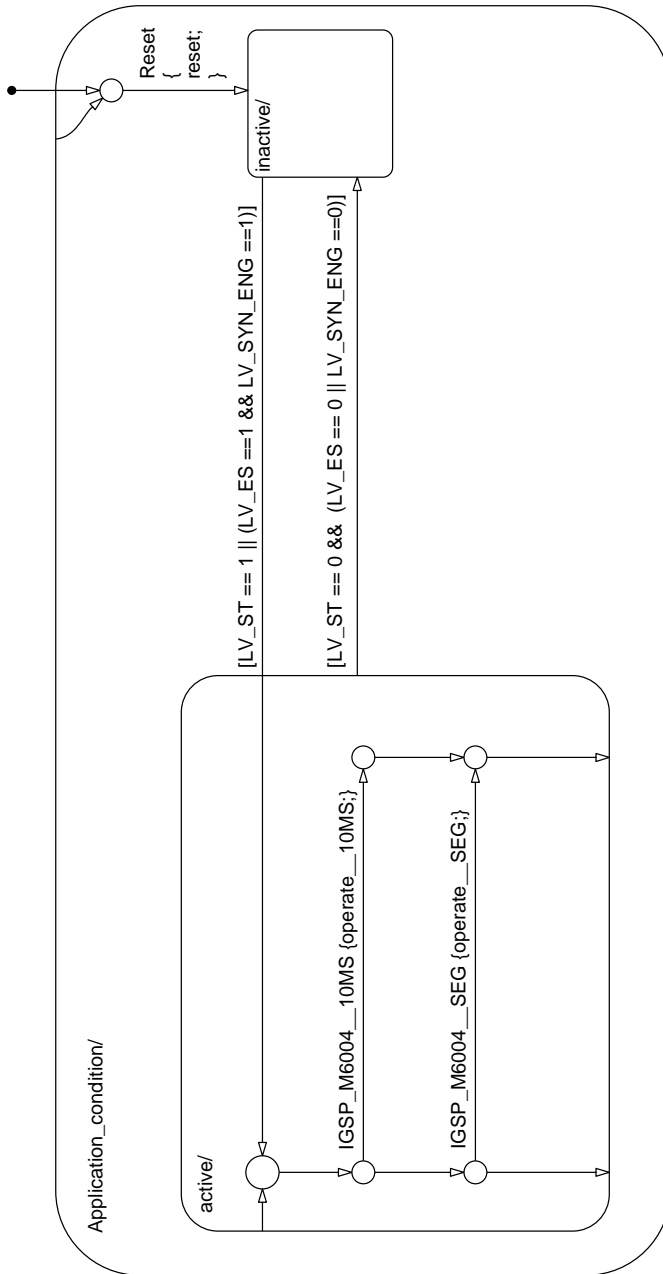



Figure 6.10.1: IGSP\_M6004/APP\_CDN/Chart

**Function Description**

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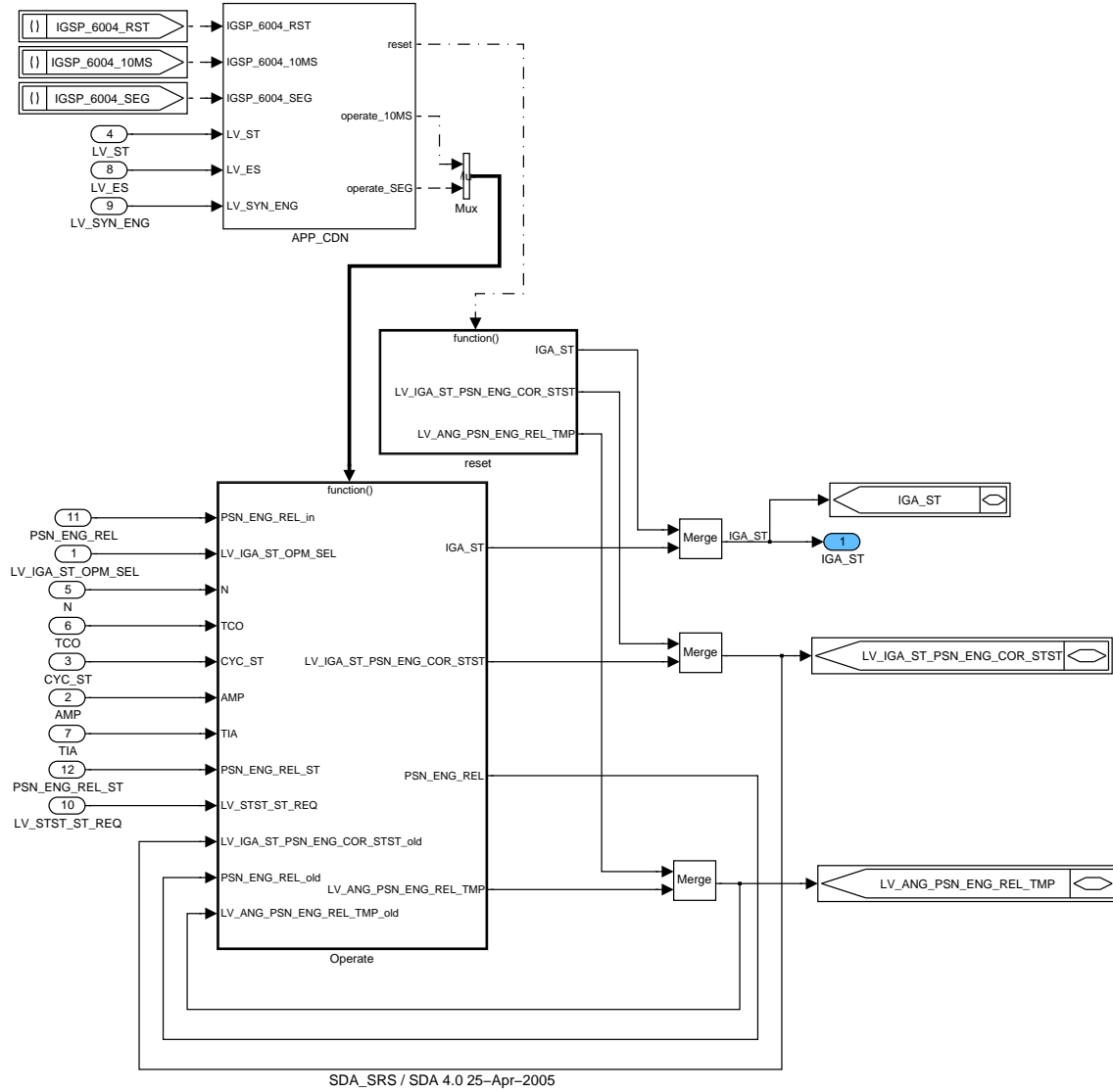


Figure 6.10.2: IGSP\_M6004

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### 6.10.1.1 Reset

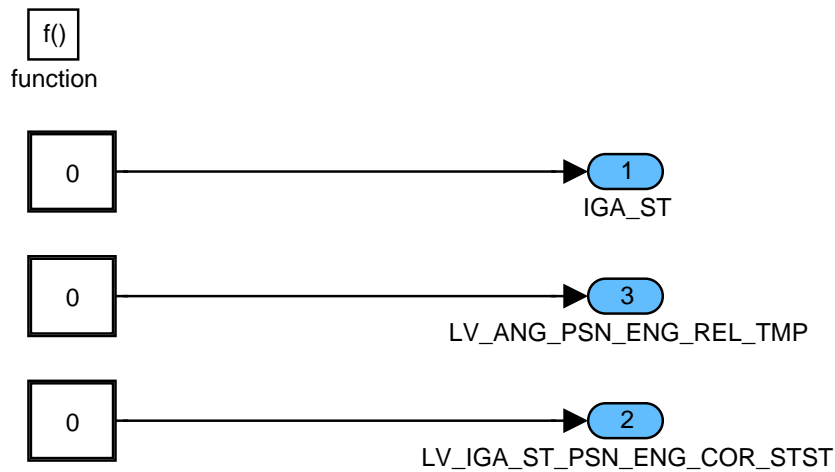


Figure 6.10.3: IGSP\_M6004/reset

### 6.10.1.2 Overview of IGA\_ST calculation

f()  
function

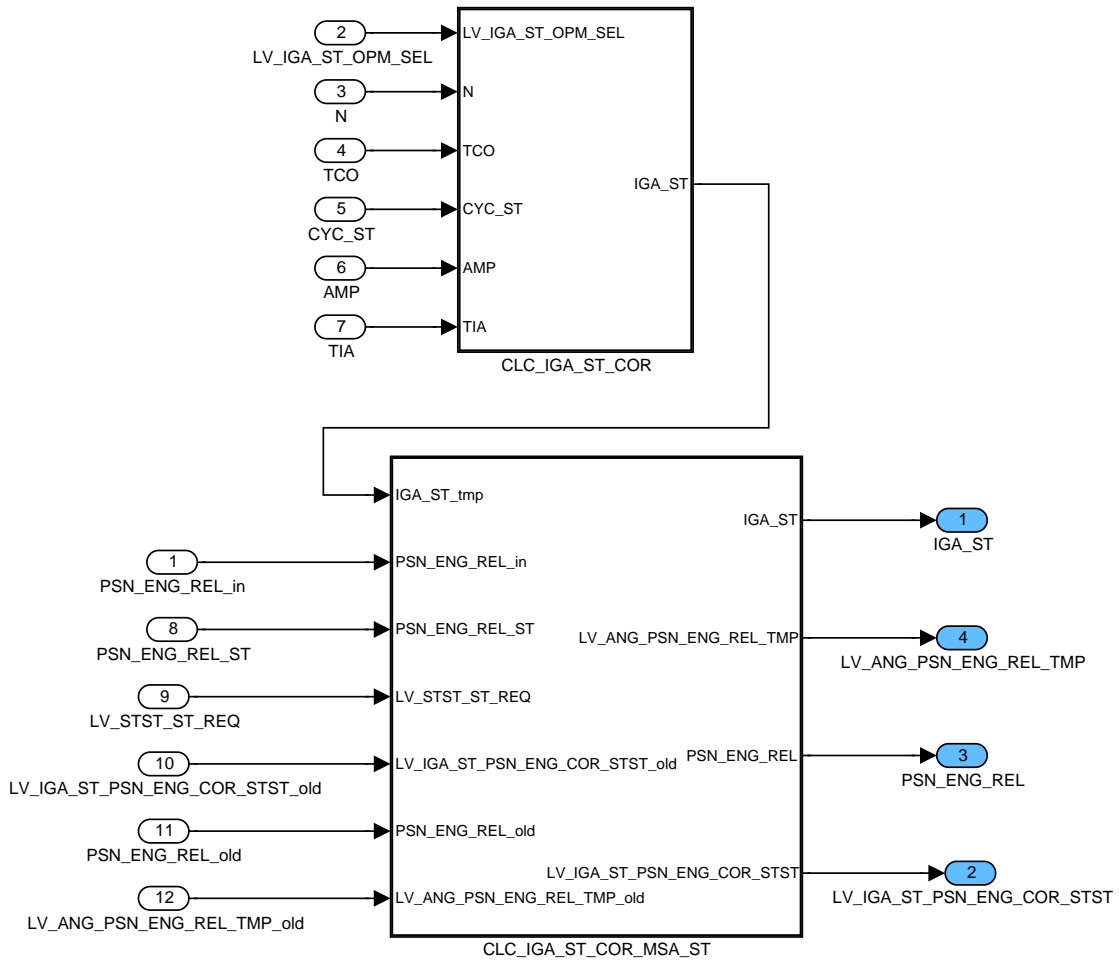


Figure 6.10.4: IGSP\_M6004/Operate

#### Calculation of standard IGA\_ST correction

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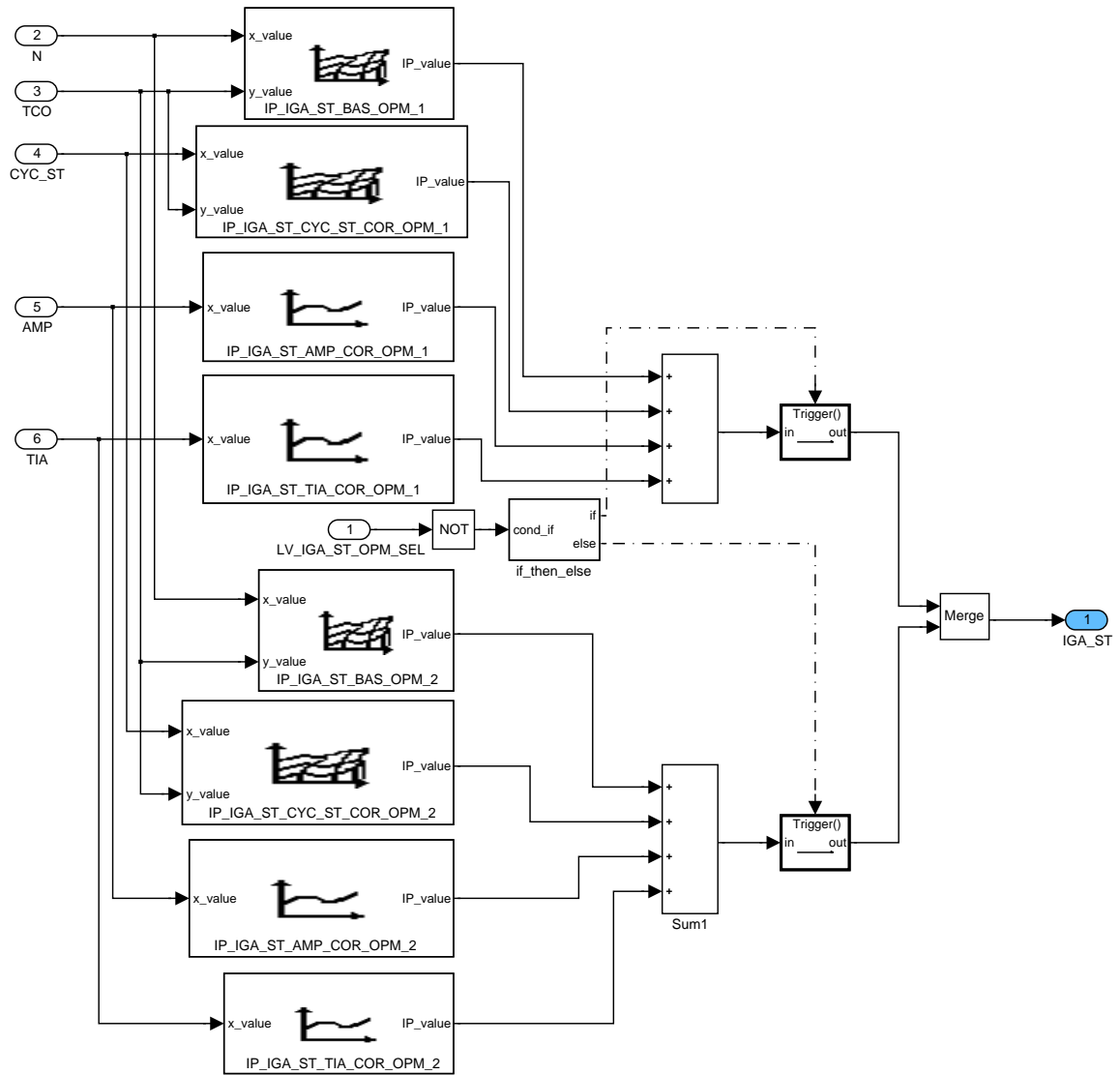


Figure 6.10.5: IGSP\_M6004/Operate/CLC\_IGA\_ST\_COR

**Calculation of IGA\_ST correction in case of MSA start (engine start stop automatic)**

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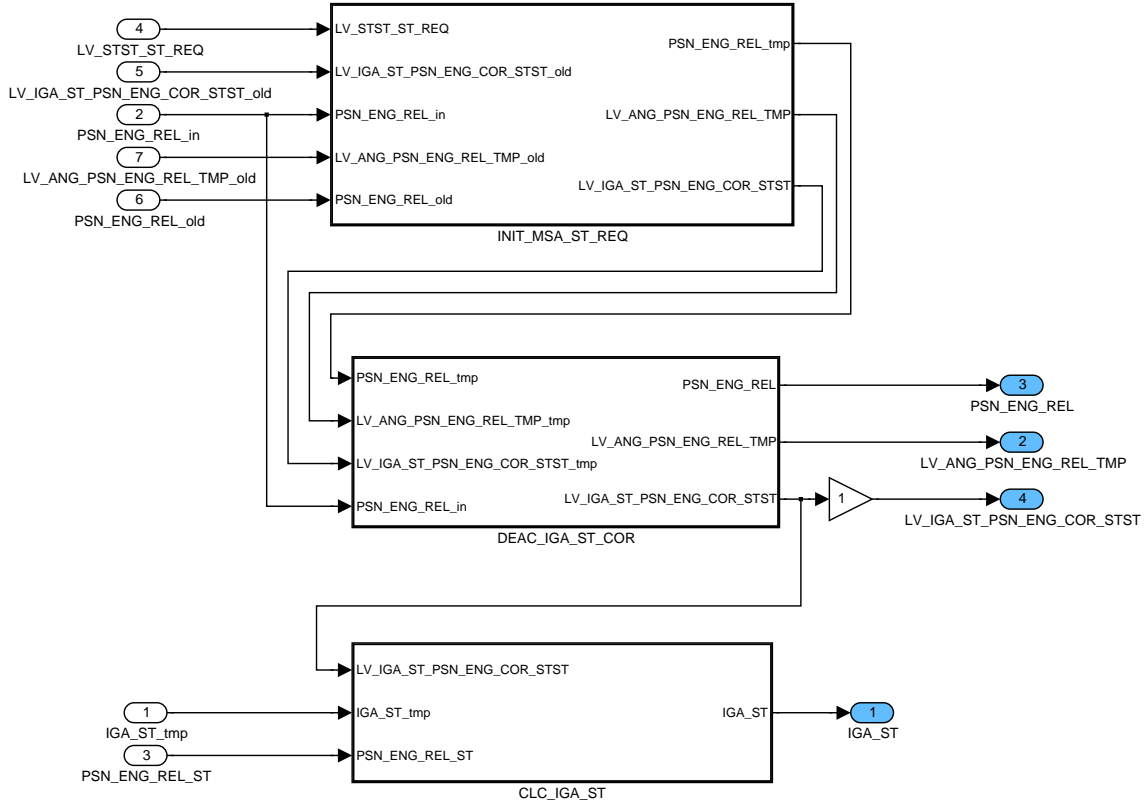


Figure 6.10.6: IGSP\_M6004/Operate/CLC\_IGA\_ST\_COR\_MSA\_ST

**Initialisation at MSA start request**

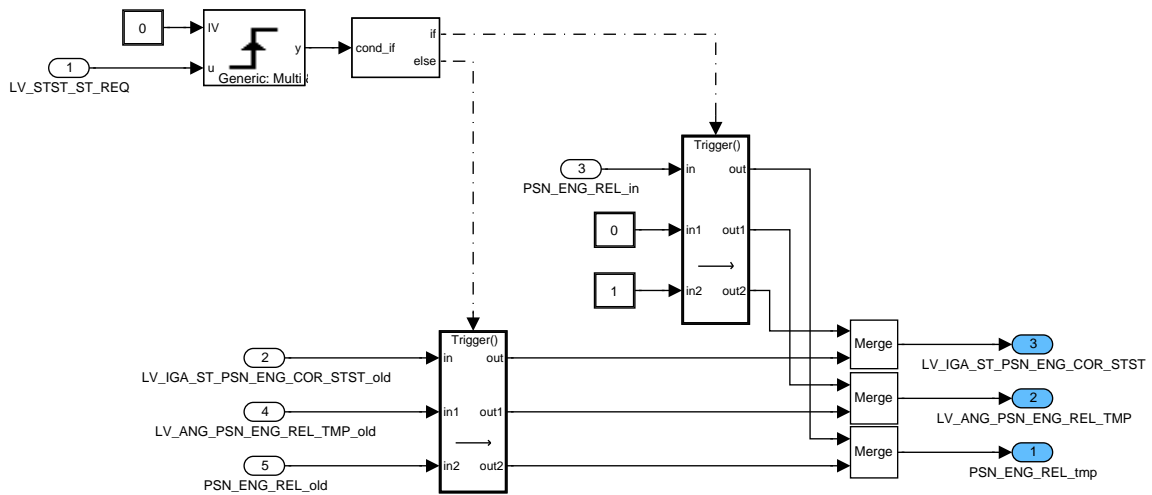



Figure 6.10.7: IGSP\_M6004/Operate/CLC\_IGA\_ST\_COR\_MSA\_ST/INIT\_MSA\_ST\_REQ

**Deactivation of IGA\_ST correction**

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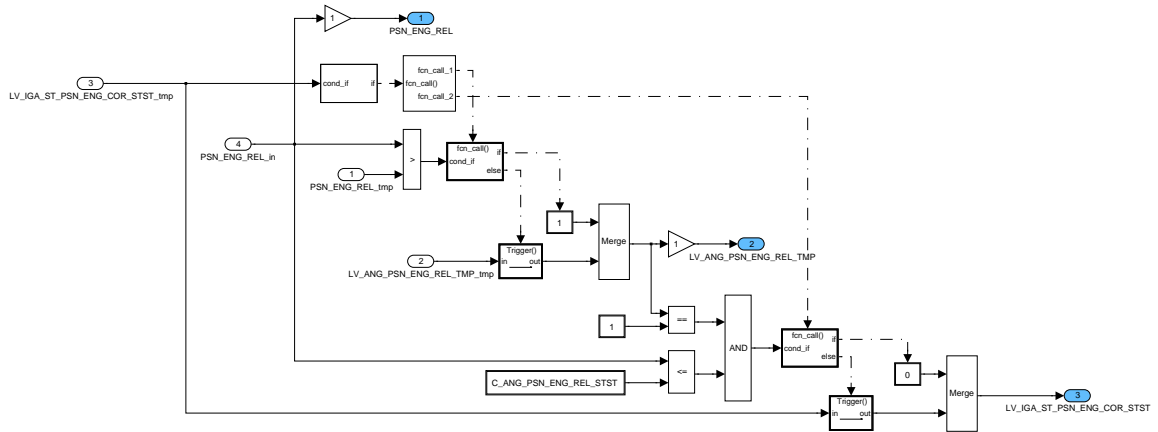


Figure 6.10.8: IGSP\_M6004/Operate/CLC\_IGA\_ST\_COR\_MSA\_ST/DEAC\_IGA\_ST\_COR

**Calculation of corrected IGA\_ST**

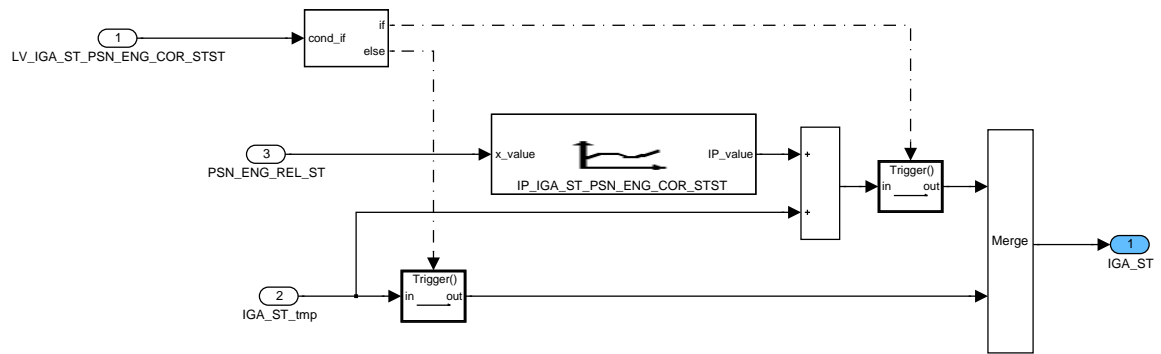


Figure 6.10.9: IGSP\_M6004/Operate/CLC\_IGA\_ST\_COR\_MSA\_ST/CLC\_IGA\_ST

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## 6.11 Exhaust gas recirculation correction

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EGR_RATIO_COR_2	V	0... FFFFH	0... 99.99847	1.5259e-3	%
corrected EGR_RATIO for LDP of IP_IGA_BAS_EGR					
IGA_BAS_EGR_COR	O/V	80... 7FH	-48... 47.625	0.375	°CRK
additive basic ignition angle correction due to EGR influence					
IGA_BAS_EGR_COR_HOM	V	80... 7FH	-48... 47.625	0.375	°CRK
additive basic ignition angle correction due to EGR influence in homogenous mode					
IGA_BAS_EGR_COR_S	V	80... 7FH	-48... 47.625	0.375	°CRK
additive basic ignition angle correction due to EGR influence in stratified mode					

### Input data:

EGR_RATIO_SP {p. 8197}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_EGR_ACT {p. 987}	LV_SP_RATE_CYL_EGR_SWI {p. 8137}
MAF {p. 8277}	MFF_SP_S {p. 8243}	N_32 {p. 1525}	TCO {p. 1100}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_IGA_BAS_EGR_LAMB	-	0... FFH	0... 0.996	0.0039063	-
LDPM_N_32_IP_EGR_RATIO	12	0... FFH	0... 8160	32	rpm
LDPM_MAF_IP_EGR_RATIO	12	0... FFFFH	0... 1389	0.0212	mg/stk
factor for EGR_RATIO list of datapoints					
IP_FAC_RATE_EGR_AFL	-	0... FFH	0... 1.992	0.007813	-
LDPM_TCO_IGA_EGR	5	0... FEH	-48... 142.5	0.75	°C
temperature corrective factor					
IP_IGA_BAS_EGR	-	0... FFH	-48... 47.625	0.375	°CRK
LDP_EGR_RATIO_COR_2_IGA_BAS	6	0... FFFFH	0... 99.998	1.525e-3	%
basis for EGR correction IGA_BAS					
IP_IGA_BAS_EGR_FAC_N_MAF	-	0... FFH	0... 1.992	0.007813	-
LDPM_N_32_IP_EGR_RATIO	12	0... FFH	0... 8160	32	rpm
LDPM_MAF_IP_EGR_RATIO	12	0... FFFFH	0... 1389	0.0212	mg/stk
No description given					
IP_IGA_EGR_S	-	0... FFH	-48... 47.625	0.375	°CRK
LDPM_TCO_IGA_EGR	5	0... FEH	-48... 142.5	0.75	°C
Temperature based correction (stratified mode)					


### FUNCTION DESCRIPTION:

#### General information:

#### Homogeneous mode:

In homogeneous mode, if EGR function is active, the basic ignition angle IGA\_BAS\_IVVT is improved by the additive EGR correction value IGA\_BAS\_EGR\_COR. This value depends from N\_32, MAF, TCO, EGR\_RATIO\_SP and LAMB\_SP.

#### Stratified mode:


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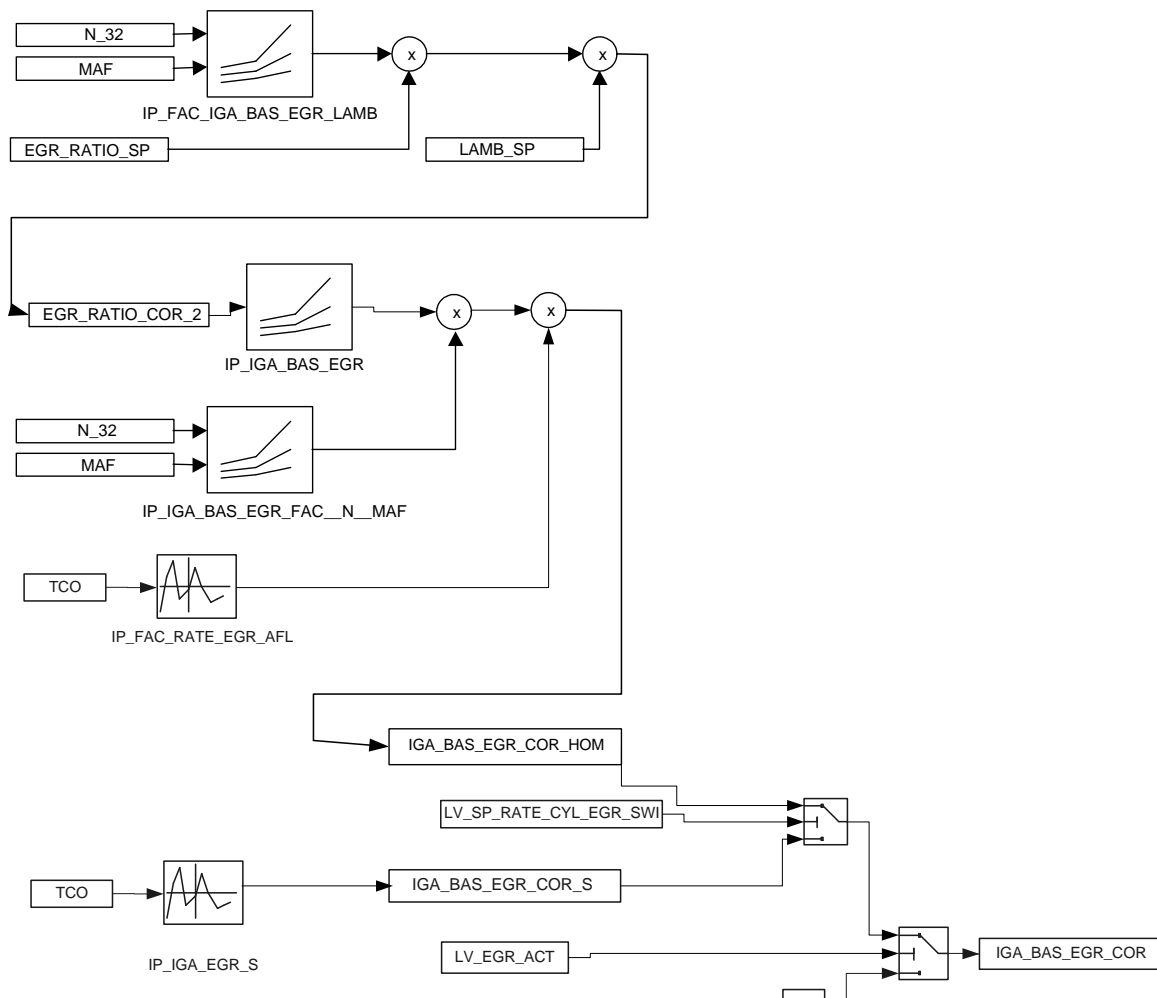
In stratified mode, if EGR function is active, the basic ignition angle IGA\_BAS\_S is improved by the additive EGR correction value IGA\_BAS\_EGR\_COR. IGA\_BAS\_EGR\_COR is calculated from the coolant temperature TCO (IP\_IGA\_EGR\_S).

### Application conditions

**Activation:** LV\_EGR\_ACT = 1  
**Deactivation:** LV\_EGR\_ACT = 0  
**Update Rate:** 10 ms  
**Initialization:** IGA\_BAS\_EGR\_COR = 0

### Signal flow diagram:

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**Formula section:**

$$EGR\_RATIO\_COR\_2 = EGR\_RATIO\_SP * IP\_FAC\_IGA\_BAS\_EGR\_LAMB * LAMB\_SP$$


$$IGA\_BAS\_EGR\_COR\_HOM = IP\_IGA\_BAS\_EGR *$$

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```

                                IP_IGA_BAS_EGR_FAC__N__MAF *
                                IP_FAC_RATE_EGR_AFL
IGA_BAS_EGR_COR_S      =      IP_IGA_EGR_S
if  LV_EGR_ACT = 0
  then  IGA_BAS_EGR_COR = 0
  elseif LV_SP_RATE_CYL_EGR_SWI = 1
    then  IGA_BAS_EGR_COR = IGA_BAS_EGR_COR_HOM
    else  IGA_BAS_EGR_COR = IGA_BAS_EGR_COR_S
  endif
endif
endif

```

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 1924 of 8404</b>	
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## 6.12 TQM - Minimum ignition angle

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA_DIF_MIN_AST_H_RNG	V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Intermediate variable: correction on IGA_DIF_MIN for combustion cycles after start management in wide range					
IGA_DIF_MIN_DELTA_H_RNG	V	0... B40H	0... -180	-0.0625	°CRK
Extra retard on IGA_DIF_MIN in case of torque intervention in wide range					
IGA_DIF_MIN_H_RNG	O/V	0... B40H	0... -180	-0.0625	°CRK
Difference of minimum ignition angle to reference ignition angle in wide range					
IGA_MIN_BAS_1_H_RNG	V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Intermediate variable: basic minimum ignition angle in wide range					
IGA_MIN_BAS_2_H_RNG	V	FA60... 5A0H	-90 ...90	0.0625	°CRK
basic minimum ignition angle including cat heating in wide range					
IGA_MIN_BAS_2_OPM_1_H_RNG	V	0... B40H	-90 ...90	0.0625	°CRK
basic minimum ignition angle high range regarding cat heating and OPM 1					
IGA_MIN_BAS_2_OPM_2_H_RNG	V	0... B40H	-90 ...90	0.0625	°CRK
basic minimum ignition angle high range regarding cat heating and OPM 2					
IGA_MIN_BAS_EXT_H_RNG	V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Intermediate variable: basic minimum ignition angle in wide range					
IGA_MIN_BAS_H_RNG	V	FA60... 5A0H	-90 ...90	0.0625	°CRK
basic minimum ignition angle in wide range					
IGA_MIN_BAS_INT_H_RNG	V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Intermediate variable: basic minimum ignition angle in wide range					
IGA_MIN_BAS_OPM_H_RNG	V	0... B40H	-90 ...90	0.0625	°CRK
basic minimum ignition angle depending on engine operation mode					
IGA_MIN_BAS_PU_H_RNG	V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Intermediate variable: PU minimum ignition angle in wide range					
IGA_MIN_BAS_PUC_H_RNG	V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Intermediate variable: basic minimum ignition angle in wide range					
LV_IGA_DIF_MIN_DELTA_ACT	V	0... 1H	0 ...1	1	-
Flag to enable and declare the acting of the extra retard on IGA_DIF_MIN					

### Input data:

AMP {p. 982}	CYC_CAST {p. 1766}	FAC_IGA_OPM_SEL {p. 8266}	IGA_DIF_SP_H_RNG {p. 1948}
IGA_REF_COR {p. 8266}	LV_AST_END {p. 2100}	LV_AT {p. 654}	LV_CH_TQ_ADD {p. 799}
LV_CH_TQ_ADD_IS {p. 799}	LV_HOM_ACT {p. 8136}	LV_HOM_RUN {p. 8136}	LV_IGA_MIN_EXT {p. 8266}
LV_IGA_MIN_PUC {p. 1720}	LV_TQ_IGA_ACT {p. 1948}	MAF_HB {p. 805}	N_32 {p. 1525}
N_DIF {p. 1122}	OPM_AV {p. 8137}	OPM_REQ {p. 8137}	TCO {p. 1100}
TQ_ADD_CH {p. 6582}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DELTA_TEMP_DIS	-	0... FFH	0... 2.55	0.01	s
Disable time of extra spark retard on IGA_DIF_MIN after end of gradient return					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_IGA_DIF_MIN_BAS_LGRD_H_RNG	-	0... B40H	0... 180	0.0625	°CRK
Step gradient limitation					
C_IGA_DIF_MIN_DELTA_LGRD_H_RNG	-	0... B40H	0... -180	-0.0625	°CRK
Step gradient limitation after extra spark retard on IGA_DIF_MIN					
C_IGA_DIF_MIN_DELTA_TEMP_DIS	-	0... FFH	0... 2.55	0.01	s
Disable time of extra spark retard on IGA_DIF_MIN after end of gradient return					
C_IGA_DIF_MIN_DELTA_TEMP_ENA	-	0... FFH	0... 2.55	0.01	s
Maintaining time of extra retard on IGA_DIF_MIN					
C_IGA_MIN_PUC_LGRD_H_RNG	-	0... B40H	0... 180	0.0625	°CRK
Step gradient limitation					
IP_FAC_IGA_DIF_AST	-	0... FFH	0... 1.99218	0.0078125	-
LDPM_N_DIF_IGSP	8	8000... 7FFFH	-32768 ...32767	1	rpm
scaling N_DIF correction for minimum ignition angle ast					
IP_FAC_IGA_DIF_MIN_AMP	-	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_CYC_CAST_IP_IGA_DIF_MIN	8	0... FFFFH	0... 65535	1	-
scaling AMP correction for minimum ignition angle AST					
IP_FAC_IGA_MIN_TCO	V	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_N_32_2_IGSP	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_2_IGSP	6	0... FFH	0... 1389	5.4470588	mg/stk
scaling TCO correction for minimum ignition angle					
IP_FAC_IGA_MIN_TCO_EXT	V	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_N_32_2_IGSP	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_2_IGSP	6	0... FFH	0... 1389	5.4470588	mg/stk
scaling TCO correction for minimum ignition angle					
IP_FAC_IGA_MIN_TCO_PU	V	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_N_32_2_IGSP	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_2_IGSP	6	0... FFH	0... 1389	5.4470588	mg/stk
scaling TCO correction for minimum ignition angle					
IP_IGA_DIF_MIN_CYC_AMP_AT_H_RNG	V	0... B40H	-90 ...90	0.0625	°CRK
LDP_AMP_IP_IGA_DIF_MIN_CYC_AMP	6	0... FFFFH	0... 5434	0.0829175	hPa
LDPM_TCO_1_IGSP	8	0... FEH	-48... 142.5	0.75	°C
Altitude correction on minimum ignition angle for after start for automatic transmission					
IP_IGA_DIF_MIN_CYC_AMP_MT_H_RNG	V	0... B40H	-90 ...90	0.0625	°CRK
LDP_AMP_IP_IGA_DIF_MIN_CYC_AMP	6	0... FFFFH	0... 5434	0.0829175	hPa
LDPM_TCO_1_IGSP	8	0... FEH	-48... 142.5	0.75	°C
Altitude correction on minimum ignition angle for after start for manual transmission					
IP_IGA_DIF_MIN_CYC_AT	V	0... FFH	-48... 47.625	0.375	°CRK
LDPM_CYC_CAST_IP_IGA_DIF_MIN	8	0... FFFFH	0... 65535	1	-
LDPM_TCO_1_IGSP	8	0... FEH	-48... 142.5	0.75	°C
Correction on minimum ignition angle for combustion cycles after start for automatic transmission					
IP_IGA_DIF_MIN_CYC_MT	V	0... FFH	-48... 47.625	0.375	°CRK
LDPM_CYC_CAST_IP_IGA_DIF_MIN	8	0... FFFFH	0... 65535	1	-

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_TCO_1_IGSP	8	0... FEH	-48... 142.5	0.75	°C
Correction on minimum ignition angle for combustion cycles after start for manual transmission					
IP_IGA_DIF_MIN_DELTA_H_RNG	V	0... B40H	0... -180	-0.0625	°CRK
LDPM_N_32_2_IGSP	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_2_IGSP	6	0... FFH	0... 1389	5.4470588	mg/stk
Extra spark retard on minimum ignition angle in case of torque intervention					
IP_IGA_DIF_MIN_TCO	-	0... FFH	-48... 47.625	0.375	°CRK
LDPM_TCO_1_IGSP	8	0... FEH	-48... 142.5	0.75	°C
TCO correction for minimum ignition angle					
IP_IGA_DIF_MIN_TCO_EXT_H_RNG	-	0... B40H	-90 ...90	0.0625	°CRK
LDPM_TCO_1_IGSP	8	0... FEH	-48... 142.5	0.75	°C
TCO correction for minimum ignition angle					
IP_IGA_DIF_MIN_TCO_H_RNG	-	0... B40H	-90 ...90	0.0625	°CRK
LDPM_TCO_1_IGSP	8	0... FEH	-48... 142.5	0.75	°C
TCO correction for minimum ignition angle					
IP_IGA_DIF_MIN_TCO_PU_H_RNG	-	0... B40H	-90 ...90	0.0625	°CRK
LDPM_TCO_1_IGSP	8	0... FEH	-48... 142.5	0.75	°C
TCO correction for minimum ignition angle					
IP_IGA_MIN_CH_COR_H_RNG	V	0... B40H	-90 ...90	0.0625	°CRK
LDPM_N_32_2_IGSP	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_2_IGSP	6	0... FFH	0... 1389	5.4470588	mg/stk
Offset on basic minimum ignition angle caused by cat heating					
IP_IGA_MIN_N_MAF_EXT_H_RNG	V	0... B40H	-90 ...90	0.0625	°CRK
LDPM_N_32_2_IGSP	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_2_IGSP	6	0... FFH	0... 1389	5.4470588	mg/stk
Basic minimum ignition angle difference value					
IP_IGA_MIN_N_MAF_H_RNG	V	0... B40H	-90 ...90	0.0625	°CRK
LDPM_N_32_2_IGSP	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_2_IGSP	6	0... FFH	0... 1389	5.4470588	mg/stk
Basic minimum ignition angle difference value					
IP_IGA_MIN_N_MAF_PU_H_RNG	V	0... B40H	-90 ...90	0.0625	°CRK
LDPM_N_32_2_IGSP	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_2_IGSP	6	0... FFH	0... 1389	5.4470588	mg/stk
Basic minimum ignition angle difference value					
IP_IGA_MIN_OPM_COR_H_RNG	V	0... B40H	-90 ...90	0.0625	°CRK
LDPM_N_32_2_IGSP	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_2_IGSP	6	0... FFH	0... 1389	5.4470588	mg/stk
Offset on basic minimum ignition angle caused by engine throttled mode					
IP_T_IGA_MIN_PUC	-	0... FFH	0... 2.55	0.01	s
LDPM_N_32_2_IGSP	8	0... FFH	0... 8160	32	rpm
timer inside puc					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_INH_IGA_MIN_PUC	-	0... 1H	0 ...1	1	-
Logical constant for inhibiting ramping of IGA_MIN_BAS_PUC_H_RNG to IGA_BAS_COR in case of LV_PUC=1					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_USE_IGA_MIN_AST	-	0... 1H	0 ...1	1	-
Compiler switch for specific minimum IGA after start phase enabled					

**FUNCTION DESCRIPTION:**

The minimum ignition angle is the minimum allowable ignition angle which is possible to apply to the engine. The basic minimum ignition angle determined through a calibration map is corrected by a temperature dependent additive term. Furthermore there are additive influences by cat heating and engine operating mode like throttled or unthrottled. In some special engine running states, the minimal ignition angle calibrated in this function can be limited by external request to avoid too strong spark retards during those states. Hence, in all practical cases IGA\_DIF\_MIN\_H\_RNG is a negative value which is the maximum allowable spark retard determined by a calibration map. It includes the coolant temperature correction (*for engine protection, pollution condition, etc...*).

**6.12.1 IGA\_DIF\_MIN\_H\_RNG calculation with extra spark retard for torque intervention and after start management****General information:**


In case of a strong fast torque intervention requested (*ie. if IGA\_DIF\_SP\_H\_RNG hence requested by torque intervention becomes lower than IGA\_DIF\_MIN\_0\_H\_RNG*) then a specific over-retard (*IGA\_DIF\_MIN\_DELTA\_H\_RNG*) is authorised on minimum ignition angle for a while. It permits to manage a strongest response from the engine to a torque reduction request. IGA\_DIF\_MIN\_0\_H\_RNG is just an intermediate variable introduced here for clarification of explanations. IGA\_DIF\_MIN\_0\_H\_RNG is just the result of the interpolation map without other affects. This over-retard is only allowed for a given time (*C\_IGA\_DIF\_MIN\_DELTA\_TEMP\_ENA*). In case of a rising edge of the flag for enabling extra-retard (*LV\_IGA\_DIF\_MIN\_DELTA\_ACT=0->1*) the active counter is reset to *C\_IGA\_DIF\_MIN\_DELTA\_TEMP\_ENA*. If torque intervention by spark retard is active as well as homogeneous ignition angle and injection parameters are applied to the engine (*LV\_TQ\_IGA\_ACT=1* and *LV\_HOM\_ACT=1*) the active counter is decremented to 0, otherwise it is incremented back to *C\_IGA\_DIF\_MIN\_DELTA\_TEMP\_ENA*. The counter for extra-retard is set to avoid exhaust gas over-heating and thus protect the exhaust branch. At the end of this counter, this over-retard on IGA\_DIF\_MIN\_H\_RNG goes back up to 0 with a limited gradient (*C\_IGA\_DIF\_MIN\_DELTA\_LGRD\_H\_RNG*) for its come-back law. This limited gradient for come-back is necessary to avoid the changes on ignition angle applied can be felt on-board the car. At the end of this gradient limited come-back, such an other kind of extra retard is inhibited during a while (*C\_IGA\_DIF\_MIN\_DELTA\_TEMP\_ENA*) just to be sure to avoid any problems of exhaust gas over-heating. This functionality aims to deal with thermal exchange effects. So, the timer are in time units (*sec.*) and the calibration map here defined for extra retard is related to LDP of temperature.

**Application conditions**

**Activation:** LV\_HOM\_RUN = 1

**Deactivation:** LV\_HOM\_RUN = 0

**Initialisation:** IGA\_DIF\_MIN\_H\_RNG = 0° CRK at reset  
 IGA\_DIF\_MIN\_0\_H\_RNG = 0 °CRK  
 IGA\_DIF\_MIN\_AST\_H\_RNG = 0 °CRK

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IGA\_DIF\_MIN\_DELTA\_H\_RNG = 0 °CRK  
 IGA\_MIN\_BAS\_x\_H\_RNG = -35.625 °CRK

**Update Rate:** whole functionality => 10 ms  
 IP\_IGA\_DIF\_MIN\_TCO\_H\_RNG => 1000 ms

### Formula section:

Condition to enable the extra-spark retard:

**If** LV\_IGA\_DIF\_MIN\_DELTA\_ACT = 0  
**And When** IGA\_DIF\_SP\_H\_RNG becomes lower than IGA\_DIF\_MIN\_0\_H\_RNG<sub>n-1</sub>  
**Then** LV\_IGA\_DIF\_MIN\_DELTA\_ACT = 1  
**And** IGA\_DIF\_MIN\_DELTA\_H\_RNG = IGA\_DIF\_MIN\_DELTA\_1\_H\_RNG  
**Elseif** LV\_IGA\_DIF\_MIN\_DELTA\_ACT = 1  
**And When** IGA\_DIF\_SP\_H\_RNG becomes lower than IGA\_DIF\_MIN\_0\_H\_RNG<sub>n-1</sub>  
**Then** IGA\_DIF\_MIN\_DELTA\_H\_RNG = IGA\_DIF\_MIN\_DELTA\_1\_H\_RNG  
**Else if** IGA\_DIF\_SP\_H\_RNG is greater than IGA\_DIF\_MIN\_0\_H\_RNG<sub>n-1</sub>  
**And** LV\_IGA\_DIF\_MIN\_DELTA\_ACT = 0 or 1  
*(Whatever should be the state of LV\_IGA\_DIF\_MIN\_DELTA\_ACT)*

**Then** LV\_IGA\_DIF\_MIN\_DELTA\_ACT remains in its previous state  
**And** IGA\_DIF\_MIN\_DELTA\_H\_RNG = 0

**Endif**

*IGA\_DIF\_MIN\_DELTA\_1\_H\_RNG and IGA\_DIF\_MIN\_0\_H\_RNG are only an intermediate variable just used for calculation and clarification*

Management of extra spark retard:

**IF** (LV\_IGA\_DIF\_MIN\_DELTA\_ACT<sub>n</sub> = 1 and  
 LV\_IGA\_DIF\_MIN\_DELTA\_ACT<sub>n-1</sub> = 0)  
**THEN** CTR\_IGA\_DIF\_MIN\_DELTA\_TEMP\_ENA<sub>n</sub> =  
 C\_IGA\_DIF\_MIN\_DELTA\_TEMP\_ENA  
*the timer for extra-retard authorised is reseted*  
**ENDIF**

**IF** (LV\_HOM\_ACT = 1 and LV\_TQ\_IGA\_ACT = 1)  
**THEN** CTR\_IGA\_DIF\_MIN\_DELTA\_TEMP\_ENA<sub>n</sub> =  
 CTR\_IGA\_DIF\_MIN\_DELTA\_TEMP\_ENA<sub>n-1</sub> - 1  
*the timer for extra-retard authorised is decremented*  
 IGA\_DIF\_MIN\_DELTA\_1\_H\_RNG=  
 IP\_IGA\_DIF\_MIN\_DELTA\_H\_RNG(N\_32,MAF\_HB)  
**ELSE** CTR\_IGA\_DIF\_MIN\_DELTA\_TEMP\_ENA<sub>n</sub> =  
 CTR\_IGA\_DIF\_MIN\_DELTA\_TEMP\_ENA<sub>n-1</sub> + 1  
*the timer for extra-retard authorised is incremented*  
 IGA\_DIF\_MIN\_DELTA\_1\_H\_RNG=  
 IP\_IGA\_DIF\_MIN\_DELTA\_H\_RNG(N\_32,MAF\_HB)

**ENDIF**

**IF** CTR\_IGA\_DIF\_MIN\_DELTA\_TEMP\_ENA<sub>n</sub> = 0  
*at the end of timer for extra-retard authorized*

**THEN** IGA\_DIF\_MIN\_DELTA\_2\_H\_RNG<sub>n</sub> =  
 Min[(IGA\_DIF\_MIN\_DELTA\_H\_RNG<sub>n-1</sub> -

```

C_IGA_DIF_MIN_DELTA_LGRD_H_RNG), 0]
IGA_DIF_MIN_DELTA_1_H_RNGn = IGA_DIF_MIN_DELTA_2_H_RNGn
    Gradient limited come-back of the over-retard bordered to 0

ENDIF

IF          IGA_DIF_MIN_DELTA_2_H_RNG = 0
    at the end of the gradient limited come-back to 0

THEN       CTR_IGA_DIF_MIN_DELTA_TEMP_DISn =
    C_IGA_DIF_MIN_DELTA_TEMP_DIS

IF         CTR_IGA_DIF_MIN_DELTA_TEMP_DISn > 0
THEN       IGA_DIF_MIN_DELTA_1_H_RNGn = 0
    CTR_IGA_DIF_MIN_DELTA_TEMP_DISn =
    CTR_IGA_DIF_MIN_DELTA_TEMP_DISn-1 -1
    Inhibition of another over-retard at the end of a first one during the
    lasting of the timer C_IGA_DIF_MIN_DELTA_TEMP_DIS


ELSE
IF         (CTR_IGA_DIF_MIN_DELTA_TEMP_DISn = 0 and
    (CTR_IGA_DIF_MIN_DELTA_TEMP_DISn-1 = 1)
THEN       LV_IGA_DIF_MIN_DELTA_ACT = 0
    At the end of the inhibition time, another extra retard is allowed
    again

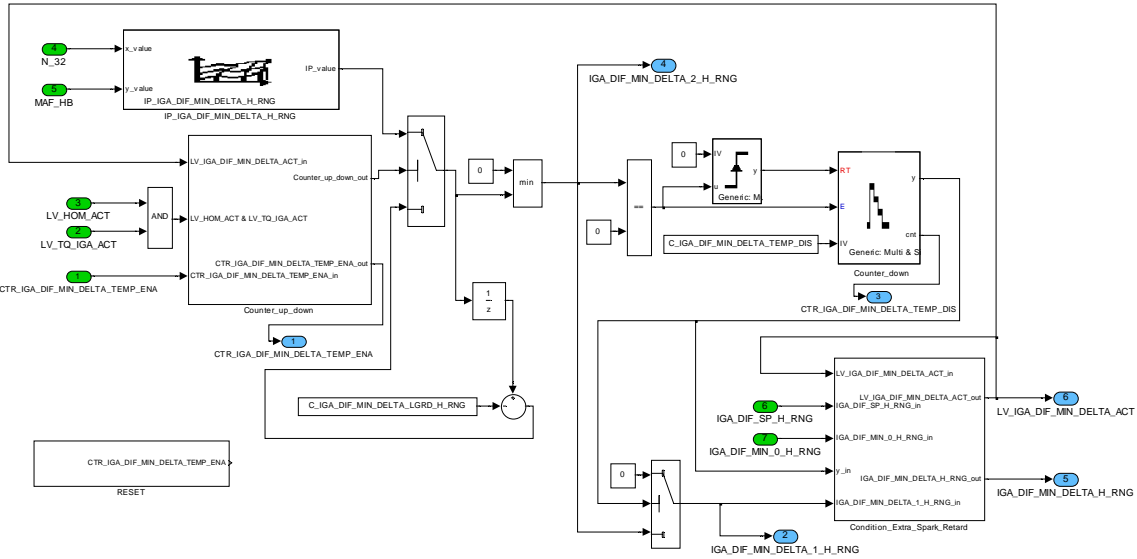
ENDIF
ENDIF
ENDIF

```

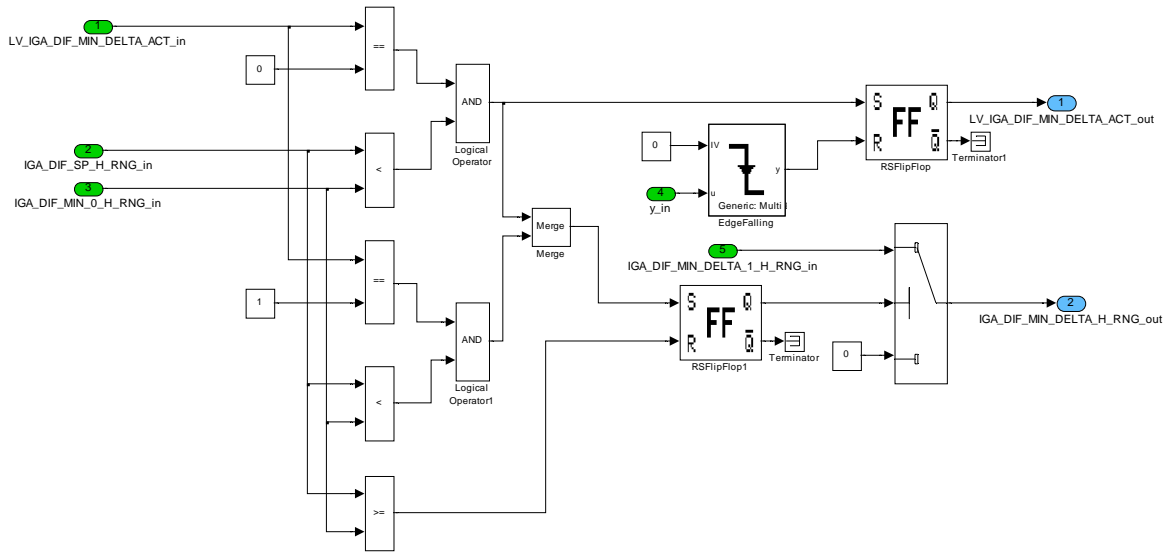
*Note: CTR\_IGA\_DIF\_MIN\_DELTA\_TEMP\_ENA, IGA\_DIF\_MIN\_DELTA\_2\_H\_RNG and CTR\_IGA\_DIF\_MIN\_DELTA\_TEMP\_DIS are only intermediate variables just used for calculation and clarification*

### Management of extra spark retard

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 1930 of 8404</b>	
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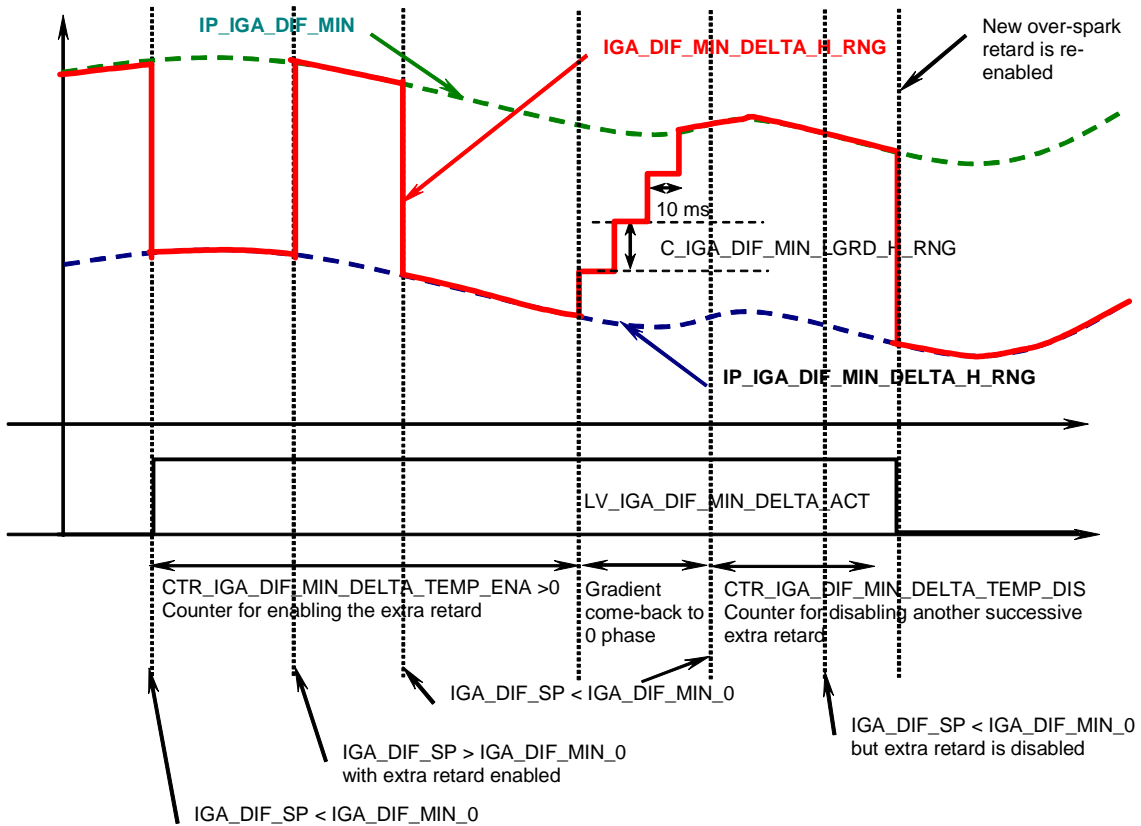
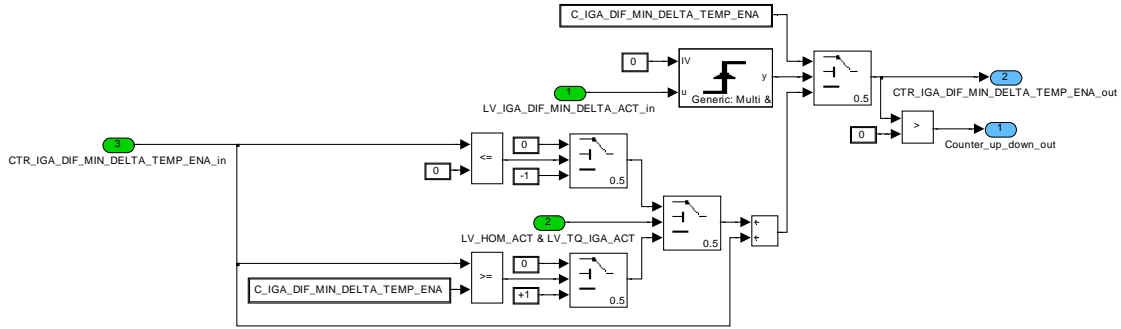
**Condition Extra Spark Retard**



**Counter up down**

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**After start correction on IGA\_DIF\_MIN\_H\_RNG:**  
 ery 10ms **if NLC\_USE\_IGA\_MIN\_AST = 1**

*The following calculations are only performed in homogenous mode during the after start phase (LV\_AST\_END = 0) and only if considered by project management choice (if NLC\_USE\_IGA\_MIN\_AST = 1). In other case, they can be switched off. The update rate is 10ms.*

**If** LV\_AT = 1 **and** LV\_AST\_END = 0 **and** NLC\_USE\_IGA\_MIN\_AST = 1  
**Then** IGA\_DIF\_MIN\_AST\_H\_RNG = (IP\_IGA\_DIF\_MIN\_CYC\_AT + IP\_IGA\_DIF\_MIN\_CYC\_AMP\_AT\_H\_RNG \* IP\_FAC\_IGA\_DIF\_MIN\_AMP) \* IP\_FAC\_IGA\_DIF\_AST

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```

elseif    LV_AT = 0          and    LV_AST_END = 0          and    NLC_USE_IGA_
MIN_AST = 1
then      IGA_DIF_MIN_AST_H_RNG =    (IP_IGA_DIF_MIN_CYC_MT  +
                                       IP_IGA_DIF_MIN_CYC_AMP_MT_H_RNG    *
                                       IP_FAC_IGA_DIF_MIN_AMP) *
                                       IP_FAC_IGA_DIF_AST

```

**Elseif** IGA\_DIF\_MIN\_AST\_H\_RNG = 0 *the computation can be switched off*  
**Endif**

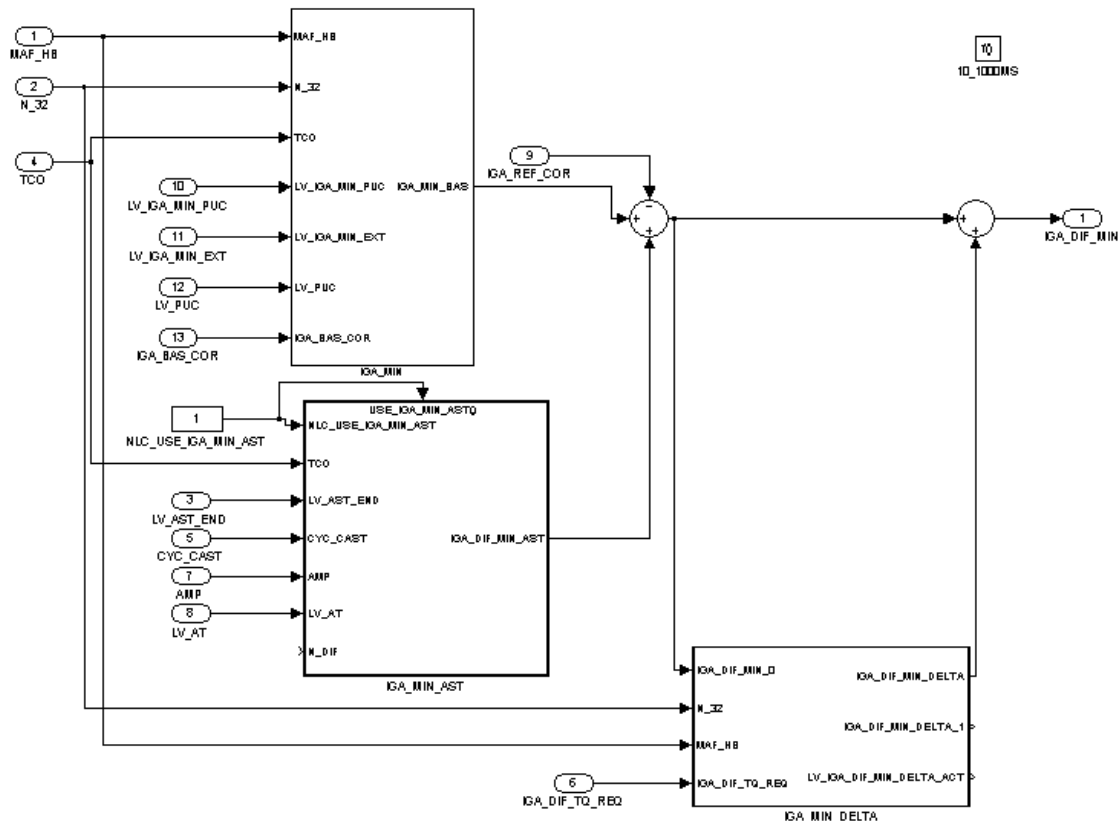
## 6.12.2 Limitation of IGA\_DIF\_MIN\_H\_RNG for after start management

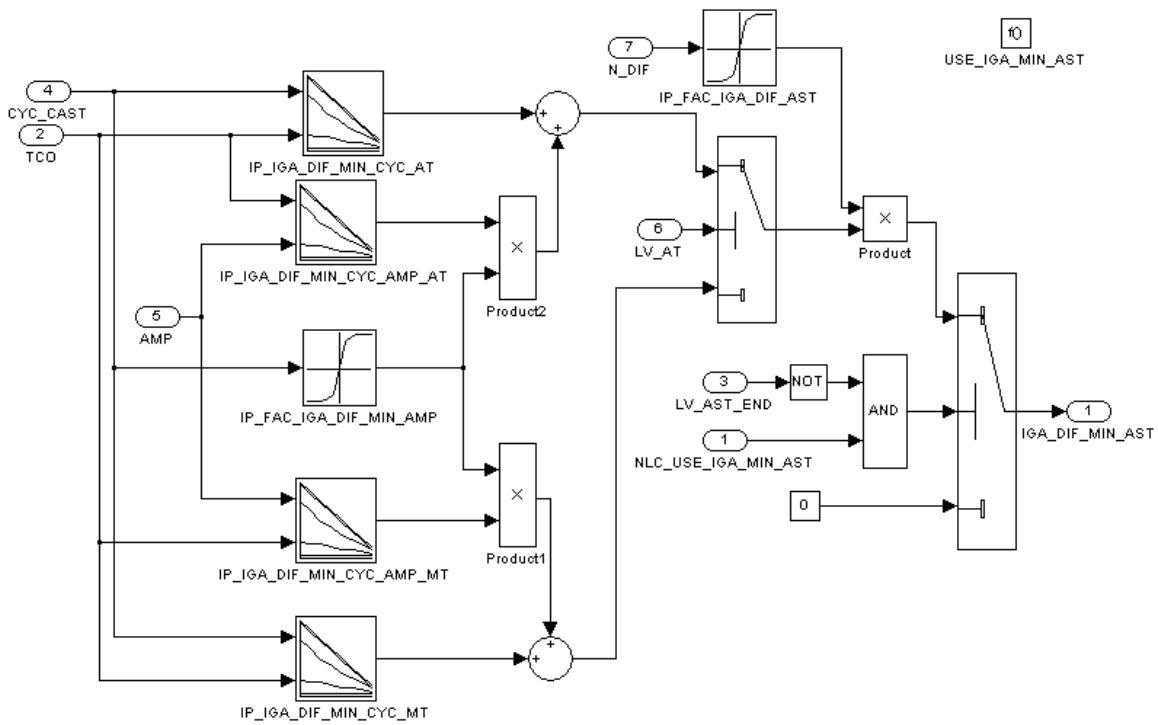
### General information:

After start phase it is possible to include a specific correction depending on engine cycles after start and engine coolant temperature to the minimum ignition angle calculated from basic maps to improve the efficiency of catalyst heating.

**Note:** *All this following part is only computed - and integrated in the SW - if NLC\_USE\_IGA\_MIN\_AST = 1*

### Signal flow diagram:

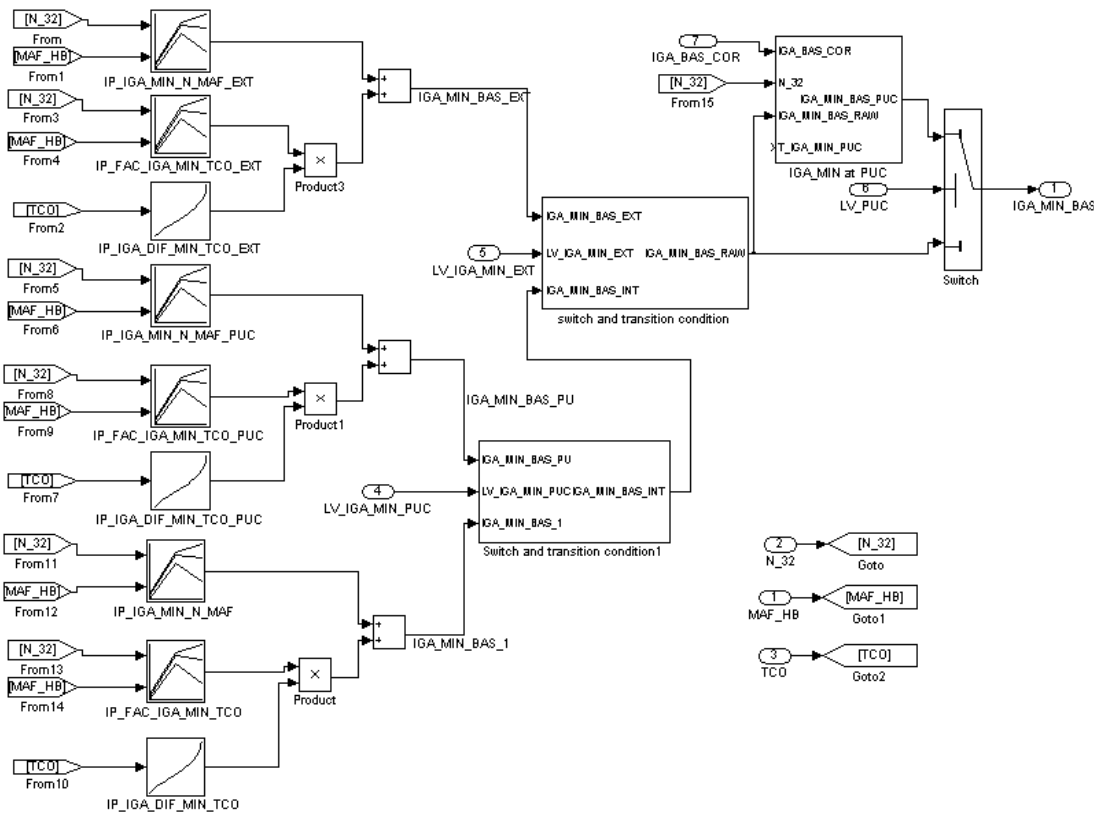




### 6.12.3 IGA\_MIN switch conditions

**Signal flow diagram:**

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Additional maps are introduced to consider the influence of cat heating and throttled engine mode.  $IP\_IGA\_MIN\_CH\_COR$  and  $IP\_IGA\_MIN\_OPM\_COR$  are additive corrections on  $IGA\_MIN\_BAS\_H\_RNG$ . Each one is depending on  $N\_32$  and  $MAF\_HB$ . The combined sum results in  $IGA\_MIN\_BAS\_OPM$ .

The fading of  $IP\_IGA\_MIN\_CH\_COR$  in dependence of operation mode is managed by function  $OPM\_SWI$ .

#### Formula description:

IF  $OPM\_REQ\_CUS = 66$             or             $OPM\_REQ\_CUS = 82$

THEN

$IGA\_MIN\_BAS\_2\_H\_RNG = IGA\_MIN\_BAS\_H\_RNG + IP\_IGA\_MIN\_CH\_COR\_H\_RNG$

ELSE

$IGA\_MIN\_BAS\_2\_H\_RNG = IGA\_MIN\_BAS\_H\_RNG$

ENDIF

$IGA\_MIN\_BAS\_2\_OPM\_1\_H\_RNG = IGA\_MIN\_BAS\_2\_H\_RNG$

$IGA\_MIN\_BAS\_2\_OPM\_2\_H\_RNG = IGA\_MIN\_BAS\_2\_H\_RNG + IP\_IGA\_MIN\_OPM\_COR\_H\_RNG$

$IGA\_MIN\_BAS\_OPM\_H\_RNG =$  Function call  $OPM\_SWI$             (described in chapter 1.5)

### 6.12.4 Operation mode manager (function $OPM\_SWI$ )

There are two input values  $IGA\_MIN\_BAS\_2\_OPM\_1\_H\_RNG$ ,  $IGA\_MIN\_BAS\_2\_OPM\_2\_H\_RNG$ . Each input value belongs to a special operation mode  $OPM\_1$ ,  $OPM\_2$ . Moreover the value  $OPM\_SEL\_AV$  indicates the active and  $OPM\_SEL\_REQ$  indicates the requested operation mode. The aim of the operation manager is to create an output value depending on the active operation mode. If there is

a switch from one mode to another a smooth changeover from one input value to the other is possible by using the interpolation factor FAC\_IGA\_OPM\_SEL .

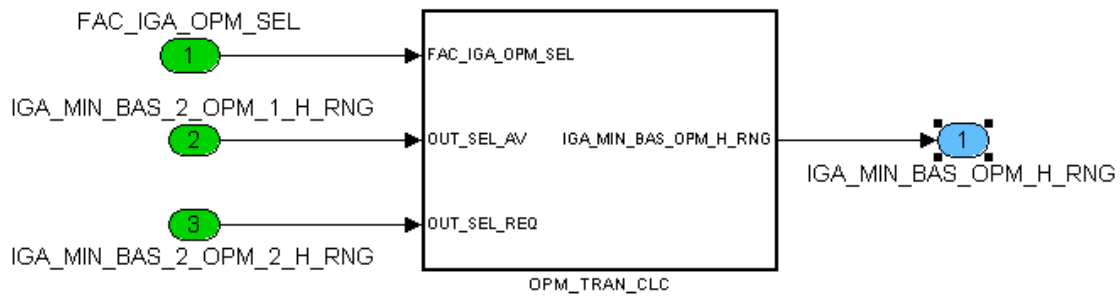


Figure 6.12.1: Operation mode manager

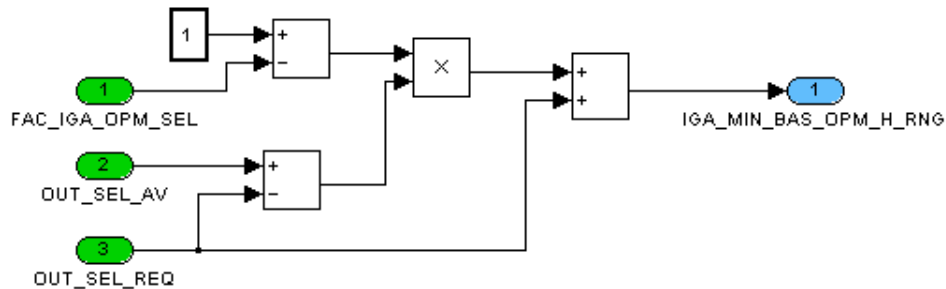


Figure 6.12.2: OPM\_TRAN\_CLC

To prevent a jump in the IGA\_MIN a transition is necessary at switching to an other IGA\_MIN\_BAS\_x\_H\_RNG with the change limitation of C\_IGA\_DIF\_MIN\_BAS\_LGRD\_H\_RNG.

**LV\_IGA\_MIN\_PUC == from 0 to 1 and LV\_IGA\_MIN\_EXT == 0:**

**IF**  $IGA\_MIN\_BAS\_INT\_H\_RNG_{n-1} - IGA\_MIN\_BAS\_PU\_H\_RNG_n > 0$

**Then**  $IGA\_MIN\_BAS\_INT\_H\_RNG_{n-1} - C\_IGA\_DIF\_MIN\_BAS\_LGRD\_H\_RNG$

**until**  $IGA\_MIN\_BAS\_INT\_H\_RNG_{n-1} - IGA\_MIN\_BAS\_PU\_H\_RNG_n \leq C\_IGA\_DIF\_MIN\_BAS\_LGRD\_H\_RNG$

**Then**  $IGA\_MIN\_BAS\_INT\_H\_RNG_n = IGA\_MIN\_BAS\_PU\_H\_RNG$

**else**

**IF**  $IGA\_MIN\_BAS\_INT\_H\_RNG_{n-1} - IGA\_MIN\_BAS\_PU\_H\_RNG_n < 0$

**Then**  $IGA\_MIN\_BAS\_INT\_H\_RNG_{n-1} + C\_IGA\_DIF\_MIN\_BAS\_LGRD\_H\_RNG$

**until**  $IGA\_MIN\_BAS\_INT\_H\_RNG_{n-1} - IGA\_MIN\_BAS\_PU\_H\_RNG_n \leq C\_IGA\_DIF\_MIN\_BAS\_LGRD\_H\_RNG$

**Then**  $IGA\_MIN\_BAS\_INT\_H\_RNG_n = IGA\_MIN\_BAS\_PU\_H\_RNG$

**LV\_IGA\_MIN\_PUC == from 1 to 0 and LV\_IGA\_MIN\_EXT == 0:**

**IF**  $IGA\_MIN\_BAS\_INT\_H\_RNG_{n-1} - IGA\_MIN\_BAS\_1\_H\_RNG_n > 0$

**Then**  $IGA\_MIN\_BAS\_INT\_H\_RNG_{n-1} - C\_IGA\_DIF\_MIN\_BAS\_LGRD\_H\_RNG$

**until**  $IGA\_MIN\_BAS\_INT\_H\_RNG_{n-1} - IGA\_MIN\_BAS\_1\_H\_RNG_n \leq C\_IGA\_DIF\_MIN\_BAS\_LGRD\_H\_RNG$



```

Then IGA_MIN_BAS_INT_H_RNGn = IGA_MIN_BAS_1_H_RNG
else
IF IGA_MIN_BAS_INT_H_RNGn-1 - IGA_MIN_BAS_1_H_RNGn < 0
Then IGA_MIN_BAS_INT_H_RNGn-1 + C_IGA_DIF_MIN_BAS_LGRD_H_RNG
until IGA_MIN_BAS_INT_H_RNGn-1 - IGA_MIN_BAS_1_H_RNGn <= C_IGA_DIF_
MIN_BAS_LGRD_H_RNG
Then IGA_MIN_BAS_INT_H_RNGn = IGA_MIN_BAS_1_H_RNG

```

LV\_IGA\_MIN\_EXT == from 0 to 1:

```

IF IGA_MIN_BAS_RAW_H_RNGn-1 - IGA_MIN_BAS_EXT_H_RNGn > 0
Then IGA_MIN_BAS_RAW_H_RNGn-1 - C_IGA_DIF_MIN_BAS_LGRD_H_RNG
until IGA_MIN_BAS_RAW_H_RNGn-1 - IGA_MIN_BAS_EXT_H_RNGn <= C_IGA_DIF_MIN_BAS_
LGRD_H_RNG
Then IGA_MIN_BAS_RAW_H_RNGn = IGA_MIN_BAS_EXT_H_RNG
else
IF IGA_MIN_BAS_RAW_H_RNGn-1 - IGA_MIN_BAS_EXT_H_RNGn < 0
Then IGA_MIN_BAS_RAW_H_RNGn-1 + C_IGA_DIF_MIN_BAS_LGRD_H_RNG
until IGA_MIN_BAS_RAW_H_RNGn-1 - IGA_MIN_BAS_EXT_H_RNGn <= C_IGA_DIF_MIN_BAS_
LGRD_H_RNG
Then IGA_MIN_BAS_RAW_H_RNGn = IGA_MIN_BAS_EXT_H_RNG

```

LV\_IGA\_MIN\_EXT == from 1 to 0:

```

IF IGA_MIN_BAS_RAW_H_RNGn-1 - IGA_MIN_BAS_INT_H_RNGn > 0
Then IGA_MIN_BAS_RAW_H_RNGn-1 - C_IGA_DIF_MIN_BAS_LGRD_H_RNG
until IGA_MIN_BAS_RAW_H_RNGn-1 - IGA_MIN_BAS_INT_H_RNGn <= C_IGA_DIF_MIN_
BAS_LGRD_H_RNG
Then IGA_MIN_BAS_RAW_H_RNGn = IGA_MIN_BAS_INT_H_RNG
else
IF IGA_MIN_BAS_RAW_H_RNGn-1 - IGA_MIN_BAS_INT_H_RNGn < 0
Then IGA_MIN_BAS_RAW_H_RNGn-1 + C_IGA_DIF_MIN_BAS_LGRD_H_RNG
until IGA_MIN_BAS_RAW_H_RNGn-1 - IGA_MIN_BAS_INT_H_RNGn <= C_IGA_DIF_MIN_
BAS_LGRD_H_RNG
Then IGA_MIN_BAS_RAW_H_RNGn = IGA_MIN_BAS_INT_H_RNG


```

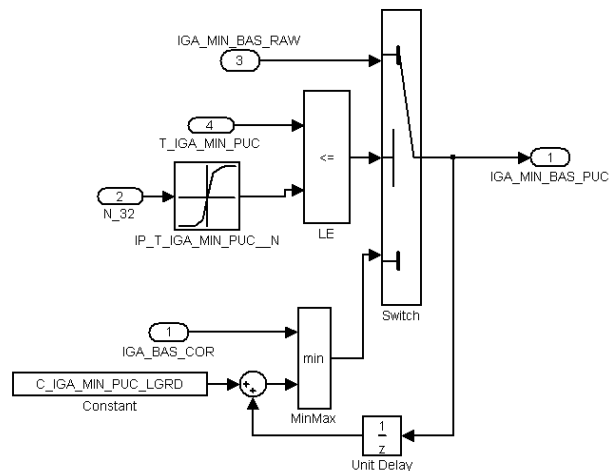
LV\_IGA\_MIN\_EXT == 1:

```

IF LV_IGA_MIN_PUC == 0
Then IGA_MIN_BAS_INT_H_RNG = IGA_MIN_BAS_1_H_RNG
else
IGA_MIN_BAS_INT_H_RNG = IGA_MIN_BAS_PU_H_RNG
endif

```

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```

IF      LV_PUCn = 1 AND LV_PUCn-1 = 0 AND LC_INH_IGA_MIN_PUC = 0
Then start timer T_IGA_MIN_PUC incrementation
IF      T_IGA_MIN_PUC <= IP_T_IGA_MIN_PUC
then    IGA_MIN_BAS_PUC_H_RNG = IGA_MIN_BAS_RAW_H_RNG
else    IGA_MIN_BAS_PUC_H_RNGn = min((IGA_MIN_BAS_PUC_H_RNGn-1 +
                                         C_IGA_MIN_PUC_LGRD_H_RNG;
                                         IGA_BAS_COR)
endif

```

endif

```

IF      LV_PUC == 0
Then    IGA_MIN_BAS_H_RNG = IGA_MIN_BAS_RAW_H_RNG
else    IGA_MIN_BAS_H_RNG = IGA_MIN_BAS_PUC_H_RNG
endif

```

**Maximum possible spark retard:**

every 10ms

The two following calculations are always performed (in homogenous mode) at an update rate of 10ms.

$$\begin{aligned}
 \text{IGA\_DIF\_MIN\_0\_H\_RNG} &= -1 * \text{IGA\_REF\_COR} + \\
 &\text{IGA\_MIN\_BAS\_OPM\_H\_RNG} + \\
 &\text{IGA\_DIF\_MIN\_AST\_H\_RNG} \quad \text{after start correction}
 \end{aligned}$$

*IGA\_DIF\_MIN\_0\_H\_RNG is just the standard result of the interpolation maps*

$$\text{IGA\_DIF\_MIN\_H\_RNG} = (\text{IGA\_DIF\_MIN\_0\_H\_RNG} + \text{IGA\_DIF\_MIN\_DELTA\_H\_RNG})$$

## 6.13 Exhaust gas temperature protection - Minimum ignition angle limitation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA_DIF_MIN_TEG_1_H_RNG	-	0... B40H	0... -180	0.0625	°CRK
Difference of minimum ignition angle with reference one according to TEG value - Intermediate variable					
IGA_DIF_MIN_TEG_H_RNG	O/V	0... B40H	0... -180	0.0625	°CRK
Difference of minimum ignition angle with reference one - TEG correction included					
IGA_MIN_TEG_H_RNG	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
minimum ignition angle					
TEG_CAT_UP_MDL_MAX	O/V	0... 7FF0H	0... 2047	0.0625	°C
Maximal Temperature of exhaust gas between all cylinder bank					
TEG_DYN_HYS	V	0... 7FF0H	0... 2047	0.0625	°C
Temperature of exhaust gas with hysteresis for IGA_MIN limitation					

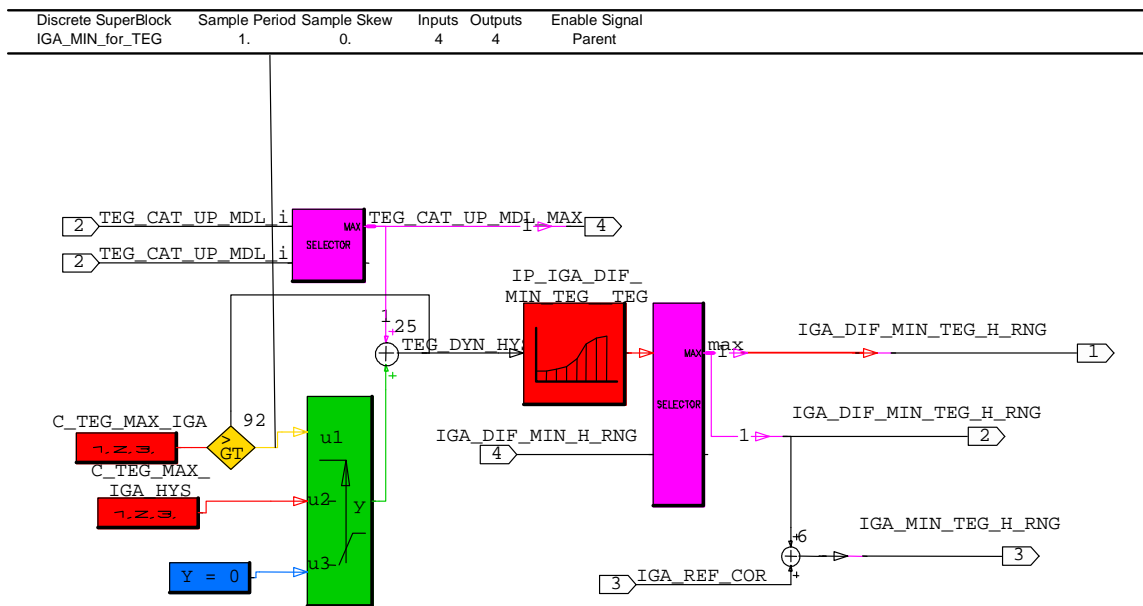
### Input data:

IGA_DIF_MIN_H_RNG {p. 1925}	IGA_REF_COR {p. 8266}	LV_ES {p. 1720}	LV_HOM_RUN {p. 8136}
LV_ST {p. 1720}	TEG_CAT_UP_MDL [i] {p. 8236}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TEG_MAX_IGA	-	0... 7FF0H	0... 2047	0.0625	°C
Maximum allowable exhaust gas temperature for spark retard control					
C_TEG_MAX_IGA_HYS	-	0... 7FF0H	0... 2047	0.0625	°C
Hysteresis on exhaust gas temperature for spark retard control					
IP_IGA_DIF_MIN_TEG_H_RNG__TEG	-	0... B40H	0... -180	0.0625	°CRK
LDP_TEG_DYN_HYS	16	0... 7FF0H	0... 2047	0.0625	°C
Minimum ignition angle versus exhaust gas temperature					

### FUNCTION DESCRIPTION:



### General information:

The minimum ignition angle IGA\_MIN is the minimum allowable ignition angle that is possible to apply to the engine. Hence, it only includes the combustion stability concern. It does not take into account any thermal effect. It should be used during the torque intervention phases in order to produce a fast reduction of the torque.

Applying IGA\_MIN as actual ignition angle results in efficiency losses that should lead to an exhaust gas overheating and/or engine damages.

In order to avoid overheating of the components in the exhaust-system branch, minimum spark retard has to be limited in accordance with the actual exhaust gas temperature TEG\_CAT\_UP\_MDL[NC\_CBK\_EX\_NR].

Moreover to determine the maximum possible torque reserve for catalyst heating, the torque reserve co-ordination module needs the minimum ignition angle efficiency and the minimum ignition angle with exhaust branch protection efficiency in order to limit and choose the different torque reserve requests.

Hence another minimum spark retard difference have to be calculated IGA\_DIF\_MIN\_TEG\_H\_RNG which takes into account the exhaust gas system protection. It is the maximum between the one calculated versus the maximal exhaust gases temperature (TEG\_CAT\_UP\_MDL\_MAX) and the basic one IGA\_DIF\_MIN\_H\_RNG.

Classically IGA\_DIF\_MIN is calculated from a basic value of the minimum ignition angle corrected with a temperature dependent additive term. The basic minimum spark advance is here extracted from a calibration map.

To calculate the minimum spark retard limitation according to the exhaust gas temperature the map IP\_IGA\_DIF\_MIN\_TEG\_H\_RNG\_TEG is used. TEG\_DYN\_HYS is used as input for this map. This intermediate variable TEG\_DYN\_HYS represents the exhaust gas temperature TEG\_CAT\_UP\_MDL[NC\_CBK\_EX\_NR] increased by an hysteresis in order to anticipate the exhaust-system branch overheat.

The influence of the ignition angle on the exhaust gas temperature results from the ignition angle efficiency. Thus - in order to calibrate easily the map IP\_IGA\_DIF\_MIN\_TEG\_H\_RNG\_TEG - one should use the efficiencies resulting from IGA\_DIF\_MIN\_H\_RNG values with the map IP\_EFF\_IGA\_IGA\_DIF and limit these efficiencies according to the actual exhaust gas temperature to avoid exhaust-system branch overheat. Then, thanks to the reverse map IP\_IGA\_DIF\_\_EFF or thanks to the torque model for ignition angle efficiency, it is possible to calculate the value of the map IP\_IGA\_DIF\_MIN\_TEG\_H\_RNG\_TEG.

So, in all practical cases IGA\_DIF\_MIN\_H\_RNG is a negative value that is the maximum allowable spark retard for engine stable running and pollutant conditions. It includes the coolant temperature correction. The exhaust gas temperature limitation is then taken into account in IGA\_DIF\_MIN\_TEG\_H\_RNG: The actual exhaust gas temperature TEG\_CAT\_UP\_MDL[NC\_CBK\_EX\_NR] can be either measured by a sensor on the exhaust-system branch or calculated from an exhaust gas temperature model. For engines with multiple cylinder banks, this temperature TEG\_CAT\_UP\_MDL[NC\_CBK\_EX\_NR] of exhaust gas before catalyst is defined and dedicated for each cylinder banks individually. Since here the limitation of IGA\_MIN is just a protective function versus the catalyst overheating, only the maximal value from all those cylinder bank related TEG\_CAT\_UP\_MDL[NC\_CBK\_EX\_NR] temperature will be taken into account.

**Note:** Two different update rates are used in the following calculations: for everything related to TEG only 1000ms rate is used to update calculation in synchronisation with TEG updates; for calculations related to ignition angle a 10 time faster update rate of 100ms.

These calculations are only performed when engine is running (*not stalled*) in homogenous mode after the end of start phase.

### Application conditions

**Activation:** LV\_HOM\_RUN = 1 **and** LV\_ST = 0 **and** LV\_ES = 0  
*active only in homogenous mode after the end of start phase before engine stall*

**Deactivation:** LV\_HOM\_RUN = 0 **or** LV\_ST = 1 **or** LV\_ES = 1

**Initialisation:** IGA\_MIN\_TEG\_H\_RNG = -90 °CRK  
 IGA\_DIF\_MIN\_TEG\_H\_RNG = -180 °CRK  
 IGA\_DIF\_MIN\_TEG\_1\_H\_RNG = -180 °CRK  
 TEG\_DYN\_HYS = 0 at reset

**Update Rate:** TEG\_DYN\_HYS => 1000ms  
**and** synchronised with TEG\_CAT\_UP\_MDL[NC\_CBK\_EX\_NR] updates.  
 IGA\_DIF\_MIN\_TEG\_H\_RNG => 100ms  
 IGA\_MIN\_TEG\_H\_RNG => 100ms  
 EFF\_IGA\_MIN\_TEG => 100ms

### Formula section:

*Maximal cylinder bank exhaust gas temperature determination:*

every 1000ms

in synchronisation with TEG\_CAT\_

UP\_MDL[NC\_CBK\_EX\_NR] updates

$$\text{TEG\_CAT\_UP\_MDL\_MAX} = \text{Max}_0^{\text{NC\_CBK\_NR}-1} (\text{TEG\_CAT\_UP\_MDL}_i)$$


*Hysteris function on exhaust gas temperature for ignition effects anticipation:*

every 1000ms

in synchronisation with TEG\_CAT\_

UP\_MDL[NC\_CBK\_EX\_NR] updates

**If** TEG\_DYN\_HYS<sub>n-1</sub> > C\_TEG\_MAX\_IGA  
**Then** TEG\_DYN\_HYS<sub>n</sub> = TEG\_CAT\_UP\_MDL\_MAX<sub>n</sub> + C\_TEG\_MAX\_IGA\_HYS  
**Else** TEG\_DYN\_HYS<sub>n</sub> = TEG\_CAT\_UP\_MDL\_MAX<sub>n</sub>  
**Endif**

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$IGA\_DIF\_MIN\_TEG\_1\_H\_RNG = IP\_IGA\_DIF\_MIN\_TEG\_H\_RNG\_TEG(TEG\_DYN\_HYS)$   
*IGA\_DIF\_MIN\_TEG\_1\_H\_RNG is just an intermediate variable for calculation to name the result of the interpolation*

*Limitation of Maximum possible spark retard according to exhaust temperature TEG\_DYN\_HYS:*  
 every 100ms

$IGA\_DIF\_MIN\_TEG\_H\_RNG = \text{Max}(IGA\_DIF\_MIN\_H\_RNG, IGA\_DIF\_MIN\_TEG\_1\_H\_RNG)$

*Minimum ignition angle limited for exhaust temperature protection:*  
 every 100ms

$IGA\_MIN\_TEG\_H\_RNG = IGA\_REF\_COR + IGA\_DIF\_MIN\_TEG\_H\_RNG$

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## 6.14 Ignition angle difference for catalyst heating with post injection

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA_DIF_S_CH	O/V	0... FFH	-35.625 ...60	0.375	°CRK
Ignition angle difference for stratified catalyst heating with post injection					

### Input data:

MFF_SP_MV {p. 2151}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}
STATE_CH {p. 1777}	STATE_CH_MOD {p. 1796}	STATE_CH_MOD_REQ {p. 1796}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_IGA_DIF_ADD_MFF_POST_CH_L	-	0... FFH	-35.625 ...60	0.375	°CRK
Mass of post injection depending correction for ignition angle difference for low load catalyst heating					
C_IGA_DIF_S_CH_AST_BAS	-	0... F00H	-720 ...720	0.375	°CRK
Ignition angle difference for stratified catalyst hating with post injection					
C_IGA_DIF_S_CH_L_BAS	-	0... F00H	-720 ...720	0.375	°CRK
Ignition angle difference for stratified low load catalyst heating with post injection					
C_IGA_DIF_S_CH_MAN	-	0... FFH	-35.625 ...60	0.375	°CRK
Manual setting of ignition angle difference for stratified catalyst heating with post injection					
LC_IGA_DIF_S_CH_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of ignition angle difference for stratified catalyst heating with post injection					

### Overview

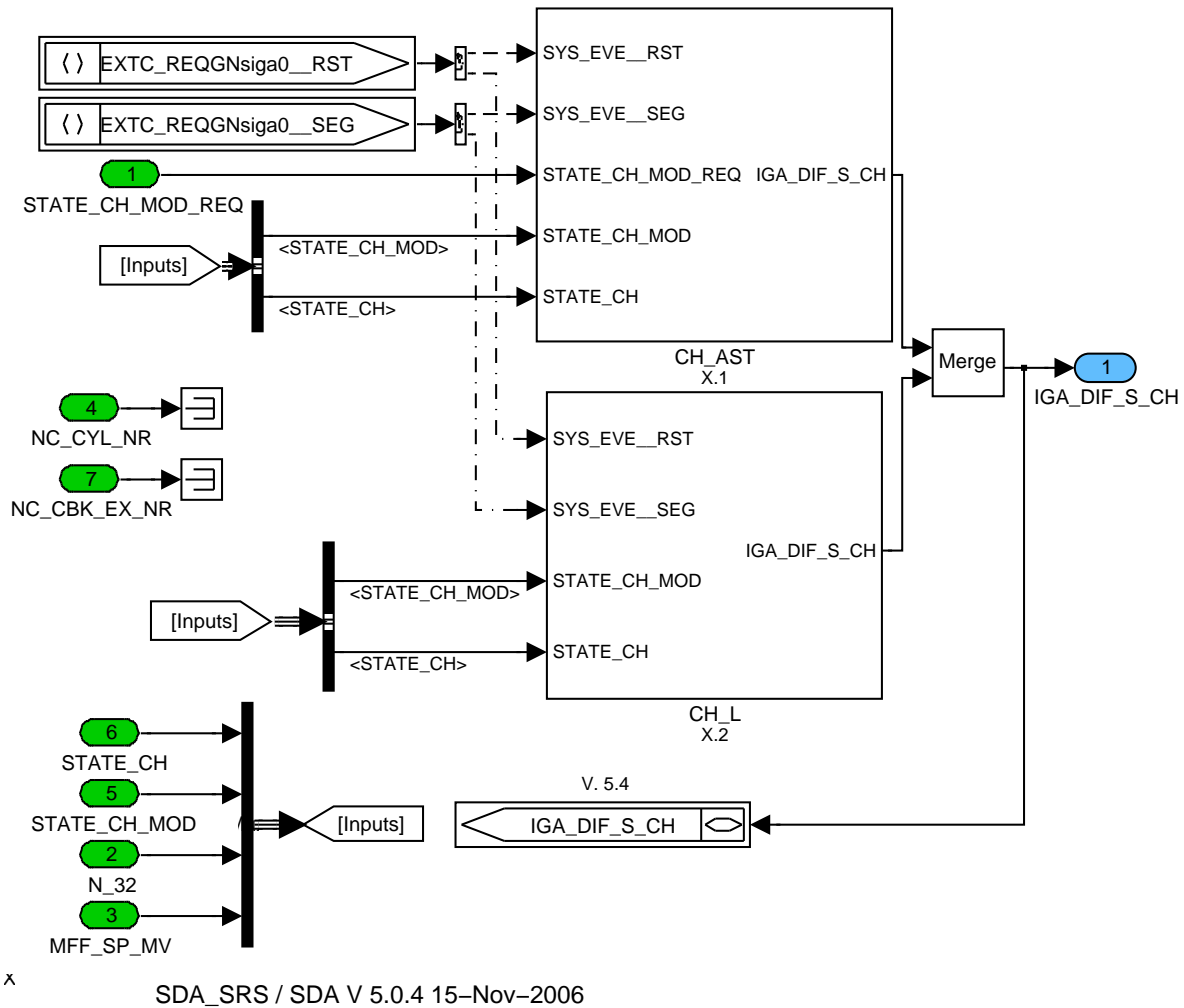


Figure 6.14.1: : Path: EXTC\_REQGNsiga0

## General Information

For catalyst heating in stratified mode possibly with post injection there is an increase of exhaust gas temperature due to retarding the ignition angle. In this module a difference of the ignition angle is generated.

The function is divided into two parts: After start and low load catalyst heating.

### 6.14.1 Catalyst heating after start

#### Application Conditions



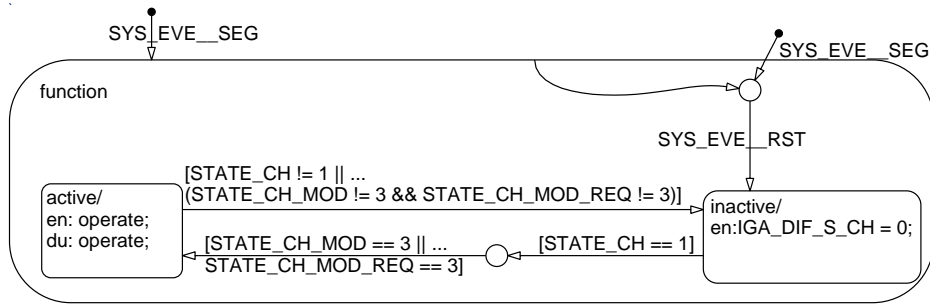


Figure 6.14.2: : Path: EXTC\_REQGNsiga0/CH\_AST/APP\_CDN/Chart

**Function description**

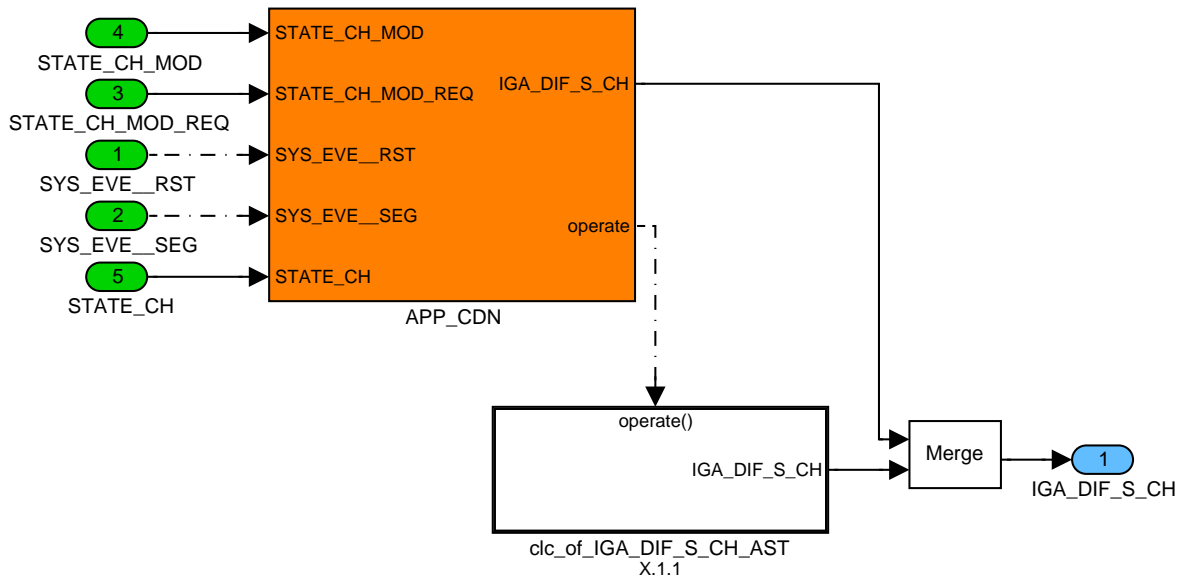


Figure 6.14.3: : Path: EXTC\_REQGNsiga0/CH\_AST

**6.14.1.1 Function: Catalyst heating after start**

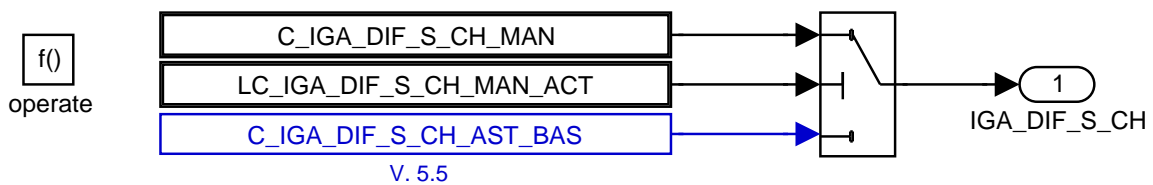


Figure 6.14.4: : Path: EXTC\_REQGNsiga0/CH\_AST/clc\_of\_IGA\_DIF\_S\_CH\_AST

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### 6.14.2 Low load catalyst heating

#### Application Conditions

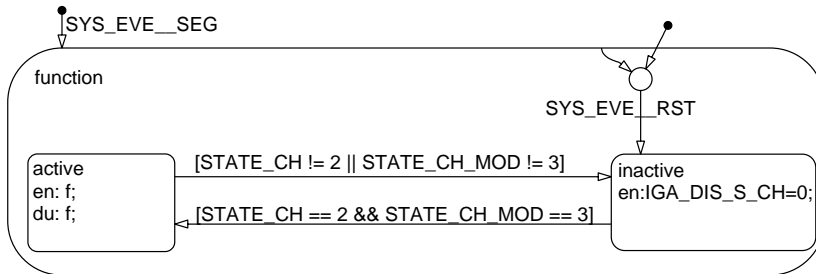


Figure 6.14.5: : Path: EXTC\_REQGNsiga0/CH\_L/APP\_CDN/Chart

#### Function description

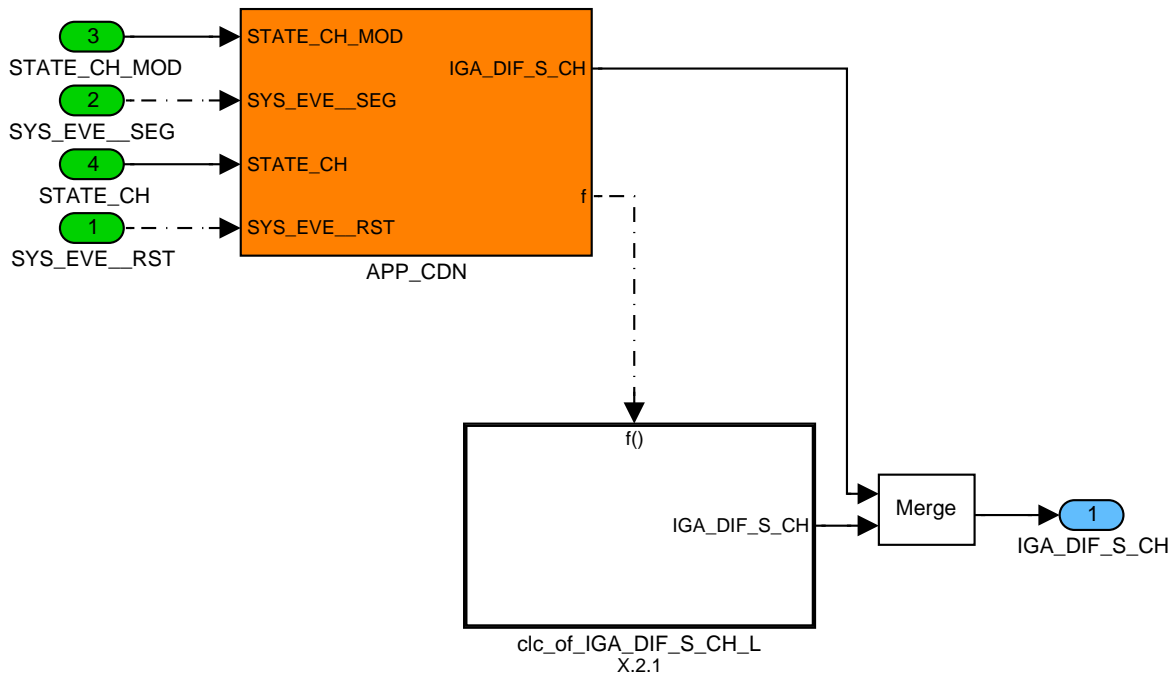


Figure 6.14.6: : Path: EXTC\_REQGNsiga0/CH\_L

#### 6.14.2.1 Function: Low load catalyst heating

For low load CH there is a second correction depending on the actual fuel mass of post injection beside the CH\_AST functionality. The read\_vector block picks out one element (here the 1st) of the cylinder individual MFF\_POSTvector.

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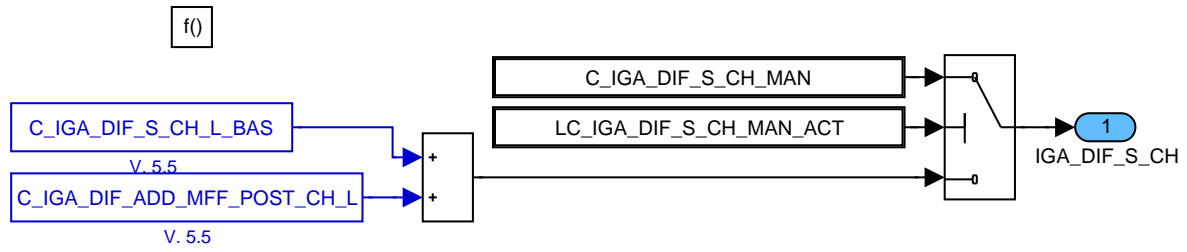



Figure 6.14.7: : Path: EXTC\_REQGNsiga0/CH\_L/clc\_of\_IGA\_DIF\_S\_CH\_L

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## 6.15 TQM - Setpoint ignition angle

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_IGA_INV_COR_CBK	V	0... 4E20H	0... 100	0.005	%
Setpoint ignition efficiency; inverted and corrected depending on engine state bank selective					
EFF_IGA_INV_COR_CBK_CAN	V	0... 4E20H	0... 100	0.005	%
Setpoint ignition efficiency CAN; inverted and corrected depending on engine state bank selective					
EFF_IGA_SP_CBK [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996	30.5e-6	-
Setpoint ignition efficiency bank selective					
EFF_IGA_SP_CBK_1 [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996	30.5e-6	-
Setpoint ignition efficiency bank selective					
EFF_IGA_SP_CBK_1_CAN [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996	30.5e-6	-
Setpoint ignition efficiency for CAN bank selective					
EFF_IGA_SP_CBK_CAN [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996	30.5e-6	-
Setpoint ignition efficiency for CAN bank selective					
IGA_DIF_SP_CBK_CAN_H_RNG [NC_CBK_EX_NR]	O/V	0... B40H	0... -180	-0.0625	°CRK
Setpoint subtrahend ignition angle in wide range for CAN bank selective					
IGA_DIF_SP_CBK_H_RNG	O/V	0... B40H	0... -180	-0.0625	°CRK
Setpoint subtrahend ignition angle in wide range bank selective					
IGA_DIF_SP_H_RNG	O/V	0... B40H	0... -180	-0.0625	°CRK
Setpoint subtrahend ignition angle in wide range					
IGA_SP_CAN_H_RNG	O/V	0... B40H	0... -180	-0.0625	°CRK
Setpoint ignition angle from torque management for CAN					
IGA_SP_CBK_CAN_H_RNG [NC_CBK_EX_NR]	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Setpoint ignition angle from torque management for CAN bank selective					
IGA_SP_CBK_H_RNG [NC_CBK_EX_NR]	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Setpoint ignition angle from torque management bank selective					
IGA_SP_H_RNG	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Setpoint ignition angle from torque management					
LV_TQ_IGA_ACT	O/V	0... 1H	0 ...1	1	-
Logical variable torque intervention by spark retard is active					
LV_TQ_IGA_REQ	V	0... 1H	0 ...1	1	-
Logical variable torque intervention by spark retard is request					

### Input data:

EFF_IGA_BAS_COR_CBK [NC_CBK_EX_NR] {p. 1845}	EFF_LAMB_AV_CBK [NC_CBK_EX_NR] {p. 8379}	EFF_SCC_AV {p. 6665}	FAC_EFF_IGA {p. 1845}
IGA_REF_COR_CBK [NC_CBK_EX_NR] {p. 8266}	LV_ACT_AJ {p. 8192}	LV_HOM_RUN {p. 8136}	LV_REQ_ISC {p. 3501}
LV_TQ_IGA_ENA {p. 8379}	TQI_REF {p. 8380}	TQI_SP_CAN {p. 8391}	TQI_SP_CBK [NC_CBK_EX_NR] {p. 8391}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EFF_IGA_THD_1	-	0... FFFFH	0... 1.99996	30.5e-6	-
Threshold ignition efficiency for deactivation spark retard					
C_EFF_IGA_THD_AJ	-	0... FFFFH	0... 1.99996	30.5e-6	-
Threshold on ignition efficiency for deactivation of spark retard in anti-jerk intervention					
C_EFF_IGA_THD_IS	-	0... FFFFH	0... 1.99996	30.5e-6	-
Threshold on ignition efficiency for deactivation of spark retard in idle speed					
C_TQ_IGA_INH	-	0... 2H	0 ...2	1	-
Constant inhibition TQ-intervention by spark retard (0..no inh, 1..Inh, 2..calculated old way)					
IP_IGA_DIF_SP_H_RNG	-	0... B40H	0... -180	-0.0625	°CRK
LDP_EFF_IGA_INV_COR_IP_IGA_DIF	16	0... 4E20H	0... 100	0.005	%
Setpoint spark retard for torque intervention					

**FUNCTION DESCRIPTION:****General information:**

For homogeneous ( $LV\_HOM\_RUN = 1$ ) the module ignition angle setpoint delivers IGA\_DIF\_SP\_H\_RNG as an output which depends on the torque setpoint TQI\_SP\_CBK[NC\_CBK\_EX\_NR]. For the calculation of the setpoint of ignition efficiency EFF\_IGA\_SP the actual cylinder fuel cut-off efficiency EFF\_SCC\_AV, the Exhaust Gas Re-circulation efficiency and the actual lambda efficiency EFF\_LAMB\_AV are considered which are multiplied with the reference torque value TQI\_REF.

By evaluation of the standardised ignition characteristic the spark retard value IGA\_DIF\_SP\_H\_RNG is calculated (*a negative value*) and will be applied on the reference ignition angle to define the ignition angle setpoint for torque interventions. In a system with variable valve lift the standardised ignition characteristic depends on the actual engine mode. Two modes are distinguished: load control via inlet valve lift and load control via the main throttle. To pay this different load controls attention the basic standardised ignition characteristic given by IP\_IGA\_DIF\_SP\_H\_RNG is corrected with engine mode depending factor FAC\_IGA\_DIF.

Hereafter, it is determined if a fast torque intervention request implies a spark retard for its application through the logical flag LV\_TQ\_IGA\_REQ.


If  $EFF\_IGA\_SP \geq EFF\_IGA\_BAS\_COR$  then no torque intervention is necessary and LV\_TQ\_IGA\_ACT is set to 0 since there is no spark retard requested by torque. In this case IGA\_DIF\_SP\_H\_RNG is set to the passive value which is the maximum value for difference ignition angle ( $=0$  °CRK). Then IGA\_DIF\_SP\_H\_RNG is not a limitation for the basic ignition angle in any case.

If  $EFF\_IGA\_SP < (EFF\_IGA\_BAS\_COR - \text{Threshold})$  then a significant spark retard resulting from a torque request has to be applied. For this LV\_TQ\_IGA\_REQ is set to 1.

The value of the Threshold used here depends on both if an anti-jerk intervention is activated and if the engine is in idle speed phase. In normal condition (*no anti-jerk nor idle speed*) the threshold is  $\text{Threshold} = C\_EFF\_IGA\_THD\_1$ . In case of Anti-Jerk intervention a specific threshold will be used ( $\text{Threshold}_1 = C\_EFF\_IGA\_THD\_AJ$ ); in idle speed also another specific threshold ( $\text{Threshold}_2 = C\_EFF\_IGA\_THD\_IS$ ) instead of the normal one. Finally, the minimal threshold between both preceding is retained to be applied ( $\text{Threshold} = \text{Min}(\text{Threshold}_1, \text{Threshold}_2)$ ).

IGA\_DIF\_SP\_H\_RNG is deduced from EFF\_IGA\_SP and is added (*negative value*) to the reference ignition angle to get the ignition angle setpoint for torque intervention.

The main reason for the existence of these two cases is to reduce ignition angle jitters if torque values are jittering (TQI\_SP\_CBK[NC\_CBK\_EX\_NR] and TQI\_REF). If no significant torque intervention is recognised then IGA\_DIF\_SP\_H\_RNG is set to the passive value 0°CRK. In this case the torque

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controlled ignition angle setpoint has definitely no impact any more to the applied ignition angle which is then only determined from the basic ignition angle and knock control.

This functionality allows choosing what parameter (*Ignition, Injection, ETC, etc...*) will be impacted first by a fast torque intervention and how this torque reduction request will be handled.

IGA\_SP\_CAN\_H\_RNG is calculated like IGA\_SP\_H\_RNG only with calculations depending on TQI\_SP\_CAN.

### **Application conditions:**

**Activation:** LV\_HOM\_RUN = 1  
**Deactivation:** LV\_HOM\_RUN = 0  
**Initialisation:** IGA\_SP\_CBK\_H\_RNG[NC\_CBK\_EX\_NR] = IGA\_SP\_H\_RNG = 60°CRK **and**  
 IGA\_SP\_CBK\_CAN\_H\_RNG[NC\_CBK\_EX\_NR] = IGA\_SP\_CAN\_H\_RNG = 60°CRK **and** LV\_  
**TQ\_IGA\_ACT = 0** at reset  
**Update Rate:** 10 ms

### **Formula section:**

```

IF          EFF_SCC_AV > 0
then       EFF_IGA_SP_CBK_1[NC_CBK_EX_NR]      = TQI_SP_CBK[NC_CBK_EX_NR] / (TQI_REF * EFF_SCC_AV * EFF_LAMB_AV_CBK[NC_CBK_EX_NR] )
else       EFF_IGA_SP_CBK_1[NC_CBK_EX_NR]      = TQI_SP_CBK[NC_CBK_EX_NR] / (TQI_REF * EFF_LAMB_AV_CBK[NC_CBK_EX_NR] )
endif
EFF_IGA_SP_CBK_1_CAN[NC_CBK_EX_NR]      = TQI_SP_CAN / (TQI_REF * EFF_SCC_AV * EFF_LAMB_AV_CBK[NC_CBK_EX_NR] )
  
```

*note: if division by 0 then set EFF\_IGA\_SP\_CBK\_1 to maximum Hexa value.*

```

EFF_IGA_SP_CBK[NC_CBK_EX_NR]=Min(EFF_IGA_SP_CBK_1[NC_CBK_EX_NR] , 1.0)
EFF_IGA_SP_CBK_CAN[NC_CBK_EX_NR]=Min(EFF_IGA_SP_CBK_1_CAN[NC_CBK_EX_NR] , 1.0)
  
```

*Those preliminary calculations have to be done all the time whatever should be the value of LV\_TQ\_IGA\_ACT.*

#### *Fast torque intervention request determination*

*Preliminary calculations for threshold:*

```

If          LV_ACT_AJ = 1
Then         Threshold_1 = C_EFF_IGA_THD_AJ
Else         Threshold_1 = C_EFF_IGA_THD_1
Endif
  
```

```

If          LV_REQ_ISC = 1
Then         Threshold_2 = C_EFF_IGA_THD_IS
Else         Threshold_2 = C_EFF_IGA_THD_1
Endif
  
```

```

And          Threshold = Min(Threshold_1,Threshold_2)
  
```


*Threshold, Threshold\_1, Threshold\_2 here are only an intermediate variable to clarify those choices on the Torque intervention.*

#### *Fast Torque Intervention request determination upon Threshold*

*(Reduction to a global variable instead of cylinder bank selective approach):*

```

If          (EFF_IGA_SP_CBK[CBK_1]<(EFF_IGA_BAS_COR_CBK[CBK_1] - Threshold) Or
              (EFF_IGA_SP_CBK[CBK_2]<(EFF_IGA_BAS_COR_CBK[CBK_2] - Threshold))
Then         LV_TQ_IGA_REQ = 1
Elseif       EFF_IGA_SP_CBK[CBK_1] >= EFF_IGA_BAS_COR_CBK[CBK_1]
Or
  
```

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```

EFF_IGA_SP_CBK[CBK_2] >= EFF_IGA_BAS_COR_CBK[CBK_2]
then          LV_TQ_IGA_REQ = 0
else          LV_TQ_IGA_REQn = LV_TQ_IGA_ACTn-1

```

**Endif**

//LV\_TQ\_IGA\_ACT determination:

```

if          C_TQ_IGA_INH = 0
Then       LV_TQ_IGA_ACT = LV_TQ_IGA_ENA
Else       if          C_TQ_IGA_INH = 1
              Then       LV_TQ_IGA_ACT = 0
              Else       if          LV_TQ_IGA_ENA = 1 and LV_TQ_IGA_REQ = 1
                            Then       LV_TQ_IGA_ACT = 1
                            Else       LV_TQ_IGA_ACT = 0
                            Endif
              Endif
Endif

```

**Endif**

Setpoint spark retard calculation (for visual purposes, [C]=[NC\_EX\_CBK\_NR] in the following concerning \_CBK\_ variables):

```

if          LV_TQ_IGA_ACT = 1
Then       EFF_IGA_INV_COR_CBK[C] = (100 - EFF_IGA_SP_CBK[C]*100) /FAC_EFF_IGA
              EFF_IGA_INV_COR_CBK_CAN[C] = (100 - EFF_IGA_SP_CBK_CAN[C]*100) /FAC_EFF_IGA

```

IGA

$$IGA\_DIF\_SP\_CBK\_H\_RNG[C] = IP\_IGA\_DIF\_SP\_H\_RNG(EFF\_IGA\_INV\_COR\_CBK[C])$$

$$IGA\_DIF\_SP\_CBK\_CAN\_H\_RNG[C] = IP\_IGA\_DIF\_SP\_H\_RNG(EFF\_IGA\_INV\_COR\_CBK\_CAN[C])$$

$$IGA\_SP\_CBK\_H\_RNG[C] = IGA\_REF\_COR\_CBK[C] + IGA\_DIF\_SP\_CBK\_H\_RNG[C]$$

$$IGA\_SP\_CBK\_CAN\_H\_RNG[C] = IGA\_REF\_COR\_CBK[C] + IGA\_DIF\_SP\_CBK\_CAN\_H\_RNG[C]$$

```

Else       IGA_SP_CBK_H_RNG[C] = IGA_SP_CBK_CAN_H_RNG[C] = 60°CRK

```

**Endif**

#### Calculation of Arithmetic Mean Values:

$$IGA\_SP\_H\_RNG = \text{mean}(IGA\_SP\_CBK\_H\_RNG[C])$$

$$IGA\_DIF\_SP\_H\_RNG = \text{mean}(IGA\_DIF\_SP\_CBK\_H\_RNG[C])$$

$$IGA\_SP\_CAN\_H\_RNG = \text{mean}(IGA\_SP\_CBK\_CAN\_H\_RNG[C])$$

$$IGA\_DIF\_SP\_CAN\_H\_RNG = \text{mean}(IGA\_DIF\_SP\_CBK\_CAN\_H\_RNG[C])$$

## 6.16 Knock control (Appl. Inc.)


### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_0_KNK_PRE_DET [NC_NR_FRF_KNK_PRE]	V/S	0... FFH	0... 255	1	-
Freeze frame for number of pre window events when pre-ignition is detected					
CTR_1_KNK_PRE_DET [NC_NR_FRF_KNK_PRE]	V/S	0... FFH	0... 255	1	-
Freeze frame for number of main window events when pre-ignition is detected					
CTR_IGA_DIF_MAX_KNK [NC_CYL_NR]	V/S	0... FFH	0... 255	1	-
Counter for number of occurred excursion limit events (cylinder individual)					
CTR_TOT_KNK_PRE_DET [NC_CYL_NR]	V/S	0... FFH	0... 255	1	-
Counter for total number of occurred pre-ignition detections (cylinder individual)					
CYL_ID_IGA_DIF_MAX_KNK [NC_NR_FRF_KNK_RTD]	V/S	0... FFH	0... 255	1	-
Freeze frame for knocking cylinder identification when excursion limit event occurs					
CYL_ID_KNK_PRE_DET [NC_NR_FRF_KNK_PRE]	V/S	0... FFH	0... 255	1	-
Freeze frame for cylinder identification where pre-ignition is detected					
KNK_CTL_DIS	O/V	0... 1H	0 ...1	1	-
knock control disabled due to malfunctions					
MAF_IGA_DIF_MAX_KNK [NC_NR_FRF_KNK_RTD]	V/S	0... FFH	0... 1389	5.4470588	mg/stk
Freeze frame for mass air flow when excursion limit event occurs					
MAF_KNK_PRE_DET [NC_NR_FRF_KNK_PRE]	V/S	0... FFH	0... 1389	5.4470588	mg/stk
Freeze frame for mass air flow when pre-ignition is detected					
N_IGA_DIF_MAX_KNK [NC_NR_FRF_KNK_RTD]	V/S	0... FFH	0... 8160	32	rpm
Freeze frame for engine speed when excursion limit event occurs					
N_KNK_PRE_DET [NC_NR_FRF_KNK_PRE]	V/S	0... FFH	0... 8160	32	rpm
Freeze frame for engine speed when pre-ignition is detected					
TCO_IGA_DIF_MAX_KNK [NC_NR_FRF_KNK_RTD]	V/S	0... FEH	-48... 142.5	0.75	°C
Freeze frame for coolant temperature when excursion limit event occurs					
TIA_IGA_DIF_MAX_KNK [NC_NR_FRF_KNK_RTD]	V/S	0... FEH	-48... 142.5	0.75	°C
Freeze frame for temperatur of injected air when excursion limit event occurs					

### Input data:

CTR_KNK_PRE_DET_0 [NC_CYL_NR] {p. 1960}	CTR_KNK_PRE_DET_1 [NC_CYL_NR] {p. 1960}	CYL_ID_KNK {p. 1960}	IGA [NC_CYL_NR] {p. 1828}
IGA_ADJ_KNK [NC_CYL_NR] {p. 1960}	IGA_KNK [NC_CYL_NR] {p. 1960}	KNKS [NC_CYL_NR] {p. 849}	LC_AD_CLR_RON {p. 527}
LV_ERR_CRK {p. 4455}	LV_ERR_KNKs [NC_NR_SENS_KNK] {p. 4903}	LV_ERR_SPI_KNK {p. 4245}	LV_ES {p. 1720}

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LV_IGA_DIF_MAX_KNK {p. 1961}	LV_IGK {p. 906}	LV_KNK {p. 1961}	LV_KNK_PRE_DET {p. 1962}
MAF {p. 8277}	MAF_HB {p. 805}	N {p. 1525}	N_32 {p. 1525}
NC_CYL_NR {p. 1526}	NL [NC_CYL_NR] {p. 1962}	SEG_NR {p. 1525}	TCO {p. 1100}
TIA {p. 1226}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_IGA_LGRD_3	-	0... 7FFFH	0... 47.99853	1.46e-3	°CRK
gradient limitation when underspending knock load threshold					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_FRF_KNK_PRE	-	0... FFH	1... 256	1	-
Number of freeze frame datasets for storing operation point and cylinder number for pre-ignition analysis					
NC_NR_FRF_KNK_RTD	-	0... FFH	1... 256	1	-
Number of freeze frame datasets for storing operation point and cylinder number for excursion limit analysis					

## 6.16.1 Inhibition of knock control

**General information:**

To activate the knock control, a macro function (KNK\_CTL\_DIS) is executed which checks if knock control is disabled due to malfunctions. If KNK\_CTL\_DIS = 0 the conditions are fulfilled and the knock control is enabled.

**Application conditions**

**Initialisation:**                   at reset **or** LV\_ES 0->1:  
**If**                   LV\_ERR\_CRK = 0 **and** LV\_ERR\_KNKS [NC\_NR\_SENS\_KNK] =  
0 **and** LV\_ERR\_SPI\_KNK = 0  
**Then**               KNK\_CTL\_DIS = 0

**Recurrence:**                   *every segment*

**Activation:**                   LV\_ES = 0


**Formula section:**

**If**                   LV\_ERR\_CRK = 1                   **or**  
                      LV\_ERR\_KNKS[NC\_NR\_SENS\_KNK] = 1                   **or**  
                      LV\_ERR\_SPI\_KNK = 1  
**Then**               KNK\_CTL\_DIS = 1  
**Endif**

## 6.16.2 Excursion Limit Analysis

**FUNCTION DESCRIPTION:**

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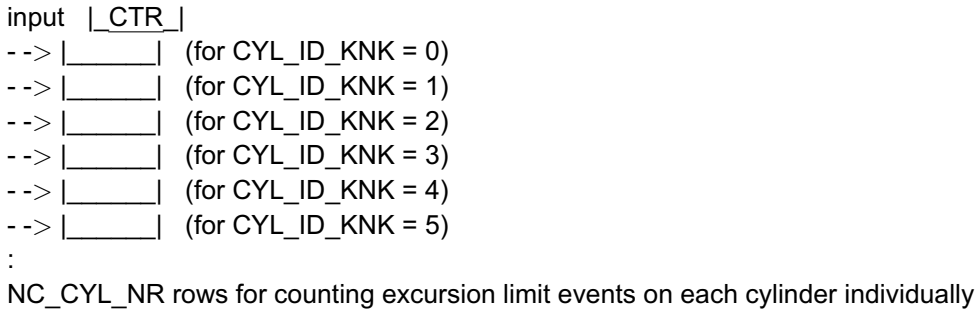
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**General information:**

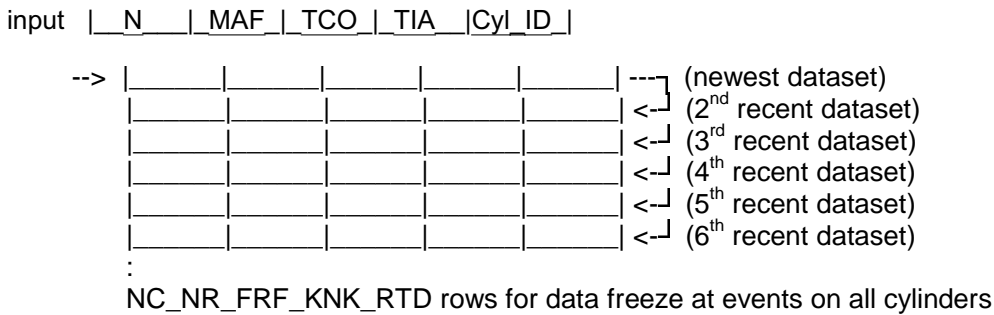
'Control Excursion Limit' in the 'Knock Control' module is used to limit the difference of the ignition adjustment angle through knock control of the single cylinders to a certain value. When a limitation on one cylinder is done, LV\_IGA\_DIF\_MAX\_KNK is set in order to give this information to the 'Excursion Limit Analysis' functionality. Here the values for the concerning cylinder and actual operation point are stored.

Graphical interpretation:

- Cylinder individual counter CTR\_IGA\_DIF\_MAX\_KNK[NC\_CYL\_NR]



- Frozen operation point data and id of concerning cylinder (shifting register with newest values on top position)  
 N\_IGA\_DIF\_MAX\_KNK[NC\_NR\_FRF\_KNK\_RTD],  
 MAF\_IGA\_DIF\_MAX\_KNK[NC\_NR\_FRF\_KNK\_RTD],  
 TCO\_IGA\_DIF\_MAX\_KNK[NC\_NR\_FRF\_KNK\_RTD],  
 TIA\_IGA\_DIF\_MAX\_KNK[NC\_NR\_FRF\_KNK\_RTD],  
 CYL\_ID\_IGA\_DIF\_MAX\_KNK[NC\_NR\_FRF\_KNK\_RTD]




**Application conditions**

**Initialisation:** *CTR\_IGA\_DIF\_MAX\_KNK[0 to NC\_CYL\_NR - 1],  
 N\_IGA\_DIF\_MAX\_KNK[0 to NC\_NR\_FRF\_KNK\_RTD - 1],  
 MAF\_IGA\_DIF\_MAX\_KNK[0 to NC\_NR\_FRF\_KNK\_RTD - 1],  
 TCO\_IGA\_DIF\_MAX\_KNK[0 to NC\_NR\_FRF\_KNK\_RTD - 1],  
 TIA\_IGA\_DIF\_MAX\_KNK[0 to NC\_NR\_FRF\_KNK\_RTD - 1],  
 CYL\_ID\_IGA\_DIF\_MAX\_KNK[0 to NC\_NR\_FRF\_KNK\_RTD - 1]  
 get values from E2PROM at reset*

**Recurrence:** *every segment*

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**Activation:** *at every engine state except engine stop*

**Deactivation:** *at engine stop*

**Formula section:**

Module has to be executed  
- after calculation of 'Control Excursion Limit' module  
- within the same SEG\_NR.

fix number of 'freeze frames' with respect to storage space:  
NC\_NR\_FRF\_KNK\_RTD = 10

cylinder individual counter for recognition of reaching excursion limit:

```

If      LV_IGA_DIF_MAX_KNK = 1 And CTR_IGA_DIF_MAX_KNK[CYL_ID_KNK]n < 255
Then    CTR_IGA_DIF_MAX_KNK[CYL_ID_KNK]n = CTR_IGA_DIF_MAX_KNK[CYL_ID_KNK]n-1
          + 1
Endif
    
```

overwriting old values in 'freeze frames': data are shifted, latest values are stored

```

If      LV_IGA_DIF_MAX_KNK = 1
Then    For      i = NC_NR_FRF_KNK_RTD - 1 To 1 Step -1
          N_IGA_DIF_MAX_KNK[i] = N_IGA_DIF_MAX_KNK[i-1]
          MAF_IGA_DIF_MAX_KNK[i] = MAF_IGA_DIF_MAX_KNK[i-1]
          TCO_IGA_DIF_MAX_KNK[i] = TCO_IGA_DIF_MAX_KNK[i-1]
          TIA_IGA_DIF_MAX_KNK[i] = TIA_IGA_DIF_MAX_KNK[i-1]
          CYL_ID_IGA_DIF_MAX_KNK[i] = CYL_ID_IGA_DIF_MAX_KNK[i-1]
          Next      i
          N_IGA_DIF_MAX_KNK[0] = N_32
          MAF_IGA_DIF_MAX_KNK[0] = MAF_HB
          TCO_IGA_DIF_MAX_KNK[0] = TCO
          TIA_IGA_DIF_MAX_KNK[0] = TIA
          CYL_ID_IGA_DIF_MAX_KNK[0] = CYL_ID_KNK
    
```

**Endif**

N.B.: i represents identification index of stored info data set  
(shifting in 'For' loop has not to be executed, if NC\_NR\_FRF\_KNK\_RTD = 1)  
(efficiency of CPU load could be optimized, if only 'filled' freeze frames are shifted)

**6.16.3 Pre-Ignition Analysis**


**FUNCTION DESCRIPTION:**

**General information:**

'Normal Operation Pre-Ignition' in the 'Knock Control' module is used to cut off injection of a single cylinder in case of pre-ignition detection. LV\_KNK\_PRE\_DET is set and gives this information to the 'Pre-Ignition Analysis' functionality. Here the values for the concerning cylinder and actual operation point are stored. Also the number of pre window (CTR\_0\_...) and main window (CTR\_1...) events when pre-ignition is detected is monitored.

Graphical interpretation:

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- Cylinder individual counter CTR\_TOT\_KNK\_PRE\_DET[NC\_CYL\_NR]

input |\_CTR\_|

- > |\_\_\_\_\_| (for CYL\_ID\_KNK = 0)
- > |\_\_\_\_\_| (for CYL\_ID\_KNK = 1)
- > |\_\_\_\_\_| (for CYL\_ID\_KNK = 2)
- > |\_\_\_\_\_| (for CYL\_ID\_KNK = 3)
- > |\_\_\_\_\_| (for CYL\_ID\_KNK = 4)
- > |\_\_\_\_\_| (for CYL\_ID\_KNK = 5)

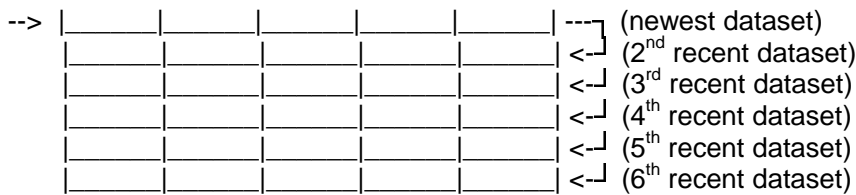
:

NC\_CYL\_NR rows for counting total number of occurred pre-ignition detections on each cylinder individually

- Frozen operation point data and id of concerning cylinder (shifting register with newest values on top position)

- N\_KNK\_PRE\_DET[NC\_NR\_FRF\_KNK\_PRE],
- MAF\_KNK\_PRE\_DET[NC\_NR\_FRF\_KNK\_PRE],
- CTR\_0\_KNK\_PRE\_DET[NC\_NR\_FRF\_KNK\_PRE],
- CTR\_1\_KNK\_PRE\_DET[NC\_NR\_FRF\_KNK\_PRE],
- CYL\_ID\_KNK\_PRE\_DET[NC\_NR\_FRF\_KNK\_PRE]

input |\_N\_| |MAF\_| |CTR 0| |CTR 1| |Cyl\_ID|



NC\_NR\_FRF\_KNK\_PRE rows for data freeze at events on all cylinders

### Application conditions

**Initialisation:**

*CTR\_TOT\_KNK\_PRE\_DET[0 to NC\_CYL\_NR - 1],  
N\_KNK\_PRE\_DET[0 to NC\_NR\_FRF\_KNK\_PRE - 1],  
MAF\_KNK\_PRE\_DET[0 to NC\_NR\_FRF\_KNK\_PRE - 1],  
CTR\_0\_KNK\_PRE\_DET[0 to NC\_NR\_FRF\_KNK\_PRE - 1],  
CTR\_1\_KNK\_PRE\_DET[0 to NC\_NR\_FRF\_KNK\_PRE - 1],  
CYL\_ID\_KNK\_PRE\_DET[0 to NC\_NR\_FRF\_KNK\_PRE - 1]  
get values from E2PROM at reset*

**Recurrence:**

*every segment*

**Activation:**

*at every engine state except engine stop*

**Deactivation:**


*at engine stop*

### Formula section:

Module has to be executed

- after calculation of 'Normal Operation Pre-Ignition' module

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- within the same SEG\_NR.

fix number of 'freeze frames' with respect to storage space:  
NC\_NR\_FRF\_KNK\_PRE = 50

cylinder individual counter for total number of occurred pre-ignition detections:

```

If      LV_KNK_PRE_DET = 1 And CTR_TOT_KNK_PRE_DET[CYL_ID_KNK]n < 255
Then    CTR_TOT_KNK_PRE_DET[CYL_ID_KNK]n = CTR_TOT_KNK_PRE_DET[CYL_ID_KNK]n-1
          + 1
Endif
    
```

overwriting old values in 'freeze frames': data are shifted, latest values are stored

```

If      LV_KNK_PRE_DET = 1
Then    For      i = NC_NR_FRF_KNK_PRE - 1 To 1 Step -1
          N_KNK_PRE_DET[i] = N_KNK_PRE_DET[i-1]
          MAF_KNK_PRE_DET[i] = MAF_KNK_PRE_DET[i-1]
          CTR_0_KNK_PRE_DET[i] = CTR_0_KNK_PRE_DET[i-1]
          CTR_1_KNK_PRE_DET[i] = CTR_1_KNK_PRE_DET[i-1]
          CYL_ID_KNK_PRE_DET[i] = CYL_ID_KNK_PRE_DET[i-1]
          Next    i
          N_KNK_PRE_DET[0] = N_32
          MAF_KNK_PRE_DET[0] = MAF_HB
          CTR_0_KNK_PRE_DET[0] = CTR_KNK_PRE_DET_0[CYL_ID_KNK]
          CTR_1_KNK_PRE_DET[0] = CTR_KNK_PRE_DET_1[CYL_ID_KNK]
          CYL_ID_KNK_PRE_DET[0] = CYL_ID_KNK
Endif
    
```

N.B.: i represents identification index of stored info data set  
(shifting in 'For' loop has not to be executed, if NC\_NR\_FRF\_KNK\_PRE = 1)  
(efficiency of CPU load could be optimized, if only 'filled' freeze frames are shifted)

## 6.16.4 Knock Control Measurement CAN-Interface

### General information:

This chapter is used as interface between the variables on the local CAN bus of the knock control measurement with CAN-interface and the system variables.

The process is as followed:

- a.) start the output of systemvalues
- b.) output of the systemvalue
- c.) stop the output of systemvalues

### 6.16.4.1 CAN Protocol


#### Description:

The following control units participate to CAN-communication:

DME: Engine management system  
IAV: Measurement equipment from BMW

Baudrate: 500 kBaud

The IAV sends for starting its measurement values on CAN Messages the ID = **700H**.

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The DME sends its measurement concerning the IAV interface on CAN Messages with the ID = **701H and 702H**.

The IAV sends for stopping its measurement values on CAN Messages the ID = **70AH**.

### 6.16.4.2 Send messages by DME ID 701H and ID702H

#### ID 701H

Byte No.	Signal Name supplier	Byte Name Of Customer	Bit No.	Bit Name of Customer	Function Description
0	SEG_NR		0 - 7		segment number
1	CYL_ID_KNK		0 - 7		cylinder identification number
2	KNKS[NC_CYL_NR] (low Byte)		0 - 7		knock value
3	KNKS[NC_CYL_NR] (high Byte)		0 - 7		knock value
4	NL[NC_CYL_NR] (low Byte)		0 - 7		noise level
5	NL[NC_CYL_NR] (high Byte)		0 - 7		noise level
6	IGA[NC_CYL_NR]		0 - 7		ignition of cylinder x
7	IGA_KNK[NC_CYL_NR]		0 - 7		knock ignition value

#### ID 702H

Byte No.	Signal Name supplier	Byte Name Of Customer	Bit No.	Bit Name of Customer	Function Description
0	SEG_NR		0 - 7		segment number
1	LV_KNK		0 - 7		state of knock control
2	IGA_ADJ_KNK[NC_CYL_NR]		0 - 7		jerk ignition of knock control
3	FF		0 - 7		dummy value fix
4	N (low Byte)		0 - 7		engine speed
5	N (high Byte)		0 - 7		engine speed
6	MAF (low Byte)		0 - 7		mass air flow
7	MAF (high Byte)		0 - 7		mass air flow

### Application conditions

**Initialisation:**

**Recurrence:** *segment synchronous*

**Activation:** *LV\_IGK = 1*

The resolution and the Hex-limits for the values within the message is equal to the defined system quantity.

### 6.16.4.3 Received messages by the DME ID 700H and ID70AH

#### General information:

This message starts or stops the data transfer from the ECU to the IAV.

### Application conditions

**Recurrence:** *10 ms*

**Activation:**                   LV\_IGK = 1  
                                       ID 700H

Byte No.	Signal Name supplier	Byte Name Of Customer	Bit No.	Bit Name of Customer	Function Description

### ID 70AH

Byte No.	Signal Name supplier	Byte Name Of Customer	Bit No.	Bit Name of Customer	Function Description

## 6.17 Knock control

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_KNK_CMB	V	0... FFH	0... 255	1	-
Counter to disable KNK control after combustion mode switch					
CTR_KNK_PRE_DET [NC_CYL_NR]	V	0... FFFFH	0... 65535	1	-
Detection counter for evaluated knock and pre-ignition events					
CTR_KNK_PRE_DET_0 [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
Number of pre window events for pre-ignition detection					
CTR_KNK_PRE_DET_1 [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
Number of main window events for pre-ignition detection					
CTR_KNK_PRE_DET_NR [NC_CYL_NR]	V	0... FFH	0... 255	1	-
Counter for number of occurred pre-ignition detections in actual driving cycle					
CYCNR_INH_IV_KNK_PRE_DET [NC_CYL_NR]	V	0... FFH	0... 255	1	-
Cycle counter for duration of injection shut off by pre-ignition detection					
CYCNR_KNK_PRE_DET	V	0... FFFFH	0... 65535	1	-
Cycle counter for observation period pre-ignition					
CYL_ID_KNK	O/V	0... FFH	0... 255	1	-
Cylinder number for knock control					
FAC_IGA_MAX_KNK	V	0... FFH	0... 0.99609	3.9063e-3	-
Weighting factor for the max. spark retard against coolant					
IGA_ADJ_KNK [NC_CYL_NR]	O/V	0... 80H	-48 ...0	0.375	°CRK
Total spark retard through knock control with adaptation (cylinder individual)					
IGA_ADJ_MAX_KNK	V	0... FFH	-35.625 ...60	0.375	°CRK
Total spark retard through knock control including adaptation (cylinder individual)					
IGA_DEC_KNK	-	1... 7FH	0.375... 47.625	0.375	°CRK/cyc
Spark retard at recognised knocking					
IGA_KNK [NC_CYL_NR]	O/V	0... 80H	-48 ...0	0.375	°CRK
Spark retard due to knocking combustion					
IGA_KNK_BAS [NC_CYL_NR]	-	0... 80H	-48 ...0	0.375	°CRK
Spark retard through knock control prior adaptation (cylinder individual)					
IGA_MV_ADJ_KNK	O/V	0... 80H	-48 ...0	0.375	°CRK
Meanvalue of actual retard adjustment with adaptation values					
IGA_MV_CBK_ADJ_KNK [NC_CBK_EX_NR]	O/V	0... 80H	-48 ...0	0.375	°CRK
Meanvalue of actual retard adjustment with adaptation values bank selective					
IGA_MV_KNK	V	0... 80H	-48 ...0	0.375	°CRK
Mean value of actual retard adjustment without adaptation values					
INH_IV_KNK	O/V	0... FFH	0... 255	1	-
Ignition shut off pattern from knock control pre-ignition					
KNK_AD_SF [NC_CYL_NR]	-	0... 1H	0 ...1	1	-
Flag for transition from passive to active					
KNK_THD [NC_CYL_NR]	V	0... FFH	0... 4.98046	0.0195313	V
Knock Threshold cylinder x					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
KNK_THD_MAX	V	0... FFH	0... 4.998	0.0195313	V
Maximum knock threshold in main window					
KNK_THD_PRE	V	0... FFH	0... 4.998	0.0195313	V
Knock Threshold cylinder x in pre-window					
KNKS_1_DIAG	O	0... FFH	0... 255	1	-
Assignment of cylinder number to knock sensor 1 (diagnosis only)					
KNKS_2_DIAG	O	0... FFH	0... 255	1	-
Assignment of cylinder number to knock sensor 2 (diagnosis only)					
KNKS_CMD_CONF [NC_CYL_NR]	O	0... FFH	0... 255	1	-
Configuration value for the analogue channel of knock sensor					
KNKS_CMD_FIL [NC_CYL_NR]	O/V	0... 3FH	0... 63	1	-
Knock Filter Frequency and Reference Filter Frequency Cyl.x					
KNKS_CMD_FIL_PRE [NC_CYL_NR]	O/V	0... 3FH	0... 63	1	-
Knock Filter Frequency and Reference Filter Frequency Cyl.x					
KNKS_CMD_GAIN [NC_CYL_NR]	O/V	0... 3FH	0... 63	1	-
Amplification precontrol Cyl.x					
KNKS_CMD_GAIN_PRE [NC_CYL_NR]	O/V	0... 3FH	0... 63	1	-
Amplification precontrol Cyl.x					
KNKS_CMD_INT [NC_CYL_NR]	O/V	0... 1FH	0... 31	1	-
Integration Time Constant Cyl.x					
KNKS_CMD_INT_PRE [NC_CYL_NR]	O/V	0... 1FH	0... 31	1	-
Integration Time Constant Cyl.x					
KNKWB [NC_CYL_NR]	O/V	0... FFH	0... 95.625	0.375	°CRK
Beginning of Measurement Window Cyl.x					
KNKWB_PRE [NC_CYL_NR]	O/V	0... FFH	0... 95.625	0.375	°CRK
Beginning of Measurement Window Cyl.x first window					
KNKWE [NC_CYL_NR]	O/V	0... FFH	0... 95.625	0.375	°CRK
End of Measurement Window Cyl.x					
KNKWE_PRE [NC_CYL_NR]	O/V	0... FFH	0... 95.625	0.375	°CRK
End of Measurement Window Cyl.x first window					
LV_CTR_KNK_CMB	V	0... 1H	0 ...1	1	-
Logical variable to enable counter after combustion mode change					
LV_IGA_DIF_MAX_KNK	O/V	0... 1H	0 ...1	1	-
Indicator for excursion limit analysis (knock ignition angle of one cylinder is at maximum deviation limit from mean value)					
LV_KNK	O/V	0... 1H	0 ...1	1	-
Logical variable for recognition of knock					
LV_KNK_CTL_ENA	O/V	0... 1H	0 ...1	1	-
Boolean for knock control enabled					
LV_KNK_CTL_PRE_ENA	O/V	0... 1H	0 ...1	1	-
Boolean for knock control pre-ignition enabled					
LV_KNK_CTL_PRE_INH	V	0... 1H	0 ...1	1	-
Logical variable for complete inhibition of knock control pre-ignition					
LV_KNK_MAX	V	0... 1H	0 ...1	1	-
Logical variable for recognition of knock above maximum threshold					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_KNK_PAS_TRAN_ACT	-	0... 1H	0 ...1	1	-
Transition for knock control passive to active					
LV_KNK_PRE	V	0... 1H	0 ...1	1	-
Logical variable for recognition of knock in first window					
LV_KNK_PRE_DET	O/V	0... 1H	0 ...1	1	-
Logical variable for pre-ignition recognition by algorithm					
LV_KNK_TRA_MAF	V	0... 1H	0 ...1	1	-
Logical variable for Load Dynamic Function active or passive					
LV_KNK_TRA_N	V	0... 1H	0 ...1	1	-
Logical variable for Engine Speed Dynamic Function active or passive					
LV_KNKWE_PRE_GAP	V	0... 1H	0 ...1	1	-
Boolean for indication of pre-window restriction, caused by hardware required gap for save operation					
MAF_KNK	O/V	0... FFH	0... 1389	5.4470588	mg/stk
Mass air flow with hysteresis					
N_KNK	V	0... FFH	0... 8160	32	rpm
Engine speed with hysteresis					
NL [NC_CYL_NR]	O/V	0... FFFFH	0... 4.99992	76.3e-6	V
Floating mean value of the noise signal					
STATE_CMB_CTL_KNK	V	0... 8H	0 ...8	1	-
States of the combustion management to be saved for further use					
STATE_CMB_CTL_TMP	V	0H	HOM_AFS	-	-
		1H	AFS_TO_AFL		
		2H	HOM_AFL		
		3H	AFL_TO_AFS		
		4H	HOM_TO_		
		5H	HOMS		
		6H	BACKS		
		7H	S		
		8H	S_TO_HOMS		
9H	BACKHOM				
States of the combustion management					

**Input data:**

C_IGA_LGRD_3 {p. 1953}	IGA_CH {p. 798}	IGA_WOUT_KNK [NC_CYL_NR] {p. 1828}	KNK_CTL_DIS {p. 1952}
KNKS [NC_CYL_NR] {p. 849}	KNKS_PRE [NC_CYL_NR] {p. 849}	LV_CH {p. 8232}	LV_ERR_KNKS [NC_NR_SENS_KNK] {p. 4903}
LV_ES {p. 1720}	LV_FL {p. 1759}	LV_HOM_ACT {p. 8136}	LV_IGA_TRA_KNK {p. 8304}
LV_IGK {p. 906}	LV_ST {p. 1720}	MAF {p. 8277}	MFF_SP_MV {p. 2151}
N_32 {p. 1525}	N_GRD {p. 1525}	NC_KNKS_CONF {p. 1967}	OPM_AV {p. 8137}
SEG_NR {p. 1525}	TCO {p. 1100}		


**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CYCNR_KNK_PRE_DET_RST	-	0... FFFFH	0... 65535	1	-
Reset threshold for observation period pre-ignition cycle counter					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_KNK_TRA	-	0... FFH	0... 1.99218	0.0078125	-
Factor for weighted KNKS consideration at knocking in transient condition					
C_FAC_TRA_KNK	-	0... FFH	0... 7.96875	0.03125	-
correction factor for load dynamic active					
C_FIL_FRQ_KNK_AFL [NC_CYL_NR]	-	0... 3FH	0... 63	1	-
Knock Filter Frequency and Reference Filter Frequency Cyl.x in AFL or S					
C_IGA_DIF_MIN_MAX_KNK	-	0... 80H	-48 ...0	0.375	°CRK
Control excursion limit valid for spark advance and spark retard					
C_INC_CTR_KNK_PRE_DET_0_1	-	0... FFH	0... 255	1	-
Increment for knock detection in normal knock window					
C_INC_CTR_KNK_PRE_DET_1_0	-	0... FFH	0... 255	1	-
Increment for knock detection in knock pre-window					
C_INC_CTR_KNK_PRE_DET_1_1	-	0... FFH	0... 255	1	-
Increment for knock detection in normal and knock pre-window					
C_ITC_KNK_AFL [NC_CYL_NR]	-	0... 1FH	0... 31	1	-
Integration Time Constant Cyl.x in AFL or S					
C_KNK_THD_MAX	-	0... FFH	0... 4.998	0.0195313	V
Maximum knock threshold					
C_KNKS_1_DIAG	-	0... FFH	0... 255	1	-
Assignment of cylinder number to knock sensor 1 (diagnosis only)					
C_KNKS_2_DIAG	-	0... FFH	0... 255	1	-
Assignment of cylinder number to knock sensor 2 (diagnosis only)					
C_MAF_IGA_HYS_KNK	-	0... FFH	0... 1389	5.45	mg/stk
Air-Mass Hysteresis for Knock Control					
C_N_IGA_HYS_KNK	-	0... FFH	0... 8160	32	rpm
Speed Hysteresis for Knock Control					
C_N_KNK_CTL_PRE_INH	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for complete inhibition of knock control pre-ignition					
C_NL_CRLC_CMB	-	0... FFH	0... 0.99609	3.9063e-3	-
Averaging Constant for Noise Value Calculation at HOM_AFS combustion					
C_NL_CRLC_TRA	-	0... FFH	0... 0.99609	3.9063e-3	-
Averaging Constant for Noise Value Calculation for Transient Case					
C_NL_CRLC_TRA_AFL	-	0... FFH	0... 0.99609	3.9063e-3	-
Averaging Constant for Noise Value Calculation for Transient Case at AFL or S combustion					
C_NL_MIN	-	0... FFH	0... 4.998	19.5e-3	V
Minimum noise value					
ID_CTR_KNK_CMB	-	0... FFH	0... 255	1	-

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_STATE_CMB_CTL_KNK	0	0H 1H 2H 3H 4H 5H 6H 7H 8H	HOM_AFS AFS_TO_AFL HOM_AFL AFL_TO_AFS HOM_TO_S BACKS S S_TO_HOM BACKHOM	-	-
Counter to disable KNK control after combustion mode switch					
ID_CYCNR_FAC_TRA_KNK__N	-	0... FFH	0... 255	1	seg
LDPM_N_6_4	4	0... FFH	0... 8160	32	rpm
Cycle counter during which the Load Dynamic Function stays active after triggering					
ID_FIL_FRQ_KNK [NC_CYL_NR]	-	0... 3FH	0... 63	1	-
LDPM_N_FIL_FRQ_KNK	4	0... FFH	0... 8160	32	rpm
Knock Filter Frequency and Reference Filter Frequency Cyl.x					
ID_FIL_FRQ_KNK_PRE [NC_CYL_NR]	-	0... 3FH	0... 63	1	-
LDPM_N_FIL_FRQ_KNK	4	0... FFH	0... 8160	32	rpm
Knock Filter Frequency and Reference Filter Frequency Cyl.x previous					
ID_IGA_DEC_KNK_1__N	-	1... 7FH	0.375... 47.625	0.375	°CRK/cyc
LDPM_N_4_9	3	0... FFH	0... 8160	32	rpm
Spark retard at recognised knocking, Intensity 1					
ID_IGA_DEC_KNK_2__N	-	1... 7FH	0.375... 47.625	0.375	°CRK/cyc
LDPM_N_4_9	3	0... FFH	0... 8160	32	rpm
Spark retard at recognised knocking, Intensity 2					
ID_IGA_DEC_KNK_AFL_1__N	-	1... 7FH	0.375... 47.625	0.375	-
LDPM_N_4_9	3	0... FFH	0... 8160	32	rpm
Spark retard at recognised knocking, Intensity 1 in AFL or S					
ID_IGA_DEC_KNK_AFL_2__N	-	1... 7FH	0.375... 47.625	0.375	-
LDPM_N_4_9	3	0... FFH	0... 8160	32	rpm
Spark retard at recognised knocking, Intensity 2 in AFL or S					
ID_ITC_KNK [NC_CYL_NR]	V	0... 1FH	0... 31	1	-
LDPM_N_2_9	16	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_9	4	0... FFH	0... 1389	5.45	mg/stk
Integration Time Constant Cyl.x					
ID_ITC_KNK_PRE [NC_CYL_NR]	V	0... 1FH	0... 31	1	-
LDPM_N_2_9	16	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_9	4	0... FFH	0... 1389	5.45	mg/stk
Integration Time Constant Cyl.x previous					
ID_KNK_THD_MAX_PRE	-	0... FFH	0... 4.998	0.0195313	V
LDPM_N_KNK_THD_MAX	6	0... FFH	0... 8160	32	rpm
Maximum knock threshold pre-window					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_N_GRD_MAX_KNK_N	-	0... 7FH	0... 4064	32	rpm/s
LDPM_N_IGA_AD	8	0... FFH	0... 8160	32	rpm
Speed Gradient for dynamic identification					
ID_NL_CRLC	-	0... FFH	0... 0.99609	3.9063e-3	-
LDP_N_KNK_NL_CRLC	4	0... FFH	0... 8160	32	rpm
Averaging Constant for Noise Value Calculation					
IP_CTR_KNK_PRE_DET_THD	-	0... FFFFH	0... 65535	1	-
LDP_N_CTR_KNK_PRE_DET	6	0... FFH	0... 8160	32	rpm
Threshold for evaluated pre-ignition detection counter					
IP_CYCNR_INH_IV_KNK_PRE_DET	V	0... FFH	0... 255	1	-
LDP_N_CTR_KNK_PRE_DET_NR	4	0... FFH	0... 8160	32	rpm
LDP_CTR_KNK_PRE_DET_NR	4	0... FFH	0... 255	1	-
Cycle number of injection shut off duration by pre-ignition detection					
IP_FAC_IGA_MAX_KNK_TCO_TIA	V	0... FFH	0... 0.99609	3.9063e-3	-
LDP_TCO_FAC_IGA_TCO_KNK	4	0... FEH	-48... 142.5	0.75	°C
LDP_TIA_FAC_IGA_TIA_KNK	4	0... FEH	-48... 142.5	0.75	°C
Weighting factor for the max. spark retard against coolant					
IP_FAC_NL_UPD_DEAC	-	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_N_2_9	16	0... FFH	0... 8160	32	rpm
Factor on KNK_THD for comparison with KNKS to deactivate an update of NL values					
IP_FAC_THD_KNK [NC_CYL_NR]	V	0... FFH	0... 7.96875	0.03125	-
LDPM_N_2_9c	16	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_9	4	0... FFH	0... 1389	5.45	mg/stk
Knock Factor Table Cyl. X					
IP_FAC_THD_KNK_AFL [NC_CYL_NR]	V	0... FFH	0... 7.96875	0.03125	-
LDPM_N_2_9	16	0... FFH	0... 8160	32	rpm
LDPM_MFF_1_9	4	0... FFFFH	0... 1389	0.0211948	mg/stk
Knock Factor Table Cyl. X in AFL or S					
IP_GAIN_KNK [NC_CYL_NR]	V	0... 3FH	0... 63	1	-
LDPM_N_2_9	16	0... FFH	0... 8160	32	rpm
LDPM_MAF_GAIN_KNK	12	0... FFH	0... 1389	5.4470588	mg/stk
Amplification precontrol Cyl.x					
IP_GAIN_KNK_AFL [NC_CYL_NR]	V	0... 3FH	0... 63	1	-
LDPM_N_2_9	16	0... FFH	0... 8160	32	rpm
LDPM_MFF_1_9	4	0... FFFFH	0... 1389	0.0211948	mg/stk
Amplification precontrol Cyl.x in AFL or S					
IP_GAIN_KNK_PRE [NC_CYL_NR]	V	0... 3FH	0... 63	1	-
LDPM_N_2_9	16	0... FFH	0... 8160	32	rpm
LDPM_MAF_GAIN_KNK	12	0... FFH	0... 1389	5.4470588	mg/stk
Amplification precontrol Cyl.x previous					
IP_IGA_BAS_MAX_KNK_N_MAF	V	0... FFH	-35.625 ...60	0.375	°CRK
LDPM_N_IGA_MAX_KNK	8	0... FFH	0... 8160	32	rpm


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_MAF_IGA_MAX_KNK	8	0... FFH	0... 1389	5.4470588	mg/stk
Maximum value for spark retard					
IP_IGA_BAS_MAX_KNK_ERR_N_MAF	V	0... FFH	-35.625 ...60	0.375	°CRK
LDPM_N_IGA_MAX_KNK	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_IGA_MAX_KNK	8	0... FFH	0... 1389	5.4470588	mg/stk
Maximum value for spark retard in case of KNK sensor error					
IP_IGA_INC_KNK__N	-	1... 7FFFH	0.00146... 47.99853	1.4648e-3	°CRK/cyc
LDPM_N_6_4	4	0... FFH	0... 8160	32	rpm
Re-set Increment KNK					
IP_IGA_OFS_MAX_KNK__N_MAF	V	0... FFH	-48... 47.625	0.375	°CRK
LDPM_N_IGA_MAX_KNK	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_IGA_MAX_KNK	8	0... FFH	0... 1389	5.4470588	mg/stk
Maximum value for spark retard					
IP_KNK_THD_ADD_N	-	0... FFH	-2.56 ...2.54	0.02	V
LDPM_N_2_9	16	0... FFH	0... 8160	32	rpm
Knock summand					
IP_KNK_THD_ADD_N_AFL	-	0... FFH	-2.56 ...2.54	0.02	V
LDPM_N_2_9	16	0... FFH	0... 8160	32	rpm
Knock summand in AFL or S					
IP_KNK_THD_MAX	V	0... FFH	0... 4.998	0.0195313	V
LDPM_N_KNK_THD_MAX	6	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_9	4	0... FFH	0... 1389	5.4470588	mg/stk
Maximum knock threshold					
IP_KNKWB [NC_CYL_NR]	V	0... FFH	0... 95.625	0.375	°CRK
LDPM_N_KNKWB	10	0... FFH	0... 8160	32	rpm
LDPM_MAF_KNKWB	4	0... FFH	0... 1389	5.4470588	mg/stk
Beginning of Measurement Window Cyl.x					
IP_KNKWB_AFL	V	0... FFH	0... 95.625	0.375	°CRK
LDPM_N_KNKWB	10	0... FFH	0... 8160	32	rpm
LDPM_MFF_1_9	4	0... FFFFH	0... 1389	0.0211948	mg/stk
Beginning of Measurement Window for all Cyl. in AFL or S					
IP_KNKWB_PRE [NC_CYL_NR]	V	0... FFH	0... 95.625	0.375	°CRK
LDPM_N_KNKWB	10	0... FFH	0... 8160	32	rpm
LDPM_MAF_KNKWB	4	0... FFH	0... 1389	5.4470588	mg/stk
Beginning of Measurement Window Cyl.x previous					
IP_KNKWE [NC_CYL_NR]	V	0... FFH	0... 95.625	0.375	°CRK
LDPM_N_KNKWB	10	0... FFH	0... 8160	32	rpm
LDPM_MAF_KNKWB	4	0... FFH	0... 1389	5.4470588	mg/stk
End of Measurement Window Cyl.x					
IP_KNKWE_AFL	V	0... FFH	0... 95.625	0.375	°CRK
LDPM_N_KNKWB	10	0... FFH	0... 8160	32	rpm

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_MFF_1_9	4	0... FFFFH	0... 1389	0.0211948	mg/stk
End of Measurement Window for all Cyl. in AFL or S					
IP_KNKWE_PRE [NC_CYL_NR]	V	0... FFH	0... 95.625	0.375	°CRK
LDPM_N_KNKWB	10	0... FFH	0... 8160	32	rpm
LDPM_MAF_KNKWB	4	0... FFH	0... 1389	5.4470588	mg/stk
End of Measurement Window Cyl.x previous					
IP_KNKWE_PRE_GAP	-	0... FFH	0... 95.625	0.375	°CRK
LDP_N_KNKWE_PRE_GAP	4	0... FFH	0... 8160	32	rpm
Gap restricting Knock Pre-Window for save IC operation					
IP_MAF_MIN_KNK_N_TCO	V	0... FFH	0... 1389	5.45	mg/stk
LDPM_N_3_9	8	0... FFH	0... 8160	32	rpm
LDP_TCO__MAF_MIN_KNK	4	0... FEH	-48... 142.5	0.75	°C
Air-mass Threshold Release KNK					
IP_MAF_MIN_KNK_PRE	-	0... FFH	0... 1389	5.4470588	mg/stk
LDPM_N_3_9	8	0... FFH	0... 8160	32	rpm
Air-mass Threshold Release KNK Pre-Ignition					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_KNKS_CONF	-	0... FFH	0... 255	1	-
Configuration value of analogue channel of knock sensor for all cylinders (eg. 6 cylinder: 00101010b)					
NC_KNKWB_INI	-	0... FFH	0... 95.625	0.375	°CRK
Beginning of Measurement Window Cyl.x					
NC_KNKWB_PRE_INI	-	0... FFH	0... 95.625	0.375	°CRK
Beginning of Measurement Pre-Window Cyl.x					
NC_KNKWE_INI	-	0... FFH	0... 95.625	0.375	°CRK
End of Measurement Window Cyl.x					
NC_KNKWE_PRE_INI	-	0... FFH	0... 95.625	0.375	°CRK
End of Measurement Pre-Window Cyl.x					

**Overview**

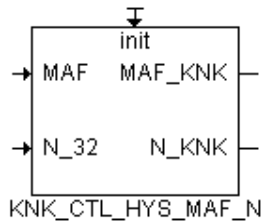
Released by <b>Tettenborn Frank</b>		Date <b>2013-02-13</b>	File <b>43601604.00C</b>
	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 1967 of 8404</b>	
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## 6.17.1 Pre-processing

### 6.17.1.1 Hysteresis Function for MAF and N\_32



#### General information:

Hysteresis functions for engine speed and air-mass changes are defined for the tables relevant for the knock control in order to avoid steps recognisable for the driver due to small changes of the operation point.

#### Application conditions

**Activation:** *at every engine state except engine stop*

**Deactivation:** *at engine stop*

**Initialization:** *MAF\_KNK = N\_KNK = 0 at reset and engine running to engine stop*

**Update Rate:** *every segment*

#### Formula section:


if  $|(N_{32} - N_{KNK})| \geq C_{N\_IGA\_HYS\_KNK}$   
 $N_{KNK} = N_{32}$

else  
 $N_{KNK}$  remains unchanged  
end if

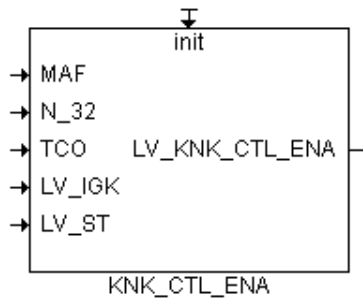
if  $|(MAF - MAF_{KNK})| \geq C_{MAF\_IGA\_HYS\_KNK}$   
 $MAF_{KNK} = MAF$

else  
 $MAF_{KNK}$  remains unchanged  
end if

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### 6.17.1.2 Knock Control Enable



#### Application conditions

**Activation:** *at every engine state except engine stop*

**Deactivation:** *at engine stop*

**Initialization:**  
 LV\_KNK\_CTL\_ENA = 0 at reset and engine running to engine stop  
 LV\_KNK\_CTL\_PRE\_ENA = 0 at reset and engine running to engine stop  
 LV\_CTR\_KNK\_CMB = 0 reset and engine running to engine stop  
 CTR\_KNK\_CMB = 0 reset and engine running to engine stop

**Update Rate:** *every segment*

#### Formula section:

knock control enable:

```

if      (LV_ST = 1 or LV_IGK = 0)
then    LV_KNK_CTL_ENA = 0
else
    if    (MAF_KNK >= IP_MAF_MIN_KNK_N_TCO)
        LV_KNK_CTL_ENA = 1
    else
        LV_KNK_CTL_ENA = 0
    end if
end if
    
```

knock control pre-ignition enable:

```

if      LV_KNK_CTL_ENA = 1 and MAF_KNK >= IP_MAF_MIN_KNK_PRE
then    LV_KNK_CTL_PRE_ENA = 1
else    LV_KNK_CTL_PRE_ENA = 0
end if
    
```

inhibit knock control pre-ignition:

```

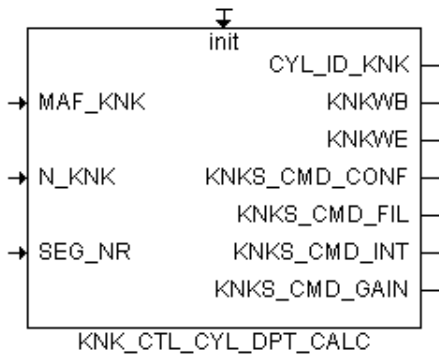
if      N_32 > C_N_KNK_CTL_PRE_INH
then    LV_KNK_CTL_PRE_INH = 1
else    LV_KNK_CTL_PRE_INH = 0
end if
    
```

If the relevant air-mass is below the air-mass threshold ( $LV\_KNK\_CTL\_ENA = 0$ ), only the noise value calculation is executed.

An additional air-mass threshold exists for enabling cylinder cut off algorithm ( $LV\_KNK\_CTL\_PRE\_ENA$ ).

A complete inhibition of pre-window calculation and consideration is forced ( $LV\_KNK\_CTL\_PRE\_INH = 1$ ), when pre-window is initialized with 0 (see IRS); especially when engine speed is above a calibratable threshold.

### 6.17.1.3 Cylinder Dependent Calculations



#### 6.17.1.3.1 Cylinder Number for Knock Control

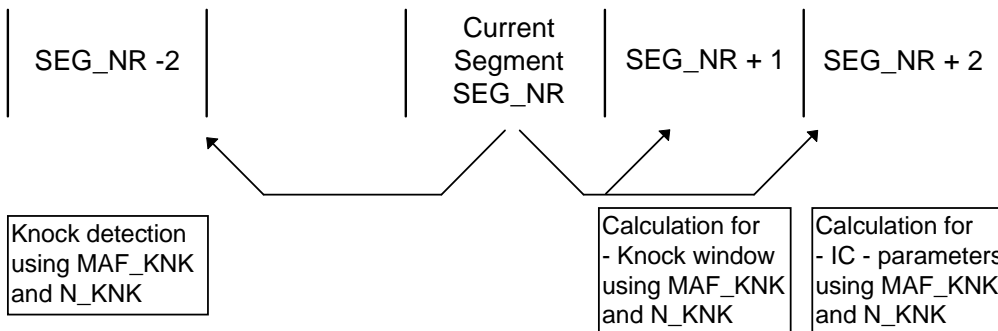
##### Application conditions

- Activation:** *at every engine state except engine stop*
- Deactivation:** *at engine stop*
- Initialization:** *CYL\_ID\_KNK = 0 at reset and engine running to engine stop*
- Update Rate:** *every segment*


##### Formula section:

$$CYL\_ID\_KNK = SEG\_NR - 2$$

Description:



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### 6.17.1.3.2 Knock Measurement Window

#### General information:

The knock detection is performed for cylinder-individually defined measurement windows since knock-typical oscillations only occur for certain crankshaft angles. The measurement windows (crank angle of beginning and end) are specified as function of the engine speed and load.

If the estimated 'End of the Knock Measurement Window' is lower or equal compared to the 'Beginning of the Knock measurement Window', both values are initialized.

The crank angle for the beginning of the knock measurement window is taken for each cylinder from the respective table IP\_KNKWB[x] according to the firing order.

The crank angle for the end of the knock measurement window is taken for each cylinder from the respective table IP\_KNKWE[x] according to the firing order.

Apart from window settings for AFS (stoichiometric) separate windows are existing in operation mode AFL (lean) and S (stratified).

#### Application conditions

**Activation:** *at every engine state except engine stop*

**Deactivation:** *at engine stop*

**Initialization:** *at reset and engine running to engine stop*  
 KNKWB[0 to NC\_CYL\_NR] = NC\_KNKWB\_INI  
 KNKWE[0 to NC\_CYL\_NR] = NC\_KNKWE\_INI  
 KNKWB\_PRE[0 to NC\_CYL\_NR] = NC\_KNKWB\_PRE\_INI  
 KNKWE\_PRE[0 to NC\_CYL\_NR] = NC\_KNKWE\_PRE\_INI

**Update Rate:** *every segment*

#### Formula section:

Definition of cylinder dependent knock window ranges:

RNG\_WB =  $(720^\circ / \text{NC\_CYL\_NR}) - 12^\circ$   
 RNG\_WB\_HEX =  $\text{HEX}(\text{RNG\_WB} / 0.375^\circ)$   
 RNG\_WE =  $(720^\circ / \text{NC\_CYL\_NR}) - 6^\circ$   
 RNG\_WE\_HEX =  $\text{HEX}(\text{RNG\_WE} / 0.375^\circ)$

```

if OPM_AV = "AFS"
then KNKWB[x] = IP_KNKWB[x]
     KNKWE[x] = IP_KNKWE[x]
else KNKWB[x] = IP_KNKWB_AFL
     KNKWE[x] = IP_KNKWE_AFL
end if
    
```


```

if (KNKWE[x] ≤ KNKWB[x])
then KNKWB[x] = NC_KNKWB_INI
     KNKWE[x] = NC_KNKWE_INI
end if
    
```

```

if LV_KNK_CTL_PRE_INH = 0
then KNKWB_PRE[x] = IP_KNKWB_PRE[x]
     KNKWE_PRE[x] = IP_KNKWE_PRE[x]
    
```

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```

if    KNKWE_PRE[x] + IP_KNKWE_PRE_GAP >= KNKWB[x]
then  KNKWE_PRE[x] = KNKWB[x] - IP_KNKWE_PRE_GAP
      LV_KNKWE_PRE_GAP = 1
else  LV_KNKWE_PRE_GAP = 0
end if

if    (KNKWE_PRE[x] ≤ KNKWB_PRE[x])
then  LV_KNK_CTL_PRE_INH = 1
end if

endif

if    LV_KNK_CTL_PRE_INH = 1
then  KNKWB_PRE[x] = NC_KNKWB_PRE_INI
      KNKWE_PRE[x] = NC_KNKWE_PRE_INI
endif

call action interface for pre and normal window

```

<b>ACTION_INFR_SetKnkWindow</b> (IN <Knkwb>, IN <Knkwd>, IN <Cyl>, IN <Win>)
Sets knock window for cylinder <i>cyl</i>

**N.B.:** x represents current SEG\_NR + 1

Important information for calibration:

In order to have the possibility of two windows (pre- and main) in one segment, BSW is calculating with double number of segments with half of the original length. Every window begin (pre- or main) must lie within one of such doubled segments. The beginning of a segment for the main window is fixed in BSW to 2°CRK after TDC. Due to that the main knock window KNKWB[x] must be calibrated not before 2°CRK.

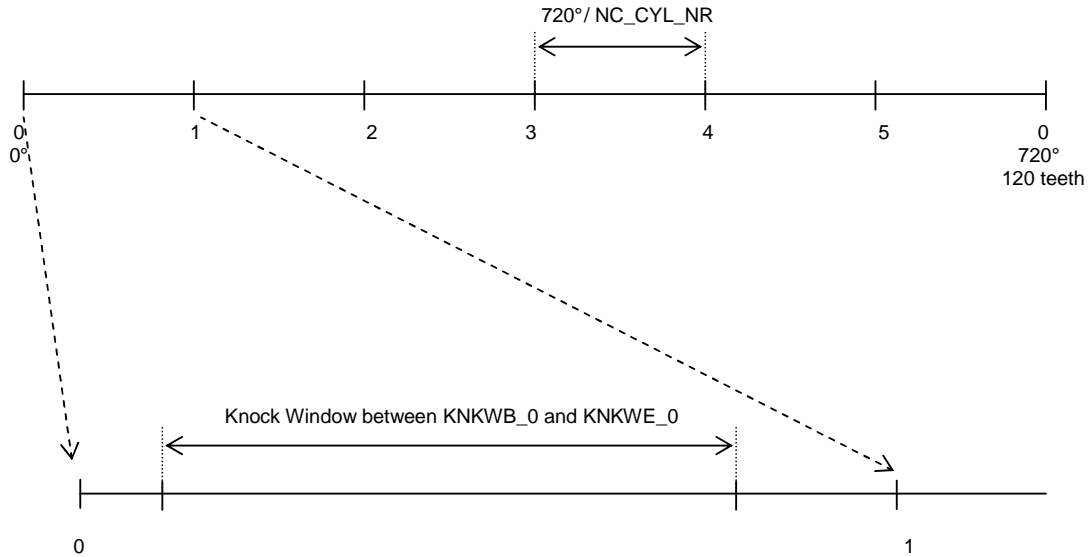
IP\_KNKWE\_PRE\_GAP calibration must be done before KNKS\_PRE signal parameter calibration (window, gain, filter frequency, integration time constant), in order to assure right calculated and transferred values from the knock IC and not to have different values because of new window length after changing this restriction. The duration of the gap between KNKWE\_PRE and KNKWB is determined by the SPI bus communication. During the gap the integrator value of the pre-window has to be read and the ATIC62 device has to be programmed with the main window parameters (window, gain, filter frequency, integration time constant). The required duration has to be determined system individually by the BSW SW department.

Special restrictions must be considered, if distance between 0°CRK (minimum possible value for pre-window begin and end; also when set inactive a activation peak is remaining) and main window begin should be smaller than this determined gap or a smaller gap in general should be used. Then especially the same parametrisation for pre- and main window is required and no inhibition for pre-window calculation is allowed. Thus in BSW right parameters for main window are already set during pre-window parametrisation.

To have low CPU load, the knock pre-ignition window can be set to 0 by LV\_KNK\_CTL\_PRE\_INH = 1. This is done either above a calibratable engine speed threshold or at implausibility, when pre-window end is earlier than pre-window begin. KNKWB\_PRE and KNKWE\_PRE values are initialized with the NC values 0. Then no parametrisation and knock IC processing is executed (see IRS). Also the detection algorithm and KNK\_THR\_PRE aren't executed any longer.

Description:

(example for NC\_CYL\_NR=6; TDC offset = 0°CRK)



### 6.17.1.3.3 Assignment of cylinder number to Knock sensor diagnosis

#### FUNCTION DESCRIPTION:

The physically defined cylinder number is defined in firing order 1 5 3 6 2 4 for a in-line 6 cyl. engine. There is the possibility to define especially for the knock sensor diagnosis which cylinder should be used for the knock sensor diagnosis via the help of the calibration constants C\_KNKS\_1/ 2\_DIAG. Only 'loud' cylinders should be used to detect a malfunction of the Knock sensor signal.

The maximum possible number of cylinders is defined with NC\_KNKS\_CONF. Only cylinders can be used which are assigned for the knock detection of the individual knock sensor.

e.g. in-line 6 cyl. engine:

logically:	0	1	2	3	4	5	
physically:	1	5	3	6	2	4	
assignment KR	0	1	0	1	0	1	NC_KNKS_CONF = 2A hex
assignment KNKS1		1	0	1	0	1	C_KNK_1_DIAG = 15 hex
assignment KNKS2		0	1	0	1	0	C_KNK_2_DIAG = 2A hex

#### Application conditions

**Initialisation:** *all = 0 at reset and engine running to engine stop*

**Recurrence:** *segment synchronous*

**Activation:** *all engine states except LV\_ES*

### 6.17.1.3.4 Calibration of ATIC62 device


#### FUNCTION DESCRIPTION:

##### General information:

The knock control in the engine management works with the ATIC62 device. The output value of the integrator after the end of the measurement window is fed as Knock Value KNKS through an analogue channel to the control algorithm.

(Further information may be obtained in "Applications Guide to ATIC62 ".)

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Apart from parameters for AFS (stoichiometric) separate sets of parameters are existing in operation mode AFL (lean) and S (stratified).

### Application conditions

**Activation:** *at every engine state except engine stop*

**Deactivation:** *at engine stop*

**Initialization:**

KNKS_CMD_INT[0 to NC_CYL_NR]	=	0
KNKS_CMD_FIL[0 to NC_CYL_NR]	=	0
KNKS_CMD_GAIN[0 to NC_CYL_NR]	=	0
KNKS_CMD_INT_PRE[0 to NC_CYL_NR]	=	0
KNKS_CMD_FIL_PRE[0 to NC_CYL_NR]	=	0
KNKS_CMD_GAIN_PRE[0 to NC_CYL_NR]	=	0
KNKS_CMD_CONF[0 to NC_CYL_NR]	=	value of configuration bit at position x in NC_KNKS_CONF

at reset and engine running to engine stop

**Update Rate:** *every segment*

### Formula section:

**If** OPM\_AV = "AFS"

**Then**

KNKS_CMD_INT[x]	=	ID_ITC_KNK[x]
KNKS_CMD_FIL[x]	=	ID_FIL_FRQ_KNK[x]
KNKS_CMD_GAIN[x]	=	IP_GAIN_KNK[x]
KNKS_CMD_INT_PRE[x]	=	ID_ITC_KNK_PRE[x]
KNKS_CMD_FIL_PRE[x]	=	ID_FIL_FRQ_KNK_PRE[x]
KNKS_CMD_GAIN_PRE[x]	=	IP_GAIN_KNK_PRE[x]

**Else**

KNKS_CMD_INT[x]	=	C_ITC_KNK_AFL[x]
KNKS_CMD_FIL[x]	=	C_FIL_FRQ_KNK_AFL[x]
KNKS_CMD_GAIN[x]	=	IP_GAIN_KNK_AFL[x]
KNKS_CMD_INT_PRE[x]	=	C_ITC_KNK_AFL[x]
KNKS_CMD_FIL_PRE[x]	=	C_FIL_FRQ_KNK_AFL[x]
KNKS_CMD_GAIN_PRE[x]	=	IP_GAIN_KNK_AFL[x]

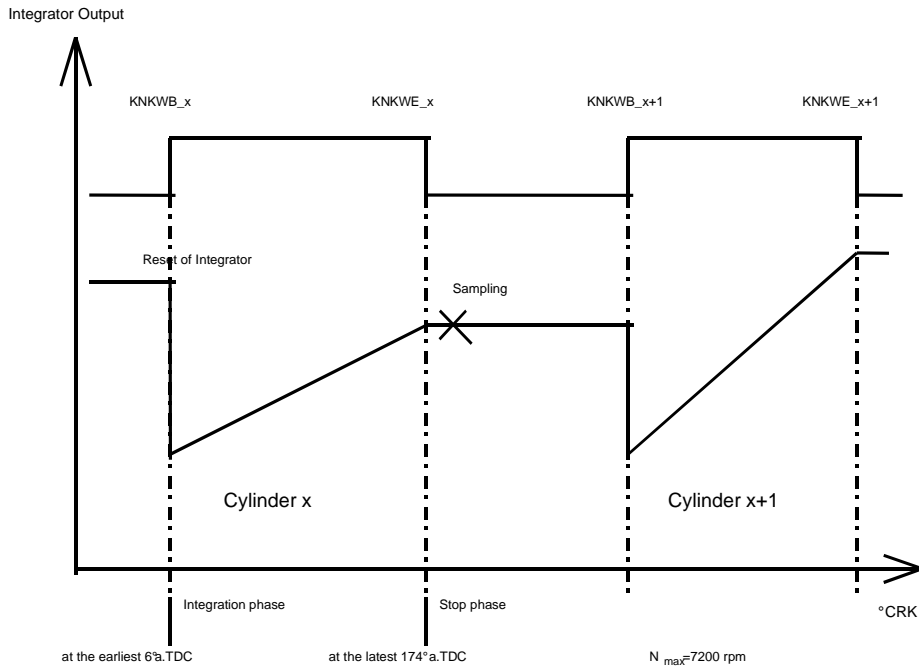
**Endif**

call action interface for pre and normal window parameters

<b>ACTION_INFR_SetKnkCfg</b> (IN <Cmd_fil>, IN <Cmd_gain>, IN <Cmd_int>, IN <Cyl>, IN <Win>)
Sets knock pre-processor window, filter, gain and integrator factors for cylinder <i>cy</i>

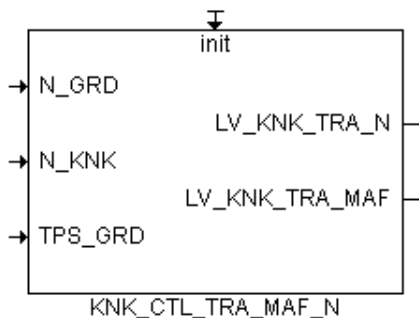
**N.B.:** x represents current SEG\_NR + 2  
Description (example for 4 cylinder engine):

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**Note:** These calibration data have to be adjusted if the processor sampling rate is changed.

### 6.17.1.4 Load and Speed Dynamics



#### 6.17.1.4.1 Speed Dynamics Function

##### FUNCTION DESCRIPTION:

##### General information:

In order to keep track with the noise values for large engine speed gradients (LV\_KNK\_TRA\_N = 1), the standard filtering constant is exchanged by a faster averaging constant C\_NL\_CRLC\_TRA.


Care needs to be given to the absolute function evaluation, so that there is no difference in the treatment of positive and negative speed gradients.

Furthermore the values of Knock -Adaptation-circuits 1 + 2 are only read at active speed dynamics.

##### Application conditions

**Activation:** *at every engine state except engine stop*

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**Deactivation:** *at engine stop*

**Initialization:** *LV\_KNK\_TRA\_N = 0 at reset and engine running to engine stop*

**Update Rate:** *every segment*

**Formula section:**

if  $(|N\_GRD| \geq ID\_N\_GRD\_MAX\_KNK\_N)$

LV\_KNK\_TRA\_N = 1

else

LV\_KNK\_TRA\_N = 0

end if

**6.17.1.4.2 Load Dynamics Function**

**FUNCTION DESCRIPTION:**

General information:

In order to keep track with the noise values for large (positive) load gradients (LV\_KNK\_TRA\_MAF = 1), the standard filtering constant is exchanged by a faster averaging constant C\_NL\_CRLC\_TRA. After the triggering of the load dynamics the special filtering constant C\_NL\_CRLC\_TRA is applied for the number of ID\_CYCNR\_FAC\_TRA\_KNK\_N cycles. In addition, at active load dynamics function, the knock detection (KNK\_THD[x]) is made less sensitive with the help of the factor C\_FAC\_TRA\_KNK. The values from the knock adaptation-circuits 1 + 2 are only read.

**Application conditions**

**Activation:** *at every engine state except engine stop*

**Deactivation:** *at engine stop*

**Initialization:** *LV\_KNK\_TRA\_MAF = 0 at reset and engine running to engine stop*

**Update Rate:** *every segment*

**Formula section:**

if LV\_IGA\_TRA\_KNK 0 -> 1

LV\_KNK\_TRA\_MAF = 1 for ID\_CYCNR\_FAC\_TRA\_KNK\_N cycles


else

if (ID\_CYCNR\_FAC\_TRA\_KNK\_N has elapsed)  
LV\_KNK\_TRA\_MAF = 0

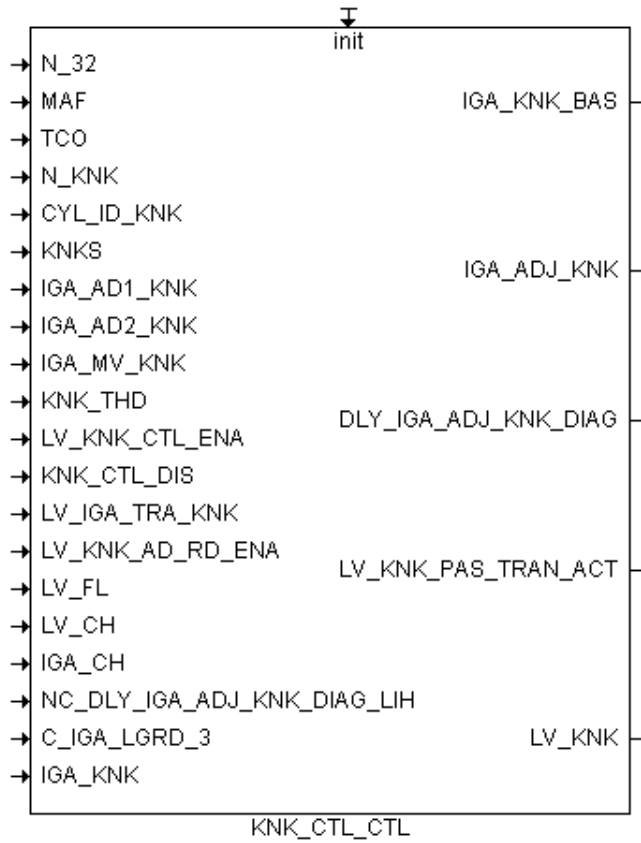
end if

end if

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## 6.17.2 Knock Control



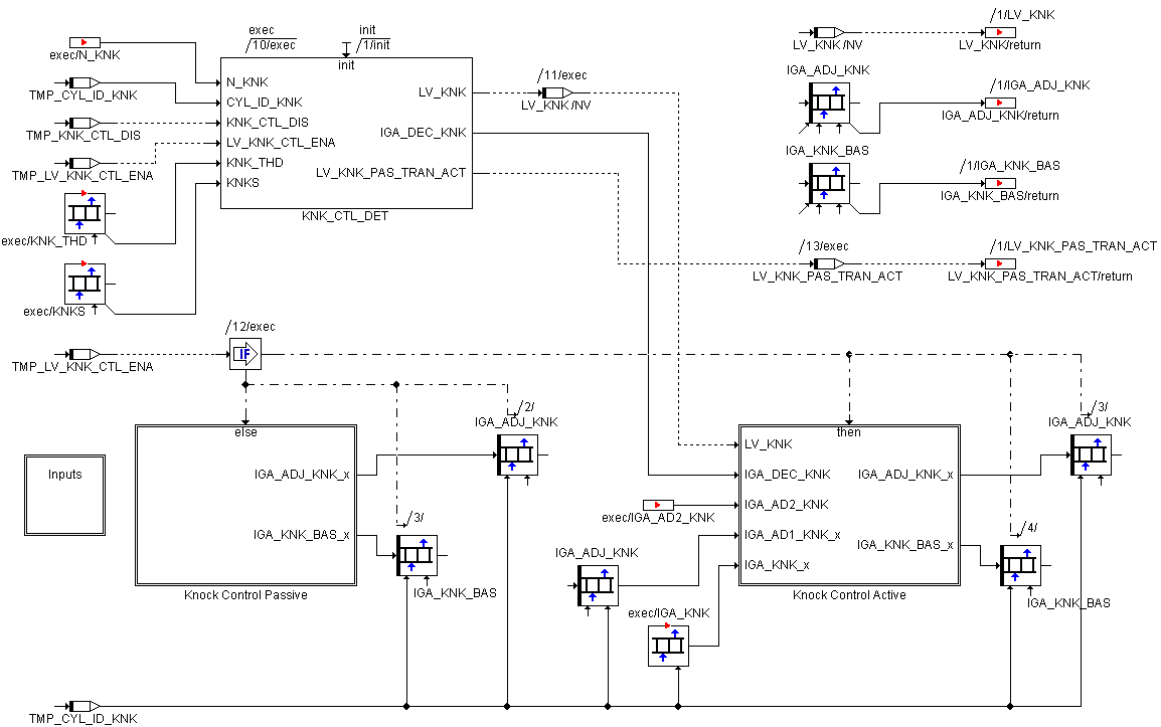
### Overview:

- Knock Control at change of operation mode
- Knock Detection in separate window
- Knock Detection
- if (LV\_KNK\_CTL\_ENA = 1)
  - Knock Control active
    - if Combustion mode = 'stratified'
      - Calculation 'knock control in stratified mode'
    - else
      - if
        - Calculation of Maximum Retard Adjustment
          - if (KNK\_CTL\_DIS = 1)
            - Limp Home operation
          - else
            - if (LV\_KNK\_CTL\_PRE\_ENA = 1)
              - Normal Operation Pre-Ignition
          - end if
            - Normal operation
            - Control excursion limit
        - end if
          - Limitation of total ignition retard

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```

else
    → Reset of Knock control
end if
endif
else
    → Knock control passive (Reset after abandoning the Knock-Operating-Limit)
end if
    
```



### Application conditions

**Activation:** at every engine state except engine stop

**Deactivation:** at engine stop

**Initialisation:** at reset and engine running to engine stop  
 IGA\_ADJ\_KNK[NC\_CYL\_NR] = 0  
 STATE\_CMB\_CTL\_KNK = 0

**Update Rate:** every segment

#### 6.17.2.1 Knock Control at change of operation mode

Changing the operation mode causes some additional noise. To avoid faulty detection of knock, the knock control is cut off for a calibratable time. The noise level has to be shifted with a own correlation constant. This calculation has to be done before IGA\_DEC\_KNK is calculated.

Definition of temp variable for change between combustion states:

**if** OPM\_AV(n) != OPM\_AV(n-1) // operation mode has changed

**then**

**if** OPM\_AV = "AFS" to "AFL"

**then** STATE\_CMB\_CTL\_TMP = "AFS\_TO\_AFL" (1H)

**elseif** OPM\_AV = "AFS" to "S"

```

    then      STATE_CMB_CTL_TMP = "HOM_TO_S "      (4H)

    elseif   OPM_AV = "S" to "AFL"
    then     STATE_CMB_CTL_TMP = "BACKHOM"          (8H)

    elseif   OPM_AV = "S" to "AFS"
    then     STATE_CMB_CTL_TMP = "S_TO_HOM "        (7H)

    elseif   OPM_AV = "AFL" to "AFS"
    then     STATE_CMB_CTL_TMP = "AFL_TO_AFS"       (3H)

    elseif   OPM_AV = "AFL" to "S"
    then     STATE_CMB_CTL_TMP = "BACKS"            (5H)
else
    if       OPM_AV = "AFS"
    then     STATE_CMB_CTL_TMP = "HOM_AFS"          (0H)

    elseif   OPM_AV = "AFL"
    then     STATE_CMB_CTL_TMP = "HOM_AFL"          (2H)

    elseif   OPM_AV = "S"
    then     STATE_CMB_CTL_TMP = "S"                (6H)
endif

```

```

if      OPM_AV(n) != OPM_AV(n-1) // operation mode has changed
then
    LV_CTR_KNK_CMB = 1
    CTR_KNK_CMB = 0
    STATE_CMB_CTL_KNK = STATE_CMB_CTL_TMP
endif

```

```

if    LV_CTR_KNK_CMB = 1 and CTR_KNK_CMB < ID_CTR_KNK_CMB
then
    CTR_KNK_CMB ++
else
    CTR_KNK_CMB = 0
    LV_CTR_KNK_CMB = 0
endif

```

ID\_CTR\_KNK\_CMB is to be used in dividers of six (six segments equal one working cycle)

### 6.17.2.2 Knock Detection in separate window


#### FUNCTION DESCRIPTION:

##### General information:

##### Application conditions

**Activation:** *at every engine state except engine stop*

**Deactivation:** *at engine stop*

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**Initialisation:**           at reset and engine running to engine stop  
                                   LV\_KNK\_PRE = 0  
                                   CYCNR\_KNK\_PRE\_DET = 0  
                                   CTR\_KNK\_PRE\_DET[0 to NC\_CYL\_NR] = 0  
                                   CTR\_KNK\_PRE\_DET\_0[0 to NC\_CYL\_NR] = 0  
                                   CTR\_KNK\_PRE\_DET\_1[0 to NC\_CYL\_NR] = 0  
                                   LV\_KNK\_PRE\_DET = 0  
                                   CTR\_KNK\_PRE\_DET\_NR[0 to NC\_CYL\_NR] = 0  
                                   CYCNR\_INH\_IV\_KNK\_PRE\_DET[0 to NC\_CYL\_NR] = 0  
                                   set all bits in INH\_IV\_KNK = 0

**Update Rate:**            *every segment*

**Formula section:**

if    **(LV\_KNK\_CTL\_PRE\_ENA = 1)**  
       *Knock Control Pre-Ignition Active:*  
   if    **(KNK\_CTL\_DIS = 0)**  
       if    **(NC\_CYL\_NR cycles has elapsed after Passive or Limp-Home)**  
           **LV\_KNK\_PAS\_TRAN\_ACT = 1**

call action interface for acquisition of knks signal for pre-window


<b>ACTION_INFR_GetVKnks(OUT &lt;V_knks&gt;, IN &lt;Cyl&gt;, IN &lt;Win&gt;)</b>
Gets the formatted knock noise raw signal

```

if    LV_KNK_CTL_PRE_INH = 0 and
      (KNKS_PRE[x] >= KNK_THD_PRE) and
      LV_CTR_KNK_CMB=0 and
          OPM_AV = "AFS" (no pre-window used in AFL or S)
then
      LV_KNK_PRE = 1
else
      LV_KNK_PRE = 0
end if
else
      LV_KNK_PAS_TRAN_ACT = 0
      LV_KNK_PRE = 0
      CYCNR_KNK_PRE_DET = 0 (reset of counter for observation period)
      CTR_KNK_PRE_DET[x] = 0 (reset of detection counter)
      CTR_KNK_PRE_DET_0[x] = 0 (reset of pre window counter)
      CTR_KNK_PRE_DET_1[x] = 0 (reset of main window counter)
      LV_KNK_PRE_DET = 0 (reset of bit for detected pre-ignition)
      CYCNR_INH_IV_KNK_PRE_DET[x] = 0 (reset of injection shut off counter)
      set all bits in INH_IV_KNK = 0 (reset of pre-ignition inhibit bits)
end if
else
      LV_KNK_PAS_TRAN_ACT = 0
      LV_KNK_PRE = 0
      CYCNR_KNK_PRE_DET = 0 (reset of counter for observation period)
      CTR_KNK_PRE_DET[x] = 0 (reset of detection counter)
      CTR_KNK_PRE_DET_0[x] = 0 (reset of pre window counter)
      CTR_KNK_PRE_DET_1[x] = 0 (reset of main window counter)
      LV_KNK_PRE_DET = 0 (reset of bit for detected pre-ignition)

```

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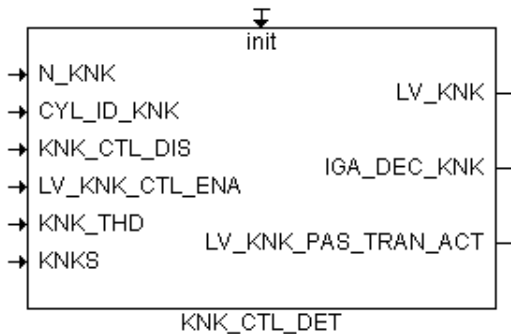
```

        CYCNR_INH_IV_KNK_PRE_DET[x] = 0 (reset of injection shut off counter)
        set all bits in INH_IV_KNK = 0 (reset of pre-ignition inhibit bits)
    end if
else
    LV_KNK_PAS_TRAN_ACT = 0
    LV_KNK_PRE = 0
    CYCNR_KNK_PRE_DET = 0 (reset of counter for observation period)
    CTR_KNK_PRE_DET[x] = 0 (reset of detection counter)
    CTR_KNK_PRE_DET_0[x] = 0 (reset of pre window counter)
    CTR_KNK_PRE_DET_1[x] = 0 (reset of main window counter)
    LV_KNK_PRE_DET = 0 (reset of bit for detected pre-ignition)
    CYCNR_INH_IV_KNK_PRE_DET[x] = 0 (reset of injection shut off counter)
    set all bits in INH_IV_KNK = 0 (reset of pre-ignition inhibit bits)
end if

```

**N.B.:** x represents current CYL\_ID\_KNK

### 6.17.2.3 Knock Detection



#### FUNCTION DESCRIPTION:

##### General information:

##### Application conditions


**Activation:** *at every engine state except engine stop*  
**Deactivation:** *at engine stop*  
**Initialisation:** *-*  
**Update Rate:** *every segment*

##### Formula section:

```

if (LV_KNK_CTL_ENA = 1)
    Knock Control Active:
    if (KNK_CTL_DIS = 0)
        if (NC_CYL_NR cycles has elapsed after Passive or Limp-Home)
            LV_KNK_PAS_TRAN_ACT = 1
        end if
    end if
end if

```

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call action interface for acquisition of knks signal for normal window

**ACTION\_INFR\_GetVKnks(OUT <V\_knks>, IN <Cyl>, IN <Win>)**  
Gets the formatted knock noise raw signal

```

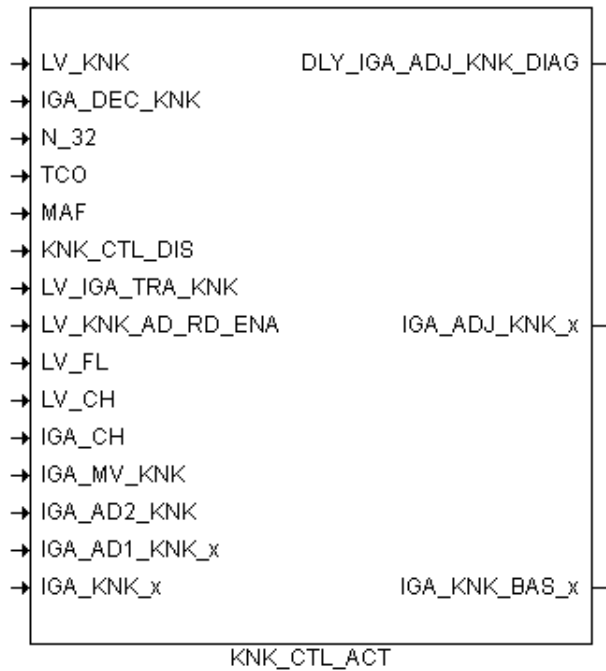
if (KNKS[x] >= KNK_THD[x]) and LV_CTR_KNK_CMB = 0
  LV_KNK = 1
  if OPM_AV = "AFS"
    if (KNKS[x] ≥ 2 * KNK_THD[x])
      Intensity 2:
      IGA_DEC_KNK = ID_IGA_DEC_KNK_2
    else
      Intensity 1:
      IGA_DEC_KNK = ID_IGA_DEC_KNK_1
    end if
  else
    if (KNKS[x] ≥ 2 * KNK_THD[x])
      Intensity 2:
      IGA_DEC_KNK = ID_IGA_DEC_KNK_AFL_2
      Intensity 1:
      IGA_DEC_KNK = ID_IGA_DEC_KNK_AFL_1
    end if
  end if
else
  LV_KNK = 0
end if
if (KNKS[x] >= KNK_THD_MAX) and LV_CTR_KNK_CMB = 0
  LV_KNK_MAX = 1
else
  LV_KNK_MAX = 0
end if
else
  LV_KNK_PAS_TRAN_ACT = 0
  LV_KNK = 0
end if
else
  Limp-Home Intensity 1:
  IGA_DEC_KNK = ID_IGA_DEC_KNK_1
  LV_KNK_PAS_TRAN_ACT = 0
  LV_KNK = 0
end if
else
  Knock Control Passive:
  LV_KNK_PAS_TRAN_ACT = 0
  LV_KNK = 0
end if

```

**N.B.:** x represents current CYL\_ID\_KNK

Different adjustment decrements are also produced due to the different knock intensities. Then it is possible to react to hard knock-strikes with a greater ignition - timing retardation.

### 6.17.2.4 Knock control active



#### General information:

The spark retard is calculated cylinder-individual at every firing event. The spark retard due to the knock control system is determined by the spark retard due to knocking combustion (IGA\_KNK[x]). The sum of these retard components is limited to a maximum spark retard.

#### Application conditions

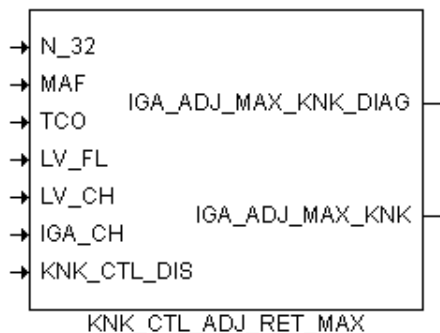
**Activation:** *at every engine state except engine stop*

**Deactivation:** *LV\_ES = 1*

**Initialisation:** *-*

**Update Rate:** *every segment*

#### 6.17.2.4.1 Calculation of Maximum Retard Adjustment



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**FUNCTION DESCRIPTION:**

General information:

This ignition angle is also executed if a knock control related malfunction is detected (KNK\_CTL\_DIS = 1).

**Please note that this maximum spark retard is an absolute ignition angle referring to TDC.**

**Application conditions**

**Activation:** *at every engine state except engine stop*  
**Deactivation:** -  
**Initialisation:** -  
**Update Rate:** *every segment*

**Formula section:**

```

IGA_OFS_MAX_KNK      = IP_IGA_OFS_MAX_KNK(N_32, MAF)
FAC_IGA_MAX_KNK      = IP_FAC_IGA_MAX_KNK(TCO, TIA)
IF    LV_ERR_KNKS[NC_NR_SENS_KNK] = 1    (or condition)
Then
    IGA_BAS_MAX_KNK    = IP_IGA_BAS_MAX_KNK_ERR(N_32, MAF)
Else
    IGA_BAS_MAX_KNK    = IP_IGA_BAS_MAX_KNK(N_32, MAF)
Endlf
IGA_ADJ_MAX_KNK = IGA_BAS_MAX_KNK + (IGA_OFS_MAX_KNK * FAC_IGA_MAX_KNK)
    
```

**6.17.2.4.2 Normal Operation Pre-Ignition**

**FUNCTION DESCRIPTION:**

General information:


Surface ignition, before the regular ignition is triggered, is called pre-ignition. This kind of autoignition is caused by a hot spot, generated by prolonged, heavy spark knock. It is known as knock-induced pre-ignition. This is the most damaging side effect of spark knock.

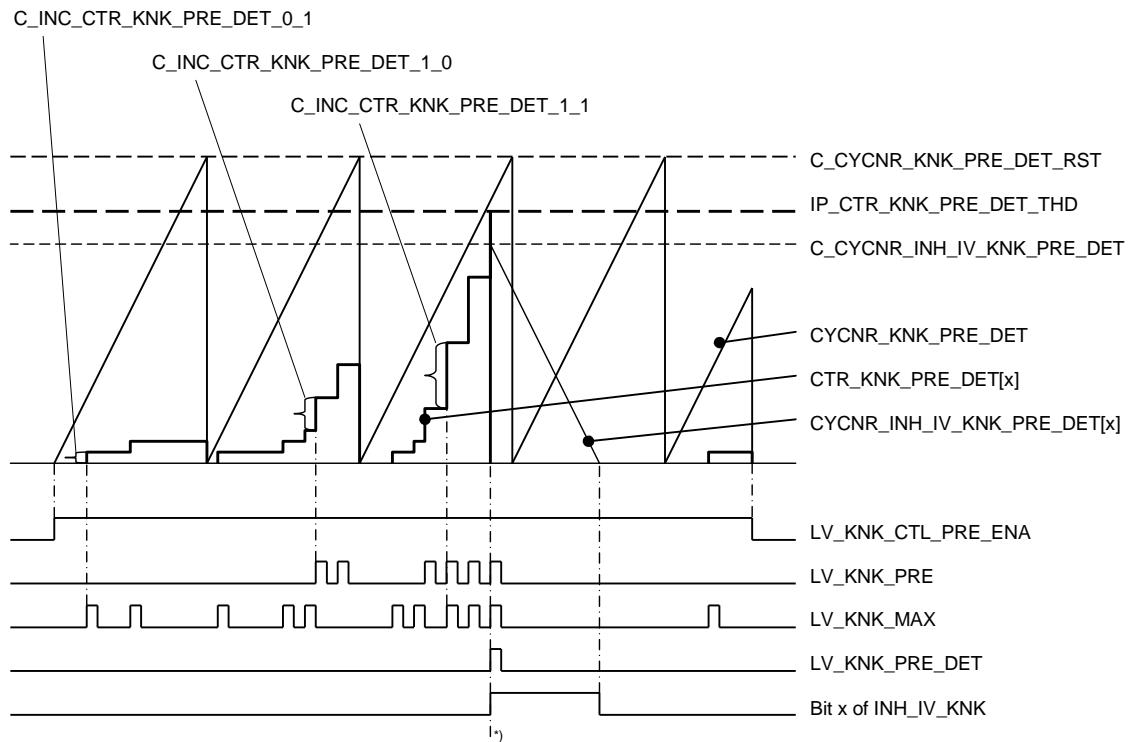
Knock-induced pre-ignition is detected by following algorithm, that is observing normal knocking (normal knock window) and pre-ignition (pre-knock window). Both windows are evaluated to detect occurring pre-ignition events. If either many knock events are detected in the normal knock window or in the pre-knock window or in the normal knock window plus the pre-knock window during a certain number of firing events, autoignition is detected and the protection function of the engine is activated. Then the injection of the concerned cylinder is shut off for a calibratable number of firing events, which can be increased in case of multiple detection events during one driving cycle, in order to prevent engine damage.

(No execution, if not (LV\_KNK\_CTL\_PRE\_ENA = 1))

Detection algorithm:

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<sup>\*)</sup> counter exceeds threshold within observation period --> cycle counter for injection inhibition starts

LV\_KNK\_PRE refers to ID\_KNK\_THD\_MAX\_PRE threshold,  
LV\_KNK\_MAX refers to IP\_KNK\_THD\_MAX threshold!

### Formula section:

cycle counter for observation period  
(update rate: every 720°)

$$CYCNR\_KNK\_PRE\_DET = CYCNR\_KNK\_PRE\_DET_{n-1} + 1$$

cycle counter and detection counter reset when reaching cycle counter threshold  
(update rate: every 720°)

**If**  $CYCNR\_KNK\_PRE\_DET > C\_CYCNR\_KNK\_PRE\_DET\_RST$

**Then**  $CYCNR\_KNK\_PRE\_DET = 0$   
 $CTR\_KNK\_PRE\_DET[0 \text{ to } NC\_CYL\_NR] = 0$

**Endif**

detection counter  
(cylinder individually)

**If**  $CTR\_KNK\_PRE\_DET[x] = 0$   
**Then**  $CTR\_KNK\_PRE\_DET_0[x] = 0$   
 $CTR\_KNK\_PRE\_DET_1[x] = 0$

**Endif**

**If**  $LV\_KNK\_PRE = 0$  and  $LV\_KNK\_MAX = 1$   
**Then**  $CTR\_KNK\_PRE\_DET[x] = CTR\_KNK\_PRE\_DET[x]_{n-1} +$   
 $INC\_CTR\_KNK\_PRE\_DET\_0\_1$   
 $CTR\_KNK\_PRE\_DET_1[x] ++$

**Elseif**  $LV\_KNK\_PRE = 1$  and  $LV\_KNK\_MAX = 0$

```

Then CTR_KNK_PRE_DET[x] = CTR_KNK_PRE_DET[x]n-1 +
INC_CTR_KNK_PRE_DET_1_0
      CTR_KNK_PRE_DET_0[x] ++
Elseif LV_KNK_PRE = 1 and LV_KNK_MAX = 1
Then CTR_KNK_PRE_DET[x] = CTR_KNK_PRE_DET[x]n-1 +
INC_CTR_KNK_PRE_DET_1_1
      CTR_KNK_PRE_DET_0[x] ++
      CTR_KNK_PRE_DET_1[x] ++
Endif

```

knock pre-ignition detection and detection counter reset when reaching detection threshold  
(cylinder individually)

```

If CTR_KNK_PRE_DET[x] > IP_CTR_KNK_PRE_DET_THD
Then LV_KNK_PRE_DET = 1
      CTR_KNK_PRE_DET[x] = 0
Else LV_KNK_PRE_DET = 0
Endif

```

injection shut off for adjustable number of cycles  
(cylinder individually)

```

If LV_KNK_PRE_DET = 1
Then CTR_KNK_PRE_DET_NR[x] ++
      CYCNR_INH_IV_KNK_PRE_DET[x] = IP_CYCNR_INH_IV_KNK_PRE_DET
      (N_KNK, CTR_KNK_PRE_DET_NR[x])
Endif

```

```

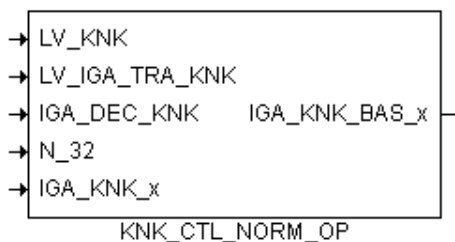
If CYCNR_INH_IV_KNK_PRE_DET[x] > 0
Then CYCNR_INH_IV_KNK_PRE_DET[x] = CYCNR_INH_IV_KNK_PRE_DET[x]n-1 - 1
      set bit x for corresponding cylinder in INH_IV_KNK = 1
Else set bit x for corresponding cylinder in INH_IV_KNK = 0
Endif

```

**this calculation has to be done before 'Cylinder Shut Off (Application Incidences)'**


**N.B.:** x represents current CYL\_ID\_KNK

### 6.17.2.4.3 Normal Operation



## FUNCTION DESCRIPTION:

General information:

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The spark retard is calculated cylinder-individual at every firing event. The spark retard due to the knock control system is determined by the spark retard due to knocking combustion (IGA\_KNK[NC\_CYL\_NR]). The sum of these retard components is limited to a maximum spark retard.

In case of knock free operation (LV\_KNK=0) and LV\_KNK\_CTL\_ENA = 1 the Ignition retard due to knock control is re-set to zero (Controlled reset at Knock-free operation).

The controlled ignition-timing reset remains active until either the map ignition timing (IGA\_KNK\_BAS[x] = 0) is reached or until knocking occurs.

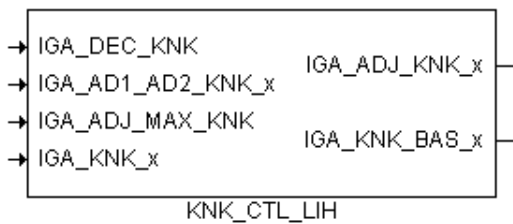
**Formula section:**

```

if          (LV_KNK = 1)
then       IGA_KNK_BAS[x] = IGA_KNK[x] - IGA_DEC_KNK
else       Controlled reset at Knock-free operation
    if       (LV_IGA_TRA_KNK = 0)
    then     IGA_KNK_BAS[x] = IGA_KNK[x] + IP_IGA_INC_KNK__N
    else     IGA_KNK_BAS[x] = IGA_KNK[x]
    end if
end if
    
```

**N.B.:** x represents current CYL\_ID\_KNK

**6.17.2.4.4 Limp Home Operation**



**FUNCTION DESCRIPTION:**

General information:

After an diagnosis error on the knock control system is detected (KNK\_CTL\_DIS = 1) the limp home spark retard level is achieved via spark retard Intensity 1 (IGA\_DEC\_KNK).

**Formula section:**

Check if limphome spark retard level is already reached

**if** IGA\_KNK[x] - IGA\_DEC\_KNK < IGA\_ADJ\_MAX\_KNK - IGA\_WOUT\_KNK  
 limphome spark retard level reached: Limitation to max. absolute (referring to TDC) possible ignition retard


**then**  
 IGA\_KNK\_BAS[x] = IGA\_ADJ\_MAX\_KNK - IGA\_WOUT\_KNK

Limphome spark retard level not yet reached

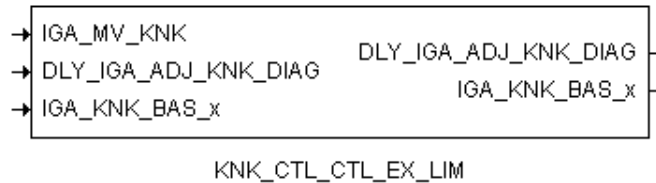
**else**  
 IGA\_KNK\_BAS[x] = IGA\_KNK[x] - IGA\_DEC\_KNK

**end if**

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### 6.17.2.4.5 Control Excursion limit



#### FUNCTION DESCRIPTION:

##### General information:

The control excursion limit is used to limit the difference of the ignition adjustment angle through knock-control of the single cylinders to a certain value. All 720 °CRK the arithmetic mean value of the cylinder ignition adjustment angles IGA\_KNK\_BAS[NC\_CYL\_NR] is calculated:

All 720/Cyl. °CRK a test will be done, to see whether the ignition adjustment angle of the just calculated cylinder is more retarded or advanced than IGA\_MV\_KNK - C\_IGA\_DIF\_MIN\_MAX\_KNK. In this case the knock control adjustment angle is limited to the control excursion limit.

In case that ignition angle retard reaches the maximum limit, LV\_IGA\_DIF\_MAX\_KNK is set in order to give this information to the 'Excursion Limit Analysis' functionality, where the values for concerning cylinder and actual operation point are stored.

##### Formula section:

##### Case Differentiation:

Analysis trigger reset:

LV\_IGA\_DIF\_MAX\_KNK = 0

**if** IGA\_KNK\_BAS[x] IGA\_MV\_KNK + C\_IGA\_DIF\_MIN\_MAX\_KNK

advance limitation:

**then** IGA\_KNK\_BAS[x] = IGA\_MV\_KNK + C\_IGA\_DIF\_MIN\_MAX\_KNK

**else**

**if** IGA\_KNK\_BAS[x] IGA\_MV\_KNK - C\_IGA\_DIF\_MIN\_MAX\_KNK

retard limitation:

**then** IGA\_KNK\_BAS[x] = IGA\_MV\_KNK - C\_IGA\_DIF\_MIN\_MAX\_KNK

Analysis trigger for cylinder individual counter, freeze of Cyl\_ID\_KNK and operation point:

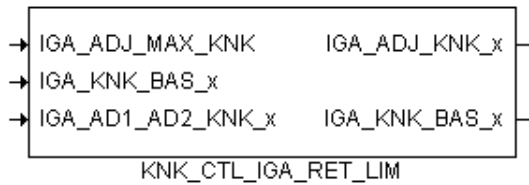
LV\_IGA\_DIF\_MAX\_KNK = 1

**endif**

**end if**

**N.B.:** x represents current CYL\_ID\_KNK

### 6.17.2.4.6 Limitation of total ignition retard



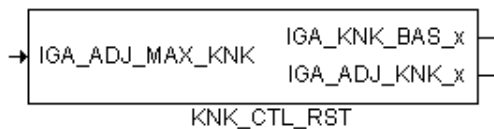
#### Formula section:

```

if LV_HOM_ACT = 1
then
    check if limhome spark retard level is already reached
    if IGA_KNK_BAS[x] < IGA_ADJ_MAX_KNK - IGA_WOUT_KNK
        limhome spark retard level reached: Limitation to max. absolute (referring to TDC) possible ignition
        retard
        then
            IGA_KNK_BAS[x] = IGA_ADJ_MAX_KNK - IGA_WOUT_KNK
        endif
    endif
endif
IGA_KNK[x] = IGA_KNK_BAS[x]
IGA_ADJ_KNK[x] = IGA_KNK_BAS[x]
    
```

N.B.: x represents current CYL\_ID\_KNK

### 6.17.2.4.7 Reset of Knock control



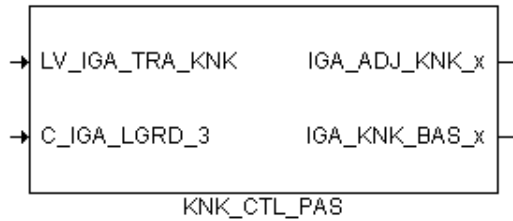
#### Formula section:

```

IGA_KNK_BAS[x]           = 0°CRK
IGA_ADJ_KNK[x]          = IGA_ADJ_MAX_KNK - IGA_WOUT_KNK
    
```

N.B.: x represents current CYL\_ID\_KNK

### 6.17.2.5 Knock control passiv (Reset after abandoning the Knock-Operating-Limit)



#### FUNCTION DESCRIPTION:

##### General information:

If the operating limit falls below (LV\_KNK\_CTL\_ENA = 0;), then the ignition adjustment angle IGA\_KNK\_BAS[x] is re-set to 0, with the change limitation C\_IGA\_LGRD\_3 - however referring to 720° CRK -, in order to reach the map ignition timing.

##### Formula section:

```

if (LV_IGA_TRA_KNK = 0)
then
    IGA_ADJ_KNK[x] = IGA_ADJ_KNK[x](N-1) + C_IGA_LGRD_3
    IGA_KNK_BAS[x] = 0
else
    IGA_ADJ_KNK[x] = IGA_ADJ_KNK[x](N-1) (remains unchanged)
    IGA_KNK_BAS[x] = 0
end if
    
```

### 6.17.2.6 Knock Control in Stratified Mode

#### FUNCTION DESCRIPTION:

##### General information:

Knock detection and knock control is also active in stratified combustion mode. As ignition retard is not usable in stratified mode and may lead to problems at combustion mode changes, the spark retard variables IGA\_ADJ\_KNK and IGA\_KNK\_BAS are set to zero during stratified. If stratified mode is left, the spark retard has to start at 0 °CRK when knock is recognized.

##### Formula section:

```

if OPM_AV = 'S'          (stratified combustion, 1H)
then
call action interface for acquisition of knks signal for pre and normal window
    
```

**ACTION\_INFR\_GetVKnks(OUT <V\_knks>, IN <Cyl>, IN <Win>)**  
Gets the formatted knock noise raw signal

IGA\_ADJ\_KNK[x] = 0 °CRK  
IGA\_KNK\_BAS[x] = 0 °CRK

```

if      (KNKSx >= KNK_THD[x])
  then  LV_KNK = 1
  else  LV_KNK = 0
endif
if      (KNKS_PRE[x] ≥ KNK_THD_PRE)
  then  LV_KNK_PRE = 1
  else  LV_KNK_PRE = 0
end if
CYCNR_KNK_PRE_DET = 0 (reset of counter for observation period)
CTR_KNK_PRE_DET[x] = 0 (reset of detection counter)
CTR_KNK_PRE_DET_0[x] = 0 (reset of pre window counter)
CTR_KNK_PRE_DET_1[x] = 0 (reset of main window counter)
LV_KNK_PRE_DET = 0 (reset of bit for detected pre-ignition)
CYCNR_INH_IV_KNK_PRE_DET[x] = 0 (reset of injection shut off counter)
set all bits in INH_IV_KNK = 0 (reset of pre-ignition inhibit bits)
else
  IGA_ADJ_KNK[x] is calculated as described in the previous chapters
  IGA_KNK_BAS[x] is calculated as described in the previous chapters
end if

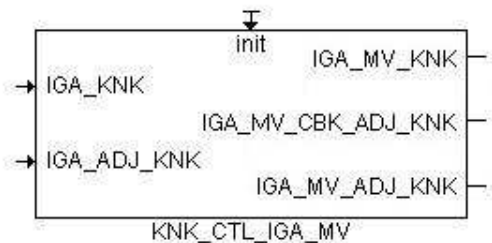
```

**Hints:**

Due to former changes IGA\_KNK[x] is now identical to IGA\_KNK\_BAS[x].  
 At transition from stratified combustion mode to normal operation mode of knock control, NC\_CYL\_NR cycles have to be elapsed for spark retard.

**6.17.3 Post-processing**

**6.17.3.1 Meanvalues of knock-control ignition adjustment**



**Application conditions**


**Activation:** *at every engine state except engine stop*

**Deactivation:** -

**Initialisation:** *at reset and engine running to engine stop*  
 IGA\_MV\_KNK = IGA\_MV\_ADJ\_KNK = 0  
 IGA\_MV\_CBK\_ADJ\_KNK [NC\_CBK\_EX\_NR] = 0

**Update Rate:** *every 720° CRK: IGA\_MV\_KNK, IGA\_MV\_ADJ\_KNK*  
*every segment: IGA\_MV\_CBK\_ADJ\_KNK [NC\_CBK\_EX\_NR]*

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**Formula section:**

$$IGA\_MV\_KNK = \frac{\sum_{i=1}^{NC\_CYL\_NR} (IGA\_KNK\_x)}{NC\_CYL\_NR}$$


$$IGA\_MV\_ADJ\_KNK = \frac{\sum_{i=1}^{NC\_CYL\_NR} (IGA\_ADJ\_KNK\_x)}{NC\_CYL\_NR}$$

**Calculation of IGA\_MV\_CBK\_ADJ\_KNK[NC\_CBK\_EX\_NR]:**

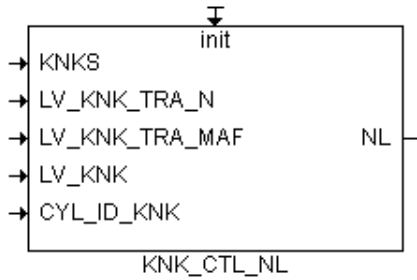
```

IF      NC_CBK_EX_NR > 1                (please note physical meaning)
THEN
  FOR i = 1 TO NC_CBK_EX_NR            (please note physical meaning)
    IGA_MV_CBK_ADJ_KNK[i] = 0
  ENDFOR
  FOR x = 0 TO (NC_CYL_NR - 1)
    IF (NC_LAMB_REF AND 2x) 0        (bitwise)
      THEN
        Bank 2:
          IGA_MV_CBK_ADJ_KNK[2] += IGA_ADJ_KNK[x]
        ELSE
          Bank 1:
          IGA_MV_CBK_ADJ_KNK[1] += IGA_ADJ_KNK[x]
        ENDIF
      ENDFOR
    FOR i = 1 TO NC_CBK_EX_NR
      IGA_MV_CBK_ADJ_KNK[i] = IGA_MV_CBK_ADJ_KNK[i] /
        (NC_CYL_NR / NC_CBK_EX_NR)
    ENDFOR
  ELSE
    IGA_MV_CBK_ADJ_KNK[1] = 0
    FOR x = 0 TO (NC_CYL_NR - 1)
      IGA_MV_CBK_ADJ_KNK[1] += IGA_ADJ_KNK[x]
    ENDFOR
    IGA_MV_CBK_ADJ_KNK[1] = IGA_MV_CBK_ADJ_KNK[1] / NC_CYL_NR
  ENDFIF

```

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### 6.17.3.2 Noise Value



#### FUNCTION DESCRIPTION:

The noise value is cylinder-individually calculated as sliding average from the knock values. The averaging constant is either taken from ID\_NL\_CRLC, if no knock control transient function is active (LV\_KNK\_TRA\_N = 0 and LV\_KNK\_TRA\_MAF = 0) or C\_NL\_CRLC\_TRA, when a knock control transient function is active (LV\_KNK\_TRA\_N = 1 or LV\_KNK\_TRA\_MAF = 1).

#### Application conditions

- Activation:** *at every engine state except engine stop*
- Deactivation:** *at engine stop*
- Initialization:** NL[0 to NC\_CYL\_NR] = C\_KNK\_THD\_MAX  
*at reset or engine running to engine stop*
- Update Rate:** *every segment*

#### Formula section:

```

if      (LV_KNK_TRA_N or LV_KNK_TRA_MAF)
then    if      OPM_AV = "AFS"
        then    NL[x] = NL[x] + (KNKS[x] - NL[x]) * C_NL_CRLC_TRA
        else    NL[x] = NL[x] + (KNKS[x] - NL[x]) * C_NL_CRLC_TRA_AFL
        end if

        elseif  LV_CTR_KNK_CMB = 1
        then    NL[x] = NL[x] + (KNKS[x] - NL[x]) * C_NL_CRLC_CMB

else
        NL[x] = NL[x] + (KNKS[x] - NL[x]) * ID_NL_CRLC
end if
    
```

NL[NC\_CYL\_NR] shows always the measured noise value from the ATIC62 device. The noise value is calculated always (independant from detection of knocking combustion).

**In transient condition, if knocking combustions are detected (LV\_KNK = 1) after knock-free operation, the first noise value is used weighted ((KNKS[x] / IP\_FAC\_THD\_KNK) \* C\_FAC\_KNK\_TRA instead of simply use of KNKS[x]) to calculate the noise level, the second and the following are taken into consideration for normal transient calculation of noise level again.**

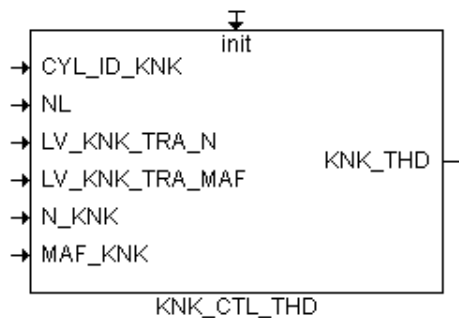
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**Else, if  $KNKS[x] \geq IP\_FAC\_NL\_UPD\_DEAC * KNK\_THD[x]$  (signal near threshold) AND  $LV\_KNK\_PAS\_TRAN\_ACT = 1$  (delay cycles elapsed after passive or limp-home) AND  $LV\_CTR\_KNK\_CMB = 0$  (delay counter elapsed after combustion mode switch), the first and the second noise value isn't used to calculate the noise level ( $NL[NC\_CYL\_NR]$  remains unchanged), the third and the following are taken into consideration for calculation of noise level.  $NL[NC\_CYL\_NR]$  remains unchanged for this time.**

**N.B.:** x represents current  $CYL\_ID\_KNK$

### 6.17.3.3 Relative and Absolute Knock Threshold



#### FUNCTION DESCRIPTION:

##### General information:

The knock threshold ( $KNK\_THD[NC\_CYL\_NR]$ ) is the limit for the knock values ( $KNKS_x$ ), which are used for knock decision. If the knock values are greater or equal to the knock threshold, then knocking is recognised ( $LV\_KNK = 1$ ) and an ignition timing retardation follows. If the knock values are smaller, knocking is not detected ( $LV\_KNK = 0$ ) and the relevant  $KNK$ -ignition-angle is reset ( $\rightarrow$  Knock-free Operation after Knocking).

The knock threshold is calculated for each cylinder separately and depends on the cylinder-individual noise value. Calculation of the knock threshold occurs with help from the cylinder-individual knock factors  $IP\_FAC\_THD\_KNK[NC\_CYL\_NR]$  and knock summand  $IP\_ADD\_KNK\_N$ .


If the noise value is above the minimum threshold  $C\_NL\_MIN$ , the knock threshold is calculated on the basis of the cylinder-individually noise value  $NL[NC\_CYL\_NR]$ . If the noise value is below  $C\_NL\_MIN$  this value is used as noise value for calculation of the knock threshold. If the knock threshold is above  $ID\_THD\_MAX\_KNK$  this value is used as knock threshold (Limitation).

$C\_THD\_MAX\_KNK$  stays preserved as initialisation value for  $NL$  and  $NL\_0\_5$  (in multiplexer specification).

**N.B.:** The actual knock value  $KNKS[x]_n$  is not used in the calculation of the actual knock threshold  $KNK\_THD[x]_n$  but in the calculation of the next threshold  $KNK\_THD[x]_{n+1}$ . So the decision knocking combustion yes/no is done with using the knock threshold  $KNKS[x]_{n-1}$ .

#### Application conditions

**Activation:** *at every engine state except engine stop*

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**Deactivation:** *at engine stop*

**Initialization:**  $KNK\_THD[0 \text{ to } NC\_CYL\_NR] = KNK\_THD\_PRE = 5V$   
*at reset and engine running to engine stop*

**Update Rate:** *every segment*

**Formula section:**

The lower absolute threshold is one value for all cylinders and is represented by the constant C\_NL\_MIN.

```

if  NL[x] < C_NL_MIN
    NL_LIM = C_NL_MIN
else
    NL_LIM = NL[x]
end if

if  OPM_AV = "AFS"
    if  (LV_KNK_TRA_N = 0 and LV_KNK_TRA_MAF = 0)
        KNK_THD[x] = ( NL_LIM + IP_KNK_THD_ADD_N ) * IP_FAC_THD_KNK[x]
    else
        KNK_THD[x] = ( NL_LIM + IP_KNK_THD_ADD_N ) * IP_FAC_THD_KNK[x] *
                    C_FAC_TRA_KNK
    end if
else
    if  (LV_KNK_TRA_N = 0 and LV_KNK_TRA_MAF = 0)
        KNK_THD[x] = ( NL_LIM + IP_KNK_THD_ADD_N_AFL ) *
                    IP_FAC_THD_KNK_AFL[x]
    else
        KNK_THD[x] = ( NL_LIM + IP_KNK_THD_ADD_N_AFL ) *
                    IP_FAC_THD_KNK_AFL[x] * C_FAC_TRA_KNK
    end if
end if

```

The knock threshold is generally limited to KNK\_THD\_MAX

```

KNK_THD_MAX = IP_KNK_THD_MAX
if (KNK_THD[x] > KNK_THD_MAX)
    KNK_THD[x] = KNK_THD_MAX
end if

```

```

if LV_KNK_CTL_PRE_INH = 0
    KNK_THD_PRE = ID_KNK_THD_MAX_PRE
end if

```


**N.B.:** x represents current CYL\_ID\_KNK

(\*) The correction factor C\_FAC\_TRA\_KNK is part of the KNK-load dynamics function and is effective after recognised load dynamics ID\_CYCNR\_FAC\_TRA\_KNK\_N cycles.

The knock factor is the multiplicative part used for calculation of the knock threshold from the noise value.

The knock summand is an additive correction of the knock noise value. Thereby the knock threshold can be moved, dependent on the speed, in a positive or negative direction.


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**KNK\_THD\_MAX** with respect to **IP\_KNK\_THD\_MAX** is used as absolute threshold for detection algorithm in main window.


**KNK\_THD\_PRE** with respect to **ID\_KNK\_THD\_MAX\_PRE** is used as absolute threshold for detection algorithm in pre-window.

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
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## 7.1 Final injection timing

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_DIF_SOI_IGN	O	0... F00H	0... 1440	0.375	°CRK
Output variable for LACO					
FAC_PRS_COR_DAMP_1_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
Pressure pulsation correction factor due to delay time and fuel pressure; first pulse homogeneous mode					
FAC_PRS_COR_DAMP_2_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
Pressure pulsation correction factor due to delay time and fuel pressure; second pulse homogeneous mode					
FAC_PRS_COR_DAMP_3_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
Pressure pulsation correction factor due to delay time and fuel pressure; third pulse homogeneous mode					
FAC_PRS_COR_MFF_1_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
Pressure pulsation correction factor due to previous injected fuel mass; first pulse homogeneous mode					
FAC_PRS_COR_MFF_2_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
Pressure pulsation correction factor due to previous injected fuel mass; second pulse homogeneous mode					
FAC_PRS_COR_MFF_3_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
Pressure pulsation correction factor due to previous injected fuel mass; third pulse homogeneous mode					
FAC_PRS_COR_OSC_1_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
Pressure pulsation correction factor due to delay time and injection time; first pulse homogeneous mode					
FAC_PRS_COR_OSC_2_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
Pressure pulsation correction factor due to delay time and injection time; second pulse homogeneous mode					
FAC_PRS_COR_OSC_3_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
Pressure pulsation correction factor due to delay time and injection time; third pulse homogeneous mode					
FAC_TI_2_S_COR [NC_CBK_HPP_NR]	V	0... FFFFH	0... 1.99996	30.5e-6	-
Correction factor for mass flow difference at double injection, caused by duration of the second pulse.					
FAC_TI_2_S_DLY_COR [NC_CBK_HPP_NR]	V	0... FFFFH	0... 1.99996	30.5e-6	-
Correction factor for mass flow difference at double injection					
FAC_TI_3_S_COR [NC_CBK_HPP_NR]	V	0... FFFFH	0... 1.99996	30.5e-6	-
Correction factor for mass flow difference at multiple injection, caused by duration of the third pulse.					
FAC_TI_3_S_DLY_COR [NC_CBK_HPP_NR]	V	0... FFFFH	0... 1.99996	30.5e-6	-
Correction factor for mass flow difference at multiple injection; 3. pulse strat. mode					
FAC_TI_PRS_COR_1	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Pressure pulsation correction factor for first pulse					
FAC_TI_PRS_COR_1_HOM [NC_CBK_HPP_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Pressure pulsation correction factor for first pulse homogeneous mode					
FAC_TI_PRS_COR_2	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Pressure pulsation correction factor for the second pulse					
FAC_TI_PRS_COR_2_HOM [NC_CBK_HPP_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Pressure pulsation correction factor for second pulse homogeneous mode					
FAC_TI_PRS_COR_2_S [NC_CBK_HPP_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Pressure pulsation correction factor for second pulse stratified mode					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TI_PRS_COR_3	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Pressure pulsation correction factor for the third pulse					
FAC_TI_PRS_COR_3_HOM [NC_CBK_HPP_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Pressure pulsation correction factor for third pulse homogeneous mode					
FAC_TI_PRS_COR_3_S [NC_CBK_HPP_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Pressure pulsation correction factor for third pulse stratified mode					
IDX_TI_1_HOM_CLC [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Couting factor index for first pulse HOM					
IDX_TI_1_S_CLC [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Couting factor index for first pulse S					
IDX_TI_1_STND_HOM [NC_CYL_NR]	V	0... FFFFH	0... 65535	1	-
Couting factor index for first pulse HOM intermediate value					
IDX_TI_2_HOM_CLC [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Couting factor index for second pulse HOM					
IDX_TI_2_S_CLC [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Couting factor index for second pulse S					
IDX_TI_2_STND_HOM [NC_CYL_NR]	V	0... FFFFH	0... 65535	1	-
Couting factor index for second pulse HOM intermediate value					
IDX_TI_3_HOM_CLC [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Couting factor index for third pulse HOM					
IDX_TI_3_S_CLC [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Couting factor index for third pulse S					
IDX_TI_3_STND_HOM [NC_CYL_NR]	V	0... FFFFH	0... 65535	1	-
Couting factor index for third pulse HOM intermediate value					
LV_AUTH_TI_MIN_AFL	O/V	0... 1H	0 ...1	1	-
Logical variable to authorize homogeneous lean mode if injection time is not to less					
LV_AUTH_TI_MIN_S	O/V	0... 1H	0 ...1	1	-
Logical variable to authorize stratified mode if injection time is not to less					
LV_TI_1_HOM_MIN	O/V	0... 1H	0 ...1	1	-
Flag to indicate that minimum injection time is reached for homogeneous mode, first pulse					
LV_TI_1_S_MIN	O/V	0... 1H	0 ...1	1	-
Flag to indicate that minimum injection time is reached for stratified mode, first pulse					
LV_TI_2_HOM_MIN	O/V	0... 1H	0 ...1	1	-
Flag to indicate that minimum injection time is reached for homogeneous mode, second pulse					
LV_TI_2_S_MIN	O/V	0... 1H	0 ...1	1	-
Flag to indicate that minimum injection time is reached for stratified mode, second pulse					
LV_TI_3_HOM_MIN	O/V	0... 1H	0 ...1	1	-
Flag to indicate that minimum injection time is reached for homogeneous mode, third pulse					
LV_TI_3_S_MIN	O/V	0... 1H	0 ...1	1	-
Flag to indicate that minimum injection time is reached for stratified mode, third pulse					
MFF_SP_1_HOM_COR_INJ [NC_CYL_NR]	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Cylinder individual mass fuel flow set-point for homogeneous mode corrected by piezo energy carryover, first pulse					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MFF_SP_1_S_COR_INJ [NC_CYL_NR]	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Cylinder individual mass fuel flow set-point for stratified mode corrected by piezo energy carryover, first pulse					
MFF_SP_2_HOM_COR_INJ [NC_CYL_NR]	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Cylinder individual mass fuel flow set-point for homogeneous mode corrected by piezo energy carryover, second pulse					
MFF_SP_2_S_COR_INJ [NC_CYL_NR]	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Cylinder individual mass fuel flow set-point for stratified mode corrected by piezo energy carryover, second pulse					
MFF_SP_3_HOM_COR_INJ [NC_CYL_NR]	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Cylinder individual mass fuel flow set-point for homogeneous mode corrected by piezo energy carryover, third pulse					
MFF_SP_3_S_COR_INJ [NC_CYL_NR]	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Cylinder individual mass fuel flow set-point for stratified mode corrected by piezo energy carryover, third pulse					
RATIO_T_PER_PRS_COR_1_HOM	V	0... FFFFH	0... 0.99998	15.3e-6	-
Ratio of offset time to periode time of fuel rail pressure pulsation; homogeneous first pulse					
RATIO_T_PER_PRS_COR_2_HOM	V	0... FFFFH	0... 0.99998	15.3e-6	-
Ratio of offset time to periode time of fuel rail pressure pulsation; homogeneous second pulse					
RATIO_T_PER_PRS_COR_3_HOM	V	0... FFFFH	0... 0.99998	15.3e-6	-
Ratio of offset time to periode time of fuel rail pressure pulsation; homogeneous third pulse					
RATIO_TI_1_HOM	V	0... FFFFH	0... 15.99975	244.1e-6	-
Ratio of injection time to periode time of fuel rail pressure pulsation; homogeneous first pulse					
RATIO_TI_2_HOM	V	0... FFFFH	0... 15.99975	244.1e-6	-
Ratio of injection time to periode time of fuel rail pressure pulsation; homogeneous second pulse					
RATIO_TI_3_HOM	V	0... FFFFH	0... 15.99975	244.1e-6	-
Ratio of injection time to periode time of fuel rail pressure pulsation; homogeneous third pulse					
T_AUTH_TI_MIN_AFL	-	0... FFFFH	0.01... 655.36	0.01	s
Delay time after AFL mode was inhibited due to injection time limitation					
T_CHA_PER_HOM [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV charge period for homogeneous mode					
T_CHA_PER_HOM_2 [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV charge period for homogeneous mode second pulse					
T_CHA_PER_HOM_3 [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV charge period for homogeneous mode third pulse					
T_CHA_PER_POST	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV charge period for post injection pulse					
T_CHA_PER_S_1 [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV charge period for stratified mode first pulse					
T_CHA_PER_S_2 [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV charge period for stratified mode second pulse					
T_CHA_PER_S_3 [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV charge period for stratified mode third pulse					
T_DCHA_PER_HOM [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV discharge period for homogeneous mode first pulse					
T_DCHA_PER_HOM_2 [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV discharge period for homogeneous mode second pulse					
T_DCHA_PER_HOM_3 [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV discharge period for homogeneous mode third pulse					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_DCHA_PER_POST	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV discharge period for post injection pulse					
T_DCHA_PER_S_1 [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV discharge period for stratified mode first pulse					
T_DCHA_PER_S_2 [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV discharge period for stratified mode second pulse					
T_DCHA_PER_S_3 [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV discharge period for stratified mode; third pulse					
T_DLY_1_1_HOM	V	0... FFFFH	0... 65.535	0.001	ms
Delay time between the first pulses of two consecutive cylinders at homogeneous single injection					
T_DLY_1_2_HOM	V	0... FFFFH	0... 65.535	0.001	ms
Delay time between the first and second pulse at homogeneous multi injection					
T_DLY_2_3_HOM	V	0... FFFFH	0... 65.535	0.001	ms
Delay time between the second and third pulse at homogeneous multi injection					
T_PER_PRS_COR_1_HOM	V	0... FFFFH	0... 65.535	0.001	ms
Periode time of fuel rail pressure pulsation; homogeneous first pulse					
T_PER_PRS_COR_2_HOM	V	0... FFFFH	0... 65.535	0.001	ms
Periode time of fuel rail pressure pulsation; homogeneous second pulse					
T_PER_PRS_COR_3_HOM	V	0... FFFFH	0... 65.535	0.001	ms
Periode time of fuel rail pressure pulsation; homogeneous third pulse					
T_RLS_DLY_DCHA_1_HOM [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Release delay time for first pulse in homogeneous mode.					
T_RLS_DLY_DCHA_1_S [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Release delay time for first pulse in stratified mode.					
T_RLS_DLY_DCHA_2_HOM [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Release delay time for second pulse in homogeneous mode.					
T_RLS_DLY_DCHA_2_S [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Release delay time for second pulse in stratified mode.					
T_RLS_DLY_DCHA_3_HOM [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Release delay time for third pulse in homogeneous mode.					
T_RLS_DLY_DCHA_3_S [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Release delay time for third pulse in stratified mode.					
T_RLS_DLY_DCHA_POST	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Release delay time for post injection.					
TEMP_PRS_COR_1_HOM	V	0... FEH	-48... 142.5	0.75	°C
Fuel temperature for pressure pulsations correction; first pulse homogeneous mode					
TEMP_PRS_COR_2_HOM	V	0... FEH	-48... 142.5	0.75	°C
Fuel temperature for pressure pulsations correction; second pulse homogeneous mode					
TI_1_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, homogeneous mode, first pulse (intermediate value)					
TI_1_HOM_CLC [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, homogeneous mode, first pulse (intermediate value)					
TI_1_HOM_CLC_MAX	O/V	0... FFFFH	0... 65.535	0.001	ms
Maximum injection time of first pulse, homogeneous mode					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TI_1_HOM_CLC_MIN	V	0... FFFFH	0... 65.535	0.001	ms
Minimum injection time of first pulse, homogeneous mode					
TI_1_S [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, stratified mode, fist pulse (intermediate value)					
TI_1_S_CLC [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, stratified mode, fist pulse (intermediate value)					
TI_1_S_CLC_MIN	V	0... FFFFH	0... 65.535	0.001	ms
Minimum injection time of first pulse, stratified mode					
TI_1_STND_HOM [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Mapped Injection time, homogeneous mode, 1. pulse					
TI_2_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, homogeneous mode, second pulse (intermediate value)					
TI_2_HOM_CLC [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, homogeneous mode, second pulse (intermediate value)					
TI_2_HOM_CLC_MAX	O/V	0... FFFFH	0... 65.535	0.001	ms
Maximum injection time of second pulse, homogeneous mode					
TI_2_HOM_CLC_MIN	V	0... FFFFH	0... 65.535	0.001	ms
Minimum injection time of second pulse, homogeneous mode					
TI_2_S [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, stratified mode, second pulse (intermediate value)					
TI_2_S_CLC [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, stratified mode, second pulse (intermediate value)					
TI_2_S_CLC_MIN	V	0... FFFFH	0... 65.535	0.001	ms
Minimum injection time of second pulse, stratified mode					
TI_2_STND_HOM [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Mapped Injection time, homogeneous mode, 2. pulse					
TI_3_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, homogeneous mode, third pulse					
TI_3_HOM_CLC [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, homogeneous mode, third pulse (intermediate value)					
TI_3_HOM_CLC_MAX	O/V	0... FFFFH	0... 65.535	0.001	ms
Maximum injection time of third pulse, homogeneous mode					
TI_3_HOM_CLC_MIN	V	0... FFFFH	0... 65.535	0.001	ms
Minimum injection time of third pulse, homogeneous mode					
TI_3_S [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, stratified mode, third pulse					
TI_3_S_CLC [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, stratified mode, third pulse (intermediate value)					
TI_3_S_CLC_MIN	V	0... FFFFH	0... 65.535	0.001	ms
Minimum injection time of third pulse, stratified mode					
TI_3_STND_HOM [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Mapped Injection time, homogeneous mode, 3. pulse					
TI_MIN_HOM	O/V	0... FFFFH	0... 65.535	0.001	ms
Minimum injection time limitation for homogeneous mode					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
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**Input data:**

CRK_DIF_SOI_IGN_HOM {p. 2122}	CRK_DIF_SOI_IGN_S {p. 2140}	CTR_CYL_NR_ST_CLC_ INJR {p. 3327}	EOI_2_HOM_EXT [NC_CYL_NR] {p. 2146}
EOI_3_HOM_EXT [NC_CYL_NR] {p. 2146}	FAC_MFF_DIF_HOM [NC_CYL_NR] {p. 2260}	FAC_MFF_DIF_S [NC_CYL_NR] {p. 2260}	FAC_MFF_TFU {p. 2224}
FAC_N {p. 3327}	FAC_TI_1_PRS_CYL_HOM [NC_CYL_NR] {p. 2200}	FAC_TI_1_PRS_CYL_S [NC_CYL_NR] {p. 2212}	FAC_TI_2_PRS_CYL_HOM [NC_CYL_NR] {p. 2204}
FAC_TI_2_PRS_CYL_S [NC_CYL_NR] {p. 2216}	FAC_TI_3_PRS_CYL_HOM [NC_CYL_NR] {p. 2208}	FAC_TI_3_PRS_CYL_S [NC_CYL_NR] {p. 2220}	FAC_TI_COR_IV_EGY_ RNG_L [NC_CBK_HPP_NR] {p. 2260}
FAC_TI_L_PRS {p. 3327}	FUP_H_INJ [NC_CBK_HPP_NR] {p. 3327}	IDX_PRS_COR_CYL_ CLC_MPLH [NC_CBK_HPP_NR] {p. 3327}	IDX_PRS_COR_CYL_ CLC_S [NC_CBK_HPP_NR] {p. 3327}
INJ_MOD_SP_HOM [NC_CYL_NR] {p. 3329}	INJ_MOD_SP_HOMS [NC_CYL_NR] {p. 3329}	INJ_MOD_SP_S [NC_CYL_NR] {p. 3330}	LF_PRS_COR_HPP_ENA {p. 3330}
LV_AFL_CLC {p. 1822}	LV_EGY_RNG_IV_PLS_1_ HOM [NC_CYL_NR] {p. 2261}	LV_EGY_RNG_IV_PLS_1_ S [NC_CYL_NR] {p. 2261}	LV_EGY_RNG_IV_PLS_2_ HOM [NC_CYL_NR] {p. 2261}
LV_EGY_RNG_IV_PLS_2_ S [NC_CYL_NR] {p. 2261}	LV_EGY_RNG_IV_PLS_3_ HOM [NC_CYL_NR] {p. 2261}	LV_EGY_RNG_IV_PLS_3_ S [NC_CYL_NR] {p. 2261}	LV_IV_POST_EGY_RNG {p. 2179}
LV_PRS_COR_MPLH_ENA {p. 3331}	LV_PRS_COR_SNGH_ ENA {p. 3331}	LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}
MFF_ADD_REAC [NC_CYL_NR] {p. 3331}	MFF_SP_1_HOM [NC_CYL_NR] {p. 8242}	MFF_SP_1_S [NC_CYL_NR] {p. 8242}	MFF_SP_2_HOM [NC_CYL_NR] {p. 8242}
MFF_SP_2_S [NC_CYL_NR] {p. 8242}	MFF_SP_3_HOM [NC_CYL_NR] {p. 8243}	MFF_SP_3_S [NC_CYL_NR] {p. 8243}	NC_CBK_HPP_NR [1] {p. 812}
NC_IDX_CYL_HPP_REF [NC_CYL_NR] {p. 626}	NC_INJ_MOD_HOM {p. 2045}	NC_INJ_MOD_MASK_1 {p. 2045}	NC_NR_IDX_MFF_1_INJ {p. 627}
NC_NR_IDX_MFF_2_INJ {p. 627}	NC_NR_IDX_MFF_SP_2 {p. 627}	NC_NR_IDX_MFF_SP_3 {p. 627}	NC_NR_IDX_PRS_DEC_ INJ {p. 627}
NC_NR_IDX_PRS_DEC_ INJ_2 {p. 627}	NC_NR_IDX_T_DLY_1_2_ S_COR {p. 627}	NC_NR_IDX_T_DLY_1_2_ S_DLY_COR {p. 627}	NC_NR_IDX_T_DLY_2_3_ S_COR {p. 627}
NC_NR_IDX_T_DLY_2_3_ S_DLY_COR {p. 627}	NC_NR_IDX_TI_1_INJ {p. 627}	NC_NR_IDX_TI_2_INJ {p. 627}	NC_NR_IDX_TI_2_S {p. 627}

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NC_NR_IDX_TI_3_S {p. 627}	NR_CYL_CLC_RED_INJ {p. 3331}	PRS_DEC_INJ_1_HOM [NC_CYL_NR] {p. 2200}	PRS_DEC_INJ_1_S [NC_CYL_NR] {p. 2212}
PRS_DEC_INJ_2_HOM [NC_CYL_NR] {p. 2204}	PRS_DEC_INJ_2_S [NC_CYL_NR] {p. 2216}	PRS_DEC_INJ_3_HOM [NC_CYL_NR] {p. 2208}	PRS_DEC_INJ_3_S [NC_CYL_NR] {p. 2220}
SOI_1_HOM_EXT [NC_CYL_NR] {p. 2146}	STATE_CMB_CTL {p. 8137}	STATE_INJ_MOD_HOMS_ REQ {p. 3331}	STATE_INJ_MOD_REQ {p. 3332}
STATE_INJ_MOD_S_REQ {p. 3332}	T_DLY_1_2_S_EXT [NC_CYL_NR] {p. 2146}	T_DLY_2_3_S_EXT [NC_CYL_NR] {p. 2146}	TCO {p. 1100}
TEMP_CAPA_IV_MV {p. 2241}	TFU_INJ {p. 3332}	TI_2_PRS_HOM_SP [NC_CYL_NR] {p. 2204}	TI_2_STND_S [NC_CYL_NR] {p. 2216}
TI_3_PRS_HOM_SP [NC_CYL_NR] {p. 2208}	TI_3_STND_S [NC_CYL_NR] {p. 2220}	TI_ADD [NC_CYL_NR] {p. 999}	TI_FAC [NC_CYL_NR] {p. 999}
TI_TUN_ADD_IV [NC_CYL_NR] {p. 2233}	TI_TUN_IV [NC_CYL_NR] {p. 2233}		


**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_PRS_COR_TEMP_SEL	-	0... 8H	0 ...8	1	-
Constant to select temperature for pressure pulsation correction (0=TFU_INJ; 1=TEMP_CAPA_IV_MV; 2=TCO)					
C_T_AUTH_TI_MIN_AFL	-	0... FFFFH	0.01... 655.36	0.01	s
Delay time after AFL mode was inhibited due to injection time limitation					
C_T_CHA_PER_H	-	0... 7FFFH	0... 3276.7	0.1	µs
Piezo injector charging time for high injector needle lift					
C_T_CHA_PER_L	-	0... 7FFFH	0... 3276.7	0.1	µs
Piezo injector charging time for low injector needle lift					
C_T_MIN_DIF_CHA_DCHA	-	8000... 7FFFH	-3276.8 ...3276.7	0.1	µs
Minimum time between end of charging procedure and begin of discharging procedure for injection valve					
C_TI_1_HOM_MAN	-	0... FFFFH	0... 65.535	0.001	ms
Manual setpoint for injection time in homogeneous mode, 1. pulse					
C_TI_1_S_MAN	-	0... FFFFH	0... 65.535	0.001	ms
Manual setpoint for injection time in stratified mode, 1. pulse					
C_TI_2_HOM_MAN	-	0... FFFFH	0... 65.535	0.001	ms
Manual setpoint for injection time in homogeneous mode, 2. pulse					
C_TI_2_S_MAN	-	0... FFFFH	0... 65.535	0.001	ms
Manual setpoint for injection time in stratified mode, 2. pulse					
C_TI_3_HOM_MAN	-	0... FFFFH	0... 65.535	0.001	ms
Manual setpoint for injection time in homogeneous mode, 3. pulse					
C_TI_3_S_MAN	-	0... FFFFH	0... 65.535	0.001	ms
Manual setpoint for injection time in stratified mode, 3. pulse					
C_TI_MIN_HYS_S	-	0... FFH	0... 1.02	0.004	ms
Hysteresis to TI_MIN, (injection time limitation at stratified mode)					
C_TI_MIN_OFS	-	0... FFH	0... 1.02	0.004	ms
Offset to TI_MIN, (injection time limitation at AFL mode and stratified mode)					
ID_T_PER_PRS_COR_1_HOM	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_NR_OSC_1_INJR	5	0... 9H	0 ...9	1	-
Pressure pulsation correction factor due increasing delay time; homogeneous first pulse					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_T_PER_PRS_COR_2_HOM	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_NR_OSC_1_INJR	5	0... 9H	0 ...9	1	-
Pressure pulsation correction factor due increasing delay time; homogeneous second pulse					
ID_T_PER_PRS_COR_3_HOM	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_NR_OSC_1_INJR	5	0... 9H	0 ...9	1	-
Pressure pulsation correction factor due increasing delay time; homogeneous third pulse					
IP_FAC_PRS_COR_DAMP_1_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_T_DLY_1_INJR	8	0... FFFFH	0... 65.535	0.001	ms
LDPM_FUP_H_2_INJR	6	0... FFFFH	0... 347776	5.3067216	hPa
Pressure pulsation correction factor due to delay time and fuel pressure; homogeneous first pulse					
IP_FAC_PRS_COR_DAMP_2_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_T_DLY_1_INJR	8	0... FFFFH	0... 65.535	0.001	ms
LDPM_FUP_H_2_INJR	6	0... FFFFH	0... 347776	5.3067216	hPa
Pressure pulsation correction factor due to delay time and fuel pressure; homogeneous second pulse					
IP_FAC_PRS_COR_DAMP_3_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_T_DLY_1_INJR	8	0... FFFFH	0... 65.535	0.001	ms
LDPM_FUP_H_2_INJR	6	0... FFFFH	0... 347776	5.3067216	hPa
Pressure pulsation correction factor due to delay time and fuel pressure; homogeneous third pulse					
IP_FAC_PRS_COR_MFF_1_HOM	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_MFF_1_INJR	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Pressure pulsation correction factor due to previous injected fuel mass; homogeneous first pulse					
IP_FAC_PRS_COR_MFF_2_HOM	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_MFF_1_INJR	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Pressure pulsation correction factor due to previous injected fuel mass; homogeneous second pulse					
IP_FAC_PRS_COR_MFF_3_HOM	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_MFF_1_INJR	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Pressure pulsation correction factor due to previous injected fuel mass; homogeneous third pulse					
IP_FAC_PRS_COR_OSC_1_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_RATIO_T_PER_1_INJR	12	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_RATIO_TI_1_INJR	12	0... FFFFH	0... 15.99975	244.1e-6	-
Pressure pulsation correction factor due to delay time and injection time; homogeneous first pulse					
IP_FAC_PRS_COR_OSC_2_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_RATIO_T_PER_1_INJR	12	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_RATIO_TI_1_INJR	12	0... FFFFH	0... 15.99975	244.1e-6	-
Pressure pulsation correction factor due to delay time and injection time; homogeneous second pulse					
IP_FAC_PRS_COR_OSC_3_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_RATIO_T_PER_1_INJR	12	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_RATIO_TI_1_INJR	12	0... FFFFH	0... 15.99975	244.1e-6	-
Pressure pulsation correction factor due to delay time and injection time; homogeneous third pulse					
IP_FAC_TI_2_S_COR	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_TI_2_S_IP_FAC_TI_2_S_COR	NC_ NR_ IDX_ TI_2_ S	0... FFFFH	0... 65.535	0.001	ms

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_T_DLY_1_2_S_IP_FAC_COR_2_S	NC_ NR_ IDX_ T_ DLY_ 1_2_ S_ COR	0... FFFFH	0... 65.535	0.001	ms
This calibration data is for correction of the mass flow difference between the mass flow sum of two pulses in comparison with the same requested mass for one pulse. This correction compensates different second injection duration.					
IP_FAC_TI_2_S_DLY_COR	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_T_DLY_1_2_S_IP_FAC_TI_2_S	NC_ NR_ IDX_ T_ DLY_ 1_2_ S_ DLY_ COR	0... FFFFH	0... 65.535	0.001	ms
LDP_MFF_SP_IP_FAC_TI_2_S	NC_ NR_ IDX_ MFF_ SP_2	0... FFFFH	0... 1389	0.0211948	mg/stk
This calibration data is for correction of the mass flow difference between the mass flow sum of two pulses in comparison with the same requested mass for one pulse. The difference is caused by physical effects of the piezo injector.					
IP_FAC_TI_3_S_COR	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_TI_3_S_IP_FAC_TI_3_S_COR	NC_ NR_ IDX_ TI_3_ S	0... FFFFH	0... 65.535	0.001	ms
LDP_T_DLY_2_3_S_IP_FAC_COR_3_S	NC_ NR_ IDX_ T_ DLY_ 2_3_ S_ COR	0... FFFFH	0... 65.535	0.001	ms
This calibration data is for correction of the mass flow difference between the mass flow sum of two pulses in comparison with the same requested mass for one pulse. This correction compensates different third injection duration.					

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 2007 of 8404</b>	
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_TI_3_S_DLY_COR	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_T_DLY_2_3_S_IP_FAC_TI_3_S	NC_ NR_ IDX_ T_ DLY_ 2_3_ S_ DLY_ COR	0... FFFFH	0... 65.535	0.001	ms
LDP_MFF_SP_IP_FAC_TI_3_S	NC_ NR_ IDX_ MFF_ SP_3	0... FFFFH	0... 1389	0.0211948	mg/stk
This calibration data is for correction of the mass flow difference between the mass flow sum of two pulses in comparison with the same requested mass for one pulse. The difference is caused by physical effects of the piezo injector.					
IP_MFF_IDX_TI_EGY_H	V	0... FFFFH	0... 65535	1	-
LDPM_MFF_SP_1_INJR	NC_ NR_ IDX_ MFF_ 1_INJ	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_PRS_DEC_INJ_2_INJR	NC_ NR_ IDX_ PRS_ DEC_ INJ_2	0... FFFFH	0... 347776	5.3067216	hPa
Injector characteristic at different injector pressure differences, for high energy range					
IP_MFF_IDX_TI_EGY_L	V	0... FFFFH	0... 65535	1	-
LDPM_MFF_SP_1_INJR	NC_ NR_ IDX_ MFF_ 1_INJ	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_PRS_DEC_INJ_2_INJR	NC_ NR_ IDX_ PRS_ DEC_ INJ_2	0... FFFFH	0... 347776	5.3067216	hPa
Injector characteristic at different injector pressure differences, for low energy range					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_MFF_TI_EGY_H	V	0... FFFFH	0... 65.535	0.001	ms
LDPM_MFF_SP_2_INJR	NC_ NR_ IDX_ MFF_ 2_INJ	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_PRS_DEC_INJ_3_INJR	NC_ NR_ IDX_ PRS_ DEC_ INJ	0... FFFFH	0... 347776	5.3067216	hPa
Injector characteristic at different injector pressure differences, for high energy range					
IP_MFF_TI_EGY_L	V	0... FFFFH	0... 65.535	0.001	ms
LDPM_MFF_SP_2_INJR	NC_ NR_ IDX_ MFF_ 2_INJ	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_PRS_DEC_INJ_3_INJR	NC_ NR_ IDX_ PRS_ DEC_ INJ	0... FFFFH	0... 347776	5.3067216	hPa
Injector characteristic at different injector pressure differences, for low energy range					
IP_T_CHA_PER_H	-	0... 7FFFH	0... 3276.7	0.1	µs
LDPM_IDX_TI_1_INJR	NC_ NR_ IDX_ TI_1_ INJ	0... FFFFH	0... 65535	1	-
Injector charging time for high injector needle lift.					
IP_T_CHA_PER_L	-	0... 7FFFH	0... 3276.7	0.1	µs
LDPM_IDX_TI_2_INJR	NC_ NR_ IDX_ TI_2_ INJ	0... FFFFH	0... 65535	1	-
Injector charging time for low injector needle lift.					
IP_T_PER_PRS_COR_1_HOM	V	0... FFFFH	0... 65.535	0.001	ms
LDPM_TEMP_PRS_COR_1_INJR	5	0... FEH	-48... 142.5	0.75	°C
LDPM_FUP_H_2_INJR	6	0... FFFFH	0... 347776	5.3067216	hPa
Periode time of fuel rail pressure pulsation; homogeneous first pulse					
IP_T_PER_PRS_COR_2_HOM	V	0... FFFFH	0... 65.535	0.001	ms

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_TEMP_PRS_COR_1_INJR	5	0... FEH	-48... 142.5	0.75	°C
LDPM_FUP_H_2_INJR	6	0... FFFFH	0... 347776	5.3067216	hPa
Periode time of fuel rail pressure pulsation; homogeneous second pulse					
IP_T_PER_PRS_COR_3_HOM	V	0... FFFFH	0... 65.535	0.001	ms
LDPM_TEMP_PRS_COR_1_INJR	5	0... FEH	-48... 142.5	0.75	°C
LDPM_FUP_H_2_INJR	6	0... FFFFH	0... 347776	5.3067216	hPa
Periode time of fuel rail pressure pulsation; homogeneous third pulse					
IP_T_RLS_DLY_T_DCHA	-	0... 7FFFH	0... 3276.7	0.1	µs
LDP_T_DCHA_IP_T_RLS_DLY	6	0... 7FFFH	0... 3276.7	0.1	µs
Release Delay time depending on the discharge time					
IP_TI_H	-	0... FFFFH	0... 65.535	0.001	ms
LDPM_IDX_TI_1_INJR	NC_ NR_ IDX_ TI_1_ INJ	0... FFFFH	0... 65535	1	-
Injection time for high injector needle lift.					
IP_TI_L	-	0... FFFFH	0... 65.535	0.001	ms
LDPM_IDX_TI_2_INJR	NC_ NR_ IDX_ TI_2_ INJ	0... FFFFH	0... 65535	1	-
Injection time for low injector needle lift.					
IP_TI_MIN_HOM	-	0... FFFFH	0... 65.535	0.001	ms
LDPM_PRS_DEC_INJ_1_INJR	6	0... FFFFH	0... 347776	5.3067216	hPa
Minimum injection time limitation for homogeneous mode					
LC_CUR_SHP_INJ_ENA	-	0... 1H	0 ...1	1	-
Switch to enable injection current shaping via IDX_TI calculation.					
LC_PRS_COR_MPLH_ENA	-	0... 1H	0 ...1	1	-
Switch to enable correction of rail pressure pulsations in homogeneous multi injection mode					
LC_PRS_COR_MPLS_ENA	-	0... 1H	0 ...1	1	-
Switch to enable correction of rail pressure pulsations in multiple stratified mode					
LC_PRS_COR_SNGH_ENA	-	0... 1H	0 ...1	1	-
Switch to enable correction of rail pressure pulsations in homogeneous single injection mode					
LC_PRS_COR_SOI_DLY_ENA	-	0... 1H	0 ...1	1	-
Switch to enable delaytime calculation from start of injection in homogeneous mode					
LC_TI_1_HOM_MAN_ACT	-	0... 1H	0 ...1	1	-
Manual switch for manual setpoint for injection time in homogeneous mode					
LC_TI_1_S_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual setpoint for injection time in stratified mode, 1. pulse					
LC_TI_2_HOM_MAN_ACT	-	0... 1H	0 ...1	1	-
Manual switch for manual setpoint for injection time in homogeneous mode, 2. pulse					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_TI_2_S_MAN_ACT	-	0... 1H	0 ...1	1	-
switch for manual setpoint for injection time in stratified mode, 2. pulse					
LC_TI_3_HOM_MAN_ACT	-	0... 1H	0 ...1	1	-
Manual switch for manual setpoint for injection time in homogeneous mode, 3. pulse					
LC_TI_3_S_MAN_ACT	-	0... 1H	0 ...1	1	-
switch for manual setpoint for injection time in stratified mode, 3. pulse					

## Overview:

### Calculation of the cylinder individual injection times for homogeneous mode:

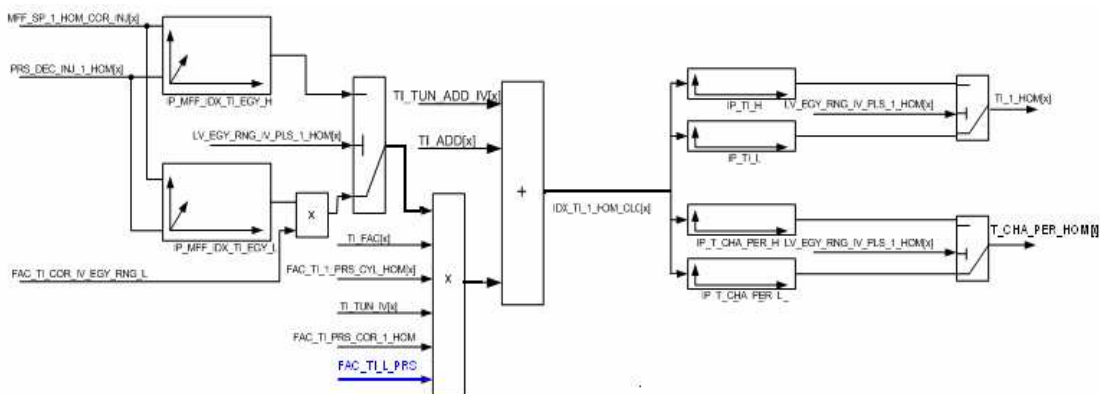
#### First pulse:

This module calculates the cylinder individual injection times  $TI\_1\_HOM[x]$ , which are applied at the injectors.

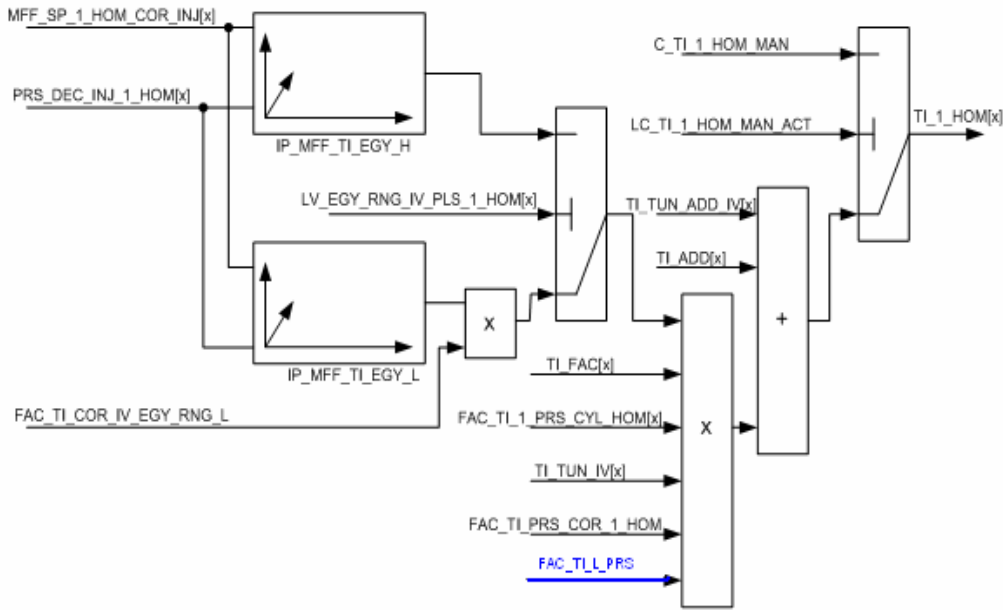
The injection time can be set manually. If the switch  $LC\_TI\_1\_HOM\_MAN\_ACT$  is set to one, the constant  $C\_TI\_1\_HOM\_MAN$  is applied.

If homogeneous lean mode is active ( $STATE\_CMB\_CTL = HOM\_AFL$ ) and  $TI\_1\_HOM[x]$  is smaller than  $(TI\_MIN + C\_TI\_MIN\_OFS)$ , the combustion mode changes to homogeneous mode. This is indicated if the flag  $LV\_AUTH\_TI\_MIN\_AFL$  is set to zero. Switching back to homogeneous lean mode is allowed at the earliest if the delay time  $C\_T\_AUTH\_TI\_MIN\_AFL$  has elapsed. Then the flag  $LV\_AUTH\_TI\_MIN\_AFL$  is set back to zero.

Overview for calculation of the first pulse in homogenous mode with active current shaping ( $LC\_CUR\_SHP\_INJ\_ENA = 1$ ):



Overview for calculation of the first pulse in homogenous mode with inactive current shaping ( $LC\_CUR\_SHP\_INJ\_ENA = 0$ ):



**Second pulse:**

If double injection is active (STATE\_INJ\_MOD\_HOM\_REQ = MPLH), then TI\_2\_HOM[x] is calculated.

**Third pulse:**

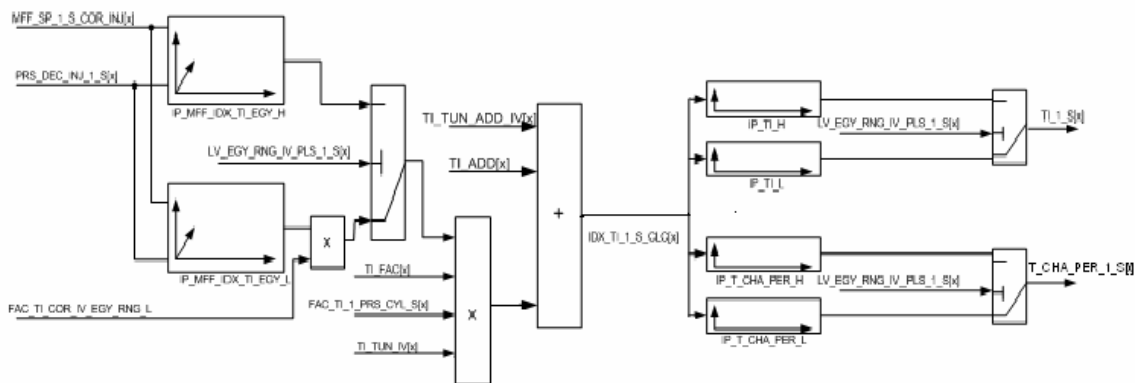
If triple injection is active (STATE\_INJ\_MOD\_HOM\_REQ = MPLH+PLS3), then TI\_3\_HOM[x] is calculated.

**Calculation of the cylinder individual injection times for stratified mode:**

**First pulse:**


The injection time TI\_1\_S[x] can be set manually. If the switch LC\_TI\_1\_S\_MAN\_ACT is set to one, the constant C\_TI\_1\_S\_MAN is applied.

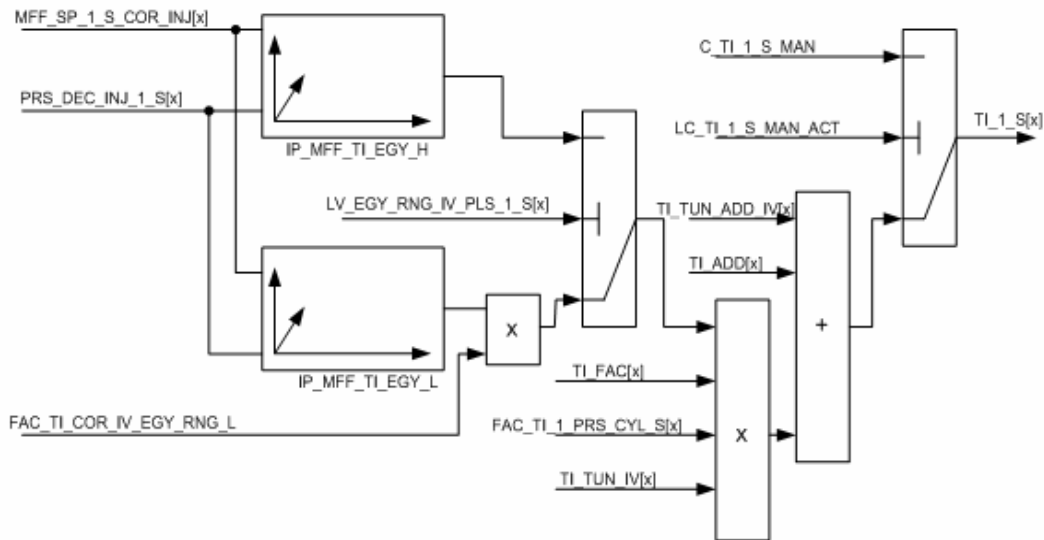
Overview for calculation of the first pulse in stratified mode with active current shaping (LC\_CUR\_SHP\_INJ\_ENA = 1):



Overview for calculation of the first pulse in stratified mode with inactive current shaping (LC\_CUR\_SHP\_INJ\_ENA = 0):

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### Second pulse:

If double injection is active ( $STATE\_INJ\_MOD\_S\_REQ = MPLS$ ), then  $TI\_2\_S[x]$  is calculated.

The injection time  $TI\_2\_S[x]$  can be set manually. If the switch  $LC\_TI\_2\_S\_MAN\_ACT$  is set to one, the constant  $C\_TI\_2\_S\_MAN$  is applied.

### Third pulse:

If triple injection is active ( $STATE\_INJ\_MOD\_S\_REQ = MPLS+PLS3$ ), then  $TI\_3\_S[x]$  is calculated.

The injection time  $TI\_3\_S[x]$  can be set manually. If the switch  $LC\_TI\_3\_S\_MAN\_ACT$  is set to one, the constant  $C\_TI\_3\_S\_MAN$  is applied.

## FUNCTION DESCRIPTION:


### 7.1.1 Segment synchronous tasks

#### Application conditions

**Activation:** every engine state

**Deactivation:** -

**Initialization:** at reset:  $TI\_3\_HOM\_CLC\_MIN = 65.535 \text{ ms}$   
 $TI\_2\_HOM\_CLC\_MIN = 65.535 \text{ ms}$   
 $TI\_1\_HOM\_CLC\_MIN = 65.535 \text{ ms}$   
 $T\_CHA\_PER\_HOM[ ] = C\_T\_CHA\_PER\_H // \text{ all } NC\_CYL\_NR \text{ elements}$   
 $T\_DCHA\_PER\_HOM[ ] = C\_T\_CHA\_PER\_H // \text{ all } NC\_CYL\_NR \text{ elements}$   
 $T\_CHA\_PER\_HOM\_2[ ] = C\_T\_CHA\_PER\_H // \text{ all } NC\_CYL\_NR \text{ elements}$   
 $T\_DCHA\_PER\_HOM\_2[ ] = C\_T\_CHA\_PER\_H // \text{ all } NC\_CYL\_NR \text{ elements}$   
 $T\_CHA\_PER\_HOM\_3[ ] = C\_T\_CHA\_PER\_H // \text{ all } NC\_CYL\_NR \text{ elements}$   
 $T\_DCHA\_PER\_HOM\_3[ ] = C\_T\_CHA\_PER\_H // \text{ all } NC\_CYL\_NR \text{ elements}$   
 $T\_CHA\_PER\_S\_1[ ] = C\_T\_CHA\_PER\_H // \text{ all } NC\_CYL\_NR \text{ elements}$   
 $T\_DCHA\_PER\_S\_1[ ] = C\_T\_CHA\_PER\_H // \text{ all } NC\_CYL\_NR \text{ elements}$

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```

T_CHA_PER_S_2[ ] = C_T_CHA_PER_H // all NC_CYL_NR elements
T_DCHA_PER_S_2[ ] = C_T_CHA_PER_H // all NC_CYL_NR elements
T_CHA_PER_S_3[ ] = C_T_CHA_PER_H // all NC_CYL_NR elements
T_DCHA_PER_S_3[ ] = C_T_CHA_PER_H // all NC_CYL_NR elements
T_CHA_PER_POST = C_T_CHA_PER_H
T_DCHA_PER_POST = C_T_CHA_PER_H
T_RLS_DLY_DCHA_1_HOM[ ] = 200µs // all NC_CYL_NR elements
T_RLS_DLY_DCHA_2_HOM[ ] = 200µs // all NC_CYL_NR elements
T_RLS_DLY_DCHA_3_HOM[ ] = 200µs // all NC_CYL_NR elements
T_RLS_DLY_DCHA_1_S[ ] = 200µs // all NC_CYL_NR elements
T_RLS_DLY_DCHA_2_S[ ] = 200µs // all NC_CYL_NR elements
T_RLS_DLY_DCHA_3_S[ ] = 200µs // all NC_CYL_NR elements
T_RLS_DLY_DCHA_POST = 200µs

```

**Recurrence:**

```

LV_ST_END = 0: 10 ms
LV_ST_END = 1: segment synchronous

```

### Formula section:

For loop for runtime optimization:

In this specification the for loop

```

FOR i = 0, i < NR_CYL_CLC_RED_INJ DO
    x = CTR_CYL_NR_ST_CLC_INJR + i
    (1a)IF x >= NC_CYL_NR
    (1a)THEN
        x = x - NC_CYL_NR
    (1a)ENDIF
    <loop content>

```

**ENDFOR**

is substituted by

```

FOR cylinder_start to cylinder_stop DO
    <loop content>

```

**ENDFOR**

**Note:** In the for loops, x will be used as loop variable to indicate the cylinder x!

## 7.1.1.1 Calculation of the cylinder individual injection times for homogeneous mode

### 7.1.1.1.1 Calculation of the minimal applied injection time

TI\_MIN\_HOM is used to for deactivation of air fuel lean mode.

```

(1)IF LV_AFL_CLC = 1
(1)THEN
    TI_MIN_HOM = IP_TI_MIN_HOM
    ... (Input data for IP_TI_MIN_HOM is
        PRS_DEC_INJ_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[0]])
(1)ENDIF

```


### 7.1.1.1.2 First pulse (main pulse)

Correction of fuel pressure pulsations for homogeneous single injection mode:

```

(1)IF STATE_INJ_MOD_HOM_REQ = "SNGH"
    AND LC_PRS_COR_SNGH_ENA = 1
    AND LV_PRS_COR_SNGH_ENA = 1
(1)THEN


```

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```

(1a)FOR m = 0 TO NC_CBK_HPP_NR - 1 DO
  (1a)IF Bit m of LF_PRS_COR_HPP_ENA = 1
    (1a)THEN
      Correction due to MFF_SP_1_HOM:
      FAC_PRS_COR_MFF_1_HOM = IP_FAC_PRS_COR_MFF_1_HOM(
        Input: (MFF_SP_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] + MFF_ADD_REAC[IDX_
          PRS_COR_CYL_CLC_MPLH[m]]) * (1+ FAC_MFF_DIF_HOM[IDX_PRS_COR_CYL_CLC_
            MPLH[m]]) * FAC_MFF_TFU)
      Correction of damping depending on FUP and delay time between pulses:
      (2)IF LC_PRS_COR_SOI_DLY_ENA = 1
        (2)THEN
          T_DLY_1_1_HOM = (720°/(NC_CYL_NR/NC_CBK_HPP_NR)) /FAC_N
        (2)ELSE
          T_DLY_1_1_HOM = (720°/(NC_CYL_NR/NC_CBK_HPP_NR)) /FAC_N
            - TI_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]]
          Note: Previous calculated TI_1_HOM is used to calculate delay time between
            pulses
        (2)ENDIF
      FAC_PRS_COR_DAMP_1_HOM = IP_FAC_PRS_COR_DAMP_1_HOM(
        Inputs: T_DLY_1_1_HOM; FUP_H_INJ[m])
      Calculate period time of pressure waves:
      (3)IF C_PRS_COR_TEMP_SEL = 0
        (3)THEN
          TEMP_PRS_COR_1_HOM = TFU_INJ
        (3)ELSE
          (4) IF C_PRS_COR_TEMP_SEL = 1
            (4)THEN
              TEMP_PRS_COR_1_HOM =
                TEMP_CAPA_IV_MV
            (4)ELSE
              TEMP_PRS_COR_1_HOM = TCO
            (4)ENDIF
          (3)ENDIF
      T_PER_PRS_COR_1_HOM = IP_T_PER_PRS_COR_1_HOM(
        Inputs: TEMP_PRS_COR_1_HOM; FUP_H_INJ[m])
      Calculate Time offset within one wave:
      i = 0 // i indicates the number of while loops
      (1)WHILE T_DLY_1_1_HOM > T_PER_PRS_COR_1_HOM DO
        T_DLY_1_1_HOM = T_DLY_1_1_HOM
          - (T_PER_PRS_COR_1_HOM * ID_T_PER_PRS_COR_1_HOM(Input: i))
        Note: In case of i > 4 use 4 as input for ID map to prevent overflow
        i = i + 1
        Note: To prevent an endless loop, break the while-loop if i reaches 50. In that
          case, set T_DLY_1_1_HOM to 0!
      (1)ENDWHILE
      Calculate normalized Time offset within one wave:
      RATIO_T_PER_PRS_COR_1_HOM =
        T_DLY_1_1_HOM/(T_PER_PRS_COR_1_HOM
          * ID_T_PER_PRS_COR_1_HOM(Input: i))
      RATIO_TI_1_HOM = TI_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]]/
        (T_PER_PRS_COR_1_HOM * ID_T_PER_PRS_COR_1_HOM(Input: i))
      Calculate correction due to wave position and injection time:

```

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FAC\_PRS\_COR\_OSC\_1\_HOM = IP\_FAC\_PRS\_COR\_OSC\_1\_HOM(  
 Inputs: RATIO\_T\_PER\_PRS\_COR\_1\_HOM; RATIO\_TI\_1\_HOM)

Note: Previous calculated TI\_1\_HOM is used to calculate factor

Calculate final correction factor:

FAC\_TI\_PRS\_COR\_1\_HOM[m] = 1 + (FAC\_PRS\_COR\_MFF\_1\_HOM  
 \* FAC\_PRS\_COR\_DAMP\_1\_HOM \* FAC\_PRS\_COR\_OSC\_1\_HOM)

(1a)ENDIF

(1a)ENDFOR

(1)ELSE

(1b)FOR m = 0 TO NC\_CBK\_HPP\_NR - 1 DO

FAC\_TI\_PRS\_COR\_1\_HOM[m] = 1

(1b)ENDFOR

(1)ENDIF

Calculation of injection time for homogeneous first pulse:

(1)FOR cylinder\_start to cylinder\_stop DO

MFF\_SP\_1\_HOM\_COR\_INJ[x] = (MFF\_SP\_1\_HOM[x] + MFF\_ADD\_REAC[x]) \* (1+ FAC\_MFF\_DIF\_HOM[x]) \* FAC\_MFF\_TFU

(2a)IF LC\_CUR\_SHP\_INJ\_ENA = 1

(2a)THEN // current shaping via IDX\_TI calculation is active

(2)IF LV\_EGY\_RNG\_IV\_PLS\_1\_HOM[x] = 1

(2)THEN

IDX\_TI\_1\_STND\_HOM[x] = IP\_MFF\_IDX\_TI\_EGY\_H(MFF\_SP\_1\_HOM\_COR\_INJ[x];  
 PRS\_DEC\_INJ\_1\_HOM[x])

(2)ELSE

IDX\_TI\_1\_STND\_HOM[x] = IP\_MFF\_IDX\_TI\_EGY\_L(MFF\_SP\_1\_HOM\_COR\_INJ[x];  
 PRS\_DEC\_INJ\_1\_HOM[x])  
 \* FAC\_TI\_COR\_IV\_EGY\_RNG\_L[NC\_IDX\_CYL\_HPP\_REF[x]]

(2)ENDIF

IDX\_TI\_1\_HOM\_CLC[x] = IDX\_TI\_1\_STND\_HOM[x]

\* FAC\_TI\_1\_PRS\_CYL\_HOM[x]

\* TI\_FAC[x]

\* TI\_TUN\_IV[x]

\* FAC\_TI\_PRS\_COR\_1\_HOM[NC\_IDX\_CYL\_HPP\_REF[x]]

\* FAC\_TI\_L\_PRS

+ (TI\_TUN\_ADD\_IV[x] / 0.001ms)

+ (TI\_ADD[x] / 0.001ms)

**Calculate section 1.1.3.1:**

**Calculate\_Pulse\_timing\_parameters**(IN <LV\_EGY\_RNG\_IV\_PLS\_1\_HOM[x]>,  
 IN <IDX\_TI\_1\_HOM\_CLC[x]>, OUT <T\_CHA\_PER\_HOM[x]>,  
 OUT <TI\_1\_HOM\_CLC[x]>)

(2a)ELSE // current shaping is inactive; classic TI calculation applied

(2b)IF LV\_EGY\_RNG\_IV\_PLS\_1\_HOM[x] = 1

(2b)THEN

TI\_1\_STND\_HOM[x] = IP\_MFF\_TI\_EGY\_H(MFF\_SP\_1\_HOM\_COR\_INJ[x];  
 PRS\_DEC\_INJ\_1\_HOM[x])

T\_CHA\_PER\_HOM[x] = C\_T\_CHA\_PER\_H

(2b)ELSE



```

TI_1_STND_HOM[x] = IP_MFF_TI_EGY_L(MFF_SP_1_HOM_COR_INJ[x];
                    PRS_DEC_INJ_1_HOM[x])
                    * FAC_TI_COR_IV_EGY_RNG_L[NC_IDX_CYL_HPP_REF[x]]
T_CHA_PER_HOM[x] = C_T_CHA_PER_L
(2b)ENDIF
TI_1_HOM_CLC[x] = TI_1_STND_HOM[x]

```

```
* FAC_TI_1_PRS_CYL_HOM[x]
```

```
* TI_FAC[x]
```

```
* TI_TUN_IV[x]
```

```
* FAC_TI_PRS_COR_1_HOM[NC_IDX_CYL_HPP_REF[x]]
```

```
* FAC_TI_L_PRS
```

```
+ TI_TUN_ADD_IV[x]
```

```
+ TI_ADD[x]
```

```
(2a)ENDIF
```

```
(1) ENDFOR
```

```
TI_1_HOM_CLC_MIN = MIN(TI_1_HOM_CLC[ ]) // Minimum of all NC_CYL_NR cylinders
```

```
TI_1_HOM_CLC_MAX = MAX(TI_1_HOM_CLC[ ]) // Maximum of all NC_CYL_NR cylinders
```

```
(4) IF LC_TI_1_HOM_MAN_ACT = 1
```

```
(4) THEN
```

```
(4)FOR cylinder_start to cylinder_stop DO
```

```
TI_1_HOM[x] = C_TI_1_HOM_MAN
```

```
(4a)IF LV_EGY_RNG_IV_PLS_1_HOM[x] = 1
```

```
(4a)THEN
```

```
T_CHA_PER_HOM[x] = C_T_CHA_PER_H
```

```
(4a)ELSE
```

```
T_CHA_PER_HOM[x] = C_T_CHA_PER_L
```

```
(4a)ENDIF
```

```
(4)ENDFOR
```

```
LV_TI_1_HOM_MIN = 0
```

```
(4) ELSE
```

```
(5)FOR cylinder_start to cylinder_stop DO
```

```
TI_1_HOM[x] = TI_1_HOM_CLC[x]
```

```
(5)ENDFOR
```

```
LV_TI_1_HOM_MIN = 0
```

```
(4) ENDFOR
```

```
(6)FOR cylinder_start to cylinder_stop DO
```

```
T_CHA_PER_HOM[x] = MIN(T_CHA_PER_HOM[x];
                        TI_1_HOM[x] - C_T_MIN_DIF_CHA_DCHA)
```


```
T_DCHA_PER_HOM[x] = T_CHA_PER_HOM[x]
```

**Note:** In case of  $TI_1\_HOM[x] < C\_T\_MIN\_DIF\_CHA\_DCHA$ , set

$T\_CHA/DCHA\_PER\_HOM[x]$  to 0!

**Note:** For calibration purposes the injection time  $TI_1\_HOM[x]$  can be set manually to the value

$C\_TI_1\_HOM\_MAN$

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Calculate release delay:

$T\_RLS\_DLY\_DCHA\_1\_HOM[x] = IP\_T\_RLS\_DLY\_T\_DCHA(T\_DCHA\_PER\_HOM[x])$

**(6)ENDFOR**

### 7.1.1.1.3 Second pulse

Correction of fuel pressure pulsations for homogeneous multi injection mode:

**(1)IF** (STATE\_INJ\_MOD\_HOM\_REQ = "MPLH"

OR STATE\_INJ\_MOD\_HOM\_REQ = "MPLH+PLS3")

AND LC\_PRS\_COR\_MPLH\_ENA = 1

AND LV\_PRS\_COR\_MPLH\_ENA = 1

**(1)THEN**

**(2a)FOR** m = 0 TO NC\_CBK\_HPP\_NR - 1 DO

**(2a)IF** Bit m of LF\_PRS\_COR\_HPP\_ENA = 1

**(2a)THEN**

Correction due to MFF\_SP\_1\_HOM:

$FAC\_PRS\_COR\_MFF\_2\_HOM = IP\_FAC\_PRS\_COR\_MFF\_2\_HOM($

Input: MFF\_SP\_1\_HOM\_COR\_INJ[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]]

Correction of damping depending on FUP and delay time between pulses:

**(2)IF** LC\_PRS\_COR\_SOI\_DLY\_ENA = 1

**(2)THEN**

$T\_DLY\_1\_2\_HOM =$

(SOI\_1\_HOM\_EXT[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]]

- (EOI\_2\_HOM\_EXT[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]]

+ TI\_2\_PRS\_HOM\_SP[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]]

\* FAC\_N)) / FAC\_N

**(2)ELSE**

$T\_DLY\_1\_2\_HOM =$

(SOI\_1\_HOM\_EXT[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]]

- TI\_1\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]] \* FAC\_N

- (EOI\_2\_HOM\_EXT[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]]

+ TI\_2\_PRS\_HOM\_SP[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]]

\* FAC\_N)) / FAC\_N

**(2)ENDIF**

$FAC\_PRS\_COR\_DAMP\_2\_HOM = IP\_FAC\_PRS\_COR\_DAMP\_2\_HOM($

Inputs: T\_DLY\_1\_2\_HOM; FUP\_H\_INJ[m]

Calculate period time of pressure waves:

**(3)IF** C\_PRS\_COR\_TEMP\_SEL = 0

**(3)THEN**

$TEMP\_PRS\_COR\_2\_HOM = TFU\_INJ$

**(3)ELSE**

**(4) IF** C\_PRS\_COR\_TEMP\_SEL = 1

**(4)THEN**

$TEMP\_PRS\_COR\_2\_HOM =$

TEMP\_CAPA\_IV\_MV

**(4)ELSE**

$TEMP\_PRS\_COR\_2\_HOM = TCO$

**(4)ENDIF**

**(3)ENDIF**

$T\_PER\_PRS\_COR\_2\_HOM = IP\_T\_PER\_PRS\_COR\_2\_HOM($

Inputs: TEMP\_PRS\_COR\_2\_HOM; FUP\_H\_INJ[m])

Calculate Time offset within one wave:

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$i = 0$  //  $i$  indicates the number of while loops

**(1)WHILE** T\_DLY\_1\_2\_HOM > T\_PER\_PRS\_COR\_2\_HOM **DO**

T\_DLY\_1\_2\_HOM = T\_DLY\_1\_2\_HOM

- (T\_PER\_PRS\_COR\_2\_HOM

\* ID\_T\_PER\_PRS\_COR\_2\_HOM(Input:  $i$ ))

**Note:** In case of  $i > 4$  use 4 as input for ID map to prevent overflow

$i = i + 1$

**Note:** To prevent an endless loop, break the while-loop if  $i$  reaches 50.

In that case, set T\_DLY\_1\_2\_HOM to 0!

**(1)ENDWHILE**

Calculate normalized Time offset within one wave:

RATIO\_T\_PER\_PRS\_COR\_2\_HOM =

T\_DLY\_1\_2\_HOM/

(T\_PER\_PRS\_COR\_2\_HOM \* ID\_T\_PER\_PRS\_COR\_2\_HOM(Input:  $i$ ))

RATIO\_TI\_2\_HOM =

TI\_2\_PRS\_HOM\_SP[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[ $m$ ]]/

(T\_PER\_PRS\_COR\_2\_HOM \* ID\_T\_PER\_PRS\_COR\_2\_HOM(Input:  $i$ ))

Calculate correction due to wave position and injection time:

FAC\_PRS\_COR\_OSC\_2\_HOM = IP\_FAC\_PRS\_COR\_OSC\_2\_HOM(

Inputs: RATIO\_T\_PER\_PRS\_COR\_2\_HOM; RATIO\_TI\_2\_HOM)

Calculate final correction factor:

FAC\_TI\_PRS\_COR\_2\_HOM[ $m$ ] = 1 + (FAC\_PRS\_COR\_MFF\_2\_HOM

\* FAC\_PRS\_COR\_DAMP\_2\_HOM \* FAC\_PRS\_COR\_OSC\_2\_HOM)

**(2a)ENDIF**

**(2a)ENDFOR**

**(1)ELSE**

**(2b)FOR**  $m = 0$  **TO** NC\_CBK\_HPP\_NR - 1 **DO**

FAC\_TI\_PRS\_COR\_2\_HOM[ $m$ ] = 1

**(2b)ENDFOR**

**(1)ENDIF**

Calculation of injection time for homogeneous second pulse:

**(3)FOR** cylinder\_start to cylinder\_stop **DO**

**(1)IF** INJ\_MOD\_SP\_HOM[ $x$ ] = "SNGH" (if single injection is requested)

**(1) THEN**

TI\_2\_HOM[ $x$ ] = 0

IDX\_TI\_2\_HOM\_CLC[ $x$ ] = 0

**(1) ELSE** (if multiple injection is requested)

MFF\_SP\_2\_HOM\_COR\_INJ[ $x$ ] = MFF\_SP\_2\_HOM[ $x$ ] \*(1+ FAC\_MFF\_DIF\_HOM[ $x$ ])

\* FAC\_MFF\_TFU

**(2a)IF** LC\_CUR\_SHP\_INJ\_ENA = 1

**(2a)THEN** // current shaping via IDX\_TI calculation is active

**(4) IF** LV\_EGY\_RNG\_IV\_PLS\_2\_HOM[ $x$ ] = 1

**(4) THEN**

IDX\_TI\_2\_STND\_HOM[ $x$ ] = IP\_MFF\_IDX\_TI\_EGY\_H(MFF\_SP\_2\_HOM\_COR\_INJ[ $x$ ];

PRS\_DEC\_INJ\_2\_HOM[ $x$ ])


**(4) ELSE**

IDX\_TI\_2\_STND\_HOM[ $x$ ] = IP\_MFF\_IDX\_TI\_EGY\_L(MFF\_SP\_2\_HOM\_COR\_INJ[ $x$ ];

PRS\_DEC\_INJ\_2\_HOM[ $x$ ])

\* FAC\_TI\_COR\_IV\_EGY\_RNG\_L[NC\_IDX\_CYL\_HPP\_REF[ $x$ ]]

**(4) ENDIF**

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```

IDX_TI_2_HOM_CLC[x] =      IDX_TI_2_STND_HOM[x]
                          * FAC_TI_2_PRS_CYL_HOM[x]
                          * FAC_TI_PRS_COR_2_HOM[NC_IDX_CYL_HPP_REF[x]]

                          * TI_FAC[x]
                          * TI_TUN_IV[x]


* FAC_TI_L_PRS
  Calculate section 1.1.3.1:
  Calculate_pulse_timing_parameters(IN <LV_EGY_RNG_IV_PLS_2_HOM[x]>,
  IN <IDX_TI_2_HOM_CLC[x]>, OUT <T_CHA_PER_HOM_2[x]>,
  OUT <TI_2_HOM_CLC[x]>)
(2a)ELSE // current shaping is inactive; classic TI calculation applied
  (4a) IF LV_EGY_RNG_IV_PLS_2_HOM[x] = 1
    (4a) THEN
      TI_2_STND_HOM[x] = IP_MFF_TI_EGY_H(MFF_SP_2_HOM_COR_INJ[x];
      PRS_DEC_INJ_2_HOM[x])
      T_CHA_PER_HOM_2[x] = C_T_CHA_PER_H
    (4a) ELSE
      TI_2_STND_HOM[x] = IP_MFF_TI_EGY_L(MFF_SP_2_HOM_COR_INJ[x];
      PRS_DEC_INJ_2_HOM[x])
      * FAC_TI_COR_IV_EGY_RNG_L[NC_IDX_CYL_HPP_REF[x]]
      T_CHA_PER_HOM_2[x] = C_T_CHA_PER_L
    (4a) ENDIF
    TI_2_HOM_CLC[x] =      TI_2_STND_HOM[x]
                          * FAC_TI_2_PRS_CYL_HOM[x]
                          * FAC_TI_PRS_COR_2_HOM[NC_IDX_CYL_HPP_REF[x]]
                          * TI_FAC[x]

* TI_TUN_IV[x]

* FAC_TI_L_PRS
(2a)ENDIF

(7) IF LC_TI_2_HOM_MAN_ACT = 1
(7) THEN
  TI_2_HOM[x] = C_TI_2_HOM_MAN
(7a)IF LV_EGY_RNG_IV_PLS_2_HOM[x] = 1
(7a)THEN
  T_CHA_PER_HOM_2[x] = C_T_CHA_PER_H
(7a)ELSE
  T_CHA_PER_HOM_2[x] = C_T_CHA_PER_L
(7a)ENDIF
(7) ELSE
  TI_2_HOM[x] = TI_2_HOM_CLC[x]
(7) ENDIF
T_CHA_PER_HOM_2[x] = MIN(T_CHA_PER_HOM_2[x];
                        TI_2_HOM[x] - C_T_MIN_DIF_CHA_DCHA)
T_DCHA_PER_HOM_2[x] = T_CHA_PER_HOM_2[x]
Note: In case of TI_2_HOM[x] < C_T_MIN_DIF_CHA_DCHA, set
  T_CHA/DCHA_PER_HOM_2[x] to 0!
Note: For calibration purposes the injection time TI_2_HOM[x] can be set manually to the value C_
  TI_2_HOM_MAN

```

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Calculate release delay:

$$T\_RLS\_DLY\_DCHA\_2\_HOM[x] = IP\_T\_RLS\_DLY\_T\_DCHA(T\_DCHA\_PER\_HOM\_2[x])$$

**(1) ENDIF**

**(3) ENDFOR**

LV\_TI\_2\_HOM\_MIN = 0

TI\_2\_HOM\_CLC\_MIN = **MIN**(TI\_2\_HOM\_CLC[ ]) // Minimum of all NC\_CYL\_NR cylinders

TI\_2\_HOM\_CLC\_MAX = **MAX**(TI\_2\_HOM\_CLC[ ]) // Maximum of all NC\_CYL\_NR cylinders

#### 7.1.1.1.4 Third pulse

Correction of fuel pressure pulsations for homogeneous multi injection mode:

**(1) IF** STATE\_INJ\_MOD\_HOM\_REQ = "MPLH+PLS3"

**AND** LC\_PRS\_COR\_MPLH\_ENA = 1

**AND** LV\_PRS\_COR\_MPLH\_ENA = 1

**(1) THEN**

**(3a) FOR** m = 0 **TO** NC\_CBK\_HPP\_NR - 1 **DO**

**(3a) IF** Bit m of LF\_PRS\_COR\_HPP\_ENA = 1

**(3a) THEN**

Correction due to MFF\_SP\_2\_HOM:

FAC\_PRS\_COR\_MFF\_3\_HOM = IP\_FAC\_PRS\_COR\_MFF\_3\_HOM(  
Input: MFF\_SP\_2\_HOM\_COR\_INJ[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]])

Correction of damping depending on FUP and delay time between pulses:

**(2) IF** LC\_PRS\_COR\_SOI\_DLY\_ENA = 1

**(2) THEN**

T\_DLY\_2\_3\_HOM =

(EOI\_2\_HOM\_EXT[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]]  
+ TI\_2\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]] \* FAC\_N  
- (EOI\_3\_HOM\_EXT[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]]  
+ TI\_3\_PRS\_HOM\_SP[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]]  
\* FAC\_N)) / FAC\_N

**(2) ELSE**

T\_DLY\_2\_3\_HOM =

(EOI\_2\_HOM\_EXT[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]]  
- (EOI\_3\_HOM\_EXT[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]]  
+ TI\_3\_PRS\_HOM\_SP[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]]  
\* FAC\_N)) / FAC\_N

**(2) ENDIF**

FAC\_PRS\_COR\_DAMP\_3\_HOM = IP\_FAC\_PRS\_COR\_DAMP\_3\_HOM(  
Inputs: T\_DLY\_2\_3\_HOM; FUP\_H\_INJ[m])

Calculate period time of pressure waves:

T\_PER\_PRS\_COR\_3\_HOM = IP\_T\_PER\_PRS\_COR\_3\_HOM(  
Inputs: TEMP\_PRS\_COR\_2\_HOM; FUP\_H\_INJ[m])

Calculate Time offset within one wave:

i = 0 // i indicates the number of while loops

**(1) WHILE** T\_DLY\_2\_3\_HOM > T\_PER\_PRS\_COR\_3\_HOM **DO**

T\_DLY\_2\_3\_HOM = T\_DLY\_2\_3\_HOM


- (T\_PER\_PRS\_COR\_3\_HOM \* ID\_T\_PER\_PRS\_COR\_3\_HOM(Input: i))

**Note:** In case of i > 4 use 4 as input for ID map to prevent overflow

i = i + 1

**Note:** To prevent an endless loop, break the while-loop if i reaches 50.

In that case, set T\_DLY\_2\_3\_HOM to 0!

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**(1)ENDWHILE**

Calculate normalized Time offset within one wave:

$$\text{RATIO\_T\_PER\_PRS\_COR\_3\_HOM} = \frac{\text{T\_DLY\_2\_3\_HOM}}{\text{T\_PER\_PRS\_COR\_3\_HOM} * \text{ID\_T\_PER\_PRS\_COR\_3\_HOM}(\text{Input: i})}$$

$$\text{RATIO\_TI\_3\_HOM} = \frac{\text{TI\_3\_PRS\_HOM\_SP}[\text{IDX\_PRS\_COR\_CYL\_CLC\_MPLH}[m]]}{(\text{T\_PER\_PRS\_COR\_3\_HOM} * \text{ID\_T\_PER\_PRS\_COR\_3\_HOM}(\text{Input: i}))}$$

Calculate correction due to wave position and injection time:

$$\text{FAC\_PRS\_COR\_OSC\_3\_HOM} = \text{IP\_FAC\_PRS\_COR\_OSC\_3\_HOM}(\text{Inputs: RATIO\_T\_PER\_PRS\_COR\_3\_HOM; RATIO\_TI\_3\_HOM})$$

Calculate final correction factor:

$$\text{FAC\_TI\_PRS\_COR\_3\_HOM}[m] = 1 + (\text{FAC\_PRS\_COR\_MFF\_3\_HOM} * \text{FAC\_PRS\_COR\_DAMP\_3\_HOM} * \text{FAC\_PRS\_COR\_OSC\_3\_HOM})$$
**(3a)ENDIF****(3a)ENDFOR****(1)ELSE****(3b)FOR m = 0 TO NC\_CBK\_HPP\_NR - 1 DO**

$$\text{FAC\_TI\_PRS\_COR\_3\_HOM}[m] = 1$$
**(3b)ENDFOR****(1)ENDIF****(3)FOR cylinder\_start to cylinder\_stop DO**

**(1)IF** INJ\_MOD\_SP\_HOM[x] ≠ "MPLH+PLS3" (if third injection is not requested)

**(1) THEN**

$$\text{TI\_3\_HOM}[x] = 0$$

$$\text{IDX\_TI\_3\_HOM\_CLC}[x] = 0$$

**(1) ELSE** (if third injection is requested)

$$\text{MFF\_SP\_3\_HOM\_COR\_INJ}[x] = \text{MFF\_SP\_3\_HOM}[x] * (1 + \text{FAC\_MFF\_DIF\_HOM}[x] * \text{FAC\_MFF\_TFU})$$

**(2a)IF** LC\_CUR\_SHP\_INJ\_ENA = 1

**(2a)THEN** // current shaping via IDX\_TI calculation is active

**(4) IF** LV\_EGY\_RNG\_IV\_PLS\_3\_HOM[x] = 1

**(4) THEN**

$$\text{IDX\_TI\_3\_STND\_HOM}[x] = \text{IP\_MFF\_IDX\_TI\_EGY\_H}(\text{MFF\_SP\_3\_HOM\_COR\_INJ}[x]; \text{PRS\_DEC\_INJ\_3\_HOM}[x])$$
**(4) ELSE**

$$\text{IDX\_TI\_3\_STND\_HOM}[x] = \text{IP\_MFF\_IDX\_TI\_EGY\_L}(\text{MFF\_SP\_3\_HOM\_COR\_INJ}[x]; \text{PRS\_DEC\_INJ\_3\_HOM}[x])$$

$$* \text{FAC\_TI\_COR\_IV\_EGY\_RNG\_L}[\text{NC\_IDX\_CYL\_HPP\_REF}[x]]$$
**(4) ENDIF**

$$\text{IDX\_TI\_3\_HOM\_CLC}[x] = \text{IDX\_TI\_3\_STND\_HOM}[x]$$

$$* \text{FAC\_TI\_3\_PRS\_CYL\_HOM}[x]$$

$$* \text{FAC\_TI\_PRS\_COR\_3\_HOM}[\text{NC\_IDX\_CYL\_HPP\_REF}[x]]$$

$$* \text{TI\_FAC}[x]$$

$$* \text{TI\_TUN\_IV}[x]$$

$$* \text{FAC\_TI\_L\_PRS}$$
**Calculate section 1.1.3.1:**


**Calculate\_Pulse\_timing\_parameters**(IN <LV\_EGY\_RNG\_IV\_PLS\_3\_HOM[x]> ,

IN <IDX\_TI\_3\_HOM\_CLC[x]> , OUT <T\_CHA\_PER\_HOM\_3[x]> ,

OUT <TI\_3\_HOM\_CLC[x]> )

**(2a)ELSE** // current shaping is inactive; classic TI calculation applied

**(4a) IF** LV\_EGY\_RNG\_IV\_PLS\_3\_HOM[x] = 1

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**(4a) THEN**

TI\_3\_STND\_HOM[x] = IP\_MFF\_TI\_EGY\_H(MFF\_SP\_3\_HOM\_COR\_INJ[x];  
PRS\_DEC\_INJ\_3\_HOM[x])

T\_CHA\_PER\_HOM\_3[x] = C\_T\_CHA\_PER\_H

**(4a) ELSE**

TI\_3\_STND\_HOM[x] = IP\_MFF\_TI\_EGY\_L(MFF\_SP\_3\_HOM\_COR\_INJ[x];  
PRS\_DEC\_INJ\_3\_HOM[x])  
\* FAC\_TI\_COR\_IV\_EGY\_RNG\_L[NC\_IDX\_CYL\_HPP\_REF[x]]

T\_CHA\_PER\_HOM\_3[x] = C\_T\_CHA\_PER\_L

**(4a) ENDIF**

TI\_3\_HOM\_CLC[x] = TI\_3\_STND\_HOM[x]  
\* FAC\_TI\_3\_PRS\_CYL\_HOM[x]  
\* FAC\_TI\_PRS\_COR\_3\_HOM[NC\_IDX\_CYL\_HPP\_REF[x]]  
\* TI\_FAC[x]

\* TI\_TUN\_IV[x]

\* FAC\_TI\_L\_PRS

**(2a)ENDIF**

**(7) IF** LC\_TI\_3\_HOM\_MAN\_ACT = 1

**(7) THEN**

TI\_3\_HOM[x] = C\_TI\_3\_HOM\_MAN

**(7a)IF** LV\_EGY\_RNG\_IV\_PLS\_3\_HOM[x] = 1

**(7a)THEN**

T\_CHA\_PER\_HOM\_3[x] = C\_T\_CHA\_PER\_H

**(7a)ELSE**

T\_CHA\_PER\_HOM\_3[x] = C\_T\_CHA\_PER\_L

**(7a)ENDIF**

**(7) ELSE**

TI\_3\_HOM[x] = TI\_3\_HOM\_CLC[x]

**(7) ENDIF**

T\_CHA\_PER\_HOM\_3[x] = **MIN**(T\_CHA\_PER\_HOM\_3[x];  
TI\_3\_HOM[x] - C\_T\_MIN\_DIF\_CHA\_DCHA)

T\_DCHA\_PER\_HOM\_3[x] = T\_CHA\_PER\_HOM\_3[x]

**Note:** In case of TI\_3\_HOM[x] < C\_T\_MIN\_DIF\_CHA\_DCHA, set

T\_CHA/DCHA\_PER\_HOM\_3[x] to 0!

**Note:** For calibration purposes the injection time TI\_3\_HOM[x] can be set manually to the value C\_TI\_3\_HOM\_MAN

Calculate release delay:

T\_RLS\_DLY\_DCHA\_3\_HOM[x] = IP\_T\_RLS\_DLY\_T\_DCHA(T\_DCHA\_PER\_HOM\_3[x])

**(1) ENDIF**

**(3)ENDFOR**


LV\_TI\_3\_HOM\_MIN = 0

TI\_3\_HOM\_CLC\_MIN = **MIN**(TI\_3\_HOM\_CLC[ ]) // Minimum of all NC\_CYL\_NR cylinders

TI\_3\_HOM\_CLC\_MAX = **MAX**(TI\_3\_HOM\_CLC[ ]) // Maximum of all NC\_CYL\_NR cylinders

**7.1.1.2 Calculation of the cylinder individual injection times for stratified mode and homogeneous-stratified mode**

**(1) IF** LV\_S\_CLC = 1 (Note: this part is only calculated, if stratified mode or homogeneous-stratified mode is enabled)

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## 1. THEN

### 7.1.1.2.1 First pulse

**(1)FOR** cylinder\_start to cylinder\_stop **DO**

MFF\_SP\_1\_S\_COR\_INJ[x] = MFF\_SP\_1\_S[x]\*(1 + FAC\_MFF\_DIF\_S[x]) \* FAC\_MFF\_TFU

**(0)IF** LC\_CUR\_SHP\_INJ\_ENA = 1

**(0)THEN** // current shaping via IDX\_TI calculation is active

**(1a) IF** LV\_EGY\_RNG\_IV\_PLS\_1\_S[x] = 1

**(1a) THEN** (high injector needle lift is selected for the first pulse)

IDX\_TI\_1\_S\_CLC[x] = IP\_MFF\_IDX\_TI\_EGY\_H(MFF\_SP\_1\_S\_COR\_INJ[x];

PRS\_DEC\_INJ\_1\_S[x])

\* TI\_FAC[x]

\* TI\_TUN\_IV[x]

\* FAC\_TI\_1\_PRS\_CYL\_S[x]

+ (TI\_TUN\_ADD\_IV[x] /0.001ms)

+ (TI\_ADD[x] /0.001ms)

**(1a) ELSE** (low injector needle lift is selected for the first pulse)

IDX\_TI\_1\_S\_CLC[x] = IP\_MFF\_IDX\_TI\_EGY\_L(MFF\_SP\_1\_S\_COR\_INJ[x];

PRS\_DEC\_INJ\_1\_S[x])

\* FAC\_TI\_COR\_IV\_EGY\_RNG\_L

[NC\_IDX\_CYL\_HPP\_REF[x]]

\* TI\_FAC[x]

\* TI\_TUN\_IV[x]

\* FAC\_TI\_1\_PRS\_CYL\_S[x]

+ (TI\_TUN\_ADD\_IV[x] /0.001ms)

+ (TI\_ADD[x] /0.001ms)

**(1a) ENDIF**

**Calculate section 1.1.3.1:**

**Calculate\_pulse\_timing\_parameters**(IN <LV\_EGY\_RNG\_IV\_PLS\_1\_S[x]>,

IN <IDX\_TI\_1\_S\_CLC[x]>, OUT <T\_CHA\_PER\_S\_1[x]>,

OUT <TI\_1\_S\_CLC[x]>)

**(0)ELSE** // current shaping is inactive; classic TI calculation applied


**(1b) IF** LV\_EGY\_RNG\_IV\_PLS\_1\_S[x] = 1

**(1b) THEN** (high injector needle lift is selected for the first pulse)

TI\_1\_S\_CLC[x] = IP\_MFF\_TI\_EGY\_H (MFF\_SP\_1\_S\_COR\_INJ[x];

PRS\_DEC\_INJ\_1\_S[x])

\* TI\_FAC[x]

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```

* TI_TUN_IV[x]

* FAC_TI_1_PRS_CYL_S[x]

+ TI_TUN_ADD_IV[x]

+ TI_ADD[x]
  T_CHA_PER_S_1[x] = C_T_CHA_PER_H
(1b) ELSE (low injector needle lift is selected for the first pulse)
  TI_1_S_CLC[x] = IP_MFF_TI_EGY_L (MFF_SP_1_S_COR_INJ[x];

  PRS_DEC_INJ_1_S[x])

* FAC_TI_COR_IV_EGY_RNG_L

[NC_IDX_CYL_HPP_REF[x]]

* TI_FAC[x]

* TI_TUN_IV[x]


* FAC_TI_1_PRS_CYL_S[x]

+ TI_TUN_ADD_IV[x]

+ TI_ADD[x]
  T_CHA_PER_S_1[x] = C_T_CHA_PER_L
(1b) ENDIF
(0)ENDIF
(1)ENDFOR
TI_1_S_CLC_MIN = MIN(TI_1_S_CLC[ ]) // Minimum of all NC_CYL_NR cylinders

(2) IF
LC_TI_1_S_MAN_ACT = 1
(2) THEN
  (2)FOR cylinder_start to cylinder_stop DO
    TI_1_S[x] = C_TI_1_S_MAN
    (2a)IF LV_EGY_RNG_IV_PLS_1_S[x] = 1
    (2a)THEN
      T_CHA_PER_S_1[x] = C_T_CHA_PER_H
    (2a)ELSE
      T_CHA_PER_S_1[x] = C_T_CHA_PER_L
    (2a)ENDIF
    T_CHA_PER_S_1[x] = MIN(T_CHA_PER_S_1[x];
      TI_1_S[x] - C_T_MIN_DIF_CHA_DCHA)
    T_DCHA_PER_S_1[x] = T_CHA_PER_S_1[x]
    Note: In case of TI_1_S[x] < C_T_MIN_DIF_CHA_DCHA, set
      T_CHA/DCHA_PER_S_1[x] to 0!
    Calculate release delay:
    T_RLS_DLY_DCHA_1_S[x] =
      IP_T_RLS_DLY_T_DCHA(T_DCHA_PER_S_1[x])
  (2)ENDFOR

```

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LV\_AUTH\_TI\_MIN\_S = 1

LV\_TI\_1\_S\_MIN = 0

**(2) ELSE**

**(3)FOR** cylinder\_start to cylinder\_stop **DO**

TI\_1\_S[x] = TI\_1\_S\_CLC[x]

T\_CHA\_PER\_S\_1[x] = **MIN**(T\_CHA\_PER\_S\_1[x];  
TI\_1\_S[x] - C\_T\_MIN\_DIF\_CHA\_DCHA)

T\_DCHA\_PER\_S\_1[x] = T\_CHA\_PER\_S\_1[x]

**Note:** In case of TI\_1\_S[x] < C\_T\_MIN\_DIF\_CHA\_DCHA, set

T\_CHA/DCHA\_PER\_S\_1[x] to 0!

Calculate release delay:

T\_RLS\_DLY\_DCHA\_1\_S[x] =

IP\_T\_RLS\_DLY\_T\_DCHA(T\_DCHA\_PER\_S\_1[x])

**(3)ENDFOR**

LV\_AUTH\_TI\_MIN\_S = 1

LV\_TI\_1\_S\_MIN = 0

**(2) ENDIF**

**Note:** For calibration purposes the injection time TI\_1\_S[x] can be set manually to the value C\_TI\_1\_S\_MAN

**7.1.1.2.2 Second pulse**

**(6) IF** (STATE\_INJ\_MOD\_REQ = 'HOMS' **OR** STATE\_INJ\_MOD\_REQ = 'HOMS+PLS3')  
**OR** LC\_PRS\_COR\_MPLS\_ENA = 0

**(6) THEN**

**(4)FOR** m = 0 **TO** NC\_CBK\_HPP\_NR - 1 **DO**

FAC\_TI\_2\_S\_DLY\_COR[m] = 1

FAC\_TI\_2\_S\_COR[m] = 1

FAC\_TI\_PRS\_COR\_2\_S[m] = 1

**(4)ENDFOR**

**(6) ELSE**

**(4a)FOR** m = 0 **TO** NC\_CBK\_HPP\_NR - 1 **DO**

FAC\_TI\_2\_S\_DLY\_COR[m] = IP\_FAC\_TI\_2\_S\_DLY\_COR (  
Input: T\_DLY\_1\_2\_S\_EXT[IDX\_PRS\_COR\_CYL\_CLC\_S[m]],  
SP\_1\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]])

FAC\_TI\_2\_S\_COR[m] = IP\_FAC\_TI\_2\_S\_COR (  
Input: TI\_2\_STND\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]];  
T\_DLY\_1\_2\_S\_EXT[IDX\_PRS\_COR\_CYL\_CLC\_S[m]])

FAC\_TI\_PRS\_COR\_2\_S[m] = FAC\_TI\_2\_S\_DLY\_COR[m]  
\* FAC\_TI\_2\_S\_COR[m]

MFF\_

This correction factor is for correction of the mass flow difference between the mass flow sum of two pulses in comparison with the same requested mass for one pulse. The difference is caused by physical effects of the piezo injector.

**(4a)ENDFOR**

**(6) ENDIF**


**(5)FOR** cylinder\_start to cylinder\_stop **DO**

**(5)IF** INJ\_MOD\_SP\_S[x] = "SNGS"

**AND** INJ\_MOD\_SP\_HOMS[x] = "HOMS-SNG"

**(5)THEN**

TI\_2\_S[x] = 0

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IDX\_TI\_2\_S\_CLC[x] = 0

**(5)ELSE**

MFF\_SP\_2\_S\_COR\_INJ[x] = MFF\_SP\_2\_S[x]\*(1 + FAC\_MFF\_DIF\_S[x]) \* FAC\_MFF\_TFU

**(0)IF** LC\_CUR\_SHP\_INJ\_ENA = 1

**(0)THEN** // current shaping via IDX\_TI calculation is active

**(2a) IF** LV\_EGY\_RNG\_IV\_PLS\_2\_S[x] = 1

**(2a) THEN** (high injector needle lift is selected for the second pulse)

IDX\_TI\_2\_S\_CLC[x] = IP\_MFF\_IDX\_TI\_EGY\_H(MFF\_SP\_2\_S\_COR\_INJ[x];

PRS\_DEC\_INJ\_2\_S[x])

\* TI\_FAC[x]

\* TI\_TUN\_IV[x]

\* FAC\_TI\_2\_PRS\_CYL\_S[x]

\* FAC\_TI\_PRS\_COR\_2\_S[NC\_IDX\_CYL\_HPP\_REF[x]]

**(2a) ELSE** (low injector needle lift is selected for the second pulse)

IDX\_TI\_2\_S\_CLC[x] = IP\_MFF\_IDX\_TI\_EGY\_L(MFF\_SP\_2\_S\_COR\_INJ[x];

PRS\_DEC\_INJ\_2\_S[x])

\* FAC\_TI\_COR\_IV\_EGY\_RNG\_L

[NC\_IDX\_CYL\_HPP\_REF[x]]

\* TI\_FAC[x]

\* TI\_TUN\_IV[x]

\* FAC\_TI\_2\_PRS\_CYL\_S[x]

\* FAC\_TI\_PRS\_COR\_2\_S[NC\_IDX\_CYL\_HPP\_REF[x]]

**(2a) ENDIF**

**Calculate section 1.1.3.1:**

**Calculate\_Pulse\_timing\_parameters**(IN <LV\_EGY\_RNG\_IV\_PLS\_2\_S[x]>,

IN <IDX\_TI\_2\_S\_CLC[x]>, OUT <T\_CHA\_PER\_S\_2[x]>,

OUT <TI\_2\_S\_CLC[x]>)

**(0)ELSE** // current shaping is inactive; classic TI calculation applied

**(2b) IF** LV\_EGY\_RNG\_IV\_PLS\_2\_S[x] = 1

**(2b) THEN** (high injector needle lift is selected for the second pulse)

TI\_2\_S\_CLC[x] = IP\_MFF\_TI\_EGY\_H (MFF\_SP\_2\_S\_COR\_INJ[x];

PRS\_DEC\_INJ\_2\_S[x])


\* TI\_FAC[x]

\* TI\_TUN\_IV[x]

\* FAC\_TI\_2\_PRS\_CYL\_S[x]

\* FAC\_TI\_PRS\_COR\_2\_S[NC\_IDX\_CYL\_HPP\_REF[x]]

T\_CHA\_PER\_S\_2[x] = C\_T\_CHA\_PER\_H

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**(2b) ELSE** (low injector needle lift is selected for the second pulse)

TI\_2\_S\_CLC[x] = IP\_MFF\_TI\_EGY\_L (MFF\_SP\_2\_S\_COR\_INJ[x];  
PRS\_DEC\_INJ\_2\_S[x])

\* FAC\_TI\_COR\_IV\_EGY\_RNG\_L

[NC\_IDX\_CYL\_HPP\_REF[x]]

\* TI\_FAC[x]

\* TI\_TUN\_IV[x]

\* FAC\_TI\_2\_PRS\_CYL\_S[x]

\* FAC\_TI\_PRS\_COR\_2\_S[NC\_IDX\_CYL\_HPP\_REF[x]]  
T\_CHA\_PER\_S\_2[x] = C\_T\_CHA\_PER\_L

**(2b) ENDIF**

**(0)ENDIF**

**(7) IF**

LC\_TI\_2\_S\_MAN\_ACT = 1

**(7) THEN**

TI\_2\_S[x] = C\_TI\_2\_S\_MAN

**(7a)IF** LV\_EGY\_RNG\_IV\_PLS\_2\_S[x] = 1

**(7a)THEN**

T\_CHA\_PER\_S\_2[x] = C\_T\_CHA\_PER\_H

**(7a)ELSE**

T\_CHA\_PER\_S\_2[x] = C\_T\_CHA\_PER\_L

**(7a)ENDIF**

**(7) ELSE**

TI\_2\_S[x] = TI\_2\_S\_CLC[x]

**(7) ENDIF**

T\_CHA\_PER\_S\_2[x] = MIN(T\_CHA\_PER\_S\_2[x];  
TI\_2\_S[x] - C\_T\_MIN\_DIF\_CHA\_DCHA)

T\_DCHA\_PER\_S\_2[x] = T\_CHA\_PER\_S\_2[x]

**Note:** In case of  $TI_2_S[x] < C_T\_MIN\_DIF\_CHA\_DCHA$ , set  $T\_CHA/DCHA\_PER\_S_2[x]$  to

0!

**Note:** For calibration purposes the injection time  $TI_2_S[x]$  can be set manually to the value  $C\_TI\_2\_S\_MAN$

Calculate release delay:

$T\_RLS\_DLY\_DCHA\_2\_S[x] = IP\_T\_RLS\_DLY\_T\_DCHA(T\_DCHA\_PER\_S_2[x])$

**(5) ENDIF**

**(5)ENDFOR**

LV\_TI\_2\_S\_MIN = 0

TI\_2\_S\_CLC\_MIN = MIN (TI\_2\_S\_CLC[x]) // Minimum of all NC\_CYL\_NR cylinders


### 7.1.1.2.3 Third pulse

**(10) IF** STATE\_INJ\_MOD\_REQ = 'HOMS+PLS3'

**OR** LC\_PRS\_COR\_MPLS\_ENA = 0

**(10) THEN**

**(6)FOR** m = 0 **TO** NC\_CBK\_HPP\_NR - 1 **DO**

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```

FAC_TI_3_S_DLY_COR[m] = 1
FAC_TI_3_S_COR[m] = 1
FAC_TI_PRS_COR_3_S[m] = 1

```

**(6)ENDFOR**

**(10) ELSE**

**(6a)FOR m = 0 TO NC\_CBK\_HPP\_NR - 1 DO**

```

FAC_TI_3_S_DLY_COR[m] = IP_FAC_TI_3_S_DLY_COR
    (Input: T_DLY_2_3_S_EXT[IDX_PRS_COR_CYL_CLC_S[m]],
MFF_SP_2_S[IDX_PRS_COR_CYL_CLC_S[m]])

```

```

FAC_TI_3_S_COR[m] = IP_FAC_TI_3_S_COR
    (Input: TI_3_STND_S[IDX_PRS_COR_CYL_CLC_S[m]];
T_DLY_2_3_S_EXT[IDX_PRS_COR_CYL_CLC_S[m]])
FAC_TI_PRS_COR_3_S[m] = FAC_TI_3_S_DLY_COR[m]
    * FAC_TI_3_S_COR[m]

```

This correction factor is for correction of the mass flow difference between the mass flow sum of two pulses in comparison with the same requested mass for one pulse. The difference is caused by physical effects of the piezo injector.

**(6a)ENDFOR**

**(10) ENDIF**

**(8)FOR cylinder\_start to cylinder\_stop DO**

**(9)IF INJ\_MOD\_SP\_S[x] = "MPLS+PLS3"**

**OR INJ\_MOD\_SP\_HOMS[x] = "HOMS+PLS3"**

**(9)THEN**

```

MFF_SP_3_S_COR_INJ[x] = MFF_SP_3_S[x]*(1 + FAC_MFF_DIF_S[x])
    * FAC_MFF_TFU

```

**(0)IF LC\_CUR\_SHP\_INJ\_ENA = 1**

**(0)THEN // current shaping via IDX\_TI calculation is active**

**(3a) IF LV\_EGY\_RNG\_IV\_PLS\_3\_S[x] = 1**

**(3a) THEN (high injector needle lift is selected for the third pulse)**

```

IDX_TI_3_S_CLC[x] = IP_MFF_IDX_TI_EGY_H(MFF_SP_3_S_COR_INJ[x];

```

```

PRS_DEC_INJ_3_S[x])

```

\* TI\_FAC[x]

\* TI\_TUN\_IV[x]

\* FAC\_TI\_3\_PRS\_CYL\_S[x]

\* FAC\_TI\_PRS\_COR\_3\_S[NC\_IDX\_CYL\_HPP\_REF[x]]

**(3a) ELSE (low injector needle lift is selected for the third pulse)**

```

IDX_TI_3_S_CLC[x] = IP_MFF_IDX_TI_EGY_L(MFF_SP_3_S_COR_INJ[x];

```

```

PRS_DEC_INJ_3_S[x])

```

\* FAC\_TI\_COR\_IV\_EGY\_RNG\_L

[NC\_IDX\_CYL\_HPP\_REF[x]]

\* TI\_FAC[x]

\* TI\_TUN\_IV[x]

\* FAC\_TI\_3\_PRS\_CYL\_S[x]

\* FAC\_TI\_PRS\_COR\_3\_S[NC\_IDX\_CYL\_HPP\_REF[x]]

**(3a) ENDIF**

**Calculate section 1.1.3.1:**

**Calculate\_Pulse\_timing\_parameters**(IN <LV\_EGY\_RNG\_IV\_PLS\_3\_S[x]>,  
IN <IDX\_TI\_3\_S\_CLC[x]>, OUT <T\_CHA\_PER\_S\_3[x]>,  
OUT <TI\_3\_S\_CLC[x]>)

**(0)ELSE** // current shaping is inactive; classic TI calculation applied

**(3b) IF** LV\_EGY\_RNG\_IV\_PLS\_3\_S[x] = 1

**(3b) THEN** (high injector needle lift is selected for the third pulse)

TI\_3\_S\_CLC[x] = IP\_MFF\_TI\_EGY\_H (MFF\_SP\_3\_S\_COR\_INJ[x];

PRS\_DEC\_INJ\_3\_S[x])

\* TI\_FAC[x]

\* TI\_TUN\_IV[x]

\* FAC\_TI\_3\_PRS\_CYL\_S[x]

\* FAC\_TI\_PRS\_COR\_3\_S[NC\_IDX\_CYL\_HPP\_REF[x]]

T\_CHA\_PER\_S\_3[x] = C\_T\_CHA\_PER\_H

**(3b) ELSE** (low injector needle lift is selected for the third pulse)

TI\_3\_S\_CLC[x] = IP\_MFF\_TI\_EGY\_L (MFF\_SP\_3\_S\_COR\_INJ[x];

PRS\_DEC\_INJ\_3\_S[x])

\* FAC\_TI\_COR\_IV\_EGY\_RNG\_L

[NC\_IDX\_CYL\_HPP\_REF[x]]

\* TI\_FAC[x]

\* TI\_TUN\_IV[x]

\* FAC\_TI\_3\_PRS\_CYL\_S[x]

\* FAC\_TI\_PRS\_COR\_3\_S[NC\_IDX\_CYL\_HPP\_REF[x]]

T\_CHA\_PER\_S\_3[x] = C\_T\_CHA\_PER\_L

**(3b) ENDIF**


**(0)ENDIF**

**(11) IF** LC\_TI\_3\_S\_MAN\_ACT = 1

**(11) THEN**

TI\_3\_S[x] = C\_TI\_3\_S\_MAN

**(11a)IF** LV\_EGY\_RNG\_IV\_PLS\_3\_S[x] = 1

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```

(11a)THEN
    T_CHA_PER_S_3[x] = C_T_CHA_PER_H
(11a)ELSE
    T_CHA_PER_S_3[x] = C_T_CHA_PER_L
(11a)ENDIF
(11) ELSE
    TI_3_S[x] = TI_3_S_CLC[x]
(11) ENDIF
T_CHA_PER_S_3[x] = MIN(T_CHA_PER_S_3[x];
                        TI_3_S[x] - C_T_MIN_DIF_CHA_DCHA)
T_DCHA_PER_S_3[x] = T_CHA_PER_S_3[x]
Note: In case of TI_3_S[x] < C_T_MIN_DIF_CHA_DCHA, set
        T_CHA/DCHA_PER_S_3[x] to 0!
Note: For calibration purposes the injection time TI_3_S[x] can be set manually to the value
        C_TI_3_S_MAN

Calculate release delay:
T_RLS_DLY_DCHA_3_S[x] = IP_T_RLS_DLY_T_DCHA(T_DCHA_PER_S_3[x])

(9) ELSE (No third pulse in stratified mode or homogeneous-stratified mode is required)
    TI_3_S[x] = 0
    IDX_TI_3_S_CLC[x] = 0
(9) ENDIF
(8)ENDFOR
LV_TI_3_S_MIN = 0
TI_3_S_CLC_MIN = MIN (TI_3_S_CLC[x]) // Minimum of all NC_CYL_NR cylinders

(1) ELSE - LV_S_CLC
    (12)FOR cylinder_start to cylinder_stop DO
        TI_1_S[x] = 0, TI_2_S[x] = 0, TI_3_S[x] = 0
        IDX_TI_1_S_CLC[x] = 0, IDX_TI_2_S_CLC[x] = 0, IDX_TI_3_S_CLC[x] = 0
    (12)ENDFOR
    LV_AUTH_TI_MIN_S = 0
    LV_TI_1_S_MIN = 0, LV_TI_2_S_MIN = 0, LV_TI_3_S_MIN = 0
(1) ENDIF

```

### 7.1.1.3 Calculate charge and discharge period of post pulse:

This section calculates the charging and discharging time for the post injection pulse.

```


if(1) LV_IV_POST_EGY_RNG = 1
then
    T_CHA_PER_POST = C_T_CHA_PER_H
else(1)
    T_CHA_PER_POST = C_T_CHA_PER_L
endif(1)
T_DCHA_PER_POST = T_CHA_PER_POST

```

Calculate release delay:

```
T_RLS_DLY_DCHA_POST = IP_T_RLS_DLY_T_DCHA(T_DCHA_PER_POST)
```

### 7.1.2 Calculate interface to monitoring unit:

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### 7.1.3 (1)IF STATE\_INJ\_MOD\_REQ BitwiseAND NC\_INJ\_MOD\_MASK\_1 = NC\_INJ\_MOD\_HOM

### 7.1.4 (1)THEN

### 7.1.5 FAC\_TI\_PRS\_COR\_1 = MEAN(FAC\_TI\_PRS\_COR\_1\_HOM[ ])

```

// mean value of all elements
FAC_TI_PRS_COR_2 = MEAN(FAC_TI_PRS_COR_2_HOM[ ])
// mean value of all elements
FAC_TI_PRS_COR_3 = MEAN(FAC_TI_PRS_COR_3_HOM[ ])
// mean value of all elements
    
```

### (1)ELSE

### 7.1.6 FAC\_TI\_PRS\_COR\_1 = 1

```

FAC_TI_PRS_COR_2 = MEAN(FAC_TI_PRS_COR_2_S[ ])
// mean value of all elements
FAC_TI_PRS_COR_3 = MEAN(FAC_TI_PRS_COR_3_S[ ])
// mean value of all elements
    
```

### 7.1.6.1 (1)ENDIF

### 7.1.6.2 Subroutines

This chapter describes the sub functions which are called from the main sections.

#### 7.1.6.2.1 Calculate Pulse timing parameters

This section calculates the pulse timing parameters (Charge Time, TI) for the given counting factor index and needle lift.

Input parameters: PRM\_LV\_EGY\_RNG\_IV, PRM\_IDX\_TI\_CLC

Output parameters: PRM\_T\_CHA\_PER, PRM\_TI

Parameter description:

PRM_LV_EGY_RNG_IV	IN	0...1H	0...1	1	[-]
Injector needle lift.					
PRM_IDX_TI_CLC	IN	0...FFFFH	0...65535	1	[-]
Counting factor index					
PRM_T_CHA_PER	OUT	0...7FFFH	0...3276.7	0.1	[µs]
Injector charge periode					
PRM_TI	OUT	0...FFFFH	0...65.535	0.001	[ms]
Injection time					

**Calculate\_Pulse\_timing\_parameters**(IN <PRM\_LV\_EGY\_RNG\_IV>, IN <PRM\_IDX\_TI\_CLC>, OUT <PRM\_T\_CHA\_PER>, OUT <PRM\_TI>)

(1)IF PRM\_LV\_EGY\_RNG\_IV = 1

(1)THEN - high injector needle lift

PRM\_TI = IP\_TI\_H(PRM\_IDX\_TI\_CLC)

PRM\_T\_CHA\_PER = IP\_T\_CHA\_PER\_H(PRM\_IDX\_TI\_CLC)

(1)ELSE - low injector needle lift

PRM\_TI = IP\_TI\_L(PRM\_IDX\_TI\_CLC)

PRM\_T\_CHA\_PER = IP\_T\_CHA\_PER\_L(PRM\_IDX\_TI\_CLC)



**(1)ENDIF**

**End of Calculate\_Pulse\_timing\_parameters**

**7.1.7 Time synchronous tasks**

**Application conditions**

**Activation:** every engine state  
**Deactivation:** -  
**Initialization:** at reset: LV\_AUTH\_TI\_MIN\_AFL = 1  
**Recurrence:** 10 ms

**Calculation of LV\_AUTH\_TI\_MIN\_AFL:**

If homogeneous lean mode is active (STATE\_CMB\_CTL = HOM\_AFL) and the electrical injection time is smaller than (TI\_MIN\_HOM + C\_TI\_MIN\_OFS), the combustion mode changes to homogeneous stoichiometric mode. Switching back to homogeneous lean mode is allowed at the earliest if the delay time C\_T\_AUTH\_TI\_MIN\_AFL has elapsed.

```


1. IF
LV_AFL_CLC = 0
1. THEN
LV_AUTH_TI_MIN_AFL = 1
T_AUTH_TI_MIN_AFL = 0
(1) ELSE
(2) IF
LV_AUTH_TI_MIN_AFL = 1
AND
STATE_CMB_CTL = 'HOM_AFL' (homogeneous lean mode)
AND
TI_1_HOM_CLC_MIN < (TI_MIN_HOM + C_TI_MIN_OFS)
(2) THEN
LV_AUTH_TI_MIN_AFL = 0
T_AUTH_TI_MIN_AFL = C_T_AUTH_TI_MIN_AFL
(2) ELSE
(3) IF
T_AUTH_TI_MIN_AFL (n) > 0.01s (0H)
(3) THEN
T_AUTH_TI_MIN_AFL (n+1) = T_AUTH_TI_MIN_AFL (n) - 0.01 [s]
(3) ELSE
LV_AUTH_TI_MIN_AFL = 1
(3) ENDIF
(2) ENDIF
(1) ENDIF
    
```

**Output variable for LACO:**

```

(4) IF (STATE_INJ_MOD_REQ = 'SNGH') OR (STATE_INJ_MOD_REQ = 'MPLH')
OR (STATE_INJ_MOD_REQ = 'MPLH+PLS3')
(4) THEN
CRK_DIF_SOI_IGN = CRK_DIF_SOI_IGN_HOM
(4) ELSE
CRK_DIF_SOI_IGN = CRK_DIF_SOI_IGN_S
    
```

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#### (4) ENDIF


##### Application hint:

The input value TI\_FAC[x] and TI\_ADD[x] are the output value of the module "Coordination of Injection Time Correction Factors for Cylinder Balancing ". If the Cylinder Balancing Function is not used than TI\_FAC[x] and TI\_ADD[x] have to be initialized in an "Initialization Module" as follows:

TI\_FAC[x] =1

TI\_ADD [x] = 0

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## 7.2 Transfer to basic software for injection

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CAPA_IV_1_CLC [NC_CYL_NR]	V	0... FFFFH	0... 27.96	426.642e-6	µF
Capacity of the piezo injector for the first pulse, calculated from measurement data					
CAPA_IV_2_CLC [NC_CYL_NR]	V	0... FFFFH	0... 27.96	426.642e-6	µF
Capacity of the piezo injector for the second pulse, calculated from measurement data					
CAPA_IV_POST_CLC [NC_CYL_NR]	V	0... FFFFH	0... 27.96	426.642e-6	µF
Capacity of the piezo injector for the post injection pulse, calculated from measurement data					
CDN_DIAG_IV_RAW [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
Detailed error condition information of injection valve, cylinder individual I/O-SW returned raw value					
CDN_DIAG_PBK_IV_RAW [NC_PBK_IV_NR]	O/V	0... FFH	0... 255	1	-
Detailed error condition information of injection valve power stages, ATIC bank individual I/O-SW returned raw value					
CHA_IV_1_MES [NC_CYL_NR]	O/V	0... 3FFH	0... 2272.6968	2.2216	µAs
Actual measured charge value of a carried out first pulse on the piezo injector, cylinder individual					
CHA_IV_2_MES [NC_CYL_NR]	O/V	0... 3FFH	0... 2272.6968	2.2216	µAs
Actual measured charge value of a carried out second pulse on the piezo injector, cylinder individual					
CHA_IV_POST_MES [NC_CYL_NR]	O/V	0... 3FFH	0... 2272.6968	2.2216	µAs
Actual measured charge value of a carried out post injection pulse on the piezo injector, cylinder individual					
CHR_INJ_TRIM_0 [NC_PBK_IV_NR]	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	µAs
Measured charge at begin offset cancellation trim pulse					
CHR_INJ_TRIM_1 [NC_PBK_IV_NR]	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	µAs
Measured charge at end offset cancellation trim pulse					
CHR_INJ_TRIM_2 [NC_PBK_IV_NR]	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	µAs
Measured charge at begin gain cancellation trim pulse					
CHR_INJ_TRIM_3 [NC_PBK_IV_NR]	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	µAs
Measured charge at end gain cancellation trim pulse					
CHR_IV_MES_BEG_CHA	-	0... 3FFH	0... 2272.6968	2.2216	µAs
Reference charge value before start of charge phase of injection valve.					
CHR_IV_MES_END_CHA	-	0... 3FFH	0... 2272.6968	2.2216	µAs
Remaining charge value after charge phase of injection valve.					
CRK_PSN_ENG_IGN_INJ_UPD [NC_CYL_NR]	V	0... 780H	0... 720	0.375	°CRK
Expected engine update position at start of transmitting ignition and injection parameter to I/O-SW					
CRK_PSN_INJ_BAS [NC_CYL_NR]	V	0... 780H	0... 720	0.375	°CRK
Engine position relative to INJ_BAS angle					
CRK_WIN_SEL_IGN_INJ [NC_CYL_NR]	V	0H	NO_CLC	-	-
		1H	NO_WIN		
		2H	ADC_WIN		
		3H	RTD_WIN		
		4H	UPD_OLD_STATE		
Selected injection window for update/mode switch					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_WIN_SEL_PREV	-	0H 1H 2H 3H 4H	NO_CLC NO_WIN ADC_WIN RTD_WIN UPD_OLD_ STATE	-	-
Previous selected injection window for update/mode switch; temporary value					
CRK_WIN_SEL_TMP	-	0H 1H 2H 3H 4H	NO_CLC NO_WIN ADC_WIN RTD_WIN UPD_OLD_ STATE	-	-
Selected injection window for update/mode switch; temporary value					
CTR_INH_IV_MIS_GEN [NC_CYL_NR]	V	0... FFH	0... 255	1	-
Counter of number of cycles where shut off caused by misfire generator was active					
CTR_INJ_SWI_ACK_ERR	V	0... FFFFH	0... 65535	1	-
Counter for injection update errors					
CTR_PBK_IV_INI	V	0... FFH	0... 255	1	-
Counter of consecutive injection power stage initializations.					
CTR_PBK_IV_INI_MPL	O/V/S	0... FFH	0... 255	1	-
Counter of injection power stage initializations which produced at least one error.					
CTR_PSN_INH_IV_DYN	-	0... FH	0... 15	1	-
Position counter for dynamic cylinder shut off sequence calculation					
CTR_STATE_PREV_PBK_IV [NC_PBK_IV_NR]	V	0... FFH	0... 255	1	-
Number of activated IV on the selected power stage bank during last engine cycle (720°CRK)					
CTR_TEST_MOD_IV [NC_CYL_NR]	V	0... FFH	0... 255	1	-
Counter of number of injection valve actuator test cycles, cylinder individual					
CUR_CHA_OFS_CNL [NC_PBK_IV_NR]	O/V	8000... 7FFFH	-8.388608 ...8.388352	0.000256	A
Current applied at the initialization for offset cancellation purposes					
EGY_IV_1_CLC [NC_CYL_NR]	O/V	0... FFFFH	0... 255	0.00389105	mJ
Energy inside injector calculated from measurement data for the first pulse					
EGY_IV_2_CLC [NC_CYL_NR]	V	0... FFFFH	0... 255	0.00389105	mJ
Energy inside injector calculated from measurement data for the second pulse					
EGY_IV_POST_CLC [NC_CYL_NR]	V	0... FFFFH	0... 255	0.00389105	mJ
Energy inside injector calculated from measurement data for the post injection pulse					
EOI_1_MES [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Actual performed EOI of the first injection pulse, estimated					
EOI_2_HOM_CSERS_TEST [NC_CYL_NR]	V	0... 780H	0... 720	0.375	°CRK
End of injection for homogeneous mode for CSERS_INJ demo mode, 2.pulse					
EOI_2_MES [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Actual performed EOI of the second injection pulse, estimated					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EOI_3_HOM_CSERS_TEST [NC_CYL_NR]	V	0... 780H	0... 720	0.375	°CRK
End of injection for homogeneous mode for CSERS_INJ demo mode, 3.pulse					
EOI_INJ_UPD_PSN	-	0... 780H	0... 720	0.375	°CRK
End of injection position for autonomous generated update pulses					
EOI_POST_MES [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Actual performed EOI of the post injection pulse, estimated					
FAC_ADC_REF_INJ	V	0... FFFFH	0... 1.9999694824218	30.5175e-6	-
Correction factor for ADC measurement values due to ADC reference voltage calibration.					
FAC_ADD_PULSE	O/V	0... FFH	0... 1.9921875	0.0078125	-
Weighting factor for injection time update at transient conditions (additive pulse)					
IGA_IGC_H_RNG_ACT [NC_CYL_NR]	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Ignition angle (high range) currently applied by I/O-SW, cylinder individual					
IGA_TMP_SYN	-	FA60... 5A0H	-90 ...90	0.0625	°CRK
Temporary ignition angle for ignition/injection synchronization calculations					
INH_IV_DYN	O/V	0... FFH	0... 255	1	-
Shut off pattern for dynamic shut off (fixed cylinder allocation)					
INH_IV_MIS_GEN_ACK	V	0... FFH	0... 255	1	-
Shut off pattern for shut off caused by misfire generator					
INJ_MOD [NC_CYL_NR]	O/V	1H	SNGS	-	-
		2H	MPLS		
		3H	MPLS+PLS3		
		4H	PRE_INJ		
		6H	CRASH		
		7H	TEST_PULSE		
		21H	SNGS+MPLP		
		22H	MPLS+MPLP		
		41H	HOMS-SNG		
		42H	HOMS		
		43H	HOMS+PLS3		
		62H	HOMS+MPLP		
		80H	DISABLE		
		81H	SNGH		
82H	MPLH				
83H	MPLH+PLS3				
Cylinder individual injection mode					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INJ_UPD_ACK [NC_CYL_NR]	V	0... FFH	0... 255	1	-
Actual applied update mode; returned by I/O software					
LV_CTR_PBK_IV_INI_INC	V	0... 1H	0 ...1	1	-
Flag to trigger another injection power stage initialization after init failed.					
LV_CUR_CHA_OFS_INI	V	0... 1H	0 ...1	1	-
Flag to indicate that offset cancellation current is initialized for all power banks.					
LV_EGY_RNG_IV_PLS_1_ACK [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Cylinder individual flag to indicate that the first injection pulse was executed with high injector needle lift (1 = high).					
LV_EGY_RNG_IV_PLS_1_ACT [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Flag for the injector energy range of the first pulse (0 = low range, 1 = high range); for injection update calculations					
LV_IGN_INJ_COPL_HOM_ACT [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Flag to indicate that ignition injection coupling is active during HOM mode.					
LV_IGN_INJ_UPD_WIN	V	0... 1H	0 ...1	1	-
Flag to indicate that an injection mode switch or update is possible					
LV_INH_INJ [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Flag that indicates if cylinder shut off is active or not					
LV_INH_INJ_OLD	-	0... 1H	0 ...1	1	-
Flag that indicates if cylinder shut off was active or not. It contains the information from previous calculation run.					
LV_INH_INJ_UPD_MOD_UPD [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Flag to indicate an inhibition of update mode update					
LV_INJ_DEAC_BACK_ENG	V	0... 1H	0 ...1	1	-
Flag to indicate deactivated injection due to backward rotation of engine					
LV_INJ_MOD_UPD	V	0... 1H	0 ...1	1	-
Flag to indicate that the possibility of an injection mode data update (1) or mode switch (0) has to be checked					
LV_INJ_MPLP_CYL [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Logical variable for enabling post injection, cylinder individual					
LV_INJ_REST_ENA	V	0... 1H	0 ...1	1	-
Flag to indicate a possible restart of injection during running engine					
LV_INJ_UPD_CLC_ENA	V	0... 1H	0 ...1	1	-
Flag to enable injection update calculations					
LV_IV_MES_VLD	O/V	0... 1H	0 ...1	1	-
The flag indicates if the measurements for charge and voltage of the piezo injector is valid					
LV_IV_PLS_MES_VLD [NC_NR_IV_PLS]	V	0... 1H	0 ...1	1	-
Flag to indicate valid measurement of charge and voltage of each injection pulse.					
LV_SOI_ACT_SWI [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Flag to indicate the use of start of injection angle for injection mode switch calculations					
LV_SOI_ACT_UPD [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Flag to indicate the use of start of injection angle for injection mode update calculations					
LV_ST_INJ	O/V	0... 1H	0 ...1	1	-
Flag which indicates that the injection has started after engine synchronization					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_STATE_PBK_IV_INI_ACT	V	0... 1H	0 ...1	1	-
Flag to indicate an active injection driver initialization phase					
LV_STATE_PREV_IV [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Cylinder individual flag which indicates whether last injection was activated or deactivated					
LV_STATE_PREV_PBK_IV [NC_PBK_IV_NR]	V	0... 1H	0 ...1	1	-
Injection valve power stage bank individual flag which indicates if the power stage bank was activated (=1) or deactivated during the last injection cycles					
LV_TI_3_HOM_ACT	-	0... 1H	0 ...1	1	-
Logical value indicating active homogeneous injection for third pulse					
NR_CYL_INH_IV_DYN	-	0... 7H	0 ...7	1	-
Destination logical cylinder number for dynamic fuel shut off					
NR_CYL_INJ_BAS	O/V	0... 7H	0 ...7	1	-
Number of the current cylinder, which has reached its CRK_INJ_BAS[x]-Event					
NR_CYL_INJ_BAS_PREV	O/V	0... 7H	0 ...7	1	-
Number of the previous cylinder, which had reached its CRK_INJ_BAS[x]-Event					
NR_CYL_OFS_INH_IV_DYN	V	0... 7H	0 ...7	1	-
Cylinder offset for destination of current cylinder number for dynamic fuel shut off					
NR_PBK_IV_INI	V	0... 8H	0 ...8	1	-
Number of initialized injection valve power banks					
PREV_STATE_IV	O/V	0... FFH	0... 255	1	-
Bit coded byte which indicates whether a cylinder was deactivated or not					
PWM_DCDC_SP	V	0... FFFFH	0... 99.998474121093	0.00152587	%
Pulse width modulated signal to adjust DCDC converter setpoint.					
SOI_1_HOM_CSERS_TEST [NC_CYL_NR]	V	0... 780H	0... 720	0.375	°CRK
Start of injection for homogeneous mode for CSERS_INJ demo mode, 1.pulse					
SOI_1_MES [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Actual performed SOI of the first injection pulse, estimated					
SOI_2_MES [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Actual performed SOI of the second injection pulse, estimated					
SOI_EOI_ACT_SWI [NC_CYL_NR]	V	0... 780H	0... 720	0.375	°CRK
Start or end of injection angle for injection mode switch calculations					
SOI_EOI_ACT_UPD [NC_CYL_NR]	V	0... 780H	0... 720	0.375	°CRK
Start or end of injection angle for injection mode data update calculations					
SOI_POST_MES [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Actual performed SOI of the post injection pulse, estimated					
SOI_TMP_SYN	-	0... 780H	0... 720	0.375	°CRK
Temporary start of injection angle for ignition/injection synchronization calculations					
SOI_TMP_SYN_PREV	-	0... 780H	0... 720	0.375	°CRK
Temporary start of injection angle for ignition/injection synchronization calculations (previous value)					
STATE_ERR_IV_CYL_RAW [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
Detailed error information of injection valve, cylinder individual I/O-SW raw value					
STATE_ERR_PBK_IV_RAW [NC_PBK_IV_NR]	O/V	0... FFH	0... 255	1	-
Detailed error information of injection valve power stages, ATIC bank individual I/O-SW raw value					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_ERR_PBK_IV_ST_RAW [NC_PBK_IV_NR]	O/V	0... FFH	0... 255	1	-
Detailed error information of injection valve power stages during startup phase, ATIC bank individual I/O-SW raw value					
STATE_IGN_UPD_ENA	V	0... FFH	0... 255	1	-
Bitmask to enable/disable ignition update calculations					
STATE_INJ_CRASH_ACT	V	0... FFH	0... 255	1	-
Injection driver state during vehicle crash request					
STATE_INJ_DR	V	0H 1H 2H 3H 4H 5H	DISABLED INI CONF WAIT WAIT2RUN RUN	-	-
Actual state of injection driver					
STATE_INJ_UPD_TRM	O/V	0... FFH	0... 255	1	-
State, which indicates that at least one data set per cylinder was sent to I/O-SW (bit x of assigned cylinder =1)					
STATE_PBK_IV_INI	O/V	0H 1H 2H 3H	INIT_PENDING REINIT_ PENDING INIT_ACTIVE INIT_FINISHED	-	-
State variable indicating the current status of initialization of injection valve power stage banks					
STATE_UPD_IGN [NC_CYL_NR]	V	0H 1H 2H	NONE TRIG_IT TRIG_EXT	-	-
State of ignition update for ignition/injection synchronization calculations					
T_INJ_CRASH_ACT	V	0... FFFFH	0... 655350	10	ms
Injection valve opening time during vehicle crash					
TD_IGC_ACT [NC_CYL_NR]	O/V	0... FFFFH	0... 262.14	0.004	ms
Dwell time currently applied by I/O-SW, cylinder individual					
TD_TMP_SYN	-	0... FFFFH	0... 262.14	0.004	ms
Temporary ignition dwell time for ignition/injection synchronization calculations					
TI_1_ADD_DLY_HOM	V	8000... 7FFFH	-32768 ...32767	1	µs
Injector dead time correction first pulse, homogeneous mode					
TI_1_HOM_CSERS_TEST [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time for CSERS_INJ demo mode, first pulse (intermediate value)					
TI_1_MES [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Actual performed cylinder individual injection time, first pulse					
TI_2_HOM_CSERS_TEST [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time for CSERS_INJ demo mode, second pulse (intermediate value)					
TI_2_MES [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Actual performed cylinder individual injection time, second pulse or additional pulse					
TI_3_HOM_CSERS_TEST [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time for CSERS_INJ demo mode, third pulse (intermediate value)					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TI_ACT_SWI [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Injection time for injection mode switch calculations					
TI_ACT_UPD [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Injection time for injection mode data update calculations					
TI_ADD_PULSE_MIN	O/V	0... FFFFH	0... 65.535	0.001	ms
Minimum injection time for additive injection pulse					
TI_POST_MES [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Actual performed cylinder individual injection time, post injection pulse					
V_ADC_REF_MES_INJ	V	0... FFFFH	0... 9.9998474121093	152.587e-6	V
Filtered ADC reference calibration voltage.					
V_ADC_REF_MES_INJ_RAW	V	0... FFFFH	0... 9.9998474121093	152.587e-6	V
Raw ADC reference calibration voltage.					
V_IV_1_MES [NC_CYL_NR]	O/V	0... 7FFFH	0... 639.98046875	0.01953125	V
Actual measured voltage of a carried out first pulse on the piezo injector, cylinder individual					
V_IV_2_MES [NC_CYL_NR]	O/V	0... 7FFFH	0... 639.98046875	0.01953125	V
Actual measured voltage of a carried out second pulse on the piezo injector, cylinder individual					
V_IV_POST_MES [NC_CYL_NR]	O/V	0... 7FFFH	0... 639.98046875	0.01953125	V
Actual measured voltage of a carried out post pulse on the piezo injector, cylinder individual					
VBOOST_PBK_IV_MES [NC_NR_DCDC_INJ]	V	0... 7FFFH	0... 639.98046875	0.01953125	V
Actual measured voltage of the DCDC converter for the injection valve power stage banks					

**Input data:**

C_T_CHA_PER_H {p. 2005}	CRK_INJ_BAS [NC_CYL_NR] {p. 2122}	CRK_PSN_STAT_IGN_ UPD_END {p. 3327}	CRK_PSN_STAT_IGN_ UPD_ST {p. 3327}
CRK_PSN_STAT_WIN_ END {p. 3327}	CRK_PSN_STAT_WIN_ST {p. 3327}	CUR_CHA_OFS_CNL_ OUT [NC_PBK_IV_NR] {p. 3432}	EGY_STEP_INJ_CHA_ GRD [NC_CYL_NR] {p. 2277}
EGY_STEP_INJ_CHA_ GRD_L [NC_CYL_NR] {p. 2277}	EGY_STEP_INJ_DCHA_ GRD [NC_CYL_NR] {p. 2277}	EGY_STEP_INJ_DCHA_ GRD_L [NC_CYL_NR] {p. 2277}	EOI_1_S [NC_CYL_NR] {p. 2140}
EOI_2_HOM [NC_CYL_NR] {p. 2130}	EOI_2_HOMS [NC_CYL_NR] {p. 2136}	EOI_3_HOM [NC_CYL_NR] {p. 2133}	EOI_3_HOMS [NC_CYL_NR] {p. 2136}
EOI_LIM_HOM {p. 2122}	EOI_LIM_POST {p. 2188}	FAC_CHA_IV_MES_PBK [NC_PBK_IV_NR] {p. 2090}	FAC_COR_SLOP_CHA_ CAL [NC_PBK_IV_NR] {p. 3432}
FAC_N {p. 3327}	FAC_V_IV_MES_PBK [NC_PBK_IV_NR] {p. 2090}	IDX_PRS_COR_CYL_ CLC_MPLH [NC_CBK_HPP_NR] {p. 3327}	IGA_AV_H_RNG [NC_CYL_NR] {p. 1828}

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IGA_AV_H_RNG_HOMS [NC_CYL_NR] {p. 1828}	IGA_AV_H_RNG_S [NC_CYL_NR] {p. 1828}	INH_INJ {p. 2295}	INH_IV {p. 2295}
INH_IV_MIS_GEN {p. 7194}	INJ_MOD_SP [NC_CYL_NR] {p. 3328}	INJ_MOD_SP_HOM [NC_CYL_NR] {p. 3329}	INJ_MOD_SP_HOMS [NC_CYL_NR] {p. 3329}
INJ_MOD_SP_S [NC_CYL_NR] {p. 3330}	LV_ADD_PULSE_ENA {p. 8242}	LV_CSERS_INJ_PLS_ TEST_MOD_ENA {p. 6117}	LV_DIAG_END_RLY_ MAIN_DLY {p. 4933}
LV_EGY_RNG_IV_PLS_1_ HOM [NC_CYL_NR] {p. 2261}	LV_EGY_RNG_IV_PLS_1_ S [NC_CYL_NR] {p. 2261}	LV_EGY_RNG_IV_PLS_2_ HOM [NC_CYL_NR] {p. 2261}	LV_EGY_RNG_IV_PLS_2_ S [NC_CYL_NR] {p. 2261}
LV_EGY_RNG_IV_PLS_3_ HOM [NC_CYL_NR] {p. 2261}	LV_EGY_RNG_IV_PLS_3_ S [NC_CYL_NR] {p. 2261}	LV_EOI_2_DELTA_HOM_ CUS {p. 8269}	LV_ERR_TMP_MU_MC {p. 7072}
LV_ES {p. 1720}	LV_IGA_AND_INJ_SWI_ HOMS {p. 8136}	LV_IGK {p. 906}	LV_INJ_CRASH_ACT {p. 3330}
LV_INJ_DI_PLS_UPD_ MPLH {p. 2146}	LV_INJ_OFF_TMR_INJ_ ENA {p. 7158}	LV_IV_POST_EGY_RNG {p. 2179}	LV_IV_TEST_MOD_AUTH {p. 3330}
LV_MC_SOPC_INH_DI {p. 7186}	LV_POST_INJ_ACT {p. 2179}	LV_RLY_MAIN_DLY_ERR {p. 4933}	LV_ST_END {p. 1720}
LV_ST_INJ_REQ {p. 3331}	LV_SYN_ENG {p. 1506}	LV_TI_EXT_ADJ [NC_CYL_NR] {p. 3331}	N_32 {p. 1525}
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NC_IV_CRASH {p. 626}	NC_N_MAX_IV_TEST_ MOD {p. 627}	NC_NR_DCDC_INJ {p. 627}	NC_NR_IV_PLS {p. 627}
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NC_STATE_STST_ENA {p. 628}	NC_TD_LIM_MIN {p. 1877}	NC_TI_CRASH {p. 629}	NC_TI_TEST_PLS_PER {p. 629}
NC_V_ADC_REF_INJ {p. 629}	NLC_CSERS_INJ_PLS_ TEST_CONF {p. 629}	NR_CYL_IV_TEST_MOD {p. 3331}	PRS_DEC_INJ_1_HOM [NC_CYL_NR] {p. 2200}
PSN_ENG {p. 1525}	SEG_NR {p. 1525}	SOI_1_HOM [NC_CYL_NR] {p. 2122}	SOI_1_HOMS [NC_CYL_NR] {p. 2136}
SOI_LIM {p. 2122}	SOI_LIM_POST {p. 2188}	SOI_POST_INJ [NC_CYL_NR] {p. 2188}	STATE_INH_IV_DYN {p. 2295}
STATE_INJ_UPD_ENA {p. 3332}	SUM_INH_INJ {p. 2295}	T_CHA_PER_HOM [NC_CYL_NR] {p. 2001}	T_CHA_PER_HOM_2 [NC_CYL_NR] {p. 2001}

T_CHA_PER_HOM_3 [NC_CYL_NR] {p. 2001}	T_CHA_PER_POST {p. 2001}	T_CHA_PER_S_1 [NC_CYL_NR] {p. 2001}	T_CHA_PER_S_2 [NC_CYL_NR] {p. 2001}
T_CHA_PER_S_3 [NC_CYL_NR] {p. 2001}	T_DCHA_PER_HOM [NC_CYL_NR] {p. 2001}	T_DCHA_PER_HOM_2 [NC_CYL_NR] {p. 2001}	T_DCHA_PER_HOM_3 [NC_CYL_NR] {p. 2001}
T_DCHA_PER_POST {p. 2002}	T_DCHA_PER_S_1 [NC_CYL_NR] {p. 2002}	T_DCHA_PER_S_2 [NC_CYL_NR] {p. 2002}	T_DCHA_PER_S_3 [NC_CYL_NR] {p. 2002}
T_DLY_1_2_S_EXT [NC_CYL_NR] {p. 2146}	T_DLY_2_3_S_EXT [NC_CYL_NR] {p. 2146}	T_RLS_DLY_DCHA_1_ HOM [NC_CYL_NR] {p. 2002}	T_RLS_DLY_DCHA_1_S [NC_CYL_NR] {p. 2002}
T_RLS_DLY_DCHA_2_ HOM [NC_CYL_NR] {p. 2002}	T_RLS_DLY_DCHA_2_S [NC_CYL_NR] {p. 2002}	T_RLS_DLY_DCHA_3_ HOM [NC_CYL_NR] {p. 2002}	T_RLS_DLY_DCHA_3_S [NC_CYL_NR] {p. 2002}
T_RLS_DLY_DCHA_POST {p. 2002}	TCO {p. 1100}	TD {p. 1873}	TD_AD [NC_CYL_NR] {p. 932}
TD_LIM_MAX {p. 1876}	TD_S {p. 1875}	TECU {p. 1256}	TI_1_HOM [NC_CYL_NR] {p. 2002}
TI_1_S [NC_CYL_NR] {p. 2003}	TI_2_HOM [NC_CYL_NR] {p. 2003}	TI_2_S [NC_CYL_NR] {p. 2003}	TI_3_HOM [NC_CYL_NR] {p. 2003}
TI_3_S [NC_CYL_NR] {p. 2003}	TI_EXT_ADJ [NC_CYL_NR] {p. 3332}	TI_POST_INJ [NC_CYL_NR] {p. 2179}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CSERS_INJ_PLS_TEST_ANG_ADD [NC_NR_IV_PLS]	V	FF01... FFH	-95.625 ...95.625	0.375	°CRK
Calibrated offset to change injection phase for CSERS_INJ demo mode					
C_CSERS_INJ_PLS_TEST_TI_FAC [NC_NR_IV_PLS]	V	0... FFH	0 ...1	0.00392156	-
Calibrated factor to change injection time for CSERS_INJ demo mode					
C_CTR_PBK_IV_INI_MAX	V	0... FFH	0... 255	1	-
Maximum number of injection power stage initializations before an error is detected.					
C_FAC_FIL_V_ADC_REF	V	0... FFFFH	0... 0.9999847412109	15.2587e-6	-
Filter constant of PT1-filter for measured ADC reference calibration voltage.					
C_NR_CYL_OFS_INH_IV_DYN	V	0... 7H	0 ...7	1	-
Cylinder offset for destination of current cylinder number for dynamic fuel shut off					
C_SOI_EXT_ADJ	V	0... 780H	0... 720	0.375	°CRK
Start of injection for external adjustment (service tool intervention)					
C_SOI_MIN_UPD_PLS_SNGH	V	0... 780H	0... 720	0.375	°CRK
Minimum start (limit) of injection for makeup pulse at homogeneous single injection mode					
C_T_CHA_FALL_H	V	0... 7FFFH	0... 3276.7	0.1	µs
Charge fall time for injector charge current at high needle lift.					
C_T_CHA_FALL_L	V	0... 7FFFH	0... 3276.7	0.1	µs
Charge fall time for injector charge current at low needle lift.					
C_T_CHA_RISE_H	V	0... 7FFFH	0... 3276.7	0.1	µs
Charge rise time for injector charge current at high needle lift.					
C_T_CHA_RISE_L	V	0... 7FFFH	0... 3276.7	0.1	µs
Charge rise time for injector charge current at low needle lift.					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DCHA_FALL_H	V	0... 7FFFH	0... 3276.7	0.1	µs
Discharge fall time for injector discharge current at high needle lift.					
C_T_DCHA_FALL_L	V	0... 7FFFH	0... 3276.7	0.1	µs
Discharge fall time for injector discharge current at low needle lift.					
C_T_DCHA_RISE_H	V	0... 7FFFH	0... 3276.7	0.1	µs
Discharge rise time for injector discharge current at high needle lift.					
C_T_DCHA_RISE_L	V	0... 7FFFH	0... 3276.7	0.1	µs
Discharge rise time for injector discharge current at low needle lift.					
C_T_OFS_UPD_IGN_INJ_SYN	V	0... FFFFH	0... 65.535	0.001	ms
Task run time offset for a synchronized update of ignition and injection parameters to I/O-SW					
C_V_ADC_REF_INJ	V	0... FFFFH	0... 9.9998474121093	152.587e-6	V
ADC reference calibration voltage.					
C_V_ADC_REF_MES_INJ_MAX_PLAUS	V	0... FFFFH	0... 9.9998474121093	152.587e-6	V
Maximum plausible value of measured ADC reference calibration voltage.					
C_V_ADC_REF_MES_INJ_MIN_PLAUS	V	0... FFFFH	0... 9.9998474121093	152.587e-6	V
Minimum plausible value of measured ADC reference calibration voltage.					
CLF_CSERS_INJ_PLS_TEST_CYL_ON [NC_NR_IV_PLS]	V	0... FFFFH	0... 65535	1	-
Calibrated bitfield enabling CSERS_INJ demo mode test pulse on chosen cylinder, bit 0 enabling cylinder 0, bit 1 enabling cylinder 1, ...					
IP_EOI_INJ_UPD_PSN	V	0... 780H	0... 720	0.375	°CRK
LDP_N_32_IP_EOI_INJ_UPD_PSN	6	0... FFH	0... 8160	32	rpm
End of injection position for autonomous generated update pulses					
IP_FAC_ADD_PULSE	V	0... FFH	0... 1.9921875	0.0078125	-
LDP_N_32_IP_FAC_ADD_PULSE	7	0... FFH	0... 8160	32	rpm
LDP_TCO_IP_FAC_ADD_PULSE	7	0... FEH	-48... 142.5	0.75	°C
Weighting factor for additive pulses in case of injection time update at transient conditions					
IP_PWM_DCDC_PCTL	V	0... FFFFH	0... 99.998474121093	0.00152587	%
LDPM_TECU_DCDC_PCTL	6	0... FEH	-48... 142.5	0.75	°C
Pulse wide modulated pre control for DCDC converter					
IP_TI_ADD_DLY_HPDI_EGY_H	V	0... FFFFH	-32768 ...32767	1	µs
LDPM_PRS_DEC_INJ_1_INJR	6	0... FFFFH	0... 347776	5.30672159	hPa
Injector dead time correction for high energy range of the injector					
IP_TI_ADD_DLY_HPDI_EGY_L	V	0... FFFFH	-32768 ...32767	1	µs
LDPM_PRS_DEC_INJ_1_INJR	6	0... FFFFH	0... 347776	5.30672159	hPa
Injector dead time correction for low energy range of the injector					
IP_TI_ADD_PULSE_MIN	V	0... FFFFH	0... 65.535	0.001	ms
LDPM_PRS_DEC_INJ_1_INJR	6	0... FFFFH	0... 347776	5.30672159	hPa
Minimum injection time for additive injection pulse, pressure dependent					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_CSERS_INJ_PLS_TEST_TYP	V	0... 1H	0 ...1	1	-
Switch to choose type of injection pulse change for CSERS_INJ demo mode; 0 = phase shift is active, 1 = timing change is active					
LC_CUR_CHA_INJ_H_L_SEL_ENA	V	0... 1H	0 ...1	1	-
Flag to enable page selection for high and low injector needle lift.					
LC_IGN_INJ_COPL_MOD_SWI_ENA	V	0... 1H	0 ...1	1	-
Switch to enable mode switch strategy at change of ignition injection coupling during HOM mode.					
LC_IGN_UPD_STAT_ENA	V	0... 1H	0 ...1	1	-
Flag to enable static update calculation of ignition angle (at ignition/injection synchronization)					
LC_INJ_PLS_UPD_MOD	V	0H 1H	IMMEDIATE AUTONOMOUS	-	-
Logical constant for selection of injection pulse update mode					
LC_INJ_UPD_OLD_MOD_ENA	V	0... 1H	0 ...1	1	-
Flag to enable injection data update of old injection mode in case of mode switch failed					
LC_IV_ADD_PLS_MPLH_ENA	V	0... 1H	0 ...1	1	-
Switch to enable pulse update functionality at homogeneous multiple injection					
LC_IV_ADD_PLS_SNGH_ENA	V	0... 1H	0 ...1	1	-
Switch to enable makeup pulse functionality at homogeneous single injection					
LC_V_ADC_REF_CAL_INJ	V	0... 1H	0 ...1	1	-
Switch ADC calibration voltage reference between calibratable voltage (= 1) and configurable voltage (= 0).					
LC_V_ADC_REF_ENA	V	0... 1H	0 ...1	1	-
Flag to enable ADC reference voltage calibration.					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_INJ_MOD_DI	-	0... FFH	0... 255	1	-
Constant defined to indicate that injection is disabled					
NC_INJ_MOD_HOM	-	0... FFH	0... 255	1	-
Constant defined to indicate homogeneous mode					
NC_INJ_MOD_HOMS	-	0... FFH	0... 255	1	-
Constant defined to indicate homogeneous stratified mode					
NC_INJ_MOD_MASK_1	-	0... FFH	0... 255	1	-
Mask for injection mode determination					
NC_INJ_MOD_MASK_2	-	0... FFH	0... 255	1	-
Mask for injection pulse type determination					
NC_INJ_MOD_MULTI	-	0... FFH	0... 255	1	-
Constant defined to indicate multi injection mode					
NC_INJ_MOD_MULTI_PLS3	-	0... FFH	0... 255	1	-
Constant defined to indicate multi injection mode with three pulses					
NC_INJ_MOD_S	-	0... FFH	0... 255	1	-
Constant defined to indicate stratified mode					
NC_INJ_MOD_SINGLE	-	0... FFH	0... 255	1	-
Constant defined to indicate single injection mode					
NC_INJ_MOD_TEST_PLS	-	0... FFH	0... 255	1	-
Constant defined to indicate injection mode for actuator tests by diagnostic tester					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
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### Action definition

<b>ACTION_INJR_IgnUpdate</b> (IN<PRM_IGA_IGC_H_RNG>,IN<PRM_CYL>)					Mode: O
This action sets the cylinder individual ignition angle for mode switch and data update of <Cyl> to <Iga_IGC_H_Rng>..					
Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_IGA_IGC_H_RNG	in	FA60... 5A0H	-90 ...90	0.0625	°CRK
This parameter defines the new ignition angle for homogeneous single injection mode.					
PRM_CYL	in	0... 7H	0 ...7	1	-
This action affects the injection mode of cylinder Cyl.					


### Import actions:

<b>ACTION_IGRE_SendTrigForIgnUpd</b> (IN<PRM_STATE_IGN_UPD_ENA>)
<b>ACTION_INFR_GetInjDiagElectric</b> (IN<PRM_CYL>,OUT<PRM_ERR_DIAG>,OUT<PRM_DIAG_VALID>)
<b>ACTION_INFR_GetInjDiagIni</b> (IN<PRM_BANK_NR>,OUT<PRM_ERR_INI>,OUT<PRM_INI_VALID>)
<b>ACTION_INFR_GetInjMesEoi</b> (IN<PRM_CYL>,IN<PRM_PLS_NR>,OUT<PRM_PLS_POSITION>)
<b>ACTION_INFR_GetInjMesPulsePer</b> (IN<PRM_CYL>,IN<PRM_PLS_NR>,OUT<PRM_PERIOD>)
<b>ACTION_INFR_GetInjMesSoi</b> (IN<PRM_CYL>,IN<PRM_PLS_NR>,OUT<PRM_PLS_POSITION>)
<b>ACTION_INFR_IniInjDriver</b> ()
<b>ACTION_INFR_ReqInjPulse</b> (IN<PRM_CYL>,IN<PRM_PULSE_PER>)
<b>ACTION_INFR_ReqInjUpdate</b> (IN<PRM_CYL>,IN<PRM_MODE>,OUT<PRM_ACKNOWLEDGE>)
<b>ACTION_INFR_SetInjChaCur</b> (IN<PRM_CYL>,IN<PRM_PAGE_NR>,IN<PRM_CHA_CUR>)
<b>ACTION_INFR_SetInjDchaCur</b> (IN<PRM_CYL>,IN<PRM_PAGE_NR>,IN<PRM_DCHA_CUR>)
<b>ACTION_INFR_SetInjEoiLim</b> (IN<PRM_CYL>,IN<PRM_PACKET_NR>,IN<PRM_EOI_LIM>)
<b>ACTION_INFR_SetInjInhibit</b> (IN<PRM_CYL>,IN<PRM_LV_INH_INJ>)
<b>ACTION_INFR_SetInjPlsUpdFactor</b> (IN<PRM_PLSUPD_FACTOR>)
<b>ACTION_INFR_SetInjPlsUpdOffset</b> (IN<PRM_CYL>,IN<PRM_UPD_OFFSET>)
<b>ACTION_INFR_SetInjPulseType</b> (IN<PRM_CYL>,IN<PRM_PLS_NR>,IN<PRM_PLS_TYPE>)
<b>ACTION_INFR_SetInjSoiLim</b> (IN<PRM_CYL>,IN<PRM_PACKET_NR>,IN<PRM_SOI_LIM>)
<b>ACTION_INJR_SetOfsCurlni</b> (IN<PRM_OFSCURLNI>,IN<PRM_BANK>)
<b>ACTION_INJR_SetStateInjUpdEna</b> (IN<PRM_CYL>,IN<PRM_STATE_INJ_UPD_ENA>)

### General information

#### More import actions:

<b>ACTION_INFR_GetInjDiagPower</b> (IN<Bank_nr>,OUT<Err_power>,OUT<Power_valid>)
<b>ACTION_INFR_GetInjMesQ</b> (IN<Cyl>,IN<Pulse>,IN<Event>,OUT<Charge>)
<b>ACTION_INFR_GetInjMesQTrim</b> (IN<Bank>,IN<Event>,OUT<Charge>)
<b>ACTION_INFR_GetInjMesU</b> (IN<Cyl>,IN<Pulse>,IN<Event>,OUT<Voltage>)
<b>ACTION_INFR_GetInjMesUDcdc</b> (IN<Dcdc>,OUT<Voltage_dcdc>)
Continued on next page

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<b>ACTION_INFR_GetInjMesURef(OUT&lt;Voltage&gt;)</b>
<b>ACTION_INFR_GetInjMesVId(IN&lt;Cyl&gt;,IN&lt;Pulse&gt;,OUT&lt;Mes_VId&gt;)</b>
<b>ACTION_INFR_GetInjOfsCur(IN&lt;Bank&gt;,OUT&lt;Ofs_cur&gt;)</b>
<b>ACTION_INFR_ReqInjMode(IN&lt;Mode&gt;)</b>
<b>ACTION_INFR_SetInjChaFallPer(IN&lt;Page_nr&gt;,IN&lt;Cha_fall_per&gt;)</b>
<b>ACTION_INFR_SetInjChaPer(IN&lt;Cyl&gt;,IN&lt;Pulse&gt;,IN&lt; Cha_per &gt;)</b>
<b>ACTION_INFR_SetInjChaRisePer(IN&lt;Page_nr&gt;,IN&lt;Cha_rise_per&gt;)</b>
<b>ACTION_INFR_SetInjDcdc(IN&lt;Dcdc_nr&gt;,IN&lt;Dcdc_ducy&gt;)</b>
<b>ACTION_INFR_SetInjDchaFallPer(IN&lt;Page_nr&gt;,IN&lt;Dcha_fall_per&gt;)</b>
<b>ACTION_INFR_SetInjDchaPer(IN&lt;Cyl&gt;,IN&lt;Pulse&gt;,IN&lt; Dis_cha_per &gt;)</b>
<b>ACTION_INFR_SetInjDchaRisePer(IN&lt;Page_nr&gt;,IN&lt;Dcha_rise_per&gt;)</b>
<b>ACTION_INFR_SetInjOfsCur(IN&lt;Bank&gt;,IN&lt; Of_s_cur &gt;)</b>
<b>ACTION_INFR_SetInjPlsUpdMinPer(IN&lt;Plsupd_min_per&gt;)</b>
<b>ACTION_INFR_SetInjPlsUpdMode(IN&lt;Cyl&gt;,IN&lt;Pulse&gt;,IN&lt;Plsupd_mode&gt;)</b>
<b>ACTION_INFR_SetInjPulseDurPer(IN&lt;Cyl&gt;,IN&lt;Pulse&gt;,IN&lt;Pls_duration&gt;)</b>
<b>ACTION_INFR_SetInjPulseEna(IN&lt;Cyl&gt;,IN&lt;Pulse&gt;,IN&lt; Pulse_ena &gt;)</b>
<b>ACTION_INFR_SetInjPulsePage(IN&lt;Cyl&gt;,IN&lt;Pls_nr&gt;,IN&lt;Page_nr&gt;)</b>
<b>ACTION_INFR_SetInjPulsePosAng(IN&lt;Cyl&gt;,IN&lt;Pulse&gt;,IN&lt; Position_ang&gt;)</b>
<b>ACTION_INFR_SetInjPulsePosPer(IN&lt;Cyl&gt;,IN&lt;Pulse&gt;,IN&lt; Position_per&gt;)</b>
<b>ACTION_INFR_SetInjSeqEndDly(IN&lt;Cyl&gt;,IN&lt;Pulse&gt;,IN&lt; Seq_end_delay &gt;)</b>
<b>ACTION_INFR_SetInjTdcToBaseAng(IN&lt;Tdc_to_base_ang &gt;)</b>

The purpose of this module is the transfer of injection related data to IO-Software under real time conditions. The most important thing is to maintain the data consistency. The figure 1 shows the general flow of data:

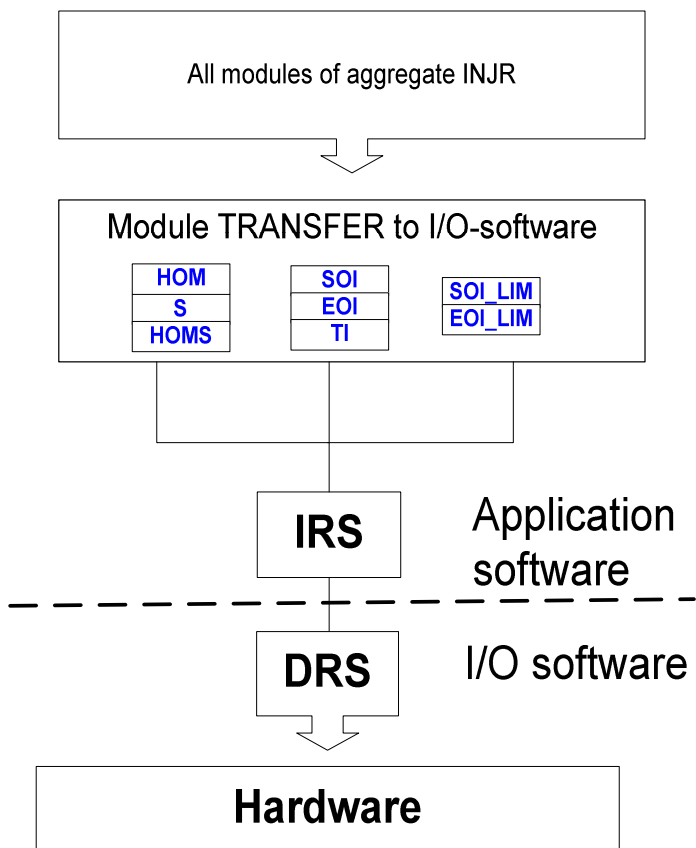


Figure 7.2.1: overview Interface to I/O-software

**Control of piezo injector needle lift**

To control the needle lift of the piezo injector the energy loaded into the actuator is set by the number of energy packets. In the actual version are two possible setting: High lift and low lift. The data is an input data from module needle lift. The variables are T\_CHA\_PER\_xxx and T\_DCHA\_PER\_xxx, which describe the charge and discharge time.

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NR\_EGY\_STEP\_INJ

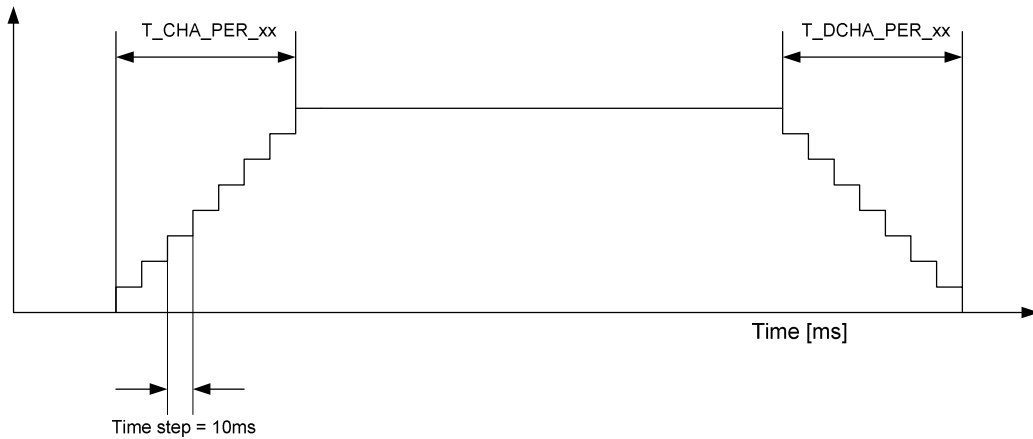


Figure 7.2.2: setting of energy packets for piezo injector

For different injection modes, the energy packets can be different. The following picture shows the overview of the different setting and the update timing conditions.

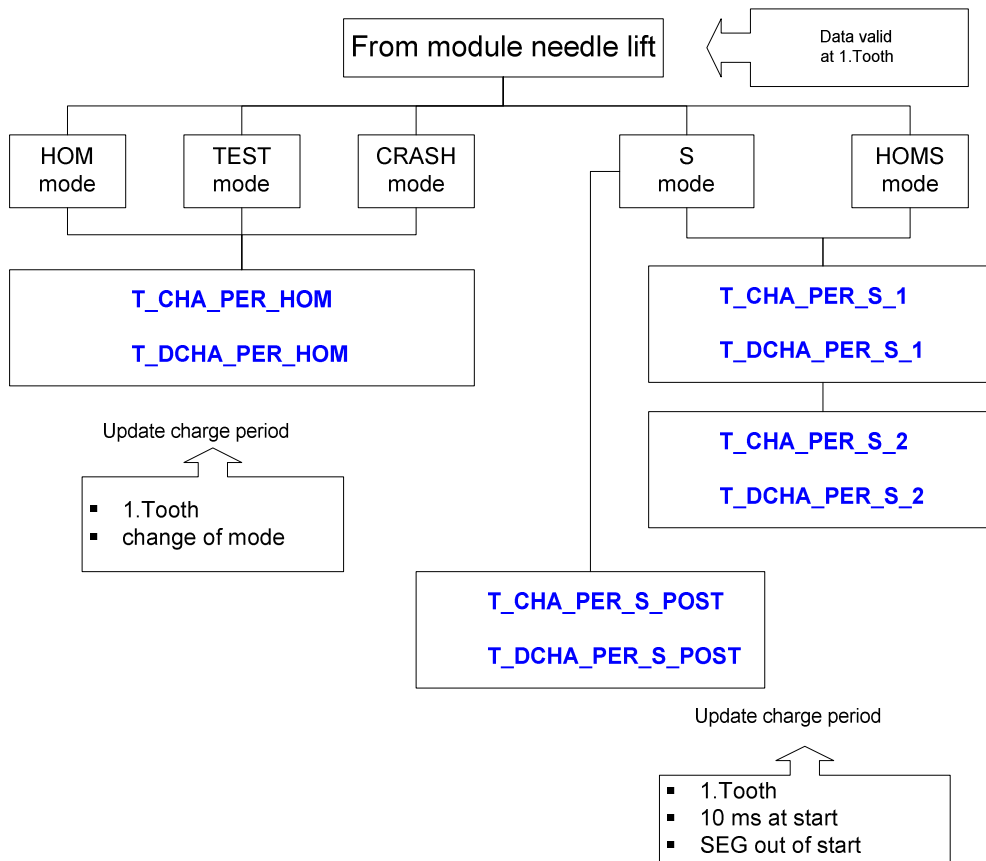


Figure 7.2.3: overview

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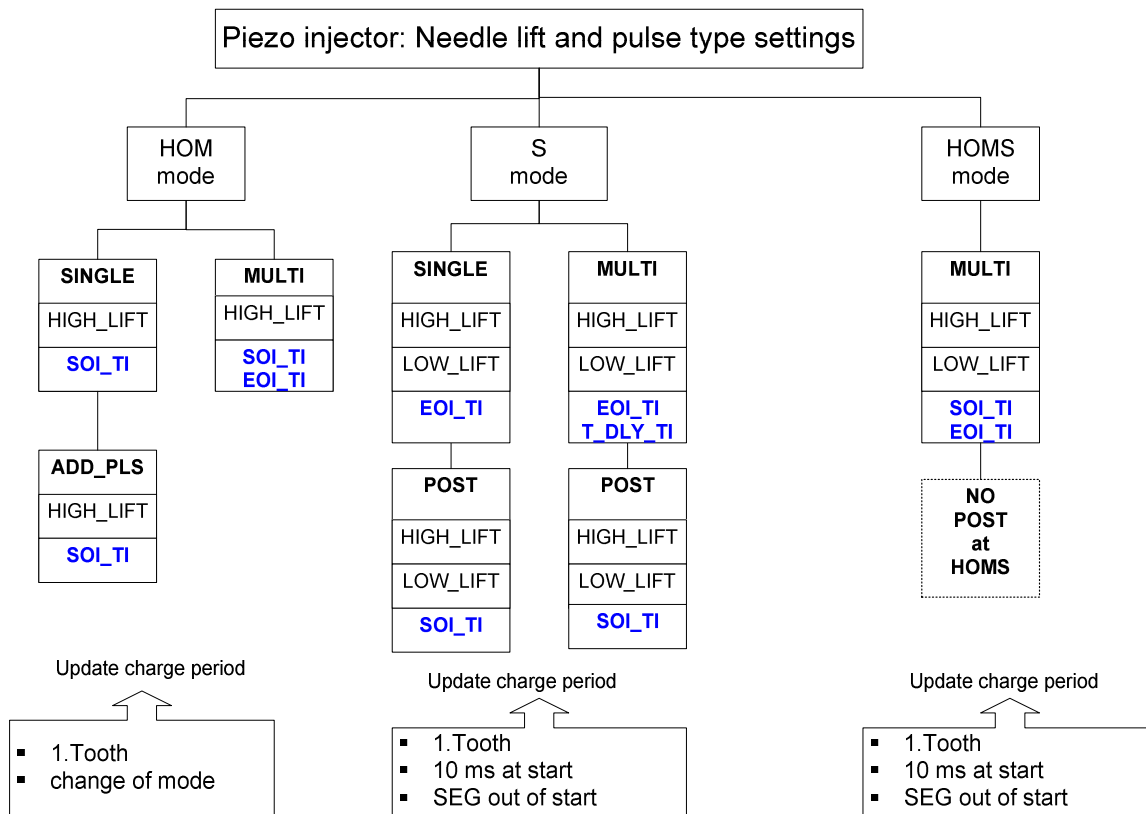
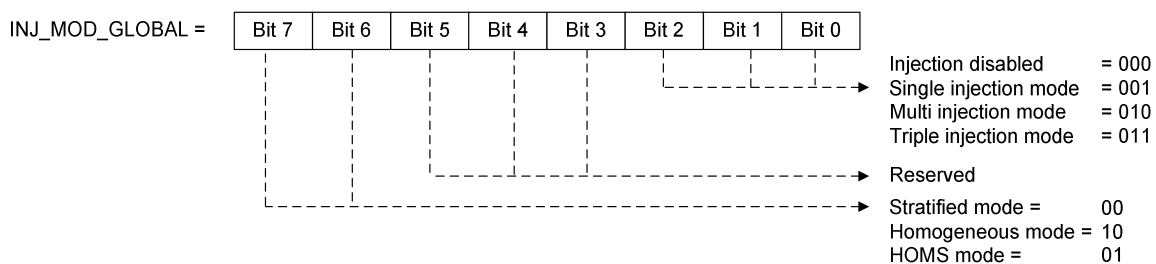


Figure 7.2.4: settings of needle lift and pulse type

**Definitions bit masks for injection mode**

**Byte definition**

INJ\_MOD[x], INJ\_MOD\_SP[x]



Example: homogenous multi injection mode (MPLH)

INJ\_MOD\_GLOBAL = [ 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 ]

Figure 7.2.5: Byte definition injection mode

**Definition of NC constants**

NC\_INJ\_MOD\_DI = 0x00H  
 NC\_INJ\_MOD\_S = 0x00H  
 NC\_INJ\_MOD\_HOM = 0x80H

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```

NC_INJ_MOD_HOMS      = 0x40H
NC_INJ_MOD_SINGLE   = 0x01H
NC_INJ_MOD_MULTI    = 0x02H
NC_INJ_MOD_MULTI_PLS3 = 0x03H
NC_INJ_MOD_TEST_PLS = 0x07H
NC_INJ_MOD_MASK_1   = 0xC0H
NC_INJ_MOD_MASK_2   = 0x07H

```

## 7.2.1 Reset tasks

### General information:

This chapter describes the procedures required at reset for an accurate engine start.

### Application conditions:

**Initialisation:** -

**Activation:** at reset  
*Note! This task has to be called first in calculation order of reset tasks.*

**Deactivation:** -

**Recurrence:** once at reset

### Function description:

#### Formula section:

*Set the crankshaft position where the infrastructure generates the trigger INJBAS at the end of the injection of each cylinder:*

```
ACTION_INFR_SetInjTdcToBaseAng (IN Tdc_to_base_ang= NC_CRK_INJ_BAS_REF)
```

```
PWM_DCDC_SP = IP_PWM_DCDC_PCTL (TECU)
```

*Limit DCDC converter setpoint to maximum and minimum value to prevent power stage destruction:*

```
PWM_DCDC_SP = MAX (PWM_DCDC_SP, NC_PWM_DCDC_SP_MIN)
```

```
PWM_DCDC_SP = MIN (PWM_DCDC_SP, NC_PWM_DCDC_SP_MAX)
```

```

FOR d = 0 TO (NC_NR_DCDC_INJ - 1) DO:
ACTION_INFR_SetInjDcdc (IN Dcdc_nr= d, IN Dcdc_ducy= PWM_DCDC_SP)
ENDFOR

```

```
CTR_INJ_SWI_ACK_ERR = 0
```


```
STATE_INJ_UPD_TRM = 0
```

```
LV_INJ_UPD_CLC_ENA = 0
```

```

FOR x = 0 TO (NC_CYL_NR -1) DO:
INJ_MOD [x]          = "DISABLE"
SOI_1_MES [x]        = 720° CRK
SOI_2_MES [x]        = 720° CRK
SOI_POST_MES [x]     = 720° CRK
ENDFOR

```

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Do not start injection before first valid tooth event was reached. Injection driver is locked.

```
LV_ST_INJ           = 1
STATE_INJ_DR       = "DISABLED"
STATE_PBK_IV_INI   = "INIT_PENDING"
LV_INJ_REST_ENA    = 0
LV_STATE_PBK_IV_INI_ACT = 0
LV_CUR_CHA_OFS_INI = 0
LV_CTR_PBK_IV_INI_INC = 0
```

Initialize ADC voltage reference calibration:

```
FAC_ADC_REF_INJ = 1
```

Set filter output to expected reference voltage:

```
IF LC_V_ADC_REF_CAL_INJ = 1
THEN V_ADC_REF_MES_INJ = C_V_ADC_REF_INJ
ELSE V_ADC_REF_MES_INJ = NC_V_ADC_REF_INJ
ENDIF
```

```
#IF NC_PBK_IV_TYP = 1
```

```
#THEN //Set page data t_cha_rise, t_cha_fall, t_dcha_rise and t_dcha_fall
(only supported by specific injection hardware):
```

Note: Page 0 is used for high injector needle lift, page 1 for low injector needle lift!

```
ACTION_INFR_SetInjChaNisePer (IN Page_nr= 0, Cha_rise_per= C_T_CHA_RISE_H)
ACTION_INFR_SetInjChaNisePer (IN Page_nr= 1, Cha_rise_per= C_T_CHA_RISE_L)
ACTION_INFR_SetInjChaNisePer (IN Page_nr= 0, Cha_fall_per= C_T_CHA_FALL_H)
ACTION_INFR_SetInjChaNisePer (IN Page_nr= 1, Cha_fall_per= C_T_CHA_FALL_L)
ACTION_INFR_SetInjDchaRisePer (IN Page_nr= 0, Dcha_rise_per= C_T_DCHA_RISE_H)
ACTION_INFR_SetInjDchaRisePer (IN Page_nr= 1, Dcha_rise_per= C_T_DCHA_RISE_L)
ACTION_INFR_SetInjDchaFallPer (IN Page_nr= 0, Dcha_fall_per= C_T_DCHA_FALL_H)
ACTION_INFR_SetInjDchaFallPer (IN Page_nr= 1, Dcha_fall_per= C_T_DCHA_FALL_L)
#ENDIF
```

## 7.2.2 Power stage initialization


### General information:

This chapter describes the procedures to initialize the power stage driver.

### Application conditions:

**Initialisation:** at NVMY initialization: CTR\_PBK\_IV\_INI\_MPL = 0  
**Activation:** at every engine state  
**Deactivation:** -  
**Recurrence:** 10 ms

### Function description:

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**Formula section:**

```

//Initialization of injection IO-driver
IF STATE_PBK_IV_INI = "INIT_PENDING" AND
    LV_MC_SOPC_INH_DI = 0 AND
    LV_ERR_TMP_MU_MC = 0 AND
    LV_DIAG_END_RLY_MAIN_DLY = 1 AND
    LV_RLY_MAIN_DLY_ERR = 0 AND
    LV_INJ_OFF_TMR_INJ_ENA = 1 AND
    LV_STATE_PBK_IV_INI_ACT = 0
THEN STATE_PBK_IV_INI = "INIT_ACTIVE"
    NR_PBK_IV_INI = 0
    CTR_PBK_IV_INI = 0
    LV_STATE_PBK_IV_INI_ACT = 1
    ACTION_INFR_IniInjDriver()
ENDIF

//Re-initialization of injection IO-driver
IF STATE_PBK_IV_INI = "REINIT_PENDING" AND
    LV_IGK = 1 AND
    LV_INJ_OFF_TMR_INJ_ENA= 1 AND
    LV_STATE_PBK_IV_INI_ACT = 0
THEN STATE_PBK_IV_INI = "INIT_ACTIVE"
    NR_PBK_IV_INI = 0
    CTR_PBK_IV_INI = 0
    LV_STATE_PBK_IV_INI_ACT = 1
    ACTION_INFR_IniInjDriver()
ENDIF

//Repeat injection power stage initialization if finished with errors
IF LV_CTR_PBK_IV_INI_INC = 1
THEN LV_CTR_PBK_IV_INI_INC = 0
    NR_PBK_IV_INI = 0
    ACTION_INFR_IniInjDriver()
ENDIF

//Set flag to indicate that a proper start was performed
IF LV_ST_END = 1
THEN LV_INJ_REST_ENA = 1
ENDIF

```


**7.2.3 End of injection driver initialization****General information:****Application conditions:**

**Initialisation:** -

**Activation:** every INJEOD-event (EndOfDriverInitialization)

**Deactivation:** -

**Recurrence:** INJEOD-event (EndOfDriverInitialization)

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**Function description:****Formula section:**

*//Note! p represents the power-stage bank which reached the INJEOD-event.*  
**NR\_PBK\_IV\_INI = NR\_PBK\_IV\_INI + 1**

**ACTION\_INFR\_GetInjDiagIni** (IN p, OUT STATE\_ERR\_PBK\_IV\_ST\_RAW[p]= Err\_ini,  
 OUT Ini\_valid not used)

**#IF** NC\_PBK\_IV\_TYP = 1

**#THEN** *//Get Initial value for offset cancellation of bank p and initialize  
 offset cancellation controller:*

**ACTION\_INFR\_GetInjOfsCur** (IN Bank= p, OUT CUR\_CHA\_OFS\_CNL[p]= Ofs\_cur)

**ACTION\_INJR\_SetOfsCurIni** (IN Bank= p, IN OfsCurIni= CUR\_CHA\_OFS\_CNL[p])

**#ENDIF**

(1) **IF** NR\_PBK\_IV\_INI ≥ NC\_PBK\_IV\_NR

(1) **THEN** *//every injection valve powerbank was initialized*  
 CTR\_PBK\_IV\_INI++ *//increment counter by 1*

(2) **IF** STATE\_ERR\_PBK\_IV\_ST\_RAW[] = 0 *//all NC\_PBK\_IV\_NR elements*  
**OR** CTR\_PBK\_IV\_INI ≥ C\_CTR\_PBK\_IV\_INI\_MAX

(2) **THEN** LV\_CUR\_CHA\_OFS\_INI = 1  
 LV\_STATE\_PBK\_IV\_INI\_ACT = 0

(3) **IF** STATE\_PBK\_IV\_INI = "INIT\_ACTIVE"

(3) **THEN** STATE\_PBK\_IV\_INI = "INIT\_FINISHED"

(4) **IF** STATE\_INJ\_DR = "DISABLED" **AND** LV\_INJ\_REST\_ENA = 1

(4) **THEN** Calculate subroutine **"Start initialization"**

(4) **ENDIF**

(3) **ENDIF**

(5) **IF** CTR\_PBK\_IV\_INI > 1

(5) **THEN** CTR\_PBK\_IV\_INI\_MPL++ *//increment counter by 1*  
*//Note: CTR\_PBK\_IV\_INI\_MPL shall be stored in the non volatile memory!*

(5) **ENDIF**

(2) **ELSE** *//initialization with errors*  
 LV\_CTR\_PBK\_IV\_INI\_INC = 1

(2) **ENDIF**

(1) **ENDIF**

**7.2.4 First valid tooth tasks****General information:**

This chapter describes the procedures required at first valid tooth for an accurate engine start.


**Application conditions:**

**Initialisation:** -

**Activation:** at first valid tooth

**Deactivation:** -

**Recurrence:** once at first valid tooth

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**Function description:****Formula section:**

Calculate subroutine "**Start initialization**"

```
LV_ST_INJ = 0
```

**7.2.5 Crank synchronous tasks****General information:**

Note: In this specification the LSB of a bit field (e. g. STATE\_INJ\_UPD\_ENA) is reverved to as Bit 0! That means that the first loop of the for loop (x = 0) reveres to the LSBs, the next (x = 1) to the next and so on.

**Application conditions:**

**Initialisation:** -

**Activation:** every engine state

**Deactivation:** -

**Recurrence:** LV\_ST\_END = 0: 10 ms  
LV\_ST\_END = 1: segment synchronous

**Function description:****Formula section:**

```
(1) IF LV_INJ_UPD_CLC_ENA = 1
(1) THEN STATE_IGN_UPD_ENA = 0 //all bits
```

*//Minimum injection time for additional pulse:*

*In case of single injection and homogeneous mode, a second injection pulse can be applied by the I/ O-software at transient engine operation (as a result of an injection update). For this pulse, a minimum injection time TI\_ADD\_PULSE\_MIN is defined. Each of the applied IP\_TI\_ADD\_PULSE\_MIN data should be greater than the smallest calculated TI\_MIN.*

```
TI_ADD_PULSE_MIN = 0
FOR m = 0 TO NC_CBK_HPP_NR - 1 DO:
TI_ADD_PULSE_MIN = MAX (TI_ADD_PULSE_MIN; IP_TI_ADD_PULSE_MIN (Input:
PRR_DEC_INJ_1_HOM [IDX_PRR_COR_CLY_CLC_MPLH [m] ] ) )
ENDFOR
FAC_ADD_PULSE = IP_FAC_ADD_PULSE (N_32, TCO)
```

```
(1) FOR x = 0 TO (NC_CYL_NR-1) DO:
```

Cylinder shut off transfer data:

Disable\_task\_interruption

```
LV_INH_INJ[x] = (Bit x of INH_INJ OR
```

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```

                Bit x of INH_IV_MIS_GEN_ACK)           //logical
ACTION_INFR_SetInjInhibit (IN Cyl= x, IN Lv_inhibit= LV_INH_INJ[x])
Enable_task_interruption

```

Set injection mode set-point:

```

(2) IF Bit x of STATE_INJ_UPD_TRM = 0
(2) THEN //no valid data set within I/ O software

(3) IF Bit x of STATE_INJ_UPD_ENA = 1
(3) THEN INJ_MOD[x] = INJ_MOD_SP[x]
        Calculate subroutine "Configure injection"
        Calculate subroutine "Update injection data"
        ACTION_INJR_SetStateInjUpdEna (IN Cyl= x, State_Inj_Upd_Ena= 0)
        ACTION_INFR_ReqInjUpdate (IN Cyl= x, IN Mode= Immediate,
                                OUT INJ_UPD_ACK[x]= Acknowledge)
        Calculate subroutine "Update ignition data"
        Bit x of STATE_IGN_UPD_ENA = 1
        CRK_WIN_SEL_IGN_INJ[x] = "NO_CLC"
        Bit x of STATE_INJ_UPD_TRM = 1

(3) ENDIF

(2) ELSE //valid data set within I/ O software
        Calculate subroutine "Check engine position"

(4) IF INJ_MOD[x] = INJ_MOD_SP[x]
(4) THEN //no mode switch requested

(5) IF CRK_WIN_SEL_IGN_INJ[x] = "ADC_WIN" OR "RTD_WIN"
(5) THEN //update possible

(6) IF Bit x of STATE_INJ_UPD_ENA = 1
(6) THEN Calculate subroutine "Update injection data"
        ACTION_INJR_SetStateInjUpdEna (IN Cyl= x,
                                IN State_Inj_Upd_Ena= 0)
        ACTION_INFR_ReqInjUpdate (IN Cyl= x, IN Mode= Immediate,
                                OUT INJ_UPD_ACK[x]= Acknowledge)

(6) ENDIF
(5) ENDIF

(4) ELSE //mode switch requested


(7) IF CRK_WIN_SEL_IGN_INJ[x] = "ADC_WIN" OR "RTD_WIN"
(7) THEN //mode switch possible
        INJ_MOD[x] = INJ_MOD_SP[x]
        Calculate subroutine "Configure injection"
        Calculate subroutine "Update injection data"
        ACTION_INJR_SetStateInjUpdEna (IN Cyl= x, IN State_Inj_Upd_Ena= 0)
        ACTION_INFR_ReqInjUpdate (IN Cyl= x, IN Mode= Cycle,
                                OUT INJ_UPD_ACK[x]= Acknowledge)

(8) IF INJ_UPD_ACK[x] ≠ "Cycle"
(8) THEN CTR_INJ_SWI_ACK_ERR++ //increment counter by 1
(8) ENDIF

(7) ELSE //mode switching failed
        Check if old injection mode can be updated
        LV_INJ_MOD_UPD = 1
        Calculate subroutine "Check variable window" (input: LV_INJ_MOD_UPD;
                                output: LV_IGN_INJ_UPD_WIN)

(9) IF LC_INJ_UPD_OLD_MOD_ENA = 1 AND
        LV_IGN_INJ_UPD_WIN = 1 AND

```

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```

        LV_INH_INJ_UPD_MOD_UPD[x] = 0                AND
        ( INJ_MOD[x] = INJ_MOD_SP_HOM[x]                OR
        INJ_MOD[x] = INJ_MOD_SP_S[x] AND LV_IGA_AND_INJ_SWI_HOMS = 0 OR
        INJ_MOD[x] = INJ_MOD_SP_HOMS[x] AND LV_IGA_AND_INJ_SWI_HOMS = 1
    )

        AND NOT
        ( INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_1 = NC_INJ_MOD_S AND
        INJ_MOD_SP[x] BitwiseAND NC_INJ_MOD_MASK_1 = NC_INJ_MOD_HOMS )

        AND NOT
        ( INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_1 = NC_INJ_MOD_HOMS AND
        INJ_MOD_SP[x] BitwiseAND NC_INJ_MOD_MASK_1 = NC_INJ_MOD_S )
    (9) THEN
        Calculate subroutine "Update injection data"
        ACTION_INFR_ReqInjUpdate(IN Cyl= x, IN Mode= Immediate,
                                OUT INJ_UPD_ACK[x]= Acknowledge)
        CRK_WIN_SEL_IGN_INJ[x] = "UPD_OLD_STATE"
        STATE_UPD_IGN[x]      = "TRIG_IT"
    (9) ENDIF
    (7) ENDIF
    (4) ENDIF

    (10) IF STATE_UPD_IGN[x] = "TRIG_IT"
    (10) THEN
        Bit x of STATE_IGN_UPD_ENA = 1
        Calculate subroutine "Update ignition data"
    (10) ENDIF
    (2) ENDIF
    (1) ENDFOR

ACTION_IGRE_SendTrigForIgnUpd(IN PRM_STATE_IGN_UPD_ENA= STATE_IGN_UPD_ENA)
    (1) ENDIF

//get actual measured voltage of the DCDC converter:
FOR d = 0 TO (NC_NR_DCDC_INJ - 1) DO:
ACTION_INFR_GetInjMesUDcdc(IN Dcdc= d,
                            OUT VBOOST_PBK_IV_MES[d]= Voltage_dcdc)
ENDFOR

```

## 7.2.6 INJBAS triggered tasks

### General information:

Note! x represents the current assigned active cylinder cyl\_av, which is used for subsequent data calculations.


### Application conditions:

**Initialisation:** -

**Activation:** every INJBAS event

**Deactivation:** -

**Recurrence:** INJBAS synchronous

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**Function description:****Formula section:****7.2.6.1 Get actual and previous cylinder number of CRK\_INJ\_BAS**

*//The Parameter Cyl\_av is delivered from the I/ O SW and indicates the logical cylinder number for the actual INJBAS event.  
The cylinder index x is provided as parameter by the INJBAS Trigger*

```
NR_CYL_INJ_BAS_PREV = NR_CYL_INJ_BAS
NR_CYL_INJ_BAS      = x
```

**7.2.6.2 Transfer data**

```
CTR_PSN_INH_IV_DYN = (STATE_INH_IV_DYN / 216) AND 0x0F //...bitwise
NR_CYL_INH_IV_DYN = (NC_CYL_NR + x - NR_CYL_OFS_INH_IV_DYN) MODULO NC_CYL_NR
IF (STATE_INH_IV_DYN AND 2CTR_PSN_INH_IV_DYN) ≠ 0 //...bitwise
THEN //cylinder will be switched off
INH_IV_DYN = INH_IV_DYN OR 2NR_CYL_INH_IV_DYN //...bitwise
ELSE //cylinder will be switched on
INH_IV_DYN = INH_IV_DYN AND NOT(2NR_CYL_INH_IV_DYN) //...bitwise
ENDIF
```

```
CTR_PSN_INH_IV_DYN++ //increment counter by 1
```

```
IF CTR_PSN_INH_IV_DYN ≥ NC_INJ_INH_SWI_IV_SHIFT_NR
THEN CTR_PSN_INH_IV_DYN = 0
ENDIF
```

```
STATE_INH_IV_DYN = (STATE_INH_IV_DYN AND 0x0000FFFF) OR
(CTR_PSN_INH_IV_DYN * 216) //...bitwise
INH_INJ = INH_IV OR INH_IV_DYN //...bitwise
LV_INH_INJ_OLD = LV_INH_INJ[NR_CYL_INH_IV_DYN]
LV_INH_INJ[NR_CYL_INH_IV_DYN] = Bit NR_CYL_INH_IV_DYN of INH_INJ OR
Bit NR_CYL_INH_IV_DYN of INH_IV_MIS_GEN
```

*//Note! Pay attention on data consistency of INH\_INJ, INH\_IV\_DYN and LV\_INH\_INJ[x].*

```
SUM_INH_INJ = the sum of the digits of INH_INJ
```

```
IF Bit NR_CYL_INH_IV_DYN of INH_IV_MIS_GEN = 0
```

```
THEN
```

```
INH_IV_MIS_GEN_ACK = INH_IV_MIS_GEN_ACK AND NOT 2NR_CYL_INH_IV_DYN //...bitwise
CTR_INH_IV_MIS_GEN[NR_CYL_INH_IV_DYN] = 0
```

```
ELSE
```

```
INH_IV_MIS_GEN_ACK = INH_IV_MIS_GEN_ACK OR 2NR_CYL_INH_IV_DYN //...bitwise
CTR_INH_IV_MIS_GEN[NR_CYL_INH_IV_DYN]++ //increment counter by 1
```


```
ENDIF
```

*//Please Note! STATE\_INH\_IV\_DYN is an output data of cylinder shut off specification. The content of the data will be changed in this interrupt procedure. Pay attention on data consistency, even at cylinder shut off module*

```
IF LV_INH_INJ[NR_CYL_INH_IV_DYN] ≠ LV_INH_INJ_OLD
```

```
THEN ACTION_INFR_SetInjInhibit (IN Cyl= NR_CYL_INH_IV_DYN,
IN Lv_inhibit= LV_INH_INJ[NR_CYL_INH_IV_DYN])
```

```
ENDIF
```

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### 7.2.6.3 Post injection


```

IF LV_INJ_MPLP_CYL[x] ≠ LV_POST_INJ_ACT AND
    INJ_MOD[x] AND NC_INJ_MOD_MASK_1 = NC_INJ_MOD_S //... bitwise AND
    INJ_MOD[x] AND NC_INJ_MOD_MASK_2 ≠ NC_INJ_MOD_MULTI_PLS3 //... bitwise

THEN //stratified mode
    LV_INJ_MPLP_CYL[x] = LV_POST_INJ_ACT
    IF LV_INJ_MPLP_CYL[x] = 1
    THEN //activate post injection:
        ACTION_INFR_SetInjPulseType(IN Cyl= x, IN Pulse= 3,
            IN Pulse_type= SOI_TI)
        ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 3,
            IN Plsupd_mode= NONE)
        ACTION_INFR_SetInjSoiLim(IN Cyl= x, IN Packet_nr= 1,
            IN Soi_lim= - SOI_LIM_POST)
        ACTION_INFR_SetInjEoiLim(IN Cyl= x, IN Packet_nr= 1,
            IN Eoi_lim= - EOI_LIM_POST)
        ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse= 3,
            IN Position_ang= - SOI_POST_INJ[x])
        ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse= 3,
            IN Pls_duration= TI_POST_INJ[x])
        ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 3, IN Pulse_ena= 1)
    ELSE //deactivate post injection:
        SOI_POST_MES[x] = 720° CRK
        EOI_POST_MES[x] = 0° CRK
        TI_POST_MES[x] = 0 ms
        ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 3, IN Pulse_ena= 0)
    ENDIF
ENDIF

ELSE //not stratified
    IF LV_INJ_MPLP_CYL[x] = 1 AND
        INJ_MOD[x] AND NC_INJ_MOD_MASK_1 = NC_INJ_MOD_S //... bitwise
    THEN //deactivate post injection:
        LV_INJ_MPLP_CYL[x] = 0
        SOI_POST_MES[x] = 720° CRK
        EOI_POST_MES[x] = 0° CRK
        TI_POST_MES[x] = 0 ms
        ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 3, IN Pulse_ena= 0)
    ENDIF
ENDIF

```

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### 7.2.6.4 Transfer of measured injection related data from I/O-SW

After an injection was performed, the (cylinder individual) SOI, EOI and TI of that injection are indicated at the output interface as (x = current assigned active cylinder cyl\_av):

```
SOI_1_MES[x]      //actual performed SOI of the first injection pulse
SOI_2_MES[x]      //actual performed SOI of the second injection pulse or
                  the additional pulse
SOI_POST_MES[x]   //actual performed SOI of the third injection pulse
EOI_1_MES[x]      //actual performed EOI of the first injection pulse
EOI_2_MES[x]      //actual performed EOI of the second injection pulse or
                  the additional pulse
EOI_POST_MES[x]   //actual performed EOI of the third injection pulse
TI_1_MES[x]       //actual performed injection time of the first injection
                  pulse
TI_2_MES[x]       //actual performed injection time of the second injection
                  pulse or the additional pulse
TI_POST_MES[x]    //actual performed injection time of the third injection
                  pulse
```

```
ACTION_INFR_GetInjMesPulsePer (IN Cyl= x, IN Pulse= 0,
                               OUT TI_1_MES[x]= Pls_Period)
ACTION_INFR_GetInjMesPulsePer (IN Cyl= x, IN Pulse= 1,
                               OUT TI_2_MES[x]= Pls_Period)
ACTION_INFR_GetInjMesPulsePer (IN Cyl= x, IN Pulse= 2,
                               OUT TI_POST_MES[x]= Pls_Period)
```

Get measured values:

```
IF TI_1_MES[x] > 0ms
THEN ACTION_INFR_GetInjMesSoi (IN Cyl= x, IN Pulse= 0,
                                OUT SOI_1_MES[x]= - Pls_position)
      ACTION_INFR_GetInjMesEoi (IN Cyl= x, IN Pulse= 0,
                                OUT EOI_1_MES[x]= - Pls_position)
ELSE SOI_1_MES[x] = 720°CRK
      EOI_1_MES[x] = 0°CRK
ENDIF

IF TI_2_MES[x] > 0ms
THEN ACTION_INFR_GetInjMesSoi (IN Cyl= x, IN Pulse= 1,
                                OUT SOI_2_MES[x]= - Pls_position)
      ACTION_INFR_GetInjMesEoi (IN Cyl= x, IN Pulse= 1,
                                OUT EOI_2_MES[x]= - Pls_position)
ELSE SOI_2_MES[x] = 720°CRK
      EOI_2_MES[x] = 0°CRK
ENDIF

IF TI_POST_MES[x] > 0ms
THEN LV_TI_3_HOM_ACT = 1
      ACTION_INFR_GetInjMesSoi (IN Cyl= x, IN Pulse= 2,
                                OUT SOI_POST_MES[x]= - Pls_position)
      ACTION_INFR_GetInjMesEoi (IN Cyl= x, IN Pulse= 2,
                                OUT EOI_POST_MES[x]= - Pls_position)
ELSE ACTION_INFR_GetInjMesPulsePer (IN Cyl=x, IN Pulse= 3,
                                       OUT TI_POST_MES[x]= Pls_Period)

IF TI_POST_MES[x] > 0ms
THEN LV_TI_3_HOM_ACT = 0
      ACTION_INFR_GetInjMesSoi (IN Cyl= x, IN Pulse= 3,
                                OUT SOI_POST_MES[x]= - Pls_position)
      ACTION_INFR_GetInjMesEoi (IN Cyl= x, IN Pulse= 3,
                                OUT EOI_POST_MES[x]= - Pls_position)
ELSE SOI_POST_MES[x] = 720°CRK
```

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```

EOI_POST_MES[x] = 0°CRK
ENDIF
ENDIF

Get previous injection state:
//Note: Due to current injection concept, pulse number one is always executed
expect during cylinder shut off!
IF TI_1_MES[x] = 0
THEN LV_STATE_PREV_IV[x] = 0 //no injection during previous cycle
ELSE LV_STATE_PREV_IV[x] = 1 //injection during previous cycle
ENDIF

IF LV_STATE_PREV_IV[x] = 1
THEN set bit x of PREV_STATE_IV
CTR_STATE_PREV_PBK_IV[NC_IDX_CYL_PBK_IV_REF[x]]++ //increment
counter by 1
ELSE clear bit x of PREV_STATE_IV
ENDIF
Note! Pay attention to data consistency of PREV_STATE_IV and LV_STATE_PREV_IV[x]
Lv_prev_state_iv = 1 .... logical cylinder x was injected
Lv_prev_state_iv = 0 .... logical cylinder x was not injected

```

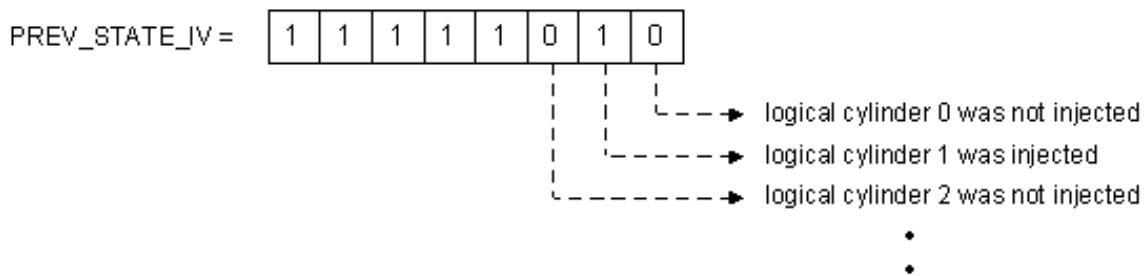


Figure 7.2.6:

```

IF STATE_ERR_PBK_IV_ST_RAW[NC_IDX_CYL_PBK_IV_REF[x]] AND
NC_STATE_PBK_IV_ST_TRIM_ERR) ≠ 0 //...bitwise
THEN LV_IV_MES_VLD = 0
LV_IV_PLS_MES_VLD[ ] = 0 //all NC_NR_IV_PLS elements
ELSE ACTION_INFR_GetInjMesVld(IN Cyl= x, Pulse= 0,
OUT LV_IV_PLS_MES_VLD[0]= Mes_Vld)
ACTION_INFR_GetInjMesVld(IN Cyl= x, Pulse= 1,
OUT LV_IV_PLS_MES_VLD[1]= Mes_Vld)
IF LV_TI_3_HOM_ACT = 1
THEN ACTION_INFR_GetInjMesVld(IN Cyl= x, Pulse= 2,
OUT LV_IV_PLS_MES_VLD[2]= Mes_Vld)
ELSE ACTION_INFR_GetInjMesVld(IN Cyl= x, Pulse= 3,
OUT LV_IV_PLS_MES_VLD[2]= Mes_Vld)
ENDIF

```

//Calculate global measurement valid flag:

In case of a measured injection time which is greater than zero, the corresponding measurement valid flag of the same pulse must be set to indicate a valid measurement. In case of  $TI_x\_MES = 0$ , the corresponding valid flag has "don't care" status.

```

IF LV_IV_PLS_MES_VLD[0] = 1 OR TI_1_MES[x] = 0 AND
LV_IV_PLS_MES_VLD[1] = 1 OR TI_2_MES[x] = 0 AND
LV_IV_PLS_MES_VLD[2] = 1 OR TI_POST_MES[x] = 0
THEN LV_IV_MES_VLD = 1

```

```

ELSE LV_IV_MES_VLD = 0
ENDIF
ENDIF

IF TI_1_MES[x] > 0 AND LV_IV_PLS_MES_VLD[0] = 1
THEN ACTION_INFR_GetInjMesQ(IN Cyl= x, IN Pulse= 0, IN Event= BEG_CHA,
OUT Charge= CHR_IV_MES_BEG_CHA)
ACTION_INFR_GetInjMesQ(IN Cyl= x, IN Pulse= 0, IN Event= END_CHA,
OUT Charge= CHR_IV_MES_END_CHA)
CHA_IV_1_MES[x] = (CHR_IV_MES_END_CHA - CHR_IV_MES_BEG_CHA)
* FAC_CHA_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
* FAC_COR_SLOP_CHA_CAL[NC_IDX_CYL_PBK_IV_REF[x]]
* FAC_ADC_REF_INJ
ACTION_INFR_GetInjMesU(IN Cyl= x, IN Pulse= 0, IN Event= END_CHA,
OUT V_IV_1_MES [x]= Voltage)
V_IV_1_MES[x] = V_IV_1_MES[x]
* FAC_V_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
* FAC_ADC_REF_INJ
//calculate energy and capacity out of measured data:
EGY_IV_1_CLC[x] = 0.5 * CHA_IV_1_MES[x] * V_IV_1_MES[x]
CAPA_IV_1_CLC[x] = CHA_IV_1_MES[x] / V_IV_1_MES[x]

ELSE CHA_IV_1_MES[x] = 0
V_IV_1_MES[x] = 0
EGY_IV_1_CLC[x] = 0
CAPA_IV_1_CLC[x] = 0

ENDIF


IF TI_2_MES[x] > 0 AND LV_IV_PLS_MES_VLD[1] = 1
THEN ACTION_INFR_GetInjMesQ(IN Cyl= x, IN Pulse= 1, IN Event= BEG_CHA,
OUT Charge= CHR_IV_MES_BEG_CHA)
ACTION_INFR_GetInjMesQ(IN Cyl= x, IN Pulse= 1, IN Event= END_CHA,
OUT Charge= CHR_IV_MES_END_CHA)
CHA_IV_2_MES[x] = (CHR_IV_MES_END_CHA - CHR_IV_MES_BEG_CHA)
* FAC_CHA_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
* FAC_COR_SLOP_CHA_CAL[NC_IDX_CYL_PBK_IV_REF[x]]
* FAC_ADC_REF_INJ
ACTION_INFR_GetInjMesU(IN Cyl= x, IN Pulse= 1, IN Pulse = END_CHA,
OUT V_IV_2_MES[x]= Voltage)
V_IV_2_MES[x] = V_IV_2_MES[x]
* FAC_V_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
* FAC_ADC_REF_INJ
//calculate energy and capacity out of measured data:
EGY_IV_2_CLC[x] = 0.5 * CHA_IV_2_MES[x] * V_IV_2_MES[x]
CAPA_IV_2_CLC[x] = CHA_IV_2_MES[x] / V_IV_2_MES[x]

ELSE CHA_IV_2_MES[x] = 0
V_IV_2_MES[x] = 0
EGY_IV_2_CLC[x] = 0
CAPA_IV_2_CLC[x] = 0

ENDIF

IF TI_POST_MES[x] > 0 AND LV_IV_PLS_MES_VLD[2] = 1
THEN
IF LV_TI_3_HOM_ACT = 1
THEN ACTION_INFR_GetInjMesQ(IN Cyl= x, IN Pulse= 2, IN Event= BEG_CHA,
OUT Charge= CHR_IV_MES_BEG_CHA)
ACTION_INFR_GetInjMesQ(IN Cyl= x, IN Pulse= 2, IN Event= END_CHA,
OUT Charge= CHR_IV_MES_END_CHA)
CHA_IV_POST_MES[x] = (CHR_IV_MES_END_CHA - CHR_IV_MES_BEG_CHA)
* FAC_CHA_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]

```

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```

* FAC_COR_SLOP_CHA_CAL[NC_IDX_CYL_PBK_IV_REF[x]]
* FAC_ADC_REF_INJ
ACTION_INFR_GetInjMesU(IN Cyl= x, IN Pulse= 2, IN Event= END_CHA,
    OUT V_IV_POST_MES[x]= Voltage)
V_IV_POST_MES[x] = V_IV_POST_MES[x]
* FAC_V_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
* FAC_ADC_REF_INJ

ELSE ACTION_INFR_GetInjMesQ(IN Cyl= x, IN Pulse= 3, IN Event= BEG_CHA,
    OUT Charge= CHR_IV_MES_BEG_CHA)
ACTION_INFR_GetInjMesQ(IN Cyl= x, IN Pulse= 3, IN Event= END_CHA,
    OUT Charge= CHR_IV_MES_END_CHA)
CHA_IV_POST_MES[x] = (CHR_IV_MES_END_CHA - CHR_IV_MES_BEG_CHA)
* FAC_CHA_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
* FAC_COR_SLOP_CHA_CAL[NC_IDX_CYL_PBK_IV_REF[x]]
* FAC_ADC_REF_INJ
ACTION_INFR_GetInjMesU(IN Cyl= x, IN Pulse= 3, IN Event= END_CHA,
    OUT V_IV_POST_MES[x]= Voltage)
V_IV_POST_MES[x] = V_IV_POST_MES[x]
* FAC_V_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
* FAC_ADC_REF_INJ

ENDIF
//calculate energy and capacity out of measured data:
EGY_IV_POST_CLC[x] = 0.5 * CHA_IV_POST_MES[x] * V_IV_POST_MES[x]
CAPA_IV_POST_CLC[x] = CHA_IV_POST_MES[x] / V_IV_POST_MES[x]

ELSE CHA_IV_POST_MES[x] = 0
V_IV_POST_MES[x] = 0
EGY_IV_POST_CLC[x] = 0
CAPA_IV_POST_CLC[x] = 0

ENDIF


#IF NC_PBK_IV_TYP = 1
#THEN //Get measured charge values of trim pulses for integrator offset cancellation
and gain calibration:
ACTION_INFR_GetInjMesQTrim(IN Bank= NC_IDX_CYL_PBK_IV_REF[x],
    IN Event= BEG_OFS, OUT CHR_INJ_TRIM_0[NC_IDX_CYL_PBK_IV_REF[x]]= Charge)
CHR_INJ_TRIM_0[NC_IDX_CYL_PBK_IV_REF[x]] =
    CHR_INJ_TRIM_0[NC_IDX_CYL_PBK_IV_REF[x]]
* FAC_CHA_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
* FAC_ADC_REF_INJ

//Note: Trim measurement has to be corrected by end of line trim and voltage
reference calibration.
ACTION_INFR_GetInjMesQTrim(IN Bank= NC_IDX_CYL_PBK_IV_REF[x],
    IN Event= END_OFS,
    OUT CHR_INJ_TRIM_1[NC_IDX_CYL_PBK_IV_REF[x]]= Charge)
CHR_INJ_TRIM_1[NC_IDX_CYL_PBK_IV_REF[x]] =
    CHR_INJ_TRIM_1[NC_IDX_CYL_PBK_IV_REF[x]]
* FAC_CHA_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
* FAC_ADC_REF_INJ

ACTION_INFR_GetInjMesQTrim(IN Bank= NC_IDX_CYL_PBK_IV_REF[x],
    IN Event = BEG_GAIN,
    OUT CHR_INJ_TRIM_2[NC_IDX_CYL_PBK_IV_REF[x]]= Charge)
CHR_INJ_TRIM_2[NC_IDX_CYL_PBK_IV_REF[x]] =
    CHR_INJ_TRIM_2[NC_IDX_CYL_PBK_IV_REF[x]]
* FAC_CHA_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
* FAC_ADC_REF_INJ

ACTION_INFR_GetInjMesQTrim(IN Bank= NC_IDX_CYL_PBK_IV_REF[x],
    IN Event= END_GAIN,
    OUT CHR_INJ_TRIM_3[NC_IDX_CYL_PBK_IV_REF[x]] = Charge)

```

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```

CHR_INJ_TRIM_3[NC_IDX_CYL_PBK_IV_REF[x]] =
    CHR_INJ_TRIM_3[NC_IDX_CYL_PBK_IV_REF[x]]
    * FAC_CHA_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
    * FAC_ADC_REF_INJ
ACTION_INFR_GetInjOfsCur (IN Bank= NC_IDX_CYL_PBK_IV_REF[x],
    OUT CUR_CHA_OFS_CNL[NC_IDX_CYL_PBK_IV_REF[x]]= Ofs_cur)

```

*//Send new value for integrator offset cancellation current:*

**Note:** *new values are only sent after offset current initialization during power stage initialization!*

```

IF LV_CUR_CHA_OFS_INI = 1
THEN ACTION_INFR_SetInjOfsCur (IN Bank= NC_IDX_CYL_PBK_IV_REF[x],
    IN Ofs_cur= CUR_CHA_OFS_CNL_OUT[NC_IDX_CYL_PBK_IV_REF[x]])
ENDIF
#ENDIF

```

### 7.2.6.5 Transfer of injection valve diagnosis I/O-SW raw values

```

ACTION_INFR_GetInjDiagElectric (IN Cyl= x,
    OUT STATE_ERR_IV_CYL_RAW[x]= Err_diag,
    OUT CDN_DIAG_IV_RAW[x]= Diag_valid)

```

## 7.2.7 Synchronized start

### General information:

### Application conditions:


**Initialisation:** -

**Activation:** at every engine state

**Deactivation:** -

**Recurrence:** 10 ms  
Note! This task has to be called separately in calculation order after IGR.

### Function description:

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**Formula section:**

```

IF (LV_ST_INJ = 0 AND LV_ST_INJ_REQ = 1) OR
  (STATE_INJ_DR = "DISABLED" AND LV_INJ_REST_ENA = 1 AND
  LV_INJ_DEAC_BACK_ENG = 0)
THEN //check if at least one data set was sent to I/ O-SW before starting
  the injection.
  IF STATE_INJ_UPD_TRM = 2NC_CYL_NR -1 AND
  STATE_INJ_CRASH_ACT = 00H AND
  LV_SYN_ENG = 1 AND
  STATE_PBK_IV_INI = "INIT_FINISHED"
  THEN ACTION_INFR_ReqInjMode (IN Mode= DISABLE)
  ACTION_INFR_ReqInjMode (IN Mode= SEQUENTIAL)
  STATE_INJ_DR = "RUN"
  //Please note, that this step was necessary to prevent a mode
  switch from IV test mode to sequential injection mode directly.
  LV_ST_INJ = 1

ENDIF
ENDIF

```

**7.2.8 ECU-state-transition from synchronous to asynchronous state****General information:**

Relevant only for start stop projects. Comply with the compiler switch NC\_STATE\_STST\_ENA = 1.

**Application conditions:**

**Initialisation:** -

**Activation:** at ECU-state-transition from SYN\_ENG\_IGK\_ON to ENG\_RUN (SYN\_ON to ASYN\_ON)

**Deactivation:** -

**Recurrence:** every ECU-state-transition from SYN\_ENG\_IGK\_ON to ENG\_RUN (SYN\_ON to ASYN\_ON)


**Function description:****Formula section:**

```

#IF NC_STATE_STST_ENA = 1
#THEN LV_INJ_DEAC_BACK_ENG = 1
  ACTION_INFR_ReqInjMode (IN Mode= DISABLE)
  STATE_INJ_DR = "DISABLED"
#ENDIF

```

**7.2.9 ECU-state-transition from asynchronous to synchronous state**

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**General information:**

Relevant only for start stop projects. Comply with the compiler switch NC\_STATE\_STST\_ENA = 1.

**Application conditions:**

**Initialisation:** -

**Activation:** at ECU-state-transition from ENG\_RUN to SYN\_ENG\_IGK\_ON (ASYN\_ON to SYN\_ON)

**Deactivation:** -

**Recurrence:** every ECU-state-transition from ENG\_RUN to SYN\_ENG\_IGK\_ON (ASYN\_ON to SYN\_ON)

**Function description:****Formula section:**

```
#IF NC_STATE_STST_ENA = 1
#THEN
  IF LV_INJ_DEAC_BACK_ENG = 1
  THEN Calculate subroutine "Start initialization"
         LV_ST_INJ = 0
         LV_INJ_DEAC_BACK_ENG = 0
  ENDF
#ENDIF
```

**7.2.10 Ignition key OFF****General information:****Application conditions:**

**Initialisation:** -

**Activation:** at transition of LV\_IGK from 1==>0


**Deactivation:** -

**Recurrence:** every transition of LV\_IGK from 1==>0

**Function description:****Formula section:**

```
STATE_PBK_IV_INI = "REINIT_PENDING"
LV_INJ_DEAC_BACK_ENG = 0
```

**7.2.11 Ignition key on**

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**General information:**

This chapter describes the procedures required at ignition key on to ensure an accurate engine restart at running engine.

**Application conditions:****Initialisation:**

-

**Activation:**

at ignition key on event (LV\_IGK = 0==&gt;1)

**Deactivation:**

-

**Recurrence:**

once at every ignition key on event

Note: This section has to be calculated before all other time and segment synchronous sections which are dependent on LV\_IGK!

**Function description:****Formula section:**

```
IF STATE_PBK_IV_INI = "REINIT_PENDING"
THEN Calculate subroutine "Disable injection driver functionality"
ENDIF
```

## 7.2.12 Engine stop

**General information:****Application conditions:****Initialisation:**

-

**Activation:**

at transition of LV\_ES from 0==&gt;1

**Deactivation:**

-


**Recurrence:**

every transition of LV\_ES from 0==&gt;1

**Function description:****Formula section:**

```
Calculate subroutine "Disable injection driver functionality"
LV_INJ_REST_ENA = 0
LV_INJ_DEAC_BACK_ENG = 0
```

## 7.2.13 Injection valve power stage diagnosis

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**General information:**

This chapter describes the procedure to get injection power stage diagnosis information from I/O-SW.

**Application conditions:**

**Initialisation:** -  
**Activation:** every engine state  
**Deactivation:** -  
**Recurrence:** segment synchronous


**Function description:****Formula section:**

```

IF STATE_PBK_IV_INI = "INIT_FINISHED" AND
    LV_ST_INJ = 1 AND
    LV_INJ_UPD_CLC_ENA = 1 AND
    STATE_INJ_UPD_TRM = 2NC_CYL_NR - 1
THEN
    IF SEG_NR = 0
    THEN
    FOR p = 0 TO (NC_PBK_IV_NR - 1) DO:
    Disable_task_interruption
    ACTION_INFR_GetInjDiagPower (IN Bank_nr= p,
                                OUT STATE_ERR_PBK_IV_RAW[p]= Err_power,
                                OUT CDN_DIAG_PBK_IV_RAW[p]= Power_valid)
        IF CTR_STATE_PREV_PBK_IV[p] > 0
        THEN
        CTR_STATE_PREV_PBK_IV[p] = 0
        LV_STATE_PREV_PBK_IV[p] = 1
        CDN_DIAG_PBK_IV_RAW[p] = CDN_DIAG_PBK_IV_RAW[p] OR 0x08 //...bitwise
        ELSE
        LV_STATE_PREV_PBK_IV[p] = 0
        ENDIF
    Enable_task_interruption
    ENDFOR
    ENDIF
ELSE
FOR p = 0 TO (NC_PBK_IV_NR - 1) DO:
    STATE_ERR_PBK_IV_RAW[p] = 0
    CDN_DIAG_PBK_IV_RAW[p] = 0
    CTR_STATE_PREV_PBK_IV[p] = 0
    LV_STATE_PREV_PBK_IV[p] = 0
ENDFOR
ENDIF

```

**7.2.14 Injector test mode**

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**General information:**

This chapter describes the procedure for actuator tests by diagnostic tester.

**Application conditions:**

**Initialisation:** at EXIT\_ST event: CTR\_TEST\_MOD\_IV[NC\_CYL\_NR] = 0  
**Activation:** LV\_ES = 1  
**Deactivation:** -  
**Recurrence:** 1 s


**Function description:****Formula section:**

```

IF LV_IV_TEST_MOD_AUTH =1 AND
    N_32 <= NC_N_MAX_IV_TEST_MOD AND
    CTR_TEST_MOD_IV[NR_CYL_IV_TEST_MOD] < NC_CTR_MAX_IV_TEST_MOD AND
    INJ_MOD[NR_CYL_IV_TEST_MOD] AND NC_INJ_MOD_MASK_2 = NC_INJ_MOD_DI //... bitwise
AND
THEN
CTR_TEST_MOD_IV[NR_CYL_IV_TEST_MOD]++ //increment counter by 1
ACTION_INFR_ReqInjMode (IN Mode= STATIC)
STATE_INJ_DR = "RUN"
ACTION_INFR_SetInjChaPer (IN Cyl= NR_CYL_IV_TEST_MOD, IN Pulse= 0,
                          IN Cha_per= C_T_CHA_PER_H)
ACTION_INFR_SetInjDchaPer (IN Cyl= NR_CYL_IV_TEST_MOD, IN Pulse= 0,
                           IN Dis_cha_per= C_T_CHA_PER_H)
#IF NC_PBK_IV_TYP = 1
#THEN
ACTION_INFR_SetInjSeqEndDly (IN Cyl= NR_CYL_IV_TEST_MOD, IN Pulse= 0,
                             IN Seq_end_delay= T_RLS_DLY_DCHA_1_HOM[NR_CYL_IV_TEST_MOD])
IF LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
THEN //set Page: High needle lift - page 0
ACTION_INFR_SetInjPulsePage (IN Cyl= NR_CYL_IV_TEST_MOD, IN Pulse= 0,
                              IN Page= 0))
ENDIF
#ENDIF
ACTION_INFR_ReqInjUpdate (IN Cyl= NR_CYL_IV_TEST_MOD, IN Mode= IMMEDIATE)
ACTION_INFR_ReqInjPulse (IN Cyl=NR_CYL_IV_TEST_MOD,
                          IN Duration= NC_TI_TEST_PLS_PER)
ENDIF

```

**7.2.15 Crash signal reaction of injection driver**

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**General information:**

This chapter describes the behavior of the injection driver during vehicle crash. Under crash conditions, all selected injectors (NC\_IV\_CRASH) are open for a predefined period, to drain off the fuel from the rail into the cylinder. This will reduce the danger of fire or explosion, if the rail will be damaged.

Definition of STATE\_INJ\_CRASH\_ACT:

00H = no request received;

The injection driver works under normal conditions.

01H = vehicle crash reaction request received by LV\_INJ\_CRASH\_ACT = 1;

The injection driver will be shut down.

02H = injection driver crash reaction acknowledged;

The selected injectors are opened for NC\_TI\_CRASH period.

03H = injection driver crash reaction finished;

All working injectors are closed. The driver is under hold conditions.

**Application conditions:**

**Initialisation:** at reset: T\_INJ\_CRASH\_ACT = 0  
STATE\_INJ\_CRASH\_ACT = 00H

**Activation:** every engine state

**Deactivation:** -

**Recurrence:** 10 ms

**Function description:****Formula section:**


```

IF STATE_INJ_CRASH_ACT = 01H AND
STATE_PBK_IV_INI = "INIT_FINISHED"
THEN
ACTION_INFR_ReqInjMode (IN Mode = STATIC)
STATE_INJ_DR = "RUN"
FOR x = 0 TO (NC_CYL_NR -1) DO:
ACTION_INFR_SetInjChaPer (IN Cyl= x, IN Pulse= 0,
IN Cha_per= C_T_CHA_PER_H)
ACTION_INFR_SetInjDchaPer (IN Cyl= x, IN Pulse= 0,
IN Dis_cha_per= C_T_CHA_PER_H)

#IF NC_PBK_IV_TYP = 1
#THEN
ACTION_INFR_SetInjSeqEndDly (IN Cyl= x, IN Pulse= 0,
IN Seq_end_delay= C_T_CHA_PER_H)
IF LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
THEN //set Page: High needle lift - page 0
ACTION_INFR_SetInjPulsePage (IN Cyl= x, IN Pulse= 0, IN Page= 0))
ENDIF
#ENDIF
IF bit x of NC_IV_CRASH = 1
THEN
ACTION_INFR_ReqInjUpdate (IN Cyl= x, IN Mode= IMMEDIATE)
ACTION_INFR_ReqInjPulse (IN Cyl= x,
IN Duration= MIN(470 ms, NC_TI_CRASH))

ENDIF
ENDFOR
STATE_INJ_CRASH_ACT = 02H

```

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**ENDIF**

**IF** LV\_INJ\_CRASH\_ACT = 1 **AND** STATE\_INJ\_CRASH\_ACT = 00H

**THEN**

Disable\_task\_interruption

STATE\_INJ\_CRASH\_ACT = 01H

**FOR** x = 0 **TO** (NC\_CYL\_NR -1) **DO:**

INJ\_MOD[x] = "DISABLE"

**ENDFOR**

LV\_ST\_INJ = 1

Enable\_task\_interruption

ACTION\_INFR\_ReqInjMode (IN Mode= DISABLE)

STATE\_INJ\_DR = "DISABLED"

**ENDIF**

**IF** STATE\_INJ\_CRASH\_ACT = 02H **AND** T\_INJ\_CRASH\_ACT ≥ NC\_TI\_CRASH

**THEN**

STATE\_INJ\_CRASH\_ACT = 03H

ACTION\_INFR\_ReqInjMode (IN Mode= DISABLE)

STATE\_INJ\_DR = "DISABLED"

**ENDIF**

**IF** STATE\_INJ\_CRASH\_ACT = 02H

**THEN**

T\_INJ\_CRASH\_ACT = T\_INJ\_CRASH\_ACT + 10 ms

**IF** (T\_INJ\_CRASH\_ACT **MODULO** 500ms) = 0

**THEN**

**FOR** x = 0 **TO** (NC\_CYL\_NR -1) **DO:**

**IF** bit x of NC\_IV\_CRASH = 1

**THEN** ACTION\_INFR\_ReqInjPulse (IN Cyl= x,  
IN Duration= **MIN**( 480 ms, (NC\_TI\_CRASH  
- (T\_INJ\_CRASH\_ACT - 10 ms)))

**ENDIF**

**ENDFOR**

**ENDIF**

**ENDIF**

## 7.2.16 Time synchronous tasks (1s)


### General information:

This chapter describes time synchronous tasks with the recurrence of 1 second.

Here, the voltage setpoint for the DCDC converter is set depending on the temperature of the ECU. The DCDC voltage is transferred via PWM value.

### Application conditions:

<b>Initialisation:</b>	-
<b>Activation:</b>	at every engine state
<b>Deactivation:</b>	-
<b>Recurrence:</b>	1 s

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**Function description:****Formula section:**

Calculate DCDC converter setpoint and send it to basic software:

```
PWM_DCDC_SP = IP_PWM_DCDC_PCTL(TECU)
```

Limit DCDC converter setpoint to maximum and minimum value to prevent power stage destruction:

```
PWM_DCDC_SP = MAX(PWM_DCDC_SP, NC_PWM_DCDC_SP_MIN)
```

```
PWM_DCDC_SP = MIN(PWM_DCDC_SP, NC_PWM_DCDC_SP_MAX)
```

```
FOR d = 0 TO (NC_NR_DCDC_INJ - 1) DO:
```

```
ACTION_INFR_SetInjDcdc(IN Dcdc_nr= d, IN Dcdc_ducy= PWM_DCDC_SP)
```

```
ENDFOR
```

Get measured reference calibration voltage and calculate ADC voltage reference calibration:

The measured voltage NC\_V\_ADC\_REF\_INJ is more accurate than the ADC reference voltage. By calculating a correction factor for all ADC measurement values, this accuracy can be transferred to all ADC measurements. This feature exists only for certain injection hardware drivers.

```
#IF NC_PBK_IV_TYP = 1
```

```
#THEN
```

```
ACTION_INFR_GetInjMesURef(OUT V_ADC_REF_MES_INJ_RAW= Voltage)
```

```
#ENDIF
```

Voltage reference calibration is activated by LC switch and a positive plausibility check of the raw value.

```
IF NC_PBK_IV_TYP = 1 AND
```

```
LC_V_ADC_REF_ENA = 1 AND
```

```
V_ADC_REF_MES_INJ_RAW > C_V_ADC_REF_MES_INJ_MIN_PLAUS AND
```

```
V_ADC_REF_MES_INJ_RAW < C_V_ADC_REF_MES_INJ_MAX_PLAUS
```

```
THEN //filter analogue signal V_ADC_REF_MES_INJ_RAW with PT1-filter:
```

```
V_ADC_REF_MES_INJ = (C_FAC_FIL_V_ADC_REF *  
                    (V_ADC_REF_MES_INJ_RAW - V_ADC_REF_MES_INJ))  
                    + V_ADC_REF_MES_INJ
```

```
IF LC_V_ADC_REF_CAL_INJ = 1
```

```
THEN FAC_ADC_REF_INJ = C_V_ADC_REF_INJ / V_ADC_REF_MES_INJ
```


```
ELSE FAC_ADC_REF_INJ = NC_V_ADC_REF_INJ / V_ADC_REF_MES_INJ
```

```
ENDIF
```

```
ENDIF
```

**7.2.17 Subroutines****General information:**

This section defines the subroutines. The following chapters are only calculated if called by another section like a function call. The input parameters are mentioned at the function calls.

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**Application conditions:**

**Initialisation:** -

**Activation:** if called by another section

**Deactivation:** -

**Recurrence:** once if called by another section

**Function description:****Formula section:****7.2.17.1 Start initialization**

```
PWM_DCDC_SP = IP_PWM_DCDC_PCTL(TECU) //Mode independent
```

*Limit DCDC converter setpoint to maximum and minimum value to prevent power stage destruction:*

```
PWM_DCDC_SP = MAX(PWM_DCDC_SP, NC_PWM_DCDC_SP_MIN)
```

```
PWM_DCDC_SP = MIN(PWM_DCDC_SP, NC_PWM_DCDC_SP_MAX)
```

```
FOR d = 0 TO (NC_NR_DCDC_INJ - 1) DO:
```

```
    ACTION_INFR_SetInjDcdc(IN Dcdc_nr= d, IN Dcdc_ducy= PWM_DCDC_SP)
```

```
ENDFOR
```

```
INH_IV_DYN = 0
```

```
NR_CYL_OFS_INH_IV_DYN = C_NR_CYL_OFS_INH_IV_DYN
```

```
STATE_INJ_UPD_TRM = 0 (all bits)
```

```
LV_INJ_UPD_CLC_ENA = 1
```

```
INH_IV_MIS_GEN_ACK = 0
```

```
FOR x = 0 TO (NC_CYL_NR - 1) DO:
```

```
    ACTION_INJR_SetStateInjUpdEna(IN Cyl= x, State_Inj_Upd_Ena= 0)
```

```
    CTR_INH_IV_MIS_GEN[x] = 0
```

```
ENDFOR
```

```
NR_CYL_INJ_BAS = 0
```

```
NR_CYL_INJ_BAS_PREV = NC_CYL_NR - 1
```

### 7.2.17.2 Disable injection driver functionality

*//This chapter describes the engine stop procedure as required for this specification. It is called either at engine run to engine stop event or at ignition key off event*

```
FOR x = 0 TO (NC_CYL_NR -1) DO:
INJ_MOD[x] = "DISABLE"
ENDFOR
```

```
LV_ST_INJ          = 1
LV_INJ_UPD_CLC_ENA = 0
```

```
IF STATE_INJ_CRASH_ACT = 00H
THEN
ACTION_INFR_ReqInjMode (IN Mode= DISABLE)
STATE_INJ_DR          = "DISABLED"
ENDIF
```

```
PREV_STATE_IV = 0    //no injection is performed by I/ O-SW from this time
```

Do the following calculations for all cylinders:

```
FOR x = 0 TO (NC_CYL_NR -1) DO:
ACTION_INJR_SetStateInjUpdEna (IN Cyl= x, State_Inj_Upd_Ena= 0)
LV_STATE_PREV_IV[x] = 0
LV_INJ_MPLP_CYL[x] = 0
SOI_1_MES[x]       = 720° CRK
SOI_2_MES[x]       = 720° CRK
SOI_POST_MES[x]    = 720° CRK
EOI_1_MES[x]       = 0° CRK
EOI_2_MES[x]       = 0° CRK
EOI_POST_MES[x]    = 0° CRK
TI_1_MES[x]        = 0 ms
TI_2_MES[x]        = 0 ms
TI_POST_MES[x]     = 0 ms
```

```
CHA_IV_1_MES [x] = 0
V_IV_1_MES [x] = 0
EGY_IV_1_CLC [x] = 0
CAPA_IV_1_CLC [x] = 0
```

```
CHA_IV_2_MES [x] = 0
V_IV_2_MES [x] = 0
EGY_IV_2_CLC [x] = 0
CAPA_IV_2_CLC [x] = 0
```


```
CHA_IV_POST_MES [x] = 0
V_IV_POST_MES [x] = 0
EGY_IV_POST_CLC [x] = 0
CAPA_IV_POST_CLC [x] = 0
```

**ENDFOR**

Do the following calculations for all power stage banks:

```
FOR p = 0 TO (NC_PBK_IV_NR -1) DO:
STATE_ERR_PBK_IV_RAW[p] = 0
CDN_DIAG_PBK_IV_RAW[p] = 0
CTR_STATE_PREV_PBK_IV[p] = 0
LV_STATE_PREV_PBK_IV[p] = 0
ENDFOR
```

**ENDFOR**

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### 7.2.17.3 Configure Injection

The CSERS\_TEST variables show the injection set points which will be activated if CSERS. Be aware that bad calibration of injection pulses, e.g. injection pulse during / after ignition may harm components of the test vehicle.

Calculation of CSERS\_INIJ\_DIAG test timing and phasing outputs for visibility

```
#IF NLC_CSERS_INJ_PLS_TEST_CONF == 0
#THEN
  TI_1_HOM_CSERS_TEST[x] = TI_1_HOM[x] * NC_CSERS_INJ_PLS_TEST_TI_FAC[0]
  SOI_1_HOM_CSERS_TEST[x] =
    SOI_1_HOM[x] + NC_CSERS_INJ_PLS_TEST_ANG_ADD[0]

  TI_2_HOM_CSERS_TEST[x] = TI_2_HOM[x] * NC_CSERS_INJ_PLS_TEST_TI_FAC[1]
  EOI_2_HOM_CSERS_TEST[x] =
    EOI_2_HOM[x] + NC_CSERS_INJ_PLS_TEST_ANG_ADD[1]

  TI_3_HOM_CSERS_TEST[x] = TI_3_HOM[x] * NC_CSERS_INJ_PLS_TEST_TI_FAC[2]
  EOI_3_HOM_CSERS_TEST[x] =
    EOI_3_HOM[x] + NC_CSERS_INJ_PLS_TEST_ANG_ADD[2]

#ELSE
  TI_1_HOM_CSERS_TEST[x] = TI_1_HOM[x] * C_CSERS_INJ_PLS_TEST_TI_FAC[0]
  SOI_1_HOM_CSERS_TEST[x] =
    SOI_1_HOM[x] + C_CSERS_INJ_PLS_TEST_ANG_ADD[0]

  TI_2_HOM_CSERS_TEST[x] = TI_2_HOM[x] * C_CSERS_INJ_PLS_TEST_TI_FAC[1]
  EOI_2_HOM_CSERS_TEST[x] =
    EOI_2_HOM[x] + C_CSERS_INJ_PLS_TEST_ANG_ADD[1]

  TI_3_HOM_CSERS_TEST[x] = TI_3_HOM[x] * C_CSERS_INJ_PLS_TEST_TI_FAC[2]
  EOI_3_HOM_CSERS_TEST[x] =
    EOI_3_HOM[x] + C_CSERS_INJ_PLS_TEST_ANG_ADD[2]

#ENDIF
```

```
TI_ACT_SWI[x] = 0
TI_ACT_UPD[x] = 0
```


//Disable post pulse:

```
LV_INJ_MPLP_CYL[x] = 0 (post injection disabled)
ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 3, IN Pulse_ena= 0)
```

//Homogeneous combustion mode:

```
(1) IF INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_1 = NC_INJ_MOD_HOM
(1) THEN //homogeneous combustion mode
(2) IF INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_2 ≠ NC_INJ_MOD_SINGLE
(2) THEN //homogeneous mode multi injection
  Settings for first pulse
  ACTION_INFR_SetInjPulseType(IN Cyl= x, IN Pulse= 0, IN Pulse_type= SOI_TI)
  ACTION_INFR_SetInjPlsUpdMode(IN Cyl = x, IN Pulse= 0, IN Plsupd_mode= NONE)
  ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 0, IN Pulse_ena= 1)
  Settings for second pulse
  ACTION_INFR_SetInjPulseType(IN Cyl= x, IN Pulse= 1, IN Pulse_type= EOI_TI)
(3) IF LC_IV_ADD_PLS_MPLH_ENA = 1
(3) THEN ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 1,
    IN Plsupd_mode= UPDATE)
(3) ELSE ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 1,
    IN Plsupd_mode= NONE)

(3) ENDIF
```

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```

ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 1, IN Pulse_ena= 1)
Settings for third pulse
(4) IF INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_2 = NC_INJ_MOD_MULTI_PLS3
(4) THEN ACTION_INFR_SetInjPulseType(IN Cyl= x, IN Pulse= 2,
                                     IN Pulse_type= EOI_TTI)
        ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 2,
                                     IN Plsupd_mode= NONE)
        ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 2,
                                    IN Pulse_ena= 1)
(4) ELSE ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 2,
                                    IN Pulse_ena= 0)


(4) ENDIF
(2) ELSE //homogeneous mode single injection
Settings for first pulse
ACTION_INFR_SetInjPulseType(IN Cyl= x, IN Pulse= 0, IN Pulse_type= SOI_TTI)
ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 0, IN Plsupd_mode= NONE)
Enable first pulse
ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 0, IN Pulse_ena= 1)
Disable third pulse
ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 2, IN Pulse_ena= 0)
(5) IF LC_IV_ADD_PLS_SNGH_ENA = 1
(5) THEN
Settings makeup pulse
ACTION_INFR_SetInjPulseType(IN Cyl= x, IN Pulse= 1, IN Pulse_type= EOI_TTI)
(6) IF LC_INJ_PLS_UPD_MOD = AUTONOMOUS
(6) THEN ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 1,
                                     IN Plsupd_mode= AUTONOMOUS)
(6) ELSE ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 1,
                                     IN Plsupd_mode= IMMEDIATE)

(6) ENDIF
Enable second (makeup) pulse
ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 1, IN Pulse_ena= 1)
(5) ELSE
Disable second (makeup) pulse
ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 1, IN Pulse_ena= 0)
(5) ENDIF
(2) ENDIF
(1) ENDIF

//Stratified combustion mode:
(1) IF INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_1 = NC_INJ_MOD_S
(1) THEN //stratified combustion mode
(2) IF INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_2 ≠ NC_INJ_MOD_SINGLE
(2) THEN //stratified multi injection
Settings for first pulse
ACTION_INFR_SetInjPulseType(IN Cyl= x, IN Pulse= 0, IN Pulse_type= EOI_TTI)
ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 0, IN Plsupd_mode= NONE)
Settings for second pulse
ACTION_INFR_SetInjPulseType(IN Cyl= x, IN Pulse= 1, IN Pulse_type= T_TTI)
ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 1, IN Plsupd_mode= NONE)
Enable first pulse
ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 0, IN Pulse_ena= 1)
Enable second pulse
ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 1, IN Pulse_ena= 1)
(3) IF INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_2 = NC_INJ_MOD_MULTI_PLS3
(3) THEN //stratified triple injection
Settings for third pulse
ACTION_INFR_SetInjPulseType(IN Cyl= x, IN Pulse= 2, IN Pulse_type= T_TTI)
ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 2,
                              IN Plsupd_mode= NONE)

Enable third pulse

```


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```

ACTION_INFR_SetInjPulseEna (IN Cyl= x, IN Pulse= 2, IN Pulse_ena= 1)
(3) ELSE
Disable third pulse
ACTION_INFR_SetInjPulseEna (IN Cyl= x, IN Pulse= 2, IN Pulse_ena= 0)
(3) ENDIF
(2) ELSE //Stratified mode single injection
Settings for first pulse
ACTION_INFR_SetInjPulseType (IN Cyl= x, IN Pulse= 0, IN Pulse_type= EOI_TI)
ACTION_INFR_SetInjPlsUpdMode (IN Cyl= x, IN Pulse= 0, IN Plsupd_mode= NONE)
Enable first pulse
ACTION_INFR_SetInjPulseEna (IN Cyl= x, IN Pulse= 0, IN Pulse_ena= 1)
Disable second pulse
ACTION_INFR_SetInjPulseEna (IN Cyl= x, IN Pulse= 1, IN Pulse_ena= 0)
Disable third pulse
ACTION_INFR_SetInjPulseEna (IN Cyl= x, IN Pulse= 2, IN Pulse_ena= 0)
(2) ENDIF
(1) ENDIF

//Homogeneous-stratified combustion mode:
(1) IF INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_1 = NC_INJ_MOD_HOMS
(1) THEN //homs mode
(2) IF INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_2 ≠ NC_INJ_MOD_SINGLE
(2) THEN //homs multi injection
Settings for first pulse
ACTION_INFR_SetInjPulseType (IN Cyl= x, IN Pulse= 0, IN Pulse_type= SOI_TI)
ACTION_INFR_SetInjPlsUpdMode (IN Cyl= x, IN Pulse= 0, IN Plsupd_mode= NONE)
Settings for second pulse
ACTION_INFR_SetInjPulseType (IN Cyl= x, IN Pulse= 1, IN Pulse_type= EOI_TI)
ACTION_INFR_SetInjPlsUpdMode (IN Cyl= x, IN Pulse= 1, IN Plsupd_mode= NONE)
Enable first pulse
ACTION_INFR_SetInjPulseEna (IN Cyl= x, IN Pulse= 0, IN Pulse_ena= 1)
Enable second pulse
ACTION_INFR_SetInjPulseEna (IN Cyl= x, IN Pulse= 1, IN Pulse_ena= 1)
(3) IF INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_2 = NC_INJ_MOD_MULTI_PLS3
(3) THEN //homs triple injection
Settings for third pulse
ACTION_INFR_SetInjPulseType (IN Cyl= x, IN Pulse= 2, IN Pulse_type= EOI_TI)
ACTION_INFR_SetInjPlsUpdMode (IN Cyl= x, IN Pulse= 2, IN Plsupd_mode= NONE)
Enable third pulse
ACTION_INFR_SetInjPulseEna (IN Cyl= x, IN Pulse= 2, IN Pulse_ena= 1)
(3) ELSE
Disable third pulse
ACTION_INFR_SetInjPulseEna (IN Cyl= x, IN Pulse= 2, IN Pulse_ena= 0)
(3) ENDIF
(2) ELSE //homs single injection
Settings for first pulse
ACTION_INFR_SetInjPulseType (IN Cyl= x, IN Pulse= 0, IN Pulse_type= SOI_TI)
ACTION_INFR_SetInjPlsUpdMode (IN Cyl= x, IN Pulse= 0, IN Plsupd_mode= NONE)
Enable first pulse
ACTION_INFR_SetInjPulseEna (IN Cyl= x, IN Pulse= 0, IN Pulse_ena= 1)
Disable second pulse
ACTION_INFR_SetInjPulseEna (IN Cyl= x, IN Pulse= 1, IN Pulse_ena= 0)
Disable third pulse
ACTION_INFR_SetInjPulseEna (IN Cyl= x, IN Pulse= 2, IN Pulse_ena= 0)
(2) ENDIF
(1) ENDIF

```

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### 7.2.17.4 Update injection data

The CSERS\_TEST variables show the injection set points which will be activated if CSERS multiple injection diagnosis demo mode is activated and catalyst heating is active. They are also calculated out of demo mode in order to enable a control of the demo mode set points before activating the demo mode.

Be aware that bad calibration of injection pulses, e.g. injection pulse during / after ignition may harm components of the test vehicle.

Calculation of CSERS\_INIJ\_DIAG test timing and phasing outputs for visibility

```

#IF      NLC_CSERS_INJ_PLS_TEST_CONF == 0
#THEN
  TI_1_HOM_CSERS_TEST[x] = TI_1_HOM[x] * NC_CSERS_INJ_PLS_TEST_TI_FAC[0]
  SOI_1_HOM_CSERS_TEST[x] =
    SOI_1_HOM[x] + NC_CSERS_INJ_PLS_TEST_ANG_ADD[0]

  TI_2_HOM_CSERS_TEST[x] = TI_2_HOM[x] * NC_CSERS_INJ_PLS_TEST_TI_FAC[1]
  EOI_2_HOM_CSERS_TEST[x] =
    EOI_2_HOM[x] + NC_CSERS_INJ_PLS_TEST_ANG_ADD[1]

  TI_3_HOM_CSERS_TEST[x] = TI_3_HOM[x] * NC_CSERS_INJ_PLS_TEST_TI_FAC[2]
  EOI_3_HOM_CSERS_TEST[x] =
    EOI_3_HOM[x] + NC_CSERS_INJ_PLS_TEST_ANG_ADD[2]

#ELSE
  TI_1_HOM_CSERS_TEST[x] = TI_1_HOM[x] * C_CSERS_INJ_PLS_TEST_TI_FAC[0]
  SOI_1_HOM_CSERS_TEST[x] =
    SOI_1_HOM[x] + C_CSERS_INJ_PLS_TEST_ANG_ADD[0]

  TI_2_HOM_CSERS_TEST[x] = TI_2_HOM[x] * C_CSERS_INJ_PLS_TEST_TI_FAC[1]
  EOI_2_HOM_CSERS_TEST[x] =
    EOI_2_HOM[x] + C_CSERS_INJ_PLS_TEST_ANG_ADD[1]

  TI_3_HOM_CSERS_TEST[x] = TI_3_HOM[x] * C_CSERS_INJ_PLS_TEST_TI_FAC[2]
  EOI_3_HOM_CSERS_TEST[x] =
    EOI_3_HOM[x] + C_CSERS_INJ_PLS_TEST_ANG_ADD[2]

#ENDIF

```

//Transfer data for charge and discharge current.

**Note:** In case of active page selection, the data on page 0 refers to high injector needle lift, the data on page 1 to low injector needle lift.

```

ACTION_INFR_SetInjChaCur (IN Cyl= x, IN Page= 0,
    IN Cha_cur= EGY_STEP_INJ_CHA_GRD[x])
ACTION_INFR_SetInjDchaCur (IN Cyl= x, IN Page= 0,
    IN Dis_cha_cur= EGY_STEP_INJ_DCHA_GRD[x])

```

```

#IF  NC_PBK_IV_TYP = 1
#THEN  ACTION_INFR_SetInjChaCur (IN Cyl= x, IN Page= 1,
    IN Cha_cur= EGY_STEP_INJ_CHA_GRD_L[x])
    ACTION_INFR_SetInjDchaCur (IN Cyl= x, IN Page= 1,
    IN Dis_cha_cur= EGY_STEP_INJ_DCHA_GRD_L[x])
#ENDIF


```

```

IF  LV_INJ_MPLP_CYL[x] = 1 //post injection enabled
THEN  ACTION_INFR_SetInjChaPer (IN Cyl= x, IN Pulse= 3,
    IN Cha_per= T_CHA_PER_POST)
    ACTION_INFR_SetInjDchaPer (IN Cyl= x, IN Pulse= 3,
    IN Dis_cha_per= T_DCHA_PER_POST)

#IF  NC_PBK_IV_TYP = 1
#THEN

```

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```

IF LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
THEN //Set Page: high needle lift - page 0; low needle lift - page 1
ACTION_INFR_SetInjPulsePage(IN Cyl= x, IN Pulse= 3,
                             IN Page= NOT(LV_IV_POST_EGY_RNG))

ENDIF
ACTION_INFR_SetInjSeqEndDly(IN Cyl= x, IN Pulse= 3,
                             IN Seq_end_delay= T_RLS_DLY_DCHA_POST)

#ENDIF
ACTION_INFR_SetInjSoiLim(IN Cyl= x, IN Packet_nr= 1,
                         IN Soi_lim= - SOI_LIM_POST)
ACTION_INFR_SetInjEoiLim(IN Cyl= x, IN Packet_nr= 1,
                         IN Eoi_lim= - EOI_LIM_POST)
ACTION_INFR_SetInjPulsePosAng(IN Cyl=x, IN Pulse= 3,
                              IN Position_ang= - SOI_POST_INJ[x])
ACTION_INFR_SetInjPulseDurPer(IN Cyl=x, IN Pulse= 3,
                              IN Pls_duration= TI_POST_INJ[x])

ENDIF

//Homogeneous combustion mode:
(1) IF INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_1 = NC_INJ_MOD_HOM
(1) THEN //Homogeneous mode
(2) IF INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_2 ≠ NC_INJ_MOD_SINGLE
(2) THEN //homogeneous mode multi injection
(3) IF LC_IV_ADD_PLS_MPLH_ENA
(3) THEN
ACTION_INFR_SetInjPlsUpdFactor(IN Plsupd_factor= FAC_ADD_PULSE)
ACTION_INFR_SetInjPlsUpdMinPer(IN Plsupd_min_per= TI_ADD_PULSE_MIN)
(3) ENDIF
ACTION_INFR_SetInjChaPer(IN Cyl= x, IN Pulse= 1,
                        IN Cha_per= T_CHA_PER_HOM_2[x])
ACTION_INFR_SetInjDchaPer(IN Cyl= x, IN Pulse= 1,
                          IN Dis_cha_per= T_DCHA_PER_HOM_2[x])

#IF NC_PBK_IV_TYP = 1
#THEN
(4) IF LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
(4) THEN //Set Page: High needle lift - page 0; low needle lift - page 1
ACTION_INFR_SetInjPulsePage(IN Cyl= x, IN Pulse= 1,
                             IN Page= NOT(LV_EGY_RNG_IV_PLS_2_HOM[x]))


(4) ENDIF
ACTION_INFR_SetInjSeqEndDly(IN Cyl= x, IN Pulse= 1,
                             IN Seq_end_delay= T_RLS_DLY_DCHA_2_HOM[x])

#ENDIF
(21) IF LV_CSERS_INJ_PLS_TEST_MOD_ENA == 1
(21) THEN // * CSERS_INJ demo mode on */
(22) IF CLF_CSERS_INJ_PLS_TEST_CYL_ON[1][bit x] == 1
(22) THEN // * CSERS_INJ demo mode change for this pulse */
(23) IF LC_CSERS_INJ_PLS_TEST_TYP == 0
(23) THEN // * move injection phase for CSERS_INJ demo test */
ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse = 1,
                              IN Pls_duration = TI_2_HOM[x])
ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse = 1,
                              IN Position_ang = - EOI_2_HOM_CSERS_TEST[x])

(23) ELSE // * change injection time for CSERS_INJ demo test */
ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse = 1,
                              IN Position_ang = - EOI_2_HOM[x])
ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse = 1,
                              IN Pls_duration = TI_2_HOM_CSERS_TEST[x])

(23) ENDIF
(22) ELSE // * test mode active, no pulse change */
ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse = 1,

```

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```

                                IN Position_ang = - EOI_2_HOM[x])
ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse = 1,
                                IN Pls_duration = TI_2_HOM[x])

(22)ENDIF
(21)ELSE /*normal mode - CSERS_INJ demo mode not active,no pulse change*/

ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse= 1,
                                IN Position_ang= - EOI_2_HOM[x])
ACTION_INFR_SetInjPulseDurPer(IN Cyl=x, IN Pulse= 1,
                                IN Pls_duration= TI_2_HOM[x])

(21)ENDIF

(5)IF INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_2 = NC_INJ_MOD_MULTI_PLS3
(5)THEN //homogeneous mode triple injection
ACTION_INFR_SetInjChaPer(IN Cyl= x, IN Pulse= 2,
                            IN Cha_per= T_CHA_PER_HOM_3[x])
ACTION_INFR_SetInjDchaPer(IN Cyl= x, IN Pulse= 2,
                            IN Dis_cha_per= T_DCHA_PER_HOM_3[x])


#IF NC_PBK_IV_TYP = 1
#THEN
(6)IF LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
(6)THEN //Set Page: High needle lift - page 0; low needle lift - page 1
ACTION_INFR_SetInjPulsePage(IN Cyl= x, IN Pulse= 2,
                            IN Page= NOT(LV_EGY_RNG_IV_PLS_3_HOM[x]))
(6)ENDIF
ACTION_INFR_SetInjSeqEndDly(IN Cyl= x, IN Pulse= 2,
                            IN Seq_end_delay= T_RLS_DLY_DCHA_3_HOM[x])
#ENDIF
(51)IF LV_CSERS_INJ_PLS_TEST_MOD_ENA == 1
(51)THEN /* CSERS_INJ demo mode on */
(52)IF CLF_CSERS_INJ_PLS_TEST_CYL_ON[2][bit x] == 1
(52)THEN /* CSERS_INJ demo mode change for this pulse */
(53)IF LC_CSERS_INJ_PLS_TEST_TYP == 0
(53)THEN /* move injection phase for CSERS_INJ demo test */
ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse = 2,
                                IN Pls_duration = TI_3_HOM[x])
ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse = 2,
                                IN Position_ang = - EOI_3_HOM_CSERS_TEST[x])
(53)ELSE /* change injection time for CSERS_INJ demo test */
ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse = 2,
                                IN Position_ang = - EOI_3_HOM[x])
ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse = 2,
                                IN Pls_duration = TI_3_HOM_CSERS_TEST[x])
(53)ENDIF
(52)ELSE /* test mode active, no pulse change */
ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse = 2,
                                IN Position_ang = - EOI_3_HOM[x])
ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse = 2,
                                IN Pls_duration = TI_3_HOM[x])
(52)ENDIF
(51)ELSE /*normal mode - CSERS_INJ demo mode not active,no pulse change*/

ACTION_INFR_SetInjPulsePosAng(IN Cyl=x, IN Pulse= 2,
                                IN Position_ang= - EOI_3_HOM[x])
ACTION_INFR_SetInjPulseDurPer(IN Cyl=x, IN Pulse= 2,
                                IN Pls_duration= TI_3_HOM[x])

(51)ENDIF

(5)ENDIF

```

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```
SOI_EOI_ACT_UPD[x] = EOI_2_HOM[x]
LV_SOI_ACT_UPD[x]  = 0
TI_ACT_UPD[x]     = TI_2_HOM[x]
```

(2) **ELSE** //homogeneous mode single injection

*Handling of makeup pulse*

(3) **IF** LC\_IV\_ADD\_PLS\_SNGH\_ENA = 1

```
(3) THEN ACTION_INFR_SetInjChaPer (IN Cyl= x, IN Pulse= 1,
                                     IN Cha_per= T_CHA_PER_HOM[x])
        ACTION_INFR_SetInjDchaPer (IN Cyl= x, IN Pulse= 1,
                                     IN Dis_cha_per= T_DCHA_PER_HOM[x])
```

**#IF** NC\_PBK\_IV\_TYP = 1

**#THEN**

(4) **IF** LC\_CUR\_CHA\_INJ\_H\_L\_SEL\_ENA = 1

(4) **THEN** //Set Page: high needle lift - page 0;  
low needle lift - page 1

```
ACTION_INFR_SetInjPulsePage (IN Cyl= x, IN Pulse= 1,
                              IN Page= NOT(LV_EGY_RNG_IV_PLS_1_HOM[x]))
```

(4) **ENDIF**

```
ACTION_INFR_SetInjSeqEndDly (IN Cyl= x, IN Pulse= 1,
                              IN Seq_end_delay= T_RLS_DLY_DCHA_1_HOM[x])
```

**#ENDIF**

(5) **IF** (LC\_INJ\_PLS\_UPD\_MOD = AUTONOMOUS)

(5) **THEN**

```
EOI_INJ_UPD_PSN = IP_EOI_INJ_UPD_PSN(N_32)
```

```
ACTION_INFR_SetInjPulsePosAng (IN Cyl=x, IN Pulse= 1,
                                IN Position_ang= - EOI_INJ_UPD_PSN)
```

(5) **ELSE**

```
ACTION_INFR_SetInjPulsePosAng (IN Cyl=x, IN Pulse= 1,
                                IN Position_ang= - MAX(C_SOI_MIN_UPD_PLS_SNGH; EOI_LIM_HOM))
```

(5) **ENDIF**

```
ACTION_INFR_SetInjPlsUpdFactor (IN Plsupd_factor= FAC_ADD_PULSE)
```

```
ACTION_INFR_SetInjPlsUpdMinPer (IN Plsupd_min_per= TI_ADD_PULSE_MIN)
```

(6) **IF** LV\_EGY\_RNG\_IV\_PLS\_1\_HOM[x] = 1

(6) **THEN**

```
TI_1_ADD_DLY_HOM = IP_TI_ADD_DLY_HPDI_EGY_H (PRS_DEC_INJ_1_HOM[x])
```

(6) **ELSE**

```
TI_1_ADD_DLY_HOM = IP_TI_ADD_DLY_HPDI_EGY_L (PRS_DEC_INJ_1_HOM[x])
```

(6) **ENDIF**

```
ACTION_INFR_SetInjPlsUpdOffset (IN Cyl= x,
                                 IN Plsupd_offset= TI_1_ADD_DLY_HOM)
```

```
SOI_EOI_ACT_UPD[x] = MAX(C_SOI_MIN_UPD_PLS_SNGH; EOI_LIM_HOM)
```

```
LV_SOI_ACT_UPD[x] = 1
```

(3) **ELSE**

```
SOI_EOI_ACT_UPD[x] = SOI_1_HOM[x]
```

```
LV_SOI_ACT_UPD[x] = 1
```

(3) **ENDIF**

(2) **ENDIF**

*Calculations for all homogeneous modes*

```
ACTION_INFR_SetInjChaPer (IN Cyl= x, IN Pulse= 0,
                           IN Cha_per= T_CHA_PER_HOM[x])
```

```
ACTION_INFR_SetInjDchaPer (IN Cyl= x, IN Pulse= 0,
                             IN Dis_cha_per= T_DCHA_PER_HOM[x])
```

**#IF** NC\_PBK\_IV\_TYP = 1

**#THEN**


(7) **IF** LC\_CUR\_CHA\_INJ\_H\_L\_SEL\_ENA = 1

(7) **THEN** //Set Page: high needle lift - page 0; low needle lift - page 1

```
ACTION_INFR_SetInjPulsePage (IN Cyl= x, IN Pulse= 0,
                              IN Page= NOT(LV_EGY_RNG_IV_PLS_1_HOM[x]))
```

(7) **ENDIF**

```
ACTION_INFR_SetInjSeqEndDly (IN Cyl= x, IN Pulse= 0,
```

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```

                                IN Seq_end_delay= T_RLS_DLY_DCHA_1_HOM[x])
#ENDIF
LV_EGY_RNG_IV_PLS_1_ACT[x] = LV_EGY_RNG_IV_PLS_1_HOM[x]
LV_IGN_INJ_COPL_HOM_ACT[x] = LV_EOI_2_DELTA_HOM_CUS
(8) IF CRK_WIN_SEL_IGN_INJ[x] ≠ "RTD_WIN"
(8) THEN LV_EGY_RNG_IV_PLS_1_ACK[x] = LV_EGY_RNG_IV_PLS_1_ACT[x]
(8) ENDIF
//Service tool intervention:
(9) IF LV_TI_EXT_ADJ[x] = 0
(9) THEN //no service tool intervention
(91) IF LV_CSERS_INJ_PLS_TEST_MOD_ENA == 1
(91) THEN /* CSERS_INJ demo mode on */
(92) IF CLF_CSERS_INJ_PLS_TEST_CYL_ON[1][bit x] == 1
(92) THEN /* CSERS_INJ demo mode change for this pulse */
(93) IF LC_CSERS_INJ_PLS_TEST_TYP == 0
(93) THEN /* move injection phase for CSERS_INJ demo test */
ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse = 0,
                                IN Pls_duration = TI_1_HOM[x])
ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse = 0,
                                IN Position_ang = - SOI_1_HOM_CSERS_TEST[x])

(93) ELSE /* change injection time for CSERS_INJ demo test */
ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse = 0,
                                IN Position_ang = - SOI_1_HOM[x])
ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse = 0,
                                IN Pls_duration = TI_1_HOM_CSERS_TEST[x])

(93) ENDIF
(92) ELSE /* test mode active, no pulse change */
ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse = 0,
                                IN Position_ang = - SOI_1_HOM[x])
ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse = 0,
                                IN Pls_duration = TI_1_HOM[x])

(92) ENDIF
(91) ELSE /*normal mode - CSERS_INJ demo mode not active,no pulse change*/

ACTION_INFR_SetInjPulsePosAng(IN Cyl=x, IN Pulse= 0,
                                IN Position_ang= - SOI_1_HOM[x])
ACTION_INFR_SetInjPulseDurPer(IN Cyl=x, IN Pulse= 0,
                                IN Pls_duration= TI_1_HOM[x])

(91) ENDIF


SOI_EOI_ACT_SWI[x] = SOI_1_HOM[x]
LV_SOI_ACT_SWI[x] = 1
(9) ELSE //service tool intervention
ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse= 0,
                                IN Position_ang= - C_SOI_EXT_ADJ)
ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse= 0,
                                IN Pls_duration= TI_EXT_ADJ[x])

SOI_EOI_ACT_SWI[x] = C_SOI_EXT_ADJ
LV_SOI_ACT_SWI[x] = 1
(9) ENDIF
ACTION_INFR_SetInjSoiLim (IN Cyl= x, IN Packet_nr= 0, IN Soi_lim= - SOI_LIM)
ACTION_INFR_SetInjEoiLim (IN Cyl= x, IN Packet_nr= 0,
                            IN Eoi_lim= - EOI_LIM_HOM)

(1) ENDIF

//Stratified combustion mode:
(1) IF INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_1 = NC_INJ_MOD_S
(1) THEN
Set limits
ACTION_INFR_SetInjSoiLim(IN Cyl= x, IN Packet_nr= 0,IN Soi_lim= - SOI_LIM)

```

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```

ACTION_INFR_SetInjEoiLim(IN Cyl= x, IN Packet_nr= 0, IN Eoi_lim= 0° CRK)
(2) IF INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_2 ≠ NC_INJ_MOD_SINGLE
(2) THEN //stratified multi injeciton
Settings for second pulse:
Set injector needle lift by charge and discharge time
ACTION_INFR_SetInjChaPer(IN Cyl= x, IN Pulse= 1,
                          IN Cha_per= T_CHA_PER_S_2[x])
ACTION_INFR_SetInjDchaPer(IN Cyl= x, IN Pulse= 1,
                           IN Dis_cha_per= T_DCHA_PER_S_2[x])

#IF NC_PBK_IV_TYP = 1
#THEN
(3) IF LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
(3) THEN //Set Page: high needle lift - page 0; low needle lift - page 1
ACTION_INFR_SetInjPulsePage(IN Cyl= x, IN Pulse= 1,
                              IN Page= NOT(LV_EGY_RNG_IV_PLS_2_S[x]))

(3) ENDIF
ACTION_INFR_SetInjSeqEndDly(IN Cyl= x, IN Pulse= 1,
                              IN Seq_end_delay= T_RLS_DLY_DCHA_2_S[x])

#ENDIF
Set time and phasing
ACTION_INFR_SetInjPulsePosPer(IN Cyl= x, IN Pulse= 1,
                               IN Position_per= T_DLY_1_2_S_EXT[x])
ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse= 1,
                                IN Pls_duration= TI_2_S[x])

(4) IF INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_2 = NC_INJ_MOD_MULTI_PLS3
(4) THEN //stratified triple injection
ACTION_INFR_SetInjChaPer(IN Cyl= x, IN Pulse= 2,
                          IN Cha_per= T_CHA_PER_S_3[x])
ACTION_INFR_SetInjDchaPer(IN Cyl= x, IN Pulse= 2,
                            IN Dis_cha_per= T_DCHA_PER_S_3[x])

#IF NC_PBK_IV_TYP = 1
#THEN
(5) IF LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
(5) THEN //Set Page: high needle lift - page 0;
          low needle lift - page 1
ACTION_INFR_SetInjPulsePage(IN Cyl= x, IN Pulse= 2,
                              IN Page= NOT(LV_EGY_RNG_IV_PLS_3_S[x]))

(5) ENDIF
ACTION_INFR_SetInjSeqEndDly(IN Cyl= x, IN Pulse= 2,
                              IN Seq_end_delay= T_RLS_DLY_DCHA_3_S[x])


#ENDIF
ACTION_INFR_SetInjPulsePosPer(IN Cyl=x, IN Pulse= 2,
                               IN Position_per= T_DLY_2_3_S_EXT[x])
ACTION_INFR_SetInjPulseDurPer(IN Cyl=x, IN Pulse = 2,
                                IN Pls_duration= TI_3_S[x])

(4) ENDIF
(2) ENDIF
Stratified mode single injection
Settings for first pulse; Set injector needle lift by charge and discharge time
ACTION_INFR_SetInjChaPer(IN Cyl= x, IN Pulse= 0,
                          IN Cha_per= T_CHA_PER_S_1[x])
ACTION_INFR_SetInjDchaPer(IN Cyl= x, IN Pulse= 0,
                            IN Dis_cha_per= (T_DCHA_PER_S_1[x])

#IF NC_PBK_IV_TYP = 1
#THEN
(6) IF LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
(6) THEN //Set Page: high needle lift - page 0; low needle lift - page 1
ACTION_INFR_SetInjPulsePage(IN Cyl= x, IN Pulse= 0,
                              IN Page= NOT(LV_EGY_RNG_IV_PLS_1_S[x]))

(6) ENDIF
ACTION_INFR_SetInjSeqEndDly(IN Cyl= x, IN Pulse= 0,

```

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```


                                IN Seq_end_delay= T_RLS_DLY_DCHA_1_S[x])
#ENDIF
LV_EGY_RNG_IV_PLS_1_ACT[x] = LV_EGY_RNG_IV_PLS_1_S[x]
(7) IF CRK_WIN_SEL_IGN_INJ[x] ≠ "RTD_WIN"
(7) THEN    LV_EGY_RNG_IV_PLS_1_ACK[x] = LV_EGY_RNG_IV_PLS_1_ACT[x]
(7) ENDIF
Set time and phasing
ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse= 0,
                                IN Position_ang= - EOI_1_S[x])
ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse= 0,
                                IN Pls_duration= TI_1_S[x])
SOI_EOI_ACT_SWI[x] = EOI_1_S[x]
LV_SOI_ACT_SWI[x] = 0
TI_ACT_SWI[x] = TI_1_S[x]
SOI_EOI_ACT_UPD[x] = EOI_1_S[x]
LV_SOI_ACT_UPD[x] = 0
TI_ACT_UPD[x] = TI_1_S[x]
(1) ENDIF

//Homogeneous Stratified mode:
(1) IF INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_1 = NC_INJ_MOD_HOMS
(1) THEN
Set limits
ACTION_INFR_SetInjSoiLim(IN Cyl= x, IN Packet_nr= 0, IN Soi_lim= - SOI_LIM)
ACTION_INFR_SetInjEoiLim(IN Cyl= x, IN Packet_nr= 0, IN Eoi_lim= 0° CRK)
(2) IF (INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_2) ≠ NC_INJ_MOD_SINGLE
(2) THEN    //Homogeneous stratified mode multi injection
Settings for second pulse:
Set injector needle lift by charge and discharge time
ACTION_INFR_SetInjChaPer(IN Cyl= x, IN Pulse= 1,
                            IN Cha_per= T_CHA_PER_S_2[x])
ACTION_INFR_SetInjDchaPer(IN Cyl= x, IN Pulse= 1,
                            IN Dis_cha_per= T_DCHA_PER_S_2[x])

#IF NC_PBK_IV_TYP = 1
#THEN
(3) IF LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
(3) THEN    //Set Page: high needle lift - page 0; low needle lift - page 1
ACTION_INFR_SetInjPulsePage(IN Cyl= x, IN Pulse= 1,
                            IN Page= NOT(LV_EGY_RNG_IV_PLS_2_S[x]))
(3) ENDIF
ACTION_INFR_SetInjSeqEndDly(IN Cyl= x, IN Pulse= 1,
                            IN Seq_end_delay= T_RLS_DLY_DCHA_2_S[x])
#ENDIF
Set time and phasing
ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse= 1,
                                IN Position_ang= - EOI_2_HOMS[x])
ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse= 1,
                                IN Pls_duration= TI_2_S[x])
(4) IF INJ_MOD[x] BiswiseAND NC_INJ_MOD_MASK_2 = NC_INJ_MOD_MULTI_PLS3
(4) THEN    //Homogeneous Stratified mode triple injection
ACTION_INFR_SetInjChaPer(IN Cyl= x, IN Pulse= 2,
                            IN Cha_per= T_CHA_PER_S_3[x])
ACTION_INFR_SetInjDchaPer(IN Cyl= x, IN Pulse= 2,
                            IN Dis_cha_per= T_DCHA_PER_S_3[x])

#IF NC_PBK_IV_TYP = 1
#THEN
(5) IF LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
(5) THEN    //Set Page: high needle lift - page 0;
                low needle lift - page 1
ACTION_INFR_SetInjPulsePage(IN Cyl= x, IN Pulse= 2,
                            IN Page= NOT(LV_EGY_RNG_IV_PLS_3_S[x]))

```

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```

(5) ENDIF
ACTION_INFR_SetInjSeqEndDly (IN Cyl= x, IN Pulse= 2,
                             IN Seq_end_delay= T_RLS_DLY_DCHA_3_S[x])
#ENDIF
ACTION_INFR_SetInjPulsePosAng (IN Cyl=x, IN Pulse= 2,
                               IN Position_ang= - EOI_3_HOMS[x])
ACTION_INFR_SetInjPulseDurPer (IN Cyl=x, IN Pulse= 2,
                               IN Pls_duration= TI_3_S[x])

(4) ENDIF
SOI_EOI_ACT_UPD[x] = EOI_2_HOMS[x]
LV_SOI_ACT_UPD[x] = 0
TI_ACT_UPD[x] = TI_2_S[x]
(2) ELSE //homogeneous stratified mode single injection
SOI_EOI_ACT_UPD[x] = SOI_1_HOMS[x]
LV_SOI_ACT_UPD[x] = 1
(2) ENDIF
Homogeneous Stratified mode single injection and multi injection
Settings for first pulse Set injector needle lift by charge and discharge time
ACTION_INFR_SetInjChaPer (IN Cyl= x, IN Pulse= 0,
                          IN Cha_per= T_CHA_PER_S_1[x])
ACTION_INFR_SetInjDchaPer (IN Cyl= x, IN Pulse= 0,
                           IN Dis_cha_per= T_DCHA_PER_S_1[x])

#IF NC_PBK_IV_TYP = 1
#THEN
(6) IF LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
(6) THEN //Set Page: High needle lift - page 0; low needle lift - page 1
ACTION_INFR_SetInjPulsePage (IN Cyl= x, IN Pulse= 0,
                             IN Page= NOT(LV_EGY_RNG_IV_PLS_1_S[x]))
(6) ENDIF
ACTION_INFR_SetInjSeqEndDly (IN Cyl= x, IN Pulse= 0,
                             IN Seq_end_delay= T_RLS_DLY_DCHA_1_S[x])
#ENDIF
LV_EGY_RNG_IV_PLS_1_ACT[x] = LV_EGY_RNG_IV_PLS_1_S[x]
(7) IF CRK_WIN_SEL_IGN_INJ[x] ≠ "RTD_WIN"
(7) THEN LV_EGY_RNG_IV_PLS_1_ACK[x] = LV_EGY_RNG_IV_PLS_1_ACT[x]
(7) ENDIF
Set time and phasing
ACTION_INFR_SetInjPulsePosAng (IN Cyl= x, IN Pulse= 0,
                               IN Position_ang= - SOI_1_HOMS[x])
ACTION_INFR_SetInjPulseDurPer (IN Cyl= x, IN Pulse= 0,
                               IN Pls_duration= TI_1_S[x])
SOI_EOI_ACT_SWI[x] = SOI_1_HOMS[x]
LV_SOI_ACT_SWI[x] = 1
(1) ENDIF


```

### 7.2.17.5 Update ignition data

```

IF INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_1 = NC_INJ_MOD_S
THEN //stratified combustion mode
IGA_IGC_H_RNG_ACT[x] = IGA_AV_H_RNG_S[x]
TD_TMP_SYN = TD_S
ELSE
IF INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_1 = NC_INJ_MOD_HOMS
THEN //homogeneous-stratified combustion mode
IGA_IGC_H_RNG_ACT[x] = IGA_AV_H_RNG_HOMS[x]
TD_TMP_SYN = TD_S
ELSE //homogeneous combustion mode
IGA_IGC_H_RNG_ACT[x] = IGA_AV_H_RNG[x]
TD_TMP_SYN = TD
ENDIF
ENDIF
TD_IGC_ACT[x] = MIN(TD_LIM_MAX; MAX(NC_TD_LIM_MIN; TD_TMP_SYN + TD_AD[x]))

```

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## 7.2.17.6 Check engine position

//This section calculates the actual engine position of the given cylinder x and the possibility of injection mode switch or data update.

```
LV_INH_INJ_UPD_MOD_UPD[x] = 0
//Set acknowledged injector needle lift of first injection pulse to value transmitted to BSW:
```

```
LV_EGY_RNG_IV_PLS_1_ACK[x] = LV_EGY_RNG_IV_PLS_1_ACT[x]
CRK_PSN_INJ_BAS[x] = ((720° - PSN_ENG - CRK_INJ_BAS[0]) + (x*720°/ NC_CYL_NR)
                    +720°) MODULO 720°
```

```
(1) IF LC_IGN_UPD_STAT_ENA = 0 OR
```

```
    Bit x of STATE_INJ_UPD_ENA = 1
```

```
(1) THEN CRK_PSN_ENG_IGN_INJ_UPD[x] = CRK_PSN_INJ_BAS[x] -
        C_T_OFS_UPD_IGN_INJ_SYN * FAC_N
```

//**Note:** In case of  $C\_T\_OFS\_UPD\_IGN\_INJ\_SYN * FAC\_N > CRK\_PSN\_INJ\_BAS[x]$ , limit  $CRK\_PSN\_ENG\_IGN\_INJ\_UPD[x]$  to zero!

```
CRK_WIN_SEL_TMP = "NO_WIN"
```

```
CRK_WIN_SEL_PREV = CRK_WIN_SEL_IGN_INJ[x]
```

```
(2) IF CRK_PSN_INJ_BAS[x] < CRK_PSN_STAT_WIN_ST
```

```
(2) THEN CRK_WIN_SEL_TMP = "RTD_WIN"
```

```
(2) ELSE
```

```
(3) IF CRK_PSN_INJ_BAS[x] > CRK_PSN_STAT_WIN_END
```

```
(3) THEN CRK_WIN_SEL_TMP = "ADC_WIN"
```

```
(3) ELSE
```

```
(4) IF INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_1 = NC_INJ_MOD_HOM
```

```
(4) THEN
```

```
(5) IF INJ_MOD[x] = "SNGH"
```

```
(5) THEN
```

```
(6) IF LV_ADD_PULSE_ENA = 0 OR
```

```
    LV_EGY_RNG_IV_PLS_1_HOM[x] ≠ LV_EGY_RNG_IV_PLS_1_ACT[x] OR
```

```
    LC_IV_ADD_PLS_SNGH_ENA = 0 OR
```

```
    (LV_IGN_INJ_COPL_HOM_ACT[x] ≠ LV_EOI_2_DELTA_HOM_CUS
```

```
    AND LC_IGN_INJ_COPL_MOD_SWI_ENA = 1)
```

```
(6) THEN LV_INH_INJ_UPD_MOD_UPD[x] = 1
```

```
(6) ENDIF
```

```
(5) ELSE
```

```
(7) IF LV_EGY_RNG_IV_PLS_1_HOM[x] ≠ LV_EGY_RNG_IV_PLS_1_ACT[x] OR
```

```
    (LV_EGY_RNG_IV_PLS_1_HOM[x] = 0
```

```
    AND LV_EGY_RNG_IV_PLS_2_HOM[x] = 1) OR
```

```
    LC_IV_ADD_PLS_MPLH_ENA = 0 OR
```

```
    LV_INJ_DI_PLS_UPD_MPLH = 1 OR
```

```
    (LV_IGN_INJ_COPL_HOM_ACT[x] ≠ LV_EOI_2_DELTA_HOM_CUS
```

```
    AND LC_IGN_INJ_COPL_MOD_SWI_ENA = 1)
```

```
(7) THEN LV_INH_INJ_UPD_MOD_UPD[x] = 1
```

```
(7) ENDIF
```

```
(5) ENDIF
```

```
(4) ENDIF
```

```
(8) IF (INJ_MOD[x] = "HOMS" OR INJ_MOD[x] = "HOMS+PLS3") AND
```

```
    LV_EGY_RNG_IV_PLS_1_S[x] ≠ LV_EGY_RNG_IV_PLS_1_ACT[x]
```

```
(8) THEN LV_INH_INJ_UPD_MOD_UPD[x] = 1
```

```
(8) ENDIF
```

```
(9) IF INJ_MOD[x] ≠ INJ_MOD_SP[x] OR
```

```
    LV_INH_INJ_UPD_MOD_UPD[x] = 1
```


```
(9) THEN //check window for switching to INJ_MOD_SP[x]
```

```
    LV_INJ_MOD_UPD = 0
```

```
(9) ELSE //check window for update of INJ_MOD[x]
```

```
    LV_INJ_MOD_UPD = 1
```

```
(9) ENDIF
```


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```

Calculate subroutine  "check variable window" (input:  LV_INJ_MOD_UPD;
                                                output:  LV_IGN_INJ_UPD_WIN)

(10) IF  LV_IGN_INJ_UPD_WIN = 1
(10) THEN  CRK_WIN_SEL_TMP  = "ADC_WIN"
(10) ENDIF
(3) ENDIF
(2) ENDIF
CRK_WIN_SEL_IGN_INJ[x] = CRK_WIN_SEL_TMP
(11) IF  LC_IGN_UPD_STAT_ENA = 0
(11) THEN
(12) IF  CRK_WIN_SEL_TMP = "ADC_WIN"  OR
        CRK_WIN_SEL_TMP = "NO_WIN" AND CRK_WIN_SEL_PREV = "RTD_WIN"
(12) THEN  STATE_UPD_IGN[x]  = "TRIG_IT"
(12) ELSE  STATE_UPD_IGN[x]  = "NONE"
(12) ENDIF
(11) ELSE
(13) IF  INJ_MOD[x] ≠ INJ_MOD_SP[x]
(13) THEN
(14) IF  CRK_WIN_SEL_TMP = "ADC_WIN"  OR
        (CRK_WIN_SEL_TMP ≠ "RTD_WIN"
         AND CRK_PSN_INJ_BAS[x] < CRK_PSN_STAT_IGN_UPD_ST
         AND CRK_PSN_INJ_BAS[x] > CRK_PSN_STAT_IGN_UPD_END)
(14) THEN  STATE_UPD_IGN[x]  = "TRIG_IT"
(14) ELSE  STATE_UPD_IGN[x]  = "NONE"
(14) ENDIF
(13) ELSE
(15) IF  CRK_PSN_INJ_BAS[x] < CRK_PSN_STAT_IGN_UPD_ST  AND
        CRK_PSN_INJ_BAS[x] > CRK_PSN_STAT_IGN_UPD_END
(15) THEN  STATE_UPD_IGN[x]  = "TRIG_IT"
(15) ELSE  STATE_UPD_IGN[x]  = "NONE"
(15) ENDIF
(13) ENDIF
(11) ENDIF
(1) ELSE
CRK_WIN_SEL_IGN_INJ[x] = "NO_CLC"
  IF  CRK_PSN_INJ_BAS[x] < CRK_PSN_STAT_IGN_UPD_ST  AND
      CRK_PSN_INJ_BAS[x] > CRK_PSN_STAT_IGN_UPD_END
  THEN  STATE_UPD_IGN[x]  = "TRIG_IT"
  ELSE  STATE_UPD_IGN[x]  = "NONE"
  ENDIF
(1) ENDIF

```

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### 7.2.17.7 Check variable window

//This section calculates, if an injection mode switch ( $LV\_INJ\_MOD\_UPD = 0$ ) or an injection data update at no mode switch ( $LV\_INJ\_MOD\_UPD = 1$ ) is possible. Therefore, the engine position must be within the "variable window". This is indicated by  $LV\_IGN\_INJ\_UPD\_WIN = 1$ .


**Note:** This section works like a function with  $LV\_INJ\_MOD\_UPD$  as input and  $LV\_IGN\_INJ\_UPD\_WIN$  as output.

```
LV_IGN_INJ_UPD_WIN = 0
IF CRK_PSN_ENG_IGN_INJ_UPD[x] > (IGA_IGC_H_RNG_ACT[x] - CRK_INJ_BAS[0]
    + TD_IGC_ACT[x] * FAC_N)
THEN
    IF LV_INJ_MOD_UPD = 1
    THEN //calculate temporary values of previous SOI for data update
        IF LV_SOI_ACT_UPD[x] = 1
        THEN SOI_TMP_SYN_PREV = SOI_EOI_ACT_UPD[x]
        ELSE SOI_TMP_SYN_PREV = SOI_EOI_ACT_UPD[x] + TI_ACT_UPD[x] * FAC_N
        ENDIF
    ELSE //calculate temporary values of previous SOI for injection mode
        switch
        IF LV_SOI_ACT_SWI[x] = 1
        THEN SOI_TMP_SYN_PREV = SOI_EOI_ACT_SWI[x]
        ELSE SOI_TMP_SYN_PREV = SOI_EOI_ACT_SWI[x] + TI_ACT_SWI[x] * FAC_N
        ENDIF
    ENDIF
    IF CRK_PSN_ENG_IGN_INJ_UPD[x] > SOI_TMP_SYN_PREV
    THEN Calculate subroutine "Determine new ignition and injection
        values for variable window"
        IF CRK_PSN_ENG_IGN_INJ_UPD[x] > MAX(IGA_TMP_SYN - CRK_INJ_BAS[0] +
            (TD_TMP_SYN + TD_AD[x]) * FAC_N; SOI_TMP_SYN)
        THEN //switch or update to new ignition and injection data also
            possible
            LV_IGN_INJ_UPD_WIN = 1
        ENDIF
    ENDIF
ENDIF
```

### 7.2.17.8 Determine new ignition and injection values for variable window

//This section calculates the temporary values of ignition angle, dwell time and start of injection for either mode switch ( $LV\_INJ\_MOD\_UPD = 0$ ) or data update in case of no mode switch ( $LV\_INJ\_MOD\_UPD = 1$ ).

```
(1) IF LV_INJ_MOD_UPD = 1
(1) THEN //calculate temporary values for data update
(2) IF INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_1 = NC_INJ_MOD_S
(2) THEN //stratified combustion mode
IGA_TMP_SYN = IGA_AV_H_RNG_S[x]
TD_TMP_SYN = TD_S
SOI_TMP_SYN = EOI_1_S[x] + TI_1_S[x] * FAC_N
(2) ELSE
(3) IF INJ_MOD[x] BitwiseAND NC_INJ_MOD_MASK_1 = NC_INJ_MOD_HOMS
(3) THEN //homogeneous-stratified combustion mode
IGA_TMP_SYN = IGA_AV_H_RNG_HOMS[x]
TD_TMP_SYN = TD_S
(4) IF INJ_MOD[x] = "HOMS_SNG"
(4) THEN SOI_TMP_SYN = SOI_1_HOMS[x]
(4) ELSE SOI_TMP_SYN = EOI_2_HOMS[x] + TI_2_S[x] * FAC_N
```

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```

(4) ENDIF
(3) ELSE //homogeneous combustion mode
IGA_TMP_SYN = IGA_AV_H_RNG[x]
TD_TMP_SYN = TD
(5) IF INJ_MOD[x] = "SNGH"
(5) THEN
(6) IF LC_IV_ADD_PLS_SNGH_ENA = 1
(6) THEN SOI_TMP_SYN = MAX(C_SOI_MIN_UPD_PLS_SNGH; EOI_LIM_HOM)
(6) ELSE SOI_TMP_SYN = SOI_1_HOM[x]
(6) ENDIF
(5) ELSE
SOI_TMP_SYN = EOI_2_HOM[x] + TI_2_HOM[x] * FAC_N
(5) ENDIF
(3) ENDIF
(2) ENDIF
(1) ELSE //calculate temporary values for mode switch
(7) IF INJ_MOD_SP[x] BitwiseAND NC_INJ_MOD_MASK_1 = NC_INJ_MOD_S
(7) THEN //stratified combustion mode
IGA_TMP_SYN = IGA_AV_H_RNG_S[x]
TD_TMP_SYN = TD_S
SOI_TMP_SYN = EOI_1_S[x] + TI_1_S[x] * FAC_N
(7) ELSE
(8) IF INJ_MOD_SP[x] BitwiseAND NC_INJ_MOD_MASK_1 = NC_INJ_MOD_HOMS
(8) THEN //homogeneous-stratified combustion mode
IGA_TMP_SYN = IGA_AV_H_RNG_HOMS[x]
TD_TMP_SYN = TD_S
SOI_TMP_SYN = SOI_1_HOMS[x]
(8) ELSE //homogeneous combustion mode
IGA_TMP_SYN = IGA_AV_H_RNG[x]
TD_TMP_SYN = TD
SOI_TMP_SYN = SOI_1_HOM[x]
(8) ENDIF
(7) ENDIF
(1) ENDIF


```

## 7.2.18 ACTION\_INJR\_IgnUpdate

```

IGA_IGC_H_RNG_ACT[Cyl] = Iga_Igc_H_Rng
STATE_UPD_IGN[Cyl] = "TRIG_EXT"

```

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## 7.3 Transfer to basic software for injection (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_CHA_IV_MES_PBK [NC_PBK_IV_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Factor to correct the measured injector charge due to end of line trimming					
FAC_V_IV_MES_PBK [NC_PBK_IV_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Factor to correct the measured injector voltage due to end of line trimming					

### Input data:

C_FAC_CHA_IV_MES_PBK_0_0	C_FAC_CHA_IV_MES_PBK_0_1	C_FAC_CHA_IV_MES_PBK_0_CPL	C_FAC_CHA_IV_MES_PBK_1_0
C_FAC_CHA_IV_MES_PBK_1_1	C_FAC_CHA_IV_MES_PBK_1_CPL	C_FAC_V_IV_MES_PBK_0_0	C_FAC_V_IV_MES_PBK_0_1
C_FAC_V_IV_MES_PBK_0_CPL	C_FAC_V_IV_MES_PBK_1_0	C_FAC_V_IV_MES_PBK_1_1	C_FAC_V_IV_MES_PBK_1_CPL
NC_PBK_IV_NR {p. 628}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_CHA_IV_MES_PBK_MAX_PLAUS	-	0... FFFFH	0... 1.99996	30.5e-6	-
Maximum value for injector charge correction plausibility check due to end of line trimming					
C_FAC_CHA_IV_MES_PBK_MIN_PLAUS	-	0... FFFFH	0... 1.99996	30.5e-6	-
Minimum value for injector charge correction plausibility check due to end of line trimming					
C_FAC_V_IV_MES_PBK_MAX_PLAUS	-	0... FFFFH	0... 1.99996	30.5e-6	-
Maximum value for injector voltage correction plausibility check due to end of line trimming					
C_FAC_V_IV_MES_PBK_MIN_PLAUS	-	0... FFFFH	0... 1.99996	30.5e-6	-
Minimum value for injector voltage correction plausibility check due to end of line trimming					
LC_FAC_IV_MES_PBK_ENA	-	0... 1H	0 ...1	1	-
Switch to enable the use of ECU end of line trimming values for injector voltage and charge measurement					

### FUNCTION DESCRIPTION:

This function reads the ECU end of line trimming values for piezo injector energy measurement. A check against the complementary values is done as well as a plausibility check.

### General information:

The piezo injector energy measurement consists of a voltage measurement and a charge measurement. Both kinds of measurement have to be calibrated at the end of production line (EOL trimming) to improve measurement accuracy. The results of the EOL trimming are one correction factor for voltage measurement and one correction factor for charge measurement for each injection driver ATIC.

### Signal flow diagram:

-

**Description:**

If the functionality is activated by LC, each values are checked against their complementary values which are also stored within the ECU at end of produciton line. After that, a plausibility check is done by using an upper and a lower threshold. If the complementary check or the plausibility check fails or if the functionality is deactivated by LC, the trimming factors are set to 1.

**Application conditions**

**Initialisation:** -  
**Recurrence:** *only once at reset*  
**Activation:** *every engine state*  
**Deactivation:** -

**Formula section:**

**(1) IF** LC\_FAC\_IV\_MES\_PBK\_ENA = 1  
**(1) THEN**

Injector voltage correction of first power bank:

Check the ECU end of line trimming values against their binary complement and select a valid value or set the correction factor to one in case of invalid trimming values.

**(2) IF** (C\_FAC\_V\_IV\_MES\_PBK\_0\_0 **BitwiseXOR** C\_FAC\_V\_IV\_MES\_PBK\_0\_CPL = FFFFH)

**(2) THEN**

FAC\_V\_IV\_MES\_PBK[0] = C\_FAC\_V\_IV\_MES\_PBK\_0\_0

**(2) ELSE**

**(3) IF** (C\_FAC\_V\_IV\_MES\_PBK\_0\_1 **BitwiseXOR** C\_FAC\_V\_IV\_MES\_PBK\_0\_CPL = FFFFH)

**(3) THEN**

FAC\_V\_IV\_MES\_PBK[0] = C\_FAC\_V\_IV\_MES\_PBK\_0\_1

**(3) ELSE**

FAC\_V\_IV\_MES\_PBK[0] = 1

**(3) ENDIF**

**(2) ENDIF**

Check the calculated correction factor for plausibility

**(4) IF** (FAC\_V\_IV\_MES\_PBK[0] > C\_FAC\_V\_IV\_MES\_PBK\_MAX\_PLAUS **OR** (FAC\_V\_IV\_MES\_PBK[0] < C\_FAC\_V\_IV\_MES\_PBK\_MIN\_PLAUS)

**(4) THEN**

FAC\_V\_IV\_MES\_PBK[0] = 1

**(4) ENDIF**

Injector charge correction of first power bank:


Check the ECU end of line trimming values against their binary complement and select a valid value or set the correction factor to one in case of invalid trimming values.

**(5) IF** (C\_FAC\_CHA\_IV\_MES\_PBK\_0\_0 **BitwiseXOR** C\_FAC\_CHA\_IV\_MES\_PBK\_0\_CPL = FFFFH)

**(5) THEN**

FAC\_CHA\_IV\_MES\_PBK[0] = C\_FAC\_CHA\_IV\_MES\_PBK\_0\_0

**(5) ELSE**

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```

(6) IF (C_FAC_CHA_IV_MES_PBK_0_1 BitwiseXOR
      C_FAC_CHA_IV_MES_PBK_0_CPL = FFFFH)
(6) THEN
      FAC_CHA_IV_MES_PBK[0] = C_FAC_CHA_IV_MES_PBK_0_1
(6) ELSE
      FAC_CHA_IV_MES_PBK[0] = 1
(6) ENDIF
(5) ENDIF

```

Check the calculated correction factor for plausibility

```

(7) IF (FAC_CHA_IV_MES_PBK[0] > C_FAC_CHA_IV_MES_PBK_MAX_PLAUS OR
      (FAC_CHA_IV_MES_PBK[0] < C_FAC_CHA_IV_MES_PBK_MIN_PLAUS)
(7) THEN
      FAC_CHA_IV_MES_PBK[0] = 1
(7) ENDIF

```

Injector voltage correction of second power bank:

Check the ECU end of line trimming values against their binary complement and select a valid value or set the correction factor to one in case of invalid trimming values.

```

(8) IF (C_FAC_V_IV_MES_PBK_1_0 BitwiseXOR C_FAC_V_IV_MES_PBK_1_CPL
      = FFFFH)
(8) THEN
      FAC_V_IV_MES_PBK[1] = C_FAC_V_IV_MES_PBK_1_0
(8) ELSE
(9) IF (C_FAC_V_IV_MES_PBK_1_1 BitwiseXOR
      C_FAC_V_IV_MES_PBK_1_CPL = FFFFH)
(9) THEN
      FAC_V_IV_MES_PBK[1] = C_FAC_V_IV_MES_PBK_1_1
(9) ELSE
      FAC_V_IV_MES_PBK[1] = 1
(9) ENDIF
(8) ENDIF

```

Check the calculated correction factor for plausibility

```

(10) IF (FAC_V_IV_MES_PBK[1] > C_FAC_V_IV_MES_PBK_MAX_PLAUS OR
      (FAC_V_IV_MES_PBK[1] < C_FAC_V_IV_MES_PBK_MIN_PLAUS)
(10) THEN
      FAC_V_IV_MES_PBK[1] = 1
(10) ENDIF

```


Injector charge correction of second power bank:

Check the ECU end of line trimming values against their binary complement and select a valid value or set the correction factor to one in case of invalid trimming values.

```

(11) IF (C_FAC_CHA_IV_MES_PBK_1_0 BitwiseXOR
      C_FAC_CHA_IV_MES_PBK_1_CPL = FFFFH)
(11) THEN
      FAC_CHA_IV_MES_PBK[1] = C_FAC_CHA_IV_MES_PBK_1_0
(11) ELSE
(12) IF (C_FAC_CHA_IV_MES_PBK_1_1 BitwiseXOR
      C_FAC_CHA_IV_MES_PBK_1_CPL = FFFFH)
(12) THEN
      FAC_CHA_IV_MES_PBK[1] = C_FAC_CHA_IV_MES_PBK_1_1

```

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**(12) ELSE**

FAC\_CHA\_IV\_MES\_PBK[1] = 1

**(12) ENDIF**

**(11) ENDIF**

Check the calculated correction factor for plausibility

**(13) IF** (FAC\_CHA\_IV\_MES\_PBK[1] > C\_FAC\_CHA\_IV\_MES\_PBK\_MAX\_PLAUS **OR**  
(FAC\_CHA\_IV\_MES\_PBK[1] < C\_FAC\_CHA\_IV\_MES\_PBK\_MIN\_PLAUS)

**(13) THEN**

FAC\_CHA\_IV\_MES\_PBK[1] = 1

**(13) ENDIF**

**(1) ELSE**


**(1) FOR** i = 0 **TO** NC\_PBK\_IV\_NR - 1

FAC\_V\_IV\_MES\_PBK[i] = 1

FAC\_CHA\_IV\_MES\_PBK[i] = 1

**(1) ENDFOR**

**(1) ENDIF**

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## 7.4 Restart function

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_ST_REST	O/V	0... FFH	0... 1.9921875	0.0078125	-
Restart factor for the correction of mass fuel flow at start					

### Input data:

LV_REST {p. 1766}	LV_STALL {p. 1766}	LV_T_REL_CAN_REG {p. 1567}	T_AST_REST {p. 1766}
T_ES_2 {p. 1444}	TCO {p. 1100}	TCO_STOP {p. 1100}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_REST	-	0... FFH	0... 0.99609307	0.00390625	-
LDP_T_AST_REST	8	0... FFFFH	0... 6553.5	0.1	s
LDP_TCO_STOP_FAC_REST	8	0... FEH	0... 142.5	0.75	°C
Considering coolant stop temperature and after start time for re start calculation					
IP_FAC_STALL	-	0... FFH	0... 0.99609307	0.00390625	-
LDPM_TCO_FAC_STALL	8	0... FEH	0... 142.5	0.75	°C
Special cold start reduction factor in case of re start after engine stall out					
IP_FAC_STND_REST	-	0... FFH	0... 0.99609307	0.00390625	-
LDPM_TCO_TI_ST_REST	8	0... FEH	0... 142.5	0.75	°C
Cold start reduction factor in case of re start with no engine stop time T_ES available					
IP_REST	-	0... FFH	0... 0.99609307	0.00390625	-
LDP_T_ES_2_REST	10	0... FFFFH	0... 1092.25	0.01666667	min
Considering the shut off time for re start calculation					

### 7.4.1 FMSP\_M7003

#### FUNCTION DESCRIPTION:

##### General information:

In order to improve restarts, a correction factor of mass fuel flow during preinjection and start injection is calculated. This factor is multiplicative and decreases the mass fuel flow. In order to prevent, that no calculation of T\_ES was done, the T\_ES calculation task is called.

#### Application Condition

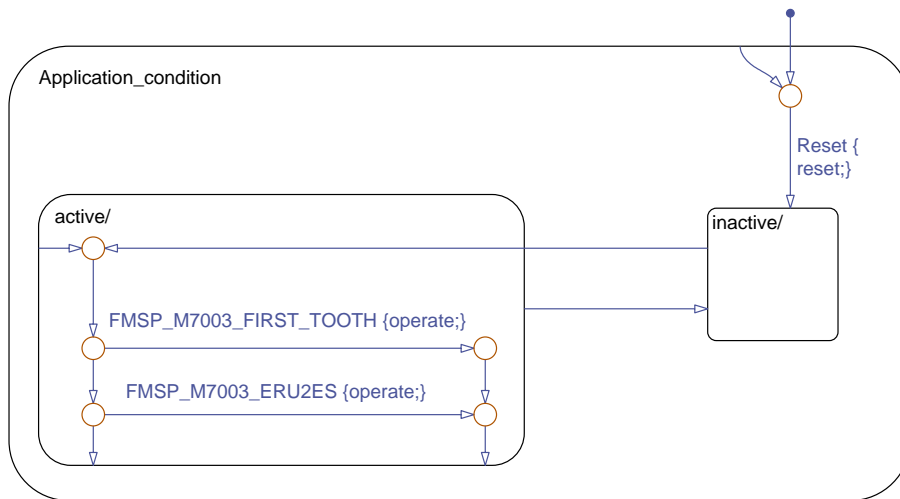



Figure 7.4.1: FMSP\_M7003/APP\_CDN/Chart

**Function Description**

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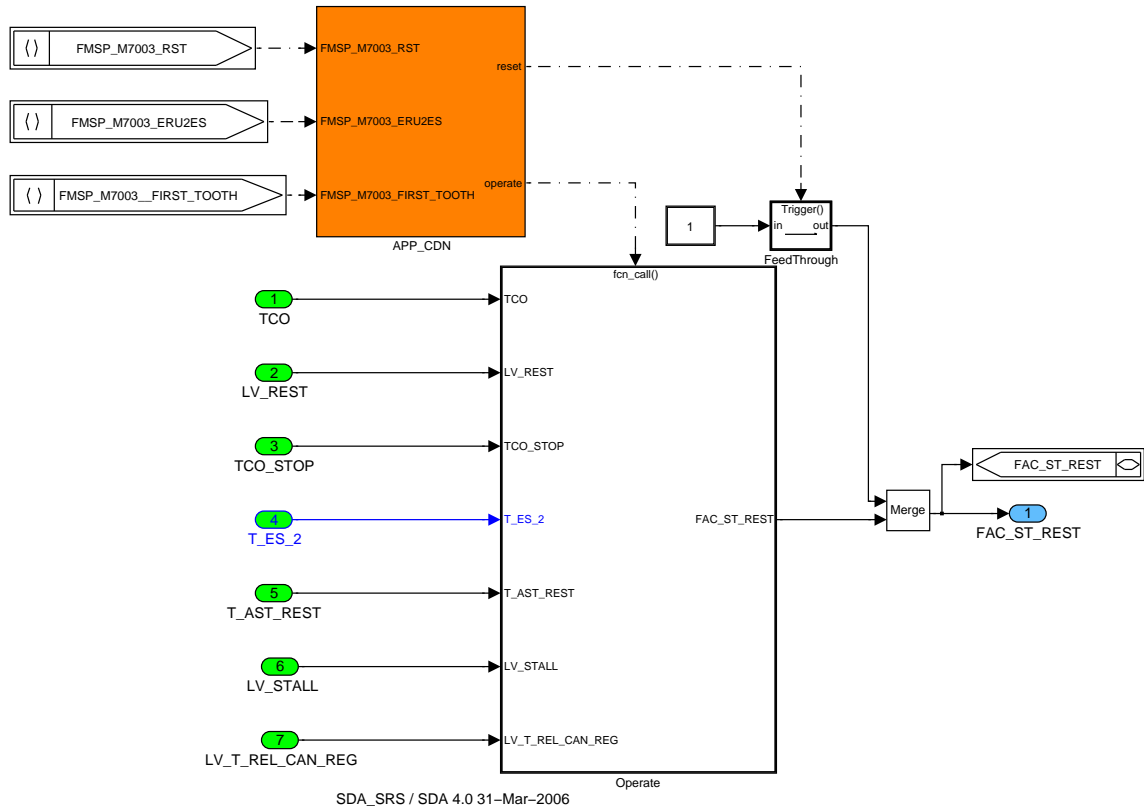


Figure 7.4.2: FMSM\_M7003

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### 7.4.1.1 SUBFUNCTION: Operate

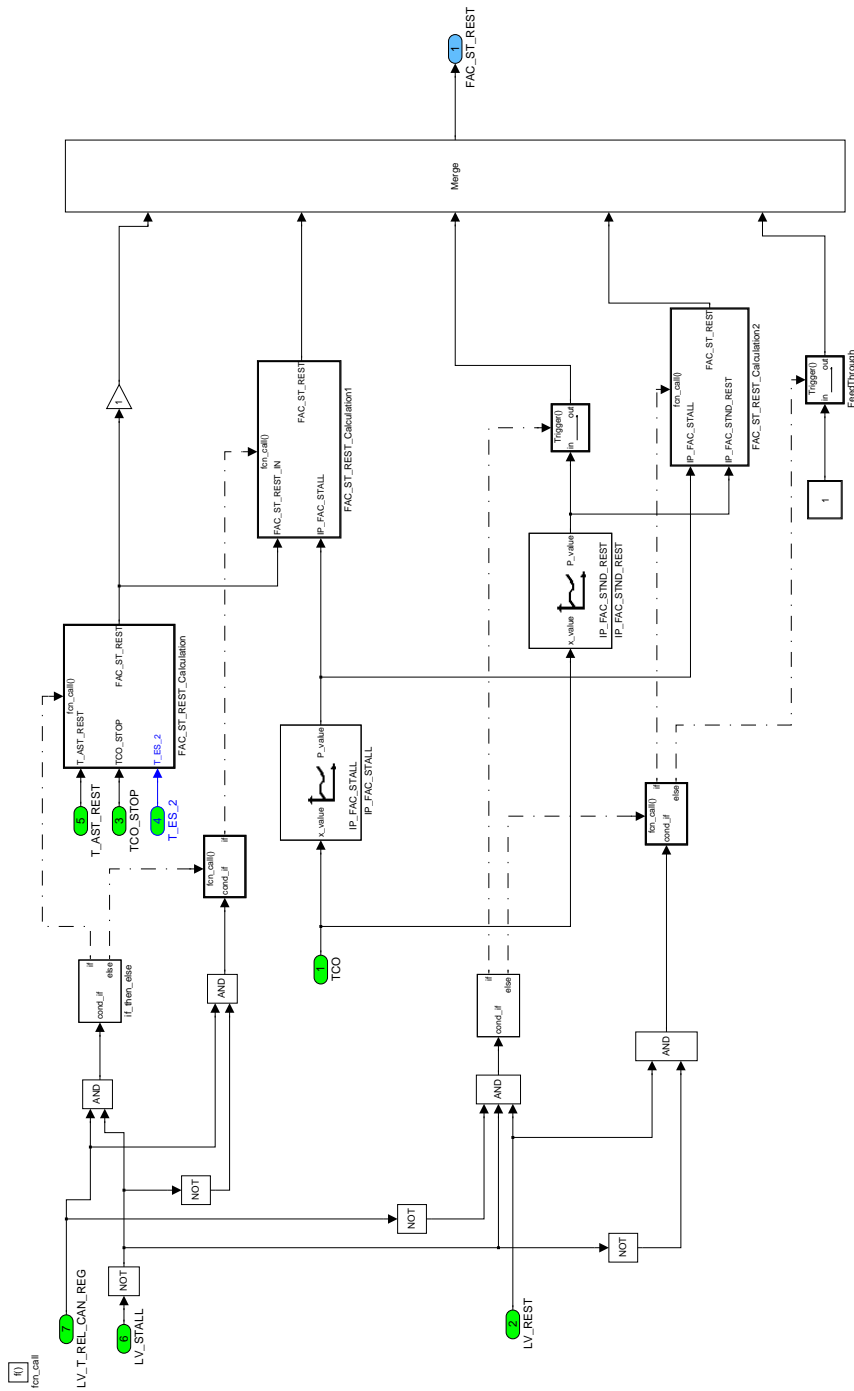


Figure 7.4.3: FMSP\_M7003/Operate

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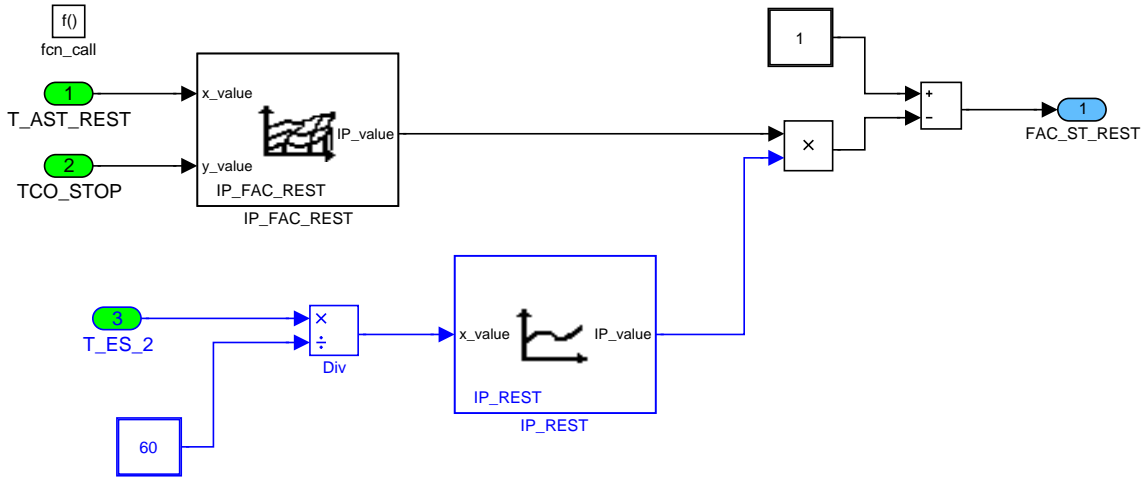


Figure 7.4.4: FMSP\_M7003/Operate/FAC\_ST\_REST\_Calculation

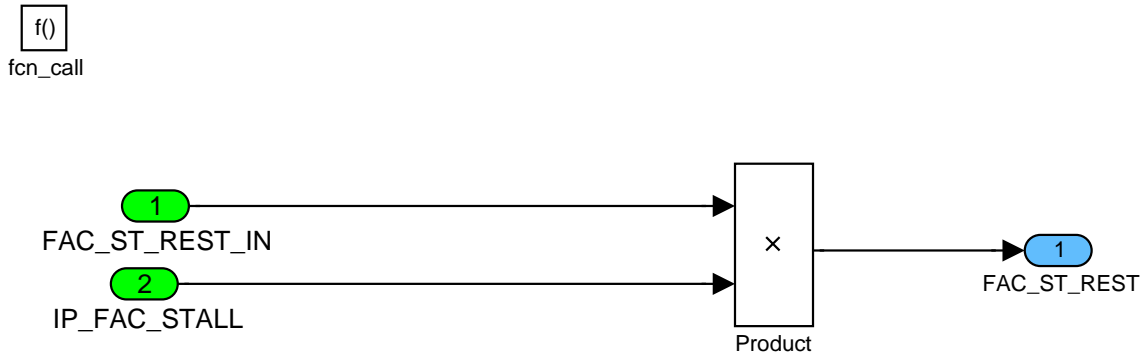


Figure 7.4.5: FMSP\_M7003/Operate/FAC\_ST\_REST\_Calculation1

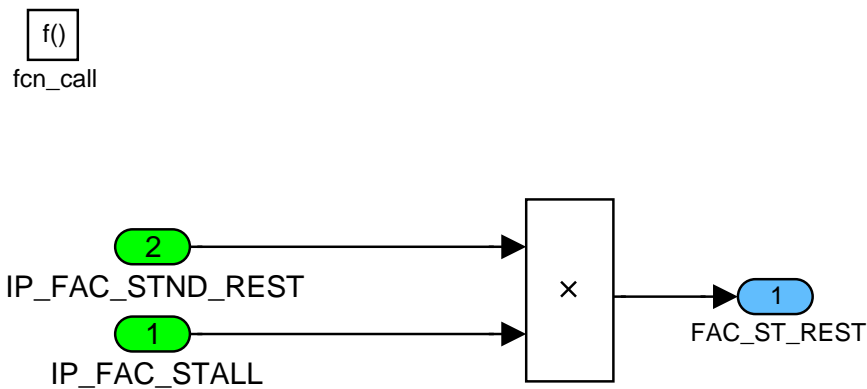


Figure 7.4.6: FMSP\_M7003/Operate/FAC\_ST\_REST\_Calculation2

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## 7.5 Ambient pressure correction at start

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_ST_AMP	O/V	0... FFH	0... 1.9922	0.0078	-
Injection correction at start upon AMP					

### Input data:

AMP {p. 982}	LV_ST_END {p. 1720}		
--------------	---------------------	--	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_ST_AMP	-	0... FFH	0... 1.9922	0.0078	-
LDP_AMP_IP_FAC_ST_AMP	6	0... FFFFH	0... 5434	0.083	hPa
Cranking injection time correction upon ambient pressure					

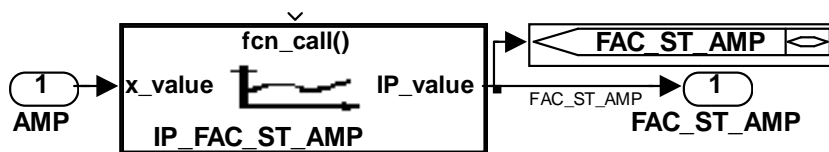
### Overview:

The purpose of this strategy is to correct the injection time depending on the ambient pressure before the MAF (manifold air pressure) variable is available.

### Application conditions

<b>Activation:</b>	$LV\_ST\_END = 0$
<b>Deactivation:</b>	-
<b>Initialization:</b>	-
<b>Recurrence:</b>	10 ms

### FUNCTION DESCRIPTION:



## 7.6 Cold post start correction

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TI_CAST_FUP	V	0... FFH	0... 1.9921875	0.0078125	-
Factor for weighting the influence of fuel pressure on cold post start injection					
LV_AST_END	O/V	0... 1H	0 ...1	1	-
logical bit for after start end					
TI_CAST	O/V	0... FFFFH	0... 3.99993896	610.352e3	-
cold post start injection time correction					
TI_CAST_H_PRS	V	0... FFFFH	0... 3.99993896	610.352e3	-
cold start fuel mass flow at high fuel pressure					
TI_CAST_LIH_L_PRS	V	0... FFFFH	0... 3.99993896	610.352e3	-
cold start fuel mass flow at limb home low fuel pressure					

### Input data:

CYC_CAST {p. 1766}	FAC_ST_REST {p. 2094}	FUP {p. 1283}	LV_AST {p. 1766}
LV_CLC_2SEG {p. 1825}	LV_CLC_2SEG_ENA {p. 1825}	LV_ST_END {p. 1720}	MAF_HB {p. 805}
N_32 {p. 1525}	TCO {p. 1100}	TIA {p. 1226}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FAC_TI_CAST_FUP	-	0... FFH	0... 0.99609375	0.00390625	-
Low pass filter correlation constant for the weighting factor of fuel pressure					
IP_FAC_REST_TI_CAST_H_PRS	-	0... FFH	0... 0.99609375	0.00390625	-
LDPM_CYC_CAST_1	8	0... FFFFH	0... 65535	1	-
LDPM_FAC_ST_REST	6	0... FFH	0... 1.9921875	0.0078125	-
Correction of TI_CAST at restart high fuel pressure					
IP_FAC_REST_TI_CAST_LIH_L_PRS	-	0... FFH	0... 0.99609375	0.00390625	-
LDPM_CYC_CAST_1	8	0... FFFFH	0... 65535	1	-
LDPM_FAC_ST_REST	6	0... FFH	0... 1.9921875	0.0078125	-
Correction of TI_CAST at restart low fuel pressure					
IP_FAC_TI_CAST_FUP	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_FUP_FAC_TI_CAST	6	0... FFFFH	0... 347776	5.3067216	hPa
Factor for weighting the influence of fuel pressure on cold post start injection					
IP_FAC_TI_CAST_H_PRS	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_MAF_6	8	0... FFH	0... 1389	5.44705882	mg/stk
LDPM_N_3_9	8	0... FFH	0... 8160	32	rpm
Cold after start injection correction at high fuel pressure (engine operating point)					
IP_FAC_TI_CAST_LIH_L_PRS	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_MAF_6	8	0... FFH	0... 1389	5.44705882	mg/stk
LDPM_N_3_9	8	0... FFH	0... 8160	32	rpm
Cold after start injection correction at limp home low fuel pressure (engine operating point)					
IP_TI_CAST_H_PRS	-	0... FFH	0... 3.984375	0.015625	-
LDPM_TIA_IP_TI_CAST	2	0... FEH	0... 142.5	0.75	°C

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_TCO__MFF_DEAC_CST	10	0... FEH	0... 142.5	0.75	°C
Initialization value of post start enrichment factor at high fuel pressure					
IP_TI_CAST_LIH_L_PRS	-	0... FFH	0... 3.984375	0.015625	-
LDPM_TIA_IP_TI_CAST	2	0... FEH	0... 142.5	0.75	°C
LDPM_TCO__MFF_DEAC_CST	10	0... FEH	0... 142.5	0.75	°C
Initialization value of post start enrichment factor at low fuel pressure					
IP_TI_DEAC_CAST_H_PRS	-	0... FFH	0... 0.99609307	0.00390625	-
LDPM_CYC_CAST_2	16	0... FFFFH	0... 65535	1	-
LDPM_TCO__MFF_DEAC_CST	10	0... FEH	0... 142.5	0.75	°C
Deactivation factor of post start enrichment at high fuel pressure					
IP_TI_DEAC_CAST_LIH_L_PRS	-	0... FFH	0... 0.99609307	0.00390625	-
LDPM_CYC_CAST_2	16	0... FFFFH	0... 65535	1	-
LDPM_TCO__MFF_DEAC_CST	10	0... FEH	0... 142.5	0.75	°C
Deactivation factor of post start enrichment at low fuel pressure					

## 7.6.1 FMSP\_M7009

### FUNCTION DESCRIPTION:

#### General information:

This enrichment takes place just after start in order to ensure the first combustions in cold conditions.

CYC\_CAST is first the number of cycles (segments) at start. At the transition to after start, the counter is reset and represents then the number of afterstart cycles during LV\_AST=1.

Depending on fuel pressure FUP the functionality weighs up 2 cold post start injection times. Both injection times are calculated continuously and depending on a factor based on fuel pressure a interpolation between high and low pressure path estimates the executed after start injection TI\_CAST.

#### Application conditions:

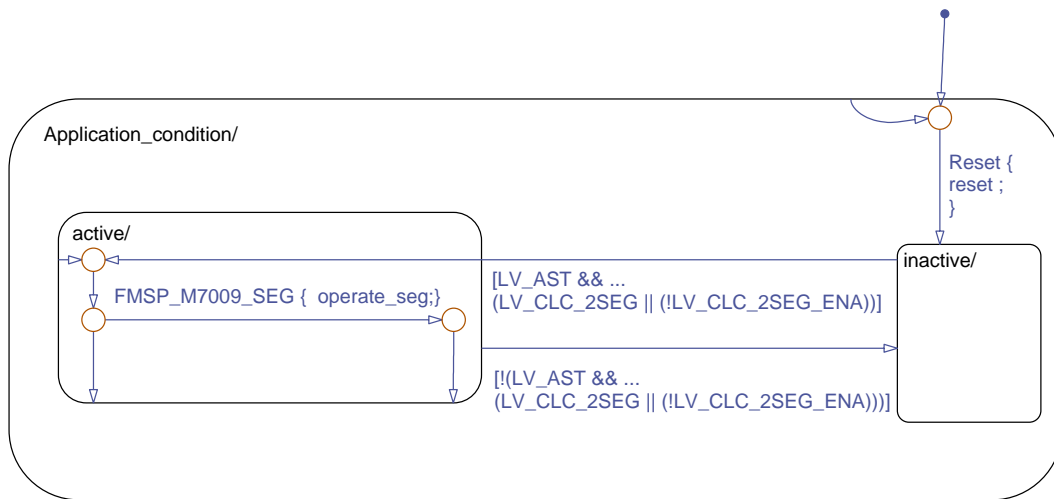
Initialisation: all outputs = 0 at ECU reset

Recurrence: segmentsynchronous

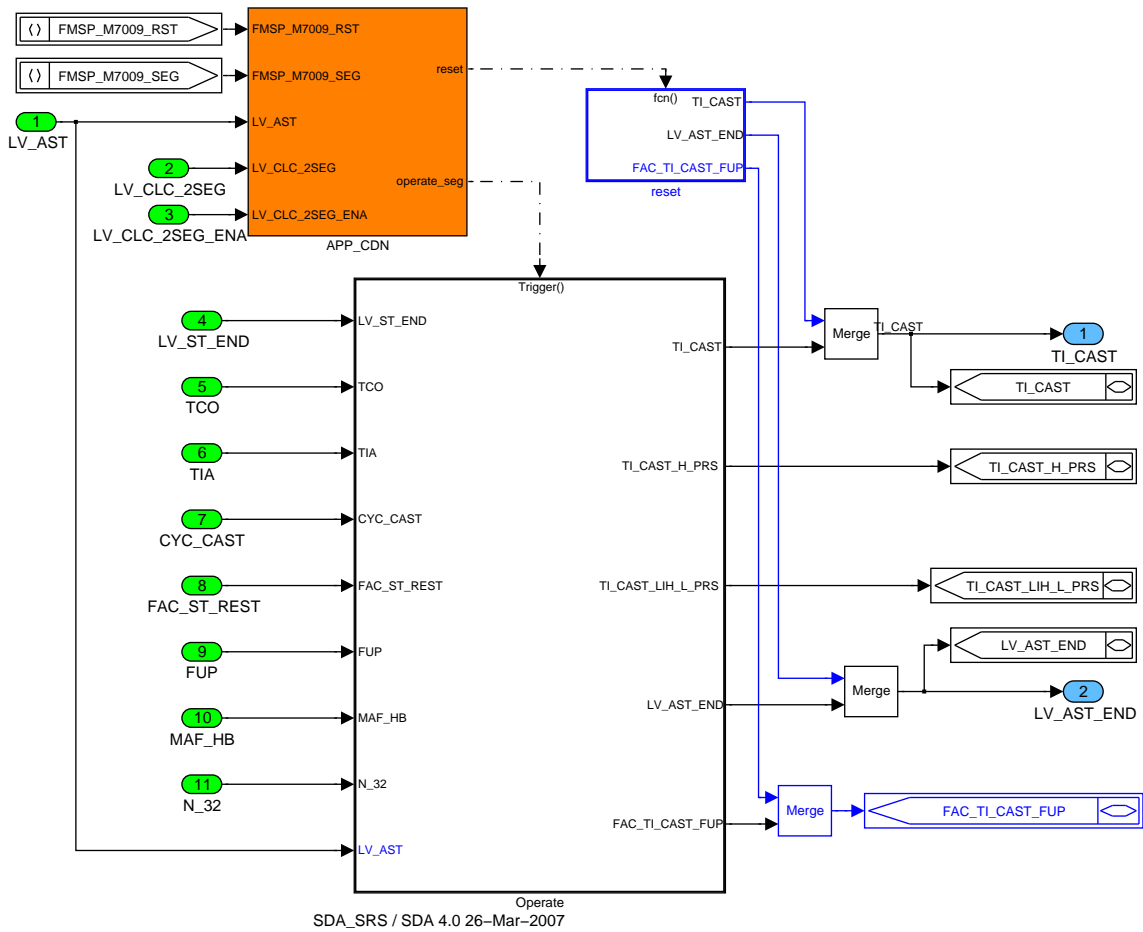
Activation: Post start auxiliary function (LV\_AST) activated (exit from LV\_ST to LV\_IS or LV\_PL) and (LV\_CLC\_2SEG = 1 or LV\_CLC\_2SEG\_ENA = 0)

Deactivation: not Activation

### Application Condition



### Function Description



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Figure 7.6.1: FMSP\_M7009

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 2102 of 8404</b>	
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### 7.6.1.1 SUBFUNCTION: Operate

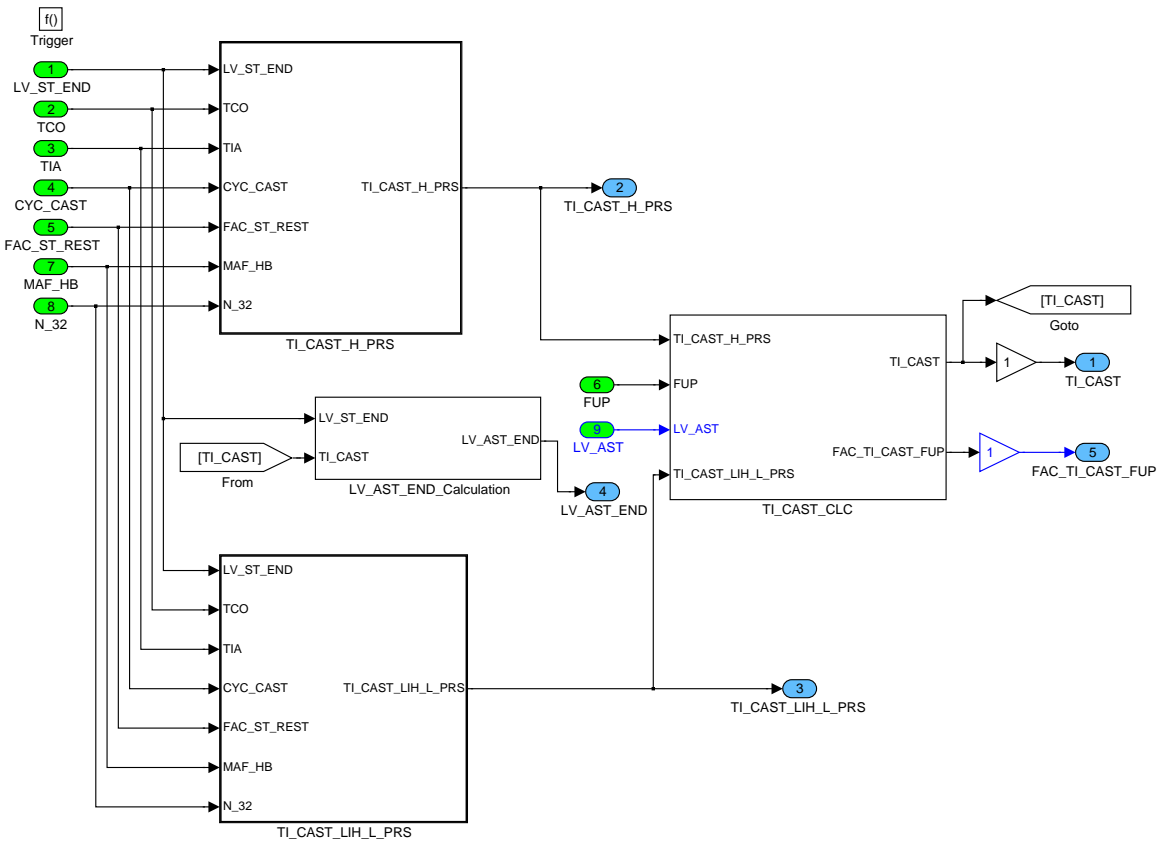


Figure 7.6.2: FMSP\_M7009/Operate

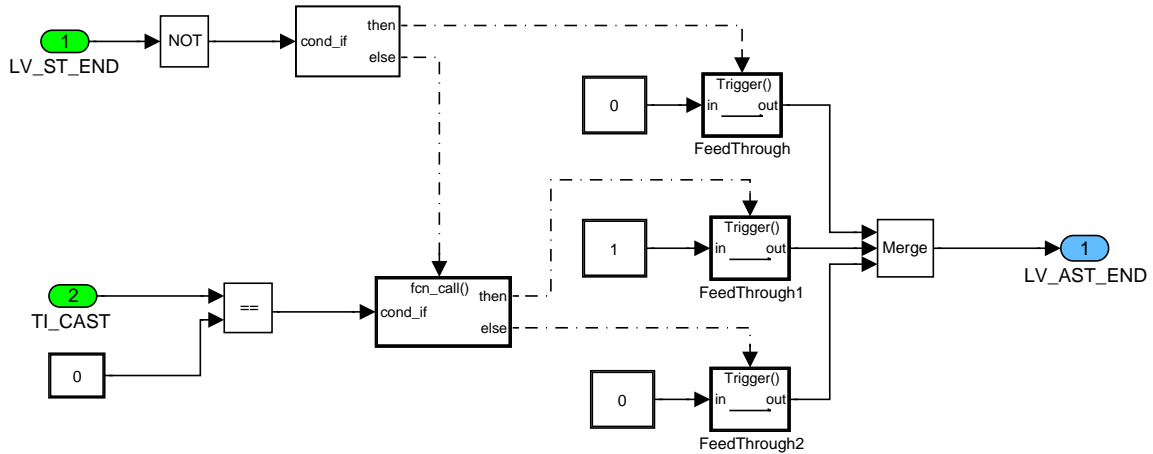


Figure 7.6.3: FMSP\_M7009/Operate/LV\_AST\_END\_Calculation

### TI\_CAST\_SWI

There are two input values TI\_CAST\_H\_PRS and TI\_CAST\_LIH\_L\_PRS. Each input value belongs to the fuel pressure. Moreover FUP indicates which path is more weighted. It is ensured that a continuous

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crossfading in the range TI\_CAST\_H\_PRS and TI\_CAST\_LIH\_L\_PRS is active in the after start time interval. The algorithms are calculated until LV\_AST drops.

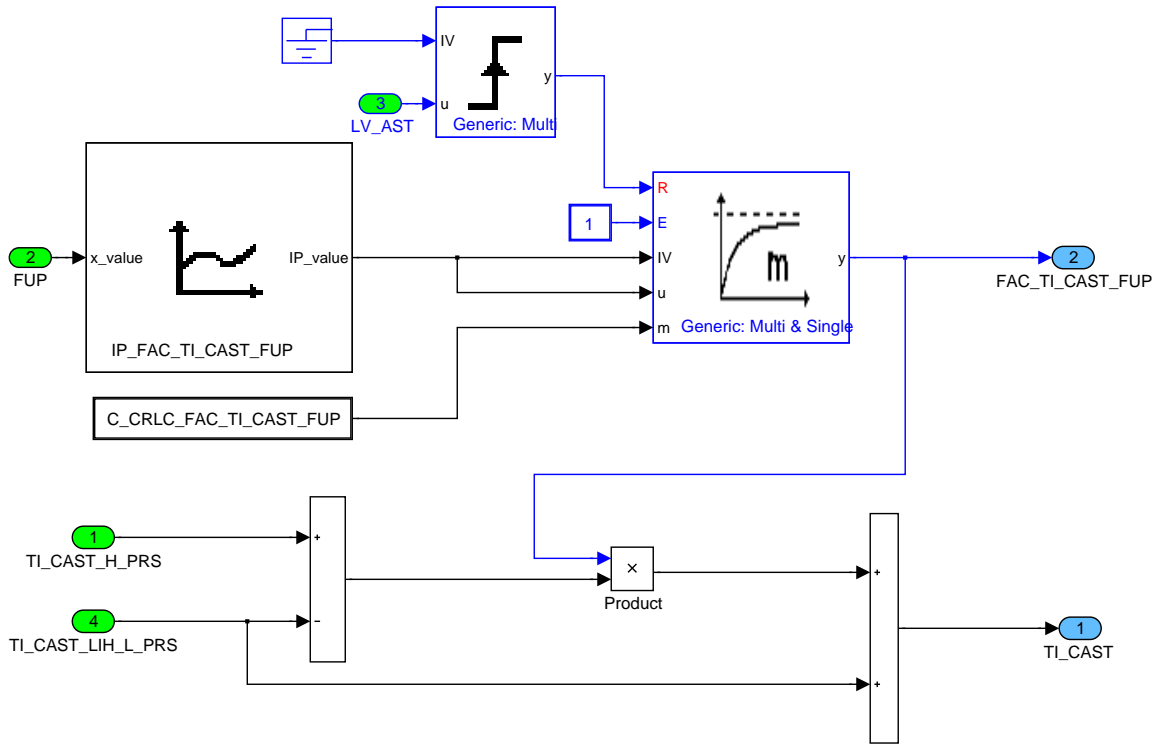



Figure 7.6.4: FMSP\_M7009/Operate/TI\_CAST\_CLC

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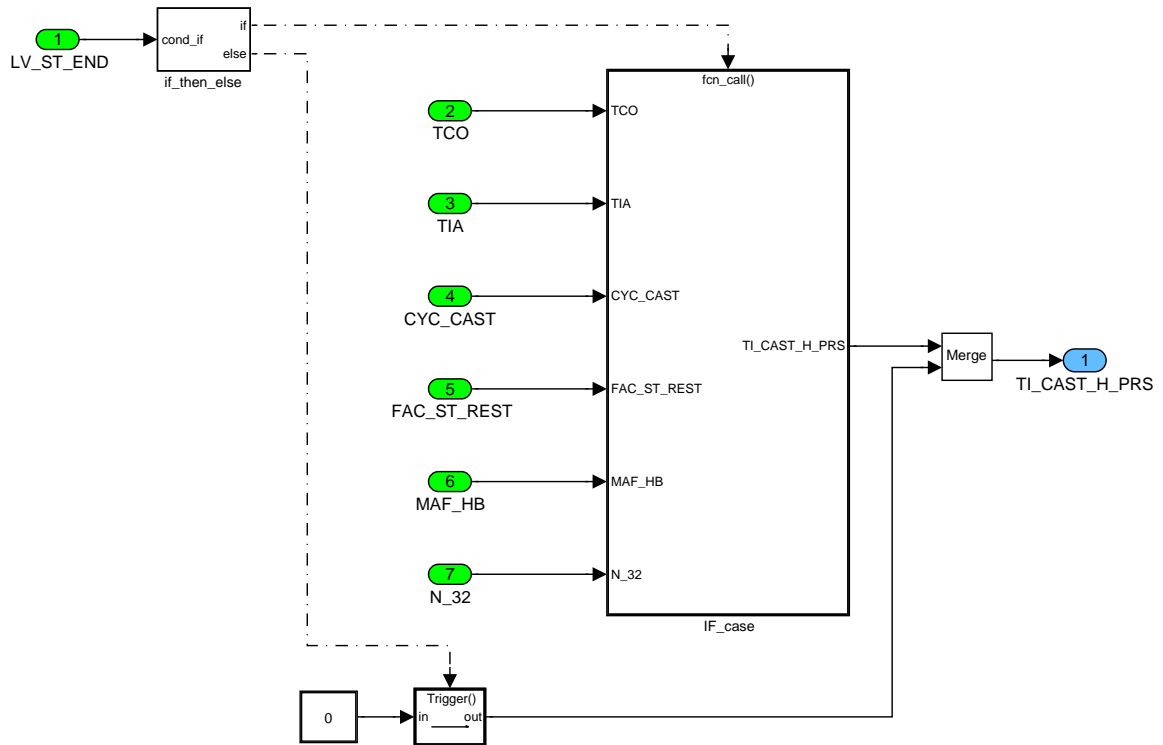


Figure 7.6.5: FMSP\_M7009/Operate/TI\_CAST\_H\_PRS

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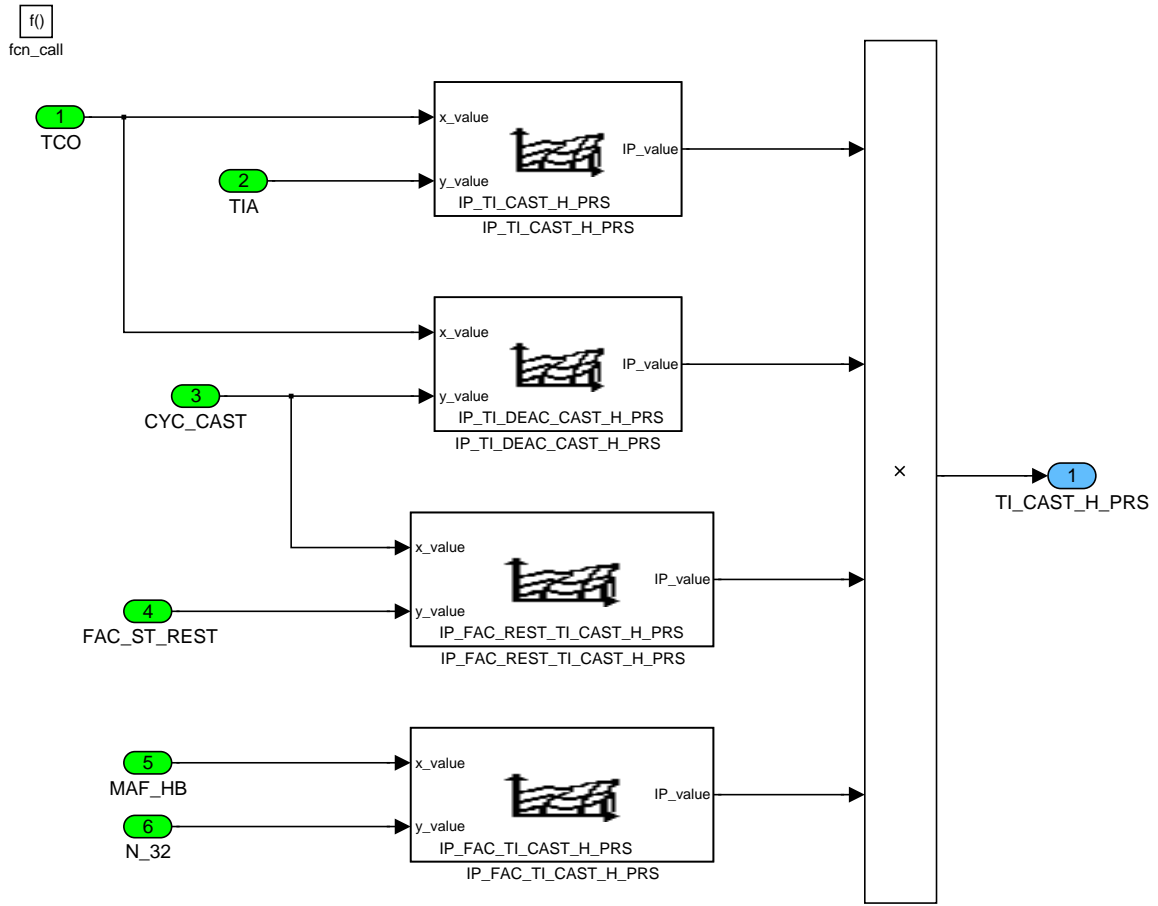


Figure 7.6.6: FMSP\_M7009/Operate/TI\_CAST\_H\_PRS/IF\_case

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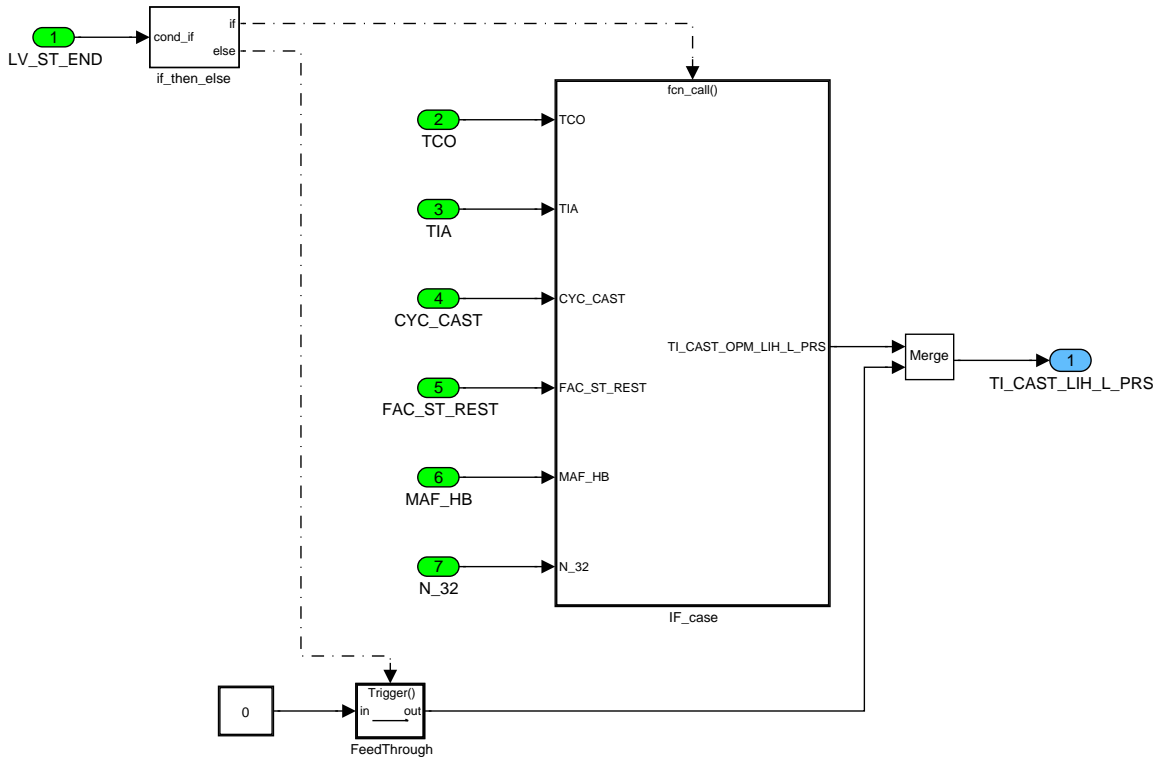


Figure 7.6.7: FMSP\_M7009/Operate/TI\_CAST\_LIH\_L\_PRS

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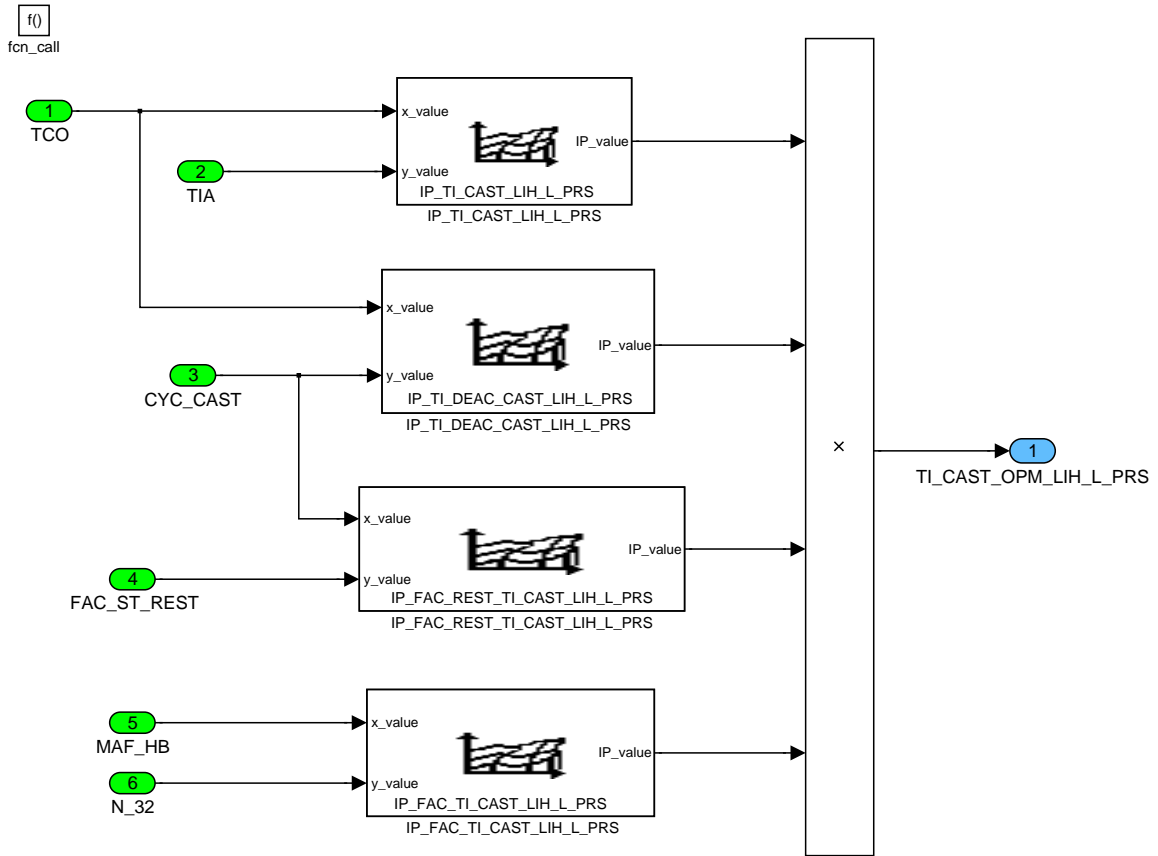


Figure 7.6.8: FMSP\_M7009/Operate/TI\_CAST\_LIH\_L\_PRS/IF\_case

### 7.6.1.2 SUBFUNCTION: reset

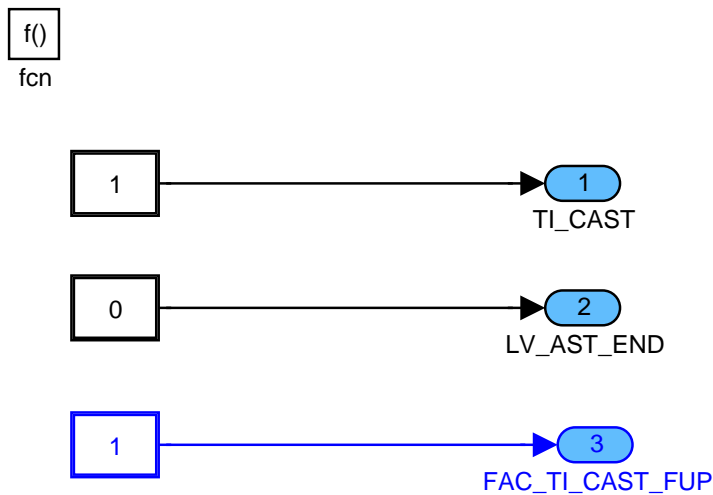


Figure 7.6.9: FMSP\_M7009/reset

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## 7.7 Warm up correction

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TI_WUP_FUP	V	0... FFH	0... 1.9921875	0.0078125	-
Factor for weighting the influence of fuel pressure on warm up injection					
TI_TEMP	V	0... FFFFH	0... 3.99993896	610.352e3	-
Warm up enrichment part, intermediate, permanent part					
TI_WUP	O/V	0... FFFFH	0... 3.99993896	610.352e3	-
Warm up enrichment, total value					
TI_WUP_1	V	0... FFFFH	0... 3.99993896	610.352e3	-
Warm up enrichment part after operation mode manager, intermediate value					
TI_WUP_1_ADD	O/V	0... FFFFH	0... 3.99993896	610.352e3	-
Warm up enrichment, additive part of intermediate value					
TI_WUP_1_ADD_H_PRS	V	0... FFFFH	0... 3.99993896	610.352e3	-
Warm up enrichment, additive part of intermediate value at high fuel pressure					
TI_WUP_1_ADD_LIH_L_PRS	V	0... FFFFH	0... 3.99993896	610.352e3	-
Warm up enrichment, additive part of intermediate value at low fuel pressure					
TI_WUP_1_H_PRS	V	0... FFFFH	0... 3.99993896	610.352e3	-
Warm up enrichment part at high fuel pressure					
TI_WUP_1_LIH_L_PRS	V	0... FFFFH	0... 3.99993896	610.352e3	-
Warm up enrichment part at low fuel pressure					

### Input data:

AMP {p. 982}	FUP {p. 1283}	INJ_MOD_HOM_REQ {p. 8241}	LV_CLC_2SEG {p. 1825}
LV_CLC_2SEG_ENA {p. 1825}	LV_ES {p. 1720}	LV_WUP {p. 1775}	MAF_HB {p. 805}
MAP {p. 8278}	N_32 {p. 1525}	TCO {p. 1100}	TCO_ST {p. 1100}
TIA {p. 1226}	TOIL {p. 8204}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FAC_TI_WUP_FUP	-	0... FFH	0... 0.99609375	0.00390625	-
Low pass filter correlation constant for the weighting factor of fuel pressure					
IP_FAC_TI_TCO_WUP_H_PRS	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_TCO__TI_WUP_H_PRS	8	0... FEH	0... 142.5	0.75	°C
warm up basic factor at high fuel pressure					
IP_FAC_TI_TCO_WUP_LIH_L_PRS	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_TCO__TI_WUP_LIH_L_PRS	8	0... FEH	0... 142.5	0.75	°C
warm up basic factor at low fuel pressure					
IP_FAC_TI_VO_WUP	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_MAP_DIF__FAC_TI_VO_WUP	8	0... FFFFH	0... 5434	0.08291752	hPa
LDPM_N_32__TI_WUP	8	0... FFH	0... 8160	32	rpm
Factor map for TCO/VO dependent warm up correction					
IP_FAC_TI_WUP_FUP	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_FUP_FAC_TI_WUP	6	0... FFFFH	0... 347776	5.3067216	hPa
Factor for weighting the influence of fuel pressure on warm up injection					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TI_FAC_N_MAP	-	0... FFH	0... 0.99609375	0.00390625	-
LDP_MAP__TI_FAC_N_MAP	8	0... FFFFH	0... 5434	0.08291752	hPa
LDP_N_32__TI_FAC_N_MAP	8	0... FFH	0... 8160	32	rpm
Injection time weighting for temperature influence f(operating point)					
IP_TI_FAC_TCO	-	0... FFH	0... 0.99609375	0.00390625	-
LDP_TCO__TI_FAC_TCO	3	0... FEH	0... 142.5	0.75	°C
Injection time weighting for temperature influence f(coolant temperature)					
IP_TI_FAC_TIA_TOIL	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_TIA_TI_FAC_TIA_TOIL	6	0... FEH	0... 142.5	0.75	°C
LDP_TOIL_TI_FAC_TIA_TOIL	6	0... C8H	0... 160	1	°C
Injection time weighting for temperature influence f(TIA, TOIL)					
IP_TI_TCO_WUP_H_PRS	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_TCO_ST_TI_TCO_WUP_H_PRS	6	0... FEH	0... 142.5	0.75	°C
LDPM_TCO__TI_WUP_H_PRS	8	0... FEH	0... 142.5	0.75	°C
TCO/TCO_ST dependent warm up correction at high fuel pressure					
IP_TI_TCO_WUP_LIH_L_PRS	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_TCO_ST_TI_TCO_WUP_LIH_L_PRS	6	0... FEH	0... 142.5	0.75	°C
LDPM_TCO__TI_WUP_LIH_L_PRS	8	0... FEH	0... 142.5	0.75	°C
TCO/TCO_ST dependent warm up correction at low fuel pressure					
IP_TI_WUP_H_PRS	-	0... FFH	0... 0.99609375	0.00390625	-
LDPM_MAF_HB__TI_WUP	8	0... FFH	0... 1389	5.44705882	mg/stk
LDPM_N_32__TI_WUP	8	0... FFH	0... 8160	32	rpm
TI warm up correction at high fuel pressure					
IP_TI_WUP_H_PRS_SNGH	-	0... FFH	0... 0.99609375	0.00390625	-
LDPM_MAF_HB__TI_WUP	8	0... FFH	0... 1389	5.44705882	mg/stk
LDPM_N_32__TI_WUP	8	0... FFH	0... 8160	32	rpm
TI warm up correction at high fuel pressure for SNGH					
IP_TI_WUP_LIH_L_PRS	-	0... FFH	0... 0.99609375	0.00390625	-
LDPM_MAF_HB__TI_WUP	8	0... FFH	0... 1389	5.44705882	mg/stk
LDPM_N_32__TI_WUP	8	0... FFH	0... 8160	32	rpm
TI warm up correction at low fuel pressure					

## 7.7.1 FMSP\_M700A

### FUNCTION DESCRIPTION:

#### General information:

To cover the increased fuel requirement while the engine is cold, injection is corrected via the warm up enrichment.

The function splits up 2 warmup enrichment parts intermediate value (applied for 2 different fuel pressure modes). In accordance with the received fuel pressure FUP the warm up injection represents the weighted enrichment parts.


#### Application conditions:

**Activation :** at every engine operating state, when  
(LV\_CLC\_2SEG = 1 or LV\_CLC\_2SEG\_ENA = 0)

**Deactivation :** not Activation

**Initialization :** at ECUinitialisation, LV\_ES = 0 > 1, LV\_ST = 0 > 1:  
TI\_WUP, TI\_TEMP and FAC\_TI\_WUP\_FUP = 1,0  
TI\_WUP\_1 = 1,000061, TI\_WUP\_1\_ADD = 0,000061

**Update rate :** 1/segment

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### Application Condition

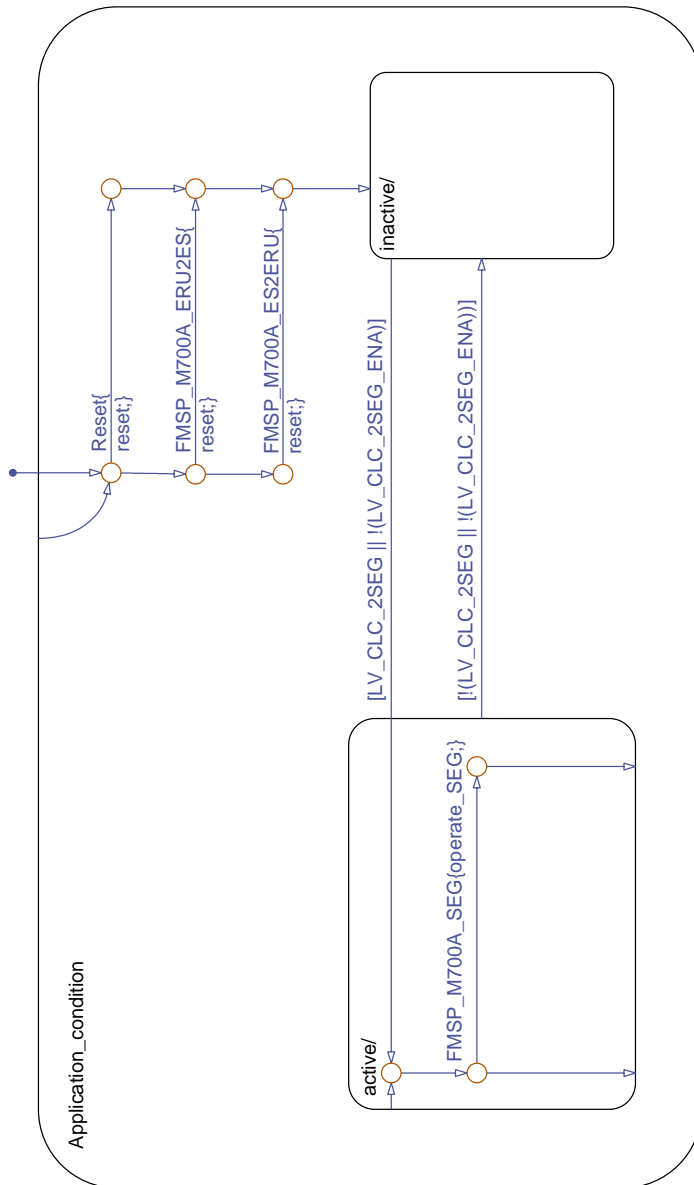



Figure 7.7.1: FMSP\_M700A/APP\_CDN/Chart

### Function Description

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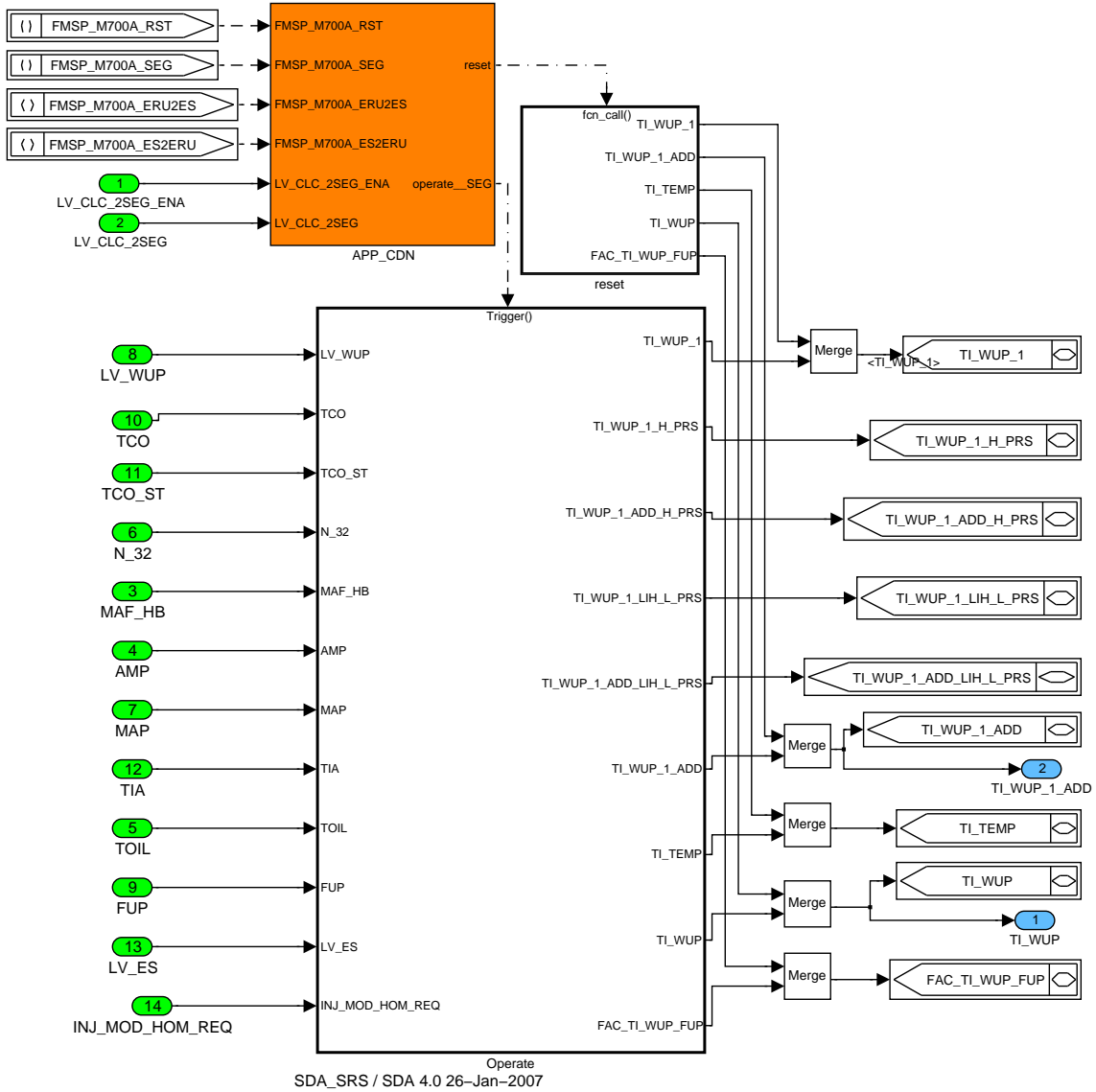


Figure 7.7.2: FMSP\_M700A

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### 7.7.1.1 SUBFUNCTION: Operate

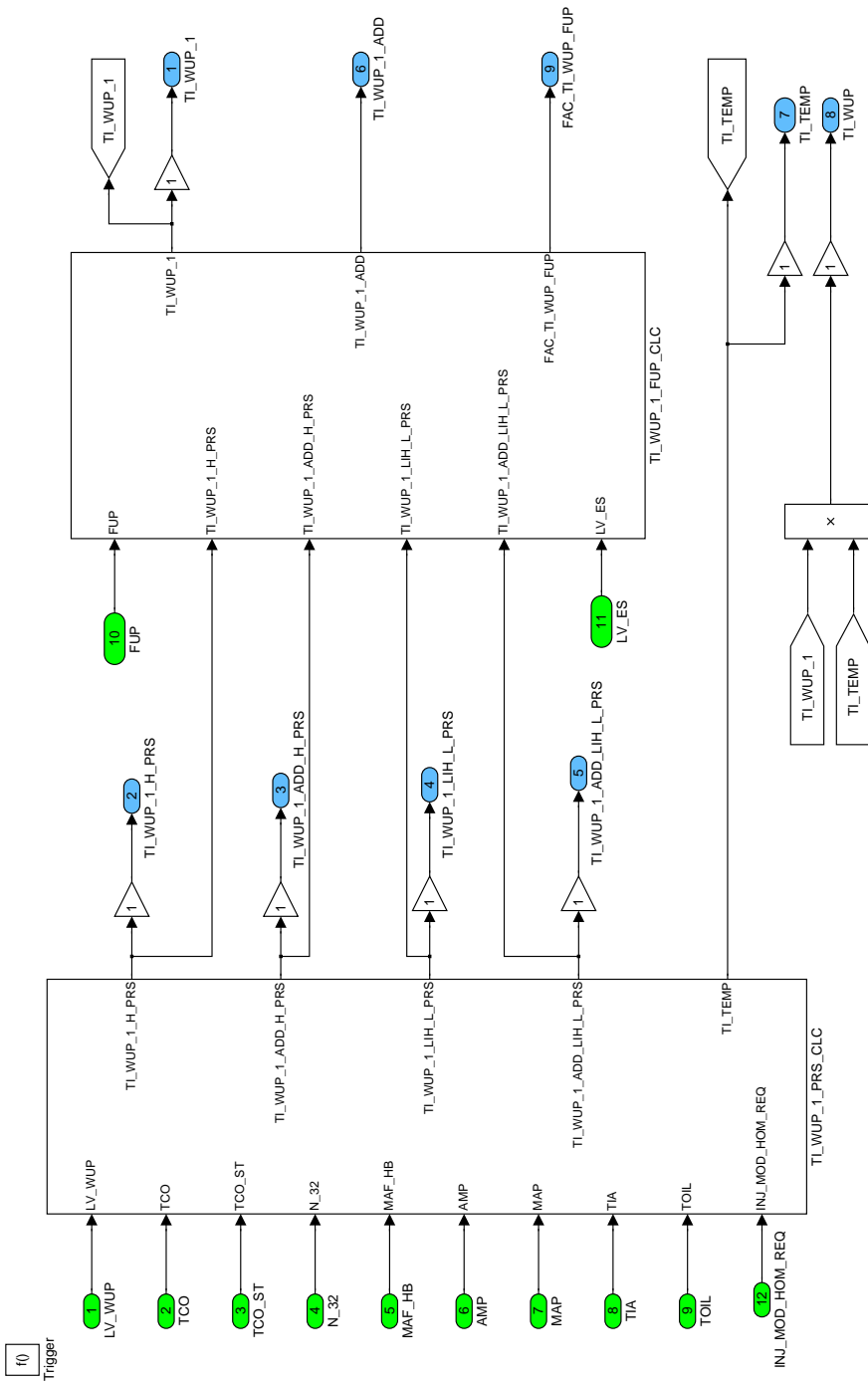


Figure 7.7.3: FMSP\_M700A/Operate

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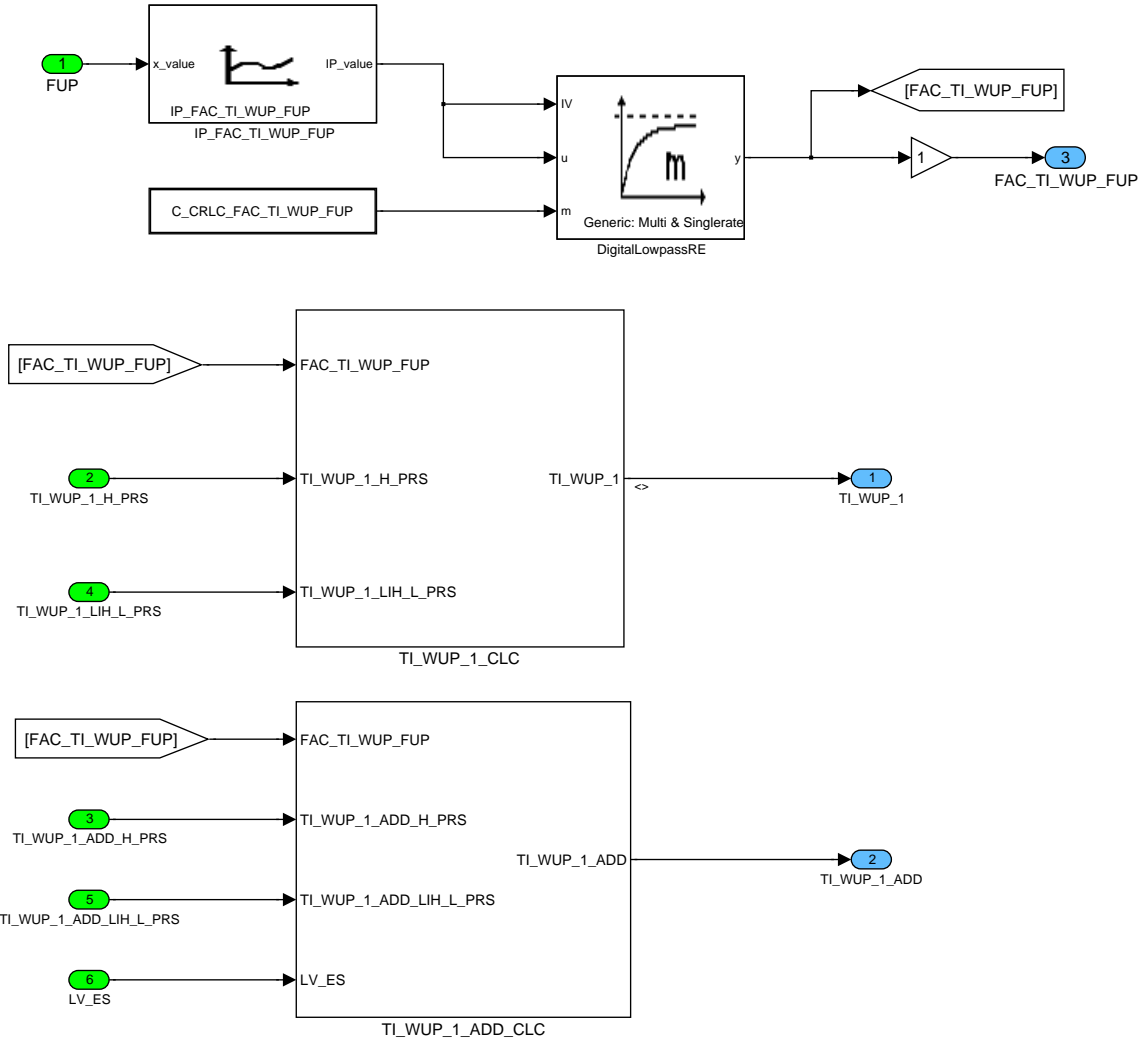


Figure 7.7.4: FMSP\_M700A/Operate/TI\_WUP\_1\_FUP\_CLC

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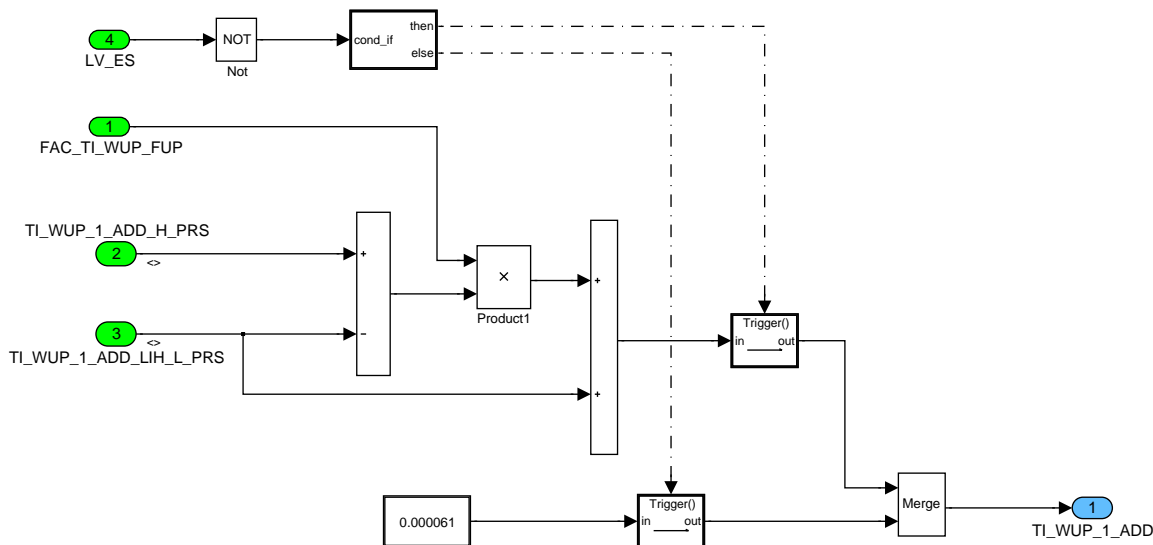


Figure 7.7.5: FMSM\_M700A/Operate/TI\_WUP\_1\_FUP\_CLC/TI\_WUP\_1\_ADD\_CLC

**FMSM\_M700A/OPERATE/TI\_WUP\_1\_FUP\_CLC/TI\_WUP\_1\_CLC**

The input values TI\_WUP\_1\_H\_PRS and TI\_WUP\_1\_LIH\_L\_PRS are calculated for the fuel high pressure and the fuel limp home low pressure mode. Each input value belongs to a fuel pressure mode. Depending on FUP a factor indicates which path is executed as a result of the interpolation.

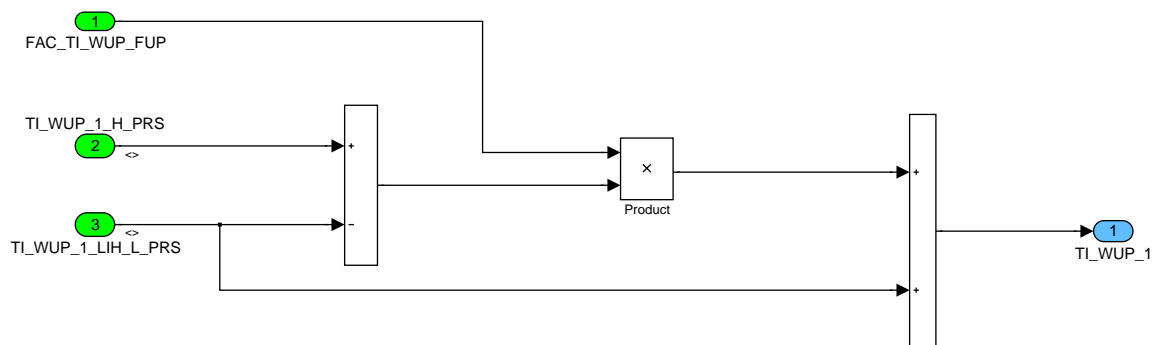


Figure 7.7.6: FMSM\_M700A/Operate/TI\_WUP\_1\_FUP\_CLC/TI\_WUP\_1\_CLC

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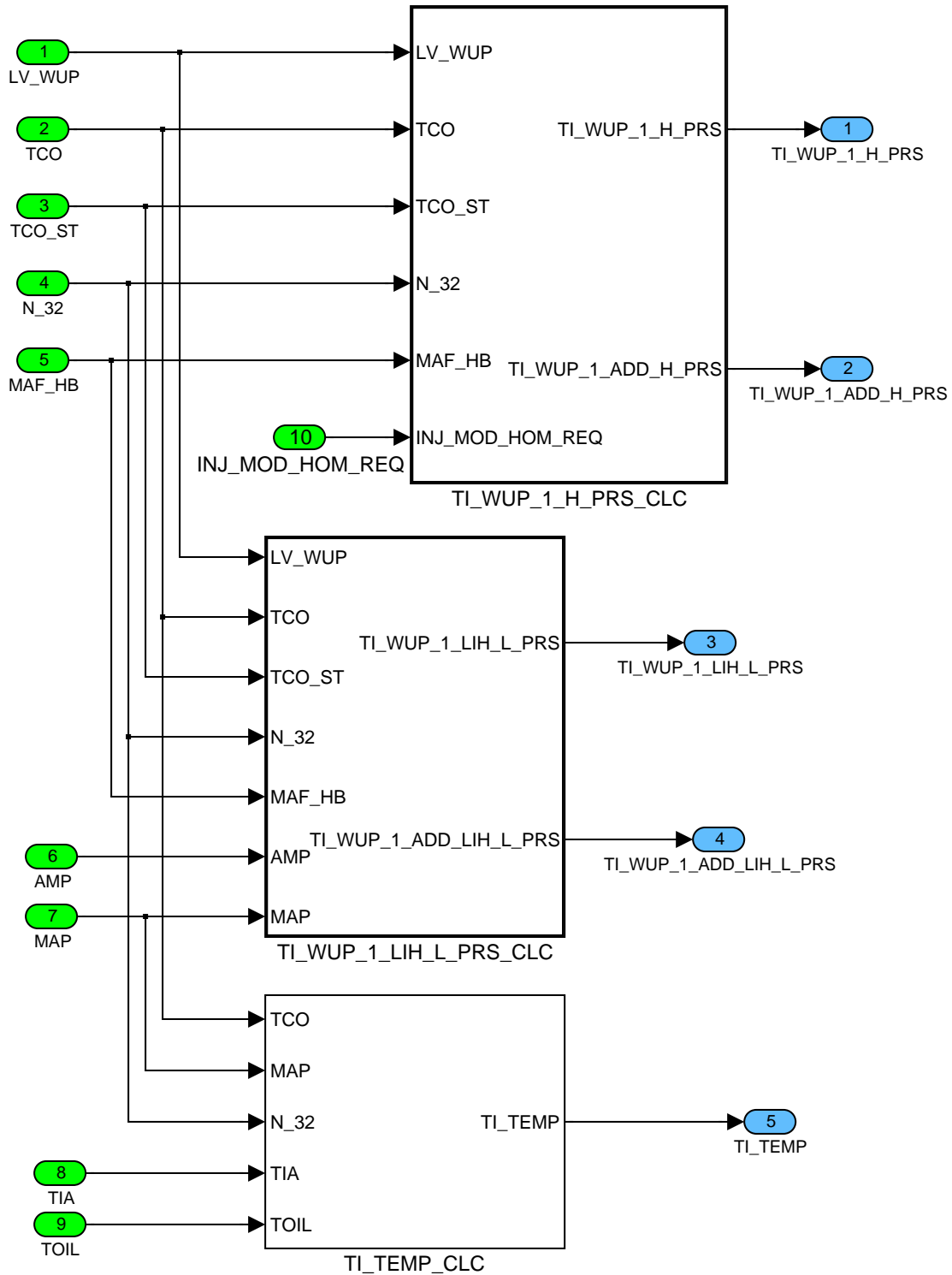



Figure 7.7.7: FMSP\_M700A/Operate/TI\_WUP\_1\_PRS\_CLC

**FMSP\_M700A/OPERATE/TI\_WUP\_1\_PRS\_CLC/TI\_TEMP\_CLC**

content

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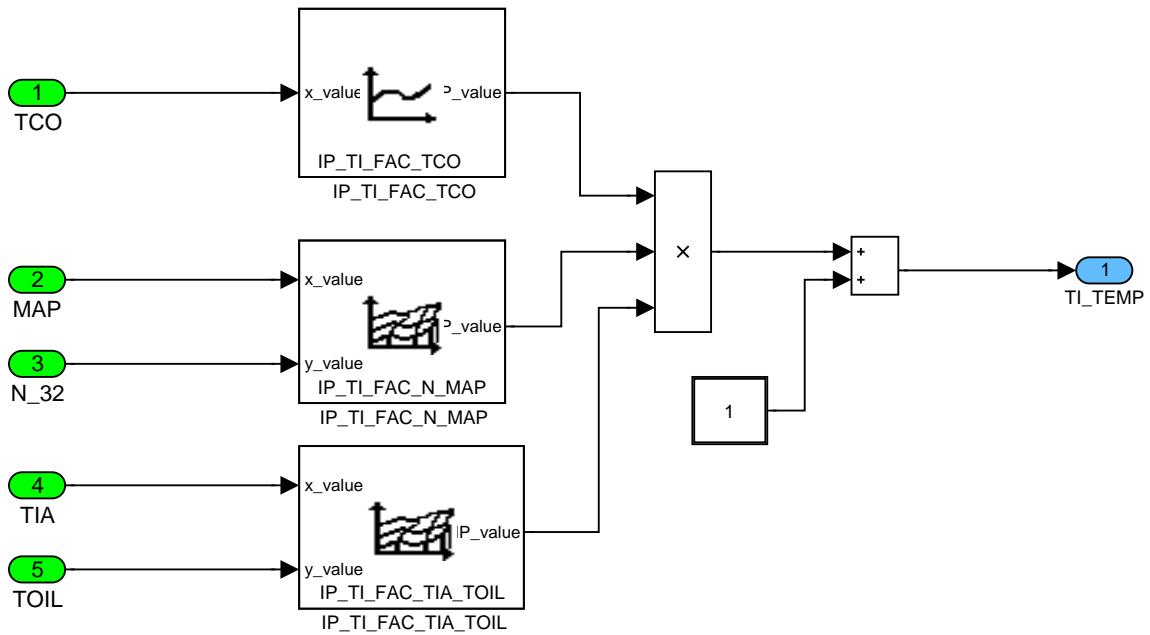


Figure 7.7.8: FMSP\_M700A/Operate/TI\_WUP\_1\_PRS\_CLC/TI\_TEMP\_CLC

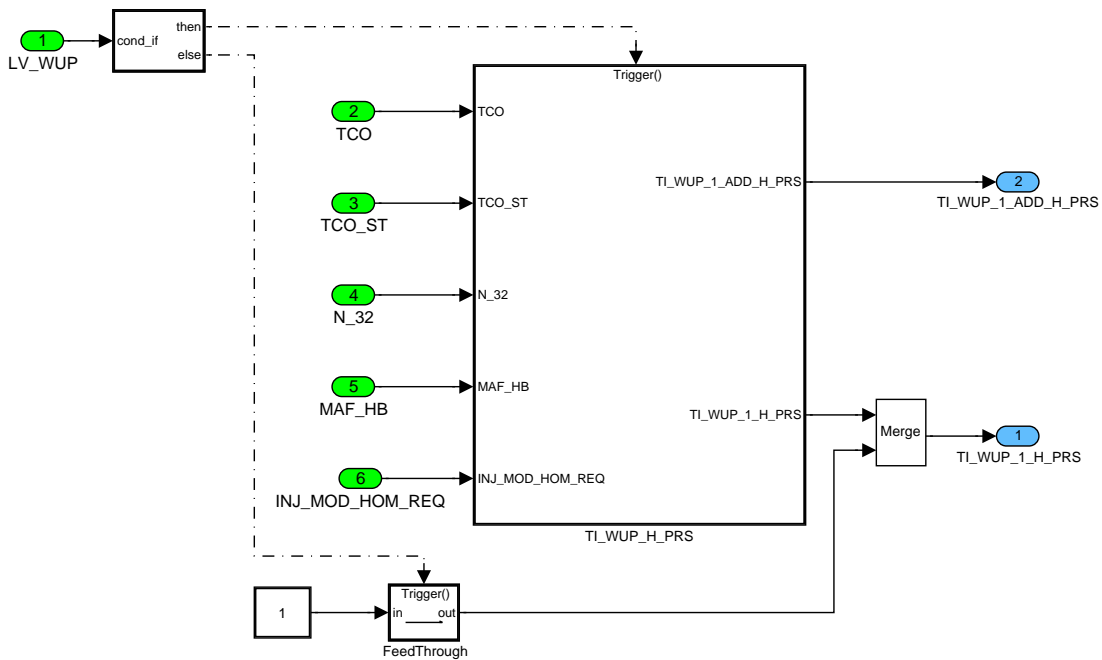


Figure 7.7.9: FMSP\_M700A/Operate/TI\_WUP\_1\_PRS\_CLC/TI\_WUP\_1\_H\_PRS\_CLC

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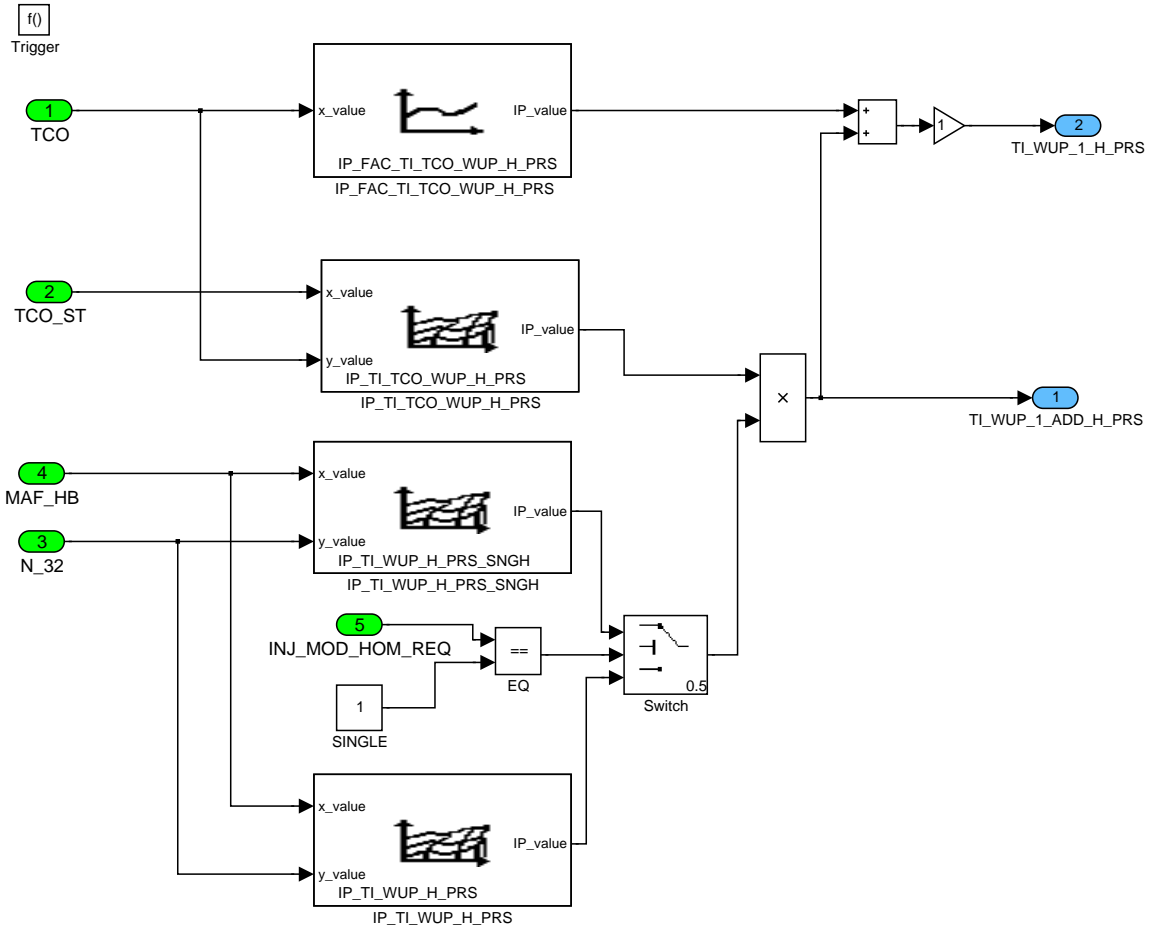


Figure 7.7.10:  
FMSP\_M700A/Operate/TI\_WUP\_1\_PRS\_CLC/TI\_WUP\_1\_H\_PRS\_CLC/TI\_WUP\_H\_PRS

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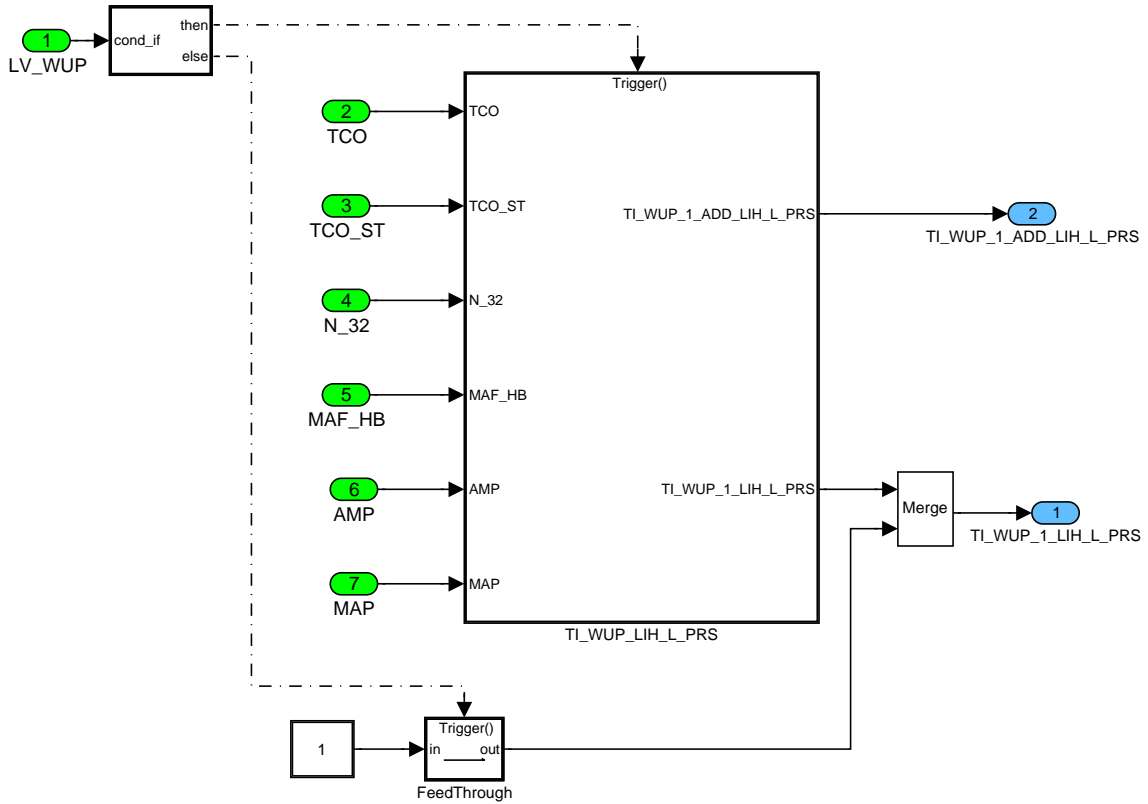


Figure 7.7.11: FMSP\_M700A/Operate/TI\_WUP\_1\_PRS\_CLC/TI\_WUP\_1\_LIH\_L\_PRS\_CLC

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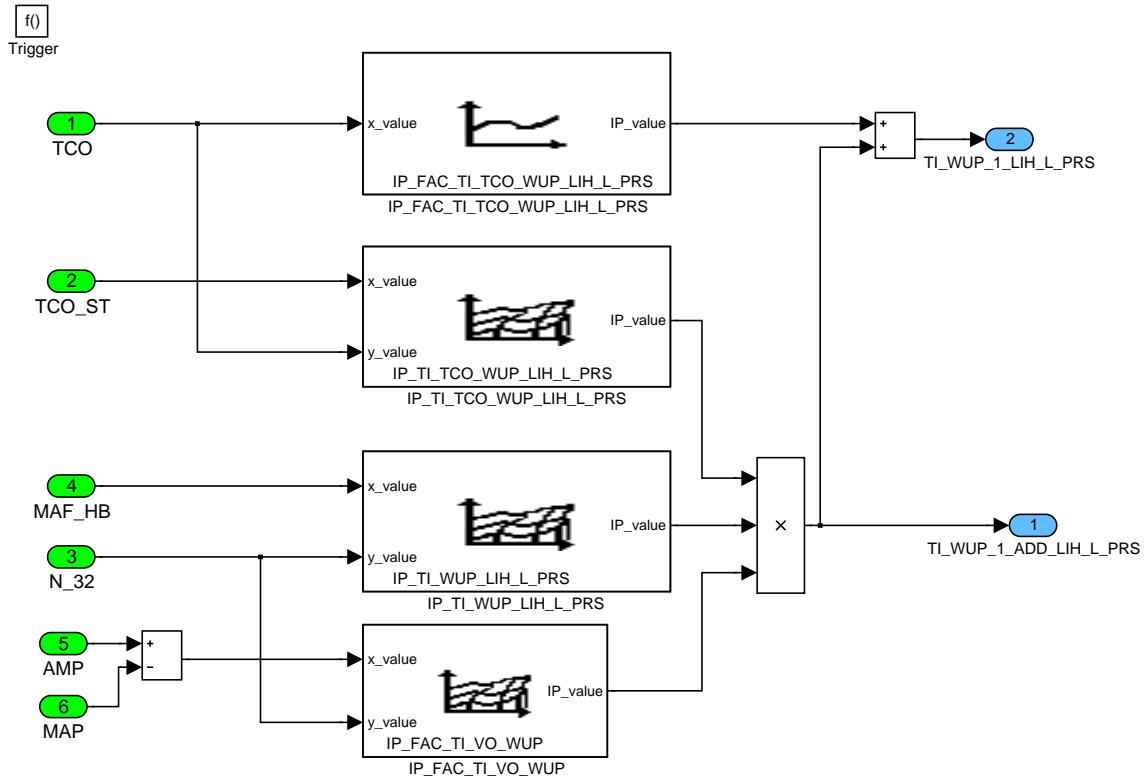


Figure 7.7.12:  
 FMSP\_M700A/Operate/TI\_WUP\_1\_PRS\_CLC/TI\_WUP\_1\_LIH\_L\_PRS\_CLC/TI\_WUP\_LIH\_L\_PRS

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### 7.7.1.2 SUBFUNCTION: reset

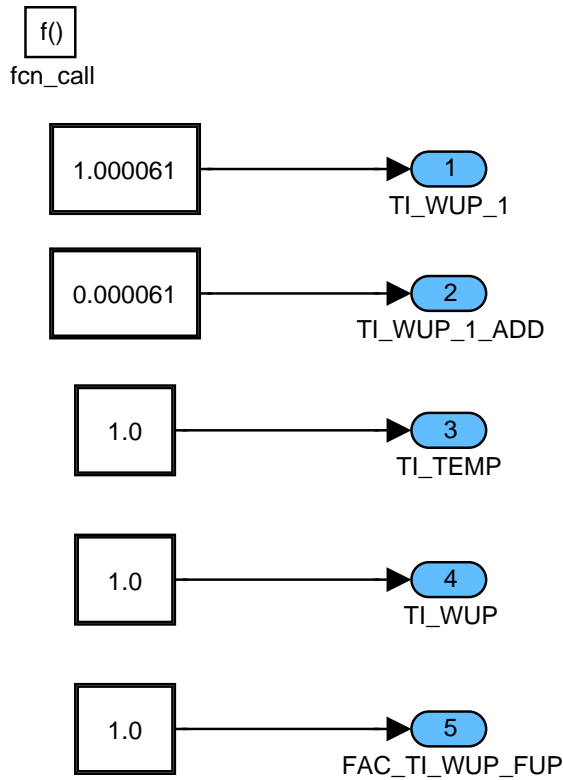


Figure 7.7.13: FMSP\_M700A/reset

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## 7.8 Injection phase for homogeneous mode - 1. pulse

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_DIF_SOI_IGN_HOM	O/V	0... F00H	0... 1440	0.375	°CRK
Current start of injection phase related to ignition TDC					
CRK_INJ_BAS [NC_CYL_NR]	O/V	F100... F00H	-1440 ...1440	0.375	°CRK
Cylinder individual zero position for phasing related to ignition TDC					
EOI_1_HOM	O/V	0... 780H	0... 720	0.375	°CRK
End of injection for homogeneous mode, 1.pulse - non cylinder individual HPDI-Version					
EOI_LIM_HOM	O/V	0... 780H	0... 720	0.375	°CRK
Latest possible EOI at homogeneous mode					
LV_CRK_DIF_SOI_EOI_LIM	O/V	0... 1H	0 ...1	1	-
Difference between SOI and EOI is beyond the maximum, the pulse will be limited					
LV_EOI_LIM_HOM	V	0... 1H	0 ...1	1	-
At least one injection was repositioned to EOI_LIM_HOM					
SOI_1_HOM [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Start of injection for homogeneous mode, 1.pulse - cylinder individual HPDI-Version					
SOI_1_HOM_CLC [NC_CYL_NR]	V	0... 780H	0... 720	0.375	°CRK
Calculated start of injection for homogeneous mode, 1.pulse - cylinder individual HPDI-Version					
SOI_1_HOM_MAX	-	0... 780H	0... 720	0.375	°CRK
Maximum start of injection angle for homogeneous mode, 1.pulse					
SOI_LIM	O/V	0... 780H	0... 720	0.375	°CRK
Earliest possible SOI					

### Input data:

CAM_SHIFT_EX {p. 2146}	CTR_CYL_NR_ST_CLC_INJR {p. 3327}	EOI_2_HOM_EXT [NC_CYL_NR] {p. 2146}	FAC_N {p. 3327}
FUP_H_INJ [NC_CBK_HPP_NR] {p. 3327}	INJ_MOD_HOM_REQ {p. 8241}	LV_EOI_2_DELTA_HOM_CUS {p. 8269}	LV_EOI_LIM_EOLP_OFS {p. 800}
LV_EOI_ST_ENA {p. 8242}	LV_ST_END {p. 1720}	NC_CBK_HPP_NR [1] {p. 812}	NC_CRK_INJ_BAS_REF {p. 626}
NC_CRK_INJ_REF_TDC {p. 626}	NC_CRK_INJ_RNG {p. 626}	NC_CYL_NR {p. 1526}	NC_INJ_MOD_SINGLE {p. 2045}
NC_T_MIN_OFS_INJ_CYL {p. 628}	NR_CYL_CLC_RED_INJ {p. 3331}	SOI_1_HOM_EXT [NC_CYL_NR] {p. 2146}	TI_1_HOM [NC_CYL_NR] {p. 2002}
TI_1_HOM_CLC_MAX {p. 2002}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EOI_LIM_EOLP_OFS	-	FC40... 3C0H	-360 ...360	0.375	°CRK
Constant to add offset to EOI_LIM_HOM when engine first starts at end of line (EOL)					
C_EOI_LIM_HOM	-	0... 780H	0... 720	0.375	°CRK
Latest possible EOI at homogeneous mode					
C_EOI_LIM_HOM_CH_COR	-	FC40... 3C0H	-360 ...360	0.375	°CRK
Additive correction on EOI_LIM_HOM during catalyst heating					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EOI_LIM_HOM_MULTI_COR	-	FC40... 3C0H	-360 ...360	0.375	°CRK
Correction value for calculation of the latest possible EOI, if homogeneous multi injection mode is active					
C_EOI_LIM_HOM_ST	-	0... 780H	0... 720	0.375	°CRK
Latest possible EOI at homogeneous mode at start					
C_SOI_1_HOM_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual setpoint for homogeneous SOI					
C_SOI_1_HOM_ST_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual setpoint for homogeneous SOI during start					
C_SOI_LIM	-	0... 780H	0... 720	0.375	°CRK
Earliest possible SOI					
IP_EOI_LIM_HOM_FUP_COR	-	0... 780H	-360 ...360	0.375	°CRK
LDPM_FUP_H_1_INJR	8	0... FFFFH	0... 347776	5.3067216	hPa
FUP correction of EOI_LIM_HOM					
LC_SOI_1_HOM_MAN	-	0... 1H	0 ...1	1	-
Switch to activate the manual setpoint for homogeneous SOI					
LC_SOI_1_HOM_ST_MAN	-	0... 1H	0 ...1	1	-
Switch to activate the manual setpoint for homogeneous SOI during start					

## FUNCTION DESCRIPTION:

### 7.8.1 Definition of the injection range

#### Application conditions

<b>Activation:</b>	<i>at reset</i>
<b>Deactivation:</b>	-
<b>Initialization:</b>	-
<b>Recurrence:</b>	<i>once at reset</i>

The fuel can be injected over a range of 720 °CRK. The cylinder individual zero position of this range is defined via the constants NC\_CRK\_INJ\_REF\_TDC and NC\_CRK\_INJ\_BAS\_REF with reference to the ignition TDC of cylinder 0, see figure below.

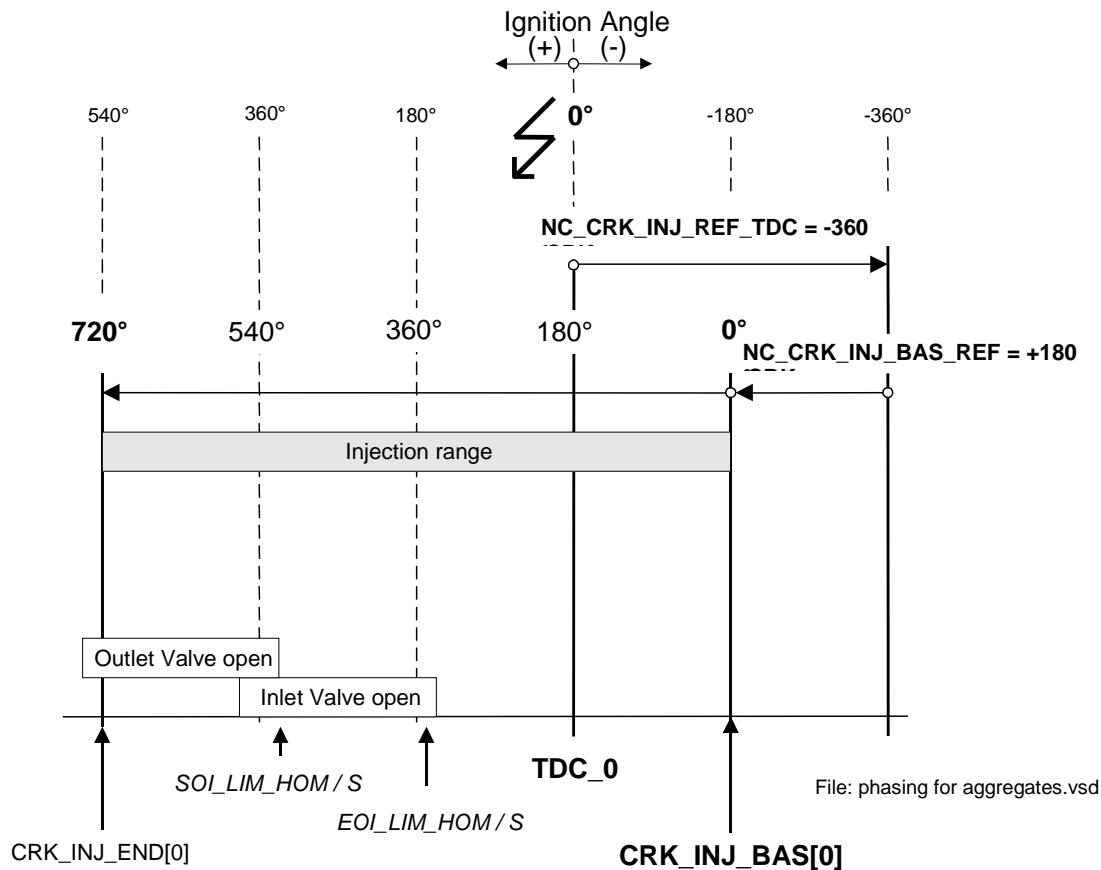
#### Formula section:

Related to tdc cylinder 0:

**FOR** x = 0 **TO** (NC\_CYL\_NR-1) **DO**:

$CRK\_INJ\_BAS[x] = NC\_CRK\_INJ\_REF\_TDC + NC\_CRK\_INJ\_BAS\_REF - x * (720 / NC\_CYL\_NR)$

**ENDFOR**



### Definition of the non calibrateable constants:

$NC\_CRK\_INJ\_REF\_TDC = -360^\circ CRK$

$NC\_CRK\_INJ\_BAS = 180^\circ CRK$

### For loop for runtime optimization:

In this specification the for loop

```

FOR i = 0, i < NR_CYL_CLC_RED_INJ DO
  x = CTR_CYL_NR_ST_CLC_INJR + i
  (1a)IF x >= NC_CYL_NR
  (1a)THEN
    x = x - NC_CYL_NR
  (1a)ENDIF
  <loop content>

```

**ENDFOR**

is substituted by

```

FOR cylinder_start to cylinder_stop DO
  <loop content>

```

**ENDFOR**

**Note:** In the for loops, x will be used as loop variable to indicate the cylinder x!

## 7.8.2 Injection phasing at start

### Application conditions

**Activation:** LV\_ST\_END = 0  
**Deactivation:** –  
**Initialization:** –  
**Recurrence:** 10ms

### Formula section:

All calculations are related to CRK\_INJ\_BAS[NC\_CYL\_NR].

EOI\_LIM\_HOM = 0

**(1) IF** (single injection)

INJ\_MOD\_HOM\_REQ = NC\_INJ\_MOD\_SINGLE (if single injection is requested)

**(1) THEN**

**FOR** m = 0 **TO** NC\_CBK\_HPP\_NR - 1 **DO**

EOI\_LIM\_HOM = **MAX**(EOI\_LIM\_HOM;

C\_EOI\_LIM\_HOM\_ST + IP\_EOI\_LIM\_HOM\_FUP\_COR (Input: FUP\_H\_INJ[m])

)

**ENDFOR**

**(1) ELSE** (multiple injection)

For double injection the minimum injection angle will be limited by the following calculation:

**FOR** m = 0 **TO** NC\_CBK\_HPP\_NR - 1 **DO**

EOI\_LIM\_HOM = **MAX**(EOI\_LIM\_HOM;

C\_EOI\_LIM\_HOM\_ST + IP\_EOI\_LIM\_HOM\_FUP\_COR (Input: FUP\_H\_INJ[m])

+ C\_EOI\_LIM\_HOM\_MULTI\_COR )

**ENDFOR**

**(1) ENDIF**

**IF** LV\_EOI\_LIM\_EOLP\_OFS = 1

**THEN**

EOI\_LIM\_HOM = EOI\_LIM\_HOM + C\_EOI\_LIM\_EOL\_OFS

// limit EOI\_LIM\_HOM to its physical limits

**END**

SOI\_LIM = C\_SOI\_LIM + CAM\_SHIFT\_EX

Check if the difference between SOI and EOI is beyond the maximum.

**(2) IF**

(TI\_1\_HOM\_CLC\_MAX \* FAC\_N + EOI\_LIM\_HOM) > SOI\_LIM

**(2) THEN**

LV\_CRK\_DIF\_SOI\_EOI\_LIM = 1 (TI is beyond the maximum)

**(2) ELSE**

LV\_CRK\_DIF\_SOI\_EOI\_LIM = 0 (TI is below the maximum)

**(2) ENDIF**

Calculation of SOI:

**(3) IF**

LC\_SOI\_1\_HOM\_ST\_MAN = 1

**(3) THEN****(1) FOR** x = 0 **TO** (NC\_CYL\_NR -1) **DO**:

SOI\_1\_HOM\_CLC[x] = C\_SOI\_1\_HOM\_ST\_MAN

**(1) ENDFOR****(3) ELSE****(4) IF** LV\_EOI\_ST\_ENA = 1**(4) THEN****(2) FOR** x = 0 **TO** (NC\_CYL\_NR -1) **DO**:

SOI\_1\_HOM\_CLC[x] = TI\_1\_HOM[x] \* FAC\_N + EOI\_2\_HOM\_EXT[x]

**(2) ENDFOR****(4) ELSE****(3) FOR** x = 0 **TO** (NC\_CYL\_NR -1) **DO**:

SOI\_1\_HOM\_CLC[x] = SOI\_1\_HOM\_EXT[x]

**(3) ENDFOR****(4) ENDIF****(3) ENDIF**Limitation to the end of injection:

SOI\_1\_HOM\_MAX = 0

**(4) FOR** x = 0 **TO** (NC\_CYL\_NR -1) **DO**:**(5) IF**

SOI\_1\_HOM\_CLC[x] - TI\_1\_HOM[x] \* FAC\_N &lt; EOI\_LIM\_HOM

**(5) THEN**

SOI\_1\_HOM[x] = EOI\_LIM\_HOM + TI\_1\_HOM[x] \* FAC\_N

LV\_EOI\_LIM\_HOM = 1

At least one injection was repositioned to EOI\_LIM\_HOM

**(5) ELSE**

SOI\_1\_HOM[x] = SOI\_1\_HOM\_CLC[x]

LV\_EOI\_LIM\_HOM = 0

**(5) ENDIF**

Limit SOI\_1\_HOM to SOI\_LIM:

SOI\_1\_HOM[x] = **MIN**(SOI\_1\_HOM[x]; SOI\_LIM)SOI\_1\_HOM\_MAX = **MAX**(SOI\_1\_HOM\_MAX, SOI\_1\_HOM[x])**(4) ENDFOR****(6) IF** (single injection)

INJ\_MOD\_HOM\_REQ = NC\_INJ\_MOD\_SINGLE (if single injection is requested)

**(6) THEN**EOI\_LIM\_HOM = **MAX**(EOI\_LIM\_HOM, (SOI\_1\_HOM\_MAX

- (NC\_CRK\_INJ\_RNG - NC\_T\_MIN\_OFS\_INJ\_CYL \*FAC\_N)))

**(6) ENDIF**


EOI\_1\_HOM = 720°CRK

**(5) FOR** x = 0 **TO** (NC\_CYL\_NR -1) **DO**:EOI\_1\_HOM = **MIN**(EOI\_1\_HOM, (SOI\_1\_HOM[x] - TI\_1\_HOM[x] \* FAC\_N))**(5) ENDFOR**Output variable for LACO:

CRK\_DIF\_SOI\_IGN\_HOM = SOI\_1\_HOM[0] + CRK\_INJ\_BAS [0]

## 7.8.3 Injection phasing out of start

### Application conditions

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**Activation:** LV\_ST\_END = 1  
**Deactivation:** -  
**Initialization:** -  
**Recurrence:** segment synchronous

### Formula section:

Out of start injection phasing is defined via SOI.  
 All calculations are related to CRK\_INJ\_BAS[NC\_CYL\_NR].

EOI\_LIM\_HOM = 0

**(1) IF** (single injection)

INJ\_MOD\_HOM\_REQ = NC\_INJ\_MOD\_SINGLE (if single injection is requested)

**(1) THEN**

**FOR** m = 0 **TO** NC\_CBK\_HPP\_NR - 1 **DO**

EOI\_LIM\_HOM = **MAX**(EOI\_LIM\_HOM;

C\_EOI\_LIM\_HOM + IP\_EOI\_LIM\_HOM\_FUP\_COR (Input: FUP\_H\_INJ[m]) )

**ENDFOR**

1. **ELSE** (multiple injection)

**(1a) IF** LV\_EOI\_2\_DELTA\_HOM\_CUS = 1

**(1a) THEN**

**FOR** m = 0 **TO** NC\_CBK\_HPP\_NR - 1 **DO**

Minimum injection angle during catalyst heating:

EOI\_LIM\_HOM = **MAX**(EOI\_LIM\_HOM;

C\_EOI\_LIM\_HOM

+ IP\_EOI\_LIM\_HOM\_FUP\_COR (Input: FUP\_H)

+ C\_EOI\_LIM\_HOM\_CH\_COR)

**ENDFOR**

**(1a) ELSE**

For double injection the minimum injection angle will be limited by the following calculation:

**FOR** m = 0 **TO** NC\_CBK\_HPP\_NR - 1 **DO**

EOI\_LIM\_HOM = **MAX**(EOI\_LIM\_HOM;

C\_EOI\_LIM\_HOM + IP\_EOI\_LIM\_HOM\_FUP\_COR (Input: FUP\_H\_INJ[m])

+ C\_EOI\_LIM\_HOM\_MULTI\_COR )

**ENDFOR**

**(1a) ENDIF**

**(1) ENDIF**

**IF** LV\_EOI\_LIM\_EOLP\_OFS = 1

**THEN**


EOI\_LIM\_HOM = EOI\_LIM\_HOM + C\_EOI\_LIM\_EOL\_OFS

// limit EOI\_LIM\_HOM to its physical limits

**END**

SOI\_LIM = C\_SOI\_LIM + CAM\_SHIFT\_EX

Check if the difference between SOI and EOI is beyond the maximum.

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**(2) IF**

$$(TI\_1\_HOM\_CLC\_MAX * FAC\_N + EOI\_LIM\_HOM) > SOI\_LIM$$
**(2) THEN**

$$LV\_CRK\_DIF\_SOI\_EOI\_LIM = 1 \quad (TI \text{ is beyond the maximum})$$
**(2) ELSE**

$$LV\_CRK\_DIF\_SOI\_EOI\_LIM = 0 \quad (TI \text{ is below the maximum})$$
**(2) ENDIF**

Calculation of SOI:

**(3) IF**

$$LC\_SOI\_1\_HOM\_MAN = 1$$
**(3) THEN**

**(1)FOR** cylinder\_start to cylinder\_stop **DO**

$$SOI\_1\_HOM\_CLC[x] = C\_SOI\_1\_HOM\_MAN$$

**(1) ENDFOR**

**(3) ELSE**

**(2)FOR** cylinder\_start to cylinder\_stop **DO**

Dynamical limitation of SOI under consideration of NC\_CRK\_INJ\_RNG:

**(4) IF**  $SOI\_1\_HOM\_EXT[x] < (EOI\_1\_HOM + (NC\_CRK\_INJ\_RNG - NC\_T\_MIN\_OFS\_INJ\_CYL * FAC\_N))$

**(4) THEN**

$$SOI\_1\_HOM\_CLC[x] = SOI\_1\_HOM\_EXT[x]$$

**(4) ELSE**

$$SOI\_1\_HOM\_CLC[x] = EOI\_1\_HOM + (NC\_CRK\_INJ\_RNG - NC\_T\_MIN\_OFS\_INJ\_CYL * FAC\_N)$$

**(4) ENDIF**

**(2) ENDFOR**

**(3) ENDIF**

Limitation to the end of injection:

$$SOI\_1\_HOM\_MAX = 0$$

**(3)FOR** cylinder\_start to cylinder\_stop **DO**

**(5) IF**

$$SOI\_1\_HOM\_CLC[x] - TI\_1\_HOM[x] * FAC\_N < EOI\_LIM\_HOM$$

**(5) THEN**

$$SOI\_1\_HOM[x] = EOI\_LIM\_HOM + TI\_1\_HOM[x] * FAC\_N$$

$$LV\_EOI\_LIM\_HOM = 1 \quad \text{At least one injection was repositioned to EOI\_LIM\_HOM}$$

**(5) ELSE**

$$SOI\_1\_HOM[x] = SOI\_1\_HOM\_CLC[x]$$

$$LV\_EOI\_LIM\_HOM = 0$$

**(5) ENDIF**

Limit SOI\_1\_HOM to SOI\_LIM:

$$SOI\_1\_HOM[x] = \text{MIN}(SOI\_1\_HOM[x]; SOI\_LIM)$$

$$SOI\_1\_HOM\_MAX = \text{MAX}(SOI\_1\_HOM\_MAX, SOI\_1\_HOM[x])$$

**(3) ENDFOR**

**(6) IF** (single injection)

$$INJ\_MOD\_HOM\_REQ = NC\_INJ\_MOD\_SINGLE \text{ (if single injection is requested)}$$

**(6) THEN**

$$EOI\_LIM\_HOM = \text{MAX}(EOI\_LIM\_HOM, (SOI\_1\_HOM\_MAX - (NC\_CRK\_INJ\_RNG - NC\_T\_MIN\_OFS\_INJ\_CYL * FAC\_N)))$$

**(6) ENDIF**



EOI\_1\_HOM = 720°CRK


**(4)FOR** cylinder\_start to cylinder\_stop **DO**

EOI\_1\_HOM = MIN(EOI\_1\_HOM, (SOI\_1\_HOM[x] - TI\_1\_HOM[x] \* FAC\_N))

**(4) ENDFOR**

Output variable for LACO (10 ms synchronous):

CRK\_DIF\_SOI\_IGN\_HOM = SOI\_1\_HOM[0] + CRK\_INJ\_BAS[0]

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## 7.9 Injection phase for homogeneous mode - 2. pulse

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EOI_1_SOI_2_GAP_HOM	V	0... 780H	0... 720	0.375	°CRK
Gap between the two injections at cylinder 0					
EOI_2_HOM [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of injection of the second injection for hom. combustion mode (intermediate value)					
EOI_2_HOM_INTER [NC_CYL_NR]	-	0... 780H	0... 720	0.375	°CRK
end of injection of the second injection for hom. combustion mode (intermediate value)					
SOI_2_HOM	V	0... 780H	0... 720	0.375	°CRK
Start of injection of the second injection for homogeneous combustion					
SOI_2_HOM_INTER [NC_CYL_NR]	-	0... 780H	0... 720	0.375	°CRK
Calibrated start of injection of the second injection for homogeneous combustion mode					
SOI_2_HOM_TOL	-	0... 780H	0... 720	0.375	°CRK
Top limit for the start of the second injection					

### Input data:

CTR_CYL_NR_ST_CLC_INJR {p. 3327}	EOI_1_HOM {p. 2122}	EOI_2_HOM_EXT [NC_CYL_NR] {p. 2146}	FAC_N {p. 3327}
INJ_MOD_SP_HOM [NC_CYL_NR] {p. 3329}	LV_ST_END {p. 1720}	NC_CYL_NR {p. 1526}	NR_CYL_CLC_RED_INJ {p. 3331}
SOI_2_MAX_HOM_EXT {p. 2146}	TI_2_HOM [NC_CYL_NR] {p. 2003}		

### Calibration data:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DELTA_T_MIN_DUI	-	0... FFFFH	0... 65.535	0.001	ms
Least time between two injections					
C_EOI_2_HOM_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual setpoint for EOI					
LC_EOI_2_HOM_MAN	-	0... 1H	0...1	1	-
switch for using the manual setpoint for EOI					

### FUNCTION DESCRIPTION:

For the definition of the injection range see module "Injection phase for homogeneous mode, 1. pulse".  
The injection phase for the second pulse is defined via EOI.  
All calculations are related to CRK\_INJ\_BAS[NC\_CYL\_NR].

### Application conditions

**Activation:** every engine state  
**Deactivation:** -  
**Initialization:** -  
**Recurrence:** LV\_ST\_END = 0: 10 ms  
 LV\_ST\_END = 1: segment synchronous

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**Formula section:**

For loop for runtime optimization:

In this specification the for loop

```

FOR i = 0, i < NR_CYL_CLC_RED_INJ DO
    x = CTR_CYL_NR_ST_CLC_INJR + i
    (1a)IF x >= NC_CYL_NR
    (1a)THEN
        x = x - NC_CYL_NR
    (1a)ENDIF
    <loop content>

```

**ENDFOR**

is substituted by

```

FOR cylinder_start to cylinder_stop DO
    <loop content>

```

**ENDFOR**

**Note: In the for loops, x will be used as loop variable to indicate the cylinder x!**

Start of the 2<sup>nd</sup> injection has to be earliest at SOI\_2\_MAX\_HOM\_EXT and after the end of the 1<sup>st</sup> pulse plus a defined delay time C\_DELTA\_T\_MIN\_DUI.

SOI\_2\_HOM\_TOL = MIN(EOI\_1\_HOM - C\_DELTA\_T\_MIN\_DUI \* FAC\_N; SOI\_2\_MAX\_HOM\_EXT)

SOI\_2\_HOM = 0

**FOR** cylinder\_start to cylinder\_stop **DO**

(1)**IF** INJ\_MOD\_SP\_HOM[x] ≠ "SNGH"

(1)**THEN**

(2) **IF**

LC\_EOI\_2\_HOM\_MAN = 1

(2) **THEN**

EOI\_2\_HOM\_INTER[x] = C\_EOI\_2\_HOM\_MAN

(2) **ELSE**

EOI\_2\_HOM\_INTER[x] = EOI\_2\_HOM\_EXT[x]

(2) **ENDIF**

SOI\_2\_HOM\_INTER[x] = EOI\_2\_HOM\_INTER[x] + TI\_2\_HOM[x] \* FAC\_N

(3) **IF**

SOI\_2\_HOM\_INTER[x] > SOI\_2\_HOM\_TOL

(3) **THEN**

EOI\_2\_HOM[x] = EOI\_2\_HOM\_INTER[x] - (SOI\_2\_HOM\_INTER[x] - SOI\_2\_HOM\_TOL)

SOI\_2\_HOM = MAX(SOI\_2\_HOM; SOI\_2\_HOM\_TOL)

(3) **ELSE**

EOI\_2\_HOM[x] = EOI\_2\_HOM\_INTER[x]

SOI\_2\_HOM = MAX(SOI\_2\_HOM; SOI\_2\_HOM\_INTER[x])


(3) **ENDIF**

(1) **ELSE**

EOI\_2\_HOM[x] = 0

(1) **ENDIF**

**ENDFOR**

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Gap between the two injections:

**(4)IF** SOI\_2\_HOM  $\neq$  0


**(4)THEN**

EOI\_1\_SOI\_2\_GAP\_HOM = EOI\_1\_HOM - SOI\_2\_HOM

**(4)ELSE**

EOI\_1\_SOI\_2\_GAP\_HOM = 0

**(4)ENDIF**

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## 7.10 Injection phase for homogeneous mode - 3. pulse

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EOI_2_SOI_3_GAP_HOM	V	0... 780H	0... 720	0.375	°CRK
Gap between the second and the third injection at cylinder 0					
EOI_3_HOM [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of injection of the third injection for hom. combustion mode					
EOI_3_HOM_INTER [NC_CYL_NR]	-	0... 780H	0... 720	0.375	°CRK
End of injection of the third injection for hom. combustion mode (intermediate value)					
SOI_3_HOM_INTER [NC_CYL_NR]	-	0... 780H	0... 720	0.375	°CRK
Calibrated start of injection of the third injection for homogeneous combustion mode					
SOI_3_HOM_MAX	V	0... 780H	0... 720	0.375	°CRK
Maximum start of injection angle of the third injection for homogeneous combustion mode					
SOI_3_HOM_TOL	-	0... 780H	0... 720	0.375	°CRK
Top limit for the start of the third injection					

### Input data:

C_DELTA_T_MIN_DUI {p. 2130}	CTR_CYL_NR_ST_CLC_INJR {p. 3327}	EOI_2_HOM [NC_CYL_NR] {p. 2130}	EOI_3_HOM_EXT [NC_CYL_NR] {p. 2146}
FAC_N {p. 3327}	IDX_PRS_COR_CYL_CLC_MPLH [NC_CBK_HPP_NR] {p. 3327}	INJ_MOD_SP_HOM [NC_CYL_NR] {p. 3329}	LV_ST_END {p. 1720}
NC_CBK_HPP_NR [1] {p. 812}	NC_CYL_NR {p. 1526}	NR_CYL_CLC_RED_INJ {p. 3331}	TI_3_HOM [NC_CYL_NR] {p. 2003}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EOI_3_HOM_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual setpoint for EOI of third pulse, homogeneous combustion mode					
LC_EOI_3_HOM_MAN	-	0... 1H	0 ...1	1	-
Switch for enabling the manual setpoint for EOI of third pulse, homogeneous combustion mode					

### FUNCTION DESCRIPTION:

For the definition of the injection range see module "Injection phase for homogeneous mode, 1. pulse".  
The injection phase for the second pulse is defined via EOI.  
All calculations are related to CRK\_INJ\_BAS[NC\_CYL\_NR].

### For loop for runtime optimization:

In this specification the for loop

```
FOR i = 0, i < NR_CYL_CLC_RED_INJ DO
  x = CTR_CYL_NR_ST_CLC_INJR + i
  (1a)IF x >= NC_CYL_NR
  (1a)THEN
    x = x - NC_CYL_NR
  (1a)ENDIF
<loop content>
```

**ENDFOR**

is substituted by

**FOR** cylinder\_start to cylinder\_stop **DO**

<loop content>

**ENDFOR**

**Note:** In the for loops, x will be used as loop variable to indicate the cylinder x!

**Application conditions**

**Activation:** every engine state  
**Deactivation:** -  
**Initialization:** -  
**Recurrence:** LV\_ST\_END = 0: 10 ms  
 LV\_ST\_END = 1: segment synchronous

**Formula section:**

SOI\_3\_HOM\_MAX = 0°CRK

**FOR** cylinder\_start to cylinder\_stop **DO**

(1)IF INJ\_MOD\_SP\_HOM[x] = "MPLH+PLS3"

(1)THEN

SOI\_3\_HOM\_TOL = EOI\_2\_HOM[x] - C\_DELTA\_T\_MIN\_DUI \* FAC\_N

(2) IF LC\_EOI\_3\_HOM\_MAN = 1

(2) THEN

EOI\_3\_HOM\_INTER[x] = C\_EOI\_3\_HOM\_MAN

(2) ELSE

EOI\_3\_HOM\_INTER[x] = EOI\_3\_HOM\_EXT[x]

(2) ENDIF

SOI\_3\_HOM\_INTER[x] = EOI\_3\_HOM\_INTER[x] + TI\_3\_HOM[x] \* FAC\_N

(3) IF SOI\_3\_HOM\_INTER[x] > SOI\_3\_HOM\_TOL

(3) THEN

EOI\_3\_HOM[x] = EOI\_3\_HOM\_INTER[x] - (SOI\_3\_HOM\_INTER[x] - SOI\_3\_HOM\_TOL)

SOI\_3\_HOM\_MAX = MAX(SOI\_3\_HOM\_MAX, SOI\_3\_HOM\_TOL)

(3) ELSE

EOI\_3\_HOM[x] = EOI\_3\_HOM\_INTER[x]

SOI\_3\_HOM\_MAX = MAX(SOI\_3\_HOM\_MAX, SOI\_3\_HOM\_INTER[x])

(3) ENDIF

(1)ELSE

EOI\_3\_HOM[x] = 0

(1)ENDIF

**ENDFOR**

Gap between the second and the third injection:

(4)IF SOI\_3\_HOM\_MAX ≠ 0


(4)THEN

**FOR** m = 0 **TO** NC\_CBK\_HPP\_NR - 1 **DO**

(5)IF INJ\_MOD\_SP\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m] =  
 "MPLH+PLS3"

(5)THEN

EOI\_2\_SOI\_3\_GAP\_HOM = EOI\_2\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]]  
 - (EOI\_3\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]])

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```
+ TI_3_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] *FAC_N)
```

```
Break the for-loop after condition is fulfilled one time
```


```
(5)ENDIF
```

```
ENDFOR
```

```
(4)ELSE
```

```
EOI_2_SOI_3_GAP_HOM = 0
```

```
(4)ENDIF
```

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## 7.11 Injection phase for homogeneous /stratified mode

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EOI_2_HOMS [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of the second injection for homogeneous stratified mode					
EOI_3_HOMS [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of the third injection for homogeneous stratified mode					
SOI_1_HOMS [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Start of the first injection for homogeneous stratified mode					

### Input data:

CTR_CYL_NR_ST_CLC_INJR {p. 3327}	EOI_1_HOMS_EXT [NC_CYL_NR] {p. 2146}	EOI_2_HOMS_EXT [NC_CYL_NR] {p. 2146}	EOI_3_HOMS_EXT [NC_CYL_NR] {p. 2146}
FAC_N {p. 3327}	INJ_MOD_SP_HOMS [NC_CYL_NR] {p. 3329}	LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}
NC_CYL_NR {p. 1526}	NC_T_MIN_OFS_INJ_PLS {p. 628}	NR_CYL_CLC_RED_INJ {p. 3331}	SOI_1_HOMS_EXT [NC_CYL_NR] {p. 2146}
T_DLY_2_3_MIN_HOMS [NC_CYL_NR] {p. 2146}	TI_1_S [NC_CYL_NR] {p. 2003}	TI_2_S [NC_CYL_NR] {p. 2003}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EOI_2_HOMS_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual setpoint for EOI of the second pulse during homogeneous stratified mode					
C_EOI_3_HOMS_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual setpoint for EOI of the third pulse during homogeneous stratified mode					
C_SOI_1_HOMS_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual setpoint for SOI of the first pulse during homogeneous stratified mode					
LC_EOI_2_HOMS_MAN	-	0... 1H	0 ...1	1	-
Switch to activate the manual setpoint for EOI_2, homogeneous stratified mode					
LC_EOI_3_HOMS_MAN	-	0... 1H	0 ...1	1	-
Switch to activate the manual setpoint for EOI_3, homogeneous stratified mode					
LC_SOI_1_HOMS_MAN	-	0... 1H	0 ...1	1	-
Switch to activate the manual setpoint for SOI_1, homogeneous stratified mode					

### FUNCTION DESCRIPTION:

Calculation of injection phasing for homogeneous-stratified mode.

### Application conditions

**Activation:**  $LV\_S\_CLC = 1$

**Deactivation:**  $LV\_S\_CLC = 0$

**Initialization at Reset:** -

**Recurrence:**  $LV\_ST\_END = 0:$  10 ms  
 $LV\_ST\_END = 1:$  segment synchronous



**Formula section:****For loop for runtime optimization:**

In this specification the for loop

```

FOR i = 0, i < NR_CYL_CLC_RED_INJ DO
    x = CTR_CYL_NR_ST_CLC_INJR + i
    (1a)IF x >= NC_CYL_NR
    (1a)THEN
        x = x - NC_CYL_NR
    (1a)ENDIF
    <loop content>

```

**ENDFOR**

is substituted by

```

FOR cylinder_start to cylinder_stop DO
    <loop content>

```

**ENDFOR**

**Note: In the for loops, x will be used as loop variable to indicate the cylinder x!**

**(0)FOR** cylinder\_start to cylinder\_stop **DO**

**Single injection**

**(0)IF** INJ\_MOD\_SP\_HOMS[x] = "HOMS-SNG"

**(0)THEN**

(1) **IF** LC\_SOI\_1\_HOMS\_MAN = 1

(1) **THEN**

SOI\_1\_HOMS[x] = C\_SOI\_1\_HOMS\_MAN

(1) **ELSE**

SOI\_1\_HOMS[x] = EOI\_1\_HOMS\_EXT[x] + TI\_1\_S[x]\*FAC\_N

(1) **ENDIF**

EOI\_2\_HOMS[x] = 0

EOI\_3\_HOMS[x] = 0

**(0) ENDIF**

**Double injection**

**(0)IF** INJ\_MOD\_SP\_HOMS[x] = "HOMS"

**(0)THEN**

(1) **IF** LC\_SOI\_1\_HOMS\_MAN = 1

(1) **THEN**

SOI\_1\_HOMS[x] = C\_SOI\_1\_HOMS\_MAN

(1) **ELSE**

SOI\_1\_HOMS[x] = SOI\_1\_HOMS\_EXT[x]

(1) **ENDIF**

(2) **IF** LC\_EOI\_2\_HOMS\_MAN = 1

(2) **THEN**


EOI\_2\_HOMS[x] = C\_EOI\_2\_HOMS\_MAN

(2) **ELSE**

EOI\_2\_HOMS[x] = EOI\_2\_HOMS\_EXT[x]

(2) **ENDIF**

EOI\_3\_HOMS[x] = 0

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**(0) ENDIF****Triple injection****(0)IF** INJ\_MOD\_SP\_HOMS[x] = "HOMS+PLS3"**(0)THEN****(1) IF** LC\_SOI\_1\_HOMS\_MAN = 1**(1) THEN**

SOI\_1\_HOMS[x] = C\_SOI\_1\_HOMS\_MAN

**(1) ELSE**

SOI\_1\_HOMS[x] = SOI\_1\_HOMS\_EXT[x]

**(1) ENDIF****(2) IF** LC\_EOI\_2\_HOMS\_MAN = 1**(2) THEN**

EOI\_2\_HOMS[x] = C\_EOI\_2\_HOMS\_MAN

**(2) ELSE**

EOI\_2\_HOMS[x] = EOI\_2\_HOMS\_EXT[x]

**(2) ENDIF****(1) IF** LC\_EOI\_3\_HOMS\_MAN = 1**(1) THEN**

EOI\_3\_HOMS[x] = C\_EOI\_3\_HOMS\_MAN


**(1) ELSE**

EOI\_3\_HOMS[x] = EOI\_3\_HOMS\_EXT[x]

**(1) ENDIF****(0) ENDIF****(0)ENDFOR**


Check plausibility of calculated injection angles. If necessary, move the first pulse:

**(5)FOR** cylinder\_start to cylinder\_stop **DO****(6)IF** INJ\_MOD\_SP\_HOMS[x] = "HOMS+PLS3"**(6) THEN****(7) IF** (EOI\_3\_HOMS[x] + TI\_3\_S[x] \*FAC\_N + T\_DYL\_2\_3\_MIN\_HOMS[x]\*FAC\_N)  
> EOI\_2\_HOMS[x]**(7) THEN**EOI\_2\_HOMS[x] = EOI\_3\_HOMS[x] + TI\_3\_S[x] \*FAC\_N  
+ T\_DYL\_2\_3\_MIN\_HOMS[x]\*FAC\_N**(7) ENDIF****(7) IF** (EOI\_2\_HOMS[x] + TI\_2\_S[x] \*FAC\_N + NC\_T\_MIN\_OFS\_INJ\_PLS \*FAC\_N)  
>  
(SOI\_1\_HOMS[x] - TI\_1\_S[x] \*FAC\_N)**(7) THEN**SOI\_1\_HOMS[x] = EOI\_2\_HOMS[x] + TI\_2\_S[x] \*FAC\_N + TI\_1\_S[x] \*FAC\_N  
+ NC\_T\_MIN\_OFS\_INJ\_PLS \*FAC\_N**(7) ENDIF****(6) ENDIF****(6)IF** INJ\_MOD\_SP\_HOMS[x] = "HOMS"**(6) THEN****(7) IF** (EOI\_2\_HOMS[x] + TI\_2\_S[x] \*FAC\_N + T\_DYL\_2\_3\_MIN\_HOMS[x]\*FAC\_N)  
> (SOI\_1\_HOMS[x] - TI\_1\_S[x] \*FAC\_N)**(7) THEN**SOI\_1\_HOMS[x] = EOI\_2\_HOMS[x] + TI\_2\_S[x] \*FAC\_N + TI\_1\_S[x] \*FAC\_N  
+ T\_DYL\_2\_3\_MIN\_HOMS[x]\*FAC\_N**(7) ENDIF**

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(6) ENDIF  
 (5) ENDFOR

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## 7.12 Injection phase for stratified mode - 1. pulse

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_DIF_SOI_IGN_S	O	0... F00H	0... 1440	0.375	°CRK
Output variable for LACO					
EOI_1_S [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of the first injection for stratified mode					
SOI_1_S [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Start of the first injection phase for stratified mode					

### Input data:

CRK_INJ_BAS [NC_CYL_NR] {p. 2122}	CTR_CYL_NR_ST_CLC_ INJR {p. 3327}	EOI_1_S_EXT [NC_CYL_NR] {p. 2146}	FAC_N {p. 3327}
INJ_MOD_SP_S [NC_CYL_NR] {p. 3330}	LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}	NC_CYL_NR {p. 1526}
NR_CYL_CLC_RED_INJ {p. 3331}	SOI_2_S [NC_CYL_NR] {p. 2142}	T_DLY_1_2_S_EXT [NC_CYL_NR] {p. 2146}	TI_1_S [NC_CYL_NR] {p. 2003}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EOI_1_S_MAN	-	0... 780H	0... 720	0.375	°CRK
Global application assistance for the second injection					
LC_EOI_1_S_MAN	-	0... 1H	0...1	1	-
Global application assistance switch passive/active for the second injection					

## FUNCTION DESCRIPTION:

### Application conditions

**Activation:**  $LV\_S\_CLC = 1$

**Deactivation:** -

**Initialization at Reset:** -

**Recurrence:**  $LV\_ST\_END = 0:$  10 ms  
 $LV\_ST\_END = 1:$  segment synchronous

### Formula section:


For loop for runtime optimization:

In this specification the for loop

```

FOR i = 0, i < NR_CYL_CLC_RED_INJ DO
  x = CTR_CYL_NR_ST_CLC_INJR + i
  (1a)IF x >= NC_CYL_NR
  (1a)THEN
    x = x - NC_CYL_NR
  (1a)ENDIF
<loop content>

```

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**ENDFOR**

is substituted by

**FOR** cylinder\_start to cylinder\_stop **DO**

<loop content>

**ENDFOR**

**Note:** In the for loops, x will be used as loop variable to indicate the cylinder x!

**FOR** cylinder\_start to cylinder\_stop **DO**

(1) **IF** INJ\_MOD\_SP\_S[x] ≠ "SNGS"

(1) **THEN**

EOI\_1\_S[x] = SOI\_2\_S[x] + T\_DLY\_1\_2\_S\_EXT[x] \* FAC\_N

(1) **ELSE**

(2) **IF** LC\_EOI\_1\_S\_MAN = 1

(2) **THEN**

EOI\_1\_S[x] = C\_EOI\_1\_S\_MAN

(2) **ELSE**

EOI\_1\_S[x] = EOI\_1\_S\_EXT[x]

(2) **ENDIF**


(1) **ENDIF**

SOI\_1\_S[x] = EOI\_1\_S[x] + TI\_1\_S[x] \* FAC\_N

**ENDFOR**

Output variable for LACO (10 ms synchronous):

CRK\_DIF\_SOI\_IGN\_S = SOI\_1\_S[CTR\_CYL\_NR\_ST\_CLC\_INJR] + CRK\_INJ\_BAS[0]

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## 7.13 Injection phase for stratified mode - 2. pulse

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EOI_2_S [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of the second injection for stratified mode					
SOI_2_S [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Start of the second injection for stratified mode					

### Input data:

CTR_CYL_NR_ST_CLC_INJR {p. 3327}	EOI_2_S_EXT [NC_CYL_NR] {p. 2146}	FAC_N {p. 3327}	INJ_MOD_SP_S [NC_CYL_NR] {p. 3330}
LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}	NC_CYL_NR {p. 1526}	NR_CYL_CLC_RED_INJ {p. 3331}
SOI_3_S [NC_CYL_NR] {p. 2144}	T_DLY_2_3_S_EXT [NC_CYL_NR] {p. 2146}	TI_2_S [NC_CYL_NR] {p. 2003}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EOI_2_S_MAN	-	0... 780H	0... 720	0.375	°CRK
Global application assistance for the second injection					
LC_EOI_2_S_MAN	-	0... 1H	0...1	1	-
Global application assistance switch passive/active for the second injection					

### FUNCTION DESCRIPTION:

#### Application conditions

**Activation:**  $LV\_S\_CLC = 1$

**Deactivation:**  $LV\_S\_CLC = 0$

**Initialization at Reset:** -

**Recurrence:**  $LV\_ST\_END = 0:$  10 ms  
 $LV\_ST\_END = 1:$  segment synchronous

#### Formula section:

##### For loop for runtime optimization:

In this specification the for loop

```
FOR i = 0, i < NR_CYL_CLC_RED_INJ DO
  x = CTR_CYL_NR_ST_CLC_INJR + i
  (1a)IF x >= NC_CYL_NR
  (1a)THEN
    x = x - NC_CYL_NR
  (1a)ENDIF
  <loop content>
ENDFOR
```

is substituted by

**FOR** cylinder\_start to cylinder\_stop **DO**  
 <loop content>

**ENDFOR**

**Note:** In the for loops, x will be used as loop variable to indicate the cylinder x!

**FOR** cylinder\_start to cylinder\_stop **DO**

**(1)IF** INJ\_MOD\_SP\_S[x] = "MPLS+PLS3"

**(1)THEN**

EOI\_2\_S[x] = SOI\_3\_S[x] + T\_DLY\_2\_3\_S\_EXT[x]\* FAC\_N

SOI\_2\_S[x] = EOI\_2\_S[x] + TI\_2\_S[x]\*FAC\_N

**(1)ELSE**

**(2) IF** INJ\_MOD\_SP\_S[x] = "MPLS"

**(2) THEN**

**(3) IF** LC\_EOI\_2\_S\_MAN = 1

**(3) THEN**

EOI\_2\_S[x] = C\_EOI\_2\_S\_MAN

**(3) ELSE**

EOI\_2\_S[x] = EOI\_2\_S\_EXT[x]

**(3) ENDIF**

SOI\_2\_S[x] = EOI\_2\_S[x] + TI\_2\_S[x]\*FAC\_N

**(2) ELSE**


SOI\_2\_S[x] = 0

EOI\_2\_S[x] = 0

**(2) ENDIF**

**(1) ENDIF**

**ENDFOR**

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## 7.14 Injection phase for stratified mode - 3. pulse

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EOI_3_S [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of the third injection for stratified mode					
SOI_3_S [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Start of the third injection for stratified mode					

### Input data:

CTR_CYL_NR_ST_CLC_INJR {p. 3327}	EOI_3_S_EXT [NC_CYL_NR] {p. 2146}	FAC_N {p. 3327}	INJ_MOD_SP_S [NC_CYL_NR] {p. 3330}
LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}	NC_CYL_NR {p. 1526}	NR_CYL_CLC_RED_INJ {p. 3331}
TI_3_S [NC_CYL_NR] {p. 2003}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EOI_3_S_MAN	-	0... 780H	0... 720	0.375	°CRK
Global application assistance for the third injection					
LC_EOI_3_S_MAN	-	0... 1H	0...1	1	-
Global application assistance switch passive/active for the third injection					

## FUNCTION DESCRIPTION:

### Application conditions

**Activation:**  $LV\_S\_CLC = 1$

**Deactivation:**  $LV\_S\_CLC = 0$

**Initialization at Reset:** -

**Recurrence:**  $LV\_ST\_END = 0:$  10 ms  
 $LV\_ST\_END = 1:$  segment synchronous

### Formula section:

For loop for runtime optimization:

In this specification the for loop

```

FOR i = 0, i < NR_CYL_CLC_RED_INJ DO
    x = CTR_CYL_NR_ST_CLC_INJR + i
    (1a)IF x >= NC_CYL_NR
    (1a)THEN
        x = x - NC_CYL_NR
    (1a)ENDIF
    <loop content>
  
```

**ENDFOR**

is substituted by



**FOR** cylinder\_start to cylinder\_stop **DO**  
 <loop content>

**ENDFOR**

**Note:** In the for loops, x will be used as loop variable to indicate the cylinder x!

**FOR** cylinder\_start to cylinder\_stop **DO**

(1)**IF** INJ\_MOD\_SP\_S[x] = "MPLS+PLS3"

(1)**THEN**

(2) **IF**

LC\_EOI\_3\_S\_MAN = 1

(2) **THEN**

EOI\_3\_S[x] = C\_EOI\_3\_S\_MAN

(2) **ELSE**

EOI\_3\_S[x] = EOI\_3\_S\_EXT[x]

(2) **ENDIF**

SOI\_3\_S[x] = EOI\_3\_S[x] + TI\_3\_S[x] \* FAC\_N


(1)**ELSE**

EOI\_3\_S[x] = 0

SOI\_3\_S[x] = 0

(1)**ENDIF**

**ENDFOR**

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## 7.15 Injection phase (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CAM_SHIFT_EX	O/V	FC40... 3C0H	-360 ...360	0.375	°CRK
Shift of the exhaust camshaft relative to passiv position					
CAM_SHIFT_IN	O/V	FC40... 3C0H	-360 ...360	0.375	°CRK
Shift of the inlet camshaft relative to passiv position					
EOI_1_HOMS_EXT [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of injection for homogeneous stratified mode, 1. pulse - base value from customer layer					
EOI_1_S_EXT [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of injection for stratified mode, 1.pulse - base value from customer layer					
EOI_2_HOM_EXT [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of injection for homogeneous mode, 2.pulse - base value from customer layer					
EOI_2_HOMS_EXT [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of injection for homogeneous stratified mode, 2.pulse - base value from customer layer					
EOI_2_S_EXT [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of injection for stratified mode, 2.pulse - base value from customer layer					
EOI_3_HOM_EXT [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of injection for homogeneous mode, 3.pulse - base value from customer layer					
EOI_3_HOMS_EXT [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of injection for homogeneous stratified mode, 3.pulse - base value from customer layer					
EOI_3_S_EXT [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of injection for stratified mode, 3.pulse - base value from customer layer					
LV_INJ_DI_PLS_UPD_MPLH	O/V	0... 1H	0 ...1	1	-
Flag to disable pulse updates in multiple homogeneous mode.					
LV_INJ_PLS_UPD_MPLH_DEAC	O/V	0... 1H	0 ...1	1	-
Flag to deactivate pulse updates in multiple homogeneous mode					
SOI_1_HOM_EXT [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Start of injection for homogeneous mode, 1.pulse - base value from customer layer					
SOI_1_HOMS_EXT [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Start of injection for homogeneous stratified mode, 1.pulse - base value from customer layer					
SOI_2_MAX_HOM_EXT	O/V	0... 780H	0... 720	0.375	°CRK
Earliest start of injection for the second pulse in homogeneous injection mode					
T_DLY_1_2_S_EXT [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Interval between first and second pulse of stratified injection base value from MSD70 layer					
T_DLY_2_3_MIN_HOMS [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Minimum time delay between second and third pulse for homogeneous-stratified mode					
T_DLY_2_3_S_EXT [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Interval between second and third pulse of stratified injection; base value from MSD70 layer					

### Input data:

CRK_INJ_BAS [NC_CYL_NR] {p. 2122}	CTR_CYL_NR_ST_CLC_ INJR {p. 3327}	EOI_2_HOM_CUS [NC_CYL_NR] {p. 8269}	EOI_2_HOMS_CUS [NC_CYL_NR]
EOI_3_HOM_CUS [NC_CYL_NR]	EOI_3_HOMS_CUS [NC_CYL_NR] {p. 8269}	EOI_3_S_CUS [NC_CYL_NR] {p. 8269}	FAC_N {p. 3327}
IGA_AV_H_RNG [NC_CYL_NR] {p. 1828}	INJ_MOD_SP_HOM [NC_CYL_NR] {p. 3329}	INJ_MOD_SP_HOMS [NC_CYL_NR] {p. 3329}	INJ_MOD_SP_S [NC_CYL_NR] {p. 3330}

LF_SOI_S_ENA {p. 8269}	LV_EOI_2_DELTA_HOM_CUS {p. 8269}	LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}
NC_CYL_NR {p. 1526}	NR_CYL_CLC_RED_INJ {p. 3331}	SOI_1_HOM_CUS [NC_CYL_NR] {p. 8270}	SOI_1_HOMS_CUS [NC_CYL_NR] {p. 8270}
SOI_2_MAX_CUS {p. 8270}	SOI_S_CUS [NC_CYL_NR] {p. 8270}	STATE_INJ_MOD_HOM_REQ {p. 3331}	T_DLY_1_2_S_CUS [NC_CYL_NR] {p. 8270}
T_DLY_2_3_MIN_HOMS_CUS [NC_CYL_NR] {p. 8270}	T_DLY_2_3_S_CUS [NC_CYL_NR] {p. 8270}	TI_1_S [NC_CYL_NR] {p. 2003}	TI_2_S [NC_CYL_NR] {p. 2003}
TI_3_S [NC_CYL_NR] {p. 2003}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DLY_1_2_S_EXT_MAN	-	0... FFFFH	0... 65.535	0.001	ms
Manual setpoint for time interval between first and second pulse of stratified injection					
C_T_DLY_2_3_S_EXT_MAN	-	0... FFFFH	0... 65.535	0.001	ms
Manual setpoint for time interval between second and third pulse of stratified injection					
LC_T_DLY_1_2_S_EXT_MAN_ENA	-	0... 1H	0 ...1	1	-
Switch to enable manual setpoint for time interval between first and second pulse of stratified injection					
LC_T_DLY_2_3_S_EXT_MAN_ENA	-	0... 1H	0 ...1	1	-
Switch to enable manual setpoint for time interval between second and third pulse of stratified injection					

**FUNCTION DESCRIPTION:**

In this part, the conversion of injection phasing from customer nomenclature to supplier nomenclature is done.

For calculation order purposes, the specification is divided in two parts. The part that calculates the delay times for stratified combustion mode must be calculated before the task "Final injection timing", the part that calculates the rest of the phasing must be calculated after.

**For loop for runtime optimization:**

In this specification the for loop

```

FOR i = 0, i < NR_CYL_CLC_RED_INJ DO
    x = CTR_CYL_NR_ST_CLC_INJR + i
    (1a)IF x >= NC_CYL_NR
    (1a)THEN
        x = x - NC_CYL_NR
    (1a)ENDIF
    <loop content>

```

**ENDFOR**

is substituted by

```

FOR cylinder_start to cylinder_stop DO
    <loop content>


```

**ENDFOR**

**Note:** In the for loops, x will be used as loop variable to indicate the cylinder x!

**7.15.1 Calculation of pulse delay times for stratified combustion mode**

**Note:** This task must be calculated **before** the task "Final injection timing"!

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## Application conditions

**Activation:** every engine state  
**Deactivation:** -  
**Initialization:** -  
**Recurrence:** LV\_ST\_END = 0: 10ms  
 LV\_ST\_END = 1: segment synchronous

## Formula section:

Deactivate pulse update during double injection in HOM mode with ignition related injection:

**IF** LV\_EOI\_2\_DELTA\_HOM\_CUS = 1  
**AND** STATE\_INJ\_MOD\_HOM\_REQ  $\neq$  MPLH+PLS3

**THEN**  
 LV\_INJ\_PLS\_UPD\_MPLH\_DEAC = 1

**ELSE**  
 LV\_INJ\_PLS\_UPD\_MPLH\_DEAC = 0

**ENDIF**

LV\_INJ\_DI\_PLS\_UPD\_MPLH = LV\_INJ\_PLS\_UPD\_MPLH\_DEAC

**(1)FOR** cylinder\_start to cylinder\_stop **DO**

SOI\_1\_HOM\_EXT[x] = SOI\_1\_HOM\_CUS[x] - CRK\_INJ\_BAS[0]

**(1) IF** LV\_EOI\_2\_DELTA\_HOM\_CUS = 1  
**AND** INJ\_MOD\_SP\_HOM[x]  $\neq$  MPLH+PLS3

**(1) THEN**  
 EOI\_2\_HOM\_EXT[x] = EOI\_2\_HOM\_CUS[x] + (IGA\_AV\_H\_RNG[x] - CRK\_INJ\_BAS[0])

**(1) ELSE**  
 EOI\_2\_HOM\_EXT[x] = EOI\_2\_HOM\_CUS[x] - CRK\_INJ\_BAS[0]

**(1) ENDIF**  
**(1a) IF** LV\_EOI\_2\_DELTA\_HOM\_CUS = 1  
**AND** INJ\_MOD\_SP\_HOM[x] = MPLH+PLS3

**(1a) THEN**  
 EOI\_3\_HOM\_EXT[x] = EOI\_3\_HOM\_CUS[x] + (IGA\_AV\_H\_RNG[x] - CRK\_INJ\_BAS[0])

**(1a) ELSE**  
 EOI\_3\_HOM\_EXT[x] = EOI\_3\_HOM\_CUS[x] - CRK\_INJ\_BAS[0]

**(1a) ENDIF**

**(1)IF** LV\_S\_CLC = 1

**(1)THEN**

Calculation of pulse delay times:

**(2)IF** INJ\_MOD\_SP\_S[x] = "MPLS+PLS3" (triple injection)


**(2)THEN**

T\_DLY\_1\_2\_S\_EXT[x] = T\_DLY\_1\_2\_S\_CUS[x]

T\_DLY\_2\_3\_S\_EXT[x] = T\_DLY\_2\_3\_S\_CUS[x]

**(2)ENDIF**

**(3)IF** INJ\_MOD\_SP\_S[x] = "MPLS" (double injection)

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(3)THEN

T\_DLY\_1\_2\_S\_EXT[x] = T\_DLY\_2\_3\_S\_CUS[x]

(3)ENDIF

Manual setting of pulse delay times:

(4)IF LC\_T\_DLY\_1\_2\_S\_EXT\_MAN\_ENA = 1

(4)THEN

T\_DLY\_1\_2\_S\_EXT[x] = C\_T\_DLY\_1\_2\_S\_EXT\_MAN

(4)ENDIF

(5)IF LC\_T\_DLY\_2\_3\_S\_EXT\_MAN\_ENA = 1

(5)THEN

T\_DLY\_2\_3\_S\_EXT[x] = C\_T\_DLY\_2\_3\_S\_EXT\_MAN

(5)ENDIF

(1)ENDIF

(1)ENDFOR

## 7.15.2 Calculation of injection phasing

**Note:** This task must be calculated **after** the task "Final injection timing"!

### Application conditions

**Activation:** every engine state  
**Deactivation:** -  
**Initialization:** -  
**Recurrence:** LV\_ST\_END = 0: 10ms  
 LV\_ST\_END = 1: segment synchronous

### Formula section:

CAM\_SHIFT\_EX = 0

CAM\_SHIFT\_IN = 0

SOI\_2\_MAX\_HOM\_EXT = SOI\_2\_MAX\_CUS - CRK\_INJ\_BAS[0]

(1)FOR cylinder\_start to cylinder\_stop DO

(0)IF LV\_S\_CLC = 1

(0)THEN

#### Mapping for stratified combustion mode

(1)IF INJ\_MOD\_SP\_S[x] = "MPLS+PLS3" (triple injection)

(1) THEN

(1a)IF Bit x of LF\_SOI\_S\_ENA = 0

(1a)THEN

EOI\_3\_S\_EXT[x] = EOI\_3\_S\_CUS[x] - CRK\_INJ\_BAS[0]

(1a)ELSE

EOI\_3\_S\_EXT[x] = SOI\_S\_CUS[x] - CRK\_INJ\_BAS[0]


- (TI\_3\_S[x] \* FAC\_N)

(1a)ENDIF

(1) ENDIF

(2)IF INJ\_MOD\_SP\_S[x] = "MPLS" (double injection)

(2) THEN

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**(2a)IF** Bit x of LF\_SOI\_S\_ENA = 0

**(2a)THEN**

EOI\_2\_S\_EXT[x] = EOI\_3\_S\_CUS[x] - CRK\_INJ\_BAS[0]

**(2a)ELSE**

EOI\_2\_S\_EXT[x] = SOI\_S\_CUS[x] - CRK\_INJ\_BAS[0]  
- (TI\_2\_S[x] \* FAC\_N)

**(2a)ENDIF**

1. **ENDIF**

**(3)IF** INJ\_MOD\_SP\_S[x] ="SNGS" (single injection)

**(3) THEN**

**(2a)IF** Bit x of LF\_SOI\_S\_ENA = 0

**(2a)THEN**

EOI\_1\_S\_EXT[x] = EOI\_3\_S\_CUS[x] - CRK\_INJ\_BAS[0]

**(2a)ELSE**

EOI\_1\_S\_EXT[x] = SOI\_S\_CUS[x] - CRK\_INJ\_BAS[0]  
- (TI\_1\_S[x] \* FAC\_N)

**(2a)ENDIF**

1. **ENDIF**

### Mapping for homogeneous stratified combustion mode

**(1)IF** INJ\_MOD\_SP\_HOMS[x] ="HOMS+PLS3" (triple injection)

EOI\_3\_HOMS\_EXT[x] = EOI\_3\_HOMS\_CUS[x] - CRK\_INJ\_BAS[0]

EOI\_2\_HOMS\_EXT[x] = EOI\_2\_HOMS\_CUS[x] - CRK\_INJ\_BAS[0]

SOI\_1\_HOMS\_EXT[x] = SOI\_1\_HOMS\_CUS[x] - CRK\_INJ\_BAS[0]

**(1) ENDIF**

**(2)IF** INJ\_MOD\_SP\_HOMS[x] ="HOMS" (double injection)

EOI\_2\_HOMS\_EXT[x] = EOI\_3\_HOMS\_CUS[x] - CRK\_INJ\_BAS[0]

SOI\_1\_HOMS\_EXT[x] = SOI\_1\_HOMS\_CUS[x] - CRK\_INJ\_BAS[0]

**(2) ENDIF**

**(3)IF** INJ\_MOD\_SP\_HOMS[x] ="HOMS-SNG" (single injection)

EOI\_1\_HOMS\_EXT[x] = EOI\_3\_HOMS\_CUS[x] - CRK\_INJ\_BAS[0]

**(3) ENDIF**

T\_DLY\_2\_3\_MIN\_HOMS[x] = T\_DLY\_2\_3\_MIN\_HOMS\_CUS[x]

**(0)ENDIF** - LV\_S\_CLC

**(1) ENDFOR**

## 7.16 Calculation of mass fuel flow setpoint

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MFF_SP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow setpoint after combustion selection, bank selective					
MFF_SP_FUP_CTL	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow setpoint for fuel pressure control					
MFF_SP_HOM [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow setpoint for homogeneous mode, bank selective					
MFF_SP_HOM_BAS_MV	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Arithmetic Mean of mass fuel flow setpoint for homogeneous mode					
MFF_SP_HOM_ENG [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow setpoint after combustion selection					
MFF_SP_MV	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow setpoint after combustion selection					

### Input data:

LV_IGA_AND_INJ_SWI {p. 8136}	LV_ST_END {p. 1720}	MFF_SP_1_HOM [NC_CYL_NR] {p. 8242}	MFF_SP_1_S [NC_CYL_NR] {p. 8242}
MFF_SP_2_HOM [NC_CYL_NR] {p. 8242}	MFF_SP_2_S [NC_CYL_NR] {p. 8242}	MFF_SP_3_HOM [NC_CYL_NR] {p. 8243}	MFF_SP_3_S [NC_CYL_NR] {p. 8243}
MFF_SP_HOM_BAS [NC_CBK_EX_NR] {p. 8243}	SUM_INH_INJ {p. 2295}		

### FUNCTION DESCRIPTION:

#### General information:

MFF\_SP\_MV is set to MFF\_SP\_HOM or MFF\_SP\_S depending on LV\_IGA\_AND\_INJ\_SWI.  
MFF\_SP serves as input, e.g. for the function „Fuel Pressure Control”.


#### Application conditions

<b>Initialisation:</b>	at reset
<b>Recurrence:</b>	If LV_ST_END = 0: 10 ms If LV_ST_END = 1: every TDC
<b>Activation:</b>	every engine state
<b>Deactivation:</b>	-

#### Formula section:

##### Calculation of MFF\_SP\_MV and MFF\_SP\_FUP\_CTL:

IF LV\_IGA\_AND\_INJ\_SWI = 1 (homogeneous mode)  
THEN MFF\_SP\_MV = (MFF\_SP\_1\_HOM[x] + MFF\_SP\_2\_HOM[x] + MFF\_SP\_3\_HOM[x])  
/NC\_CYL\_NR

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```

MFF_SP_FUP_CTL = MFF_SP_MV * (1-(SUM_INH_INJ /NC_CYL_NR))
ELSE (stratified mode)
MFF_SP_MV      = (MFF_SP_1_S[x] + MFF_SP_2_S[x] + MFF_SP_3_S[x]) /NC_CYL_
NR
MFF_SP_FUP_CTL = MFF_SP_MV * (1-(SUM_INH_INJ /NC_CYL_NR))
ENDIF

```

**Calculation of MFF\_SP[NC\_CBK\_EX\_NR]:**

```

IF NC_CBK_EX_NR > 1 (please note physical meaning)
THEN
FOR i = 1 TO NC_CBK_EX_NR (please note physical meaning)
MFF_SP[i] = 0
ENDFOR
FOR x = 0 TO (NC_CYL_NR - 1)
IF (NC_LAMB_REF AND 2x) ≠ 0 (bitwise)
THEN
Bank 2:
IF LV_IGA_AND_INJ_SWI = 1 (homogeneous mode)
THEN MFF_SP[2] += MFF_SP_1_HOM[x] + MFF_SP_2_HOM[x]
+ MFF_SP_3_HOM[x]
ELSE (stratified mode)
MFF_SP[2] += MFF_SP_1_S[x] + MFF_SP_2_S[x] +
MFF_SP_3_S[x]
ENDIF
ELSE
Bank 1:
IF LV_IGA_AND_INJ_SWI = 1 (homogeneous mode)
THEN MFF_SP[1] += MFF_SP_1_HOM[x] + MFF_SP_2_HOM[x]
+ MFF_SP_3_HOM[x]
ELSE (stratified mode)
MFF_SP[1] += MFF_SP_1_S[x] + MFF_SP_2_S[x] +
MFF_SP_3_S[x]
ENDIF
ENDIF
ENDFOR
FOR i = 1 TO NC_CBK_EX_NR
MFF_SP[i] = MFF_SP[i] / (NC_CYL_NR / NC_CBK_EX_NR)
ENDFOR
ELSE
MFF_SP[1] = 0
FOR x = 0 TO (NC_CYL_NR - 1)
IF LV_IGA_AND_INJ_SWI = 1 (homogeneous mode)
THEN MFF_SP[1] += MFF_SP_1_HOM[x] + MFF_SP_2_HOM[x]
+ MFF_SP_3_HOM[x]
ELSE (stratified mode)
MFF_SP[1] += MFF_SP_1_S[x] + MFF_SP_2_S[x] +
MFF_SP_3_S[x]
ENDIF
ENDFOR
MFF_SP[1] = MFF_SP[1] / NC_CYL_NR
ENDIF

```

**Calculation of MFF\_SP\_HOM[NC\_CBK\_EX\_NR]:**

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```

IF    NC_CBK_EX_NR > 1                (please note physical meaning)
THEN
    FOR i = 1 TO NC_CBK_EX_NR        (please note physical meaning)
        MFF_SP_HOM[i] = 0
    ENDFOR

    FOR x = 0 TO (NC_CYL_NR - 1)
        IF (NC_LAMB_REF AND 2x) ≠ 0    (bitwise)
            THEN
                Bank 2:
                    MFF_SP_HOM[2] += MFF_SP_1_HOM[x] + MFF_SP_2_HOM[x]
                                + MFF_SP_3_HOM[x]

                ELSE
                    Bank 1:
                    MFF_SP_HOM[1] += MFF_SP_1_HOM[x] + MFF_SP_2_HOM[x]
                                + MFF_SP_3_HOM[x]

                ENDIF
            ENDFOR
        ENDFOR

    FOR i = 1 TO NC_CBK_EX_NR
        MFF_SP_HOM[i] = MFF_SP_HOM[i] / (NC_CYL_NR / NC_CBK_EX_NR)
        MFF_SP_HOM_ENG[i] = MFF_SP_HOM[i]
    ENDFOR

ELSE
    MFF_SP_HOM[1] = 0
    FOR x = 0 TO (NC_CYL_NR - 1)
        MFF_SP_HOM[1] += MFF_SP_1_HOM[x] + MFF_SP_2_HOM[x]
                    + MFF_SP_3_HOM[x]

    ENDFOR
    MFF_SP_HOM[1] = MFF_SP_HOM[1] / NC_CYL_NR
    MFF_SP_HOM_ENG[1] = MFF_SP_HOM[1]
ENDIF


```

**Calculation of MFF\_SP\_HOM\_BAS\_MV:**

```

MFF_SP_HOM_BAS_MV = SUM( MFF_SP_HOM_BAS[NC_CBK_EX_NR] )
                    / NC_CBK_EX_NR

```

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## 7.17 Homogeneous catalyst heating with multiple injection 1. pulse

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
SOI_1_MPLH_CH [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Start of 1st injection for catalyst heating with multiple injection in homogeneous					

### Input data:

LV_IS {p. 1720}	LV_MPLH_ACT {p. 8269}	MAF {p. 8277}	N_32 {p. 1525}
NC_CYL_NR {p. 1526}	STATE_CH {p. 1777}	STATE_CH_MOD {p. 1796}	STATE_CH_MOD_REQ {p. 1796}
TCO {p. 1100}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_SOI_1_MPLH_CH_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual setting of start of injection for catalyst heating					
IP_SOI_1_CH_ADD_TCO	-	0... F00H	-720 ...720	0.375	°CRK
LDP_TCO_IP_SOI_1_CH_ADD_TCO	6	0... FEH	-48... 142.5	0.75	°C
Additive value for end of 1st injection related to ignition angle depending on coolant temperature					
IP_SOI_1_MPLH_CH_AST	V	0... 780H	0... 720	0.375	°CRK
LDPM_N_32_7_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_EXTC	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic start of injection for CH					
IP_SOI_1_MPLH_CH_AST_IS	V	0... 780H	0... 720	0.375	°CRK
LDPM_N_32_5_EXTC	6	0... FFH	0... 8160	32	rpm
LDP_MAF_IP_SOI_1_MPLH_CH_AST_IS	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic start of injection for CH in idle					
IP_SOI_1_MPLH_CH_SO2P	V	0... 780H	0... 720	0.375	°CRK
LDPM_N_32_8_EXTC	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_2_EXTC	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic start of injection for MPLH during catalyst heating for desulfation					
LC_SOI_1_MPLH_CH_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of start of injection for catalyst heating					

### Overview

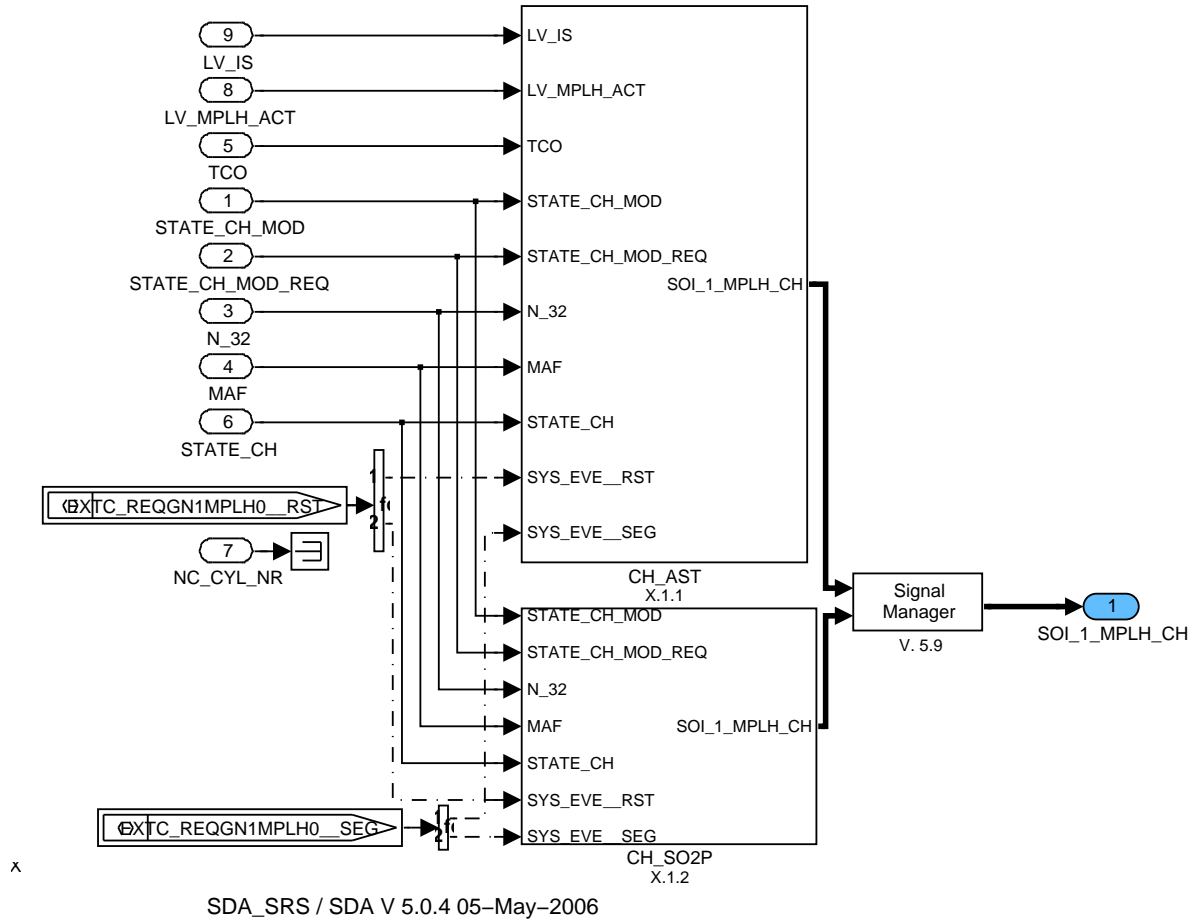


Figure 7.17.1: : Path: EXTC\_REQGN1MPLH0

**General Information**

In this module a special phasing of the 1st pulse in homogeneous split injection in case of catalyst heating is generated.

**7.17.1 Catalyst heating after start**

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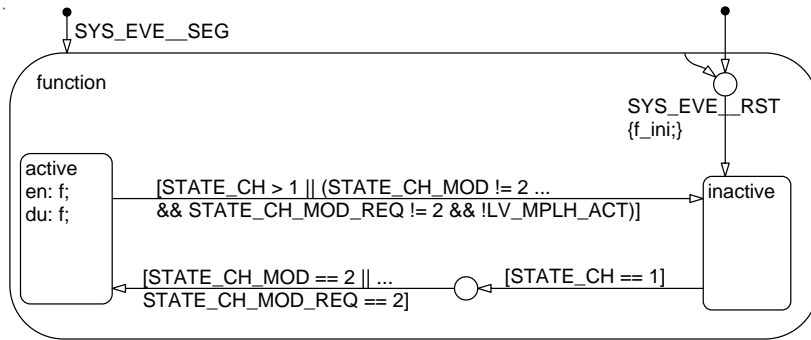


Figure 7.17.2: : Path: EXTC\_REQGN1MPLH0/CH\_AST/APP\_CDN/Chart

**Function description**

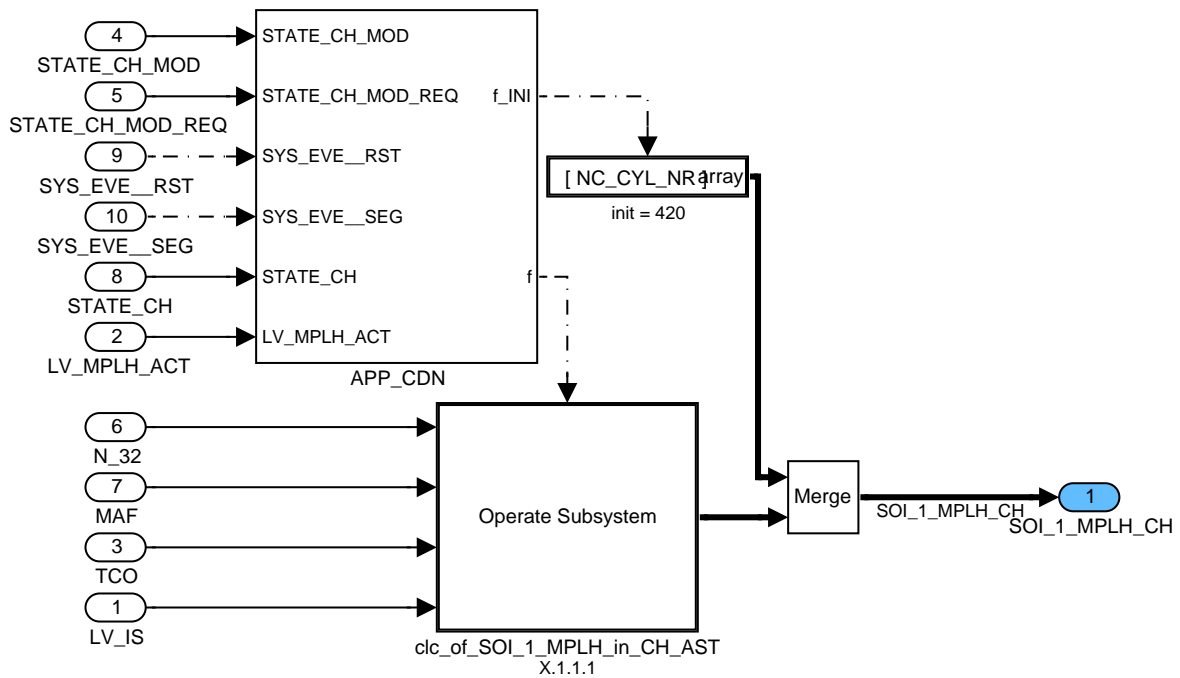


Figure 7.17.3: : Path: EXTC\_REQGN1MPLH0/CH\_AST

**7.17.1.1 Catalyst heating after start - Subsystem**

In the For-system the scalar value is written to each row of the NC\_CYL\_NR-dimensional vector.

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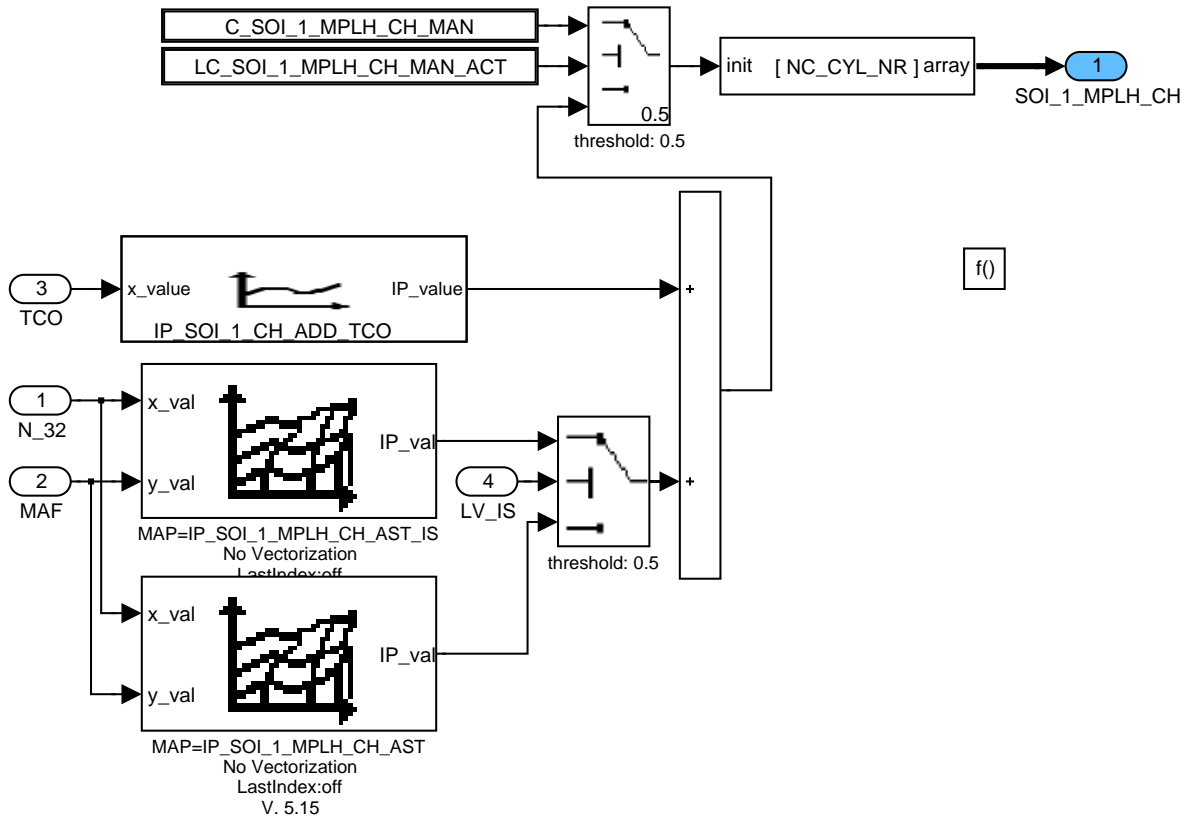


Figure 7.17.4: : Path: EXTC\_REQGN1MPLH0/CH\_AST/clc\_of\_SOI\_1\_MPLH\_in\_CH\_AST

### 7.17.2 Catalyst heating for desulfation

#### Application Conditions

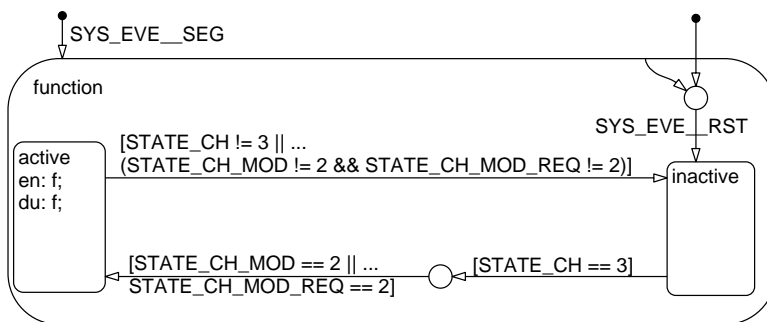


Figure 7.17.5: : Path: EXTC\_REQGN1MPLH0/CH\_SO2P/APP\_CDN/Chart

#### Function description

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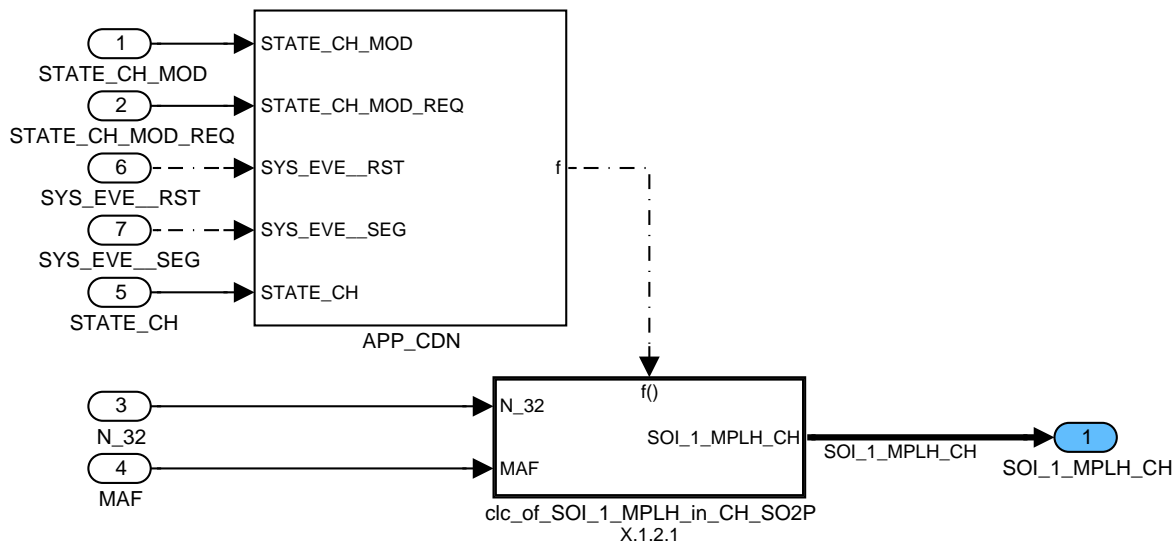


Figure 7.17.6: : Path: EXTC\_REQGN1MPLH0/CH\_SO2P

### 7.17.2.1 Catalyst heating for desulfation - Subsystem

In the For-system the scalar value is written to each row of the NC\_CYL\_NR-dimensional vector.

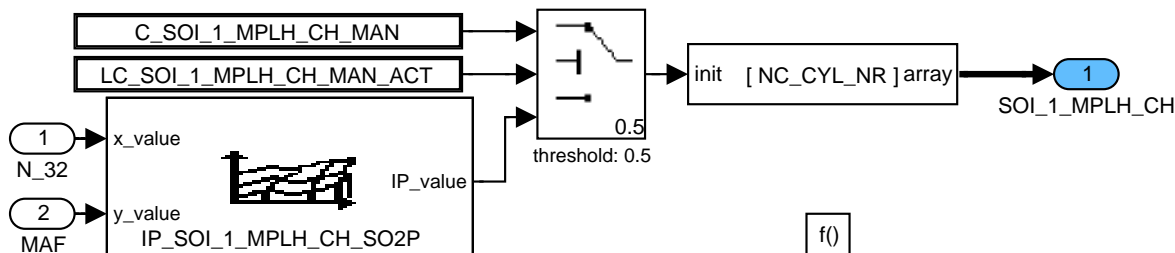


Figure 7.17.7: : Path: EXTC\_REQGN1MPLH0/CH\_SO2P/clc\_of\_SOI\_1\_MPLH\_in\_CH\_SO2P

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## 7.18 Homogeneous catalyst heating with multiple injection 2. pulse

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EOI_2_DELTA_MPLH_CH	O/V	0... 780H	0... 720	0.375	°CRK
End of injection of the second injection for catalyst heating - related to ignition angle					

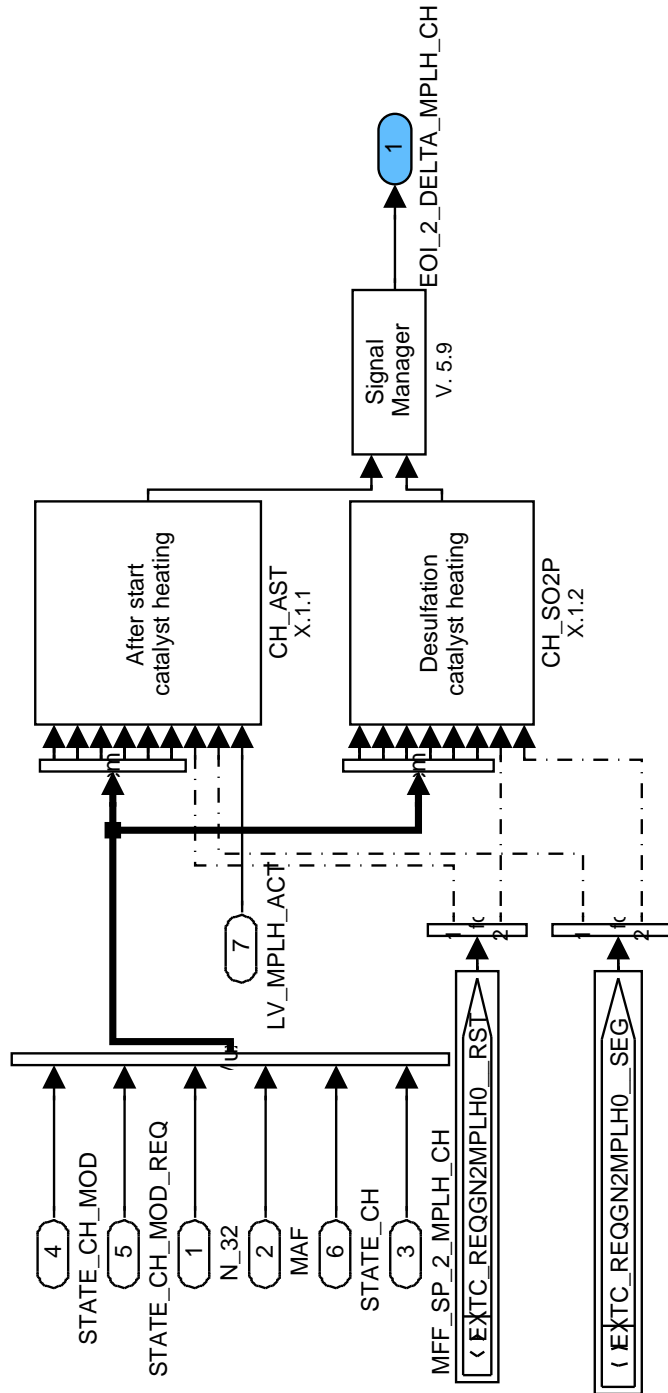
### Input data:

LV_MPLH_ACT {p. 8269}	MAF {p. 8277}	MFF_SP_2_MPLH_CH {p. 2164}	N_32 {p. 1525}
STATE_CH {p. 1777}	STATE_CH_MOD {p. 1796}	STATE_CH_MOD_REQ {p. 1796}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EOI_2_DELTA_MPLH_CH_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual setting of end of injection of the second injection for catalyst heating					
IP_EOI_2_DELTA_MPLH_CH_AST	-	0... 780H	0... 720	0.375	°CRK
LDPM_N_32_7_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_EXTC	6	0... FFFFH	0... 1389	0.0211948	mg/stk
End of 2nd injection in after start catalyst heating in homogeneous with split injection- related to ignition angle					
IP_EOI_2_DELTA_MPLH_CH_SO2P	-	0... 780H	0... 720	0.375	°CRK
LDPM_N_32_8_EXTC	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_2_EXTC	8	0... FFFFH	0... 1389	0.0211948	mg/stk
End of 2nd injection in desulfation catalyst heating in homogeneous with split injection- related to ignition angle					
IP_EOI_2_MPLH_CH_ADD_MFF_2	-	0... F00H	-720 ...720	0.375	°CRK
LDP_MFF_2_IP_EOI_2_MPLH_CH_ADD	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Additive value for end of 2nd injection					
LC_EOI_2_DELTA_MPLH_CH_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of end of injection of the second injection for catalyst heating					

### Overview



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Figure 7.18.1: : Path: EXTC\_REQGN2MPLH0

**General Information**

For catalyst heating in homogeneous split mode an additional injection pulse is generated. This module contains the phasing of this pulse.

EOI\_2\_DELTA\_MPLH\_CH therefore is defined as crankshaft angle difference between end of injection of 2nd pulse and ignition angle.

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### 7.18.1 After start catalyst heating

#### Application Conditions

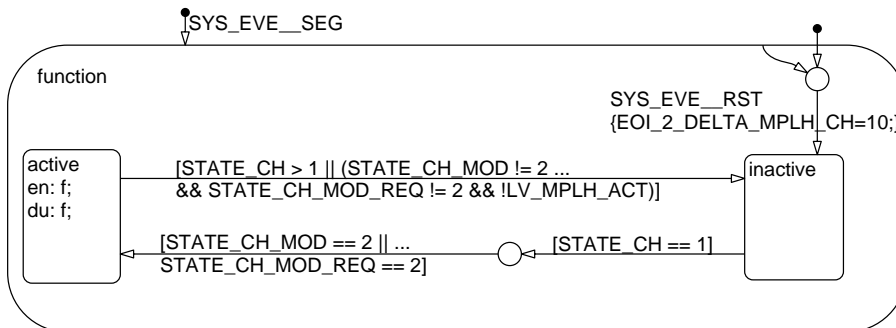


Figure 7.18.2: : Path: EXTC\_REQGN2MPLH0/CH\_AST/APP\_CDN/Chart

#### Function description

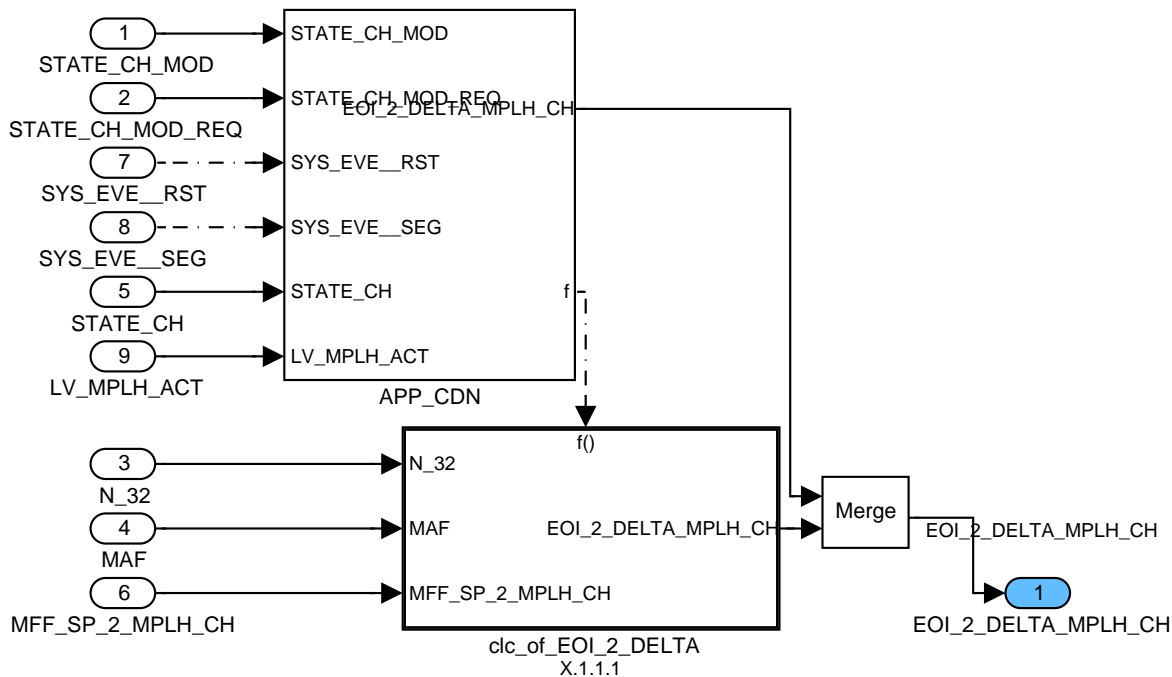


Figure 7.18.3: : Path: EXTC\_REQGN2MPLH0/CH\_AST

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### 7.18.1.1 Calculation of phasing for 2nd pulse

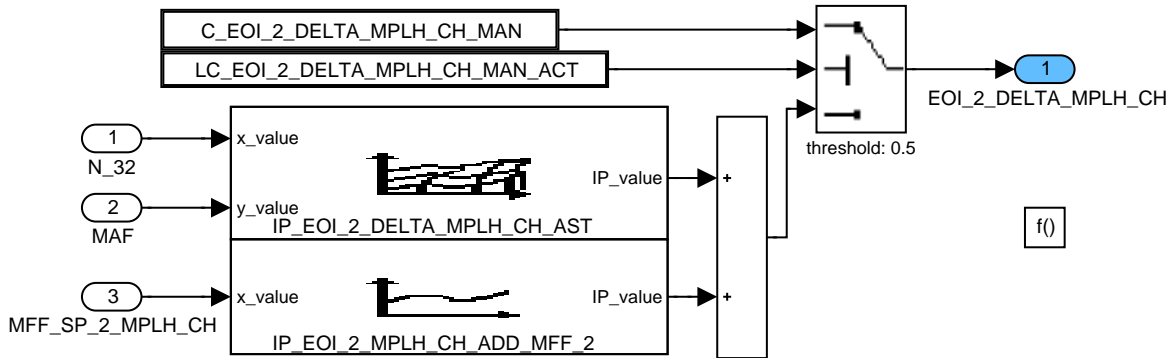


Figure 7.18.4: : Path: EXTC\_REQGN2MPLH0/CH\_AST/clc\_of\_EOI\_2\_DELTA

### 7.18.2 Desulfation catalyst heating

#### Application Conditions

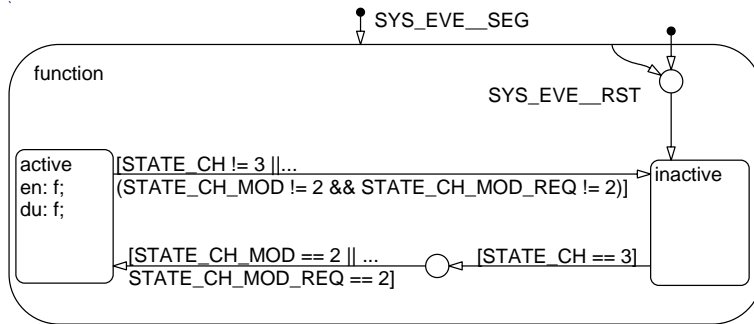


Figure 7.18.5: : Path: EXTC\_REQGN2MPLH0/CH\_SO2P/APP\_CDN/Chart

#### Function description

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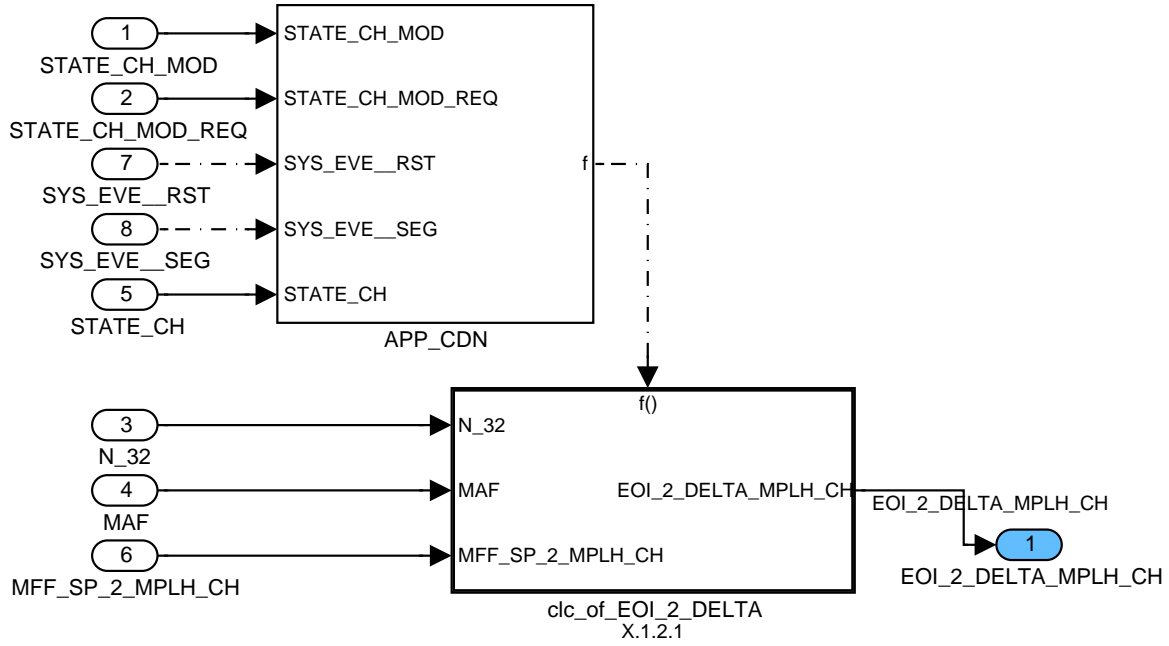


Figure 7.18.6: : Path: EXTC\_REQGN2MPLH0/CH\_SO2P

### 7.18.2.1 Calculation of phasing for 2nd pulse

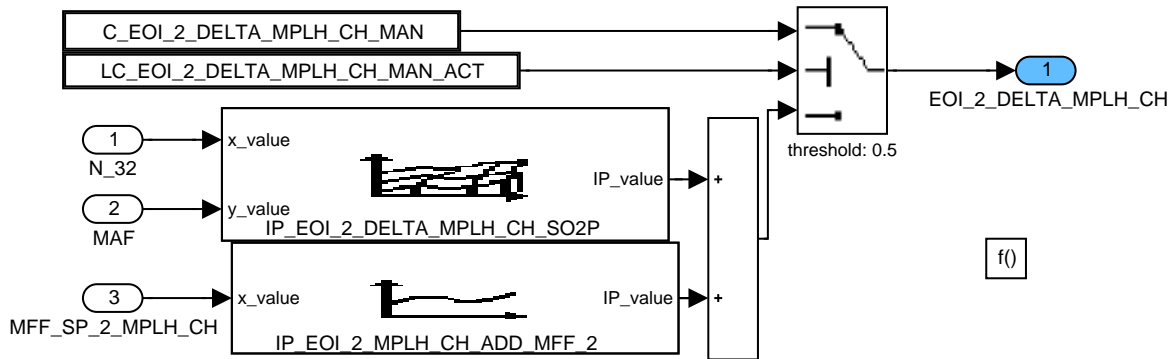


Figure 7.18.7: : Path: EXTC\_REQGN2MPLH0/CH\_SO2P/clc\_of\_EOI\_2\_DELTA

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## 7.19 Fuel mass split up for catalyst heating

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MFF_SP_2_MPLH_CH	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass for second injection pulse					

### Input data:

IGA_AV_MV_H_RNG {p. 1828}	LV_MPLH_ACT {p. 8269}	MAF {p. 8277}	N_32 {p. 1525}
STATE_CH {p. 1777}	STATE_CH_MOD {p. 1796}	STATE_CH_MOD_REQ {p. 1796}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MFF_SP_2_MPLH_CH_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Manual setting of fuel mass for second injection pulse					
IP_MFF_SP_2_ADD_IGA_CH	-	0... FFFFH	-694.5... 694.4788	0.02119-	mg/stk
LDP_IGA_H_RNG_IP_MFF_2_MPLH_CH	4	0... B40H	-90 ...90	0.0625	°CRK
Ignition angle depending correction of fuel mass for second injection pulse					
IP_MFF_SP_2_MPLH_CH_AST	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_32_7_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_EXTC	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic fuel mass for second injection pulse in after start catalyst heating					
IP_MFF_SP_2_MPLH_CH_SO2P	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_32_8_EXTC	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_2_EXTC	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass for second injection pulse in desulfation catalyst heating					
LC_MFF_SP_2_MPLH_CH_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of fuel mass for second injection pulse					

### Overview

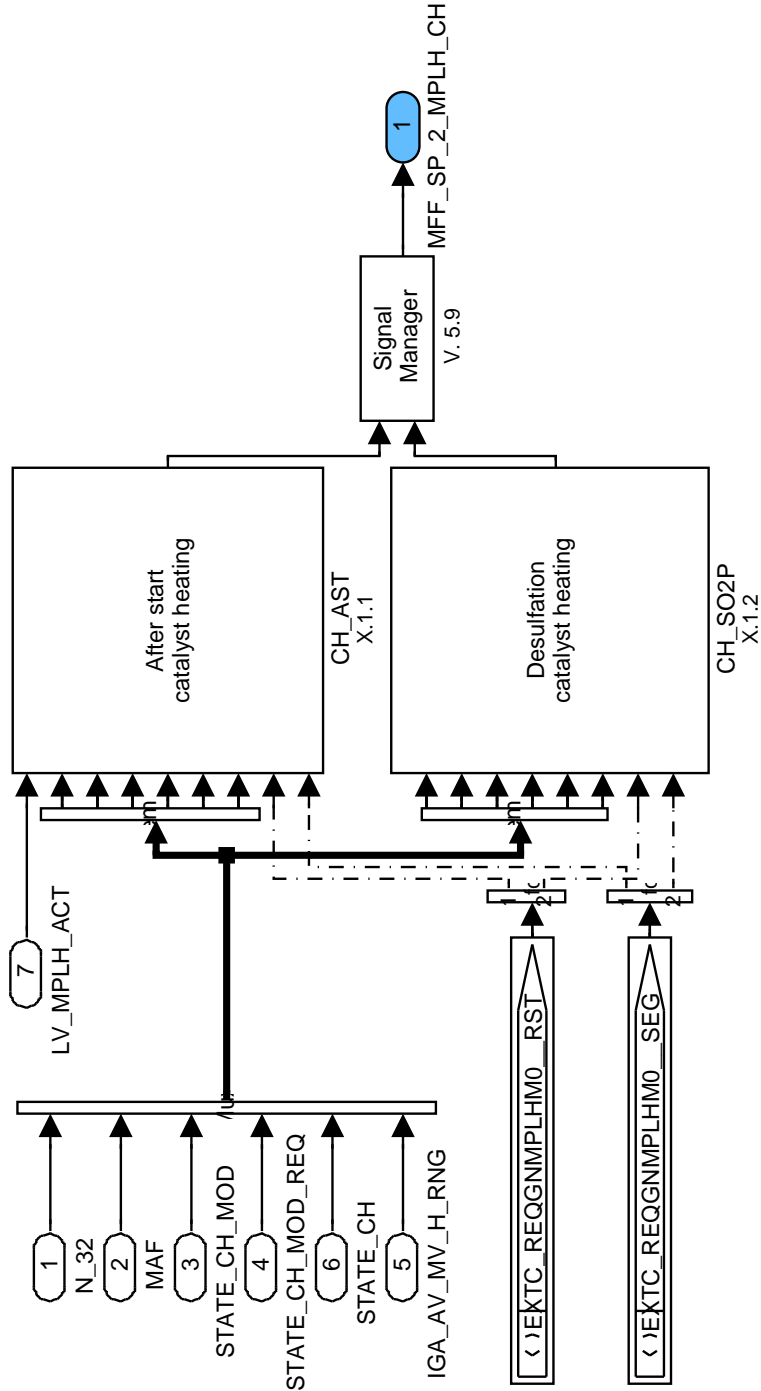



Figure 7.19.1: Path: EXTC\_REQGNMPLHM0

**General Information**

To heat up the catalyst a 2nd fuel mass pulse is injected in homogeneous mode short time before ignition. In this module the mass of this pulse is generated.

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The ignition angle is being retarded to increase the exhaust temperature. The 2nd injection mass MFF\_SP\_2\_MPLH\_CH should be calculated depending on ignition angle. That is done through IGA\_AV\_MV\_H\_RNG.

### 7.19.1 After start catalyst heating

#### Application Conditions

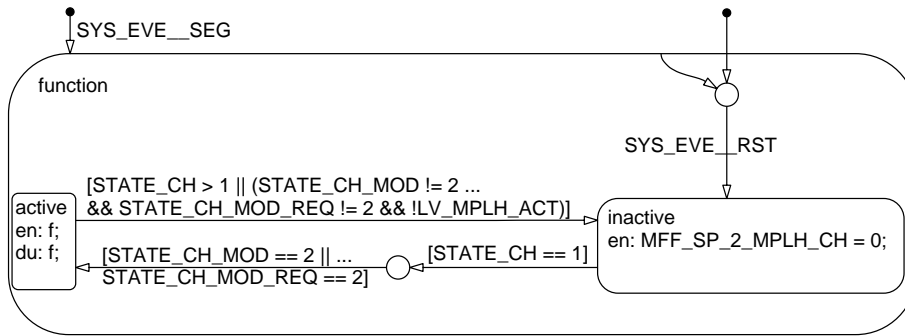
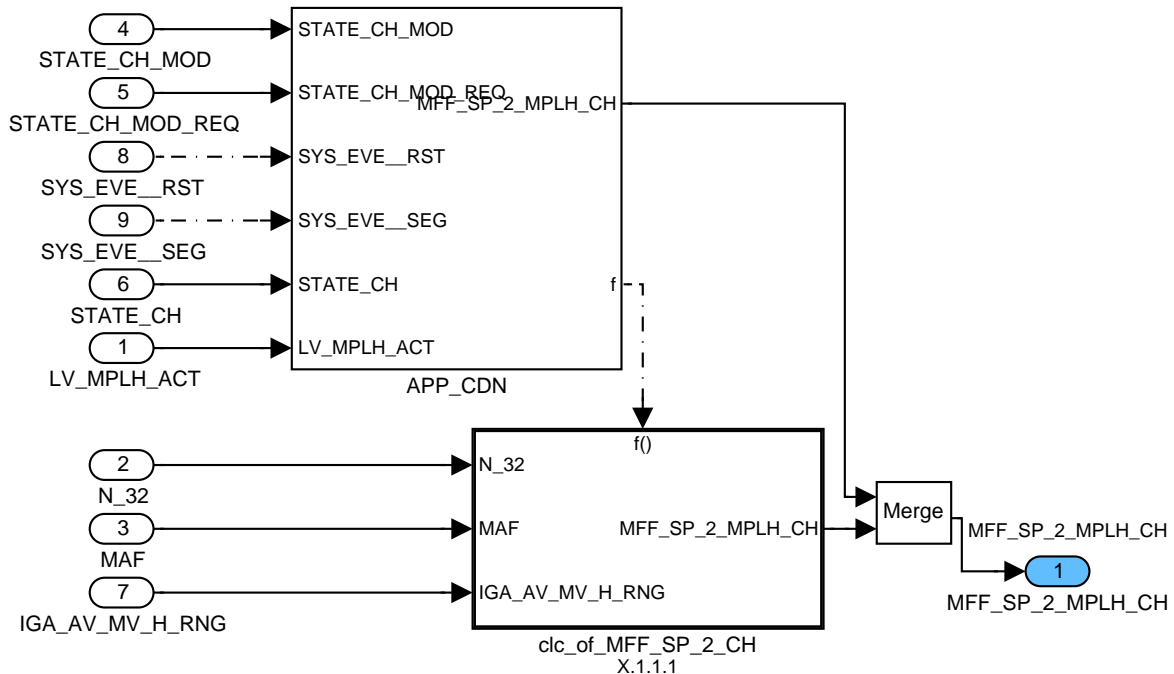



Figure 7.19.2: : Path: EXTC\_REQGNMPLHM0/CH\_AST/APP\_CDN/Chart

#### Function description



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Figure 7.19.3: : Path: EXTC\_REQGNMPLHM0/CH\_AST

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### 7.19.1.1 Function: After start catalyst heating

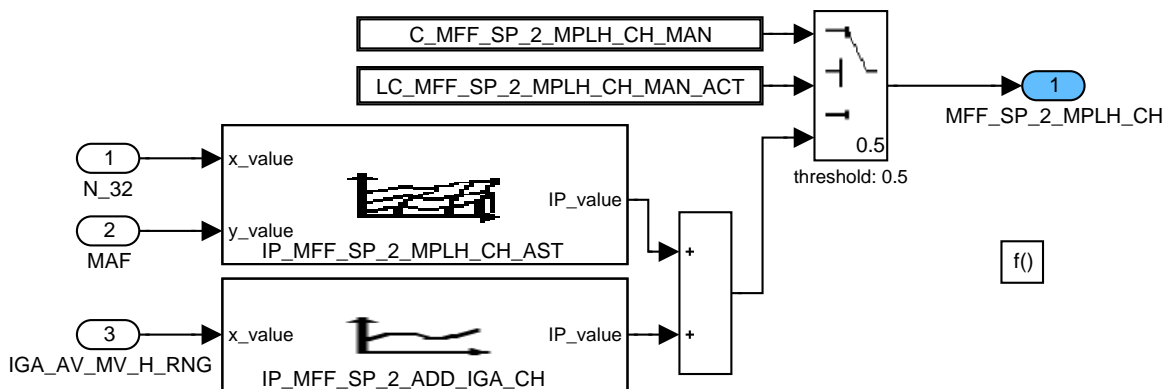


Figure 7.19.4: : Path: EXTC\_REQGNMPLHM0/CH\_AST/clc\_of\_MFF\_SP\_2\_CH

### 7.19.2 Desulfation catalyst heating

#### Application Conditions

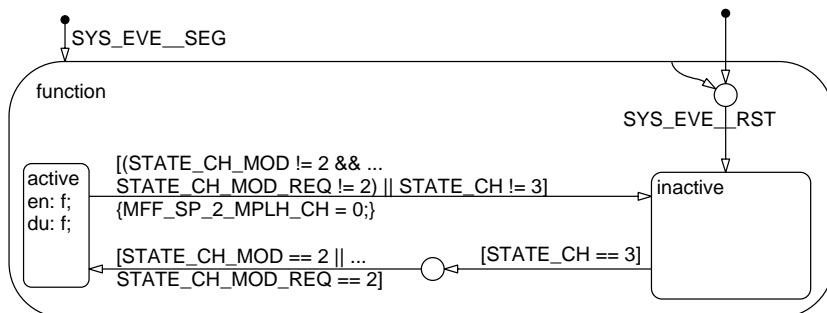


Figure 7.19.5: : Path: EXTC\_REQGNMPLHM0/CH\_SO2P/APP\_CDN/Chart

#### Function description

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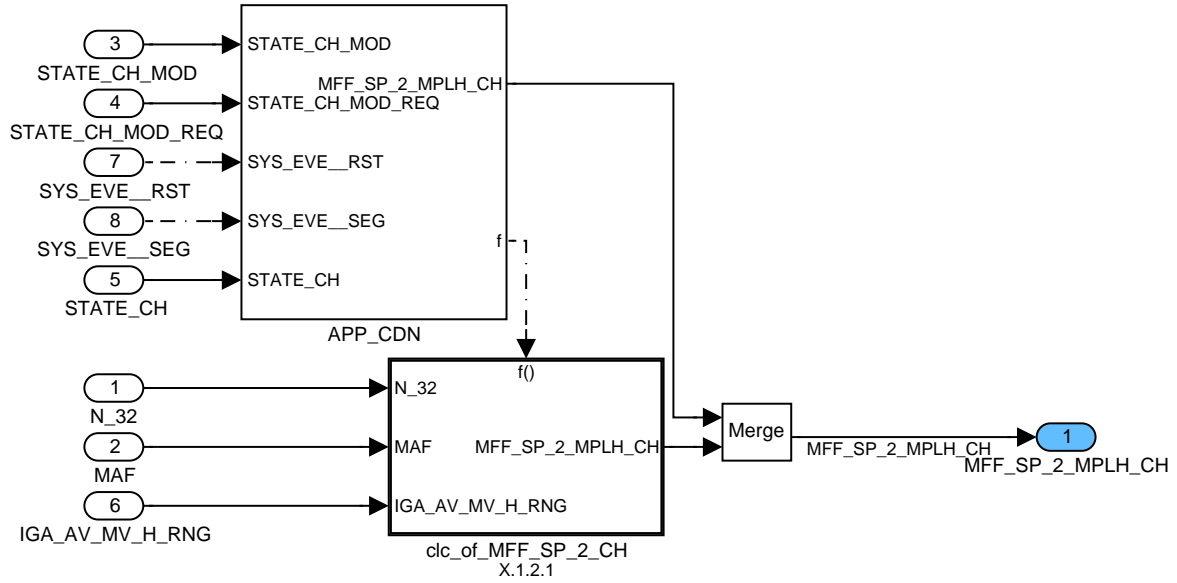


Figure 7.19.6: : Path: EXTC\_REQGNMPLHM0/CH\_SO2P

### 7.19.2.1 Function: Desulfation catalyst heating

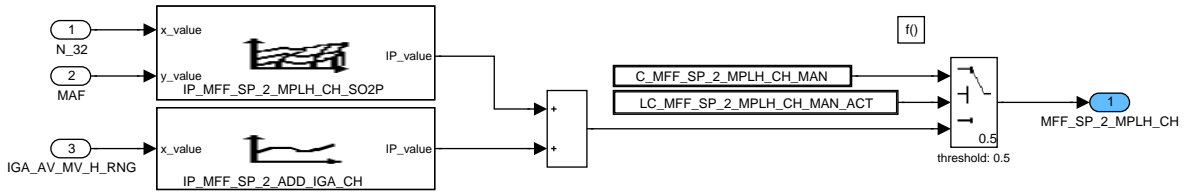


Figure 7.19.7: : Path: EXTC\_REQGNMPLHM0/CH\_SO2P/clc\_of\_MFF\_SP\_2\_CH

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## 7.20 Lambda setpoint for catalyst heating

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_SP_CH [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Lambda setpoint for catalyst heating - bankselective					
LAMB_SP_CH_SO2P [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Lambda setpoint for catalyst heating - bankselective, during desulfation					

### Input data:

LAMB_PULS_SO2P [NC_CBK_EX_NR] {p. 3150}	LAMB_SO2P [NC_CBK_EX_NR] {p. 3129}	LV_DLY_CH_MOD_REQ_ SO2P_HOM {p. 1813}	LV_IS {p. 1720}
LV_SO2P_FAST_REQ {p. 3129}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	STATE_CH {p. 1777}
STATE_CH_MOD {p. 1796}	STATE_CH_MOD_REQ {p. 1796}	T_AST {p. 1766}	TCO {p. 1100}
TQI_REQ_SLOW {p. 8391}			


### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_MV_CH_L_RGN	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Mean lambda value during catalyst heating with lambda split					
C_LAMB_SP_CH_MAN [NC_CBK_EX_NR]	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Manual setting of lambda setpoint for catalyst heating - bankselective					
IP_LAMB_ADD_CH_AST_HOM	V	0... 7FFFH	-16... 15.9990234375	976.563e-6	-
LDPM_T_AST_4_EXTC	6	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_5_EXTC	8	0... FEH	-48... 142.5	0.75	°C
T_AST and TCO depending additional correction for lambda setpoint for catalyst heating					
IP_LAMB_ADD_CH_AST_MPLH	V	0... 7FFFH	-16... 15.9990234375	976.563e-6	-
LDPM_T_AST_4_EXTC	6	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_5_EXTC	8	0... FEH	-48... 142.5	0.75	°C
T_AST and TCO depending additional correction for lambda setpoint for catalyst heating with dual injection					
IP_LAMB_CH_AST_HOM	V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDPM_N_32_10_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_SLOW_3_EXTC	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Lambda setpoint for homogeneous after start catalyst heating in idle speed					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_LAMB_CH_AST_HOM_IS	V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDPM_N_32_9_EXTC	4	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_SLOW_4_EXTC	4	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Lambda setpoint for homogeneous after start catalyst heating in idle speed					
IP_LAMB_CH_AST_MPLH	V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDPM_N_32_10_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_SLOW_3_EXTC	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Lambda setpoint for homogeneous after start catalyst heating with dual injection					
IP_LAMB_CH_AST_MPLH_IS	V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDPM_N_32_9_EXTC	4	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_SLOW_4_EXTC	4	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Lambda setpoint for homogeneous catalyst heating with dual injection in idle speed					
IP_LAMB_CH_L_RGN	V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDP_N_32_IP_LAMB_CH_L_RGN	6	0... FFH	0... 8160	32	rpm
LDP_TQI_REQ_SLOW_IP_LAMB_CH_RGN	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Lambda split value for enriched bank.					
LC_LAMB_SO2P_FAST_ENA	-	0... 1H	0 ...1	1	-
Enables using of LAMB_SO2P in case of LV_SO2P_FAST_REQ (fast desulfation without wobble)					
LC_LAMB_SP_CH_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of LAMB_SP_CH					
LC_LAMB_SP_CH_SO2P_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of LAMB_SP_CH_SO2P					

## Overview

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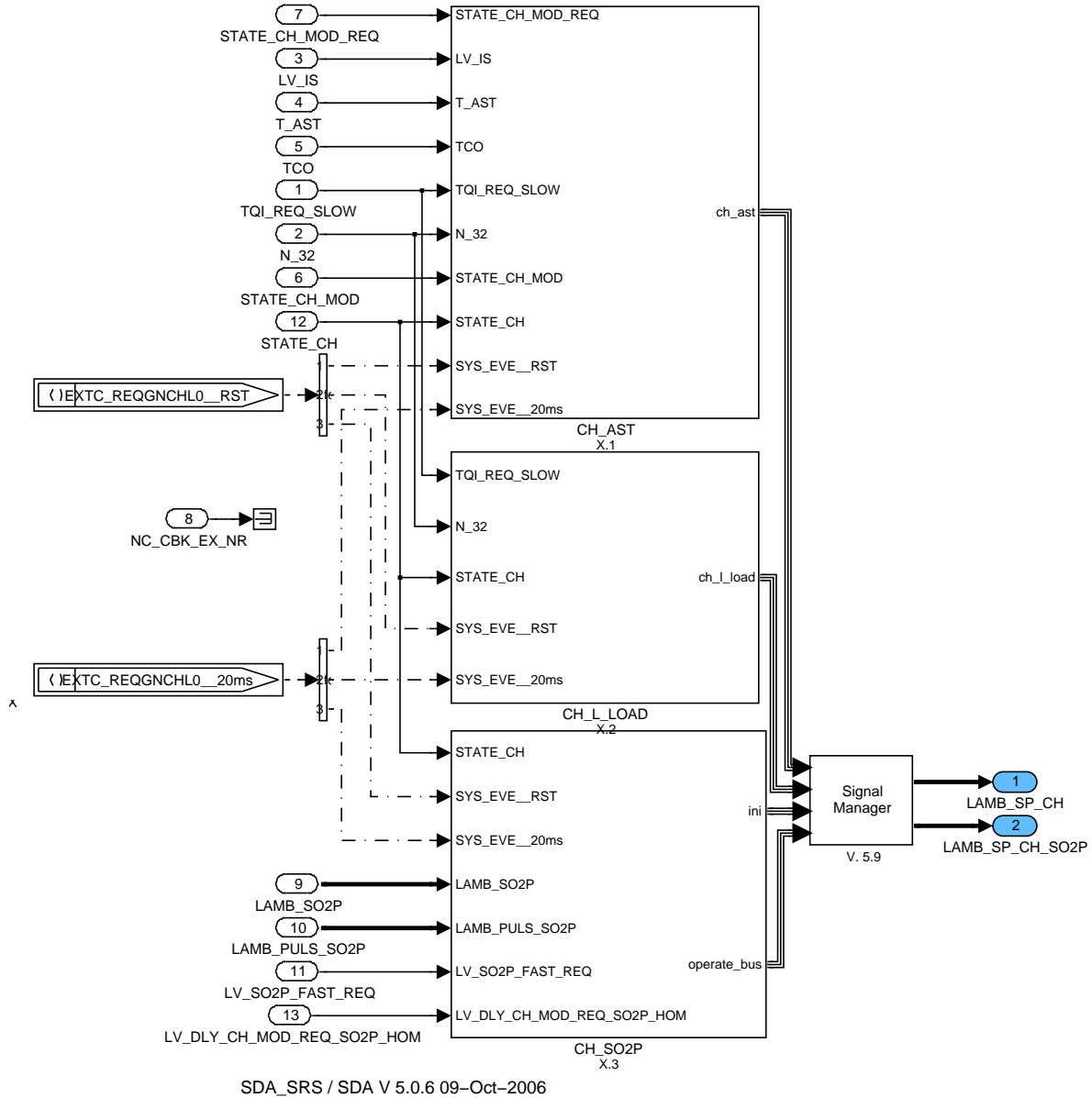


Figure 7.20.1: : Path: EXTC\_REQGNCHL0

**General Information**


In this module a lambda-setpoint for homogeneous catalyst heating is generated.

**7.20.1 After start catalyst heating**

In stratified mode the lambda setpoint is also calculated if homogenous (split) mode is requested by STATE\_CH\_MOD\_REQ.

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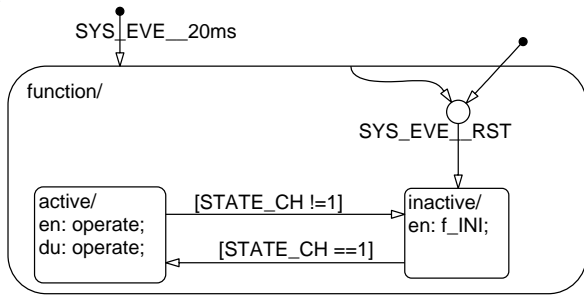



Figure 7.20.2: : Path: EXTC\_REQGNCHL0/CH\_AST/APP\_CDN/Chart

**Function description**

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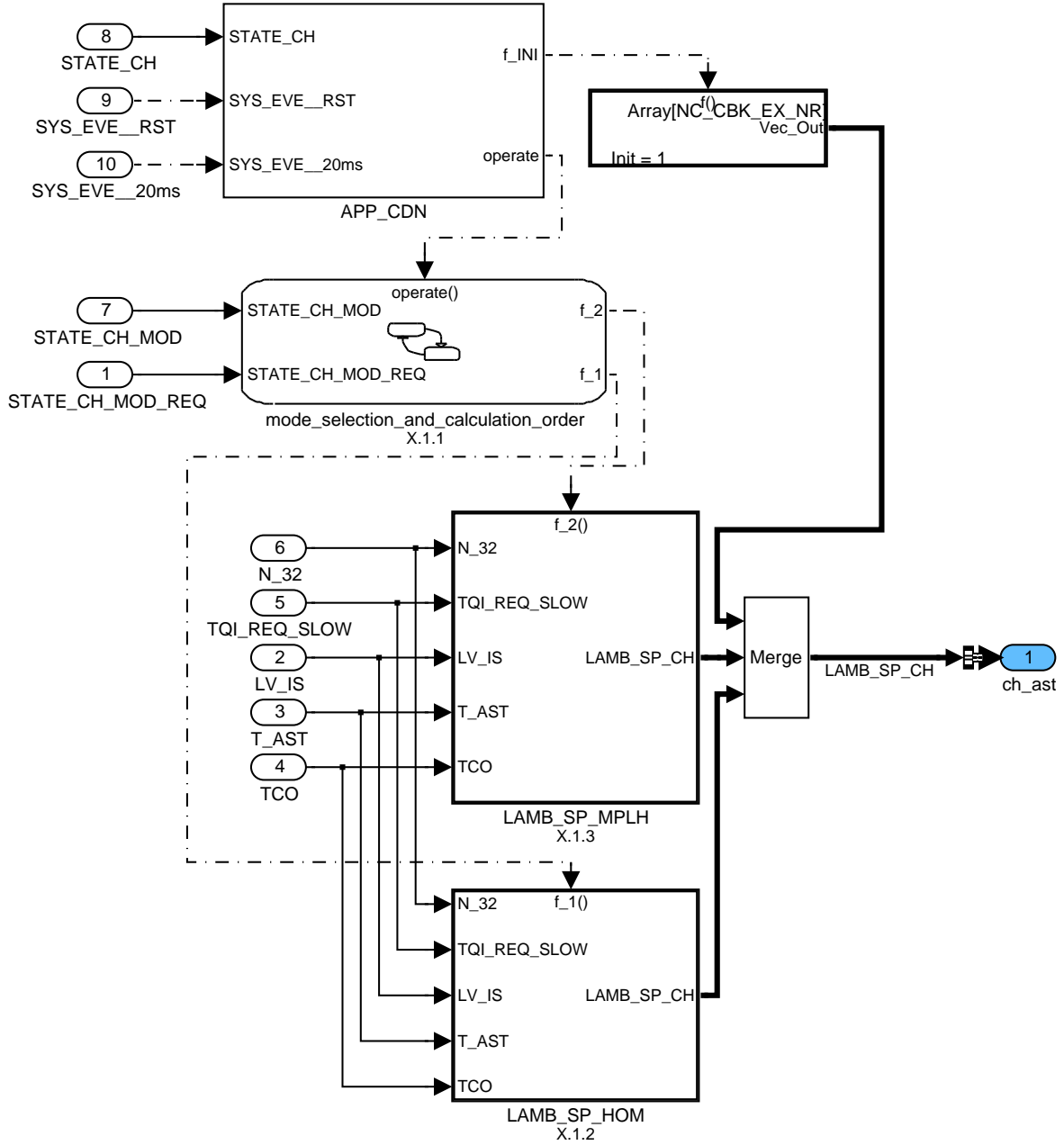


Figure 7.20.3: : Path: EXTC\_REQGNCHL0/CH\_AST

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### 7.20.1.1 No title given

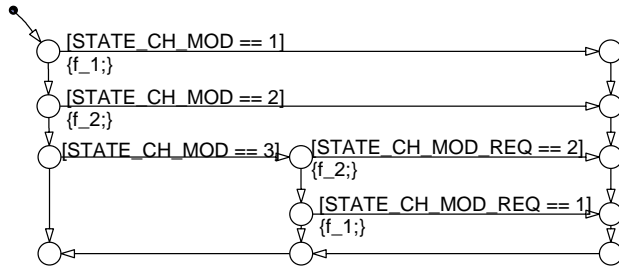


Figure 7.20.4: : Path: EXTC\_REQGNCHL0/CH\_AST/mode\_selection\_and\_calculation\_order

### 7.20.1.2 After start catalyst heating, single injection

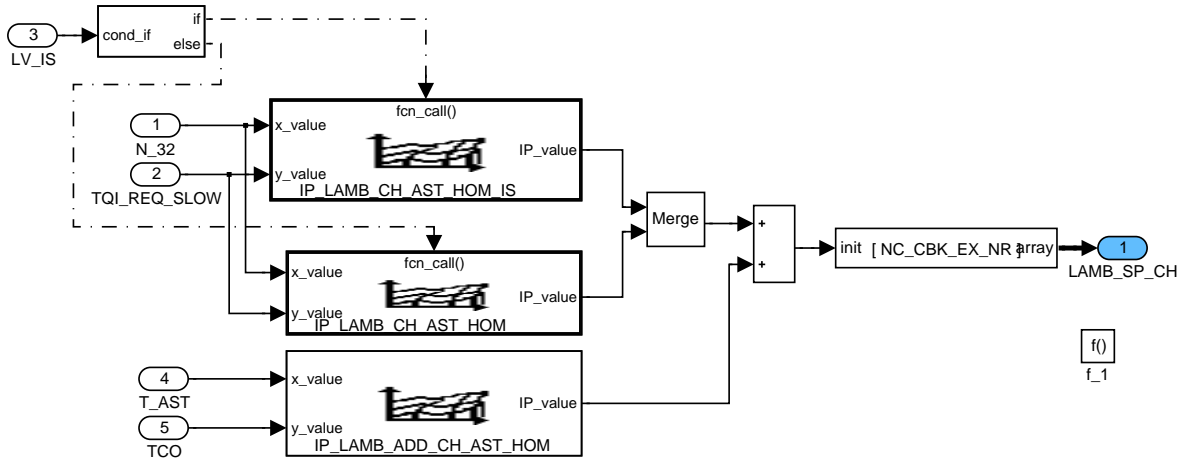


Figure 7.20.5: : Path: EXTC\_REQGNCHL0/CH\_AST/LAMB\_SP\_HOM

### 7.20.1.3 After start catalyst heating, multiple injection

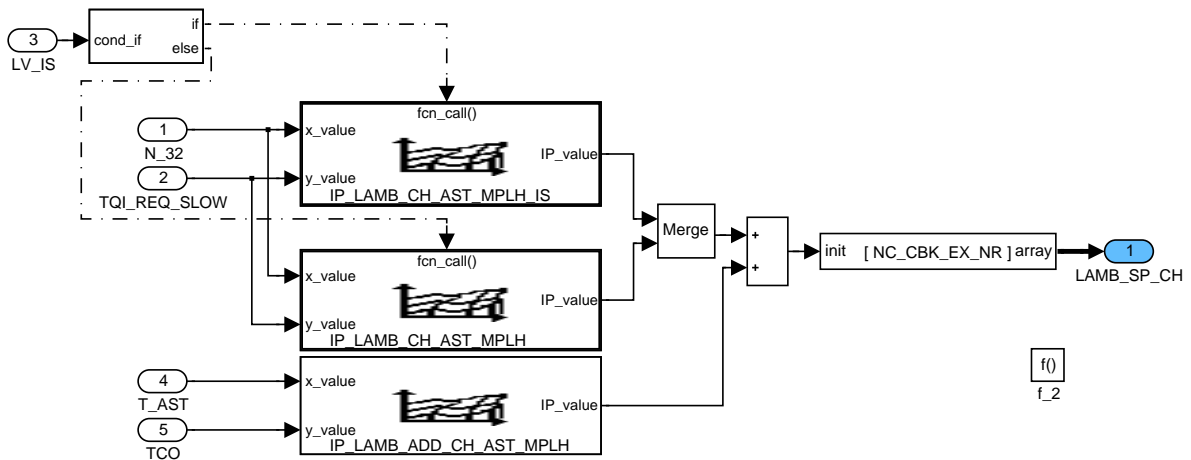


Figure 7.20.6: : Path: EXTC\_REQGNCHL0/CH\_AST/LAMB\_SP\_MPLH

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### 7.20.2 Low load catalyst heating

Low load catalyst heating is activated after regeneration. With this function it is possible to apply different lambda-setpoints for each bank. The function can only be used with Y exhaust-systems because the exhaust gases of the lean and the rich cylinder banks are mixed upstream the NOx-trap and cause exothermic reaction.

#### Application Conditions

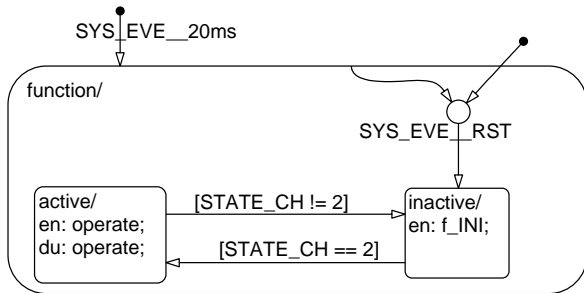


Figure 7.20.7: : Path: EXTC\_REQGNCHL0/CH\_L\_LOAD/APP\_CDN/Chart

#### Function description

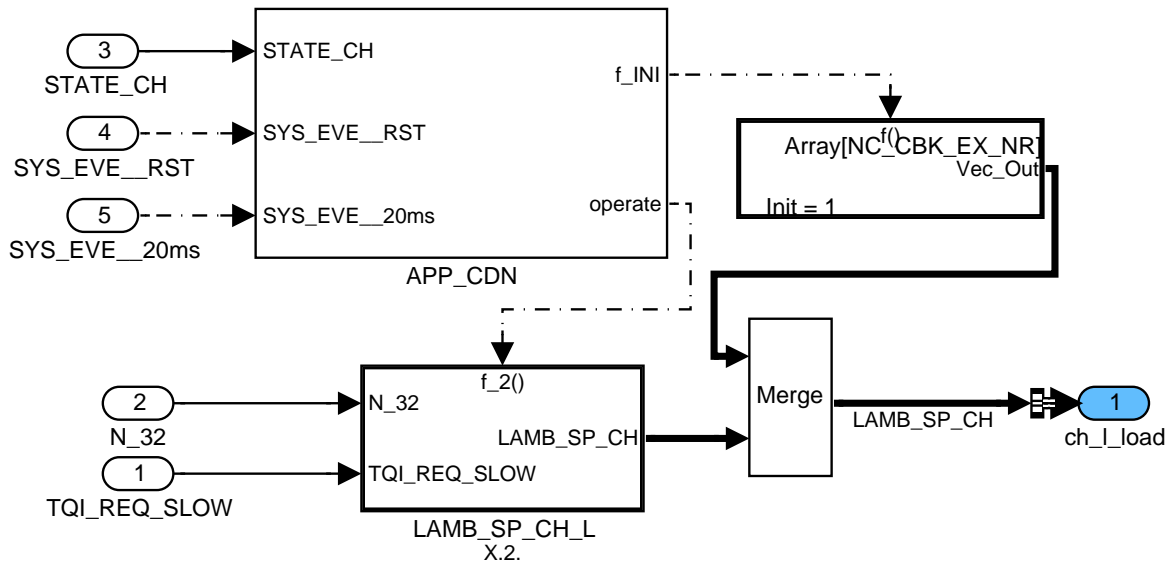


Figure 7.20.8: : Path: EXTC\_REQGNCHL0/CH\_L\_LOAD

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### 7.20.2.1 Function: Low load catalyst heating

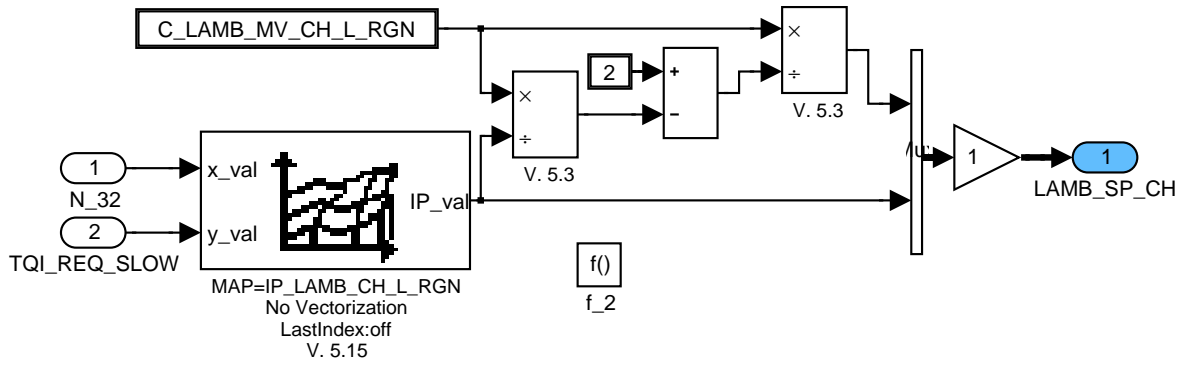


Figure 7.20.9: : Path: EXTC\_REQGNCHL0/CH\_L\_LOAD/LAMB\_SP\_CH\_L

### 7.20.3 Desulfation catalyst heating

#### Application Conditions

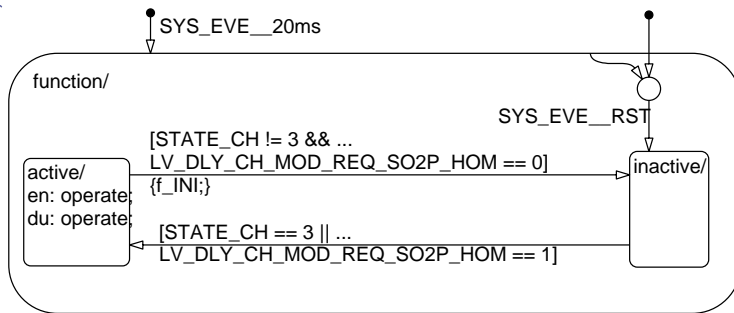


Figure 7.20.10: : Path: EXTC\_REQGNCHL0/CH\_SO2P/APP\_CDN/Chart

#### Function description

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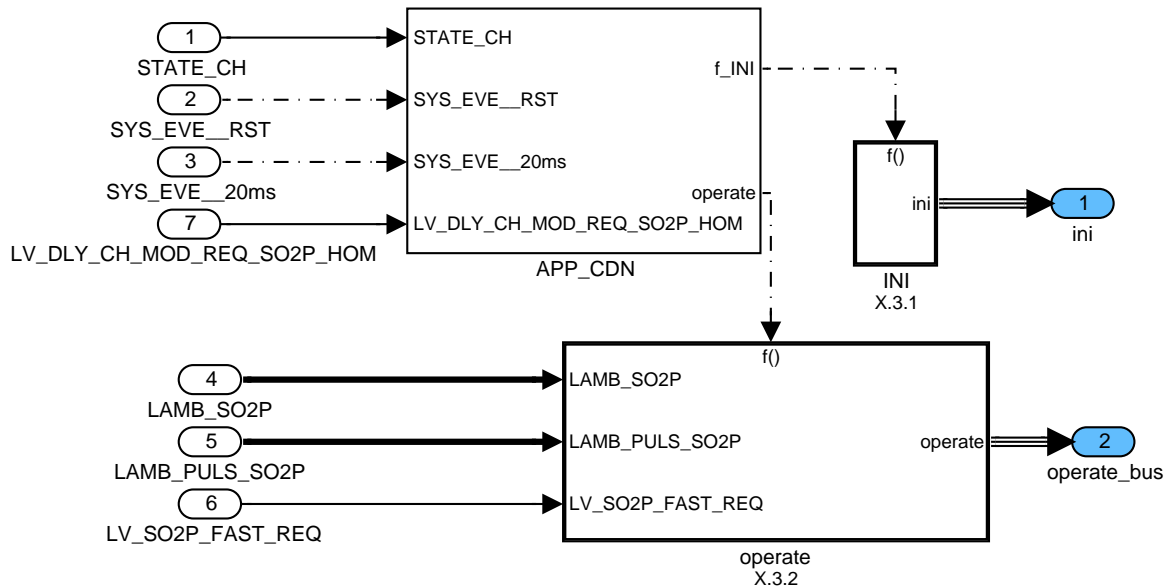


Figure 7.20.11: : Path: EXTC\_REQGNCHL0/CH\_SO2P

### 7.20.3.1 Initialisation

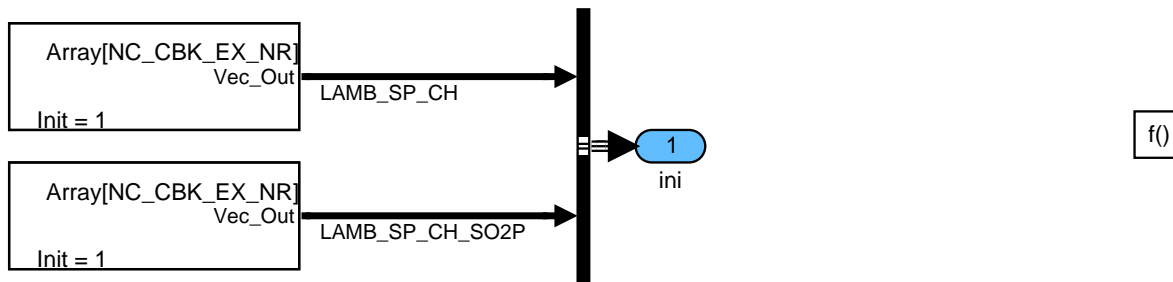


Figure 7.20.12: : Path: EXTC\_REQGNCHL0/CH\_SO2P/INI

### 7.20.3.2 Function: Desulfation catalyst heating

The basic lambda value for catalyst desulfation catalyst heating is applicable for single or splitted injection. A temperature-depending factor weighs the difference between this basic-value and lambda=1. The resulting lambda setpoint is used for both cylinder banks. LAMB\_SP\_CH is used during catalyst heating phase, LAMB\_SP\_CH\_SO2P is used during desulfation if there was catalyst heating active before. Due to C\_LAMB\_SP\_CH\_MAN it is possible to set the lambda setpoint cylinder individual.

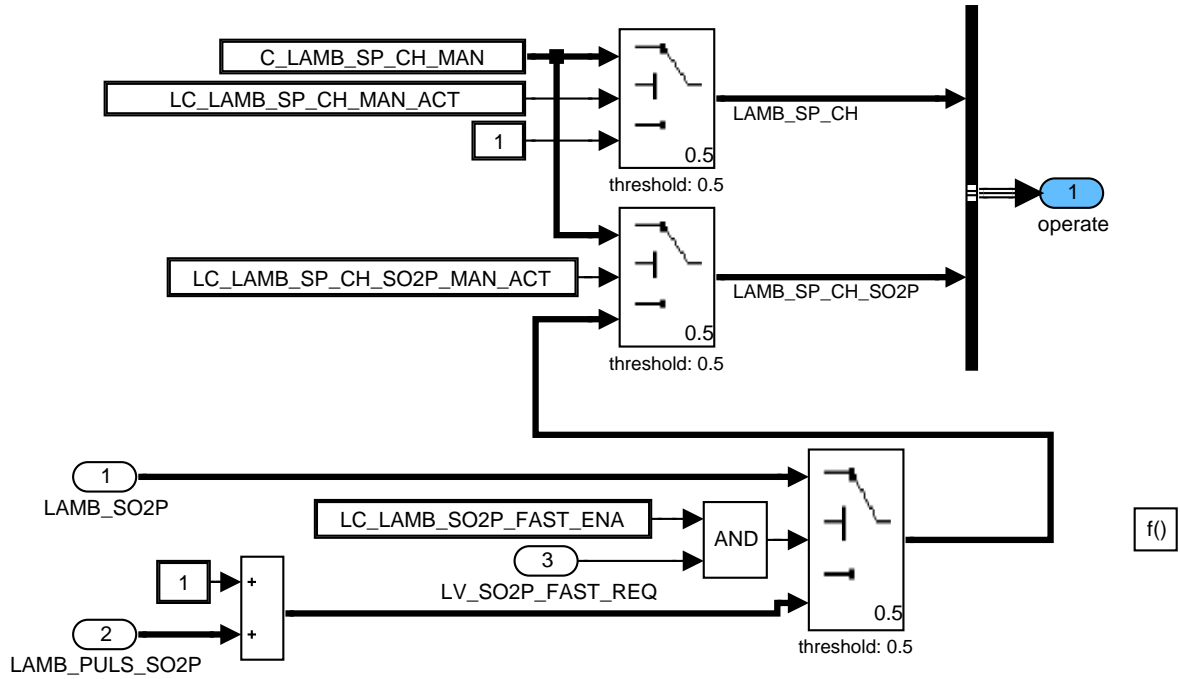


Figure 7.20.13: : Path: EXTC\_REQGNCHL0/CH\_SO2P/operate

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## 7.21 Fuel mass setpoint of post injection for catalyst heating

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_CMB_S	V	0... FFFFH	0... 31.9995117188	488.281e-6	-
Lambda of stratified combustion - without post pulse					
LV_IV_POST_EGY_RNG	O/V	0... 1H	0 ...1	1	-
Boolean variable indicating used piezo IV energy range for post injection					
LV_POST_INJ_ACT	O/V	0... 1H	0 ...1	1	-
Boolean variable indicating the post injection is active					
MFF_MPLP_CH	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass for post injection					
MFF_POST_INJ [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow of the post injection					
TI_POST_INJ [NC_CYL_NR]	O	0... FFFFH	0... 65.535	1e-3	ms
Injection time of the post injection					

### Input data:

CYC_CAST {p. 1766}	FAC_MFF_TFU {p. 2224}	FUP_H {p. 1283}	IP_MFF_TI_EGY_H {p. 2009}
IP_MFF_TI_EGY_L {p. 2009}	MAF {p. 8277}	MFF_SP_MPLP [NC_CYL_NR] {p. 8243}	MFF_SP_MV {p. 2151}
N_32 {p. 1525}	NC_CYL_NR {p. 1526}	STATE_CH {p. 1777}	STATE_CH_MOD {p. 1796}
STATE_CH_MOD_REQ {p. 1796}	STATE_INJ_MOD_SWI_ ACT {p. 3332}	TCO {p. 1100}	TEMP_CAT_DIF_CH_L {p. 1777}
TI_FAC [NC_CYL_NR] {p. 999}	TNT_DIF_CH_L {p. 1777}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_MFF_MPLP_CH_AST	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Correction factor depending on TCO and CYC_CAST for the mass fuel flow of the post injection					
C_FAC_MFF_MPLP_CH_AST_N_32	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Engine speed correction factor for the mass fuel flow of the post injection					
C_FAC_MFF_MPLP_CH_L	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Difference between cat. temperatures and target temp. depending correction for TQ_ADD_CH_L					
C_FAC_TI_POST_PRS_CYL	-	0... FFFFH	0... 15.9997558594	244.141e-6	-
Correction factor to compensate the influence of the cylinder counter pressure					
C_FUP_COR_POST_INJ	-	0... FFFFH	0... 347776	5.3067216	hPa
Manual additive correction factor for injector pressure difference at post injection					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_FAC_POST_INJ	-	0... FFFFH	0... 31.9995117188	488.281e-6	-
Constant for stoichiometric air/fuel ratio (=14.7)					
C_MFF_MPLP_CH_AST	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic map for the mass fuel flow of the post injection for after start catalyst heating					
C_MFF_MPLP_CH_L	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic map for the mass fuel flow of the post injection for low load CH					
C_MFF_MPLP_CH_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Manual mass fuel flow for the post injection for catalyst heating					
IP_FAC_COR_POST_INJ	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
LDP_N_32_IP_FAC_COR_POST_INJ	6	0... FFH	0... 8160	32	rpm
Engine speed correction factor for the mass fuel flow of the post injection					
LC_IV_POST_EGY_RNG	-	0... 1H	0 ...1	1	-
Switch to select energy range					
LC_MFF_MPLP_CH_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual mass fuel flow for the post injection for catalyst heating					

## Overview

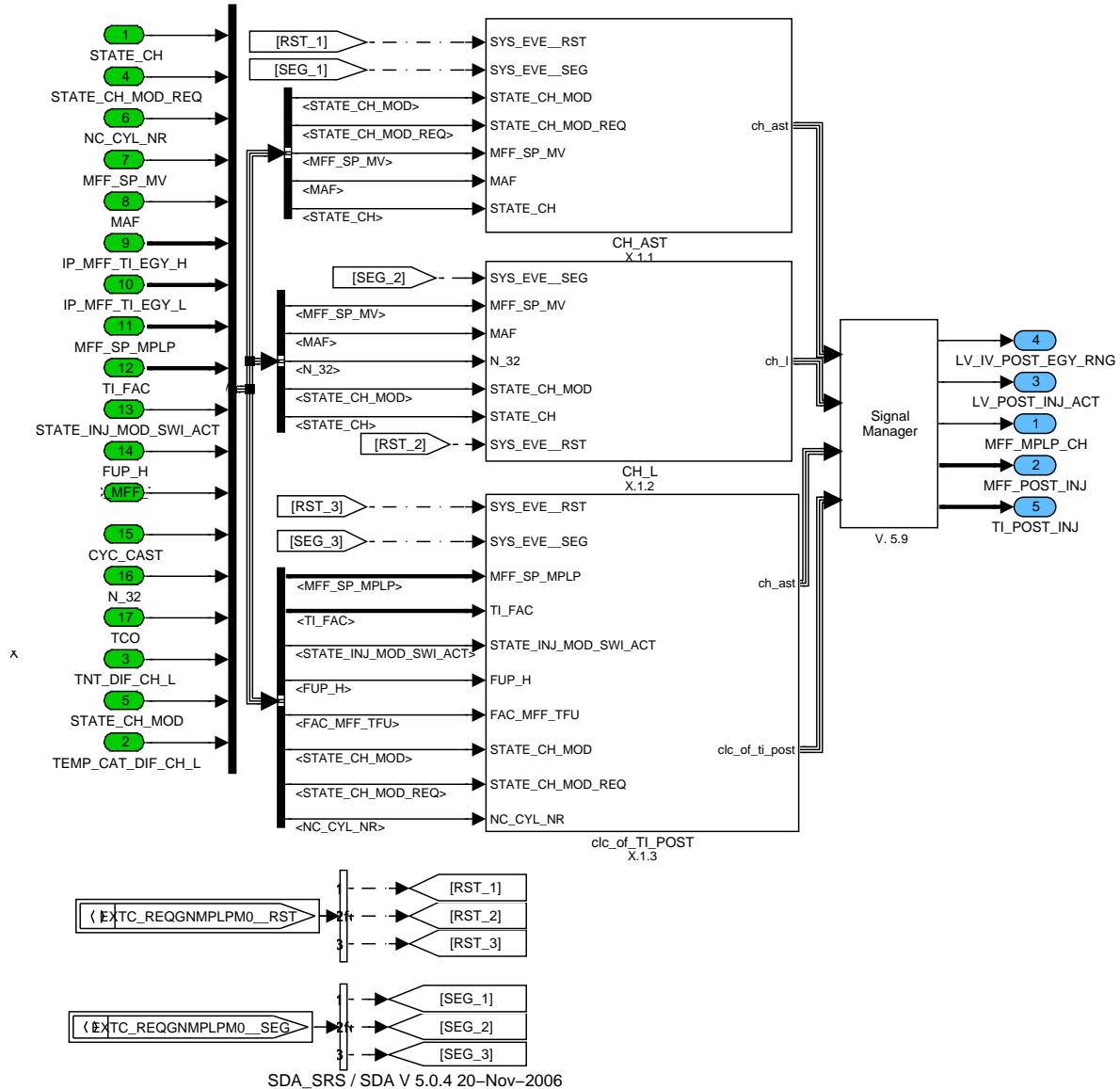


Figure 7.21.1: : Path: EXTC\_REQGNMPLPM0

**General Information**

For catalyst heating an additional fuel mass pulse is injected after the stratified injected main combustion has occurred. In this module the mass of this so called post injection is generated. The module has to be calculated before Injection phase of post injection for catalyst heating , MAF correction for catalyst heating in stratified mode and Ignition angle difference for catalyst heating with post injection .

**7.21.1 After start catalyst heating**

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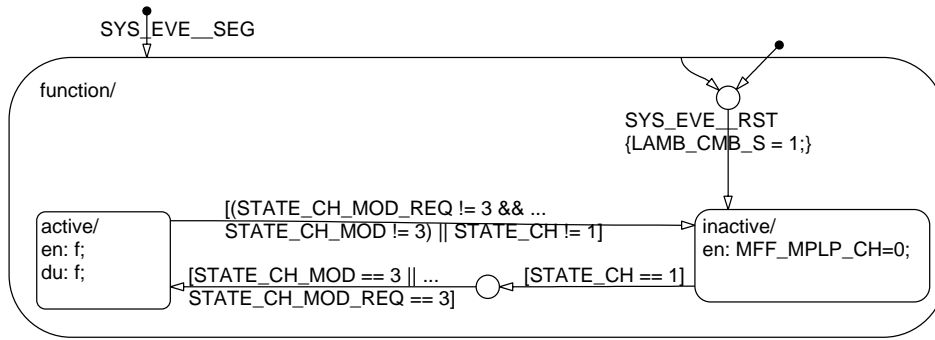


Figure 7.21.2: : Path: EXTC\_REQGNMPLPM0/CH\_AST/APP\_CDN/Chart

**Function description**

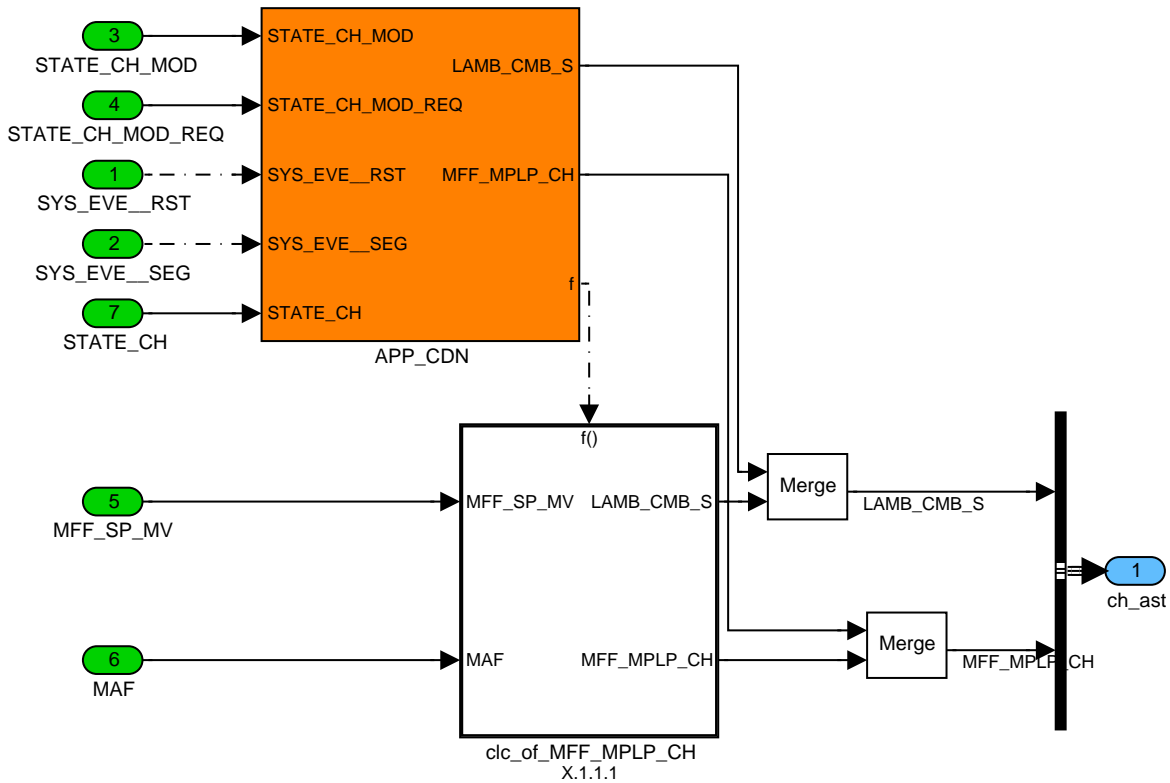


Figure 7.21.3: : Path: EXTC\_REQGNMPLPM0/CH\_AST

**7.21.1.1 Calculation of MFF\_MPLP\_CH in after start catalyst heating**

LAMB\_CMB\_S is the global lambda of the stratified main combustion without post injection. If MFF\_SP is 0, LAMB\_CMB\_S should be set to its maximum limit. C\_MAF\_FAC\_POST\_INJ shell be 14.7 .

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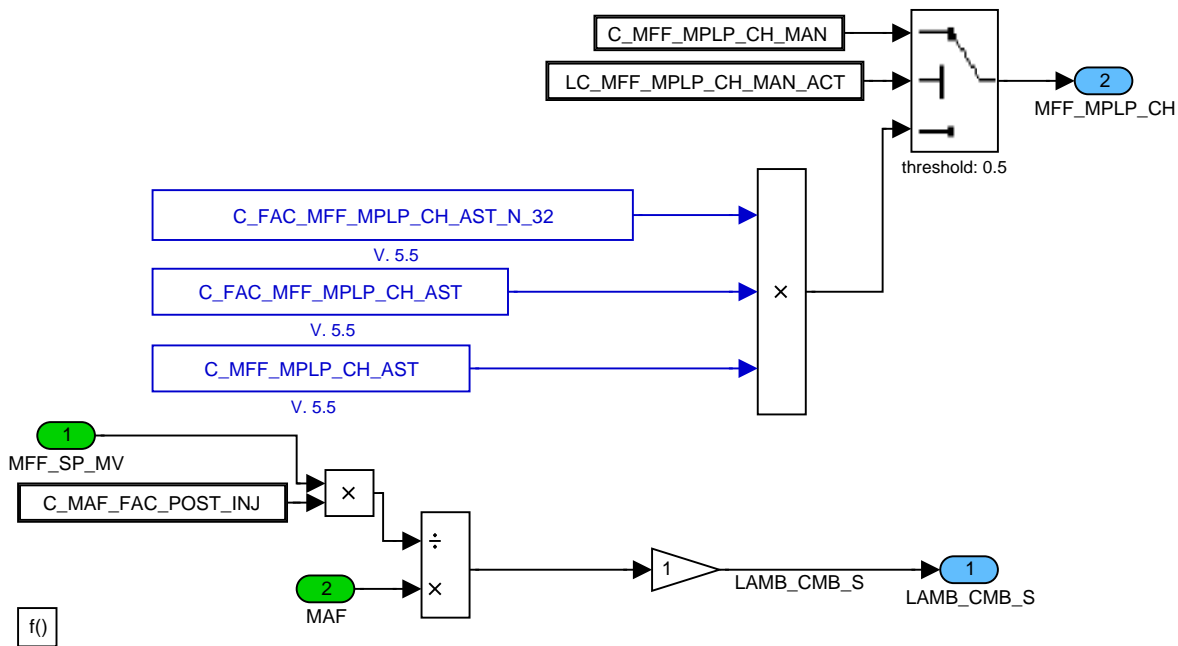


Figure 7.21.4: : Path: EXTC\_REQGNMPLPM0/CH\_AST/clc\_of\_MFF\_MPLP\_CH

## 7.21.2 Low load catalyst heating

### Application Conditions

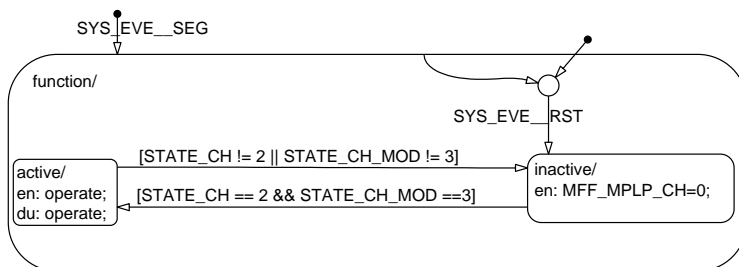


Figure 7.21.5: : Path: EXTC\_REQGNMPLPM0/CH\_L/APP\_CDN/Chart

### Function description

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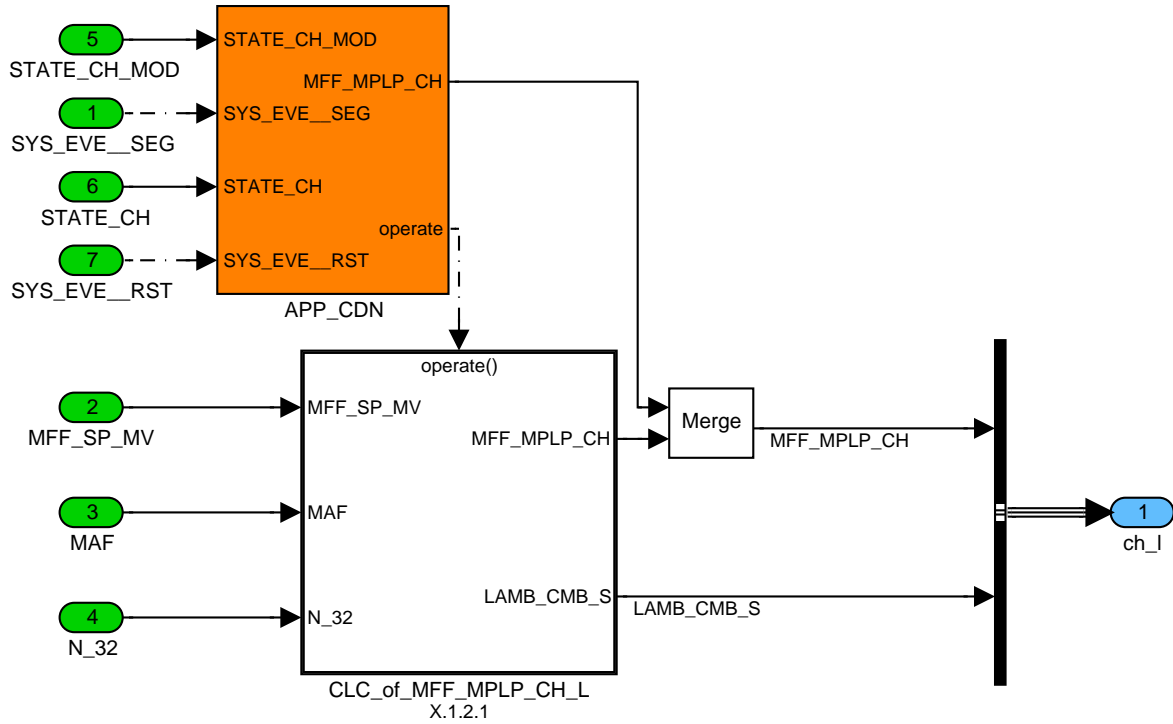


Figure 7.21.6: : Path: EXTC\_REQGNMPLPM0/CH\_L

**7.21.2.1 Calculation of MFF\_MPLP\_CH in low load catalyst heating**

LAMB\_CMB\_S is the global lambda of the stratified main combustion without post injection.

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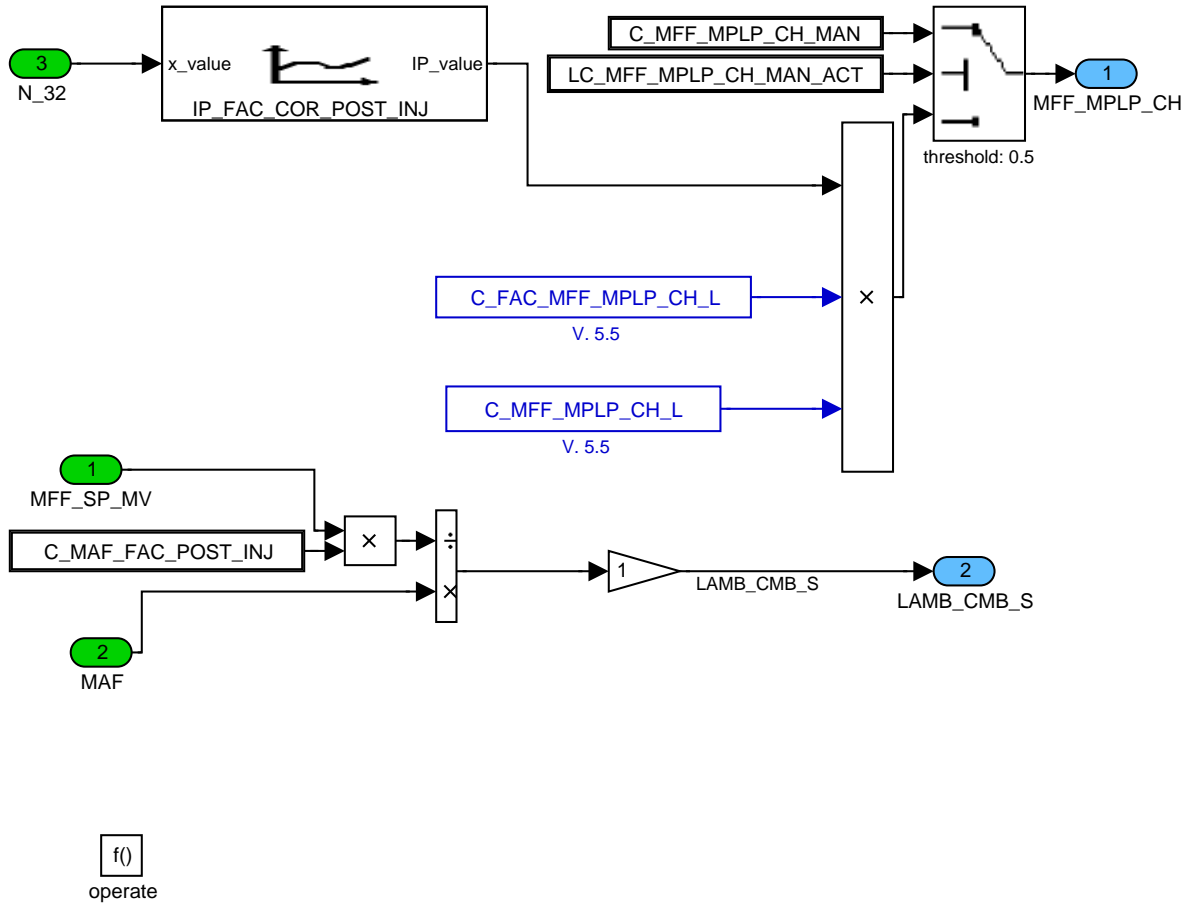


Figure 7.21.7: : Path: EXTC\_REQGNMPLPM0/CH\_L/CLC\_of\_MFF\_MPLP\_CH\_L

### 7.21.3 Injection time of post injection

#### Application Conditions

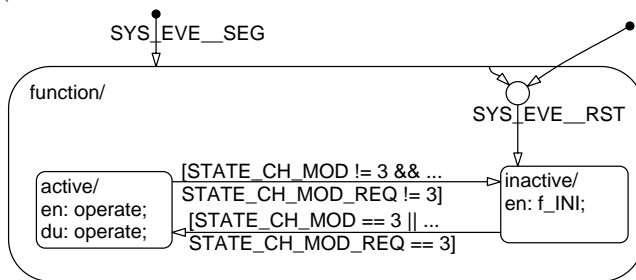


Figure 7.21.8: : Path: EXTC\_REQGNMPLPM0/clc\_of\_TI\_POST/APP\_CDN/Chart

#### Function description

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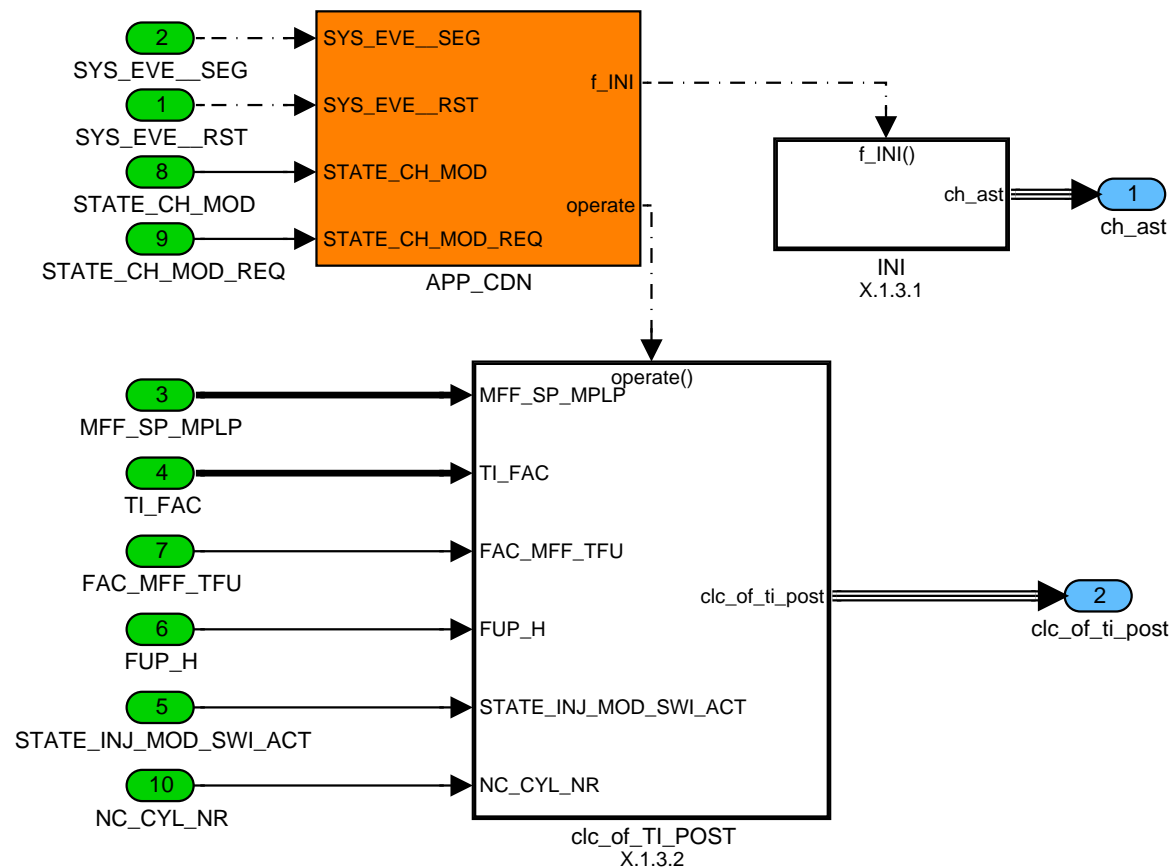


Figure 7.21.9: : Path: EXTC\_REQGNMPLPM0/clc\_of\_TI\_POST

### 7.21.3.1 Initialization

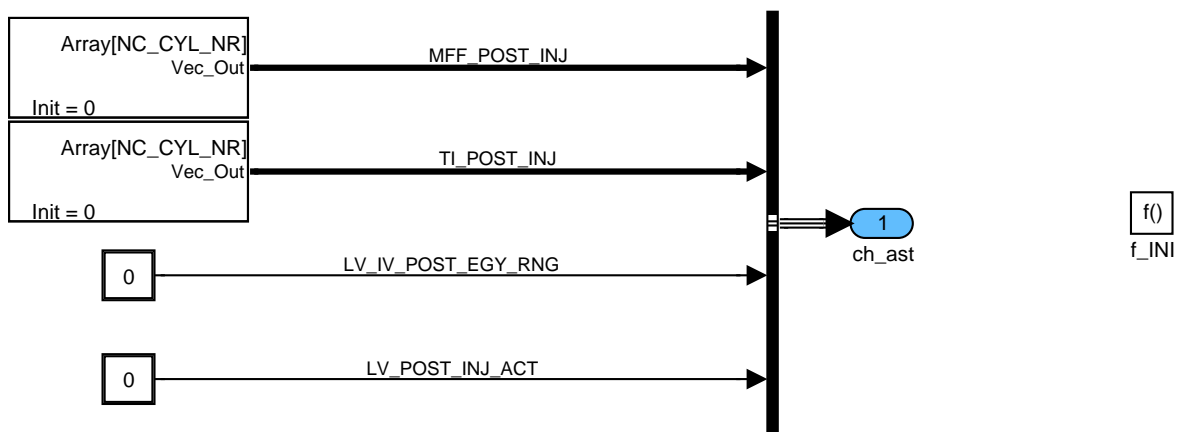


Figure 7.21.10: : Path: EXTC\_REQGNMPLPM0/clc\_of\_TI\_POST/INI

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### 7.21.3.2 Calculation of post injection

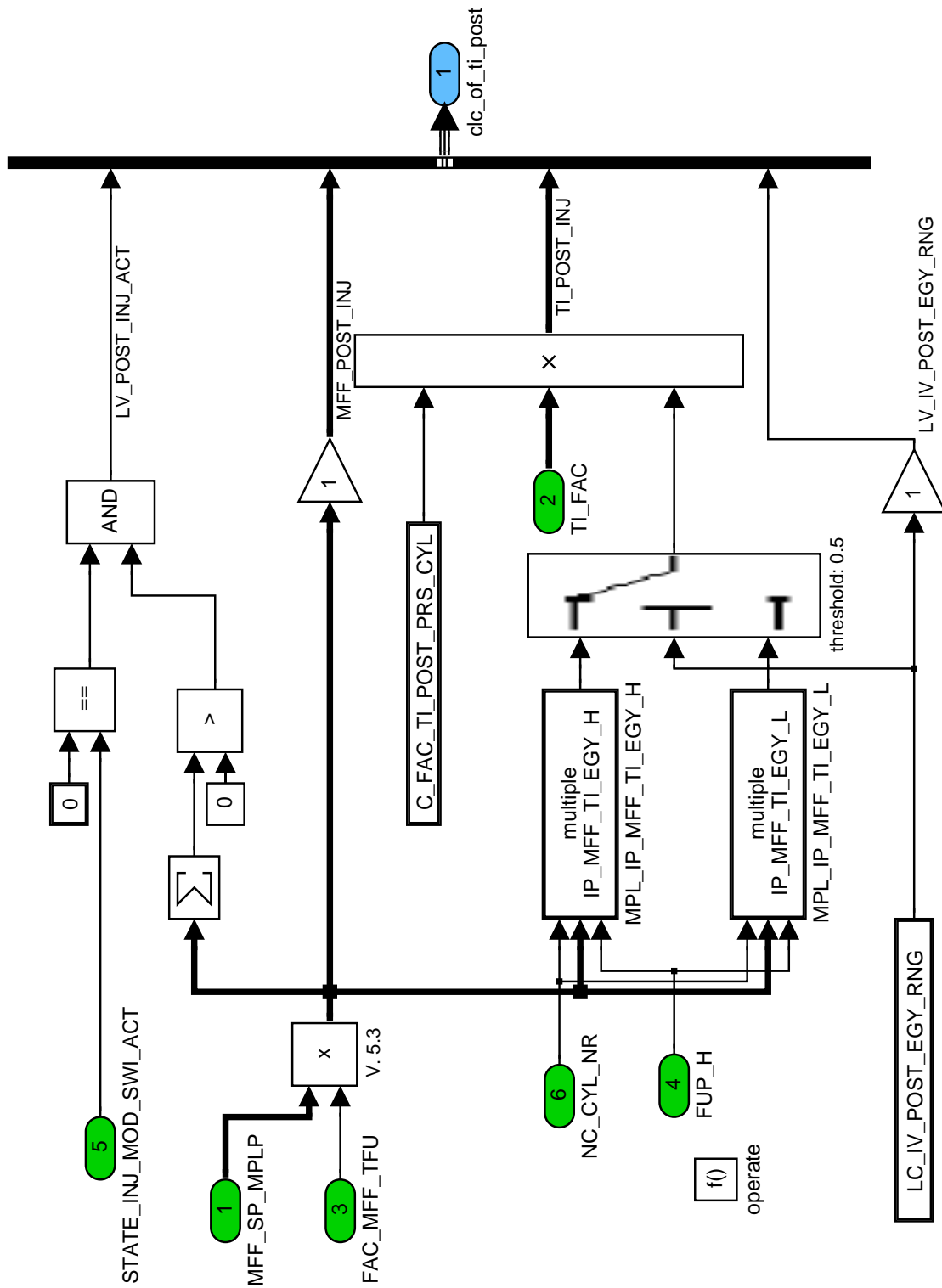


Figure 7.21.11: Path: EXTC\_REQGNMPLPM0/clc\_of\_TI\_POST/clc\_of\_TI\_POST

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## 7.22 Injection phase of post injection for catalyst heating

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EOI_LIM_POST	O/V	0... 780H	0... 720	0.375	°CRK
Latest possible EOI for post injection					
EOI_POST_INJ [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of the post injection					
SOI_LIM_POST	O/V	0... 780H	0... 720	0.375	°CRK
Earliest possible SOI for post injection					
SOI_MPLP_DIF_CH	O/V	0... 780H	0... 720	0.375	°CRK
Start of injection of the second injection for catalyst heating					
SOI_POST_INJ [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Start of the post injection to EOI_LIM					

### Input data:

CRK_INJ_BAS [NC_CYL_NR] {p. 2122}	FAC_N {p. 3327}	MFF_POST_INJ [NC_CYL_NR] {p. 2179}	MFF_SP_MV {p. 2151}
N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	SOI_MPLP_CUS [NC_CYL_NR] {p. 8270}
STATE_CH {p. 1777}	STATE_CH_MOD {p. 1796}	STATE_CH_MOD_REQ {p. 1796}	TI_POST_INJ [NC_CYL_NR] {p. 2179}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EOI_LIM_POST	-	0... 780H	0... 720	0.375	°CRK
Latest possible EOI for post injection relatet to EOI_LIM					
C_SOI_LIM_POST	-	0... 780H	0... 720	0.375	°CRK
Earliest possible SOI for post injection related to EOI_LIM					
C_SOI_MPLP_ADD_MFF_POST_CH_L	-	0... 780H	0... 720	0.375	°CRK
Mass of post injection depending correction of start of injection of post injection for low load strat. CH					
C_SOI_MPLP_DIF_CH_AST	-	0... 780H	0... 720	0.375	°CRK
Start of injection of the post injection for catalyst heating related to ignition angle					
C_SOI_MPLP_DIF_CH_L	-	0... 780H	0... 720	0.375	°CRK
Start of injection of post injection for low load stratified catalyst heating					
C_SOI_MPLP_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual start of injection for the post injection					
C_SOI_POST_INJ_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual start of injection for the post injection					
LC_SOI_MPLP_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual start of injection for the post injection					
LC_SOI_POST_INJ_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual start of injection for the post injection					

### Overview

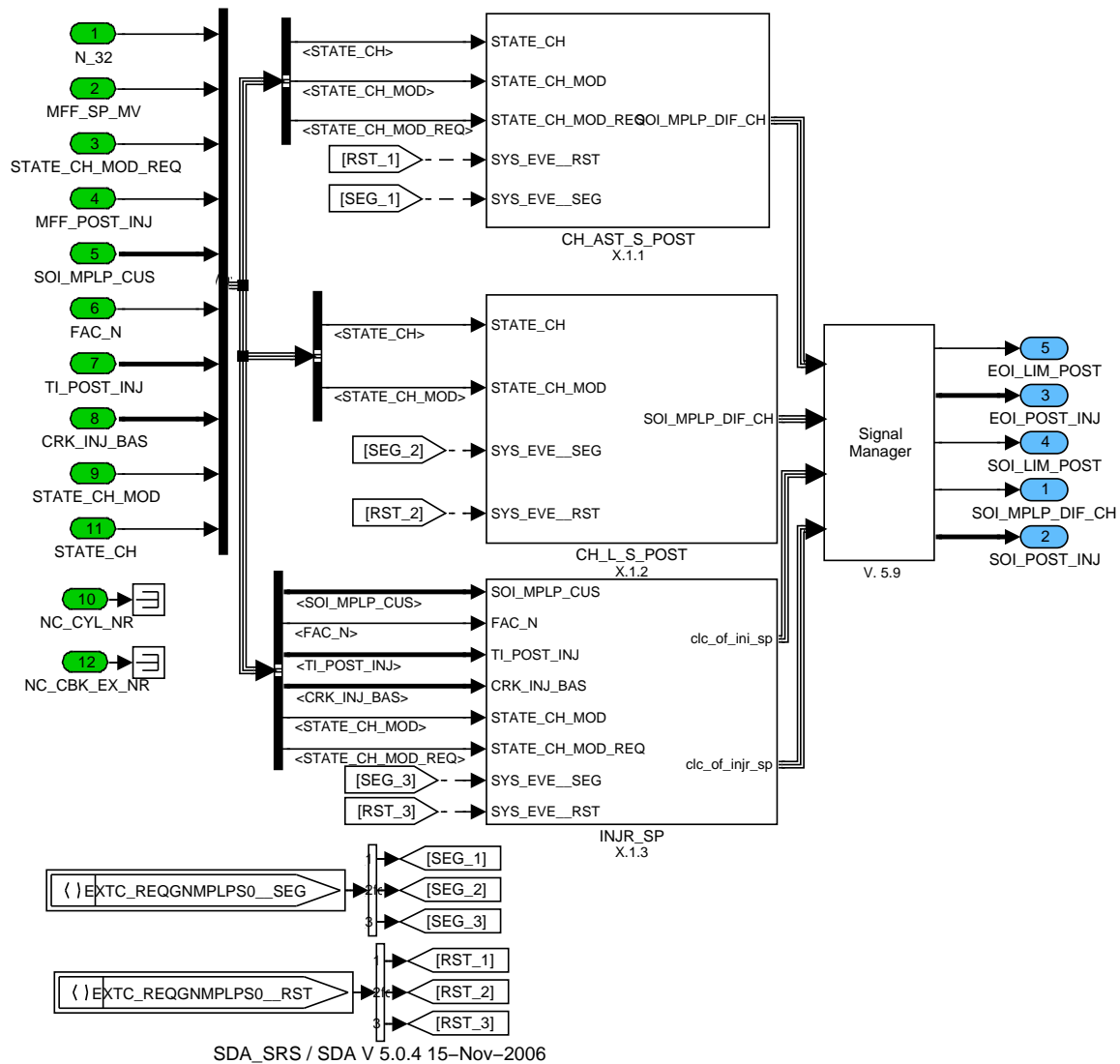


Figure 7.22.1: : Path: EXTC\_REQGNMPLPS0

## General Information

For catalyst heating an additional fuel mass pulse is injected after the stratified injected main combustion has occurred. This will increase the temperature in the exhaust system, especially in the catalyst. In this module the injection phase of this so called post injection is generated.

The function is splitted into 3 parts: the phasing for after start catalyst heating, the phasing for low load heating and the calculation of further setpoints for the INJR aggregate.

SOI\_MPLP\_DIF\_CH is an input for BMWfunctions where SOI\_3\_S\_CUS is the (eventually changed) output. SOI\_POST\_INJ and EOI\_POST\_INJ are the actually phasings.

SOI\_MPLP\_DIF\_CH means the difference crankshaft angle between the ignition angle and the start of the post injection.

### 7.22.1 Post injection for after start catalyst heating

### Application Conditions

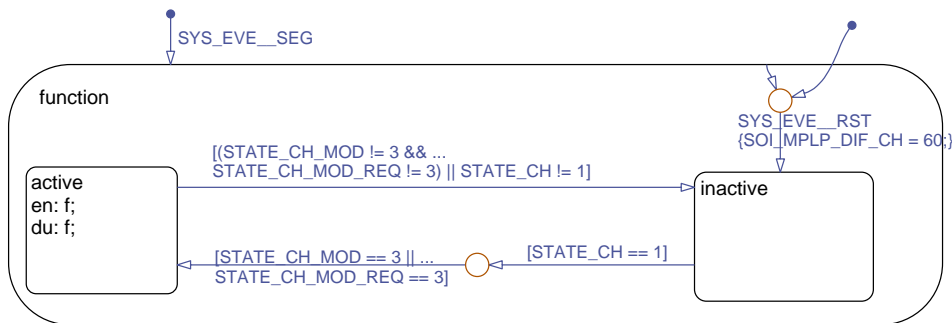


Figure 7.22.2: : Path: EXTC\_REQGNMPLPS0/CH\_AST\_S\_POST/APP\_CDN/Chart

### Function description

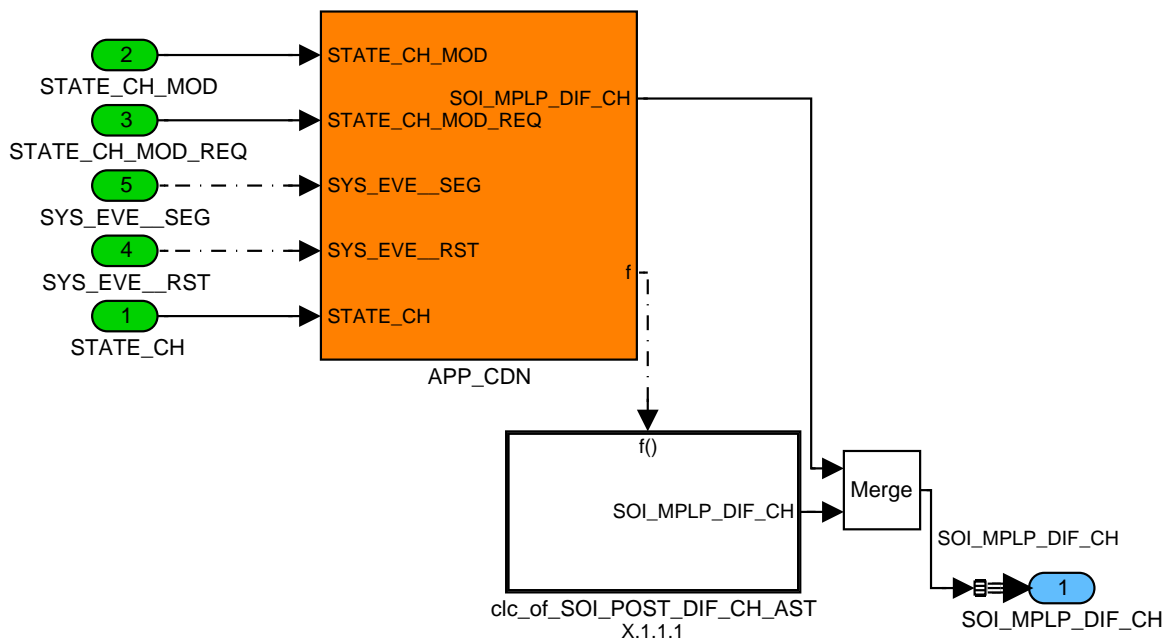


Figure 7.22.3: : Path: EXTC\_REQGNMPLPS0/CH\_AST\_S\_POST

#### 7.22.1.1 Function: Post injection for after start catalyst heating

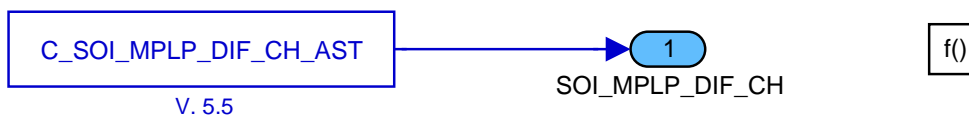


Figure 7.22.4: : Path: EXTC\_REQGNMPLPS0/CH\_AST\_S\_POST/clc\_of\_SOI\_POST\_DIF\_CH\_AST

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## 7.22.2 Post injection for low load catalyst heating

### Application Conditions

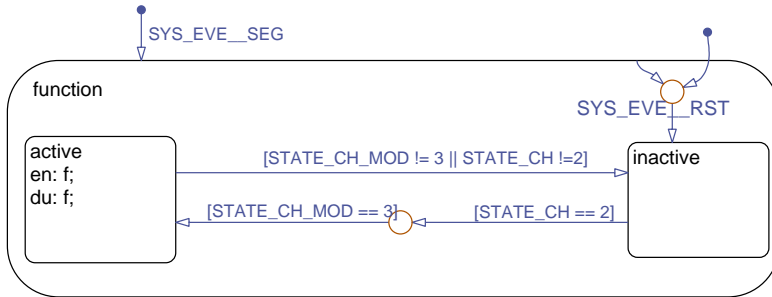


Figure 7.22.5: : Path: EXTC\_REQGNMPLPS0/CH\_L\_S\_POST/APP\_CDN/Chart

### Function description

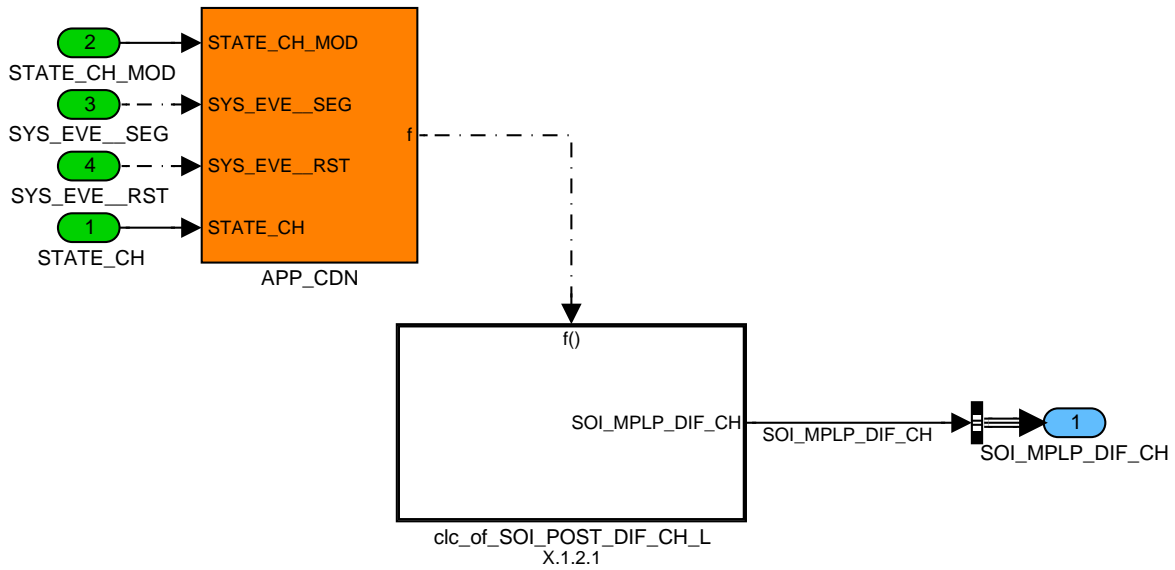


Figure 7.22.6: : Path: EXTC\_REQGNMPLPS0/CH\_L\_S\_POST

### 7.22.2.1 Function: Post injection for low load heating

For low load CH there is a second correction dependend on the actual fuel mass of post injection beside the CH\_AST-functionality. The read\_vector block picks out one element (here the 1st)of the cylinder indiviuell MFF\_POST-vector.

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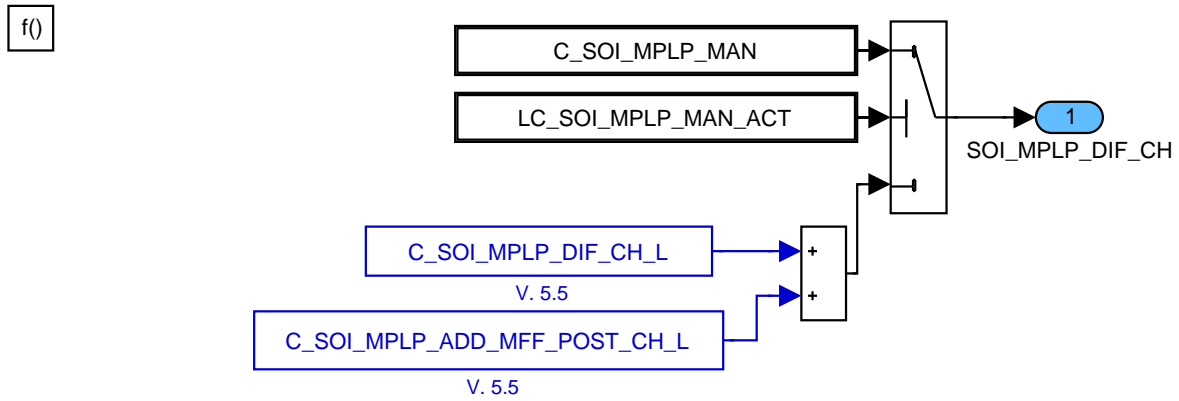


Figure 7.22.7: : Path: EXTC\_REQGNMPLPS0/CH\_L\_S\_POST/clc\_of\_SOI\_POST\_DIF\_CH\_L

### 7.22.3 Setpoint calculation for the INJR aggregate

Up to now the calculation of EOI\_POST\_INJ and the limitation values are not done in INJR (injection realization).

#### Application Conditions

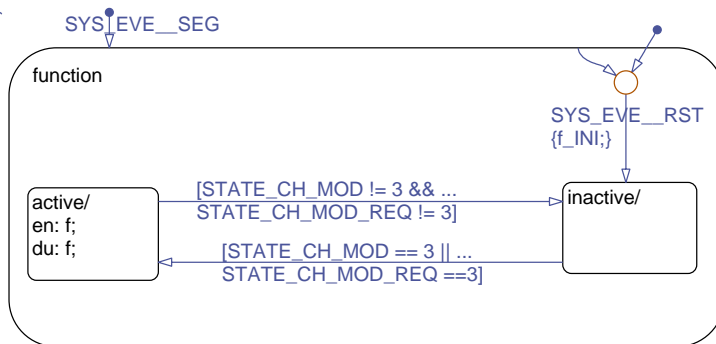


Figure 7.22.8: : Path: EXTC\_REQGNMPLPS0/INJR\_SP/APP\_CDN/Chart

#### Function description

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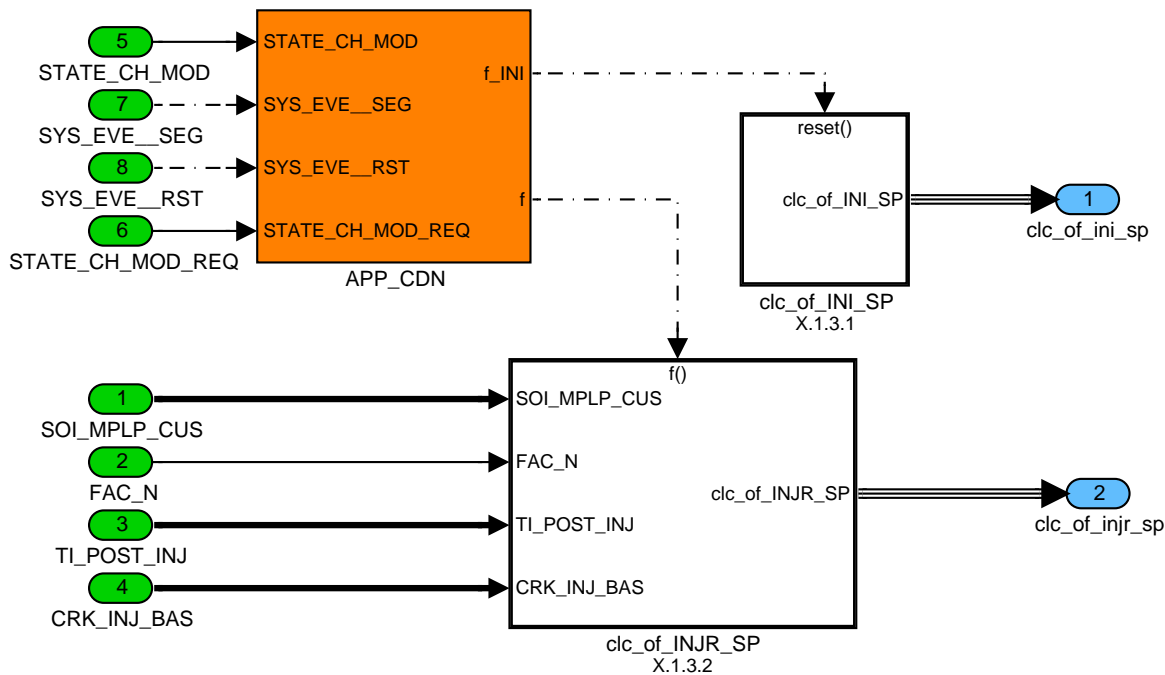


Figure 7.22.9: : Path: EXTC\_REQGNMPLPS0/INJR\_SP

### 7.22.3.1 Initialization

The limitations are initialized by the calibratable value. The set\_vector block initializes the Vec\_out with the value Init.

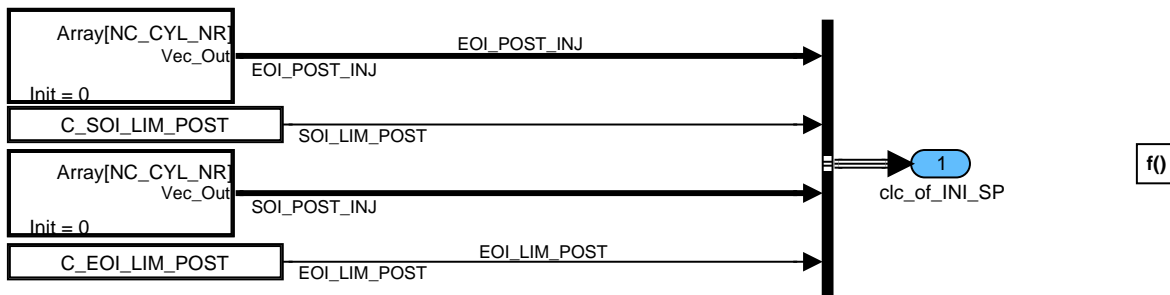


Figure 7.22.10: : Path: EXTC\_REQGNMPLPS0/INJR\_SP/clc\_of\_INI\_SP

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### 7.22.3.2 Function: Setpoint calculation for the INJR aggregate

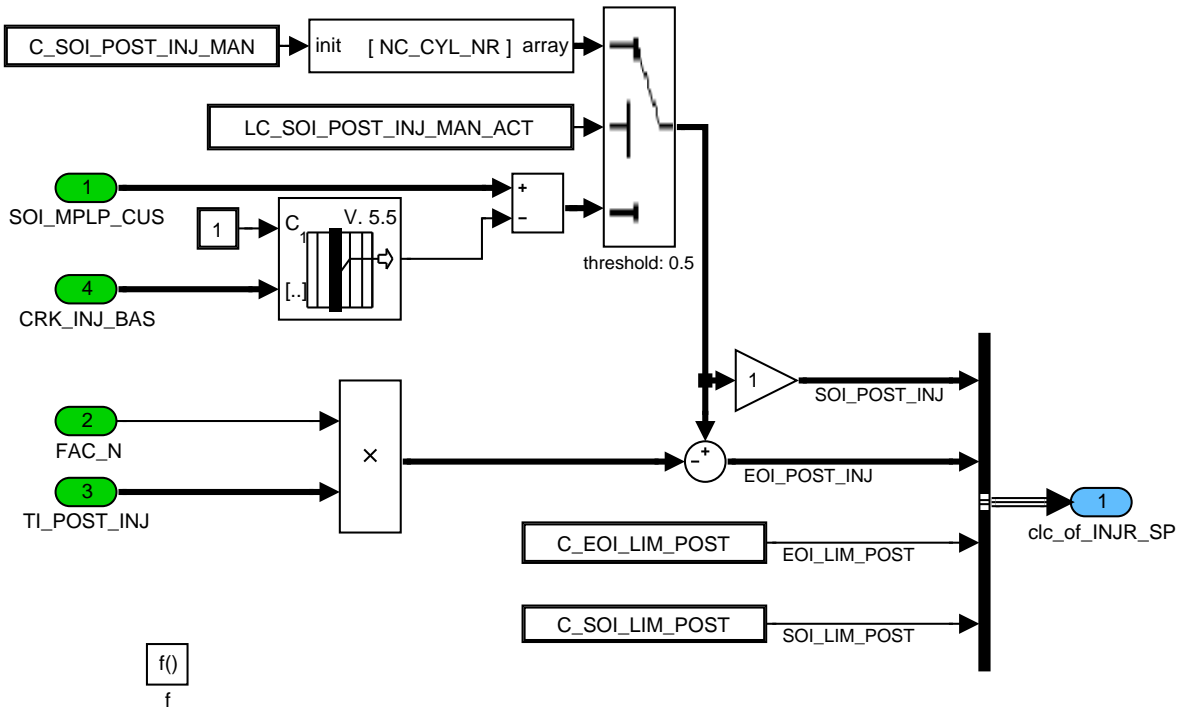


Figure 7.22.11: : Path: EXTC\_REQGNMPLPS0/INJR\_SP/clc\_of\_INJR\_SP

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## 7.23 Catalyst overheating prevention

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_COP_CUS [i]	O/V	0... 7FFFH	0... 31.9990234	980e-6	-
lambda for catalyst overheating prevention					
LAMB_TEG_CAT_DOWN_COP [i]	V	0... 7FFFH	0... 31.9990234	980e-6	-
calculation value for catalyst overheating prevention downstream the precatlyst					
LAMB_TEG_CAT_UP_MDL_COP [i]	V	0... 7FFFH	0... 31.9990234	980e-6	-
calculation value for catalyst overheating prevention upstream of the precatlyst					
LAMB_TNT_MDL_H_COP [i]	V	0... 7FFFH	0... 31.9990234	980e-6	-
calculation value for catalyst overheating prevention in the NOx-trap catalyst					
LV_LAMB_COP_CUS [i]	O/V	00... 01H	0 ...1	1	-
general flag for catalyst overheating prevention active and output					
LV_TEG_CAT_DOWN_COP [i]	V	00... 01H	0 ...1	1	-
flag for catalyst overheating prevention active					
LV_TEG_CAT_UP_MDL_COP [i]	V	00... 01H	0 ...1	1	-
flag for catalyst overheating prevention active					
LV_TNT_MDL_H_COP [i]	V	00... 01H	0 ...1	1	-
flag for catalyst overheating prevention active					
TEG_CAT_DOWN [i]	V	0... 7FFF0H	0... 2047	0.0625	°C
Exhaust gas temperature downstream the catalyst					

### Input data:

LAMB_BAS [NC_CBK_EX_NR] {p. 8340}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_AST {p. 1766}	LV_PUC {p. 1720}
LV_SCC [NC_CBK_EX_NR] {p. 2295}	LV_ST_END {p. 1720}	TEG_CAT_DOWN_MDL {p. 8236}	TEG_CAT_UP_MDL [i] {p. 8236}
TEG_PCAT_DOWN [NC_CBK_EX_NR] {p. 1253}	TNT_MDL_H {p. 8237}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_COP_MIN	-	0... 7FFFH	0.31.9990234	-	-
minimum value for catalyst overheating protection					
C_LAMB_COP_PAS	-	0... 7FFFH	0.31.9990234	-	-
passive value for the lambda catalyst overheating prevention					
C_LAMB_TEG_CAT_DOWN_COP_I	-	0... FFFFH	0... 0.003922	59.8e-9	1/°C
I-part of controller					
C_LAMB_TEG_CAT_UP_MDL_COP_I	-	0... FFFFH	0... 0.003922	59.8e-9	1/°C
I-part of controller					
C_LAMB_TNT_MDL_H_COP_I	-	0... FFFFH	0... 0.003922	59.8e-9	1/°C
I-part of controller					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TEG_CAT_DOWN_THD_COP	-	0... 7FF0H	0... 2047	0.0625	°C
threshold for exhaust gas temperature downstream of the precatlyst - I-controller activation					
C_TEG_CAT_DOWN_THD_MAX_COP	-	0... 7FF0H	0... 2047	0.0625	°C
Maximum threshold for exhaust gas temperature downstream of the precatlyst					
C_TEG_CAT_DOWN_THD_MIN_COP	-	0... 7FF0H	0... 2047	0.0625	°C
bottom threshold for exhaust gas temperature downstream of the precatlyst					
C_TEG_CAT_UP_MDL_THD_COP	-	0... 7FF0H	0... 2047	0.0625	°C
threshold for exhaust gas temperature upstream of the precatlyst - I-controller activation					
C_TEG_CAT_UP_MDL_THD_MAX_COP	-	0... 7FF0H	0... 2047	0.0625	°C
Maximum threshold for exhaust gas temperature upstream of the precatlyst					
C_TEG_CAT_UP_MDL_THD_MIN_COP	-	0... 7FF0H	0... 2047	0.0625	°C
bottom threshold for exhaust gas temperature upstream of the precatlyst					
C_TNT_MDL_H_THD_COP	-	0... FFFFH	0... 1024	0.015625	°C
threshold for temperature in the NO <sub>x</sub> Trap catalyst - I-controller activation					
C_TNT_MDL_H_THD_MAX_COP	-	0... FFFFH	0... 1024	0.015625	°C
maximum threshold for temperature in the NO <sub>x</sub> Trap catalyst					
C_TNT_MDL_H_THD_MIN_COP	-	0... FFFFH	0... 1024	0.015625	°C
bottom threshold for temperature in the NO <sub>x</sub> Trap catalyst					

## FUNCTION DESCRIPTION:

### Application conditions:

Recurrence: every 1 s.

Initialisation: at reset LAMB\_COP\_CUS\_i = C\_LAMB\_COP\_PAS

Activation: If LV\_ST\_END = 1

Deactivation: -

### General information:

If the temperature in the exhaust line exceeds a certain limit, the catalytic converter or even the exhaust line can be destroyed. To reduce the temperature the lambda is ramped down.

The exhaust line of a gasoline direct injection engine consists of a precatlyst and a NO<sub>x</sub>-trap catalyst. The actual temperatures upstream (TEG\_CAT\_UP\_MDL\_i) and downstream of the precatlyst (TEG\_CAT\_DOWN\_MDL\_i or TEG\_PCAT\_DOWN\_i, respectively) and the temperature in the NO<sub>x</sub>-trap (TNT\_MDL\_H\_i) are compared to thresholds, separate for each temperature. The difference between an actual temperature and a threshold is input for an I-controller. Three different I-controllers are working in parallel.

Descriptions of LAMB\_COP\_i is the output LAMB\_COP\_CUS\_i


In the following, **xx** serves as substitute for specification purposes. This is in detail:

**xx** = TEG\_CAT\_UP\_MDL for I-controller 1 (temperature upstream of the precatlyst)

**xx** = TEG\_CAT\_DOWN cat.) for I-controller 2 (temperature downstream of the precatlyst)

**xx** = TNT\_MDL\_H for I-controller 3 (temperature in the NO<sub>x</sub>-trap catalyst)

### Formula section:

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### 7.23.1 Maximal selection between model or sensor based temperatur downstream the precatlyst

If a temperature sensor downstream the precatlyst is available the maximum value between the sensor based temperature TEG\_PCAT\_DOWN\_i and the the model based temperature TEG\_CAT\_DOWN\_MDL\_i is choosen.

$$TEG\_CAT\_DOWN\_i = \text{MAX} (TEG\_PCAT\_DOWN\_i, TEG\_CAT\_DOWN\_MDL\_i)$$

**Note:**

If no temperature sensor downstream the precatlyst is available the variable has to be initialized as follows:

$$TEG\_PCAT\_DOWN\_i = 0$$

### 7.23.2 Activation and Deactivation of the Controller

A single controller is activated (LV\_xx\_COP\_i = 1) if the temperature xx\_i exceeds its threshold C\_xx\_THD\_COP. A singel controller is deactivated (LV\_xx\_COP\_i = 0) if the temperature xx\_i is below the threshold C\_xx\_THD\_MIN\_COP or if the temperature xx\_i is below the threshold C\_xx\_THD\_COP after the lambda was ramped up and has reached the the basic lambda setpoint LAMB\_BAS\_i.

All controllers are deactivated if one of the following logical variables is set to one:

LV\_AST, LV\_PUC, LV\_SCC\_i.


For that case the lambda for catalyst overheat protection LAMB\_COP\_i is set to the passive value C\_LAMB\_COP\_PAS.

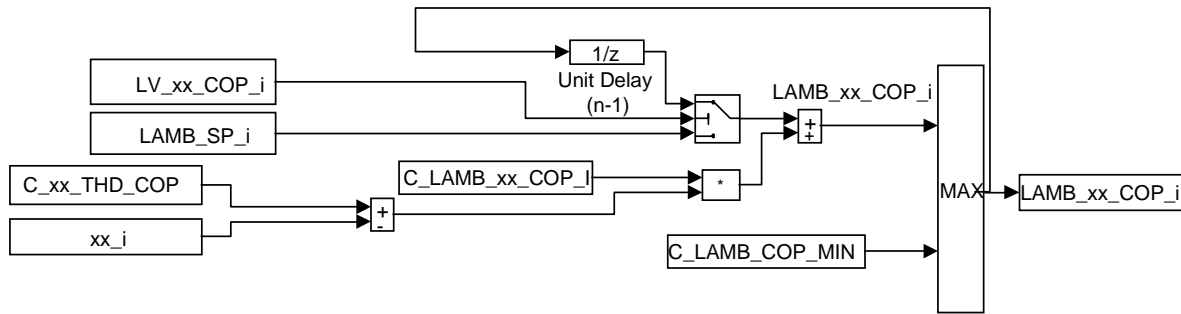
```
(1) If          LV_AST = 1 or LV_PUC = 1 or LV_SCC_i = 1
(1) then      LV_xx_COP_i = 0
    1. else
        (2) if          xx_i >= C_xx_THD_MIN_COP
        (2) then
            (3) if          xx_i >= C_xx_THD_COP
            (3) then      LV_xx_COP_i = 1
            (3) else
                (4) if          LAMB_xx_COP_i > LAMB_BAS_i
                (4) then      LV_xx_COP_i = 0
                (4) endif
            (3) endif
        (2) else      LV_xx_COP_i = 0
        (2) endif
    1. endif
```

At transition LV\_xx\_COP\_i = 0 -> 1 the variable LAMB\_xx\_COP\_i is initialized with LAMB\_SP\_i .

### 7.23.3 Controller Equations

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If  $LV\_xx\_COP\_i = 1$  ..... (controller active)  
 then  
 $LAMB\_xx\_COP\_i(n) = LAMB\_xx\_COP\_i(n-1) + C\_LAMB\_xx\_COP\_I * (C\_xx\_THD\_COP - xx\_i)$   
 else  $LAMB\_xx\_COP\_i = C\_LAMB\_COP\_PAS$  ..... (controller inactive)  
 endif

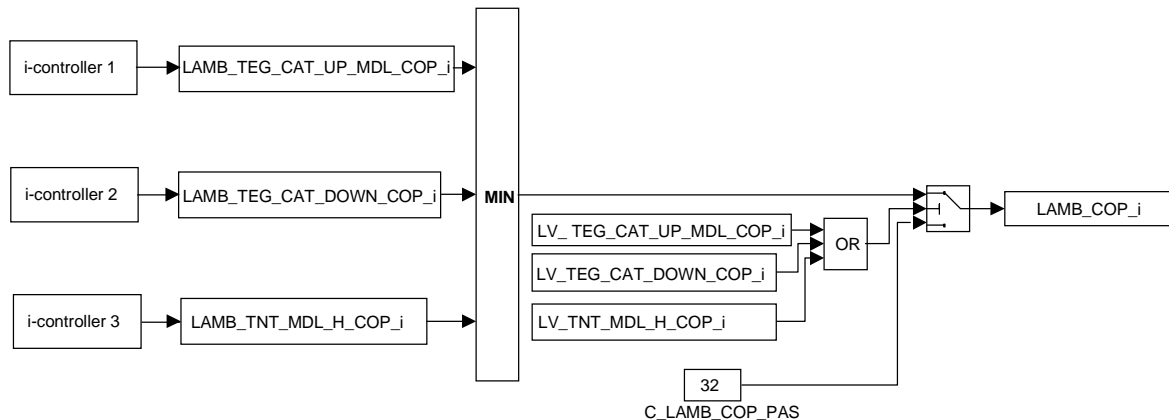
Application Hint: The passive value  $C\_LAMB\_COP\_PAS$  should be set to 32.

The value  $LAMB\_xx\_COP\_i$  can not be smaller than the minimum allowed lambda value  $C\_LAMB\_COP\_MIN$ :

$$LAMB\_xx\_COP\_i = \text{MAX}(LAMB\_xx\_COP\_i, C\_LAMB\_COP\_MIN)$$


### 7.23.4 Calculation of LAMB\_COP (Resulting lambda request)

System flow diagramm:



If at least one controller is active ( $LV\_xx\_COP\_i = 1$ ) the minimum controller output is selected for  $LAMB\_COP\_i$ :

if  $LV\_TEG\_CAT\_UP\_MDL\_COP\_i = 1$   
 or  
 $LV\_TEG\_CAT\_DOWN\_COP\_i = 1$   
 or  
 $LV\_TNT\_MDL\_H\_COP\_i = 1$   
 then  $LAMB\_COP\_i = \text{MIN}(LAMB\_xx\_COP\_i)$   
 $LV\_LAMB\_COP\_i = 1$   
 else  $LAMB\_COP\_i = C\_LAMB\_COP\_PAS$

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```

LV_LAMB_COP_i = 0
endif
If one of the temperatures xx_i exceeds the maximum threshold C_xx_THD_MAX_COP, the lambda
enrichment is set to the minimum allowed lambda value C_LAMB_COP_MIN immediately.

If
TEG_CAT_UP_MDL_i >= C_TEG_CAT_UP_MDL_THD_MAX_COP
or
TEG_CAT_DOWN_MDL_i >= C_TEG_CAT_DOWN_THD_MAX_COP
or
TNT_MDL_H_i >= C_TNT_MDL_H_THD_MAX_COP

then LAMB_COP_i = C_LAMB_COP_MIN
endif

```

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## 7.24 Injection pressure correction - HOM 1. pulse

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_INJ_1_HOM	V	0... 780H	0... 720	0.375	°CRK
Estimated value for injection angle (EOI-SOI), 1. pulse homogeneous mode					
FAC_TI_1_PRS_CYL_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
correction factor to compensate the influence of the cylinder counter pressure, 1. pulse homogeneous					
FAC_TI_1_PRS_CYL_HOM_TMP	-	0... FFFFH	0... 15.99975	244.1e-6	-
correction factor to compensate the influence of the cylinder counter pressure, 1. pulse homogeneous; temporary value					
IDX_TI_1_PRS_HOM_SP_TMP	-	0... FFFFH	0... 65535	1	-
Temporary counting factor index for pressure correction calculation; first pulse HOM.					
PRS_DEC_INJ_1_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Pressure difference at the injector, 1. pulse homogeneous mode					
PRS_DEC_INJ_1_HOM_TMP	-	0... FFFFH	0... 347776	5.3067216	hPa
Pressure difference at the injector, 1. pulse homogeneous mode; temporary value					
PRS_INJ_MV_1_HOM	V	0... FFFFH	0... 347776	5.3067216	hPa
Mean cylinder pressure during injection, 1. Pulse homogeneous mode					
TI_1_PRS_HOM_SP_TMP	-	0... FFFFH	0... 65.535	0.001	ms
Injection time setpoint for calculation of injection pressure correction at homogeneous mode, first pulse; temporary value					

### Input data:

FAC_MFF_DIF_HOM [NC_CYL_NR] {p. 2260}	FAC_MFF_TFU {p. 2224}	FAC_N {p. 3327}	FAC_TI_COR_IV_EGY_ RNG_L [NC_CBK_HPP_NR] {p. 2260}
FUP_H_INJ [NC_CBK_HPP_NR] {p. 3327}	IDX_PRS_COR_CYL_ CLC_MPLH [NC_CBK_HPP_NR] {p. 3327}	IP_MFF_IDX_TI_EGY_H {p. 2008}	IP_MFF_IDX_TI_EGY_L {p. 2008}
IP_MFF_TI_EGY_H {p. 2009}	IP_MFF_TI_EGY_L {p. 2009}	IP_PRS_INC_CMP {p. 2204}	IP_TI_H {p. 2010}
IP_TI_L {p. 2010}	LC_CUR_SHP_INJ_ENA {p. 2010}	LF_PRS_COR_HPP_ENA {p. 3330}	LV_EGY_RNG_IV_PLS_1_ HOM [NC_CYL_NR] {p. 2261}
LV_ST_END {p. 1720}	MAP_INJ [NC_CBK_HPP_NR] {p. 3331}	MFF_ADD_REAC [NC_CYL_NR] {p. 3331}	MFF_SP_1_HOM [NC_CYL_NR] {p. 8242}
NC_CBK_HPP_NR [1] {p. 812}	NC_CYL_NR {p. 1526}	NC_IDX_CYL_HPP_REF [NC_CYL_NR] {p. 626}	SOI_1_HOM [NC_CYL_NR] {p. 2122}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_TI_PRS_CYL	-	0... FFFFH	0... 15.99975	244.1e-6	-
LDP_PRS_INJ_IP_FAC_TI_PRS_CYL	12	0... FFFFH	0... 347776	5.3067216	hPa
correction factor to compensate the influence of the cylinder counter pressure					
IP_FAC_TI_PRS_CYL_L	-	0... FFFFH	0... 15.99975	244.1e-6	-
LDP_PRS_INJ_IP_FAC_TI_PRS_CYL	12	0... FFFFH	0... 347776	5.3067216	hPa
correction factor to compensate the influence of the cylinder counter pressure for low injector needle lift.					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_PRS_COR_1_HOM_CMP_ENA	-	0... 1H	0 ...1	1	-
Flag to enable fuel pressure correction with compression influence for 1st pulse homogeneous mode					

## FUNCTION DESCRIPTION:

### General information:

The module calculates a correction factor to compensate the influence of the cylinder counter pressure at the injector (here: MAP) and the influence of the fuel temperature on the injected fuel mass. Also, the pressure difference at the injector is calculated.

### Application conditions

**Activation:** every engine state

**Deactivation:** -

**Initialisation:** at reset: `FAC_TI_1_PRS_CYL_HOM[ ] = 1` // all NC\_CYL\_NR elements

**Update rate:** LV\_ST\_END = 0: 10 ms  
LV\_ST\_END = 1: segment synchronous

### Formula section:

**FOR** m = 0 **TO** NC\_CBK\_HPP\_NR - 1 **DO**

Check, if fuel bank m has to be calculated:

**(1)IF** Bit m of LF\_PRS\_COR\_HPP\_ENA = 1

**(1)THEN**

**(1a)IF** LV\_ST\_END = 0 **OR** LC\_PRS\_COR\_1\_HOM\_CMP\_ENA = 0

**(1a)THEN**

`PRS_DEC_INJ_1_HOM_TMP = FUP_H_INJ[m] - MAP_INJ[m]`

**(1b)IF** LV\_EGY\_RNG\_IV\_PLS\_1\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]] = 1

**(1b)THEN**

`FAC_TI_1_PRS_CYL_HOM_TMP = IP_FAC_TI_PRS_CYL(MAP_INJ[m])`

**(1b)ELSE**

`FAC_TI_1_PRS_CYL_HOM_TMP = IP_FAC_TI_PRS_CYL_L(MAP_INJ[m])`

**(1b)ENDIF**

**(1a)ELSE**

Calculation of an injection time for pressure correction:

**(2a)IF** LC\_CUR\_SHP\_INJ\_ENA = 1

**(2a)THEN** // current shaping via IDX\_TI calculation is active


**(2)IF** LV\_EGY\_RNG\_IV\_PLS\_1\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]] = 1

**(2)THEN**

`IDX_TI_1_PRS_HOM_SP_TMP = IP_MFF_IDX_TI_EGY_H(  
((MFF_SP_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] +  
MFF_ADD_REAC[IDX_PRS_COR_CYL_CLC_MPLH[m]])*(1 +  
FAC_MFF_DIF_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]])  
*FAC_MFF_TFU);`

`PRS_DEC_INJ_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1))`

`* FAC_TI_1_PRS_CYL_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1)`

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$$TI\_1\_PRS\_HOM\_SP\_TMP = IP\_TI\_H(IDX\_TI\_1\_PRS\_HOM\_SP\_TMP)$$

**(2)ELSE**

$$IDX\_TI\_1\_PRS\_HOM\_SP\_TMP = IP\_MFF\_IDX\_TI\_EGY\_L($$

$$((MFF\_SP\_1\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]] +$$

$$MFF\_ADD\_REAC[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]])*(1 +$$

$$FAC\_MFF\_DIF\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]])$$

$$*FAC\_MFF\_TFU);$$

$$PRS\_DEC\_INJ\_1\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]](n-1))$$

$$* FAC\_TI\_COR\_IV\_EGY\_RNG\_L[m]$$

$$* FAC\_TI\_1\_PRS\_CYL\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]](n-1)$$

$$TI\_1\_PRS\_HOM\_SP\_TMP = IP\_TI\_L(IDX\_TI\_1\_PRS\_HOM\_SP\_TMP)$$

**(2)ENDIF**

**(2a)ELSE** // current shaping is inactive; classic TI calculation applied

**(2)IF** LV\_EGY\_RNG\_IV\_PLS\_1\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]] = 1

**(2)THEN**

$$TI\_1\_PRS\_HOM\_SP\_TMP = IP\_MFF\_TI\_EGY\_H($$

$$((MFF\_SP\_1\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]] +$$

$$MFF\_ADD\_REAC[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]])*(1 +$$

$$FAC\_MFF\_DIF\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]])*FAC\_MFF\_TFU);$$

$$PRS\_DEC\_INJ\_1\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]](n-1))$$

$$* FAC\_TI\_1\_PRS\_CYL\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]](n-1)$$

**(2)ELSE**

$$TI\_1\_PRS\_HOM\_SP\_TMP = IP\_MFF\_TI\_EGY\_L($$

$$((MFF\_SP\_1\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]] +$$

$$MFF\_ADD\_REAC[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]])*(1 +$$

$$FAC\_MFF\_DIF\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]])*FAC\_MFF\_TFU);$$

$$PRS\_DEC\_INJ\_1\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]](n-1))$$

$$* FAC\_TI\_COR\_IV\_EGY\_RNG\_L[m]$$

$$* FAC\_TI\_1\_PRS\_CYL\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]](n-1)$$

**(2)ENDIF**

**(2a)ENDIF**

A rough injection duration angle CRK\_INJ\_1\_HOM is estimated from TI\_1\_PRS\_HOM\_SP\_TMP and engine speed (FAC\_N):

From the manifold pressure MAP\_INJ[m], the end of injection and the rough injection angle a mean counter pressure within the cylinder during the injection is calculated.

The pressure difference at the injector is calculated from fuel rail pressure and the manifold pressure.

The correction factor FAC\_TI\_1\_PRS\_CYL\_HOM is used to compensate the influence of the cylinder counter pressure on the injector needle lift.

$$CRK\_INJ\_1\_HOM = TI\_1\_PRS\_HOM\_SP\_TMP * FAC\_N$$

$$PRS\_INJ\_MV\_1\_HOM = MAP\_INJ[m] * IP\_PRS\_INC\_CMP$$

(Input data for IP\_PRS\_INC\_CMP is

(SOI\_1\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]] -

TI\_1\_PRS\_HOM\_SP\_TMP\*FAC\_N) and CRK\_INJ\_1\_HOM)

$$PRS\_DEC\_INJ\_1\_HOM\_TMP = FUP\_H\_INJ[m] - PRS\_INJ\_MV\_1\_HOM$$


**(3)IF** LV\_EGY\_RNG\_IV\_PLS\_1\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]] = 1

**(3)THEN**

$$FAC\_TI\_1\_PRS\_CYL\_HOM\_TMP = IP\_FAC\_TI\_PRS\_CYL(PRS\_INJ\_MV\_1\_HOM)$$

**(3)ELSE**

$$FAC\_TI\_1\_PRS\_CYL\_HOM\_TMP =$$

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IP\_FAC\_TI\_PRS\_CYL\_L(PRS\_INJ\_MV\_1\_HOM)

**(3)ENDIF**

**(1a)ENDIF**

Calculate cylinder individual injection pressure correction values:

**FOR** x = 0 **TO** NC\_CYL\_NR - 1 **DO**

**IF** NC\_IDX\_CYL\_HPP\_REF[x] = m

**THEN**

PRS\_DEC\_INJ\_1\_HOM[x] = PRS\_DEC\_INJ\_1\_HOM\_TMP


FAC\_TI\_1\_PRS\_CYL\_HOM[x] = FAC\_TI\_1\_PRS\_CYL\_HOM\_TMP

**ENDIF**

**ENDFOR**

**(1)ENDIF**

**ENDFOR**

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## 7.25 Injection pressure correction for multiple injection - HOM 2. pulse

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_INJ_2_HOM	V	0... 780H	0... 720	0.375	°CRK
rough value for injection angle (EOI-SOI), 2. pulse					
FAC_TI_2_PRS_CYL_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Correction factor to compensate the influence of the cylinder counter pressure, 2. Pulse homogeneous					
FAC_TI_2_PRS_CYL_HOM_TMP	-	0... FFFFH	0... 15.99975	244.1e-6	-
Correction factor to compensate the influence of the cylinder counter pressure, 2. Pulse homogeneous; temporary value					
IDX_TI_2_PRS_HOM_SP_TMP	-	0... FFFFH	0... 65535	1	-
Temporary counting factor index for pressure correction calculations; second pulse HOM.					
PRS_DEC_INJ_2_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Pressure difference at the injector, 2. pulse homogeneous mode					
PRS_DEC_INJ_2_HOM_TMP	-	0... FFFFH	0... 347776	5.3067216	hPa
Pressure difference at the injector, 2. pulse; temporary value					
PRS_INJ_MV_2_HOM	V	0... FFFFH	0... 347776	5.3067216	hPa
mean cylinder pressure during injection, 2. Pulse					
TI_2_PRS_HOM_SP [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Injection time setpoint for calculation of injection pressure correction at homogeneous mode, second pulse					
TI_2_PRS_HOM_SP_TMP	-	0... FFFFH	0... 65.535	0.001	ms
Injection time setpoint for calculation of injection pressure correction at homogeneous mode, second pulse; temporary value					

### Input data:

EOI_2_HOM [NC_CYL_NR] {p. 2130}	FAC_MFF_DIF_HOM [NC_CYL_NR] {p. 2260}	FAC_MFF_TFU {p. 2224}	FAC_N {p. 3327}
FAC_TI_COR_IV_EGY_RNG_L [NC_CBK_HPP_NR] {p. 2260}	FUP_H_INJ [NC_CBK_HPP_NR] {p. 3327}	IDX_PRS_COR_CYL_CLC_MPLH [NC_CBK_HPP_NR] {p. 3327}	INJ_MOD_SP_HOM [NC_CYL_NR] {p. 3329}
IP_FAC_TI_PRS_CYL {p. 2200}	IP_FAC_TI_PRS_CYL_L {p. 2200}	IP_MFF_IDX_TI_EGY_H {p. 2008}	IP_MFF_IDX_TI_EGY_L {p. 2008}
IP_MFF_TI_EGY_H {p. 2009}	IP_MFF_TI_EGY_L {p. 2009}	IP_TI_H {p. 2010}	IP_TI_L {p. 2010}
LC_CUR_SHP_INJ_ENA {p. 2010}	LF_PRS_COR_HPP_ENA {p. 3330}	LV_EGY_RNG_IV_PLS_2_HOM [NC_CYL_NR] {p. 2261}	LV_ST_END {p. 1720}
MAP_INJ [NC_CBK_HPP_NR] {p. 3331}	MFF_SP_2_HOM [NC_CYL_NR] {p. 8242}	NC_CBK_HPP_NR [1] {p. 812}	NC_CYL_NR {p. 1526}
NC_IDX_CYL_HPP_REF [NC_CYL_NR] {p. 626}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_PRS_INC_CMP	V	0... FFFFH	0... 31.99951	488.299e-6	-
LDP_EOI_IP_PRS_INC_CMP	12	0... 780H	0... 720	0.375	°CRK
LDP_CRK_INJ_IP_PRS_INC_CMP	16	0... 780H	0... 720	0.375	°CRK
Mean pressure increase in cylinder due to compression					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

## Overview

The module calculates a correction factor to compensate the influence of the cylinder counter pressure and the influence of the fuel temperature on the injected fuel mass.

## Application conditions

<b>Activation:</b>	every engine state
<b>Deactivation:</b>	-
<b>Initialization:</b>	-
<b>Update rate:</b>	LV_ST_END = 0: 10 ms LV_ST_END = 1: every TDC

## Function Description

**(1)FOR m = 0 TO NC\_CBK\_HPP\_NR - 1 DO**


**(1)IF** INJ\_MOD\_SP\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]] = "MPLH" **OR**  
INJ\_MOD\_SP\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]] = "MPLH+PLS3"  
**(1) THEN**

Check, if fuel bank m has to be calculated:

**(2)IF** Bit m of LF\_PRS\_COR\_HPP\_ENA = 1  
**(2)THEN**

Calculation of an injection time for pressure correction:

**(2a)IF** LC\_CUR\_SHP\_INJ\_ENA = 1  
**(2a)THEN** // current shaping via IDX\_TI calculation is active  
**(3)IF** LV\_EGY\_RNG\_IV\_PLS\_2\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]] = 1  
**(3)THEN**  
IDX\_TI\_2\_PRS\_HOM\_SP\_TMP = IP\_MFF\_IDX\_TI\_EGY\_H(  
    (MFF\_SP\_2\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]]\*(1 +  
    FAC\_MFF\_DIF\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]])  
    \*FAC\_MFF\_TFU);  
    PRS\_DEC\_INJ\_2\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]](n-1))  
\* FAC\_TI\_2\_PRS\_CYL\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]](n-1)  
TI\_2\_PRS\_HOM\_SP\_TMP = IP\_TI\_H(IDX\_TI\_2\_PRS\_HOM\_SP\_TMP)  
**(3)ELSE**  
IDX\_TI\_2\_PRS\_HOM\_SP\_TMP = IP\_MFF\_IDX\_TI\_EGY\_L(  
    (MFF\_SP\_2\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]]\*(1 +  
    FAC\_MFF\_DIF\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]])  
    \*FAC\_MFF\_TFU);  
    PRS\_DEC\_INJ\_2\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]](n-1))  
\* FAC\_TI\_COR\_IV\_EGY\_RNG\_L[m]  
\* FAC\_TI\_2\_PRS\_CYL\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]](n-1)  
TI\_2\_PRS\_HOM\_SP\_TMP = IP\_TI\_L(IDX\_TI\_2\_PRS\_HOM\_SP\_TMP)  
**(3)ENDIF**

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```

(2a)ELSE // current shaping is inactive; classic TI calculation applied
(3a)IF LV_EGY_RNG_IV_PLS_2_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] = 1
(3a)THEN
  TI_2_PRS_HOM_SP_TMP = IP_MFF_TI_EGY_H(
    (MFF_SP_2_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]]*(1 +
    FAC_MFF_DIF_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]])
    *FAC_MFF_TFU);
    PRS_DEC_INJ_2_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1))
    * FAC_TI_2_PRS_CYL_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1)
(3a)ELSE
  TI_2_PRS_HOM_SP_TMP = IP_MFF_TI_EGY_L(
    (MFF_SP_2_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]]*(1 +
    FAC_MFF_DIF_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]])
    *FAC_MFF_TFU);
    PRS_DEC_INJ_2_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1))
    * FAC_TI_COR_IV_EGY_RNG_L[m]
    * FAC_TI_2_PRS_CYL_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1)
(3a)ENDIF
(2a)ENDIF

```

Calculation of the counter pressure within the cylinder:

A rough injection duration angle CRK\_INJ\_2\_HOM is estimated from TI\_2\_PRS\_HOM\_SP\_TMP and engine speed (FAC\_N):

From the manifold pressure MAP, the end of injection EOI\_2\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]] and the rough injection angle a mean counter pressure within the cylinder during the injection is calculated.

The pressure difference at the injector is calculated from fuel rail pressure and the mean counter pressure.

The total correction factor results from the map IP\_FAC\_TI\_PRS\_CYL.  
For low injector needle lift, a separate map IP\_FAC\_TI\_PRS\_CYL\_L is used.

$$CRK\_INJ\_2\_HOM = TI\_2\_PRS\_HOM\_SP\_TMP * FAC\_N$$

$$PRS\_INJ\_MV\_2\_HOM = MAP\_INJ[m] * IP\_PRS\_INC\_CMP$$

(Input data for IP\_PRS\_INC\_CMP is

EOI\_2\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]] and CRK\_INJ\_2\_HOM)

$$PRS\_DEC\_INJ\_2\_HOM\_TMP = FUP\_H\_INJ[m] - PRS\_INJ\_MV\_2\_HOM$$

```

(3a)IF LV_EGY_RNG_IV_PLS_2_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] = 1

```

```

(3a)THEN

```

$$FAC\_TI\_2\_PRS\_CYL\_HOM\_TMP = IP\_FAC\_TI\_PRS\_CYL(PRS\_INJ\_MV\_2\_HOM)$$

```

(3a)ELSE

```

$$FAC\_TI\_2\_PRS\_CYL\_HOM\_TMP = IP\_FAC\_TI\_PRS\_CYL\_L(PRS\_INJ\_MV\_2\_HOM)$$

```

(3a)ENDIF

```

```


(2)FOR x = 0 TO NC_CYL_NR - 1 DO

```

```

  (4)IF NC_IDX_CYL_HPP_REF[x] = m

```


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```

(4)THEN
    PRS_DEC_INJ_2_HOM[x] = PRS_DEC_INJ_2_HOM_TMP
    FAC_TI_2_PRS_CYL_HOM[x] = FAC_TI_2_PRS_CYL_HOM_TMP
    TI_2_PRS_HOM_SP[x] = TI_2_PRS_HOM_SP_TMP
(4)ENDIF
(2)ENDFOR
(2)ENDIF

(1)ELSE
    (3)FOR x = 0 TO NC_CYL_NR - 1 DO
        (5)IF NC_IDX_CYL_HPP_REF[x] = m
            (5)THEN
                FAC_TI_2_PRS_CYL_HOM[x] = 1.0
                PRS_DEC_INJ_2_HOM[x] = FUP_H_INJ[m]
            (5)ENDIF
        (3)ENDFOR
    (1)ENDIF
(1)ENDFOR

```

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## 7.26 Injection pressure correction for multiple injection - HOM 3. pulse

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_INJ_3_HOM	V	0... 780H	0... 720	0.375	°CRK
rough value for injection angle (EOI-SOI), 3. pulse					
FAC_TI_3_PRS_CYL_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Correction factor to compensate the influence of the cylinder counter pressure, 3. Pulse homogeneous					
FAC_TI_3_PRS_CYL_HOM_TMP	-	0... FFFFH	0... 15.99975	244.1e-6	-
Correction factor to compensate the influence of the cylinder counter pressure, 3. Pulse homogeneous; temporary value					
IDX_TI_3_PRS_HOM_SP_TMP	-	0... FFFFH	0... 65535	1	-
Temporary counting factor index for pressure correction calculations; third pulse HOM.					
PRS_DEC_INJ_3_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Pressure difference at the injector, 3. pulse homogeneous mode					
PRS_DEC_INJ_3_HOM_TMP	-	0... FFFFH	0... 347776	5.3067216	hPa
Pressure difference at the injector, 3. pulse homogeneous mode; temporary value					
PRS_INJ_MV_3_HOM	V	0... FFFFH	0... 347776	5.3067216	hPa
mean cylinder pressure during injection, 3. Pulse					
TI_3_PRS_HOM_SP [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Injection time setpoint for calculation of injection pressure correction at homogeneous mode, third pulse					
TI_3_PRS_HOM_SP_TMP	-	0... FFFFH	0... 65.535	0.001	ms
Injection time setpoint for calculation of injection pressure correction at homogeneous mode, third pulse; temporary value					


### Input data:

EOI_3_HOM [NC_CYL_NR] {p. 2133}	FAC_MFF_DIF_HOM [NC_CYL_NR] {p. 2260}	FAC_MFF_TFU {p. 2224}	FAC_N {p. 3327}
FAC_TI_COR_IV_EGY_RNG_L [NC_CBK_HPP_NR] {p. 2260}	FUP_H_INJ [NC_CBK_HPP_NR] {p. 3327}	IDX_PRS_COR_CYL_CLC_MPLH [NC_CBK_HPP_NR] {p. 3327}	INJ_MOD_SP_HOM [NC_CYL_NR] {p. 3329}
IP_FAC_TI_PRS_CYL {p. 2200}	IP_FAC_TI_PRS_CYL_L {p. 2200}	IP_MFF_IDX_TI_EGY_H {p. 2008}	IP_MFF_IDX_TI_EGY_L {p. 2008}
IP_MFF_TI_EGY_H {p. 2009}	IP_MFF_TI_EGY_L {p. 2009}	IP_PRS_INC_CMP {p. 2204}	IP_TI_H {p. 2010}
IP_TI_L {p. 2010}	LC_CUR_SHP_INJ_ENA {p. 2010}	LF_PRS_COR_HPP_ENA {p. 3330}	LV_EGY_RNG_IV_PLS_3_HOM [NC_CYL_NR] {p. 2261}
LV_ST_END {p. 1720}	MAP_INJ [NC_CBK_HPP_NR] {p. 3331}	MFF_SP_3_HOM [NC_CYL_NR] {p. 8243}	NC_CBK_HPP_NR [1] {p. 812}
NC_CYL_NR {p. 1526}	NC_IDX_CYL_HPP_REF [NC_CYL_NR] {p. 626}		

### Overview

The module calculates a correction factor to compensate the influence of the cylinder counter pressure and the influence of the fuel temperature on the injection time..

### Application conditions

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**Activation:** every engine state  
**Deactivation:** -  
**Initialisation:** -  
**Update rate:** LV\_ST\_END = 0: 10 ms  
 LV\_ST\_END = 1: segment synchronous

### Function Description

**(1)FOR** m = 0 **TO** NC\_CBK\_HPP\_NR - 1 **DO**

**(1) IF** (INJ\_MOD\_SP\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]] = "MPLH+PLS3")

**(1) THEN**

Check, if fuel bank m has to be calculated:

**(2)IF** Bit m of LF\_PRS\_COR\_HPP\_ENA = 1

**(2)THEN**

Calculation of an injection time for pressure correction:

**(2a)IF** LC\_CUR\_SHP\_INJ\_ENA = 1

**(2a)THEN** // current shaping via IDX\_TI calculation is active

**(3)IF** LV\_EGY\_RNG\_IV\_PLS\_3\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]] = 1

**(3)THEN**

IDX\_TI\_3\_PRS\_HOM\_SP\_TMP = IP\_MFF\_IDX\_TI\_EGY\_H(  
 (MFF\_SP\_3\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]]\*(1 +  
 FAC\_MFF\_DIF\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]])\*FAC\_MFF\_TFU);  
 PRS\_DEC\_INJ\_3\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]](n-1))  
 \* FAC\_TI\_3\_PRS\_CYL\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]](n-1)  
 TI\_3\_PRS\_HOM\_SP\_TMP = IP\_TI\_H(IDX\_TI\_3\_PRS\_HOM\_SP\_TMP)

**(3)ELSE**

IDX\_TI\_3\_PRS\_HOM\_SP\_TMP = IP\_MFF\_IDX\_TI\_EGY\_L(  
 (MFF\_SP\_3\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]]\*(1 +  
 FAC\_MFF\_DIF\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]])\*FAC\_MFF\_TFU);  
 PRS\_DEC\_INJ\_3\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]](n-1))  
 \* FAC\_TI\_COR\_IV\_EGY\_RNG\_L[m]  
 \* FAC\_TI\_3\_PRS\_CYL\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]](n-1)  
 TI\_3\_PRS\_HOM\_SP\_TMP = IP\_TI\_L(IDX\_TI\_3\_PRS\_HOM\_SP\_TMP)

**(3)ENDIF**

**(2a)ELSE** // current shaping is inactive; classic TI calculation applied


**(3a)IF** LV\_EGY\_RNG\_IV\_PLS\_3\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]] = 1

**(3a)THEN**

TI\_3\_PRS\_HOM\_SP\_TMP = IP\_MFF\_TI\_EGY\_H(  
 (MFF\_SP\_3\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]]\*(1 +  
 FAC\_MFF\_DIF\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]])\*FAC\_MFF\_TFU);  
 PRS\_DEC\_INJ\_3\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]](n-1))  
 \* FAC\_TI\_3\_PRS\_CYL\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]](n-1)

**(3a)ELSE**

TI\_3\_PRS\_HOM\_SP\_TMP = IP\_MFF\_TI\_EGY\_L(  
 (MFF\_SP\_3\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]]\*(1 +  
 FAC\_MFF\_DIF\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]])\*FAC\_MFF\_TFU);  
 PRS\_DEC\_INJ\_3\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]](n-1))  
 \* FAC\_TI\_COR\_IV\_EGY\_RNG\_L[m]

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\* FAC\_TI\_3\_PRS\_CYL\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]](n-1)

**(3a)ENDIF**

**(2a)ENDIF**

Calculation of the counter pressure within the cylinder:

A rough injection duration angle CRK\_INJ\_3\_HOM is estimated from TI\_3\_PRS\_HOM\_SP\_TMP and engine speed (FAC\_N):

From the manifold pressure MAP, the end of injection EOI\_3\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]] and the rough injection angle a mean counter pressure within the cylinder during the injection is calculated.

The pressure difference at the injector is calculated from fuel rail pressure and the mean counter pressure.

The total correction factor results from the map IP\_FAC\_TI\_PRS\_CYL.

For low injector needle lift, a separate map IP\_FAC\_TI\_PRS\_CYL\_L is used.

CRK\_INJ\_3\_HOM = TI\_3\_PRS\_HOM\_SP\_TMP \* FAC\_N

PRS\_INJ\_MV\_3\_HOM = MAP\_INJ[m] \* IP\_PRS\_INC\_CMP

(Input data for IP\_PRS\_INC\_CMP is

EOI\_3\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]] and CRK\_INJ\_3\_HOM)

PRS\_DEC\_INJ\_3\_HOM\_TMP = FUP\_H\_INJ[m] - PRS\_INJ\_MV\_3\_HOM

**(3a)IF** LV\_EGY\_RNG\_IV\_PLS\_3\_HOM[IDX\_PRS\_COR\_CYL\_CLC\_MPLH[m]] = 1

**(3a)THEN**

FAC\_TI\_3\_PRS\_CYL\_HOM\_TMP =

IP\_FAC\_TI\_PRS\_CYL(PRS\_INJ\_MV\_3\_HOM)

**(3a)ELSE**

FAC\_TI\_3\_PRS\_CYL\_HOM\_TMP =

IP\_FAC\_TI\_PRS\_CYL\_L(PRS\_INJ\_MV\_3\_HOM)

**(3a)ENDIF**

**(2)FOR** x = 0 TO NC\_CYL\_NR - 1 DO

**(4)IF** NC\_IDX\_CYL\_HPP\_REF[x] = m

**(4)THEN**

PRS\_DEC\_INJ\_3\_HOM[x] = PRS\_DEC\_INJ\_3\_HOM\_TMP

FAC\_TI\_3\_PRS\_CYL\_HOM[x] = FAC\_TI\_3\_PRS\_CYL\_HOM\_TMP

TI\_3\_PRS\_HOM\_SP[x] = TI\_3\_PRS\_HOM\_SP\_TMP

**(4)ENDIF**

**(2)ENDFOR**

**(2)ENDIF**

**(1)ELSE**

**(3)FOR** x = 0 TO NC\_CYL\_NR - 1 DO

**(5)IF** NC\_IDX\_CYL\_HPP\_REF[x] = m

**(5)THEN**


FAC\_TI\_3\_PRS\_CYL\_HOM[x] = 1.0

PRS\_DEC\_INJ\_3\_HOM[x] = FUP\_H\_INJ[m]

**(5)ENDIF**


**(3)ENDFOR**

**(1)ENDIF**

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**(1)ENDFOR**

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## 7.27 Injection pressure correction for multiple injection - S 1. pulse

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_INJ_1_S	V	0... 780H	0... 720	0.375	°CRK
rough value for injection angle (EOI-SOI), stratified mode 1. pulse					
FAC_TI_1_PRS_CYL_S [NC_CYL_NR]	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
factor for correction of fuel injection time due to an influence of cylinder counter pressure, strat. mode 1. pulse					
FAC_TI_1_PRS_CYL_S_TMP	-	0... FFFFH	0... 15.99975	244.1e-6	-
factor for correction of fuel injection time due to an influence of cylinder counter pressure, strat. mode 1. pulse; temporary value					
FUP_PRS_COR [NC_CBK_HPP_NR]	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure for calculation of the pressure correction at stratified mode					
IDX_TI_1_PRS_S_SP_TMP	-	0... FFFFH	0... 65535	1	-
Temporary counting factor index for pressure correction calculations; first pulse S.					
PRS_DEC_INJ_1_S [NC_CYL_NR]	O/V	0... FFFFH	0... 347776	5.3067216	hPa
pressure decrease at the injector, stratified mode 1. pulse					
PRS_DEC_INJ_1_S_TMP	-	0... FFFFH	0... 347776	5.3067216	hPa
pressure decrease at the injector, stratified mode 1. pulse; temporary value					
PRS_INJ_MV_1_S	V	0... FFFFH	0... 347776	5.3067216	hPa
mean cylinder pressure during injection, stratified mode 1. pulse					
TI_1_PRS_S_SP_TMP	-	0... FFFFH	0... 65.535	0.001	ms
Injection time setpoint for calculation of injection pressure correction, stratified mode, 1. pulse; temporary value					

### Input data:

EOI_1_S [NC_CYL_NR] {p. 2140}	FAC_MFF_DIF_S [NC_CYL_NR] {p. 2260}	FAC_MFF_TFU {p. 2224}	FAC_N {p. 3327}
FAC_TI_COR_IV_EGY_ RNG_L [NC_CBK_HPP_NR] {p. 2260}	FUP_H_INJ [NC_CBK_HPP_NR] {p. 3327}	FUP_H_SP_S {p. 3868}	FUP_H_SP_S_INJ [NC_CBK_HPP_NR] {p. 3327}
IDX_PRS_COR_CYL_ CLC_S [NC_CBK_HPP_NR] {p. 3327}	IP_FAC_TI_PRS_CYL {p. 2200}	IP_FAC_TI_PRS_CYL_L {p. 2200}	IP_MFF_IDX_TI_EGY_H {p. 2008}
IP_MFF_IDX_TI_EGY_L {p. 2008}	IP_MFF_TI_EGY_H {p. 2009}	IP_MFF_TI_EGY_L {p. 2009}	IP_TI_H {p. 2010}
IP_TI_L {p. 2010}	LC_CUR_SHP_INJ_ENA {p. 2010}	LF_PRS_COR_HPP_ENA {p. 3330}	LV_EGY_RNG_IV_PLS_1_ S [NC_CYL_NR] {p. 2261}
LV_IGA_AND_INJ_SWI {p. 8136}	LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}	MAP_INJ [NC_CBK_HPP_NR] {p. 3331}
MFF_SP_1_S [NC_CYL_NR] {p. 8242}	NC_CBK_HPP_NR [1] {p. 812}	NC_CYL_NR {p. 1526}	NC_IDX_CYL_HPP_REF [NC_CYL_NR] {p. 626}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_PRS_INC_CMP_S	V	0... FFFFH	0... 31.99951	488.299e-6	-

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_EOI_2_S_0_IP_PRS_INC_CMP_S	12	0... 780H	0... 720	0.375	°CRK
LDP_CRK_INJ_2_S_IP_PRS_INC_CMP	16	0... 780H	0... 720	0.375	°CRK
Mean pressure increase in cylinder due to compression					

## FUNCTION DESCRIPTION:

### General information:

The module calculates a correction factor to compensate the influence of the cylinder counter pressure and the influence of the fuel temperature on the injected fuel mass.

### Application conditions

<b>Activation:</b>	every engine state
<b>Deactivation:</b>	-
<b>Initialisation:</b>	-
<b>Update rate:</b>	LV_ST_END = 0: 10 ms LV_ST_END = 1: segment synchronous

### Formula section:

(1)FOR m = 0 TO NC\_CBK\_HPP\_NR - 1 DO

(1) IF

LV\_S\_CLC = 1

(1) THEN

Check, if fuel bank m has to be calculated:

(2)IF Bit m of LF\_PRS\_COR\_HPP\_ENA = 1

(2)THEN

The injection time TI\_1\_PRS\_S\_SP\_TMP is necessary to calculate CRK\_INJ\_1\_S.

Calculation of TI\_1\_PRS\_S\_SP\_TMP:

(2a)IF LC\_CUR\_SHP\_INJ\_ENA = 1

(2a)THEN // current shaping via IDX\_TI calculation is active

(3)IF LV\_EGY\_RNG\_IV\_PLS\_1\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]] = 1

(3)THEN

$$\text{IDX\_TI\_1\_PRS\_S\_SP\_TMP} = \text{IP\_MFF\_IDX\_TI\_EGY\_H}(\text{MFF\_SP\_1\_S}[\text{IDX\_PRS\_COR\_CYL\_CLC\_S}[\text{m}]] * (1 + \text{FAC\_MFF\_DIF\_S}[\text{IDX\_PRS\_COR\_CYL\_CLC\_S}[\text{m}]] * \text{FAC\_MFF\_TFU}) + \text{PRS\_DEC\_INJ\_1\_S}[\text{IDX\_PRS\_COR\_CYL\_CLC\_S}[\text{m}]] * (\text{n}-1))$$

\* FAC\_TI\_1\_PRS\_CYL\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]]\*(n-1)


TI\_1\_PRS\_S\_SP\_TMP = IP\_TI\_H(IDX\_TI\_1\_PRS\_S\_SP\_TMP)

(3)ELSE

$$\text{IDX\_TI\_1\_PRS\_S\_SP\_TMP} = \text{IP\_MFF\_IDX\_TI\_EGY\_L}(\text{MFF\_SP\_1\_S}[\text{IDX\_PRS\_COR\_CYL\_CLC\_S}[\text{m}]] * (1 + \text{FAC\_MFF\_DIF\_S}[\text{IDX\_PRS\_COR\_CYL\_CLC\_S}[\text{m}]] * \text{FAC\_MFF\_TFU}) + \text{PRS\_DEC\_INJ\_1\_S}[\text{IDX\_PRS\_COR\_CYL\_CLC\_S}[\text{m}]] * (\text{n}-1))$$

\* FAC\_TI\_COR\_IV\_EGY\_RNG\_L[m]

\* FAC\_TI\_1\_PRS\_CYL\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]]\*(n-1)

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```

TI_1_PRS_S_SP_TMP = IP_TI_L(IDX_TI_1_PRS_S_SP_TMP)
(3)ENDIF
(2a)ELSE // current shaping is inactive; classic TI calculation applied
(3a)IF LV_EGY_RNG_IV_PLS_1_S[IDX_PRS_COR_CYL_CLC_S[m]] = 1
(3a)THEN
TI_1_PRS_S_SP_TMP = IP_MFF_TI_EGY_H(
(MFF_SP_1_S[IDX_PRS_COR_CYL_CLC_S[m]]*(1 +
FAC_MFF_DIF_S[IDX_PRS_COR_CYL_CLC_S[m]])*FAC_MFF_TFU);
PRS_DEC_INJ_1_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1))
* FAC_TI_1_PRS_CYL_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1)
(3a)ELSE
TI_1_PRS_S_SP_TMP = IP_MFF_TI_EGY_L(
(MFF_SP_1_S[IDX_PRS_COR_CYL_CLC_S[m]]*(1 +
FAC_MFF_DIF_S[IDX_PRS_COR_CYL_CLC_S[m]])*FAC_MFF_TFU);
PRS_DEC_INJ_1_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1))
* FAC_TI_COR_IV_EGY_RNG_L[m]
* FAC_TI_1_PRS_CYL_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1)
(3a)ENDIF
(2a)ENDIF

```

A rough injection duration angle CRK\_INJ\_1\_S is estimated from TI\_1\_PRS\_S\_SP\_TMP and engine speed:

From the manifold pressure MAP\_INJ[m], the end of injection EOI\_1\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]] and the rough injection angle a mean counter pressure within the cylinder during the injection is calculated.

$$CRK\_INJ\_1\_S = TI\_1\_PRS\_S\_SP\_TMP * FAC\_N$$

$$PRS\_INJ\_MV\_1\_S = MAP\_INJ[m] * IP\_PRS\_INC\_CMP\_S \\ (EOI\_1\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]]; CRK\_INJ\_1\_S)$$

The pressure difference at the injector is calculated from fuel rail pressure and the mean counter pressure.

If the engine is not running in stratified mode (LV\_IGA\_AND\_INJ\_SWI = 1), for a correct calculation of the pressure correction the FUP\_H\_SP\_S\_INJ[m] has to be used instead of the actual FUP\_H\_INJ[m], because the actual FUP\_H\_INJ[m] is tuned for a different combustion mode than stratified.

```

(4)IF LV_IGA_AND_INJ_SWI = 1
(4)THEN
FUP_PRS_COR[m] = FUP_H_SP_S_INJ[m]
(4)ELSE
FUP_PRS_COR[m] = FUP_H_INJ[m]
(4)ENDIF
PRS_DEC_INJ_1_S_TMP = FUP_PRS_COR[m] - PRS_INJ_MV_1_S

```


The total correction factor results from the map IP\_FAC\_TI\_PRS\_CYL.

For low injector needle lift, a separate map IP\_FAC\_TI\_PRS\_CYL\_L is used.

```

(4a)IF LV_EGY_RNG_IV_PLS_1_S[IDX_PRS_COR_CYL_CLC_S[m]] = 1
(4a)THEN
FAC_TI_1_PRS_CYL_S_TMP = IP_FAC_TI_PRS_CYL(PRS_INJ_MV_1_S)
(4a)ELSE

```

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```

    FAC_TI_1_PRS_CYL_S_TMP = IP_FAC_TI_PRS_CYL_L(PRS_INJ_MV_1_S)
(4a)ENDIF

(2)FOR x = 0 TO NC_CYL_NR - 1 DO
    (5)IF NC_IDX_CYL_HPP_REF[x] = m
        (5)THEN
            PRS_DEC_INJ_1_S[x] = PRS_DEC_INJ_1_S_TMP
            FAC_TI_1_PRS_CYL_S[x] = FAC_TI_1_PRS_CYL_S_TMP
        (5)ENDIF
    (2)ENDFOR
(2)ENDIF

(1) ELSE
    (3)FOR x = 0 TO NC_CYL_NR - 1 DO
        (5)IF NC_IDX_CYL_HPP_REF[x] = m
            (5)THEN
                PRS_DEC_INJ_1_S[x] = FUP_H_SP_S_INJ[m]
            (5)ENDIF
        (3)ENDFOR
    (1) ENDIF
(1)ENDFOR

```

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## 7.28 Injection pressure correction for multiple injection - S 2. pulse

### Data definition:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_INJ_2_S	V	0... 780H	0... 720	0.375	°CRK
rough value for injection angle (EOI-SOI), stratified mode 1. pulse					
FAC_TI_2_PRS_CYL_S [NC_CYL_NR]	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
factor for correction of fuel injection time due to an influence of cylinder counter pressure, strat. mode 2. pulse					
FAC_TI_2_PRS_CYL_S_TMP	-	0... FFFFH	0... 15.99975	244.1e-6	-
Factor for correction of fuel injection time due to an influence of cylinder counter pressure, strat. mode 2. pulse; temporary value					
IDX_TI_2_PRS_S_SP_TMP	-	0... FFFFH	0... 65535	1	-
Temporary counting factor index for pressure correction calculations; second pulse S.					
PRS_DEC_INJ_2_S [NC_CYL_NR]	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Pressure decrease at the injector, stratified mode 2. pulse					
PRS_DEC_INJ_2_S_TMP	-	0... FFFFH	0... 347776	5.3067216	hPa
Pressure decrease at the injector, stratified mode 2. pulse; temporary value					
PRS_INJ_MV_2_S	V	0... FFFFH	0... 347776	5.3067216	hPa
mean cylinder pressure during injection, stratified mode 2. pulse					
TI_2_PRS_S_SP_TMP	-	0... FFFFH	0... 65.535	0.001	ms
Injection time setpoint for calculation of injection pressure correction, stratified mode, 2. pulse; temporary value					
TI_2_STND_S [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Mapped Injection time, stratified mode, 2. pulse					

### Input data:

EOI_2_S [NC_CYL_NR] {p. 2142}	FAC_MFF_DIF_S [NC_CYL_NR] {p. 2260}	FAC_MFF_TFU {p. 2224}	FAC_N {p. 3327}
FAC_TI_COR_IV_EGY_ RNG_L [NC_CBK_HPP_NR] {p. 2260}	FUP_H_SP_S_INJ [NC_CBK_HPP_NR] {p. 3327}	FUP_PRS_COR [NC_CBK_HPP_NR] {p. 2212}	IDX_PRS_COR_CYL_ CLC_S [NC_CBK_HPP_NR] {p. 3327}
INJ_MOD_SP_HOMS [NC_CYL_NR] {p. 3329}	INJ_MOD_SP_S [NC_CYL_NR] {p. 3330}	IP_FAC_TI_PRS_CYL {p. 2200}	IP_FAC_TI_PRS_CYL_L {p. 2200}
IP_MFF_IDX_TI_EGY_H {p. 2008}	IP_MFF_IDX_TI_EGY_L {p. 2008}	IP_MFF_TI_EGY_H {p. 2009}	IP_MFF_TI_EGY_L {p. 2009}
IP_PRS_INC_CMP_S {p. 2212}	IP_TI_H {p. 2010}	IP_TI_L {p. 2010}	LC_CUR_SHP_INJ_ENA {p. 2010}
LF_PRS_COR_HPP_ENA {p. 3330}	LV_EGY_RNG_IV_PLS_2_ S [NC_CYL_NR] {p. 2261}	LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}
MAP_INJ [NC_CBK_HPP_NR] {p. 3331}	MFF_SP_2_S [NC_CYL_NR] {p. 8242}	NC_CBK_HPP_NR [1] {p. 812}	NC_CYL_NR {p. 1526}
NC_IDX_CYL_HPP_REF [NC_CYL_NR] {p. 626}	NC_INJ_MOD_MULT1 {p. 2045}		

### FUNCTION DESCRIPTION:

### General information:

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The module calculates a correction factor to compensate the influence of the cylinder counter pressure and the influence of the fuel temperature on the injected fuel mass.

### Application conditions

**Activation:** every engine state  
**Deactivation:** -  
**Initialisation:** -  
**Update rate:** LV\_ST\_END = 0: 10 ms  
 LV\_ST\_END = 1: segment synchronous

### Formula section:

**(1)FOR** m = 0 **TO** NC\_CBK\_HPP\_NR - 1 **DO**

**(1)IF** LV\_S\_CLC = 1 **AND**

(INJ\_MOD\_SP\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]] = "MPLS" **OR**  
 INJ\_MOD\_SP\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]] = "MPLS+PLS3" **OR**  
 INJ\_MOD\_SP\_HOMS[IDX\_PRS\_COR\_CYL\_CLC\_S[m]] = "HOMS" **OR**  
 INJ\_MOD\_SP\_HOMS[IDX\_PRS\_COR\_CYL\_CLC\_S[m]] = "HOMS+PLS3")

**(1)THEN**

Check, if fuel bank m has to be calculated:

**(2)IF** Bit m of LF\_PRS\_COR\_HPP\_ENA = 1

**(2)THEN**

The injection time TI\_2\_PRS\_S\_SP\_TMP is necessary to calculate CRK\_INJ\_2\_S.

Calculation of TI\_2\_PRS\_S\_SP\_TMP:

**(2a)IF** LC\_CUR\_SHP\_INJ\_ENA = 1

**(2a)THEN** // current shaping via IDX\_TI calculation is active

**(3)IF** LV\_EGY\_RNG\_IV\_PLS\_2\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]] = 1

**(3)THEN**

IDX\_TI\_2\_PRS\_S\_SP\_TMP = IP\_MFF\_IDX\_TI\_EGY\_H(  
 (MFF\_SP\_2\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]]\*(1 +  
 FAC\_MFF\_DIF\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]])\*FAC\_MFF\_TFU);  
 PRS\_DEC\_INJ\_2\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]](n-1))  
 \* FAC\_TI\_2\_PRS\_CYL\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]](n-1)

TI\_2\_PRS\_S\_SP\_TMP = IP\_TI\_H(IDX\_TI\_2\_PRS\_S\_SP\_TMP)

**(3)ELSE**

IDX\_TI\_2\_PRS\_S\_SP\_TMP = IP\_MFF\_IDX\_TI\_EGY\_L(  
 (MFF\_SP\_2\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]]\*(1 +  
 FAC\_MFF\_DIF\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]])\*FAC\_MFF\_TFU);  
 PRS\_DEC\_INJ\_2\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]](n-1))

\* FAC\_TI\_COR\_IV\_EGY\_RNG\_L[m]

\* FAC\_TI\_2\_PRS\_CYL\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]](n-1)

TI\_2\_PRS\_S\_SP\_TMP = IP\_TI\_L(IDX\_TI\_2\_PRS\_S\_SP\_TMP)


**(3)ENDIF**

**(2a)ELSE** // current shaping is inactive; classic TI calculation applied

**(3a)IF** LV\_EGY\_RNG\_IV\_PLS\_2\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]] = 1

**(3a)THEN**

TI\_2\_PRS\_S\_SP\_TMP = IP\_MFF\_TI\_EGY\_H(  
 (MFF\_SP\_2\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]]\*(1 +  
 FAC\_MFF\_DIF\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]])\*FAC\_MFF\_TFU);  
 PRS\_DEC\_INJ\_2\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]](n-1))

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\* FAC\_TI\_2\_PRS\_CYL\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]](n-1)

**(3a)ELSE**

TI\_2\_PRS\_S\_SP\_TMP = IP\_MFF\_TI\_EGY\_L(  
 (MFF\_SP\_2\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]]\*(1 +  
 FAC\_MFF\_DIF\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]])\*FAC\_MFF\_TFU);  
 PRS\_DEC\_INJ\_2\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]](n-1))

\* FAC\_TI\_COR\_IV\_EGY\_RNG\_L[m]

\* FAC\_TI\_2\_PRS\_CYL\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]](n-1)

**(3a)ENDIF**

**(2a)ENDIF**

A rough injection duration angle CRK\_INJ\_2\_S is estimated from TI\_2\_PRS\_S\_SP\_TMP and engine speed:

From the manifold pressure MAP\_INJ[m], the end of injection EOI\_2\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]] and the rough injection angle a mean counter pressure within the cylinder during the injection is calculated.

The pressure difference at the injector is calculated from fuel rail pressure and the mean counter pressure.

The total correction factor results from the map IP\_FAC\_TI\_PRS\_CYL.

For low injector needle lift, a separate map IP\_FAC\_TI\_PRS\_CYL\_L is used.

CRK\_INJ\_2\_S = TI\_2\_PRS\_S\_SP\_TMP \* FAC\_N

PRS\_INJ\_MV\_2\_S = MAP\_INJ[m] \* IP\_PRS\_INC\_CMP\_S

(Input data for IP\_PRS\_INC\_CMP\_S is EOI\_2\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]] and CRK\_INJ\_2\_S)

PRS\_DEC\_INJ\_2\_S\_TMP = FUP\_PRS\_COR[m] - PRS\_INJ\_MV\_2\_S

**(3a)IF** LV\_EGY\_RNG\_IV\_PLS\_2\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]] = 1

**(3a)THEN**

FAC\_TI\_2\_PRS\_CYL\_S\_TMP = IP\_FAC\_TI\_PRS\_CYL(PRS\_INJ\_MV\_2\_S)

**(3a)ELSE**

FAC\_TI\_2\_PRS\_CYL\_S\_TMP = IP\_FAC\_TI\_PRS\_CYL\_L(PRS\_INJ\_MV\_2\_S)

**(3a)ENDIF**

**(2)FOR** x = 0 **TO** NC\_CYL\_NR - 1 **DO**

**(4)IF** NC\_IDX\_CYL\_HPP\_REF[x] = m

**(4)THEN**

PRS\_DEC\_INJ\_2\_S[x] = PRS\_DEC\_INJ\_2\_S\_TMP

FAC\_TI\_2\_PRS\_CYL\_S[x] = FAC\_TI\_2\_PRS\_CYL\_S\_TMP

TI\_2\_STND\_S[x] = TI\_2\_PRS\_S\_SP\_TMP

**(4)ENDIF**

**(2)ENDFOR**

**(2)ENDIF**

**(1)ELSE**


**(3)FOR** x = 0 **TO** NC\_CYL\_NR - 1 **DO**

**(5)IF** NC\_IDX\_CYL\_HPP\_REF[x] = m

**(5)THEN**

PRS\_DEC\_INJ\_2\_S[x] = FUP\_H\_SP\_S\_INJ[m]

**(5)ENDIF**


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```

(3)ENDFOR
(1)ENDIF
(1)ENDFOR

```

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## 7.29 Injection pressure correction for multiple injection - S 3. pulse

### Data definition:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_INJ_3_S	V	0... 780H	0... 720	0.375	°CRK
Rough value for injection angle (SOI-EOI), stratified mode 3. pulse					
FAC_TI_3_PRS_CYL_S [NC_CYL_NR]	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
factor for correction of fuel injection time due to an influence of cylinder counter pressure, strat. mode 3. pulse					
FAC_TI_3_PRS_CYL_S_TMP	-	0... FFFFH	0... 15.99975	244.1e-6	-
factor for correction of fuel injection time due to an influence of cylinder counter pressure, strat. mode 3. pulse; temporary value					
IDX_TI_3_PRS_S_SP_TMP	-	0... FFFFH	0... 65535	1	-
Temporary counting factor index for pressure correction calculations; third pulse S.					
PRS_DEC_INJ_3_S [NC_CYL_NR]	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Pressure decrease at the injector, stratified mode 3. pulse					
PRS_DEC_INJ_3_S_TMP	-	0... FFFFH	0... 347776	5.3067216	hPa
Pressure decrease at the injector, stratified mode 3. pulse; temporary value					
PRS_INJ_MV_3_S	V	0... FFFFH	0... 347776	5.3067216	hPa
Cylinder pressure (mean value) during injection, stratified mode 3. pulse					
TI_3_PRS_S_SP_TMP	-	0... FFFFH	0... 65.535	0.001	ms
Injection time setpoint for calculation of injection pressure correction, stratified mode, 3. pulse; temporary value					
TI_3_STND_S [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Mapped Injection time, stratified mode, 3. pulse					

### Input data:

EOI_3_S [NC_CYL_NR] {p. 2144}	FAC_MFF_DIF_S [NC_CYL_NR] {p. 2260}	FAC_MFF_TFU {p. 2224}	FAC_N {p. 3327}
FAC_TI_COR_IV_EGY_ RNG_L [NC_CBK_HPP_NR] {p. 2260}	FUP_H_SP_S_INJ [NC_CBK_HPP_NR] {p. 3327}	FUP_PRS_COR [NC_CBK_HPP_NR] {p. 2212}	IDX_PRS_COR_CYL_ CLC_S [NC_CBK_HPP_NR] {p. 3327}
INJ_MOD_SP_HOMS [NC_CYL_NR] {p. 3329}	INJ_MOD_SP_S [NC_CYL_NR] {p. 3330}	IP_FAC_TI_PRS_CYL {p. 2200}	IP_FAC_TI_PRS_CYL_L {p. 2200}
IP_MFF_IDX_TI_EGY_H {p. 2008}	IP_MFF_IDX_TI_EGY_L {p. 2008}	IP_MFF_TI_EGY_H {p. 2009}	IP_MFF_TI_EGY_L {p. 2009}
IP_PRS_INC_CMP_S {p. 2212}	IP_TI_H {p. 2010}	IP_TI_L {p. 2010}	LC_CUR_SHP_INJ_ENA {p. 2010}
LF_PRS_COR_HPP_ENA {p. 3330}	LV_EGY_RNG_IV_PLS_3_ S [NC_CYL_NR] {p. 2261}	LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}
MAP_INJ [NC_CBK_HPP_NR] {p. 3331}	MFF_SP_3_S [NC_CYL_NR] {p. 8243}	NC_CBK_HPP_NR [1] {p. 812}	NC_CYL_NR {p. 1526}
NC_IDX_CYL_HPP_REF [NC_CYL_NR] {p. 626}			

### FUNCTION DESCRIPTION:

### General information:

Released by Tettendorf Frank		Date 2013-02-13	File 6W708E01.00B
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 2220 of 8404	
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The module calculates a correction factor to compensate the influence of the cylinder counter pressure and the influence of the fuel temperature on the injected fuel mass.

### Application conditions

**Activation:** every engine state  
**Deactivation:** -  
**Initialisation:** -  
**Update rate:** LV\_ST\_END = 0: 10 ms  
 LV\_ST\_END = 1: segment synchronous

### Formula section:

**(1)FOR** m = 0 **TO** NC\_CBK\_HPP\_NR - 1 **DO**

**(1)IF** (LV\_S\_CLC = 1) **AND**

(INJ\_MOD\_SP\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]] = "MPLS+PLS3" **OR**  
 INJ\_MOD\_SP\_HOMS[IDX\_PRS\_COR\_CYL\_CLC\_S[m]] = "HOMS+PLS3")

**(1)THEN**

Check, if fuel bank m has to be calculated:

**(2)IF** Bit m of LF\_PRS\_COR\_HPP\_ENA = 1

**(2)THEN**

The injection time TI\_3\_PRS\_S\_SP\_TMP is necessary to calculate CRK\_INJ\_3\_S.

Calculation of TI\_3\_PRS\_S\_SP\_TMP:

**(2a)IF** LC\_CUR\_SHP\_INJ\_ENA = 1

**(2a)THEN** // current shaping via IDX\_TI calculation is active

**(3)IF** LV\_EGY\_RNG\_IV\_PLS\_3\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]] = 1

**(3)THEN**

IDX\_TI\_3\_PRS\_S\_SP\_TMP = IP\_MFF\_IDX\_TI\_EGY\_H(  
 (MFF\_SP\_3\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]]\*(1 +  
 FAC\_MFF\_DIF\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]])\*FAC\_MFF\_TFU);  
 PRS\_DEC\_INJ\_3\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]](n-1))

\* FAC\_TI\_3\_PRS\_CYL\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]](n-1)

TI\_3\_PRS\_S\_SP\_TMP = IP\_TI\_H(IDX\_TI\_3\_PRS\_S\_SP\_TMP)

**(3)ELSE**

IDX\_TI\_3\_PRS\_S\_SP\_TMP = IP\_MFF\_IDX\_TI\_EGY\_L(  
 (MFF\_SP\_3\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]]\*(1 +  
 FAC\_MFF\_DIF\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]])\*FAC\_MFF\_TFU);  
 PRS\_DEC\_INJ\_3\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]](n-1))

\* FAC\_TI\_COR\_IV\_EGY\_RNG\_L[m]

\* FAC\_TI\_3\_PRS\_CYL\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]](n-1)

TI\_3\_PRS\_S\_SP\_TMP = IP\_TI\_L(IDX\_TI\_3\_PRS\_S\_SP\_TMP)

**(3)ENDIF**

**(2a)ELSE** // current shaping is inactive; classic TI calculation applied


**(3a)IF** LV\_EGY\_RNG\_IV\_PLS\_3\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]] = 1

**(3a)THEN**

TI\_3\_PRS\_S\_SP\_TMP = IP\_MFF\_TI\_EGY\_H(  
 (MFF\_SP\_3\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]]\*(1 +  
 FAC\_MFF\_DIF\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]])\*FAC\_MFF\_TFU);  
 PRS\_DEC\_INJ\_3\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]](n-1))

\* FAC\_TI\_3\_PRS\_CYL\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]](n-1)

**(3a)ELSE**

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```

TI_3_PRS_S_SP_TMP = IP_MFF_TI_EGY_L(
    (MFF_SP_3_S[IDX_PRS_COR_CYL_CLC_S[m]]*(1 +
    FAC_MFF_DIF_S[IDX_PRS_COR_CYL_CLC_S[m]])*FAC_MFF_TFU);
    PRS_DEC_INJ_3_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1))
* FAC_TI_COR_IV_EGY_RNG_L[m]
* FAC_TI_3_PRS_CYL_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1)

```

**(3a)ENDIF**

**(2a)ENDIF**

A rough injection duration angle CRK\_INJ\_3\_S is estimated from TI\_3\_PRS\_S\_SP\_TMP and engine speed:

Note: TI\_3\_PRS\_S\_SP\_TMP is calculated with the pressure correction information of the previous calculated injector pressure difference PRS\_DEC\_INJ\_3\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]].

From the manifold pressure MAP\_INJ[m], the end of injection EOI\_3\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]] and the rough injection angle a mean counter pressure within the cylinder during the injection is calculated.

The pressure difference at the injector is calculated from fuel rail pressure and the mean counter pressure.

The total correction factor results from the map IP\_FAC\_TI\_PRS\_CYL.

For low injector needle lift, a separate map IP\_FAC\_TI\_PRS\_CYL\_L is used.

```
CRK_INJ_3_S = TI_3_PRS_S_SP_TMP * FAC_N
```

```
PRS_INJ_MV_3_S = MAP_INJ[m] * IP_PRS_INC_CMP_S
```

(Input data for IP\_PRS\_INC\_CMP\_S is EOI\_3\_S[IDX\_PRS\_COR\_CYL\_CLC\_S[m]] and CRK\_INJ\_3\_S)

```
PRS_DEC_INJ_3_S_TMP = FUP_PRS_COR[m] - PRS_INJ_MV_3_S
```

```
(3a)IF LV_EGY_RNG_IV_PLS_3_S[IDX_PRS_COR_CYL_CLC_S[m]] = 1
```

```
(3a)THEN
```

```
    FAC_TI_3_PRS_CYL_S_TMP = IP_FAC_TI_PRS_CYL (PRS_INJ_MV_3_S)
```

```
(3a)ELSE
```

```
    FAC_TI_3_PRS_CYL_S_TMP = IP_FAC_TI_PRS_CYL_L(PRS_INJ_MV_3_S)
```

```
(3a)ENDIF
```

```
(2)FOR x = 0 TO NC_CYL_NR - 1 DO
```

```
    (4)IF NC_IDX_CYL_HPP_REF[x] = m
```

```
    (4)THEN
```

```
        PRS_DEC_INJ_3_S[x] = PRS_DEC_INJ_3_S_TMP
```

```
        FAC_TI_3_PRS_CYL_S[x] = FAC_TI_3_PRS_CYL_S_TMP
```

```
        TI_3_STND_S[x] = TI_3_PRS_S_SP_TMP
```

```
    (4)ENDIF
```

```
(2)ENDFOR
```


```
(2)ENDIF
```

```
(1)ELSE
```

```
    (3)FOR x = 0 TO NC_CYL_NR - 1 DO
```

```
        (5)IF NC_IDX_CYL_HPP_REF[x] = m
```


```
        (5)THEN
```

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```

    PRS_DEC_INJ_3_S[x] = FUP_H_SP_S_INJ[m]
(5)ENDIF
(3)ENDFOR
(1)ENDIF
(1)ENDFOR

```

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 2223 of 8404</b>
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## 7.30 Fuel temperature correction

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_MFF_TFU	O/V	0... 1FFFH	0... 1.999755859375	244.14e-6	-
Factor to correct fuel mass due to the fuel temperature in rail.					

### Input data:

TFU_INJ {p. 3332}			
-------------------	--	--	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_MFF_TEMP_COR	V	0... 1FFFH	0... 1.999755859375	244.14e-6	-
LDP_TFU_IP_FAC_MFF_TEMP_COR	12	0... FEH	-48... 142.5	0.75	°C
factor for correction of fuel injection due to the fuel temperature					

### General information

Density fluctuations of fuel due to temperature variation can be compensated with a correction factor on the fuel mass setpoint.

### Application conditions:

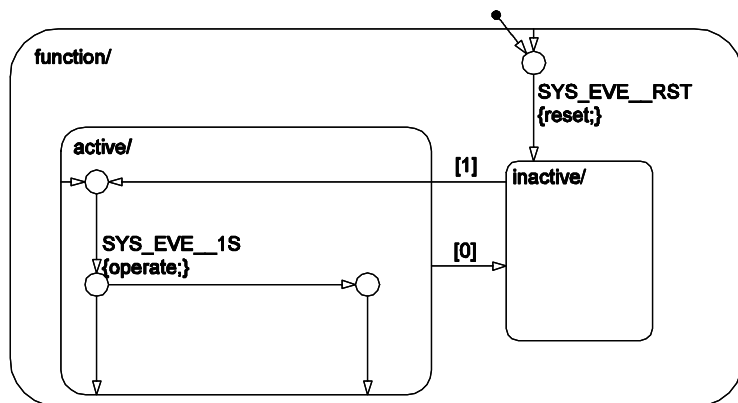


Figure 7.30.1: INJR\_ISPCLTFU0/APP\_CDN/Chart

### Function description:

### Signal flow diagram:

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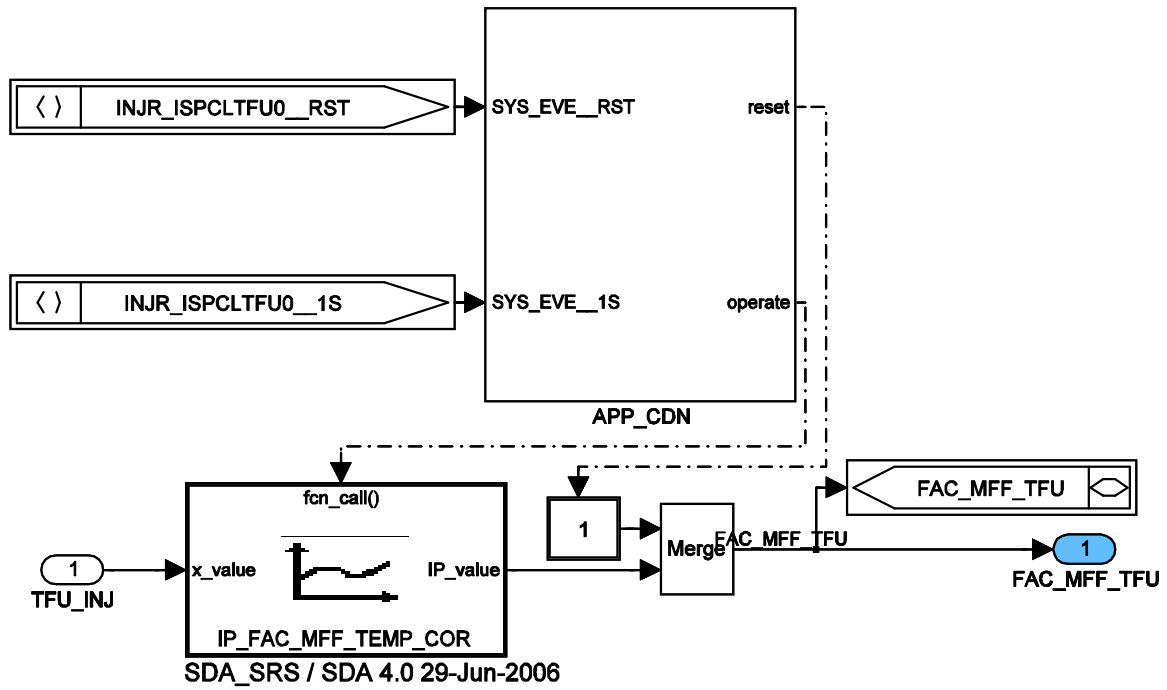


Figure 7.30.2: INJR\_ISPCLTFU0

**Formula section:**

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## 7.31 Compensation of temperature influence on the injector needle lift

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EGY_ADD_TEMP	O/V	8000... 7FFFH	-127.50194 ...127.49805	3.8911e-3	mJ
Additive piezo energy correction depending on the injector temperature					
LV_EGY_ADD_ST_TMP	-	0... 1H	0 ...1	1	-
Ramping from Start Energy correction to Correction Value from Map is active					

### Input data:

NC_CYL_NR {p. 1526}	TCO_ST {p. 1100}	TEMP_CAPA_IV_MV {p. 2241}	TFU_INJ {p. 3332}
---------------------	------------------	------------------------------	-------------------

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EGY_ADD_TEMP_GRAD	-	0... 7FFFH	0... 127.99609	3.9062e-3	mJ/s
Gradient to ramp from Energy Temperature Offset during Start to normal Energy Temperature Offset					
C_EGY_ADD_TEMP_ST	-	8000... 7FFFH	-127.50194 ...127.49805	3.8911e-3	mJ
Energy Temperature Offset during Start					
IP_EGY_ADD_TEMP	V	0... FFFFH	-127.50194 ...127.49805	3.8911e-3	mJ
LDP_TFU_INJ_IP_EGY_ADD_TEMP	6	0... FEH	-48... 142.5	0.75	°C
LDP_TCO_ST_IP_EGY_ADD_TEMP	6	0... FEH	-48... 142.5	0.75	°C
Additive piezo energy correction depending on the injector temperature					
LC_EGY_ADD_TEMP_ST_ENA	-	0... 1H	0 ...1	1	-
Switch to enable new Energy Temperature correction					
LC_TEMP_CAPA_IV_ENA	-	0... 1H	0 ...1	1	-
Switch to enable usage of piezo stack temperature					

### Overview:

The needle lift of piezo actuators depends on the injector temperature. In order to compensate this effect and to keep the needle lift constant an additive correction of the piezo stack energy has to be applied.,

### FUNCTION DESCRIPTION:

#### Application conditions


**Activation:** *every engine state*

**Deactivation:** -

**Initialisation:** at reset:  
EGY\_ADD\_TEMP=0

EGY\_ADD\_TEMP\_IP=0 // only local variable

LV\_EGY\_ADD\_ST\_TMP =0

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
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Recurrence: 1 s


**Formula section:**

When LC\_EGY\_ADD\_TEMP\_ST\_ENA ist enabled during Start the Energy correction is made by a calibrateable constant C\_EGY\_ADD\_TEMP\_ST. When LV\_ST\_END is reached the correction Value is ramped with the Gradient C\_EGY\_ADD\_TEMP\_GRAD to the respective Map Value depending on TCO\_ST and TEMP\_CAPA\_IV or TFU\_INJ.

```
(1)IF LV_ST_END=0 AND LC_EGY_ADD_TEMP_ST_ENA =1
(1)THEN
    EGY_ADD_TEMP = C_EGY_ADD_TEMP_ST
LV_EGY_ADD_ST_TMP = 1
(1)ELSE
    (2)IF LC_TEMP_CAPA_IV_ENA =1
(2)THEN
    EGY_ADD_TEMP_IP = IP_EGY_ADD_TEMP (TEMP_CAPA_IV_MV; TCO_ST)
    (2) ELSE
    EGY_ADD_TEMP_IP = IP_EGY_ADD_TEMP (TFU_INJ;TCO_ST)
    (2) ENDIF
```

//ramp up or down with calibrateable Gradient

```
(3) IF abs(EGY_ADD_TEMP_IP - EGY_ADD_TEMP) > C_EGY_ADD_TEMP_GRAD
AND LV_EGY_ADD_ST_TMP = 1
(3) THEN
(4) IF EGY_ADD_TEMP_IP - EGY_ADD_TEMP > 0
(4) THEN
    increment EGY_ADD_TEMP by C_EGY_ADD_TEMP_GRAD
(4) ELSE
    decrement EGY_ADD_TEMP by C_EGY_ADD_TEMP_GRAD
(4)ENDIF
(3) ELSE
EGY_ADD_TEMP = EGY_ADD_TEMP_IP
LV_EGY_ADD_ST_TMP=0 // Ramping only once at Start end
(3) ENDIF
(1)ENDIF
```

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 2227 of 8404	
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## 7.32 Compensation of fuel pressure influence on the injector needle lift

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EGY_ADD_FUP [NC_CBK_HPP_NR]	O/V	8000... 7FFFH	0... 127.498054	0.00389105	mJ
Additive piezo energy correction depending on the fuel pressure					

### Input data:

FUP_H_INJ [NC_CBK_HPP_NR] {p. 3327}	LV_ST_END {p. 1720}	NC_CBK_HPP_NR [1] {p. 812}	
---	---------------------	-------------------------------	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_EGY_ADD_FUP	-	0... FFFFH	0... 127.498054	0.00389105	mJ
LDP_FUP_IP_EGY_ADD_FUP	12	0... FFFFH	0... 347776	5.3067216	hPa
Additive piezo energy correction depending on the fuel pressure					

### General information

The needle lift of injection valves with piezo actuators depends on the fuel pressure. In order to compensate this effect and to keep the needle lift constant an additive correction of the piezo stack energy has to be applied.

### Application Condition

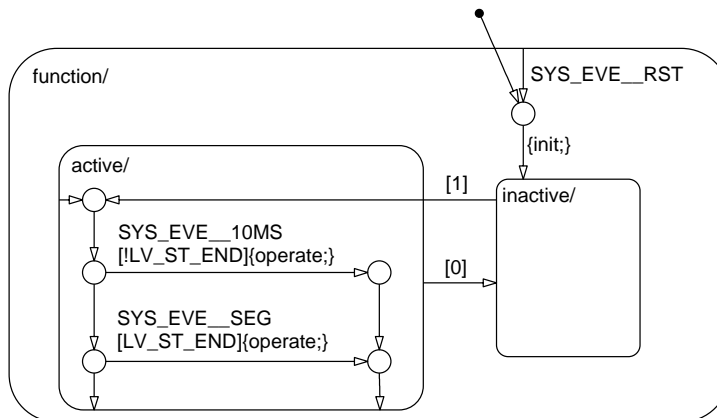


Figure 7.32.1: INJR\_ISPCLFUCOR0/APP\_CDN/Chart

### Function Description

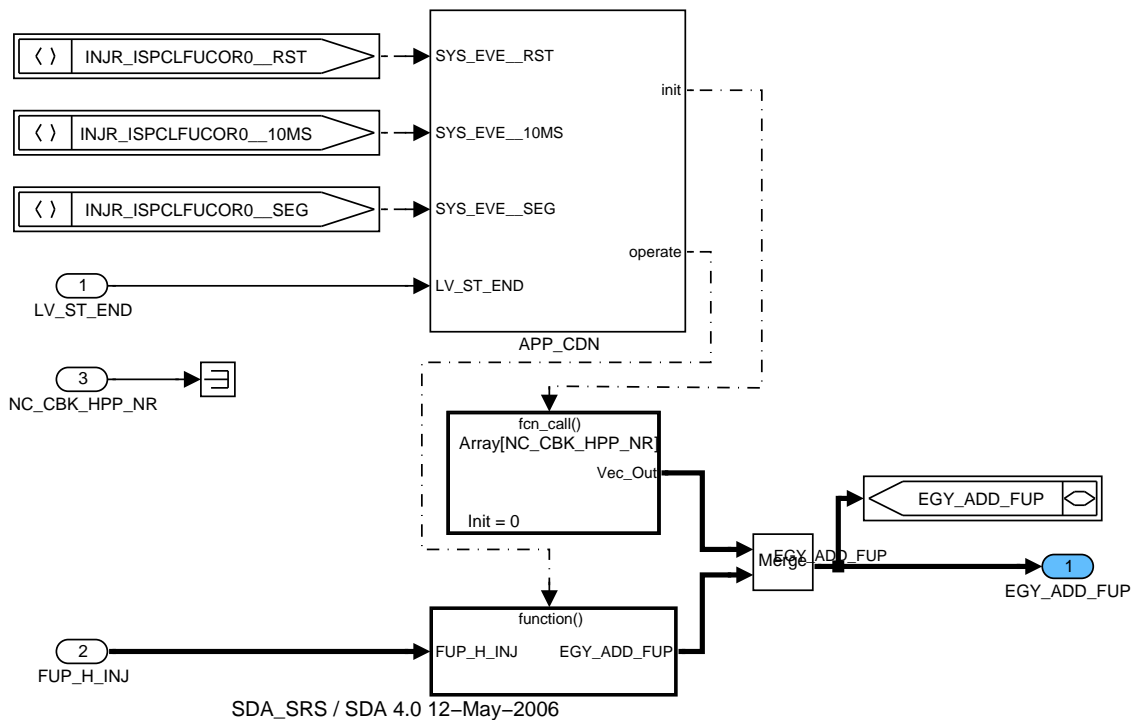


Figure 7.32.2: INJR\_ISPCLFUCOR0

### 7.32.1 SUBFUNCTION: Subsystem

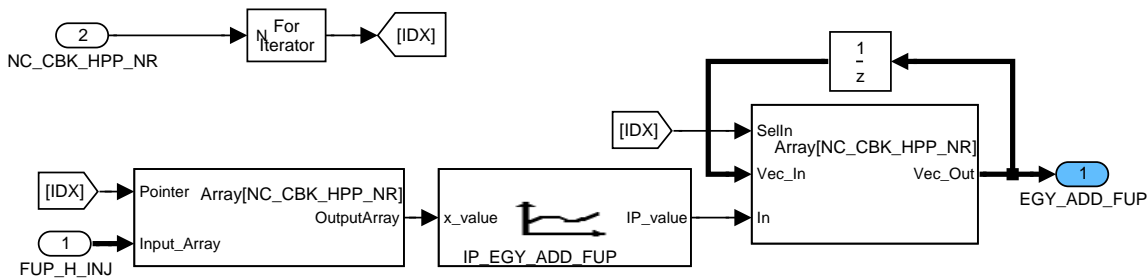


Figure 7.32.3: INJR\_ISPCLFUCOR0/Subsystem/For\_Iterator

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## 7.33 Compensation of the injection duty cycle on the injector needle lift

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DUCY_TI_N	V	0... 4000H	0... 100	0.00610352	%
Injection duty cycle					
EGY_ADD_DUCY	O/V	8000... 7FFFH	0... 127.498054	0.00389105	mJ
Additive piezo energy correction depending on the injection duty cycle					

### Input data:

FAC_N {p. 3327}	LV_ST_END {p. 1720}	N_32 {p. 1525}	TI_1_MES [NC_CYL_NR] {p. 2040}
TI_2_MES [NC_CYL_NR] {p. 2040}	TI_POST_MES [NC_CYL_NR] {p. 2041}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_EGY_ADD_DUCY	-	0... FFFFH	0... 127.498054	0.00389105	mJ
LDP_DUCY_IP_EGY_ADD_DUCY	7	0... 4000H	0... 100	0.00610352	%
LDP_N_IP_EGY_ADD_DUCY	7	0... FFH	0... 8160	32	rpm
Additive piezo energy correction depending on the injection duty cycle					
LC_EGY_ADD_DUCY_ENA	-	0... 1H	0 ...1	1	-
Flag to activate energy correction accounting for injection duty cycle					

### General information

The needle lift of injection valves with piezo actuators depends on the injection duty cycle. In order to compensate this effect and to keep the needle lift constant an additive correction of the piezo stack energy has to be applied.

### Application Condition

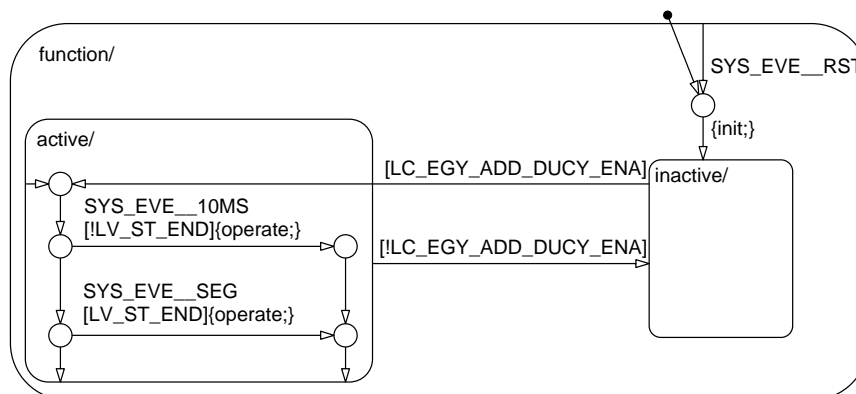


Figure 7.33.1: INJR\_ISPCLDUCY0/APP\_CDN/Chart

**Function Description**

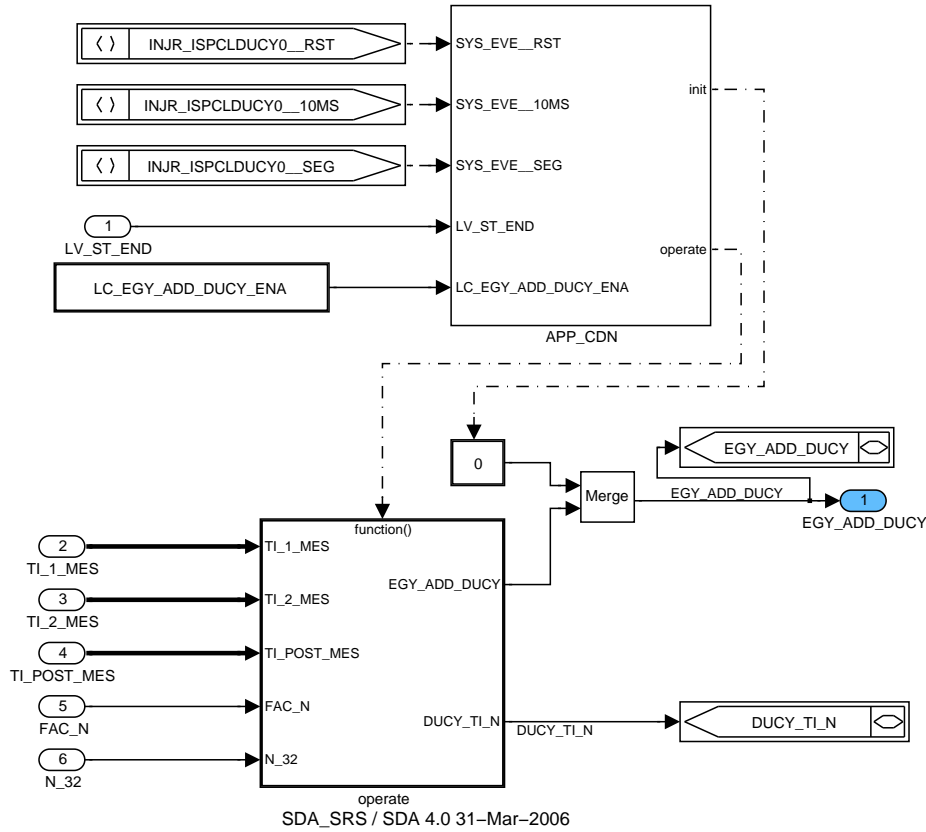


Figure 7.33.2: INJR\_ISPCLDUCY0

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### 7.33.1 SUBFUNCTION: operate

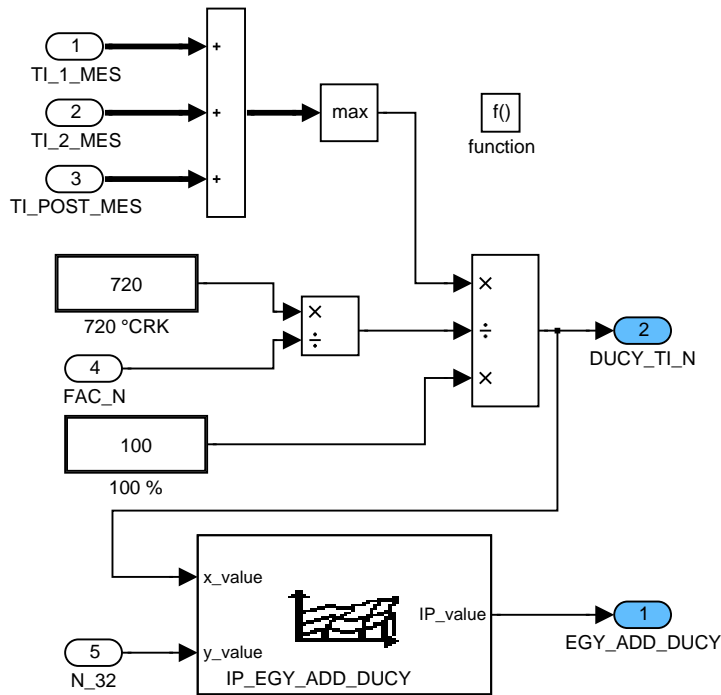


Figure 7.33.3: INJR\_ISPCLDUCY0/operate

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## 7.34 Correction of injection via application system

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TI_ADD_AS_CBK_EX [NC_CBK_EX_NR]	V	8000... 7FFFH	-131.072 ...131.068	0.004	ms
Exhaust bank selective injection time correction caused by service tool intervention - additive value					
TI_AS	O/V	0... FFFFH	0... 15.99975	244e-6	-
Global Injection Time Correction by the Application System - multiplicative					
TI_AS_CBK_EX [NC_CBK_EX_NR]	V	0... FFFFH	0... 15.99975	244e-6	-
Exhaust bank selective injection time correction caused by service tool intervention - multiplicative value					
TI_TUN_ADD_IV [NC_CYL_NR]	O/V	8000... 7FFFH	-131.072 ...131.068	0.004	ms
Cylinder selective Injection Time Correction by the Application System - additive value					
TI_TUN_IV [NC_CYL_NR]	O/V	0... FFFFH	0... 15.99975	244e-6	-
Cylinder selective Injection Time Correction by the Application System - multiplicative value					

### Input data:

FAC_TI_EXT_ADJ {p. 3327}	LV_FAC_TI_EXT_ADJ {p. 3330}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}
NC_USE_TI_AS_CBK {p. 629}			


### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TI_ADD_AS [NC_CYL_NR]	-	8000... 7FFFH	-131.072 ...131.068	0.004	ms
Cylinder selective Injection Time Correction - additive value					
C_TI_ADD_AS_CBK_EX [NC_CBK_EX_NR]	-	8000... 7FFFH	-131.072 ...131.068	0.004	ms
Exhaust bank selective Injection Time Correction - additive value					
C_TI_ADD_AS_GLOBAL	-	8000... 7FFFH	-131.072 ...131.068	0.004	ms
Global Injection Time Correction - additive value					
C_TI_AS [NC_CYL_NR]	-	0... FFFFH	0... 15.99975	244e-6	-
Injection time factor (cylinder selective) to correct cylinder injection value					
C_TI_AS_CBK_EX [NC_CBK_EX_NR]	-	0... FFFFH	0... 15.99975	244e-6	-
Injection time factor (exhaust bank selective) to correct cylinder injection value					
C_TI_AS_GLOBAL	-	0... FFFFH	0... 15.99975	244e-6	-
Global injection time correction					
LC_TI_AS_CBK_UPD_DIS	-	0... 1H	0 ...1	1	-
Switch to disable TI_AS_CBK_EX and TI_ADD_AS_CBK_EX data update, for customer delivery it has to be 0					

### Overview

For development, the application tool can perform a cylinder specific injection time correction. Additionally - for service tool tests - an exhaust bank dependent TI correction can be applied also.

### FUNCTION DESCRIPTION:

Released by Tetenborn Frank		Date 2013-02-13	File 30701501.00E
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 2233 of 8404	
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## Application conditions

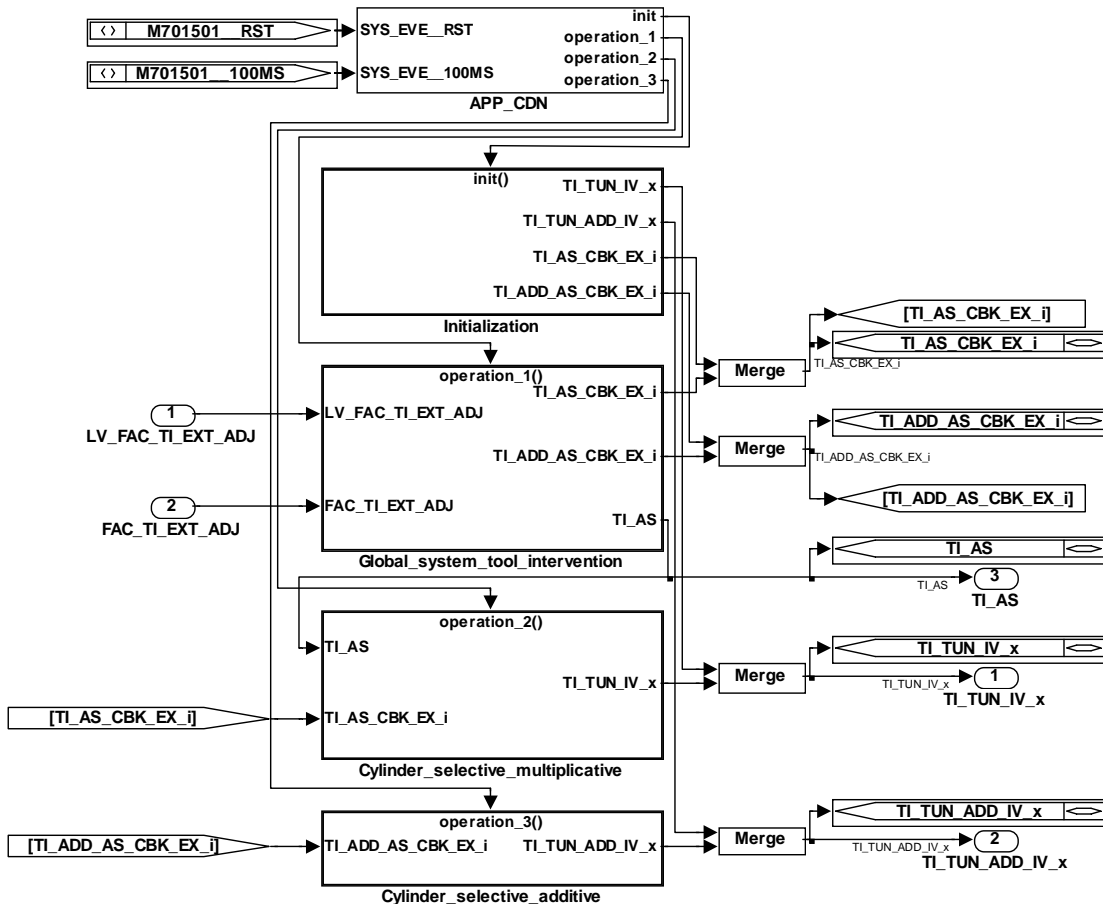
**Activation:** every engine state

**Deactivation:** -

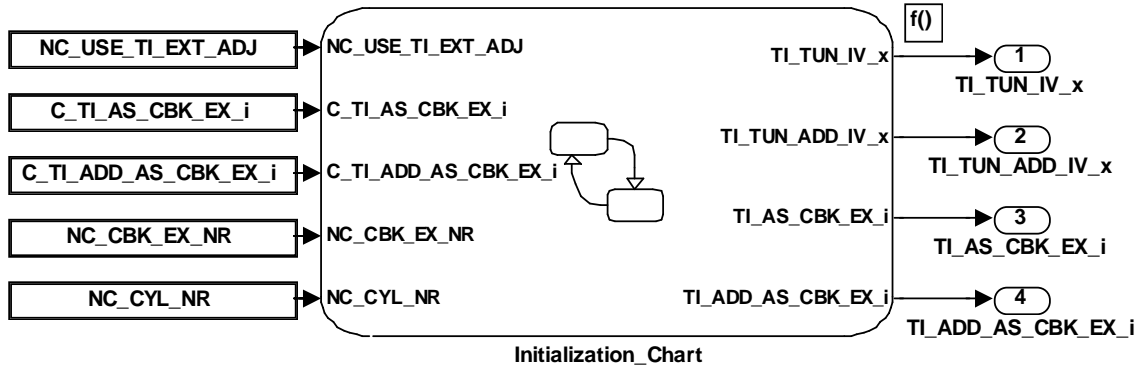
**Initialization:** at reset:

```
(1) FOR x = 0 TO (NC_CYL_NR -1 ) DO:
    TI_TUN_IV[x] = 1
    TI_TUN_ADD_IV[x] = 0
(1) ENDFOR
#if (NC_USE_TI_EXT_ADJ = 1)
(2) FOR i = 1 TO NC_CBK_EX_NR DO:
    TI_AS_CBK_EX[i] = C_TI_AS_CBK_EX[i]
    TI_ADD_AS_CBK_EX[i] = C_TI_ADD_AS_CBK_EX[i]
(2) ENDFOR
#endif
Recurrence: 100ms
```

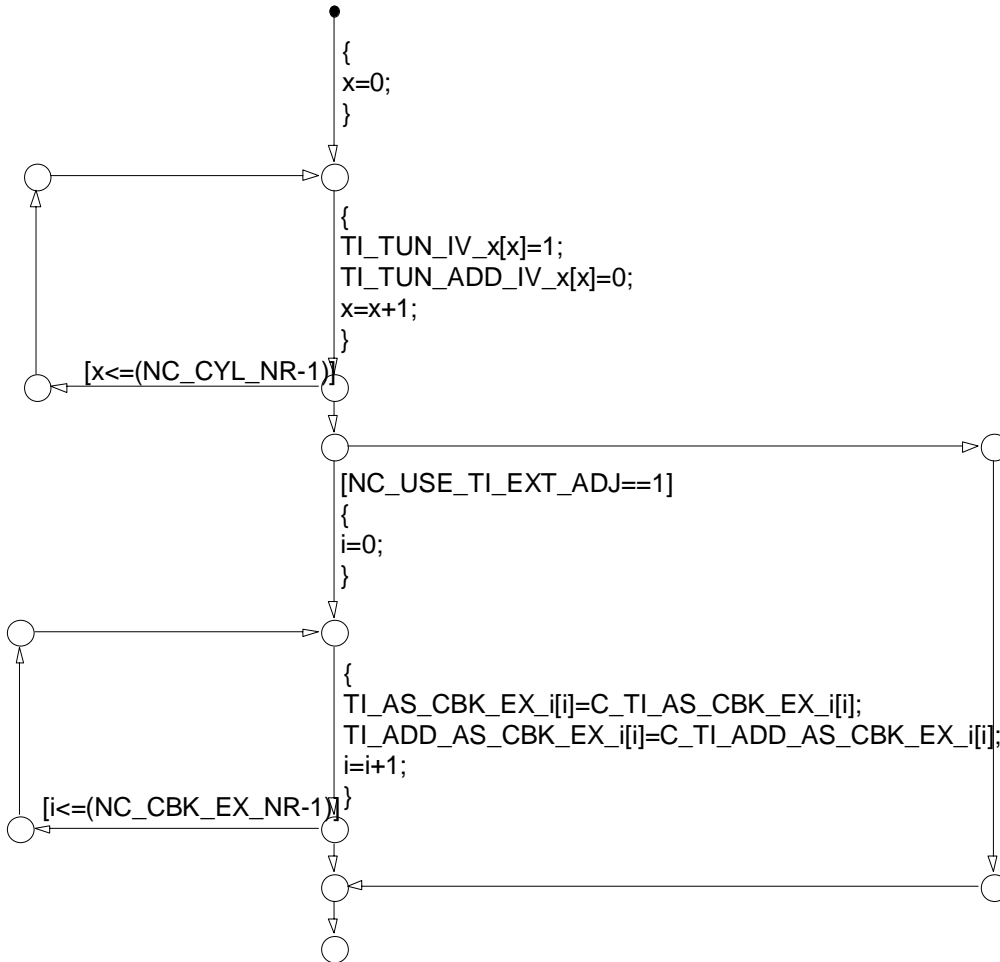
## Main System:



## Initialization:

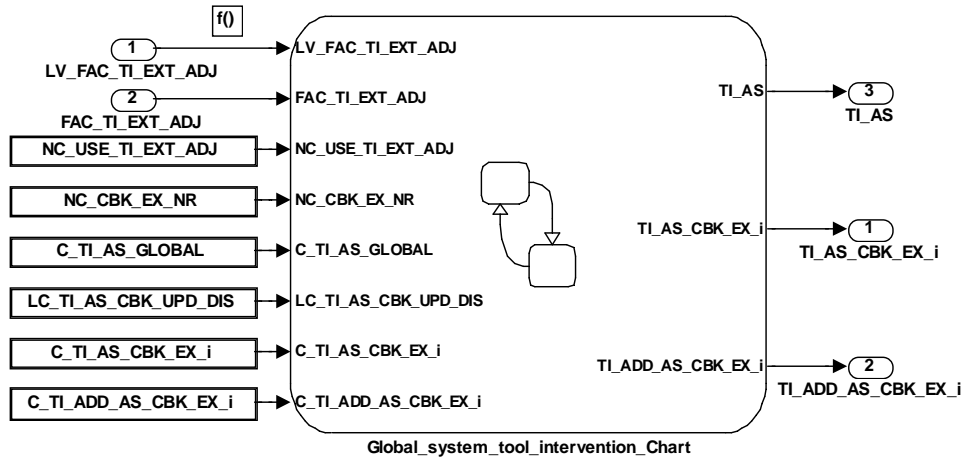


Initialization\_Chart:

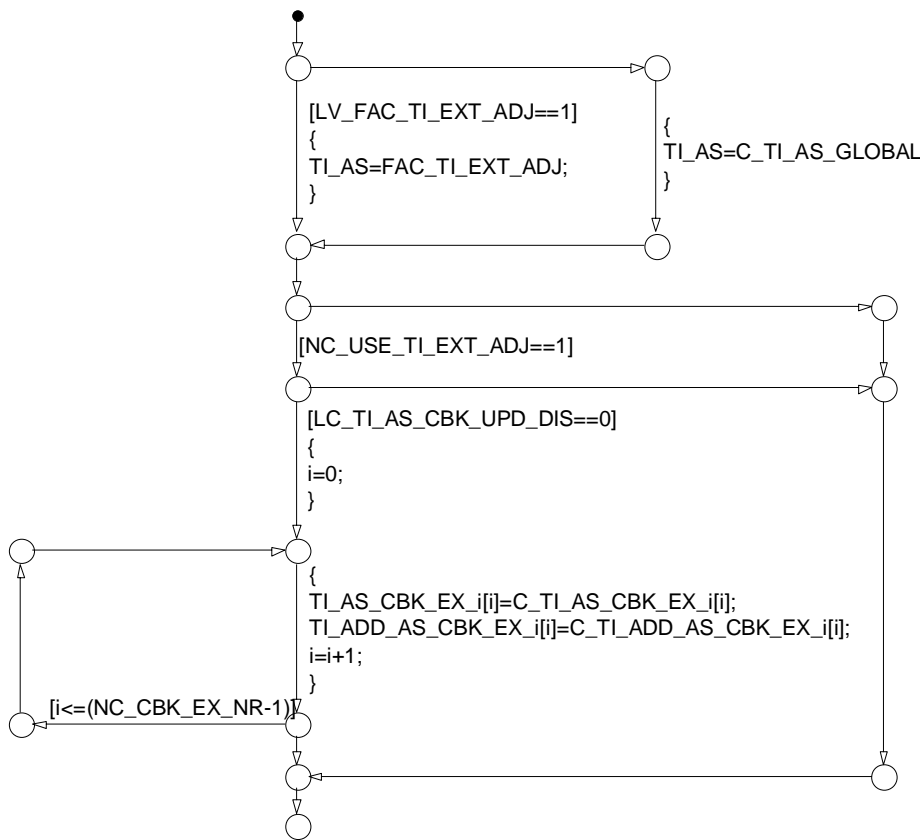


Global\_system\_tool\_intervention:

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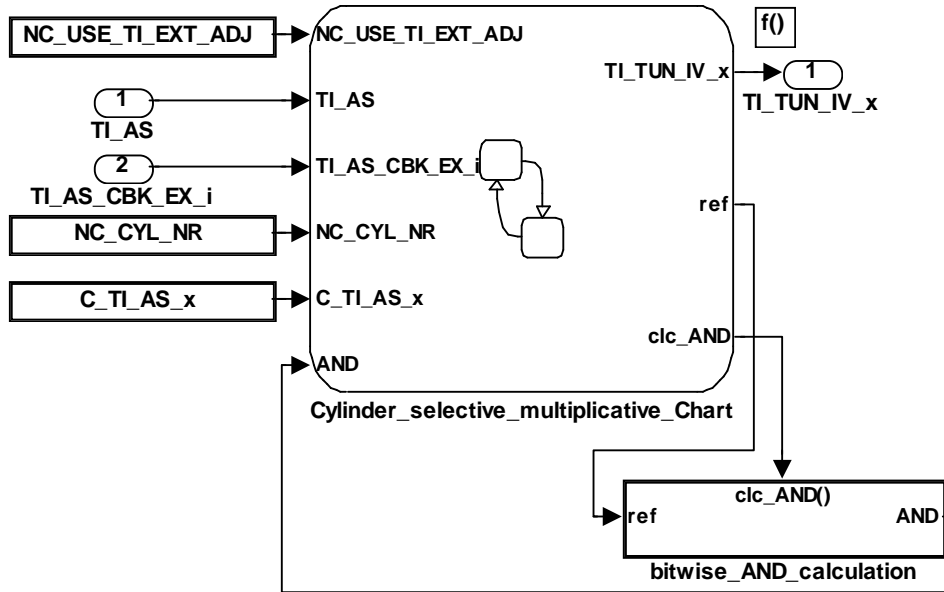


Global\_system\_tool\_intervention\_Chart:

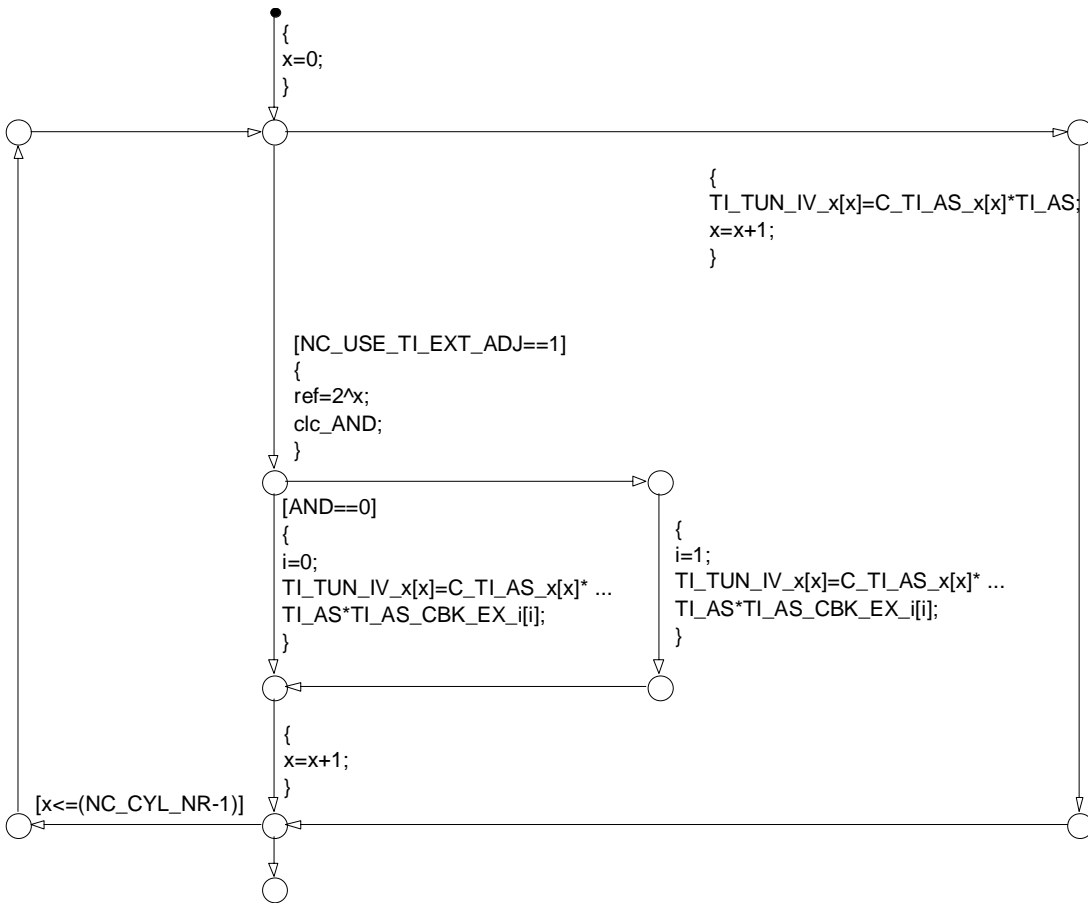


Cylinder selective multiplative:

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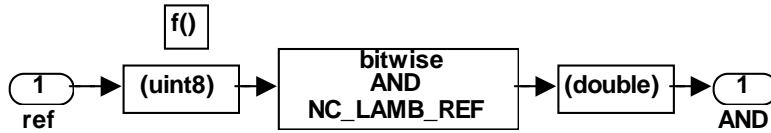


Cylinder\_selective\_multiplative\_Chart:

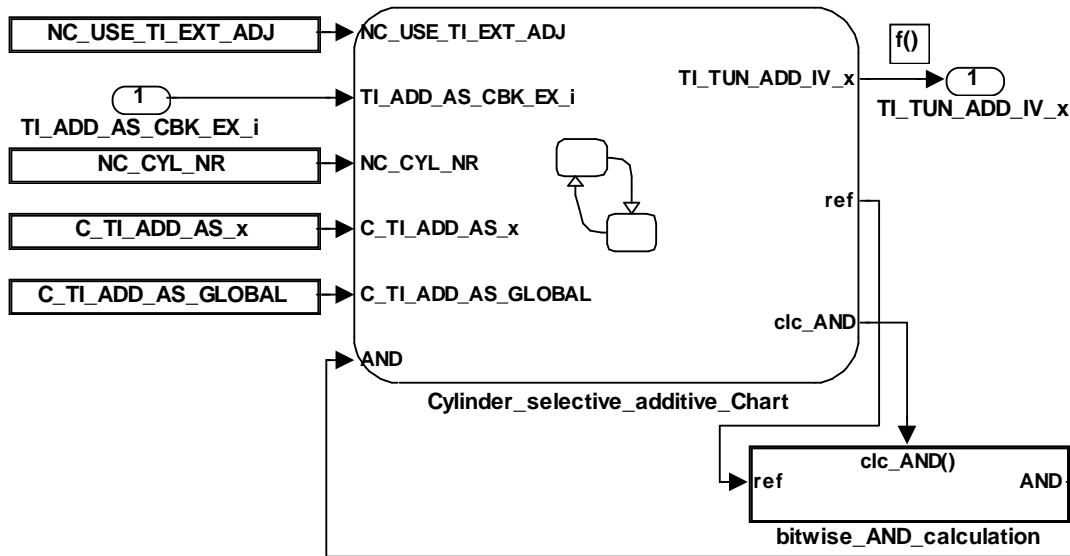


bitwise\_AND\_calculation:

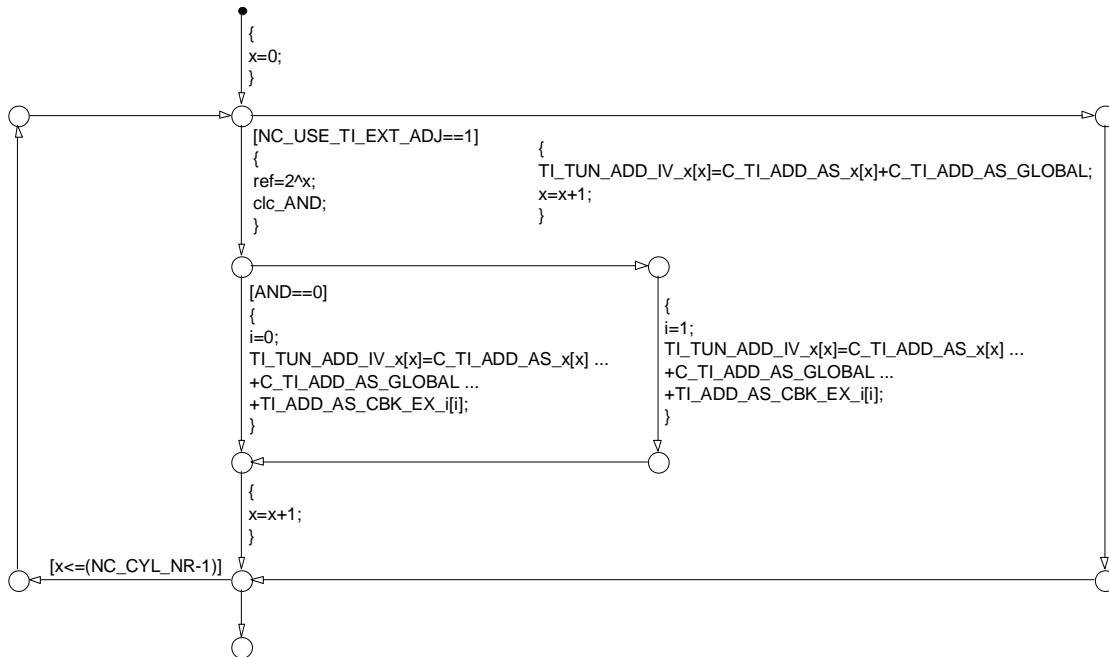
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Cylinder selective additive:

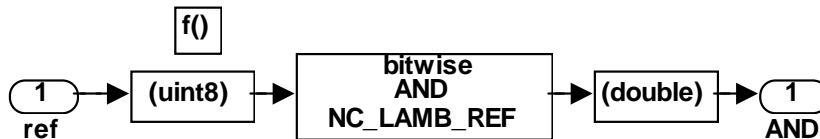


Cylinder selective additive\_Chart:



bitwise\_AND\_calculation:

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### Formula section:

#### 7.34.1 Global application system/service tool intervention

```

(1) IF      LV_FAC_TI_EXT_ADJ = 1          ... Service tool intervention active
(1) THEN   TI_AS = FAC_TI_EXT_ADJ
(1) ELSE   TI_AS = C_TI_AS_GLOBAL        ... Application system intervention active
(1) ENDIF
#if (NC_USE_TI_AS_CBK = 1)
(2) IF      LC_TI_AS_CBK_UPD_DIS = 0      ... If switch is not set, update adaptation factors.
          If not, a data update from service tool is necessary
(2) THEN
(3) FOR i = 1 TO NC_CBK_EX_NR DO:
    TI_AS_CBK_EX[i] = C_TI_AS_CBK_EX[i]
    TI_ADD_AS_CBK_EX[i] = C_TI_ADD_AS_CBK_EX[i]
(3) ENDFOR
(2) ENDIF
#endif
  
```

#### 7.34.2 Cylinder selective injection time correction - multiplicative

```

(4) FOR x = 0 TO (NC_CYL_NR-1) DO:
  #if (NC_USE_TI_AS_CBK = 1)
    i = {exhaust bank number which corresponds to cylinder x }
    TI_TUN_IV[x] = C_TI_AS[x]          ... Cylinder specific application system intervention
                * TI_AS                ... Global application system/service tool
                * TI_AS_CBK_EX[i]      ... Used and updated by service tool
  #else
    TI_TUN_IV[x] = C_TI_AS[x]          ... Cylinder specific application system intervention
                * TI_AS                ... Global application system/service tool
  #endif
(4) ENDFOR
  
```

#### 7.34.3 Cylinder selective injection time correction - additive

```


(5) FOR x = 0 TO (NC_CYL_NR-1) DO:
  #if (NC_USE_TI_AS_CBK = 1)
    i = {exhaust bank number which corresponds to cylinder x }
    TI_TUN_ADD_IV[x] = C_TI_ADD_AS[x]  ... Cylinder specific application system interven-
    tion
                + C_TI_ADD_AS_GLOBAL  ... Global application system
                + TI_ADD_AS_CBK_EX[i] ... Used and updated by service tool
  #else
  
```

```

TI_TUN_ADD_IV[x] = C_TI_ADD_AS[x]    ... Cylinder specific application system interven-
tion
                                + C_TI_ADD_AS_GLOBAL    ... Global application system

#endif
(5) ENDFOR

```

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 2240 of 8404</b>	
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## 7.35 Piezo capacity temperature determination

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CAPA_IV_1_FIL [NC_CYL_NR]	O/V	0... FFFFH	0... 27.96	42.6642e3	µF
Capacity of the piezo injector for the first pulse, filtered value					
CAPA_IV_DIF_NOM [NC_CYL_NR]	O/V/S	8000... 7FFFH	0... 13.9797867	42.6642e3	µF
Capacity offset of the piezo injector to the nominal value					
LV_T_ES_CAPA_TEMP_VLD	O/V	0... 1H	0 ...1	1	-
Engine stop time is valid for calculation of capacity offset					
LV_TEMP_CAPA_IV_CLC_ENA [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Cylinder individual flag to enable calculation of piezo temperature out of its capacity value					
LV_TEMP_CAPA_IV_EOL	O/V/S	0... 1H	0 ...1	1	-
Flag indicating valid capacity temperature adaptation at end of line					
TEMP_CAPA_IV [NC_CYL_NR]	O/V	0... FEH	0... 142.5	0.75	°C
Temperature of the piezo stack derived from its capacity					
TEMP_CAPA_IV_MV	O/V/S	0... FEH	0... 142.5	0.75	°C
Temperature of the piezo stacks derived from their capacities, mean value					
TEMP_CAPA_IV_SUB	V	0... FEH	0... 142.5	0.75	°C
Temperature of the piezo stacks, substitutional value					

### Input data:

CAPA_IV_1_CLC [NC_CYL_NR] {p. 2035}	EGY_IV_1_CLC [NC_CYL_NR] {p. 2036}	FUP_H_INJ [NC_CBK_HPP_NR] {p. 3327}	LV_CH {p. 8232}
LV_EGY_RNG_IV_PLS_1_1_1 ACK [NC_CYL_NR] {p. 2038}	LV_IV_MES_VLD {p. 2038}	LV_ST_END {p. 1720}	LV_SYN_ENG {p. 1506}
LV_T_ES_NOT_PLAUS {p. 4467}	NC_CBK_HPP_NR [1] {p. 812}	NC_CYL_NR {p. 1526}	NC_IDX_CYL_HPP_REF [NC_CYL_NR] {p. 626}
NR_CYL_INJ_BAS {p. 2039}	SEG_CTR {p. 1525}	T_ES {p. 1444}	TCO {p. 1100}
TI_1_MES [NC_CYL_NR] {p. 2040}			

### Calibration data:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CAPA_IV_DIF_NOM_LIM	-	0... FFFFH	0... 27.96	42.6642e3	µF
Limit of the capacity offset of the piezo injector to the nominal value					
C_CRLC_TEMP_CAPA_IV	-	0... FFH	0... 0.99609375	0.00390625	-
constant for LowPass filtering for TEMP_CAPA_IV					
C_FAC_FIL_CAPA_IV	-	0... FFH	0... 0.99609375	0.00390625	-
PT1 Filter constant for piezo capacity					
C_SEG_CTR_CAPA_TEMP	-	0... FFFFH	0... 65535	1	-
Number of segments for capacity offset calculation					
C_T_ES_CAPA_TEMP	-	0... FFFFH	0... 65535	1	min
Minimum engine of duration for capacity offset calculation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TEMP_CAPA_INC	-	0... 2000H	0... 1.5	18.3105e3	°C
Temperature increment					
C_TEMP_CAPA_IV_EOL	-	0... 1H	0 ...1	1	-
Flag for capacity temperature adaptation at end of line, manual setting					
C_TI_MIN_CAPA_FIL	-	0... FFFFH	0... 65.535	0.001	ms
Minimum injection time limit for calculation of filtered capacity					
IP_CAPA_COR_EGY_IV	-	0... FFFFH	0... 13.9797867	42.6642e3	µF
LDP_EGY_IP_CAPA_COR_EGY_IV	6	0... FFFFH	0... 255	0.00389105	mJ
Capacity correction depending on the piezo injector s energy					
IP_CAPA_IV_NOM	-	0... FFFFH	0... 27.96	42.6642e3	µF
LDP_TCO_IP_CAPA_IV_NOM	8	0... FEH	0... 142.5	0.75	°C
LDPM_FUP_2_INJR	6	0... FFFFH	0... 347776	5.3067216	hPa
Nominal capacity of the piezo injector depending on temperature and fuel pressure					
IP_FAC_T_ES_TEMP_CAPA_IV_2	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_T_ES_1_INJR	8	0... FFFFH	0... 65535	1	min
2. factor for piezo stack temperature substitution accounting for engine off time					
IP_TEMP_CAPA_IV_NOM	-	0... FEH	0... 142.5	0.75	°C
LDP_CAPA_IP_TEMP_CAPA_IV_NOM	8	0... FFFFH	0... 27.96	42.6642e3	µF
LDPM_FUP_2_INJR	6	0... FFFFH	0... 347776	5.3067216	hPa
Nominal temperature capacity relationship of the piezo injector depending on fuel pressure					
LC_CAPA_IV_DIF_NOM_INH_CH_ENA	-	0... 1H	0 ...1	1	-
Logical constant to enable inhibition of capacity offset determination for catalyst heating					
LC_TEMP_CAPA_IV_CLC_ENA	-	0... 1H	0 ...1	1	-
Flag to enable calculation of piezo temperature					
LC_TEMP_CAPA_IV_EOL_MAN	-	0... 1H	0 ...1	1	-
Logical constant to enable manual setting of end of line bit for capacity temperature adaptation					

## General information

The large signal capacity of the piezo stack rises with temperature. This dependency can be used to determine the piezo temperature out of its capacity. Since the capacity is also influenced by forces acting on the piezo stack the fuel pressure has to be taken into account. This dependency is described by the map IP\_TEMP\_CAPA\_IV\_NOM supplying a temperature for a certain nominal (mean) capacity and fuel pressure level. The map IP\_CAPA\_IV\_NOM describes the inverse relationship supplying a capacity for a given temperature and fuel pressure. The lookup curve IP\_CAPA\_COR\_EGY\_IV accounts for the dependency of the capacity on the energy stored in the piezo stack and provides an additive correction for the capacity value.

The capacity value deviates from one stack to another due to manufacturing variations, aging effects etc.. Therefore the offset of each injector to the nominal capacity has to be determined at a reference temperature.(Fig. 1)

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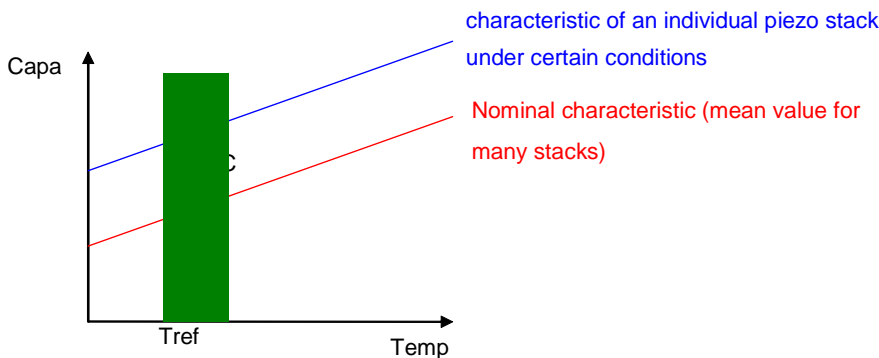


Figure 7.35.1: : capacity temperature relationship for piezo stacks

The capacity offset of each injector is stored in the nonvolatile memory (NVMY). Once the capacity offset is available the individual capacity can be shifted to the nominal characteristic allowing for a determination of the piezo temperature (Fig. 2).

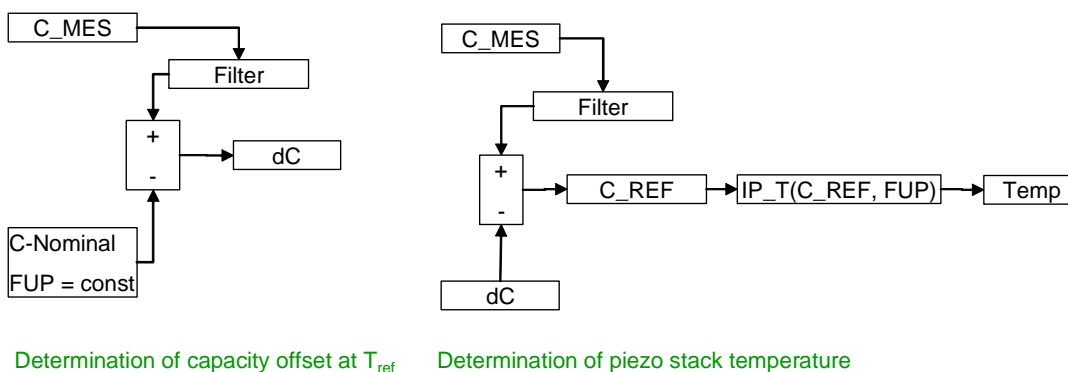


Figure 7.35.2: : Functional overview

**Application Condition**

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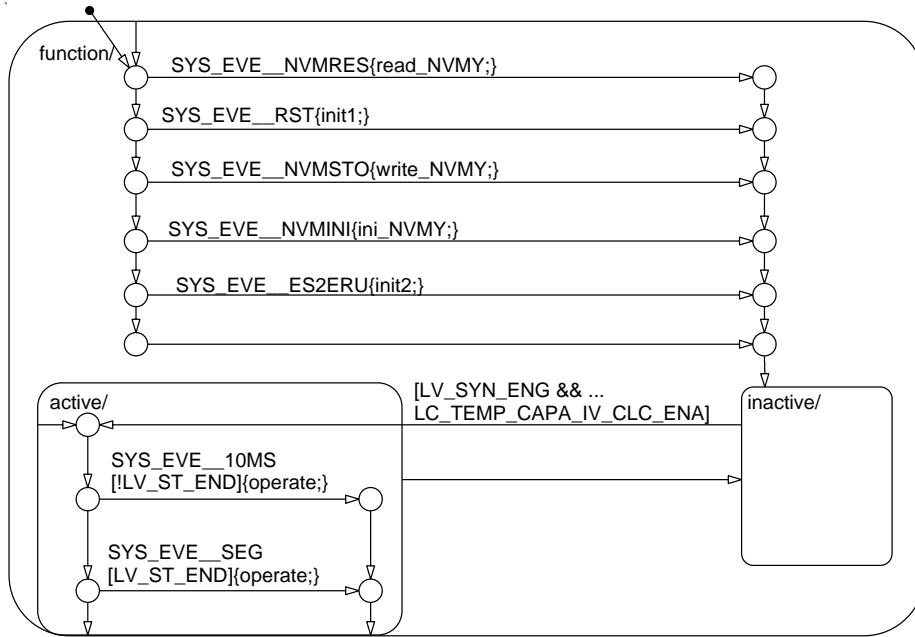



Figure 7.35.3: INJR\_ISPCLCAPA0/APP\_CDN/Chart

**Function Description**

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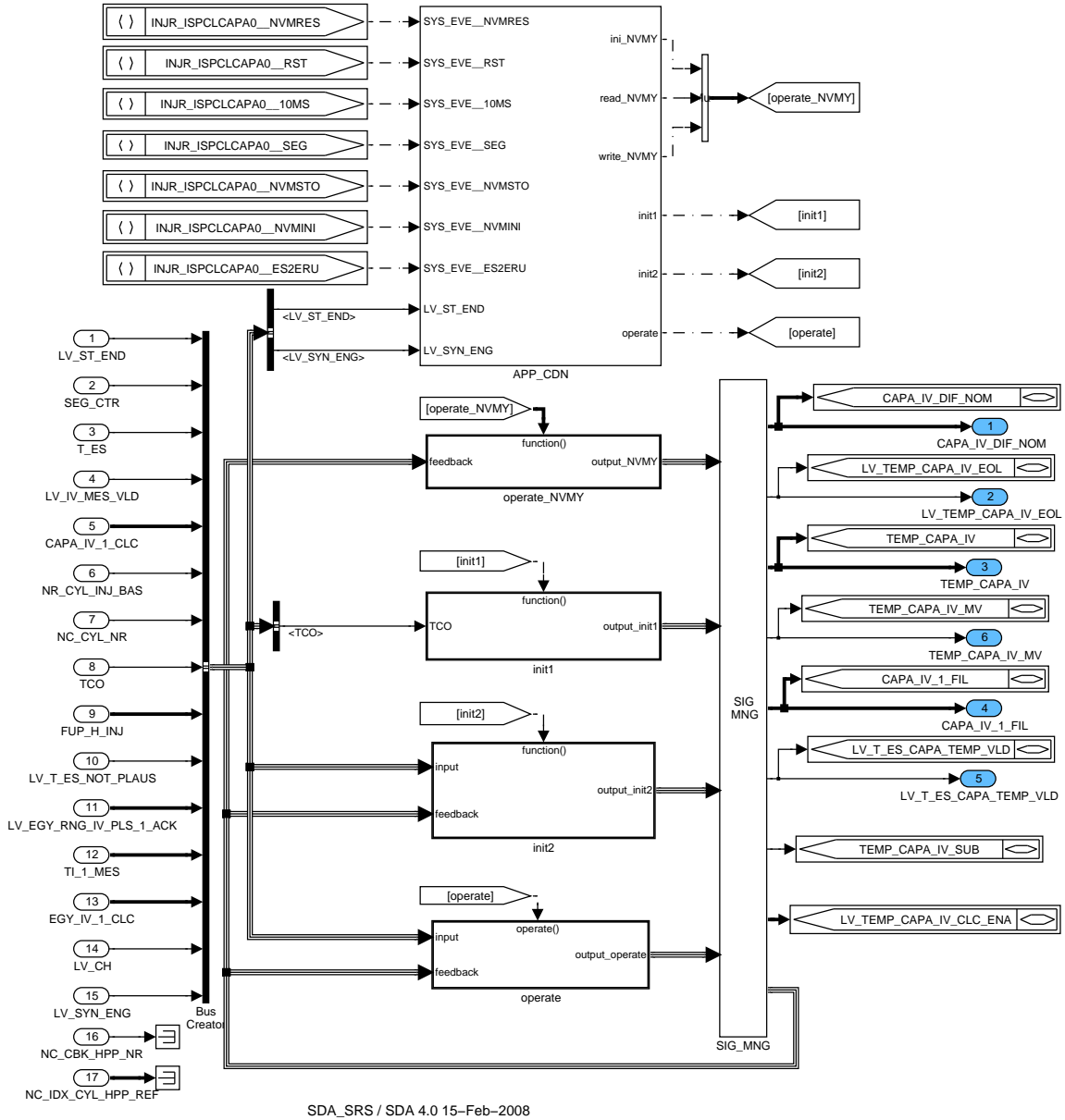


Figure 7.35.4: INJR\_ISPCLCAPA0

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### 7.35.1 SUBFUNCTION: SIG\_MNG

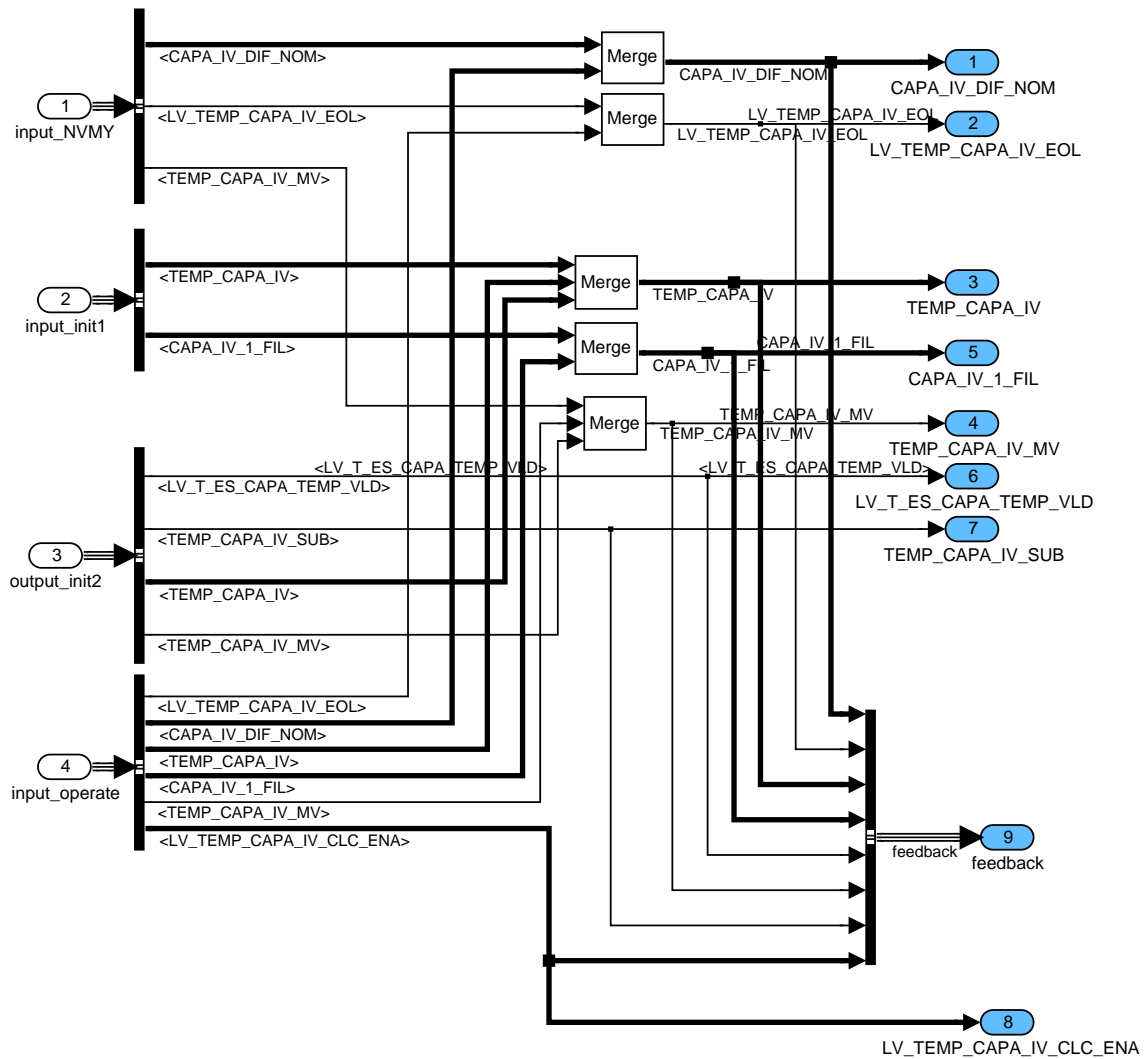


Figure 7.35.5: INJR\_ISPCLCAPA0/SIG\_MNG

### 7.35.2 Initialization

The piezo stack temperature is initialized with the coolant temperature at ECUreset.

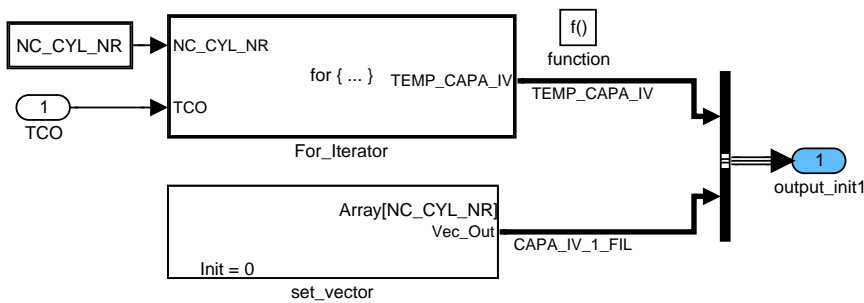


Figure 7.35.6: INJR\_ISPCLCAPA0/init1

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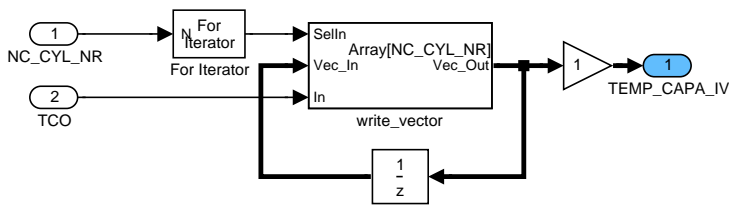


Figure 7.35.7: INJR\_ISPCLCAPA0/init1/For\_Iterator

### 7.35.3 Plausibility check of engine off time and calculation of substitute value for TEMP\_CAPA\_IV

A new adaptation value of the capacity offset is calculated if the engine off-time is plausible and greater than a calibratable constant. If both conditions are true the bit LV\_T\_ES\_CAPA\_TEMP\_VLD is set. For the first engine start at end-of-line the capacity offset adaptation is always done. At the first engine start LV\_TEMP\_CAPA\_IV\_EOL is zero. It is set to one if the capacity offset is adapted and will be stored in the nonvolatile memory. Furthermore an substitute value for the piezo-capacity temperature is determined via engine off-time, coolant-temperature and the mean value of the piezo-temperatures of the last driving cycle.

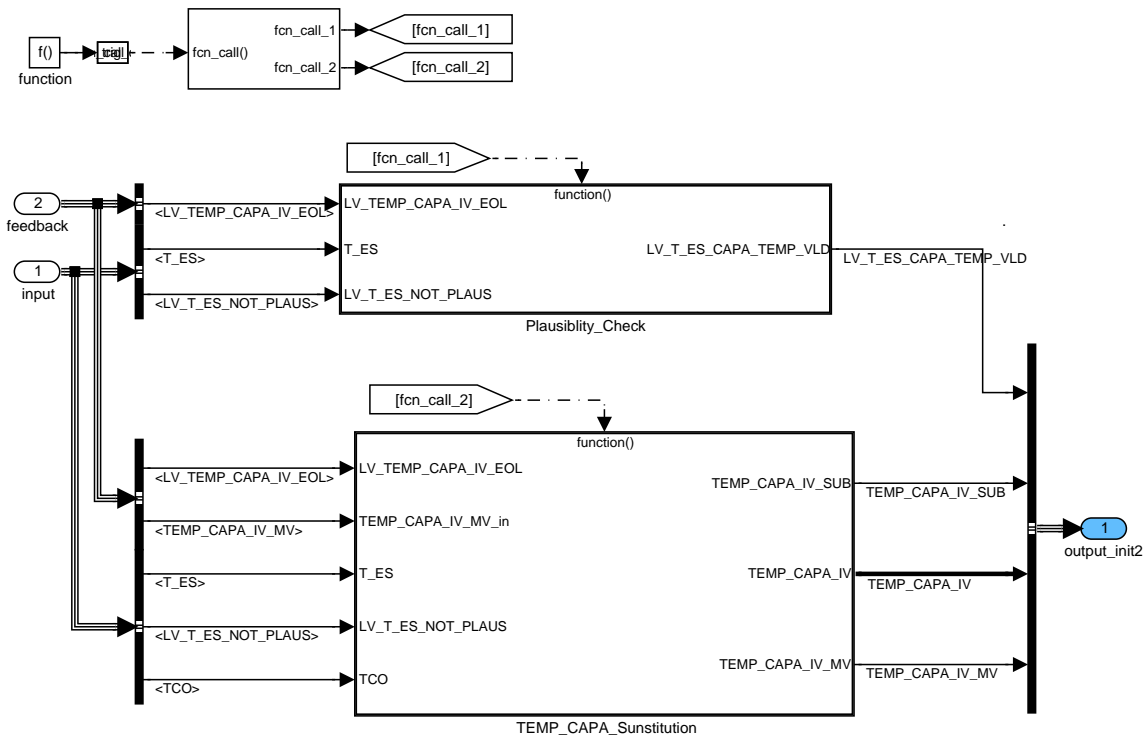


Figure 7.35.8: INJR\_ISPCLCAPA0/init2

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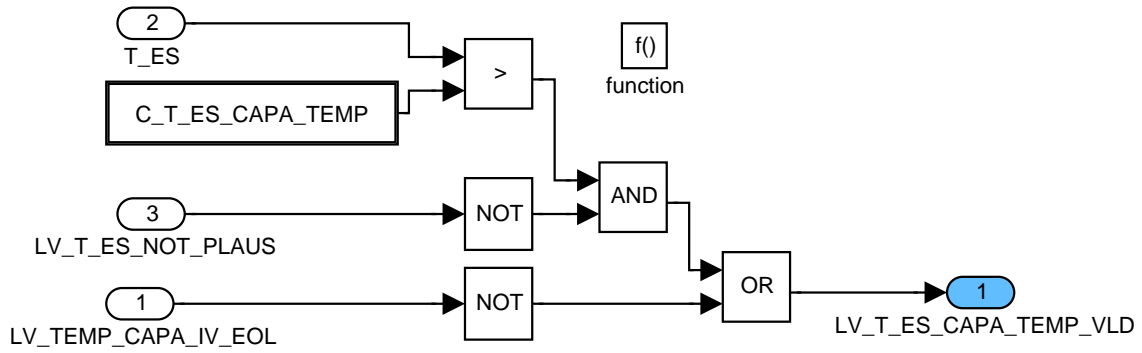


Figure 7.35.9: INJR\_ISPCLCAPA0/init2/Plausibility\_Check

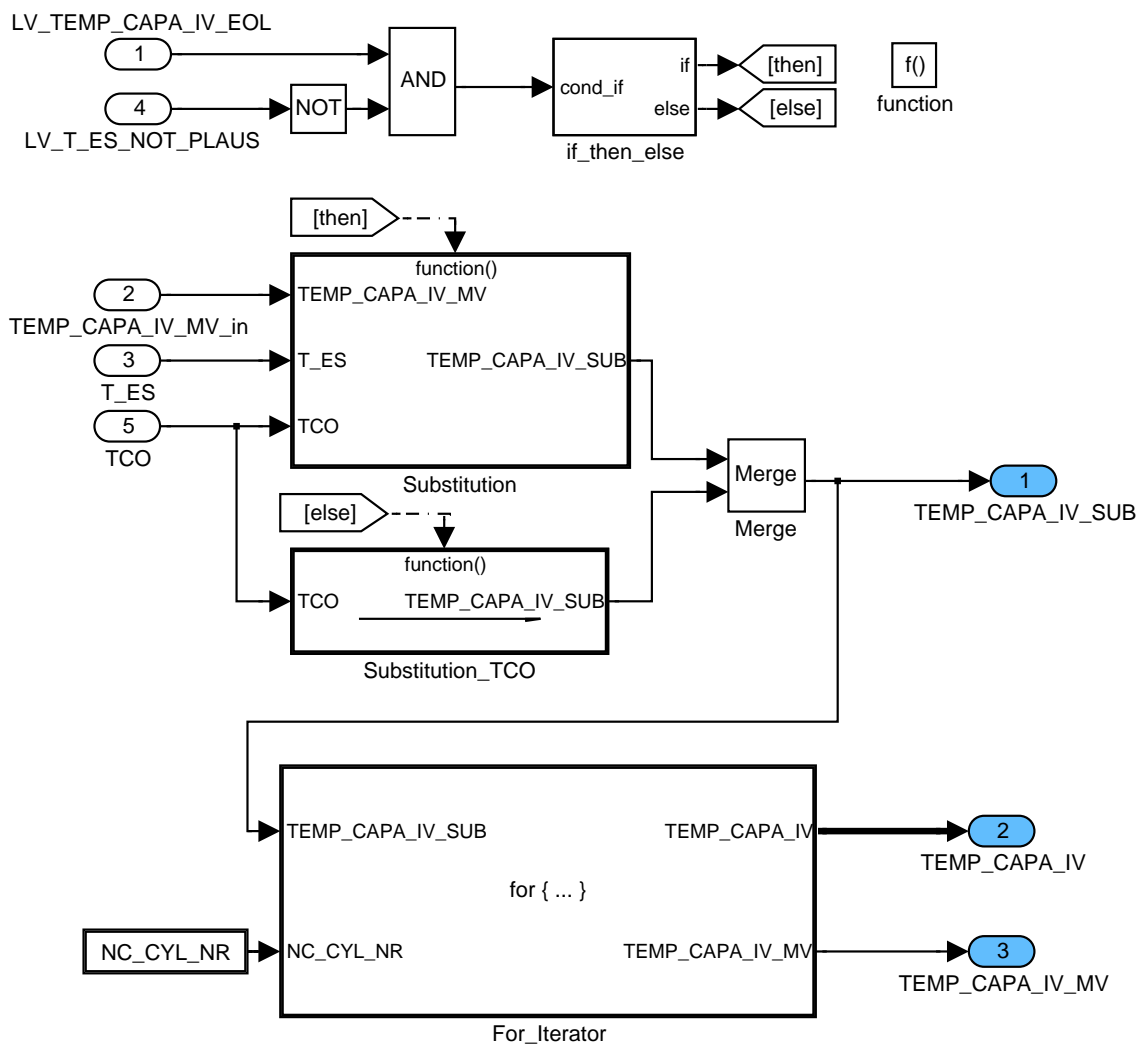


Figure 7.35.10: INJR\_ISPCLCAPA0/init2/TEMP\_CAPA\_Sunstitution

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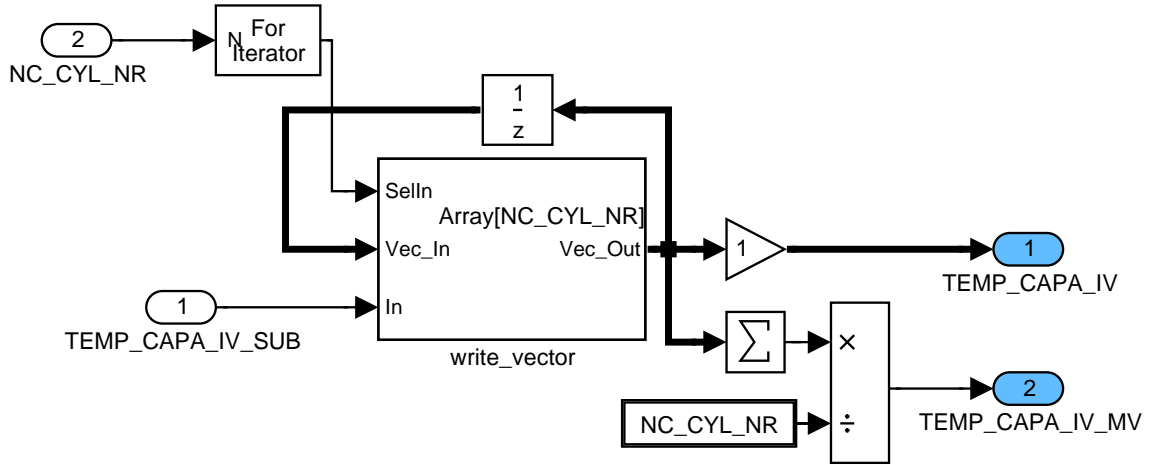


Figure 7.35.11: INJR\_ISPCLCAPA0/init2/TEMP\_CAPA\_Sunstitution/For\_Iterator

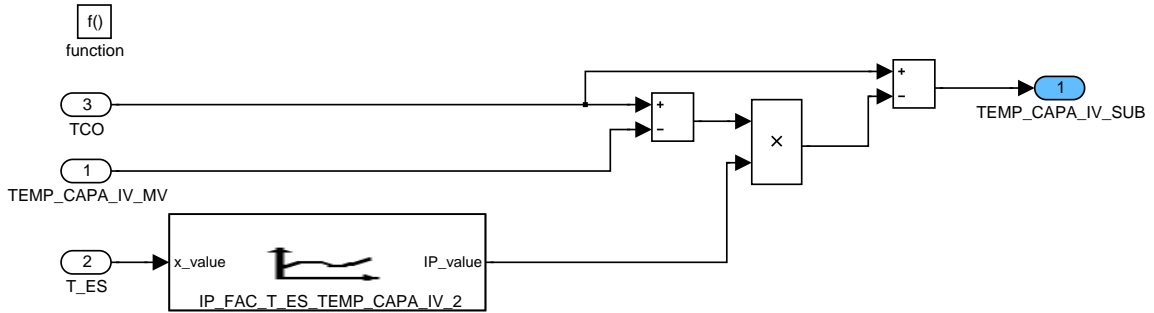
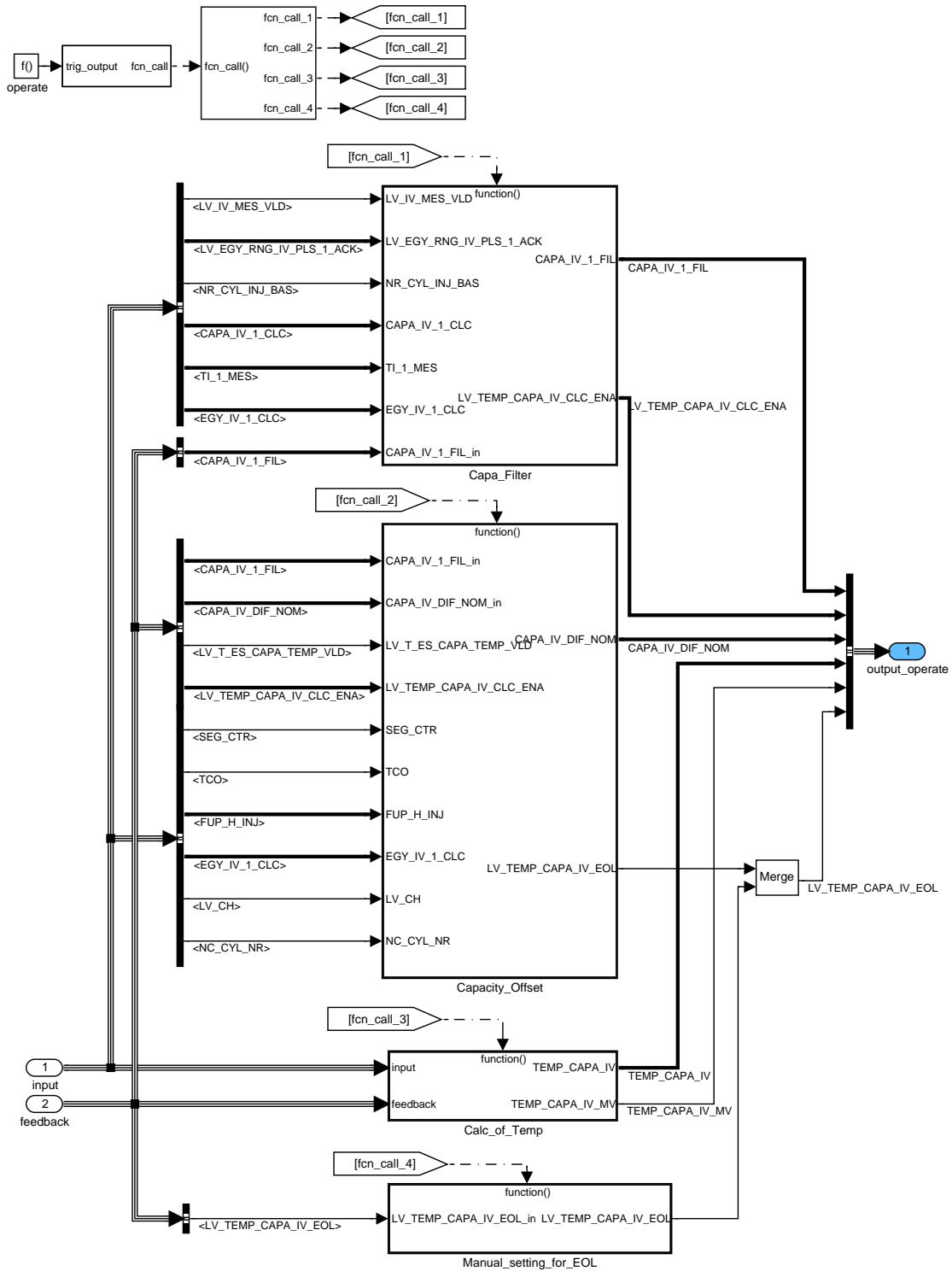


Figure 7.35.12: INJR\_ISPCLCAPA0/init2/TEMP\_CAPA\_Sunstitution/Substitution

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### 7.35.4 Calculation of filtered capacity, capacity offset and stack temperature



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Figure 7.35.13: INJR\_ISPCLCAPA0/operate

#### Calculation of piezo stack temperature

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While the segment counter is lower than a calibratable constant the temperature of the piezo stacks is set to the substitute value TEMP\_CAPA\_IV\_SUB. When the SEG\_CTR exceed this threshold the temperature is extracted from the map IP\_TEMP\_CAPA\_IV\_NOM accounting for each stack's individual capacity offset to the nominal value.

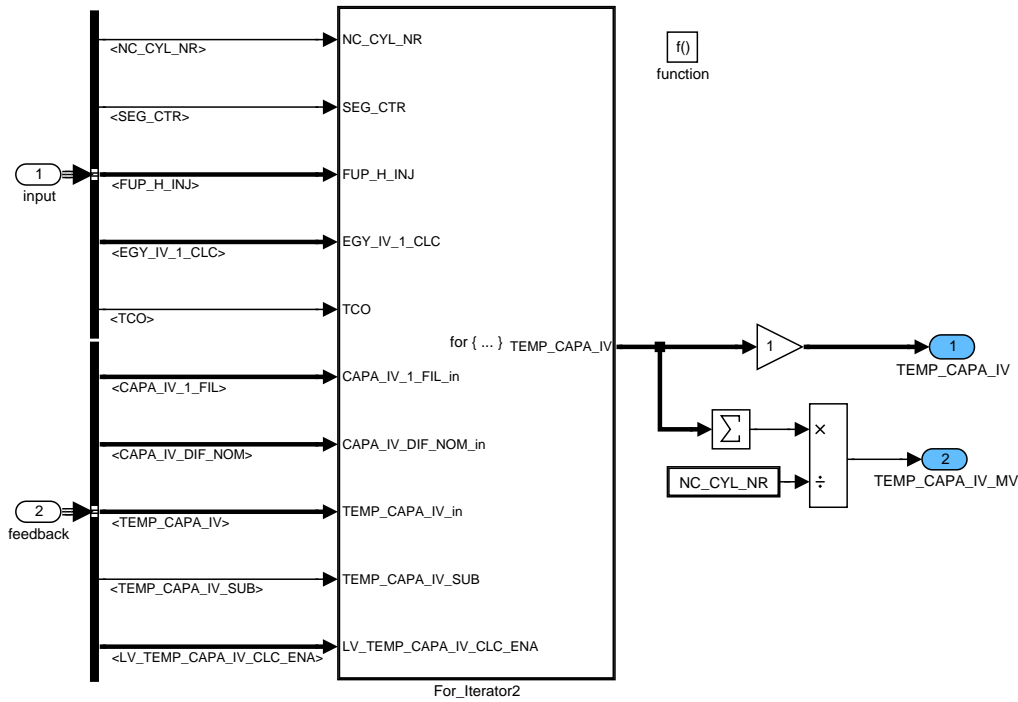


Figure 7.35.14: INJR\_ISPCLCAPA0/operate/Calc\_of\_Temp

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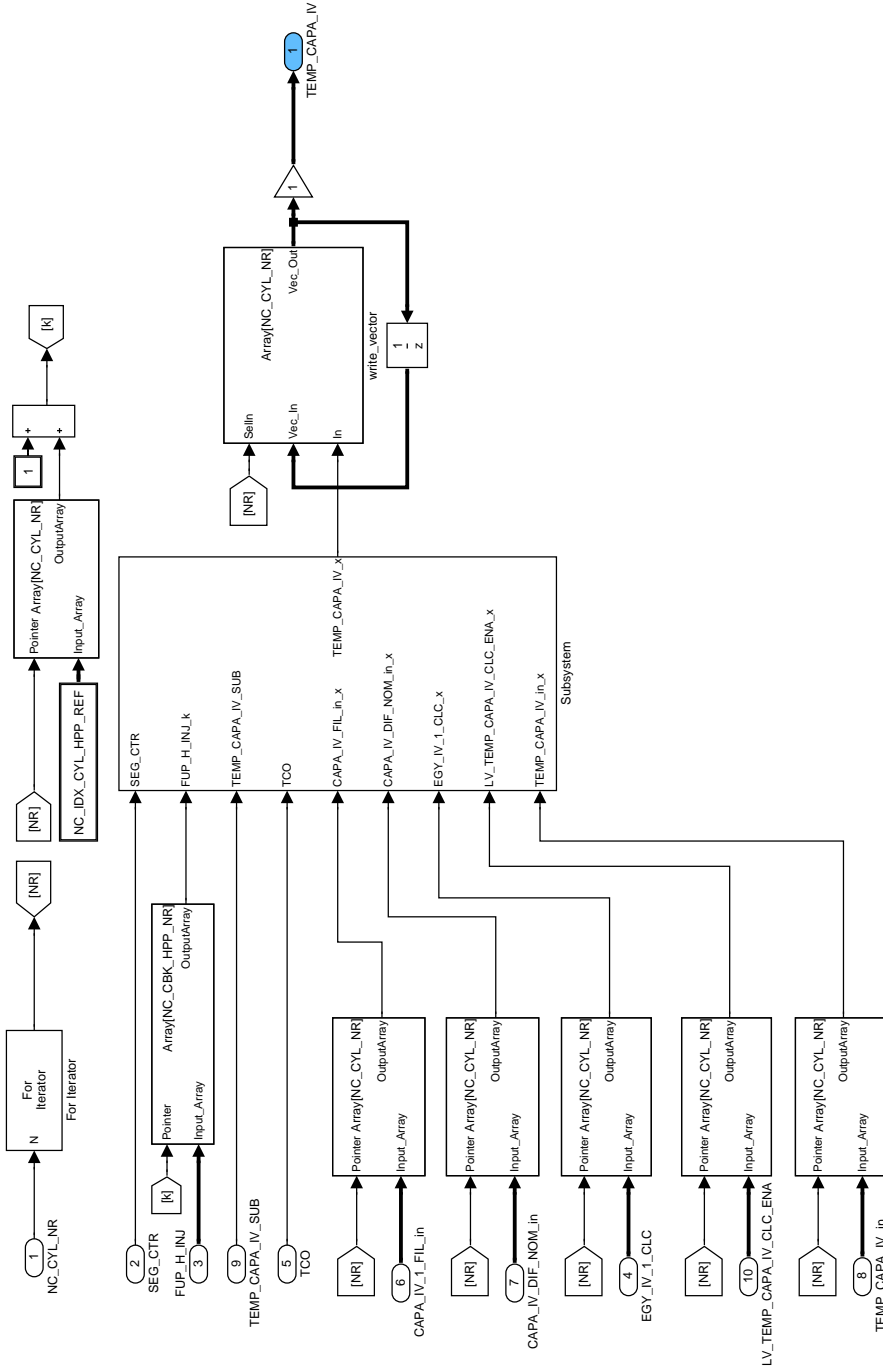


Figure 7.35.15: INJR\_ISPCLCAPA0/operate/Calc\_of\_Temp/For\_Iterator2

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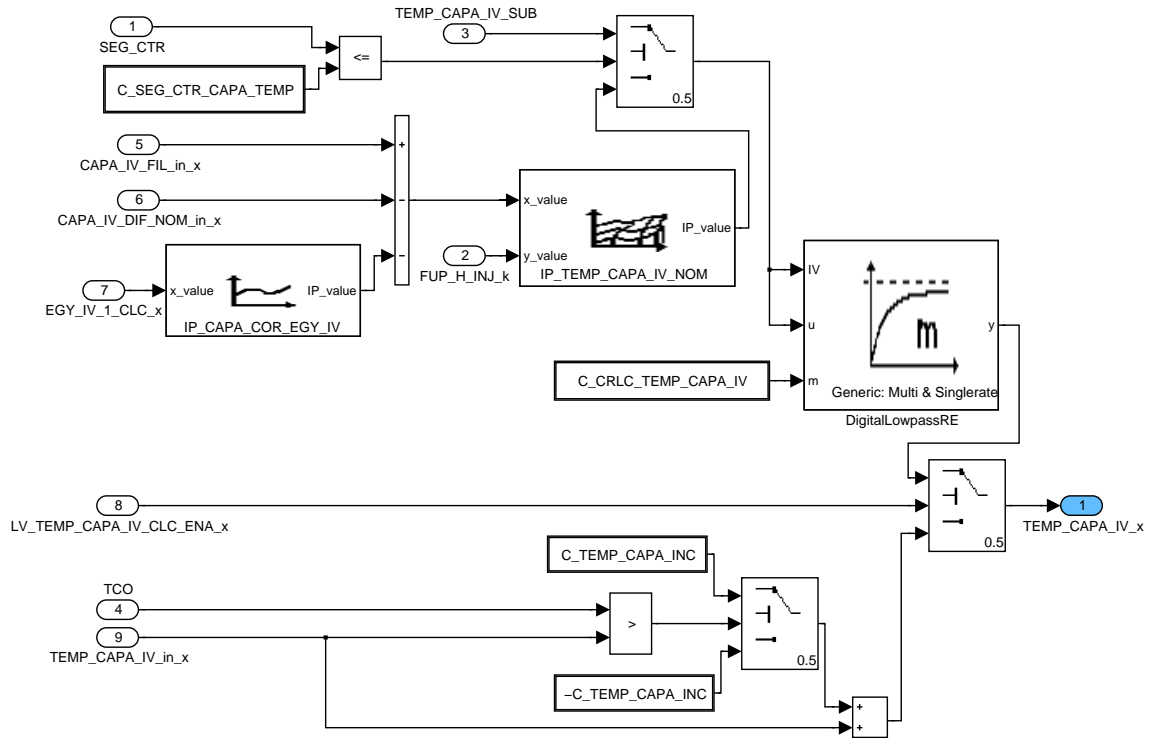


Figure 7.35.16: INJR\_ISPCLCAPA0/operate/Calc\_of\_Temp/For\_Iterator2/Subsystem

**Filtering of piezo capacity**

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The large signal capacity is calculated out of measured charge and voltage value. Since the signal is noisy it has to be low pass filtered. The filter constant can be applied via C\_FAC\_FIL\_CAPA\_IV. The filtered capacity is used for the further calculations. At first entry the filtered capacity is set to the measured capacity value via reset (R) and initial value (IV) input ports. The filter is enabled if the measured voltage and charge values are valid (LV\_IV\_MES\_VLD), if the measured injection time is greater than a calibratable constant and if high energy range is used (LV\_EGY\_RNG\_IV\_PLS\_1\_ACT).

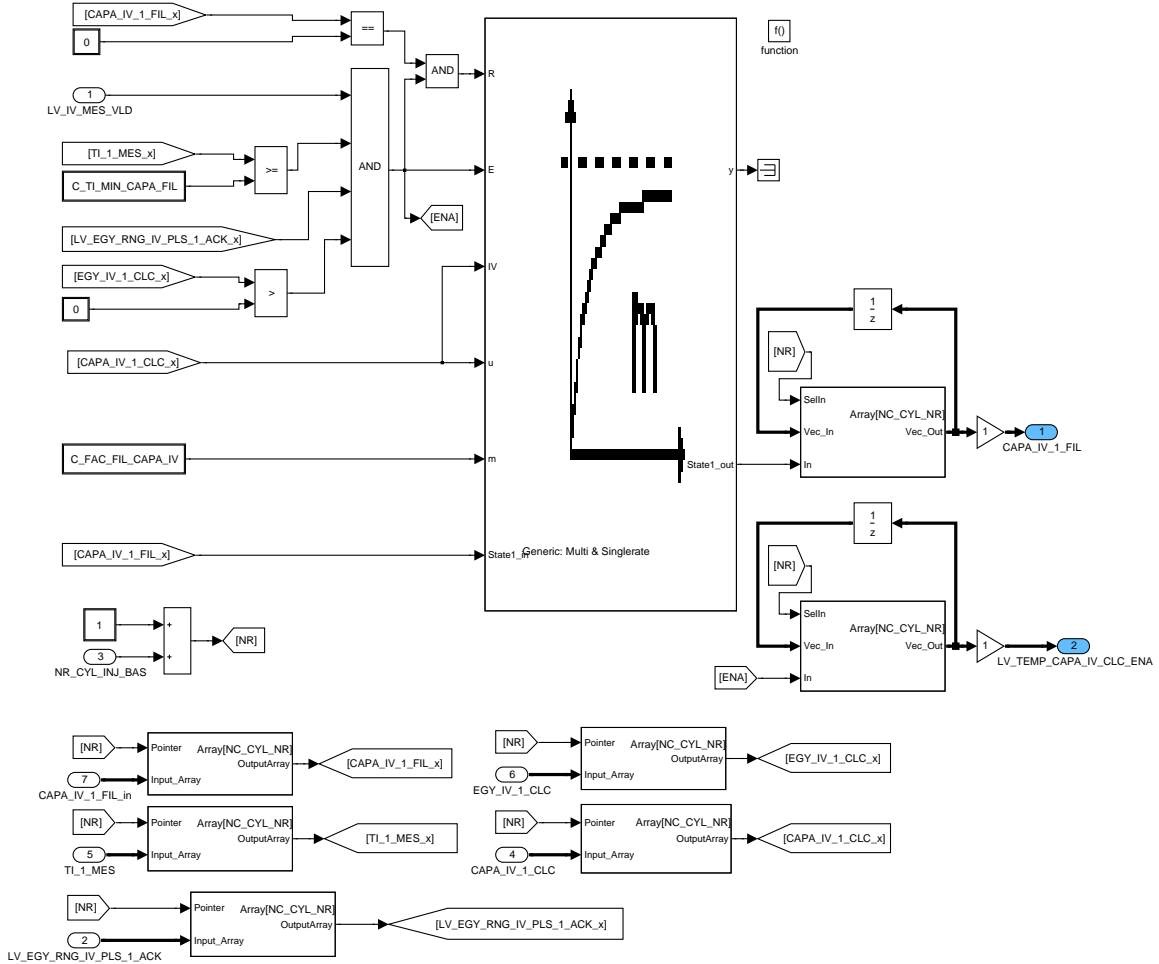


Figure 7.35.17: INJR\_ISPCLCAPA0/operate/Capa\_Filter

**Calculation of capacity offset**

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The capacity offset of each injector is stored in the nonvolatile memory. A new adaptation value is calculated if the engine offtime T\_ES is plausible and greater than a calibratable constant (LV\_T\_ES\_CAPA\_TEMP\_VLD = TRUE). Then the coolant temperature TCO is used as the reference temperature. The calculation of the offset value is triggered as soon as the segment counter exceeds a calibratable level. The capacity offset is limited to C\_CAPA\_IV\_DIF\_NOM\_LIM. The calculation of capacity offset can be inhibited if catalyst heating is active. For the first engine start the end-of-line flag LV\_TEMP\_CAPA\_IV\_EOL is set if adaptation was done.

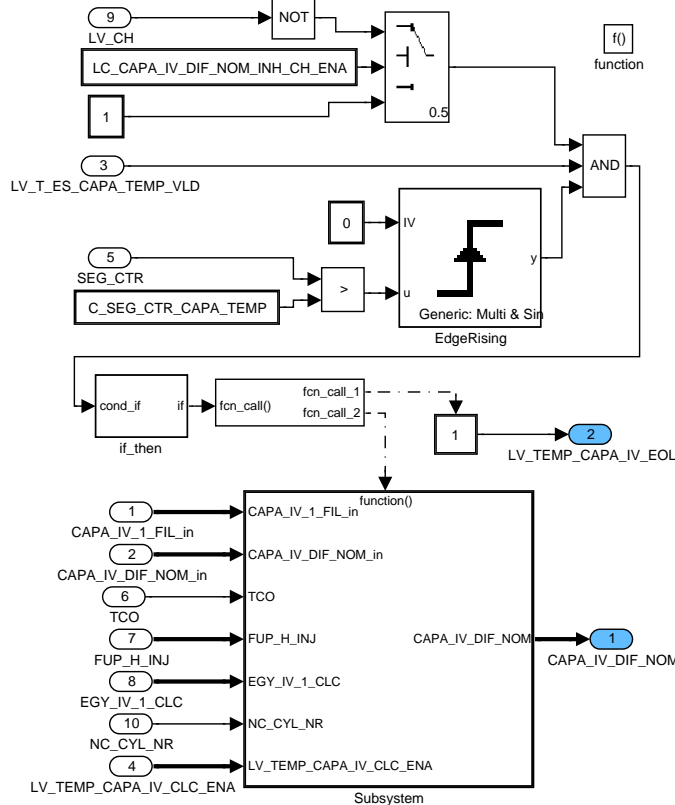


Figure 7.35.18: INJR\_ISPCLCAPA0/operate/Capacity\_Offset

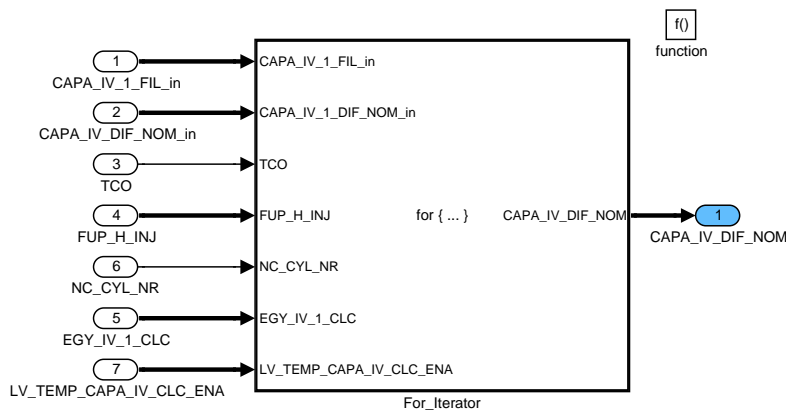


Figure 7.35.19: INJR\_ISPCLCAPA0/operate/Capacity\_Offset/Subsystem

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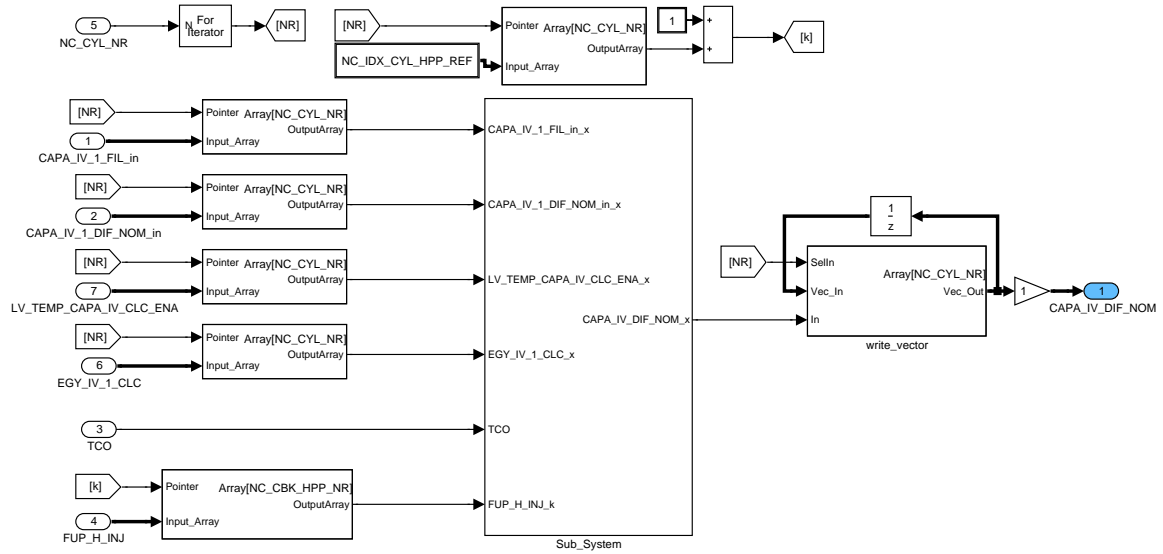


Figure 7.35.20: INJR\_ISPCLCAPA0/operate/Capacity\_Offset/Subsystem/For\_Iterator

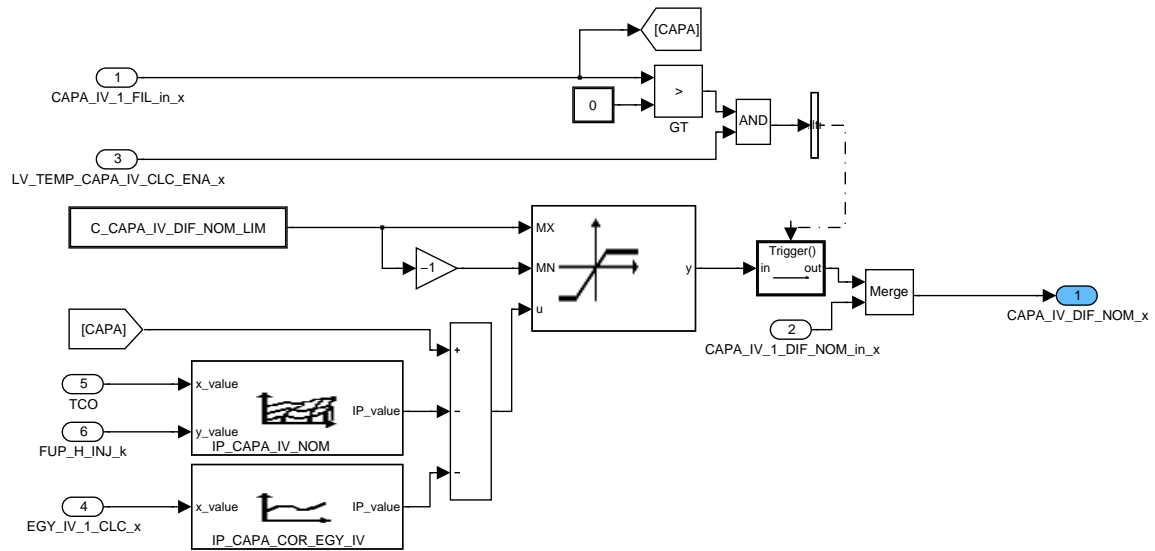


Figure 7.35.21: INJR\_ISPCLCAPA0/operate/Capacity\_Offset/Subsystem/For\_Iterator/Sub\_System

**Manual setting for end of line flag**

The endofline fag LV\_TEMP\_CAPA\_IV\_EOL can be set manually via LC\_TEMP\_CAPA\_IV\_EOL\_MAN and C\_TEMP\_CAPA\_IV\_EOL.

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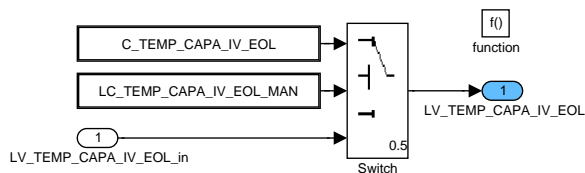


Figure 7.35.22: INJR\_ISPCLCAPA0/operate/Manual\_setting\_for\_EOL

### 7.35.5 Handling of nonvolatile memory

The capacity offset of each injector is stored. It is read and written to the NVMY before/after each complete driving cycle.

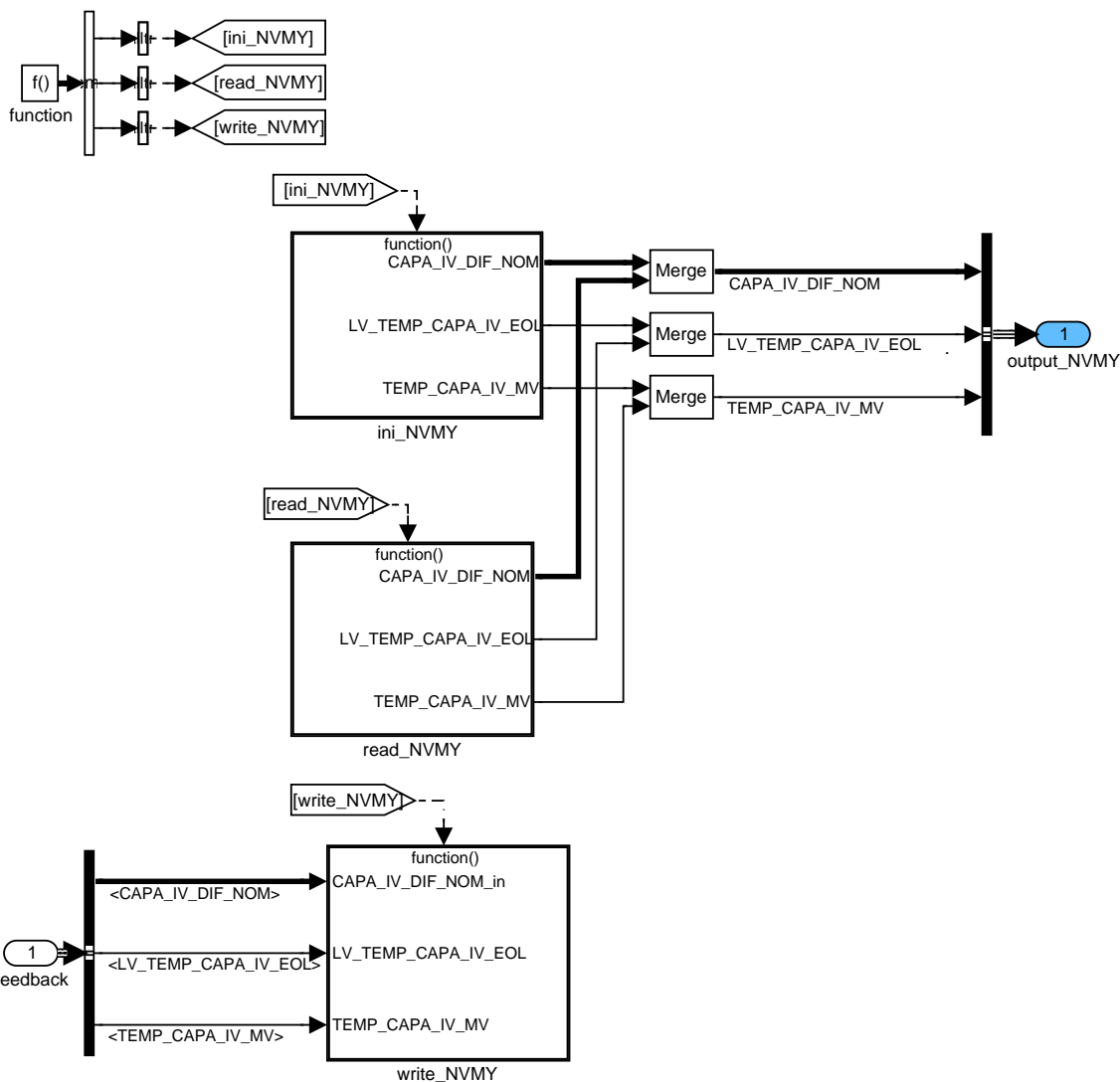



Figure 7.35.23: INJR\_ISPCLCAPA0/operate\_NVMY

### Initialization of nonvolatile memory

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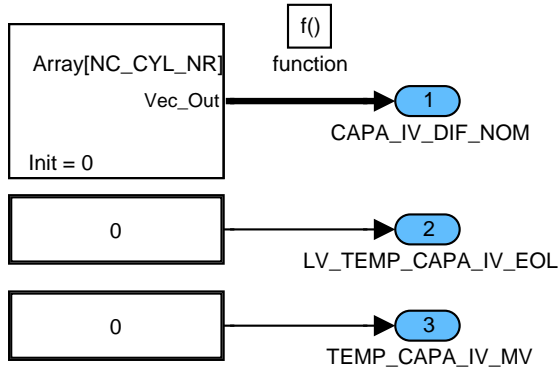


Figure 7.35.24: INJR\_ISPCLCAPA0/operate\_NVMY/ini\_NVMY

**Reading of nonvolatile memory**

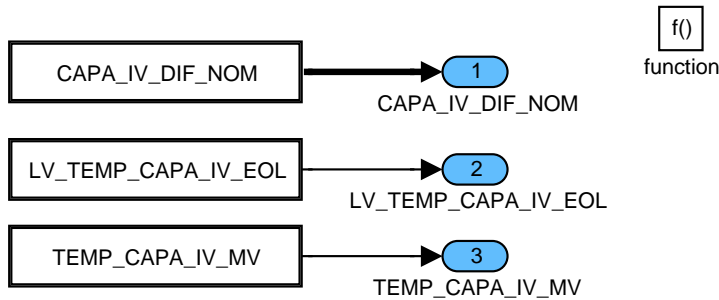


Figure 7.35.25: INJR\_ISPCLCAPA0/operate\_NVMY/read\_NVMY

**Writing of nonvolatile memory**

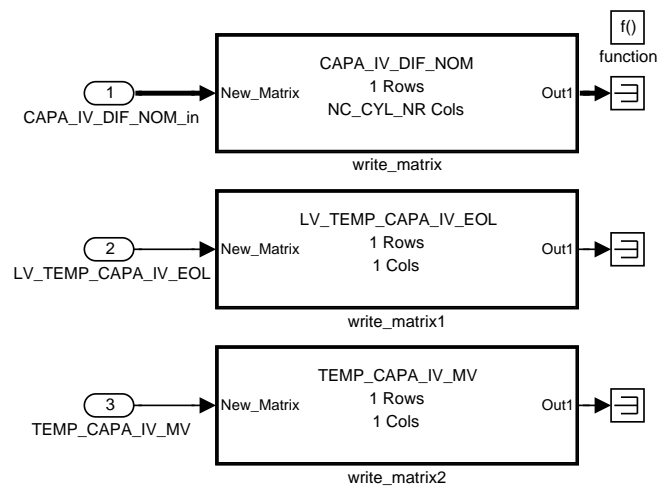



Figure 7.35.26: INJR\_ISPCLCAPA0/operate\_NVMY/write\_NVMY

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## 7.36 Injector needle lift adjustment

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EGY_ADD_AD [NC_CYL_NR]	O/V	E000... 2000H	-50 ...50	6.1035e-3	%
Adaptive piezo energy correction depending on CYBL + CILC corrections					
EGY_STEP_INJ_CHA_GRD_DIF_HOM [NC_CYL_NR]	V	E000... 2000H	-50 ...50	6.1035e-3	%
Piezo injector energy charge gradient abundance for a single step - homogenous operation					
EGY_STEP_INJ_CHA_GRD_DIF_S [NC_CYL_NR]	V	E000... 2000H	-50 ...50	6.1035e-3	%
Piezo injector energy charge gradient abundance for a single step - stratified operation					
EGY_STEP_INJ_CHA_GRD_LIM_NOT [NC_CYL_NR]	V	0... 4000H	0... 100	6.1035e-3	%
Unlimited piezo injector energy charge gradient for a single step					
FAC_EGY_DIF_HOM [NC_CYL_NR]	V	0... 4000H	-50 ...50	6.1035e-3	%
Energy-level-difference factor - homogenous operation					
FAC_EGY_DIF_S [NC_CYL_NR]	V	0... 4000H	-50 ...50	6.1035e-3	%
Energy-level-difference factor - stratified operation					
FAC_MFF_DIF_HOM [NC_CYL_NR]	O/V	0... FFFFH	-1... 0.99996	30.5e-6	-
MFF-difference factor - homogenous operation					
FAC_MFF_DIF_MV	O/V	0... FFFFH	-1... 0.99996	30.5e-6	-
MFF-difference factor - mean value					
FAC_MFF_DIF_S [NC_CYL_NR]	O/V	0... FFFFH	-1... 0.99996	30.5e-6	-
MFF-difference factor - stratified operation					
FAC_TI_COR_IV_EGY_RNG_L [NC_CBK_HPP_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Multiplicative injection time correction factor for corrections in case of injector low lift					
IDX_TI_1_STND_S_TMP [NC_CYL_NR]	-	0... FFFFH	0... 65535	1	-
Temporary counting factor index for first pulse S.					
IDX_TI_2_STND_S_TMP [NC_CYL_NR]	-	0... FFFFH	0... 65535	1	-
Temporary counting factor index for second pulse S.					
IDX_TI_3_STND_S_TMP [NC_CYL_NR]	-	0... FFFFH	0... 65535	1	-
Temporary counting factor index for third pulse S.					
IDX_TI_HYS_IV_EGY_RNG	V	0... FFFFH	0... 65535	1	-
Counting factor index hysteresis for selection of injector energy range					
IDX_TI_THD_IV_EGY_RNG	V	0... FFFFH	0... 65535	1	-
Counting factor index threshold for the selection of the injector energy range in stratified mode.					
LF_EGY_RNG_IV_1_HOM_REQ	V	0... FFH	0... 255	1	-
Bit coded injector needle lift request for each cylinder; first pulse homogeneous mode					
LF_EGY_RNG_IV_1_S_REQ	V	0... FFH	0... 255	1	-
Bit coded injector needle lift request for each cylinder; first pulse stratified mode					
LF_EGY_RNG_IV_2_HOM_REQ	V	0... FFH	0... 255	1	-
Bit coded injector needle lift request for each cylinder; second pulse homogeneous mode					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LF_EGY_RNG_IV_2_S_REQ	V	0... FFH	0... 255	1	-
Bit coded injector needle lift request for each cylinder; second pulse stratified mode					
LF_EGY_RNG_IV_3_HOM_REQ	V	0... FFH	0... 255	1	-
Bit coded injector needle lift request for each cylinder; third pulse homogeneous mode					
LF_EGY_RNG_IV_3_S_REQ	V	0... FFH	0... 255	1	-
Bit coded injector needle lift request for each cylinder; third pulse stratified mode					
LV_EGY_ADD_AD_LIM [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Adaptive piezo energy correction is at limit, cylinder individual					
LV_EGY_ADD_AD_LIM_TOL [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Adaptive piezo energy correction is at top limit, cylinder individual					
LV_EGY_RNG_IV_PLS_1_HOM [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag for the injector energy range of the first pulse homogeneous mode (0 = low range, 1 = high range)					
LV_EGY_RNG_IV_PLS_1_S [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag for the injector energy range of the first pulse stratified mode (0 = low range, 1 = high range)					
LV_EGY_RNG_IV_PLS_2_HOM [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag for the injector energy range of the second pulse homogeneous mode (0 = low range, 1 = high range)					
LV_EGY_RNG_IV_PLS_2_S [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag for the injector energy range of the second pulse stratified mode (0 = low range, 1 = high range)					
LV_EGY_RNG_IV_PLS_3_HOM [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag for the injector energy range of the third pulse homogeneous mode (0 = low range, 1 = high range)					
LV_EGY_RNG_IV_PLS_3_S [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag for the injector energy range of the third pulse stratified mode (0 = low range, 1 = high range)					
LV_IV_EGY_RNG_1	O/V	0... 1H	0 ...1	1	-
Flag for the injector energy range of the first pulse (0 = low range, 1 = high range)					
LV_IV_EGY_RNG_2	O/V	0... 1H	0 ...1	1	-
Flag for the injector energy range of the second pulse (0 = low range, 1 = high range)					
LV_IV_EGY_RNG_3	O/V	0... 1H	0 ...1	1	-
Flag for the injector energy range of the third pulse (0 = low range, 1 = high range)					
MFF_THD_EGY_RNG_IV	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass threshold for the selection of the injector energy range depending on fuel pressure. Pulse specific					


**Input data:**

CTR_CYL_NR_ST_CLC_INJR {p. 3327}	EGY_LEVEL_IV_BAL [NC_CYL_NR] {p. 3215}	EGY_LEVEL_IV_BAL_CONV [NC_CYL_NR] {p. 3215}	EGY_STEP_INJ_CHA_GRD_BAS [NC_CYL_NR] {p. 2277}
EGY_STEP_INJ_CHA_LIM_DIF [NC_CYL_NR] {p. 2277}	FAC_TI_1_PRS_CYL_S [NC_CYL_NR] {p. 2212}	FAC_TI_2_PRS_CYL_S [NC_CYL_NR] {p. 2216}	FAC_TI_3_PRS_CYL_S [NC_CYL_NR] {p. 2220}
FUP_H_INJ [NC_CBK_HPP_NR] {p. 3327}	INJ_MOD_SP_HOM [NC_CYL_NR] {p. 3329}	INJ_MOD_SP_HOMS [NC_CYL_NR] {p. 3329}	INJ_MOD_SP_S [NC_CYL_NR] {p. 3330}
IP_EGY_LEVEL_IV_BAL_CONV {p. 3216}	IP_FAC_EGY_LEVEL_IV_BAL_COR {p. 3216}	IP_MFF_IDX_TI_EGY_H {p. 2008}	IP_MFF_TI_EGY_H {p. 2009}

LC_CUR_SHP_INJ_ENA {p. 2010}	LF_EGY_RNG_HOM_EXT {p. 3330}	LFT_L_IV_HOM_REQ {p. 3330}	LFT_L_IV_S_REQ {p. 3330}
LV_EGY_RNG_HOM_EXT_ENA {p. 3330}	LV_EGY_STEP_INJ_CHA_LIM [NC_CYL_NR] {p. 2277}	LV_IV_POST_EGY_RNG {p. 2179}	LV_S_CLC {p. 1822}
LV_ST_END {p. 1720}	MFF_SP_1_S [NC_CYL_NR] {p. 8242}	MFF_SP_2_HOM [NC_CYL_NR] {p. 8242}	MFF_SP_2_S [NC_CYL_NR] {p. 8242}
MFF_SP_3_HOM [NC_CYL_NR] {p. 8243}	MFF_SP_3_S [NC_CYL_NR] {p. 8243}	MFF_SP_MV {p. 2151}	N_32 {p. 1525}
NC_CBK_HPP_NR [1] {p. 812}	NC_CYL_NR {p. 1526}	NC_IDX_CYL_HPP_REF [NC_CYL_NR] {p. 626}	NC_INJ_MOD_HOM {p. 2045}
NC_INJ_MOD_MASK_1 {p. 2045}	NC_INJ_MOD_MULT1 {p. 2045}	NR_CYL_CLC_RED_INJ {p. 3331}	PRS_DEC_INJ_1_S [NC_CYL_NR] {p. 2212}
PRS_DEC_INJ_2_S [NC_CYL_NR] {p. 2216}	PRS_DEC_INJ_3_S [NC_CYL_NR] {p. 2220}	STATE_INJ_MOD_HOM_REQ {p. 3331}	STATE_INJ_MOD_HOMS_REQ {p. 3331}
STATE_INJ_MOD_REQ {p. 3332}	STATE_INJ_MOD_S_REQ {p. 3332}	TFU_INJ {p. 3332}	TI_FAC [NC_CYL_NR] {p. 999}
TI_TUN_IV [NC_CYL_NR] {p. 2233}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EGY_STEP_INJ_CHA_GRD_MAX_HOM	-	0... 4000H	0... 100	6.1035e-3	%
Upper threshold of energy charge gradient for a single step - homogenous operation					
C_EGY_STEP_INJ_CHA_GRD_MAX_S	-	0... 4000H	0... 100	6.1035e-3	%
Upper threshold of energy charge gradient for a single step - stratified operation					
C_EGY_STEP_INJ_CHA_GRD_MIN_HOM	-	0... 4000H	0... 100	6.1035e-3	%
Lower threshold of energy charge gradient for a single step - homogenous operation					
C_EGY_STEP_INJ_CHA_GRD_MIN_S	-	0... 4000H	0... 100	6.1035e-3	%
Lower threshold of energy charge gradient for a single step - stratified operation					
C_IDX_TI_HYS_IV_EGY_RNG	-	0... FFFFH	0... 65535	1	-
Counting factor index hysteresis for the selection of the injector energy range.					
C_MFF_HYS_IV_EGY_RNG	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass hysteresis for the selection of the injector energy range					
C_TI_HYS_IV_EGY_RNG	-	0... FFFFH	0... 65.535	0.001	ms
Injection time hysteresis for the selection of the injector energy range					
ID_IDX_TI_THD_IV_EGY_RNG	-	0... FFFFH	0... 65535	1	-
LDP_N_32_TI_THD_IV_EGY_RNG	3	0... FFH	0... 8160	32	rpm
Counting factor index threshold for the selection of the injector energy range depending on engine speed.					
ID_TI_THD_IV_EGY_RNG	-	0... FFFFH	0... 65.535	0.001	ms
LDP_N_32_TI_THD_IV_EGY_RNG	3	0... FFH	0... 8160	32	rpm
Injection time threshold for the selection of the injector energy range depending on engine speed					
IP_FAC_TI_COR_IV_EGY_RNG_L	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_FUP_FAC_TI_COR_IV_EGY_RNG_L	12	0... FFFFH	0... 347776	5.3067216	hPa
Multiplicative injection time correction factor for corrections in case of injector low lift depending on FUP					
IP_MFF_THD_IV_EGY_RNG	-	0... FFFFH	0... 1389	0.0211948	mg/stk

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_FUP_MFF_THD_IV_EGY_RNG	4	0... FFFFH	0... 347776	5.3067216	hPa
Fuel mass threshold for the selection of the injector energy range depending on Cyl PRS					
LC_EGY_RNG_IV_CYL_IND_DI	-	0... 1H	0 ...1	1	-
Switch to disable cylinder individual injector needle lift					

## DESCRIPTION:

### General information:

This functionality switches between two different base energy ranges for PIEZO injectors. Starting with these base ranges, specific energy levels are calculated for each cylinder depending on the cylinder balancing injection valve energy level.

### Application conditions

**Initialization:** at reset and at first valid tooth:

```

LF_EGY_RNG_IV_1_HOM_REQ = (2^NC_CYL_NR) - 1
LF_EGY_RNG_IV_2_HOM_REQ = (2^NC_CYL_NR) - 1
LF_EGY_RNG_IV_3_HOM_REQ = (2^NC_CYL_NR) - 1
LF_EGY_RNG_IV_1_S_REQ = (2^NC_CYL_NR) - 1
LF_EGY_RNG_IV_2_S_REQ = (2^NC_CYL_NR) - 1
LF_EGY_RNG_IV_3_S_REQ = (2^NC_CYL_NR) - 1
LV_IV_EGY_RNG_1 = 1
LV_IV_EGY_RNG_2 = 1
LV_IV_EGY_RNG_3 = 1
LV_EGY_RNG_IV_PLS_1_S[ ] = 1 // all NC_CYL_NR elements
LV_EGY_RNG_IV_PLS_2_S[ ] = 1 // all NC_CYL_NR elements
LV_EGY_RNG_IV_PLS_3_S[ ] = 1 // all NC_CYL_NR elements
LV_EGY_RNG_IV_PLS_1_HOM[ ] = 1 // all NC_CYL_NR elements
LV_EGY_RNG_IV_PLS_2_HOM[ ] = 1 // all NC_CYL_NR elements
LV_EGY_RNG_IV_PLS_3_HOM[ ] = 1 // all NC_CYL_NR elements

```

EGY\_ADD\_AD[x] = EGY\_LEVEL\_IV\_BAL[x]

```

EGY_STEP_INJ_CHA_GRD_DIF_HOM[x] = 0
FAC_EGY_DIF_HOM[x] = 0
FAC_MFF_DIF_HOM[x] = 0
EGY_STEP_INJ_CHA_GRD_DIF_S[x] = 0
FAC_EGY_DIF_S[x] = 0
FAC_MFF_DIF_S[x] = 0
FAC_MFF_DIF_MV = 0


```

FAC\_TI\_COR\_IV\_EGY\_RNG\_L = 1.0

### Recurrence:

LV\_ST\_END = 0: 10ms

LV\_ST\_END = 1: segment synchronous

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**Activation:** every engine state

**Deactivation:** -

**Formula section:**

For loop for runtime optimization:

In this specification the for loop

```
FOR i = 0, i < NR_CYL_CLC_RED_INJ DO
    x = CTR_CYL_NR_ST_CLC_INJR + i
    (1a)IF x >= NC_CYL_NR
    (1a)THEN
        x = x - NC_CYL_NR
    (1a)ENDIF
    <loop content>
```

**ENDFOR**

is substituted by

```
FOR cylinder_start to cylinder_stop DO
    <loop content>
```

**ENDFOR**


**Note:** In the for loops, x will be used as loop variable to indicate the cylinder x!

### 7.36.1 Cylinder individual adjustment of the energy level

This function calculates cylinder individual charge and discharge gradients depending on the cylinder balancing injection valve energy level. Should the unlimited gradient value run out of the lower/upper limits, the gradient variable shall be limited to the maximum or minimum threshold - dependently on engine operation mode (homogenous or stratified) - and the energy-level-difference factor shall be converted in the MFF-difference factor.

```
if(1)      {(STATE_INJ_MOD_REQ & NC_INJ_MOD_MASK_1) = NC_INJ_MOD_HOM}
           [Bit-wise AND- operator]
then
    for(2)      cylinder_start to cylinder_stop DO
        EGY_STEP_INJ_CHA_GRD_LIM_NOT[x] =
            EGY_STEP_INJ_CHA_GRD_BAS[x]
        + EGY_LEVEL_IV_BAL[x]
        if(3)      EGY_STEP_INJ_CHA_GRD_LIM_NOT[x] >
            C_EGY_STEP_INJ_CHA_GRD_MAX_
HOM
        then
            LV_EGY_ADD_AD_LIM[x] = 1
            LV_EGY_ADD_AD_LIM_TOL[x] = 1
            EGY_STEP_INJ_CHA_GRD_DIF_HOM[x] =
            EGY_STEP_INJ_CHA_GRD_LIM_
NOT[x] -
            C_EGY_STEP_INJ_CHA_GRD_MAX_
HOM
        if(4)      LV_EGY_STEP_INJ_CHA_LIM[x] = 1
        then
            FAC_EGY_DIF_HOM[x] =
            (100% + EGY_LEVEL_IV_BAL_
CONV[x])*
```

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```

HOM[x] +
SP_MV)
CONV[x])*
HOM[x]/
SP_MV)
else(4)
    FAC_EGY_DIF_HOM[x] =
        (100% + EGY_LEVEL_IV_BAL_
        EGY_STEP_INJ_CHA_GRD_DIF_
        (100% + EGY_LEVEL_IV_BAL[x])/
        IP_FAC_EGY_LEVEL_IV_BAL_COR(MFF_
        endif(4)
        FAC_MFF_DIF_HOM[x] = inverse(IP_EGY_LEVEL_IV_BAL_CONV
        (FAC_EGY_DIF_HOM[x]))
        EGY_ADD_AD[x] = C_EGY_STEP_INJ_CHA_GRD_MAX_HOM -
        EGY_STEP_INJ_CHA_GRD_BAS[x]
    else(3)
        if(4)
            EGY_STEP_INJ_CHA_GRD_LIM_NOT[x] <
            C_EGY_STEP_INJ_CHA_GRD_MIN_
        HOM
        then
            LV_EGY_ADD_AD_LIM[x] = 1
            EGY_STEP_INJ_CHA_GRD_DIF_HOM[x] =
            EGY_STEP_INJ_CHA_GRD_LIM_
        NOT[x] -
        HOM
            if(5)
                LV_EGY_STEP_INJ_CHA_LIM[x] = 1
            then
                FAC_EGY_DIF_HOM[x] =
                (100% + EGY_LEVEL_IV_BAL_
                (EGY_STEP_INJ_CHA_GRD_DIF_
                EGY_STEP_INJ_CHA_LIM_DIF[x])/
                (100% + EGY_LEVEL_IV_BAL[x])/
                IP_FAC_EGY_LEVEL_IV_BAL_COR(MFF_
            SP_MV)
            else(5)
                FAC_EGY_DIF_HOM[x] =
                (100% + EGY_LEVEL_IV_BAL_
                EGY_STEP_INJ_CHA_GRD_DIF_
                HOM[x]/

```

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```

(100% + EGY_LEVEL_IV_BAL[x])/
IP_FAC_EGY_LEVEL_IV_BAL_COR(MFF_
SP_MV)
endif(5)
FAC_MFF_DIF_HOM[x] =
CONV
inverse(IP_EGY_LEVEL_IV_BAL_
(FAC_EGY_DIF_HOM[x]))
EGY_ADD_AD[x] = C_EGY_STEP_INJ_CHA_GRD_MIN_HOM -
EGY_STEP_INJ_CHA_GRD_BAS[x]
else(4)
if(5) LV_EGY_STEP_INJ_CHA_LIM[x] = 1
then
FAC_EGY_DIF_HOM[x] =
CONV[x]*
(100% + EGY_LEVEL_IV_BAL_
EGY_STEP_INJ_CHA_LIM_DIF[x]/
(100% + EGY_LEVEL_IV_BAL[x])/
IP_FAC_EGY_LEVEL_IV_BAL_COR(MFF_
SP_MV)
FAC_MFF_DIF_HOM[x] =
CONV
inverse(IP_EGY_LEVEL_IV_BAL_
(FAC_EGY_DIF_HOM[x]))
else(5)
FAC_EGY_DIF_HOM[x] = 0
FAC_MFF_DIF_HOM[x] = 0
endif(5)
EGY_STEP_INJ_CHA_GRD_DIF_HOM[x] = 0
EGY_ADD_AD[x] = EGY_LEVEL_IV_BAL[x]
LV_EGY_ADD_AD_LIM[x] = 0
LV_EGY_ADD_AD_LIM_TOL[x] = 0
endif(4)
endif(3)
endfor(2)

```

calculation of mean value of FAC\_MFF\_DIF\_HOM[ ] (mean value over all cylinders):  
FAC\_MFF\_DIF\_MV = mean(FAC\_MFF\_DIF\_HOM[ ])

```

else(1)
for(2) cylinder_start to cylinder_stop DO
EGY_STEP_INJ_CHA_GRD_LIM_NOT[x] =
EGY_STEP_INJ_CHA_GRD_BAS[x]
+ EGY_LEVEL_IV_BAL[x]
if(3) EGY_STEP_INJ_CHA_GRD_LIM_NOT[x] >
C_EGY_STEP_INJ_CHA_GRD_MAX_S
then
LV_EGY_ADD_AD_LIM[x] = 1
LV_EGY_ADD_AD_LIM_TOL[x] = 1


```

```

EGY_STEP_INJ_CHA_GRD_DIF_S[x] =
NOT[x] -
S
EGY_STEP_INJ_CHA_GRD_LIM_
C_EGY_STEP_INJ_CHA_GRD_MAX_
S[x] +
if(4) LV_EGY_STEP_INJ_CHA_LIM[x] = 1
then
FAC_EGY_DIF_S[x] = (100% + EGY_LEVEL_IV_BAL_CONV[x])*
(EGY_STEP_INJ_CHA_GRD_DIF_
EGY_STEP_INJ_CHA_LIM_DIF[x])/
(100% + EGY_LEVEL_IV_BAL[x])/
IP_FAC_EGY_LEVEL_IV_BAL_COR(MFF_
SP_MV)
else(4)
FAC_EGY_DIF_S[x] = (100% + EGY_LEVEL_IV_BAL_CONV[x])*
EGY_STEP_INJ_CHA_GRD_DIF_
S[x]/
(100% + EGY_LEVEL_IV_BAL[x])/
IP_FAC_EGY_LEVEL_IV_BAL_COR(MFF_
SP_MV)
endif(4)
FAC_MFF_DIF_S[x] = inverse(IP_EGY_LEVEL_IV_BAL_CONV
(FAC_EGY_DIF_S[x]))
EGY_ADD_AD[x] = C_EGY_STEP_INJ_CHA_GRD_MAX_S -
EGY_STEP_INJ_CHA_GRD_BAS[x]
else(3)
if(4) EGY_STEP_INJ_CHA_GRD_LIM_NOT[x] <
C_EGY_STEP_INJ_CHA_GRD_MIN_
S
then
LV_EGY_ADD_AD_LIM[x] = 1
EGY_STEP_INJ_CHA_GRD_DIF_S[x] =
NOT[x] -
S
EGY_STEP_INJ_CHA_GRD_LIM_
C_EGY_STEP_INJ_CHA_GRD_MIN_
CONV[x])*
S[x] +
if(5) LV_EGY_STEP_INJ_CHA_LIM[x] = 1
then
FAC_EGY_DIF_S[x] =
(100% + EGY_LEVEL_IV_BAL_
(EGY_STEP_INJ_CHA_GRD_DIF_
EGY_STEP_INJ_CHA_LIM_DIF[x])/
(100% + EGY_LEVEL_IV_BAL[x])/
IP_FAC_EGY_LEVEL_IV_BAL_COR(MFF_
SP_MV)
else(5)

```

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```


                                FAC_EGY_DIF_S[x] =
CONV[x])*                                (100% + EGY_LEVEL_IV_BAL_
S[x]/                                EGY_STEP_INJ_CHA_GRD_DIF_
                                (100% + EGY_LEVEL_IV_BAL[x])/
SP_MV)                                IP_FAC_EGY_LEVEL_IV_BAL_COR(MFF_
                                endif(5)
                                FAC_MFF_DIF_S[x] = inverse(IP_EGY_LEVEL_IV_BAL_CONV
                                (FAC_EGY_DIF_S[x]))
EGY_ADD_AD[x] = C_EGY_STEP_INJ_CHA_GRD_MIN_S -
                                EGY_STEP_INJ_CHA_GRD_BAS[x]
else(4)
                                if(5) LV_EGY_STEP_INJ_CHA_LIM[x] = 1
                                then
                                FAC_EGY_DIF_S[x] =
CONV[x])*                                (100% + EGY_LEVEL_IV_BAL_
                                EGY_STEP_INJ_CHA_LIM_DIF[x]/
                                (100% + EGY_LEVEL_IV_BAL[x])/
SP_MV)                                IP_FAC_EGY_LEVEL_IV_BAL_COR(MFF_
                                FAC_MFF_DIF_S[x] =
CONV                                inverse(IP_EGY_LEVEL_IV_BAL_
                                (FAC_EGY_DIF_S[x]))
                                else(5)
                                FAC_EGY_DIF_S[x] = 0
                                FAC_MFF_DIF_S[x] = 0
                                endif(5)
                                EGY_STEP_INJ_CHA_GRD_DIF_S[x] = 0
                                EGY_ADD_AD[x] = EGY_LEVEL_IV_BAL[x]
                                LV_EGY_ADD_AD_LIM[x] = 0
                                LV_EGY_ADD_AD_LIM_TOL[x] = 0
                                endif(4)
                                endif(3)
                                endfor(2)

```

calculation of mean value of FAC\_MFF\_DIF\_S[ ] (mean value over all cylinders):  
 FAC\_MFF\_DIF\_MV = mean(FAC\_MFF\_DIF\_S[ ])

**endif**<sup>(1)</sup>

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## 7.36.2 Selection of injector energy range

### 7.36.2.1 Basis calculations

The minimum fuel mass setpoint for stratified mode is determined from the pulses with a fuel mass setpoint greater than zero. The corresponding minimum injection time is calculated and if the injection time is greater than a threshold or homogeneous mode is selected, high energy range will be selected for the injector, pulse individual.

The energy range can also be clipped to low range by dynamic injector needle lift selection (bit field LFT\_L\_IV\_S\_REQ).

**Important note:** For better readability of the specification, the LSB of the bit field LFT\_L\_IV\_S\_REQ, which corresponds to the physically first injection pulse, is referred to as bit 1 (**not** bit 0 as it would be in SW). The next bit would be bit 2 etc.

### 7.36.2.2 Main calculations for stratified combustion mode:

```

FOR m = 0 TO NC_CBK_HPP_NR - 1 DO
    FAC_TI_COR_IV_EGY_RNG_L[m] =
        IP_FAC_TI_COR_IV_EGY_RNG_L (Input: FUP_H_INJ[m])
ENDFOR
if(1) LV_S_CLC = 1      Check if stratified mode has to be calculated
then
    if(1a) LC_CUR_SHP_INJ_ENA = 1
    then(1a) // current shaping via IDX_TI calculation is active
        IDX_TI_THD_IV_EGY_RNG = ID_IDX_TI_THD_IV_EGY_RNG (Input: N_32)
        IDX_TI_HYS_IV_EGY_RNG = C_IDX_TI_HYS_IV_EGY_RNG
    else(1a) // current shaping is inactive; classic TI calculation applied
        IDX_TI_THD_IV_EGY_RNG = ID_TI_THD_IV_EGY_RNG (Input: N_32)
            /0.001ms
        IDX_TI_HYS_IV_EGY_RNG = C_TI_HYS_IV_EGY_RNG /0.001ms
    endif(1a)
    (1)FOR cylinder_start to cylinder_stop DO
        check, if third pulse stratified mode has to be calculated
    if(2) INJ_MOD_SP_S[x] = "MPLS+PLS3" OR
        INJ_MOD_SP_HOMS[x] = "HOMS+PLS3"
    then [Third pulse has to be calculated]
        calculate section 1.2.2 (third pulse stratified)
    endif(2)
        check, if second pulse stratified mode has to be calculated
    if(3) INJ_MOD_SP_S[x] = "MPLS" OR
        INJ_MOD_SP_S[x] = "MPLS+PLS3" OR
        INJ_MOD_SP_HOMS[x] = "HOMS" OR
        INJ_MOD_SP_HOMS[x] = "HOMS+PLS3"
    then
        calculate section 1.2.3 (second pulse stratified)
    endif(3)
        always calculate first pulse stratified mode, if LV_S_CLC = 1
        calculate section 1.2.4 (first pulse stratified)
    (1)ENDFOR
endif(1)
end of section 1.2.1

```

### 7.36.2.3 Calculate energy selection parameters for the third injection pulse stratified mode:

**Note:** Calculate this section only if called by another section

```

if(1)      LC_CUR_SHP_INJ_ENA = 1
then
    IDX_TI_3_STND_S_TMP[x] = IP_MFF_IDX_TI_EGY_H (
        MFF_SP_3_S[x]*(1 + FAC_MFF_DIF_S[x]); PRS_DEC_INJ_3_S[x]
        * TI_FAC[x] * TI_TUN_IV[x] * FAC_TI_3_PRS_CYL_S[x]
else(1)
    IDX_TI_3_STND_S_TMP[x] = (IP_MFF_TI_EGY_H (
        MFF_SP_3_S[x]*(1 + FAC_MFF_DIF_S[x]); PRS_DEC_INJ_3_S[x]
        /0.001ms)
        * TI_FAC[x] * TI_TUN_IV[x] * FAC_TI_3_PRS_CYL_S[x]
endif(1)

if(2)      (IDX_TI_3_STND_S_TMP[x] < IDX_TI_THD_IV_EGY_RNG) or
            Bit 3 of LFT_L_IV_S_REQ = 1
then
    LV_EGY_RNG_IV_PLS_3_S[x] = 0
    Bit x of LF_EGY_RNG_IV_3_S_REQ = 0
    [Select low energy range]

else(2)
    if(3)      IDX_TI_3_STND_S_TMP[x] > (IDX_TI_THD_IV_EGY_RNG
            + IDX_TI_HYS_IV_EGY_RNG)
    then
        LV_EGY_RNG_IV_PLS_3_S[x] = 1
        Bit x of LF_EGY_RNG_IV_3_S_REQ = 1
        [Select high energy range]

    else(3)
        [no operation: energy range unchanged]
    endif(3)
endif(2)
    
```

**end of section 1.2.2**

### 7.36.2.4 Calculate energy selection parameters for the second injection pulse stratified mode:

**Note:** Calculate this section only if called by another section

```

if(1)      LC_CUR_SHP_INJ_ENA = 1
then
    IDX_TI_2_STND_S_TMP[x] = IP_MFF_IDX_TI_EGY_H (
        MFF_SP_2_S[x]*(1 + FAC_MFF_DIF_S[x]); PRS_DEC_INJ_2_S[x]
        * TI_FAC[x] * TI_TUN_IV[x] * FAC_TI_2_PRS_CYL_S[x]
else(1)
    IDX_TI_2_STND_S_TMP[x] = (IP_MFF_TI_EGY_H (
        MFF_SP_2_S[x]*(1 + FAC_MFF_DIF_S[x]); PRS_DEC_INJ_2_S[x]
        /0.001ms)
        * TI_FAC[x] * TI_TUN_IV[x] * FAC_TI_2_PRS_CYL_S[x]
endif(1)
    
```

```

if(2)      (IDX_TI_2_STND_S_TMP[x] < IDX_TI_THD_IV_EGY_RNG) or
            Bit 2 of LFT_L_IV_S_REQ = 1
then
            LV_EGY_RNG_IV_PLS_2_S[x] = 0
            Bit x of LF_EGY_RNG_IV_2_S_REQ = 0
            [Select low energy range]

else(2)
if(3)      IDX_TI_2_STND_S_TMP[x] > (IDX_TI_THD_IV_EGY_RNG
                                     + IDX_TI_HYS_IV_EGY_RNG)
then
            LV_EGY_RNG_IV_PLS_2_S[x] = 1
            Bit x of LF_EGY_RNG_IV_2_S_REQ = 1
            [Select high energy range]

else(3)
            [no operation: energy range unchanged]
endif(3)
endif(2)

```

**end of section 1.2.3**

### 7.36.2.5 Calculate energy selection parameters for the first injection pulse stratified mode:


**Note:** Calculate this section only if called by another section

```

if(1)      LC_CUR_SHP_INJ_ENA = 1
then
            IDX_TI_1_STND_S_TMP[x] = IP_MFF_IDX_TI_EGY_H (
                MFF_SP_1_S[x]*(1 + FAC_MFF_DIF_S[x]); PRS_DEC_INJ_1_S[x])
                * TI_FAC[x] * TI_TUN_IV[x] * FAC_TI_1_PRS_CYL_S[x]
else(1)
            IDX_TI_1_STND_S_TMP[x] = (IP_MFF_TI_EGY_H (
                MFF_SP_1_S[x]*(1 + FAC_MFF_DIF_S[x]); PRS_DEC_INJ_1_S[x])
                /0.001ms)
                * TI_FAC[x] * TI_TUN_IV[x] * FAC_TI_1_PRS_CYL_S[x]
endif(1)
if(2)      (IDX_TI_1_STND_S_TMP[x] < IDX_TI_THD_IV_EGY_RNG) or
            Bit 1 of LFT_L_IV_S_REQ = 1
then
            LV_EGY_RNG_IV_PLS_1_S[x] = 0
            Bit x of LF_EGY_RNG_IV_1_S_REQ = 0
            [Select low energy range]

else(2)
if(3)      IDX_TI_1_STND_S_TMP[x] > (IDX_TI_THD_IV_EGY_RNG
                                     + IDX_TI_HYS_IV_EGY_RNG)
then
            LV_EGY_RNG_IV_PLS_1_S[x] = 1
            Bit x of LF_EGY_RNG_IV_1_S_REQ = 1
            [Select high energy range]

```

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```

else(3)
    [no operation: energy range unchanged]
endif(3)
endif(2)

```

end of section 1.2.4

### 7.36.2.6 Energy range calculations for multiple homogeneous mode (Main calculations)

If multiple homogenous injection mode is selected, the second/third fuel mass setpoint will be checked against a threshold. If the fuel mass is below the threshold, the second/third injection pulse will be executed with low energy range.

The energy range can also be clipped to low range by dynamic injector needle lift selection (bit field LFT\_L\_IV\_HOM\_REQ).

**Important note:** For better readability of the specification, the LSB of the bit field LFT\_L\_IV\_HOM\_REQ, which corresponds to the physically first injection pulse, is referred to as bit 1 (**not** bit 0 as it would be in SW). The next bit would be bit 2 etc.

**Note:** For improvement of runtime, calculate the map IP\_MFF\_THD\_IV\_EGY\_RNG only once per recurrence for every fuel pressure value!

#### ENDFOR

```

(1)FOR cylinder_start to cylinder_stop DO
    check, if second or second and third pulse homogeneous mode has to be calculated
    if(1)
        INJ_MOD_SP_HOM[x] = 'MPLH' OR
        INJ_MOD_SP_HOM[x] = 'MPLH+PLS3'
        [Homogeneous multiple injection mode requested]
    then
        calculate section 1.2.7 (second pulse homogeneous)

        check, if third pulse homogeneous mode has to be calculated
        if(2)
            INJ_MOD_SP_HOM[x] = 'MPLH+PLS3'
            [Homogeneous triple injection mode requested]
        then
            calculate section 1.2.8 (third pulse homogeneous)
        endif(2)
    endif(1)

    always calculate parameters for the first pulse homogeneous mode
    calculate section 1.2.9 (first pulse homogeneous)
(1)ENDFOR
end of section 1.2.6

```


### 7.36.2.7 Calculate energy selection parameters for the second injection pulse at homogeneous mode based on fuel mass threshold:

**Note:** Calculate this section only if called by another section

```

if(1)
    LV_EGY_RNG_HOM_EXT_ENA = 1

```

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```

then // set injector needle lift to external value
    LV_EGY_RNG_IV_PLS_2_HOM[x] = Bit 1 of LF_EGY_RNG_HOM_EXT
    Bit x of LF_EGY_RNG_IV_2_HOM_REQ = Bit 1 of LF_EGY_RNG_HOM_EXT
else(1)
MFF_THD_EGY_RNG_IV = IP_MFF_THD_IV_EGY_RNG(INPUT: PRS_DEC_INJ_2_HOM[x])

    if(2)      (MFF_SP_2_HOM[x] < MFF_THD_EGY_RNG_IV)
                or Bit 2 of LFT_L_IV_HOM_REQ = 1
    then
        LV_EGY_RNG_IV_PLS_2_HOM[x] = 0
        Bit x of LF_EGY_RNG_IV_2_HOM_REQ = 0
        [Select low energy range]

    else(2)
        if(3)      MFF_SP_2_HOM[x] >
                    (MFF_THD_EGY_RNG_IV
                    + C_MFF_HYS_IV_EGY_RNG)
        then
            LV_EGY_RNG_IV_PLS_2_HOM[x] = 1
            Bit x of LF_EGY_RNG_IV_2_HOM_REQ = 1
            [Select high energy range]

        else(3)
            [no operation: energy range unchanged]
        endif(3)
    endif(2)
endif(1)
end of section 1.2.7

```

### 7.36.2.8 Calculate energy selection parameters for the third injection pulse at homogeneous mode based on fuel mass threshold:

**Note:** Calculate this section only if called by another section


```

if(1)      LV_EGY_RNG_HOM_EXT_ENA = 1
then // set injector needle lift to external value
    LV_EGY_RNG_IV_PLS_3_HOM[x] = Bit 2 of LF_EGY_RNG_HOM_EXT
    Bit x of LF_EGY_RNG_IV_3_HOM_REQ = Bit 2 of LF_EGY_RNG_HOM_EXT
else(1)
MFF_THD_EGY_RNG_IV = IP_MFF_THD_IV_EGY_RNG(INPUT: PRS_DEC_INJ_3_HOM[x])

    if(2)      (MFF_SP_3_HOM[x] < MFF_THD_EGY_RNG_IV)
                or Bit 3 of LFT_L_IV_HOM_REQ = 1
    then
        LV_EGY_RNG_IV_PLS_3_HOM[x] = 0
        Bit x of LF_EGY_RNG_IV_3_HOM_REQ = 0
        [Select low energy range]

    else(2)
        if(3)      MFF_SP_3_HOM[x] >
                    (MFF_THD_EGY_RNG_IV
                    + C_MFF_HYS_IV_EGY_RNG)
        then

```

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```

LV_EGY_RNG_IV_PLS_3_HOM[x] = 1
Bit x of LF_EGY_RNG_IV_3_HOM_REQ = 1
[Select high energy range]

else(3)
    [no operation: energy range unchanged]
endif(3)
endif(2)
endif(1)
end of section 1.2.8

```

### 7.36.2.9 Calculate energy selection parameters for the first injection pulse at homogeneous mode:

**Note:** Calculate this section only if called by another section

```

if(1) LV_EGY_RNG_HOM_EXT_ENA = 1
then // set injector needle lift to external value
    LV_EGY_RNG_IV_PLS_1_HOM[x] = Bit 0 of LF_EGY_RNG_HOM_EXT
    Bit x of LF_EGY_RNG_IV_1_HOM_REQ = Bit 0 of LF_EGY_RNG_HOM_EXT
else(1)
    MFF_THD_EGY_RNG_IV = IP_MFF_THD_IV_EGY_RNG(INPUT: PRS_DEC_INJ_1_HOM[x])

    if(2) (MFF_SP_1_HOM[x] < MFF_THD_EGY_RNG_IV)
        or Bit 1 of LFT_L_IV_HOM_REQ = 1
    then
        LV_EGY_RNG_IV_PLS_1_HOM[x] = 0
        Bit x of LF_EGY_RNG_IV_1_HOM_REQ = 0
        [Select low energy range]

    else(2)
        if(3) MFF_SP_1_HOM[x] >
            (MFF_THD_EGY_RNG_IV
             + C_MFF_HYS_IV_EGY_RNG)
        then
            LV_EGY_RNG_IV_PLS_1_HOM[x] = 1
            Bit x of LF_EGY_RNG_IV_1_HOM_REQ = 1
            [Select high energy range]

        else(3)
            [no operation: energy range unchanged]
        endif(3)
    endif(2)
endif(1)
end of section 1.2.9


```

### 7.36.2.10 Calculate global energy selection parameters for monitoring unit:

```

(1)IF LC_EGY_RNG_IV_CYL_IND_DI = 1 AND LV_EGY_RNG_HOM_EXT_ENA = 0
(1)THEN
    (2)IF LV_S_CLC = 1
    (2)THEN
        (3)IF LF_EGY_RNG_IV_1_S_REQ = (2^NC_CYL_NR) - 1
        (3)THEN


```

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```

(1)FOR cylinder_start to cylinder_stop DO
    LV_EGY_RNG_IV_PLS_1_S[x] = 1
(1)ENDFOR
(3)ELSE
(2)FOR cylinder_start to cylinder_stop DO
    LV_EGY_RNG_IV_PLS_1_S[x] = 0
(2)ENDFOR
(3)ENDIF
(4)IF (STATE_INJ_MOD_S_REQ = "MPLS" OR
    STATE_INJ_MOD_S_REQ = "MPLS+PLS3" OR
    STATE_INJ_MOD_HOMS_REQ = "HOMS" OR
    STATE_INJ_MOD_HOMS_REQ = "HOMS+PLS3")
(4)THEN
(5)IF LF_EGY_RNG_IV_2_S_REQ = (2*NC_CYL_NR) - 1
(5)THEN
(3)FOR cylinder_start to cylinder_stop DO
    LV_EGY_RNG_IV_PLS_2_S[x] = 1
(3)ENDFOR
(5)ELSE
(4)FOR cylinder_start to cylinder_stop DO
    LV_EGY_RNG_IV_PLS_2_S[x] = 0
(4)ENDFOR
(5)ENDIF
(4)ENDIF
(6)IF (STATE_INJ_MOD_S_REQ = "MPLS+PLS3" OR
    STATE_INJ_MOD_HOMS_REQ = "HOMS+PLS3")
(6)THEN
(7)IF LF_EGY_RNG_IV_3_S_REQ = (2*NC_CYL_NR) - 1
(7)THEN
(5)FOR cylinder_start to cylinder_stop DO
    LV_EGY_RNG_IV_PLS_3_S[x] = 1
(5)ENDFOR
(7)ELSE
(6)FOR cylinder_start to cylinder_stop DO
    LV_EGY_RNG_IV_PLS_3_S[x] = 0
(6)ENDFOR
(7)ENDIF
(6)ENDIF
(2)ENDIF - LV_S_CLC
(8)IF LF_EGY_RNG_IV_1_HOM_REQ = (2*NC_CYL_NR) - 1
(8)THEN
(7)FOR cylinder_start to cylinder_stop DO
    LV_EGY_RNG_IV_PLS_1_HOM[x] = 1
(7)ENDFOR
(8)ELSE
(8)FOR cylinder_start to cylinder_stop DO
    LV_EGY_RNG_IV_PLS_1_HOM[x] = 0
(8)ENDFOR
(8)ENDIF
(9)IF (STATE_INJ_MOD_HOM_REQ = "MPLH" OR
    STATE_INJ_MOD_HOM_REQ = "MPLH+PLS3")
(9)THEN

```

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(10)IF LF_EGY_RNG_IV_2_HOM_REQ = (2^NC_CYL_NR) - 1
(10)THEN
    (9)FOR cylinder_start to cylinder_stop DO
        LV_EGY_RNG_IV_PLS_2_HOM[x] = 1
    (9)ENDFOR
(10)ELSE
    (10)FOR cylinder_start to cylinder_stop DO
        LV_EGY_RNG_IV_PLS_2_HOM[x] = 0
    (10)ENDFOR
(10)ENDIF
(9)ENDIF
(11)IF STATE_INJ_MOD_HOM_REQ = "MPLH+PLS3"
(11)THEN
    (12)IF LF_EGY_RNG_IV_3_HOM_REQ = (2^NC_CYL_NR) - 1
    (12)THEN
        (11)FOR cylinder_start to cylinder_stop DO
            LV_EGY_RNG_IV_PLS_3_HOM[x] = 1
        (11)ENDFOR
    (12)ELSE
        (12)FOR cylinder_start to cylinder_stop DO
            LV_EGY_RNG_IV_PLS_3_HOM[x] = 0
        (12)ENDFOR
    (12)ENDIF
(11)ENDIF
(1)ENDIF - LC_EGY_RNG_IV_CYL_IND_DI
    To keep the interface to the monitoring unit stable, LV_IV_EGY_RNG_1, LV_IV_EGY_RNG_2 and
    LV_IV_EGY_RNG_3 have to be set to the values of the homogeneous path in case of requested
    homogeneous injection or to the values of the stratified path else.
if(1)    {(STATE_INJ_MOD_REQ & NC_INJ_MOD_MASK_1) = NC_INJ_MOD_HOM}
then
    global requested injection mode is homogeneous mode; use homogeneous
    values
    LV_IV_EGY_RNG_1 =
        LV_EGY_RNG_IV_PLS_1_HOM[CTR_CYL_NR_ST_CLC_INJR]
    LV_IV_EGY_RNG_2 =
        LV_EGY_RNG_IV_PLS_2_HOM[CTR_CYL_NR_ST_CLC_INJR]
    LV_IV_EGY_RNG_3 =
        LV_EGY_RNG_IV_PLS_3_HOM[CTR_CYL_NR_ST_CLC_INJR]

else

    global requested injection mode is homs or stratified mode; use stratified values
    LV_IV_EGY_RNG_1 =
        LV_EGY_RNG_IV_PLS_1_S[CTR_CYL_NR_ST_CLC_INJR]
    LV_IV_EGY_RNG_2 =
        LV_EGY_RNG_IV_PLS_2_S[CTR_CYL_NR_ST_CLC_INJR]
    LV_IV_EGY_RNG_3 =
        LV_EGY_RNG_IV_PLS_3_S[CTR_CYL_NR_ST_CLC_INJR]

endif(1)

```


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## 7.37 Injector needle lift control

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EGY_MAX_V_LIM [NC_CYL_NR]	V	0... FFFFH	0... 255	0.00389105	mJ
Maximum limit of energy after voltage limiter					
EGY_SP [NC_CYL_NR]	V	0... FFFFH	0... 255	0.00389105	mJ
Energy setpoint for piezo injector energy controller after voltage limiter					
EGY_SP_NOT_LIM [NC_CYL_NR]	V	0... FFFFH	0... 255	0.00389105	mJ
Unlimited energy setpoint for piezo injector energy controller					
EGY_STEP_INJ_CHA_GRD [NC_CYL_NR]	O/V	0... 4000H	0... 100	0.00610352	%
Piezo injector energy charge gradient for a single step					
EGY_STEP_INJ_CHA_GRD_BAS [NC_CYL_NR]	O/V	0... 4000H	0... 100	0.00610352	%
Piezo injector base energy charge gradient for a single step, without adaptation corrections.					
EGY_STEP_INJ_CHA_GRD_L [NC_CYL_NR]	O/V	0... 4000H	0... 100	0.00610352	%
Piezo injector energy charge gradient for low injector needle lift.					
EGY_STEP_INJ_CHA_GRD_OFS	V	E000... 2000H	0... 50	0.00610352	%
Piezo injector energy charge and discharge gradient offset					
EGY_STEP_INJ_CHA_LIM_DIF [NC_CYL_NR]	O/V	0... 4000H	0... 100	0.00610352	%
Difference of piezo stack energy, which is over the voltage limit					
EGY_STEP_INJ_DCHA_GRD [NC_CYL_NR]	O/V	0... 4000H	0... 100	0.00610352	%
Piezo injector energy discharge gradient for a single step					
EGY_STEP_INJ_DCHA_GRD_L [NC_CYL_NR]	O/V	0... 4000H	0... 100	0.00610352	%
Piezo injector energy discharge gradient for low injector needle lift.					
FAC_EGY_COR_FIL_TMP [NC_CYL_NR]	-	8000... 7FFFH	0... 0.99996948	305.176e3	%/mJ
Temporary correction factor after PT1 filter, cylinder individual					
FAC_EGY_COR_I_TMP [NC_CYL_NR]	-	8000... 7FFFH	0... 0.99996948	305.176e3	%/mJ
Temporary correction factor before Integrator, cylinder individual					
FAC_EGY_PWM_AD [NC_CYL_NR]	O/V/S	0... FFFFH	0... 1.99996948	305.176e3	%/mJ
Conversion factor: EGY to % PWM for piezo injector					
FAC_EGY_PWM_AD_INI [NC_CYL_NR]	-	0... FFFFH	0... 1.99996948	305.176e3	%/mJ
Conversion factor: EGY to % PWM for piezo injector at RESET					
LV_EGY_AD_ENA	V	0... 1H	0 ...1	1	-
Piezo energy adaption is enabled and active, if set					
LV_EGY_PWM_LIM [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Piezo stack energy demand over 100% PWM					
LV_EGY_STEP_INJ_CHA_LIM [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Piezo stack energy is out of limit (over voltage protection)					
LV_V_LIM_ENA	V	0... 1H	0 ...1	1	-
Piezo voltage limitation is enabled and active, if set					
MAX_INJ_EGY_LEVEL	O/V	E000... 2000H	0... 50	0.00610352	%
Maximum correction value of injector energy level (calibrateable)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MIN_INJ_EGY_LEVEL	O/V	E000... 2000H	0... 50	0.00610352	%
Minimum correction value of injector energy level (calibrateable)					
NR_EGY_CTL_CYL_CLC	V	0... 7H	0...7	1	-
Cylinder for that the injector needle lift control is calculated					
TEMP_SEL_EGY_CTL	V	0... FEH	0... 142.5	0.75	°C
Selected temperature for engergy controller functions.					
V_INJ_IV_ERR	-	8000... 7FFFH	0... 639.980469	0.01953125	V
Control error of voltage dependent energy limiter					

**Input data:**

EGY_ADD_AD [NC_CYL_NR] {p. 2260}	EGY_ADD_COR_EXT [NC_CYL_NR] {p. 2289}	EGY_ADD_DUCY {p. 2230}	EGY_ADD_FUP [NC_CBK_HPP_NR] {p. 2228}
EGY_ADD_TEMP {p. 2226}	EGY_IV_1_CLC [NC_CYL_NR] {p. 2036}	EGY_SP_IV_EXT [NC_CYL_NR] {p. 2289}	FUP_H_INJ [NC_CBK_HPP_NR] {p. 3327}
LV_EGY_ADD_AD_LIM [NC_CYL_NR] {p. 2261}	LV_EGY_ADD_AD_LIM_ TOL [NC_CYL_NR] {p. 2261}	LV_EGY_RNG_IV_PLS_1_ ACK [NC_CYL_NR] {p. 2038}	LV_ES {p. 1720}
LV_IV_MES_VLD {p. 2038}	MFF_SP_MV {p. 2151}	N {p. 1525}	NC_CBK_HPP_NR [1] {p. 812}
NC_CYL_NR {p. 1526}	NC_IDX_CYL_HPP_REF [NC_CYL_NR] {p. 626}	NC_PWM_EGY_INJ_MAX {p. 628}	NC_PWM_EGY_INJ_MIN {p. 628}
NR_CYL_INJ_BAS {p. 2039}	SEG_CTR {p. 1525}	STATE_DIAG_IV {p. 4803}	TCO {p. 1100}
TECU {p. 1256}	TEMP_CAPA_IV_MV {p. 2241}	TFU_INJ {p. 3332}	TI_1_MES [NC_CYL_NR] {p. 2040}
V_IV_1_MES [NC_CYL_NR] {p. 2041}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EGY_BAS_INJ_SP_H	-	0... FFFFH	0... 255	0.00389105	mJ
Energy base value for piezo injector at high needle lift					
C_EGY_CTL_ENA_THD_MAX	-	0... FFFFH	0... 255	0.00389105	mJ
Upper energy threshold to activate controller					
C_EGY_CTL_ENA_THD_MIN	-	0... FFFFH	0... 255	0.00389105	mJ
Lower energy threshold to activate controller					
C_EGY_CTL_I_GAIN	-	0... FFFFH	0... 1.99996948	305.176e3	%/mJ
Integral gain for piezo energy controller					
C_EGY_CTL_P_GAIN	-	0... FFFFH	0... 1.99996948	305.176e3	%/mJ
proportional gain for energy controller					
C_EGY_INJ_MAX_LIM	-	0... FFFFH	0... 255	0.00389105	mJ
Maximum value for voltage dependent injector energy limiter					
C_EGY_STEP_INJ_CHA_GRD [NC_CYL_NR]	-	0... 4000H	0... 100	0.00610352	%
Piezo injector energy charge and discharge gradient for a single step					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_COR_EGY_STEP_INJ_DCHA_GRD	-	0... FFFFH	0... 1.99996948	305.176e3	-
Multiplicative correction factor for cylinder balancing influence on discharge gradient calculation					
C_FAC_EGY_PWM_AD_MAX	-	0... FFFFH	0... 1.99996948	305.176e3	%/mJ
Maximal value of conversion factot EGY to % PWM					
C_FAC_EGY_PWM_AD_MIN	-	0... FFFFH	0... 1.99996948	305.176e3	%/mJ
Minimal value of conversion factot EGY to % PWM					
C_FAC_EGY_PWM_MAN [NC_CYL_NR]	-	0... FFFFH	0... 1.99996948	305.176e3	%/mJ
Manually set conversion factor: EGY to % PWM for piezo injector					
C_FAC_LPF_EGY_PWM_AD	-	0... FFH	0... 0.99609375	0.00390625	-
Factor for PT1 Filter for calculation of FAC_EGY_PWM_AD					
C_MAX_INJ_EGY_LEVEL_COR	-	E000... 2000H	0... 50	0.00610352	%
Maximum correction value of injector energy level					
C_MIN_INJ_EGY_LEVEL_COR	-	E000... 2000H	0... 50	0.00610352	%
Minimum correction value of injector energy level					
C_PWM_FAC_COR_EGY_GRD_DCHA_L	-	0... FFFFH	0... 1.99996948	305.176e3	-
Factor to correct the energy discharge gradient for low needle lift.					
C_PWM_FAC_COR_EGY_GRD_H_L	-	0... FFFFH	0... 1.99996948	305.176e3	-
Factor to correct the energy gradient for low needle lift regarding the energy gradient for high needle lift.					
C_PWM_LIM_V_MAX_I_GAIN	-	0... FFFFH	0... 1.99996948	305.176e3	mJ/V
Integral gain for PWM limiting related to stack voltage					
C_PWM_OFS_COR_EGY_GRD_DCHA_L	-	E000... 2000H	0... 50	0.00610352	%
Offset to correct the energy discharge gradient for low needle lift.					
C_PWM_OFS_COR_EGY_GRD_H_L	-	E000... 2000H	0... 50	0.00610352	%
Offset to correct the energy gradient for low needle lift regarding the energy gradient for high needle lift.					
C_PWM_OFS_COR_STEP_INJ_DCHA_GRD	-	E000... 2000H	0... 50	0.00610352	%
Offset of injector discharge gradient					
C_SEG_CTR_EGY_AD_ENA	-	0... FFFFH	0... 65535	1	-
Number of segments for activation of piezo energy adaptation					
C_TECU_MIN_EGY_CTL_ENA	-	0... FEH	0... 142.5	0.75	°C
Minimum ECU temperature to activate piezo injector energy controller.					
C_TEMP_MIN_EGY_CTL_ENA	-	0... FEH	0... 142.5	0.75	°C
Minimum selected temperature to activate piezo injector energy controller.					
C_TEMP_SEL_EGY_CTL	-	0... FFH	0... 255	1	-
Switch to select temperature for energy controller functions; 0: TEMP_CAPA_IV_MV, 1: TFU_INJ, 2: TCO;					
C_TI_EGY_CTL_CLC_MIN	-	0... FFFFH	0... 65.535	0.001	ms
Minimum injection time limit for calculation of energy control					
IP_EGY_STEP_INJ_CHA_GRD_OFS	-	0... 4000H	0... 50	0.00610352	%
LDP_FUP_IP_EGY_STEP_INJ_CHA_GRD	6	0... FFFFH	0... 347776	5.3067216	hPa
LDP_TFU_INJ_IP_EGY_STEP_INJ_CHA	4	0... FEH	0... 142.5	0.75	°C
Piezo injector energy charge and discharge gradient offset for a single step					
IP_V_IV_MAX	-	0... 7FFFH	0... 639.980469	0.01953125	V
LDP_TFU_INJ_IP_V_IV_MAX	6	0... FEH	0... 142.5	0.75	°C
Maximum allowed voltage on piezo stack before limiting					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_EGY_ADD_AD_LIM_ENA	-	0... 1H	0 ...1	1	-
Enable blocking of adaption if additive corrections (EGY_ADD_AD) are limited					
LC_EGY_SP_IV_EXT_ENA	-	0... 1H	0 ...1	1	-
Logical constant to enable external energy setpoint for injector energy controller					
LC_EGY_STEP_CTL_DYN_ENA	-	0... 1H	0 ...1	1	-
Enable complete piezo energy controller					
LC_ENA_ADAP_EGY_CTL	-	0... 1H	0 ...1	1	-
Enable new adaptation of piezo energy controller values after engine start					

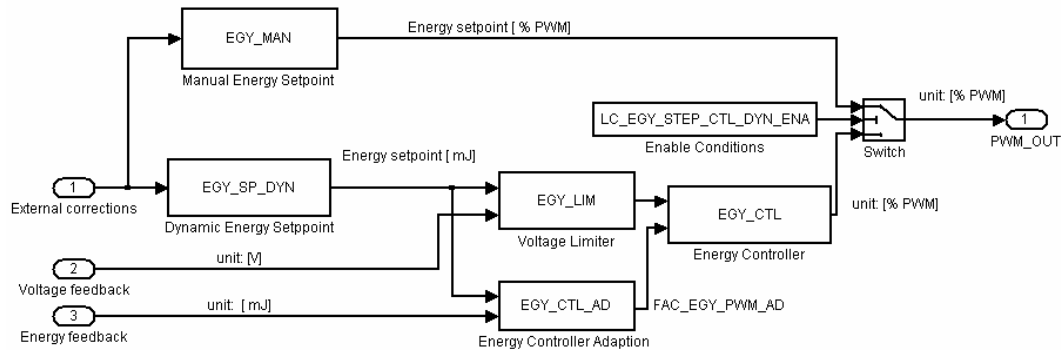
**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_EGY_RNG_H	-	0... 1H	0 ...1	1	-
Symbolic constant for usage of high energy range of PIEZO injection valve					

**Exported actions:**

<b>ACTION_INJR_SetFacEgyPwmAd</b> (IN <Cyl>, IN <Fac>)
Sets the cylinder individual conversion factor FAC_EGY_PWM_AD of cylinder <Cyl> to value <Fac>.

**7.37.1 Controller concept overview**



There are several modes to operate the piezo energy controller unit.

If **LC\_EGY\_STEP\_CTL\_DYN\_ENA** is FALSE, the manual set point calculation with direct feed through to the PWM output is active.

Otherwise the dynamic set point calculation and voltage limiter are activated.

For the voltage limiter are proper feedback conditions necessary.

The adaption of the conversion factor **FAC\_EGY\_PWM\_AD** is calculated, if switched ON only, and if proper feedback is granted.

Value of **NC\_EGY\_RNG\_H** = 1.

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### 7.37.1.1 Description for ACTION\_INJR\_SetFacEgyPwmAd

<b>ACTION_INJR_SetFacEgyPwmAd (IN &lt;Cyl&gt;, IN &lt;Fac&gt;)</b>					
Sets the cylinder individual conversion factor FAC_EGY_PWM_AD of cylinder <Cyl> to value <Fac>.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
Cyl	IN	0...7 H	0...7	1	1
This action affects the conversion factor FAC_EGY_PWM_AD of cylinder Cyl.					
Fac	IN	0...FFFFH	0...1.99996948	3.05176 E-5	%/mJ
This parameter defines the new value of FAC_EGY_PWM_AD.					

#### Formula Section for ACTION\_INJR\_SetFacEgyPwmAd:

FAC\_EGY\_PWM\_AD[Cyl] = Fac

#### Application Condition

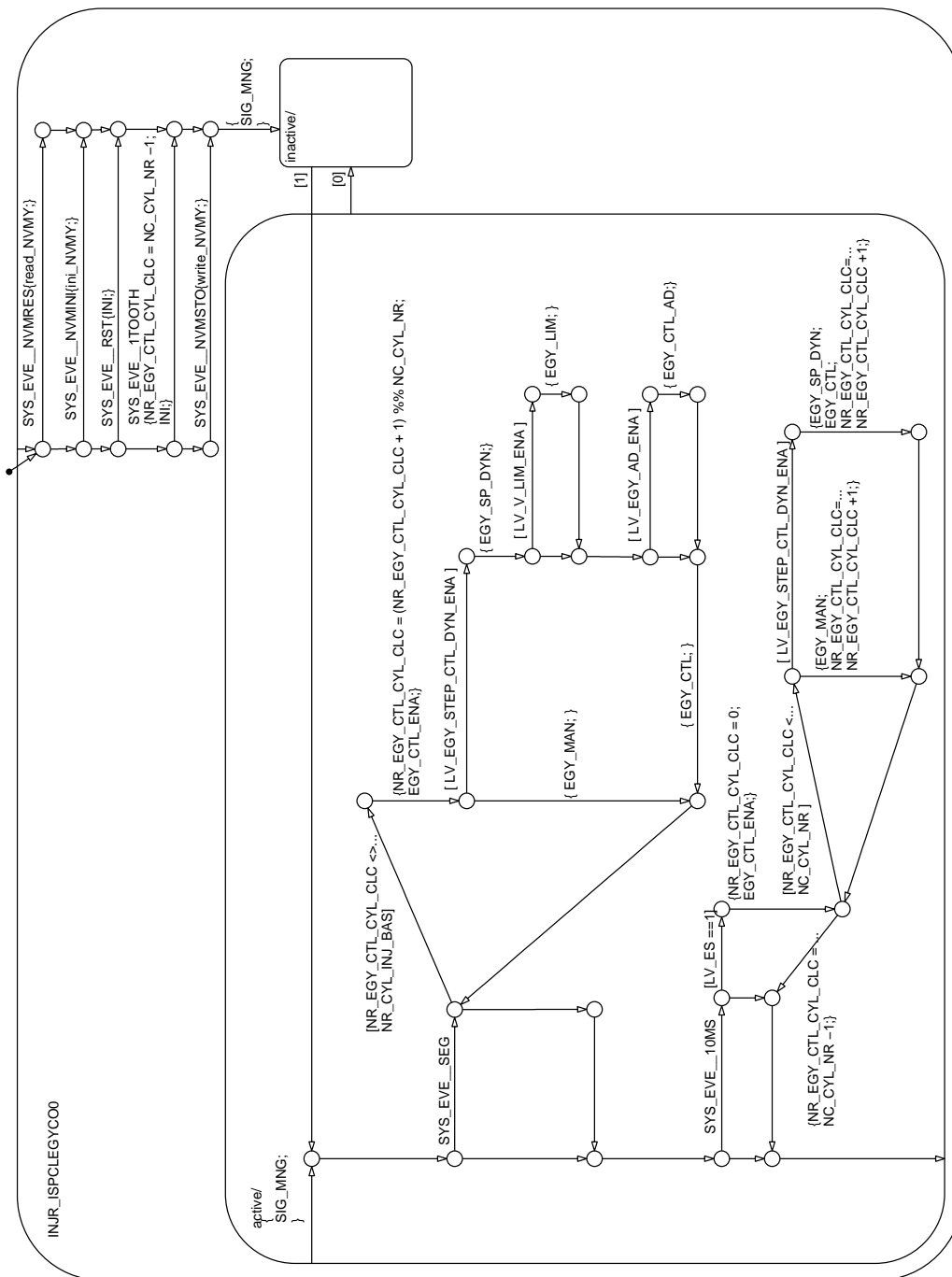



Figure 7.37.1: INJR\_ISPCLEGYCO0/APP\_CDN/Chart

**Function Description**

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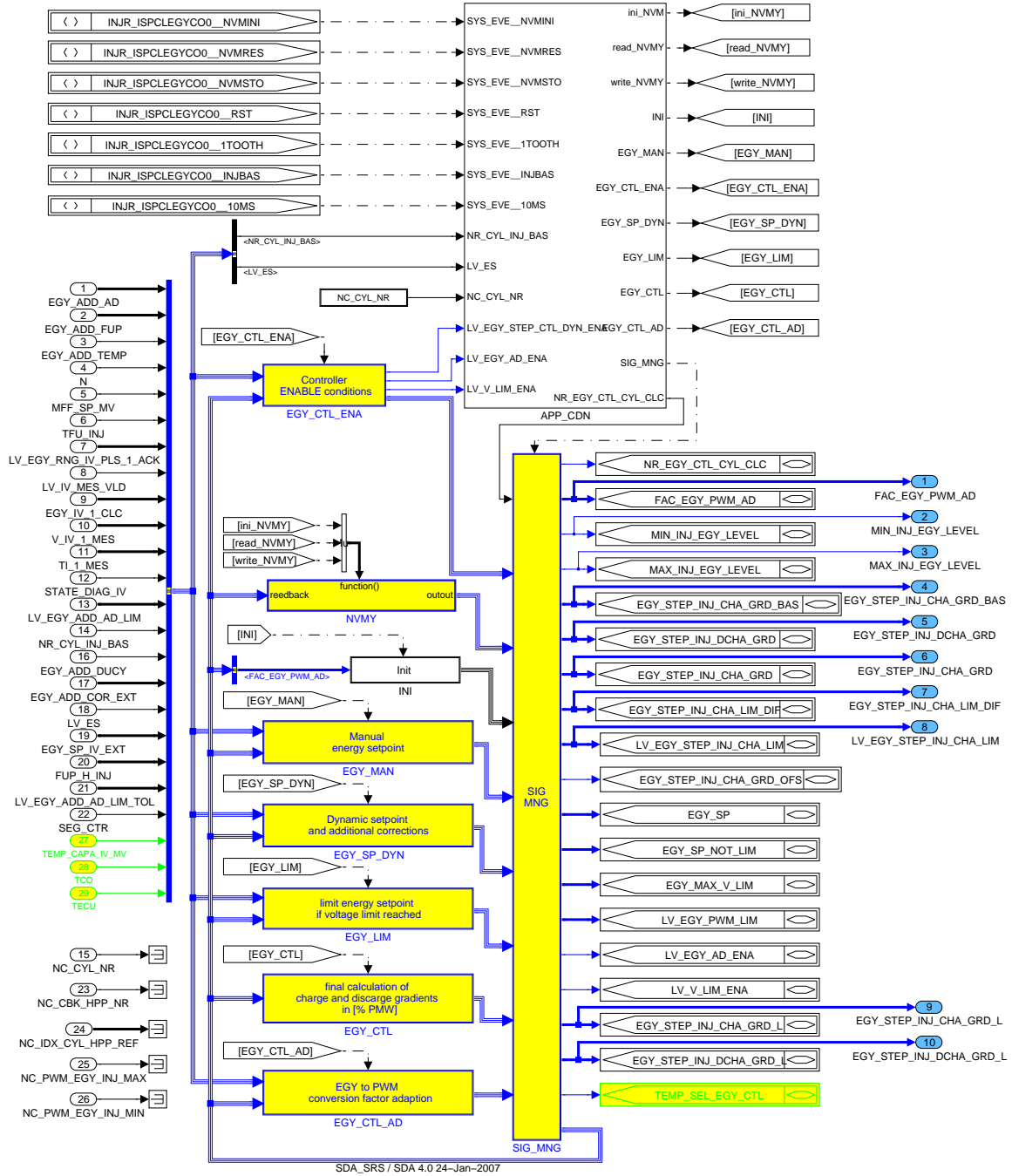


Figure 7.37.2: INJR\_ISPCLEGYCO0

### 7.37.1.2 Handling of nonvolatile memory

The conversion factor FAC\_EGY\_PWM\_AD is stored in the nonvolatile memory. It is read and written to the NVMY before/after each complete driving cycle. The NVMY is initialized with C\_FAC\_EGY\_PWM\_MAN.

### 7.37.1.3 Initialization

Do all initializations at RESET

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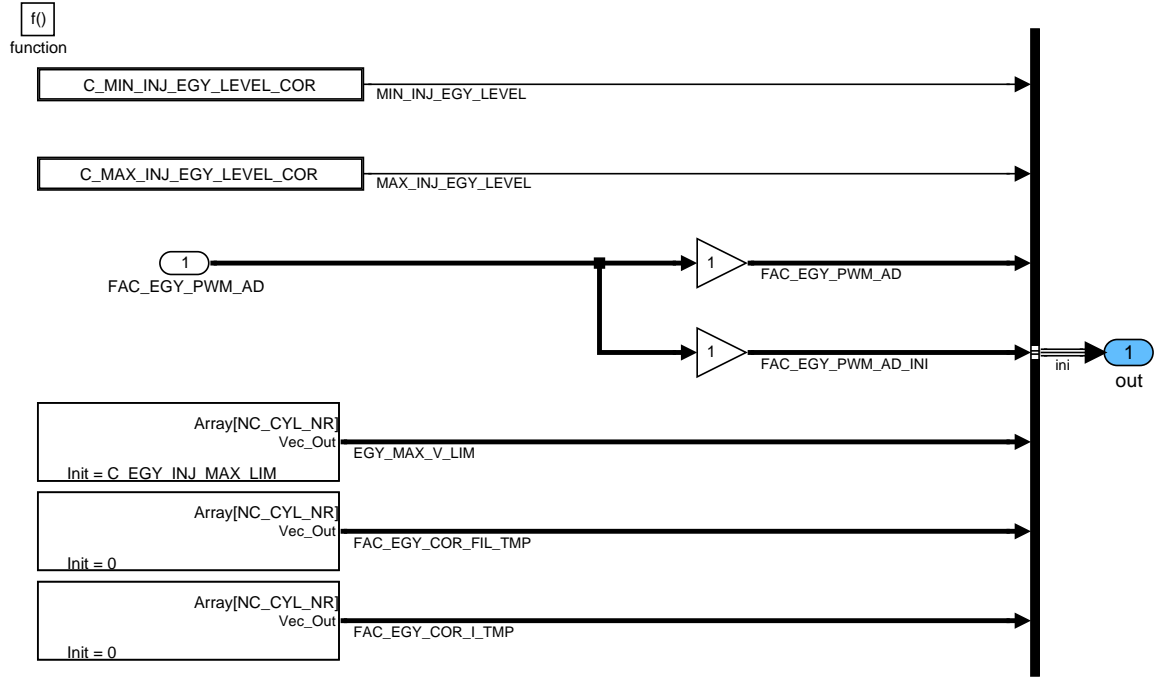


Figure 7.37.3: INJR\_ISPCLEGYCO0/INI

### 7.37.1.4 SUBFUNCTION: EGY\_MAN

#### Manual set point calculation and direct PWM signal output

If dynamic control is not enabled the manual set point is written directly to PWM outputs

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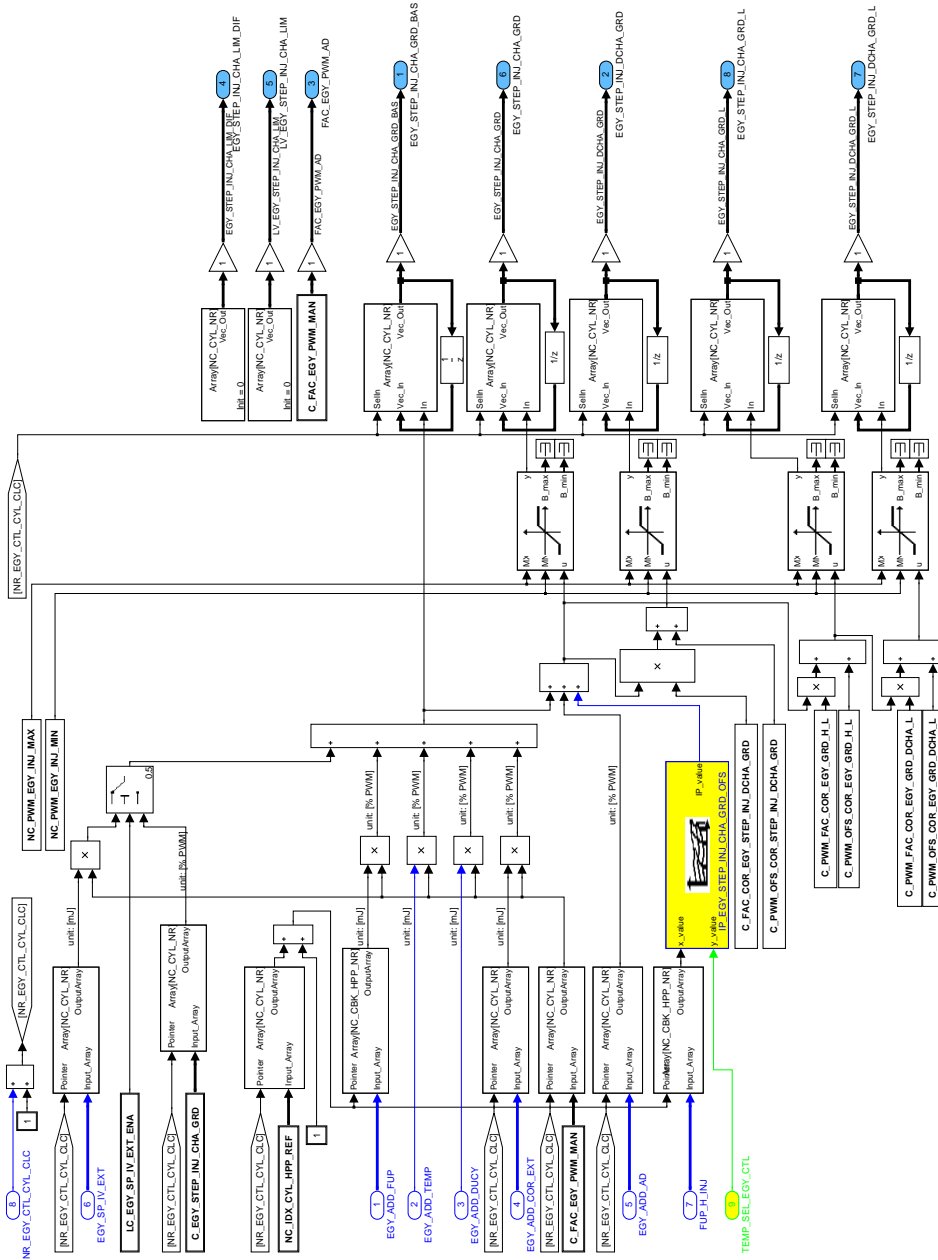



Figure 7.37.4: INJR\_ISPCLEGYCO0/EGY\_MAN/EGY\_SP\_MAN

### 7.37.1.5 SUBFUNCTION: EGY\_CTL\_ENA

#### ENABLE conditions for energy controller and controller gain adaption

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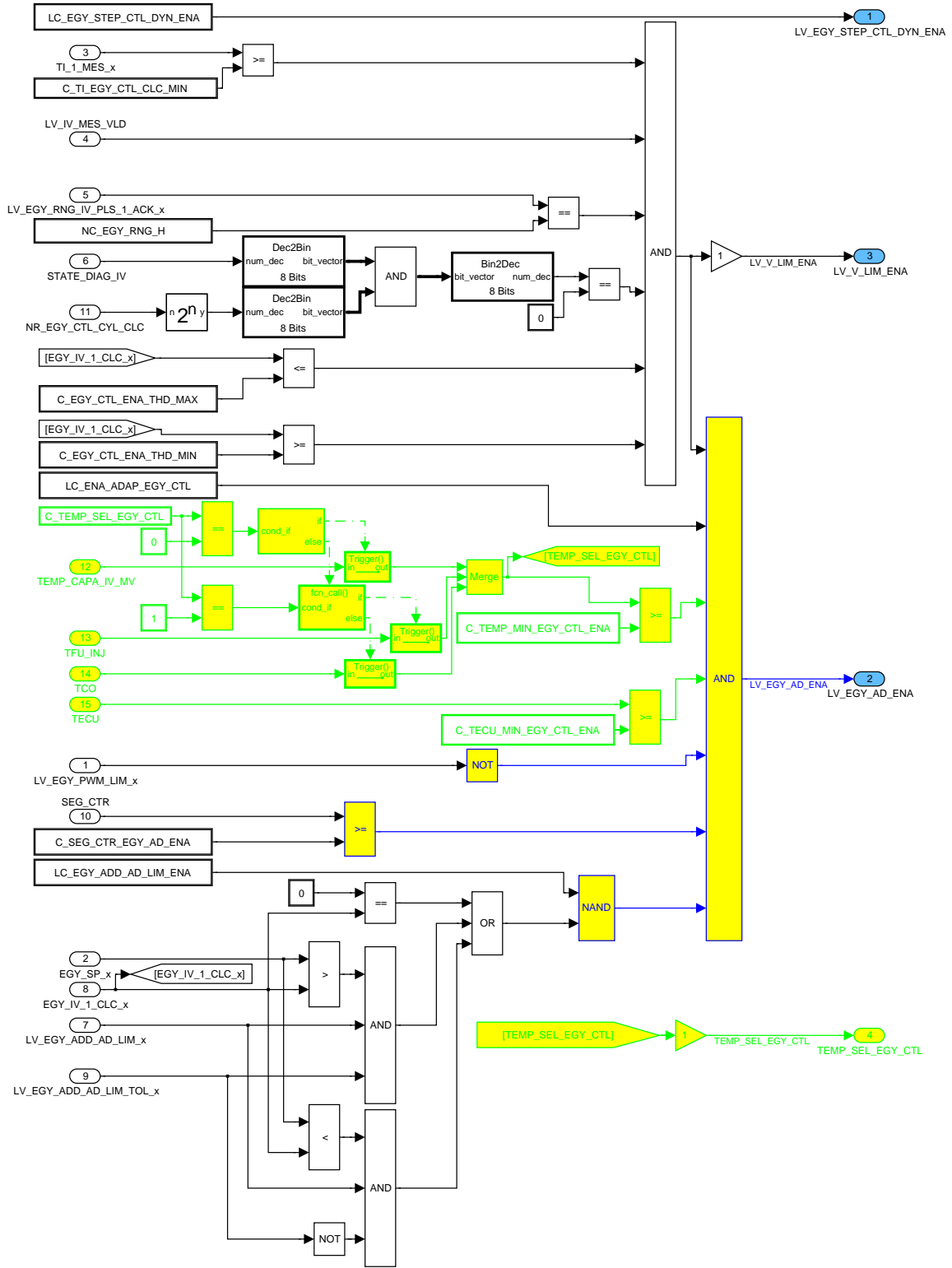


Figure 7.37.5: INJR\_ISPCLEGYCO0/EGY\_CTL\_ENA/EGY\_CTL\_ENA\_x

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### 7.37.1.6 SUBFUNCTION: EGY\_SP\_DYN

#### Dynamic Energy set point calculation with additional correction

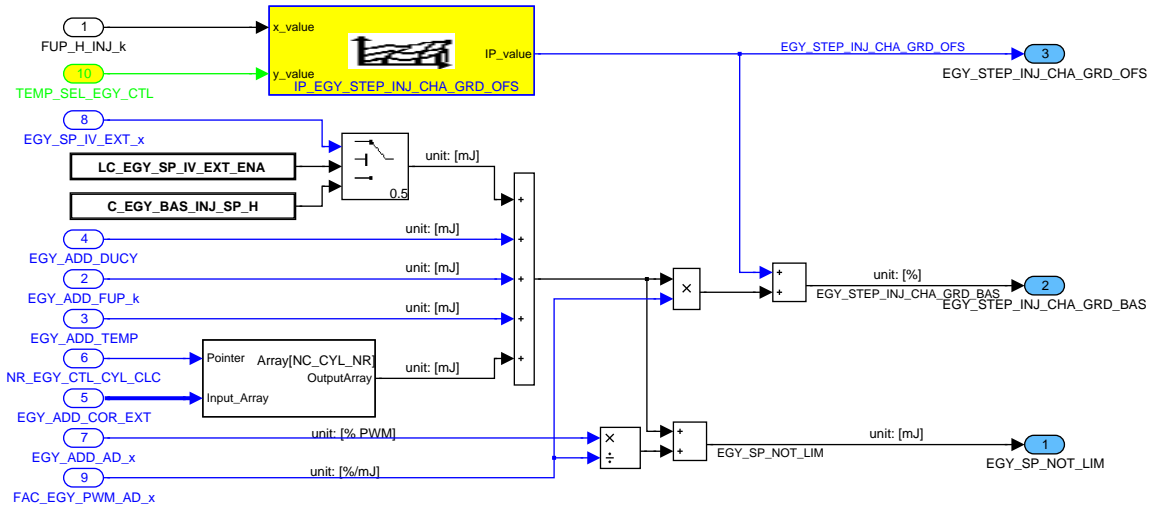


Figure 7.37.6: INJR\_ISPCLEGYCO0/EGY\_SP\_DYN/EGY\_SP\_DYN\_x

### 7.37.1.7 SUBFUNCTION: EGY\_LIM

#### Limitation of energy set point if stack voltage limit is reached

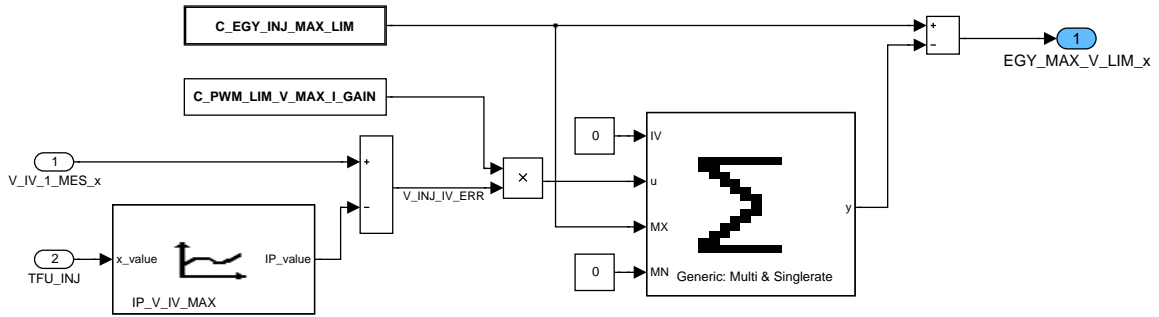


Figure 7.37.7: INJR\_ISPCLEGYCO0/EGY\_LIM/EGY\_LIM\_x

### 7.37.1.8 SUBFUNCTION: EGY\_CTL

#### Energy controller for direct calculation of PWM signal out of energy set point

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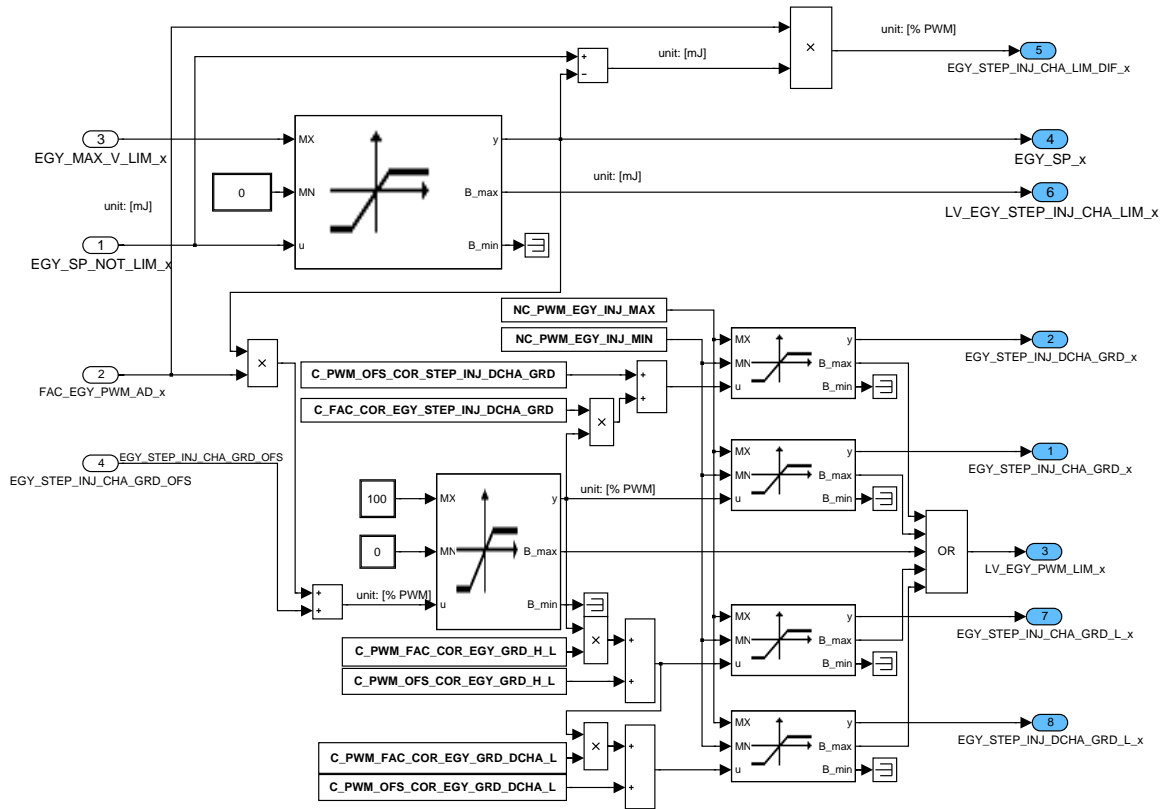


Figure 7.37.8: INJR\_ISPCLEGYCO0/EGY\_CTL/EGY\_CTL\_x

### 7.37.1.9 SUBFUNCTION: EGY\_CTL\_AD

#### Adaption of energy to PWM conversion factor FAC\_EGY\_PWM\_AD

At RESET the factor is set to the stored value from the non volatile memory or to '1' if the stored value is not valid.

At Engine switch off the last learned value is stored to the NVMY.

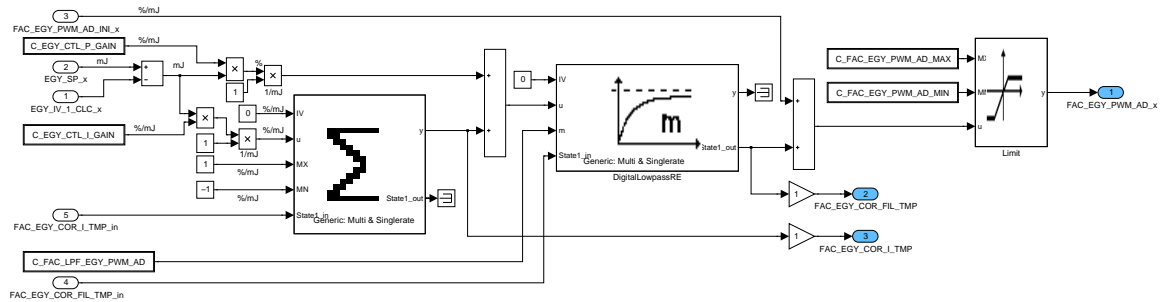


Figure 7.37.9: INJR\_ISPCLEGYCO0/EGY\_CTL\_AD/EGY\_CTL\_AD\_x

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## 7.38 Injector needle lift control (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DIST_IV_CHG [NC_CYL_NR]	O/V/S	0... FFFFH	0... 524280	8	km
Cylinder individual distance accumulation [8 km] at injector change					
EGY_ADD_COR_EXT [NC_CYL_NR]	O/V	8000... 7FFFH	0... 127.498054	0.00389105	mJ
External additive piezo energy correction					
EGY_SP_IV_EXT [NC_CYL_NR]	O/V	0... FFFFH	0... 255	0.00389105	mJ
External injection valve EGY setpoint value for energy controller					

### Input data:

DIST_KWP {p. 1183}	EGY_LAM_ADJ_COR_LAM_AD_CUS [NC_CYL_NR] {p. 8308}	EGY_SP_IV_EXT_ADJ [NC_CYL_NR] {p. 7679}	LF_ERR_PLAUS_IV_EGY_CAL {p. 4790}
LV_ST_END {p. 1720}	MFF_SP_MV {p. 2151}	N {p. 1525}	NC_CYL_NR {p. 1526}
STATE_INJ_MOD_REQ {p. 3332}	STATE_IV_CHG {p. 7683}		


### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EGY_SP_IV_EXT_ADJ [NC_CYL_NR]	-	0... FFFFH	0... 255	0.00389105	mJ
Default value for external energy setpoint for piezo injector energy controller calculation					
IP_EGY_ADD_COR_EXT_HOM	-	0... FFFFH	0... 127.498054	0.00389105	mJ
LDPM_N_IP_EGY_ADD_COR_EXT	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MFF_SP_IP_EGY_ADD_COR_EXT	8	0... FFFFH	0... 1389	0.02119478	mg/stk
Additive piezo injector energy correction depending on engine speed and load, HOM mode					
IP_EGY_ADD_COR_EXT_HOMS	-	0... FFFFH	0... 127.498054	0.00389105	mJ
LDPM_N_IP_EGY_ADD_COR_EXT	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MFF_SP_IP_EGY_ADD_COR_EXT	8	0... FFFFH	0... 1389	0.02119478	mg/stk
Additive piezo injector energy correction depending on engine speed and load, HOMS mode					
IP_EGY_ADD_COR_EXT_S	-	0... FFFFH	0... 127.498054	0.00389105	mJ
LDPM_N_IP_EGY_ADD_COR_EXT	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MFF_SP_IP_EGY_ADD_COR_EXT	8	0... FFFFH	0... 1389	0.02119478	mg/stk
Additive piezo injector energy correction depending on engine speed and load, S mode					
IP_EGY_ADD_IV_AGI_DIST	-	0... FFFFH	0... 127.498054	0.00389105	mJ
LDPM_DIST_IP_EGY_ADD_IV_AGI	16	0... FFFFH	0... 524280	8	km
Additive piezo energy depending on accumulated driving distance for compensation of aging effects					
LC_EGY_SP_IV_EXT_ADJ_ENA	-	0... 1H	0...1	1	-
Logical constant to enable external energy setpoint calculation for piezo injector energy controller					

### General information

This module generates an external cylinder individual set point for the piezo energy controller. EGY\_SP\_IV\_EXT. Furthermore an additive piezo energy correction is supplied. It is taken into account for the energy set point calculation.

### Application Condition

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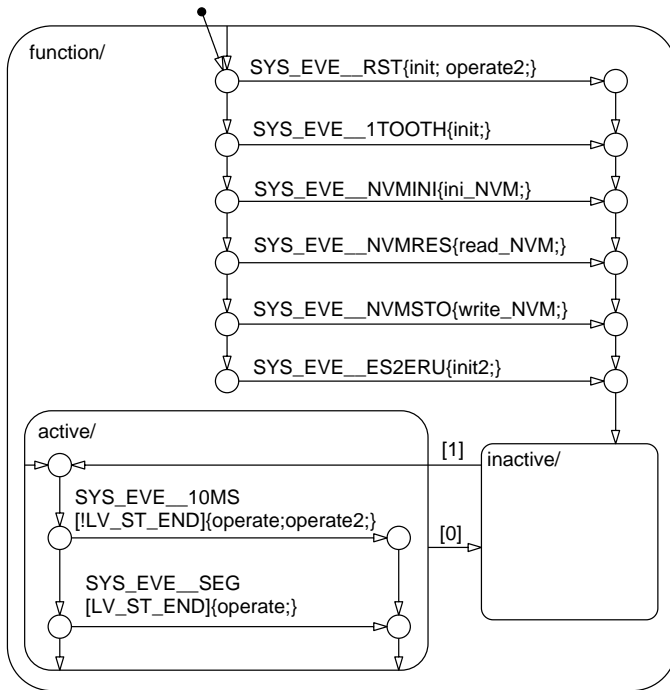



Figure 7.38.1: INJR\_ISPCLEGYAI0/APP\_CDN/Chart

**Function Description**

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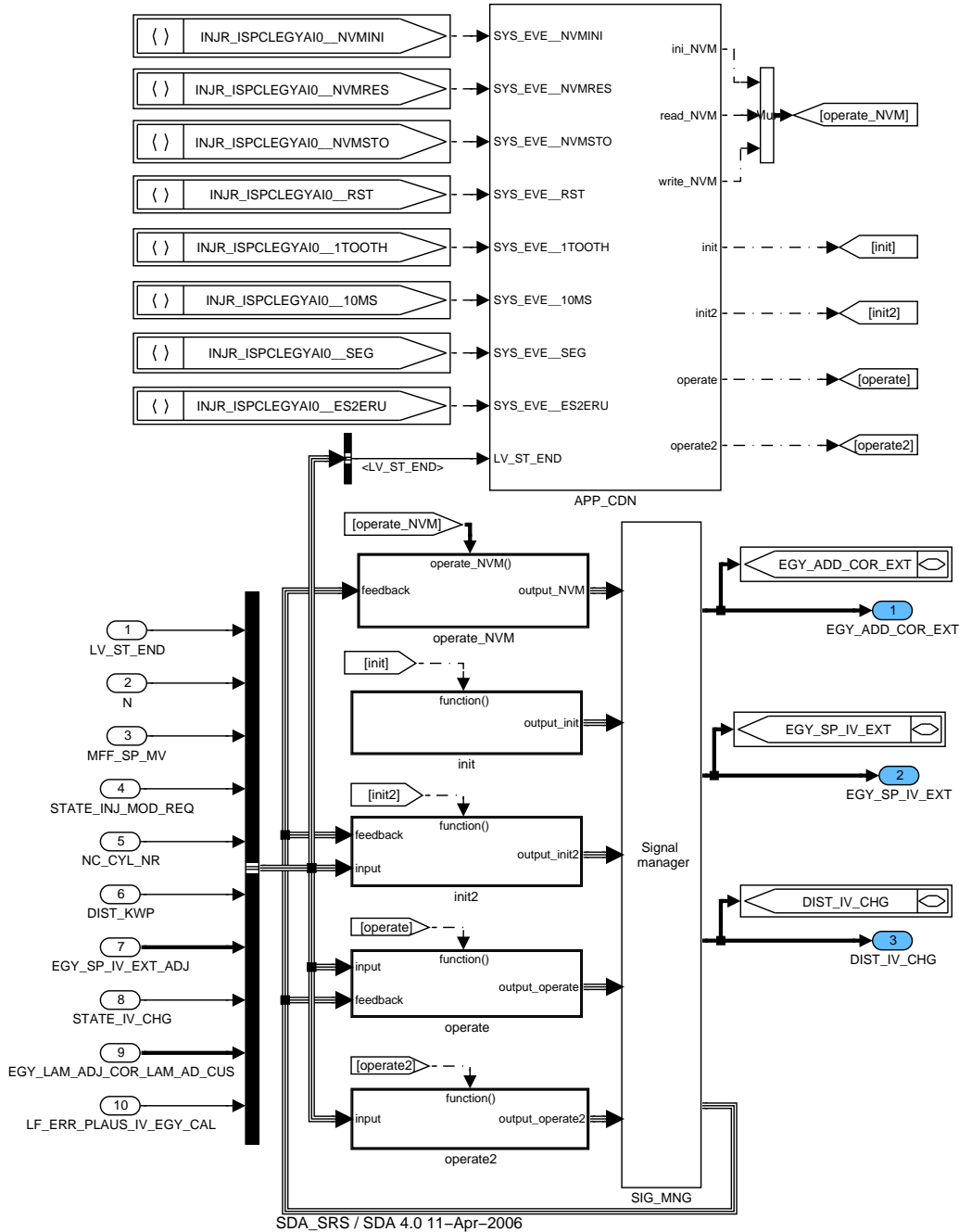


Figure 7.38.2: INJR\_ISPCLEGYAI0

### 7.38.1 Nonvolatile memory operations


The accumulated driving distance at injector change DIST\_IV\_CHG is stored in the nonvolatile memory (NVM). It is read from and written to the NVM before/after each complete driving cycle.

**Please note:** DIST\_IV\_CHG has to be allocated in that part of the NVM-RAM which is not erased during reflashing of ECU.

### 7.38.2 Initialization at reset and first valid tooth

At reset and fist valid tooth the additive energy correction is set to 0.

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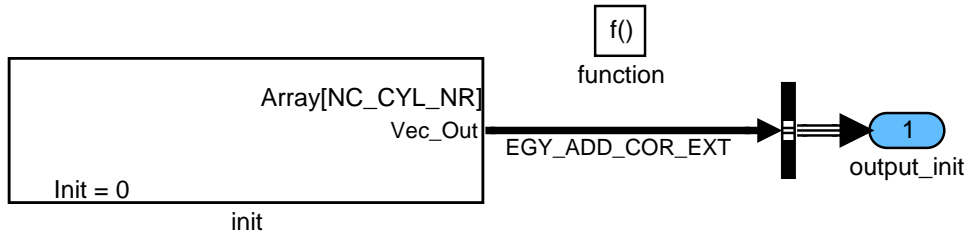


Figure 7.38.3: INJR\_ISPCLEGYAI0/init

### 7.38.3 Calculation at engine stop to engine run

At ES2RUN it is determined whether an injection valve was changed: STATE\_IV\_CHG is provided by the keywordprotocol KWP and supplies a bit coded information: If the bit on position x is set the injector was changed. DIST\_IV\_CHG is the cylinder individual driving distance when the injector was changed. It is stored in the nonvolatile memory.

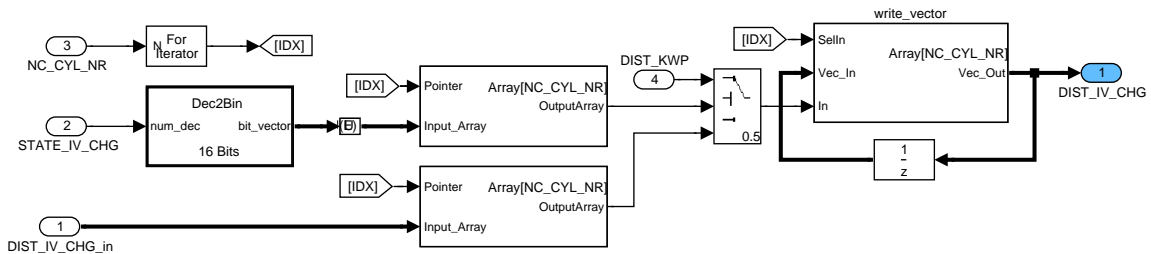



Figure 7.38.4: INJR\_ISPCLEGYAI0/init2/Forlterator

### 7.38.4 Calculation of additive energy correction

An additive piezo energy correction depending on engine speed and load is supplied. Depending on the requested combustion modes (homogeneous, homogeneousstratified and stratified) different maps are used. Furthermore an additive correction accounting for aging effects of the piezo injection valve is supplied cylinder individually. The accumulated driving distance is used as an indicator for aging. It is given by the difference of the actual driving distance and the driving distance at the last injector change. EGY\_LAM\_ADJ\_COR\_LAM\_AD\_CUS accounts for the long term lambda adaptation.

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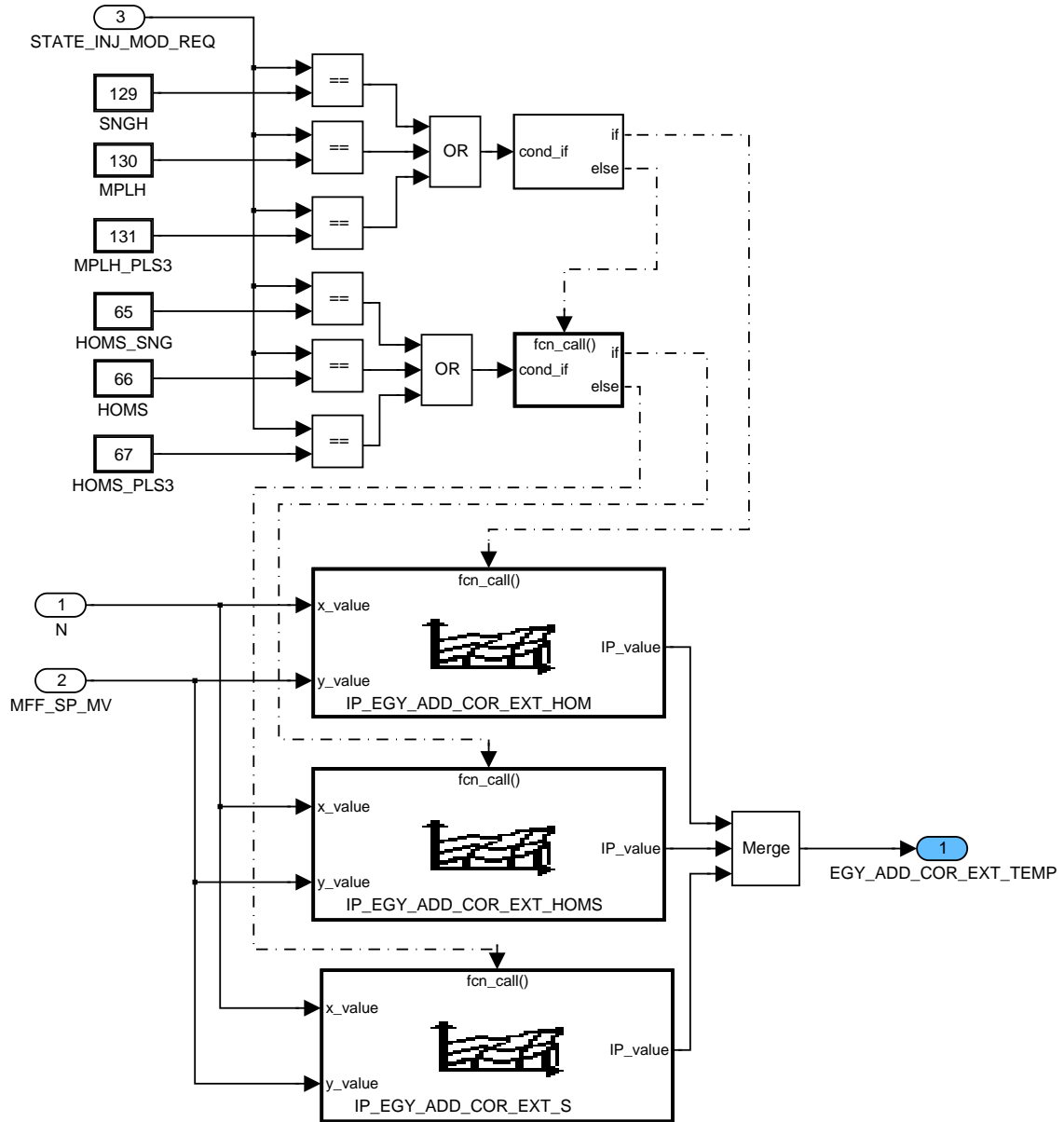


Figure 7.38.5: INJR\_ISPCLEGYAI0/operate/CLC\_EGY\_ADD\_COR\_EXT

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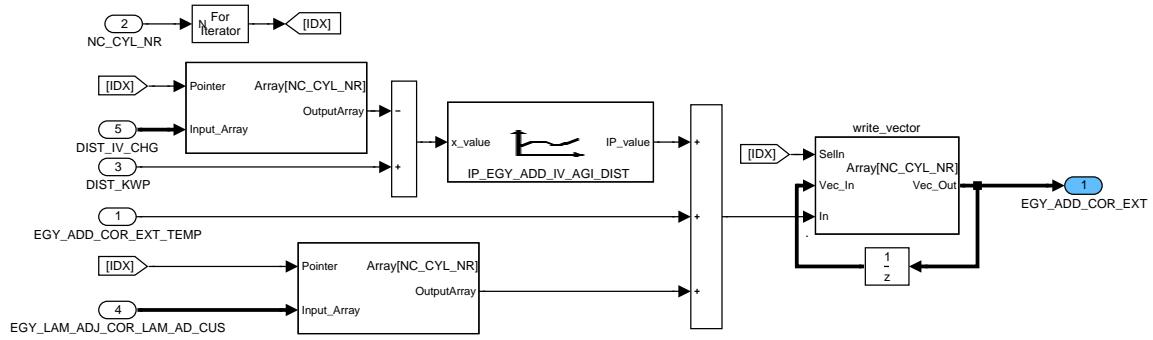


Figure 7.38.6: INJR\_ISPCLEGYAI0/operate/Forlterator

### 7.38.5 External energy setpoint for energy controller

This functionality supplies a cylinder individual injection valve energy set point for the energy controller. It is set to EGY\_SP\_IV\_EXT\_ADJ given by the KWP if the cylinder individual values are plausible (bit x is zero in bit-mask LF\_ERR\_PLAUS\_IV\_EGY\_CAL for logical cylinder x) and if LC\_EGY\_SP\_IV\_EXT\_ADJ\_ENA is set. Otherwise cylinder individual values can be supplied manually via the calibration constant C\_EGY\_SP\_IV\_EXT\_ADJ.

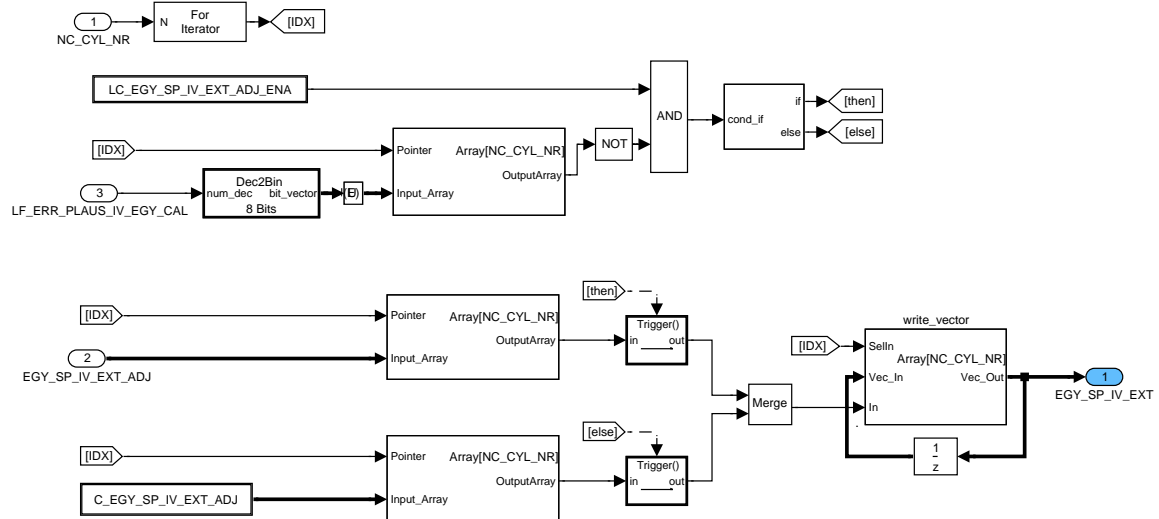


Figure 7.38.7: INJR\_ISPCLEGYAI0/operate2/Calc\_of\_EGY\_SP/For\_Iterator

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## 7.39 Cylinder shut off


### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INH_INJ	O/V	0... FFH	0... 255	1	-
Final cylinder shut off pattern (fixed cylinder allocation)					
INH_IV	O/V	0... FFH	0... 255	1	-
Shut off pattern for static cylinder shut off (fixed cylinder allocation)					
INH_IV_IGK	V	0... FFH	0... 255	1	-
Shut off pattern of IGK					
INH_IV_MON	V	0... FFH	0... 255	1	-
Shut off pattern of shut off request by monitoring concept					
INH_IV_N_MAX_REQ_FCUT	V	0... FFH	0... 255	1	-
Shut off pattern of LV_N_MAX_REQ_FCUT (engine speed limitation)					
INH_IV_PUC	V	0... FFH	0... 255	1	-
Shut off pattern of pull fuel shut off					
INH_SWI_IV	O/V	0... FFFFH	0... 65535	1	-
Shut off pattern for dynamic cylinder shut off					
LV_FCUT_IND	O/V	0... 1H	0 ...1	1	-
At least one cylinder is shut off					
LV_INJ_CUT	O/V	0... 1H	0 ...1	1	-
All cylinders shut-off					
LV_SCC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag that indicates static single cylinder shut off, exhaust cylinder bank individual					
NR_PAT	O/V	0... FFH	0... 255	1	-
Index corresponding to the highest shut off level (fuel shut off with pattern)					
NR_PAT_OLD	-	0... FFH	0... 255	1	-
Index corresponding to the highest shut off level (fuel shut off with pattern) from previous calculation run					
STATE_INH_IV_DYN	O/V	0... FFFFFFFFH	0... 4294967295	1	-
State of the dynamic cylinder shut off request					
SUM_INH_INJ	O/V	0... 8H	0 ...8	1	-
Sum of INH_INJ					
SUM_INH_IV	O/V	0... 8H	0 ...8	1	-
Sum of INH_IV					
SUM_INH_IV_CBK [NC_CBK_EX_NR]	O/V	0... 8H	0 ...8	1	-
Sum of those bits within INH_IV which are allocated to exhaust cylinder bank i					
SUM_INH_IV_DYN	O/V	0... 8H	0 ...8	1	-
Sum of INH_IV_DYN					

### Input data:

INH_IV_DYN {p. 2037}	INH_IV_EXT {p. 2304}	INH_IV_IGC {p. 4780}	INH_IV_MIS {p. 6237}
LF_IV_INH_PUC_EXT {p. 3330}	LV_ERR_TMP_MU_MC {p. 7072}	LV_IGK {p. 906}	LV_INJ_PUC_ENA {p. 3330}
LV_N_MAX_REQ_FCUT {p. 3779}	LV_OFF_IV_MON {p. 6877}	LV_PUC {p. 1720}	LV_SEL_CYL {p. 2307}
LV_ST_END {p. 1720}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_INJ_INH_SWI_IV_ SHIFT_NR {p. 626}

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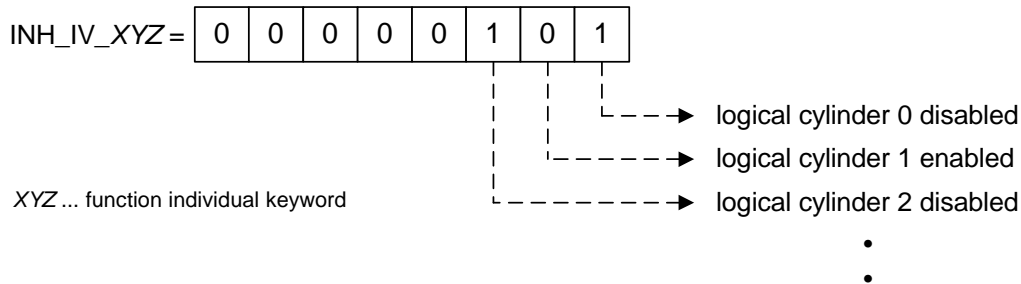
NC_LAMB_REF [NC_CYL_NR] {p. 812}	NR_PAT_SCC {p. 6665}	NR_PAT_SEL_CYL {p. 2307}	
-------------------------------------	----------------------	-----------------------------	--

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_INH_SWI_IV	-	0... FFFFH	0... 65535	1	-
LDP_NR_PAT_ID_INH_SWI_IV	17	0... FFH	0... 255	1	-
Cylinder shut off pattern for dynamic cylinder shut off					
LC_SWI_MOD_INH_IV_DYN	-	0... 1H	0...1	1	-
Mode switch between different dynamic fuel shut off algorithm					

**General information****Static fuel shut off:**

In several engine operating- and system states and in case of malfunctions of the injection or ignition system the fuel injection must be disabled at individual cylinders. All the shut off requirements are coordinated, hence these requirements have to have the same structure as described below:

**Dynamic fuel shut off:**

The information which cylinder has to be shut off static, is coded within a byte (with the length of 8 bit) at the cylinder corresponding position.

In some engine operating states, e. g. fast torque reduction, restart fuel feed or pull fuel cut off, the injection has to be disabled for a certain subsequent numbers of injections. The fuel cut off starts immediately at the next cylinder following an order defined in a pattern. That means, different to the cylinder individual static fuel shut off, there is no predefined and fixed association between cylinders and the shut off sequence.

**Injections, which are already started, will not be stopped.**

**FUNCTION DESCRIPTION:****Application conditions**

**Activation:** every engine state

**Deactivation:** -

**Initialization:** -

Reccurrence: if LV\_ST\_END = 0: 10 ms  
if LV\_ST\_END = 1: segment synchronous



### 7.39.1 Static fuel shut off

#### 7.39.1.1 Ignition Key

**IF** LV\_IGK = 0

**THEN** all cylinders are shut off

INH\_IV\_IGK = 

1	1	1	1	1	1	1	1
---	---	---	---	---	---	---	---

**ELSE** no cylinder is shut off

INH\_IV\_IGK = 

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

**ENDIF**

#### 7.39.1.2 Ignition System

INH\_IV\_IGC (Input pattern)

#### 7.39.1.3 Monitoring Concept

**IF** (LV\_OFF\_IV\_MON = 1) OR (LV\_ERR\_TMP\_MU\_MC = 1)

**THEN** all cylinders are shut off

INH\_IV\_MON = 

1	1	1	1	1	1	1	1
---	---	---	---	---	---	---	---

**ELSE** no cylinder is shut off

INH\_IV\_MON = 

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

**ENDIF**

#### 7.39.1.4 Misfire Detection

INH\_IV\_MIS (Input pattern)

#### 7.39.1.5 Pull Fuel Cut Off

To guarantee a moderate transition from trailing throttle PU to trailing throttle fuel cut off, the transition is handled by the module "Sequential fuel cut off and restart fuel feed", see chapter Cylinder Individual Fuel Shut Off with Pattern. After the transition is finished (indicated by the flag LV\_SEL\_CYL) all cylinders are shut off by INH\_IV\_PUC.

**IF** LV\_PUC = 1  
AND  
LV\_SEL\_CYL = 0

**THEN**

IF LV\_INJ\_PUC\_ENA = 1  
**THEN**

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INH\_IV\_PUC = LF\_IV\_INH\_PUC\_EXT  
**ELSE**

all cylinders are shut off

INH\_IV\_PUC = 

1	1	1	1	1	1	1	1
---	---	---	---	---	---	---	---

**ENDIF**

**ELSE** no cylinder is shut off

INH\_IV\_PUC = 

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

**ENDIF**

### 7.39.1.6 Engine speed limitation

**IF** LV\_N\_MAX\_REQ\_FCUT = 1

**THEN** all cylinders are shut off

INH\_IV\_N\_MAX\_REQ\_FCUT = 

1	1	1	1	1	1	1	1
---	---	---	---	---	---	---	---

**ELSE** no cylinder is shut off

INH\_IV\_N\_MAX\_REQ\_FCUT = 

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

**ENDIF**

### 7.39.1.7 Shut Off Pattern from Application Incidences

INH\_IV\_EXT (Input pattern)

Additional shut off requirements are coordinated within the module “Cylinder Shut Off (Application Incidences)”.

### 7.39.1.8 Coordination of the Static Fuel Shut Off Requirements

The output pattern INH\_IV is the bitwise OR of all pattern, linked with a mask ((2<sup>NC\_CYL\_NR</sup>)-1).  
As an example see below:

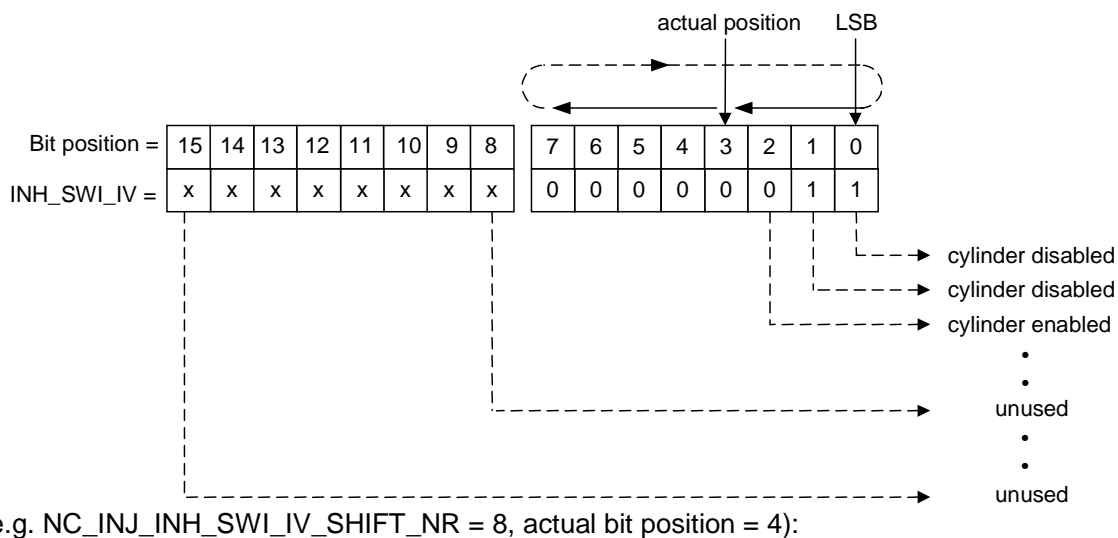
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NR_PAT (Index)	Shut off sequence
0	xxxxxxxx 00000000
1	xxxxxxxx 00000001
2	xxxxxxxx 00000011
3	xxxxxxxx 00000111
4	xxxxxxxx 00001111
5	xxxxxxxx 00011111
6	xxxxxxxx 00111111
7	xxxxxxxx 01111111
8	xxxxxxxx 11111111
The following sequences can be used for reactivation of cylinders	
9	xxxxxxxx 11111111
10	xxxxxxxx 01111111
11	xxxxxxxx 00111111
12	xxxxxxxx 00011111
13	xxxxxxxx 00001111
14	Xxxxxxxxx 00000111
15	xxxxxxxx 00000011
16	xxxxxxxx 00000001

**Note:**

To guarantee that the algorithm works correct, the table ID\_INH\_SWI\_IV has to be applied as follows:  
The higher the index NR\_PAT, the higher the number of cylinders deactivated.

**INH\_SWI\_IV is defined as follows:**

If the bit at a bit position = 1 → cylinder disabled

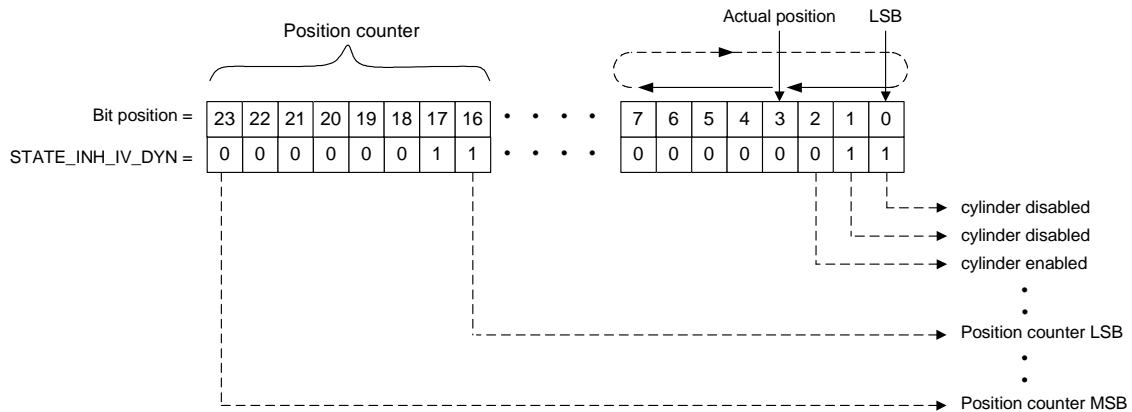
If the bit at a bit position = 0 → cylinder enabled

The length of the pattern is 16 bit. NC\_INJ\_INH\_SWI\_IV\_SHIFT\_NR defines how many bits are used for the shut off sequence.

$$NC\_CYL\_NR \leq NC\_INJ\_INH\_SWI\_IV\_SHIFT\_NR \leq 16$$

**Calculation of STATE\_INH\_IV\_DYN:**

**Definition of STATE\_INH\_IV\_DYN:**



**Note! The position counter data field inside STATE\_INH\_IV\_DYN will be updated at TRIG\_EOI\_LIM[x].**

**It contains the 'Actual position' inside the shut off pattern sequence.**

Select between two different algorithm for STATE\_INH\_IV\_DYN calculation:

**(1) IF LC\_SWI\_MOD\_INH\_IV\_DYN = 0**

**(1) THEN** Classic mode: If NR\_PAT increases, then STATE\_INH\_IV\_DYN starts always with a new fuel cut off sequence and 'Actual position' will be set to zero. Otherwise the 'Actual position' stays unchanged and a new shut off pattern - or the old one - is used based on INH\_SWI\_IV - see picture above.

**(2) IF NR\_PAT > NR\_PAT\_OLD**

**(2) THEN**

Start with a new fuel cut off sequence at the first bit position (LSB). Use as sequence the current content of INH\_SWI\_IV.

$$STATE\_INH\_IV\_DYN = INH\_SWI\_IV$$

**(2) ELSE**

Continue with the fuel cut off sequence at 'Actual position' and change the shut off pattern depending on INH\_SWI\_IV:

$$STATE\_INH\_IV\_DYN = STATE\_INH\_IV\_DYN \text{ AND } 0xFFFF0000 \text{ ...bitwise}$$

**OR** ...bitwise

$$INH\_SWI\_IV \text{ AND } 0x0000FFFF \text{ ...bitwise}$$

**Note! Pay attention of data consistency of STATE\_INH\_IV\_DYN.**

**(2) ENDIF**

**(1) ELSE** Modern mode: Only if NR\_PAT was zero and increases, then STATE\_INH\_IV\_DYN starts with a new fuel cut off sequence and 'Actual position' will be set to zero. Otherwise the 'Actual position' stays unchanged and a new shut off pattern - or the old one - is used based on INH\_SWI\_IV - see picture above.

**(3) IF (NR\_PAT\_OLD = 0) AND (NR\_PAT > NR\_PAT\_OLD)**

**(3) THEN**

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Start with a new fuel cut off sequence at the first bit position (LSB). Use as sequence the current content of INH\_SWI\_IV.

STATE\_INH\_IV\_DYN = INH\_SWI\_IV

**(3) ELSE**

Continue with the fuel cut off sequence at 'Actual position' and change the shut off pattern depending on INH\_SWI\_IV:

STATE\_INH\_IV\_DYN = STATE\_INH\_IV\_DYN AND 0xFFFF0000 ...bitwise  
**OR** ...bitwise  
 INH\_SWI\_IV AND 0x0000FFFF ...bitwise

**Note! Pay attention of data consistency of STATE\_INH\_IV\_DYN.**

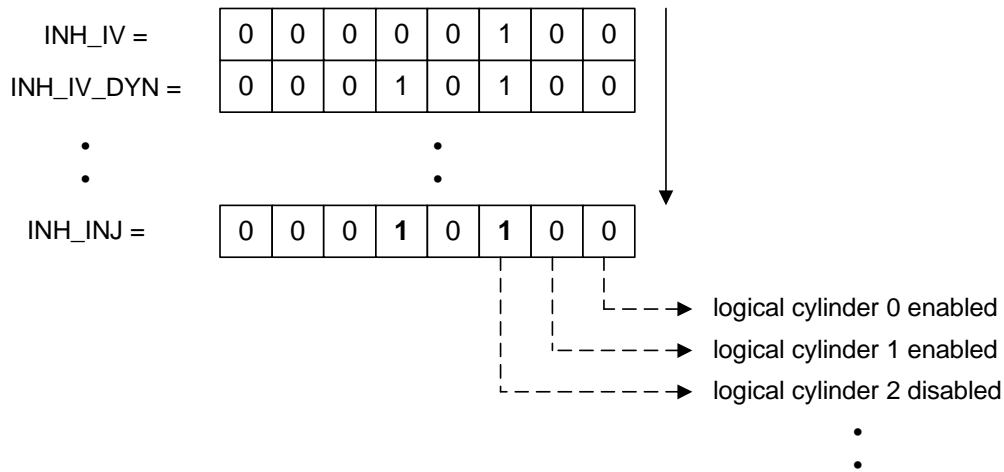
**(3) ENDIF**

**(1) ENDIF**

**7.39.3 Coordination of shut off information for basic software (INH\_INJ)**

The output pattern INH\_INJ is the bitwise OR of the pattern INH\_IV and INH\_IV\_DYN, linked with a mask ((2<sup>NC\_CYL\_NR</sup>)-1).

As an example see below:



**Note! Pay attention of data consistency of INH\_IV.**

**7.39.4 Shut Off Status Information**

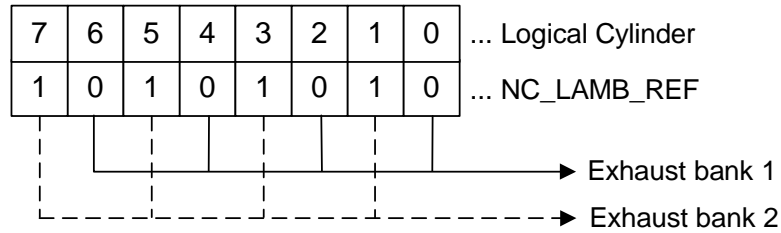
- SUM\_INH\_IV ..... sum of INH\_IV
- SUM\_INH\_IV\_CBK\_i ..... sum of those bits within INH\_IV which are allocated to exhaust cylinderbank i, with i = 1 for exhaust cylinderbank 1 and i = 2 for exhaust cylinderbank 2.
- SUM\_INH\_IV\_DYN ..... sum of INH\_IV\_DYN
- SUM\_INH\_INJ ..... sum of INH\_INJ

**Note! Pay attention on data consistency of SUM\_INH\_INJ and SUM\_INH\_IV\_DYN**

**Note:**

The allocation between physical cylinders and exhaust cylinderbank 1 and 2 is defined by the pattern NC\_LAMB\_REF. For example an 8 cylinder engine:

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```

(1) IF SUM_INH_INJ ≠ 0
(1) THEN
    LV_FCUT_IND = 1          (at least one cylinder is shut off)
1. (2) IF SUM_INH_INJ NC_CYL_NR
    (2) THEN                (all cylinders are shut off)
        LV_INJ_CUT = 1
        (3) FOR i = 1 TO NC_CBK_EX_NR DO:
            LV_SCC[i] = 1    (i = 1 and 2, for exhaust cylinder bank 1 and 2)
        (3) ENDFOR
    (2) ELSE
        LV_INJ_CUT = 0
        (4) FOR i = 1 TO NC_CBK_EX_NR DO:
            (5) IF SUM_INH_IV_CBK[i] ≠ 0
            (5) THEN
                LV_SCC[i] = 1
            (5) ELSE
                LV_SCC[i] = 0
            (5) ENDIF
        (4) ENDFOR
    (2) ENDIF
(1) ELSE
    LV_FCUT_IND = 0
    LV_INJ_CUT = 0
    (6) FOR i = 1 TO NC_CBK_EX_NR DO:
        LV_SCC[i] = 0
    (6) ENDFOR
1. ENDIF

```

## 7.40 Cylinder shut off (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INH_IV_EXT	O/V	0... FFH	0... 255	1	-
Shut off pattern for cylinder shut off (cylinder allocated)					
INH_IV_IGN_INJ_LOCK_REQ	V	0... FFH	0... 255	1	-
Shut off request from ENSD due to backwards rotation detection					
INH_IV_SWI_MAN	V	0... FFH	0... 255	1	-
Manual shut off request					

### Input data:

INH_IV_CUS {p. 8269}	INH_IV_DIAG_ERR {p. 4810}	INH_IV_FTL_MIN {p. 4762}	INH_IV_IMOB
INH_IV_KNK {p. 1960}	INH_IV_KWP {p. 7482}	INH_IV_MIS {p. 6237}	INH_IV_STST {p. 798}
INH_PBK_IV_DIAG_ERR {p. 4794}	LV_IGN_INJ_LOCK_REQ {p. 4455}	LV_ST_END {p. 1720}	NC_STATE_STST_ENA {p. 628}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_INJ_LOCK_REQ_TMP	-	0... 1H	0 ...1	1	-
Switch for lock of injection until complete engine stop					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_INH_IV_SWI_MAN	-	0... FFH	0... 255	1	-
Application constant for manual shut off request					
LC_INH_IV_DIAG_ERR_IMDT_ENA	-	0... 1H	0 ...1	1	-
Manual switch to activate cylinder shut off immediate after debouncing of an IV error without accordance to MISF					

### 7.40.1 Cylinder Individual Static Fuel Shut Off

#### Application conditions


**Activation:** every engine state

**Deactivation:** -

**Initialization:** at reset all 0  
 # IF NC\_STATE\_STST\_ENA = 1  
 # THEN  
 at ECU\_STATE transition SYN\_ENG\_IGK\_ON to RUN\_ENG  
 LV\_INJ\_LOCK\_REQ\_TMP = 1  
 at ECU\_STATE transition RUN\_ENG to ENG\_STOP  
 LV\_INJ\_LOCK\_REQ\_TMP = 0  
 # ENDIF

Reccurence: if LV\_ST\_END = 0: 10 ms  
 if LV\_ST\_END = 1: segment synchronous

**Note:** The module has to be calculated before the module "Cylinder Shut Off".

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```

((INH_IV_DIAG_ERR AND INH_IV_MIS) ≠ 0)           ... bitwise
THEN
  INH_IV_DIAG_ERR (Input pattern)
ELSE
  0x00 (Input pattern)
ENDIF

```

**7.40.1.2.7 Inhibition of the injection by pre-ignition knock control**

Cylinder individual shut off in case of knock pre-ignition      INH\_IV\_KNK (Input pattern)

**7.40.1.2.8 FTL\_MIN diagnosis**

Cylinder individual shut off in case of less fuel      INH\_IV\_FTL\_MIN

**7.40.1.2.9 Inhibition of the injection by customer**

Cylinder individual shut off by customer request      INH\_IV\_CUS

**7.40.1.2.10 Workshop tester**

Cylinder individual shut off by KWP-job, sent from tester:      INH\_IV\_KWP

**7.40.1.2.11 Inhibition of the injection for engine shut down due to stop request**

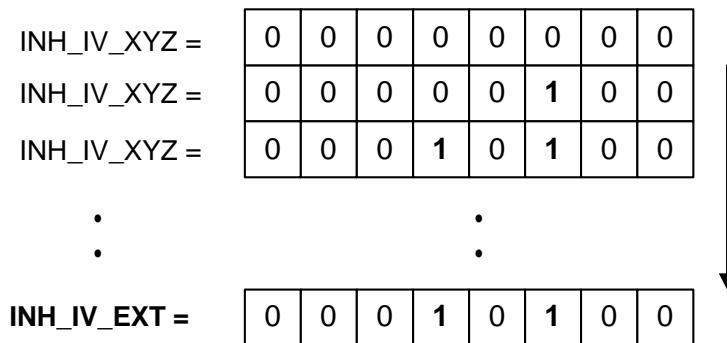
INH\_IV\_STST (Input pattern)

**7.40.1.2.12 Inhibition of the injection due to injector power bank errors**

Cylinder individual shut off in case of injector power bank errors  
INH\_PBK\_IV\_DIAG\_ERR

**7.40.1.3 Coordination of the Static Fuel Shut Off Requirements**

The output pattern INH\_IV\_EXT is the bitwise OR of all patterns INH\_IV\_XYZ (and INH\_PBK\_IV\_DIAG\_ERR). As an example see below:



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## 7.41 Sequential fuel cutoff and restart fuel feed

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CASE_SEL_CYL	V	0... 3 H	0 ...3	1	-
Case selector					
LV_FCUT_CDN_PUC_PL	V	0... 1H	0 ...1	1	-
External authorization of sequential or 2-step-method at transition from PUC to PL					
LV_FCUT_CDN_PUC_PU_IS	V	0... 1H	0 ...1	1	-
External authorization of sequential or 2-step-method at transition from PUC to PU or IS					
LV_SEL_CYL	O/V	0... 1H	0 ...1	1	-
Boolean for Cylinder specific transition PU-PUC, PUC-IS or PUC-PL ongoing					
NR_PAT_SEL_CYL	O/V	0... FFH	0... 255	1	-
Selected index of Fuel cut off pattern for transition PU-PUC, PUC-IS, PUC-PL					
NR_SEL_CYL	V	1... 8 H	1 ...8	1	-
Index number of the selective cylinder pattern					
T_FCUT_AJ	V	0... FF H	0... 2.55	0.01	s
Timer value during jerk minimal sequential fuel cut-off					
T_OSC_DT	V	0... FF H	0... 2.55	0.01	s
Period of time of the oscillation of the drive-train					
TQI_SP_SLOW_DIF	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Difference in requested torque for slow path from actual to last segment					

### Input data:

GEAR {p. 1302}	LV_AT {p. 654}	LV_DT {p. 1310}	LV_ES {p. 1720}
LV_IGK {p. 906}	LV_IS {p. 1720}	LV_PL {p. 1720}	LV_PU {p. 1720}
LV_PUC {p. 1720}	LV_ST {p. 1720}	N_DIF_COR {p. 1122}	N_GRD {p. 1525}
STATE_ENG {p. 1720}	T_SEG_AV {p. 1525}	TQI_SP_SLOW {p. 811}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_DIF_MAX_SEL_RIS	-	8000... 7FFFH	-32768 ...32767	1	rpm
N_DIF_COR threshold for deactivation of cylinder individual cut-off for restart IS					
C_N_GRD_MIN_SEL_RIS	-	80... 7FH	-4096 ...4064	32	1/min/s
N_GRD threshold for cancelling cylinder individual cut-off for restart IS					
C_NR_SEL_CYL_1	-	1... 8 H	1 ...8	1	-
Start pattern index for transition from PU -> PUC (case 1)					
C_NR_SEL_CYL_2	-	1... 8 H	1 ...8	1	-
Start pattern index for transition from PUC -> IS, PU (case 2)					
C_NR_SEL_CYL_3	-	1... 8 H	1 ...8	1	-
Start pattern index for transition from PUC -> PL (case 3)					
C_TQI_SP_SLOW_DIF_MAX	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
TQI_SP_SLOW_DIF threshold for cancelling cylinder individual cut-off for restart in PL					
ID_PAT_SEL_CYL	V	0... FFH	0... 255	1	-
LDP_CASE_SEL_CYL_ID_PAT_SEL_CYL	3	1... 3H	1 ...3	1	-
LDP_NR_SEL_CYL_ID_PAT_SEL_CYL	8	1... 8H	1 ...8	1	-
Table for cylinder specific restart and trailing throttle fuel cut off					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_T_OSC_DT	-	0... FF H	0... 2.55	0.01	s
LDP_GEAR_1_DRVB	8	0... FF H	0... 255	1	-
Characteristic period of time of the eigenfrequency of the powertrain					
LC_ENA_FCUT_AJ	-	0, 1 H	0, 1	-	-
Logical variable to enable jerk minimal sequential fuel cut-off					
LC_INH_DT_PU	-	0, 1 H	0, 1	-	-
Logical variable to inhibit LV_DT impact on jerk minimal sequential fuel cut-off activation					

## FUNCTION DESCRIPTION:

### General information:

At transition from trailing throttle to trailing throttle fuel cut off, torque jumps generally occur at trailing throttle fuel cut off which are noticeable as jerks in the vehicle. To reduce the torque at this transition, the ignition timing is retarded and the combustion air is adjusted to small values.

These procedures however do not always achieve the required torque reduction, because ignition timing and combustion air can only be reduced that far, that jerk free engine operation is still possible.

To support the above mentioned torque reduction measurement, it is possible that the injection is switched on and/or switched off for individual cylinders within a defined number of engine cycles (on and/or deactivation) incase of PUC and reentry into Idle.

The engine speed gradient is monitored in order to cancel the selective reentry idle at rapid engine speed drops. If the engine speed gradient is below the threshold C\_N\_GRD\_MIN\_SEL\_RIS or N\_DIF\_COR is greater than or equal to C\_N\_DIF\_MAX\_SEL\_RIS then all cylinders are immediately activated (-> CASE 2). The same happens if during selective reentry there is a significant increase of torque request, e.g. TQI\_SP\_SLOW\_DIF is higher than C\_TQI\_SP\_SLOW\_DIF\_MAX (-> CASE 2 and 3).

### 7.41.1 Calculation of TQI\_SP\_SLOW dynamic

#### Description:

This value is needed for fast restart of fuel feed.

#### Application conditions

<b>Initialisation:</b>	$TQI\_SP\_SLOW\_DIF = 0$
<b>Recurrence:</b>	20ms
<b>Activation:</b>	at every engine state
<b>Deactivation:</b>	-

#### Formula section:


$$TQI\_SP\_SLOW\_DIF = TQI\_SP\_SLOW(n) - TQI\_SP\_SLOW(n-1)$$

### 7.41.2 NR\_PAT\_SEL\_CYL calculation

Recurrence: Segment-synchronous

#### 7.41.2.1 Calculation of T\_OSC\_DT:

if LV\_AT = 0

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```

then      T_OSC_DT = ID_T_OSC_DT(GEAR)
else      T_OSC_DT = 0
endif

```

#### Description (Example for 4-cylinder engines)

At a transition LV\_PU → LV\_PUC, LV\_PUC → LV\_IS and LV\_PUC → LV\_PL, 32 cycles ( 8 x 720°CRK ) in case of a 4-cylinder can be influenced. To realize this, a table ID\_PAT\_SEL\_CYL contains the sequences of injection patterns ( 0...7 ), predefined in the table ID\_PAT\_IND. " NR\_SEL\_CYL " means the logical number in the shut off sequence ( 1...8 ).

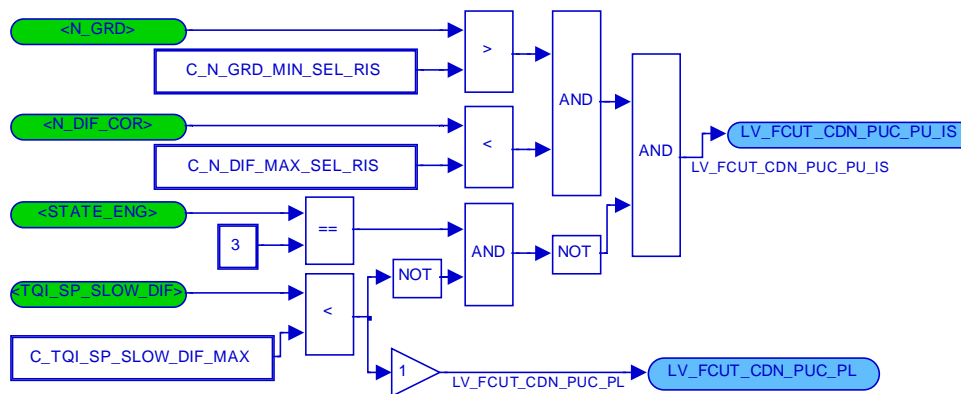
#### Application conditions:

##### Activation:

At active cylinder specific transitions LV\_SEL\_CYL = 1

#### 7.41.2.2 Calculation of exit conditions for running sequences ( CASE 2 and CASE 3 )

These bits are needed to terminate running sequences.



#### 7.41.2.3 Transition from PU ? PUC ( CASE 1 )

The entrance in the transition pattern for PUC follows, when all conditions for PUC are fulfilled.  
if LC\_ENA\_FCUT\_AJ = 0 or LV\_AT = 1

then if (LV\_DT = 0 and LC\_INH\_DT\_PU = 0)

then NR\_SEL\_CYL = 8

NR\_PAT\_SEL\_CYL = ID\_PAT\_SEL\_CYL(NR\_SEL\_CYL)

else NR\_SEL\_CYL starts from 1 and is incremented every 720 °KW until its maximum value. In case of deactivation NR\_SEL\_CYL is reset to 1.

else

if (LV\_DT = 0 and LC\_INH\_DT\_PU = 0)

then NR\_SEL\_CYL = 8

NR\_PAT\_SEL\_CYL = ID\_PAT\_SEL\_CYL(NR\_SEL\_CYL)

T\_FCUT\_AJ is initialized with T\_OSC\_DT / 2

else NR\_SEL\_CYL = C\_NR\_SEL\_CYL\_1

NR\_PAT\_SEL\_CYL = ID\_PAT\_SEL\_CYL(NR\_SEL\_CYL)

LV\_SEL\_CYL = 1

if T\_FCUT\_AJ - T\_SEG\_AV = 0

then NR\_SEL\_CYL = 8

NR\_PAT\_SEL\_CYL = ID\_PAT\_SEL\_CYL(NR\_SEL\_CYL)

```

        T_FCUT_AJ is initialized with T_OSC_DT /2
        LV_SEL_CYL = 0
    else    NR_SEL_CYLn = NR_SEL_CYLn-1
           T_FCUT_AJ is decremented
    end
end
end

```

The transition is completed, when the last of the 32 transition cycles has run out. The pattern index applied as last one has to be the highest used for the cut-off strategy, that means all cylinders are cut off. NR\_SEL\_CYL is reset to 1.

If in the course of the transition pattern or while the time sequence an engine operating state change to PU, PL or IS happens, all cylinders are switched on immediately (pattern index : "0" ), NR\_SEL\_CYL is reset to 1.

#### 7.41.2.4 Transition from PUC ? IS or PUC ? PU ( CASE 2 )

The entrance in the transition pattern for RIS (reactivation idle speed ) follows, when all conditions for IS resp. PU are fulfilled.

```

if LC_ENA_FCUT_AJ = 0 or LV_AT = 1
then    if (LV_DT = 0 and LC_INH_DT_PU = 0) or LV_FCUT_CDN_PUC_PU_IS = 0
        then    NR_SEL_CYL = 8
                NR_PAT_SEL_CYL = ID_PAT_SEL_CYL(NR_SEL_CYL)
        else    NR_SEL_CYL starts from 1 and is incremented every 720 °KW
                until its maximum value.

else


    if (LV_DT = 0 and LC_INH_DT_PU = 0) or LV_FCUT_CDN_PUC_PU_IS = 0
    then    NR_SEL_CYL = 8
            NR_PAT_SEL_CYL = ID_PAT_SEL_CYL(NR_SEL_CYL)
            T_FCUT_AJ is initialized with T_OSC_DT /2
    else    NR_SEL_CYL = C_NR_SEL_CYL_2
            NR_PAT_SEL_CYL = ID_PAT_SEL_CYL(NR_SEL_CYL)
            LV_SEL_CYL = 1
            if T_FCUT_AJ - T_SEG_AV = 0
            then    NR_SEL_CYL = 8
                    NR_PAT_SEL_CYL = ID_PAT_SEL_CYL(NR_SEL_CYL)
                    T_FCUT_AJ is initialized with T_OSC_DT /2
                    LV_SEL_CYL = 0
            else    NR_SEL_CYLn = NR_SEL_CYLn-1
                    T_FCUT_AJ is decremented
            end
    end
end
end

```

The transition pattern is completed, when the last cycle of the 32 transition cycles has run out. The pattern number applied as last one has to be „0" , that means all cylinders are switched on. NR\_SEL\_CYL is reset to 1.

If in the course of the transition pattern or while time sequence a engine operating state change to PUC happens, the transition pattern or time sequence for RIS runs out to its end and after that the transition pattern for PUC starts, if required.

If the function is deactivated (see deactivation conditions), all cylinders are switched on immediately. In case of deactivation NR\_SEL\_CYL is reset to 1.

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The following cases are distinguished in ID\_PAT\_SEL\_CYL:

**CASE 1:** Trailing throttle fuel cut off ( PUC )

**CASE 2:** Restart IS ( RIS )

**CASE 3:** Restart PL ( RPL )

Example for shut-off sequences with 8 levels and a shut off pattern for the 4 next injections (4-cylinder)

	CASE_SEL_CYL				NR_SEL_CYL →			
	1	2	3	4	5	6	7	8
1	1	1	2	2	3	3	4	4
2	5	5	5	6	6	7	7	0
3	5	6	6	7	0	0	0	0

According shut off sequences: ( 0 : Injection, 1: no injection )

Case 1	1 0 0 0	1 0 0 0	1 0 1 0	1 0 1 0	1 0 1 1	1 0 1 1	1 1 1 1	1 1 1 1
Case 2	0 1 1 1	0 1 1 1	0 1 1 1	0 1 0 1	0 1 0 1	0 0 0 1	0 0 0 1	0 0 0 0
Case 3	0 1 1 1	0 1 0 1	0 1 0 1	0 0 0 1	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0

### Formula section:

NR\_PAT\_SEL\_CYL = ID\_PAT\_SEL\_CYL

### Application assistances

Handling of reactivation functions (out of PUC):

*Injection (Reactivation fuel feed)* : To ensure, that all cylinders get at least once the same amount of TI\_ADD\_REAC, TI\_ADD\_REAC is not decremented as long as sequential transition PUC → IS resp. PUC → PL is ongoing.

*Ignition*: The according reactivation functions are not concerned by sequential transition functions.

Handling of engine states:

The detection of PU, PUC, PL and IS is not concerned by sequential transition functions.



## 7.42 O2 sensor (lin, up) signal compensation and conversion

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CYC_T_WAIT_OFS_ADJ_RED [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter of cycles for application of reduced repetition rate for offset adjustment during engine warm-up					
CTR_ERR_LSL_IF_SPI_OFS_ADJ_SAVE [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Storage variable for SPI communication error counter value of WRAF controller					
CTR_VLS_MV_LSL_NR_SAMPLE [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Sample counter for mean value calculation					
IPLSL_COR [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-12.596... 12.59561	384e-6	mA
Compensated nominal pumping current ( after sensor /sensor dispersion compensation for new /aged sensor)					
LAMB_LS_UP [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda signal value of the WRAF sensor					
LAMB_LS_UP_MIN	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Minimum lambda in multiple-branched exhaust gas lines					
LAMB_LS_UP_MV	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Mean value of lambda in multiple-branched exhaust gas lines					
LAMB_LS_UP_MV_TMP	-	0... FFFFFFFFH	0... 4194303.99902	976.599e-6	-
Temporary storage for calculation of mean value of lambda in multiple-branched exhaust gas lines					
LV_LAMB_PLS_SWI_OFF [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Indicator for need to switch off forced lambda stimulation					
LV_LAMB_STI_OFF_LSL_OFS_ADJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request for disabling of forced lambda stimulation, or keeping it disabled, resp.					
LV_LSL_OFS_ACT_AST [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Switch to chose activation conditions directly after engine start					
LV_LSL_OFS_ADJ_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
State of the offset measurement (active /not active)					
LV_LSL_OFS_ADJ_IS [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Offset measurement carried out during current idle phase					
LV_LSL_OFS_GAIN_SWI_CYC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating active Ip gain range for alternating offset adjustment					
LV_LSL_UP_SHO_PER_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Trigger the short period stop mode of Lambda controller during offset adjustment and gain switching					
LV_SWI_CLC_LSL_OFS_ADJ [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable for switching of lambda calculation routines					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_SWI_GAIN_LSL_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag configuring the WRAF sensor interface gain-selection for Ip measurement ( 0 = g8, 1 = g16 )					
LV_VLS_OFS_ADJ_CMPL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating successful completion of offset adjustment cycle					
LV_VLS_OFS_ADJ_ENA_LSL_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag requesting enabling of offset adjustment mode of WRAF sensor interface for lambda signal output voltage					
LV_VLS_OFS_LIM_LSL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating limitation of output voltage offset adjustment value for Ip gain16					
LV_VLS_OFS_LIM_LSL_L_GAIN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating limitation of output voltage offset adjustment value for Ip gain8					
STATE_LSL_OFS_ADJ [NC_CBK_EX_NR]	V	0H 1H 2H 3H 4H	WAIT PREPARE ADJUST_H ADJUST_L RETURN	-	-
State of WRAF controller lambda output voltage offset adjustment					
T_DLY_LAMB_STI_OFF_OFS_ADJ [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Wait timer to allow for lambda signal settling upon deactivation of forced stimulation					
T_DLY_LSL_OFS_ADJ [NC_CBK_EX_NR]	V	0... FFH	0... 2.55	0.01	s
Wait timer to delay acquisition of measurement values upon activation of adjustment					
T_DLY_LSL_OFS_ADJ_IS [NC_CBK_EX_NR]	V	0... FFH	0... 2.55	0.01	s
Wait timer to delay activation of offset adjustment upon entering engine state idle speed					
T_DLY_LSL_OFS_ADJ_PUC_END [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Wait timer to delay activation of offset adjustment after leaving fuel cut-off phase					
T_INI_DLY_LSL_SIG_ACQ [NC_CBK_EX_NR]	V	0... FFH	0... 2.55	0.01	s
Delay of aquisition after freeze of signal. Assures that segment synchronous meanvalue calc has reached final value.					
T_WAIT_LSL_OFS_ADJ [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Wait timer to define minimum interval between two subsequent offset adjustment cycles					
VLS_COR_H_RES_LSL [NC_CBK_EX_NR]	V	0... FFFFH	0... 9.99984	152.6e-6	V
Compensated output signal of lambda sensor with extended resolution					
VLS_COR_MV_LSL [NC_CBK_EX_NR]	V	0... FFFFH	0... 9.99984	152.6e-6	V
Optional average over two samples of compensated output signal of lambda sensor					
VLS_COR_TMP_LSL [NC_CBK_EX_NR]	V	0... FFFFH	0... 9.99984	152.6e-6	V
Temporary storage value of compensated output signal of lambda sensor					
VLS_DELTA_TMP_LSL [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-327680... 327679.99984	153e-6	V
Controller setpoint free, gain and exhaust pressure corrected output signal					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VLS_MMV_LSL [NC_CBK_EX_NR]	V	0... 7FFFH	0... 4.99984	153e-6	V
Moving mean value of output signal of linear lambda sensor for Ip gain16					
VLS_MMV_LSL_L_GAIN [NC_CBK_EX_NR]	V	0... 7FFFH	0... 4.99984	153e-6	V
Moving mean value of output signal of linear lambda sensor for Ip gain8					
VLS_MV_LSL [NC_CBK_EX_NR]	V	0... 7FFFH	0... 4.99984	153e-6	V
Mean value of output signal of linear lambda sensor					
VLS_MV_LSL_BUF [NC_CBK_EX_NR]	V	0... FFFFH	0... 319.99511	4.88e-3	V
Buffer for mean value calculation					
VLS_OFS_LSL [NC_CBK_EX_NR]	V	8000... 7FFFH	-5... 4.99984	153e-6	V
Output signal offset of linear lambda sensor for Ip gain16					
VLS_OFS_LSL_L_GAIN [NC_CBK_EX_NR]	V	8000... 7FFFH	-5... 4.99984	153e-6	V
Output signal offset of linear lambda sensor for Ip gain8					
VLS_OFS_TMP_LSL [NC_CBK_EX_NR]	V	8000... 7FFFH	-5... 4.99984	153e-6	V
Intermediate storage variable for calculated offset value for Ip gain16					
VLS_OFS_TMP_OLD_LSL [NC_CBK_EX_NR]	V	8000... 7FFFH	-5... 4.99984	153e-6	V
Storage variable for calculated offset value for Ip gain16					
VLS_OFS_TMP_OLD_LSL_L_GAIN [NC_CBK_EX_NR]	V	8000... 7FFFH	-5... 4.99984	152.6e-6	V
Storage variable for calculated offset value for Ip gain8					
VLS_UP_COR [NC_CBK_EX_NR]	O/V	0... 7FFH	0... 9.99511	4.8828e-3	V
Compensated output signal of lambda sensor					
VLS_UP_COR_H_GAIN [NC_CBK_EX_NR]	O/V	0... 7FFH	0... 9.99511	4.8828e-3	V
Ip gain16 equivalent of compensated output signal of lambda sensor					
VLS_UP_DIAG [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-160... 159.99511	4.88e-3	V
Offset and exhaust pressure compensated VLS_UP[i] which is used for sensor diagnoses					

**Input data:**

CTR_ERR_LSL_IF_SPI_WR [NC_CBK_EX_NR] {p. 955}	FAC_LSL_GAIN_AD [NC_CBK_EX_NR] {p. 2371}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_INH_LSL_OFS_ADJ [NC_CBK_EX_NR] {p. 2333}	LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}	LV_IS {p. 1720}	LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}
LV_LS_UP_READY [NC_CBK_EX_NR] {p. 2335}	LV_LS_UP_READY_CDN [NC_CBK_EX_NR] {p. 2335}	LV_LSH_UP_MAN_ACT [NC_CBK_EX_NR] {p. 2385}	LV_LSL_IF_SPI_RST_END [NC_CBK_EX_NR] {p. 1313}
LV_PU {p. 1720}	LV_PUC {p. 1720}	LV_ST_END {p. 1720}	LV_TTIP_MES_VLD_LS_UP [NC_CBK_EX_NR] {p. 1320}
LV_VLS_UP_INIT [NC_CBK_EX_NR] {p. 1341}	LV_VLS_UP_VLD [NC_CBK_EX_NR] {p. 1341}	NC_CBK_EX_NR {p. 1829}	PRS_EX_PCAT_UP {p. 807}
STATE_CAT_DIAG [NC_CBK_EX_NR] {p. 5474}	STATE_LSH_UP [NC_CBK_EX_NR] {p. 2385}	STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 956}	TTIP_MES_LS_UP [NC_CBK_EX_NR] {p. 1321}

VB {p. 1185}	VLS_UP [NC_CBK_EX_NR] {p. 1341}	VLS_UP_10_RAW [NC_CBK_EX_NR] {p. 1342}	
--------------	---------------------------------------	--	--

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_VLS_UP_OFS_ADJ	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for filtering of mean value of WRAF sensor lambda signal for Ip gain16					
C_CRLC_VLS_UP_OFS_ADJ_L_GAIN	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for filtering of mean value of WRAF sensor lambda signal for Ip gain8					
C_FAC_LPF_VLS_COR_LSL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Low pass filter constant for filtering of corrected output signal of WRAF sensor					
C_ICPLSL_COR_ADD	-	8000... 7FFFH	-12.596... 12.59561	384.4e-6	mA
Additive correction of pump current due to adjusted value of pumped reference current					
C_IPLSL_GAIN	-	0... FFFFH	0... 5.0384	76.9e-6	mA/V
Total gain of WRAF sensor interface circuit ( Ip / ( V_LMBD_IP - C_VLS_OFS_SP_LSL ) ) for Ip gain16lp: for NTK UEGO = pumping current through sensor, for BOSCH LSU = current through measurement resistor					
C_LAMB_LS_UP_GAIN_SWI_MAX	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Lean lambda threshold for switching of Ip gain16 -> gain8					
C_LAMB_LS_UP_GAIN_SWI_MIN	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Rich lambda threshold for switching of Ip gain16 -> gain8					
C_LAMB_LS_UP_MAX_OFS_ADJ	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Maximum lambda threshold for the offset calculation					
C_LAMB_LS_UP_MIN_OFS_ADJ	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Minimum lambda threshold for the offset calculation					
C_LAMB_LS_UP_VLS_UP_H_GAIN_MAX	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Upper limit of Ip gain16 band in terms of lambda					
C_LAMB_LS_UP_VLS_UP_H_GAIN_MIN	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Bottom limit of Ip gain16 band in terms of lambda					
C_NR_CYC_T_WAIT_LSL_OFS_ADJ_RED	-	0... FFH	0... 255	1	-
Number of cycles for application of reduced repetition rate for offset adjustment during engine warm-up					
C_T_DLY_LAMB_STI_OFF_OFS_ADJ	-	0... FFFFH	0... 655.35	0.01	s
Delay time for the offset calculation after switching-off forced lambda stimulation					
C_T_DLY_LSL_OFS_ADJ	-	0... FFH	0... 2.55	0.01	s
Delay time for the offset calculation after activating offset adjustment					
C_T_DLY_LSL_OFS_ADJ_CYC	-	0... FFH	0... 2.55	0.01	s
Delay time for second offset determination after switching Ip ranges					
C_T_DLY_LSL_OFS_ADJ_IS	-	0... FFH	0... 2.55	0.01	s
Delay time for activation of offset adjustment upon entering engine state idle speed					
C_T_DLY_LSL_OFS_ADJ_PUC_END	-	0... FFFFH	0... 655.35	0.01	s
Delay time for activation of offset adjustment after leaving fuel cut-off phase					
C_T_INI_DLY_LSL_SIG_ACQ	-	0... FFH	0... 2.55	0.01	s
Delay of acquisition after freeze of signal. Assures that segment synchronous mean value calc has reached final value.					
C_T_WAIT_LSL_OFS_ADJ	-	0... FFFFH	0... 655.35	0.01	s
Lock time after an offset calculation prior to the next calculation for warm engine					

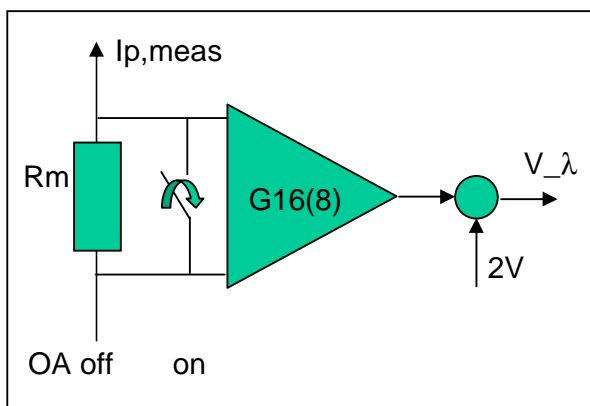
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_WAIT_LSL_OFS_ADJ_RED	-	0... FFFFH	0... 655.35	0.01	s
Lock time after an offset calculation prior to the next calculation during engine warm-up					
C_VB_MIN_OFS_ADJ	-	0... FFH	0... 25.89843	0.1015625	V
Minimum battery voltage for accurate offset adjustment based on related reference voltages					
C_VLS_OFS_DELTA_ADD	-	8000... 7FFFH	-5... 4.99984	152.6e-6	V
Additive share of correlation between offset value in Ip gain16, and Ip gain8					
C_VLS_OFS_DELTA_CBK_EX_MAN	-	8000... 7FFFH	-5... 4.99984	152.6e-6	V
Diametrical shift of offset values for different exhaust banks for diagnostic test purpose					
C_VLS_OFS_DIF_OK_LSL	-	0... 7FFFH	0... 4.99984	153e-6	V
Maximum permitted deviation of two successive offset values for Ip gain16					
C_VLS_OFS_DIF_OK_LSL_L_GAIN	-	0... 7FFFH	0... 4.99984	153e-6	V
Maximum permitted deviation of two successive offset values for Ip gain8					
C_VLS_OFS_MAX_ABSV_LSL	-	0... 7FFFH	0... 4.99984	153e-6	V
Limit value for the offset as a maximum value (absolute value) for Ip gain16					
C_VLS_OFS_MAX_ABSV_LSL_L_GAIN	-	0... 7FFFH	0... 4.99984	153e-6	V
Limit value for the offset as a maximum value (absolute value) for Ip gain8					
C_VLS_OFS_SP_LSL	-	0... 7FFFH	0... 4.99984	153e-6	V
Nominal WRAF controller output offset voltage ( valid for Ip = 0 or lambda = 1)					
IP_FAC_COR_IPLSL_AFR_PRS_EX	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_PRS_EX_IP_FAC_COR_IPLSL	8	0... FFFFH	0... 5434	0.0829175	hPa
Factor for exhaust gas pressure correction at rich conditions					
IP_FAC_COR_IPLSL_PRS_EX	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_PRS_EX_IP_FAC_COR_IPLSL	8	0... FFFFH	0... 5434	0.0829175	hPa
Factor for exhaust gas pressure correction at lean conditions					
IP_FAC_COR_IPLSL_TTIP_LS_UP	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_TTIP_LS_UP_IP_FAC_COR_IPLSL	8	0... FFFFH	-2048... 2047.9375	0.0625	°C
Factor for correction of tip temperature influence					
IP_LAMB_LS_UP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
LDP_VLS_COR_MV_IP_LAMB_LS_UP	32	0... FFFFH	0... 9.99984	152.6e-6	V
Characteristic curve of the lambda sensor (LAMB_LS_UP[i] vs. compensated VLS_COR_MV_LSL[i])					
LC_CAT_DIAG_ACT_WAIT	-	0... 1H	0 ...1	1	-
Switch to grant catalyst diagnosis priority to be completed without interruption by OA					
LC_CTR_ERR_LSL_IF_SAVE_MAN_INC	-	0... 1H	0 ...1	1	-
Switch enabling simulation of SPI communication error with WRAF controller					
LC_IPLSL_GAIN_SWI_ACT	-	0... 1H	0 ...1	1	-
Switch to enable gain switching for measurement of pumping current					
LC_LAMB_PLS_ACT_NEUT	-	0... 1H	0 ...1	1	-
Switch to perform OA regardless of current status of forced lambda stimulation					
LC_LSL_OFS_ADJ_ENA	-	0... 1H	0 ...1	1	-
Switch to enable offset adjustment in every engine state					
LC_LSL_OFS_ADJ_GAIN_SEL	-	0... 1H	0 ...1	1	-
Switch to choose Ip measurement range in which singular offset adjustment shall be performed ( 0 = gain8, 1 = gain16 )					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_LSL_OFS_ADJ_H_L_GAIN	-	0... 1H	0 ...1	1	-
Switch to enable offset adjustment in both Ip measurement ranges					
LC_LSL_OFS_GAIN_SWI_CYC	-	0... 1H	0 ...1	1	-
Switch to choose alternating offset adjustment in Ip gain16 /gain8 mode					
LC_SWI_GAIN_LSL_IF_PUC_ACT	-	0... 1H	0 ...1	1	-
Switch to activate Ip gain switching gain16 -> gain8 during PUC					
LC_VLS_COR_MV_LSL_ACT	-	0... 1H	0 ...1	1	-
Switch for ( de )activation of averaging of VLS_COR_H_RES_LSL[i] prior to conversion					
LC_VLS_UP_THD_SWI_GAIN_AFL_ACT	-	0... 1H	0 ...1	1	-
Boolean flag for activation of Ip gain switching due to possible VLS_UP_RAW[i] lean side signal saturation					
LC_VLS_UP_THD_SWI_GAIN_AFR_ACT	-	0... 1H	0 ...1	1	-
Boolean flag for activation of Ip gain switching due to possible VSL_UP_RAW[i] rich side signal saturation					

### FUNCTION DESCRIPTION:

OA = Offset adjustment.

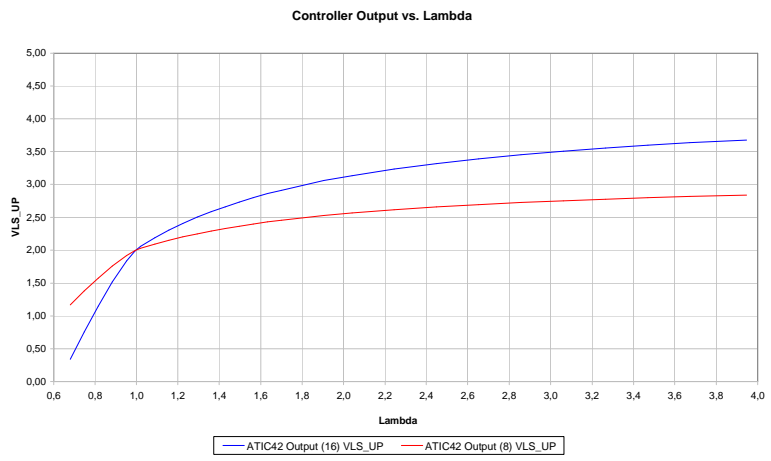
Based on short circuiting of Ip measurement amplifier input.



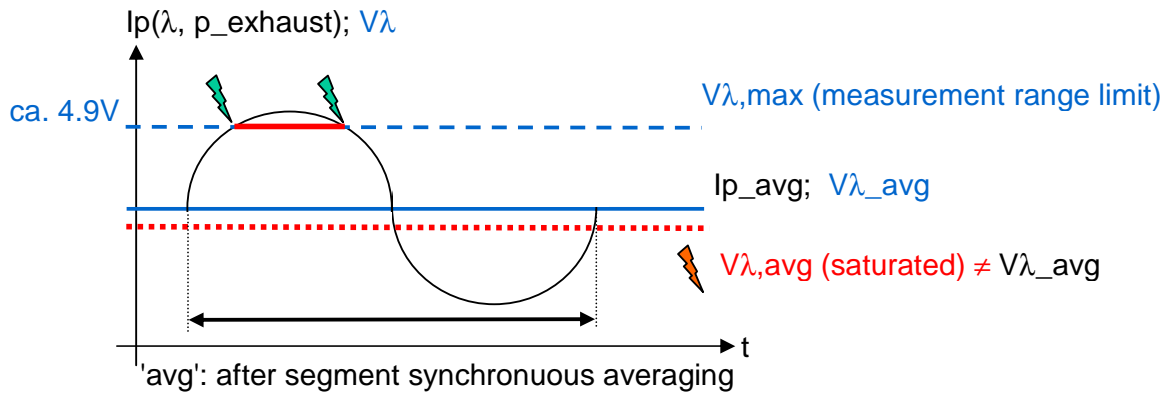
Ip measurement gain16 = High Gain ('1')

Ip measurement gain8 = Low Gain ('0')

Use cases				
LOGICAL CONSTANT Effect ('0' / '1')	gain16 only	gain8 only	gain16&8 simultaneously	gain16/8 alternating
LC_LSL_OFS_ADJ_GAIN_SEL Defines default Ip measurement gain	1	0	1	1
LC_LSL_OFS_ADJ_H_L_GAIN OA in default gain only ( second range is approximated ) / for both gains	0	0	1	1
LC_LSL_OFS_GAIN_SWI_CYC Simultaneous / alternating OA for both gains	0	0	0	1
LC_IPLSL_GAIN_SWI_ACT Gain switching during Ip measurement active	0 / 1	0 / 1	0 / 1	0 / 1

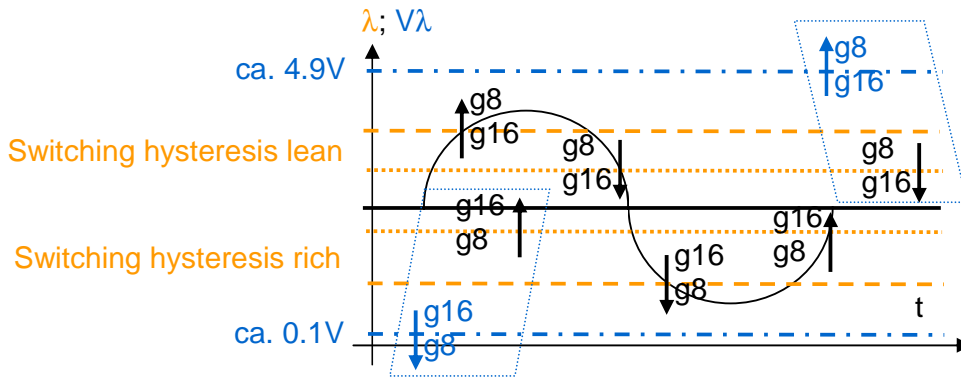


Ip measurement range vs. resolution (exemplary).



Range switching triggered by  $V$  thresholds to avoid saturation effects of Ip measurement.

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### Switching thresholds/hysteresis

#### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned

(  $NC\_CBK\_EX\_NR = 2$  ), then

$i = 1$ , for exhaust cylinder bank 1

$i = 2$ , for exhaust cylinder bank 2

otherwise (  $NC\_CBK\_EX\_NR = 1$  )

$i = 1$ , for single exhaust cylinder bank.

#### Application conditions


##### Initialisation:

The following variable initialisation shall take place at **LV\_IGK 0->1**, **afterRESET**, or **upon erase of error management**:

```

VLS_UP_COR[i] = 0
VLS_COR_H_RES_LSL[i] = 0
VLS_UP_COR_H_GAIN[i] = 0
VLS_DELTA_TMP_LSL[i] = 0
VLS_OFS_LSL[i] = 0
VLS_OFS_TMP_LSL[i] = 0
VLS_OFS_TMP_OLD_LSL[i] = 0
VLS_OFS_LSL_L_GAIN[i] = 0
VLS_OFS_TMP_OLD_LSL_L_GAIN[i] = 0
IPLSL_COR[i] = 0
LV_VLS_OFS_LIM_LSL[i] = 0
LV_VLS_OFS_LIM_LSL_L_GAIN[i] = 0
VLS_MV_LSL[i] = 0
LAMB_LS_UP[i] = 1
LAMB_LS_UP_MV = 1
LAMB_LS_UP_MIN = 1
VLS_COR_TMP_LSL[i] = C_VLS_OFS_SP_LSL
VLS_COR_MV_LSL[i] = C_VLS_OFS_SP_LSL
LV_SWI_CLC_LSL_OFS_ADJ[i] = 0
VLS_MMV_LSL[i]i-1 = C_VLS_OFS_SP_LSL
VLS_MMV_LSL_L_GAIN[i]i-1 = C_VLS_OFS_SP_LSL
CTR_CYC_T_WAIT_OFS_ADJ_RED[i] = 0
LV_LSL_UP_SHO_PER_REQ[i] = 0
LV_LSL_OFS_ACT_AST[i] = 1
LV_LSL_OFS_ADJ_ACT[i] = 0
LV_LSL_OFS_ADJ_IS[i] = 0
LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] = 0

```

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```

LV_LAMB_PLS_SWI_OFF[i] = 0
T_WAIT_LSL_OFS_ADJ[i] = 0
CTR_ERR_LSL_IF_SPI_OFS_ADJ_SAVE[i]
= CTR_ERR_LSL_IF_SPI_WR[i]
STATE_LSL_OFS_ADJ[i] = WAIT
T_DLY_LSL_OFS_ADJ_IS[i] = C_T_DLY_LSL_OFS_ADJ_IS
LV_SWI_GAIN_LSL_IF[i] = LC_LSL_OFS_ADJ_GAIN_SEL
LV_VLS_OFS_ADJ_CMPL[i] = 0
LV_LSL_OFS_GAIN_SWI_CYC[i] = LC_LSL_OFS_ADJ_GAIN_SEL
T_DLY_LSL_OFS_ADJ_PUC_END[i] = 0
T_INI_DLY_SIG_ACQ[i] = 0

```

The following variable initialisation shall take place according to below condition:

```

If      ( LV_LSH_UP_MAN_ACT[i] == 0 ->1 and LV_ST_END ==
0 )
or      ( LV_LSH_UP_MAN_ACT[i] == 0 and LV_ST_END == 0 ->1
)
then
    LV_LSL_OFS_ACT_AST[i] = 1
    LV_LSL_OFS_ADJ_ACT[i] = 0
    LV_LSL_OFS_ADJ_IS[i] = 0
    LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] = 0
    LV_LAMB_PLS_SWI_OFF[i] = 0
    T_WAIT_LSL_OFS_ADJ[i] = 0
    CTR_ERR_LSL_IF_SPI_OFS_ADJ_SAVE[i]
    = CTR_ERR_LSL_IF_SPI_WR[i]
    STATE_LSL_OFS_ADJ[i] = WAIT
    T_DLY_LSL_OFS_ADJ_IS[i] = C_T_DLY_LSL_OFS_ADJ_IS
    LV_SWI_GAIN_LSL_IF[i] = LC_LSL_OFS_ADJ_GAIN_SEL
    LV_VLS_OFS_ADJ_CMPL[i] = 0
    LV_LSL_OFS_GAIN_SWI_CYC[i] = LC_LSL_OFS_ADJ_GAIN_SEL
    T_DLY_LSL_OFS_ADJ_PUC_END[i] = 0
endif

```

**Recurrence:**  $T_{SAMPLE} = 10ms$

### 7.42.1 Compensation of WRAF controller electrical offset voltage and system gain error

#### Activation:

To avoid disturbances to the WRAF interface due to EMC interference of the starter, the function shall be activated after engine start.

```

If      ( LV_ST_END == 1
or      LV_LSH_UP_MAN_ACT[i] == 1 )
and      LV_LSL_IF_SPI_RST_END[i] == 1
( Initialisation of WRAF controller ASIC completed successfully )
and      LV_ERR_OFS_LSL_UP[i] == 0
then    " function enabled "
else    " function disabled "

```


The following variable initialisation shall take place after function deactivation:

```

LV_VLS_OFS_ADJ_ENA_LSL_IF[i] = 0
LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] = 0
LV_LAMB_PLS_SWI_OFF[i] = 0
LV_LSL_OFS_ADJ_ACT[i] = 0
LV_LSL_OFS_ADJ_IS[i] = 0

```

**endif**

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```

if                LV_LSL_OFS_ACT_AST[i] == 1
then              " 1.1.1 Conditions for offset adjustment directly after engine start "
else              " 1.1.2 Conditions for offset adjustment during normal engine operation "
endif
    
```

Deactivation: - -

### 7.42.1.1 Conditions for offset adjustment directly after engine start

#### Description:

#### Formula section:

```

if                ( LV_LS_UP_READY[i] == 0
or                LV_LSH_UP_MAN_ACT[i] == 1 )
and                LV_INH_LSL_OFS_ADJ[i] == 0
and                VB > C_VB_MIN_OFS_ADJ
and                STATE_LSL_IF_SPI_RD[i] ( bit LSL_ENA ) == 1
and                CTR_ERR_LSL_IF_SPI_OFS_ADJ_SAVE[i] == CTR_ERR_LSL_IF_SPI_WR[i]
then              LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] = 1
                    if                LC_LSL_OFS_ADJ_H_L_GAIN == 1
                    and                LV_LSL_OFS_ADJ_ACT[i] == 0
                    then              LV_SWI_GAIN_LSL_IF[i] = 1
                    endif
else              CTR_ERR_LSL_IF_SPI_OFS_ADJ_SAVE[i] = CTR_ERR_LSL_IF_SPI_WR[i]
                    LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] = 0
                    LV_SWI_GAIN_LSL_IF[i] = LC_LSL_OFS_ADJ_GAIN_SEL
                    if                LV_VLS_OFS_ADJ_ENA_LSL_IF[i] == 1 ( first measurement aborted )
                    or                LV_LS_UP_READY[i] == 1 ( regular engine operation reached )
                    then              LV_LSL_OFS_ACT_AST[i] = 0 ( leave after start phase )
                    STATE_LSL_OFS_ADJ[i] = WAIT
                    endif
                    LV_VLS_OFS_ADJ_ENA_LSL_IF[i] = 0
endif
    
```

### 7.42.1.2 Conditions for offset adjustment during normal engine operation

#### Description:

#### Formula section:

$T\_WAIT\_LSL\_OFS\_ADJ[i] = T\_WAIT\_LSL\_OFS\_ADJ[i] - T\_SAMPLE$

```

if                LV_IS == 0
then              T_DLY_LSL_OFS_ADJ_IS[i] = C_T_DLY_LSL_OFS_ADJ_IS
else              T_DLY_LSL_OFS_ADJ_IS[i] = T_DLY_LSL_OFS_ADJ_IS[i] - T_SAMPLE
endif
    
```

```


if                LV_PUC == 1
    
```

```

then      T_DLY_LSL_OFS_ADJ_PUC_END[i] = C_T_DLY_LSL_OFS_ADJ_PUC_END
else      T_DLY_LSL_OFS_ADJ_PUC_END[i]
            = T_DLY_LSL_OFS_ADJ_PUC_END[i] - T_SAMPLE
endif

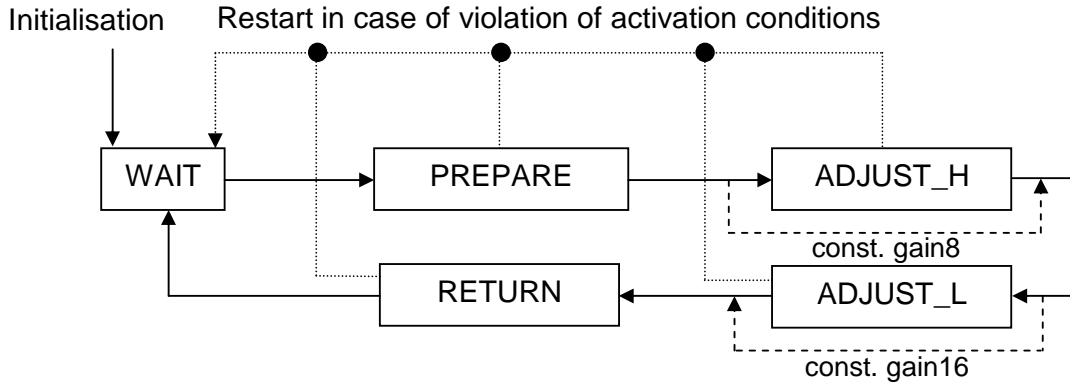
if        T_WAIT_LSL_OFS_ADJ[i] == 0
and       LV_INH_LSL_OFS_ADJ[i] == 0
and       LV_LS_UP_READY[i] == 1
and       LV_LSH_UP_MAN_ACT[i] == 0
and       VB > C_VB_MIN_OFS_ADJ
and       LV_PUC == 0
and       T_DLY_LSL_OFS_ADJ_PUC_END[i] == 0
and       LV_PU == 0
and       ( LC_LSL_OFS_ADJ_ENA == 1
or        ( LV_IS == 1
and T_DLY_LSL_OFS_ADJ_IS[i] == 0 ) )
and       LV_LSL_OFS_ADJ_IS[i] == 0
and       ( C_LAMB_LS_UP_MIN_OFS_ADJ < LAMB_SP[i]
            < C_LAMB_LS_UP_MAX_OFS_ADJ
or        LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] == 1 )
and       ( LC_CAT_DIAG_ACT_WAIT == 0
or        STATE_CAT_DIAG[i] == PASSIVE
or        STATE_CAT_DIAG[i] == END )
and       STATE_LSL_IF_SPI_RD[i] ( bit LSL_ENA ) == 1
and       CTR_ERR_LSL_IF_SPI_OFS_ADJ_SAVE[i] == CTR_ERR_LSL_IF_SPI_WR[i]
then     if      ( LC_LSL_OFS_ADJ_H_L_GAIN == 1
            and      LV_SWI_GAIN_LSL_IF[i] == 1
            and      STATE_LSL_IF_SPI_RD[i] ( bit SWI_GAIN ) == 1 )
            ( OA for both ranges active: starts once gain16 is selected in
              measurement mode, is performed for gain16 and gain8
              simultaneously /alternating, return to gain16 -> measurement mode )
            or      ( LC_LSL_OFS_ADJ_H_L_GAIN == 0
            and      LV_SWI_GAIN_LSL_IF[i] == LC_LSL_OFS_ADJ_GAIN_SEL
            and      STATE_LSL_IF_SPI_RD[i] ( bit SWI_GAIN )
            == LC_LSL_OFS_ADJ_GAIN_SEL )
            ( OA is performed for default range only )
            then     if      LV_LAMB_PLS_ACT[i] == 1
            and      LC_LAMB_PLS_ACT_NEUT == 0
            then     LV_LAMB_PLS_SWI_OFF[i] = 1
            endif
            LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] = 1
            endif
else     CTR_ERR_LSL_IF_SPI_OFS_ADJ_SAVE[i] = CTR_ERR_LSL_IF_SPI_WR[i]
            LV_LAMB_PLS_SWI_OFF[i] = 0
            LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] = 0
            if      LV_IS == 0
            then     LV_LSL_OFS_ADJ_IS[i] = 0
            endif
            STATE_LSL_OFS_ADJ[i] = WAIT
            LV_VLS_OFS_ADJ_ENA_LSL_IF[i] = 0
endif

```

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### 7.42.1.3 Offset calculation

**Description:**



**Formula section:**

Initial state upon (re)start of state machine

```


STATE WAIT :
LV_VLS_OFS_ADJ_CMPL[i] = 0
if STATE_LSL_IF_SPI_RD[i] ( bit VLS_OFS_ENA ) == 0
then LV_LSL_OFS_ADJ_ACT[i] = 0
    if LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] == 1
    and ( LV_LAMB_PLS_ACT[i] == 0
    or LC_LAMB_PLS_ACT_NEUT == 1 )
    then if LV_LAMB_PLS_SWI_OFF[i] == 1
    and LC_LAMB_PLS_ACT_NEUT == 0
    then T_DLY_LAMB_STI_OFF_OFS_ADJ[i]
    = C_T_DLY_LAMB_STI_OFF_OFS_ADJ
    else T_DLY_LAMB_STI_OFF_OFS_ADJ[i] = 0
    endif
    STATE_LSL_OFS_ADJ[i] = PREPARE
    endif
endif
    
```

**endif**

```

STATE PREPARE :
if T_DLY_LAMB_STI_OFF_OFS_ADJ[i] == 0
then LV_LSL_OFS_ADJ_ACT[i] = 1
    LV_VLS_OFS_ADJ_ENA_LSL_IF[i] = 1
    if LC_LSL_OFS_GAIN_SWI_CYC[i] == 1
    and LV_LSL_OFS_GAIN_SWI_CYC[i] == 0
    ( alternating OA, gain8 recurrence )
    then LV_SWI_GAIN_LSL_IF[i] = 0
    endif
    if LC_CTR_ERR_LSL_IF_SAVE_MAN_INC == 1
    then CTR_ERR_LSL_IF_SPI_OFS_ADJ_SAVE[i]
    = CTR_ERR_LSL_IF_SPI_OFS_ADJ_SAVE[i] + 1
    
```

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```

endif
if STATE_LSL_IF_SPI_RD[i] ( bit VLS_OFS_ENA ) == 1
  ( ATIC42 OA mode enabled )
then T_DLY_LSL_OFS_ADJ[i] = C_T_DLY_LSL_OFS_ADJ
CTR_VLS_MV_LSL_NR_SAMPLE[i] = 0
VLS_MV_LSL_BUF[i] = 0
if ( LC_LSL_OFS_ADJ_H_L_GAIN == 0
and LC_LSL_OFS_ADJ_GAIN_SEL == 0 )
  ( OA for gain8 only )
  or LV_LSL_OFS_GAIN_SWI_CYC[i] == 0
    ( Alternating OA gain16/8 )
  then STATE_LSL_OFS_ADJ[i] = ADJUST_L
else STATE_LSL_OFS_ADJ[i] = ADJUST_H
endif
endif
else T_DLY_LAMB_STI_OFF_OFS_ADJ[i]
      = T_DLY_LAMB_STI_OFF_OFS_ADJ[i] - T_SAMPLE
endif

STATE ADJUST_H :
if STATE_LSL_IF_SPI_RD[i] ( bit SWI_GAIN ) == 1 ( gain16 )
then if T_DLY_LSL_OFS_ADJ[i] == 0
  then 1.1.3.1 Measurement acquisition
    if CTR_VLS_MV_LSL_NR_SAMPLE[i] >= 4
    then VLS_MV_LSL[i] = VLS_MV_LSL_BUF[i] /4
      1.1.3.2 Offset adjustment High Gain
      if LC_LSL_OFS_ADJ_H_L_GAIN == 1
      ( OA for both ranges active )
      then if LC_LSL_OFS_GAIN_SWI_CYC == 0
        ( Simultaneous OA gain16& 8 )
        or LV_LSL_OFS_ACT_AST[i] == 1
          ( Initial OA in both gain16& 8 )
          then T_DLY_LSL_OFS_ADJ[i]
              = C_T_DLY_LSL_OFS_ADJ_CYC
              CTR_VLS_MV_LSL_NR_SAMPLE[i] = 0
              VLS_MV_LSL_BUF[i] = 0
              LV_SWI_GAIN_LSL_IF[i] = 0
              STATE_LSL_OFS_ADJ[i] = ADJUST_L
            else ( Alternating OA gain16/8 )
              LV_LSL_OFS_GAIN_SWI_CYC = 0
              STATE_LSL_OFS_ADJ[i] = RETURN
            endif
          else ( OA for gain16 only )
            VLS_OFS_TMP_LSL[i]
            = ( ( VLS_OFS_TMP_LSL[i] - C_VLS_OFS_DELTA_ADD )
              /2 ) + C_VLS_OFS_DELTA_ADD
            1.1.3.3. Offset adjustment Low Gain
            ( calculation of corresponding offset for gain8 )
            STATE_LSL_OFS_ADJ[i] = RETURN
          endif
        endif
      endif
    else T_DLY_LSL_OFS_ADJ[i] = T_DLY_LSL_OFS_ADJ[i] - T_SAMPLE
  endif

```

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```

    endif
endif

STATE ADJUST_L :
If      STATE_LSL_IF_SPI_RD[i] ( bit SWI_GAIN ) == 0      ( gain8 )
then    If      T_DLY_LSL_OFS_ADJ[i] == 0
        then    1.1.3.1 Measurement acquisition
                If      CTR_VLS_MV_LSL_NR_SAMPLE[i] >= 4
                then    VLS_MV_LSL[i] = VLS_MV_LSL_BUF[i] /4
                        1.1.3.3 Offset adjustment Low Gain
                        If      LC_LSL_OFS_ADJ_H_L_GAIN == 1
                                ( OA for both ranges active )
                        then    LV_SWI_GAIN_LSL_IF[i] = 1
                        else    ( OA for gain8 only )
                                VLS_OFS_TMP_LSL[i] = ( ( VLS_OFS_TMP_LSL[i]
                                                            - C_VLS_OFS_DELTA_ADD ) * 2 )
                                                            + C_VLS_OFS_DELTA_ADD
                                1.1.3.2 Offset adjustment High Gain
                                ( calculation of corresponding offset for gain16 )
                                endif
                        If      LC_LSL_OFS_GAIN_SWI_CYC == 1
                        then    LV_LSL_OFS_GAIN_SWI_CYC[i] = 1
                        endif
                                STATE_LSL_OFS_ADJ[i] = RETURN
                        endif
                else    T_DLY_LSL_OFS_ADJ[i] = T_DLY_LSL_OFS_ADJ[i] - T_SAMPLE
        endif
endif

STATE RETURN :
LV_VLS_OFS_ADJ_ENA_LSL_IF[i] = 0
If      LC_LSL_OFS_ADJ_H_L_GAIN == 0
( OA in default range only: no gain switching has taken place during calibration)
or      STATE_LSL_IF_SPI_RD[i] ( bit SWI_GAIN ) == 1
( OA in both ranges: wait for return to gain16 prior to exiting to measurement mode )
then    If      LV_LSL_OFS_ACT_AST[i] == 0
        then    If      CTR_CYC_T_WAIT_OFS_ADJ_RED[i]
                < C_NR_CYC_T_WAIT_LSL_OFS_ADJ_RED
                then    T_WAIT_LSL_OFS_ADJ[i]
                        = C_T_WAIT_LSL_OFS_ADJ_RED
                        CTR_CYC_T_WAIT_OFS_ADJ_RED[i]
                        = CTR_CYC_T_WAIT_OFS_ADJ_RED[i] + 1
                else    T_WAIT_LSL_OFS_ADJ[i] = C_T_WAIT_LSL_OFS_ADJ
                endif
                If      LV_IS == 1
                then    LV_LSL_OFS_ADJ_IS[i] = 1
                endif
        else    LV_LSL_OFS_ACT_AST[i] = 0
        endif
STATE_LSL_OFS_ADJ[i] = WAIT
LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] = 0
LV_VLS_OFS_ADJ_CMPL[i] = 1

```

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**endif**

### 7.42.1.3.1 Measurement acquisition

#### Description:

#### Formula section:

```

if          CTR_VLS_MV_LSL_NR_SAMPLE[i] < 4
then       VLS_MV_LSL_BUF[i] = VLS_MV_LSL_BUF[i] + VLS_UP_10_RAW[i]
            CTR_VLS_MV_LSL_NR_SAMPLE[i] =
                CTR_VLS_MV_LSL_NR_SAMPLE[i] + 1
endif
    
```


### 7.42.1.3.2 Offset adjustment High Gain

#### Description:

#### Formula section:

```

if          LC_LSL_OFS_ADJ_H_L_GAIN == 1
    ( skip gain16 measurement acquisition for OA in gain8 only
      -> calculation of corresponding offset for gain16 )
or          LC_LSL_OFS_ADJ_GAIN_SEL == 1
then       if          LV_LSL_OFS_ACT_AST[i] == 1
            then       VLS_MMV_LSL[i] = VLS_MV_LSL[i]
            else       VLS_MMV_LSL[i] = VLS_MMV_LSL[i-1] + C_CRLC_VLS_UP_OFS_ADJ
                                * ( VLS_MV_LSL[i] - VLS_MMV_LSL[i-1] )
            endif
            VLS_OFS_TMP_LSL[i] = C_VLS_OFS_SP_LSL - VLS_MMV_LSL[i]
endif
if          I VLS_OFS_TMP_LSL[i] - VLS_OFS_TMP_OLD_LSL[i] I
            < C_VLS_OFS_DIF_OK_LSL
or          LV_LSL_OFS_ACT_AST[i] == 1
then       if          | VLS_OFS_TMP_LSL[i] | < C_VLS_OFS_MAX_ABSV_LSL
            then       LV_VLS_OFS_LIM_LSL[i] = 0
                    VLS_OFS_LSL[i] = VLS_OFS_TMP_LSL[i]
                    ( offset adjustment valid; VLS_OFS_LSL[i] is changed )
            else       LV_VLS_OFS_LIM_LSL[i] = 1
                    if          VLS_OFS_TMP_LSL[i] > 0
                    then       VLS_OFS_LSL[i] = + C_VLS_OFS_MAX_ABSV_LSL
                    else       VLS_OFS_LSL[i] = C_VLS_OFS_MAX_ABSV_LSL
                    ( set offset voltage to threshold value which has been reached,
                      taking into account the correct sign )
                    endif
endif
endif
endif
VLS_OFS_TMP_OLD_LSL[i] = VLS_OFS_TMP_LSL[i]
    
```

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### 7.42.1.3.3 Offset adjustment Low Gain

#### Description:

#### Formula section:

```

if                LC_LSL_OFS_ADJ_H_L_GAIN == 1
(skip gain8 measurement acquisition for OA in gain16 only
-> calculation of corresponding offset for gain8)
or                LC_LSL_OFS_ADJ_GAIN_SEL == 0
then             if          LV_LSL_OFS_ACT_AST[i] == 1
then             then          VLS_MMV_LSL_L_GAIN[i] = VLS_MV_LSL[i]
else             VLS_MMV_LSL_L_GAIN[i] = VLS_MMV_LSL_L_GAIN[i]i-1
                  + C_CRLC_VLS_UP_OFS_ADJ_L_GAIN
                  * ( VLS_MV_LSL[i] - VLS_MMV_LSL_L_GAIN[i]i-1 )
endif
VLS_OFS_TMP_LSL[i] = C_VLS_OFS_SP_LSL - VLS_MMV_LSL_L_GAIN[i]
endif
if                I VLS_OFS_TMP_LSL[i] - VLS_OFS_TMP_OLD_LSL_L_GAIN[i] I
                  < C_VLS_OFS_DIF_OK_LSL_L_GAIN
or                LV_LSL_OFS_ACT_AST[i] == 1
then             if          | VLS_OFS_TMP_LSL[i] | < C_VLS_OFS_MAX_ABSV_LSL_L_GAIN
then             LV_VLS_OFS_LIM_LSL_L_GAIN[i] = 0
                  VLS_OFS_LSL_L_GAIN[i] = VLS_OFS_TMP_LSL[i]
(offset adjustment valid; VLS_OFS_LSL_L_GAIN[i] is changed)
else             LV_VLS_OFS_LIM_LSL_L_GAIN[i] = 1
                  if          VLS_OFS_TMP_LSL[i] > 0
                  then          VLS_OFS_LSL_L_GAIN[i] =
                              + C_VLS_OFS_MAX_ABSV_LSL_L_GAIN
                  else          VLS_OFS_LSL_L_GAIN[i] =
                              C_VLS_OFS_MAX_ABSV_LSL_L_GAIN
(set offset voltage to threshold value which has been reached,
taking into account the correct sign)
                  endif
endif
endif
VLS_OFS_TMP_OLD_LSL_L_GAIN[i] = VLS_OFS_TMP_LSL[i]

```

### 7.42.2 Signal acquisition and conversion for WRAF sensor

#### FUNCTION DESCRIPTION:

#### Description:

#### *Activation:*

```

if                STATE_LSH_UP[i] <> OFF
and               LV_LSL_IF_SPI_RST_END[i] == 1
(Initialisation of WRAF controller ASIC completed successfully)

```

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```

then      " function enabled "
else      " function disabled "

```

### 7.42.2.1 WRAF sensor interface gain-switching for Ip measurement

#### Description:

**NOTE:** The logical variable *LV\_SWI\_GAIN\_LSL\_IF[i]* is mapped in the interface byte *STATE\_LSL\_IF\_SPI\_WR[i]*.

Its initialization at ECU RESET shall be done according to the corresponding bit value of *C\_STATE\_LSL\_IF\_SP\_WR\_INI* in *ASW-BSW Interface , 4033*.

#### Formula section:


```

If          LC_IPLSL_GAIN_SWI_ACT == 1          (Ip gain switching active)
and
and         LV_IPLSL_VLD[i] == 1
and         LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] == 0
then       If          STATE_LSL_IF_SPI_RD[i] ( bit SWI_GAIN          ) == 1          (gain16)
           and         LV_SWI_GAIN_LSL_IF[i] == 1
           then       If          LV_VLS_UP_VLD[i] == ( 1 -> 0 )
                   and         (( LAMB_LS_UP[i] > 1
                   and         LC_VLS_UP_THD_SWI_GAIN_AFL_ACT == 1 )
                   or          ( LAMB_LS_UP[i] < 1
                   and         LC_VLS_UP_THD_SWI_GAIN_AFR_ACT == 1 ) )
                   or          ( LC_SWI_GAIN_LSL_IF_PUC_ACT == 1
                   and         LV_PUC == 1 )
                   or          LAMB_LS_UP[i] > C_LAMB_LS_UP_GAIN_SWI_MAX
                   or          LAMB_LS_UP[i] < C_LAMB_LS_UP_GAIN_SWI_MIN
           then       LV_SWI_GAIN_LSL_IF[i] = 0 ( gain16 -> gain8 )
           endif
           else       ( gain8 )
           If          STATE_LSL_IF_SPI_RD[i] ( bit SWI_GAIN ) == 0
           and         LV_SWI_GAIN_LSL_IF[i] == 0
           and         ( C_LAMB_LS_UP_VLS_UP_H_GAIN_MIN
                       < LAMB_LS_UP[i]
                       < C_LAMB_LS_UP_VLS_UP_H_GAIN_MAX )
           or          ( LC_SWI_GAIN_LSL_IF_PUC_ACT == 1
           and         LV_PUC == 1 )
           then       LV_SWI_GAIN_LSL_IF[i] = 1
                       ( gain8 -> gain16, including hysteresis )
           endif
           endif
else       If          LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] == 0
           then       LV_SWI_GAIN_LSL_IF[i] = LC_LSL_OFS_ADJ_GAIN_SEL
                       ( stay in default gain mode )
           endif
endif

```

### 7.42.2.2 Calculation of compensated WRAF controller output voltage and WRAF sensor pumping current

#### Description:


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**Formula section:**

```

if          LV_VLS_UP_INIT[i] == 0          ( no gain switching currently ongoing )
and        LV_SWI_GAIN_LSL_IF[i] == STATE_LSL_IF_SPI_RD[i] ( bit SWI_GAIN )
and        LV_LSL_OFS_ADJ_ACT[i] == 0
            ( OA mode of WRAF controller not active )
then      if          STATE_LSL_IF_SPI_RD[i] ( bit SWI_GAIN ) == 1 ( gain16 )
            then      VLS_DELTA_TMP_LSL[i]
                    = ( VLS_UP[i] + VLS_OFS_LSL[i] - C_VLS_OFS_SP_LSL )
            if          C_VLS_OFS_DELTA_CBK_EX_MAN <> 0
            ( request for simulated diametrical misalignment of cylinder banks
              for diagnostic test purpose )
            then      if          i == 1
                    then          VLS_DELTA_TMP_LSL[i] = VLS_DELTA_TMP_LSL[i]
                                + C_VLS_OFS_DELTA_CBK_EX_MAN
                    else          VLS_DELTA_TMP_LSL[i] = VLS_DELTA_TMP_LSL[i]
                                - C_VLS_OFS_DELTA_CBK_EX_MAN
                    endif
            endif
            else      ( gain8 )
                    VLS_DELTA_TMP_LSL[i] = ( VLS_UP[i] + VLS_OFS_LSL_L_GAIN[i]
                                - C_VLS_OFS_SP_LSL ) * 2
            endif
            if          VLS_DELTA_TMP_LSL[i] >= 0
            then          VLS_DELTA_TMP_LSL[i] = VLS_DELTA_TMP_LSL[i]
                    * IP_FAC_COR_IPLSL_PRS_EX
            else          VLS_DELTA_TMP_LSL[i] = VLS_DELTA_TMP_LSL[i]
                    * IP_FAC_COR_IPLSL_AFR_PRS_EX
            endif
            VLS_UP_DIAG[i] = VLS_DELTA_TMP_LSL[i] + C_VLS_OFS_SP_LSL
            if          LV_LS_UP_READY[i] == 1
            and        LV_LS_UP_READY_CDN[i] == 0
            then          VLS_DELTA_TMP_LSL[i] = VLS_DELTA_TMP_LSL[i]
                    * IP_FAC_COR_IPLSL_TTIP_LS_UP
            endif
            VLS_DELTA_TMP_LSL[i] = VLS_DELTA_TMP_LSL[i] * FAC_LSL_GAIN_AD[i]
                    + ( C_ICPLSL_COR_ADD / C_IPLSL_GAIN )
                    IPLSL_COR[i] = VLS_DELTA_TMP_LSL[i] * C_IPLSL_GAIN
            else          VLS_DELTA_TMP_LSL[i]n = VLS_DELTA_TMP_LSL[i]n-1
                    VLS_UP_DIAG[i]n = VLS_UP_DIAG[i]n-1
                    IPLSL_COR[i]n = IPLSL_COR[i]n-1
            endif

% Low pass filtering of compensated signal.
if          C_FAC_LPF_VLS_COR_LSL > 0
and        LV_VLS_UP_INIT = 0
then
            VLS_COR_H_RES_LSL[i]n = VLS_COR_H_RES_LSL[i]n-1
                    + ( VLS_DELTA_TMP_LSL[i] + C_VLS_OFS_SP_LSL
                    - VLS_COR_H_RES_LSL[i]n-1 ) * C_FAC_LPF_VLS_COR_LSL
            else
            VLS_COR_H_RES_LSL[i]n = VLS_DELTA_TMP_LSL[i] + C_VLS_OFS_SP_LSL
    
```

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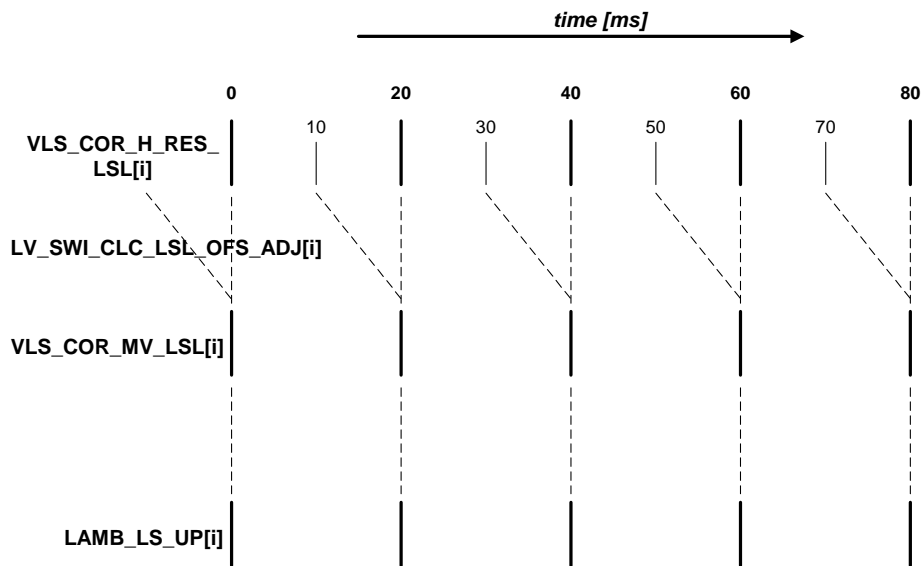
**endif**

VLS\_UP\_COR[i] = VLS\_COR\_H\_RES\_LSL[i]  
VLS\_UP\_COR\_H\_GAIN[i] = VLS\_COR\_H\_RES\_LSL[i]

### 7.42.2.3 Conversion into lambda signal

#### Description:

Signal flow diagram for activated averaging ( LC\_VLS\_COR\_MV\_LSL\_ACT == 1 ):



#### Formula section:

#### Calculation in case of LC\_VLS\_COR\_MV\_LSL\_ACT = 1

```

if      LV_VLS_UP_INIT[i] = ( 1 -> 0 )      ( initialization of current Ip range complete )
and    LV_LSL_OFS_ADJ_ACT[i] == 0
          ( OA mode of WRAF controller not active )
then   VLS_COR_TMP_LSL[i] = VLS_COR_H_RES_LSL[i]
          VLS_COR_MV_LSL[i] = VLS_COR_H_RES_LSL[i]
          LV_LSL_UP_SHO_PER_REQ[i] = 0
          LAMB_LS_UP[i] = IP_LAMB_LS_UP
else   if      LV_VLS_UP_INIT[i] == 1 ( gain switching is currently taking place )
          or      LV_SWI_GAIN_LSL_IF[i] STATE_LSL_IF_SPI_RD[i] ( bit SWI_GAIN )
          or      LV_LSL_OFS_ADJ_ACT[i] == 1
          ( OA mode of WRAF controller active )
          then   VLS_COR_TMP_LSL[i]n = VLS_COR_TMP_LSL[i]n-1
                  VLS_COR_MV_LSL[i]n = VLS_COR_MV_LSL[i]n-1
                  LV_LSL_UP_SHO_PER_REQ[i] = 1
                  LAMB_LS_UP[i]n = LAMB_LS_UP[i]n-1
                  LV_SWI_CLC_LSL_OFS_ADJ[i] = 0
          else   if      LV_SWI_CLC_LSL_OFS_ADJ[i] == 0
          then   LV_SWI_CLC_LSL_OFS_ADJ[i] = 1
    
```

```

        VLS_COR_TMP_LSL[i] = VLS_COR_H_RES_LSL[i]
    else
        LV_SWI_CLC_LSL_OFS_ADJ[i] = 0
        VLS_COR_MV_LSL[i] = ( VLS_COR_H_RES_LSL[i]
                            + VLS_COR_TMP_LSL[i] ) /2
        LV_LSL_UP_SHO_PER_REQ[i] = 0
        LAMB_LS_UP[i] = IP_LAMB_LS_UP
    endif
endif
endif

```

**(end of calculations in case of LC\_VLS\_COR\_MV\_LSL\_ACT = 1)**

**Calculation in case of LC\_VLS\_COR\_MV\_LSL\_ACT = 0**

```

if          LV_VLS_UP_INIT[i] == 1 ( gain switching is currently taking place )
or          LV_SWI_GAIN_LSL_IF[i] STATE_LSL_IF_SPI_RD[i] ( bit SWI_GAIN )
or          LV_LSL_OFS_ADJ_ACT[i] == 1 ( OA mode of WRAF controller active )
then
    VLS_COR_TMP_LSL[i]n = VLS_COR_TMP_LSL[i]n-1
    VLS_COR_MV_LSL[i]n = VLS_COR_MV_LSL[i]n-1
    LV_LSL_UP_SHO_PER_REQ[i] = 1
    LAMB_LS_UP[i]n = LAMB_LS_UP[i]n-1
    T_INI_DLY_LSL_SIG_ACQ[i] = C_T_INI_DLY_LSL_SIG_ACQ
else
    if          T_INI_DLY_LSL_SIG_ACQ[i] > 0
    then
        decrement T_INI_DLY_LSL_SIG_ACQ[i]
        VLS_COR_TMP_LSL[i]n = VLS_COR_TMP_LSL[i]n-1
        VLS_COR_MV_LSL[i]n = VLS_COR_MV_LSL[i]n-1
        LV_LSL_UP_SHO_PER_REQ[i] = 1
        LAMB_LS_UP[i]n = LAMB_LS_UP[i]n-1
    else
        VLS_COR_TMP_LSL[i] = VLS_COR_H_RES_LSL[i]
        VLS_COR_MV_LSL[i] = VLS_COR_H_RES_LSL[i]
        LV_LSL_UP_SHO_PER_REQ[i] = 0
        LAMB_LS_UP[i] = IP_LAMB_LS_UP
    endif
endif

```

**(end of calculations in case of LC\_VLS\_COR\_MV\_LSL\_ACT = 1)**

Set LAMB\_LS\_UP\_MIN\_TMP = 32, and LAMB\_LS\_UP\_MV\_TMP = 0, i\_ctr\_tmp = 0, prior to execution of FOR loop depending on [i].

```

LAMB_LS_UP_MIN_TMP = MIN ( LAMB_LS_UP[i], LAMB_LS_UP_MIN_TMP )
LAMB_LS_UP_MIN = LAMB_LS_UP_MIN_TMP
LAMB_LS_UP_MV_TMP = LAMB_LS_UP_MV_TMP + LAMB_LS_UP[i]
increment          i_ctr_tmp
LAMB_LS_UP_MV = LAMB_LS_UP_MV_TMP / i_ctr_tmp

```

## 7.43 O2 sensor (lin, up) signal compensation and conversion (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_LSL_OFS_ADJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that upstream oxygen sensor Ip offset adjustment shall be inhibited					
T_HOM_ACT_OFS_ADJ	O/V	0... FFFFH	0... 655.35	0.01	s
Time in homogenous mode for enabling offset adjustment					

### Input data:

C_T_DLY_TTIP_MES_ OBD_LSH_UP {p. 5440}	C_T_DLY_TTIP_RES_ OBD_LSH_UP {p. 5440}	LV_HOM_ACT {p. 8136}	LV_LAM_AD_INJ_ACT {p. 3348}
STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 956}			

### FUNCTION DESCRIPTION:

#### General information:

The calculation shall be done for all exhaust cylinder banks.  
For instance, if two separate catalyst systems are concerned  
(NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

The Boolean flag LV\_INH\_LSL\_OFS\_ADJ[i] shall indicate whether the upstream oxygen sensor Ip offset adjustment shall be permitted to take place.

When set, Ip offset adjustment shall be inhibited.

#### Description:

#### Application conditions:

##### Initialisation:

The following initialisation shall be carried out **after RESET**, **after engine start**, or **upon erase of error management**.

LV\_INH\_LSL\_OFS\_ADJ [i] = 0


T\_HOM\_ACT\_OFS\_ADJ = max phys. value

##### Recurrence:

T\_SAMPLE = 10ms

##### Activation:

LV\_ST\_END == 1

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Deactivation:

--

**Formula section:**

```


IF                LV_HOM_ACT = 0
THEN             T_HOM_ACT_OFS_ADJ = 0
ELSE             increment T_HOM_ACT_OFS_ADJ (timer shall saturate at max phys. limit)
ENDIF

```

```

if                STATE_LSL_IF_SPI_RD[i] bit LSL_ENA == 0
or                LV_LAM_AD_INJ_ACT = 1
or                (T_HOM_ACT_OFS_ADJ <= (C_T_DLY_TTIP_MES_OBD_LSH_UP + C_T_DLY_TTIP_RES_
OBD_LSH_UP))
then             LV_INH_LSL_OFS_ADJ[i] = 1
else             LV_INH_LSL_OFS_ADJ[i] = 0
endif

```

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## 7.44 O2 sensor (up) operability detection

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_DE_INT_LS_UP_READY [NC_CBK_EX_NR]	V	0... FFFFH	0... 63.9990234	97.6563e3	-
Value as a measure of the sensor signal variation vs. time					
LAMB_MV_LS_UP_READY [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234	97.6563e3	-
Mean value of the converted upstream oxygen sensor signal in terms of A/F ratio					
LV_LS_UP_READY [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable for operative readiness of upstream oxygen sensor					
LV_LS_UP_READY_CDN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable for forced operative readiness of upstream oxygen sensor					
LV_LS_UP_READY_RAW [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable for raw operative readiness of upstream oxygen sensor					
LV_LSL_UP_ERR_SUSP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
error suspicion of upstream oxygen sensor signal, set reduced limitation of Lambda controller					
LV_LSL_UP_SUSP_ENA [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Enable setting of LV_LSL_UP_ERR_SUSP once the WRAF sensor is ready					
LV_TEG_MIN_DLY [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable indicating sufficient delay after dew point detection prior to forced sensor activation					
T_DLY_CHK_LS_UP_READY [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Delay timer for start of readiness detection after engine start					
T_DLY_LS_UP_READY_TEG_MIN [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Delay time after dew point detection prior to forced sensor activation					
T_LAMB_DE_INT_RST [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer for duration of summation of sensor signal dispersion up to reset thereof					
T_TOUT_LS_UP_READY [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer for forced activation of linear lambda sensor					

### Input data:

LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_ERR_TTIP_MES_LSH_ UP [NC_CBK_EX_NR] {p. 5438}	LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}
LV_LSL_DEAC [NC_CBK_EX_NR] {p. 955}	LV_PUC {p. 1720}	LV_ST_END {p. 1720}	LV_TEMP_DEW_LS_UP [NC_CBK_EX_NR] {p. 1007}
LV_TTIP_MES_VLD_LS_ UP [NC_CBK_EX_NR] {p. 1320}	LV_V_REF_VLD_R_IT_LS_ UP [NC_CBK_EX_NR] {p. 1320}	MAF_INT_PUC_ACT {p. 2942}	NC_CBK_EX_NR {p. 1829}
STATE_ERR_IPLSL [NC_CBK_EX_NR] {p. 955}	STATE_LSH_UP [NC_CBK_EX_NR] {p. 2385}	STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 956}	TCO_ST {p. 1100}
TTIP_MES_LS_UP [NC_CBK_EX_NR] {p. 1321}			

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**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_LAMB_LS_UP_READY	-	0... FFH	0... 0.99609375	0.00390625	-
Correlation constant for mean value calculation of lambda sensor output signal					
C_LAMB_DE_INT_THD_LS_UP_READY	-	0... FFFFH	0... 63.9990234	97.6563e3	-
Sensor signal dispersion threshold for readiness detection					
C_LAMB_THD_MAX_LS_UP_READY	-	0... 7FFFH	0... 1.99902344	97.6563e3	-
Upper threshold of sensor signal for readiness detection					
C_LAMB_THD_MIN_LS_UP_READY	-	0... 7FFFH	0... 1.99902344	97.6563e3	-
Lower threshold of sensor signal for readiness detection					
C_MAF_INT_PUC_MAX_LS_UP_READY	-	0... FFFFH	0... 2912.67	0.04444444	g
Maximum MAF integral value during PUC used for reset of operability					
C_T_DLY_LS_UP_READY_TEG_MIN	-	0... FFFFH	0... 1310.7	0.02	s
Threshold of delay time after dew point detection prior to forced sensor activation					
C_T_LAMB_DE_INT_RST	-	0... FFFFH	0... 1310.7	0.02	s
Time for sensor dispersion calculation up to reset					
C_TTIP_MIN_LS_UP_READY	-	8000... 7FFFH	0... 2047.94	0.0625	°C
Minimum oxygen sensor ceramic temperature for safe operation					
ID_T_DLY_CHK_LS_UP_READY	-	0... FFFFH	0... 1310.7	0.02	s
LDP_TCO_ST_ID_T_DLY_CHK_LS_UP	8	0... FEH	0... 142.5	0.75	°C
Delay time for begin of readiness detection after engine start					
ID_T_TOUT_LS_UP_READY	-	0... FFFFH	0... 1310.7	0.02	s
LDP_TCO_ST_ID_T_TOUT_LS_UP	4	0... FEH	0... 142.5	0.75	°C
Time out constant for readiness detection > forced readiness detection					
LC_TEG_MIN_DEAC	-	0... 1H	0 ...1	1	-
Test switch to disable dependance of readiness detection on dew point detection					
LC_TEG_MIN_THD_DEAC_TEST	-	0... 1H	0 ...1	1	-
Test switch to check function behaviour at revocation of dew point					

**FUNCTION DESCRIPTION****General information:**

This is a particular **version for linear oxygen sensors to be used if the oxygen sensor ceramic temperature is determined by internal resistance measurement of the Nernst cell**. It requires that the oscillator can be switched on and off depending on LV\_LS\_UP\_READY\_RAW[i] which is determined in this function.

The operability check for the lambda sensor shall detect the moment at which the sensor reaches principal ability to generate plausible output signals ( once pump current control loop has successfully been activated! ). It shall analyse the sensor signal and distinguish between two stages of operative readiness. The criterion for raw sensor operability may be the variation of the sensor signal as well as the crossing of a maximum or minimum threshold by the sensor signal or simply when a delay has been exceeded. When the raw operative readiness has been sensed, the full operative readiness shall be determined by waiting until the minimum oxygen sensor ceramic temperature for safe sensor operation has been reached.

The calculation shall be done for all exhaust cylinder banks.


For instance, if two separate catalyst systems are concerned ( NC\_CBK\_EX\_NR = 2 ) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

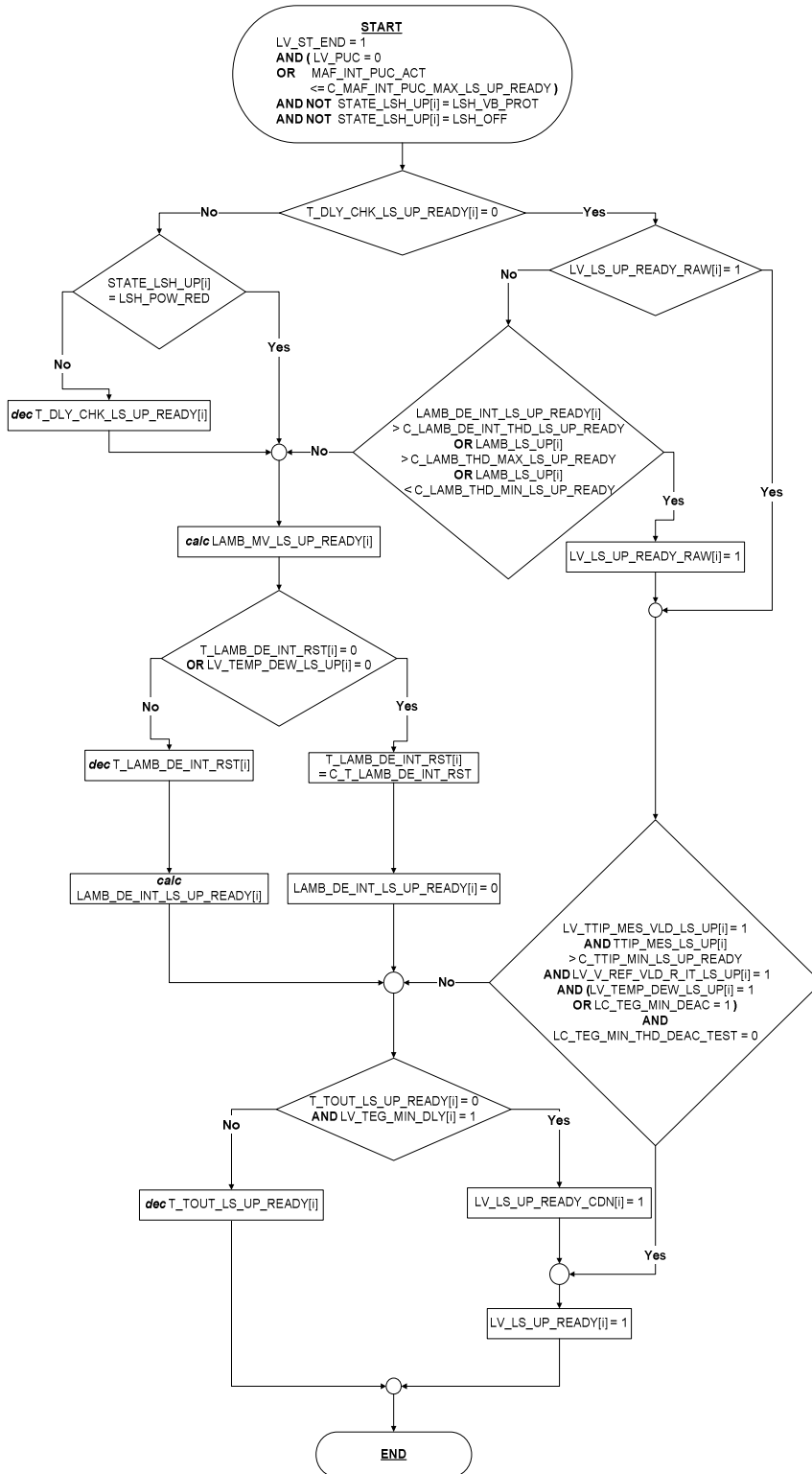
otherwise ( NC\_CBK\_EX\_NR = 1 )

i = 1, for single exhaust cylinder bank.

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Signal flow diagram:



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Description:

The function shall be activated with the following conditions being fulfilled:

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Engine start is left, i.e. "exit START" ( LV\_ST\_END = 1 ) and  
 Upstream heater has left the batteryvoltage protection mode ( STATE\_LSH\_UP[i] LSH\_VB\_PROT )  
 and  
 Upstream heater is not in off mode ( STATE\_LSH\_UP[i] LSH\_OFF ) and  
 Threshold value of MAF integral is not exceeded during PUC.  
 The function shall be deactivated once any one of these conditions is not fulfilled anymore.  
 Function restart shall also take place upon erase of error management.  
 Precondition for starting the operability check is that the delay time ID\_T\_DLY\_CHK\_LS\_UP\_READY  
 has expired.

The sensor is subsequently recognized as being fully operable ( LV\_LS\_UP\_READY[i] = 1 ) if

(  
 the value LAMB\_DE\_INT\_LS\_UP\_READY[i] exceeds the threshold  
 C\_LAMB\_DE\_INT\_THD\_LS\_UP\_READY once  
**OR** if the sensor output signal LAMB\_LS\_UP[i] exceeds the window defined by  
 the limiting values C\_LAMB\_THD\_MIN\_LS\_UP\_READY and  
 C\_LAMB\_THD\_MAX\_LS\_UP\_READY

< This state is called raw sensor operability ( LV\_LS\_UP\_READY\_RAW[i] = 1 )  
 >

**AN  
D**

the value for ceramic temperature is valid ( LV\_TTIP\_MES\_VLD\_LS\_UP[i] = 1 )  
 )

**AND** the value of the reference voltage is valid ( LV\_V\_REF\_VLD\_R\_IT\_LS\_UP[i] = 1 )  
**AND** the temperature of the sensor is higher than a threshold ( TTIP\_MES\_LS\_UP[i] > C\_TTIP\_MIN\_LS\_UP\_READY )

**AN  
D**

the dew point was exceeded ( LV\_TEMP\_DEW\_LS\_UP[i] = 1 )  
**OR** LC\_TEG\_MIN\_DEAC = 1 ( only for test purpose in conjunction with forced  
 sensor heating prior to engine start! )

**AN  
D**


LC\_TEG\_MIN\_THD\_DEAC\_TEST = 0

)  
**OR**

the timer for forced activation has expired ( T\_TOUT\_LS\_UP\_READY[i] = 0 )  
**AND** dew point was exceeded ( LV\_TEMP\_DEW\_LS\_UP[i] = 1 ) for certain  
 time delay ( LV\_TEG\_MIN\_DLY[i] = 1 )  
 < This state is called forced sensor operability ( LV\_LS\_UP\_READY\_CDN[i] =  
 1 ) >

The logical value LV\_LS\_UP\_READY\_RAW[i] detects changes in sensor signal as basis for recognition  
 of the raw sensor operability.

**REMARK:** The CARB has defined that the sensor must be recognized as being operable after a certain  
 time upon engine start. This requirement is realized using the timer T\_TOUT\_LS\_UP\_READY[i].

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If the timer has expired the sensor will be set operable (  $LV\_LS\_UP\_READY[i] = 1$  ) and in addition the conditional readiness bit (  $LV\_LS\_UP\_READY\_CDN[i]$  ) will be set to 1 , initializing the forced activation of sensor.

The flag  $LV\_LSL\_UP\_ERR\_SUSP[i]$  indicates that a fault may be present in the sensor, which is not yet debounced but may lead to wrong lambda measurement. It may be used to restrict the usage of the sensor signal by functions like lambda control or adaptation or diagnosis functions. The detection of these conditions is effectively masked with  $LV\_LSL\_UP\_SUSP\_ENA[i]$ , which ensures that  $LV\_LSL\_UP\_ERR\_SUSP[i]$  is not set during sensor warmup.

### Application Condition

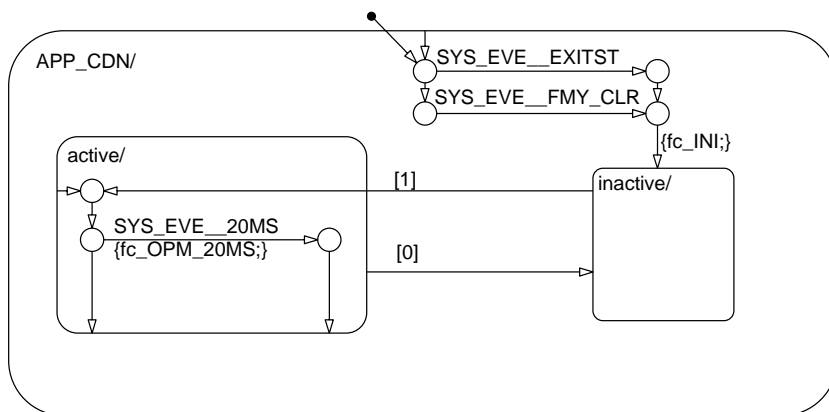


Figure 7.44.1: EGCP\_DTSYSLSL0/APP\_CDN/Chart

### Function Description

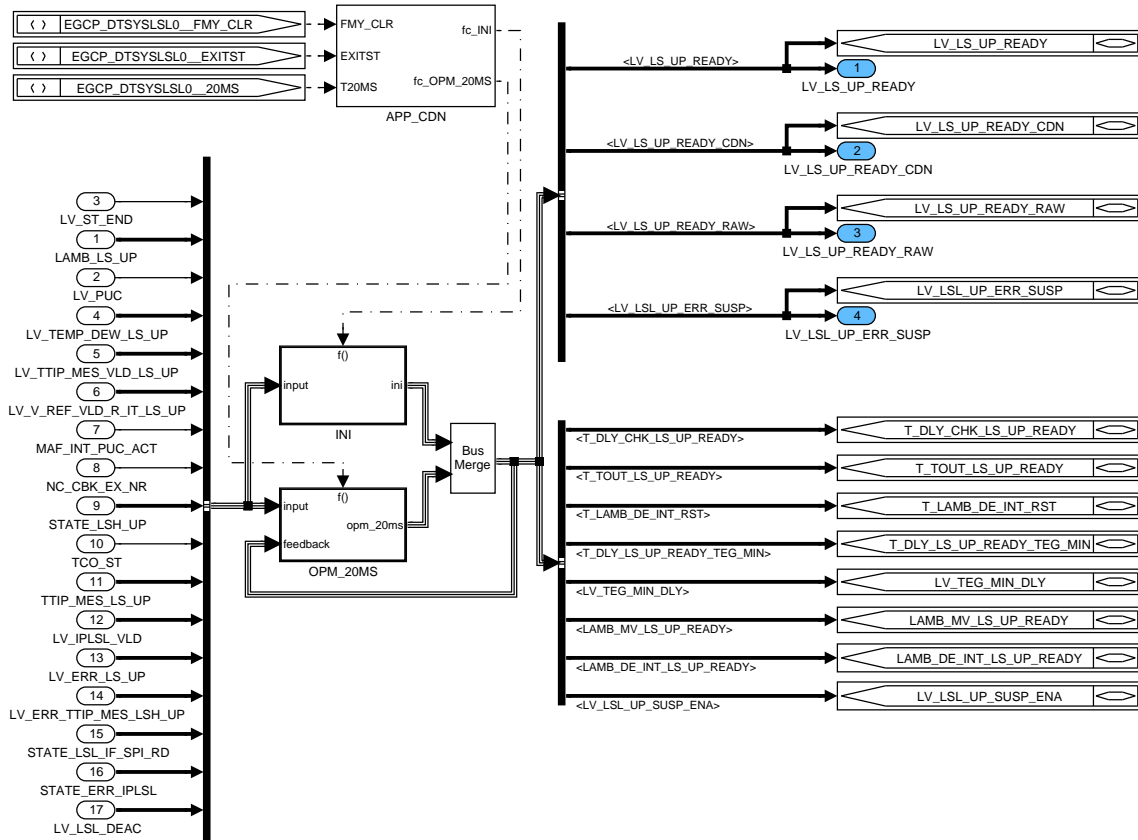


Figure 7.44.2: EGCP\_DTSYSLSL0

### 7.44.1 INITIALIZATION

#### Initialization at reset and cleaning of fault memory

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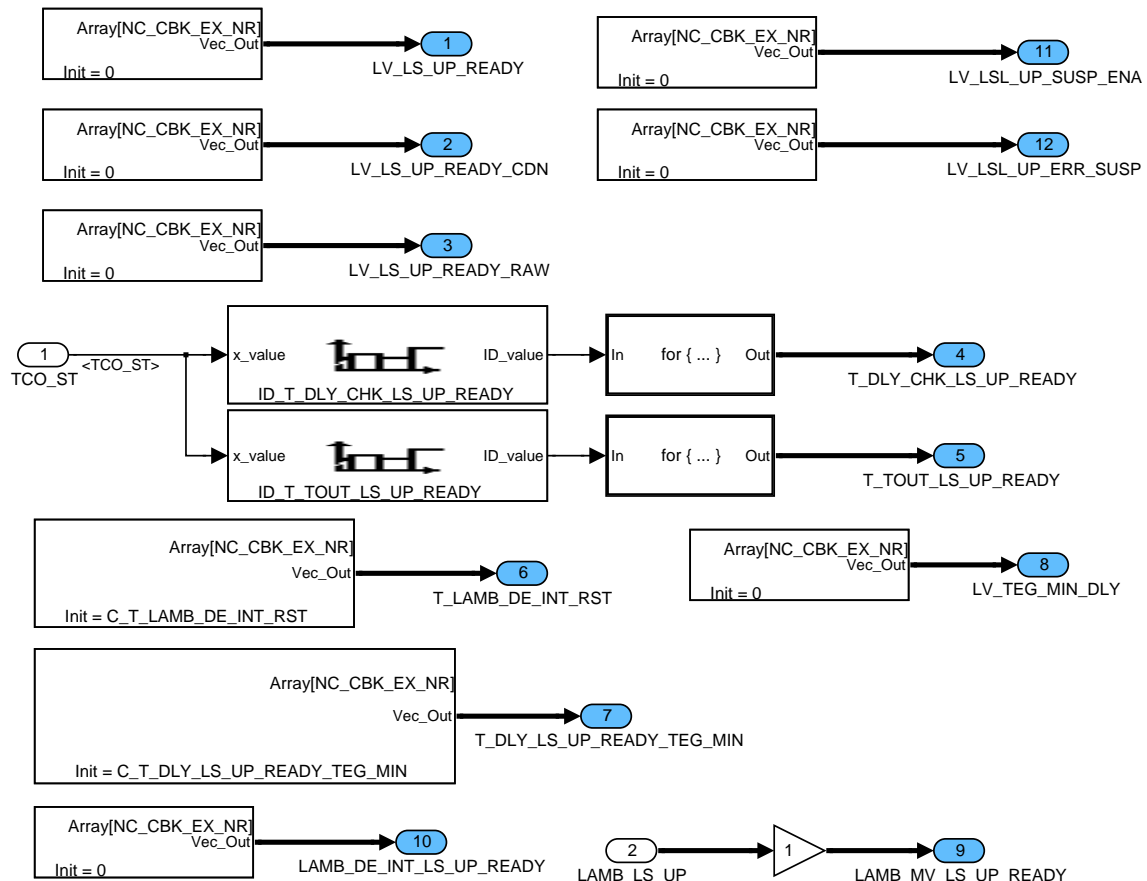


Figure 7.44.3: EGCP\_DTSYLSL0/INI/INI

## 7.44.2 FORMULA SECTION

Content of the formula section:

SECTION 1: Check of the general condition for initialization or activation

SECTION 2: Calculation active (FCN\_ACT)

SECTION 2.1: Check of full operative readiness

SECTION 2.2: Check of sensor readiness

SECTION 2.2.1: Readiness detection (READ\_DET)

SECTION 2.2.1.1: Check of the delay time for start of readiness

SECTION 2.2.1.2: Calculation of mean value and sensor signal variation

SECTION 2.2.1.3: Calculation of the delay time after dew point detection

SECTION 2.2.1.4: Forced operative readiness

SECTION 2.3: Generation of signal quality flags

SECTION 3: Initialization due to MAF integral exceeding during PUC (INI\_MAF\_INT\_EXC)

SECTION 4: Initialization in case calculation not active (INI\_VL\_PROT)

### SECTION 1: Check of the general condition for initialization or activation

fc\_FCN\_ACT triggers the calculation of whole Section 2

fc\_INI\_MAF\_INT\_EXC triggers the calculation of Section 3

fc\_INI\_VL\_PROT triggers the calculation of Section 4

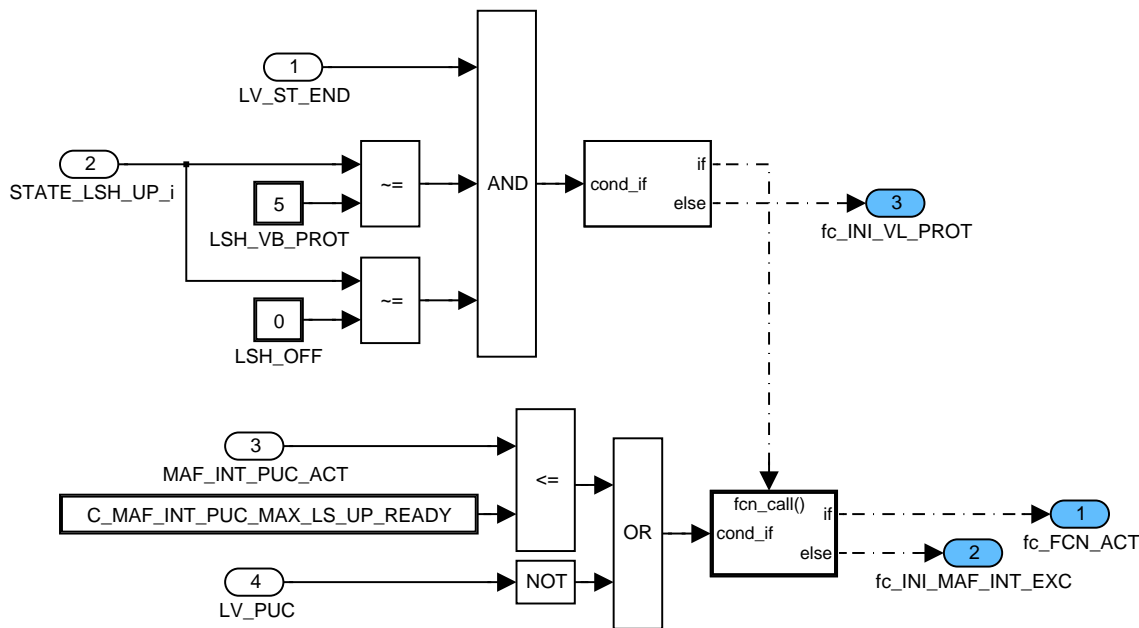


Figure 7.44.4: EGCP\_DTSYSLSL0/OPM\_20MS/FLP/OPM/CHK\_ACT\_CDN

**SECTION 2: Calculation active (fc\_FCIN\_ACT)**

**SECTION 2.1: Check of full operative readiness**

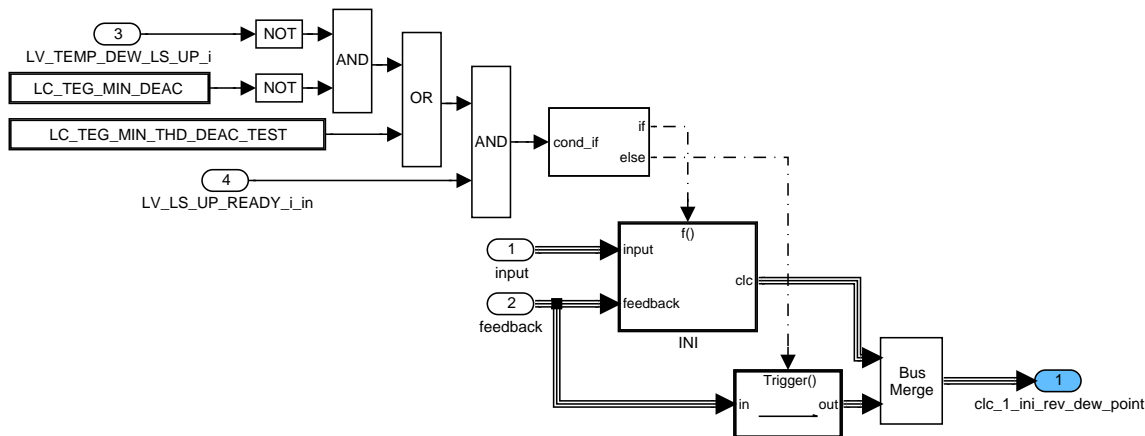



Figure 7.44.5: EGCP\_DTSYSLSL0/OPM\_20MS/FLP/OPM/CLC\_OPER\_DET\_FOR\_LLS/FCIN\_ACT/CLC\_1\_INI\_REV\_DEW\_POINT

**Initialization due to revocation of dew point upon successful initial detection of full operative readiness**

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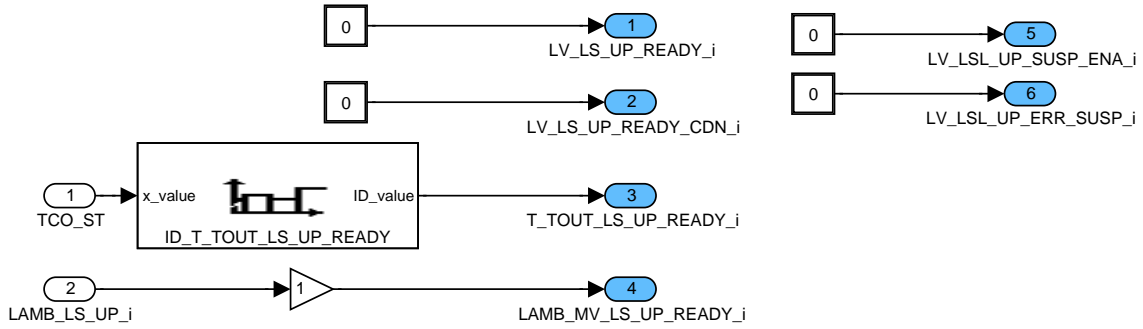


Figure 7.44.6: EGCP\_DTSYSLSL0/OPM\_20MS/FLP/OPM/CLC\_OPER\_DET\_FOR\_LLS/FCN\_ACT/CLC\_1\_INI\_REV\_DEW\_POINT/INI/INI

**SECTION 2.2: Check of sensor readiness**

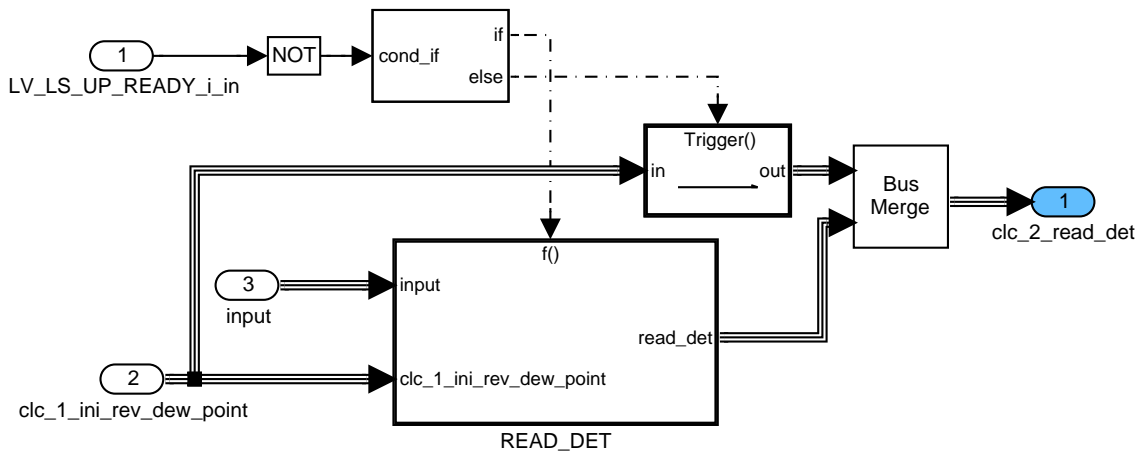



Figure 7.44.7: EGCP\_DTSYSLSL0/OPM\_20MS/FLP/OPM/CLC\_OPER\_DET\_FOR\_LLS/FCN\_ACT/CLC\_2\_READ\_DET

**SECTION 2.2.1: Readiness detection (READ\_DET)**

**SECTION 2.2.1.1: Check of the delay time for start of readiness**

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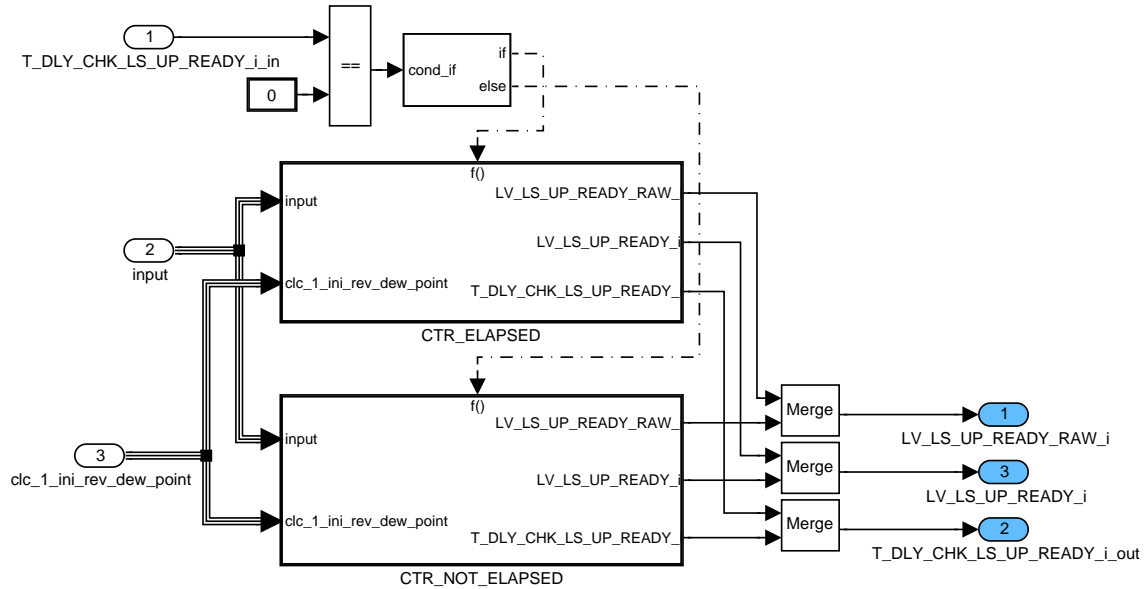


Figure 7.44.8: EGCP\_DTSYSLSL0/OPM\_20MS/FLP/OPM/CLC\_OPER\_DET\_FOR\_LLS/FCN\_ACT/CLC\_2\_READ\_DET/READ\_DET/CLC\_1\_T\_DLY\_CHK

**Delay time elapsed (CTR\_ELAPSED) - recognition of sensor operability**

The detection of sensor operability is done in two calculations:

Calculation 1: RAW sensor operability detection

Calculation 2: Full sensor operability detection

**Calculation 1: RAW sensor operability detection**

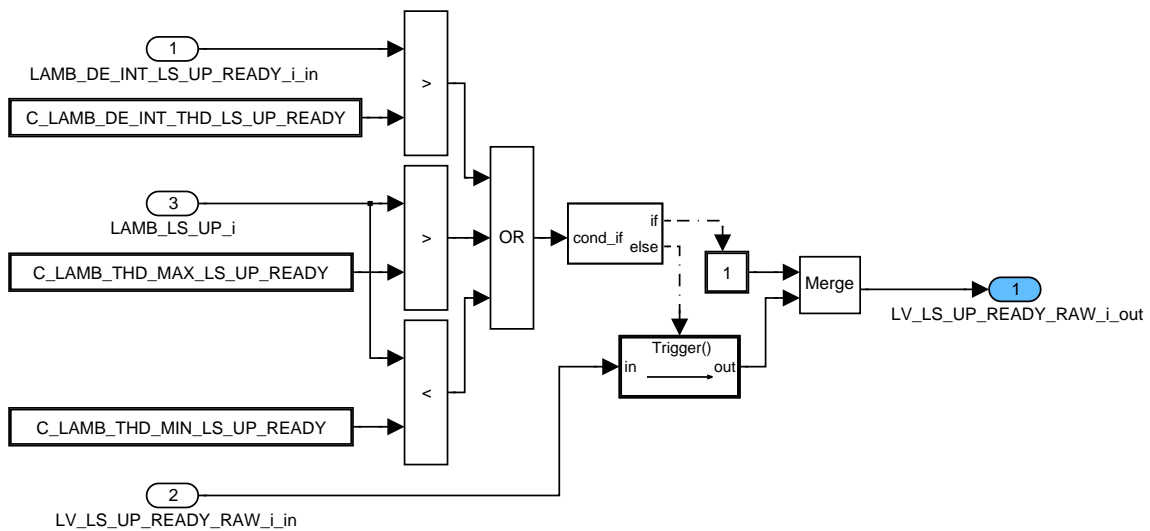


Figure 7.44.9: EGCP\_DTSYSLSL0/OPM\_20MS/FLP/OPM/CLC\_OPER\_DET\_FOR\_LLS/FCN\_ACT/CLC\_2\_READ\_DET/READ\_DET/CLC\_1\_T\_DLY\_CHK/CTR\_ELAPSED/CTR\_ELAPSED\_1

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**Calculation 2: Full sensor operability detection**

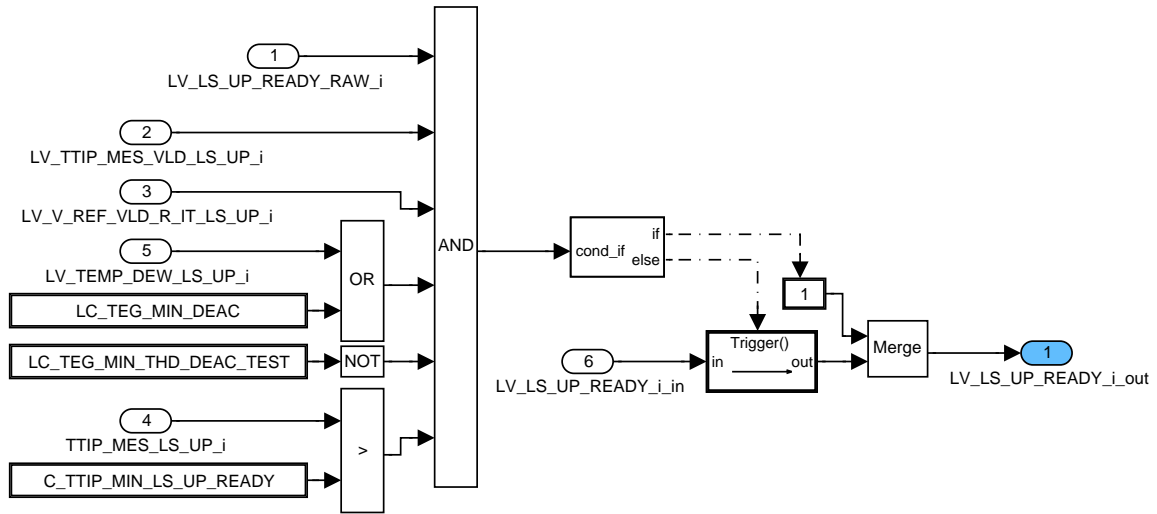


Figure 7.44.10: EGCP\_DTSYSL0/OPM\_20MS/FLP/OPM/CLC\_OPER\_DET\_FOR\_LLS/FCN\_ACT/CLC\_2\_READ\_DET/READ\_DET/CLC\_1\_T\_DLY\_CHK/CTR\_ELAPSED/CTR\_ELAPSED\_2

**Delay time not elapsed (CTR\_NOT\_ELAPSED)**

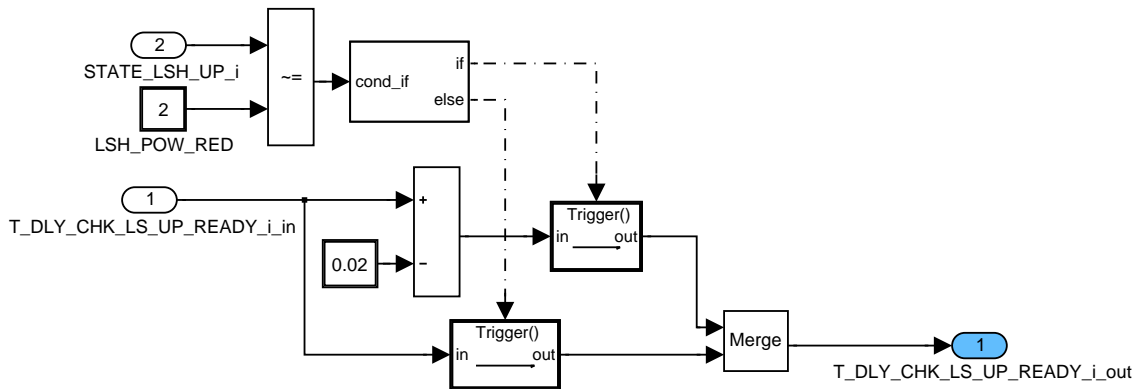


Figure 7.44.11: EGCP\_DTSYSL0/OPM\_20MS/FLP/OPM/CLC\_OPER\_DET\_FOR\_LLS/FCN\_ACT/CLC\_2\_READ\_DET/READ\_DET/CLC\_1\_T\_DLY\_CHK/CTR\_NOT\_ELAPSED/CTR\_NOT\_ELAPSED

**SECTION 2.2.1.2: Calculation of mean value and sensor signal variation**

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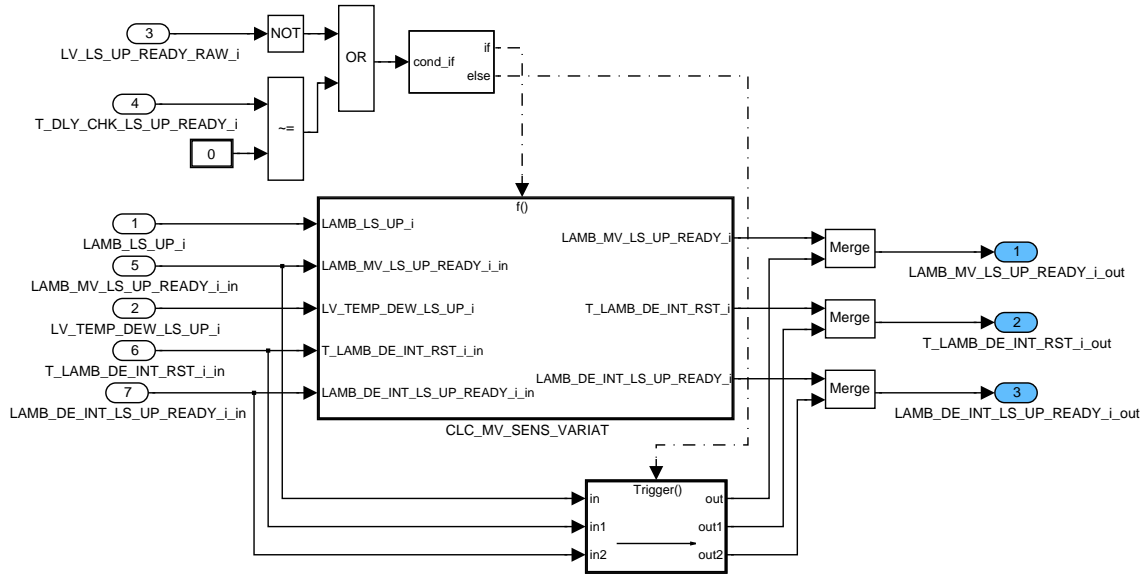


Figure 7.44.12: EGCP\_DTSYLSL0/OPM\_20MS/FLP/OPM/CLC\_OPER\_DET\_FOR\_LLS/FCN\_ACT/CLC\_2\_READ\_DET/READ\_DET/CLC\_2\_MV\_SENS\_SIG

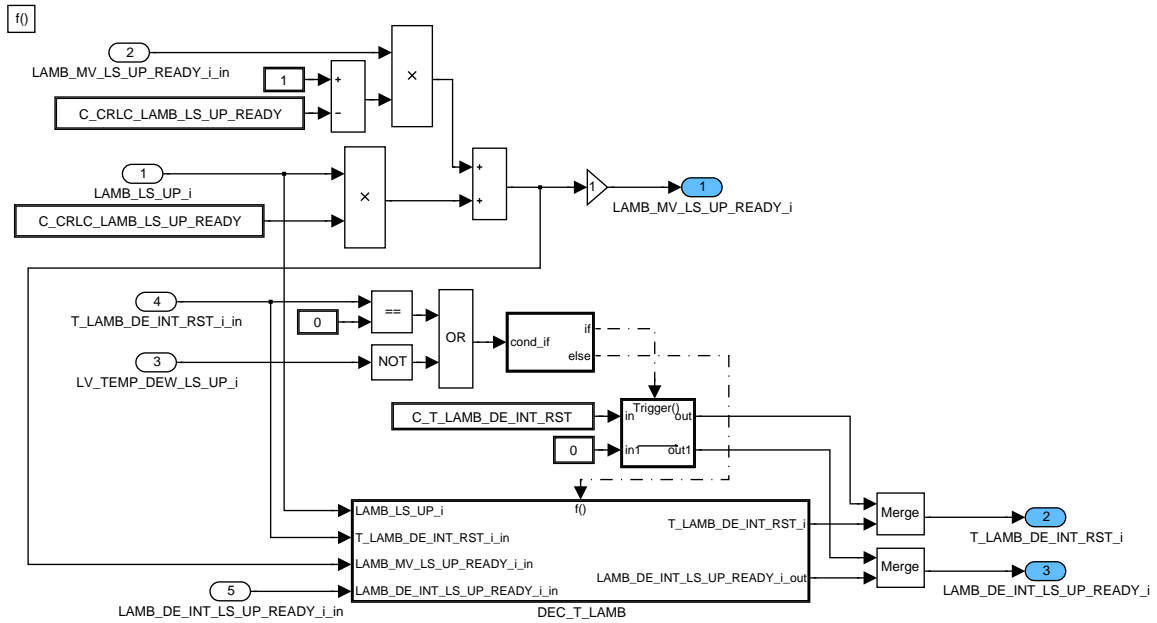


Figure 7.44.13: EGCP\_DTSYLSL0/OPM\_20MS/FLP/OPM/CLC\_OPER\_DET\_FOR\_LLS/FCN\_ACT/CLC\_2\_READ\_DET/READ\_DET/CLC\_2\_MV\_SENS\_SIG/CLC\_MV\_SENS\_VARIAT

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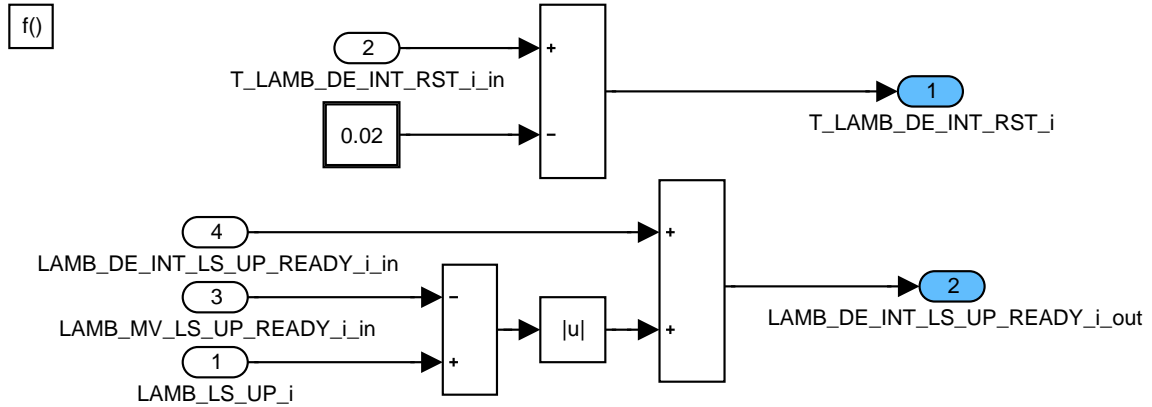


Figure 7.44.14: EGCP\_DTSYSLSL0/OPM\_20MS/FLP/OPM/CLC\_OPER\_DET\_FOR\_LLS/FCN\_ACT/CLC\_2\_READ\_DET/READ\_DET/CLC\_2\_MV\_SENS\_SIG/CLC\_MV\_SENS\_VARIAT/DEC\_T\_LAMB

**SECTION 2.2.1.3: Calculation of the delay time after dew point detection**

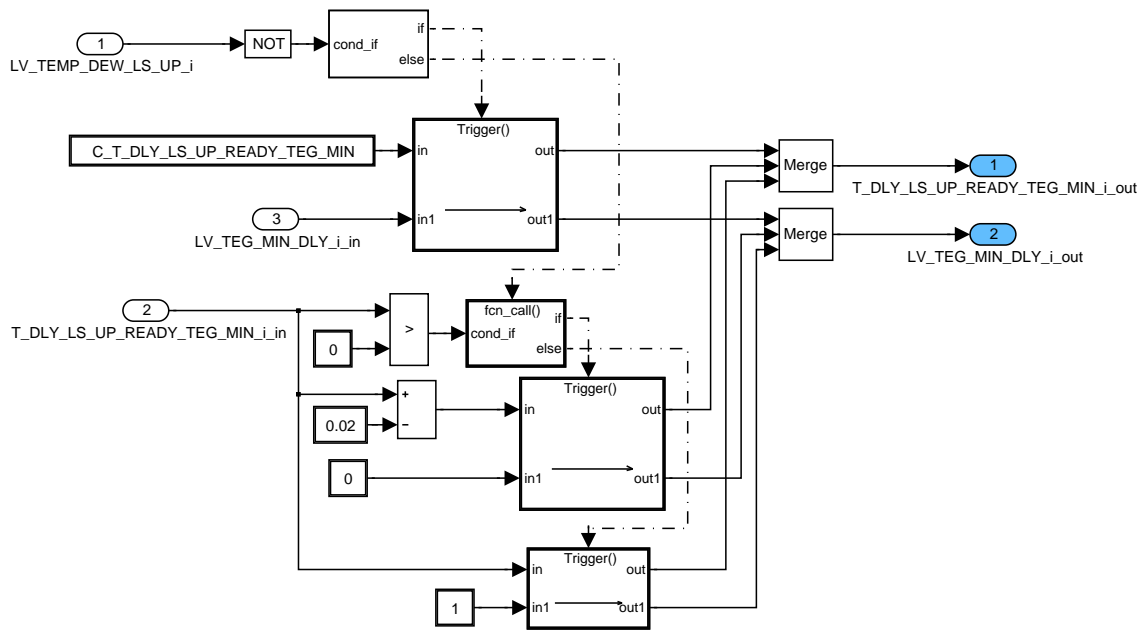


Figure 7.44.15: EGCP\_DTSYSLSL0/OPM\_20MS/FLP/OPM/CLC\_OPER\_DET\_FOR\_LLS/FCN\_ACT/CLC\_2\_READ\_DET/READ\_DET/CLC\_3\_DLY\_TIME

**SECTION 2.2.1.4: Forced operative readiness**

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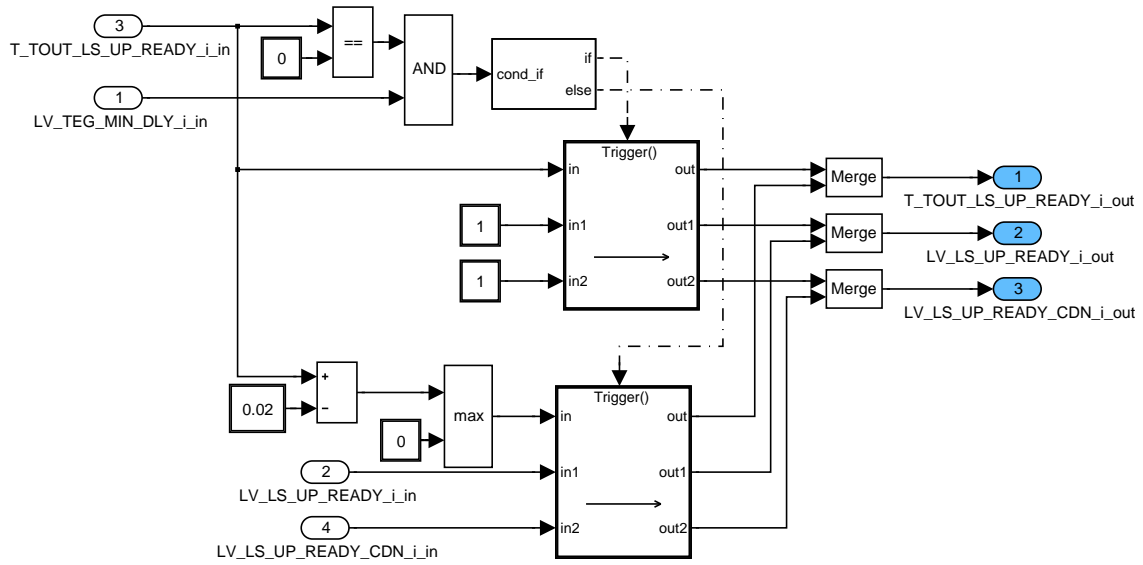


Figure 7.44.16: EGCP\_DTSYSLSL0/OPM\_20MS/FLP/OPM/CLC\_OPER\_DET\_FOR\_LLS/FCN\_ACT/CLC\_2\_READ\_DET/READ\_DET/CLC\_4\_CHK\_FORCE\_ACT\_SENS

**SECTION 2.3: Generation of signal quality flags**

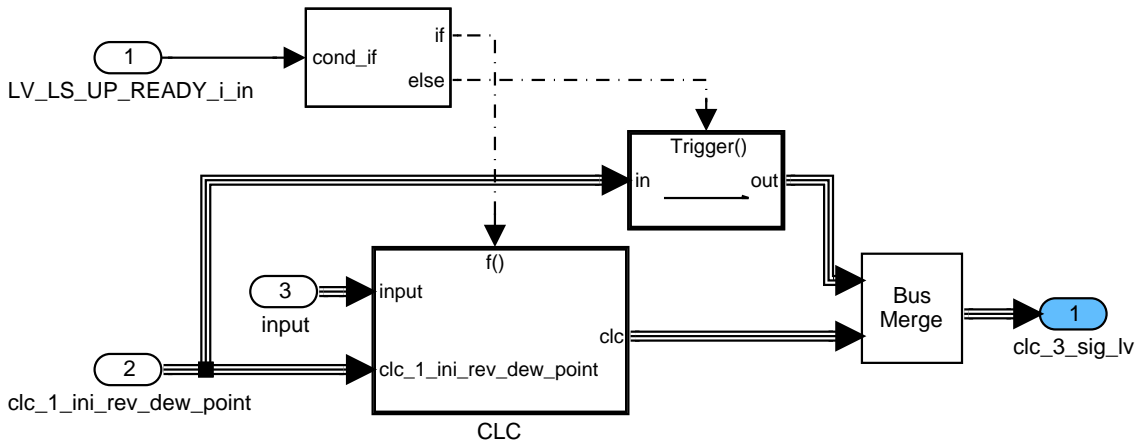


Figure 7.44.17: EGCP\_DTSYSLSL0/OPM\_20MS/FLP/OPM/CLC\_OPER\_DET\_FOR\_LLS/FCN\_ACT/CLC\_3\_SIG\_LV

**Calculation active (CLC)**

**Unlock the error suspicion flag**

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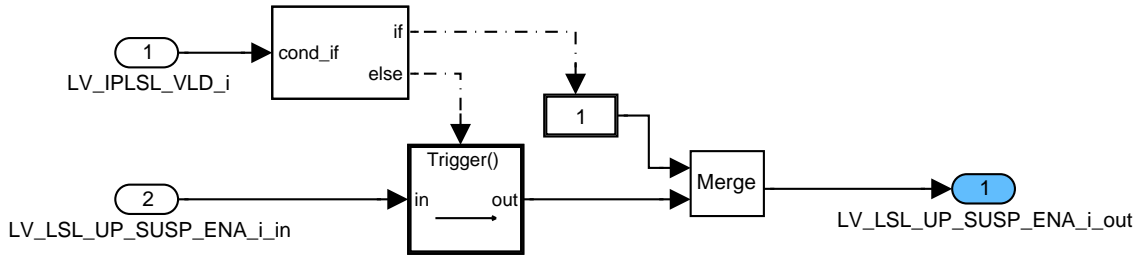


Figure 7.44.18: EGCP\_DTSYSLSL0/OPM\_20MS/FLP/OPM/CLC\_OPER\_DET\_FOR\_LLS/FCN\_ACT/CLC\_3\_SIG\_LV/CLC/CLC\_1\_IPLSL\_VLD

**Error suspicion present**

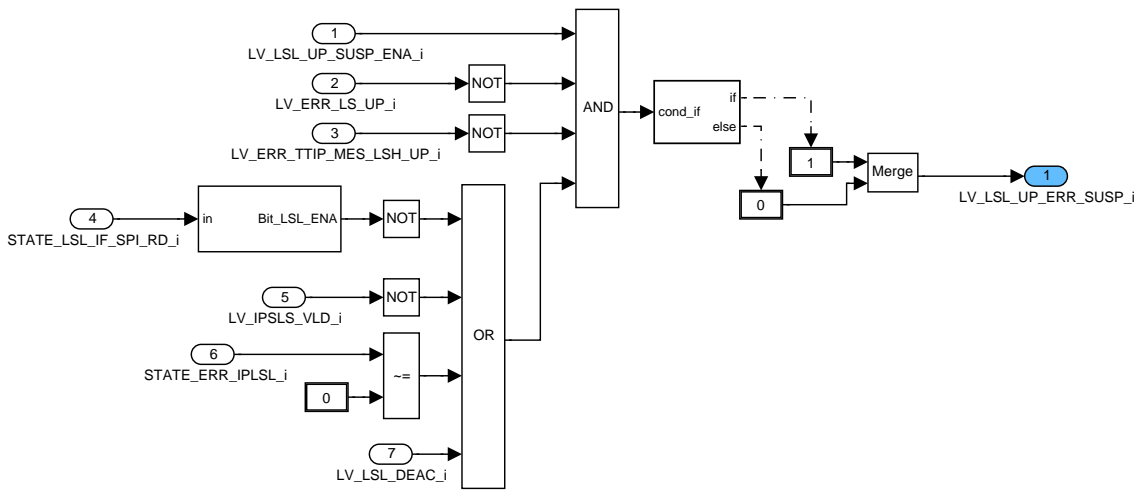


Figure 7.44.19: EGCP\_DTSYSLSL0/OPM\_20MS/FLP/OPM/CLC\_OPER\_DET\_FOR\_LLS/FCN\_ACT/CLC\_3\_SIG\_LV/CLC/CLC\_2\_ERR\_SUSP

**SECTION 3: Initialization due to MAF integral exceeding during PUC (fc\_INI\_MAF\_INT\_EXC)**

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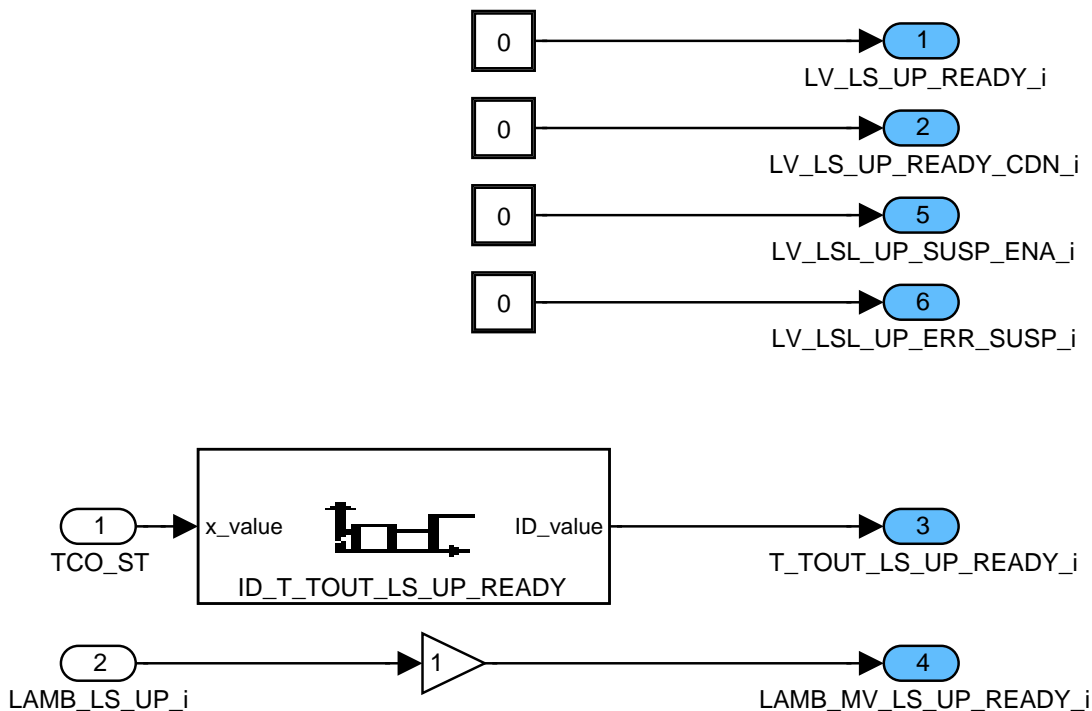


Figure 7.44.20: EGCP\_DTSYSLSL0/OPM\_20MS/FLP/OPM/CLC\_OPER\_DET\_FOR\_LLS/INI\_MAF\_INT\_EXC/INI\_MAF\_INT\_EXC

**SECTION 4: Initialization in case calculation not active (fc\_INI\_VL\_PROT)**

Initialization due to "Voltage protection" or "off" mode or "not yet left engine start"

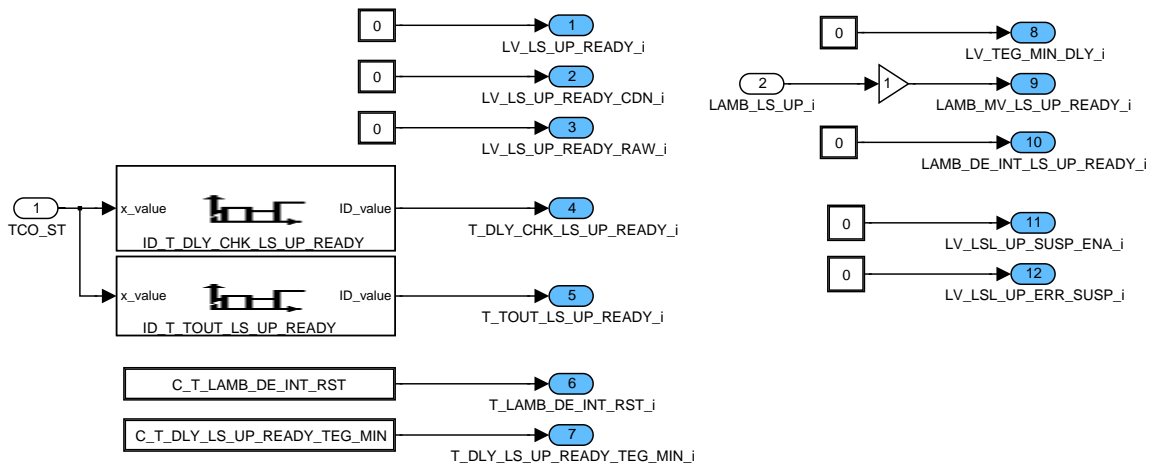


Figure 7.44.21: EGCP\_DTSYSLSL0/OPM\_20MS/FLP/OPM/CLC\_OPER\_DET\_FOR\_LLS/INI\_VL\_PROT/INI\_VL\_PROT

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## 7.45 O2 sensor (lin, up) operating strategy

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ICPLSL [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Counter used to approximate filling & emptying of WRAF sensor pumped reference area					
CTR_ICPLSL_MAX [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Delay for filling & emptying of WRAF sensor pumped reference area					
CTR_IPLSL_CTL_ENA_NR_CYC [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Cycle counter for pulsed activation of pump current					
CTR_IPLSL_CTL_ENA_PWM_OFF [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for duration of Ip off phase during pulsed activation of pump current					
CTR_IPLSL_CTL_ENA_PWM_ON [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for duration of Ip on phase during pulsed activation of pump current					
ICPLSL_LSL_IF [NC_CBK_EX_NR]	O/V	0... 1FH	0... 31	1	-
Value of the pumping current applied for filling of WRAF sensor oxygen reference area (lcp)					
LAMB_THD_TMP_VPLSL_LIM [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.99902	976.999e-6	-
Intermediate storage variable of threshold for Vp limitation in terms of lambda					
LAMB_THD_VPLSL_LIM [NC_CBK_EX_NR]	O/V/S	0... 7FFFH	0... 31.99902	976.999e-6	-
Threshold for Vp limitation in terms of lambda					
LV_ICPLSL_ENA_LSL_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag requesting activation /deactivation of reference pumping current (lcp)					
LV_ICPLSL_VLD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating that WRAF sensor pumped reference area is completely filled					
LV_IPLSL_CTL_ENA_LSL_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag requesting activation /deactivation of pumping current (Ip) controller					
LV_IPLSL_CTL_ENA_PLS_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that pulsed activation of pump current is active					
LV_IPLSL_CTL_INH_VNLSL_LIM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that pump current control is inhibited by active lcp cut-off /Vn overvoltage conditions					
LV_IPLSL_CTL_INH_VPLSL_LIM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that pump current control is inhibited by active active pumping voltage (Vp) limitation conditions					
LV_IPLSL_NOT_VLD_VB_L [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that increased heater-coupling due to permanent battery undervoltage might be present					
LV_IPLSL_VLD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that WRAF sensor pump current is valid					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAMB_LS_UP_ESTIM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable indicating limited accuracy of measured lambda signal					
LV_LAMB_LS_UP_VLD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that lambda signal from WRAF system is reliable and up-to-date					
LV_VPLSL_LIM_ACT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating active pumping voltage (Vp) limitation conditions					
R_IT_IPLSL [NC_CBK_EX_NR]	V	0... FFFFH	0... 16383.75	0.25	ohm
Calculated value of internal DC resistance of WRAF sensor pump cell					
T_DLY_IPLSL_CTL_ENA [NC_CBK_EX_NR]	V	0... FFH	0... 2.55	0.01	s
Delay timer for validation of Ip after enabling of Ip control loop, used to allow for signal settling					
T_DLY_VNLSL_LIM_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Timer for limitation of duration of Ip control loop inhibition due to lcp cut-off /Vn overvoltage conditions					
T_ICPLSL_DLY_PWL [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Delay timer for limited lcp supply during ECU power latch					
T_IPLSL_CTL_LSH_UP_MAN_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Timer for delay in activation of pump current control upon engine start in case of forced sensor pre-heating					
T_IPLSL_NOT_VLD_VB_L [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Delay timer for possible occurrence of increased heater coupling due to permanent battery undervoltage					
T_IPLSL_NOT_VLD_VB_L_THD [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Upper limit of delay timer for possible occurrence of increased heater coupling					
VPLSL [NC_CBK_EX_NR]	V	80... 7FH	-3.224... 3.19881	0.0251875	V
Calculated voltage across WRAF sensor pump cell ( Vp = VIP-VG )					

**Input data:**

CTR_ERR_LSL_IF_SPI_WR [NC_CBK_EX_NR] {p. 955}	IPLSL_COR [NC_CBK_EX_NR] {p. 2313}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}
LV_DIAG_OBD_SYM_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_IGK {p. 906}	LV_LAMB_STI_OFF_LSL_OFS_ADJ [NC_CBK_EX_NR] {p. 2313}
LV_LS_UP_READY [NC_CBK_EX_NR] {p. 2335}	LV_LS_UP_READY_CDN [NC_CBK_EX_NR] {p. 2335}	LV_LSH_UP_MAN_ACT [NC_CBK_EX_NR] {p. 2385}	LV_LSL_DEAC [NC_CBK_EX_NR] {p. 955}
LV_LSL_IF_SPI_RST_END [NC_CBK_EX_NR] {p. 1313}	LV_LSL_OFS_ADJ_ACT [NC_CBK_EX_NR] {p. 2313}	LV_SAP {p. 804}	LV_SAV {p. 804}
LV_ST_END {p. 1720}	LV_SWI_GAIN_LSL_IF [NC_CBK_EX_NR] {p. 2314}	LV_VLS_OFS_ADJ_ENA_LSL_IF [NC_CBK_EX_NR] {p. 2314}	LV_VLS_UP_INIT [NC_CBK_EX_NR] {p. 1341}
LV_VLS_UP_VLD [NC_CBK_EX_NR] {p. 1341}	LV_VNLSL_LIM [NC_CBK_EX_NR] {p. 955}	LV_VPLSL_LIM [NC_CBK_EX_NR] {p. 955}	MAF_KGH {p. 1195}




N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	R_IT_LS_UP [NC_CBK_EX_NR] {p. 1320}	SAF_KGH {p. 807}
STATE_ERR_IPLSL [NC_CBK_EX_NR] {p. 955}	STATE_LSH_UP [NC_CBK_EX_NR] {p. 2385}	STATE_LSL_IF_CONF_ SPI_RD [NC_CBK_EX_NR] {p. 956}	STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 956}
TTIP_MES_LS_UP [NC_CBK_EX_NR] {p. 1321}	VB {p. 1185}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_ICPLSL_DEC	-	0... FFH	0... 255	1	-
Decrement of counter used to approximate emptying of WRAF sensor oxygen reference area					
C_CTR_ICPLSL_INC	-	0... FFH	0... 255	1	-
Increment of counter used to approximate filling of WRAF sensor oxygen reference area					
C_CTR_ICPLSL_THD	-	0... FFFFH	0... 65535	1	-
Threshold of counter used to approximate filling state of WRAF sensor oxygen reference area during discharge					
C_CTR_IPLSL_CTL_ENA_NR_CYC	-	0... FFH	0... 255	1	-
Number of cycles for pulsed activation of pump current					
C_CTR_IPLSL_CTL_ENA_PWM_OFF	-	0... FFH	0... 255	1	-
Threshold for duration of Ip off phase during pulsed activation of pump current					
C_CTR_IPLSL_CTL_ENA_PWM_ON	-	0... FFH	0... 255	1	-
Threshold for duration of Ip on phase during pulsed activation of pump current					
C_ICPLSL_PWL_LSL_IF	-	0... 1FH	0... 31	1	-
Configuration of current to pump reference air (Icp) during power latch phase, or forced sensor pre-heating, resp.					
C_LAMB_SP_MAX_IPLSL_CTL_ENA	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Maximum value of lambda setpoint for activation of Ip control loop					
C_LAMB_SP_MIN_IPLSL_CTL_ENA	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Minimum value of lambda setpoint for activation of Ip control loop					
C_LAMB_THD_MAX_VNLSL_LIM	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Maximum value of lambda threshold for Vn overvoltage /reverse Icp cut-off monitoring					
C_LAMB_THD_MAX_VPLSL_LIM	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Maximum value of lambda threshold for Vp limitation					
C_MAF_KGH_MIN_LAMB_LS_UP_ESTIM	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Minimum MAF_KGH to guarantee sufficient sensor signal dynamics lambda-wise					
C_N_32_MAX_LAMB_LS_UP_ESTIM	-	0... FFH	0... 8160	32	rpm
N threshold above which limited accuracy of measured lambda signal is expected					
C_R_IT_IPLSL_AGI_ADD	-	0... FFFFH	0... 16383.75	0.25	ohm
Additive ageing constant for WRAF sensor internal pump cell DC resistance					
C_R_IT_IPLSL_AGI_FAC	-	0... FFH	0... 7.96875	0.03125	-
Multiplicative ageing factor for WRAF sensor internal pump cell DC resistance					
C_T_DLY_IPLSL_CTL_ENA	-	0... FFH	0... 2.55	0.01	s
Delay to be exceeded from switching on of pump current control to setting validity flag					
C_T_DLY_MAX_VNLSL_LIM_ACT	-	0... FFFFH	0... 655.35	0.01	s
Delay from determining Icp cut-off /Vn overvoltage to forced revocation of Ip control loop disable flag					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_ICPLSL_DLY_PWL	-	0... FFFFH	0... 655.35	0.01	s
Delay time for limited lcp supply during ECU power latch					
C_T_IPLSL_CTL_LSH_UP_MAN_ACT	-	0... FFFFH	0... 655.35	0.01	s
Delay time for activation of pump current control after engine start in case of forced sensor pre-heating					
C_T_IPLSL_NOT_VLD_VB_L_DEC	-	0... FFFFH	0... 655.35	0.01	s
Delay time for revocation of indicated increased heater coupling					
C_T_IPLSL_NOT_VLD_VB_L_INC	-	0... FFFFH	0... 655.35	0.01	s
Delay time for possible occurrence of increased heater coupling due to permanent battery undervoltage					
C_TTIP_MIN_LAMB_LS_UP_ESTIM	-	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Minimum element temperature for accurate compensation of measured lambda signal					
C_TTIP_THD_ICPLSL_INC_LS_UP	-	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Ceramic temperature above which lcp can be switched to elevated values ( warm sensor )					
C_TTIP_THD_IPLSL_ACT_LS_UP	-	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Ceramic temperature above which lp control loop may be activated					
C_VB_L_THD_IPLSL_NOT_VLD	-	0... FFH	0... 25.89843	0.1015625	V
Battery undervoltage threshold for possible increase of heater-coupling					
C_VB_MIN_IPLSL_CTL_ENA	-	0... FFH	0... 25.89843	0.1015625	V
Threshold value of battery voltage for accurate operation of ATIC42					
C_VPLSL_THD_VNLSL_LIM	-	80... 7FH	-3.224... 3.19881	0.0251875	V
Pumping voltage (Vp) threshold below which lcp cut-off /Vn overvoltage conditions are detected					
ID_CTR_ICPLSL_THD	V	0... FFFFH	0... 65535	1	-
LDP_TTIP_LS_IP_CTR_ICPLSL_THD	3	0... FFFFH	-2048... 2047.9375	0.0625	°C
LDP_ICPLSL_IP_CTR_ICPLSL_THD	3	0... 1FH	0... 31	1	-
Variable threshold of counter used to approximate filling & emptying of WRAF sensor pumped reference area					
ID_LSL_IF_ICPLSL_IPLSL_CTL_DI	V	0... 1FH	0... 31	1	-
LDP_LAMB_SP_IP_ICPLSL_IPLSL_DI	3	0... 7FFFH	0... 31.99902	976.999e-6	-
LDP_SAF_KGH_IP_ICPLSL_IPLSL_DI	3	0... FFFFH	0... 1023.98437	0.015625	kg/h
Configuration of current to pump reference air (lcp) with lp control disabled and warm WRAF sensor					
ID_LSL_IF_ICPLSL_WUP	V	0... 1FH	0... 31	1	-
LDP_LAMB_SP_IP_ICPLSL_WUP	3	0... 7FFFH	0... 31.99902	976.999e-6	-
LDP_SAF_KGH_IP_ICPLSL_WUP	3	0... FFFFH	0... 1023.98437	0.015625	kg/h
Configuration of current to pump reference air (lcp) with lp control disabled and cold WRAF sensor					
IP_LSL_IF_ICPLSL_IPLSL_CTL_ENA	-	0... 1FH	0... 31	1	-
LDP_LAMB_IP_ICPLSL_IPLSL_ENA	3	0... 7FFFH	0... 31.99902	976.999e-6	-
Configuration of current to pump reference air (lcp) with lp control enabled					
IP_R_IT_IPLSL	V	0... FFFFH	0... 16383.75	0.25	ohm
LDP_R_IT_LS_UP_IP_R_IT_IPLSL	8	0... FFFFH	0... 16383.75	0.25	ohm
LDP_LAMB_SP_IP_R_IT_IPLSL	8	0... 7FFFH	0... 31.99902	976.999e-6	-
Internal DC resistance of WRAF sensor pump cell					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_ICPLSL_ACT	-	0... 1H	0 ...1	1	-
Boolean flag indicating whether upstream WRAF sensors are of type pumped-reference or not					
LC_ICPLSL_ENA_LSL_IF	-	0... 1H	0 ...1	1	-
Boolean flag permitting manual activation /deactivation of pumped-reference current (lcp)					
LC_IPLSL_CTL_ENA_MAN_LSL_IF	-	0... 1H	0 ...1	1	-
Boolean flag requesting activation /deactivation of pump current control during manual control					
LC_IPLSL_CTL_ENA_MAN_SWI_LSL_IF	-	0... 1H	0 ...1	1	-
Boolean flag permitting manual activation /deactivation of pump current control					
LC_VB_L_SIM_MAN	-	0... 1H	0 ...1	1	-
Switch for simulation of battery undervoltage which can be used for function testing					

## FUNCTION DESCRIPTION:

### General information:

The purpose of this function is the management of supply of pumped reference current (lcp), and pump current (lp) control for ATIC42 WRAF sensor interface.

The lcp current is required by certain WRAF sensor types to provide a pumped oxygen reference for the Nernst cell sensing portion, as this is not provided by venting air into a chamber within the sensor. The value of the lcp current is programmed according to certain operating states of the WRAF system, and the lcp current is enabled or disabled.

lp current is a measure of lambda. The lp controller shall be required to meet stringent sensor protection requirements. For certain critical operating states of WRAF sensor, it may be undesirable to have the lp control active and hence the function shall enable /disable the lp control as required.

Both danger of implausible lambda measurement, e.g. due to signal saturation effects, and physical sensor destruction have to be detected and appropriate measures are taken.

lp control is activated with a repeated pulse routine to avoid excessive pumping voltage (Vp) supply at point of activation. During activation, some of the provided sensor protection mechanisms are inhibited because they would produce inappropriate results due to transient behaviour.

Validity of pumping current signal is judged depending on current state of WRAF system. Certain operating conditions lead to temporary revocation of validity flag, e.g. danger of increased heater-coupling on lp signal circuit due to longer term battery undervoltage.

In case of pumping voltage (Vp) across sensor pump cell violating certain bounds or of reverse lcp cut-off, lp control also has to be inhibited to avoid physical destruction of sensor element, i.e. by blackening effect of zirconia dioxide ceramic.

Two logical variables stating short term profound reliability of measured lambda signal, and signal accuracy level (regular /limited), resp., shall be provided.


### Description:

The function shall be activated once the transition from engine start to engine run has taken place and once the initialisation of the WRAF sensor 'ASW<=>BSW' interface has successfully been carried out. It shall stay active up to the end of ECU power latch.

Alternative activation of certain chapters shall take place in case of forced sensor pre-heating prior to engine start.

The function is split into ten main sections:

1. Activation of pumped reference current (lcp)
2. Value of pumped reference current ( Set lcp programming value )

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3. Determination of Icp cut-off conditions ( Overvoltage at sensor Vn pin )
4. Determination of required status of pump current (Ip) control loop
5. Activation of pump current (Ip) control loop
6. Possibility of increased heater-coupling due to permanent battery undervoltage
7. Validity of pump current (Ip)
8. Pumping voltage (Vp) limitation strategy
9. Provision of a cumulative logical variable LV\_LAMB\_LS\_UP\_VLD\_i for judgement of short term reliability of WRAF system lambda output signal.
10. Indication of regular /limited accuracy of measurement signal.

*Remark:* Below description of functional units within WRAF sensor control module aims to provide a general survey on physical backgrounds of sensor behaviour and derived actions for operational strategy. For related **variable names** please respect corresponding diagrams provided within **formula section**.

#### 1. Activation of pumped reference current

This section shall provide the Icp enable and appropriate programming value information to the WRAF sensor interface and indicate whether the pumped reference has been filled via corresponding validity flag.

Should the sensor type being used not have a pumped oxygen reference or a general WRAF sensor error has occurred, then this section shall be disabled, i.e. status flag for Icp validity is revoked, Icp is programmed to its minimum value, and Icp supply is deactivated.

If none of these two conditions is present, this section behaves as follows:

During pulsed Ip control activation only programming value of Icp is evaluated and no other change in Icp supply conditions is performed.

In case of permanent operation of Ip loop with no SPI fault present, sufficiently high battery voltage for accurate operation of ATIC42, and no Vn overvoltage in conjunction with under-run of rich lambda setpoint threshold present (occurrence is limited to rich atmosphere, forced Icp cut-off is automatically performed by ATIC42 HW), routine waits for successful mirroring of latest Icp status and programming value commands sent via SPI bus.

Once command transfer has been successful, Icp flow is requested, sensor element temperature has exceeded calibratable threshold, counter limit for filling time of pumped reference is determined. Latter condition can be replaced by OBD2 heater fault present in conjunction with operative sensor readiness (-> tip temperature not reliable), or in case of conditional operative readiness (-> forced sensor activation).

If repeated evaluation of corresponding index table (which depends on sensed element temperature and Icp programming value) leads to a higher value than adjusted before and pumped reference has not been filled completely yet, counter limit is increased. To force initial determination of counter limit this action is also performed when entering the condition with a filling counter value of zero.

Once Icp counter limit is reached the Icp valid flag is set, otherwise counter for Icp filling status is incremented.

General Icp activation is treated depending on engine condition (Icp active with engine running), status of forced sensor heating, and value of power latch delay timer. Latter provides for extended Icp supply after engine stop.


Next Subroutine Value of pumped reference current is executed to determine appropriate Icp programming value.

Should any of the following conditions hold true, filling status of pumped reference has to be verified: SPI command transfer fault, low battery voltage, Vn overvoltage in conjunction with under-run of rich lambda setpoint threshold, revocation of Icp activation, tip temperature drop below threshold.

If pumped reference area has been judged to be completely filled before, Icp counter limit is set to calibratable threshold which represents delay for emptying prior to revocation of 'Icp valid' status bit - to take into account for transient disturbances without immediate reset. Revocation takes place once counter has been decremented to zero.

In case of forced sensor pre-heating prior to engine start, simplified filling procedure of pumped reference is applied which bypasses certain conditions.

#### 1. Value of pumped reference current

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Icp value to be programmed is determined for four different operating states taking into account dependency of provided reference pumping current on (estimated) exhaust lambda and on sensor element temperature:

- Power Latch phase (engine stalled and forced sensor pre-heating inactive): Exhaust system filled with air; Ip control loop disabled. Icp supply is limited to calibratable delay time.
- Ip control active or pulsed activation thereof: Exhaust lambda provided by WRAF sensor.
- Ip control inactive, cold sensor: Exhaust lambda derived from combustion lambda setpoint (LAMB\_SP[i]) and additional secondary air flow (SAF\_KGH). For calibration it has to be taken into account that LAMB\_SP[i] does not represent composition of exhaust atmosphere present at linear oxygen sensor during activation of secondary air; under these conditions lean conditions prevail at sensor mounting location regardless of LAMB\_SP[i]!
- Ip control inactive, warm sensor, or OBD2 heater fault present in conjunction with operative sensor readiness (-> tip temperature not reliable), or in case of conditional operative readiness (-> forced sensor activation): same as above.

The influence of secondary air on exhaust lambda at sensor mounting position is taken into account for disabled Ip control loop.

Current status of Ip control loop is judged by evaluation of corresponding ATIC42 interface bit.

Distinction between cold and warm sensor is made by evaluation of calibratable ceramic temperature threshold.

As long as Ip control is in disabled state, Electromagnetic force (EMF) across sensor nernst cell adjusts itself in a range between 0 ... 1V depending on surrounding exhaust gas atmosphere - comparable to the behaviour of a binary type oxygen sensor. With enabled loop, EMF is controlled to be approx. -0mV constantly.

As a rule of thumb for conversion of Icp programming value to actual value of Icp current provided by ATIC42 (which is split between sensor nernst cell and shunt resistance within ATIC42 module which serves as voltage limitation for cold sensor) the following formula can be applied:

$$I_{cp} = (k + 1) * 5\mu A \quad \text{with } k: \text{Icp programming value.}$$

#### 1. Determination of Icp cut-off conditions

Under worst case tolerances and rich conditions, the potential at sensor pin VN may exceed the threshold up to which Icp generation can be guaranteed for sensors of pumped reference type. Under such circumstances the Icp may temporarily be reduced or even cut-off by ATIC42 protection mechanism. This may lead to lean Ip misindication and also to sensor damage.

ATIC42 2<sup>nd</sup> silicon provides for automatic Icp cut-off in case of Vn overvoltage and signals the presence of such a condition through its interface.


Hence when Icp cut-off is signaled to occur by ATIC42, Ip control shall be disabled reducing the potential Vp across the pump cell and thereby also reducing the potential at pin Vn.

The voltage Vp across the pump cell shall be modelled by multiplying the measured pump current Ip with the pump cell internal DC resistance obtained from the relationship between the internal resistance of the Nernst cell and the pump cell.

The pump cell DC internal resistance (Rip) shall be obtained from a mapping dependent on value of nernst cell inner resistance (Ri, representing sensor temperature), and lambda setpoint. Both internal resistances are linked by sensor temperature and design. Additionally the pump cell resistance is dependent on the sensor lambda environment, hence the lambda setpoint dependence. Preliminary Rip value is then multiplied by a factor and a constant is added. Both parameters permit the dependency of the resistances to be modified to take worst case ageing into account.

The pump cell voltage Vp shall be calculated by multiplying modelled Rip by corrected value of pump current Ip.

Providing that WRAF sensor is of pumped reference type, the function shall determine whether Icp cut-off conditions are already active. If true, then the condition shall only be deemed to no longer persist when Rip is less than the value stored once Icp cut-off conditions were determined (i.e. sensor element got hotter), or lambda setpoint is greater than (i.e. leaner) than the value stored once Icp cut-off conditions were determined. Or, if maximum duration of active Vp limitation is calibrated to be non-zero, when the internal timer TIMER\_2 has expired. In addition, for all three cases, VN overvoltage shall no longer be indicated by ATIC42. If all this holds true, then TIMER\_2 shall be stopped, the stored Rip and

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lambda setpoint values shall be reset and the Ip control inhibition flag revoked. Otherwise TIMER\_2 is decremented.

If the lcp cut-off conditions are inactive, and pulsed Ip control activation has been completed, calculated Vp voltage shall be compared to a minimum threshold. If this rich threshold is exceeded or Vn overvoltage is sensed by ATIC42 and rich environment is present at sensor (i.e. rich lambda setpoint threshold is under-run), lcp cut-off conditions may occur. Should they be present for longer than estimated emptying delay of pumped reference, TIMER\_2 shall be initialized, the current Rip and lambda setpoint values shall be stored, and Ip control inhibition flag shall be set.

#### 1. Determination of required status of pump current (Ip) control loop

This section shall collect the various requests for activation /deactivation of the Ip control loop and provide the information to the WRAF sensor interface.

The function shall provide for manual switching of the Ip control loop by means of logical constants. If manual activation is requested, subroutine Activation of pump current control loop is executed.

In case of automatic switching, no general WRAF sensor error present and running engine (or with activated forced sensor pre-heating), the function checks if pumped reference of a sensor requiring lcp is not completely filled yet, or if lcp cut-off or Vp limitation sensor protection routine is active (and forced sensor pre-heating is inactive). Either one of these conditions leads to Ip passivation by resetting corresponding ATIC42 interface bit. At the same time all variables needed for next Activation of pump current control loop are initialized.

Next the function shall determine whether the conditional operative readiness is set or pulsed Ip control activation is running. If so then the evaluation of further conditions related to sensor readiness and tolerated lambda setpoint range for Ip activation shall be skipped and Activation of pump current control loop shall be executed.

If former conditions are not present, then the function shall determine whether operative readiness is set (or forced sensor pre-heating is activated). If not, then the Ip control loop shall be deactivated.

Once oxygen sensor ceramic temperature is greater or equal to a calibratable threshold, Ip loop shall be enabled once lambda setpoint is located within calibratable bounds, or secondary air is active (providing for lean exhaust gas atmosphere), and Ip offset adjustment is not pending. The same action is taken once OBD2 heater fault is present (-> tip temperature not reliable). Otherwise Ip loop shall stay disabled.

Thus pumping voltage saturation because of high pumping current requirements for << >> 1 can be avoided at point of Ip control loop activation. During secondary air phase, output signal of WRAF sensor is used for monitoring purposes. Thus Ip loop has to be activated even at very lean surrounding atmosphere which is present at that time. In general pumping voltage saturation in lean direction is not critical for WRAF sensor operation in conjunction with ATIC42 as it is for rich atmosphere.

#### 1. Activation of pump current (Ip) control

In order to avoid excessive supply of pumping voltage Vp to WRAF sensor during switch-on of Ip control loop (which might lead to sensor destruction due to blackening effect for applied rich voltages  $V_p < 2V$ ), a pulsed activation with PWM-behaviour is provided.

For a calibratable number of cycles, ON- and OFF- phases of variable length are applied to WRAF sensor interface. Calibration can also be used to skip sensor protection mechanisms during one-time Ip switch-on for a certain time. In this case OFF-phase is of zero length.


#### 1. Indication of possibility for increased heater-coupling due to permanent battery undervoltage

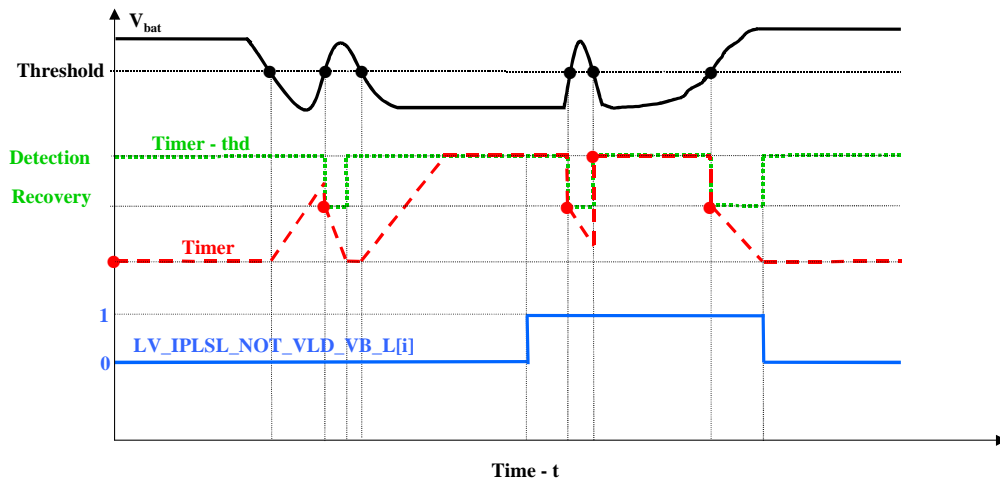
For the linear oxygen sensor BOSCH LSU4.9, up to and including Äp3.1, there is a danger that for longer term battery undervoltage in combination with maximum heater PWM, increased heater-coupling to the pumping current signal circuit of the sensor might appear.

This effect is related to ion migration within the sensor element due to long term application of a certain ion activation potential to negative sensor heater electrode which is of active low type.

Once regular battery voltage conditions are restored the exaggerated heater coupling vanishes within several seconds and returns to regular values.

A timer based detection strategy for possibility of increased heater coupling has been developed and is depicted in below figure.

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Once the critical battery undervoltage condition is met for a certain delay time after leaving engine start - usually also leading to high PWM values - pumping current validity shall be revoked.

Since detection and recovery might be linked to different delay times, timer threshold is switched depending on presence of battery undervoltage condition.

If recovery delay time is interrupted by repeated undervoltage condition the delay timer is set to and kept at detection threshold value.

Should time based thresholds for detection and recovery be calibrated identically, latter ist incremented for one step to avoid ambiguities within algorithm execution.

#### 1. Validity of pump current (Ip)

This section shall model the basic validity of the Ip current. For short term reliability of ATIC42 lambda output signal a special indicator bit is introduced in chapter 9.

The function shall check if a general WRAF sensor error is present or if a SPI error has occurred since the last function recurrence. Latter information is retrieved by comparison of corresponding error counter with its previously stored value. If the values differ from each other then current value shall be stored for next comparison, the internal timer TIMER\_1 and the Ip validity flag shall be reset.

If sufficient battery voltage for power supply of ATIC42 is available, function shall wait for the sent Ip control enable /disable information to be mirrored by comparing to ATIC42 SPI response byte.

In case of forced sensor pre-heating additional delay time **after engine start** can be calibrated. If corresponding timer threshold is calibrated to be zero, validity of pump current shall also be detectable prior to engine start.

Next the function checks if pulsed activation of pump current control loop is active. If so, Ip validity is revoked.

If not, the function shall determine whether the Ip control loop has been requested to be active. In addition the danger of increased heater coupling due to permanent battery undervoltage has to be excluded.

If all validation conditions hold true, a delay shall be exceeded prior to setting the Ip validity flag. If false, then the internal timer TIMER\_1 and the Ip validity flag shall be reset.

#### 1. Pumping voltage (Vp) limitation strategy

Since it is crucial for pumping voltage (Vp) across WRAF sensor pump cell not to exceed certain bounds depending on sensor temperature and exhaust lambda ( roughly  $|Vp| \leq 2V$  for sensor at operating temperature, less during sensor warm-up ), compliance with these limits has to be ensured under all operating conditions. Exceeding these limits may lead to physical sensor destruction by blackening of zirconia sensor element especially under rich conditions.

Sensor ageing (increase in pump cell inner resistance), insufficient sensor operating temperature, or high pressure conditions, resp., may lead to restriction of measurable lambda range within permitted pumping voltage range.

Since physical Vp threshold for WRAF sensors can be extended to  $V_p > 2V$  in lean area, HW based analog Vp limitation provided by ATIC42 offers sufficient protection. For rich area, evaluation of digital limitation threshold LV\_LSL\_VP\_LIM\_i enables strict limitation of Vp to fixed threshold of  $V_p = -2V$  also under dynamic conditions by means of SW intervention on status of Ip control loop.

Gradual increase in limitation of operational lambda range in rich environment due to long term effects shall lead to adaptation of corresponding threshold which is stored in non-volatile ECU memory.

Once digital Vp limitation is indicated by ATIC42, and rich lambda setpoint limitation threshold is under-run, and secondary air /pulsed Ip control activation both are not active, current measured lambda value is temporarily stored as new threshold for reactivation of Ip control. Since digital limitation might already limit pumping current, measured lambda value is equal or greater actual lambda which provides additional security margin for reactivation of Ip control loop.

Should Lambda signal be indicated not to be reliable at that time, current lambda setpoint value is adopted as new temporary threshold.

To guarantee minimum operational range in rich direction, e.g. for Ip activation during sensor warm-up, a calibratable maximum value for Vp limitation lambda threshold has to be respected in addition.

Vp limitation threshold is assigned with either latter value or previously determined temporary threshold.

Upon storage of Vp limitation threshold, Ip control is inhibited by setting corresponding flag and Vp limitation status bit is set thus preventing second evaluation of limitation threshold during current Vp limitation phase.

Should Vp limitation not be indicated any longer, but Vp limitation still be active, lambda setpoint is crosschecked with actual Vp limitation threshold. Once setpoint value exceeds latter, Vp limitation status is reset and inhibition of Ip control loop is revoked.

With Vp limitation inactive and reliable lambda value exceeding limitation threshold in rich direction an improvement in WRAF sensor behaviour is detected (due to sensor change or vanishing of temporary effects which led to an increase in Vp requirements, like e.g. elevated exhaust pressure or decreased sensor temperature) and Vp limitation threshold is relaxed.

#### 1. Logical variable for judgement of WRAF sensor lambda signal reliability

Various conditions for operative readiness of WRAF system, consisting of WRAF sensor ( including heater ) & WRAF controller, have to be fulfilled and no diagnostic contraindications are allowed to be present to judge WRAF lambda signal as being *completely* reliable (for details see formula section). Evaluation of this variable has to take place at start of Vp limitation check.

#### 1. Logical variable for judgement of lambda sensor signal accuracy level

Certain environmental conditions or functional limitations might lead to decrease in signal accuracy level (regular -> limited) due to need for additional compensative measures which are subject to tolerances, or limited functional performance.

Presence of any of these conditions is indicated by cumulative flag.

## Application conditions

### **Initialisation:**

The following initialisation shall take place for each newly-flashed ECU or upon detection of EEPROM error:

LAMB\_THD\_VPLSL\_LIM[i] = 0

The following initialisation shall take place directly after RESET:


ICPLSL\_LSL\_IF[i] = 0

T\_IPLSL\_NOT\_VLD\_VB\_L\_THD[i] = C\_T\_IPLSL\_NOT\_VLD\_VB\_L\_INC

T\_IPLSL\_NOT\_VLD\_VB\_L[i] = 0

The following initialisation shall take place after ECU RESET, at LV\_IGK = 0->1, or upon erase of error management:

R\_IT\_IPLSL[i] = 16383.75 (i.e. FFFFH)

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```

VPLSL[i] = 0
CTR_ICPLSL[i] = 0
CTR_ICPLSL_MAX[i] = 0
T_ICPLSL_DLY_PWL[i] = 0
LV_ICPLSL_VLD[i] = 0
LV_IPLSL_VLD[i] = 0
LV_IPLSL_CTL_ENA_PLS_ACT[i] = 0
CTR_IPLSL_CTL_ENA_NR_CYC[i] = 0
CTR_IPLSL_CTL_ENA_PWM_ON[i] = 0
CTR_IPLSL_CTL_ENA_PWM_OFF[i] = 0
LV_IPLSL_CTL_INH_VNLSL_LIM[i] = 0
LV_VPLSL_LIM_ACT[i] = 0
LAMB_THD_TMP_VPLSL_LIM[i] = 0
LV_IPLSL_CTL_INH_VPLSL_LIM[i] = 0
LV_LAMB_LS_UP_VLD[i] = 0
LV_IPLSL_NOT_VLD_VB_L[i] = 0
T_IPLSL_CTL_LSH_UP_MAN_ACT[i] = C_T_IPLSL_CTL_LSH_UP_MAN_ACT
LV_LAMB_LS_UP_ESTIM[i] = 1

```

R\_IT\_IPLSL[i] **Store** = 16383.75 (i.e. FFFFH)

LAMB\_SP[i] **Store** = 0

Reset internal timers T\_DLY\_IPLSL\_CTL\_ENA[i] & T\_DLY\_VPLSL\_LIM\_ACT [i]

*Recurrence:*

T\_SAMPLE = 10ms.

*Activation:*

For chapters 3. /6. /8. /9.: Transition from engine start to run and SPI initialisation complete.

LV\_LSL\_IF\_SPI\_RST\_END[i] == 1

**and** LV\_ST\_END == 1

For chapters 1. /2. /4. /5. /7. /10.: Extended supply of pumped reference current and activation of Ip control loop prior to engine start in case of forced sensor pre-heating.

LV\_LSL\_IF\_SPI\_RST\_END[i] == 1

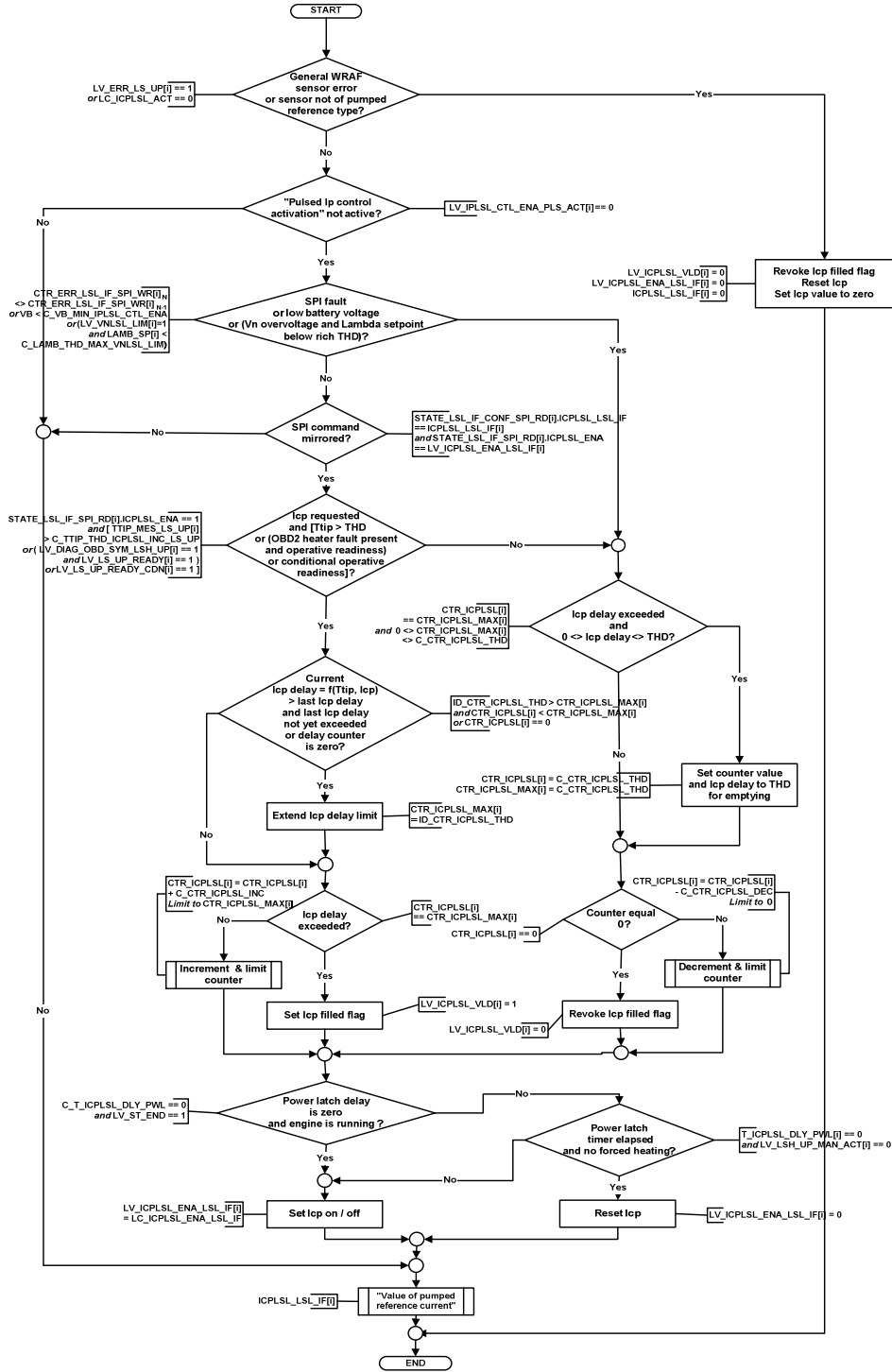
**and** ( LV\_ST\_END == 1  
**or** LV\_LSH\_UP\_MAN\_ACT[i] == 1 )

*Deactivation:*

At the end of ECU power latch.

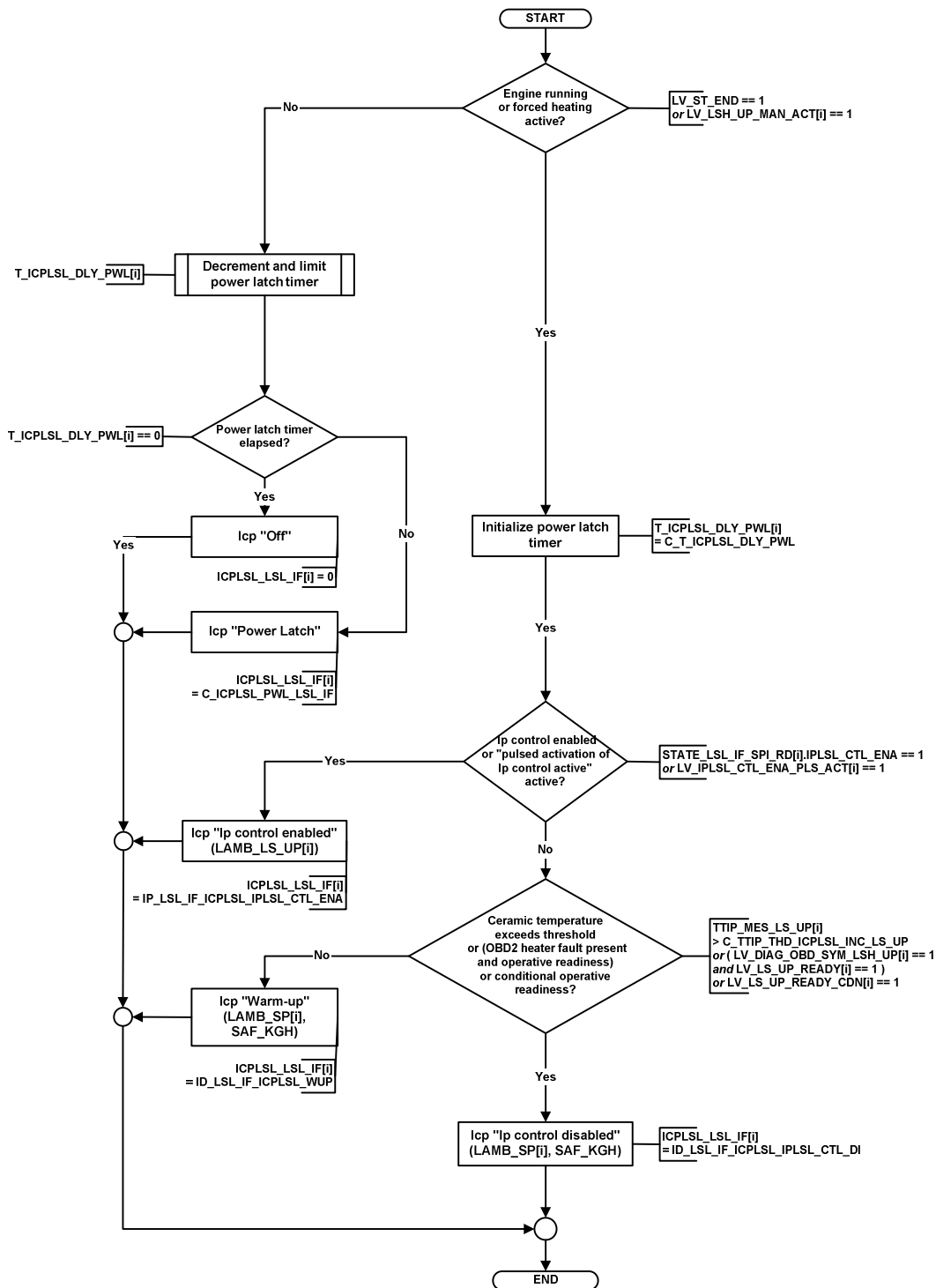
### Formula section:

#### 1. Activation of pumped reference current



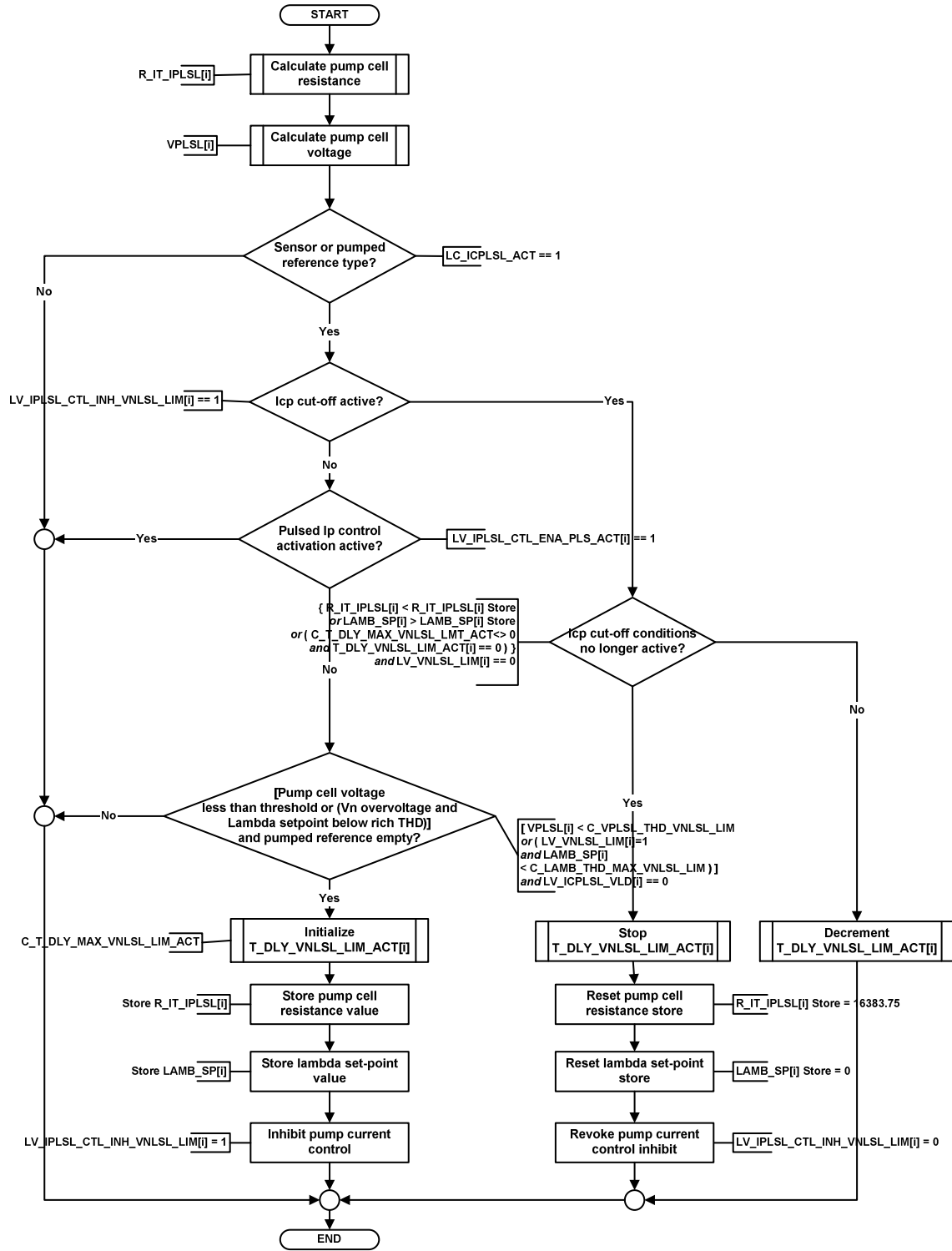
1. Value of pumped reference current

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1. Determination of Icp cut-off conditions

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**Calculation of modelled WRAF sensor pump cell DC resistance**

See determination of lcp cut-off conditions above for use.


$$R\_IT\_IPLSL[i] = (IP\_R\_IT\_IPLSL ( R\_IT\_LS\_UP[i], LAMB\_SP[i] ) * C\_R\_IT\_IPLSL\_AGI\_FAC ) + C\_R\_IT\_IPLSL\_AGI\_ADD$$

**Calculation of modelled voltage across WRAF sensor pump cell**

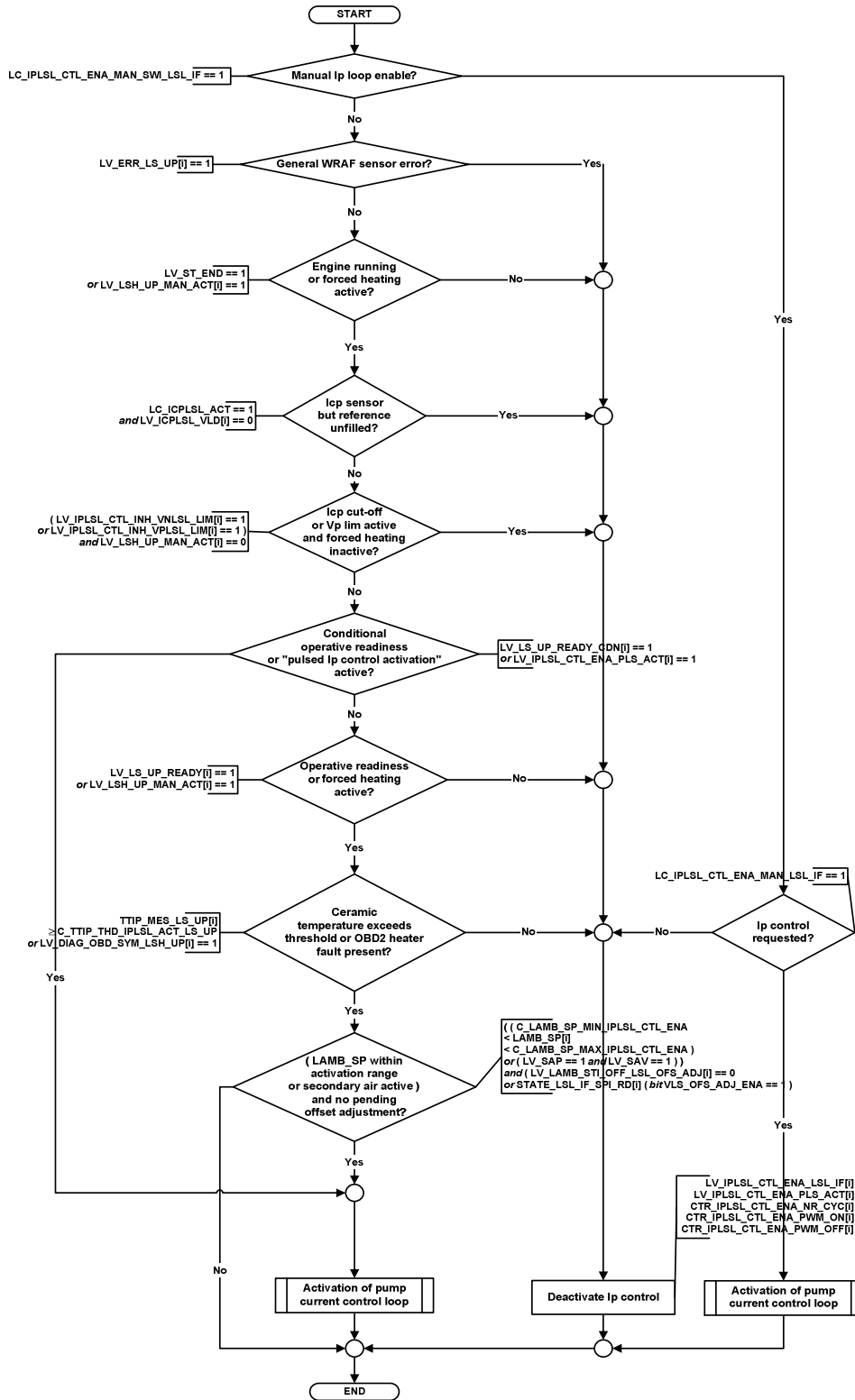
See determination of lcp cut-off conditions above for use.

$$VPLSL[i] = R\_IT\_IPLSL[i] * IPLSL\_COR[i]$$

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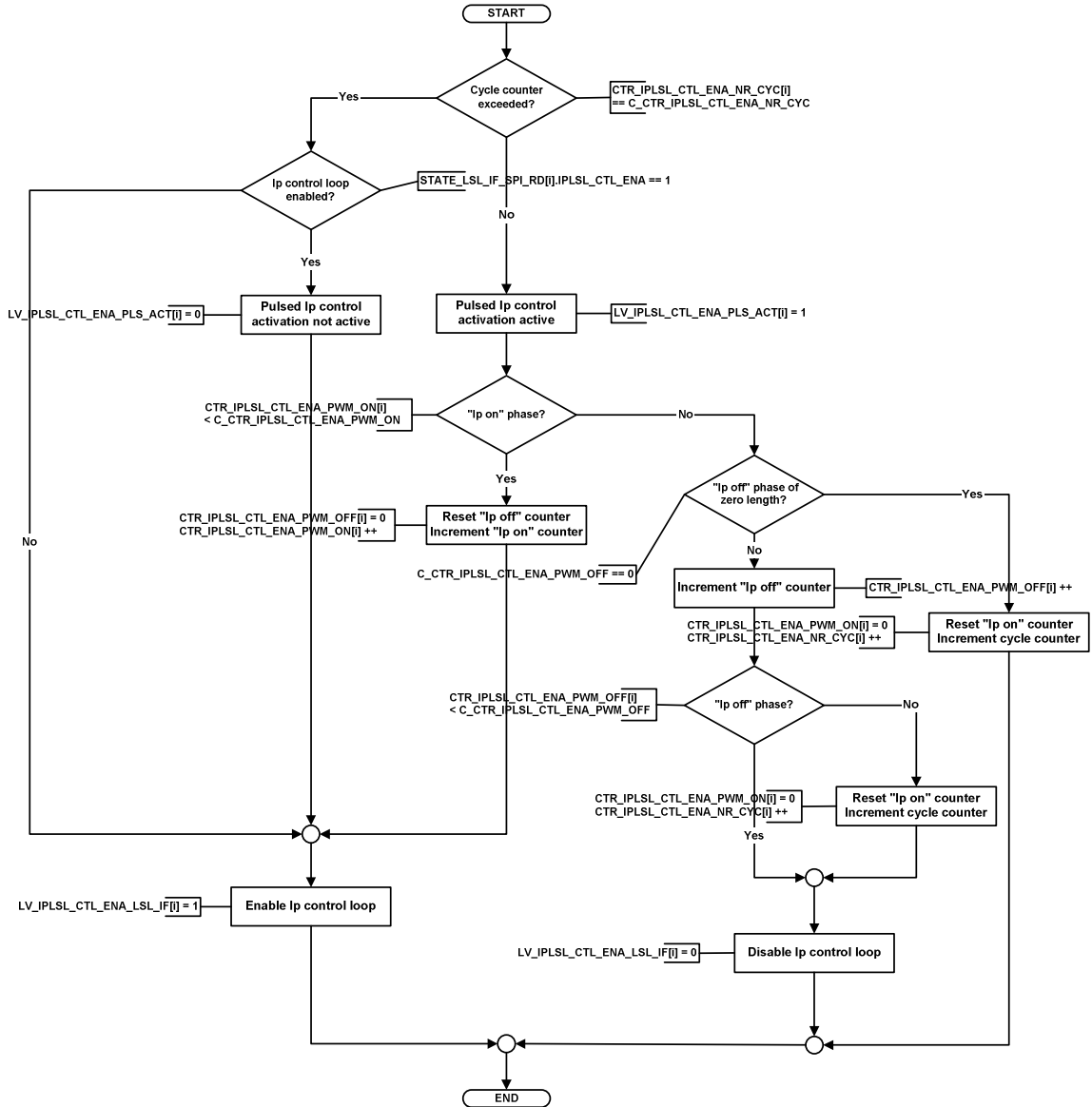
1. Determine required status of pump current (Ip) control loop



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1. Activation of pump current (Ip) control loop

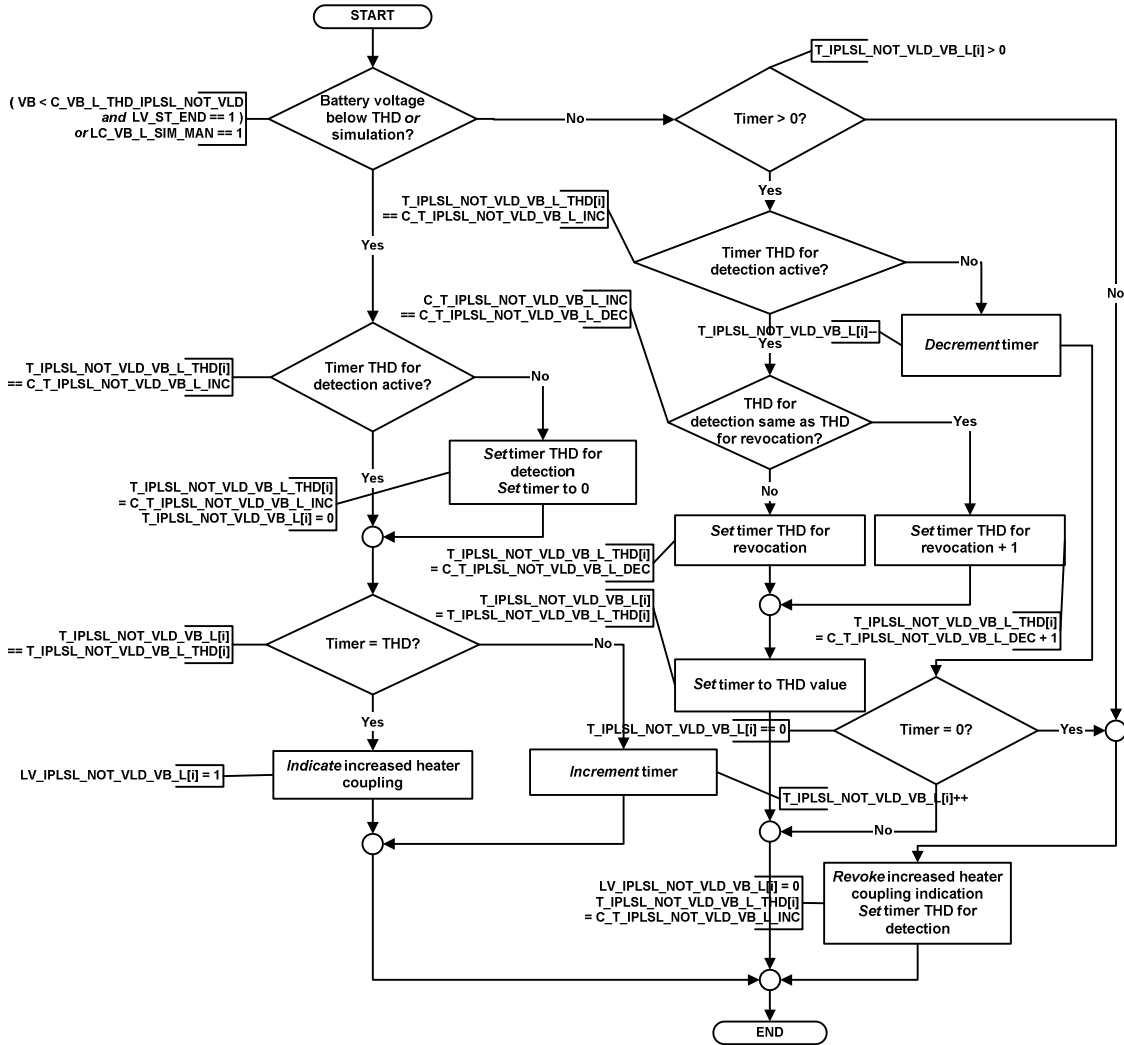
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1. Indication of possibility for increased heater-coupling due to permanent battery undervoltage

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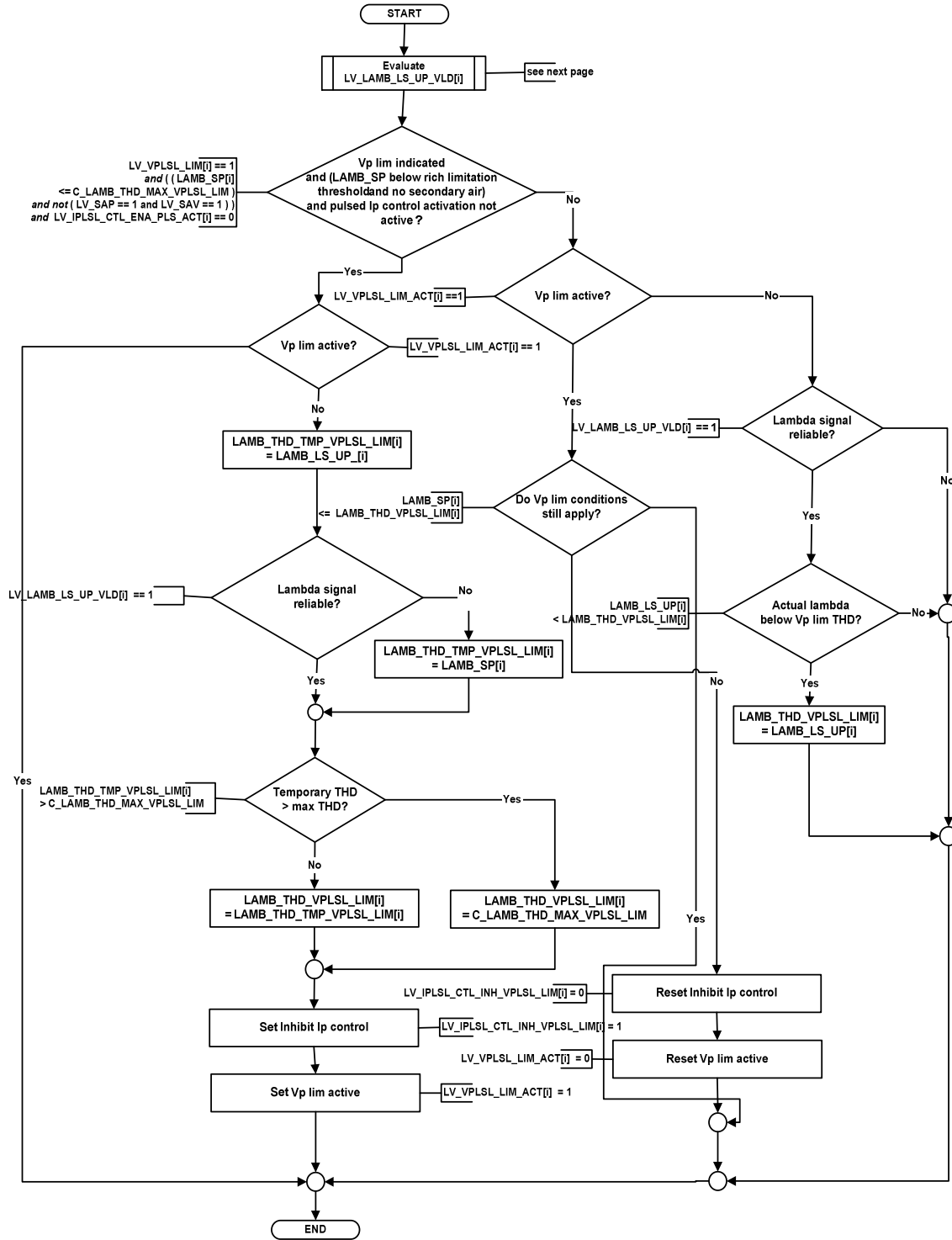


1. Validity of pump current (I<sub>p</sub>)

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1. Logical variable for judgement of short term WRAF sensor lambda signal reliability

**if** LV\_LS\_UP\_READY[i] == 1  
 /\* WRAF sensor full operative readiness detected \*/  
**and** LV\_LSL\_OFS\_ADJ\_ACT[i] == 0  
**and** LV\_VLS\_OFS\_ADJ\_ENA\_LSL\_IF[i] == 0  
 /\* WRAF controller electrical offset adjustment not active \*/  
**and** STATE\_LSL\_IF\_SPI\_RD[i] (bit LSL\_ENA) == 1

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```

/* WRAF sensor coupled */
and      ( LV_ICPLSL_VLD[i] == 1 or LC_ICPLSL_ACT == 0 )
/* Reference pumping current valid or sensor not of pumped reference type */
and      LV_IPLSL_VLD[i] == 1
/* WRAF sensor pumping current valid */
and      LV_VLS_UP_VLD[i] == 1
/* No clipping of ATIC42 output voltage present */
and      LV_VLS_UP_INIT[i] == 0
and      LV_SWI_GAIN_LSL_IF[i] == STATE_LSL_IF_SPI_RD[i] ( bit SWI_GAIN )
/* Initialisation of VLS_UP[i] has successfully been performed
upon Ip gain-switching */
and      STATE_ERR_IPLSL[i] == 0
/* Pumping current within allowed bounds */
and      LV_LSL_DEAC[i] == 0
/* No OBD1 signal fault pending */
and      LV_ERR_LS_UP[i] == 0
/* No WRAF system error present */
then     LV_LAMB_LS_UP_VLD[i] = 1
/* WRAF system lambda signal reliable */
else     LV_LAMB_LS_UP_VLD[i] = 0
/* WRAF system lambda signal NOT reliable */
endif


```

#### 1. Logical variable for judgement of lambda sensor signal accuracy level

```

if      LV_IPLSL_VLD[i] == 0
/* WRAF sensor pump current is valid in general */
or      TTIP_MES_LS_UP[i] < C_TTIP_MIN_LAMB_LS_UP_ESTIM
or      MAF_KGH < C_MAF_KGH_MIN_LAMB_LS_UP_ESTIM
or      N_32 > C_N_32_MAX_LAMB_LS_UP_ESTIM
then    LV_LAMB_LS_UP_ESTIM[i] = 1
/* Reduced accuracy of linear lambda signal */
else    LV_LAMB_LS_UP_ESTIM[i] = 0
/* No constraint on general pump current validity */
endif

```

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## 7.46 O2 sensor (lin, up) IP gain adaptation in PUC

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LSL_GAIN_AD [NC_CBK_EX_NR]	O/V/S	0... FFFFH	0... 1.99996	30.5e-6	-
Adaptive factor for WRAF sensor gain					
IPLSL_COR_BEG_PURGE [NC_CBK_EX_NR]	V	8000... 7FFFH	-12.596... 12.59561	384.4e-6	mA
Corrected pumping current during fuel cut at begin of purged condition					
IPLSL_COR_CHG_PURGE [NC_CBK_EX_NR]	V	8000... 7FFFH	-12.596... 12.59561	384.4e-6	mA
Change of corrected pumping current during acquisition at purged condition					
IPLSL_COR_MMV_FCUT [NC_CBK_EX_NR]	V	8000... 7FFFH	-12.596... 12.59561	384.4e-6	mA
Moving mean value of corrected pumping current during fuel cut					
IPLSL_MMV_VLD_FCUT [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	-12.596... 12.59561	384.4e-6	mA
Moving mean of valid samples of pumping current during fuel cut					
IPLSL_MV_PURGE [NC_CBK_EX_NR]	V	8000... 7FFFH	-12.596... 12.59561	384.4e-6	mA
Arithmetic mean of compensated pumping current during fuel cut at purged condition					
IPLSL_PURGE [NC_CBK_EX_NR]	V	8000... 7FFFH	-12.596... 12.59561	384.4e-6	mA
Compensated (excluding factor for gain adaptation) pumping current during fuel cut at purged condition					
IPLSL_VARI_PURGE [NC_CBK_EX_NR]	V	0... FFFFFFFFH	0... 634.63686	147.799e-9	(mA)**2
Variance of corrected pumping current during fuel cut at purged condition					
IPLSL_VARI_VLD_FCUT [NC_CBK_EX_NR]	O/V/S	0... FFFFFFFFH	0... 634.63686	147.799e-9	(mA)**2
Moving variance of valid samples of pumping current during fuel cut					
LV_FAC_LSL_GAIN_AD_LIM_MAX [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Status flag for limitation of WRAF gain adaptation factor to maximum					
LV_FAC_LSL_GAIN_AD_LIM_MIN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Status flag for limitation of WRAF gain adaptation factor to minimum					
LV_IPLSL_COR_MMV_FCUT_VLD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag stating validity of latest moving mean value of corrected pumping current during PUC					
LV_IPLSL_VLD_FCUT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Valid Ip sample has been acquired during current fuel cut					
LV_LSL_FCUT_MES_NOT_PLAUS [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Actual fuel cut Ip measurement not plausible					
LV_LSL_FCUT_MES_REP_INH [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Status flag indicating successful fuel cut Ip measurement during current PUC phase					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LSL_FIRST_GAIN_AD [NC_CBK_EX_NR]	V/S	0... 1H	0 ...1	1	-
Bit indicating that Gainadaptation is calculated for the first time					
LV_LSL_GAIN_AD_FCUT_NOT_OK [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Factor for gain adaptation out of valid range					
LV_LSL_GAIN_AD_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request for fuel cut Ip measurement					
LV_LSL_GAIN_AD_REQ_VLD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Validation of request for fuel cut Ip measurement					
LV_MAP_PUC_LIM_REQ_LSL_GAIN_AD	O/V	0... 1H	0 ...1	1	-
Status flag for request of limitation of MAP during next PUC phase from torque management					
MAF_INT_PUC_MIN_LSL_GAIN_AD [NC_CBK_EX_NR]	V	0... FFFFH	0... 2912.66666	0.0444444	g
treshold for MAF-integral as transition condition from PURGE to ACQ					
STATE_IPLSL_AD_FCUT [NC_CBK_EX_NR]	V	0H 1H 2H 3H 4H	INIT WAIT PURGE ACQ ADAPT	-	-
State of fuel cut gain adaptation procedure					
STATE_IPLSL_GAIN_AD [NC_CBK_EX_NR]	V	0H 1H 2H 3H	IN_RANGE LOW_LIMIT HIGH_LIMIT IMPOSSIBLE	-	-
State of WRAF sensor gain adaptation factor					
T_ACQ_IPLSL_PURGE [NC_CBK_EX_NR]	V	0... FFH	0... 25.5	0.1	s
Timer for acquisition interval of compensated pumping current during fuel cut at purged condition					
T_DLY_IPLSL_COR_MMV_FCUT_VLD [NC_CBK_EX_NR]	V	0... FFH	0... 25.5	0.1	s
Delay timer for retry of gain adaptation upon detection of possible saturation effects on Ip measurement					


**Input data:**

AMP {p. 982}	CTR_STOP_FSD {p. 6133}	GEAR {p. 1302}	IPLSL_COR [NC_CBK_EX_NR] {p. 2313}
LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LV_CP_CLOSE_ACT {p. 3749}	LV_IGK {p. 906}	LV_INH_LSL_GAIN_AD [NC_CBK_EX_NR] {p. 2383}
LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}	LV_LAMB_LS_UP_VLD [NC_CBK_EX_NR] {p. 2352}	LV_LS_UP_READY [NC_CBK_EX_NR] {p. 2335}	LV_MAP_PUC_LIM_ACT_LSL_GAIN_AD {p. 981}
LV_PUC {p. 1720}	LV_SWI_GAIN_LSL_IF [NC_CBK_EX_NR] {p. 2314}	LV_V_REF_VLD_R_IT_LS_UP [NC_CBK_EX_NR] {p. 1320}	LV_VLS_UP_INIT [NC_CBK_EX_NR] {p. 1341}
LV_VLS_UP_VLD [NC_CBK_EX_NR] {p. 1341}	LV_VPLSL_LIM [NC_CBK_EX_NR] {p. 955}	MAF_INT_PUC_ACT {p. 2942}	MAF_KGH {p. 1195}

N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 956}	TAM {p. 1579}
TCO {p. 1100}	TTIP_MES_LS_UP [NC_CBK_EX_NR] {p. 1321}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_MIN_LSL_GAIN_AD	-	0... FFFFH	0... 5434	82.8999e-3	hPa
Minimum ambient pressure to allow fuel cut Ip determination					
C_CRLC_IPLSL_COR_FCUT	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for filtering of corrected pumping current					
C_CRLC_IPLSL_MV_VLD	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for filtering of valid Ip samples (is also time constant for adaptation)					
C_CTR_STOP_FSD_THD	-	0... FFH	0... 255	1	-
threshold for CTR_STOP_FSD to allow gain adaptation					
C_FAC_IPLSL_COR_THD_FCUT	-	0... FFH	0... 0.99609	3.91e-3	-
Factor for minimum threshold of the low pass filtered pumping current to detect stable conditions (end of PURGE)					
C_FAC_LSL_GAIN_AD_LIM_MAX	-	0... FFFFH	0... 1.99996	30.5e-6	-
Maximum threshold for WRAF sensor gain adaptation					
C_FAC_LSL_GAIN_AD_LIM_MIN	-	0... FFFFH	0... 1.99996	30.5e-6	-
Minimum threshold for WRAF sensor gain adaptation					
C_FAC_LSL_GAIN_AD_MAN_ADJ	-	0... FFFFH	0... 1.99996	30.5e-6	-
Value for manual adjustment of WRAF sensor gain adaptation factor					
C_IPLSL_COR_GRD_THD_FCUT	-	8000... 7FFFH	-12.596... 12.59561	384e-6	mA/ 100ms
Maximum gradient of low pass filtered pumping current to detect stable conditions (end of PURGE)					
C_IPLSL_MV_VLD_VARI_MAX	-	0... FFFFFFFFH	0... 634.63686	148e-9	mA**2
Maximum permitted variance of valid Ip sample to allow adaptation					
C_IPLSL_NOM_PURGE	-	8000... 7FFFH	-12.596... 12.59561	384e-6	mA
Nominal pumping current at fuel cut					
C_IPLSL_VARI_THD_MAX_PURGE	-	0... FFFFFFFFH	0... 634.63686	148e-9	mA**2
Maximum variance of the low pass filtered pumping current to confirm stable conditions					
C_IPLSL_VARI_THD_MIN_PURGE	-	0... FFFFFFFFH	0... 634.63686	148e-9	mA**2
Minimum variance of the low pass filtered pumping current to confirm that sensor is operable					
C_N_32_BOL_LSL_GAIN_AD	-	0... FFH	0... 8160	32	rpm
Additional bottom limit above which fuel cut Ip determination is allowed to take place					
C_N_32_MAX_LSL_GAIN_AD	-	0... FFH	0... 8160	32	rpm
Maximum engine speed to allow fuel cut Ip determination					
C_N_32_MIN_LSL_GAIN_AD	-	0... FFH	0... 8160	32	rpm
Minimum engine speed to allow fuel cut Ip determination					
C_N_32_TOL_LSL_GAIN_AD	-	0... FFH	0... 8160	32	rpm
Additional top limit below which fuel cut Ip determination is allowed to take place					
C_NR_GEAR_MIN_LSL_GAIN_AD	-	0... FFH	0... 255	1	-
Minimum gear to allow fuel cut Ip determination					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_ACQ_IPLSL_PURGE	-	1... FFH	0.1... 25.5	0.1	s
Duration of Ip acquisition and averaging					
C_T_DLY_IPLSL_COR_MMV_FCUT_VLD	-	1... FFH	0.1... 25.5	0.1	s
Delay time for retry of gain adaptation upon detection of possible saturation effects on Ip measurement					
C_TAM_MAX_LSL_GAIN_AD	-	0... FEH	-48... 142.5	0.75	°C
Maximum ambient temperature to allow fuel cut Ip determination					
C_TCO_MIN_LSL_GAIN_AD	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature to allow fuel cut Ip determination					
C_TTIP_MAX_LSL_GAIN_AD	-	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Maximum tip temperature to allow fuel cut Ip determination					
C_TTIP_MIN_LSL_GAIN_AD	-	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Minimum tip temperature to allow fuel cut Ip determination					
IP_FAC_COR_IPLSL_CHG_PURGE	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_IPLSL_CHG_PURGE_IP_IPLSL	4	0... FFFFH	-12.596... 12.59561	384e-6	mA
Factor for residual gas after purging correction					
IP_FAC_COR_IPLSL_MAF_KGH	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_MAF_KGH_IP_FAC_COR_IPLSL	12	0... FFFFH	0... 2047.96875	0.03125	kg/h
Factor for MAF correction					
IP_FAC_COR_IPLSL_N_32	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_N_32_IP_FAC_COR_IPLSL	16	0... FFH	0... 8160	32	rpm
Factor for engine speed correction					
IP_MAF_INT_PUC_MIN_LSL_GAIN_AD	-	0... FFFFH	0... 2912.66666	0.0444444	g
LDP_LAMB_LS_UP_IP_MAF_INT	6	0... 7FFFH	0... 31.99902	976.599e-6	-
Threshold for MAF-integral as transition condition from PURGE to ACQ					
LC_FAC_LSL_GAIN_AD_ENA	-	0... 1H	0 ...1	1	-
Enable adoption of WRAF sensor gain adaptation factor					
LC_FAC_LSL_GAIN_AD_LIM_RST	-	0... 1H	0 ...1	1	-
Switch for reset of adaptation factor to one when exceeding thresholds, or for adoption of threshold value, resp.					
LC_FAC_LSL_GAIN_AD_MAN_ADJ_ENA	-	0... 1H	0 ...1	1	-
Enable manual adjustment of WRAF sensor gain adaptation factor					
LC_IPLSL_GAIN_SEL_LSL_GAIN_AD	-	0... 1H	0 ...1	1	-
Determines which Ip gain has to be active during execution of gain adaptation ( 0 = gain8, 1 = gain16 )					
LC_LSL_FIRST_GAIN_AD	-	0... 1H	0 ...1	1	-
1: no filtering for first calculation of correction value after exchange of ECU or sensor					
LC_LSL_GAIN_AD_ENA	-	0... 1H	0 ...1	1	-
Enable WRAF sensor gain adaptation					
LC_LSL_GAIN_AD_TEST	-	0... 1H	0 ...1	1	-
Manual enable of LV_LSL_GAIN_AD_REQ_i for test purposes					
LC_MAP_PUC_LIM_ACT_NOT_VLD	-	0... 1H	0 ...1	1	-
Flag to ignore activation of limitation of MAP during PUC by torque management					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_MAP_PUC_LIM_REQ_LSL_GAIN_AD	-	0... 1H	0 ...1	1	-
Enable request to torque management for limitation of MAP during PUC					

## FUNCTION DESCRIPTION:

During fuel cut-off the engine purges the exhaust line with air. This condition is the best suitable engine operating condition to check the WRAF sensor's static gain.

The function comprises:

1. the recognition of a condition to be stable enough for a significant pumping current measurement.
2. pumping current correction due to interfering impacts as: exhaust pressure etc.
3. current acquisition and averaging during fuel cut.
4. evaluation of adaptation conditions
5. WRAF sensor gain adaptation

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned ( NC\_CBK\_EX\_NR = 2 ) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise ( NC\_CBK\_EX\_NR = 1 )

i = 1, for single exhaust cylinder bank.

## Application conditions

**Activation:** at LV\_IGK = 1

**Deactivation:** at LV\_IGK = 0

Initialization at first ECU run :

FAC\_LSL\_GAIN\_AD[i] = 1

IPLSL\_MMV\_VLD\_FCUT[i] = C\_IPLSL\_NOM\_PURGE

IPLSL\_VARI\_VLD\_FCUT[i] = 0

LV\_LSL\_FIRST\_GAIN\_AD[i] = 1

Initialization at every transition LV\_IGK = 0 -> 1, ECU Reset, or upon erase of error management:

STATE\_IPLSL\_AD\_FCUT[i] = INIT

### 7.46.1 Conditions for WRAF Sensor fuel cut-off Ip determination

#### FUNCTION:

These conditions must be verified the whole time during the fuel cut-off Ip determination.

Request of MAP limitation during next PUC phase by any arbitrary exhaust cylinder bank shall lead to corresponding request to torque management.

**Recurrence:** T\_SAMPLE = 100ms.

Perform prior to execution of FOR loop depending on [i].


**if** LV\_PUC == 0

**then** LV\_MAP\_PUC\_LIM\_REQ\_LSL\_GAIN\_AD = 0

**endif**

Fuel cut-off Ip determination is requested only:

**if** ( LV\_LS\_UP\_READY [i] == 1

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```

and      LV_IPLSL_VLD[i] == 1
and      LV_CP_CLOSE_ACT == 1
and      CTR_STOP_FSD <= C_CTR_STOP_FSD_THD
and      TCO > C_TCO_MIN_LSL_GAIN_AD
and      TAM < C_TAM_MAX_LSL_GAIN_AD
and      ( C_N_32_MIN_LSL_GAIN_AD < N_32 < C_N_32_MAX_LSL_GAIN_AD
or      C_N_32_BOL_LSL_GAIN_AD < N_32 < C_N_32_TOL_LSL_GAIN_AD )
and      C_TTIP_MIN_LSL_GAIN_AD < TTIP_MES_LS_UP[i]
          < C_TTIP_MAX_LSL_GAIN_AD
and      AMP > C_AMP_MIN_LSL_GAIN_AD
and      LV_V_REF_VLD_R_IT_LS_UP[i] == 1
          ( tip temperature of upstream sensor is valid )
and      LC_LSL_GAIN_AD_ENA == 1
and      GEAR C_NR_GEAR_MIN_LSL_GAIN_AD
and      LV_INH_LSL_GAIN_AD[i] == 0
and      LC_FAC_LSL_GAIN_AD_MAN_ADJ_ENA == 0 )
or      LC_LSL_GAIN_AD_TEST == 1
then    ( general conditions fulfilled )
if      LV_PUC == 0
then    if      LC_MAP_PUC_LIM_REQ_LSL_GAIN_AD == 1
          then    LV_MAP_PUC_LIM_REQ_LSL_GAIN_AD = 1
          endif
          ( MAP limitation during next PUC is requested )
          LV_LSL_GAIN_AD_REQ_VLD[i] = 1
          ( request of gain adaptation will be seen valid )
          LV_LSL_GAIN_AD_REQ[i] = 0
else    if      LV_LSL_GAIN_AD_REQ_VLD[i] == 1
          then    LV_LSL_GAIN_AD_REQ[i] = 1
          ( gain adaptation is requested )
          if      LV_LAMB_LS_UP_VLD[i] == 1
          and    LV_VPLSL_LIM[i] == 0
          and    LV_VLS_UP_VLD[i] == 1
          and    T_DLY_IPLSL_COR_MMV_FCUT_VLD[i] == 0
          then    LV_IPLSL_COR_MMV_FCUT_VLD[i] = 1
          else    decrement T_DLY_IPLSL_COR_MMV_FCUT_VLD[i]
          endif
          endif
          endif
else    if      LC_FAC_LSL_GAIN_AD_MAN_ADJ_ENA == 1
          then    FAC_LSL_GAIN_AD[i] = C_FAC_LSL_GAIN_AD_MAN_ADJ
          LV_LSL_GAIN_AD_FCUT_NOT_OK[i] = 0
          LV_FAC_LSL_GAIN_AD_LIM_MAX[i] = 0
          LV_FAC_LSL_GAIN_AD_LIM_MIN[i] = 0
          endif
          LV_LSL_GAIN_AD_REQ[i] = 0
          LV_LSL_GAIN_AD_REQ_VLD[i] = 0
endif

```

## 7.46.2 Low Pass Filtering of Pumping Current during fuel cut

### FUNCTION:

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Recurrence:  $T\_SAMPLE = 10 \text{ ms.}$

*Remark:* Index 'k' is linked to  $T\_SAMPLE = 10\text{ms.}$

```

if      LV_LSL_GAIN_AD_REQ[i] == 1
then   if      LV_LAMB_LS_UP_VLD[i] = 1
          and    LV_VPLSL_LIM[i] = 0
          and    LV_VLS_UP_VLD[i] = 1
          then   IPLSL_COR_MMV_FCUT[i]k = IPLSL_COR_MMV_FCUT[i]k-1
              + C_CRLC_IPLSL_COR_FCUT
              * ( IPLSL_COR[i] - IPLSL_COR_MMV_FCUT[i]k-1 )
          else   LV_IPLSL_COR_MMV_FCUT_VLD[i] = 0
              T_DLY_IPLSL_COR_MMV_FCUT_VLD[i]
              = C_T_DLY_IPLSL_COR_MMV_FCUT_VLD
              IPLSL_COR_MMV_FCUT[i] = IPLSL_COR[i]
          endif
          else   IPLSL_COR_MMV_FCUT[i] = IPLSL_COR [i]
          endif

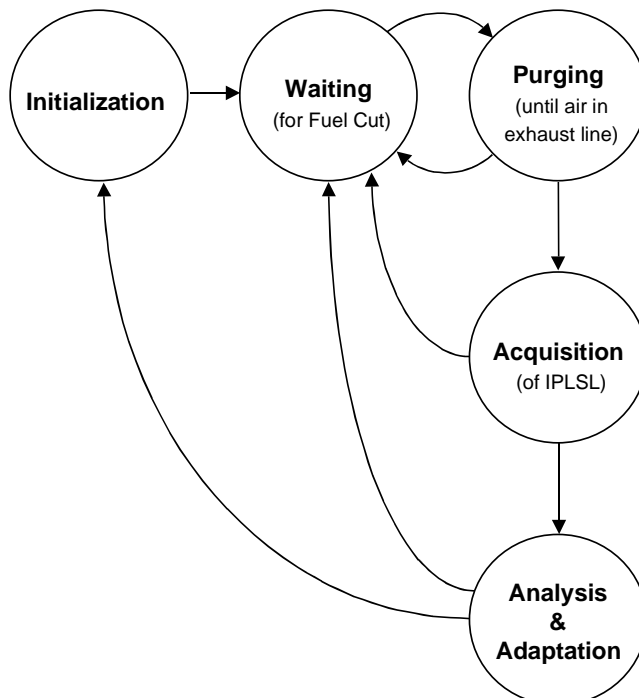
```

### 7.46.3 Sequence for fuel cut-off Ip determination:

#### FUNCTION:


Recurrence:  $T\_SAMPLE = 100 \text{ ms.}$

*Remark:* Index 'n' is linked to  $T\_SAMPLE = 100\text{ms.}$



#### 7.46.3.1 State INIT :

##### Actions:

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```

LV_LSL_GAIN_AD_REQ[i] = 0
  LV_LSL_FCUT_MES_REP_INH[i] = 0
  LV_LSL_FCUT_MES_NOT_PLAUS[i] = 0
  LV_LSL_GAIN_AD_FCUT_NOT_OK[i] = 0
LV_IPLSL_COR_MMV_FCUT_VLD[i] = 1
T_DLY_IPLSL_COR_MMV_FCUT_VLD[i] = 0

```

Transition to state "WAIT":

Conditions:

none

Actions during transition:

```
STATE_IPLSL_AD_FCUT[i] = WAIT
```

### 7.46.3.2 State WAIT :

STATE\_IPLSL\_AD\_FCUT[i] remains in this wait state as long as the conditions for fuel cut Off Ip determination are not fulfilled or not fulfilled anymore. Furthermore it is taken care that only one measurement per fuel cut is done.

Actions:

```

if    LV_PUC == 0
then  LV_LSL_FCUT_MES_REP_INH[i] = 0
endif

```

Transition to state "PURGE":

Conditions:

```

if    LV_LSL_GAIN_AD_REQ[i] == 1
and   LV_LSL_FCUT_MES_REP_INH[i] == 0
      ( LV_LSL_FCUT_MES_REP_INH[i] == 1 prevents a second measurement
        during the same fuel cut )
and   ( LV_MAP_PUC_LIM_ACT_LSL_GAIN_AD == 1
or    LC_MAP_PUC_LIM_ACT_NOT_VLD == 1 )
and   LV_SWI_GAIN_LSL_IF[i] == LC_IPLSL_GAIN_SEL_LSL_GAIN_AD
and   STATE_LSL_IF_SPI_RD[i] ( bit SWI_GAIN )
      == LC_IPLSL_GAIN_SEL_LSL_GAIN_AD
and   LV_VLS_UP_INIT[i] == 0
      ( Confirmation that required gain for pump current measurement is active )
then  " transition to PURGE "
endif


```

Actions during transition:

```

STATE_IPLSL_AD_FCUT[i] = PURGE
IPLSL_COR_MMV_FCUT[i] = IPLSL_COR[i]
IPLSL_COR_MMV_FCUT[i]n-1 = IPLSL_COR_MMV_FCUT[i]n
LV_IPLSL_VLD_FCUT[i] = 0
MAF_INT_PUC_MIN_LSL_GAIN_AD[i]
= IP_MAF_INT_PUC_MIN_LSL_GAIN_AD(LAMB_LS_UP[i] )

```

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### 7.46.3.3 State: PURGE :

During fuel cut STATE\_IPLSL\_AD\_FCUT[i] waits until the exhaust system is purged and the pumping current is stable. The stability is reached if:

1. the gradient of the averaged pumping current is below a threshold
2. and the absolute pumping current is higher than a given threshold.

Actions:

none

Transition to state "WAIT":

Conditions:

```

if      LV_LSL_GAIN_AD_REQ[i] == 0
then    " transition to WAIT "
endif

```

Actions during transition:

STATE\_IPLSL\_AD\_FCUT[i] = WAIT

Transition to state "Acquisition":

Conditions:

```

if      LV_LSL_GAIN_AD_REQ[i] == 1
and    ( IPLSL_COR_MMV_FCUT[i]n - IPLSL_COR_MMV_FCUT[i]n-1 )
          < C_IPLSL_COR_GRD_THD_FCUT
and    IPLSL_COR_MMV_FCUT[i]n
          > C_FAC_IPLSL_COR_THD_FCUT * C_IPLSL_NOM_PURGE
and    MAF_INT_PUC_ACT > MAF_INT_PUC_MIN_LSL_GAIN_AD[i]
then    " transition to ACQUISITION "
else    IPLSL_COR_MMV_FCUT[i]n-1 = IPLSL_COR_MMV_FCUT[i]n
          " stay in PURGE "
endif

```

Actions during transition:

```

STATE_IPLSL_AD_FCUT[i] = ACQUISITION
IPLSL_VARI_PURGE[i] = 0
T_ACQ_IPLSL_PURGE[i] = 0
IPLSL_COR_BEG_PURGE[i] = IPLSL_COR_MMV_FCUT[i]

```

### 7.46.3.4 State Acquisition :

As input the pumping current ( IPLSL\_COR\_MMV\_FCUT[i] ) is compensated for actual impacts of:

1. ambient pressure
2. engine speed
3. MAF\_KGH
4. ( and WRAF sensor TTIP\_MES\_LS\_UP[i] )

Afterwards the real current ( IPLSL\_PURGE[i] ) is calculated by division with the actual compensation factor ( FAC\_LSL\_GAIN\_AD[i] ).


During the acquisition time ( C\_T\_ACQ\_IPLSL\_PURGE ) the actual real current (at fuel cut and at purged exhaust line) is averaged ( IPLSL\_MV\_PURGE[i] ) and its variance ( IPLSL\_VARI\_PURGE[i] ) is calculated. At the end of the acquisition a final compensation of residual gas purging is done by multiplying with IP\_FAC\_COR\_IPLSL\_CHG\_PURGE with the latter depending on the Ip change from start to end of acquisition.

Actions:

```

if      LV_IPLSL_COR_MMV_FCUT_VLD[i] = 1
then    if      T_ACQ_IPLSL_PURGE[i] < C_T_ACQ_IPLSL_PURGE
          then    IPLSL_PURGE[i] = IPLSL_COR_MMV_FCUT[i]
          * IP_FAC_COR_IPLSL_MAF_KGH * IP_FAC_COR_IPLSL_N_32
FAC_LSL_GAIN_AD[i]

```

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```

IPLSL_MV_PURGE[i]n = ( T_ACQ_IPLSL_PURGE[i]
    * IPLSL_MV_PURGE[i]n-1 + T_SAMPLE * IPLSL_PURGE[i] )
    / ( T_ACQ_IPLSL_PURGE[i] + T_SAMPLE )
IPLSL_VARI_PURGE[i]n =
    ( T_ACQ_IPLSL_PURGE[i] * IPLSL_VARI_PURGE[i]n-1
    + T_SAMPLE * ( IPLSL_MV_PURGE[i] - IPLSL_PURGE[i] ) ^2 )
    / ( T_ACQ_IPLSL_PURGE[i] + T_SAMPLE )
T_ACQ_IPLSL_PURGE[i]n = T_ACQ_IPLSL_PURGE[i]n-1 + T_SAMPLE
endif
else
IPLSL_COR_BEG_PURGE[i] = IPLSL_COR_MMV_FCUT[i]
T_ACQ_IPLSL_PURGE[i] = 0
IPLSL_VARI_PURGE[i] = 0
endif
If
T_ACQ_IPLSL_PURGE[i] == C_T_ACQ_IPLSL_PURGE
and
LV_LSL_FCUT_MES_REP_INH[i] == 0
then
LV_LSL_FCUT_MES_REP_INH[i] = 1
IPLSL_COR_CHG_PURGE[i] =
    IPLSL_COR_MMV_FCUT[i] - IPLSL_COR_BEG_PURGE[i]
IPLSL_MV_PURGE[i] =
    IPLSL_MV_PURGE[i] * IP_FAC_COR_IPLSL_CHG_PURGE
endif

```

Transition to state "WAIT":

Conditions:

```

If    LV_LSL_GAIN_AD_REQ[i] == 0
then  " transition to WAIT "
endif

```

Actions during transition:

```
STATE_IPLSL_AD_FCUT[i] = WAIT
```

Transition to state "ADAPT":

Conditions:

```

If    LV_LSL_GAIN_AD_REQ[i] == 1
and   LV_LSL_FCUT_MES_REP_INH[i] == 1
then  " transition to ADAPT "
endif

```

Actions during transition:

```
STATE_IPLSL_AD_FCUT[i] = ADAPT
```


### 7.46.3.5 State ADAPT :

The fuel cut pumping current sample is checked for sensor operability and stability during the previous acquisition phase. Therefore the variance of the output must be between allowed limits. If this condition or the conditions for "fuel cut-off Ip determination" are not fulfilled anymore the STATE\_IPLSL\_AD\_FCUT[i] switches back to "WAIT".

If the conditions are fulfilled it will be declared as "valid sample". Next a MMV value and the variance of the valid Ip samples are calculated.

If the gain adaptation takes place for the first time (in case of a new sensor or new ECU) the MMV value is initialized with the mean-value of the first measurement. The variance stays on the initial value (zero) in this case. The calculation of MMV and variance is started as soon as one successful gain adaptation was carried out (by setting LV\_FIRST\_GAIN\_AD = 0).

A new adaptive factor ( FAC\_LSL\_GAIN\_AD[i] ) for the WRAF sensor's gain is calculated if the following conditions for adaptation are fulfilled:

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1. Variance of previous valid samples in permitted range.
2. Adaptive factor ( FAC\_LSL\_GAIN\_AD[i] ) in permitted range

Since the new adaptive factor is calculated based on the MMV value of the valid samples it follows the average of the last measurements and not direct every particular fuel cut sample. The response time of the adaptation is defined by the correlation constant ( C\_CRLC\_IPLSL\_MV\_VLD ).

#### Actions:

```

if LV_IPLSL_VLD_FCUT[i] == 0
    ( LV_IPLSL_VLD_FCUT[i] == 1 prevents a second evaluation and
      updating of IPLSL_MMV_VLD_FCUT[i] during the same fuel cut )
and C_IPLSL_VARI_THD_MIN_PURGE <= IPLSL_VARI_PURGE[i]
      < C_IPLSL_VARI_THD_MAX_PURGE
then LV_LSL_FCUT_MES_NOT_PLAUS[i] = 0
      LV_IPLSL_VLD_FCUT[i] = 1
  
```

#### Average of recent valid fuel cuts & Variance of recent valid fuel cuts:

```

if (LV_LSL_FIRST_GAIN_AD[i] == 1 and LC_LSL_FIRST_GAIN_AD == 1)
then IPLSL_MMV_VLD_FCUT[i]i = IPLSL_MV_PURGE[i]i
      IPLSL_VARI_VLD_FCUT[i]i = IPLSL_VARI_VLD_FCUT[i]i-1

else IPLSL_MMV_VLD_FCUT[i]i = IPLSL_MMV_VLD_FCUT[i]i-1
      + C_CRLC_IPLSL_MV_VLD * ( IPLSL_MV_PURGE[i]

• IPLSL_MMV_VLD_FCUT[i]i-1 )
      IPLSL_VARI_VLD_FCUT[i]i = IPLSL_VARI_VLD_FCUT[i]i-1
      + C_CRLC_IPLSL_MV_VLD * (( IPLSL_MV_PURGE[i]
      - IPLSL_MMV_VLD_FCUT[i]i ) ^2 - IPLSL_VARI_VLD_FCUT[i]i-1 )
  
```

**end**

#### Adaptation conditions

```

if IPLSL_VARI_VLD_FCUT[i] > C_IPLSL_MV_VLD_VARI_MAX
then STATE_IPLSL_GAIN_AD[i] = 3 ( impossible )
      ( adaptation impossible due variance limit of valid fuel cut
        measurements exceeded )

else if ( C_IPLSL_NOM_PURGE /IPLSL_MMV_VLD_FCUT[i] )
          > C_FAC_LSL_GAIN_AD_LIM_MAX
then STATE_IPLSL_GAIN_AD[i] = 1 ( low Ip limit )
      if LC_FAC_LSL_GAIN_AD_LIM_RST == 1
      then FAC_LSL_GAIN_AD[i] = 1
      else FAC_LSL_GAIN_AD[i]
          = C_FAC_LSL_GAIN_AD_LIM_MAX

endif
      LV_FAC_LSL_GAIN_AD_LIM_MIN[i] = 0
      LV_FAC_LSL_GAIN_AD_LIM_MAX[i] = 1
      ( upper adapt. factor limit exceeded
        since pumping current lower than allowed limit )

else LV_FAC_LSL_GAIN_AD_LIM_MAX[i] = 0
      if ( C_IPLSL_NOM_PURGE /IPLSL_MMV_VLD_FCUT[i] )
          < C_FAC_LSL_GAIN_AD_LIM_MIN
then STATE_IPLSL_GAIN_AD[i] = 2 ( high Ip limit )
      if LC_FAC_LSL_GAIN_AD_LIM_RST = 1
  
```

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```

        then FAC_LSL_GAIN_AD[i] = 1
        else FAC_LSL_GAIN_AD[i]
              = C_FAC_LSL_GAIN_AD_LIM_MIN
        endif
        LV_FAC_LSL_GAIN_AD_LIM_MIN[i] = 1
        ( lower adaptation factor limit exceeded,
          since pumping current higher than allowed limit )
    else STATE_IPLSL_GAIN_AD[i] = 0 ( in range )
        LV_FAC_LSL_GAIN_AD_LIM_MIN[i] = 0
    endif
endif
endif

```

#### Adaptation

```

if STATE_IPLSL_GAIN_AD[i] == 0 ( in range )
then LV_LSL_GAIN_AD_FCUT_NOT_OK[i] = 0
      if LC_FAC_LSL_GAIN_AD_ENA == 1
then FAC_LSL_GAIN_AD[i] =
          C_IPLSL_NOM_PURGE /IPLSL_MMV_VLD_FCUT[i]
          ( New adaptation factor = nominal current divided by MMV
            of uncompensated current )
          LV_LSL_FIRST_GAIN_AD[i] = 0
      else FAC_LSL_GAIN_AD[i] = 1
      endif
else LV_LSL_GAIN_AD_FCUT_NOT_OK[i] = 1
endif
else LV_LSL_FCUT_MES_NOT_PLAUS[i] = 1
endif

```

#### Transition to state "WAIT":

##### Conditions:

```

if LV_LSL_FCUT_MES_NOT_PLAUS[i] == 1
or LV_LSL_GAIN_AD_FCUT_NOT_OK[i] == 1
then " transition to WAIT "
endif

```

##### Actions during transition:

```
STATE_IPLSL_AD_FCUT[i] = WAIT
```

#### Transition to state "INIT":

##### Conditions:


```

if LV_IPLSL_VLD_FCUT[i] == 1
and LV_PUC == 0
then " transition to INIT "
endif

```

##### Actions during transition:

```
STATE_IPLSL_AD_FCUT[i] = INIT
```

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## 7.47 Activation conditions for WRAF sensor gain adaptation at fuel cutoff

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_LSL_GAIN_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
WRAF sensor Gain Adaptation: application incidences for inhibition					

### Input data:

LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAM_CUS {p. 1042}	LV_ERR_CHG_LS_UP {p. 5416}
LV_ERR_CRK {p. 4455}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}
LV_ERR_EL_CPS {p. 4708}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}	LV_ERR_IGC {p. 4772}
LV_ERR_IVVT {p. 1062}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_ERR_MAF {p. 4815}
LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_SA_SAV {p. 801}	LV_ERR_SA_SAV_LSL {p. 801}
LV_ERR_SAP {p. 802}	LV_ERR_SAV {p. 802}	LV_ERR_TAM_CAN {p. 5076}	LV_ERR_TAM_PLAUS {p. 5076}
LV_ERR_TCO {p. 4496}	LV_ERR_TPS {p. 4982}	LV_ERR_TTIP_MES_LSH_ UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}
LV_IGK {p. 906}	LV_MIS_STATE_A {p. 6238}	LV_MIS_STATE_B {p. 6238}	LV_ST_END {p. 1720}
NC_CBK_EX_NR {p. 1829}	OPM_AV {p. 8137}	STATE_ERR_IV {p. 4803}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_LSL_GAIN_AD_ENA_ALL_OPM	-	0... 1H	0 ...1	1	-
Logical constant to enable gain adaption in all engine operation modes					

## FUNCTION DESCRIPTION:

### General information:

If one of the below mentioned conditions is not fulfilled, the inhibit bit interrupts the WRAF sensor gain adaptation at fuel cut-off.

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)





## 7.48 O2 sensor (up) heater management

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LSHPWM_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 99.60937	0.390625	%
Heater driver PWM duty cycle, acquired also by BSW					
LV_LSH_CTL_CLL_LSH_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean variable indicating closed loop control mode active					
LV_LSH_UP_MAN_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean variable indicating that forced lambda probe heating before engine start is active					
LV_V_EFC_LIM_BOL_LSH_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating effective heater voltage limited due to sum of voltage components falling below zero.					
LV_V_EFC_LIM_MAX_LSH_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating effective heater voltage limited due to exceeding absolute maximum voltage spec.					
LV_V_EFC_LIM_PROT_VB_LSH_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean variable indicating effective heater voltage limited due to excessive battery voltage level					
LV_V_EFC_LIM_TOL_LSH_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating effective heater voltage limited due to exceeding threshold for period of time.					
STATE_LSH_UP [NC_CBK_EX_NR]	O/V	0H	LSH_OFF	-	-
		1H	LSH_POW_ RISE		
		2H	LSH_POW_ RED		
		3H	LSH_POW_ FALL		
		4H	LSH_POW_ CTL		
		5H	LSH_VB_ PROT		
		6H	LSH_TEMP_ PROT		
Present heater state					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_POW_RISE_LSH_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 6553.5	0.1	s
Timer indicating the duration of the pre-heating and post dew point heating phases					
T_V_EFC_LIM_LSH_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer indicating the duration of the effective heater voltage limitation preventing overvoltage					
T_V_EFC_TOL_LSH_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer indicating permitted effective heater voltage overvoltage duration					
TTIP_MES_DIF_LS_UP [NC_CBK_EX_NR]	V	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Difference between actual and set oxygen sensor tip temperature					
V_EFC_CLC_LSH_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 25.9996	397e-6	V
Effective calculated heater voltage value prior to overvoltage protection					
V_EFC_CTL_ADD_LSH_UP [NC_CBK_EX_NR]	V	80... 7FH	-13... 12.89843	0.1015625	V
Additive effective heater voltage from closed loop controller					
V_EFC_CTL_I_LSH_UP [NC_CBK_EX_NR]	V	8000... 7FFFH	-13... 12.9996	397e-6	V
Additive effective heater voltage from closed loop controller, I term					
V_EFC_CTL_I_LSH_UP_TMP [NC_CBK_EX_NR]	-	8000... 7FFFH	-13... 12.9996	396.7e-6	V
Intermediate additive effective heater voltage from closed loop controller, I term					
V_EFC_CTL_P_LSH_UP [NC_CBK_EX_NR]	V	8000... 7FFFH	-13... 12.9996	397e-6	V
Additive effective heater voltage from closed loop controller, P term					
V_EFC_CTL_P_LSH_UP_TMP [NC_CBK_EX_NR]	-	8000... 7FFFH	-13... 12.9996	396.7e-6	V
Intermediate additive effective heater voltage from closed loop controller, P term					
V_EFC_LSH_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 25.89843	0.1015625	V
Effective final output value of heater voltage					

**Input data:**


LSHPWM_EXT_LS_UP [NC_CBK_EX_NR] {p. 2406}	LV_ES {p. 1720}	LV_INH_LSH_CTL_CLL_ LSH_UP [NC_CBK_EX_NR] {p. 2406}	LV_INH_LSH_UP [NC_CBK_EX_NR] {p. 2406}
LV_LS_UP_READY_CDN [NC_CBK_EX_NR] {p. 2335}	LV_ST_END {p. 1720}	LV_STST_STOP_CYC {p. 805}	LV_TEMP_DEW_LS_UP [NC_CBK_EX_NR] {p. 1007}
LV_TTIP_MES_VLD_LS_ UP [NC_CBK_EX_NR] {p. 1320}	LV_V_REF_VLD_R_IT_LS_ UP [NC_CBK_EX_NR] {p. 1320}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}
T_AST {p. 1766}	TEG_DYN_LS_UP [NC_CBK_EX_NR] {p. 1008}	TEMP_INI_LS_UP [NC_CBK_EX_NR] {p. 2406}	TTIP_MES_LS_UP [NC_CBK_EX_NR] {p. 1321}
VB {p. 1185}	VS {p. 1176}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_CTL_I_LSH_UP	-	0... FFH	0... 6.348	24.9e-3	-
Multiplicative scaling factor for closed loop I-term					
C_FAC_CTL_P_LSH_UP	-	0... FFH	0... 6.348	24.9e-3	-
Multiplicative scaling factor for closed loop P-term					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_V_EFC_AS_LSH_UP	-	0... FFH	0... 1.99218	0.0078125	-
Multiplicative correction factor to effective heater voltage					
C_FAC_V_EFC_LSH_UP_MAN_ACT	-	0... FFH	0... 1.99218	0.0078125	-
Multiplicative correction factor to effective heater voltage with activated forced heating before engine start for state LSH_POW_CTL					
C_T_AST_MAX_LSH_UP	-	0... FFFFH	0... 6553.5	0.1	s
Time after start at which step in max. effective heater voltage applied, if LSH_POW_CTL active (T_POW_RISE_LSH_UP[NC_CBK_EX_NR] stopped)					
C_T_MAX_CDN_LSH_UP_MAN_ACT	-	0... FFFFH	0... 6553.5	0.1	s
Time threshold for transition from state POW_RISE to POW_CTL with activated forced heating before engine start					
C_T_MAX_POW_RISE_LSH_UP	-	0... FFFFH	0... 6553.5	0.1	s
Duration of open loop pre-heating in LSH_POW_RISE from dew-point to set-point temperature					
C_T_MAX_V_EFC_LIM_LSH_UP	-	0... FFFFH	0... 6553.5	0.1	s
Maximum duration of effective heater voltage limiting					
C_T_MAX_V_EFC_MAX_ST_LSH_UP	-	0... FFH	0... 25.5	0.1	s
Time after start at which step in max. effective heater voltage applied					
C_T_MAX_V_EFC_TOL_LSH_UP	-	0... FFFFH	0... 6553.5	0.1	s
Maximum permitted duration where excessive effective heater voltage tolerated					
C_TEG_DYN_MAX_LSH_UP	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Maximum permitted exhaust gas temperature above which LSH switched off					
C_TTIP_DIF_MIN_CTL_P_LS_UP	-	0... 7FFFH	0... 2047.9375	0.0625	°C
Minimum required temperature difference in order to calculate P term of controller					
C_TTIP_SP_LS_UP [NC_CBK_EX_NR]	-	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Oxygen sensor set temperature for closed loop control					
C_V_EFC_AS_LSH_UP	-	80... 7FH	-13... 12.89843	0.1015625	V
Effective heater voltage calibration system additive factor					
C_V_EFC_DEC_LSH_UP	-	0... FFH	0... 1.625	6.37e-3	V/100ms
Effective heater voltage decrement to lower temperature					
C_V_EFC_INC_LSH_UP	-	0... FFH	0... 1.625	6.37e-3	V/100ms
Effective heater voltage increment to raise temperature					
C_V_EFC_INI_LSH_UP_MAN_ACT	-	0... FFFFH	0... 25.9996	396.7e-6	V
Initial effective heater voltage when forced heating before engine start activated					
C_V_EFC_LIM_LSH_UP	-	0... FFH	0... 25.89843	0.1015625	V
Effective heater voltage limit under persistent excessive heater voltage condition					
C_V_EFC_MAX_LSH_UP	-	0... FFH	0... 25.89843	0.1015625	V
Absolute maximum permitted effective heater voltage after initial phase; threshold & limit					
C_V_EFC_MAX_LSH_UP_MAN_ACT	-	0... FFFFH	0... 25.9996	396.7e-6	V
Absolute maximum permitted effective heater voltage during forced heating phase before engine start					
C_V_EFC_MAX_ST_LSH_UP	-	0... FFH	0... 25.89843	0.1015625	V
Absolute maximum permitted effective heater voltage during initial phase; threshold & limit					
C_V_EFC_PROT_VB_LSH_UP	-	0... FFH	0... 25.89843	0.1015625	V
Effective heater voltage in the case of battery voltage overvoltage condition					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_V_EFC_RED_LSH_UP	-	0... FFH	0... 25.89843	0.1015625	V
Reduced effective heater voltage during danger of water splash damage					
C_V_EFC_STEP_LSH_UP	-	80... 7FH	-13... 12.89843	0.1015625	V
Additional effective heater voltage step on transition from LSH_POW_RED to LSH_POW_RISE					
C_V_EFC_TOL_LSH_UP	-	0... FFH	0... 25.89843	0.1015625	V
Effective heater voltage threshold above which voltage limiting may occur if threshold persistently exceeded					
C_VB_MAX_PROT_LSH_UP	-	0... FFH	0... 25.89843	0.1015625	V
Maximum permitted battery voltage threshold, over which overvoltage detected					
ID_TTIP_SP_DIF_LSH_UP	-	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
LDP_T_POW_RISE_LSH_UP_ID_TTIP	4	0... FFFFH	0... 6553.5	0.1	s
Reducing value for TTIP threshold of transition conditions LSH_POW_RISE to LSH_POW_CTL					
IP_FAC_NEG_CTL_I_LSH_UP	V	0... FFH	0... 0.255	0.001	V/K
LDPM_N_32_1_EGCP	6	0... FFH	0... 8160	32	rpm
LDPM_TEG_DYN_LS_UP_1_EGCP	6	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Closed loop controller I-term factor for temperature too high; decrease heater voltage					
IP_FAC_NEG_CTL_P_LSH_UP	V	0... FFH	0... 0.255	0.001	V/K
LDPM_N_32_1_EGCP	6	0... FFH	0... 8160	32	rpm
LDPM_TEG_DYN_LS_UP_1_EGCP	6	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Closed loop controller P-term factor for temperature too high; decrease heater voltage					
IP_FAC_POS_CTL_I_LSH_UP	V	0... FFH	0... 0.255	0.001	V/K
LDPM_N_32_1_EGCP	6	0... FFH	0... 8160	32	rpm
LDPM_TEG_DYN_LS_UP_1_EGCP	6	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Closed loop controller I-term factor for temperature too low; increase heater voltage					
IP_FAC_POS_CTL_P_LSH_UP	V	0... FFH	0... 0.255	0.001	V/K
LDPM_N_32_1_EGCP	6	0... FFH	0... 8160	32	rpm
LDPM_TEG_DYN_LS_UP_1_EGCP	6	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Closed loop controller P-term factor for temperature too low; increase heater voltage					
IP_FAC_V_EFC_TEG_LSH_UP	-	0... FFH	0... 3.98437	0.015625	-
LDP_VS_IP_FAC_V_EFC_TEG_LSH_UP	6	0... FFH	0... 255	1	km/h
Factor for the heat transfer rate, bank 2 only					
IP_T_TEMP_THD_LSH_UP	-	0... FFH	0... 25.5	0.1	s
LDPM_TEMP_INI_LS_UP_1_EGCP	6	0... FFFFH	-2048... 2047.9375	0.0625	°C
Duration until critical water splash sensor temperature reached					
IP_V_EFC_CTL_LSH_UP	V	0... FFH	0... 25.89843	0.1015625	V
LDPM_N_32_1_EGCP	6	0... FFH	0... 8160	32	rpm
LDPM_TEG_DYN_LS_UP_1_EGCP	6	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Open loop control effective heater voltage					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_V_EFC_INI_LSH_UP	-	0... FFH	0... 25.89843	0.1015625	V
LDPM_TEMP_INI_LS_UP_1_EGCP	6	0... FFFFH	-2048... 2047.9375	0.0625	°C
Initial effective heater voltage					
LC_LSH_CTL_CLL_INH_LSH_UP [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Boolean constant to permit suspension of closed loop heater control					
LC_LSH_UP_MAN_ACT [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Boolean constant to permit forced lambda sensor heating before engine start					
LC_TEMP_DEW_LSH_UP	-	0... 1H	0 ...1	1	-
Logical calibration data to force LSH_OFF to LSH_POW_RED transition if no dew point recognized					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_LSHPWM_BOL_LSH_UP	-	0... FFH	0... 99.60937	0.390625	%
Heater driver PWM duty cycle lower limit					
NC_LSHPWM_TOL_LSH_UP	-	0... FFH	0... 99.60937	0.390625	%
Heater driver PWM duty cycle upper limit					

**Import actions:**

<b>ACTION_INFR_SetPwmLshUp</b> (IN<i>,IN<ducy>)
---

**FUNCTION DESCRIPTION:****General information:**

If two separate cylinder banks are concerned, then

i = 1, for cylinder bank 1

i = 2, for cylinder bank 2


The heater control shall be realised by use of a state machine. Each upstream oxygen sensor shall have its own state machine and each state machine shall run independently of the other.

**Lambda probe heating after engine start (normal case)**

The goal of the heater control shall be to control the oxygen sensor heating such that the optimal operating temperature is reached in the shortest time possible. At the same time, the maximum permissible temperature gradient (possible damage to ceramic due to thermal stress), the possible occurrence of water splash under the dew point (possible damage to ceramic due to thermal shock) and the absolute maximum ratings specified for the sensor shall be taken into account.

The function shall permit oxygen sensor heating under open and closed loop control.

Signal flow:

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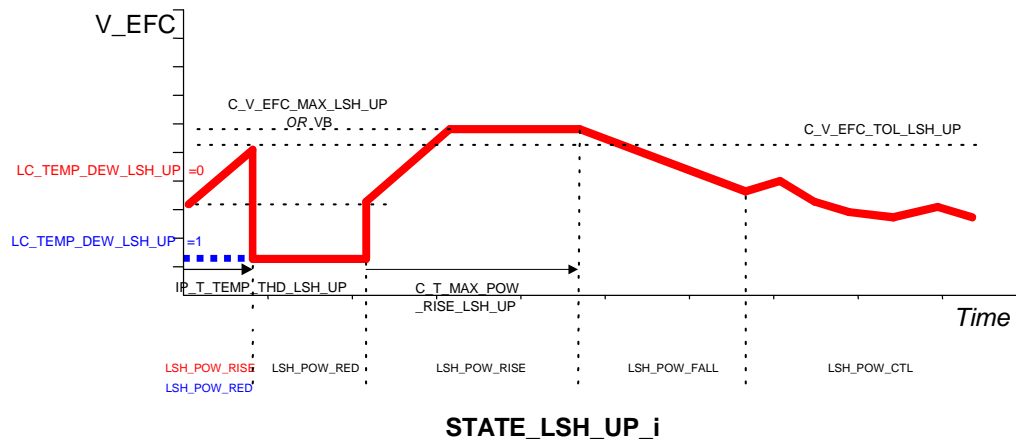


Figure 7.48.1: : Course of effective heater voltage over time /state

The heater control shall be initialised to the LSH\_OFF state at the start of a new driving cycle. Hence the oxygen sensor will not initially be electrically heated if not otherwise required (see sub chapter "forced lambda probe heating before engine start").

In the normal case (no forced heating before engine start) heating shall be started when the engine has transitioned from the start state (LV\_ST\_END = 1) and the heater management inhibit bit for the corresponding bank is not set (LV\_INH\_LSH\_UP[i] = 0). Depending on the lambda sensor requirement specification following two methods of initial lambda sensor heating are possible as judged by calibration of LC\_TEMP\_DEW\_LSH\_UP (see figure 1). This is due to the fact that for lambda sensors until dew point recognition either a certain temperature limit or a defined voltage limit must not be exceeded as the lambda sensor may be damaged by water splash or excessive temperature gradient otherwise. Depending on the setting of LC\_TEMP\_DEW\_LSH\_UP the heater management state machine shall thus switch from LSH\_OFF to LSH\_POW\_RISE (LC\_TEMP\_DEW\_LSH\_UP = 0) or to LSH\_POW\_RED (LC\_TEMP\_DEW\_LSH\_UP = 1). In case of direct dew point recognition after hot restart the state machine shall switch to LSH\_POW\_RISE.

#### 1.) Transition from LSH\_OFF to LSH\_POW\_RED before dew point recognition

In case of transition from LSH\_OFF to LSH\_POW\_RED the initial heater power is set by setting the effective heater voltage to C\_V\_EFC\_RED\_LSH\_UP. The reduced heating state where water splash may occur shall persist until the dew point in the exhaust gas system has been recognized, i.e. until LV\_TEMP\_DEW\_LS\_UP[i] = 1, at which point the heater state shall switch to LSH\_POW\_RISE.

The effective heater voltage shall be set to the effective heater voltage as determined by IP\_V\_EFC\_INI\_LSH\_UP, which may be modified by the calibration data C\_V\_EFC\_STEP\_LSH\_UP, and may further be incremented with a gradient of C\_V\_EFC\_INC\_LSH\_UP without danger of damaging the oxygen sensor. Additionally the timer T\_POW\_RISE\_LSH\_UP[i] shall be reinitialised with the IP\_T\_TEMP\_THD\_LSH\_UP determined at function start.

#### 2.) Transition from LSH\_OFF to LSH\_POW\_RISE before dew point recognition

In case of transition from heater state LSH\_OFF to LSH\_POW\_RISE the initial value for the effective heater voltage shall be determined by obtaining the oxygen sensor temperature at start (TEMP\_INI\_LS\_UP[i]) from input data. This shall then be used to obtain the appropriate effective heater starting voltage from map IP\_V\_EFC\_INI\_LSH\_UP. In the state LSH\_POW\_RISE, the effective heater voltage shall be incremented with the gradient of C\_V\_EFC\_INC\_LSH\_UP. The continuation of the heating gradient shall depend on whether the dew point at sensor location has been recognized.

Should the dew point not have been exceeded (LV\_TEMP\_DEW\_LS\_UP[i] = 0) but timer T\_POW\_RISE\_LSH\_UP[i] has equalled or exceeded IP\_T\_TEMP\_THD\_LSH\_UP, it shall be assumed that condensed water splash at the oxygen sensor location may occur. In order to protect the oxygen sensor by keeping the temperature of the ceramic lower than the specified critical temperature, the

heater power shall be reduced immediately by setting the effective heater voltage to C\_V\_EFC\_RED\_LSH\_UP. In this case, the heater state shall be set to LSH\_POW\_RED (see above).

The reduced heating state shall persist until the dew point in the exhaust gas system has been recognized, i.e. until LV\_TEMP\_DEW\_LS\_UP[i] = 1, at which point the heater state shall return to LSH\_POW\_RISE. For further operation please refer to case 1.)

Should the initial exhaust gas temperature at start have been determined to exceed the dew point (LV\_TEMP\_DEW\_LS\_UP[i] = 1), the heater control shall not enter the reduced heater power state but continue to incrementally increase the heater power within the LSH\_POW\_RISE state.

Dependent on whether closed loop control is permitted, the heater management shall enter either LSH\_POW\_CTL or LSH\_POW\_FALL. Should closed loop be permitted (LV\_INH\_LSH\_CTL\_CLL\_LSH\_UP[i] = 0) and the ceramic temperature reference be valid (LV\_V\_REF\_VLD\_R\_IT\_LS\_UP[i] = 1) and ceramic temperature exceed the set temperature (TTIP\_MES\_LS\_UP[i] C\_TTIP\_SP\_LS\_UP[i]) then the state machine shall change to LSH\_POW\_CTL and the timer shall be frozen. This state change shall permit the controller to take over heating when the operative readiness has been detected in order to prevent under- & overshoot of the ceramic temperature. Should the conditional operative readiness be set (LV\_LS\_UP\_READY\_CDN[i] = 1) then the state machine shall also enter state LSH\_POW\_CTL and stop the timer. This shall permit the heater stability diagnosis to be carried out even when the heater is sufficiently defective to prevent the set temperature from being reached. Should the closed loop controller be inhibited or the ceramic temperature calibration be faulty, and T\_POW\_RISE\_LSH\_UP[i] be determined to have equalled or exceeded the value C\_T\_MAX\_POW\_RISE\_LSH\_UP (irrespective of the dew point having been exceeded or not), the heater state shall change to LSH\_POW\_FALL and the timer shall be frozen.

In the LSH\_POW\_FALL state, the effective heater voltage shall be reduced with a gradient of C\_V\_EFC\_DEC\_LSH\_UP until such time that it falls below or equals the value set for the open loop control at the current engine operating point. For cylinder bank 1, this value is determined by map IP\_V\_EFC\_CTL\_LSH\_UP alone. For cylinder bank 2, this value is determined by IP\_V\_EFC\_CTL\_LSH\_UP \* IP\_FAC\_V\_EFC\_TEG\_LSH\_UP. The latter factor shall be necessary to accommodate differences in heat transfer rates between cylinder banks at the oxygen sensor location, particularly for transversal mounted V6-engines. At such time the effective heater voltage falls below or equals the respective threshold, the heater state shall change to LSH\_POW\_CTL.

Should, however, the Boolean flag LV\_TEMP\_DEW\_LS\_UP[i] be reset whilst in the state LSH\_POW\_FALL, then the closed loop controller terms shall be reset, the Boolean flags to indicate closed loop control and effective heater voltage limitation shall be reset and the heater control shall resume at state LSH\_POW\_RED following the procedures outlined above.

The control of the effective heater voltage may be carried out in open loop or closed loop mode. Unless either the closed loop control inhibit bit (LV\_INH\_LSH\_CTL\_CLL\_LSH\_UP[i]) is set or the reference voltage validity bit (LV\_V\_REF\_VLD\_R\_IT\_LS\_UP[i]) is reset, the effective heater voltage shall be controlled in closed loop mode. Closed loop control conditions met shall be indicated by setting LV\_LSH\_CTL\_CLL\_LSH\_UP[i]. Should at any time one of the above conditions no longer be met, the heater controller shall revert to open loop control, reset the closed loop variables and reset LV\_LSH\_CTL\_CLL\_LSH\_UP[i].


In the open loop heater control mode, the effective heater voltage shall be obtained from map IP\_V\_EFC\_CTL\_LSH\_UP and is dependent upon the engine speed and the modelled exhaust gas temperature. For cylinder bank 2, an additional multiplicative factor (IP\_FAC\_V\_EFC\_TEG\_LSH\_UP) may be required for the reasons outlined above.

In the closed loop heater control mode, a PI controller, that affects the open loop effective heater voltage in an additive manner, shall regulate the effective heater voltage such that the temperature specified by C\_TTIP\_SP\_LS\_UP[i] is maintained. The closed loop control may be further described as follows:

The current temperature of the oxygen sensor (TTIP\_MES\_LS\_UP[i]) shall be obtained and the difference between this temperature and the set temperature computed to obtain the input variable to the controller (TTIP\_MES\_DIF\_LS\_UP[i]). Note that this variable shall be computed in both open and closed loop control modes but shall only be used in the closed loop control mode.

The controller shall then determine the appropriate additive voltage (V\_EFC\_CTL\_ADD\_LSH\_UP[i]) by computing the P and I terms separately and then adding the two terms.

The P term (V\_EFC\_CTL\_P\_LSH\_UP[i]) shall calculate a voltage proportional to the temperature difference and thus converting a temperature delta into voltage. The P term shall only be calculated when the

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absolute temperature difference (TTIP\_MES\_DIF\_LS\_UP[i]) equals or exceeds a constant (C\_TTIP\_DIF\_MIN\_CTL\_P\_LS\_UP). This shall be achieved via the map IP\_FAC\_xxx\_P\_LSH\_UP\_CTL, where xxx stands for either POS or NEG dependent on the sign of the temperature difference. The map values are dependent on engine speed and exhaust gas temperature. A further dimensionless constant C\_FAC\_CTL\_P\_LSH\_UP shall permit global parameter changes to be made.

The I term (V\_EFC\_CTL\_I\_LSH\_UP[i]) shall calculate an integral of a voltage that shall be proportional to the temperature difference and thus converting a temperature delta into voltage. This shall be achieved via the map IP\_FAC\_xxx\_I\_LSH\_UP\_CTL, where xxx stands for either POS or NEG dependent on the sign of the temperature difference. The map values are dependent on engine speed and exhaust gas temperature. A further dimensionless constant C\_FAC\_CTL\_I\_LSH\_UP shall permit global parameter changes to be made.

Once the additive voltage has been determined, this shall then be added to the open loop control voltage along with a calibration system constant (C\_V\_EFC\_AS\_LSH\_UP) to permit a global change in the total effective heater voltage to be made. Thus the calculated effective heater voltage (V\_EFC\_CLC\_LSH\_UP[i]) shall be computed from the open loop value, the closed loop additive term and the global correction value.

The closed loop control computations shall be suspended should either the Boolean flag LC\_LSH\_CTL\_CLL\_INH\_LSH\_UP[i] be set or the ceramic temperature no longer be valid, for example due to an active reference voltage measurement, as indicated by LV\_TTIP\_MES\_VLD\_LS\_UP[i] being reset. This shall freeze the P and I terms at their last calculated value. Upon revoking the suspension, the controller shall continue to compute from where the point immediately prior to the suspension, i.e. shall not start anew. Furthermore should the sum of the components used to calculate the effective heater voltage be negative, LV\_V\_EFC\_LIM\_BOL\_LSH\_UP[i] shall be set. This shall prevent the controller from decreasing the effective heater voltage further but not prevent it from increasing the voltage. When the sum of the components is no longer negative, LV\_V\_EFC\_LIM\_BOL\_LSH\_UP[i] shall be reset. Similarly, should either of the overvoltage limitation Boolean flags LV\_V\_EFC\_LIM\_TOL\_LSH\_UP[i] & LV\_V\_EFC\_LIM\_MAX\_LSH\_UP[i] be set, as described later, the controller shall be prevented from increasing the effective heater voltage further but not prevent it from decreasing the voltage. When the overvoltage flags are no longer set and the other applicable conditions are met, the controller shall resume normal operation.

Should, however, the Boolean flag LV\_TEMP\_DEW\_LS\_UP[i] be reset whilst in the state LSH\_POW\_CTL, then the closed loop controller terms shall be reset, the Boolean flags to indicate closed loop control and effective heater voltage limitation shall be reset and the heater control shall resume at state LSH\_POW\_RED following the procedures outlined above.


Should at any time the battery voltage VB exceed the threshold C\_VB\_MAX\_PROT\_LSH\_UP, as determined by the state of logical variable LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_UP[i], the oxygen sensor heater power shall be reduced by reducing the effective heater voltage used to calculate the driver duty cycle to C\_V\_EFC\_PROT\_VB\_LSH\_UP. The heater state shall change to LSH\_VB\_PROT on the next recurrence of the state machine and the effective heater voltage set to the aforementioned limit. This shall prevent damage to the sensor due to excessive heater voltages e.g. due to jump start from 24 V.

Should the battery voltage recover when in the state LSH\_VB\_PROT, as indicated by LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_UP[i] = 0, T\_POW\_RISE\_LSH\_UP[i] shall be reset, V\_EFC\_LSH\_UP[i] shall be initialised to IP\_V\_EFC\_INI\_LSH\_UP calculated after the start, the closed loop controller terms shall be reset, the Boolean flags to indicate closed loop control and effective heater voltage limitation shall be reset and the heater control shall resume at state LSH\_POW\_RISE following the procedures outlined above.

Short term voltage excursions shall cause the heater power to be limited but will only cause the state machine to change state should the voltage excursion persist until the next recurrence of the state machine. The state machine shall not be able to enter the LSH\_VB\_PROT state directly from LSH\_OFF but shall be required to pass through LSH\_POW\_RISE.

The sensor shall also be protected from over-temperature. This shall be achieved by evaluating the value of the modelled exhaust gas temperature TEG\_DYN\_LS\_UP[i] in all states other than LSH\_OFF. Should the exhaust gas temperature exceed the threshold C\_TEG\_DYN\_MAX\_LSH\_UP, the calculated effective heater voltage shall be reduced to 0, the state shall change to LSH\_TEMP\_PROT thus suspending closed loop control, if active.

Should the exhaust gas temperature fall below the threshold, the state shall change dependent on the state active immediately prior to the over-temperature protection. If the state was LSH\_POW\_CTL,

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the state machine shall return to this state and the effective heater voltage shall take the new value as computed by the open /closed loop control. The closed loop controller shall not be started anew. If the state was any other than LSH\_POW\_CTL, the state shall change to LSH\_POW\_RISE. In this case T\_POW\_RISE\_LSH\_UP[i] shall be reset, V\_EFC\_LSH\_UP[i] shall be initialised to IP\_V\_EFC\_INI\_LSH\_UP calculated after the start, the closed loop controller terms shall be reset, the Boolean flags to indicate closed loop control and effective heater voltage limitation shall be reset and the heater control shall resume at state LSH\_POW\_RISE following the procedures outlined above.

Furthermore, in order to protect the sensor heater against long term high voltage stress it shall be necessary to limit the effective heater voltage should the value of V\_EFC\_CLC\_LSH\_UP[i] equal or exceed the threshold C\_V\_EFC\_TOL\_LSH\_UP.

In this instance, the timer T\_V\_EFC\_TOL\_LSH\_UP[i] shall be started. Should the overvoltage condition persist, such that this timer equals or exceeds the threshold C\_T\_MAX\_V\_EFC\_TOL\_LSH\_UP, timer T\_V\_EFC\_LIM\_LSH\_UP[i] shall be started and the Boolean flag LV\_V\_EFC\_LIM\_TOL\_LSH\_UP[i] shall be set. This flag shall prevent the controller from increasing effective the voltage further. If however the value of V\_EFC\_CLC\_LSH\_UP[i] should fall below the threshold C\_V\_EFC\_TOL\_LSH\_UP at any time, LV\_V\_EFC\_LIM\_TOL\_LSH\_UP[i] shall be reset.

Once timer T\_V\_EFC\_LIM\_LSH\_UP[i] has been started, Boolean flag LV\_V\_EFC\_LIM\_TOL\_LSH\_UP[i] shall be set or reset depending on the value of V\_EFC\_CLC\_LSH\_UP[i]. Once the timer T\_V\_EFC\_LIM\_LSH\_UP[i] equals or exceeds threshold C\_T\_MAX\_V\_EFC\_LIM\_LSH\_UP, both timers shall be reset and timer T\_V\_EFC\_TOL\_LSH\_UP[i] must exceed the threshold C\_T\_MAX\_V\_EFC\_TOL\_LSH\_UP again in order to permit further limiting to take place.

To prevent damage to the sensor, V\_EFC\_CLC\_LSH\_UP[i] shall not be permitted to exceed the lower of the values C\_V\_EFC\_MAX\_LSH\_UP, C\_V\_EFC\_MAX\_ST\_LSH\_UP or VB dependent on the value of T\_POW\_RISE\_LSH\_UP[i].

If T\_POW\_RISE\_LSH\_UP[i] equals or exceeds the constant C\_T\_MAX\_V\_EFC\_MAX\_ST\_LSH\_UP STEP or conditions regarding T\_AST and STATE\_LSH\_UP[i] then V\_EFC\_CLC\_LSH\_UP[i] shall be checked against VB & C\_V\_EFC\_MAX\_LSH\_UP. If either of the values is exceeded then Boolean flag LV\_V\_EFC\_LIM\_MAX\_LSH\_UP[i] shall be set and V\_EFC\_CLC\_LSH\_UP[i] limited to the lower of VB & C\_V\_EFC\_MAX\_LSH\_UP otherwise LV\_V\_EFC\_LIM\_MAX\_LSH\_UP[i] shall be reset.

If T\_POW\_RISE\_LSH\_UP[i] is lower then constant C\_T\_MAX\_V\_EFC\_MAX\_ST\_LSH\_UP then V\_EFC\_CLC\_LSH\_UP[i] shall be checked against VB & C\_V\_EFC\_MAX\_ST\_LSH\_UP. If either of the values is exceeded then Boolean flag LV\_V\_EFC\_LIM\_MAX\_LSH\_UP[i] shall be set and V\_EFC\_CLC\_LSH\_UP[i] limited to the lower of VB & C\_V\_EFC\_MAX\_ST\_LSH\_UP otherwise LV\_V\_EFC\_LIM\_MAX\_LSH\_UP[i] shall be reset.


The flag LV\_V\_EFC\_LIM\_MAX\_LSH\_UP[i] shall prevent the controller from increasing effective the voltage further and permit the final effective heater voltage to be limited, as described later.

Should timer T\_V\_EFC\_LIM\_LSH\_UP[i] be unequal to zero, i.e. overvoltage no longer tolerated as it has been present for certain time, V\_EFC\_LSH\_UP[i] shall be the lower of the values V\_EFC\_CLC\_LSH\_UP[i] & C\_V\_EFC\_LIM\_LSH\_UP otherwise V\_EFC\_LSH\_UP[i] shall be set to V\_EFC\_CLC\_LSH\_UP[i].

Once the effective heater voltage has been determined throughout the various heater states other than LSH\_OFF, it shall be used to compute the PWM duty cycle (LSHPWM\_UP[i]) that shall control the appropriate heater driver. The heater power shall be corrected to take into account deviations in the measured battery voltage and limited to the range bounded by NC\_LSHPWM\_TOL\_LSH\_UP & NC\_LSHPWM\_BOL\_LSH\_UP. The evaluation of excess battery voltage shall be determined at the same recurrence as the computation of the duty cycle as described above. The PWM value may also be modified by use of constant C\_FAC\_V\_EFC\_AS\_LSH\_UP.

Should at any time an inhibit flag be set (LV\_INH\_LSH\_UP[i] = 1), the corresponding oxygen sensor heater shall be switched off and the STATE\_LSH\_UP[i] set to LSH\_OFF. This shall allow project specific application conditions to turn off oxygen sensor heating according to project philosophy. Should the heater function be inhibited, then the PWM duty cycle shall be set to input LSHPWM\_EXT\_LS\_UP[i]. On a transition of the inhibit bit LV\_INH\_LSH\_UP[i] from 1 0, the heater function shall start from anew.

### **Forced lambda probe heating before engine start (for application purpose)**

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Additionally to normal sensor heating after engine start setting  $LC\_LSH\_UP\_MAN\_ACT[i] = 1$  allows forced pre-heating of the lambda sensor before engine start. The aim is to ramp up the sensor element to operating temperature in order to achieve a reliable lambda sensor signal already at the time when the engine is started. It has to be emphasized that this method covers a high risk for sensor damage by water splash as operating temperature is already reached before dew-point recognition. Therefore this feature shall only be used for application purpose.

If forced heating is activated, i.e. condition 15 being fulfilled, the state machine shall enter the state  $LSH\_POW\_RISE$  and a heater voltage  $C\_V\_EFC\_INI\_LSH\_UP\_MAN\_ACT$  shall be applied. Before engine start no forced convection and consequently no lambda sensor cooling by the exhaust gas is present. Therefore the initial heater voltage may be reduced to  $C\_V\_EFC\_INI\_LSH\_UP\_MAN\_ACT$  in order to prevent excessive temperature gradients and overheating. Additionally the  $STATE\_LSH\_UP[i]$  shall be set to  $LSH\_POW\_RISE$ , the timer  $T\_POW\_RISE\_LSH\_UP[i]$  shall be incremented and the status flag  $LV\_LSH\_UP\_MAN\_ACT[i]$  indicating activated forced heating shall be set. Forced pre-heating activation by evaluating the transition of  $LC\_LSH\_UP\_MAN\_ACT[i]$  from 0 to 1 ensures that forced heating may not become active in field application even if  $LC\_LSH\_UP\_MAN\_ACT[i]$  remains 1 for the final series data.

In the state  $LSH\_POW\_RISE$  the lambda sensor heater voltage shall further be increased with the same voltage ramp as for inactive forced heating. It should be considered that too high ramp values may lead to excessive temperature gradients. The heater voltage during this initial phase is limited to  $C\_V\_EFC\_MAX\_LSH\_UP\_MAN\_ACT$ . Resetting  $LC\_LSH\_UP\_MAN\_ACT[i]$  shall also reset  $LV\_LSH\_UP\_MAN\_ACT[i]$ . If  $T\_POW\_RISE\_LSH\_UP[i]$  exceeds the threshold  $C\_T\_MAX\_CDN\_LSH\_UP\_MAN\_ACT$  the state machine shall change to state  $LSH\_POW\_CTL$ .

In the state  $LSH\_POW\_CTL$  while forced heating is active the element temperature shall be controlled in open loop. The corresponding effective heater voltage is derived from the same map  $IP\_V\_EFC\_CTL\_LSH\_UP$  as for inactive forced heating, reduced by the factor  $C\_FAC\_V\_EFC\_LSH\_UP\_MAN\_ACT$ . If forced heating is activated the lambda sensor protection states  $LSH\_VB\_PROT$  and  $LSH\_TEMP\_PROT$  may be reached. Should the corresponding conditions no longer be met, the state  $LSH\_POW\_RISE$  shall be re-entered.

### **Application conditions:**

#### *Activation:*

At any engine operating state.

#### *Deactivation:*

-

#### *Time recurrence:*

The state machine, sensor protection and effective heater voltage definition shall be carried out once every 100 ms.

The determination of the oxygen sensor heater driver duty cycle and associated excessive battery voltage protection shall be carried out once every 10 ms.

#### *Initialisation:*

The following variable initialisation shall take place at  $LV\_IGK = 0 \rightarrow 1$ :

$STATE\_LSH\_UP[i] = LSH\_OFF$

$T\_POW\_RISE\_LSH\_UP[i] = 0$

$T\_V\_EFC\_TOL\_LSH\_UP[i] = 0$

$T\_V\_EFC\_LIM\_LSH\_UP[i] = 0$

$LSHPWM\_UP[i] = 0$

$V\_EFC\_CTL\_P\_LSH\_UP[i] = 0$

$V\_EFC\_CTL\_I\_LSH\_UP[i] = 0$


$V\_EFC\_CTL\_ADD\_LSH\_UP[i] = 0$

$V\_EFC\_LSH\_UP[i] = 0$

$V\_EFC\_CLC\_LSH\_UP[i] = 0$

$LV\_LSH\_CTL\_CLL\_LSH\_UP[i] = 0$

$LV\_LSH\_UP\_MAN\_ACT[i] = 0$

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```

LV_V_EFC_LIM_BOL_LSH_UP[i] = 0
LV_V_EFC_LIM_TOL_LSH_UP[i] = 0
LV_V_EFC_LIM_MAX_LSH_UP[i] = 0
LV_V_EFC_LIM_PROT_VB_LSH_UP[i] = 0
TTIP_MES_DIF_LS_UP[i] = 0

```

**At reset:**

```

ACTION_INFR_SetPwmLshUp(
    IN      i
    IN      LSHPWM_UP[i])

```

**NOTE: Projects not making use of the inhibit flags LV\_INH\_LSH\_UP[i] & LV\_INH\_LSH\_CTL\_CLL\_LSH\_UP[i] shall ensure that they are initialised with and remain 0, thus never disabling the oxygen sensor heater function or thus never disabling the oxygen sensor heater closed loop control function respectively**

**Formula section:**

The following formula shall be evaluated before the state machine is calculated:

```


if          LC_LSH_UP_MAN_ACT[i] = 1 → 0
then       LV_LSH_UP_MAN_ACT[i] = 0
endif

```

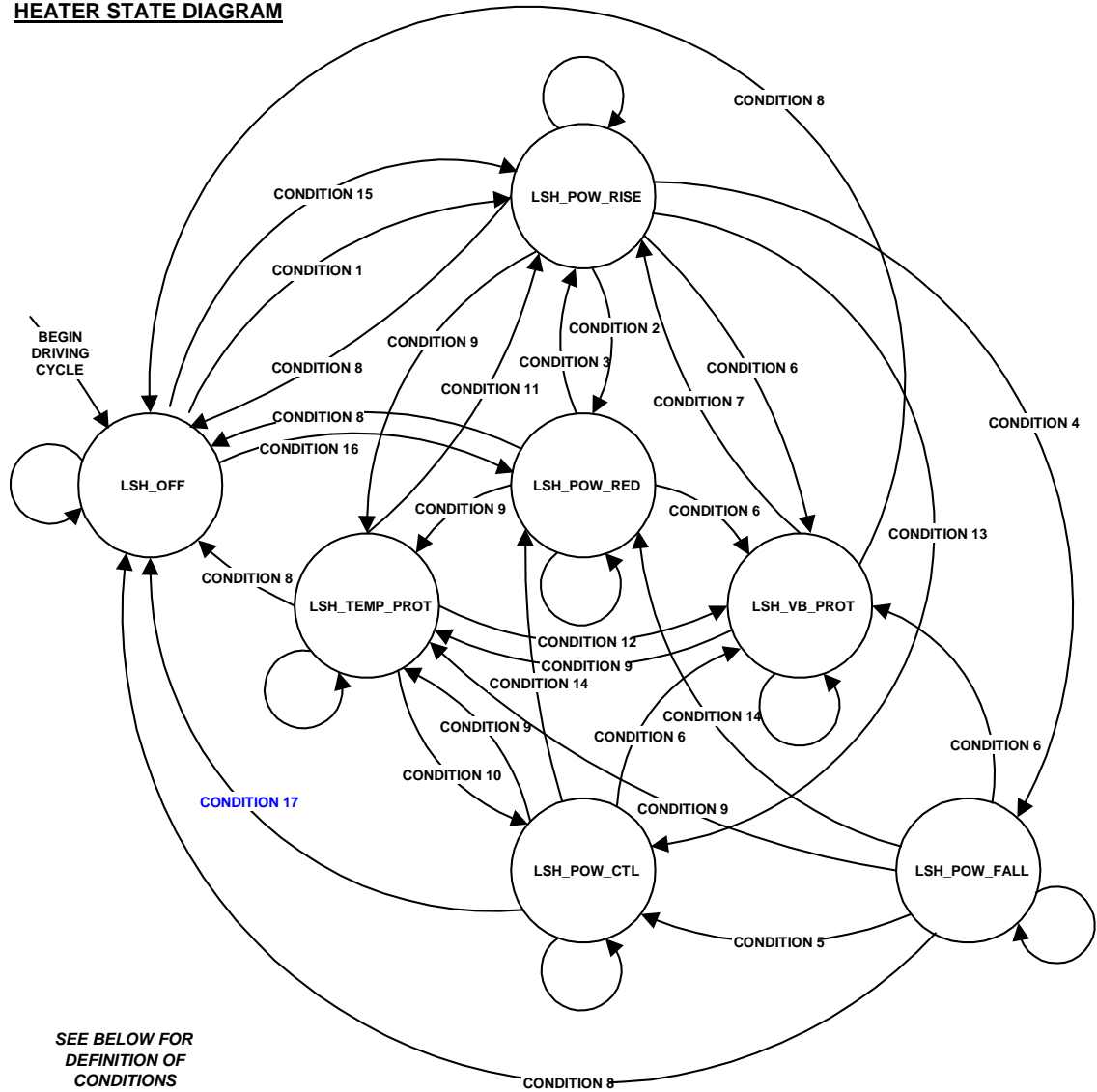
**7.48.1 Heater management state machine**

The state machine shall remain in its current state and carry out the actions specified to occur within that state once per recurrence unless otherwise specified. The state machine shall only move to another state when one of the conditions has been determined to be met.

**Note: The priorities of the conditions to change between states shall be defined by the order in which these conditions are listed within the appropriate state as described below.**

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**HEATER STATE DIAGRAM**



SEE BELOW FOR DEFINITION OF CONDITIONS


Figure 2: Heater management state diagram

**STATE\_LSH\_UP[i] LSH\_OFF**

Actions:

- T\_POW\_RISE\_LSH\_UP[i] = 0
- T\_V\_EFC\_TOL\_LSH\_UP[i] = 0
- T\_V\_EFC\_LIM\_LSH\_UP[i] = 0
- V\_EFC\_CTL\_P\_LSH\_UP[i] = 0
- V\_EFC\_CTL\_I\_LSH\_UP[i] = 0
- V\_EFC\_CTL\_ADD\_LSH\_UP[i] = 0
- V\_EFC\_LSH\_UP[i] = 0
- V\_EFC\_CLC\_LSH\_UP[i] = 0
- LV\_LSH\_CTL\_CLL\_LSH\_UP[i] = 0
- LV\_LSH\_UP\_MAN\_ACT[i] = 0
- LV\_V\_EFC\_LIM\_BOL\_LSH\_UP[i] = 0
- LV\_V\_EFC\_LIM\_TOL\_LSH\_UP[i] = 0
- LV\_V\_EFC\_LIM\_MAX\_LSH\_UP[i] = 0
- LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_UP[i] = 0
- TTIP\_MES\_DIF\_LS\_UP[i] = 0

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**Note: The above listed actions must be carried out at least once when the state has been entered for the first time or from any other state!**

Condition 1: LSH\_OFF to LSH\_POW\_RISE

LV\_ST\_END = 1 &

LV\_INH\_LSH\_UP[i] = 0 &

(LV\_TEMP\_DEW\_LS\_UP[i] = 1 or

LC\_TEMP\_DEW\_LSH\_UP = 0)

*Transition actions:*

V\_EFC\_CLC\_LSH\_UP[i] = IP\_V\_EFC\_INI\_LSH\_UP (TEMP\_INI\_LS\_UP[i])

Timer T\_POW\_RISE\_LSH\_UP[i] shall be started

STATE\_LSH\_UP[i] = LSH\_POW\_RISE

Condition 16: LSH\_OFF to LSH\_POW\_RED

LV\_ST\_END = 1 &

LV\_INH\_LSH\_UP[i] = 0 &

LV\_TEMP\_DEW\_LS\_UP[i] = 0 &

LC\_TEMP\_DEW\_LSH\_UP = 1

*Transition actions:*

V\_EFC\_CLC\_LSH\_UP[i] = C\_V\_EFC\_RED\_LSH\_UP

Condition 15: Forced transition LSH\_OFF to LSH\_POW\_RISE before engine start.

LV\_ES = 1 & LC\_LSH\_UP\_MAN\_ACT[i] = 0→1

*Transition actions:*

V\_EFC\_CLC\_LSH\_UP[i] = C\_V\_EFC\_INI\_LSH\_UP\_MAN\_ACT

Timer T\_POW\_RISE\_LSH\_UP[i] shall be started

STATE\_LSH\_UP[i] = LSH\_POW\_RISE

LV\_LSH\_UP\_MAN\_ACT[i] = 1

**STATE\_LSH\_UP[i] LSH\_POW\_RISE**

*Actions:*

**if** LV\_LSH\_UP\_MAN\_ACT[i] = 1 & LV\_ST\_END = 0

**then** V\_EFC\_CLC\_LSH\_UP[i]<sub>N</sub> = MIN(V\_EFC\_CLC\_LSH\_UP[i]<sub>N-1</sub> +  
C\_V\_EFC\_INC\_LSH\_UP \* 100 ms, C\_V\_EFC\_MAX\_LSH\_UP\_MAN\_ACT)

**else** V\_EFC\_CLC\_LSH\_UP[i]<sub>N</sub> = V\_EFC\_CLC\_LSH\_UP[i]<sub>N-1</sub> +  
C\_V\_EFC\_INC\_LSH\_UP \* 100 ms

**endif**

**Note: See section General oxygen sensor voltage protection for notes on limiting the applied heater voltage.**

Condition 8: LSH\_POW\_RISE to LSH\_OFF

(LV\_ST\_END = 0 & LV\_LSH\_UP\_MAN\_ACT[i] = 0) or LV\_INH\_LSH\_UP[i] = 1

*Transition actions:*

STATE\_LSH\_UP[i] = LSH\_OFF

V\_EFC\_LSH\_UP[i] = 0

Condition 9: LSH\_POW\_RISE to LSH\_TEMP\_PROT

TEG\_DYN\_LS\_UP[i] > C\_TEG\_DYN\_MAX\_LSH\_UP &

LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_UP[i] = 0


*Transition actions:*

STATE\_LSH\_UP[i] = LSH\_TEMP\_PROT

Condition 6: LSH\_POW\_RISE to LSH\_VB\_PROT

LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_UP[i] = 1

*Transition actions:*

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STATE\_LSH\_UP[i] = LSH\_VB\_PROT

*Condition 2: LSH\_POW\_RISE to LSH\_POW\_RED*

(T\_POW\_RISE\_LSH\_UP[i] IP\_T\_TEMP\_THD\_LSH\_UP (TEMP\_INI\_LS\_UP[i])) &  
LV\_TEMP\_DEW\_LS\_UP[i] = 0) & LV\_LSH\_UP\_MAN\_ACT[i] = 0

*Transition actions:*

STATE\_LSH\_UP[i] = LSH\_POW\_RED

*Condition 13: LSH\_POW\_RISE to LSH\_POW\_CTL*

(LV\_INH\_LSH\_CTL\_CLL\_LSH\_UP[i] = 0 &

LV\_V\_REF\_VLD\_R\_IT\_LS\_UP[i] = 1 &

TTIP\_MES\_LS\_UP[i] C\_TTIP\_SP\_LS\_UP[i] - ID\_TTIP\_SP\_DIF\_LSH\_UP &

LV\_TTIP\_MES\_VLD\_LS\_UP[i] = 1) or

LV\_LS\_UP\_READY\_CDN[i] = 1 or

(LV\_LSH\_UP\_MAN\_ACT[i] = 1 &

T\_POW\_RISE\_LSH\_UP[i] C\_T\_MAX\_CDN\_LSH\_UP\_MAN\_ACT)

*Transition actions:*

Stop timer T\_POW\_RISE\_LSH\_UP[i] and freeze value

STATE\_LSH\_UP[i] = LSH\_POW\_CTL

*Condition 4: LSH\_POW\_RISE to LSH\_POW\_FALL*

((LV\_INH\_LSH\_CTL\_CLL\_LSH\_UP[i] = 1 or

LV\_V\_REF\_VLD\_R\_IT\_LS\_UP[i] = 0) &

T\_POW\_RISE\_LSH\_UP[i] C\_T\_MAX\_POW\_RISE\_LSH\_UP + IP\_T\_TEMP\_THD\_LSH\_UP (TEMP\_INI\_LS\_UP[i])) & LV\_LSH\_UP\_MAN\_ACT[i] = 0

*Transition actions:*

Stop timer T\_POW\_RISE\_LSH\_UP[i] and freeze value

STATE\_LSH\_UP[i] = LSH\_POW\_FALL

**STATE\_LSH\_UP[i] LSH\_POW\_RED**

*Actions:*

V\_EFC\_CLC\_LSH\_UP[i] = C\_V\_EFC\_RED\_LSH\_UP

*Condition 8: LSH\_POW\_RED to LSH\_OFF*

(LV\_ST\_END = 0 & LV\_LSH\_UP\_MAN\_ACT[i] = 0) or LV\_INH\_LSH\_UP[i] = 1

*Transition actions:*

STATE\_LSH\_UP[i] = LSH\_OFF

V\_EFC\_LSH\_UP[i] = 0

*Condition 9: LSH\_POW\_RED to LSH\_TEMP\_PROT*

TEG\_DYN\_LS\_UP[i] > C\_TEG\_DYN\_MAX\_LSH\_UP &

LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_UP[i] = 0

*Transition actions:*

STATE\_LSH\_UP[i] = LSH\_TEMP\_PROT

*Condition 6: LSH\_POW\_RED to LSH\_VB\_PROT*

LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_UP[i] = 1

*Transition actions:*

STATE\_LSH\_UP[i] = LSH\_VB\_PROT

*Condition 3: LSH\_POW\_RED to LSH\_POW\_RISE*


LV\_TEMP\_DEW\_LS\_UP[i] = 1

*Transition actions:*

V\_EFC\_CLC\_LSH\_UP[i] = IP\_V\_EFC\_INI\_LSH\_UP (TEMP\_INI\_LS\_UP[i]) (same value as at start) + C\_V\_EFC\_STEP\_LSH\_UP

Re-initialise timer T\_POW\_RISE\_LSH\_UP[i] with IP\_T\_TEMP\_THD\_LSH\_UP (TEMP\_INI\_LS\_UP[i]) (same value as at start)

STATE\_LSH\_UP[i] = LSH\_POW\_RISE

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**Note:** See section **General oxygen sensor voltage protection** for notes on limiting the applied heater voltage. The function shall prevent the effective heater voltage from becoming negative by limiting to 0 where necessary.

### STATE\_LSH\_UP[i] LSH\_POW\_FALL

Actions:

$V\_EFC\_CLC\_LSH\_UP[i]_N = V\_EFC\_CLC\_LSH\_UP[i]_{N-1} - C\_V\_EFC\_DEC\_LSH\_UP * 100 \text{ ms}$

**Note:** See section **General oxygen sensor voltage protection** for notes on limiting the applied heater voltage. The function shall prevent the effective heater voltage from becoming negative by limiting to 0 where necessary.

Condition 8: LSH\_POW\_FALL to LSH\_OFF

$(LV\_ST\_END = 0 \ \& \ LV\_LSH\_UP\_MAN\_ACT[i] = 0) \ \text{or} \ LV\_INH\_LSH\_UP[i] = 1$

Transition actions:

STATE\_LSH\_UP[i] = LSH\_OFF

V\_EFC\_LSH\_UP[i] = 0

Condition 9: LSH\_POW\_FALL to LSH\_TEMP\_PROT

$TEG\_DYN\_LS\_UP[i] > C\_TEG\_DYN\_MAX\_LSH\_UP \ \&$

$LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_UP[i] = 0$

Transition actions:

STATE\_LSH\_UP[i] = LSH\_TEMP\_PROT

Condition 6: LSH\_POW\_FALL to LSH\_VB\_PROT

$LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_UP[i] = 1$

Transition actions:

STATE\_LSH\_UP[i] = LSH\_VB\_PROT

Condition 14: LSH\_POW\_FALL to LSH\_POW\_RED

$LV\_TEMP\_DEW\_LS\_UP[i] = 0$

Transition actions:

$T\_V\_EFC\_TOL\_LSH\_UP[i] = 0$

$T\_V\_EFC\_LIM\_LSH\_UP[i] = 0$

$V\_EFC\_CTL\_P\_LSH\_UP[i] = 0$

$V\_EFC\_CTL\_I\_LSH\_UP[i] = 0$

$V\_EFC\_CTL\_ADD\_LSH\_UP[i] = 0$

$LV\_LSH\_CTL\_CLL\_LSH\_UP[i] = 0$

$LV\_V\_EFC\_LIM\_BOL\_LSH\_UP[i] = 0$

$LV\_V\_EFC\_LIM\_TOL\_LSH\_UP[i] = 0$

$LV\_V\_EFC\_LIM\_MAX\_LSH\_UP[i] = 0$

$TTIP\_MES\_DIF\_LS\_UP[i] = 0$

STATE\_LSH\_UP[i] = LSH\_POW\_RED

Condition 5: LSH\_POW\_FALL to LSH\_POW\_CTL

For Bank 1; i = 1

$V\_EFC\_LSH\_UP[i] \quad IP\_V\_EFC\_CTL\_LSH\_UP (N\_32, TEG\_DYN\_LS\_UP[i])$

For Bank 2; i = 2

$V\_EFC\_LSH\_UP[i] \quad IP\_V\_EFC\_CTL\_LSH\_UP (N\_32, TEG\_DYN\_LS\_UP[i]) \ * \\ IP\_FAC\_V\_EFC\_TEG\_LSH\_UP$

Transition actions:

STATE\_LSH\_UP[i] = LSH\_POW\_CTL


### STATE\_LSH\_UP[i] LSH\_POW\_CTL

Actions:

Determine deviation between desired operating temperature and measured temperature:

$TTIP\_MES\_DIF\_LS\_UP[i] = C\_TTIP\_SP\_LS\_UP[i] - TTIP\_MES\_LS\_UP[i]$

**Note:** TTIP\_MES\_DIF\_LS\_UP[i] shall be computed in both open loop and closed loop control modes.

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Determine whether closed loop control permitted, if not revert to open loop control:

**if** (LV\_INH\_LSH\_CTL\_CLL\_LSH\_UP[i] = 0) &  
(LV\_V\_REF\_VLD\_R\_IT\_LS\_UP[i] = 1)

**then** **Closed loop control:**

LV\_LSH\_CTL\_CLL\_LSH\_UP[i] = 1

**Case A: Closed loop control**

**else** **Open loop control:**

LV\_LSH\_CTL\_CLL\_LSH\_UP[i] = 0

PI controller shall be re-initialised, i.e.:

V\_EFC\_CTL\_P\_LSH\_UP[i] = 0

V\_EFC\_CTL\_I\_LSH\_UP[i] = 0

V\_EFC\_CTL\_ADD\_LSH\_UP[i] = 0

**endif.**

**Case A: Closed loop control:**

Determine conditions for computation of closed loop control variables:

**if** (LC\_LSH\_CTL\_CLL\_INH\_LSH\_UP[i] = 1) **or**  
(LV\_TTIP\_MES\_VLD\_LS\_UP[i] = 0)

**then** **General suspension and re-initialisation of closed loop control computation, i.e.:**

V\_EFC\_CTL\_ADD\_LSH\_UP[i] = 0

V\_EFC\_CTL\_P\_LSH\_UP[i] = 0

V\_EFC\_CTL\_I\_LSH\_UP[i] = 0

**else** **Normal closed loop control computation:**

**Case B: Closed loop control & Not generally suspended:**

**endif.**

**End Case A: Closed loop control:**

**Case B: Closed loop control & Not generally suspended:**

**if** (TTIP\_MES\_LS\_UP[i] > C\_TTIP\_SP\_LS\_UP[i]) *i.e. Temperature difference negative*

**then** **Compute I terms of controller:**

V\_EFC\_CTL\_I\_LSH\_UP\_TMP[i]<sub>N</sub> = V\_EFC\_CTL\_I\_LSH\_UP[i]<sub>N-1</sub> +

TTIP\_MES\_DIF\_LS\_UP[i] \*

IP\_FAC\_NEG\_CTL\_I\_LSH\_UP (N\_32, TEG\_DYN\_LS\_UP[i])\*

C\_FAC\_CTL\_I\_LSH\_UP

**if** ( | TTIP\_MES\_DIF\_LS\_UP[i] | > C\_TTIP\_DIF\_MIN\_CTL\_P\_LS\_UP)

**then** **Compute P term of controller:**

V\_EFC\_CTL\_P\_LSH\_UP\_TMP[i] = TTIP\_MES\_DIF\_LS\_UP[i] \*

IP\_FAC\_NEG\_CTL\_P\_LSH\_UP (N\_32, TEG\_DYN\_LS\_UP[i])\*

C\_FAC\_CTL\_P\_LSH\_UP

**else** V\_EFC\_CTL\_P\_LSH\_UP\_TMP[i] = 0

**endif**

**if** (LV\_V\_EFC\_LIM\_BOL\_LSH\_UP[i] = 0) *i.e. no lower limiting active*

**then** V\_EFC\_CTL\_I\_LSH\_UP[i]<sub>N</sub> = V\_EFC\_CTL\_I\_LSH\_UP\_TMP[i]

V\_EFC\_CTL\_P\_LSH\_UP[i]<sub>N</sub> = V\_EFC\_CTL\_P\_LSH\_UP\_TMP[i]

**else** V\_EFC\_CTL\_I\_LSH\_UP[i]<sub>N</sub> = MAX(V\_EFC\_CTL\_I\_LSH\_UP[i]<sub>N-1</sub>,  
V\_EFC\_CTL\_I\_LSH\_UP\_TMP[i])

V\_EFC\_CTL\_P\_LSH\_UP[i]<sub>N</sub> = MAX(V\_EFC\_CTL\_P\_LSH\_UP[i]<sub>N-1</sub>,

V\_EFC\_CTL\_P\_LSH\_UP\_TMP[i])

**endif**

**else** **Temperature difference positive or zero; compute I term of controller:**

V\_EFC\_CTL\_I\_LSH\_UP\_TMP[i]<sub>N</sub> = V\_EFC\_CTL\_I\_LSH\_UP[i]<sub>N-1</sub> +

TTIP\_MES\_DIF\_LS\_UP[i] \*

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```

IP_FAC_POS_CTL_I_LSH_UP (N_32, TEG_DYN_LS_UP[i])*
C_FAC_CTL_I_LSH_UP
if      ( | TTIP_MES_DIF_LS_UP[i] | C_TTIP_DIF_MIN_CTL_P_LS_UP)
then    Compute P term of controller:
          V_EFC_CTL_P_LSH_UP_TMP[i] = TTIP_MES_DIF_LS_UP[i] *
          IP_FAC_POS_CTL_P_LSH_UP (N_32, TEG_DYN_LS_UP[i])*
          C_FAC_CTL_P_LSH_UP
else    V_EFC_CTL_P_LSH_UP_TMP[i] = 0
endif
if      LV_V_EFC_LIM_MAX_LSH_UP[i] = 0 &
          LV_V_EFC_LIM_TOL_LSH_UP[i] = 0 i.e. no upper limiting active
then    V_EFC_CTL_I_LSH_UP[i]N = V_EFC_CTL_I_LSH_UP_TMP[i]
          V_EFC_CTL_P_LSH_UP[i]N = V_EFC_CTL_P_LSH_UP_TMP[i]
else    V_EFC_CTL_I_LSH_UP[i]N = MIN(V_EFC_CTL_I_LSH_UP[i]N-1,
          V_EFC_CTL_I_LSH_UP_TMP[i])
          V_EFC_CTL_P_LSH_UP[i]N = MIN(V_EFC_CTL_P_LSH_UP[i]N-1,
          V_EFC_CTL_P_LSH_UP_TMP[i])
endif

```

**endif**

**Note:** In cases where the effective heater voltage has been limited as shown by the state of the Boolean flag *LV\_V\_EFC\_LIM\_BOL\_LSH\_UP[i]*, the controller shall only be permitted to increase the effective voltage. In the case of limiting via Boolean flags *LV\_V\_EFC\_LIM\_TOL\_LSH\_UP[i]* & *LV\_V\_EFC\_LIM\_MAX\_LSH\_UP[i]* the closed loop control shall only be permitted to decrease the effective heater voltage. In all other cases, the controller shall effectively be suspended, i.e. *P* & *I* terms shall remain unchanged but applied, until the applicable limitation is revoked. Upon revoking the limitation, the function shall resume to compute the *P* & *I* terms according to the conditions specified above.

Combine P and I terms:

```

V_EFC_CTL_ADD_LSH_UP[i] =
V_EFC_CTL_P_LSH_UP[i] + V_EFC_CTL_I_LSH_UP[i]

```

**Note:** Although variables *V\_EFC\_CTL\_P\_LSH\_UP[i]* and *V\_EFC\_CTL\_I\_LSH\_UP[i]* are defined as words, the summation shall be carried out as a 16 bit addition and the resultant 16 bit value converted to an 8 bit value, by taking the high byte, and placed in *V\_EFC\_CTL\_ADD\_LSH\_UP[i]*. This shall prevent controller from stopping short of the target temperature.

**End Case B:** Closed loop control; Not suspended:

Compute effective heater voltage from open loop control and closed loop delta voltages:

```

if      LV_LSH_UP_MAN_ACT[i] = 1 & LV_ST_END = 0
then    V_EFC_CLC_LSH_UP[i] = IP_V_EFC_CTL_LSH_UP (N_32, TEG_DYN_LS_UP[i]) *
          C_FAC_V_EFC_LSH_UP_MAN_ACT

```

**else**

For Bank 1; i = 1

```

V_EFC_CLC_LSH_UP[i] = IP_V_EFC_CTL_LSH_UP (N_32, TEG_DYN_LS_UP[i]) + V_EFC_CTL_
ADD_LSH_UP[i] + C_V_EFC_AS_LSH_UP

```

**Note:** If  $(IP\_V\_EFC\_CTL\_LSH\_UP + V\_EFC\_CTL\_ADD\_LSH\_UP[i] + C\_V\_EFC\_AS\_LSH\_UP) < 0$ , i.e. would cause the effective heater voltage to be negative, *V\_EFC\_CLC\_LSH\_UP[i]* shall be limited to 0 and further reduction of the effective heater voltage via by the closed loop controller *P* & *I* terms shall be prevented by setting *LV\_V\_EFC\_LSH\_UP\_LIM\_BOL[i]*, until the sum less than zero condition is no longer met at which point *LV\_V\_EFC\_LSH\_UP\_LIM\_BOL[i]* shall be reset.


For Bank 2; i = 2

```

V_EFC_CLC_LSH_UP[i] = IP_V_EFC_CTL_LSH_UP (N_32, TEG_DYN_LS_UP[i])* IP_FAC_V_EFC_
TEG_LSH_UP + V_EFC_CTL_ADD_LSH_UP[i] + C_V_EFC_AS_LSH_UP

```

**Note:** If  $(IP\_V\_EFC\_CTL\_LSH\_UP * IP\_FAC\_V\_EFC\_TEG\_LSH\_UP + V\_EFC\_CTL\_ADD\_LSH\_UP[i] + C\_V\_EFC\_AS\_LSH\_UP) < 0$ , i.e. would cause the effective heater voltage to be negative, *V\_*

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***EFC\_CLC\_LSH\_UP[i]* shall be limited to 0 and further reduction of the effective heater voltage via by the closed loop controller P & I terms shall be prevented by setting LV\_V\_EFC\_LSH\_UP\_LIM\_BOL[i], until the sum less than zero condition is no longer met at which point LV\_V\_EFC\_LSH\_UP\_LIM\_BOL[i] shall be reset.**

**endif**

Condition 17: LSH\_POW\_CTL to LSH\_OFF

(LV\_ST\_END = 0 & LV\_LSH\_UP\_MAN\_ACT[i] = 0 & LV\_STST\_STOP\_CYC = 0 ) or LV\_INH\_LSH\_UP[i] = 1

*Transition actions:*

STATE\_LSH\_UP[i] = LSH\_OFF

V\_EFC\_LSH\_UP[i] = 0

Condition 9: LSH\_POW\_CTL to LSH\_TEMP\_PROT

TEG\_DYN\_LS\_UP[i] > C\_TEG\_DYN\_MAX\_LSH\_UP &

LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_UP[i] = 0

*Transition actions:*

STATE\_LSH\_UP[i] = LSH\_TEMP\_PROT

Condition 6: LSH\_POW\_CTL to LSH\_VB\_PROT

LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_UP[i] = 1

*Transition actions:*

STATE\_LSH\_UP[i] = LSH\_VB\_PROT

Condition 14: LSH\_POW\_CTL to LSH\_POW\_RED

LV\_TEMP\_DEW\_LS\_UP[i] = 0 & LV\_LSH\_UP\_MAN\_ACT[i] = 0

*Transition actions:*

T\_V\_EFC\_TOL\_LSH\_UP[i] = 0

T\_V\_EFC\_LIM\_LSH\_UP[i] = 0

V\_EFC\_CTL\_P\_LSH\_UP[i] = 0

V\_EFC\_CTL\_I\_LSH\_UP[i] = 0

V\_EFC\_CTL\_ADD\_LSH\_UP[i] = 0

LV\_LSH\_CTL\_CLL\_LSH\_UP[i] = 0

LV\_V\_EFC\_LIM\_BOL\_LSH\_UP[i] = 0

LV\_V\_EFC\_LIM\_TOL\_LSH\_UP[i] = 0

LV\_V\_EFC\_LIM\_MAX\_LSH\_UP[i] = 0

TTIP\_MES\_DIF\_LS\_UP[i] = 0

STATE\_LSH\_UP[i] = LSH\_POW\_RED

**STATE\_LSH\_UP[i] LSH\_VB\_PROT**

*Actions:*

V\_EFC\_CLC\_LSH\_UP[i] = C\_V\_EFC\_PROT\_VB\_LSH\_UP

Condition 8: LSH\_VB\_PROT to LSH\_OFF

(LV\_ST\_END = 0 & LV\_LSH\_UP\_MAN\_ACT[i] = 0) or LV\_INH\_LSH\_UP[i] = 1

*Transition actions:*

STATE\_LSH\_UP[i] = LSH\_OFF

V\_EFC\_LSH\_UP[i] = 0

Condition 9: LSH\_VB\_PROT to LSH\_TEMP\_PROT

TEG\_DYN\_LS\_UP[i] > C\_TEG\_DYN\_MAX\_LSH\_UP &

LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_UP[i] = 0

*Transition actions:*

STATE\_LSH\_UP[i] = LSH\_TEMP\_PROT


Condition 7: LSH\_VB\_PROT to LSH\_POW\_RISE

LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_UP[i] = 0

*Transition actions:*

T\_POW\_RISE\_LSH\_UP[i] = 0

**If** LV\_LSH\_UP\_MAN\_ACT[i] = 0

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```

then V_EFC_CLC_LSH_UP[i] = IP_V_EFC_INI_LSH_UP (TEMP_INI_LS_UP[i])
else V_EFC_CLC_LSH_UP[i] = C_V_EFC_INI_LSH_UP_MAN_ACT
endif
T_V_EFC_TOL_LSH_UP[i] = 0
T_V_EFC_LIM_LSH_UP[i] = 0
V_EFC_CTL_P_LSH_UP[i] = 0
V_EFC_CTL_I_LSH_UP[i] = 0
V_EFC_CTL_ADD_LSH_UP[i] = 0
LV_LSH_CTL_CLL_LSH_UP[i] = 0
LV_V_EFC_LIM_BOL_LSH_UP[i] = 0
LV_V_EFC_LIM_TOL_LSH_UP[i] = 0
LV_V_EFC_LIM_MAX_LSH_UP[i] = 0
TTIP_MES_DIF_LS_UP[i] = 0
STATE_LSH_UP[i] = LSH_POW_RISE
STATE_LSH_UP[i] LSH_TEMP_PROT

```

*Actions:*

```
V_EFC_CLC_LSH_UP[i] = 0
```

*Condition 8: LSH\_TEMP\_PROT to LSH\_OFF*

```
(LV_ST_END = 0 & LV_LSH_UP_MAN_ACT[i] = 0) or LV_INH_LSH_UP[i] = 1
```

*Transition actions:*

```
STATE_LSH_UP[i] = LSH_OFF
```

```
V_EFC_LSH_UP[i] = 0
```

*Condition 12: LSH\_TEMP\_PROT to LSH\_VB\_PROT*

```
LV_V_EFC_LIM_PROT_VB_LSH_UP[i] = 1
```

*Transition actions:*

```
STATE_LSH_UP[i] = LSH_VB_PROT
```

*Condition 10: LSH\_TEMP\_PROT to LSH\_POW\_CTL*

```
TEG_DYN_LS_UP[i] C_TEG_DYN_MAX_LSH_UP &
```

```
Previous state of STATE_LSH_UP[i] = LSH_POW_CTL
```

*Transition actions:*

```
STATE_LSH_UP[i] = LSH_POW_CTL
```

*Condition 11: LSH\_TEMP\_PROT to LSH\_POW\_RISE*

```
TEG_DYN_LS_UP[i] C_TEG_DYN_MAX_LSH_UP &
```

```
Previous state of STATE_LSH_UP[i] LSH_POW_CTL
```

*Transition actions:*

```
T_POW_RISE_LSH_UP[i] = 0
```

```
if LV_LSH_UP_MAN_ACT[i] = 0
```

```
then V_EFC_CLC_LSH_UP[i] = IP_V_EFC_INI_LSH_UP (TEMP_INI_LS_UP[i])
```

```
else V_EFC_CLC_LSH_UP[i] = C_V_EFC_INI_LSH_UP_MAN_ACT
```

```
endif
```

```
T_V_EFC_TOL_LSH_UP[i] = 0
```

```
T_V_EFC_LIM_LSH_UP[i] = 0
```

```
V_EFC_CTL_P_LSH_UP[i] = 0
```

```
V_EFC_CTL_I_LSH_UP[i] = 0
```

```
V_EFC_CTL_ADD_LSH_UP[i] = 0
```

```
LV_LSH_CTL_CLL_LSH_UP[i] = 0
```


```
LV_V_EFC_LIM_BOL_LSH_UP[i] = 0
```

```
LV_V_EFC_LIM_TOL_LSH_UP[i] = 0
```

```
LV_V_EFC_LIM_MAX_LSH_UP[i] = 0
```

```
TTIP_MES_DIF_LS_UP[i] = 0
```

```
STATE_LSH_UP[i] = LSH_POW_RISE
```

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**Note:** Should none of the conditions have been determined to be met, the state machine shall remain in the same state.

## 7.48.2 Oxygen sensor heater voltage protection

Prolonged exposure to heater voltages that exceed the absolute maximum ratings specified shall be prevented. The preventative measures shall be applicable to all heater states other than LSH\_OFF.

```


if STATE_LSH_UP[i] LSH_OFF
then
  if (V_EFC_CLC_LSH_UP[i] C_V_EFC_TOL_LSH_UP)
    then
      if (T_V_EFC_TOL_LSH_UP[i] C_T_MAX_V_EFC_TOL_LSH_UP)
        then
          if T_V_EFC_LIM_LSH_UP[i]
            C_T_MAX_V_EFC_LIM_LSH_UP
          then LV_V_EFC_LIM_TOL_LSH_UP[i] = 0
          Reset timer T_V_EFC_LIM_LSH_UP[i]
          Reset timer T_V_EFC_TOL_LSH_UP[i]
          else LV_V_EFC_LIM_TOL_LSH_UP[i] = 1
          Increment timer T_V_EFC_LIM_LSH_UP[i]
          endif
        else LV_V_EFC_LIM_TOL_LSH_UP[i] = 0
        Reset timer T_V_EFC_LIM_LSH_UP[i]
        Increment timer T_V_EFC_TOL_LSH_UP[i]
        endif
      else LV_V_EFC_LIM_TOL_LSH_UP[i] = 0
    endif
  else LV_V_EFC_LIM_TOL_LSH_UP[i] = 0

  if T_V_EFC_LIM_LSH_UP[i] = 0
    or T_V_EFC_LIM_LSH_UP[i]
      C_T_MAX_V_EFC_LIM_LSH_UP
    then Reset timer T_V_EFC_LIM_LSH_UP[i]
    Reset timer T_V_EFC_TOL_LSH_UP[i]
    else Increment timer T_V_EFC_LIM_LSH_UP[i]
    endif
  endif

if T_POW_RISE_LSH_UP[i] C_T_MAX_V_EFC_MAX_ST_LSH_UP
or (T_AST C_T_AST_MAX_LSH_UP
and STATE_LSH_UP[i] = "LSH_POW_CTL")
then
  if V_EFC_CLC_LSH_UP[i] > VB
    or V_EFC_CLC_LSH_UP[i] > C_V_EFC_MAX_LSH_UP
  then LV_V_EFC_LIM_MAX_LSH_UP[i] = 1
  V_EFC_CLC_LSH_UP[i] = MIN (VB, C_V_EFC_MAX_LSH_UP)
  else LV_V_EFC_LIM_MAX_LSH_UP[i] = 0
  endif
else
  if V_EFC_CLC_LSH_UP[i] > VB
    or V_EFC_CLC_LSH_UP[i] > C_V_EFC_MAX_ST_LSH_UP
  then LV_V_EFC_LIM_MAX_LSH_UP[i] = 1
  V_EFC_CLC_LSH_UP[i] =
    MIN (VB, C_V_EFC_MAX_ST_LSH_UP)
  else LV_V_EFC_LIM_MAX_LSH_UP[i] = 0
  endif
endif

if T_V_EFC_LIM_LSH_UP[i] <> 0
then V_EFC_LSH_UP[i] =
  MIN (V_EFC_CLC_LSH_UP[i], C_V_EFC_LIM_LSH_UP)

```

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```

        else          V_EFC_LSH_UP[i] = V_EFC_CLC_LSH_UP[i]
    endif
endif

```

### 7.48.3 Oxygen sensor heater driver duty cycle computation

The PWM duty cycle for the appropriate heater driver shall continually be calculated in all heater states at the specified recurrence.

```

if      (STATE_LSH_UP[i] = LSH_OFF & LC_LSH_UP_MAN_ACT[i] = 0)
then    LSHPWM_UP[i] = LSHPWM_EXT_LS_UP[i]
else    if      (VB_C_VB_MAX_PROT_LSH_UP)
then    LV_V_EFC_LIM_PROT_VB_LSH_UP[i] = 1
          LSHPWM_UP[i] = C_V_EFC_PROT_VB_LSH_UP2 * 100 / VBN2
else    LV_V_EFC_LIM_PROT_VB_LSH_UP[i] = 0
          LSHPWM_UP[i] = V_EFC_LSH_UP[i]N2 *
                        C_FAC_V_EFC_AS_LSH_UP * 100 / VBN2
          if      LSHPWM_UP[i] NC_LSHPWM_TOL_LSH_UP
          then    LSHPWM_UP[i] = NC_LSHPWM_TOL_LSH_UP
          else    if      LSHPWM_UP[i] NC_LSHPWM_BOL_LSH_UP
          then    LSHPWM_UP[i] = NC_LSHPWM_BOL_LSH_UP
          else    LSHPWM_UP[i] = LSHPWM_UP[i]
          endif
          endif
endif
endif
endif
ACTION_INFR_SetPwmLshUp(
    IN      i
    IN      LSHPWM_UP[i])

```

The value C\_FAC\_V\_EFC\_AS\_LSH\_UP is a correction signal generated in the application system.

**NOTE:** The recurrence of the heater driving duty cycle shall occur at the same recurrence as the Vbatt acquisition. This shall prevent short duration voltage drop-outs during engine start from causing long duration Vbatt corrections being made where the Vbatt has since recovered. This may otherwise cause excessive current to flow in the heater driver.

The computation of the duty cycle shall be checked to ensure that the result remains positive (i.e. 0) at all times and that now under- or overflows are caused by the values of the calibration system constants.

The multiplication of the corrected voltage ratio by 100 to obtain a unit of percent (%) may not necessarily be implemented in the SW but in the data bank definition of the variables.

## 7.49 O2 sensor (up) heater management (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LSHPWM_EXT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 99.60937	0.390625	%
Heater driver PWM duty cycle - external adjustment					
LSHPWM_UP_MAN	V	0... FFH	0... 99.60937	0.390625	%
Heater driver PWM duty cycle - manual adjustment via application system					
LV_INH_LSH_CTL_CLL_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating project specific application conditions closed loop heater control not met					
LV_INH_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating project specific application conditions for heating not met					
TEMP_INI_LS_UP [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Oxygen sensor temperature at engine start					
V_EFC_LSH_UP_MAN	V	0... FFH	0... 25.89843	0.1015625	V
Effective output value of heater voltage via application system					

### Input data:

LSHPWM_UP_EXT_ADJ [NC_CBK_EX_NR] {p. 7431}	LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}
LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_IGK {p. 906}	LV_LSHPWM_UP_EXT_ADJ [NC_CBK_EX_NR] {p. 7434}
LV_ST_END {p. 1720}	LV_VAR_LSH_UP {p. 656}	NC_CBK_EX_NR {p. 1829}	TEG_WALL_CAT_UP_MDL [NC_CBK_EX_NR] {p. 8237}


### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_INC_V_EFC_MAN	-	0... FFH	0... 1.625	6.37e-3	V/100ms
Effective heater voltage increment to raise temperature via application system					
C_V_EFC_MAN	-	0... FFH	0... 25.89843	0.1015625	V
Maximum permitted effective heater voltage via application system					
LC_LSH_UP [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Boolean variable to enable oxygen sensor heating					
LC_LSH_UP_CLL_CTL [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Boolean variable to enable closed loop oxygen sensor heater control					
LC_LSHPWM_UP_MAN_ADJ [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Boolean variable to enable oxygen sensor heating via application system					

## FUNCTION DESCRIPTION:

### General information:

The calculation shall be done for all exhaust cylinderbanks.

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$i = 1 \dots NC\_CBK\_EX\_NR$

### Description:

The Boolean constant `LC_LSH_UP[i]` shall permit the appropriate oxygen sensor to be heated. When set, the Boolean inhibit flag `LV_INH_LSH_UP[i]` shall be reset. When reset, `LV_INH_LSH_UP[i]` shall be set.

The Boolean flag `LV_INH_LSH_CTL_CLL_LSH_UP[i]` shall indicate whether closed loop heating shall be inhibited or not. Should either the Boolean constant `LC_LSH_UP_CLL_CTL[i]` be reset or one of several upstream

sensor error bits be set then the Boolean inhibit flag `LV_INH_LSH_CTL_CLL_LSH_UP[i]` shall be set (open loop heater control), otherwise `LV_INH_LSH_CTL_CLL_LSH_UP[i]` shall be reset (closed loop heater control permitted).

### Application conditions

**Activation:**  $LV\_IGK = 1$

**Deactivation:**  $LV\_IGK = 0$

**Recurrence:**  $100\ ms$

**Initialisation:**

```

LV_INH_LSH_UP[i] = 0
LV_INH_LSH_CTL_CLL_LSH_UP[i] = 0
LSHPWM_EXT_LS_UP[i] = 0%
V_EFC_LSH_UP_MAN = C_V_EFC_MAN
TEMP_INI_LS_UP[i] = TEG_WALL_CAT_UP_MDL[i]

```


### Formula section:

Calculation of LSHPWM during external adjustment, manual adjustment via application system or not learnt variant

```

If(1)          LV_LSHPWM_UP_EXT_ADJ[i]= 0                // no adjustment by tester
Then(1)
  If(2)          ( LC_LSHPWM_UP_MAN_ADJ[i] = 1          and
                    'not serial software' )              // adjustment by application system
Then(2)        LV_INH_LSH_UP[i] = 1
  If(3)          V_EFC_LSH_UP_MAN < C_V_EFC_MAN
Then(3)
  V_EFC_LSH_UP_MANN = V_EFC_LSH_UP_MANN-1 + C_INC_V_EFC_MAN
  LSHPWM_UP_MAN = V_EFC_LSH_UP_MANN2 * 100/VBN2           // in %
Else(3)        V_EFC_LSH_UP_MANN = C_V_EFC_MAN
  LSHPWM_UP_MAN = C_V_EFC_MAN2 * 100/VBN2           // in %
Endif(3)
  LSHPWM_EXT_LS_UP[i] = LSHPWM_UP_MAN
Else(2)
  If(3)          LV_VAR_LSH_UP = 0
  Then(3)        LV_INH_LSH_UP[i] = 1
  LSHPWM_EXT_LS_UP[i] = 5%
Else(3)        LV_INH_LSH_UP[i] = ! LC_LSH_UP[i]
  LSHPWM_EXT_LS_UP[i] = 0
  LSHPWM_UP_MAN = 0
Endif(2)
Else(1)        LV_INH_LSH_UP[i] = 1

```

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LSHPWM\_EXT\_LS\_UP[i] = LSHPWM\_UP\_EXT\_ADJ[i]

**Endif(1)**

Calculation of Oxygen sensor temperature at engine start

One time determination after finishing engine state start

**If** LV\_ST\_END = 1 for first time after LV\_ST\_END = 0

**Then** TEMP\_INI\_LS\_UP[i] = TEG\_WALL\_CAT\_UP\_MDL[i]

**Endif**


Inhibition of closed loop heater control

**If** LC\_LSH\_UP\_CLL\_CTL[i] = 0           **or**  
     LV\_ERR\_OC\_LSL\_UP[i] = 1           **or**  
     LV\_ERR\_LSL\_UP\_IF[i] = 1           **or**  
     LV\_ERR\_EL\_LSL\_UP[i] = 1           **or**  
     LV\_ERR\_OBD\_VLD\_LSH\_UP[i] = 1       **or**  
     LV\_VAR\_LSH\_UP = 0               **or**  
     LV\_ERR\_LSH\_UP[i] = 1

**Then** LV\_INH\_LSH\_CTL\_CLL\_LSH\_UP[i] = 1

**Else** LV\_INH\_LSH\_CTL\_CLL\_LSH\_UP[i] = 0

**Endif**

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## 7.50 O2 sensor (bin, down) signal evaluation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_VLS_DOWN_MMV_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating calibrateable delay since PUC deactivation passed					
LV_VLS_DOWN_MMV_LIM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating VLS_DOWN_MMV_xxx[i] signals being limited when set					
VLS_DOWN_BOL [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Variable switching threshold for calculation of VLS_DOWN_MMV_MIN[i]					
VLS_DOWN_DRV1_ABS_MAX [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 4.99992	76.3e-6	V/10ms
Absolute maximum value within buffer containing 1st derivative of VLS_DOWN[i] signal					
VLS_DOWN_DRV1_MMV [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-2.5... 2.4999	76.3e-6	V/10ms
Mean of buffer containing 1st derivative of VLS_DOWN[i] signal					
VLS_DOWN_DRV1_MMV_MIN [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-2.5... 2.4999	76.3e-6	V/10ms
Minimum value of mean of buffer containing 1st derivative of VLS_DOWN[i] signal in lean phase					
VLS_DOWN_MMV_HYS [NC_CBK_EX_NR]	V	0... 3333H	0... 0.99998	76.3e-6	V
Variable hysteresis used to determine switching thresholds					
VLS_DOWN_MMV_MAX [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 4.99992	76.3e-6	V
Mean oxygen sensor rich voltage					
VLS_DOWN_MMV_MIN [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 4.99992	76.3e-6	V
Mean oxygen sensor lean voltage					
VLS_DOWN_TOL [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Variable switching threshold for calculation of VLS_DOWN_MMV_MAX[i]					

### Input data:

LV_ES {p. 1720}	LV_PUC {p. 1720}	NC_CBK_EX_NR {p. 1829}	STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}
VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_DOWN_H_RES [NC_CBK_EX_NR] {p. 967}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_VLS_DOWN	-	0... FFFFH	0... 0.99998	15.3e-6	-
Filter constant for determination of VLS_DOWN_MMV_xxx[i] values when respective threshold passed					
C_CRLC_VLS_DOWN_OFF	-	0... FFFFH	0... 0.99998	15.3e-6	-
Filter constant for determination of VLS_DOWN_MMV_xxx[i] values when respective threshold not passed					
C_CTR_VLS_DOWN_BUF	-	1... AH	1... 10	1	-
Constant to change the time range for the calculation of the moving mean value					
C_FAC_VLS_DOWN_MMV_HYS	-	0... FFH	0... 0.99609	3.9063e-3	-
Multiplicative factor governing amplitude of hysteresis					
C_T_DLY_PUC_END_VLS_DOWN	-	0... FFFFH	0... 655.35	0.01	s
Delay between completion of engine state PUC and computation of VLS_DOWN_MMV_xxx[i]					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VLS_DOWN_INI_MAX	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Upper initialisation value for VLS_DOWN_BOL[i]. VLS_DOWN_MMV_MAX[i]					
C_VLS_DOWN_INI_MIN	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Lower initialisation value for VLS_DOWN_TOL[i]. VLS_DOWN_MMV_MIN[i]					
C_VLS_DOWN_MMV_HYS_MIN	-	0... 3333H	0... 0.99998	76.3e-6	V
Minimum hysteresis for the computation of the thresholds VLS_DOWN_TOL[i] and VLS_DOWN_BOL[i]					

## 7.50.1 Signal evaluation

### FUNCTION DESCRIPTION:

#### General information:

The function shall evaluate the oxygen sensor signal voltage and compute a number of resultant values that may be used by other functions. These values shall include:

1. Moving mean of sensor voltage first derivative, i.e. average signal gradient
2. Minimum value of moving mean of sensor voltage first derivative in lean phase
3. Absolute maximum of sensor voltage first derivative over defined number of previous samples, i.e. measure of sensor voltage stability
4. Moving mean value of lean sensor voltage
5. Moving mean value of rich sensor voltage.

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank

#### Signal flow diagram:

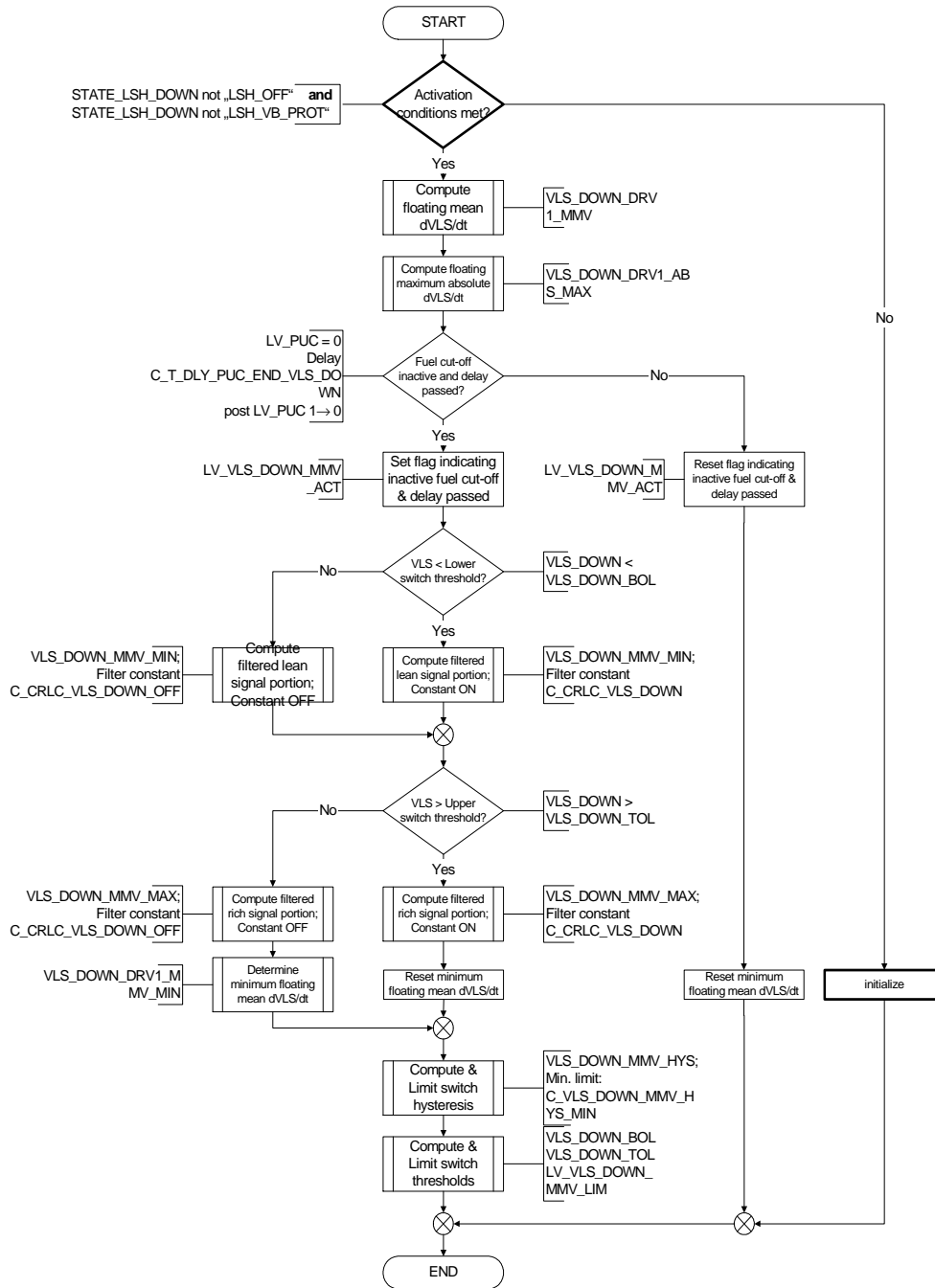


Figure 1 Function flow chart, Signal evaluation

**Description:**

The function shall evaluate the downstream oxygen sensor signal VLS\_DOWN and VLS\_DOWN\_H\_RES[i] and provide variables quantifying the signal characteristics: Floating mean gradient, Floating maximum signal deviation between samples, Filtered mean rich signal voltage & Filtered mean lean signal voltage (voltage will deviate from stable level signal with ageing of the catalyst). This shall be carried out as follows:

The function shall be active when the heater state is not "off" or "overvoltage protection".

Once the activation conditions have been met the function may be described in the following blocks:

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1. Computation of moving mean of first derivative VLS\_DOWN\_DRV1\_MMV[i]: The moving mean value of oxygen sensor signal voltage first derivative VLS\_DOWN\_DRV1\_MMV[i] shall be computed by averaging the last differences between consecutive VLS\_DOWN\_H\_RES[i] samples, i.e. the most current difference (VLS\_DOWN\_H\_RES[i]<sub>N</sub> - VLS\_DOWN\_H\_RES[i]<sub>N-1</sub>) and the previous C\_CTR\_VLS\_DOWN\_BUF differences. This shall indicate a measure for the signal gradient.

2. Computation of absolute maximum of first derivative VLS\_DOWN\_DRV1\_ABS\_MAX[i]: The absolute maximum of the oxygen sensor voltage first derivative VLS\_DOWN\_DRV1\_ABS\_MAX[i] shall be computed by taking the maximum of the absolute values of the last differences between consecutive VLS\_DOWN\_H\_RES[i] samples, i.e. the most current difference (VLS\_DOWN\_H\_RES[i]<sub>N</sub> - VLS\_DOWN\_H\_RES[i]<sub>N-1</sub>) and the previous 5 differences. This shall indicate a measure for the signal stability.

3. Computation of moving mean value of lean and rich sensor voltages, VLS\_DOWN\_MMV\_XXX[i]: The computation of the moving mean value of lean and rich sensor voltages, associated switch thresholds and switch hysteresis shall only be carried out when the overrun fuel cut-off flag is reset (LV\_PUC = 0) and the time C\_T\_DLY\_PUC\_END\_VLS\_DOWN has passed since the deactivation of the last occurring engine state PUC (i.e. LV\_PUC 1 = 0). The lean and rich mean signal voltages shall be implemented by use of first order low pass filtering and floating switching thresholds. For example:

Should the VLS\_DOWN[i] signal exceeds the threshold VLS\_DOWN\_TOL[i], the rich mean signal voltage VLS\_DOWN\_MMV\_MAX[i] shall be computed by filtering the VLS\_DOWN [i] signal with filter constant C\_CRLC\_VLS\_DOWN. This shall continue until threshold VLS\_DOWN\_TOL[i] is no longer exceeded, after which VLS\_DOWN\_MMV\_MAX[i] shall be computed by filtering with filter constant C\_CRLC\_VLS\_DOWN\_OFF. This constant is much smaller than C\_CRLC\_VLS\_DOWN and the effect is to cause the VLS\_DOWN\_MMV\_MAX[i] to follow the rich peaks. The OFF constant shall permit the VLS\_DOWN\_MMV\_MAX[i] signal to follow the VLS\_DOWN[i] signal for sudden decreases in signal amplitude, i.e. maximum VLS\_DOWN[i] lower than VLS\_DOWN\_TOL[i].

The same procedure shall be carried out for the computation of VLS\_DOWN\_MMV\_MIN[i], i.e. where VLS\_DOWN[i] falls below VLS\_DOWN\_BOL[i], VLS\_DOWN\_MMV\_MIN[i] shall be computed with filter constant C\_CRLC\_VLS\_DOWN and where VLS\_DOWN[i] no longer falls below VLS\_DOWN\_BOL[i], the filter constant C\_CRLC\_VLS\_DOWN\_OFF shall be used.

4. Determination of the minimum value of the moving mean of first derivative VLS\_DOWN\_DRV1\_MMV\_MIN[i]: The same conditions as for the computation of VLS\_DOWN\_MMV\_XXX[i] shall apply. Should VLS\_DOWN[i] fall below or equal VLS\_DOWN\_TOL[i], VLS\_DOWN\_DRV1\_MMV\_MIN[i]<sub>N</sub> shall be equal to the lower of VLS\_DOWN\_DRV1\_MMV\_MIN[i]<sub>N-1</sub> & VLS\_DOWN\_DRV1\_MMV[i]. When VLS\_DOWN[i] exceeds VLS\_DOWN\_TOL[i], the LV\_PUC condition in conjunction with delay C\_T\_DLY\_PUC\_END\_VLS\_DOWN is not met or the function is deactivated, VLS\_DOWN\_DRV1\_MMV\_MIN[i] shall be reset to 0.


5. Compute & limit switch hysteresis: The value of the hysteresis, VLS\_DOWN\_MMV\_HYS[i], used to determine the switching thresholds VLS\_DOWN\_BOL[i] & VLS\_DOWN\_TOL[i] shall be made proportional using factor C\_FAC\_VLS\_DOWN\_MMV\_HYS to the oxygen sensor signal amplitude, as determined by taking the absolute difference of the moving mean lean /rich variables. The hysteresis shall also be limited so that it may not fall below the calibrateable threshold C\_VLS\_DOWN\_MMV\_HYS\_MIN.

6. Compute & limit switch thresholds: The function shall limit the minimum amplitude of the difference between the moving mean lean /rich variables (VLS\_DOWN\_MMV\_MAX[i] - VLS\_DOWN\_MMV\_MIN[i]) to twice that of the switch hysteresis, VLS\_DOWN\_MMV\_HYS[i].

Should the amplitude of the aforementioned difference fall below the said threshold, both the switch thresholds VLS\_DOWN\_BOL[i] & VLS\_DOWN\_TOL[i] shall be set to the average of the moving mean lean /rich variables, the moving mean lean /rich variables are recalculated based on the limited switching thresholds and hysteresis and the flag LV\_VLS\_DOWN\_MMV\_LIM[i] shall be set to indicate that switch threshold limiting is active.

Should no limiting be required, the switch thresholds VLS\_DOWN\_BOL[i] & VLS\_DOWN\_TOL[i] shall be calculated based on the switch hysteresis, moving mean lean variable and moving mean rich variable respectively. The flag LV\_VLS\_DOWN\_MMV\_LIM[i] shall be reset to indicate that no switch threshold limiting is being carried out.

The above blocks shall be cycled through once every function recurrence.

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**Application conditions:**

*Recurrence:*

The function shall be carried out once every oxygen sensor acquisition, i.e. every 10 ms.

*Initialisation:*

The following initialisation shall be carried out at RESET and when the function is inactive (or at least once when the function becomes inactive).

VLS\_DOWN\_MMV\_MIN[i] = C\_VLS\_DOWN\_INI\_MIN  
 VLS\_DOWN\_MMV\_MAX[i] = C\_VLS\_DOWN\_INI\_MAX  
 VLS\_DOWN\_BOL[i] = C\_VLS\_DOWN\_INI\_MAX  
 VLS\_DOWN\_TOL[i] = C\_VLS\_DOWN\_INI\_MIN  
 VLS\_DOWN\_MMV\_HYS[i] = C\_VLS\_DOWN\_MMV\_HYS\_MIN  
 LV\_VLS\_DOWN\_MMV\_LIM[i] = 0  
 LV\_VLS\_DOWN\_MMV\_ACT[i] = 0  
 VLS\_DOWN\_DRV1\_MMV[i] = 0  
 VLS\_DOWN\_DRV1\_MMV\_MIN[i] = 0  
 VLS\_DOWN\_DRV1\_ABS\_MAX[i] = 0

Buffer contents from which VLS\_DOWN\_DRV1\_MMV[i] & VLS\_DOWN\_DRV1\_ABS\_MAX[i] computed = 0.

*Activation:*

STATE\_LSH\_DOWN[i] **not** LSH\_OFF **and**  
 STATE\_LSH\_DOWN[i] **not** LSH\_VB\_PROT

*Deactivation:*

STATE\_LSH\_DOWN[i] = LSH\_OFF **or**  
 STATE\_LSH\_DOWN[i] = LSH\_VB\_PROT

**Formula section:**

The following function shall be carried out in the order listed and as indicated by the function flow chart:  
 Computation of moving mean of first derivative VLS\_DOWN\_DRV1\_MMV[i]

$$VLS\_DOWN\_DRV1\_MMV[i] = \frac{\sum_{x=0}^{C\_CTR\_VLS\_DOWN\_BUF-1} (VLS\_DOWN\_H\_RES[i]_{N-x} - VLS\_DOWN\_H\_RES[i]_{N-(x+1)})}{C\_CTR\_VLS\_DOWN\_BUF * 10ms}$$

The above may be facilitated for example by use of a C\_CTR\_VLS\_DOWN\_BUF value ring buffer. The most current difference, (VLS\_DOWN\_H\_RES[i]<sub>N</sub> - VLS\_DOWN\_H\_RES[i]<sub>N-1</sub>), would overwrite the oldest difference in the buffer, (VLS\_DOWN\_H\_RES[i]<sub>N-5</sub> - VLS\_DOWN\_H\_RES[i]<sub>N-6</sub>), and the average of the buffer contents recalculated.


Computation of absolute maximum of first derivative number of previous samples VLS\_DOWN\_DRV1\_ABS\_MAX[i]

$$VLS\_DOWN\_DRV1\_ABS\_MAX[i] =$$

$$MAXIMUM \left| \sum_{x=0}^{C\_CTR\_VLS\_DOWN\_BUF-1} (VLS\_DOWN\_H\_RES[i]_{N-x} - VLS\_DOWN\_H\_RES[i]_{N-(x+1)}) \right|$$

The above may be facilitated for example by use of the same C\_CTR\_VLS\_DOWN\_BUF value ring buffer, as proposed above for the computation of VLS\_DOWN\_DRV1\_MMV[i]. The function would calculate the absolute values of the buffer contents and take the maximum of these values.

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*Computation of moving mean value of lean and rich sensor voltages, VLS\_DOWN\_MMV\_xxx[i]*

```

if (LV_PUC = 0) &
    (delay since last LV_PUC 1 0 transition C_T_DLY_PUC_END_VLS_DOWN)
then LV_VLS_DOWN_MMV_ACT[i] = 1
    if (VLS_DOWN[i] < VLS_DOWN_BOL[i])
    then Compute moving mean lean signal, filter constant ON
    else Compute moving mean lean signal, filter constant OFF
    endif
    if (VLS_DOWN[i] > VLS_DOWN_TOL[i])
    then Compute moving mean rich signal, filter constant ON
        VLS_DOWN_DRV1_MMV_MIN[i] = 0
    else Compute moving mean rich signal, filter constant OFF
        Determine minimum of moving mean of first derivative
    endif
    Compute & limit switch hysteresis
    Compute & limit switch thresholds
else LV_VLS_DOWN_MMV_ACT[i] = 0
    Reset timer used for delay C_T_DLY_PUC_END_VLS_DOWN
    VLS_DOWN_DRV1_MMV_MIN[i] = 0
endif.
  
```

*Compute moving mean lean signal, filter constant ON*

The moving mean of the lean signal voltage shall be realised by use of a 1st order low pass digital filter with the filter constant C\_CRCLC\_VLS\_DOWN.

$$VLS\_DOWN\_MMV\_MIN[i]_N = VLS\_DOWN\_MMV\_MIN[i]_{N-1} * (1-C\_CRCLC\_VLS\_DOWN) + VLS\_DOWN[i]_N * C\_CRCLC\_VLS\_DOWN$$

*Compute moving mean lean signal, filter constant OFF*

The moving mean of the lean signal voltage shall be realised by use of a 1st order low pass digital filter with the filter constant C\_CRCLC\_VLS\_DOWN\_OFF.

$$VLS\_DOWN\_MMV\_MIN[i]_N = VLS\_DOWN\_MMV\_MIN[i]_{N-1} * (1-C\_CRCLC\_VLS\_DOWN\_OFF) + VLS\_DOWN[i]_N * C\_CRCLC\_VLS\_DOWN\_OFF$$

*Compute moving mean rich signal, filter constant ON*

The moving mean of the rich signal voltage shall be realised by use of a 1st order low pass digital filter with the filter constant C\_CRCLC\_VLS\_DOWN.

$$VLS\_DOWN\_MMV\_MAX[i]_N = VLS\_DOWN\_MMV\_MAX[i]_{N-1} * (1-C\_CRCLC\_VLS\_DOWN) + VLS\_DOWN[i]_N * C\_CRCLC\_VLS\_DOWN$$

*Compute moving mean rich signal, filter constant OFF*

The moving mean of the rich signal voltage shall be realised by use of a 1st order low pass digital filter with the filter constant C\_CRCLC\_VLS\_DOWN\_OFF.

$$VLS\_DOWN\_MMV\_MAX[i]_N = VLS\_DOWN\_MMV\_MAX[i]_{N-1} * (1-C\_CRCLC\_VLS\_DOWN\_OFF) + VLS\_DOWN[i]_N * C\_CRCLC\_VLS\_DOWN\_OFF$$

*Determine minimum of moving mean of first derivative VLS\_DOWN\_DRV1\_MMV\_MIN[i]*


The determination of the minimum of VLS\_DOWN\_DRV1\_MMV[i] shall take place when the condition VLS\_DOWN[i] > VLS\_DOWN\_TOL[i] has been met. In this case:

$$VLS\_DOWN\_DRV1\_MMV\_MIN[i] = \min(VLS\_DOWN\_DRV1\_MMV\_MIN[i], VLS\_DOWN\_DRV1\_MMV[i])$$

Should the above condition no longer met, the LV\_PUC with delay condition not be met or the initial activation conditions not be met then VLS\_DOWN\_DRV1\_MMV\_MIN[i] shall be reset to 0.

*Compute & limit switch hysteresis*


$$VLS\_DOWN\_MMV\_HYS[i] = |VLS\_DOWN\_MMV\_MAX[i] - VLS\_DOWN\_MMV\_MIN[i]| *$$

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```

                C_FAC_VLS_DOWN_MMV_HYS
if (VLS_DOWN_MMV_HYS[i] < C_VLS_DOWN_MMV_HYS_MIN)
then VLS_DOWN_MMV_HYS[i] = C_VLS_DOWN_MMV_HYS_MIN
endif.
Compute & limit switch thresholds
if ( (VLS_DOWN_MMV_MAX[i] - VLS_DOWN_MMV_MIN[i])
      2 * VLS_DOWN_MMV_HYS[i] )
then VLS_DOWN_BOL[i] = (VLS_DOWN_MMV_MAX[i] + VLS_DOWN_MMV_MIN[i]) /2
      VLS_DOWN_TOL[i] = (VLS_DOWN_MMV_MAX[i] + VLS_DOWN_MMV_MIN[i]) /2
      VLS_DOWN_MMV_MIN[i] = VLS_DOWN_BOL[i] - VLS_DOWN_MMV_HYS[i]
      VLS_DOWN_MMV_MAX[i] = VLS_DOWN_TOL[i] + VLS_DOWN_MMV_HYS[i]
      LV_VLS_DOWN_MMV_LIM[i] = 1
else VLS_DOWN_BOL[i] = VLS_DOWN_MMV_MIN[i] + VLS_DOWN_MMV_HYS[i]
      VLS_DOWN_TOL[i] = VLS_DOWN_MMV_MAX[i] - VLS_DOWN_MMV_HYS[i]
      LV_VLS_DOWN_MMV_LIM[i] = 0
endif.

```

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## 7.51 O2 sensor (bin, down) operability detection

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LS_DOWN_READY [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable for operative readiness of downstream oxygen sensor(s)					
LV_LS_DOWN_READY_DEAC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable indicating that operative readiness of downstream oxygen sensor(s) has been reset					
LV_VLS_DOWN_NOT_STAT	V	0... 1H	0 ...1	1	-
Logical variable to indicate non stationary conditions at downstream sensor (for Y configuration with NOx trap)					
MAF_INT_DLY_EG_NOX_EQU_DOWN	V	0... FFFFH	0... 2912.66666	0.0444444	g
MAF integral to consider gas flow delay between downstream sensor and NOx sensor (for Y configuration)					
MAF_INT_NOT_STAT	V	0... FFFFH	0... 2912.66666	0.0444444	g
MAF integral during non stationary condition at downstream sensor (for Y configuration with NOx trap)					
NR_CBK_EX_LS_DOWN	-	0... 4H	0 ...4	1	-
exhaust gas bank with downstream sensor (for Y configuration with NOx trap)					
NR_CBK_EX_NOT_LS_DOWN	-	0... 4H	0 ...4	1	-
exhaust gas bank without downstream sensor (for Y configuration with NOx trap)					
T_TEMP_DEW_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time after dew point detection for downstream lambda probe					

### Input data:

LV_ERR_LS_DOWN [NC_CBK_EX_NR] {p. 5449}	LV_ES {p. 1720}	LV_PUC {p. 1720}	LV_TEMP_DEW_LS_DOWN [NC_CBK_EX_NR] {p. 1007}
LV_VLS_NS_VLD [NC_NOX_SENS_CONF] {p. 992}	MAF_CYL {p. 8277}	MAF_INT_PUC_ACT {p. 2942}	MAF_INT_PUC_NOT_ACT {p. 2942}
NC_CBK_EX_NR {p. 1829}	NR_CONF_CBK_EX {p. 944}	NT_AGI {p. 3073}	STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}
TEG_DYN_LS_DOWN [NC_CBK_EX_NR] {p. 1007}	VLS_DIF_LAM_ADJ [NC_CBK_EX_NR] {p. 2590}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_INT_PUC_MAX_DOWN_LS_READY	-	0... FFFFH	0... 2912.66666	0.0444444	g
Maximum MAF integral during PUC for operability reset					
C_MAF_INT_PUC_NOT_LS_DOWN_READY	-	0... FFFFH	0... 2912.66666	0.0444444	g
Minimum MAF integral after operability reset for restart of readiness detection					
C_MAF_MAX_INT_NOT_STAT	-	0... FFFFH	0... 2912.66666	0.0444444	g
MAF integral threshold above which non stationary condition at downstream sensor apply					
C_T_MIN_TEMP_DEW_LS_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time threshold after dew point recognition for lambda probe readiness detection					
C_TEG_DYN_MIN_LS_DOWN_READY	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Temperature threshold above which O2 sensor recognised as operatively ready					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VLS_DIF_MAX_LAM_ADJ	-	FC00... 3FFH	-5... 4.99511	4.8828e-3	V
maximum positive setpoint deviation tolerable to use NOx sensor signal instead of downstream sensor					
C_VLS_DIF_MIN_LAM_ADJ	-	FC00... 3FFH	-5... 4.99511	4.8828e-3	V
maximum negative setpoint deviation tolerable to use NOx sensor signal instead of downstream sensor					
C_VLS_DOWN_AFL_THD_READY	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Lean VLS_DOWN[i] threshold for operative readiness detection					
C_VLS_DOWN_AFR_THD_READY	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Rich VLS_DOWN[i] threshold for operative readiness detection					
IP_MAF_MAX_DLY_EG_FAC_NT_AGI	-	0... FFFFH	0... 2912.66666	0.0444444	g
LDP_NT_AGI_IP_MAF_MAX_DLY_EG	6	0... FFFFH	0... 0.99998	15.3e-6	-
MAF integral threshold for consideration of gas delay flow (dependent on NOx trap ageing)					

## FUNCTION DESCRIPTION:

### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

The operative readiness of the downstream oxygen sensor(s) shall be determined by this function to allow other functions to act accordingly dependent upon the readiness.

### Description:

The operative readiness shall only be determined for a downstream oxygen sensor which is not operatively ready. The oxygen sensor shall be set as inoperable after a ECU reset, in the state *Engine Stop*, when during PUC the MAF integral exceeds a calibrated threshold or when the dew point LV\_TEMP\_DEW\_LS\_DOWN[i] switches back to 0.


The operative readiness shall be determined by analysing the downstream oxygen sensor voltage (VLS\_DOWN[i]) and determining whether the voltage has left a pre-determined voltage band after the lambda probe heater state machine has reached LSH\_POW\_CTL.

A second condition shall permit the forced operative readiness state, should the voltage level condition not be met, by assuming that when the modelled exhaust gas temperature at lambda probe position has reached a pre-determined threshold, that the downstream oxygen sensor is also at operating temperature and functioning. The forced readiness detection may additionally be delayed until dew point detection or even longer until the calibratable threshold C\_T\_MIN\_TEMP\_DEW\_LS\_DOWN has been reached, depending on its calibration.

Should the sensor's operative readiness be reset due to a sufficiently long fuel cut-off phase or reset of dew-point recognition a certain mass air flow integral threshold after leaving fuel cut-off shall be awaited until operability detection is started again. This shall ensure that the sensor heater has sufficient time to raise the temperature up to normal operating conditions prior to start of readiness detection in order to increase its reliability.

The operative readiness of the downstream oxygen sensor(s) shall be recorded in the variable LV\_LS\_DOWN\_READY[i].

### Application conditions:

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**Initialisation:**

At reset: reset all variables to 0

Recurrence:  $T\_SAMPLE = 100\text{ ms}$

Activation: In all engine states

**Formula section:**

*% only relevant for Y configurations with one downstream sensor and 1 NOx sensor*

*%SW-hint: The following if-then-else calculation can be done outside the for-loop, since calculation is independent of exhaust bank.*

**#if** NC\_CBK\_EX\_NR = 2

**#then**

**if** NR\_CONF\_CBK\_EX = 3 *% downstream sensor on bank 1 is missing*

**then** NR\_CBK\_EX\_LS\_DOWN = 2  
NR\_CBK\_EX\_NOT\_LS\_DOWN = 1

**elseif** NR\_CONF\_CBK\_EX = 4 *% downstream sensor on bank 2 is missing*  
NR\_CBK\_EX\_LS\_DOWN = 1  
NR\_CBK\_EX\_NOT\_LS\_DOWN = 2

**else** *% no downstream sensor is missing*  
NR\_CBK\_EX\_LS\_DOWN = 0  
NR\_CBK\_EX\_NOT\_LS\_DOWN = 0

**endif**

**#else** *% NC\_CBK\_EX\_NR = 1*

NR\_CBK\_EX\_LS\_DOWN = 0  
NR\_CBK\_EX\_NOT\_LS\_DOWN = 0

**#endif**

**if** LV\_ES = 1

**then**

LV\_LS\_DOWN\_READY[i] = 0  
T\_TEMP\_DEW\_LS\_DOWN[i] = 0  
LV\_LS\_DOWN\_READY\_DEAC[i] = 0

**else**

**if** i = NR\_CBK\_EX\_NOT\_LS\_DOWN

*% only relevant for Y configurations with one downstream sensor and 1 NOx sensor*

**then** *% calculation for the exhaust bank without any downstream sensor*

**if** VLS\_DIF\_LAM\_ADJ[NR\_CBK\_EX\_LS\_DOWN] >=

VLS\_DIF\_MAX\_LAM\_ADJ

**or** VLS\_DIF\_LAM\_ADJ[NR\_CBK\_EX\_LS\_DOWN] <=

VLS\_DIF\_MIN\_LAM\_ADJ

**then**

**if** MAF\_INT\_NOT\_STAT < C\_MAF\_MAX\_INT\_NOT\_STAT

**then** MAF\_INT\_NOT\_STAT<sub>n</sub> = MAF\_INT\_NOT\_STAT<sub>n-1</sub> + MAF\_CYL \*

SAMPLE[ms] \* 1/3600 [g\*h/(kg\*ms)]

*% increment MAF\_INT\_NOT\_STAT*

**endif**

**else** MAF\_INT\_NOT\_STAT<sub>n</sub> = MAF\_INT\_NOT\_STAT<sub>n-1</sub> - MAF\_CYL \*

SAMPLE[ms] \* 1/3600 [g\*h/(kg\*ms)]

*% decrement MAF\_INT\_NOT\_STAT*

**endif**

**if** MAF\_INT\_NOT\_STAT >= C\_MAF\_MAX\_INT\_NOT\_STAT

**then** *% deviation on bank with downstream of intolerable magnitude*

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```

                LV_VLS_DOWN_NOT_STAT = 1
    else        LV_VLS_DOWN_NOT_STAT = 0
    endif
    if          LV_LS_DOWN_READY[NR_CBK_EX_LS_DOWN] = 1
    and        LV_ERR_LS_DOWN[NR_CBK_EX_LS_DOWN] = 0
    and        LV_VLS_DOWN_NOT_STAT = 0
    then      % wait for gas flow delay from downstream sensor to NOx sensor
                MAF_INT_DLY_EG_NOX_EQU_DOWNn =
INT_DLY_EG_NOX_EQU_DOWNn-1 + MAF_CYL *          T_SAM-
PLE[ms] * 1/3600 [g*h/(kg*ms)]
                % increment MAF_INT_DLY_EG_NOX_EQU_DOWN
    else      MAF_INT_DLY_EG_NOX_EQU_DOWN = 0
    endif
    if          MAF_INT_DLY_EG_NOX_EQU_DOWN >
MAF_MAX_DLY_EG_FAC_NT_AGI
                % maximum gas flow delay is dependent on NOx trap ageing
    and        LV_VLS_NS_VLD[1] = 1
    then      % deviation on bank with downstream sensor is low enough to neglect influence
                LV_LS_DOWN_READY[i] = 1
    else      LV_LS_DOWN_READY[i] = 0
    endif
else % all other configurations
    if          (LV_PUC = 1
    and        MAF_INT_PUC_ACT > C_MAF_INT_PUC_MAX_DOWN_LS_READY
    and        MAF_INT_PUC_ACTn > MAF_INT_PUC_ACTn-1)
    or        LV_TEMP_DEW_LS_DOWN[i] = 1 -> 0
    then      LV_LS_DOWN_READY[i] = 0
                LV_LS_DOWN_READY_DEAC[i] = 1
    endif
    if          LV_LS_DOWN_READY[i] = 0
    and        LV_LS_DOWN_READY_DEAC[i] = 0
    then      execute section "Readiness detection"
    else
        if          MAF_INT_PUC_NOT_ACT >= C_MAF_INT_PUC_NOT_LS_DOWN_READY
                and        MAF_INT_PUC_NOT_ACTn > MAF_INT_PUC_NOT_ACTn-1
        then      LV_LS_DOWN_READY_DEAC[i] = 0
                    T_TEMP_DEW_LS_DOWN[i] = 0
        endif
    endif
    endif
endif
endif

```


### Readiness detection

#### **% all other configurations**

```

if          LV_TEMP_DEW_LS_DOWN[i] = 1
then      T_TEMP_DEW_LS_DOWN[i] = T_TEMP_DEW_LS_DOWN[i] + T_SAMPLE
else      T_TEMP_DEW_LS_DOWN[i] = 0
endif
if          ( (C_VLS_DOWN_AFR_THD_READY < VLS_DOWN[i]      or
VLS_DOWN[i] < C_VLS_DOWN_AFL_THD_READY) and
STATE_LSH_DOWN[i] = LSH_POW_CTL )


```

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```

or( TEG_DYN_LS_DOWN[i] > C_TEG_DYN_MIN_LS_DOWN_READY  and
      T_TEMP_DEW_LS_DOWN[i] >= C_T_MIN_TEMP_DEW_LS_DOWN )
then  LV_LS_DOWN_READY[i] = 1
endif

```


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## 7.52 O2 sensor (bin, down) heater management

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LSHPWM_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 99.60937	0.390625	%
Heater driver PWM duty cycle; acquired also by BSW					
LV_V_EFC_LIM_BOL_LSH_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating effective heater voltage limited due to sum of voltage components falling below zero.					
LV_V_EFC_LIM_MAX_LSH_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating effective heater voltage limited due to exceeding absolute maximum voltage spec.					
LV_V_EFC_LIM_PROT_VB_LSH_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean variable indicating effective heater voltage limited due to excessive battery voltage level					
LV_V_EFC_LIM_TOL_LSH_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating effective heater voltage limited due to exceeding threshold for period of time.					
STATE_LSH_DOWN [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H 4H 5H 6H	LSH_OFF LSH_POW_ RISE LSH_POW_ RED LSH_POW_ FALL LSH_POW_ CTL LSH_VB_ PROT LSH_TEMP_ PROT	-	-
Present heater state					
T_POW_RISE_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 6553.5	0.1	s
Timer indicating the duration of the pre-heating and post dew point heating phases					
T_V_EFC_LIM_LSH_DOWN [NC_CBK_EX_NR]	V	0... FFH	0... 25.5	0.1	s
Timer indicating the duration of the effective heater voltage limitation preventing overvoltage					
T_V_EFC_TOL_LSH_DOWN [NC_CBK_EX_NR]	V	0... FFH	0... 25.5	0.1	s
Timer indicating permitted effective heater voltage overvoltage duration					
V_EFC_CLC_LSH_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 25.9996	397e-6	V
Effective calculated heater voltage value prior to overvoltage protection					
V_EFC_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 25.89843	0.1015625	V
Effective final output value of heater voltage					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**Input data:**

LSHPWM_EXT_LS_DOWN [NC_CBK_EX_NR] {p. 2435}	LV_INH_LSH_DOWN [NC_CBK_EX_NR] {p. 2435}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_ST_END {p. 1720}
LV_TEMP_DEW_LS_DOWN [NC_CBK_EX_NR] {p. 1007}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	T_AST {p. 1766}
TEG_DYN_LS_DOWN [NC_CBK_EX_NR] {p. 1007}	TEMP_INI_LS_DOWN [NC_CBK_EX_NR] {p. 2435}	VB {p. 1185}	VS {p. 1176}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_V_EFC_AS_LSH_DOWN	-	0... FFH	0... 1.99218	0.0078125	-
Multiplicative correction factor to effective heater voltage					
C_T_AST_MAX_LSH_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
Time after start at which step in max. effective heater voltage applied, if LSH_POW_CTL active (T_POW_RISE_LSH_DOWN[i] stopped)					
C_T_MAX_POW_RISE_LSH_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
Duration of open loop pre-heating in LSH_POW_RISE from dew-point to set-point temperature					
C_T_MAX_V_EFC_LIM_LSH_DOWN	-	0... FFH	0... 25.5	0.1	s
Maximum duration of effective heater voltage limiting					
C_T_MAX_V_EFC_MAX_ST_LSH_DOWN	-	0... FFH	0... 25.5	0.1	s
Time after start at which step in max. effective heater voltage applied					
C_T_MAX_V_EFC_TOL_LSH_DOWN	-	0... FFH	0... 25.5	0.1	s
Maximum permitted duration where excessive effective heater voltage tolerated					
C_TEG_DYN_MAX_LSH_DOWN	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Maximum permitted exhaust gas temperature above which LSH switched off					
C_V_EFC_AS_LSH_DOWN	-	80... 7FH	-13... 12.89843	0.1015625	V
Effective heater voltage calibration system additive factor					
C_V_EFC_DEC_LSH_DOWN	-	0... FFH	0... 1.625	6.37e-3	V/100ms
Effective heater voltage decrement to lower temperature					
C_V_EFC_INC_LSH_DOWN	-	0... FFH	0... 1.625	6.37e-3	V/100ms
Effective heater voltage increment to raise temperature					
C_V_EFC_LIM_LSH_DOWN	-	0... FFH	0... 25.89843	0.1015625	V
Effective heater voltage limit under persistent excessive heater voltage condition					
C_V_EFC_MAX_LSH_DOWN	-	0... FFH	0... 25.89843	0.1015625	V
Absolute maximum permitted effective heater voltage after initial phase; threshold & limit					
C_V_EFC_MAX_ST_LSH_DOWN	-	0... FFH	0... 25.89843	0.1015625	V
Absolute maximum permitted effective heater voltage during initial phase; threshold & limit					
C_V_EFC_PROT_VB_LSH_DOWN	-	0... FFH	0... 25.89843	0.1015625	V
Effective heater voltage in the case of battery voltage overvoltage condition					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_V_EFC_RED_LSH_DOWN	-	0... FFH	0... 25.89843	0.1015625	V
Reduced effective heater voltage during danger of water splash damage					
C_V_EFC_STEP_LSH_DOWN	-	80... 7FH	-13... 12.89843	0.1015625	V
Additional effective heater voltage step on transition from LSH_POW_RED to LSH_POW_RISE					
C_V_EFC_TOL_LSH_DOWN	-	0... FFH	0... 25.89843	0.1015625	V
Effective heater voltage threshold above which voltage limiting may occur if threshold persistently exceeded					
C_VB_MAX_PROT_LSH_DOWN	-	0... FFH	0... 25.89843	0.1015625	V
Maximum permitted battery voltage threshold, over which overvoltage detected					
IP_FAC_V_EFC_TEG_LSH_DOWN	-	0... FFH	0... 3.98437	0.015625	-
LDPM_VS_1_EGCP	6	0... FFH	0... 255	1	km/h
Factor for the heat transfer rate, bank 2 only					
IP_T_TEMP_THD_LSH_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
LDPM_TEMP_INI_LS_DOWN_1_EGCP	6	0... FFFFH	-2048... 2047.9375	0.0625	°C
Duration until critical water splash sensor temperature reached					
IP_V_EFC_CTL_LSH_DOWN	V	0... FFH	0... 25.89843	0.1015625	V
LDPM_N_32_3_EGCP	6	0... FFH	0... 8160	32	rpm
LDPM_TEG_DYN_LS_DOWN_1_EGCP	6	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Open loop control effective heater voltage					
IP_V_EFC_INI_LSH_DOWN	-	0... FFH	0... 25.89843	0.1015625	V
LDPM_TEMP_INI_LS_DOWN_1_EGCP	6	0... FFFFH	-2048... 2047.9375	0.0625	°C
Initial effective heater voltage					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_LSHPWM_BOL_LSH_DOWN	-	0... FFH	0... 99.60937	0.390625	%
Heater driver PWM duty cycle lower limit					
NC_LSHPWM_TOL_LSH_DOWN	-	0... FFH	0... 99.60937	0.390625	%
Heater driver PWM duty cycle upper limit					

**Import actions:**

<b>ACTION_INFR_SetPwmLshDown</b> (IN<i><,IN<ducy><)
---

**FUNCTION DESCRIPTION:****General information:**

The calculation shall be done for all exhaust cylinder banks.


For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

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The goal of the heater control shall be to control the oxygen sensor heating such that the optimal operating temperature is reached in the shortest time possible. At the same time, the maximum permissible temperature gradient (possible damage to ceramic due to thermal stress), the possible occurrence of water splash under the dew point (possible damage to ceramic due to thermal shock) and the absolute maximum ratings specified for the sensor shall be taken into account. The function shall permit oxygen sensor heating under open loop control.

### Signal flow:

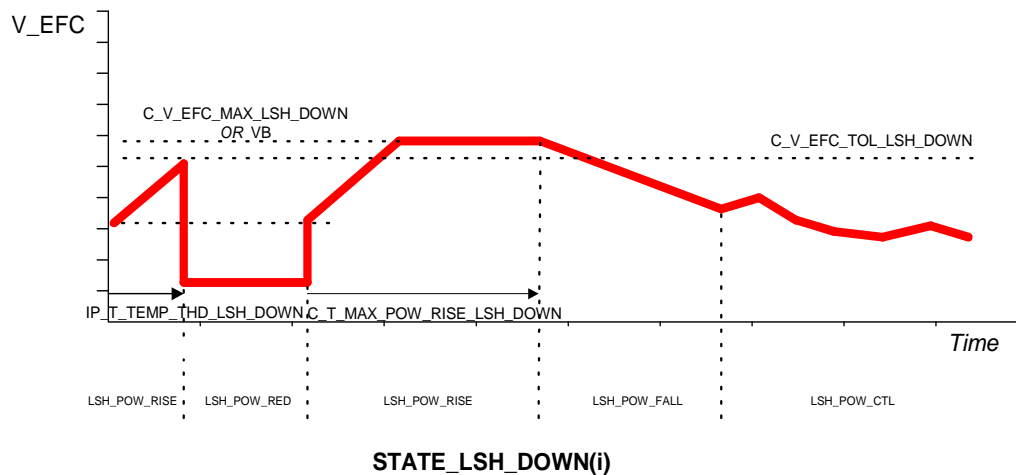


Figure 7.52.1: : Course of effective heater voltage over time /state

### Description:

The heater control shall be realised by use of a state machine. Each downstream oxygen sensor shall have its own state machine and each state machine shall run independently of the other.

The heater control shall be initialised to the LSH\_OFF state at the start of a new driving cycle. Hence the oxygen sensor will not initially be electrically heated.

Heating shall commence should the activation conditions listed below be met. i.e. when the engine has transitioned from the start state (LV\_ST\_END = 1) and the heater management inhibit bit for the corresponding bank is not set (LV\_INH\_LSH\_DOWN[i] = 0). The appropriate heater state shall change to LSH\_POW\_RISE and the initial value for the effective heater voltage shall be determined by obtaining the oxygen sensor temperature at start (TEMP\_INI\_LS\_DOWN[i]) from input data. This shall then be used to obtain the appropriate effective heater starting voltage from map IP\_V\_EFC\_INI\_LSH\_DOWN.

In the state LSH\_POW\_RISE, the effective heater voltage shall be incremented with the gradient of C\_V\_EFC\_INC\_LSH\_DOWN.

The continuation of the heating gradient shall depend on whether the dew point at the sensor location has been determined to have been exceeded, i.e. the temperature of the inner manifold wall at the sensor location has exceeded the temperature threshold where water in the exhaust gas may condense, as determined by LV\_TEMP\_DEW\_LS\_DOWN[i].

Should the dew point not have been exceeded (LV\_TEMP\_DEW\_LS\_DOWN[i] = 0) but timer T\_POW\_RISE\_LSH\_DOWN[i] has equalled or exceeded IP\_T\_TEMP\_THD\_LSH\_DOWN, it shall be assumed that condensed water splash at the oxygen sensor location may occur. In order to protect the oxygen sensor by keeping the temperature of the ceramic lower than the specified critical temperature, the heater power shall be reduced immediately by setting the effective heater voltage to C\_V\_EFC\_RED\_LSH\_DOWN. In this case, the heater state shall be set to LSH\_POW\_RED.



The reduced heating state shall persist until the dew point in the exhaust gas system has been determined to have been exceeded, i.e. until  $LV\_TEMP\_DEW\_LS\_DOWN[i] = 1$ , at which point the heater state shall return to  $LSH\_POW\_RISE$ . The effective heater voltage shall be set to the same effective heater voltage as determined at start ( $IP\_V\_EFC\_INI\_LSH\_DOWN$ ), which may be modified by the calibration data  $C\_V\_EFC\_STEP\_LSH\_DOWN$ , may be further incremented with a gradient of  $C\_V\_EFC\_INC\_LSH\_DOWN$  without danger of damaging the oxygen sensor and the timer  $T\_POW\_RISE\_LSH\_DOWN[i]$  shall be reinitialised with the  $IP\_T\_TEMP\_THD\_LSH\_DOWN$  determined at function start.

Should the initial exhaust gas temperature at start have been determined to exceed the dew point ( $LV\_TEMP\_DEW\_LS\_DOWN[i] = 1$ ), the heater control shall not enter the reduced heater power state but continue to incrementally increase the heater power within the  $LSH\_POW\_RISE$  state.

Should  $T\_POW\_RISE\_LSH\_DOWN[i]$  be determined to have equalled or exceeded the value  $C\_T\_MAX\_POW\_RISE\_LSH\_DOWN$  (irrespective of the dew point having been exceeded or not), the heater state shall change to  $LSH\_POW\_FALL$  and the timer shall be frozen.

In the  $LSH\_POW\_FALL$  state, the effective heater voltage shall be reduced with a gradient of  $C\_V\_EFC\_DEC\_LSH\_DOWN$  until such time that it falls below or equals the value set for the open loop control at the current engine operating point. For cylinder bank 1, this value is determined by map  $IP\_V\_EFC\_CTL\_LSH\_DOWN$  alone. For cylinder bank 2, this value is determined by  $IP\_V\_EFC\_CTL\_LSH\_DOWN * IP\_FAC\_V\_EFC\_TEG\_LSH\_DOWN$ . The latter factor shall be necessary to accommodate differences in heat transfer rates between cylinder banks at the oxygen sensor location, particularly for transversal mounted V6-engines. At such time the effective heater voltage falls below or equals the respective threshold, the heater state shall change to  $LSH\_POW\_CTL$ .

Should, however, the Boolean flag  $LV\_TEMP\_DEW\_LS\_DOWN[i]$  be reset whilst in the state  $LSH\_POW\_FALL$ , the heater control shall resume at state  $LSH\_POW\_RED$  following the procedures outlined above.

The control of the effective heater voltage is carried out in open loop mode.

In the open loop heater control mode, the effective heater voltage shall be obtained from map  $IP\_V\_EFC\_CTL\_LSH\_DOWN$  and is dependent upon the engine speed and the modelled exhaust gas temperature. For cylinder bank 2, an additional multiplicative factor ( $IP\_FAC\_V\_EFC\_TEG\_LSH\_DOWN$ ) may be required for the reasons outlined above.


To the open loop control voltage a calibration system constant ( $C\_V\_EFC\_AS\_LSH\_DOWN$ ) can be added to permit a global change in the total effective heater voltage to be made. Thus the calculated effective heater voltage ( $V\_EFC\_CLC\_LSH\_DOWN[i]$ ) shall be computed from the open loop value and the global correction value.

Furthermore should the sum of the components used to calculate the effective heater voltage be negative,  $LV\_V\_EFC\_LIM\_BOL\_LSH\_DOWN[i]$  shall be set. This shall prevent the controller from decreasing the effective heater voltage further but not prevent it from increasing the voltage. When the sum of the components is no longer negative,  $LV\_V\_EFC\_LIM\_BOL\_LSH\_DOWN[i]$  shall be reset. Similarly, should either of the overvoltage limitation Boolean flags  $LV\_V\_EFC\_LIM\_TOL\_LSH\_DOWN[i]$  &  $LV\_V\_EFC\_LIM\_MAX\_LSH\_DOWN[i]$  be set, as described later, the controller shall be prevented from increasing the effective heater voltage further but not prevent it from decreasing the voltage. When the overvoltage flags are no longer set and the other applicable conditions are met, the controller shall resume normal operation.

Should, however, the Boolean flag  $LV\_TEMP\_DEW\_LS\_DOWN[i]$  be reset whilst in the state  $LSH\_POW\_CTL$ , then the open loop controller terms shall be reset, the Boolean flags to indicate open loop control and effective heater voltage limitation shall be reset and the heater control shall resume at state  $LSH\_POW\_RED$  following the procedures outlined above.

Should at any time the battery voltage  $VB$  exceed the threshold  $C\_VB\_MAX\_PROT\_LSH\_DOWN$ , as determined by the state of logical variable  $LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_DOWN[i]$ , the oxygen sensor heater power shall be reduced by reducing the effective heater voltage used to calculate the driver duty cycle to  $C\_V\_EFC\_PROT\_VB\_LSH\_DOWN$ . The heater state shall change to  $LSH\_VB\_PROT$  on the next recurrence of the state machine and the effective heater voltage set to the aforementioned limit. This shall prevent damage to the sensor due to excessive heater voltages e.g. due to jump start from 24 V.

Should the battery voltage recover when in the state  $LSH\_VB\_PROT$ , as indicated by  $LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_DOWN[i] = 0$ ,  $T\_POW\_RISE\_LSH\_DOWN[i]$  shall be reset,  $V\_EFC\_LSH\_DOWN[i]$

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shall be initialised to IP\_V\_EFC\_INI\_LSH\_DOWN calculated after the start, the heater control shall resume at state LSH\_POW\_RISE following the procedures outlined above.

Short term voltage excursions shall cause the heater power to be limited but will only cause the state machine to change state should the voltage excursion persist until the next recurrence of the state machine. The state machine shall not be able to enter the LSH\_VB\_PROT state directly from LSH\_OFF but shall be required to pass through LSH\_POW\_RISE.

The sensor shall also be protected from over-temperature. This shall be achieved by evaluating the value of the modelled exhaust gas temperature TEG\_DYN\_LS\_DOWN[i] in all states other than LSH\_OFF. Should the exhaust gas temperature exceed the threshold C\_TEG\_DYN\_MAX\_LSH\_DOWN, the calculated effective heater voltage shall be reduced to 0, the state shall change to LSH\_TEMP\_PROT thus suspending open loop control, if active.

Should the exhaust gas temperature fall below the threshold, the state shall change dependent on the state active immediately prior to the over-temperature protection. If the state was LSH\_POW\_CTL, the state machine shall return to this state and the effective heater voltage shall take the new value as computed by the open loop control. If the state was any other than LSH\_POW\_CTL, the state shall change to LSH\_POW\_RISE. In this case T\_POW\_RISE\_LSH\_DOWN[i] shall be reset, V\_EFC\_LSH\_DOWN[i] shall be initialised to IP\_V\_EFC\_INI\_LSH\_DOWN calculated after the start, effective heater voltage limitation shall be reset and the heater control shall resume at state LSH\_POW\_RISE following the procedures outlined above.

Furthermore, in order to protect the sensor heater against long term high voltage stress it shall be necessary to limit the effective heater voltage should the value of V\_EFC\_CLC\_LSH\_DOWN[i] equal or exceed the threshold C\_V\_EFC\_TOL\_LSH\_DOWN.

In this instance, the timer T\_V\_EFC\_TOL\_LSH\_DOWN[i] shall be started. Should the overvoltage condition persist, such that this timer equals or exceeds the threshold C\_T\_MAX\_V\_EFC\_TOL\_LSH\_DOWN, timer T\_V\_EFC\_LIM\_LSH\_DOWN[i] shall be started and the Boolean flag LV\_V\_EFC\_LIM\_TOL\_LSH\_DOWN[i] shall be set. This flag shall prevent the controller from increasing effective the voltage further. If however the value of V\_EFC\_CLC\_LSH\_DOWN[i] should fall below the threshold C\_V\_EFC\_TOL\_LSH\_DOWN at any time, LV\_V\_EFC\_LIM\_TOL\_LSH\_DOWN[i] shall be reset.

Once timer T\_V\_EFC\_LIM\_LSH\_DOWN[i] has been started, Boolean flag LV\_V\_EFC\_LIM\_TOL\_LSH\_DOWN[i] shall be set or reset depending on the value of V\_EFC\_CLC\_LSH\_DOWN[i]. Once the timer T\_V\_EFC\_LIM\_LSH\_DOWN[i] equals or exceeds threshold C\_T\_MAX\_V\_EFC\_LIM\_LSH\_DOWN, both timers shall be reset and timer T\_V\_EFC\_TOL\_LSH\_DOWN[i] must exceed the threshold C\_T\_MAX\_V\_EFC\_TOL\_LSH\_DOWN again in order to permit further limiting to take place.

To prevent damage to the sensor, V\_EFC\_CLC\_LSH\_DOWN[i] shall not be permitted to exceed the lower of the values C\_V\_EFC\_MAX\_LSH\_DOWN, C\_V\_EFC\_MAX\_ST\_LSH\_DOWN or VB dependent on the value of T\_POW\_RISE\_LSH\_DOWN[i].


If T\_POW\_RISE\_LSH\_DOWN[i] equals or exceeds the constant C\_T\_MAX\_V\_EFC\_MAX\_ST\_LSH\_DOWN or conditions regarding T\_AST and STATE\_LSH\_DOWN[i] then V\_EFC\_CLC\_LSH\_DOWN[i] shall be checked against VB & C\_V\_EFC\_MAX\_LSH\_DOWN. If either of the values is exceeded then Boolean flag LV\_V\_EFC\_LIM\_MAX\_LSH\_DOWN[i] shall be set and V\_EFC\_CLC\_LSH\_DOWN[i] limited to the lower of VB & C\_V\_EFC\_MAX\_LSH\_DOWN otherwise LV\_V\_EFC\_LIM\_MAX\_LSH\_DOWN[i] shall be reset.

If T\_POW\_RISE\_LSH\_DOWN[i] is lower then constant C\_T\_MAX\_V\_EFC\_MAX\_ST\_LSH\_DOWN then V\_EFC\_CLC\_LSH\_DOWN[i] shall be checked against VB & C\_V\_EFC\_MAX\_ST\_LSH\_DOWN. If either of the values is exceeded then Boolean flag LV\_V\_EFC\_LIM\_MAX\_LSH\_DOWN[i] shall be set and V\_EFC\_CLC\_LSH\_DOWN[i] limited to the lower of VB & C\_V\_EFC\_MAX\_ST\_LSH\_DOWN otherwise LV\_V\_EFC\_LIM\_MAX\_LSH\_DOWN[i] shall be reset.

The flag LV\_V\_EFC\_LIM\_MAX\_LSH\_DOWN[i] shall prevent the controller from increasing effective the voltage further and permit the final effective heater voltage to be limited, as described later.

Should timer T\_V\_EFC\_LIM\_LSH\_DOWN[i] be unequal to zero, i.e. overvoltage no longer tolerated as it has been present for certain time, V\_EFC\_LSH\_DOWN[i] shall be the lower of the values V\_EFC\_CLC\_LSH\_DOWN[i] & C\_V\_EFC\_LIM\_LSH\_DOWN otherwise V\_EFC\_LSH\_DOWN[i] shall be set to V\_EFC\_CLC\_LSH\_DOWN[i].

Once the effective heater voltage has been determined throughout the various heater states other than LSH\_OFF, it shall be used to compute the PWM duty cycle (LSHPWM\_DOWN[i]) that shall control the appropriate heater driver. The heater power shall be corrected to take into account deviations in the

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measured battery voltage and limited to the range bounded by NC\_LSHPWM\_TOL\_LSH\_DOWN & NC\_LSHPWM\_BOL\_LSH\_DOWN. The evaluation of excess battery voltage shall be determined at the same recurrence as the computation of the duty cycle as described above. The PWM value may also be modified by use of constant C\_FAC\_V\_EFC\_AS\_LSH\_DOWN.

Should at any time an inhibit flag be set (LV\_INH\_LSH\_DOWN[i] = 1), the corresponding oxygen sensor heater shall be switched off and the STATE\_LSH\_DOWN[i] set to LSH\_OFF. This shall allow project specific application conditions to turn off oxygen sensor heating according to project philosophy. Should the heater function be inhibited, then the PWM duty cycle shall be set to input LSHPWM\_EXT\_LS\_DOWN[i]. On a transition of the inhibit bit LV\_INH\_LSH\_DOWN[i] from 1 to 0, the heater function shall start from anew.

### **Application conditions:**

#### *Activation:*

At any engine operating state.

#### *Deactivation:*

-

#### *Time recurrence:*

The state machine, sensor protection and effective heater voltage definition shall be carried out once every 100 ms. T\_SAMPLE\_1 = 100ms

The determination of the oxygen sensor heater driver duty cycle and associated excessive battery voltage protection shall be carried out once every 10 ms. T\_SAMPLE\_2 = 10ms

#### *Initialisation:*

The following variable initialisation shall take place at the beginning of a new driving cycle:

```
STATE_LSH_DOWN[i] = LSH_OFF
T_POW_RISE_LSH_DOWN[i] = 0
T_V_EFC_TOL_LSH_DOWN[i] = 0
T_V_EFC_LIM_LSH_DOWN[i] = 0
LSHPWM_DOWN[i] = 0
V_EFC_LSH_DOWN[i] = 0
V_EFC_CLC_LSH_DOWN[i] = 0
LV_V_EFC_LIM_BOL_LSH_DOWN[i] = 0
LV_V_EFC_LIM_TOL_LSH_DOWN[i] = 0
LV_V_EFC_LIM_MAX_LSH_DOWN[i] = 0
LV_V_EFC_LIM_PROT_VB_LSH_DOWN[i] = 0
```

### **At reset:**

#### **ACTION\_INFR\_SetPwmLshDown(**


```
IN      i
IN      LSHPWM_DOWN[i])
```

***NOTE: Projects not making use of the inhibit flags LV\_INH\_LSH\_DOWN[i] shall ensure that they are initialised with and remain 0, thus never disabling the oxygen sensor heater function or thus never disabling the oxygen sensor heater open loop control function respectively***

### **Formula section:**

## **7.52.1 Heater management state machine**

The state machine shall remain in its current state and carry out the actions specified to occur within that state once per recurrence unless otherwise specified. The state machine shall only move to another state when one of the conditions has been determined to be met.

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**Note: The priorities of the conditions to change between states shall be defined by the order in which these conditions are listed within the appropriate state as described below.**

### HEATER STATE DIAGRAM

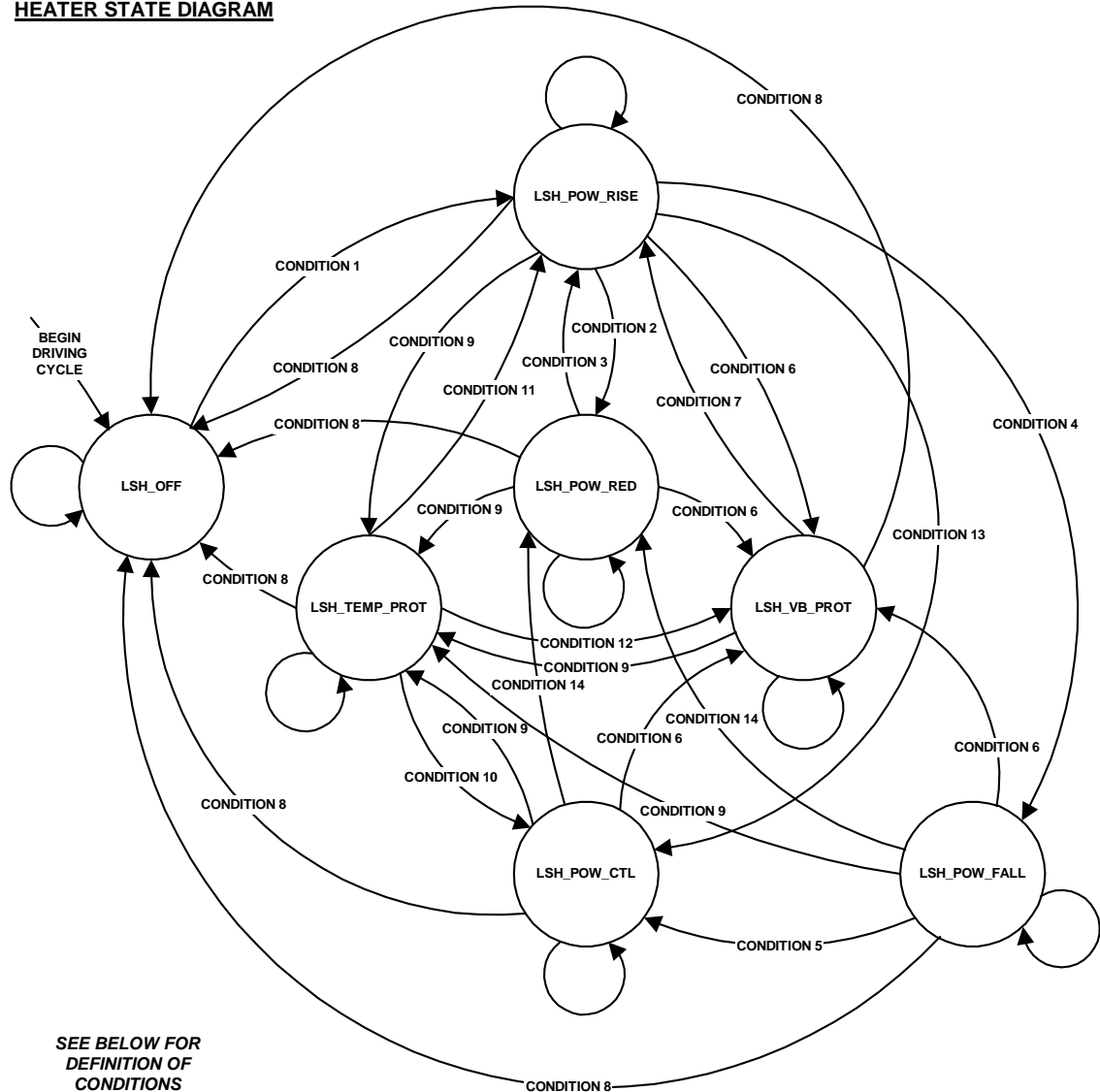


Figure 2: Heater management state diagram

#### STATE\_LSH\_DOWN[i] LSH\_OFF

Actions:

T\_POW\_RISE\_LSH\_DOWN[i] = 0  
 T\_V\_EFC\_TOL\_LSH\_DOWN[i] = 0  
 T\_V\_EFC\_LIM\_LSH\_DOWN[i] = 0  
 V\_EFC\_LSH\_DOWN[i] = 0  
 V\_EFC\_CLC\_LSH\_DOWN[i] = 0  
 LV\_V\_EFC\_LIM\_BOL\_LSH\_DOWN[i] = 0  
 LV\_V\_EFC\_LIM\_TOL\_LSH\_DOWN[i] = 0  
 LV\_V\_EFC\_LIM\_MAX\_LSH\_DOWN[i] = 0  
 LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_DOWN[i] = 0

**Note: The above listed actions must be carried out at least once when the state has been entered for the first time or from any other state!**

Condition 1: LSH\_OFF to LSH\_POW\_RISE

LV\_ST\_END = 1 &amp;

LV\_INH\_LSH\_DOWN[i] = 0

*Transition actions:*

V\_EFC\_CLC\_LSH\_DOWN[i] = IP\_V\_EFC\_INI\_LSH\_DOWN (TEMP\_INI\_LS\_DOWN[i])

Timer T\_POW\_RISE\_LSH\_DOWN[i] shall be started

STATE\_LSH\_DOWN[i] = LSH\_POW\_RISE

**STATE\_LSH\_DOWN[i] LSH\_POW\_RISE***Actions:*

$$V\_EFC\_CLC\_LSH\_DOWN[i]_N = V\_EFC\_CLC\_LSH\_DOWN[i]_{N-1} + C\_V\_EFC\_INC\_LSH\_DOWN$$

$$T\_SAMPLE\_1$$

Increment timer T\_POW\_RISE\_LSH\_DOWN[i]

**Note: See section Oxygen sensor heater voltage protection for notes on limiting the applied heater voltage.**Condition 8: LSH\_POW\_RISE to LSH\_OFF

LV\_ST\_END = 0 or LV\_INH\_LSH\_DOWN[i] = 1

*Transition actions:*

STATE\_LSH\_DOWN[i] = LSH\_OFF

Condition 9: LSH\_POW\_RISE to LSH\_TEMP\_PROT

TEG\_DYN\_LS\_DOWN[i] &gt; C\_TEG\_DYN\_MAX\_LSH\_DOWN &amp;

LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_DOWN[i] = 0

*Transition actions:*

STATE\_LSH\_DOWN[i] = LSH\_TEMP\_PROT

Condition 6: LSH\_POW\_RISE to LSH\_VB\_PROT

LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_DOWN[i] = 1

*Transition actions:*

STATE\_LSH\_DOWN[i] = LSH\_VB\_PROT

Condition 2: LSH\_POW\_RISE to LSH\_POW\_RED

T\_POW\_RISE\_LSH\_DOWN[i] IP\_T\_TEMP\_THD\_LSH\_DOWN (TEMP\_INI\_LS\_DOWN[i]) &amp;

LV\_TEMP\_DEW\_LS\_DOWN[i] = 0

*Transition actions:*

STATE\_LSH\_DOWN[i] = LSH\_POW\_RED

Condition 13: LSH\_POW\_RISE to LSH\_POW\_CTL

LV\_LS\_DOWN\_READY[i] = 1

*Transition actions:*

Stop timer T\_POW\_RISE\_LSH\_DOWN[i] and freeze value

STATE\_LSH\_DOWN[i] = LSH\_POW\_CTL

Condition 4: LSH\_POW\_RISE to LSH\_POW\_FALL

$$T\_POW\_RISE\_LSH\_DOWN[i] \ C\_T\_MAX\_POW\_RISE\_LSH\_DOWN + IP\_T\_TEMP\_THD\_LSH\_DOWN$$

$$\% \ IP\_ \dots (TEMP\_INI\_LS\_DOWN[i])$$
*Transition actions:*

Stop timer T\_POW\_RISE\_LSH\_DOWN[i] and freeze value

STATE\_LSH\_DOWN[i] = LSH\_POW\_FALL

**STATE\_LSH\_DOWN[i] LSH\_POW\_RED***Actions:*

V\_EFC\_CLC\_LSH\_DOWN[i] = C\_V\_EFC\_RED\_LSH\_DOWN

Condition 8: LSH\_POW\_RED to LSH\_OFF


LV\_ST\_END = 0 or LV\_INH\_LSH\_DOWN[i] = 1

*Transition actions:*

STATE\_LSH\_DOWN[i] = LSH\_OFF

Condition 9: LSH\_POW\_RED to LSH\_TEMP\_PROT

TEG\_DYN\_LS\_DOWN[i] &gt; C\_TEG\_DYN\_MAX\_LSH\_DOWN &amp;

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LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_DOWN[i] = 0

Transition actions:

STATE\_LSH\_DOWN[i] = LSH\_TEMP\_PROT

*Condition 6: LSH\_POW\_RED to LSH\_VB\_PROT*

LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_DOWN[i] = 1

Transition actions:

STATE\_LSH\_DOWN[i] = LSH\_VB\_PROT

*Condition 3: LSH\_POW\_RED to LSH\_POW\_RISE*

LV\_TEMP\_DEW\_LS\_DOWN[i] = 1

Transition actions:

V\_EFC\_CLC\_LSH\_DOWN[i] = IP\_V\_EFC\_INI\_LSH\_DOWN

+ C\_V\_EFC\_STEP\_LSH\_DOWN

% IP\_... (TEMP\_INI\_LS\_DOWN[i]) same value as at start

T\_POW\_RISE\_LSH\_DOWN[i] = IP\_T\_TEMP\_THD\_LSH\_DOWN

% TEMP\_INI\_LS\_DOWN[i] same value as at start

STATE\_LSH\_DOWN[i] = LSH\_POW\_RISE

**Note: See section Oxygen sensor heater voltage protection for notes on limiting the applied heater voltage. The function shall prevent the effective heater voltage from becoming negative by limiting to 0 where necessary.**

**STATE\_LSH\_DOWN[i] LSH\_POW\_FALL**

Actions:

V\_EFC\_CLC\_LSH\_DOWN[i]<sub>N</sub> = V\_EFC\_CLC\_LSH\_DOWN[i]<sub>N-1</sub> - C\_V\_EFC\_DEC\_LSH\_DOWN \*  
T\_SAMPLE\_1

**Note: See section Oxygen sensor heater voltage protection for notes on limiting the applied heater voltage. The function shall prevent the effective heater voltage from becoming negative by limiting to 0 where necessary.**

*Condition 8: LSH\_POW\_FALL to LSH\_OFF*

LV\_ST\_END = 0 or LV\_INH\_LSH\_DOWN[i] = 1

Transition actions:

STATE\_LSH\_DOWN[i] = LSH\_OFF

*Condition 9: LSH\_POW\_FALL to LSH\_TEMP\_PROT*

TEG\_DYN\_LS\_DOWN[i] > C\_TEG\_DYN\_MAX\_LSH\_DOWN &

LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_DOWN[i] = 0

Transition actions:

STATE\_LSH\_DOWN[i] = LSH\_TEMP\_PROT

*Condition 6: LSH\_POW\_FALL to LSH\_VB\_PROT*

LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_DOWN[i] = 1

Transition actions:

STATE\_LSH\_DOWN[i] = LSH\_VB\_PROT

*Condition 14: LSH\_POW\_FALL to LSH\_POW\_RED*

LV\_TEMP\_DEW\_LS\_DOWN[i] = 0

Transition actions:

T\_V\_EFC\_TOL\_LSH\_DOWN[i] = 0

T\_V\_EFC\_LIM\_LSH\_DOWN[i] = 0

LV\_V\_EFC\_LIM\_BOL\_LSH\_DOWN[i] = 0

LV\_V\_EFC\_LIM\_TOL\_LSH\_DOWN[i] = 0

LV\_V\_EFC\_LIM\_MAX\_LSH\_DOWN[i] = 0

STATE\_LSH\_DOWN[i] = LSH\_POW\_RED

*Condition 5: LSH\_POW\_FALL to LSH\_POW\_CTL*

For bank 1; i = 1

V\_EFC\_LSH\_DOWN[i]IP\_V\_EFC\_CTL\_LSH\_DOWN(N\_32,TEG\_DYN\_LS\_DOWN[i])

For bank 2; i = 2

V\_EFC\_LSH\_DOWN[i]IP\_V\_EFC\_CTL\_LSH\_DOWN(N\_32,TEG\_DYN\_LS\_DOWN[i])

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\* IP\_FAC\_V\_EFC\_TEG\_LSH\_DOWN

*Transition actions:*

STATE\_LSH\_DOWN[i] = LSH\_POW\_CTL

**STATE\_LSH\_DOWN[i] LSH\_POW\_CTL**

*Actions:*

Compute effective heater voltage from open loop control and closed loop delta voltages:

For Bank 1; i = 1

$$V\_EFC\_CLC\_LSH\_DOWN[i] = IP\_V\_EFC\_CTL\_LSH\_DOWN + C\_V\_EFC\_AS\_LSH\_DOWN \\ + \% IP\_ \dots (N\_32, TEG\_DYN\_LS\_DOWN[i])$$

**Note: If  $(IP\_V\_EFC\_CTL\_LSH\_DOWN + C\_V\_EFC\_AS\_LSH\_DOWN) < 0$ , i.e. would cause the effective heater voltage to be negative,  $V\_EFC\_CLC\_LSH\_DOWN[i]$  shall be limited to 0 and  $LV\_V\_EFC\_LIM\_BOL\_LSH\_DOWN[i]$  shall be set, until the sum less than zero condition is no longer met at which point  $LV\_V\_EFC\_LIM\_BOL\_LSH\_DOWN[i]$  shall be reset.**

For Bank 2; i = 2

$$V\_EFC\_CLC\_LSH\_DOWN[i] = IP\_V\_EFC\_CTL\_LSH\_DOWN * IP\_FAC\_V\_EFC\_TEG\_LSH\_DOWN \\ + C\_V\_EFC\_AS\_LSH\_DOWN \\ + \% IP\_ \dots (N\_32, TEG\_DYN\_LS\_DOWN[i])$$

**Note: If  $(IP\_V\_EFC\_CTL\_LSH\_DOWN * IP\_FAC\_V\_EFC\_TEG\_LSH\_DOWN + C\_V\_EFC\_AS\_LSH\_DOWN) < 0$ , i.e. would cause the effective heater voltage to be negative,  $V\_EFC\_CLC\_LSH\_DOWN[i]$  shall be limited to 0 and  $LV\_V\_EFC\_LIM\_BOL\_LSH\_DOWN[i]$  shall be set, until the sum less than zero condition is no longer met at which point  $LV\_V\_EFC\_LIM\_BOL\_LSH\_DOWN[i]$  shall be reset.**

Condition 8: LSH\_POW\_CTL to LSH\_OFF

LV\_ST\_END = 0 or LV\_INH\_LSH\_DOWN[i] = 1

*Transition actions:*

STATE\_LSH\_DOWN[i] = LSH\_OFF

Condition 9: LSH\_POW\_CTL to LSH\_TEMP\_PROT

TEG\_DYN\_LS\_DOWN[i] > C\_TEG\_DYN\_MAX\_LSH\_DOWN &

LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_DOWN[i] = 0

*Transition actions:*

STATE\_LSH\_DOWN[i] = LSH\_TEMP\_PROT

Condition 6: LSH\_POW\_CTL to LSH\_VB\_PROT

LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_DOWN[i] = 1

*Transition actions:*

STATE\_LSH\_DOWN[i] = LSH\_VB\_PROT

Condition 14: LSH\_POW\_CTL to LSH\_POW\_RED

LV\_TEMP\_DEW\_LS\_DOWN[i] = 0

*Transition actions:*

T\_V\_EFC\_TOL\_LSH\_DOWN[i] = 0

T\_V\_EFC\_LIM\_LSH\_DOWN[i] = 0

LV\_V\_EFC\_LIM\_BOL\_LSH\_DOWN[i] = 0

LV\_V\_EFC\_LIM\_TOL\_LSH\_DOWN[i] = 0

LV\_V\_EFC\_LIM\_MAX\_LSH\_DOWN[i] = 0

STATE\_LSH\_DOWN[i] = LSH\_POW\_RED

**STATE\_LSH\_DOWN[i] LSH\_VB\_PROT**

*Actions:*

V\_EFC\_CLC\_LSH\_DOWN[i] = C\_V\_EFC\_PROT\_VB\_LSH\_DOWN

Condition 8: LSH\_VB\_PROT to LSH\_OFF


LV\_ST\_END = 0 or LV\_INH\_LSH\_DOWN[i] = 1

*Transition actions:*

STATE\_LSH\_DOWN[i] = LSH\_OFF

Condition 9: LSH\_VB\_PROT to LSH\_TEMP\_PROT

TEG\_DYN\_LS\_DOWN[i] > C\_TEG\_DYN\_MAX\_LSH\_DOWN &

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LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_DOWN[i] = 0

*Transition actions:*

STATE\_LSH\_DOWN[i] = LSH\_TEMP\_PROT

*Condition 7: LSH\_VB\_PROT to LSH\_POW\_RISE*

LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_DOWN[i] = 0

*Transition actions:*

T\_POW\_RISE\_LSH\_DOWN[i] = 0

V\_EFC\_CLC\_LSH\_DOWN[i] = IP\_V\_EFC\_INI\_LSH\_DOWN

% IP\_ ... (TEMP\_INI\_LS\_DOWN[i]) same value as at start

T\_V\_EFC\_TOL\_LSH\_DOWN[i] = 0

T\_V\_EFC\_LIM\_LSH\_DOWN[i] = 0

LV\_V\_EFC\_LIM\_BOL\_LSH\_DOWN[i] = 0

LV\_V\_EFC\_LIM\_TOL\_LSH\_DOWN[i] = 0

LV\_V\_EFC\_LIM\_MAX\_LSH\_DOWN[i] = 0

STATE\_LSH\_DOWN[i] = LSH\_POW\_RISE

**STATE\_LSH\_DOWN[i] LSH\_TEMP\_PROT**

*Actions:*

V\_EFC\_CLC\_LSH\_DOWN[i] = 0

*Condition 8: LSH\_TEMP\_PROT to LSH\_OFF*

LV\_ST\_END = 0 or LV\_INH\_LSH\_DOWN[i] = 1

*Transition actions:*

STATE\_LSH\_DOWN[i] = LSH\_OFF

*Condition 12: LSH\_TEMP\_PROT to LSH\_VB\_PROT*

LV\_V\_EFC\_LIM\_PROT\_VB\_LSH\_DOWN[i] = 1

*Transition actions:*

STATE\_LSH\_DOWN[i] = LSH\_VB\_PROT

*Condition 10: LSH\_TEMP\_PROT to LSH\_POW\_CTL*

TEG\_DYN\_LS\_DOWN[i] C\_TEG\_DYN\_MAX\_LSH\_DOWN &

Previous state of STATE\_LSH\_DOWN[i] = LSH\_POW\_CTL

*Transition actions:*

STATE\_LSH\_DOWN[i] = LSH\_POW\_CTL

*Condition 11: LSH\_TEMP\_PROT to LSH\_POW\_RISE*

TEG\_DYN\_LS\_DOWN[i] C\_TEG\_DYN\_MAX\_LSH\_DOWN &

Previous state of STATE\_LSH\_DOWN[i] LSH\_POW\_CTL

*Transition actions:*

T\_POW\_RISE\_LSH\_DOWN[i] = 0

V\_EFC\_CLC\_LSH\_DOWN[i] = IP\_V\_EFC\_INI\_LSH\_DOWN (TEMP\_INI\_LS\_DOWN[i])

% IP\_ ... (TEMP\_INI\_LS\_DOWN[i]) same value as at start

T\_V\_EFC\_TOL\_LSH\_DOWN[i] = 0

T\_V\_EFC\_LIM\_LSH\_DOWN[i] = 0

LV\_V\_EFC\_LIM\_BOL\_LSH\_DOWN[i] = 0

LV\_V\_EFC\_LIM\_TOL\_LSH\_DOWN[i] = 0

LV\_V\_EFC\_LIM\_MAX\_LSH\_DOWN[i] = 0

STATE\_LSH\_DOWN[i] = LSH\_POW\_RISE


**Note: Should none of the conditions have been determined to be met, the state machine shall remain in the same state.**

## 7.52.2 Oxygen sensor heater voltage protection

Prolonged exposure to heater voltages that exceed the absolute maximum ratings specified shall be prevented. The preventative measures shall be applicable to all heater states other than LSH\_OFF.

**If** STATE\_LSH\_DOWN[i] LSH\_OFF

**then** **if** V\_EFC\_CLC\_LSH\_DOWN[i] C\_V\_EFC\_TOL\_LSH\_DOWN

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```


then      if      T_V_EFC_TOL_LSH_DOWN[i]
              C_T_MAX_V_EFC_TOL_LSH_DOWN
then      if      T_V_EFC_LIM_LSH_DOWN[i]
              C_T_MAX_V_EFC_LIM_LSH_DOWN
then      LV_V_EFC_LIM_TOL_LSH_DOWN[i] = 0
              Reset timer T_V_EFC_LIM_LSH_DOWN[i]
              Reset timer T_V_EFC_TOL_LSH_DOWN[i]
else      LV_V_EFC_LIM_TOL_LSH_DOWN[i] = 1
              Increment timer T_V_EFC_LIM_LSH_DOWN[i]
endif
else      LV_V_EFC_LIM_TOL_LSH_DOWN[i] = 0
              Reset timer T_V_EFC_LIM_LSH_DOWN[i]
              Increment timer T_V_EFC_TOL_LSH_DOWN[i]
endif
else      LV_V_EFC_LIM_TOL_LSH_DOWN[i] = 0
if      T_V_EFC_LIM_LSH_DOWN[i] = 0
or      T_V_EFC_LIM_LSH_DOWN[i]
              C_T_MAX_V_EFC_LIM_LSH_DOWN
then      Reset timer T_V_EFC_LIM_LSH_DOWN[i]
              Reset timer T_V_EFC_TOL_LSH_DOWN[i]
else      Increment timer T_V_EFC_LIM_LSH_DOWN[i]
endif
endif
if      T_POW_RISE_LSH_DOWN[i]
              C_T_MAX_V_EFC_MAX_ST_LSH_DOWN
or      (T_AST C_T_AST_MAX_LSH_DOWN
and      STATE_LSH_DOWN[i] = "LSH_POW_CTL")
then      if      V_EFC_CLC_LSH_DOWN[i] > VB
or      V_EFC_CLC_LSH_DOWN[i] > C_V_EFC_MAX_LSH_DOWN
then      LV_V_EFC_LIM_MAX_LSH_DOWN[i] = 1
              V_EFC_CLC_LSH_DOWN[i] =
                  MIN (VB; C_V_EFC_MAX_LSH_DOWN)
else      LV_V_EFC_LIM_MAX_LSH_DOWN[i] = 0
endif
else      if      V_EFC_CLC_LSH_DOWN[i] > VB
or      V_EFC_CLC_LSH_DOWN[i] > C_V_EFC_MAX_ST_LSH_DOWN
then      LV_V_EFC_LIM_MAX_LSH_DOWN[i] = 1
              V_EFC_CLC_LSH_DOWN[i] =
                  MIN (VB, C_V_EFC_MAX_ST_LSH_DOWN)
else      LV_V_EFC_LIM_MAX_LSH_DOWN[i] = 0
endif
endif
if      T_V_EFC_LIM_LSH_DOWN[i] <> 0
then      V_EFC_LSH_DOWN[i] =
              MIN (V_EFC_CLC_LSH_DOWN[i], C_V_EFC_LIM_LSH_DOWN)
else      V_EFC_LSH_DOWN[i] = V_EFC_CLC_LSH_DOWN[i]
endif
endif

```

**endif**

### 7.52.3 Oxygen sensor heater driver duty cycle computation

The PWM duty cycle for the appropriate heater driver shall continually be calculated in all heater states at the specified recurrence.

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```

if          STATE_LSH_DOWN[i] = LSH_OFF
then       LSHPWM_DOWN[i] = LSHPWM_EXT_LS_DOWN[i]
else       if          VB C_VB_MAX_PROT_LSH_DOWN
then       LV_V_EFC_LIM_PROT_VB_LSH_DOWN[i] = 1
             LSHPWM_DOWN[i] = C_V_EFC_PROT_VB_LSH_DOWN2 * 100 /VBN2
else       LV_V_EFC_LIM_PROT_VB_LSH_DOWN[i] = 0
             LSHPWM_DOWN[i] = V_EFC_LSH_DOWN[i]N2 *
             C_FAC_V_EFC_AS_LSH_DOWN *100 /VBN2
             if          LSHPWM_DOWN[i] NC_LSHPWM_TOL_LSH_DOWN
             then       LSHPWM_DOWN[i] = NC_LSHPWM_TOL_LSH_DOWN
             else       if          LSHPWM_DOWN[i] NC_LSHPWM_BOL_LSH_DOWN
             then       LSHPWM_DOWN[i] = NC_LSHPWM_BOL_LSH_DOWN
             else       LSHPWM_DOWN[i] = LSHPWM_DOWN[i]
             endif
             endif
             endif
endif
endif
ACTION_INFR_SetPwmLshDown(
    IN          i
    IN          LSHPWM_DOWN[i])


```

The value C\_FAC\_V\_EFC\_AS\_LSH\_DOWN is a correction signal generated in the application system.

**NOTE:** The recurrence of the heater driving duty cycle shall occur at the same recurrence as the Vbatt acquisition. This shall prevent short duration voltage drop-outs during engine start from causing long duration Vbatt corrections being made where the Vbatt has since recovered. This may otherwise cause excessive current to flow in the heater driver.

The computation of the duty cycle shall be checked to ensure that the result remains positive (i.e. 0) at all times and that now under- or overflows are caused by the values of the calibration system constants.

The multiplication of the corrected voltage ratio by 100 to obtain a unit of percent (%) may not necessarily be implemented in the SW but in the data bank definition of the variables.

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## 7.53 O2 sensor (bin, down) heater management (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LSHPWM_EXT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 99.60937	0.390625	%
Downstream heater PWM duty cycle preset from external tester					
LV_INH_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating project specific application conditions for heating not met					
TEMP_INI_LS_DOWN [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Oxygen sensor temperature at start					

### Input data:

LSHPWM_DOWN_EXT_ADJ [NC_CBK_EX_NR] {p. 7431}	LV_IGK {p. 906}	LV_LSHPWM_DOWN_EXT_ADJ [NC_CBK_EX_NR] {p. 7434}	LV_VAR_LSH_DOWN {p. 656}
NC_CBK_EX_NR {p. 1829}	NC_LSHPWM_BOL_LSH_DOWN {p. 2423}	TEG_WALL_CAT_DOWN_MDL [NC_CBK_EX_NR] {p. 8236}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_LSH_DOWN [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Boolean variable to enable oxygen sensor heating					

## FUNCTION DESCRIPTION:

### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

### Description:

The Boolean constant LC\_LSH\_DOWN[i] shall permit the appropriate oxygen sensor to be heated. When set, the Boolean inhibit flag LV\_INH\_LSH\_DOWN[i] shall be reset. When reset, LV\_INH\_LSH\_DOWN[i] shall be set.

The oxygen sensor temperature at start TEMP\_INI\_LS\_DOWN[i] shall be obtained from the input variable TEG\_WALL\_CAT\_DOWN\_MDL[i] (this is the exhaust duct temperature downstream) every time an engine start is finished.

All actions beside the initialisation routine are done only, if the variant with monitor lambda sensors is on the table.

## Application conditions

**Activation:**  $LV\_IGK = 1$

**Deactivation:**  $LV\_IGK = 0$

**Recurrence:**  $1\ s$

### Initialisation:

The following variable initialisation shall take place at the beginning of a new driving cycle:

$$LV\_INH\_LSH\_DOWN[i] = 0$$

$$LSHPWM\_EXT\_LS\_DOWN[i] = 0$$

$$TEMP\_INI\_LS\_DOWN[i] = 0\ ^\circ C$$

### Formula section:

```

IF          LV_LSHPWM_DOWN_EXT_ADJ[i] = 0
THEN
    if      LV_VAR_LSH_DOWN = 0
    then    LV_INH_LSH_DOWN[i] = 1
            LSHPWM_EXT_LS_DOWN[i] = NC_LSHPWM_BOL_LSH_DOWN
    else    LV_INH_LSH_DOWN[i] = ! LC_LSH_DOWN[i]
            LSHPWM_EXT_LS_DOWN[i] = 0
ELSE       LV_INH_LSH_DOWN[i] = 1
            LSHPWM_EXT_LS_DOWN[i] = LSHPWM_DOWN_EXT_ADJ[i]
ENDIF

```

Once at every function activation:

$$TEMP\_INI\_LS\_DOWN[i] = TEG\_WALL\_CAT\_DOWN\_MDL[i]$$

## 7.54 O2 sensor lambda setpoint intervention

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_SP_DIAG_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda set point for active plausibility test					
LV_LAMB_SP_REQ_DIAG_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Lambda coordination request to change set point for active plausibility test					

### Input data:

LAMB_SP_DIAG_OC_ LSL_UP [NC_CBK_EX_NR] {p. 4300}	LAMB_SP_DIAG_OPL_ LS_UP_DOWN [NC_CBK_EX_NR] {p. 5387}	LAMB_SP_OSC_CHK [NC_CBK_EX_NR] {p. 5214}	LV_ST_END {p. 1720}
--	--	--	---------------------

### FUNCTION DESCRIPTION:

#### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

This function provides an internal coordination of lambda setpoint requests from functions within EGCP.

#### Description:

The function shall perform a priority ranking for several lambda setpoint requests established inside the EGCP aggregate and forward one request to functions outside EGCP. The flag LV\_LAMB\_SP\_REQ\_DIAG\_ACT[i] shall indicate that at least one setpoint request is active. No check should be performed whether the setpoint is reached, nor should a request for open or closed loop lambda control be output. The possible sources of lambda setpoint requests are:


- plausibility check of upstream and downstream O2 sensor,
- monitor for downstream O2 sensor during oscillation check,
- monitor for upstream O2 sensor during open circuit check.

#### Application conditions

#### Initialisation:

At LV\_IGK = 0 to 1, reset or at clearing error memory initialize all variables and bits with 0, with the expectation of:

LAMB\_SP\_DIAG\_LS\_UP\_DOWN[i] which is initialized with 1.

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**Recurrence:**

This function shall be carried out every 100 ms.

**Activation:**

LV\_ST\_END = 1

**Formula section:**

*% priority is open loop check > oscillation check > open circuit check*

**If** LAMB\_SP\_DIAG\_OPL\_LS\_UP\_DOWN[i] > 0

**then**

LAMB\_SP\_DIAG\_LS\_UP\_DOWN[i] = LAMB\_SP\_DIAG\_OPL\_LS\_UP\_DOWN[i]  
LV\_LAMB\_SP\_REQ\_DIAG\_ACT[i] = 1

**elseif** LAMB\_SP\_OSC\_CHK[i] > 0

**then**

LAMB\_SP\_DIAG\_LS\_UP\_DOWN[i] = LAMB\_SP\_OSC\_CHK[i]  
LV\_LAMB\_SP\_REQ\_DIAG\_ACT[i] = 1

**elseif** LAMB\_SP\_DIAG\_OC\_LSL\_UP[i] > 0

**and**

LAMB\_SP\_DIAG\_OPL\_LS\_UP\_DOWN[i] = 0 for all i


**then**

LAMB\_SP\_DIAG\_LS\_UP\_DOWN[i] = LAMB\_SP\_DIAG\_OC\_LSL\_UP[i]  
LV\_LAMB\_SP\_REQ\_DIAG\_ACT[i] = 1

**else**

LAMB\_SP\_DIAG\_LS\_UP\_DOWN[i] = 1  
LV\_LAMB\_SP\_REQ\_DIAG\_ACT[i] = 0

**endif**

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## 7.55 O2 sensor air fuel cycle evaluation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_AFL_CYC [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Counter indicating number of air fuel cycles					
LV_AFL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating detection of lean Air-Fuel mixture when set					
LV_AFL_OLD_1_EGCP [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Auxiliary flag indicating lean Air-Fuel mixture status of previous sample step					
T_AFL_CYC [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 655.35	0.01	s
Lean mixture cycle time					
T_AFL_CYC_HLD [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 655.35	0.01	s
Lean mixture cycle time, held until next new value available					
T_AFR_CYC [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 655.35	0.01	s
Rich mixture cycle time					
T_SUM_AFL_AFR_CYC [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 655.35	0.01	s
Lean plus rich mixture cycle time; time of last forced lambda stimulation period					

### Input data:

LAMB_PLS [NC_CBK_EX_NR] {p. 2558}	LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}	LV_ST_END {p. 1720}	NC_CBK_EX_NR {p. 1829}
---	--	---------------------	------------------------

### FUNCTION DESCRIPTION:

#### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

- i = 1, for exhaust cylinder bank 1
- i = 2, for exhaust cylinder bank 2,

otherwise (NC\_CBK\_EX\_NR = 1)

- i = 1, for single exhaust cylinder bank.

#### Signal flow diagram:

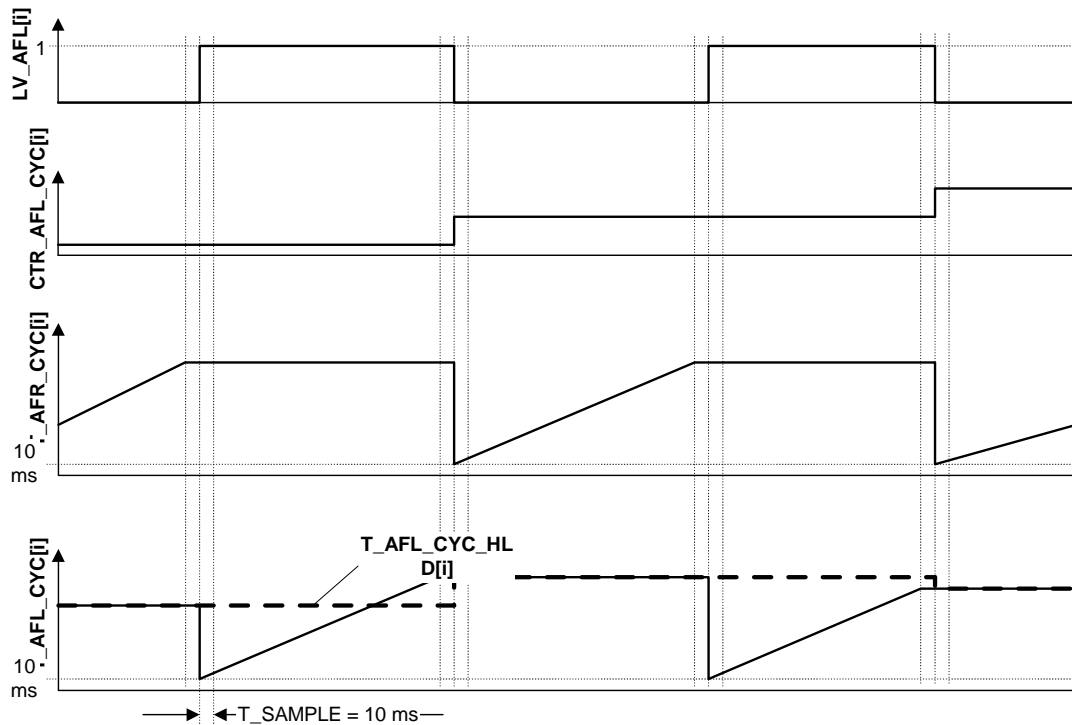


Figure 7.55.1: : Definition of dwell times

### Description:

The logical variable LV\_AFL\_i that indicates a lean air fuel ratio (lambda set point is lean) is calculated based on the output of the forced lambda stimulation. In case of a positive LAMB\_PLS[i] the flag is set to one. The lean dwell time T\_AFL\_CYC[i] is calculated in that case. If LAMB\_PLS[i] is negative or zero LV\_AFL[i] is 0. In that case the rich dwell time T\_AFR\_CYC[i] is calculated.

When LV\_AFL[i] switches from 0 to 1 T\_AFL\_CYC[i] is reset. When LV\_AFL[i] switches from 1 to 0 T\_AFR\_CYC[i] is reset and the current value of T\_AFL\_CYC[i] is stored in the variable T\_AFL\_CYC\_HLD[i]

The function is only active when the forced lambda stimulation is active (LV\_LAMB\_PLS\_ACT[i] = 1). For further explanation see Figure 1.

T\_SUM\_AFL\_AFR\_CYC[i] is the period time of the forced lambda stimulation. It is updated each rising edge of LV\_AFL[i].

### Application conditions

#### Initialisation:

at engine start (LV\_ST\_END = 0 -> 1) and at each function activation:

```

LV_AFL[i] = 0
LV_AFL_OLD_1_EGCP[i] = 0
CTR_AFL_CYC[i] = 0
T_AFR_CYC[i] = T_SAMPLE
T_AFL_CYC[i] = T_SAMPLE
T_AFL_CYC_HLD[i] = T_SAMPLE
T_SUM_AFL_AFR_CYC[i] = T_SAMPLE

```

#### Recurrence:

$T\_SAMPLE = 10\text{ ms}$

#### Activation:

$LV\_LAMB\_PLS\_ACT[i] = 1$




**Deactivation:** -

**Formula section:**

```

IF LAMB_PLS[i] > 0    /* lean */
THEN
LV_AFL[i] = 1
IF LV_AFL_OLD_1_EGCP[i] = 0    /* rising edge LV_AFL[i] = 0 -> 1 */
THEN
T_SUM_AFL_AFR_CYC[i] = T_AFL_CYC_HLD[i] + T_AFR_CYC[i]
T_AFL_CYC[i] = T_SAMPLE
ELSE
T_AFL_CYC[i] = T_AFL_CYC[i] + T_SAMPLE
ENDIF
ELSE /* rich */
LV_AFL[i] = 0
IF LV_AFL_OLD_1_EGCP[i] = 1    /* falling edge LV_AFL[i] = 1 -> 0 */
THEN
T_AFR_CYC[i] = T_SAMPLE
T_AFL_CYC_HLD[i] = T_AFL_CYC[i]
CTR_AFL_CYC[i] = CTR_AFL_CYC[i] + 1
ELSE
T_AFR_CYC[i] = T_AFR_CYC[i] + T_SAMPLE
ENDIF
ENDIF
LV_AFL_OLD_1_EGCP[i] = LV_AFL[i]

```

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## 7.56 Exhaust gas temperature model

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_COLD_ST_DOWN	O/V/S	0... FFH	0... 255	1	-
Number of cold starts at downstream-catalyst					
CTR_COLD_ST_UP	O/V/S	0... FFH	0... 255	1	-
Number of cold starts at upstream-catalyst					
FAC_DEW_CTR_COLD_ST_DOWN	O/V	0... FFFFH	0... 255.99609	3.9062e-3	-
Factor for dew point recognition downstream					
FAC_DEW_CTR_COLD_ST_UP	O/V	0... FFFFH	0... 255.99609	3.9062e-3	-
Factor for dew point recognition upstream					
INT_TEG_MAF	V	0... FFFFH	0... 9102.08	0.1388888	g
sum of the weighted air mass flow values used for the dew point recognition					
LV_TEG_CAT_DOWN_MIN_THD	O/V	0... 1H	0 ...1	1	-
dew point has been reached pre/post cat. specific bank selective downstream					
LV_TEG_MIN_THD	O/V	0... 1H	0 ...1	1	-
Dew-point recognition					
MAF_DEW_ADD_DOWN	O/V	0... FFFFH	0... 9102.08	0.1388888	g
Additional amount of air mas flow until reaching dew point downstream					
MAF_DEW_ADD_UP	O/V	0... FFFFH	0... 9102.08	0.1388888	g
Additional amount of air mas flow until reaching dew point upstream					
MAF_INT_DEW_END_DOWN_SP	O/V	0... FFFFH	0... 9102.08	0.1388888	g
Total air mass flow wich is converted in the exhaust gas until reaching the dew point downstream					
MAF_INT_DEW_END_UP_SP	O/V	0... FFFFH	0... 9102.08	0.1388888	g
Total air mass flow wich is converted in the exhaust gas until reaching the dew point upstream					
MAF_INT_TEG_CAT_DOWN_THD	O/V	0... FFFFH	0... 9102.08	0.1388888	g
Air mass flow wich is converted in the exhaust gas until reaching the dew point downstream					
MAF_INT_TEG_THD	O/V	0... FFFFH	0... 9102.08	0.1388888	g
Air mass flow wich is converted in the exhaust gas until reaching the dew point upstream					
T_ES_DEW	O/V	0... FFFFH	0... 65535	1	min
Engine shut-off duration					

### Input data:

LV_ES {p. 1720}	LV_HOM_ACT {p. 8136}	LV_IGK {p. 906}	LV_PUC {p. 1720}
LV_ST {p. 1720}	MAF_KGH {p. 1195}	T_ES_CUS {p. 1444}	TAM {p. 1579}
TCO_ST {p. 1100}	TIA {p. 1226}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_COLD_ST_DOWN	-	0... FFH	0... 3.98437	0.015625	-
weighting factor for the consideration of the number of cold starts downstream of the catalyst					
C_CTR_COLD_ST_UP	-	0... FFH	0... 3.98437	0.015625	-
weighting factor for the consideration of the number of cold starts upstream of the catalyst					
IP_INT_TEG_CAT_DOWN_THD	V	0... FFFFH	0... 9102.08	0.1388888	g
LDPM_TCO_ST_1_EXTD	8	0... FEH	-48... 142.5	0.75	°C
LDPM_TIA_1_EXTD	6	0... FEH	-48... 142.5	0.75	°C
threshold air mass flow integral for detection of dew point downstream of catalyst					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_INT_TEG_THD	V	0... FFFFH	0... 9102.08	0.1388888	g
LDPM_TCO_ST_1_EXTD	8	0... FEH	-48... 142.5	0.75	°C
LDPM_TIA_1_EXTD	6	0... FEH	-48... 142.5	0.75	°C
threshold air mass flow integral for detection of dew point upstream of catalyst					
IP_MAF_ADD_DEW_DOWN	V	0... FFFFH	0... 9102.08	0.1388888	g
LDPM_T_ES_DEW	8	0... FFFFH	0... 65535	1	min
LDPM_TAM	6	0... FEH	-48... 142.5	0.75	°C
Additional air mass flow for consideration of cooling down effect to the exhaust wall-temperature downstream					
IP_MAF_ADD_DEW_UP	V	0... FFFFH	0... 9102.08	0.1388888	g
LDPM_T_ES_DEW	8	0... FFFFH	0... 65535	1	min
LDPM_TAM	6	0... FEH	-48... 142.5	0.75	°C
Additional air mass flow for consideration of cooling down effect to the exhaust wall-temperature upstream					

## 7.56.1 Detection of dew point

### FUNCTION DESCRIPTION:

#### General information:

The exhaust gas temperature model has been removed from supplier side and is now modelled in the BMW objects. This module does satisfy the open interfaces of the dew point recognition between supplier and BMW.

#### Application conditions

##### Initialisation:

**IF** (there are no adaptation values stored **OR** the EEPROM does not work)

**THEN**

CTR\_COLD\_ST\_UP = 0 (default value is set)

CTR\_COLD\_ST\_DOWN = 0 (default value is set)

**ELSE**

CTR\_COLD\_ST\_UP = CTR\_COLD\_ST\_UP

CTR\_COLD\_ST\_DOWN = CTR\_COLD\_ST\_DOWN

(previously stored values are assigned)

**END**

At transition LV\_ES = 1 -> 0

INT\_TEG\_MAF = 0 (Mass flow integral for dew point detection)

LV\_TEG\_MIN\_THD = 0 (State: dew point not passed)

LV\_TEG\_CAT\_DOWN\_MIN\_THD = 0 (State: dew point downstream of cat. not passed)

##### Recurrence:

1000ms

##### Activation:

LV\_ES and LV\_ST = 0 (after leaving the engine state ST)

##### Deactivation:

LV\_ES = 1 (engine state ES is active)

**Formula section:**

Calculation of the number of cold starts up-/downstream:

After leaving the engine state ST the value of CTR\_COLD\_ST\_UP/DOWN is incremented by the increment one.

The value CTR\_COLD\_ST\_UP/DOWN is a measure of the number of cold-start tests and has to be stored in the flash-memory when the engine is switched off (LV\_IGK = 0). After a new start of the engine CTR\_COLD\_ST\_UP/DOWN is initialized with the stored value.

```

IF          LV_ST_END= 0 -> 1
THEN       CTR_COLD_ST_UP = CTR_COLD_ST_UP + 1
              CTR_COLD_ST_DOWN = CTR_COLD_ST_DOWN + 1
ENDIF
    
```

Calculation of INT\_TEG\_MAF

```

IF          LV_PUC = 0      AND (LV_TEG_MIN_THD = 0 OR LV_TEG_CAT_DOWN_MIN_THD =
0)
THEN       % For PUC active no increment of INT_TEG_MAFN
              INT_TEG_MAFN = INT_TEG_MAFN-1 + MAF_KGHN * 1000ms
END
    
```

Dew point upstream of catalyst:

T\_ES\_DEW = T\_ES\_CUS

MAF\_INT\_TEG\_THD = IP\_INT\_TEG\_THD(TCO\_ST, TIA)  
 MAF\_DEW\_ADD\_UP = IP\_MAF\_ADD\_DEW\_UP(T\_ES\_DEW, TAM)  
 FAC\_DEW\_CTR\_COLD\_ST\_UP = (1 + (CTR\_COLD\_ST\_UP - 1) \* C\_CTR\_COLD\_ST\_UP)

MAF\_\_INT\_DEW\_END\_UP\_SP = (MAF\_INT\_TEG\_THD + MAF\_DEW\_ADD\_UP) \*  
 FAC\_DEW\_CTR\_COLD\_ST\_UP

```

IF          INT_TEG_MAFN >= MAF_INT_DEW_END_UP_SP
THEN
              LV_TEG_MIN_THD = 1 % dew point passed
ENDIF
    
```

Reset of cold start counter CTR\_COLD\_ST\_UP:

```

IF          LV_TEG_MIN_THD = 1
THEN
              CTR_COLD_ST_UP = 0 % reset of cold start counter upstream
ENDIF
    
```

Dew point downstream of catalyst:

MAF\_INT\_TEG\_CAT\_DOWN\_THD = IP\_INT\_TEG\_CAT\_DOWN\_THD(TCO\_ST, TIA)

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```
MAF_DEW_ADD_DOWN = IP_MAF_ADD_DEW_DOWN(T_ES_DEW, TAM)
FAC_DEW_CTR_COLD_ST_DOWN = (1 + (CTR_COLD_ST_DOWN - 1) * C_CTR_COLD_ST_DOWN)
```

```
MAF_INT_DEW_END_DOWN_SP = (MAF_INT_TEG_CAT_DOWN_THD + MAF_DEW_ADD_DOWN)
*
FAC_DEW_CTR_COLD_ST_DOWN
```

```
IF          INT_TEG_MAFN >=MAF_INT_DEW_END_DOWN_SP
THEN
LV_TEG_CAT_DOWN_MIN_THD = 1 % dew point  passed
ENDIF
```

Reset of cold start counter CTR\_COLD\_ST\_DOWN:

```
IF          LV_TEG_CAT_DOWN_MIN_THD = 1
THEN
CTR_COLD_ST_DOWN = 0 % reset of cold start counter downstream
ENDIF
```

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## 7.57 Exhaust gas temperature model (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_TEG_CAT_DOWN_MIN_THD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
dew point has been reached pre/post cat. specific bank selective downstream					
LV_TEG_MIN_THD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Dew-point recognition					
NR_CYL_SCC_TEG [NC_CBK_EX_NR]	O/V	0... 1AH	0... 13	0.5	-
Number of shut off cylinders for TEG calculation					

### Input data:

INH_CYC_IV {p. 798}	INH_SWI_IV {p. 2295}	LV_IGK {p. 906}	LV_TEG_CAT_DOWN_MIN_THD [NC_CBK_EX_NR] {p. 2446}
LV_TEG_MIN_THD [NC_CBK_EX_NR] {p. 2446}			

### 7.57.1 Mean value calculations for the TEG model

#### General information:

The TEG model is calculated at the recurrence of 500 ms. For this it is necessary to calculate mean values by high frequency influence variables. The sampling of the input data is 10 ms.

#### Application conditions

<b>Initialisation:</b>	-
<b>Recurrence:</b>	10ms
<b>Activation:</b>	LV_IGK = 1
<b>Deactivation:</b>	-

#### FUNCTION DESCRIPTION:

##### *Cylinder shut off recognition:*

This function shows bank selective the mean value of shut off cylinders about 500 ms. After this time the sampling is starting again.

#### **N53 /N54:**

⇐ Logic Cylinder Number

INH\_CYC\_IV =       XXXXXXXXX  
           Bank 1 (log): 0; 2; 4       Log:                   0 1 2 3 4 5  
           Bank 2 (log): 1; 3; 5       Pys.: R6 Cyl:       1 5 3 6 2 4

INH\_SWI\_IV =       XXXXXXXXX



## 7.58 Lambda control conditions

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_DIF_SOI_LSL_POS [NC_CBK_EX_NR]	O/V	0... 10EH	0... 1620	6	°CRK
crank shaft angle difference between the start of injection and the end of the exhaust cycle					
LV_LAM_ACT_DC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
closed loop had been enabled for at least one time					
LV_LAM_NOT_STAT_CDN	O/V	0... 1H	0 ...1	1	-
flag for stop mode activation of lambda controller by wall film					
LV_LAM_STOP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation signal for the lambda controller stop mode					
LV_LAM_STOP_SHO_PER [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
activation signal for the controller stop mode while active offset adjustment					
MAF_INT_LAM_REAC [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.42	0.0277778	g
air mass flow for lambda controller reactivation after stop mode					
STATE_LS [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H 10H	INI OL_CDN CL OL_INTR OL_ERR CL_ERR	-	-
Fuel system status					
STATE_LS_SAE [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H 10H	INI OL_CDN CL OL_INTR OL_ERR CL_ERR	-	-
PID03 Fuel system status bank 1 or 1/2					
T_LAM_NOT_STAT_CDN	V	0... FFFFH	0... 1310.7	0.02	s
time counter for lambda controller reactivation after wall film					
T_LAM_REAC [NC_CBK_EX_NR]	V	0... FFH	0... 5.1	0.02	s
time counter for lambda controller reactivation after stop mode					
T_TOUT_FAC_LAM_IN_CHK [NC_CBK_EX_NR]	O/V	0... FFH	0... 5.1	0.02	s
Timer for controller difference consideration to reactivate the lambda controller after stop mode					

### Input data:

C_CAM_OP_EX {p. 812}	CAM_EX [NC_NR_CBK_IVVT] {p. 8399}	CRK_DIF_SOI_IGN {p. 1999}	FAC_DIF_LAM_IN [NC_CBK_EX_NR] {p. 2460}
FAC_NEUT_NOT_STAT_CDN {p. 2544}	LV_ES {p. 1720}	LV_FCUT_IND {p. 2295}	LV_IGK {p. 906}
LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LAM_STOP_REQ [NC_CBK_EX_NR] {p. 2545}	LV_LAM_STOP_SHO_PER_REQ [NC_CBK_EX_NR] {p. 2545}	LV_LSL_UP_SHO_PER_REQ [NC_CBK_EX_NR] {p. 2313}



LV_MAF_INT_MIN_LAM_REAC_SWI {p. 2545}	LV_PUC {p. 1720}	LV_STATE_LS_OPL_ERR [NC_CBK_EX_NR] {p. 2545}	MAF_CYL {p. 8277}
NC_CBK_EX_NR {p. 1829}	NC_NR_CBK_IVVT {p. 604}	TCO {p. 1100}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_DIF_LAM_IN_MIN_LAM_REAC	-	0... 7FFFH	0... 0.99996948242	30.5176e-6	-
Threshold for controller difference to reactivate lambda controller after stop mode					
C_MAF_INT_MIN_LAM_REAC	-	0... FFFFH	0... 1820.42	0.0277778	g
threshold for the air mass flow integral for reactivation of the lambda controller					
C_MAF_INT_MIN_LAM_REAC_OPT	-	0... FFFFH	0... 1820.42	0.0277778	g
optional threshold for the air mass flow integral for reactivation of the lambda controller					
C_T_MIN_LAM_REAC	-	0... FFH	0... 5.1	0.02	s
time delay for lambda controller reactivation after stop mode					
C_T_MIN_TOUT_FAC_LAM_IN_CHK	-	0... FFH	0... 5.1	0.02	s
Time-out threshold for controller difference consideration to reactivate the lambda controller after stop mode					
IP_FAC_NEUT_MAX_NOT_STAT_CDN	-	0... FFFFH	-1... 0.99996948	30.5176e-6	-
LDPM_TCO_1_LACO	6	0... FEH	-48... 142.5	0.75	°C
maximum threshold for detection of non-stationary conditions for lambda controller					
IP_FAC_NEUT_MIN_NOT_STAT_CDN	-	0... FFFFH	-1... 0.99996948	30.5176e-6	-
LDPM_TCO_1_LACO	6	0... FEH	-48... 142.5	0.75	°C
minimum threshold for detection of non-stationary conditions for lambda controller					
IP_T_LAM_NOT_STAT_CDN	-	0... FFFFH	0... 1310.7	0.02	s
LDPM_TCO_1_LACO	6	0... FEH	-48... 142.5	0.75	°C
time threshold to reactivate the lambda controller after wall film					

**General information:**

This function


- manages the stop modes of the linear lambda controller,
- defines non stationary conditions,
- calculates the crankshaft difference between start of fuel injection and the position where the sensor detects the exhaust gas,
- detects whether lambda closed loop control was active at least once during the actual driving cycle and
- evaluates the fuel system status.

The recurrence time is defined by T\_SAMPLE in [ms].

NC\_CBK\_EX\_NR defines the number of exhaust banks.

For vector elements the variable extension  $_i$  is used in the model instead of  $[i]$  as found in the textual description.

**Application conditions:**

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*Initialisation:* RST, DCON  
*Recurrence:* 20MS  
*Activation:* always  
*Deactivation:* never

## Function description:

## Formula section:

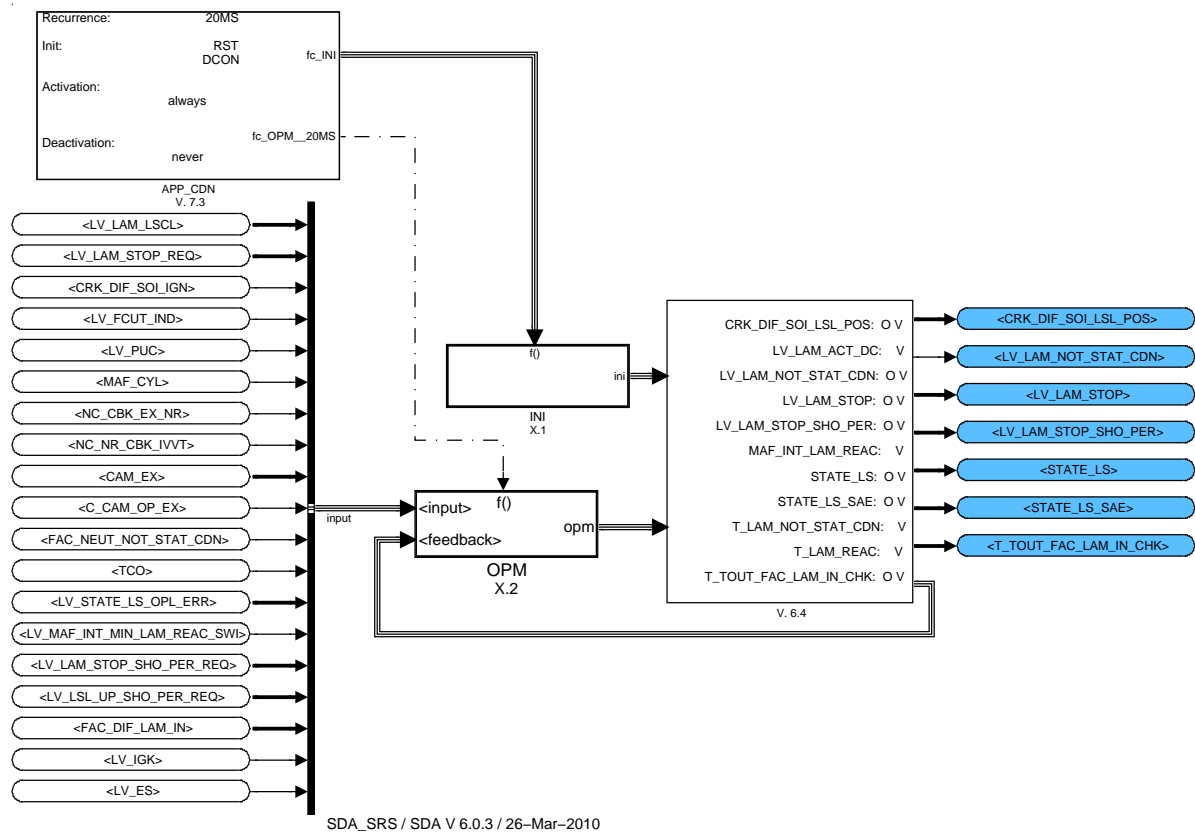


Figure 7.58.1: :

### 7.58.1 Initialization

STATE\_LS[i] is set to "INI".

STATE\_LS\_SAE[i] is set to "INI"

T\_LAM\_REAC[i] is set to C\_T\_MIN\_LAM\_REAC.

MAF\_INT\_LAM\_REAC[i] is set to C\_MAF\_INT\_MIN\_LAM\_REAC.

T\_TOUT\_FAC\_LAM\_IN\_CHK[i] is set to C\_T\_MIN\_TOUT\_FAC\_LAM\_IN\_CHK.]

All other output variables are set to 0.

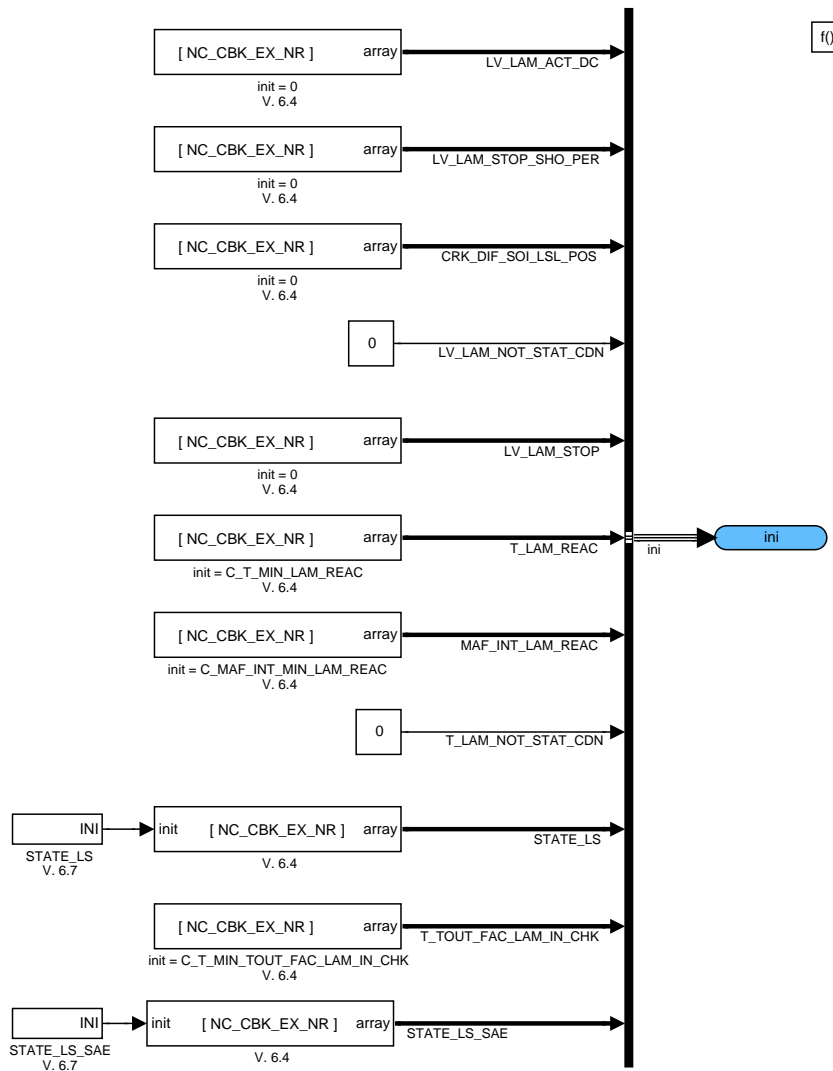


Figure 7.58.2: :

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### 7.58.2 Formula section

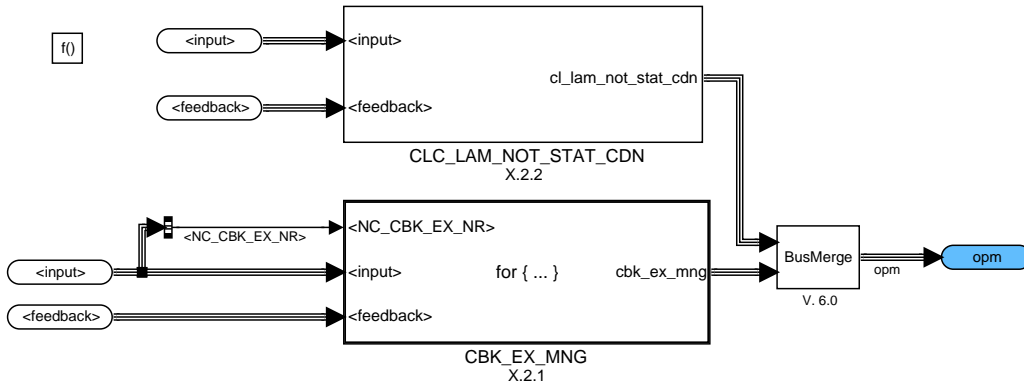


Figure 7.58.3: :

#### 7.58.2.1 Exhaust bank specific functionality

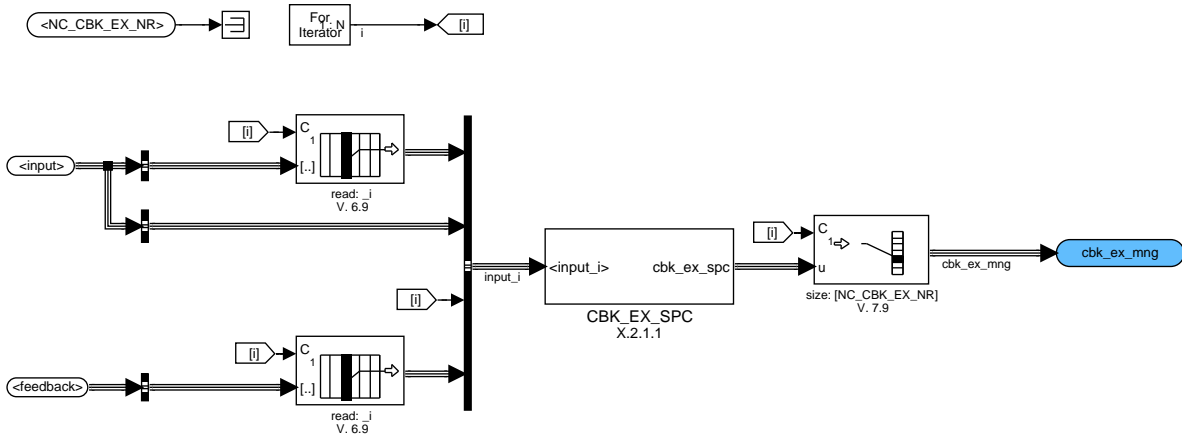


Figure 7.58.4: :

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### 7.58.2.1.1 Calculation of LV\_LAM\_STOP[i], LV\_LAM\_STOP\_SHO\_PER[i], CRK\_DIF\_SOI\_LSL\_POS[i], LV\_LAM\_LSCL[i], LV\_LAM\_ACT\_DC[i], STATE\_LS[i] and CTR\_RAF\_CHG[i]

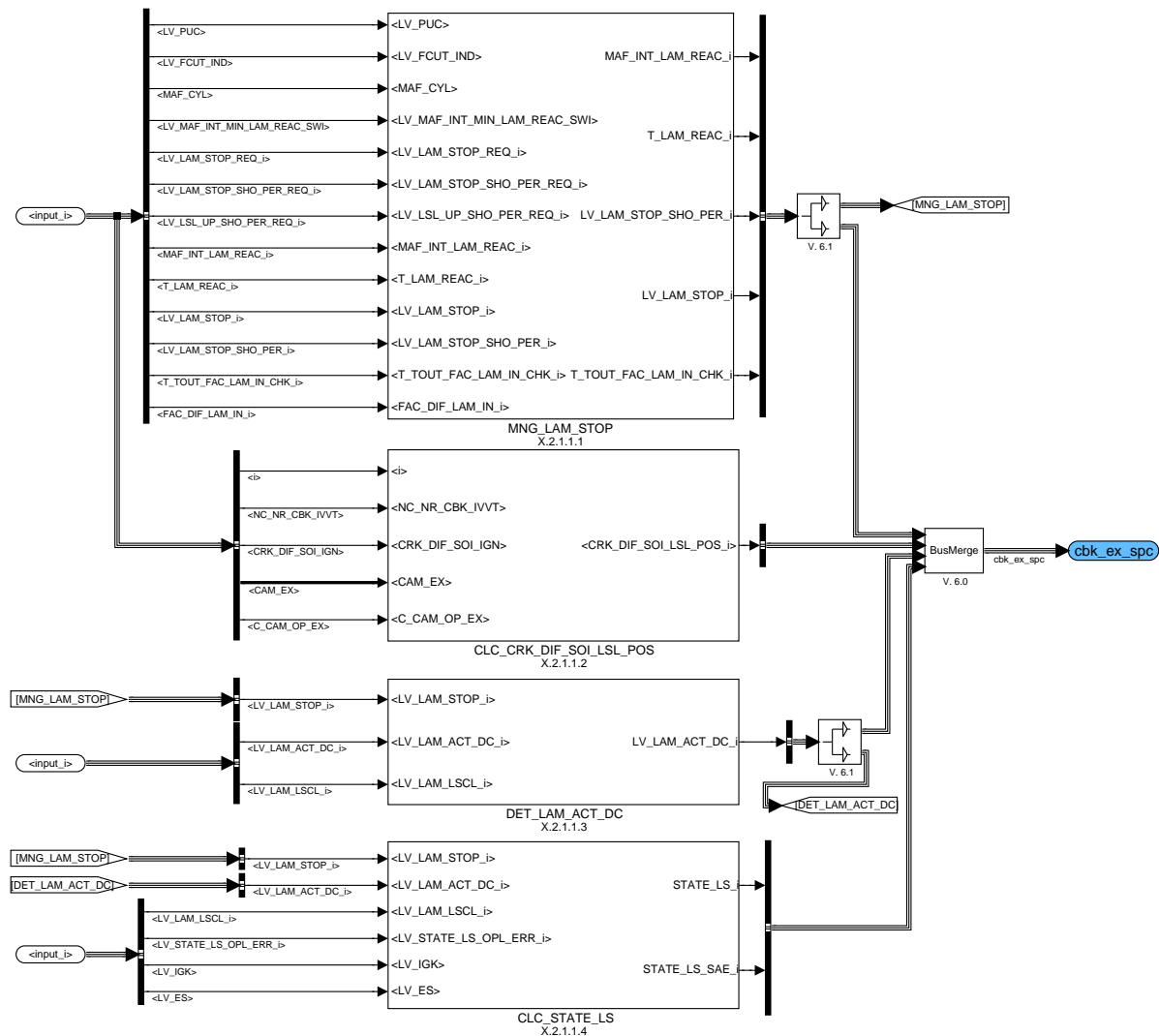



Figure 7.58.5: :

#### 7.58.2.1.1.1 Calculation of LV\_LAM\_STOP[i] and LV\_LAM\_STOP\_SHO\_PER[i]

The lambda-controller is in the stop-mode (LV\_LAM\_STOP[i] = 1) if one of the conditions

- the offset-adjustment of the lambda-sensor is active (LV\_LSL\_OFS\_ADJ\_ACT[i] = 1)
- Switching of the pump current measurement range (gain-switching) of the lambda-sensor is currently taking place (LV\_VLS\_UP\_INIT[i] = 1)
- Ip gain-switch of the lambda-sensor is not yet confirmed by the hardware (LV\_SWI\_GAIN\_LSL\_IF[i] STATE\_LSL\_IF\_SPI\_RD[i] ( bit SWI\_GAIN ))
- OBDI signal failed (LV\_LSL\_DEAC[i] = 1)
- one cylinder at least is cut off (LV\_FCUT\_IND = 1)
- the engine state LV\_PUC is active
- lambda controller stop mode request (LV\_LAM\_STOP\_REQ[i] = 1) is fulfilled.

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Additionally LV\_LAM\_STOP\_SHO\_PER[i] is set to 1 in case that condition a), b), c) or d) is true (short period stop mode).

LV\_LAM\_STOP\_SHO\_PER[i] is set to 0 if condition e), f) or g) is true (nominal stop mode). These latter conditions have the higher priority if a) or b) are fulfilled too.

If condition a) and b) are not fulfilled anymore the timer T\_LAM\_REAC[i] is to start. If this timer exceeds a calibration threshold, LV\_LAM\_STOP[i] and LV\_LAM\_STOP\_SHO\_PER[i] are set both to 0.

If condition e), f) and g) are not fulfilled anymore the integral MAF\_INT\_LAM\_REAC[i] is calculated. If this integral exceeds a calibration threshold and the controller difference FAC\_DIF\_LAM\_IN[i] is below a threshold while a time out threshold is not exceeded, LV\_LAM\_STOP[i] is set to 0.

For the calculation of the air mass flow integral the unit conversion:

$$[g] = [kg/h] * [ms] * [(g*h)/(kg*ms)] / 3600$$

has to be considered.

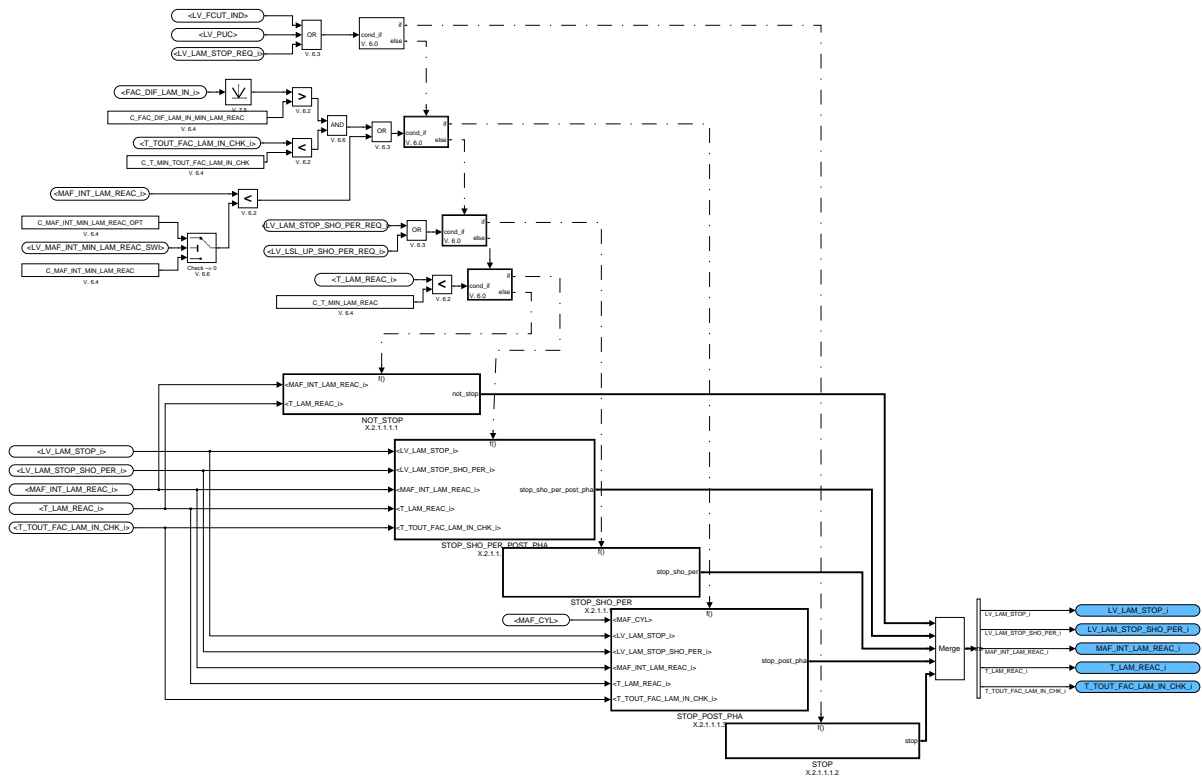


Figure 7.58.6: :

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### 7.58.2.1.1.1 No stop mode

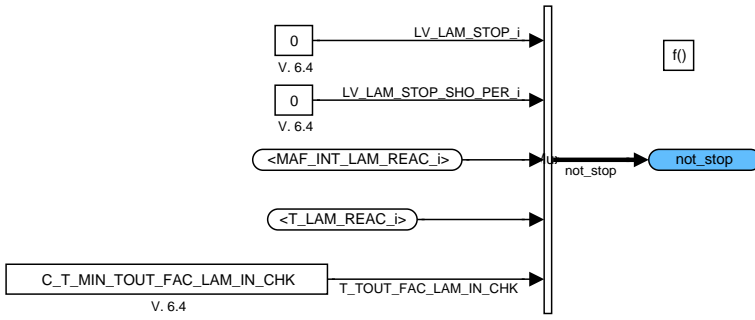


Figure 7.58.7: :

### 7.58.2.1.1.2 Nominal stop mode

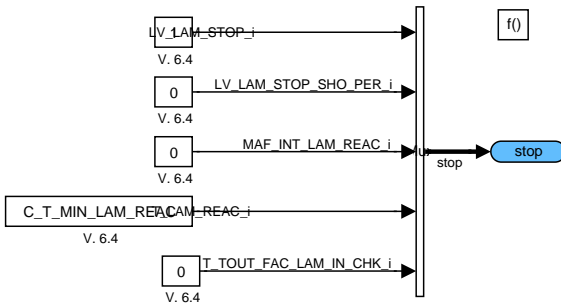


Figure 7.58.8: :

### 7.58.2.1.1.3 Post phase of nominal stop mode

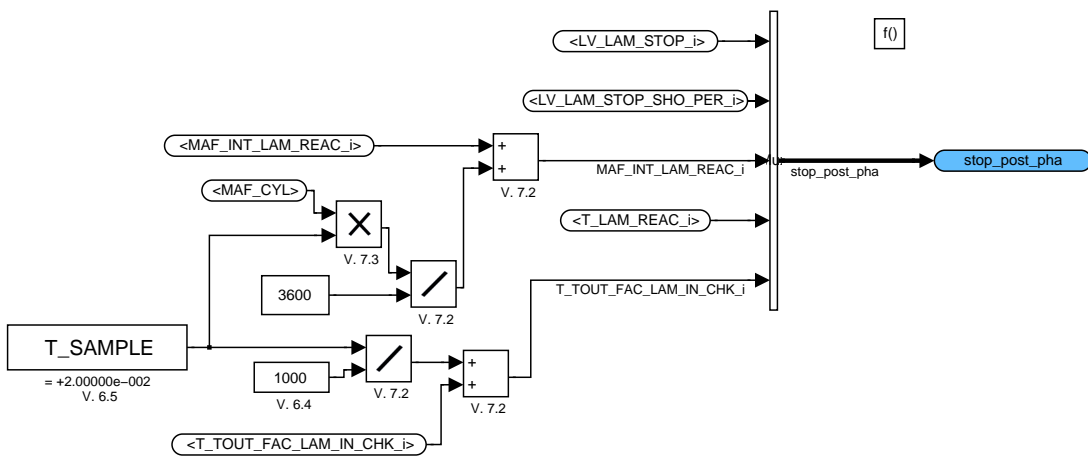


Figure 7.58.9: :

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### 7.58.2.1.1.1.4 Short period stop mode

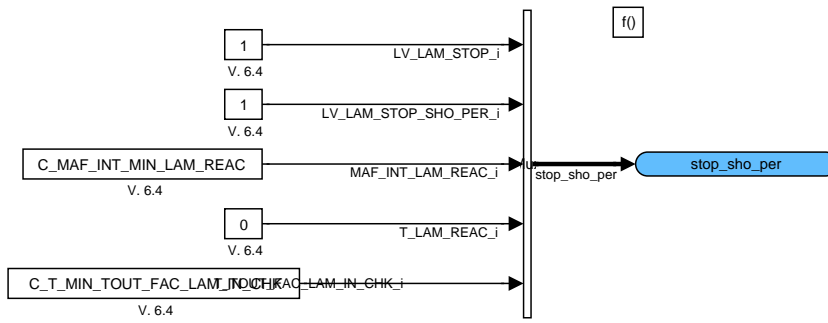


Figure 7.58.10: :

### 7.58.2.1.1.1.5 Post phase of short period stop mode

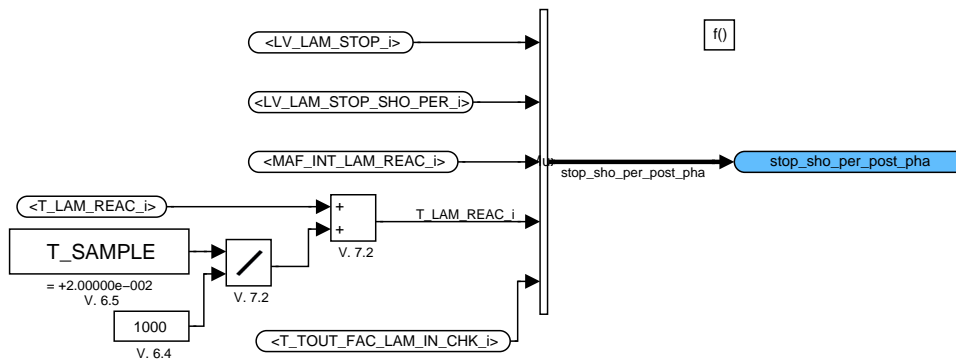


Figure 7.58.11: :

### 7.58.2.1.1.2 Calculation of CRK\_DIF\_SOI\_LSL\_POS[i]

The value of CRK\_DIF\_SOI\_LSL\_POS[i] corresponds to the crankshaft angle difference between the start of injection and the end of the exhaust cycle of the engine. This value is required for the calculation of the gas delay needed for the linear lambda controller. The distance between start of injection and top dead center where the injected fuel is ignited is defined by CRK\_DIF\_SOI\_IGN (see injection phase for homogeneous and stratified mode). The distance from the mentioned top dead center to the point where the exhaust valves close is defined by 360°CRK plus current position of exhaust camshaft (CAM\_EX[i]; is always negative) minus half of the opening period. So the opening timing edge of the exhaust valve is met.

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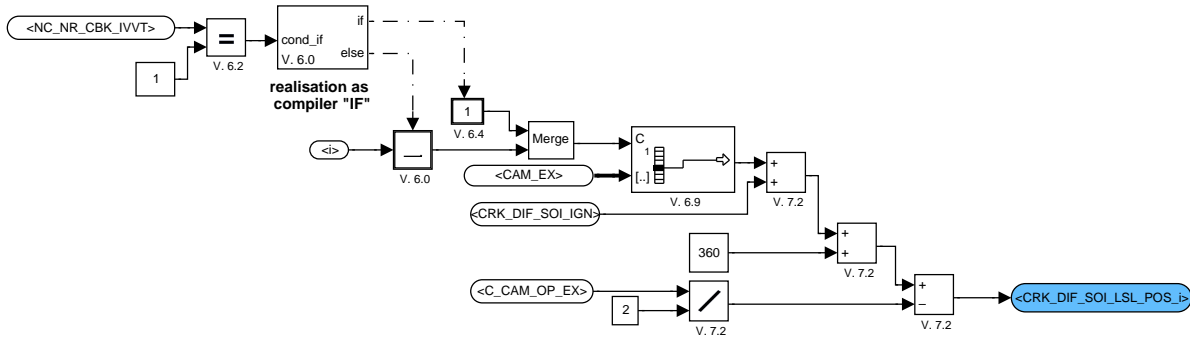


Figure 7.58.12: :

### 7.58.2.1.1.3 Calculation of LV\_LAM\_ACT\_DC[i]

The flag LV\_LAM\_ACT\_DC[i] shows that lambda closed loop control was active at least once during the actual driving cycle.

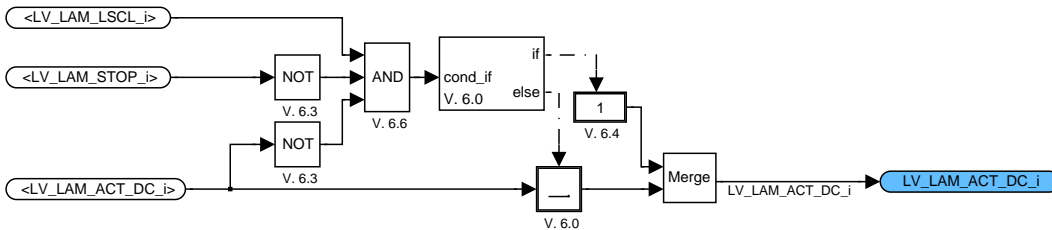


Figure 7.58.13: :

### 7.58.2.1.1.4 Evaluation of fuel system status STATE\_LS[i]

The fuel system status byte indicated the status (open /closed loop) of the cylinder bank. It belongs to the freeze frame requested by law SAE J1979. State 16 is not supported.

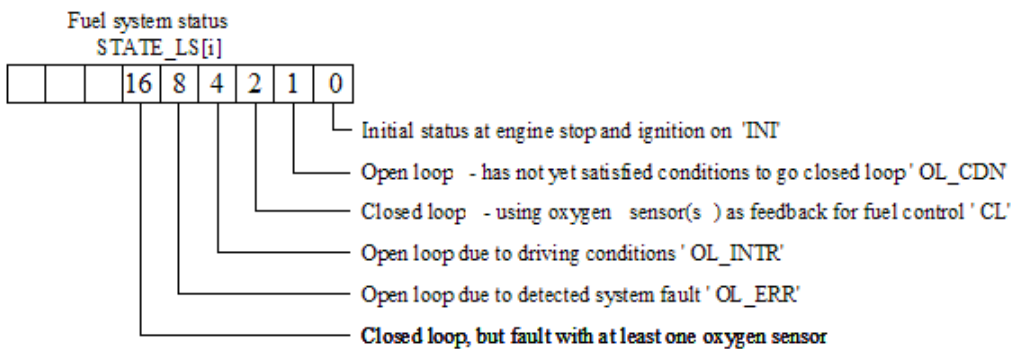


Figure 7.58.14: :

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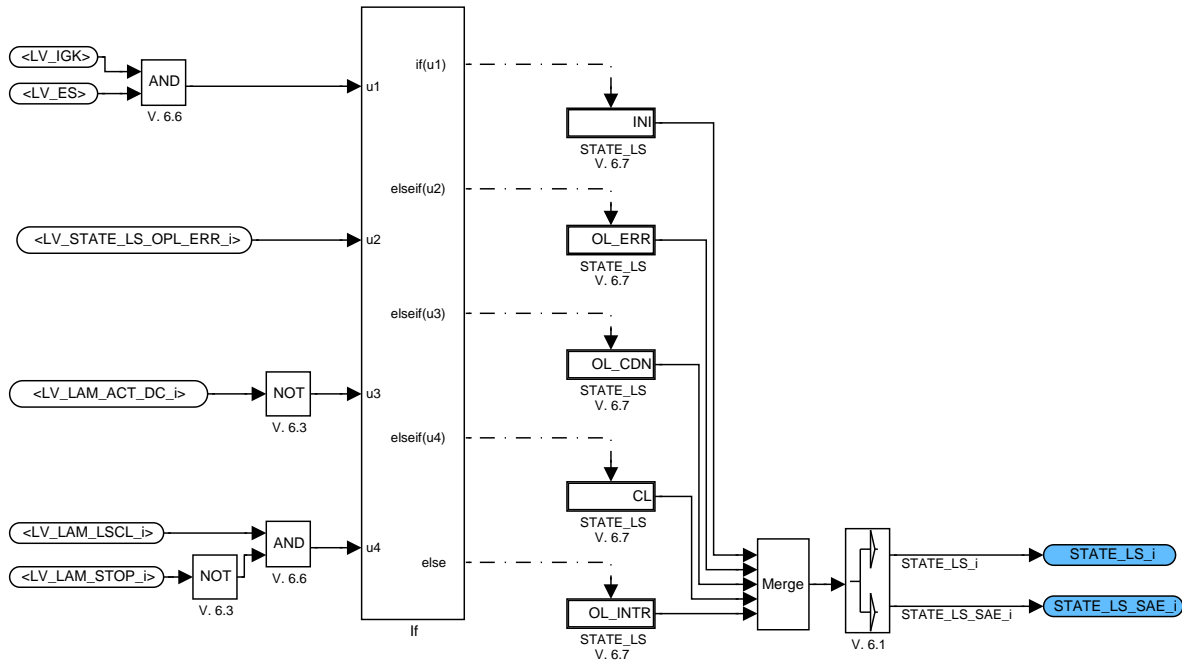


Figure 7.58.15: :

### 7.58.2.2 Definition of non stationary conditions

To avoid big controller excursion under non stationary conditions like wall film the output limitation of the lambda controller can be restricted. Therefore the flag LV\_LAM\_NOT\_STAT\_CDN is set if the neutral value FAC\_NEUT\_NOT\_STAT\_CDN exceeds the calibration minimum or maximum. The limitation itself (reaction on this flag) is executed in the module linear lambda control.

If the sum of the wall film is lower than this calibration threshold a counter is decreased. If the counter is 0 then the lambda-controller works without the limitation again.

#### 7.58.2.2.1 Definition of non stationary conditions

To avoid big controller excursion under non stationary conditions like wall film the output limitation of the lambda controller can be restricted. Therefore the flag LV\_LAM\_NOT\_STAT\_CDN is set if the neutral value FAC\_NEUT\_NOT\_STAT\_CDN exceeds the calibration minimum or maximum. The limitation itself (reaction on this flag) is executed in the module linear lambda control.

If the sum of the wall film is lower than this calibration threshold a counter is decreased. If the counter is 0 then the lambda-controller works without the limitation again.

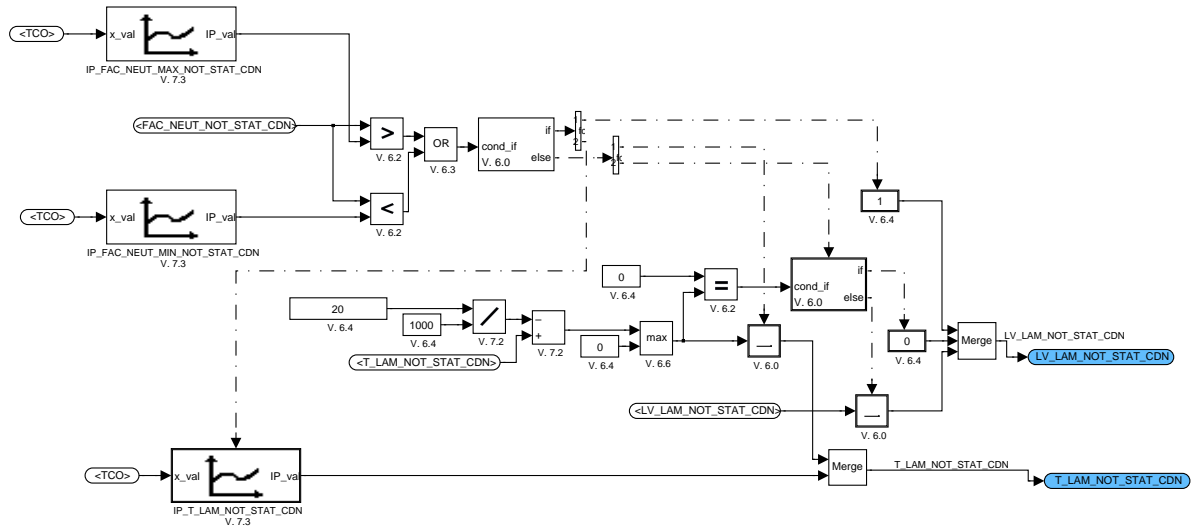



Figure 7.58.16: :

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## 7.59 Lambda control (fuel mass)

### Data definition:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRLC_2_LSL_MDL [NC_CBK_EX_NR]	V	0... FFFFH	0... 0.999985	15.3186e-6	-
Correlation constant for aged lambda sensor model with PT2 behaviour					
CRLC_LSL_MDL [NC_CBK_EX_NR]	V	0... FFFFH	0... 0.999985	15.3186e-6	-
correlation constant for lambda sensor model					
CTR_RAF_CHG [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
counter of air fuel ratio changes					
FAC_DIF_LAM_IN [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-1... 0.999969	30.5176e-6	-
controller difference (richness)					
FAC_DIF_LAM_IN_MMV [NC_CBK_EX_NR]	O/V	80000000... 7FFFFFFFH	-1... 0.9999999953	465.66e-12	-
controller difference (richness) moving mean value					
FAC_DIF_SUM_LAM_IN [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-65536... 65535.9999695	30.5176e-6	-
unlimited summation of controller difference					
FAC_DIF_SUM_LAM_IN_SAVE [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-65536... 65535.9999695	30.5176e-6	-
stored value of controller difference summation					
FAC_DIF_SUM_LIM_LAM_IN [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-65536... 65535.9999695	30.5176e-6	-
limited summation of controller difference					
FAC_EG_DLY [NC_CBK_EX_NR]	V	0... FFH	0... 31.875	0.125	-
weighting factor for the calculation of the exhaust gas delay					
FAC_GAIN_D_LAM [NC_CBK_EX_NR]	V	0... 7FFFH	0... 0.0399987793	1.2207e-6	s
gain of lambda controller D share					
FAC_GAIN_D_LAM_EXT [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 0.0399987793	1.2207e-6	s
external gain of lambda controller D-share					
FAC_GAIN_I_LAM [NC_CBK_EX_NR]	V	0... FFFFH	0... 49.9992370605	762.939e-6	1/s
gain of lambda controller I share					
FAC_GAIN_I_LAM_EXT [NC_CBK_EX_NR]	O/V	D... FFFFH	0.00991821... 49.9992370605	762.939e-6	1/s
external gain of lambda controller I-share					
FAC_GAIN_I2_LAM [NC_CBK_EX_NR]	V	0... FFFFH	0... 24.9996185303	381.47e-6	1/s**2
gain of lambda controller I <sup>2</sup> share					
FAC_GAIN_P_LAM [NC_CBK_EX_NR]	V	0... FFFFH	0... 15.999756	244.141e-6	-
gain of lambda controller P share					
FAC_GAIN_P_LAM_EXT [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 15.9997558594	244.141e-6	-
external gain of lambda controller P-share					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LAM_AD_OUT [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
fuel mass set point factor, output from lambda adaptation					
FAC_LAM_COR [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
limited lambda controller output plus pre control correction					
FAC_LAM_D_LIM [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
limited D share output signal					
FAC_LAM_DELTA_I_I2_SHIFT [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
I and I <sup>2</sup> share shift based on downstream signal evaluation					
FAC_LAM_I [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
unlimited I share output signal					
FAC_LAM_I_I2_SUM_LIM [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
limited I share + I <sup>2</sup> share output signal					
FAC_LAM_I_IT [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-50... 49.9999999767	23.2831e-9	%
unlimited internal I share used for PID control only					
FAC_LAM_I_IT_LIM [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-50... 49.9999999767	23.2831e-9	%
limited internal I share used for PID control only					
FAC_LAM_I_MAX [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
upper limitation for I share					
FAC_LAM_I_MIN [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
lower limitation for I share					
FAC_LAM_I2 [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
unlimited I <sup>2</sup> share output signal					
FAC_LAM_I2_LIM [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
limited I <sup>2</sup> share output signal					
FAC_LAM_LIM [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
limited value of lambda controller output					
FAC_LAM_MAX_NOT_LAM_LIM [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Factor for the maximum limitation of lambda controller					
FAC_LAM_MAX_NOT_STAT_CDN [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
upper limit in case of limitation under non stationary conditions					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LAM_MIN_NOT_LAM_LIM [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Factor for the minimum limitation of lamda controller					
FAC_LAM_MIN_NOT_STAT_CDN [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
bottom limit in case of limitation under non stationary conditions					
FAC_LAM_MV [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
mean value of lambda controller output					
FAC_LAM_MV_MMV [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
FAC_LAM_MV[i] average value					
FAC_LAM_MV_MMV_CP [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
mean value of lambda controller output, used by canister purge					
FAC_LAM_MV_MMV_LDC [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
moving mean value of the controller output, used for limited dynamics calculation					
FAC_LAM_MV_MMV_LDC_DIAG [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Mean value of the controller output, used by limited dynamics for cat efficiency diagnosis					
FAC_LAM_OUT [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
lambda controller output					
FAC_LAM_P_LIM [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
limited P share output signal					
FAC_LAM_PCTL [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
pre control path correction					
LAMB_COR_AV_LAM [NC_CBK_EX_NR]	V	0... 7FFFH	0... 1.999939	61.0352e-6	-
corrected signal of WRAF sensor; actual value for lambda controller					
LAMB_LS_UP_LAM_MMV [NC_CBK_EX_NR]	O/V	0... FFFFFFFFH	0... 31.9999999925	7.-058e-9	-
filtered lambda sensor signal upstream					
LAMB_LSL_MDL_OUT_TMP [NC_CBK_EX_NR]	V	0... FFFFFFFFH	0... 31.9999999925	7.-058e-9	-
temporary output variable for lambda sensor model (after 1st PT1)					
LAMB_SP_FIL_HOM [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 1.999939	61.0352e-6	-
output signal of the WRAF sensor model for homogeneous mode					
LAMB_SP_FIL_S [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902344	976.563e-6	-
output signal of the WRAF sensor model for stratified mode					
LAMB_SP_LSL_MDL_IN_HOM [NC_CBK_EX_NR]	V	0... FFFFH	0... 3.99993896484	61.0352e-6	-
lambda controller set point including forced stimulation and the influence of secondary air					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_SP_LSL_MDL_OUT_HOM [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 3.99993896484	61.0352e-6	-
output signal of the WRAF sensor model in homogeneous mode					
LAMB_SP_LSL_MDL_OUT_S [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.99902344	976.563e-6	-
output signal of the WRAF sensor model in stratified mode					
LAMB_SP_PCTL [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 1.999939	61.0352e-6	-
pre control lambda set point					
LV_FAC_LAM_ADJ_LAM_AD_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
lambda shift required by lambda adaptation was carried out					
LV_FAC_LAM_DIAGCP_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
controller shift caused by EVAP diagnosis was carried out					
LV_FAC_LAM_LIM_MAX [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
upper limit of lambda controller output reached					
LV_FAC_LAM_LIM_MIN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
lower limit of lambda controller output reached					
LV_FAC_LAM_LIM_NOT_STAT_CDN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
limitation under non stationary operating conditions (threshold exceeded)					
LV_FAC_LAM_MAX_NOT_LAM_LIM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating maximum lambda controller limitation due to FAC_LAM_MAX_NOT_LAM_LIM limitation					
LV_FAC_LAM_MIN_NOT_LAM_LIM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating minimum lambda controller limitation due to FAC_LAM_MIN_NOT_LAM_LIM limitation					
LV_FAC_LAM_SHIFT_CP_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Controller shift caused by canister purge was carried out					
LV_LAM_GAIN_EXT	O/V	0... 1H	0 ...1	1	-
lambda controller gain switch for activation of external parameters					
LV_LAM_GAIN_LS_DIAG	O/V	0... 1H	0 ...1	1	-
flag indicating that current lambda controller parameters result from EGCP request					
LV_LAM_I2_ACT	V	0... 1H	0 ...1	1	-
flag to switch between PII*2D and PID lambda controller					
LV_LAM_LSCL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
activation flag of lambda control					
LV_SENS_MDL_OFF_ACT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating that lambda sensor model switch-off is active.					
LV_T_MAX_LSCL_ACT_TCO [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
lambda controller activation by timer condition instead of TCO condition					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_VLS_DOWN_THD_AFL_LAM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that downstream sensor signal is below calibration threshold (used for lambda control)					
LV_VLS_DOWN_THD_AFR_LAM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that downstream sensor signal is above calibration threshold (used for lambda control)					
MFF_ADD_CP	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Canister Purge Fuel Mass correction corresponding to Lambda Factor Shift					
MFF_ADD_LAM_AD_OUT [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
fuel mass set point offset, output from lambda adaptation					
STATE_FAC_GAIN_PID_EXT [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Status for the condition under which the external lambda control gain factors are determined					
STATE_LAM [NC_CBK_EX_NR]	V	0H 1H 2H 3H	OFF ON STOP_SHO_ PER STOP	-	-
lambda controller state					
T_DLY_SENS_MDL_ACT [NC_CBK_EX_NR]	V	0... FFH	0... 5.1	0.02	s
Delay timer for reactivation of linear lambda sensor model					
T_DLY_SOI_LSL_POS [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1.023984	15.625e-6	s
delay between start of injection and WRAF sensor signal location					
T_LSL_UP_AGI_OFS [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996948242	30.5176e-6	s
current sensor rise-time offset of the lambda controller plant model due to sensor ageing					
T1_LSL_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1.99996948242	30.5176e-6	s
first order time lag of the WRAF sensor model					
T1_LSL_UP_OPT [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1.99996948242	30.5176e-6	s
first order time lag of the WRAF sensor model (optional)					
TOUT_I_I2_SHIFT_VLD_AFL [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
time out for I and I <sup>2</sup> share shift based on lean downstream signal					
TOUT_I_I2_SHIFT_VLD_AFR [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
time out for I and I <sup>2</sup> share shift based on rich downstream signal					
VLS_DOWN_MMV_LAM [NC_CBK_EX_NR]	V	0... FFFFH	0... 4.99992371	76.2939e-6	V
moving mean value of downstream sensor voltage					

**Input data:**

CRK_DIF_SOI_LSL_POS [NC_CBK_EX_NR] {p. 2448}	CRLC_FAC_LAM_MV_ MMV_CP {p. 3698}	FAC_EG_DLY_AGI_L2R [NC_CBK_EX_NR] {p. 2544}	FAC_EG_DLY_AGI_R2L [NC_CBK_EX_NR] {p. 2544}
FAC_IPT_SENS_MDL [NC_CBK_EX_NR] {p. 2544}	FAC_IPT_SENS_MDL_ OPT [NC_CBK_EX_NR] {p. 2544}	FAC_LAM_AD_LAM_OUT [NC_CBK_EX_NR] {p. 2641}	FAC_LAM_ADJ_LAM_AD [NC_CBK_EX_NR] {p. 2641}




FAC_LAM_DIAGCP [NC_CBK_EX_NR] {p. 798}	FAC_LAM_SHIFT_CP {p. 3699}	FAC_LAMB_SP_SA {p. 798}	LAMB_AV_DELTA_LAM [NC_CBK_EX_NR] {p. 2544}
LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_PLS [NC_CBK_EX_NR] {p. 2558}	LAMB_SP_DELTA_LAM [NC_CBK_EX_NR] {p. 2544}	LAMB_SP_HOM [NC_CBK_EX_NR] {p. 8340}
LAMB_SP_S {p. 1820}	LV_AFL [NC_CBK_EX_NR] {p. 2439}	LV_CP_RAMP_OPEN_ACT {p. 3636}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}
LV_ERR_LS_DOWN [NC_CBK_EX_NR] {p. 5449}	LV_FAC_LAM_ADJ_LAM_AD [NC_CBK_EX_NR] {p. 2642}	LV_FAC_LAM_DIAGCP {p. 1001}	LV_FAC_LAM_SHIFT_CP {p. 3699}
LV_HOM_ACT {p. 8136}	LV_INH_LSCL [NC_CBK_EX_NR] {p. 2544}	LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}	LV_IS {p. 1720}
LV_LAM_AD_EXT {p. 1016}	LV_LAM_DI_REQ [NC_CBK_EX_NR] {p. 5389}	LV_LAM_GAIN_SWI {p. 2544}	LV_LAM_NOT_STAT_CDN {p. 2448}
LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}	LV_LAM_STOP_SHO_PER [NC_CBK_EX_NR] {p. 2448}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_LSL_UP_ERR_SUSP [NC_CBK_EX_NR] {p. 2335}
LV_PUC {p. 1720}	LV_ST_END {p. 1720}	LV_TI_1_HOM_MIN {p. 2000}	MAF {p. 8277}
MAF_INT_PUC_ACT {p. 2942}	MAF_INT_S_ACT {p. 2545}	MFF_ADD_LAM_CP {p. 3692}	MFF_LAM_ADD_LAM_AD_OUT [NC_CBK_EX_NR] {p. 2642}
N {p. 1525}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}
NC_NR_FAC_GAIN_LAM {p. 826}	STATE_LAM_GAIN_REQ_LS_DIAG {p. 5349}	STATE_SENS_MDL [NC_CBK_EX_NR] {p. 2545}	T_AST {p. 1766}
T_LSL_UP_AGI_L2R [NC_CBK_EX_NR] {p. 2545}	T_LSL_UP_AGI_R2L [NC_CBK_EX_NR] {p. 2545}	T_SEG_AV {p. 1525}	TCO {p. 1100}
TCO_ST {p. 1100}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FAC_DIF_LAM_IN_MMV	-	0... FFH	0... 0.99609375	3.90625e-3	-
correlation constant for the calculation of FAC_DIF_LAM_IN_MMV[i]					
C_CRLC_FAC_LAM_MV	-	0... FFH	0... 0.99609375	3.90625e-3	-
correlation constant for calculation of the controller output mean value FAC_LAM_MV[i]					
C_CRLC_FAC_LAM_MV_MMV	-	0... FFH	0... 0.99609375	3.90625e-3	-
correlation constant for the calculation of the filtered controller output mean value FAC_LAM_MV_MMV[i]					
C_CRLC_FAC_LAM_MV_MMV_LDC	-	0... FFH	0... 0.99609375	3.90625e-3	-
correlation constant for the calculation of moving mean value for limited dynamics detection					
C_CRLC_FAC_LAM_MV_MMV_LDC_DIAG	-	0... FFH	0... 0.99609375	3.90625e-3	-
correlation constant for mean value calculation of lambda controller output, used by limited dynamics for cat efficiency diagnosis					


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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_VLS_DOWN_MMV_LAM	-	0... FFH	0... 0.99609375	3.90625e-3	-
correlation constant for the calculation of VLS_DOWN_MMV_LAM[i]					
C_FAC_GAIN_D_LAM_DLY_DIAG	-	0... 7FFFH	0... 0.0399987793	1.2207e-6	s
gain of lambda controller D share in case of delay diagnosis					
C_FAC_GAIN_D_LAM_DYN_DIAG	-	0... 7FFFH	0... 0.0399987793	1.2207e-6	s
gain of lambda controller D share in case of delay diagnosis					
C_FAC_LAM_D_MAX_LAM	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
upper limitation of the lambda controller D share					
C_FAC_LAM_D_MIN_LAM	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
bottom limitation of the lambda controller D share					
C_FAC_LAM_DELTA_LSCL_OFF	-	0... 7FFFH	0... 49.99847412	1.52588e-3	%
output signal delta to ramp the output signal to zero in case of deactivated lambda controller					
C_FAC_LAM_I_I2_SUM_MAX_LAM	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
upper limitation of lambda controller I share + I <sup>2</sup> share					
C_FAC_LAM_I_I2_SUM_MAX_LAM_CP	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
upper limitation of lambda controller I share + I <sup>2</sup> share during active canister purge					
C_FAC_LAM_I_I2_SUM_MIN_LAM	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
bottom limitation of lambda controller I share + I <sup>2</sup> share					
C_FAC_LAM_I_I2_SUM_MIN_LAM_CP	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
bottom limitation of lambda controller I share + I <sup>2</sup> share during active canister purge					
C_FAC_LAM_I_MAX_LAM_DLY_DIAG	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
upper limitation of lambda controller I share during delay diagnosis					
C_FAC_LAM_I_MAX_LAM_DYN_DIAG	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
upper limitation of lambda controller I share during dynamic diagnosis					
C_FAC_LAM_I_MAX_LAM_ERR_DYN	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
upper limitation of lambda controller I share when dynamic error detected					
C_FAC_LAM_I_MIN_LAM_DLY_DIAG	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
lower limitation of lambda controller I share during delay diagnosis					
C_FAC_LAM_I_MIN_LAM_DYN_DIAG	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
lower limitation of lambda controller I share during dynamic diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_LAM_I_MIN_LAM_ERR_DYN	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
lower limitation of lambda controller I share when dynamic error detected					
C_FAC_LAM_MAX_DLY_DIAG	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Maximum lambda controller limitation during delay diagnosis					
C_FAC_LAM_MAX_DYN_DIAG	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Maximum lambda controller limitation during dynamic diagnosis					
C_FAC_LAM_MAX_ERR_DYN	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Maximum lambda controller limitation when dynamic error detected					
C_FAC_LAM_MIN_DLY_DIAG	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Minimum lambda controller limitation during delay diagnosis					
C_FAC_LAM_MIN_DYN_DIAG	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Minimum lambda controller limitation during dynamic diagnosis					
C_FAC_LAM_MIN_ERR_DYN	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Minimum lambda controller limitation when dynamic error detected					
C_FAC_LAM_OUT_MAX	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
upper limitation of the lambda controller output					
C_FAC_LAM_OUT_MAX_CP	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
upper limitation of the lambda controller output during canister purge ramp open phase					
C_FAC_LAM_OUT_MAX_ERR_SUSP	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
upper limitation of the lambda controller output during oxygen sensor error suspicion					
C_FAC_LAM_OUT_MIN	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
bottom limitation of the lambda controller output					
C_FAC_LAM_OUT_MIN_CP	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
bottom limitation of the lambda controller output during canister purge ramp open phase					
C_FAC_LAM_OUT_MIN_ERR_SUSP	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
bottom limitation of the lambda controller output during oxygen sensor error suspicion					
C_FAC_LAM_P_MAX_LAM	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
upper limitation of lambda controller P share					
C_FAC_LAM_P_MAX_LAM_CP	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
upper limitation of lambda controller P share during active canister purge					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_LAM_P_MIN_LAM	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
bottom limitation of lambda controller P share					
C_FAC_LAM_P_MIN_LAM_CP	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
bottom limitation of lambda controller P share during active canister purge					
C_LAMB_SENS_MDL_OFF_PUC	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Lambda signal threshold during PUC to switch-off lambda sensor model					
C_N_MIN_LAM_LSCL	-	0... FFH	0... 8160	32	rpm
minimum engine speed for lambda controller activation					
C_T_DLY_SENS_MDL_ACT	-	0... FFH	0... 5.1	0.02	s
Time delay for reactivation of linear lambda sensor model					
C_TOUT_I_I2_SHIFT_VLD	-	0... FFFFH	0... 1310.7	0.02	s
time out for I and I <sup>2</sup> share shift based on downstream signal evaluation					
C_VLS_DOWN_THD_AFL_LAM	-	0... FFFFH	0... 4.99992371	76.2939e-6	V
lean threshold of downstream sensor signal for I and I <sup>2</sup> share correction					
C_VLS_DOWN_THD_AFR_LAM	-	0... FFFFH	0... 4.99992371	76.2939e-6	V
rich threshold of downstream sensor signal for I and I <sup>2</sup> share correction					
ID_T_AST_MIN_LSCL_ACT	-	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_1_LACO	6	0... FEH	-48... 142.5	0.75	°C
minimum time after start that must be elapsed before activating lambda controller					
ID_T_MAX_LSCL_ACT_TCO	-	1... FFFFH	1... 65535	1	s
LDPM_TCO_ST_1_LACO	6	0... FEH	-48... 142.5	0.75	°C
maximum time value up to that the controller can be activated by TCO condition					
ID_TCO_MIN_LAM_LSCL	-	0... FEH	-48... 142.5	0.75	°C
LDPM_TCO_ST_1_LACO	6	0... FEH	-48... 142.5	0.75	°C
minimum TCO for lambda controller activation					
ID_TCO_MIN_LAM_LSCL_IS	-	0... FEH	-48... 142.5	0.75	°C
LDPM_TCO_ST_1_LACO	6	0... FEH	-48... 142.5	0.75	°C
minimum TCO for lambda controller activation at idle speed					
IP_FAC_EG_DLY [NC_CBK_EX_NR]	V	0... FFH	0... 31.875	0.125	-
LDPM_N_1_LACO	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_LACO	8	0... FFFFH	0... 1389	0.0211948	mg/stk
weighting factor for the calculation of the exhaust gas delay					
IP_FAC_EG_DLY_L2R [NC_CBK_EX_NR]	V	0... FFH	0... 31.875	0.125	-
LDPM_N_1_LACO	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_LACO	8	0... FFFFH	0... 1389	0.0211948	mg/stk
weighting factor for the calculation of the exhaust gas delay - lean to rich					
IP_FAC_EG_DLY_L2R_IPT [NC_CBK_EX_NR]	V	0... FFH	0... 31.875	0.125	-
LDPM_N_1_LACO	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_LACO	8	0... FFFFH	0... 1389	0.0211948	mg/stk
weighting factor for the calculation of the exhaust gas delay - lean to rich, Interpolated value					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_EG_DLY_R2L [NC_CBK_EX_NR]	V	0... FFFH	0... 31.875	0.125	-
LDPM_N_1_LACO	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_LACO	8	0... FFFFH	0... 1389	0.0211948	mg/stk
weighting factor for the calculation of the exhaust gas delay - rich to lean					
IP_FAC_EG_DLY_R2L_IPT [NC_CBK_EX_NR]	V	0... FFFH	0... 31.875	0.125	-
LDPM_N_1_LACO	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_LACO	8	0... FFFFH	0... 1389	0.0211948	mg/stk
weighting factor for the calculation of the exhaust gas delay - rich to lean, Interpolated value					
IP_FAC_GAIN_D_LAM	V	0... 7FFFH	0... 0.0399987793	1.2207e-6	s
LDPM_T_DLY_SOI_LSL_POS_1_LACO	8	0... FFFFH	0... 1.023984	15.625e-6	s
LDPM_T1_LSL_UP_1_LACO	8	0... FFFFH	0... 1.99996948242	30.5176e-6	s
gain of lambda controller D share					
IP_FAC_GAIN_D_LAM_GAIN_SWI	V	0... 7FFFH	0... 0.0399987793	1.2207e-6	s
LDPM_T_DLY_SOI_LSL_POS_2_LACO	4	0... FFFFH	0... 1.023984	15.625e-6	s
LDPM_T1_LSL_UP_2_LACO	4	0... FFFFH	0... 1.99996948242	30.5176e-6	s
gain of lambda controller D share in case of LV_LAM_GAIN_SWI is set					
IP_FAC_GAIN_I_LAM	V	D... FFFFH	0.00991821... 49.9992370605	762.939e-6	1/s
LDPM_T_DLY_SOI_LSL_POS_1_LACO	8	0... FFFFH	0... 1.023984	15.625e-6	s
LDPM_T1_LSL_UP_1_LACO	8	0... FFFFH	0... 1.99996948242	30.5176e-6	s
gain of lambda controller I share					
IP_FAC_GAIN_I_LAM_DLY_DIAG	V	D... FFFFH	0.00991821... 49.9992370605	762.939e-6	1/s
LDPM_T_DLY_SOI_LSL_POS_3_LACO	NC_ NR_ FAC_ GAIN_ LAM	0... FFFFH	0... 1.023984375	15.625e-6	s
LDPM_T1_LSL_UP_3_LACO	NC_ NR_ FAC_ GAIN_ LAM	0... FFFFH	0... 1.99996948242	30.5176e-6	s
gain of lambda controller I share in case of delay diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_GAIN_I_LAM_DYN_DIAG	V	D... FFFFH	0.00991821... 49.9992370605	762.939e-6	1/s
LDPM_T_DLY_SOI_LSL_POS_3_LACO	NC_ NR_ FAC_ GAIN_ LAM	0... FFFFH	0... 1.023984375	15.625e-6	s
LDPM_T1_LSL_UP_3_LACO	NC_ NR_ FAC_ GAIN_ LAM	0... FFFFH	0... 1.99996948242	30.5176e-6	s
gain of lambda controller I share in case of DYN_DIAG					
IP_FAC_GAIN_I_LAM_GAIN_SWI	V	D... FFFFH	0.00991821... 49.9992370605	762.939e-6	1/s
LDPM_T_DLY_SOI_LSL_POS_2_LACO	4	0... FFFFH	0... 1.023984	15.625e-6	s
LDPM_T1_LSL_UP_2_LACO	4	0... FFFFH	0... 1.99996948242	30.5176e-6	s
gain of lambda controller I share in case of LV_LAM_GAIN_SWI is set					
IP_FAC_GAIN_P_LAM	V	0... FFFFH	0... 15.999756	244.141e-6	-
LDPM_T_DLY_SOI_LSL_POS_1_LACO	8	0... FFFFH	0... 1.023984	15.625e-6	s
LDPM_T1_LSL_UP_1_LACO	8	0... FFFFH	0... 1.99996948242	30.5176e-6	s
gain of lambda controller P share					
IP_FAC_GAIN_P_LAM_DLY_DIAG	V	0... FFFFH	0... 15.9997558594	244.141e-6	-
LDPM_T_DLY_SOI_LSL_POS_3_LACO	NC_ NR_ FAC_ GAIN_ LAM	0... FFFFH	0... 1.023984375	15.625e-6	s
LDPM_T1_LSL_UP_3_LACO	NC_ NR_ FAC_ GAIN_ LAM	0... FFFFH	0... 1.99996948242	30.5176e-6	s
gain of lambda controller P share in case of delay diagnosis					
IP_FAC_GAIN_P_LAM_DYN_DIAG	V	0... FFFFH	0... 15.9997558594	244.141e-6	-
LDPM_T_DLY_SOI_LSL_POS_3_LACO	NC_ NR_ FAC_ GAIN_ LAM	0... FFFFH	0... 1.023984375	15.625e-6	s

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_T1_LSL_UP_3_LACO	NC_ NR_ FAC_ GAIN_ LAM	0... FFFFH	0... 1.99996948242	30.5176e-6	s
gain of lambda controller P share in case of DYN_DIAG					
IP_FAC_GAIN_P_LAM_GAIN_SWI	V	0... FFFFH	0... 15.999756	244.141e-6	-
LDPM_T_DLY_SOI_LSL_POS_2_LACO	4	0... FFFFH	0... 1.023984	15.625e-6	s
LDPM_T1_LSL_UP_2_LACO	4	0... FFFFH	0... 1.99996948242	30.5176e-6	s
gain of lambda controller P share in case of LV_LAM_GAIN_SWI is set					
IP_FAC_LAM_MAX_NOT_STAT_CDN	-	0... FFFFH	-50... 49.99847412	1.52588e-3	%
LDPM_FAC_LAM_MV_1_LACO	8	0... FFFFH	-50... 49.99847412	1.52588e-3	%
upper limit of lambda controller output under non stationary operating conditions					
IP_FAC_LAM_MIN_NOT_STAT_CDN	-	0... FFFFH	-50... 49.99847412	1.52588e-3	%
LDPM_FAC_LAM_MV_1_LACO	8	0... FFFFH	-50... 49.99847412	1.52588e-3	%
bottom limit of lambda controller output under non stationary operating conditions					
IP_LAMB_SP_THE_PUC	-	0... FFFFH	0... 3.99993896484	61.0352e-6	-
LDP_MAF_INT_PUC_IP_LAMB_SP_THE	4	0... FFFFH	0... 2912.66666667	0.0444444	g
theoretical lambda set point during PUC					
IP_LAMB_SP_THE_S_HOM	-	0... FFFFH	0... 3.99993896484	61.0352e-6	-
LDP_MAF_INT_S_IP_LAMB_SP_THE	4	0... FFFFH	0... 2912.66666667	0.0444444	g
Theoretical lambda set point for switching from S to HOM					
IP_T1_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996948242	30.5176e-6	s
LDPM_N_1_LACO	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_LACO	8	0... FFFFH	0... 1389	0.0211948	mg/stk
first order time lag of the WRAF sensor model					
IP_T1_LSL_UP_L2R [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996948242	30.5176e-6	s
LDPM_N_1_LACO	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_LACO	8	0... FFFFH	0... 1389	0.0211948	mg/stk
first order time lag of the WRAF sensor model - lean to rich					
IP_T1_LSL_UP_L2R_IPT [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996948242	30.5176e-6	s

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_N_1_LACO	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_LACO	8	0... FFFFH	0... 1389	0.0211948	mg/stk
first order time lag of the WRAF sensor model - lean to rich, Interpolated value					
IP_T1_LSL_UP_R2L [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996948242	30.5176e-6	s
LDPM_N_1_LACO	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_LACO	8	0... FFFFH	0... 1389	0.0211948	mg/stk
first order time lag of the WRAF sensor model - rich to lean					
IP_T1_LSL_UP_R2L_IPT [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996948242	30.5176e-6	s
LDPM_N_1_LACO	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_LACO	8	0... FFFFH	0... 1389	0.0211948	mg/stk
first order time lag of the WRAF sensor model - rich to lean, Interpolated value					
LC_LAM_I2_ACT	-	0... 1H	0 ...1	1	-
calibration flag to switch between PII <sup>2</sup> D and PID lambda controller					
LC_SENS_MDL_AGI_T1_ACT	-	0... 1H	0 ...1	1	-
switch to consider sensor ageing in lambda controller plant model by additional T1 (=1) or T2 (=0) time					

### General information:

By means of a Pad approximation the delayed lambda set point LAMB\_SP\_FIL\_HOM[j] (for homogeneous mode) and LAMB\_SP\_FIL\_S[j] (for stratified mode) is calculated. All other variables which are output of these sub-systems are only necessary to realize the functionality with the desired accuracy. The behavior of the delay is described by an all-pass filter (Pad approximation of 2nd order). Its principle is shown here below.

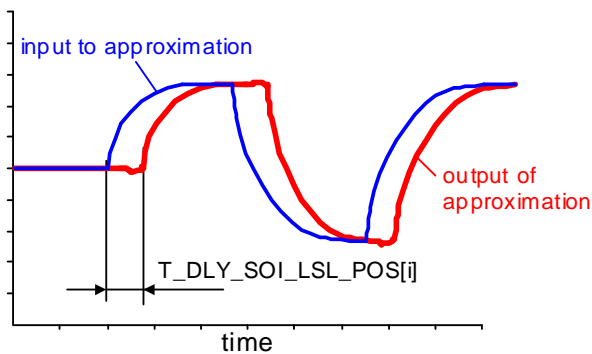



Figure 7.59.1: :

Gas delay approximation (2nd order Pad approximation)

The following formula describes the Pad approximation in its mathematical representation:

$$f_1 = \frac{T\_DLY\_SOI\_LSL\_POS[j]}{T\_SAMPLE}$$

Figure 7.59.2: :


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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 2472 of 8404	
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$$f_2 = \frac{f_1^2}{3},$$

Figure 7.59.3: :

Signal flow diagram:

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 2473 of 8404</b>	
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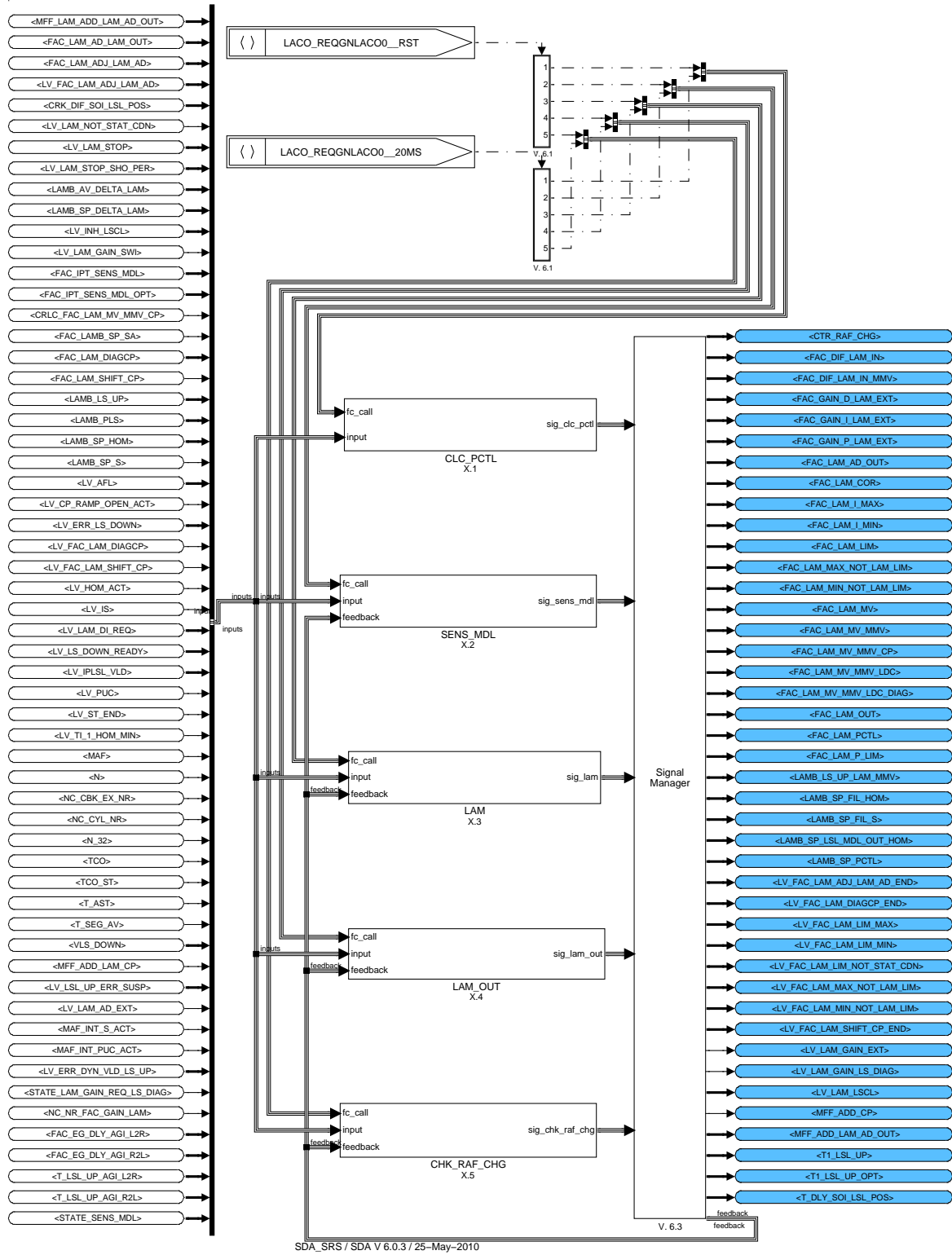


Figure 7.59.4: :

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## 7.59.1 LACO\_REQGNLACO0/SENS\_MDL/OPERATE/CBK\_EX\_MNG/CBK\_EX\_SPC/SUBSYSTEM

### General information:

### Application conditions:

*Initialisation:* RST  
*Recurrence:* 20MS  
*Activation:* LV\_ST\_END == 1  
*Deactivation:* LV\_ST\_END == 0

### Function description:

### Formula section:

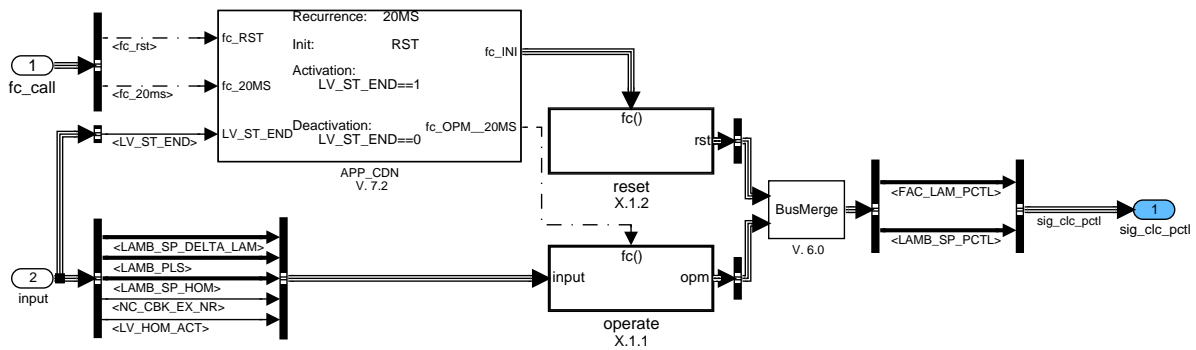


Figure 7.59.5: :

### 7.59.1.1 For loop

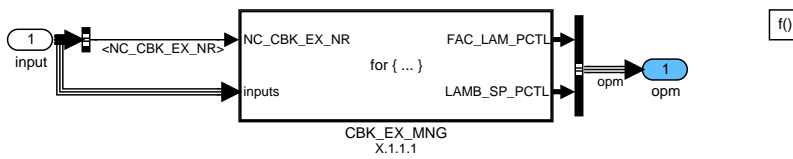


Figure 7.59.6: :

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**Application conditions:**

Initialisation: RST  
 Recurrence: 20MS  
 Activation: LV\_ST\_END == 1  
 Deactivation: LV\_ST\_END == 0

**Function description:**

**Formula section:**

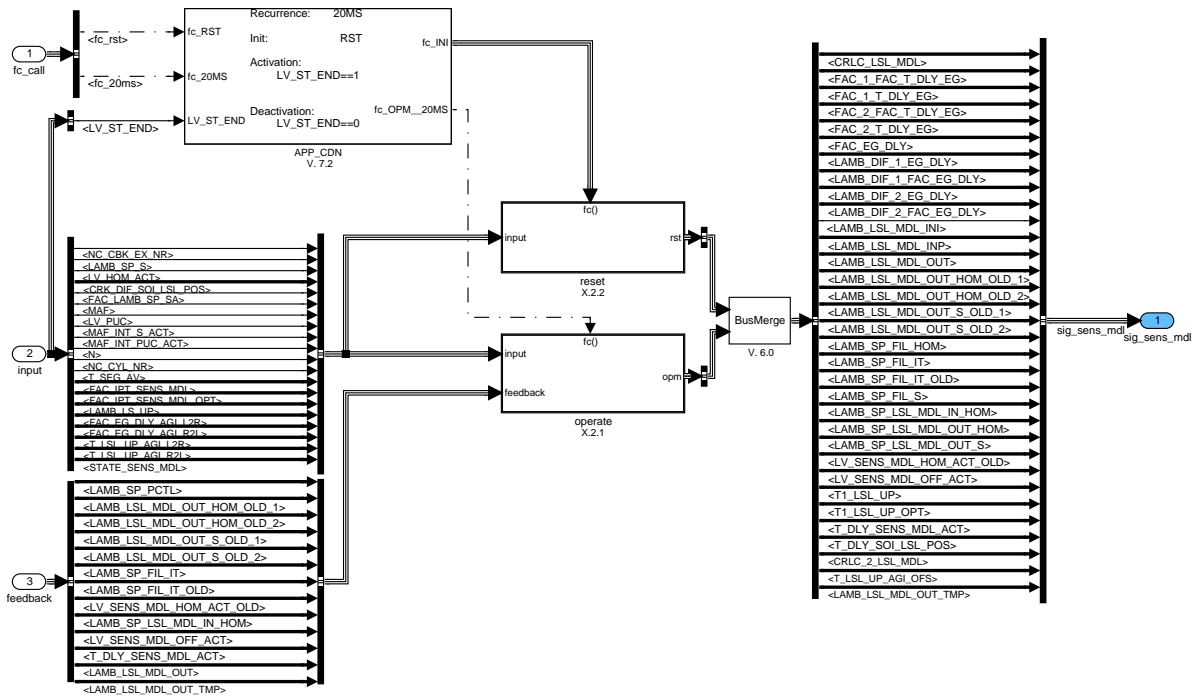


Figure 7.59.10: :

**7.59.2.1 For loop**

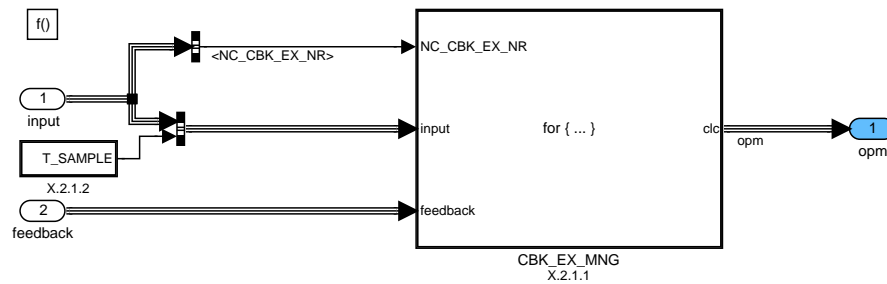


Figure 7.59.11: :

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7.59.2.1.1 for loop (i = 0 to NC\_CBK\_EX\_NR)

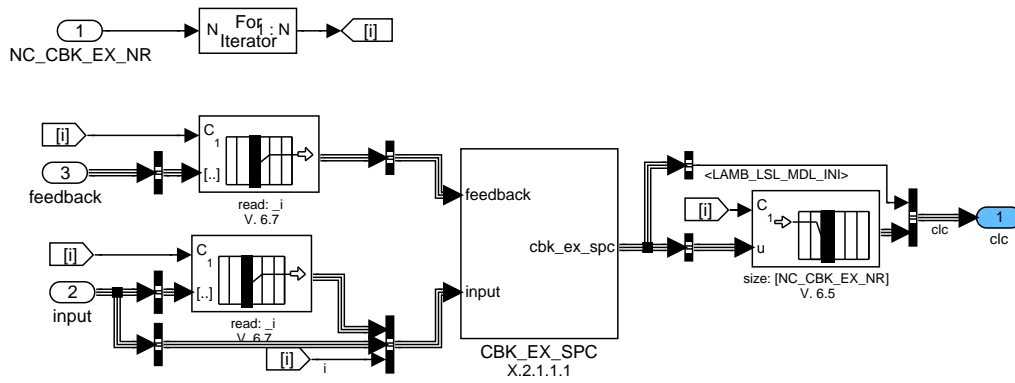



Figure 7.59.12: :

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 2478 of 8404</b>	
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### 7.59.2.1.1.1 Determination of Lambda set point

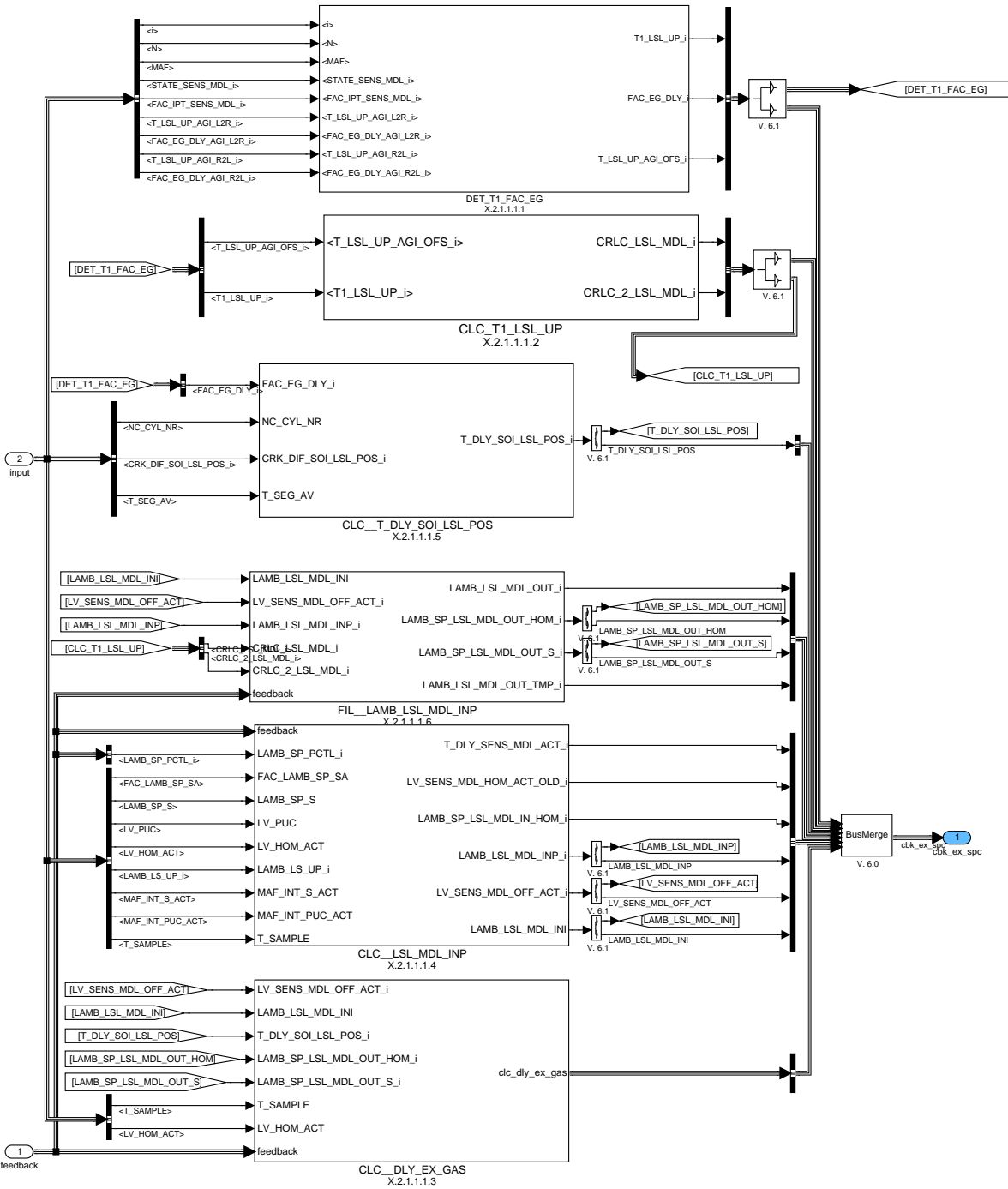


Figure 7.59.13: :

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7.59.2.1.1.1.1 Depending on STATE\_SENS\_MDL[i] different plant-models are selected

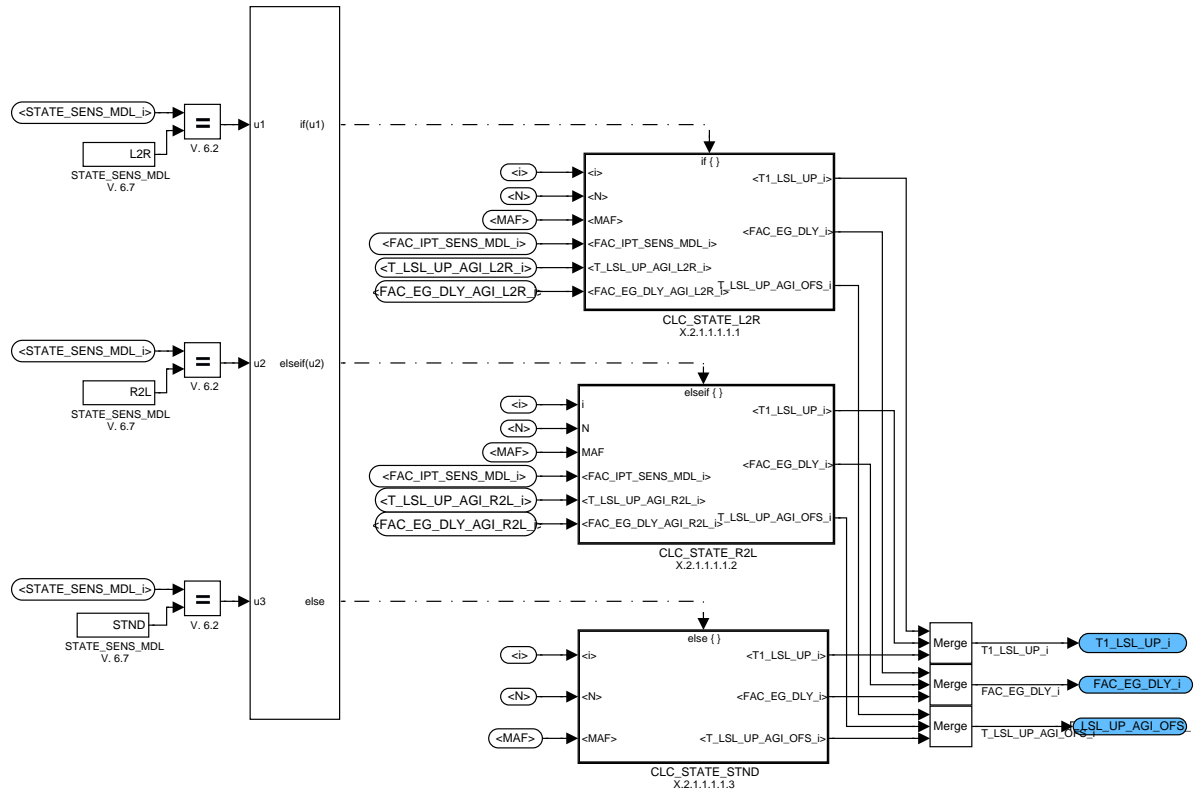


Figure 7.59.14: :

7.59.2.1.1.1.1.1 Calculation when STATE\_SENS\_MDL[i] = L2R

Lean to rich model is active

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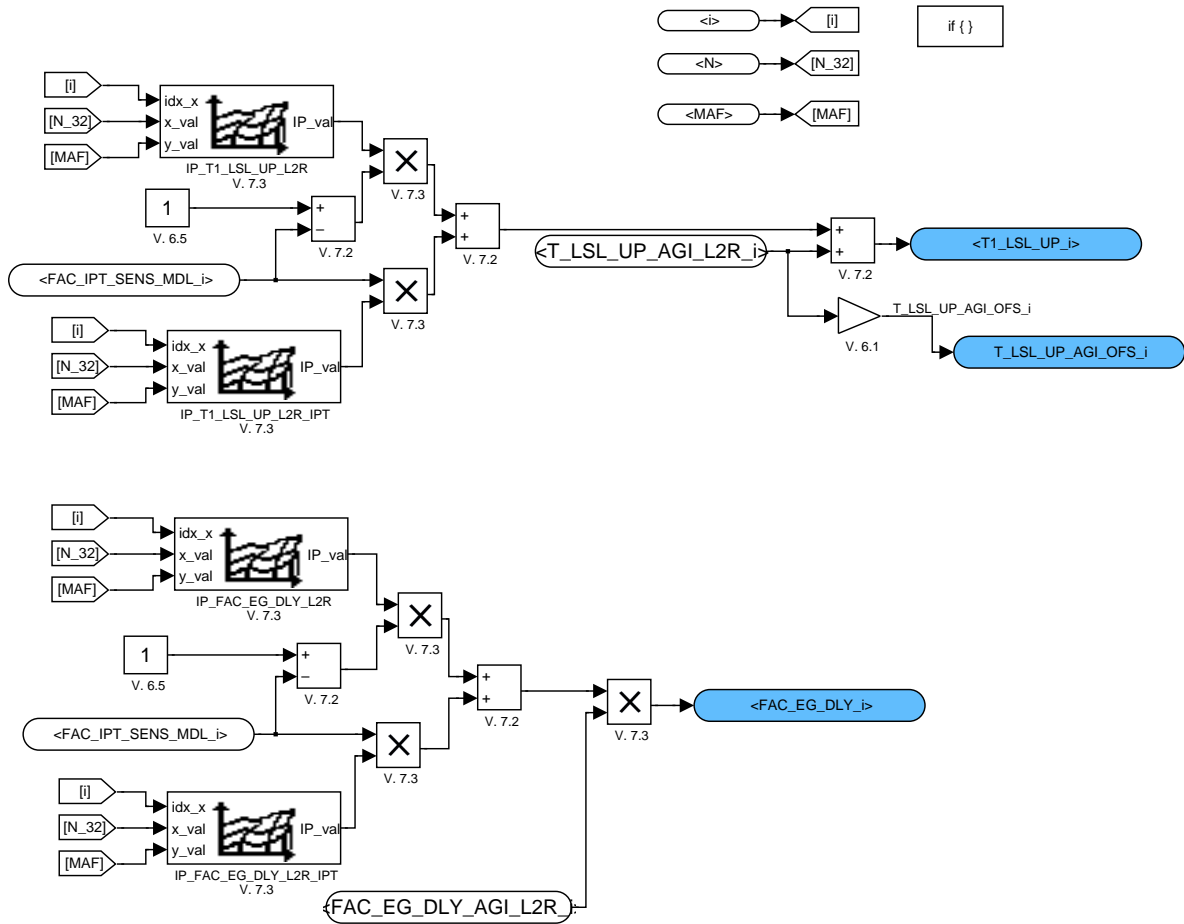


Figure 7.59.15: :

7.59.2.1.1.1.2 Calculation when STATE\_SENS\_MDL[i] = R2L

Rich to lean model is active

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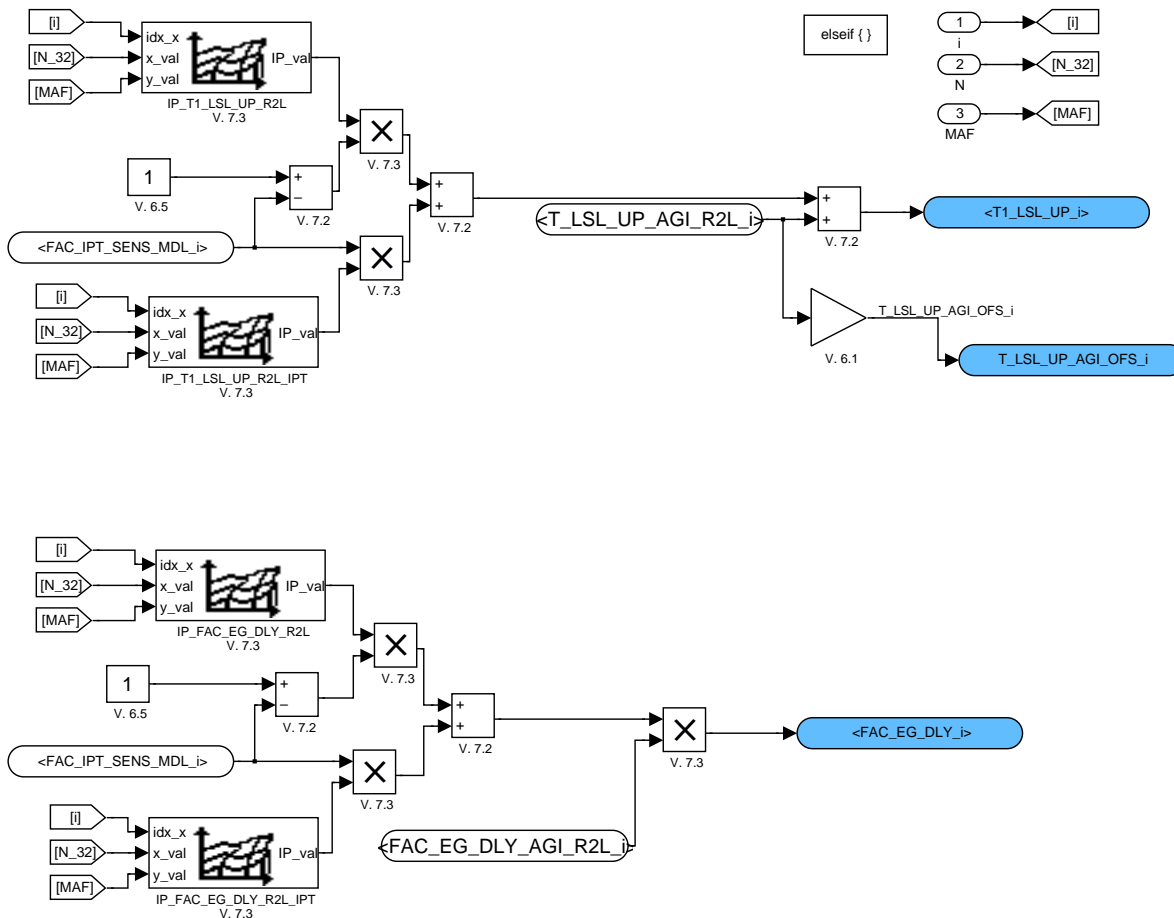


Figure 7.59.16: :

7.59.2.1.1.1.3 Calculation when STATE\_SENS\_MDL[i] = STND

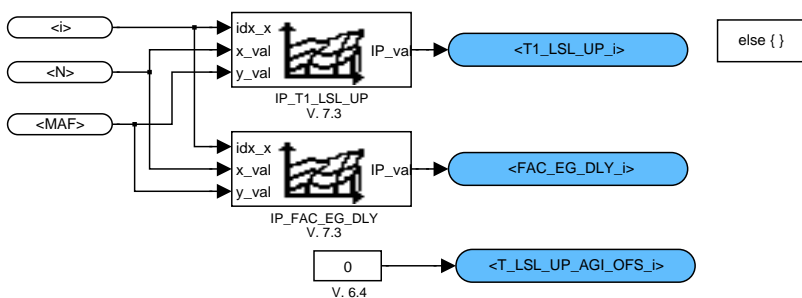


Figure 7.59.17: :

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**7.59.2.1.1.1.2 Calculation of Correlation constant for aged lambda sensor model with PT2 behaviour**

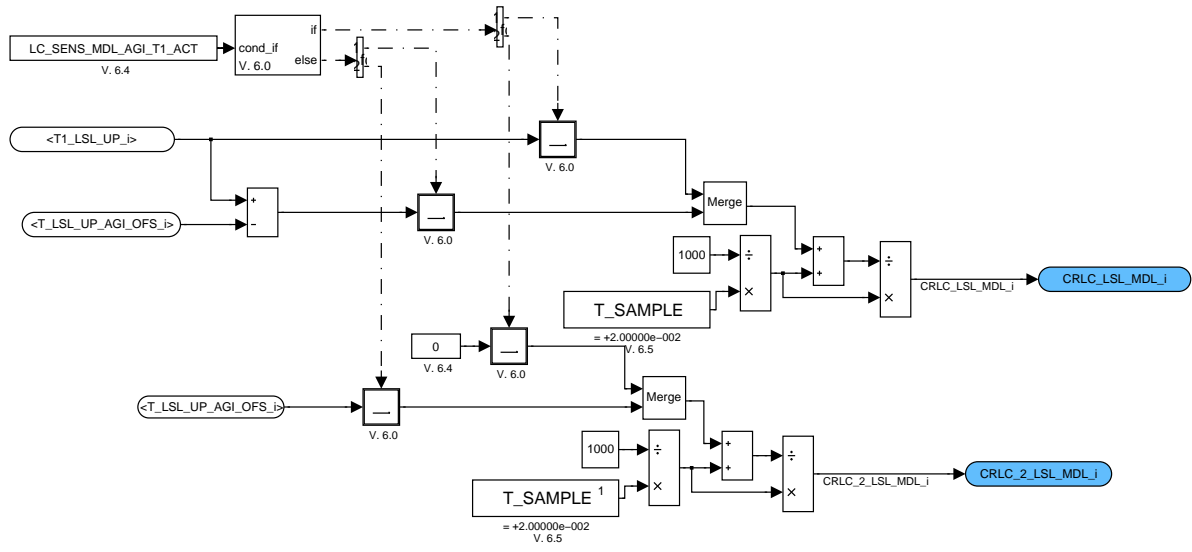


Figure 7.59.18: :

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7.59.2.1.1.1.3 internal factor of Pade filter calculation

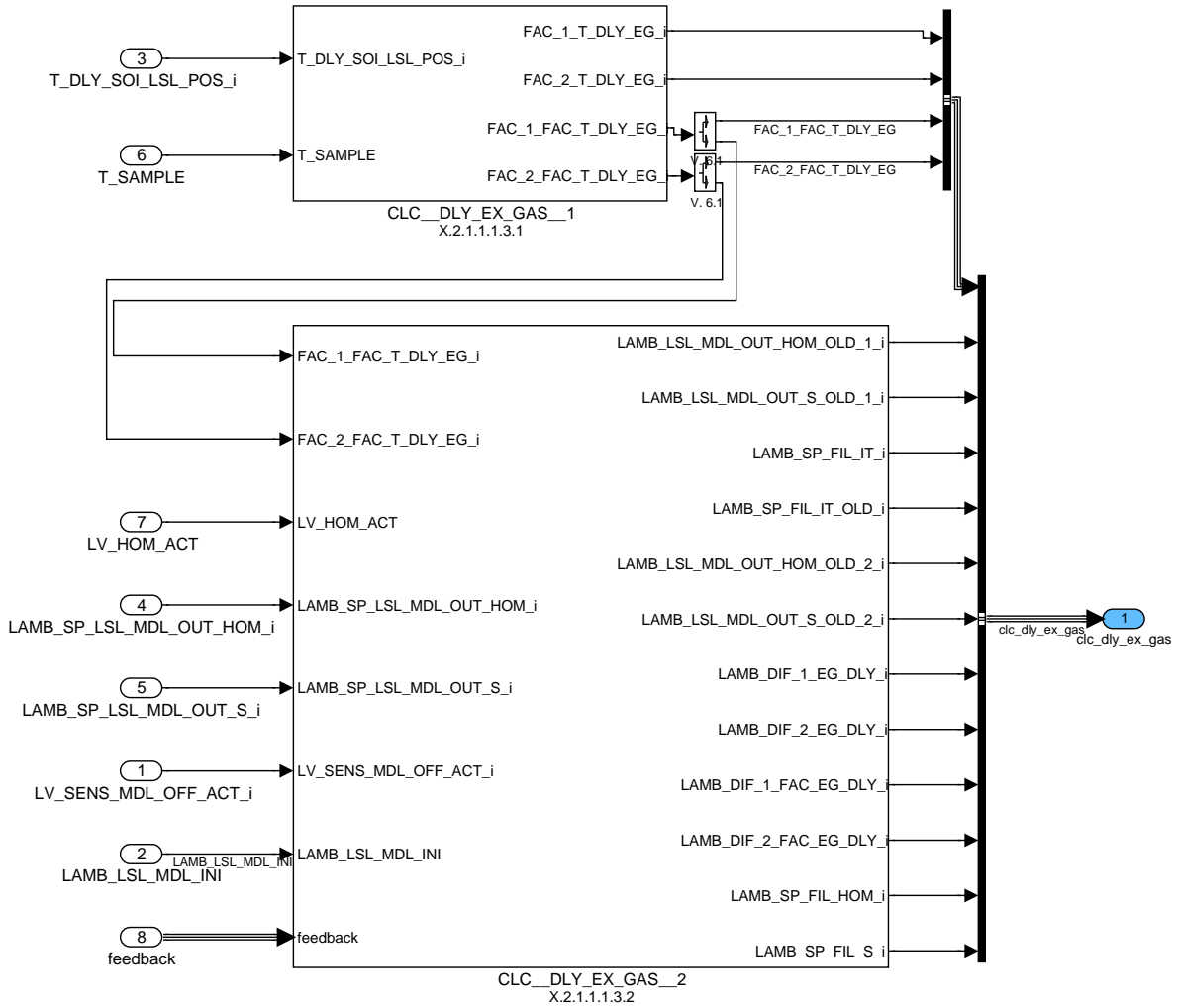


Figure 7.59.19: :

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7.59.2.1.1.1.3.1 internal factor of Pade filter calculation

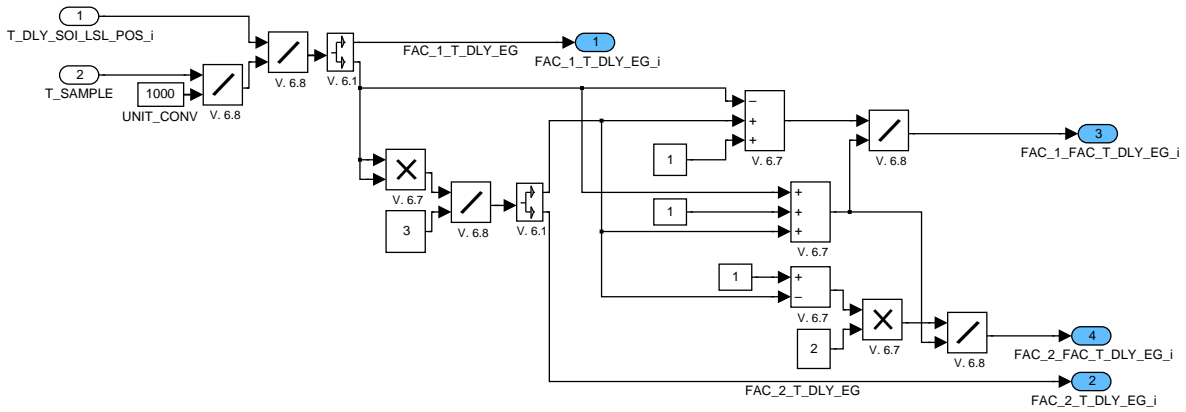


Figure 7.59.20: :

7.59.2.1.1.1.3.2 Pad approximation (part 2)

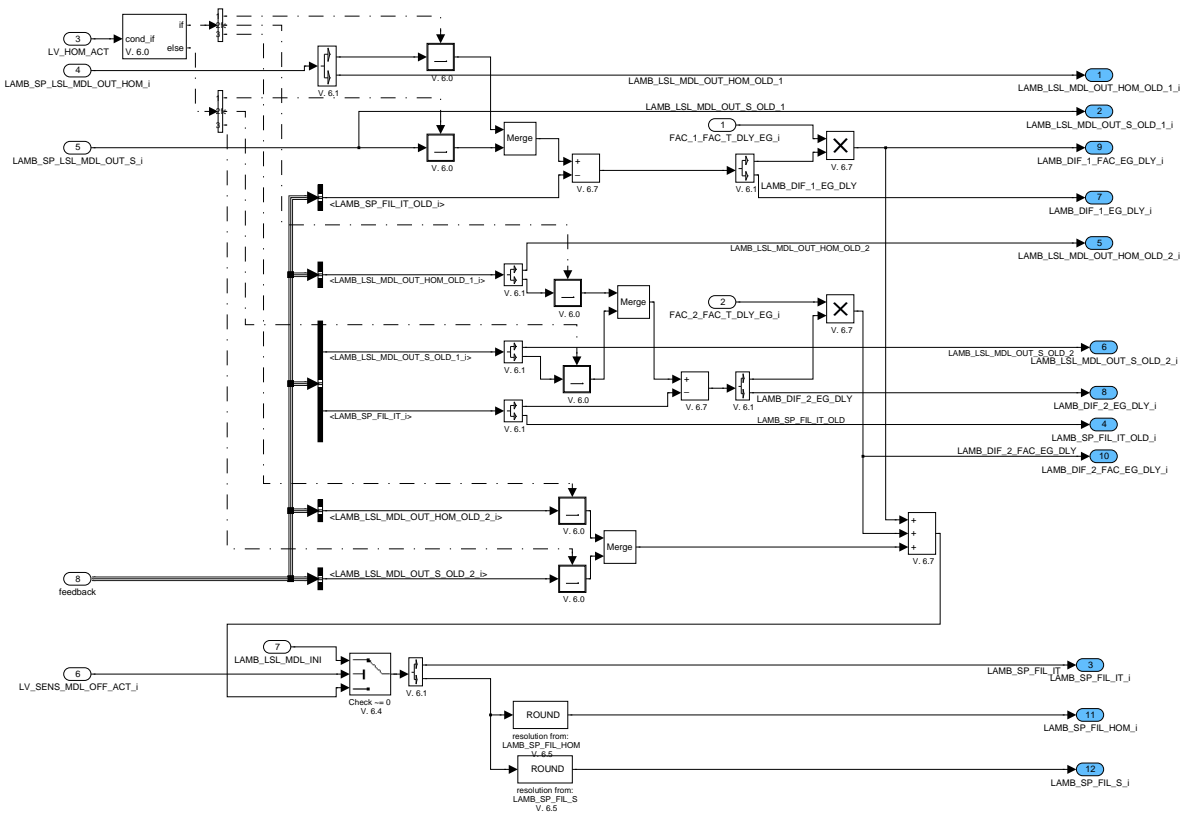


Figure 7.59.21: :

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7.59.2.1.1.4 Lambda set point as model input (LAMB\_SP\_LSL\_MDL\_IN\_HOM[i])

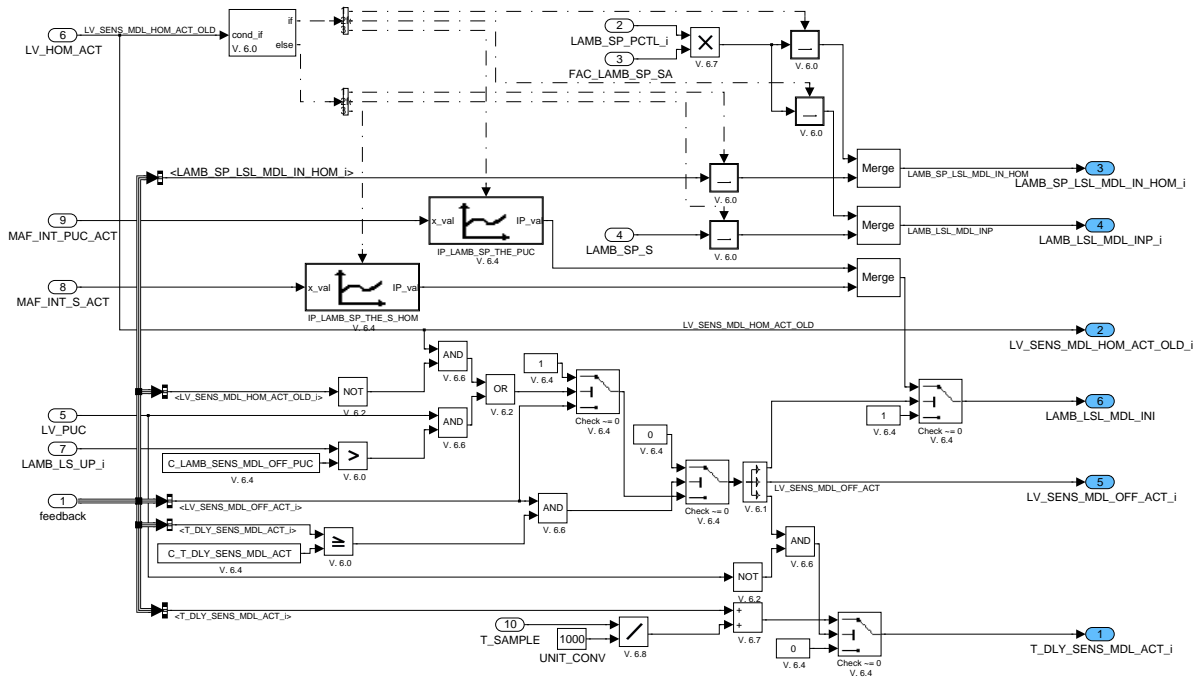


Figure 7.59.22: :

7.59.2.1.1.1.5 Calculation of gas delay time (T\_DLY\_SOI\_LSL\_POS[i])

The gas delay  $T\_DLY\_SOI\_LSL\_POS[i]$  corresponds to the time from fuel injection up to the measurement of the air fuel ratio by the WRAF sensor.  $FAC\_EG\_DLY[i]$  is a tuning factor for the sensor position and is determined together with the T1 maps by means of a system identification. The gas delay is calculated with the following formula:

$$T\_DLY\_SOI\_LSL\_POS[i] = \left[ \frac{CRK\_DF\_SOI\_LSL\_POS[i]}{180 \cdot CRK} \cdot \frac{NC\_CYL\_NR}{4} + FAC\_EG\_DLY[i] \right] \cdot T\_SEG\_AV.$$

Figure 7.59.23: :

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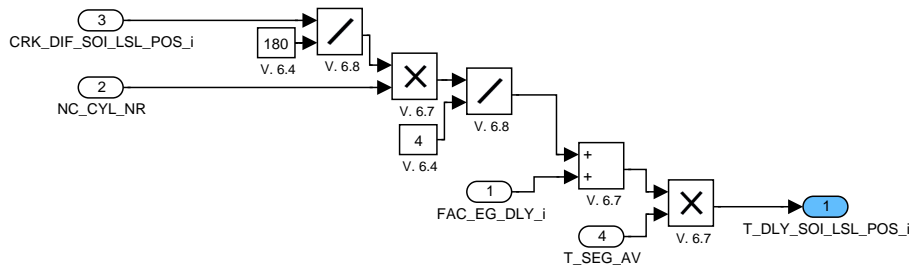


Figure 7.59.24: :

7.59.2.1.1.1.6 Filtering of lambda set point model input (LAMB\_SP\_LSL\_MDL\_OUT\_HOM/S[i])

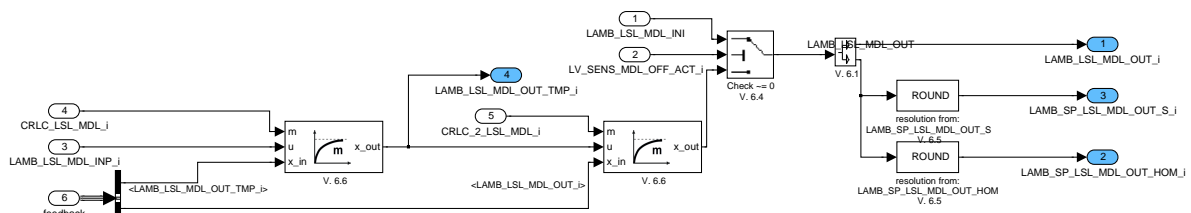
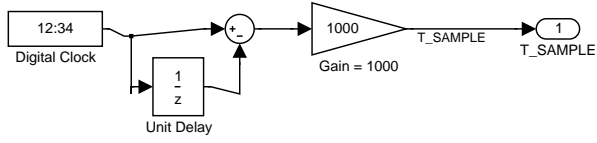


Figure 7.59.25: :

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7.59.2.1.2 No title given



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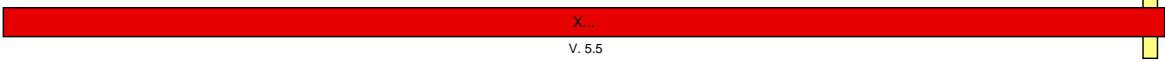



Figure 7.59.26: :

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### 7.59.2.2 Initialisation

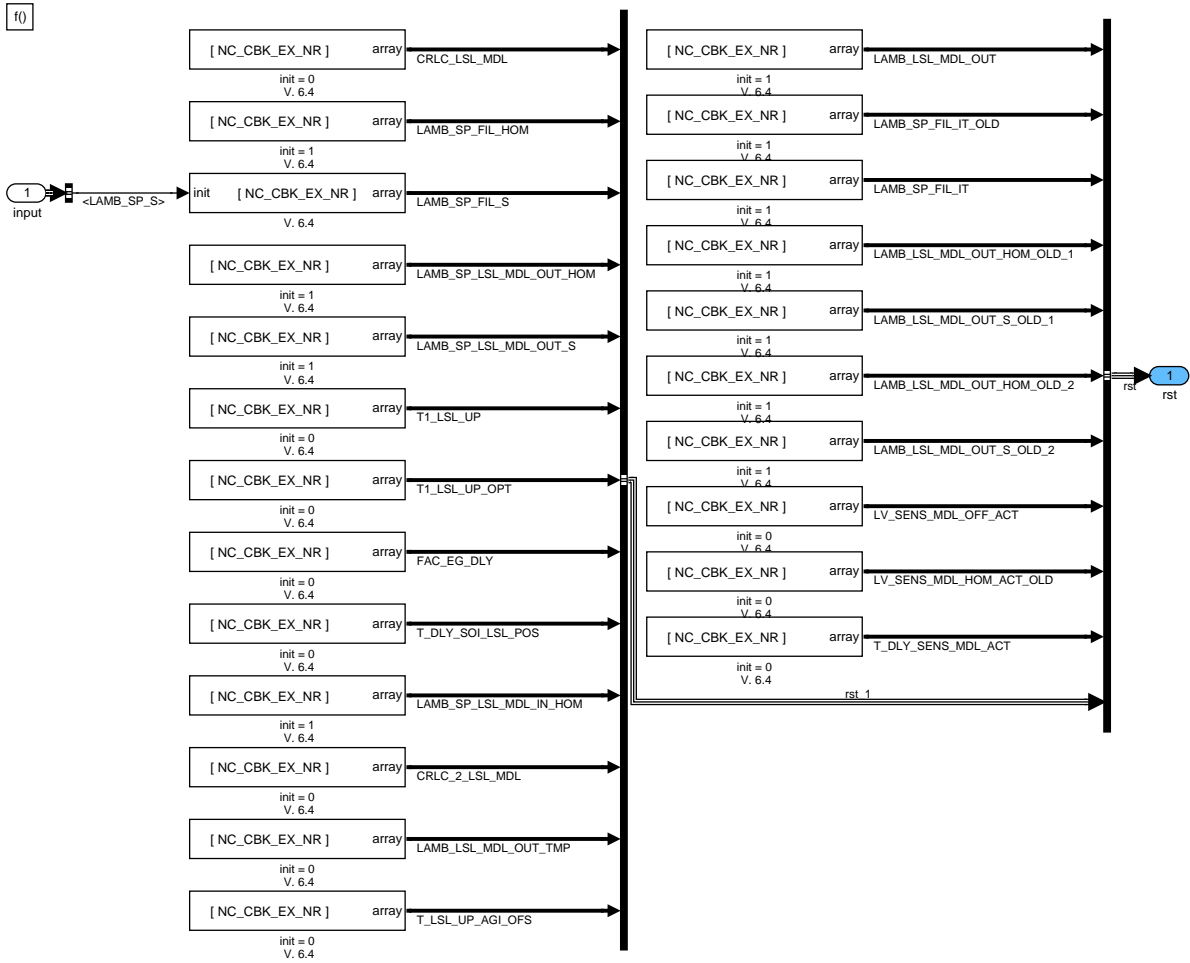


Figure 7.59.27: :

### 7.59.3 Linear lambda controller

**General information:**


**Application conditions:**

*Initialisation:* RST  
*Recurrence:* 20MS  
*Activation:* LV\_ST\_END == 1  
*Deactivation:* LV\_ST\_END == 0

**Function description:**

**Formula section:**

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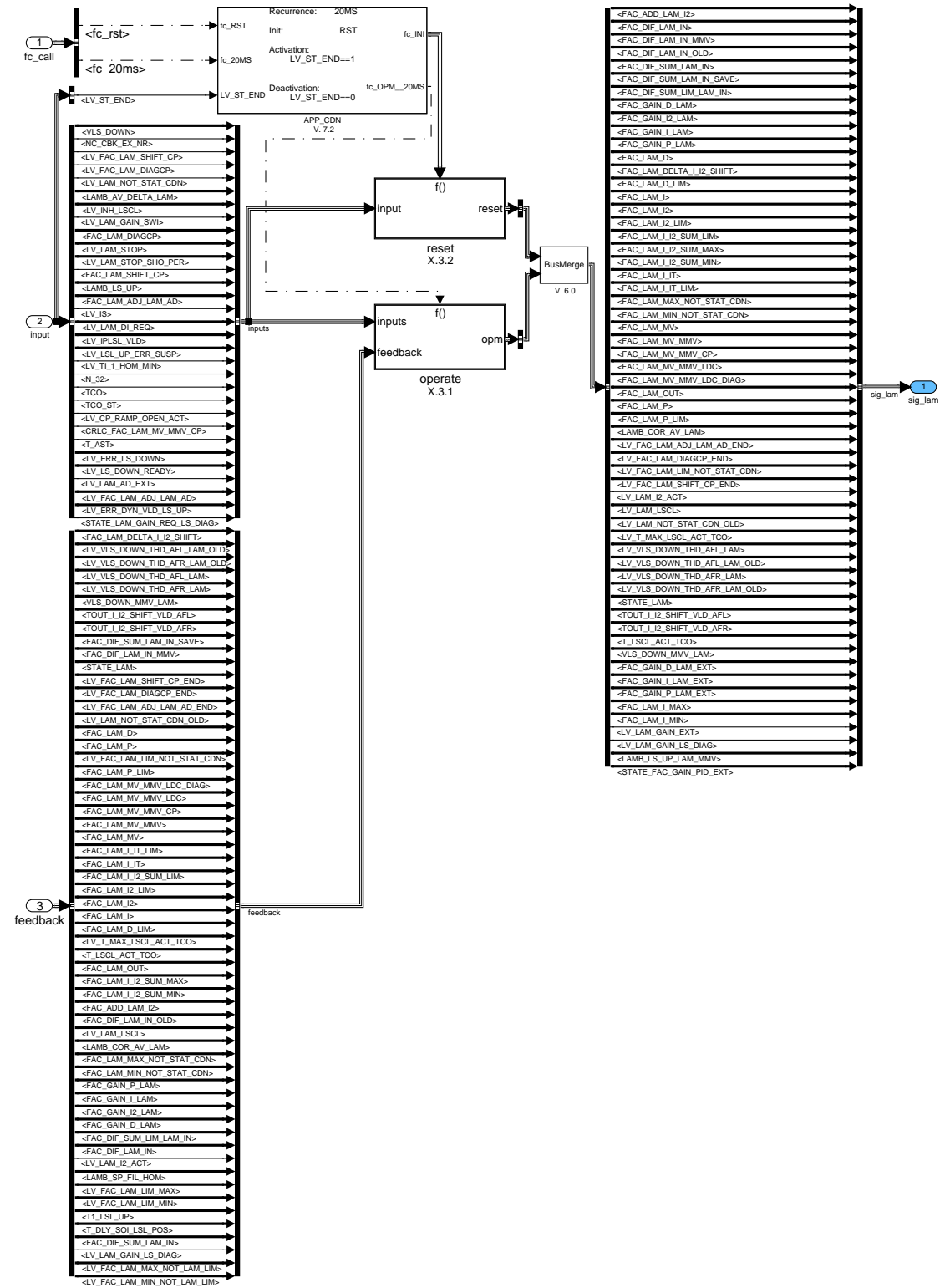


Figure 7.59.28: :

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### 7.59.3.1 Operation at 20ms

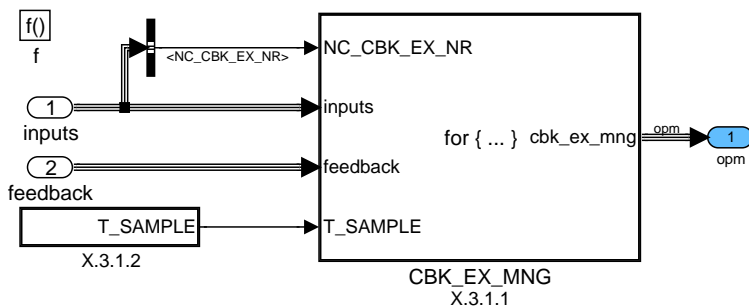


Figure 7.59.29: :

#### 7.59.3.1.1 for loop (i= 1 to NC\_CBK\_EX\_NR)

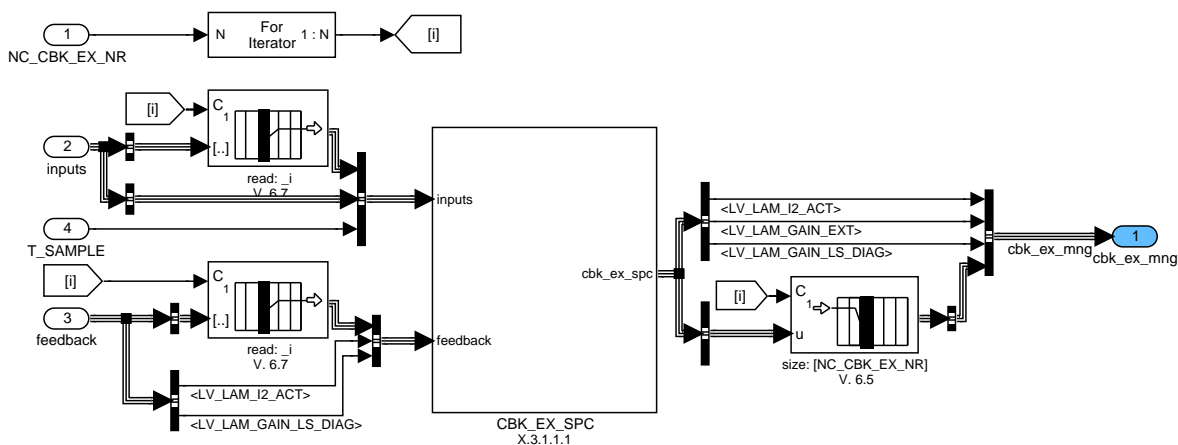


Figure 7.59.30: :

#### 7.59.3.1.1.1 Activation and state machine

The sub-system ACT\_LAM describes the activation of the lambda controller.

State machine of lambda controller:

If LV\_LAM\_LSCL[i] is 0 then state "0:OFF" is applied. Otherwise then three different states are to distinguish.

State "1:ON" is applied when the controller is not stopped by the flag LV\_LAM\_STOP[i]. In that case the controller is in normal operation mode.

If LV\_LAM\_STOP[i] is set to 1 either state "2:STOP\_SHO\_PER" or state "3:STOP" is applied depending on LV\_LAM\_STOP\_SHO\_PER[i].

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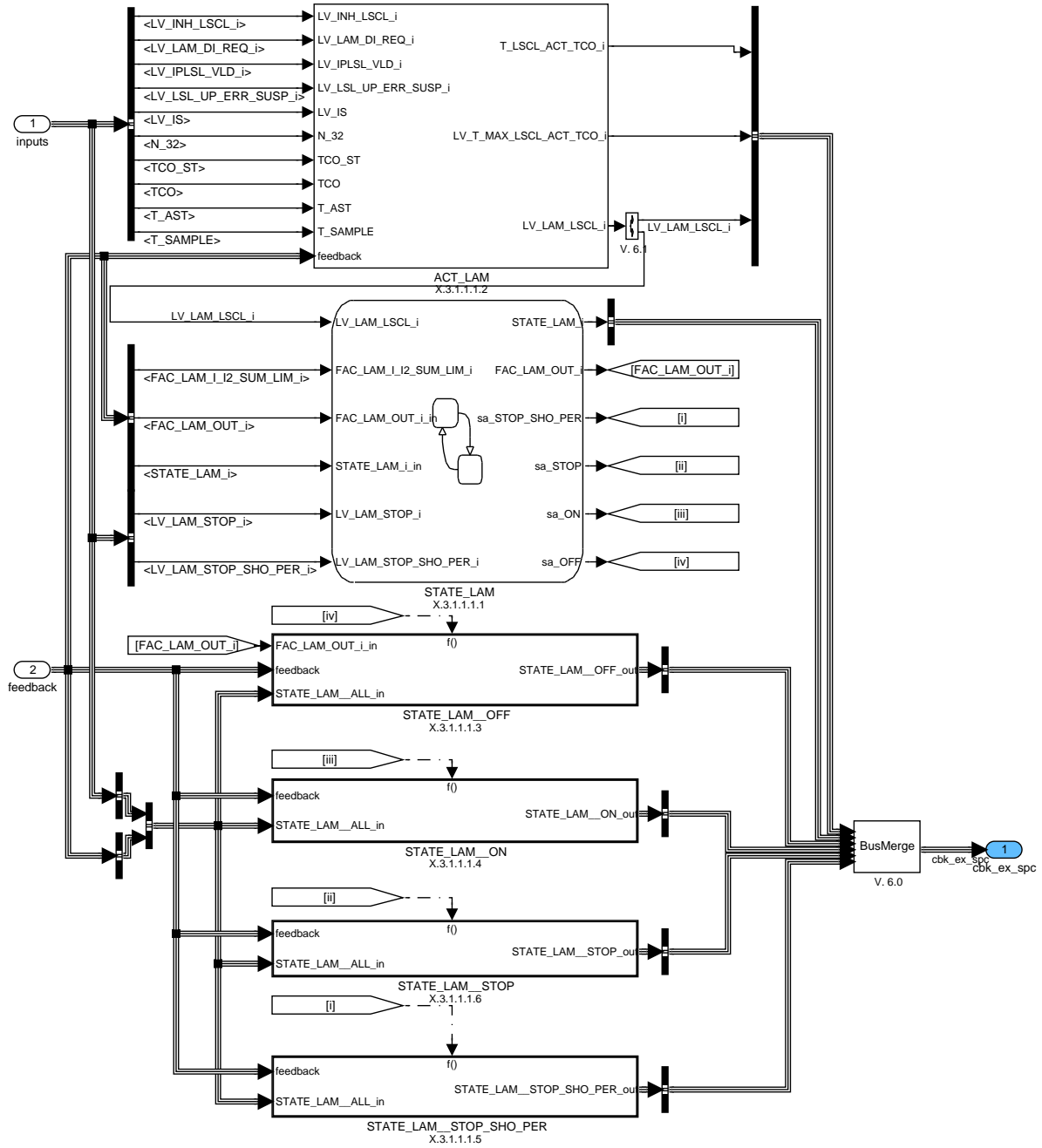


Figure 7.59.31: :

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### 7.59.3.1.1.1.1 STATE\_LAM

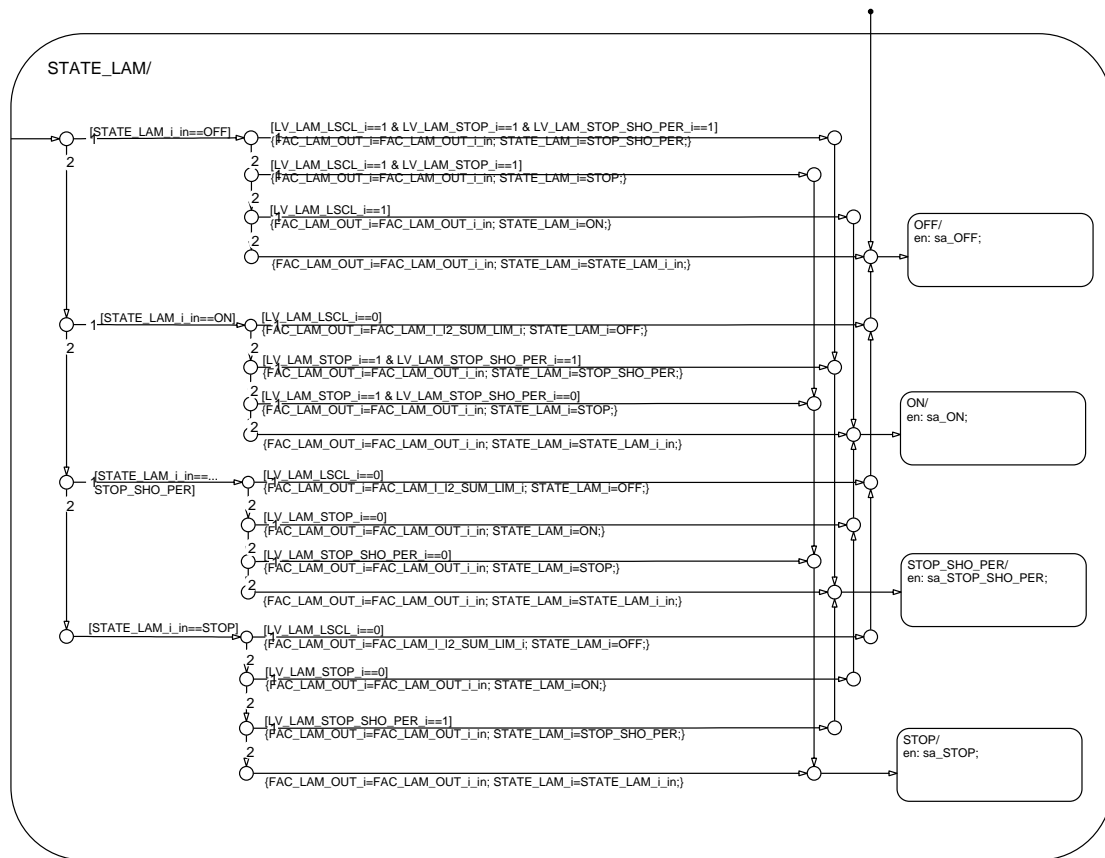


Figure 7.59.32: :

#### 7.59.3.1.1.1.2 Controller activation /deactivation

Independent of the lambda controller state (STATE\_LAM[i]) the evaluation of controller activation / deactivation is calculated.

The controller is activated by the flag LV\_LAM\_LSCL[i] = 1. This flag is set if the following conditions are fulfilled:

- inhibit flag not set (LV\_INH\_LSCL[i] = 0)
- no request from OBD function to inhibit lambda controller (LV\_LAM\_DI\_REQ[i] = 0)
- WRAF sensor operability recognised (LV\_LS\_UP\_READY[i] = 1)
- engine speed above threshold ( $N_{32} > C_{N\_MIN\_LAM\_LSCL}$ )
- time after start threshold expired ( $T_{AST} > ID_{T\_AST\_MIN\_LSCL\_ACT}$ )
- coolant temperature exceeds threshold

(in idle speed  $TCO > ID_{TCO\_MIN\_LAM\_LSCL\_IS}$

otherwise  $TCO > ID_{TCO\_MIN\_LAM\_LSCL}$ )

or the time  $ID_{T\_MAX\_LSCL\_ACT\_TCO}$  is expired

LV\_T\_MAX\_LSCL\_ACT\_TCO[i] is permanently set to 1 if the controller was activated by the time condition instead of activation by the corresponding TCO condition. Otherwise LV\_T\_MAX\_LSCL\_ACT\_TCO[i] is set to 0. If one of the conditions above is not fulfilled the flag LV\_LAM\_LSCL[i] is set to 0 and the controller is not activated.

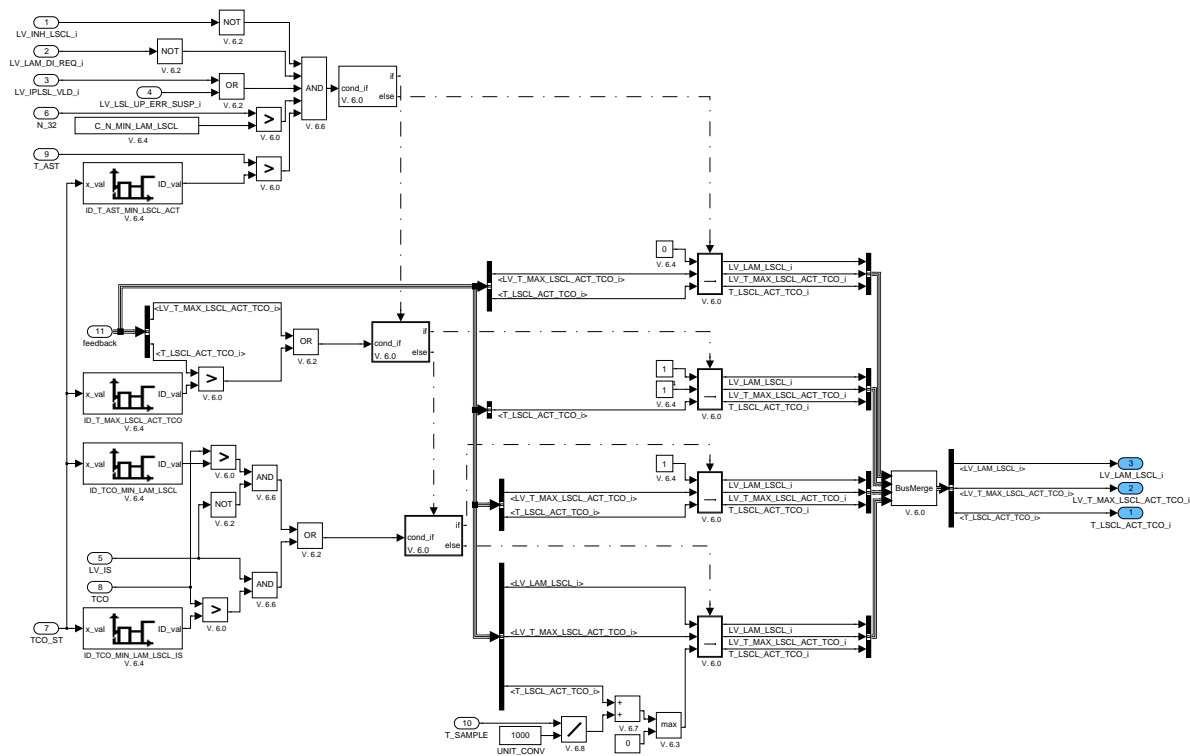


Figure 7.59.33: :

### 7.59.3.1.1.1.3 STATE\_LAM: "0:OFF"

In state "0:OFF" this calibration flag `LC_LAM_I2_ACT` is copied in the variable `LV_LAM_I2_ACT` that means a switch between PID and PII2D controller can only be applied in this state.

The reset of internal state variables and output values (Sub-System: `RST_IT_STATE_VALUE_OUT_VALUE_CBK_SPC`) is carried out.

`FAC_LAM_OUT[i]` is set to the current offset ( $1 + I2$  share) when entering this state and then ramped down to zero (`RAMP_DOWN_FAC_LAM_OUT`).

The controller difference `FAC_DIF_LAM_IN[i]` is calculated (Sub-System: `CLC_FAC_DIF_LAM`) as difference of the inverted lambda set point ( $LAMB\_SP\_FIL\_HOM[i]-1$ ) and the inverted measured lambda signal corrected by the trim control influence ( $LAMB\_LS\_UP[i] + LAMB\_AV\_DELTA\_LAM[i]-1$ ). Therefore `FAC_DIF_LAM_IN[i]` represents a richness. `LAMB_AV_DELTA_LAM[i]` is assigned in the application incidences. A moving mean value of the controller difference (`FAC_DIF_LAM_IN_MMV[i]`) is calculated in order to realise a shift of  $I$  and  $I2$  share based on downstream signal evaluation.

A moving mean value of the downstream sensor signal voltage (`VLS_DOWN_LAM_MMV[i]`) is calculated (Sub-System: `DET_VLS_DOWN_AFL_AFR`). Based on this moving mean value a too lean (100% O<sub>2</sub> loading of the catalyst) or too rich (0% O<sub>2</sub> loading of the catalyst) mixture is detected. The respective flags `LV_VLS_DOWN_THD_AFL_LAM[i]` or `LV_VLS_DOWN_THD_AFR_LAM[i]` is set to 1.

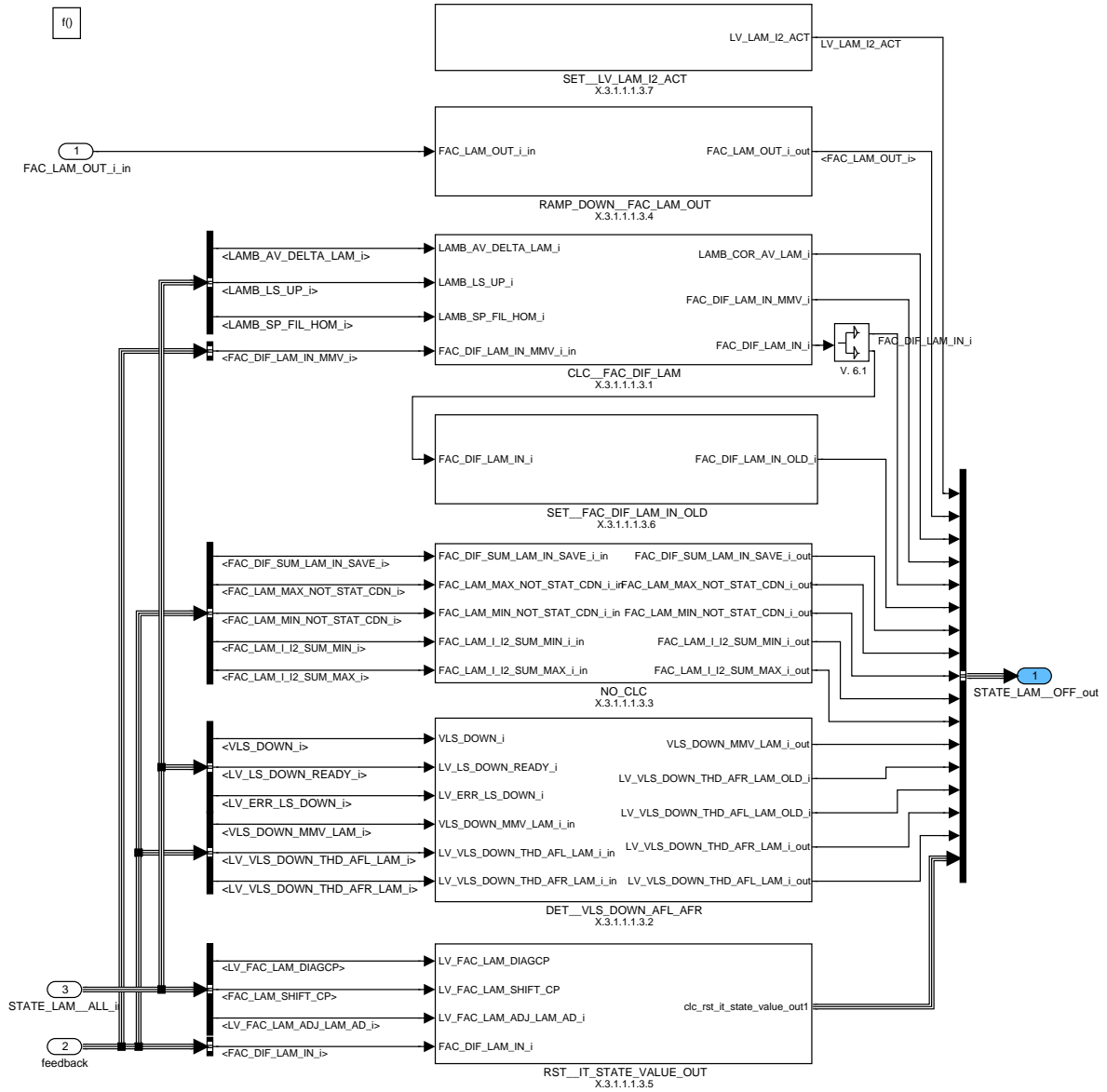


Figure 7.59.34: :

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7.59.3.1.1.1.3.1 Calculation of controller difference (as richness)

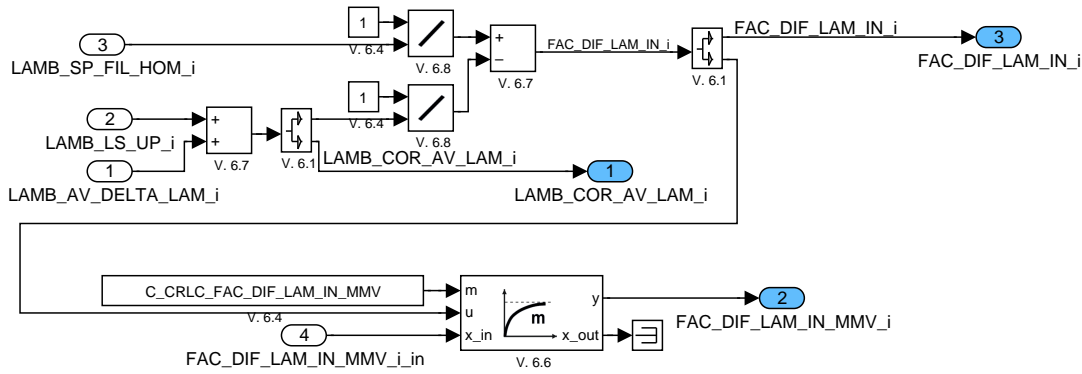


Figure 7.59.35: :

7.59.3.1.1.1.3.2 Evaluation of downstream sensor voltage

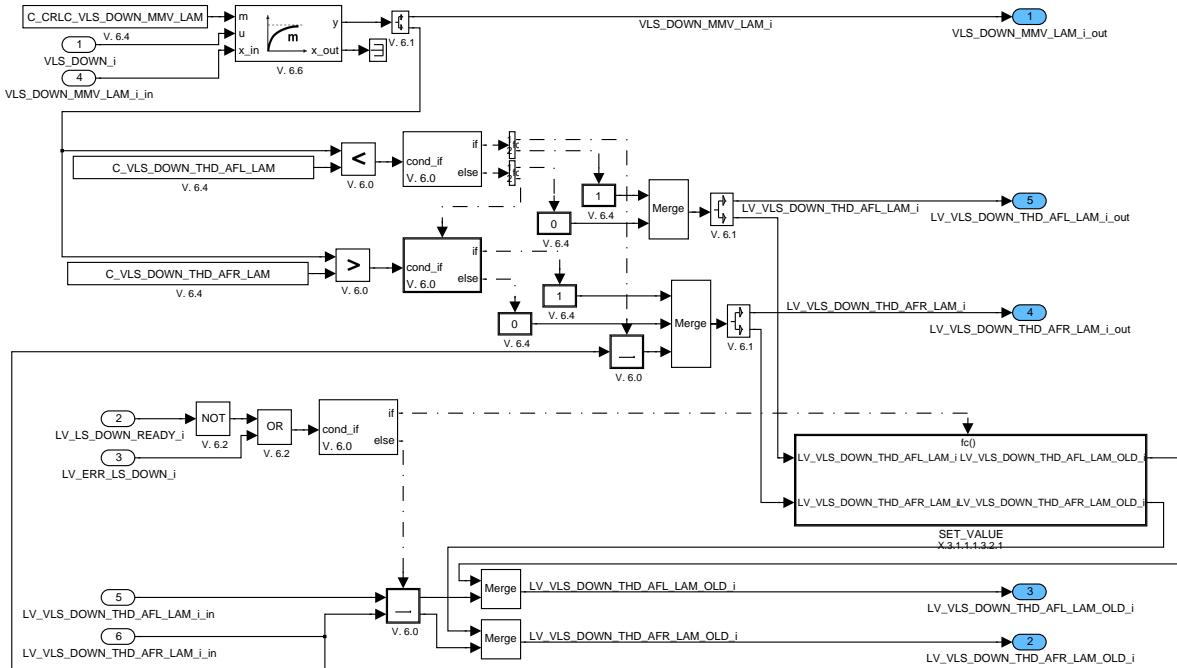


Figure 7.59.36: :

7.59.3.1.1.1.3.2.1 Calculation of old value

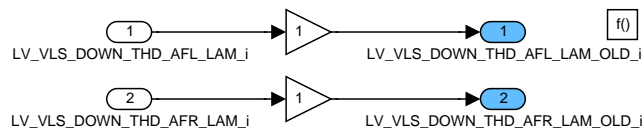


Figure 7.59.37: :

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7.59.3.1.1.1.3.3 feedthrough

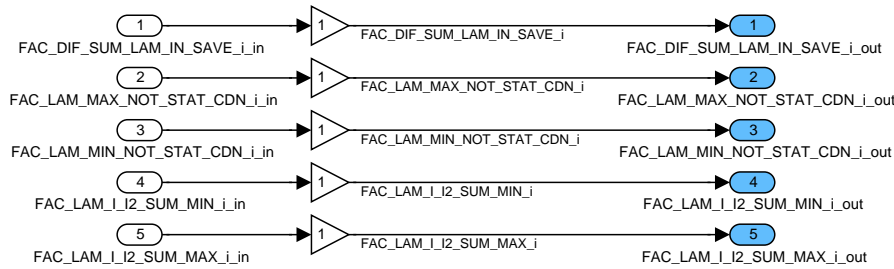


Figure 7.59.38: :

7.59.3.1.1.1.3.4 Ramping down of output signal

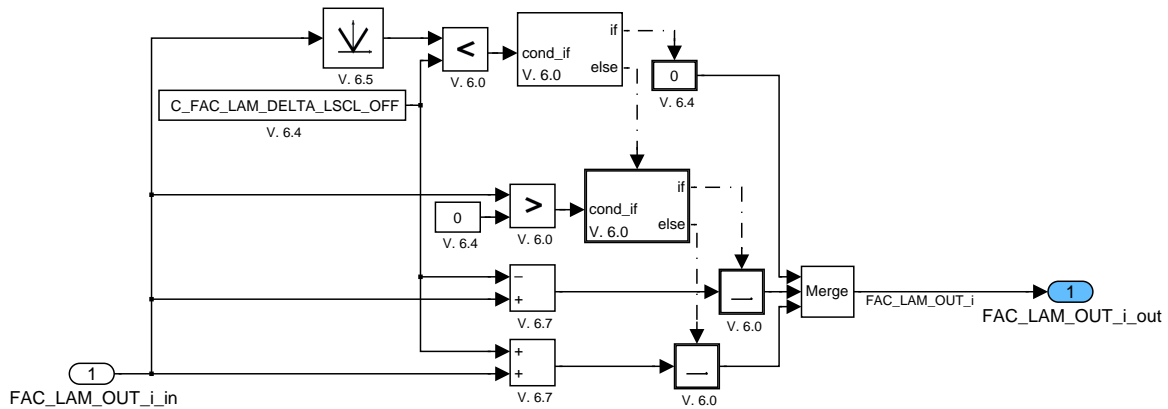


Figure 7.59.39: :

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### 7.59.3.1.1.3.5 Reset of internal state variables and output values

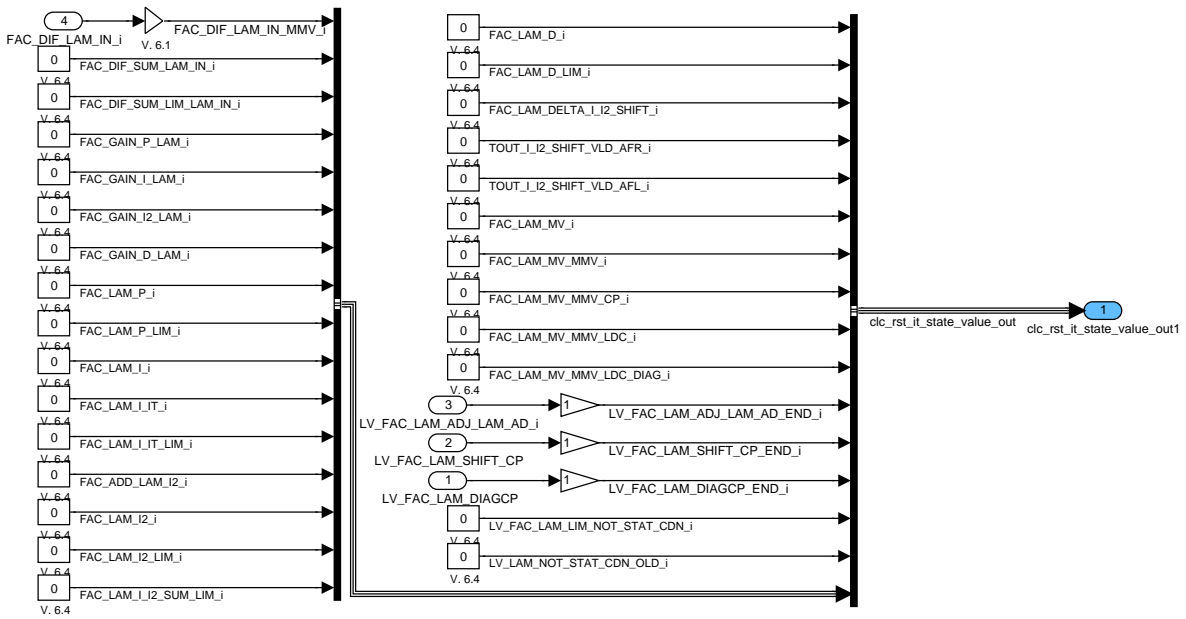


Figure 7.59.40: :

### 7.59.3.1.1.3.6 Calculation of old value

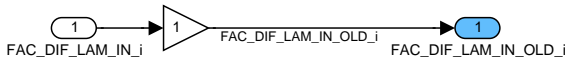


Figure 7.59.41: :

### 7.59.3.1.1.3.7 switch between PII^2D and PID lambda controller

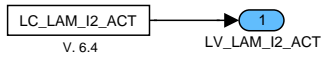


Figure 7.59.42: :

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### 7.59.3.1.1.4 Calculation of lambda controller output

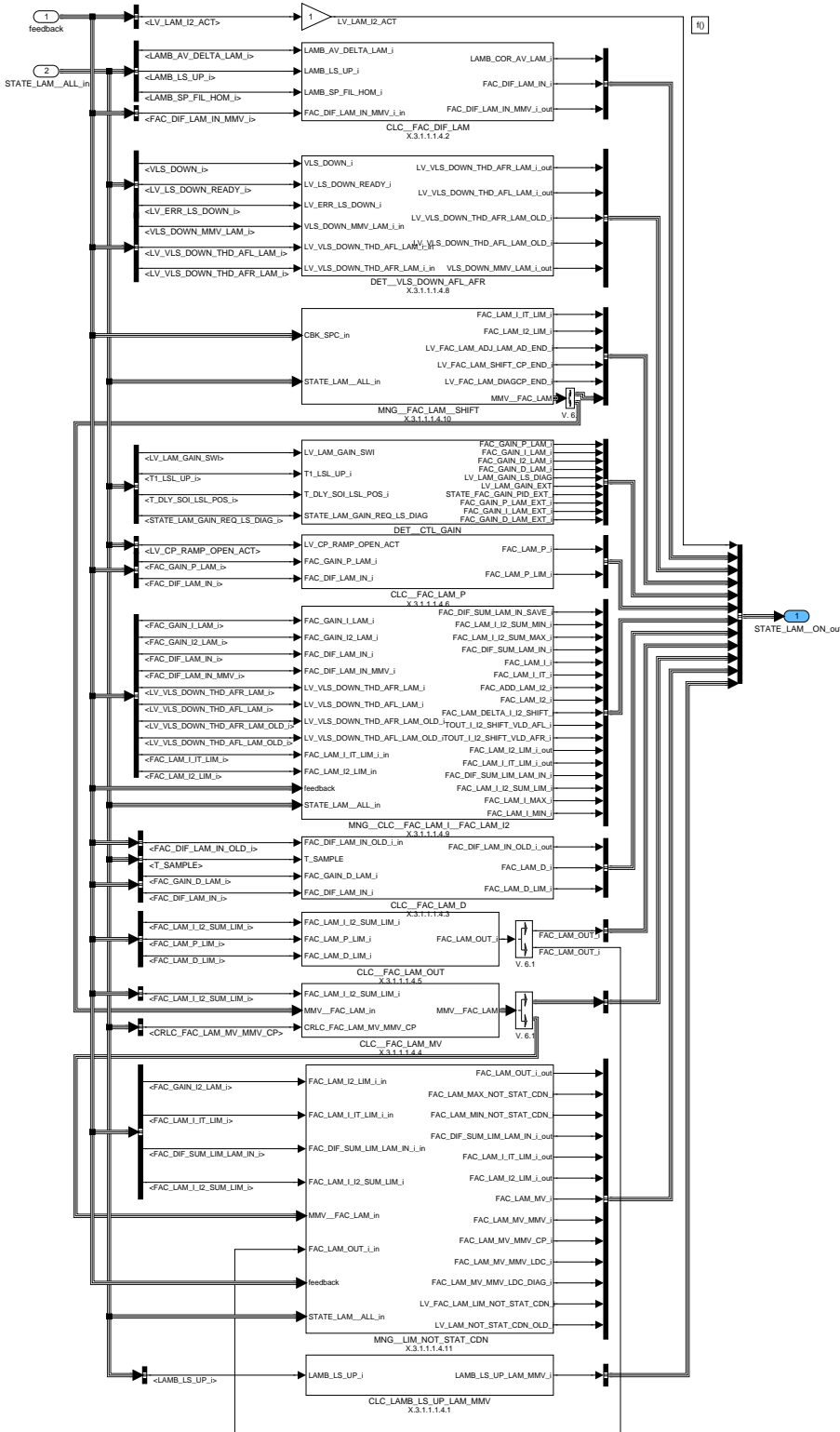


Figure 7.59.43: :

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### 7.59.3.1.1.4.1 Assignment of LAMB\_LS\_UP to LAMB\_LS\_UP\_LAM\_MMV

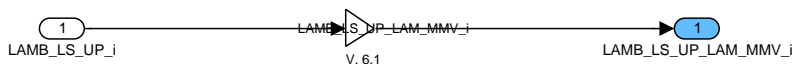


Figure 7.59.44: :

### 7.59.3.1.1.4.2 Calculation of controller difference (as richness)

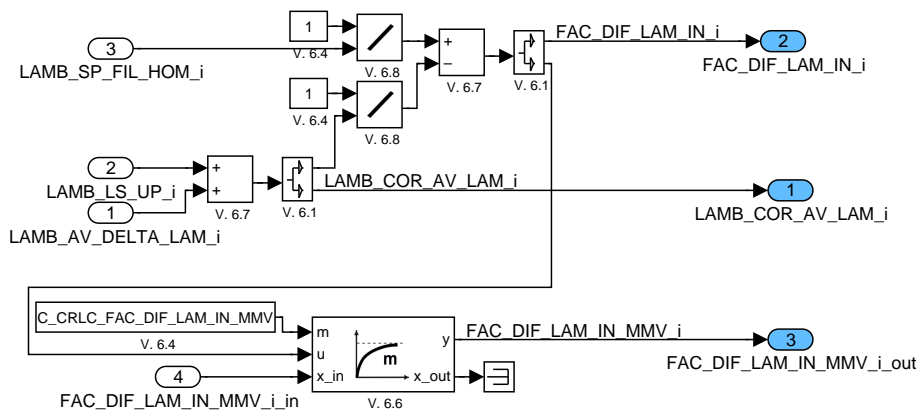


Figure 7.59.45: -:

### 7.59.3.1.1.4.3 D share calculation

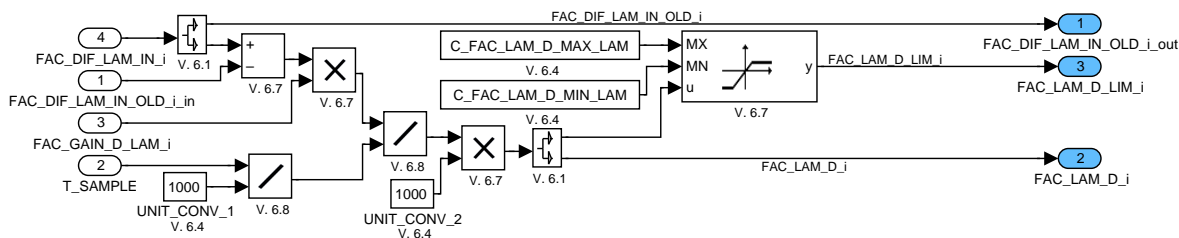


Figure 7.59.46: :

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7.59.3.1.1.1.4.4 mean value of lambda controller output

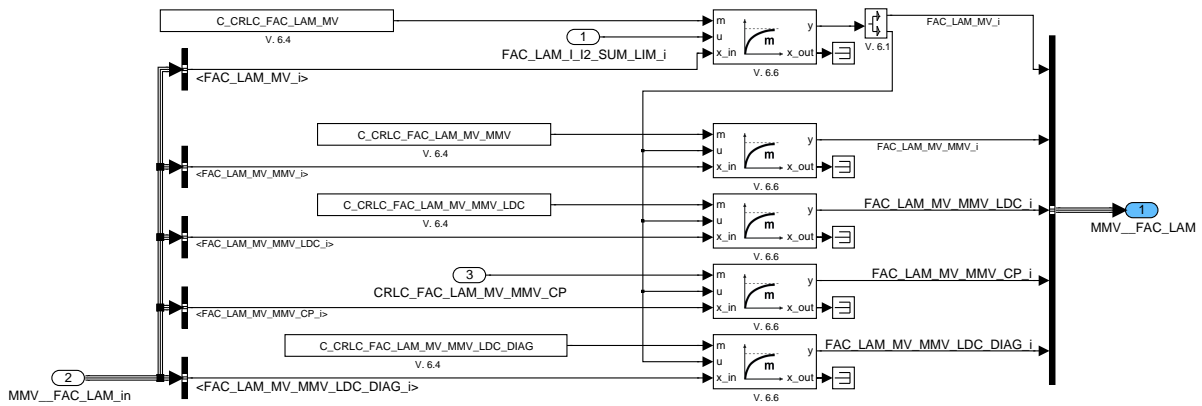


Figure 7.59.47 :

7.59.3.1.1.1.4.5 Calculation of controller output signal

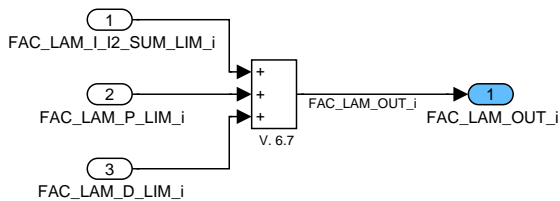


Figure 7.59.48 :

7.59.3.1.1.1.4.6 P share calculation

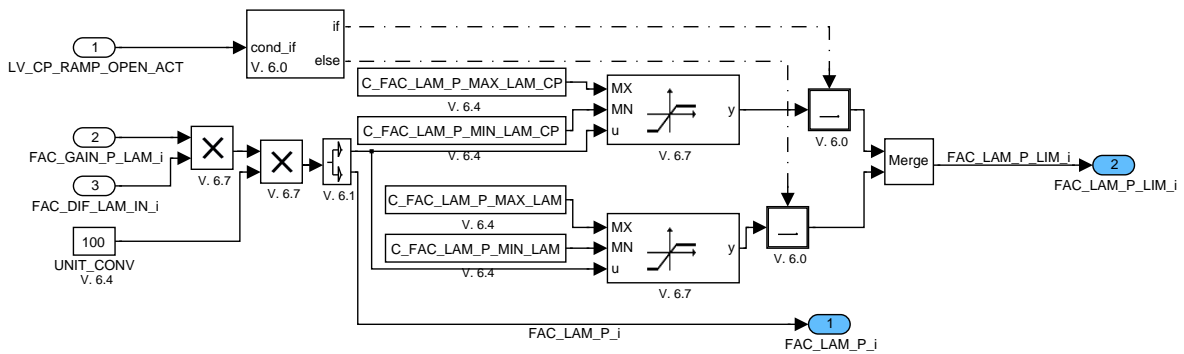


Figure 7.59.49 :

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7.59.3.1.1.1.4.7 calculation of LV\_LAM\_GAIN\_LS\_DIAG and LV\_LAM\_GAIN\_EXT

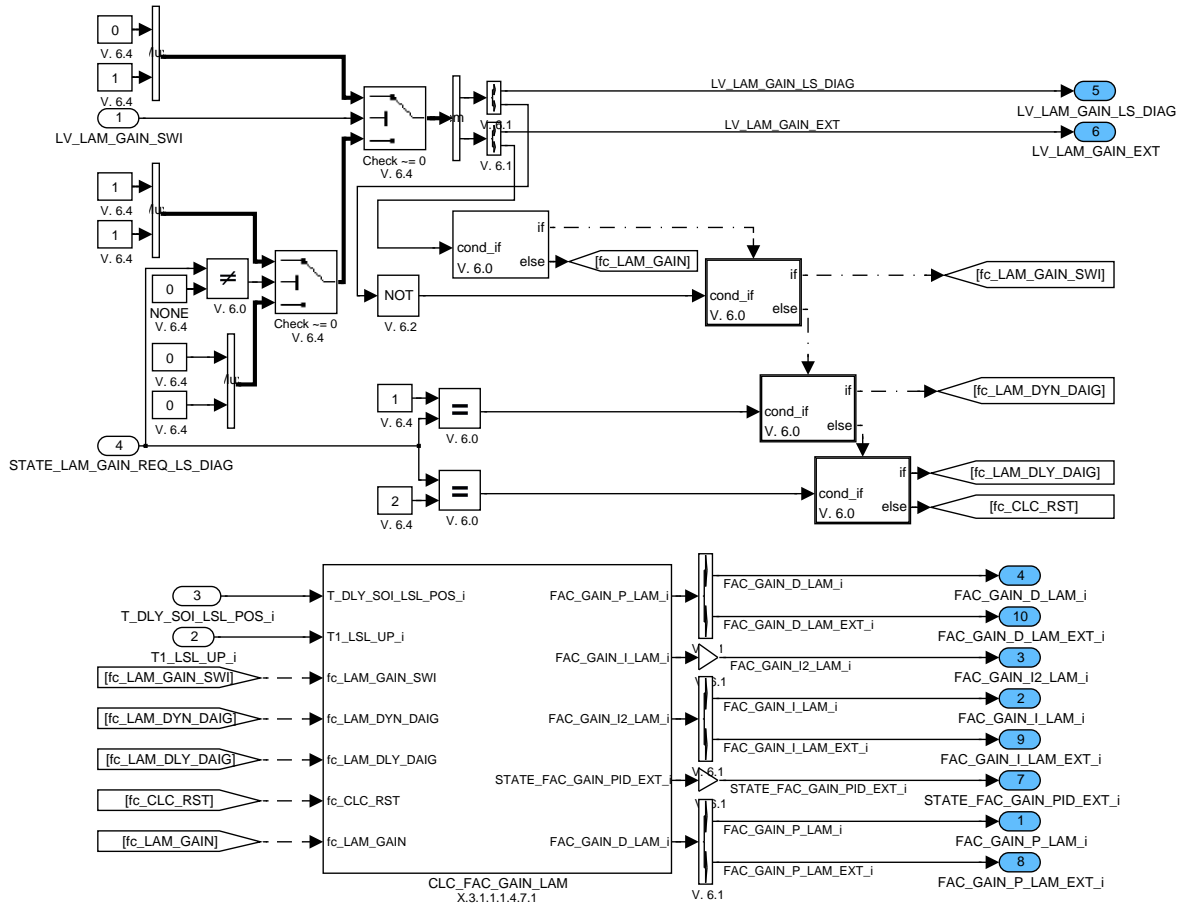


Figure 7.59.50: :

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7.59.3.1.1.4.7.1 Determination of controller parameters (FAC\_GAIN\_P/I/I2/D\_LAM[i])

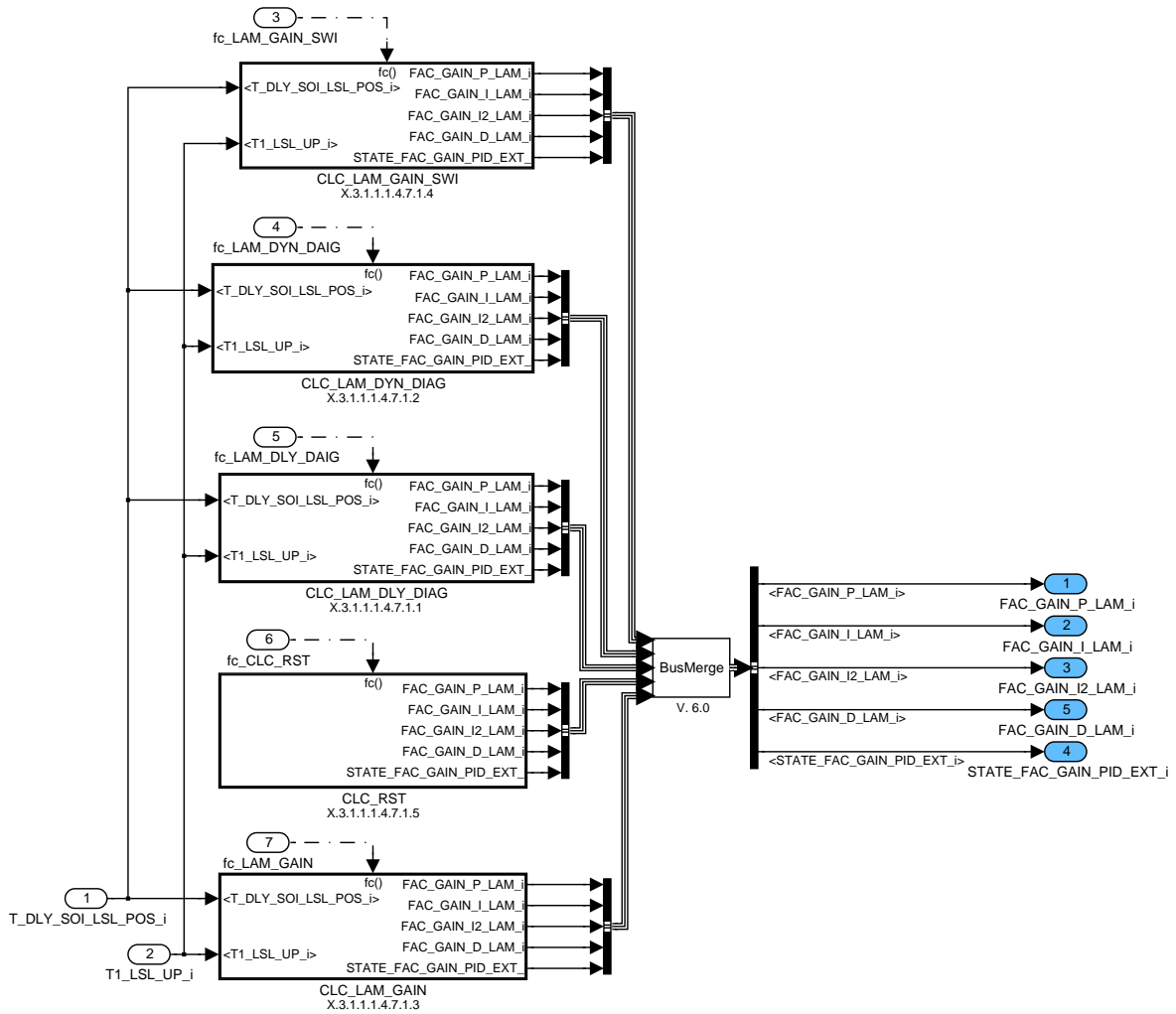


Figure 7.59.51: :

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7.59.3.1.1.4.7.1.1 Calculation of lambda controller gain factors in case of DLY\_DIAG

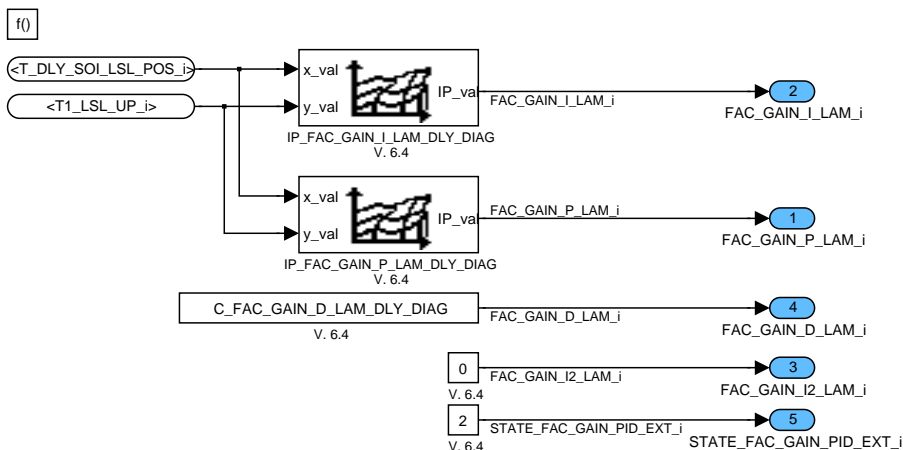


Figure 7.59.52: :

7.59.3.1.1.4.7.1.2 Calculation of lambda controller gain factors in case of DYN\_DIAG

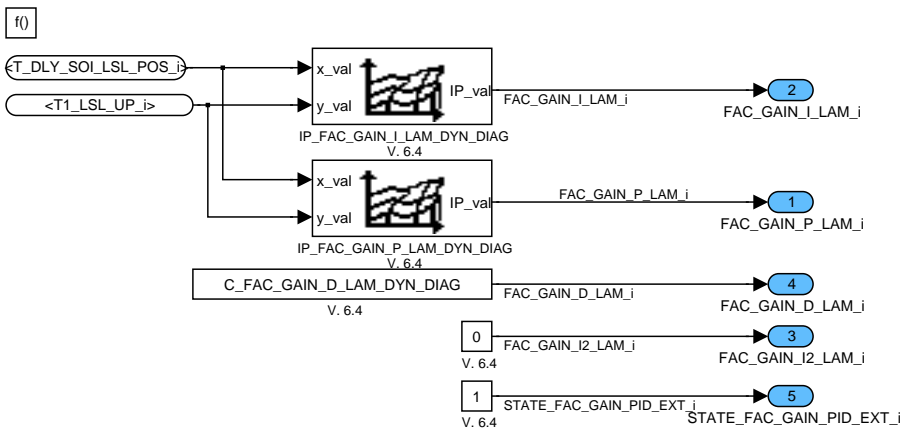


Figure 7.59.53: :

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7.59.3.1.1.4.7.1.3 regular gain factors

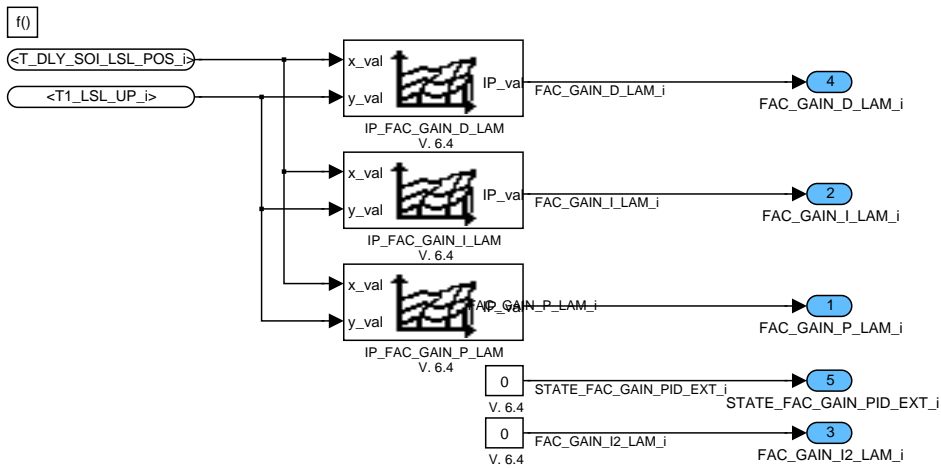


Figure 7.59.54: :

7.59.3.1.1.4.7.1.4 Calculation of lambda controller gain factors in case of LV\_LAM\_GAIN\_SWI is set

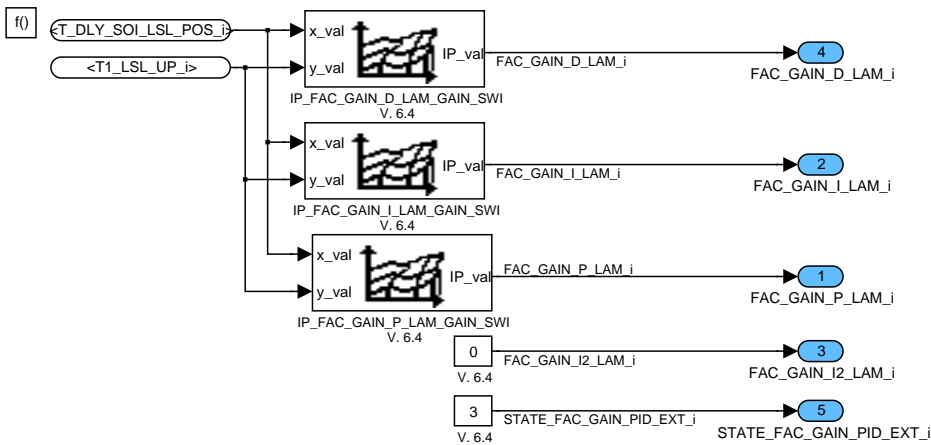


Figure 7.59.55: :

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7.59.3.1.1.4.7.1.5 All the external gain factors are set to zero

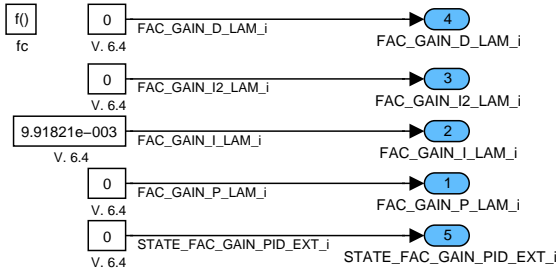


Figure 7.59.56 :

7.59.3.1.1.4.8 Evaluation of downstream sensor voltage

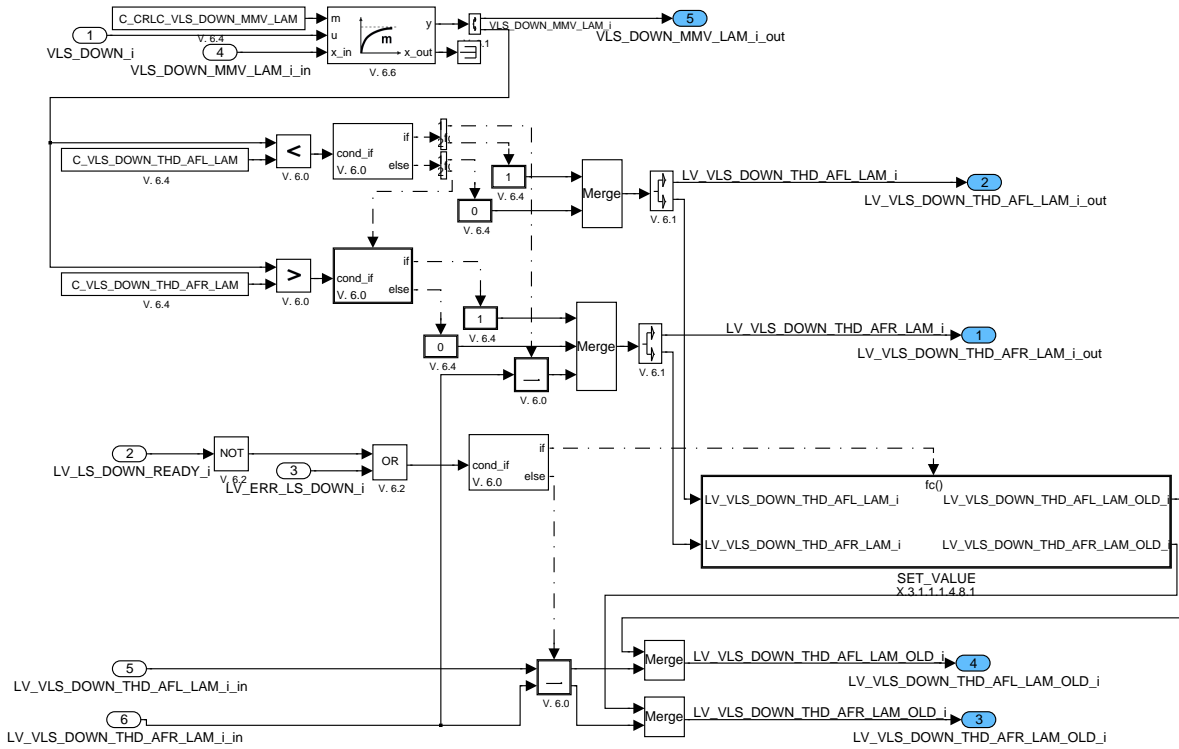


Figure 7.59.57 :

7.59.3.1.1.4.8.1 Calculation of old values

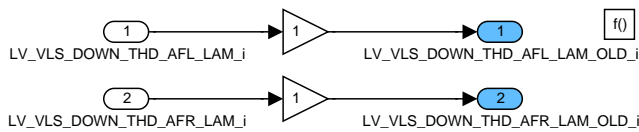


Figure 7.59.58 :

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### 7.59.3.1.1.4.9 Calculation of the I and I<sup>2</sup> share

The calculation of the I and I<sup>2</sup> share depends on the flag LV\_LAM\_I2\_ACT. If it is set to 1 then the lambda controller is calculated as an PII<sup>2</sup>D controller. Otherwise a PID controller is applied.

*PII<sup>2</sup>D controller:* The control differences are summed up in the variable FAC\_DIF\_SUM\_LAM\_IN[i]. A shift of the I and I<sup>2</sup> share based on downstream signal evaluation is realised by shifting FAC\_DIF\_SUM\_LAM\_IN[i]. This variable is then multiplied with the I share gain FAC\_GAIN\_I\_LAM[i] and the sample time. The result is stored in the variable FAC\_LAM\_I[i] which represents the unlimited I share. In case of anti wind up limitation of FAC\_LAM\_I[i] to its maximum or minimum possible range FAC\_DIF\_SUM\_LAM\_IN[i] has to be limited "backwards". FAC\_DIF\_SUM\_LAM\_IN[i] is input to the calculation of the I<sup>2</sup> share too. Therefore a multiplication with T\_SAMPLE<sup>2</sup> and FAC\_GAIN\_I2\_LAM[i] is necessary. If the product of FAC\_DIF\_SUM\_LAM\_IN[i], T\_SAMPLE<sup>2</sup> and FAC\_GAIN\_I2\_LAM[i] leads to zero result while FAC\_DIF\_SUM\_LAM\_IN[i] is not zero (FAC\_GAIN\_I2\_LAM[i] is never 0 when using a PII<sup>2</sup>D controller) then the I<sup>2</sup> share is increased or decreased by the resolution of FAC\_LAM\_I2[i]. By means of FAC\_LAM\_DELTA\_I\_I2\_SHIFT[i] the shift of the I share is realised. If the shift should be applied if this variable is not equal to 0 for one sample step. With C\_TOUT\_I\_I2\_SHIFT\_VLD an time out for the shift can be applied.

*PID controller:* The I<sup>2</sup> share FAC\_LAM\_I2[i] is always set to 0. The I share is calculated with an internal variable that has a higher resolution than FAC\_LAM\_I[i] (see formula section).

For both controllers the calculation of the I share is only executed if no limitation is applied (LV\_FAC\_LAM\_LIM\_MAX[i] = 0 and LV\_FAC\_LAM\_LIM\_MIN[i] = 0). If the injected fuel mass is not on its minimum value (indicated by LV\_TI\_1\_HOM\_MIN = 1) or LV\_FAC\_LAM\_LIM\_MIN[i] = 0 then the I share is only calculated if the controller difference is above 0. If LV\_FAC\_LAM\_LIM\_MAX[i] = 0 then the controller difference must be above 0. For the I<sup>2</sup> share calculation FAC\_DIF\_SUM\_LAM\_IN[i] must be above or below 0 in the same way in case of the mentioned limitations.

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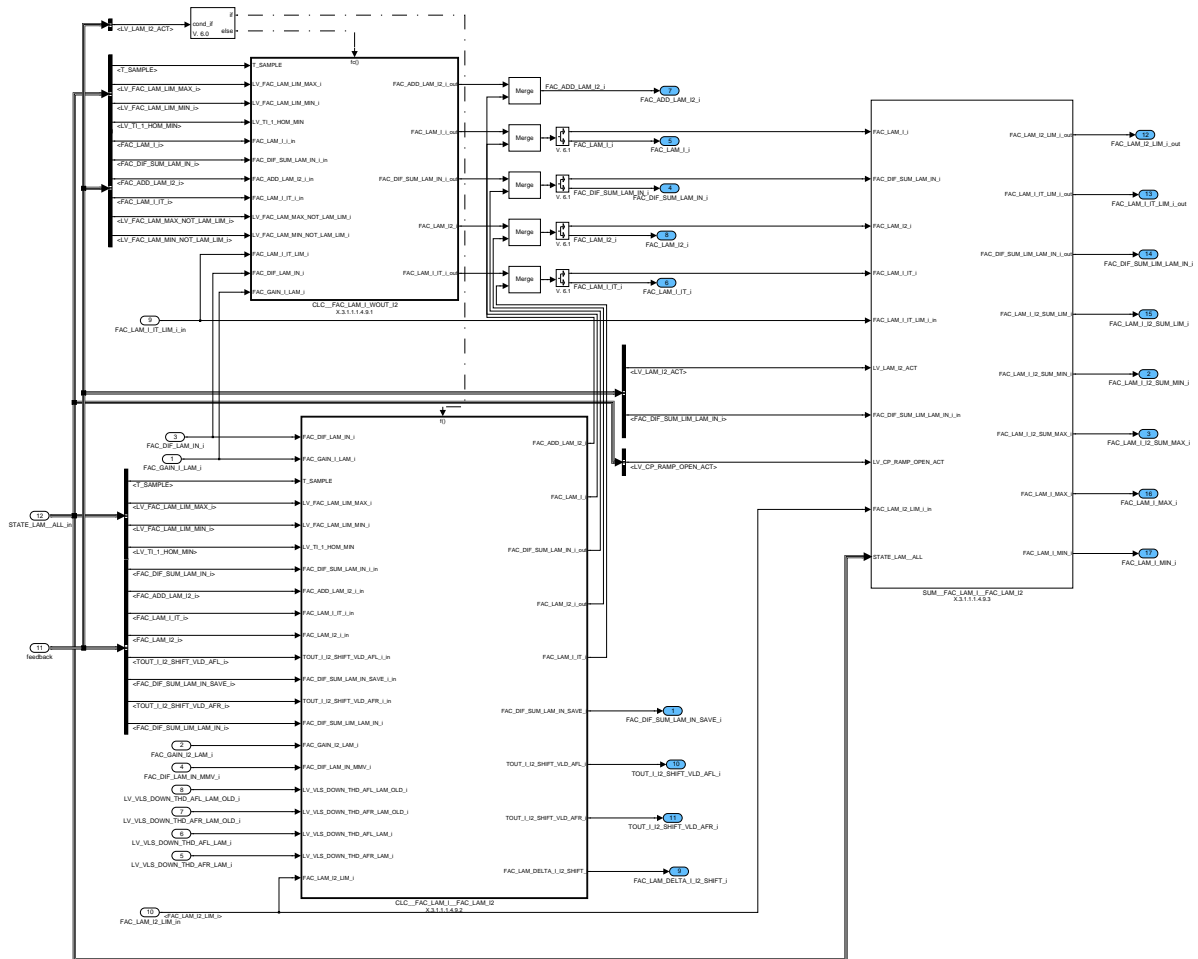


Figure 7.59.59: :

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7.59.3.1.1.1.4.9.1 I share calculation without active I2 share

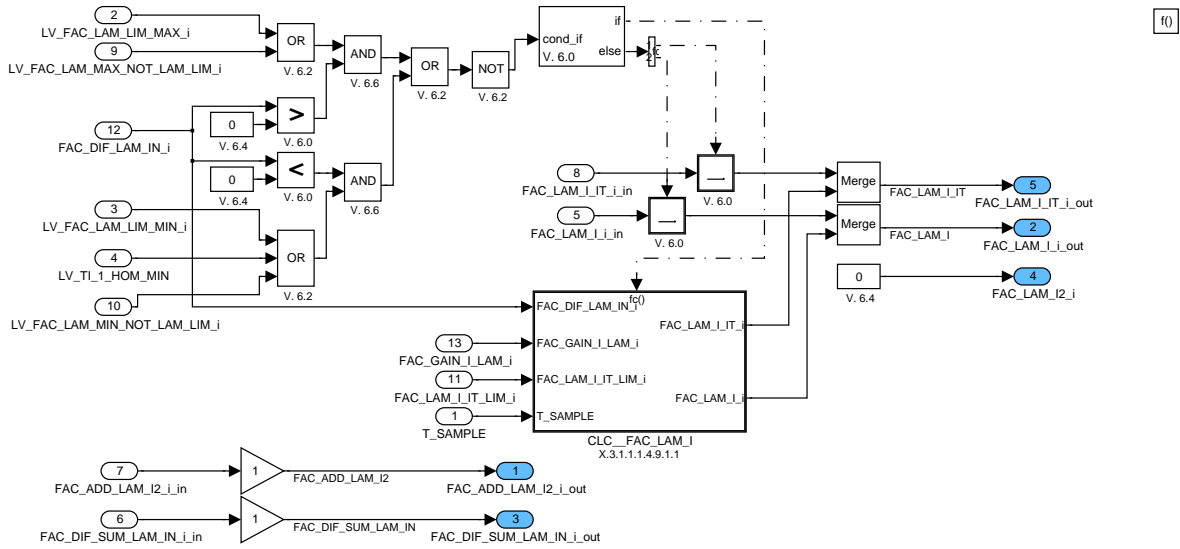


Figure 7.59.60: :

7.59.3.1.1.1.4.9.1.1 I share calculation with active I2 share

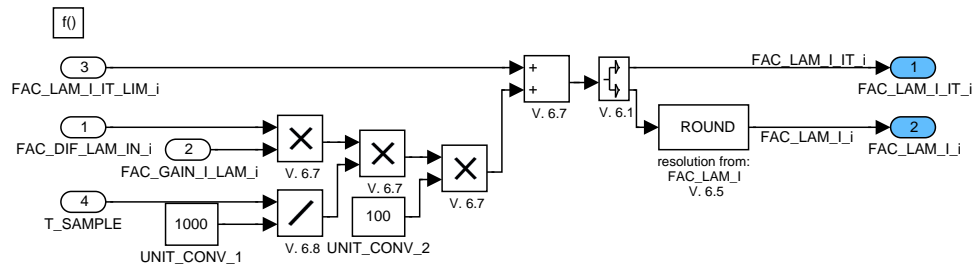


Figure 7.59.61: :

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7.59.3.1.1.4.9.2 Calculations of I2 share

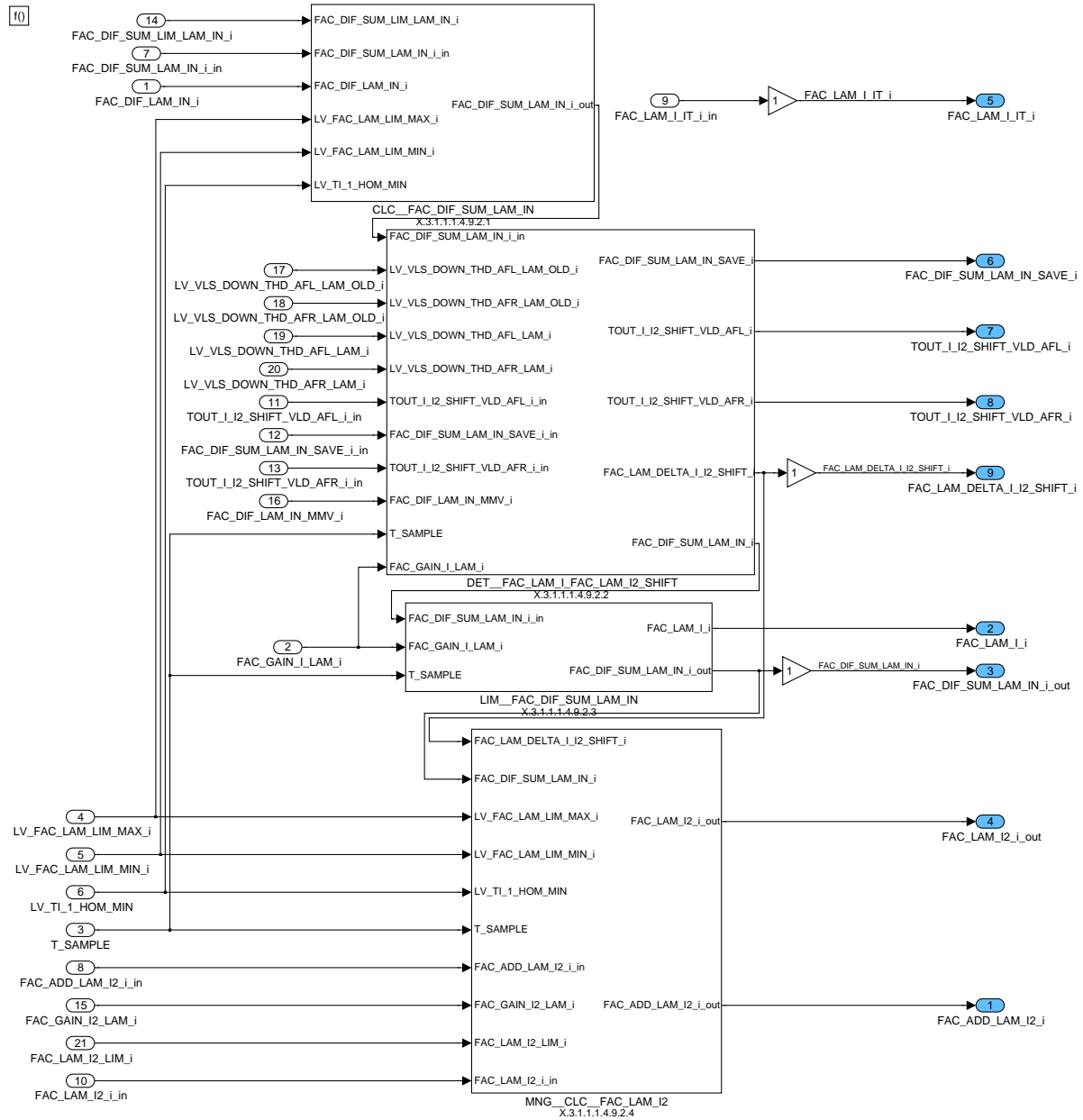


Figure 7.59.62: :

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**7.59.3.1.1.1.4.9.2.1 Summation of controller difference (only with active I2 share calculation)**

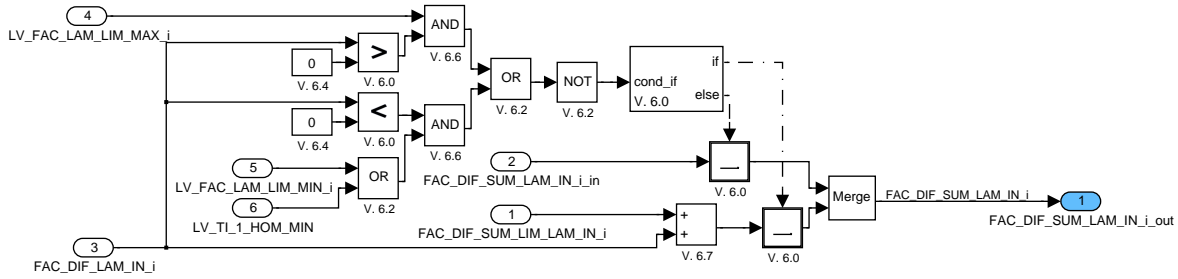


Figure 7.59.63: :

**7.59.3.1.1.1.4.9.2.2 Determination of I and I2 share shift based on downstream signal evaluation (only with active I2 share calculation)**

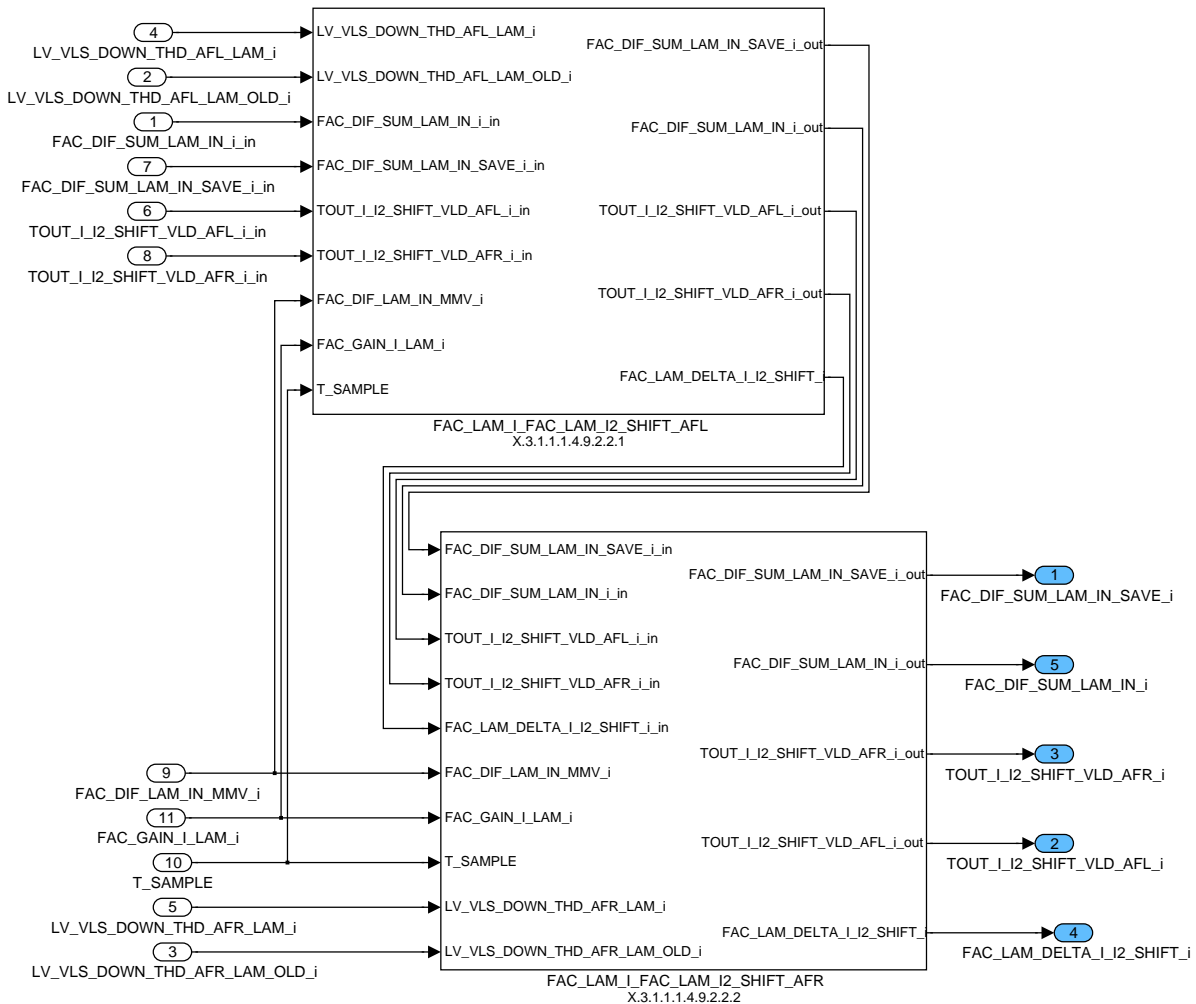


Figure 7.59.64: :

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7.59.3.1.1.4.9.2.1 Determination of I and I2 share shift for AFL

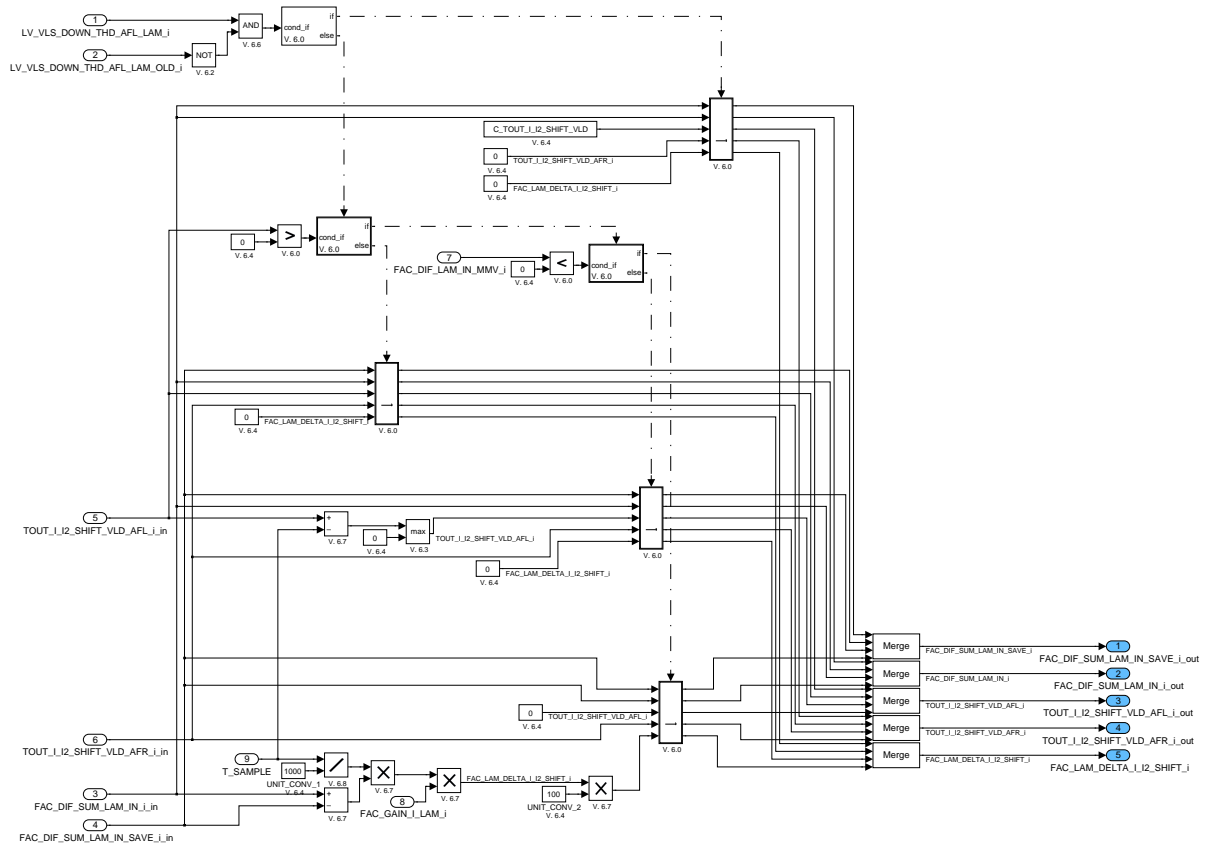


Figure 7.59.65: :

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### 7.59.3.1.1.4.9.2.2 Determination of I and I2 share shift for AFR

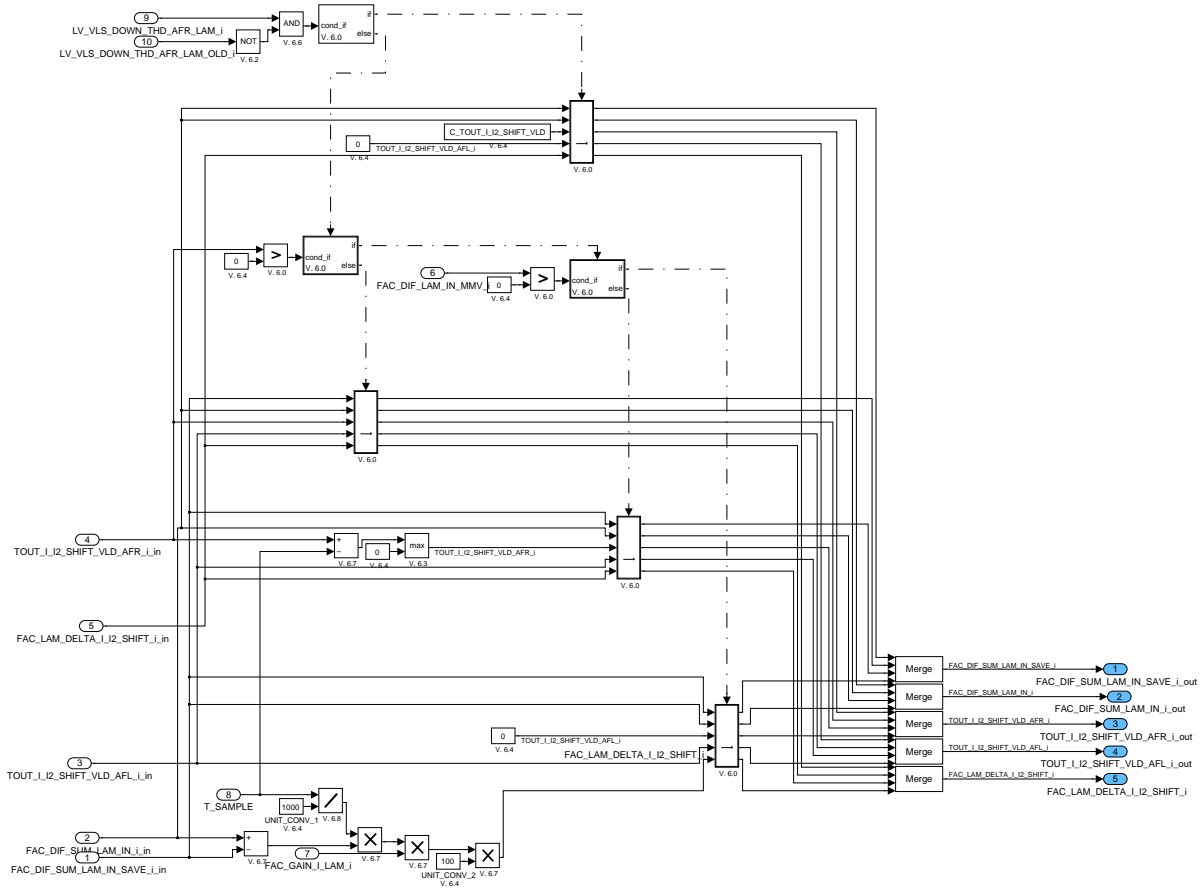


Figure 7.59.66: :

### 7.59.3.1.1.4.9.2.3 I share calculation (only with active I2 share calculation) /Anti wind up limitation of I share and controller difference summation (only with active I2 share calculation)

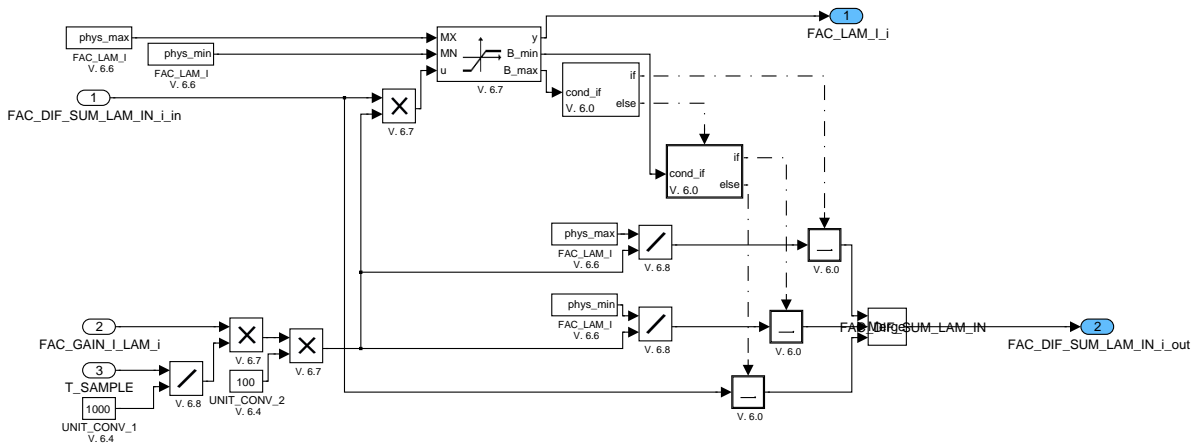


Figure 7.59.67: :

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7.59.3.1.1.1.4.9.2.4 limited I<sup>2</sup> share output signal

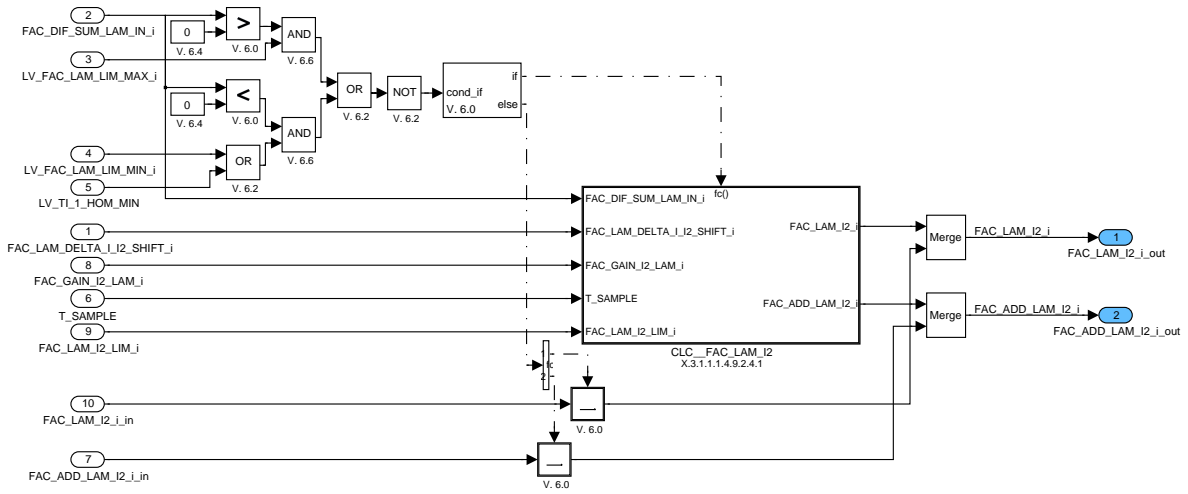


Figure 7.59.68: :

7.59.3.1.1.1.4.9.2.4.1 part that is added to the I<sup>2</sup> share every sample step

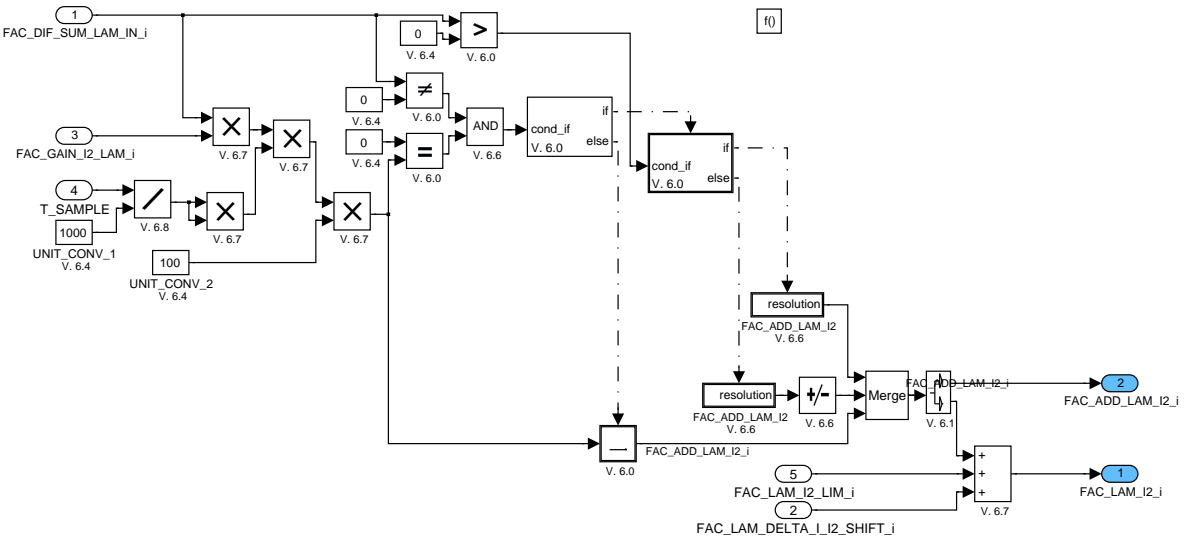


Figure 7.59.69: :

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### 7.59.3.1.1.4.9.3 Summation and limitation of I and I2 share

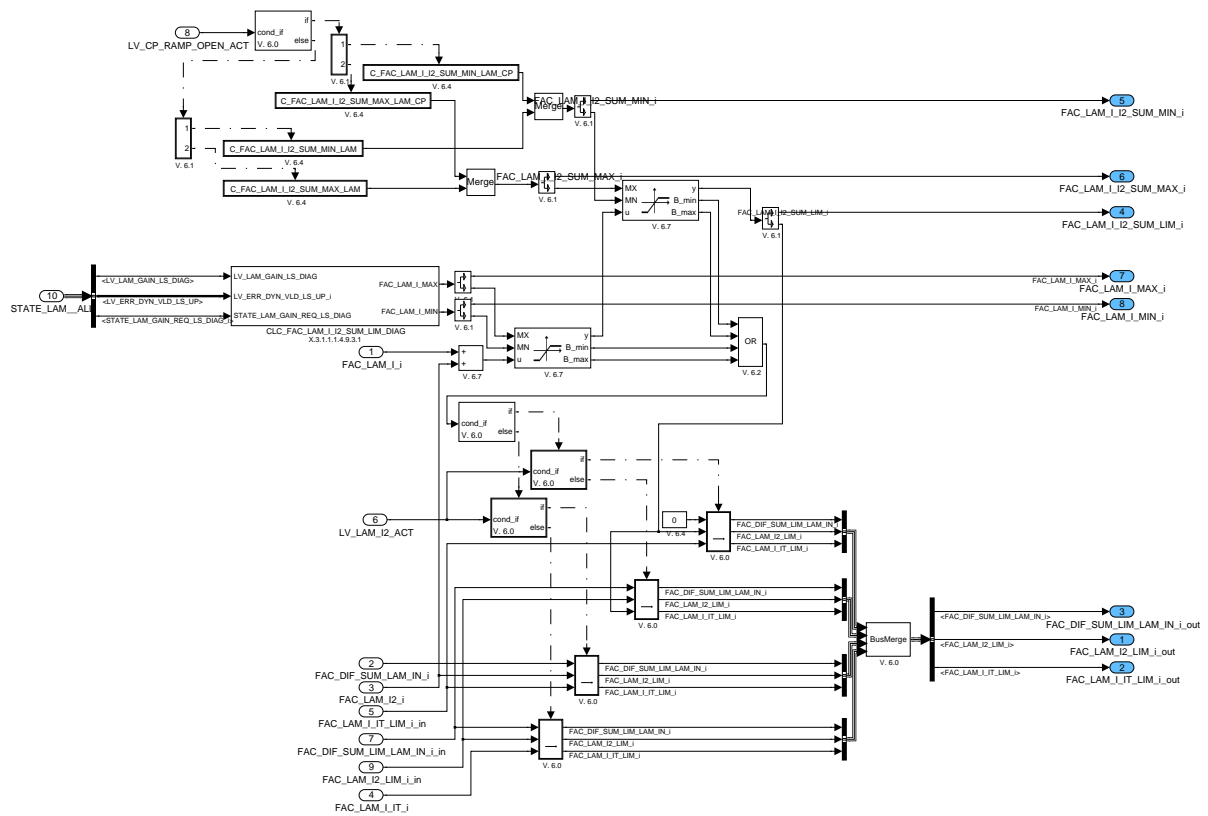


Figure 7.59.70: :

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### 7.59.3.1.1.4.9.3.1 Determination of I-share limitation

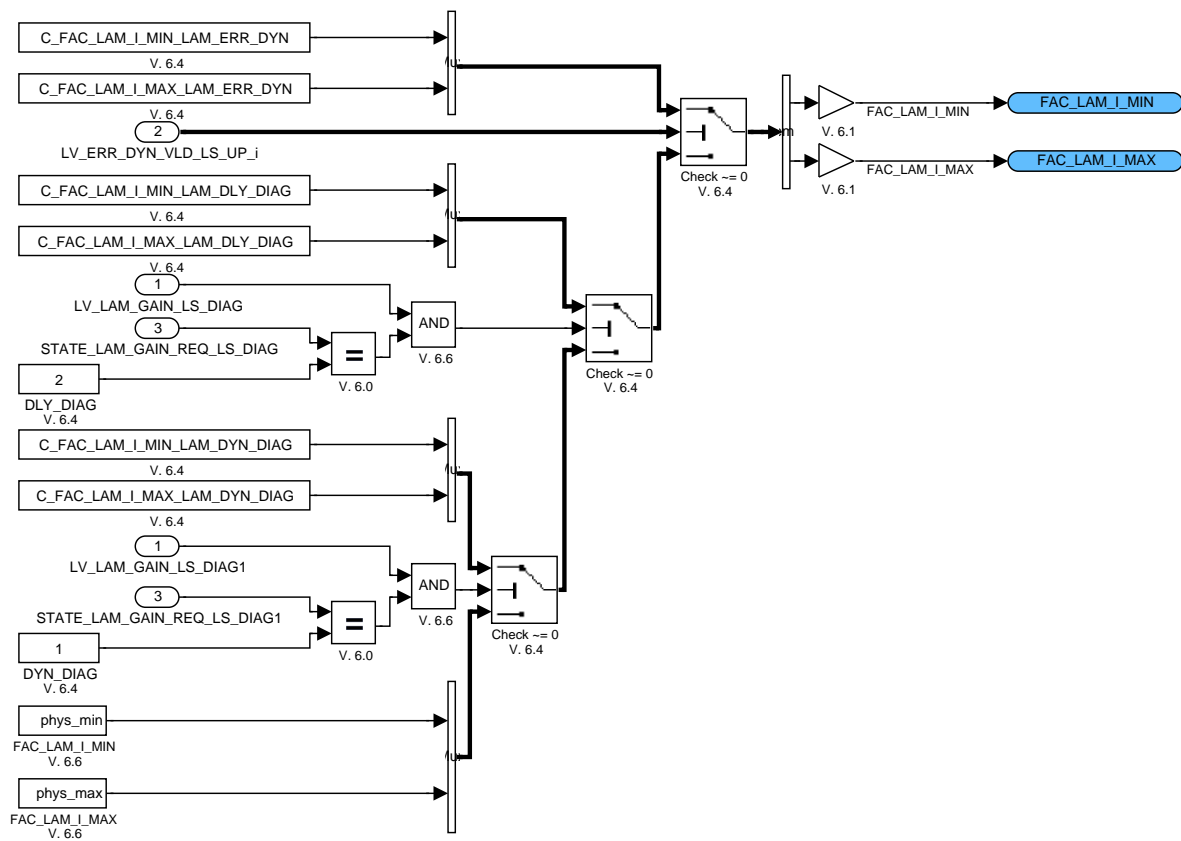



Figure 7.59.71: :

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7.59.3.1.1.4.10 Shift and initialization of lambda controller

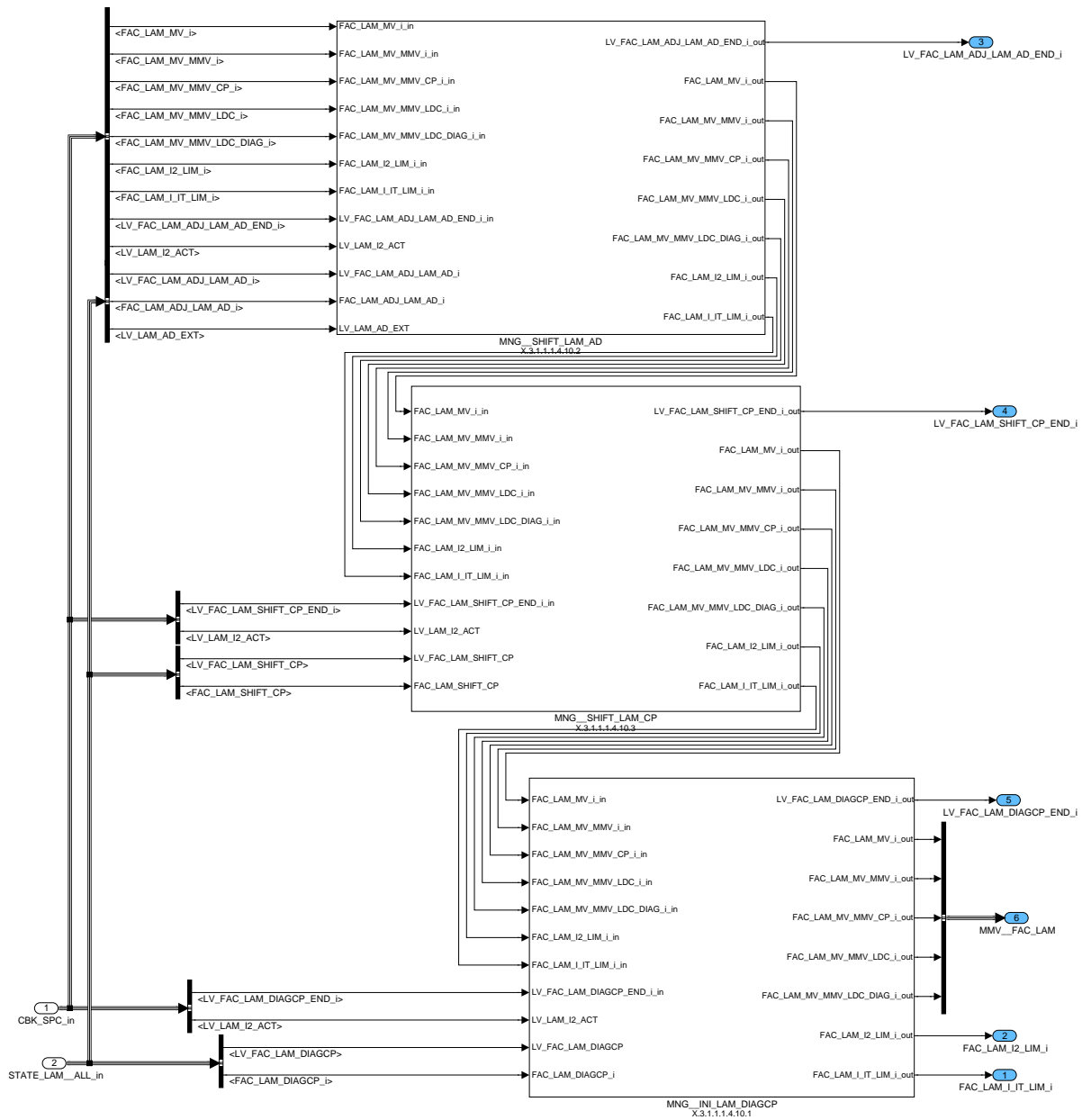


Figure 7.59.72: :

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### 7.59.3.1.1.4.10.1 Output initialisation of lambda controller by evaporative system monitoring function

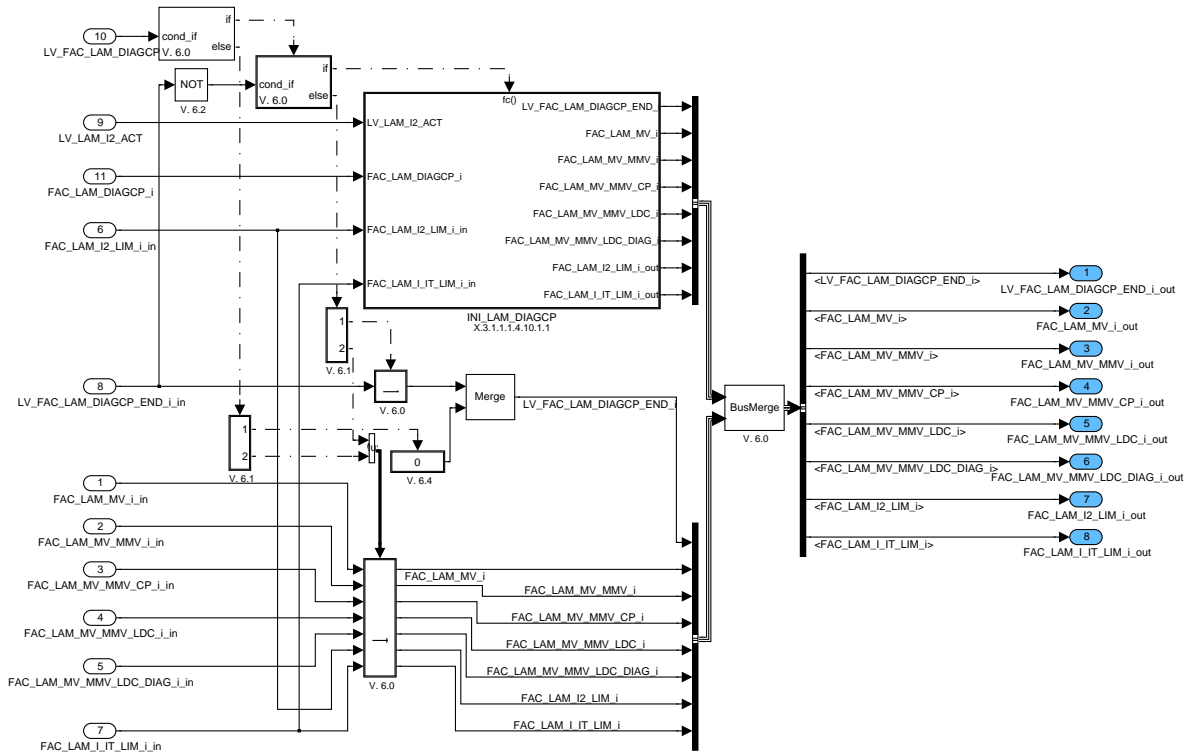


Figure 7.59.73: :

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### 7.59.3.1.1.4.10.1.1 Calculation of controller shift

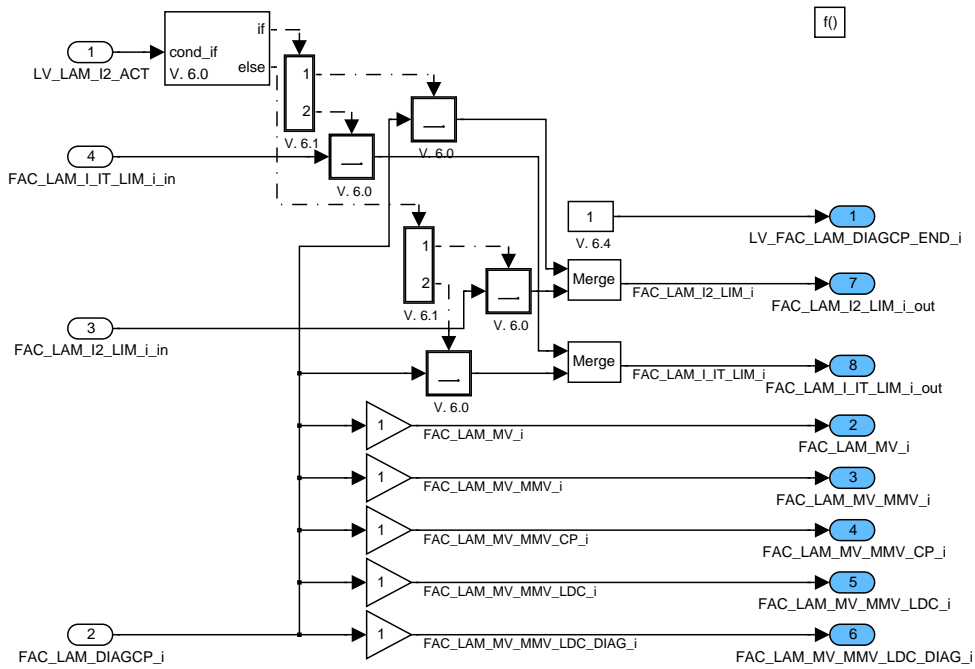


Figure 7.59.74: :

### 7.59.3.1.1.4.10.2 Output shift of the lambda controller by lambda adaptation

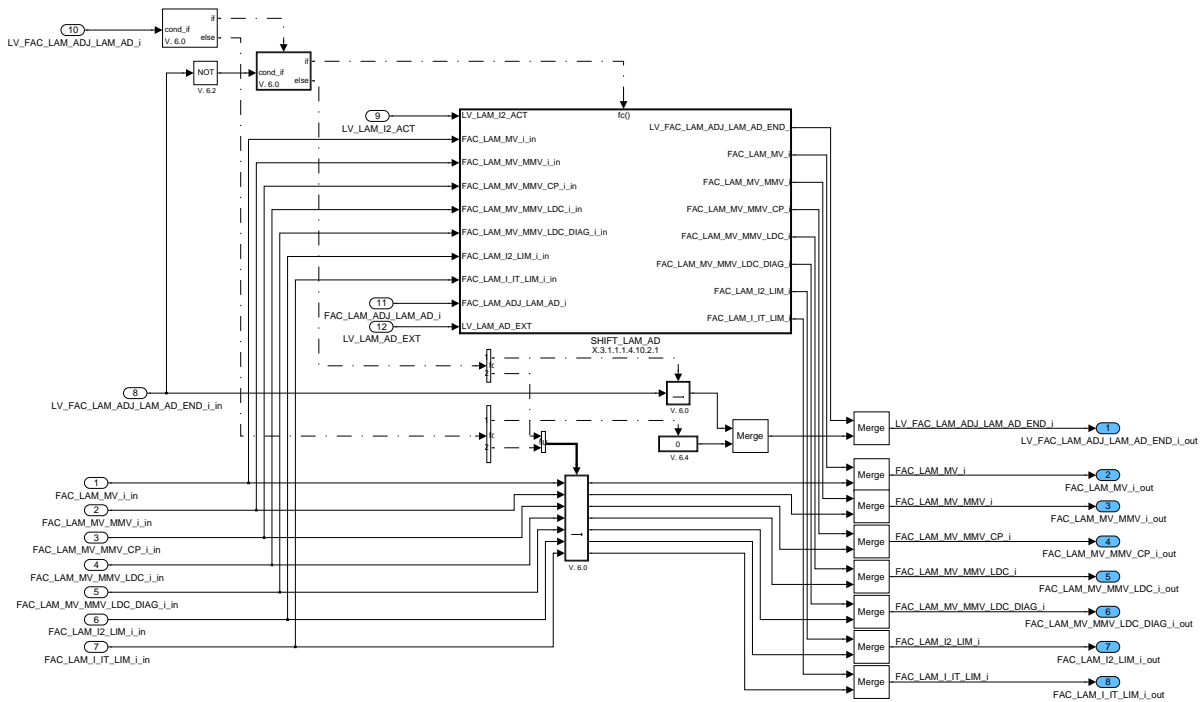


Figure 7.59.75: :

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7.59.3.1.1.4.10.2.1 Calculation of mean value of lambda controller output

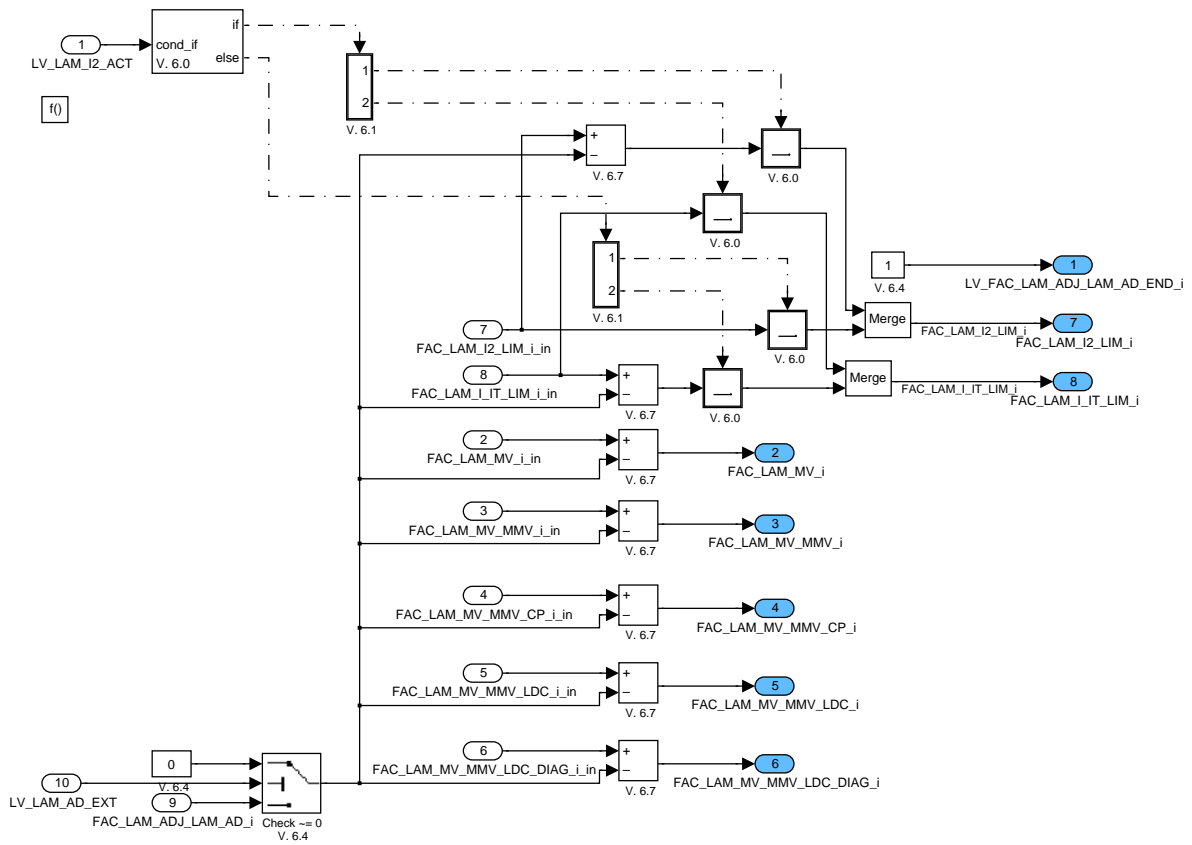



Figure 7.59.76: :

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7.59.3.1.1.4.10.3 Output shift of lambda controller by canister purge function

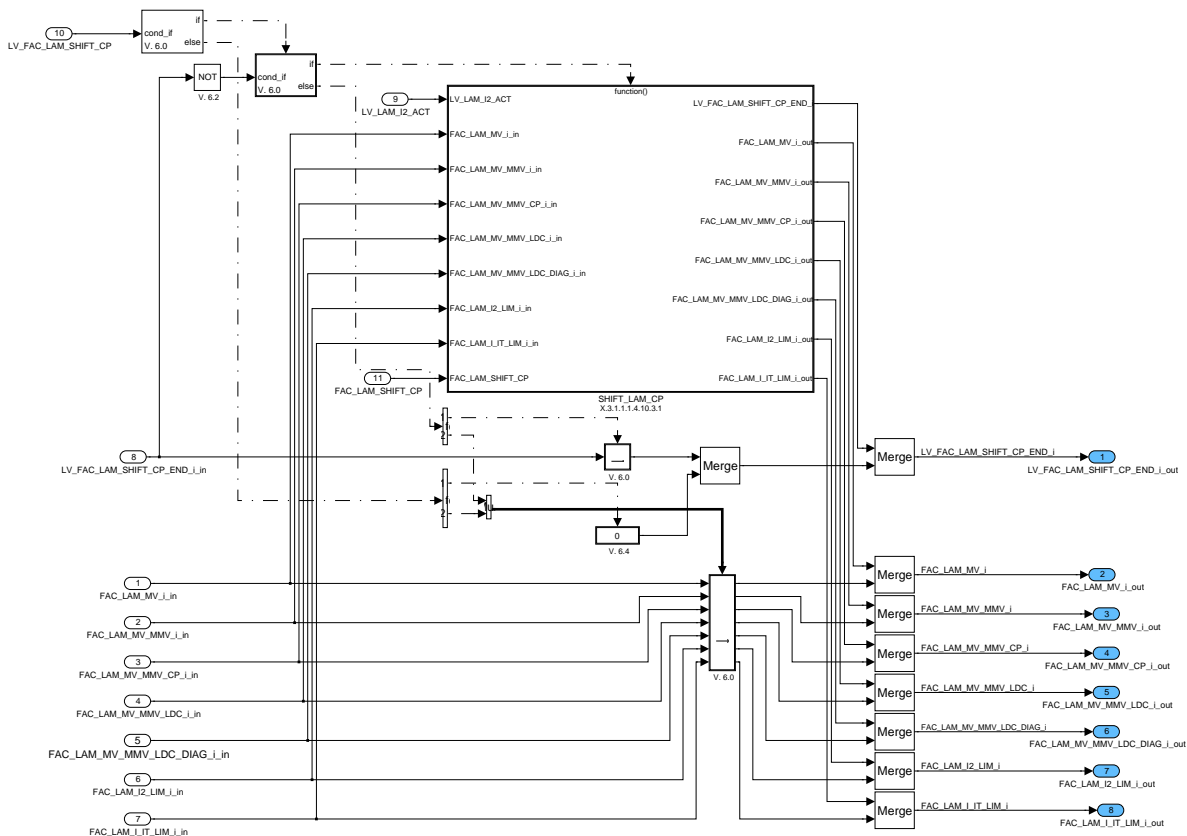


Figure 7.59.77: :

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7.59.3.1.1.4.10.3.1 Output shift of lambda controller

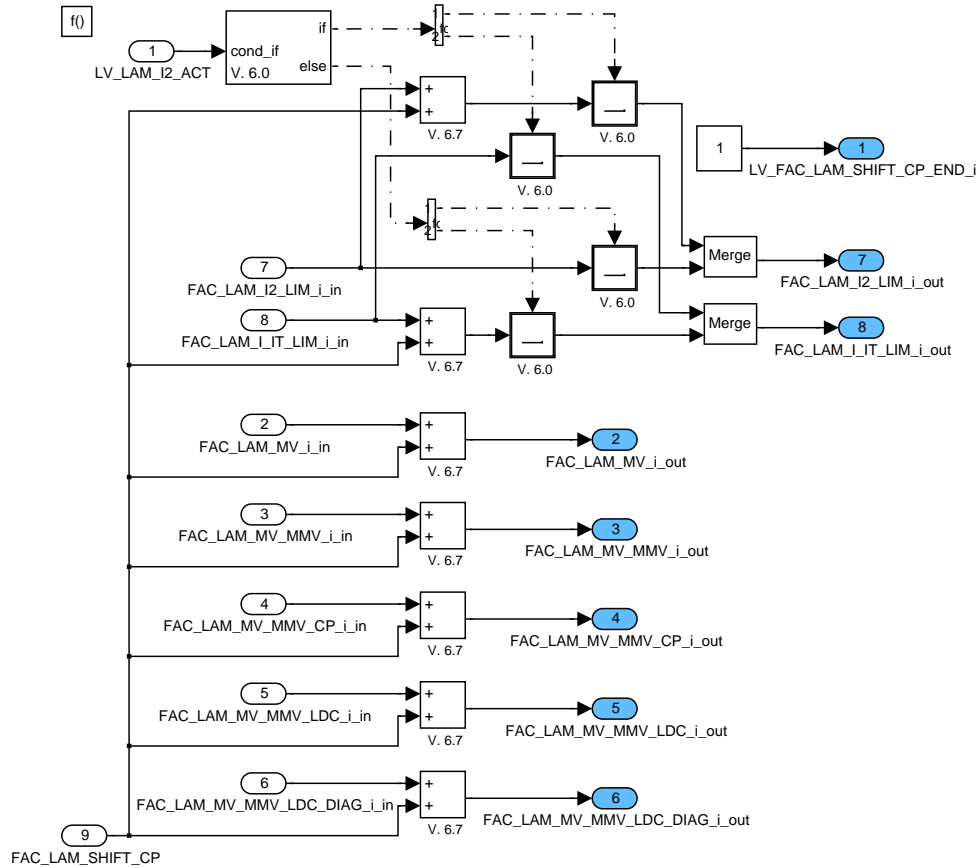



Figure 7.59.78: :

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### 7.59.3.1.1.4.11 Limitation under non stationary conditions

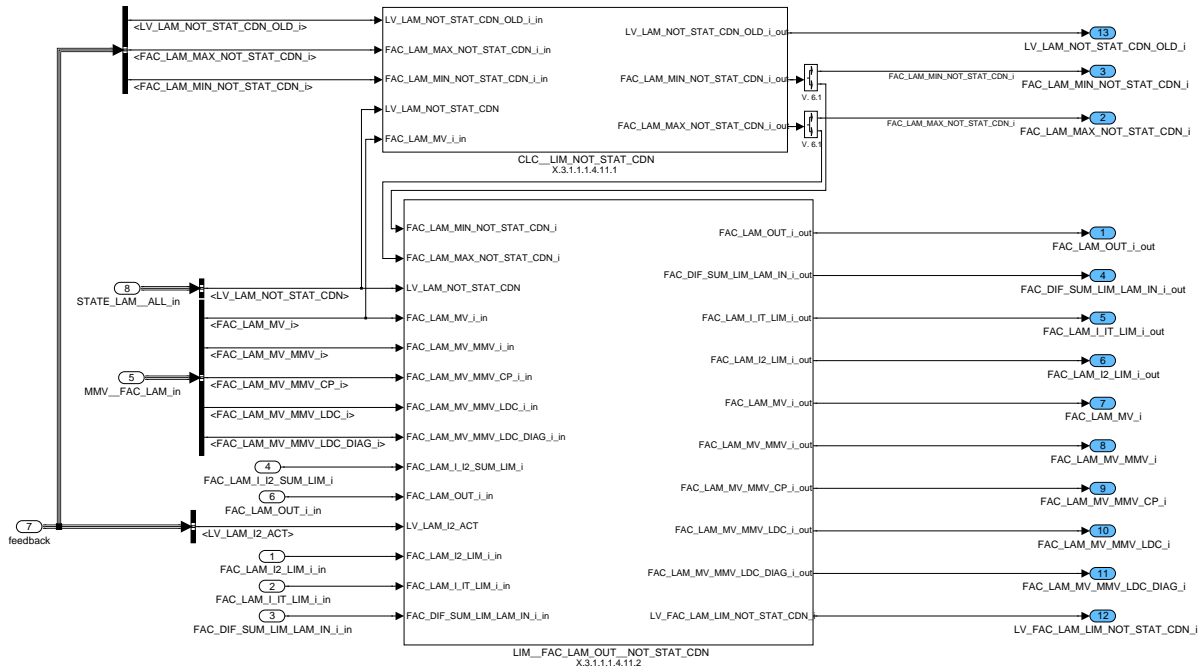


Figure 7.59.79: :

### 7.59.3.1.1.4.11.1 Limitation under non stationary conditions

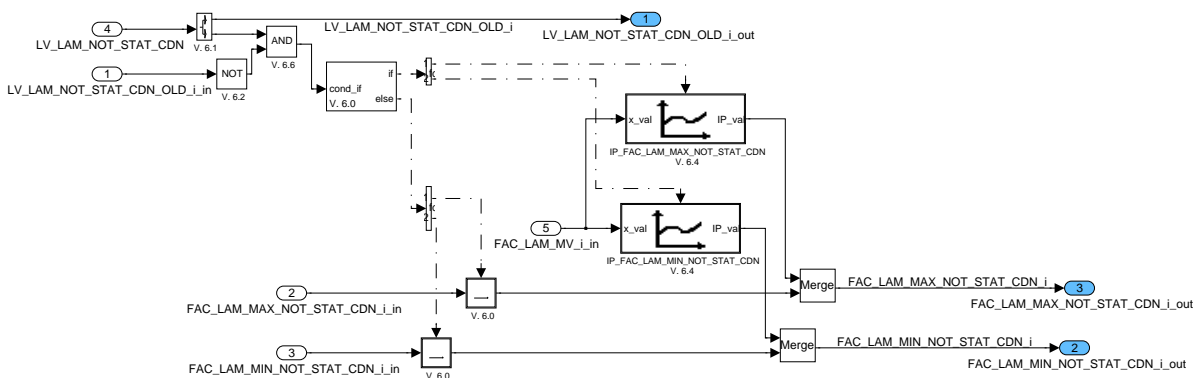


Figure 7.59.80: :

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7.59.3.1.1.4.11.2 Limitation under non stationary conditions

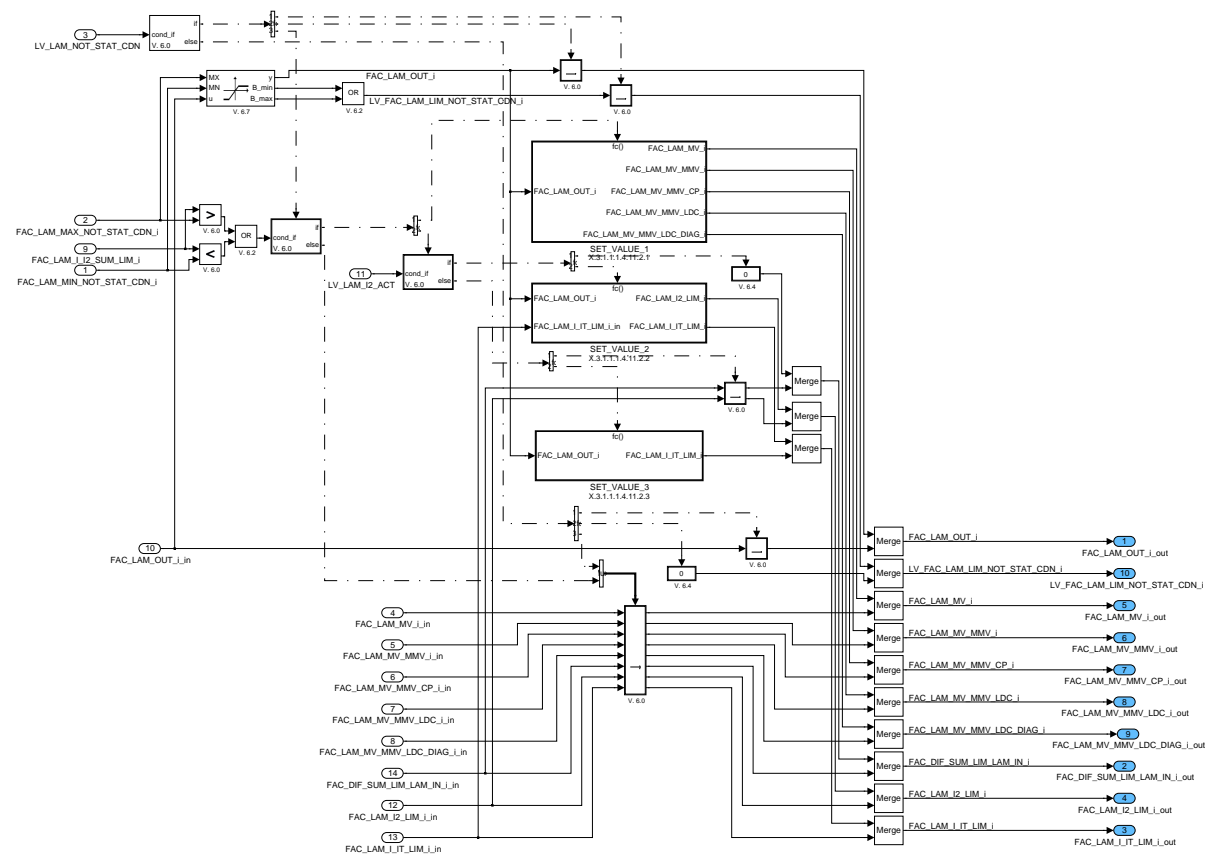


Figure 7.59.81: :

7.59.3.1.1.4.11.2.1 mean value

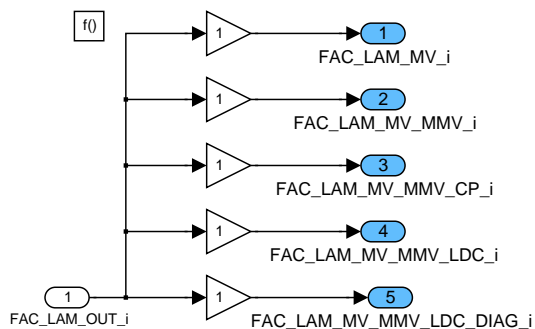


Figure 7.59.82: :

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### 7.59.3.1.1.4.11.2.2 unlimited I<sup>2</sup> share output signal

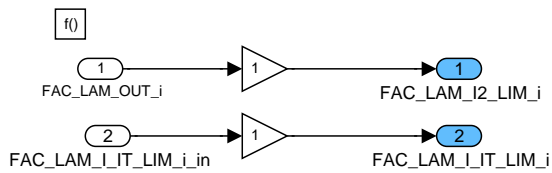


Figure 7.59.83: :

### 7.59.3.1.1.4.11.2.3 limited internal I share used for PID control only

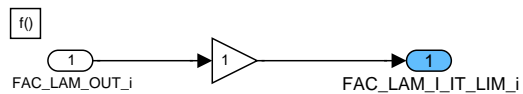


Figure 7.59.84: :

### 7.59.3.1.1.1.5 STATE\_LAM: "2:STOP\_SHO\_PER"

In state "2:STOP\_SHO\_PER " the D share is set to 0 and P, I and I2 share are frozen. The confirmation of the hereafter described output shifts or initialisation are not carried out. This state is for very short term controller stops.

For the description of Sub-System CLC\_\_FAC\_DIF\_LAM and Sub-System DET\_\_VLS\_DOWN\_AFL\_AFR see description of STATE\_LAM: 0:OFF .

For the description of Sub-System CLC\_\_FAC\_LAM\_OUT see description of STATE\_LAM: 1:ON .

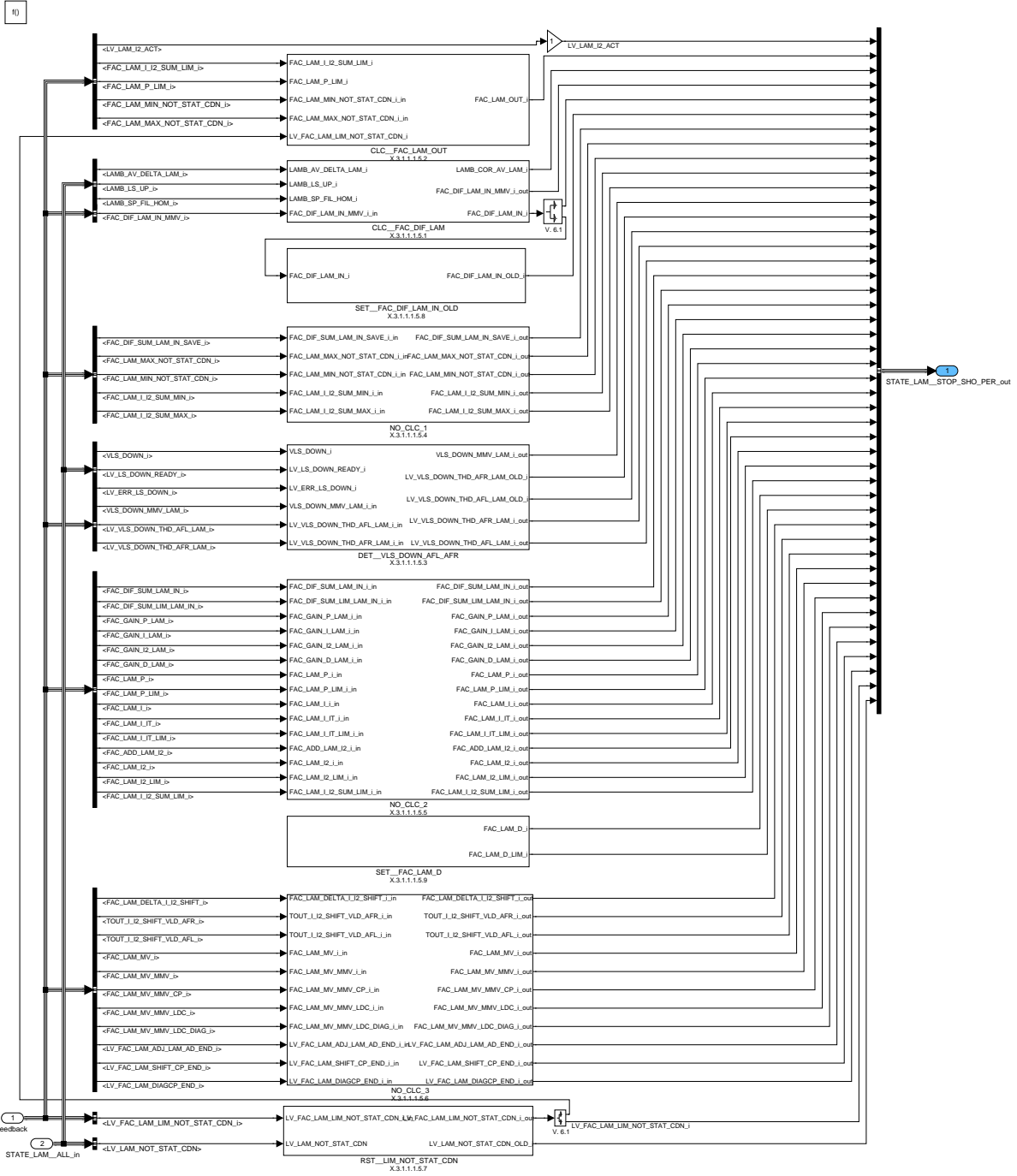


Figure 7.59.85: :

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**7.59.3.1.1.1.5.1 Calculation of controller difference (as richness)**

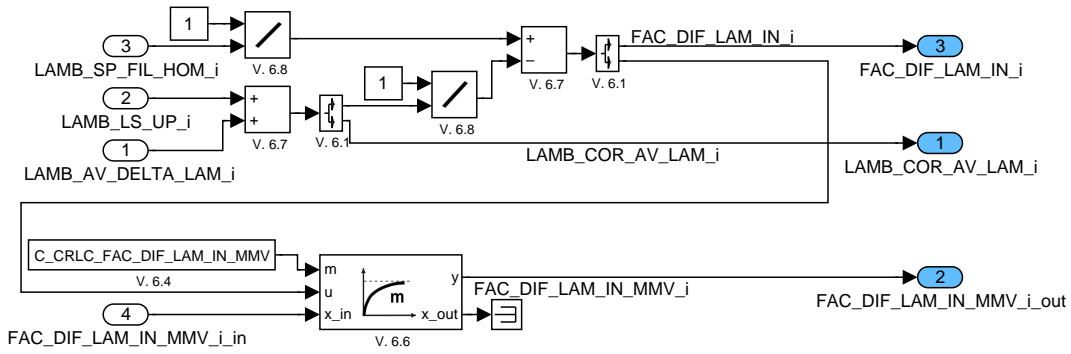


Figure 7.59.86: :

**7.59.3.1.1.1.5.2 Calculation of controller output signal**

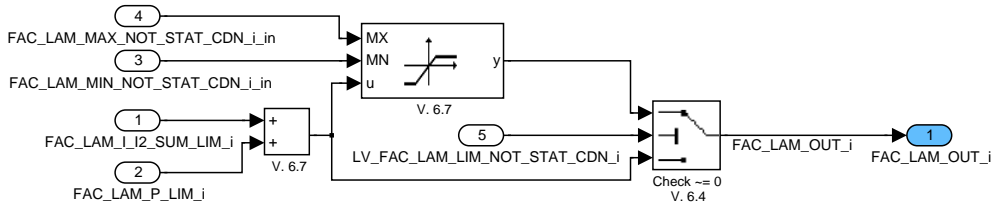


Figure 7.59.87: :

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7.59.3.1.1.5.3 Evaluation of downstream sensor voltage

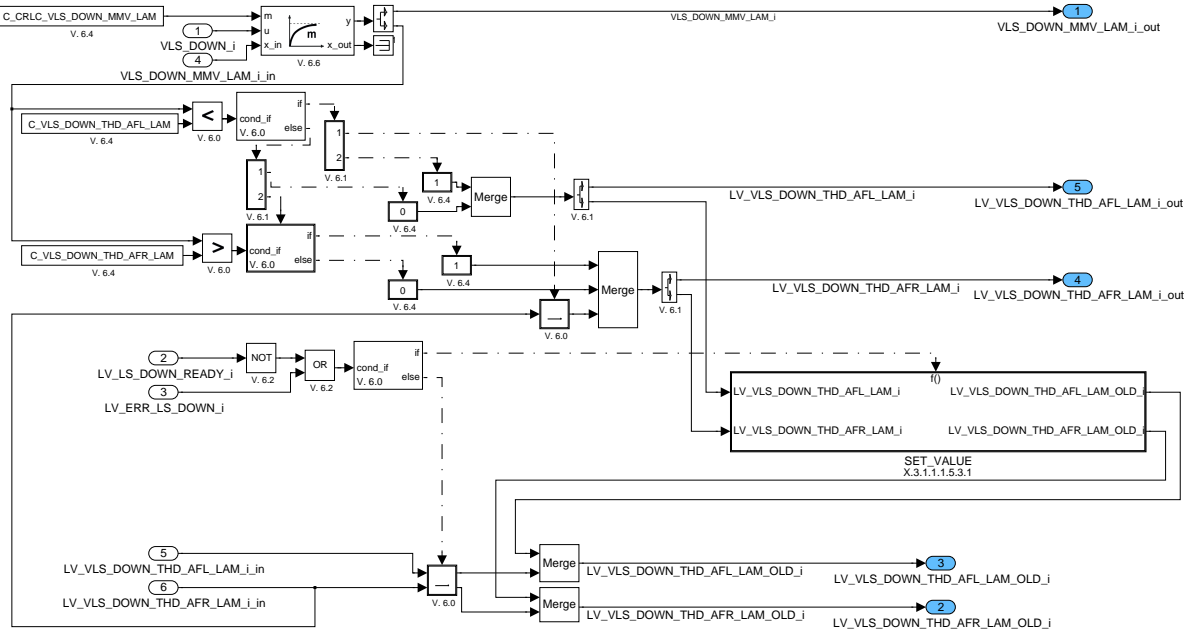


Figure 7.59.88: :

7.59.3.1.1.5.3.1 Calculation of old value

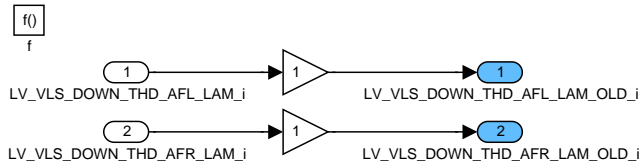


Figure 7.59.89: :

7.59.3.1.1.5.4 feedthrough

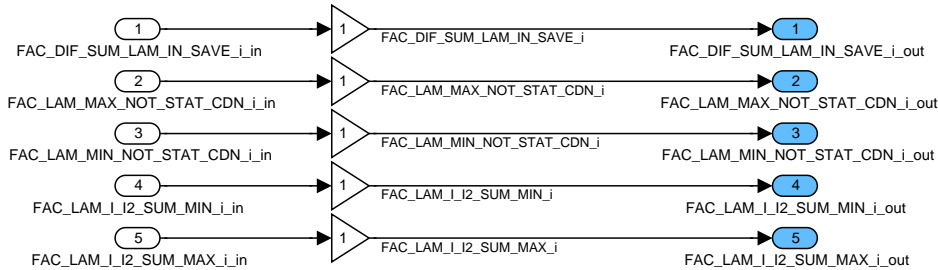


Figure 7.59.90: :

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## 7.59.3.1.1.1.5.5 feedthrough

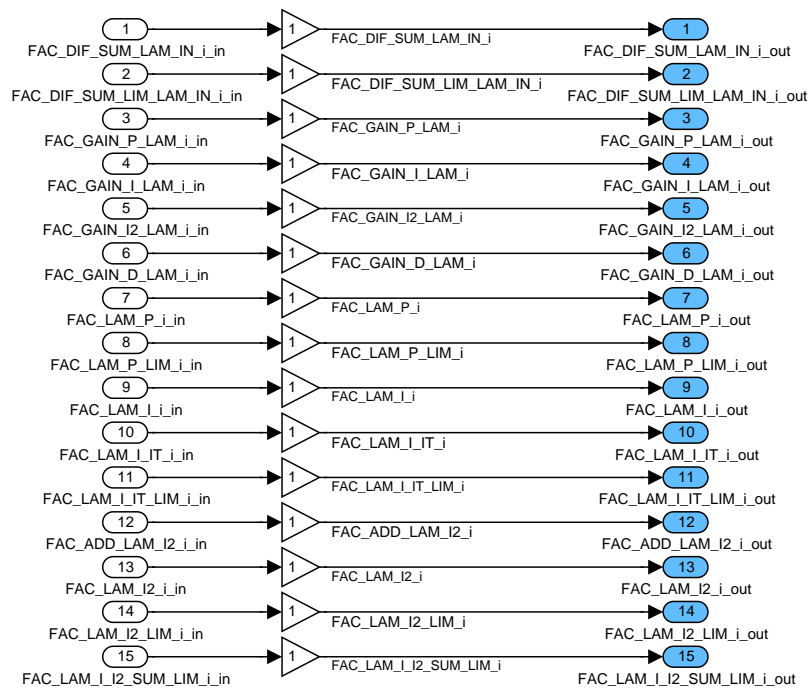


Figure 7.59.91: :

## 7.59.3.1.1.1.5.6 feedthrough

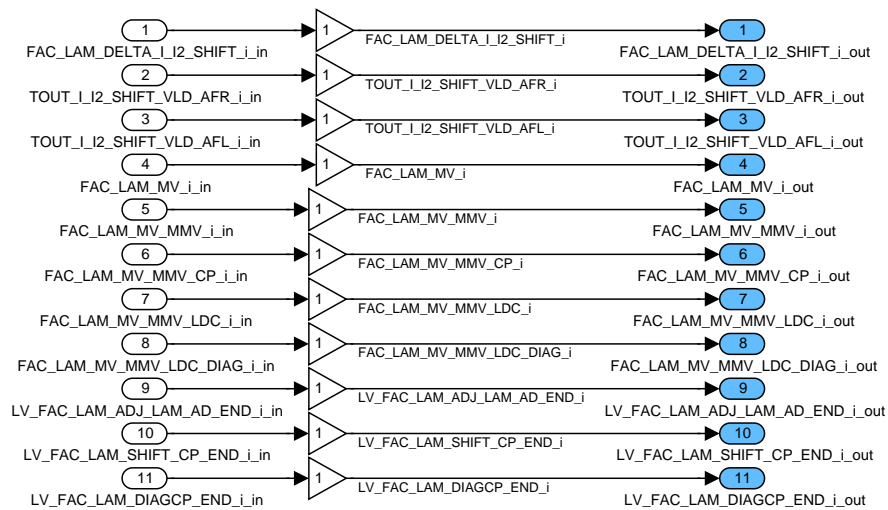


Figure 7.59.92: :

**7.59.3.1.1.1.5.7 limitation under non stationary operating conditions (threshold exceeded)**

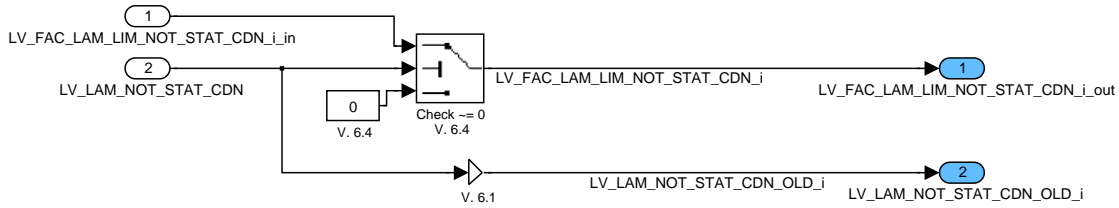


Figure 7.59.93: :

**7.59.3.1.1.1.5.8 Calculation of old value**



Figure 7.59.94: :

**7.59.3.1.1.1.5.9 unlimited D share output signal**

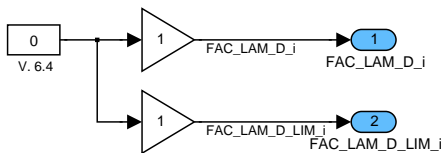



Figure 7.59.95: :

**7.59.3.1.1.1.6 STATE\_LAM: "3:\_STOP"**

In state "3:STOP" reset of internal state variables and output values (Sub-System: RST\_\_IT\_STATE\_VALUE\_OUT\_VALUE\_CBK\_SPC) and reset of FAC\_LAM\_OUT[i] is carried out. The confirmation of the hereafter described output shifts or initialisation are carried out without applying the shifts or initialisation itself.

For the description of Sub-System CLC\_\_FAC\_DIF\_LAM and Sub-System DET\_\_VLS\_DOWN\_AFL\_AFR see description of STATE\_LAM: 0:OFF .

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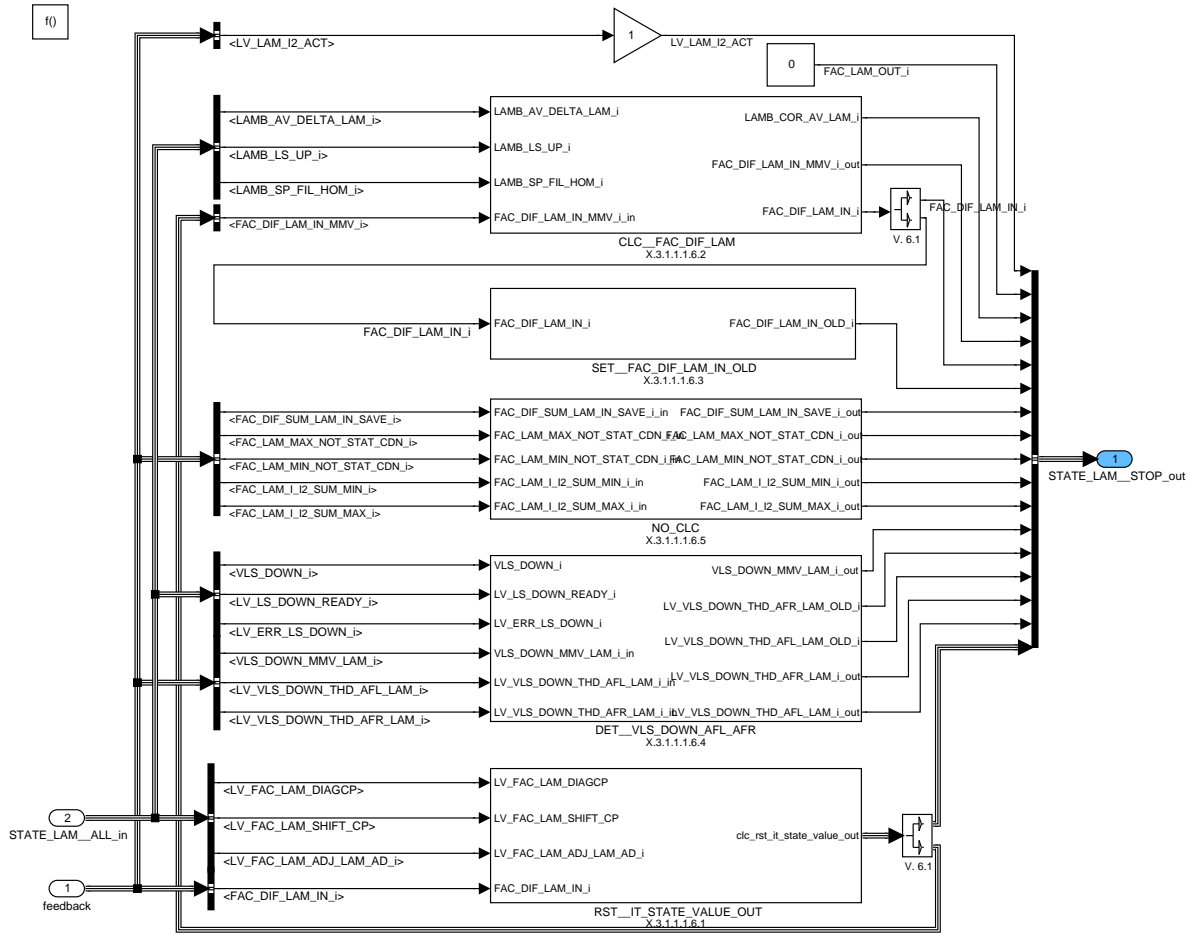


Figure 7.59.96: :

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7.59.3.1.1.6.1 Reset of internal state variables and output values

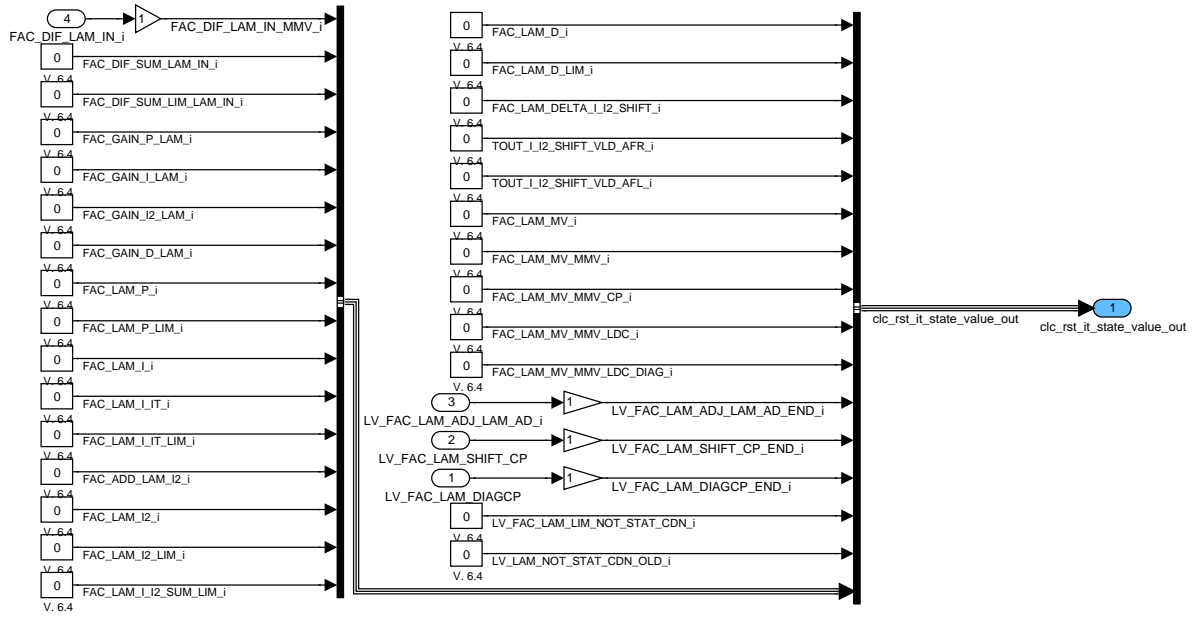


Figure 7.59.97: :

7.59.3.1.1.6.2 Calculation of controller difference (as richness)

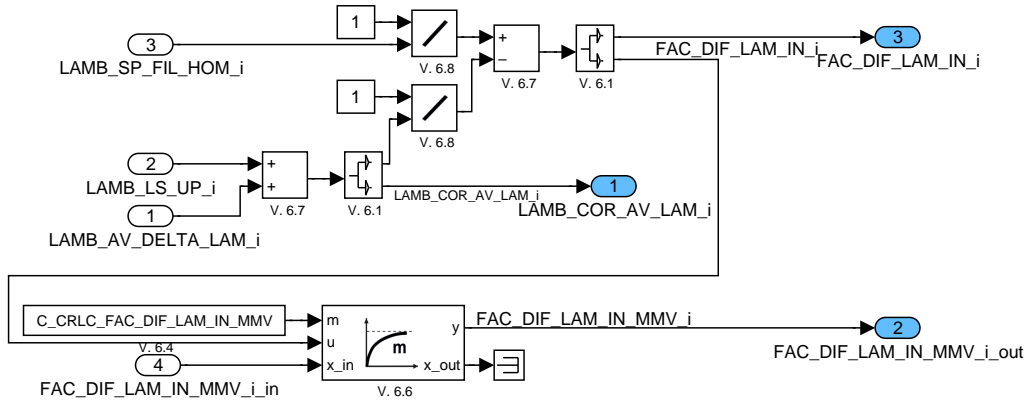


Figure 7.59.98: :

7.59.3.1.1.6.3 Calculation of old value

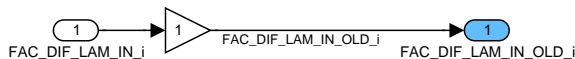


Figure 7.59.99: :

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### 7.59.3.1.1.1.6.4 Evaluation of downstream sensor voltage

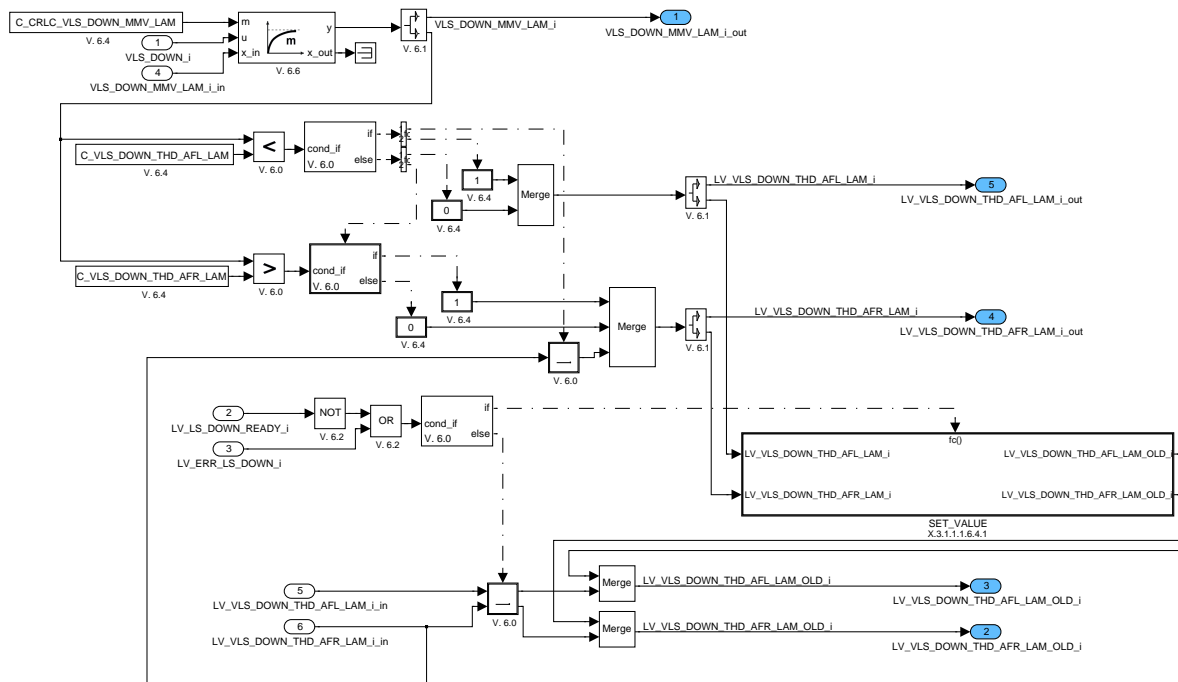


Figure 7.59.100: :

#### 7.59.3.1.1.1.6.4.1 Calculation of old value

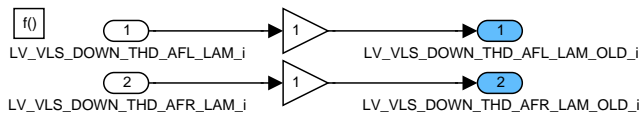


Figure 7.59.101: :

#### 7.59.3.1.1.1.6.5 feedthrough

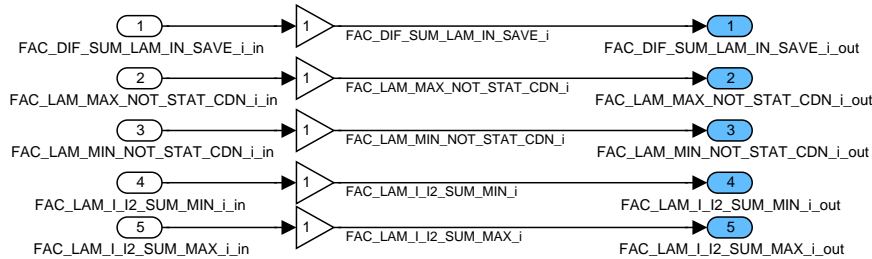
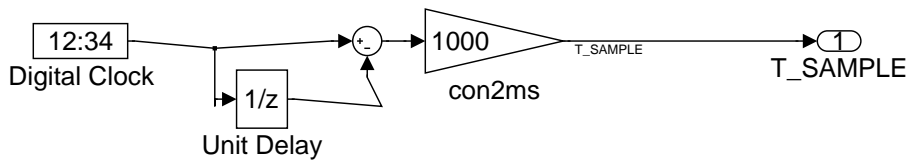


Figure 7.59.102: :

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7.59.3.1.2 No title given



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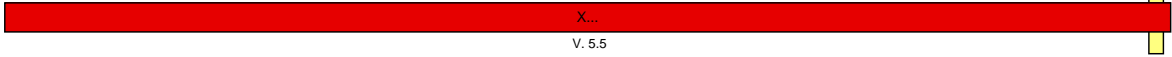

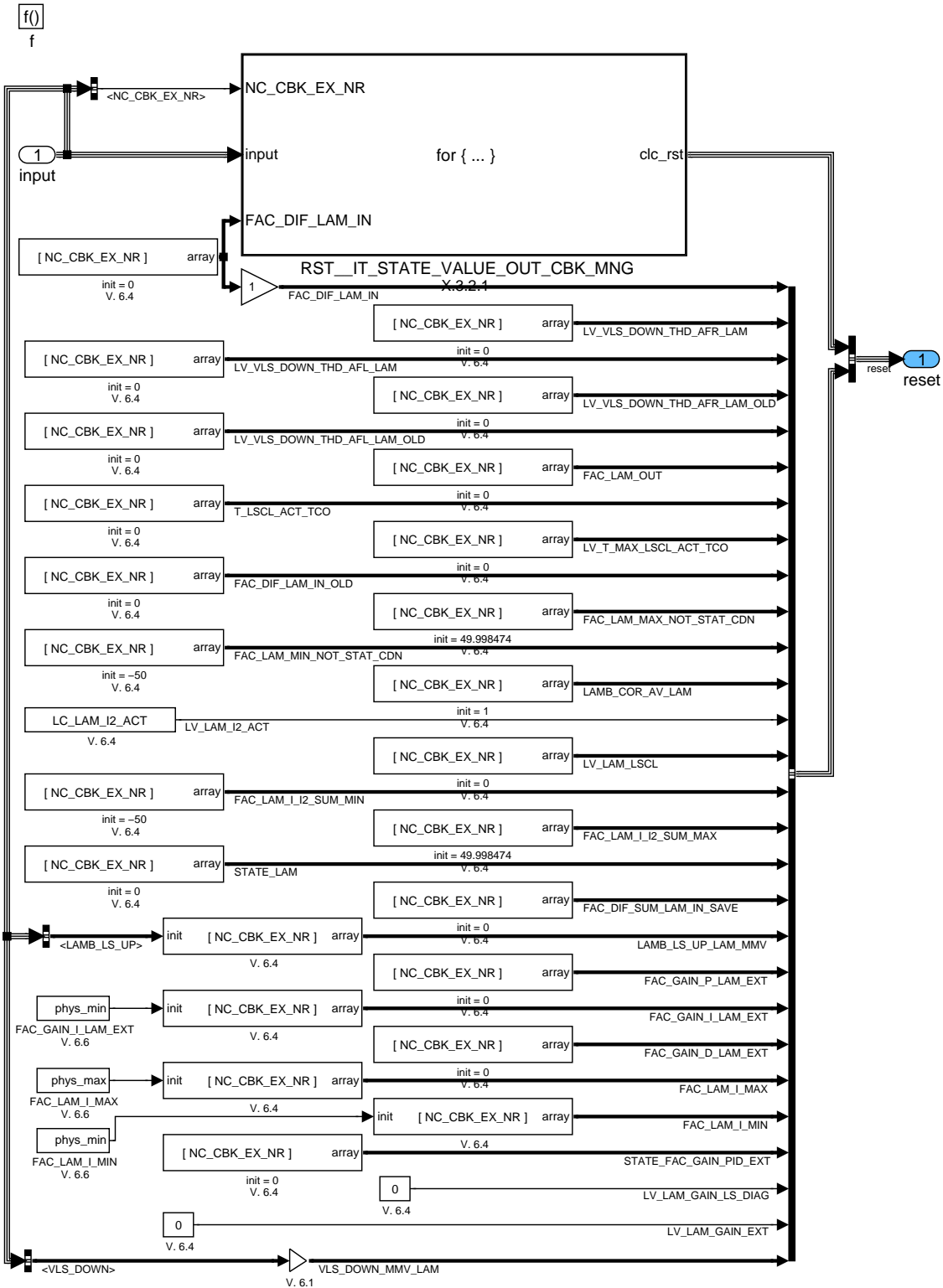


Figure 7.59.103: :


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### 7.59.3.2 Initialisation



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Figure 7.59.104: :

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 2535 of 8404</b>	
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### 7.59.3.2.1 for loop

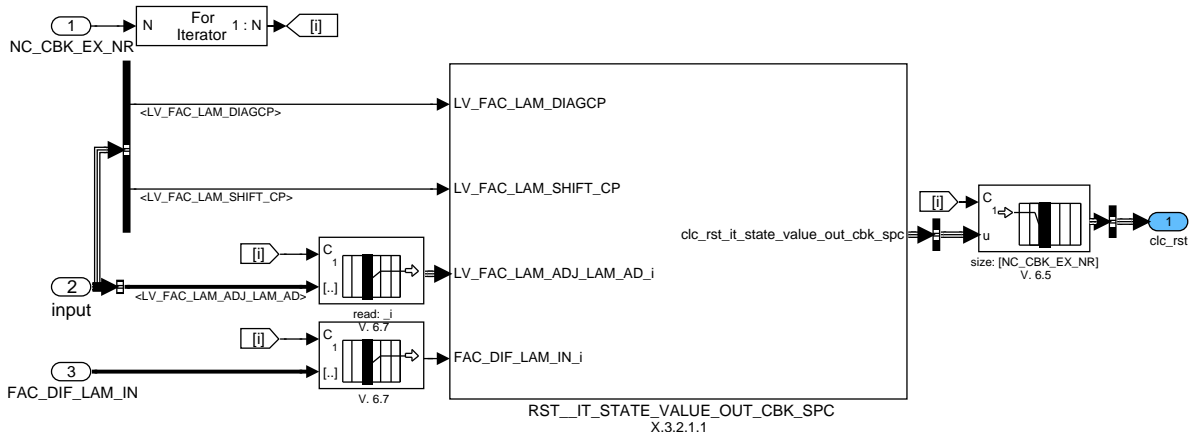


Figure 7.59.105: :

### 7.59.3.2.1.1 reset

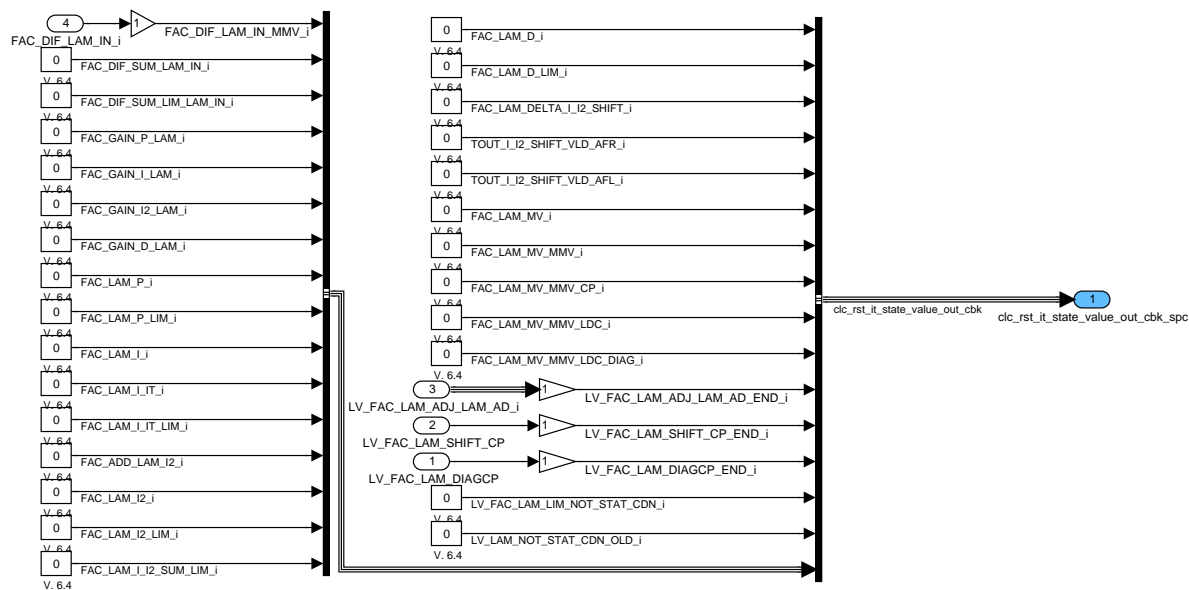


Figure 7.59.106: :

## 7.59.4 Controller output limitation and pre control path correction consideration

### General information:

### Application conditions:

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*Initialisation:* RST  
*Recurrence:* 20MS  
*Activation:* always  
*Deactivation:* never

**Function description:**

**Formula section:**

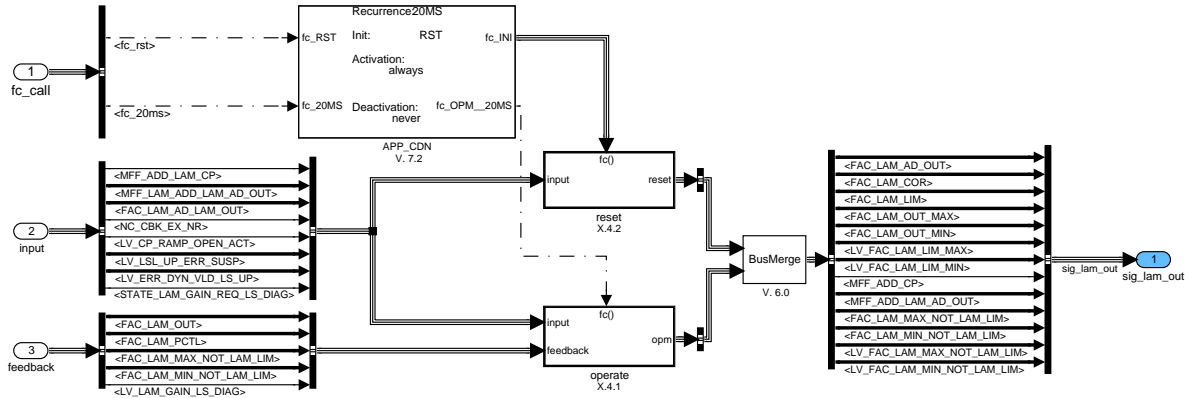


Figure 7.59.107: :

**7.59.4.1 for loop**

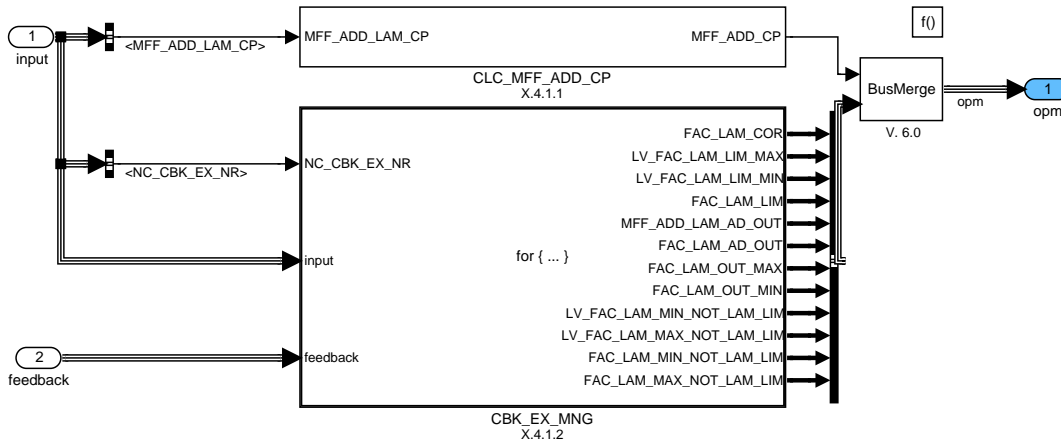


Figure 7.59.108: :

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### 7.59.4.1.1 Canister Purge Fuel Mass correction corresponding to Lambda Factor Shift

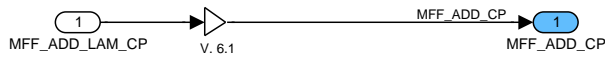


Figure 7.59.109: :

### 7.59.4.1.2 for loop (i= 0 to NC\_CBK\_EX\_NNR)

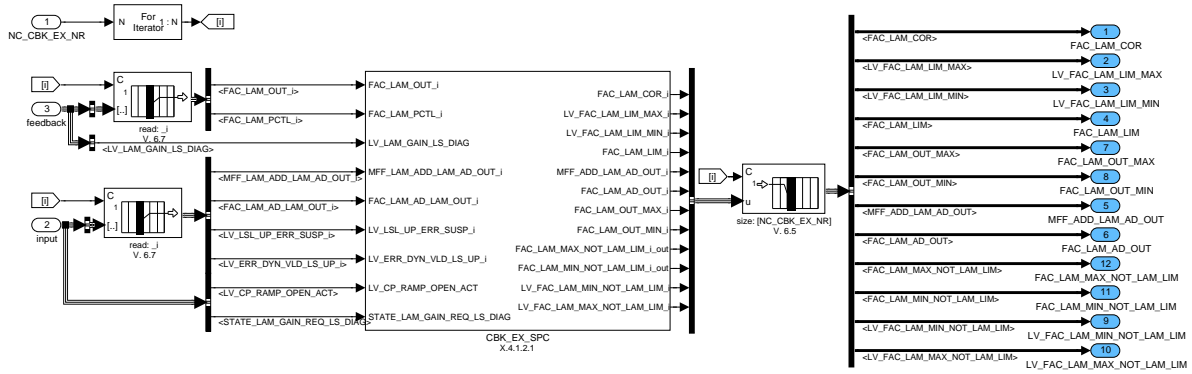


Figure 7.59.110: :

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7.59.4.1.2.1 limited lambda controller output plus pre control correction

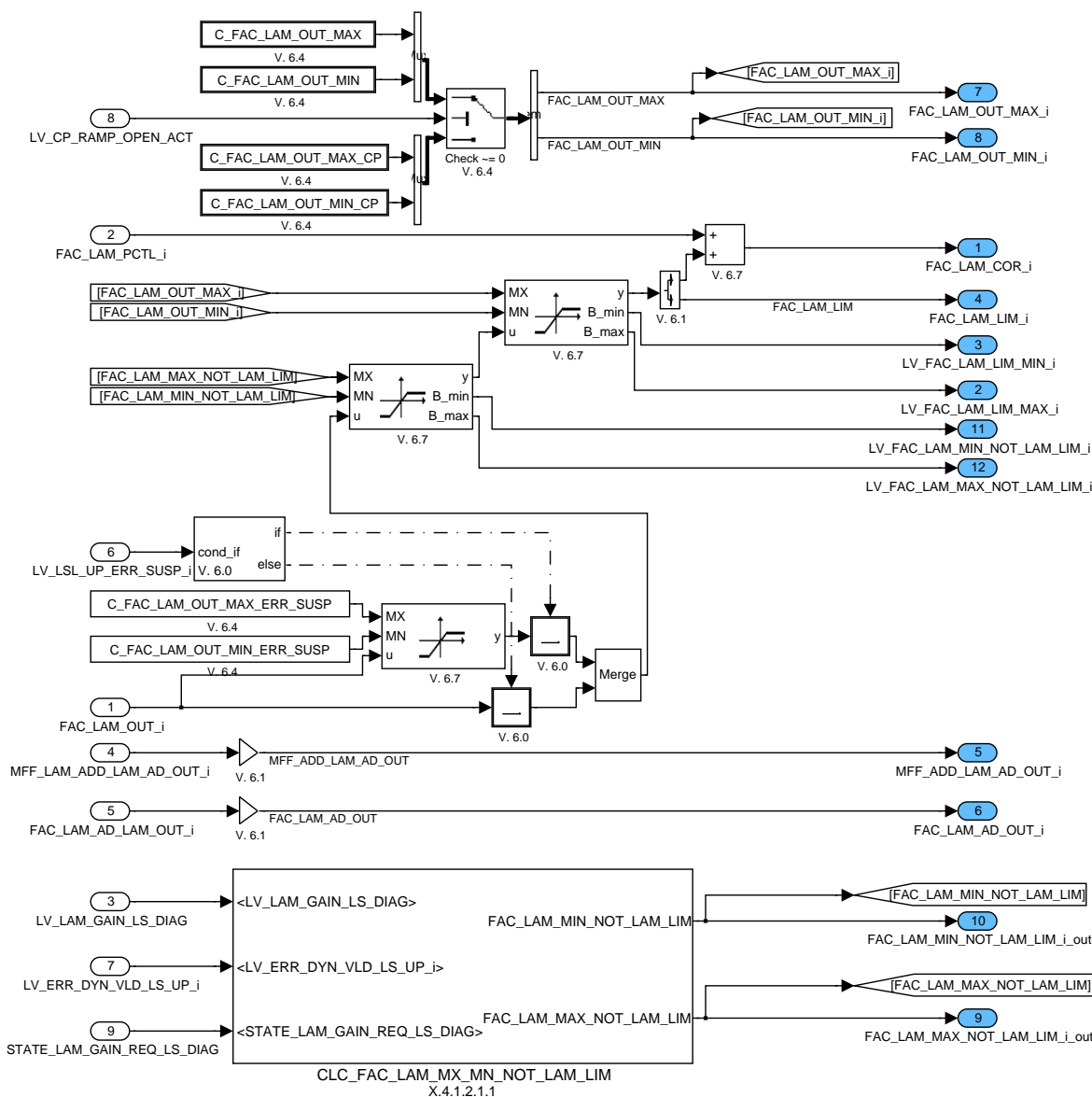


Figure 7.59.111: :

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### 7.59.4.1.2.1 Limitation of Total Lambda Controller Output

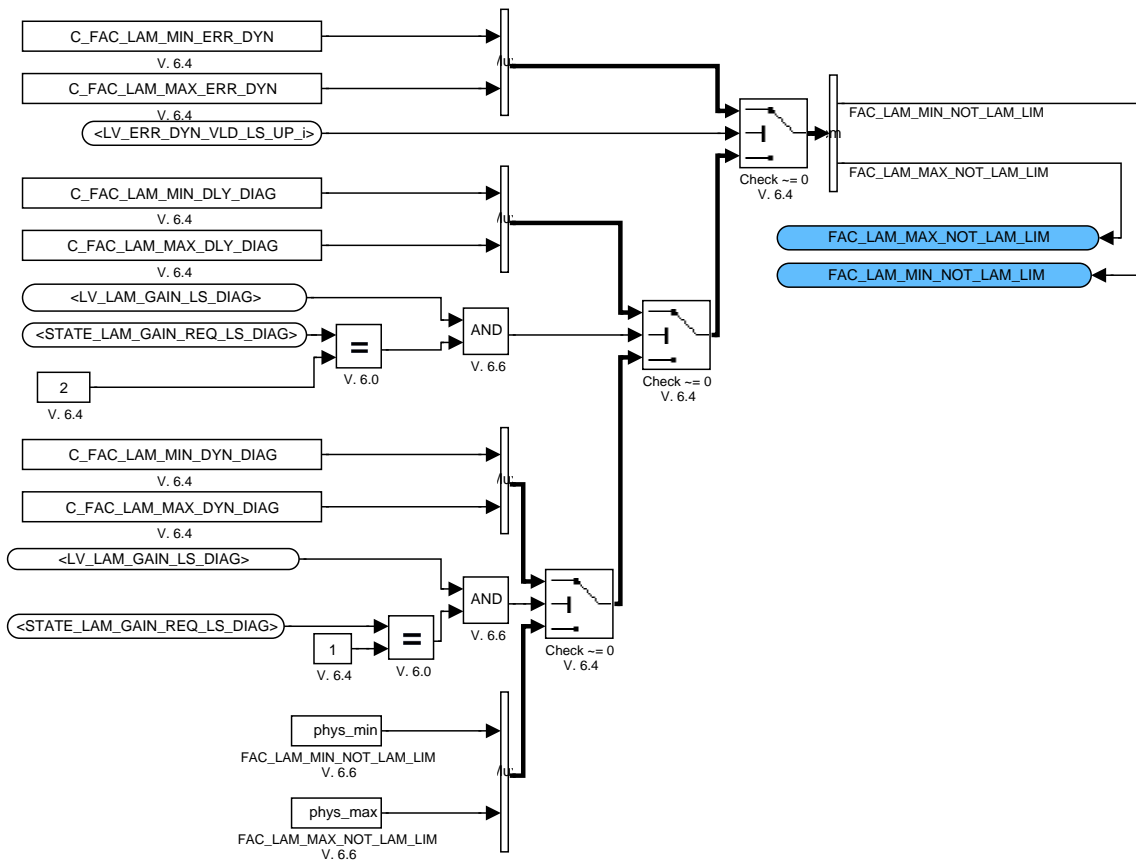


Figure 7.59.112: :

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### 7.59.4.2 reset

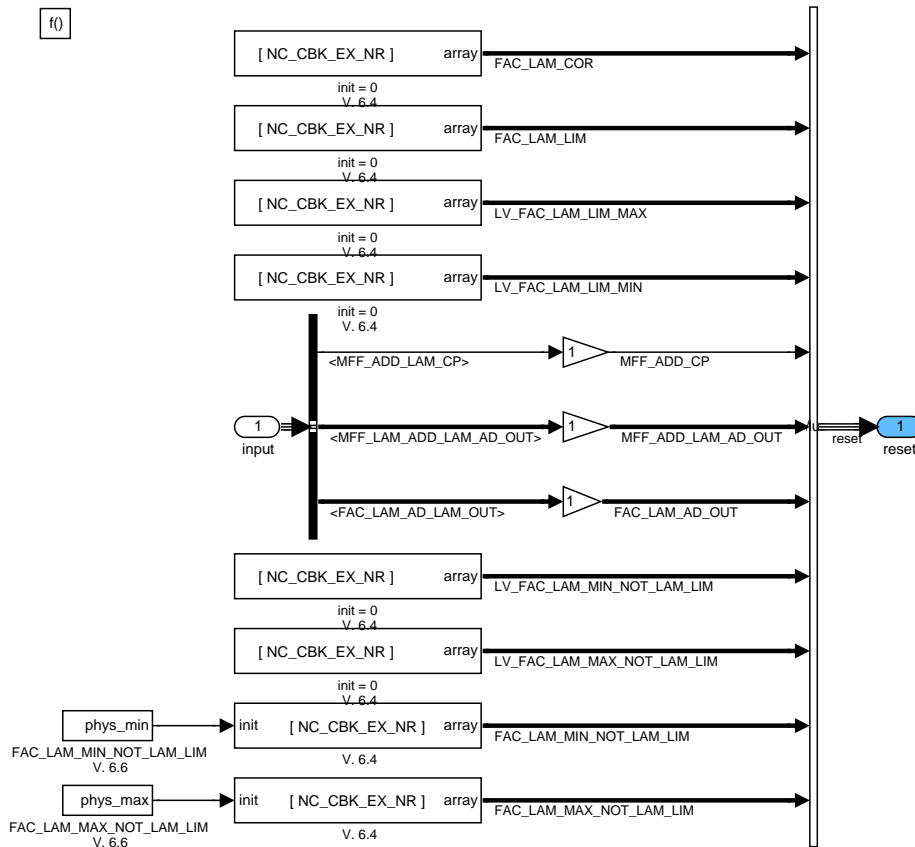


Figure 7.59.113: :

## 7.59.5 Calculation of air fuel ratio changes counter

### General information:

At each change of `LV_AFL[i]` the counter of air fuel ratio changes `CTR_RAF_CHG[i]` has to be incremented.

The counter `CTR_RAF_CHG[i]` can overflow.


`NC_CBK_EX_NR` defines the number of exhaust banks.

For vector elements the variable extension "`_i`" is used in the model instead of "`[i]`" as found in the textual description.

### Application conditions:

*Initialisation:* RST  
*Recurrence:* 20MS  
*Activation:* LV\_ST\_END == 1  
*Deactivation:* LV\_ST\_END == 0

### Function description:

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**Formula section:**

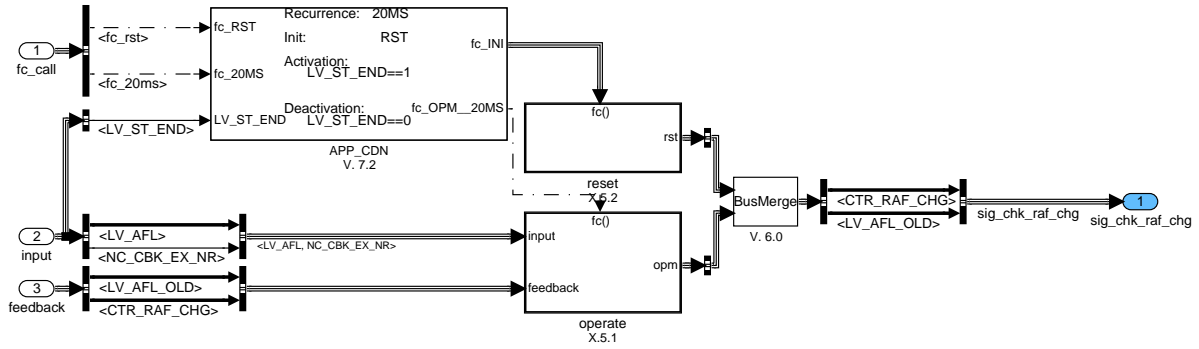


Figure 7.59.114: :

**7.59.5.1 for loop**

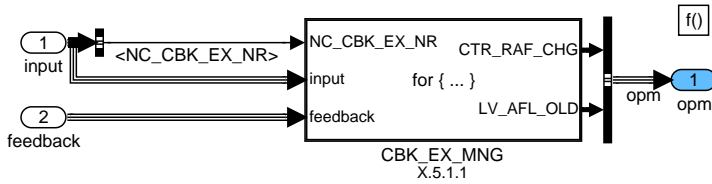


Figure 7.59.115: :

**7.59.5.1.1 for loop (i= 0 to NC\_CBK\_EX\_NR)**

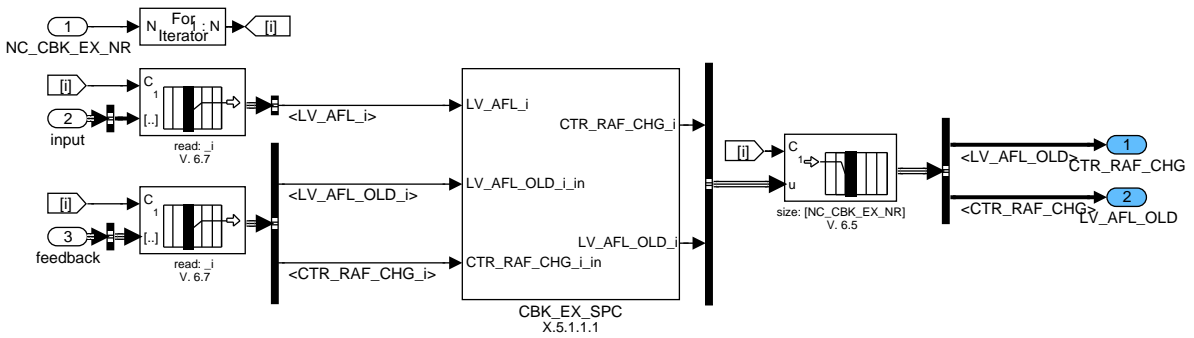


Figure 7.59.116: :

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### 7.59.5.1.1.1 counter of air fuel ratio changes

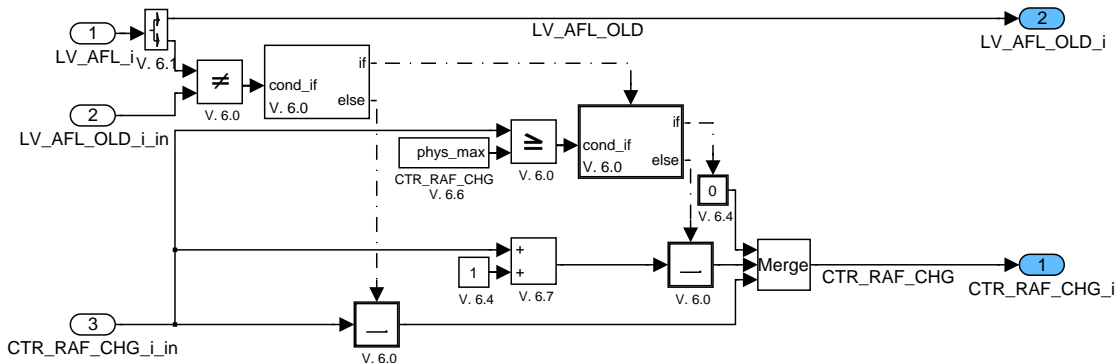


Figure 7.59.117: :

### 7.59.5.2 Initialisation

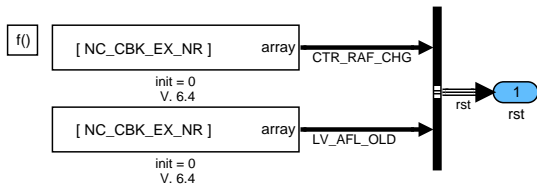


Figure 7.59.118: :


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## 7.60 Lambda control (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_EG_DLY_AGI_L2R [NC_CBK_EX_NR]	O/V	0... FFH	0... 31.875	0.125	-
Weighting factor for the calculation of the exhaust gas delay for aging in L2R-direction					
FAC_EG_DLY_AGI_R2L [NC_CBK_EX_NR]	O/V	0... FFH	0... 31.875	0.125	-
Weighting factor for the calculation of the exhaust gas delay for aging in R2L-direction					
FAC_IPT_SENS_MDL [NC_CBK_EX_NR]	O/V	0... 400H	0 ...1	976.599e-6	-
Interpolation factor for gas delay and sensor behavior model					
FAC_IPT_SENS_MDL_OPT [NC_CBK_EX_NR]	O/V	0... 400H	0 ...1	976.599e-6	-
Interpolation factor for sensor behavior model (optional)					
FAC_NEUT_NOT_STAT_CDN	O/V	8000... 7FFFH	-1... 0.99996	30.5e-6	-
value for detection of non-stationary conditions for lambda controller limitation					
FAC_TQ_REQ_OFS_LAM_NOT_STAT	V	8000... 7FFFH	-1... 0.99996	30.5e-6	-
actual torque value offset for detection of non-stationary condition					
LAMB_AV_DELTA_LAM [NC_CBK_EX_NR]	O/V	F800... 800H	-0.125 ...0.125	61e-6	-
lambda shift applied on measured lambda signal					
LAMB_DELTA_DYN_DIAG [NC_CBK_EX_NR]	V	F800... 800H	-0.125 ...0.125	61e-6	-
lambda setpoint shift for lambda controller due to active dynamic diagnosis					
LAMB_DIF_AV_CTL_ST_IN [NC_CBK_EX_NR]	V	F800... 800H	-0.125 ...0.125	61e-6	-
start lambda difference for lambda ctl.					
LAMB_DIF_AV_CTL_ST_OUT [NC_CBK_EX_NR]	V	F800... 800H	-0.125 ...0.125	61e-6	-
Lambda offset in case of first lambda ctl start in DC					
LAMB_LS_UP_DRV1 [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-0.5... 0.49998	15.3e-6	1/10ms
first derivate of upstream lambda signal					
LAMB_LS_UP_DRV1_MMV [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-0.5... 0.49998	15.3e-6	1/10ms
first derivate of upstream lambda signal - moving mean value					
LAMB_LS_UP_OLD_DRV1 [NC_CBK_EX_NR]	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Previous value of LAMB_LS_UP					
LAMB_SP_DELTA_LAM [NC_CBK_EX_NR]	O/V	F800... 800H	-0.125 ...0.125	61e-6	-
lambda shift applied on lambda set point					
LV_AFL_DRV1 [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating first derivate detection of lean Air-Fuel mixture when set					
LV_INH_LSCL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
inhibit signal for the controller deactivation					
LV_LAM_GAIN_SWI	O/V	0... 1H	0 ...1	1	-
lambda controller gain switch for idle speed					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAM_STOP_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request to stop the lambda controller					
LV_LAM_STOP_SHO_PER_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request to trigger the short period stop mode of the Lambda controller					
LV_LAMB_SP_AFL_THD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating that lambda setpoint is too lean and therefore the lambda controller is inhibited.					
LV_LAMB_SP_AFR_THD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating that lambda setpoint is too rich and therefore the lambda controller is inhibited.					
LV_MAF_INT_MIN_LAM_REAC_SWI	O/V	0... 1H	0 ...1	1	-
flag to switch limit of MAF_INT_MIN_LAM_REAC					
LV_STATE_LS_OPL_ERR [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag summarising errors that leads to open loop control					
MAF_INT_LAM_NOT_STAT	V	0... FFFFH	0... 1820.42	0.0277778	g
air mass flow integral for detection of non stationary condition					
MAF_INT_S_ACT	O/V	0... FFFFH	0... 2912.66666	0.0444444	g
air mass flow integral for during the S or HOMS operation modi					
MAF_OFS_LAM_NOT_STAT	V	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
air mass flow offset for detection of non stationary condition					
N_OFS_LAM_NOT_STAT	V	E020... 1FE0H	-8160 ...8160	1	rpm
engine speed offset for detection of non stationary condition					
STATE_SENS_MDL [NC_CBK_EX_NR]	O/V	0H 1H 2H	STND L2R R2L	-	-
State showing the active sensor plant-model					
T_LSL_UP_AGI_L2R [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	s
Time lag of the WRAF sensor model for aging in L2R-direction					
T_LSL_UP_AGI_R2L [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	s
Time lag of the WRAF sensor model for aging in R2L-direction					

**Input data:**


DELTA_LAMB_SP_O2L_MDL [NC_CBK_EX_NR] {p. 1037}	ERR_INH_LSCL [NC_CBK_EX_NR] {p. 1014}	FAC_COMP_MV_DIAG_DYN_SENS_MDL [NC_CBK_EX_NR] {p. 5345}	FAC_DIAG_DYN_LSL_UP [NC_CBK_EX_NR] {p. 5345}
FAC_TQ_REQ_DELTA_LDC {p. 2585}	LAMB_DELTA_LAM_ADJ [NC_CBK_EX_NR] {p. 2589}	LAMB_DELTA_SUM_LAM_ADJ_AD [NC_CBK_EX_NR] {p. 2622}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}
LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LAMB_SP_HOM [NC_CBK_EX_NR] {p. 8340}	LV_ACT_SA_EOL {p. 7763}	LV_AFL [NC_CBK_EX_NR] {p. 2439}
LV_HOM_ACT {p. 8136}	LV_INH_LAM_KWP {p. 7483}	LV_INH_LSCL_CUS [NC_CBK_EX_NR] {p. 8310}	LV_IS {p. 1720}

LV_LAM_AD_INJ_ACT {p. 3348}	LV_LAMB_COP [NC_CBK_EX_NR] {p. 8233}	LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}	LV_REQ_ISC {p. 3501}
LV_SA_END {p. 804}	LV_ST_END {p. 1720}	MAF {p. 8277}	MAF_CYL {p. 8277}
MAF_DELTA_LDC {p. 2585}	N {p. 1525}	N_DELTA_LDC {p. 2585}	NC_CBK_EX_NR {p. 1829}
STATE_LAM_GAIN_REQ_ LS_DIAG {p. 5349}	STATE_LS [NC_CBK_EX_NR] {p. 2448}	WGPWM [NC_CBK_EX_NR] {p. 8140}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_LAMB_LS_UP_DRV1	-	0... FFFFH	0... 0.99998	15.3e-6	-
Filtering constant for LAMB_LS_UP_DRV1_MMV					
C_FAC_DIAG_DYN_MIN_SENS_MDL_AGI	-	0... 400H	0 ...1	976.599e-6	-
Minimum FAC_DIAG_DYN-value to activate lambda controller plant model for sensor ageing					
C_FAC_TQ_REQ_DYW_LAM_NOT_STAT	-	0... FFFFH	0... 1.99996	30.5e-6	-
torque scaling factor window for detection for non stationary condition					
C_LAM_MAF_MIN_HYS	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Hysteresis for minimum MAF - threshold for lambda control					
C_LAMB_DIF_AV_CTL_ST_MAX	-	F800... 800H	-0.125 ...0.125	61e-6	-
max. allowable lambda deviation at initialisation of lambda difference for the lambda controller					
C_LAMB_DIF_AV_CTL_ST_MAX_IS	-	F800... 800H	-0.125 ...0.125	61e-6	-
max. allowable lambda deviation at initialisation of lambda difference for the lambda controller in IS					
C_LAMB_DIF_AV_CTL_ST_MIN	-	F800... 800H	-0.125 ...0.125	61e-6	-
min. allowable lambda deviation at initialisation of lambda difference for the lambda controller					
C_LAMB_DIF_AV_CTL_ST_MIN_IS	-	F800... 800H	-0.125 ...0.125	61e-6	-
min. allowable lambda deviation at initialisation of lambda difference for the lambda controller in IS					
C_LAMB_LS_UP_DRV1_THD_L2R	-	8000... 7FFFH	-0.5... 0.49998	15.3e-6	1/10ms
lambda gradient threshold below which lean2rich-model is activated					
C_LAMB_LS_UP_DRV1_THD_R2L	-	8000... 7FFFH	-0.5... 0.49998	15.3e-6	1/10ms
lambda gradient threshold above which rich2lean-model is activated					
C_LAMB_SP_AFL_THD	-	400... 1000H	1 ...4	976.599e-6	-
lean air-fuel mixture setpoint threshold					
C_LAMB_SP_AFL_THD_HYS	-	0... 400H	0 ...1	976.599e-6	-
lean air-fuel mixture setpoint threshold hysteresis					
C_LAMB_SP_AFR_THD	-	0... 400H	0 ...1	976.599e-6	-
rich air-fuel mixture setpoint threshold					
C_LAMB_SP_AFR_THD_HYS	-	0... 400H	0 ...1	976.599e-6	-
rich air-fuel mixture setpoint threshold hysteresis					
C_LGRD_LAMB_DIF_AV_CTL_ST	-	F800... 800H	-0.125 ...0.125	61e-6	-
limitation gradient of lambda deviation at initialisation of lambda difference for the lambda controller					
C_MAF_DYW_LAM_NOT_STAT	-	0... FFFFH	0... 1389	0.0211948	mg/stk
air mass flow window for detection of non stationary condition					
C_MAF_INT_LAM_NOT_STAT	-	0... FFFFH	0... 1820.41666	0.0277778	g
air mass flow integral for detection of non stationary condition					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_DYW_LAM_NOT_STAT	-	0... 1FE0H	0... 8160	1	rpm
engine speed window for detection of non stationary condition					
ID_FAC_IPT_SENS_MDL	-	0... 400H	0 ...1	976.599e-6	-
LDP_WGPWM_ID_FAC_IPT_SENS_MDL	6	0... FFFFH	0... 99.99847	1.5259e-3	%
Interpolation factor for waste gate position					
IP_FAC_EG_DLY_AGI_ASYM	-	0... FFH	0... 31.875	0.125	-
LDPM_FAC_COMP_MV_1_LACO	6	0... FFFFH	-32... 31.99902	976.599e-6	-
Additional delay time for lambda controller plant model - non symmetrical sensor ageing					
IP_FAC_IPT_SENS_MDL_OPT	-	0... 400H	0 ...1	976.599e-6	-
LDP_FAC_DYN_IP_FAC_IPT_SENS_MDL	4	0... 400H	0 ...1	976.599e-6	-
Interpolation factor for WRAF sensor dynamic					
IP_LAM_MAF_MIN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_LAM_MAF_MIN	6	0... 1FE0H	0... 8160	1	rpm
Minimum MAF - threshold for lambda control					
IP_LAMB_DELTA_DYN_DIAG	-	0... 1000H	-0.125 ...0.125	61e-6	-
LDPM_FAC_COMP_MV_1_LACO	6	0... FFFFH	-32... 31.99902	976.599e-6	-
lambda setpoint shift for lambda controller incase of active dynamic diagnosis					
IP_T_LSL_UP_AGI_ASYM	-	0... FFFFH	0... 1.99996	30.5e-6	s
LDPM_FAC_COMP_MV_1_LACO	6	0... FFFFH	-32... 31.99902	976.599e-6	-
Additional rise time for lambda controller plant model - non symmetrical sensor aging					
LC_FAC_IPT_SENS_MDL_OPT_ACT	-	0... 1H	0 ...1	1	-
switch to enable calculation of aged lin. O2 sensor signal correction (for monitoring only)					
LC_HOM_ACT_COMP	-	0... 1H	0 ...1	1	-
switching variable for the open loop/closed loop operation in stratified mode					
LC_LAM_GAIN_SWI	-	0... 1H	0 ...1	1	-
flag indicating whether lambda controller parameter switch is allowed					
LC_LAM_GAIN_SWI_LAM_AD_INJ	-	0... 1H	0 ...1	1	-
Flag indicating whether lambda controller parameter switch is allowed for minimum fuel mass adaptation					
LC_LAM_OFF_SAWUP	-	0... 1H	0 ...1	1	-
switching variable for the open loop/closed loop operation at secondary air					
LC_LAMB_COP_OFF	-	0... 1H	0 ...1	1	-
switch to disable the cat-heating-"lambda control deactivation condition"					
LC_SENS_MDL_SWI_DRV1_ACT	-	0... 1H	0 ...1	1	-
switch to activate the calculation of Lambda gradient for lambda controller plant model					

## FUNCTION DESCRIPTION:

### General information:

This module defines the project specific activation conditions and necessary output variables for the linear lambda controller.

The calculation shall be done for all exhaust cylinder banks.


For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2,

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

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## Application conditions

### Initialisation:

*at ECU reset:*

```

LV_INH_LSCL[i]           = 1
LV_LAM_GAIN_SWI         = LC_LAM_GAIN_
SWI
LAMB_SP_DELTA_LAM[i]    = 0
LAMB_AV_DELTA_LAM[i]    = 0
LV_LAM_STOP_REQ[i]      = 0
LV_STATE_LS_OPL_ERR[i]  = 0
LV_LAMB_SP_AFR_THD[i]   = 0
LV_LAMB_SP_AFL_THD[i]   = 0
LV_LAM_MAF_MIN          = 0
MFF_ADD_WF              = 0
N_OFS_LAM_NOT_STAT      = 0
MAF_OFS_LAM_NOT_STAT    = 0
MAF_INT_LAM_NOT_STAT    = 0
LAMB_DIF_AV_CTL_ST_OUT[i] = 0
LV_CLC_LAMB_DIF_AV_ST   = 1
LV_LAM_STOP_SHO_PER_REQ[i] = 0
FAC_TO_REQ_OFS_LAM_NOT_STAT = 0
MAF_INT_S_ACT           = 0
LAMB_DELTA_DYN_DIAG[i]  = 0
At LV_IGK = 0 -> 1
LAMB_DIF_AV_CTL_ST_OUT[i] = 0
LV_CLC_LAMB_DIF_AV_ST   = 1
LV_MAF_INT_MIN_LAM_REAC_SWI = 0

```

### Recurrence:

*T\_SAMPLE* = 20 ms

### Activation:

*LV\_ST\_END* = 1

### Deactivation:

-

### Formula section:

## 7.60.1 Calculation of LV\_INH\_LSCL[i]

### 7.60.1.1 Inhibition of the lambda feedback control circuit

**If(1)** LAMB\_SP[i] < C\_LAMB\_SP\_AFR\_THD

% lambda setpoint value is less than the rich air-fuel mixture threshold

**Then(1)** LV\_LAMB\_SP\_AFR\_THD[i] = 1

**Else(1)**

**If(2)** LAMB\_SP[i] > C\_LAMB\_SP\_AFR\_THD + C\_LAMB\_SP\_AFR\_THD\_HYS

**Then(2)** LV\_LAMB\_SP\_AFR\_THD[i] = 0

**Endif(2)**

**Endif(1)**

**If(1)** LAMB\_SP[i] > C\_LAMB\_SP\_AFL\_THD lambda setpoint value is greater than the lean air-fuel mixture threshold

**Then(1)** LV\_LAMB\_SP\_AFL\_THD[i] = 1

**Else(1)**


**If(2)** LAMB\_SP[i] < C\_LAMB\_SP\_AFL\_THD - C\_LAMB\_SP\_AFL\_THD\_HYS

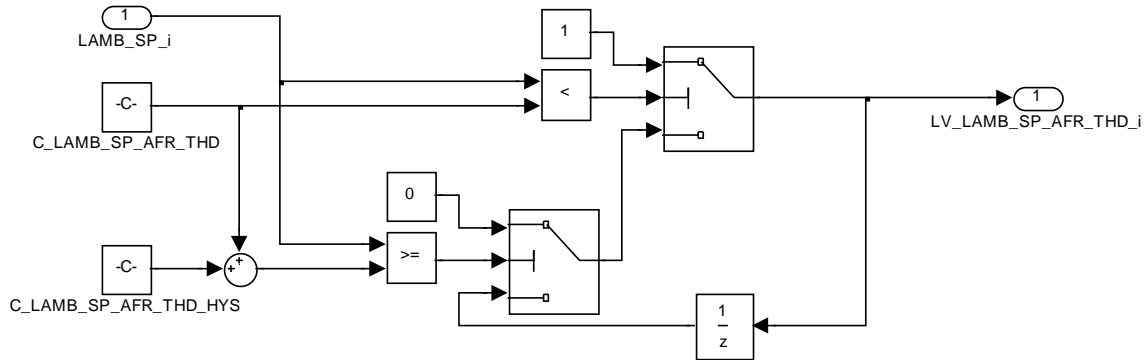
**Then(2)** LV\_LAMB\_SP\_AFL\_THD[i] = 0

**Endif(2)**

**Endif(1)**

(signal flow is analogous LV\_LAMB\_SP\_AFR\_THD[i], see above)

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```

If(1)          MAF < IP_LAM_MAF_MIN
Then(1)       LV_LAM_MAF_MIN = 1
Else(1)
If(2)          MAF > IP_LAM_MAF_MIN + C_LAM_MAF_MIN_HYS
Then(2)       LV_LAM_MAF_MIN = 0
Endif(2)
Endif(1)

```

### 7.60.1.2 Inhibition due to present error

```

If              ERR_INH_LSCL[i] > 0
Then LV_STATE_LS_OPL_ERR[i] = 1
Else LV_STATE_LS_OPL_ERR[i] = 0
Endif

```

### 7.60.1.3 Summary of all inhibition conditions for activation of lambda controller

```

If LV_STATE_LS_OPL_ERR[i] = 1 or (present error)
LV_LAMB_SP_AFR_THD[i] = 1 or (lambda setpoint to rich)
LV_LAMB_SP_AFL_THD[i] = 1 or (lambda setpoint to lean)
LV_LAM_MAF_MIN = 1 or (minimum maf not fulfilled)
(LC_LAMB_COP_OFF = 1 and
LV_LAMB_COP[i] = 1) or (catalyst overheat prevention)
LV_ACT_SA_EOL = 1 or (EOL test SA is active)
(LC_LAM_OFF_SAWUP=1 and
LV_SA_END = 0) or (secondary air is ac-
tive)
LV_INH_LAM_KWP = 1 (disable Controller via Tester)
Then LV_INH_LSCL[i] = 1
Else LV_INH_LSCL[i] = 0
Endif

```

### 7.60.1.4 Calculation of LV\_LAM\_STOP\_REQ[i]

The request to stop the lambda-controller (LV\_LAM\_STOP\_REQ[i] = 1), if one of the conditions

1. stratified charge mode (LV\_HOM\_ACT=0) **and** LC\_HOM\_ACT\_COMP = 0 **or**
2. secondary air is active (LV\_SA\_END = 0) **and** LC\_LAM\_OFF\_SAWUP = 1

is fulfilled.

```

If (LV_HOM_ACT = 0 and
LC_HOM_ACT_COMP = 0) or
LV_INH_LSCL_CUS[i] = 1 or

```

```
(LV_SA_END = 0          and
  LC_LAM_OFF_SAWUP = 1)
Then LV_LAM_STOP_REQ[i] = 1
Else LV_LAM_STOP_REQ[i] = 0
Endif
```

### 7.60.1.5 Setting of LV\_LAM\_GAIN\_SWI

The gain of the lambda controller is different between idle speed and part load. Therefore, the gain is switched in case of active idle speed controller.

```
If      (LV_REQ_ISC = 1 and LC_LAM_GAIN_SWI = 1)
  or (LV_LAM_AD_INJ_ACT = 1 and LC_LAM_GAIN_SWI_LAM_AD_INJ = 1)
Then    LV_LAM_GAIN_SWI = 1
Else    LV_LAM_GAIN_SWI = 0
Endif
```

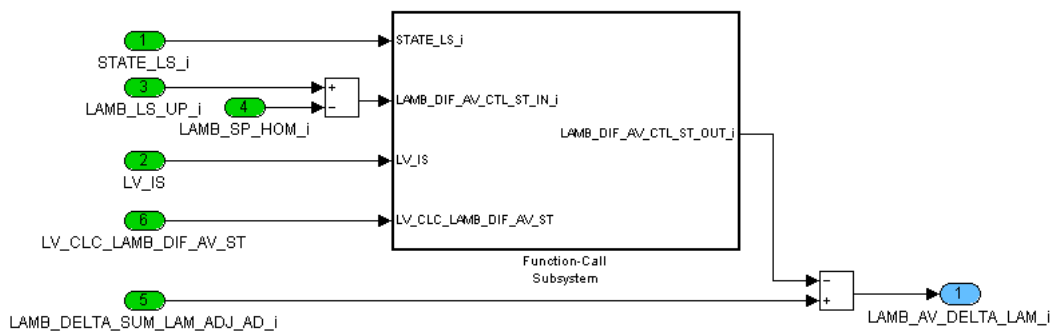
### 7.60.1.6 Assignment of LAMB\_SP\_DELTA\_LAM[i]

The output of the trim controller (P and I share) is distributed as follows as corrective intervention on the lambda set point and on the measured lambda signal:

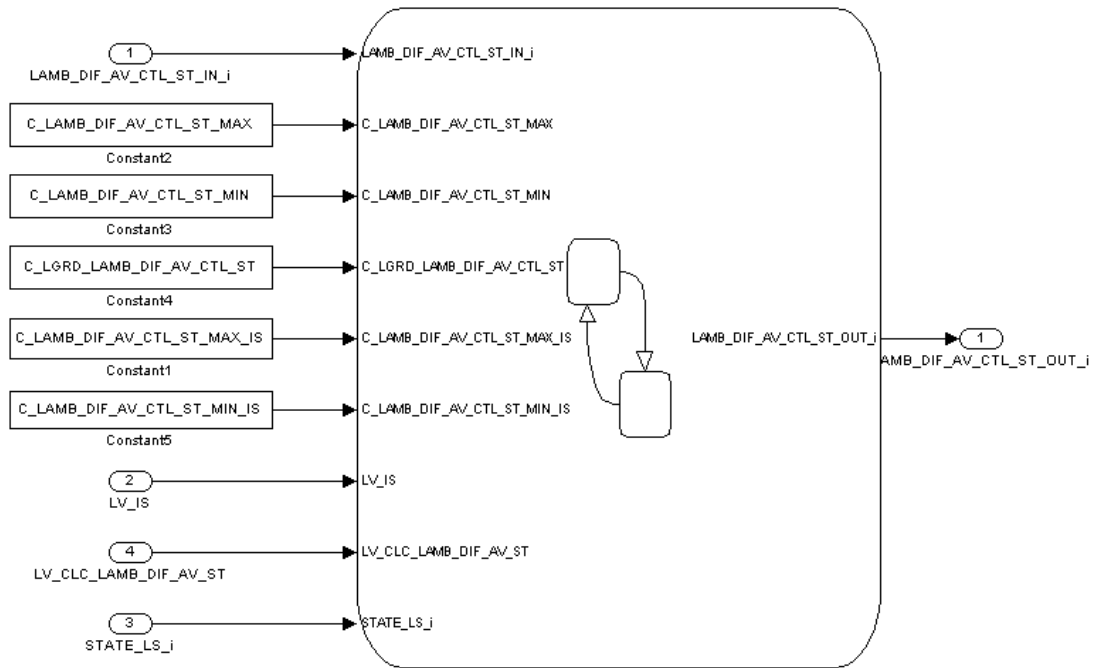
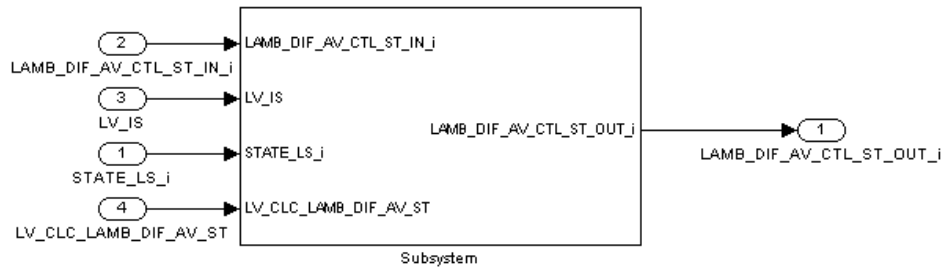
```
If    STATE_LAM_GAIN_REQ_LS_DIAG = DYN_DIAG
Then  LAMB_DELTA_DYN_DIAG[i] = IP_LAMB_DELTA_DYN_DIAG
      COMP_MV_DIAG_DYN_SENS_MDL [i]
Else  LAMB_DELTA_DYN_DIAG[i] = 0
Endif
LAMB_SP_DELTA_LAM[i] = LAMB_DELTA_LAM_ADJ[i]
                      + DELTA_LAMB_SP_O2L_MDL[i]
+ LAMB_DELTA_DYN_DIAG[i]
```

(FAC\_


### 7.60.1.7 Assignment of LAMB\_AV\_DELTA\_LAM[i]

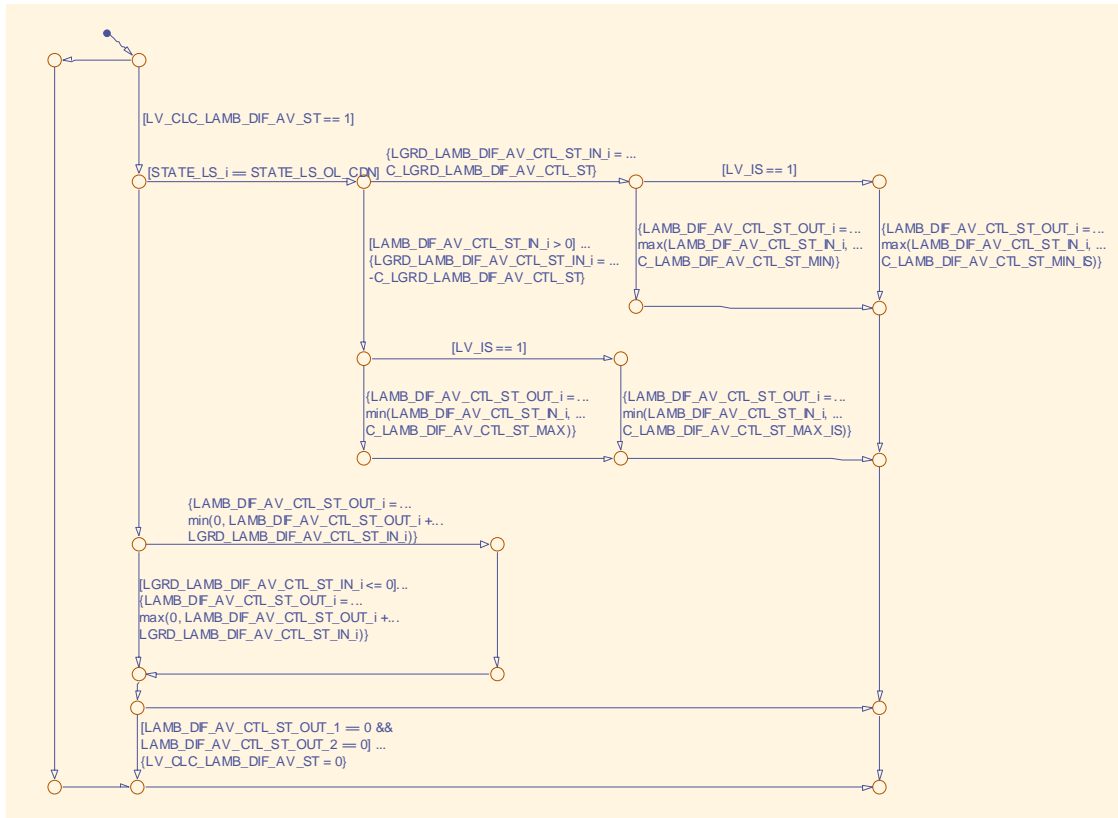


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### 7.60.1.8 1.1.7 tection of non-stationary condition

A limited dynamic condition based on N, MAF and PV\_AV is detected when the variation of those variables exceed the calibrateable threshold.

```

IF (ABS(N_DELTA_LDC) > C_N_DYW_LAM_NOT_STAT)
THEN
    IF (ABS(N_DELTA_LDC - N_OFS_LAM_NOT_STAT) > C_N_DYW_LAM_NOT_STAT)
    THEN
        N_OFS_LAM_NOT_STAT = N_DELTA_LDC
        MAF_INT_LAM_NOT_STAT = 0
    ENDIF
    ELSE
        N_OFS_LAM_NOT_STAT = 0
    ENDIF
    IF (ABS(MAF_DELTA_LDC) > C_MAF_DYW_LAM_NOT_STAT)
    THEN
        IF (ABS(MAF_DELTA_LDC - MAF_OFS_LAM_NOT_STAT) >
            C_MAF_DYW_LAM_NOT_STAT)
        THEN
            MAF_OFS_LAM_NOT_STAT = MAF_DELTA_LDC
            MAF_INT_LAM_NOT_STAT = 0
        ENDIF
    ELSE
        MAF_OFS_LAM_NOT_STAT = 0
    ENDIF

```

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```

IF (ABS(FAC_TQ_REQ_DELTA_LDC) > C_FAC_TQ_REQ_DYW_LAM_NOT_STAT)
THEN
    IF (ABS(FAC_TQ_REQ_DELTA_LDC - FAC_TQ_REQ_OFS_LAM_NOT_STAT) >
        C_FAC_TQ_REQ_DYW_LAM_NOT_STAT)
    THEN
        FAC_TQ_REQ_OFS_LAM_NOT_STAT = FAC_TQ_REQ_DELTA_LDC
        MAF_INT_LAM_NOT_STAT = 0
    ENDIF
ELSE
    FAC_TQ_REQ_OFS_LAM_NOT_STAT = 0
ENDIF
IF (MAF_INT_LAM_NOT_STAT < C_MAF_INT_LAM_NOT_STAT)
THEN % non stationary condition detected
    MAF_INT_LAM_NOT_STAT [g] = MAF_INT_LAM_NOT_STAT [g] +
        MAF_CYL [kg/h] * T_SAMPLE [ms] * 1/3600 [(g*h)/(kg*ms)]
    FAC_NEUT_NOT_STAT_CDN= 7FFFh
ELSE % stationary condition
    FAC_NEUT_NOT_STAT_CDN= 0h
ENDIF
    
```

### 7.60.1.9 Assignment of interpolation factor

```

IF LC_FAC_IPT_SENS_MDL_OPT_ACT = 1
then
    FAC_IPT_SENS_MDL[i] = 0
    FAC_IPT_SENS_MDL_OPT[i] = IP_FAC_IPT_SENS_MDL_OPT(FAC_DIAG_DYN_LSL_UP[i])
else
    FAC_IPT_SENS_MDL[i] = ID_FAC_IPT_SENS_MDL(WGPWM[i])
    FAC_IPT_SENS_MDL_OPT[i] = 0
endif
    
```

### 7.60.1.10 Calculation of air massflow integral during S/HOMS operation mode

```

IF LV_HOM_ACT = 1 -> 0
Then MAF_INT_S_ACT = 0
Elseif LV_HOM_ACT = 0
Then MAF_INT_S_ACT = MAF_INT_S_ACT + MAF_CYL [kg/h] * T_SAMPLE [ms] * 1/3600
    [(g*h)/(kg*ms)]
Elseif LV_HOM_ACT = 1
Then hold MAF_INT_S_ACT
Endif
    
```


## 7.60.2 Calculations in 10ms

### General information:

The lambda controller plant model is determined depending on STATE\_SENS\_MDL. It can be chosen between a lean2rich, a rich2lean and a default model.

The default sensor plant model is used e.g. if forced adaptation is off and gradient based switching is off or during the dynamic diagnosis to have a defined reference.

### Application conditions:

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**Initialisation:**

```

at ECU reset:
STATE_SENS_MDL[i] = STND
LAMB_LS_UP_DRV1[i] = 0
LAMB_LS_UP_DRV1_MMV[i] = 0
FAC_IPT_SENS_MDL[i] = 0
FAC_EG_DLY_AGI_L2R[i] = 0
FAC_EG_DLY_AGI_R2L[1] = 0
LAMB_DELTA_DYN_DIAG[i] = 0
LV_AFL_DRV1[i] = 0
T_LSL_UP_AGI_L2R[i] = 0
T_LSL_UP_AGI_R2L[i] = 0

```

**Recurrence:** 10 ms

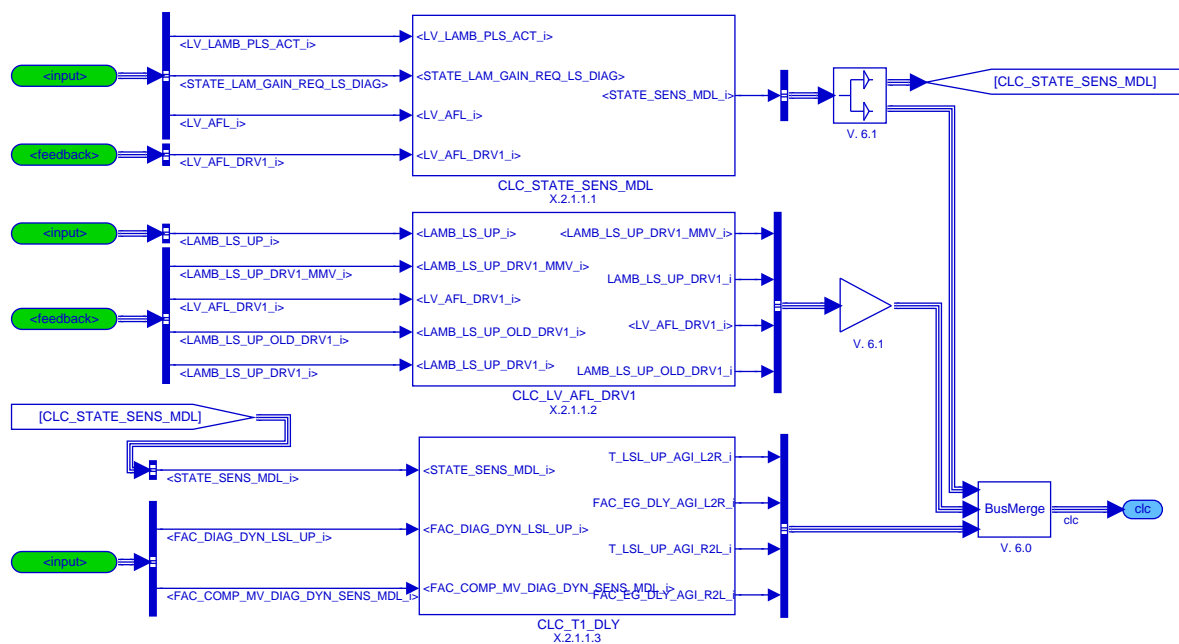
**Activation:** LV\_ST\_END = 1

**Deactivation:** LV\_ST\_END = 0

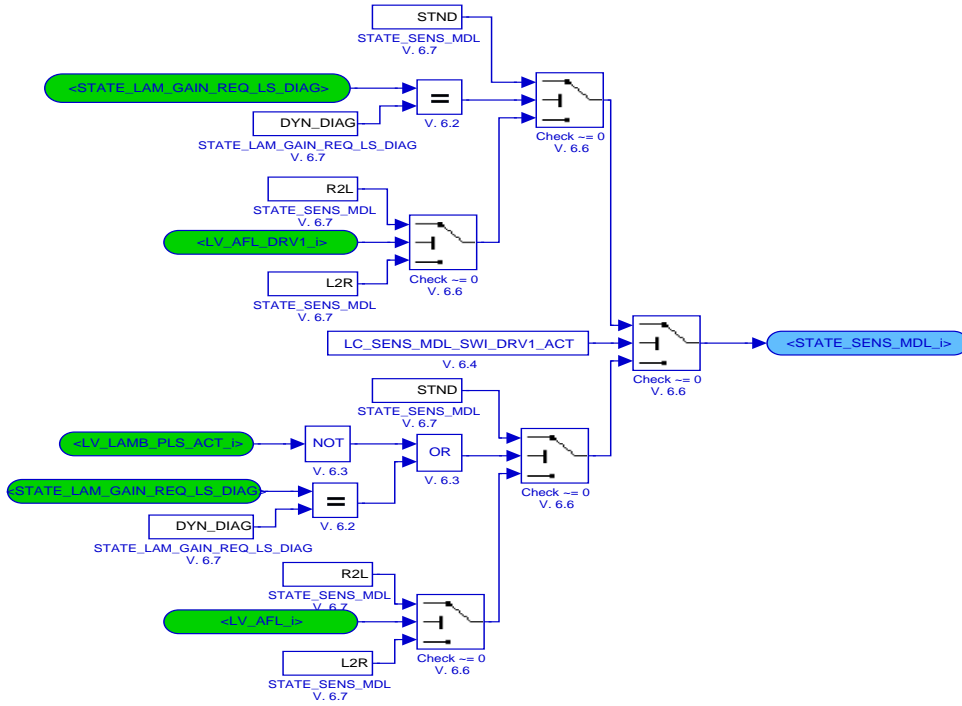
## Function description:

## Formula section:


### 7.60.2.1 Calculation of lambda controller plant model status



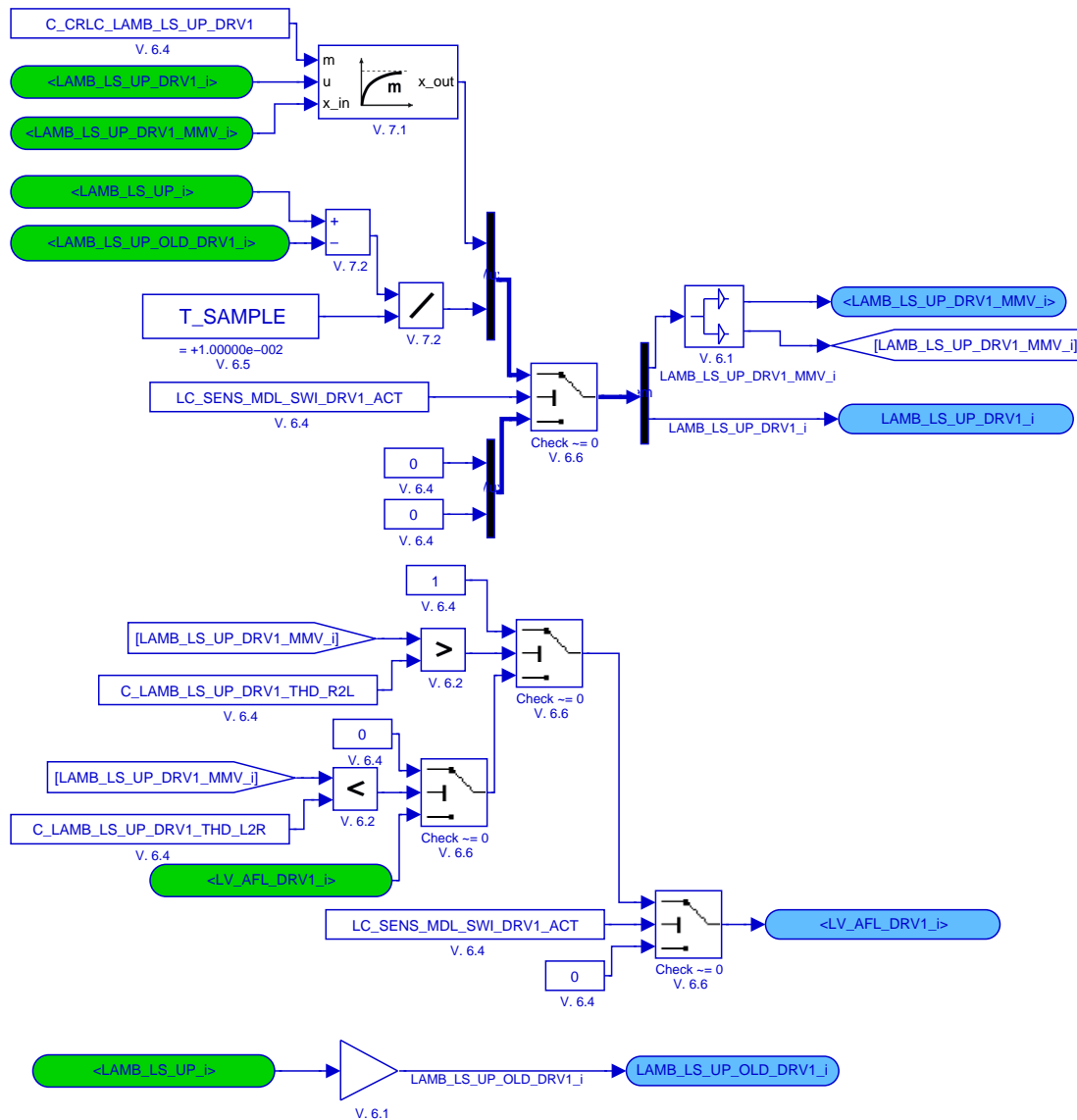
### 1.2.2 State showing the active sensor plant-model



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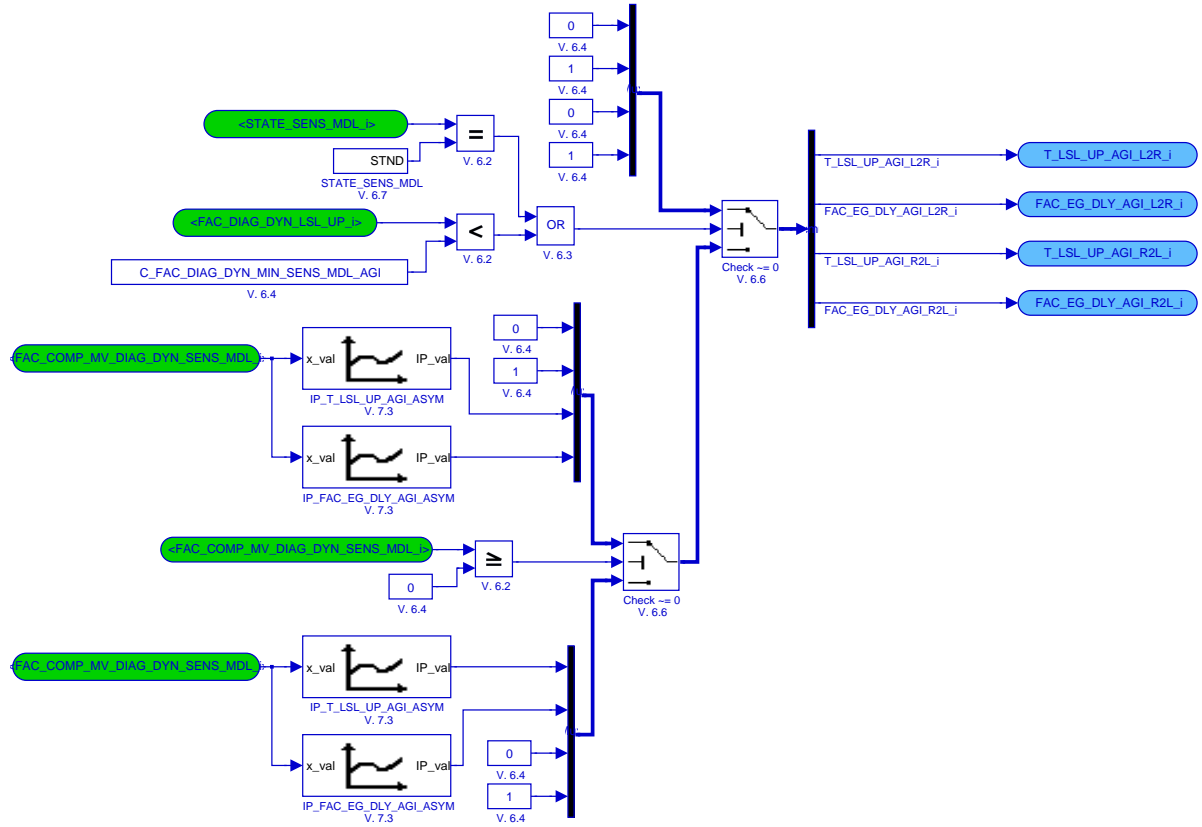
### 7.60.2.2 1.2.3 Calculation of first derivate detection of lean Air-Fuel mixture when set




### 7.60.2.3 1.2.4 Determination T1 and T-delay times for lambda controller plant model in case of ageing

FAC\_COMP\_MV\_DIAG\_DYN\_SENS\_MDL[i] is given by EGCP to indicate the asymmetric aged sensor behaviour. (e.g. -1.5=L2Rslow, 1.5=R2Lslow and 0=nominal). Depending on this value additional T1- and T-delay-times (separate ones for R2L & L2R) can be determined. These times are taken into account in the lambda controller plant model while the R2L or L2R model is active

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## 7.61 Forced lambda stimulation coordination

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_PLS [NC_CBK_EX_NR]	O/V	F800... 7FFH	0... 0.12493896	610.352e3	-
Lambda deviation for the Lambda Controller					
LV_LAMB_PLS_AFL_COR_ACT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that corrective action for lean half wave of lambda stimulation is active					
LV_LAMB_PLS_AFR_COR_ACT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that corrective action for rich half wave of lambda stimulation is active					

### Input data:

FAC_DIF_LAM_IN_MMV [NC_CBK_EX_NR] {p. 2460}	LAMB_PLS_EXT [NC_CBK_EX_NR] {p. 2579}	LAMB_PLS_O2L_OSC [NC_CBK_EX_NR] {p. 2563}	LV_ST_END {p. 1720}
NC_CBK_EX_NR {p. 1829}	STATE_LAMB_PLS_DET_ VALUE {p. 2958}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_DIF_THD_AFL_PLS_OFF	-	0... 7FFFH	0... 0.99996948	305.176e3	-
lambda control difference threshold for deactivating lean stimulation half wave					
C_FAC_DIF_THD_AFL_PLS_ON	-	8000... 7FFFH	0... 0.99996948	305.176e3	-
lambda control difference threshold for re activating lean stimulation half wave					
C_FAC_DIF_THD_AFR_PLS_OFF	-	8000... 0H	0 ...0	305.176e3	-
lambda control difference threshold for deactivating rich stimulation half wave					
C_FAC_DIF_THD_AFR_PLS_ON	-	8000... 7FFFH	0... 0.99996948	305.176e3	-
lambda control difference threshold for re activating rich stimulation half wave					
LC_LAMB_PLS_COR_ACT_IS	-	0... 1H	0 ...1	1	-
calibration flag indicating that corrective action for lambda stimulation is allowed in idle speed					
LC_LAMB_PLS_EXT	-	0... 1H	0 ...1	1	-
flag indicating that external LAMB_PLS is used					

### 7.61.1 EGTR\_DEFSPFSTICO

NC\_CBK\_EX\_NR defines the number of exhaust banks.

For vector elements, the variable extension `_i` is used in the model instead of `[i]` as found in the textual description.

### Application Condition

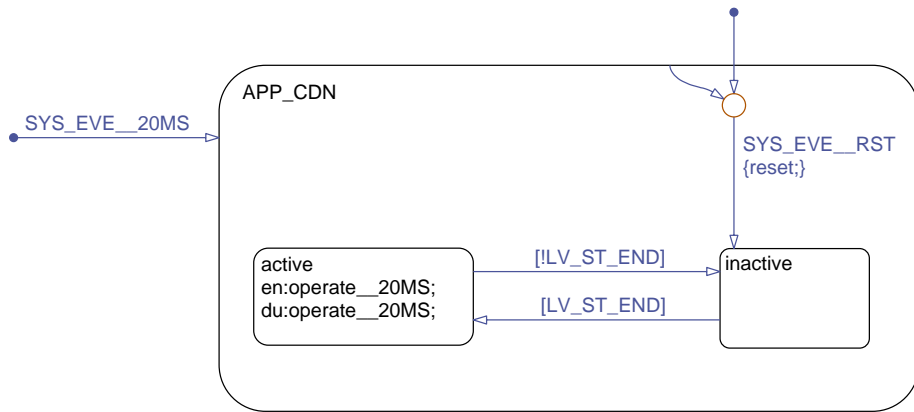


Figure 7.61.1: EGTR\_DEFSPFSTIC0/APP\_CDN/Chart

**Function Description**

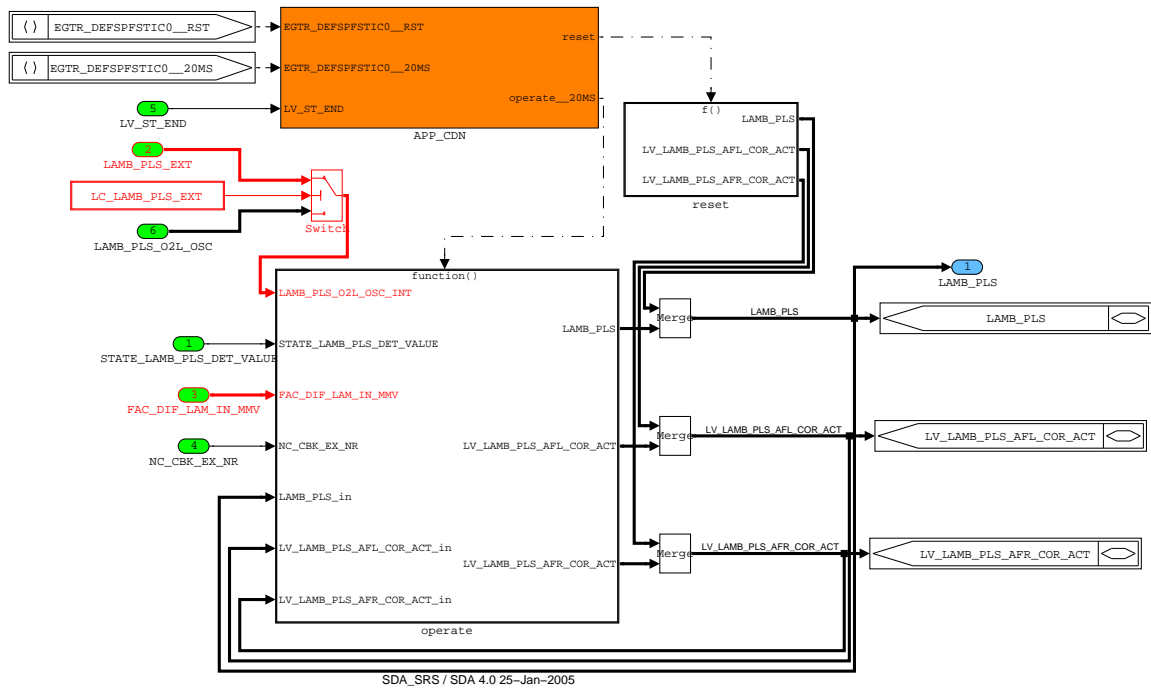


Figure 7.61.2: EGTR\_DEFSPFSTIC0

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### 7.61.1.1 SUBFUNCTION: operate



Figure 7.61.3: EGTR\_DEFSPFSTIC0/operate

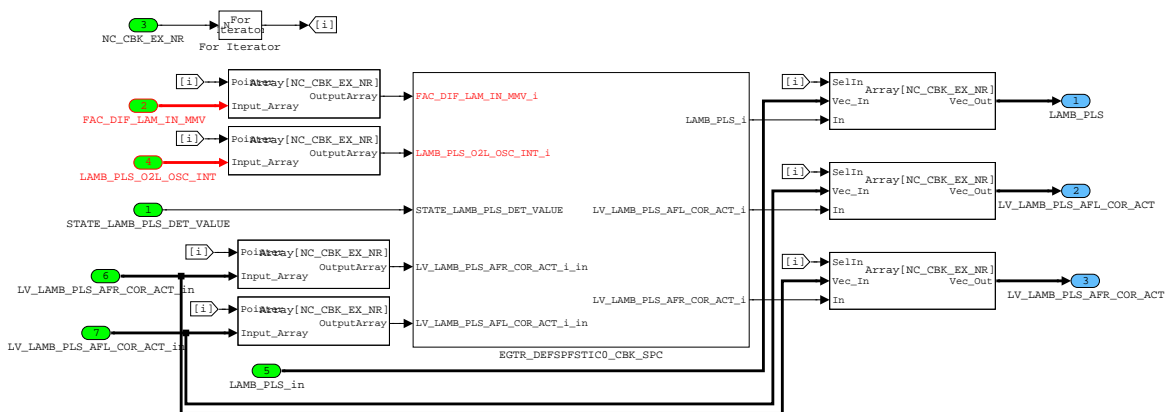


Figure 7.61.4: EGTR\_DEFSPFSTIC0/operate/EGTR\_DEFSPFSTIC0\_CBK\_MNG

#### Corrective action depending on lambda controller difference

Depending on the lambda control difference  $FAC\_LAM\_DIF\_IN[i]$  a corrective intervention on the lambda pulse can be applied. In case of too lean mixture the lean deviation can be suppressed and in case of too rich mixture the rich deviation can be suppressed. Activation and deactivation of the corrective intervention is realised with different thresholds in order to apply a hysteresis.

With  $LC\_LAMB\_PLS\_COR\_ACT\_IS$  this corrective action can also be applied in idle speed.

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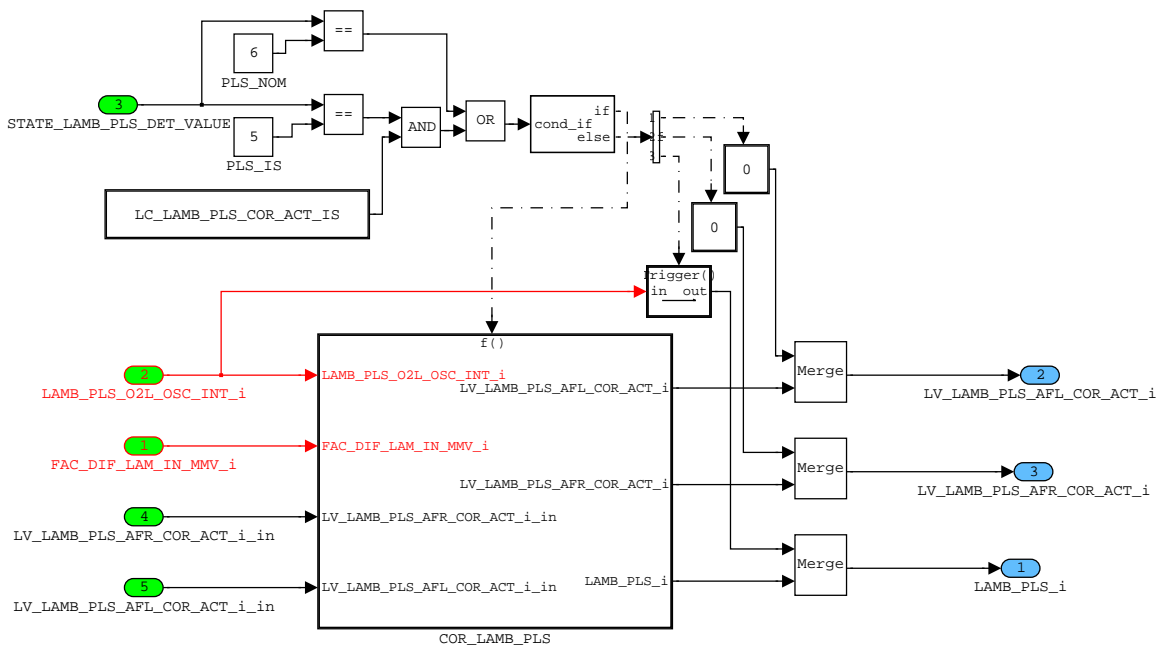


Figure 7.61.5:  
EGTR\_DEFSPFSTIC0/operate/EGTR\_DEFSPFSTIC0\_CBK\_MNG/EGTR\_DEFSPFSTIC0\_CBK\_SPC

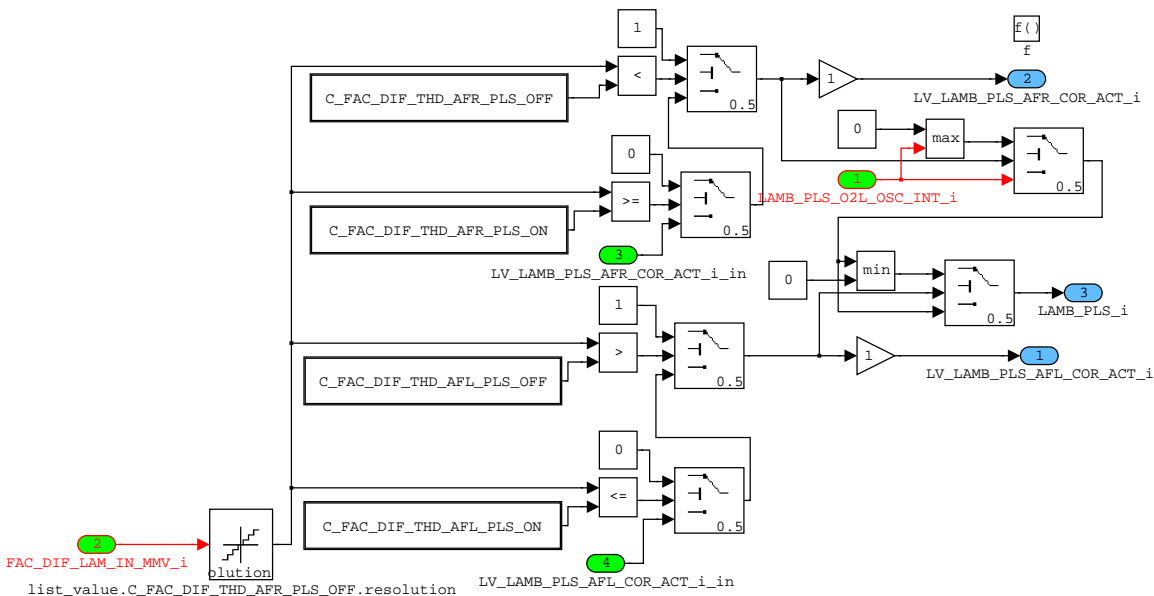


Figure 7.61.6: EGTR\_DEFSPFSTIC0/operate/EGTR\_DEFSPFSTIC0\_CBK\_MNG/  
EGTR\_DEFSPFSTIC0\_CBK\_SPC/COR\_LAMB\_PLS

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### 7.61.1.2 SUBFUNCTION: reset

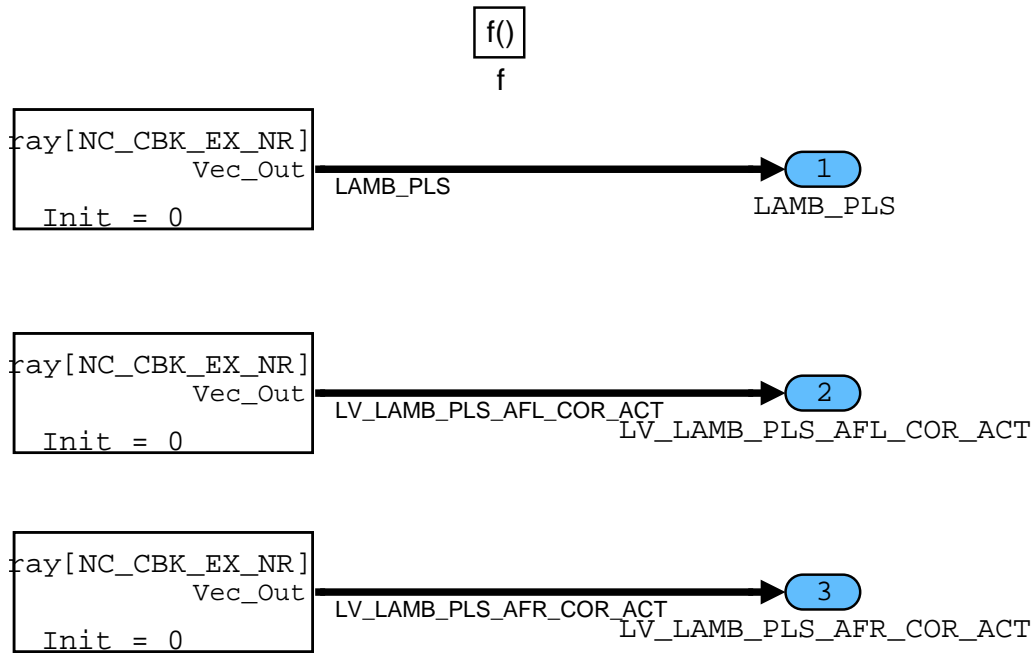


Figure 7.61.7: EGTR\_DEFSPFSTIC0/reset

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## 7.62 Forced lambda stimulation (linear control)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_O2L_LAMB_PLS [NC_CBK_EX_NR]	V	8000... 7FFFH	-0.25... 0.2499924	7.6294e-6	-
temporary factor for O2 loading calculation considering the lambda set point deviation					
LAMB_PLS_O2L_OSC [NC_CBK_EX_NR]	O/V	F800... 7FFFH	-0.125... 0.124939	61.352e-6	-
lambda set point deviation based on forced stimulation O2 balancing					
LV_LAMB_PLS_MST_CBK [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
auxiliary flag indicating that this bank is master bank for forced stimulation					
LV_LAMB_PLS_O2L_OSC_POS [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
auxiliary flag indicating positive lambda stimulation half wave					
LV_LAMB_PLS_SYN_CBK	O/V	0... 1H	0 ...1	1	-
flag used for exhaust gas bank synchronization					
O2L_ADD_LAMB_PLS [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-669.9236 ...669.9236	311.96e-9	g
O2 load to be added to the O2 load integral each sample step					
O2L_LAMB_PLS [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-669.9236 ...669.9236	311.96e-9	g
current O2 loading or release for forced lambda stimulation					
O2L_SP_HALF_LAMB_PLS [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.616849	39.306e-6	g
auxiliary value; half O2 loading set point of forced lambda stimulation					
O2L_SP_NEW_LAMB_PLS [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.616849	39.306e-6	g
O2 loading set point that is realized by forced lambda stimulation					
STATE_LAMB_PLS [NC_CBK_EX_NR]	O/V	0H 1H 2H	OFF AFL AFR	-	-
state of forced lambda stimulation					

### Input data:

LAMB_DELTA_MAX_PLS {p. 2958}	LAMB_SP_DE_PLS {p. 2958}	LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}	LV_ST_END {p. 1720}
MAF_CYL {p. 8277}	NC_CBK_EX_NR {p. 1829}	O2L_SP_PLS {p. 2958}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_LAMB_PLS_O2L_OSC_COR	-	0... 2H	0 ...2	1	-
defines operation mode of forced stimulation: 0 - amplitude symmetric, 1 - timesync COR_AFL, 2 - timesync COR_AFR					
LC_O2L_PLS_CBK_SYN	-	0... 1H	0 ...1	1	-
0: asynchronous forced stimulation, 1: synchronous forced stimulation					

### General Information

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The forced lambda stimulation generates an output signal that causes lean and rich deviations of the air fuel ratio from the lambda controller set point. By means of the stimulation parameters (set point deviation, period time and gradient) a well defined O<sub>2</sub> load for the catalyst can be calibrated. So the catalyst efficiency can be increased.

Furthermore the forced lambda stimulation is used by diagnosis functions for the up stream lambda sensor and by the catalyst efficiency diagnosis.

The recurrence time is defined by T\_SAMPLE in 20 ms.

NC\_CBK\_EX\_NR defines the number of exhaust banks.

For vector elements, the variable extension `_i` is used in the model instead of `[i]` as found in the textual description.

### Application Conditions

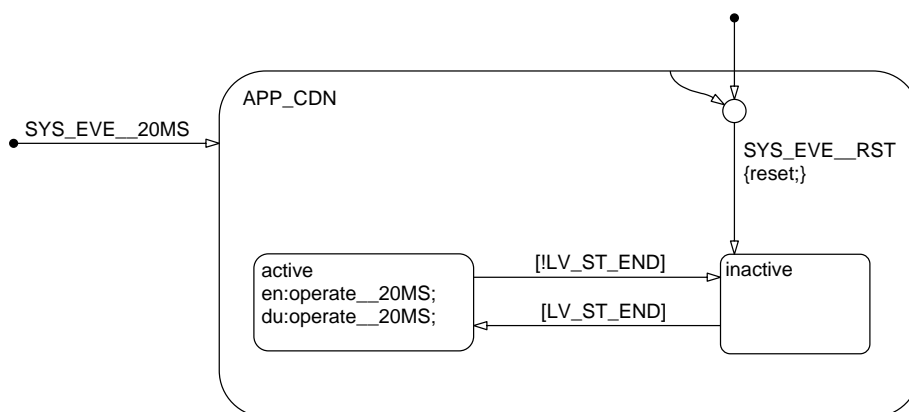
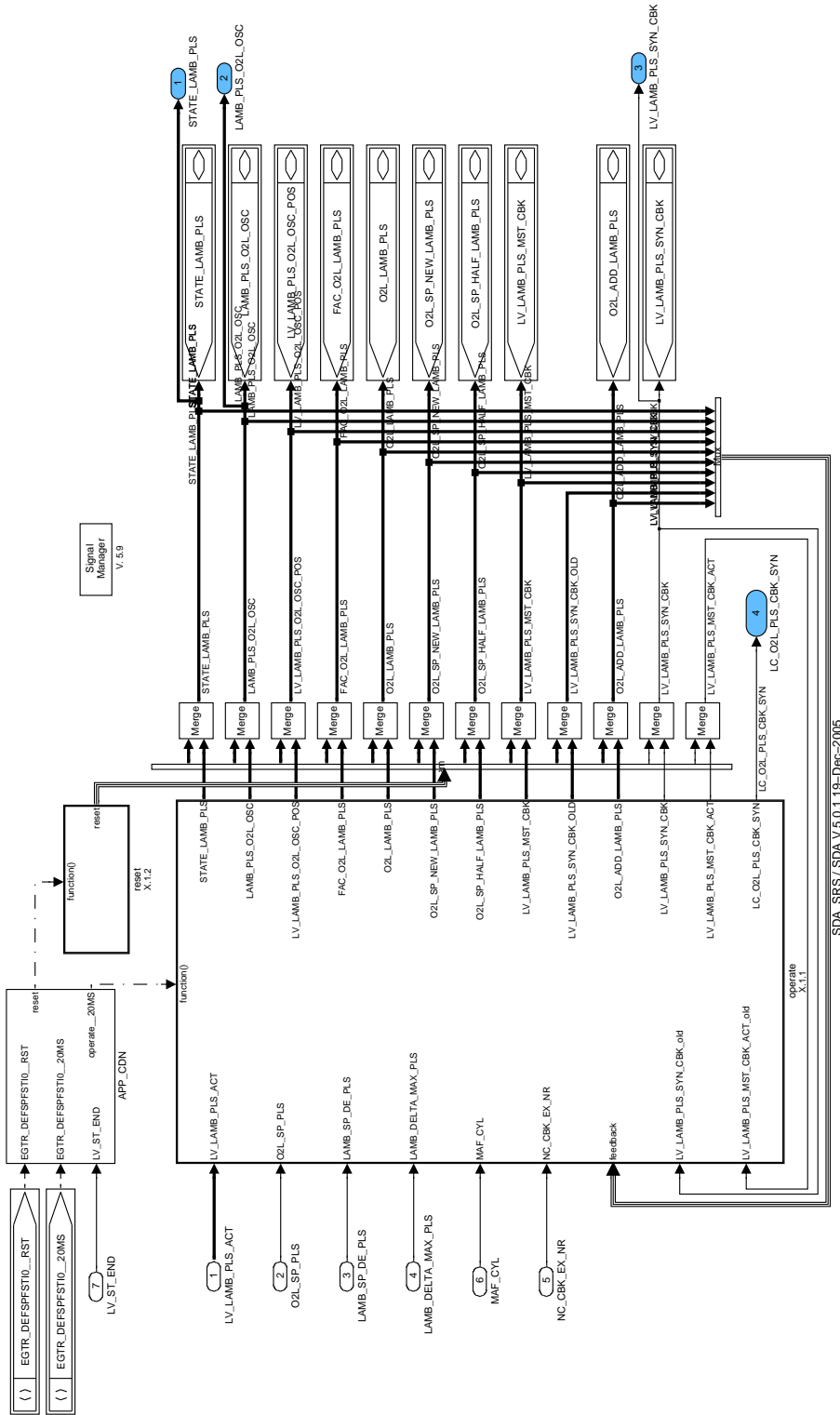


Figure 7.62.1: : Path: EGTR\_DEFSPFSTI0/APP\_CDN/Chart

### Function description

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SDA\_SRS7\_SDA\_V5.0.1.19-Dec-2005

Figure 7.62.2: : Path: EGTR\_DEFSPFSTIO

### 7.62.1 Operate level 20ms:

This level is calculated in 20ms tasks.

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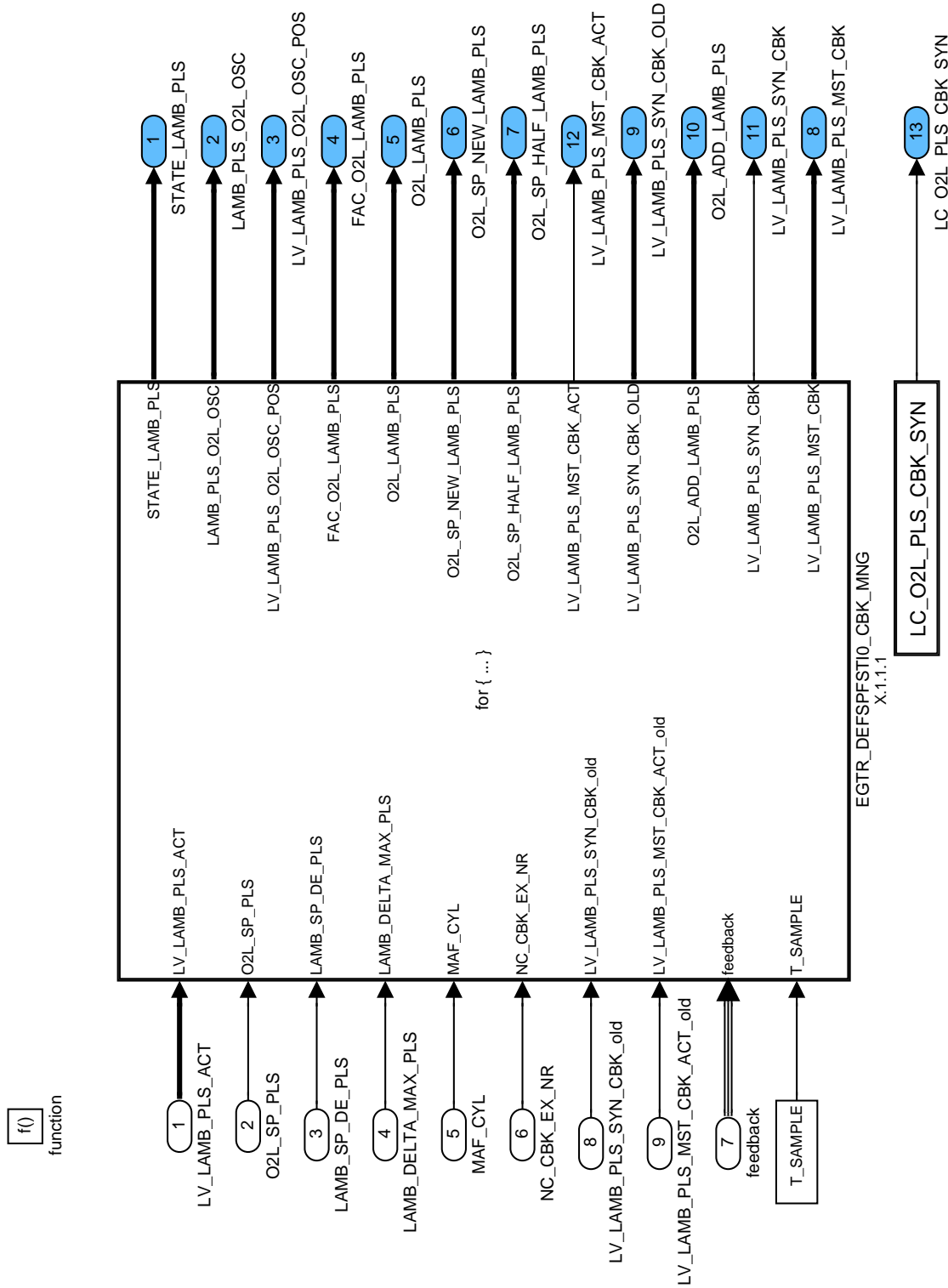


Figure 7.62.3: Path: EGTR\_DEFSPFSTIO/operate

### 7.62.1.1 Vectorization level for for-loop:

Here the vectors are split for the for-loop-calculation.

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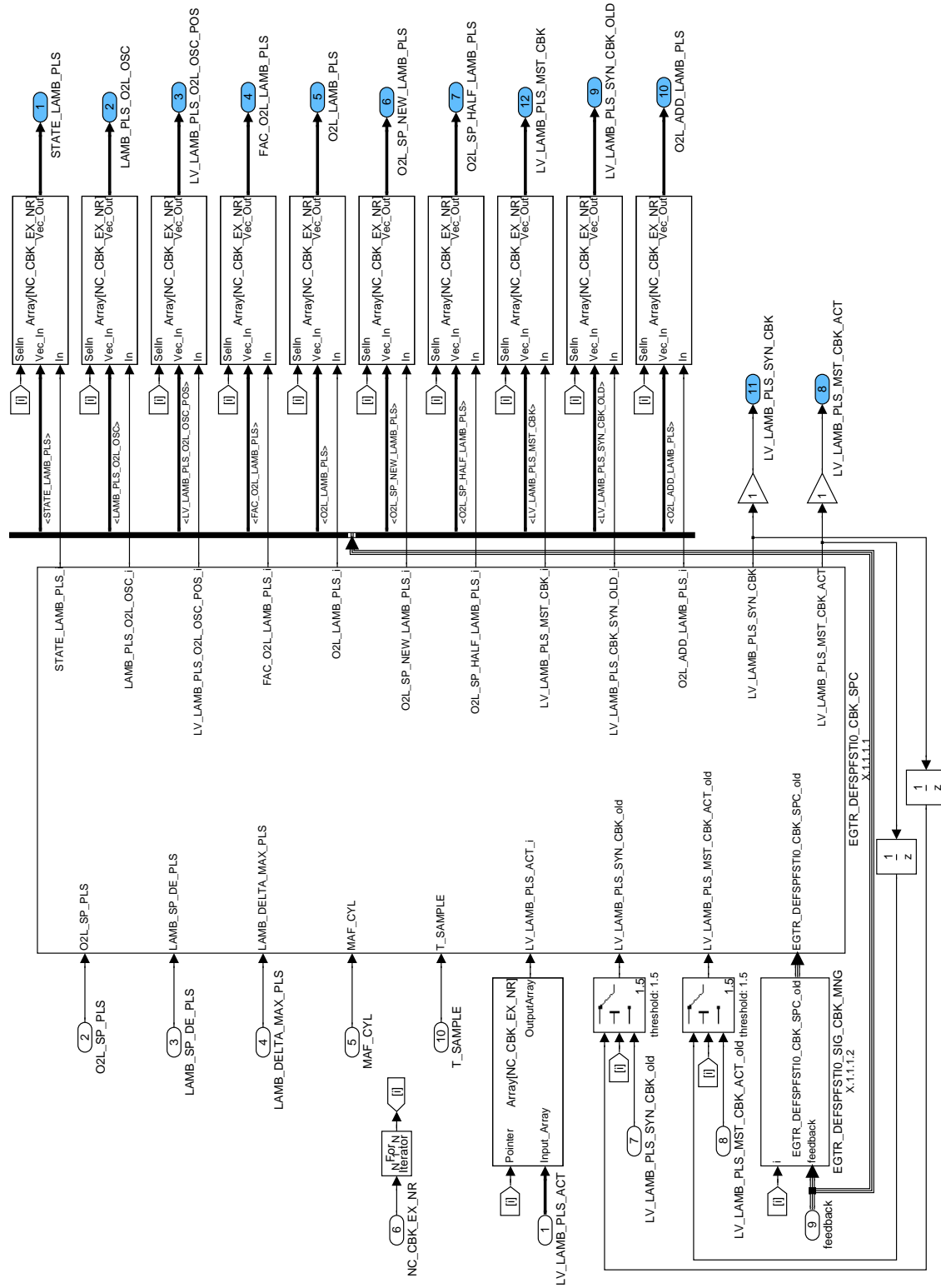



Figure 7.62.4: : Path: EGTR\_DEFSPFST10/operate/EGTR\_DEFSPFST10\_CBK\_MNG

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### 7.62.1.1.1 Execution of state machine:

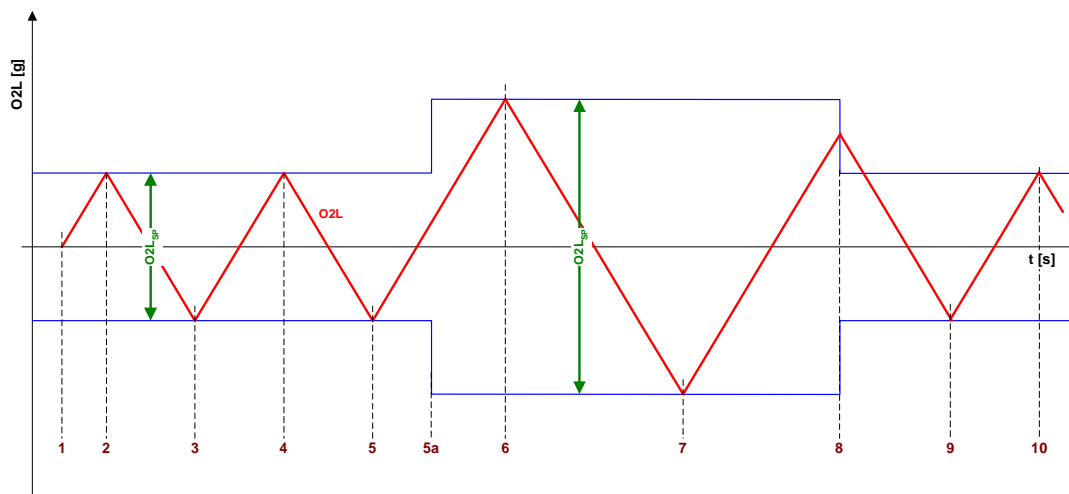
In state OFF the output of the forced lambda stimulation is 0. This state is active if LV\_LAMB\_PLS\_ACT[i] is not set.

In case of LV\_LAMB\_PLS\_ACT[i] = 1 either state AFL or state AFR is active. In state AFL the set point deviation is increased stepwise to the calibrated set point deviation. In state AFR the set point deviation is decreased. The transition between both states depend on the O2 loading calculated in both states (CLC\_O2L\_LAMB\_PLS). When the current O2 loading reaches the current set point (O2L\_SP\_NEW\_LAMB\_PLS[i]) then the transition to the opposite state takes place. The O2 loading is calculated with the formula:

$$m_{O_2} = 23\% \cdot \int \left(1 - \frac{1}{1 + \Delta \lambda_{SP}}\right) \cdot \dot{m}_{air} dt$$

In order to realise synchronisation of both banks two flags are defined. LV\_LAMB\_PLS\_MST\_CBK\_ACT is a common flag that defines whether forced stimulation is already active for one bank. Master bank is the bank that has set the flag LV\_LAMB\_PLS\_MST\_CBK\_ACT; this is also indicated by the bank selective flag LV\_LAMB\_PLS\_MST\_CBK[i] which must be set to 1 for the master bank and to 0 for the slave bank.

The second flag to synchronise both banks is LV\_LAMB\_PLS\_SYN\_CBK. This flag is set by the master when the transition from state AFR to AFL occurs in order to inform the slave to execute the desired transition.



If the set point from Determination of forced lambda stimulation parameters (O2L\_SP\_PLS) changes the O2 loading set point that is adjusted switches for the next half wave to an intermediate value and the next but one half wave will be the target value.

Asynchronous or synchronous operation:

The master bank changes from lean to rich or from rich to lean, if the O2 threshold O2L\_SP\_NEW\_PLS is reached. The synchronization pulse LV\_LAMB\_PLS\_SYN\_CBK is set at the end of the rich phase.


In case of asynchronous forced stimulation (LC\_O2L\_PLS\_CBK\_SYN=0) the slave changes from lean to rich at synchronization pulse and from rich to lean, if the O2 threshold is reached.

In case of synchronous forced stimulation (LC\_O2L\_PLS\_CBK\_SYN=1) the slave changes from rich to lean at synchronization pulse and from lean to rich, if the O2 threshold is reached.

Timesynchronous operation:

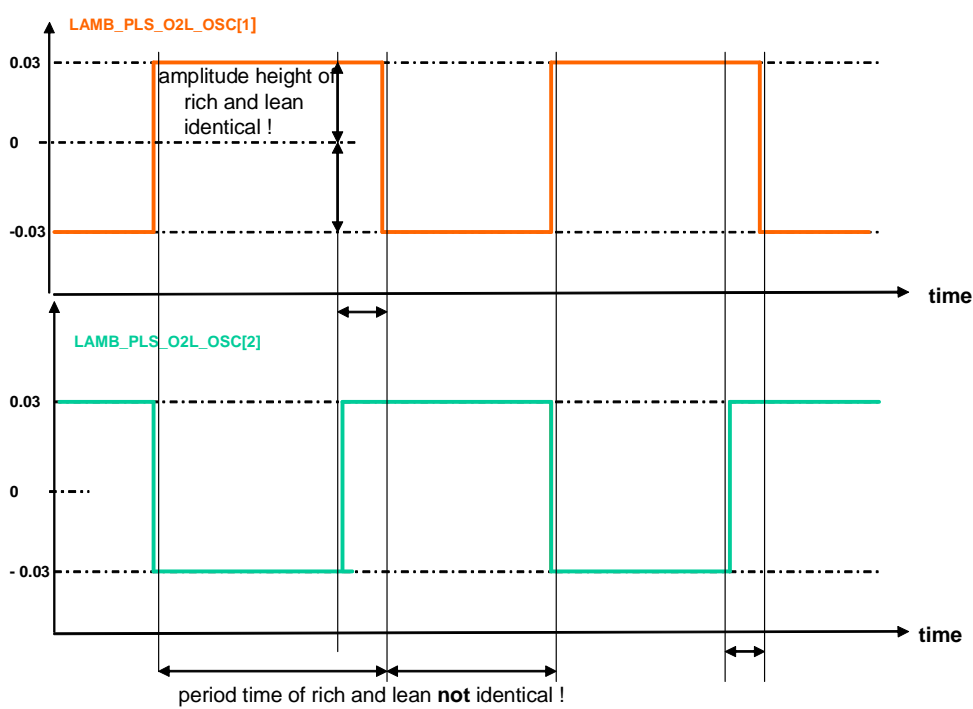
Due to the formula for O2 load calculation the time duration of the lean part of the forced stimulation period is slightly longer than the rich part.

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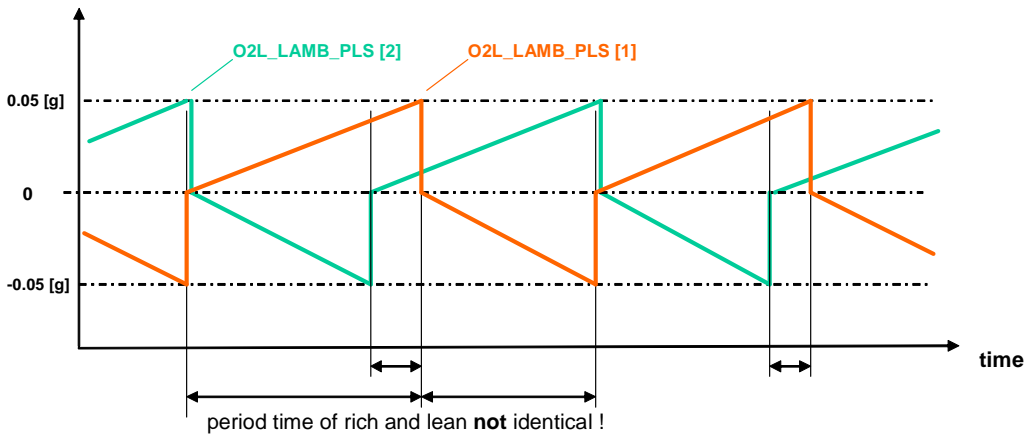
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During the bankwise asynchronous operation mode (LC\_O2L\_PLS\_CBK\_SYN=0), this fact leads to small overlapping phases, where both banks are in the same STATE\_LAMB\_PLS = RICH or LEAN.




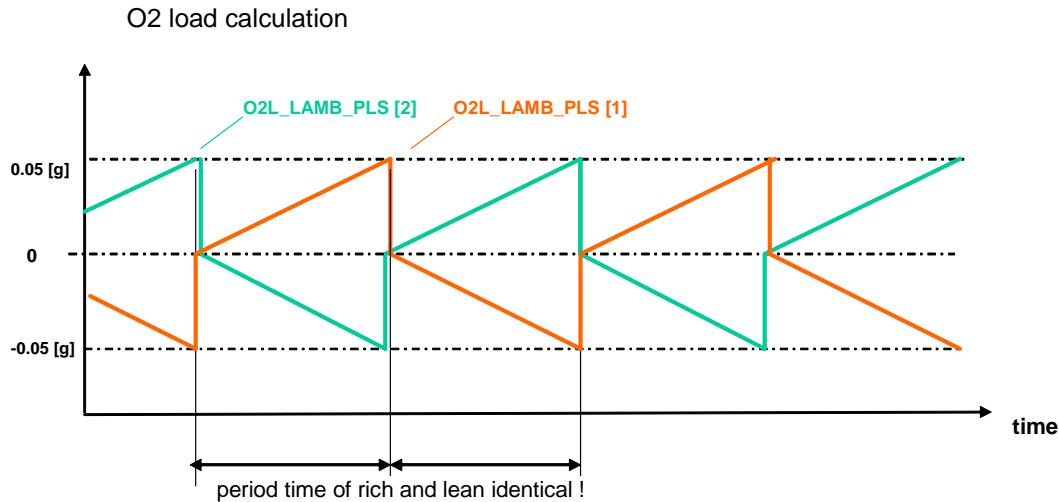
O2 load calculation



To prevent this behaviour and achieve a duration of the rich and lean phase of exact the same length, the amplitude of the forced stimulation LAMB\_PLS\_O2L\_OSC can be corrected during the lean or during the rich phase (STATE\_LAMB\_PLS = AFL or AFR).

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#### COR\_AFL:

To switch on the timesynchronous operation with correction of the amplitude in STATE\_LAMB\_PLS=AFL set C\_STATE\_LAMB\_PLS\_O2L\_OSC\_COR = 1 (COR\_AFL) .

As a consequence the amplitude LAMB\_PLS\_O2L\_OSC is no more symmetric on the lean and rich side.

LAMB\_PLS\_O2L\_OSC is limited to the calibrated value on the rich side and will be corrected to a slightly higher value on the lean side.

The correction factor on the lean side is calculated as follows:

$$m_{O_2\_lean} = -m_{O_2\_rich}$$

$$\frac{LAMB\_PLS\_O2L\_OSC(lean)}{1 + LAMB\_PLS\_O2L\_OSC(lean)} = - \frac{LAMB\_PLS\_O2L\_OSC(rich)}{1 + LAMB\_PLS\_O2L\_OSC(rich)}$$

$$LAMB\_PLS\_O2L\_OSC(lean) = - \frac{LAMB\_PLS\_O2L\_OSC(rich)}{1 + 2 * LAMB\_PLS\_O2L\_OSC(rich)}$$

#### COR\_AFR :

To switch on the timesynchronous operation with correction of the amplitude in STATE\_LAMB\_PLS=AFR set C\_STATE\_LAMB\_PLS\_O2L\_OSC\_COR = 2 (COR\_AFR).

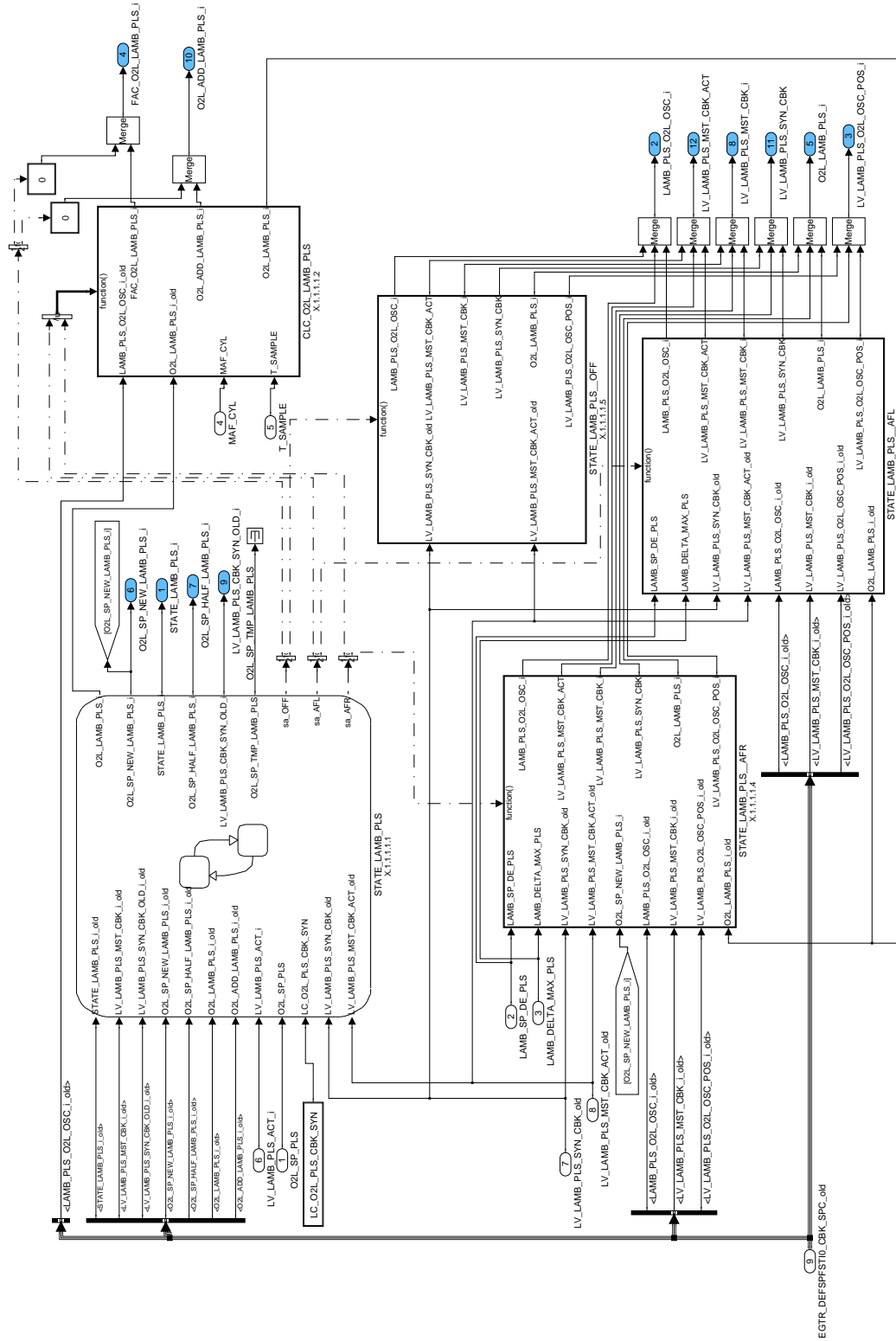
LAMB\_PLS\_O2L\_OSC is then limited to the calibrated value on the lean side and will be corrected to a slightly lower value on the rich side.

The correction factor is on the rich side calculated as follows:

$$LAMB\_PLS\_O2L\_OSC(rich) = - \frac{LAMB\_PLS\_O2L\_OSC(lean)}{1 + 2 * LAMB\_PLS\_O2L\_OSC(lean)}$$


#### COR\_OFF:

If timesynchronous operation is not requested, it is possible to enable normal operation mode with symmetric amplitude high by setting C\_STATE\_LAMB\_PLS\_O2L\_OSC\_COR = 0 (COR\_OFF).



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Figure 7.62.5: : Path:  
EGTR\_DEFSPFSTI0/operate/EGTR\_DEFSPFSTI0\_CBK\_MNG/EGTR\_DEFSPFSTI0\_CBK\_SPC

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7.62.1.1.1.1 No title given

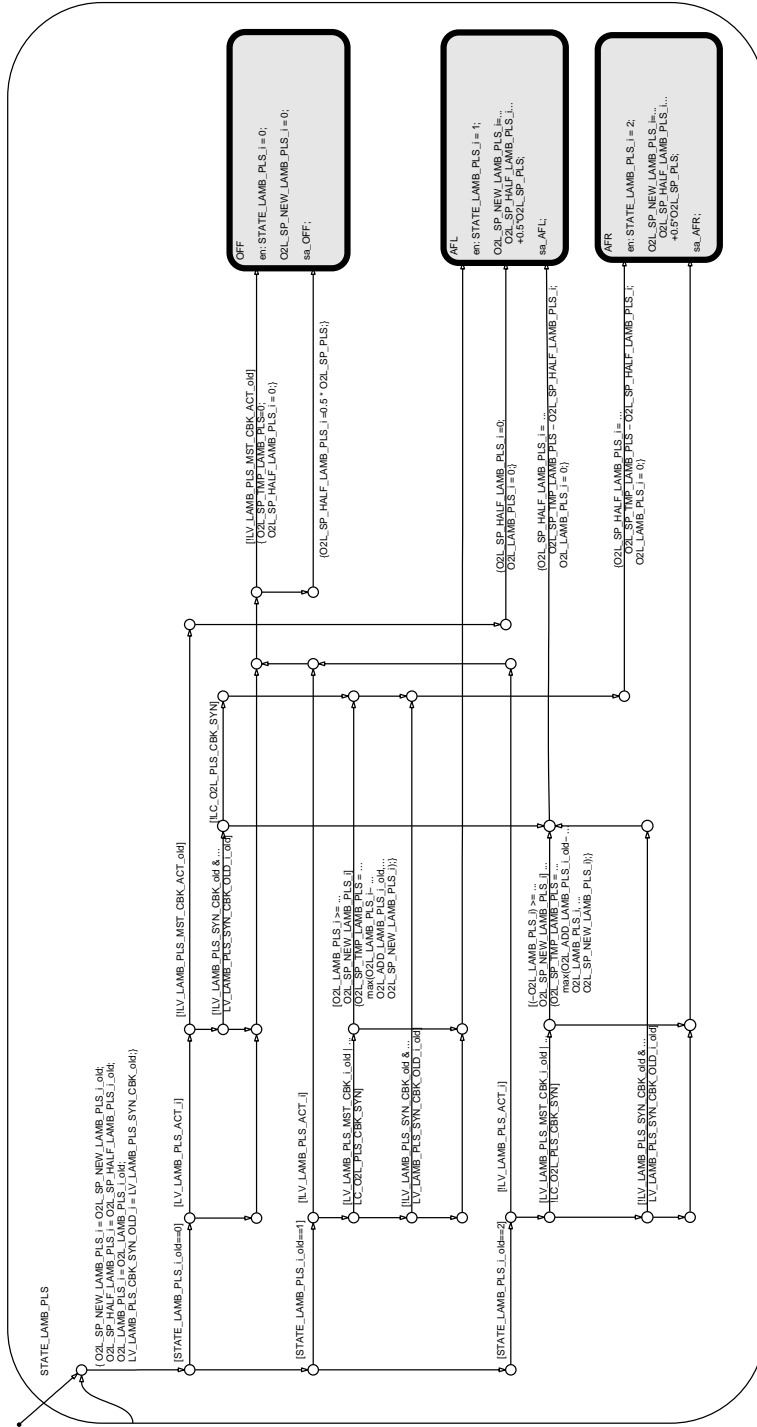


Figure 7.62.6: : Path: EGTR\_DEFSPFSTI0/operate/EGTR\_DEFSPFSTI0\_CBK\_MNG/EGTR\_DEFSPFSTI0\_CBK\_SPC/STATE\_LAMB\_PLS

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### 7.62.1.1.1.2 Calculation of O2 loading:

The O2 loading is calculated with the already mentioned formula. If the O2 loading that is to added each sample step is smaller than its resolution then the O2 loading is increased or decreased (depending on the sign) by the resolution value.

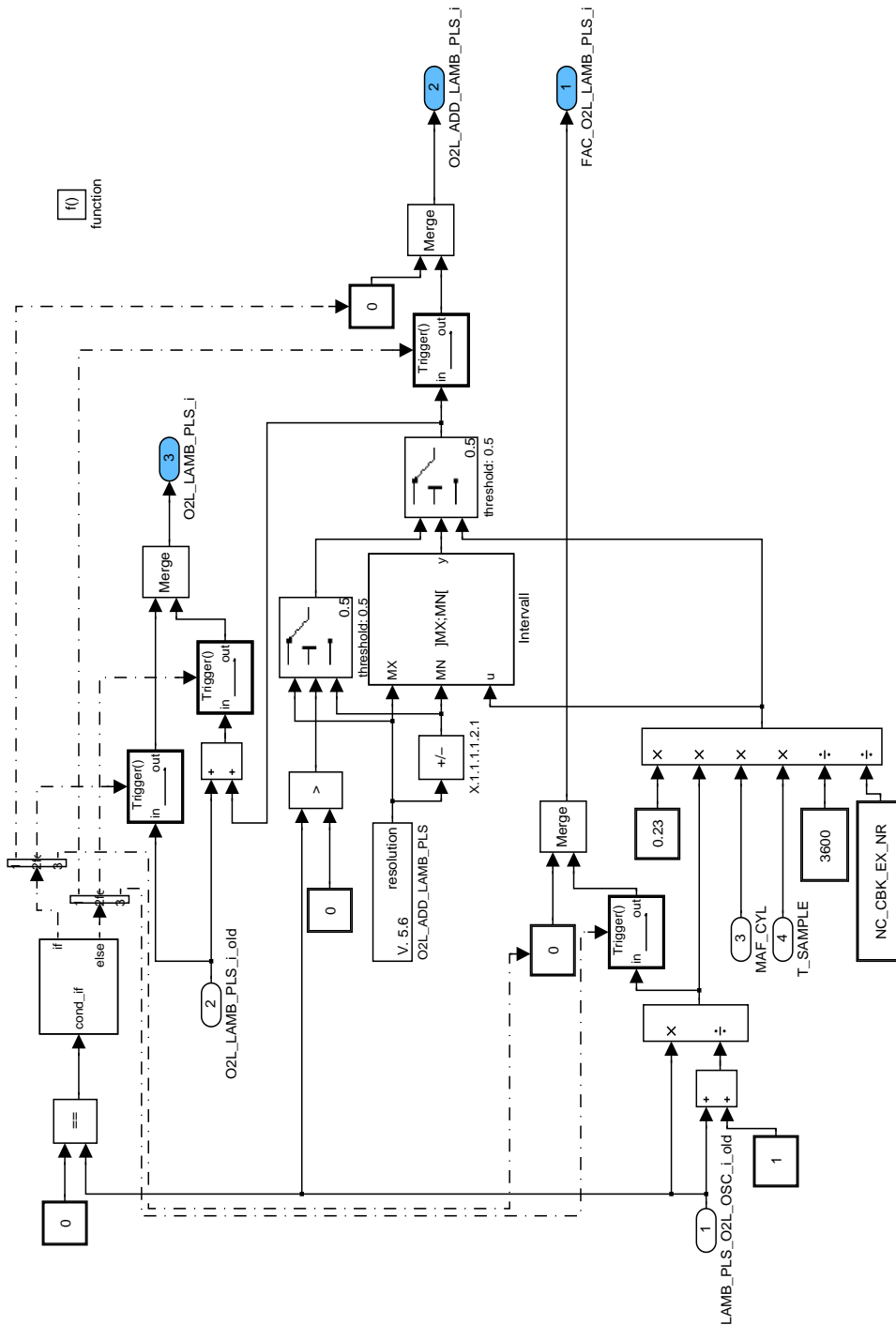



Figure 7.62.7: : Path: EGTR\_DEFSPFSTI0/operate/EGTR\_DEFSPFSTI0\_CBK\_MNG/EGTR\_DEFSPFSTI0\_CBK\_SPC/CLC\_O2L\_LAMB\_PLS

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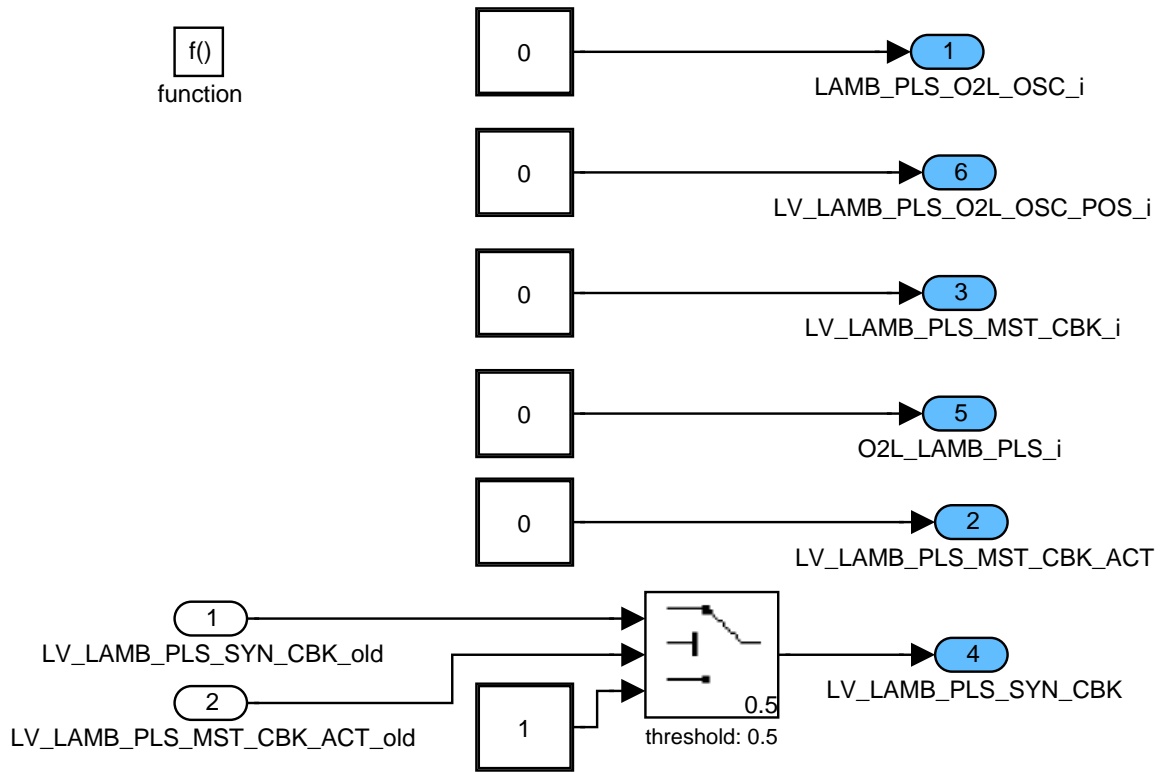
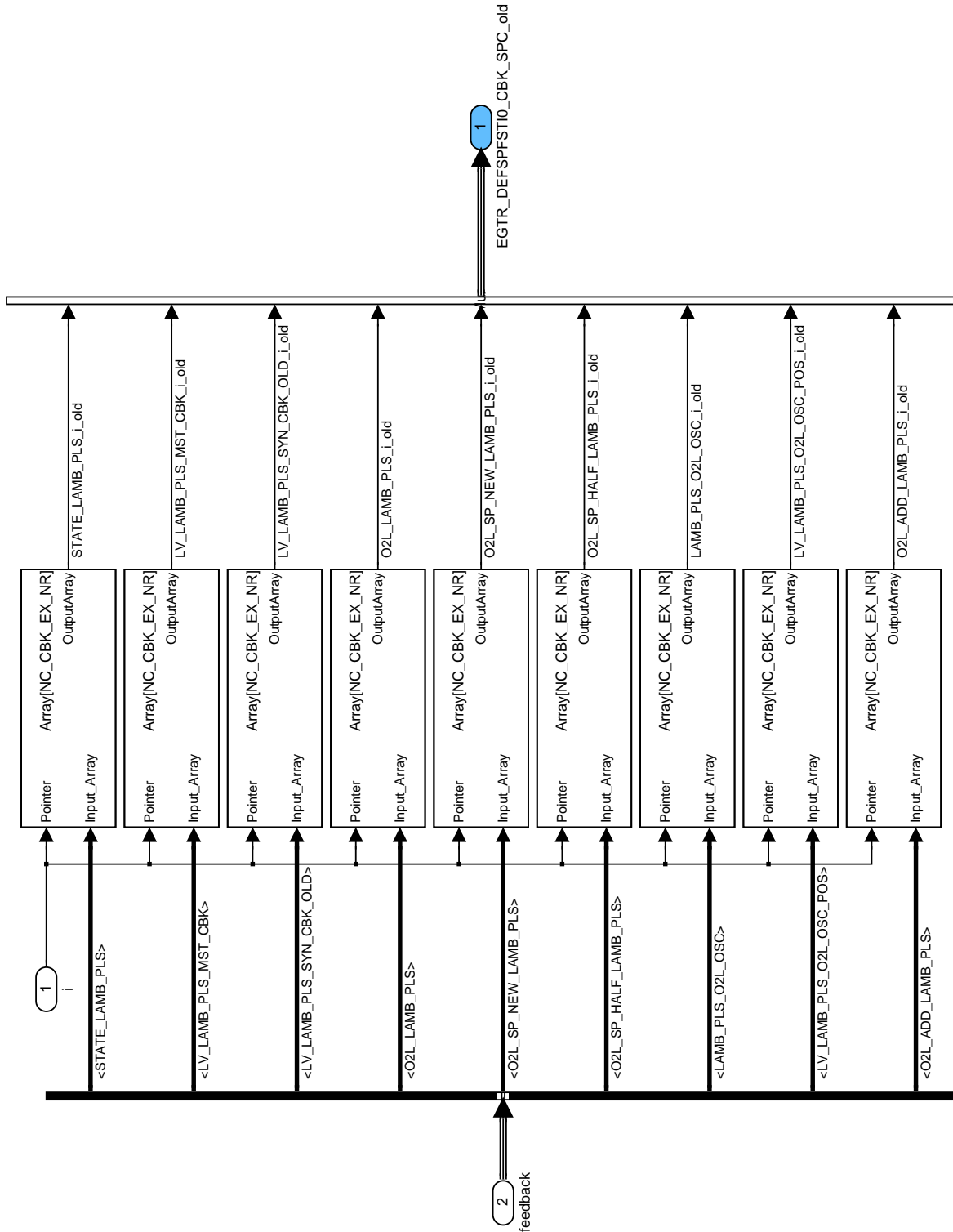


Figure 7.62.10: : Path: EGTR\_DEFSPFSTI0/operate/EGTR\_DEFSPFSTI0\_CBK\_MNG/EGTR\_DEFSPFSTI0\_CBK\_SPC/STATE\_LAMB\_PLS\_\_OFF

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7.62.1.1.2 For-loop signal manager:



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Figure 7.62.11: Path: EGTR\_DEFSPFSTI0/operate/EGTR\_DEFSPFSTI0\_CBK\_MNG/EGTR\_DEFSPFSTI0\_SIG\_CBK\_MNG

### 7.62.2 Initialization:

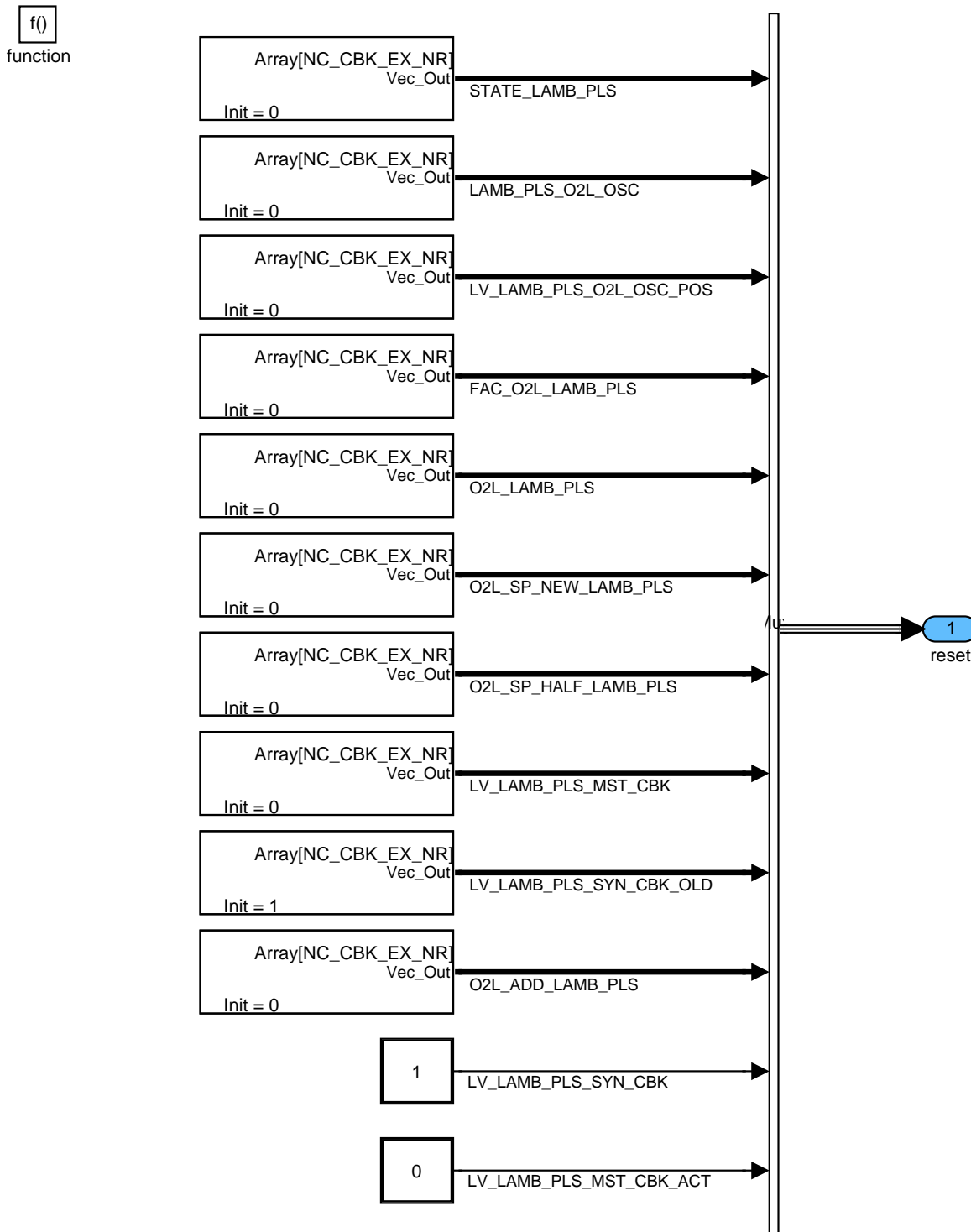


Figure 7.62.12: : Path: EGTR\_DEFSPFSTI0/reset

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## 7.63 Forced lambda stimulation (linear control) (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_DELTA_MAX_PLS_EXT	O/V	0... FFFH	0... 0.249939	61.0352e-6	-
lambda set point deviation step height per sample step during external mode					
LAMB_PLS_EXT [NC_CBK_EX_NR]	O/V	F800... 7FFH	-0.125... 0.12493896484	61.0352e-6	-
lambda set point deviation from external source					
LAMB_SP_DE_PLS_EXT	O/V	0... 7FFH	0... 0.12493896484	61.0352e-6	-
amplitude of the forced lambda stimulation during external mode					
LV_INH_LAMB_PLS [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
inhibition flag for forced lambda stimulation					
LV_LAMB_PLS_LS_DIAG	O/V	0... 1H	0 ...1	1	-
active forced lambda stimulation for WRAF sensor diagnosis					
LV_LAMB_PLS_REQ_EXT	O/V	0... 1H	0 ...1	1	-
active forced lambda stimulation for external mode					
O2L_SP_PLS_EXT	O/V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
oxygen loading set point for forced lambda stimulation during external mode					

### Input data:

LAMB_PLS_EXT_CUS [NC_CBK_EX_NR] {p. 8199}	LV_ERR_DYN_VLD_LS_ UP [NC_CBK_EX_NR] {p. 5348}	LV_LAMB_STI_OFF_LSL_ OFS_ADJ [NC_CBK_EX_NR] {p. 2313}	LV_ST_END {p. 1720}
MAF_HB {p. 805}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	STATE_LAMB_PLS_DET_ VALUE {p. 2958}
STATE_LAMB_PLS_REQ_ LS_DIAG {p. 5349}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_DELTA_MAX_DLY_DIAG_PLS	-	0... FFFH	0... 0.249939	61.0352e-6	-
lambda set point deviation step height per sample step for forced stimulation during active WRAF sensor delay diagnosis					
C_LAMB_DELTA_MAX_DYN_DIAG_PLS	-	0... FFFH	0... 0.249939	61.0352e-6	-
lambda set point deviation step height per sample step for forced stimulation during active WRAF sensor dynamic diagnosis					
C_LAMB_SP_DE_DLY_DIAG_PLS	-	0... 7FFH	0... 0.12493896484	61.0352e-6	-
amplitude of the forced lambda stimulation in case of active WRAF sensor delay diagnosis					
C_LAMB_SP_DE_DYN_DIAG_PLS	-	0... 7FFH	0... 0.12493896484	61.0352e-6	-
amplitude of the forced lambda stimulation in case of active WRAF sensor dynamic diagnosis					
IP_O2L_SP_DLY_DIAG_PLS	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_N_32_1_EGTR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_1_EGTR	8	0... FFH	0... 1389	5.4470588	mg/stk
oxygen loading set point for forced lambda stimulation in case of active delay WRAF sensor diagnosis					
IP_O2L_SP_DYN_DIAG_PLS	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
LDPM_N_32_1_EGTR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_1_EGTR	8	0... FFH	0... 1389	5.4470588	mg/stk
oxygen loading set point for forced lambda stimulation in case of active dynamic WRAF sensor diagnosis					
LC_LAMB_PLS_INH [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
calibration flag to force lambda stimulation to be inhibited					
LC_LAMB_PLS_INH_DYN_LS_UP	-	0... 1H	0 ...1	1	-
calibration flag to forced lambda stimulation to be inhibited at active WRAF sensor dynamic or delay error					
LC_LAMB_STI_OFF_LSL_OFS_ADJ	-	0... 1H	0 ...1	1	-
calibration flag to allow inhibition of lambda stimulation during offset adjustment					

## General Information

NC\_CBK\_EX\_NR defines the number of exhaust banks.

For vector elements, the variable extension `_i` is used in the model instead of `[i]` as found in the textual description.

## Application Conditions

Initialization: RST

Recurrence: 20MS

Activation: LV\_ST\_END==1

Deactivation: LV\_ST\_END==0

## Function description

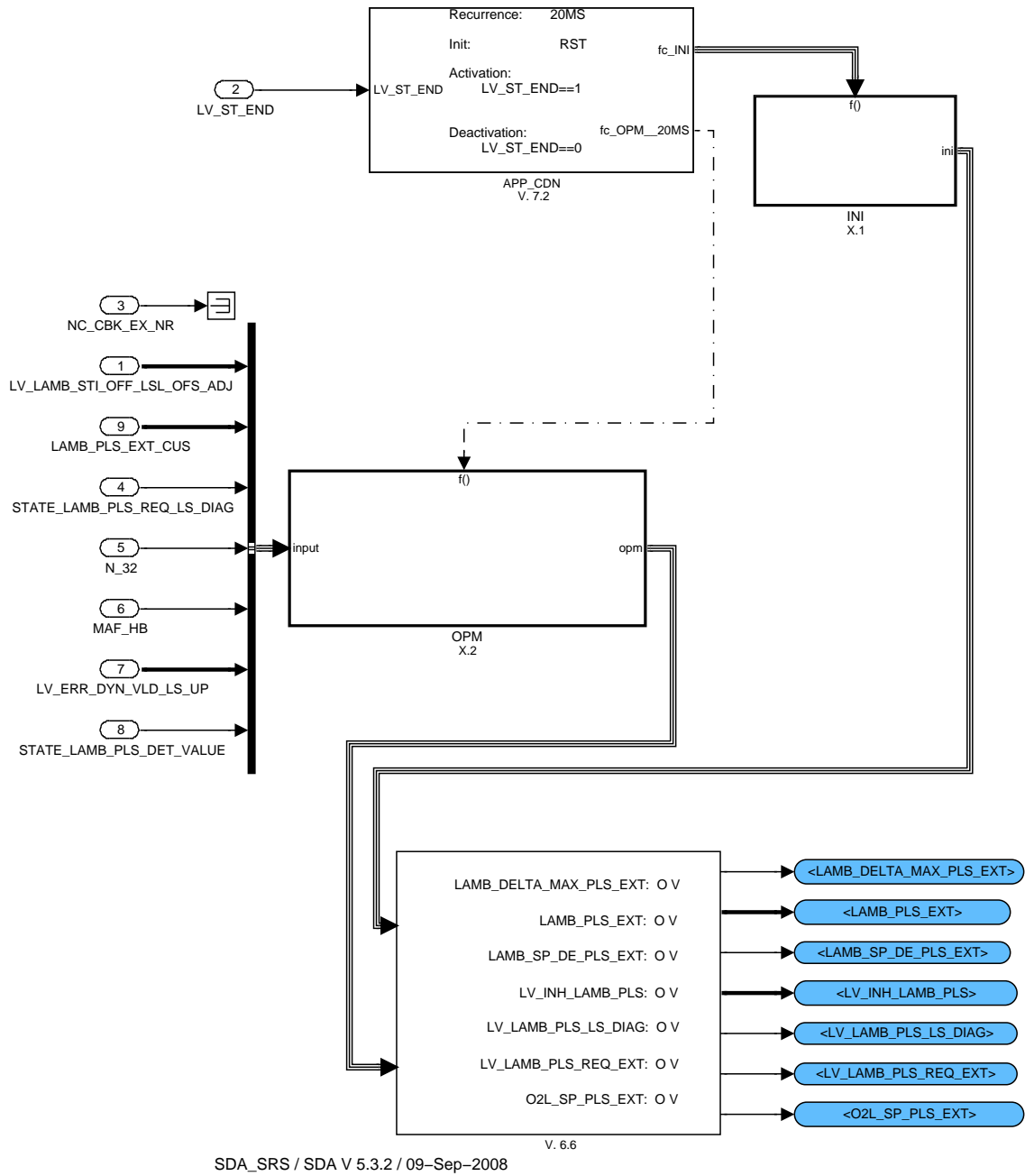


Figure 7.63.1: :

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### 7.63.1 Initialisation

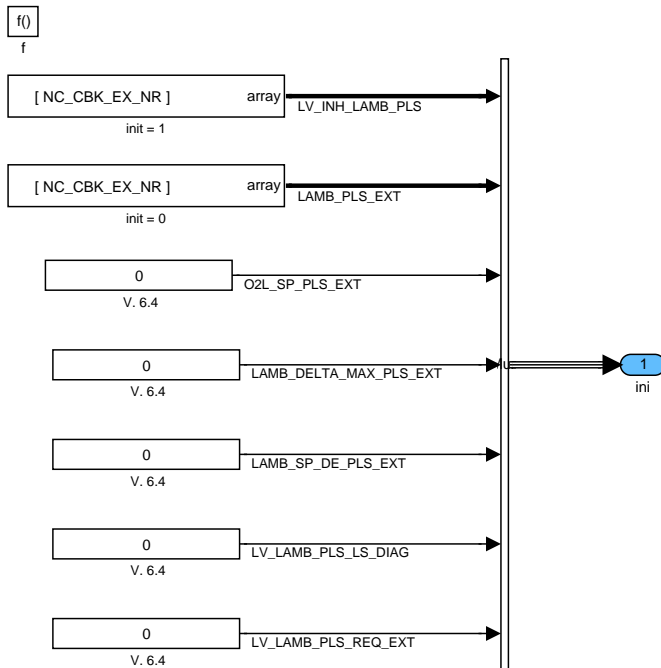


Figure 7.63.2: :

### 7.63.2 Operate

During WRAF sensor controller offset adjustment the forced lambda stimulation is switched off if the respective calibration flag allows this.

Furthermore the general calibration flag LC\_LAMB\_PLS\_INH[i] inhibits the function if set.

### 7.63.2.1 Set inhibition of forced lambda stimulation

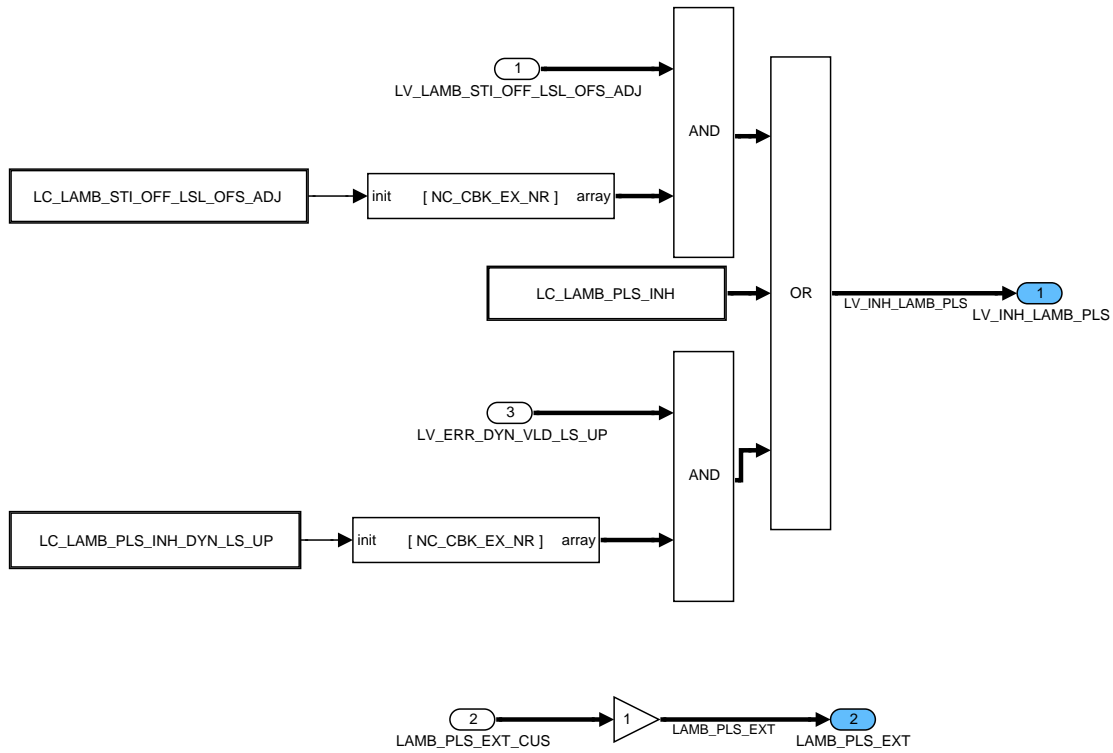



Figure 7.63.3: :

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 2583 of 8404</b>	
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### 7.63.2.2 Set forced lambda stimulation parameters for external mode

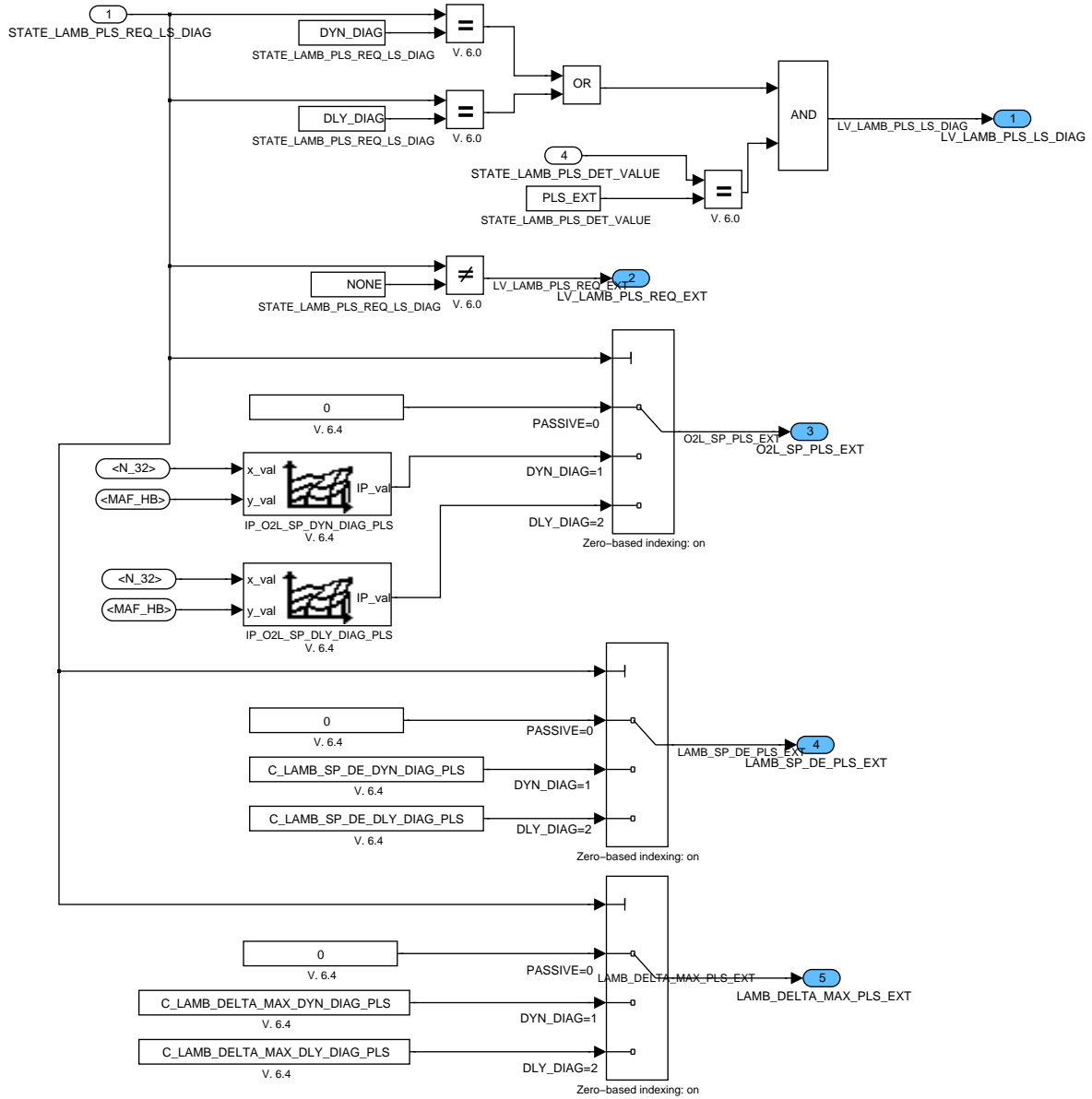


Figure 7.63.4: :

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## 7.64 Mean value calculation for limited dynamics

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LAM_MV_DELTA_LDC [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.9984741	0.00152588	%
difference between FAC_LAM_MV[i] and moving mean value of FAC_LAM_MV[i] for limited dynamics detection					
FAC_TQ_REQ_DELTA_LDC	O/V	8000... 7FFFH	-1... 0.99996948	30.5175e-6	-
difference between torque scaling factor and moving mean value thereof for limited dynamics calculation					
FAC_TQ_REQ_MMV_LDC	V	0... FFFFH	0... 1.99996948	30.5175e-6	-
moving mean value of torque scaling factor for limited dynamics detection					
MAF_DELTA_LDC	O/V	8000... 7FFFH	-694.510597 ...694.489403	0.02119478	mg/stk
difference between MAF and moving mean value of MAF for limited dynamics detection					
MAF_MMV_LDC	V	0... FFFFH	0... 1389	0.02119478	mg/stk
moving mean value of MAF for limited dynamics detection					
N_DELTA_LDC	O/V	E020... 1FE0H	-8160 ...8160	1	rpm
difference between N and moving mean value of N for limited dynamics detection					
N_MMV_LDC	V	0... 1FE0H	0... 8160	1	rpm
moving mean value of N for limited dynamics detection					

### Input data:

FAC_LAM_MV {p. 1014}	FAC_LAM_MV_MMV_LDC [NC_CBK_EX_NR] {p. 2462}	FAC_TQ_REQ {p. 6706}	LV_ST_END {p. 1720}
MAF {p. 8277}	N {p. 1525}	NC_CBK_EX_NR {p. 1829}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FAC_TQ_REQ_MMV_LDC	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
correlation constant for moving mean value calculation of torque scaling factor for limited dynamics					
C_CRLC_MAF_MMV_LDC	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
correlation constant for moving mean value calculation of MAF for limited dynamics					
C_CRLC_N_MMV_LDC	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
correlation constant for moving mean value calculation of N for limited dynamics					

### 7.64.1 LACO\_ISPCLMVLDC0

This function calculates only differences between base values and their moving means values. These differences or deltas are to be used within the function that needs limited dynamic conditions. The evaluation of the limited dynamic bit is part of the function that need this flag. So the mean value calculation is concentrated in this function.

NC\_CBK\_EX\_NR defines the number of exhaust banks.

For vector elements the variable extension "\_i" is used in the model instead of "[i]" as found in the textual description.

### Application Condition

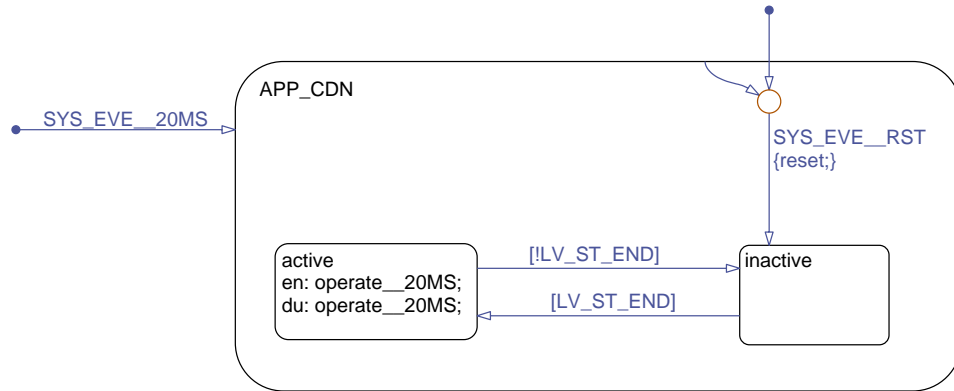
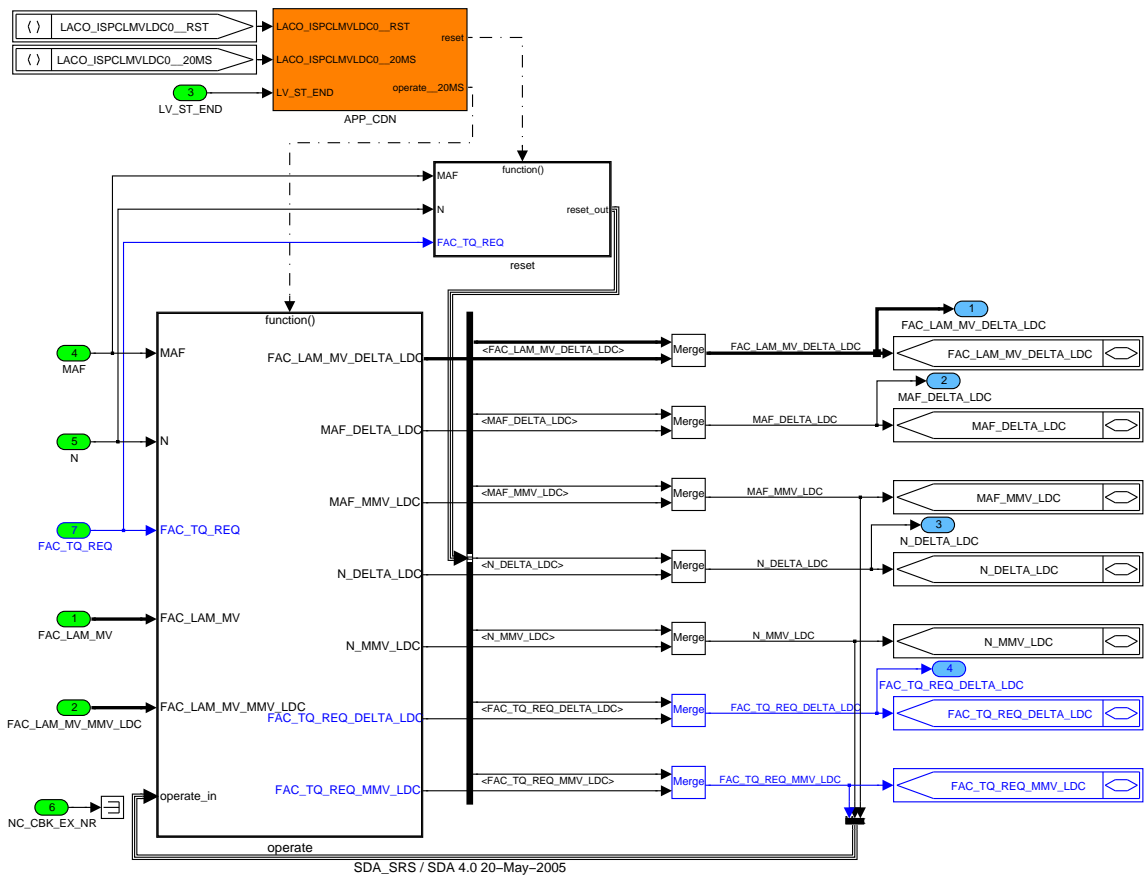



Figure 7.64.1: LACO\_ISPCLMVLD00/APP\_CDN/Chart

**Function Description**



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Figure 7.64.2: LACO\_ISPCLMVLD00

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 2586 of 8404</b>	
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### 7.64.1.1 SUBFUNCTION: reset

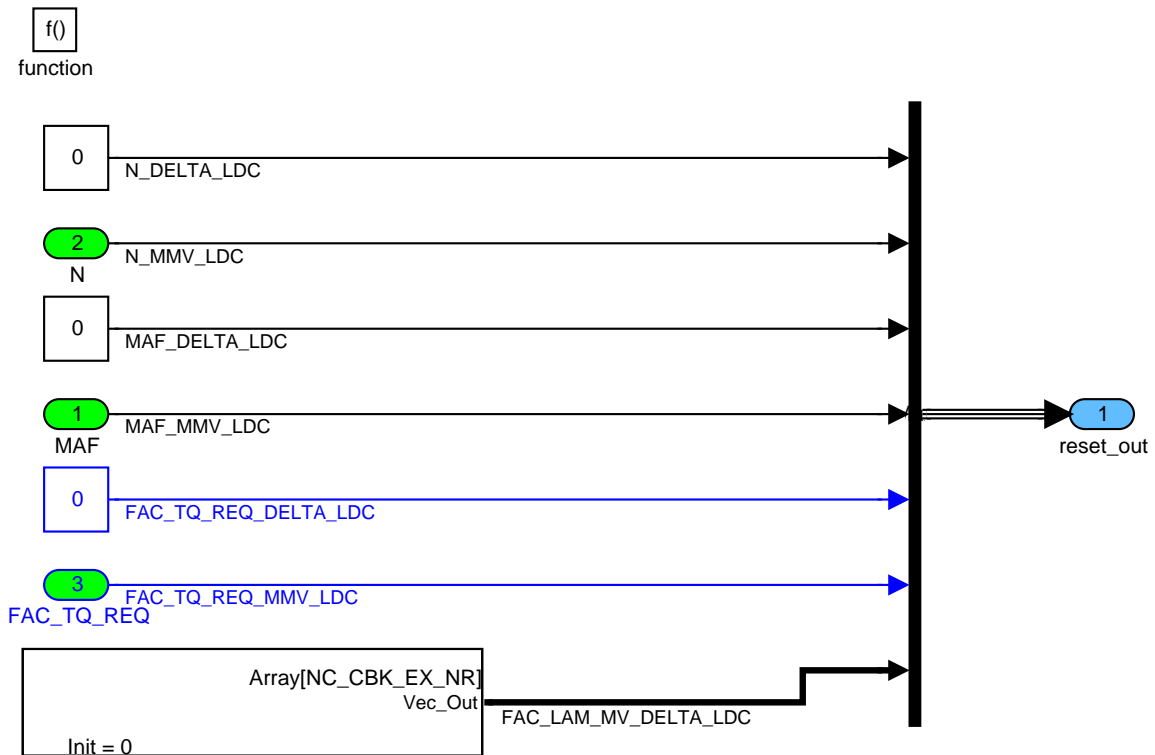


Figure 7.64.3: LACO\_ISPCLMVLDC0/reset

### 7.64.1.2 operate

This function calculates for the detection of the limited dynamics the moving mean values of engine speed (N and N\_MMV\_LDC), air mass flow (MAF and MAF\_MMV\_LDC) and degree of activation of the accelerator pedal (PV and PV\_AV\_MMV\_LDC). Furthermore the difference between these input values and the moving mean values is calculated.

For the lambda control output only the difference is evaluated because the moving mean value calculation is located in the lambda control module itself because of easier realisation of shift operations of the moving mean value (FAC\_LAM\_MV\_MMV\_LDC[j]).

Remark: The difference calculation of lambda control output is a vector operation.

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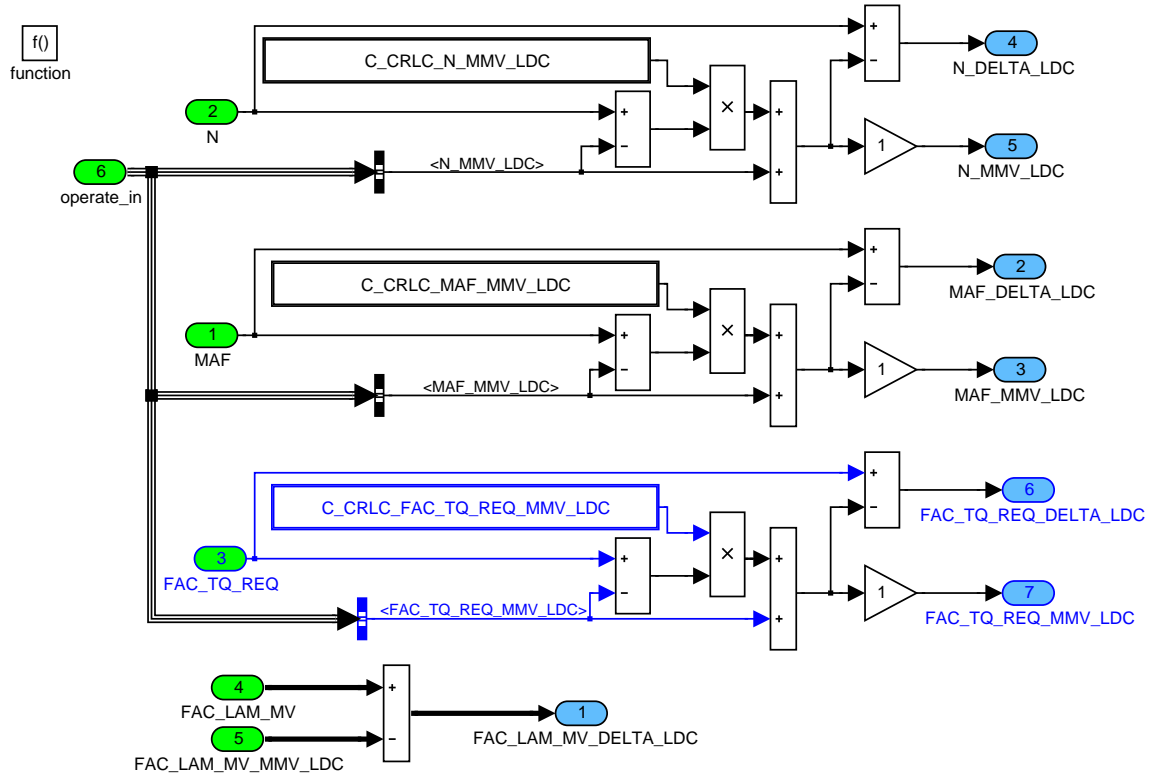


Figure 7.64.4: LACO\_ISPCLMVLDC0/operate

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## 7.65 Dynamic fuel trim

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_DELTA_D_LAM_ADJ [NC_CBK_EX_NR]	V	F800... 800H	-0.125 ...0.125	61.0352e-6	-
D share from trim control					
LAMB_DELTA_I_LAM_ADJ [NC_CBK_EX_NR]	O/V	F800... 800H	-0.125 ...0.125	61.0352e-6	-
I share from trim control					
LAMB_DELTA_I_MMV_LAM_ADJ [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-0.125... 0.1249961853	3.8147e-6	-
I share moving mean value from trim control					
LAMB_DELTA_I_SAVE_LAM_ADJ_H [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-0.125... 0.1249999994	58.208e-12	-
saved I share with high resolution from trim control					
LAMB_DELTA_LAM_ADJ [NC_CBK_EX_NR]	O/V	F800... 800H	-0.125 ...0.125	61.0352e-6	-
total output (P share + I share) from trim control					
LAMB_DELTA_P_LAM_ADJ [NC_CBK_EX_NR]	O/V	F800... 800H	-0.125 ...0.125	61.0352e-6	-
P share of from trim control					
LV_LAM_ADJ_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
activation flag of dynamic fuel trim					
LV_LAM_ADJ_AD_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that trim control I share shift was executed					
LV_LAM_ADJ_D_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
activation flag for calculation of trim controller D share					
LV_LAM_ADJ_I_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
activation flag for calculation of trim controller I share					
LV_LAM_ADJ_P_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
activation flag for calculation of trim controller P share					
MAF_INT_LAM_ADJ_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0 ...1	0.0222222	g
air mass flow integral for trim control activation					
MAF_INT_MIN_LAM_ADJ_D_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0 ...1	0.0222222	g
minimum air mass flow integral for trim control D share activation					
MAF_INT_MIN_LAM_ADJ_I_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0 ...1	0.0222222	g
minimum air mass flow integral for trim control I share activation					
MAF_INT_MIN_LAM_ADJ_P_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0 ...1	0.0222222	g
minimum air mass flow integral for trim control P share activation					
STATE_FAC_GAIN_TRIM_PID_EXT [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Status for the condition under which the external lambda control gain factors are determined					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VLS_DIF_DELTA_LAM_ADJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-5... 4.99984741211	152.588e-6	V
difference between downstream LS signal and moving mean value					
VLS_DIF_LAM_ADJ [NC_CBK_EX_NR]	O/V	FC00... 3FFFH	-5... 4.9951171875	4.88281e-3	V
difference between set point and actual downstream LS signal					
VLS_DIF_MMV_LAM_ADJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-5... 4.99984741211	152.588e-6	V
moving mean value of difference between set point and actual downstream LS signal					
VLS_SP_LAM_ADJ [NC_CBK_EX_NR]	O/V	0... 3FFFH	0... 4.9951171875	4.88281e-3	V
trim control set point					

**Input data:**


EFF_CAT_DIAG [NC_CBK_EX_NR] {p. 5535}	LAMB_DELTA_DIF_I_ LAM_ADJ_AD [NC_CBK_EX_NR] {p. 2622}	LAMB_SP_HOM [NC_CBK_EX_NR] {p. 8340}	LV_CAT_PURGE_ACT [NC_CBK_EX_NR] {p. 2927}
LV_ER_BAL_HOM_CDN {p. 800}	LV_FAC_LAM_LIM_MAX [NC_CBK_EX_NR] {p. 2463}	LV_FAC_LAM_LIM_MIN [NC_CBK_EX_NR] {p. 2463}	LV_INH_LAM_ADJ [NC_CBK_EX_NR] {p. 2613}
LV_LAM_ADJ_ACT_FAST_ LAM_LSCL [NC_CBK_EX_NR] {p. 2613}	LV_LAM_ADJ_AD_REQ [NC_CBK_EX_NR] {p. 2622}	LV_LAM_ADJ_CAT_DIAG [NC_CBK_EX_NR] {p. 5473}	LV_LAM_ADJ_REQ_DYN_ LSL_UP [NC_CBK_EX_NR] {p. 5348}
LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}	LV_LAM_STOP_SHO_PER [NC_CBK_EX_NR] {p. 2448}	LV_LAMB_DELTA_I_LAM_ ADJ_DEAC [NC_CBK_EX_NR] {p. 2613}
LV_LAMB_OHP [NC_CBK_EX_NR] {p. 1016}	LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}	LV_LDC_LAM_ADJ [NC_CBK_EX_NR] {p. 2613}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}
LV_ST_END {p. 1720}	MAF_CYL {p. 8277}	MAF_HB {p. 805}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	STATE_LAM_GAIN_REQ_ LS_DIAG {p. 5349}	T_AST {p. 1766}	TCO {p. 1100}
TEMP_CAT {p. 8237}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	VLS_AV_LAM_ADJ [NC_CBK_EX_NR] {p. 2613}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_LAMB_DELTA_I_MMV_LAM_ADJ	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
correlation constant for trim control I share moving mean value calculation for adaptation value					
C_EFF_CAT_DIAG_MAX_LAM_ADJ_ACT	-	0... FFH	0... 1.9921875	7.8125e-3	-
catalyst diagnosis value threshold for trim control activation					
C_LAMB_DELTA_I_MAX_LAM_ADJ	-	F800... 800H	-0.125 ...0.125	61.0352e-6	-
upper limit of trim control I share					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_DELTA_I_MIN_LAM_ADJ	-	F800... 800H	-0.125 ...0.125	61.0352e-6	-
bottom limit of trim control I share					
C_LAMB_SP_MAX_LAM_ADJ_ACT	-	0... 7FFFH	0... 1.99993896484	61.0352e-6	-
maximum lambda set point for trim control activation					
C_LAMB_SP_MIN_LAM_ADJ_ACT	-	0... 7FFFH	0... 1.99993896484	61.0352e-6	-
minimum lambda set point for trim control activation					
C_MAF_INT_LAM_ADJ_D_ACT_FAST [NC_CBK_EX_NR]	-	0... FFFFH	0 ...1	0.0222222	g
air mass flow integral threshold for fast trim control D share reactivation					
C_MAF_INT_LAM_ADJ_D_ACT_PURGE [NC_CBK_EX_NR]	-	0... FFFFH	0 ...1	0.0222222	g
air mass flow integral threshold for trim control D share reactivation after cat purge					
C_MAF_INT_LAM_ADJ_D_ACT_SLOW	-	0... FFFFH	0 ...1	0.0222222	g
air mass flow integral threshold for slow trim control D share reactivation					
C_MAF_INT_LAM_ADJ_I_ACT_FAST [NC_CBK_EX_NR]	-	0... FFFFH	0 ...1	0.0222222	g
air mass flow integral threshold for fast trim control I share reactivation					
C_MAF_INT_LAM_ADJ_I_ACT_PURGE [NC_CBK_EX_NR]	-	0... FFFFH	0 ...1	0.0222222	g
air mass flow integral threshold for trim control I share reactivation after cat purge					
C_MAF_INT_LAM_ADJ_I_ACT_SLOW	-	0... FFFFH	0 ...1	0.0222222	g
air mass flow integral threshold for slow trim control I share reactivation					
C_MAF_INT_LAM_ADJ_P_ACT_FAST [NC_CBK_EX_NR]	-	0... FFFFH	0 ...1	0.0222222	g
air mass flow integral threshold for fast trim control P share reactivation					
C_MAF_INT_LAM_ADJ_P_ACT_PURGE [NC_CBK_EX_NR]	-	0... FFFFH	0 ...1	0.0222222	g
air mass flow integral threshold for trim control P share reactivation after cat purge					
C_MAF_INT_LAM_ADJ_P_ACT_SLOW	-	0... FFFFH	0 ...1	0.0222222	g
air mass flow integral threshold for slow trim control P share reactivation					
C_MAF_MAX_LAM_ADJ_D_ACT	-	0... FFH	0... 1389	5.4470588	mg/stk
maximum air mass flow threshold for trim control D share calculation					
C_MAF_MAX_LAM_ADJ_P_ACT	-	0... FFH	0... 1389	5.4470588	mg/stk
maximum air mass flow threshold for trim control P share calculation					
C_MAF_MIN_LAM_ADJ_D_ACT	-	0... FFH	0... 1389	5.4470588	mg/stk
minimum air mass flow threshold for trim control D share calculation					
C_MAF_MIN_LAM_ADJ_P_ACT	-	0... FFH	0... 1389	5.4470588	mg/stk
minimum air mass flow threshold for trim control P share calculation					
C_N_MAX_LAM_ADJ_D_ACT	-	0... FFH	0... 8160	32	rpm
maximum engine speed threshold for trim control D share calculation					
C_N_MAX_LAM_ADJ_P_ACT	-	0... FFH	0... 8160	32	rpm
maximum engine speed threshold for trim control P share calculation					

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 2591 of 8404	
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_MIN_LAM_ADJ_D_ACT	-	0... FFH	0... 8160	32	rpm
minimum engine speed threshold for trim control D share calculation					
C_N_MIN_LAM_ADJ_P_ACT	-	0... FFH	0... 8160	32	rpm
minimum engine speed threshold for trim control P share calculation					
C_T_AST_LAM_ADJ_P_ACT_HST	-	0... FFFFH	0... 6553.5	0.1	s
T_AST threshold for hot start detection to immediately active trim control P share					
C_TCO_LAM_ADJ_P_ACT_HST	-	0... FEH	-48... 142.5	0.75	°C
TCO threshold for hot start detection to immediately active trim control P share					
C_TEMP_CAT_MIN_LAM_ADJ_ACT	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
minimum cat temperature threshold for trim control activation					
IP_CRLC_LAMB_DELTA_I_LAM_ADJ [NC_CBK_EX_NR]	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
LDPM_MAF_CYL_1_LACO	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
air mass flow dependent weighting coefficient for trim control I share calculation					
IP_CRLC_VLS_DIF_MMV_LAM_ADJ	V	0... FFFFH	0... 0.99998474121	15.2588e-6	-
LDPM_MAF_CYL_1_LACO	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDPM_EFF_CAT_DIAG_1_LACO	8	0... FFH	0... 1.9921875	7.8125e-3	-
correlation constant to calculate moving mean value of trim controller difference					
IP_FAC_ADD_LAMB_DELTA_D	-	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_EFF_CAT_DIAG_1_LACO	8	0... FFH	0... 1.9921875	7.8125e-3	-
additional weighting coefficient for trim control D share calculation					
IP_FAC_ADD_LAMB_DELTA_P	-	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_EFF_CAT_DIAG_1_LACO	8	0... FFH	0... 1.9921875	7.8125e-3	-
additional weighting coefficient for trim control P share calculation					
IP_FAC_LAMB_DELTA_D_LAM_ADJ [NC_CBK_EX_NR]	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
LDPM_MAF_CYL_1_LACO	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
air mass flow dependent weighting coefficient for trim control D share calculation					
IP_FAC_LAMB_DELTA_P_LAM_ADJ [NC_CBK_EX_NR]	-	0... FFFFH	0... 0.999985	15.3186e-6	-
LDPM_MAF_CYL_1_LACO	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
air mass flow dependent weighting coefficient for trim control P share calculation					
IP_LAMB_DELTA_D_LAM_ADJ	-	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDP_VLS_DIF_DELTA_IP_LAMB_D	16	0... 7FFFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control D share					
IP_LAMB_DELTA_D_LAM_ADJ_DLY_DIAG	-	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDPM_VLS_DIF_LAM_ADJ_D_DIAG	16	0... 7FFFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control D share in case of active delay diagnosis					
IP_LAMB_DELTA_D_LAM_ADJ_DYN_DIAG	-	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDPM_VLS_DIF_LAM_ADJ_D_DIAG	16	0... 7FFFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control D share in case of active dynamic diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_LAMB_DELTA_D_LAM_ADJ_ER_BAL_HOM	-	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDPM_VLS_DIF_LAM_ADJ_2_LACO	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control D share in case cylinder balancing homogenous reached					
IP_LAMB_DELTA_I_LAM_ADJ	-	0... FFFFH	-0.125... 0.1249961853	3.8147e-6	-
LDPM_VLS_DIF_LAM_ADJ_1_LACO	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control I share					
IP_LAMB_DELTA_I_LAM_ADJ_DIAG	V	0... FFFFH	-0.125... 0.1249961853	3.8147e-6	-
LDPM_VLS_DIF_LAM_ADJ_2_LACO	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
LDPM_EFF_CAT_DIAG_1_LACO	8	0... FFH	0... 1.9921875	7.8125e-3	-
characteristic line of trim control I share in case of active diagnosis function					
IP_LAMB_DELTA_I_LAM_ADJ_DLY_DIAG	-	0... FFFFH	-0.125... 0.1249961853	3.8147e-6	-
LDPM_VLS_DIF_LAM_ADJ_DIAG_2	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control I share in case of active delay diagnosis					
IP_LAMB_DELTA_I_LAM_ADJ_DYN_DIAG	-	0... FFFFH	-0.125... 0.1249961853	3.8147e-6	-
LDPM_VLS_DIF_LAM_ADJ_DIAG_2	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control I share in case of active dynamic diagnosis					
IP_LAMB_DELTA_I_LAM_ADJ_ER_BAL_HOM	-	0... FFFFH	-0.125... 0.1249961853	3.8147e-6	-
LDPM_VLS_DIF_LAM_ADJ_2_LACO	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control P share in case cylinder balancing homogenous reached					
IP_LAMB_DELTA_P_LAM_ADJ	-	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDPM_VLS_DIF_LAM_ADJ_1_LACO	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control P share					
IP_LAMB_DELTA_P_LAM_ADJ_DIAG	-	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDPM_VLS_DIF_LAM_ADJ_2_LACO	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control P share in case of active cat diagnosis					
IP_LAMB_DELTA_P_LAM_ADJ_DLY_DIAG	-	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDPM_VLS_DIF_LAM_ADJ_DIAG_2	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control P share in case of active delay diagnosis					
IP_LAMB_DELTA_P_LAM_ADJ_DYN_DIAG	-	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDPM_VLS_DIF_LAM_ADJ_DIAG_2	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control P share in case of active dynamic diagnosis					
IP_LAMB_DELTA_P_LAM_ADJ_ER_BAL_HOM	-	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDPM_VLS_DIF_LAM_ADJ_2_LACO	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control P share in case cylinder balancing homogenous reached					
IP_MAF_MAX_LAM_ADJ_I_ACT	-	0... FFH	0... 1389	5.4470588	mg/stk
LDPM_N_32_2_LACO	6	0... FFH	0... 8160	32	rpm
maximum air mass flow threshold for trim control I share calculation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_MAF_MIN_LAM_ADJ_I_ACT	-	0... FFH	0... 1389	5.4470588	mg/stk
LDPM_N_32_2_LACO	6	0... FFH	0... 8160	32	rpm
minimum air mass flow threshold for trim control I share calculation					
IP_VLS_SP_DELTA_AFL_LAM_ADJ [NC_CBK_EX_NR]	V	0... 7FFH	-5... 4.99511719	4.88281e-3	V
LDPM_EFF_CAT_DIAG_1_LACO	8	0... FFH	0... 1.9921875	7.8125e-3	-
LDPM_TEMP_CAT_1_LACO	6	0... FFFFH	-33... 990.984375	0.015625	°C
Additional offset of setpoint for lambda sensor voltage air fuel lean lambda adjustment					
IP_VLS_SP_LAM_ADJ [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.9951171875	4.88281e-3	V
LDP_MAF_HB_IP_VLS_SP_LAM_ADJ	8	0... FFH	0... 1389	5.4470588	mg/stk
LDP_N_32_IP_VLS_SP_LAM_ADJ	8	0... FFH	0... 8160	32	rpm
setpoint for downstream fuel trim controller					
LC_LAM_ADJ_I_SAVE_CAT_DIAG	-	0... 1H	0 ...1	1	-
flag indicating that I share after cat diagnosis is set to the value before cat diagnosis					
LC_LAM_ADJ_LDC_NOT_CHK	-	0... 1H	0 ...1	1	-
calibration flag to choose whether I share is calculated when limited dynamics are not fulfilled					
LC_LAMB_PLS_NOT_CHK_LAM_ADJ	-	0... 1H	0 ...1	1	-
calibration flag to choose whether I share is calculated when forced lambda stimulation is not active					

### General information:

The trim controller causes a shift of the WRAF sensor signal (upstream of the catalyst) or/and a shift of the lambda set point (in opposite direction). The output components (P share, I share, the sum of both or the adaptation value) of the trim controller can be linked in the application incidence for the lambda controller to corresponding inputs of the lambda controller. A compensation of ageing effects of the WRAF sensor as well as a better observance of the catalyst window is reached because of these shifts.

The control value is composed of P, I and D shares. All are determined depending on the trim control sensor signal (binary signal). The difference of the sensor voltage from set point value is the basic characteristic. The set point value can be applied depending on the operating point, so that the dynamic lambda can be adjusted according to the operating range.

The recurrence time is defined by T\_SAMPLE in [ms].


NC\_CBK\_EX\_NR defines the number of exhaust banks.

For vector elements the variable extension "\_i" is used in the model instead of "[i]" as found in the textual description.

### Application conditions:

*Initialisation:* RST  
*Recurrence:* 20MS  
*Activation:* LV\_ST\_END == 1  
*Deactivation:* if activation not true

### Function description:

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**Formula section:**

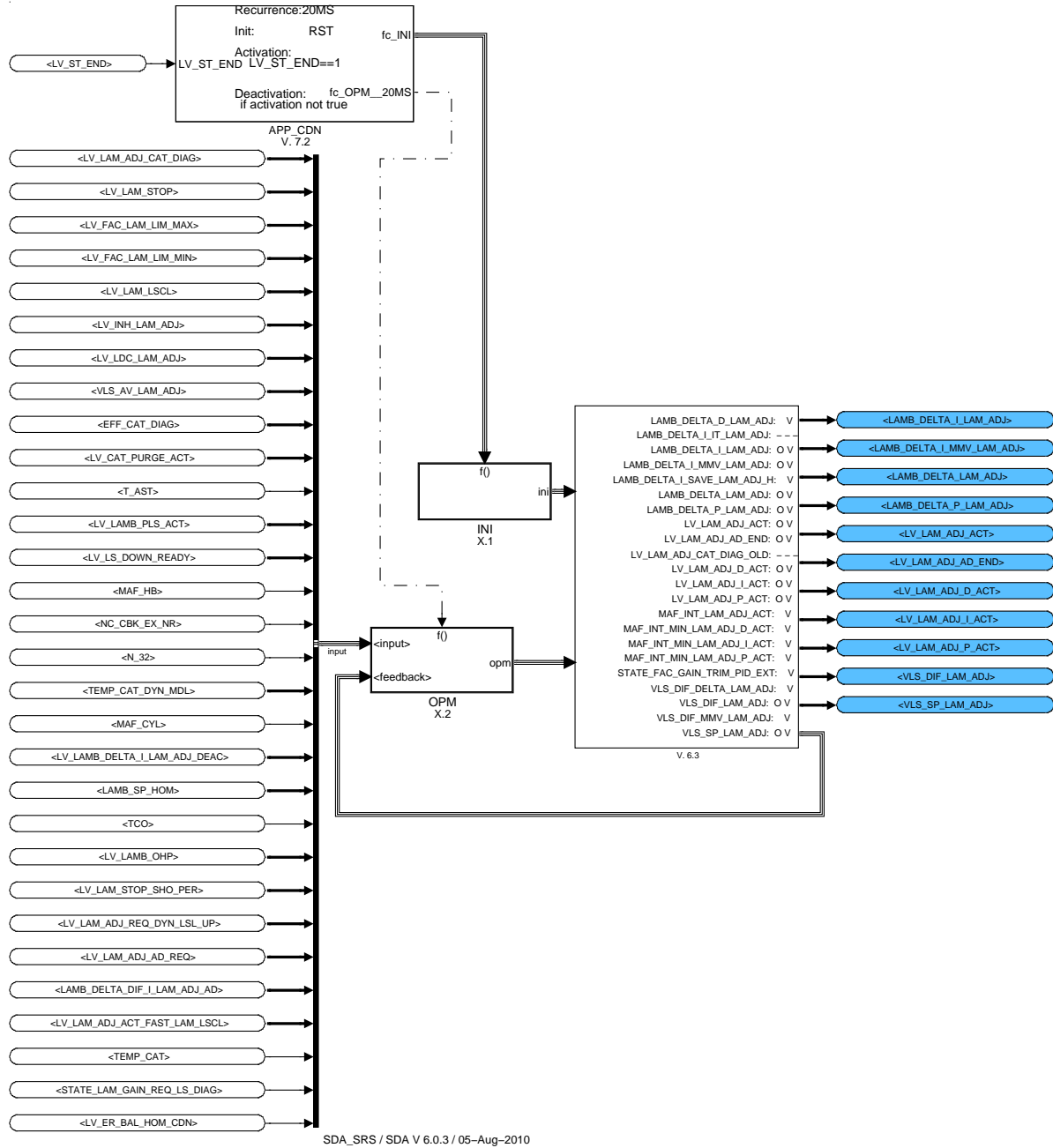


Figure 7.65.1: :

**7.65.1 Initialisation**

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## 7.65.2 Operation at 20ms

### 7.65.2.1 For loop (for i = 1 to NC\_CBK\_EX\_NR)

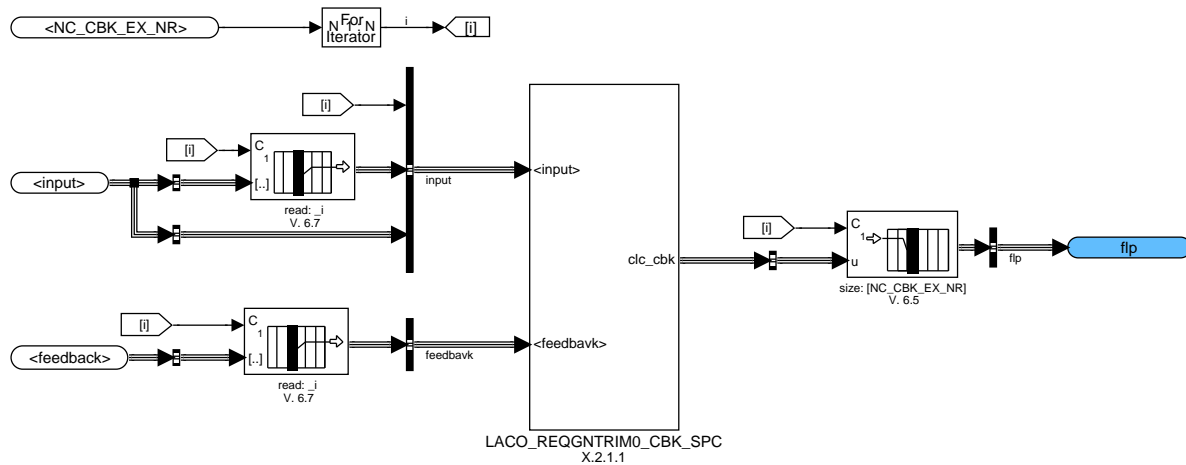


Figure 7.65.2: :

#### 7.65.2.1.1 Calculation of for loop

##### 7.65.2.1.1.1 Activation /deactivation of trim control (part I)

The trim controller is activated when the following conditions are fulfilled:

- no general inhibition
- the trim sensor is ready for operation
- the catalyst enrichment function is not active
- the lambda controller must be active
- the lambda controller must not be in short term in stop mode
- no output limitation of the lambda controller is active
- the catalyst is at operating temperature
- the catalyst efficiency is in the valid area
- the lambda set point must lie within calibration range
- no overheating protection with rich lambda is active

Before verifying the condition for P, I and/or D share activation, an air mass flow integral must exceed the threshold applied thresholds. These thresholds can be calibrated independently for P share, I share and D share activation. Depending on the deactivation reason different air mass flow integral thresholds can be applied. In case of hot start indicated by T\_AST below limit and TCO above threshold the P share can be activated immediately if no other above mentioned activation condition is not fulfilled. The activation is realised by setting the MAF integral threshold for the P share to 0.

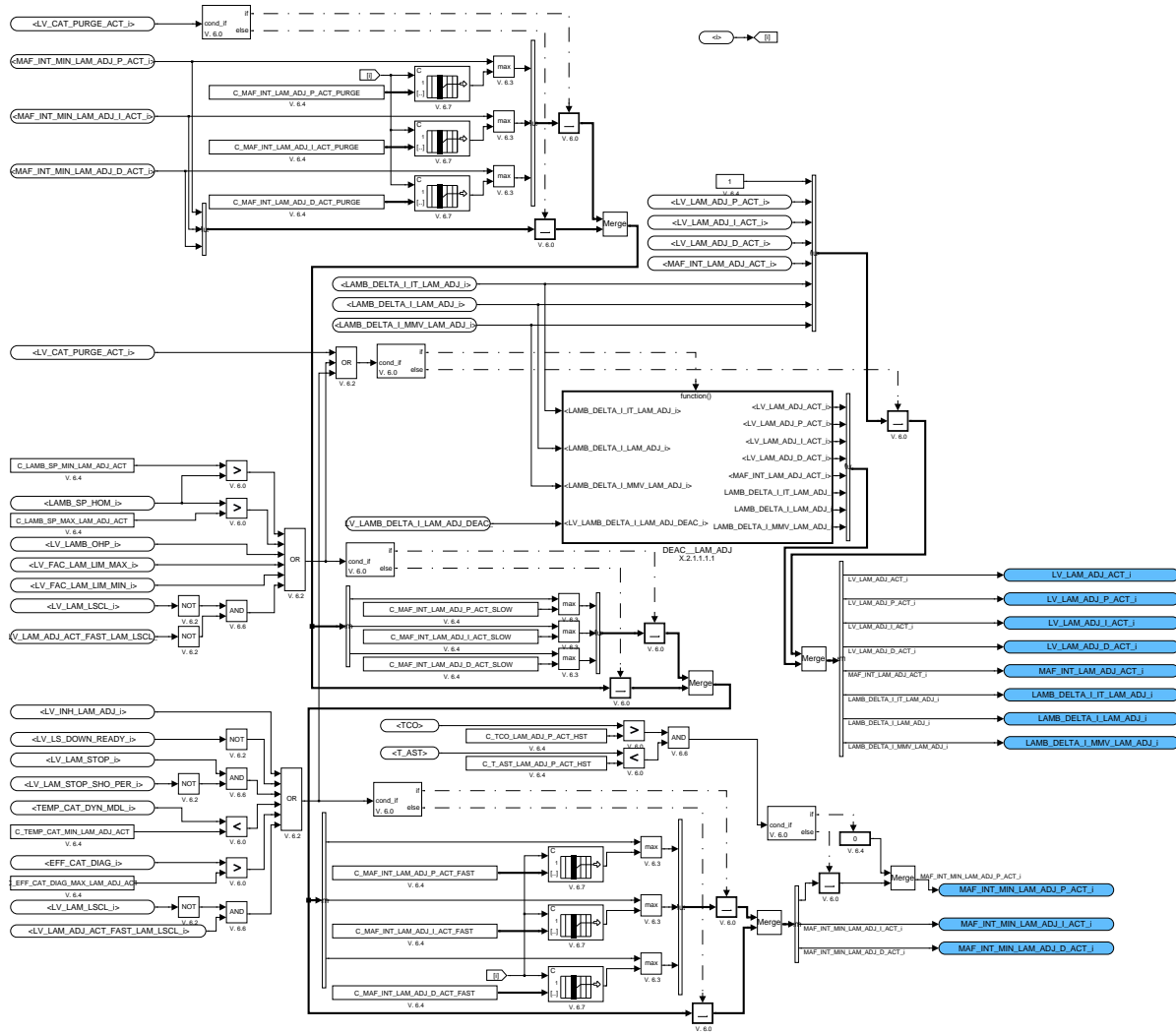


Figure 7.65.3: :

7.65.2.1.1.1 Deactivate trim controller

When deactivating the trim controller the P share and D share will get 0 and the I share remain fix (by deactivating the calualtion). If LV\_LAMB\_DELTA\_I\_LAM\_ADJ\_DEAC[i] was set to 0 (in the application incidences) then the I share is set to 0.

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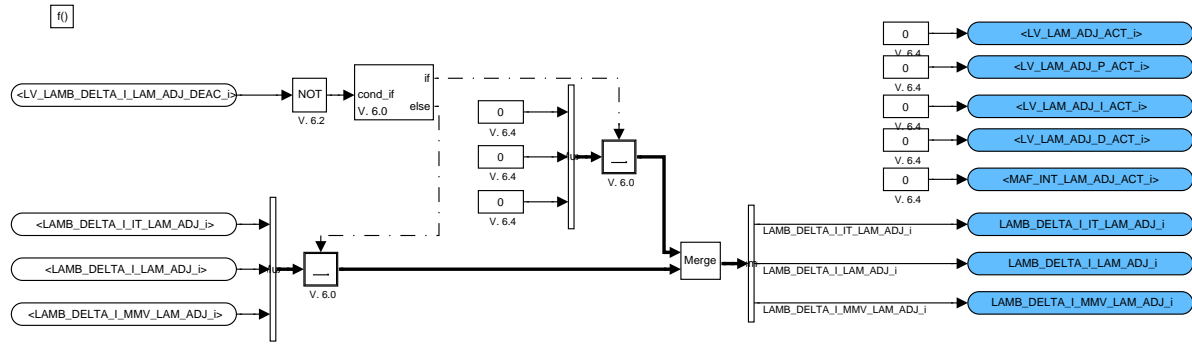


Figure 7.65.4: :

**7.65.2.1.1.2 Activation /deactivation of trim control (part II)**

When all conditions to activate the trim controller are fulfilled an air mass integral is started and the conditions for P, I and D share are checked separately.

For the calculation of the air mass flow integral the unit conversion:

$$[g] = [kg/h] * [ms] * [(g*h)/(kg*ms)] /3600$$

has to be considered.

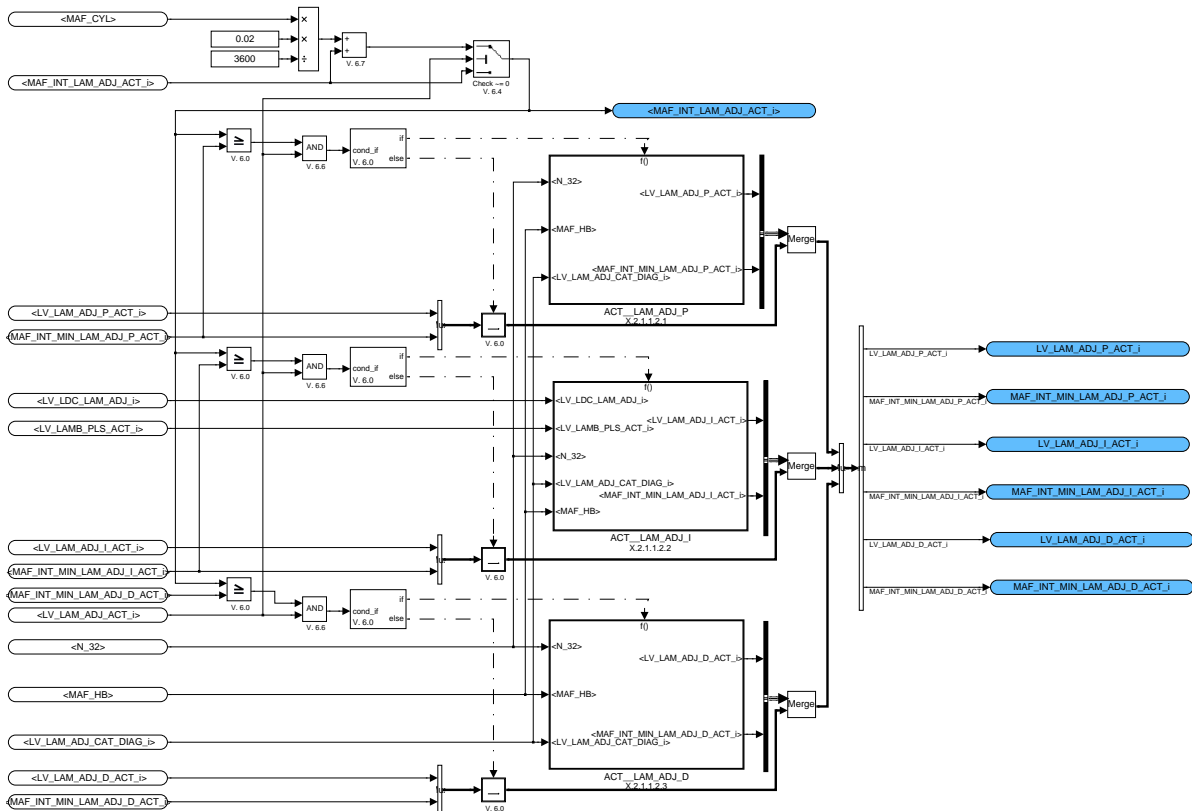


Figure 7.65.5: :

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### 7.65.2.1.1.2.1 Check P share activation conditions

The P share calculation gets active (indicated by LV\_LAM\_ADJ\_P\_ACT[i] after the P share MAF integral threshold is exceeded - only in applied N and MAF areas or when catalyst efficiency diagnosis or CYBL homogeneous activity is active.

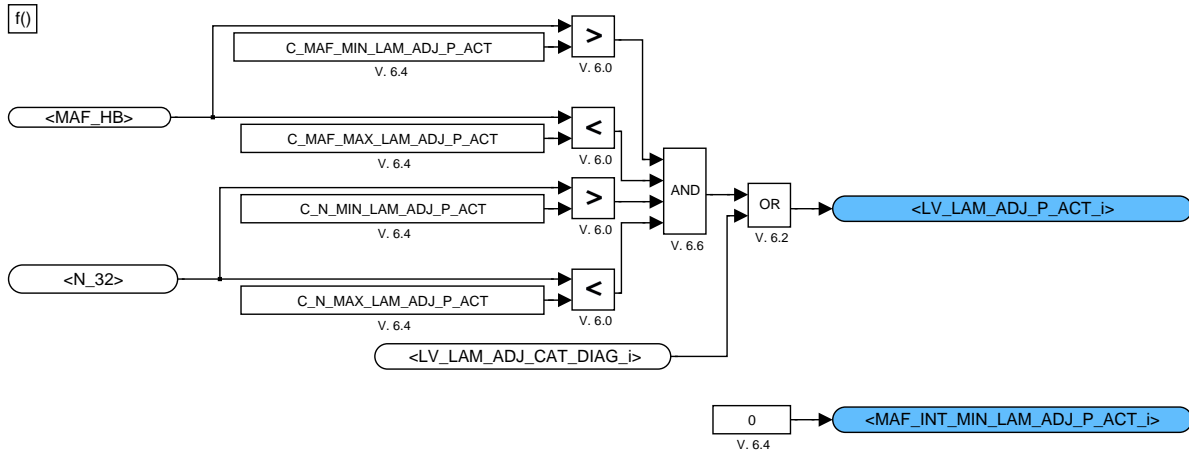


Figure 7.65.6: :

### 7.65.2.1.1.2.2 Check I share activation conditions

The I share calculation gets active (indicated by LV\_LAM\_ADJ\_I\_ACT[i]) after the I share MAF integral threshold is exceeded - in applied MAF areas when the limited dynamics conditions are fulfilled and when the forced lambda stimulation is active. Both latter conditions can be inhibited by means of calibration flags. During active cat efficiency diagnosis or CYBL homogeneous activity the I share is always active after exceeding the MAF integral threshold.

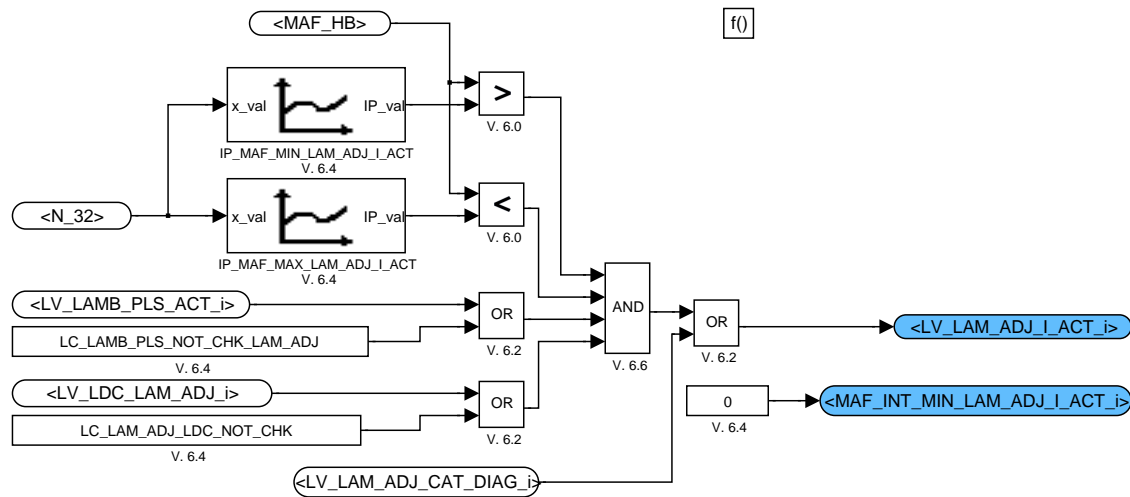


Figure 7.65.7: :

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### 7.65.2.1.1.2.3 Check D share activation conditions

The D share calculation gets active (indicated by LV\_LAM\_ADJ\_D\_ACT[i] after the D share MAF integral threshold is exceeded - only in applied N and MAF areas and when the catalyst efficiency diagnosis is not active or when CYBL homogeneous activity is active.

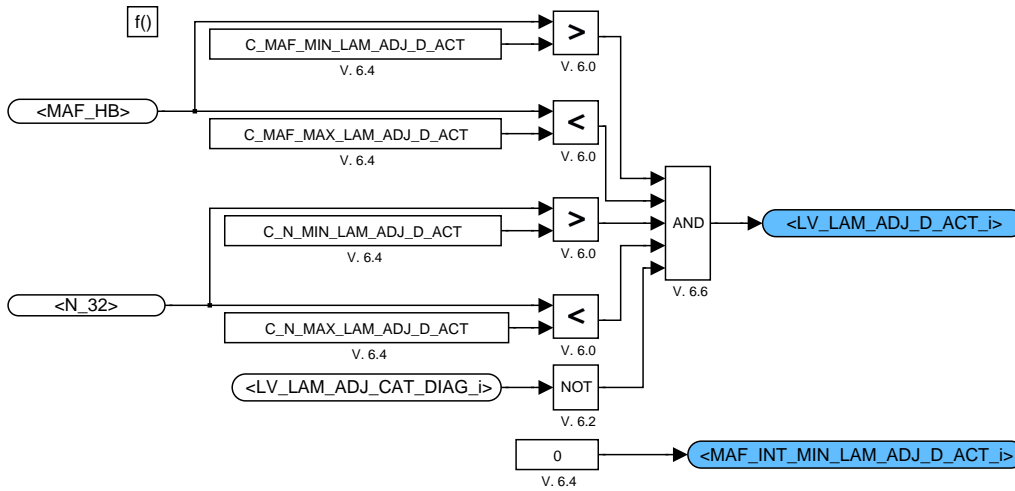


Figure 7.65.8: :

### 7.65.2.1.1.3 Calculation of controller difference

The controller deviation is defined by the difference of the set point of the sensor output voltage IP\_VLS\_SP\_LAM\_ADJ[i] and the actual value VLS\_AV\_LAM\_ADJ[i]. The setpoint can be shifted by IP\_VLS\_SP\_DELTA\_LAM\_ADJ depending on catalyst ageing to take into account stringent NOx increase with catalyst ageing.

VLS\_AV\_LAM\_ADJ[i] is calculated in the application incidences and can be directly the measured trim sensor signal or the filtered and shifted signal in case of Catalyst diagnosis (depending on project requirements). The actual value can also include an external adjustment.

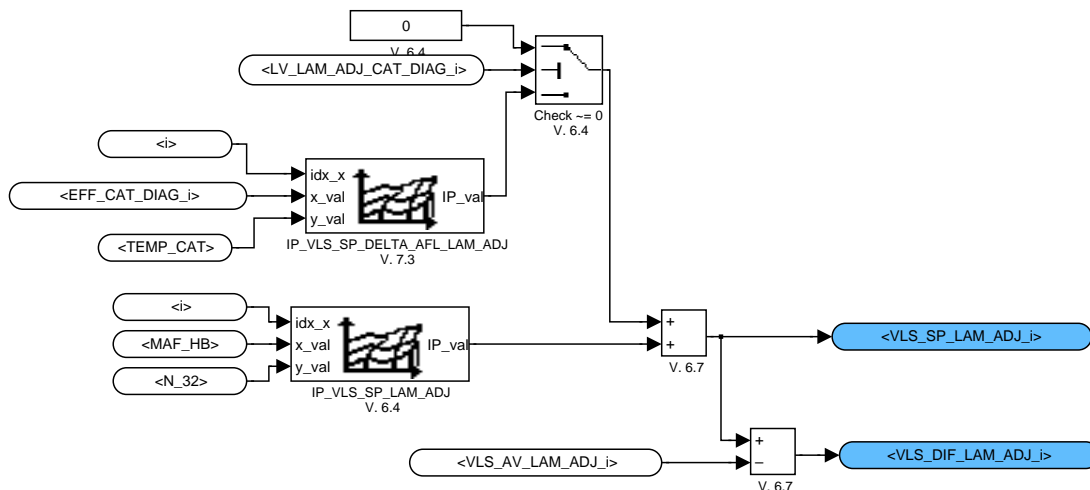


Figure 7.65.9: :

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### 7.65.2.1.1.4 P share calculation

The P share is calculated when LV\_LAM\_ADJ\_P\_ACT[i] is 1. Otherwise the P share is 0. In case of active catalysis diagnosis an own P share gain characteristic line is used.

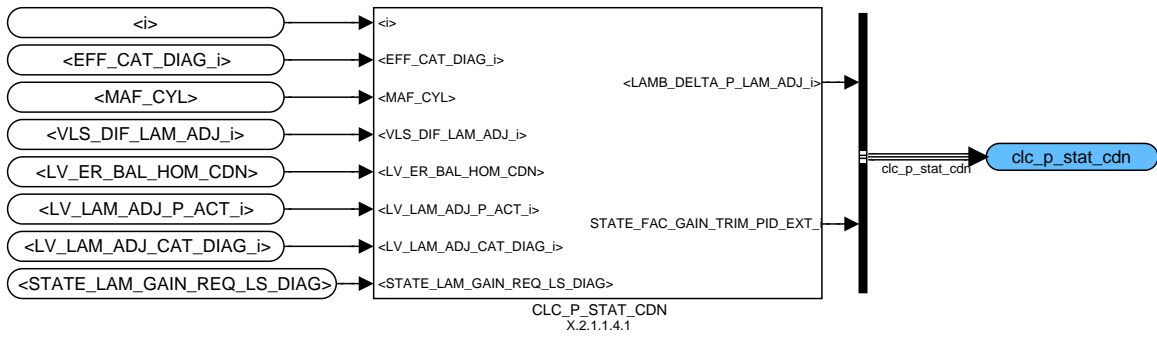



Figure 7.65.10: :

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### 7.65.2.1.1.4.1 Paramemter calculation of P share

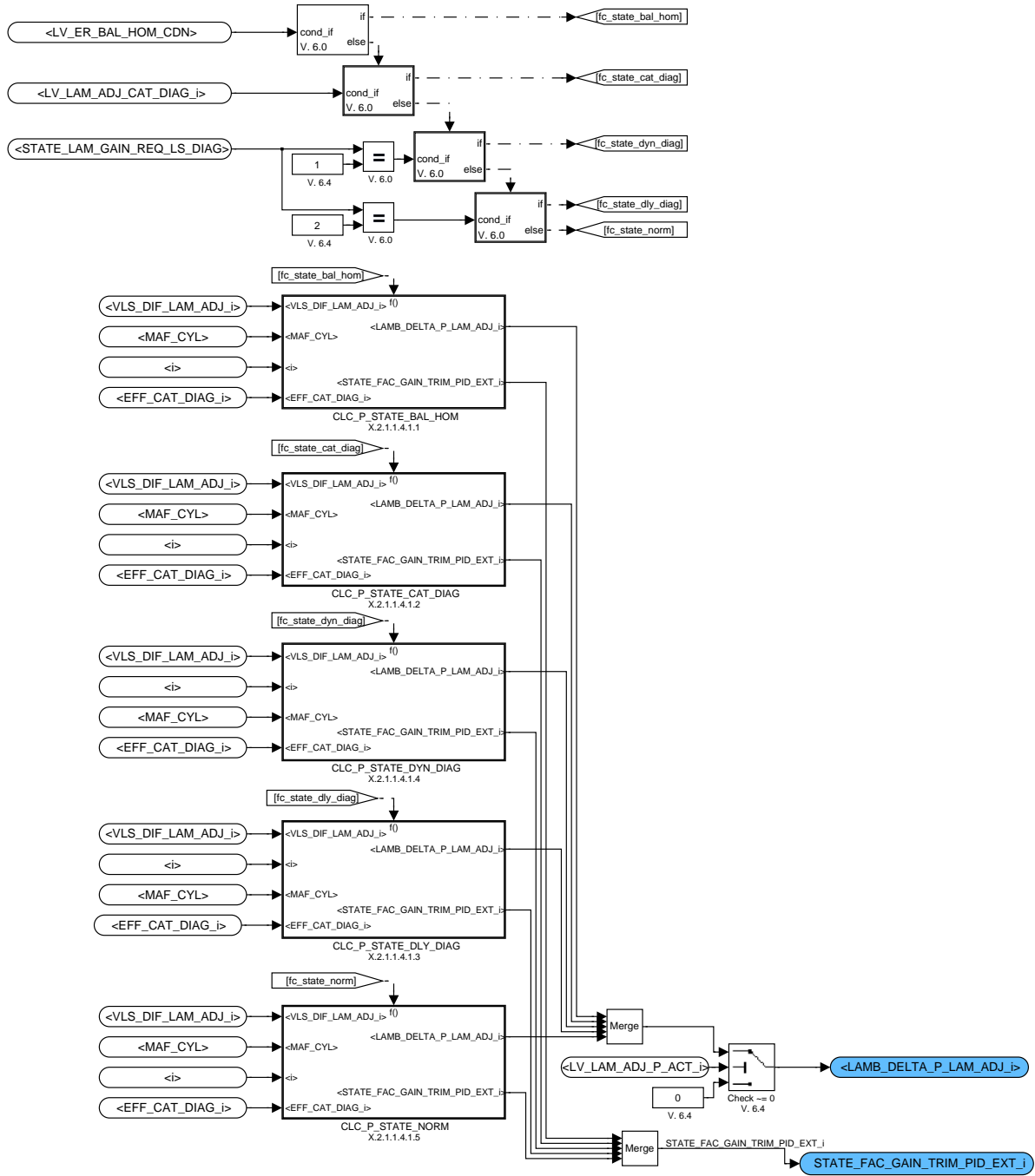


Figure 7.65.11: :

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### 7.65.2.1.1.4.1.1 P share calculation in case of cylinder balancing homogenous reached

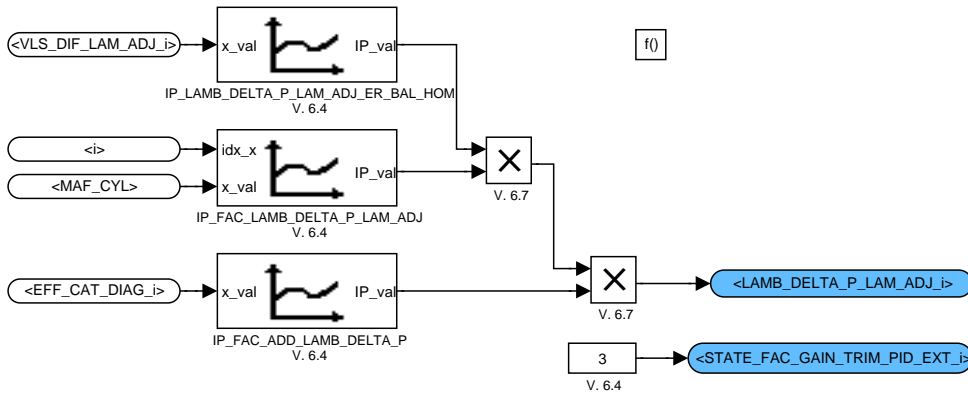


Figure 7.65.12: :

### 7.65.2.1.1.4.1.2 P share calculation in case of cat diagnosis

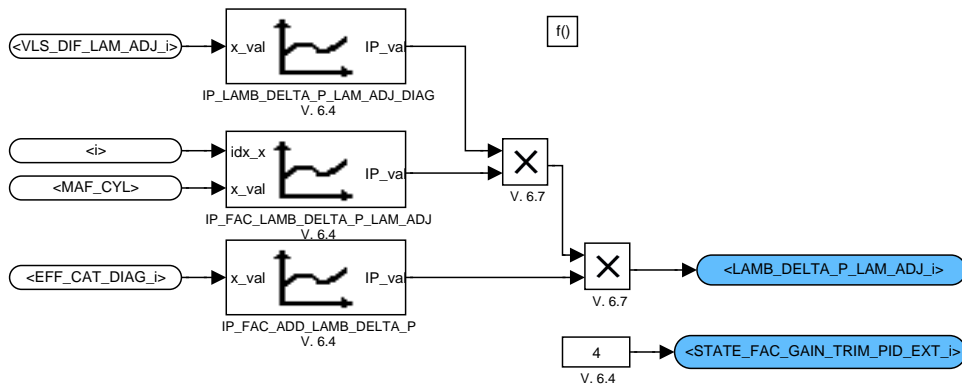


Figure 7.65.13: :

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### 7.65.2.1.1.4.1.3 P share calculation in case of delay diagnosis

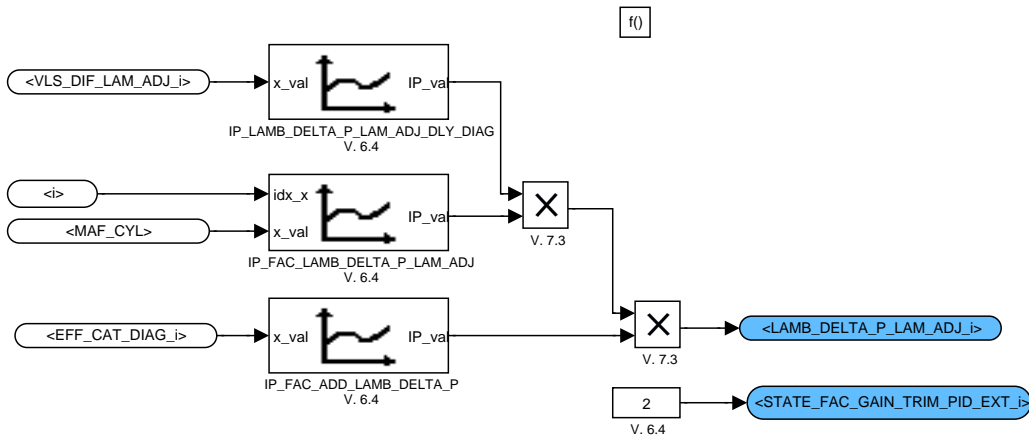


Figure 7.65.14: :

### 7.65.2.1.1.4.1.4 P share calculation in case of dynamic diagnosis

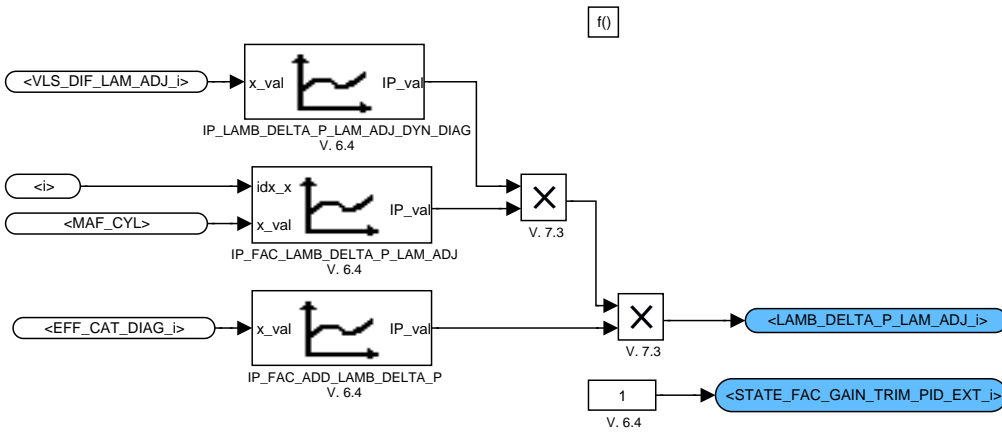


Figure 7.65.15: :

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### 7.65.2.1.1.4.1.5 P share calculation in case of normal state

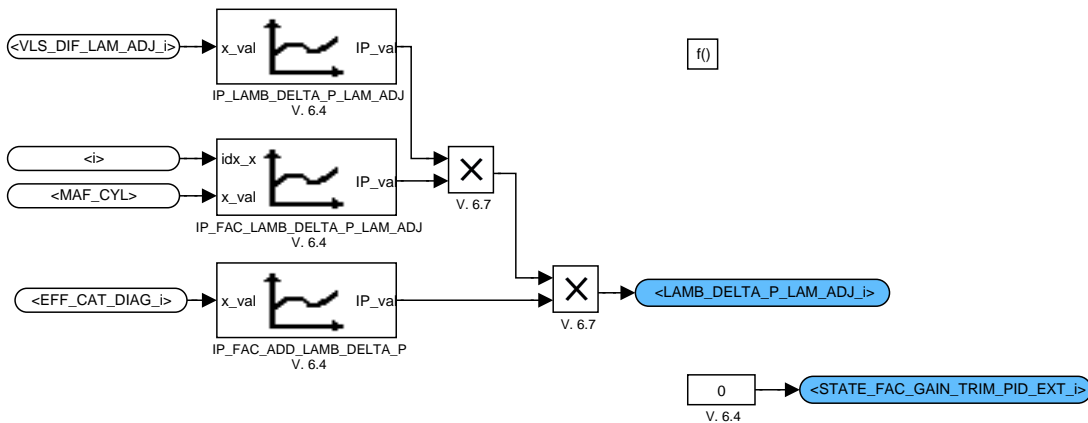


Figure 7.65.16: :

### 7.65.2.1.1.5 I share calculation management


The I share itself is calculated internally with a higher resolution than the output variable LAMB\_DELTA\_I\_LAM\_ADJ[i]. The variable LAMB\_DELTA\_I\_IT\_LAM\_ADJ[i] is used. A limitation of calibration thresholds (C\_LAMB\_DELTA\_I\_MIN\_LAM\_ADJ and C\_LAMB\_DELTA\_I\_MAX\_LAM\_ADJ) is applied at the end of the calculation. Both variables are initialised with the adaptation value LAMB\_DELTA\_AD\_LAM\_ADJ[i].

The I share is only calculated when LV\_LAM\_ADJ\_I\_ACT[i] is 1. The calculation is the summation of IP\_LAMB\_DELTA\_I\_LAM\_ADJ \* IP\_CRLC\_LAMB\_DELTA\_I\_LAM\_ADJ. This latter map is for MAF\_CYL weighting. If the I share is not calculated it remains fix.

A moving mean value of the I share LAMB\_DELTA\_I\_MMV\_LAM\_ADJ[i] (needed for WRAF sensor characteristic line adaptation) is calculated.

In case of active catalyst diagnosis and sensor dynamic diagnosis own parameters are applied (IP\_LAMB\_DELTA\_I\_LAM\_ADJ\_DIAG multiplied by IP\_CRLC\_LAMB\_DELTA\_I\_LAM\_ADJ) and the moving mean value of the I share is not calculated. When cat diagnosis gets active the I share is stored. It is written back to the corresponding variable at the end of the diagnosis only in case that LC\_LAM\_ADJ\_I\_SAVE\_CAT\_DIAG is set to 1.

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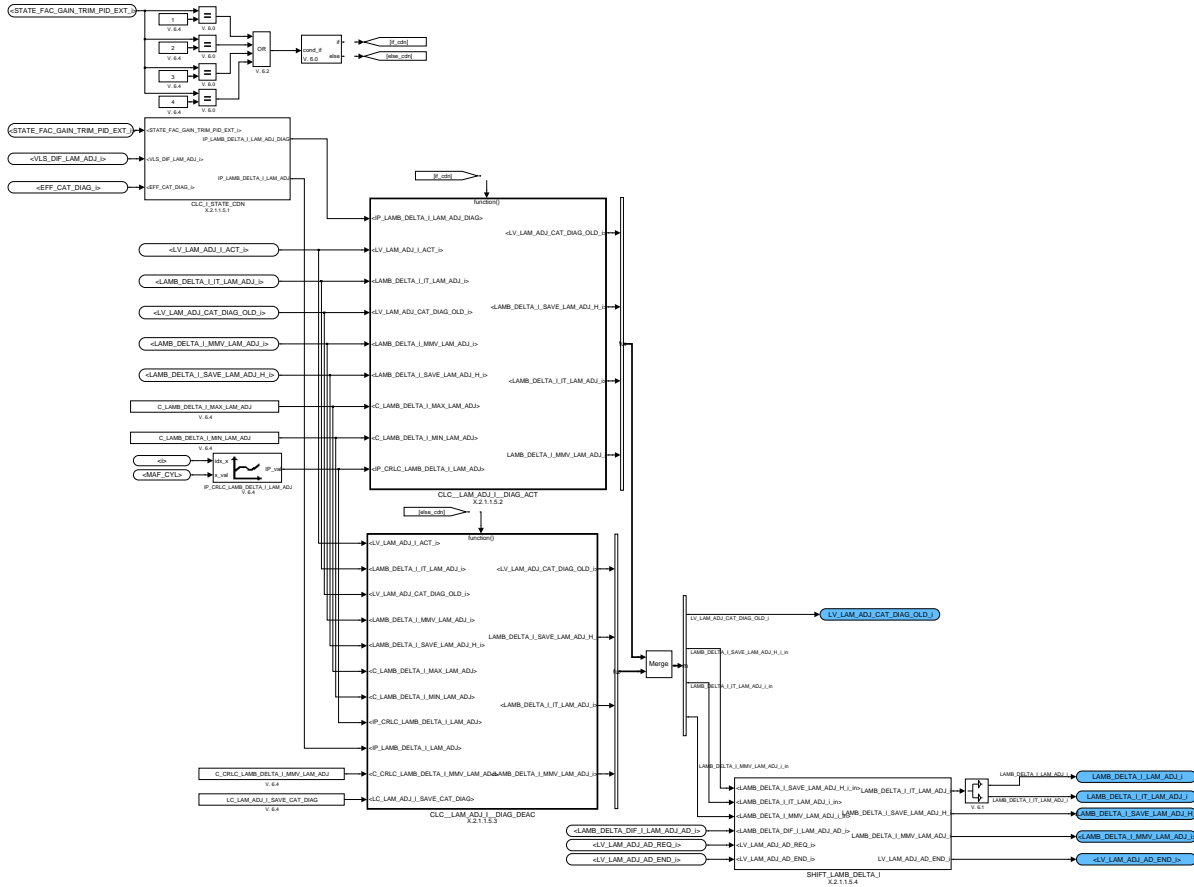


Figure 7.65.17: :

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### 7.65.2.1.1.5.1 Parameter calculation of I share

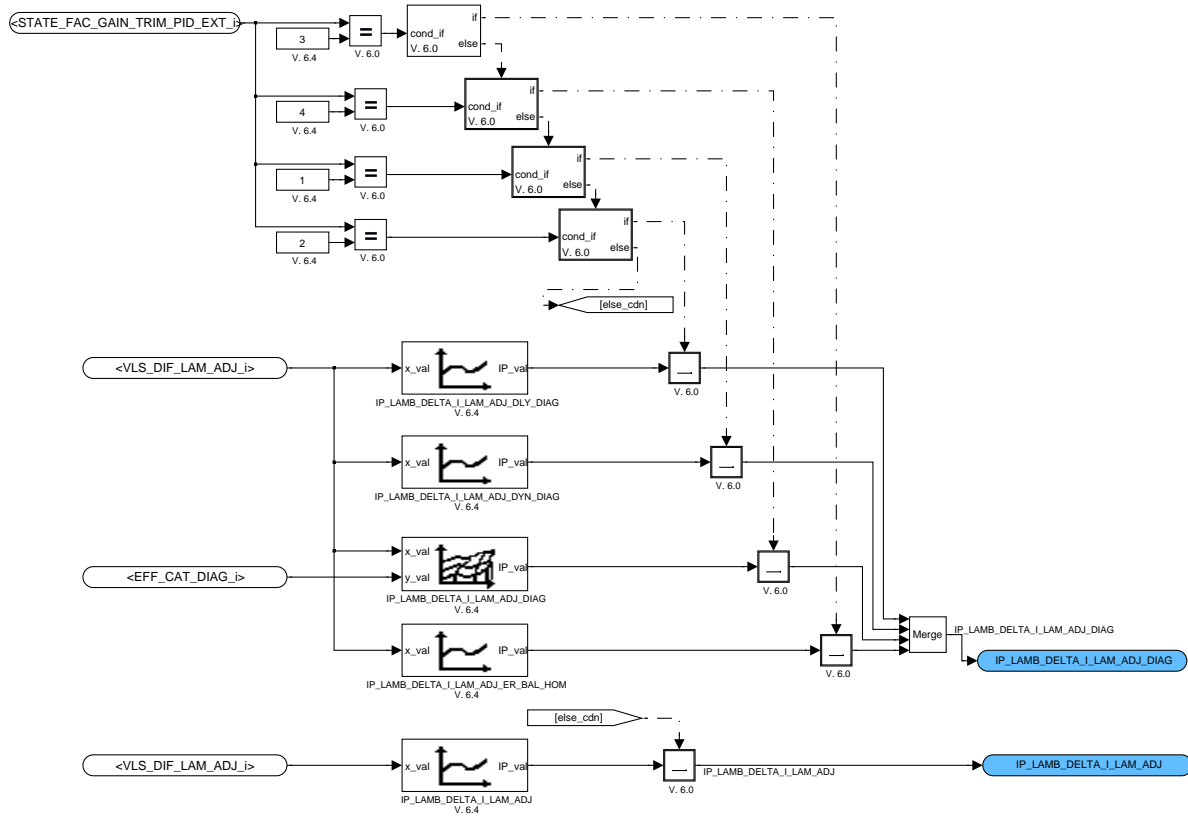


Figure 7.65.18: :

### 7.65.2.1.1.5.2 I-share during Diagnosis mode

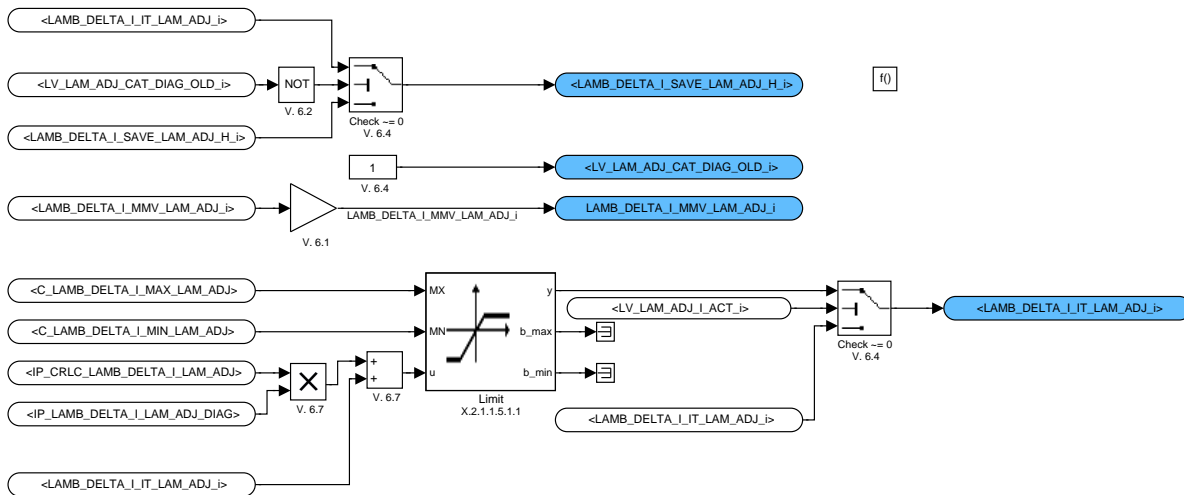


Figure 7.65.19: :

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### 7.65.2.1.1.5.3 I-share during nominal mode

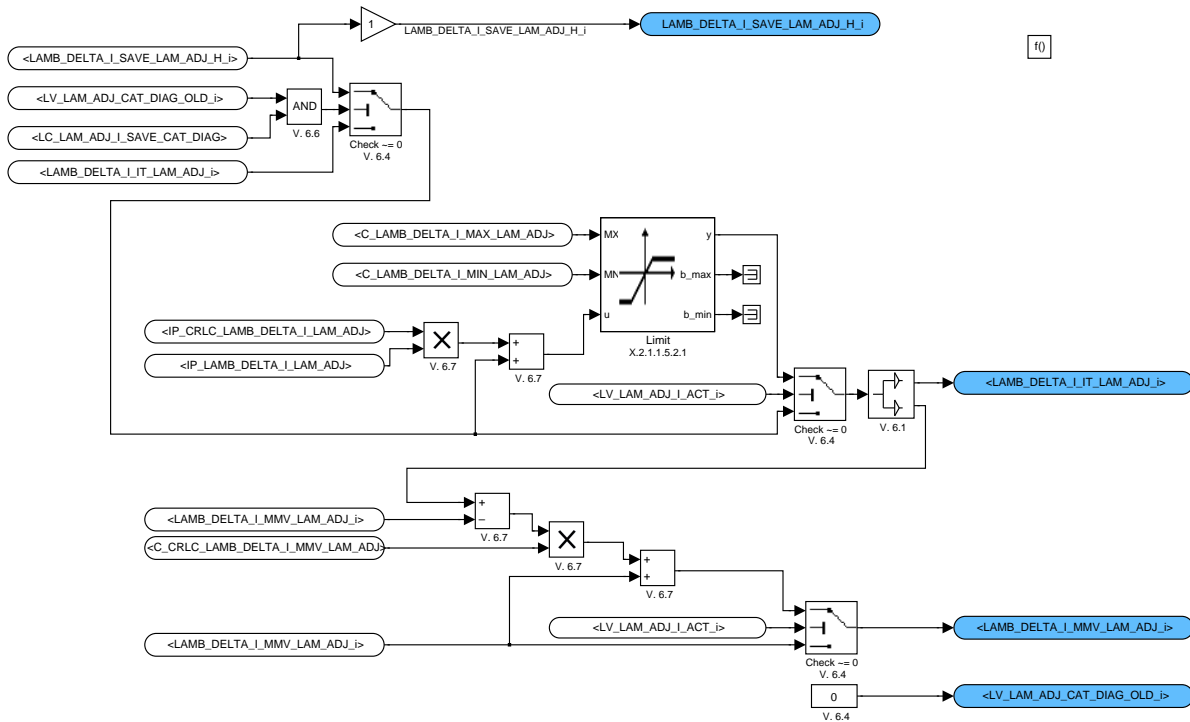


Figure 7.65.20 :

### 7.65.2.1.1.5.4 Shift of I share

When requested by the function WRAF sensor characteristic line adaptation a shift of all I share components is applied. The adaptation value in the mentioned function executes an opposite shift.

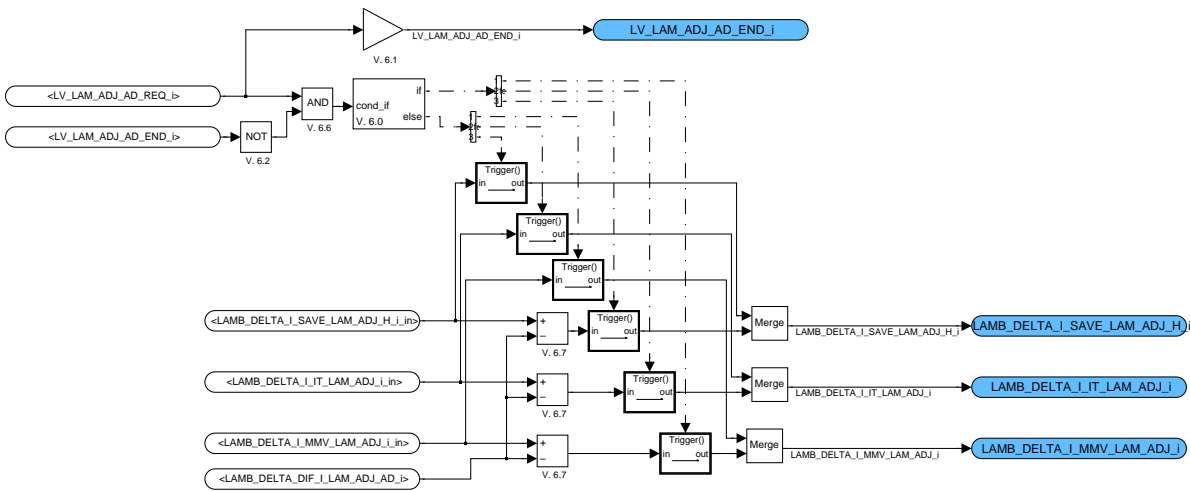


Figure 7.65.21 :

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### 7.65.2.1.1.6 D share calculation

The D share is calculated when LV\_LAM\_ADJ\_D\_ACT[i] is 1. The D share is calculated by evaluating the voltage difference between the control difference and its moving mean value. The filter parameter for moving mean value is MAF\_CYL and EFF\_CAT\_DIAG depending to take into account longer needed duration of D-share at low MAF\_CYL and shorter due to OSC deteriorating due to catalyst ageing This voltage difference is then input to a characteristic line IP\_LAMB\_DELTA\_D\_LAM\_ADJ that is weighted by MAF\_CYL and EFF\_CAT\_DIAG[i].

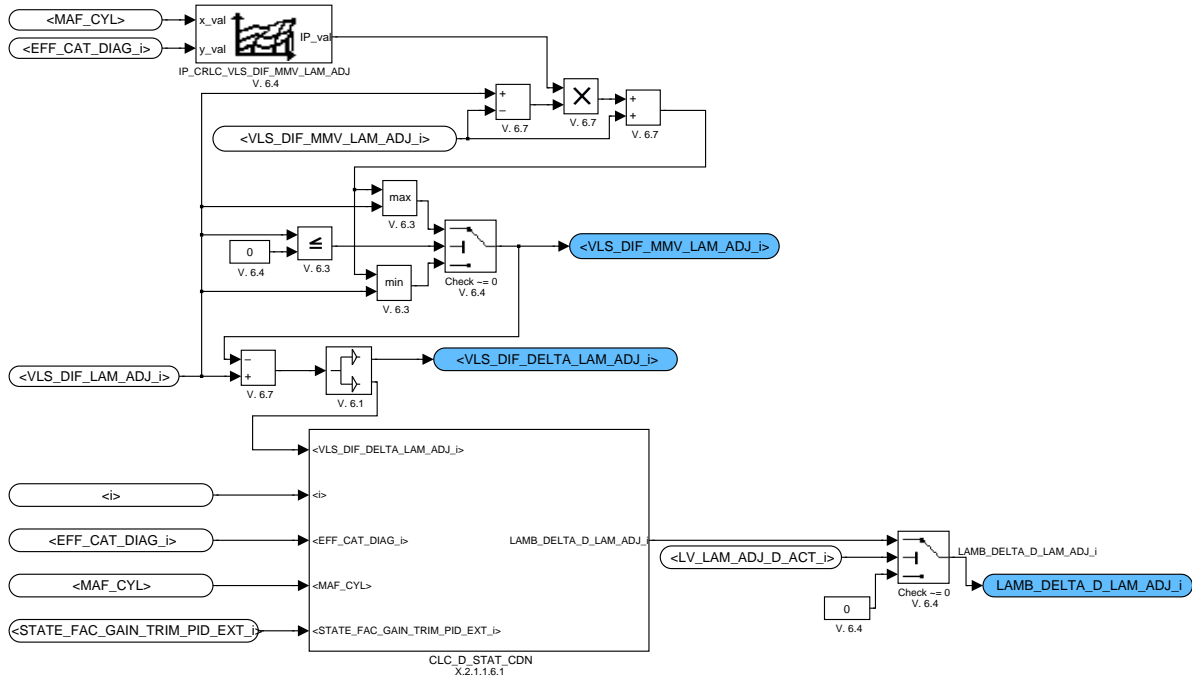


Figure 7.65.22: :

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### 7.65.2.1.1.6.1 Paramemter calculation of D share

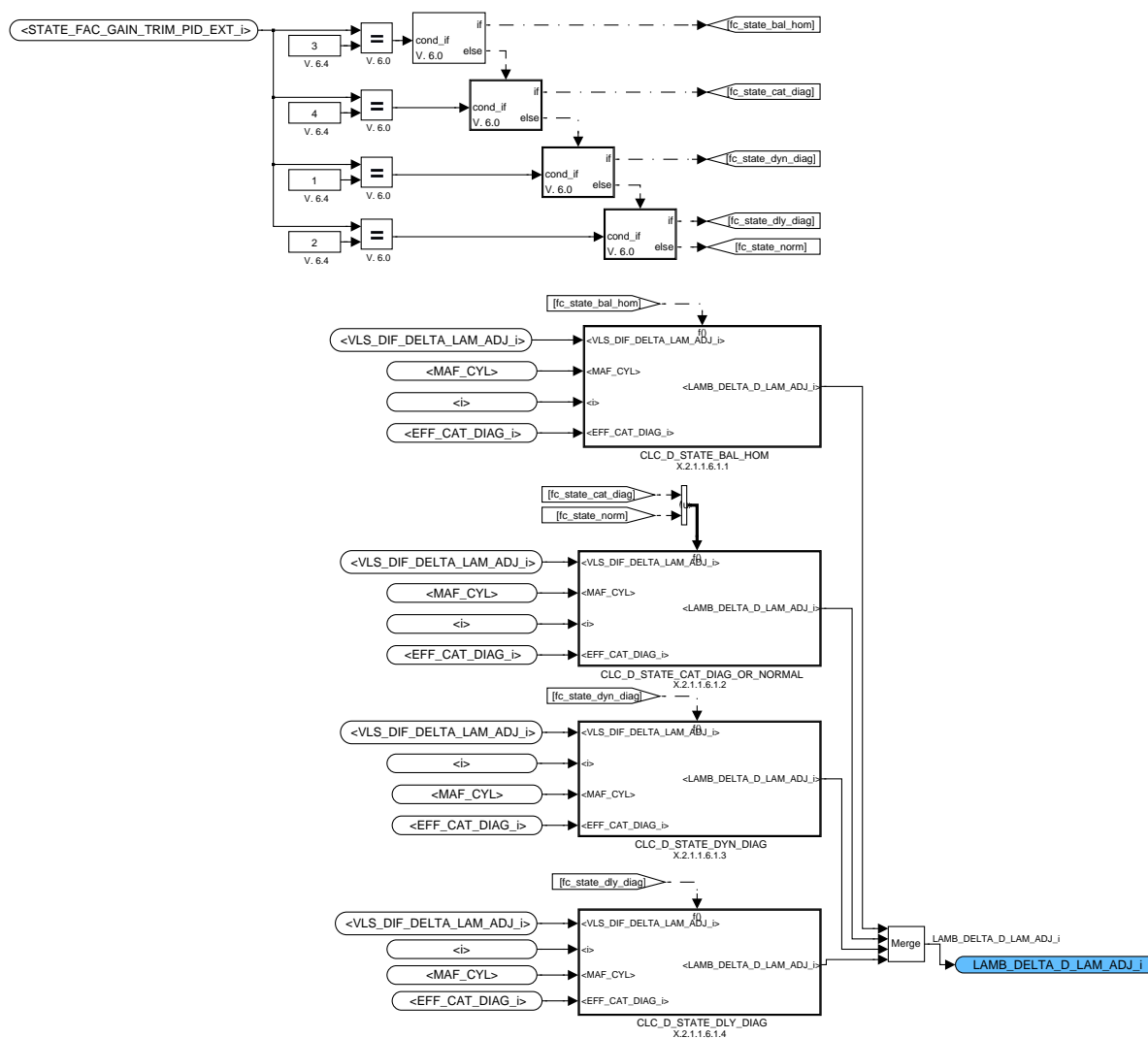


Figure 7.65.23: :

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7.65.2.1.1.6.1.1 D share calculation in case of cylinder balancing homogenous reached

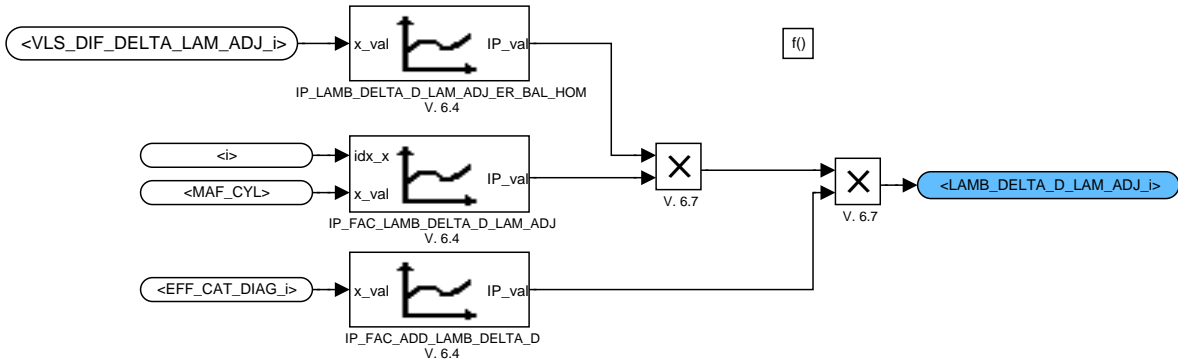


Figure 7.65.24: :

7.65.2.1.1.6.1.2 D share calculation in case of cat diagnosis

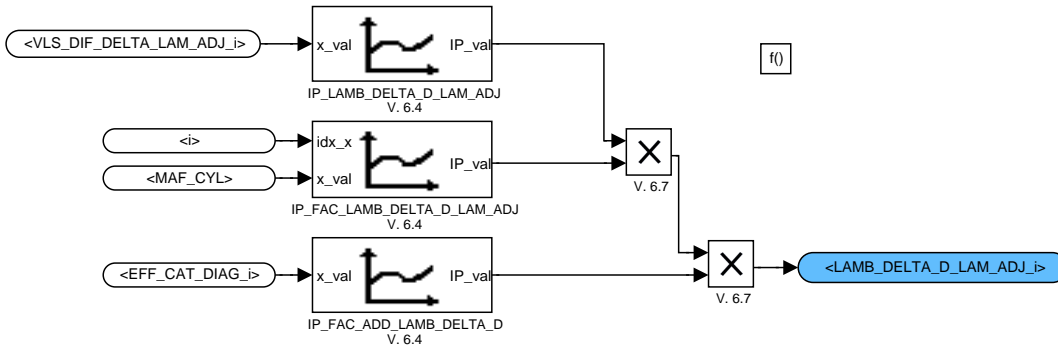


Figure 7.65.25: :

7.65.2.1.1.6.1.3 D share calculation in case of dynamic diagnosis

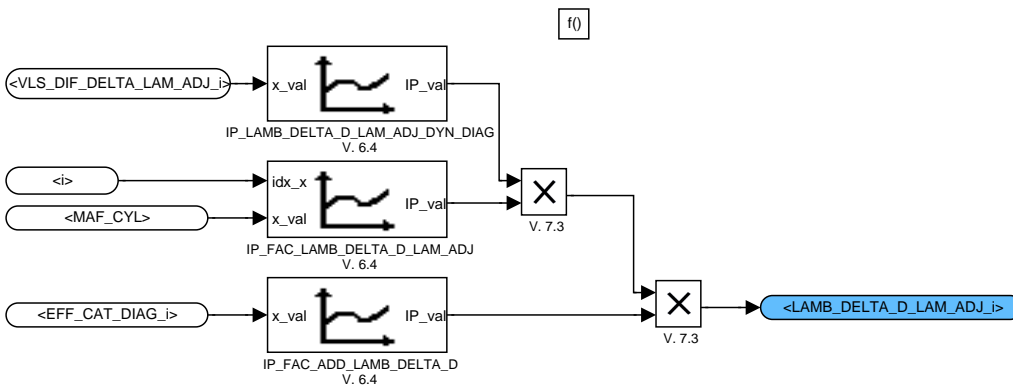


Figure 7.65.26: :

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### 7.65.2.1.1.6.1.4 D share calculation in case of delay diagnosis

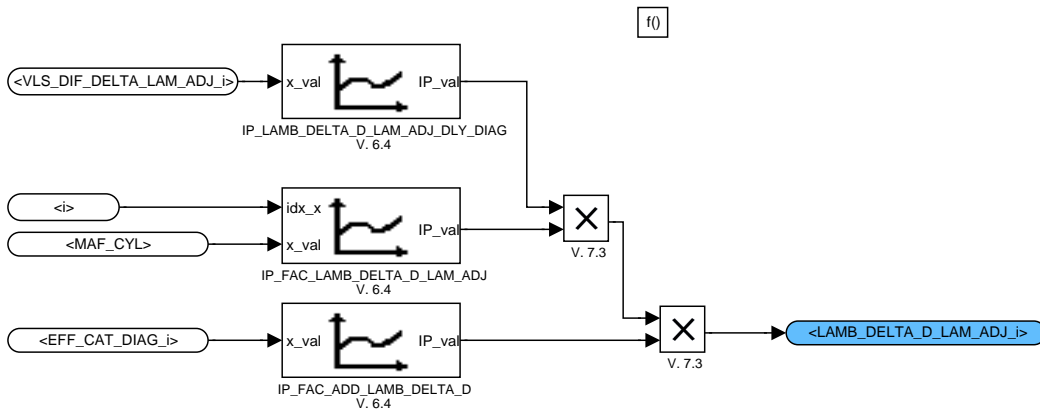


Figure 7.65.27: :

### 7.65.2.1.1.7 Calculation of total lambda shift

The total lambda shift  $LAMB\_DELTA\_LAM\_ADJ[i]$  is calculated by adding P share, I share and D share.

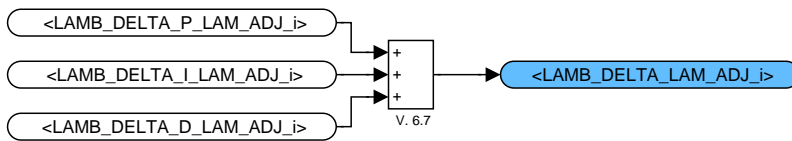


Figure 7.65.28: :

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## 7.66 Dynamic fuel trim (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DELTA_VLS_DOWN_CAT_DIAG [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Set point shift for downstream fuel trim controller in case of active cat diagnosis					
LV_INH_LAM_ADJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
inhibition flag for trim control					
LV_LAM_ADJ_ACT_FAST_LAM_LSCL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
activation flag for fast activation of dynamic fuel trim					
LV_LAMB_DELTA_AD_LAM_ADJ_CLC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that adaptation value is calculated at start of power latch phase					
LV_LAMB_DELTA_AD_LAM_ADJ_EXT	O/V	0... 1H	0 ...1	1	-
flag to set trim control adaptation value to calibration value (external adjustment)					
LV_LAMB_DELTA_I_LAM_ADJ_DEAC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that I share is fixed when deactivating lambda controller					
LV_LDC_LAM_ADJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
limited dynamic conditions for trim control					
STATE_VLS_AV_LAM_ADJ [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Status flag for representation of different conditions under which VLS_AV_LAM_ADJ is calculated					
VLS_AV_LAM_ADJ [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.9951171875	4.88281e-3	V
sensor voltage actual value for trim control					
VLS_DELTA_LAM_ADJ_CAT_DIAG [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Sensor voltage set point shift in case of active cat efficiency diagnosis					
VLS_DELTA_LAM_ADJ_DYN_DIAG [NC_CBK_EX_NR]	V	FC00... 3FFH	-5... 4.9951171875	4.88281e-3	V
sensor voltage setpoint shift for trim controller incase of active dynamic diagnosis					

### Input data:

EFF_CAT_DIAG [NC_CBK_EX_NR] {p. 5535}	ERR_INH_LAM_ADJ [NC_CBK_EX_NR] {p. 1014}	FAC_COMP_MV_DIAG_ DYN_SENS_MDL [NC_CBK_EX_NR] {p. 5345}	LV_LAM_AD_INJ_ACT {p. 3348}
LV_LAM_ADJ_ACT [NC_CBK_EX_NR] {p. 2589}	LV_LAM_ADJ_CAT_DIAG [NC_CBK_EX_NR] {p. 5473}	LV_LAM_ADJ_REQ_DYN_ LSL_UP [NC_CBK_EX_NR] {p. 5348}	LV_LDC_DLY [NC_CBK_EX_NR] {p. 2633}
LV_VAR_TCHA {p. 656}	MAF_KGH {p. 1195}	NC_CBK_EX_NR {p. 1829}	NC_NR_CAM_CBK {p. 1507}
T_AST {p. 1766}	T_SUM_AFL_AFR_CYC [NC_CBK_EX_NR] {p. 2439}	TCO_ST {p. 1100}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_CRLC_VLS_DOWN_DYN_DIAG	-	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_MAF_KGH_CRLC_VLS_DOWN	4	0... FFFFH	0... 2047.96875	0.03125	kg/h
correlation constant downstream signal during DYN_DIAG					
ID_CRLC_VLS_DOWN_T_DLY	-	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_MAF_KGH_CRLC_VLS_DOWN	4	0... FFFFH	0... 2047.96875	0.03125	kg/h
correlation constant downstream signal					
ID_T_DLY_LAM_AD [NC_CBK_EX_NR]	-	0... FFFFH	0... 6553.5	0.1	s
LDP_TCO_ST_1_EGCP	6	0... FEH	-48... 142.5	0.75	°C
activation of trim controller after calibratable time					
IP_CRLC_VLS_LAM_ADJ_CAT_DIAG	-	0... FFH	0... 0.99609375	3.90625e-3	-
LDP_T_SUM_AFL_AFR_IP_CRLC_VLS	6	0... FFFFH	0... 655.35	0.01	s
correlation constant for filtering downstream signal for catalyst efficiency diagnosis					
IP_VLS_DELTA_LAM_ADJ_CAT_DIAG	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
LDPM_EFF_CAT_DIAG_1_LACO	8	0... FFH	0... 1.9921875	7.8125e-3	-
sensor voltage set point shift in case of active cat efficiency diagnosis					
IP_VLS_DELTA_LAM_ADJ_DYN_DIAG	-	0... 7FFH	-5... 4.99511719	4.88281e-3	V
LDPM_FAC_COMP_MV_1_LACO	6	0... FFFFH	-32... 31.9990234375	976.563e-6	-
Sensor voltage setpoint shift for trim controller incase of active dynamic diagnosis					
LC_LAM_ADJ_ACT_FAST_LAM_LSCL	-	0... 1H	0 ...1	1	-
Switch to activate fast activation of dynamic fuel trim					
LC_LAM_ADJ_INH_ENA_LAM_AD_INJ	-	0... 1H	0 ...1	1	-
Switch to enable inhibition of trim controller during MFMA operation					
LC_LAMB_DELTA_AD_LAM_ADJ_EXT	-	0... 1H	0 ...1	1	-
LC for external adjustment of adaptation value for the LAMBDA-shift					
LC_VAR_EX_CUS	-	0... 1H	0 ...1	1	-
Switch to an exhaust gas configuration with 2 linear and 1 binary O2 sensor (LC = 1)					

**General information:**

There are many errors which make it necessary to stop the trim control when they occur. The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then


i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2,

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank

**Application conditions:**

Released by Tettenborn Frank		Date 2013-02-13	File 9K702D01.00C
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 2614 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

**Initialisation:** RST  
**Recurrence:** 20MS  
**Activation:** always  
**Deactivation:** never

## Function description:

## Formula section:

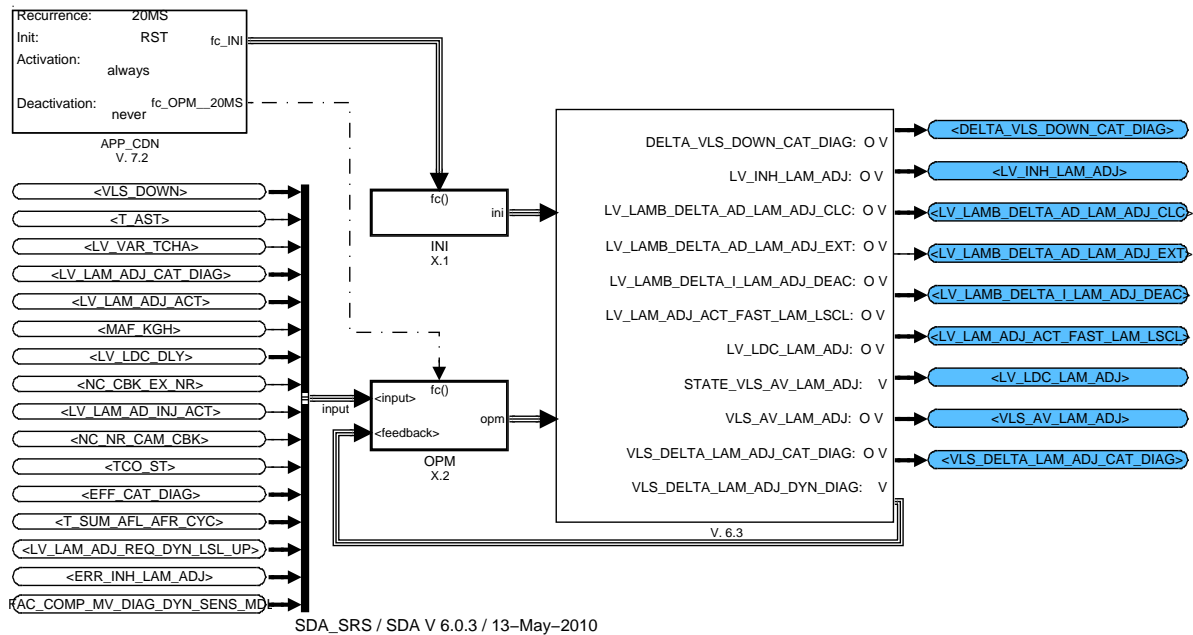


Figure 7.66.1: :

### 7.66.1 Initialization

The initialization is carried out at ECU reset

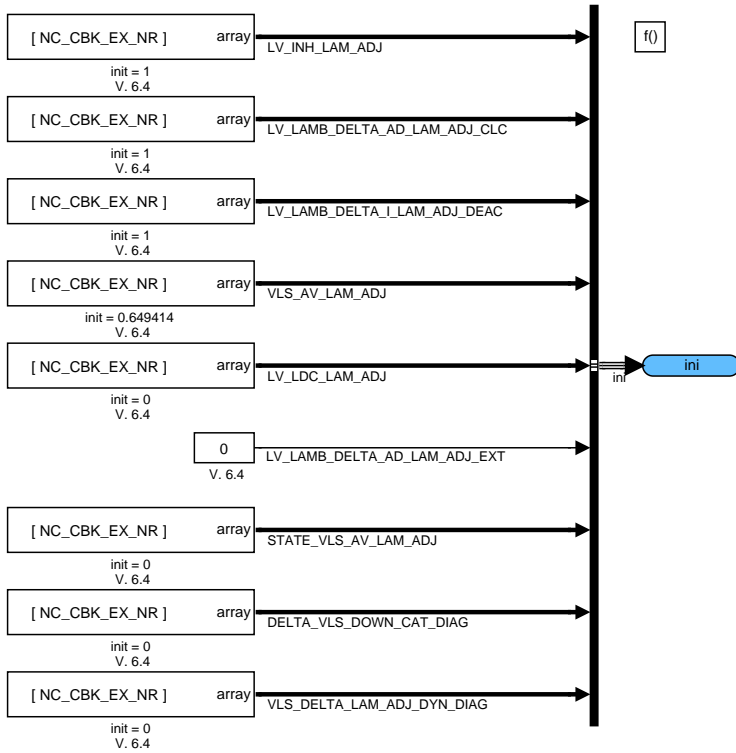


Figure 7.66.2: :

### 7.66.2 OPM

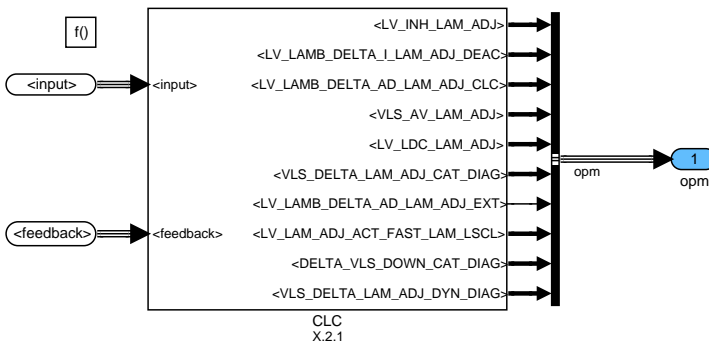


Figure 7.66.3: :

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### 7.66.2.1 Calculation

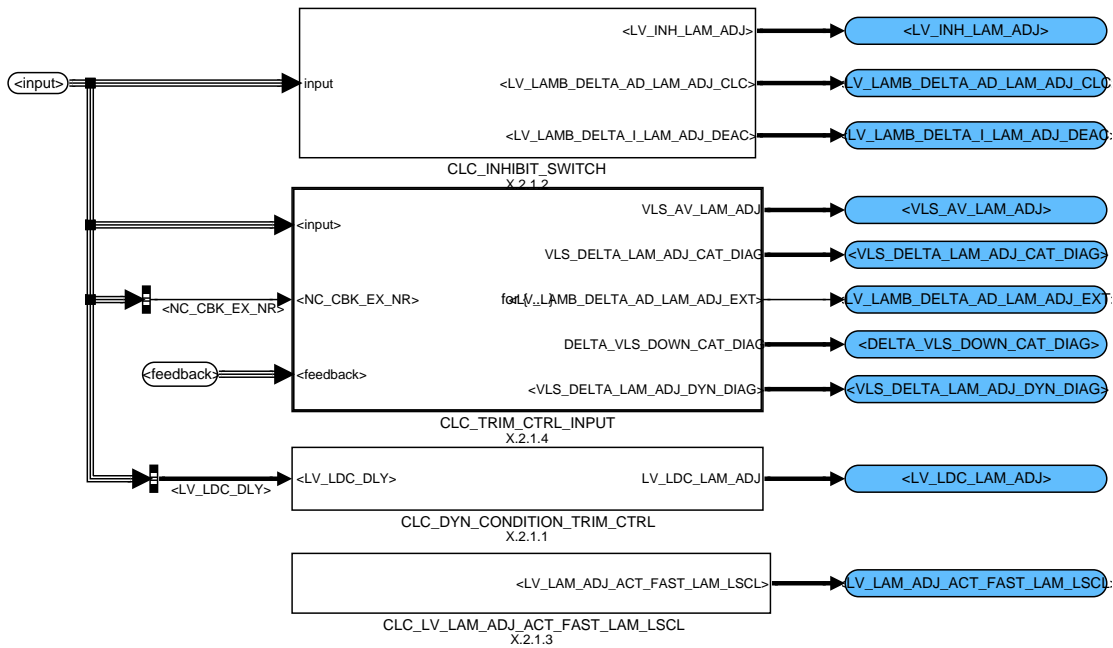


Figure 7.66.4: :

#### 7.66.2.1.1 Determination of limited dynamic conditions for the trim controller

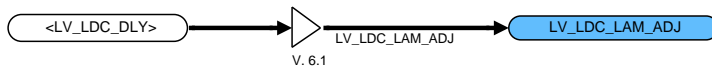


Figure 7.66.5: :

#### 7.66.2.1.2 Calculation of inhibit switch LV\_INH\_LAM\_ADJ[i]

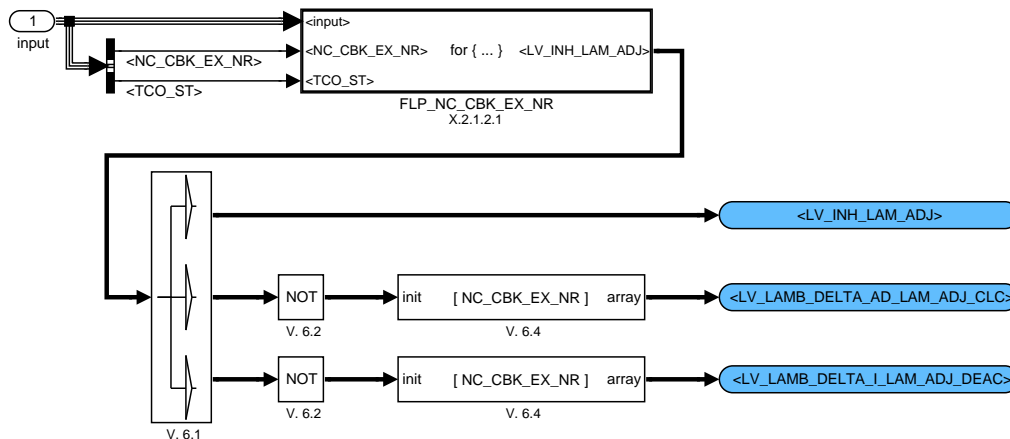


Figure 7.66.6: :

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### 7.66.2.1.2.1 FLP

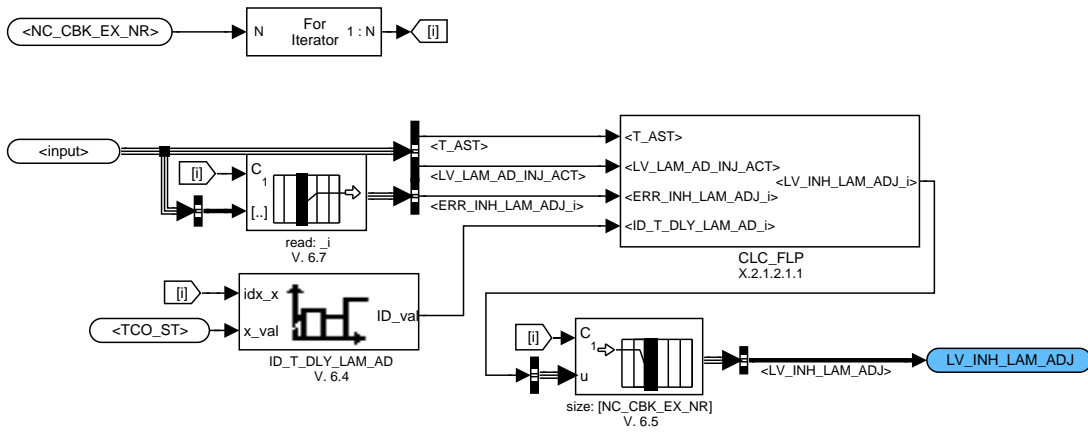


Figure 7.66.7: :

#### 7.66.2.1.2.1.1 Bank specific calculation of LV\_INH\_LAM\_ADJ[i]

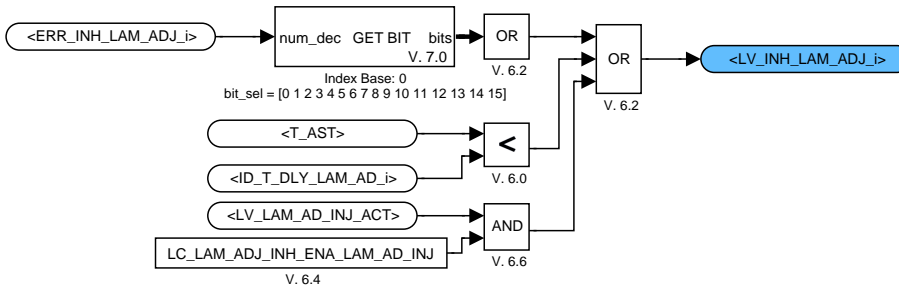


Figure 7.66.8: :

#### 7.66.2.1.3 Assignment of LV\_LAM\_ADJ\_ACT\_FAST\_LAM\_LSCL[i]

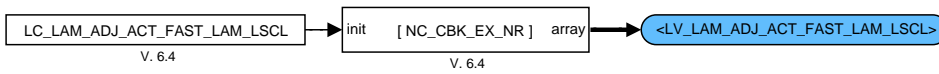


Figure 7.66.9: :

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### 7.66.2.1.4 Trim Control Input

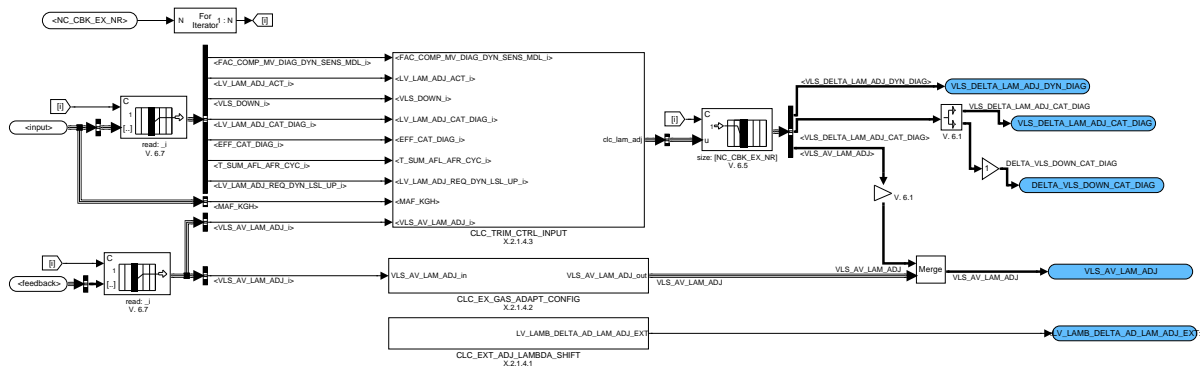


Figure 7.66.10: :

#### 7.66.2.1.4.1 Interface for external adjustment of adaptation value for the (-shift



Figure 7.66.11: :

#### 7.66.2.1.4.2 Adaptation for Exhaust Gas Configuration using 2 linear and 1 binary O2 sensors

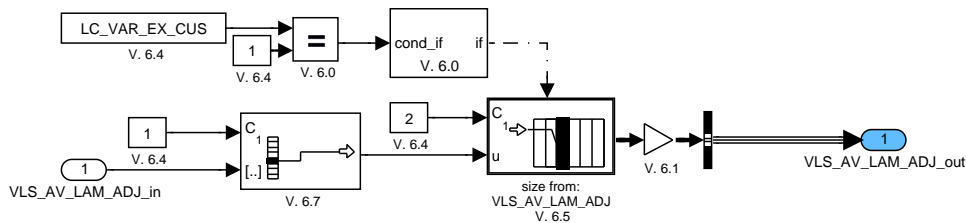


Figure 7.66.12: :

#### 7.66.2.1.4.3 Calculation of VLS\_AV\_LAM\_ADJ[i]

NOTE: VLS\_AV\_LAM\_ADJ[i] must be calculated SW internally with high resolution (32 bit) and must converge. VLS\_AV\_LAM\_ADJ[i] must be initialised with VLS\_DOWN[i] at function activation

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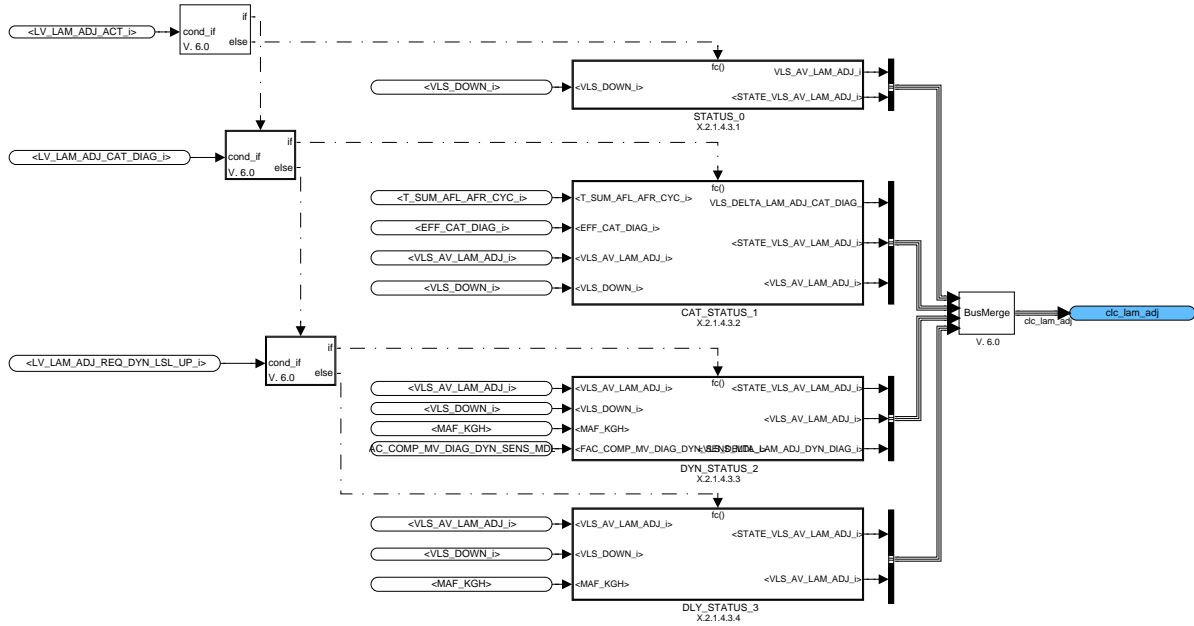


Figure 7.66.13: :

7.66.2.1.4.3.1 STATUS-0 of calculation of VLS\_AV\_LAM\_ADJ

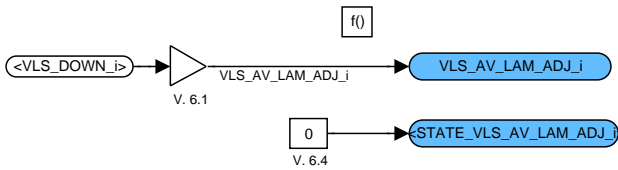


Figure 7.66.14: :

7.66.2.1.4.3.2 STATUS-1 of calculation of VLS\_AV\_LAM\_ADJ

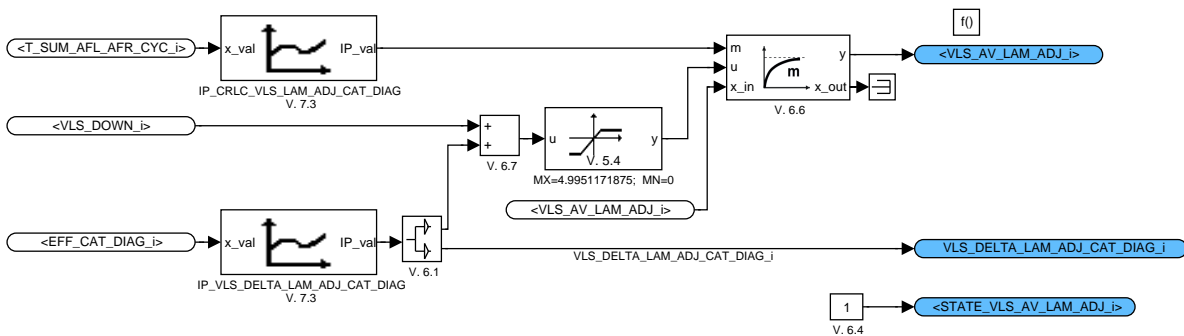


Figure 7.66.15: :

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### 7.66.2.1.4.3.3 STATUS-2 of calculation of VLS\_AV\_LAM\_ADJ

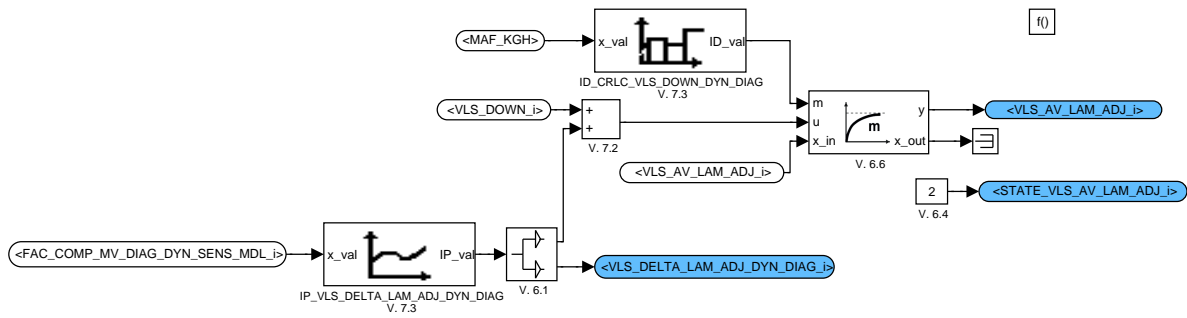


Figure 7.66.16: :

### 7.66.2.1.4.3.4 STATUS-3 of calculation of VLS\_AV\_LAM\_ADJ

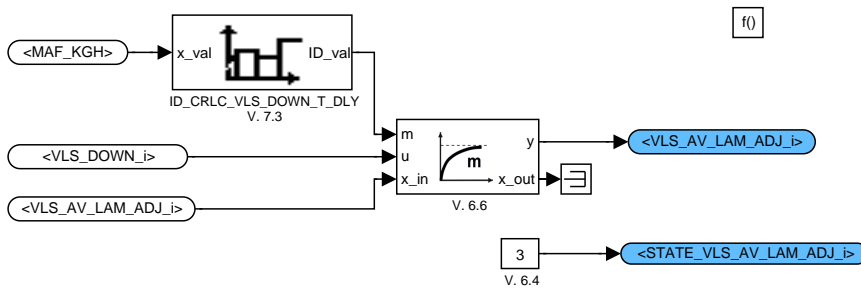


Figure 7.66.17: :

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## 7.67 WRAF sensor characteristic line adaptation with trim control

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_RAF_CHG_LAM_ADJ [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
counter for lean <-> rich air fuel ratio changes					
CTR_RAF_CHG_OLD [NC_CBK_EX_NR]	-	0... FFH	0... 255	1	-
counter old of air fuel ratio changes					
LAMB_DELTA_AD_LAM_ADJ [NC_CBK_EX_NR]	O/V/S	F800... 800H	-0.125 ...0.125	61.0352e-6	-
adaptation value for WRAF sensor characteristic line shift					
LAMB_DELTA_BAS_LAM_ADJ_AD [NC_CBK_EX_NR]	V	F800... 800H	-0.125 ...0.125	61.0352e-6	-
basic characteristic line shift of WRAF sensor					
LAMB_DELTA_DIF_I_LAM_ADJ_AD [NC_CBK_EX_NR]	O/V	F800... 800H	-0.125 ...0.125	61.0352e-6	-
trim control I share shift in case of new adaptation value for WRAF sensor characteristic line shift					
LAMB_DELTA_SUM_LAM_ADJ_AD [NC_CBK_EX_NR]	O/V	F800... 800H	-0.125 ...0.125	61.0352e-6	-
total characteristic line shift of WRAF sensor					
LV_LAM_ADJ_AD_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
request for trim control I share shift due to new adaptation value learning					

### Input data:

CTR_RAF_CHG [NC_CBK_EX_NR] {p. 2460}	EFF_CAT_DIAG [NC_CBK_EX_NR] {p. 5535}	LAMB_DELTA_I_MMV_LAM_ADJ [NC_CBK_EX_NR] {p. 2589}	LV_IS {p. 1720}
LV_LAM_ADJ_AD_CDN_OK [NC_CBK_EX_NR] {p. 2627}	LV_LAM_ADJ_AD_END [NC_CBK_EX_NR] {p. 2589}	LV_LAMB_DELTA_AD_LAM_ADJ_CLC [NC_CBK_EX_NR] {p. 2613}	LV_ST_END {p. 1720}
MAF {p. 8277}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	TEMP_CAT {p. 8237}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_LAMB_DELTA_AD_LAM_ADJ	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
correlation constant of trim control adaptation value calculation					
C_LAMB_DELTA_BAS_LAM_ADJ_IS [NC_CBK_EX_NR]	-	F800... 800H	-0.125 ...0.125	61.0352e-6	-
basic characteristic line shift of WRAF sensor in case of idle speed					
C_LAMB_DELTA_MAX_LAM_ADJ_AD	-	F800... 800H	-0.125 ...0.125	61.0352e-6	-
maximum value for WRAF sensor characteristic line shift offset					
C_LAMB_DELTA_MIN_LAM_ADJ_AD	-	F800... 800H	-0.125 ...0.125	61.0352e-6	-
minimum value for WRAF sensor characteristic line shift offset					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NR_RAF_CHG_WAIT_LAM_ADJ	-	1... FFH	1... 255	1	-
number of lean <-> rich air fuel ratio changes between two adaptation cycles					
IP_LAMB_DELTA_AFL_LAM_ADJ [NC_CBK_EX_NR]	V	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDPM_EFF_CAT_DIAG_1_LACO	8	0... FFH	0... 1.9921875	7.8125e-3	-
LDPM_TEMP_CAT_1_LACO	6	0... FFFFH	-33... 990.984375	0.015625	°C
Additional offset for air fuel lean lambda adjustment					
IP_LAMB_DELTA_BAS_LAM_ADJ [NC_CBK_EX_NR]	V	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDP_MAF_IP_LAMB_DELTA_BAS	8	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_32_IP_LAMB_DELTA_BAS	8	0... FFH	0... 8160	32	rpm
basic characteristic line shift of WRAF sensor					

## General Information

This function adapts the WRAF sensor characteristic line by observing the I share of the trim control function. A basic (load depending) lambda shift of the WRAF sensor can be corrected by means of an additional offset. This offset can change due to ageing of the sensor.

The recurrence time is defined by T\_SAMPLE in [ms].

NC\_CBK\_EX\_NR defines the number of exhaust banks.

For vector elements the variable extension "\_i" is used in the model instead of "[i]" as found in the textual description.

## Application Conditions

Initialization: RST, NVMINI, NVMRES, NVMSTO

Recurrence: 100MS

Activation: LV\_ST\_END == 1

Deactivation: never

## Function description

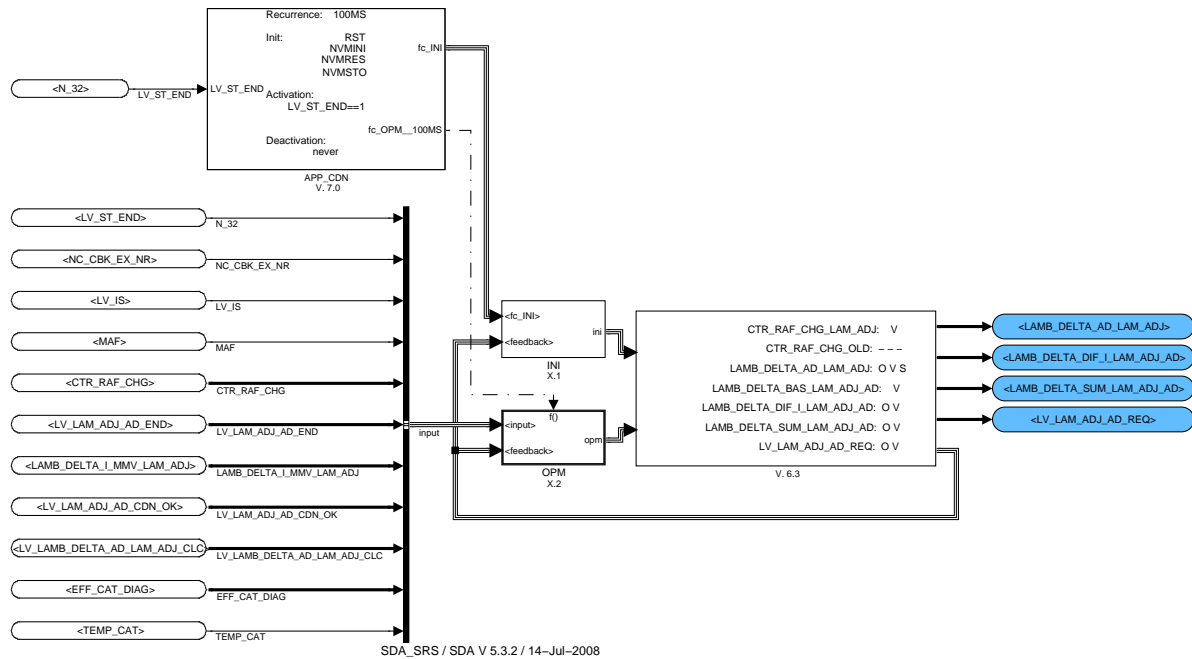


Figure 7.67.1: :

## 7.67.1 Initialization

### 7.67.1.1 All the variables are set to zero

### 7.67.1.2 Initialization of non volatile memory

### 7.67.1.3 Read non volatile memory

### 7.67.1.4 Store non volatile memory

## 7.67.2 Operation at 100ms

### 7.67.2.1 For loop

#### 7.67.2.1.1 Basic WRAF sensor characteristic line shift

##### 7.67.2.1.1.1 Conditions check for WRAF sensor characteristic line adaptation

By means of  $IP\_LAMB\_DELTA\_BAS\_LAM\_ADJ[i]$  the basic sensor characteristic line shift is defined MAF and N dependent. In idle speed the calibration data  $C\_LAMB\_DELTA\_BAS\_LAM\_ADJ\_IS[i]$  is applied. Together with the adaptive correction  $LAMB\_DELTA\_AD\_LAM\_ADJ[i]$  (stored as non volatile data) the total shift  $LAMB\_DELTA\_SUM\_LAM\_ADJ\_ADJ[i]$  is defined.

When the conditions for activating the adaptation are fulfilled the subsystem  $CLC\_AD\_CDN\_OK$  is executed. Otherwise the subsystem  $CLC\_AD\_CDN\_NOT\_OK$  is called where no action is executed.



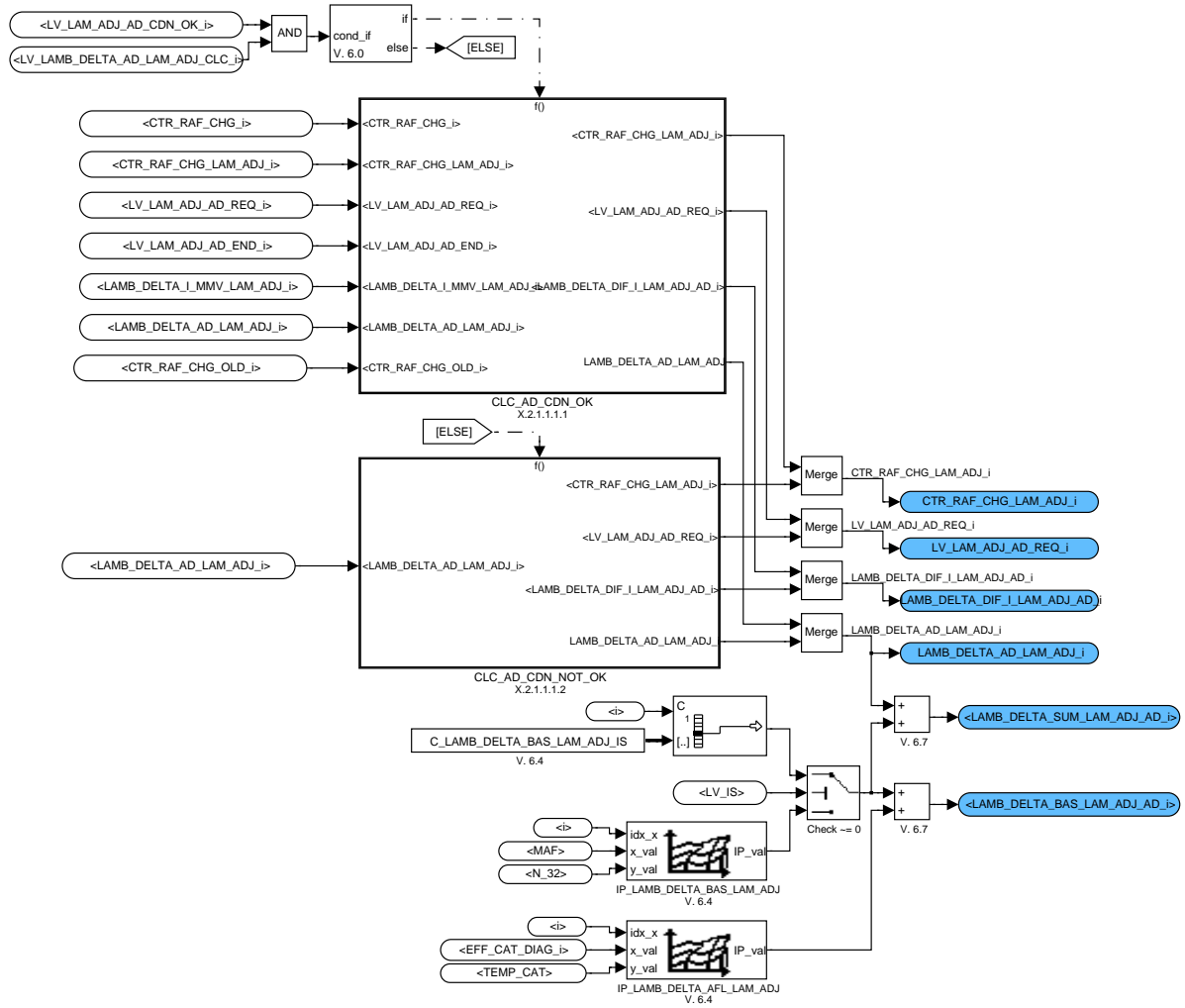


Figure 7.67.2: :

**7.67.2.1.1.1 Adaptation of WRAF sensor characteristic line offset**

The function waits a certain number of lean rich air fuel ratio changes (C\_NR\_RAF\_CHG\_WAIT\_LAM\_ADJ) between 2 adaptation cycles. Then the current I share of the trim controller is shifted by step into the adaptation value. Furthermore this latter value is limited on a calibration maximum and minimum.

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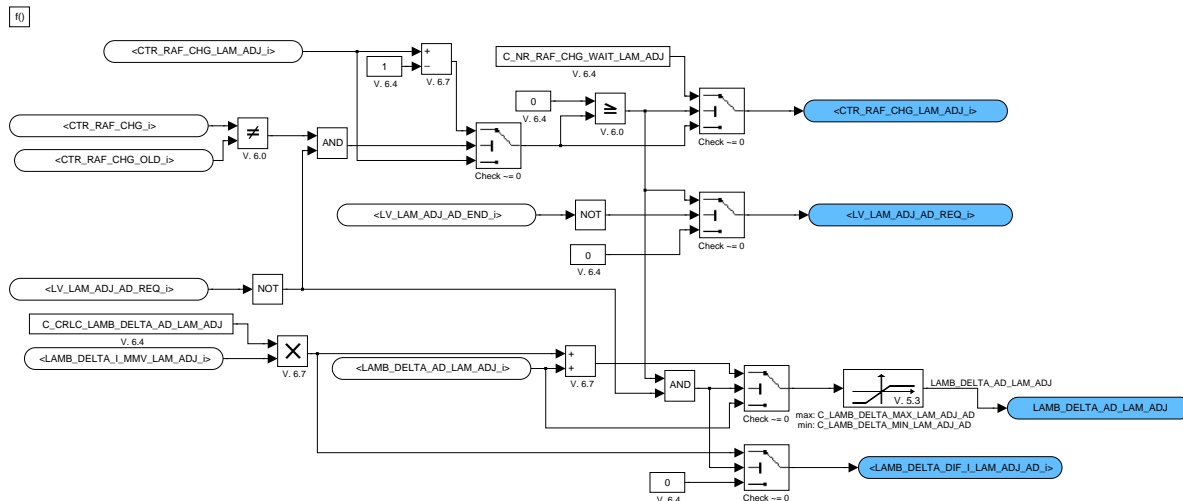


Figure 7.67.3: :

**7.67.2.1.1.1.2 If the condition is not ok for WRAF sensor characteristic line adaptation.**

Number of lean <> rich air fuel ratio changes between two adaptation cycles

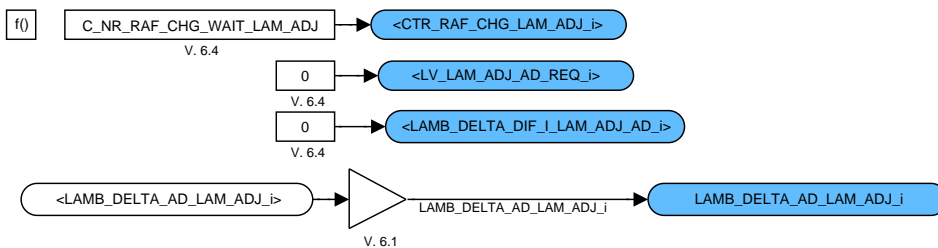


Figure 7.67.4: :

**7.67.2.1.1.2 Calculation of old value**

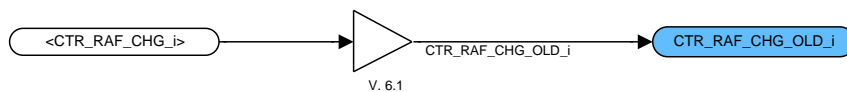


Figure 7.67.5: :

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## 7.68 Condition check for WRAF sensor adaptation with trim control

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAM_ADJ_AD_CDN_OK [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating good conditions for WRAF sensor characteristic line adaptation					
MAF_INT_LAM_ADJ_CDN [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.42	0.0277778	g
air mass flow integral for condition detection of WRAF sensor characterisitic line adaptation					

### Input data:

LAMB_DELTA_I_LAM_ADJ [NC_CBK_EX_NR] {p. 2589}	LAMB_DELTA_I_MMV_ LAM_ADJ [NC_CBK_EX_NR] {p. 2589}	LAMB_DELTA_P_LAM_ ADJ [NC_CBK_EX_NR] {p. 2589}	LV_CP_CLOSE_ACT {p. 3749}
LV_LAM_ADJ_CAT_DIAG [NC_CBK_EX_NR] {p. 5473}	LV_LAM_ADJ_I_ACT [NC_CBK_EX_NR] {p. 2589}	LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}	LV_LDC_LAM_ADJ [NC_CBK_EX_NR] {p. 2613}
LV_ST_END {p. 1720}	MAF_CYL {p. 8277}	MAF_HB {p. 805}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_DELTA_DIF_I_MMV_LAM_ADJ	-	F800... 800H	0... 0.125	610.352e3	-
difference between I share and moving mean value to allow WRAF sensor characteristic line adaptation					
C_LAMB_DELTA_P_MAX_LAM_ADJ_CDN	-	F800... 800H	0... 0.125	610.352e3	-
maximum trim control P share for WRAF sensor characteristic line adaptation					
C_LAMB_DELTA_P_MIN_LAM_ADJ_CDN	-	F800... 800H	0... 0.125	610.352e3	-
minimum trim control P share for WRAF sensor characteristic line adaptation					
C_MAF_INT_THD_LAM_ADJ_CDN	-	0... FFFFH	0... 1820.42	0.0277778	g
air mass flow integral threshold for stationary condition definition for WRAF sensor characteristic line adaptation					
C_MAF_MAX_LAM_ADJ_CDN	-	0... FFH	0... 1389	5.44706	mg/stk
maximum air mass flow threshold for WRAF sensor characteristic line adaptation					
C_MAF_MIN_LAM_ADJ_CDN	-	0... FFH	0... 1389	5.44706	mg/stk
minimum air mass flow threshold for WRAF sensor characteristic line adaptation					
C_N_MAX_LAM_ADJ_CDN	-	0... FFH	0... 8160	32	rpm
maximum engine speed threshold for WRAF sensor characteristic line adaptation					
C_N_MIN_LAM_ADJ_CDN	-	0... FFH	0... 8160	32	rpm
minimum engine speed threshold for WRAF sensor characteristic line adaptation					

### 7.68.1 LACO\_REQGNTRCDN0

This function checks several conditions that must be fulfilled in order to start the WRAF sensor characteristic line adaption. These conditions shall define a stable state of the downstream sensor signal used by trim control.

The recurrence time is defined by T\_SAMPLE in [ms].

NC\_CBK\_EX\_NR defines the number of exhaust banks.

For vector elements the variable extension "\_i" is used in the model instead of "[i]" as found in the textual description.

**Function Description**

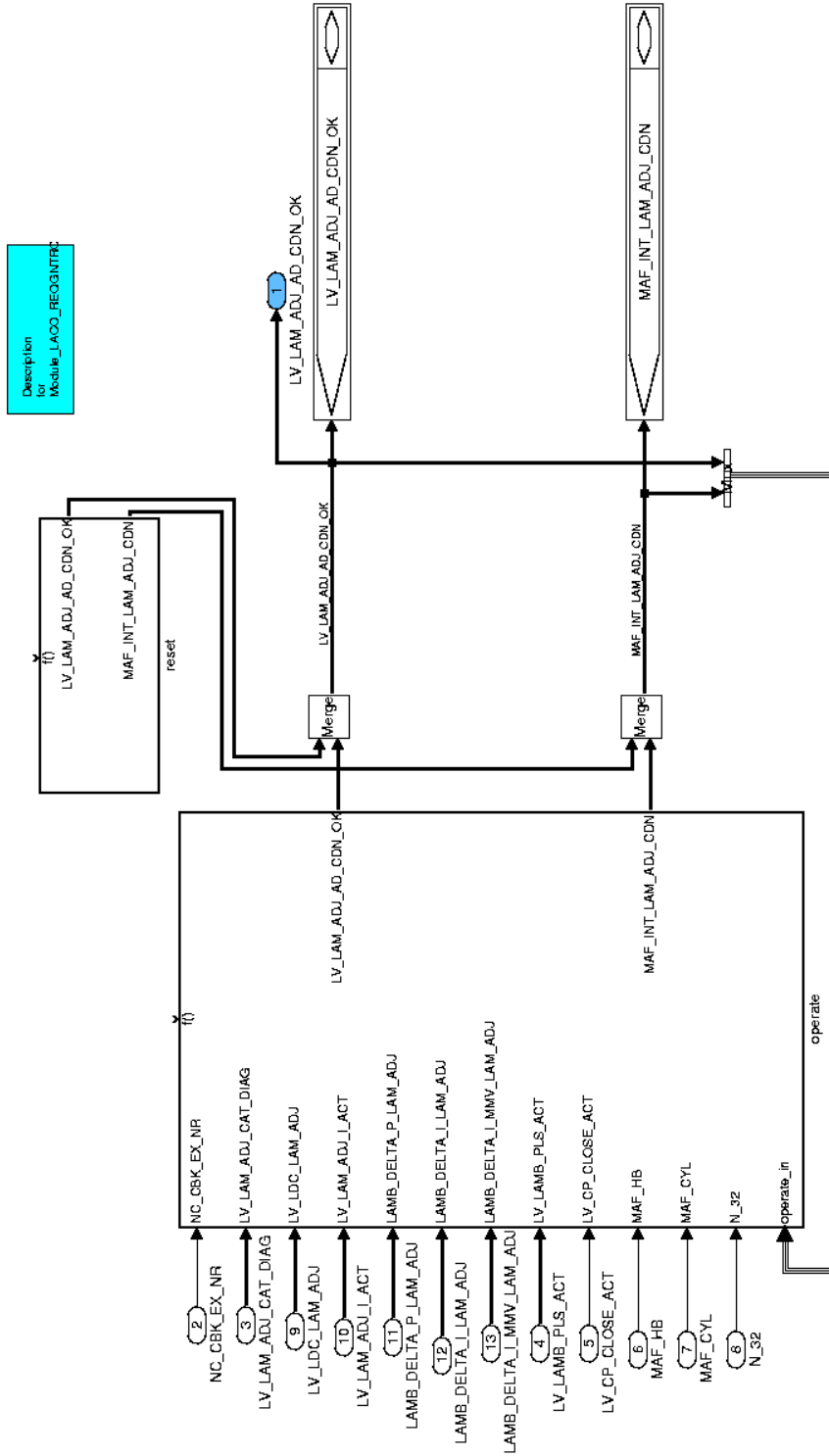



Figure 7.68.1: LACO\_REQGNTRCDN0

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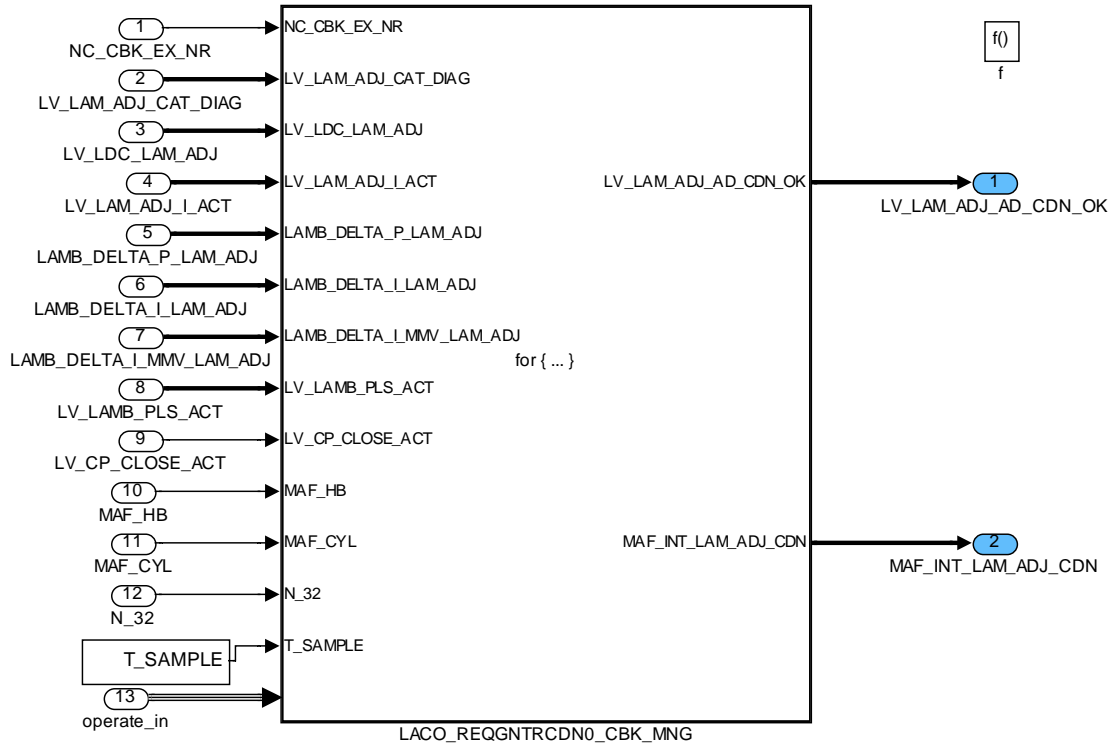


Figure 7.68.2: LACO\_REQGNTRCDN0/operate

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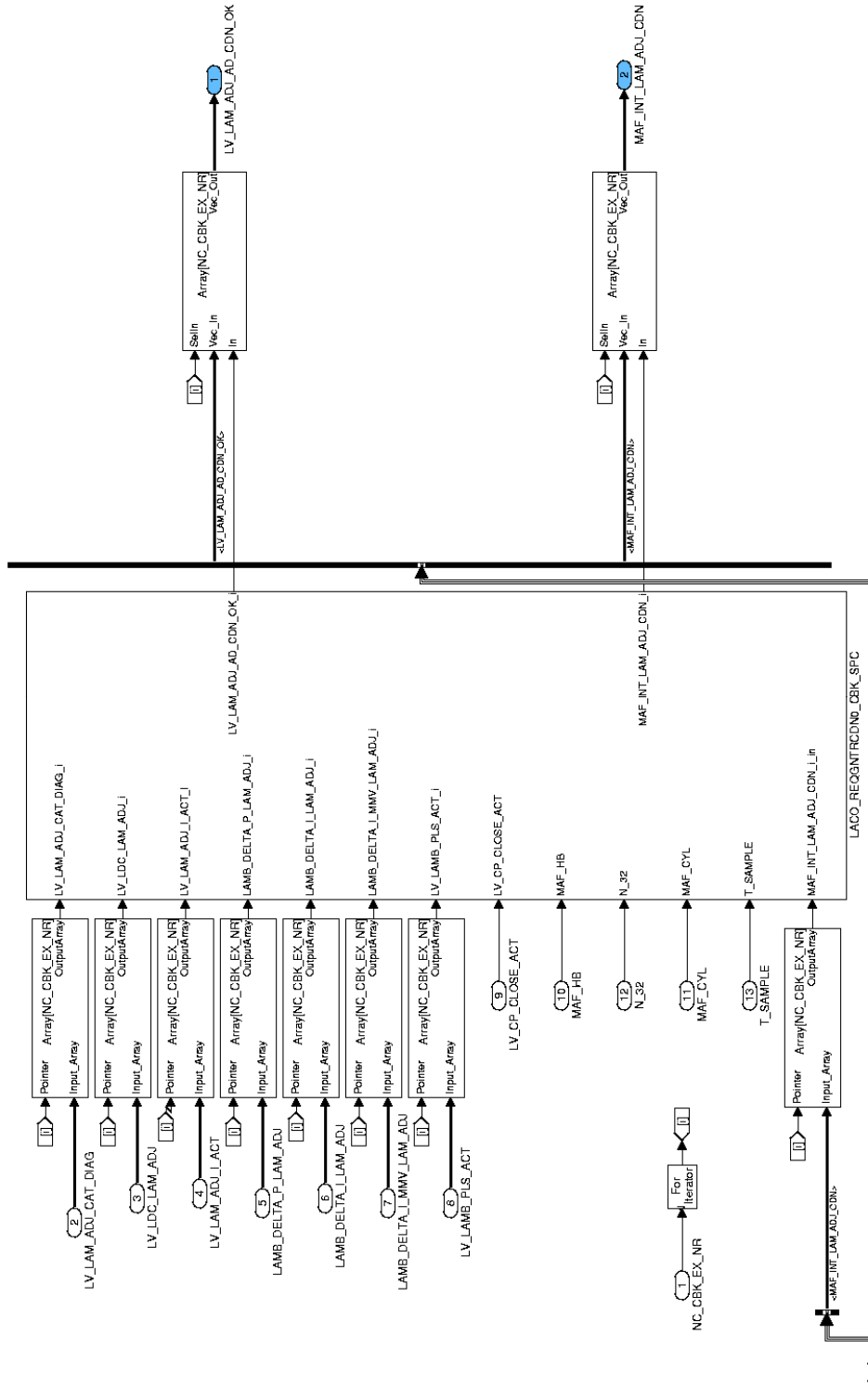


Figure 7.68.3: LACO\_REQGNTRCDN0/operate/LACO\_REQGNTRCDN0\_CBK\_MNG

**Check conditions**

If all the following conditions are fulfilled an air mass flow integral is calculated:

- Catalyst efficiency diagnosis not active
- limited dynamics (LV\_LDC\_LAM\_ADJ[i]) are fulfilled
- I share of trim control is active

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forced lambda stimulation is active  
 canister purge valve is closed  
 air mass flow is in a valid range  
 engine speed is in a valid range  
 P share of trim control must be very low (absolute value)  
 I share of trim control must be stable  
 (difference between I share and moving mean value must be small)

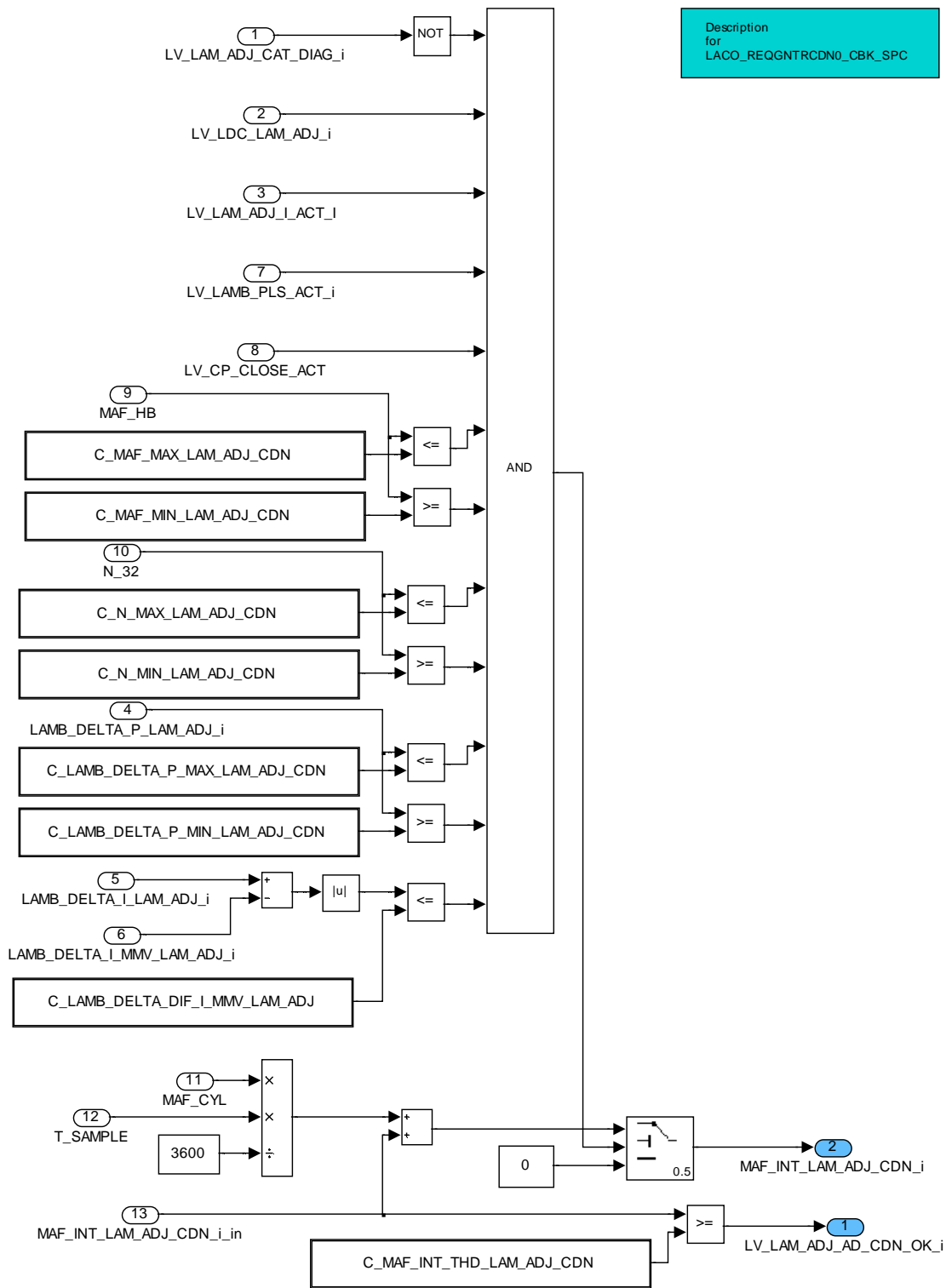
When the air mass flow integral exceeds a calibration threshold the flag LV\_LAM\_ADJ\_AD\_CDN\_OK[i] indicating that the adaptation can be started is set.

For the calculation of the air mass flow integral the unit conversion:

$$[g] = [kg/h] * [ms] * [(g*h)/(kg*ms)] / 3600$$

has to be considered.

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Figure 7.68.4: LACO\_REQGNTRCDN0/operate/LACO\_REQGNTRCDN0\_CBK\_MNG/LACO\_REQGNTRCDN0\_CBK\_SPC



## 7.69 Limited dynamic for dynamic fuel trim

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LAM_MV_MMV_DLY [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
floating mean value for limited lambda deviation					
FAC_TQ_REQ_GRD	V	8000... 7FFFH	-1... 0.99996	30.5e-6	-
Gradient of the requested factor torque					
FAC_TQ_REQ_GRD_SUM_DLY	V	0... FFFFH	0... 1.99996	30.5e-6	-
Summation of FAC_TQ_REQ_GRD to determine if a dynamic condition is present					
LV_FAC_TQ_REQ_LDC_DLY	V	0... 1H	0 ...1	1	-
Status limited dynamic of the requested torque factor					
LV_LAM_MV_LDC_DLY [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Status limited dynamic FAC_LAM_MV[NC_CBK_EX_NR]					
LV_LDC_DLY [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
status flag indicated the limited dynamic conditions is fulfilled					
LV_MAF_LDC_DLY	V	0... 1H	0 ...1	1	-
Status limited dynamic MAF					
LV_N_LDC_DLY	V	0... 1H	0 ...1	1	-
Status limited dynamic N					
MAF_INT_LDC_DLY [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1820.42	0.0277778	g
integral of mass air flow since limited dynamic conditions fulfilled					
MAF_MMV_DLY	O/V	0... FFFFH	0... 1389	21.2e-3	mg/stk
floating mean value for limited MAF					
N_MMV_DLY	O/V	0... 1FE0H	0... 8160	1	rpm
floating mean value for limited engine speed					
T_FAC_TQ_REQ_GRD_SUM_DLY	V	0... FFH	0... 5.1	0.02	s
Timer to decrement FAC_TQ_REQ_GRD_SUM_DLY					

### Input data:

FAC_LAM_MV {p. 1014}	FAC_TQ_REQ {p. 6706}	LV_IGK {p. 906}	LV_ST_END {p. 1720}
LV_VAR_LSH_UP {p. 656}	MAF {p. 8277}	MAF_KGH {p. 1195}	N {p. 1525}
NC_FAC_MAF_INT_20 {p. 651}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQ_REQ_GRD_DEC_DLY	-	0... FFFFH	0... 1.999969	30.5175e-6	-
decrement for calculation PV_AV gradient					
C_FAC_TQ_REQ_GRD_MIN_LDC_DLY	-	0... FFFFH	0... 1.99996	30.5e-6	-
minimum value of FAC_TQ_REQ_GRD to increment FAC_TQ_REQ_GRD_SUM_DLY					
C_FAC_TQ_REQ_GRD_SUM_MAX_DLY	-	0... FFFFH	0... 1.999969	30.5175e-6	-
threshold to reset the limited dynamic flag LV_LDC_DLY[i] due to present high FAC_TQ_REQ_GRD condition					
C_FAC_TQ_REQ_GRD_SUM_MIN_DLY	-	0... FFFFH	0... 1.999969	30.5175e-6	-
threshold to set the limited dynamic flag LV_LDC_DLY[i] when no high FAC_TQ_REQ_GRD condition is met					
C_LAM_MV_CRLC_DLY	-	0... FFFFH	0... 0.99998	15.3e-6	-
correlation constant floating mean value calculation lambda					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAM_MV_DYW_DLY	-	0... FFFFH	0... 99.99847	1.53e-3	%
threshold limited dynamic lambda					
C_MAF_CRLC_DLY	-	0... FFFFH	0... 0.99998	15.3e-6	-
correlation constant floating mean value calculation MAF					
C_MAF_DYW_DLY	-	0... FFFFH	0... 1389	21.2e-3	mg/stk
threshold limited dynamic engine MAF					
C_MAF_INT_MIN_LDC_DLY	-	0... FFFFH	0... 1820.42	27.7999e-3	g
MAF integral after setting limited dynamic conditions LV_LDC_DLYi before starting the monitoring cycle					
C_N_CRLC_DLY	-	0... FFFFH	0... 0.99998	15.3e-6	-
correlation constant floating mean value calculation engine speed					
C_N_DYW_DLY	-	0... 1FE0H	0... 8160	1	rpm
threshold limited dynamic engine speed					
C_T_FAC_TQ_REQ_GRD_SUM_DLY	-	0... FFH	0... 5.1	0.02	s
time periods for calculation limited dynamic FAC_TQ_REQ_GRD					

## FUNCTION DESCRIPTION:

### General information:

For a two bank exhaust gas configuration the calculation of the limited dynamic condition LV\_LDC\_DLY[i] is calculated for each bank separately. To differentiate variables and calibration data the index i is used.

i = 1, for cylinder bank 1

i = 2, for cylinder bank 2

The limited dynamic conditions LV\_LDC\_DLY[i] for dynamic fuel trim is detected if engine speed, mass air flow, FAC\_LAM\_MV[i] and the factor torque request gradient are within the correspondent dynamic window. Once this condition is met, an integral of the air flow is incremented until the calibrated threshold exceeds. After this point the flag LV\_LDC\_DLY[i] is set to indicate the trim controller, that the engine is running under limited dynamic conditions.

### Application conditions

#### Initialisation:

at reset:  
 LV\_LDC\_DLY[i] = 0  
 MAF\_INT\_LDC\_DLY[i] = 0

#### Recurrence:

20ms

#### Activation:


LV\_VAR\_LSH\_UP = 1 **and** LV\_ST\_END = 1 **and** LV\_IGK = 1

#### Deactivation:

LV\_VAR\_LSH\_UP = 0 **or** LV\_ST\_END = 0 **or** LV\_IGK = 0


Initialisation at deactivation:

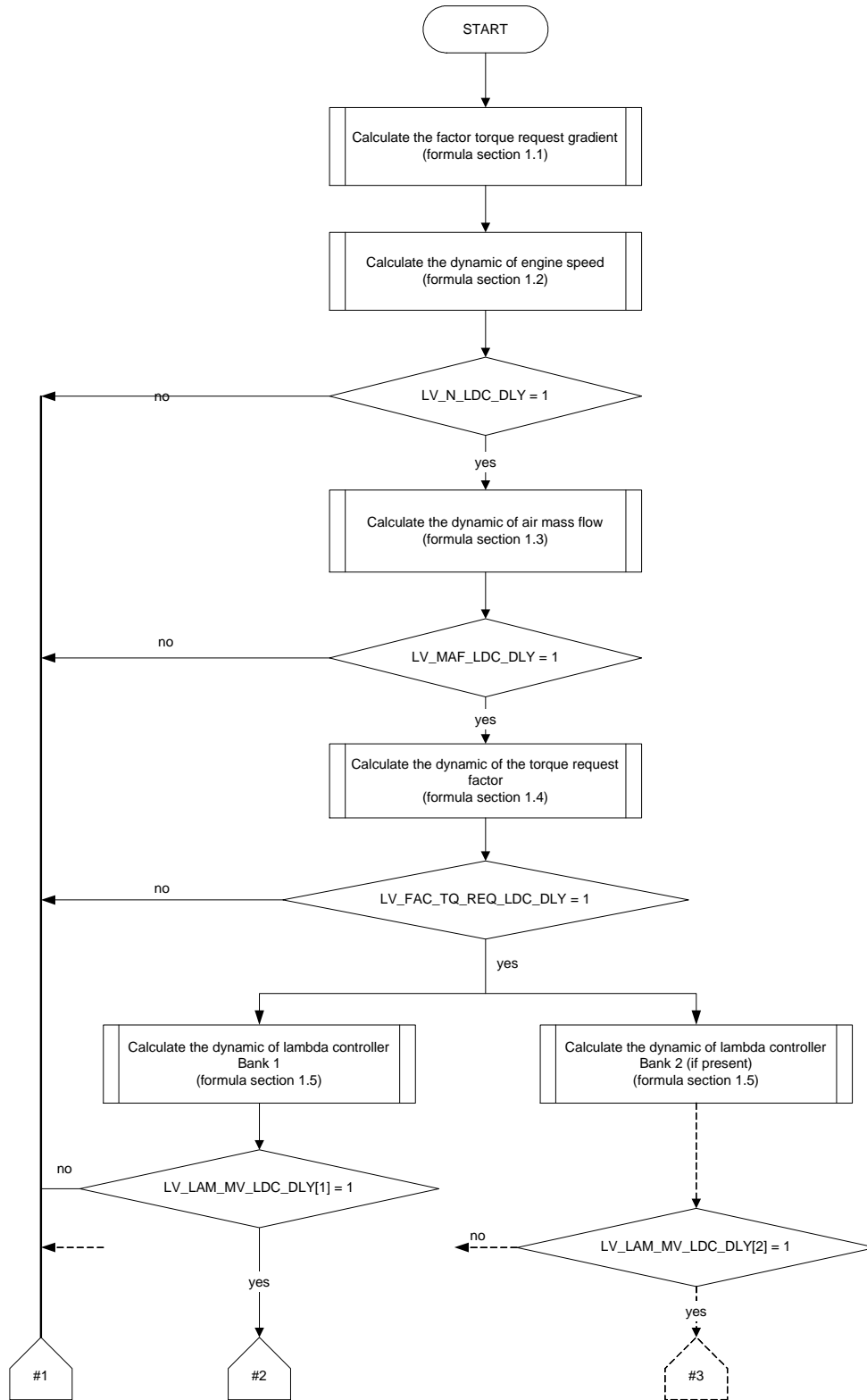
LV\_LDC\_DLY[i] = 0  
 LV\_N\_LDC\_DLY = 0  
 LV\_MAF\_LDC\_DLY = 0  
 MAF\_INT\_LDC\_DLY[i] = 0  
 N\_MMV\_DLY = N  
 MAF\_MMV\_DLY = MAF  
 FAC\_LAM\_MV\_MMV\_DLY[i] = FAC\_LAM\_MV[i]  
 FAC\_TQ\_REQ\_GRD\_SUM\_DLY = 0

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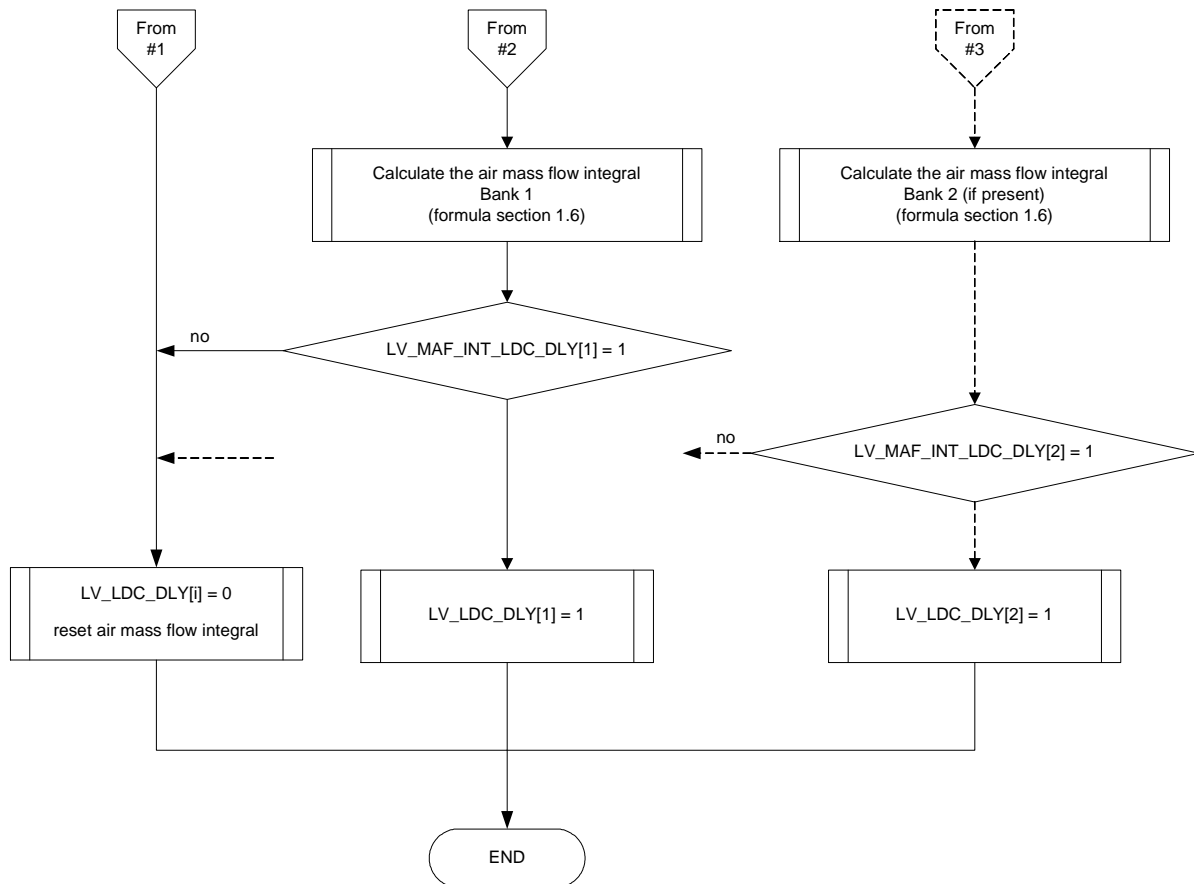
All ring buffer registers shall be initialized with the same value, namely the value of FAC\_TQ\_REQ at the moment of activation.

**Signal flow diagram:**

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### Formula section:

#### 7.69.1 Calculation of the factor torque request gradient FAC\_TQ\_REQ\_GRD

At every recurrence the variable FAC\_TQ\_REQ shall be written into a ring buffer containing the last four FAC\_TQ\_REQ values. The gradient of FAC\_TQ\_REQ (FAC\_TQ\_REQ\_GRD) is calculated based on the FAC\_TQ\_REQ difference between the values contained in the first and last position of the ring buffer.

#### 7.69.2 Limited engine speed (N) dynamics

The floating mean value N\_MMV\_DLY is computed using the averaging constant C\_N\_CRLC\_DLY. The limited dynamics condition only exist while the engine speed N lies within the dynamics window around N\_MMV\_DLY.

If the above limited dynamics condition is violated, the floating mean value N\_MMV\_DLY is set to the current engine speed in order to reach the limited dynamics condition faster:

$$N\_MMV\_DLY = N\_MMV\_DLY * (1 - C\_N\_CRLC\_DLY) + C\_N\_CRLC\_DLY * N$$

**IF**  $|N - N\_MMV\_DLY| < C\_N\_DYW\_DLY$

**THEN** LV\_N\_LDC\_DLY = 1

**ELSE** LV\_N\_LDC\_DLY = 0

N\_MMV\_DLY = N

**ENDIF**

### 7.69.3 Limited mass air flow (MAF) dynamics

The floating mean value MAF\_MMV\_DLY is computed using the averaging constant C\_MAF\_CRLC\_DLY. The limited dynamics condition only exist while the air mass MAF stays within the dynamics window around MAF\_MMV\_DLY.

If the above limited dynamics condition is violated, the floating mean value MAF\_MMV\_DLY is set to the current air-mass value in order to reach the limited dynamics condition faster:

```

IF LV_N_LDC_DLY = 1
THEN
    MAF_MMV_DLY = MAF_MMV_DLY * (1 - C_MAF_CRLC_DLY) +
                  C_MAF_CRLC_DLY * MAF

    IF |MAF - MAF_MMV_DLY| < C_MAF_DYW_DLY
        THEN      LV_MAF_LDC_DLY = 1
        ELSE      LV_MAF_LDC_DLY = 0
                  MAF_MMV_DLY = MAF
    ENDIF
ELSE
    MAF_MMV_DLY = MAF
    LV_MAF_LDC_DLY = 0
    LV_LDC_DLY[i] = 0
    MAF_INT_LDC_DLY[i] = 0
ENDIF
  
```

### 7.69.4 Limited requested torque factor gradient (FAC\_TQ\_REQ\_GRD) dynamics

The FAC\_TQ\_REQ\_GRD reflects the dynamic of the actual driver's demand prior to the corrections and is calculated with the recurrence T\_SAMPLE in [ms].

If C\_FAC\_TQ\_REQ\_GRD\_SUM\_MIN is larger than C\_FAC\_TQ\_REQ\_GRD\_SUM\_MAX the FAC\_TQ\_REQ gradient summation FAC\_TQ\_REQ\_GRD\_SUM\_LDC\_DLY will be no condition to determine the limited dynamic bit LV\_LDC\_DLY[i].

```

IF(3) LV_MAF_LDC_DLY = 1
THEN(3)
    IF(3a) |FAC_TQ_REQ_GRD| > C_FAC_TQ_REQ_GRD_MIN_LDC_DLY
        THEN(3a) FAC_TQ_REQ_GRD_SUM_DLYn+1 = FAC_TQ_REQ_GRD_SUM_DLYn
                + |FAC_TQ_REQ_GRD|
                % Incrementation of FAC_TQ_REQ_GRD_SUM_DLY if FAC_TQ_REQ_GRD exceeds
                a threshold
    ENDIF(3a)

    T_FAC_TQ_REQ_GRD_SUM_DLYn =
        T_FAC_TQ_REQ_GRD_SUM_DLYn-1 + 1

    IF(3b) T_FAC_TQ_REQ_GRD_SUM_DLY ≥
            C_T_FAC_TQ_REQ_GRD_SUM_DLY
        THEN(3b)
            FAC_TQ_REQ_GRD_SUM_DLYn =
                FAC_TQ_REQ_GRD_SUM_DLYn-1 -
                C_FAC_TQ_REQ_GRD_DEC_DLY
            % The decrementation by C_FAC_TQ_REQ_GRD_DEC_DLY is done every
            % C_T_FAC_TQ_REQ_GRD_SUM_DLY intervalls
  
```

```

    T_FAC_TQ_REQ_GRD_SUM_DLY = 0
ENDIF(3b)

IF(3c) C_FAC_TQ_REQ_GRD_SUM_MIN_DLY <
    C_FAC_TQ_REQ_GRD_SUM_MAX_DLY
THEN(3c) % FAC_TQ_REQ_GRD_SUM_DLY is condition for limited dynamic bit
IF(4) LV_FAC_TQ_REQ_LDC_DLY = 0
THEN(4) % limited dynamic bit deactivate, activation possible
IF(5) FAC_TQ_REQ_GRD_SUM_DLY ≤
    C_FAC_TQ_REQ_GRD_SUM_MIN_DLY
THEN(5) % activation of limited dynamic bit
    LV_FAC_TQ_REQ_LDC_DLY = 1
ENDIF(5)
ELSE(4) % limited dynamic bit active, deactivation possible

IF(6) FAC_TQ_REQ_GRD_SUM_DLY >
    C_FAC_TQ_REQ_GRD_SUM_MAX_DLY
THEN(6) % deactivation of limited dynamic bit
    LV_FAC_TQ_REQ_LDC_DLY = 0
ENDIF(6)
ENDIF(4)
ELSE(3c)
    LV_FAC_TQ_REQ_LDC_DLY = 1
ENDIF(3c)
ELSE(3)
    FAC_TQ_REQ_GRD_SUM_DLY = 0
    T_FAC_TQ_REQ_GRD_SUM_DLY = 0
    LV_FAC_TQ_REQ_LDC_DLY = 0
    LV_LDC_DLY[i] = 0
    MAF_INT_LDC_DLY[i] = 0
ENDIF(3)

```

### 7.69.5 Limited mean lambda controller output (FAC\_LAM\_MV[i]) dynamics


The floating mean value of the mean lambda controller output FAC\_LAM\_MV\_MMV\_DLY[i] is computed by using the averaging constant C\_FAC\_LAM\_MV\_CRLC\_DLY. The limited dynamics condition is present while FAC\_LAM\_MV[i] stays within the dynamics window around FAC\_LAM\_MV\_MMV\_DLY[i]. If this condition violated, the correspondent flag is reset indicating a dynamic condition is present and the floating mean value FAC\_LAM\_MV\_MMV\_DLY[i] is set to the current value in order to reach the limited dynamics condition faster.

```

IF LV_FAC_TQ_REQ_LDC_DLY = 1
THEN
    FAC_LAM_MV_MMV_DLY[i] =
        FAC_LAM_MV_MMV_DLY[i] * (1 - C_LAM_MV_CRLC_DLY) +
        C_LAM_MV_CRLC_DLY * FAC_LAM_MV[i]

IF | FAC_LAM_MV[i] - FAC_LAM_MV_MMV_DLY[i] | < C_LAM_MV_DYW_DLY
THEN LV_LAM_MV_LDC_DLY[i] = 1
ELSE LV_LAM_MV_LDC_DLY[i] = 0
        FAC_LAM_MV_MMV_DLY[i] = FAC_LAM_MV[i]

```

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```

ENDIF
ELSE
  FAC_LAM_MV_MMV_DLY[i] = FAC_LAM_MV[i]
  LV_LAM_MV_LDC_DLY[i] = 0
  LV_LDC_DLY[i] = 0
  MAF_INT_LDC_DLY[i] = 0
ENDIF


```

### 7.69.6 Calculation of mass air flow integral

```

IF LV_LAM_MV_LDC_DLY[i] = 1
THEN
  IF MAF_INT_LDC_DLY[i] ≤ C_MAF_INT_MIN_LDC_DLY
  THEN
    LV_LDC_DLY[i] = 0
    MAF_INT_LDC_DLY[i]n = MAF_INT_LDC_DLY[i]n-1 +
      MAF_KGH * NC_FAC_MAF_INT_20
  ELSE
    LV_LDC_DLY[i] = 1
  ENDIF
ELSE
  LV_LDC_DLY[i] = 0
  MAF_INT_LDC_DLY[i] = 0
ENDIF

```

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## 7.70 Lambda adaptation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_DELTA_H_RNG_LAM_AD [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 49.9984741	0.00152588	%
difference of lambda adaptation factor of high field to previous adaptation					
FAC_DELTA_L_RNG_LAM_AD [NC_CBK_EX_NR]	O/V	8000... 7FFFH	0... 49.9984741	0.00152588	%
difference of lambda adaptation factor of low field to previous adaptation					
FAC_H_RNG_LAM_AD [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	0... 49.9984741	0.00152588	%
fuel mass set point factor of high field, stored value of lambda adaptation					
FAC_L_RNG_LAM_AD [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	0... 49.9984741	0.00152588	%
fuel mass set point factor of low field, stored value of lambda adaptation					
FAC_LAM_AD [NC_CBK_EX_NR]	O/V	8000... 7FFFH	0... 49.9984741	0.00152588	%
fuel mass set point factor of lambda adaptation, interpolation of both factor areas (high and low field)					
FAC_LAM_AD_LAM_OUT [NC_CBK_EX_NR]	O/V	8000... 7FFFH	0... 49.9984741	0.00152588	%
fuel mass set point factor, output from lambda adaptation, input into lambda controller					
FAC_LAM_ADJ_LAM_AD [NC_CBK_EX_NR]	O/V	8000... 7FFFH	0... 49.9984741	0.00152588	%
output value from lambda adaptation for the lambda controller shift					
FAC_MFF_ADD_FAC_LAM_AD [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	0... 99.996948	0.00305176	%
lambda adaptation correction for scan tool (factor and relative offset)					
FAC_MFF_ADD_LAM_AD_OUT [NC_CBK_EX_NR]	O/V	8000... 7FFFH	0... 99.996948	0.00305176	%
relative lambda adaptation offset quotient					
LV_FAC_H_RNG_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that lambda adaptation in factor learning upper field is active					
LV_FAC_H_RNG_LAM_AD_INI [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating that high range Lambda adaptation is initialized with value of low range					
LV_FAC_H_RNG_LIM_MAX_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating top limitation of lambda adaptation factor of upper area					
LV_FAC_H_RNG_LIM_MIN_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating bottom limitation of lambda adaptation factor of upper area					
LV_FAC_L_RNG_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that lambda adaptation in factor learning lower field is active					
LV_FAC_L_RNG_LAM_AD_INI [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating that low range Lambda adaptation is initialized with value of high range					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_FAC_L_RNG_LIM_MAX_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating top limitation of lambda adaptation factor of lower area					
LV_FAC_L_RNG_LIM_MIN_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating bottom limitation of lambda adaptation factor of lower area					
LV_FAC_LAM_AD_SHIFT_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Shift of Lambda adaptation was carried out					
LV_FAC_LAM_ADJ_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag to request lambda controller shift					
LV_LAM_AD_AFS_REQ	O/V	0... 1H	0 ...1	1	-
request flag for combustion manager to force lambda eq. 1 conditions for lambda adaptation					
LV_LAM_AD_CDN	O/V	0... 1H	0 ...1	1	-
flag for time scheduler indicating good conditions for lambda adaptation					
LV_LAM_AD_END	O/V	0... 1H	0 ...1	1	-
logical value indicating temporary end of lambda adaptation					
LV_LAM_AD_END_CBK [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
logical value indicating temporary end of lambda adaptation (bank specific flag)					
LV_LAM_AD_STOP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
logical variable indicating stop of the lambda adaptation cycle					
LV_LAM_AD_STOP_CBK_EX	V	0... 1H	0 ...1	1	-
logical variable indicating stop of at least one bank of the lambda adaptation cycle					
LV_MFF_ADD_LIM_MAX_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating top limitation of lambda adaptation offset					
LV_MFF_ADD_LIM_MIN_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating bottom limitation of lambda adaptation offset					
LV_MFF_ADD_RNG_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that lambda adaptation in offset learning field is active					
MFF_ADD_LAM_AD [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
fuel mass set point offset, stored value of lambda adaptation					
MFF_DELTA_ADD_LAM_AD [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
difference of lambda adaptation offset to previous adaptation					
MFF_DELTA_ADD_LAM_AD_H_RES [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 10.8496689	33.1116e3	mg/stk
difference integral with high resolution of lambda adaptation offset					
MFF_LAM_ADD_LAM_AD_OUT [NC_CBK_EX_NR]	O/V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
fuel mass set point offset, output from lambda adaptation, input into lambda controller					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_LAM_AD [NC_CBK_EX_NR]	O/V	0H	INIT	-	-
		1H	WAIT		
		2H	CDN_FAC_L		
		3H	CDN_FAC_H		
		4H	CDN_ADD		
		5H	ADAPT_FAC_L		
		6H	ADAPT_FAC_H		
7H	ADAPT_ADD				
state of lambda adaptation					
T_PRI_LAM_AD [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
priority time for next requested lambda adaptation					
T_PRI_TOT_LAM_AD	O/V	0... FFFFH	0... 6553.5	0.1	s
minimum priority time of all exhaust cylinder banks for next requested lambda adaptation					
T_WAIT_LAM_AD [NC_CBK_EX_NR]	V	0... FFH	0... 5.1	0.02	s
waiting time between two adaptations					

**Input data:**

C_TCO_MIN_LAM_AD {p. 2724}	CRLC_LAM_AD [NC_CBK_EX_NR] {p. 2721}	FAC_LAM_AD_SHIFT [NC_CBK_EX_NR] {p. 2721}	FAC_LAM_AD_WUP [NC_CBK_EX_NR] {p. 2677}
FAC_LAM_ADJ_LAM_AD_WUP [NC_CBK_EX_NR] {p. 2677}	FAC_LAM_MV_MMV [NC_CBK_EX_NR] {p. 2462}	LV_FAC_LAM_AD_SHIFT [NC_CBK_EX_NR] {p. 2721}	LV_FAC_LAM_ADJ_LAM_AD_END [NC_CBK_EX_NR] {p. 2463}
LV_FAC_LAM_ADJ_LAM_AD_WUP [NC_CBK_EX_NR] {p. 2677}	LV_IGK {p. 906}	LV_LAM_AD_ACT [NC_CBK_EX_NR] {p. 2721}	LV_LAM_AD_CDN_ADD [NC_CBK_EX_NR] {p. 2721}
LV_LAM_AD_CDN_H_RNG [NC_CBK_EX_NR] {p. 2721}	LV_LAM_AD_CDN_L_RNG [NC_CBK_EX_NR] {p. 2721}	LV_LAM_AD_DEAC_ERR [NC_CBK_EX_NR] {p. 2721}	LV_LAM_AD_ENA {p. 3737}
LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}	LV_ST_END {p. 1720}	MFF_SP [NC_CBK_EX_NR] {p. 2151}	MFF_SP_AD [NC_CBK_EX_NR] {p. 2721}
N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	T_WAIT_MAX_LAM_AD [NC_CBK_EX_NR] {p. 2721}	TCO {p. 1100}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_MAX_H_RNG_LAM_AD	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
maximum value of upper area lambda adaptation factor					
C_FAC_MAX_L_RNG_LAM_AD	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
maximum value of lower area lambda adaptation factor					
C_FAC_MIN_H_RNG_LAM_AD	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
minimum value of upper area lambda adaptation factor					
C_FAC_MIN_L_RNG_LAM_AD	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
minimum value of lower area lambda adaptation factor					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MFF_MAX_ADD_RNG_LAM_AD	-	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
maximum value of lambda adaptation offset					
C_MFF_MIN_ADD_RNG_LAM_AD	-	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
minimum value of lambda adaptation offset					
C_MFF_SP_TOL_ADD_RNG_LAM_AD	-	0... FFFFH	0... 1389	0.02119478	mg/stk
maximum fuel mass set point for offset lambda adaptation					
C_N_BOL_FAC_H_RNG_LAM_AD	-	0... FFH	0... 8160	32	rpm
minimum engine speed for upper area factor lambda adaptation					
C_N_BOL_FAC_L_RNG_LAM_AD	-	0... FFH	0... 8160	32	rpm
minimum engine speed for lower area factor lambda adaptation					
C_N_TOL_ADD_RNG_LAM_AD	-	0... FFH	0... 8160	32	rpm
maximum engine speed for offset lambda adaptation					
C_N_TOL_FAC_H_RNG_LAM_AD	-	0... FFH	0... 8160	32	rpm
maximum engine speed for upper area factor lambda adaptation					
C_N_TOL_FAC_L_RNG_LAM_AD	-	0... FFH	0... 8160	32	rpm
maximum engine speed for lower area factor lambda adaptation					
C_T_PRI_MAX_LAM_AD	-	0... FFFFH	0... 6553.5	0.1	s
maximum priority time to set temporary end of adaptation flag					
ID_MFF_SP_BOL_FAC_H_RNG_LAM_AD	-	0... FFFFH	0... 1389	0.02119478	mg/stk
LDP_N_32_ID_MFF_SP_BOL_H_RNG	8	0... FFH	0... 8160	32	rpm
minimum fuel mass set point for upper area factor lambda adaptation					
ID_MFF_SP_BOL_FAC_L_RNG_LAM_AD	-	0... FFFFH	0... 1389	0.02119478	mg/stk
LDP_N_32_ID_MFF_SP_BOL_L_RNG	8	0... FFH	0... 8160	32	rpm
minimum fuel mass set point for lower area factor lambda adaptation					
ID_MFF_SP_TOL_FAC_H_RNG_LAM_AD	-	0... FFFFH	0... 1389	0.02119478	mg/stk
LDP_N_32_ID_MFF_SP_TOL_H_RNG	8	0... FFH	0... 8160	32	rpm
maximum fuel mass set point for upper area factor lambda adaptation					
ID_MFF_SP_TOL_FAC_L_RNG_LAM_AD	-	0... FFFFH	0... 1389	0.02119478	mg/stk
LDP_N_32_ID_MFF_SP_TOL_L_RNG	8	0... FFH	0... 8160	32	rpm
maximum fuel mass set point for lower area factor lambda adaptation					
ID_T_PRI_FAC_H_RNG_LAM_AD	-	0... FFFFH	0... 6553.5	0.1	s
LDP_FAC_DELTA_H_RNG_LAM_AD_PRI	8	0... FFFFH	0... 49.998474	0.0015259	%
priority time for next requested lambda adaptation according to factor difference or upper area					
ID_T_PRI_FAC_L_RNG_LAM_AD	-	0... FFFFH	0... 6553.5	0.1	s
LDP_FAC_DELTA_L_RNG_LAM_AD_PRI	8	0... FFFFH	0... 49.998474	0.0015259	%
priority time for next requested lambda adaptation according to factor difference or lower area					
ID_T_PRI_MFF_ADD_RNG_LAM_AD	-	0... FFFFH	0... 6553.5	0.1	s
LDP_MFF_DELTA_ADD_LAM_AD_T_PRI	8	0... FFFFH	0... 694.489403	0.021195	mg/stk
priority time for next requested lambda adaptation according to offset difference					
IP_FAC_N_FAC_LAM_AD	-	0... 80H	0 ...1	0.0078125	-
LDPN_N_32_4_LACO	6	0... FFH	0... 8160	32	rpm
factor on lambda adaptation factor depending on engine speed					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_N_MFF_ADD_LAM_AD	-	0... 80H	0 ...1	0.0078125	-
LDPM_N_32_4_LACO	6	0... FFH	0... 8160	32	rpm
factor on lambda adaptation offset depending on engine speed					
IP_MFF_SP_MAX_FAC_L_RNG_LAM_AD	-	0... FFFFH	0... 1389	0.02119478	mg/stk
LDPM_N_32_5_LACO	8	0... FFH	0... 8160	32	rpm
fuel mass set point threshold for consideration of only lower field lambda adaptation factor					
IP_MFF_SP_MIN_FAC_H_RNG_LAM_AD	-	0... FFFFH	0... 1389	0.02119478	mg/stk
LDPM_N_32_5_LACO	8	0... FFH	0... 8160	32	rpm
fuel mass set point threshold for consideration of only upper field lambda adaptation factor					
LC_FAC_H_RNG_AFS_REQ_LAM_AD	-	0... 1H	0 ...1	1	-
logical calibration to allow forced lambda eq. 1 conditions for factor adaptation at upper area					
LC_FAC_L_RNG_AFS_REQ_LAM_AD	-	0... 1H	0 ...1	1	-
logical calibration to allow forced lambda eq. 1 conditions for factor adaptation at upper area					
LC_FAC_LAM_AD_INI_ACT	-	0... 1H	0 ...1	1	-
logical calibration to allow initialization of adaptation factor from other range					
LC_MFF_ADD_RNG_AFS_REQ_LAM_AD	-	0... 1H	0 ...1	1	-
logical calibration to allow forced lambda eq. 1 conditions for offset adaptation					

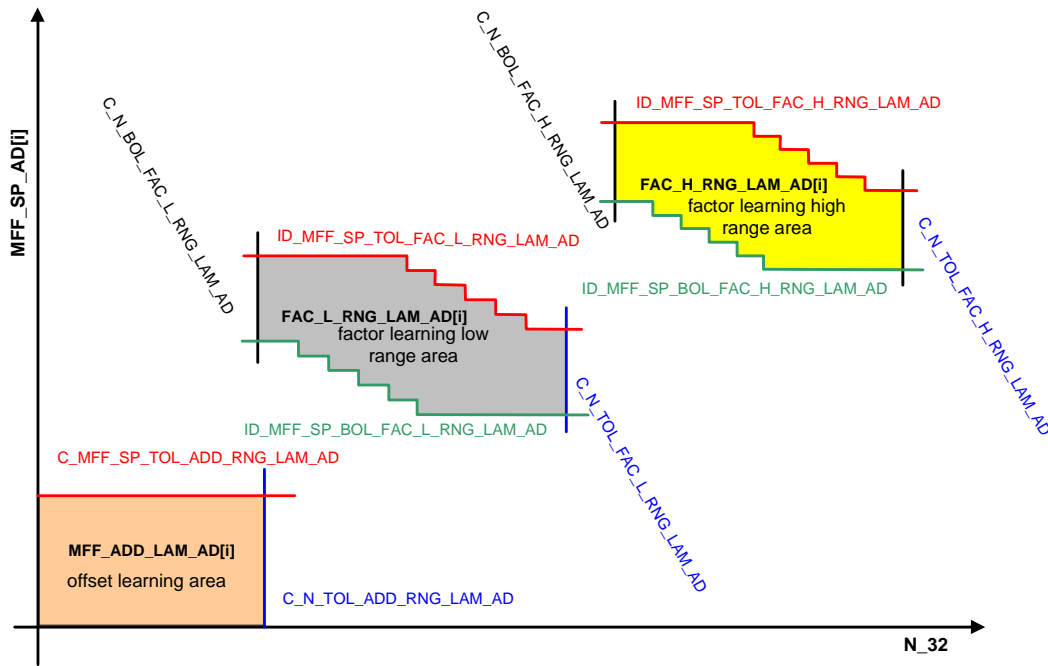
## General Information

In order to compensate serial production tolerances of components, an adaptive correction is calculated (one additive and two multiplicative) based on the filtered lambda controller output.

The additive and multiplicative adaptation corrections are used for calculating the injection time for all engine operating states, except at engine stop and engine start.

Lambda adaptation, for precision reason, needs to be performed at lambda equal 1 conditions. The function itself is activated by the corresponding LV\_LAM\_AD\_ACT[i].

Depending on load and engine speed three different adaptation fields (one offset and two factor areas) are observed.



Adaptation field diagram

According to project philosophy homogeneous mode and suitable conditions can be forced by setting:  
 LC\_MFF\_ADD\_RNG\_AFS\_REQ\_LAM\_AD,  
 LC\_FAC\_L\_RNG\_AFS\_REQ\_LAM\_AD and/or  
 LC\_FAC\_H\_RNG\_AFS\_REQ\_LAM\_AD.

Furthermore this function is used by the lambda adaptation in warmup phase to provide an unique interface to lambda controller and fuel mass set point calculation.

NC\_CBK\_EX\_NR defines the number of exhaust banks.

For vector elements the variable extension "\_i" is used in the model instead of "[i]" as found in the textual description.

**Application Condition**

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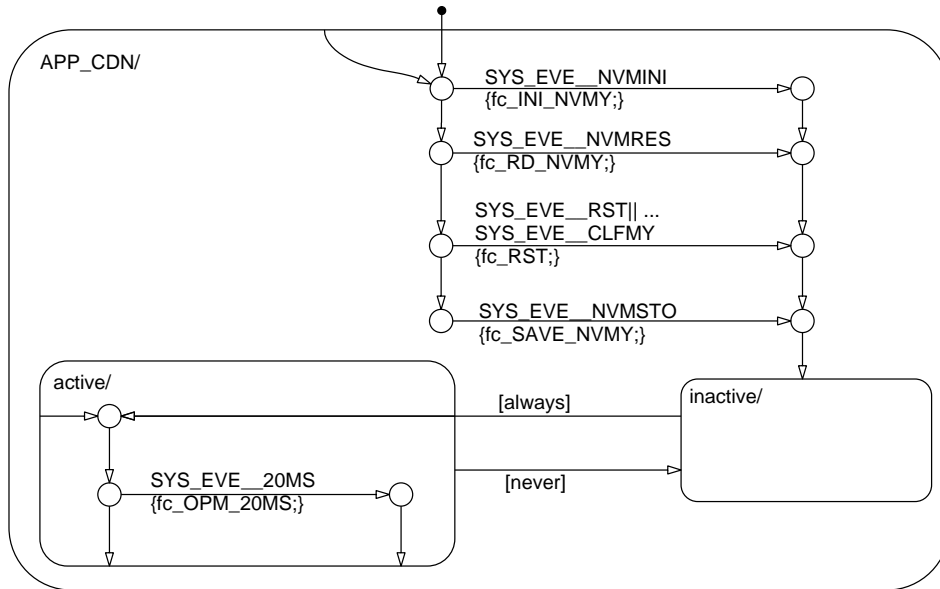



Figure 7.70.1: LACO\_ISPCLADA0/APP\_CDN/Chart

**Function Description**

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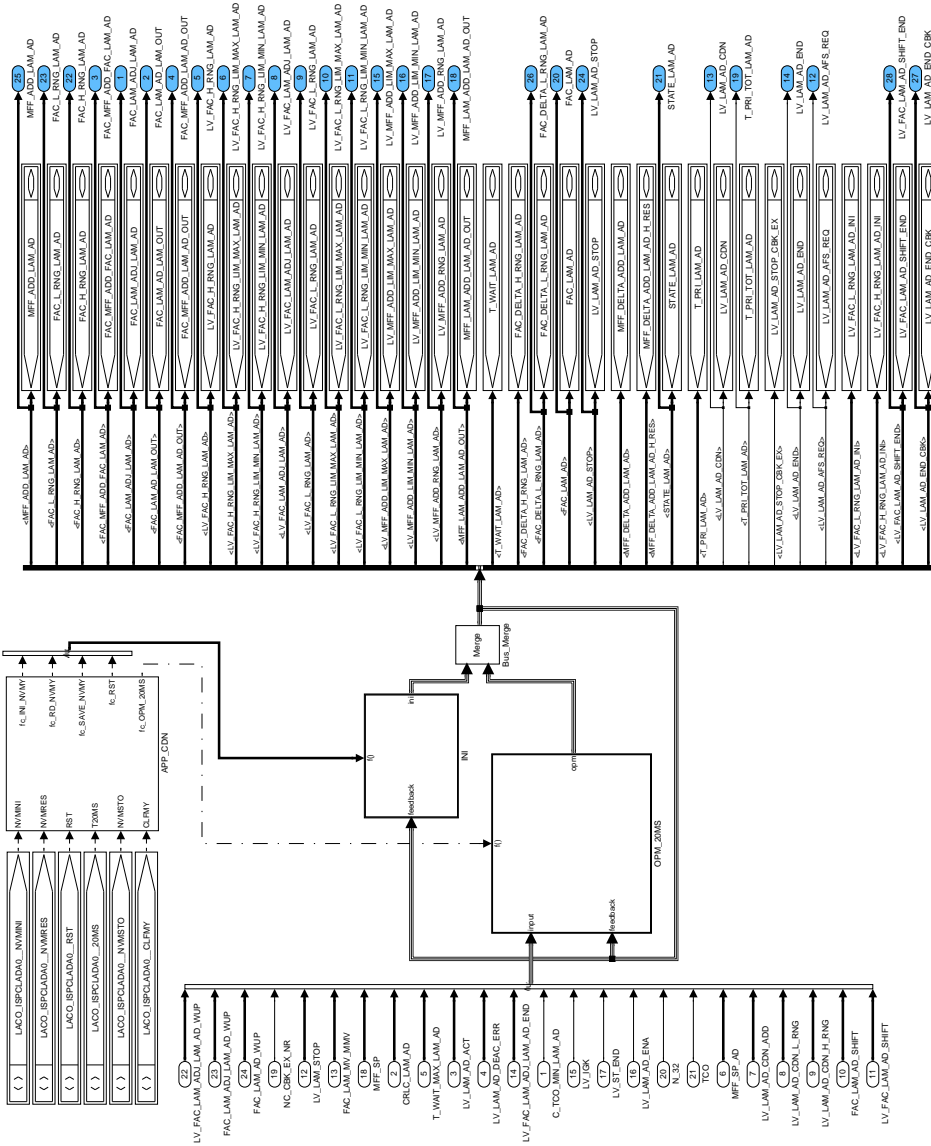


Figure 7.70.2: LACO\_ISPCLADA0

## 7.70.1 Initialization and Non Volatile Memory Data Handling

### ECU Reset

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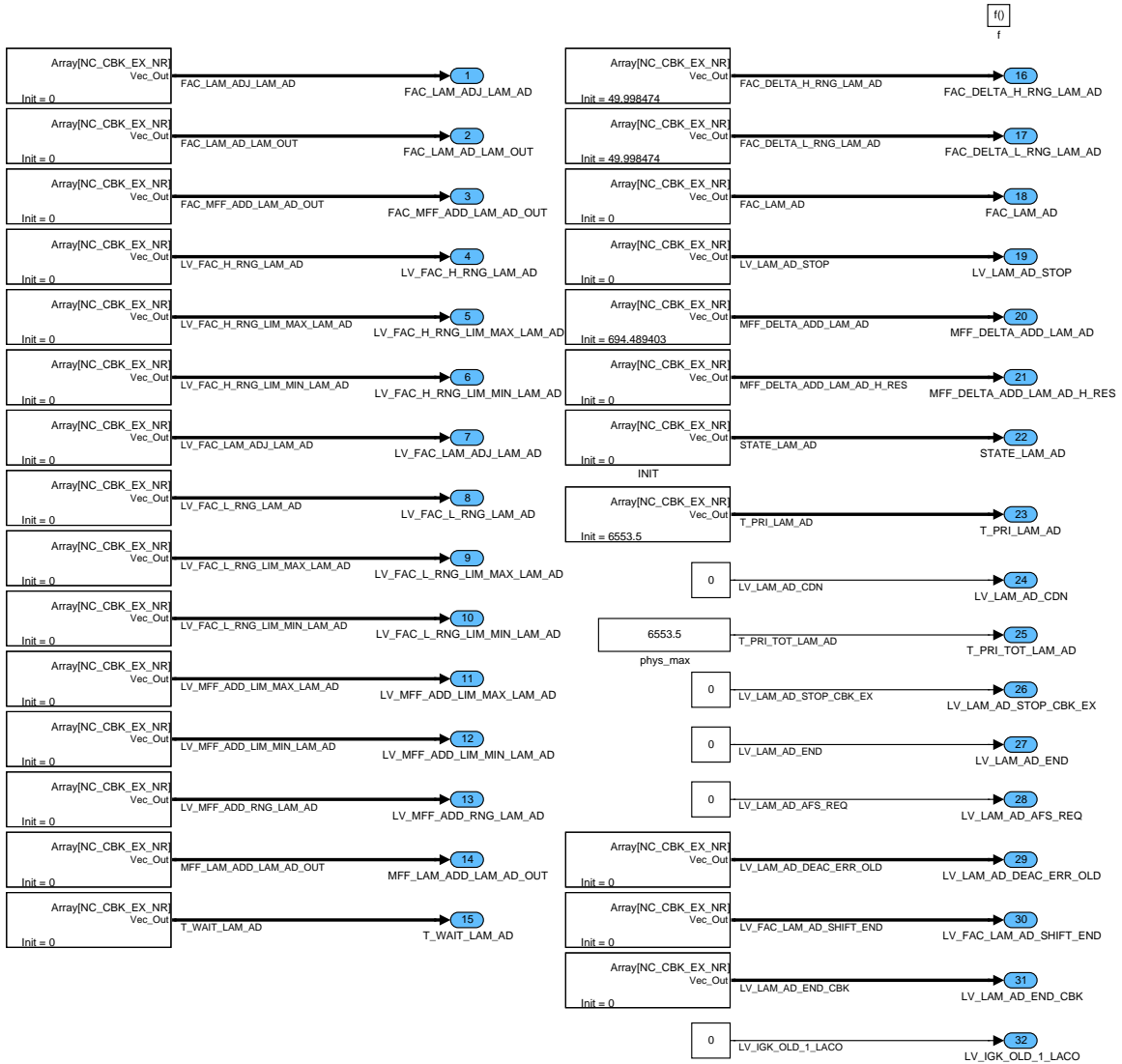


Figure 7.70.3: LACO\_ISPCLADA0/INI/RST

### Non Volatile Memory Data

MFF\_ADD\_LAM\_AD[i], FAC\_L\_RNG\_LAM\_AD[i], FAC\_H\_RNG\_LAM\_AD[i] and FAC\_MFF\_ADD\_FAC\_LAM\_AD[i] are stored in the NVMY (at the end of PWL phase) and read out at ECU reset.

If the ECU is brand new or in case of EEPROM error these data are set to the default value 0.

Furthermore the variables MFF\_ADD\_LAM\_AD\_TMP[i], FAC\_L\_RNG\_LAM\_AD\_TMP[i] and FAC\_H\_RNG\_LAM\_AD\_TMP[i] are used to store the initial values of MFF\_ADD\_LAM\_AD[i], FAC\_L\_RNG\_LAM\_AD[i] and FAC\_H\_RNG\_LAM\_AD[i] during the whole driving cycle for potential use.

If the low range or the high adaptation value is zero indicating that the adaptation value was not yet learned since the last reset of the NVMY data, LV\_FAC\_L\_RNG\_LAM\_AD\_INI[i] respectively LV\_FAC\_H\_RNG\_LAM\_AD\_INI[i] are set to one.

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## 7.70.2 Formula Section

The main functionality is executed by means of a FOR loop over the number of exhaust banks. Only the determination of the priority information for the priority manager between canister purge and lambda adaptation is independent of the number of exhaust banks and executed after the FOR loop.

### For Loop over Number of Exhaust Banks

#### Initialization of FOR Loop

#### Set Variables

Before executing the for loop variables are initialized.

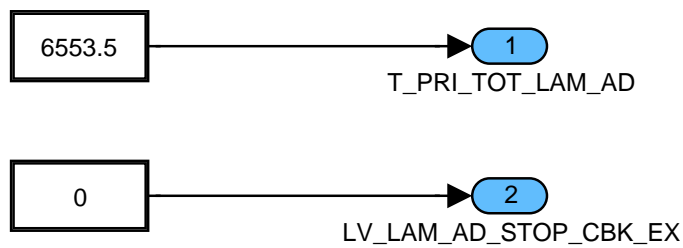


Figure 7.70.4: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/FB\_INI\_FLP/INI\_FLP

### State Machine Management and State Independent Calculations

#### Manage Lambda Adaptation State Machine

#### Determine Calibration Values Used inside State Machine

The calibration data used to determine the current adaptation field are evaluated.

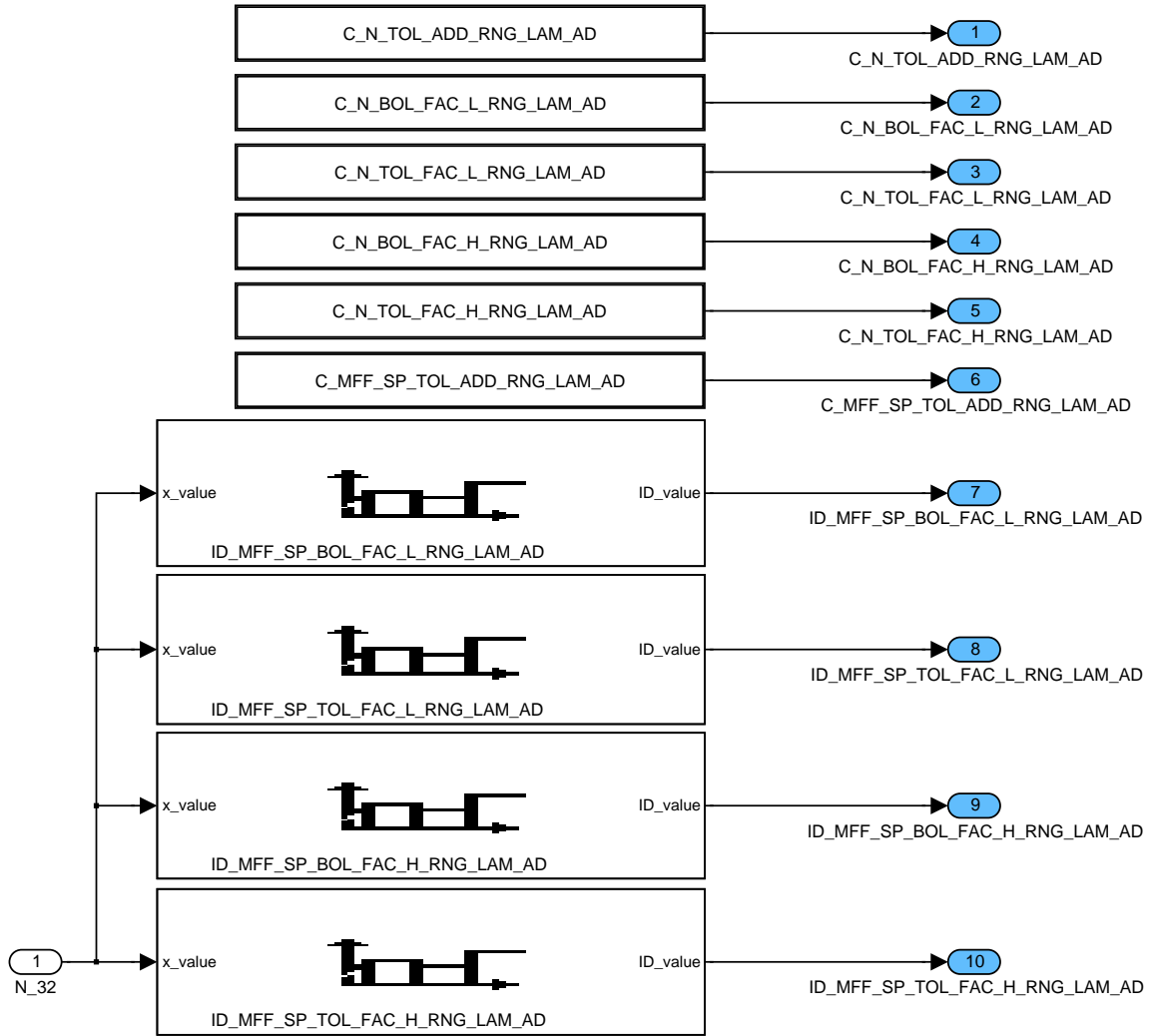
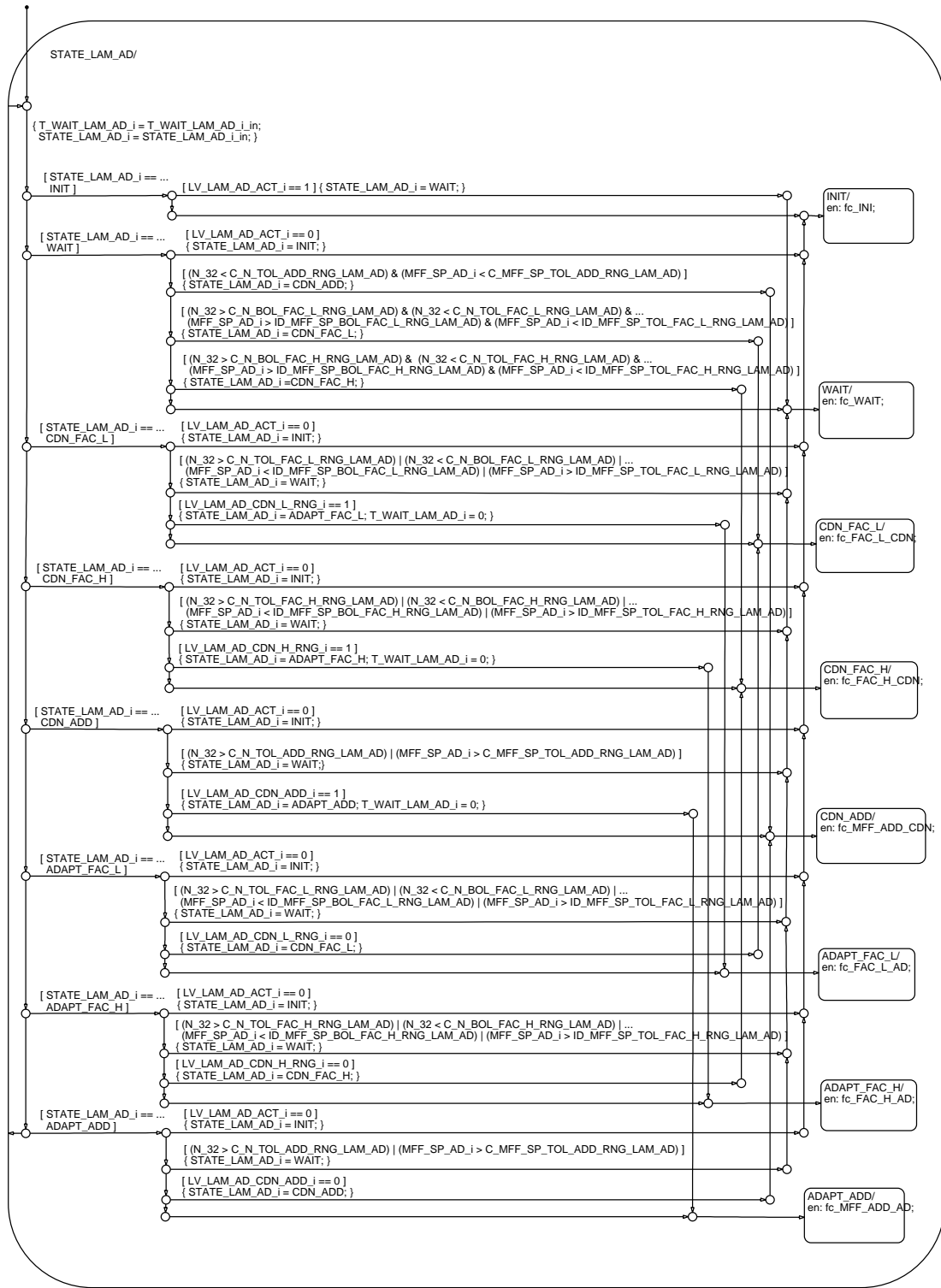


Figure 7.70.5:  
LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/DET\_STATE\_LAM\_AD/SET\_CAL\_VALUE

### State Machine

If the lambda adaptation is not active the state INIT is applied.  
 If the engine is not running in one of the adaptation fields the state WAIT is applied.  
 Depending on fuel mass flow and engine speed limits the respective states are entered.  
 If the respective condition bit LV\_LAM\_AD\_CDN\_ADD; LV\_LAM\_AD\_CDN\_L\_RNG or LV\_LAM\_AD\_CDN\_H\_RNG is set, the adaptation state ADAPT\_ADD, ADAPT\_FAC\_L or ADAPT\_FAC\_H is applied. Otherwise one of the condition states is applied (CDN\_ADD, CDN\_FAC\_L or CDN\_FAC\_H).  
 Furthermore at each transition to one of the adaptation states the counter CTR\_RAF\_CHG\_LAM\_AD[i] is set to 0.


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Figure 7.70.6: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/DET\_STATE\_LAM\_AD/STATE\_LAM\_AD/STATE\_LAM\_AD

**State Actions**

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The following flags are set in any state.

LV\_LAM\_AD\_CDN is indicating that the conditions for adaptation are fulfilled (used by priority manager between canister purge and lambda adaptation).

LV\_LAM\_AD\_END sets the temporary end of lambda adaptation (to indicate to the priority manager that the priority for lambda adaptation is low).

LV\_LAM\_AD\_AFS\_REQ (if set to 1) requests stoichiometric mixture.

LV\_MFF\_ADD\_RNG\_LAM\_AD[i], LV\_FAC\_L\_RNG\_LAM\_AD[i] and LV\_FAC\_H\_RNG\_LAM\_AD[i] are indicating that the lambda adaptation is active and running in the respective adaptation field.

**State INIT**

**Set Variables**

The general flags are set to 0. All other variables remain unchanged.

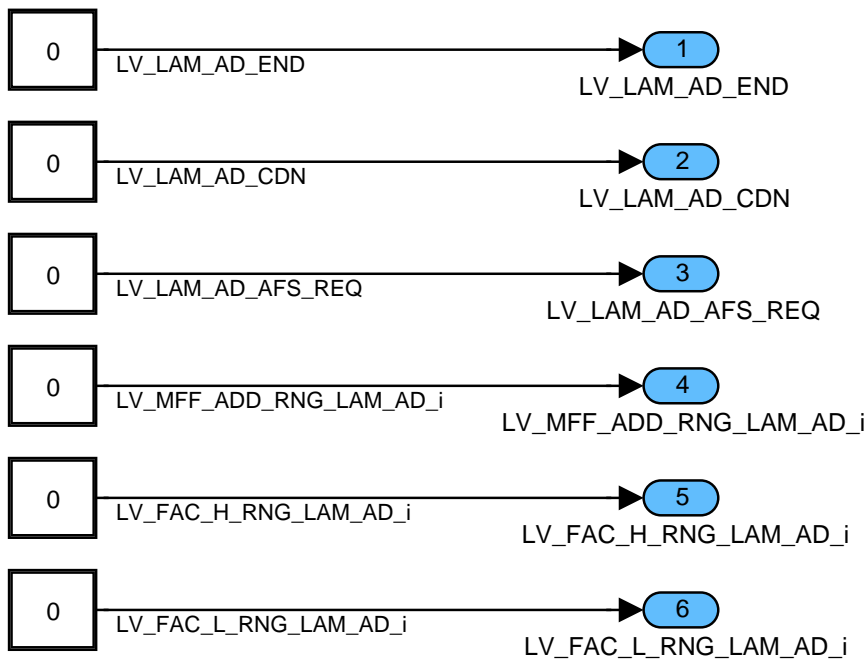


Figure 7.70.7:  
LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/INI/SET\_VALUE

**State WAIT**

**Set Variables**

The general flags are set to 0. The time T\_PRI\_LAM\_AD[i] is set to the maximum value of the 3 adaptation fields. All other variables remain unchanged.

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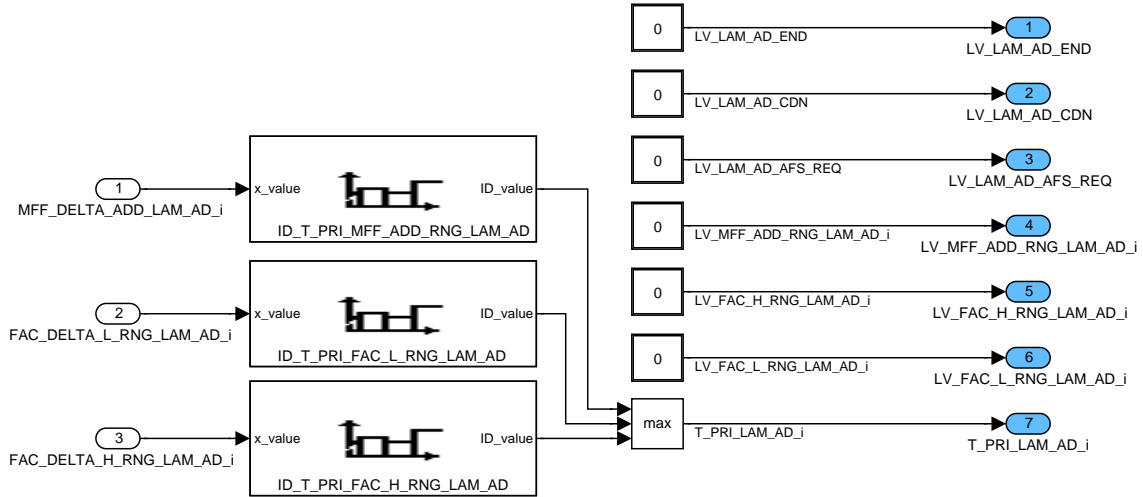


Figure 7.70.8:  
LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/WAIT/SET\_VALUE

**State CDN\_ADD**

**Set Variables**

LV\_LAM\_AD\_CDN is set to 1 as the load conditions for adaptation are fulfilled.  
 If LV\_LAM\_AD\_ENA is set by the priority manager and stoichiometry request is allowed for offset adaptation by means of the respective calibration flag LV\_LAM\_AD\_AFS\_REQ is set to 1.  
 T\_PRI\_LAM\_AD[i] is set depending on the last learned value in this adaptation field.  
 The other general flags are set to 0 and all other variables remain unchanged.

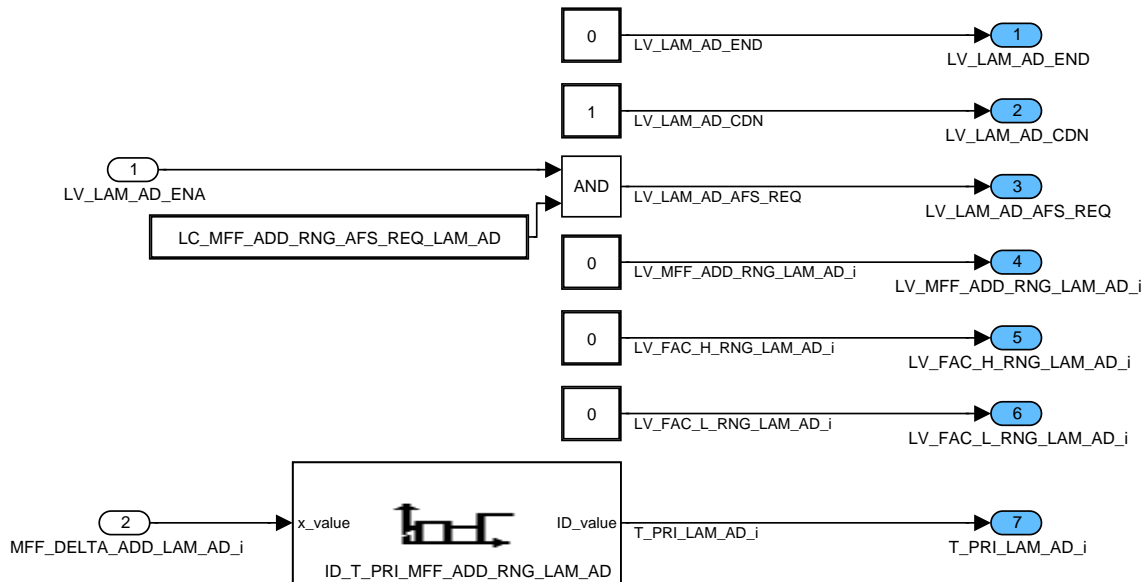



Figure 7.70.9: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/MFF\_ADD\_CDN/SET\_VALUE

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## State ADAPT\_ADD

### Set Variables

LV\_MFF\_ADD\_RNG\_LAM\_AD[i] is set to 1 as adaptation is active in the respective adaptation field.

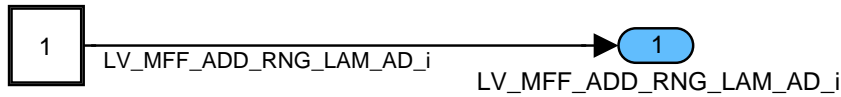


Figure 7.70.10:  
LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/MFF\_ADD\_AD/SET\_VALUE

### Check Stopped Lambda Adaptation Cycle

Lambda adaptation cycle shall not be stopped (LV\_LAM\_AD\_STOP[i] must be 0).

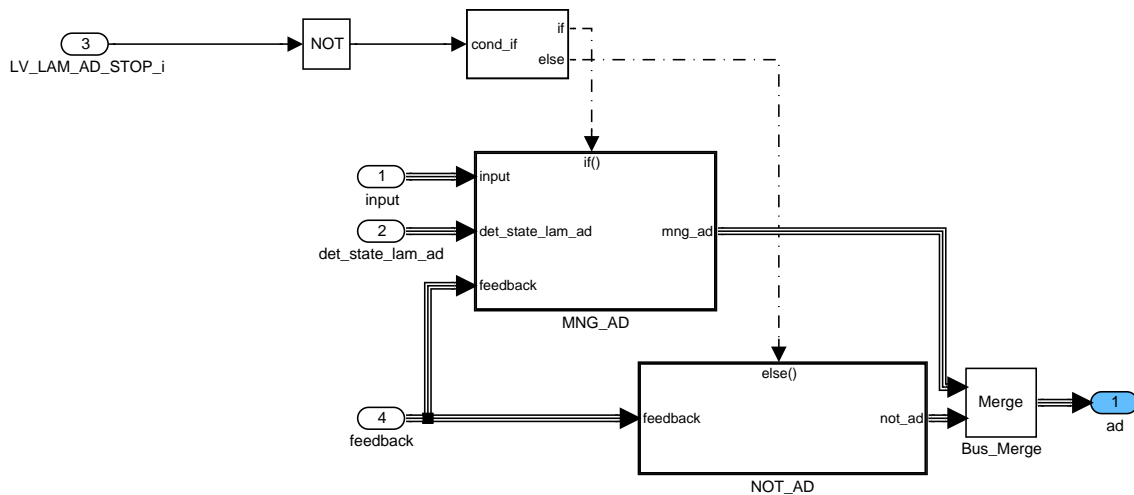


Figure 7.70.11:  
LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/MFF\_ADD\_AD/AD

### Wait for Timer Threshold Reached

### Increment Counter

Wait timer is incremented by T\_SAMPLE.

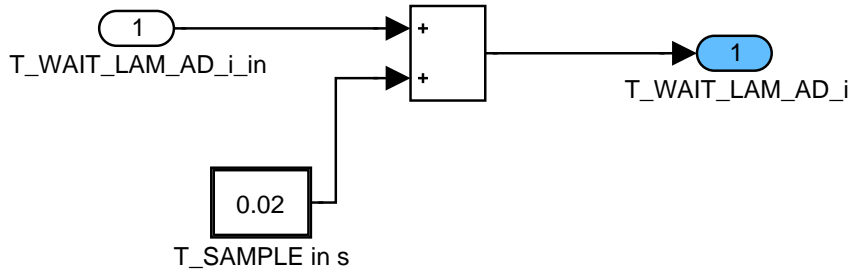


Figure 7.70.12: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/MFF\_ADD\_AD/AD/MNG\_AD/INC\_CTR

### Check Wait Timer Threshold

New adaptation value is calculated if wait timer reaches threshold.

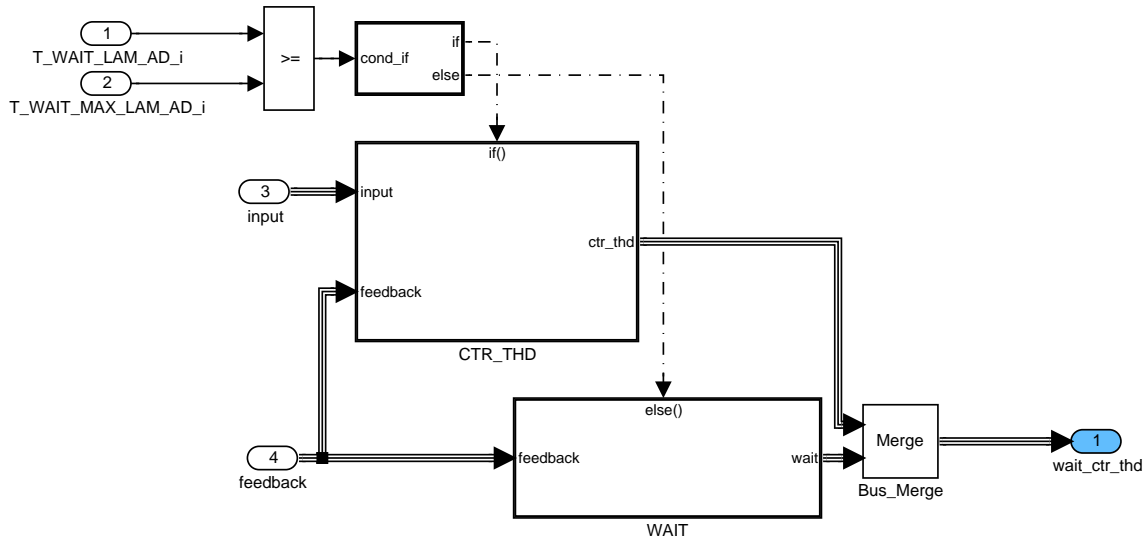


Figure 7.70.13: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/MFF\_ADD\_AD/AD/MNG\_AD/WAIT\_CTR\_THD


### Wait Timer threshold reached

#### Calculation of lambda controller shift

In order to apply the lambda controller shift with the same amount as the lambda adaptation shift  $FAC\_LAM\_ADJ\_LAM\_AD[i]$  is calculated based on the lambda controller output and a correlation constant (defined in application incidences) The respective lambda adaptation shift is calculated (with high resolution by the internal variable  $MFF\_DELTA\_ADD\_LAM\_AD\_H\_RES[i]$ ) by multiplying  $FAC\_LAM\_ADJ\_LAM\_AD[i]$  with the fuel mass flow set point. The result is assigned to  $MFF\_DELTA\_ADD\_LAM\_AD[i]$  which is the lambda adaptation shift that is finally applied.

The variable  $MFF\_DELTA\_ADD\_LAM\_AD[i]$  will be 0 as long as the absolute value of  $MFF\_DELTA\_ADD\_LAM\_AD\_H\_RES[i]$  is below the resolution of  $MFF\_DELTA\_ADD\_LAM\_AD[i]$

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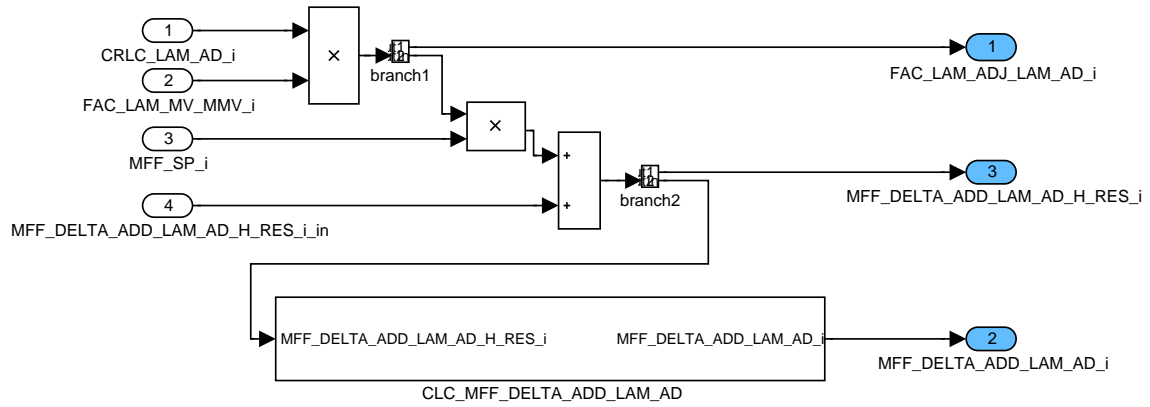



Figure 7.70.14: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/MFF\_ADD\_AD/AD/MNG\_AD/WAIT\_CTR\_THD/CTR\_THD/CLC\_LAM\_SHIFT

**Wait for determination of new adaptation value**

As long as MFF\_DELTA\_ADD\_LAM\_AD[i] is 0 no new adaptation value is taken into account.

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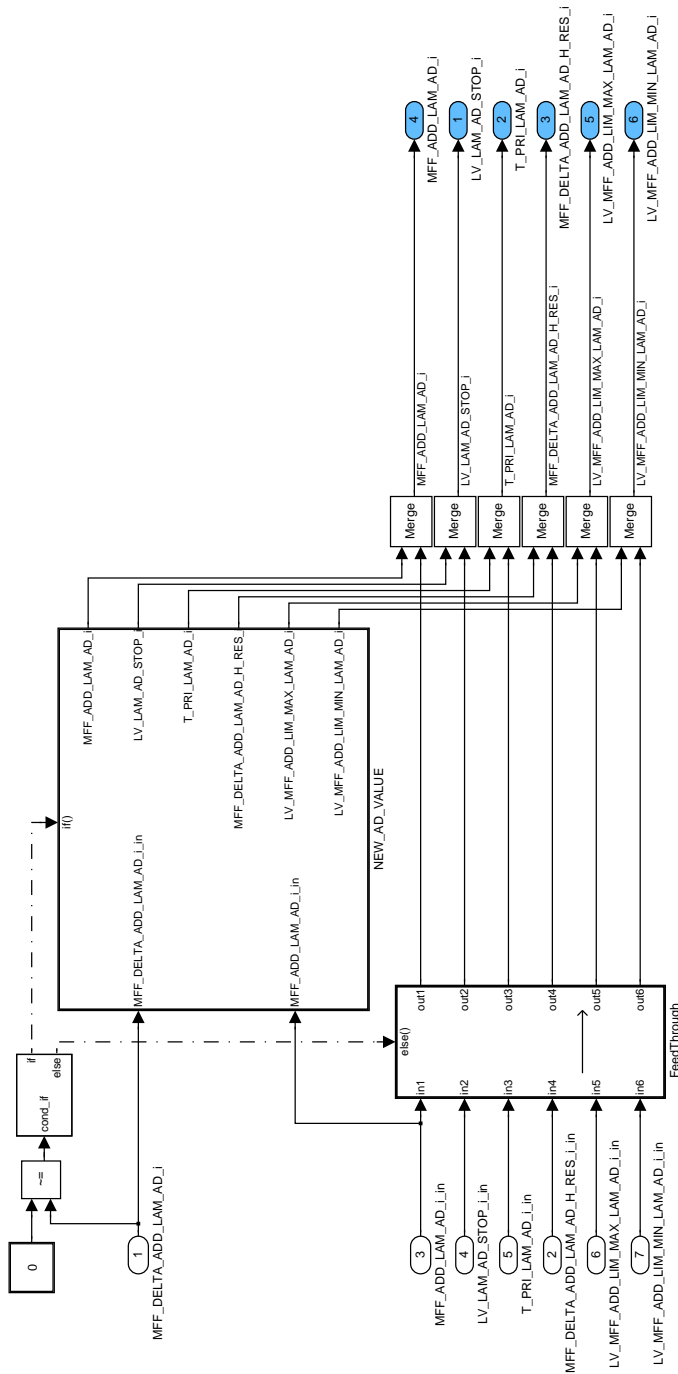


Figure 7.70.15: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/MFF\_ADD\_AD/AD/MNG\_AD/WAIT\_CTR\_THD/CTR\_THD/WAIT\_NEW\_AD\_VALUE


### Determine new adaptation value

The new delta is added to the adaptation value and limited on upper and lower thresholds. If these thresholds are exceeded the respective flags are set to 1.

A new priority time is evaluated based on the delta.

`LV_LAM_AD_STOP[i]` is set to 1 to indicate that a lambda controller shift can take place.

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MFF\_DELTA\_ADD\_LAM\_AD\_H\_RES[i] is set to 0 for next learning sequence.

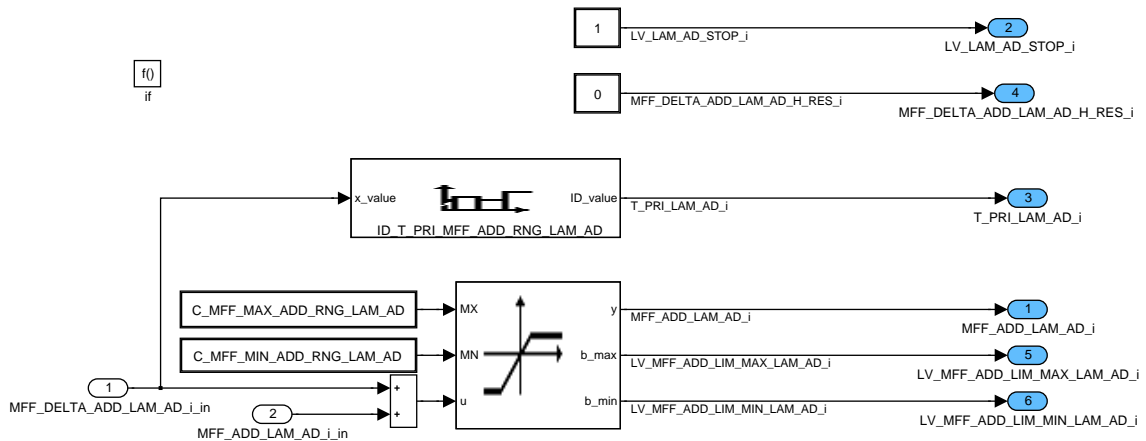


Figure 7.70.16: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/MFF\_ADD\_AD/AD/MNG\_AD/WAIT\_CTR\_THD/CTR\_THD/WAIT\_NEW\_AD\_VALUE/NEW\_AD\_VALUE

### State CDN\_FAC\_L

#### Set Variables

LV\_LAM\_AD\_CDN is set to 1 as the load conditions for adaptation are fulfilled.  
 If LV\_LAM\_AD\_ENA is set by the priority manager and stoichiometry request is allowed for lower factor field adaptation by means of the respective calibration flag LV\_LAM\_AD\_AFS\_REQ is set to 1.  
 T\_PRI\_LAM\_AD[i] is set depending on the last learned value in this adaptation field.  
 The other general flags are set to 0 and all other variables remain unchanged.

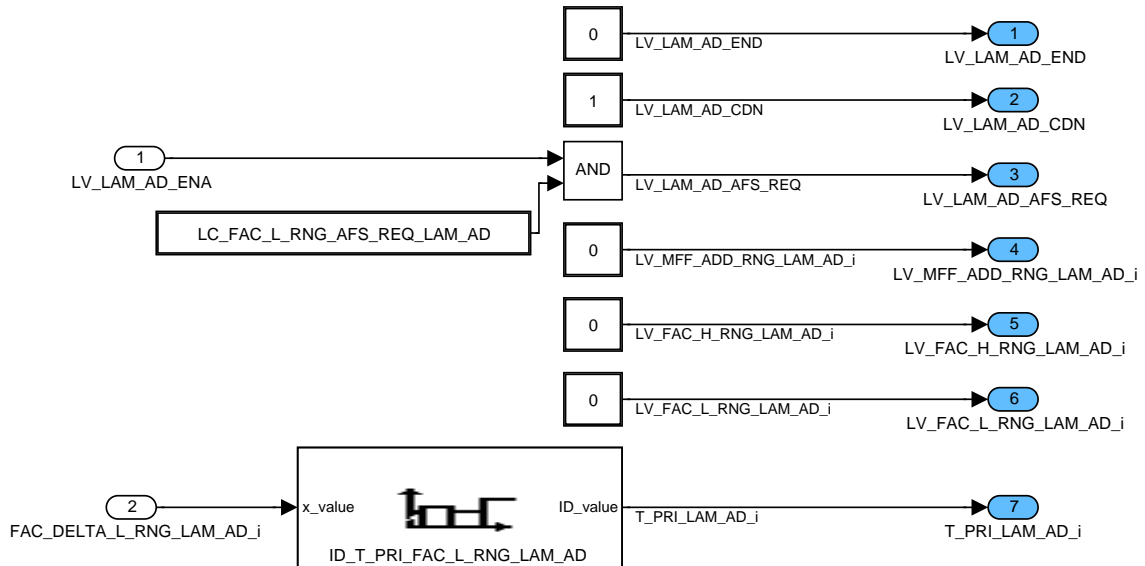


Figure 7.70.17: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/FAC\_L\_CDN/SET\_VALUE

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## State ADAPT\_FAC\_L

### Set Variables

LV\_FAC\_L\_RNG\_LAM\_AD[i] is set to 1 as adaptation is active in the respective adaptation field.

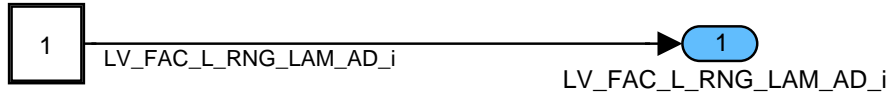


Figure 7.70.18:  
LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/FAC\_L\_AD/SET\_VALUE

### Check Stopped Lambda Adaptation Cycle

Lambda adaptation cycle shall not be stopped (LV\_LAM\_AD\_STOP[i] must be 0).

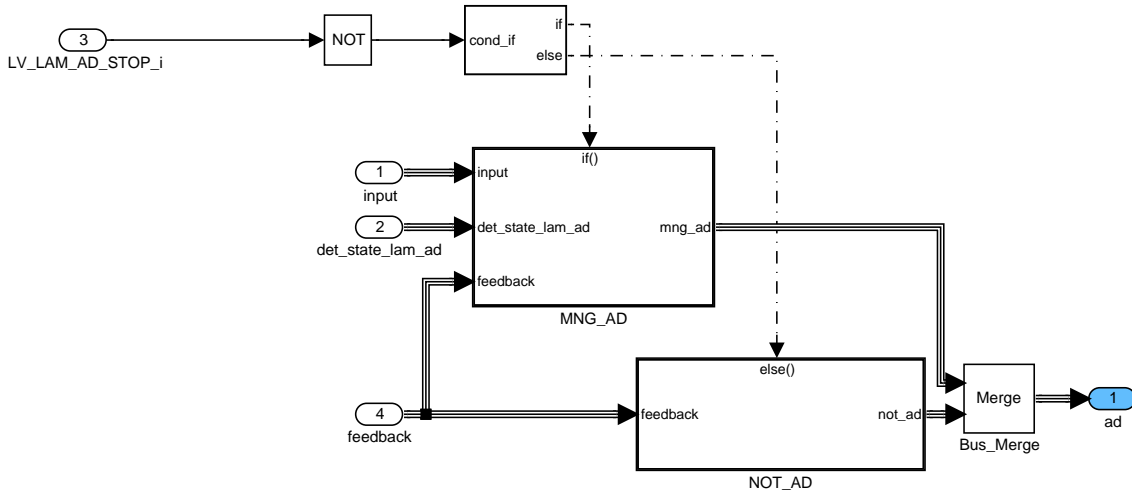


Figure 7.70.19:  
LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/FAC\_L\_AD/AD

### Wait for Timer Threshold Reached

### Increment Counter

Wait timer is incremented by T\_SAMPLE.

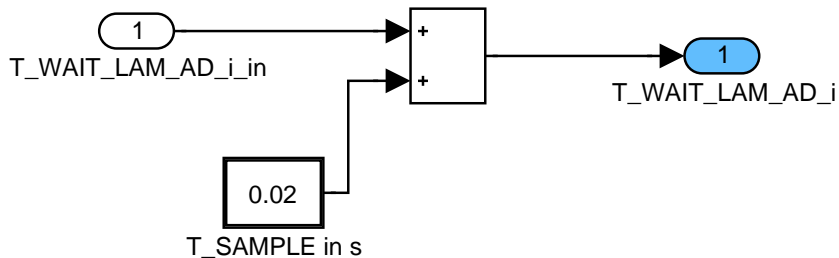


Figure 7.70.20: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/FAC\_L\_AD/AD/MNG\_AD/INC\_CTR

### Check Wait Timer Threshold

New adaptation value is calculated if wait timer reaches threshold.

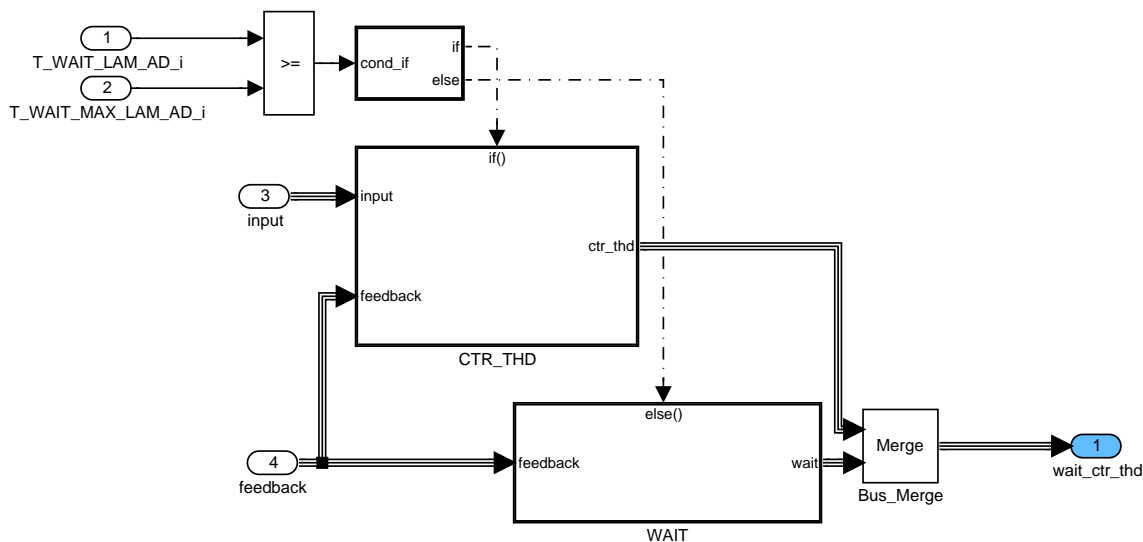


Figure 7.70.21: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/FAC\_L\_AD/AD/MNG\_AD/WAIT\_CTR\_THD

### Wait Timer Threshold Reached

### Calculation of Lambda Controller Shift

The new delta for the adaptation value is calculated based on the lambda controller output and a correlation constant (defined in application incidences). This value is the same as for the shift applied to the lambda controller.

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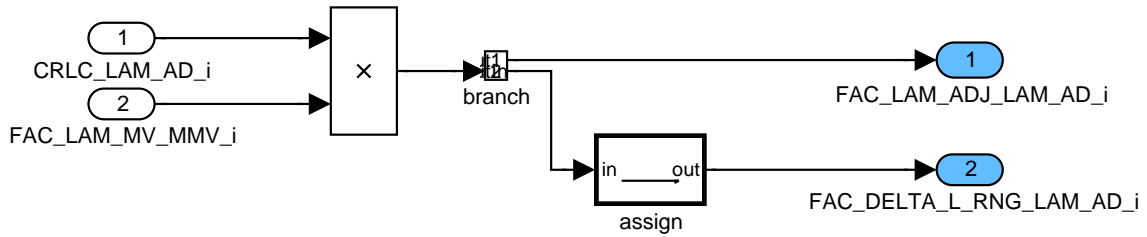


Figure 7.70.22: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/FAC\_L\_AD/AD/MNG\_AD/WAIT\_CTR\_THD/CTR\_THD/CLC\_LAM\_SHIFT

### Determine New Adaptation Value

The new delta is added to the adaptation value and limited on upper and lower thresholds. If these thresholds are exceeded the respective flags are set to 1.

In case the high range adaptation value was not yet learned since the last reset of the NVMY data (indicated by LV\_FAC\_H\_RNG\_LAM\_AD\_INI[i] = 1), the low range value is written to the high range value.

A new priority time is evaluated based on the delta.

LV\_LAM\_AD\_STOP[i] is set to 1 to indicate that a lambda controller shift can take place.

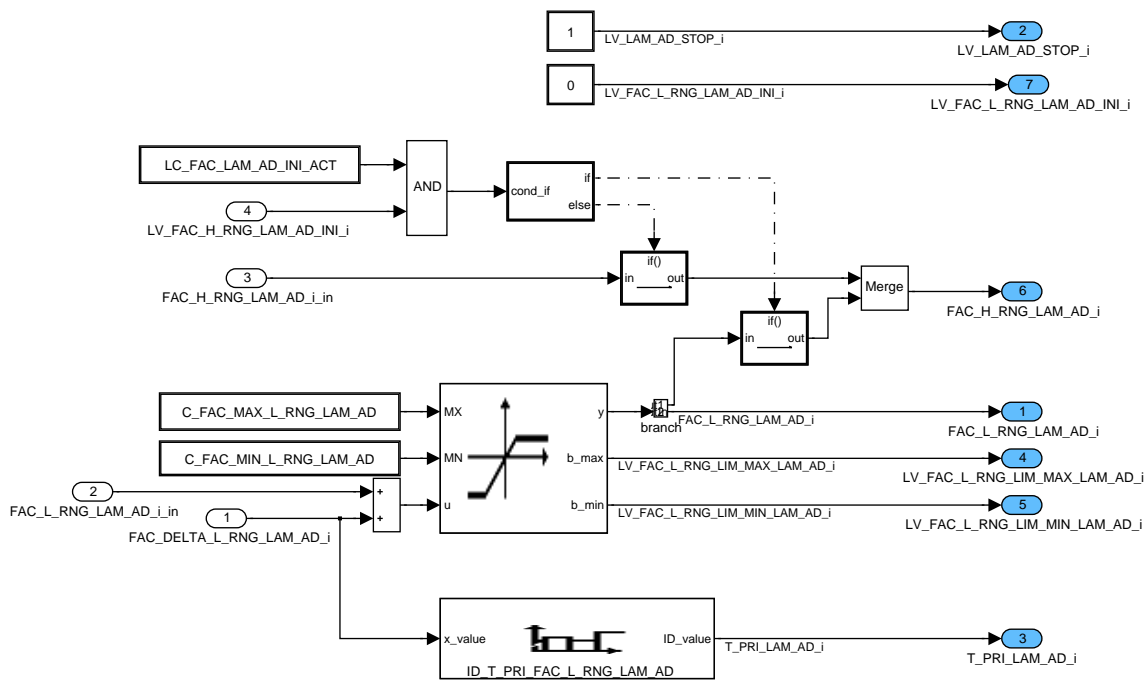



Figure 7.70.23: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/FAC\_L\_AD/AD/MNG\_AD/WAIT\_CTR\_THD/CTR\_THD/NEW\_AD\_VALUE

### State CDN\_FAC\_H

### Set Variables

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LV\_LAM\_AD\_CDN is set to 1 as the load conditions for adaptation are fulfilled.  
 If LV\_LAM\_AD\_ENA is set by the priority manager and stoichiometry request is allowed for higher factor field adaptation by means of the respective calibration flag LV\_LAM\_AD\_AFS\_REQ is set to 1.  
 T\_PRI\_LAM\_AD[i] is set depending on the last learned value in this adaptation field.  
 The other general flags are set to 0 and all other variables remain unchanged.

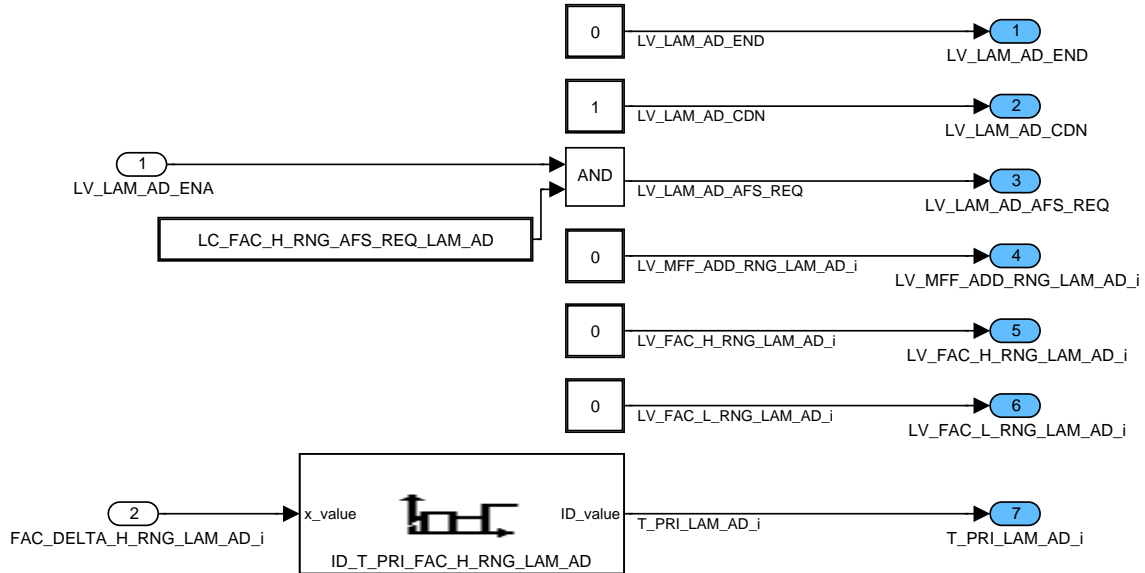


Figure 7.70.24:  
LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/FAC\_H\_CDN/SET\_VALUE

**State ADAPT\_FAC\_H**

**Set Variables**

LV\_FAC\_H\_RNG\_LAM\_AD[i] is set to 1 as adaptation is active in the respective adaptation field.

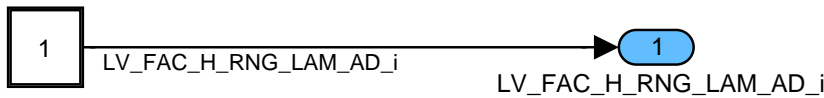


Figure 7.70.25:  
LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/FAC\_H\_AD/SET\_VALUE

**Check Stopped Lambda Adaptation Cycle**

Lambda adaptation cycle shall not be stopped (LV\_LAM\_AD\_STOP[i] must be 0).

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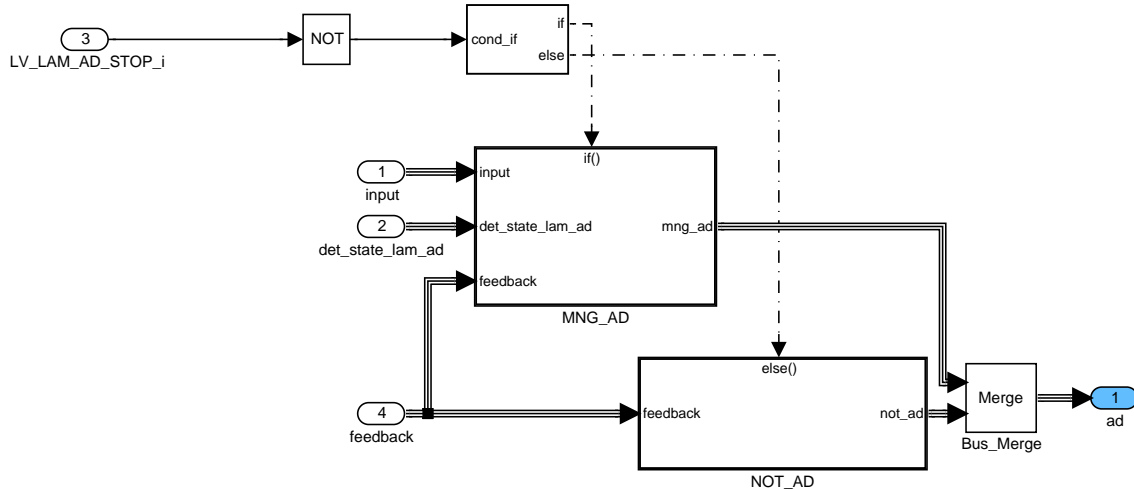


Figure 7.70.26:  
LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/FAC\_H\_AD/AD

**Wait for Timer Threshold Reached**

**Increment Counter**

Wait timer is incremented by T\_SAMPLE.

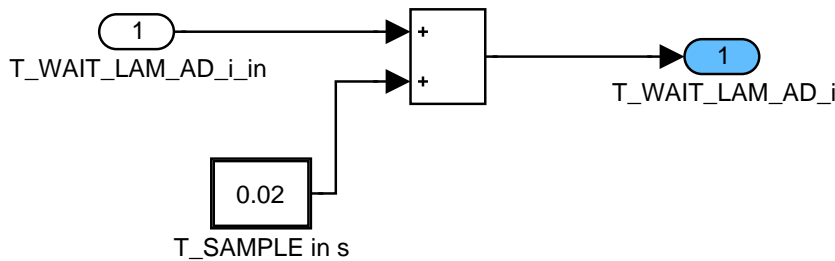


Figure 7.70.27: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/FAC\_H\_AD/AD/MNG\_AD/INC\_CTR

**Check Wait Timer Threshold**

New adaptation value is calculated if wait timer reaches threshold.

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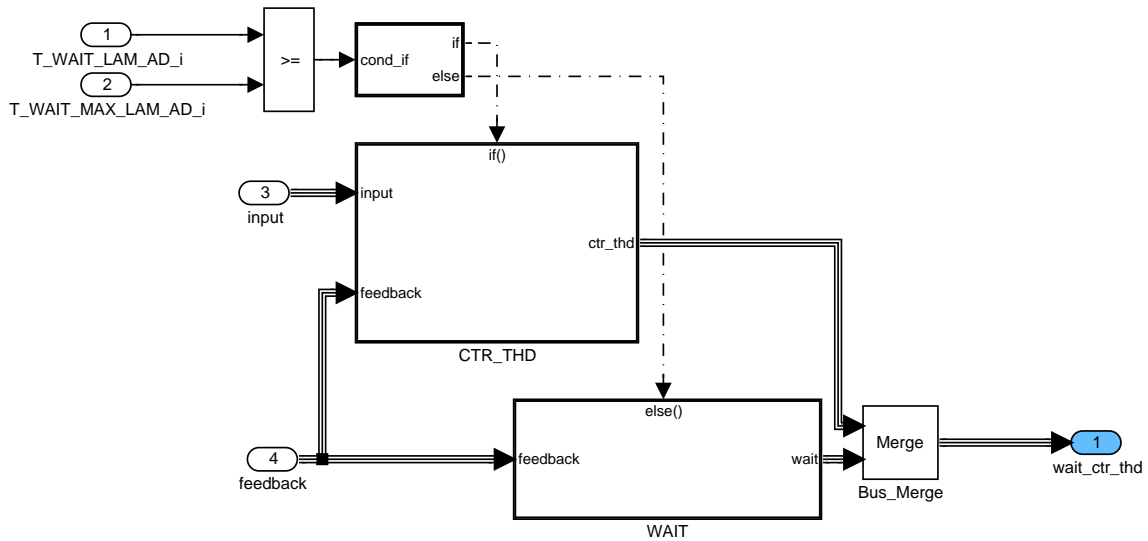


Figure 7.70.28: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/FAC\_H\_AD/AD/MNG\_AD/WAIT\_CTR\_THD

**Wait Timer Threshold Reached**

**Calculation of Lambda Controller Shift**

The new delta for the adaptation value is calculated based on the lambda controller output and a correlation constant (defined in application incidences). This value is the same as for the shift applied to the lambda controller.

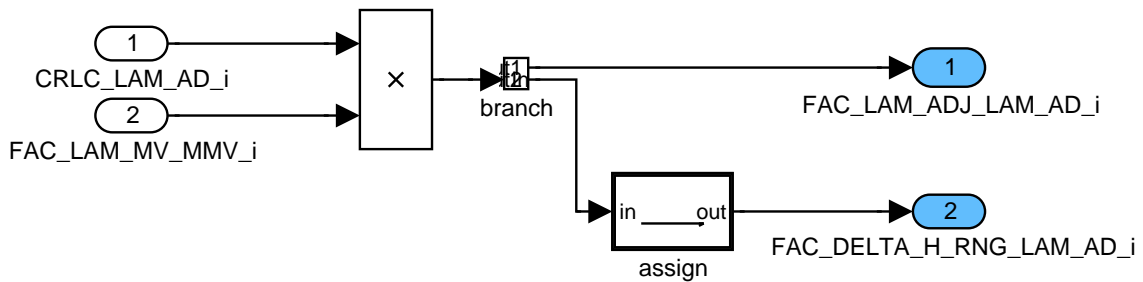


Figure 7.70.29: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/FAC\_H\_AD/AD/MNG\_AD/WAIT\_CTR\_THD/CTR\_THD/CLC\_LAM\_SHIFT


**Determine New Adaptation Value**

The new delta is added to the adaptation value and limited on upper and lower thresholds. If these thresholds are exceeded the respective flags are set to 1.

In case the low range adaptation value was not yet learned since the last reset of the NVMY data (indicated by LV\_FAC\_L\_RNG\_LAM\_AD\_INI[i] = 1), the high range value is written to the low range value.

A new priority time is evaluated based on the delta.

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LV\_LAM\_AD\_STOP[i] is set to 1 to indicate that a lambda controller shift can take place.

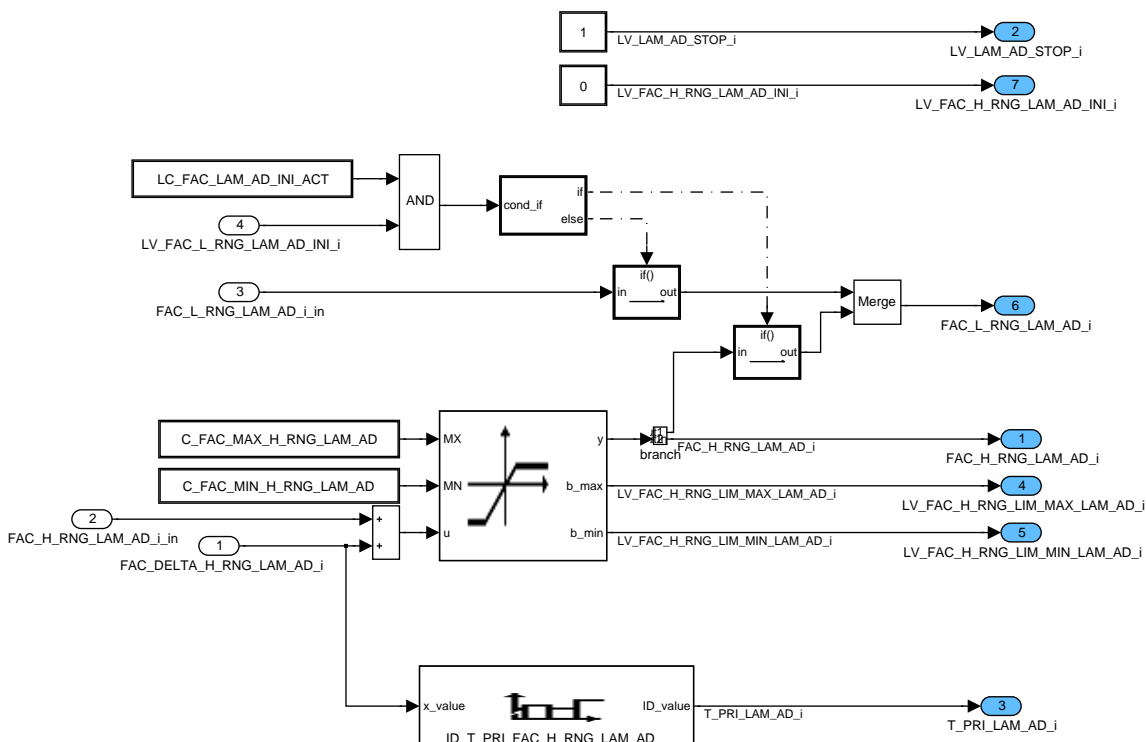



Figure 7.70.30: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/STATE\_ACTION/FAC\_H\_AD/AD/MNG\_AD/WAIT\_CTR\_THD/CTR\_THD/NEW\_AD\_VALUE

**State Machine Independent Calculations**

**Re Writing of Adaptation Correction at transition of ignition key**

Rewriting of the adaptation values if required if not both adaptation factors were learned in the past.

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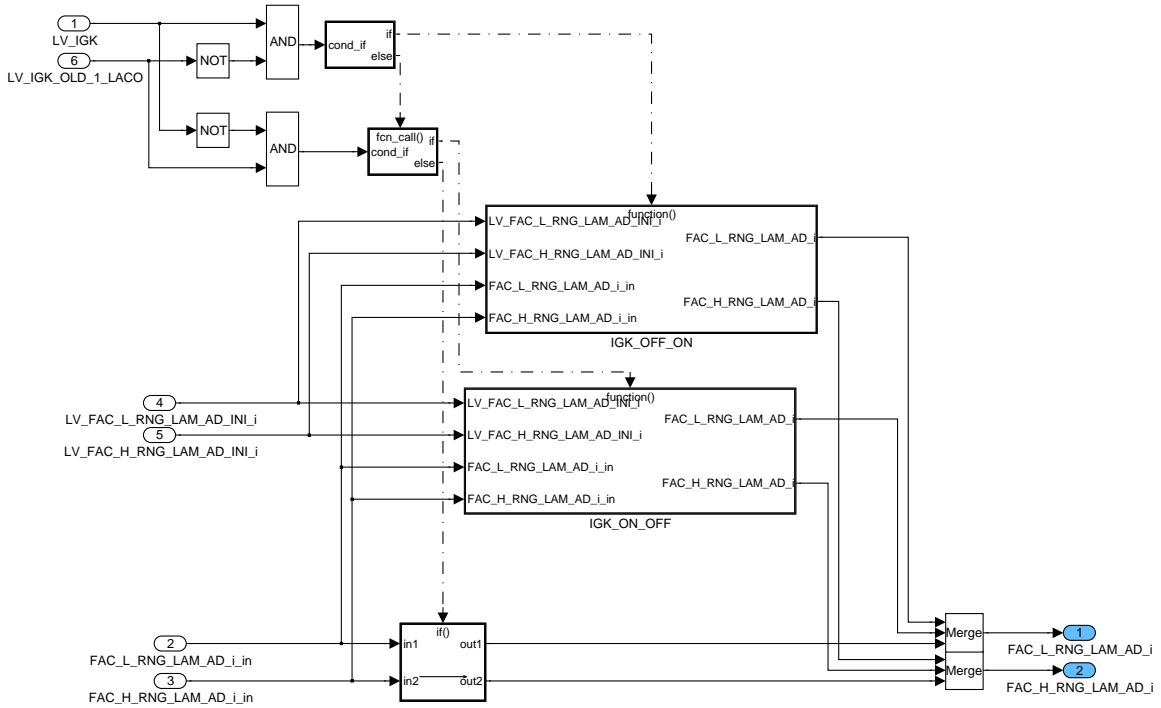


Figure 7.70.31: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/CLC\_CMN/IGK\_LAM\_AD

**Ignition key transition off to on**

If only one of the initialization flags is set, then the respective adaptation value is reinitialized with the adaptation value of the other adaptation range.

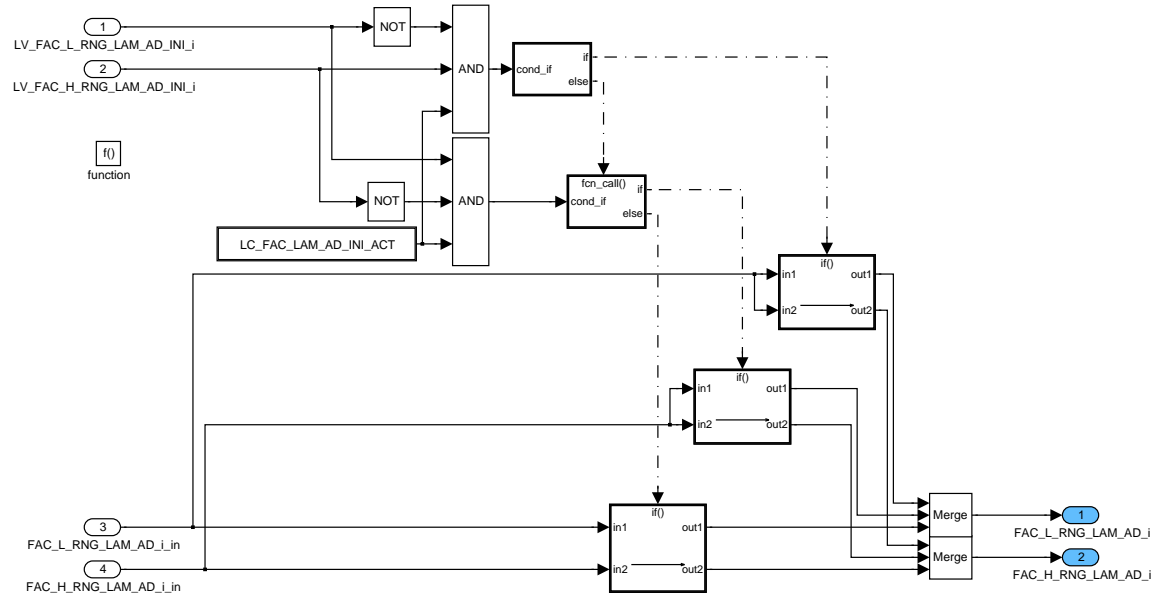


Figure 7.70.32: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/CLC\_CMN/IGK\_LAM\_AD/IGK\_OFF\_ON

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### Ignition key transition on to off

If the flag indicating that no adaptation was done in the relevant adaptation range, the adaptation values shall be reset to zero. This is required to set LV\_FAC\_L\_RNG\_LAM\_AD\_INI[i] respectively LV\_FAC\_H\_RNG\_LAM\_AD\_INI[i] in the next driving cycle.

If by any chance a adaptation of exactly zero was learned, a adaptation value of 1 hex shall be written to the NVMY in order to avoid any false setting of LV\_FAC\_L\_RNG\_LAM\_AD\_INI[i] respectively LV\_FAC\_H\_RNG\_LAM\_AD\_INI[i] in the next driving cycle.

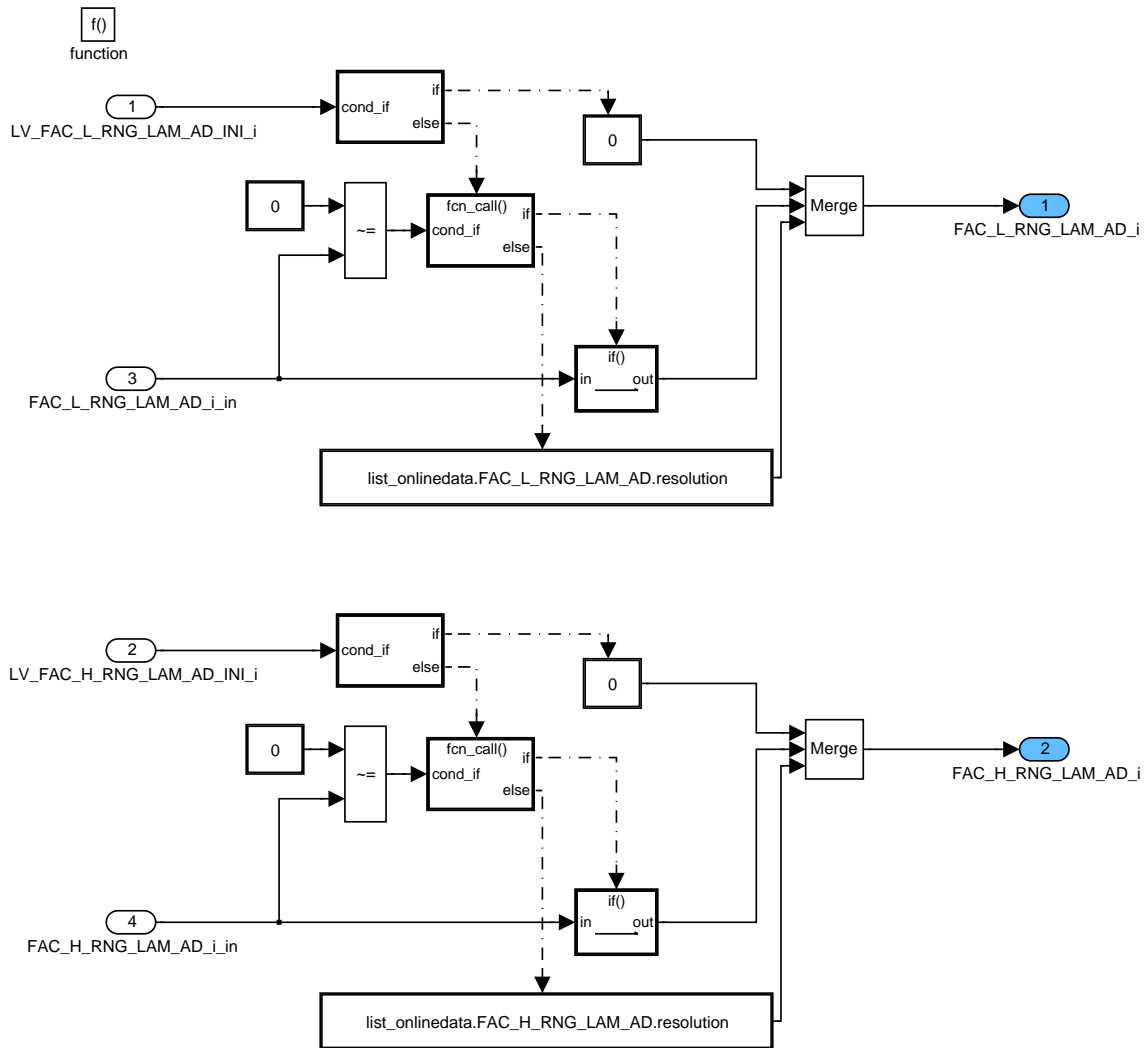



Figure 7.70.33:  
LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/CLC\_CMN/IGK\_LAM\_AD/IGK\_ON\_OFF

### Re Writing of Adaptation Correction with Non Volatile Stored Values

In case of lambda adaptation relevant errors (see application incidences) the adaptation correction values MFF\_ADD\_LAM\_AD[i], FAC\_L\_RNG\_LAM\_AD[i] and FAC\_H\_RNG\_LAM\_AD[i] must be rewritten with the values stored at the end of the last driving cycle. These values are available with the variables MFF\_ADD\_LAM\_AD\_TMP[i], FAC\_L\_RNG\_LAM\_AD\_TMP[i] and FAC\_H\_RNG\_LAM\_AD\_TMP[i] written to at the beginning of the driving cycle with the stored values of the last driving cycle.

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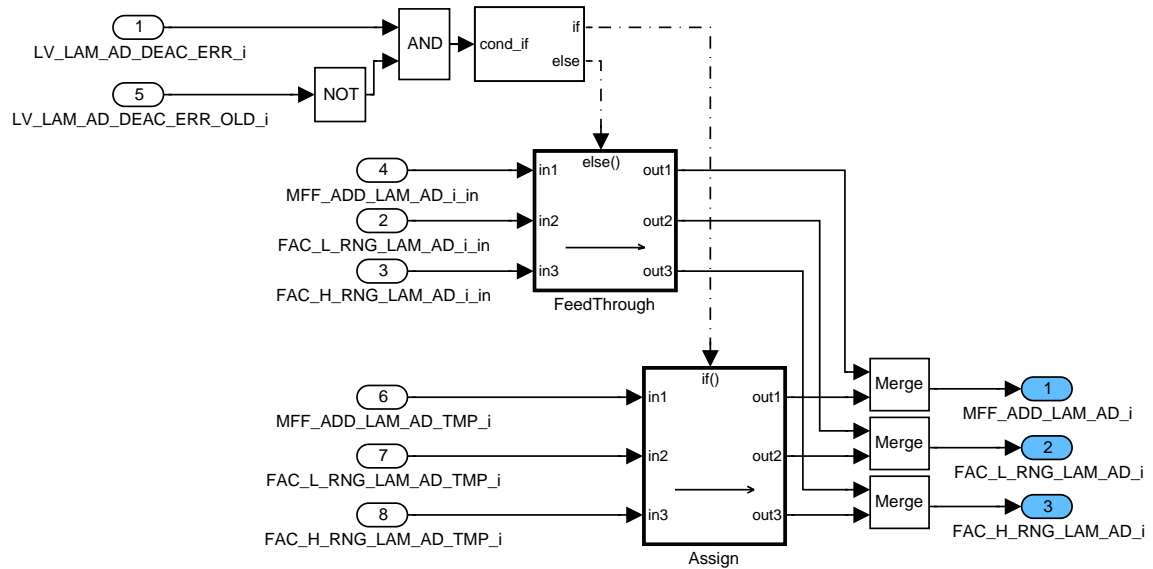


Figure 7.70.34: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/CLC\_CMN/ERR\_LAM\_AD

### Shift of adaptation values by external function

External functions might require an inverse step change in the Lambda adaptation value. The control of the value shift takes place in the external function and is indicated by the flags LV\_FAC\_LAM\_AD\_SHIFT[i].

The Lambda adaptation is shifted if the condition LV\_FAC\_LAM\_AD\_SHIFT[i] = 1 is valid. This variable is to be reset if the Lambda adaptation shift was carried out. That requires a confirmation of the executed controller shift. The confirmation is done by setting the variable LV\_FAC\_LAM\_AD\_SHIFT\_END[i] to 1.

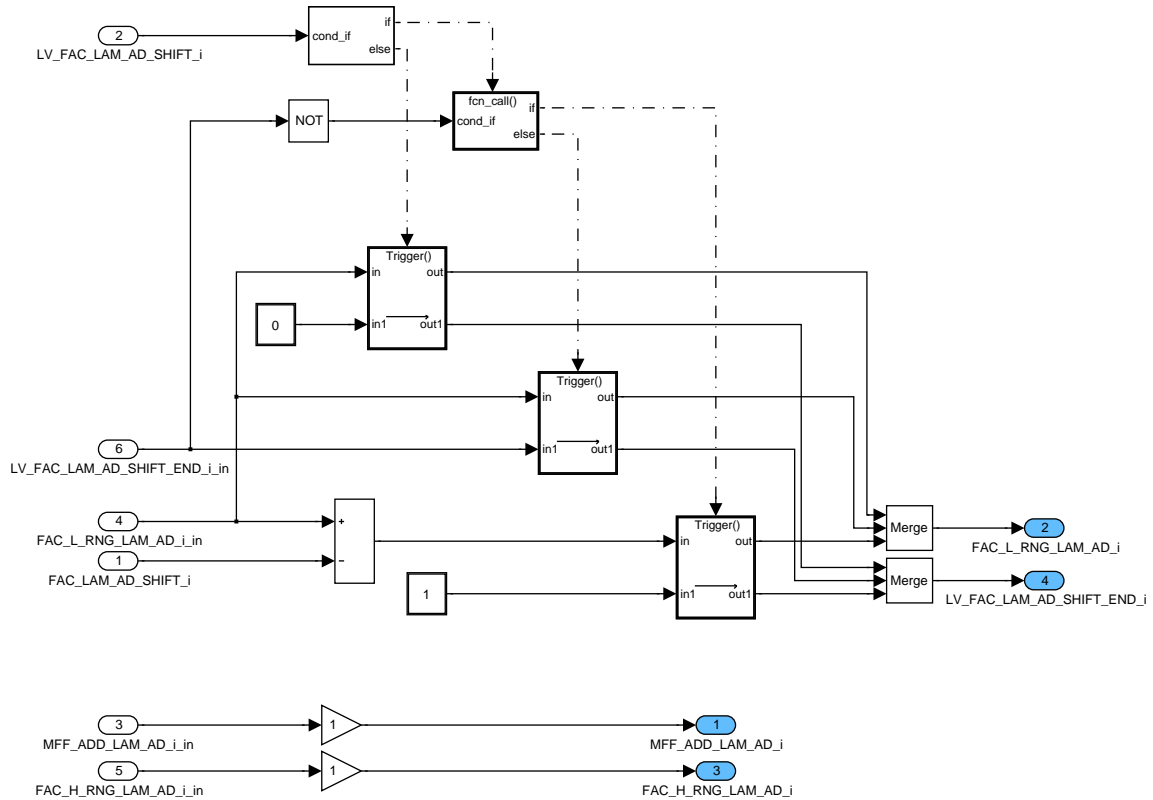



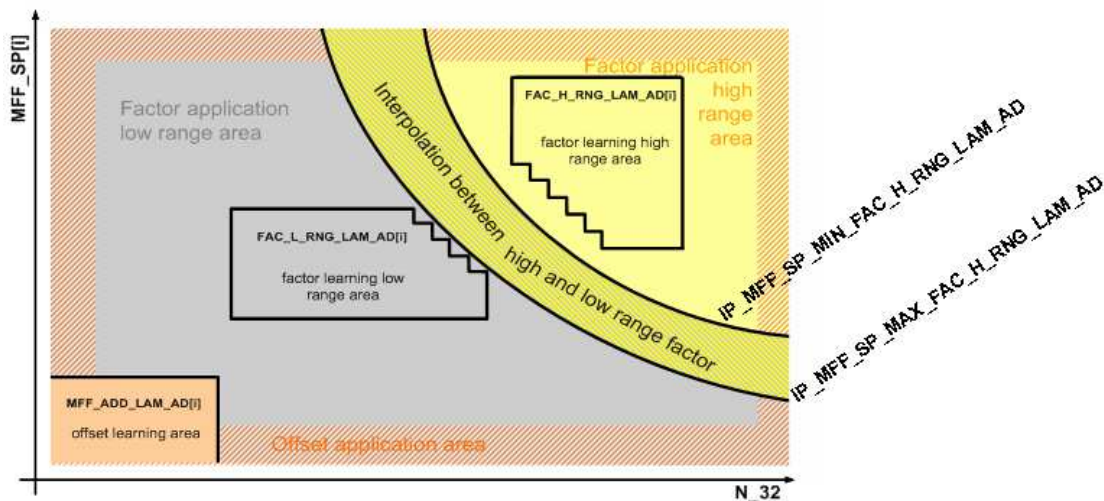
Figure 7.70.35: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/CLC\_CMN/SHIFT\_LAM\_AD

**Determination of Interpolated Lambda Adaptation Factor**

In order to meet the physical behaviour of engine components (especially the air mass flow sensor), the actual multiplicative factor is calculated out of the two determined factors by interpolation at every state. Interpolation is applied between the borders  
 IP\_MFF\_SP\_MAX\_FAC\_H\_RNG\_LAM\_AD (lower border) and  
 IP\_MFF\_SP\_MIN\_FAC\_H\_RNG\_LAM\_AD (upper border)  
 as shown in the figure.

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Interpolation of adaptation factors

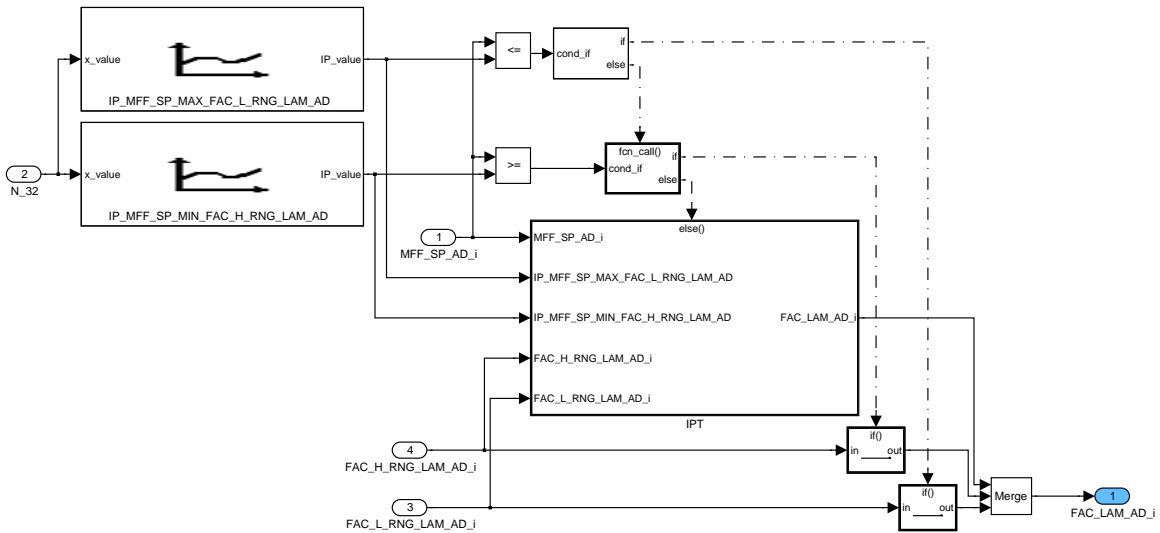


Figure 7.70.36:  
LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/CLC\_CMN/CLC\_FAC\_LAM\_AD

**Calculation of Output Signals for Fuel Mass Flow Set Point Correction**

In order to avoid mixture problems when the engine has not reached its service temperature (warm up), lambda adaptation factors and their corresponding relative intermediate results can be decreased versus TCO and their own value (which is applied when the engine has its service temperature). This is performed by weighting the adaptive factors as long as the lambda adaptation is disabled due to TCO C\_TCO\_MIN\_LAM\_AD (see: "application incidences"). The quotient of the additive relative factor is determined. The values MFF\_LAM\_ADD\_LAM\_AD\_OUT[i] and MFF\_SP[i] should be conditioned so, that FAC\_MFF\_ADD\_LAM\_AD\_OUT[i] does not exceed the physical range of +/-100 %! The relative lambda adaptation FAC\_MFF\_ADD\_FAC\_LAM\_AD[i] as long term adaptation is calculated out of both adaptation factors.

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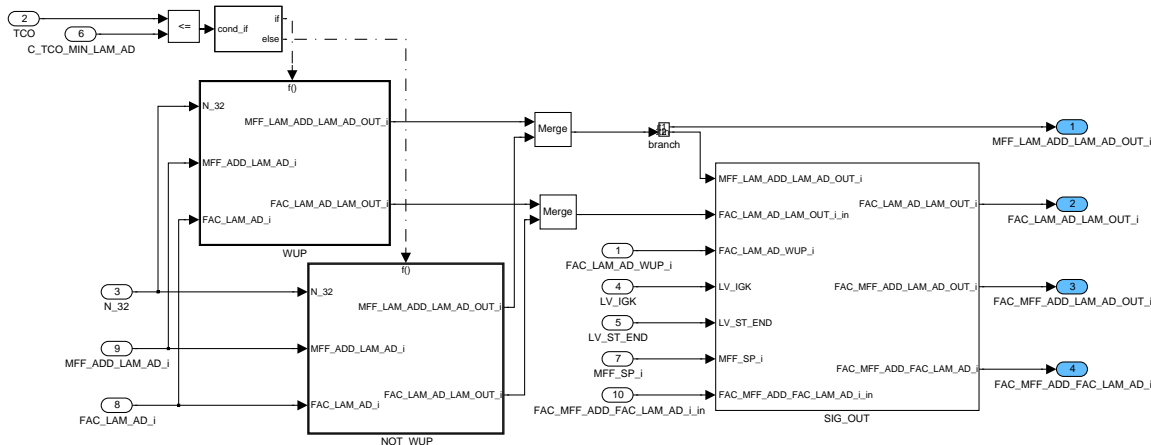


Figure 7.70.37: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/CLC\_CMN/CLC\_SIG\_OUT

**Apply Weighting Factors**

A factor depending on engine speed can be applied if the lambda adaptation correction must not be applied by 100% in the whole engine speed range.

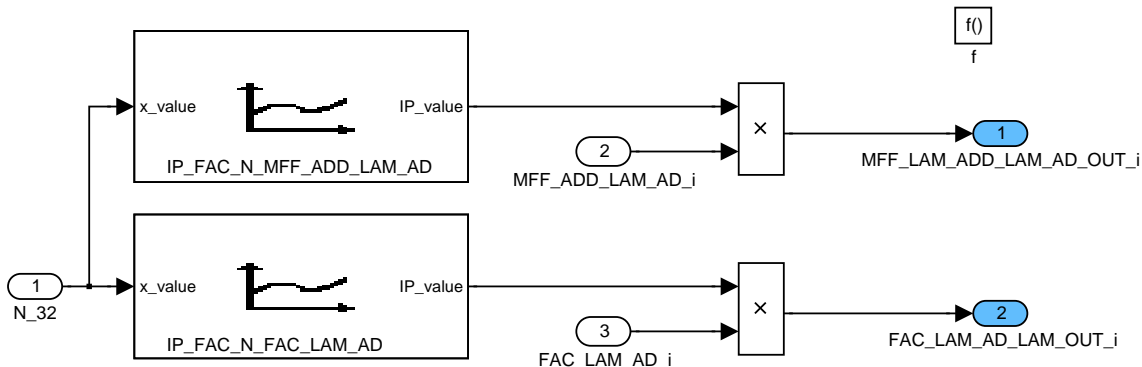


Figure 7.70.38: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/CLC\_CMN/CLC\_SIG\_OUT/NOT\_WUP

**Apply Weighting Factors during Warm Up Phase**

During warmup an additional factor depending on the lambda adaptation correction itself is applied.

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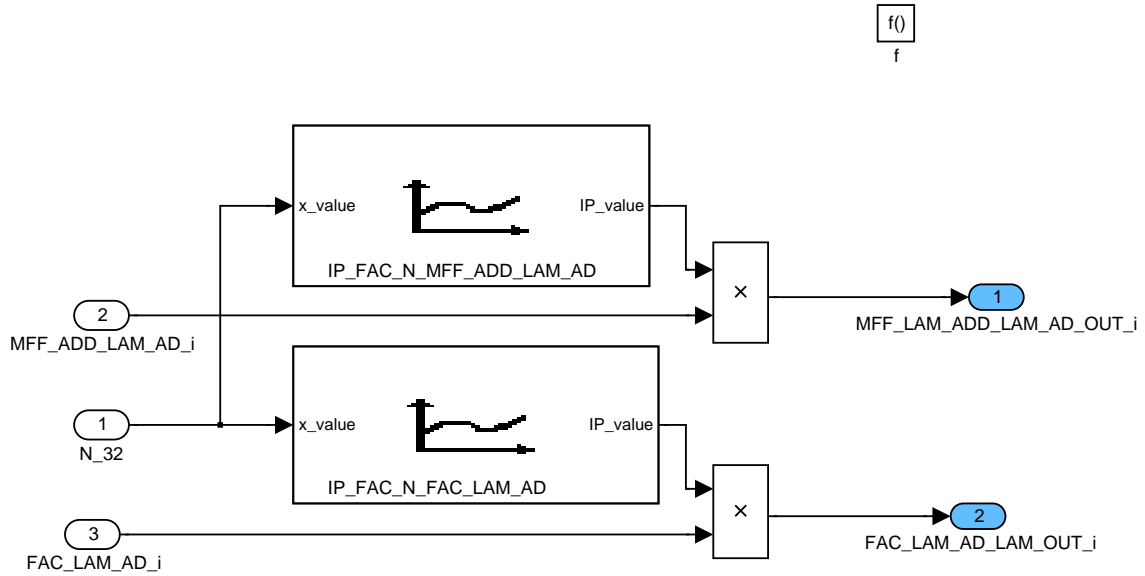


Figure 7.70.39:  
LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/CLC\_CMN/CLC\_SIG\_OUT/WUP

### Final Output

FAC\_MFF\_ADD\_LAM\_AD\_OUT[i] is the additive correction related to the fuel mass flow set point in order to have the same definition as for the multiplicative correction. When the engine is running this value is added to the multiplicative correction; so with the variable FAC\_MFF\_ADD\_FAC\_LAM\_AD[i] the whole lambda adaptation correction is expressed.

If the lambda adaptation in warmup phase (external module) is active the respective output of this function FAC\_LAM\_AD\_WUP[i] is not zero and added here to the over all lambda adaptation multiplicative correction.

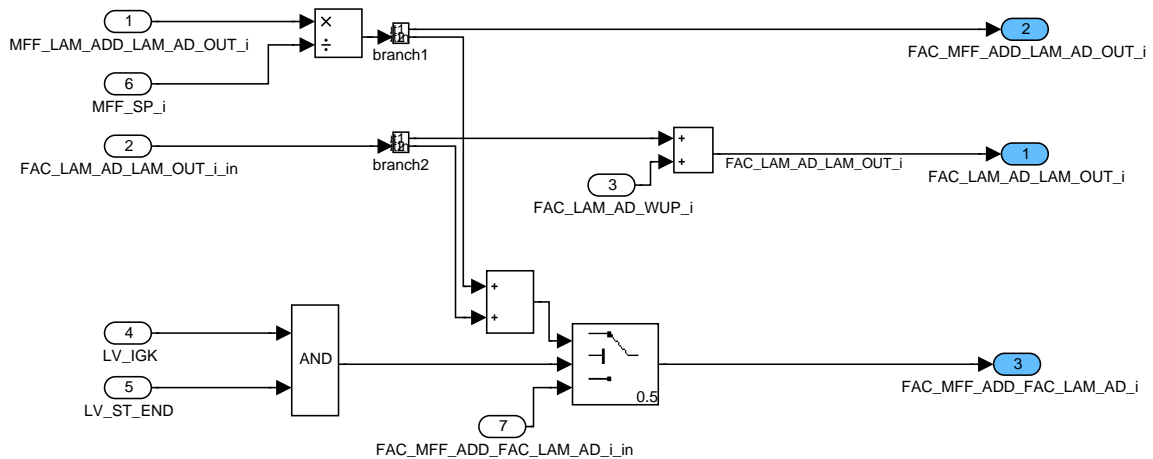



Figure 7.70.40:  
LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/CLC\_CMN/CLC\_SIG\_OUT/SIG\_OUT

### Interface to Lambda Controller

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### Interfacing Lambda Adaptation (this function)

A shift of the lambda controller output after the calculation of a valid adaptation value by FAC\_LAM\_ADJ\_LAM\_AD[i] is required in order to avoid rapid changes in the air fuel ratio caused by the lambda adaptation. FAC\_LAM\_ADJ\_LAM\_AD[i] is calculated in the states "ADAPT\_ADD", "ADAPT\_FAC\_L" and "ADAPT\_FAC\_H".

The shift of the lambda controller output is not carried out, if the lambda controller is stopped. To avoid a loss of adaptation values in that case, the lambda controller shall confirm the successful lambda controller shift.

If the lambda controller does not confirm the controller shift by FAC\_LAM\_ADJ\_LAM\_AD[i] by setting LV\_FAC\_LAM\_ADJ\_LAM\_AD\_END[i] to 1, the lambda adaptation stops further calculations (LV\_LAM\_AD\_STOP[i] is set to 1) until the controller shift is confirmed. FAC\_LAM\_ADJ\_LAM\_AD[i] shall be set to 0 and LV\_FAC\_LAM\_ADJ\_LAM\_AD[i] and LV\_LAM\_AD\_STOP[i] are reset, if at a stopped lambda adaptation the deactivating conditions are fulfilled.

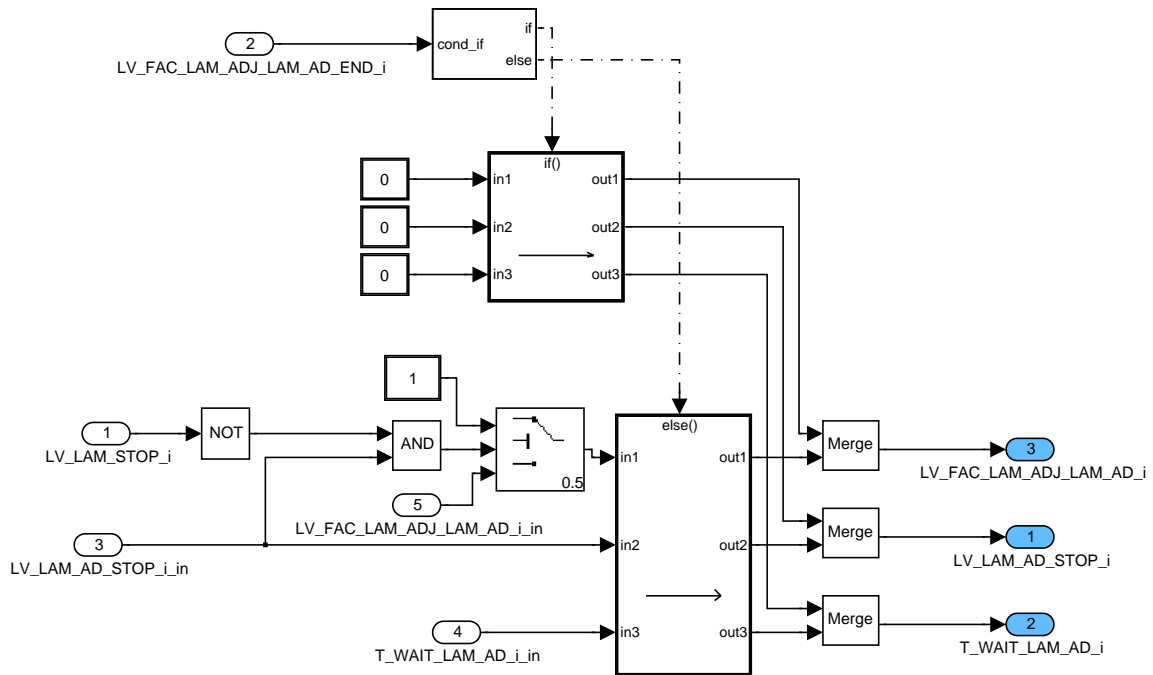


Figure 7.70.41: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/CLC\_CMN/LAM\_IF/LAM\_AD

### Interfacing Lambda Adaptation in Warm up phase (external module)

If TCO is below C\_TCO\_MIN\_LAM\_AD, any required shift by the warmup lambda adaptation is taken into account. Above this threshold lambda adaptation is active and any shift of this function is taken into account. As both adaptation function cannot be active at the same time the request flag LV\_FAC\_LAM\_ADJ\_LAM\_AD[i] is used for both.

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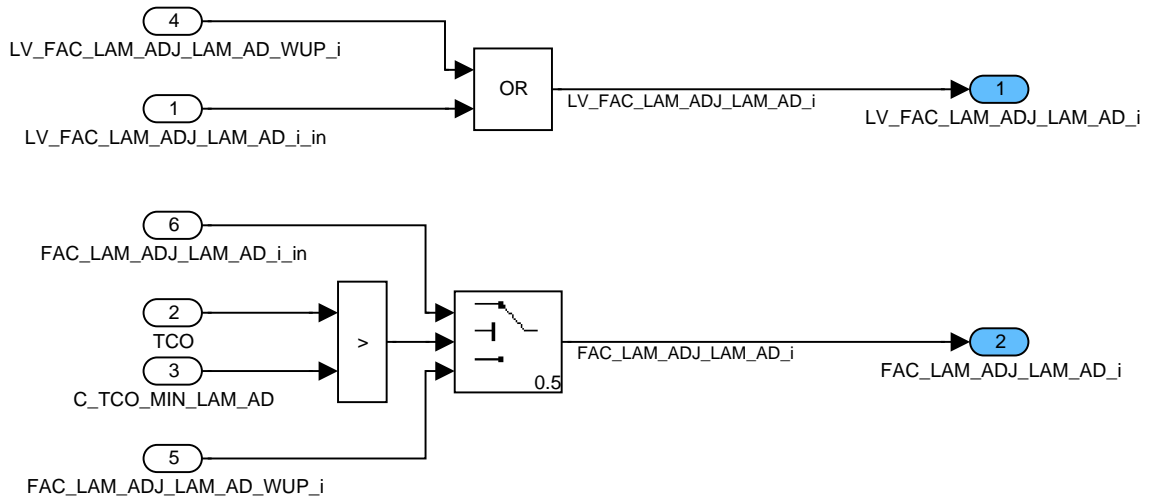


Figure 7.70.42:

LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/CLC\_CMN/LAM\_IF/LAM\_AD\_WUP

### Check of Requirements for Time Scheduler

In order to observe the priority of further lambda adaptations, the differences between the old and the new adapted factors are observed. According to the observed deviations the new maximum time for next adaptation is calculated regarding the present conditions.

The output value for the time scheduler T\_PRI\_TOT\_LAM\_AD is not bank selective and represents the minimum time of all cylinder banks. In case of single exhaust cylinder bank T\_PRI\_TOT\_LAM\_AD is equal to T\_PRI\_LAM\_AD[i] of this single bank.

If at least for one exhaust bank LV\_LAM\_AD\_STOP[i] is set then the auxiliary flag LV\_LAM\_AD\_STOP\_CBK\_EX is set to 1.

If the Lambda adaptation priority of any bank is below a limit (that means that the priority time is above a calibration threshold), the bank selective temporary Lambda adaptation end flag is set. When T\_PRI\_LAM\_AD[i] exceeds C\_T\_PRI\_MAX\_LAM\_AD the flag LV\_LAM\_AD\_END\_CBK[i] is set.

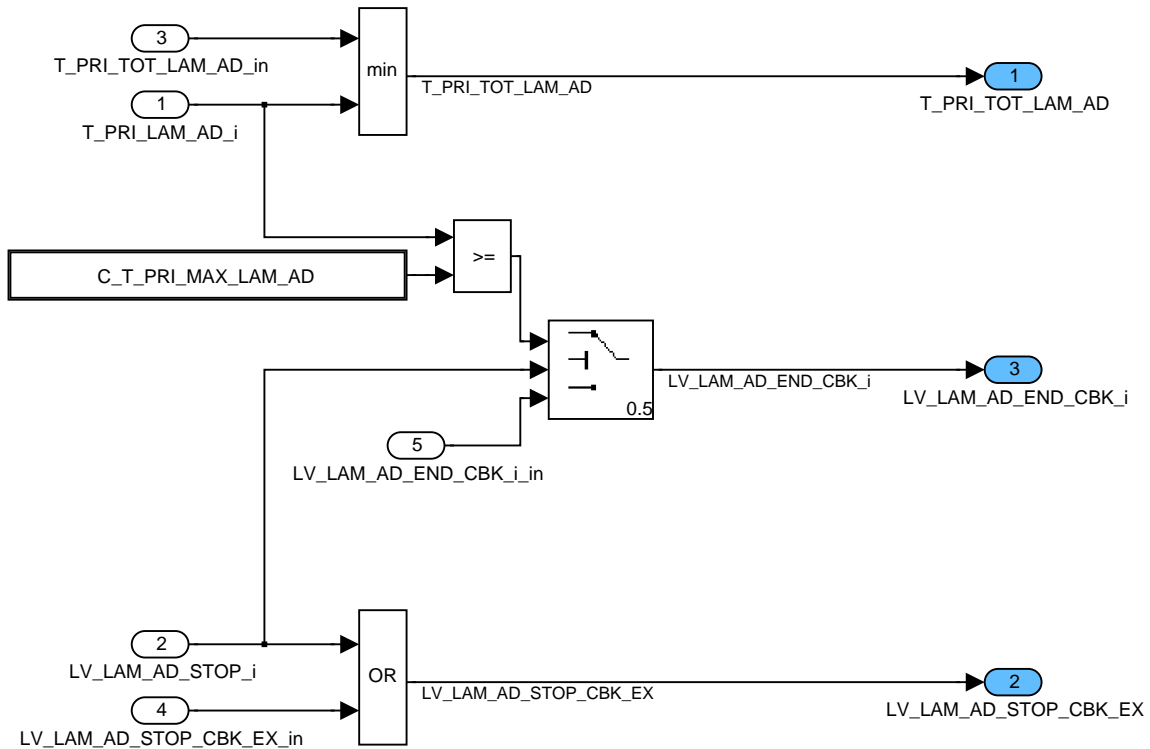


Figure 7.70.43: LACO\_ISPCLADA0/OPM\_20MS/CBK\_MNG/CBK\_FLP/CLC\_CMN/T\_PRI\_MNG

**Not exhaust bank specific calculations**

**Set Lambda Adaptation End Flag**

If the total lambda adaptation priority of both exhaust banks is below a limit (that means that the priority time is above a calibration threshold), the temporary lambda adaptation end flag is set. When T\_PRI\_TOT\_LAM\_AD exceeds C\_T\_PRI\_MAX\_LAM\_AD the flag LV\_LAM\_AD\_END is set.

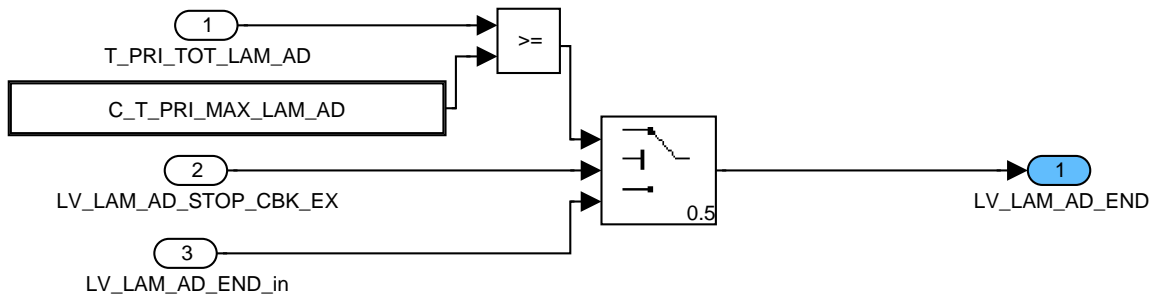


Figure 7.70.44: LACO\_ISPCLADA0/OPM\_20MS/NOT\_CBK\_SPC/SET\_LAM\_AD\_END

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## 7.71 Lambda adaptation in warm up phase

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRLC_FAC_LAM_TCO_X [NC_CBK_EX_NR]	V	0... 80H	0 ...1	0.0078125	-
correlation factor for updating FAC_LAM_TCO_X					
CTR_TCO_MIN_INTER [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
counter for detection of TCO_MIN_INTER_LAM_AD_WUP					
FAC_BEG_L_RNG_LAM_AD [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 49.9984741	0.00152588	%
Lambda adaptation value in low range after reset and after auto shift					
FAC_LAM_AD_WUP [NC_CBK_EX_NR]	O/V	8000... 7FFFH	0... 49.9984741	0.00152588	%
fuel mass set point factor of lambda adaptation in warm up phase					
FAC_LAM_AD_WUP_SHIFT [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 49.9984741	0.00152588	%
shift value of lambda adaptation in warm up phase after 1st learning					
FAC_LAM_ADD_CHG_FQ_DET [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 49.9984741	0.00152588	%
additive shift of adaptation values if change in fuel quality is detected					
FAC_LAM_ADJ_LAM_AD_WUP [NC_CBK_EX_NR]	O/V	8000... 7FFFH	0... 49.9984741	0.00152588	%
output value from lambda adaptation in warm up phase for the lambda controller shift					
FAC_LAM_DIF_LAM_AD_WUP_MV [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 49.9984741	0.00152588	%
average value of Lambda controller output for Lambda adaptation in warm up phase					
FAC_LAM_TCO_A [NC_CBK_EX_NR]	V/S	8000... 7FFFH	0... 49.9984741	0.00152588	%
Lambda controller output at C_TCO_A_LAM_AD_WUP					
FAC_LAM_TCO_B [NC_CBK_EX_NR]	V/S	8000... 7FFFH	0... 49.9984741	0.00152588	%
Lambda controller output at C_TCO_B_LAM_AD_WUP					
FAC_LAM_TCO_C [NC_CBK_EX_NR]	V/S	8000... 7FFFH	0... 49.9984741	0.00152588	%
Lambda controller output at C_TCO_C_LAM_AD_WUP					
FAC_LAM_TCO_D [NC_CBK_EX_NR]	V/S	8000... 7FFFH	0... 49.9984741	0.00152588	%
Lambda controller output at C_TCO_D_LAM_AD_WUP					
FAC_LAM_TCO_E [NC_CBK_EX_NR]	V/S	8000... 7FFFH	0... 49.9984741	0.00152588	%
Lambda controller output at C_TCO_E_LAM_AD_WUP					
FAC_LAM_TCO_MIN [NC_CBK_EX_NR]	V/S	8000... 7FFFH	0... 49.9984741	0.00152588	%
Lambda controller output at TCO_MIN_LAM_AD_WUP					
LV_CTR_MAX_TCO_MIN_INTER [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that counter based criteria for transient phase has expired					
LV_FAC_LAM_ADJ_LAM_AD_WUP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag to request lambda controller shift from Lambda adaptation in warm up phase					
LV_LAM_AD_WUP_CHG_FQ_DET [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that change in fuel quality was detected in this driving cycle					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAM_AD_WUP_STOP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
logical variable indicating need of Lambda controller shift to mirror shift in Lambda adaptation in warm up phase					
LV_LOAD_VLD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that conditions for valid learning are fulfilled					
LV_T_MAX_LAM_AD_WUP_TRA_PHA [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that time dependent criteria for transient phase has expired					
LV_TCO_A_LAM_AD_WUP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that Lambda adaptation value in warm up phase at C_TCO_A_LAM_AD_WUP was updated					
LV_TCO_B_LAM_AD_WUP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that Lambda adaptation value in warm up phase at C_TCO_B_LAM_AD_WUP was updated					
LV_TCO_C_LAM_AD_WUP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that Lambda adaptation value in warm up phase at C_TCO_C_LAM_AD_WUP was updated					
LV_TCO_D_LAM_AD_WUP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that Lambda adaptation value in warm up phase at C_TCO_D_LAM_AD_WUP was updated					
LV_TCO_E_LAM_AD_WUP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that Lambda adaptation value in warm up phase at C_TCO_E_LAM_AD_WUP was updated					
LV_TCO_MIN_INTER_LAM_AD_WUP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that learning conditions for Lambda adaptation value in warm up phase are fulfilled					
LV_TCO_MIN_LAM_AD_WUP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that Lambda adaptation value in warm up phase at TCO_MIN_LAM_AD_WUP was updated					
T_LAM_AD_WUP_LDC [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
timer to have valid limited dynamic phase for Lambda adaptation in warm up phase (partial load)					
T_LAM_AD_WUP_TRA_PHA [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
timer indicating transient phase of Lambda adaptation in warm up phase					
TCO_A_LAM_AD_WUP [NC_CBK_EX_NR]	V/S	0... FEH	0... 142.5	0.75	°C
actual coolant temperature in range around point A at which adaptation value was learnt					
TCO_B_LAM_AD_WUP [NC_CBK_EX_NR]	V/S	0... FEH	0... 142.5	0.75	°C
actual coolant temperature in range around point B at which adaptation value was learnt					
TCO_C_LAM_AD_WUP [NC_CBK_EX_NR]	V/S	0... FEH	0... 142.5	0.75	°C
actual coolant temperature in range around point C at which adaptation value was learnt					
TCO_D_LAM_AD_WUP [NC_CBK_EX_NR]	V/S	0... FEH	0... 142.5	0.75	°C
actual coolant temperature in range around point D at which adaptation value was learnt					
TCO_E_LAM_AD_WUP [NC_CBK_EX_NR]	V/S	0... FEH	0... 142.5	0.75	°C
actual coolant temperature in range around point E at which adaptation value was learnt					
TCO_MIN_INTER_LAM_AD_WUP [NC_CBK_EX_NR]	V	0... FEH	0... 142.5	0.75	°C
minimum TCO of current driving cycles where learning conditions for Lambda adaptation in warm up phase are fulfilled					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TCO_MIN_LAM_AD_WUP [NC_CBK_EX_NR]	V/S	0... FEH	0... 142.5	0.75	°C
minimum TCO of all driving cycles where learning conditions for Lambda adaptation in warm up phase (partial load) are fulfilled					

**Input data:**


FAC_DELTA_L_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	FAC_L_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	FAC_LAM_LIM [NC_CBK_EX_NR] {p. 2461}	LV_FAC_LAM_ADJ_LAM_AD_END [NC_CBK_EX_NR] {p. 2463}
LV_LAM_AD_DEAC_ERR [NC_CBK_EX_NR] {p. 2721}	LV_LAM_AD_WUP_ACT [NC_CBK_EX_NR] {p. 2721}	LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}
LV_LDC_LAM_AD [NC_CBK_EX_NR] {p. 2721}	MFF_ADD_LAM_AD [NC_CBK_EX_NR] {p. 2642}	MFF_SP [NC_CBK_EX_NR] {p. 2151}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	STATE_LS [NC_CBK_EX_NR] {p. 2448}	TCO {p. 1100}	TCO_ST {p. 1100}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FAC_DIF_LAM_AD_WUP_MV	-	0... 80H	0 ...1	0.0078125	-
correlation constant for calculation of the controller deviation in warm up phase					
C_CRLC_FAC_LAM_TCO_X	-	0... 80H	0 ...1	0.0078125	-
correlation constant for updating FAC_LAM_TCO_X					
C_CRLC_FAC_LAM_TCO_X_FIRST_DC	-	0... 80H	0 ...1	0.0078125	-
correlation constant for updating FAC_LAM_TCO_X in first driving cycle					
C_CRLC_GLOBAL_FAC_LAM_AD_WUP	-	0... 80H	0 ...1	0.0078125	-
correlation constant for calculation of adaptation value in warm up phase					
C_CTR_TCO_MIN_INTER	-	0... 1FFFH	0... 8191	1	-
counter threshold for detecting minimum temperature for valid learning of adaptation value in warm up phase for current driving cycle					
C_FAC_LAM_AD_WUP_DELTA	-	0... 7FFFH	0... 49.9984741	0.00152588	%
delta of applied adaptation value in warm up phase to ramp the signal to new value					
C_FAC_LAM_AD_WUP_MAX_INTER	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
maximum value for adaptation value in warm up phase while in transient phase before valid learning is possible					
C_FAC_LAM_AD_WUP_MAX_LSCL_OFF	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
maximum value for adaptation value in warm up phase while Lambda controller is off					
C_FAC_LAM_AD_WUP_MIN_GAP	-	0... 7FFFH	0... 49.9984741	0.00152588	%
minimum (absolute) gap between old and new adaptation value in warm up phase necessary to update adaptation values					
C_FAC_LAM_AD_WUP_MIN_INTER	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
minimum value for adaptation value in warm up phase while in transient phase before valid learning is possible					
C_FAC_LAM_AD_WUP_MIN_LSCL_OFF	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
minimum value for adaptation value in warm up phase while Lambda controller is off					
C_MFF_SP_TOL_LAM_AD_WUP	-	0... FFFFH	0... 1389	0.02119478	mg/stk
maximum fuel mass set point for lambda adaptation in warm up phase (partial speed)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_BOL_LAM_AD_WUP	-	0... FFH	0... 8160	32	rpm
minimum engine speed for lambda adaptation in warm up phase (partial load)					
C_N_TOL_LAM_AD_WUP	-	0... FFH	0... 8160	32	rpm
maximum engine speed for lambda adaptation in warm up phase (partial load)					
C_T_MAX_LAM_AD_WUP_LDC	-	0... FFFFH	0... 6553.5	0.1	s
threshold for elapsed time with limited dynamics for learning of adaptation value in warm up phase under load					
C_T_MAX_LAM_AD_WUP_TRA_PHA	-	0... FFFFH	0... 6553.5	0.1	s
threshold for timer indicating transient phase of Lambda adaptation in warm up phase					
C_TCO_A_LAM_AD_WUP	-	0... FEH	0... 142.5	0.75	°C
coolant temperature of point A for Lambda adaptation in warm up phase					
C_TCO_B_LAM_AD_WUP	-	0... FEH	0... 142.5	0.75	°C
coolant temperature of point B for Lambda adaptation in warm up phase					
C_TCO_C_LAM_AD_WUP	-	0... FEH	0... 142.5	0.75	°C
coolant temperature of point C for Lambda adaptation in warm up phase					
C_TCO_D_LAM_AD_WUP	-	0... FEH	0... 142.5	0.75	°C
coolant temperature of point D for Lambda adaptation in warm up phase					
C_TCO_E_LAM_AD_WUP	-	0... FEH	0... 142.5	0.75	°C
coolant temperature of point E for Lambda adaptation in warm up phase					
C_TCO_F_LAM_AD_WUP	-	0... FEH	0... 142.5	0.75	°C
coolant temperature of point F for Lambda adaptation in warm up phase					
C_TCO_LAM_AD_WUP_RNG	-	0... FE00H	0... 190.5	0.00292969	°C
temperature window for learning of adaptations value in warm up phase					
C_TCO_RNG_WR_DOWN_LAM_AD_WUP	-	0... FE00H	0... 190.5	0.00292969	°C
temperature window in which first learnt adaptation value can be written down to next lower point					
C_THD_DIF_L_RNG_LAM_AD	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
threshold value of change in low range adaptation factor to force auto shift					
C_THD_FAC_DELTA_L_RNG	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
threshold of lambda adaptation difference in low range to allow auto shift					
ID_FAC_THD_CHG_FQ_DET	-	0... FFFFH	0... 49.9984741	0.00152588	%
LDPM_TCO_3_LACO	6	0... FEH	0... 142.5	0.75	°C
threshold of difference in Lambda adaptation to detect change in fuel quality during warm up phase					
ID_MFF_SP_BOL_LAM_AD_WUP	-	0... FFFFH	0... 1389	0.02119478	mg/stk
LDP_N_32_ID_MFF_BOL_LAM_AD_WUP	4	0... FFH	0... 8160	32	rpm
minimum fuel mass set point for lambda adaptation in warm up phase (partial load)					
IP_FAC_CHG_FQ_DET_SCA	-	0... 80H	0 ...1	0.0078125	-
LDPM_TCO_3_LACO	6	0... FEH	0... 142.5	0.75	°C
scaling factor to shift adaptation values in warm up phase after detection of change in fuel quality					
IP_FAC_LAM_AD_WUP_MAX	-	0... FFFFH	0... 49.9984741	0.00152588	%
LDPM_TCO_3_LACO	6	0... FEH	0... 142.5	0.75	°C
maximum value for adaptation value in warm up phase					
IP_FAC_LAM_AD_WUP_MIN	-	0... FFFFH	0... 49.9984741	0.00152588	%
LDPM_TCO_3_LACO	6	0... FEH	0... 142.5	0.75	°C
minimum value for adaptation value in warm up phase					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_FAC_RAW_LAM_AD_WUP_LIM_ACT	-	0... 1H	0 ...1	1	-
logical calibration to force FAC_LAM_AD_WUP to FAC_LAM_TCO_MIN at temperature below TCO_MIN					
LC_FAC_WR_DOWN_LAM_AD_WUP	-	0... 1H	0 ...1	1	-
First learnt adaptation values shall be written down to next lower interpolation					
LC_LAM_AD_WUP_CLR_INH	-	0... 1H	0 ...1	1	-
Inhibit initialization of NVMY data (for application purposes only)					
LC_LAM_AD_WUP_SHIFT_ACT	-	0... 1H	0 ...1	1	-
logical calibration to enable auto shift in Lambda adaptation in warm up phase in all driving cycles					

### 7.71.1 LACO\_ISPCLADAW0

The Lambda adaptation in warmup phase enhances the Lambda adaptation functionality to obtain a more precise correction at low temperatures (< 50°C). The adaptive correction is applied to compensate serial production tolerances of components at low.

TCO dependent correction factors (%/°C) are learned in five temperature ranges. The correction factors are derived from the Lambda controller output. They are learned in an adaptation field specified by MFF\_SP[i] and N\_32. They are, however, to correct the injection time for all engine states. Learning of these factors requires that the Lambda controller is in the state 'ON'.

The recurrence time is defined by T\_SAMPLE in [ms].

NC\_CBK\_EX\_NR defines the number of exhaust banks. For vector elements the variable extension "\_i" is used in the model instead of "[i]" as found in the textual description.

#### Application Condition

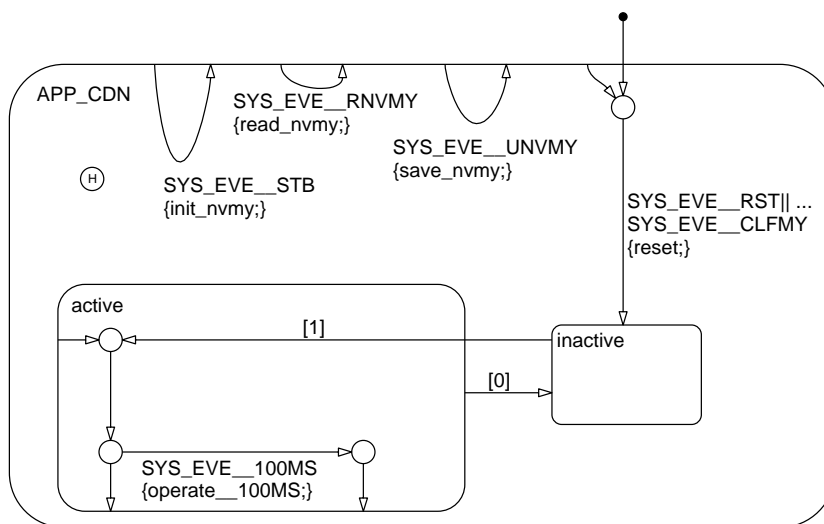


Figure 7.71.1: LACO\_ISPCLADAW0/APP\_CDN/Chart

#### Function Description

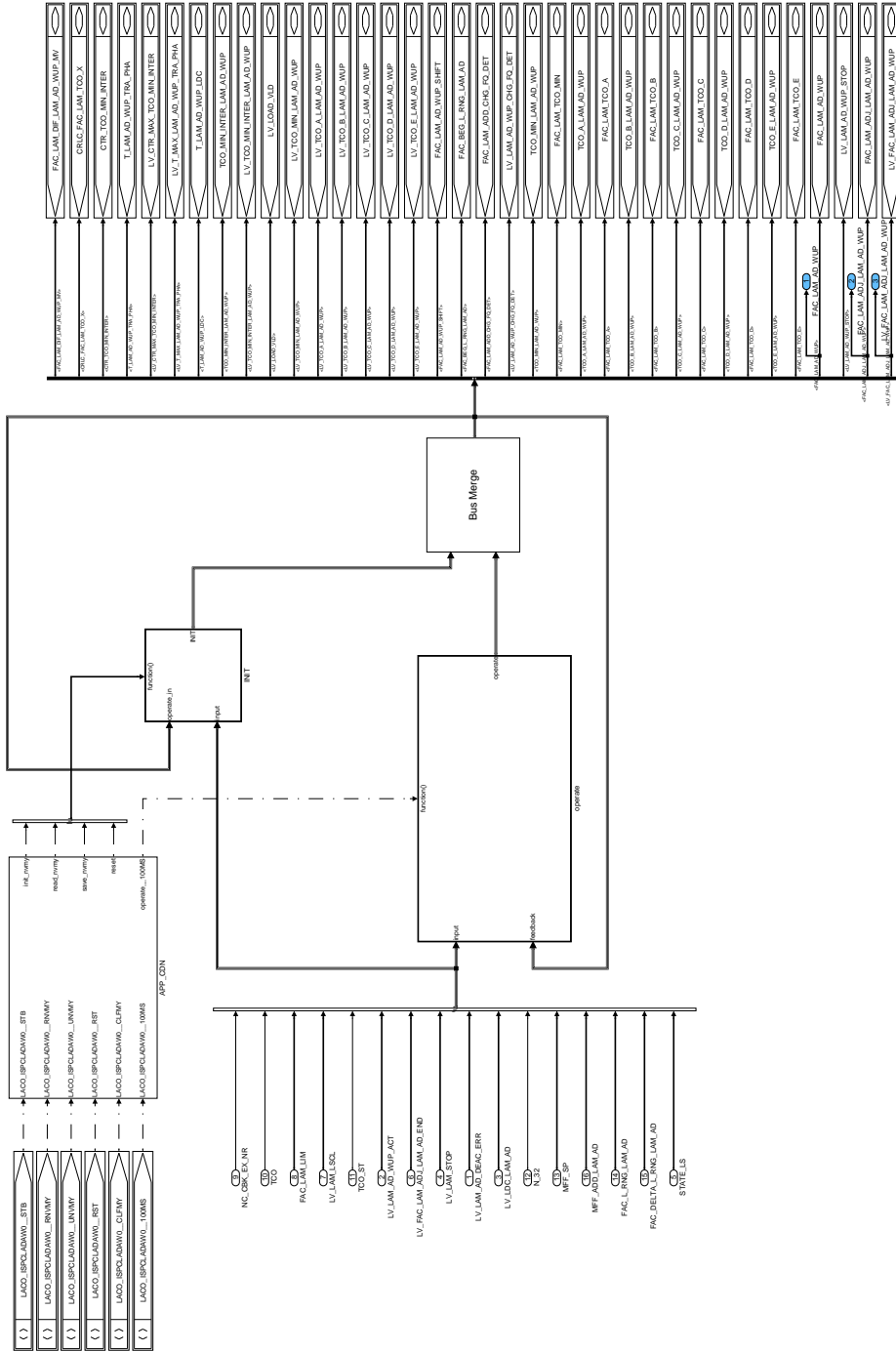



Figure 7.71.2: LACO\_ISPCLADAW0

7.71.1.1 SUBFUNCTION: operate

Calculation of the uncorrected Lambda controller output

To obtain the actual load on the Lambda controller, the controller output without adaptation is calculated. This is the sum of FAC\_LAM\_LIM[i] and applied adaptive correction in the warmup phase. The actual load is then filtered to have a smoother signal. In case of a not yet activated Lambda controller the value

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is set to zero. This is necessary in order to facilitate the detection of end of the transient phase after the start of the Lambda controller.

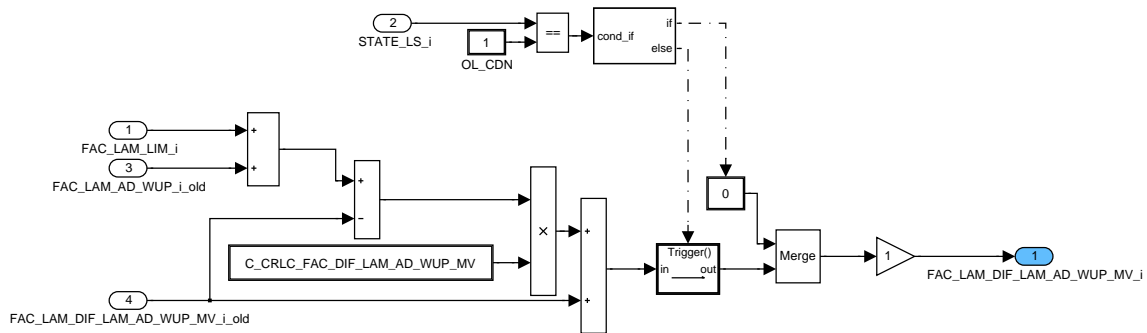


Figure 7.71.3: LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/  
FAC\_LAM\_AD\_WUP\_CBK\_SPC/FAC\_LAM\_DIF\_LAM\_AD\_WUP\_MV

### Correlation constant for updating of adaptation factors

In the update process of the adaptation factor a correlation constant is taken into account. Typically this value will be less than one to reduce the impact of outlier.

In case of a brand new ECU the cold adaptation values need to be shifted, if they are learned before the warm adaptation values are learned. The shift value amounts to the adaptation factor in the low range area. During this shift process no correlation constant is considered. Hence, in case of a brand new ECU the correlation constant is set to 1. Otherwise the auto shift value will not correspond to the corresponding value learned in the cold adaptation.

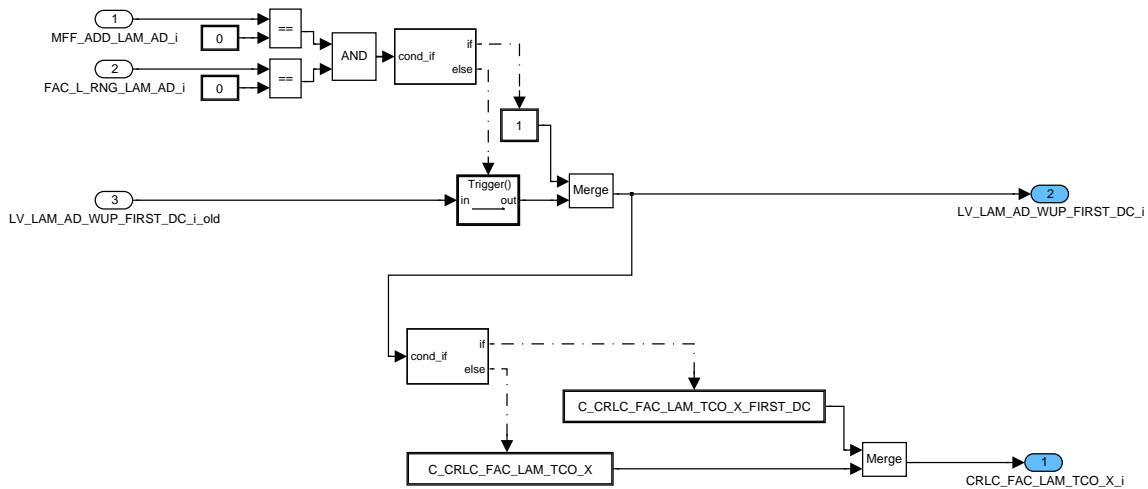


Figure 7.71.4: LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/  
FAC\_LAM\_AD\_WUP\_CBK\_SPC/CLC\_CRCLC\_LAM\_TCO\_X

### Determination of valid partial load phase

To enable learning of the adaptation factor the conditions for valid learning have been fulfilled for at least the calibratable time C\_T\_MAX\_LAM\_AD\_WUP\_LDC.

The conditions are:

Limited dynamics of the Lambda adaptation are fulfilled.

Lambda controller is active.

Lambda controller is not in the stop mode.

$N_{32}$  is below a threshold, but above another threshold.

-  $MFF\_SP[i]$  is below a threshold, but above another threshold.

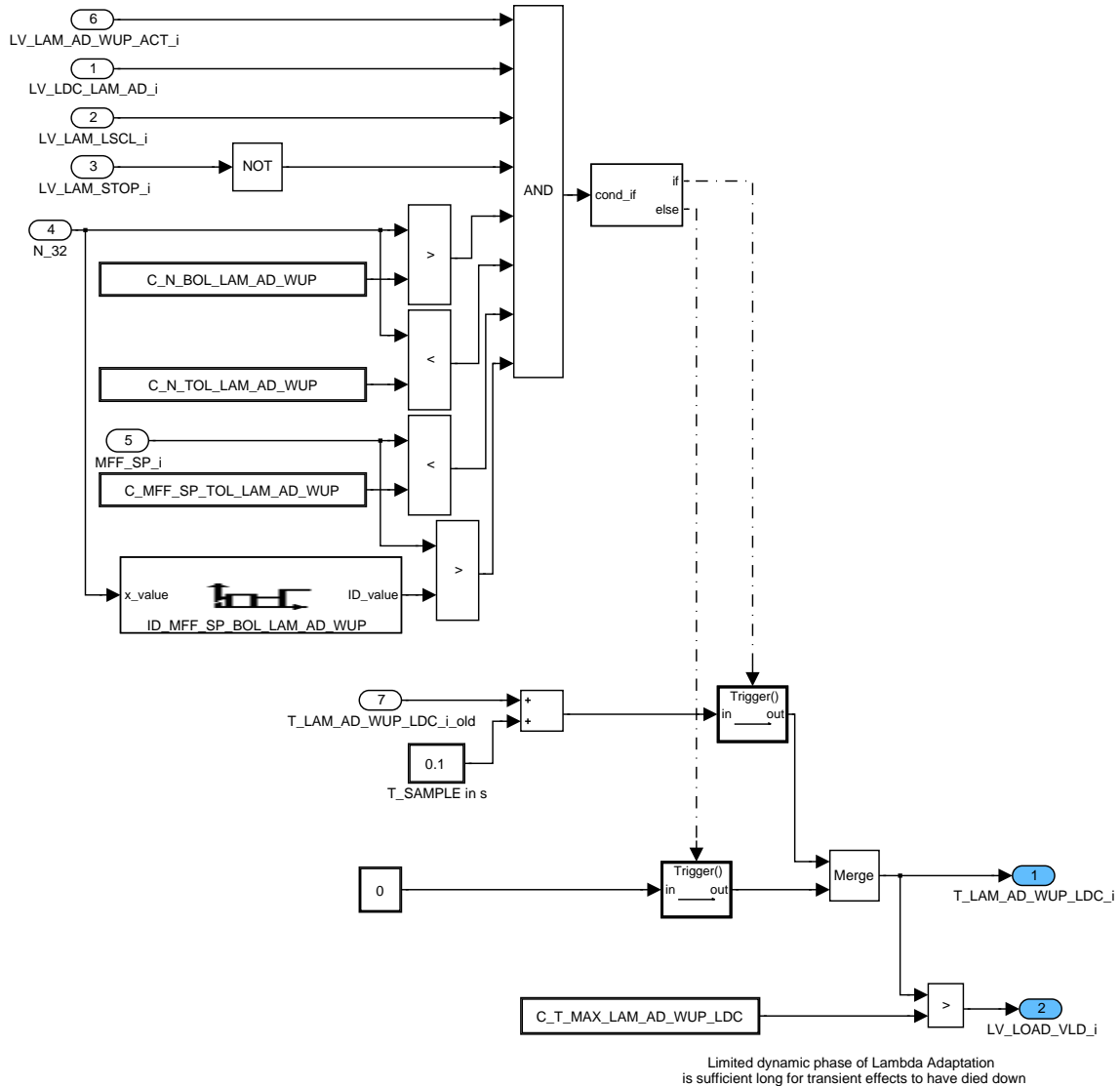


Figure 7.71.5: LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/  
FAC\_LAM\_AD\_WUP\_CBK\_SPC/TCO\_MIN\_INTER\_LAM\_AD\_WUP/CLC\_T\_LAM\_AD\_WUP\_LDC

### Determination of minimum temperature valid for learning in current driving cycle

To enable learning in the current driving cycle for the first time the following conditions must be satisfied:

The counter as well as the timer criteria are fulfilled, thus is transient phase is over.

The global activation conditions are fulfilled.

Limited dynamics are given, the Lambda controller is in state on and engine operating point is within the required mass air flow and speed range (see also definition of  $LV\_LOAD\_VLD[i]$ ).








## Detection of change in fuel quality

In each driving cycle it is checked whether the fuel quality has changed to the worse. This check is done once per driving cycle at the time when the conditions for learning are fulfilled for the first time. A change of fuel quality is detected if the uncorrected Lambda controller output has shifted by at least a calibratable threshold towards lean. The threshold is specified in a map with TCO as an input. This allows taking into account the TCO dependent deterioration effect of poor fuel quality.

Once fuel of low quality is detected, a flag indicating that detection was done in the current driving cycle is set to one. Furthermore, the difference in the uncorrected Lambda controller output (which led to this detection) is normalized. The normalization is done using a TCO dependent map. The same map is used later on to shift all adaptation values. Therefore, the map has to represent the qualitative course of the additional enrichment demand caused by the poor fuel quality.

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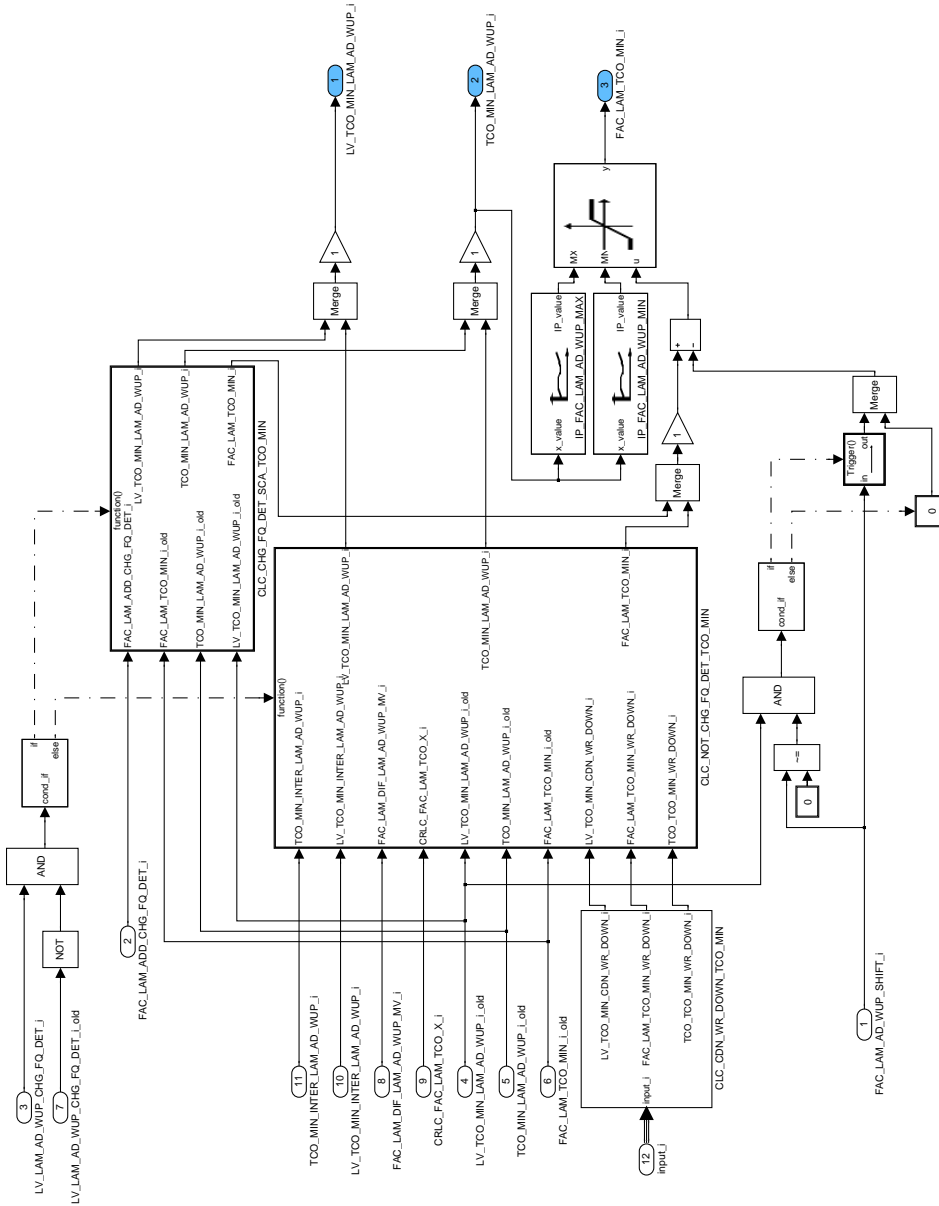


Figure 7.71.10: LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/FAC\_LAM\_AD\_WUP\_CBK\_SPC/TCO\_MIN\_LAM\_AD\_WUP

**Determination of adaptation value during detection of change in fuel quality**

First it is checked whether the adaptation factor is different from zero to confirm, that it has been updated at some point in the past. If this is not the case no shift is realized at this particular interpolation point. For shifting the normalized shift value is multiplied by a TCO dependent weighting factor and then added to the old adaptation factor. The weighting factor takes into account that the negative effects of the low quality fuel disappear with rising temperature. Hence, the weighting factor should be around 1 for the lowest interpolation point and at around zero for the highest temperature.

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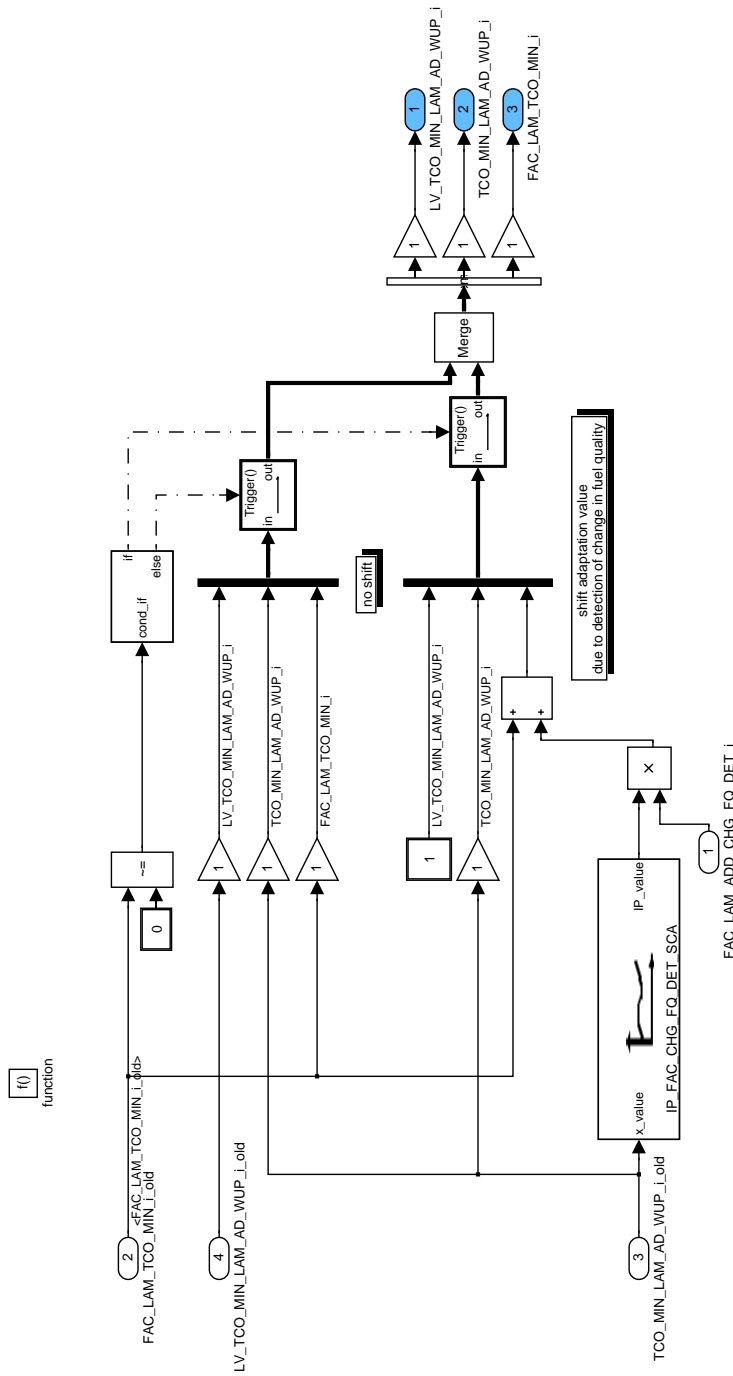


Figure 7.71.11: LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/  
 FAC\_LAM\_AD\_WUP\_CBK\_SPC/TCO\_MIN\_LAM\_AD\_WUP/CLC\_CHG\_FQ\_DET\_SCA\_TCO\_MIN

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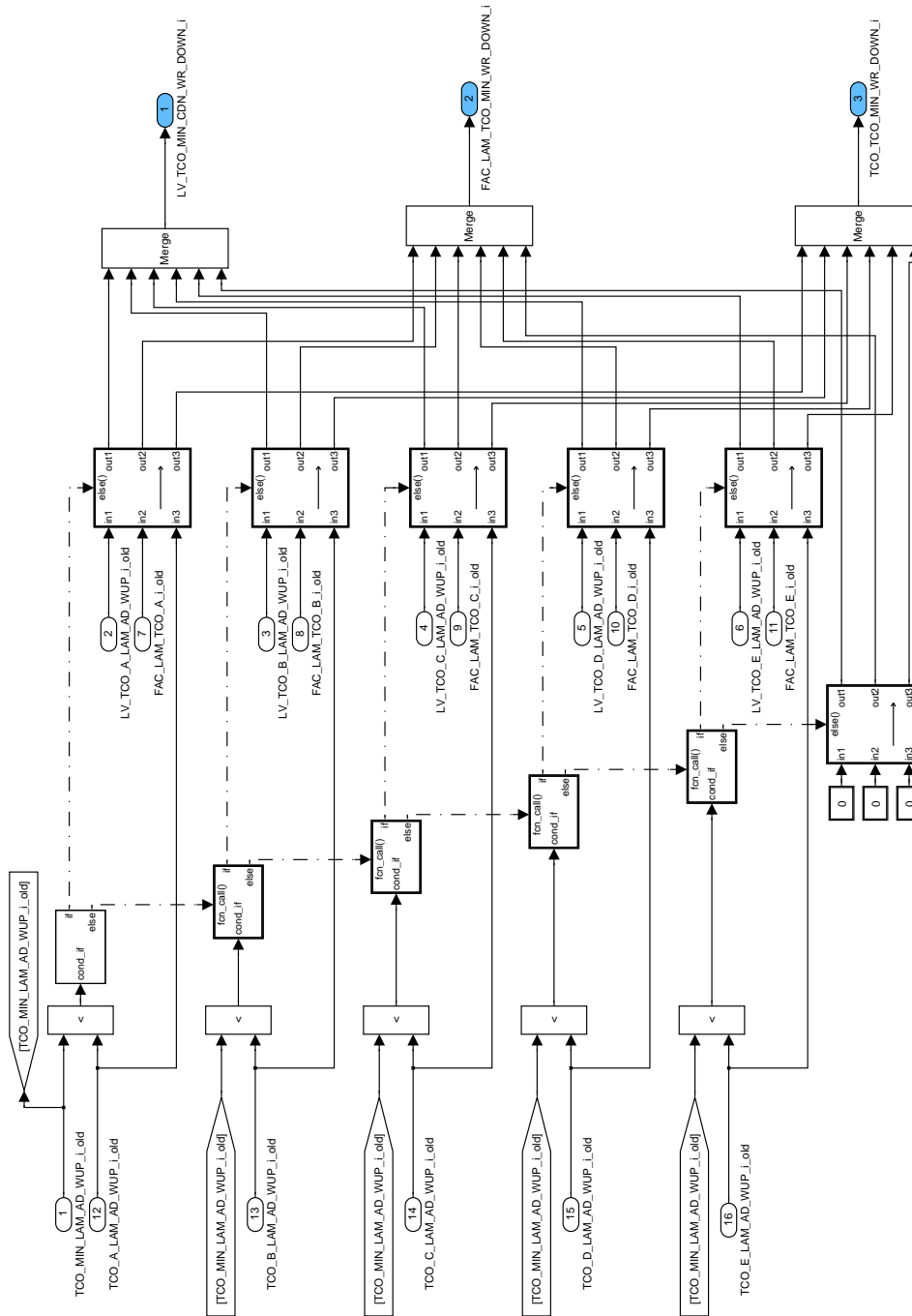



Figure 7.71.12: LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/  
FAC\_LAM\_AD\_WUP\_CBK\_SPC/TCO\_MIN\_LAM\_AD\_WUP/CLC\_CDN\_WR\_DOWN\_TCO\_MIN/CLC

**Determination of minimum temperature valid for learning of all driving cycles**

TCO\_MIN is updated with TCO\_MIN\_INTER if the value for the current driving cycle (TCO\_MIN\_INTER) is smaller than the previously stored value of TCO\_MIN. During update the correlation constant is considered.

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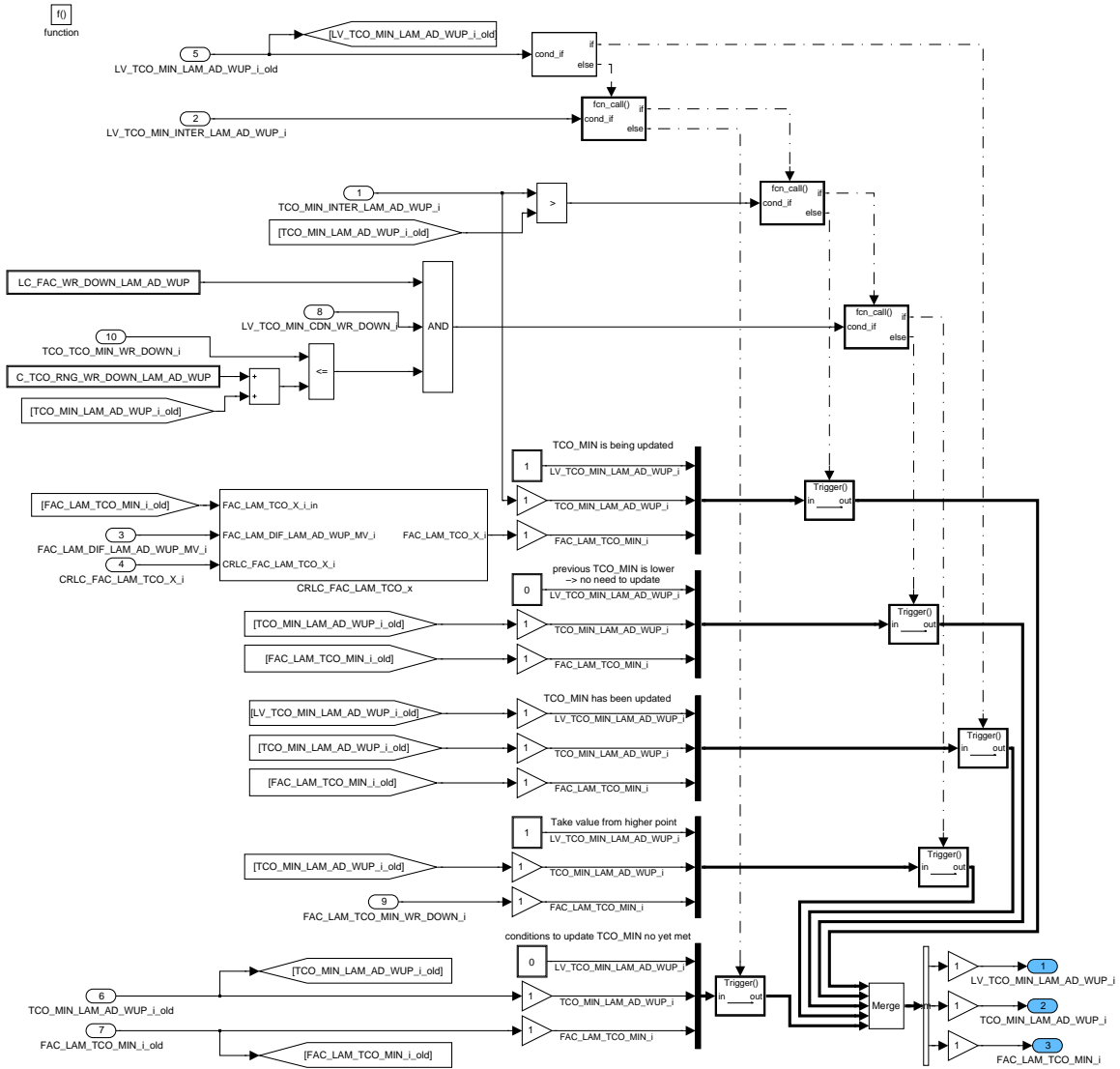


Figure 7.71.13: LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/FAC\_LAM\_AD\_WUP\_CBK\_SPC/TCO\_MIN\_LAM\_AD\_WUP/CLC\_NOT\_CHG\_FQ\_DET\_TCO\_MIN

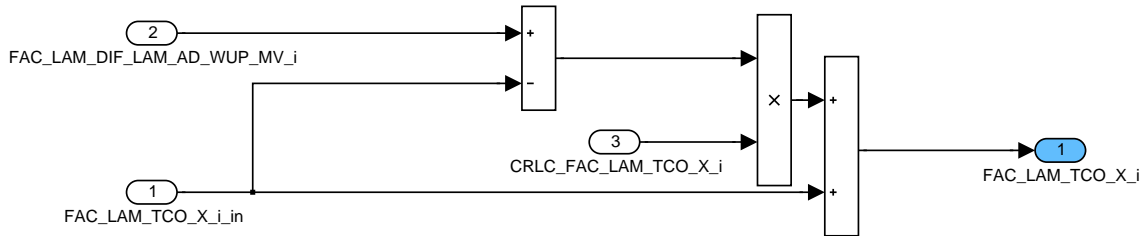



Figure 7.71.14: LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/FAC\_LAM\_AD\_WUP\_CBK\_SPC/TCO\_MIN\_LAM\_AD\_WUP/CLC\_NOT\_CHG\_FQ\_DET\_TCO\_MIN/CRLC\_FAC\_LAM\_TCO\_x

**Determination of new adaptation value at point A to E**

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If a change in fuel quality is detected the normal update process of the adaptation factor is inhibited. The auto shift value is always zero with the exception of the calculation recurrence during which the shift is executed. Furthermore, if the adaptation factor was not updated in this driving cycle (LV\_TCO\_X\_LAM\_AD\_WUP[i]), then the auto shift correction is not applied.

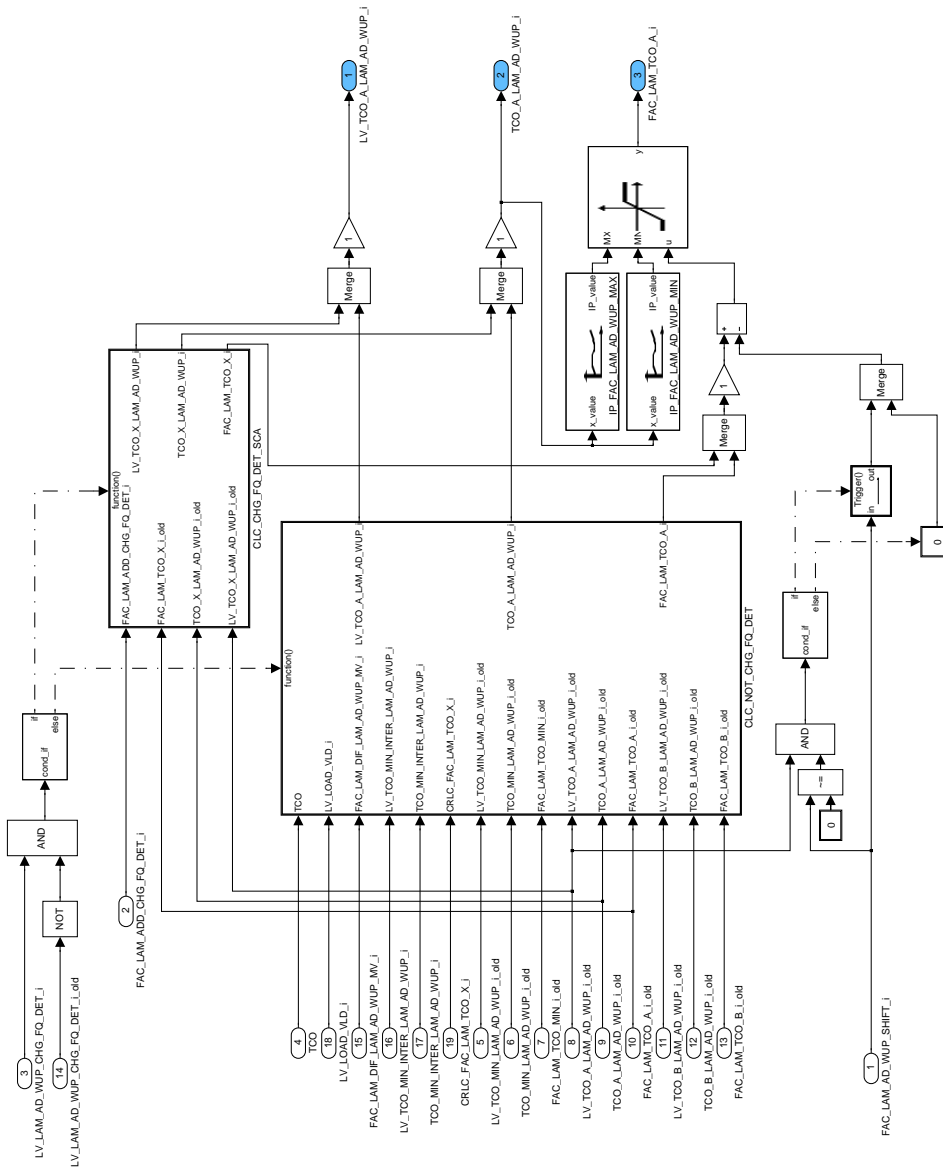


Figure 7.71.15: LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/FAC\_LAM\_AD\_WUP\_CBK\_SPC/TCO\_LAM\_AD\_WUP/CLC\_FAC\_LAM\_TCO\_A

**Determination of adaptation value during detection of change in fuel quality**

First it is checked whether the adaptation factor is different from zero to confirm, that it has been updated at some point in the past. If this is not the case no shift is realized at this particular interpolation point. For shifting the normalized shift value is multiplied by a TCO dependent weighting factor and then added to the old adaptation factor. The weighting factor takes into account that the negative effects of the low quality fuel disappear with rising temperature. Hence, the weighting factor should be around 1 for the lowest interpolation point and at around zero for the highest temperature.

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2.) The adaptation factor the corresponding temperature are updated once the following conditions are met:

TCO is within the temperature window

End of transient phase has been detected, thus TCO\_MIN\_INTER[i] is set

The conditions for valid learning are fulfilled sufficiently long (LV\_LOAD\_VLD[i])


The difference to the previously stored value is sufficiently large

If all above conditions are met, the adaptation factor is updated with the uncorrected Lambda controller output (in this process a correlation factor is considered) and the corresponding temperature is updated with the current TCO. Additionally the indicator flag is set to one.

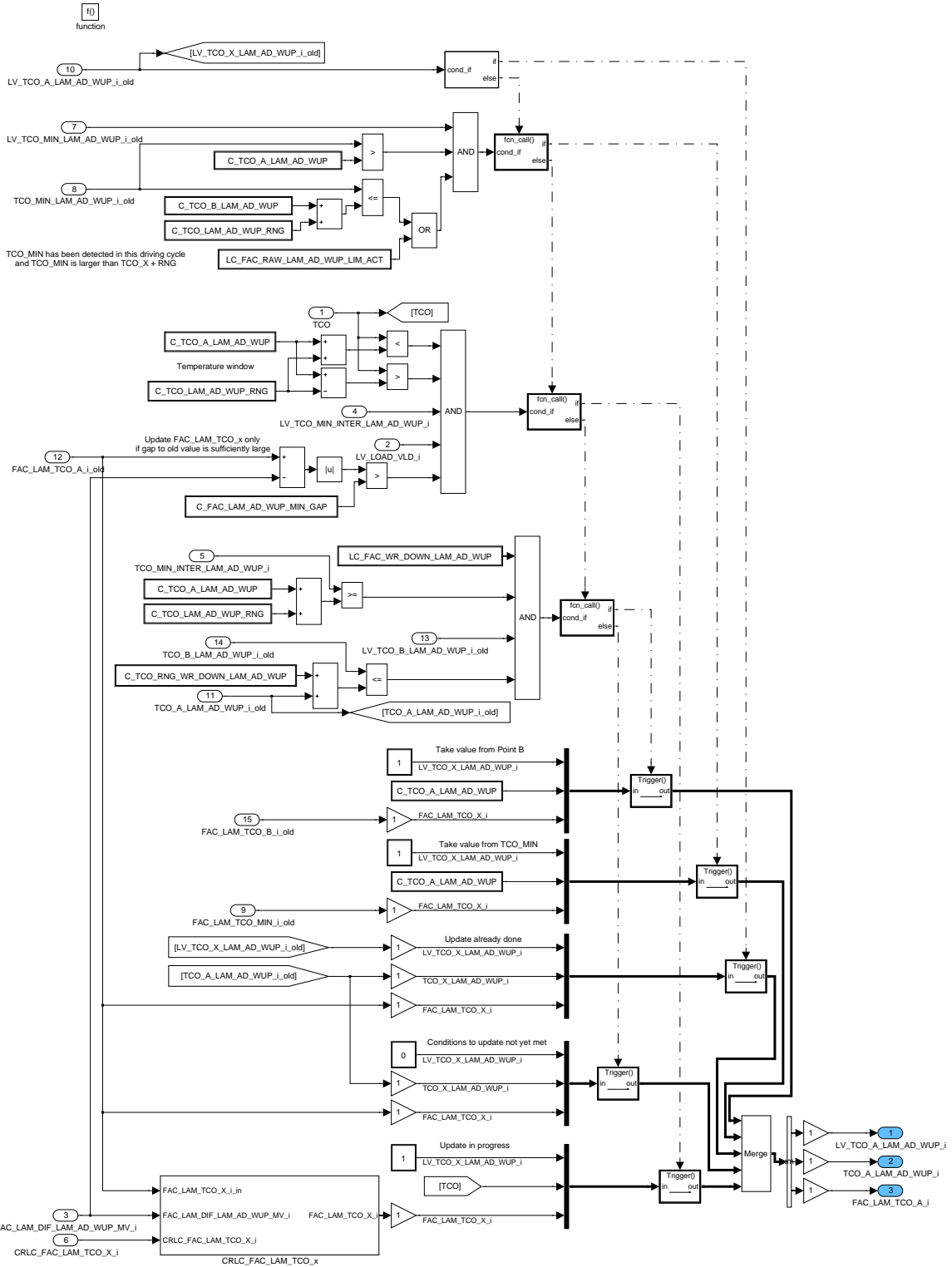
3.) If TCO\_MIN[i] is updated (the lowest ever learnt temperature is reduced) and it is larger than the temperature of the interpolation point, then the adaptation value is updated with factor belonging to TCO\_MIN[i]. The corresponding temperature is not updated in this state. This update procedure can be restricted in such that TCO\_MIN[i] needs to be within temperature of point of A and point B plus size of the temperature window.

4.) Update was already done in this driving cycle: No actions are undertaken.

The calculation at point B to E proceed analogous. At interpolation point F the correction factor is fixed at zero, in order to fade out the correction smoothly.

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Figure 7.71.17:  
 LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/FAC\_LAM\_AD\_WUP\_CBK\_SPC/  
 TCO\_LAM\_AD\_WUP/CLC\_FAC\_LAM\_TCO\_A/CLC\_NOT\_CHG\_FQ\_DET

**Determination of new adaptation value at point B**

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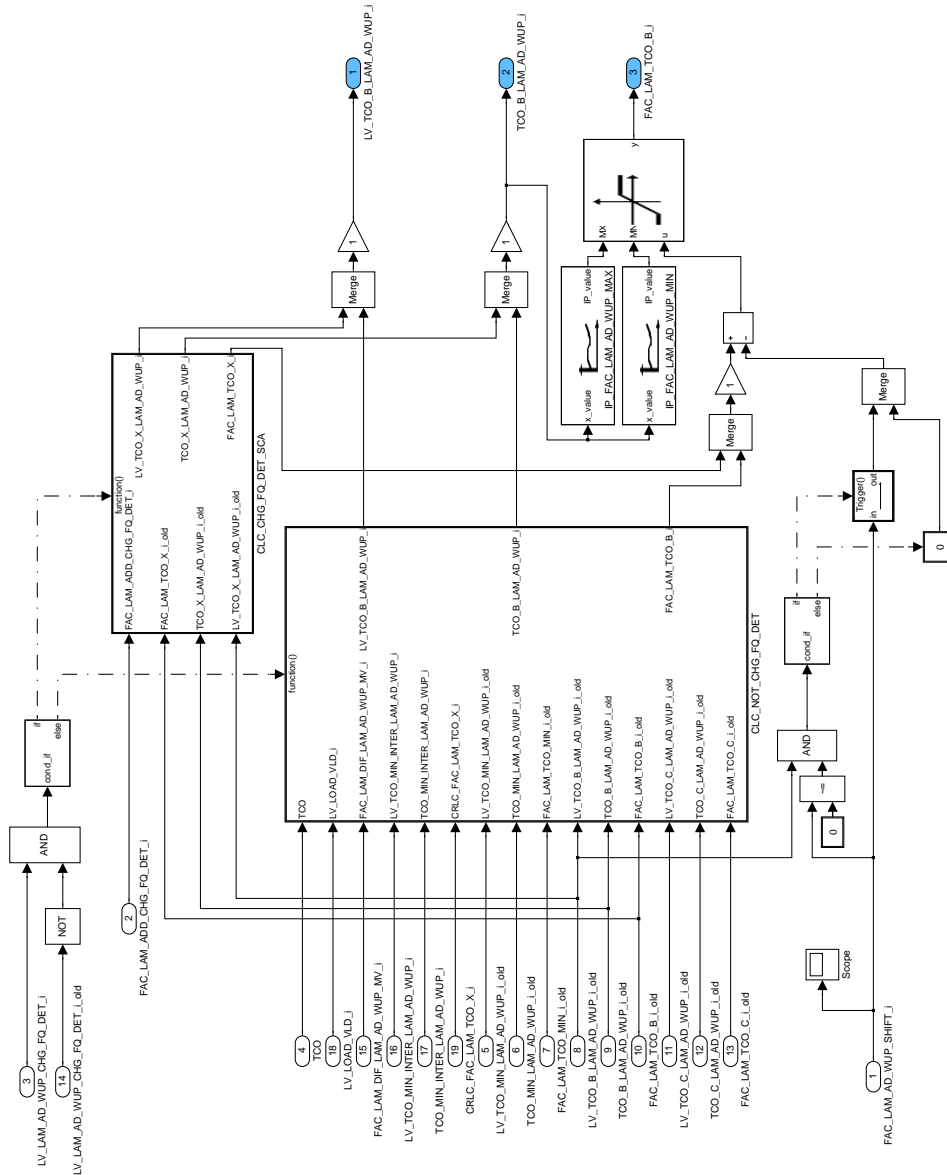


Figure 7.71.18: LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/FAC\_LAM\_AD\_WUP\_CBK\_SPC/TCO\_LAM\_AD\_WUP/CLC\_FAC\_LAM\_TCO\_B

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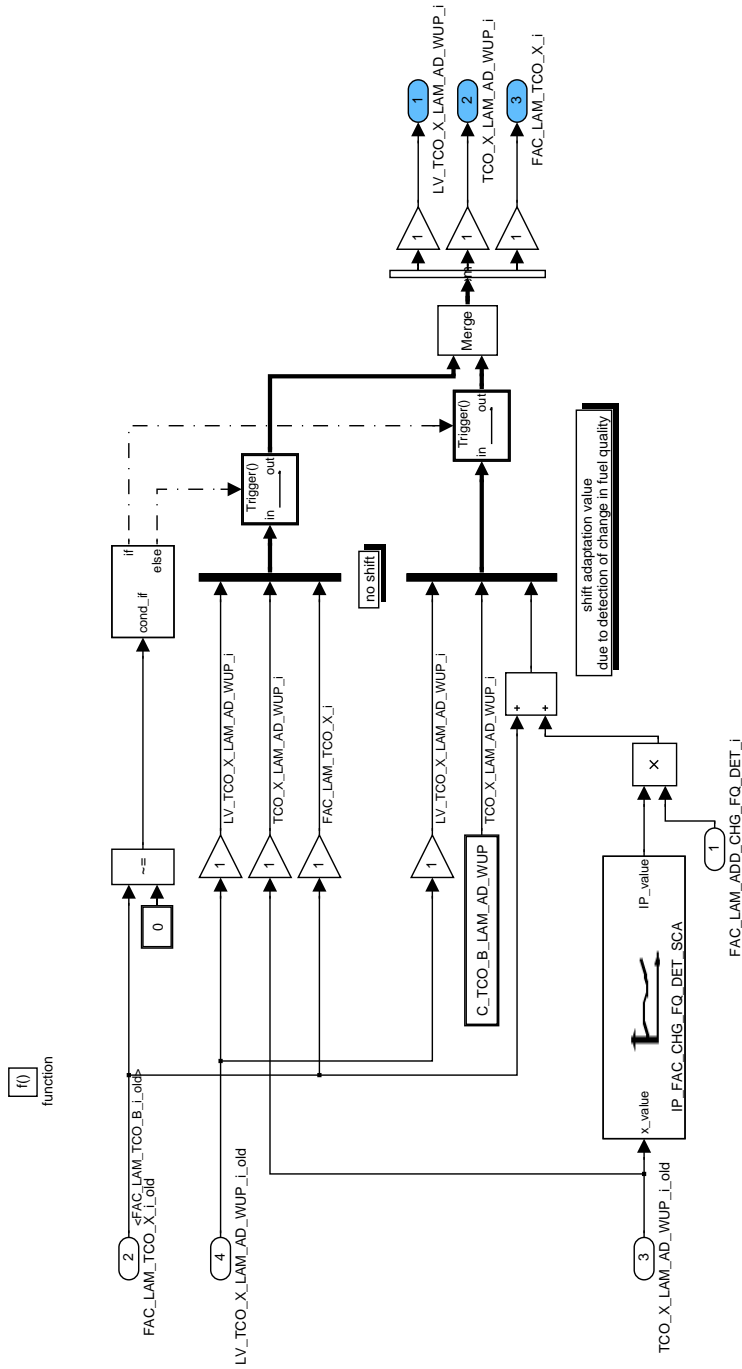
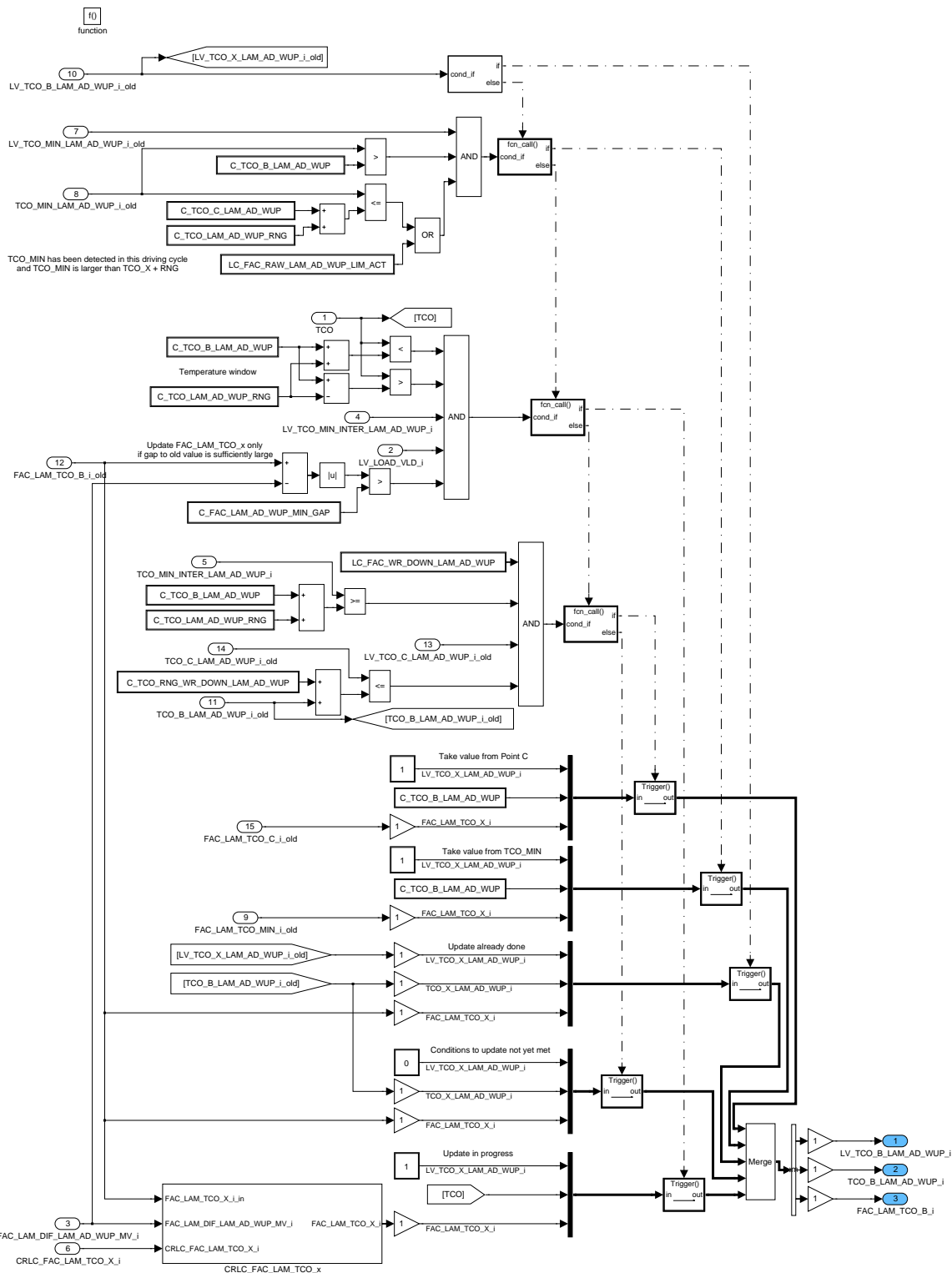


Figure 7.71.19:  
 LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/FAC\_LAM\_AD\_WUP\_CBK\_SPC/  
 TCO\_LAM\_AD\_WUP/CLC\_FAC\_LAM\_TCO\_B/CLC\_CHG\_FQ\_DET\_SCA


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Figure 7.71.20:  
 LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/FAC\_LAM\_AD\_WUP\_CBK\_SPC/  
 TCO\_LAM\_AD\_WUP/CLC\_FAC\_LAM\_TCO\_B/CLC\_NOT\_CHG\_FQ\_DET

**Determination of new adaptation value at point C**

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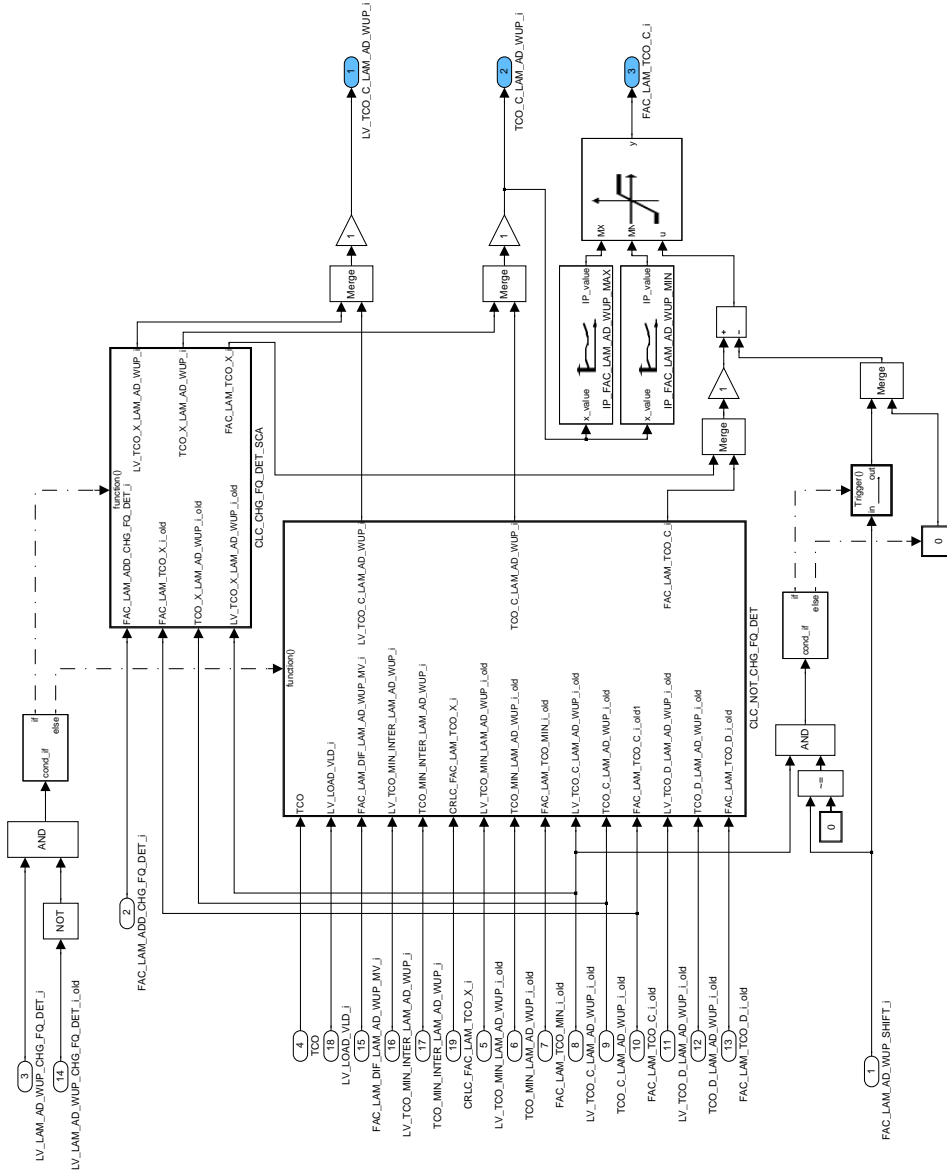



Figure 7.71.21: LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/FAC\_LAM\_AD\_WUP\_CBK\_SPC/TCO\_LAM\_AD\_WUP/CLC\_FAC\_LAM\_TCO\_C

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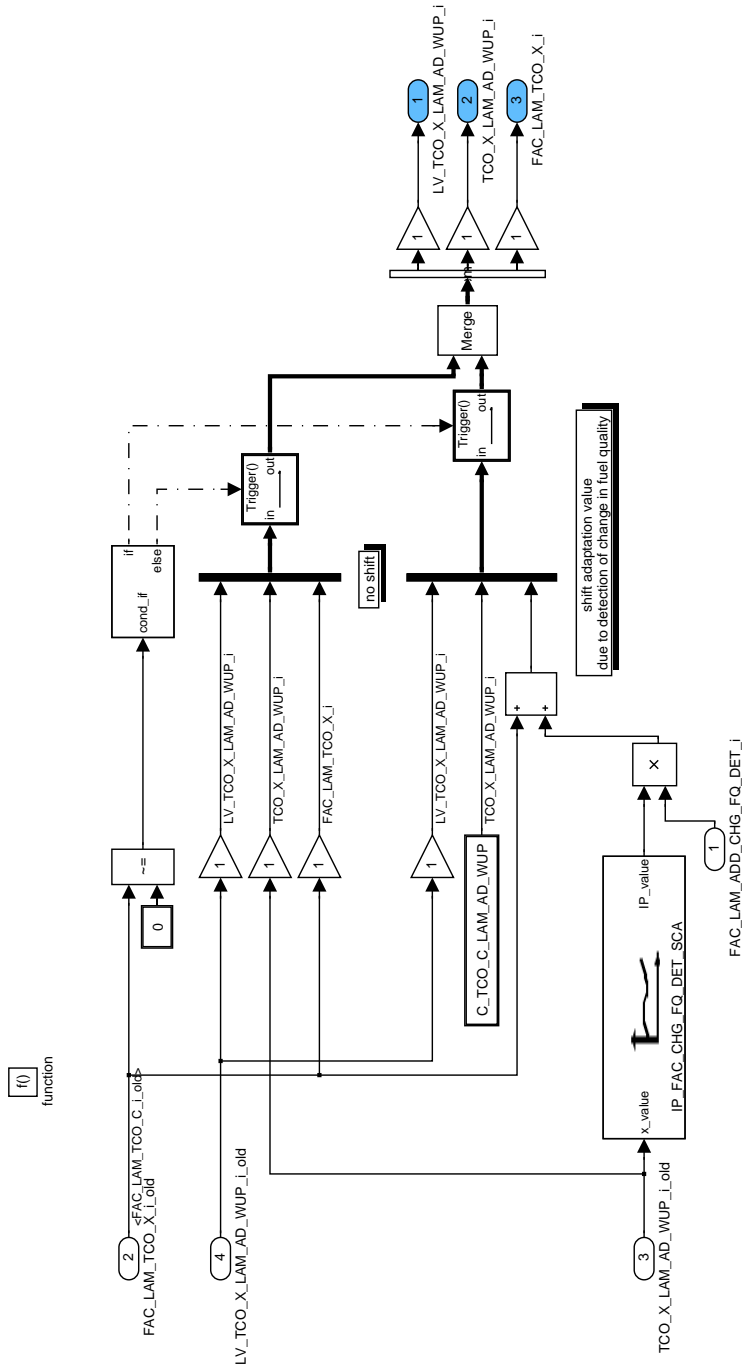
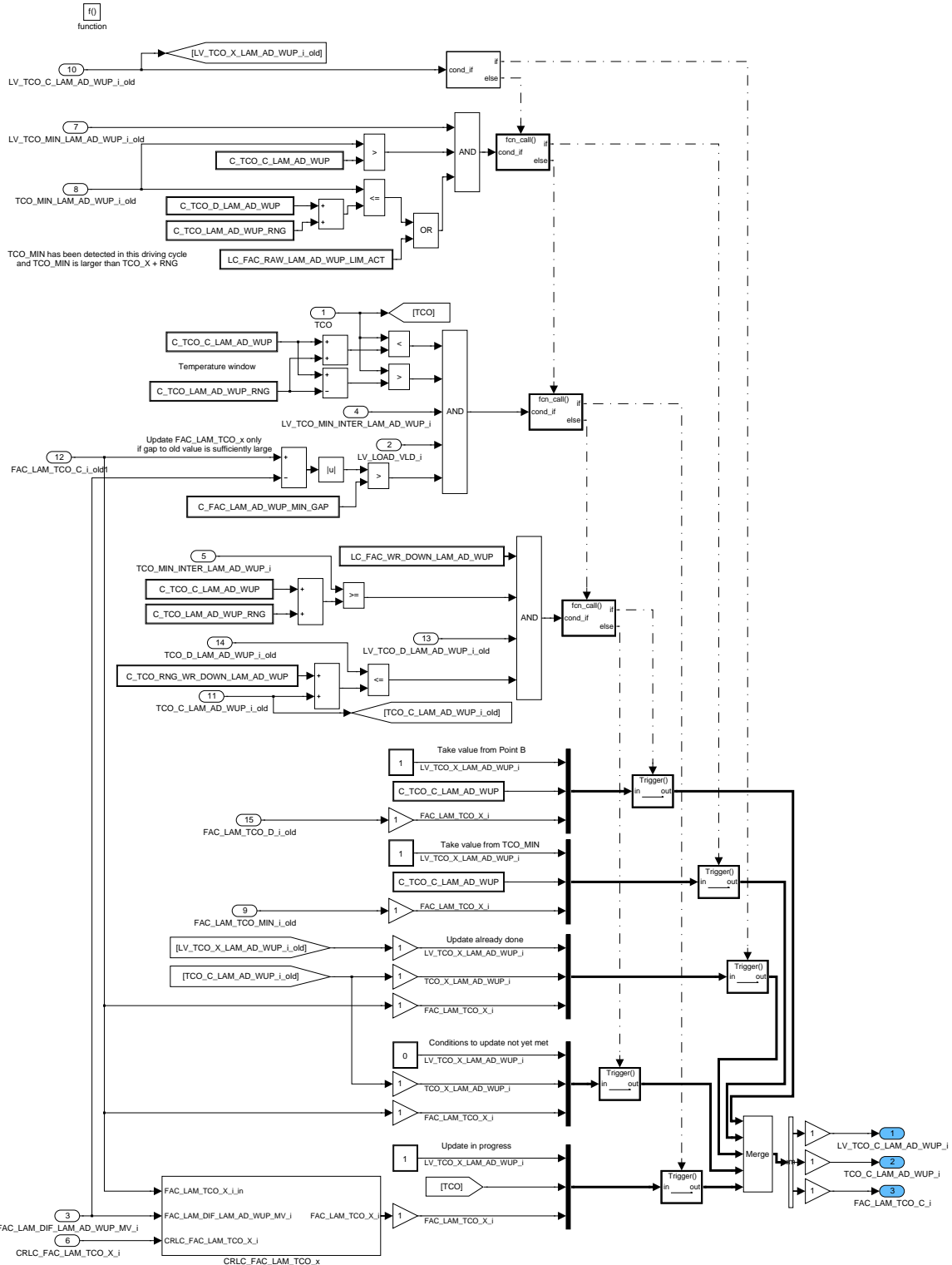


Figure 7.71.22:  
 LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/FAC\_LAM\_AD\_WUP\_CBK\_SPC/  
 TCO\_LAM\_AD\_WUP/CLC\_FAC\_LAM\_TCO\_C/CLC\_CHG\_FQ\_DET\_SCA


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Figure 7.71.23:  
 LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/FAC\_LAM\_AD\_WUP\_CBK\_SPC/  
 TCO\_LAM\_AD\_WUP/CLC\_FAC\_LAM\_TCO\_C/CLC\_NOT\_CHG\_FQ\_DET

**Determination of new adaptation value at point D**

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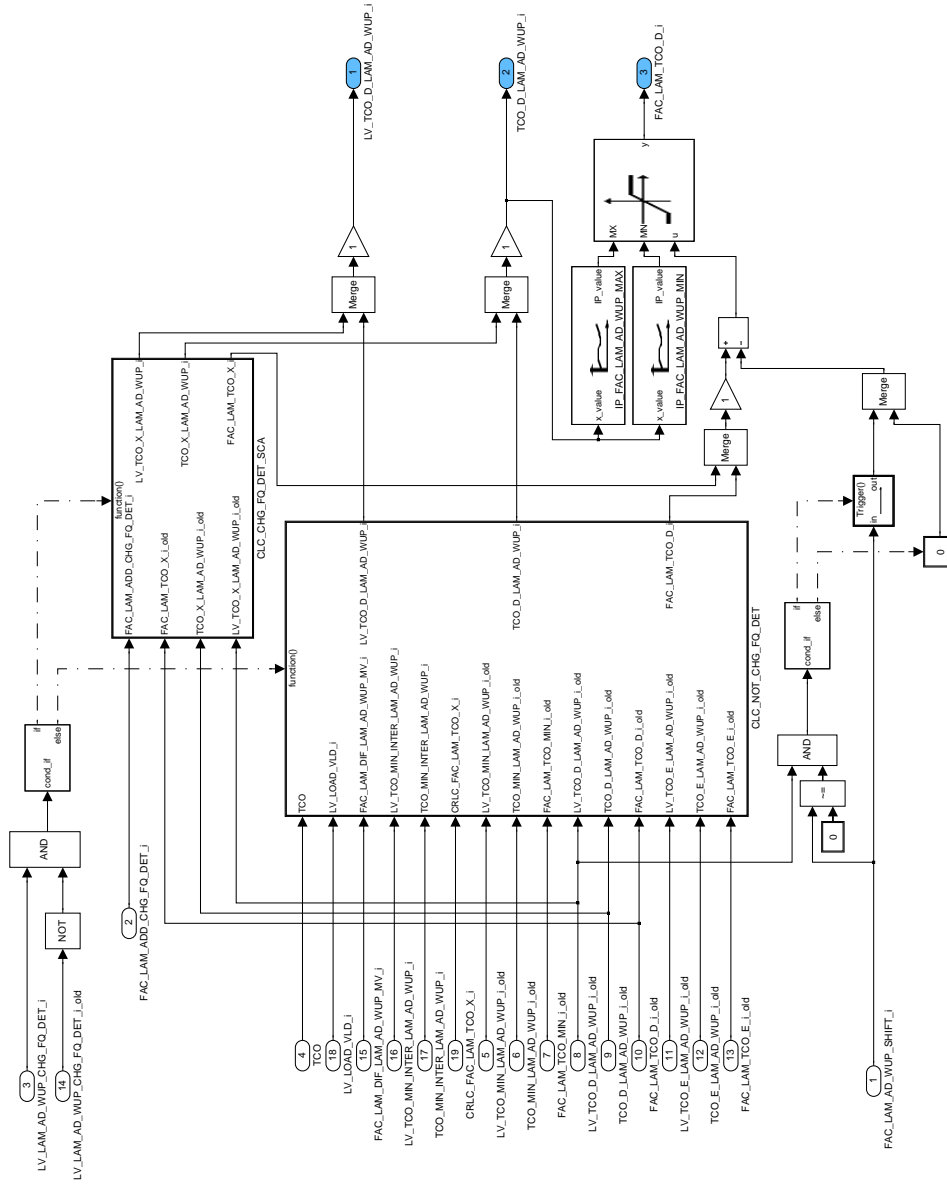


Figure 7.71.24: LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/  
FAC\_LAM\_AD\_WUP\_CBK\_SPC/TCO\_LAM\_AD\_WUP/CLC\_FAC\_LAM\_TCO\_D

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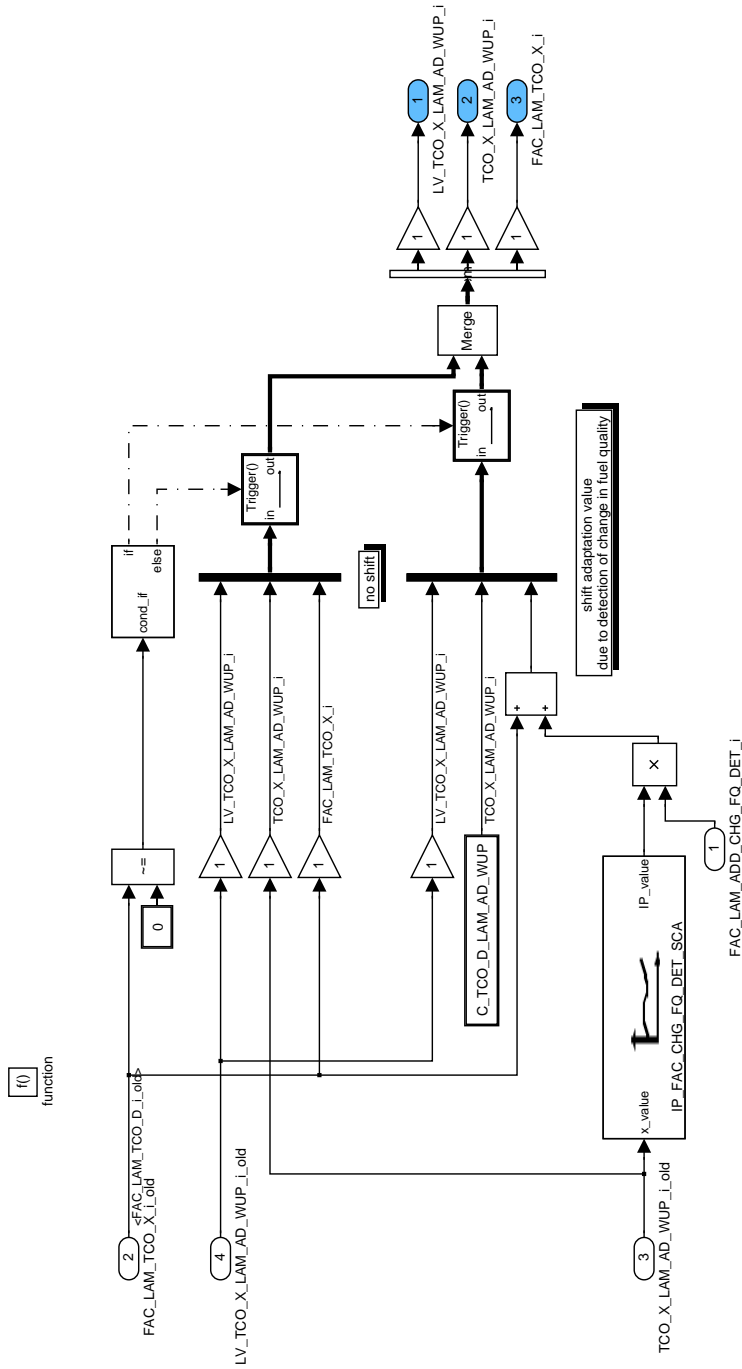
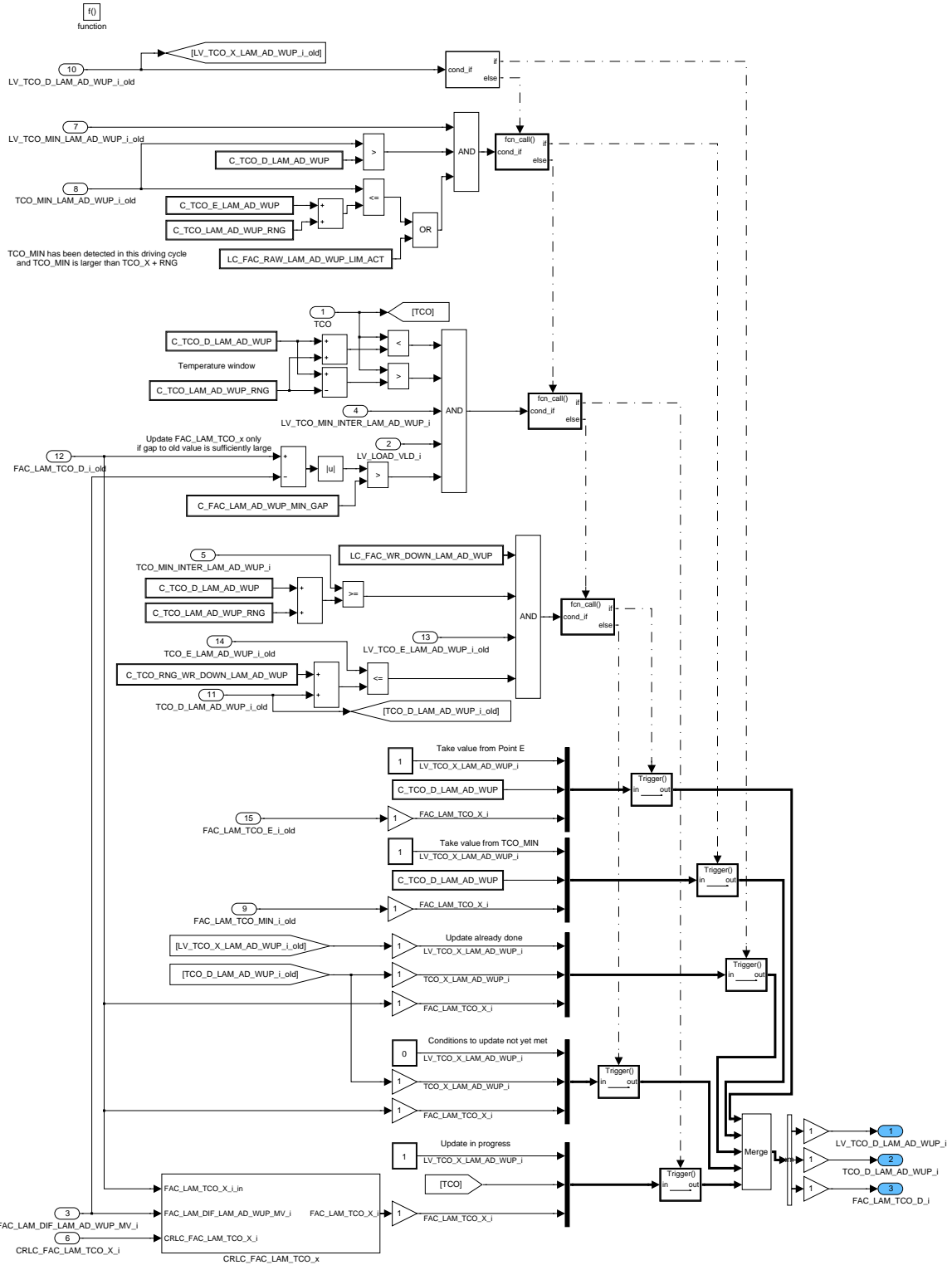


Figure 7.71.25:  
 LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/FAC\_LAM\_AD\_WUP\_CBK\_SPC/  
 TCO\_LAM\_AD\_WUP/CLC\_FAC\_LAM\_TCO\_D/CLC\_CHG\_FQ\_DET\_SCA


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Figure 7.71.26:  
 LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/FAC\_LAM\_AD\_WUP\_CBK\_SPC/  
 TCO\_LAM\_AD\_WUP/CLC\_FAC\_LAM\_TCO\_D/CLC\_NOT\_CHG\_FQ\_DET

**Determination of new adaptation value at point E**

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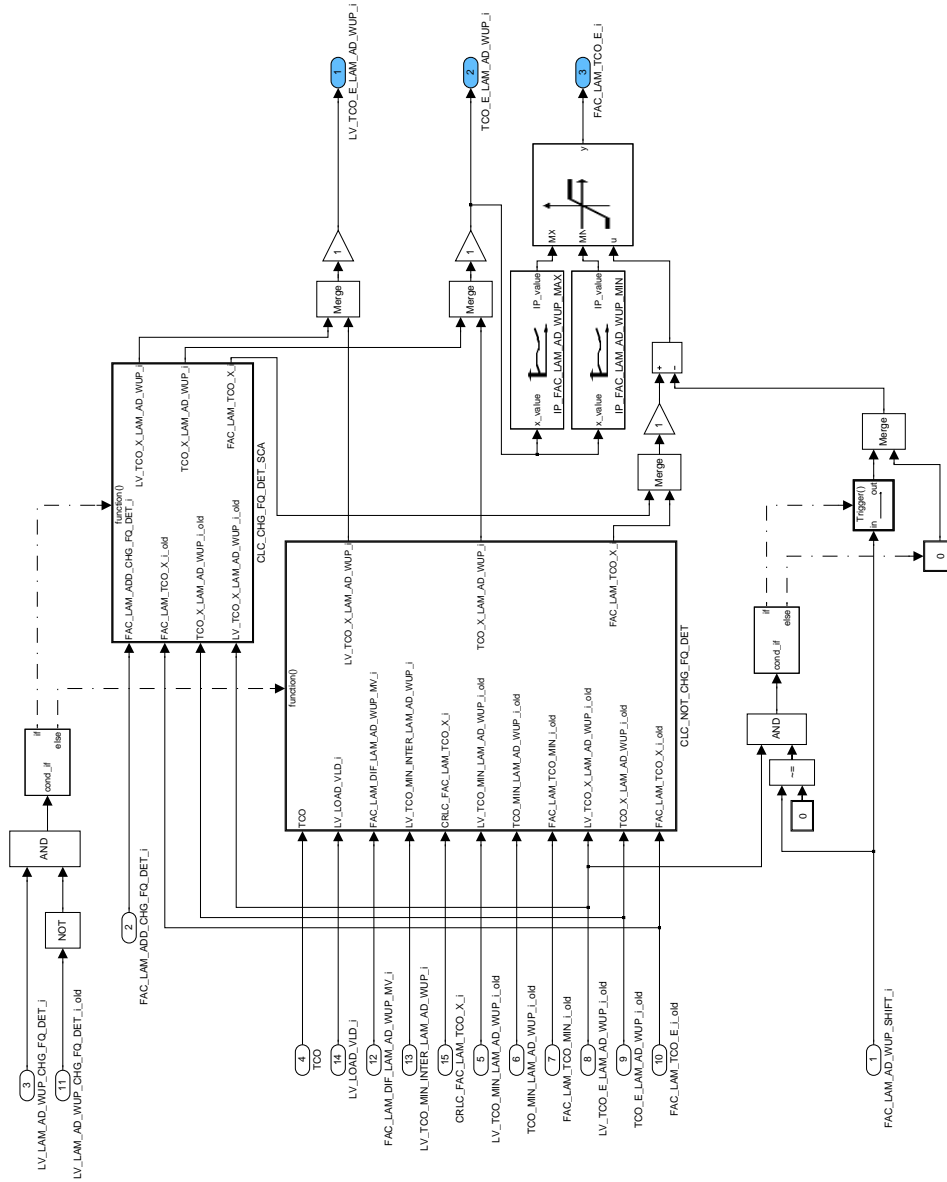


Figure 7.71.27: LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/FAC\_LAM\_AD\_WUP\_CBK\_SPC/TCO\_LAM\_AD\_WUP/CLC\_FAC\_LAM\_TCO\_E

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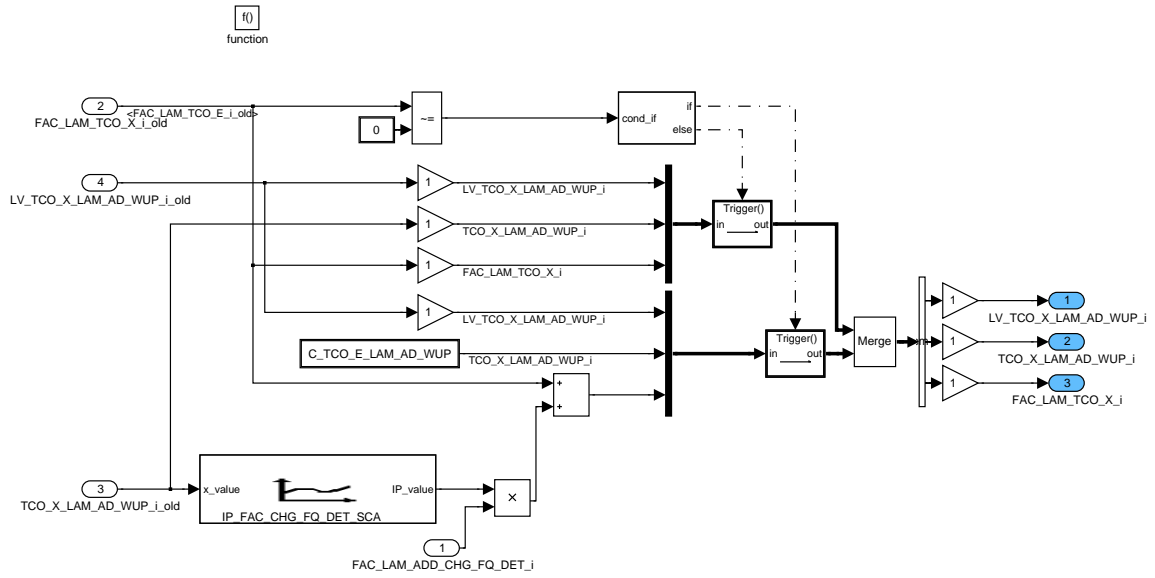



Figure 7.71.28:  
 LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/FAC\_LAM\_AD\_WUP\_CBK\_SPC/  
 TCO\_LAM\_AD\_WUP/CLC\_FAC\_LAM\_TCO\_E/CLC\_CHG\_FQ\_DET\_SCA

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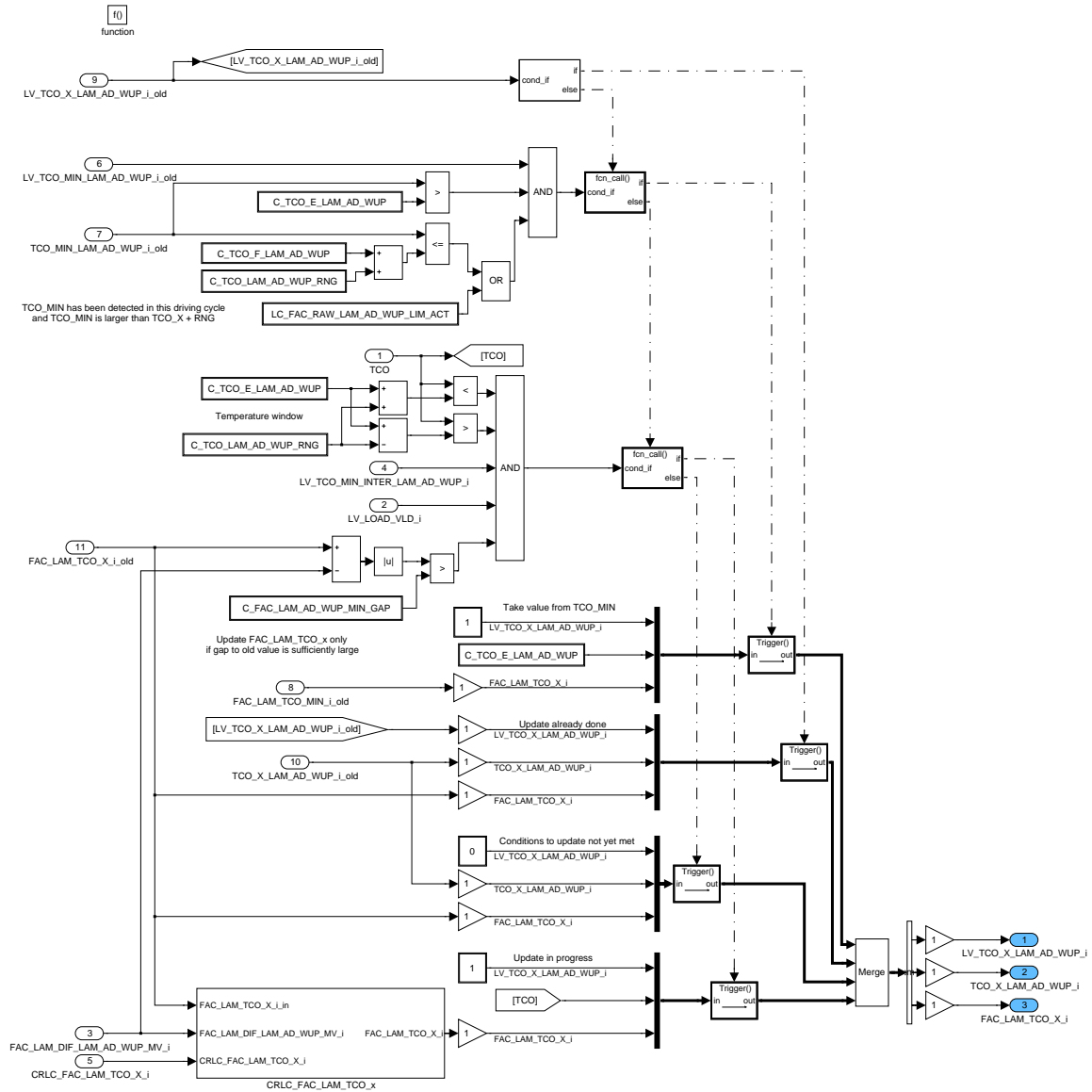


Figure 7.71.29:  
LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/FAC\_LAM\_AD\_WUP\_CBK\_SPC/  
TCO\_LAM\_AD\_WUP/CLC\_FAC\_LAM\_TCO\_E/CLC\_NOT\_CHG\_FQ\_DET

**Set variables at point F**

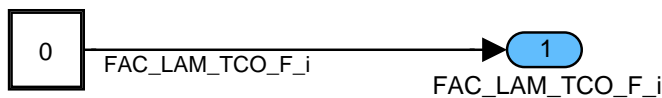


Figure 7.71.30: LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/  
FAC\_LAM\_AD\_WUP\_CBK\_SPC/TCO\_LAM\_AD\_WUP/CLC\_FAC\_LAM\_TCO\_F

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## Parameters for slope equation

Here the parameters which are required to solve the slope equation are arranged.

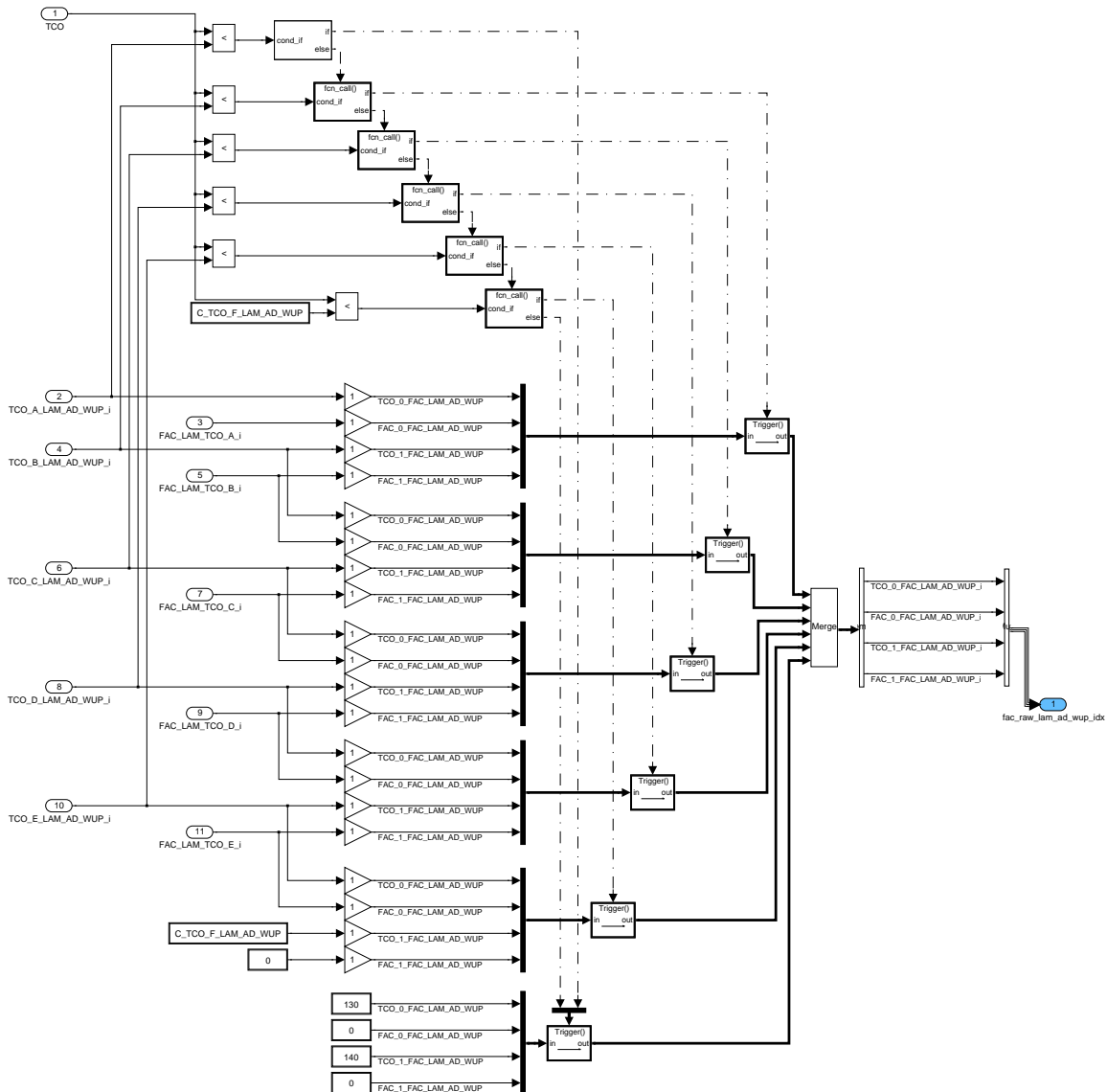


Figure 7.71.31: LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/  
FAC\_LAM\_AD\_WUP\_CBK\_SPC/CLC\_FAC\_LAM\_AD\_WUP/FAC\_RAW\_LAM\_AD\_WUP\_IDX

## Calculation of the Lambda adaptation factor in the warm up phase

The respective adaptation factor in warmup phase is derived from slope equation with TCO as an input. Five different cases for the calculation of FAC\_RAW\_LAM\_AD\_WUP must be distinguished:

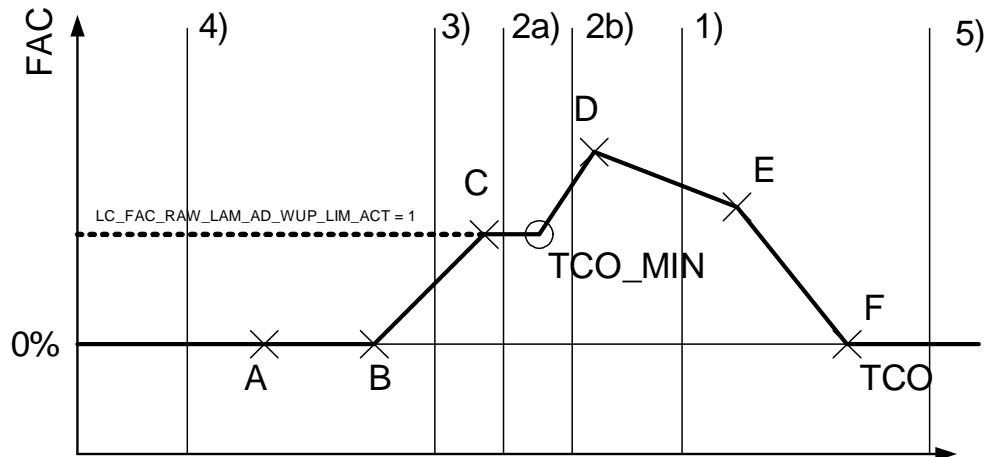
- 1.) The momentary TCO is between two interpolation points with TCO\_MIN *smaller* than the lower interpolation point: Solving the slope equation with the two interpolation points and TCO as an input will yield FAC\_RAW\_LAM\_AD\_WUP.
- 2.) The momentary TCO is between two interpolation points with TCO\_MIN *larger* than the lower interpolation point: Between the lower interpolation point and TCO\_MIN, the output is fixed to FAC\_LAM\_TCO\_MIN. Between TCO\_MIN and the upper interpolation point, the slope equation made up from TCO\_MIN and the upper interpolation point shall be used to calculate FAC\_RAW\_LAM\_AD\_WUP.


3.) TCO is smaller than TCO\_MIN and TCO\_MIN is larger than the next higher interpolation point. If LC\_FAC\_RAW\_LAM\_AD\_WUP\_LIM\_ACT is set to one, the output value is fixed to FAC\_LAM\_TCO\_MIN; otherwise it shall be obtained by solving the slope equation.

4.) TCO is smaller than temperature at point A:

If LC\_FAC\_RAW\_LAM\_AD\_WUP\_LIM\_ACT is set to one, the output value is fixed to FAC\_LAM\_TCO\_MIN, otherwise it is zero.

5.) TCO is larger than temperature of point F: the output is zero.



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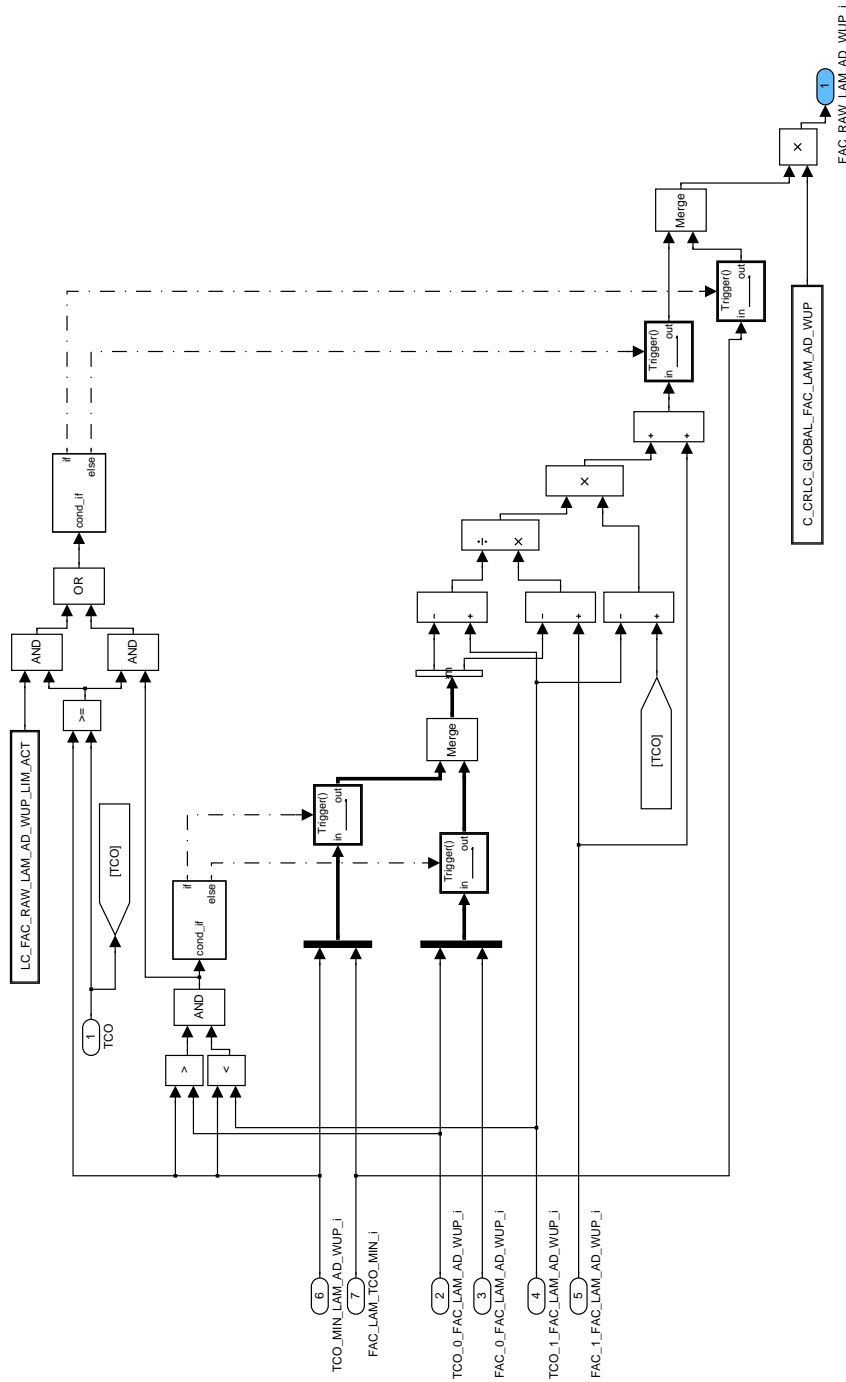



Figure 7.71.32: LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/  
FAC\_LAM\_AD\_WUP\_CBK\_SPC/CLC\_FAC\_LAM\_AD\_WUP/FAC\_RAW\_LAM\_AD\_WUP

**Limitation of adaptation factor**

Three different limitations of the Lambda adaptation factor in warmup phase can be applied. If the conditions to go closed loop Lambda control are not yet fulfilled ( $STATE\_LS == 0$ )  $C\_FAC\_LAM\_AD\_WUP\_MAX/MIN\_LSCL\_OFF$  is applied. In the transient phase until  $TCO\_MIN\_INTER$  is detected  $C\_$

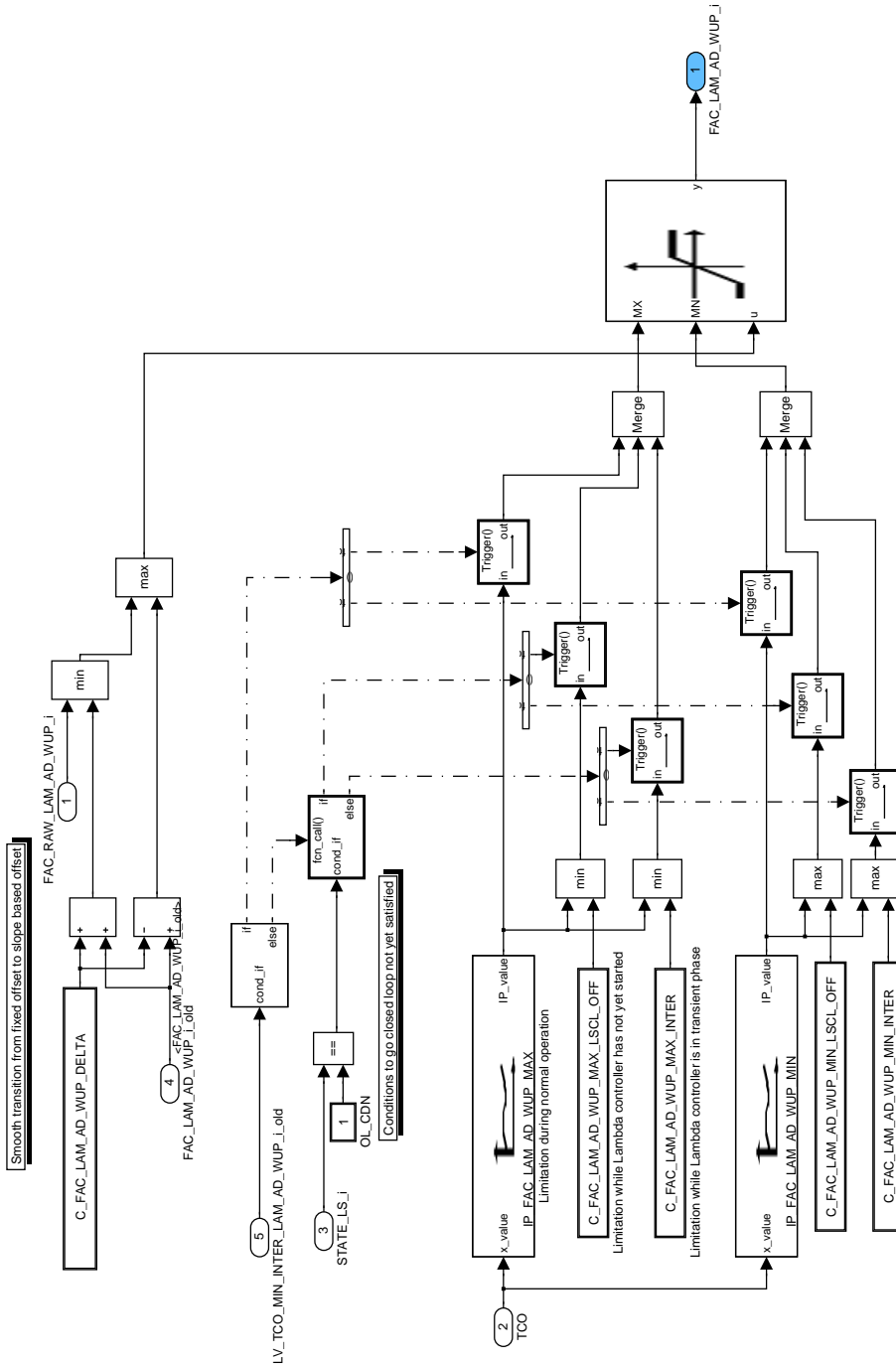
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FAC\_LAM\_AD\_WUP\_MAX/MIN\_INTER is the relevant limitation. After detection of TCO\_MIN\_INTER the limitation are specified by IP\_FAC\_LAM\_AD\_WUP\_MAX/MIN.

With C\_FAC\_LAM\_AD\_WUP\_DELTA the shifts in the Lambda adaptation factor in warmup phase can be smoothed by specifying the maximum step value. It has been observed that for large changes in the adaptation value that Lambda controller output is not reduced as fast as the adaptation value increases (due to transient effects). This causes unwanted deviation of the Lambda value, which can be avoided by specifying a smooth transition between different values of the adaptation factor.



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Figure 7.71.33: LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/  
FAC\_LAM\_AD\_WUP\_CBK\_SPC/CLC\_FAC\_LAM\_AD\_WUP/FAC\_LAM\_AD\_WUP\_LIM

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### Shift of the Lambda controller

A shift of the Lambda controller output is required if the value of FAC\_LAM\_AD\_WUP[i] has changed since the last calculation recurrence in order to avoid large Lambda controller excursions.

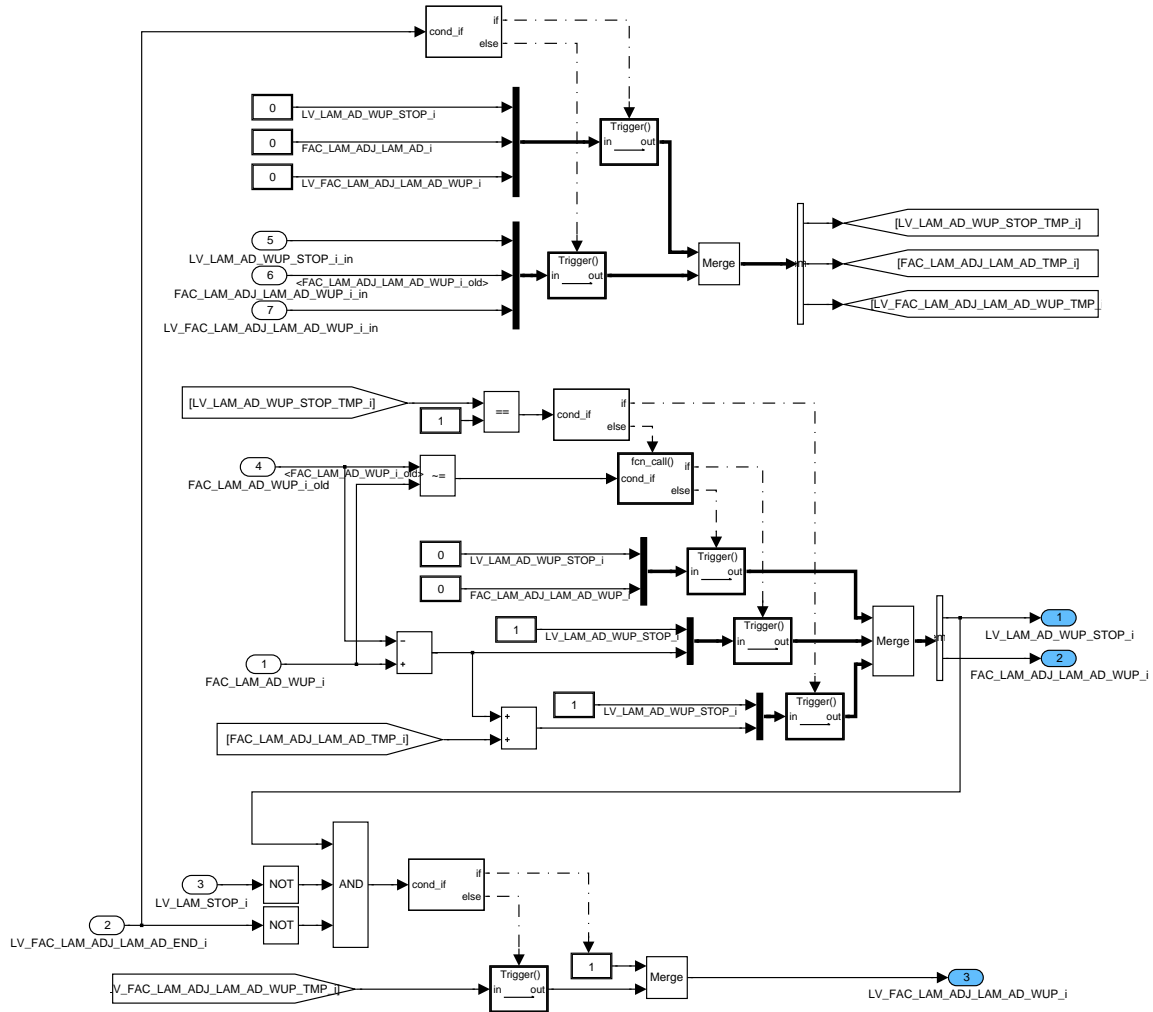


Figure 7.71.34: LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/  
FAC\_LAM\_AD\_WUP\_CBK\_SPC/CLC\_FAC\_LAM\_AD\_WUP/CLC\_FAC\_LAM\_ADJ\_LAM\_AD\_WUP

### Rewriting of adaptation correction in warm up phase with non volatile stored values

In case of Lambda adaptation relevant errors (see application incidences) the values of the data to be stored in the nonvolatile memory must be rewritten with the values stored at the end of the last driving cycle.

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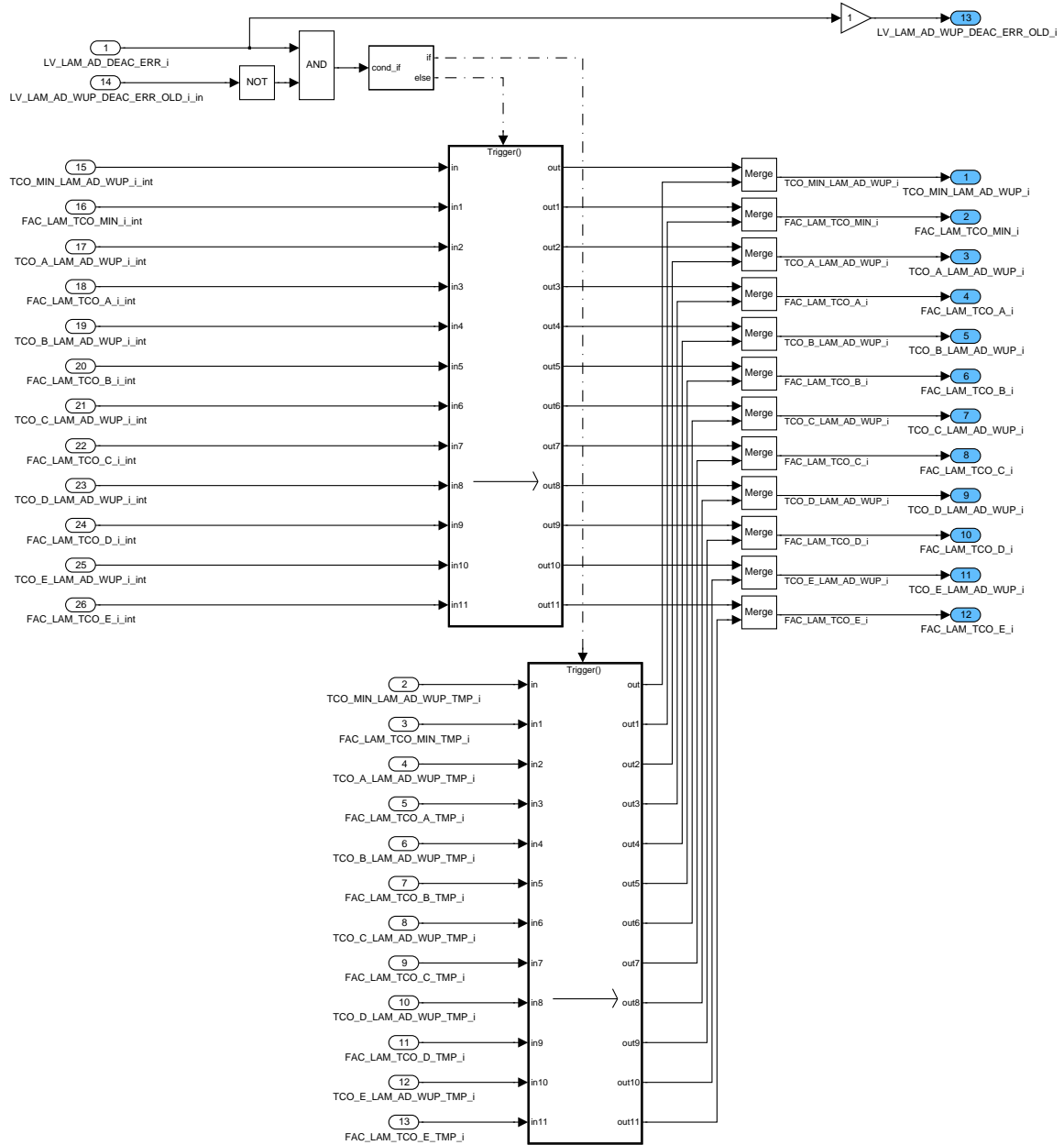


Figure 7.71.35: LACO\_ISPCLADAW0/operate/FAC\_LAM\_AD\_WUP\_CBK\_MNG/  
FAC\_LAM\_AD\_WUP\_CBK\_SPC/ERR\_LAM\_AD\_WUP

### 7.71.1.2 Initialization and Non Volatile Memory Data Handling

#### Non Volatile Memory Data

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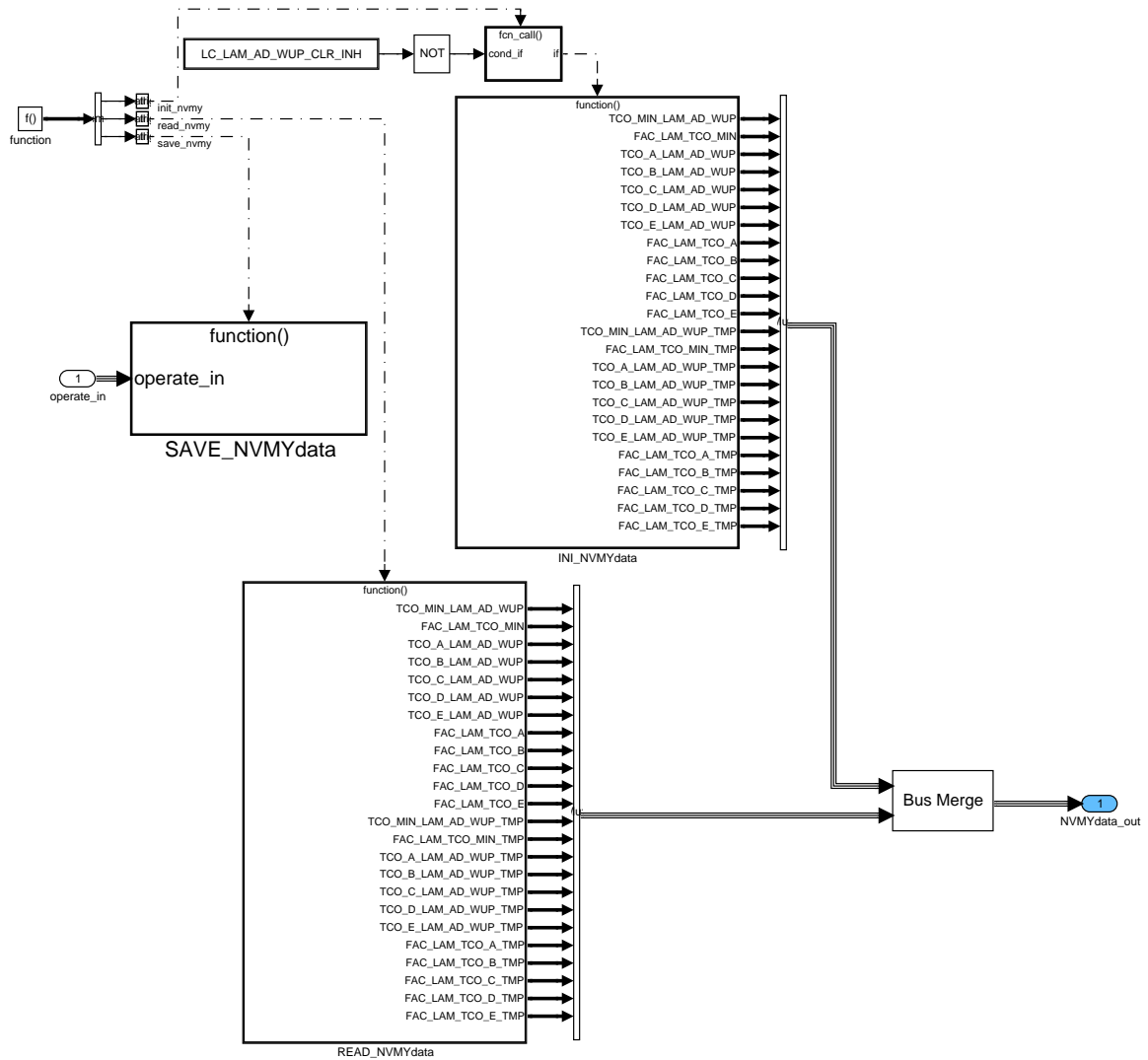


Figure 7.71.36: LACO\_ISPCLADAW0/INIT/NVMYdata

**Initialization of NVMY Data**

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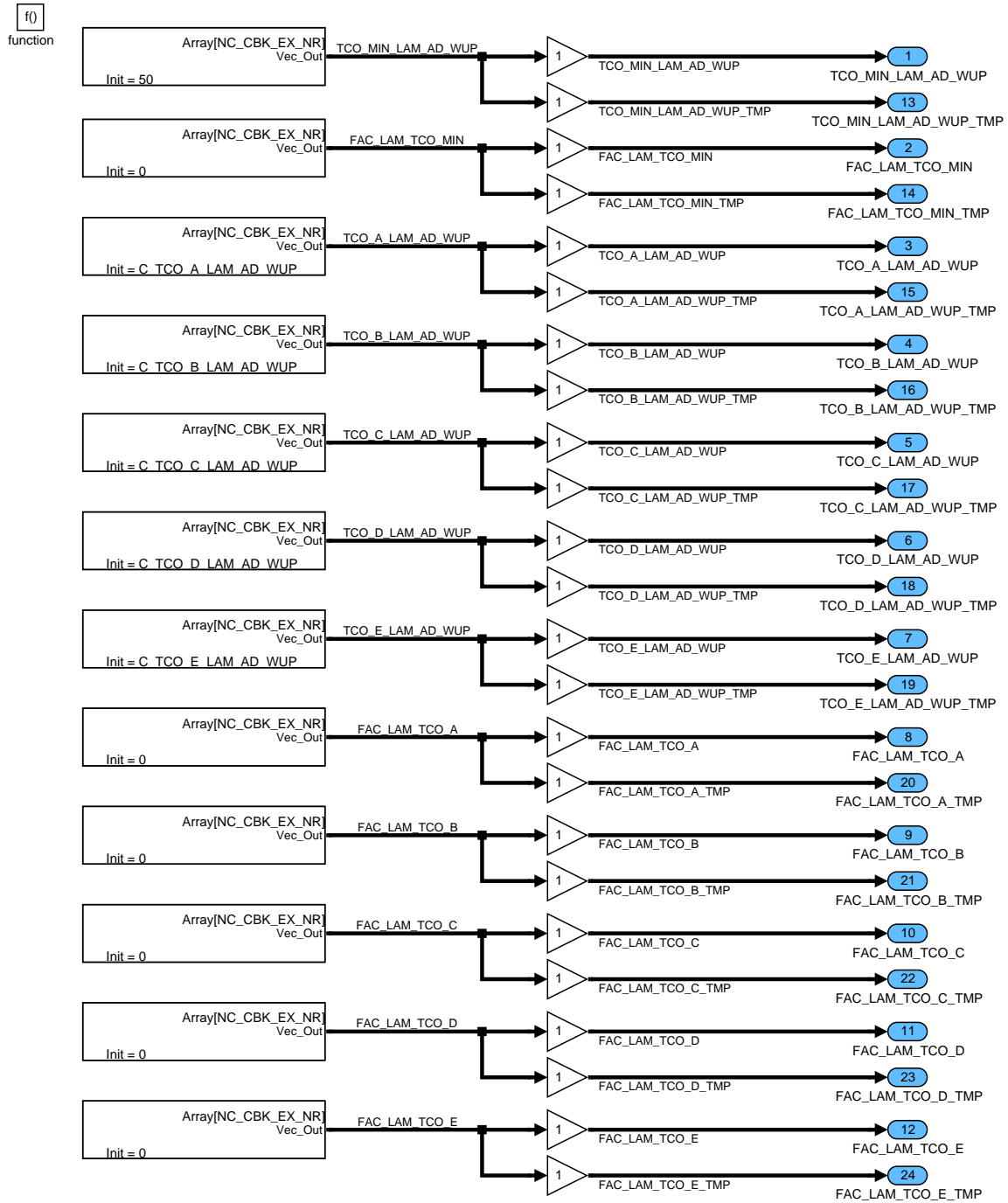



Figure 7.71.37: LACO\_ISPCLADAW0/INIT/NVMYdata/INI\_NVMYdata

**Read NVMY Data**

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f() function

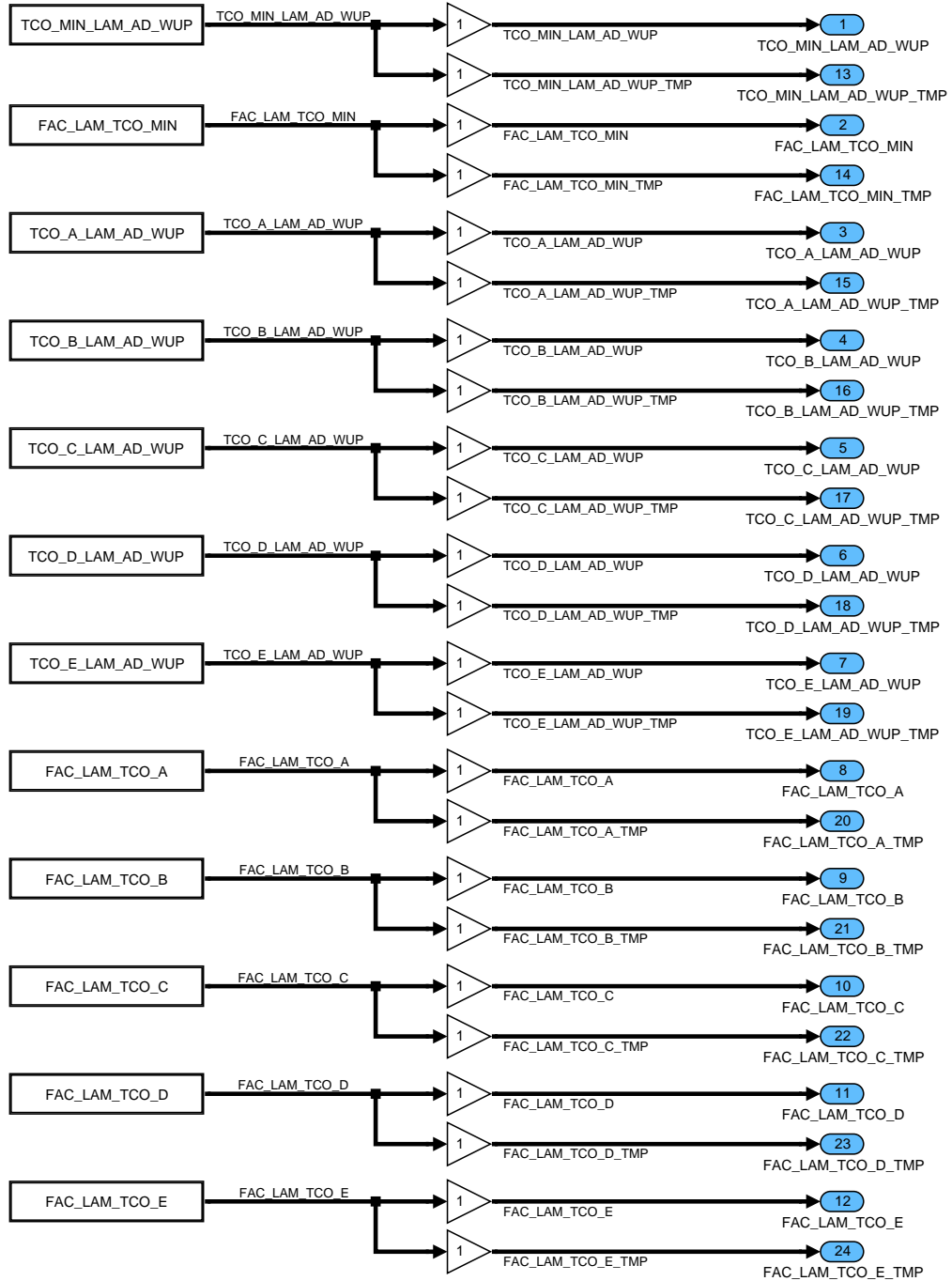



Figure 7.71.38: LACO\_ISPCLADAW0/INIT/NVMYdata/READ\_NVMYdata

**Store NVMY**

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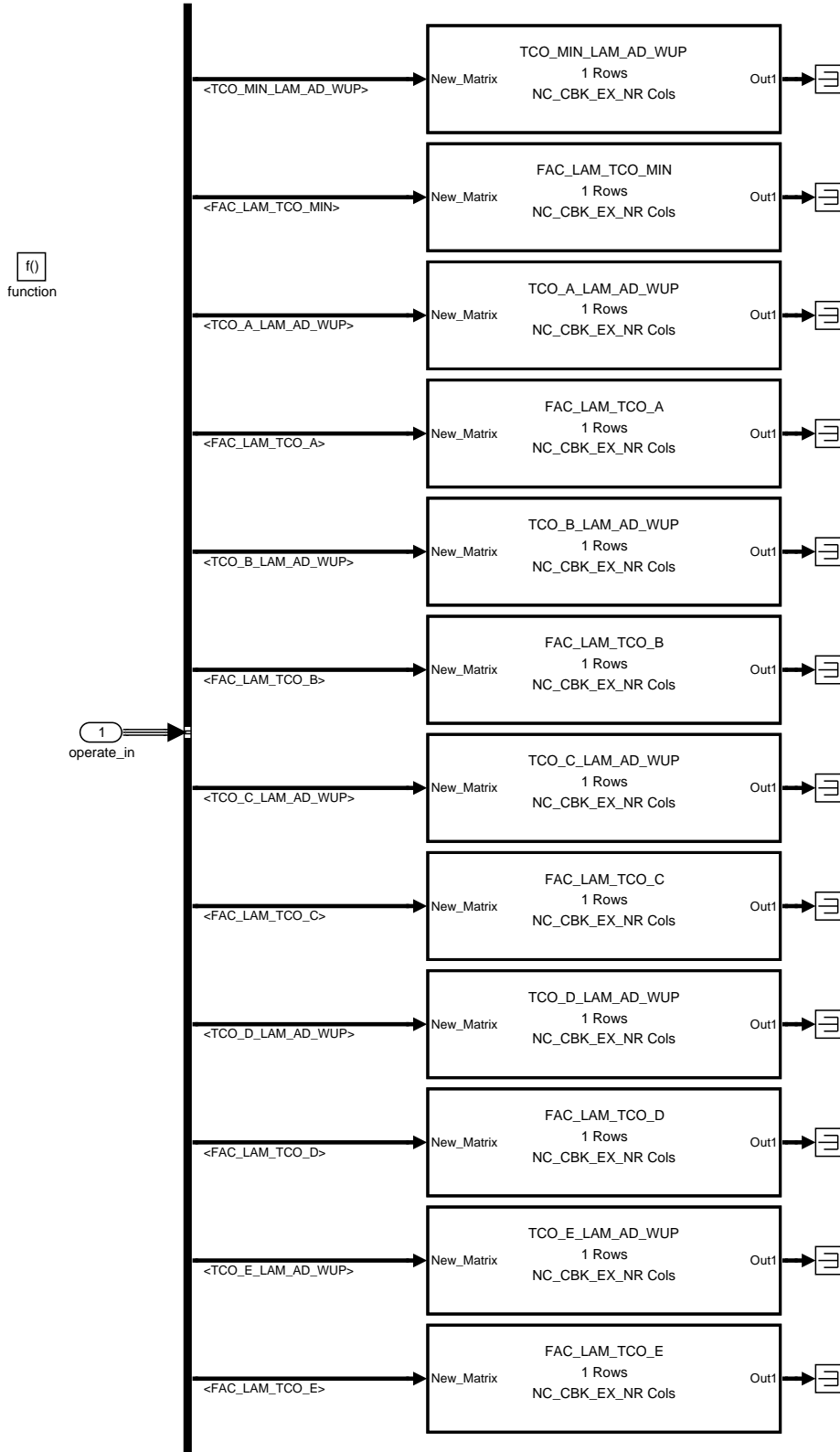



Figure 7.71.39: LACO\_ISPCLADAW0/INIT/NVMYdata/SAVE\_NVMYdata

**ECU Reset**

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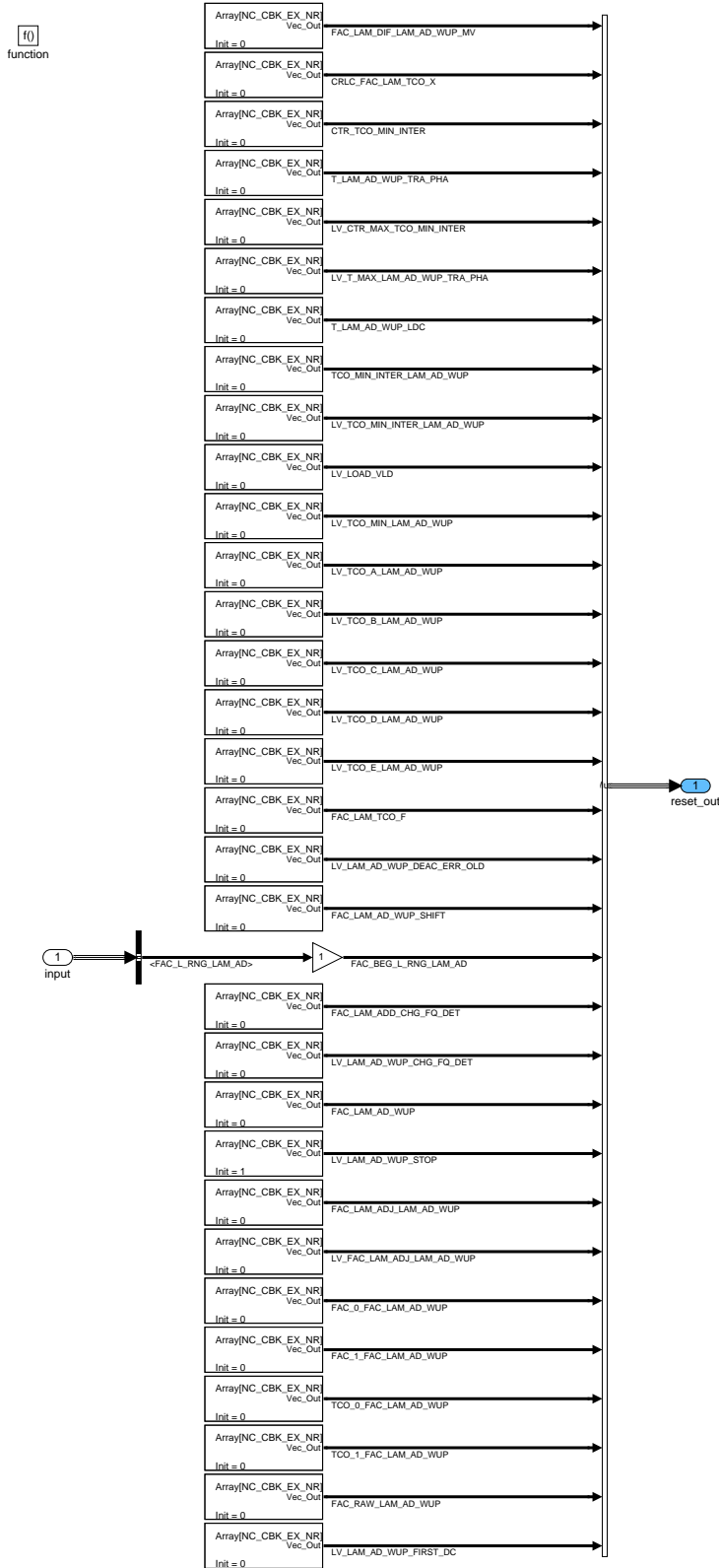


Figure 7.71.40: LACO\_ISPCLADAW0/INIT/reset

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## 7.72 Lambda adaptation (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRLC_LAM_AD [NC_CBK_EX_NR]	O/V	0... FFH	0... 0.99609	3.9062e-3	-
correlation constant for calculation of adaptive values					
FAC_LAM_AD_SHIFT [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Output value for shift of Lambda adaptation					
FAC_LAM_MV_OFS_LDC_LAM_AD [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
filtered lambda controller output offset for limited dynamics calculation					
LV_FAC_LAM_AD_SHIFT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag to request shift of Lambda adaptation					
LV_LAM_AD_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that lambda adaptation can be activated					
LV_LAM_AD_ACT_ERR [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that lambda adaptation can be activated because of no error detected					
LV_LAM_AD_CDN_ADD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
condition bit for activation of lambda adaptation ADAPT_ADD					
LV_LAM_AD_CDN_H_RNG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
condition bit for activation of lambda adaptation ADAPT_FAC_H					
LV_LAM_AD_CDN_L_RNG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
condition bit for activation of lambda adaptation ADAPT_FAC_L					
LV_LAM_AD_DEAC_ERR [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that lambda adaptation is deactivated due to an error					
LV_LAM_AD_WUP_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that lambda adaptation in warm-up phase can be activated					
LV_LDC_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
limited dynamic conditions for lambda adaptation					
MAF_INT_LDC_LAM_AD [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.42	0.0277778	g
air mass flow integral during limited dynamics not fulfilled					
MAF_OFS_LDC_LAM_AD [NC_CBK_EX_NR]	V	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
air mass flow offset for limited dynamics calculation					
MFF_SP_AD [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow setpoint for lambda adaptation - bank selective					
N_OFS_LDC_LAM_AD [NC_CBK_EX_NR]	V	E020... 1FE0H	-8160 ...8160	1	rpm
engine speed offset for limited dynamics calculation					
T_WAIT_MAX_LAM_AD [NC_CBK_EX_NR]	-	0... FFH	0... 5.1	0.02	s
threshold of waiting time between two adaptations					

### Input data:

AMP {p. 982}	ERR_INH_LAM_AD_ACT [NC_CBK_EX_NR] {p. 1014}	FAC_L_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	FAC_LAM_AD_CUS_SHIFT [NC_CBK_EX_NR] {p. 8308}
FAC_LAM_MV_DELTA_LDC [NC_CBK_EX_NR] {p. 2585}	FUP {p. 1283}	LAMB_SP_HOM [NC_CBK_EX_NR] {p. 8340}	LV_CP_RAMP_OPEN_ACT {p. 3636}

LV_FAC_H_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	LV_FAC_L_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	LV_FAC_LAM_AD_CUS_ SHIFT [NC_CBK_EX_NR] {p. 8309}	LV_HOM_ACT {p. 8136}
LV_INH_FSD_STOP_OIL {p. 6133}	LV_LAM_AD_ENA {p. 3737}	LV_LAM_AD_EXT {p. 1016}	LV_LAM_AD_INJ_ACT {p. 3348}
LV_LAM_LIM_LAM_AD [NC_CBK_EX_NR] {p. 6141}	LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}	LV_MFF_ADD_RNG_LAM_ AD [NC_CBK_EX_NR] {p. 2642}
MAF_CYL {p. 8277}	MAF_DELTA_LDC {p. 2585}	MAF_KGH {p. 1195}	MFF_ADD_LAM_AD [NC_CBK_EX_NR] {p. 2642}
MFF_SP_HOM_BAS_MV {p. 2151}	MFF_SP_S_SWI_HOM {p. 8243}	N_DELTA_LDC {p. 2585}	NC_CBK_EX_NR {p. 1829}
NC_CYL_NR {p. 1526}	STATE_LAM_AD [NC_CBK_EX_NR] {p. 2643}	TAM {p. 1579}	TCO {p. 1100}
TIA {p. 1226}	WGPWM [NC_CBK_EX_NR] {p. 8140}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_MIN_LAM_AD	-	0... FFFFH	0... 5434	0.0829175	hPa
Minimum ambient pressure to activate lambda adaptation					
C_CRLC_LAM_AD_ADD	-	0... FFH	0... 0.99609	3.9062e-3	-
correlation constant for lambda adaptation at offset learning area					
C_CRLC_LAM_AD_ADD_LAM_LIM	-	0... FFH	0... 0.99609	3.9062e-3	-
correlation constant for lambda adaptation at offset learning area when forced modus is required					
C_CRLC_LAM_AD_H	-	0... FFH	0... 0.99609	3.9062e-3	-
correlation constant for lambda adaptation at high area					
C_CRLC_LAM_AD_H_LAM_LIM	-	0... FFH	0... 0.99609	3.9062e-3	-
correlation constant for lambda adaptation at high area when forced modus is required					
C_CRLC_LAM_AD_L	-	0... FFH	0... 0.99609	3.9062e-3	-
correlation constant for lambda adaptation at low area					
C_CRLC_LAM_AD_L_LAM_LIM	-	0... FFH	0... 0.99609	3.9062e-3	-
correlation constant for lambda adaptation at low area when forced modus is required					
C_FAC_LAM_MV_DYW_LDC_LAM_AD	-	0... 7FFFH	0... 49.99847	1.5259e-3	%
lambda control output window for limited dynamic conditions lambda adaptation					
C_FUP_MAX_LAM_AD	-	0... FFFFH	0... 347776	5.3067216	hPa
Minimum fuel pressure mean value to activate lambda adaptation					
C_FUP_MIN_LAM_AD	-	0... FFFFH	0... 347776	5.3067216	hPa
Minimum fuel pressure mean value to activate lambda adaptation					
C_LAMB_SP_AD_MAX_ADD	-	0... 7FFFH	0... 1.99993	61e-6	-
maximum lambda setpoint to allow lambda adaptation at offset learning area					
C_LAMB_SP_AD_MAX_H	-	0... 7FFFH	0... 1.99993	61e-6	-
maximum lambda setpoint to allow lambda adaptation at high range operating point					
C_LAMB_SP_AD_MAX_L	-	0... 7FFFH	0... 1.99993	61e-6	-
maximum lambda setpoint to allow lambda adaptation at low range operating point					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_SP_AD_MAX_WUP_ADD	-	0... 7FFFH	0... 1.99993	61e-6	-
maximum lambda setpoint to allow lambda adaptation at offset learning area during warm-up phase					
C_LAMB_SP_AD_MAX_WUP_H	-	0... 7FFFH	0... 1.99993	61e-6	-
maximum lambda setpoint to allow lambda adaptation at high range operating point during warm-up phase					
C_LAMB_SP_AD_MAX_WUP_L	-	0... 7FFFH	0... 1.99993	61e-6	-
maximum lambda setpoint to allow lambda adaptation at low range operating point during warm-up phase					
C_LAMB_SP_AD_MIN_ADD	-	0... 7FFFH	0... 1.99993	61e-6	-
minimum lambda setpoint to allow lambda adaptation at offset learning area					
C_LAMB_SP_AD_MIN_H	-	0... 7FFFH	0... 1.99993	61e-6	-
minimum lambda setpoint to allow lambda adaptation at high range operating point					
C_LAMB_SP_AD_MIN_L	-	0... 7FFFH	0... 1.99993	61e-6	-
minimum lambda setpoint to allow lambda adaptation at low range operating point					
C_LAMB_SP_AD_MIN_WUP_ADD	-	0... 7FFFH	0... 1.99993	61e-6	-
minimum lambda setpoint to allow lambda adaptation at offset learning area during warm-up phase					
C_LAMB_SP_AD_MIN_WUP_H	-	0... 7FFFH	0... 1.99993	61e-6	-
minimum lambda setpoint to allow lambda adaptation at high range operating point during warm-up phase					
C_LAMB_SP_AD_MIN_WUP_L	-	0... 7FFFH	0... 1.99993	61e-6	-
minimum lambda setpoint to allow lambda adaptation at low range operating point during warm-up phase					
C_MAF_DYW_LDC_LAM_AD	-	0... FFFFH	0... 1389	0.0211948	mg/stk
air mass flow window for limited dynamic conditions lambda adaptation					
C_MAF_INT_LDC_LAM_AD	-	0... FFFFH	0... 1820.42	0.0277778	g
air mass flow integral for duration of violation of limited dynamic conditions lambda adaptation					
C_MAF_KGH_MAX_LAM_AD	-	0... FFFFH	0... 1023.98437	0.015625	kg/h
maximum mass air flow for adaptive learning					
C_MAF_KGH_MAX_LAM_AD_WUP	-	0... FFFFH	0... 1023.98437	0.015625	kg/h
maximum mass air flow for adaptive learning during warm-up phase					
C_MAF_KGH_MIN_LAM_AD_WUP	-	0... FFFFH	0... 1023.98437	0.015625	kg/h
minimum mass air flow for adaptive learning during warm-up phase					
C_N_DYW_LDC_LAM_AD	-	0... 1FE0H	0... 8160	1	rpm
engine speed window for limited dynamic conditions trim control					
C_T_AST_BOL_INH_LAM_AD	-	0... FFFFH	0... 6553.5	0.1	s
Bottom of boundary of time window to inhibit lambda adaption					
C_T_AST_TOL_INH_LAM_AD	-	0... FFFFH	0... 6553.5	0.1	s
Top of boundary of time window to inhibit lambda adaption					
C_T_WAIT_MAX_LAM_AD	-	0... FFH	0... 5.1	0.02	s
threshold of waiting time between two adaptations					
C_T_WAIT_MAX_LAM_AD_ADD	-	0... FFH	0... 5.1	0.02	s
threshold of waiting time between two adaptations at offset learning area					
C_T_WAIT_MAX_LAM_AD_H_RNG	-	0... FFH	0... 5.1	0.02	s
threshold of waiting time between two adaptations in high adaptation range					
C_T_WAIT_MAX_LAM_AD_L_RNG	-	0... FFH	0... 5.1	0.02	s
threshold of waiting time between two adaptations in low adaptation range					
C_TAM_MIN_LAM_AD	-	0... FEH	-48... 142.5	0.75	°C
Minimum ambient temperature for activation of lambda adaptation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_MAX_LAM_AD_WUP	-	0... FEH	-48... 142.5	0.75	°C
maximum coolant temperature for Lambda adaptation in warm-up phase					
C_TCO_MAX_T_AST_INH_LAM_AD	-	0... FEH	-48... 142.5	0.75	°C
Max. TCO to allow time window to inhibit lambda adaption					
C_TCO_MIN_LAM_AD	-	0... FEH	-48... 142.5	0.75	°C
minimum coolant temperature for adaptive learning					
C_TCO_MIN_LAM_AD_WUP	-	0... FEH	-48... 142.5	0.75	°C
minimum coolant temperature for Lambda adaptation in warm-up phase					
C_TIA_MAX_LAM_AD	-	0... FEH	-48... 142.5	0.75	°C
maximum air temperature for adaptive learning					
C_WGPWM_MIN_LAM_AD	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Minimum waste gate signal for lambda adaptation at active driving cycle					
LC_LAM_AD_INH_STOP_OIL	-	0... 1H	0 ...1	1	-
Logical constant to inibit the lambda adaptation when LV_INH_FSD_STOP_OIL is set.					
LC_LAM_AD_WUP_ADD_RNG_CDN	-	0... 1H	0 ...1	1	-
Logical switch to require previous adaptation in ADD Range					
LC_LAM_AD_WUP_DEAC [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
logical calibration to disable Lambda adaptation in warm-up pahse					
LC_LAM_AD_WUP_INH_STOP_OIL	-	0... 1H	0 ...1	1	-
Logical constant to inibit the lambda adaptation WUP when LV_INH_FSD_STOP_OIL is set.					
LC_LAM_AD_WUP_L_RNG_CDN	-	0... 1H	0 ...1	1	-
Logical switch to require previous adaptation in FAC_L Range					
LC_WGPWM_INH_LAM_AD_ENA	-	0... 1H	0 ...1	1	-
Logical constant to enable inhibition of the lambda adaptation below a wastegate PWM value					

## FUNCTION DESCRIPTION:

### General information:

The calculation shall be done for all exhaust cylinder banks. For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2,

otherwise (NC\_CBK\_EX\_NR = 1)


i = 1, for single exhaust cylinder bank.

### Description:

The activation conditions of the lambda adaptation depends on:

- coolant temperature thresholds,
- temperature of intake air into manifold threshold,
- air mass flow threshold,
- secondary air function including diagnosis finished
- lambda setpoint thresholds
- and several error flags that must be zero

If all activation conditions are fulfilled, during the warm-up phase LV\_LAM\_AD\_WUP\_ACT[i] is set and during normal warm conditions LV\_LAM\_AD\_ACT[i] is set to 1. That means that the lambda adaptation can get active if no other inhibition defined in the lambda adaptation module is set.

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The detection of the limited dynamics is calculated based on the current engine speed, air mass flow and filtered lambda control output. The input to this function is the difference between each of the mentioned base values and its moving mean values. If one of those differences exceeds a calibrated threshold, an air mass flow integral is started to be calculated until a calibrated MAF threshold is reached. During the calculation the limited dynamics are defined to be not fulfilled ( $LV\_LDC\_LAM\_AD[i] = 0$ ). In order to reset the difference between base value and moving mean value after each threshold exceeding, an offset variable is introduced (see formula section).

Furthermore the correlation constant for calculation of adaptive values and the distance between two adaptations are determined dependent on the different adaptation ranges.

## Application conditions

### Initialisation:

*at ECU reset:*

$LV\_LAM\_AD\_ACT[i] = 0$   
 $LV\_LAM\_AD\_WUP\_ACT[i] = 0$   
 $LV\_LAM\_AD\_ACT\_ERR[i] = 0$   
 $CRLC\_LAM\_AD[i] = 0$   
 $T\_WAIT\_MAX\_LAM\_AD[i] = 0$   
 $LV\_LDC\_LAM\_AD[i] = 0$   
 $N\_OFS\_LDC\_LAM\_AD[i] = 0 \text{ rpm}$   
 $MAF\_OFS\_LDC\_LAM\_AD[i] = 0 \text{ mg/ stk}$   
 $FAC\_LAM\_MV\_OFS\_LDC\_LAM\_AD[i] = 0 \%$   
 $MAF\_INT\_LDC\_LAM\_AD[i] = 0 \text{ g}$   
 $LV\_LAM\_AD\_DEAC\_ERR[i] = 0$   
 $LV\_LAM\_AD\_CDN\_H\_RNG[i] = 0$   
 $LV\_LAM\_AD\_CDN\_L\_RNG[i] = 0$   
 $LV\_LAM\_AD\_CDN\_ADD[i] = 0$   
 $MFF\_SP\_AD[i] = MFF\_SP\_HOM\_$

*BAS\_MV*

*At transition  $LV\_IGK = 1 \rightarrow 0$ :*

$LV\_LAM\_AD\_ACT[i] = 0$   
 $LV\_LAM\_AD\_WUP\_ACT[i] = 0$

### Recurrence:

$T\_SAMPLE = 20 \text{ ms}$

### Activation:

$LV\_IGK = 1$

### Deactivation:

$LV\_IGK = 0$


## Formula section:

### Determination of activation conditions for lambda adaptation:

If

Bit 0 of  $ERR\_INH\_LAM\_AD\_ACT[i] = 0$     **and**  
 Bit 1 of  $ERR\_INH\_LAM\_AD\_ACT[i] = 0$     **and**  
 Bit 2 of  $ERR\_INH\_LAM\_AD\_ACT[i] = 0$     **and**

Bit 4 of  $ERR\_INH\_LAM\_AD\_ACT[i] = 0$     **and**  
 Bit 5 of  $ERR\_INH\_LAM\_AD\_ACT[i] = 0$     **and**  
 Bit 6 of  $ERR\_INH\_LAM\_AD\_ACT[i] = 0$     **and**  
 Bit 7 of  $ERR\_INH\_LAM\_AD\_ACT[i] = 0$     **and**  
 Bit 8 of  $ERR\_INH\_LAM\_AD\_ACT[i] = 0$     **and**  
 Bit 9 of  $ERR\_INH\_LAM\_AD\_ACT[i] = 0$     **and**  
 Bit 10 of  $ERR\_INH\_LAM\_AD\_ACT[i] = 0$     **and**  
 Bit 11 of  $ERR\_INH\_LAM\_AD\_ACT[i] = 0$     **and**  
 Bit 12 of  $ERR\_INH\_LAM\_AD\_ACT[i] = 0$     **and**

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```

C_LAMB_SP_AD_MIN_ADD > LAMB_SP_HOM[i] > C_LAMB_SP_AD_MAX_ADD ) or
(WGPWM[i] ≤ C_WGPWM_MIN_LAM_AD and LV_LAM_CYL_ACT = 1 and LC_WPPWM_INH_
LAM_AD_ENA = 1)
or
(LV_INH_FSD_STOP_OIL=1 & LC_LAM_AD_INH_STOP_OIL = 1)
or
((C_T_AST_BOL_INH_LAM_AD < T_AST < C_T_AST_TOL_INH_LAM_AD)
& TCO < C_TCO_MAX_T_AST_INH_LAM_AD)
then LV_LAM_AD_ACT[i] = 0
else LV_LAM_AD_ACT[i] = 1
endif

```

```

if LV_LAM_AD_ENA = 1 and
LV_LAM_LSCL[i] = 1 and
LV_LAM_STOP[i] = 0 and
LV_LDC_LAM_AD[i] = 1

```

```

then
LV_LAM_AD_CDN_L_RNG[i] = 1
if LV_LAM_AD_EXT = 0
then LV_LAM_AD_CDN_H_RNG[i] = 1
LV_LAM_AD_CDN_ADD[i] = 1
else LV_LAM_AD_CDN_H_RNG[i] = 0
LV_LAM_AD_CDN_ADD[i] = 0
end

```

```

else
LV_LAM_AD_CDN_H_RNG[i] = 0
LV_LAM_AD_CDN_L_RNG[i] = 0
LV_LAM_AD_CDN_ADD[i] = 0
endif

```

Determination of mass fuel flow setpoint for lambda adaptation:

```

If LV_HOM_ACT = 1
Then MFF_SP_AD[i] = MFF_SP_HOM_BAS_MV
% set value of MFF_SP_HOM_BAS_MV to both banks.
Else MFF_SP_AD[i] = MFF_SP_S_SWI_HOM
% set value of MFF_SP_S_SWI_HOM to both banks.

```

**Endif**

Detection of limited dynamic conditions for lambda adaptation:

```

If (ABS(N_DELTA_LDC) > C_N_DYW_LDC_LAM_AD)
then
If (ABS(N_DELTA_LDC - N_OFS_LDC_LAM_AD[i]) > C_N_DYW_LDC_LAM_AD)
then N_OFS_LDC_LAM_AD[i] = N_DELTA_LDC
MAF_INT_LDC_LAM_AD[i] = 0
endif

```

```

else N_OFS_LDC_LAM_AD[i] = 0
endif

```

```

If (ABS(MAF_DELTA_LDC) > C_MAF_DYW_LDC_LAM_AD)

```


**then**

```

If (ABS(MAF_DELTA_LDC - MAF_OFS_LDC_LAM_AD[i]) >
C_MAF_DYW_LDC_LAM_AD)
then MAF_OFS_LDC_LAM_AD[i] = MAF_DELTA_LDC
MAF_INT_LDC_LAM_AD[i] = 0
endif

```

**endif**

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```

else          MAF_OFS_LDC_LAM_AD[i] = 0
endif

If          (ABS(FAC_LAM_MV_DELTA_LDC[i]) > C_FAC_LAM_MV_DYW_LDC_LAM_AD)
then
  If          (ABS(FAC_LAM_MV_DELTA_LDC[i] - FAC_LAM_MV_OFS_LDC_LAM_AD[i]) >
              C_FAC_LAM_MV_DYW_LDC_LAM_AD)
  then          FAC_LAM_MV_OFS_LDC_LAM_AD[i] = FAC_LAM_MV_DELTA_LDC[i]
  MAF_INT_LDC_LAM_AD[i] = 0
  endif
else          FAC_LAM_MV_OFS_LDC_LAM_AD[i] = 0
endif

If          (MAF_INT_LDC_LAM_AD[i] < C_MAF_INT_LDC_LAM_AD)
then          MAF_INT_LDC_LAM_AD[i] [g] = MAF_INT_LDC_LAM_AD[i] [g] +
MAF_CYL [kg/h] * T_SAMPLE [ms] * 1/3600 [(g*h)/(kg*ms)]
              LV_LDC_LAM_AD[i] = 0
else          LV_LDC_LAM_AD[i] = 1
endif

```


Determination of correlation constant for lambda adaptation and of distance between two adaptation calculations:

Note: Waiting time between two adaptations and correlation constant are solely dependent on the different adaptation ranges.

```

If          STATE_LAM_AD[i] = "ADAPT_ADD"
Then          T_WAIT_MAX_LAM_AD[i] = C_T_WAIT_MAX_LAM_AD_ADD
              If LV_LAM_LIM_LAM_AD[i] = 0
              Then C_RLC_LAM_AD[i] = C_C_RLC_LAM_AD_ADD
              Else C_RLC_LAM_AD[i] = C_C_RLC_LAM_AD_ADD_LAM_LIM
              Endif
Else          If          STATE_LAM_AD[i] = "ADAPT_FAC_L"
              Then          T_WAIT_MAX_LAM_AD[i] = C_T_WAIT_MAX_LAM_AD_L_RNG
              If LV_LAM_LIM_LAM_AD[i] = 0
              Then C_RLC_LAM_AD[i] = C_C_RLC_LAM_AD_L
              Else C_RLC_LAM_AD[i] = C_C_RLC_LAM_AD_L_LAM_LIM
              Endif
              Else          If          STATE_LAM_AD[i] = "ADAPT_FAC_H"
              Then          T_WAIT_MAX_LAM_AD[i] = C_T_WAIT_MAX_LAM_AD_H_
RNG
              If LV_LAM_LIM_LAM_AD[i] = 0
              Then C_RLC_LAM_AD[i] = C_C_RLC_LAM_AD_H
              Else C_RLC_LAM_AD[i] = C_C_RLC_LAM_AD_H_LAM_LIM
              Endif
              Else          T_WAIT_MAX_LAM_AD[i] = C_T_WAIT_MAX_LAM_AD
              If LV_LAM_LIM_LAM_AD[i] = 0
              Then C_RLC_LAM_AD[i] = C_C_RLC_LAM_AD_H
              Else C_RLC_LAM_AD[i] = C_C_RLC_LAM_AD_H_LAM_LIM
              Endif
              Endif
            Endif
          Endif
        Endif

```


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*Assignment of Lambda adaptation shift values*

$$\text{FAC\_LAM\_AD\_SHIFT}[i] = \text{FAC\_LAM\_AD\_CUS\_SHIFT}[i]$$

$$\text{LV\_FAC\_LAM\_AD\_SHIFT}[i] = \text{LV\_FAC\_LAM\_AD\_CUS\_SHIFT}[i]$$

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## 7.73 Cylinder balancing via lambda sensor

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_CYL_LAM [NC_CYL_NR]	O/V	0... F0H	0... 1440	6	°CRK
Value of phase displacement					
CTR_LAM_CYL_SEL_REF_CLL [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Segment based reference counter to close the control loop					
CTR_LAMB_CYL_SEL_CQ_DRIFT_THD [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
CILC- drift-away counter based on CQ value					
CTR_LAMB_CYL_SEL_CQ_STAB [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
CILC- stability counter based on CQ value					
CTR_T_LAM_CYL_ADJ [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	s
Timer of cylinder individual lambda control adaptation					
DELTA_LAMB_AV [NC_CBK_EX_NR]	V	8000... 7FFFH	-8... 7.99975	244.1e-6	-
Signal value of the WRAF Sensor, sampled with an appropriate resolution and shifted by its mean value					
DELTA_LAMB_CYL [NC_CYL_NR]	V	8000... 7FFFH	-8... 7.99975	244.1e-6	-
Individual adjusted signal					
DELTA_LAMB_CYL_SEL [NC_CBK_EX_NR]	V	8000... 7FFFH	-8... 7.99975	244.1e-6	-
Reassembled signal, made of individual adjusted signals					
DELTA_LAMB_CYL_SEL_CQ [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 7.99987	122.1e-6	-
Characteristic value of the estimated values					
DELTA_LAMB_CYL_SEL_CQ_FIL [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
Filter value of characteristic quantity of estimated cylinder individual lambda deviation					
DELTA_LAMB_DIF_CYL [NC_CYL_NR]	V	8000... 7FFFH	-8... 7.99975	244.1e-6	-
Control error for each cylinder					
DELTA_LAMB_ERR [NC_CBK_EX_NR]	V	8000... 7FFFH	-8... 7.99975	244.1e-6	1/s
Weighted estimation-error					
DELTA_LAMB_ERR_CYL_SEL [NC_CYL_NR]	V	8000... 7FFFH	-8... 7.99975	244.1e-6	1/s
Weighted estimation-error (split)					
DELTA_LAMB_ERR_RAW [NC_CBK_EX_NR]	V	8000... 7FFFH	-8... 7.99975	244.1e-6	-
Difference between the measured and the estimated value of the WRAF sensor					
DELTA_LAMB_MDL [NC_CBK_EX_NR]	V	8000... 7FFFH	-8... 7.99975	244.1e-6	-
Estimated value of the WRAF Sensor					
FAC_CYL_LAM [NC_CYL_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Output of the cylinder individual controller					
FAC_CYL_LAM_ABSV_SUM [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 49.99847	1.5259e-3	%
Sum of the absolute cylinder individual controller outputs					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_CYL_LAM_COR [NC_CYL_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Factor for the injection time correction of cylinder x					
FAC_CYL_LAM_I_MV_SHIFT [NC_CYL_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual controller output - I component, shifted by its mean value					
FAC_CYL_LAM_INT [NC_CYL_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual controller output - I component					
FAC_CYL_LAM_P [NC_CYL_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual controller output - P component					
FAC_CYL_LAM_P_MV_SHIFT [NC_CYL_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual controller output - P component, shifted by its mean value					
FAC_LAM_CYL_SEL_ADJ [NC_CYL_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual adaptation correction factor					
FAC_LAM_CYL_SEL_ADJ_CST [NC_CYL_NR]	O/V/S	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual adaptation correction factor under engine-cold condition					
FAC_LAM_CYL_SEL_ADJ_CST_FIL [NC_CYL_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual adaptation filter output under engine cold condition					
FAC_LAM_CYL_SEL_ADJ_CST_MV [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Mean value of cold-range adaptation - calculated out of the cylinder individual correction values					
FAC_LAM_CYL_SEL_ADJ_FIL [NC_CYL_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual adaptation filter output					
FAC_LAM_CYL_SEL_ADJ_H_RNG [NC_CYL_NR]	O/V/S	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual adaptation correction factor (high-range)					
FAC_LAM_CYL_SEL_ADJ_H_RNG_MV [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Mean value of high-range adaptation - calculated out of the cylinder individual correction values					
FAC_LAM_CYL_SEL_ADJ_INTER [NC_CYL_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual adaptation correction factor (cold-nominal-interpolation)					
FAC_LAM_CYL_SEL_ADJ_L_RNG [NC_CYL_NR]	O/V/S	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual adaptation correction factor (low-range)					
FAC_LAM_CYL_SEL_ADJ_L_RNG_MV [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Mean value of low-range adaptation - calculated out of the cylinder individual correction values					
FAC_T [NC_CBK_EX_NR]	V	0... FFFFH	0... 63.99902	976.599e-6	-
Time factor of the exponential function for the sensor model					
FAC_VAL_LAM_CYL_SEL_REAC	V	0... FFFFH	0... 0.99998	15.3e-6	-
Valuated factor for internal states at reactivation moment					
LAMB_CYL_SEL [NC_CYL_NR]	V	0... 7FFFH	0... 7.99975	244.1e-6	-
Cylinder individual lambda value					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_CYL_SEL_CQ_DIF_REF [NC_CBK_EX_NR]	V	8000... 7FFFH	-0.5... 0.49998	15.3e-6	-
Deviation of CILC - Characteristic Quantity from the stored reference value					
LAMB_CYL_SEL_CQ_REF [NC_CBK_EX_NR]	V	0... FFFFH	0... 0.99998	15.3e-6	-
Reference CILC - Characteristic Quantity stored at virtual limit transition					
LV_FAC_CYL_LAM_LIM_MAX [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that the cylinder individual lambda controller output is out of upper limit					
LV_FAC_CYL_LAM_LIM_MIN [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that the cylinder individual lambda controller output is out of lower limit					
LV_FAC_CYL_LAM_VIRT_LIM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating that the cylinder individual lambda control is out of virtual limit					
LV_FAC_LAM_CYL_ADJ_CST_LIM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating that at least one of the cold-adaptation values is out of range					
LV_FAC_LAM_CYL_SEL_ADJ_LIM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating that at least one of the nominal-adaptation values is out of range					
LV_LAM_CYL_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Cylinder individual lambda control is active					
LV_LAM_CYL_SEL_ADJ_H_RNG_VLD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that the value of cylinder individual lambda adaptation in high-range is valid					
LV_LAM_CYL_SEL_ADJ_L_RNG_VLD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that the value of cylinder individual lambda adaptation in low-range is valid					
LV_LAM_CYL_SEL_ADJ_VLD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that the value of cylinder individual lambda adaptation is valid for the current adaptation state					
LV_LAM_CYL_SEL_CTL_DRIFT_PRED [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Drift-away behaviour of cylinder individual lambda control predicted					
LV_LAM_CYL_SEL_SEG_REF_CLL [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Segment based reference flag to close the control loop					
LV_LAMB_CYL_SEL_CQ_DRIFT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Drift-away behaviour of cylinder individual lambda control detected - based on CQ value					
LV_MFF_ADD_CYL_LAM_COR_LIM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating that at least one of the fuel mass offset correction values is out of range					
MFF_ADD_CYL_LAM_COR [NC_CYL_NR]	O/V/S	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
Cylinder individual fuel mass offset correction					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MFF_ADD_CYL_LAM_COR_MV [NC_CBK_EX_NR]	V	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
Mean value of the fuel mass offset correction - calculated out of the cylinder individual correction values					
MFF_ADD_CYL_LAM_COR_OUT [NC_CYL_NR]	O/V	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
Cylinder individual fuel mass offset correction - weighted output					
MFF_DELTA_LAM_CYL_SEL_REAC	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Absolute fuel mass difference at deactivation and reactivation interval					
MFF_SP_SAVE_LAM_CYL_SEL	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Stored fuel mass setpoint at CILC deactivation moment					
STATE_LAM_CYL_SEL [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H	PAS OPL WAIT CLL	-	-
State of cylinder individual lambda control					
STATE_LAM_CYL_SEL_ADJ [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H 4H 5H 6HH	PAS WAIT_ ENG_COLD ADJ_ENG_ COLD WAIT_ENG_ NOM ADJ_NOM_L_ RNG ADJ_NOM_H_ RNG ADJ_NOM_ OFS	-	-
State of cylinder individual lambda control adaptation					
STATE_LAMB_CYL_SEL_CQ_SLOP [NC_CBK_EX_NR]	O/V/S	0H 1H 2H	NEUT RISE RISE_CYC	-	-
Slope state of CILC - Characteristic Quantity					
VLS_CYL_SEL [NC_CYL_NR]	V	0... 3FFFH	0... 4.99511	4.8828e-3	V
Upstream oxygen sensor acquisition (cylinder Individual)					

**Input data:**

AMP {p. 982}	DELTA_CRK_CYL_LAM [NC_CBK_EX_NR] {p. 2838}	LF_LS_CBK_EX_LAM_ CYL_SEL_CONF {p. 2864}	LV_DC {p. 5746}
LV_FAC_CYL_LAM_COR_ OSC [NC_CBK_EX_NR] {p. 2839}	LV_INH_OBD_DIAG_CYL_ BAL_LAM [NC_CBK_EX_NR] {p. 5113}	LV_LAM_CYL_ENA [NC_CBK_EX_NR] {p. 2864}	LV_LAM_CYL_SEL_ADJ_ OFS_REQ [NC_CBK_EX_NR] {p. 2864}
LV_LAM_CYL_SEL_ADJ_ RST_IV_EXT [NC_CBK_EX_NR] {p. 7483}	LV_LAM_CYL_SEL_CTL_ FAST_REQ {p. 2864}	LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	MAF {p. 8277}

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MFF_SP [NC_CBK_EX_NR] {p. 2151}	MFF_SP_LAM_CYL_SEL {p. 2864}	N {p. 1525}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	PHA_SHIFT_CAM_EX [NC_CBK_EX_NR] {p. 2864}	SEG_NR {p. 1525}
STATE_DELTA_CRK_CYL_LAM [NC_CBK_EX_NR] {p. 2839}	TCO {p. 1100}	TEMP_LAM_CYL_SEL {p. 2864}	VLS_CYL [NC_CYL_NR] {p. 1017}
VLS_CYL_TRIG [NC_CYL_NR] {p. 1017}			

**Calibration data:**


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRK_CYL_LAM [NC_CYL_NR]	-	88... 78H	-720 ...720	6	°CRK
Factor for different distance between lambda sensor and cylinder individual exhaust-valves					
C_CRLC_CYL_FIL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for the filter output					
C_CRLC_DELTA_LAMB_CYL_CQ_FIL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Filter correlation constant - characteristic quantity of estimated cylinder individual lambda deviation					
C_CRLC_EXV_FAC [NC_CYL_NR]	-	0... FFFFH	0... 1.99996	30.5e-6	-
Exhaust-valve manifold-port correlation factor					
C_CRLC_LAM_CYL_CST_FIL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for the filter output under engine cold condition					
C_CTR_LAM_CYL_SEL_REF_CLL_THD	-	0... FFFFH	0... 65535	1	-
Threshold for segment based reference counter to close the control loop					
C_CTR_LAMB_CYL_SEL_CQ_DRIFT_THD	-	0... FFFFH	0... 65535	1	-
CQ- drift counter threshold for inhibition of cylinder individual lambda adaptation					
C_CTR_LAMB_CYL_SEL_CQ_STAB_THD	-	0... FFFFH	0... 65535	1	-
CQ- stability counter threshold to release the cylinder individual lambda adaptation					
C_DELTA_LAMB_CYL_SP	-	8000... 7FFFH	-8... 7.99975	244.1e-6	-
Setpoint value					
C_FAC_CYL_LAM_ABSV_DEC	-	0... 7FFFH	0... 49.99847	1.5259e-3	%
Absolute decrement constant to increase or decrease the cylinder individual injection time correction					
C_FAC_CYL_LAM_MAX	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Upper limit of the cylinder individual controller output					
C_FAC_CYL_LAM_MIN	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Lower limit of the cylinder individual controller output					
C_FAC_CYL_LAM_VIRT_MAX	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Upper virtual limit of the cylinder individual controller output					
C_FAC_CYL_LAM_VIRT_MIN	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Lower virtual limit of the cylinder individual controller output					
C_FAC_LAM_CYL_SEL_ADJ_CST_MAX	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Upper limit of the cylinder individual cold-adaptation correction factor					
C_FAC_LAM_CYL_SEL_ADJ_CST_MIN	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Lower limit of the cylinder individual cold-adaptation correction factor					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_LAM_CYL_SEL_ADJ_MAX	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Upper limit of the cylinder individual nominal-adaptation correction factor					
C_FAC_LAM_CYL_SEL_ADJ_MIN	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Lower limit of the cylinder individual nominal-adaptation correction factor					
C_FAC_LAM_CYL_SEL_ADJ_VLD_THD	-	0... 7FFFH	0... 49.99847	1.5259e-3	%
Absolute-Controller-Sum-Threshold for evaluation of adaptation result					
C_LAMB_CYL_SEL_CQ_DIF_REF_THD	-	8000... 7FFFH	-0.5... 0.49998	15.3e-6	-
CQ- slope threshold for inhibition of cylinder individual lambda adaptation					
C_LAMB_CYL_SEL_CQ_DRIFT_THD	-	0... FFFFH	0... 0.99998	15.3e-6	-
CQ- drift threshold for inhibition of cylinder individual lambda adaptation					
C_MFF_LAM_CYL_ADJ_CST_MAX	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Upper fuel mass threshold for calculation of cylinder individual lambda adaptation (engine cold)					
C_MFF_LAM_CYL_ADJ_CST_MIN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Lower fuel mass threshold for calculation of cylinder individual lambda adaptation (engine cold)					
C_MFF_MAX_ADD_LAM_CYL_SEL_ADJ	-	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
Maximum value of cylinder individual fuel mass offset					
C_MFF_MAX_FAC_CYL_SEL_ADJ_H_RNG	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Upper fuel mass threshold for calculation of cylinder individual lambda adaptation (high-range)					
C_MFF_MAX_FAC_CYL_SEL_ADJ_L_RNG	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Upper fuel mass threshold for calculation of cylinder individual lambda adaptation (low-range)					
C_MFF_MIN_ADD_LAM_CYL_SEL_ADJ	-	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
Minimum value of cylinder individual fuel mass offset					
C_MFF_MIN_FAC_CYL_SEL_ADJ_H_RNG	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Lower fuel mass threshold for calculation of cylinder individual lambda adaptation (high-range)					
C_MFF_MIN_FAC_CYL_SEL_ADJ_L_RNG	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Lower fuel mass threshold for calculation of cylinder individual lambda adaptation (low-range)					
C_MFF_SP_THD_CYL_SEL_ADJ_H_RNG	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Minimum fuel mass threshold for consideration of the high range adaptation value in the injection correction					
C_MFF_SP_THD_CYL_SEL_ADJ_L_RNG	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Maximum fuel mass threshold for consideration of the low range adaptation value in the injection correction					
C_N_LAM_CYL_ADJ_CST_MAX	-	0... FFH	0... 8160	32	rpm
Upper engine speed threshold for calculation of cylinder individual lambda adaptation (cold condition)					
C_N_LAM_CYL_ADJ_CST_MIN	-	0... FFH	0... 8160	32	rpm
Lower engine speed threshold for calculation of cylinder individual lambda adaptation (cold condition)					
C_N_MAX_FAC_CYL_SEL_ADJ_H_RNG	-	0... FFH	0... 8160	32	rpm
Upper engine speed threshold for calculation of cylinder individual lambda adaptation (high-range)					
C_N_MAX_FAC_CYL_SEL_ADJ_L_RNG	-	0... FFH	0... 8160	32	rpm
Upper engine speed threshold for calculation of cylinder individual lambda adaptation (low-range)					
C_N_MIN_FAC_CYL_SEL_ADJ_H_RNG	-	0... FFH	0... 8160	32	rpm
Lower engine speed threshold for calculation of cylinder individual lambda adaptation (high-range)					
C_N_MIN_FAC_CYL_SEL_ADJ_L_RNG	-	0... FFH	0... 8160	32	rpm
Lower engine speed threshold for calculation of cylinder individual lambda adaptation (low-range)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_LAM_CYL_ADJ	-	0... FFH	0... 255	1	s
Time recurrence for adaptation update					
C_T_LAM_CYL_ADJ_CST	-	0... FFH	0... 255	1	s
Time recurrence for adaptation update under engine cold condition					
C_TEMP_LAM_CYL_CST_MAX	-	0... FEH	-48... 142.5	0.75	°C
Maximum coolant temperature for the activation of CILC under cold condition					
C_TEMP_LAM_CYL_CST_MIN	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature for the activation of CILC under cold condition					
C_TEMP_LAM_CYL_MIN	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature for the activation - nominal condition					
C_TEMP_THD_CYL_SEL_ADJ_COLD_RNG	-	0... FEH	-48... 142.5	0.75	°C
Maximum coolant temperature threshold for consideration of the cold-range adaptation value					
C_TEMP_THD_CYL_SEL_ADJ_NOM_RNG	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature threshold for consideration of the nominal-range adaptation value					
IP_CRK_DELTA_AMP_CYL_LAM	-	88... 78H	-720 ...720	6	°CRK
LDP_AMP_IP_CRK_DELTA_AMP	6	0... FFFFH	0... 5434	0.0829175	hPa
Phase shift deviation caused by elevation					
IP_CRK_SYN [NC_CBK_EX_NR]	V	0... F0H	0... 1440	6	°CRK
LDPM_N_1_CYBL	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_CYBL	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Phase displacement					
IP_CRLC_CYL_LAM	V	0... FFFFH	0... 7.99987	122.1e-6	%
LDPM_N_1_CILC	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_CILC	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Correlation characteristic for AFR equalisation - nominal controller parameter					
IP_CRLC_I_NEUT_RNG	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_DELTA_LAMB_DIF_CYL_I	8	0... FFFFH	-8... 7.99975	244.1e-6	-
Dead zone for calculation of I-component					
IP_CRLC_INT_FAST_CYL_LAM	V	0... FFFFH	0... 7.99987	122.1e-6	%
LDPM_N_1_CILC	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_CILC	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Correlation characteristic for AFR equalisation - fast controller parameter					
IP_CRLC_P_NEUT_RNG	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_DELTA_LAMB_DIF_CYL_P	8	0... FFFFH	-8... 7.99975	244.1e-6	-
Dead zone for calculation of P-component					
IP_EXP_LAMB_MDL [NC_CBK_EX_NR]	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_FAC_T_1_CYBL	16	0... FFFFH	0... 63.99902	976.599e-6	-
Exponential function for the sensor model					
IP_FAC_ERR_LAM_SEL	-	0... FFFFH	0... 255.99609	3.9063e-3	1/s
LDP_T1_LAMB_CYL_IP_FAC_ERR	6	0... FFFFH	0... 1.99996	30.5e-6	s
Weight coefficient					
IP_FAC_GAIN_P_LAM_CYL_SEL	V	0... FFFFH	0... 63.99902	976.599e-6	%
LDPM_N_1_CILC	8	0... 1FE0H	0... 8160	1	rpm

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_MAF_1_CILC	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Gain of cylinder individual controller (P-component)					
IP_FAC_N_MFF_ADD_CYL_LAM_COR	-	0... FFH	0... 0.99609	3.9063e-3	-
LDP_N_32_IP_FAC_MFF_ADD_CYL	6	0... FFH	0... 8160	32	rpm
Engine speed dependent factor for realization of cylinder individual fuel mass offset correction					
IP_FAC_OPP_LAM_CYL_SEL_ADJ	V	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_N_1_CYBL	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_CYBL	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Cylinder individual lambda adaptation factor depending on operating point					
IP_FAC_OPP_LAM_CYL_SEL_ADJ_FAST	V	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_N_1_CILC	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_CILC	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Cylinder individual lambda adaptation factor depending on operating point (fast adaptation)					
IP_FAC_VAL_LAM_CYL_SEL_REAC	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_MFF_DELTA_LAM_CYL_IP_FAC	6	0... FFFFH	0... 1389	0.0211948	mg/stk
MFF-difference- dependent factor for internal states at reactivation moment					
IP_FAC_WUP_MFF_ADD_CYL_LAM	-	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_TCO_1_CYBL	6	0... FEH	-48... 142.5	0.75	°C
Temperature dependent factor for realization of cylinder individual fuel mass offset correction during warm-up					
IP_LAMB_CYL [NC_CBK_EX_NR]	-	0... 7FFFH	0... 7.99975	244.1e-6	-
LDP_VLS_CYL_SEL_IP_LAMB	16	0... 3FFH	0... 4.99511	4.8828e-3	V
Characteristic curve of the WRAF sensor					
IP_N1_FAC_LAMB_MDL [NC_CBK_EX_NR]	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_FAC_T_1_CYBL	16	0... FFFFH	0... 63.99902	976.599e-6	-
N1 coefficient of the sensor model					
IP_N2_FAC_LAMB_MDL [NC_CBK_EX_NR]	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_FAC_T_1_CYBL	16	0... FFFFH	0... 63.99902	976.599e-6	-
N2 coefficient of the sensor model					
IP_T1_LAMB_CYL_SEL [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996	30.5e-6	s
LDPM_N_1_CYBL	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_CYBL	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Time lag of the lambda-sensor model specified for cylinder individual lambda control					
LC_ADAPT_COR_OUT	-	0... 1H	0 ...1	1	-
Adaptation switch (=1)					
LC_FAC_CYL_LAM_P_SWI	-	0... 1H	0 ...1	1	-
Calculation switch for the choice of the control structure (= 0 'I - controller'; = 1 'PI controller')					
LC_FAC_LAM_CYL_SEL_ADJ_CST_ENA	-	0... 1H	0 ...1	1	-
Switch enabling the adaptation under engine cold condition (=1)					
LC_FAC_LAM_CYL_SEL_ADJ_P_I_ENA	-	0... 1H	0 ...1	1	-
Calculation switch for the choice of the adaptation method (= 0 'I - component concerned'; = 1 'PI concerned')					
LC_LAM_CYL_SEL_ERR_RST	-	0... 1H	0 ...1	1	-
Switch enabling the reset of adaptation values in case of error (=1)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_LAM_CYL_SEL_OPL	-	0... 1H	0 ...1	1	-
Switch for open loop operation (=1)					
LC_LAMB_DELTA_MDL_HLD	-	0... 1H	0 ...1	1	-
Calculation switch for the choice of the discretization method of the sensor model (= 0 'zoh'; = 1 'foh')					

## DESCRIPTION:

### General information:

```

if(1) two separate cylinder banks are concerned
then
    i = 1, for cylinder bank 1 ( x = 0, 2, 4, ... )
    i = 2, for cylinder bank 2 ( x = 1, 3, 5, ... )
else(1)
    i = 1 ( x = 0 ... 3 or 4 )
endif(1)

```

### Description of index "[i]" and "[x]":


*x*: logical cylinder

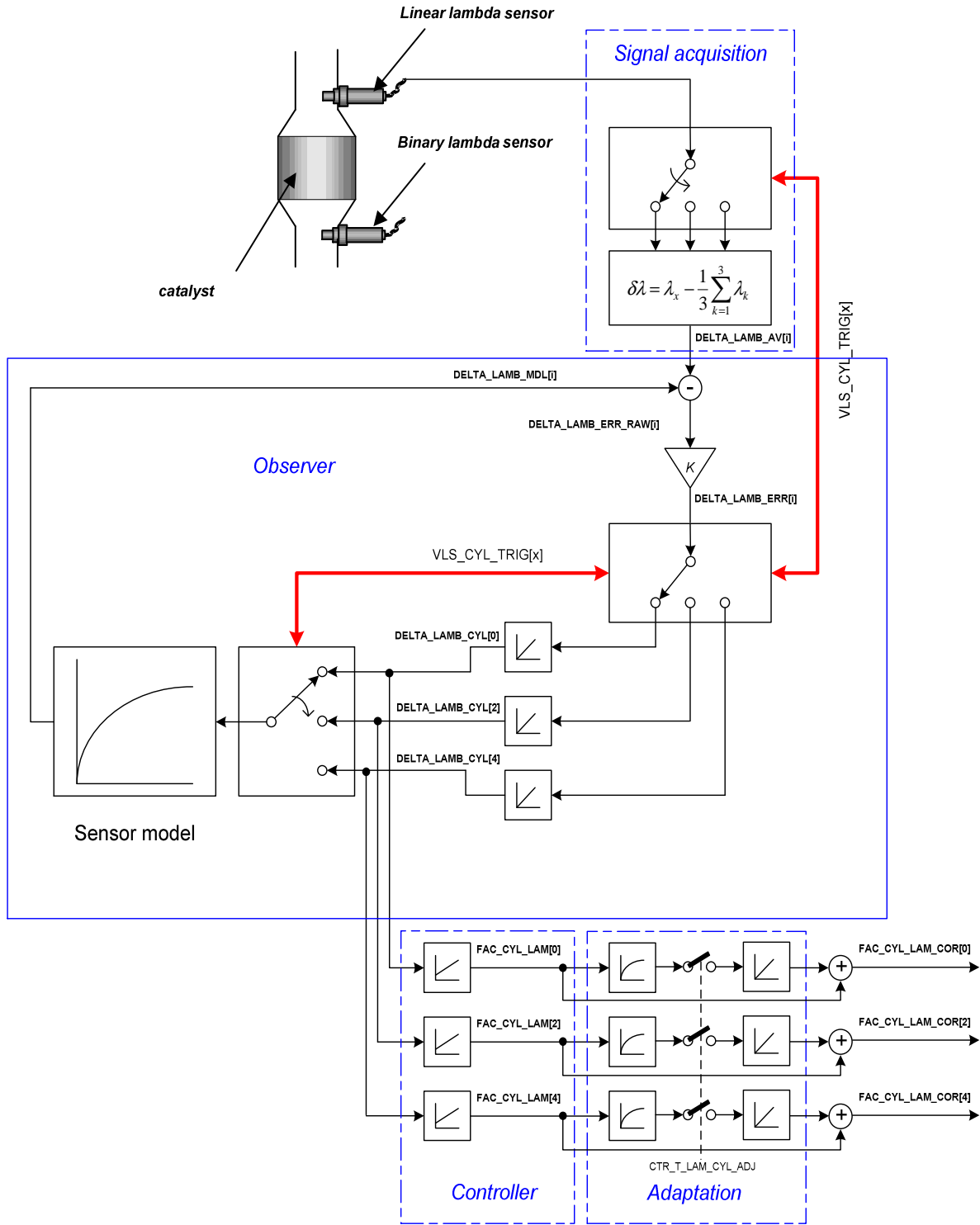
use **NC\_CYL\_NR** : number of engine cylinders - index "[x]"

use **LF\_LS\_CBK\_EX\_LAM\_CYL\_SEL\_CONF**: pattern for allocation of physical cylinders to exhaust bank - index "[i]"

The purpose of this function is detection and control the cylinder to cylinder air-fuel ratio deviation in an internal combustion engine using an observer to estimate the deviation of each cylinder that is not measurable and a controller for each cylinder separately. In this connection the periodic signal of the WRAF sensor is reconstructed using a sensor model and adapted to the measured value. The estimated state describes the deviation in percentage for each cylinder. The mentioned value is an input to a control system that balances the air- /fuel ratio in each cylinder separately (Figure 1).


**Figure 1: Structure of the cylinder individual lambda control for a 3-cylinder-exhaust-bank**

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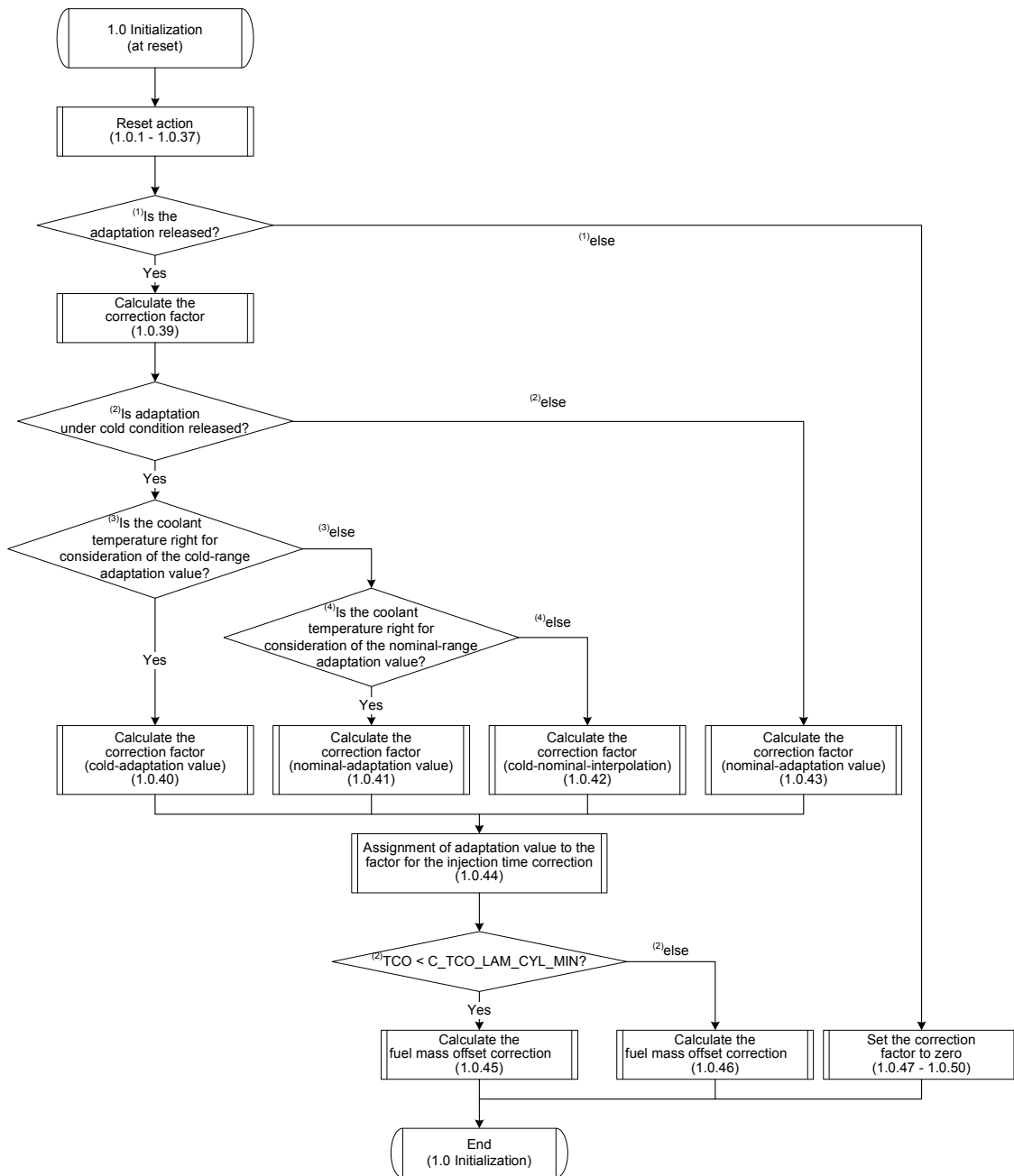


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### 7.73.1 Initialization (at reset):



$\Delta_{LAMB\_CYL\_SEL\_CQ}[i] = 0$

(1.0.1)

$\Delta_{LAMB\_CYL\_SEL\_CQ\_FIL}[i] = 0$

(1.0.2)

$\lambda_{CYL\_SEL\_CQ\_REF}[i] = 0$

(1.0.3)

$\lambda_{CYL\_SEL\_CQ\_DIF\_REF}[i] = 0$

(1.0.4)

$\Delta_{LAMB\_AV}[i] = 0$

(1.0.5)

$\Delta_{LAMB\_ERR\_RAW}[i] = 0$

DELTA_LAMB_ERR[i] = 0	(1.0.6)
DELTA_LAMB_ERR_CYL_SEL[x] = 0	(1.0.7)
DELTA_LAMB_CYL[x] = 0	(1.0.8)
DELTA_LAMB_CYL_SEL[i] = 0	(1.0.9)
DELTA_LAMB_MDL[i] = 0	(1.0.10)
DELTA_LAMB_DIF_CYL[x] = 0	(1.0.11)
FAC_CYL_LAM_INT[x] = 0	(1.0.12)
FAC_CYL_LAM_P[x] = 0	(1.0.13)
FAC_CYL_LAM_I_MV_SHIFT[x] = 0	(1.0.14)
FAC_CYL_LAM_P_MV_SHIFT[x] = 0	(1.0.15)
FAC_CYL_LAM[x] = 0	(1.0.16)
FAC_LAM_CYL_SEL_ADJ_FIL[x] = 0	(1.0.17)
FAC_LAM_CYL_SEL_ADJ_CST_FIL[x] = 0	(1.0.18)
LV_FAC_CYL_LAM_LIM_MIN[x] = 0	(1.0.19)
LV_FAC_CYL_LAM_LIM_MAX[x] = 0	(1.0.20)
LV_LAM_CYL_SEL_SEG_REF_CLL[i] = 0	(1.0.21)
LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 0	(1.0.22)
STATE_LAM_CYL_SEL[i] = 0 [PAS]	(1.0.23)
STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]	(1.0.24)
CTR_T_LAM_CYL_ADJ[i] = 0	(1.0.25)
MFF_ADD_CYL_LAM_COR_MV[i] = 0	(1.0.26)
MFF_DELTA_LAM_CYL_SEL_REAC = 0	(1.0.27)
FAC_VAL_LAM_CYL_SEL_REAC = 0	(1.0.28)
FAC_CYL_LAM_ABSV_SUM[i] = 0	(1.0.29)
MFF_SP_SAVE_LAM_CYL_SEL = 0	(1.0.30)
CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] = 0	(1.0.31)

```

LV_LAMB_CYL_SEL_CQ_DRIFT[i] = 0                                     (1.0.32)
CTR_LAM_CYL_SEL_REF_CLL[i] = 0                                   (1.0.33)
LV_LAM_CYL_SEL_ADJ_VLD[i] = 0                                   (1.0.34)
LV_MFF_ADD_CYL_LAM_COR_LIM[i] = 0                               (1.0.35)
LV_FAC_CYL_LAM_VIRT_LIM[i] = 0                                  (1.0.36)
CTR_LAMB_CYL_SEL_CQ_STAB[i] = 0                                (1.0.37)
if(1) LC_ADAPT_COR_OUT = 1                                        (1.0.38)
then
    FAC_LAM_CYL_SEL_ADJ[x] = FAC_LAM_CYL_SEL_ADJ_L_RNG[x]      (1.0.39)
    if(2) LC_FAC_LAM_CYL_SEL_ADJ_CST_ENA = 1
        [adaptation under cold condition released]
    then
        if(3) TEMP_LAM_CYL_SEL_C_TEMP_THD_CYL_SEL_ADJ_COLD_RNG
        then
            FAC_LAM_CYL_SEL_ADJ_INTER[x] =
                FAC_LAM_CYL_SEL_ADJ_CST[x]
(1.0.40)
        else(3)
            if(4) TEMP_LAM_CYL_SEL
                C_TEMP_THD_CYL_SEL_ADJ_NOM_
RNG
            then
                FAC_LAM_CYL_SEL_ADJ_INTER[x] =
                    FAC_LAM_CYL_SEL_ADJ[x] (1.0.41)
            else(4)
                FAC_LAM_CYL_SEL_ADJ_INTER[x] =
                    FAC_LAM_CYL_SEL_ADJ_CST[x]
+
                (TEMP_LAM_CYL_SEL -
RNG)*
                    C_TEMP_THD_CYL_SEL_ADJ_COLD_
                    (FAC_LAM_CYL_SEL_ADJ[x] -
                    FAC_LAM_CYL_SEL_ADJ_CST[x])/
                    (C_TEMP_THD_CYL_SEL_ADJ_
                    C_TEMP_THD_CYL_SEL_ADJ_COLD_
NOM_RNG -
RNG) (1.0.42)
            endif(4)
        endif(3)
    else(2)
        FAC_LAM_CYL_SEL_ADJ_INTER[x] = FAC_LAM_CYL_SEL_ADJ[x]
(1.0.43)
    endif(2)
endif(1)

```

$$\text{FAC\_CYL\_LAM\_COR}[x] = \text{FAC\_LAM\_CYL\_SEL\_ADJ\_INTER}[x]$$

**(1.0.44)**

**if**<sup>(2)</sup>             $\text{TEMP\_LAM\_CYL\_SEL} < \text{C\_TEMP\_LAM\_CYL\_MIN}$

**then**

$$\text{MFF\_ADD\_CYL\_LAM\_COR\_OUT}[x] = \text{MFF\_ADD\_CYL\_LAM\_COR}[x] * \text{IP\_FAC\_WUP\_MFF\_ADD\_CYL\_LAM}$$

**(1.0.-)**

**else**<sup>(2)</sup>

$$\text{MFF\_ADD\_CYL\_LAM\_COR\_OUT}[x] = \text{MFF\_ADD\_CYL\_LAM\_COR}[x]$$

**(1.0.46)**

**endif**<sup>(2)</sup>

**else**<sup>(1)</sup>

$$\text{FAC\_LAM\_CYL\_SEL\_ADJ}[x] = 0$$

**(1.0.47)**

$$\text{FAC\_LAM\_CYL\_SEL\_ADJ\_INTER}[x] = 0$$

**(1.0.48)**

$$\text{FAC\_CYL\_LAM\_COR}[x] = 0$$

**(1.0.49)**

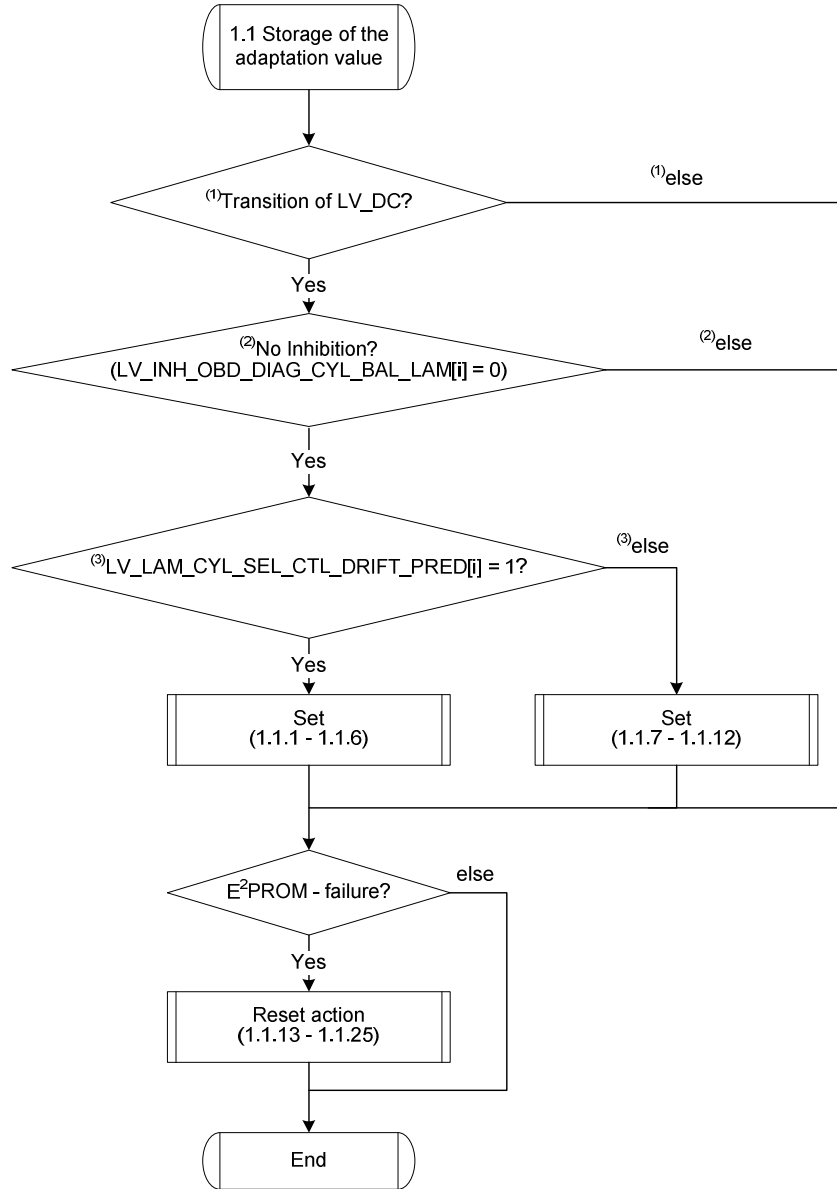
$$\text{MFF\_ADD\_CYL\_LAM\_COR\_OUT}[x] = 0$$

**(1.0.50)**

**endif**<sup>(1)</sup>

### 7.73.2 Storage of the adaptation value:

The value of  $\text{FAC\_LAM\_CYL\_SEL\_ADJ\_L\_RNG}[x]$ ,  $\text{FAC\_LAM\_CYL\_SEL\_ADJ\_H\_RNG}[x]$ ,  $\text{FAC\_LAM\_CYL\_SEL\_ADJ\_CST}[x]$  and  $\text{MFF\_ADD\_CYL\_LAM\_COR}[x]$  shall be stored in the non-volatile memory at DC- transition (LV\_DC 1 0). Should the value of cylinder individual injection time fall into the lower/ upper limit, the adaptation value shall not be stored in the non-volatile memory. I.e., if one of the exhaust-bank-related cylinders is out of range, the adaptation values for all cylinders of the concerned exhaust bank shall be taken from the last driving cycle (LDC).



**if**<sup>(1)</sup> LV\_DC 1 0  
**then**

**if**<sup>(2)</sup> LV\_INH\_OBD\_DIAG\_CYL\_BAL\_LAM[i] = 0  
**then**

**if**<sup>(3)</sup> LV\_LAM\_CYL\_SEL\_CTL\_DRIFT\_PRED[i] = 1  
**then**

**(1.1.1)** FAC\_LAM\_CYL\_SEL\_ADJ\_L\_RNG[x] = FAC\_LAM\_CYL\_SEL\_ADJ\_L\_RNG[x]<sub>LDC</sub>

**(1.1.2)** FAC\_LAM\_CYL\_SEL\_ADJ\_H\_RNG[x] = FAC\_LAM\_CYL\_SEL\_ADJ\_H\_RNG[x]<sub>LDC</sub>

FAC\_LAM\_CYL\_SEL\_ADJ\_CST[x] = FAC\_LAM\_CYL\_SEL\_ADJ\_CST[x]<sub>LDC</sub> **(1.1.3)**

MFF\_ADD\_CYL\_LAM\_COR[x] = MFF\_ADD\_CYL\_LAM\_COR[x]<sub>LDC</sub> **(1.1.4)**

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```

LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i] =
VLD[i]LDC(1.1.5) LV_LAM_CYL_SEL_ADJ_H_RNG_
LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i] =
VLD[i]LDC(1.1.6) LV_LAM_CYL_SEL_ADJ_L_RNG_
else(3)
(1.1.7) FAC_LAM_CYL_SEL_ADJ_L_RNG[x] =
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]CDC
(1.1.8) FAC_LAM_CYL_SEL_ADJ_H_RNG[x] =
FAC_LAM_CYL_SEL_ADJ_H_RNG[x]CDC
FAC_LAM_CYL_SEL_ADJ_CST[x] =
MFF_ADD_CYL_LAM_COR[x] = MFF_ADD_CYL_LAM_COR[x]CDC
LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i] =
VLD[i]CDC(1.1.11) LV_LAM_CYL_SEL_ADJ_H_RNG_
LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i] =
VLD[i]CDC(1.1.12) LV_LAM_CYL_SEL_ADJ_L_RNG_
endif(3)
endif(2)
[Remark: the cylinder based limitation (index x) shall be
assigned to the corresponding exhaust bank (index i)]
endif(1)

```


**At E\*\*2PROM - failure:**

```

FAC_LAM_CYL_SEL_ADJ_L_RNG[x] = 0 (1.1.13)
FAC_LAM_CYL_SEL_ADJ_H_RNG[x] = 0 (1.1.14)
FAC_LAM_CYL_SEL_ADJ_CST[x] = 0 (1.1.15)
MFF_ADD_CYL_LAM_COR[x] = 0 (1.1.16)
LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i] = 0 (1.1.17)
LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i] = 0 (1.1.18)
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]LDC = 0 (1.1.19)
FAC_LAM_CYL_SEL_ADJ_H_RNG[x]LDC = 0 (1.1.20)
FAC_LAM_CYL_SEL_ADJ_CST[x]LDC = 0 (1.1.21)
MFF_ADD_CYL_LAM_COR[x]LDC = 0 (1.1.22)
LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i]LDC = 0 (1.1.23)

```

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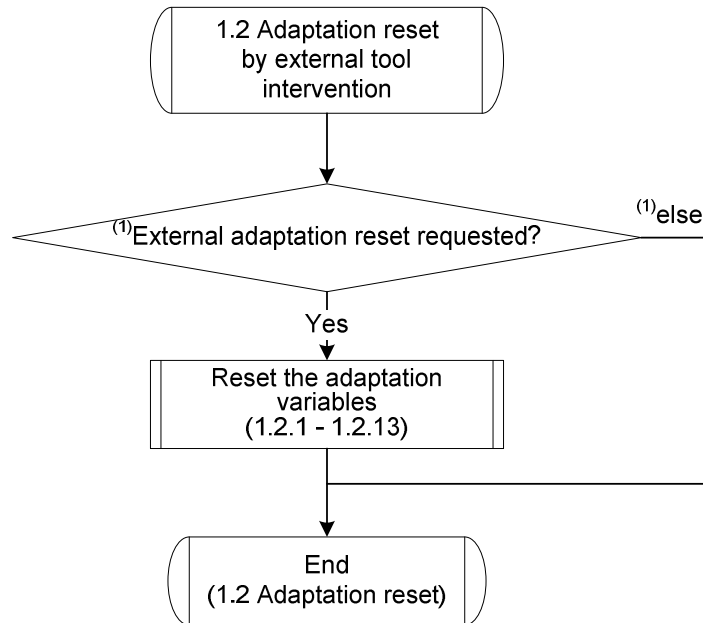
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$$LV\_LAM\_CYL\_SEL\_ADJ\_L\_RNG\_VLD[i]_{LDC} = 0 \quad (1.1.24)$$

$$STATE\_LAMB\_CYL\_SEL\_CQ\_SLOP[i] = 0 \quad (1.1.25)$$

### 7.73.3 Adaptation reset by external tool intervention

Following calculation shall be carried out independently of the activation condition (time recurrence: 100 ms):



**if**<sup>(1)</sup> LV\_LAM\_CYL\_SEL\_ADJ\_RST\_IV\_EXT[i] = 1

**then**

[Remark: the exhaust bank based calculation shall be executed for all of the exhaust-bank-related cylinders (index "[i]" -> index "[x]")]

$$FAC\_LAM\_CYL\_SEL\_ADJ\_L\_RNG[x] = 0 \quad (1.2.1)$$

$$FAC\_LAM\_CYL\_SEL\_ADJ\_H\_RNG[x] = 0 \quad (1.2.2)$$

$$FAC\_LAM\_CYL\_SEL\_ADJ\_CST[x] = 0 \quad (1.2.3)$$

$$MFF\_ADD\_CYL\_LAM\_COR[x] = 0 \quad (1.2.4)$$

$$LV\_LAM\_CYL\_SEL\_ADJ\_H\_RNG\_VLD[i] = 0 \quad (1.2.5)$$

$$LV\_LAM\_CYL\_SEL\_ADJ\_L\_RNG\_VLD[i] = 0 \quad (1.2.6)$$

$$FAC\_LAM\_CYL\_SEL\_ADJ\_L\_RNG[x]_{LDC} = 0 \quad (1.2.7)$$

$$FAC\_LAM\_CYL\_SEL\_ADJ\_H\_RNG[x]_{LDC} = 0 \quad (1.2.8)$$

$$FAC\_LAM\_CYL\_SEL\_ADJ\_CST[x]_{LDC} = 0 \quad (1.2.9)$$

$$MFF\_ADD\_CYL\_LAM\_COR[x]_{LDC} = 0 \quad (1.2.10)$$

$$\text{LV\_LAM\_CYL\_SEL\_ADJ\_H\_RNG\_VLD}[i]_{LDC} = 0 \quad (1.2.11)$$

$$\text{LV\_LAM\_CYL\_SEL\_ADJ\_L\_RNG\_VLD}[i]_{LDC} = 0 \quad (1.2.12)$$


$$\text{STATE\_LAMB\_CYL\_SEL\_CQ\_SLOP}[i] = 0 \quad (1.2.13)$$

**endif**<sup>(1)</sup>

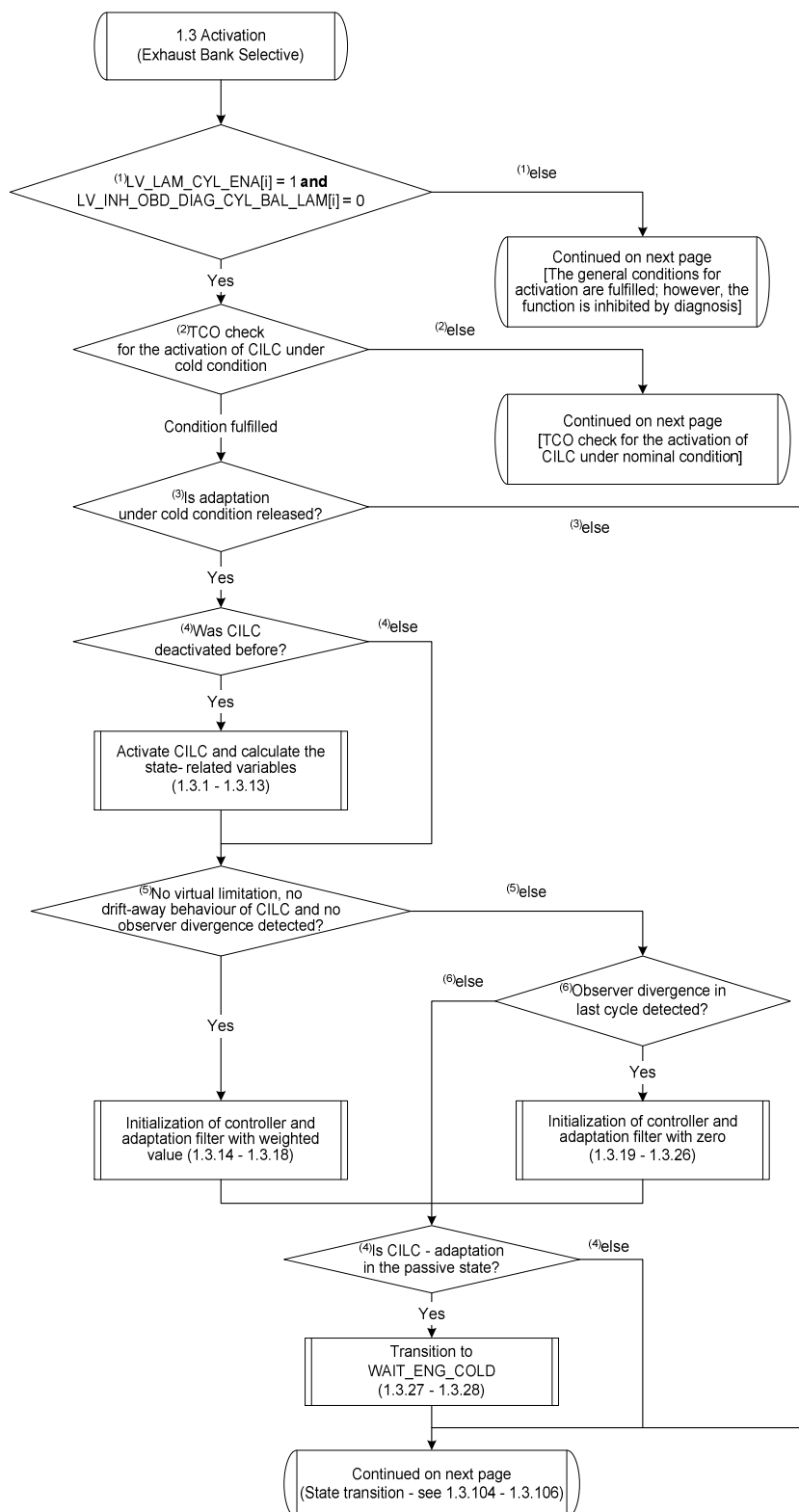
Time recurrence:

every TDC; 100 ms **(1.2)**; every C\_T\_LAM\_CYL\_ADJ\_CST **(1.12.9)**;

every C\_T\_LAM\_CYL\_ADJ **(1.12.9)**;


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### 7.73.4 Activation (exhaust bank selective):



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Figure 7.73.1: TOLOMEOGRAPHIC 269252-7.ps

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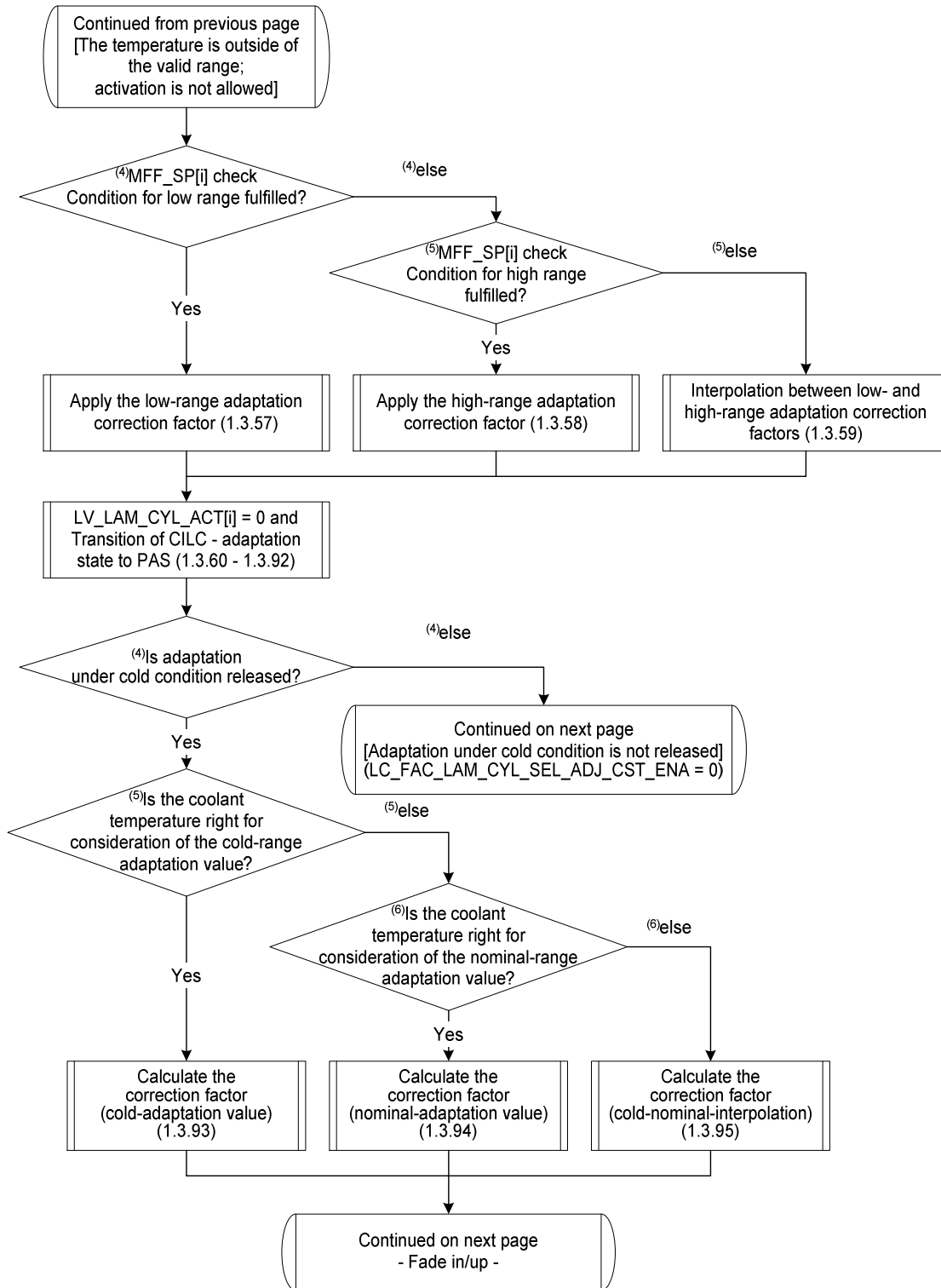
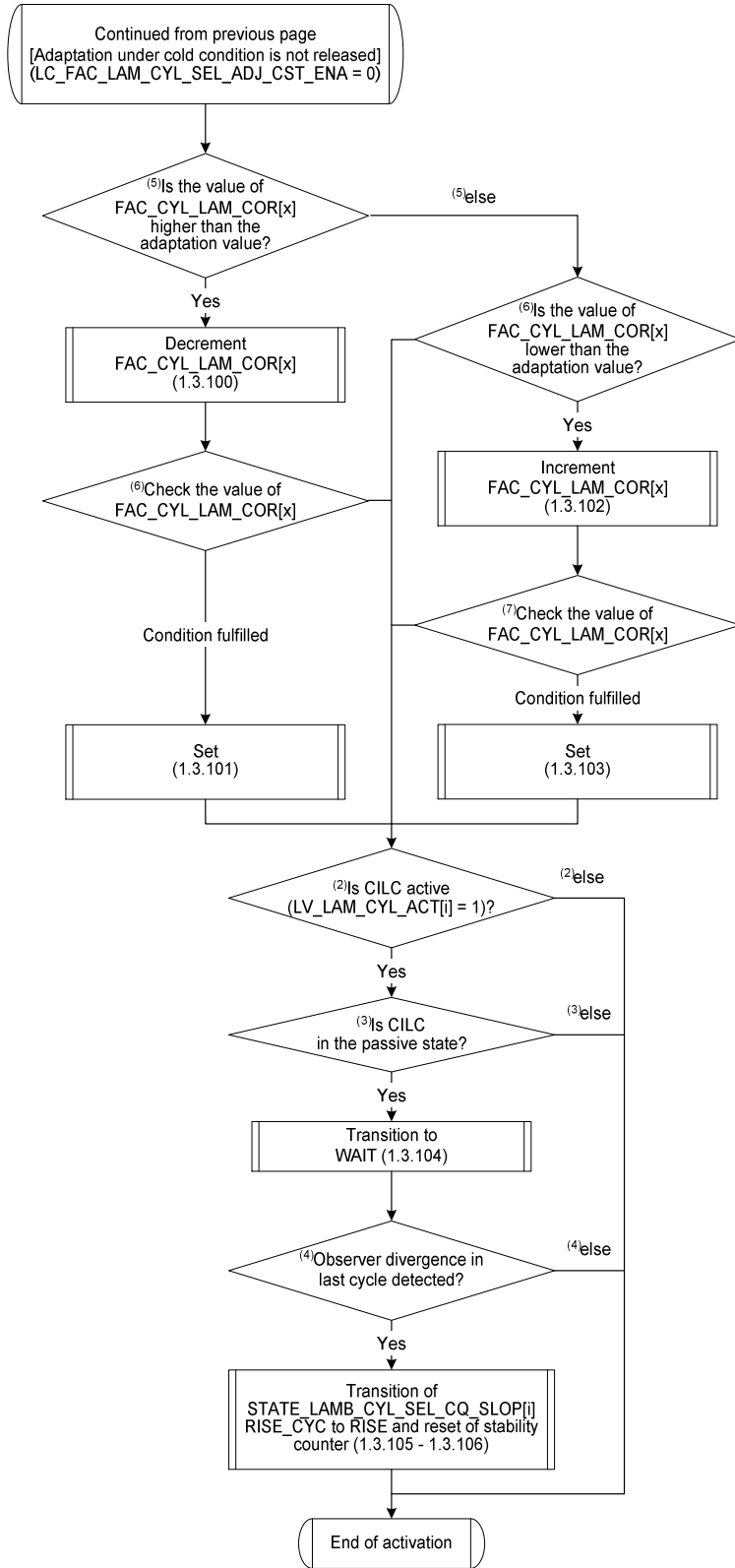



Figure 7.73.2: TOLOMEOGRAPHIC 269252-9.ps

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Figure 7.73.3: TOLOMEOGRAPHIC 269252-11.ps

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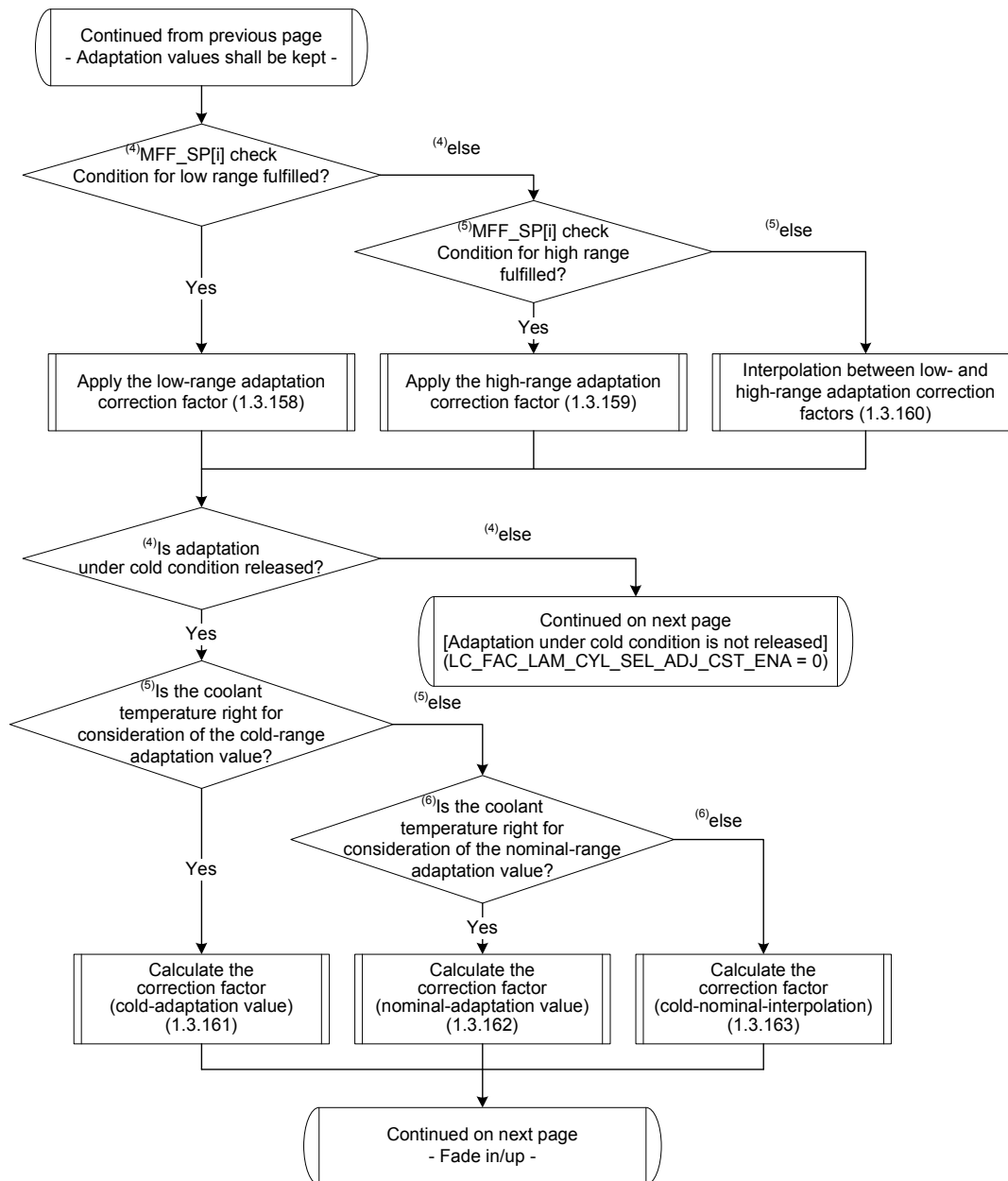
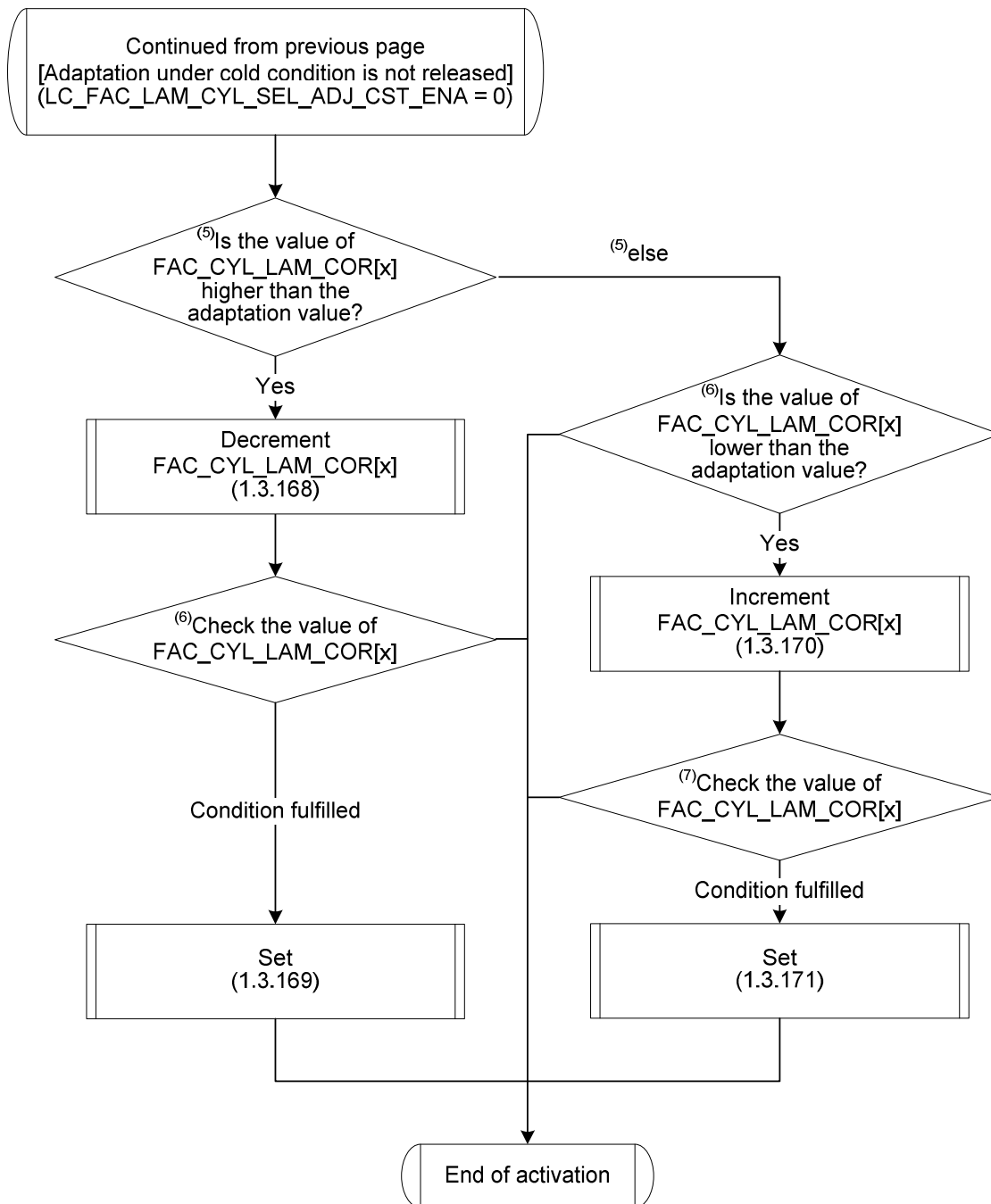


Figure 7.73.4: TOLOMEOGRAPHIC 269252-13.ps

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**if**<sup>(1)</sup> (LV\_LAM\_CYL\_ENA[i] = 1 and LV\_INH\_OBD\_DIAG\_CYL\_BAL\_LAM[i] = 0)  
**then**  
     **if**<sup>(2)</sup> (C\_TEMP\_LAM\_CYL\_CST\_MIN < TEMP\_LAM\_CYL\_SEL <  
             C\_TEMP\_LAM\_CYL\_CST\_MAX and  
             TEMP\_LAM\_CYL\_SEL < C\_TEMP\_  
 LAM\_CYL\_MIN and  
             LV\_LAM\_LSCL[i] = 1)  
     [the temperature is inside of the valid range for activation under engine-cold  
     condition]  
     **then**  
         **if**<sup>(3)</sup> LC\_FAC\_LAM\_CYL\_SEL\_ADJ\_CST\_ENA = 1



```


                                [adaptation under cold condition released]
then
    if(4)          LV_LAM_CYL_ACT[i] = 0
    then
        LV_LAM_CYL_ACT[i] = 1
                                (1.3.1)
        MFF_DELTA_LAM_CYL_SEL_REAC =
                                abs(MFF_SP_SAVE_LAM_CYL_
SEL -
                                MFF_SP_LAM_CYL_SEL) (1.3.2)
        FAC_VAL_LAM_CYL_SEL_REAC =
                                IP_FAC_VAL_LAM_CYL_SEL_REAC
                                (MFF_DELTA_LAM_CYL_SEL_REAC)
(1.3.3)
        DELTA_LAMB_CYL_SEL_CQ[i] =
                                DELTA_LAMB_CYL_SEL_CQ[i]*
                                FAC_
VAL_LAM_CYL_SEL_REAC (1.3.4)
        DELTA_LAMB_CYL_SEL_CQ_FIL[i] =
                                DELTA_LAMB_CYL_SEL_CQ_FIL[i]*
FAC_VAL_LAM_CYL_SEL_REAC (1.3.5)
        DELTA_LAMB_AV[i] = DELTA_LAMB_AV[i]*
                                FAC_VAL_LAM_CYL_SEL_REAC
(1.3.6)
        DELTA_LAMB_ERR_RAW[i] = DELTA_LAMB_ERR_RAW[i]*
                                FAC_VAL_LAM_CYL_SEL_REAC
(1.3.7)
        DELTA_LAMB_ERR[i] = DELTA_LAMB_ERR[i]*
                                FAC_VAL_LAM_CYL_SEL_REAC
(1.3.8)
        DELTA_LAMB_ERR_CYL_SEL[x] =
                                DELTA_LAMB_ERR_CYL_SEL[x]*
                                FAC_VAL_LAM_CYL_SEL_REAC
(1.3.9)
        DELTA_LAMB_CYL[x] = DELTA_LAMB_CYL[x]*
                                FAC_VAL_LAM_CYL_SEL_REAC
(1.3.10)
        DELTA_LAMB_CYL_SEL[i] = DELTA_LAMB_CYL_SEL[i]*
                                FAC_VAL_LAM_CYL_SEL_REAC
(1.3.11)
        DELTA_LAMB_MDL[i] = DELTA_LAMB_MDL[i]*
                                FAC_VAL_LAM_CYL_SEL_REAC
(1.3.12)
        DELTA_LAMB_DIF_CYL[x] = DELTA_LAMB_DIF_CYL[x]*
                                FAC_VAL_LAM_CYL_SEL_REAC
(1.3.13)
    if(5)          (LV_FAC_CYL_LAM_VIRT_LIM[i] = 0 and
                                LV_LAM_CYL_SEL_CTL_DRIFT_
PRED[i] = 0 and
                                STATE_LAMB_CYL_SEL_CQ_SLOP[i]
= 0)
    then
        FAC_CYL_LAM_INT[x] = FAC_CYL_LAM_INT[x]*

```

```

FAC_VAL_LAM_CYL_SEL_REAC
(1.3.14)
FAC_CYL_LAM_I_MV_SHIFT[x] =
FAC_CYL_LAM_I_MV_SHIFT[x]*
FAC_VAL_LAM_CYL_SEL_REAC
(1.3.15)
FAC_CYL_LAM[x] = FAC_CYL_LAM[x]*
FAC_VAL_LAM_CYL_SEL_REAC
(1.3.16)
FAC_CYL_LAM_ABSV_SUM[i] =
FAC_CYL_LAM_ABSV_SUM[i]*
FAC_VAL_LAM_CYL_SEL_REAC
(1.3.17)
FAC_LAM_CYL_SEL_ADJ_CST_FIL[x] =
FAC_LAM_CYL_SEL_ADJ_CST_
FIL[x]*
FAC_VAL_LAM_CYL_SEL_REAC
(1.3.18)
else(5)
  if(6) STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 2
  then
    FAC_CYL_LAM_INT[x] = 0
    (1.3.19)
    FAC_CYL_LAM_I_MV_SHIFT[x] = 0
    (1.3.20)
    FAC_CYL_LAM[x] = 0
    (1.3.21)
    FAC_CYL_LAM_ABSV_SUM[i] = 0
    (1.3.22)
    FAC_LAM_CYL_SEL_ADJ_CST_FIL[x] = 0
    (1.3.23)
    LV_FAC_CYL_LAM_LIM_MIN[x] = 0
    (1.3.24)
    LV_FAC_CYL_LAM_LIM_MAX[x] = 0
    (1.3.25)
    LV_FAC_CYL_LAM_VIRT_LIM[i] = 0
    (1.3.26)
  endif(5)
endif(4)
if(4) STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
then
  STATE_LAM_CYL_SEL_ADJ[i] = 1 [WAIT_ENG_COLD]
  (1.3.27)
  CTR_T_LAM_CYL_ADJ[i] = C_T_LAM_CYL_ADJ_CST
  (1.3.28)
endif(4)
endif(3)
else(2) [the temperature is outside of the valid range for activation under engine-cold
condition]
if(3) TEMP_LAM_CYL_SEL C_TEMP_LAM_CYL_MIN
then
  if(4) LV_LAM_CYL_ACT[i] = 0
  then

```

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$LV\_LAM\_CYL\_ACT[i] = 1$   
**(1.3.29)**  
 $MFF\_DELTA\_LAM\_CYL\_SEL\_REAC =$   
**SEL -**  $abs(MFF\_SP\_SAVE\_LAM\_CYL\_$   
 $MFF\_SP\_LAM\_CYL\_SEL)$  **(1.3.30)**  
 $FAC\_VAL\_LAM\_CYL\_SEL\_REAC =$   
**(1.3.31)**  $IP\_FAC\_VAL\_LAM\_CYL\_SEL\_REAC$   
 $(MFF\_DELTA\_LAM\_CYL\_SEL\_REAC)$   
 $DELTA\_LAMB\_CYL\_SEL\_CQ[i] =$   
**VAL\\_LAM\\_CYL\\_SEL\\_REAC (1.3.32)**  $DELTA\_LAMB\_CYL\_SEL\_CQ[i]*$  **FAC\\_**  
 $DELTA\_LAMB\_CYL\_SEL\_CQ\_FIL[i] =$   
 $DELTA\_LAMB\_CYL\_SEL\_CQ\_FIL[i]*$   
**FAC\\_VAL\\_LAM\\_CYL\\_SEL\\_REAC (1.3.33)**  
 $DELTA\_LAMB\_AV[i] = DELTA\_LAMB\_AV[i]*$   
**(1.3.34)**  $FAC\_VAL\_LAM\_CYL\_SEL\_REAC$   
 $DELTA\_LAMB\_ERR\_RAW[i] = DELTA\_LAMB\_ERR\_RAW[i]*$   
**(1.3.35)**  $FAC\_VAL\_LAM\_CYL\_SEL\_REAC$   
 $DELTA\_LAMB\_ERR[i] = DELTA\_LAMB\_ERR[i]*$   
**(1.3.36)**  $FAC\_VAL\_LAM\_CYL\_SEL\_REAC$   
 $DELTA\_LAMB\_ERR\_CYL\_SEL[x] =$   
**(1.3.37)**  $DELTA\_LAMB\_ERR\_CYL\_SEL[x]*$   
 $DELTA\_LAMB\_CYL[x] = DELTA\_LAMB\_CYL[x]*$   
**(1.3.38)**  $FAC\_VAL\_LAM\_CYL\_SEL\_REAC$   
 $DELTA\_LAMB\_CYL\_SEL[i] = DELTA\_LAMB\_CYL\_SEL[i]*$   
**(1.3.39)**  $FAC\_VAL\_LAM\_CYL\_SEL\_REAC$   
 $DELTA\_LAMB\_MDL[i] = DELTA\_LAMB\_MDL[i]*$   
**(1.3.40)**  $FAC\_VAL\_LAM\_CYL\_SEL\_REAC$   
 $DELTA\_LAMB\_DIF\_CYL[x] = DELTA\_LAMB\_DIF\_CYL[x]*$   
**(1.3.41)**  $FAC\_VAL\_LAM\_CYL\_SEL\_REAC$   
**if<sup>(5)</sup>**  $(LV\_FAC\_CYL\_LAM\_VIRT\_LIM[i] = 0$  **and**  
 $LV\_LAM\_CYL\_SEL\_CTL\_DRIFT\_$   
**PRED[i] = 0 and**  $STATE\_LAMB\_CYL\_SEL\_CQ\_SLOP[i]$   
 $= 0)$   
**then**  
 $FAC\_CYL\_LAM\_INT[x] = FAC\_CYL\_LAM\_INT[x]*$   
**(1.3.42)**  $FAC\_VAL\_LAM\_CYL\_SEL\_REAC$   
 $FAC\_CYL\_LAM\_I\_MV\_SHIFT[x] =$   
**(1.3.43)**  $FAC\_CYL\_LAM\_I\_MV\_SHIFT[x]*$   
 $FAC\_VAL\_LAM\_CYL\_SEL\_REAC$

```

(1.3.44) FAC_CYL_LAM[x] = FAC_CYL_LAM[x]*
          FAC_VAL_LAM_CYL_SEL_REAC

(1.3.-)  FAC_CYL_LAM_ABSV_SUM[i] =
          FAC_CYL_LAM_ABSV_SUM[i]*
          FAC_VAL_LAM_CYL_SEL_REAC

(1.3.46) FAC_LAM_CYL_SEL_ADJ_FIL[x] =
          FAC_LAM_CYL_SEL_ADJ_FIL[x]*
          FAC_VAL_LAM_CYL_SEL_REAC


else(5)
  if(6) STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 2
  then
    FAC_CYL_LAM_INT[x] = 0
    (1.3.47)
    FAC_CYL_LAM_I_MV_SHIFT[x] = 0
    (1.3.48)
    FAC_CYL_LAM[x] = 0
    (1.3.49)
    FAC_CYL_LAM_ABSV_SUM[i] = 0
    (1.3.50)
    FAC_LAM_CYL_SEL_ADJ_FIL[x] = 0
    (1.3.51)
    LV_FAC_CYL_LAM_LIM_MIN[x] = 0
    (1.3.52)
    LV_FAC_CYL_LAM_LIM_MAX[x] = 0
    (1.3.53)
    LV_FAC_CYL_LAM_VIRT_LIM[i] = 0
    (1.3.54)
  endif(6)
endif(5)
endif(4)
if(4) STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
then
  STATE_LAM_CYL_SEL_ADJ[i] = 3 [WAIT_ENG_NOM]
  (1.3.55)
  CTR_T_LAM_CYL_ADJ[i] = C_T_LAM_CYL_ADJ
  (1.3.56)
endif(4)
else(3) [the temperature is outside of the valid range; activation is not allowed]
  if(4) MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_L_RNG
  then
    FAC_LAM_CYL_SEL_ADJ[x] =
    FAC_LAM_CYL_SEL_ADJ_L_RNG[x]
  (1.3.57)
  else(4)
    if(5) MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_H_RNG
    then
      FAC_LAM_CYL_SEL_ADJ[x] =
      FAC_LAM_CYL_SEL_ADJ_H_RNG[x]
    (1.3.58)
    else(5)

```

```

FAC_LAM_CYL_SEL_ADJ[x] =
+
CYL_SEL_ADJ_L_RNG)*
-
H_RNG -
L_RNG) (1.3.59)
endif(5)
endif(4)
LV_LAM_CYL_ACT[i] = 0 (1.3.60)
MFF_DELTA_LAM_CYL_SEL_REAC = 0 (1.3.61)
MFF_SP_SAVE_LAM_CYL_SEL = 0 (1.3.62)
FAC_VAL_LAM_CYL_SEL_REAC = 0 (1.3.63)
DELTA_LAMB_CYL_SEL_CQ[i] = 0 (1.3.64)
DELTA_LAMB_CYL_SEL_CQ_FIL[i] = 0 (1.3.65)
LAMB_CYL_SEL_CQ_REF[i] = 0 (1.3.66)
LAMB_CYL_SEL_CQ_DIF_REF[i] = 0 (1.3.67)
CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] = 0 (1.3.68)
CTR_LAMB_CYL_SEL_CQ_STAB[i] = 0 (1.3.69)
LV_LAMB_CYL_SEL_CQ_DRIFT[i] = 0 (1.3.70)
LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 0 (1.3.71)
DELTA_LAMB_AV[i] = 0 (1.3.72)
DELTA_LAMB_ERR_RAW[i] = 0 (1.3.73)
DELTA_LAMB_ERR[i] = 0 (1.3.74)
DELTA_LAMB_ERR_CYL_SEL[x] = 0 (1.3.75)
DELTA_LAMB_CYL[x] = 0 (1.3.76)
DELTA_LAMB_CYL_SEL[i] = 0 (1.3.77)
DELTA_LAMB_MDL[i] = 0 (1.3.78)

```

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```

DELTA_LAMB_DIF_CYL[x] = 0
(1.3.79)
FAC_CYL_LAM_INT[x] = 0
(1.3.80)
FAC_CYL_LAM_I_MV_SHIFT[x] = 0
(1.3.81)
FAC_CYL_LAM[x] = 0
(1.3.82)
FAC_CYL_LAM_ABSV_SUM[i] = 0
(1.3.83)
FAC_LAM_CYL_SEL_ADJ_FIL[x] = 0
(1.3.84)
FAC_LAM_CYL_SEL_ADJ_CST_FIL[x] = 0
(1.3.85)
STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
(1.3.86)
STATE_LAM_CYL_SEL[i] = 0 [PAS]
(1.3.87)
CTR_LAM_CYL_SEL_REF_CLL[i] = 0
(1.3.88)
LV_LAM_CYL_SEL_ADJ_VLD[i] = 0
(1.3.89)
LV_FAC_CYL_LAM_LIM_MIN[x] = 0
(1.3.90)
LV_FAC_CYL_LAM_LIM_MAX[x] = 0
(1.3.91)
LV_FAC_CYL_LAM_VIRT_LIM[i] = 0
(1.3.92)
if(4) LC_FAC_LAM_CYL_SEL_ADJ_CST_ENA = 1
    [adaptation under cold condition released]
then
    if(5) TEMP_LAM_CYL_SEL
        C_TEMP_THD_CYL_SEL_ADJ_COLD_
RNG
    then
        FAC_LAM_CYL_SEL_ADJ_INTER[x] =
            FAC_LAM_CYL_SEL_ADJ_CST[x]
        (1.3.93)
    else(5)
        if(6) TEMP_LAM_CYL_SEL
            C_TEMP_THD_CYL_SEL_ADJ_NOM_
RNG
        then
            FAC_LAM_CYL_SEL_ADJ_INTER[x] =
                FAC_LAM_CYL_SEL_ADJ[x]
            (1.3.94)
        else(6)
            FAC_LAM_CYL_SEL_ADJ_INTER[x] =
                FAC_LAM_CYL_SEL_ADJ_CST[x]
+
            (TEMP_LAM_CYL_SEL -
                C_TEMP_THD_CYL_SEL_ADJ_COLD_
RNG)*

```

NOM\_RNG -  
RNG) (1.3.95)

(FAC\_LAM\_CYL\_SEL\_ADJ[x] -  
FAC\_LAM\_CYL\_SEL\_ADJ\_CST[x])/

(C\_TEMP\_THD\_CYL\_SEL\_ADJ\_  
C\_TEMP\_THD\_CYL\_SEL\_ADJ\_COLD\_

(1.3.97)

```

endif(6)
endif(5)
if(5) FAC_CYL_LAM_COR[x]k >
FAC_LAM_CYL_SEL_ADJ_INTER[x]
then
FAC_CYL_LAM_COR[x]k = FAC_CYL_LAM_COR[x]k-1 -
C_FAC_CYL_LAM_ABSV_DEC (1.3.96)
if(6) FAC_CYL_LAM_COR[x]k <
FAC_LAM_CYL_SEL_ADJ_INTER[x]
then
FAC_CYL_LAM_COR[x]k =
FAC_LAM_CYL_SEL_ADJ_INTER[x]

```

(1.3.99)

```

endif(6)
else(5)
if(6) FAC_CYL_LAM_COR[x]k <
FAC_LAM_CYL_SEL_ADJ_INTER[x]
then
FAC_CYL_LAM_COR[x]k =
FAC_CYL_LAM_COR[x]k-1 +
C_FAC_CYL_LAM_ABSV_DEC (1.3.98)
if(7) FAC_CYL_LAM_COR[x]k >
FAC_LAM_CYL_SEL_ADJ_INTER[x]
then
FAC_CYL_LAM_COR[x]k =
FAC_LAM_CYL_SEL_ADJ_INTER[x]

```

```


endif(7)
endif(6)
endif(5)
else(4) [adaptation under cold condition not released]
if(5) FAC_CYL_LAM_COR[x]k > FAC_LAM_CYL_SEL_ADJ[x]
then
FAC_CYL_LAM_COR[x]k = FAC_CYL_LAM_COR[x]k-1 -
C_FAC_CYL_LAM_ABSV_DEC (1.3.100)
if(6) FAC_CYL_LAM_COR[x]k <
FAC_LAM_CYL_SEL_ADJ[x]
then
FAC_CYL_LAM_COR[x]k =
FAC_LAM_CYL_SEL_ADJ[x] (1.3.101)
endif(6)
else(5)
if(6) FAC_CYL_LAM_COR[x]k <
FAC_LAM_CYL_SEL_ADJ[x]
then
FAC_CYL_LAM_COR[x]k =

```

```

FAC_CYL_LAM_COR[x]k-1 +
C_FAC_CYL_LAM_ABSV_DEC (1.3.102)
if(7) FAC_CYL_LAM_COR[x]k >
FAC_LAM_CYL_SEL_ADJ[x]
then
FAC_CYL_LAM_COR[x]k =
FAC_LAM_CYL_SEL_ADJ[x] (1.3.103)
endif(7)
endif(6)
endif(5)
endif(4)
endif(3)
endif(2)
if(2) LV_LAM_CYL_ACT[i] = 1
then
if(3) STATE_LAM_CYL_SEL[i] = 0 [PAS]
then
STATE_LAM_CYL_SEL[i] = 2 [WAIT]
(1.3.104)
if(4) STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 2
then
STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 1
(1.3.105)
CTR_LAMB_CYL_SEL_CQ_STAB[i] = 0
(1.3.106)
endif(4)
endif(3)
endif(2)
else(1) [the general conditions for activation are fulfilled; however, the function is
inhibited by diagnosis]
if(2) (LV_LAM_CYL_ENA[i] = 1 and LV_INH_OBD_DIAG_CYL_BAL_LAM[i] = 1)
then
LV_LAM_CYL_ACT[i] = 0
(1.3.107)
LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 0
(1.3.108)
DELTA_LAMB_CYL_SEL_CQ[i] = 0
(1.3.109)
DELTA_LAMB_CYL_SEL_CQ_FIL[i] = 0
(1.3.110)
LAMB_CYL_SEL_CQ_REF[i] = 0
(1.3.111)
LAMB_CYL_SEL_CQ_DIF_REF[i] = 0
(1.3.112)
CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] = 0
(1.3.113)
CTR_LAMB_CYL_SEL_CQ_STAB[i] = 0
(1.3.114)
LV_LAMB_CYL_SEL_CQ_DRIFT[i] = 0
(1.3.115)
DELTA_LAMB_AV[i] = 0
(1.3.116)

```

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$\text{DELTA\_LAMB\_ERR\_RAW}[i] = 0$  (1.3.117)  
 $\text{DELTA\_LAMB\_ERR}[i] = 0$  (1.3.118)  
 $\text{DELTA\_LAMB\_ERR\_CYL\_SEL}[x] = 0$  (1.3.119)  
 $\text{DELTA\_LAMB\_CYL}[x] = 0$  (1.3.120)  
 $\text{DELTA\_LAMB\_CYL\_SEL}[i] = 0$  (1.3.121)  
 $\text{DELTA\_LAMB\_MDL}[i] = 0$  (1.3.122)  
 $\text{DELTA\_LAMB\_DIF\_CYL}[x] = 0$  (1.3.123)  
 $\text{FAC\_CYL\_LAM\_INT}[x] = 0$  (1.3.124)  
 $\text{FAC\_CYL\_LAM\_P}[x] = 0$  (1.3.125)  
 $\text{FAC\_CYL\_LAM\_I\_MV\_SHIFT}[x] = 0$  (1.3.126)  
 $\text{FAC\_CYL\_LAM\_P\_MV\_SHIFT}[x] = 0$  (1.3.127)  
 $\text{FAC\_CYL\_LAM}[x] = 0$  (1.3.128)  
 $\text{FAC\_CYL\_LAM\_ABSV\_SUM}[i] = 0$  (1.3.129)  
 $\text{FAC\_LAM\_CYL\_SEL\_ADJ\_FIL}[x] = 0$  (1.3.130)  
 $\text{FAC\_LAM\_CYL\_SEL\_ADJ\_CST\_FIL}[x] = 0$  (1.3.131)  
 $\text{LV\_LAM\_CYL\_SEL\_SEG\_REF\_CLL}[i] = 0$  (1.3.132)  
 $\text{STATE\_LAM\_CYL\_SEL}[i] = 0$  [PAS] (1.3.133)  
 $\text{STATE\_LAM\_CYL\_SEL\_ADJ}[i] = 0$  [PAS] (1.3.134)  
 $\text{CTR\_T\_LAM\_CYL\_ADJ}[i] = 0$  (1.3.135)  
 $\text{CTR\_LAM\_CYL\_SEL\_REF\_CLL}[i] = 0$  (1.3.136)  
 $\text{LV\_LAM\_CYL\_SEL\_ADJ\_VLD}[i] = 0$  (1.3.& %■)  
 $\text{LV\_FAC\_CYL\_LAM\_LIM\_MIN}[x] = 0$  (1.3.138)  
 $\text{LV\_FAC\_CYL\_LAM\_LIM\_MAX}[x] = 0$  (1.3.139)  
 $\text{LV\_FAC\_CYL\_LAM\_VIRT\_LIM}[i] = 0$  (1.3.140)

**if**<sup>(3)</sup>  $\text{LC\_LAM\_CYL\_SEL\_ERR\_RST} = 1$   
*[adaptation values shall be reset]*


**then**

**if**<sup>(4)</sup>  $\text{FAC\_CYL\_LAM\_COR}[x]_k > 0$

```

then
    FAC_CYL_LAM_COR[x]k = FAC_CYL_LAM_COR[x]k-1 -
                                C_FAC_CYL_LAM_ABSV_DEC (1.3.141)
if(5)    FAC_CYL_LAM_COR[x]k < 0
then
    FAC_CYL_LAM_COR[x]k = 0
                                (1.3.142)
endif(5)
else(4)
if(5)    FAC_CYL_LAM_COR[x]k < 0
then
    FAC_CYL_LAM_COR[x]k = FAC_CYL_LAM_COR[x]k-1 +
                                C_FAC_CYL_LAM_ABSV_DEC (1.3.143)
if(6)    FAC_CYL_LAM_COR[x]k > 0
then
    FAC_CYL_LAM_COR[x]k = 0
                                (1.3.144)
endif(6)
endif(5)
endif(4)
    FAC_LAM_CYL_SEL_ADJ_L_RNG[x]LDC = 0
                                (1.3.1-1)
    FAC_LAM_CYL_SEL_ADJ_H_RNG[x]LDC = 0
                                (1.3.146)
    FAC_LAM_CYL_SEL_ADJ_CST[x]LDC = 0
                                (1.3.147)
    MFF_ADD_CYL_LAM_COR[x]LDC = 0
                                (1.3.148)
    LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i]LDC = 0
                                (1.3.149)
    LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i]LDC = 0
                                (1.3.150)
    FAC_LAM_CYL_SEL_ADJ[x] = 0
                                (1.3.151)
    FAC_LAM_CYL_SEL_ADJ_L_RNG[x] = 0
                                (1.3.152)
    FAC_LAM_CYL_SEL_ADJ_H_RNG[x] = 0
                                (1.3.153)
    FAC_LAM_CYL_SEL_ADJ_CST[x] = 0
                                (1.3.154)
    MFF_ADD_CYL_LAM_COR[x] = 0
                                (1.3.155)
    LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i] = 0
                                (1.3.156)
    LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i] = 0
                                (1.3.157)
else(3)    [adaptation values shall be kept]
if(4)    MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_L_RNG
then
    FAC_LAM_CYL_SEL_ADJ[x] =
                                FAC_LAM_CYL_SEL_ADJ_L_RNG[x]LDC (1.3.158)
else(4)


```

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```

if(5)      MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_H_RNG
then
      FAC_LAM_CYL_SEL_ADJ[x] =
      FAC_LAM_CYL_SEL_ADJ_H_RNG[x]LDC (1.3.15)
else(5)
      FAC_LAM_CYL_SEL_ADJ[x] =
      FAC_LAM_CYL_SEL_ADJ_L_RNG[x]LDC
+
      (MFF_SP[i] - C_MFF_SP_THD_
CYL_SEL_ADJ_L_RNG)*
-
      (FAC_LAM_CYL_SEL_ADJ_H_RNG[x]LDC
      FAC_LAM_CYL_SEL_ADJ_L_RNG[x]LDC)/
      (C_MFF_SP_THD_CYL_SEL_ADJ_
H_RNG -
L_RNG) (1.3.160)
endif(5)
endif(4)
if(4)      LC_FAC_LAM_CYL_SEL_ADJ_CST_ENA = 1
      [adaptation under cold condition released]
then
      if(5)      TEMP_LAM_CYL_SEL
      C_TEMP_THD_CYL_SEL_ADJ_COLD_
RNG
      then
      FAC_LAM_CYL_SEL_ADJ_INTER[x] =
      FAC_LAM_CYL_SEL_ADJ_CST[x]LDC
(1.3.161)
      else(5)
      if(6)      TEMP_LAM_CYL_SEL
      C_TEMP_THD_CYL_SEL_ADJ_NOM_
RNG
      then
      FAC_LAM_CYL_SEL_ADJ_INTER[x] =
      FAC_LAM_CYL_SEL_ADJ[x]
(1.3.162)
      else(6)
      FAC_LAM_CYL_SEL_ADJ_INTER[x] =
      FAC_LAM_CYL_SEL_ADJ_CST[x]LDC
+
      (TEMP_LAM_CYL_SEL -
      C_TEMP_THD_CYL_SEL_ADJ_COLD_
RNG)*
      (FAC_LAM_CYL_SEL_ADJ[x] -
      FAC_LAM_CYL_SEL_ADJ_CST[x]LDC)/
      (C_TEMP_THD_CYL_SEL_ADJ_
      C_TEMP_THD_CYL_SEL_ADJ_COLD_
NOM_RNG -
RNG) (1.3.163)
endif(6)


```

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```

endif(5)
if(5) FAC_CYL_LAM_COR[x]k >
    FAC_LAM_CYL_SEL_ADJ_INTER[x]
then
    FAC_CYL_LAM_COR[x]k = FAC_CYL_LAM_COR[x]k-1
    - C_FAC_CYL_LAM_ABSV_DEC
(1.3.164)
if(6) FAC_CYL_LAM_COR[x]k <
    FAC_LAM_CYL_SEL_ADJ_INTER[x]
then
    FAC_CYL_LAM_COR[x]k =
    FAC_LAM_CYL_SEL_ADJ_INTER[x]
(1.3.165)
endif(6)
else(5)
if(6) FAC_CYL_LAM_COR[x]k <
    FAC_LAM_CYL_SEL_ADJ_INTER[x]
then
    FAC_CYL_LAM_COR[x]k =
    FAC_CYL_LAM_COR[x]k-1 +
    C_FAC_CYL_LAM_ABSV_DEC (1.3.166)
if(7) FAC_CYL_LAM_COR[x]k >
    FAC_LAM_CYL_SEL_ADJ_INTER[x]
then
    FAC_CYL_LAM_COR[x]k =
    FAC_LAM_CYL_SEL_ADJ_INTER[x]
    (1.3.167)
endif(7)
endif(6)
endif(5)
else(4) [adaptation under cold condition not released]
if(5) FAC_CYL_LAM_COR[x]k > FAC_LAM_CYL_SEL_ADJ[x]
then
    FAC_CYL_LAM_COR[x]k = FAC_CYL_LAM_COR[x]k-1 -
    C_FAC_CYL_LAM_ABSV_DEC (1.3.168)
if(6) FAC_CYL_LAM_COR[x]k <
    FAC_LAM_CYL_SEL_ADJ[x]
then
    FAC_CYL_LAM_COR[x]k =
    FAC_LAM_CYL_SEL_ADJ[x] (1.3.169)
endif(6)
else(5)
if(6) FAC_CYL_LAM_COR[x]k <
    FAC_LAM_CYL_SEL_ADJ[x]
then
    FAC_CYL_LAM_COR[x]k =
    FAC_CYL_LAM_COR[x]k-1 +
    C_FAC_CYL_LAM_ABSV_DEC (1.3.170)
if(7) FAC_CYL_LAM_COR[x]k >
    FAC_LAM_CYL_SEL_ADJ[x]
then
    FAC_CYL_LAM_COR[x]k =

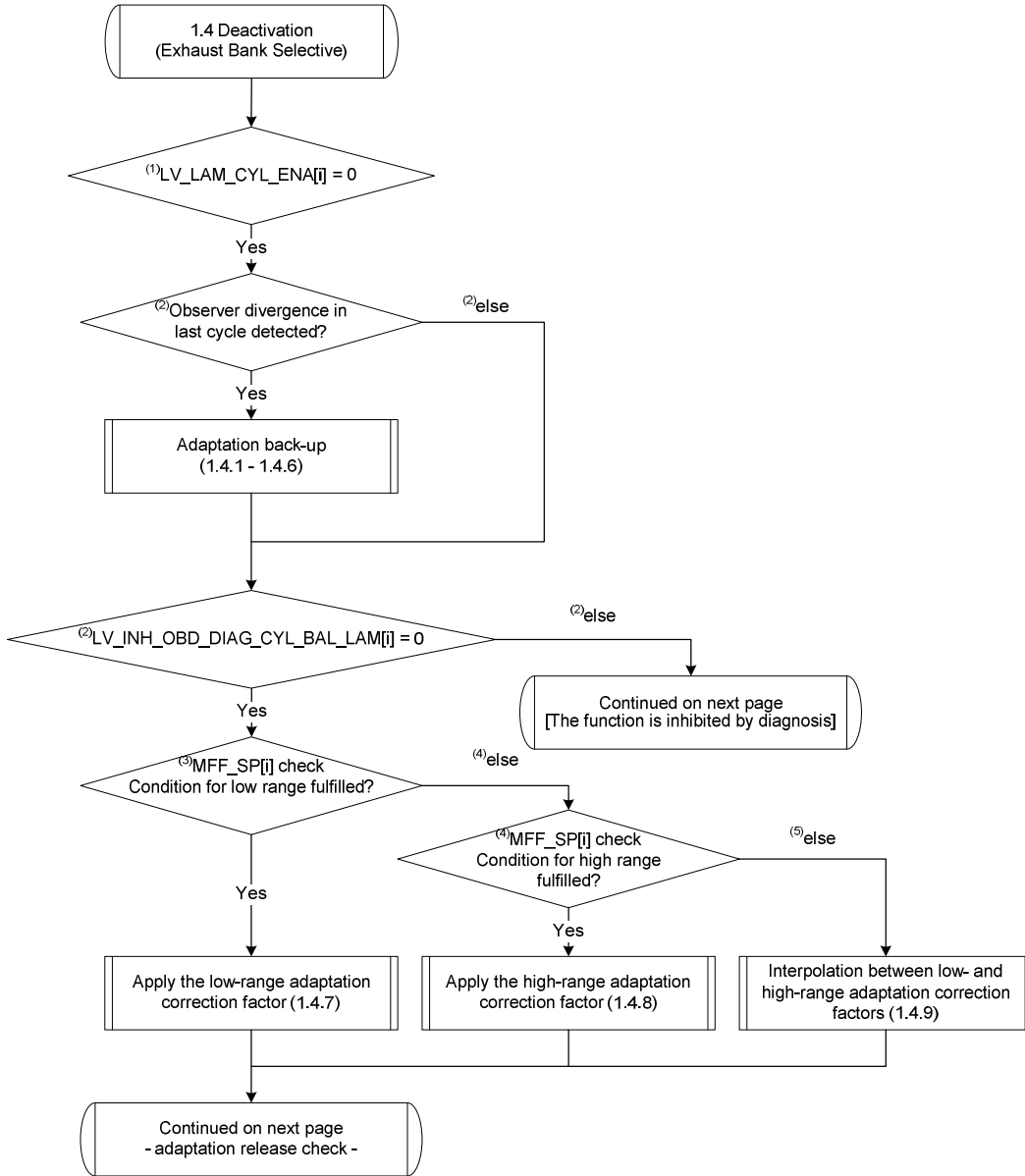
```

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FAC\_LAM\_CYL\_SEL\_ADJ[x](1.3.171)

endif<sup>(1)</sup>  
 endif<sup>(2)</sup>  
 endif<sup>(3)</sup>  
 endif<sup>(4)</sup>  
 endif<sup>(5)</sup>  
 endif<sup>(6)</sup>  
 endif<sup>(7)</sup>

7.73.5 Deactivation (exhaust bank selective):



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Figure 7.73.5: TOLOMEOGRAPHIC 269252-16.ps

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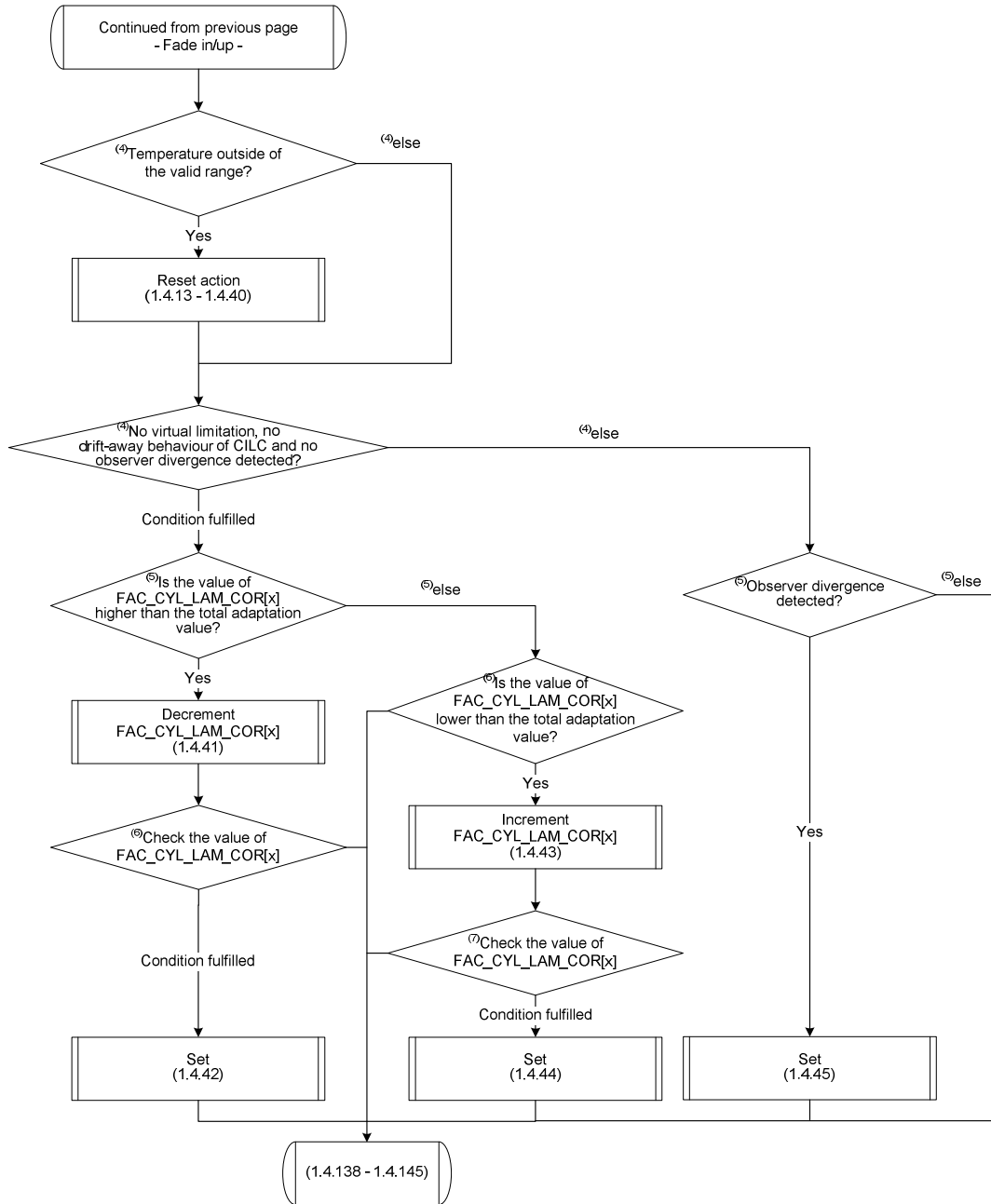


Figure 7.73.6: TOLOMEOGRAPHIC 269252-18.ps

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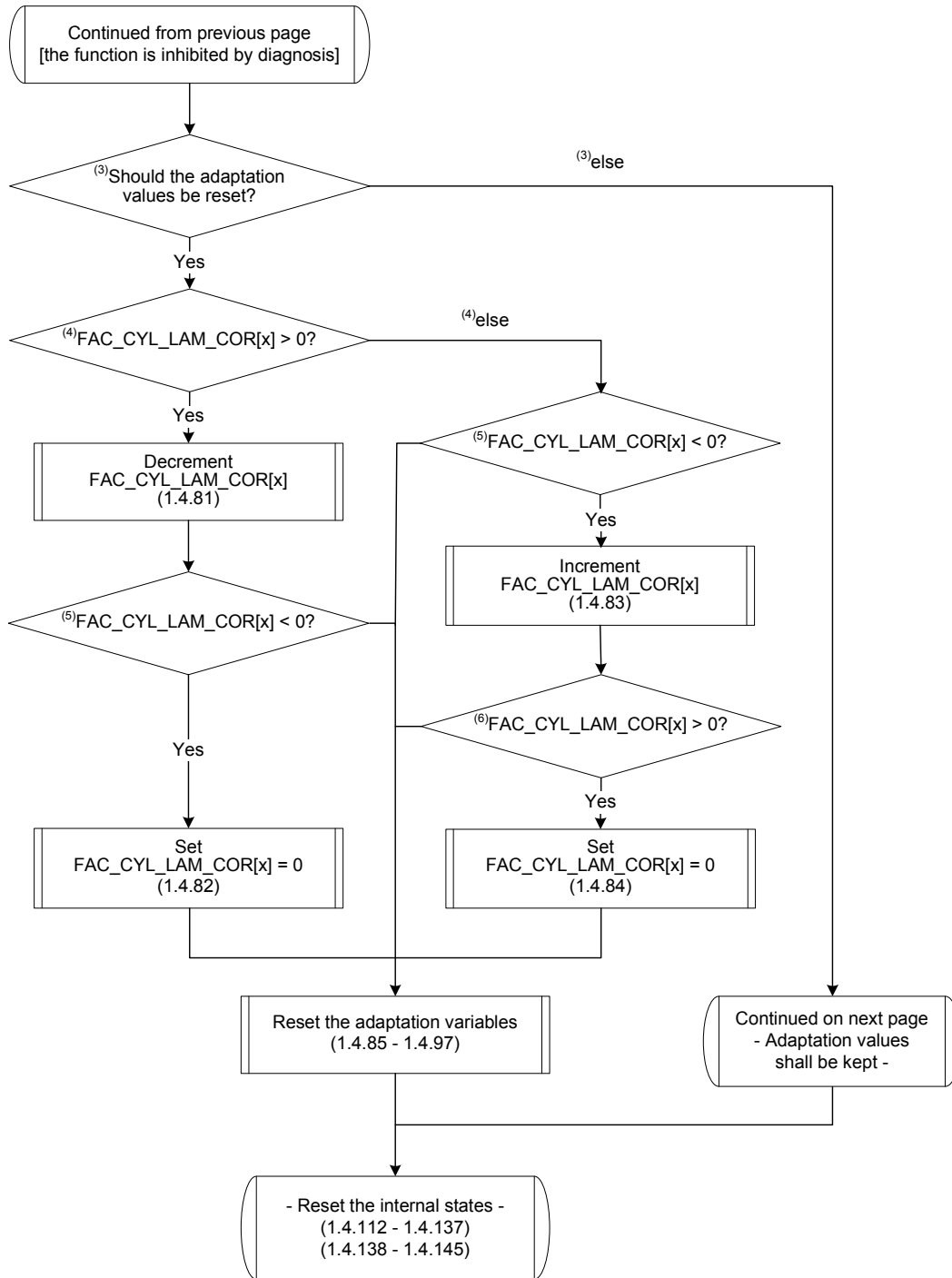


Figure 7.73.7: TOLOMEOGRAPHIC 269252-20.ps

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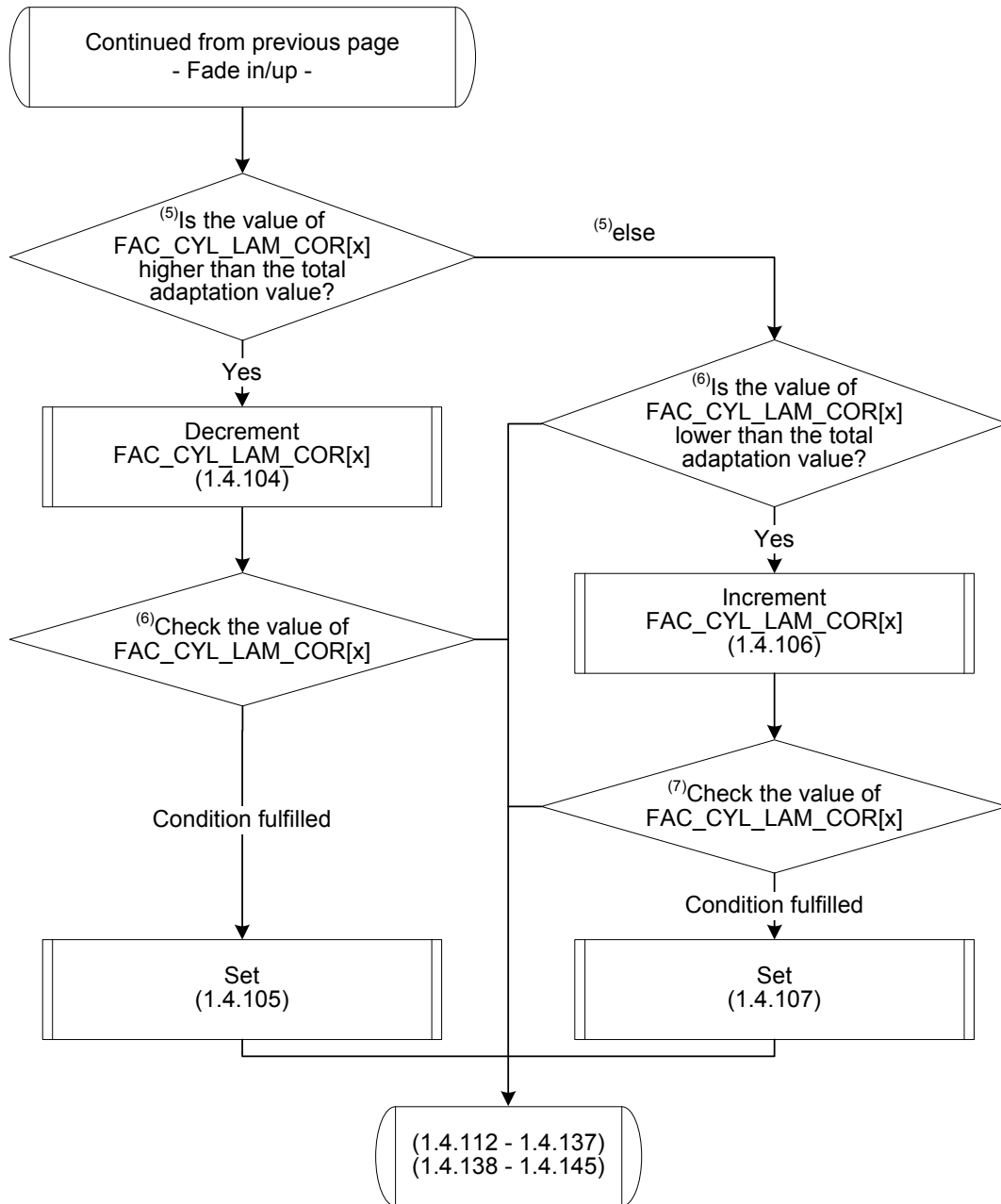


Figure 7.73.8: TOLOMEOGRAPHIC 269252-22.ps

**if**<sup>(1)</sup> LV\_LAM\_CYL\_ENA[i] = 0  
**then**

**if**<sup>(2)</sup> STATE\_LAMB\_CYL\_SEL\_CQ\_SLOP[i] = 2  
**then**

**for**<sup>(3)</sup> j(x) = 1 : Number of cylinders per exhaust bank

FAC\_LAM\_CYL\_SEL\_ADJ\_L\_RNG[x] =

FAC\_LAM\_CYL\_SEL\_ADJ\_L\_RNG[x]<sub>LDC</sub>

**(1.4.1)**

FAC\_LAM\_CYL\_SEL\_ADJ\_H\_RNG[x] =

FAC\_LAM\_CYL\_SEL\_ADJ\_H\_RNG[x]<sub>LDC</sub>

**(1.4.2)**

FAC\_LAM\_CYL\_SEL\_ADJ\_CST[x] =



```


MFF_ADD_CYL_LAM_COR[x] = FAC_LAM_CYL_SEL_ADJ_CST[x]LDC (1.4.3)
LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i] = MFF_ADD_CYL_LAM_COR[x]LDC (1.4.4)
VLD[i]LDC (1.4.5) LV_LAM_CYL_SEL_ADJ_H_RNG_
LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i] = LV_LAM_CYL_SEL_ADJ_L_RNG_
VLD[i]LDC (1.4.6)
  endfor(3)
endif(2)
if(2) LV_INH_OBD_DIAG_CYL_BAL_LAM[i] = 0
  then
    if(3) MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_L_RNG
    then
      FAC_LAM_CYL_SEL_ADJ[x] = FAC_LAM_CYL_SEL_ADJ_L_RNG[x]
      (1.4.7)
    else(3)
      if(4) MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_H_RNG
      then
        FAC_LAM_CYL_SEL_ADJ[x] =
          FAC_LAM_CYL_SEL_ADJ_H_RNG[x]
        (1.4.8)
      else(4)
        FAC_LAM_CYL_SEL_ADJ[x] =
          FAC_LAM_CYL_SEL_ADJ_L_RNG[x]
          +
          (MFF_SP[i] - C_MFF_SP_THD_
          CYL_SEL_ADJ_L_RNG)*
          (FAC_LAM_CYL_SEL_ADJ_H_RNG[x]
          -
          FAC_LAM_CYL_SEL_ADJ_L_RNG[x])/
          (C_MFF_SP_THD_CYL_SEL_ADJ_
          H_RNG -
          C_MFF_SP_THD_CYL_SEL_ADJ_
          L_RNG) (1.4.9)
      endif(4)
    endif(3)
  if(3) LC_FAC_LAM_CYL_SEL_ADJ_CST_ENA = 1
  [adaptation under cold condition released]
  then
    if(4) TEMP_LAM_CYL_SEL
    then
      FAC_LAM_CYL_SEL_ADJ_INTER[x] =
        C_TEMP_THD_CYL_SEL_ADJ_COLD_
        FAC_LAM_CYL_SEL_ADJ_CST[x]
      (1.4.10)
    else(4)
      if(5) TEMP_LAM_CYL_SEL
      then
        FAC_LAM_CYL_SEL_ADJ_INTER[x] =
          C_TEMP_THD_CYL_SEL_ADJ_NOM_
          FAC_LAM_CYL_SEL_ADJ_CST[x]
      endif(5)
    endif(4)
  endif(3)
endif(2)

```

```

then
    FAC_LAM_CYL_SEL_ADJ_INTER[x] =
        FAC_LAM_CYL_SEL_ADJ[x] (1.4.11)
else(5)
    FAC_LAM_CYL_SEL_ADJ_INTER[x] =
        FAC_LAM_CYL_SEL_ADJ_CST[x]
+
        (TEMP_LAM_CYL_SEL -
RNG)*
        C_TEMP_THD_CYL_SEL_ADJ_COLD_
        (FAC_LAM_CYL_SEL_ADJ[x] -
        FAC_LAM_CYL_SEL_ADJ_CST[x])/
        (C_TEMP_THD_CYL_SEL_ADJ_
NOM_RNG -
        C_TEMP_THD_CYL_SEL_ADJ_COLD_
RNG) (1.4.12)
endif(5)
endif(4)
if(4) [(TEMP_LAM_CYL_SEL < C_TEMP_LAM_CYL_CST_MIN) or
        (C_TEMP_LAM_CYL_CST_MAX
<
        TEMP_LAM_CYL_SEL < C_TEMP_
LAM_CYL_MIN)]
then
    MFF_DELTA_LAM_CYL_SEL_REAC = 0
        (1.4.13)
    MFF_SP_SAVE_LAM_CYL_SEL = 0
        (1.4.14)
    FAC_VAL_LAM_CYL_SEL_REAC = 0
        (1.4.15)
    DELTA_LAMB_CYL_SEL_CQ[i] = 0
        (1.4.16)
    DELTA_LAMB_CYL_SEL_CQ_FIL[i] = 0
        (1.4.17)
    LAMB_CYL_SEL_CQ_REF[i] = 0
        (1.4.18)
    LAMB_CYL_SEL_CQ_DIF_REF[i] = 0
        (1.4.19)
    CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] = 0
        (1.4.20)
    CTR_LAMB_CYL_SEL_CQ_STAB[i] = 0
        (1.4.21)
    LV_LAMB_CYL_SEL_CQ_DRIFT[i] = 0
        (1.4.22)
    LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 0
        (1.4.23)
    DELTA_LAMB_AV[i] = 0
        (1.4.24)
    DELTA_LAMB_ERR_RAW[i] = 0
        (1.4.25)
    DELTA_LAMB_ERR[i] = 0
        (1.4.26)

```

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$$\text{DELTA\_LAMB\_ERR\_CYL\_SEL}[x] = 0$$

(1.4.27)

$$\text{DELTA\_LAMB\_CYL}[x] = 0$$

(1.4.28)

$$\text{DELTA\_LAMB\_CYL\_SEL}[i] = 0$$

(1.4.29)

$$\text{DELTA\_LAMB\_MDL}[i] = 0$$

(1.4.30)

$$\text{DELTA\_LAMB\_DIF\_CYL}[x] = 0$$

(1.4.31)

$$\text{FAC\_CYL\_LAM\_INT}[x] = 0$$

(1.4.32)

$$\text{FAC\_CYL\_LAM\_I\_MV\_SHIFT}[x] = 0$$

(1.4.33)

$$\text{FAC\_CYL\_LAM}[x] = 0$$

(1.4.34)

$$\text{FAC\_CYL\_LAM\_ABSV\_SUM}[i] = 0$$

(1.4.35)

$$\text{FAC\_LAM\_CYL\_SEL\_ADJ\_FIL}[x] = 0$$

(1.4.36)

$$\text{FAC\_LAM\_CYL\_SEL\_ADJ\_CST\_FIL}[x] = 0$$

(1.4.37)

$$\text{LV\_FAC\_CYL\_LAM\_LIM\_MIN}[x] = 0$$

(1.4.38)

$$\text{LV\_FAC\_CYL\_LAM\_LIM\_MAX}[x] = 0$$

(1.4.39)

$$\text{LV\_FAC\_CYL\_LAM\_VIRT\_LIM}[i] = 0$$

(1.4.40)

**endif**<sup>(4)</sup>**if**<sup>(4)</sup> (LV\_FAC\_CYL\_LAM\_VIRT\_LIM[i] = 0 and

LV\_LAM\_CYL\_SEL\_CTL\_DRIFT\_

PRED[i] = 0 and

STATE\_LAMB\_CYL\_SEL\_CQ\_SLOP[i]

= 0)

**then****if**<sup>(5)</sup> FAC\_CYL\_LAM\_COR[x]<sub>k</sub> >

FAC\_LAM\_CYL\_SEL\_ADJ\_INTER[x]

**then**FAC\_CYL\_LAM\_COR[x]<sub>k</sub> = FAC\_CYL\_LAM\_COR[x]<sub>k-1</sub> -

C\_FAC\_CYL\_LAM\_ABSV\_DEC (1.4.41)

**if**<sup>(6)</sup> FAC\_CYL\_LAM\_COR[x]<sub>k</sub> <

FAC\_LAM\_CYL\_SEL\_ADJ\_INTER[x]

**then**FAC\_CYL\_LAM\_COR[x]<sub>k</sub> =


FAC\_LAM\_CYL\_SEL\_ADJ\_INTER[x]

(1.4.42)

**endif**<sup>(6)</sup>**else**<sup>(5)</sup>**if**<sup>(6)</sup> FAC\_CYL\_LAM\_COR[x]<sub>k</sub> <

FAC\_LAM\_CYL\_SEL\_ADJ\_INTER[x]

**then**FAC\_CYL\_LAM\_COR[x]<sub>k</sub> =

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(1.4.43)

$$\text{FAC\_CYL\_LAM\_COR}[x]_{k-1} \\ + \text{C\_FAC\_CYL\_LAM\_ABSV\_DEC}$$

```

if(7)    FAC_CYL_LAM_COR[x]k >
        FAC_LAM_CYL_SEL_ADJ_INTER[x]

```

```

    then

```

```

        FAC_CYL_LAM_COR[x]k =
        FAC_LAM_CYL_SEL_ADJ_INTER[x]
        (1.4.44)

```

```

    endif(7)

```

```

endif(6)

```

```

endif(5)

```

```

else(4)

```

```

    if(5)    STATE_LAMB_CYL_SEL_CQ_SLOP[i] 0

```

```

    then

```

```

        FAC_CYL_LAM_COR[x]k =

```

```

        FAC_LAM_CYL_SEL_ADJ_INTER[x]

```

(1.4.-)

```

    endif(5)

```

```

endif(4)

```

```

else(3)    [adaptation under cold condition not released]

```

```

    if(4)    TEMP_LAM_CYL_SEL < C_TEMP_LAM_CYL_MIN

```

```

    then

```

```

        MFF_DELTA_LAM_CYL_SEL_REAC = 0

```

```

        (1.4.46)

```

```

        MFF_SP_SAVE_LAM_CYL_SEL = 0

```

```

        (1.4.47)

```

```

        FAC_VAL_LAM_CYL_SEL_REAC = 0

```

```

        (1.4.48)

```

```

        DELTA_LAMB_CYL_SEL_CQ[i] = 0

```

```

        (1.4.49)

```

```

        DELTA_LAMB_CYL_SEL_CQ_FIL[i] = 0

```

```

        (1.4.50)

```

```

        LAMB_CYL_SEL_CQ_REF[i] = 0

```

```

        (1.4.51)

```

```

        LAMB_CYL_SEL_CQ_DIF_REF[i] = 0

```

```

        (1.4.52)

```

```

        CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] = 0

```

```

        (1.4.53)

```

```

        CTR_LAMB_CYL_SEL_CQ_STAB[i] = 0

```

```

        (1.4.54)

```

```

        LV_LAMB_CYL_SEL_CQ_DRIFT[i] = 0

```

```

        (1.4.55)

```

```

        LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 0

```

```

        (1.4.56)

```

```

        DELTA_LAMB_AV[i] = 0

```

```

        (1.4.57)

```

```

        DELTA_LAMB_ERR_RAW[i] = 0

```

```

        (1.4.58)

```

```

        DELTA_LAMB_ERR[i] = 0

```

```


        (1.4.59)

```

```

        DELTA_LAMB_ERR_CYL_SEL[x] = 0


```

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```

DELTA_LAMB_CYL[x] = 0 (1.4.60)
DELTA_LAMB_CYL_SEL[i] = 0 (1.4.61)
DELTA_LAMB_MDL[i] = 0 (1.4.62)
DELTA_LAMB_MDL[i] = 0 (1.4.63)
DELTA_LAMB_DIF_CYL[x] = 0 (1.4.64)
DELTA_LAMB_DIF_CYL[x] = 0 (1.4.64)
FAC_CYL_LAM_INT[x] = 0 (1.4.65)
FAC_CYL_LAM_I_MV_SHIFT[x] = 0 (1.4.66)
FAC_CYL_LAM[x] = 0 (1.4.67)
FAC_CYL_LAM_ABSV_SUM[i] = 0 (1.4.68)
FAC_LAM_CYL_SEL_ADJ_FIL[x] = 0 (1.4.69)
FAC_LAM_CYL_SEL_ADJ_CST_FIL[x] = 0 (1.4.70)
LV_FAC_CYL_LAM_LIM_MIN[x] = 0 (1.4.71)
LV_FAC_CYL_LAM_LIM_MAX[x] = 0 (1.4.72)
LV_FAC_CYL_LAM_VIRT_LIM[i] = 0 (1.4.73)
endif(4)
if(4) (LV_FAC_CYL_LAM_VIRT_LIM[i] = 0 and
LV_LAM_CYL_SEL_CTL_DRIFT_
PRED[i] = 0 and
STATE_LAMB_CYL_SEL_CQ_SLOP[i]
= 0)
then
if(5) FAC_CYL_LAM_COR[x]k > FAC_LAM_CYL_SEL_ADJ[x]
then
FAC_CYL_LAM_COR[x]k = FAC_CYL_LAM_COR[x]k-1 -
C_FAC_CYL_LAM_ABSV_DEC (1.4.74)
if(6) FAC_CYL_LAM_COR[x]k <
FAC_LAM_CYL_SEL_ADJ[x]
then
FAC_CYL_LAM_COR[x]k =
FAC_LAM_CYL_SEL_ADJ[x]
(1.4.75)
endif(6)
else(5)
if(6) FAC_CYL_LAM_COR[x]k <
FAC_LAM_CYL_SEL_ADJ[x]
then
FAC_CYL_LAM_COR[x]k =
FAC_CYL_LAM_COR[x]k-1 +
C_FAC_CYL_LAM_ABSV_DEC (1.4.76)


```

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```

                                if(7)      FAC_CYL_LAM_COR[x]k >
                                        FAC_LAM_CYL_SEL_ADJ[x]
                                then
                                        FAC_CYL_LAM_COR[x]k =
                                        FAC_LAM_CYL_SEL_ADJ[x] (1.4.77)
                                endif(7)
                                endif(6)
                                endif(5)
else(4)
    if(5)      STATE_LAMB_CYL_SEL_CQ_SLOP[i] 0
    then
        FAC_CYL_LAM_COR[x]k =
        FAC_LAM_CYL_SEL_ADJ[x] (1.4.78)
    endif(5)
endif(4)
endif(3)
if(3)      LV_LAM_CYL_ACT[i] = 1
then
    MFF_SP_SAVE_LAM_CYL_SEL = MFF_SP_LAM_CYL_SEL
                                (1.4.79)
    LV_LAM_CYL_ACT[i] = 0
                                (1.4.80)
endif(3)
else(2) [the function is inhibited by diagnosis]
    if(3)      LC_LAM_CYL_SEL_ERR_RST = 1
                [adaptation values shall be reset]
    then
        if(4)      FAC_CYL_LAM_COR[x]k > 0
        then
            FAC_CYL_LAM_COR[x]k = FAC_CYL_LAM_COR[x]k-1 -
                                C_FAC_CYL_LAM_ABSV_DEC (1.4.81)
        if(5)      FAC_CYL_LAM_COR[x]k < 0
        then
            FAC_CYL_LAM_COR[x]k = 0
                                (1.4.82)
        endif(5)
        else(4)
            if(5)      FAC_CYL_LAM_COR[x]k < 0
            then
                FAC_CYL_LAM_COR[x]k = FAC_CYL_LAM_COR[x]k-1 +
                                    C_FAC_CYL_LAM_ABSV_DEC (1.4.83)
            if(6)      FAC_CYL_LAM_COR[x]k > 0
            then
                FAC_CYL_LAM_COR[x]k = 0
                                    (1.4.84)
            endif(6)
        endif(5)
    endif(4)
    FAC_LAM_CYL_SEL_ADJ_L_RNG[x]LDC = 0
                                (1.4.85)
    FAC_LAM_CYL_SEL_ADJ_H_RNG[x]LDC = 0
                                (1.4.86)

```

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```

FAC_LAM_CYL_SEL_ADJ_CST[x]LDC = 0
(1.4.87)
MFF_ADD_CYL_LAM_COR[x]LDC = 0
(1.4.88)
LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i]LDC = 0
(1.4.89)
LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i]LDC = 0
(1.4.90)
FAC_LAM_CYL_SEL_ADJ[x] = 0
(1.4.91)
FAC_LAM_CYL_SEL_ADJ_L_RNG[x] = 0
(1.4.92)
FAC_LAM_CYL_SEL_ADJ_H_RNG[x] = 0
(1.4.93)
FAC_LAM_CYL_SEL_ADJ_CST[x] = 0
(1.4.94)
MFF_ADD_CYL_LAM_COR[x] = 0
(1.4.95)
LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i] = 0
(1.4.96)
LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i] = 0
(1.4.97)
else(3) [adaptation values shall be kept]
if(4) MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_L_RNG
then
FAC_LAM_CYL_SEL_ADJ[x] =
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]LDC (1.4.98)
else(4)
if(5) MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_H_RNG
then
FAC_LAM_CYL_SEL_ADJ[x] =
FAC_LAM_CYL_SEL_ADJ_H_RNG[x]LDC (1.4.99)
else(5)
FAC_LAM_CYL_SEL_ADJ[x] =
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]LDC
+
CYL_SEL_ADJ_L_RNG)*
-
H_RNG -
L_RNG) (1.4.100)
endif(5)
endif(4)
if(4) LC_FAC_LAM_CYL_SEL_ADJ_CST_ENA = 1
[adaptation under cold condition released]
then
if(5) TEMP_LAM_CYL_SEL

```

```

C_TEMP_THD_CYL_SEL_ADJ_COLD_
RNG
    then
        FAC_LAM_CYL_SEL_ADJ_INTER[x] =
            FAC_LAM_CYL_SEL_ADJ_CST[x]LDC
            (1.4.101)
    else(5)
        if(6)    TEMP_LAM_CYL_SEL
                C_TEMP_THD_CYL_SEL_ADJ_NOM_
RNG
    then
        FAC_LAM_CYL_SEL_ADJ_INTER[x] =
            FAC_LAM_CYL_SEL_ADJ[x]
            (1.4.102)
    else(6)
        FAC_LAM_CYL_SEL_ADJ_INTER[x] =
            FAC_LAM_CYL_SEL_ADJ_CST[x]LDC
+
        (TEMP_LAM_CYL_SEL -
        C_TEMP_THD_CYL_SEL_ADJ_COLD_
RNG)*
        (FAC_LAM_CYL_SEL_ADJ[x] -
        FAC_LAM_CYL_SEL_ADJ_CST[x]LDC)/
NOM_RNG -
        (C_TEMP_THD_CYL_SEL_ADJ_
RNG) (1.4.103)
        C_TEMP_THD_CYL_SEL_ADJ_COLD_
        endif(6)
    endif(5)
if(5)    FAC_CYL_LAM_COR[x]k >
        FAC_LAM_CYL_SEL_ADJ_INTER[x]
    then
        FAC_CYL_LAM_COR[x]k = FAC_CYL_LAM_COR[x]k-1
        - C_FAC_CYL_LAM_ABSV_DEC
(1.4.104)
        if(6)    FAC_CYL_LAM_COR[x]k <
                FAC_LAM_CYL_SEL_ADJ_INTER[x]
            then
                FAC_CYL_LAM_COR[x]k =
                FAC_LAM_CYL_SEL_ADJ_INTER[x]
(1.4.105)
            endif(6)
        else(5)
            if(6)    FAC_CYL_LAM_COR[x]k <
                    FAC_LAM_CYL_SEL_ADJ_INTER[x]
                then
                    FAC_CYL_LAM_COR[x]k =
                    FAC_CYL_LAM_COR[x]k-1 +
                    C_FAC_CYL_LAM_ABSV_DEC (1.4.106)
                if(7)    FAC_CYL_LAM_COR[x]k >
                        FAC_LAM_CYL_SEL_ADJ_INTER[x]
                    then

```

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```

                                FAC_CYL_LAM_COR[x]k =
                                FAC_LAM_CYL_SEL_ADJ_INTER[x]
                                (1.4.107)
                                endif(7)
                                endif(6)
                                endif(5)
else(4) [adaptation under cold condition not released]
if(5) FAC_CYL_LAM_COR[x]k > FAC_LAM_CYL_SEL_ADJ[x]
then
FAC_CYL_LAM_COR[x]k = FAC_CYL_LAM_COR[x]k-1 -
C_FAC_CYL_LAM_ABSV_DEC (1.4.108)
if(6) FAC_CYL_LAM_COR[x]k <
FAC_LAM_CYL_SEL_ADJ[x]
then
FAC_CYL_LAM_COR[x]k =
FAC_LAM_CYL_SEL_ADJ[x](1.4.109)
endif(6)
else(5)
if(6) FAC_CYL_LAM_COR[x]k <
FAC_LAM_CYL_SEL_ADJ[x]
then
FAC_CYL_LAM_COR[x]k =
FAC_CYL_LAM_COR[x]k-1 +
C_FAC_CYL_LAM_ABSV_DEC (1.4.110)
if(7) FAC_CYL_LAM_COR[x]k >
FAC_LAM_CYL_SEL_ADJ[x]
then
FAC_CYL_LAM_COR[x]k =
FAC_LAM_CYL_SEL_ADJ[x](1.4.111)
endif(7)
endif(6)
endif(5)
endif(4)
endif(3)
LV_LAM_CYL_ACT[i] = 0
(1.4.112)
DELTA_LAMB_CYL_SEL_CQ[i] = 0
(1.4.113)
DELTA_LAMB_CYL_SEL_CQ_FIL[i] = 0
(1.4.114)
LAMB_CYL_SEL_CQ_REF[i] = 0
(1.4.115)
LAMB_CYL_SEL_CQ_DIF_REF[i] = 0
(1.4.116)
CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] = 0
(1.4.117)
CTR_LAMB_CYL_SEL_CQ_STAB[i] = 0
(1.4.118)
LV_LAMB_CYL_SEL_CQ_DRIFT[i] = 0
(1.4.119)
LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 0
(1.4.120)

```

```

DELTA_LAMB_AV[i] = 0
(1.4.121)
DELTA_LAMB_ERR_RAW[i] = 0
(1.4.122)
DELTA_LAMB_ERR[i] = 0
(1.4.123)
DELTA_LAMB_ERR_CYL_SEL[x] = 0
(1.4.124)
DELTA_LAMB_CYL[x] = 0
(1.4.125)
DELTA_LAMB_CYL_SEL[i] = 0
(1.4.126)
DELTA_LAMB_MDL[i] = 0
(1.4.127)
DELTA_LAMB_DIF_CYL[x] = 0
(1.4.128)
FAC_CYL_LAM_INT[x] = 0
(1.4.129)
FAC_CYL_LAM_I_MV_SHIFT[x] = 0
(1.4.130)
FAC_CYL_LAM[x] = 0
(1.4.131)
FAC_CYL_LAM_ABSV_SUM[i] = 0
(1.4.132)
FAC_LAM_CYL_SEL_ADJ_FIL[x] = 0
(1.4.133)
FAC_LAM_CYL_SEL_ADJ_CST_FIL[x] = 0
(1.4.134)
LV_FAC_CYL_LAM_LIM_MIN[x] = 0
(1.4.135)
LV_FAC_CYL_LAM_LIM_MAX[x] = 0
(1.4.136)
LV_FAC_CYL_LAM_VIRT_LIM[i] = 0
(1.4.& %■)

endif(2)
STATE_LAM_CYL_SEL[i] = 0 [PAS]
(1.4.138)
STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
(1.4.139)
LV_LAM_CYL_SEL_SEG_REF_CLL[i] = 0
(1.4.140)
FAC_CYL_LAM_P[x] = 0
(1.4.141)
FAC_CYL_LAM_P_MV_SHIFT[x] = 0
(1.4.142)
CTR_T_LAM_CYL_ADJ[i] = 0
(1.4.143)
CTR_LAM_CYL_SEL_REF_CLL[i] = 0
(1.4.144)
LV_LAM_CYL_SEL_ADJ_VLD[i] = 0
(1.4.1-)
endif(1)

```

**Formula section:**

**7.73.6 Signal evaluation (segment synchronous)**

The aim of signal evaluation with a low sampling rate is the precise dividing of the lambda sensor output signal into the identified cylinder. Therefore, the sampling moment shall be computed, depending on the engine operating state, precisely. The Sampling moment is influenced by phase displacement predetermined by IP\_CRK\_SYN[i]. The value of the phase shift is given in CRK.

**7.73.6.1 Calculation of the segment period**

Depending on the engine speed the segment period is simply computed by

if<sup>(1)</sup> two separate exhaust banks are concerned, then

$$TA = 2 * \frac{2 * 60}{N * NC\_CYL\_NR}$$

(1.5.1.1)

else<sup>(1)</sup>

$$TA = \frac{2 * 60}{N * NC\_CYL\_NR}$$

(1.5.1.2)

endif<sup>(1)</sup>

**7.73.6.2 Calculation of the phase displacement**

The phase shift - caused by system delayed response - is computed once per combustion cycle using the map IP\_CRK\_SYN[i], adjusted by C\_CRK\_CYL\_LAM[x], PHA\_SHIFT\_CAM\_EX[i] and DELTA\_CRK\_CYL\_LAM[i]. It shall be determined at the beginning of the combustion cycle (SEG\_NR = 0). That applies to the first and ensuing segments.

if<sup>(1)</sup> SEG\_NR = 0  
then

$$CRK\_CYL\_LAM[x] = IP\_CRK\_SYN[i] + C\_CRK\_CYL\_LAM[x] + PHA\_SHIFT\_CAM\_EX[i] + DELTA\_CRK\_CYL\_LAM[i] + IP\_CRK\_DELTA\_AMP\_CYL\_LAM$$

(1.5.2.1)

if<sup>(2)</sup> CRK\_CYL\_LAM[x] > \*720 °CRK  
then  
CRK\_CYL\_LAM[x] = CRK\_CYL\_LAM[x] - \*720 °CRK


(1.5.2.2)

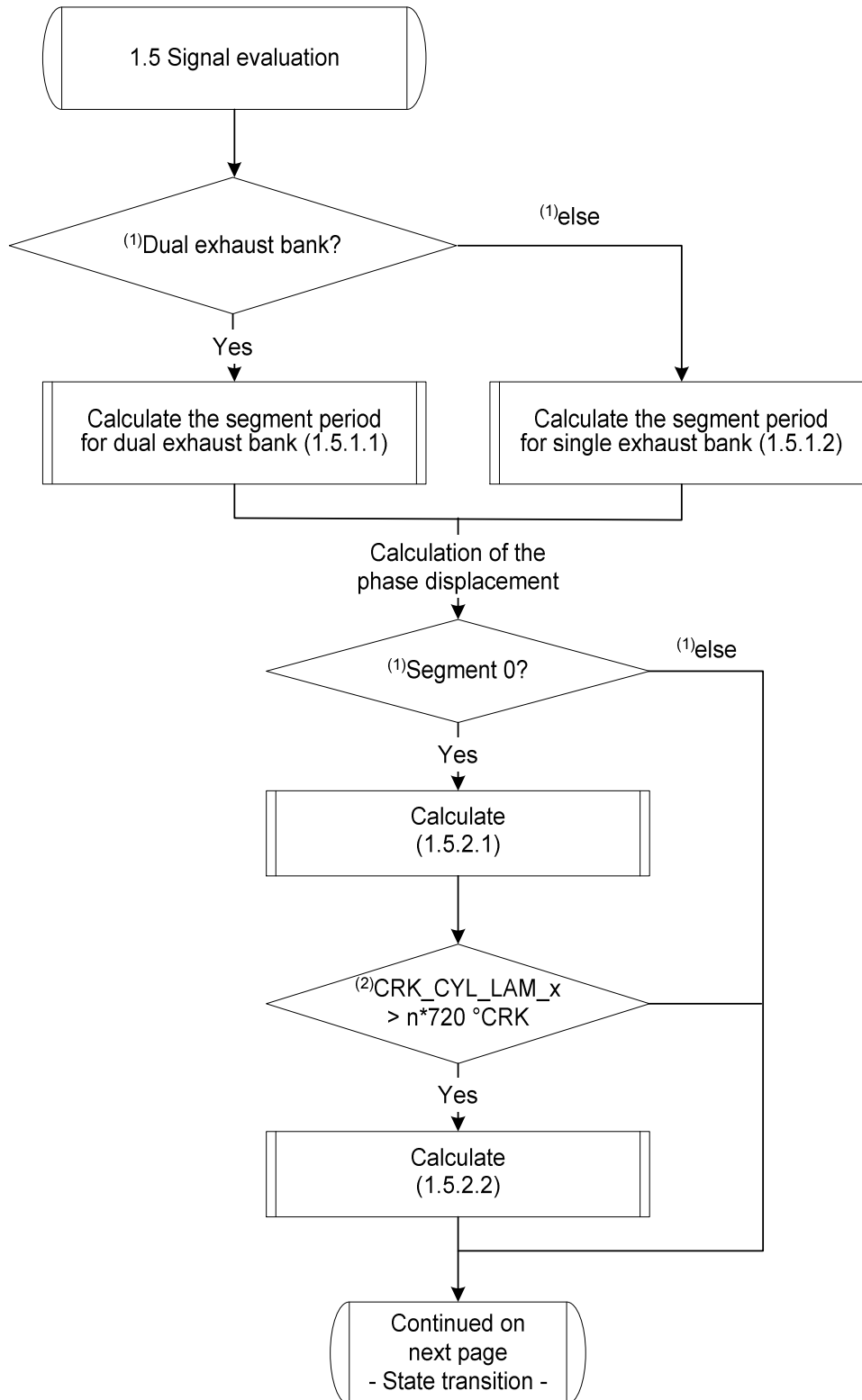
endif<sup>(2)</sup>

endif<sup>(1)</sup>

Remark:  
= 1, 2, ...

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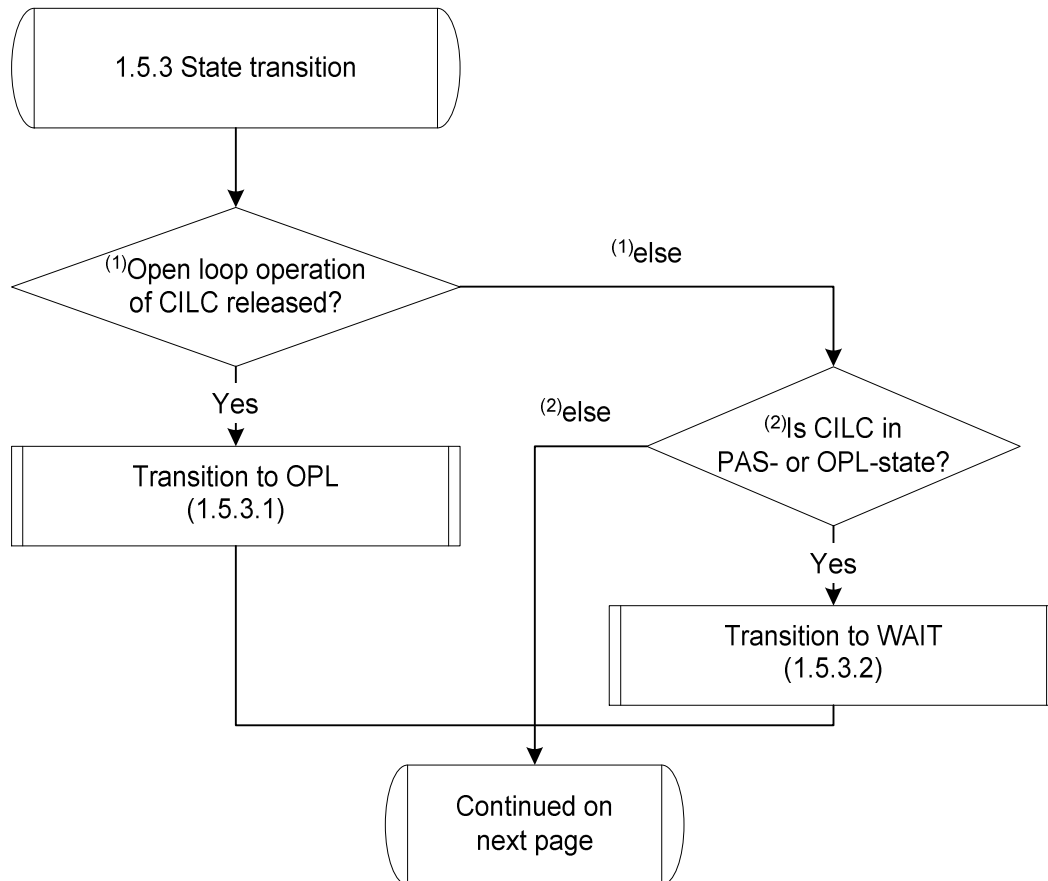


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### 7.73.6.3 State - Transition

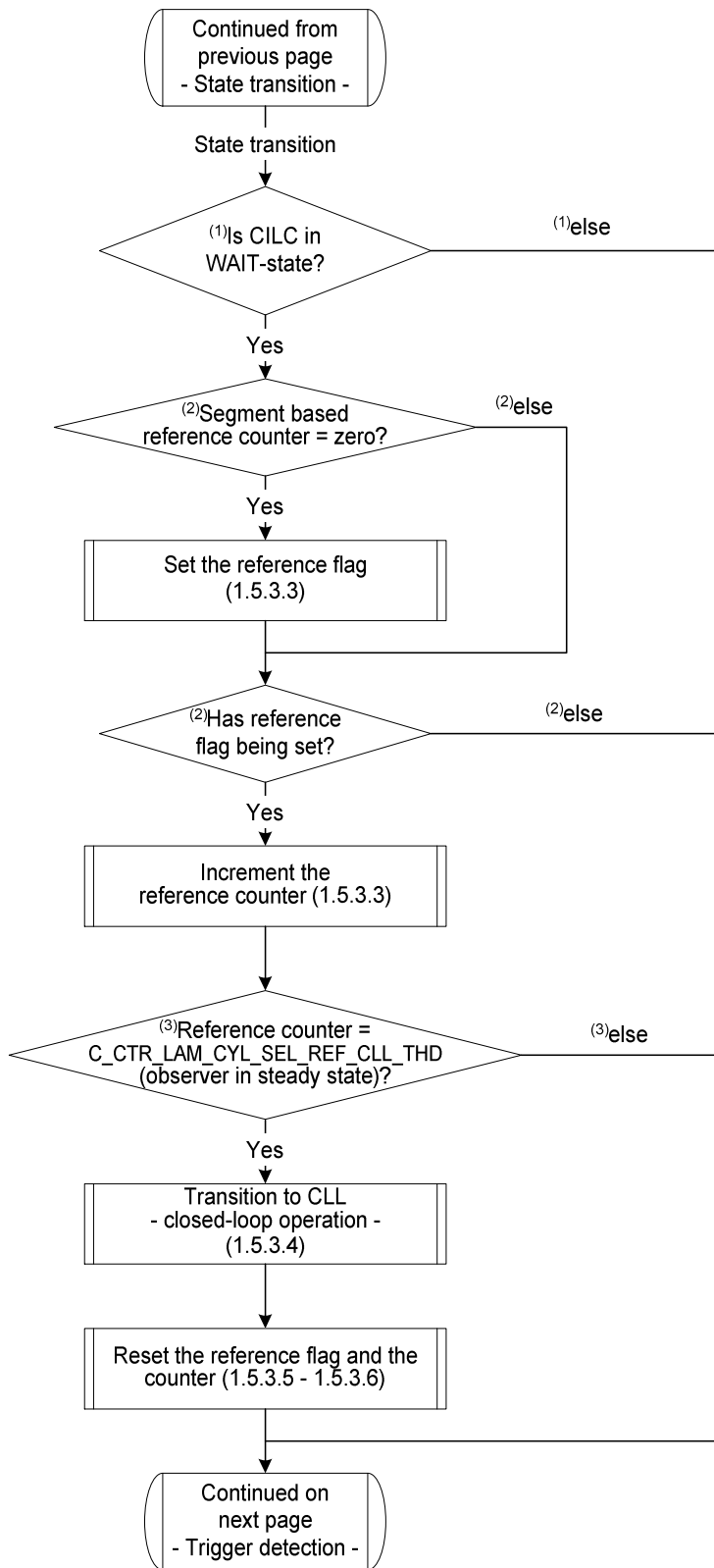
In case of first activation or even reactivation the calculations in chapter 1.9 may be carried out on condition that at least one combustion cycle has been completed and the function is not in open loop mode.

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```


if(1)      LC_LAM_CYL_SEL_OPL = 1
then
    STATE_LAM_CYL_SEL[i] = 1 [OPL]
                                          (1.5.3.1)
else(1)
    if(2)      (STATE_LAM_CYL_SEL[i] = 0 [PAS] or STATE_LAM_CYL_SEL[i] = 1 [OPL])
    then
        STATE_LAM_CYL_SEL[i] = 2 [WAIT]
                                          (1.5.3.2)
    endif(2)
endif(1)
  
```



```

if(1) STATE_LAM_CYL_SEL[i] = 2 [WAIT]
then
    if(2) CTR_LAM_CYL_SEL_REF_CLL[i] = 0
    then
        LV_LAM_CYL_SEL_SEG_REF_CLL[i] = 1
    
```

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```

endif(2)
if(2)    LV_LAM_CYL_SEL_SEG_REF_CLL[i] = 1
then
    increment(CTR_LAM_CYL_SEL_REF_CLL[i])
    if(3)    CTR_LAM_CYL_SEL_REF_CLL[i] =
THD
        C_CTR_LAM_CYL_SEL_REF_CLL_
    then
        STATE_LAM_CYL_SEL[i] = 3 [CLL]
        LV_LAM_CYL_SEL_SEG_REF_CLL[i] = 0
        CTR_LAM_CYL_SEL_REF_CLL[i] = 0
    endif(3)
endif(2)
endif(1)
    
```

(1.5.3.3)

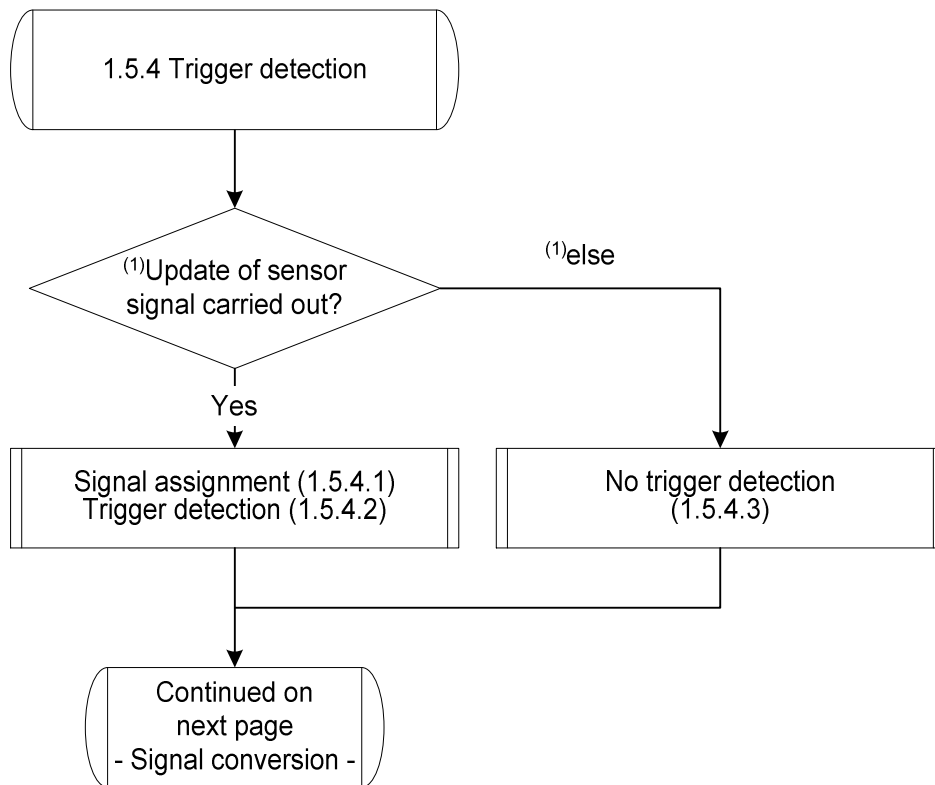
(1.5.3.4)

(1.5.3.5)

(1.5.3.6)

### 7.73.6.4 Trigger detection

The trigger for the corresponding segment is created if the state of the variable VLS\_CYL\_TRIG[x] changes. At the same time the value of VLS\_CYL[x] shall be transferred to VLS\_CYL\_SEL[x].



```

if(1)    VLS_CYL_TRIG[x]  VLS_CYL_TRIG[x]k-1
then
    VLS_CYL_SEL[x] = VLS_CYL[x]
    LV_TRIG[x] = 1
    
```

(1.5.4.1)

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**else**<sup>(1)</sup> (1.5.4.2)  
     LV\_TRIG[x] = 0

**endif**<sup>(1)</sup> (1.5.4.3)

### 7.73.7 Signal conversion

The voltage value of VLS\_CYL\_SEL[x] shall be converted to Lambda using the characteristic curve IP\_LAMB\_CYL<sub>x</sub> and has to be shifted by its mean value. The resulting value represents the global AFR deviation. Calculation and shifting the mean value shall be carried out in segment step.

**if**<sup>(1)</sup>       LV\_TRIG[x] = 1  
**then**  
     LAMB\_CYL\_SEL[x] = IP\_LAMB\_CYL (VLS\_CYL\_SEL[x]) (1.6.1)

$$\text{DELTA\_LAMB\_AV}[i] = \text{LAMB\_CYL\_SEL}[x] - \frac{1}{\alpha} \sum_{k=1}^{\alpha} \text{LAMB\_CYL\_SEL}[x];$$

$\alpha$  : number of cylinders per bank

(1.6.2)

### 7.73.8 Calculation of time lag of the lambda-sensor model

$$\text{T1\_LAMB\_CYL\_SEL}[i] = \text{IP\_T1\_LAMB\_CYL\_SEL}[i] \quad (1.7.1)$$

### 7.73.9 Calculation of the estimation-error

Estimation error represents the difference between the measured value, DELTA\_LAMB\_AV[i], and the estimated value, DELTA\_LAMB\_MDL[i].

$$\text{DELTA\_LAMB\_ERR\_RAW}[i] = \text{DELTA\_LAMB\_AV}[i] - \text{DELTA\_LAMB\_MDL}[i][x(n-1)] \quad (1.8.1)$$

*Remark:* Software shall guarantee a segment synchronous comparison, i.e. the value of DELTA\_LAMB\_AV[i] at the segment-time x shall be compared with that DELTA\_LAMB\_MDL[i] which was calculated in segment x during the last combustion cycle [x(n-1)].

### 7.73.10 Weighting the estimation-error

Depending on T1\_LAMB\_CYL\_SEL[i], the error shall be weighted. This is carried out by means of a characteristic curve. A non-linear dependent weighting function might be considered for late come out.

$$\text{DELTA\_LAMB\_ERR}[i] = \text{DELTA\_LAMB\_ERR\_RAW}[i] * \text{IP\_FAC\_ERR\_LAM\_SEL} \quad (1.9.1)$$

### 7.73.11 Signal splitting /Calculation of the cylinder selective AFR /Signal merge

Splitting procedure shall be implemented in order the weighted error signal to be allocated to an internal state, which describes the current estimated value of air -/fuel ratio in each cylinder respectively (Figure 2).

$$\text{DELTA\_LAMB\_ERR\_CYL\_SEL}[x] = \text{DELTA\_LAMB\_ERR}[i] \quad (1.10.1)$$



An adaptation mechanism, including an integral-action element for each cylinder - corrected by exhaust-manifold-port factor  $C\_CRLC\_EXV\_FAC[x]$ , adjusts the estimated value to the actual one. The adjusted value of the cylinder individual deviation is calculated by the equation

$$DELTA\_LAMB\_CYL[x]_k = (DELTA\_LAMB\_CYL[x]_{k-1} + DELTA\_LAMB\_ERR\_CYL\_SEL[x]_k * TA) * C\_CRLC\_EXV\_FAC[x] \quad (1.10.2)$$

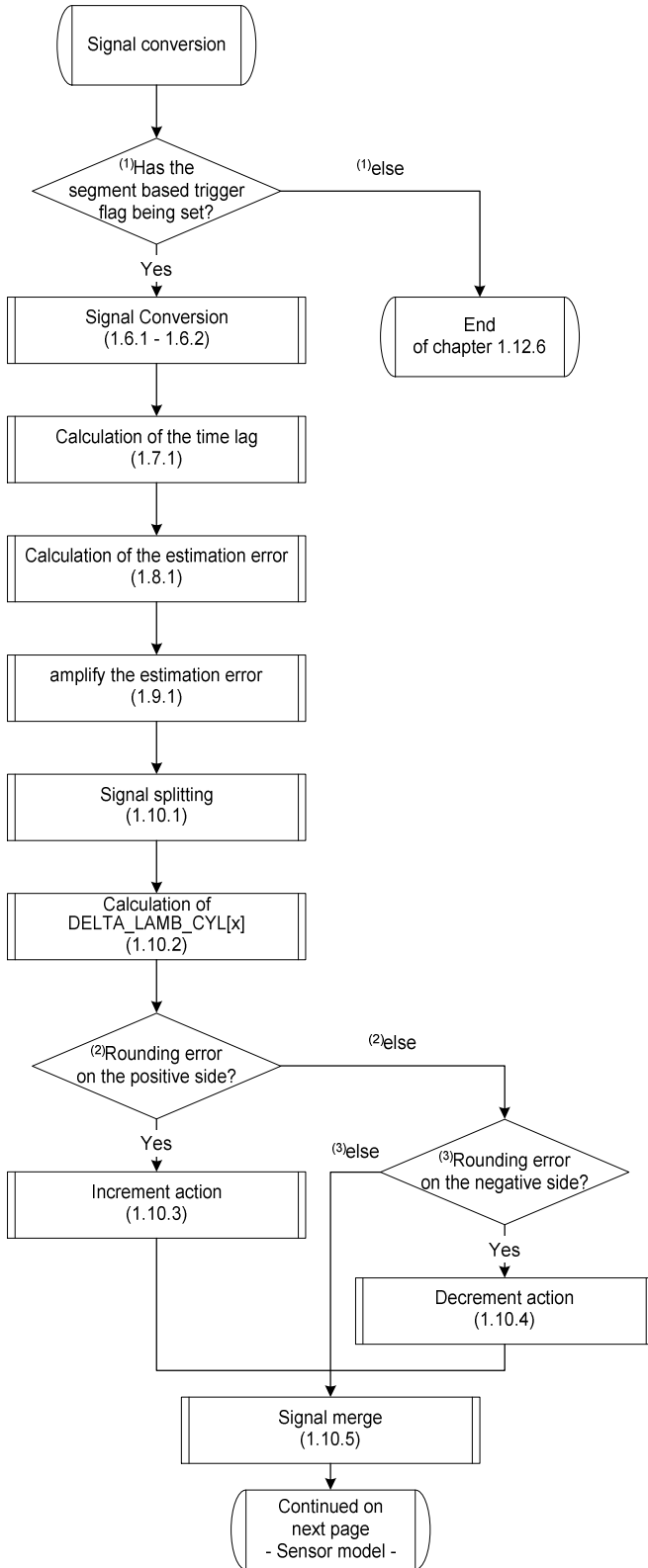
In order to avoid rounding error that leads to zero-readout of the gradient term in aforementioned equation, following scan shall be made:

```

if(2) (DELTA_LAMB_ERR_CYL_SEL[x]k*TA = 0 and
    DELTA_LAMB_ERR_CYL_SEL[x]k
> 0)
    then
    increment(DELTA_LAMB_ERR_CYL_SEL[x]k*TA)
    (1.10.3)
    else(2)
    if(3)(DELTA_LAMB_ERR_CYL_SEL[x]k*TA = 0 and
    DELTA_LAMB_ERR_CYL_SEL[x]k<
0)
    then
    decrement (DELTA_LAMB_ERR_CYL_SEL[x]k*TA)
    (1.10.4)
    endif(3)
endif(2)
    
```

In accordance with the ignition sequence signal-reassembling procedure shall be carried out in order to get the divided signals together.  $DELTA\_LAMB\_CYL\_SEL[i]$  is input of the sensor model for the current segment.

$$DELTA\_LAMB\_CYL\_SEL[i]_k = DELTA\_LAMB\_CYL[x]_k \quad (1.10.5)$$



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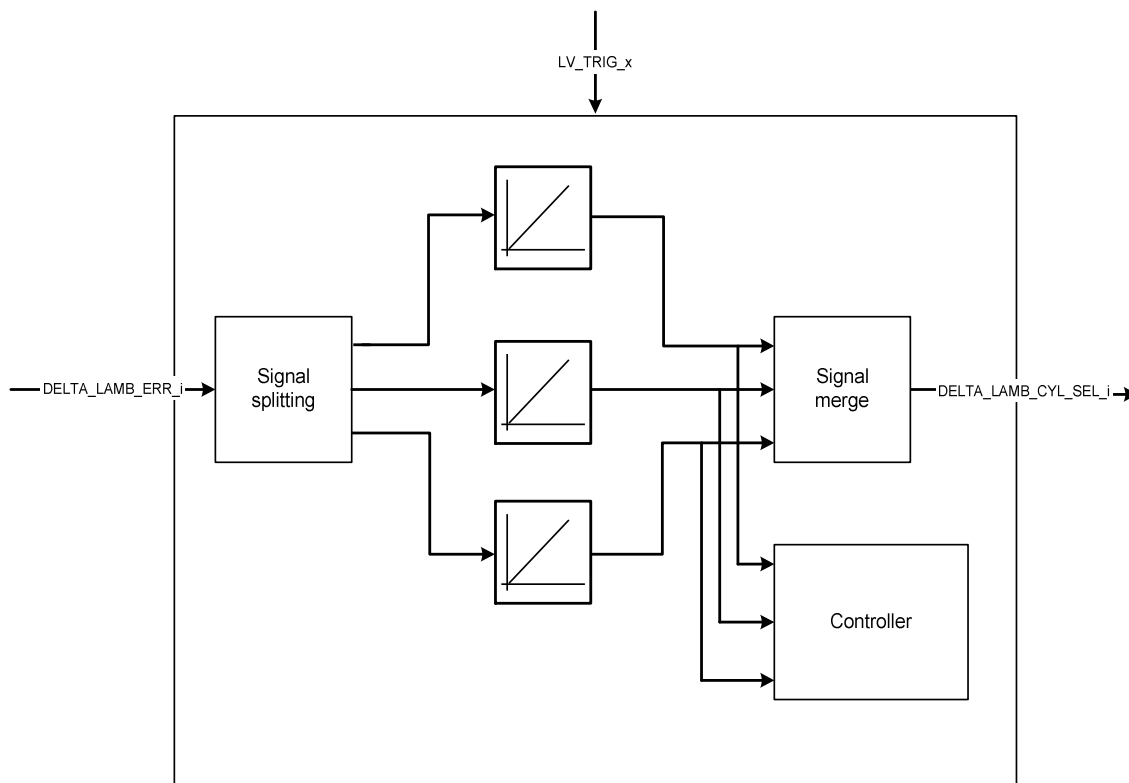


Figure 7.73.9: : Signal splitting, adjustment and signal merge

### 7.73.12 Sensor model

The dynamic behaviour of WRAF sensor is described by a sensor model, first order low-pass-filter. This is characterised by a time lag, T1\_LAMB\_CYL\_SEL[i]. Furthermore, the effect of the delay is considered by choice of an adequate sampling time relevant to crankshaft angle. This is depicted in 0 ... 720 CRK range.

The approximated model is theoretically defined in time range as

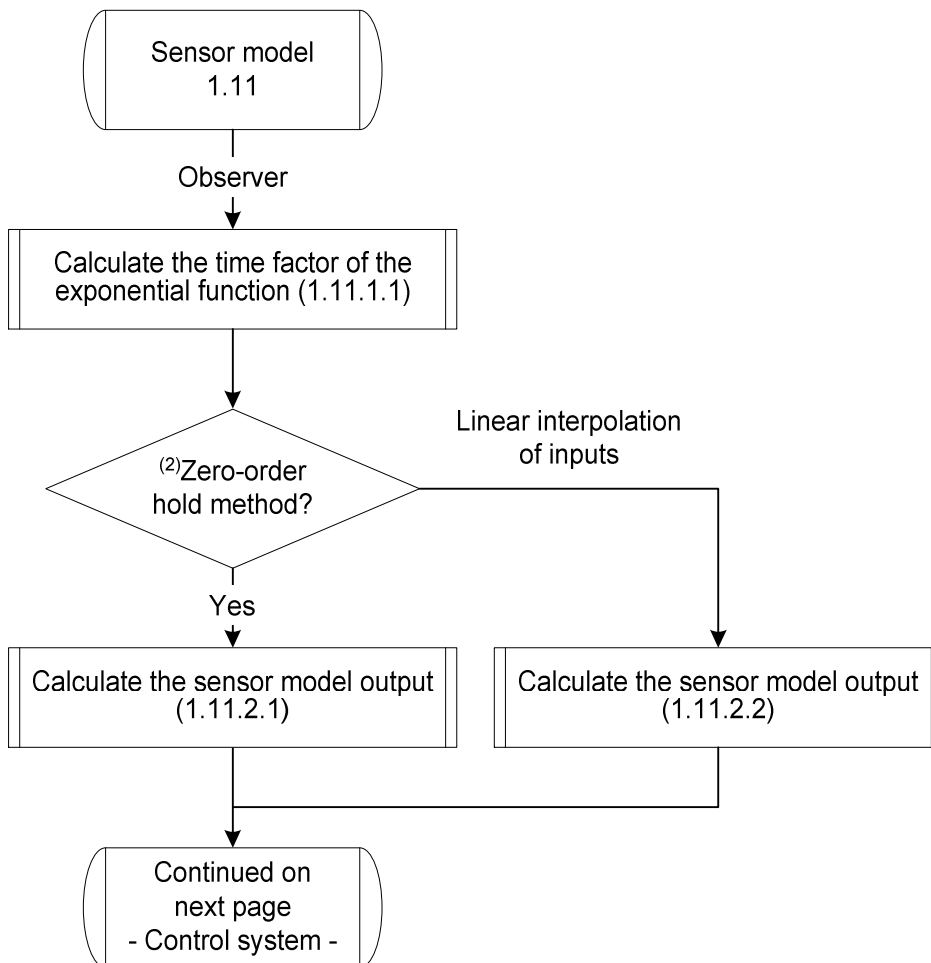
$$y(t) = 1 - e^{-t/T}$$

and described in frequency range as continuous-time model

$$G(s) = \frac{1}{1 + sT}$$

with  $T = T1\_LAMB\_CYL\_SEL[i]$

Conversion of continuous-time model to discrete-time model with sample time TA can be made using either 'zoh'- or 'foh'-method.



### 7.73.12.1 Calculation of model parameters

$$FAC\_T[i] = \frac{T1\_LAMB\_CYL\_SEL[i]}{TA}$$

(1.11.1.1)

- Zero-order hold on the inputs 'zoh' - recommended method (LC\_LAMB\_DELTA\_MDL\_HLD = 0)

calibration maps are

$$IP\_EXP\_LAMB\_MDL[i] = e^{-\frac{1}{FAC\_T[i]}}$$

IP\_N1\_FAC\_LAMB\_MDL[i] = 1 - IP\_EXP\_LAMB\_MDL[i] and  
IP\_N2\_FAC\_LAMB\_MDL[i] = 0

- Linear interpolation of inputs 'foh' (LC\_LAMB\_DELTA\_MDL\_HLD = 1)  
calibration maps are

$$IP\_EXP\_LAMB\_MDL[i] = e^{-\frac{1}{FAC\_T[i]}}$$

$$IP\_N1\_FAC\_LAMB\_MDL[i] = 1 - FAC\_T[i] * (1 - IP\_EXP\_LAMB\_MDL[i]) \text{ and}$$

$$IP\_N2\_FAC\_LAMB\_MDL[i] = FAC\_T[i] - (1 + FAC\_T[i]) * IP\_EXP\_LAMB\_MDL[i]$$

### 7.73.12.2 Calculation of the sensor model output

The output of sensor model is governed by DELTA\_LAMB\_MDL[i].

```

if(2) LC_LAMB_DELTA_MDL_HLD = 0
then
    DELTA_LAMB_MDL[i]k = IP_EXP_LAMB_MDL[i]*DELTA_LAMB_MDL[i]k-1 +
    IP_N1_FAC_LAMB_MDL[i]*DELTA_
LAMB_CYL_SEL[i]k
(1.11.2.1)
else(2)
    DELTA_LAMB_MDL[i]k = IP_EXP_LAMB_MDL[i]*DELTA_LAMB_MDL[i]k-1 +
    IP_N1_FAC_LAMB_MDL[i]*DELTA_
LAMB_CYL_SEL[i]k +
    IP_N2_FAC_LAMB_MDL[i]*DELTA_
LAMB_CYL_SEL[i]k-1
(1.11.2.2)
endif(2)

```

#### Attention:


Precise allocation required. For segment x, DELTA\_LAMB\_MDL[i]<sub>k-1</sub> and DELTA\_LAMB\_CYL\_SEL[i]<sub>k-1</sub> are buffered variables that were calculated in the segment x - 1 for one bank system and x - 2 for two bank system.

## 7.73.13 Control system

A cylinder individual AFR regulation is carried out (Figure 3).

### 7.73.13.1 Control deviation

The tracking error for corresponding cylinder is defined as DELTA\_LAMB\_DIF\_CYL[x].

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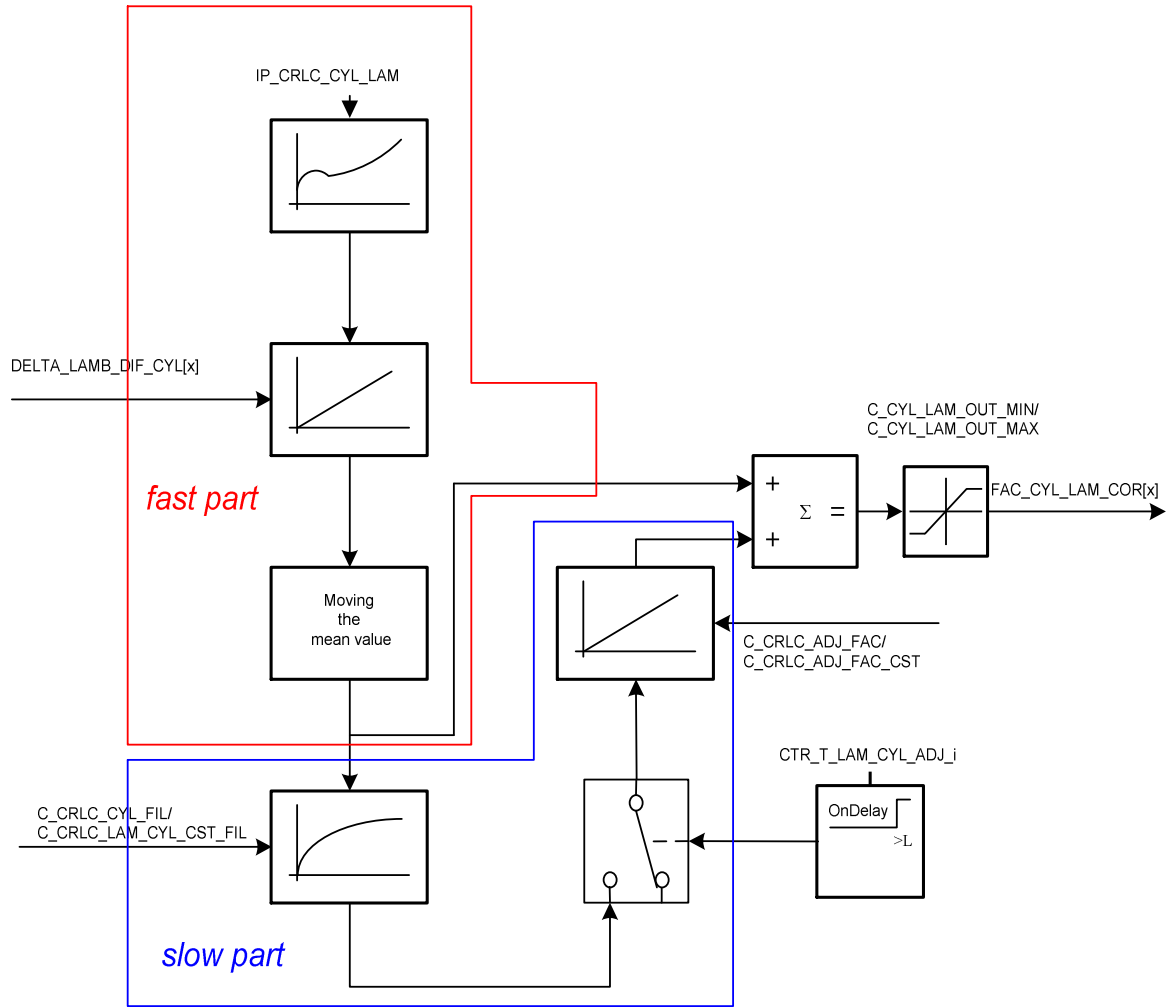
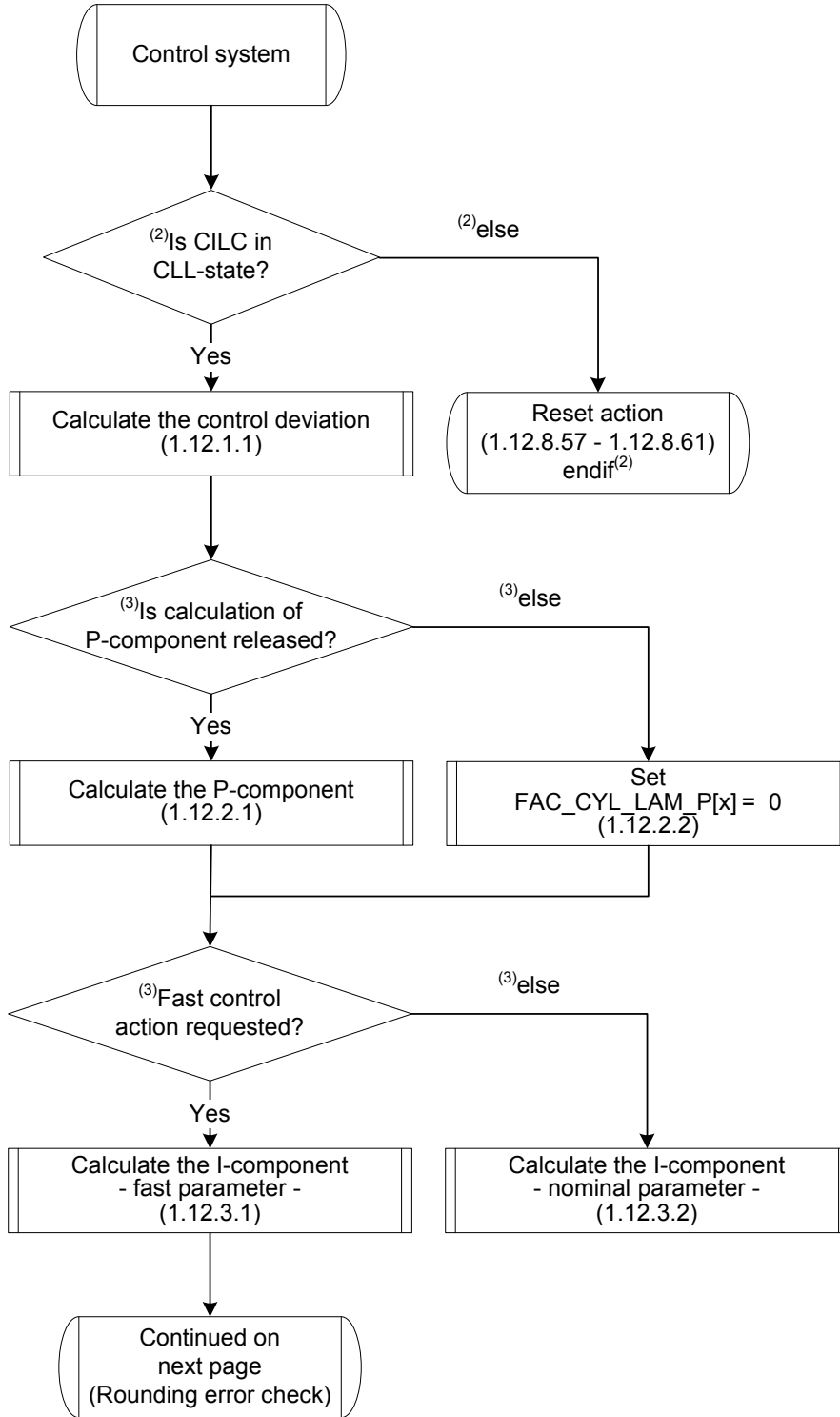


Figure 7.73.10: : Control system including the adaptation mechanism

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```

if(2) STATE_LAM_CYL_SEL[i] = 3 [CLL]
then
    DELTA_LAMB_DIF_CYL[x] = DELTA_LAMB_CYL[x]
                                - C_DELTA_LAMB_CYL_SP (1.12.1.1)
    
```

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### 7.73.13.2 Calculation of proportional-action controller (P-Component)

The P-Component can be switched off using an on-off switch

```

if(3)          LC_FAC_CYL_LAM_P_SWI = 1
then
                FAC_CYL_LAM_P[x]= IP_FAC_GAIN_P_LAM_CYL_SEL *
                                DELTA_LAMB_DIF_CYL[x]*IP_CRLC_
P_NEUT_RNG (1.12.2.1)
else(3)
                FAC_CYL_LAM_P[x]= 0
                                (1.12.2.2)
endif(3)
    
```

### 7.73.13.3 Calculation of integral-action controller (I-Component)

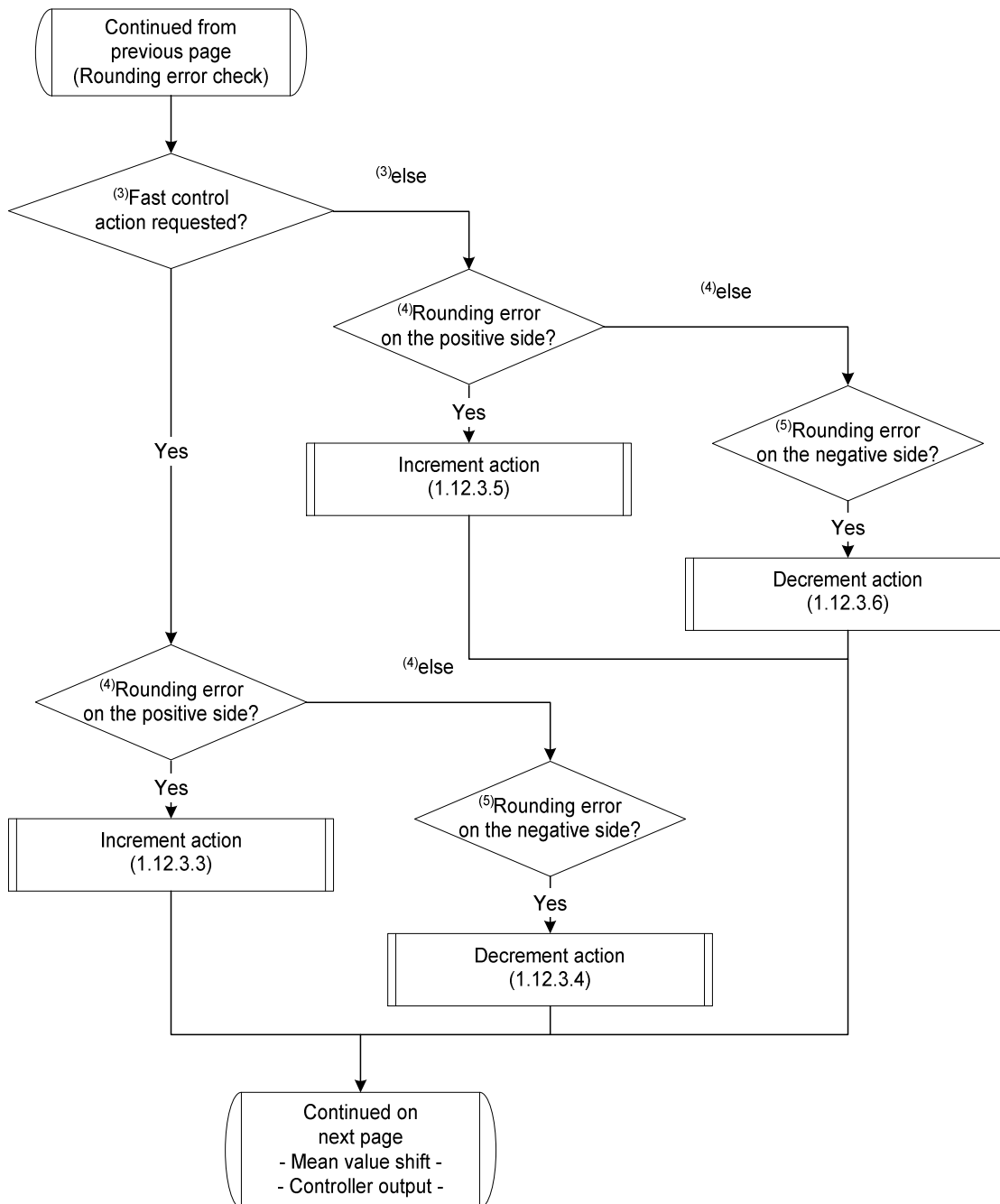
Tracking step disturbances with zero steady state error requires integration of the tracking error. Integral action can be incorporated by defining an internal state FAC\_CYL\_LAM\_INT[x] that represents the integrated tracking error. This state is governed by FAC\_CYL\_LAM\_INT[x]. For the injection systems being not adapted the integral action can be switched to the fast control parameter. The action is then triggered by LV\_LAM\_CYL\_SEL\_CTL\_FAST\_REQ.

```

if(3)          LV_LAM_CYL_SEL_CTL_FAST_REQ = 1
then
                FAC_CYL_LAM_INT[x]k= FAC_CYL_LAM_INT[x]k-1 +
                                IP_CRLC_INT_FAST_CYL_LAM*DELTA_
LAMB_DIF_CYL[x]k*
                                IP_CRLC_I_NEUT_RNG (1.12.3.1)
else(3)
                FAC_CYL_LAM_INT[x]k= FAC_CYL_LAM_INT[x]k-1 +
                                IP_CRLC_CYL_LAM*DELTA_LAMB_
DIF_CYL[x]k*
                                IP_CRLC_I_NEUT_RNG (1.12.3.2)
endif(3)
    
```

In order to avoid rounding error that leads to zero-readout of the gradient term in aforementioned equation, following scan shall be made:





```

if(3) LV_LAM_CYL_SEL_CTL_FAST_REQ = 1
then
    if(4) (IP_CRLC_INT_FAST_CYL_LAM*DELTA_LAMB_DIF_CYL[x]k*
        IP_CRLC_I_NEUT_RNG = 0 and
        IP_CRLC_INT_FAST_CYL_LAM >
0 and
        IP_CRLC_I_NEUT_RNG > 0 and
        DELTA_LAMB_DIF_CYL[x]k > 0)
    then
        increment (IP_CRLC_INT_FAST_CYL_LAM*
            DELTA_LAMB_DIF_CYL[x]k*
            IP_CRLC_I_NEUT_RNG) (1.12.3.3)
    
```

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```

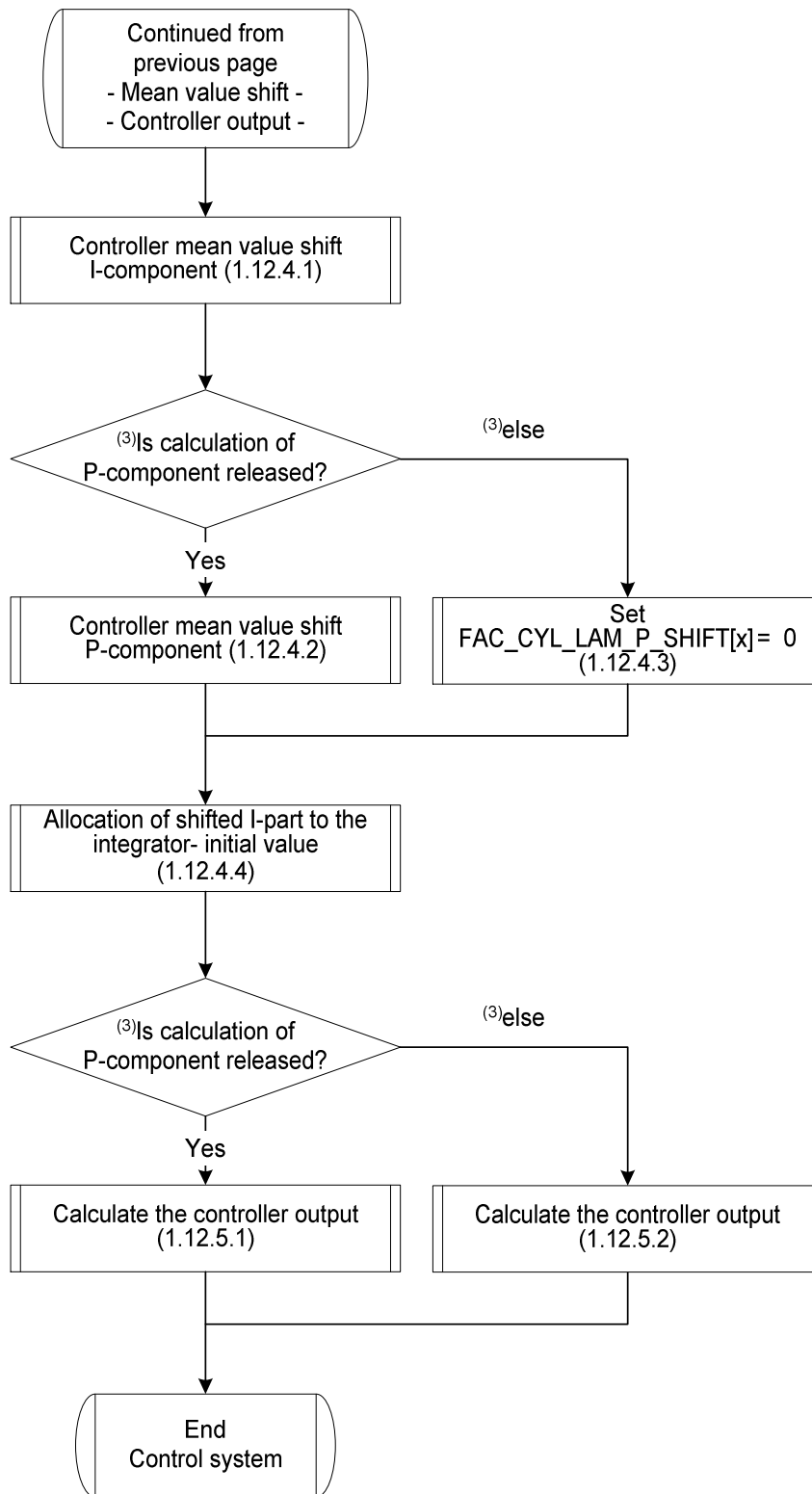
else(4)
  if(5)      (IP_CRLC_INT_FAST_CYL_LAM*
              DELTA_LAMB_DIF_CYL[x]k*
              IP_CRLC_I_NEUT_RNG = 0 and
              IP_CRLC_INT_FAST_CYL_LAM >
0 and
              IP_CRLC_I_NEUT_RNG > 0 and
              DELTA_LAMB_DIF_CYL[x]k < 0)
    then
      decrement (IP_CRLC_INT_FAST_CYL_LAM*
                  DELTA_LAMB_DIF_CYL[x]k*
                  IP_CRLC_I_NEUT_RNG) (1.12.3.4)
    endif(5)
  endif(4)
else(3)
  if(4)      (IP_CRLC_CYL_LAM*DELTA_LAMB_DIF_CYL[x]k*
              IP_CRLC_I_NEUT_RNG = 0 and
IP_CRLC_CYL_LAM > 0 and
              IP_CRLC_I_NEUT_RNG > 0 and
              DELTA_LAMB_DIF_CYL[x]k > 0)
    then
      increment (IP_CRLC_CYL_LAM*DELTA_LAMB_DIF_CYL[x]k*
                 IP_CRLC_I_NEUT_RNG) (1.12.3.5)
    else(4)
      if(5)      (IP_CRLC_CYL_LAM*DELTA_LAMB_DIF_CYL[x]k*
                  IP_CRLC_I_NEUT_RNG = 0 and
                  IP_CRLC_CYL_LAM > 0 and
                  IP_CRLC_I_NEUT_RNG > 0 and
                  DELTA_LAMB_DIF_CYL[x]k < 0)
        then
          decrement (IP_CRLC_CYL_LAM*
                      DELTA_LAMB_DIF_CYL[x]k*
                      IP_CRLC_I_NEUT_RNG) (1.12.3.6)
        endif(5)
      endif(4)
    endif(3)

```

### 7.73.13.4 Mean value shift

In order to avoid that the output of the cylinder individual control system affects the main controller for mean - control, it shall be shifted by its mean value.

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$$FAC\_CYL\_LAM\_I\_MV\_SHIFT[x]_k = FAC\_CYL\_LAM\_INT[x]_k -$$

$$\frac{1}{\alpha} * \sum_{x=1}^{\alpha} FAC\_CYL\_LAM\_INT[x]$$

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**(1.12.4.1)**

```

if(3)      LC_FAC_CYL_LAM_P_SWI = 1
then
      FAC_CYL_LAM_P_MV_SHIFT[x]k = FAC_CYL_LAM_P[x]k -
                                      $\frac{1}{\alpha} * \sum_{x=1}^{\alpha} \text{FAC\_CYL\_LAM\_P}[x]$ 
       $\alpha$ : number of cylinders per bank

```

**(1.12.4.2)**

```

else(3)
      FAC_CYL_LAM_P_MV_SHIFT[x] = 0

```

**(1.12.4.3)**

```

endif(3)

```

The value of FAC\_CYL\_LAM\_I\_MV\_SHIFT[x] shall be allocated to the initial value of the integrator:

**(1.12.4.4)**

$$\text{FAC\_CYL\_LAM\_INT}[x]_k = \text{FAC\_CYL\_LAM\_I\_MV\_SHIFT}[x]_k$$

### 7.73.13.5 Calculation of the controller output

```

if(3)      LC_FAC_CYL_LAM_P_SWI = 1
then
      FAC_CYL_LAM[x]k = FAC_CYL_LAM_P_MV_SHIFT[x]k +
                                     FAC_CYL_LAM_I_MV_SHIFT[x]k (1.12.5.1)
else(3)
      FAC_CYL_LAM[x]k =      FAC_CYL_LAM_I_MV_SHIFT[x]k
                                     (1.12.5.2)
endif(3)

```

### 7.73.13.6 Limitation of the controller output

If the cylinder individual controller output falls into the defined lower/upper limit, the corresponding flag has to be set and the involved controller output shall be limited to the minimum or maximum value.

```

if(3)      FAC_CYL_LAM[x]k < C_FAC_CYL_LAM_MIN
then
      FAC_CYL_LAM[x]k = C_FAC_CYL_LAM_MIN
                                     (1.12.6.1)

```

**(1.12.6.2)**

$$\text{LV\_FAC\_CYL\_LAM\_LIM\_MIN}[x] = 1$$


**(1.12.6.3)**

$$\text{LV\_FAC\_CYL\_LAM\_LIM\_MAX}[x] = 0$$

```

else(3)
      if(4)      FAC_CYL_LAM[x]k > C_FAC_CYL_LAM_MAX
      then
        FAC_CYL_LAM[x]k = C_FAC_CYL_LAM_MAX
                                     (1.12.6.4)
        LV_FAC_CYL_LAM_LIM_MAX[x] = 1
                                     (1.12.6.5)
        LV_FAC_CYL_LAM_LIM_MIN[x] = 0

```

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(1.12.6.6)

**else**<sup>(4)</sup>

LV\_FAC\_CYL\_LAM\_LIM\_MIN[x] = 0

(1.12.6.7)

LV\_FAC\_CYL\_LAM\_LIM\_MAX[x] = 0

(1.12.6.8)

**endif**<sup>(4)</sup>**endif**<sup>(4)</sup>

### 7.73.13.7 Anti-Wind-Up

As anti wind up measure for the integral-action element, FAC\_CYL\_LAM\_INT[x], following calculations shall be carried out if the controller output is limited.

**if**<sup>(3)</sup> LV\_FAC\_CYL\_LAM\_LIM\_MIN[x] = 1**then**FAC\_CYL\_LAM\_INT[x]<sub>k</sub> =

$$\frac{\alpha}{\alpha - 1} * C\_FAC\_CYL\_LAM\_MIN + \frac{1}{\alpha - 1} * \sum_{j=x+1}^{x-1} FAC\_CYL\_LAM\_INT[j]_k$$

(1.12.7.1)

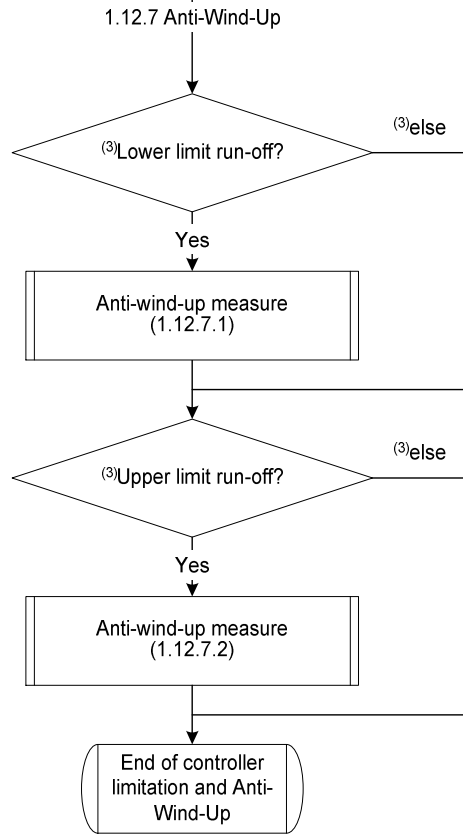
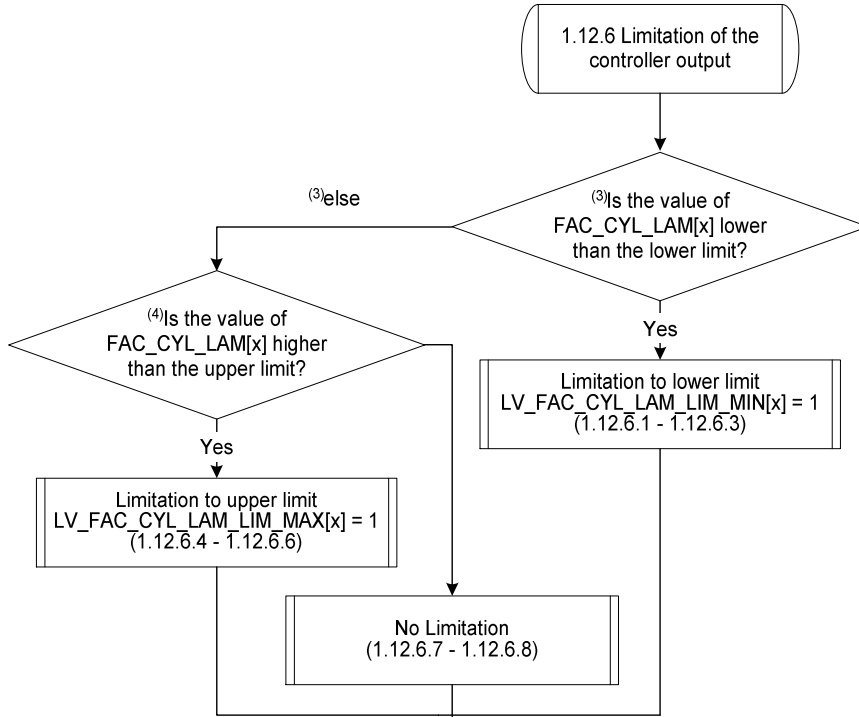
**endif**<sup>(3)</sup>**if**<sup>(3)</sup> LV\_FAC\_CYL\_LAM\_LIM\_MAX[x] = 1**then**FAC\_CYL\_LAM\_INT[x]<sub>k</sub> =

$$\frac{\alpha}{\alpha - 1} * C\_FAC\_CYL\_LAM\_MAX + \frac{1}{\alpha - 1} * \sum_{j=x+1}^{x-1} FAC\_CYL\_LAM\_INT[j]_k$$

(1.12.7.2)

**endif**<sup>(3)</sup>


: number of cylinders per bank



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### 7.73.13.8 Cylinder individual lambda adaptation

The cylinder individual lambda adaptation shall be carried out in an applied MAF- area. The mechanism consists of a first-order lag element. The output of this lowpass-filter is FAC\_LAM\_CYL\_SEL\_ADJ\_

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FIL[x] under nominal conditions (optimal operating temperature) and FAC\_LAM\_CYL\_SEL\_ADJ\_FIL\_CST[x] under engine-cold condition.

### **Remark:**

For application purpose the mechanism can be switched off using LC\_ADAPT\_COR\_OUT:

LC\_ADAPT\_COR\_OUT = 1: Adaptation is switched on.

LC\_ADAPT\_COR\_OUT = 0: Adaptation is switched off, and the adaptation output signal shall be set to zero.


```

if(3)      LC_ADAPT_COR_OUT = 1
then
    if(4)      LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 0
    then
        if(5)      STATE_LAM_CYL_SEL_ADJ[i] = 1 [WAIT_ENG_COLD]
        then
            if(6)      ((C_MFF_LAM_CYL_ADJ_CST_MIN <
                        MFF_SP_LAM_CYL_SEL <
                        C_MFF_LAM_CYL_ADJ_CST_MAX)
                        (C_N_LAM_CYL_ADJ_CST_MIN
                        C_N_LAM_CYL_ADJ_CST_MAX))
            then
                STATE_LAM_CYL_SEL_ADJ[i] = 2
                [ADJ_ENG_COLD] (1.12.8.1)
            endif(6)
            if(6)      TEMP_LAM_CYL_SEL < C_TEMP_LAM_CYL_MIN
            then
                STATE_LAM_CYL_SEL_ADJ[i] = 3
                [WAIT_ENG_NOM] (1.12.8.2)
            else(6)
                if(7)      (TEMP_LAM_CYL_SEL <
                        C_TEMP_LAM_CYL_CST_MIN or
                        (TEMP_LAM_CYL_SEL >
                        C_TEMP_LAM_CYL_CST_MAX and
                        TEMP_LAM_CYL_SEL <
                        C_TEMP_LAM_CYL_MIN) or
                        LV_LAM_LSCL[i] = 0)
                then
                    STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
                    (1.12.8.3)
                endif(7)
            endif(6)
        endif(5)
    endif(4)
    if(5)      STATE_LAM_CYL_SEL_ADJ_i = 3 [WAIT_ENG_NOM]
    then
        if(6)      LV_LAM_CYL_SEL_ADJ_OFS_REQ[i] = 0
        then
            if(7)      ((N_32

```

**and**

N\_32

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```

L_RNG and                                C_N_MIN_FAC_CYL_SEL_ADJ_
                                           N_32
                                           C_N_MAX_FAC_CYL_SEL_ADJ_

L_RNG and                                MFF_SP_LAM_CYL_SEL
                                           C_MFF_MIN_FAC_CYL_SEL_ADJ_

L_RNG and                                MFF_SP_LAM_CYL_SEL
                                           C_MFF_MAX_FAC_CYL_SEL_ADJ_

L_RNG))

    then
        STATE_LAM_CYL_SEL_ADJ[i] = 4
        [ADJ_NOM_L_RNG] (1.12.8.4)
    else(7)
        if(8) ((N_32
            C_N_MIN_FAC_CYL_SEL_ADJ_

            and N_32
            C_N_MAX_FAC_CYL_SEL_ADJ_

            and MFF_SP_LAM_CYL_SEL
            C_MFF_MIN_FAC_CYL_SEL_ADJ_

            and MFF_SP_LAM_CYL_SEL
            C_MFF_MAX_FAC_CYL_SEL_ADJ_


            H_RNG))

                then
                    STATE_LAM_CYL_SEL_ADJ[i] = 5
                    [ADJ_NOM_H_RNG] (1.12.8.5)
                endif(8)
            endif(7)
        else(6)
            STATE_LAM_CYL_SEL_ADJ[i] = 6
            [ADJ_NOM_OFS] (1.12.8.6)
        endif(6)
        if(6) (C_TEMP_LAM_CYL_CST_MIN <
            TEMP_LAM_CYL_SEL <
            C_TEMP_LAM_CYL_CST_MAX and
            LV_LAM_LSCL[i] = 1)

            then
                STATE_LAM_CYL_SEL_ADJ[i] = 1
                [WAIT_ENG_COLD] (1.12.8.7)
            else(6)
                if(7) (TEMP_LAM_CYL_SEL <
                    C_TEMP_LAM_CYL_CST_MIN or
                    (TEMP_LAM_CYL_SEL >
                    C_TEMP_LAM_CYL_CST_MAX and
                    TEMP_LAM_CYL_SEL <
                    C_TEMP_LAM_CYL_MIN))

                    then
                        STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
                        (1.12.8.8)
                    endif
                endif
            endif
        endif
    endif

```

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```

                                endif(7)
                            endif(6)
                        endif(5)

                    if(5)          STATE_LAM_CYL_SEL_ADJ[i] = 2 [ADJ_ENG_COLD]
                    then
                        if(6)          (MFF_SP_LAM_CYL_SEL <
                                C_MFF_LAM_CYL_ADJ_CST_MIN
                                MFF_SP_LAM_CYL_SEL >
                                C_MFF_LAM_CYL_ADJ_CST_MAX
                                N_32 < C_N_LAM_CYL_ADJ_CST_
                                N_32 > C_N_LAM_CYL_ADJ_CST_
                                MIN or
                                MAX)
                        then
                            if(7)          (C_TEMP_LAM_CYL_CST_MIN <
                                TEMP_LAM_CYL_SEL <
                                C_TEMP_LAM_CYL_CST_MAX and
                                LV_LAM_LSCL[i] = 1)
                            then
                                STATE_LAM_CYL_SEL_ADJ[i] = 1
                                [WAIT_ENG_COLD] (1.12.8.9)
                            endif(7)
                        endif(6)
                    if(6)          TEMP_LAM_CYL_SEL < C_TEMP_LAM_CYL_MIN
                    then
                        STATE_LAM_CYL_SEL_ADJ[i] = 3
                        [WAIT_ENG_NOM] (1.12.8.10)
                    else(6)
                        if(7)          (TEMP_LAM_CYL_SEL <
                                C_TEMP_LAM_CYL_CST_MIN or
                                (TEMP_LAM_CYL_SEL >
                                C_TEMP_LAM_CYL_CST_MAX and
                                TEMP_LAM_CYL_SEL <
                                C_TEMP_LAM_CYL_MIN) or
                                LV_LAM_LSCL[i] = 0)
                        then
                            STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
                            (1.12.8.11)
                        endif(7)
                    endif(6)
                endif(5)

            if(5)          STATE_LAM_CYL_SEL_ADJ[i] = 4 [ADJ_NOM_L_RNG]
            then
                if(6)          (N_32 <
                                C_N_MIN_FAC_CYL_SEL_ADJ_
                                N_32 > C_N_MAX_FAC_CYL_SEL_
                                MFF_SP_LAM_CYL_SEL <
                                L_RNG or
                                ADJ_L_RNG or

```

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```

L_RNG or
C_MFF_MIN_FAC_CYL_SEL_ADJ_
MFF_SP_LAM_CYL_SEL >
C_MFF_MAX_FAC_CYL_SEL_ADJ_
L_RNG or
LV_LAM_CYL_SEL_ADJ_OFS_REQ[i]
= 1)

then
  if(7) TEMP_LAM_CYL_SEL
        C_TEMP_LAM_CYL_MIN
  then
    STATE_LAM_CYL_SEL_ADJ[i] = 3
    [WAIT_ENG_NOM] (1.12.8.12)
  endif(7)
endif(6)
if(6) (C_TEMP_LAM_CYL_CST_MIN <
      TEMP_LAM_CYL_SEL <
      C_TEMP_LAM_CYL_CST_MAX and
      LV_LAM_LSCL[i] = 1)
  then
    STATE_LAM_CYL_SEL_ADJ[i] = 1
    [WAIT_ENG_COLD] (1.12.8.13)
  else(6)
    if(7) (TEMP_LAM_CYL_SEL <
          C_TEMP_LAM_CYL_CST_MIN or
          (TEMP_LAM_CYL_SEL >
           C_TEMP_LAM_CYL_CST_MAX and
           TEMP_LAM_CYL_SEL <
           C_TEMP_LAM_CYL_MIN))
      then
        STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
        (1.12.8.14)
      endif(7)
    endif(6)
  endif(5)
if(5) STATE_LAM_CYL_SEL_ADJ[i] = 5 [ADJ_NOM_H_RNG]
then
  if(6) (N_32 < C_N_MIN_FAC_CYL_SEL_ADJ_H_RNG or
        N_32 > C_N_MAX_FAC_CYL_SEL_
ADJ_H_RNG or
MFF_SP_LAM_CYL_SEL <
C_MFF_MIN_FAC_CYL_SEL_ADJ_
H_RNG or
MFF_SP_LAM_CYL_SEL >
C_MFF_MAX_FAC_CYL_SEL_ADJ_
H_RNG or
LV_LAM_CYL_SEL_ADJ_OFS_REQ[i]
= 1)
  then
    if(7) TEMP_LAM_CYL_SEL
          C_TEMP_LAM_CYL_MIN

```

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```

    then
        STATE_LAM_CYL_SEL_ADJ[i] = 3
        [WAIT_ENG_NOM] (1.12.8.15)
    endif(7)
endif(6)
if(6)    (C_TEMP_LAM_CYL_CST_MIN <
        TEMP_LAM_CYL_SEL <
        C_TEMP_LAM_CYL_CST_MAX and
        LV_LAM_LSCL[i] = 1)

    then
        STATE_LAM_CYL_SEL_ADJ[i] = 1
        [WAIT_ENG_COLD] (1.12.8.16)
    else(6)
        if(7)    (TEMP_LAM_CYL_SEL <
            C_TEMP_LAM_CYL_CST_MIN or
            (TEMP_LAM_CYL_SEL >
            C_TEMP_LAM_CYL_CST_MAX and
            TEMP_LAM_CYL_SEL <
            C_TEMP_LAM_CYL_MIN))


            then
                STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
                (1.12.8.17)
            endif(7)
        endif(6)
    endif(5)
if(5)    STATE_LAM_CYL_SEL_ADJ[i] = 6 [ADJ_NOM_OFS]
then
    if(6)    LV_LAM_CYL_SEL_ADJ_OFS_REQ[i] = 0
    then
        if(7)    TEMP_LAM_CYL_SEL
            C_TEMP_LAM_CYL_MIN

            then
                STATE_LAM_CYL_SEL_ADJ[i] = 3
                [WAIT_ENG_NOM] (1.12.8.18)
            endif(7)
        endif(6)
    else(6)
        if(6)    (C_TEMP_LAM_CYL_CST_MIN <
            TEMP_LAM_CYL_SEL <
            C_TEMP_LAM_CYL_CST_MAX and
            LV_LAM_LSCL[i] = 1)

            then
                STATE_LAM_CYL_SEL_ADJ[i] = 1
                [WAIT_ENG_COLD] (1.12.8.19)
            else(6)
                if(7)    (TEMP_LAM_CYL_SEL <
                    C_TEMP_LAM_CYL_CST_MIN or
                    (TEMP_LAM_CYL_SEL >
                    C_TEMP_LAM_CYL_CST_MAX and
                    TEMP_LAM_CYL_SEL <
                    C_TEMP_LAM_CYL_MIN))

                    then
                        STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
                    endif(7)
            endif(6)
        endif(6)
    endif(5)
endif(5)

```

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(1.12.8.20)


```

endif(7)
endif(6)
endif(5)
[Remark: the cylinder based limitation (index x) shall be
assigned to the corresponding exhaust bank (index i)]

if(5)(STATE_LAM_CYL_SEL_ADJ[i] = 1 [WAIT_ENG_COLD] or
STATE_LAM_CYL_SEL_ADJ[i] =
2 [ADJ_ENG_COLD])
then
FAC_LAM_CYL_SEL_ADJ_FIL[x]k = 0
(1.12.8.21)
if(6) LC_FAC_LAM_CYL_SEL_ADJ_P_I_ENA = 1
then
FAC_LAM_CYL_SEL_ADJ_CST_FIL[x]k =
FAC_LAM_CYL_SEL_ADJ_CST_
FIL[x]k-1 +
(FAC_CYL_LAM[x]k -
FIL[x]k-1)
FAC_LAM_CYL_SEL_ADJ_CST_
*C_CRLC_LAM_CYL_CST_FIL (1.12.8.22)
else(6)
FAC_LAM_CYL_SEL_ADJ_CST_FIL[x]k =
FAC_LAM_CYL_SEL_ADJ_CST_
FIL[x]k-1 +
(FAC_CYL_LAM_I_MV_SHIFT[x]k -
FIL[x]k-1)
FAC_LAM_CYL_SEL_ADJ_CST_
*C_CRLC_LAM_CYL_CST_FIL (1.12.8.23)
endif(6)
else(5)
if(6) (STATE_LAM_CYL_SEL_ADJ[i] = 3
[WAIT_ENG_NOM] or
STATE_LAM_CYL_SEL_ADJ[i] =
4
[ADJ_NOM_L_RNG] or
STATE_LAM_CYL_SEL_ADJ[i] =
5
[ADJ_NOM_H_RNG] or
STATE_LAM_CYL_SEL_ADJ[i] =
6
[ADJ_NOM_OFS])
then
FAC_LAM_CYL_SEL_ADJ_CST_FIL[x]k = 0
(1.12.8.24)
if(7) LC_FAC_LAM_CYL_SEL_ADJ_P_I_ENA = 1
then
FAC_LAM_CYL_SEL_ADJ_FIL[x]k =
FAC_LAM_CYL_SEL_ADJ_FIL[x]k-1
+
(FAC_CYL_LAM[x]k -

```

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```

FAC_LAM_CYL_SEL_ADJ_FIL[x]k-1)*
C_CRLC_CYL_FIL (1.12.8.25)
else(7)
FAC_LAM_CYL_SEL_ADJ_FIL[x]k =
FAC_LAM_CYL_SEL_ADJ_FIL[x]k-1
+
(FAC_CYL_LAM_I_MV_SHIFT[x]k
-
FAC_LAM_CYL_SEL_ADJ_FIL[x]k-1)*
C_CRLC_CYL_FIL (1.12.8.26)
endif(7)
else(6)
FAC_LAM_CYL_SEL_ADJ_FIL[x]k = 0
(1.12.8.27)
FAC_LAM_CYL_SEL_ADJ_CST_FIL[x]k = 0
(1.12.8.28)
endif(6)
endif(5)
else(4)
FAC_LAM_CYL_SEL_ADJ_FIL[x] = 0
(1.12.8.29)
FAC_LAM_CYL_SEL_ADJ_CST_FIL[x] = 0
(1.12.8.30)
CTR_T_LAM_CYL_ADJ[i] = 0
(1.12.8.31)
if(5) (C_TEMP_LAM_CYL_CST_MIN <
TEMP_LAM_CYL_SEL <
C_TEMP_LAM_CYL_CST_MAX and
LV_LAM_LSCL[i] = 1)
then
STATE_LAM_CYL_SEL_ADJ[i] = 1
[WAIT_ENG_COLD] (1.12.8.32)
else(5)
if(6) TEMP_LAM_CYL_SEL < C_TEMP_LAM_CYL_MIN
then
STATE_LAM_CYL_SEL_ADJ[i] = 3
[WAIT_ENG_NOM] (1.12.8.33)
else(6)
STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
(1.12.8.34)
endif(6)
endif(6)
LV_LAM_CYL_SEL_ADJ_VLD[i] = 0
(1.12.8.35)
endif(4)
else(3)
MFF_ADD_CYL_LAM_COR[x] = 0
(1.12.8.36)
MFF_ADD_CYL_LAM_COR[x]LDC = 0
(1.12.8.37)
FAC_LAM_CYL_SEL_ADJ[x] = 0
(1.12.8.38)

```

```

FAC_LAM_CYL_SEL_ADJ_L_RNG[x] = 0
(1.12.8.39)
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]LDC = 0
(1.12.8.40)
FAC_LAM_CYL_SEL_ADJ_H_RNG[x] = 0
(1.12.8.41)
FAC_LAM_CYL_SEL_ADJ_H_RNG[x]LDC = 0
(1.12.8.42)
FAC_LAM_CYL_SEL_ADJ_CST[x] = 0
(1.12.8.43)
FAC_LAM_CYL_SEL_ADJ_CST[x]LDC = 0
(1.12.8.44)
FAC_LAM_CYL_SEL_ADJ_FIL[x] = 0
(1.12.8.-)
FAC_LAM_CYL_SEL_ADJ_CST_FIL[x] = 0
(1.12.8.46)
CTR_T_LAM_CYL_ADJ[i] = 0
(1.12.8.47)
STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
(1.12.8.48)
LV_LAM_CYL_SEL_ADJ_VLD[i] = 0
(1.12.8.49)
LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i] = 0
(1.12.8.50)
LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i] = 0
(1.12.8.51)
LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i]LDC = 0
(1.12.8.52)
LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i]LDC = 0
(1.12.8.53)
LV_FAC_LAM_CYL_ADJ_CST_LIM[i] = 0
(1.12.8.54)
LV_FAC_LAM_CYL_SEL_ADJ_LIM[i] = 0
(1.12.8.55)
LV_MFF_ADD_CYL_LAM_COR_LIM[i] = 0
(1.12.8.56)

```

```
endif(3)
```

```
else(2)
```

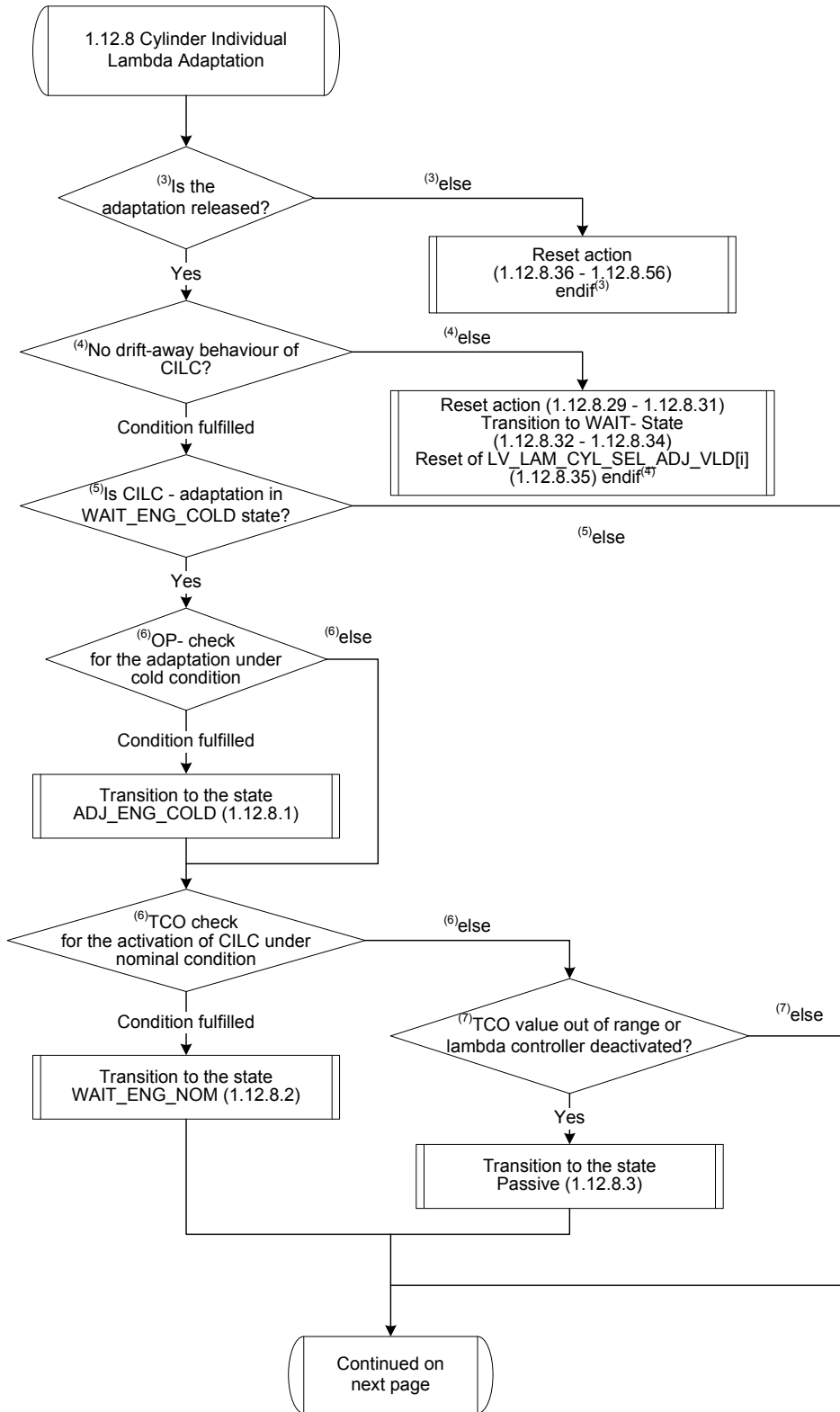
```

FAC_LAM_CYL_SEL_ADJ_FIL[x] = 0
(1.12.8.57)
FAC_LAM_CYL_SEL_ADJ_CST_FIL[x] = 0
(1.12.8.58)
CTR_T_LAM_CYL_ADJ[i] = 0
(1.12.8.59)
STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
(1.12.8.60)
LV_LAM_CYL_SEL_ADJ_VLD[i] = 0
(1.12.8.61)

```


```
endif(2)
```

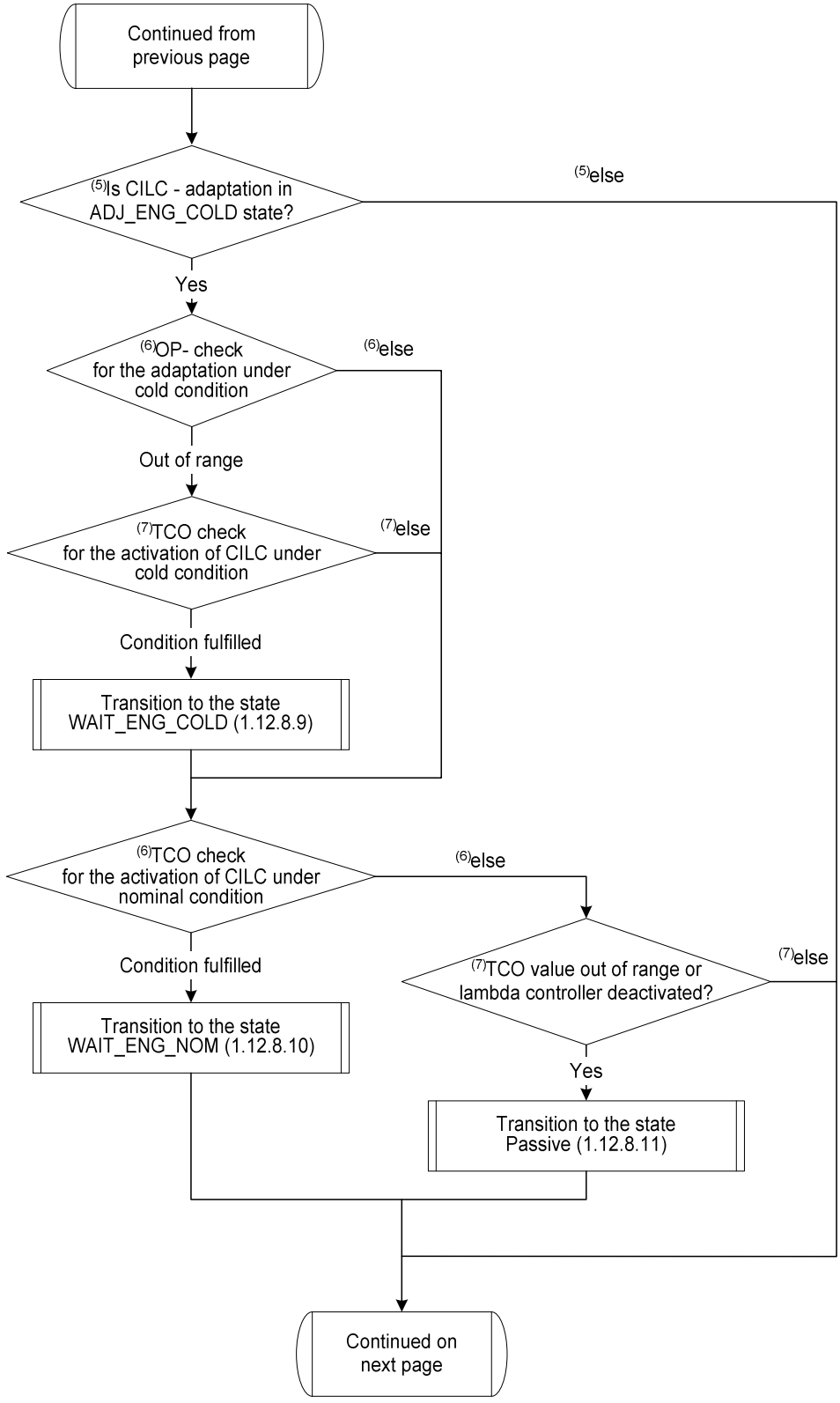
```
endif(1)
```



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Figure 7.73.11: TOLOMEOGRAPHIC 269252-48.ps

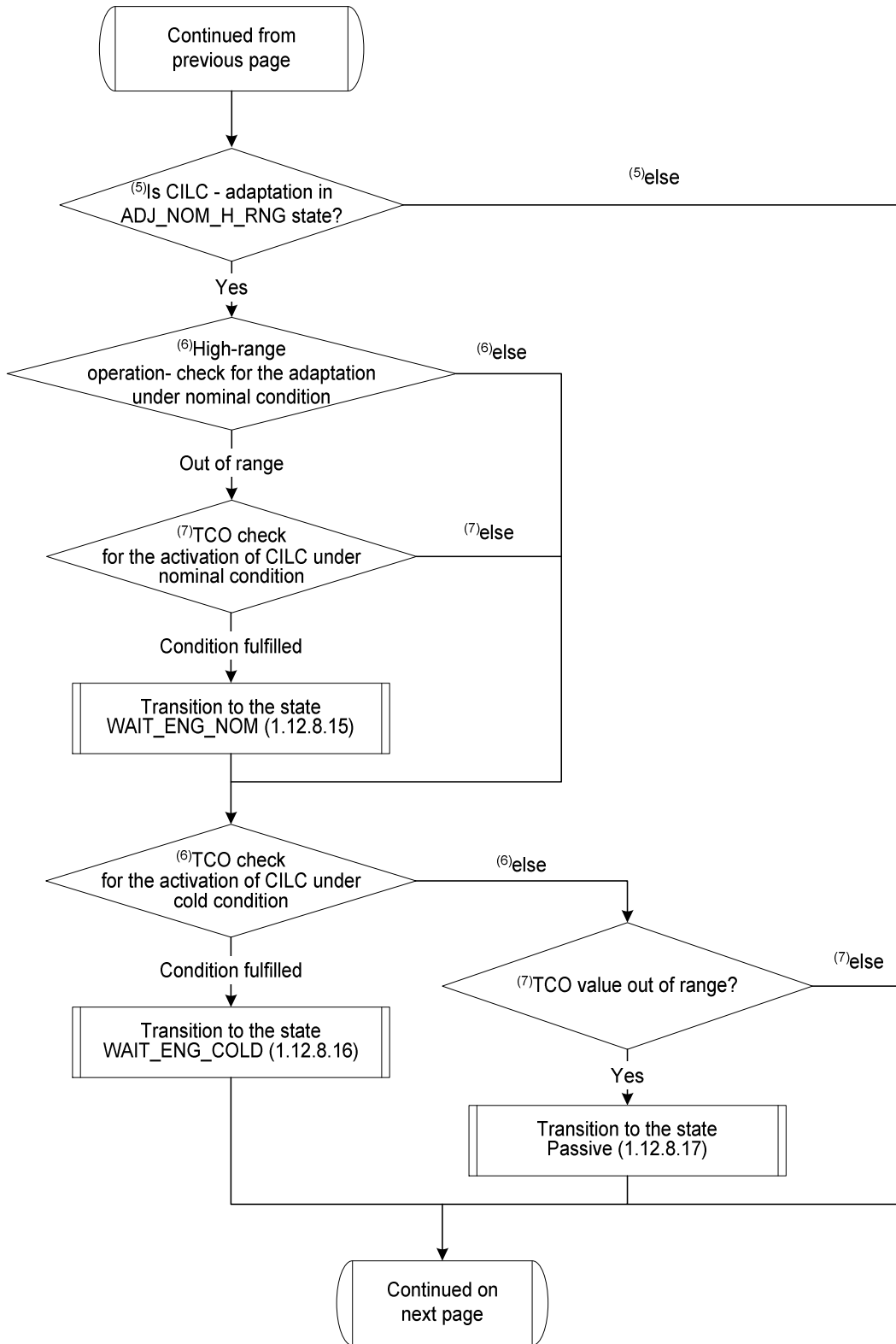
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Figure 7.73.12: TOLOMEOGRAPHIC 269252-50.ps

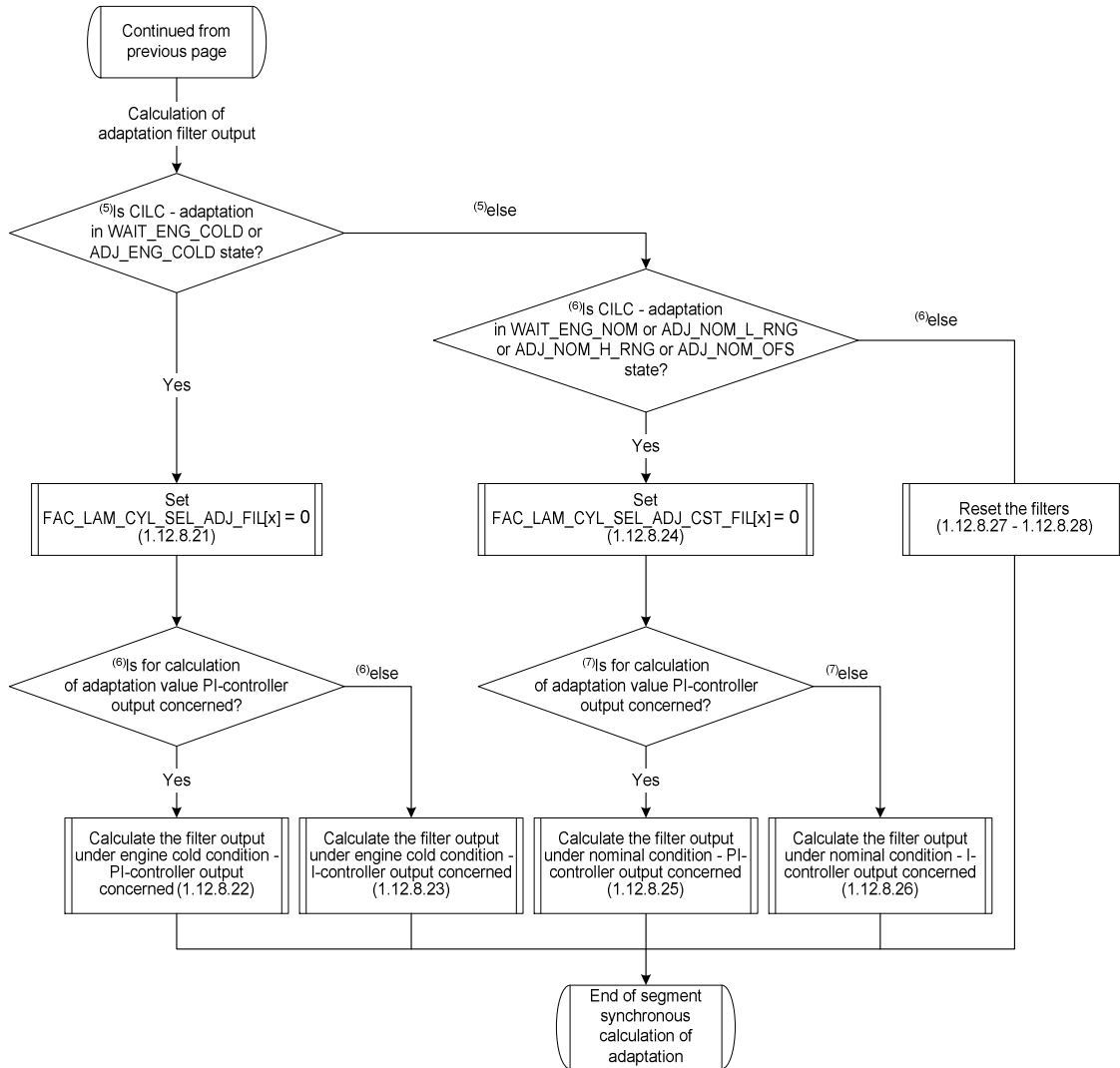




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Figure 7.73.13: TOLMEOGRAPHIC 269252-52.ps

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### 7.73.13.9 Update of cylinder individual lambda adaptation values

The computation of the cylinder individual lambda adaptation shall be updated in the time-cycle  $C\_T\_LAM\_CYL\_ADJ\_CST/C\_T\_LAM\_CYL\_ADJ$ . When the computation was carried out, then the initial value of cylinder individual lambda-controller,  $FAC\_CYL\_LAM\_INT[x]$ , and low pass filter,  $FAC\_LAM\_CYL\_SEL\_ADJ\_FIL[x]/FAC\_LAM\_CYL\_SEL\_ADJ\_CST\_FIL[x]$  shall be shifted. On the deactivation condition all cylinder individual filter outputs,  $FAC\_LAM\_CYL\_SEL\_ADJ\_FIL[x]$  and the timer  $CTR\_T\_LAM\_CYL\_ADJ[i]$  shall be set to zero.

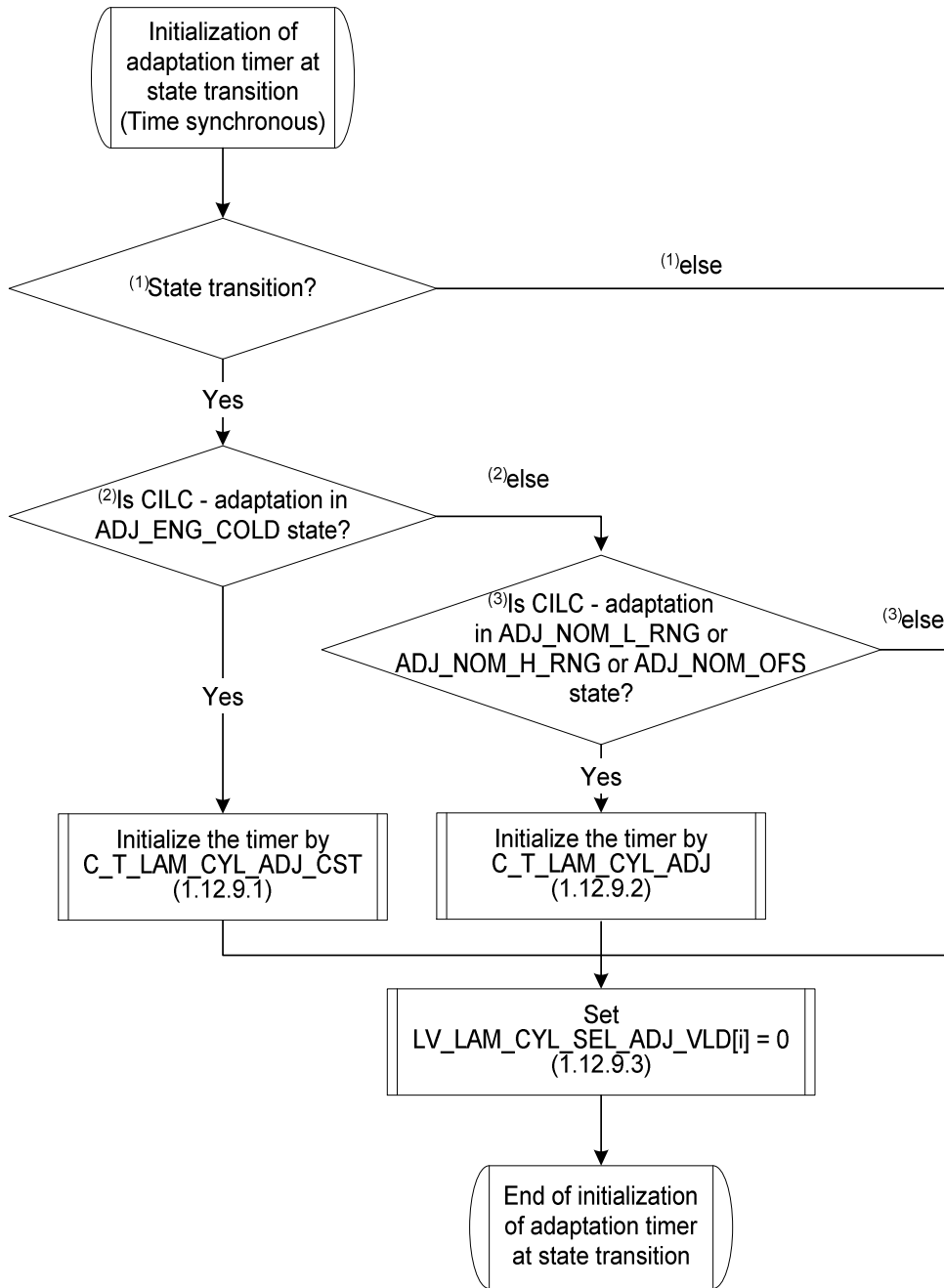
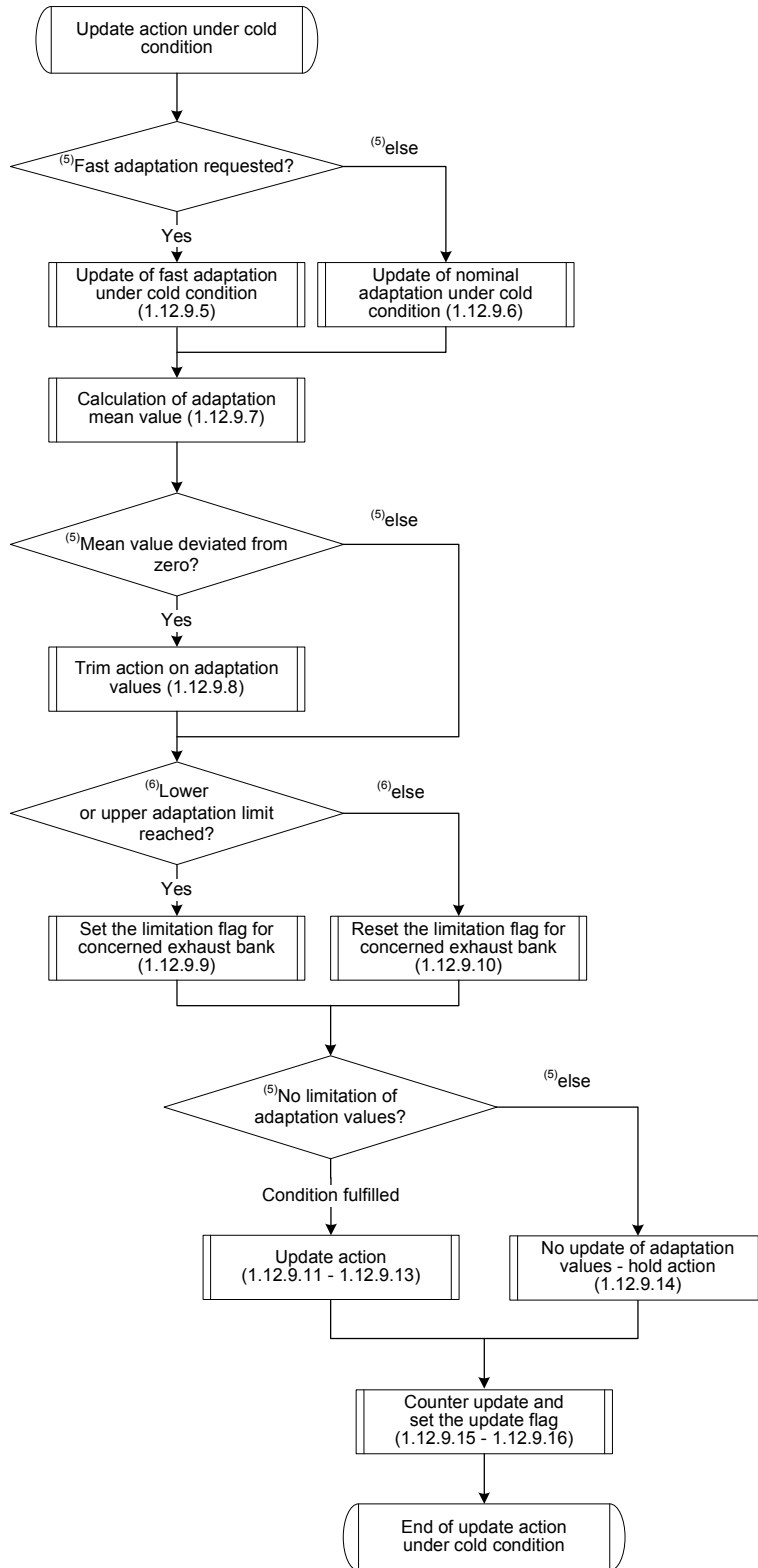



Figure 7.73.14: TOLOMEOGRAPHIC 269252-55.ps

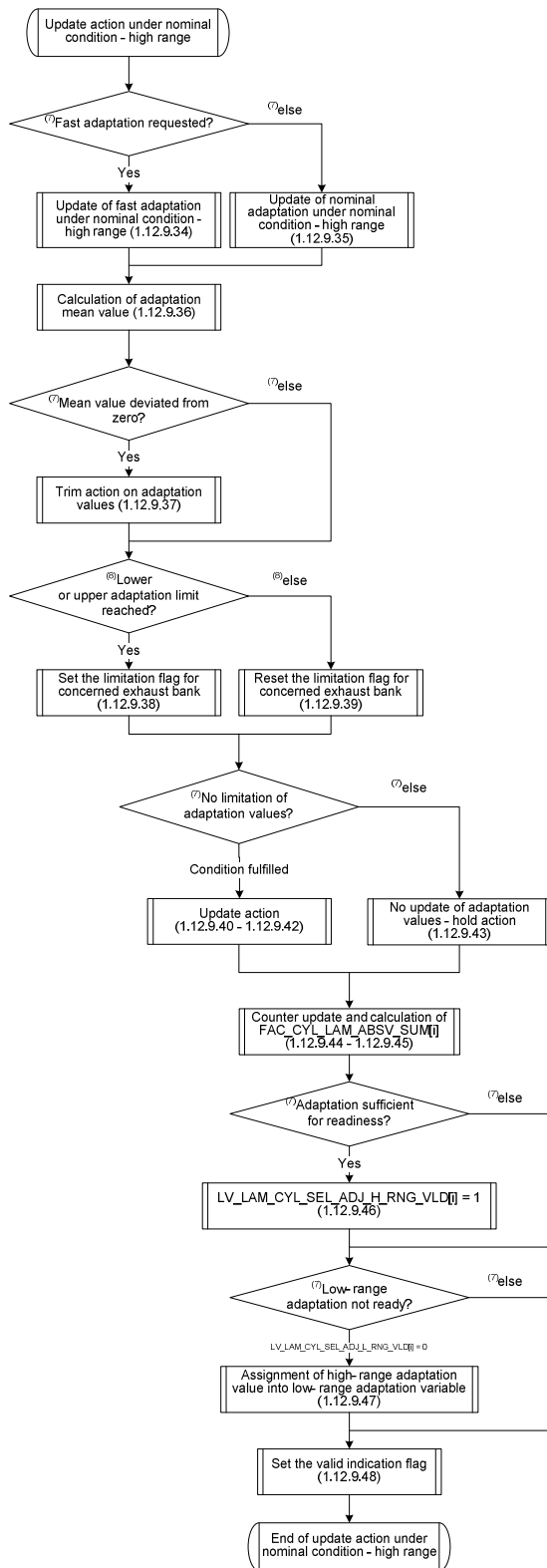
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Figure 7.73.15: TOLMEOGRAPHIC 269252-57.ps

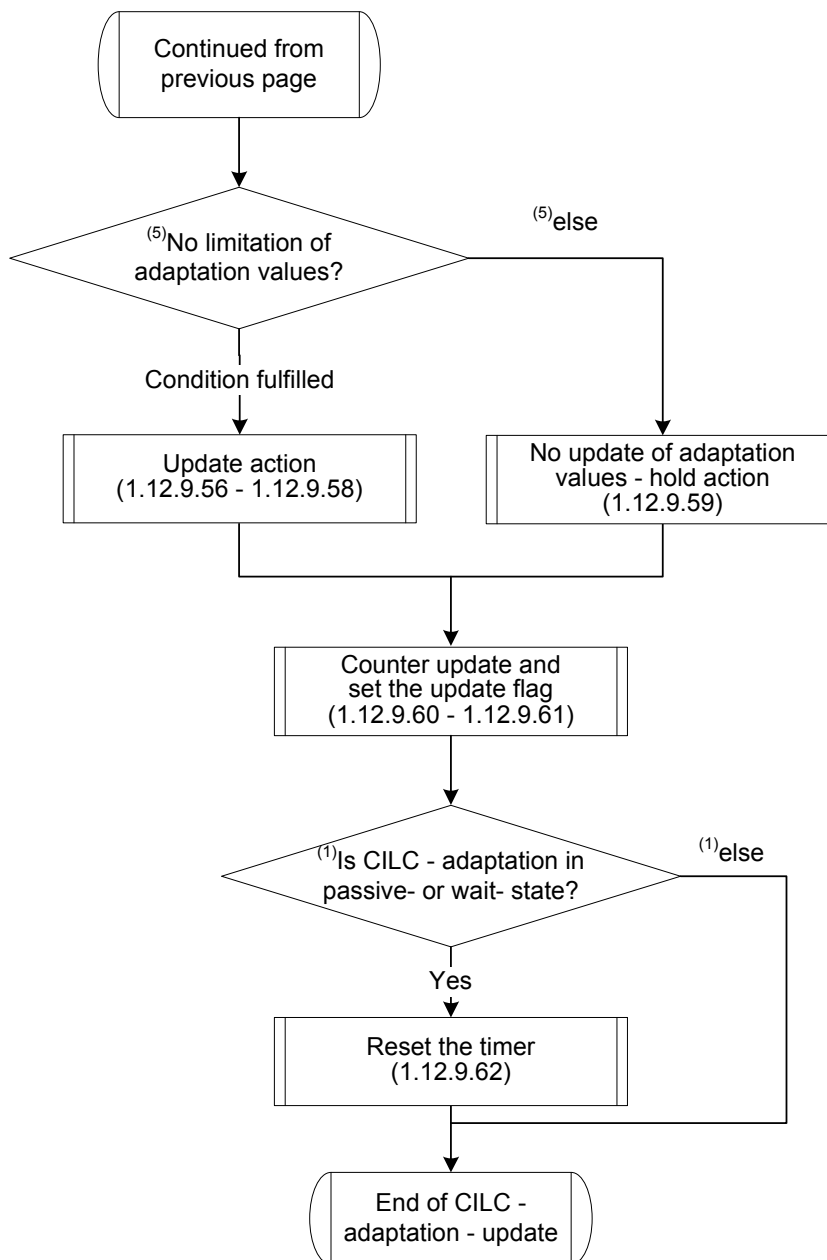
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Figure 7.73.16: TOLOMEOGRAPHIC 269252-59.ps

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```

if(1) STATE_LAM_CYL_SEL_ADJ[i]k STATE_LAM_CYL_SEL_ADJ[i]k-1
then
  if(2) STATE_LAM_CYL_SEL_ADJ[i] = 2 [ADJ_ENG_COLD]
  then
    CTR_T_LAM_CYL_ADJ[i] = C_T_LAM_CYL_ADJ_CST
    (1.12.9.1)
  else(2)
    if(3) (STATE_LAM_CYL_SEL_ADJ[i] = 4 [ADJ_NOM_L_RNG] or
    STATE_LAM_CYL_SEL_ADJ[i] =
    5 [ADJ_NOM_H_RNG] or
    STATE_LAM_CYL_SEL_ADJ[i] =
    6 [ADJ_NOM_OFS])
    then
      CTR_T_LAM_CYL_ADJ[i] = C_T_LAM_CYL_ADJ
  
```

```

                                                                    (1.12.9.2)
                    endif(3)
endif(2)
LV_LAM_CYL_SEL_ADJ_VLD[i] = 0
                                                                    (1.12.9.3)
endif(1)

if(1)      LC_ADAPT_COR_OUT = 1
then
    if(2)      STATE_LAM_CYL_SEL[i] = 3 [CLL]
    then
        if(3)      STATE_LAM_CYL_SEL_ADJ[i] = 2 [ADJ_ENG_COLD]
        then
            if(4)      CTR_T_LAM_CYL_ADJ[i] 0
            then
                decrement      CTR_T_LAM_CYL_ADJ[i]
                                                                    (1.12.9.4)
            endif(4)
            if(4)      CTR_T_LAM_CYL_ADJ[i] = 0
            then
                if(5)      LV_LAM_CYL_SEL_CTL_FAST_REQ = 1
                then
                    for(6)      j(x) = 1 : Number of cylinders per exhaust bank
                    FAC_LAM_CYL_SEL_ADJ_CST[x]k =
                                                                    FAC_LAM_CYL_SEL_ADJ_CST[x]k-1
+
FAST*
                                                                    IP_FAC_OPP_LAM_CYL_SEL_ADJ_
FIL[x] (1.12.9.5)
                                                                    FAC_LAM_CYL_SEL_ADJ_CST_

                    endfor(6)
                else(5)
                    for(6)      j(x) = 1 : Number of cylinders per exhaust bank
                    FAC_LAM_CYL_SEL_ADJ_CST[x]k =
                                                                    FAC_LAM_CYL_SEL_ADJ_CST[x]k-1
+
                                                                    IP_FAC_OPP_LAM_CYL_SEL_ADJ*
FIL[x] (1.12.9.6)
                                                                    FAC_LAM_CYL_SEL_ADJ_CST_

                    endfor(6)
                endif(5)
                FAC_LAM_CYL_SEL_ADJ_CST_MV[i] =
                    
$$\frac{1}{\alpha} * \sum_{x=1}^{\alpha} \text{FAC\_LAM\_CYL\_SEL\_ADJ\_CST}[x]$$

                                                                    : number of cylinders per bank(1.12.9.7)

            if(5)      FAC_LAM_CYL_SEL_ADJ_CST_MV[i] 0
            then
                for(6)      j(x) = 1 : Number of cylinders per exhaust bank
                FAC_LAM_CYL_SEL_ADJ_CST[x]k =

```

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```


-
MV[i] (1.12.9.8)
    endfor(6)
endif(5)

for(5)    j(x) = 1 : Number of cylinders per exhaust bank
if(6)    (FAC_LAM_CYL_SEL_ADJ_CST[x]k >
        C_FAC_LAM_CYL_SEL_ADJ_CST_
MAX or
        FAC_LAM_CYL_SEL_ADJ_CST[x]k
<
        C_FAC_LAM_CYL_SEL_ADJ_CST_
MIN)
    then
        LV_FAC_LAM_CYL_ADJ_CST_LIM[i] = 1
        (1.12.9.9)
        break(5)
    else(6)
        LV_FAC_LAM_CYL_ADJ_CST_LIM[i] = 0
        (1.12.9.10)
    endif(6)
endif(5)

if(5)    LV_FAC_LAM_CYL_ADJ_CST_LIM[i] = 0
then
    for(6)    j(x) = 1 : Number of cylinders per exhaust bank
        FAC_CYL_LAM[x]k = FAC_CYL_LAM[x] -
        (FAC_LAM_CYL_SEL_ADJ_CST[x]k
-
        FAC_LAM_CYL_SEL_ADJ_CST[x]k-1)
(1.12.9.11)

        FAC_CYL_LAM_INT[x]k = FAC_CYL_LAM[x]k
        (1.12.9.12)
        FAC_LAM_CYL_SEL_ADJ_CST_FIL[x]k =
        FAC_LAM_CYL_SEL_ADJ_CST_
        (FAC_LAM_CYL_SEL_ADJ_CST[x]k
-
        FAC_LAM_CYL_SEL_ADJ_CST[x]k-1)
(1.12.9.13)
    endfor(6)
else(5)
    for(6)    j(x) = 1 : Number of cylinders per exhaust bank
        FAC_LAM_CYL_SEL_ADJ_CST[x]k =
        FAC_LAM_CYL_SEL_ADJ_CST[x]k-1 (1.12.9.14)
    endfor(6)
endif(5)
CTR_T_LAM_CYL_ADJ[i] = C_T_LAM_CYL_ADJ_CST
(1.12.9.15)
LV_LAM_CYL_SEL_ADJ_VLD[i] = 1

```

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## (1.12.9.16)


```

endif(4)
else(3)
  if(4) STATE_LAM_CYL_SEL_ADJ[i] = 4 [ADJ_NOM_L_RNG]
  then
    if(5) CTR_T_LAM_CYL_ADJ[i] 0
    then
      decrement CTR_T_LAM_CYL_ADJ[i]
      (1.12.9.17)
    endif(5)
    if(5) CTR_T_LAM_CYL_ADJ[i] = 0
    then
      if(6) LV_LAM_CYL_SEL_CTL_FAST_REQ = 1
      then
        for(7) j(x) = 1 : Number of cylinders per exhaust
          bank
          FAC_LAM_CYL_SEL_ADJ_L_RNG[x]k =
            FAC_LAM_CYL_SEL_ADJ_L_RNG[x]k-1
          +
          IP_FAC_OPP_LAM_CYL_SEL_ADJ_
          FAC_LAM_CYL_SEL_ADJ_FIL[x]k (1.12.9.18)
        endfor(7)
      else(6)
        for(7) j(x) = 1 : Number of cylinders per exhaust
          bank
          FAC_LAM_CYL_SEL_ADJ_L_RNG[x]k =
            FAC_LAM_CYL_SEL_ADJ_L_RNG[x]k-1
          +
          IP_FAC_OPP_LAM_CYL_SEL_ADJ*
          FAC_LAM_CYL_SEL_ADJ_FIL[x]k (1.12.9.19)
        endfor(7)
      endif(6)
      FAC_LAM_CYL_SEL_ADJ_L_RNG_MV[i] =
        
$$\frac{1}{\alpha} * \sum_{x=1}^{\alpha} \text{FAC\_LAM\_CYL\_SEL\_ADJ\_L\_RNG}[x]$$

        : number of cylinders per bank (1.12.9.20)
      if(6) FAC_LAM_CYL_SEL_ADJ_L_RNG_MV[i] 0
      then
        for(7) j(x) = 1 : Number of cylinders per exhaust
          bank
          FAC_LAM_CYL_SEL_ADJ_L_RNG[x]k =
            FAC_LAM_CYL_SEL_ADJ_L_RNG[x]k
          -
          FAC_LAM_CYL_SEL_ADJ_L_RNG_
          (1.12.9.21)
        endfor(7)
      endif(6)

```

MV[i]

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```

for(6)      j(x) = 1 : Number of cylinders per exhaust bank
if(7)      (FAC_LAM_CYL_SEL_ADJ_L_RNG[x]k >
              C_FAC_LAM_CYL_SEL_ADJ_MAX
              FAC_LAM_CYL_SEL_ADJ_L_RNG[x]k
              C_FAC_LAM_CYL_SEL_ADJ_MIN)
then
  LV_FAC_LAM_CYL_SEL_ADJ_LIM[i] = 1
  (1.12.9.22)
  break(6)
else(7)
  LV_FAC_LAM_CYL_SEL_ADJ_LIM[i] = 0
  (1.12.9.23)
endif(7)
endfor(6)

if(6)      LV_FAC_LAM_CYL_SEL_ADJ_LIM[i] = 0
then
  for(7)      j(x) = 1 : Number of cylinders per exhaust
              bank
  FAC_CYL_LAM[x]k = FAC_CYL_LAM[x] -
              (FAC_LAM_CYL_SEL_ADJ_L_RNG[x]k
              FAC_LAM_CYL_SEL_ADJ_L_RNG[x]k-1)
  (1.12.9.24)
  FAC_CYL_LAM_INT[x]k =
              FAC_CYL_LAM[x]k (1.12.9.25)
  FAC_LAM_CYL_SEL_ADJ_FIL[x]k =
              FAC_LAM_CYL_SEL_ADJ_FIL[x]
              (FAC_LAM_CYL_SEL_ADJ_L_RNG[x]k
              FAC_LAM_CYL_SEL_ADJ_L_RNG[x]k-1)
  (1.12.9.26)
endfor(7)
else(6)
  for(7)      j(x) = 1 : Number of cylinders per exhaust
              bank
  FAC_LAM_CYL_SEL_ADJ_L_RNG[x]k =
              FAC_LAM_CYL_SEL_ADJ_L_RNG[x]k-1
  (1.12.9.27)
endfor(7)
endif(6)
CTR_T_LAM_CYL_ADJ[i] = C_T_LAM_CYL_ADJ
(1.12.9.28)

FAC_CYL_LAM_ABSV_SUM[i] =  $\sum_{x=1}^{\alpha} |FAC\_CYL\_LAM[x]|$ 
 $\alpha$  :nr. of cylinders per bank

```

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```

(1.12.9.29)
if(6)      FAC_CYL_LAM_ABSV_SUM[i]
          C_FAC_LAM_CYL_SEL_ADJ_VLD_

THD

      then
LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i] = 1
(1.12.9.30)
      endif(6)
if(6)      LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i] = 0
      then
          FAC_LAM_CYL_SEL_ADJ_H_RNG[x] =
          FAC_LAM_CYL_SEL_ADJ_L_RNG[x](1.12.9.31)
      endif(6)
LV_LAM_CYL_SEL_ADJ_VLD[i] = 1
(1.12.9.32)
      endif(5)
else(4)
if(5)      STATE_LAM_CYL_SEL_ADJ[i] = 5 [ADJ_NOM_H_RNG]
      then
          if(6)      CTR_T_LAM_CYL_ADJ[i]  0
          then
              decrement      CTR_T_LAM_CYL_ADJ[i]
              (1.12.9.33)
          endif(6)
          if(6)      CTR_T_LAM_CYL_ADJ[i] = 0
          then
              if(7)      LV_LAM_CYL_SEL_CTL_FAST_REQ = 1
              then
                  for(8)      j(x) = 1 : Number of cylinders per
                              exhaust bank
                  FAC_LAM_CYL_SEL_ADJ_H_RNG[x]k =
                  FAC_LAM_CYL_SEL_ADJ_H_RNG[x]k-1
+
                  IP_FAC_OPP_LAM_CYL_SEL_ADJ_
FAST*
                  FAC_LAM_CYL_SEL_ADJ_FIL[x]k
                  (1.12.9.34)
                  endfor(8)
              else(7)
                  for(8)      j(x) = 1 : Number of cylinders per
                              exhaust bank
                  FAC_LAM_CYL_SEL_ADJ_H_RNG[x]k =
                  FAC_LAM_CYL_SEL_ADJ_H_RNG[x]k-1
+
                  IP_FAC_OPP_LAM_CYL_SEL_ADJ*
                  FAC_LAM_CYL_SEL_ADJ_FIL[x]k
                  (1.12.9.35)
                  endfor(8)
              endif(7)
          endif(5)
      endif(4)

```

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FAC\_LAM\_CYL\_SEL\_ADJ\_H\_RNG\_MV[i] =

$$\frac{1}{\alpha} * \sum_{x=1}^{\alpha} \text{FAC\_LAM\_CYL\_SEL\_ADJ\_H\_RNG}[x]$$

$\alpha$ : number of cylinders per bank (1.12.9.36)

if<sup>(7)</sup> FAC\_LAM\_CYL\_SEL\_ADJ\_H\_RNG\_MV[i] 0

then

for<sup>(8)</sup> j(x) = 1 : Number of cylinders per  
exhaust bank

FAC\_LAM\_CYL\_SEL\_ADJ\_H\_RNG[x]<sub>k</sub> =  
FAC\_LAM\_CYL\_SEL\_ADJ\_H\_RNG[x]<sub>k</sub>

-

MV[i]

FAC\_LAM\_CYL\_SEL\_ADJ\_H\_RNG\_

(1.12.9.37)

endfor<sup>(8)</sup>

endif<sup>(7)</sup>

for<sup>(7)</sup> j(x) = 1 : Number of cylinders per exhaust  
bank

if<sup>(8)</sup> (FAC\_LAM\_CYL\_SEL\_ADJ\_H\_RNG[x]<sub>k</sub>

>

C\_FAC\_LAM\_CYL\_SEL\_ADJ\_MAX

or

FAC\_LAM\_CYL\_SEL\_ADJ\_H\_RNG[x]<sub>k</sub>

<

C\_FAC\_LAM\_CYL\_SEL\_ADJ\_MIN)

then

LV\_FAC\_LAM\_CYL\_SEL\_ADJ\_LIM[i] = 1

(1.12.9.38)

break<sup>(7)</sup>

else<sup>(8)</sup>

LV\_FAC\_LAM\_CYL\_SEL\_ADJ\_LIM[i] = 0

(1.12.9.39)

endif<sup>(8)</sup>

endfor<sup>(7)</sup>

if<sup>(7)</sup> LV\_FAC\_LAM\_CYL\_SEL\_ADJ\_LIM[i] = 0

then

for<sup>(8)</sup> j(x) = 1 : Number of cylinders per  
exhaust bank

FAC\_CYL\_LAM[x]<sub>k</sub> =  
FAC\_CYL\_LAM[x] -  
(FAC\_LAM\_CYL\_SEL\_ADJ\_H\_RNG[x]<sub>k</sub>


-

FAC\_LAM\_CYL\_SEL\_ADJ\_H\_RNG[x]<sub>k-1</sub>)  
(1.12.9.40)

FAC\_CYL\_LAM\_INT[x]<sub>k</sub> =  
FAC\_CYL\_LAM[x]<sub>k</sub> (1.12.9.41)

FAC\_LAM\_CYL\_SEL\_ADJ\_FIL[x]<sub>k</sub> =  
FAC\_LAM\_CYL\_SEL\_ADJ\_FIL[x]

-


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```

(FAC_LAM_CYL_SEL_ADJ_H_RNG[x]k
-
FAC_LAM_CYL_SEL_ADJ_H_RNG[x]k-1)
(1.12.9.42)
endfor(8)
else(7)
for(8) j(x) = 1 : Number of cylinders per
exhaust bank
FAC_LAM_CYL_SEL_ADJ_H_RNG[x]k =
FAC_LAM_CYL_SEL_ADJ_H_RNG[x]k-1
(1.12.9.43)
endfor(8)
endif(7)
CTR_T_LAM_CYL_ADJ[i] = C_T_LAM_CYL_ADJ
(1.12.9.44)

FAC_CYL_LAM_ABSV_SUM[i] =  $\sum_{x=1}^{\alpha} |FAC\_CYL\_LAM[x]|$ 
 $\alpha$ :nr. of cylinders per bank
(1.12.9.-)
if(7) FAC_CYL_LAM_ABSV_SUM[i]
C_FAC_LAM_CYL_SEL_ADJ_VLD_
THD
then
LV_LAM_CYL_SEL_ADJ_H_RNG_
VLD[i] = 1
(1.12.9.46)
endif(7)
if(7) LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i] = 0
then
FAC_LAM_CYL_SEL_ADJ_L_RNG[x] =
FAC_LAM_CYL_SEL_ADJ_H_RNG[x](1.12.9.47)
endif(7)
LV_LAM_CYL_SEL_ADJ_VLD[i] = 1
(1.12.9.48)
endif(6)
endif(5)
endif(4)
endif(3)
if(3) STATE_LAM_CYL_SEL_ADJ[i] = 6 [ADJ_NOM_OFS]
then
if(4) CTR_T_LAM_CYL_ADJ[i] = 0
then
decrement CTR_T_LAM_CYL_ADJ[i]
(1.12.9.49)
endif(4)
if(4) CTR_T_LAM_CYL_ADJ[i] = 0
then
if(5) LV_LAM_CYL_SEL_CTL_FAST_REQ = 1
then
for(6) j(x) = 1 : Number of cylinders per exhaust bank

```

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```

MFF_ADD_CYL_LAM_COR[x]k =
MFF_ADD_CYL_LAM_COR[x]k-1
+ MFF_SP[i]*
FAST*
IP_FAC_OPP_LAM_CYL_SEL_ADJ_
FAC_LAM_CYL_SEL_ADJ_FIL[x]k (1.12.9.50)
endfor(6)
else(5)
for(6) j(x) = 1 : Number of cylinders per exhaust bank
MFF_ADD_CYL_LAM_COR[x]k =
MFF_ADD_CYL_LAM_COR[x]k-1
+ MFF_SP[i]*
IP_FAC_OPP_LAM_CYL_SEL_ADJ*
FAC_LAM_CYL_SEL_ADJ_FIL[x]k (1.12.9.51)
endfor(6)
endif(5)
MFF_ADD_CYL_LAM_COR_MV[i] =

$$\frac{1}{\alpha} * \sum_{x=1}^{\alpha} \text{MFF\_ADD\_CYL\_LAM\_COR}[x]$$

: number of cylinders per bank
(1.12.9.52)

```

```

if(5) MFF_ADD_CYL_LAM_COR_MV[i] 0
then
for(6) j(x) = 1 : Number of cylinders per exhaust bank
MFF_ADD_CYL_LAM_COR[x]k =
MFF_ADD_CYL_LAM_COR[x]k -
MFF_ADD_CYL_LAM_COR_MV[i]
endif(6)
endif(5)
(1.12.9.53)

```

```

for(5) j(x) = 1 : Number of cylinders per exhaust bank
if(6) (MFF_ADD_CYL_LAM_COR[x]k >
C_MFF_MAX_ADD_LAM_CYL_SEL_
ADJ or
MFF_ADD_CYL_LAM_COR[x]k <
ADJ)
C_MFF_MIN_ADD_LAM_CYL_SEL_
then
LV_MFF_ADD_CYL_LAM_COR_LIM[i] = 1
(1.12.9.54)
break(5)
else(6)
LV_MFF_ADD_CYL_LAM_COR_LIM[i] = 0
(1.12.9.55)
endif(6)
endif(5)

```

```

if(5)          LV_MFF_ADD_CYL_LAM_COR_LIM[i] = 0
then
  for(6)          j(x) = 1 : Number of cylinders per exhaust bank
    FAC_CYL_LAM[x]k = FAC_CYL_LAM[x]k -
      (MFF_ADD_CYL_LAM_COR[x]k -
      MFF_ADD_CYL_LAM_COR[x]k-1)/
      MFF_SP[i] (1.12.9.56)
    FAC_CYL_LAM_INT[x]k = FAC_CYL_LAM[x]k
      (1.12.9.57)
    FAC_LAM_CYL_SEL_ADJ_FIL[x]k =
      FAC_LAM_CYL_SEL_ADJ_FIL[x]k
      (MFF_ADD_CYL_LAM_COR[x]k -
      MFF_ADD_CYL_LAM_COR[x]k-1)/
      MFF_SP[i] (1.12.9.58)
  endfor(6)
  else(5)
    for(6)          j(x) = 1 : Number of cylinders per exhaust bank
      MFF_ADD_CYL_LAM_COR[x]k =
        MFF_ADD_CYL_LAM_COR[x]k-1 (1.12.9.59)
    endfor(6)
  endif(5)
  CTR_T_LAM_CYL_ADJ[i] = C_T_LAM_CYL_ADJ
    (1.12.9.60)
  LV_LAM_CYL_SEL_ADJ_VLD[i] = 1
    (1.12.9.61)
endif(4)
endif(3)
endif(2)
endif(1)

```

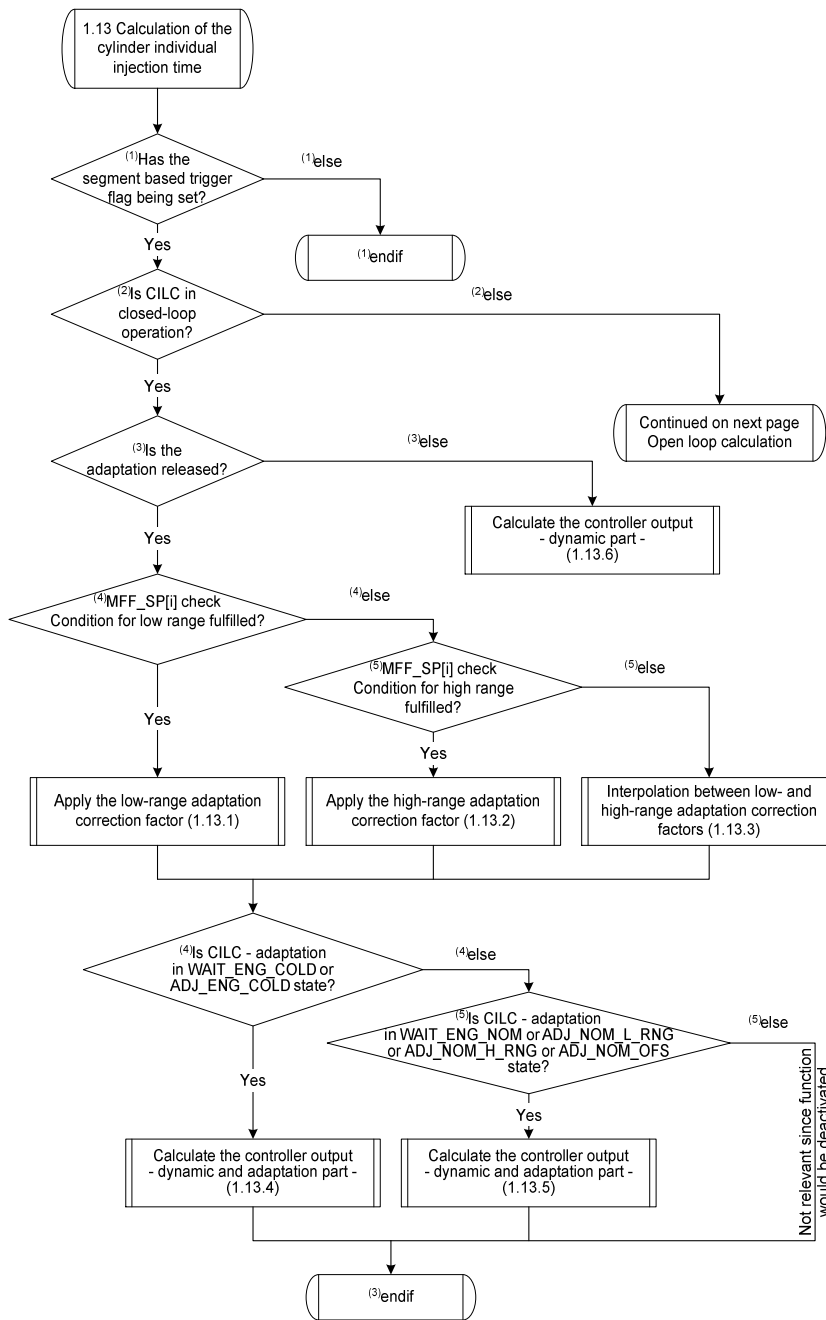
```

if(1)          (STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS] or
  STATE_LAM_CYL_SEL_ADJ[i] =
  1 [WAIT_ENG_COLD] or
  STATE_LAM_CYL_SEL_ADJ[i] =
  3 [WAIT_ENG_NOM])
then
  CTR_T_LAM_CYL_ADJ[i] = 0
    (1.12.9.62)
endif(1)

```

### 7.73.14 Calculation of the cylinder individual injection time correction

The value of the controller output FAC\_CYL\_LAM\_COR[x] shall be calculated depending on adaptation state STATE\_LAM\_CYL\_SEL\_ADJ[i].




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Figure 7.73.17: TOLMEOGRAPHIC 269252-68.ps

```

if(1) LV_TRIG[x] = 1
then
    if(2) STATE_LAM_CYL_SEL[i] = 3 [CLL]
    
```


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```

then
    if(3)          LC_ADAPT_COR_OUT = 1
    then
        if(4)      MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_L_RNG
        then
            FAC_LAM_CYL_SEL_ADJ[x] =
                FAC_LAM_CYL_SEL_ADJ_L_RNG[x]
(1.13.1)
        else(4)
            if(5)      MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_H_RNG
            then
                FAC_LAM_CYL_SEL_ADJ[x] =
                    FAC_LAM_CYL_SEL_ADJ_H_RNG[x]
(1.13.2)
            else(5)
                FAC_LAM_CYL_SEL_ADJ[x] =
                    FAC_LAM_CYL_SEL_ADJ_L_RNG[x]
+
                    (MFF_SP[i] - C_MFF_SP_THD_
CYL_SEL_ADJ_L_RNG)*
                    (FAC_LAM_CYL_SEL_ADJ_H_RNG[x]
-
                    FAC_LAM_CYL_SEL_ADJ_L_RNG[x])/
                    (C_MFF_SP_THD_CYL_SEL_ADJ_
H_RNG -
                    C_MFF_SP_THD_CYL_SEL_ADJ_
L_RNG) (1.13.3)
                endif(5)
            endif(4)
            if(4)      (STATE_LAM_CYL_SEL_ADJ[i] = 1 [WAIT_ENG_COLD] or
                STATE_LAM_CYL_SEL_ADJ[i] =
2 [ADJ_ENG_COLD])
            then
                FAC_CYL_LAM_COR[x]k = FAC_LAM_CYL_SEL_ADJ_CST[x]
                    + FAC_CYL_LAM[x]k (1.13.4)
            else(4)
                if(5)      (STATE_LAM_CYL_SEL_ADJ[i] = 3 [WAIT_ENG_NOM]
                    or STATE_LAM_CYL_SEL_ADJ[i]
= 4 [ADJ_NOM_L_RNG]
                    or STATE_LAM_CYL_SEL_ADJ[i]
= 5 [ADJ_NOM_H_RNG]
                    or STATE_LAM_CYL_SEL_ADJ[i]
= 6 [ADJ_NOM_OFS])
                then
                    FAC_CYL_LAM_COR[x]k = FAC_LAM_CYL_SEL_ADJ[x]
                        + FAC_CYL_LAM[x]k (1.13.5)
                endif(5)
            endif(4)
        else(3)
            FAC_CYL_LAM_COR[x]k = FAC_CYL_LAM[x]k
(1.13.6)
        endif(3)


```

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```

else(2)
  if(3)      LC_ADAPT_COR_OUT = 1
  then
    if(4)    MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_L_RNG
    then
      FAC_LAM_CYL_SEL_ADJ[x] =
(1.13.7)                                     FAC_LAM_CYL_SEL_ADJ_L_RNG[x]
    else(4)
      if(5)    MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_H_RNG
      then
        FAC_LAM_CYL_SEL_ADJ[x] =
(1.13.8)                                     FAC_LAM_CYL_SEL_ADJ_H_RNG[x]
      else(5)
        FAC_LAM_CYL_SEL_ADJ[x] =
+                                             FAC_LAM_CYL_SEL_ADJ_L_RNG[x]
CYL_SEL_ADJ_L_RNG)*                          (MFF_SP[i] - C_MFF_SP_THD_
-                                             (FAC_LAM_CYL_SEL_ADJ_H_RNG[x]
H_RNG -                                       FAC_LAM_CYL_SEL_ADJ_L_RNG[x])/
L_RNG) (1.13.9)                             (C_MFF_SP_THD_CYL_SEL_ADJ_
                                                C_MFF_SP_THD_CYL_SEL_ADJ_
    endif(5)
  endif(4)
  if(4)    (C_TEMP_LAM_CYL_CST_MIN < TEMP_LAM_CYL_SEL <
          C_TEMP_LAM_CYL_CST_MAX)
  then
    if(5)    LC_LAM_CYL_SEL_OPL = 0
    then
      FAC_CYL_LAM_COR[x]k =
+                                             FAC_LAM_CYL_SEL_ADJ_CST[x]
          FAC_CYL_LAM[x]k (1.13.10)
    else(5)
      FAC_CYL_LAM_COR[x]k =
(1.13.11)                                     FAC_LAM_CYL_SEL_ADJ_CST[x]
    endif(5)
  else(4)
    if(5)    TEMP_LAM_CYL_SEL C_TEMP_LAM_CYL_MIN
    then
      if(6)    LC_LAM_CYL_SEL_OPL = 0
      then
        FAC_CYL_LAM_COR[x]k =
          FAC_LAM_CYL_SEL_ADJ[x]
          + FAC_CYL_LAM[x]k (1.13.12)
      else(6)

```

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$$\text{FAC\_CYL\_LAM\_COR}[x]_k = \text{FAC\_LAM\_CYL\_SEL\_ADJ}[x] \quad (1.13.13)$$

```

endif(6)
endif(5)
endif(4)
else(3)
    FAC_CYL_LAM_COR[x]k = 0
endif(3)
endif(2)

```

[Remark: the cylinder based calculation (index x) shall be assigned to the corresponding exhaust bank (index i)]

```
endif(1)
```

### 7.73.15 Calculation of the characteristic value of the state variables - control action result

In order to evaluate the control-action result the absolute value of mean value-deviation of the state variables shall be averaged over the whole combustion cycle.

In order to evaluate the adaptation result the sum of the absolute cylinder individual controller outputs is calculated (FAC\_CYL\_LAM\_ABSV\_SUM[i]).

Convergence of FAC\_CYL\_LAM\_ABSV\_SUM[i] is an indication of a well-running adaptation process.

In case of separate exhaust banks existing, the calculation shall be carried out for both exhaust banks at the beginning of the combustion cycle (SEG\_NR = 0).

```
if(1)    SEG_NR = 0
then
    if(2)    STATE_LAM_CYL_SEL[i] = 3 [calculation is exhaust bank selective]
    then
```

$$\text{DELTA\_LAMB\_CYL\_SEL\_CQ}[i] = \frac{1}{\alpha} \sum_{x=1}^{\alpha} \left| \frac{1}{\alpha} \sum_{x=1}^{\alpha} \text{DELTA\_LAMB\_CYL}[x] - \text{DELTA\_LAMB\_CYL}[x] \right|$$

$\alpha$ :nr. of cylinders per bank

(1.14.1)

$$\text{FAC\_CYL\_LAM\_ABSV\_SUM}[i] = \sum_{x=1}^{\alpha} |\text{FAC\_CYL\_LAM}[x]|$$

$\alpha$ :nr. of cylinders per bank

(1.14.2)

[Remark: the cylinder based variables (index x) shall be assigned to the corresponding exhaust bank (index i)]

$$\begin{aligned} \text{DELTA\_LAMB\_CYL\_SEL\_CQ\_FIL}[i]_k &= \text{DELTA\_LAMB\_CYL\_SEL\_CQ\_FIL}[i]_{k-1} + \\ & (\text{DELTA\_LAMB\_CYL\_SEL\_CQ}[i]_k \\ - \text{DELTA\_LAMB\_CYL\_SEL\_CQ\_FIL}[i]_{k-1}) \\ & * \text{C\_CRLC\_DELTA\_LAMB\_CYL\_CQ\_} \\ \text{FIL} \end{aligned} \quad (1.14.3)$$

```

if(3)    CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] <
THD                                             C_CTR_LAMB_CYL_SEL_CQ_DRIFT_

then

if(4)    DELTA_LAMB_CYL_SEL_CQ_FIL[i]
THD                                             C_LAMB_CYL_SEL_CQ_DRIFT_


then
    increment (CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i])
    (1.14.4)
if(5)    CTR_LAMB_CYL_SEL_CQ_STAB[i] > 0
then
    decrement (CTR_LAMB_CYL_SEL_CQ_STAB[i])
    (1.14.5)
endif(5)
else(4)
if(5)    CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] > 0
then
    decrement (CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i])
    (1.14.6)
endif(5)
if(5)    CTR_LAMB_CYL_SEL_CQ_STAB[i] <
THD                                             C_CTR_LAMB_CYL_SEL_CQ_STAB_

then
    increment (CTR_LAMB_CYL_SEL_CQ_STAB[i])
    (1.14.7)
endif(5)
endif(4)
else(3)
if(4)    DELTA_LAMB_CYL_SEL_CQ_FIL[i] <
THD                                             C_LAMB_CYL_SEL_CQ_DRIFT_

then
if(5)    CTR_LAMB_CYL_SEL_CQ_STAB[i] <
THD                                             C_CTR_LAMB_CYL_SEL_CQ_STAB_

then
    increment (CTR_LAMB_CYL_SEL_CQ_STAB[i])
    (1.14.8)
endif(5)
if(5)    CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] > 0
then
    decrement (CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i])
    (1.14.9)
endif(5)
else(4)
if(5)    CTR_LAMB_CYL_SEL_CQ_STAB[i] > 0
then
    decrement (CTR_LAMB_CYL_SEL_CQ_STAB[i])
    (1.14.10)
endif(5)
endif(4)

```

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```

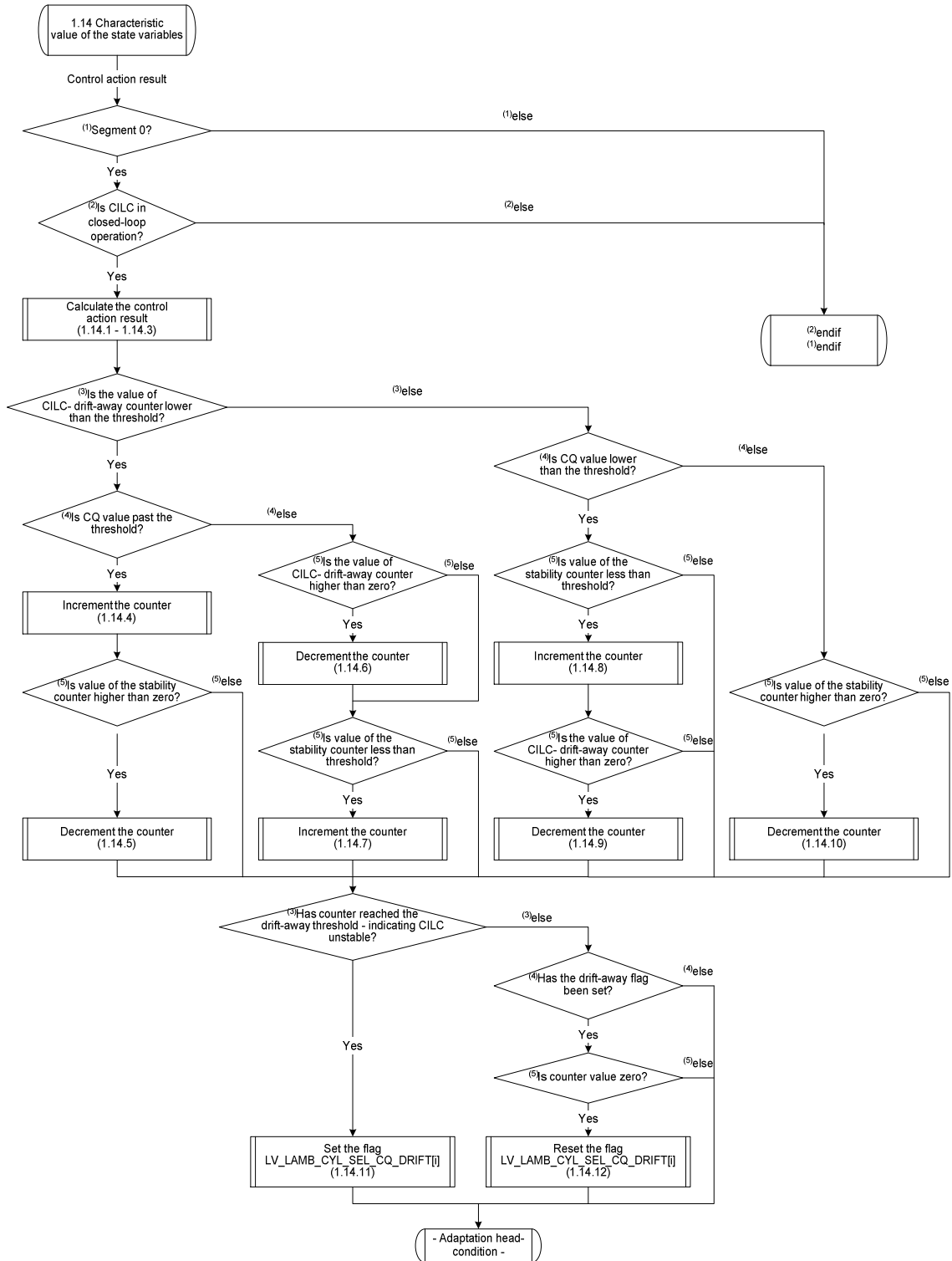
endif(3)

if(3)    CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] =
THD      C_CTR_LAMB_CYL_SEL_CQ_DRIFT_

    then
        LV_LAMB_CYL_SEL_CQ_DRIFT[i] = 1
                                           (1.14.11)
    else(3)
        if(4)    LV_LAMB_CYL_SEL_CQ_DRIFT[i] = 1
        then
            if(5)    CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] = 0
            then
                LV_LAMB_CYL_SEL_CQ_DRIFT[i] = 0
                                           (1.14.12)
            endif(5)
        endif(4)
    endif(3)

```


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### 7.73.16 Detection of observer divergence

In order to detect the observer divergence in closed-loop operation and stop the adaptation process consequently, virtual limitation (C\_FAC\_CYL\_LAM\_VIRT\_MIN/MAX) is defined. As soon as the single controller output (FAC\_CYL\_LAM[x]) passes the virtual limit over, the value of CILC- Characteristic Quantity (CQ- value as a measure for the observer behaviour) for the concerned exhaust bank is stored. Should one of the concerned exhaust-bank members (cylinders) reach the actual limit (LV\_FAC\_CYL\_

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LAM\_LIM\_MIN/MAX[x] = 1) the current CQ- value has to be compared with the stored value at virtual limit transition. A positive ascent of characteristic value (CQ- value) in current activation cycle (STATE\_LAMB\_CYL\_SEL\_CQ\_SLOP[i] = 2) is interpreted as for unstable behaviour of CILC and shall involve inhibition of adaptation process.

```

if(3) (STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 0 or
STATE_LAMB_CYL_SEL_CQ_SLOP[i]
= 1)
then
if(4) (FAC_CYL_LAM[x]k < C_FAC_CYL_LAM_VIRT_MIN or
FAC_CYL_LAM[x]k > C_FAC_CYL_
LAM_VIRT_MAX)
then
if(5) LV_FAC_CYL_LAM_VIRT_LIM[i] = 0
then
LAMB_CYL_SEL_CQ_REF[i] =
DELTA_LAMB_CYL_SEL_CQ_FIL[i]
(1.15.1)
LV_FAC_CYL_LAM_VIRT_LIM[i] = 1
(1.15.2)
else(5)
if(6) (LV_FAC_CYL_LAM_LIM_MIN[x] = 1 or
LV_FAC_CYL_LAM_LIM_MAX[x]
= 1)
then
LAMB_CYL_SEL_CQ_DIF_REF[i] =
DELTA_LAMB_CYL_SEL_CQ_FIL[i]
-
LAMB_CYL_SEL_CQ_REF[i] (1.15.3)
if(7) LAMB_CYL_SEL_CQ_DIF_REF[i] >
C_LAMB_CYL_SEL_CQ_DIF_REF_
THD
then
STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 2
(1.15.4)
else(7)
if(8) (STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 1
and CTR_LAMB_CYL_SEL_CQ_
STAB[i] =
C_CTR_LAMB_CYL_SEL_CQ_STAB_
THD)
then
STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 0
(1.15.5)
endif(8)
endif(7)
else(6)
if(7) (STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 1
and CTR_LAMB_CYL_SEL_CQ_
STAB[i] =
C_CTR_LAMB_CYL_SEL_CQ_STAB_
THD)
then

```


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```

STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 0
(1.15.6)
endif(7)
endif(6)
endif(5)
else(4)
LV_FAC_CYL_LAM_VIRT_LIM[i] = 0
(1.15.7)
if(5) (STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 1 and
CTR_LAMB_CYL_SEL_CQ_STAB[i]
=
C_CTR_LAMB_CYL_SEL_CQ_STAB_
THD)
then
STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 0
(1.15.8)
endif(5)
endif(4)
endif(3)
endif(2)
endif(1)

```

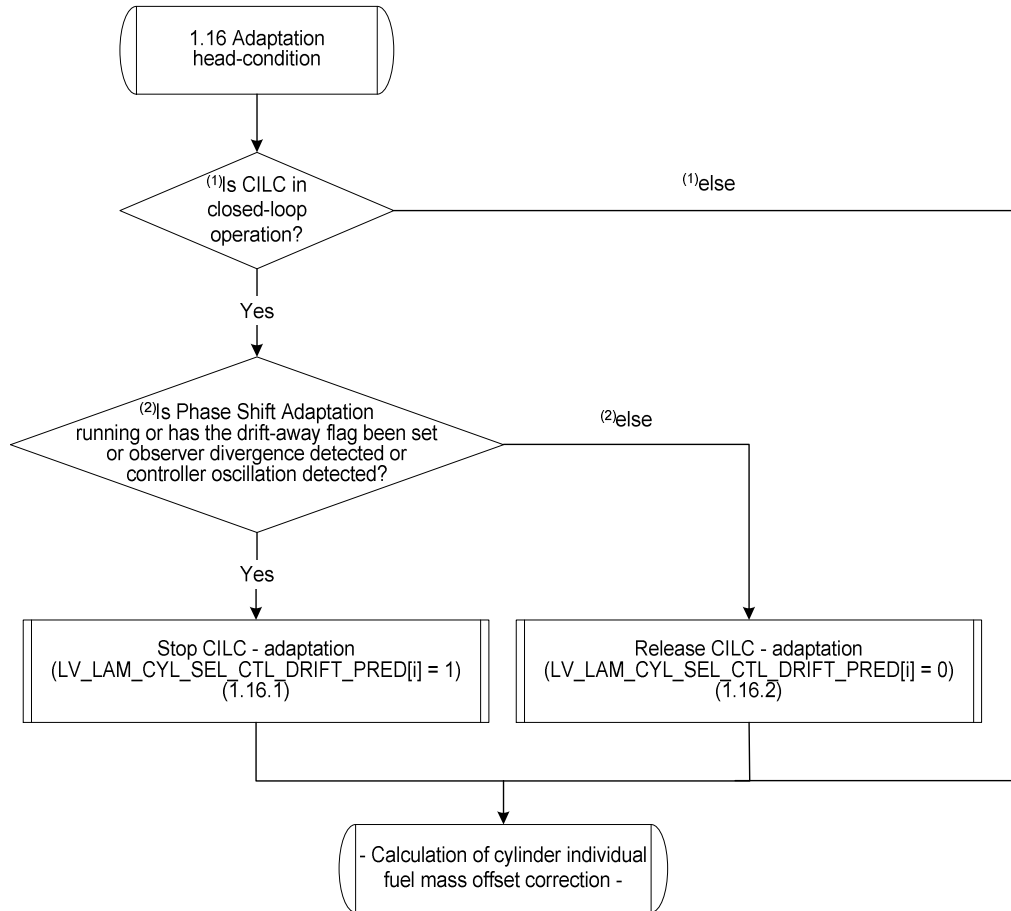
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### 7.73.17 Adaptation head-condition

In order to stop the long-term adaptation in case of controller outputs drift away, controller behaviour shall be predicted using following auxiliary variables:

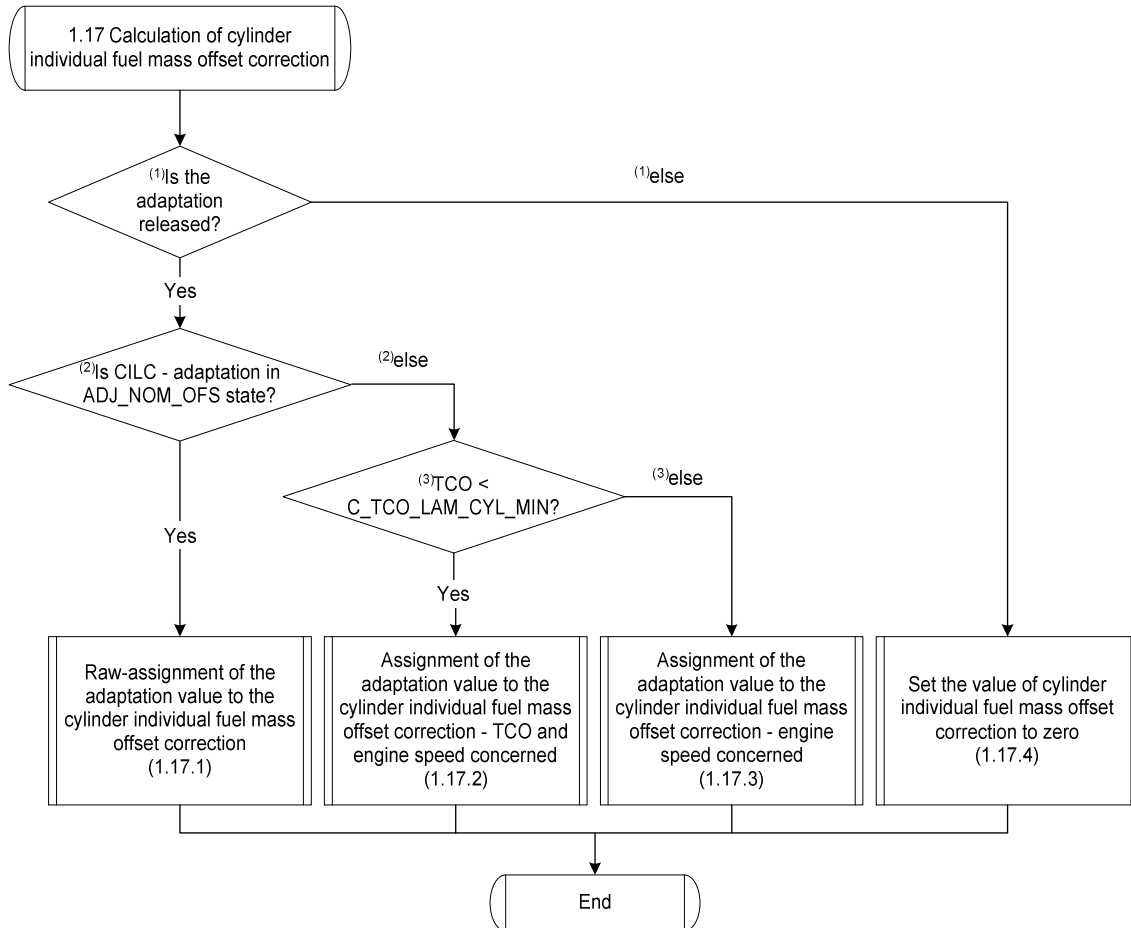


```

if(1) STATE_LAM_CYL_SEL[i] = 3 [calculation is exhaust bank selective]
then
  if(2) (STATE_DELTA_CRK_CYL_LAM[i] = 3 'AD_INI' or
    STATE_DELTA_CRK_CYL_LAM[i]
  = 4 'AD_DEC' or
    STATE_DELTA_CRK_CYL_LAM[i]
  = 5 'AD_INC' or
    LV_LAMB_CYL_SEL_CQ_DRIFT[i]
  = 1 or
    STATE_LAMB_CYL_SEL_CQ_SLOP[i]
  = 0 or
    LV_FAC_CYL_LAM_COR_OSC[i]
  = 1)
  then
    LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 1 (1.16.1)
  else(2)
    LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 0 (1.16.2)
  endif(2)
endif(1)
  
```

### 7.73.18 Calculation of cylinder individual fuel mass offset correction - weighted output

The value of cylinder individual fuel mass offset correction should be weighted versus engine speed, and temperature up to engine runs to the nominal temperature for activation of cylinder individual lambda control. The calculation shall be carried out independently of the activation condition for all of the cylinders.



```

if(1)
then
    LC_ADAPT_COR_OUT = 1
else(2)
    if(2)
    then
        STATE_LAM_CYL_SEL_ADJ[i] = 6 [ADJ_NOM_OFS]
        MFF_ADD_CYL_LAM_COR_OUT[x] = MFF_ADD_CYL_LAM_COR[x]
        (1.17.1)
    else(2)
        if(3)
        then
            TEMP_LAM_CYL_SEL < C_TEMP_LAM_CYL_MIN
            MFF_ADD_CYL_LAM_COR_OUT[x] = MFF_ADD_CYL_LAM_COR[x]*
            IP_FAC_N_MFF_ADD_CYL_LAM_
            COR*
            IP_FAC_WUP_MFF_ADD_CYL_LAM
        else(3)
            MFF_ADD_CYL_LAM_COR_OUT[x] = MFF_ADD_CYL_LAM_COR[x]*
        (1.17.2)
    end
end
    
```

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```

COR (1.17.3)
    endif(3)
  endif(2)
else(1)
  MFF_ADD_CYL_LAM_COR_OUT[x] = 0
endif(1)


```

IP\_FAC\_N\_MFF\_ADD\_CYL\_LAM\_

(1.17.4)

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## 7.74 Phase shift adaptation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_CHG_FAC_PHA_SHIFT_AD [NC_CBK_EX_NR]	V	1... 78H	1... 120	1	-
Recursive change factor					
CRK_CYL_LAM_DELTA_INI [NC_CBK_EX_NR]	O/V/S	88... 78H	-720 ...720	6	°CRK
Initial CRK - adaptation value					
CRK_CYL_LAM_INT [NC_CBK_EX_NR]	V	88... 78H	-720 ...720	6	°CRK
Output of the integral-action					
CTR_CQ_FIL_FALL [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for improved cycles of cylinder individual lambda control response - CQ based					
CTR_CQ_MAX_OSC [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Duration of exceeded CQ limit					
CTR_CQ_MON_PHA_SHIFT_AD [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Period of CQ monitoring					
CTR_ER_MON_PHA_SHIFT_AD [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Period of engine roughness monitoring					
CTR_FAC_CYL_LAM_COR_DIF_ABSV [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for improved cycles of cylinder individual lambda control response - FAC_CYL_LAM_COR based					
CTR_PHA_SHIFT_AD_TRIG [NC_CBK_EX_NR]	O/V/S	0... FFH	0... 255	1	-
Counter for triggering the phase shift adaptation					
CTR_RESP_CYC_LAM_CYL_SEL [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for evaluation of cylinder individual lambda control response					
CTR_RESP_LAM_CYL_SEL [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Response time for adaptation result					
CTR_SUM_FAC_CYL_LAM_COR_OSC [NC_CYL_NR]	V	0... FFFFH	0... 65535	1	-
Duration of oscillation monitoring					
DELTA_CRK_CYL_LAM [NC_CBK_EX_NR]	O/V/S	88... 78H	-720 ...720	6	°CRK
Value of adapted phase displacement					
ER_STND_MMV_DIF_ABSV_SUM_GRD [NC_CBK_EX_NR]	V	8000... 7FFFH	-325.78 ...325.77	9.942e-3	1/s**2
Gradient of the absolute difference of filtered normalized and average engine roughness value					
ER_STND_MMV_DIF_ABSV_SUM_PRE [NC_CBK_EX_NR]	V	0... 7FFFH	0... 325.77	9.942e-3	1/s**2
Sum of the absolute difference of filtered normalized and average engine roughness value - previous sample					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ER_STND_MMV_DIF_BAL_ABSV_SUM [NC_CBK_EX_NR]	V	0... 7FFFH	0... 325.77	9.942e-3	1/s**2
Sum of the absolute difference of filtered normalized and average engine roughness value					
FAC_CYL_LAM_ABSV_SUM_GRD [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Gradient of the CILC outputs absolute sum					
FAC_CYL_LAM_ABSV_SUM_PRE [NC_CBK_EX_NR]	V	0... 7FFFH	0... 49.99847	1.5259e-3	%
Sum of the absolute cylinder individual controller outputs - previous sample					
FAC_CYL_LAM_SAVE [NC_CYL_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Value of the saved cylinder individual lambda controller output					
LV_DELTA_CRK_CYL_LAM_ERR [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Error flag indicating the adaptation value is not correct					
LV_ER_ABSV_SUM_GRD_RISE [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Unstable engine roughness detected					
LV_FAC_CYL_LAM_COR_LIM_OSC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Alternating limitation detected					
LV_FAC_CYL_LAM_COR_OSC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Oscillation detected					
LV_FAC_CYL_LAM_OSC_MAX_THD [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Flag indicating the upper limit of cylinder individual lambda control was reached - oscillation monitoring					
LV_FAC_CYL_LAM_OSC_MIN_THD [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Flag indicating the lower limit of cylinder individual lambda control was reached - oscillation monitoring					
LV_STATE_DELTA_CRK_WAIT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Waiting for adaptation response					
STATE_DELTA_CRK_CYL_LAM [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H 4H 5H 6H	AD_PAS AD_ACT AD_CDN AD_INI AD_DEC AD_INC AD_HOLD	-	-
Adaptation state					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**Input data:**

CTR_LAMB_CYL_SEL_ CQ_DRIFT_THD [NC_CBK_EX_NR] {p. 2730}	DELTA_LAMB_CYL_SEL_ CQ [NC_CBK_EX_NR] {p. 2730}	DELTA_LAMB_CYL_SEL_ CQ_FIL [NC_CBK_EX_NR] {p. 2730}	ER_STND_MMV_DIF_BAL [NC_CYL_NR] {p. 1489}
FAC_CYL_LAM [NC_CYL_NR] {p. 2730}	FAC_CYL_LAM_ABSV_ SUM [NC_CBK_EX_NR] {p. 2730}	LF_LS_CBK_EX_LAM_ CYL_SEL_CONF {p. 2864}	LV_CRK_CYL_LAM_ DELTA_RST_LS_EXT [NC_CBK_EX_NR]
LV_DC {p. 5746}	LV_ER_STND_ER_BAL_ ACT {p. 4022}	LV_ES {p. 1720}	LV_FAC_CYL_LAM_LIM_ MAX [NC_CYL_NR] {p. 2732}
LV_FAC_CYL_LAM_LIM_ MIN [NC_CYL_NR] {p. 2732}	LV_LAM_CYL_SEL_CTL_ DRIFT_PRED [NC_CBK_EX_NR] {p. 2732}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}
SEG_NR {p. 1525}	STATE_LAM_CYL_SEL_ [NC_CBK_EX_NR] {p. 2733}	STATE_LAMB_CYL_SEL_ CQ_SLOP [NC_CBK_EX_NR] {p. 2733}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRK_CHG_FAC_MAX	-	1... 78H	1... 120	1	-
Upper limit of the CRK change factor					
C_CRK_CHG_STEP	-	88... 78H	-720 ...720	6	°CRK
CRK change step					
C_CRK_CYL_LAM_DELTA_INI	-	88... 78H	-720 ...720	6	°CRK
CRK - initial constant					
C_CRK_CYL_LAM_INI_RED	-	0... 78H	0... 720	6	°CRK
CRK - initial reduction factor					
C_CTR_CQ_FIL_FALL_MIN	-	0... FFH	0... 255	1	-
Least number of improvement cycles to extend the waiting time for evaluation of adaptation result - CQ - based					
C_CTR_CQ_FIL_FALL_OK	-	0... FFH	0... 255	1	-
Minimum number of improved cycles to accept the adaptation value - CQ - based					
C_CTR_CQ_MIN_PHA_SHIFT_AD	-	0... FFFFH	0... 65535	1	-
Minimum time of exceeded CQ limit to request the adaptation					
C_CTR_CQ_MON_PHA_SHIFT_AD_MAX	-	0... FFFFH	0... 65535	1	-
Maximum time of oscillation monitoring - CQ - based					
C_CTR_ER_MON_PHA_SHIFT_AD_MAX	-	0... FFFFH	0... 65535	1	-
Maximum time for engine roughness monitoring					
C_CTR_ER_RESP_MIN_LAM_CYL_SEL	-	0... FFFFH	0... 65535	1	-
Minimum response time of engine roughness for evaluation of adaptation result					
C_CTR_FAC_CYL_LAM_DIF_ABSV_MIN	-	0... FFH	0... 255	1	-
Least number of improvement cycles to extend the waiting time for evaluation of adaptation result - FAC_CYL_LAM_COR - based					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_FAC_CYL_LAM_DIF_ABSV_OK	-	0... FFH	0... 255	1	-
Minimum number of improved cycles to accept the adaptation value - FAC_CYL_LAM_COR - based					
C_CTR_PHA_SHIFT_AD_TRIG_THD	-	0... FFH	0... 255	1	-
Trigger threshold for delayed phase shift adaptation					
C_CTR_RESP_CYC_MIN_LAM_CYL_SEL	-	0... FFH	0... 255	1	-
Minimum number of response cycles to evaluate the adaptation result					
C_CTR_RESP_MIN_LAM_CYL_SEL	-	0... FFFFH	0... 65535	1	-
Minimum response time for adaptation result					
C_CTR_SUM_FAC_CYL_LAM_OSC_MAX	-	0... FFFFH	0... 65535	1	-
Maximum time of oscillation monitoring - FAC_CYL_LAM_COR - based					
C_DELTA_CRK_OUT_MAX	-	88... 78H	-720 ...720	6	°CRK
Upper limit of the adapted phase displacement					
C_DELTA_CRK_OUT_MIN	-	88... 78H	-720 ...720	6	°CRK
Lower limit of the adapted phase displacement					
C_DELTA_LAMB_CYL_SEL_CQ_AD_THD	-	0... FFFFH	0... 0.99998	15.3e-6	-
Adaptation-release threshold					
C_ER_ABSV_GRD_FALL_THD_CRK_CHG	-	8000... 7FFFH	-325.78 ...325.77	9.942e-3	1/s**2
Threshold of engine roughness gradient drop for a safe adaptation result					
C_ER_ABSV_GRD_RISE_THD_CRK_CHG	-	0... 7FFFH	0... 325.77	9.942e-3	1/s**2
Maximum limit of engine roughness gradient rise					
C_FAC_CYL_LAM_ABSV_GRD_FALL_THD	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Threshold of CILC gradient drop for a safe adaptation result					
C_FAC_CYL_LAM_ABSV_GRD_RISE_THD	-	0... 7FFFH	0... 49.99847	1.5259e-3	%
Maximum limit of CILC gradient rise					
C_FAC_CYL_LAM_DIF_ABSV_MAX	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Maximum of allowed FAC_CYL_LAM_COR oscillation space					
C_FAC_CYL_LAM_MAX_PHA_SHIFT_AD	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Upper limit of FAC_CYL_LAM_COR value to detect the oscillation					
C_FAC_CYL_LAM_MIN_PHA_SHIFT_AD	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Lower limit of FAC_CYL_LAM_COR value to detect the oscillation					
C_NR_SEG_REF_CBK_EX_2	-	0... 7H	0 ...7	1	-
Segment number for identification of the first fired cylinder of exhaust bank 2					
LC_CRK_CYL_LAM_DELTA_OUT	-	0... 1H	0 ...1	1	-
Adaptation switch					
LC_CRK_DELTA_CQ_SWI	-	0... 1H	0 ...1	1	-
Adaptation via characteristic quantity					

## Phase Shift Adaptation

### FUNCTION DESCRIPTION:


#### General information:

This module enables an adaptation of phase shift, which might be influenced by ageing effect of wide range A/F sensor or even calibration-error for instance.

**if**<sup>(1)</sup> two separate exhaust banks are concerned  
**then**

i = 1, for cylinder bank 1 ( x = 0, 2, 4, ... )

i = 2, for cylinder bank 2 ( x = 1, 3, 5, ... )

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```
else(1)
    i = 1 ( x = 0 ... 3 or 4 )
endif(1)
```

**Description of index "[i]" and "[x]":**

*x: logical cylinder*

*use NC\_CYL\_NR : number of engine cylinders - index "[x]"*

*use LF\_LS\_CBK\_EX\_LAM\_CYL\_SEL\_CONF: pattern for allocation of physical cylinders to exhaust bank - index "[i]"*


Time recurrence: every TDC

**7.74.1 Initialization (at reset)**

The following initialization shall be carried out after a RESET and upon leaving the engine state Engine Stop (LV\_ES).

- STATE\_DELTA\_CRK\_CYL\_LAM[i] = 0 'AD\_PAS' (1.0.1)
- FAC\_CYL\_LAM\_SAVE[x] = 0 (1.0.2)
- LV\_FAC\_CYL\_LAM\_COR\_OSC[i] = 0 (1.0.3)
- LV\_FAC\_CYL\_LAM\_COR\_LIM\_OSC[i] = 0 (1.0.4)
- LV\_FAC\_CYL\_LAM\_OSC\_MAX\_THD[x] = 0 (1.0.5)
- LV\_FAC\_CYL\_LAM\_OSC\_MIN\_THD[x] = 0 (1.0.6)
- LV\_STATE\_DELTA\_CRK\_WAIT[i] = 0 (1.0.7)
- CTR\_SUM\_FAC\_CYL\_LAM\_COR\_OSC[x] = 0 (1.0.8)
- CTR\_CQ\_MON\_PHA\_SHIFT\_AD[i] = 0 (1.0.9)
- CTR\_ER\_MON\_PHA\_SHIFT\_AD[i] = 0 (1.0.10)
- CTR\_CQ\_MAX\_OSC[i] = 0 (1.0.11)
- CTR\_RESP\_LAM\_CYL\_SEL[i] = 0 (1.0.12)
- CTR\_RESP\_CYC\_LAM\_CYL\_SEL[i] = 0 (1.0.13)
- CTR\_FAC\_CYL\_LAM\_COR\_DIF\_ABSV[i] = 0 (1.0.14)
- CTR\_CQ\_FIL\_FALL[i] = 0 (1.0.15)
- CRK\_CHG\_FAC\_PHA\_SHIFT\_AD[i] = 1

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(1.0.16)

LV\_DELTA\_CRK\_CYL\_LAM\_ERR[i] = 0

(1.0.17)

LV\_ER\_ABSV\_SUM\_GRD\_RISE[i]= 0

(1.0.18)

ER\_STND\_MMV\_DIF\_BAL\_ABSV\_SUM[i]= 0

(1.0.19)

ER\_STND\_MMV\_DIF\_ABSV\_SUM\_PRE[i]= 0

(1.0.20)

ER\_STND\_MMV\_DIF\_ABSV\_SUM\_GRD[i]= 0

(1.0.21)

FAC\_CYL\_LAM\_ABSV\_SUM\_PRE[i]= 0

(1.0.22)

FAC\_CYL\_LAM\_ABSV\_SUM\_GRD[i]= 0

(1.0.23)

CRK\_CYL\_LAM\_INT[i] = DELTA\_CRK\_CYL\_LAM[i]

(1.0.24)

**if**<sup>(1)</sup>            DELTA\_CRK\_CYL\_LAM[i] = 0

**then**

CRK\_CYL\_LAM\_DELTA\_INI[i] = C\_CRK\_CYL\_LAM\_DELTA\_INI

(1.0.25)

**endif**<sup>(1)</sup>

### 7.74.2 Reset at E\*\*2PROM - failure

**At E\*\*2PROM - failure:**

DELTA\_CRK\_CYL\_LAM[i] = 0

(1.1.1)

CRK\_CYL\_LAM\_DELTA\_INI[i] = 0

(1.1.2)

CTR\_PHA\_SHIFT\_AD\_TRIG[i] = 0

(1.1.3)

### 7.74.3 Adaptation reset by external tool intervention

Following calculation shall be carried out independently of the activation condition (time recurrence: 100 ms):

**if**<sup>(1)</sup>            LV\_CRK\_CYL\_LAM\_DELTA\_RST\_LS\_EXT[i] = 1

**then**

DELTA\_CRK\_CYL\_LAM[i] = 0

(1.2.1)

CRK\_CYL\_LAM\_DELTA\_INI[i] = C\_CRK\_CYL\_LAM\_DELTA\_INI

(1.2.2)

FAC\_CYL\_LAM\_SAVE[x] = 0

(1.2.3)

LV\_FAC\_CYL\_LAM\_COR\_OSC[i] = 0

(1.2.4)

LV\_FAC\_CYL\_LAM\_COR\_LIM\_OSC[i] = 0

(1.2.5)


LV\_FAC\_CYL\_LAM\_OSC\_MAX\_THD[x] = 0

(1.2.6)

LV\_FAC\_CYL\_LAM\_OSC\_MIN\_THD[x] = 0

(1.2.7)

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```

LV_STATE_DELTA_CRK_WAIT[i] = 0
(1.2.8)
CTR_SUM_FAC_CYL_LAM_COR_OSC[x] = 0
(1.2.9)
CTR_CQ_MON_PHA_SHIFT_AD[i] = 0
(1.2.10)
CTR_ER_MON_PHA_SHIFT_AD[i] = 0
(1.2.11)
CTR_CQ_MAX_OSC[i] = 0
(1.2.12)
CTR_RESP_LAM_CYL_SEL[i] = 0
(1.2.13)
CTR_RESP_CYC_LAM_CYL_SEL[i] = 0
(1.2.14)
CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] = 0
(1.2.15)
CTR_CQ_FIL_FALL[i] = 0
(1.2.16)
CRK_CHG_FAC_PHA_SHIFT_AD[i] = 1
(1.2.17)
LV_DELTA_CRK_CYL_LAM_ERR[i] = 0
(1.2.18)
LV_ER_ABSV_SUM_GRD_RISE[i] = 0
(1.2.19)
ER_STND_MMV_DIF_BAL_ABSV_SUM[i] = 0
(1.2.20)
ER_STND_MMV_DIF_ABSV_SUM_PRE[i] = 0
(1.2.21)
ER_STND_MMV_DIF_ABSV_SUM_GRD[i] = 0
(1.2.22)
FAC_CYL_LAM_ABSV_SUM_PRE[i] = 0
(1.2.23)
FAC_CYL_LAM_ABSV_SUM_GRD[i] = 0
(1.2.24)
CRK_CYL_LAM_INT[i] = 0
(1.2.25)
CTR_PHA_SHIFT_AD_TRIG[i] = 0
(1.2.26)

```

**endif**<sup>(1)</sup>

#### 7.74.4 Activation

```

if(1) LV_DELTA_CRK_CYL_LAM_ERR[i] = 0
then
    if(2) STATE_DELTA_CRK_CYL_LAM[i] = 0 'AD_PAS'
    then
        STATE_DELTA_CRK_CYL_LAM[i] = 1 'AD_ACT'
    endif(2)
endif(1)
(1.3.1)


```

**end** **if**<sup>(1)</sup>

```

if(1) STATE_LAM_CYL_SEL[i] = 0 [calculation is exhaust bank selective]
then

```

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```

if(2)      (LV_FAC_CYL_LAM_COR_OSC[i] = 1 and
C_CTR_PHA_SHIFT_AD_TRIG_THD)
then
    LV_FAC_CYL_LAM_COR_OSC[i] = 0
    LV_FAC_CYL_LAM_OSC_MAX_THD[x] = 0
    LV_FAC_CYL_LAM_OSC_MIN_THD[x] = 0
    CTR_SUM_FAC_CYL_LAM_COR_OSC[x] = 0
    CTR_CQ_MON_PHA_SHIFT_AD[i] = 0
    CTR_CQ_MAX_OSC[i] = 0
endif(2)
if(2)      (LV_FAC_CYL_LAM_COR_LIM_OSC[i] = 1 and
C_CTR_PHA_SHIFT_AD_TRIG_THD)
then
    LV_FAC_CYL_LAM_COR_LIM_OSC[i] = 0
endif(2)
if(2)      (LV_ER_ABSV_SUM_GRD_RISE[i] = 1 and
C_CTR_PHA_SHIFT_AD_TRIG_THD)
then
    LV_ER_ABSV_SUM_GRD_RISE[i] = 0
endif(2)
end      if(1)

```

CTR\_PHA\_SHIFT\_AD\_TRIG[i] <  
(1.3.2)  
(1.3.3)  
(1.3.4)  
(1.3.5)  
(1.3.6)  
(1.3.7)  
  
CTR\_PHA\_SHIFT\_AD\_TRIG[i] <  
(1.3.8)  
  
CTR\_PHA\_SHIFT\_AD\_TRIG[i] <  
(1.3.9)

### 7.74.5 Deactivation

```

if(1)      LV_DELTA_CRK_CYL_LAM_ERR[i] = 1
then
    STATE_DELTA_CRK_CYL_LAM[i] = 0 'AD_PAS'
endif(1)

```

(1.4.1)

#### Formula section:

## 7.74.6 Monitoring the engine roughness

```

if(1) STATE_LAM_CYL_SEL[i] = 3 [calculation is exhaust bank selective]
then
    if(2) (SEG_NR = 0 [calculation for exhaust bank 1] or
           SEG_NR = C_NR_SEG_REF_CBK_EX_2 [calculation for exhaust bank 2])
    then
        if(3) LV_ER_STND_ER_BAL_ACT = 1
        then
            if(4) LV_STATE_DELTA_CRK_WAIT[i] = 0
            then
                if(5) CTR_ER_MON_PHA_SHIFT_AD[i] = 0
                then
                    FAC_CYL_LAM_ABSV_SUM_PRE[i] =
                    FAC_CYL_LAM_ABSV_SUM[i] (1.5.1)
                endif(5)
                increment CTR_ER_MON_PHA_SHIFT_AD[i] (1.5.2)
                if(5) CTR_ER_MON_PHA_SHIFT_AD[i] =
                    C_CTR_ER_MON_PHA_SHIFT_AD_MAX
                then
                    if(6) ER_STND_MMV_DIF_BAL_ABSV_SUM[i] ≠ 0
                    then
                        ER_STND_MMV_DIF_ABSV_SUM_PRE[i] =
                        ER_STND_MMV_DIF_BAL_ABSV_SUM[i] (1.5.3)
                    endif(6)
                        ER_STND_MMV_DIF_BAL_ABSV_SUM[i] =
                            
$$\sum_{x=1}^{\alpha} |ER\_STND\_MMV\_DIF\_BAL[x]|$$

                        
$$\alpha : \text{nr. of cylinders per bank}$$

                        (1.5.4)
                    [Remark: the cylinder based variables (index x) shall be assigned to the corresponding exhaust bank (index i)]
                    if(6) ER_STND_MMV_DIF_ABSV_SUM_PRE[i] ≠ 0
                    then
                        ER_STND_MMV_DIF_ABSV_SUM_GRD[i] =
                        ER_STND_MMV_DIF_BAL_ABSV_SUM[i] -
                        ER_STND_MMV_DIF_ABSV_SUM_PRE[i] (1.5.5)
                    endif(6)
                        FAC_CYL_LAM_ABSV_SUM_GRD[i] =
                        FAC_CYL_LAM_ABSV_SUM[i] -
                        FAC_CYL_LAM_ABSV_SUM_PRE[i] (1.5.6)
                    CTR_ER_MON_PHA_SHIFT_AD[i] = 0 (1.5.7)
                endif(5)
            endif(4)
        endif(3)
    endif(2)
endif(1)

```

```

    endif(2)
else(1)
    CTR_ER_MON_PHA_SHIFT_AD[i] = 0
                                                    (1.5.8)
endif(1)

```

### 7.74.7 Detection of the cylinder individual lambda controller output oscillation:

The controller outputs of cylinder individual lambda control are monitored during the time the function is in closed loop mode (STATE\_LAM\_CYL\_SEL[i] = CLL).

```

if(1) STATE_LAM_CYL_SEL[i] = 3 [calculation is exhaust bank selective]
then
    if(2) (SEG_NR = 0 [calculation for exhaust bank 1] or
        SEG_NR = C_NR_SEG_REF_CBK_
EX_2 [calculation for exhaust bank 2]
    then
        if(3) (LC_CRK_DELTA_CQ_SWI = 0 and
= 0)
            then
                if(4) [(FAC_CYL_LAM[x]
AD) and
= 0 and
= 0]
                    then
                        LV_FAC_CYL_LAM_OSC_MAX_THD[x] = 1
                                                    (1.6.1)
                    endif(4)
                    if(4) LV_FAC_CYL_LAM_OSC_MAX_THD[x] = 1
                    then
                        if(5) LV_FAC_CYL_LAM_COR_OSC[i] = 0
                        then
                            increment CTR_SUM_FAC_CYL_LAM_COR_OSC[x]
                                                    (1.6.2)
                        endif(5)
                        if(5) [(FAC_CYL_LAM[x]
AD) and
OSC[x] <
MAX]]
                            then
                                if(6) LV_FAC_CYL_LAM_COR_OSC[i] = 0
                                then
                                    LV_FAC_CYL_LAM_COR_OSC[i] = 1
                                                    (1.6.3)

```

[Remark: the cylinder based Oscillation (index x)  
shall be assigned to the correspond-  
ing exhaust bank  
(index i)]


```

if(7) CTR_PHA_SHIFT_AD_TRIG[i] <
    C_CTR_PHA_SHIFT_AD_TRIG_
    then
        increment(CTR_PHA_SHIFT_AD_TRIG[i])
        (1.6.4)
    endif(7)
endif(6)
endif(5)
endif(4)

if(4) [(FAC_CYL_LAM[x] <
    C_FAC_CYL_LAM_MIN_PHA_SHIFT_
    LV_FAC_CYL_LAM_OSC_MAX_
    LV_FAC_CYL_LAM_COR_LIM_OSC[i]
    then
        LV_FAC_CYL_LAM_OSC_MIN_THD[x] = 1
        (1.6.5)
    endif(4)
if(4) LV_FAC_CYL_LAM_OSC_MIN_THD[x] = 1
    then
        if(5) LV_FAC_CYL_LAM_COR_OSC[i] = 0
        then
            increment CTR_SUM_FAC_CYL_LAM_COR_OSC[x]
            (1.6.6)
        endif(5)
        if(5) [(FAC_CYL_LAM[x] >
    C_FAC_CYL_LAM_MAX_PHA_SHIFT_
    (CTR_SUM_FAC_CYL_LAM_COR_
    C_CTR_SUM_FAC_CYL_LAM_OSC_
    then
        if(6) LV_FAC_CYL_LAM_COR_OSC[i] = 0
        then
            LV_FAC_CYL_LAM_COR_OSC[i] = 1
            (1.6.7)
        [Remark: the cylinder based Oscillation (index x)  
shall be assigned to the correspond-  
ing exhaust bank  
(index i)]
        if(7) CTR_PHA_SHIFT_AD_TRIG[i] <
            C_CTR_PHA_SHIFT_AD_TRIG_
            then

```

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```

                                increment(CTR_PHA_SHIFT_AD_TRIG[i])
                                (1.6.8)
                            endif(7)
                        endif(6)
                    endif(5)
                endif(4)
if(4)    [(CTR_SUM_FAC_CYL_LAM_COR_OSC[x] =
                                C_CTR_SUM_FAC_CYL_LAM_OSC_
MAX) and
                                LV_FAC_CYL_LAM_COR_OSC[i]
= 0]
    then
        CTR_SUM_FAC_CYL_LAM_COR_OSC[x] = 0
        (1.6.9)
        LV_FAC_CYL_LAM_OSC_MIN_THD[x] = 0
        (1.6.10)
        LV_FAC_CYL_LAM_OSC_MAX_THD[x] = 0
        (1.6.11)
    endif(4)

```

### 7.74.8 Detection of Cylinder Individual lambda Control Instability - based on CILC- controller output:


For detection of unstable state of CILC the controller output of adjacent cylinders are considered. Should two of the cylinders be at the opposite limit and a drift-away behaviour of cylinder individual lambda control be detected, thus the unstable behaviour of CILC is assumed.

```

if(4)    [(LV_FAC_CYL_LAM_LIM_MIN[x] = 1
                                and LV_FAC_CYL_LAM_LIM_MAX[x+1]
= 1) or
                                (LV_FAC_CYL_LAM_LIM_MAX[x]
= 1 and
                                LV_FAC_CYL_LAM_LIM_MIN[x+1]
= 1)} and
                                LV_LAM_CYL_SEL_CTL_DRIFT_
PRED[i] = 1]
late to the in succession
haust bank]
    then
        if(5)    LV_FAC_CYL_LAM_COR_LIM_OSC[i] = 0
        then
            LV_FAC_CYL_LAM_COR_LIM_OSC[i] = 1
            (1.7.1)
            [Remark: the cylinder based Oscillation (index x) shall be
            assigned to the corresponding exhaust bank (index i)]
            if(6)    CTR_PHA_SHIFT_AD_TRIG[i] <
                                C_CTR_PHA_SHIFT_AD_TRIG_
THD
                                then
                                    increment(CTR_PHA_SHIFT_AD_TRIG[i])
                                    (1.7.2)

```

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```

                endif(6)
            endif(5)
        else(4)
            LV_FAC_CYL_LAM_COR_LIM_OSC[i] = 0
                (1.7.3)
        endif(4)
    
```


### 7.74.9 Detection of Cylinder Individual lambda Control Instability - based on CILC - Characteristic Quantity:

For detection of unstable state of CILC the value of Characteristic Quantity (CQ) is considered (LC\_CRK\_DELTA\_CQ\_SWI = 1).

```

        elseif(3)      (LC_CRK_DELTA_CQ_SWI = 1 and
                                LV_ER_ABSV_SUM_GRD_RISE[i]
= 0)
        then
            increment      CTR_CQ_MON_PHA_SHIFT_AD[i]
                                (1.8.1)
            if(4)      DELTA_LAMB_CYL_SEL_CQ_FIL[i]
                                C_DELTA_LAMB_CYL_SEL_CQ_
AD_THD
        then
            if(5)      LV_FAC_CYL_LAM_COR_OSC[i] = 0
            then
                increment      CTR_CQ_MAX_OSC[i]
                                (1.8.2)
            endif(5)
            if(5)      [(CTR_CQ_MAX_OSC[i] =
                                C_CTR_CQ_MIN_PHA_SHIFT_AD)
                                (CTR_CQ_MON_PHA_SHIFT_AD[i]
                                <
                                C_CTR_CQ_MON_PHA_SHIFT_
AD_MAX)]
        and
        <
        AD_MAX)]
        then
            if(6)      LV_FAC_CYL_LAM_COR_OSC[i] = 0
            then
                LV_FAC_CYL_LAM_COR_OSC[i] = 1
                                (1.8.3)
            if(7)      CTR_PHA_SHIFT_AD_TRIG[i] <
                                C_CTR_PHA_SHIFT_AD_TRIG_
THD
        then
            increment(CTR_PHA_SHIFT_AD_TRIG[i])
                                (1.8.4)
        endif(7)
    endif(6)
endif(5)
endif(4)
if(4)      CTR_CQ_MON_PHA_SHIFT_AD[i] =
                                C_CTR_CQ_MON_PHA_SHIFT_
AD_MAX
    
```

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```

then
    CTR_CQ_MON_PHA_SHIFT_AD[i] = 0
                                (1.8.5)
    if(5)    LV_FAC_CYL_LAM_COR_OSC[i] = 0
    then
        CTR_CQ_MAX_OSC[i] = 0
                                (1.8.6)
    endif(5)
endif(4)

endif(3)

```

### 7.74.10 Detection of Cylinder Individual lambda Control Instability - based on engine roughness:

```

if(3)    (LV_FAC_CYL_LAM_COR_OSC[i] = 0 and
= 0)    LV_FAC_CYL_LAM_COR_LIM_OSC[i]
    then
        if(4)    LV_ER_ABSV_SUM_GRD_RISE[i] = 0
        then
            if(5)    (ER_STND_MMV_DIF_ABSV_SUM_GRD[i] >
CRK_CHG and    C_ER_ABSV_GRD_RISE_THD_
>    FAC_CYL_LAM_ABSV_SUM_GRD[i]
RISE_THD)    C_FAC_CYL_LAM_ABSV_GRD_
            then
                LV_ER_ABSV_SUM_GRD_RISE[i] = 1
                                (1.9.1)
                FAC_CYL_LAM_ABSV_SUM_PRE[i] =
                                FAC_CYL_LAM_ABSV_SUM[i]
                                (1.9.2)
                if(6)    CTR_PHA_SHIFT_AD_TRIG[i] <
THD    C_CTR_PHA_SHIFT_AD_TRIG_
            then
                increment(CTR_PHA_SHIFT_AD_TRIG[i])
                                (1.9.3)
            endif(6)
        endif(5)
    endif(4)
endif(3)
endif(2)
endif(1)

```

### 7.74.11 Adaptation start

```

if(1)    (SEG_NR = 0 [calculation for exhaust bank 1] or
SEG_NR = C_NR_SEG_REF_CBK_
EX_2 [calculation for exhaust bank 2])
then

```

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```

if(2)      [(STATE_DELTA_CRK_CYL_LAM[i] = 1 'AD_ACT' or
STATE_DELTA_CRK_CYL_LAM[i]
= 6 'AD_HOLD') and
(LV_FAC_CYL_LAM_COR_OSC[i]
= 1 or
LV_FAC_CYL_LAM_COR_LIM_OSC[i]
= 1) and
LV_ER_ABSV_SUM_GRD_RISE[i]
= 1) and
CTR_PHA_SHIFT_AD_TRIG[i] =
C_CTR_PHA_SHIFT_AD_TRIG_THD]
then
STATE_DELTA_CRK_CYL_LAM[i] = 2 'AD_CDN'
(1.10.1)
endif(2)

if(2)      (STATE_DELTA_CRK_CYL_LAM[i] = 2 'AD_CDN' and
LV_STATE_DELTA_CRK_WAIT[i]
= 0 and STATE_LAM_CYL_SEL[i] = 3)
[calculation is exhaust bank selec-
tive]
then
STATE_DELTA_CRK_CYL_LAM[i] = 3 'AD_INI'
(1.10.2)
CTR_RESP_CYC_LAM_CYL_SEL[i] =
C_CTR_RESP_CYC_MIN_LAM_
CYL_SEL (1.10.3)
FAC_CYL_LAM_SAVE[x] = FAC_CYL_LAM[x]
(1.10.4)
if(3)      LV_ER_ABSV_SUM_GRD_RISE[i] = 1
then
CTR_RESP_LAM_CYL_SEL[i] =
C_CTR_ER_RESP_MIN_LAM_CYL_
SEL
(1.10.5)
else(3)
CTR_RESP_LAM_CYL_SEL[i] = C_CTR_RESP_MIN_LAM_CYL_SEL
(1.10.6)
endif(3)
CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] = 0
(1.10.7)
CTR_CQ_FIL_FALL[i] = 0
(1.10.8)
endif(2)
endif(1)

```

### 7.74.12 Evaluation of adaptation result

```


if(1)      STATE_LAM_CYL_SEL[i] = 3 [calculation is exhaust bank selective]
then
if(2)      (SEG_NR = 0 [calculation for exhaust bank 1] or
SEG_NR = C_NR_SEG_REF_CBK_
EX_2 [calculation for exhaust bank 2])
then

```

```

if(3)      (LC_CRK_DELTA_CQ_SWI = 0 and
= 0)
then
if(4)      (LV_STATE_DELTA_CRK_WAIT[i] = 1 and
= 1)
then
    decrement      CTR_RESP_LAM_CYL_SEL[i]
                    (1.11.1)
if(5)      CTR_RESP_LAM_CYL_SEL[i] = 0
then
    if(6)      [[abs(FAC_CYL_LAM_SAVE[x] -
                    FAC_CYL_LAM[x])
                    C_FAC_CYL_LAM_DIF_ABSV_MAX]
and
= 0)]
                    (LV_FAC_CYL_LAM_COR_LIM_OSC[i]
then
    increment
                    CTR_FAC_CYL_LAM_COR_DIF_
ABSV[i] (1.11.2)
endif(6)
[Remark: the counter
CTR_FAC_CYL_LAM_COR_DIF_ABSV[i]
shall be incremented only once provided that the
condition is fulfilled for all of the cylinders at the
concerned exhaust bank (AND-logical operator)]
CTR_RESP_LAM_CYL_SEL[i] =
SEL (1.11.3)
                    C_CTR_RESP_MIN_LAM_CYL_
                    FAC_CYL_LAM_SAVE[x] = FAC_CYL_LAM[x]
                    (1.11.4)
                    Decrement      CTR_RESP_CYC_LAM_CYL_SEL[i]
                    (1.11.5)
endif(5)
elseif(4)    (LV_STATE_DELTA_CRK_WAIT[i] = 1 and
= 0)
                    LV_FAC_CYL_LAM_COR_OSC[i]
then
    decrement      CTR_RESP_LAM_CYL_SEL[i]
                    (1.11.6)
if(5)      CTR_RESP_LAM_CYL_SEL[i] = 0
then
    if(6)      LV_FAC_CYL_LAM_COR_LIM_OSC[i] = 0
then
        increment
                    CTR_FAC_CYL_LAM_COR_DIF_
ABSV[i] (1.11.7)
endif(6)
CTR_RESP_LAM_CYL_SEL[i] =


```

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```

C_CTR_RESP_MIN_LAM_CYL_
SEL (1.11.8)
    FAC_CYL_LAM_SAVE[x] = FAC_CYL_LAM[x]
                                (1.11.9)
    decrement CTR_RESP_CYC_LAM_CYL_SEL[i]
                                (1.11.10)
    endif(5)
endif(4)
if(4) (LV_STATE_DELTA_CRK_WAIT[i] = 1 and
= 0) CTR_RESP_CYC_LAM_CYL_SEL[i]
    then
        CTR_RESP_CYC_LAM_CYL_SEL[i] =
CYL_SEL (1.11.11) C_CTR_RESP_CYC_MIN_LAM_
if(5) CTR_FAC_CYL_LAM_COR_DIF_ABSV[i]
OK C_CTR_FAC_CYL_LAM_DIF_ABSV_
    then
        LV_FAC_CYL_LAM_COR_OSC[i] = 0
                                (1.11.12)
        LV_FAC_CYL_LAM_OSC_MAX_THD[x] = 0
                                (1.11.13)
        LV_FAC_CYL_LAM_OSC_MIN_THD[x] = 0
                                (1.11.14)
        LV_STATE_DELTA_CRK_WAIT[i] = 0
                                (1.11.15)
        CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] = 0
                                (1.11.16)
        STATE_DELTA_CRK_CYL_LAM[i] = 6 'AD_HOLD'
                                (1.11.17)
        CRK_CHG_FAC_PHA_SHIFT_AD[i] = 1
                                (1.11.18)
        if(6) C_CRK_CYL_LAM_DELTA_INI > 0
            then
                CRK_CYL_LAM_DELTA_INI[i] =
                    CRK_CYL_LAM_DELTA_INI[i] -
                    C_CRK_CYL_LAM_INI_RED (1.11.19)
                if(7) CRK_CYL_LAM_DELTA_INI[i] < 0
                    then
                        CRK_CYL_LAM_DELTA_INI[i] = 0
                                (1.11.20)
                    endif(7)
                else(6)
                    CRK_CYL_LAM_DELTA_INI[i] =
                        CRK_CYL_LAM_DELTA_INI[i] +
                        C_CRK_CYL_LAM_INI_RED (1.11.21)
                    if(7) CRK_CYL_LAM_DELTA_INI[i] > 0
                        then
                            CRK_CYL_LAM_DELTA_INI[i] = 0
                                (1.11.22)
                        endif(7)
                    endif(6)
            endif(6)
    endif(5)
endif(4)

```

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OK) and  
ABSV[i]  
MIN]

```

elseif(5) [(CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] <
C_CTR_FAC_CYL_LAM_DIF_ABSV_
CTR_FAC_CYL_LAM_COR_DIF_
C_CTR_FAC_CYL_LAM_DIF_ABSV_

then
LV_STATE_DELTA_CRK_WAIT[i] = 1
(1.11.23)
CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] = 0
(1.11.24)

```

MIN)

```

elseif(5) (CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] <
C_CTR_FAC_CYL_LAM_DIF_ABSV_

then
LV_STATE_DELTA_CRK_WAIT[i] = 0
(1.11.25)
CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] = 0
(1.11.26)
if(6) STATE_DELTA_CRK_CYL_LAM[i] = 3 'AD_INI'
then
STATE_DELTA_CRK_CYL_LAM[i] = 4 'AD_DEC'
(1.11.27)
elseif(6) STATE_DELTA_CRK_CYL_LAM[i] = 4
'AD_DEC'
then
STATE_DELTA_CRK_CYL_LAM[i] = 5 'AD_INC'
(1.11.28)
elseif(6) STATE_DELTA_CRK_CYL_LAM[i] = 5
'AD_INC'
then
STATE_DELTA_CRK_CYL_LAM[i] = 4 'AD_DEC'
(1.11.29)
endif(6)
endif(5)
endif(4)

```

= 0)

```

elseif(3) (LC_CRK_DELTA_CQ_SWI = 1 and
LV_ER_ABSV_SUM_GRD_RISE[i]

```

= 1)


```

then
if(4) (LV_STATE_DELTA_CRK_WAIT[i] = 1 and
LV_FAC_CYL_LAM_COR_OSC[i]

then
decrement CTR_RESP_LAM_CYL_SEL[i]
(1.11.30)
if(5) CTR_RESP_LAM_CYL_SEL[i] = 0
then
if(6) DELTA_LAMB_CYL_SEL_CQ_FIL[i] <

```

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```

C_DELTA_LAMB_CYL_SEL_CQ_
AD_THD
    then
        increment      CTR_CQ_FIL_FALL[i]
                        (1.11.31)
    endif(6)
    CTR_RESP_LAM_CYL_SEL[i] =
        C_CTR_RESP_MIN_LAM_CYL_
SEL (1.11.32)
        FAC_CYL_LAM_SAVE[x] = FAC_CYL_LAM[x]
                        (1.11.33)
        Decrement      CTR_RESP_CYC_LAM_CYL_SEL[i]
                        (1.11.34)
    endif(5)
endif(4)

if(4)      (LV_STATE_DELTA_CRK_WAIT[i] = 1 and
= 0)      CTR_RESP_CYC_LAM_CYL_SEL[i]
    then
        CTR_RESP_CYC_LAM_CYL_SEL[i] =
CYL_SEL (1.11.35)
        C_CTR_RESP_CYC_MIN_LAM_
        if(5)      CTR_CQ_FIL_FALL[i] C_CTR_CQ_FIL_FALL_OK
        then
            LV_FAC_CYL_LAM_COR_OSC[i] = 0
                        (1.11.36)
            LV_STATE_DELTA_CRK_WAIT[i] = 0
                        (1.11.37)
            CTR_CQ_FIL_FALL[i] = 0
                        (1.11.38)
            STATE_DELTA_CRK_CYL_LAM[i] = 6 'AD_HOLD'
                        (1.11.39)
            CRK_CHG_FAC_PHA_SHIFT_AD[i] = 1
                        (1.11.40)
            if(6)      C_CRK_CYL_LAM_DELTA_INI > 0
            then
                CRK_CYL_LAM_DELTA_INI[i] =
                    CRK_CYL_LAM_DELTA_INI[i] -
                    C_CRK_CYL_LAM_INI_RED (1.11.41)
                if(7)      CRK_CYL_LAM_DELTA_INI[i] < 0
                then
                    CRK_CYL_LAM_DELTA_INI[i] = 0
                        (1.11.42)
                endif(7)
            else(6)
                CRK_CYL_LAM_DELTA_INI[i] =
                    CRK_CYL_LAM_DELTA_INI[i] +
                    C_CRK_CYL_LAM_INI_RED (1.11.43)
                if(7)      CRK_CYL_LAM_DELTA_INI[i] > 0
                then
                    CRK_CYL_LAM_DELTA_INI[i] = 0
                        (1.11.44)

```

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```

                                endif(7)
                                endif(6)
elseif(5)    [(CTR_CQ_FIL_FALL[i] <
                                C_CTR_CQ_FIL_FALL_OK) and
                                CTR_CQ_FIL_FALL[i] < C_CTR_
CQ_FIL_FALL_MIN]
                                then
                                LV_STATE_DELTA_CRK_WAIT[i] = 1
                                                                (1.11.-)
                                CTR_CQ_FIL_FALL[i] = 0
                                                                (1.11.46)

elseif(5)    (CTR_CQ_FIL_FALL[i] <
                                C_CTR_CQ_FIL_FALL_MIN)
                                then
                                LV_STATE_DELTA_CRK_WAIT[i] = 0
                                                                (1.11.47)
                                CTR_CQ_FIL_FALL[i] = 0
                                                                (1.11.48)
                                if(6)    STATE_DELTA_CRK_CYL_LAM[i] = 3 'AD_INI'
                                then
                                STATE_DELTA_CRK_CYL_LAM[i] = 4 'AD_DEC'
                                                                (1.11.49)
                                elseif(6)    STATE_DELTA_CRK_CYL_LAM[i] = 4
                                'AD_DEC'
                                then
                                STATE_DELTA_CRK_CYL_LAM[i] = 5 'AD_INC'
                                                                (1.11.50)
                                elseif(6)    STATE_DELTA_CRK_CYL_LAM[i] = 5
                                'AD_INC'
                                then
                                STATE_DELTA_CRK_CYL_LAM[i] = 4 'AD_DEC'
                                                                (1.11.51)
                                endif(6)
                                endif(5)
                                endif(4)
elseif(3)    LV_ER_ABSV_SUM_GRD_RISE[i] = 1
                                then
                                if(4)    LV_STATE_DELTA_CRK_WAIT[i] = 1
                                then
                                decrement    CTR_RESP_LAM_CYL_SEL[i]
                                                                (1.11.52)
                                if(5)    CTR_RESP_LAM_CYL_SEL[i] = 0
                                then
                                ER_STND_MMV_DIF_ABSV_SUM_PRE[i] =
                                                                ER_STND_MMV_DIF_BAL_ABSV_
SUM[i] (1.11.53)

```

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ER\_STND\_MMV\_DIF\_BAL\_ABSV\_SUM[i] =

$$\sum_{x=1}^{\alpha} |ER\_STND\_MMV\_DIF\_BAL[x]|$$

$\alpha$ : nr. of cylinders per bank

**(1.11.54)**

[Remark: the cylinder based variables (index x) shall be assigned to the corresponding exhaust bank (index i)]

ER\_STND\_MMV\_DIF\_ABSV\_SUM\_GRD[i] =  
ER\_STND\_MMV\_DIF\_BAL\_ABSV\_  
SUM[i] -  
ER\_STND\_MMV\_DIF\_ABSV\_SUM\_  
PRE[i] **(1.11.55)**

FAC\_CYL\_LAM\_ABSV\_SUM\_GRD[i] =  
FAC\_CYL\_LAM\_ABSV\_SUM[i] -  
FAC\_CYL\_LAM\_ABSV\_SUM\_PRE[i]  
**(1.11.56)**

FAC\_CYL\_LAM\_ABSV\_SUM\_PRE[i] =  
FAC\_CYL\_LAM\_ABSV\_SUM[i] **(1.11.57)**

**if**<sup>(6)</sup> (ER\_STND\_MMV\_DIF\_ABSV\_SUM\_GRD[i]  
C\_ER\_ABSV\_GRD\_FALL\_THD\_  
CRK\_CHG and  
FAC\_CYL\_LAM\_ABSV\_SUM\_GRD[i]  
C\_FAC\_CYL\_LAM\_ABSV\_GRD\_  
FALL\_THD)

**then**

LV\_ER\_ABSV\_SUM\_GRD\_RISE[i] = 0  
**(1.11.58)**

LV\_STATE\_DELTA\_CRK\_WAIT[i] = 0  
**(1.11.59)**

STATE\_DELTA\_CRK\_CYL\_LAM[i] = 6 'AD\_HOLD'  
**(1.11.60)**

CRK\_CHG\_FAC\_PHA\_SHIFT\_AD[i] = 1  
**(1.11.61)**

**if**<sup>(7)</sup> C\_CRK\_CYL\_LAM\_DELTA\_INI > 0  
**then**

CRK\_CYL\_LAM\_DELTA\_INI[i] =  
CRK\_CYL\_LAM\_DELTA\_INI[i] -  
C\_CRK\_CYL\_LAM\_INI\_RED **(1.11.62)**

**if**<sup>(8)</sup> CRK\_CYL\_LAM\_DELTA\_INI[i] < 0  
**then**

CRK\_CYL\_LAM\_DELTA\_INI[i] = 0  
**(1.11.63)**

**endif**<sup>(8)</sup>

**else**<sup>(7)</sup>  
CRK\_CYL\_LAM\_DELTA\_INI[i] =  
CRK\_CYL\_LAM\_DELTA\_INI[i] +

```

                                C_CRK_CYL_LAM_INI_RED (1.11.64)
                                CRK_CYL_LAM_DELTA_INI[i] > 0
                                then
                                CRK_CYL_LAM_DELTA_INI[i] = 0
                                (1.11.65)
                                endif(8)
                                endif(7)

                                else(6)
                                LV_STATE_DELTA_CRK_WAIT[i] = 0
                                (1.11.66)
                                if(7)
                                STATE_DELTA_CRK_CYL_LAM[i] = 3
                                'AD_INI'

                                then
                                STATE_DELTA_CRK_CYL_LAM[i] = 4
                                'AD_DEC' (1.11.67)
                                elseif(7)
                                STATE_DELTA_CRK_CYL_LAM[i] =
                                4 'AD_DEC'

                                then
                                STATE_DELTA_CRK_CYL_LAM[i] = 5
                                'AD_INC' (1.11.68)
                                elseif(7)
                                STATE_DELTA_CRK_CYL_LAM[i] =
                                5 'AD_INC'

                                then
                                STATE_DELTA_CRK_CYL_LAM[i] = 4
                                'AD_DEC' (1.11.69)
                                endif(7)
                                CTR_RESP_LAM_CYL_SEL[i] =
                                C_CTR_ER_RESP_MIN_LAM_CYL_
                                SEL (1.11.70)
                                endif(6)
                                endif(5)
                                endif(4)
                                endif(3)
                                endif(2)
                                endif(1)

```


## 7.74.13 Control action

### 7.74.13.1 Initial-action

```

if(1)
STATE_LAM_CYL_SEL[i] = 3 [calculation is exhaust bank selective]
then
if(2)
(SEG_NR = 0 [calculation for exhaust bank 1] or
SEG_NR = C_NR_SEG_REF_CBK_
EX_2 [calculation for exhaust bank 2]
then
if(3)
LV_STATE_DELTA_CRK_WAIT[i] = 0
then
if(4)
STATE_DELTA_CRK_CYL_LAM[i] = 3 'AD_INI'
then
CRK_CYL_LAM_INT[i]k = CRK_CYL_LAM_INT[i]k-1 +
CRK_CYL_LAM_DELTA_INI[i] (1.12.1.1)
LV_STATE_DELTA_CRK_WAIT[i] = 1

```

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(1.12.1.2)

7.74.13.2 Recursive decrement-action

```

elseif(4)      STATE_DELTA_CRK_CYL_LAM[i] = 4 'AD_DEC'
then
    if(5)      CRK_CYL_LAM_DELTA_INI[i] ≥ 0
    then
        CRK_CYL_LAM_INT[i]k = CRK_CYL_LAM_INT[i]k-1 -
            (CRK_CHG_FAC_PHA_SHIFT_AD[i]*
             C_CRK_CHG_STEP +
             CRK_CYL_LAM_DELTA_INI[i]) (1.12.2.1)
    else(5)
        CRK_CYL_LAM_INT[i]k = CRK_CYL_LAM_INT[i]k-1 -
            (CRK_CYL_LAM_DELTA_INI[i] -
             CRK_CHG_FAC_PHA_SHIFT_AD[i]*
             C_CRK_CHG_STEP) (1.12.2.2)
    endif(5)
    CRK_CHG_FAC_PHA_SHIFT_AD[i] =
        CRK_CHG_FAC_PHA_SHIFT_AD[i]
+ 1 (1.12.2.3)
    LV_STATE_DELTA_CRK_WAIT[i] = 1
                                                (1.12.2.4)

```

7.74.13.3 Recursive increment-action

```

elseif(4)      STATE_DELTA_CRK_CYL_LAM[i] = 5 'AD_INC'
then
    if(5)      CRK_CYL_LAM_DELTA_INI[i] ≥ 0
    then
        CRK_CYL_LAM_INT[i]k = CRK_CYL_LAM_INT[i]k-1 +
            (CRK_CHG_FAC_PHA_SHIFT_AD[i]*
             C_CRK_CHG_STEP +
             CRK_CYL_LAM_DELTA_INI[i]) (1.12.3.1)
    else(5)
        CRK_CYL_LAM_INT[i]k = CRK_CYL_LAM_INT[i]k-1 +
            (CRK_CYL_LAM_DELTA_INI[i] -
             CRK_CHG_FAC_PHA_SHIFT_AD[i]*
             C_CRK_CHG_STEP) (1.12.3.2)
    endif(5)
    CRK_CHG_FAC_PHA_SHIFT_AD[i] =
        CRK_CHG_FAC_PHA_SHIFT_AD[i]
+ 1 (1.12.3.3)
    LV_STATE_DELTA_CRK_WAIT[i] = 1
                                                (1.12.3.4)

```

7.74.13.4 Hold-action

```

elseif(4)      STATE_DELTA_CRK_CYL_LAM[i] = 6 'AD_HOLD'
then
    CRK_CYL_LAM_INT[i]k = CRK_CYL_LAM_INT[i]k-1
                                                (1.12.4.1)
endif(4)
endif(3)

```

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**endif**<sup>(2)</sup>  
**endif**<sup>(1)</sup>

### 7.74.13.5 Calculation of the adaptation value

For application purpose the calculation of DELTA\_CRK\_CYL\_LAM[i] can be switched off using LC\_CRK\_CYL\_LAM\_DELTA\_OUT

```

if(1)      LC_CRK_CYL_LAM_DELTA_OUT = 1
then
    if(2)      (SEG_NR = 0 [calculation for exhaust bank 1] or
                SEG_NR = C_NR_SEG_REF_CBK_
                EX_2 [calculation for exhaust bank 2])
    then
        DELTA_CRK_CYL_LAM[i] = MINMAX (CRK_CYL_LAM_INT[i],
                                        C_DELTA_CRK_OUT_MIN,
                                        C_DELTA_CRK_OUT_MAX) (1.12.5.1)
    endif(2)
    if(2)      CRK_CYL_LAM_DELTA_INI[i] = 0
    then
        CRK_CYL_LAM_DELTA_INI[i] = C_CRK_CYL_LAM_DELTA_INI
        (1.12.5.2)
    endif(2)
else(1)
    DELTA_CRK_CYL_LAM[i] = 0
    (1.12.5.3)
    CRK_CYL_LAM_INT[i] = 0
    (1.12.5.4)
    CRK_CYL_LAM_DELTA_INI[i] = C_CRK_CYL_LAM_DELTA_INI
    (1.12.5.5)
    STATE_DELTA_CRK_CYL_LAM[i] = 0 'AD_PAS'
    (1.12.5.6)
    FAC_CYL_LAM_SAVE[x] = 0
    (1.12.5.7)
    LV_FAC_CYL_LAM_COR_OSC[i] = 0
    (1.12.5.8)
    LV_FAC_CYL_LAM_COR_LIM_OSC[i] = 0
    (1.12.5.9)
    LV_FAC_CYL_LAM_OSC_MAX_THD[x] = 0
    (1.12.5.10)
    LV_FAC_CYL_LAM_OSC_MIN_THD[x] = 0
    (1.12.5.11)
    LV_STATE_DELTA_CRK_WAIT[i] = 0
    (1.12.5.12)
    CTR_SUM_FAC_CYL_LAM_COR_OSC[x] = 0
    (1.12.5.13)
    CTR_CQ_MON_PHA_SHIFT_AD[i] = 0
    (1.12.5.14)
    CTR_CQ_MAX_OSC[i] = 0
    (1.12.5.15)
    CTR_RESP_LAM_CYL_SEL[i] = 0
    (1.12.5.16)
    CTR_RESP_CYC_LAM_CYL_SEL[i] = 0
    
```

```

CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] = 0 (1.12.5.17)
CTR_CQ_FIL_FALL[i] = 0 (1.12.5.18)
CTR_ER_MON_PHA_SHIFT_AD[i] = 0 (1.12.5.19)
CRK_CHG_FAC_PHA_SHIFT_AD[i] = 1 (1.12.5.20)
LV_DELTA_CRK_CYL_LAM_ERR[i] = 0 (1.12.5.21)
LV_ER_ABSV_SUM_GRD_RISE[i]= 0 (1.12.5.22)
ER_STND_MMV_DIF_BAL_ABSV_SUM[i]= 0 (1.12.5.23)
ER_STND_MMV_DIF_ABSV_SUM_PRE[i]= 0 (1.12.5.24)
ER_STND_MMV_DIF_ABSV_SUM_GRD[i]= 0 (1.12.5.25)
FAC_CYL_LAM_ABSV_SUM_PRE[i]= 0 (1.12.5.26)
FAC_CYL_LAM_ABSV_SUM_GRD[i]= 0 (1.12.5.27)
CTR_PHA_SHIFT_AD_TRIG[i]= 0 (1.12.5.28)

```

endif<sup>(1)</sup>

### 7.74.14 Error detection

```

if(1) (SEG_NR = 0 [calculation for exhaust bank 1] or
EX_2 [calculation for exhaust bank 2]
then
    if(2) (DELTA_CRK_CYL_LAM[i] = C_DELTA_CRK_OUT_MIN or
    DELTA_CRK_CYL_LAM[i] = C_DELTA_
    CRK_OUT_MAX or
    CRK_CHG_FAC_PHA_SHIFT_AD[i]
    = C_CRK_CHG_FAC_MAX)
    then
        LV_DELTA_CRK_CYL_LAM_ERR[i] = 1 (1.13.1)
        DELTA_CRK_CYL_LAM[i] = DELTA_CRK_CYL_LAM[i]LDC (1.13.2)
    endif(2)
endif(1)

```

### 7.74.15 Storing the adaptation value after power latch

The value of DELTA\_CRK\_CYL\_LAM[i] shall be stored in the non-volatile memory on following condition.

```

if(1) LV_DC 1 0
then
    if(2) LC_CRK_CYL_LAM_DELTA_OUT = 1

```

```

    then
        if(3) (LV_DELTA_CRK_CYL_LAM_ERR[i] = 0 and
            STATE_DELTA_CRK_CYL_LAM[i]
= 6 'AD_HOLD')
            then
                DELTA_CRK_CYL_LAM[i] = DELTA_CRK_CYL_LAM[i]CDC
(1.14.1)
            else(3)
                DELTA_CRK_CYL_LAM[i] = DELTA_CRK_CYL_LAM[i]LDC
(1.14.2)
            endif(3)
        else(2)
            DELTA_CRK_CYL_LAM[i] = 0
(1.14.3)
        endif(2)
    CDC: Current Driving Cycle
    LDC: Last Driving Cycle

```

### 7.74.16 Counter update in case of CILC stable

```

    if(2) (LV_FAC_CYL_LAM_COR_OSC[i] = 0 and
        LV_FAC_CYL_LAM_COR_LIM_OSC[i]
= 0 and
        LV_ER_ABSV_SUM_GRD_RISE[i]
= 0 and
        CTR_LAMB_CYL_SEL_CQ_DRIFT_
THD[i] = 0 and
        STATE_LAMB_CYL_SEL_CQ_SLOP[i]
= 0 and
        CTR_PHA_SHIFT_AD_TRIG[i] >
0)
        then
            decrement(CTR_PHA_SHIFT_AD_TRIG[i])
(1.15.1)
        endif(2)
    endif(1)

```

## 7.75 Cylinder balancing via lambda sensor (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA_DIF_BAS_CRK_CYL_LAM	V	F4C0... B40H	-180 ...180	0.0625	°CRK
Difference between basic ignition angle stored during calibration of IP_CRK_SYN and actual value					
LF_LS_CBK_EX_LAM_CYL_SEL_CONF	O/V	0... FFH	0... 255	1	-
Logical variables data field for allocation of physical cylinders to exhaust bank					
LV_LAM_CYL_DEAC_VIM	O/V	0... 1H	0 ...1	1	-
Deactivating flag for cilc after VIM- activity					
LV_LAM_CYL_ENA [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation of the cylinder individual lambda control is open					
LV_LAM_CYL_ENA_CYL_BAL_DC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Specific activation conditions for cylinder individual lambda control are fulfilled in DC (CYBL coordination)					
LV_LAM_CYL_SEL_ADJ_OFS_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Cylinder individual fuel mass offset correction requested					
LV_LAM_CYL_SEL_CTL_FAST_REQ	O/V	0... 1H	0 ...1	1	-
Fast cylinder individual lambda control requested					
LV_LS_CBK_LAM_CYL_SEL_CONF_VLD	V	0... 1H	0 ...1	1	-
Configuration pattern for allocation of physical cylinders to exhaust bank is valid (=1)					
LV_MFF_N_CDN_LAM_CYL_ENA [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Fuel mass- and engine speed condition for the activation of the cylinder individual lambda control fulfilled					
MFF_SP_LAM_CYL_SEL	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow setpoint used by cylinder individual lambda control					
PHA_SHIFT_CAM_EX [NC_CBK_EX_NR]	O/V	88... 78H	-720 ...720	6	°CRK
Variable phase shift (variable valve timing)					
STATE_CDN_LAM_CYL_SEL_ADJ_RNG [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H	OUT_OF_RNG LOW_RNG HIGH_RNG COLD_RNG	-	-
Condition- state of cylinder individual lambda adaptation					
T_LAM_CYL_DEAC_VIM	O/V	0... FFH	0... 25.5	0.1	s
Deactivating time for cilc after VIM activity					
TEMP_LAM_CYL_SEL	O/V	0... FEH	-48... 142.5	0.75	°C
Temperature relevant for the operation of cylinder individual lambda control					

### Input data:

AMP {p. 982}	C_CAM_OP_EX {p. 812}	C_MFF_LAM_CYL_ADJ_CST_MAX {p. 2735}	C_MFF_LAM_CYL_ADJ_CST_MIN {p. 2735}
C_MFF_MAX_FAC_CYL_SEL_ADJ_H_RNG {p. 2735}	C_MFF_MAX_FAC_CYL_SEL_ADJ_L_RNG {p. 2735}	C_MFF_MIN_FAC_CYL_SEL_ADJ_H_RNG {p. 2735}	C_MFF_MIN_FAC_CYL_SEL_ADJ_L_RNG {p. 2735}
C_N_LAM_CYL_ADJ_CST_MAX {p. 2735}	C_N_LAM_CYL_ADJ_CST_MIN {p. 2735}	C_N_MAX_FAC_CYL_SEL_ADJ_H_RNG {p. 2735}	C_N_MAX_FAC_CYL_SEL_ADJ_L_RNG {p. 2735}




C_N_MIN_FAC_CYL_SEL_ ADJ_H_RNG {p. 2735}	C_N_MIN_FAC_CYL_SEL_ ADJ_L_RNG {p. 2735}	C_TEMP_LAM_CYL_CST_ MAX {p. 2736}	C_TEMP_LAM_CYL_CST_ MIN {p. 2736}
C_TEMP_LAM_CYL_MIN {p. 2736}	CAM_EX [NC_NR_CBK_IVVT] {p. 8399}	CL_MMV {p. 3698}	FAC_MV_DIAG_DYN_ LSL_UP [NC_CBK_EX_NR] {p. 5346}
IGA_IGC_0_5_H_RNG {p. 1559}	LAMB_SP_HOM [NC_CBK_EX_NR] {p. 8340}	LV_CBK_MPL {p. 654}	LV_CL_MMV_CAL_ACT {p. 3699}
LV_CYL_BAL_LAM_SEL_ AD_COLD_EOL {p. 4043}	LV_CYL_BAL_LAM_SEL_ AD_HOT_EOL {p. 4043}	LV_ERR_CAM {p. 1505}	LV_ERR_CAM_EX [NC_NR_CAM_CBK] {p. 4455}
LV_ERR_CAM_IN [NC_NR_CAM_CBK] {p. 4455}	LV_ERR_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}	LV_ERR_CAT_DIAG_AFL [NC_CBK_EX_NR] {p. 5561}	LV_ERR_CAT_DIAG_SUM [NC_CBK_EX_NR] {p. 5535}
LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CPS {p. 1001}	LV_ERR_CRK {p. 4455}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_CYL_BAL_LAM [NC_CYL_NR] {p. 5112}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_EFPPWM_ PLAUS {p. 6050}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}
LV_ERR_FSD_H_RNG [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FTL_MIN {p. 4762}	LV_ERR_FUEL_TMP {p. 6468}
LV_ERR_FUP {p. 4717}	LV_ERR_FUP_EFP {p. 4733}	LV_ERR_FUP_EFP_LIH {p. 3822}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}
LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IGC {p. 4772}
LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_IVVT {p. 1062}	LV_ERR_L_PRS_SYS {p. 6050}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}
LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_ERR_MAF {p. 4815}	LV_ERR_MAF_FRQ_EL [NC_MAF_NR] {p. 4815}	LV_ERR_MAF_FRQ_GRD [NC_MAF_NR] {p. 4815}
LV_ERR_MAF_FRQ_RNG [NC_MAF_NR] {p. 4815}	LV_ERR_MAP_DIP_ PLAUS {p. 1062}	LV_ERR_MAP_DIP_SENS {p. 4824}	LV_ERR_MAP_DIP_SHIFT {p. 4824}
LV_ERR_MAP_PLAUS {p. 1062}	LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MIS_FTL_L {p. 6264}
LV_ERR_MIS_MPL {p. 6264}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_SEG_AD_ER {p. 4367}	LV_ERR_T_SEG_ER {p. 4367}
LV_ERR_TCHA_LEAK {p. 1062}	LV_ERR_TCHA_PRS_CTL {p. 1062}	LV_ERR_TCHA_PRS_DIF {p. 1063}	LV_ERR_TCHA_PRS_ HIGH {p. 1063}

LV_ERR_TCHA_PRS_LOW {p. 1063}	LV_ERR_TCO {p. 4496}	LV_ERR_TPS {p. 4982}	LV_ERR_TPS_AD {p. 4951}
LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_ST_CHK_1 {p. 4951}	LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}
LV_ERR_VCV {p. 4729}	LV_ERR_VCV_PLAUS {p. 6062}	LV_ERR_WG_DR [NC_CBK_EX_NR]	LV_FAC_LAM_LIM_MAX [NC_CBK_EX_NR] {p. 2463}
LV_FAC_LAM_LIM_MIN [NC_CBK_EX_NR] {p. 2463}	LV_HOM_ACT {p. 8136}	LV_IND_FCUT {p. 803}	LV_INH_BAL_CUS {p. 8187}
LV_INH_OBD_DIAG_CYL_BAL_LAM [NC_CBK_EX_NR] {p. 5113}	LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}	LV_LAM_AD_INJ_ACT {p. 3348}	LV_LAM_CYL_SEL_ADJ_OFS_EXT_REQ {p. 999}
LV_LAM_CYL_SEL_CTL_DRIFT_PRED [NC_CBK_EX_NR] {p. 2732}	LV_LAM_CYL_SEL_LDC [NC_CBK_EX_NR] {p. 2882}	LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LAMB_COP [NC_CBK_EX_NR] {p. 8233}
LV_MIS_STATE_A {p. 6238}	LV_MIS_STATE_B {p. 6238}	LV_TI_CYL_BAL_LAM_ACT {p. 4022}	LV_VAR_LSH_UP {p. 656}
LV_VAR_TCHA {p. 656}	LV_VIM_1 {p. 3622}	LV_VPLSL_LIM [NC_CBK_EX_NR] {p. 955}	MAF {p. 8277}
MFF_SP_HOM_BAS_MV {p. 2151}	MFF_SP_S_SWI_HOM {p. 8243}	N {p. 1525}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_LAMB_REF [NC_CYL_NR] {p. 812}	NC_MAF_NR {p. 834}
NC_NR_CAM_CBK {p. 1507}	NC_NR_CBK_IVVT {p. 604}	STATE_CAT_DIAG [NC_CBK_EX_NR] {p. 5474}	STATE_DYN_DIAG [NC_CBK_EX_NR] {p. 5349}
TCO {p. 1100}	TEG_CAT_UP_MDL [i] {p. 8236}	TEMP_CAPA_IV_MV {p. 2241}	TFU_IV {p. 1232}
WGPWM [NC_CBK_EX_NR] {p. 8140}			


**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_LAM_CYL_MIN	-	0... FFFFH	0... 5434	0.0829175	hPa
Minimum ambient pressure for the activation					
C_CL_MMV_LAM_CYL_MAX	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Maximum canister load					
C_FAC_MV_LS_UP_DYN_LAM_CYL_THD	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
CILC-specific threshold of limit-sensor					
C_LAMB_SP_HOM_LAM_CYL_MIN_NOM	-	0... 7FFFH	0... 1.99993896484	61.0352e-6	-
Minimum Lambda SP for activation - nominal					

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MFF_MAX_LAM_CYL_SEL_ADJ_ADD	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Upper fuel mass threshold for calculation of cylinder individual lambda adaptation in the additive area					
C_N_LAM_CYL_MAX_EOL	-	0... 1FE0H	0... 8160	1	rpm
Maximum engine speed for the activation at EOL					
C_N_LAM_CYL_MAX_NOM	-	0... 1FE0H	0... 8160	1	rpm
Maximum engine speed for the activation - nominal					
C_N_LAM_CYL_MIN_EOL	-	0... 1FE0H	0... 8160	1	rpm
Minimum engine speed for the activation at EOL					
C_N_LAM_CYL_MIN_NOM	-	0... 1FE0H	0... 8160	1	rpm
Minimum engine speed for the activation - nominal					
C_N_MAX_LAM_CYL_SEL_ADJ_ADD	-	0... 1FE0H	0... 8160	1	rpm
Upper engine speed threshold for calculation of cylinder individual lambda adaptation in the additive area					
C_T_LAM_CYL_DEAC_VIM	-	0... FFH	0... 25.5	0.1	s
Timer value for deactivating cilc after VIM activity					
C_TEG_CAT_UP_MDL_LAM_CYL_MAX	-	0... 7FF0H	0... 2047	0.0625	°C
Maximum exhaust gas temperature; engine out - alternative value for sensor hexagon temperature					
C_TEMP_IV_SWI_LAM_CYL_SEL	-	0... 2H	0 ...2	1	-
Manual switch for the injection-valve-temperature based cylinder individual lambda control					
C_WGPWM_MAX_LAM_CYL_SEL	-	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Maximum threshold of waste gate signal for activation of cylinder individual lambda control					
CLF_LS_CBK_EX_LAM_CYL_SEL_CONF	-	0... FFH	0... 255	1	-
Configuration pattern for allocation of physical cylinders to exhaust bank					
IP_CRK_DELTA_IGA_LAM_CYL_SEL	-	88... 78H	-720 ...720	6	°CRK
LDP_IGA_DIF_BAS_CYL_LAM_IP_CRK	8	0... 1680H	-180... 179.937	0.0624891	°CRK
Phase shift deviation caused by IGA difference					
IP_IGA_BAS_CRK_CYL_LAM	V	FA60... 5A0H	-90 ...90	0.0625	°CRK
LDPM_N_1_CYBL	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_CYBL	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic ignition angle stored during calibration of IP_CRK_SYN					
IP_MFF_LAM_CYL_MAX_EOL	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_3_CYBL	6	0... 1FE0H	0... 8160	1	rpm
Maximum fuel mass/engine speed threshold for the activation of cylinder individual lambda at EOL					
IP_MFF_LAM_CYL_MAX_NOM	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_4_CYBL	6	0... 1FE0H	0... 8160	1	rpm
Maximum fuel mass/engine speed threshold for the activation of cylinder individual lambda - nominal					
IP_MFF_LAM_CYL_MIN_EOL	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_3_CYBL	6	0... 1FE0H	0... 8160	1	rpm
Minimum fuel mass/engine speed threshold for the activation of cylinder individual lambda at EOL					
IP_MFF_LAM_CYL_MIN_NOM	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_4_CYBL	6	0... 1FE0H	0... 8160	1	rpm
Minimum fuel mass/engine speed threshold for the activation of cylinder individual lambda - nominal					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_LAM_CYL_ENA_CDN_MAN	-	0... 1H	0 ...1	1	-
Manual switch to enable the cylinder individual lambda control ignoring the conditions are fulfilled					
LC_LAM_CYL_SEL_ADJ_OFS_RNG_REQ	-	0... 1H	0 ...1	1	-
Manual request for calculation of cylinder individual lambda adaptation in the additive area (=1)					
LC_LAM_CYL_SEL_CTL_FAST_REQ_MAN	-	0... 1H	0 ...1	1	-
Manual switch for a fast cylinder individual lambda control (=1)					

## General Information

The module serves as a check box for application conditions of the function cylinder individual lambda control . If several conditions are fulfilled the flag LV\_LAM\_CYL\_ENA is set to 1. This flag is an input to the cylinder individual lambda control.

Description of index "[i]" and "[x]":

x: logical cylinder

use NC\_CYL\_NR: number of engine cylinders index "[x]"

use LF\_LS\_CBK\_EX\_LAM\_CYL\_SEL\_CONF: pattern for allocation of physical cylinders to exhaust bank index "[i]"

## Application Conditions


Initialization: RST

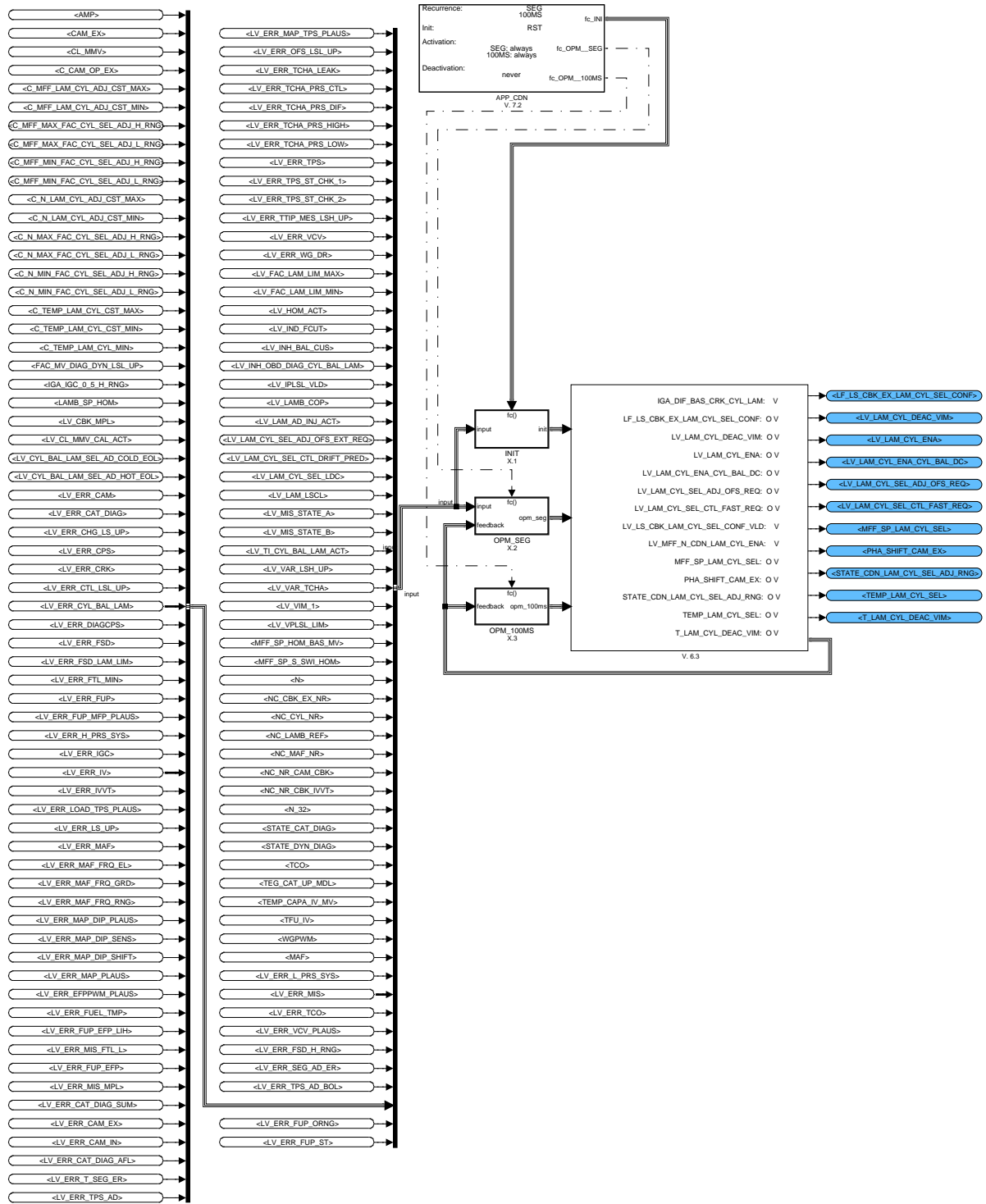
Activation: SEG: always

100MS: always

Deactivation: never

## Function description

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Figure 7.75.1: :

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## 7.75.1 Initialisation Overview

### 7.75.1.1 Initialisation at Reset

Check if CLF\_LS\_CBK\_EX\_LAM\_CYL\_SEL\_CONF is calibrated in a valid way (0 or NC\_LAMB\_REF). If not, LV\_LS\_CBK\_LAM\_CYL\_SEL\_CONF\_VLD indicates that the calibration is wrong and LV\_LAM\_CYL\_ENA[NC\_CBK\_EX\_NR] can not be set to 1.

So CILC is deactivated when calibration is wrong

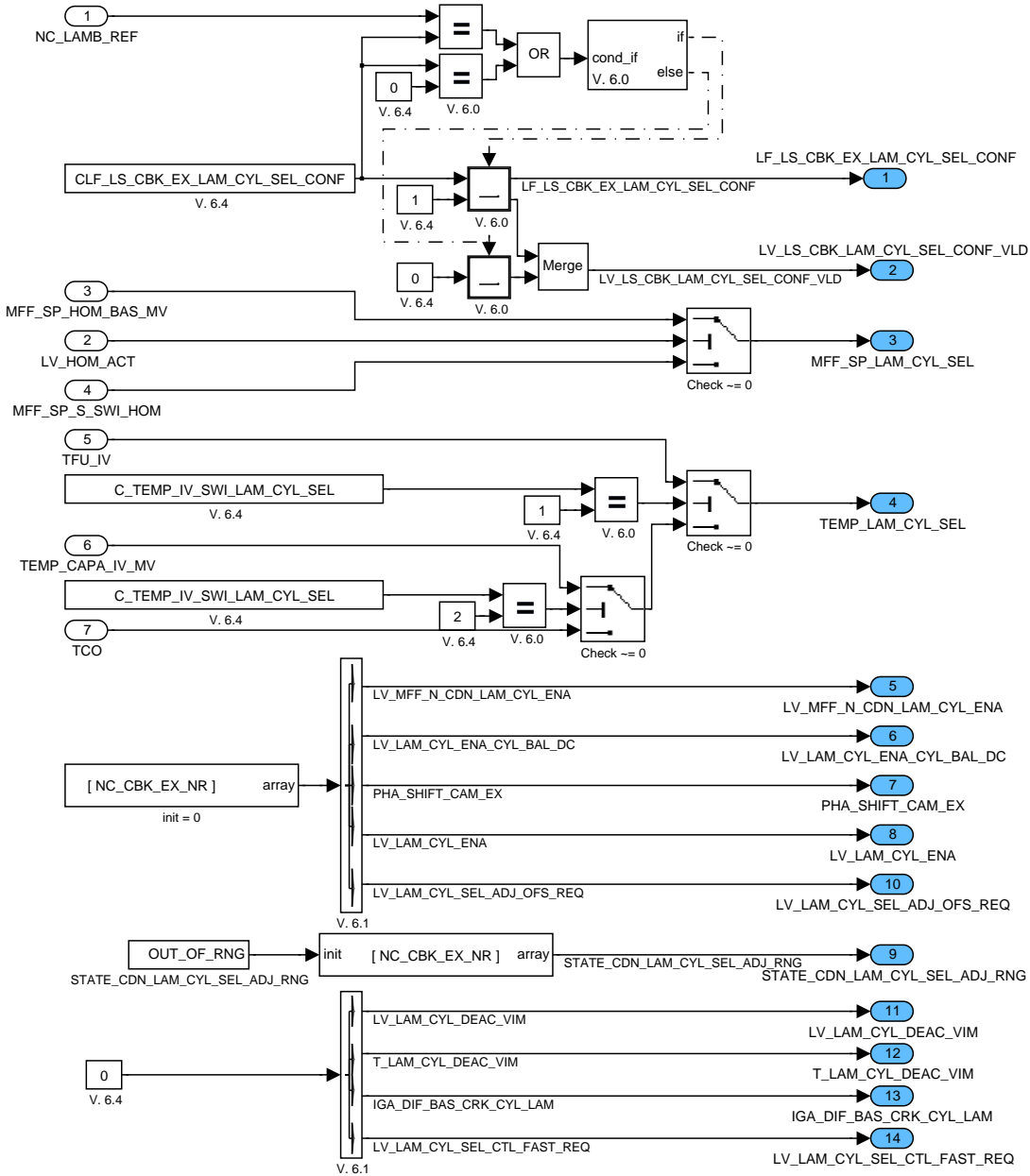


Figure 7.75.2: :

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## 7.75.2 Calculations at Segment recurrence

### 7.75.2.1 An Overview

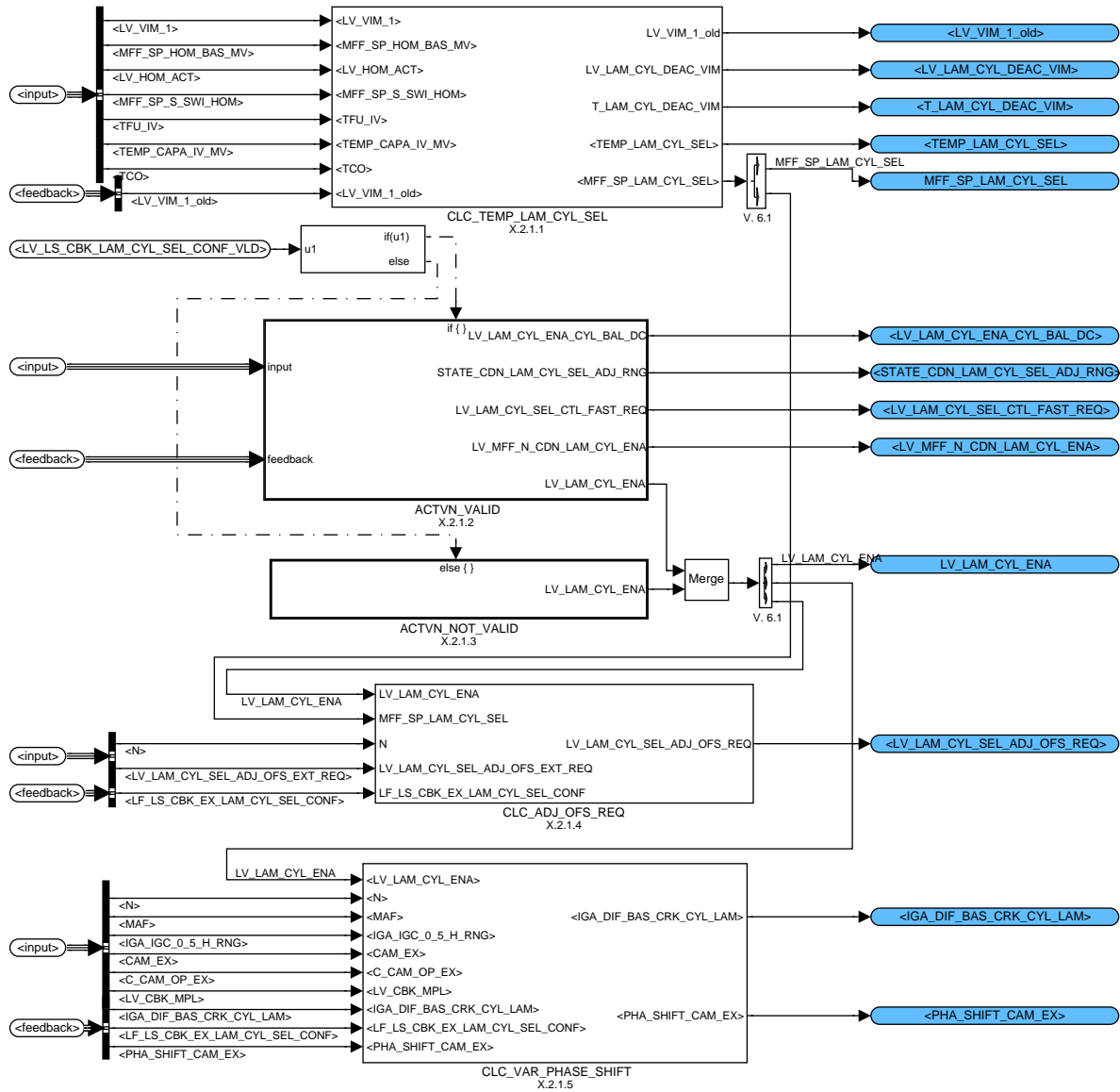


Figure 7.75.3: :

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### 7.75.2.1.1 Calculation of TEMP\_LAM\_CYL\_SEL

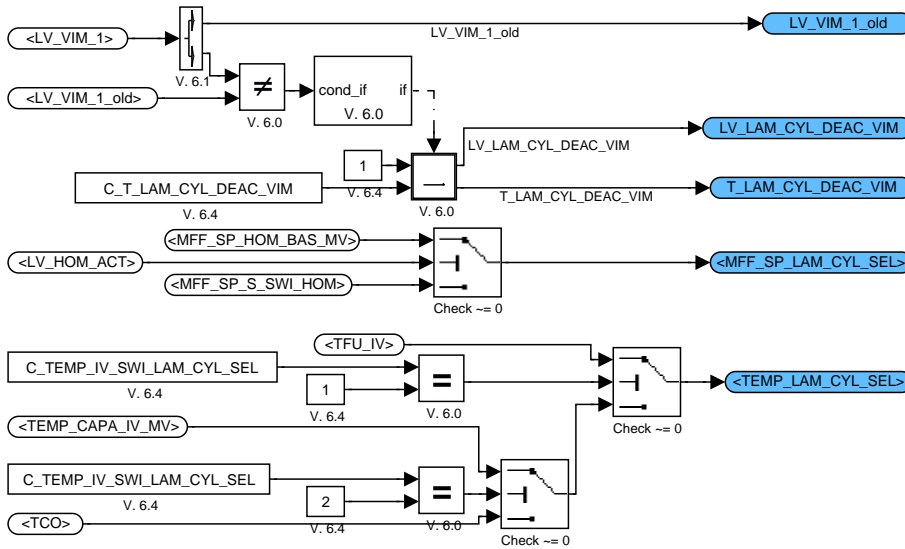


Figure 7.75.4: :

### 7.75.2.1.2 If Activation Valid

#### 7.75.2.1.2.1 Calculation of LV\_MFF\_N\_CDN\_LAM\_CYL\_ENA

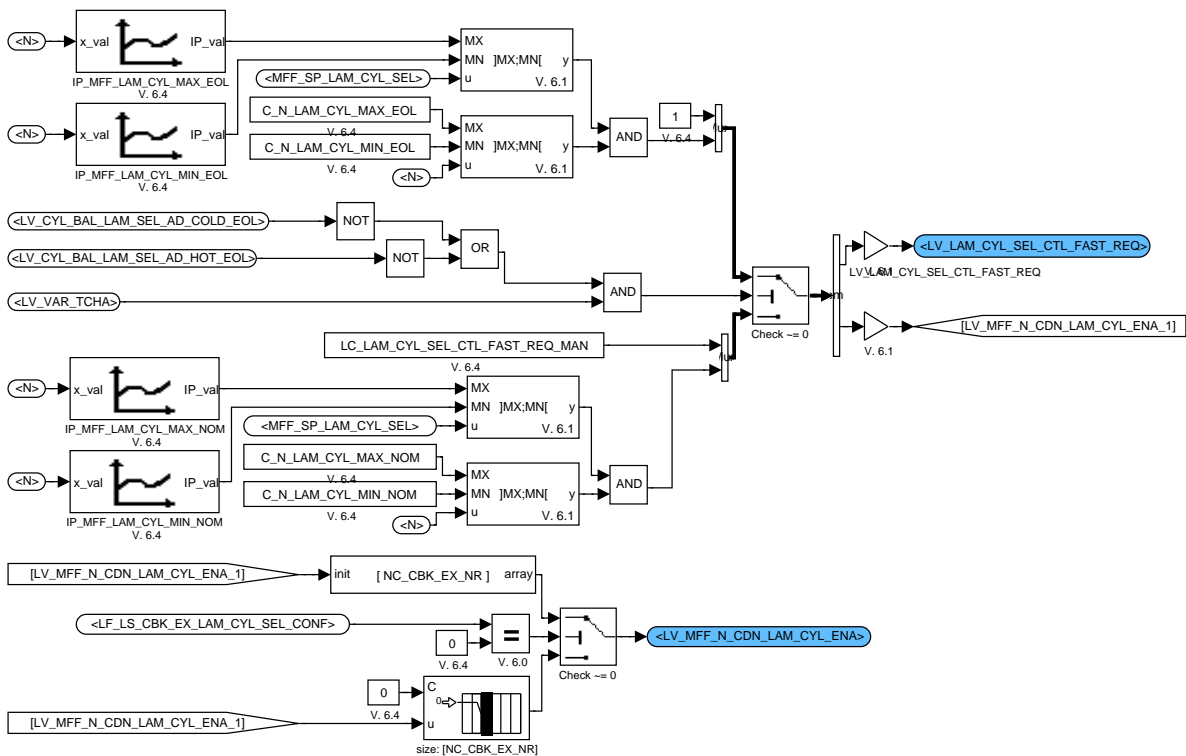


Figure 7.75.5: :

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### 7.75.2.1.2.2 Calculation of LV\_LAM\_CYL\_ENA\_CYL\_BAL\_DC

Remark:

- 1) Variables dependent on NC\_CYL\_NR shall be assigned to the corresponding exhaust bank (index i).
- 2) Every variable elements dependent on NC\_NR\_CAM\_CBK or NC\_MAF\_NR shall be assigned to all exhaust bank.

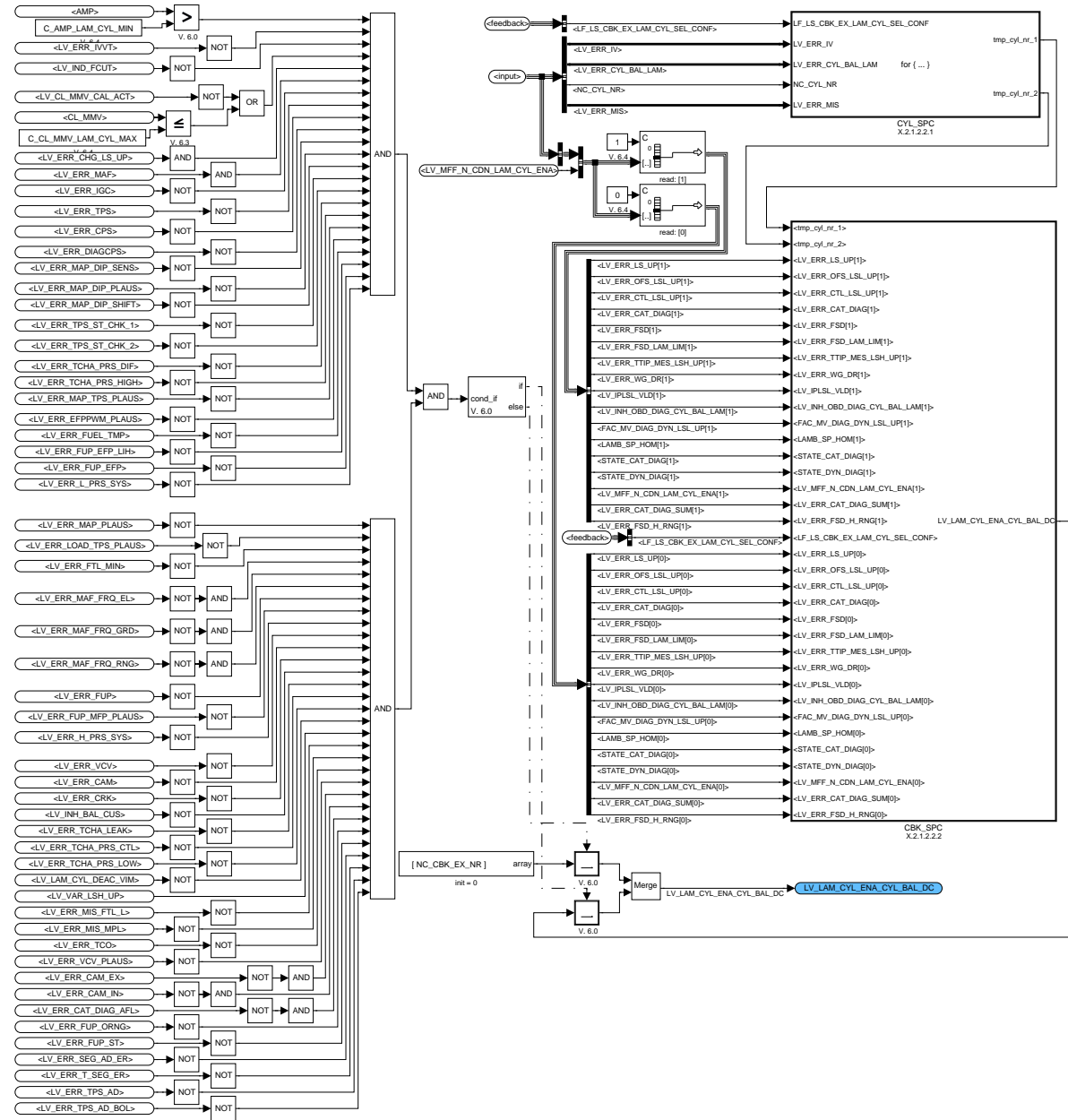


Figure 7.75.6: :

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### 7.75.2.1.2.2.1 Cylinder specific variables

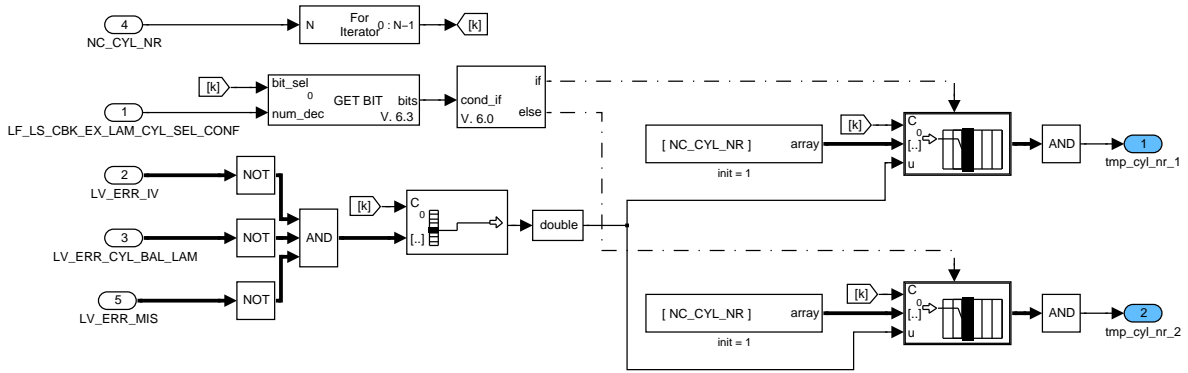


Figure 7.75.7: :

### 7.75.2.1.2.2.2 Bank specific variables

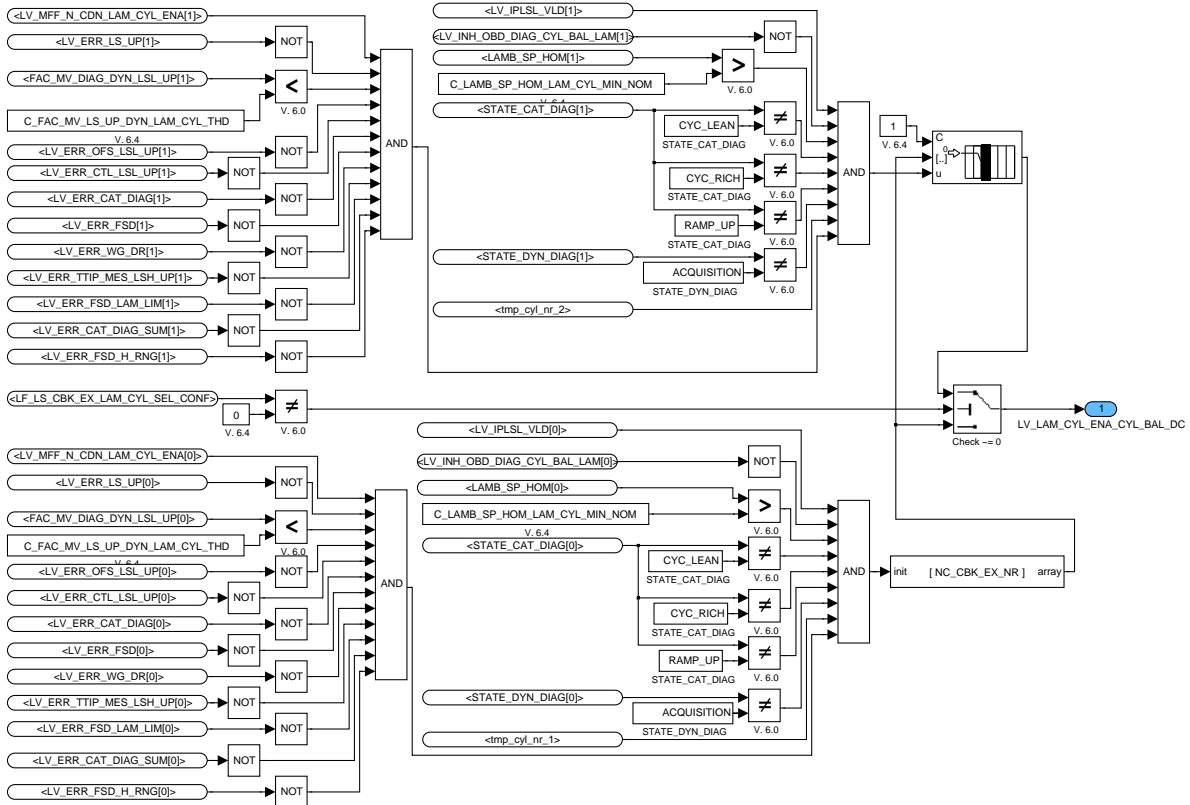


Figure 7.75.8: :

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### 7.75.2.1.2.3 Calculation of LV\_LAM\_CYL\_ENA

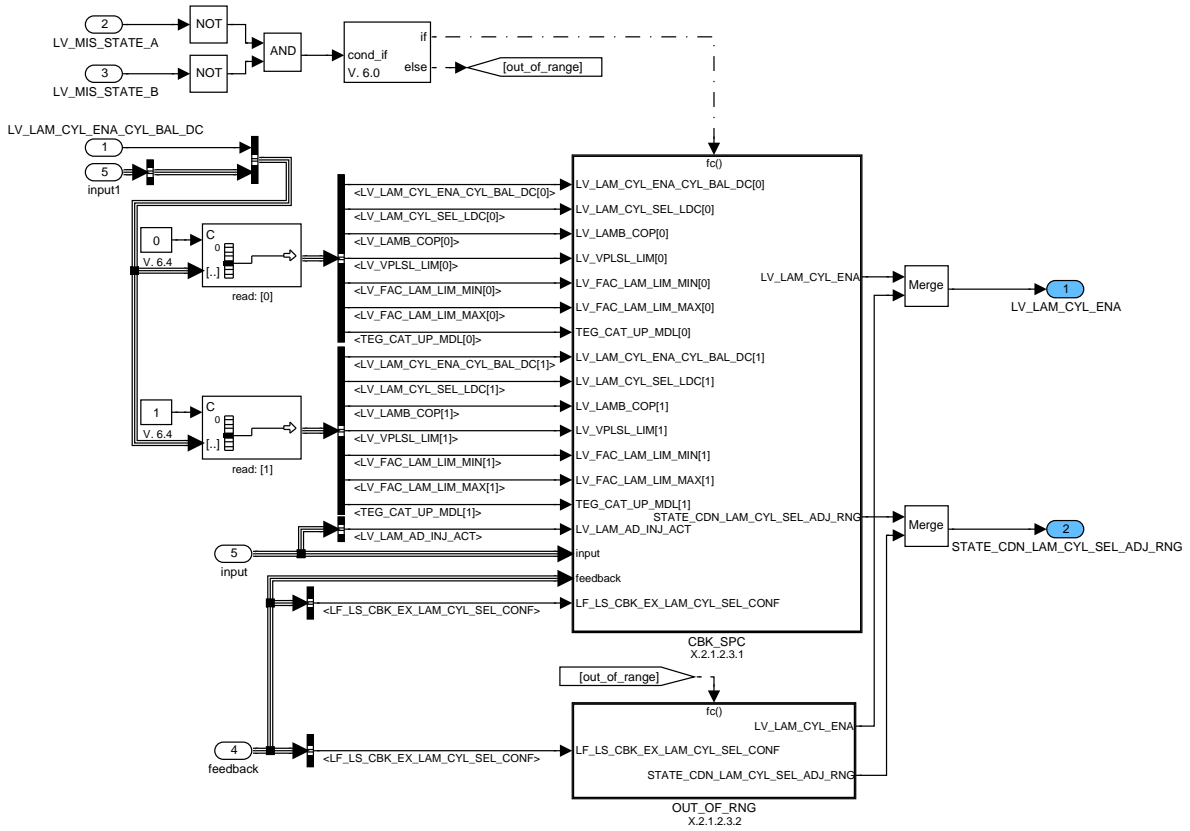


Figure 7.75.9: :

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### 7.75.2.1.2.3.1 Bank specific calculations

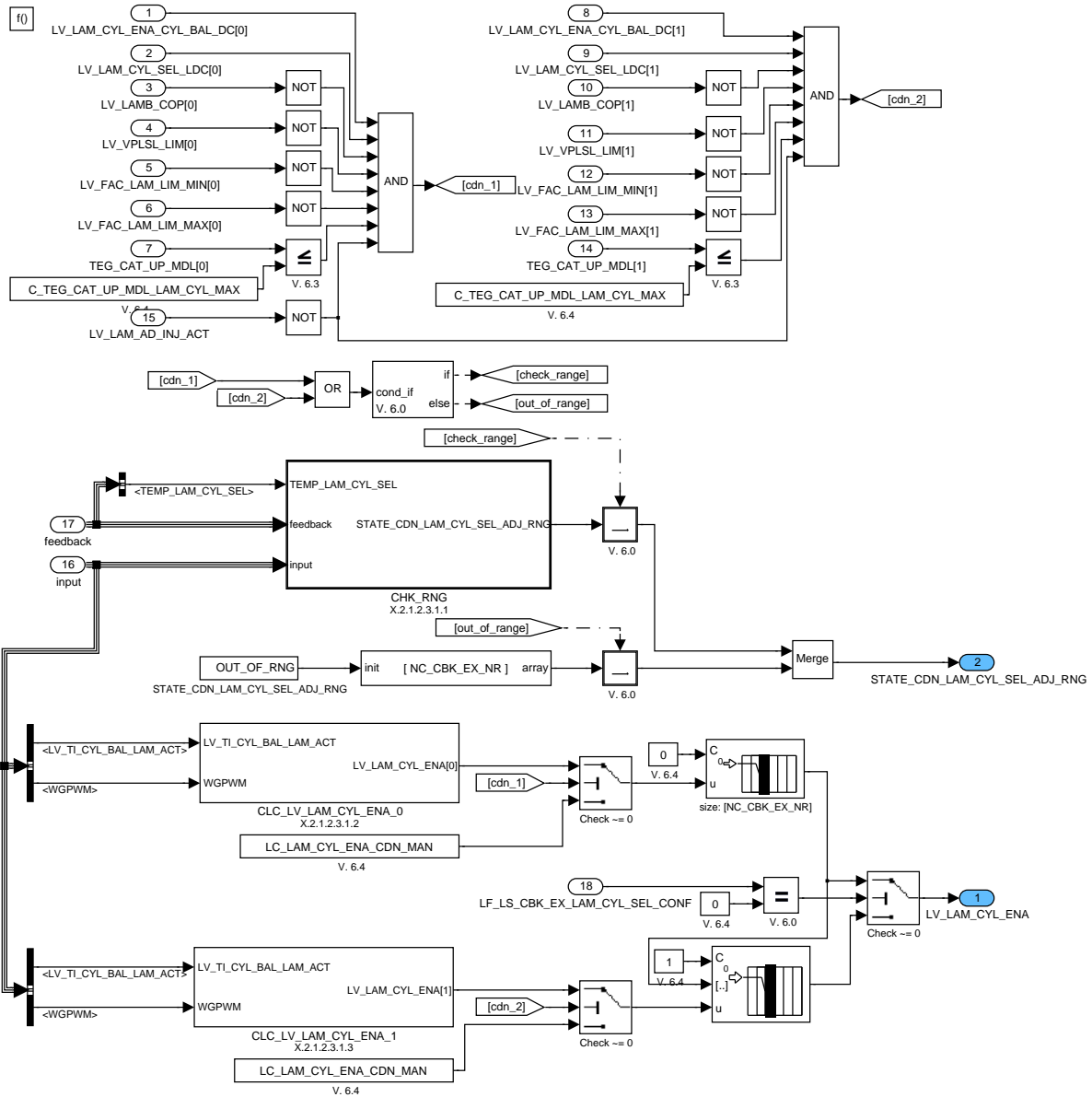


Figure 7.75.10 :

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### 7.75.2.1.2.3.1.1 Check range

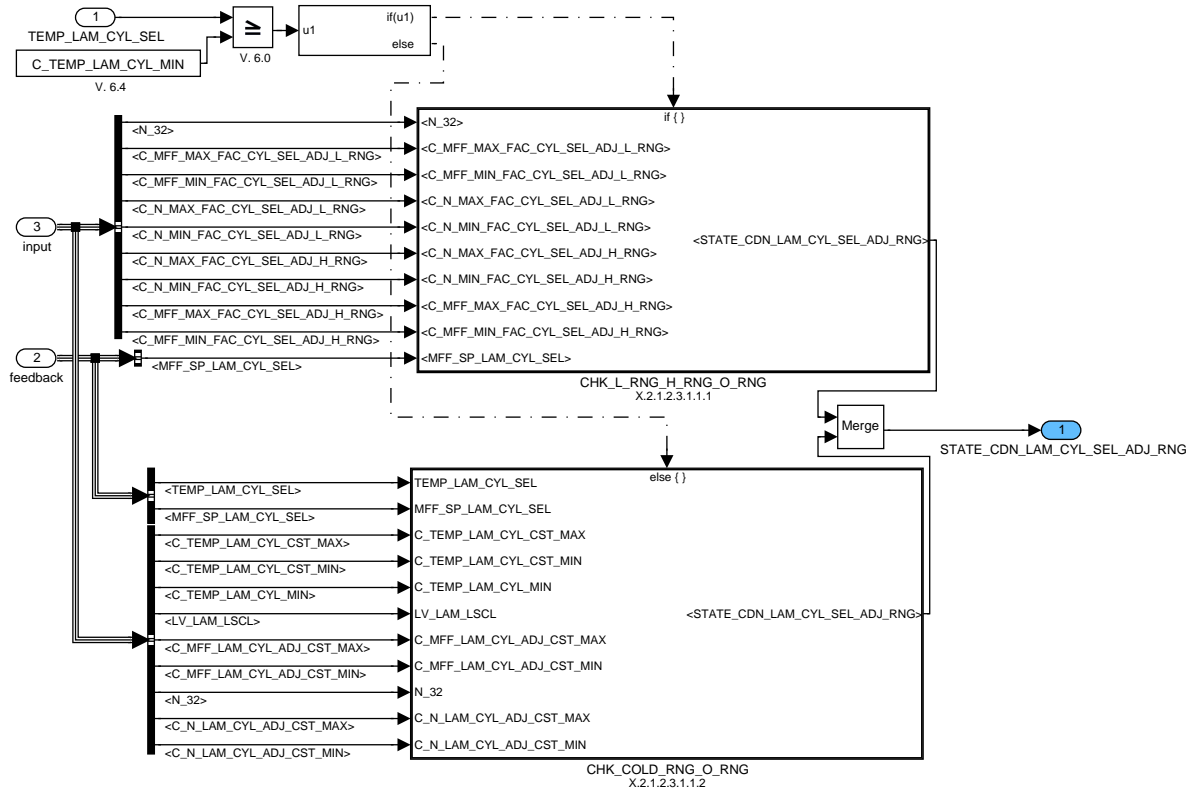


Figure 7.75.11: :

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### 7.75.2.1.2.3.1.1.1 Check for Low or High or Out of Range

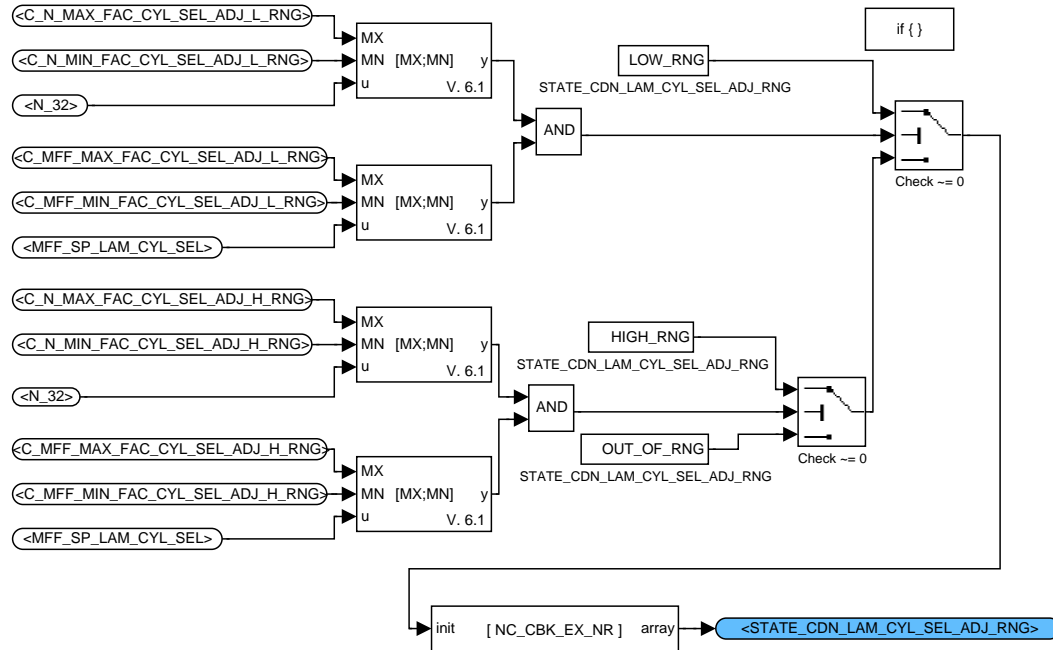


Figure 7.75.12: :

### 7.75.2.1.2.3.1.1.2 Check for Cold or Out of Range

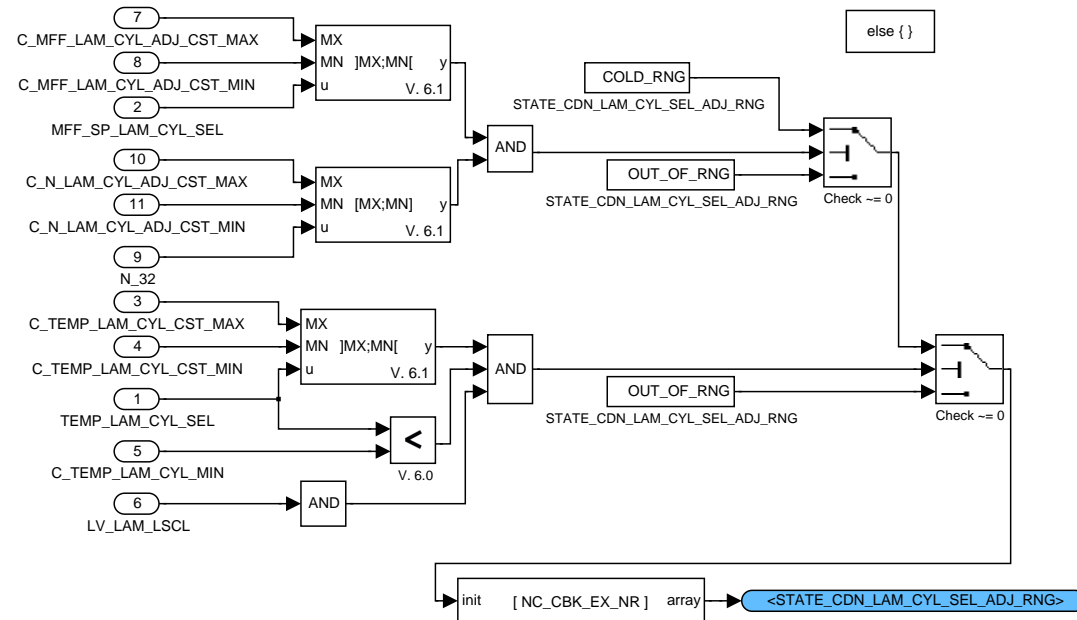


Figure 7.75.13: :

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### 7.75.2.1.2.3.1.2 Calculation of LV\_LAM\_CYL\_ENA[0]

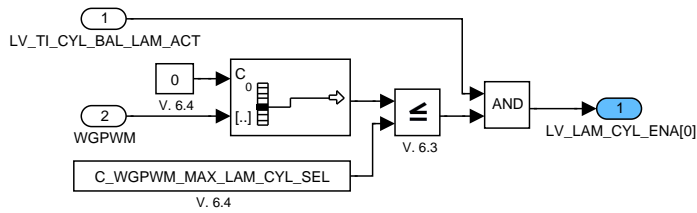


Figure 7.75.14: :

### 7.75.2.1.2.3.1.3 Calculation of LV\_LAM\_CYL\_ENA[1]

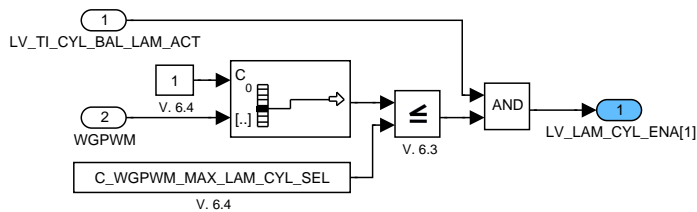


Figure 7.75.15: :

### 7.75.2.1.2.3.2 Out of Range

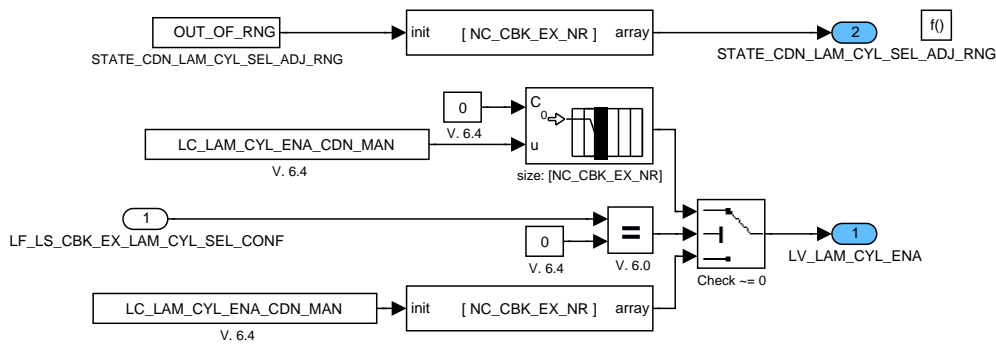


Figure 7.75.16: :

### 7.75.2.1.3 If Activation not valid

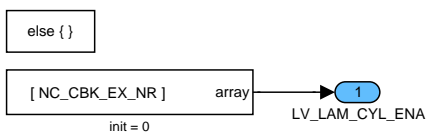


Figure 7.75.17: :

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### 7.75.2.1.4 Calculation of Offset requirement

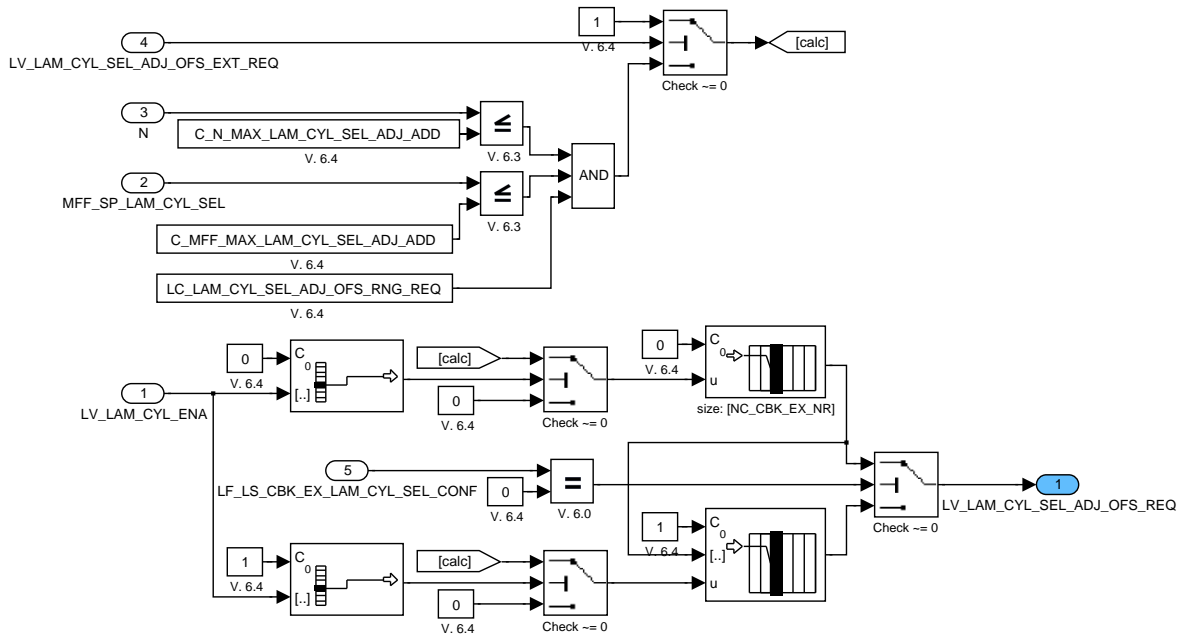


Figure 7.75.18 :

### 7.75.2.1.5 Calculation of Variable Phase shift

Regarding the influence of variable position of exhaust camshaft on phase shift, a variable phase shift, PHA\_SHIFT\_CAM\_EX[i] is defined.

For a six-cylinder engine with a variable valve timing for instance, the variable phase shift is governed by the following calculation.

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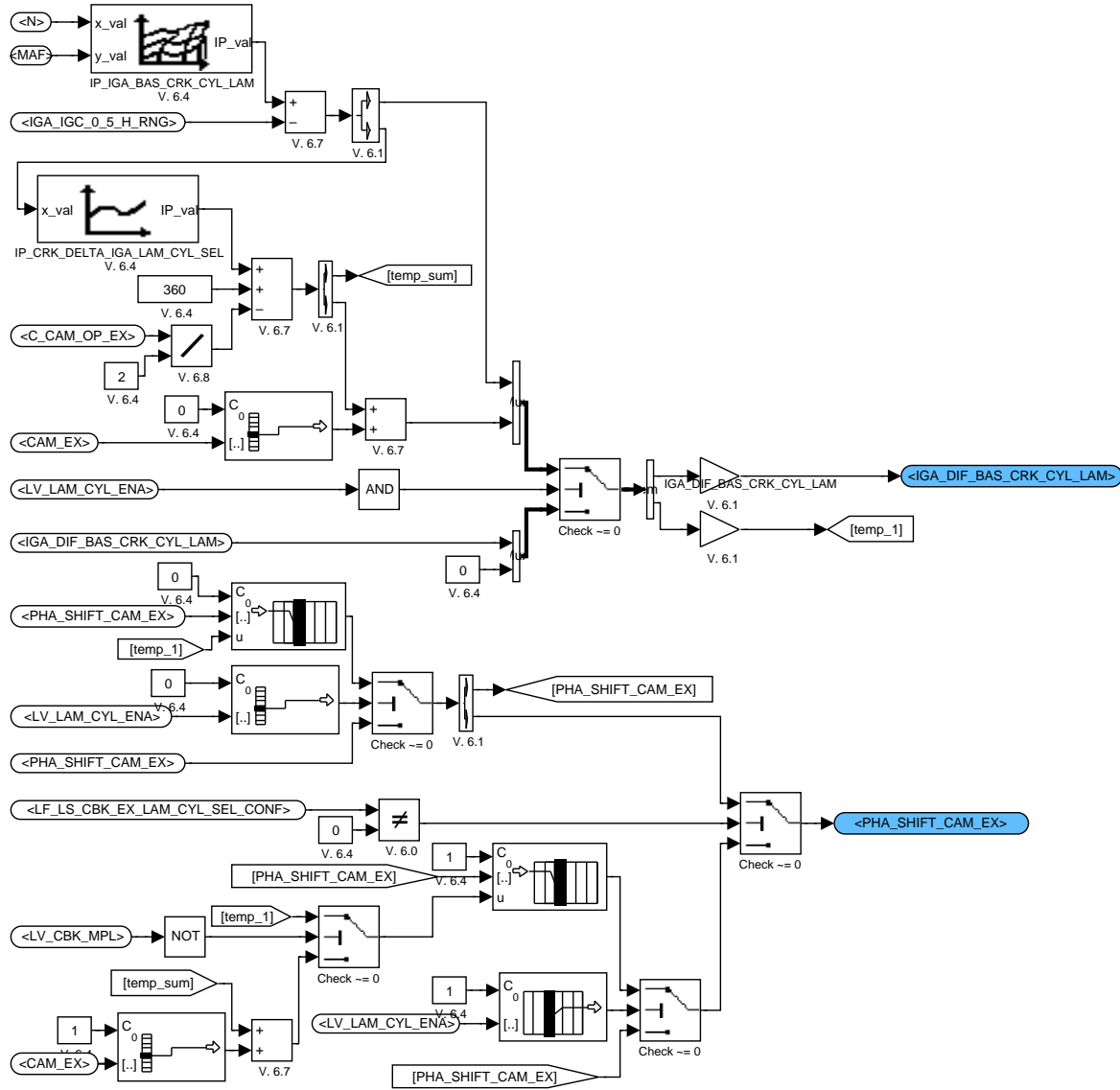


Figure 7.75.19: :

### 7.75.3 Calculations at 100ms recurrence

#### 7.75.3.1 Decrement timer value T\_LAM\_CYL\_DEAC\_VIM and reactivation of CILC timer task

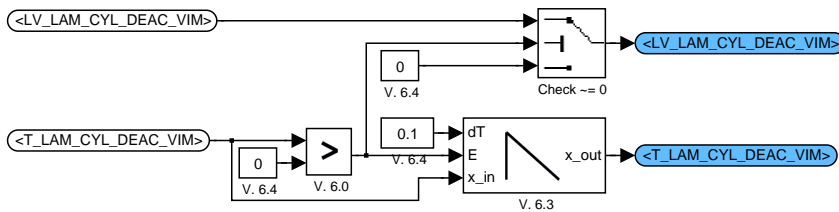


Figure 7.75.20: :

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## 7.76 Limited dynamics for cylinder individual lambda control

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LAM_MV_OFS_LDC_LAM_CYL_SEL [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.998474121093	0.00152587	%
Offset of lambda controller output mean value for detection of limited dynamics (cylinder individual lambda control)					
LV_LAM_CYL_SEL_LDC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Detection flag of limited dynamics for cylinder individual lambda control					
MAF_INT_LDC_LAM_CYL_SEL [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.45633333333e3	0.02222222	g
Air mass flow integral during the time after limited dynamics was interrupted					
MAF_OFS_LDC_LAM_CYL_SEL	V	8000... 7FFFH	- 694.5105973907 ...694.48940260929	0.02119478	mg/stk
Offset of air mass flow for detection of limited dynamics for cylinder individual lambda control					
N_OFS_LDC_LAM_CYL_SEL	V	E020... 1FE0H	-8160 ...8160	1	rpm
Offset of engine speed for detection of limited dynamics for cylinder individual lambda control					

### Input data:

FAC_LAM_MV_DELTA_LDC [NC_CBK_EX_NR] {p. 2585}	LF_LS_CBK_EX_LAM_CYL_SEL_CONF {p. 2864}	LV_ES {p. 1720}	LV_ST_END {p. 1720}
MAF_CYL {p. 8277}	MAF_DELTA_LDC {p. 2585}	N_DELTA_LDC {p. 2585}	NC_CBK_EX_NR {p. 1829}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_LAM_DYW_LDC_LAM_CYL_SEL	V	0... 7FFFH	0... 49.99847412	0.00152587	%
Dynamic window of lambda controller output for detection of limited dynamics (cylinder individual lambda control)					
C_MAF_DYW_LDC_LAM_CYL_SEL	V	0... FFFFH	0... 1389	0.02119478	mg/stk
Dynamic window of MAF for detection of limited dynamics (cylinder individual lambda control)					
C_MAF_INT_LDC_LAM_CYL_SEL	V	0... FFFFH	0... 1.45633333333e3	0.02222222	g
Threshold of air mass flow integral for detection of limited dynamics for cylinder individual lambda control					
C_N_DYW_LDC_LAM_CYL_SEL	V	0... 1FE0H	0... 8160	1	rpm
Dynamic window of engine speed for detection of limited dynamics (cylinder individual lambda control)					

### General information

The condition limited dynamics LV\_LAM\_CYL\_SEL\_LDC[i] for cylinder individual lambda control is detected if the engine speed, mass air flow and the mean value of lambda controller output are within the corresponding dynamic window. Once all of the conditions are fulfilled, the integral of the mass air flow is calculated. The limited dynamics is then detected (LV\_LAM\_CYL\_SEL\_LDC[i] = 1) if the value of mass air flow integral reaches the calibrated threshold.


### Application conditions:

#### Initialisation:

at reset, LV\_IGK = 0 → 1 and clear error memory:

LV\_LAM\_CYL\_SEL\_LDC[i] = 0

MAF\_INT\_LDC\_LAM\_CYL\_SEL[i] = 0

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```
FAC_LAM_MV_OFS_LDC_LAM_CYL_SEL[i] = 0
MAF_OFS_LDC_LAM_CYL_SEL = 0
N_OFS_LDC_LAM_CYL_SEL = 0
```

**Activation:** LV\_ST\_END = 1  
**Deactivation:** LV\_ES = 1  
**Recurrence:** T\_SAMPLE = 20 ms

### Function description:

#### Formula section:

```
if(1) two separate exhaust banks are concerned (NC_CBK_EX_NR = 2)
then
    i = 1, for exhaust bank 1
    i = 2, for exhaust bank 2
else(1)
    i = 1 (NC_CBK_EX_NR = 1)
endif(1)
```

use **LF\_LS\_CBK\_EX\_LAM\_CYL\_SEL\_CONF** to distinguish between single and 2-exhaust-bank configuration - index "[i]"

### 7.76.1 Evaluation of the dynamic window for the engine speed

```
if(1) abs(N_DELTA_LDC) > C_N_DYW_LDC_LAM_CYL_SEL
then
    if(2) abs(N_DELTA_LDC - N_OFS_LDC_LAM_CYL_SEL) >
        C_N_DYW_LDC_LAM_CYL_SEL
    then
        N_OFS_LDC_LAM_CYL_SEL = N_DELTA_LDC (1.1.1)
        MAF_INT_LDC_LAM_CYL_SEL[i] = 0 (1.1.2)
    endif(2)
else(1)
    N_OFS_LDC_LAM_CYL_SEL = 0 (1.1.3)
endif(1)
```

### 7.76.2 Evaluation of the dynamic window for the air mass flow

```
if(1) abs(MAF_DELTA_LDC) > C_MAF_DYW_LDC_LAM_CYL_SEL
then
    if(2) abs(MAF_DELTA_LDC - MAF_OFS_LDC_LAM_CYL_SEL) >
        C_MAF_DYW_LDC_LAM_CYL_SEL
    then
        MAF_OFS_LDC_LAM_CYL_SEL = MAF_DELTA_LDC (1.2.1)
        MAF_INT_LDC_LAM_CYL_SEL[i] = 0 (1.2.2)
    endif(2)
else(1)
    MAF_OFS_LDC_LAM_CYL_SEL = 0 (1.2.3)
endif(1)
```

### 7.76.3 Evaluation of the dynamic window for the lambda controller output mean value

```

if(1) abs(FAC_LAM_MV_DELTA_LDC[i]) > C_FAC_LAM_DYW_LDC_LAM_CYL_SEL
then
    if(2) abs(FAC_LAM_MV_DELTA_LDC[i] -
              FAC_LAM_MV_OFS_LDC_LAM_CYL_SEL[i]) >
              C_FAC_LAM_DYW_LDC_LAM_CYL_SEL
        then
            FAC_LAM_MV_OFS_LDC_LAM_CYL_SEL[i] = FAC_LAM_MV_DELTA_LDC[i]
                                                    (1.3.1)
            MAF_INT_LDC_LAM_CYL_SEL[i] = 0
                                                    (1.3.2)
        endif(2)
    else(1)
        FAC_LAM_MV_OFS_LDC_LAM_CYL_SEL[i] = 0
                                                    (1.3.3)
    endif(1)

```

### 7.76.4 Calculation of the air mass flow integral – detection of limited dynamics

```

if(1) MAF_INT_LDC_LAM_CYL_SEL[i] < C_MAF_INT_LDC_LAM_CYL_SEL
then
    MAF_INT_LDC_LAM_CYL_SEL[i][g] = MAF_INT_LDC_LAM_CYL_SEL[i][g] +
    MAF_CYL[kg/h]*T_SAMPLE[ms]*1/3600[(g*h)/(kg*ms)]
                                                    (1.4.1)
    LV_LAM_CYL_SEL_LDC[i] = 0
                                                    (1.4.2)
else(1)
    LV_LAM_CYL_SEL_LDC[i] = 1
                                                    (1.4.3)
endif(1)

```

## 7.77 Lambda setpoint for catalyst regeneration

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_RGN_CYC_LAMB_RGN	O/V	0... FFH	0... 255	1	-
Regenerations counter for calculating of alternate flag					
FAC_NT_AGI_RGN	V	0... FFFFH	0... 0.99998474121	15.2588e-6	-
NOx catalyst aging factor for Lambda setpoint correction factor determination					
LAMB_RGN [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Lambda setpoint for catalyst regeneration					
LAMB_RGN_FAC [NC_CBK_EX_NR]	V	0... FFH	0... 1.9921875	7.8125e-3	-
factor for the correction of the regeneration lambda					
LV_LAMB_PARK_AFL_DEAC	V	0... 1H	0 ...1	1	-
Deactivation flag for regeneration depending on T_RGN_2					
LV_LAMB_SP_SWI	O/V	0... 1H	0 ...1	1	-
Flag of alternate					
LV_RGN_NT_REQ_OLD	-	0... 1H	0 ...1	1	-
Old logical value for regeneration phase request					
LV_SENS_RGN_1_READY_OLD	-	0... 1H	0 ...1	1	-
Old value for end of first regeneration flag					
MAF_KGH_HOM	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Calculated MAF_KGH for homogeneous operation					
STATE_RGN [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H 4H	H_AMPL PARK L_AMPL PASSIVE EQUAL	-	-
NOx regeneration state					
T_RGN	O/V	0... FFFFH	0... 655.35	0.01	s
Time counter for regeneration active					
T_RGN_2	O/V	0... FFFFH	0... 655.35	0.01	s
Time counter for second regeneration					
VLS_NS_OLD [NC_NOX_SENS_CONF]	-	0... 578H	-200 ...1200	1	mV
Old binary O2 signal voltage, raw value, measured by NOx-Sensor					

### Input data:

FAC_NT_AGI_LIM {p. 3072}	LC_SENS_AFR_MOD {p. 3000}	LV_ES {p. 1720}	LV_NT_ACT {p. 2982}
LV_RGN_NT_REQ {p. 2983}	LV_SENS_AFR [NC_NT_NR] {p. 2983}	LV_SENS_RGN_1_READY {p. 2983}	LV_ST {p. 1720}
LV_VLS_GRD_NEG {p. 2983}	LV_VLS_NS_VLD [NC_NOX_SENS_CONF] {p. 992}	MAF {p. 8277}	MAF_SP_TQI {p. 8390}
N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}	NC_NT_NR {p. 644}
NT_AGI {p. 3073}	NT_AGI_SUL {p. 3073}	NT_AGI_THERMO {p. 3073}	STATE_NOX {p. 2986}


TNT_MDL_MV_SNG [NC_NT_NR] {p. 8237}	VLS_NS [NC_NOX_SENS_CONF] {p. 992}		
--	--	--	--

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_RGN_SWI_ACT	-	1... FFH	1... 255	1	-
Number of regenerations with initialization of STATE_RGN when the alternate flag is 1					
C_CTR_RGN_SWI_DEAC	-	1... FFH	1... 255	1	-
Number of regenerations with initialization of STATE_RGN when the alternate flag is 0					
C_FAC_NT_AGI_RGN_MAN	-	0... FFH	0... 1.99218	0.0078125	-
Manual set value for FAC_NT_AGI_RGN					
C_LAMB_FAC_L_AMPL_NOT_GRD	-	0... FFH	0... 1.99218	0.0078125	-
factor for the correction of the regeneration after waiting time without negative gradient of VLS_NS					
C_LAMB_PARK_BAS	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Basis lambda setpoint for park					
C_LAMB_PAS_BAS	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Basis lambda setpoint for passive state					
C_LAMB_RGN_MAX_EQU	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Maximum Lambda value for equal regeneration mode					
C_LAMB_RGN_MAX_H_AMPL	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Maximum value for high amplitude regeneration lambda					
C_LAMB_RGN_MAX_L_AMPL	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Maximum value for low amplitude regeneration lambda					
C_STATE_FAC_NT_AGI_RGN	-	0H 1H 2H 3H 4H	ALL THERMO SUL MAN LIM	-	-
Mode switch for FAC_NT_AGI_RGN					
C_STATE_LAMB_RGN_1_H_AMPL	-	0H 1H 2H 3H	NONE VLS T_RGN T_RGN_2	-	-
Lambda setpoint correction strategy for first high amplitude regeneration					
C_STATE_LAMB_RGN_2_H_AMPL	-	0H 1H 2H 3H	NONE VLS T_RGN T_RGN_2	-	-
Lambda setpoint correction strategy for second high amplitude regeneration					
C_STATE_LAMB_RGN_EQU	-	0H 1H 2H 3H	NONE VLS T_RGN T_RGN_2	-	-
Lambda setpoint correction strategy for equal mode regeneration					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_LAMB_RGN_L_AMPL	-	0H 1H 2H 3H	NONE VLS_MAF T_RGN T_RGN_2	-	-
Strategy for low amplitude regeneration					
C_STATE_RGN_1_PARK	-	0H 1H 2H 3H	NONE VLS T_RGN T_RGN_2	-	-
Park strategy for first regeneration					
C_STATE_RGN_2_PARK	-	0H 1H 2H 3H	NONE VLS T_RGN T_RGN_2	-	-
Park strategy for second regeneration					
C_STATE_RGN_INI_1	-	0H 1H 2H 3H 4H	H_AMPL PARK L_AMPL PASSIVE EQUAL	-	-
Initialisation state for first bank					
C_STATE_RGN_INI_2	-	0H 1H 2H 3H 4H	H_AMPL PARK L_AMPL PASSIVE EQUAL	-	-
Initialisation state for second bank					
C_STATE_RGN_INI_VLS_NOT_VLD_1	-	0H 1H 2H 3H 4H	H_AMPL PARK L_AMPL PASSIVE EQUAL	-	-
Initialisation state for first bank as long as NOx sensor VLS signal is not valid					
C_STATE_RGN_INI_VLS_NOT_VLD_2	-	0H 1H 2H 3H 4H	H_AMPL PARK L_AMPL PASSIVE EQUAL	-	-
Initialisation state for second bank as long as NOx sensor VLS signal is not valid					

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 2887 of 8404</b>	
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_PURGE_H_AMPL	-	0... FFFFH	0... 655.35	0.01	s
Purge time for high amplitude regeneration					
C_T_PURGE_L_AMPL	-	0... FFFFH	0... 655.35	0.01	s
Purge time for low amplitude regeneration					
C_T_RGN_2_NOT_GRD	-	0... FFFFH	0... 655.35	0.01	s
After this time the second bank will be regenerated without waiting for negative gradient of VLS_NS					
IP_LAMB_FAC_EQU_NT_AGI	-	0... FFH	0... 1.99218	0.0078125	-
LDP_FAC_NT_AGI_RGN_IP_EQU	6	0... FFFFH	0... 0.99998	15.3e-6	-
Lambda setpoint correction factor for equal regeneration mode depending on NOx catalyst aging factor					
IP_LAMB_FAC_EQU_T_RGN	-	0... FFH	0... 1.99218	0.0078125	-
LDP_T_RGN_EQU_IP_LAMB_FAC	8	0... FFFFH	0... 655.35	0.01	s
Lambda setpoint correction factor for equal mode regeneration depending on T_RGN					
IP_LAMB_FAC_H_AMPL_1_VLS	-	0... FFH	0... 1.99218	0.0078125	-
LDP_VLS_H_AMPL_1_IP_LAMB_FAC	8	0... 578H	-200 ...1200	1	mV
Lambda setpoint correction factor for first high amplitude regeneration depending on binary NS lambda signal					
IP_LAMB_FAC_H_AMPL_2_VLS	-	0... FFH	0... 1.99218	0.0078125	-
LDP_VLS_H_AMPL_2_IP_LAMB_FAC	8	0... 578H	-200 ...1200	1	mV
Lambda setpoint correction factor for second high amplitude regeneration depending on binary NS lambda signal					
IP_LAMB_FAC_H_AMPL_NT_AGI	-	0... FFH	0... 1.99218	0.0078125	-
LDP_FAC_NT_AGI_RGN_IP_H_AMPL	6	0... FFFFH	0... 0.99998	15.3e-6	-
Lambda setpoint correction factor for high amplitude regeneration mode depending on NOx catalyst aging factor					
IP_LAMB_FAC_L_AMPL_2_VLS	-	0... FFH	0... 1.99218	0.0078125	-
LDP_VLS_L_AMPL_2_IP_LAMB_FAC	8	0... 578H	-200 ...1200	1	mV
Lambda setpoint correction factor for second low amplitude regeneration depending on binary NS lambda signal					
IP_LAMB_FAC_L_AMPL_NT_AGI	-	0... FFH	0... 1.99218	0.0078125	-
LDP_FAC_NT_AGI_RGN_IP_L_AMPL	6	0... FFFFH	0... 0.99998	15.3e-6	-
Lambda setpoint correction factor for low amplitude regeneration mode depending on NOx catalyst aging factor					
IP_LAMB_FAC_L_AMPL_T_RGN_1	-	0... FFH	0... 1.99218	0.0078125	-
LDP_T_RGN_1_L_AMPL_IP_LAMB_FAC	8	0... FFFFH	0... 655.35	0.01	s
Lambda setpoint correction factor for low amplitude regeneration depending on T_RGN					
IP_LAMB_FAC_L_AMPL_T_RGN_2	-	0... FFH	0... 1.99218	0.0078125	-
LDP_T_RGN_2_L_AMPL_IP_LAMB_FAC	8	0... FFFFH	0... 655.35	0.01	s
Lambda setpoint correction factor for low amplitude regeneration depending on T_RGN_2					
IP_LAMB_FAC_L_AMPL_VLS_MAF_KGH	V	0... FFH	0... 1.99218	0.0078125	-
LDP_MAF_KGH_L_AMPL_IP_LAMB_FAC	2	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_VLS_L_AMPL_1_IP_LAMB_FAC	2	0... 578H	-200 ...1200	1	mV
Lambda setpoint correction factor for first low amplitude regeneration depending on MAF and VLS_NS					
IP_LAMB_FAC_PARK_1_T_RGN	-	0... FFH	0... 1.99218	0.0078125	-
LDP_T_RGN_1_PARK_IP_LAMB_FAC	8	0... FFFFH	0... 655.35	0.01	s
Lambda setpoint correction factor for park for first regeneration depending on T_RGN					
IP_LAMB_FAC_PARK_1_VLS	-	0... FFH	0... 1.99218	0.0078125	-
LDP_VLS_PARK_1_IP_LAMB_FAC	8	0... 578H	-200 ...1200	1	mV
Lambda setpoint correction factor for park depending on binary NS lambda signal					



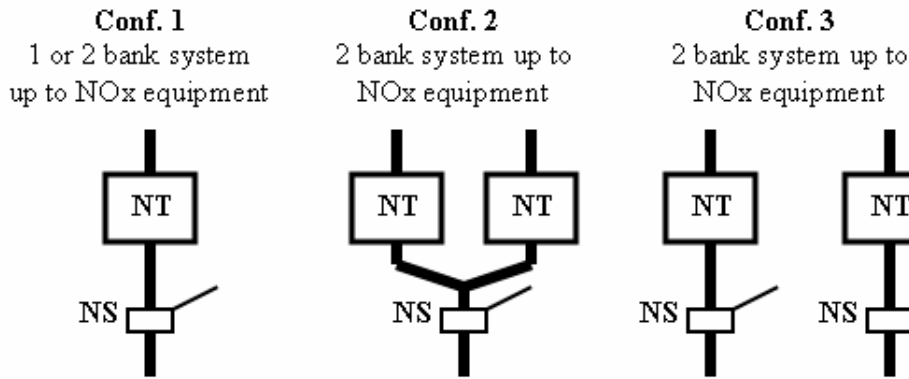
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_LAMB_FAC_PARK_2_T_RGN_2	-	0... FFH	0... 1.99218	0.0078125	-
LDP_T_RGN_2_PARK_IP_LAMB_FAC	8	0... FFFFH	0... 655.35	0.01	s
Lambda setpoint correction factor for park depending on T_RGN_2					
IP_LAMB_PURGE_H_AMPL	V	0... 7FFFH	0... 31.99902	976.599e-6	-
LDPM_TNT_MDL_MV_SNG_1_NOXM	2	0... FFFFH	0... 1023.98437	0.015625	°C
LDPM_MAF_KGH_HOM_1_NOXM	2	0... FFFFH	0... 2047.96875	0.03125	kg/h
Basis lambda purge for high amplitude regeneration					
IP_LAMB_PURGE_L_AMPL	V	0... 7FFFH	0... 31.99902	976.599e-6	-
LDPM_TNT_MDL_MV_SNG_1_NOXM	2	0... FFFFH	0... 1023.98437	0.015625	°C
LDPM_MAF_KGH_HOM_1_NOXM	2	0... FFFFH	0... 2047.96875	0.03125	kg/h
Basis lambda purge for low amplitude regeneration					
IP_LAMB_RGN_EQU_BAS	V	0... 7FFFH	0... 31.99902	976.599e-6	-
LDPM_TNT_MDL_MV_SNG_1_NOXM	2	0... FFFFH	0... 1023.98437	0.015625	°C
LDPM_MAF_KGH_HOM_1_NOXM	2	0... FFFFH	0... 2047.96875	0.03125	kg/h
Basis lambda for equal mode regeneration					
IP_LAMB_RGN_H_AMPL_BAS	V	0... 7FFFH	0... 31.99902	976.599e-6	-
LDPM_TNT_MDL_MV_SNG_1_NOXM	2	0... FFFFH	0... 1023.98437	0.015625	°C
LDPM_MAF_KGH_HOM_1_NOXM	2	0... FFFFH	0... 2047.96875	0.03125	kg/h
Basis lambda for high amplitude regeneration					
IP_LAMB_RGN_L_AMPL_BAS	V	0... 7FFFH	0... 31.99902	976.599e-6	-
LDPM_TNT_MDL_MV_SNG_1_NOXM	2	0... FFFFH	0... 1023.98437	0.015625	°C
LDPM_MAF_KGH_HOM_1_NOXM	2	0... FFFFH	0... 2047.96875	0.03125	kg/h
Basis lambda for low amplitude regeneration					
IP_LAMB_RGN_MAX_PARK	V	0... 7FFFH	0... 31.99902	976.599e-6	-
LDP_N_32_IP_LAMB_RGN_MAX_PARK	2	0... FFH	0... 8160	32	rpm
LDP_MAF_IP_LAMB_RGN_MAX_PARK	2	0... FFFFH	0... 1389	0.0211948	mg/stk
Maximum lambda during park phase of regeneration					

**Configuration data:**

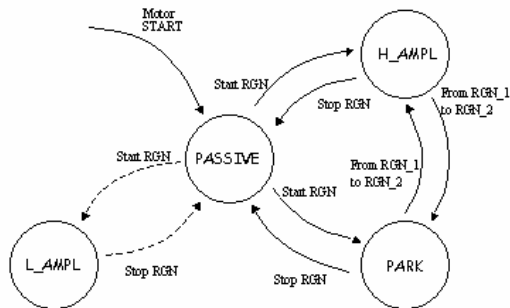
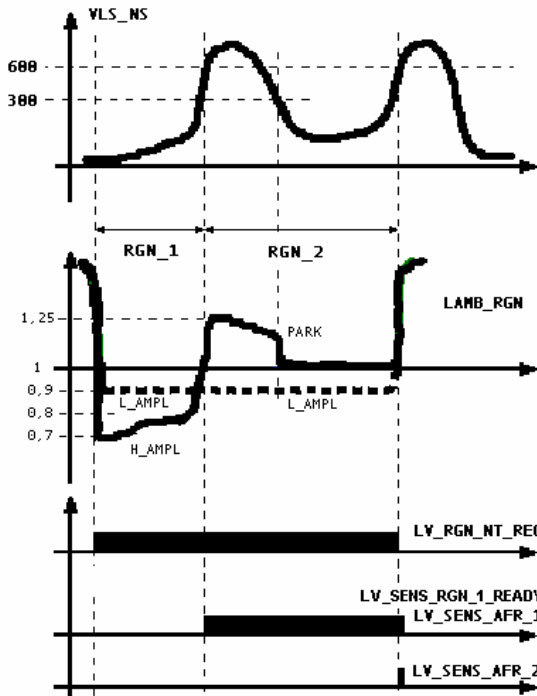
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_MAF_FAC_CYL	-	0... FFFFH	0... 11111.1111111	0.1695447	-
conversion factor between MAF					

**General Information**

The requirement of NOx storage catalyst regeneration is the engine is operated with a rich mixture. This is the lambda setpoint for catalyst regeneration edition for single- and twin-branched exhaust lines, also for the Y configuration with two NOx-Traps (NT) and one NOx-Sensor (Conf 2). In this case the lambda setpoint of the already regenerated NT is set to the park value C\_LAMB\_PARK\_BAS. The covered exhaust gas configurations are shown in the picture below:



The regeneration curves, state flow and correction options for example configuration shows the picture:



Options of correction factor calculation for RGN\_1:

	PURGE	VLS	T_RGN	VLS/MAF	NONE
L_AMPL	✓	-	✓	✓	✓
H_AMPL	✓	✓	-	-	✓
PARK	-	✓	✓	-	✓

Options of correction factor calculation for RGN\_2:

	PURGE	VLS	T_RGN_2	VLS/MAF	NONE
PARK	-	-	✓	-	✓
L_AMPL	-	✓	✓	-	✓
H_AMPL	-	✓	-	-	✓

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NC\_CBK\_EX\_NR is the number of exhaust gas lines. Therefore

- i = 1, for cylinder bank 1
- i = 2, for cylinder bank 2.

NC\_NOX\_SENS\_CONF is the number of NOx-Sensors. Therefore

- NC\_NOX\_SENS\_CONF = 0, for no NOx-Sensor
- NC\_NOX\_SENS\_CONF = 1 (n = 1), for one NOx-Sensor
- NC\_NOX\_SENS\_CONF = 2 (n = i), for two NOx-Sensors

NC\_NT\_NR is the number of NOx Catalyts. Therefore

- NC\_NT\_NR = 1 (k = 1), for one NOx Catalyst
- NC\_NT\_NR = 2 (k = i), for two NOx Catalyts

**Application Conditions**

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
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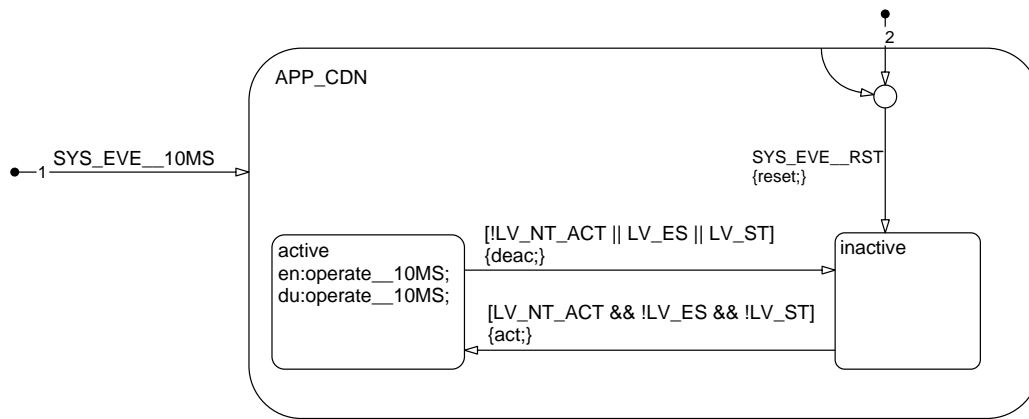



Figure 7.77.1: :

**Function description**

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 2891 of 8404</b>	
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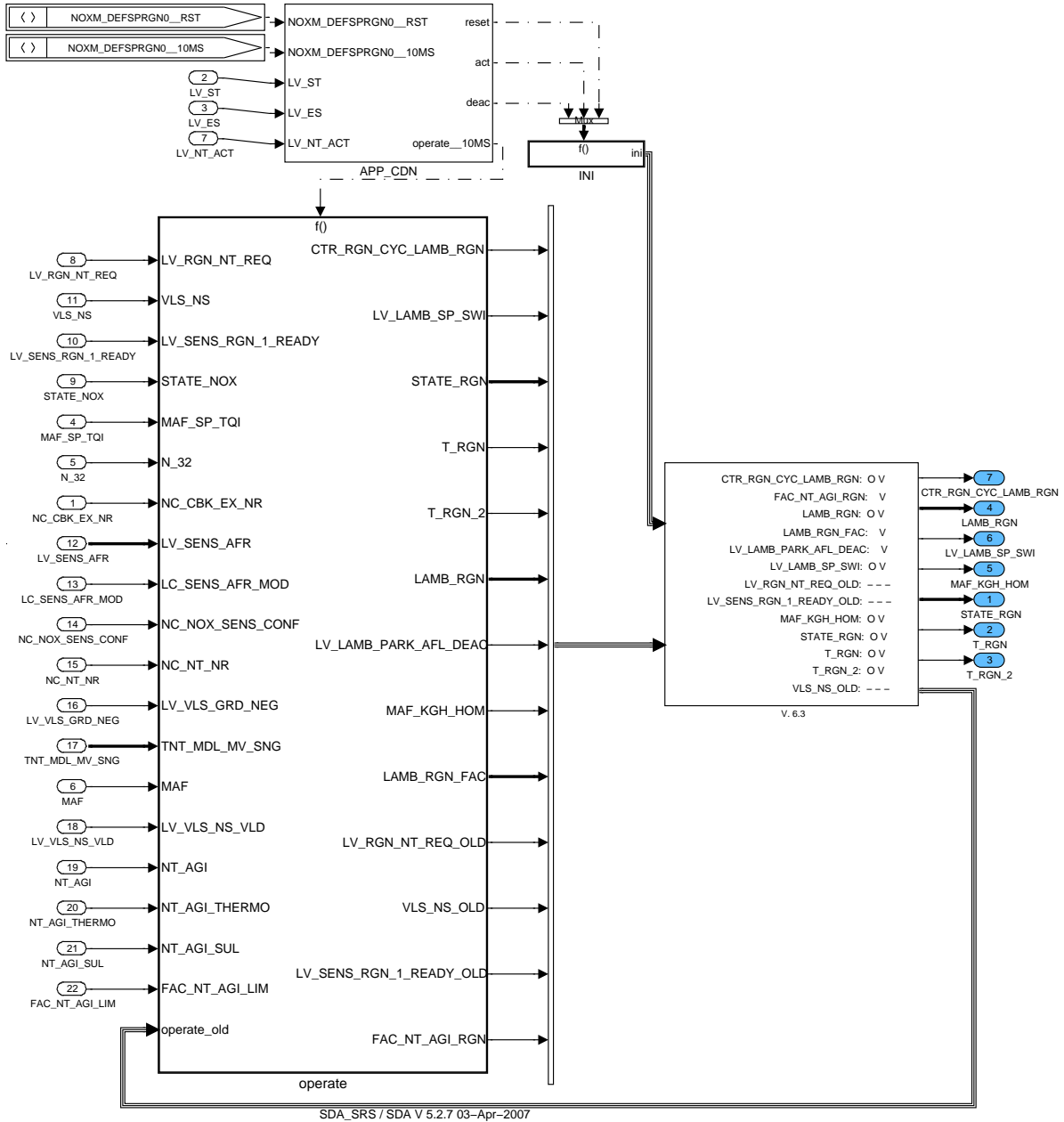


Figure 7.77.2: :

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## 7.77.1 INITIALIZATION AT RESET, ACTIVATION AND DEACTIVATION

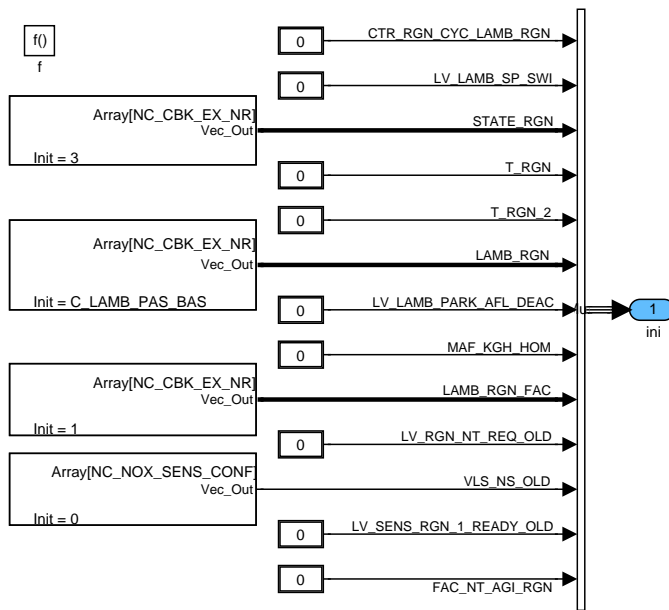


Figure 7.77.3: :

## 7.77.2 FORMULA SECTION

The function consists of two main sections:

SECTION 1: Initialization of the Regeneration State at start of the regeneration, calculation of the regeneration time and of the lambda basis for the low amplitude regeneration

SECTION 2: Calculation of the Regeneration State and the Regeneration Lambda Setpoint

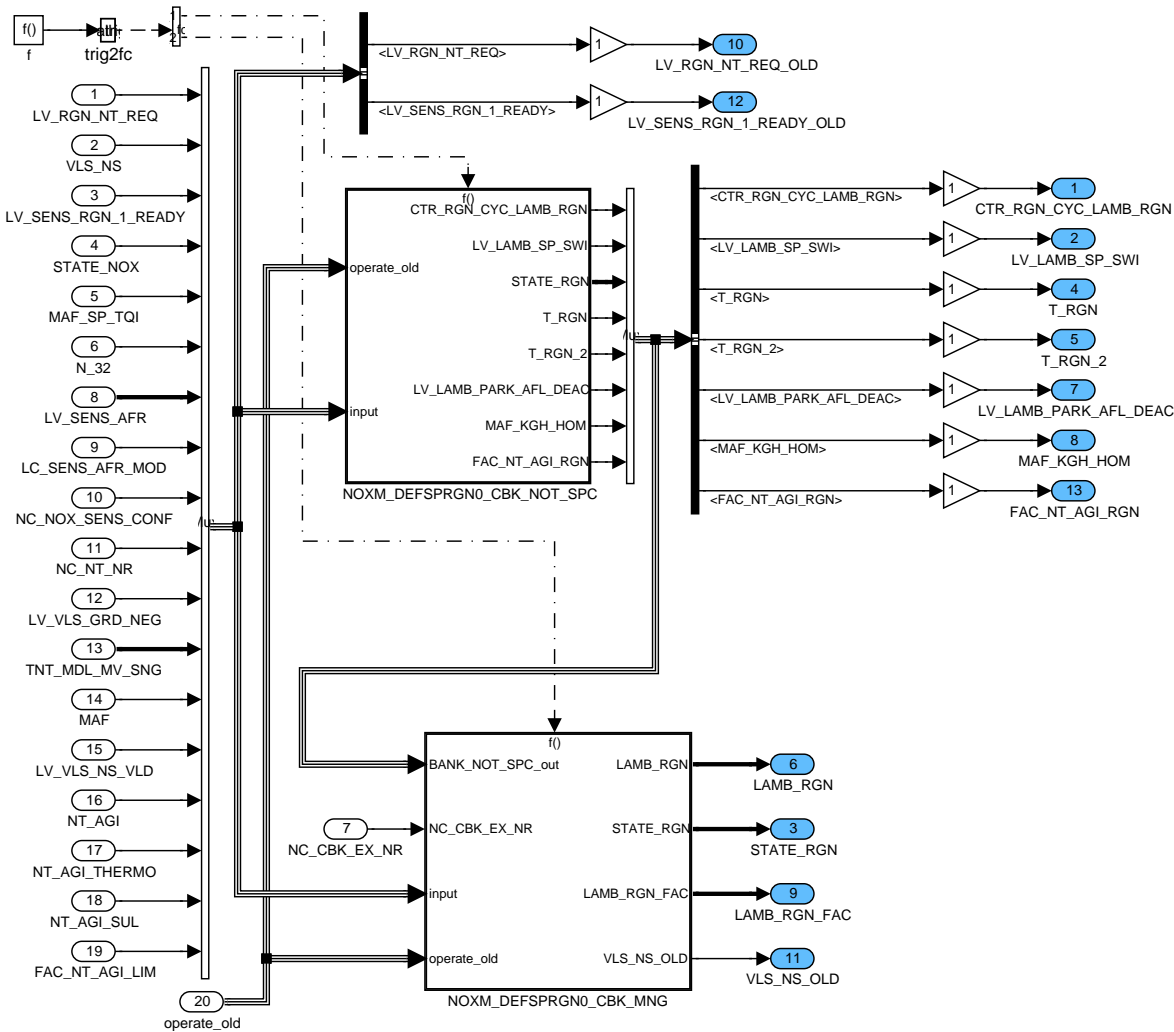


Figure 7.77.4: :

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### 7.77.2.1 SECTION 1: Initialization of Regeneration State at start of the regeneration, calculation of regeneration time and lambda basis for the low amplitude regeneration

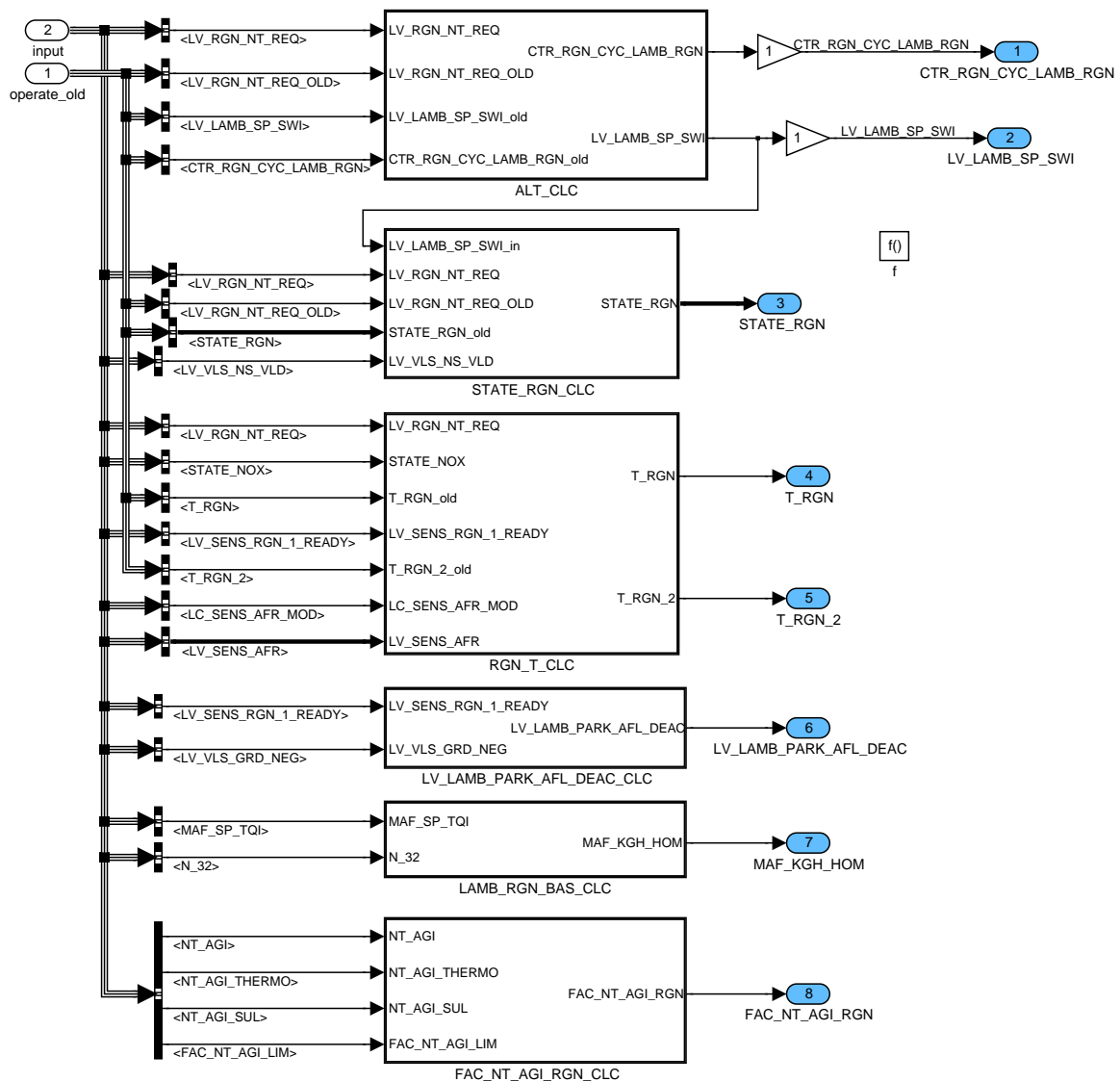


Figure 7.77.5: :

#### 7.77.2.1.1 Calculation of regeneration counter and alternate flag

The regeneration counter is incremented at entering in regeneration. The alternate flag is used for switching of initialization values for the STATE\_RGN between both banks. The interval between switching is set by the C\_CTR\_RGN\_SWI\_DEAC (alternate flag is not active) and by the C\_CTR\_RGN\_SWI\_ACT (alternate flag is active).

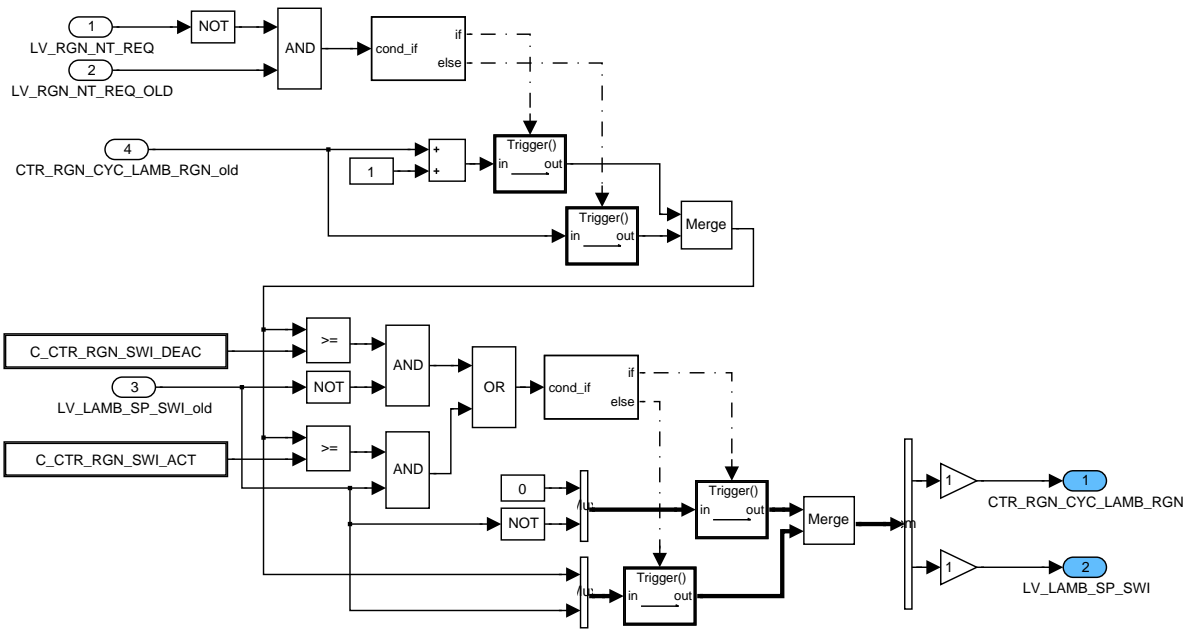


Figure 7.77.6: :

**7.77.2.1.2 Initialization of regeneration state**

The regeneration strategy for all banks is set at start of regeneration. The regeneration state is initialized depending on alternate flag.

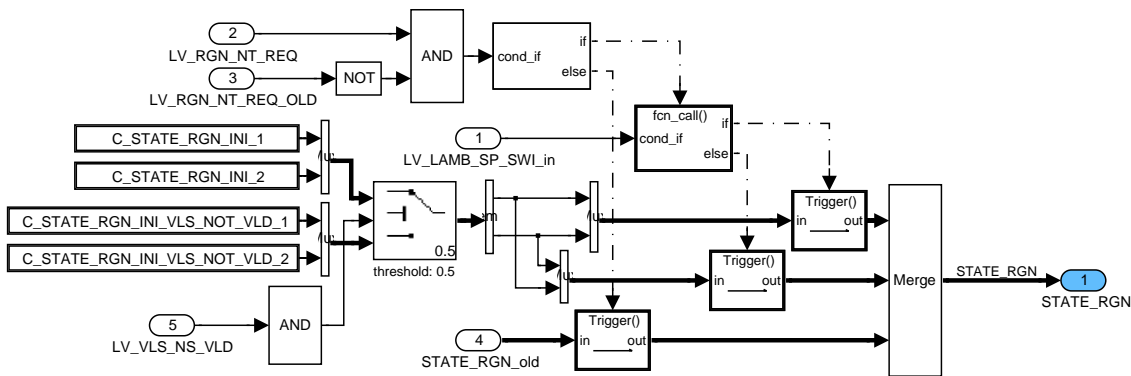


Figure 7.77.7: :

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7.77.2.1.3 Calculation of time for the first and the second regeneration

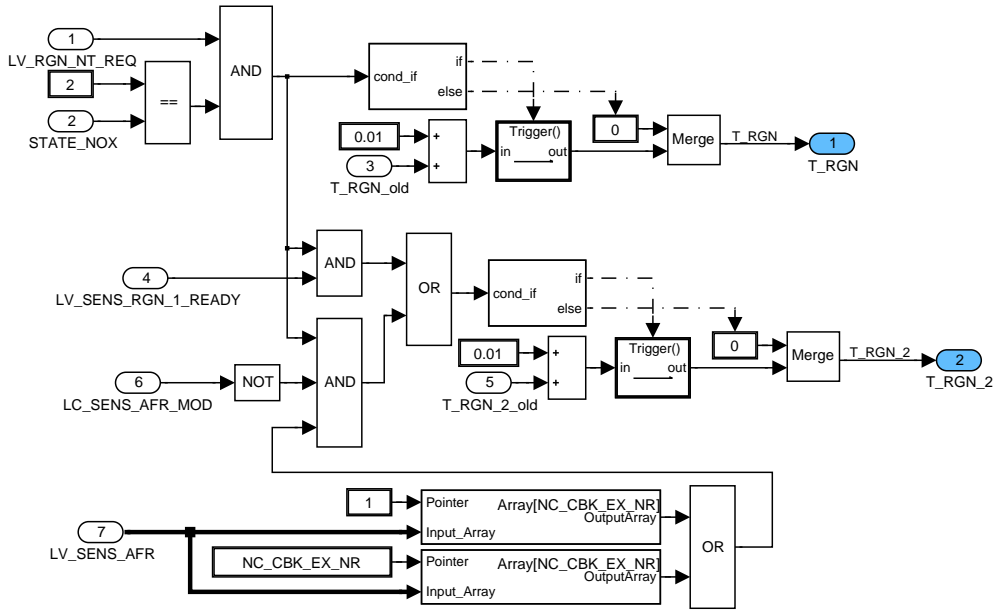


Figure 7.77.8: :

7.77.2.1.4 Deactivation of lean lambda setpoint after switch to the state "PARK".

To ensure the binary signal of the NOx Sensor can fall down after first regeneration, the deactivation of the lean lambda setpoint take place only when defined negative gradient has been reached.

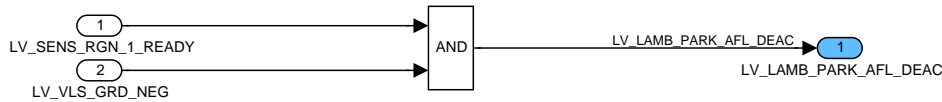


Figure 7.77.9: :

7.77.2.1.5 Calculation of MAF\_KGH for homogeneous operation

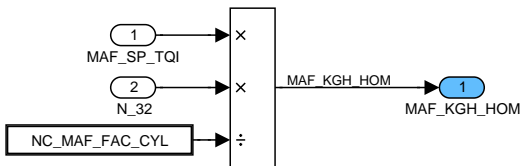


Figure 7.77.10: :

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### 7.77.2.1.6 Calculation of NOx catalyst aging factor for correction of basic Lambda setpoint for NOx regeneration

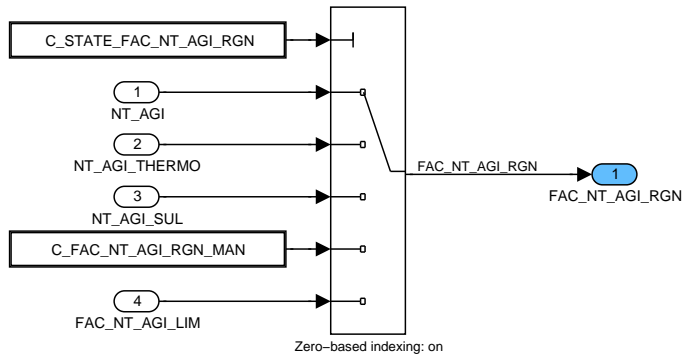



Figure 7.77.11: :

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## 7.77.2.2 FOR Loop

### 7.77.2.2.1 FOR Loop structure

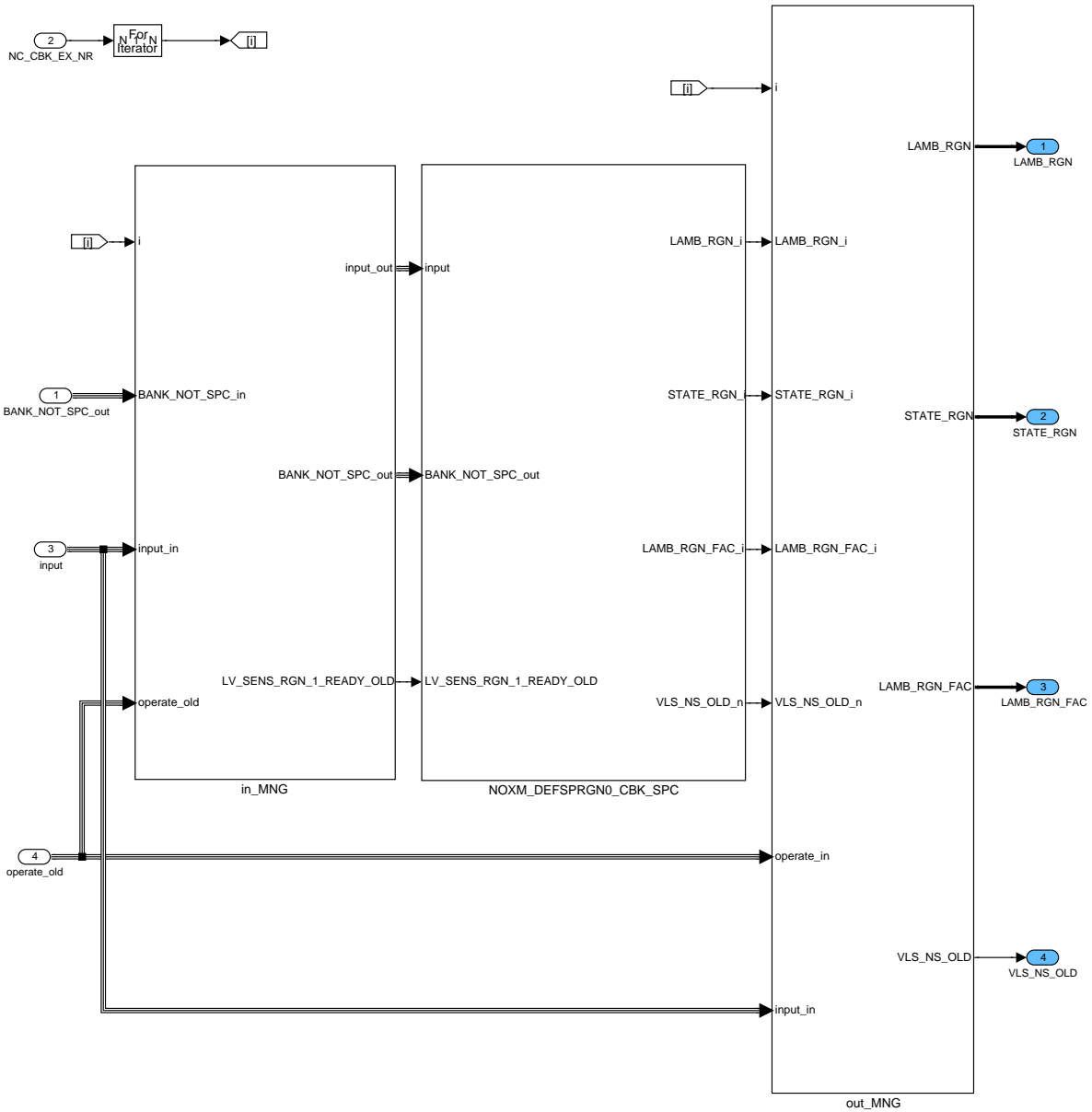


Figure 7.77.12: :

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7.77.2.2.1.1 Signal selection out of signal vectors

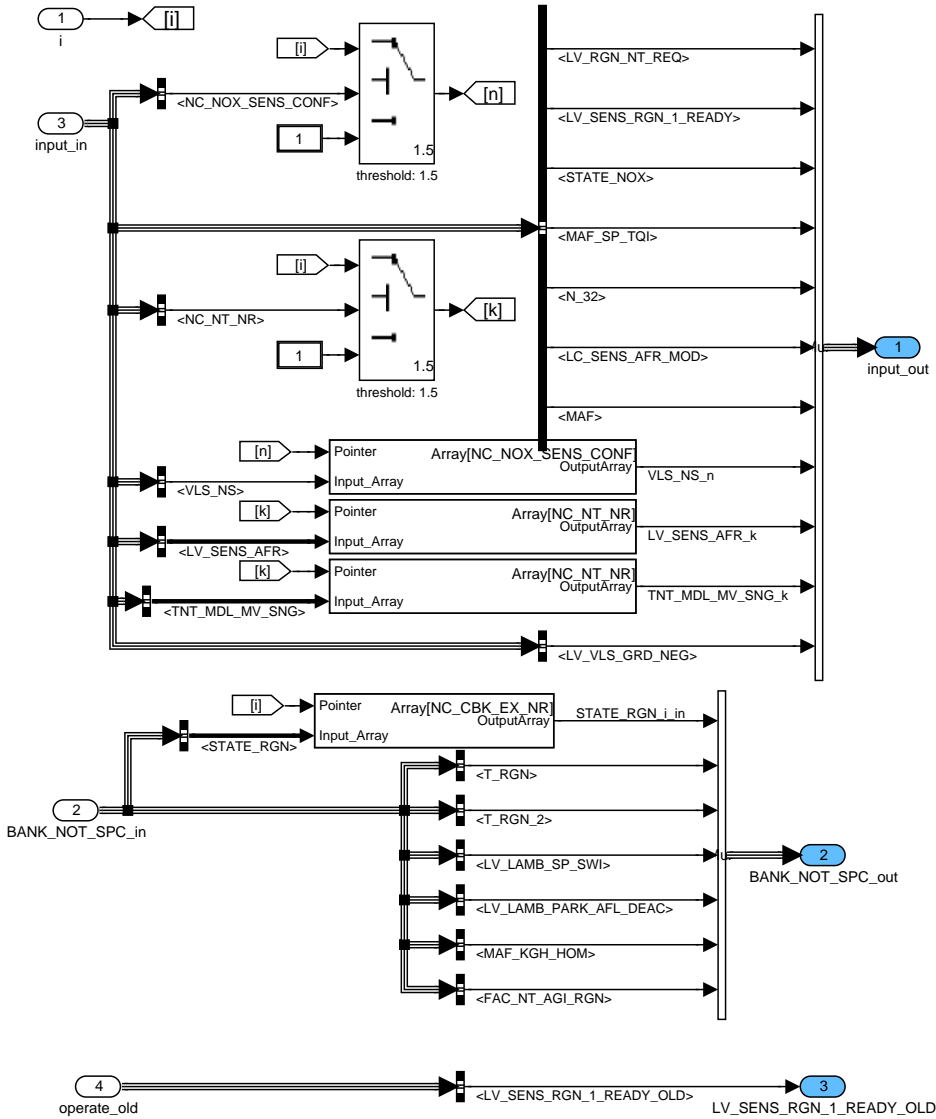


Figure 7.77.13: :

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### 7.77.2.2.1.2 SECTION 2: Calculation of the Regeneration State and the Regeneration Lambda Setpoint

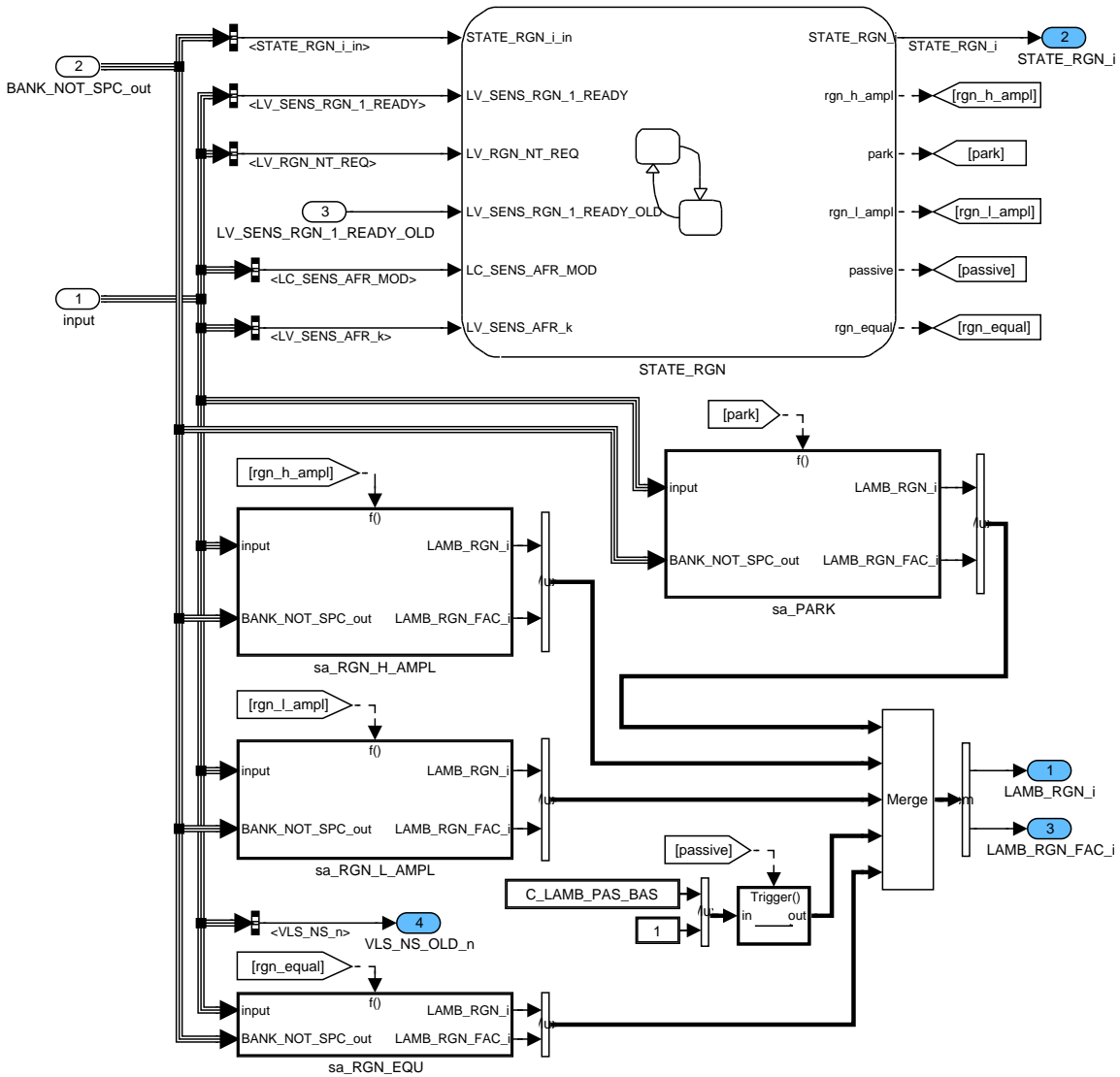


Figure 7.77.14: :

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7.77.2.2.1.2.1 STATE\_RGN

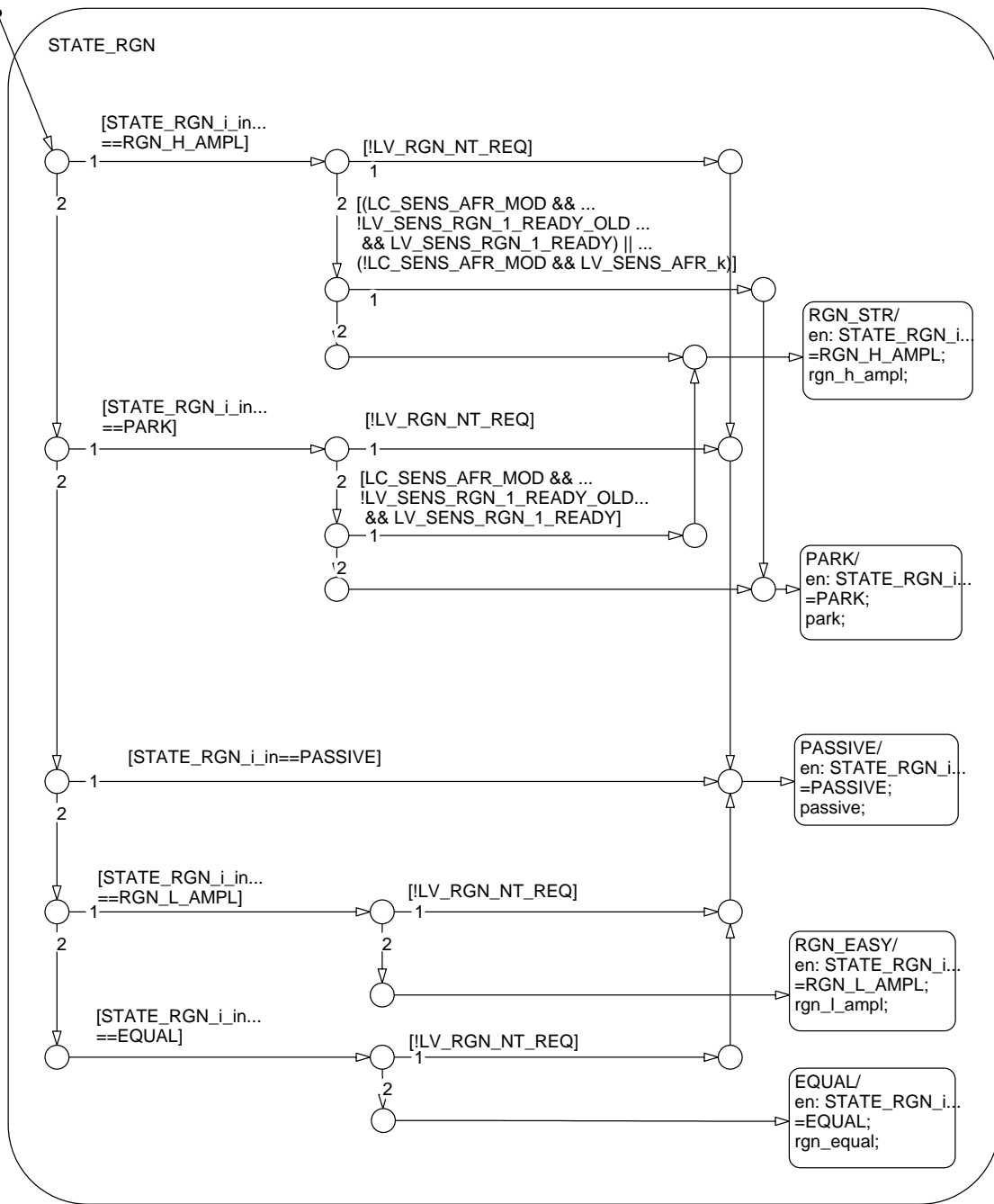



Figure 7.77.15: :

7.77.2.2.1.2.2 Regeneration with High Amplitude

The high amplitude is set for bank which should be regenerated faster. This state is also entered when the bank was initialized with the state "PARK" and the first regeneration is finished. The lambda value is limited to the maximal value to avoid a jump to lean condition.

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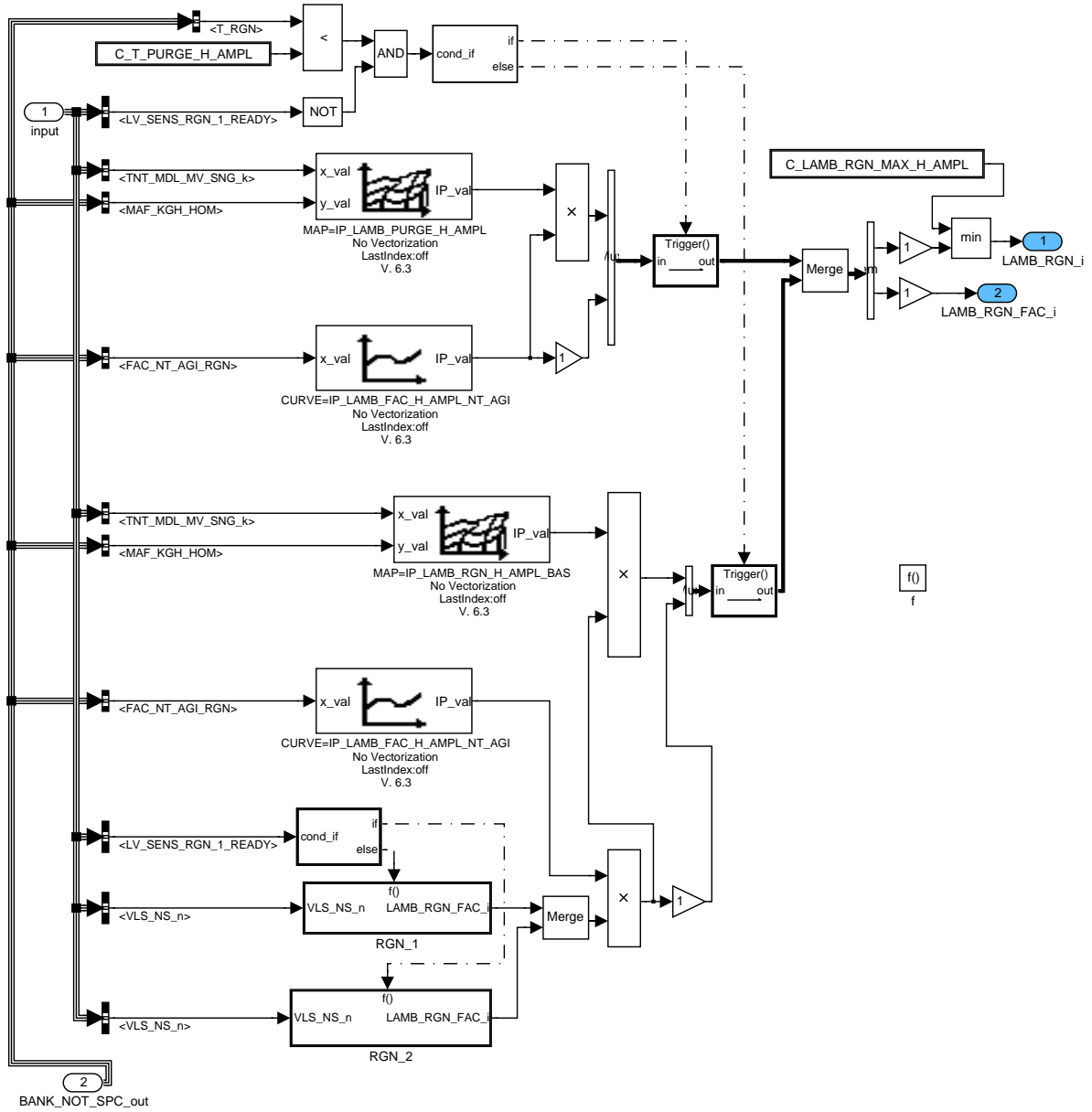


Figure 7.77.16: :

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**7.77.2.2.1.2.2.1 Regeneration with High Amplitude - calculation of the Correction Factor at the first regeneration**

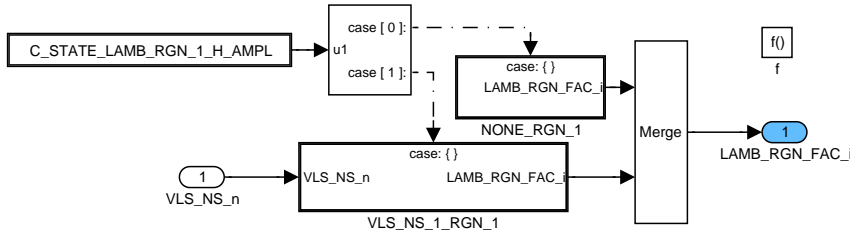


Figure 7.77.17: :

**7.77.2.2.1.2.2.1.1 Regeneration with High Amplitude - 1st regeneration - no Lambda correction**



Figure 7.77.18: :

**7.77.2.2.1.2.2.1.2 Regeneration with High Amplitude - 1st regeneration - Lambda correction by binary O2 signal of NOx sensor**

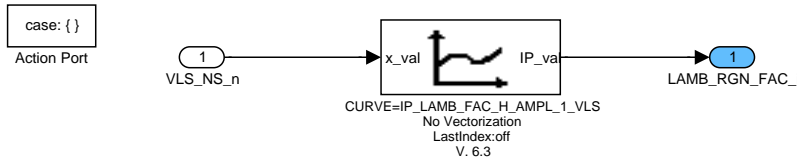


Figure 7.77.19: :

**7.77.2.2.1.2.2.2 Regeneration with High Amplitude - calculation of the Correction Factor at the second regeneration**

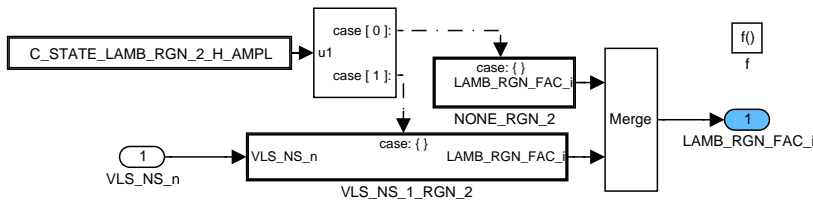


Figure 7.77.20: :

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### 7.77.2.2.1.2.2.2.1 Regeneration with High Amplitude - 2nd regeneration - no Lambda correction

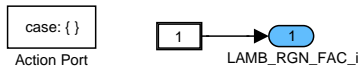


Figure 7.77.21: :

### 7.77.2.2.1.2.2.2.2 Regeneration with High Amplitude - 2nd regeneration - Lambda correction by binary O2 signal of NOx sensor

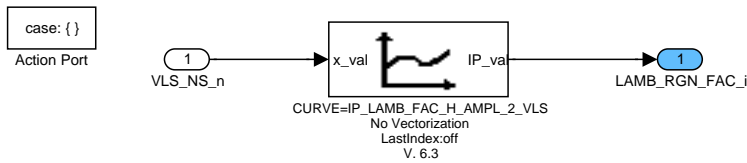


Figure 7.77.22: :

### 7.77.2.2.1.2.3 Park phase for lambda setpoint

When the bank regenerated with high amplitude is finished, the lambda value is set to neutral or to lean combustion condition. The bank can be also at entering in regeneration initialized with the state "PARK".

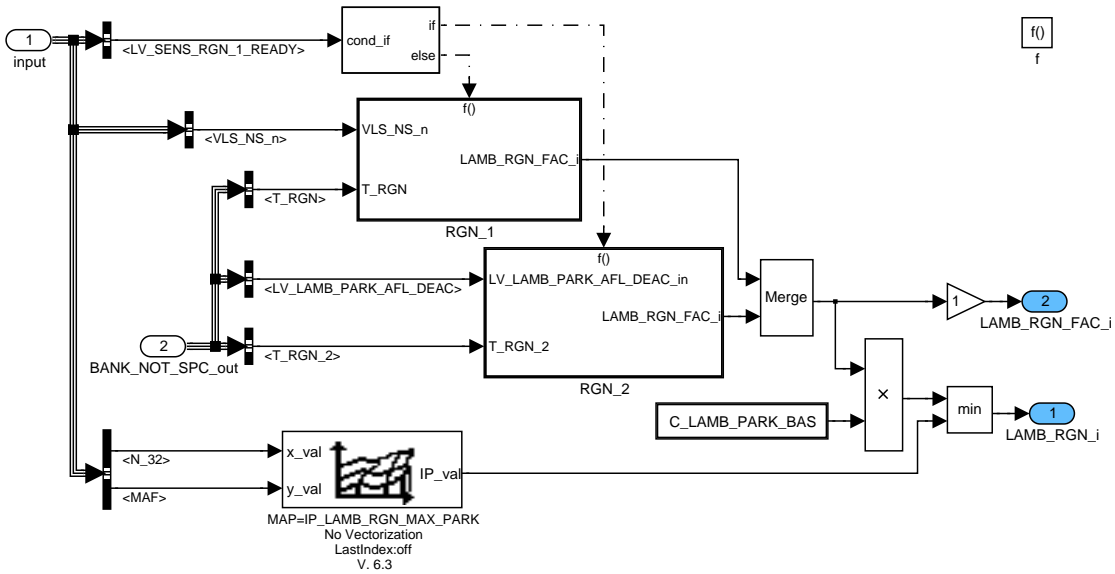


Figure 7.77.23: :

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### 7.77.2.2.1.2.3.1 Park phase for lambda setpoint - calculation of the Correction Factor at the first part of regeneration

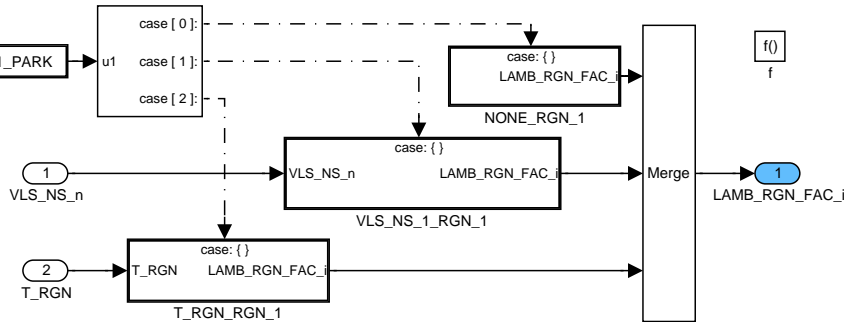


Figure 7.77.24: :

#### 7.77.2.2.1.2.3.1.1 Park phase - 1st regeneration - no Lambda correction



Figure 7.77.25: :

#### 7.77.2.2.1.2.3.1.2 Park phase - 1st regeneration - Lambda correction by binary O2 signal of NOx sensor

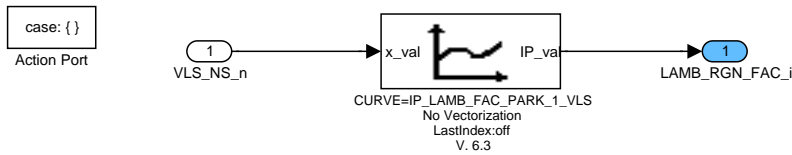


Figure 7.77.26: :

#### 7.77.2.2.1.2.3.1.3 Park phase - 1st regeneration - Lambda correction by regeneration time

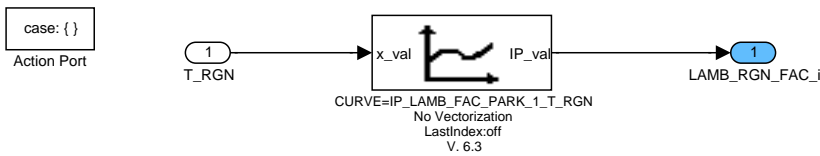


Figure 7.77.27: :

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### 7.77.2.2.1.2.3.2 Park phase for lambda setpoint - calculation of the Correction Factor at the part of second regeneration

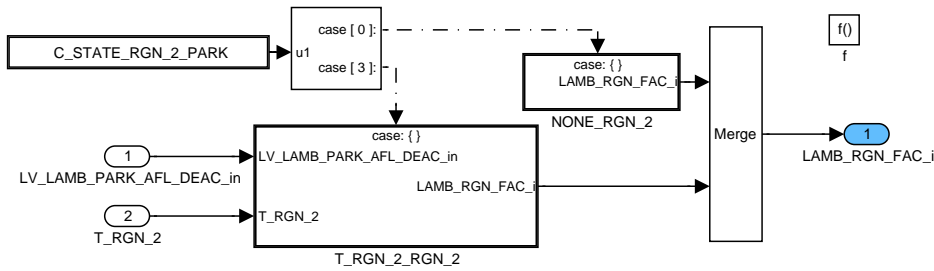


Figure 7.77.28: :

#### 7.77.2.2.1.2.3.2.1 Park phase - 2nd regeneration - no Lambda correction



Figure 7.77.29: :

#### 7.77.2.2.1.2.3.2.2 Park phase - 2nd regeneration - Lambda correction by regeneration time of 2nd regeneration

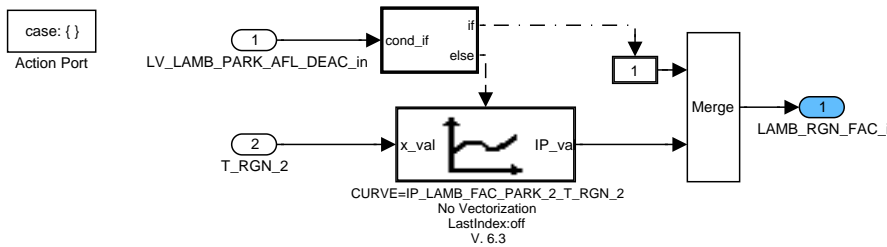


Figure 7.77.30: :

#### 7.77.2.2.1.2.4 Regeneration with Low Amplitude

The low amplitude is set for bank which should be regenerated longer. The lambda value is limited to the maximal value to avoid a jump to lean condition.

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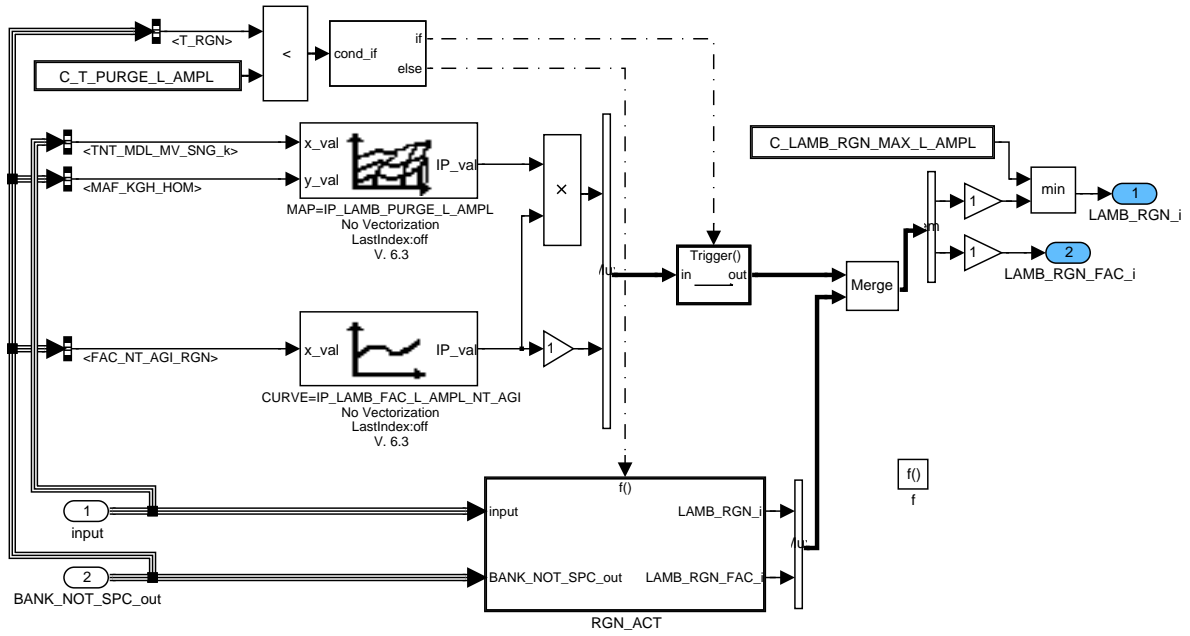



Figure 7.77.31: :

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### 7.77.2.2.1.2.4.1 Regeneration with Low Amplitude - calculation of the Correction Factor

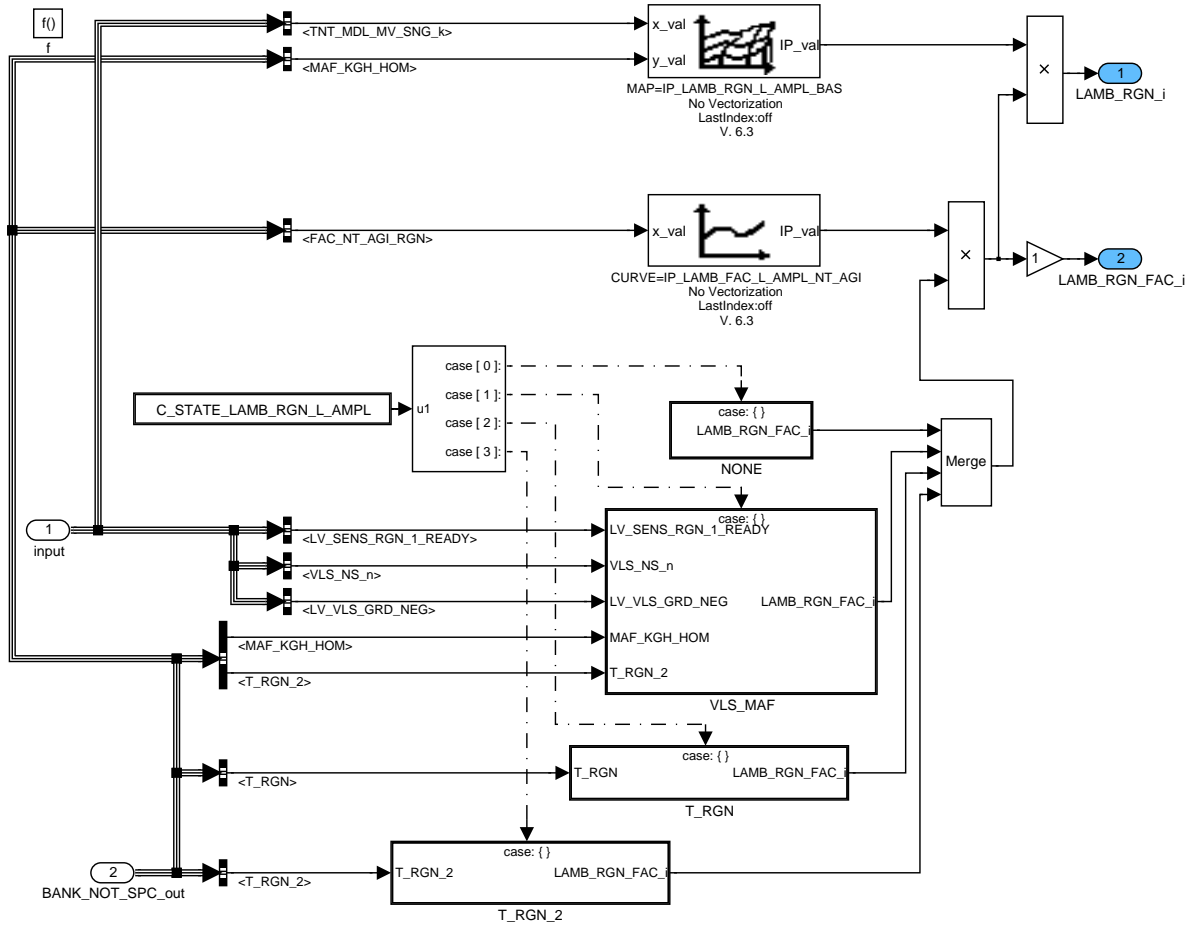


Figure 7.77.32: :

#### 7.77.2.2.1.2.4.1.1 Regeneration with Low Amplitude - no Lambda correction



Figure 7.77.33: :

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### 7.77.2.2.1.2.4.1.2 Regeneration with Low Amplitude - Lambda correction by binary O2 signal of NOx sensor and air mass flow

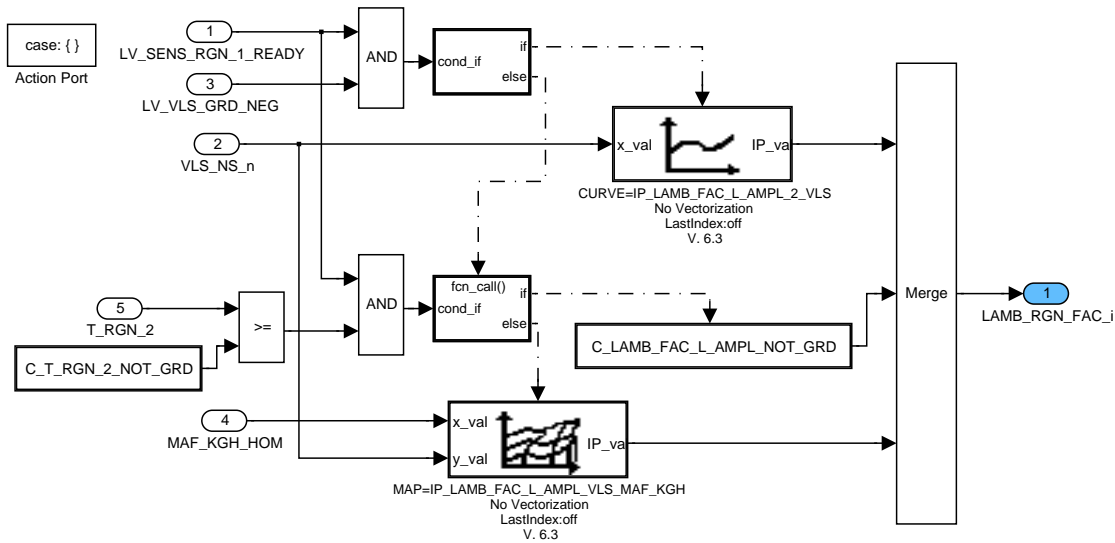


Figure 7.77.34: :

### 7.77.2.2.1.2.4.1.3 Regeneration with Low Amplitude - Lambda correction by regeneration time

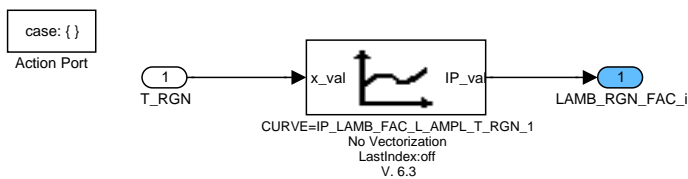


Figure 7.77.35: :

### 7.77.2.2.1.2.4.1.4 Regeneration with Low Amplitude - Lambda correction by regeneration time of 2nd regeneration

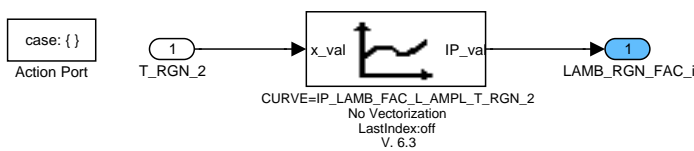


Figure 7.77.36: :

### 7.77.2.2.1.2.5 Regeneration with equal amplitude

The equal amplitude is set for both banks as long as the NOx sensor VLS signal is not valid.

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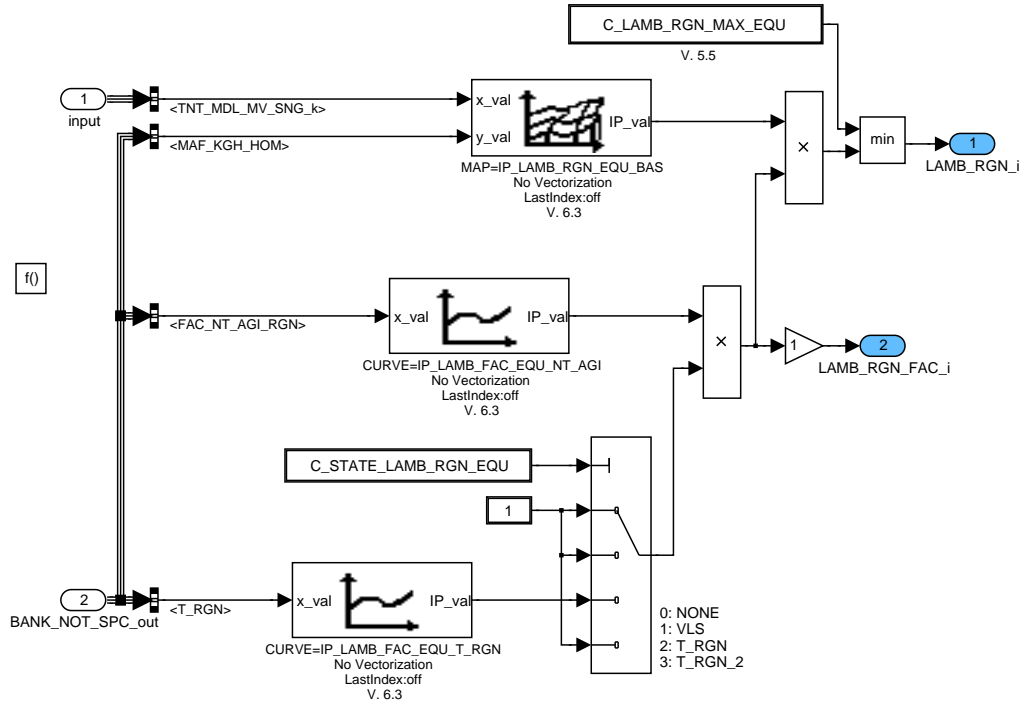


Figure 7.77.37: :

7.77.2.2.1.3 Signal combination to signal vectors

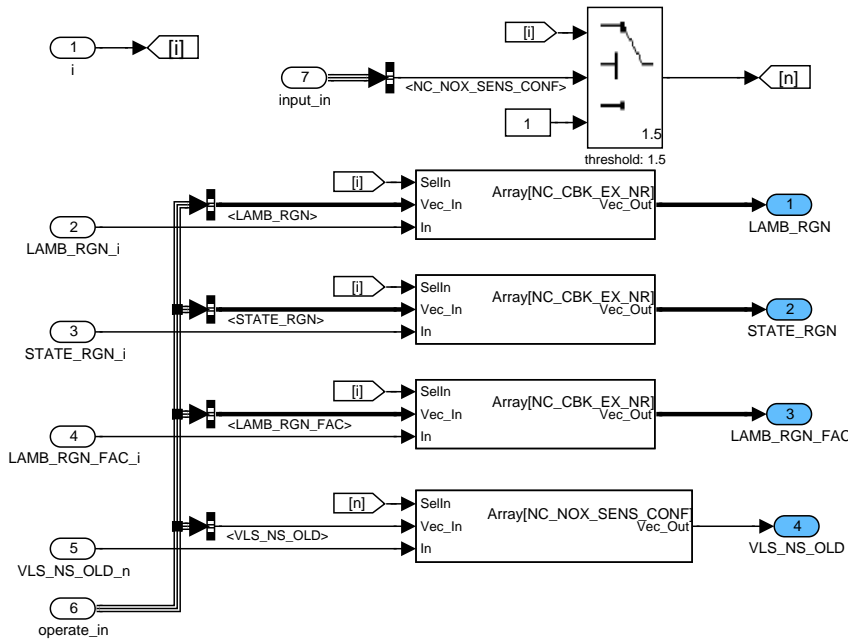


Figure 7.77.38: :

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## 7.78 Loading determination for catalyst purge function

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_ADD_MAIN_CAT_PURGE [NC_CBK_EX_NR]	O/V	0... FFH	0... 1.9921875	0.0078125	-
additional weighting factor for pre and main cat differences					
LV_CAT_PURGE_POST_PUC_TRIG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
auxiliary flag indicating that cat purge after PUC was triggered					
LV_CAT_PURGE_ST [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that cat purge can be started (set for one sample step)					
LV_GS_SCC_OLD	-	0... 1H	0 ...1	1	-
old value for cylinder cut of during gear shift					
LV_LAMB_SP_CH_ACT_CAT_PURGE [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicates that LAMB_SP_CH was under threshold					
LV_PUC_OLD [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
auxiliary flag for edge detection of LV_PUC					
LV_SAWUP_OLD [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
auxiliary flag for edge detection of LV_SAWUP					
LV_ST_END_OLD [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
auxiliary flag for edge detection of LV_ST_END					
O2L_RLS_SP_PCAT_PURGE [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 2.61684896	399.306e3	g
oxygen loading to be purged (released) during pre cat purge					
STATE_CAT_PURGE [NC_CBK_EX_NR]	V	0H	CAT_PURGE_	-	-
			OFF		
		1H	CAT_PURGE_		
			PUC		
		2H	CAT_PURGE_		
	SA				
3H	CAT_PURGE_				
	HST				
4H	CAT_PURGE_				
	CH				
5H	CAT_PURGE_				
	GS_SCC				
state indicating the activation reason of cat purge					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------


**Input data:**

EFF_CAT_DIAG [NC_CBK_EX_NR] {p. 5535}	LAMB_SP_CH [NC_CBK_EX_NR] {p. 2169}	LV_CAT_PURGE_ACT [NC_CBK_EX_NR] {p. 2927}	LV_FCUT_IND {p. 2295}
LV_GS_SCC {p. 2942}	LV_INH_CAT_PURGE [NC_CBK_EX_NR] {p. 2942}	LV_PUC {p. 1720}	LV_SAWUP {p. 804}
LV_ST_END {p. 1720}	MAF_INT_GS_SCC {p. 2942}	MAF_INT_PUC_ACT {p. 2942}	NC_CBK_EX_NR {p. 1829}
O2L_RLS_PCAT_PURGE [NC_CBK_EX_NR] {p. 2927}	TCO_ST {p. 1100}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_ADD_MAIN_CAT_PURGE_CH [NC_CBK_EX_NR]	-	0... FFH	0... 1.9921875	0.0078125	-
additional weighting factor to define oxygen loading for main cat purge after catalyst heating phase					
C_FAC_ADD_MAIN_CAT_PURGE_GS_SCC [NC_CBK_EX_NR]	-	0... FFH	0... 1.9921875	0.0078125	-
additional weighting factor for pre and main cat differences in case of gear shift with cylinder cut off					
C_FAC_ADD_MAIN_CAT_PURGE_HST [NC_CBK_EX_NR]	-	0... FFH	0... 1.9921875	0.0078125	-
additional weighting factor to define oxygen loading for main cat purge after hot start					
C_FAC_ADD_MAIN_CAT_PURGE_SA [NC_CBK_EX_NR]	-	0... FFH	0... 1.9921875	0.0078125	-
additional weighting factor to define oxygen loading for main cat purge after secondary air injection					
C_LAMB_SP_CH_THD_CAT_PURGE	-	0... 7FFFH	0... 31.9990234	97.6563e3	-
Threshold for lambda setpoint out of catalyst heating to activate catalyst purge					
C_MAF_INT_GS_SCC_MIN_CAT_PURGE	-	0... FFFFH	0... 2912.67	0.04444444	g
minimum air mass flow integral during cylinder cut off at gear shift to activate cat purge function					
C_MAF_INT_PUC_ACT_MIN_CAT_PURGE	-	0... FFFFH	0... 2912.67	0.04444444	g
minimum air mass flow integral during PUC to activate cat purge function					
C_O2L_RLS_MAX_PCAT_PURGE [NC_CBK_EX_NR]	-	0... FFFFH	0... 2.61684896	399.306e3	g
upper limit of oxygen loading set point for pre cat purge					
C_O2L_RLS_SP_PCAT_PURGE_CH [NC_CBK_EX_NR]	-	0... FFFFH	0... 2.61684896	399.306e3	g
oxygen loading to be purged after catalyst heating lean phase					
C_O2L_RLS_SP_PCAT_PURGE_HST [NC_CBK_EX_NR]	-	0... FFFFH	0... 2.61684896	399.306e3	g
oxygen loading to be purged after hot start					
C_O2L_RLS_SP_PCAT_PURGE_SA [NC_CBK_EX_NR]	-	0... FFFFH	0... 2.61684896	399.306e3	g
oxygen loading to be purged after secondary air injection					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_THD_CAT_PURGE_HST	-	0... FEH	0... 142.5	0.75	°C
temperature threshold for hot start detection of cat purge function					
IP_FAC_O2L_RLS_SP_PCAT_PURGE [NC_CBK_EX_NR]	-	0... FFH	0... 0.99609375	0.00390625	-
LDP_TEMP_CAT_IP_FAC_PCAT_PURGE	6	0... 7FFFH	0... 1774.79	0.0625	°C
LDPM_EFF_CAT_DIAG_1_EGTR	6	0... FFH	0... 1.9921875	0.0078125	-
weighting factor for oxygen loading to be released during pre cat purge					
IP_O2L_RLS_SP_PCAT_PURGE_PUC [NC_CBK_EX_NR]	-	0... FFFFH	0... 2.61684896	399.306e3	g
LDP_MAF_INT_PUC_ACT_IP_O2L_RLS	6	0... FFFFH	0... 2912.67	0.04444444	g
oxygen loading to be purged after pull cut off phase					

### 7.78.1 EGTR\_DEFSPCENRD0

This function determines the oxygen loading for different catalyst enrichment (purge) cases that is to be released during pre cat purge. The oxygen loading to be released during main cat purge is defined in the main function based on the oxygen loading for the pre catalyst. Furthermore a prioritization of the different cases is included.

The different enrichment cases after lean air fuel mixture condition, that are described within this function, are catalyst purge after trailing throttle fuel cutoff phase (PUC), after secondary air injection (SA), after hot start (HST) and after catalyst heating (CH) with lean air fuel mixture condition. after cylinder cutoff at gear shifting (GS\_SCC).

NC\_CBK\_EX\_NR defines the number of exhaust banks.

For vector elements, the variable extension `_i` is used in the model instead of `[i]` as found in the textual description.

#### Application Condition

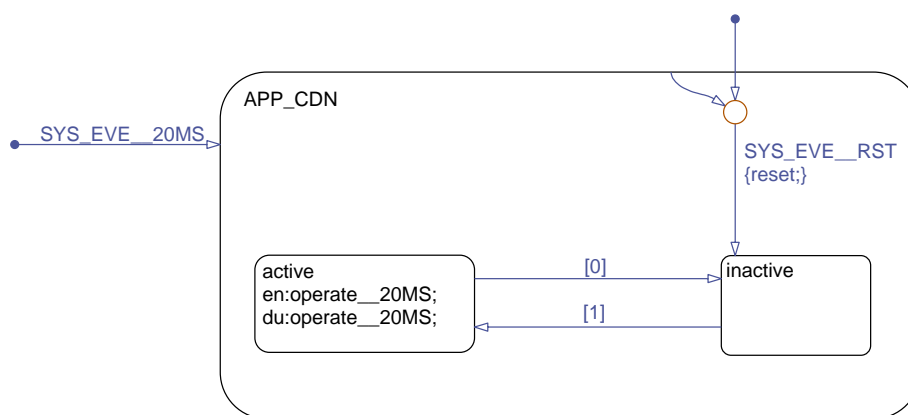



Figure 7.78.1: EGTR\_DEFSPCENRD0/APP\_CDN/Chart

#### Function Description

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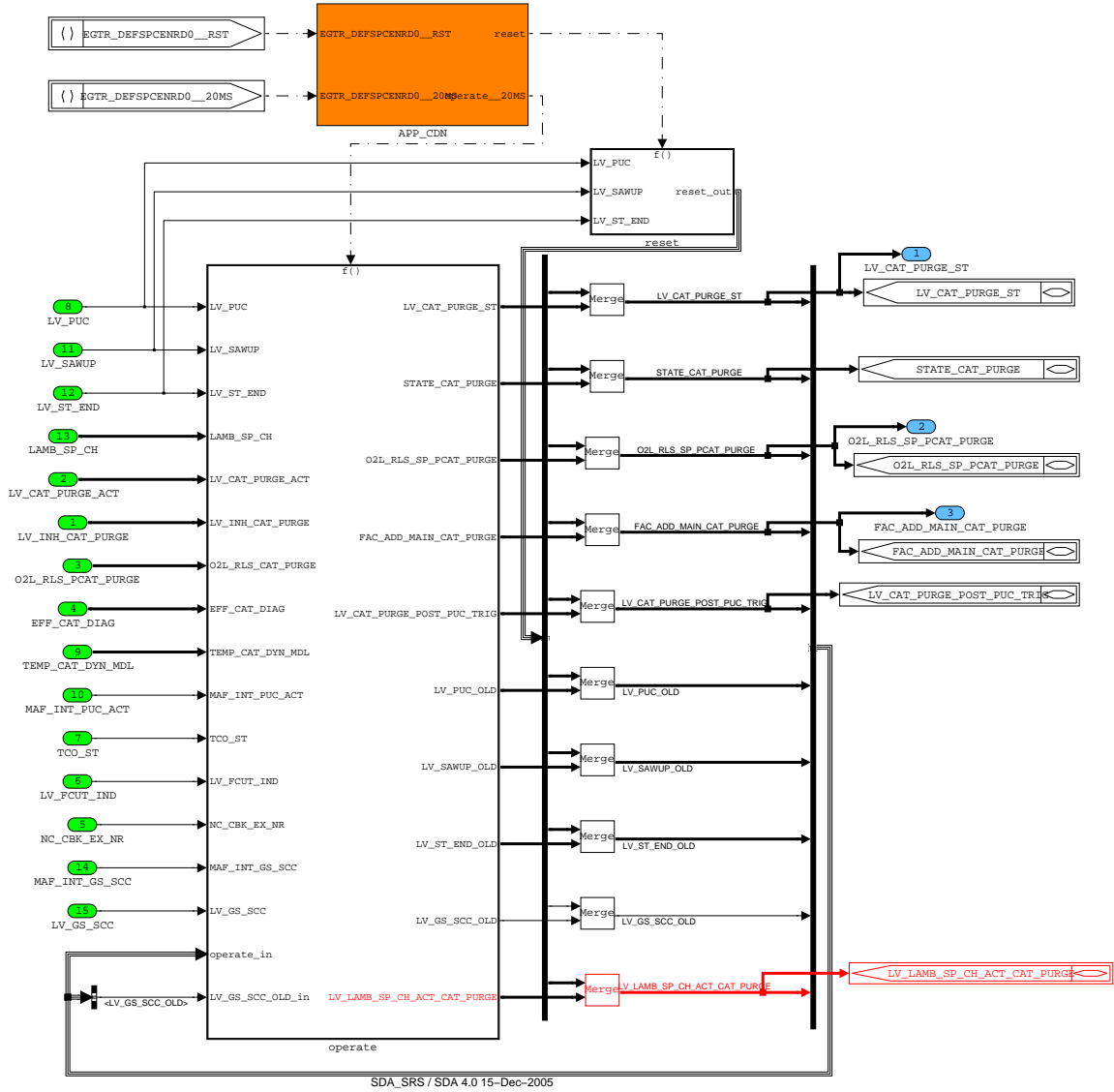


Figure 7.78.2: EGTR\_DEFSPCENRD0

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### 7.78.1.1 SUBFUNCTION: operate

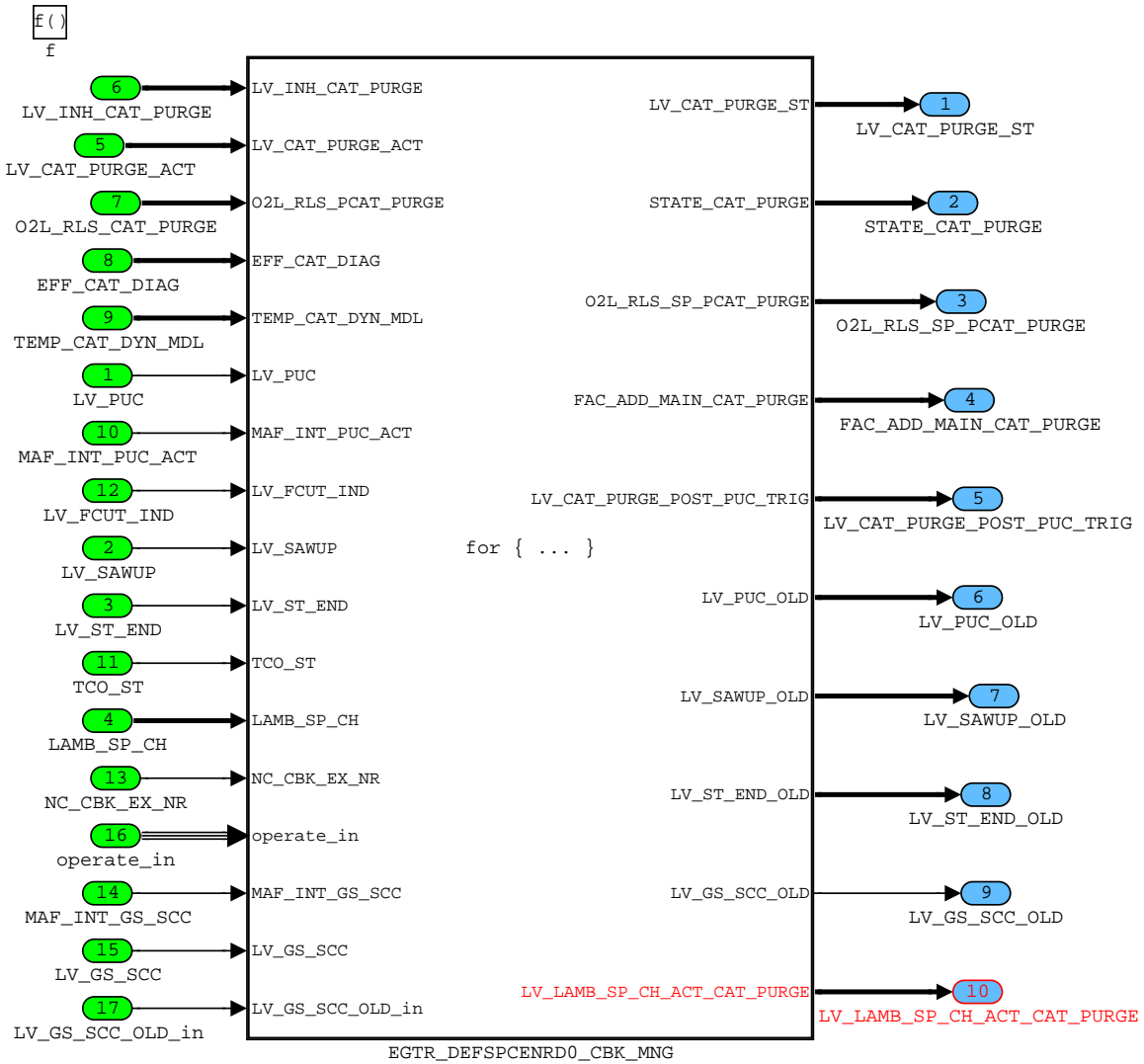


Figure 7.78.3: EGTR\_DEFSPCENRD0/operate

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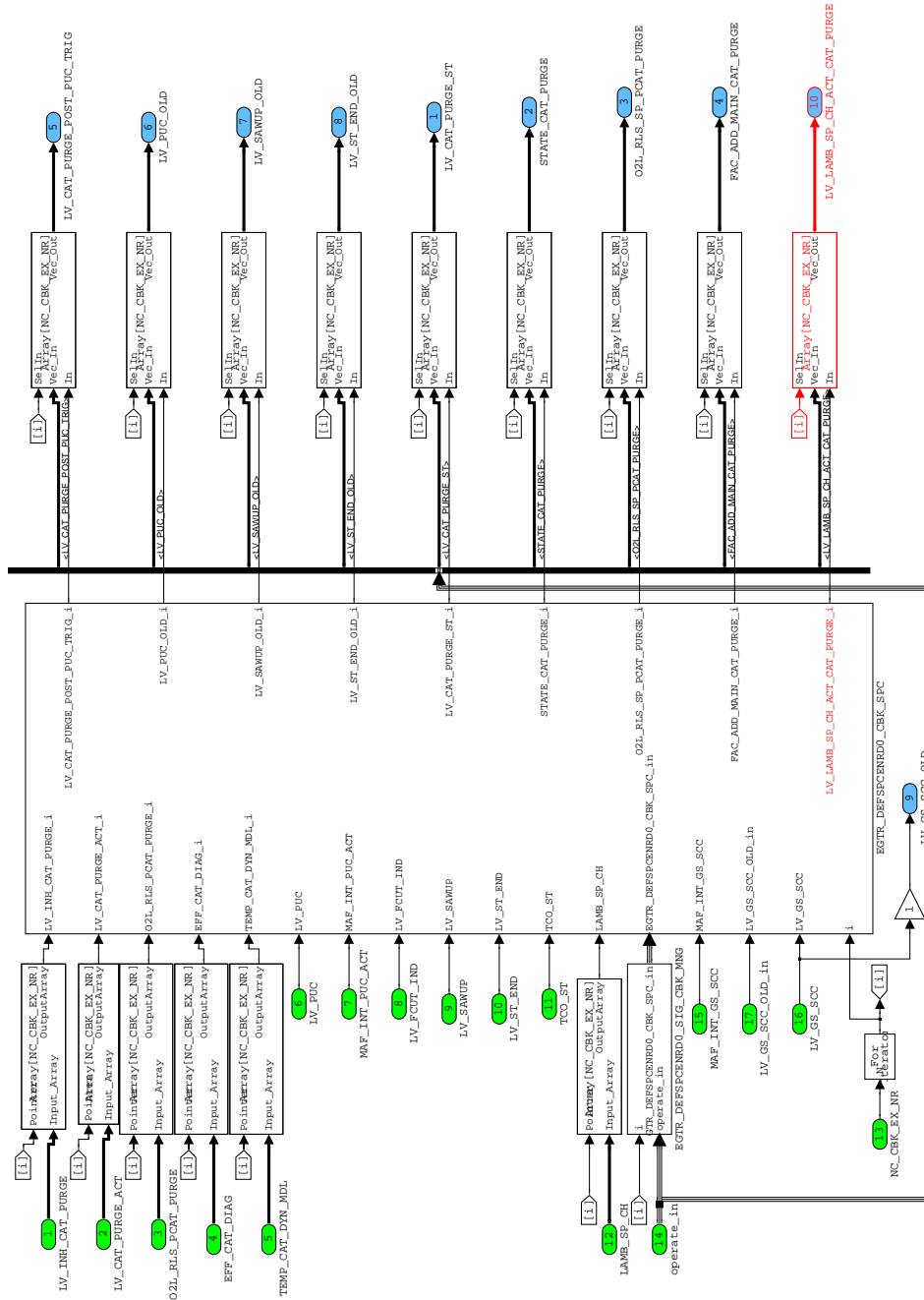


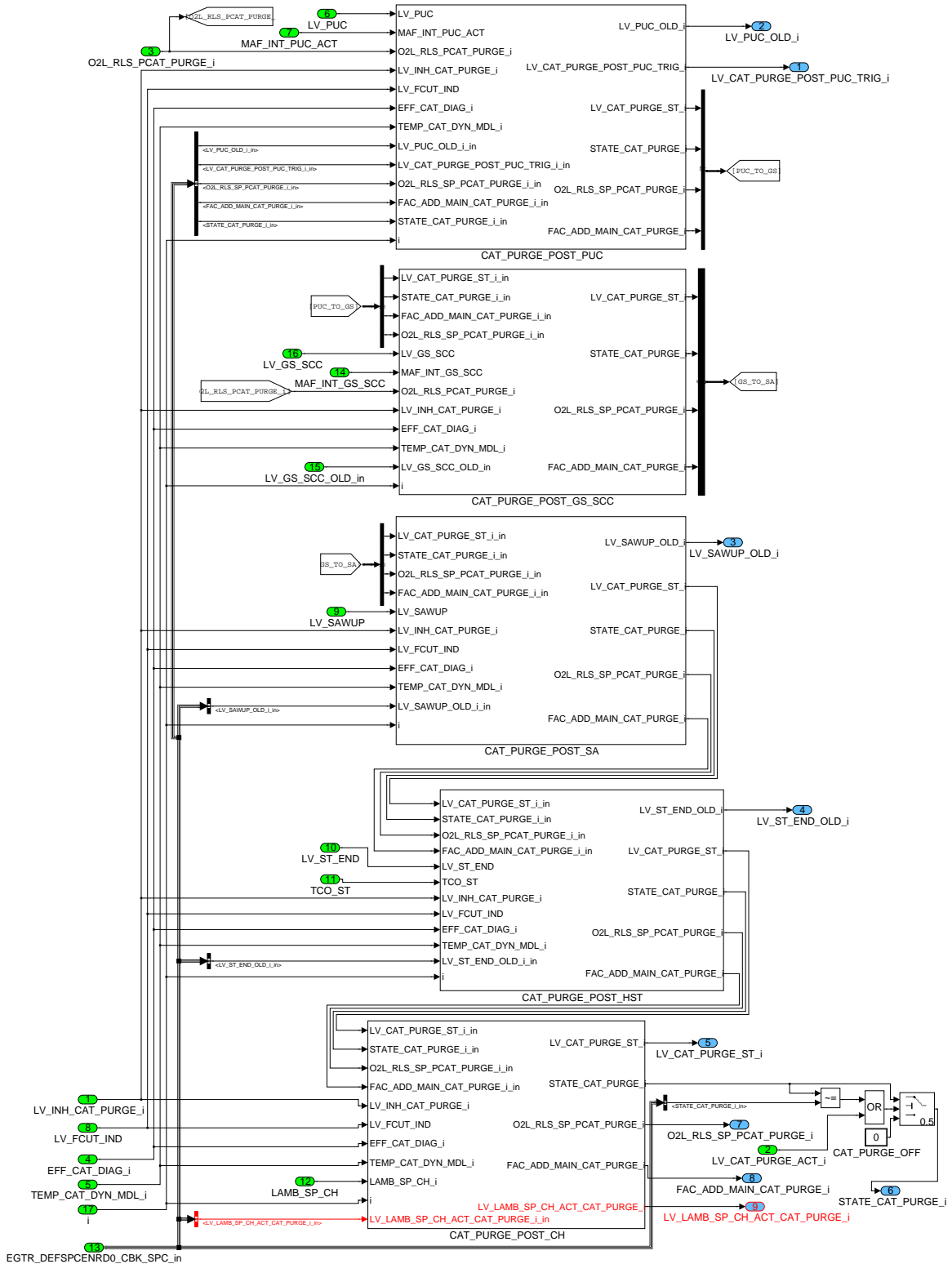
Figure 7.78.4: EGTR\_DEFSPCENRD0/operate/EGTR\_DEFSPCENRD0\_CBK\_MNG

### Different catalyst purge cases

If LV\_CAT\_PURGE\_ACT[i] is or gets 0 and STATE\_CAT\_PURGE[i] is not changing (compared to one sample step before) then the state is set to CAT\_PURGE\_OFF .

When one of the different cat purge cases gets active the flag LV\_CAT\_PURGE\_ST[i] is set for one sample step to inform the main function.


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Figure 7.78.5: EGTR\_DEFSPCENRD0/operate/EGTR\_DEFSPCENRD0\_CBK\_MNG/EGTR\_DEFSPCENRD0\_CBK\_SPC

**Catalyst purge after catalyst heating with lean air fuel mixture condition**

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Cat purge after catalyst heating is activated at falling edge of LV\_LAMB\_CH. Cat purge after trailing throttle fuel cutoff phase must not be active, no cylinder must be shut off and the inhibition flag must not be set.

The cat purge state is set to CAT\_PURGE\_CH.

The oxygen loading to be released during pre catalyst purge is defined by C\_O2L\_RLS\_SP\_PCAT\_PURGE\_CH multiplied by a catalyst temperature and efficiency depending factor. An additional factor to calculate the main catalyst loading is set by C\_FAC\_ADD\_MAIN\_CAT\_PURGE\_CH.

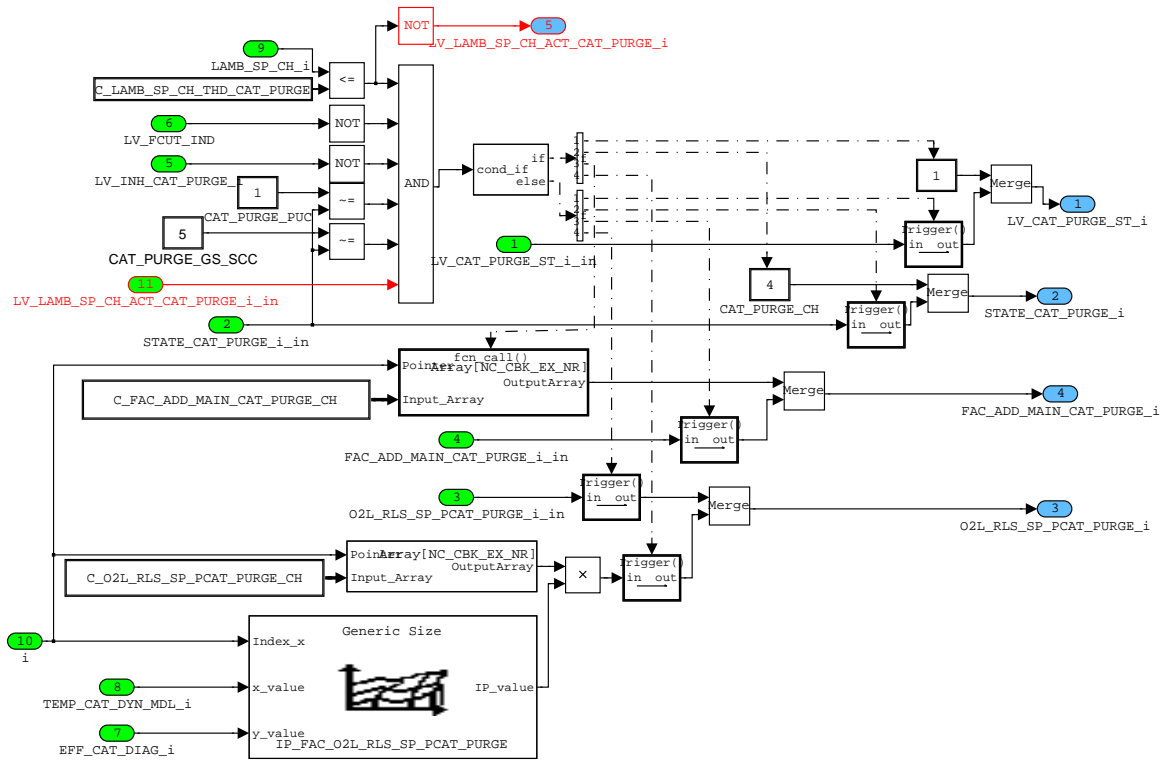


Figure 7.78.6: EGTR\_DEFSPCENRD0/operate/EGTR\_DEFSPCENRD0\_CBK\_MNG/EGTR\_DEFSPCENRD0\_CBK\_SPC/CAT\_PURGE\_POST\_CH

### Catalyst purge after cylinder cut off at gear shifting

Cat purge after cylinder cutoff at gear shifting is activated by a falling edge of LV\_GS\_SCC. It is similar to purge after PUC and has the same priority.

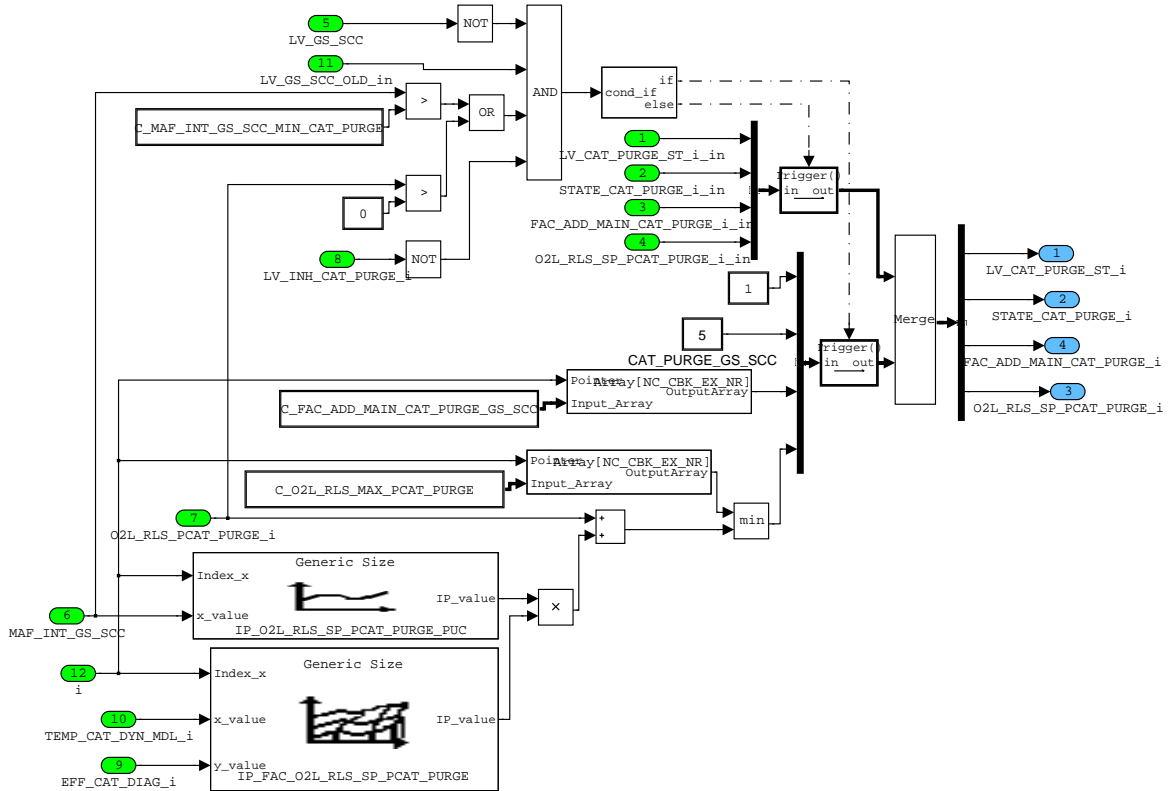


Figure 7.78.7: EGTR\_DEFSPCENRD0/operate/EGTR\_DEFSPCENRD0\_CBK\_MNG/  
EGTR\_DEFSPCENRD0\_CBK\_SPC/CAT\_PURGE\_POST\_GS\_SCC

**Catalyst purge after hot start**

Cat purge after hot start is activated at rising edge of LV\_ST\_END when the cooling temperature at start (TCO\_ST) is above a calibration threshold. No other cat purge case must be active, no cylinder must be shut off and the inhibition flag must not be set.

The cat purge state is set to CAT\_PURGE\_HST .

The oxygen loading to be relased during pre catalyst purge is defined by C\_O2L\_RLS\_SP\_PCAT\_PURGE\_HST multiplied by a catayst temperature and efficiency depending factor. An additional factor to calculate the main catayst loading is set by C\_FAC\_ADD\_MAIN\_CAT\_PURGE\_HST.

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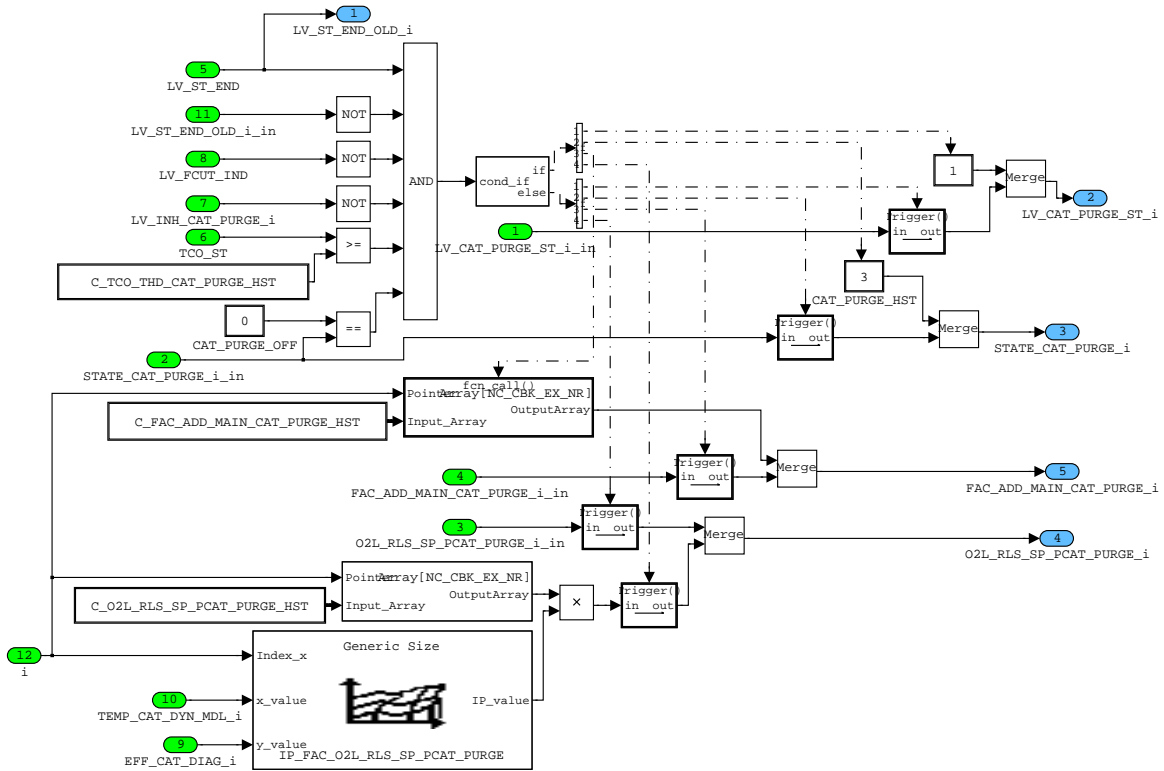


Figure 7.78.8: EGTR\_DEFSPCENRD0/operate/EGTR\_DEFSPCENRD0\_CBK\_MNG/  
EGTR\_DEFSPCENRD0\_CBK\_SPC/CAT\_PURGE\_POST\_HST

### Catalyst purge after trailing throttle fuel cut off phase

Cat purge after trailing throttle fuel cutoff (PUC) is activated at falling edge of LV\_PUC. The inhibition flag must not be set and the air mass that was integrated during PUC must be above a minimum threshold or during last cat purge the pre cat purge was not finished ( $O2L\_RLS\_PCAT\_PURGE[i] > 0$ ).

If at least one cylinder is shut off ( $LV\_FCUT\_IND = 1$ ) when the conditions above are fulfilled then the start of cat purge is delayed till no cylinder is shut off any more. This is realized by means of the auxiliary flag  $LV\_CAT\_PURGE\_POST\_PUC\_TRIG[i]$ .

The cat purge state is set to  $CAT\_PURGE\_PUC$ .

The oxygen loading to be released during pre catalyst purge is defined by  $IP\_O2L\_RLS\_SP\_PCAT\_PURGE\_PUC$  multiplied by a catalyst temperature and efficiency depending factor. The result is limited to the maximum oxygen loading of the pre catalyst defined by  $C\_O2L\_RLS\_MAX\_PCAT\_PURGE$ . The additional factor to calculate the main catalyst loading is set to 1.

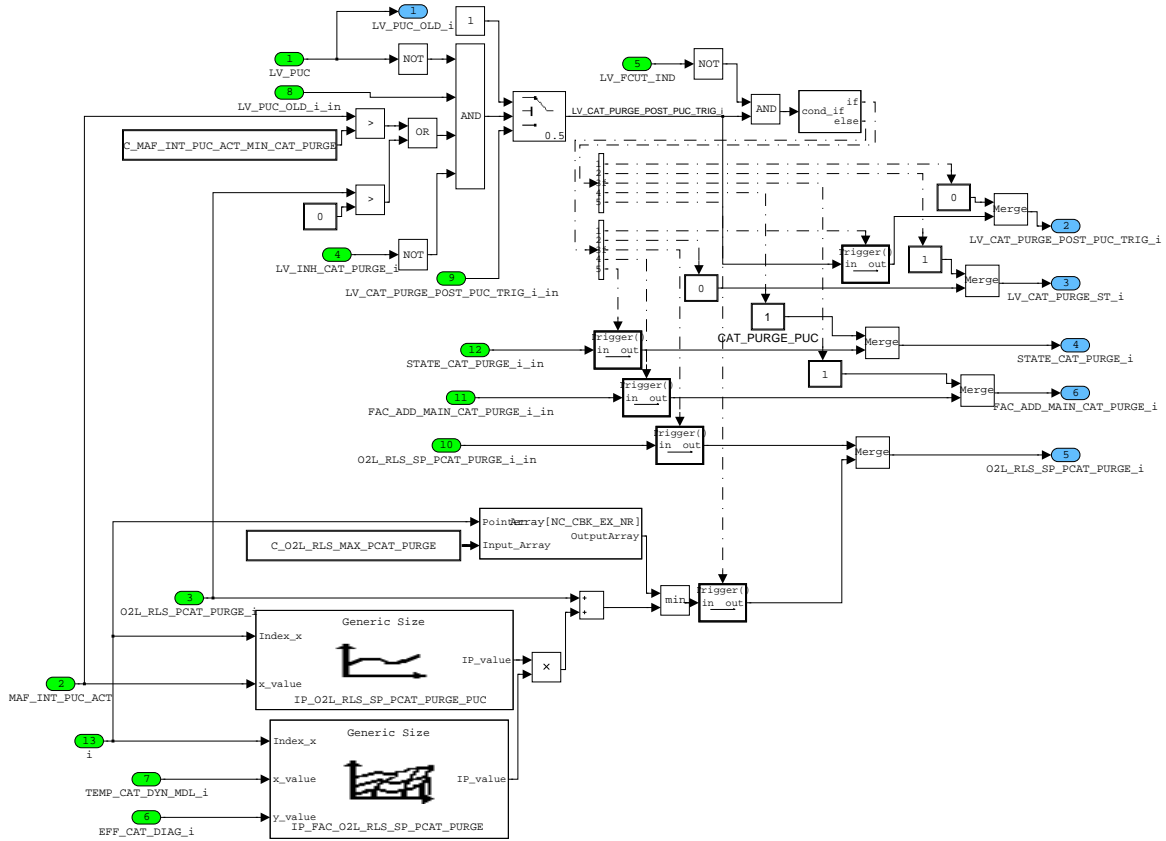


Figure 7.78.9: EGTR\_DEFSPCENRD0/operate/EGTR\_DEFSPCENRD0\_CBK\_MNG/  
EGTR\_DEFSPCENRD0\_CBK\_SPC/CAT\_PURGE\_POST\_PUC


**Catalyst purge after secondary air injection**

Cat purge after secondary air is activated at falling edge of LV\_SAWUP. Cat purge after trailing throttle fuel cutoff phase must not be active, no cylinder must be shut off and the inhibition flag must not be set.

The cat purge state is set to CAT\_PURGE\_SA .

The oxygen loading to be relased during pre catalyst purge is defined by C\_O2L\_RLS\_SP\_PCAT\_PURGE\_SA multiplied by a catayst temperature and efficiency depending factor. An additional factor to calculate the main catayst loading is set by C\_FAC\_ADD\_MAIN\_CAT\_PURGE\_SA.

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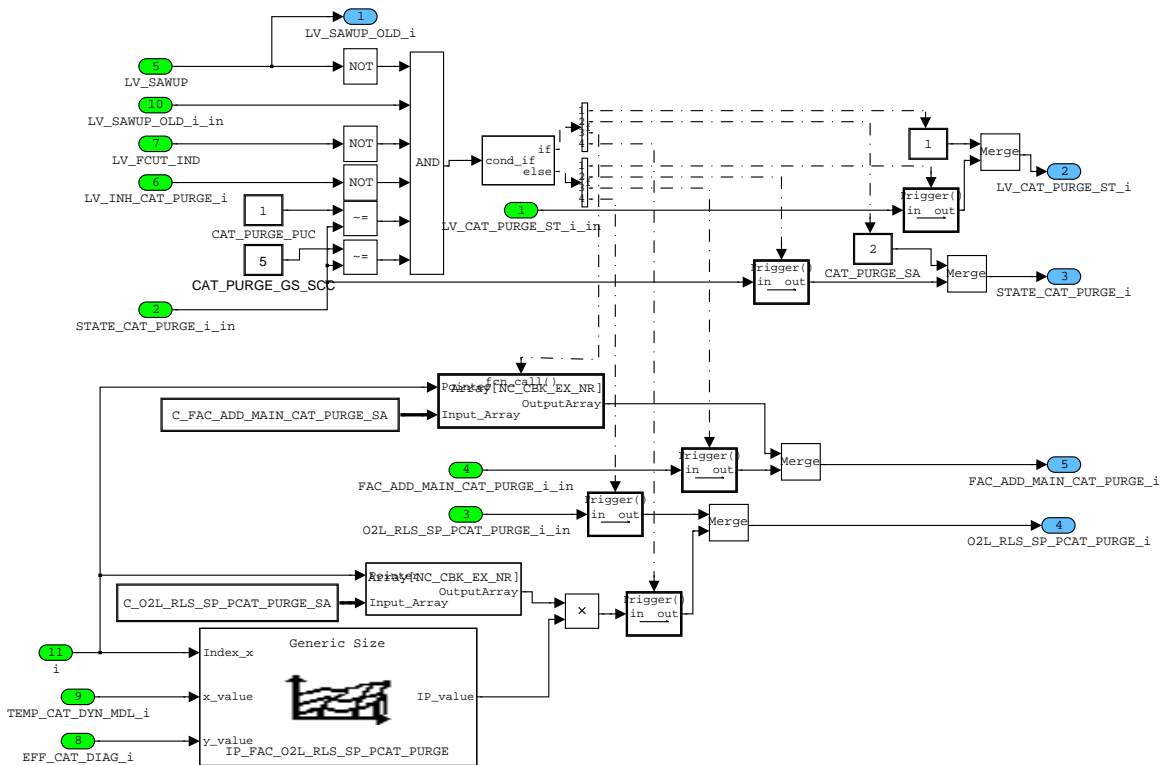


Figure 7.78.10: EGTR\_DEFSPCENRD0/operate/EGTR\_DEFSPCENRD0\_CBK\_MNG/EGTR\_DEFSPCENRD0\_CBK\_SPC/CAT\_PURGE\_POST\_SA

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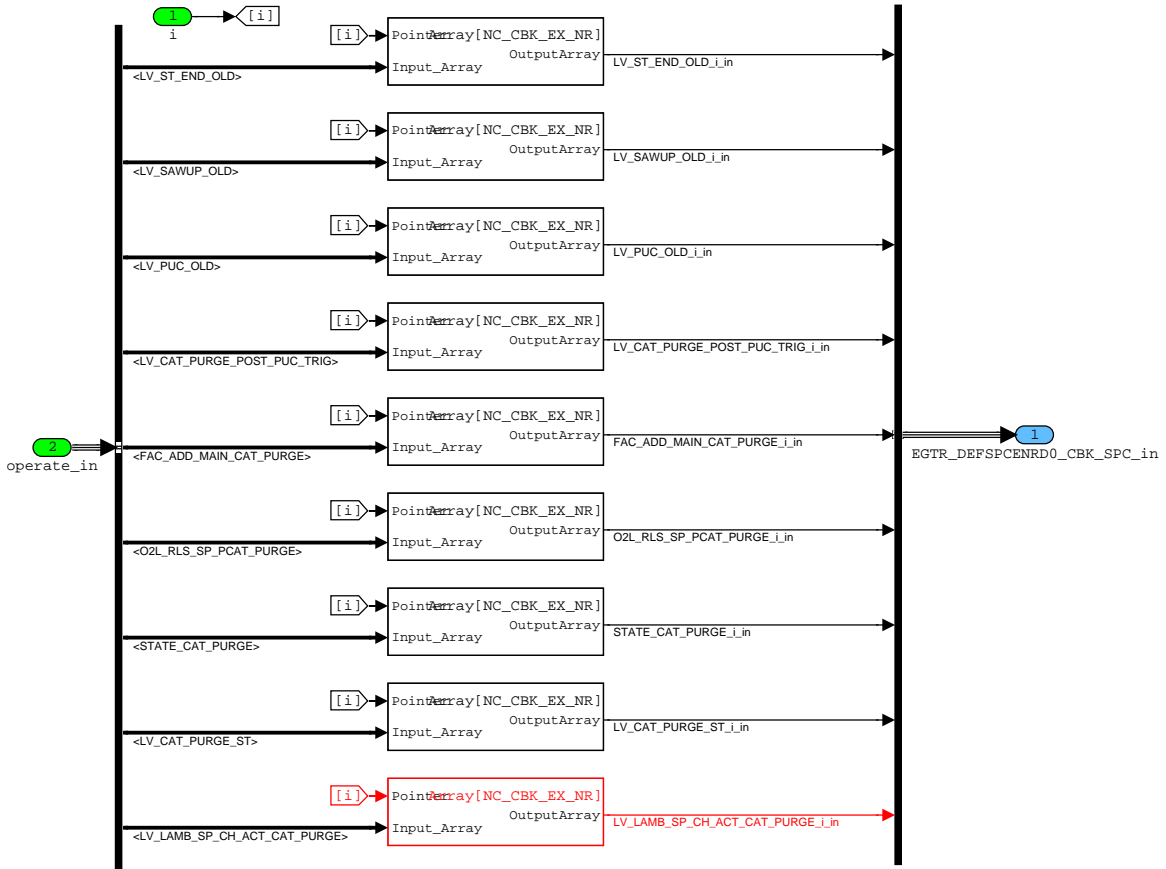


Figure 7.78.11: EGTR\_DEFSPCENRD0/operate/EGTR\_DEFSPCENRD0\_CBK\_MNG/EGTR\_DEFSPCENRD0\_SIG\_CBK\_MNG

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### 7.78.1.2 SUBFUNCTION: reset

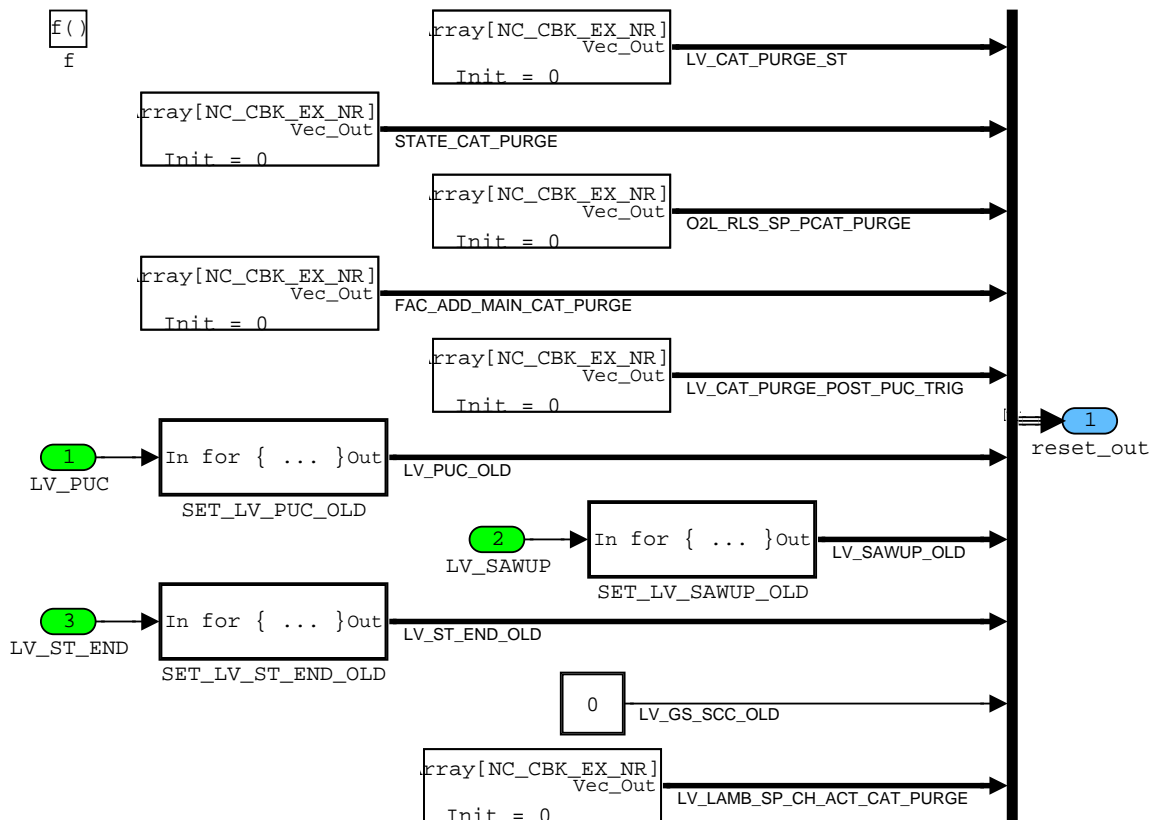


Figure 7.78.12: EGTR\_DEFSPCENRD0/reset

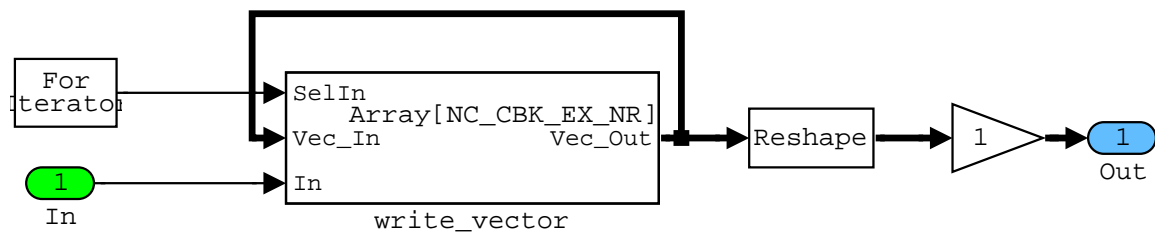


Figure 7.78.13: EGTR\_DEFSPCENRD0/reset/SET\_LV\_PUC\_OLD

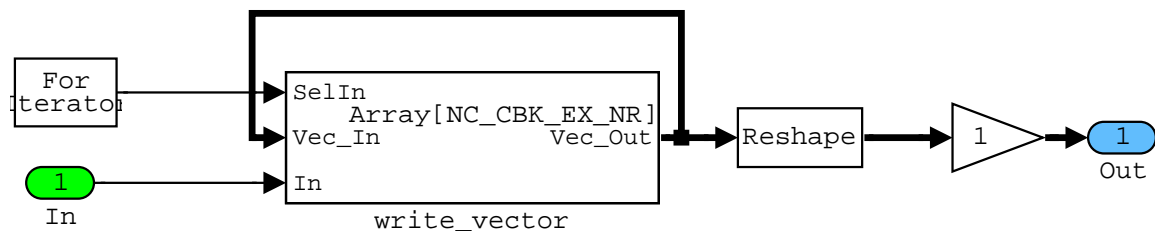


Figure 7.78.14: EGTR\_DEFSPCENRD0/reset/SET\_LV\_SAWUP\_OLD

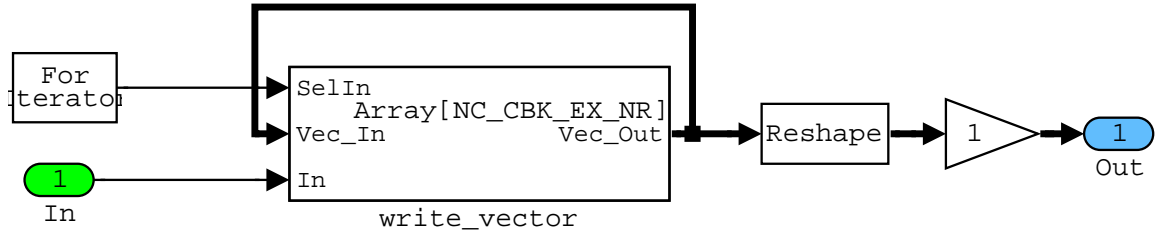



Figure 7.78.15: EGTR\_DEFSPCENRD0/reset/SET\_LV\_ST\_END\_OLD

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## 7.79 Catalyst purge function

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_O2L_RLS_CAT_PURGE [NC_CBK_EX_NR]	V	8000... 7FFFH	-0.25... 0.24999237061	7.62939e-6	-
temporary factor for O2 loading release calculation considering the lambda set point deviation					
LAMB_SP_DELTA_IT_CAT_PURGE [NC_CBK_EX_NR]	O/V	0... FFFH	0... 0.249939	61.0352e-6	-
lambda set point shift of cat purge function (internal value)					
LV_CAT_PURGE_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Status of catalyst purge activation					
LV_CAT_PURGE_MAIN_CAT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that cat purge for main cat is active					
LV_CAT_PURGE_PCAT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that cat purge for pre cat is active					
LV_VLS_DOWN_ACT_CAT_PURGE [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that downstream signal is/was below calibration threshold					
LV_VLS_MAIN_CAT_PRE_PURGE_ACT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that sensor signal after main cat is/was below calibration threshold for pre cat purge					
LV_VLS_MAIN_CAT_PURGE_ACT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that sensor signal after main cat is/was below calibration threshold					
O2L_RLS_ADD_CAT_PURGE [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-669.923556 ...669.923555	311.957e-9	g
oxygen loading to be added each sample step for cat purge air mass flow integral					
O2L_RLS_MAIN_CAT_PURGE [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-669.923556 ...669.923555	311.957e-9	g
oxygen loading to be released for main cat purge					
O2L_RLS_PCAT_PURGE [NC_CBK_EX_NR]	O/V	80000000... 7FFFFFFFH	-669.923556 ...669.923555	311.957e-9	g
oxygen loading to be released for pre cat purge					
O2L_RLS_REST_CAT_PURGE [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-669.923556 ...669.923555	311.957e-9	g
estimated rest oxygen loading to be released for pre and main cat purge					
O2L_RLS_TOT_CAT_PURGE [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-669.923556 ...669.923555	311.957e-9	g
total oxygen loading to be released for pre and main cat purge					
RATIO_O2L_RLS_CAT_PURGE [NC_CBK_EX_NR]	V	0... FFH	0... 0.99609375	3.90625e-3	-
quotient used by cat purge: current rest oxygen loading /total oxygen loading					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**Input data:**

EFF_CAT_DIAG [NC_CBK_EX_NR] {p. 5535}	FAC_ADD_MAIN_CAT_PURGE [NC_CBK_EX_NR] {p. 2912}	LV_CAT_PURGE_ST [NC_CBK_EX_NR] {p. 2912}	LV_DIAG_PUE_LS_DOWN_ADD_ACT [NC_CBK_EX_NR] {p. 2942}
LV_ERR_LS_DOWN [NC_CBK_EX_NR] {p. 5449}	LV_ERR_VLS_MAIN_CAT_PURGE [NC_CBK_EX_NR] {p. 2942}	LV_INH_CAT_PURGE [NC_CBK_EX_NR] {p. 2942}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}
LV_PUC {p. 1720}	LV_VLS_MAIN_CAT_PURGE_READY [NC_CBK_EX_NR] {p. 2942}	MAF_CYL {p. 8277}	NC_CBK_EX_NR {p. 1829}
O2L_RLS_SP_PCAT_PURGE [NC_CBK_EX_NR] {p. 2912}	STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}	TEMP_MAIN_CAT_PURGE [NC_CBK_EX_NR] {p. 2942}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}
VLS_MAIN_CAT_PURGE [NC_CBK_EX_NR] {p. 2942}			

**Calibration data:**


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VLS_DOWN_THD_CAT_PURGE [NC_CBK_EX_NR]	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
downstream voltage signal threshold for end of pre cat purge detection					
C_VLS_MAIN_CAT_PURGE_THD	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
voltage signal threshold from sensor after main cat for end of main cat purge detection					
IP_FAC_MAIN_CAT_PURGE	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_TEMP_MAIN_CAT_PURGE_IP_FAC	6	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
LDPM_EFF_CAT_DIAG_1_EGTR	6	0... FFH	0... 1.9921875	7.8125e-3	-
weighting factor considering volume ratio (pre /main cat) and cat temperature (for main cat purge)					
IP_LAMB_SP_DELTA_CAT_PURGE	V	0... FFFH	0... 0.249939	61.0352e-6	-
LDP_MAF_CYL_IP_LAMB_SP	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_RATIO_O2L_RLS_IP_LAMB_SP	8	0... FFH	0... 0.99609375	3.90625e-3	-
lambda set point shift of catalyst purge function					
LC_VLS_MAIN_CAT_PURGE [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
calibration flag to use sensor signal after main cat to abort cat purge					

**General Information**

The catalyst purge function realizes fast adjustment of optimized conditions for a high catalyst efficiency after a transition from trailing throttle fuel cut-off phase or other lean air fuel mixture conditions to stoichiometric conditions. That requires a fuel enrichment in order to reduce the oxygen content inside the catalyst. The degree of the fuel enrichment depends on the oxygen and the NOx content in the catalyst.

The recurrence time is defined by T\_SAMPLE in [ms].

NC\_CBK\_EX\_NR defines the number of exhaust banks.

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For vector elements, the variable extension `_i` is used in the model instead of `[i]` as found in the textual description.

**Application Conditions**

Initialization: RST  
 Recurrence: 20MS  
 Activation: always  
 Deactivation: never

**Function description**

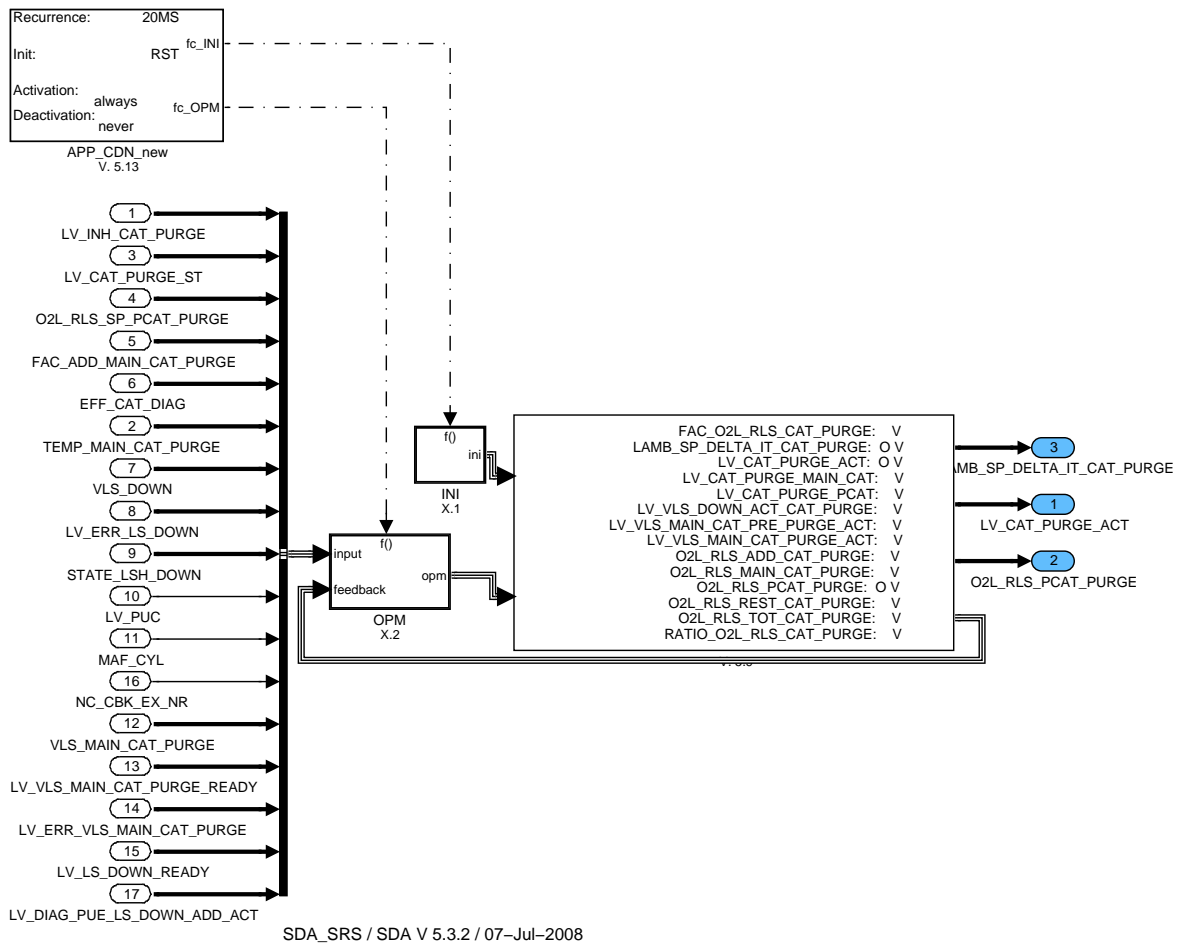


Figure 7.79.1: :

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### 7.79.1 Initialisation

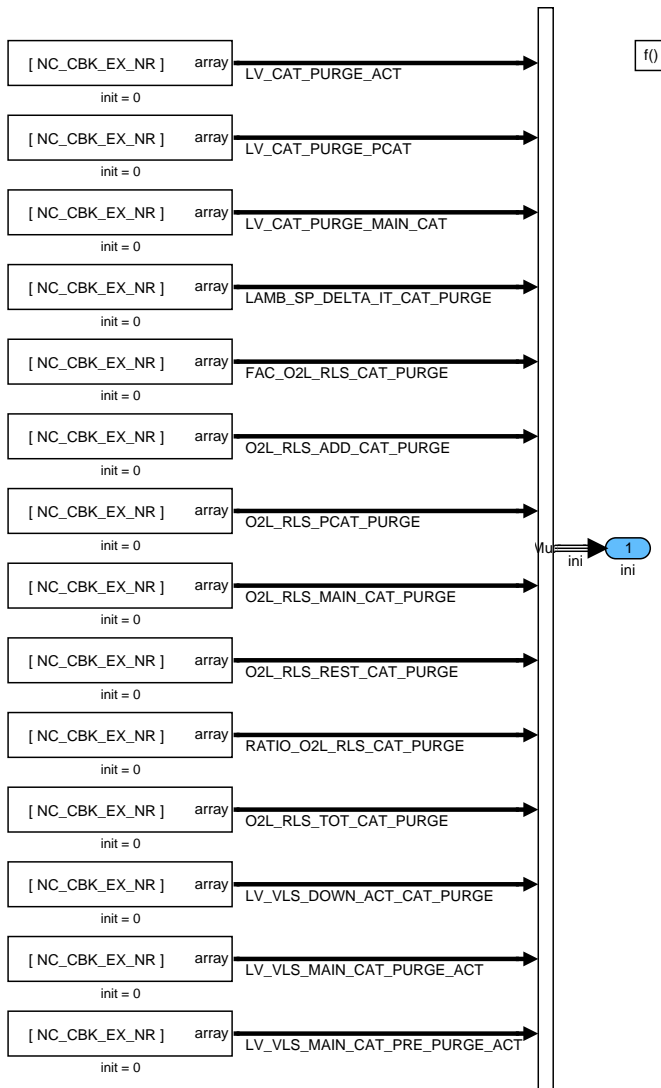


Figure 7.79.2: :

### 7.79.2 Calculation at every 20ms

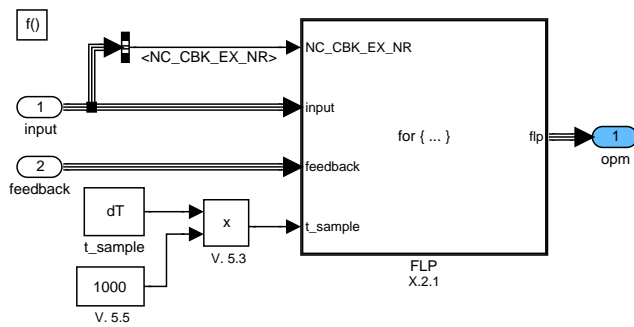



Figure 7.79.3: :

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### 7.79.2.1 Introduction of multiple bank system

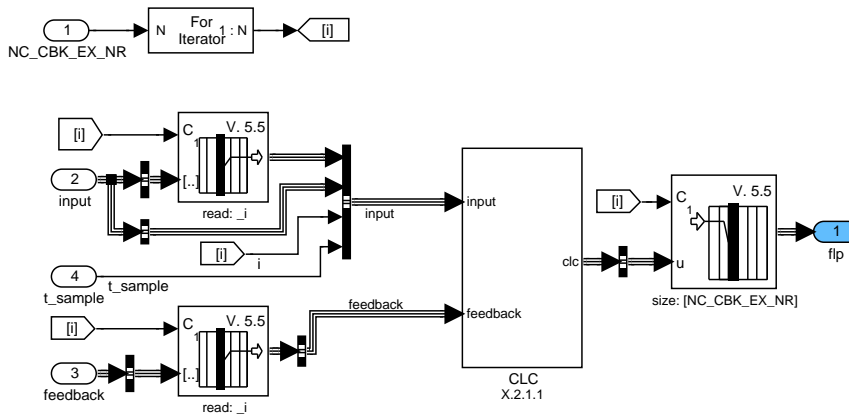


Figure 7.79.4: :

#### 7.79.2.1.1 Formula section

##### 7.79.2.1.1.1 Management of catalyst purge initialization and pre and main catalyst purge

If LV\_CAT\_PRUGE\_ST[i] is set by the function Oxygen loading determination for catalyst enrichment function the initialization sub-system ( INI\_CAT\_PURGE ) is called. The flag is set only for one sample step.

Depending on LV\_CAT\_PURGE\_PCAT[i] and LV\_CAT\_PURGE\_MAIN\_CAT[i] one of the sub-systems PRE\_CAT\_PURGE or MAIN\_CAT\_PURGE is called.

If LV\_PUC or the inhibition flag is set no cat purge is executed or an active cat purge is interrupted (sub-system NOT\_CAT\_PURGE is called).

The cat purge activity flag LV\_CAT\_PURGE[i] is set to 1 if pre or main cat purge is active.

##### 7.79.2.1.1.1.1 Condition checking

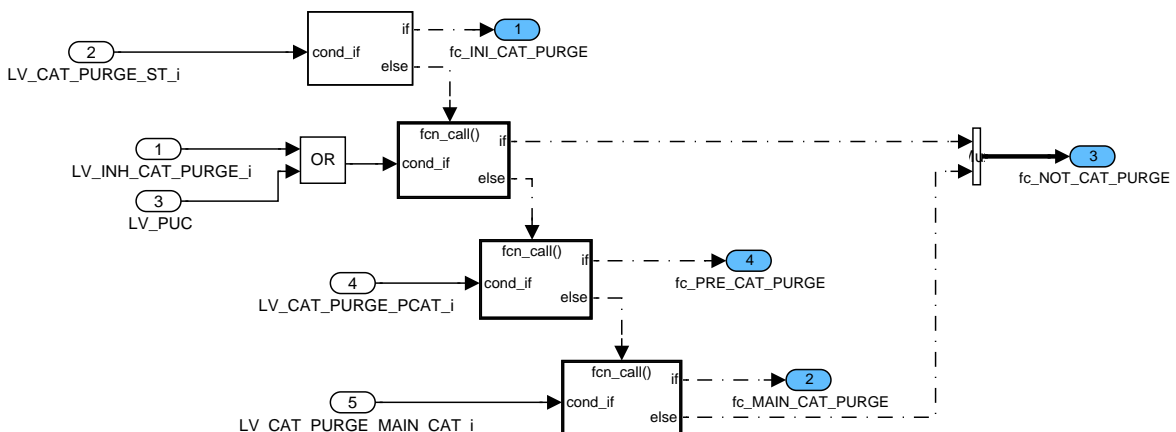



Figure 7.79.5: :

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### 7.79.2.1.1.1.2 Calculation of CAT\_PURGE

#### 7.79.2.1.1.1.2.1 Initialization of catalyst purge (fc\_INI\_CAT\_PURGE)

Pre cat purge is activated by setting the respective flag. Main cat purge is deactivated.

The oxygen loading release integral for pre cat purge  $O2L\_RLS\_PCAT\_PURGE[i]$  is initialised by  $O2L\_RLS\_SP\_PCAT\_PURGE[i]$ . The oxygen loading release integral for main cat purge is calculated by multiplying the one for pre cat purge with a factor map and with the additional factor defined in the function Oxygen loading determination for catalyst enrichment function. The rest oxygen loading release and the total oxygen loading release is the sum of the one for pre cat purge and main cat purge.

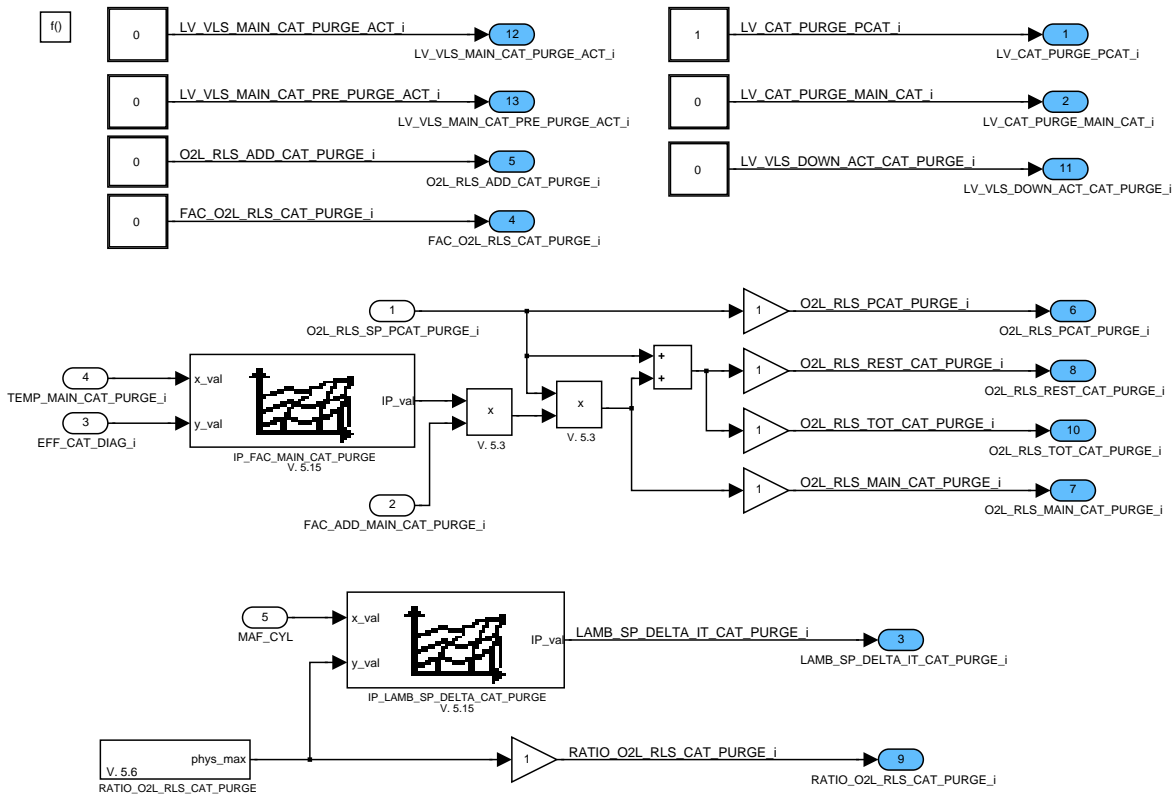


Figure 7.79.6: :

#### 7.79.2.1.1.1.2.2 Main catalyst purge (fc\_MAIN\_CAT\_PURGE)

If the oxygen loading for the main catalyst is released ( $O2L\_RLS\_MAIN\_CAT\_PURGE[i] \leq 0$ ) the end of main cat purge is detected and the respective sub-system  $MAIN\_CAT\_PURGE\_END$  is triggered. Otherwise the sub-system  $MAIN\_CAT\_PURGE\_CLC$  is called.

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7.79.2.1.1.1.2.2.1 Calculation of LV\_VLS\_DOWN\_ACT\_CAT\_PURGE

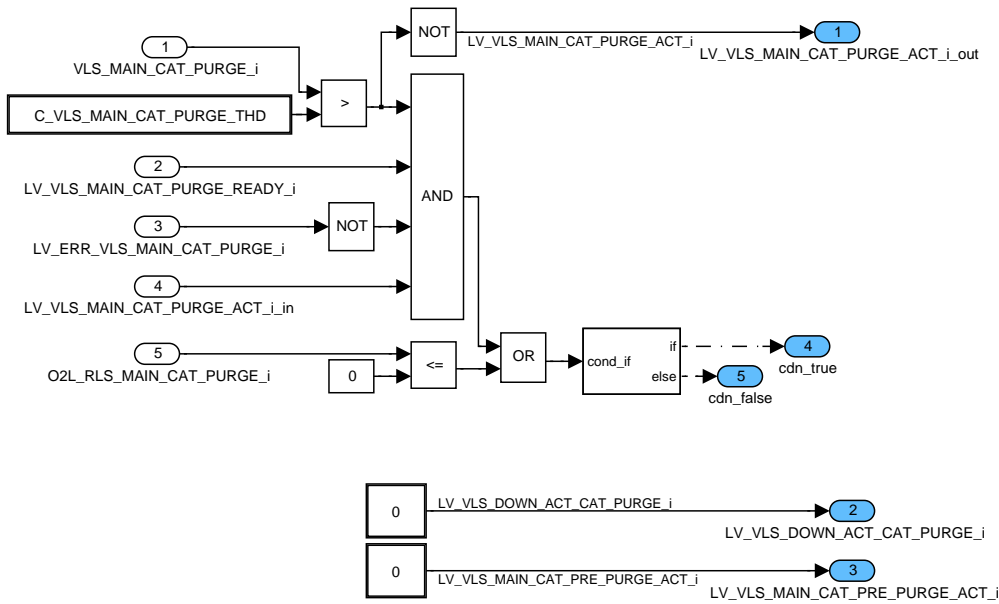


Figure 7.79.7: :

7.79.2.1.1.1.2.2.2 End of main catalyst purge (cdn\_true)

Pre cat purge and main cat purge is deactivated by setting the respective flags. The rich shift of the lambda set point is set to 0

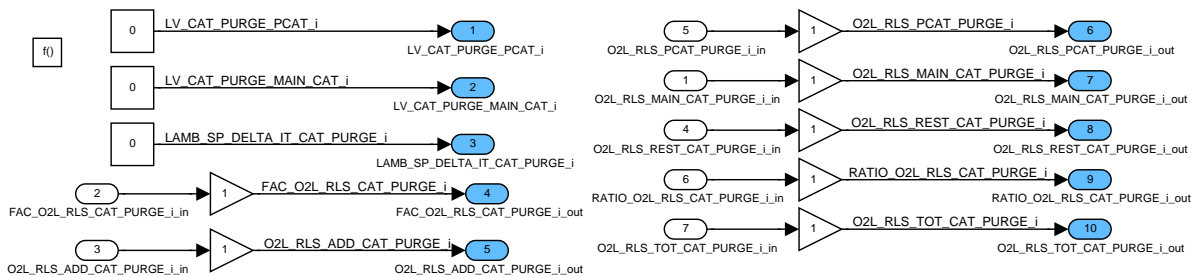


Figure 7.79.8: :

7.79.2.1.1.1.2.2.3 Calculation of main catalyst purge oxygen loading release (cdn\_false)

See textual description for Calculation of pre catalyst purge oxygen loading release .

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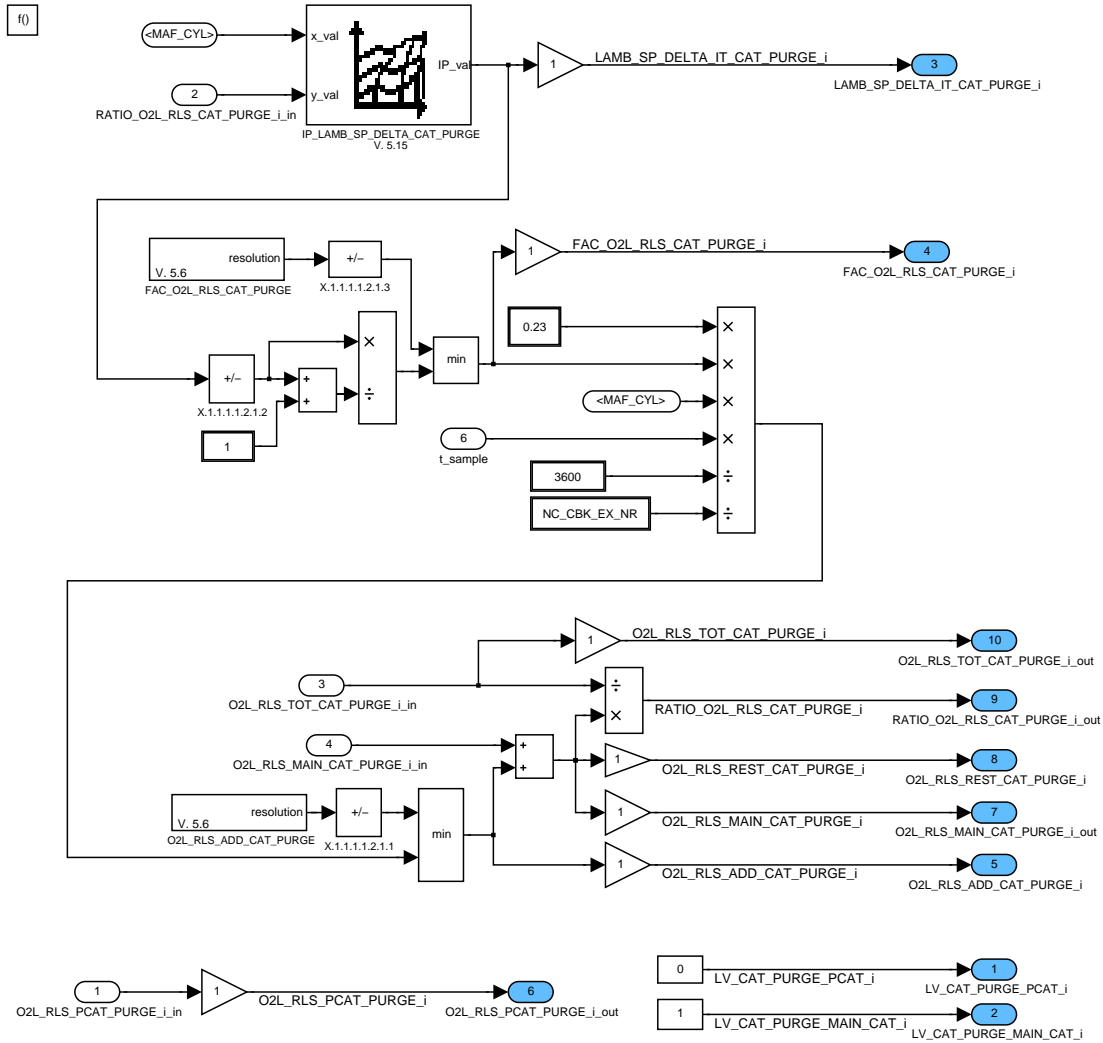



Figure 7.79.9: :

### 7.79.2.1.1.1.3 Deactivation of CAT\_PURGE

#### 7.79.2.1.1.1.3.1 Catalyst purge not active (fc\_NOT\_CAT\_PURGE)

Pre cat purge and main cat purge is deactivated by setting the respective flags to 0. The rich shift of the lambda set point is also set to 0.

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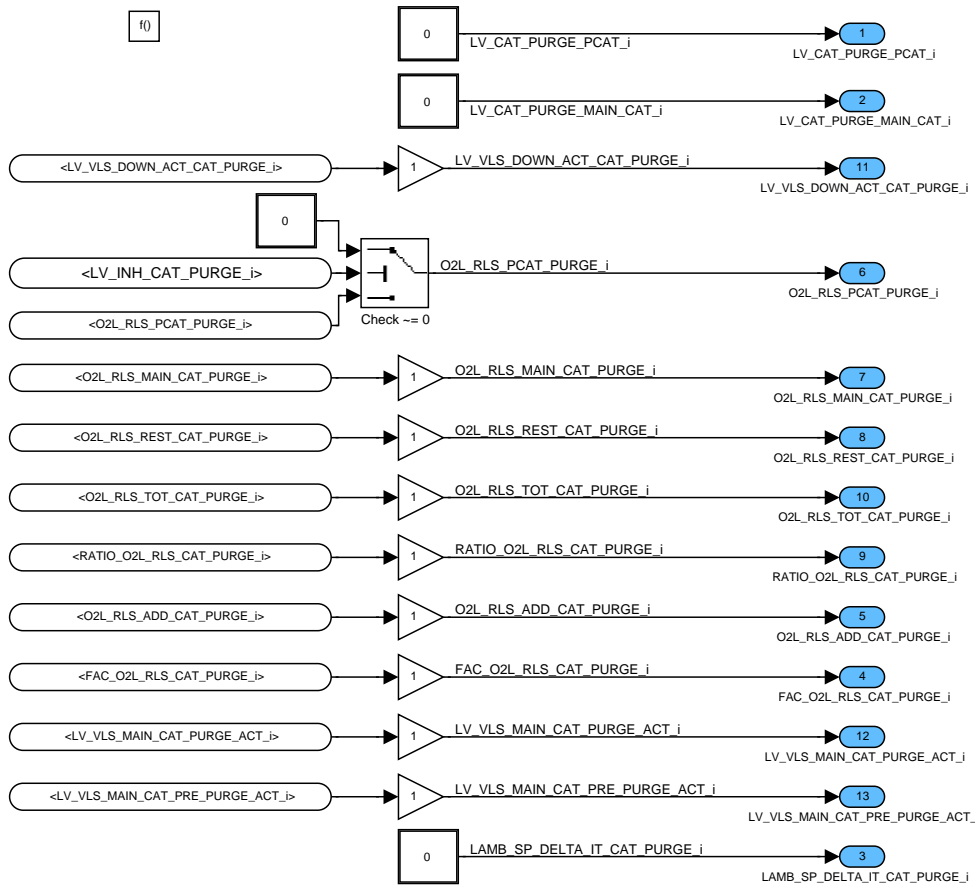



Figure 7.79.10: :

**7.79.2.1.1.1.3.2 Pre catalyst purge (fc\_PRE\_CAT\_PURGE)**

If the oxygen loading for the pre catalyst is released ( $O2L\_RLS\_PCAT\_PURGE[i] \leq 0$ ) and the lean to rich diagnosis isn't active ( $LV\_DIAG\_PUE\_LS\_DOWN\_ADD\_ACT = 0$ ) or the downstream sensor signal exceeds a calibration threshold the end of pre cat purge is detected and the respective sub-system is triggered. The downstream signal is only evaluated if no error at the downstream sensor is present and the heater state is in `LSH_POW_CTL`. Furthermore the downstream signal must have been below the calibration threshold.

If the above mentioned conditions are not fulfilled the sub-system `PRE_CAT_PRUGE_CLC` is called.

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### 7.79.2.1.1.3.2.1 Calculation of LV\_VLS\_MAIN\_CAT\_PURGE\_ACT

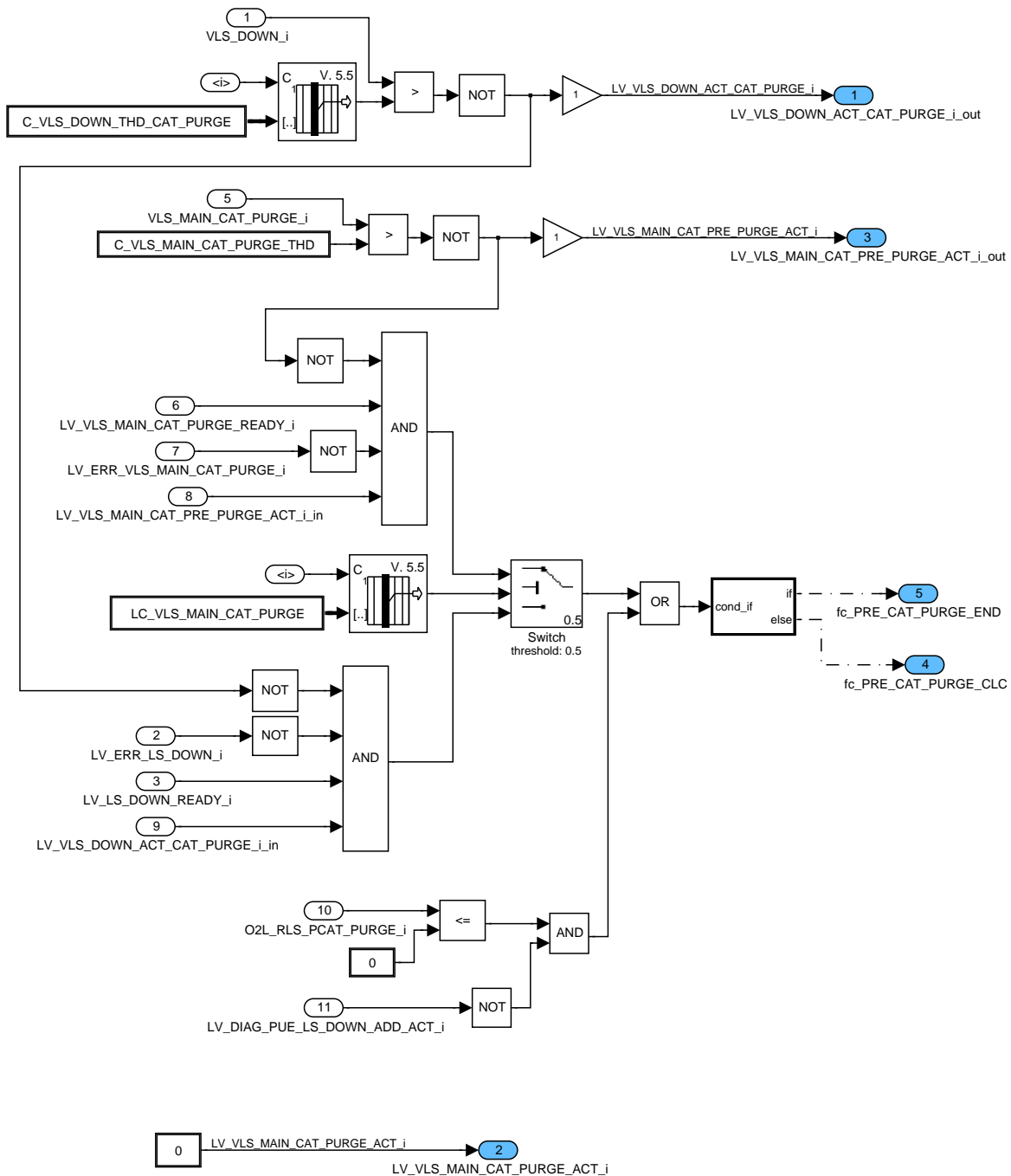


Figure 7.79.11: :

### 7.79.2.1.1.3.2.2 End of pre catalyst purge (cdn\_true)

Main cat purge is activated by setting the respective flag. Pre cat purge is deactivated.

By newly evaluating the map IP\_FAC\_MAIN\_CAT\_PURGE the oxygen loading to be released during main cat purge is updated. The rest and total oxygen loading release is renewed and the quotient: rest /total oxygen loading release is also updated.



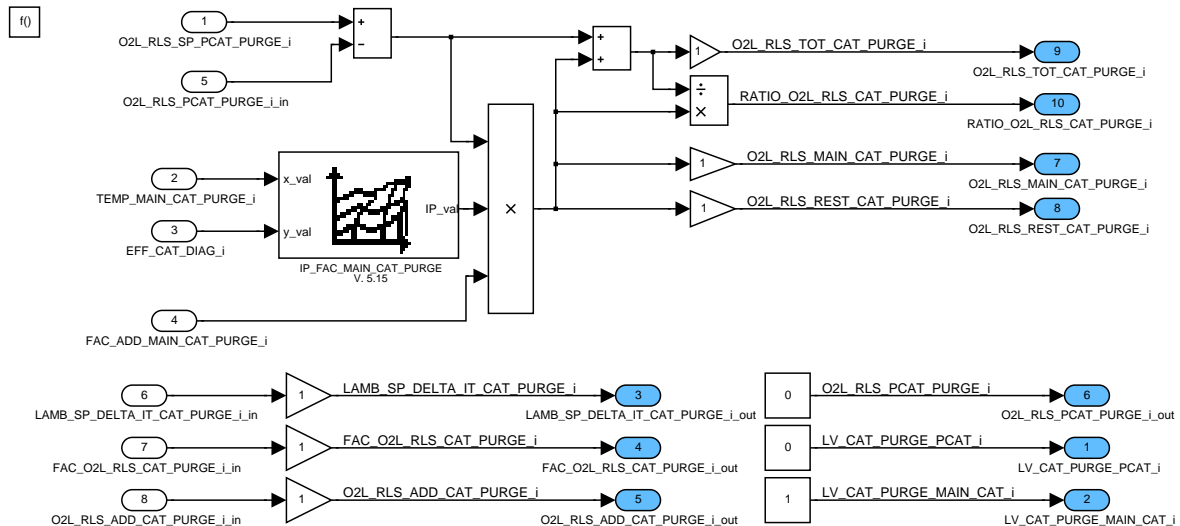


Figure 7.79.12: :

### 7.79.2.1.1.1.3.2.3 Calculation of pre catalyst purge oxygen loading release (cdn\_false)

The rich shift of the lambda set point is taken from the respective map. The oxygen loading release is calculated by the following formula:

$$m_{O_2} = 0.23 \cdot \int \frac{-\Delta\lambda_{SP}}{1-\Delta\lambda_{SP}} \cdot \dot{m}_{air} dt$$

The remaining oxygen loading release (O2L\_RLS\_REST\_CAT\_PURGE[i]) is renewed and the quotient (RATIO\_O2L\_RLS\_CAT\_PURGE[i]): rest /total oxygen loading release is calculated.

For the calculation of the oxygen loading the unit conversion:

$$[g] = [kg/h] \cdot [ms] \cdot [(g \cdot h) / (kg \cdot ms)] / 3600$$

has to be considered.

The fraction of the formula above is minimized to the resolution of its variable (FAC\_O2L\_RLS\_CAT\_PURGE[i]). The oxygen loading that is added each sample step is also minimized to the resolution of its variable (O2L\_RLS\_ADD\_CAT\_PURGE[i]).

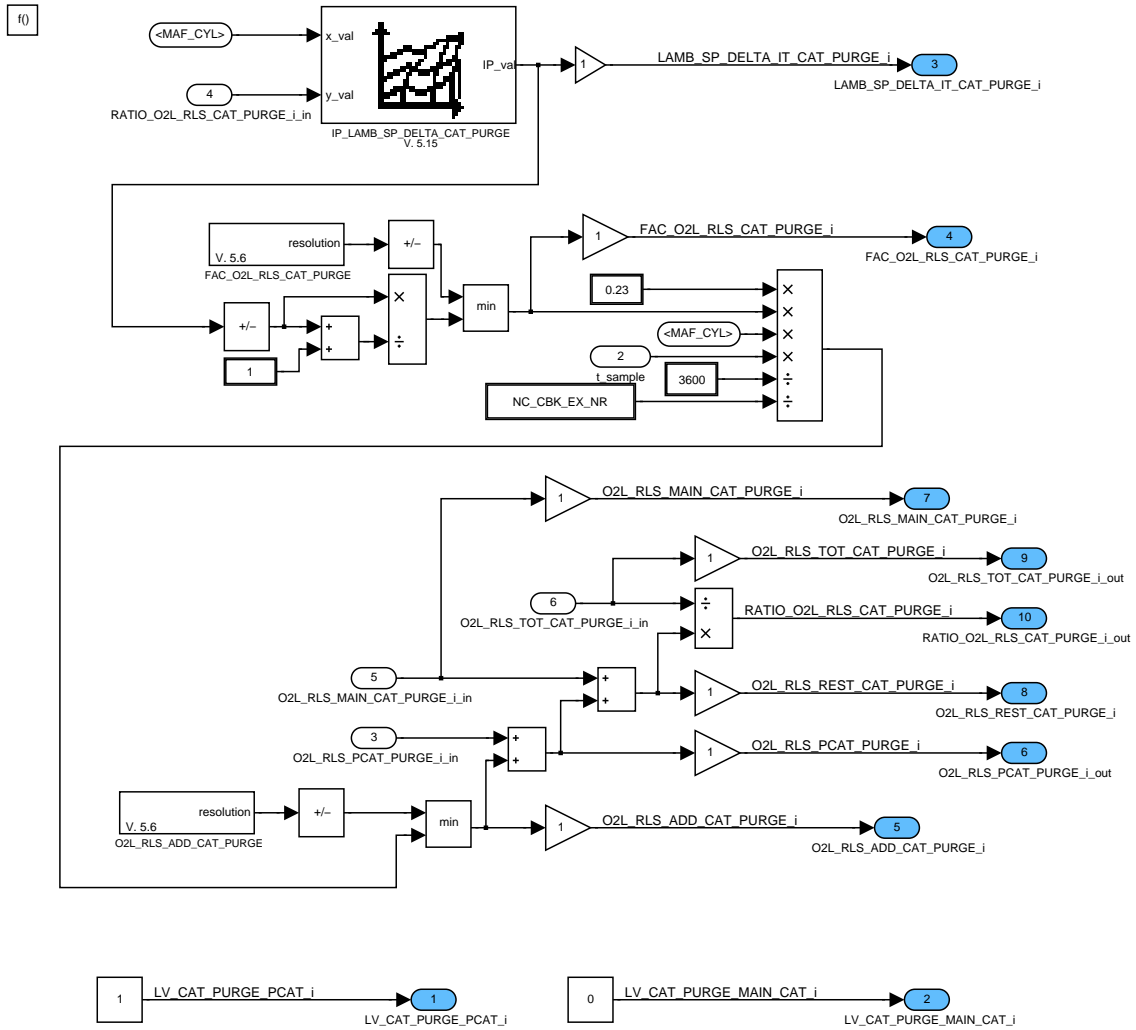


Figure 7.79.13: :

7.79.2.1.1.2 Calculation of LV\_CAT\_PURGE\_ACT

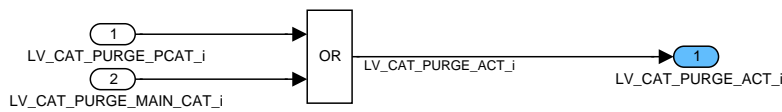


Figure 7.79.14: :

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## 7.80 Catalyst enrichment function coordination

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_SP_DELTA_CAT_PURGE [NC_CBK_EX_NR]	O/V	0... FFFH	0... 0.249939	61.0352e-6	-
Lambda set point shift of cat purge function					

### Input data:

LAMB_SP_CAT_PURGE_ ADD_PUE {p. 2942}	LAMB_SP_DELTA_ADD_ CAT_PURGE [NC_CBK_EX_NR] {p. 2942}	LAMB_SP_DELTA_IT_ CAT_PURGE [NC_CBK_EX_NR] {p. 2927}	NC_CBK_EX_NR {p. 1829}
--	--	---	------------------------

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_CAT_PURGE_PUE_ACT	-	0... 1H	0 ...1	1	-
Flag to activate amplitude for L2R diagnosis					

### General Information

This function coordinates the lambda set point rich shift of different functions. Up to now only the output of the catalyst enrichment function is considered.

NC\_CBK\_EX\_NR defines the number of exhaust banks.

### Application Conditions

Initialization: RST

Recurrence: 20MS

Activation: always

Deactivation: never

### Function description

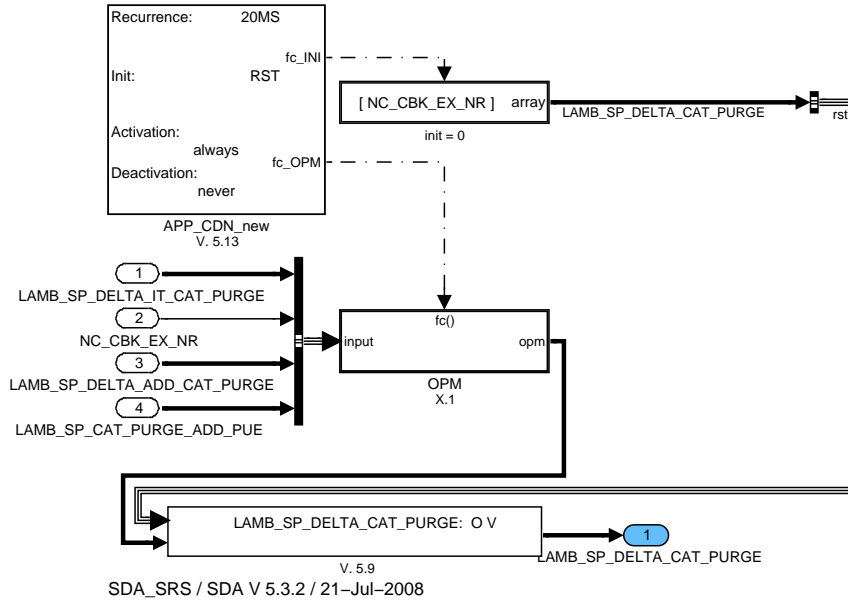


Figure 7.80.1: :

### 7.80.1 Calculation at every 20MS

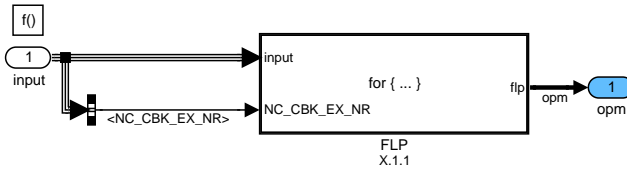


Figure 7.80.2: :

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### 7.80.1.1 Introduction of multiple bank system

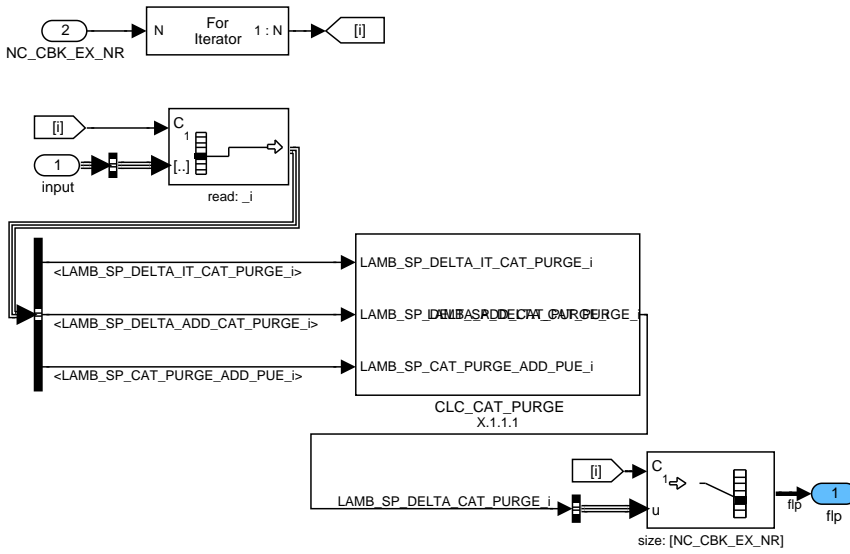


Figure 7.80.3: :

#### 7.80.1.1.1 Calculation of LAMB\_SP\_DELTA\_CAT\_PURGE

The assignment of LAMB\_SP\_DELTA\_CAT\_PURGE[i] is a vector operation.

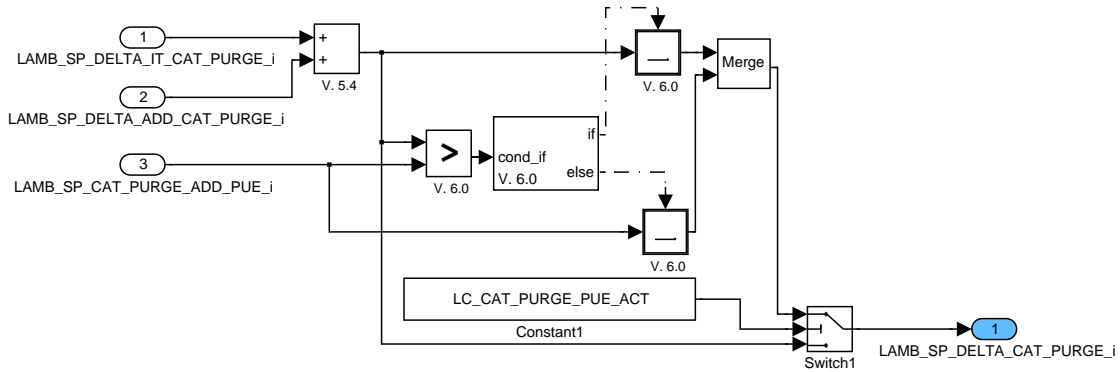


Figure 7.80.4: :

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## 7.81 Catalyst purge function (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_SP_CAT_PURGE_ADD_PUE	O/V	0... FFFH	0... 0.249939	61.0352e-6	-
Lambda setpoint shift for L2R diagnosis					
LAMB_SP_DELTA_ADD_CAT_PURGE [NC_CBK_EX_NR]	O/V	0... FFFH	0... 0.249939	61.0352e-6	-
additional lambda set point shift for cat purge output					
LV_DIAG_PUE_LS_DOWN_ADD_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag that indicates, that L2R Diagnosis is active and uses CatPurge interface					
LV_ERR_VLS_MAIN_CAT_PURGE [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Final diagnostic of the sensor after main cat					
LV_GS_SCC	O/V	0... 1H	0 ...1	1	-
cylinder cut of during gear shift					
LV_INH_CAT_PURGE [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
inhibition flag for cat purge function					
LV_PUC_CHG_H_L	-	0... 1H	0 ...1	1	-
Bit for changing LV_PUC from high to low					
LV_PUC_CHG_L_H	-	0... 1H	0 ...1	1	-
Bit for changing LV_PUC from low to high					
LV_PUC_MAF_INT_OLD	-	0... 1H	0 ...1	1	-
auxiliary flag for edge detection of LV_PUC for MAF integrals					
LV_VLS_MAIN_CAT_PURGE_READY [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable for operative readiness of sensor(s) after main cat					
MAF_INT_GS_SCC	O/V	0... FFFFH	0... 2912.66666667	0.0444444	g
air mass flow integral at cylinder cut of during gear shift phase					
MAF_INT_PUC_ACT	O/V	0... FFFFH	0... 2912.66666667	0.0444444	g
air mass flow integral during pull cut off phase					
MAF_INT_PUC_NOT_ACT	O/V	0... FFFFH	0... 2912.66666667	0.0444444	g
air mass flow integral out of pull cut off phase					
RATIO_NTL_DEC_INT [NC_CBK_EX_NR]	-	0... FFFFH	0... 7.99987792969	122.07e-6	-
Ratio of NTL_DEC_INT of both NOx traps					
TEMP_MAIN_CAT_PURGE [NC_CBK_EX_NR]	O/V	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
catalyst temperature of main cat for cat purge function					
VLS_MAIN_CAT_PURGE [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Sensor voltage measured after Main Catalyst (eg NOx sensor after NOx trap)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------


**Input data:**

EFF_SCC_AV {p. 6665}	LAMB_SP_ADD_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5168}	LV_CAT_PURGE_REQ_POST_AFL [NC_NT_NR] {p. 2982}	LV_DIAG_ACT_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5168}
LV_ERR_NS_CAN_BOFF {p. 991}	LV_ERR_NS_CAN_MSG_LOST [NC_NOX_SENS_CONF] {p. 991}	LV_ERR_NS_OBD_1_HTP [NC_NOX_SENS_CONF] {p. 4916}	LV_ERR_NS_OBD_1_VLS [NC_NOX_SENS_CONF] {p. 4916}
LV_ERR_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}	LV_GS {p. 1565}	LV_PUC {p. 1720}	LV_VLS_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}
MAF_CYL {p. 8277}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}
NC_NT_NR {p. 644}	NTL_DEC_INT [NC_NT_NR] {p. 2985}	TCO {p. 1100}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}
VLS_NS [NC_NOX_SENS_CONF] {p. 992}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_CYL_MAX_CAT_PURGE	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
maximum air mass flow threshold for cat purge activation					
C_N_MAX_CAT_PURGE	-	0... FFH	0... 8160	32	rpm
maximum engine speed for cat purge					
C_TCO_MIN_CAT_PURGE	-	0... FEH	-48... 142.5	0.75	°C
minimum TCO threshold for cat purge activation					
C_TEMP_DIF_PCAT_MAIN_CAT_PURGE [NC_CBK_EX_NR]	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
temperature difference between pre and main cat					
IP_FAC_PURGE_RATIO_NTL	-	0... FFH	0... 7.96875	0.03125	-
LDP_RATIO_NTL_DEC_INT_IP_FAC	8	0... FFFFH	0... 7.99987792969	122.07e-6	-
Correction of different regenerated NOx traps depending on ratio of NTL_DEC_INT					
IP_LAMB_ADD_PURGE	V	0... FFFH	0... 0.249939	61.0352e-6	-
LDP_MAF_CYL_IP_LAMB_ADD_PURGE	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_VLS_NOX_SENS_IP_LAMB_ADD	8	0... 578H	-200 ...1200	1	mV
delta lambda map for cat purge after lean mode					
LC_CAT_PURGE_INH [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
calibration flag to force cat purge function to be inhibited					
LC_DIAG_ACT_PUE_LS_DOWN	-	0... 1H	0 ...1	1	-
Switch to deactivate the influence of gradient monitoring diagnosis					
LC_NS_2_DEAC	-	0... 1H	0 ...1	1	-
force usage of first NOx sensor for cat purge of both banks					

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	Document key 10171571 SPE 000 AO	Pages Page 2943 of 8404
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

### General Information

This function defines the general inhibition of catalyst purge and the temperature of the main catalyst by means of a temperature gradient.

NC\_CBK\_EX\_NR defines the number of exhaust banks.

Additionally, MAFintegrals from INSY (MAF\_INT\_PUC\_ACT and MAF\_INT\_PUC\_NOT\_ACT) and an MAFintegral for gear shifting with cylinder cutoff (MAF\_INT\_GS\_SCC) are included.

An additionally interface to NOXM for cat purge after lean operation is included.

### Application Conditions


Initialization: RST

Activation: 20MS: always

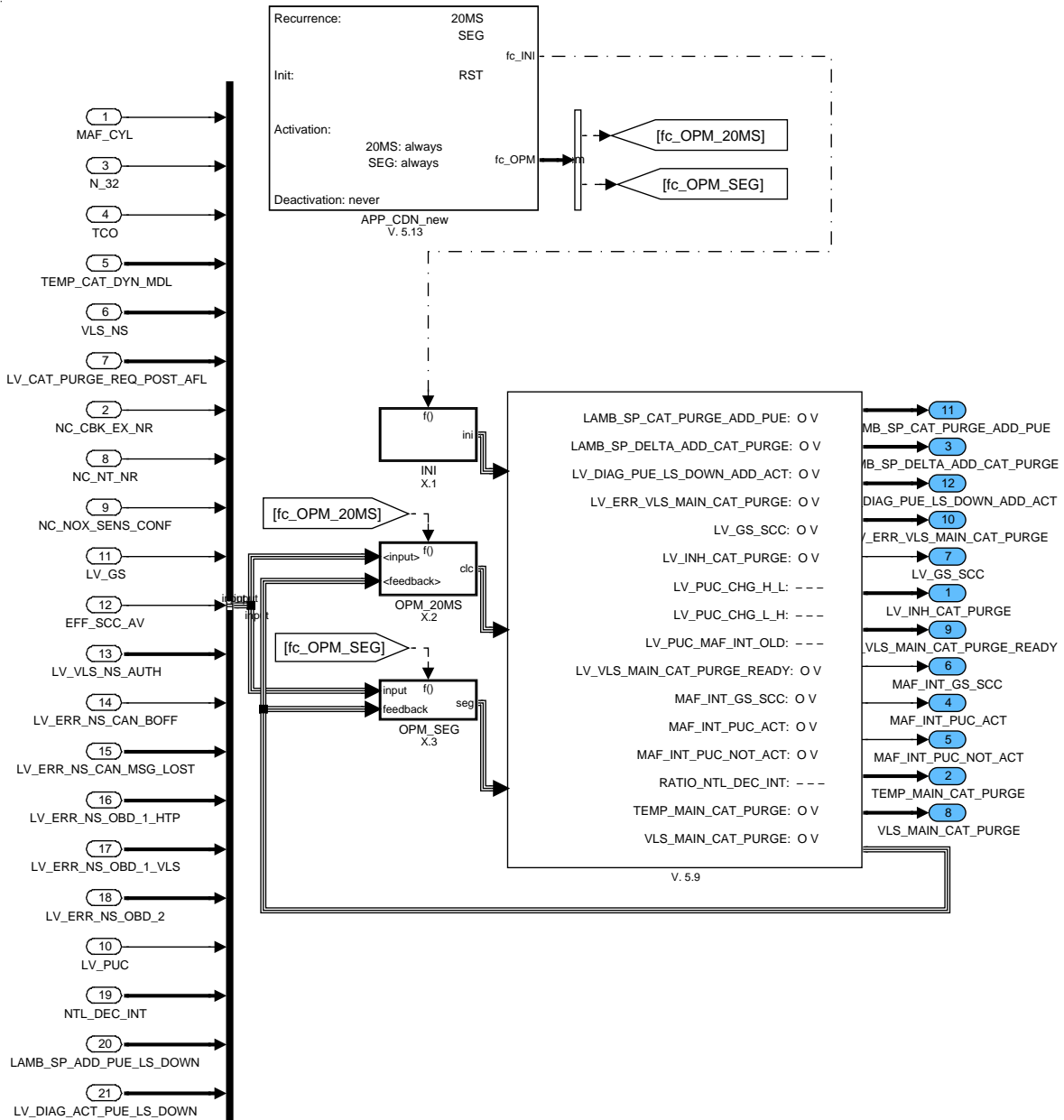
SEG: always

Deactivation: never

### Function description

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SDA\_SRS / SDA V 5.3.2 / 02-Mar-2009

Figure 7.81.1: : Path: EGTR\_DEFSPCENRIO

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## 7.81.1 Initialisation

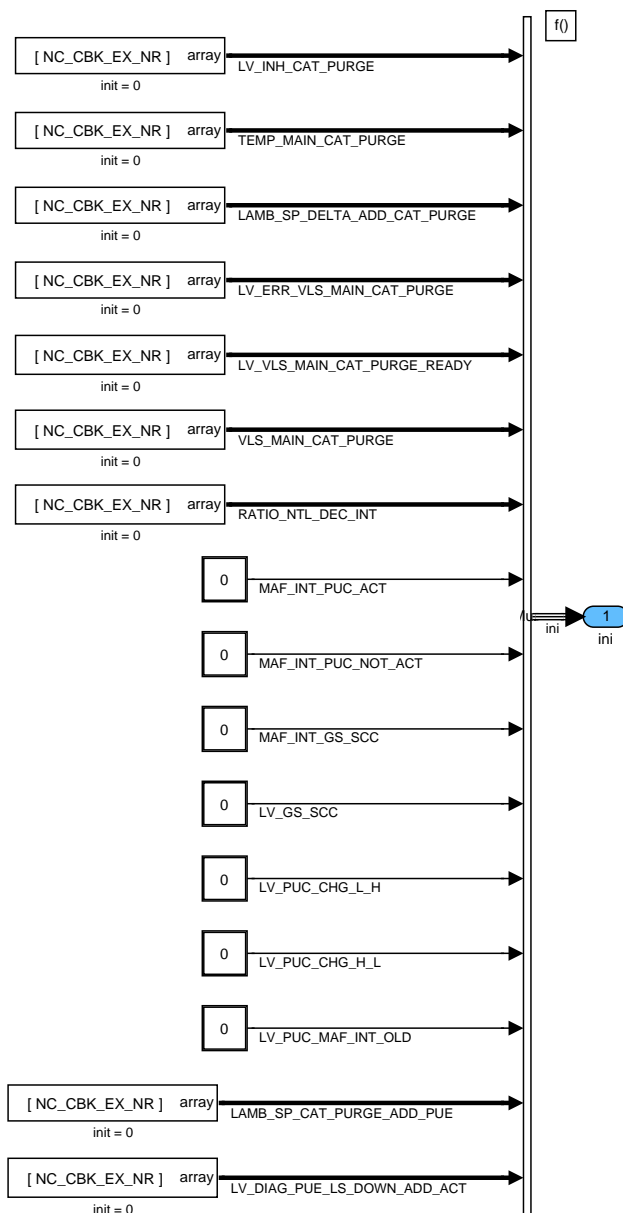


Figure 7.81.2: : Path: EGTR\_DEFSPCENR10/INI

## 7.81.2 Formula section: Calculation at every 20ms

### 7.81.2.1 LV\_INH\_CAT\_PURGE and TEMP\_MAIN\_CAT\_PURGE

LC\_CAT\_PURGE\_INH[i] can inhibit each exhaust bank separately, while the threshold conditions of MAF\_CYL, N\_32 and TCO is valid for both banks in the same way. A vector operation must be applied. The temperatur gradient calculation for the main catalyst is a vector operation too.

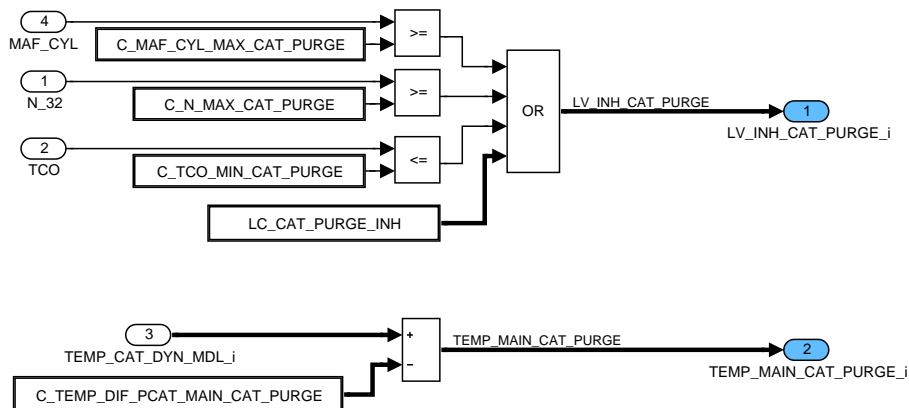


Figure 7.81.3: : Path: EGTR\_DEFSPCENRI0/OPM\_20MS/INH\_CAT\_PURGE

## 7.81.2.2 Introduction of multiple bank system

### 7.81.2.2.1 Calculation of LAMB\_SP

#### 7.81.2.2.1.1 LAMB\_SP\_DELTA\_ADD\_CAT\_PURGE

This cat purge interface to NOXM is used after lean operation.

Vector size of input signals depend from NC\_NT\_NR and NC\_NOX\_SENS\_CONF. Vector size of output signal depends from NC\_CBK\_EX\_NR. Therefore the input signals have to be used depend on different exhaust gas configurations. Especially, if NC\_CBK\_EX\_NR is greater than the number of NOx sensors or NOx traps only the signal of the first bank have to be used for calculation of both banks.

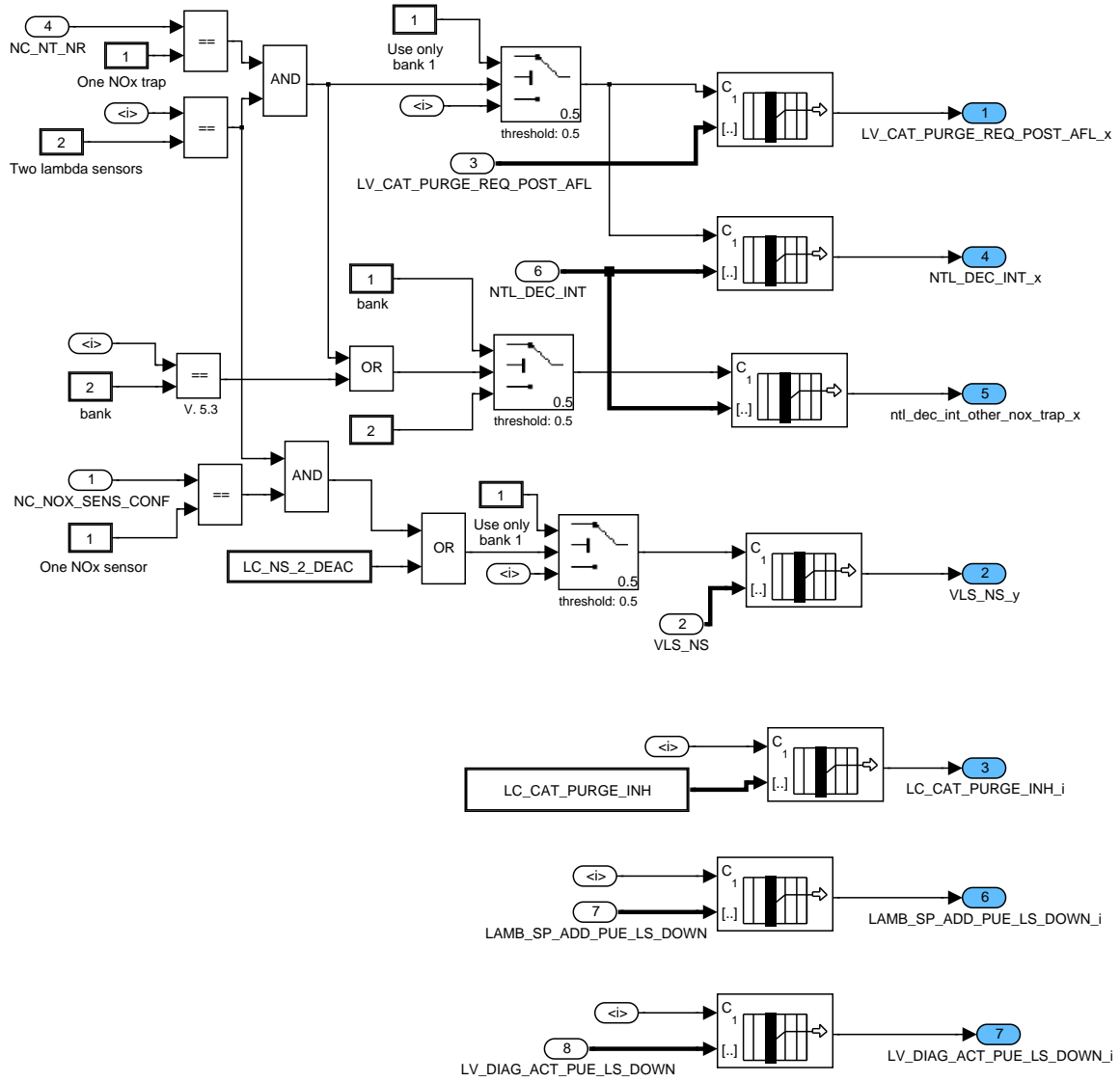


Figure 7.81.4: : Path:  
EGTR\_DEFSPCENR10/OPM\_20MS/ADD\_CAT\_PURGE/CLC\_LAMB\_SP/CLC\_LAMB\_SP

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### 7.81.2.2.1.2 Calculation of LAMB\_SP\_DELTA\_ADD\_CAT\_PURGE

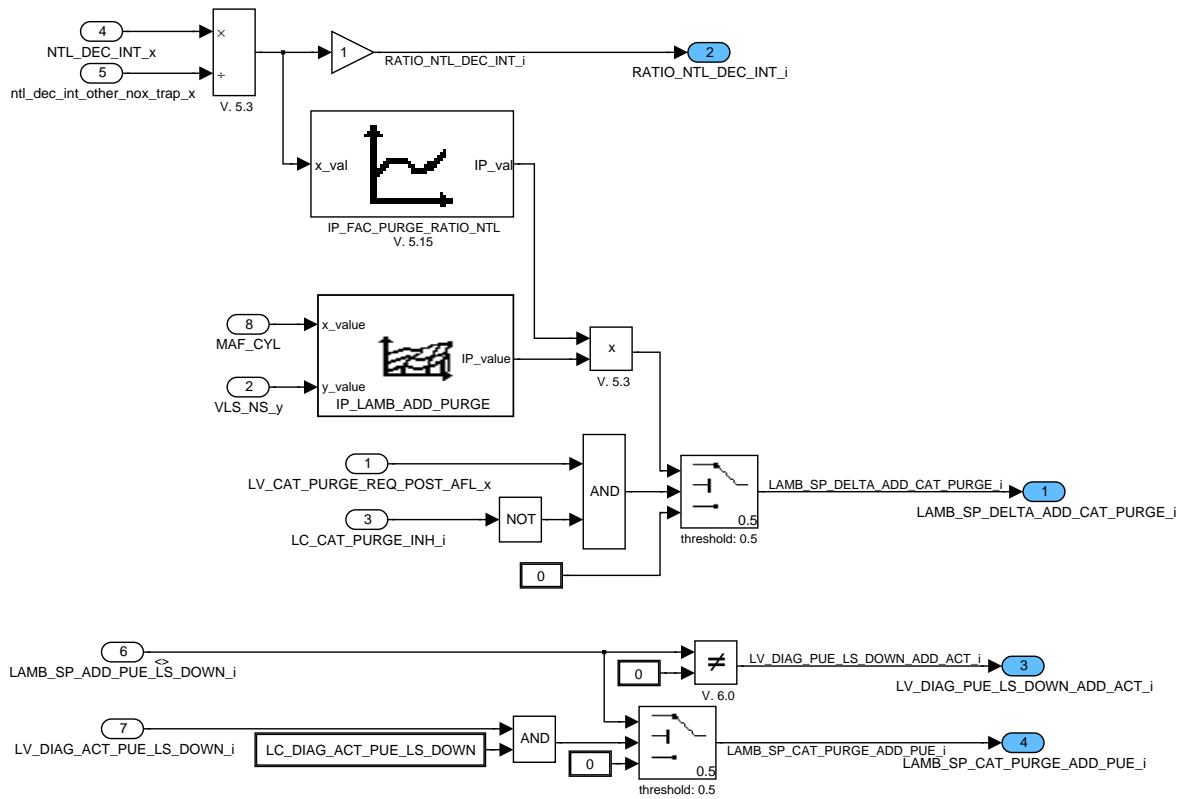


Figure 7.81.5: : Path: EGTR\_DEFSPCENRI0/OPM\_20MS/ADD\_CAT\_PURGE/CLC\_LAMB\_SP/CLC

### 7.81.2.3 MAF\_INT\_PUC\_ACT and MAF\_INT\_PUC\_NOT\_ACT

Calculation of MAF integrals is done depending on LV\_PUC, the reset of the integrals is done depending on edges of LV\_PUC.

These edges will be detected in the synchronous segment loop and stored in LV\_PUC\_CHG\_L\_H or \_H\_L, to avoid losing edges at high speed. After reset of an integral the edge memory flag will be cleared.

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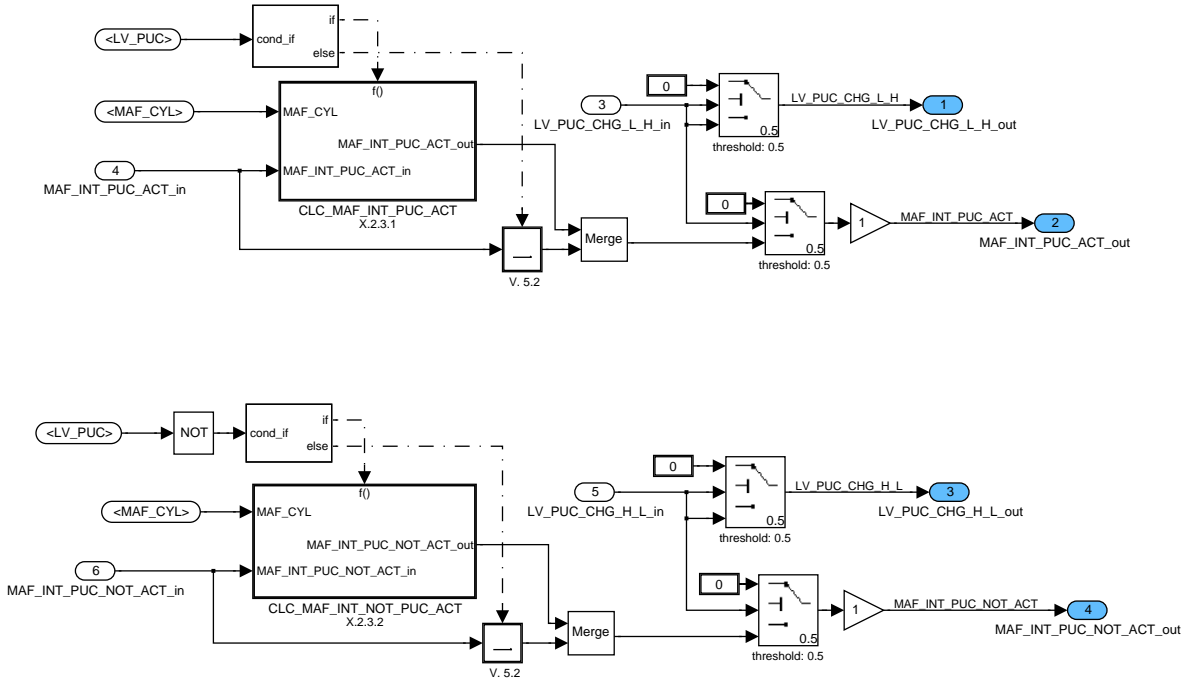


Figure 7.81.6: : Path: EGTR\_DEFSPCENR10/OPM\_20MS/MAF\_INT\_PUC

**7.81.2.3.1 Calculation of MAF\_INT\_PUC\_ACT**

remark: MAF\_INT\_PUC\_ACT have to be calculated internally on 32 bit

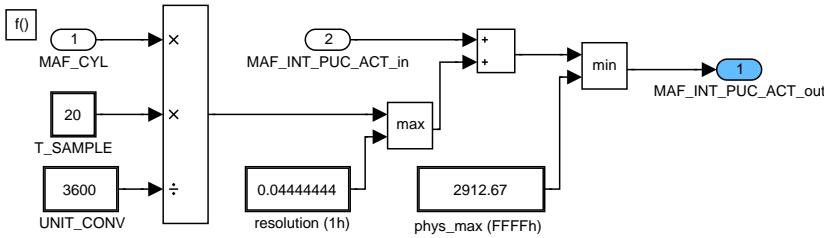


Figure 7.81.7: : Path: EGTR\_DEFSPCENR10/OPM\_20MS/MAF\_INT\_PUC/CLC\_MAF\_INT\_PUC\_ACT

**7.81.2.3.2 Calculation of MAF\_INT\_PUC\_NOT\_ACT**

remark: MAF\_INT\_NOT\_PUC\_ACT have to be calculated internally on 32 bit

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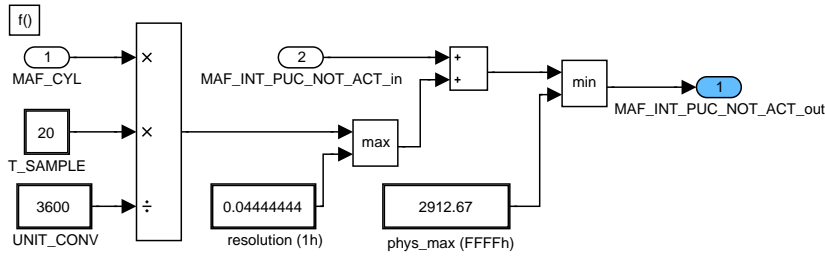


Figure 7.81.8: : Path: EGTR\_DEFSPCENRI0/OPM\_20MS/MAF\_INT\_PUC/CLC\_MAF\_INT\_NOT\_PUC\_ACT

### 7.81.2.4 LV\_GS\_SCC and MAF\_INT\_GS\_SCC

A MAF integral is calculated as long as cylinder cutoff at gear shifting is active.

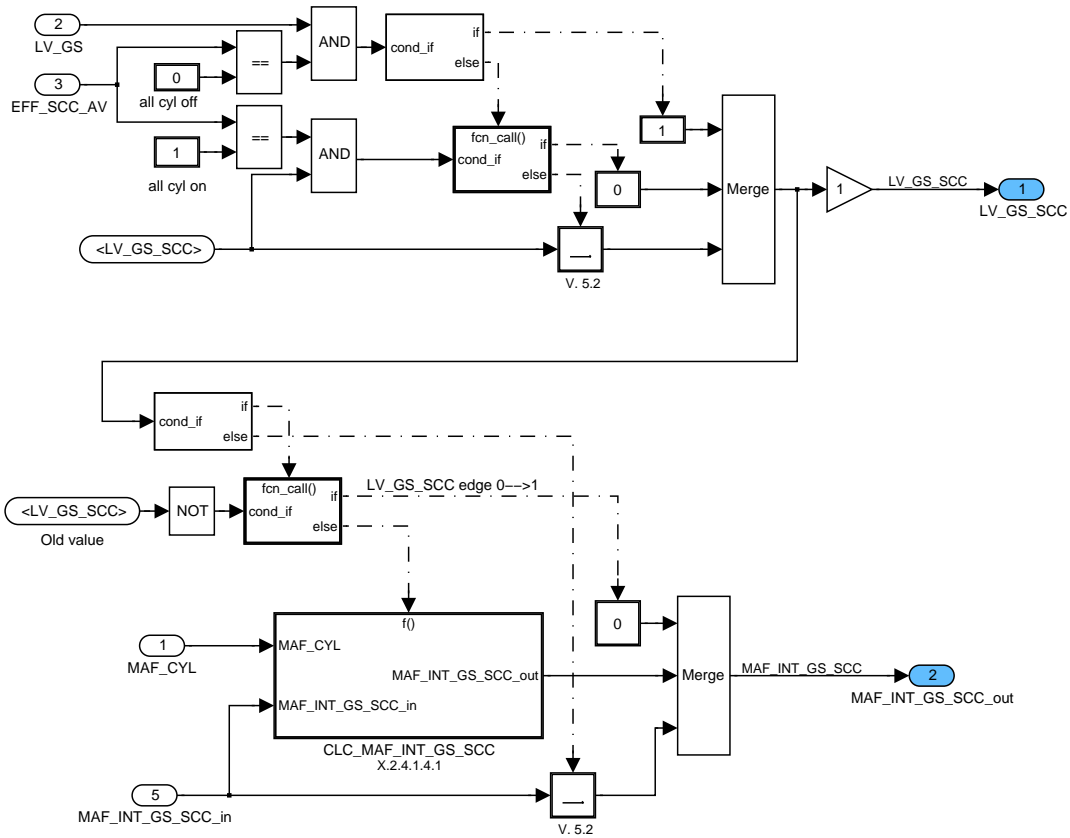


Figure 7.81.9: : Path: EGTR\_DEFSPCENRI0/OPM\_20MS/MAF\_INT\_GS

#### 7.81.2.4.1 Calculation of MAF\_INT\_GS\_SCC

remark: MAF\_INT\_GS\_SCC have to be calculated internally on 32 bit

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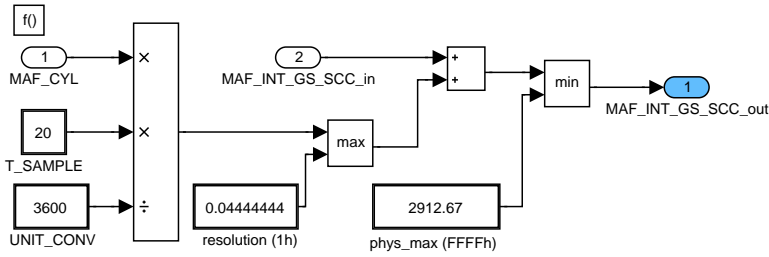


Figure 7.81.10: : Path: EGTR\_DEFSPCENRI0/OPM\_20MS/MAF\_INT\_GS/CLC\_MAF\_INT\_GS\_SCC

### 7.81.2.5 Introduction of multiple bank system

#### 7.81.2.5.1 Calculation of Main catalyst purge

##### 7.81.2.5.1.1 Detection of cancelation of main catalyst purge

The binary lambda signal of the single NOx sensor will be used to cancel the purging of both main catalysts.

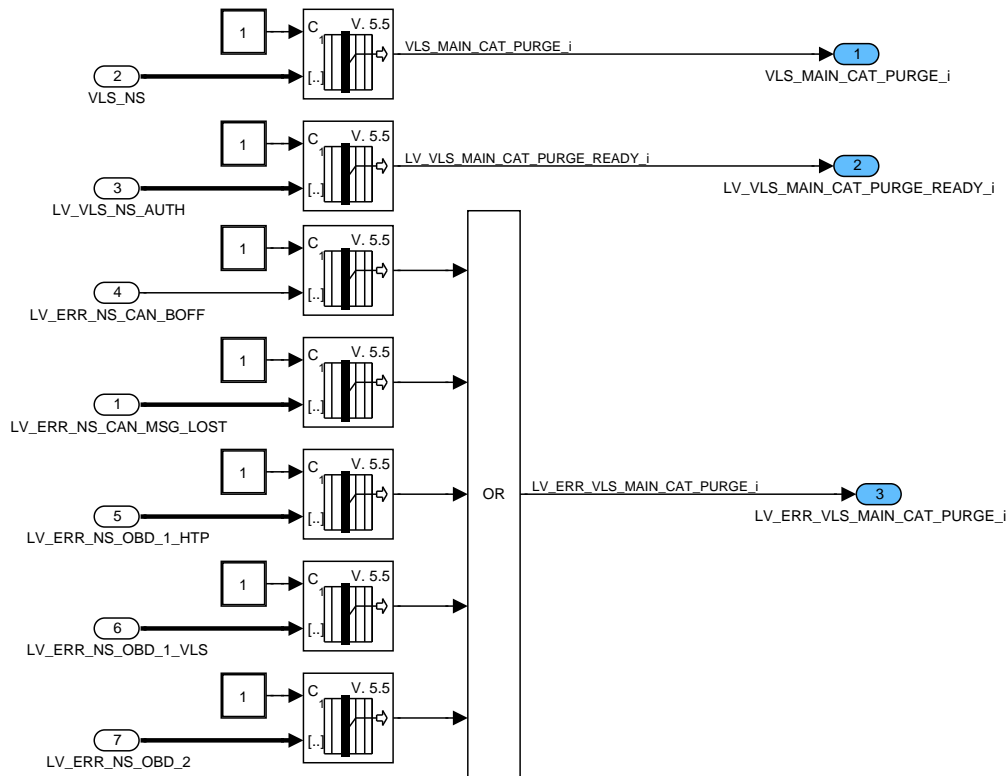


Figure 7.81.11: : Path: EGTR\_DEFSPCENRI0/OPM\_20MS/VLS\_MAIN\_CAT/CLC/CLC\_MAIN\_CAT\_PURGE

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### 7.81.3 Formula section for segment task

#### 7.81.3.1 Calculation of LV\_PUC\_CHG

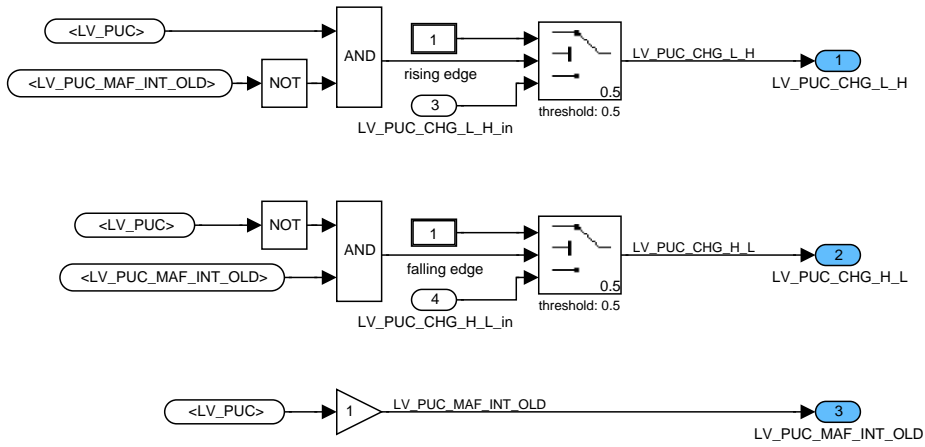



Figure 7.81.12: : Path: EGTR\_DEFSPCENRI0/OPM\_SEG/CLC\_SEG

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 2953 of 8404</b>	
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## 7.82 Activation of forced lambda stimulation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAMB_PLS_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation state variable for the forced stimulation (only in case of NC_USE_EGTR = 0)					
LV_LAMB_PLS_ACT_CAT_PURGE [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag that indicates that the forced stimulation can be activated due to cat purge					
MAF_INT_LAMB_PLS_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0... 1456.33333333	0.0222222	g
air mass flow integral for forced lambda stimulation activation					

### Input data:

LAMB_SP_DELTA_CAT_PURGE [NC_CBK_EX_NR] {p. 2939}	LAMB_SP_HOM [NC_CBK_EX_NR] {p. 8340}	LV_FAC_LAM_LIM_NOT_STAT_CDN [NC_CBK_EX_NR] {p. 2463}	LV_INH_LAMB_PLS [NC_CBK_EX_NR] {p. 2579}
LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}	LV_PUC {p. 1720}	LV_ST_END {p. 1720}
MAF_CYL {p. 8277}	NC_CBK_EX_NR {p. 1829}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_SP_DE_THD_LAMB_PLS_OFF	-	0... FFFFH	0... 0.249939	61.0352e-6	-
upper threshold of cat purge deviation for de-activating the forced stimulation					
C_LAMB_SP_DE_THD_LAMB_PLS_ON	-	0... FFFFH	0... 0.249939	61.0352e-6	-
lower threshold of cat purge deviation for activating the forced stimulation					
C_LAMB_SP_MAX_LAMB_PLS_ACT	-	0... 7FFFH	0... 1.99993896484	61.0352e-6	-
maximum lambda set point for forced lambda stimulation activation					
C_LAMB_SP_MIN_LAMB_PLS_ACT	-	0... 7FFFH	0... 1.99993896484	61.0352e-6	-
minimum lambda set point for forced lambda stimulation activation					
C_MAF_INT_MIN_LAMB_PLS_ACT	-	0... FFFFH	0... 1456.33333333	0.0222222	g
threshold for the air mass flow integral for the activation of the forced stimulation					
C_TEMP_CAT_MIN_LAMB_PLS_ACT	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
minimum value of the catalyst temperature for the activation of the forced stimulation					

### General Information

The recurrence time is defined by T\_SAMPLE in [ms].

NC\_CBK\_EX\_NR defines the number of exhaust banks.

For vector elements, the variable extension  $_i$  is used in the model instead of  $[i]$  as found in the textual description.

## Application Conditions

Initialization: RST

Recurrence: 20MS

Activation: LV\_ST\_END==1

Deactivation: LV\_ST\_END==0

## Function description

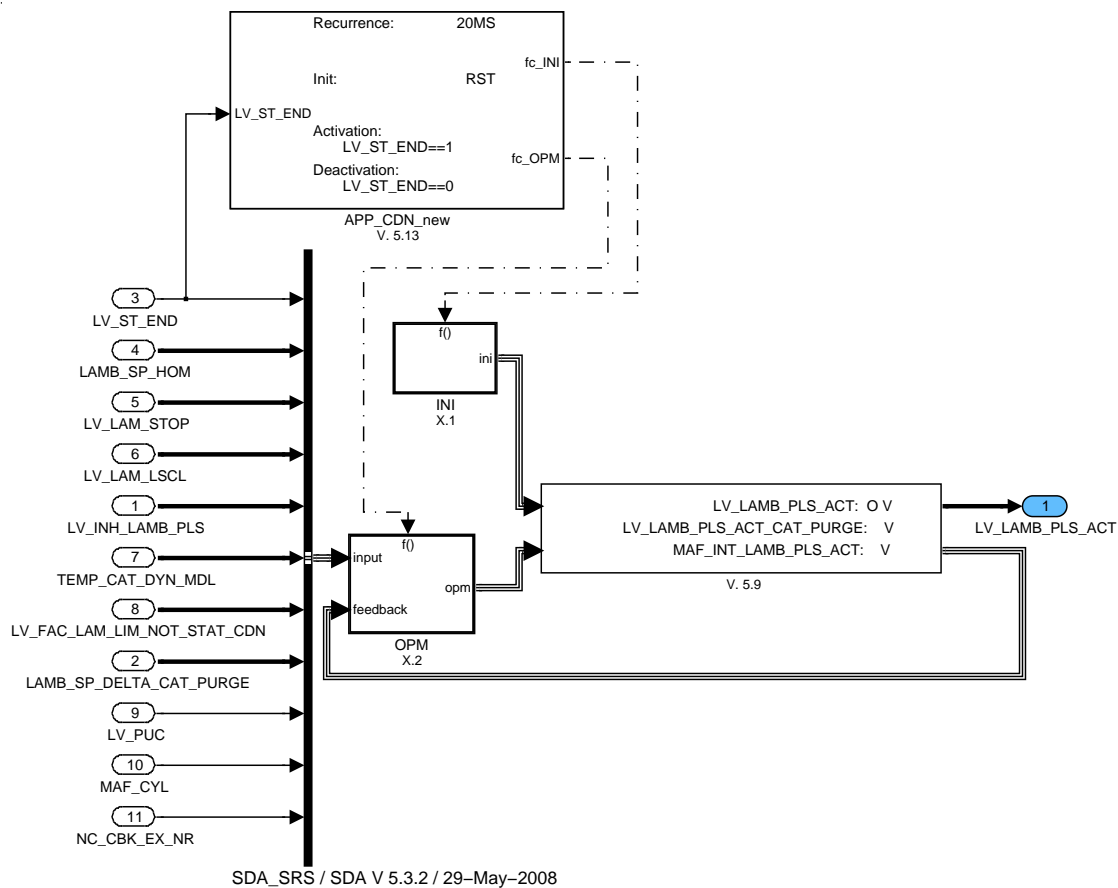


Figure 7.82.1: :

### 7.82.1 Initialisation

All variables are initialized with "0"

## Function description

## 7.82.2 Introduction multiple bank system

### 7.82.2.1 Bank specific calculations

#### 7.82.2.1.1 Check lambda set point delta and request for heater diagnosis

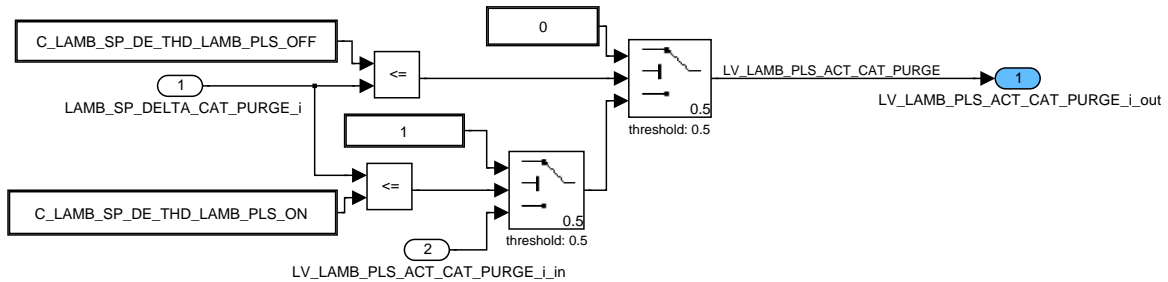


Figure 7.82.2: :

#### 7.82.2.1.2 Check lambda and lambda controller conditions

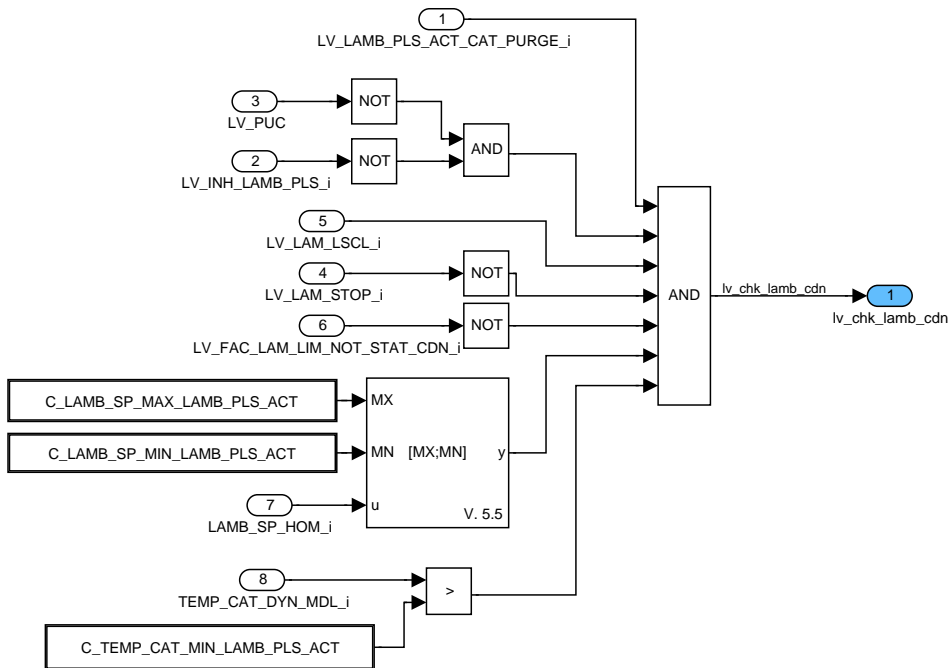


Figure 7.82.3: :

#### 7.82.2.1.3 Calculation request for cat forced stimulation

For the activation the following conditions must be fulfilled:

- engine state pull fuel cut off is inactive
- no inhibition from application incidences
- lambda controller is activated and not in stop mode
- no lambda controller limitation under non stationary operating conditions

- lambda set point deviation from catalyst purge is below calibration limit including hysteresis consideration (LV\_LAMB\_PLS\_ACT\_CAT\_PURGE[i]); this flag is evaluated each time when the activation conditions are checked
- the lambda set point is in a valid range
- the catalyst temperature value exceeds a calibration threshold

If these conditions above are all fulfilled a mass air flow integral is calculated. The forced stimulation will be finally activated when the integral exceeds a calibration limit.

For the calculation of the air mass flow integral the unit conversion:

$$[g] = [kg/h] * [ms] * [(g*h)/(kg*ms)] / 3600$$

has to be considered.

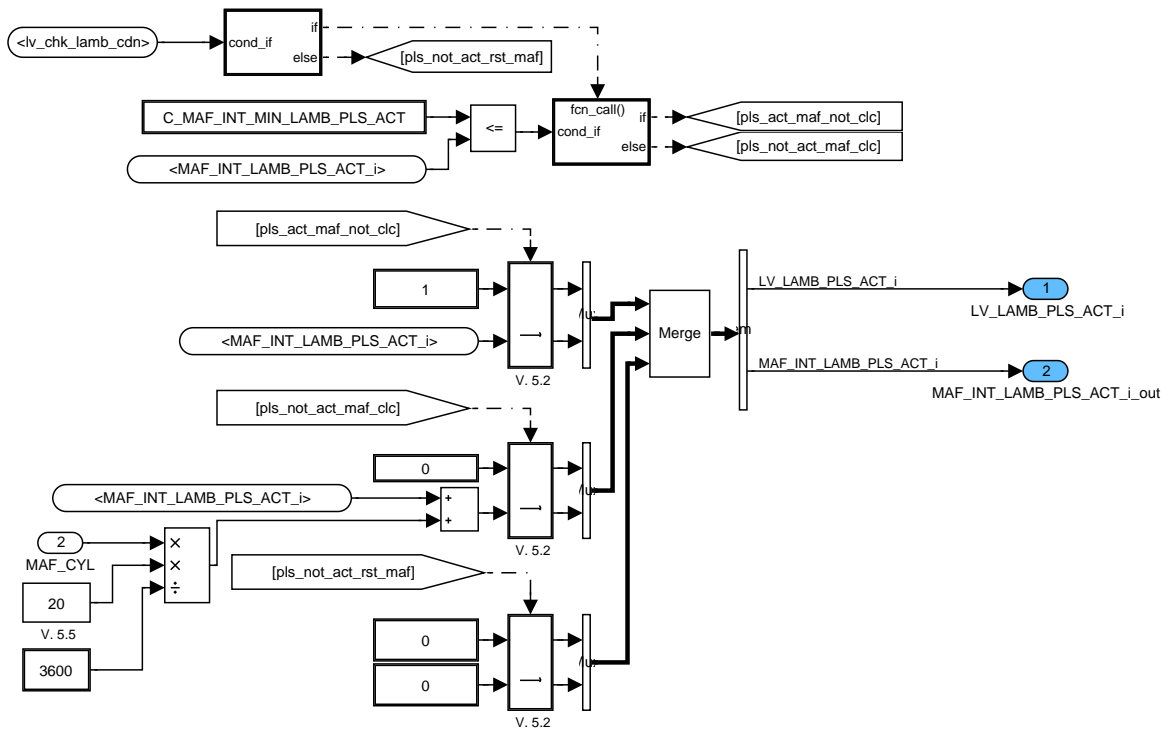


Figure 7.82.4: :

## 7.83 Determination of forced lambda stimulation parameters

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_STEP_PLS_NOM_CAT_DIAG	O/V	0... 7H	0 ...7	1	-
step counter to switch between nominal and cat diagnosis forced stimulation					
LAMB_DELTA_MAX_PLS	O/V	0... FFFH	0... 0.249939	61.0352e-6	-
lambda set point deviation step height per sample step					
LAMB_SP_DE_PLS	O/V	0... 7FFH	0... 0.12493896484	61.0352e-6	-
Amplitude of the forced lambda stimulation					
LV_STATE_LAMB_PLS_CBK_EQU	-	0... 1H	0 ...1	1	-
auxiliary flag indicating that STATE_LAMB_PLS[i] is equal at both banks					
O2L_SP_PLS	O/V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
oxygen loading set point for forced lambda stimulation					
STATE_LAMB_PLS_DET_VALUE	O/V	0H 1H 2H 3H 4H 5H 6H	PLS_OFF PLS_LSH_ DIAG PLS_CAT_ DIAG PLS_CAT_ DIAG_TRAN PLS_EXT PLS_IS PLS_NOM	-	-
State variable of forced lambda stimulation parameter determination					

### Input data:

EFF_CAT_DIAG [NC_CBK_EX_NR] {p. 5535}	LAMB_DELTA_MAX_PLS_ EXT {p. 2579}	LAMB_PLS_O2L_OSC [NC_CBK_EX_NR] {p. 2563}	LAMB_SP_DE_PLS_EXT {p. 2579}
LC_O2L_PLS_CBK_SYN {p. 2563}	LV_IS {p. 1720}	LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}	LV_LAMB_PLS_REQ_ CAT_DIAG [NC_CBK_EX_NR] {p. 5473}
LV_LAMB_PLS_REQ_EXT {p. 2579}	LV_LAMB_PLS_SYN_CBK {p. 2563}	LV_ST_END {p. 1720}	MAF_HB {p. 805}
N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	O2L_SP_PLS_EXT {p. 2579}	STATE_LAMB_PLS [NC_CBK_EX_NR] {p. 2563}
T_AST {p. 1766}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	TNT_MDL_H {p. 8237}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_DELTA_MAX_IS_PLS	-	0... FFFH	0... 0.249939	61.0352e-6	-
lambda set point deviation step height per sample step for forced stimulation in case of idle speed					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_SP_DE_IS_PLS	-	0... 7FFH	0... 0.12493896484	61.0352e-6	-
amplitude of forced stimulation in case of idle speed					
C_NR_STEP_PLS_NOM_CAT_DIAG	-	0... 7H	0...7	1	-
Number of lean - rich steps to switch between nominal and cat diagnosis forced stimulation					
C_O2L_SP_IS_PLS	-	0... FFFFH	0... 2.61684895833	39.9306e-6	g
oxygen loading set point for forced lambda stimulation in case of idle speed					
IP_FAC_1_LAMB_SP_DE_PLS	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_EFF_CAT_DIAG_IP_FAC_1_PLS	4	0... FFH	0... 1.9921875	7.8125e-3	-
first factor for forced stimulation amplitude (depending on maximal value of EFF_CAT_DIAG[i])					
IP_FAC_2_LAMB_SP_DE_PLS	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_T_AST_IP_FAC_2_PLS	4	0... FFFFH	0... 6553.5	0.1	s
LDP_TEMP_CAT_IP_FAC_2_PLS	4	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
second factor for forced stimulation amplitude(depending on time after start and cat temperature)					
IP_FAC_O2L_SP_PLS_TNT_MDL_H	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDPM_TNT_MDL_H	8	0... FFFFH	0... 1023.984375	0.015625	°C
oxygen loading set point for forced lambda stimulation dependent on NOX trap temperature					
IP_LAMB_DELTA_MAX_CAT_DIAG_PLS	V	0... FFFFH	0... 0.249939	61.0352e-6	-
LDPM_N_32_1_EGTR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_1_EGTR	8	0... FFH	0... 1389	5.4470588	mg/stk
lambda set point deviation step height per sample step for forced stimulation in case of active catalyst diagnosis					
IP_LAMB_DELTA_MAX_NOM_PLS	V	0... FFFFH	0... 0.249939	61.0352e-6	-
LDPM_N_32_1_EGTR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_1_EGTR	8	0... FFH	0... 1389	5.4470588	mg/stk
lambda set point deviation step height per sample step for nominal forced stimulation					
IP_LAMB_SP_DE_CAT_DIAG_PLS	V	0... 7FFH	0... 0.12493896484	61.0352e-6	-
LDPM_N_32_1_EGTR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_1_EGTR	8	0... FFH	0... 1389	5.4470588	mg/stk
amplitude of forced stimulation in case of active catalyst diagnosis					
IP_LAMB_SP_DE_NOM_PLS	V	0... 7FFH	0... 0.12493896484	61.0352e-6	-
LDPM_N_32_1_EGTR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_1_EGTR	8	0... FFH	0... 1389	5.4470588	mg/stk
amplitude of nominal forced stimulation					
IP_O2L_SP_CAT_DIAG_PLS	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
LDPM_N_32_1_EGTR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_1_EGTR	8	0... FFH	0... 1389	5.4470588	mg/stk
oxygen loading set point for forced lambda stimulation in case of active catalyst diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_O2L_SP_NOM_PLS	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
LDPM_N_32_1_EGTR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_1_EGTR	8	0... FFH	0... 1389	5.4470588	mg/stk
oxygen loading set point for nominal forced lambda stimulation					

### General Information

NC\_CBK\_EX\_NR defines the number of exhaust banks.

For vector elements, the variable extension `_i` is used in the model instead of `[i]` as found in the textual description.

### Application Conditions

Initialization: RST

Recurrence: 20MS

Activation: LV\_ST\_END ==1

Deactivation: LV\_ST\_END ==0

### Function description



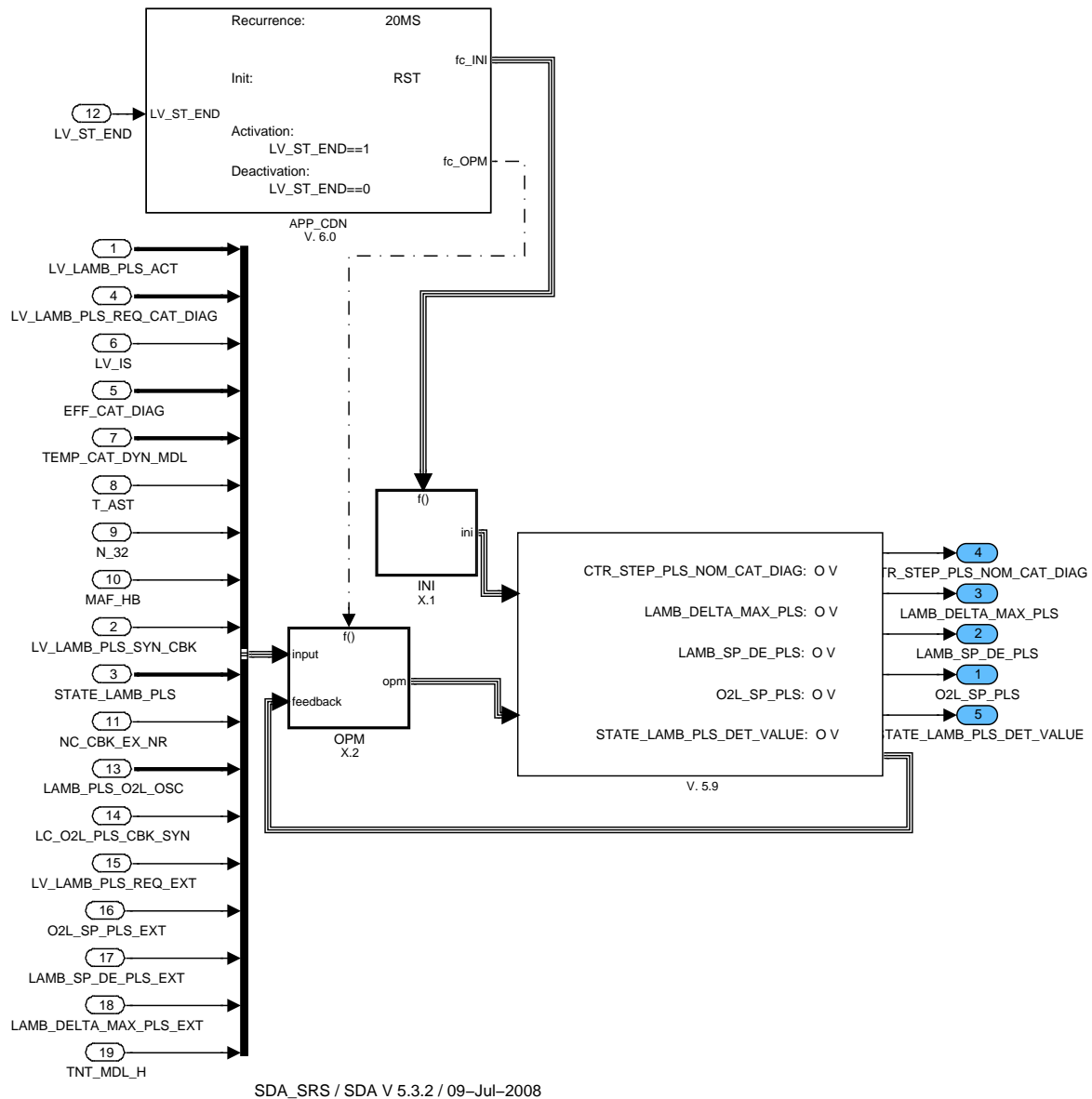


Figure 7.83.1: :

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### 7.83.1 Initialisation

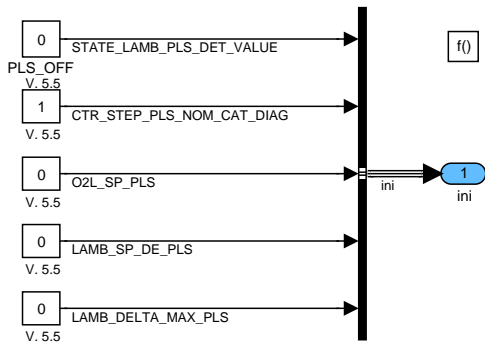


Figure 7.83.2: :

### 7.83.2 Formula section

#### 7.83.2.1 Calculations

The forced lambda stimulation distinguishes between 5 different parameters which are listed hereafter with its priority:

- a) Priority 1: forced stimulation parameters for catalyst efficiency diagnosis
- b) Priority 2: forced stimulation parameters for catalyst efficiency diagnosis ramp up
- c) Priority 3: forced stimulation parameters for requested external mode
- d) Priority 4: forced stimulation parameters for idle speed
- e) Priority 5: forced stimulation parameters for normal operation

##### 7.83.2.1.1 Check STATE\_LAMB\_PLS[i] is equal for both banks

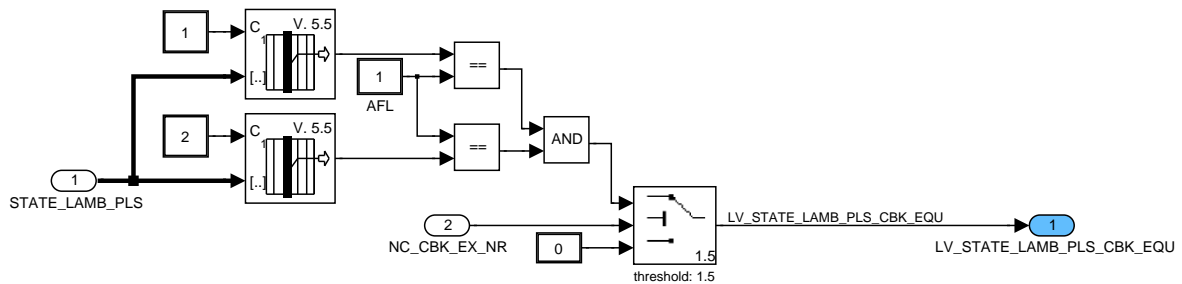


Figure 7.83.3: :

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### 7.83.2.1.2 Calculation of state contents

#### 7.83.2.1.2.1 Parameters for catalyst efficiency diagnosis

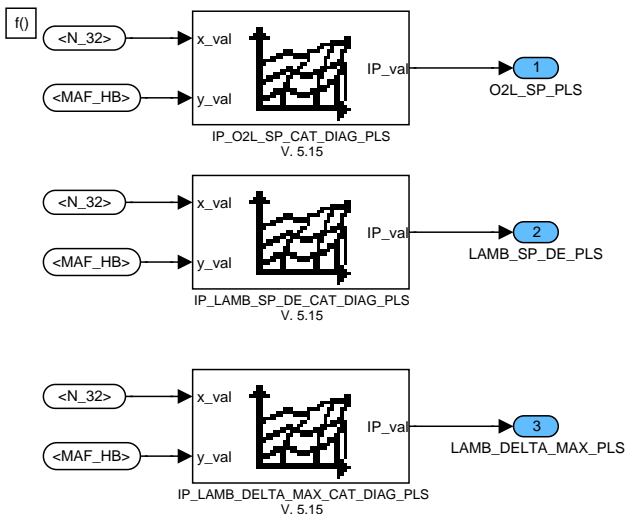


Figure 7.83.4: :

#### 7.83.2.1.2.2 Parameters for transition phase to catalyst efficiency diagnosis

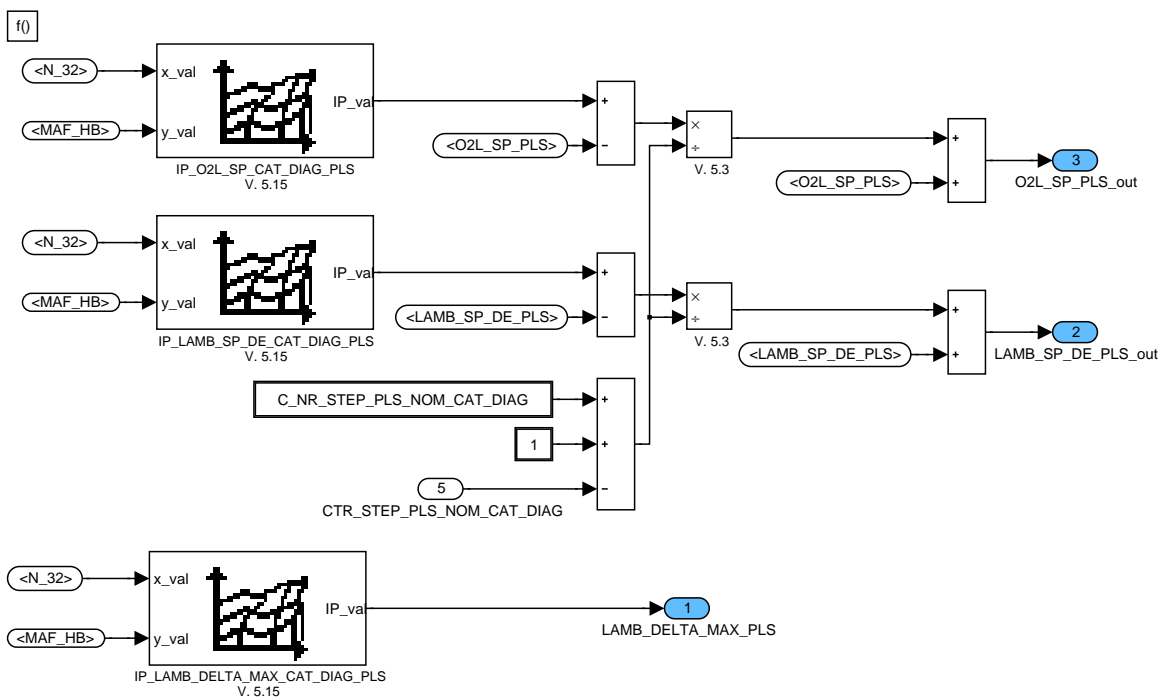


Figure 7.83.5: :

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### 7.83.2.1.2.3 Parameters for requested external mode

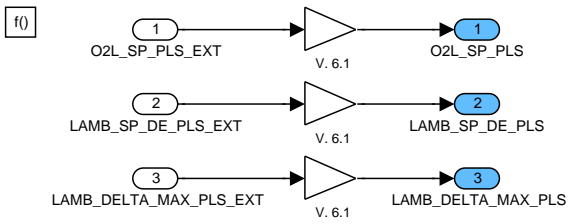


Figure 7.83.6: :

### 7.83.2.1.2.4 Parameters for IDLE speed

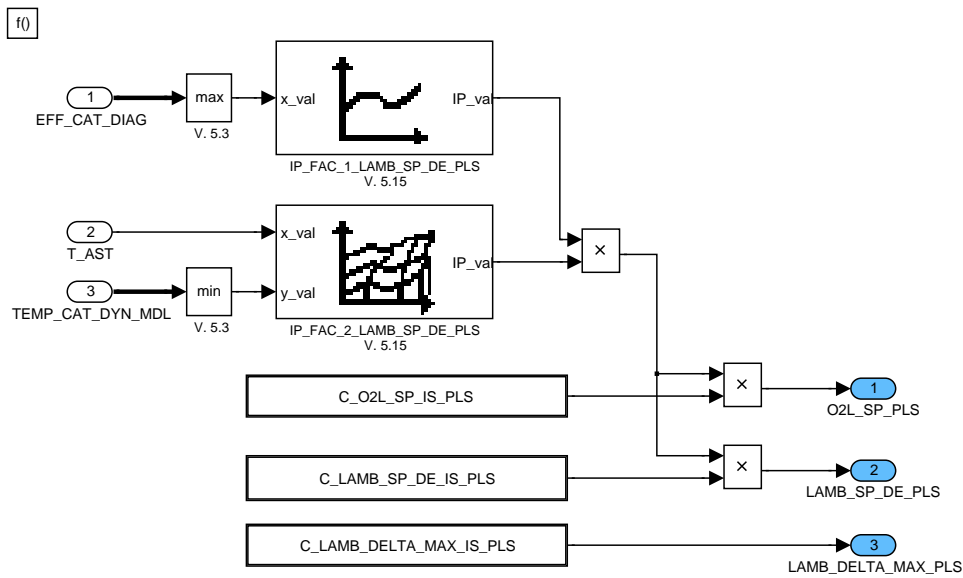


Figure 7.83.7: :

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### 7.83.2.1.2.5 Parameters for nominal stimulation

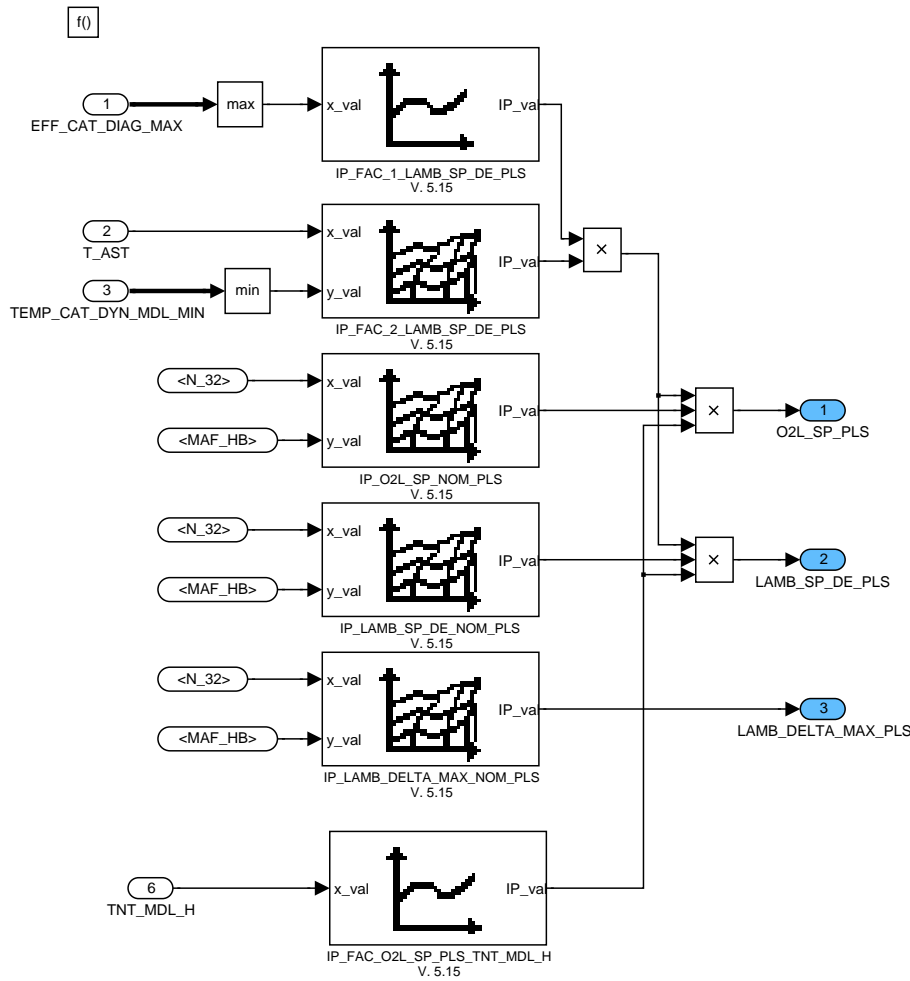


Figure 7.83.8: :

### 7.83.2.1.2.6 No parameters

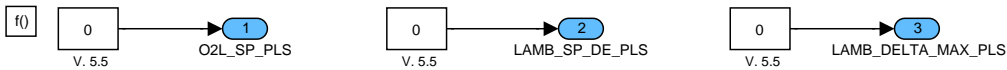


Figure 7.83.9: :

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### 7.83.2.1.3 Calculation bank crosses variables (CMN variables)

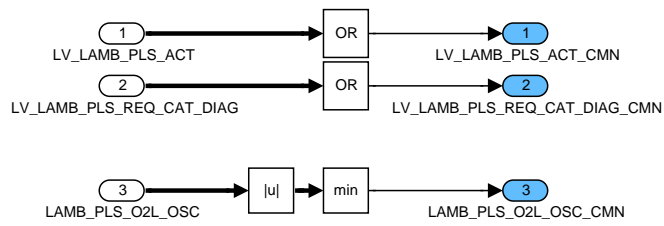


Figure 7.83.10: :

7.83.2.1.4 SET\_STATE\_LAMB\_PLS\_DET\_VALUE

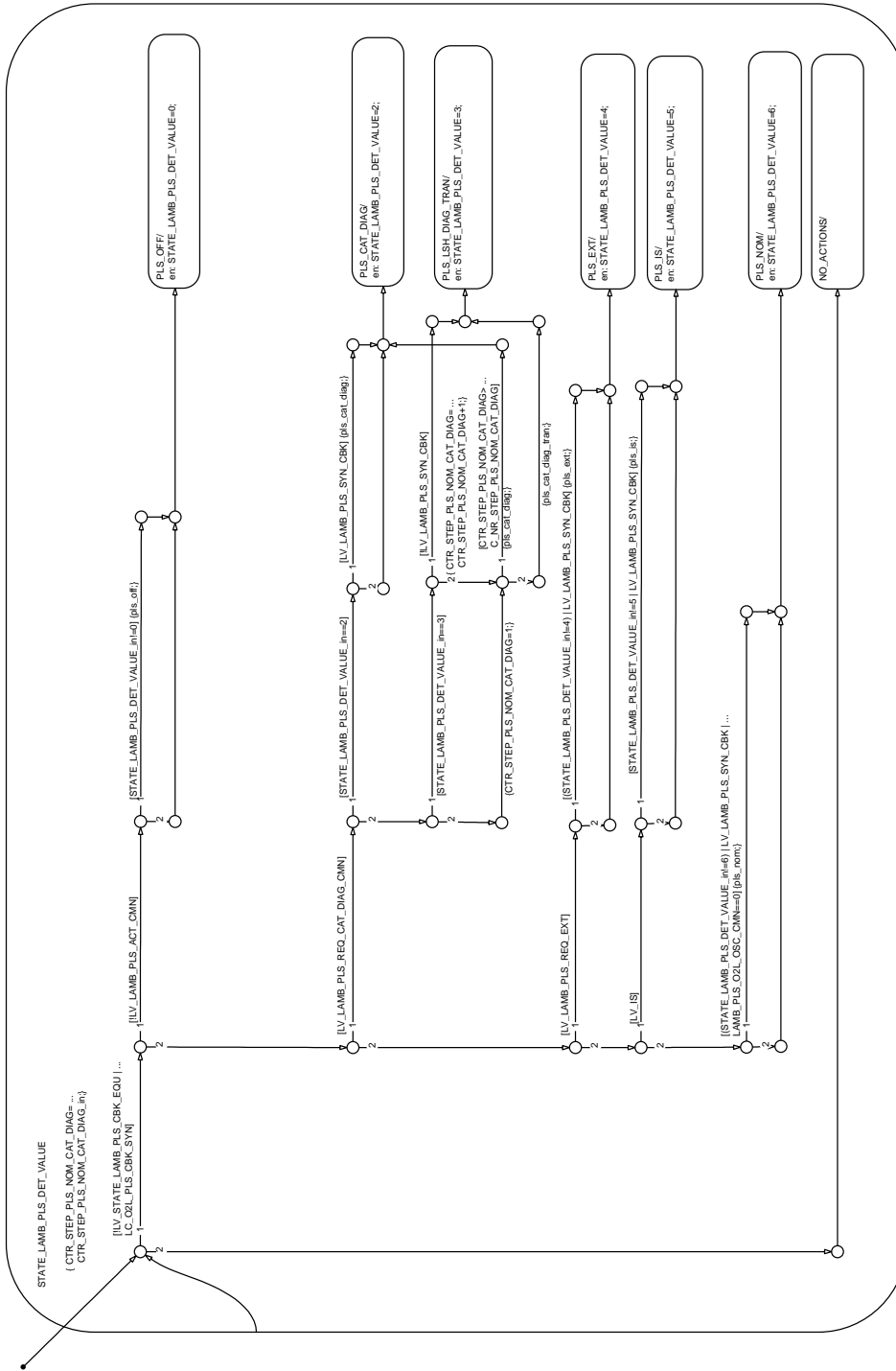



Figure 7.83.11: :

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 2967 of 8404</b>	
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## 7.84 NOx engine out emission homogeneous mode

### Data definition:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_NOX_PRED_CLC_INH	O/V	0... 1H	0...1	1	-
Inhibition of calculation of predicted NOx emissions					
MAP_DIF_NOX_HOMS	V	8000... 7FFFH	-2717.041... 2716.95854124	0.0829175	hPa
Pressure difference to basis ambient pressure of the model (homogeneous-stratified combustion mode)					
NOX_COR_HOMS	O/V	0... FFFFH	0... 1023.984375	0.015625	mg/s
Corrected engine out NOx emission in homogeneous-stratified combustion mode					
NOX_COR_HOMS_PRED	O/V	0... FFFFH	0... 1023.984375	0.015625	mg/s
Predicted engine out NOx emission for homogeneous-stratified combustion mode					
NOX_COR_HOMS_PRED_TMP	V	0... FFFFH	0... 2047.96875	0.03125	mg/s
Predicted engine out NOx emission if homogeneous-stratified combustion mode would be active (intermediate)					
NOX_COR_HOMS_TMP	V	0... FFFFH	0... 2047.96875	0.03125	mg/s
Corrected engine out NOx emission in homogeneous-stratified combustion mode (intermediate)					
RATIO_EGR_DIF_NOX_HOMS	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Exhaust gas recirculation ratio difference to basis calibration (homogeneous-stratified combustion mode)					
TCO_DIF_NOX_HOMS	V	80... 7FH	-96... 95.25	0.75	°C
Cooling water temperature difference to basis cooling temperature of the model (homogeneous-stratified combustion mode)					

### Input data:

EGR_RATIO {p. 8277}	FAC_MAF_MAX {p. 1212}	GEAR {p. 1302}	LV_AT {p. 654}
LV_CLU_SWI {p. 996}	LV_GS {p. 1565}	LV_NOX_COR_NS_AD {p. 2976}	LV_ST_END {p. 1720}
LV_VAR_TCT {p. 656}	MAP_MES {p. 1198}	MFF_SP_HOMS {p. 8243}	MFF_SP_HOMS_PRED {p. 8243}
N_32 {p. 1525}	PQ_EGR {p. 1212}	PQ_EGR_SP {p. 8278}	TCO {p. 1100}
TIA_IM {p. 984}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_BAS_NOX_HOMS	-	0... FFFFH	0... 5434	0.0829175	hPa
Basis ambient pressure for NOx engine out emission model (homogeneous-stratified combustion mode)					
C_CRLC_HOMS_PRED_FALL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for predicted value of falling NOx emissions at HOMS					
C_CRLC_HOMS_PRED_RISE	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for predicted value of rising NOx emissions at HOMS					
C_TCO_BAS_NOX_HOMS	-	0... FEH	-48... 142.5	0.75	°C
Basis cooling water temperature for NOx engine out emission model (homogeneous-stratified combustion mode)					
IP_FAC_MAF_MAX_NOX_HOMS	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_FAC_MAF_MAX_IP_FAC_HOMS	4	0... FFFFH	0... 1.99996	30.5e-6	-
Engine out NOx emission correction due to the throttle factor (homogeneous-stratified combustion mode)					
IP_NOX_EGR_RATIO_BAS_HOMS	V	0... FFFFH	-50... 49.99847	1.5259e-3	%
LDPM_MFF_SP_1_NOXM	2	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_32_1_NOXM	2	0... FFH	0... 8160	32	rpm
EGR reference value at NOx emission basis calibration (homogeneous-stratified combustion mode)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_NOX_EGR_RATIO_DIF_HOMS	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_PQ_EGR_1_NOXM	2	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_RATIO_EGR_DIF_IP_NOX_HOMS	8	0... FFFFH	-50... 49.99847	1.5259e-3	%
Engine out NOx emission correction due to EGR deviation (homogeneous-stratified combustion mode)					
IP_NOX_HOMS	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
LDPM_MFF_SP_1_NOXM	2	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_32_1_NOXM	2	0... FFH	0... 8160	32	rpm
NOx engine out base emission in homogeneous-stratified combustion mode					
IP_NOX_HOMS_NS_AD	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
LDP_MFF_SP_IP_NOX_HOMS_NS_AD	2	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_32_IP_NOX_HOMS_NS_AD	2	0... FFH	0... 8160	32	rpm
NOx engine out base emission in homogeneous operation for NOx signal gain adaptation					
IP_NOX_MAP_DIF_HOMS	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_PQ_EGR_1_NOXM	2	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_MAP_DIF_NOX_1_NOXM	2	0... FFFFH	-2717.041... 2716.95854	0.0829175	hPa
Engine out NOx emission correction due to ambient pressure deviation (homogeneous-stratified combustion mode)					
IP_NOX_TCO_HOMS	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_MAP_DIF_NOX_1_NOXM	2	0... FFFFH	-2717.041... 2716.95854	0.0829175	hPa
LDPM_TCO_DIF_NOX_1_NOXM	2	0... FFH	-96... 95.25	0.75	°C
Engine out NOx emission correction due to cooling water temperature (homogeneous-stratified combustion mode)					
IP_NOX_TCO_HOMS_PRED	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_TCO_DIF_NOX_1_NOXM	2	0... FFH	-96... 95.25	0.75	°C
Prediction of engine out NOx emission correction due to cooling water temperature (homogeneous-stratified combustion mode)					
IP_NOX_TIA_HOMS	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_N_32_IP_NOX_TIA_HOMS	8	0... FFH	0... 8160	32	rpm
LDP_TIA_IM_IP_NOX_TIA_HOMS	4	0... FEH	-48... 142.5	0.75	°C
Engine out NOx emission correction due to intake air temperature (homogeneous-stratified combustion mode)					
LC_GS_PRED_ENA	-	0... 1H	0 ...1	1	-
Selection if NOx emission prediction calculation will be disabled during LV_GS=1					
LC_MFF_HOMS_PRED_ENA	-	0... 1H	0 ...1	1	-
Selection for predicted emissions (0: MFF_SP_HOMS, 1: MFF_SP_HOMS_PRED)					
LC_MT_PRED_ENA	-	0... 1H	0 ...1	1	-
Selection if NOx emission prediction calculation will be disabled during manual gear shift					

## General Information

This module calculates the NOx engine out emission mass flow at homogeneous-stratified mode. This module guesses also a predicted value, if the homogeneous-stratified mode would become active at the actual conditions.

The calculations consist of an basis calibration, depending on fuel mass, motor speed and ambient temperature. This value will be corrected by several factors, which depend from the deviation of state variables compared to the basis calibration.

## Application Conditions

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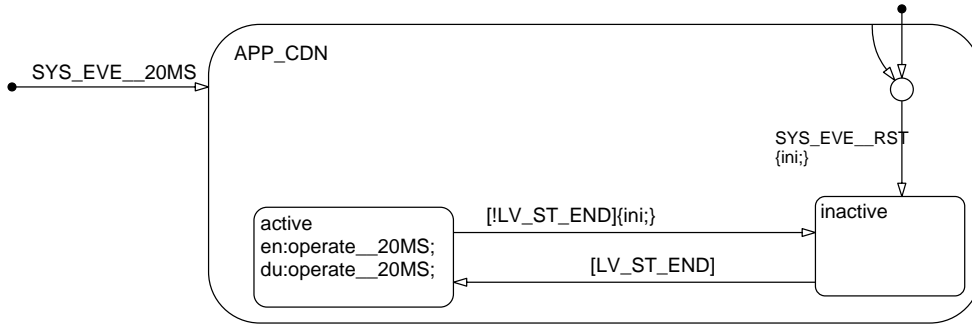


Figure 7.84.1: : Path: NOXM\_MODUL7038/APP\_CDN/Chart

**Function description**

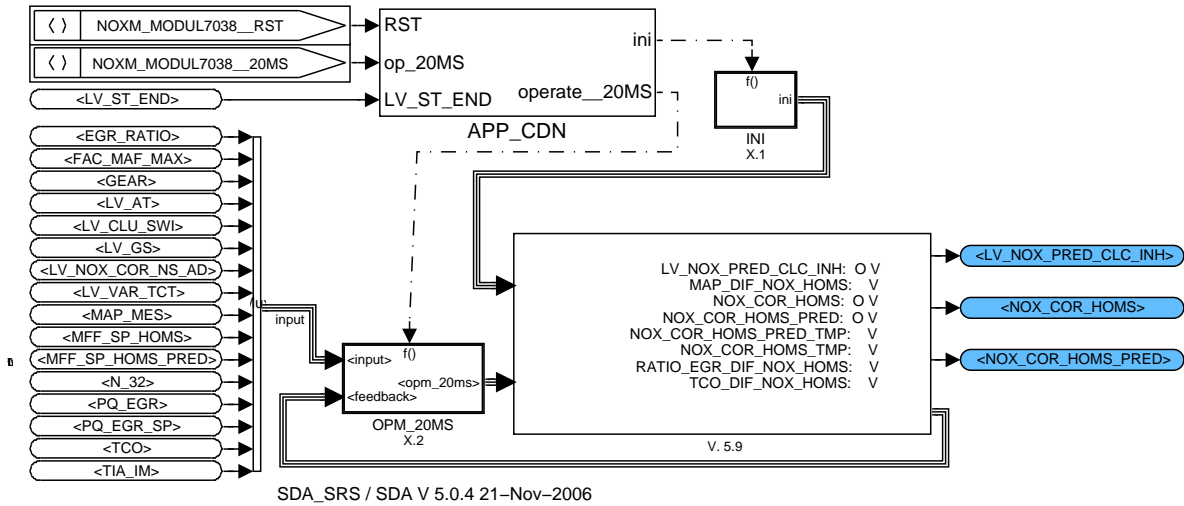


Figure 7.84.2: : Path: NOXM\_MODUL7038

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### 7.84.1 Initialization at reset and deactivation

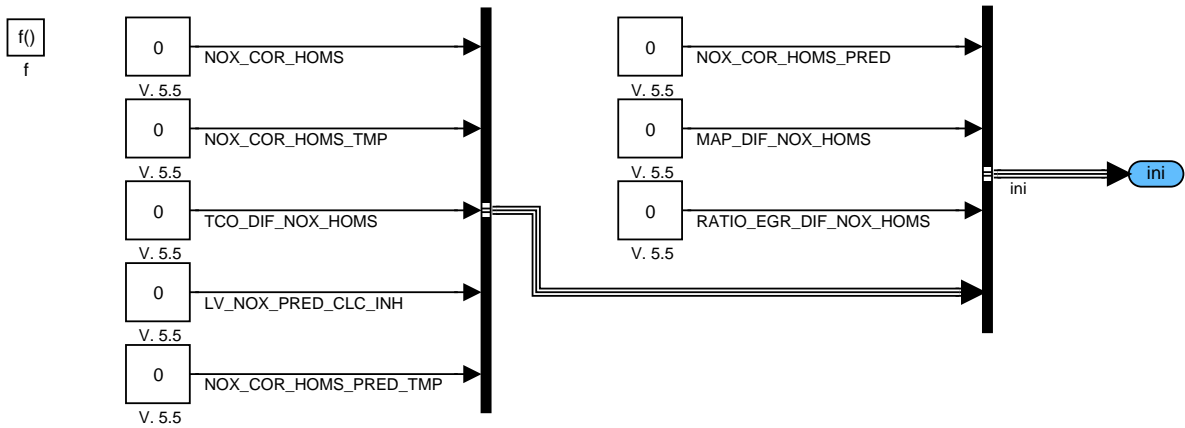


Figure 7.84.3: : Path: NOXM\_MODUL7038/INI

### 7.84.2 Calculation at 20 ms

#### 7.84.2.1 Deviation of air pressure



Figure 7.84.4: : Path: NOXM\_MODUL7038/OPM\_20MS/CLC1

#### 7.84.2.2 Deviation of cooling water temperature

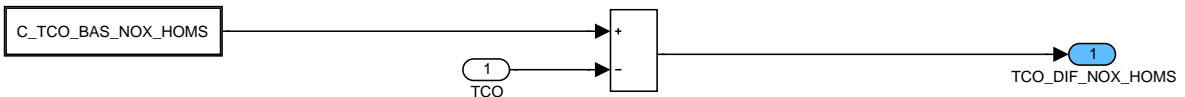


Figure 7.84.5: : Path: NOXM\_MODUL7038/OPM\_20MS/CLC2

#### 7.84.2.3 Deviation of exhaust gas recirculation

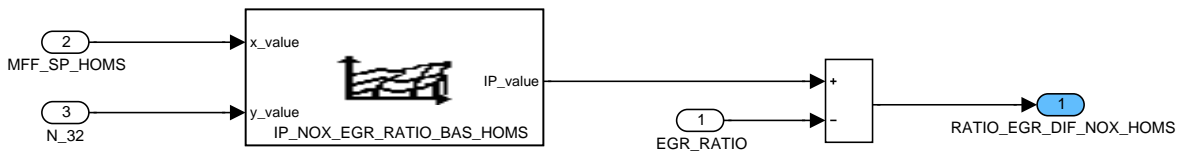


Figure 7.84.6: : Path: NOXM\_MODUL7038/OPM\_20MS/CLC3

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### 7.84.2.4 Basis calibration of NOx engine out emissions

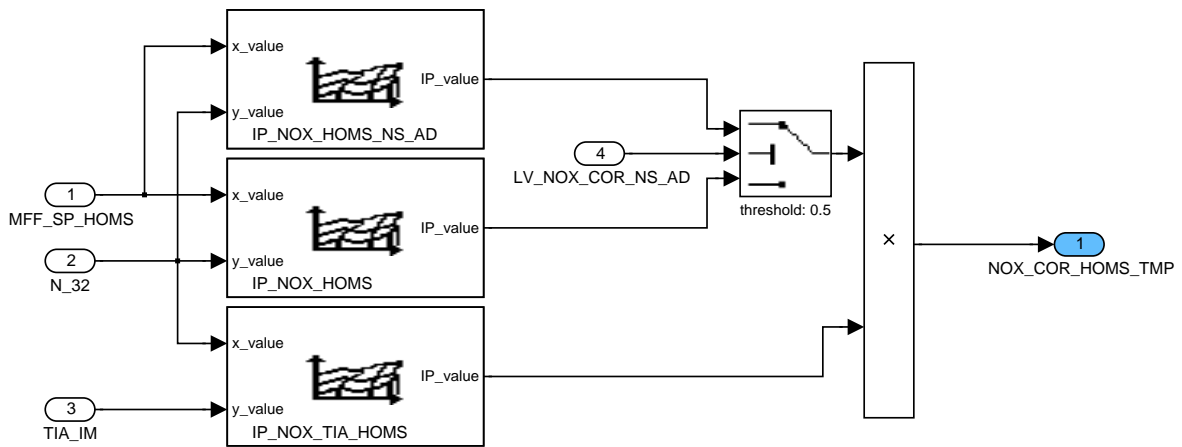

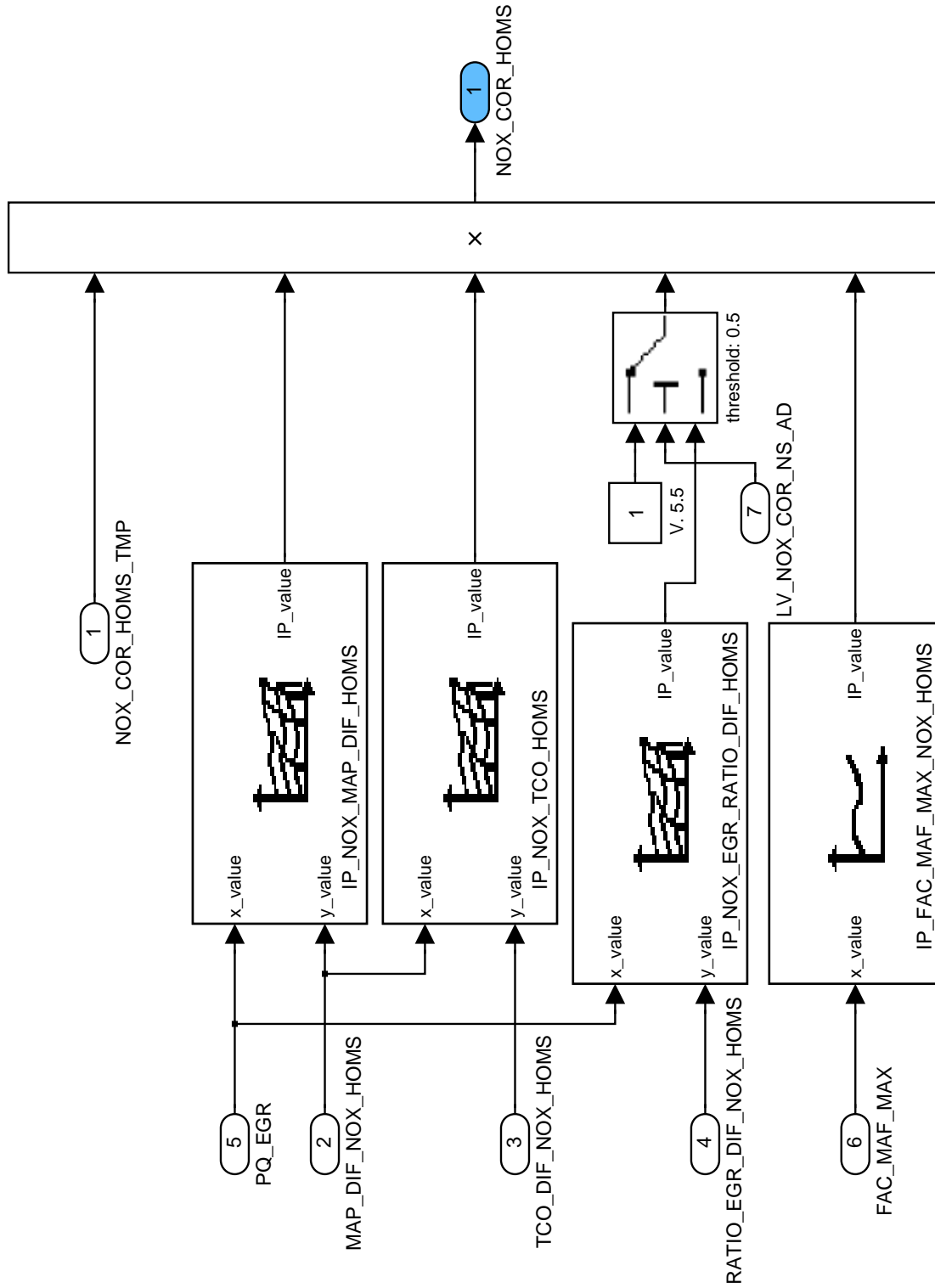


Figure 7.84.7: : Path: NOXM\_MODUL7038/OPM\_20MS/CLC4

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 2972 of 8404</b>	
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### 7.84.2.5 Corrected engine out NOx emissions



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Figure 7.84.8: : Path: NOXM\_MODUL7038/OPM\_20MS/CLC5

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### 7.84.2.6 Condition to stop calculation of predicted NOx emissions

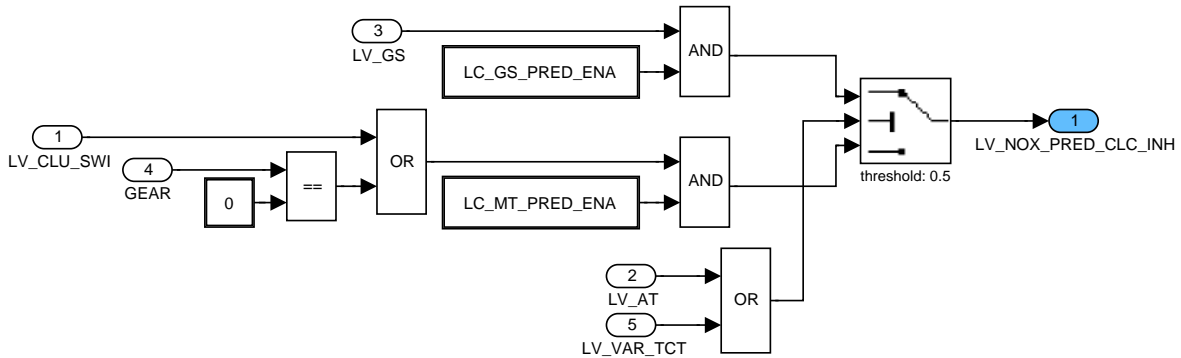


Figure 7.84.9: : Path: NOXM\_MODUL7038/OPM\_20MS/CLC7

### 7.84.2.7 Basis for predicted NOx emissions

The calibration maps are the same as for actual emissions. They deliver the predicted emissions, because the predicted fuel mass MFF\_SP\_HOMS\_PRED may be used here.

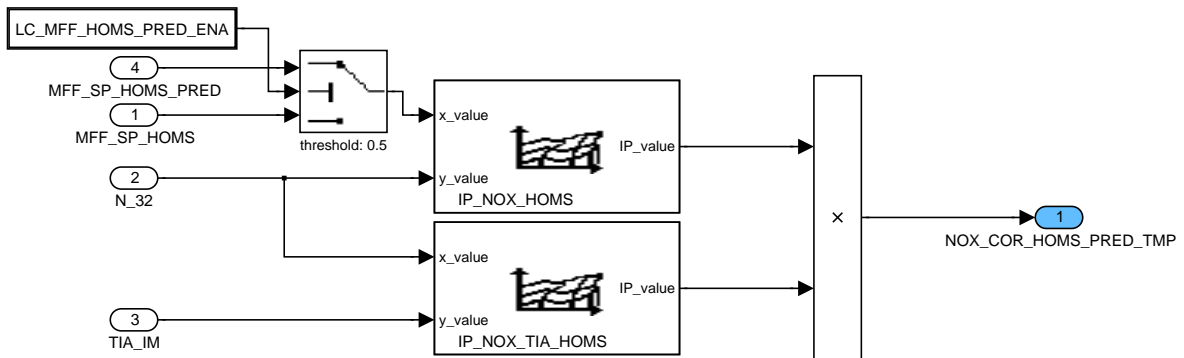


Figure 7.84.10: : Path: NOXM\_MODUL7038/OPM\_20MS/CLC8

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### 7.84.2.8 Predicted engine out NOx emissions

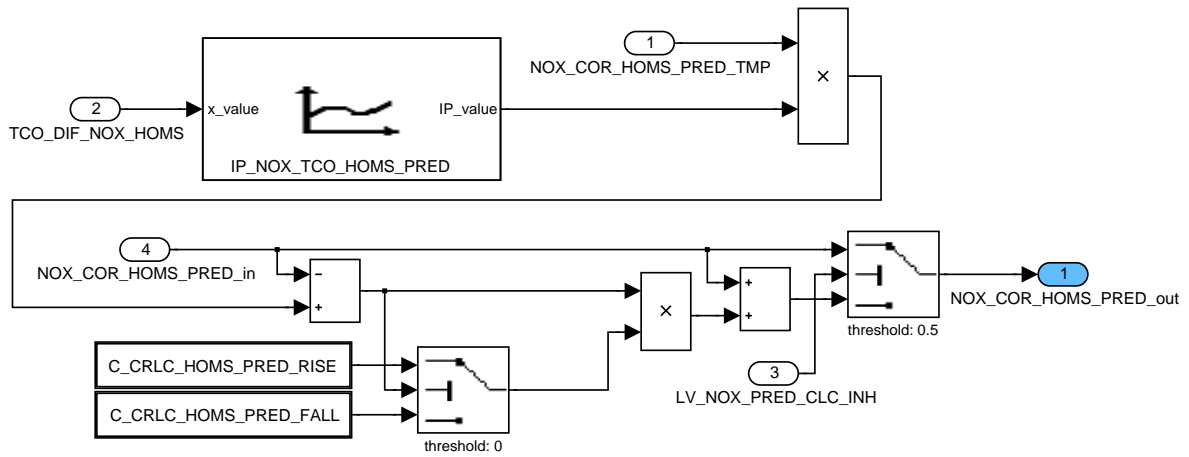



Figure 7.84.11: : Path: NOXM\_MODUL7038/OPM\_20MS/CLC9

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## 7.85 NOx engine out emission stratified mode

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_NOX_COR_NS_AD	O/V	0... 1H	0 ...1	1	-
NOx emission calculation for NOx signal gain adaptation					
MAP_DIF_NOX_S	V	8000... 7FFFH	-2717.041... 2716.95854124	0.0829175	hPa
Pressure difference to basis ambient pressure of the model					
NOX_COR_S	O/V	0... FFFFH	0... 1023.984375	0.015625	mg/s
Corrected engine out NOx emission in stratified operation mode					
NOX_COR_S_PRED	O/V	0... FFFFH	0... 1023.984375	0.015625	mg/s
Predicted engine out NOx emission for stratified operation mode					
NOX_COR_S_PRED_TMP	V	0... FFFFH	0... 2047.96875	0.03125	mg/s
Predicted engine out NOx emission for stratified operation mode (intermediate)					
NOX_COR_S_TMP	V	0... FFFFH	0... 2047.96875	0.03125	mg/s
Corrected engine out NOx emission in stratified operation mode (intermediate)					
RATIO_EGR_DIF_NOX_S	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Exhaust gas recirculation ratio difference to basis calibration					
TCO_DIF_NOX_S	V	80... 7FH	-96... 95.25	0.75	°C
Cooling water temperature difference to basis cooling temperature of the model					

### Input data:

EGR_RATIO {p. 8277}	FAC_MAF_MAX {p. 1212}	LV_NOX_PRED_CLC_INH {p. 2968}	LV_ST_END {p. 1720}
MAP_MES {p. 1198}	MFF_SP_S {p. 8243}	MFF_SP_S_PRED {p. 8243}	N_32 {p. 1525}
NC_NOX_SENS_CONF {p. 643}	OPM_REQ_CUS {p. 8137}	PQ_EGR {p. 1212}	PQ_EGR_SP {p. 8278}
TCO {p. 1100}	TIA_IM {p. 984}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_BAS_NOX_S	-	0... FFFFH	0... 5434	0.0829175	hPa
Basis ambient pressure for NOx engine out emission model					
C_CRLC_S_PRED_FALL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for predicted value of falling NOx emissions at S					
C_CRLC_S_PRED_RISE	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for predicted value of rising NOx emissions at S					
C_STATE_OPM_NOX_S_NS_AD	-	0... FFFFH	0... 65535	1	-
State of combustion mode for switch to correction factor valid at NOx signal gain adaptation					
C_TCO_BAS_NOX_S	-	0... FEH	-48... 142.5	0.75	°C
Basis cooling water temperature for NOx engine out emission model					
IP_FAC_MAF_MAX_NOX_S	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_FAC_MAF_MAX_IP_FAC_S	4	0... FFFFH	0... 1.99996	30.5e-6	-
Engine out NOx emission correction due to the throttle factor					




Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_NOX_EGR_RATIO_BAS_S	V	0... FFFFH	-50... 49.99847	1.5259e-3	%
LDPM_MFF_SP_2_NOXM	2	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_32_3_NOXM	2	0... FFH	0... 8160	32	rpm
EGR reference value at NOx emission basis calibration					
IP_NOX_EGR_RATIO_DIF_S	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_PQ_EGR_2_NOXM	2	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_RATIO_EGR_DIF_IP_NOX_S	8	0... FFFFH	-50... 49.99847	1.5259e-3	%
Engine out NOx emission correction due to EGR deviation					
IP_NOX_MAP_DIF_S	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_PQ_EGR_2_NOXM	2	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_MAP_DIF_NOX_2_NOXM	2	0... FFFFH	-2717.041... 2716.95854	0.0829175	hPa
Engine out NOx emission correction due to ambient pressure deviation					
IP_NOX_S	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
LDPM_MFF_SP_2_NOXM	2	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_32_3_NOXM	2	0... FFH	0... 8160	32	rpm
NOx engine out base emission in stratified operation					
IP_NOX_S_NS_AD	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
LDP_MFF_SP_IP_NOX_S_NS_AD	2	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_32_IP_NOX_S_NS_AD	2	0... FFH	0... 8160	32	rpm
NOx engine out base emission in stratified operation for NOx signal gain adaptation					
IP_NOX_TCO_S	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_MAP_DIF_NOX_2_NOXM	2	0... FFFFH	-2717.041... 2716.95854	0.0829175	hPa
LDPM_TCO_DIF_NOX_2_NOXM	2	0... FFH	-96... 95.25	0.75	°C
Engine out NOx emission correction due to cooling water temperature					
IP_NOX_TCO_S_PRED	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_TCO_DIF_NOX_2_NOXM	2	0... FFH	-96... 95.25	0.75	°C
Prediction of engine out NOx emission correction due to cooling water temperature					
IP_NOX_TIA_S	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_N_32_IP_NOX_TIA_S	8	0... FFH	0... 8160	32	rpm
LDP_TIA_IM_IP_NOX_TIA_S	4	0... FEH	-48... 142.5	0.75	°C
Engine out NOx emission correction due to intake air temperature					
LC_MFF_S_PRED_ENA	-	0... 1H	0 ...1	1	-
Selection for predicted emissions (0: MFF_SP_S, 1: MFF_SP_S_PRED)					

## General Information

This module calculates the NOx engine out emission mass flow at stratified mode. This module guesses also a predicted value, if the stratified mode would become active at the actual conditions.

The calculations consist of an basis calibration, depending on fuel mass, motor speed and ambient temperature. This value will be corrected by several factors, which depend from the deviation of state variables compared to the basis calibration.

## Application Conditions

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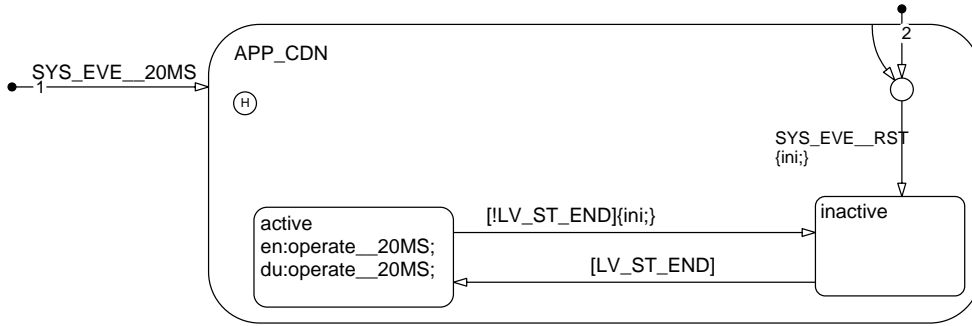


Figure 7.85.1: :

**Function description**

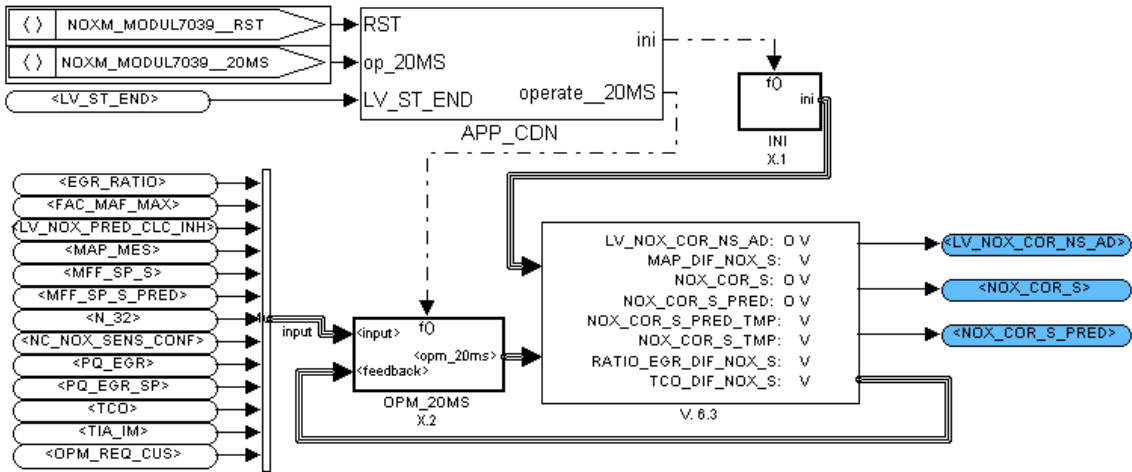


Figure 7.85.2: :

**7.85.1 Initialization at reset and deactivation**

**7.85.2 Calculation at 20 ms**

**7.85.2.1 Deviation of air pressure**

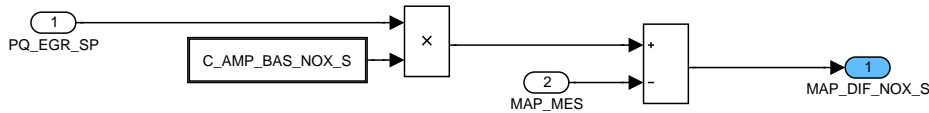


Figure 7.85.3: :

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### 7.85.2.2 Deviation of cooling water temperature

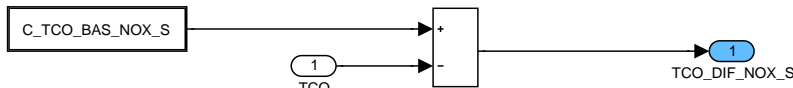


Figure 7.85.4: :

### 7.85.2.3 Deviation of exhaust gas recirculation

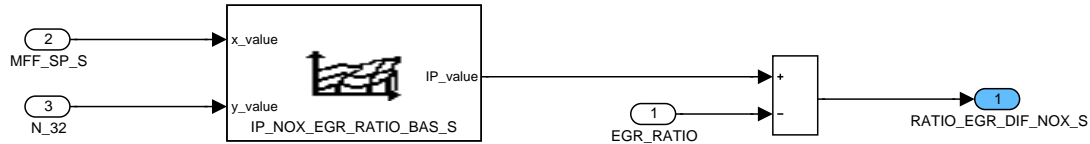


Figure 7.85.5: :

### 7.85.2.4 Detection of NOx signal gain adaptation

If the NOx signal gain adaptation for any NOx sensor is in required combustion mode, then a special basis calibration matrix is used.

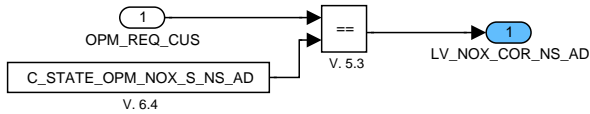


Figure 7.85.6: :

### 7.85.2.5 Basis calibration of NOx engine out emissions

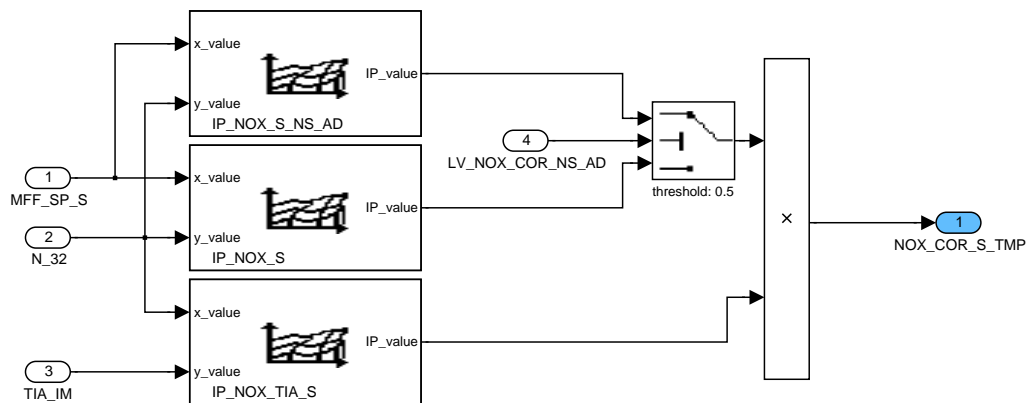


Figure 7.85.7: :

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### 7.85.2.6 Corrected engine out NOx emissions

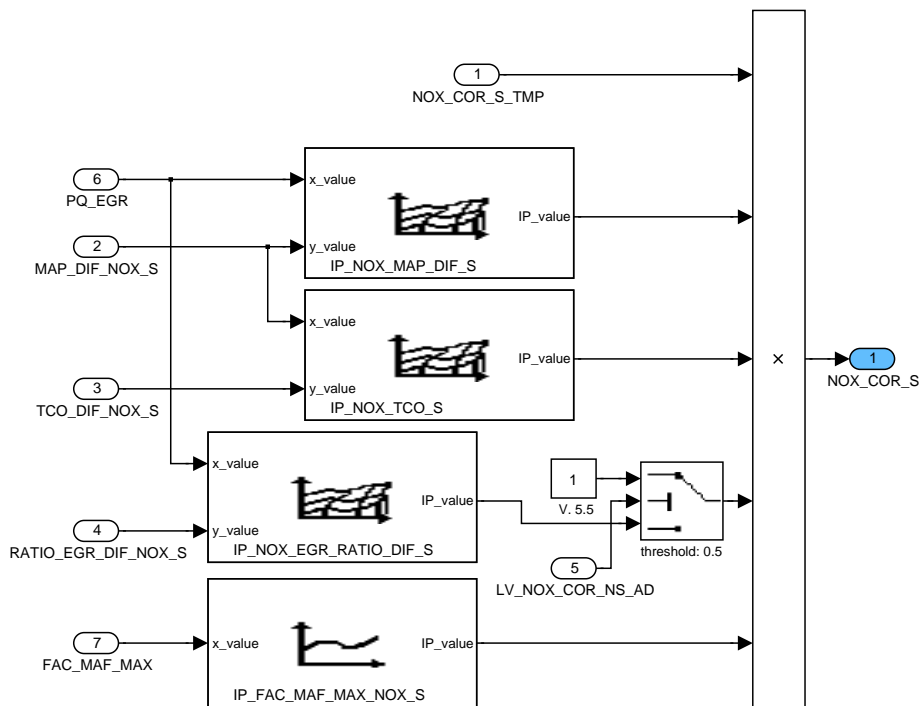


Figure 7.85.8: :

### 7.85.2.7 Basis for predicted NOx emissions

The calibration maps are the same as for actual emissions. They deliver the predicted emissions, because the predicted fuel mass MFF\_SP\_S\_PRED may be used here.

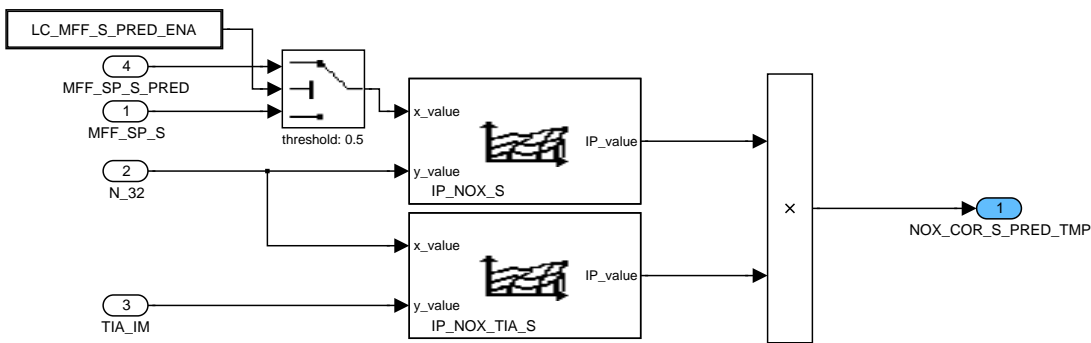


Figure 7.85.9: :

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### 7.85.2.8 Predicted engine out NOx emissions

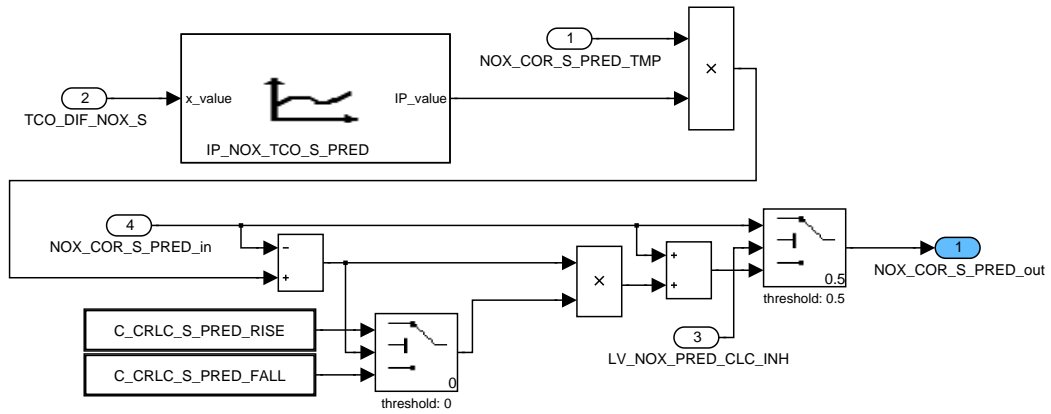



Figure 7.85.10: :

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## 7.86 NOx catalyst management

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_AFL_PURGE [NC_NT_NR]	V	0... FFH	0... 255	1	-
Activation counter for catalyst purge after lean operation					
DIST_AFL	V	0... FFFFH	0... 6553.5	0.1	km
Mileage during current lean operation phase (STATE_NOX = LOAD)					
DIST_AFL_ST	V	0... FFFFFFFFH	0... 429496729500	100	m
Mileage counter value at start of lean operation phase (STATE_NOX = LOAD)					
FAC_RGN_DEC_SHAR	V	0... 80H	0 ...1	0.0078125	-
Share factor for the reducing agent for the decrementation of NTL and O2L					
FLOW_NT_MMV	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
filtered exhaust gas flow through NOx trap					
LV_ACT_INT_PUC_AFL [NC_NT_NR]	O/V	0... 1H	0 ...1	1	-
Request for catalyst purge activation when leaving lean burn condition					
LV_AFL_NOT	O/V	0... 1H	0 ...1	1	-
Logical value: lambda1 or richer operation is requested or active					
LV_CAT_PURGE_REQ_POST_AFL [NC_NT_NR]	O/V	0... 1H	0 ...1	1	-
request for cat purge from NOx management					
LV_MDL_AFR	O/V	0... 1H	0 ...1	1	-
Model rich exhaust gas (stop of regeneration)					
LV_NOX_SENS	O/V	0... 1H	0 ...1	1	-
Logical Variable for the existence of a NOx-Sensor					
LV_NOX_SENS_NOX_VLD_RGN_ST [NC_NT_NR]	O/V	0... 1H	0 ...1	1	-
flag: NOx sensor NOx signal validity at the moment the NOx sensor rgn request is set					
LV_NOX_SENS_RGN	O/V	0... 1H	0 ...1	1	-
Regeneration request only due to NOx sensor (loading model blocked)					
LV_NT_ACT	O/V	0... 1H	0 ...1	1	-
Flag for NOx catalyst function activation					
LV_NT_AFS_REQ	O/V	0... 1H	0 ...1	1	-
Request of lambda = 1 operation mode					
LV_NT_AFS_REQ_PRED	V	0... 1H	0 ...1	1	-
Prediction result for request of homogeneous stoichiometric operation					
LV_NT_HOM_INI	O/V	0... 1H	0 ...1	1	-
flag: NOx trap initialised due to sufficient hom. stoic. operation (accumulation effects eliminated)					
LV_NT_RGN_2_NOT_VLD	V	0... 1H	0 ...1	1	-
Regeneration of second bank not successful					
LV_NT_RGN_2_NOT_VLD_SET	V	0... 1H	0 ...1	1	-
Set condition for Regeneration of second bank not successful					
LV_NT_RGN_STOP_PUC	O/V	0... 1H	0 ...1	1	-
Indicator, that a NOx regeneration was broken by engine state PUC					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_NTL_DEC_INT_AFR	V	0... 1H	0 ...1	1	-
Rich detection by NTL_DEC_INT ratio at the end of the regeneration of the second bank					
LV_NTL_DEC_INT_STOP_RGN	V	0... 1H	0 ...1	1	-
Ratio of NTL_DEC_INT reached to cancel the regeneration of the second bank					
LV_RGN_AGI [NC_NT_NR]	O/V	0... 1H	0 ...1	1	-
Flag used for communication with aging function					
LV_RGN_AGI_VLD [NC_NT_NR]	O/V	0... 1H	0 ...1	1	-
Flag used for communication with aging function					
LV_RGN_CDN	O/V	0... 1H	0 ...1	1	-
Flag for testing whether or not regeneration conditions are given					
LV_RGN_NT_REQ	O/V	0... 1H	0 ...1	1	-
Logical Variable for NOx trap regeneration phase request					
LV_RGN_REQ_NOX_SENS	O/V	0... 1H	0 ...1	1	-
Regeneration request caused by the NOx-Sensor signal					
LV_RGN_REQ_NOX_SENS_TMP [NC_NT_NR]	O/V	0... 1H	0 ...1	1	-
Bench-selective regeneration request caused by the NOx-Sensor signal					
LV_RGN_REQ_NTLD	O/V	0... 1H	0 ...1	1	-
Logical value for regeneration phase request because of the NOx trap loading degree					
LV_RGN_REQ_NTLD_AFS	O/V	0... 1H	0 ...1	1	-
Logical value for regeneration phase request before switching to stoichiometric operation or rich operation					
LV_RGN_STOP_MDL	O/V	0... 1H	0 ...1	1	-
Flag indicating: Stop of Rgn out of model enabled					
LV_RGN_STOP_SENS	O/V	0... 1H	0 ...1	1	-
Flag indicating: Stop of Rgn by sensor enabled					
LV_RGN_STOP_TOUT	O/V	0... 1H	0 ...1	1	-
Flag indicating: Stop of Rgn by time counter enabled					
LV_SENS_AFR [NC_NT_NR]	O/V	0... 1H	0 ...1	1	-
downstream sensor measures rich exhaust gas (stop of regeneration)					
LV_SENS_AFR_TRIM	O/V	0... 1H	0 ...1	1	-
downstream sensor sees rich exhaust gas (homogeneous detection threshold)					
LV_SENS_AFR_TRIM_TMP [NC_NT_NR]	O/V	0... 1H	0 ...1	1	-
downstream sensor measures rich exhaust gas (homogeneous detection threshold) (bench-selective value)					
LV_SENS_RGN_1_READY	O/V	0... 1H	0 ...1	1	-
End of first regeneration					
LV_T_AFL_MIN	O/V	0... 1H	0 ...1	1	-
flag: minimum lean time for setting a request elapsed					
LV_TOUT_AFR	O/V	0... 1H	0 ...1	1	-
rich exhaust gas after timeout (stop of regeneration)					
LV_TRIG_AFR_AFL	O/V	0... 1H	0 ...1	1	-
Logical value for triggering a transition of rich to lean operation					
LV_VLS_GRD_NEG	O/V	0... 1H	0 ...1	1	-
Negative gradient of VLS_NOX_SENS_1 between first and second regeneration					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_VLS_GRD_NEG_SET_VLS	-	0... 1H	0 ...1	1	-
Flag for indicate of reaching of negative gradient for set of LV_SENS_AFR_2 with VLS signal					
MAF_INT_STOP	O/V	0... FFFFH	0 ...1	0.0222222	g
Air mass integral since start of STATE_NOX = STOP is active					
MAF_INT_STOP_NTL	O/V	0... FFFFH	0... 5825.33333	0.0888889	g
Air mass integral since start of actual STATE_NOX = STOP phase					
NOX_CONC	O/V	0... FFFFH	0... 65535	1	ppm
NOx concentration engine out (after raw emission adaptation correction)					
NOX_CONC_MMV	V	0... FFFFH	0... 65535	1	ppm
filtered NOx engine out concentration					
NOX_CONC_OUT_MDL	O/V	0... FFFFH	0... 65535	1	ppm
corrected NOx concentration after catalyst					
NOX_CONC_OUT_MDL_MMV	V	0... FFFFH	0... 65535	1	ppm
Filtered corrected NOx concentration after catalyst					
NOX_CONC_RAW	O/V	0... FFFFH	0... 65535	1	ppm
NOx concentration engine out					
NOX_CONC_RED	O/V	0... FFFFH	0... 65535	1	ppm
corrected NOx concentration in catalyst (incl. SSR)					
NOX_CONC_RED_MMV	O/V	0... FFFFH	0... 65535	1	ppm
filtered corrected NOx concentration in catalyst (incl. SSR)					
NOX_CONC_RED_MMV_RGN_ST	O/V	0... FFFFH	0... 65535	1	ppm
filtered corrected NOx concentration in catalyst (incl. SSR) at NOx regeneration start					
NOX_COR	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
raw engine out NOx emission					
NOX_COR_INT	V	0... FFFFH	0... 10485.6	0.16	mg
Integral of modelled NOx raw emissions (pre NOx catalyst) at current lean operation phase					
NOX_COR_RED	O/V	0... FFFFH	0... 1023.98437	0.015625	mg/s
corrected engine out NOx emission (incl. SSR)					
NOX_COR_RED_MMV	O/V	0... FFFFH	0... 1023.98437	0.015625	mg/s
Moving mean value of corrected engine out NOx emission (incl. SSR)					
NOX_FLOW	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
NOx emission flow which is stored in the catalyst					
NOX_HOMS_PRED_HYS	V	0... FFFFH	-1024... 1023.96875	0.03125	mg/s
NOx hysteresis for reset of Lambda = 1.0 operation request - homogeneous lean prediction					
NOX_HOMS_PRED_THD	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
NOx threshold for set of Lambda = 1.0 operation request - homogeneous lean prediction					
NOX_NS_AD_RGN_ST [NC_NT_NR]	O/V	0... 05DCH	0... 1500	1	ppm
downstream NOx concentration, measured by NOx sensor at start of regeneration					
NOX_NS_AD_TMP [NC_NOX_SENS_CONF]	V	0... 05DCH	0... 1500	1	ppm
temporary internal NOx sensor NOx value for regeneration request calculation					
NOX_OUT_INT_TMP [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 10485.6	0.16	mg
temporary internal NOx out integral value for NOx sensor regeneration request calculation					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NOX_OUT_MDL	O/V	0... FFFFH	0... 1023.98437	0.015625	mg/s
modelled downstream NOx emission					
NOX_OUT_MDL_INT	O/V	0... FFFFH	0... 10485.6	0.16	mg
Integral of modelled downstream NOx emission for one lean /rich cycle					
NOX_S_PRED_HYS	V	0... FFFFH	-1024... 1023.96875	0.03125	mg/s
NOx hysteresis for reset of Lambda = 1.0 operation request - stratified prediction					
NOX_S_PRED_THD	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
NOx threshold for set of Lambda = 1.0 operation request - stratified prediction					
NOX_SENS_MAX	O/V	0... 05DCH	0... 1500	1	ppm
NOx sensor signal threshold for requesting a regeneration					
NOX_SENS_MAX_BAS	V	0... 05DCH	0... 1500	1	ppm
Not corrected NOx sensor signal threshold for requesting a regeneration					
NT_AGI_AV	O/V	0... FFH	0... 0.99609	3.9063e-3	-
actual aging factor (ratio of actual storage capacity vs. base storage capacity)					
NT_EFF	O/V	0... 8000H	0 ...1	30.5e-6	-
NOx trap efficiency					
NT_EFF_BAS	V	0... FFFFH	0... 0.99998	15.3e-6	-
Basis NOx trap efficiency					
NT_EFF_COR	V	0... FFH	0... 3.98437	0.015625	-
NOx trap efficiency correction factor					
NT_EFF_COR_RGN_ST	O/V	0... FFH	0... 3.98437	0.015625	-
NOx trap efficiency correction factor at regeneration start					
NT_O2_STC	O/V	0... FFFFH	0... 10485.6	0.16	mg
NOx trap oxygen storage capacity					
NT_O2_STC_BAS	O/V	0... FFFFH	0... 10485.6	0.16	mg
NOx trap base oxygen storage capacity					
NT_STC_BAS_RNG_H	O/V	0... FFFFH	0... 20971.2	0.32	mg
NOx trap base storage capacity					
NT_STC_RNG_H	V	0... FFFFH	0... 20971.2	0.32	mg
NOx trap storage capacity					
NTL	O/V/S	0... FFFFH	0... 10485.6	0.16	mg
NOx catalyst absolute loading					
NTL_DEC [NC_NT_NR]	V	0... FFFFFFFFH	0... 10485.6	2.4414e-6	mg
Decrement of NOx trap absolute NOx loading during regeneration (lack of oxygen)					
NTL_DEC_INT [NC_NT_NR]	O/V	0... FFFFH	0... 10485.6	0.16	mg
Integral of the lack of oxygen during regeneration phase					
NTL_DEC_INT_SWI [NC_NT_NR]	O/V	0... FFFFH	0... 10485.6	0.16	mg
NTL_DEC_INT until the downstream sensor switches to reach exhaust gas					
NTL_H	O/V	0... FFFFH	0... 20971.2	0.32	mg
NOx catalyst absolute loading, expanded/higher value range					
NTL_MIN	O/V	0... FFFFH	0... 10485.6	0.16	mg
Minimum NOx trap loading					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NTL_RGN_ST	O/V	0... FFFFH	0... 10485.6	0.16	mg
NOx trap absolute loading (O2+NOx) when regeneration starts					
NTL_RGN_ST_NOX	O/V	0... FFFFH	0... 10485.6	0.16	mg
NOx trap absolute loading (only NOx) when regeneration starts					
NTLD	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
NOx trap loading degree					
NTLD_MAX	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
loading degree threshold for starting a regeneration					
NTLD_MAX_AFS	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
maximum NOx trap loading degree for requesting a regeneration before lambda1 operation					
NTLD_MAX_AFS_BAS	V	0... FFFFH	0... 0.99998	15.3e-6	-
Basis maximum NOx trap loading degree for requesting a regeneration before lambda=1.0 operation					
NTLD_MAX_VS	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
loading degree threshold for starting a regeneration depending on vehicle speed					
NTLD_MDL	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
NOx trap loading degree out of model					
NTLD_RGN_ST	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
NOx trap loading degree at starting regeneration					
O2_FLOW	V	0... FFFFH	0... 16383.75	0.25	mg/s
Corrected engine out O2 flow					
O2L	O/V	0... FFFFH	0... 10485.6	0.16	mg
O2 absolute loading of the NOx trap					
RATIO_NOX [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 99.99847	1.5259e-3	%
Ratio of NOx out integral to NOx raw emission integral					
RATIO_NOX_OUT_INT_DIST [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 6.5535	0.0001	g/km
Ratio of NOx out emissions related to mileage of current lean operation phase					
STATE_AFL_PURGE [NC_NT_NR]	V	0H 1H 2H	DISABLE OFF ON	-	-
State of catalyst purge after lean operation					
STATE_NOX	O/V	0H 1H 2H 3H 4H 5H	PASSIV LOAD REGENERATION WAIT STOP WARMUP	-	-
NOx catalyst state					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
SUM_NTL_CYC	O/V/S	0... FFFFH	0... 65535	1	-
Amount of regeneration cycles carried out					
T_AFL	O/V	0... FFFFH	0... 1310.7	0.02	s
elapsed time since lean phase was started					
T_AFL_PUC	O/V	0... FFFFH	0... 1310.7	0.02	s
elapsed time since last PUC phase					
T_AFL_SUM	O/V/S	0... FFFFFFFFH	0... 858993	0.02	s
sum of lean time					
T_NT_AFS_REQ_PRED	V	0... FFFFH	0... 6553.5	0.1	s
Duration of active homogeneous stoichiometric operation request due to high predicted NOx row emissions					
T_NT_HOM	V	0... FFFFH	0... 655.35	0.01	s
counting back the minimum homogeneous time for detecting initialised catalyst state					
T_NT_HOM_DELTA	V	80... 7FH	-1.28 ... 1.27	0.01	s
decrement for T_NT_HOM counter					
T_NT_STST_ACT	V	0... FFFFH	0... 655.35	0.01	s
Activation time of NOx catalyst state management since end of last STST cycle					
T_STOP	O/V	0... FFFFH	0... 1310.7	0.02	s
Time counter since start of STATE_NOX = STOP is active					
TNT_MDL_MAX	V	0... FFH	0... 1020	4	°C
Maximum NOx trap temperature for lean operation					
TNT_MDL_MIN	V	0... FFH	0... 1020	4	°C
Minimum NOx trap temperature for lean operation					
TQI_MMV_NOX	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Filtered actual indicated engine torque for NOx emission aftertreatment					
VLS_MAX_TMP	V	0... 578H	-200 ... 1200	1	mV
Temporary local maximum of VLS_NOX_SENS_1					
VLS_MIN_TMP	V	0... 578H	-200 ... 1200	1	mV
Temporary local minimum of VLS_NOX_SENS_1					
VLS_NOX_SENS_1_OLD	-	0... 578H	-200 ... 1200	1	mV
Old binary O2 signal voltage, raw value, measured by NOx-Sensor					
VLS_NOX_SENS_MMV	V	0... 578H	-200 ... 1200	1	mV
filtered VLS_NOX_SENS for detection of regeneration state					
VS_DIF_HYS	V	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Vehicle speed difference hysteresis for reset of Lambda=1.0 operation request					
VS_DIF_NOX	V	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Vehicle speed difference for detection of transient driving conditions					
VS_DIF_THD	V	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Vehicle speed difference threshold for set of Lambda=1.0 operation request					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VS_MMV_NOX	V	0... 7FFFH	0... 255.99218	0.0078125	km/h
Filtered vehicle speed for detection of transient driving conditions					

**Input data:**

DIST {p. 1183}	LAMB_AV_COR {p. 798}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_LS_UP_MIN {p. 2313}
LAMB_LS_UP_MV {p. 2313}	LAMB_NOX_SENS [NC_NOX_SENS_CONF] {p. 1380}	LC_NOX_MDL_CTRL_ACT {p. 997}	LV_ADJ_NOX_SENS_RGN {p. 3053}
LV_AST {p. 1766}	LV_AT {p. 654}	LV_CLU_SWI {p. 996}	LV_EF {p. 3614}
LV_ERR_EGR_2 {p. 987}	LV_ES {p. 1720}	LV_FL {p. 1759}	LV_HOM_ACT {p. 8136}
LV_HOM_AFL_ACT {p. 8136}	LV_HOM_AFS_ACT {p. 8136}	LV_HOM_AFS_REQ {p. 8136}	LV_IGK {p. 906}
LV_INH_AFL {p. 1822}	LV_INH_NOX_MDL_ CTRL_RGN {p. 996}	LV_INH_NOX_SENS_RGN {p. 3053}	LV_INH_NT_ACT {p. 3053}
LV_INH_NT_AFL {p. 3053}	LV_INH_NT_RGN_STOP_ MDL_DIAG [NC_NOX_SENS_CONF] {p. 6347}	LV_INH_RGN_AD {p. 996}	LV_INH_RGN_REQ {p. 3053}
LV_INH_RGN_REQ_NOX_ SENS {p. 3053}	LV_INH_RGN_REQ_NTLD {p. 3053}	LV_INH_S {p. 1822}	LV_IS {p. 1720}
LV_LOAD_H {p. 3053}	LV_NOX_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_NOX_SENS_LAMB_ VLD [NC_NOX_SENS_CONF] {p. 1380}	LV_NOX_SENS_MAX_ADJ {p. 3107}
LV_NOX_SENS_NOX_VLD [NC_NOX_SENS_CONF] {p. 1380}	LV_NOX_SENS_VLS_VLD [NC_NOX_SENS_CONF] {p. 1381}	LV_NS_AD_REQ {p. 3189}	LV_NS_SHIFT_CMB_INT_ REQ {p. 6426}
LV_NT_AFS_REQ_AGI {p. 3072}	LV_NT_STC_MAX_AFL_ ACT {p. 996}	LV_NT_STST {p. 3053}	LV_NTLD_ADJ {p. 3053}
LV_PU {p. 1720}	LV_PUC {p. 1720}	LV_PUC_REQ {p. 1720}	LV_RGN_REQ_AD {p. 996}
LV_S_ACT {p. 8137}	LV_SCC [NC_CBK_EX_NR] {p. 2295}	LV_SO2P_REQ {p. 3129}	LV_ST {p. 1720}
LV_T_NS_VLD {p. 3193}	LV_TNT_MDL_MAX_OFS {p. 3053}	LV_VLS_NS_VLD [NC_NOX_SENS_CONF] {p. 992}	MAF_FG_CYL {p. 1212}
MAF_INT_FL_ACT {p. 3053}	MAF_INT_PUC_ACT {p. 2942}	MAF_KGH {p. 1195}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}	NC_NT_NR {p. 644}	NOX_AD_FAC {p. 996}


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NOX_COR_HOMS {p. 2968}	NOX_COR_HOMS_PRED {p. 2968}	NOX_COR_S {p. 2976}	NOX_COR_S_PRED {p. 2976}
NOX_NS_AD [NC_NOX_SENS_CONF] {p. 3193}	NOX_OUT_MES_INT [NC_NOX_SENS_CONF] {p. 3066}	NT_AGI {p. 3073}	NT_AGI_NTLD {p. 3073}
NT_AGI_S_RED {p. 3073}	NT_O2_STC_AD {p. 3177}	NTLD_MDL_DIF {p. 996}	OPM_AV {p. 8137}
STATE_RGN [NC_CBK_EX_NR] {p. 2885}	T_IS {p. 1720}	T_RGN {p. 2885}	T_RGN_2 {p. 2885}
TNT_MDL_H {p. 8237}	TNT_MDL_L {p. 8237}	TNT_MDL_MAX_OFS {p. 3054}	TNT_MDL_MV {p. 8237}
TQI_AV {p. 981}	TQI_REQ_FAST {p. 8391}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_NOX_SENS [NC_NOX_SENS_CONF] {p. 1382}
VLS_NT_DOWN [NC_NOX_SENS_CONF] {p. 811}	VS {p. 1176}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FLOW_NT	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for calculation of filtered exhaust gas flow					
C_CRLC_NOX_CONC_OUT_MDL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correction factor for filtering of NOX_CONC_OUT_MDL					
C_CRLC_NOX_CONC_RED	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correction factor for filtering of NOX_CONC_RED					
C_CRLC_NOX_COR_RED	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correction factor for filtering of NOX_COR_RED					
C_CRLC_TQI_MMV_NOX	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for calculation of filtered actual indicated engine torque					
C_CRLC_VLS_NOX_SENS	-	0... FFFFH	0... 0.99998	15.3e-6	-
filter constant for VLS_NOX_SENS					
C_CRLC_VS_MMV_NOX	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for calculation of filtered vehicle speed					
C_CTR_AFL_PURGE_MAX	-	0... FFH	0... 255	1	-
Maximum number of activation cycles for catalyst purge after lean operation at STATE_NOX = STOP					
C_DIST_AFL_MIN	-	0... FFFFH	0... 6553.5	0.1	km
Minimum mileage for calculation of RATIO_NOX_OUT_INT_DIST					
C_FAC_COR_O2L	-	0... FFH	0... 1.99218	0.0078125	-
Correction factor for the O2L deceleration					
C_FAC_NTL_DEC_INT_RGN_NOT_VLD [NC_NT_NR]	-	0... FFH	0... 1.99218	0.0078125	-
Factor for forcing a regeneration of second bank in relation to first bank					
C_FAC_NTL_DEC_INT_STOP_RGN [NC_NT_NR]	-	0... FFH	0... 1.99218	0.0078125	-
Factor for end of regeneration of second bank in relation to first bank					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_NTL_INI_ST	-	0... FFFFH	0... 65.535	0.001	-
Weighting factor for initialisation of NTL after reset					
C_FAC_NTLD_MAX_AFS_ERR_EGR	-	0... FFH	0... 1.99218	0.0078125	-
Factor to correct homogen request in case of EGR_ERR					
C_FAC_O2_EQU	-	0... FFH	0... 1.99218	0.0078125	-
Factor for the balance of stored NO O2					
C_LAMB_NOX_SENS_AFL_PURGE_OFF	-	0... 7FFFH	0... 31.99902	976.599e-6	-
LAMB_NOX_SENS deactivation threshold for catalyst purge after lean operation at STATE_NOX = STOP					
C_LAMB_NOX_SENS_AFL_PURGE_ON	-	0... 7FFFH	0... 31.99902	976.599e-6	-
LAMB_NOX_SENS activation threshold for catalyst purge after lean operation at STATE_NOX = STOP					
C_LAMB_NOX_SENS_AFR_TRIM	-	0... 7FFFH	0... 31.99902	976.599e-6	-
linear NOx sensor signal threshold for determining rich trim conditions					
C_LAMB_NOX_SENS_RGN_STOP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
linear NOx sensor signal threshold for determining rich exhaust gas					
C_LAMB_O2_STC	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda threshold for O2 storage in lean operation					
C_LAMB_RGN	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda threshold for rich operation					
C_LAMB_STC	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda threshold for lean operation					
C_MAF_INT_FL_RGN_STOP_MIN	-	0... FFFFH	0... 6553.5	0.1	g
Minimum air mass flow at full load after which a NOx regeneration break is allowed					
C_MAF_INT_PUC_NTL_H_RST	-	0... FFFFH	0... 2912.66666	0.0444444	g
Minimum mass air flow integral for reset of NTL_H at STATE_NOX = "WAIT"					
C_MAF_INT_PUC_RGN_STOP_MIN	-	0... FFFFH	0... 2912.66666	0.0444444	g
Minimum air mass flow at PUC after which a NOx regeneration break off is allowed					
C_MAF_INT_PUC_RST_RGN_REQ	-	0... FFFFH	0... 2912.66666	0.0444444	g
Minimum air mass flow at STATE_NOX = WAIT after that the reset of LV_RGN_NT_REQ is allowed					
C_MAF_INT_PUC_WAIT_MIN	-	0... FFFFH	0... 2912.66666	0.0444444	g
Minimum air mass flow at PUC after which the switch of STATE_NOX = LOAD -> WAIT is allowed					
C_MAF_INT_STOP_AFL_PURGE_MAX	-	0... FFFFH	0 ...1	0.0222222	g
Air mass integral limit for activation of catalyst purge after lean operation at STATE_NOX = STOP					
C_MAF_INT_STOP_NTL_H_RST	-	0... FFFFH	0... 5825.33333	0.0888889	g
Minimum mass air flow integral for reset of NTL_H at STATE_NOX = "STOP"					
C_NOX_CONC_COR	-	0... FFFFH	0... 8192	0.1250019	-
Correction factor of the NOx concentration regarding the mol mass					
C_NOX_COR_INT_MIN	-	0... FFFFH	0... 10485.6	0.16	mg
Minimum NOx raw emission integral value for calculation of RATIO_NOX					
C_NOX_NS_AD_DIF_MON	-	0... 05DCH	0... 1500	1	ppm
Maximum deviation between model and NOx-Sensor					
C_NOX_NS_AD_RGN_STOP	-	0... 05DCH	0... 1500	1	ppm
linear NOx sensor signal threshold for determining rich trim conditions					
C_NOX_OUT_MES_INT_MAX	-	0... FFFFH	0... 10485.6	0.16	mg
Threshold for integrated downstream emission (meas. by NOx sensor) for requesting a regeneration					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NOX_SENS_MAX_OFS	-	0... 05DCH	0... 1500	1	ppm
Threshold offset of the NOx sensor signal for requesting a regeneration					
C_NT_RGN_STOP_FL_SEL	-	0... 3H	0 ...3	1	-
Selection of NOx regeneration handling in kind of full load					
C_NT_RGN_STOP_PUC_SEL	-	0... 2H	0 ...2	1	-
Method selection for break off a running NOx regeneration if PUC has higher priority					
C_NT_STC_BAS_MAX_RNG_H	-	0... FFFFH	0... 20971.2	0.32	mg
maximum value of base NOx trap storage capacity map					
C_NT_STC_INI_RNG_H	-	0... FFFFH	0... 20971.2	0.32	mg
initialisation value of actual and base NOx trap storage capacity					
C_NTL_INI_ST	-	0... FFFFH	0... 10485.6	0.16	mg
Initialisation value of the NOx trap absolute loading after engine start					
C_NTL_TRIG_AFR_AFL	-	0... FFFFH	0... 10485.6	0.16	mg
minimum NOx trap NOx loading for triggering the transition from rich to lean operation					
C_NTLD_LGRD	-	0... FFFFH	0... 0.99998	15.3e-6	-
limitating gradient of loading degree					
C_NTLD_NT_HOM_RST	-	0... FFFFH	0... 0.99998	15.3e-6	-
loading degree threshold for resetting the homogeneous time counter T_NT_HOM					
C_NTLD_RGN_ST_INI	-	0... FFFFH	0... 0.99998	15.3e-6	-
Initialisation value for NOx trap loading degree at starting regeneration					
C_O2_FLOW_COR_FAC	-	0... FFFFH	0... 127.99804	1.9531e-3	-
Correction factor for the O2 engine out flow					
C_O2L_MIN	-	0... FFFFH	0... 10485.6	0.16	mg
minimum NOx trap oxygen loading for stopping a regeneration					
C_RATIO_NOX_MAX	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Maximum ratio of NOx out integral to NOx raw emission integral; threshold for start of a NOx regeneration					
C_RATIO_NOX_OUT_INT_DIST_MAX	-	0... FFFFH	0... 6.5535	0.0001	g/km
Maximum ratio of NOx out integral to mileage at current lean phase; threshold for start of a NOx regeneration					
C_STATE_RGN_CTL	-	0H 1H 2H 3HH	SENSOR MODEL SENSOR_ MODEL TIME	-	-
regeneration stop mode					
C_STATE_SENS_AFL_PURGE [NC_NT_NR]	-	0H 1H 2H 3H 4H	VLS_DOWN VLS_NOX_ SENS LAMB_NOX_ SENS VLS_NT_ DOWN NONE	-	-
Determination of signal for catalyst purge function after lean operation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_SENS_AFR [NC_NT_NR]	-	0H 1H 2H 3H 4H	VLS_DOWN VLS_NOX_ SENS LAMB_NOX_ SENS VLS_NT_ DOWN NONE	-	-
bench-selective mode to determine rich exhaust gas downstream NOx trap					
C_STATE_SENS_AFR_TRIM [NC_NT_NR]	-	0H 1H 2H 3H 4H	VLS_DOWN VLS_NOX_ SENS LAMB_NOX_ SENS VLS_NT_ DOWN NONE	-	-
bench-selective mode to determine trim threshold reached by downstream sensor					
C_SUM_NTL_CYC_SP	-	0... FFFFH	0... 65535	1	-
NOx trap regeneration cycle counter initialisation value					
C_SUM_O2L_NTL_MAX	-	0... FFFFH	0... 10485.6	0.16	mg
threshold of oxygen and NOx loading for requesting a NOx catalyst purge					
C_T_AFL_NT_HOM_RST	-	0... FFFFH	0... 1310.7	0.02	s
lean time after which the homogeneous time counter is re-initialised					
C_T_AFL_RGN_REQ_NTLD	-	0... FFFFH	0... 1310.7	0.02	s
Minimum duration of lean operation before permitting a regeneration request from the model					
C_T_AFL_RST	-	0... FFFFH	0... 655.35	0.01	s
Time limit for reset of T_AFL after an engine STST phase					
C_T_IS_RGN_STOP_MIN	-	0... FFFFH	0... 655.35	0.01	s
Minimum idle speed duration after which a NOx regeneration break off is allowed					
C_T_NT_AFS_REQ_PRED_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Maximum duration of of active AFS request due to high predicted NOx row emissions					
C_T_NT_HOM	-	0... FFFFH	0... 655.35	0.01	s
Lean time threshold for resetting the homogeneous time counter T_NT_HOM					
C_T_NT_HOM_MAX_VLD	-	0... FFFFH	0... 655.35	0.01	s
Lean time threshold for resetting the homogeneous time counter T_NT_HOM					
C_T_RGN_MAX_DIAG	-	0... FFFFH	0... 655.35	0.01	s
Maximum regeneration duration if sensor test is activated					
C_T_STOP_AFL_PURGE_MAX	-	0... FFFFH	0... 1310.7	0.02	s
Time limit for activation of catalyst purge after lean operation at STATE_NOX = STOP					
C_TNT_MDL_INH_PURGE	-	0... FFH	0... 1020	4	°C
NOx trap temperature threshold for inhibiting a catalyst purge					
C_TNT_MDL_MAX_HYS	-	0... FFH	0... 1020	4	°C
Temperature hysteresis for lambda=1-mode deactivation due to high temperature					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TNT_MDL_MIN_HYS	-	0... FFH	0... 1020	4	°C
Temperature hysteresis for lambda=1-mode deactivation due to low temperature					
C_TNT_MDL_MV_NTL_H_RST_HYS	-	0... FFH	0... 1020	4	°C
NOx catalyst temperature hysteresis for NTL_H calculation					
C_TNT_MDL_MV_NTL_H_RST_MAX	-	0... FFH	0... 1020	4	°C
Upper NOx catalyst temperature threshold for reset of NTL_H calculation					
C_TNT_MDL_MV_NTL_H_RST_MIN	-	0... FFH	0... 1020	4	°C
Lower NOx catalyst temperature threshold for reset of NTL_H calculation					
C_TNT_MDL_PURGE_DEAC	-	0... FFH	0... 1020	4	°C
NOx catalyst temperature for deactivation of NOx catalyst purge at STATE_NOX = STOP					
C_TNT_MDL_PURGE_MAX	-	0... FFH	0... 1020	4	°C
Maximum NOx catalyst temperature for enabling of NOx catalyst purge at STATE_NOX = STOP					
C_TNT_MDL_PURGE_MIN	-	0... FFH	0... 1020	4	°C
Minimum NOx catalyst temperature for enabling of NOx catalyst purge at STATE_NOX = STOP					
C_TNT_MDL_PURGE_REQ_MAX	-	0... FFH	0... 1020	4	°C
Maximum NOx catalyst temperature threshold for set of catalyst purge request					
C_VLS_DIST_GRD_POS	-	0... 578H	-200 ...1200	1	mV
Difference between local minimum and current value for calculation of positive gradient					
C_VLS_DOWN_AFL_PURGE_OFF	-	0... 3FFH	0... 4.99511	4.8828e-3	V
VLS_DOWN deactivation threshold for catalyst purge after lean operation at STATE_NOX = STOP					
C_VLS_DOWN_AFL_PURGE_ON	-	0... 3FFH	0... 4.99511	4.8828e-3	V
VLS_DOWN activation threshold for catalyst purge after lean operation at STATE_NOX = STOP					
C_VLS_DOWN_AFR_TRIM	-	0... 3FFH	0... 4.99511	4.8828e-3	V
binary lambda sensor signal threshold for determining rich trim conditions					
C_VLS_DOWN_MIN_NTL_DEC [NC_CBK_EX_NR]	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Minimum VLS_DOWN voltage for calculation of NTL_DEC_INT					
C_VLS_DOWN_RGN_2_MIN	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Limit for detection of a not successful regeneration of second bank					
C_VLS_GRD_NEG_VLS_SET	-	0... 578H	-200 ...1200	1	mV
Negative gradient for set of LV_SENS_AFR_2 with VLS signal					
C_VLS_MAX_RGN_1_STOP	-	0... 578H	-200 ...1200	1	mV
Threshold value for end of first regeneration					
C_VLS_MAX_RGN_2_STOP	-	0... 578H	-200 ...1200	1	mV
Threshold value for end of second regeneration					
C_VLS_NOX_SENS_AFL_PURGE_OFF	-	0... 578H	-200 ...1200	1	mV
VLS_NOX_SENS deactivation threshold for catalyst purge after lean operation at STATE_NOX = STOP					
C_VLS_NOX_SENS_AFL_PURGE_ON	-	0... 578H	-200 ...1200	1	mV
VLS_NOX_SENS activation threshold for catalyst purge after lean operation at STATE_NOX = STOP					
C_VLS_NOX_SENS_AFR_TRIM	-	0... 578H	-200 ...1200	1	mV
binary NOx sensor signal threshold for determining rich trim conditions					
C_VLS_NOX_SENS_RGN_STOP	-	0... 578H	-200 ...1200	1	mV
binary NOx sensor signal threshold for determining rich exhaust gas					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VLS_NS_RGN_2_VLD	-	0... 578H	-200 ...1200	1	mV
Limit to enable again detection of end of regeneration of second bank by sensor					
C_VS_INH_PURGE	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for inhibiting a catalyst purge					
C_VS_PURGE_MAX	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed for enabling of NOx catalyst purge at STATE_NOX = STOP					
C_VS_PURGE_REQ_MAX	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed threshold for set of catalyst purge request					
ID_VLS_DOWN_RGN_STOP	-	0... 3FFH	0... 4.99511	4.8828e-3	V
LDP_NTLD_RGN_ST_ID_VLS_DOWN	4	0... FFFFH	0... 0.99998	15.3e-6	-
downstream binary lambda sensor signal threshold for determining rich exhaust gas					
IP_FAC_NOX_SENS_MAX	V	0... FFH	0... 1.99218	0.0078125	-
LDPM_NT_AGI_S_RED	4	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_TNT_MDL_MV_IP_FAC_NOX_SENS	6	0... FFFFH	0... 1023.98437	0.015625	°C
Factor to correct threshold of the NOx sensor signal for requesting a regeneration					
IP_NOX_HOMS_AFS_REQ_AT	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
LDP_TNT_MDL_L_IP_NOX_HOMS_AT	8	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_NOX_HOMS_AT	6	0... FFFFH	0... 0.99998	15.3e-6	-
NOx threshold for set of Lambda = 1.0 operation request - homogeneous lean prediction - AT vehicle					
IP_NOX_HOMS_AFS_REQ_HYS_AT	V	0... FFFFH	-1024... 1023.96875	0.03125	mg/s
LDP_N_32_IP_NOX_HOMS_AT	6	0... FFH	0... 8160	32	rpm
LDP_TQI_MMV_NOX_IP_NOX_HOMS_AT	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
NOx hysteresis for reset of Lambda = 1.0 operation request - homogeneous lean prediction - AT vehicle					
IP_NOX_HOMS_AFS_REQ_HYS_MT	V	0... FFFFH	-1024... 1023.96875	0.03125	mg/s
LDP_N_32_IP_NOX_HOMS_MT	6	0... FFH	0... 8160	32	rpm
LDP_TQI_MMV_NOX_IP_NOX_HOMS_MT	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
NOx hysteresis for reset of Lambda = 1.0 operation request - homogeneous lean prediction - MT vehicle					
IP_NOX_HOMS_AFS_REQ_MT	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
LDP_TNT_MDL_L_IP_NOX_HOMS_MT	8	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_NOX_HOMS_MT	6	0... FFFFH	0... 0.99998	15.3e-6	-
NOx threshold for set of Lambda = 1.0 operation request - homogeneous lean prediction - MT vehicle					
IP_NOX_RED_FAC	-	0... FFH	0... 0.99609	3.9063e-3	-
LDP_TNT_MDL_MV_IP_NOX_RED_FAC	4	0... FFH	0... 1020	4	°C
Reduction factor taking into account the chemical NOx conversion					
IP_NOX_S_AFS_REQ_AT	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
LDP_TNT_MDL_L_IP_NOX_S_AT	8	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_NOX_S_AT	6	0... FFFFH	0... 0.99998	15.3e-6	-
NOx threshold for set of Lambda = 1.0 operation request - stratified prediction - AT vehicle					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_NOX_S_AFS_REQ_HYS_AT	V	0... FFFFH	-1024... 1023.96875	0.03125	mg/s
LDP_N_32_IP_NOX_S_AT	6	0... FFH	0... 8160	32	rpm
LDP_TQI_MMV_NOX_IP_NOX_S_AT	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
NOx hysteresis for reset of Lambda = 1.0 operation request - stratified prediction - AT vehicle					
IP_NOX_S_AFS_REQ_HYS_MT	V	0... FFFFH	-1024... 1023.96875	0.03125	mg/s
LDP_N_32_IP_NOX_S_MT	6	0... FFH	0... 8160	32	rpm
LDP_TQI_MMV_NOX_IP_NOX_S_MT	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
NOx hysteresis for reset of Lambda = 1.0 operation request - stratified prediction - MT vehicle					
IP_NOX_S_AFS_REQ_MT	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
LDP_TNT_MDL_L_IP_NOX_S_MT	8	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_NOX_S_MT	6	0... FFFFH	0... 0.99998	15.3e-6	-
NOx threshold for set of Lambda = 1.0 operation request - stratified prediction - MT vehicle					
IP_NOX_SENS_MAX_AT	V	0... 05DCH	0... 1500	1	ppm
LDP_FLOW_NT_MMV_IP_NOX_SENS_AT	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_N_32_IP_NOX_SENS_MAX_AT	8	0... FFH	0... 8160	32	rpm
threshold of the NOx sensor signal for requesting a regeneration for AT					
IP_NOX_SENS_MAX_MT	V	0... 05DCH	0... 1500	1	ppm
LDP_FLOW_NT_MMV_IP_NOX_SENS_MT	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_N_32_IP_NOX_SENS_MAX_MT	8	0... FFH	0... 8160	32	rpm
threshold of the NOx sensor signal for requesting a regeneration for MT					
IP_NT_AGI_RGN_FRQ	V	0... FFH	0... 0.99609	3.9063e-3	-
LDP_NT_AGI_NTLD_IP_NT_AGI_RGN	8	0... FFH	0... 0.99609	3.9063e-3	-
LDP_TNT_MDL_MV_IP_NT_AGI_RGN	8	0... FFH	0... 1020	4	°C
modification of the actual storage capacity due to aging factor NT_AGI_NTLD					
IP_NT_EFF_BAS	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_NTLD	2	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_TNT_MDL_NOX	2	0... FFH	0... 1020	4	°C
Basic NOx trap efficiency for open exhaust flap					
IP_NT_EFF_BAS_EF_CLOSE	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_NTLD	2	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_TNT_MDL_NOX	2	0... FFH	0... 1020	4	°C
Basic NOx trap efficiency for closed exhaust flap					
IP_NT_EFF_COR	V	0... FFH	0... 3.98437	0.015625	-
LDP_NOX_COR_IP_NT_EFF_COR	8	0... FFFFH	0... 1023.98437	0.015625	mg/s
LDPM_TNT_MDL_NOX	2	0... FFH	0... 1020	4	°C
NOx trap efficiency correction					
IP_NT_STC_BAS_RNG_H	V	0... FFFFH	0... 20971.2	0.32	mg
LDP_NOX_CONC_MMV_IP_NT_STC_BAS	8	0... FFFFH	0... 65535	1	ppm

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_TNT_MDL_NOX	2	0... FFFH	0... 1020	4	°C
NOx trap storage capacity					
IP_NTL_DEC_INT_MAX	-	0... FFFFH	0... 10485.6	0.16	mg
LDP_NTL_RGN_ST_IP_NTL_DEC_INT	6	0... FFFFH	0... 10485.6	0.16	mg
Maximum amount of regeneration agent					
IP_NTL_MIN	-	0... FFFFH	0... 10485.6	0.16	mg
LDPM_TNT_MDL_NOX	2	0... FFFH	0... 1020	4	°C
minimum NOx trap NOx loading for stopping a regeneration					
IP_NTL_MIN_AFL_PURGE	-	0... FFFFH	0... 10485.6	0.16	mg
LDP_VS_IP_NTL_MIN_AFL_PURGE	6	0... FFFH	0... 255	1	km/h
NTL reset threshold for AFL_PURGE control variables					
IP_NTL_MIN_RGN_STOP	-	0... FFFFH	0... 10485.6	0.16	mg
LDP_TNT_MDL_MV_IP_NTL_MIN_RGN	6	0... FFFFH	0... 1023.98437	0.015625	°C
minimum NOx catalyst NOx loading for regeneration stop					
IP_NTLD_MAX_ADJ_AT	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_TQI_REQ_FAST_IP_NTLD_ADJ_AT	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_IP_NTLD_ADJ_AT	8	0... FFFH	0... 8160	32	rpm
Maximum NOx catalyst loading for requesting a regeneration (adjusted for special purposes) - AT vehicle					
IP_NTLD_MAX_ADJ_MT	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_TQI_REQ_FAST_IP_NTLD_ADJ_MT	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_IP_NTLD_ADJ_MT	8	0... FFFH	0... 8160	32	rpm
Maximum NOx catalyst loading for requesting a regeneration (adjusted for special purposes) - MT vehicle					
IP_NTLD_MAX_AFS_AT	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_TQI_REQ_FAST_IP_NTLD_AFS_AT	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_NTLD_MAX_AFS_AT	4	0... FFFH	0... 8160	32	rpm
Maximum NOx trap loading degree for requesting a regeneration before lambda=1.0 operation (for automatic transmission)					
IP_NTLD_MAX_AFS_MT	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_TQI_REQ_FAST_IP_NTLD_AFS_MT	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_NTLD_MAX_AFS_MT	4	0... FFFH	0... 8160	32	rpm
Maximum NOx trap loading degree for requesting a regeneration before lambda=1.0 operation (for manual transmission)					
IP_NTLD_MAX_AT	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_TQI_REQ_FAST_IP_NTLD_AT	12	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_IP_NTLD_AT	8	0... FFFH	0... 8160	32	rpm
Maximum NOx catalyst loading for requesting a regeneration - AT vehicle					
IP_NTLD_MAX_MT	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_TQI_REQ_FAST_IP_NTLD_MT	12	0... FFFFH	-1024... 1023.96875	0.03125	Nm

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_N_32_IP_NTLD_MT	8	0... FFH	0... 8160	32	rpm
Maximum NOx catalyst loading for requesting a regeneration - MT vehicle					
IP_NTLD_MAX_VS_AT	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_VS_IP_NTLD_MAX_VS_AT	6	0... FFH	0... 255	1	km/h
LDP_NT_AGI_S_RED_IP_NTLD_VS_AT	6	0... FFFFH	0... 0.99998	15.3e-6	-
NOx catalyst loading for requesting a NOx regeneration depending on vehicle speed - AT vehicle					
IP_NTLD_MAX_VS_MT	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_VS_IP_NTLD_MAX_VS_MT	6	0... FFH	0... 255	1	km/h
LDP_NT_AGI_S_RED_IP_NTLD_VS_MT	6	0... FFFFH	0... 0.99998	15.3e-6	-
NOx catalyst loading for requesting a NOx regeneration depending on vehicle speed - MT vehicle					
IP_NTLD_MIN_AFL_PURGE	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_VS_IP_NTLD_MIN_AFL_PURGE	6	0... FFH	0... 255	1	km/h
NTLD reset threshold for AFL_PURGE control variables					
IP_O2_STC_MAX	V	0... FFFFH	0... 10485.6	0.16	mg
LDP_LAMB_LS_UP_MV_IP_O2_STC_MAX	8	0... 7FFFH	0... 31.99902	976.599e-6	-
LDPM_TNT_MDL_NOX	2	0... FFH	0... 1020	4	°C
max. storage capacity of O2 in the NOx-trap					
IP_T_AFL_MIN	-	0... FFFFH	0... 1310.7	0.02	s
LDPM_VS_1_NOXM	8	0... FFH	0... 255	1	km/h
minimum duration of lean operation before permitting a regeneration					
IP_T_AFL_MIN_AFS	-	0... FFFFH	0... 1310.7	0.02	s
LDP_VS_IP_T_AFL_MIN_AFS	8	0... FFH	0... 255	1	km/h
Minimum duration of lean operation before permitting a regeneration at a switch to Lambda=1.0 operation					
IP_T_AFL_MIN_NT_RGN_STOP	-	0... FFFFH	0... 1310.7	0.02	s
LDPM_VS_1_NOXM	8	0... FFH	0... 255	1	km/h
minimum duration of lean operation before permitting a NOx regeneration after a broken NOx regeneration					
IP_T_MAX_RGN_2_STOP	V	0... FFFFH	0... 655.35	0.01	s
LDP_NTL_RGN_ST_IP_T_MAX_RGN	6	0... FFFFH	0... 10485.6	0.16	mg
LDP_NTL_DEC_INT_IP_T_MAX_RGN	6	0... FFFFH	0... 10485.6	0.16	mg
Maximum time duration of second regeneration					
IP_T_NT_HOM_DEC	V	0... 7FH	0... 1.27	0.01	s
LDPM_MAF_KGH_IP_T_NT_HOM	4	0... FFH	0... 2040	8	kg/h
LDPM_LAMB_AV_COR_IP_T_NT_HOM	4	0... 7FFFH	0... 31.99902	976.599e-6	-
Weighted decrement for the homogeneous time counter					
IP_T_NT_HOM_INC	V	0... 7FH	0... 1.27	0.01	s
LDPM_MAF_KGH_IP_T_NT_HOM	4	0... FFH	0... 2040	8	kg/h
LDPM_LAMB_AV_COR_IP_T_NT_HOM	4	0... 7FFFH	0... 31.99902	976.599e-6	-
Weighted increment for the homogeneous time counter					
IP_T_RGN_MAX	V	0... FFFFH	0... 655.35	0.01	s
LDP_FLOW_NT_MMV_IP_T_RGN_MAX	4	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDPM_NT_AGI_S_RED	4	0... FFFFH	0... 0.99998	15.3e-6	-
regeneration time for manual regeneration duration selection					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TNT_MDL_MAX_AT	V	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_TNT_MAX_AT	6	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_VS_IP_TNT_MAX_AT	6	0... FFH	0... 255	1	km/h
Maximum NOx catalyst temperature for lean operation - AT vehicle					
IP_TNT_MDL_MAX_MT	V	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_TNT_MAX_MT	6	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_VS_IP_TNT_MAX_MT	6	0... FFH	0... 255	1	km/h
Maximum NOx catalyst temperature for lean operation - MT vehicle					
IP_TNT_MDL_MIN_AT	-	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_TNT_MIN_AT	4	0... FFFFH	0... 0.99998	15.3e-6	-
Minimum NOx catalyst temperature for lean operation - AT vehicle					
IP_TNT_MDL_MIN_IS_AT	-	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_TNT_IS_AT	4	0... FFFFH	0... 0.99998	15.3e-6	-
Minimum NOx catalyst temperature for lean operation at idle speed - AT vehicle					
IP_TNT_MDL_MIN_IS_MT	-	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_TNT_IS_MT	4	0... FFFFH	0... 0.99998	15.3e-6	-
Minimum NOx catalyst temperature for lean operation at idle speed - MT vehicle					
IP_TNT_MDL_MIN_MT	-	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_TNT_MIN_MT	4	0... FFFFH	0... 0.99998	15.3e-6	-
Minimum NOx catalyst temperature for lean operation - MT vehicle					
IP_VLS_DIST_GRD_NEG	-	0... 578H	-200 ...1200	1	mV
LDP_VLS_MAX_TMP_IP_VLS_DIST	6	0... 578H	-200 ...1200	1	mV
Difference between local maximum and current value for calculation of negative gradient					
IP_VS_DIF_HYS_AT	-	0... FFFFH	-256... 255.99218	0.0078125	km/h
LDP_VS_MMV_NOX_IP_VS_HYS_AT	8	0... 7FFFH	0... 255.99218	0.0078125	km/h
Vehicle speed difference hysteresis for reset of Lambda=1.0 operation request - AT vehicle					
IP_VS_DIF_HYS_MT	-	0... FFFFH	-256... 255.99218	0.0078125	km/h
LDP_VS_MMV_NOX_IP_VS_HYS_MT	8	0... 7FFFH	0... 255.99218	0.0078125	km/h
Vehicle speed difference hysteresis for reset of Lambda=1.0 operation request - MT vehicle					
IP_VS_DIF_THD_BAS_AT	V	0... FFFFH	-256... 255.99218	0.0078125	km/h
LDP_TNT_MDL_L_IP_VS_THD_AT	8	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_VS_THD_AT	8	0... FFFFH	0... 0.99998	15.3e-6	-
Vehicle speed difference threshold for set of Lambda=1.0 operation request - AT vehicle					
IP_VS_DIF_THD_BAS_MT	V	0... FFFFH	-256... 255.99218	0.0078125	km/h
LDP_TNT_MDL_L_IP_VS_THD_MT	8	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_VS_THD_MT	8	0... FFFFH	0... 0.99998	15.3e-6	-
Vehicle speed difference threshold for set of Lambda=1.0 operation request - MT vehicle					
IP_VS_DIF_THD_COR_AT	-	0... FFFFH	-256... 255.99218	0.0078125	km/h

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_VS_MMV_NOX_IP_VS_COR_AT	8	0... 7FFFH	0... 255.99218	0.0078125	km/h
Vehicle speed difference threshold correction for set of Lambda=1.0 operation request - AT vehicle					
IP_VS_DIF_THD_COR_MT	-	0... FFFFH	-256... 255.99218	0.0078125	km/h
LDP_VS_MMV_NOX_IP_VS_COR_MT	8	0... 7FFFH	0... 255.99218	0.0078125	km/h
Vehicle speed difference threshold correction for set of Lambda=1.0 operation request - MT vehicle					
LC_AFL_PURGE_RST	-	0... 1H	0 ...1	1	-
Activation of NTL and NTLD threshold for reset of NT purge control variables					
LC_INH_AFL_PURGE_TOUT	-	0... 1H	0 ...1	1	-
Inhibition of catalyst purge break if a time out condition fulfilled					
LC_INH_NT_RGN_ST	-	0... 1H	0 ...1	1	-
Inhibition of NOx regeneration request at transition STATE_NOX = 'WARMUP' -> 'REGENERATION'					
LC_INH_RGN_PU	-	0... 1H	0 ...1	1	-
Switch to forbid regeneration during PU					
LC_INH_RGN_REQ_ST	-	0... 1H	0 ...1	1	-
Check of LV_INH_RGN_REQ at transition STATE_NOX = 'WARMUP' -> 'REGENERATION'					
LC_NOX_SENS	-	0... 1H	0 ...1	1	-
Logical constant for the existence of a NOx-Sensor					
LC_NOX_SENS_RGN	-	0... 1H	0 ...1	1	-
switch to exclusively use the NOx sensor for requesting a regeneration					
LC_NS_SHIFT_INH_AFL_PURGE	-	0... 1H	0 ...1	1	-
Deactivation of catalyst purge after lean operation at NOx sensor shift diagnosis					
LC_NT_ACT	-	0... 1H	0 ...1	1	-
Logical constant for NOx catalyst function activation					
LC_NT_AFS_REQ	-	0... 1H	0 ...1	1	-
switch to force hom.mode in Passive or enable lean operation					
LC_NT_AFS_REQ_NS_SHIFT	-	0... 1H	0 ...1	1	-
Activation of Lambda=1.0 operation request by for NOx sensor shift diagnosis by LV_NT_AFS_REQ					
LC_NT_RGN_STOP_INI_NTL_O2L	-	0... 1H	0 ...1	1	-
Method selection for handling of NTL and O2L at break off of a NOx regeneration by PUC or idle speed					
LC_NT_RGN_STOP_IS	-	0... 1H	0 ...1	1	-
Method selection for break off a running NOx regeneration if idle speed has higher priority					
LC_NT_STST_ACT	-	0... 1H	0 ...1	1	-
Activation of special engine start-stop functionality into NOx catalyst functionalities					
LC_NTL_DEC_INT_AFR_ENA	-	0... 1H	0 ...1	1	-
Enabling of rich detection by NTL_DEC_INT ratio at the end of the regeneration of the second bank					
LC_NTL_DEC_INT_AFR_SENS_AFR_2	-	0... 1H	0 ...1	1	-
Enables the set of LV_SENS_AFR_2 by LV_NTL_DEC_INT_AFR					
LC_NTL_H_RST_LOAD_TNT	-	0... 1H	0 ...1	1	-
Activation of NTL_H reset at out of bounds NOx catalyst temperatures at STATE_NOX = "LOAD"					
LC_NTL_INI_ST	-	0... 1H	0 ...1	1	-
Selection of NTL initialisation method (0...by NVMY value, 1...by C_NTL_INI_ST)					
LC_NTLD_MAX_AFS	-	0... 1H	0 ...1	1	-
Switch between NTLD and NTLD_MDL for LV_RGN_REQ_NTLD_AFS					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_SENS_AFR_MOD	-	0... 1H	0 ...1	1	-
Selection of calculation method for LV_SENS_AFR_i					
LC_STATE_NOX_AFL_ACT	-	0... 1H	0 ...1	1	-
Activation of NOx state management (STATE_NOX) at LV_INH_AFL=1 or LV_INH_S=1					
LC_STATE_NOX_INH_NT_AFS_REQ	-	0... 1H	0 ...1	1	-
Enabling of STATE_NOX = "STOP" to "LOAD" transition at LV_NT_AFS_REQ = 1					
LC_STATE_NOX_OPM_AV_ACT	-	0... 1H	0 ...1	1	-
Activation of NOx state management (STATE_NOX) at OPM_AV <> "AFS"					
LC_SUM_NTL_CYC_NEW	-	0... 1H	0 ...1	1	-
Initialisation of regeneration cycle counter					
LC_VLS_NS_VLD_AFL_PURGE	-	0... 1H	0 ...1	1	-
Deactivation of catalyst purge after lean operation at not valid binary Lambda signal of NOx sensor					
LC_VLS_NS_VLD_RGN_STOP_MDL	-	0... 1H	0 ...1	1	-
NOx regeneration stop by model at invalid binary Lambda signal of NOx sensor					

## FUNCTION DESCRIPTION:

### General information:

The NOx catalyst management can handle single branch and twin branch exhaust gas lines with the configuration data NC\_NT\_NR.

If NC\_NT\_NR = 1, just one NOx catalyst is taken into account, if NC\_NT\_NR = 2, the software calculates the twin branch version concerning NOx catalysts.

with  $i = 1 \dots NC\_NT\_NR$

typical values of NC\_NT\_NR = 1; 2

If two or more separate cylinder banks are concerned, then

$m = 1$ , for cylinder bank 1

$m = 2$ , for cylinder bank 2

with  $m = 1 \dots NC\_CBK\_EX\_NR$

typical values of NC\_CBK\_EX\_NR = 1;2

NC\_NOX\_SENS\_CONF considers the number of NOx sensors in the system

with  $k = 1 \dots NC\_NOX\_SENS\_CONF$

typical values of NC\_NOX\_SENS\_CONF = 1;2

In some passages logical expressions are calculated using information of different branches (example: A\_1 and A\_2). If this module is compiled for single branched exhaust lines, only the first expression (here: A\_1) should be taken into consideration.


In case of LV\_NT\_STST = 1 all calculations of this module shall be inhibited. That's valid for all used recurrences (10ms, 20ms, 100ms, 1000ms).

### Application conditions

**Initialisation:** - -

**Recurrence:** *defined at each subchapter of this module,  
basic recurrence of this module is 10 ms*

**Activation:** *LV\_NT\_STST = 0*

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Deactivation: LV\_NT\_STST = 1

## 7.86.1 NOx catalyst management - catalyst states

### FUNCTION DESCRIPTION:

#### Application conditions

**Initialisation:**            - -  
**Recurrence:**                10 ms  
**Activation:**                 - -  
**Deactivation:**               - -

### 7.86.1.1 State transition manager

### FUNCTION DESCRIPTION:

#### General information:

The NOx catalyst state manager should be initialized with the STATE\_NOX = PASSIVE.

In order to keep the state manager as simple as possible without loss of functionality, the state STOP contains all engine states based on stoichiometric operation except the regeneration. Such possible states are besides the ordinary lambda=1 operation the desulfation, the catalyst heating (see lambda=1-request chapter). Due to lambda oscillations in lambda=1 operation, the consideration of LV\_NT\_AFS\_REQ is necessary in order to prevent an undesired leave of STOP.

The flag LV\_RGN\_AGI\_i is set to 1 when the regeneration just starts (STATE\_NOX switches from LOAD to REGENERATION) and the starting regeneration was requested by the modelled loading degree (LV\_RGN\_REQ\_NTLD=1). It is reset, when the regeneration is stopped by a downstream sensor signal (see Sub-chapter: STATE\_NOX = STOP).

STATE\_NOX has to be initialised with PASSIVE

The states of the NOx Trap function are:

- **PASSIVE** : Initialisation of NOx catalyst management
- **WARMUP** : Sensors ready, waiting for suitable catalyst temperature
- **LOAD** : storage of NOx (and oxygen) during lean burn phases
- **REGENERATION** : NOx-regeneration of the catalyst during a rich burn phase
- **STOP** : Lambda=1 operation
- **WAIT** : During Fuel Cut Off, only oxygen crosses the catalyst

#### Signal flow diagram:

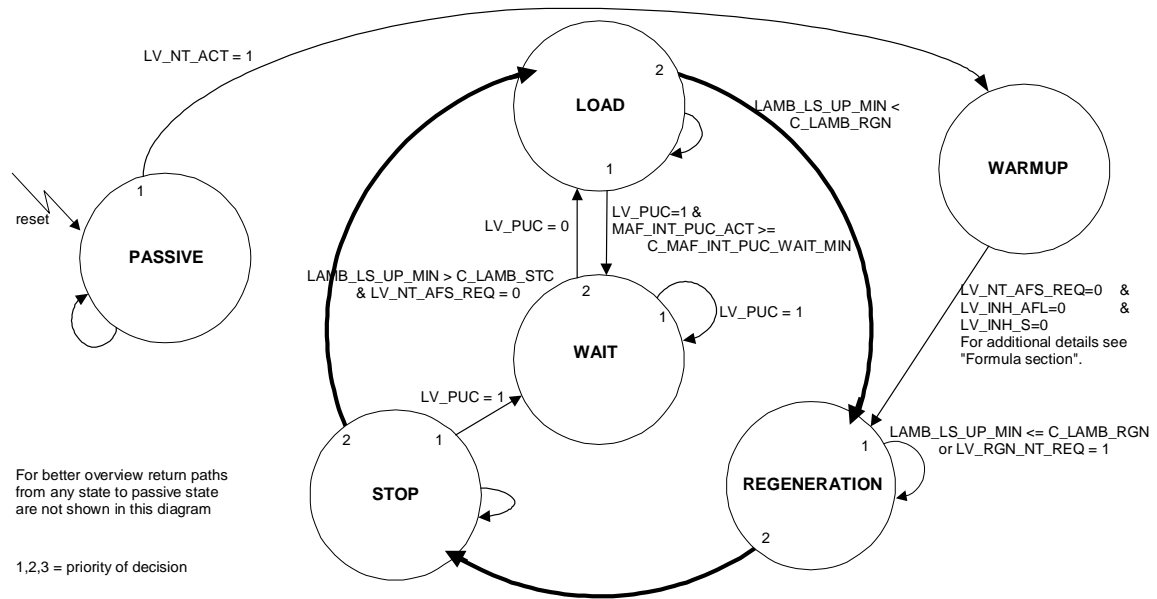


Figure 7.86.1: : State transition diagram

**Application conditions**

**Initialisation:**  $LV\_NT\_ACT = 0$  at reset  
 at deactivation:  
 $T\_NT\_STST\_ACT = 0$

**Recurrence:** 10ms

**Activation:** - -

**Deactivation:** - -

**Formula section**

```

if(135)      LC_NT_STST_ACT = 0
then(135)
    LV_NT_ACT =
        LC_NT_ACT = 1                and
        LV_INH_NT_ACT = 0           and % sen-
    sor readiness
        LV_ES = 0                   and
        LV_AST = 0                   and
        LV_ST = 0
else(135)
    LV_NT_ACT =
        LC_NT_ACT = 1                and
        LV_INH_NT_ACT = 0           and % sen-
    sor readiness
        LV_IGK = 1
endif(135)

if (1-)      T_NT_STST_ACT < maximum value (FFFFH)
then (1-)    increment T_NT_STST_ACT
    
```

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```

else (1-)          % timer remains unchanged on its maximum value
    T_NT_STST_ACT(n) = T_NT_STST_ACT(n-1)
endif (1-)
    
```

### 7.86.1.1.1 State management

```

% calculation of NTL_MIN was moved to here in order to insure the right calculation order
NTL_MIN = IP_NTL_MIN (TNT_MDL_MV)
    
```

#### Case STATE\_NOX = PASSIVE

```

if (2)          LV_NT_ACT = 1
then (2)                STATE_NOX = WARMUP    % Exit to WARMUP
else(2)            stay in PASSIVE
endif (2)
    
```

#### Case STATE\_NOX = WARMUP

```


if (3)          LV_NT_ACT = 0
then (3)                STATE_NOX = PASSIVE                                %
Exit to PASSIVE
else (3)
    if (3+)                LV_NT_AFS_REQ = 0

        (( OPM_AV <> "AFS" AND LC_STATE_NOX_OPM_AV_ACT = 1 )
        (( LV_INH_AFL = 0 OR LC_STATE_NOX_AFL_ACT = 1 )
        (( LV_INH_S = 0 OR LC_STATE_NOX_AFL_ACT = 1 )
        )
    )
then (3+)
    if (136)          LV_INH_RGN_REQ = 0 OR LC_INH_RGN_REQ_ST = 0
then (136)                STATE_NOX = REGENERATION
Exit to REGENERATION
        if (129)          LC_INH_NT_RGN_ST = 0
then (129)                LV_RGN_NT_REQ = 1
else (129)                LV_RGN_NT_REQ = 0
endif (129)
    else (136)
        if (& %■)          LC_INH_NT_RGN_ST = 0
then (& %■)                stay in WARMUP
else (& %■)                STATE_NOX = REGENER-
ATION    % Exit
        LV_RGN_NT_REQ = 0
endif (& %■)
    endif (136)
else (3+)                stay in WARMUP
endif (3+)
endif (3)
    
```

#### Case STATE\_NOX = LOAD

```

if (5)          LV_NT_ACT = 0
then (5)                STATE_NOX = PASSIVE    % Exit to PASSIVE
else (5)
    
```

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```

if (5+)                                LV_PUC = 1    AND
    MAF_INT_PUC_ACT(n-1) < MAF_INT_PUC_ACT(n)


    MAF_INT_PUC_ACT(n) >= C_MAF_INT_PUC_WAIT_MIN
then (5+)                                STATE_NOX = WAIT
Exit to WAIT
else (5+)                                if (5++)    LAMB_LS_UP_MIN < C_LAMB_RGN
    then (5++)                            call transition actions load to regeneration
    STATE_NOX = REGENERATION    %Exit to REGENERATION
    else (5++)                            stay in LOAD
    endif (5++)
endif (5+)
endif (5)

case STATE_NOX = REGENERATION
if (6)    LV_NT_ACT = 0
then (6)                                STATE_NOX = PASSIVE
Exit to PASSIVE
else (6)
    if (6+)                                (LV_RGN_NT_REQ = 1 or LAMB_LS_UP_MIN
    <= C_LAMB_RGN)
    then (6+)                                STATE_NOX = REGENERATION
    in REGENERATION
    else (6+)                                STATE_NOX = STOP
Exit to STOP
    SUM_NTL_CYC = SUM_NTL_CYC + 1
endif (6+)
endif (6)

case STATE_NOX = WAIT
if (7)    LV_NT_ACT = 0
then (7)                                STATE_NOX = PASSIVE
Exit to PASSIVE
else (7)
    if (7+) LV_PUC = 1
    then (7+)                                STATE_NOX = WAIT
    Stay in WAIT
    else (7+)                                STATE_NOX = LOAD
    LAMB_LS_UP > C_LAMB_STC
    endif (7+)
endif (7)

case STATE_NOX = STOP
if (8)                                LV_NT_ACT = 0
then (8)                                STATE_NOX = PASSIVE
Exit to PASSIVE
else (8)
    if (8+) LV_PUC = 1
    then (8+) call transition actions on exiting STOP
    STATE_NOX = WAIT
    % Exit to WAIT
    else (8+)
    if (8++)                                LAMB_LS_UP_MIN > C_LAMB_STC and
    (LV_NT_AFS_REQ = 0 or LC_STATE_NOX_INH_NT_AFS_REQ = 1)

```

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```

        then (8++)          call transition actions on exiting STOP
                           STATE_NOX = LOAD                               % Exit
                           to LOAD
        else (8++)          stay in STOP
        endif (8++)
    endif (8+)
endif (8)

```

### 7.86.1.1.2 Transition actions load to regeneration

```

NTLD_RGN_ST          = NTLD_MDL
NTL_RGN_ST           = NTL /C_FAC_O2_EQU + O2L /C_FAC_COR_O2L
NTL_RGN_ST_NOX       = NTL
NOX_CONC_RED_MMV_RGN_ST = NOX_CONC_RED_MMV
NT_EFF_COR_RGN_ST    = NT_EFF_COR
FLOW_NT_MMV         = MAF_KGH
if(14)               LV_RGN_NT_REQ = 1      % handling of LV_RGN_AGI
then (14)             LV_RGN_AGI_i = 1
endif (14)
LV_RGN_AGI_VLD_i     = 0                  % final reset
LV_TRIG_AFR_AFL      = 0                  % reset triggerbit
STATE_AFL_PURGE[i]   = DISABLED
MAF_INT_STOP_NTL     = 0
if(141)               LC_AFL_PURGE_RST = 0
then(141)             T_STOP = 0
                     MAF_INT_STOP = 0
                     CTR_AFL_PURGE[i] = 0
else(141)
    if(142)            NTL > IP_NTL_MIN_AFL_
    PURGE(VS)          AND
                     NTLD > IP_NTLD_MIN_AFL_PURGE(VS)
    then(142)          T_STOP = 0
                     MAF_INT_STOP = 0
                     CTR_AFL_PURGE[i] = 0
    endif(142)
endif(141)

```

### 7.86.1.1.3 Transition actions on exiting STOP

```

NOX_OUT_MDL_INT = 0
LV_NOX_SENS_NOX_VLD_RGN_ST_i = 0
LV_T_AFL_MIN = 0
LV_TOUT_AFR = 0
LV_MDL_AFR = 0
FLOW_NT_MMV = MAF_KGH
if (16)        T_NT_HOM > C_T_NT_HOM_MAX_VLD
then (16)      LV_NT_HOM_INI = 0
endif (16)
DIST_AFL_ST = DIST
NOX_COR_INT = 0
STATE_AFL_PURGE[i] = DISABLED
LV_CAT_PURGE_REQ_POST_AFL[i] = 0
MAF_INT_STOP_NTL = 0
if(143)        LC_AFL_PURGE_RST = 0

```

```

then(143)      T_STOP = 0
               MAF_INT_STOP = 0
               CTR_AFL_PURGE[i] = 0
endif(143)
    
```

Notes:

1. For the detection of a regeneration in catalyst purge the calibration data C\_LAMB\_RGN has to be calibrated always more lean than the calibrated lambda for catalyst purge.

The following table gives an overview, how variables are calculated depending on the NOx catalyst management state.

state-depending actions

	Passive/ Warmup	RGN	Load	Wait	Stop
NOX_COR_xx	0	0	C	0	0
NOX_CONC_xx	0	0	C	-	-
NT_STC_RNG_H	I	-	C	-	-
NTL	I	C	C	-	C
NTLD	0	C	C	-	C
NTLD_MDL	0	C	C	-	C
NT_EFF	0	0	C	0	0
NT_O2_STC	0	-	C	C	-
O2_FLOW	0	0	C	C	0
O2L	0	C	C	C	-
T_AFL	0	-	C	-	0
T_AFL_PUC	0	0	C	0	0
FLOW_NT_MMV	0	C	C	-	-
NTL_DEC_INT	0	C	0	0	-
Rgn request set	I	/	C	0	0
Purge request set / reset	0	C	C	0	0
Rgn request reset	/	C	/	0	0
AFS request block	0/C	C	C	C	C

I initialise  
 0 set to zero  
 C calculate  
 - freeze value (no changes)  
 / action forbidden

**7.86.1.2 STATE\_NOX = PASSIVE**

**FUNCTION DESCRIPTION:**


**General information:**

The state PASSIVE is active during engine stop, engine start, after start, warming up and inactivated NOx catalyst function.

The values of the variables listed below are their initialisation values.

If regeneration stop mode is model , NTL has to be initialised with a suitable high value in order to prevent the state manager to leave first regeneration (after function start) due to low model load.

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### Application conditions

```

Initialisation:           at reset:
                                if (139)           LC_NTL_INI_ST = 1
                                then (139)          NTL = C_NTL_INI_ST
                                else (139)          NTL = max (NTL(from NVMY) * C_FAC_
                                NTL_INI_ST,                                     C_NTL_INI_ST)
                                endif (139)
                                NTL_H = NTL

Recurrence:             20ms

Activation:             - -


Deactivation:          - -
    
```

### Formula section:

```

LV_TOUT_AFR = 0
LV_MDL_AFR = 0
LV_RGN_AGI_VLD_i = 0
LV_NT_HOM_INI = 0
LV_NOX_SENS_NOX_VLD_RGN_ST_i = 0
LV_T_AFL_MIN = 0
NOX_COR = 0
NOX_COR_RED = 0
NOX_COR_RED_MMV = 0
NOX_CONC_RAW = 0
NOX_CONC = 0
NOX_CONC_MMV = 0
NOX_CONC_RED = 0
NOX_CONC_RED_MMV = 0
NOX_CONC_OUT_MDL_MMV = 0
NOX_CONC_RED_MMV_RGN_ST = 0
NTLD = 0
NTLD_MDL = 0
NT_EFF = 0
NT_EFF_COR_RGN_ST = 1
NT_O2_STC = 0
O2_FLOW = 0
O2L = 0
T_AFL = 0
T_AFL_PUC = 0
NTL_DEC_INT_i = 0
NTL_DEC_INT_SWI_i = 0
NTL_RGN_ST = 0
NTL_RGN_ST_NOX = 0
NOX_OUT_MDL = 0
NOX_OUT_MDL_INT = 0
NOX_NS_AD_RGN_ST[i] = 0
FLOW_NT_MMV = 0
NT_AGI_AV = 1
NTL_DEC_INT_i = 0
LV_RGN_AGI_i = 0
    
```

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```

NOX_COR_INT = 0
DIST_AFL_ST = 0
DIST_AFL = 0
RATIO_NOX_OUT_INT_DIST_k = 0
RATIO_NOX_k = 0
LV_RGN_NT_REQ = 0
LV_ACT_INT_PUC_AFL_i = 0
NT_EFF_COR = 1
NT_STC_BAS_RNG_H = C_NT_STC_INI_RNG_H
LV_NT_AFS_REQ = LC_NT_AFS_REQ
NT_STC_RNG_H = C_NT_STC_INI_RNG_H
NTLD_RGN_ST = C_NTLD_RGN_ST_INI
T_NT_HOM = C_T_NT_HOM
LV_CAT_PURGE_REQ_POST_AFL[i] = 0
T_STOP = 0
MAF_INT_STOP = 0
MAF_INT_STOP_NTL = 0
CTR_AFL_PURGE[i] = 0
STATE_AFL_PURGE[i] = DISABLED
LV_NT_RGN_STOP_PUC = 0
MAF_INT_PUC_ACT(n-1) = MAF_INT_PUC_ACT(n)
if (140) LC_NTL_INI_ST = 1
then (140) NTL = C_NTL_INI_ST
            NTL_H = NTL
endif (140)
LV_NTL_DEC_INT_AFR = 0
LV_NTL_DEC_INT_STOP_RGN = 0
LV_NT_RGN_2_NOT_VLD = 0
LV_NT_RGN_2_NOT_VLD_SET = 0
VLS_NOX_SENS_MMV = -200
    
```

### 7.86.1.3 STATE\_NOX = WARMUP

*Initialisation:* --  
*Recurrence:* 100ms  
*Activation:* --  
*Deactivation:* --

#### Formula section:


% see also chapter 1.2.8  
**call** "Homogeneous time counter handling"  
 $T\_NT\_HOM = \min(C\_T\_NT\_HOM, T\_NT\_HOM(n-1) + 10 * T\_NT\_HOM\_DELTA)$

### 7.86.1.4 STATE\_NOX = LOAD

#### FUNCTION DESCRIPTION:

#### Application conditions

**Initialisation:** --  
**Recurrence:** 20ms (including all subchapters)

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**Activation:**                 -- --  
**Deactivation:**             -- --

**General information:**

The time counter for lean operation is incremented in STATE\_NOX = LOAD  
The integral of reducing agent is reset to zero, it is only valid in REGENERATION.

**Formula section:**

```

if (24)  LV_HOM_AFS_REQ = 0 and (LV_S_ACT = 1 or LV_HOM_AFL_ACT = 1)
then (24)  call "NOx emissions handling"
             call "NOx trap storage capacity and loading degree"
             call "NOx trap efficiency"
             call "Oxygen storage"
             if (25)      LV_NOX_SENS = 1
             then (25)
                 if (123)      NC_NT_NR = NC_NOX_SENS_CONF
                 then (123)    NOX_NS_AD_RGN_ST[i] = NOX_NS_AD[k]
                 else (123)    NOX_NS_AD_RGN_ST[i] = NOX_NS_AD[1]
                 endif (123)
             endif (25)
             endif (24)

             call "Filtered exhaust gas flow"
             T_AFL (n)      = T_AFL (n-1) + TA      %TA = recurrence time
             T_AFL_PUC (n)  = T_AFL_PUC (n-1) + TA
             NTL_DEC_INT_i  = 0
             if (26)  T_AFL >= C_T_AFL_NT_HOM_RST
                 and      NTLD_MDL >= C_NTLD_NT_HOM_RST
             then (26) T_NT_HOM = C_T_NT_HOM
             endif (26)
    
```


**7.86.1.4.1 NOx emissions handling**

**General information:**

NOX\_RED\_FAC takes into account the amount of NOx emission, chemically reduced by the catalyst.

**Signal flow diagram:**

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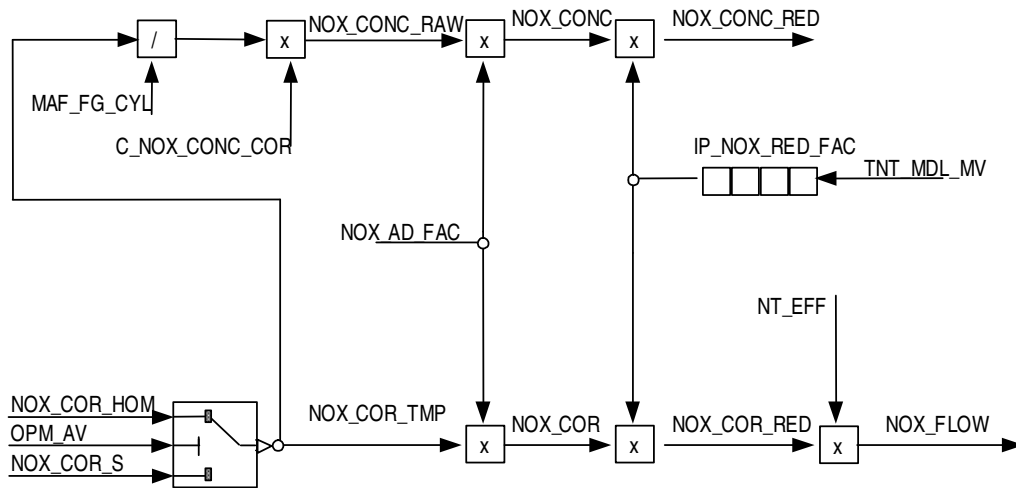


Figure 7.86.2: : NOx emissions handling

**Formula section:**

% Functions to calculate NOX\_COR\_S and NOX\_COR\_HOMS are calculated independently of this manager. All functions using NOX\_COR\_S or NOX\_COR\_HOMS have to be calculated after that.

**case selection (125) on OPM\_AV:**

**case** OPM\_AV = "S":

$$NOX\_COR\_TMP = NOX\_COR\_S$$

**case** OPM\_AV = "AFL" or

**case** OPM\_AV = "AFS":

$$NOX\_COR\_TMP = NOX\_COR\_HOMS$$

**otherwise** (default):

$$NOX\_COR\_TMP = NOX\_COR\_HOMS$$

**end case selection (125)**

$$NOX\_COR = NOX\_COR\_TMP * NOX\_AD\_FAC$$

$$NOX\_COR\_INT(n) = NOX\_COR\_INT(n-1) + NOX\_COR(n) * recurrence$$

$$NOX\_COR\_RED = NOX\_COR * IP\_NOX\_RED\_FAC (TNT\_MDL\_MV)$$

$$NOX\_COR\_RED\_MMV_n = NOX\_COR\_RED * C\_CRLC\_NOX\_COR\_RED + NOX\_COR\_RED\_MMV_{n-1} * (1 - C\_CRLC\_NOX\_COR\_RED)$$

$$NOX\_FLOW = NOX\_COR\_RED * NT\_EFF$$

$$NOX\_CONC\_RAW = (NOX\_COR\_TMP / MAF\_FG\_CYL) * C\_NOX\_CONC\_COR$$

$$NOX\_CONC = NOX\_CONC\_RAW * NOX\_AD\_FAC$$

$$NOX\_CONC\_RED = NOX\_CONC * IP\_NOX\_RED\_FAC (TNT\_MDL\_MV)$$


$$NOX\_CONC\_MMV_n = NOX\_CONC * C\_CRLC\_NOX\_CONC\_RED + NOX\_CONC\_MMV_{n-1} * (1 - C\_CRLC\_NOX\_CONC\_RED)$$

$$NOX\_CONC\_RED\_MMV_n = NOX\_CONC\_RED * C\_CRLC\_NOX\_CONC\_RED + NOX\_CONC\_RED\_MMV_{n-1} * (1 - C\_CRLC\_NOX\_CONC\_RED)$$

$$NOX\_OUT\_MDL = NOX\_COR\_RED * (1 - NT\_EFF)$$

$$NOX\_CONC\_OUT\_MDL = NOX\_CONC\_RED * (1 - NT\_EFF)$$

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$$NOX\_CONC\_OUT\_MDL\_MMV_n = NOX\_CONC\_OUT\_MDL * C\_CRLC\_NOX\_CONC\_OUT\_MDL + NOX\_CONC\_OUT\_MDL\_MMV_{n-1} * (1 - C\_CRLC\_NOX\_CONC\_OUT\_MDL)$$

$$NOX\_OUT\_MDL\_INT = NOX\_OUT\_MDL\_INT_{n-1} + NOX\_OUT\_MDL$$

% NOX\_OUT\_MDL\_INT has to be internally treated as a longint.

The factor C\_NOX\_CONC\_COR consists of the following chemical constants:

$$C\_NOX\_CONC\_COR = \text{molmass air / molmass NO2} * (1/\text{factor for transformation kg/h- -> kg/s}) = 29 / 46 * 3600 = 2269.565$$

This value should be the initialization value of the calibration data.

Due to possible small values of NOX\_OUT\_MDL, NOX\_OUT\_MDL\_INT has to be internally treated as a longint.

### 7.86.1.4.2 NOx trap storage capacity and loading degree

#### General information:

The basic catalyst storage capacity is worked out by a map depending on the raw NOx concentration NOX\_CONC and on the modelled NOx-trap temperature mean value. The aging factor NT\_AGI\_NTLD is delivered from the module NOx catalyst aging and reduces the basic storage capacity with the present aging state depending on catalyst temperature.

The current load of the NOx storage catalyst is worked out by the NOx mass flow actually available to be stored in the catalyst NOX\_FLOW and the NOx trap efficiency NT\_EFF.

The NOx trap loading degree is the ratio of the NOx trap absolute loading and the NOx storage capacity. The increase of NTLD is limited to C\_NTLD\_LGRD per time step.

#### Signal flow diagram:

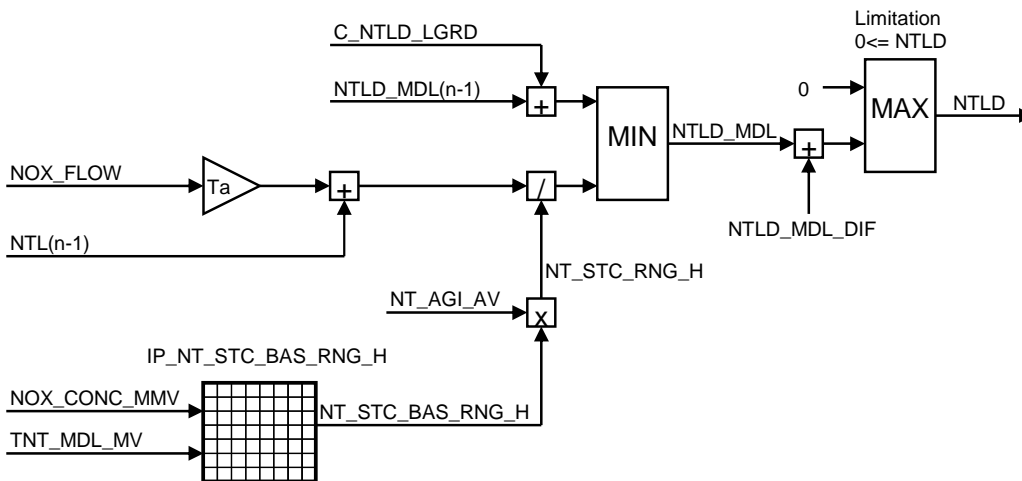


Figure 7.86.3: : NOx catalyst storage capacity, absolute loading and loading degree

#### Formula section:

$$NT\_STC\_BAS\_RNG\_H = IP\_NT\_STC\_BAS\_RNG\_H(NOX\_CONC\_MMV, TNT\_MDL\_MV))$$

$$NT\_AGI\_AV = IP\_NT\_AGI\_RGN\_FRQ(NT\_AGI\_NTLD, TNT\_MDL\_MV)$$

$$NT\_STC\_RNG\_H = NT\_STC\_BAS\_RNG\_H * NT\_AGI\_AV$$

$$NTL_n = NTL_{n-1} + NOX\_FLOW * Ta$$

```

if (164)          TNT_MDL_MV >= (C_TNT_MDL_MV_NTL_H_RST_MIN +
                                C_TNT_MDL_MV_NTL_H_RST_HYS)
TNT_MDL_MV <= (C_TNT_MDL_MV_NTL_H_RST_MAX -
                C_TNT_MDL_MV_NTL_H_RST_HYS)

```

**AND**

```

then (164)      NTL_H_n = NTL_H_{n-1} + NOX_FLOW * Ta
else (164)
    if (165)          LC_NTL_H_RST_LOAD_TNT = 1
    then (165)      NTL_H is reset
                    NTL_H_n = NTL_MIN
    else (165)      NTL_H is frozen
                    NTL_H_n = NTL_H_{n-1}
    endif (165)

```

**endif (164)**

*Attention!*

- Observe different resolutions and value ranges of NTL, NTL\_H and NTL\_MIN.
- NTL and NTL\_H should be internally calculated as longint.

$$NTLD\_MDL = \min (NTL / NT\_STC\_RNG\_H, NTLD\_MDL(n-1) + C\_NTLD\_LGRD)$$

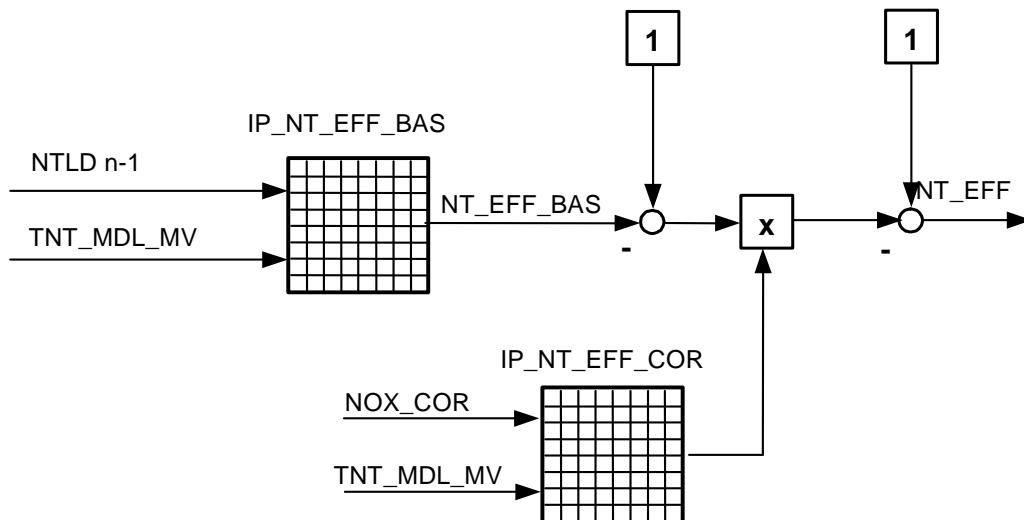
$$NTLD = \max (0, NTLD\_MDL + NTLD\_MDL\_DIF)$$

### 7.86.1.4.3 NOx trap efficiency

#### General information:


The base NOx trap efficiency is given by a map depending on NOx trap loading degree and the modelled NOx trap temperature. The base value is corrected depending on the raw NOx mass flow NOX\_COR.  
Note: The value NT\_EFF is limited to 1 in the program.

#### Signal flow diagram:



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Figure 7.86.4: : NOx trap efficiency (simplified)

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**Formula section:**

**if (30)**            LV\_EF = 0  
**then (30)**        NT\_EFF\_BAS = IP\_NT\_EFF\_BAS (NTLD, TNT\_MDL\_MV)  
**else (30)**        NT\_EFF\_BAS = IP\_NT\_EFF\_BAS\_EF\_CLOSE (NTLD, TNT\_MDL\_MV)  
                          % not shown in the figure

NT\_EFF\_COR        = IP\_NT\_EFF\_COR (NOX\_COR, TNT\_MDL\_MV)  
 NT\_EFF = 1 - (( 1 - NT\_EFF\_BAS) \* NT\_EFF\_COR)

**7.86.1.4.4 Oxygen storage**

**General information:**

During lean operation the NOx trap stores Oxygen. The current load of stored Oxygen in the NOx trap, O2L is worked out by a formula.

**Signal flow diagram:**

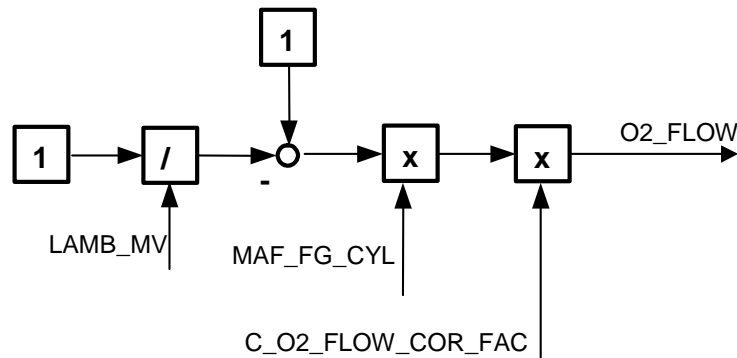


Figure 7.86.5: : Oxygen mass flow

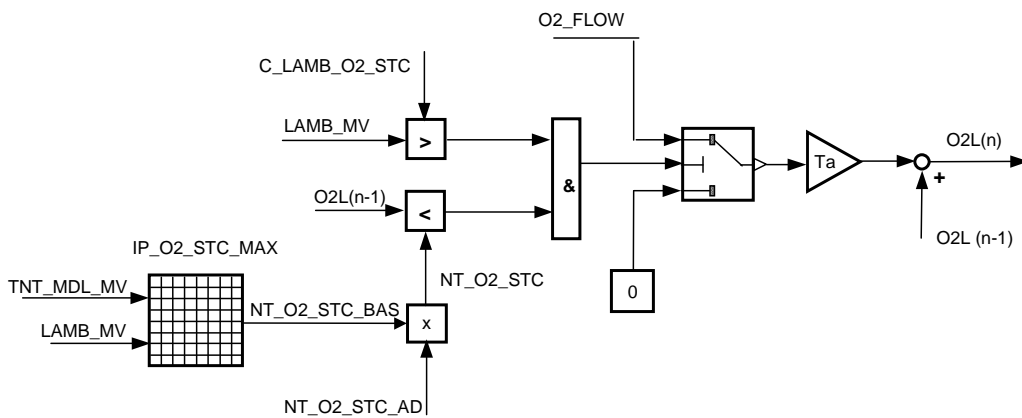



Figure 7.86.6: : Oxygen storage

**Formula section:**

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```

NT_O2_STC_BAS= IP_O2_STC_MAX (LAMB_LS_UP_MV, TNT_MDL_MV)
NT_O2_STC      = NT_O2_STC_BAS * NT_O2_STC_AD
if (32)        (LAMB_LS_UP_MV > C_LAMB_O2_STC)
               and LAMB_LS_UP_MV > 1
               and (O2L < NT_O2_STC)
then (32)      O2_FLOW = (1 - (1/LAMB_LS_UP_MV))
               * MAF_FG_CYL * C_O2_FLOW_COR_FAC
               O2L (n)   = O2L (n-1) + O2_FLOW * Ta
else (32)      O2L (n)   = O2L (n-1)
endif (32)
    
```

The factor C\_O2\_FLOW\_COR\_FAC consists of the following constants:

C\_O2\_FLOW\_COR\_FAC = (0.21 \* molmass(O2)) / molmass(air) \* factor for transformation of MAF\_FG\_CYL (kg/h) to (mg/s) = 0.21 \* 32 / 29 \* 10<sup>6</sup> / 3600 = 64.37

This value should be the initialization value of the calibration data.

### 7.86.1.5 STATE\_NOX = WAIT

#### FUNCTION DESCRIPTION:

##### Application conditions

**Initialisation:**        -- --  
**Recurrence:**            10ms  
**Activation:**            -- --  
**Deactivation:**         -- --

##### Formula section:

```

if (144)                               MAF_INT_PUC_ACT(n-1) < MAF_INT_PUC_ACT(n)
AND
    MAF_INT_PUC_ACT(n) >= C_MAF_INT_PUC_RST_RGN_REQ
then (144)                               LV_RGN_NT_REQ = 0
endif (144)
    
```

##### Application conditions

**Initialisation:**        -- --  
**Recurrence:**            20ms                    (including all subchapters)  
**Activation:**            -- --  
**Deactivation:**         -- --

### 7.86.1.5.1 General, NOx storage

#### General information:

When the engine state LV\_PUC is active (-> STATE\_NOX = WAIT), the NOx trap loading calculation is frozen.

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**Formula section:**

```

NOX_COR = 0
NOX_COR_RED = 0
NOX_COR_RED_MMV = 0
NOX_CONC_RAW = 0
NOX_CONC = 0
NOX_CONC_RED = 0
NOX_CONC_MMV = NOX_CONC_MMVn-1
NOX_CONC_RED_MMV = NOX_CONC_RED_MMVn-1
NOX_CONC_OUT_MDL_MMV = NOX_CONC_OUT_MDL_MMVn-1
NOX_OUT_MDL = 0
NT_STC_RNG_H = NT_STC_RNG_H(n-1)
NTLD = NTLD (n-1)
NTLD_MDL = NTLD_MDL (n-1)
NT_EFF = 0
T_AFL = T_AFL (n-1)
T_AFL_PUC = 0
NTL_DEC_INT_i = 0
T_NT_HOM = T_NT_HOM (n-1)
LV_CAT_PURGE_REQ_POST_AFL[i] = 0
NTL = NTLn-1
if (161) ( MAF_INT_PUC_ACT(n-1) < MAF_INT_PUC_ACT(n)
AND
    MAF_INT_PUC_ACT(n) > C_MAF_INT_PUC_NTL_H_RST )
    TNT_MDL_MV < C_TNT_MDL_MV_NTL_H_RST_MIN
    TNT_MDL_MV > C_TNT_MDL_MV_NTL_H_RST_MAX
then (161) NTL_H is reset
    NTL_H = NTL_MIN
else (161) NTL_H is frozen
    NTL_H = NTL_Hn-1
endif (161)
LV_ACT_INT_PUC_AFL_i = 0
    
```

Evaluation of slope of MAF\_INT\_PUC\_ACT moved from 20ms to 10ms.

**7.86.1.5.2 Oxygen mass flow and oxygen storage**

**General information:**

During the engine state LV\_PUC the NOx catalyst stores oxygen. The current load of stored oxygen in the NOx trap is worked out by a formula.

The calculation of the following quantities is done in the same way as in STATE\_NOX = LOAD. (see subchapter STATE\_NOX = LOAD , passage oxygen storage ) (3 pages above)


**Formula section:**

**call "Oxygen storage"**

**7.86.1.6 STATE\_NOX = REGENERATION**

**FUNCTION DESCRIPTION:**

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**General information:**

For the regeneration of the NOx trap a rich mixture is required.

**Application conditions**

**Initialisation:** - -  
**Recurrence:** 10ms (including all subchapters)  
**Activation:** - -  
**Deactivation:** - -

**7.86.1.6.1 Miscellaneous**

**Formula section:**

```

NOX_COR = 0
NOX_COR_RED = 0
NOX_COR_RED_MMV = 0
NOX_CONC_RAW = 0
NOX_CONC = 0
NOX_CONC_RED = 0
NOX_CONC_MMV = 0
NOX_CONC_RED_MMV = 0
NOX_CONC_OUT_MDL_MMV = 0
NOX_OUT_MDL = 0
NT_STC_RNG_H = NT_STC_RNG_H(n-1)
NT_EFF = 0
NT_O2_STC = NT_O2_STC(n-1)
O2_FLOW = 0
T_AFL = T_AFL(n-1)
T_AFL_PUC = 0
call " Filtered exhaust gas flow "
call "Homogeneous time counter handling"
T_NT_HOM = min (C_T_NT_HOM, T_NT_HOM(n-1) + T_NT_HOM_DELTA)
    
```

**7.86.1.6.2 Handling of trigger bits for functions using RAI signal**


**Formula section:**

```

% undefined exhaust gas during regeneration
if (38) LV_SCC[m] = 1
or LV_PUC = 1
or (C_STATE_SENS_AFR_i = "VLS_NOX_SENS" and LV_NOX_SENS_VLS_VLD_k = 0)
or (C_STATE_SENS_AFR_i = "LAMB_NOX_SENS" and
LV_NOX_SENS_LAMB_VLD_k = 0)
then (38) LV_RGN_AGI_i = 0
endif (38)

% sensor switches during valid regeneration
if(39) LV_SENS_AFR_i = 1 and LV_RGN_AGI_i = 1
then (39) LV_RGN_AGI_i = 0
    
```

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```

        LV_RGN_AGI_VLD_i = 1
    endif (39)

```

### 7.86.1.6.3 Calculation of NTL\_DEC and NTL\_DEC\_INT

#### General information:

For the regeneration of the NOx trap a rich mixture is required.

NTL\_DEC\_i represents the lack of oxygen during regeneration. This lack of oxygen corresponds to the reducing agent mass. The unit of NTL\_DEC therefore is [mg O2 /time step].

NTL\_DEC\_INT\_i represents the integral of the NTL\_DEC\_i during regeneration. It is calculated during the regeneration phase.

NTL\_DEC\_INT\_SWI represents the NTL\_DEC\_INT up to the moment the downstream sensor switches from lean to rich. This value may be used for several adaptation purposes.

Due to possible small values of NTL\_DEC (defined as a longint), NTL\_DEC\_INT has to be internally treated as a longint.

#### Formula section:

```

if (155)                                NC_NT_NR = 2
then (155)    Twin branch system with 2 TWC and 2 NOx catalysts NC_CBK_EX_NR = NC_NT_
NR = 2 => i = m = 2
    if (147)                                LAMB_LS_UP[m] < 1.0

        VLS_DOWN[m] >= C_VLS_DOWN_MIN_NTL_DEC[m]
    then (147)    NTL_DEC[i] = ((1 / LAMB_LS_UP[m]) - 1) * (MAF_FG_CYL / NC_CBK_EX_
NR) * C_O2_FLOW_COR_FAC * Recurrence
        NTL_DEC_INT_i = NTL_DEC_INT_i (n-1) + NTL_DEC[i]
    else (147)    NTL_DEC[i] = 0
        NTL_DEC_INT_i = NTL_DEC_INT_i (n-1)
    endif (147)

if (148)                                LC_SENS_AFR_MOD = 0
then (148)
    if (40)    LV_SENS_AFR[i] = 0
    then (40)    NTL_DEC_INT_SWI[i] = NTL_DEC_INT_i
    endif (40)
else (148)
    case selection on STATE_RGN[1]:
        "H_AMPL":
            if (149)    LV_SENS_AFR[1] = 0
            then (149)    NTL_DEC_INT_SWI[1] = NTL_DEC_INT_1
            endif (149)

            "L_AMPL":
                if (150)    LV_SENS_AFR[2] = 0
                then (150)    NTL_DEC_INT_SWI[1] = NTL_DEC_INT_1
                endif (150)

        "PARK":    --
        "PASSIVE" (default):    --
    end case selection

```

```

case selection on STATE_RGN[2]:
  "H_AMPL":
    if (151)          LV_SENS_AFR[1] = 0
    then (151)       NTL_DEC_INT_SWI[2] = NTL_DEC_INT_2
    endif (151)

  "L_AMPL":
    if (152)          LV_SENS_AFR[2] = 0
    then (152)       NTL_DEC_INT_SWI[2] = NTL_DEC_INT_2
    endif (152)

  "PARK":          --
  "PASSIVE" (default):  --
end case selection
endif (148)

NTL_DEC_SUM = NTL_DEC[1] + NTL_DEC[2]

else (155)      Single branch or Y system with 1 or 2 TWC and 1 NOx catalyst
  NC_CBK_EX_NR = m = 1,2; NC_NT_NR = i = 1
  if (156)          NC_CBK_EX_NR = 2
  then (156)       Y system with 2 TWC and 1 NOx catalyst
    NC_CBK_EX_NR = m = 2; NC_NT_NR = i = 1
    if (157)          LAMB_LS_UP_MV < 1.0

      VLS_DOWN[1] >= C_VLS_DOWN_MIN_NTL_DEC[1]

      VLS_DOWN[2] >= C_VLS_DOWN_MIN_NTL_DEC[2]
    then (157)      NTL_DEC[1] = ((1 /LAMB_LS_UP_MV) - 1) * (MAF_FG_CYL /NC_
    CBK_EX_NR) * C_O2_FLOW_COR_FAC * Recurrence
      NTL_DEC_INT_1 = NTL_DEC_INT_1 (n-1) + NTL_DEC[1]
    else (157)      NTL_DEC[1] = 0
      NTL_DEC_INT_1 = NTL_DEC_INT_1 (n-1)
    endif (157)

  else (156)       Single branch system with 1 TWC and 1 NOx catalyst
    NC_CBK_EX_NR = 1; NC_NT_NR = 1 => m = i = 1
    if (158)          LAMB_LS_UP[m] < 1.0

      VLS_DOWN[m] >= C_VLS_DOWN_MIN_NTL_DEC[m]
    then (158)      NTL_DEC[1] = ((1 /LAMB_LS_UP[1]) - 1) * (MAF_FG_CYL /NC_
    CBK_EX_NR) * C_O2_FLOW_COR_FAC * Recurrence
      NTL_DEC_INT_1 = NTL_DEC_INT_1 (n-1) + NTL_DEC[1]
    else (158)      NTL_DEC[1] = 0
      NTL_DEC_INT_1 = NTL_DEC_INT_1 (n-1)
    endif (158)

  endif (156)

if (154)          LV_SENS_AFR[1] = 0
then (154)       NTL_DEC_INT_SWI[1] = NTL_DEC_INT_1
endif (154)

```

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$$\text{NTL\_DEC\_SUM} = \text{NTL\_DEC}[1]$$

**endif (155)**

The factor C\_O2\_FLOW\_COR\_FAC consists of the following constants:

$$\text{C\_O2\_FLOW\_COR\_FAC} = (0.21 * \text{molmass}(\text{O2})) / \text{molmass}(\text{air}) * \text{factor for transformation of MAF\_FG\_CYL (kg/h) to (mg/s)} = 0.21 * 32 / 29 * 10^6 / 3600 = 64.37$$

This value should be the initialization value of the calibration data.

NTL\_DEC\_INT has to be internally treated as a longint.

#### 7.86.1.6.4 Decrementation of the NOx trap absolute loading of NOx and O2

##### General information:

During the regeneration phase the reducing agent is used for both, the reduction of the stored NOx and the stored O2. This is taken into account by using a share factor FAC\_RGN\_DEC\_SHAR for the decrement of the NTL and the O2L. This share factor is calculated using the ratio of stored O2 to the sum of stored O2 and NOx.

C\_FAC\_O2\_EQU and C\_FAC\_COR\_O2L are based on the chemical equation of the regeneration phase.

1. C\_FAC\_O2\_EQU should be calibrated with 1.25 to be neutral.
2. C\_FAC\_COR\_O2L should be calibrated with 1 to be neutral.

The constant C\_O2\_FLOW\_COR\_FAC and is also defined in oxygen storage subchapter of STATE\_NOX=LOAD chapter.

##### Signal flow diagram:

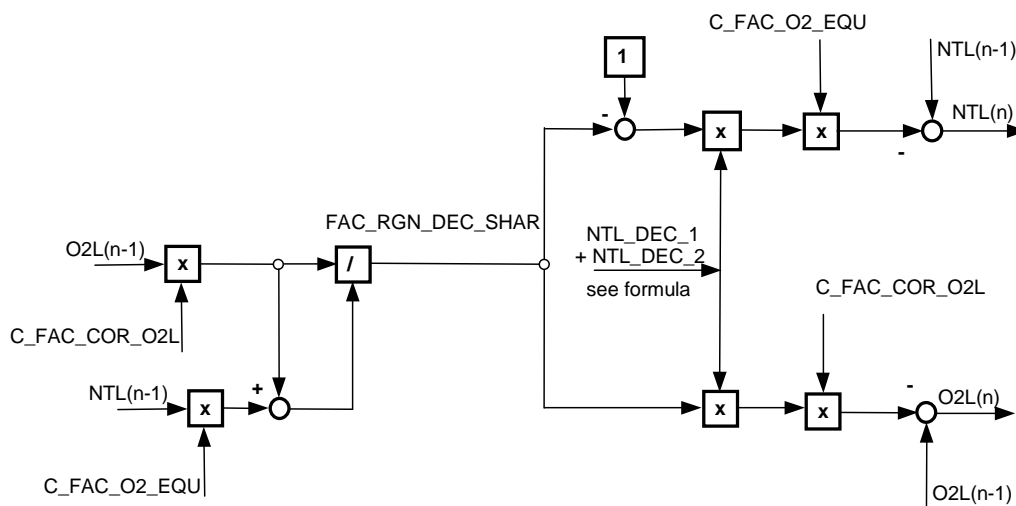


Figure 7.86.7: : NOx trap loading decrement during regeneration phase

##### Formula section:

$$\text{FAC\_RGN\_DEC\_SHAR} = \frac{\text{O2L}(n-1) * \text{C\_FAC\_COR\_O2L}}{(\text{O2L}(n-1) * \text{C\_FAC\_COR\_O2L} + \text{NTL}(n-1) * \text{C\_FAC\_O2\_EQU})}$$

$$NTL_n = \max [NTL\_MIN, NTL_{n-1} - (1-FAC\_RGN\_DEC\_SHAR) * NTL\_DEC\_SUM * C\_FAC\_O2\_EQU]$$

$$NTL\_H_n = \max [NTL\_MIN, NTL\_H_{n-1} - (1-FAC\_RGN\_DEC\_SHAR) * NTL\_DEC\_SUM * C\_FAC\_O2\_EQU]$$

*Attention!*

- Observe different resolutions and value ranges of NTL, NTL\_H and NTL\_MIN.
- NTL and NTL\_H should be internally calculated as longint.

$$O2L(n) = \max ( 0, O2L (n-1) - FAC\_RGN\_DEC\_SHAR * NTL\_DEC\_SUM * C\_FAC\_COR\_O2L)$$

$$NTLD\_MDL = NTL / NT\_STC\_RNG\_H$$

$$NTLD = \max (0, NTLD\_MDL + NTLD\_MDL\_DIF)$$

### 7.86.1.7 STATE\_NOX = STOP


#### FUNCTION DESCRIPTION:

##### General information:

When STATE\_NOX remains in STOP (e.g. due to Lambda=1-engine operation), NTL\_MIN can change due to trap temperature changes.

When the system remains in STATE\_NOX = STOP for a longer time after a lean operation phase then the catalyst purge functionality is activated. The catalyst purge functionality is controlled by an own state machine.

##### Signal flow diagram:

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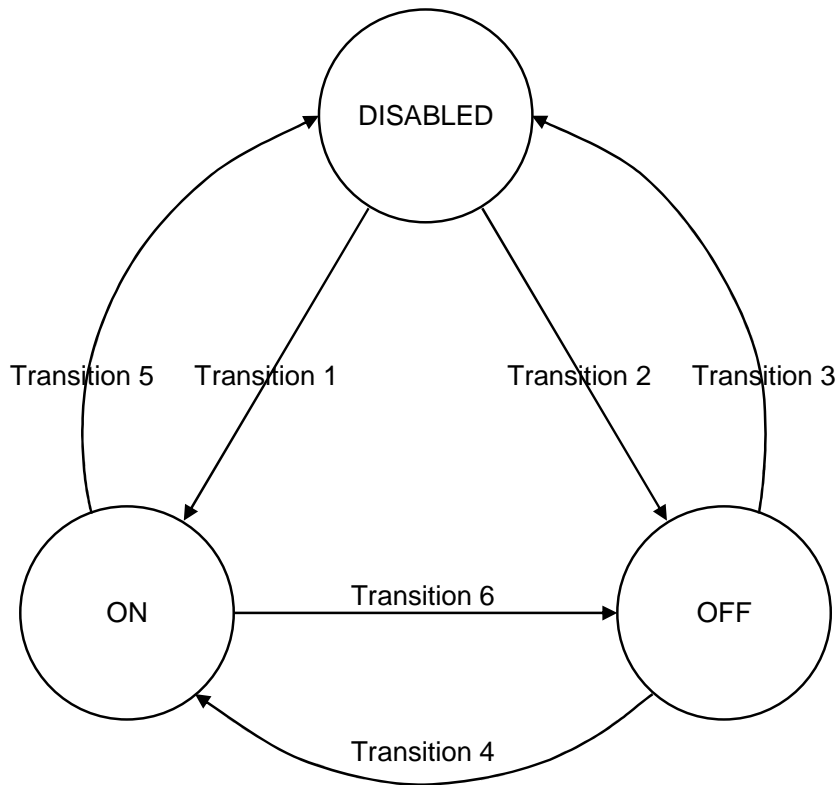


Figure 7.86.8: : State diagram for activation and deactivation of catalyst purge after lean operation


**Application conditions**

**Initialisation:** -- --  
**Recurrence:** 20ms  
**Activation:** -- --  
**Deactivation:** -- --

**Formula section:**

NOX\_COR = 0  
 NOX\_COR\_RED = 0  
 NOX\_COR\_RED\_MMV = 0  
 NOX\_CONC\_RAW = 0  
 NOX\_CONC = 0  
 NOX\_CONC\_RED = 0  
 NOX\_OUT\_MDL = 0  
 NT\_STC\_RNG\_H = NT\_STC\_RNG\_H(n-1)  
 NT\_EFF = 0  
 NT\_O2\_STC = NT\_O2\_STC(n-1)  
 O2\_FLOW = 0  
 NTL\_DEC\_INT\_i = NTL\_DEC\_INT\_i(n-1)  
 NTLD\_MDL = NTL / NT\_STC\_RNG\_H  
 NTLD = max (0, NTLD\_MDL + NTLD\_MDL\_DIF)

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**call** "Homogeneous time counter handling"

T\_NT\_HOM = **min** (C\_T\_NT\_HOM, T\_NT\_HOM<sub>(n-1)</sub> + 2 \* T\_NT\_HOM\_DELTA)  
 LV\_ACT\_INT\_PUC\_AFL\_i = 0 % purge with low priority, final reset  
 LV\_RGN\_AGI\_i = 0 % final reset

**if** (146) T\_NT\_STST\_ACT >= C\_T\_AFL\_RST  
**then** (146) T\_AFL = 0  
**else** (146) % T\_AFL remains unchanged  
 T\_AFL(n) = T\_AFL(n-1)  
**endif** (146)

**if** (162) MAF\_INT\_STOP\_NTL < maximum value (FFFFH)  
**then** (162) MAF\_INT\_STOP\_NTL(n) = MAF\_INT\_STOP\_NTL(n-1) + MAF\_KGH \* Re-  
 currence  
**else** (162) % integral remains unchanged on its maximum value  
 MAF\_INT\_STOP\_NTL(n) = MAF\_INT\_STOP\_NTL(n-1)  
**endif** (162)

**if** (-) LV\_SENS\_AFR[i] = 1 % valid for all values of i  
**then** (-) NTL = MIN (NTL (n-1), NTL\_MIN)  
 NTL\_H = MIN (NTL\_H (n-1), NTL\_MIN)  
 O2L = 0  
**else** (-) NTL = NTL (n-1)  
 O2L = O2L(n-1)  
**if** (163) MAF\_INT\_STOP\_NTL > C\_ **OR**  
 MAF\_INT\_STOP\_NTL\_H\_RST  
 TNT\_MDL\_MV < C\_TNT\_MDL\_MV\_NTL\_H\_RST\_MIN  
 TNT\_MDL\_MV > C\_TNT\_MDL\_MV\_NTL\_H\_RST\_MAX  
**then** (163) NTL\_H is reset  
 NTL\_H = NTL\_MIN  
**else** (163) NTL\_H is frozen  
 NTL\_H = NTL\_H<sub>n-1</sub>  
**endif** (163)

**endif** (-)

**if** (91) T\_STOP < maximum value (FFFFH)  
**then** (91) increment T\_STOP  
**else** (91) % timer remains unchanged on its maximum value  
 T\_STOP(n) = T\_STOP(n-1)  
**endif** (91)

**if** (92) MAF\_INT\_STOP < maximum value (FFFFH)  
**then** (92) MAF\_INT\_STOP(n) = MAF\_INT\_STOP(n-1) + MAF\_KGH \* Recurrence  
**else** (92) % integral remains unchanged on its maximum value  
 MAF\_INT\_STOP(n) = MAF\_INT\_STOP(n-1)  
**endif** (92)

% State machine for set and reset of LV\_CAT\_PURGE\_REQ\_POST\_AFL[i]  
 % The priorities of the conditions to change between states shall be defined by the order in which these  
 conditions are listed within the appropriate state as described below.  
 % If a transition condition is fulfilled, then the following transition conditions are **not** calculated.

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**STATE\_AFL\_PURGE[i] = "DISABLED"** (default state):

Transition 1: "DISABLED" to "ON"

```

if (93)    LV_CAT_PURGE_REQ_POST_AFL[i] = 1
            TNT_MDL_MV > C_TNT_MDL_PURGE_MIN
            TNT_MDL_MV < C_TNT_MDL_PURGE_MAX
            VS < C_VS_PURGE_MAX
            LV_NS_AD_REQ = 0
            (LV_NS_SHIFT_CMB_INT_REQ = 0 OR
             LC_NS_SHIFT_INH_AFL_PURGE = 0)
            (LV_VLS_NS_VLD[k] = 1 OR LC_VLS_NS_VLD_AFL_PURGE = 0)
then (93)    STATE_AFL_PURGE[i] = "ON"
            CTR_AFL_PURGE[i](n) = CTR_AFL_PURGE[i](n-1) + 1
else (93)
    
```

Transition 2: "DISABLED" to "OFF"

```

if (94)    T_STOP <= C_T_STOP_AFL_PURGE_MAX
            MAF_INT_STOP <= C_MAF_INT_STOP_AFL_PURGE_MAX
            CTR_AFL_PURGE[i] < C_CTR_AFL_PURGE_MAX
            TNT_MDL_MV > C_TNT_MDL_PURGE_MIN
            TNT_MDL_MV < C_TNT_MDL_PURGE_MAX
            VS < C_VS_PURGE_MAX
            LV_NS_AD_REQ = 0
            (LV_NS_SHIFT_CMB_INT_REQ = 0 OR
             LC_NS_SHIFT_INH_AFL_PURGE = 0)
            (LV_VLS_NS_VLD[k] = 1 OR LC_VLS_NS_VLD_AFL_PURGE = 0)
then (94)    STATE_AFL_PURGE[i] = "OFF"
else (94)
    
```

Steady state actions:

LV\_CAT\_PURGE\_REQ\_POST\_AFL[i] = 0

**endif (94)**  
**endif (93)**

**STATE\_AFL\_PURGE[i] = "OFF":**


Transition 3: "OFF" to "DISABLED"

```

if (95)    T_STOP > C_T_STOP_AFL_PURGE_MAX
            MAF_INT_STOP > C_MAF_INT_STOP_AFL_PURGE_MAX
            CTR_AFL_PURGE[i] >= C_CTR_AFL_PURGE_MAX
            TNT_MDL_MV < C_TNT_MDL_PURGE_DEAC
            TNT_MDL_MV > C_TNT_MDL_PURGE_MAX
            VS > C_VS_PURGE_MAX
            LV_NS_AD_REQ = 1
            (LV_NS_SHIFT_CMB_INT_REQ = 1 AND
             LC_NS_SHIFT_INH_AFL_PURGE = 1)
            (LV_VLS_NS_VLD[k] = 0 AND LC_VLS_NS_VLD_AFL_PURGE = 1)
then (95)    STATE_AFL_PURGE[i] = "DISABLED"
            LV_CAT_PURGE_REQ_POST_AFL[i] = 0
else (95)
    
```

Transition 4: "OFF" to "ON"

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**if (96)** NC\_NT\_NR = 2 **AND** LC\_SENS\_AFR\_  
MOD = 1

% NC\_NT\_NR = 2 means 2 NOx catalysts are within the exhaust system  
% If NC\_NT\_NR = 1 or the case above then the calculation of branch 1 is sufficient. After that  
the branch 1 results are copied to branch 2.

**then (96)**

**case selection on C\_STATE\_SENS\_AFL\_PURGE[1]:**

**case "VLS\_DOWN":**

**if (97)** VLS\_DOWN[1] < C\_VLS\_  
DOWN\_AFL\_PURGE\_ON  
**then (97)** STATE\_AFL\_PURGE[1] = "ON"  
LV\_CAT\_PURGE\_REQ\_POST\_AFL[1] = 1  
CTR\_AFL\_PURGE[1](n) = CTR\_AFL\_PURGE[1](n-1) + 1  
**endif (97)**

**case "VLS\_NOX\_SENS":**

**if (98)** VLS\_NOX\_SENS[1] < C\_  
VLS\_NOX\_SENS\_AFL\_PURGE\_ON  
**then (98)** STATE\_AFL\_PURGE[1] = "ON"  
LV\_CAT\_PURGE\_REQ\_POST\_AFL[1] = 1  
CTR\_AFL\_PURGE[1](n) = CTR\_AFL\_PURGE[1](n-1) + 1  
**endif (98)**

**case "LAMB\_NOX\_SENS":**

**if (99)** LAMB\_NOX\_SENS[1] >  
C\_LAMB\_NOX\_SENS\_AFL\_PURGE\_ON  
**then (99)** STATE\_AFL\_PURGE[1] = "ON"  
LV\_CAT\_PURGE\_REQ\_POST\_AFL[1] = 1  
CTR\_AFL\_PURGE[1](n) = CTR\_AFL\_PURGE[1](n-1) + 1  
**endif (99)**

**case "VLS\_NT\_DOWN":**

**if (100)** VLS\_NT\_DOWN[1] <  
C\_VLS\_DOWN\_AFL\_PURGE\_ON  
**then (100)** STATE\_AFL\_PURGE[1] = "ON"  
LV\_CAT\_PURGE\_REQ\_POST\_AFL[1] = 1  
CTR\_AFL\_PURGE[1](n) = CTR\_AFL\_PURGE[1](n-1) + 1  
**endif (100)**

**case "NONE":**

--

**end case selection**

STATE\_AFL\_PURGE[2] = STATE\_AFL\_PURGE[1]  
LV\_CAT\_PURGE\_REQ\_POST\_AFL[2] = LV\_CAT\_PURGE\_REQ\_POST\_AFL[1]  
CTR\_AFL\_PURGE[2] = CTR\_AFL\_PURGE[1]

**else (96)**

% Full 2 branch calculation.

**case selection on C\_STATE\_SENS\_AFL\_PURGE[i]:**

**case "VLS\_DOWN":**

**if (101)** VLS\_DOWN[m] < C\_  
VLS\_DOWN\_AFL\_PURGE\_ON



```

then (101)      STATE_AFL_PURGE[i] = "ON"
                  LV_CAT_PURGE_REQ_POST_AFL[i] = 1
                  CTR_AFL_PURGE[i](n) = CTR_AFL_PURGE[i](n-1) + 1
endif (101)

case "VLS_NOX_SENS":
  if (102)                                VLS_NOX_SENS[k] <
  C_VLS_NOX_SENS_AFL_PURGE_ON
  then (102)      STATE_AFL_PURGE[i] = "ON"
                  LV_CAT_PURGE_REQ_POST_AFL[i] = 1
                  CTR_AFL_PURGE[i](n) = CTR_AFL_PURGE[i](n-1) + 1
  endif (102)

case "LAMB_NOX_SENS":
  if (103)                                LAMB_NOX_SENS[k] >
  C_LAMB_NOX_SENS_AFL_PURGE_ON
  then (103)      STATE_AFL_PURGE[i] = "ON"
                  LV_CAT_PURGE_REQ_POST_AFL[i] = 1
                  CTR_AFL_PURGE[i](n) = CTR_AFL_PURGE[i](n-1) + 1
  endif (103)

case "VLS_NT_DOWN":
  if (104)                                VLS_NT_DOWN[k] <
  C_VLS_DOWN_AFL_PURGE_ON
  then (104)      STATE_AFL_PURGE[i] = "ON"
                  LV_CAT_PURGE_REQ_POST_AFL[i] = 1
                  CTR_AFL_PURGE[i](n) = CTR_AFL_PURGE[i](n-1) + 1
  endif (104)

case "NONE":
  --
end case selection
endif (96)

```

Steady state actions:

--

**endif (95)**

**STATE\_AFL\_PURGE[i] = "ON":**


Transition 5: "ON" to "DISABLED"

```

if (105)                                TNT_MDL_MV < C_TNT_MDL_PURGE_DEAC
OR
  TNT_MDL_MV > C_TNT_MDL_PURGE_MAX
  VS > C_VS_PURGE_MAX
  LV_NS_AD_REQ = 1
  (LV_NS_SHIFT_CMB_INT_REQ = 1
   LC_NS_SHIFT_INH_AFL_PURGE = 1)
  (LV_VLS_NS_VLD[k] = 0 AND LC_VLS_NS_VLD_AFL_PURGE = 1)
  (LC_INH_AFL_PURGE_TOUT = 0
   (T_STOP > C_T_STOP_AFL_PURGE_MAX
    MAF_INT_STOP > C_MAF_INT_STOP_AFL_PURGE_MAX
    OR
    OR
    AND
    AND
    OR

```

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```

        CTR_AFL_PURGE[i] > C_CTR_AFL_PURGE_MAX ) )
then (105)     STATE_AFL_PURGE[i] = "DISABLED"
                LV_CAT_PURGE_REQ_POST_AFL[i] = 0
else (105)

```

Transition 6: "ON" to "OFF"

```

if (106)                                     NC_NT_NR = 2 AND LC_SENS_AFR_
MOD = 1
    % NC_NT_NR = 2 means 2 NOx catalysts are within the exhaust system
    % If NC_NT_NR = 1 or the case above then the calculation of branch 1 is sufficient. After that
    the branch 1 results are copied to branch 2.

```

**then (106)**

**case selection on C\_STATE\_SENS\_AFL\_PURGE[1]:**

**case "VLS\_DOWN":**

**if (107)**

VLS\_DOWN\_AFL\_PURGE\_OFF

**then (107)** STATE\_AFL\_PURGE[1] = "OFF"

LV\_CAT\_PURGE\_REQ\_POST\_AFL[1] = 0

**endif (107)**

VLS\_DOWN[1] >= C\_

**case "VLS\_NOX\_SENS":**

**if (108)**

C\_VLS\_NOX\_SENS\_AFL\_PURGE\_OFF

**then (108)** STATE\_AFL\_PURGE[1] = "OFF"

LV\_CAT\_PURGE\_REQ\_POST\_AFL[1] = 0

**endif (108)**

VLS\_NOX\_SENS[1] >=

**case "LAMB\_NOX\_SENS":**

**if (109)**

<= C\_LAMB\_NOX\_SENS\_AFL\_PURGE\_OFF

**then (109)** STATE\_AFL\_PURGE[1] = "OFF"

LV\_CAT\_PURGE\_REQ\_POST\_AFL[1] = 0

**endif (109)**

LAMB\_NOX\_SENS[1]

**case "VLS\_NT\_DOWN":**

**if (110)**

C\_VLS\_DOWN\_AFL\_PURGE\_OFF

**then (110)** STATE\_AFL\_PURGE[1] = "OFF"

LV\_CAT\_PURGE\_REQ\_POST\_AFL[1] = 0

**endif (110)**

VLS\_NT\_DOWN[1] >=

**case "NONE":**

--

**end case selection**

STATE\_AFL\_PURGE[2] = STATE\_AFL\_PURGE[1]

LV\_CAT\_PURGE\_REQ\_POST\_AFL[2] = LV\_CAT\_PURGE\_REQ\_POST\_AFL[1]

**else (106)**

% Full 2 branch calculation.

**case selection on C\_STATE\_SENS\_AFL\_PURGE[i]:**

**case "VLS\_DOWN":**

```

    if (111)                                VLS_DOWN[m] >= C_
    VLS_DOWN_AFL_PURGE_OFF
    then (111)    STATE_AFL_PURGE[i] = "OFF"
                  LV_CAT_PURGE_REQ_POST_AFL[i] = 0
    endif (111)

case "VLS_NOX_SENS":
    if (112)                                VLS_NOX_SENS[k] >=
    C_VLS_NOX_SENS_AFL_PURGE_OFF
    then (112)    STATE_AFL_PURGE[i] = "OFF"
                  LV_CAT_PURGE_REQ_POST_AFL[i] = 0
    endif (112)

case "LAMB_NOX_SENS":
    if (113)                                LAMB_NOX_SENS[k] <=
    C_LAMB_NOX_SENS_AFL_PURGE_OFF
    then (113)    STATE_AFL_PURGE[i] = "OFF"
                  LV_CAT_PURGE_REQ_POST_AFL[i] = 0
    endif (113)

case "VLS_NT_DOWN":
    if (114)                                VLS_NT_DOWN[k] >=
    C_VLS_DOWN_AFL_PURGE_OFF
    then (114)    STATE_AFL_PURGE[i] = "OFF"
                  LV_CAT_PURGE_REQ_POST_AFL[i] = 0
    endif (114)

case "NONE":
    --
end case selection
endif (106)

```

Steady state actions:

--

endif (105)

Notes:

1. For detection of a regeneration in catalyst purge the calibration data C\_LAMB\_RGN has to be calibrated always more lean than the calibrated lambda for catalyst purge.
2. C\_NT\_STC\_BAS\_MAX\_RNG\_H should represent the maximum value of the base NOx trap storage capacity map IP\_NT\_STC\_BAS\_RNG\_H. If any changes occur to IP\_NT\_STC\_BAS\_RNG\_H, this constant must be updated manually.

## 7.86.2 NOx catalyst management - request coordination

### 7.86.2.1 Called blocks

#### FUNCTION DESCRIPTION:

These blocks are executed when called

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### 7.86.2.1.1 Filtered exhaust gas flow

#### FUNCTION DESCRIPTION:

##### Application conditions

**Initialisation:**  $FLOW\_NT\_MMV = 0$   
**Recurrence:**  $20\ ms$   
**Activation:** - -  
**Deactivation:** - -

##### Formula section:

$FLOW\_NT\_MMV = FLOW\_NT\_MMV_{(n-1)} * (1 - C\_CRLC\_FLOW\_NT) + MAF\_KGH * C\_CRLC\_FLOW\_NT$

### 7.86.2.1.2 Homogeneous time counter handling

#### FUNCTION DESCRIPTION:

##### Application conditions

**Initialisation:**  $T\_NT\_HOM\_DELTA = 0$   
**Recurrence:** - -  
**Activation:** - -  
**Deactivation:** - -


##### Formula section:

% decrement per 10ms  
**if (46)**  $LV\_HOM\_AFS\_ACT = 1$   
**then (46)**  
    **if (47)**  $LV\_SENS\_AFR\_TRIM = 1$   
    **then (47)**  $T\_NT\_HOM\_DELTA = - IP\_T\_NT\_HOM\_DEC (MAF\_KGH, LAMB\_AV\_COR)$   
    **else (47)**  $T\_NT\_HOM\_DELTA = IP\_T\_NT\_HOM\_INC (MAF\_KGH, LAMB\_AV\_COR)$   
    **endif (47)**  
**else (46)**  $T\_NT\_HOM\_DELTA = 0$   
**endif (46)**

### 7.86.2.2 General, definition of slow flags

#### FUNCTION DESCRIPTION:

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**Formula section:**

```
% definition of flag indicating initialised catalyst state
if (48)      T_NT_HOM = 0
then (48)    LV_NT_HOM_INI = 1
endif (48)
```

**7.86.2.4 General, definition of fast flags**

**FUNCTION DESCRIPTION:**

**General information:**

**This block is executed in any STATE\_NOX except PASSIVE.**

At the beginning of a regeneration phase LV\_TRIG\_AFR\_AFL must be 0. In order to trigger the transition from rich to lean operation the logical value LV\_TRIG\_AFR\_AFL is set to 1 if the NTL becomes lower than C\_NTL\_TRIG\_AFR\_AFL.

Every time when a regeneration phase is finished the value SUM\_NTL\_CYC is incremented by 1. SUM\_NTL\_CYC has to be stored in the nonvolatile memory. SUM\_NTL\_CYC can be set to the specific value C\_SUM\_NTL\_CYC\_SP using the logical constant LC\_SUM\_NTL\_CYC\_NEW.

When either the binary lambda sensor or the NOx sensor indicates a rich exhaust gas downstream NOx trap, the logical variable LV\_SENS\_AFR\_i is set to 1.

The mode of stopping a regeneration can be controlled by C\_STATE\_RGN\_CTL. Thereby, it is possible to stop the regeneration only by the model, only by the sensor signal (LV\_SENS\_AFR) or by either model or sensor. In addition, a stop of regeneration after a constant regeneration time is possible. If a special regeneration (e.g. for adaptation purposes) was requested by LV\_RGN\_REQ\_AD, the stop of the regeneration is forbidden until the adapting module re-enables it.

**Application conditions**


```
Initialisation:      - -
Recurrence:        10ms
Activation:        - -
Deactivation:     - -
```

**Formula section:**

```
% definition of regeneration stop mode
LV_RGN_STOP_SENS = ( LV_RGN_REQ_AD = 0 ) and
                   ( C_STATE_RGN_CTL = SENSOR or
                     C_STATE_RGN_CTL = SENSOR_MODEL )

LV_RGN_STOP_MDL = ( LV_RGN_REQ_AD = 0 ) and
                   ( LV_INH_NT_RGN_STOP_MDL_DIAG[k] = 0
                     % valid if all [k] = 0
                     % condition should be removed at special
                     % case NC_NOX_SENS_CONF = 0
                   ) and
                   ( C_STATE_RGN_CTL = MODEL or
                     C_STATE_RGN_CTL = SENSOR_MODEL or
                     ( LV_VLS_NS_VLD[k] = 0 and
```

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```

        LC_VLS_NS_VLD_RGN_STOP_MDL = 1 )
    )

LV_RGN_STOP_TOUT =      ( LV_RGN_REQ_AD = 0 )

% time counter for regeneration is always active; by selecting C_STATE_RGN_CTL=TIME, all other
% possibilities for stopping the regeneration are switched off

% handling of the cycle counter and over all lean-time-counter
if (49)      LC_SUM_NTL_CYC_NEW = 1
then (49)    SUM_NTL_CYC = C_SUM_NTL_CYC_SP
else (49)

    if (49+)          LV_RGN_NT_REQ = 1      AND

        STATE_NOX = LOAD -> REGENERATION
    then (49+)      T_AFL_SUMn = T_AFL_SUMn-1 + T_AFL
    endif (49+)

endif (49)

% calculation of trigger bit for end of regeneration
if (51)      NTL < C_NTL_TRIG_AFR_AFL
then (51)    LV_TRIG_AFR_AFL=1
endif (51)

if(52a)      LC_SENS_AFR_MOD = 1
then (52a)    call "Rich mode calculation of binary NOx-Senor signal"
else (52a)

    if (53) LV_SENS_AFR_i = 0 or STATE_NOX <> REGENERATION
    then (53)
        case selection on C_STATE_SENS_AFR_i:
            % detection of a rich exhaust gas downstream the NOx trap
            VLS_DOWN:
                LV_SENS_AFR_i = (VLS_DOWN[m] >=
                    ID_VLS_DOWN_RGN_STOP(NTLD_RGN_ST))
            VLS_NOX_SENS:
                if(54)          LV_NOX_SENS_VLS_VLD_k = 0
                                    % if at least one of all _i flags is 0
                then (54) LV_RGN_STOP_MDL=1
                else (54)
                    LV_SENS_AFR_i =
                    (VLS_NOX_SENS_k >= C_VLS_NOX_SENS_RGN_STOP)
                    and          (NOX_NS_AD[k] >= C_NOX_NS_AD_RGN_STOP
                        or          LV_NOX_NS_DIAG_VLD_k = 0)
                endif (54)
            LAMB_NOX_SENS:
                if (55)          LV_NOX_SENS_LAMB_VLD_k = 0
                                    % if at least one of all _i flags is 0
                then (55)      LV_RGN_STOP_MDL=1
            else (55)      LV_SENS_AFR_i = (LAMB_NOX_SENS_k <=
                                    C_LAMB_NOX_SENS_RGN_STOP)
        endif (55)
        VLS_NT_DOWN:

```

```

LV_SENS_AFR_i = (VLS_NT_DOWN_k >=
                  ID_VLS_DOWN_RGN_STOP(NTLD_RGN_ST))
NONE:
    LV_SENS_AFR_i = 0
end case selection
endif (53)
endif (52a)

```

% The homogeneous time counter T\_NT\_HOM is decremented, when the catalyst is operated slightly rich, i.e. the upstream lambda sensor indicates homogeneous mixture and the downstream sensor indicates slightly rich mixture; As the threshold for detecting a slightly rich mixture may be different from the threshold for stopping a regeneration, a separate flag is provided.

**case selection** on C\_STATE\_SENS\_AFR\_TRIM\_i:

VLS\_DOWN:

```
LV_SENS_AFR_TRIM_TMP_i = (VLS_DOWN[m] >= C_VLS_DOWN_AFR_TRIM)
```

VLS\_NOX\_SENS:

```
if (56)    LV_NOX_SENS_VLS_VLD_k = 0           % if at least one of all _k flags is 0
```

```
then (56)    LV_SENS_AFR_TRIM_TMP_i = 0
```

```
else (56)    LV_SENS_AFR_TRIM_TMP_i = (VLS_NOX_SENS_k >=
                                        C_VLS_NOX_SENS_AFR_TRIM)
```

endif (56)

LAMB\_NOX\_SENS:

```
if (57)    LV_NOX_SENS_LAMB_VLD_k = 0           % if at least one of all _k flags is 0
```

```
then (57)    LV_SENS_AFR_TRIM_TMP_i = 0
```

```
else (57)    LV_SENS_AFR_TRIM_TMP_i = (LAMB_NOX_SENS_k <= C_LAMB_NOX_SENS_
AFR_TRIM)
```

endif (57)

VLS\_NT\_DOWN:

```
LV_SENS_AFR_TRIM_TMP_i = (VLS_NT_DOWN_k >= C_VLS_DOWN_AFR_TRIM)
```

NONE:

```
LV_SENS_AFR_TRIM_TMP_i = 0
```

**end case selection**

```
LV_SENS_AFR_TRIM = LV_SENS_AFR_TRIM_TMP_1 and LV_SENS_AFR_TRIM_TMP_2
```

% detection of homogeneous lambda=1 or richer operation

```
if (58)    {(LV_HOM_AFS_REQ = 1)
            or    [(LV_HOM_ACT = 1) and (LV_HOM_AFL_ACT = 0)]}
            and    (LV_PUC_REQ = 0)
```

```
then (58) LV_AFL_NOT = 1
```


```
else (58)    LV_AFL_NOT = 0
```

endif (58)

#### 7.86.2.4.1 Rich mode calculation of binary NOx-Sensor signal

#### FUNCTION DESCRIPTION:

#### General information:

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### 7.86.3 Rich mode calculation of binary NOx-Sensor signal (named NOXY\_VL-SAFCLC110 in Figure 10)

The function sets the status flag LV\_SENS\_AFR\_1 to rich mode and parallel sets the end of first regeneration flag LV\_SENS\_RGN\_1\_READY when the binary NOx-Sensor signal goes up for the first time over a threshold and sets the status flag LV\_SENS\_AFR\_2 to rich mode in three ways (see Figure 9 below):

- a) when the same binary signal goes up for the second time over a threshold (see Figure 9a).
- b) when the binary NOx-Sensor signal goes for the first time over the threshold, then it goes not down enough and finally goes up (see Figure 9b).
- c) when the binary NOx-Sensor signal goes for the first time over the threshold and then goes not down and the maximal time is over (see Figure 9c).

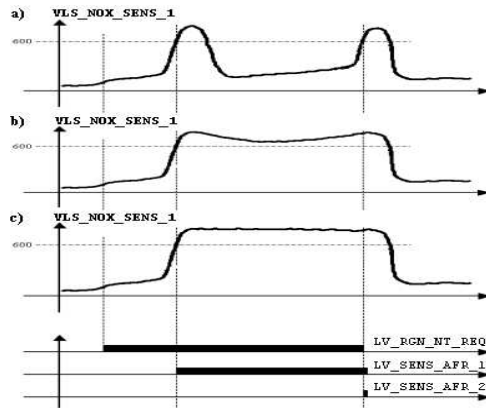



Figure 9: Signals during a NOx regeneration

This specification is special designed for systems with two banks (including two NOx-Traps) and Y-configuration of the exhaust gas system.

#### Description:

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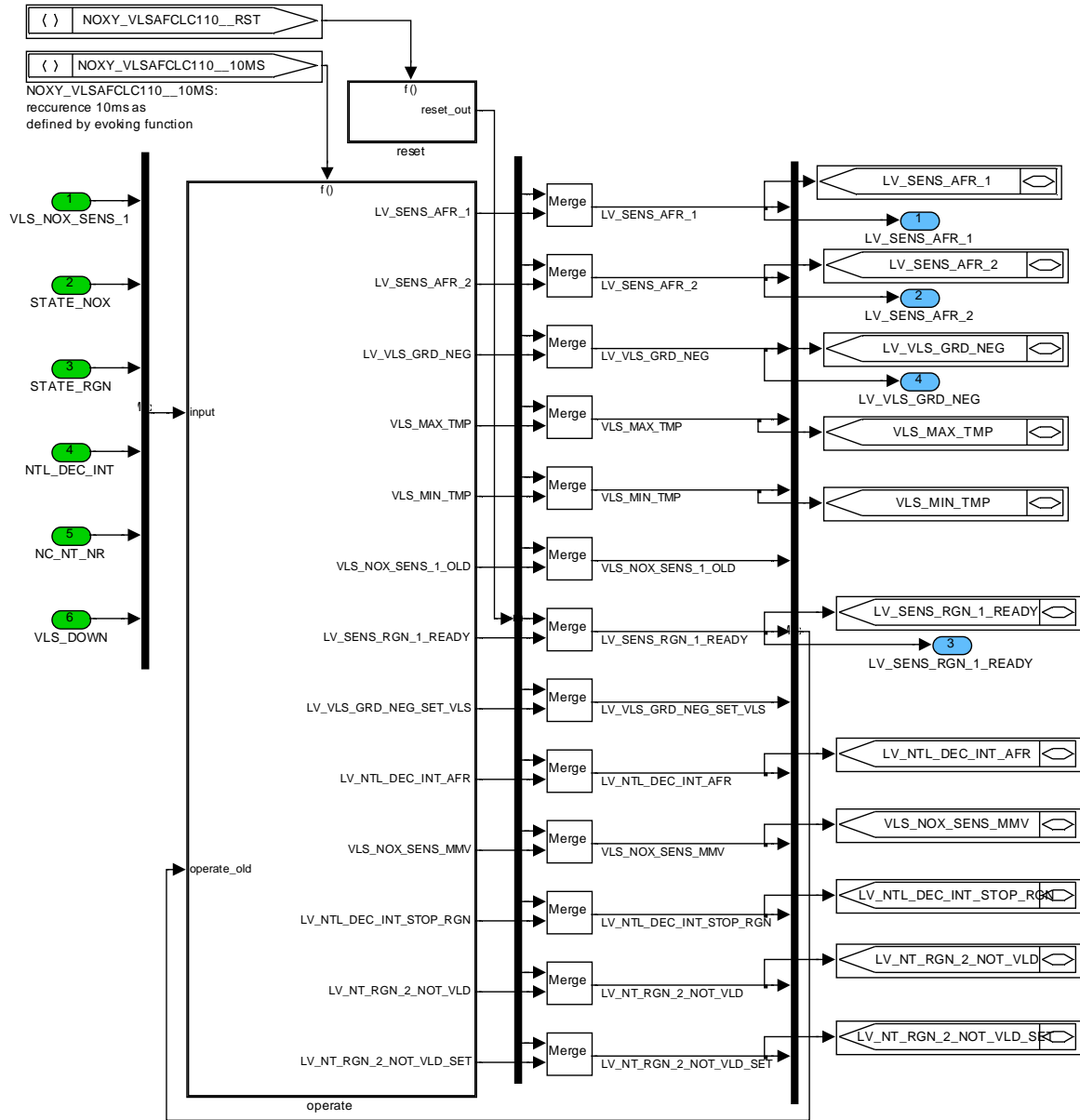


Figure 7.86.9: : NOXM\_VLSAFCLC

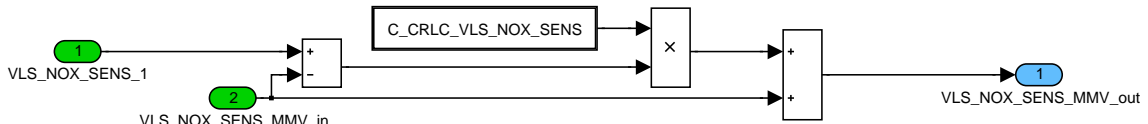


Figure 7.86.10: NOXM\_VLSAFCLC/OPERATE/CRLC

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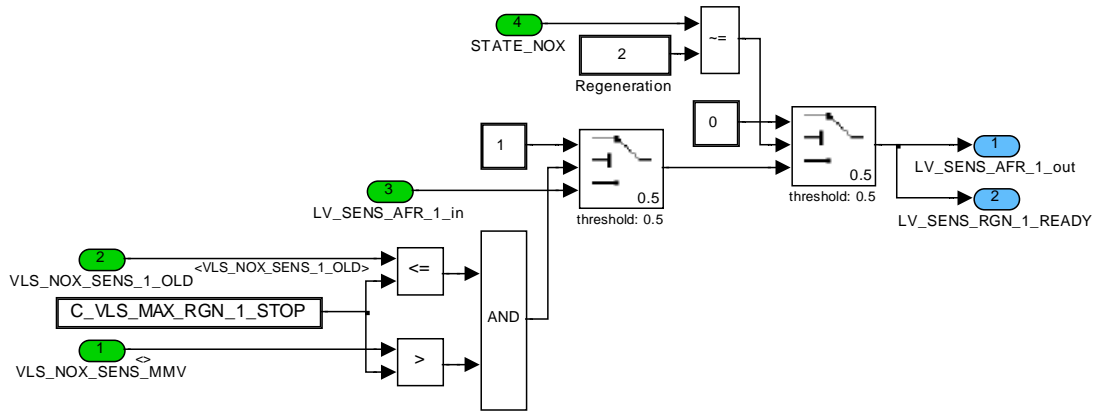


Figure 7.86.11: NOXM\_VLSAFCLC/operate/SENS\_AFR\_1

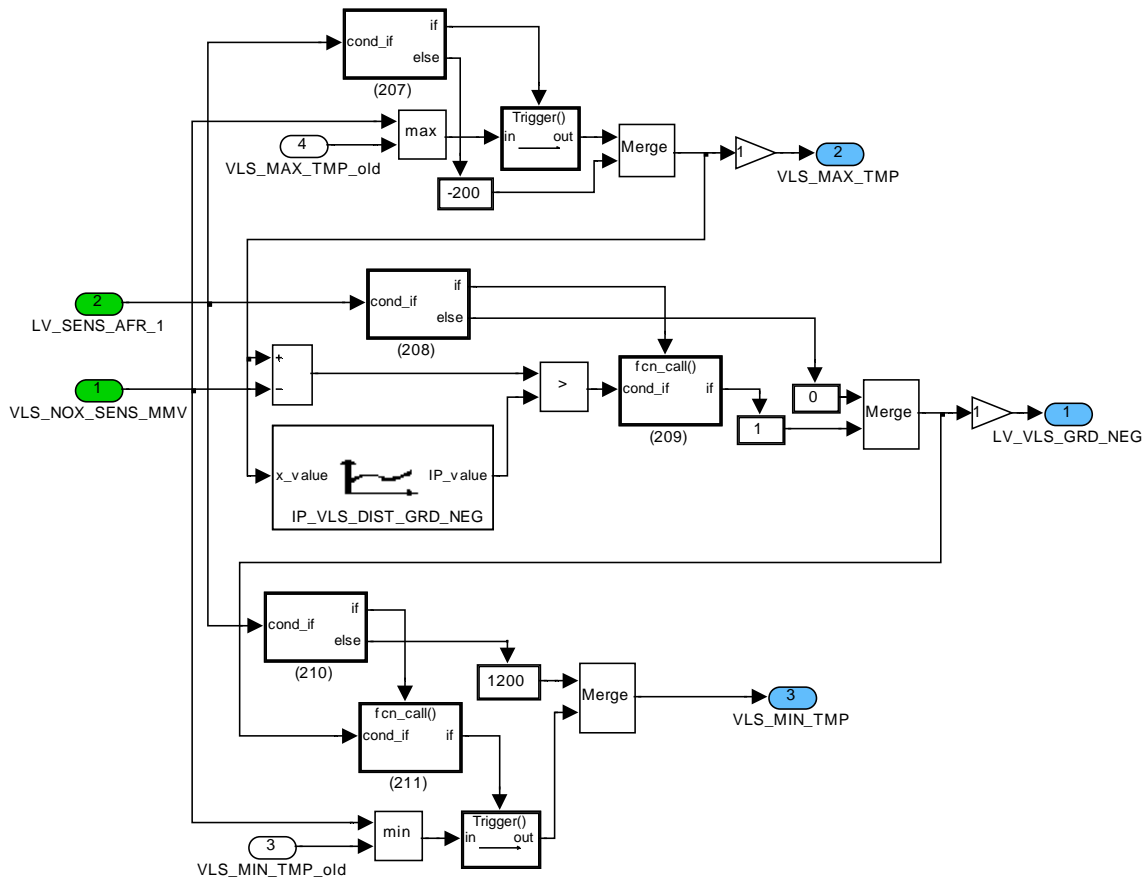


Figure 7.86.12: NOXM\_VLSAFCLC/operate/GRD\_CLC

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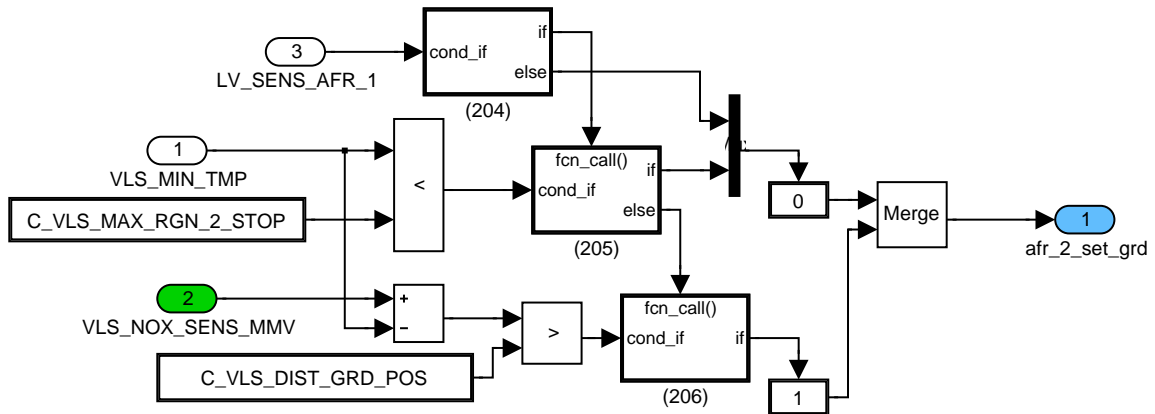


Figure 7.86.13: NOXM\_VLSAFCLC/operate/AFR\_2\_SET\_GRD

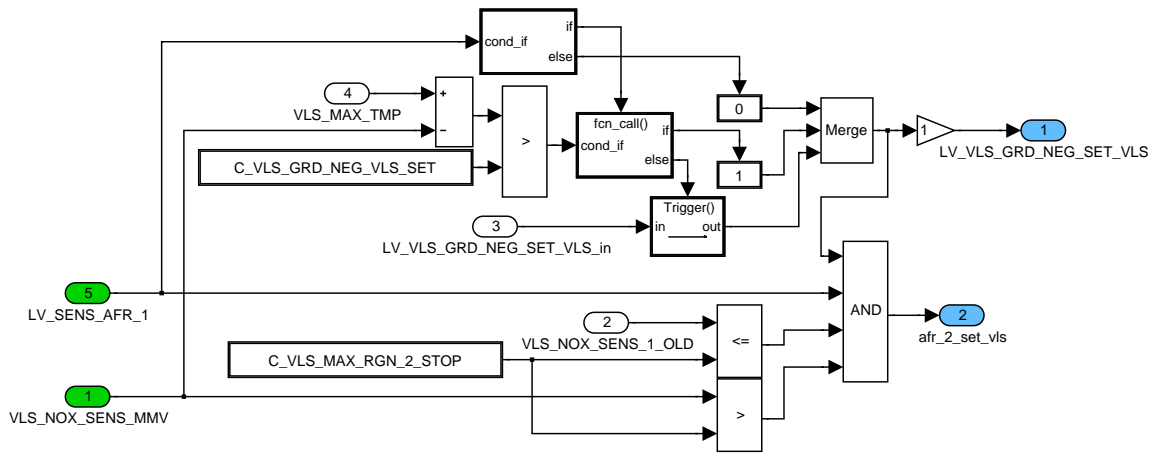
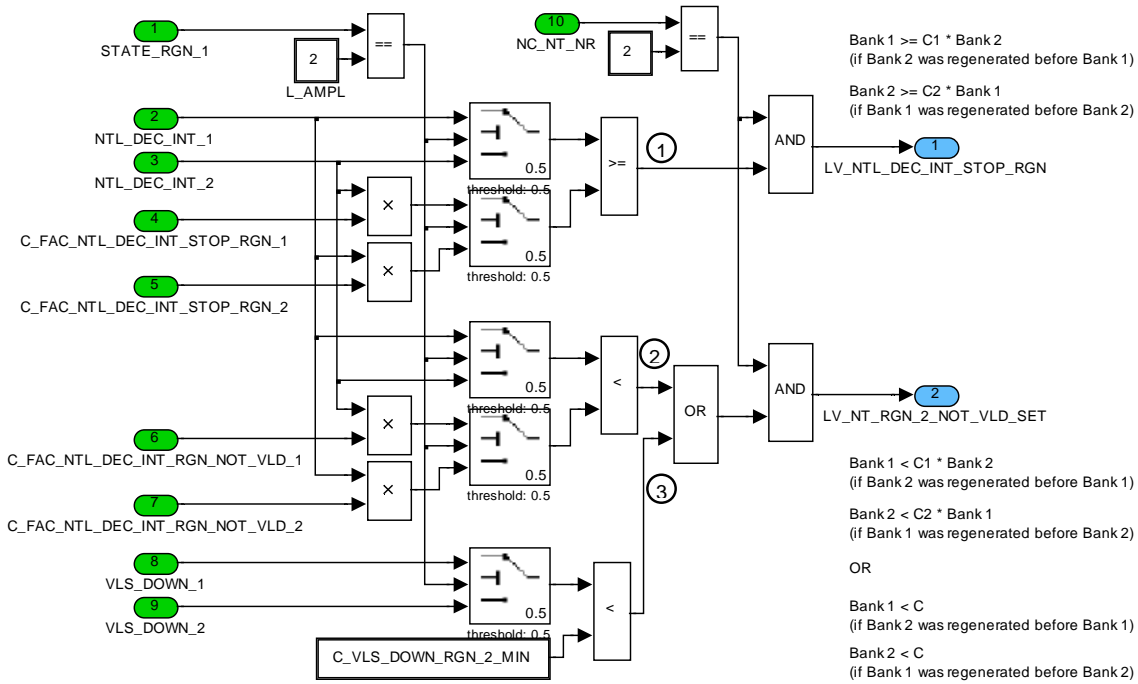


Figure 7.86.14: NOXM\_VLSAFCLC/operate/AFR\_2\_SET\_VLS

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Fo

r NC\_NT\_NR = 1 the variables NTL\_DEC\_INT\_2, C\_FAC\_NTL\_DEC\_INT\_STOP\_RGN\_2 and C\_FAC\_NTL\_DEC\_INT\_RGN\_NOT\_VLD\_2 are not defined. In this case use as substitute the variables NTL\_DEC\_INT\_1, C\_FAC\_NTL\_DEC\_INT\_STOP\_RGN\_1 and C\_FAC\_NTL\_DEC\_INT\_RGN\_NOT\_VLD\_1.  
 Figure 16 NOXM\_VLSAFCLC/operate/NTL\_DEC\_INT\_THD

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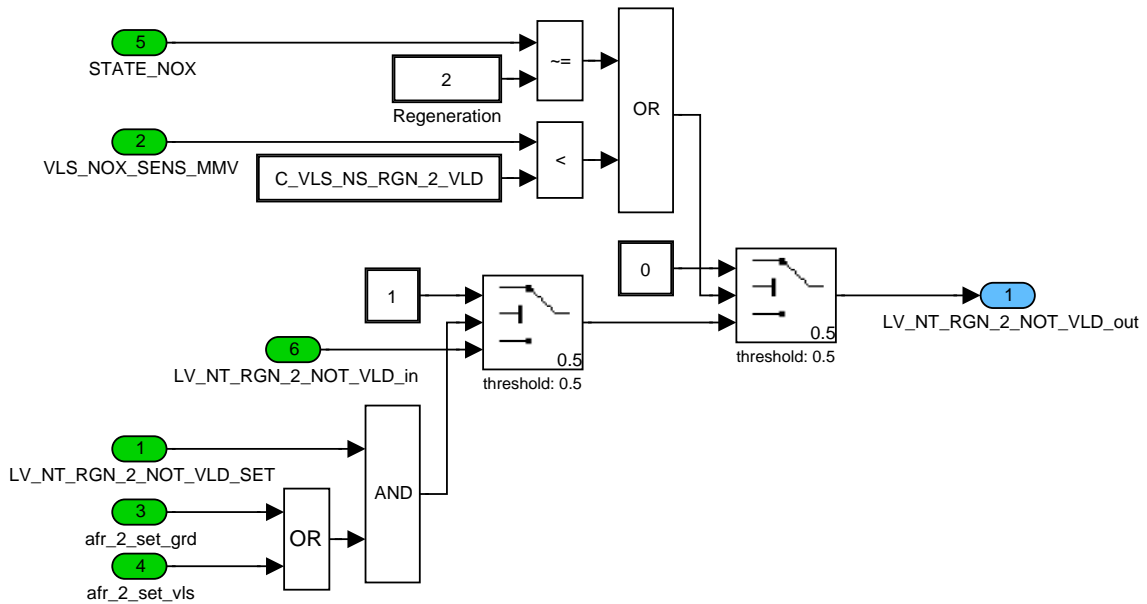


Figure 7.86.15: NOXM\_VLSAFCLC/operate/RGN\_NOT\_VLD

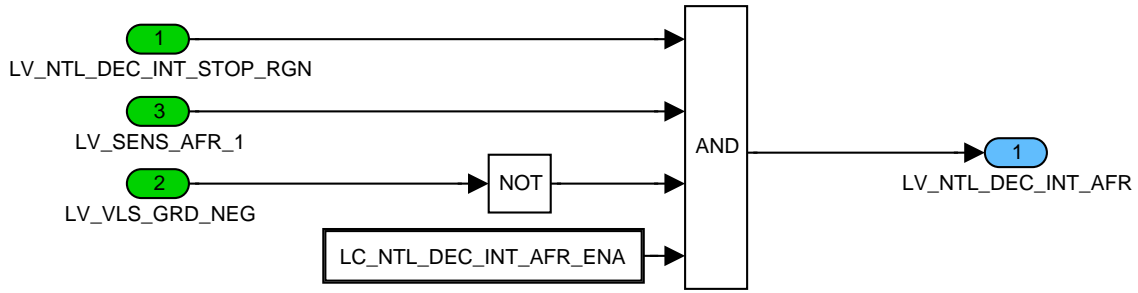
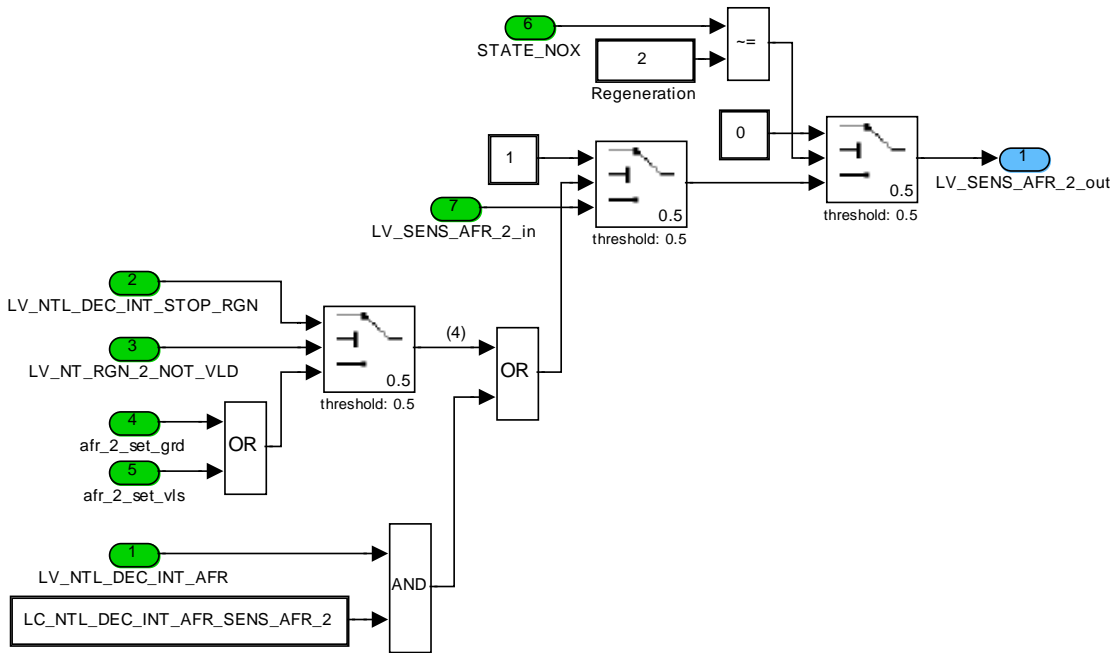


Figure 7.86.16: NOXM\_VLSAFCLC/operate/NTL\_DEC\_INT\_AFR



LV\_SENS\_AFR\_2 will only be calculated if NC\_NT\_NR = 2  
Figure 19 NOXM\_VLSAFCLC/operate/SENS\_AFR\_2

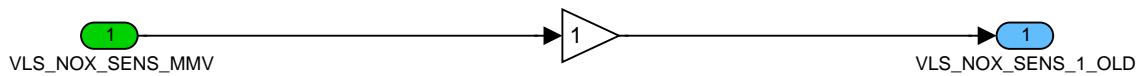


Figure 7.86.17: NOXM\_VLSAFCLC/operate/OLD

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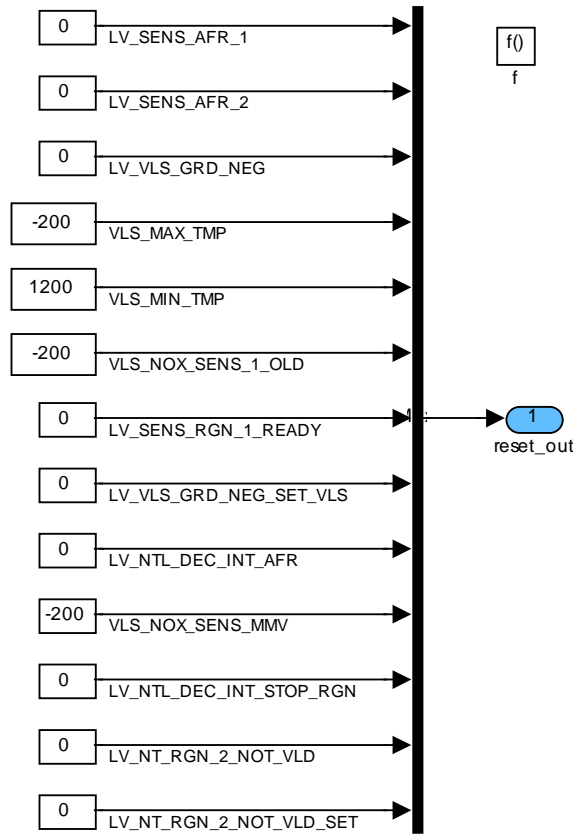


Figure 7.86.18: NOXM\_VLSAFCLC/RESET

### 7.86.3.1 Request of a regeneration phase

#### FUNCTION DESCRIPTION:

##### General information:

##### **This block is executed in STATE\_NOX = LOAD**

A request of a regeneration of the NOx catalyst can be made by the following conditions:


- |   |                     |
|---|---------------------|
| 1. from the model by a high loading degree          | LV_RGN_REQ_NTLD     |
| 2. by the signal of the post-trap NOx-Sensor        | LV_RGN_REQ_NOX_SENS |
| 3. before switching to lambda=1 or richer operation | LV_RGN_REQ_AFS      |
| 4. by the diagnosis /adaptation module              | LV_RGN_REQ_AD       |

In order to guarantee a minimum duration of the lean phase the value IP\_T\_AFL\_MIN has to be exceeded by the counter T\_AFL before any regeneration request can be set.

In order to limit the regeneration frequency, T\_AFL has to exceed C\_T\_AFL\_RGN\_REQ\_NTLD before a regeneration request can be made by the loading degree model.

After a regeneration it is prohibited to generate a new regeneration request by the NOx sensor (LV\_RGN\_REQ\_NOX\_SENS\_TMP\_i = 1) for the time C\_T\_NOX\_SENS\_VLD. The time C\_T\_NOX\_SENS\_

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VLD is controlled by the timer T\_AFL. T\_AFL has to exceed C\_T\_NOX\_SENS\_VLD before a regeneration can be requested by the NOx sensor.

In case of active auxiliary functionalities module, a regeneration request by the loading degree model or by the NOx sensor may be inhibited by the flag LV\_INH\_RGN\_AD.

When switching from lean conditions to lambda=1 or richer operation a regeneration can be required. The request of this regeneration phase depends on the maximum NOx-trap loading degree for stoichiometric operation IP\_NTLD\_MAX\_AFS\_MT /IP\_NTLD\_MAX\_AFS\_AT. The check for this maximum loading degree for stoichiometric operation is carried out ever when switching to homogeneous Lambda=1 or richer engine operation which should be indicated by LV\_AFL\_NOT=1.

A regeneration can only be requested if various conditions for allowing a regeneration are fulfilled. In this case, the logical variable LV\_RGN\_CDN is set to 1.

**Signal flow diagram:**

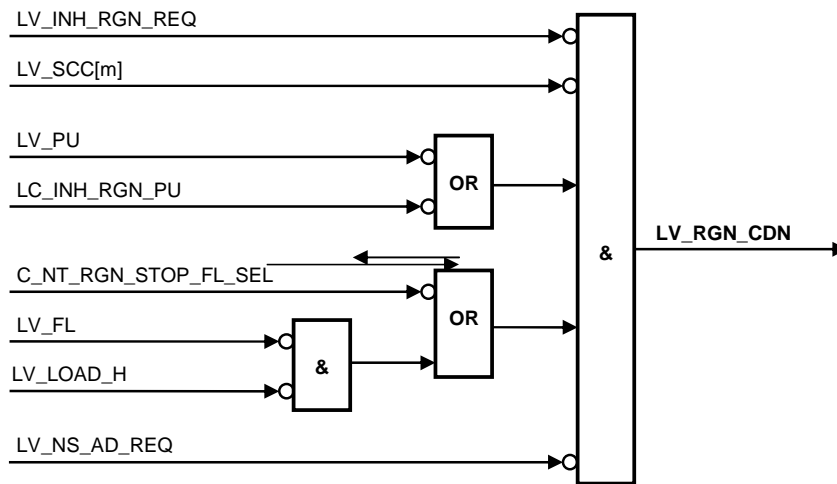


Figure 7.86.19: : determination of regeneration conditions

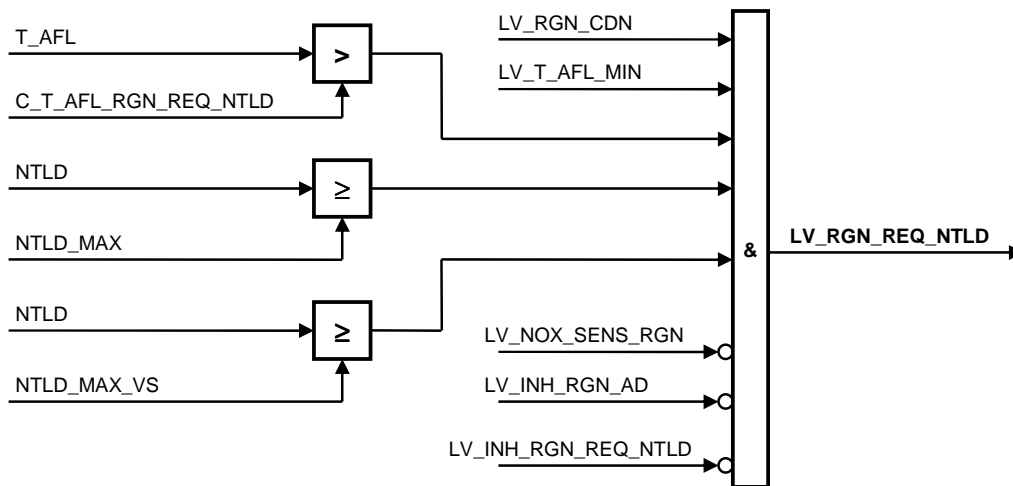


Figure 7.86.20: : regeneration request due to modelled loading degree

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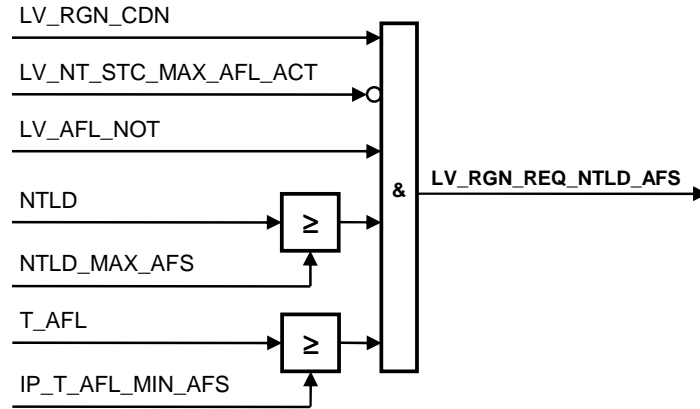


Figure 7.86.21: : regeneration request due to a transition to non-lean operation

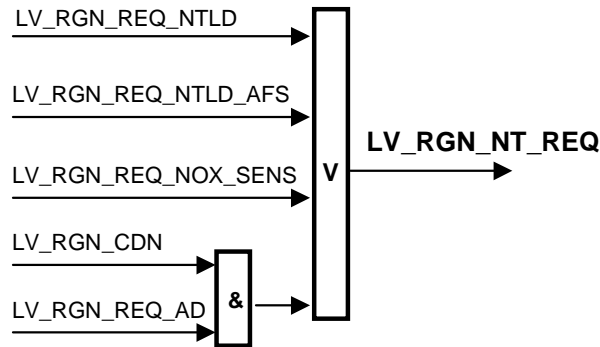


Figure 7.86.22: : central regeneration request

### Application conditions

**Initialisation:** - -  
**Recurrence:** 20ms  
**Activation:** - -  
**Deactivation:** - -

### Formula section:

```


if(59)    LV_RGN_NT_REQ = 0
then (59)    call 1.2.5.1 calculation of the sub-requests
endif (59)
    
```

// final regeneration request

```

LV_RGN_NT_REQ =
    [LV_RGN_REQ_NTLD = 1
    or    (LV_RGN_REQ_NOX_SENS = 1)
    or    (LV_RGN_REQ_AD = 1 and LV_RGN_CDN = 1)
    or    LV_RGN_REQ_NTLD_AFS = 1]
    
```

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### 7.86.3.1.1 Calculation of the sub-requests

% calculation of maximum loading degree for a model based regeneration

% (position changed)

**if (61)** LV\_NTLD\_ADJ = 1

**then (61)**

**if (131)** LV\_AT = 1

**then (131)** NTLD\_MAX = IP\_NTLD\_MAX\_ADJ\_AT (TQI\_REQ\_FAST, N\_32)

**else (131)** NTLD\_MAX = IP\_NTLD\_MAX\_ADJ\_MT (TQI\_REQ\_FAST, N\_32)

**endif (131)**

**else (61)**

**if (132)** LV\_AT = 1

**then (132)** NTLD\_MAX = IP\_NTLD\_MAX\_AT (TQI\_REQ\_FAST, N\_32)

**else (132)** NTLD\_MAX = IP\_NTLD\_MAX\_MT (TQI\_REQ\_FAST, N\_32)

**endif (132)**

**endif (61)**

**if (133)** LV\_AT = 1

**then (133)** NTLD\_MAX\_VS = IP\_NTLD\_MAX\_VS\_AT (VS, NT\_AGI\_S\_RED)

**else (133)** NTLD\_MAX\_VS = IP\_NTLD\_MAX\_VS\_MT (VS, NT\_AGI\_S\_RED)

**endif (133)**

% general conditions for a regeneration

**if (62)** (LV\_INH\_RGN\_REQ = 0)

**and** (LV\_SCC[m] = 0)

**and** (LV\_PU = 0 **or** LC\_INH\_RGN\_PU = 0)

**and** ( (LV\_FL = 0 **and** LV\_LOAD\_H = 0) **or** C\_NT\_RGN\_STOP\_FL\_SEL = 0)

**and** (LV\_NS\_AD\_REQ = 0)

**then (62)** LV\_RGN\_CDN = 1

**else (62)** LV\_RGN\_CDN = 0

**endif (62)**

% minimum lean time condition

**if (127)** LV\_NT\_RGN\_STOP\_PUC = 0

**then (127)** LV\_T\_AFL\_MIN = (T\_AFL >= IP\_T\_AFL\_MIN(VS))

**else (127)** LV\_T\_AFL\_MIN =

(T\_AFL >= IP\_T\_AFL\_MIN\_NT\_RGN\_STOP(VS))

**endif (127)**

NOx sensor threshold calculation:

**if (63)** LV\_AT = 1

**then (63)** NOX\_SENS\_MAX\_BAS = IP\_NOX\_SENS\_MAX\_AT (FLOW\_NT\_MMV, N\_32)

**else (63)** NOX\_SENS\_MAX\_BAS = IP\_NOX\_SENS\_MAX\_MT (FLOW\_NT\_MMV, N\_32)

**endif (63)**

**if (64)** LV\_NOX\_SENS\_MAX\_ADJ = 0

**then (64)** NOX\_SENS\_MAX = NOX\_SENS\_MAX\_BAS\*


IP\_FAC\_NOX\_SENS\_MAX (NT\_AGI\_S\_RED, TNT\_MDL\_MV)

**else (64)** NOX\_SENS\_MAX = NOX\_SENS\_MAX\_BAS + C\_NOX\_SENS\_MAX\_OFS

**endif (64)**

% regeneration request by NOx sensor signal

**if (65)** LV\_RGN\_CDN = 1

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```

    and LV_T_AFL_MIN = 1
    and LV_NOX_SENS = 1
    and LV_T_NS_VLD = 1                % NOx sensor readiness
    and LV_INH_RGN_REQ_NOX_SENS = 0
    and LV_INH_RGN_AD = 0
    and (LV_HOM_AFS_REQ = 0 and (LV_S_ACT = 1 or LV_HOM_AFL_ACT = 1))
then (65)    call NOx sensor based regeneration request          (see next page)
else (65)    LV_RGN_REQ_NOX_SENS = 0
endif (65)

```

% regeneration request by modelled loading degree

```

LV_RGN_REQ_NTLD =
  [LV_RGN_CDN = 1
  and LV_T_AFL_MIN = 1
  and T_AFL > C_T_AFL_RGN_REQ_NTLD
  and NTLD >= NTLD_MAX
  and NTLD >= NTLD_MAX_VS
  and LV_NOX_SENS_RGN = 0            % rgn req only by NOx sensor
  and LV_INH_RGN_AD = 0
  and LV_INH_RGN_REQ_NTLD = 0]

```

% regeneration request before switching to lambda=1.0 operation

```

if (66)      LV_AT = 1
then (66)    NTLD_MAX_AFS_BAS = IP_NTLD_MAX_AFS_AT (TQI_REQ_FAST, N_32)
else (66)    NTLD_MAX_AFS_BAS = IP_NTLD_MAX_AFS_MT (TQI_REQ_FAST, N_32)
endif (66)

```

```

if (67)      LV_ERR_EGR_2 = 1
then (67)    NTLD_MAX_AFS = NTLD_MAX_AFS_BAS*C_FAC_NTLD_MAX_AFS_ERR_EGR
else (67)    NTLD_MAX_AFS = NTLD_MAX_AFS_BAS
endif (67)

```

```


if (68)      LC_NTLD_MAX_AFS = 1
then (68)    LV_RGN_REQ_NTLD_AFS =
              [LV_RGN_CDN = 1
              and T_AFL >= IP_T_AFL_MIN_AFS(VS)
              and LV_AFL_NOT = 1
              and NTLD >= NTLD_MAX_AFS
              and LV_NT_STC_MAX_AFL_ACT = 0]
else (68)    LV_RGN_REQ_NTLD_AFS =
              [LV_RGN_CDN = 1
              and T_AFL >= IP_T_AFL_MIN_AFS(VS)
              and LV_AFL_NOT = 1
              and NTLD_MDL >= NTLD_MAX_AFS
              and LV_NT_STC_MAX_AFL_ACT = 0]
endif (68)
end

```

### 7.86.3.1.2 NOx sensor based regeneration request

This block is executed when called

#### General information:

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If the system has only 1 cylinder bank then the variable LV\_RGN\_REQ\_NOX\_SENS\_TMP\_1 generates directly the value of the logical variable LV\_RGN\_REQ\_NOX\_SENS.

If the system is equipped with 2 cylinder banks, a regeneration request is set LV\_RGN\_REQ\_NOX\_SENS = 1, if at least one cylinder bank requests a regeneration LV\_RGN\_REQ\_NOX\_SENS\_TMP\_i = 1.

With LV\_NOX\_SENS\_NOX\_VLD\_k is indicated that the signal NOX\_NS\_AD[k] is valid. In this case NOX\_NS\_AD[k] can be used for the generation of a regeneration request. Otherwise the regeneration request can not be generated by using NOX\_NS\_AD[k].

A NOx regeneration request can be generated by different methods. These are:

- the NOx concentration, which is measured downstream of NOx catalyst, exceeds a threshold
- the downstream measured NOx integral exceeds a threshold
- the ratio of downstream measured NOx integral to mileage exceeds a threshold
- the ratio of downstream measured NOx integral to upstream modelled NOx integral exceeds a threshold

Recurrence: called by superior chapter

**Signal flow diagram:**

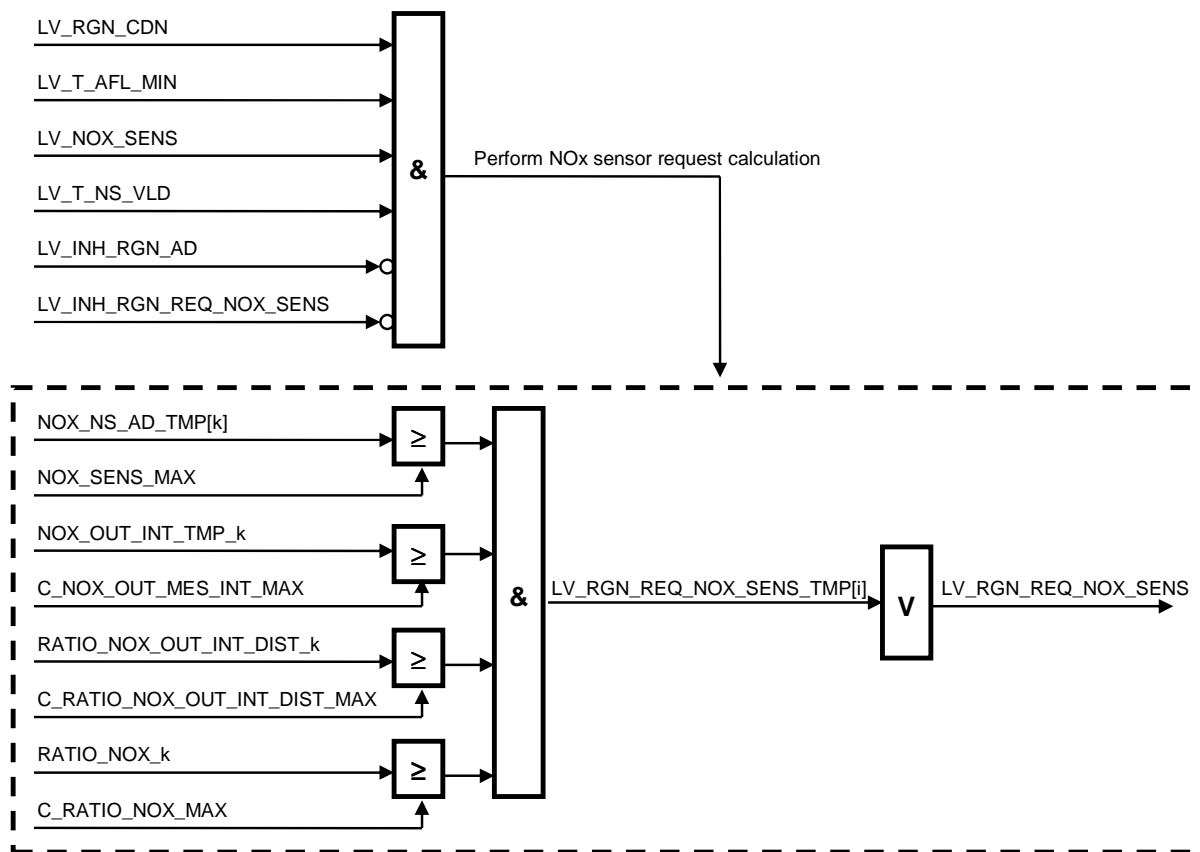



Figure 7.86.23: : Request of a catalyst regeneration by NOx sensor signal

**Formula section:**

**If (69)**            LC\_NOX\_MDL\_CTRL\_ACT = 1  
**and**              LV\_INH\_NOX\_MDL\_CTRL\_RGN = 0

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```

    and | NOX_CONC_OUT_MDL_MMV - NOX_NS_AD[k] | <= C_NOX_NS_AD_DIF_MON
        % NOX_NS_AD[k] separately treated
    then (69)    NOX_NS_AD_TMP[k] = NOX_CONC_OUT_MDL_MMV
                NOX_OUT_INT_TMP_k = NOX_OUT_MDL_INT
    else (69) if (70)    LV_NOX_SENS_NOX_VLD_k = 1
        then (70)    NOX_NS_AD_TMP[k] = NOX_NS_AD[k]
                    NOX_OUT_INT_TMP_k = NOX_OUT_MES_INT_k
        else (70)    NOX_NS_AD_TMP[k] = 0
                    NOX_OUT_INT_TMP_k = 0
    endif (70)
endif (69)

DIST_AFL = (DIST - DIST_AFL_ST)
if (89)    DIST_AFL > C_DIST_AFL_MIN
then (89)    RATIO_NOX_OUT_INT_DIST_k = NOX_OUT_INT_TMP_k /DIST_AFL
else (89)    RATIO_NOX_OUT_INT_DIST_k = 0
endif (89)

if (90)    NOX_COR_INT > C_NOX_COR_INT_MIN
then (90)    RATIO_NOX_k = (NOX_OUT_INT_TMP_k /NOX_COR_INT) * 100%
else (90)    RATIO_NOX_k = 0
endif (90)

if (71)    NOX_NS_AD_TMP[k] >= NOX_SENS_MAX
    and    NOX_OUT_INT_TMP_k >= C_NOX_OUT_MES_INT_MAX
    and    RATIO_NOX_OUT_INT_DIST_k >= C_RATIO_NOX_OUT_INT_DIST_MAX
    and    RATIO_NOX_k >= C_RATIO_NOX_MAX
then (71)    LV_RGN_REQ_NOX_SENS_TMP_i = 1
endif (71)

if (72)    LV_RGN_REQ_NOX_SENS_TMP[1] = 1        or
            LV_RGN_REQ_NOX_SENS_TMP[2] = 1
then (72)    LV_RGN_REQ_NOX_SENS = 1
            LV_NOX_SENS_NOX_VLD_RGN_ST_i = LV_NOX_SENS_NOX_VLD_k
            % both ..rgn_st_i flags have to be frozen if the common request is set
endif (72)

```

### 7.86.3.2 Request of a NOx catalyst purge

#### FUNCTION DESCRIPTION:


#### General information:

#### **This block is executed in STATE\_NOX = LOAD**

If there is no request for a regeneration before switching from lean burn condition to lambda=1 or richer mixture a NOx catalyst purge request is set dependent on the amount of stored NOx and O2 (NTL + O2L). The request is reset under the same conditions a regeneration is reset **or** when lambda exceeds C\_LAMB\_RGN.

The check for setting the request is only to be carried out if the request is yet unset.

LV\_ACT\_INT\_PUC\_AFL is passed to the *catalyst enrichment function (cat-purge function for continuous lambda control)* where a displacement of the lambda-controller setpoint will be done.

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**Signal flow diagram:**

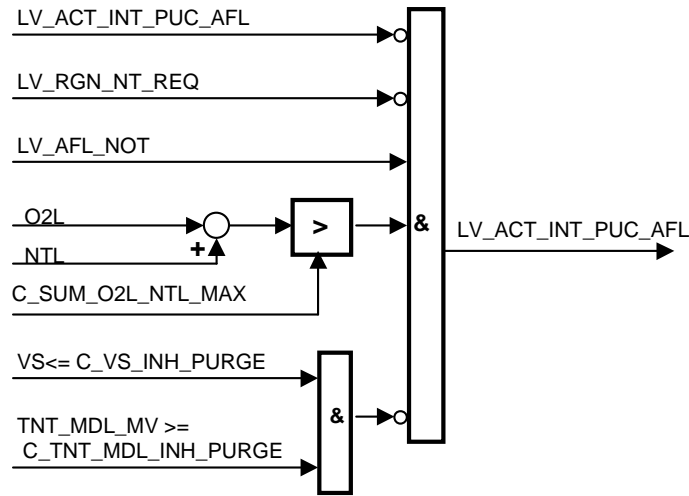


Figure 7.86.24: : request of a catalyst purge

**Application conditions**

**Initialisation:** - -  
**Recurrence:** 20ms  
**Activation:** - -  
**Deactivation:** - -

**Formula section:**

```

if (74)                                LV_ACT_INT_PUC_AFL_i = 0      and
separately treated
    LV_RGN_NT_REQ = 0                    and
    LV_AFL_NOT = 1                        and
    (O2L + NTL) > C_SUM_O2L_NTL_MAX      and
    LV_NT_STC_MAX_AFL_ACT = 0            and
    not (VS <= C_VS_INH_PURGE            and
        TNT_MDL_MV >= C_TNT_MDL_INH_PURGE) and
    VS <= C_VS_PURGE_REQ_MAX              and
    TNT_MDL_MV <= C_TNT_MDL_PURGE_REQ_MAX and
then (74)                                LV_ACT_INT_PUC_AFL_i = 1
    LV_CAT_PURGE_REQ_POST_AFL[i] = 1
else (74)
    if (130)                                LV_CAT_PURGE_REQ_POST_AFL[i] = 1      and
        LV_AFL_NOT = 0
    then (130)                                LV_ACT_INT_PUC_AFL_i = 0
        LV_CAT_PURGE_REQ_POST_AFL[i] = 0
    endif (130)
endif (74)
    
```

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### 7.86.3.3 Reset of regeneration and purge requests

#### FUNCTION DESCRIPTION:

#### General information:

#### **This block is executed in STATE\_NOX = REGENERATION**

A regeneration phase is stopped under the following conditions:

1. The modelled loadings of NOx and O2L both fall below a threshold
2. All downstream sensors detect a rich mixture LV\_SENS\_AFR
3. A constant time period is exceeded
4. an engine state with higher priority is activated. These higher prior engine states can be fuel cut-off (PUC) or full load (FL).

The regeneration stopping conditions are valid under the following circumstances:

1. A stop out of the model is possible if LV\_RGN\_STOP\_MDL is set to 1.
2. A stop by the sensor signal is possible if LV\_RGN\_STOP\_SENS is set to 1.
3. A stop by the time counter is possible if LV\_RGN\_STOP\_TOUT is set to 1.
4. Also a combination of sensor stop and model stop is possible.

The priority of the engine states fuel cut-off (PUC) and full load (FL) in relation to a running NOx regeneration are selectable by C\_NT\_RGN\_STOP\_PUC\_SEL and C\_NT\_RGN\_STOP\_FL\_SEL. It can be chosen:


C\_NT\_RGN\_STOP\_PUC\_SEL =

- 0 ... the NOx catalyst control functionality does not react on the engine state fuel cut-off (PUC)
- 1 ... a running NOx regeneration is broken, when the air mass flow at PUC exceeds a threshold;  
the minimum duration of next "LOAD" phase is defined by IP\_T\_AFL\_MIN\_NT\_RGN\_STOP
- 2 ... a running NOx regeneration is broken, when the air mass flow at PUC exceeds a threshold and the clutch is closed;  
the minimum duration of next "LOAD" phase is defined by IP\_T\_AFL\_MIN\_NT\_RGN\_STOP

C\_NT\_RGN\_STOP\_FL\_SEL =

- 0 ... the NOx catalyst control functionality does not react on the engine state full load or a high engine load near full load.
- 1 ... new NOx regeneration requests are inhibited up to the end of full load phase or high engine load phase;  
a running NOx regeneration is broken, when the air mass flow at full load exceeds a threshold;  
the minimum duration of next "LOAD" phase is defined by IP\_T\_AFL\_MIN
- 2 ... new NOx regeneration requests are inhibited up to the end of full load phase or high engine load phase;  
a running NOx regeneration is broken, when the air mass flow at full load exceeds a threshold;  
the minimum duration of next "LOAD" phase is defined by IP\_T\_AFL\_MIN\_NT\_RGN\_STOP
- 3 ... new NOx regeneration requests are inhibited up to the end of full load phase or high engine load phase;  
a running NOx regeneration is not broken

Calibration hint:

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```

        LV_NTL_DEC_INT_AFR          % stop from NTL_DEC_INT
        ratio

then (79)          LV_RGN_CDN          = 0
        LV_RGN_REQ_NTLD          = 0
        LV_RGN_REQ_NTLD_AFS          = 0
        LV_RGN_REQ_NOX_SENS_TMP[i]          = 0          % reset all
[i] requests
        LV_RGN_REQ_NOX_SENS          = 0
        O2L          = 0
        LV_RGN_NT_REQ          = 0
        LV_ACT_INT_PUC_AFL_i          = 0          % reset all [i] requests
        NTL          = NTL_MIN
        NTL_H          = NTL_MIN
        LV_NT_RGN_STOP_PUC          = 0

endif (79)

if (126) ( C_NT_RGN_STOP_PUC_SEL = 1          AND
        LV_PUC = 1 AND
        MAF_INT_PUC_ACT(n-1) < MAF_INT_PUC_ACT(n) AND
        MAF_INT_PUC_ACT(n) >= C_MAF_INT_PUC_RGN_STOP_MIN ) OR
        ( C_NT_RGN_STOP_PUC_SEL = 2          AND
        LV_CLU_SWI = 0          AND
        LV_PUC = 1          AND
        MAF_INT_PUC_ACT(n-1) < MAF_INT_PUC_ACT(n)          AND
        MAF_INT_PUC_ACT(n) >= C_MAF_INT_PUC_RGN_STOP_MIN )          OR
        ( LC_NT_RGN_STOP_IS = 1          AND
        LV_IS = 1          AND
        T_IS >= C_T_IS_RGN_STOP_MIN )          OR

        ( C_NT_RGN_STOP_FL_SEL = 2          AND
        ( LV_FL = 1 or LV_LOAD_H = 1 )          AND
        MAF_INT_FL_ACT >= C_MAF_INT_FL_RGN_STOP_MIN )
        % Calibration remark: Consider failure reaction on open wire at clutch switch circuit!


then (126)          % break off NOx regeneration because of higher priority of PUC
        LV_RGN_CDN          = 0
        LV_RGN_REQ_NTLD          = 0
        LV_RGN_REQ_NTLD_AFS          = 0
        LV_RGN_REQ_NOX_SENS_TMP[i]          = 0          % reset all
[i] requests
        LV_RGN_REQ_NOX_SENS          = 0
        LV_RGN_NT_REQ          = 0
        LV_ACT_INT_PUC_AFL_i          = 0          % reset
        all [i] requests
        LV_NT_RGN_STOP_PUC          = 1
        if (128)          LC_NT_RGN_STOP_INI_NTL_O2L = 1
        then (128)          NTL          = NTL_MIN
        NTL_H          = NTL_MIN
        O2L          = 0
        else (128)          NTL          = NTL(n-1)
        NTL_H          = NTL_H(n-1)
        O2L          = O2L(n-1)

        endif (128)

endif (126)

```

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```

if (116)                                NC_NT_NR = 2 and LC_SENS_AFR_MOD = 1
then (116)
    if (117)          LV_SENS_AFR_1 = 1
    then (117)          LV_ACT_INT_PUC_AFL_1 = 0
                        LV_ACT_INT_PUC_AFL_2 = 0
                        LV_CAT_PURGE_REQ_POST_AFL[1] = 0
                        LV_CAT_PURGE_REQ_POST_AFL[2] = 0
    endif (117)
else (116)
    if (118)                                LV_SENS_AFR_i = 1
    then (118)          LV_ACT_INT_PUC_AFL_i = 0
                        LV_CAT_PURGE_REQ_POST_AFL[i] = 0
    endif (118)
endif (116)

```

### 7.86.3.4 Request of lambda =1 operation

#### FUNCTION DESCRIPTION:

##### General information:

**This block is executed in any STATE\_NOX except PASSIVE.**

Depending on various conditions the lean operation of the engine can be forbidden using LV\_NT\_AFS\_REQ. This flag is an input to the combustion manager. There, it forces the combustion manager to switch to lambda=1 homogeneous mode.

All conditions leading to stoichiometric homogeneous operation of all modules of the NOx trap functions (including NOx catalyst aging and NOx catalyst desulfation) are handled by this subroutine in order to get only one flag as interface to the combustion manager. These conditions are:

1. catalyst temperature too high
2. catalyst temperature too low
3. aging state too bad
4. desulfation introduced
5. other reasons considered in the corresponding application incidences module

#### Application conditions

**Initialisation:**                   at reset:

```


TNT_MDL_MAX = 0
TNT_MDL_MIN = 0
LV_NT_AFS_REQ_PRED = 0
T_NT_AFS_REQ_PRED = 0
TQI_MMV_NOX = 0
VS_MMV_NOX = 0
VS_DIF_NOX = 0
VS_DIF_THD = 0
VS_DIF_HYS = 0

```

**Recurrence:**                    100 ms

**Activation:**                    -- --

**Deactivation:**                 -- --

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**Formula section:**

$TQI\_MMV\_NOX(n) = TQI\_AV * C\_CRLC\_TQI\_MMV\_NOX +$   
 $TQI\_MMV\_NOX(n-1) * (1 - C\_CRLC\_TQI\_MMV\_NOX)$   
 $VS\_MMV\_NOX(n) = VS * C\_CRLC\_VS\_MMV\_NOX +$   
 $VS\_MMV\_NOX(n-1) * (1 - C\_CRLC\_VS\_MMV\_NOX)$   
 $VS\_DIF\_NOX = VS - VS\_MMV\_NOX$

**if (124)**             $LV\_NT\_AFS\_REQ\_PRED = 1$  **AND**  $LV\_RGN\_NT\_REQ = 0$   
**then (124)**            increment  $T\_NT\_AFS\_REQ\_PRED$   
**else (124)**             $T\_NT\_AFS\_REQ\_PRED = 0$   
**endif (124)**


**if (134)**             $LV\_AT = 1$   
**then (134)**             $TNT\_MDL\_MAX = IP\_TNT\_MDL\_MAX\_AT(NT\_AGI\_S\_RED, VS) +$   
 $TNT\_MDL\_MAX\_OFS$   
**if (88)**             $LV\_IS = 1$   
**then (88)**             $TNT\_MDL\_MIN = IP\_TNT\_MDL\_MIN\_IS\_AT(NT\_AGI\_S\_RED)$   
**else (88)**             $TNT\_MDL\_MIN = IP\_TNT\_MDL\_MIN\_AT(NT\_AGI\_S\_RED)$   
**endif (88)**  
 $NOX\_S\_PRED\_THD = IP\_NOX\_S\_AFS\_REQ\_AT(TNT\_MDL\_L, NT\_AGI\_S\_RED)$   
 $NOX\_S\_PRED\_HYS = IP\_NOX\_S\_AFS\_REQ\_HYS\_AT(N\_32, TQI\_MMV\_NOX)$   
 $NOX\_HOMS\_PRED\_THD =$   
 $IP\_NOX\_HOMS\_AFS\_REQ\_AT(TNT\_MDL\_L, NT\_AGI\_S\_RED)$   
 $NOX\_HOMS\_PRED\_HYS =$   
 $IP\_NOX\_HOMS\_AFS\_REQ\_HYS\_AT(N\_32, TQI\_MMV\_NOX)$   
 $VS\_DIF\_THD = IP\_VS\_DIF\_THD\_BAS\_AT(TNT\_MDL\_L, NT\_AGI\_S\_RED) +$   
 $IP\_VS\_DIF\_THD\_COR\_AT(VS\_MMV\_NOX)$   
 $VS\_DIF\_HYS = IP\_VS\_DIF\_HYS\_AT(VS\_MMV\_NOX)$

**else (134)**             $TNT\_MDL\_MAX = IP\_TNT\_MDL\_MAX\_MT(NT\_AGI\_S\_RED, VS) +$   
 $TNT\_MDL\_MAX\_OFS$   
**if (138)**             $LV\_IS = 1$   
**then (138)**             $TNT\_MDL\_MIN = IP\_TNT\_MDL\_MIN\_IS\_MT(NT\_AGI\_S\_RED)$   
**else (138)**             $TNT\_MDL\_MIN = IP\_TNT\_MDL\_MIN\_MT(NT\_AGI\_S\_RED)$   
**endif (138)**  
 $NOX\_S\_PRED\_THD = IP\_NOX\_S\_AFS\_REQ\_MT(TNT\_MDL\_L, NT\_AGI\_S\_RED)$   
 $NOX\_S\_PRED\_HYS = IP\_NOX\_S\_AFS\_REQ\_HYS\_MT(N\_32, TQI\_MMV\_NOX)$   
 $NOX\_HOMS\_PRED\_THD =$   
 $IP\_NOX\_HOMS\_AFS\_REQ\_MT(TNT\_MDL\_L, NT\_AGI\_S\_RED)$   
 $NOX\_HOMS\_PRED\_HYS =$   
 $IP\_NOX\_HOMS\_AFS\_REQ\_HYS\_MT(N\_32, TQI\_MMV\_NOX)$   
 $VS\_DIF\_THD = IP\_VS\_DIF\_THD\_BAS\_MT(TNT\_MDL\_L, NT\_AGI\_S\_RED) +$   
 $IP\_VS\_DIF\_THD\_COR\_MT(VS\_MMV\_NOX)$   
 $VS\_DIF\_HYS = IP\_VS\_DIF\_HYS\_MT(VS\_MMV\_NOX)$

**endif (134)**

**if (119)**             $LV\_RGN\_NT\_REQ = 1$   
**and**             $( NOX\_COR\_S\_PRED > NOX\_S\_PRED\_THD$   
**or**             $NOX\_COR\_HOMS\_PRED > NOX\_HOMS\_PRED\_THD )$   
**and**             $( VS\_DIF\_NOX > VS\_DIF\_THD )$

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```

then (119)      LV_NT_AFS_REQ_PRED = 1
else (119)
    if (120)      T_NT_AFS_REQ_PRED > C_T_NT_AFS_REQ_PRED_MAX
    or ( LV_HOM_AFS_ACT = 1
        and      LV_NT_AFS_REQ_PRED = 1
        and      ( ( NOX_COR_S_PRED <=
                    ( NOX_S_PRED_THD - NOX_S_PRED_HYS )
                    and NOX_COR_HOMS_PRED <=
                    ( NOX_HOMS_PRED_THD - NOX_HOMS_PRED_HYS )
                )
            or( VS_DIF_NOX <= ( VS_DIF_THD - VS_DIF_HYS )
        )
    )
    then (120)      LV_NT_AFS_REQ_PRED = 0
endif (120)
endif (119)

```

```

if (86)      TNT_MDL_H > TNT_MDL_MAX           % cat. temp. too high
or          TNT_MDL_L < TNT_MDL_MIN - C_TNT_MDL_MIN_HYS % tnt too low
or          LV_NT_AFS_REQ_AGI = 1                % aging bad
or          LV_SO2P_REQ = 1                      % SO2P introduced
or          LV_NT_AFS_REQ_PRED = 1
or          LV_INH_NT_AFL = 1                    % flag from appl. inc. module
or          ( LV_NS_SHIFT_CMB_INT_REQ = 1
    and LC_NT_AFS_REQ_NS_SHIFT = 1 )
then (86)      LV_NT_AFS_REQ = 1                % lambda=1 request
endif (86)

```

```

if (87)      ( TNT_MDL_H < TNT_MDL_MAX - C_TNT_MDL_MAX_HYS
and          TNT_MDL_L >= TNT_MDL_MIN
and          LV_NT_AFS_REQ_AGI = 0
and          LV_SO2P_REQ = 0
and LV_NT_AFS_REQ_PRED = 0
and          LV_INH_NT_AFL = 0
    and      ( LV_NS_SHIFT_CMB_INT_REQ = 0
    or LC_NT_AFS_REQ_NS_SHIFT = 0 ) )
or          ( LV_TNT_MDL_MAX_OFS = 1 and
    TNT_MDL_H < TNT_MDL_MAX - C_TNT_MDL_MAX_HYS )
then (87)      LV_NT_AFS_REQ = 0
endif (87)

```

## 7.87 NOx catalyst management (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_RGN_MDL_CTL	O/V	0... FFH	0... 255	1	-
Counter of model controlled NOx regenerations					
LV_ADJ_NOX_SENS_RGN	O/V	0... 1H	0 ...1	1	-
Exclusively regeneration by NOx-Sensor ist allowed (=0)					
LV_INH_NOX_SENS_RGN	O/V	0... 1H	0 ...1	1	-
Inhibition flag for NOx catalyst regeneration-stop request by NOx sensor readiness					
LV_INH_NT_ACT	O/V	0... 1H	0 ...1	1	-
flag inhibiting the NOx catalyst management					
LV_INH_NT_AFL	O/V	0... 1H	0 ...1	1	-
flag inhibiting lean operation (requests air/fuel stoichiometric)					
LV_INH_NT_AFL_NS_READY	O/V	0... 1H	0 ...1	1	-
Request of Lambda=1.0 engine operation due to missing NOx sensor readiness					
LV_INH_RGN_REQ	O/V	0... 1H	0 ...1	1	-
flag inhibiting the request of a NOx catalyst regeneration					
LV_INH_RGN_REQ_NOX_SENS	O/V	0... 1H	0 ...1	1	-
Inhibition flag for NOx catalyst regeneration request by NOx sensor readiness					
LV_INH_RGN_REQ_NTLD	O/V	0... 1H	0 ...1	1	-
flag inhibiting the request of a NOx catalyst regeneration due to high loading degree					
LV_LOAD_H	O/V	0... 1H	0 ...1	1	-
High engine load detected					
LV_NT_STST	O/V	0... 1H	0 ...1	1	-
Activation/deactivation of stop/start functionalities into NOx catalyst functions					
LV_NTLD_ADJ	O/V	0... 1H	0 ...1	1	-
Flag to activate NOx catalyst loading degree threshold for regeneration without NOx sensor readiness					
LV_TNT_MDL_MAX_OFS	O/V	0... 1H	0 ...1	1	-
Catalyst cooling function activation flag					
MAF_INT_FL_ACT	O/V	0... FFFFH	0... 6553.5	0.1	g
Air mass flow since activation of full load (LV_FL = 0->1)					
STATE_RGN_REQ	V	0H 1H	SENSOR MODEL	-	-
State of regeneration request					
T_AFL_MDL_CTL	O/V	0... FFFFH	0... 6553.5	0.1	s
Model controlled lean engine operation time after x model controlled NOx regenerations					
T_AFL_MDL_CTL_SUM	O/V	0... FFFFH	0... 6553.5	0.1	s
Summary model controlled lean engine operation time at actual driving cycle					
T_IPLSL_VLD_DLY	V	0... FFH	0... 25.5	0.1	s
Timer for hiding of short LV_IPLSL_VLD[i] = 0 phases at a MSA start					
T_VS_IS_NT	V	0... FFH	0... 25.5	0.1	s
Catalyst cooling function activation timer					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TCO_ST_NS	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature at start					
TNT_MDL_MAX_OFS	O/V	80... 7FH	-512 ...508	4	°C
NOx catalyst temperature offset to enable catalyst cooling at standing car					


**Input data:**

DIST_NT {p. 3180}	LC_NT_STST_ACT {p. 2999}	LV_AT {p. 654}	LV_ERR_CAM {p. 1505}
LV_ERR_EGR_2 {p. 987}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_ERR_MAF {p. 4815}	LV_ERR_NS_CAN_BOFF {p. 991}
LV_ERR_NS_CAN_MSG_LOST [NC_NOX_SENS_CONF] {p. 991}	LV_ERR_NS_OBD_1 [NC_NOX_SENS_CONF] {p. 4915}	LV_ERR_TCO {p. 4496}	LV_FL {p. 1759}
LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}	LV_IS {p. 1720}	LV_NOX_NS_ACT [NC_NOX_SENS_CONF] {p. 6358}	LV_NOX_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}
LV_NOX_NS_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_NT_ACT {p. 2982}	LV_RGN_NT_REQ {p. 2983}	LV_STST_PRE_STOP_REQ {p. 8220}
LV_STST_STOP_CYC {p. 805}	LV_T_NS_VLD {p. 3193}	LV_VLS_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}	LV_VLS_NS_VLD [NC_NOX_SENS_CONF] {p. 992}
MAF_KGH {p. 1195}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}
NT_AGI {p. 3073}	NT_SUL {p. 3113}	NTLD {p. 2986}	OPM_AV {p. 8137}
STATE_END_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}	STATE_ERR_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}	STATE_NOX {p. 2986}	T_AST {p. 1766}
T_AST_SAE {p. 1766}	T_NOX_NS_HLD [NC_NOX_SENS_CONF] {p. 992}	T_RGN {p. 2885}	TCO_ST {p. 1100}
TCO_ST_DC {p. 1100}	TNT_MDL_H {p. 8237}	TQI_SP_MAF {p. 8380}	VS {p. 1176}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DIST_NT_INH_RGN_REQ_NTLD_AT	-	0... FFFFH	0... 524280	8	km
Inhibition of NOx regeneration requests due to NTLD at new vehicle - AT vehicle					
C_DIST_NT_INH_RGN_REQ_NTLD_MT	-	0... FFFFH	0... 524280	8	km
Inhibition of NOx regeneration requests due to NTLD at new vehicle - MT vehicle					
C_ERR_NS_NT_AFL_BIT_SEL	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to set lean engine operation request					
C_N_32_NT_STST_ACT	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for activation of stop/start functionalities into NOx catalyst functions					
C_N_32_NT_STST_DEAC	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for deactivation of stop/start functionalities into NOx catalyst functions					
C_NT_AGI_INH_RGN_REQ_NTLD_AT	-	0... FFFFH	0... 0.99998	15.3e-6	-
Inhibition of NOx regeneration requests due to NTLD at new NOx catalyst - AT vehicle					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NT_AGI_INH_RGN_REQ_NTLD_MT	-	0... FFFFH	0... 0.99998	15.3e-6	-
Inhibition of NOx regeneration requests due to NTLD at new NOx catalyst - MT vehicle					
C_NT_SUL_MIN_OFS	-	0... FFFFH	0... 10485.6	0.16	mg
Min NOx catalyst sulphur load to enable cat cooling at standing car					
C_NTLD_STATE_RGN_REQ	-	0... FFFFH	0... 0.99998	15.3e-6	-
Minimum NOx catalyst loadig degree to switch to model (< NTLD_MAX)					
C_STATE_NS_OBD_BIT_SEL_MDL	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor OBDII diagnosis types for changing from model to sensor mode					
C_T_AST_MIN_NS_READY	-	0... FFFFH	0... 65535	1	s
Minimum time after start to allow lean operation in case of late readiness of NOx sensor					
C_T_AST_NT_STST_DEAC	-	0... FFFFH	0... 6553.5	0.1	s
Time after start threshold for deactivation of stop/start functionalities into NOx catalyst functions					
C_T_IPLSL_VLD_DLY	-	0... FFH	0... 25.5	0.1	s
Delay time, during there LV_IPLSL_VLD[j] = 0 is hidid for NOx catalyst management					
C_T_NOX_SENS_VLD_STATE_RGN_REQ	-	0... FFFFH	0... 655.35	0.01	s
Minimum time with NOx sensor not valid to switch to model					
C_T_RGN_MIN_NS_READY	-	0... FFFFH	0... 655.35	0.01	s
Minimum NOx regeneration duration for counting as model controlled NOx regeneration					
C_T_VS_IS_NT	-	0... FFH	0... 25.5	0.1	s
Duration cat cooling at standing car is allowed					
C_TNT_MDL_H_MAX_OFS	-	0... FFH	0... 1020	4	°C
Min NOx catalyst temperature to enable cat cooling at standing car					
C_TNT_MDL_H_MAX_OFS_HYS	-	0... FFH	0... 1020	4	°C
NOx catalyst temperature hysteresis to disable catalyst cooling					
C_TNT_MDL_MAX_OFS	-	80... 7FH	-512 ...508	4	°C
NOx catalyst temperature offset to enable cat cooling at standing car					
C_TNT_MDL_THD_RGN_NOT	-	0... FFH	0... 1020	4	°C
NOx trap monolith temperature max. threshold for inhibit a regeneration					
C_TNT_MDL_THD_RGN_NOT_HYS	-	0... FFH	0... 1020	4	°C
NOx trap monolith temperature hysteresis for inhibit a regeneration					
C_TQI_SP_MAF_LOAD_H_HYS	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque threshold hysteresis for reset of high engine load flag					
C_VS_MIN_RGN	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed for requesting a NOx regeneration					
C_VS_TNT_MDL_MIN	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold to enable cat cooling at standing car					
C_VS_TNT_MDL_MIN_OFF	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold to disable catalyst cooling					
ID_CTR_RGN_MDL_CTL_MAX	-	0... FFH	0... 255	1	-
LDP_TCO_ST_NS_ID_CTR_RGN_MDL	6	0... FEH	-48... 142.5	0.75	°C
Maximum number of model controlled NOx regenerations					
IP_T_AFL_MDL_CTL_MAX	-	0... FFFFH	0... 6553.5	0.1	s

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_TCO_ST_NS_IP_T_AFL_MDL	6	0... FEH	-48... 142.5	0.75	°C
Maximum model controlled lean engine operation time after x model controlled NOx regenerations					
IP_T_AFL_MDL_CTL_SUM_MAX	-	0... FFFFH	0... 6553.5	0.1	s
LDP_TCO_ST_NS_IP_T_AFL_MDL_SUM	6	0... FEH	-48... 142.5	0.75	°C
Maximum model controlled lean engine operation time at actual driving cycle					
IP_T_AST_SAE_MDL_CTL_MAX	-	0... FFFFH	0... 65535	1	s
LDP_TCO_ST_NS_IP_T_AST_SAE	6	0... FEH	-48... 142.5	0.75	°C
Maximum model controlled lean engine operation duration after start					
IP_TQI_SP_MAF_LOAD_H	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_IP_LOAD_H	8	0... FFH	0... 8160	32	rpm
Torque threshold for detecting high engine load					
LC_INH_NT_ACT_OFF	-	0... 1H	0 ...1	1	-
Codeword for the manual setting of the inhibiting bit					
LC_INH_NT_AFL	-	0... 1H	0 ...1	1	-
Codeword for forcing to Lambda=1 operation					
LC_INH_NT_AFL_OFF	-	0... 1H	0 ...1	1	-
Manual setting of inhibiting Lambda = 1 request					
LC_INH_NTLD_REQ_NOX_SENS_AUTH	-	0... 1H	0 ...1	1	-
Inhibition of NOx regeneration requests due to NTLD after the NOx sensor has reached its readiness					
LC_INH_NTLD_REQ_NOX_SENS_VLD	-	0... 1H	0 ...1	1	-
Inhibition of NOx regeneration requests due to NTLD, if the NOx signal is valid					
LC_INH_REQ_NOX_SENS_OFF	-	0... 1H	0 ...1	1	-
Manual setting of inhibiting exclusively regeneration out of NOx sensor					
LC_INH_RGN_IS	-	0... 1H	0 ...1	1	-
Inhibition of NOx regeneration requests at idle speed					
LC_INH_RGN_REQ_NTLD	-	0... 1H	0 ...1	1	-
Codeword for general inhibition of regeneration request due to loading degree					
LC_NOX_NS_AUTH_CHK	-	0... 1H	0 ...1	1	-
Activation of LV_NOX_NS_AUTH[...] for NOx sensor readiness check					
LC_OPM_AV_CHK	-	0... 1H	0 ...1	1	-
Activation of OPM_AV for determination of model controlled lean engine operation time					
LC_STATE_NOX_CHK	-	0... 1H	0 ...1	1	-
Activation of STATE_NOX for determination of model controlled lean engine operation time					
LC_STST_PRE_STOP_REQ_NT_ACT	-	0... 1H	0 ...1	1	-
Activation of stop/start functionalities into NOx catalyst functions by pre-stop request					
LC_TCO_ST_SEL	-	0... 1H	0 ...1	1	-
Selection of TCO_ST (=0) or TCO_ST_DC (=1) for use at this functionality					
LC_TNT_MDL_MAX_OFS	-	0... 1H	0 ...1	1	-
Switch to enable cat cooling at standing car					
LC_VLS_NS_AUTH_CHK	-	0... 1H	0 ...1	1	-
Activation of LV_VLS_NS_AUTH[...] for NOx sensor readiness check					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_VLS_NS_VLD_INH_RGN_ENA	-	0... 1H	0 ...1	1	-
Use LV_VLS_NS_VLD for calculation of LV_INH_RGN_REQ					

## 7.87.1 Inhibiting the NOx catalyst management

### FUNCTION DESCRIPTION:

Number of NOx sensors: NC\_NOX\_SENS\_CONF k = 1...NC\_  
 NOX\_SENS\_CONF  
 Number of lambda sensors: NC\_CBK\_EX\_NR i = 1...NC\_  
 CBK\_EX\_NR

Typical configurations:

[NC\_CBK\_EX\_NR:NC\_NOX\_SENS\_CONF] =[1:1], [2:2], [2:1]

### Description:

The timer T\_IPLSL\_VLD\_DLY is limited to its maximum value. An overflow is not allowed.

### Application conditions

**Initialisation:** at reset  
 LV\_INH\_NT\_ACT = 0  
 T\_IPLSL\_VLD\_DLY = 0

**Recurrence:** 100 ms

**Activation:** at every engine state

**Deactivation:** -

### Formula section:

```

if LV_IPLSL_VLD[i] = 0 % valid if at least one [i] = 0
then T_IPLSL_VLD_DLY(n) = T_IPLSL_VLD_DLY(n-1) + Recurrence
else T_IPLSL_VLD_DLY = 0
endif

```

```

if ( ( LV_IPLSL_VLD[i] = 0 % valid if at least one [i] =
0
(readiness of upstream oxygen sensor)
and T_IPLSL_VLD_DLY >= C_T_IPLSL_VLD_DLY
)
or LV_ERR_TCO = 1
(error currently present on error location coolant temperature sensor )
or LV_ERR_MAF = 1
(error currently present on mass air flow acquisition)
or LV_ERR_CAM = 1
(global error on camshaft sensor)
)

```

```

and      LC_INH_NT_ACT_OFF = 0
then     LV_INH_NT_ACT = 1
else     LV_INH_NT_ACT = 0
endif
    
```

## 7.87.2 Inhibiting the NOx catalyst regeneration request

### FUNCTION DESCRIPTION:

#### Application conditions

```

Initialisation:      at reset
                     LV_INH_RGN_REQ = 1

Recurrence:          100 ms

Activation:           LV_NT_ACT = 1

Deactivation:        LV_NT_ACT = 0
    
```

#### Formula section:

```

if      TNT_MDL_H > C_TNT_MDL_THD_RGN_NOT
      VS < C_VS_MIN_RGN
      (LV_IS = 1 AND LC_INH_RGN_IS = 1)
      (LV_VLS_NS_VLD[k] = 0
      LC_VLS_NS_VLD_INH_RGN_ENA = 1)
      (readiness of the binary O2 signal from the NOx-Sensor)
      AND% valid if at least one [k] = 0
      OR
then    LV_INH_RGN_REQ = 1
else
      if      TNT_MDL_H < ( C_TNT_MDL_THD_RGN_NOT -
      C_TNT_MDL_THD_RGN_NOT_HYS )
      VS >= C_VS_MIN_RGN
      (LV_IS = 0 OR LC_INH_RGN_IS = 0)
      (LV_VLS_NS_VLD[k] = 1
      LC_VLS_NS_VLD_INH_RGN_ENA = 0)
      AND
      OR% valid for all [k] = 1
      AND
then    LV_INH_RGN_REQ = 0
endif
endif
    
```

## 7.87.3 Inhibiting the regeneration request due to modeled loading degree


### FUNCTION DESCRIPTION:

This is a dummy file provided for project-specific reasons to disable regeneration request due to high loading degree. Contrary to the previous subchapter, this new inhibition flag does not inhibit a regeneration due to a switch to homogeneous operation due to torque request by driver.

#### Application conditions

```

Initialisation:      at reset
                     LV_INH_RGN_REQ_NTLD = 0
    
```

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**Recurrence:** 100 ms  
**Activation:** LV\_NT\_ACT = 1  
**Deactivation:** LV\_NT\_ACT = 0

**Formula section:**

```

if          LC_INH_RGN_REQ_NTLD = 1                                OR
  ( LV_NOX_NS_AUTH[k] = 1 )                                     AND          % valid
if all [k] = 1
  LC_INH_NTLD_REQ_NOX_SENS_AUTH = 1 )                         OR
  ( LV_NOX_NS_VLD[k] = 1 )                                     AND          valid if
all [k] = 1
  LC_INH_NTLD_REQ_NOX_SENS_VLD = 1 )                         OR
  ( LV_AT = 0 AND NT_AGI > C_NT_AGI_INH_RGN_REQ_NTLD_MT )
  ( LV_AT = 1 AND NT_AGI > C_NT_AGI_INH_RGN_REQ_NTLD_AT )
  ( LV_AT = 0 AND DIST_NT < C_DIST_NT_INH_RGN_REQ_NTLD_MT )
  ( LV_AT = 1 AND DIST_NT < C_DIST_NT_INH_RGN_REQ_NTLD_AT )
then      LV_INH_RGN_REQ_NTLD = 1
else      LV_INH_RGN_REQ_NTLD = 0
endif
    
```

**7.87.4 Inhibiting the lean operation (manual request of air/fuel stoichiometric)**

**FUNCTION DESCRIPTION:**

The logical value LV\_INH\_NT\_AFL allows to force a Lambda = 1.0 operation due to project specific requirements. Lambda = 1.0 operation is forced by an error of the NOx-Sensor or manual setting.

**Application conditions**


**Initialisation:** at reset  
LV\_INH\_NT\_AFL = 0  
**Recurrence:** 100 ms  
**Activation:** every time  
**Deactivation:** -

**Formula section:**

```

if (
  or      LV_ERR_NS_CAN_MSG_LOST[k] = 1          % valid if at least one [k] = 1
  or      LV_ERR_NS_OBD_1[k] = 1                % valid if at least one [k] = 1
  or      ( STATE_ERR_NS_OBD_2[k] bitwise AND
            C_ERR_NS_NT_AFL_BIT_SEL ) != 0      %
            valid if at least one [k] = 1
  or      LV_ERR_LS_UP[i] = 1                  % valid if at least one [i] = 1
  or      LV_INH_NT_AFL_NS_READY = 1
  or      LC_INH_NT_AFL = 1
)
and      LC_INH_NT_AFL_OFF = 0
then     LV_INH_NT_AFL = 1
    
```

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```
else      LV_INH_NT_AFL = 0
endif
```

## 7.87.5 Change to model when invalid NOx-Sensor Signal flow diagram

### FUNCTION DESCRIPTION:

If the function is active (LC\_INH\_REQ\_NOX\_SENS\_OFF = 0) and the NOx signal is not valid during the NOx catalyst loading phase the mode of the NOx regeneration request is switched from "SENSOR" to "MODEL". The NOx regeneration request by NOx sensor is as long as forbidden until the NOx sensor OBDII diagnosis is carried out and no error is appeared.

### Application conditions

**Initialisation:** at reset, at deactivation:  
 LV\_INH\_RGN\_REQ\_NOX\_SENS = 0  
 LV\_INH\_NOX\_SENS\_RGN = 0  
 LV\_NTLD\_ADJ = 0  
 STATE\_RGN\_REQ = SENSOR

**Recurrence:** 100ms.

**Activation:** LC\_INH\_REQ\_NOX\_SENS\_OFF = 0

**Deactivation:** LC\_INH\_REQ\_NOX\_SENS\_OFF = 1

### Formula section:

**Default State:**  
 STATE\_RGN\_REQ = SENSOR


### Transitions:

STATE\_RGN\_REQ: SENSOR to MODEL

```
if      STATE_NOX = LOAD
      and      (LV_NOX_NS_VLD[k] = 0
      and T_NOX_NS_HLD[k] >= C_T_NOX_SENS_VLD_STATE_RGN_REQ)
      % valid if at least one condition for [k] = true
      and      LV_T_NS_VLD = 1
      and      NTLD >= C_NTLD_STATE_RGN_REQ
then    STATE_RGN_REQ = MODEL
endif
```

STATE\_RGN\_REQ: MODEL to SENSOR

```
if      % valid if all conditions for [k] = true
      ( (bit-wise not(STATE_END_NS_OBD_2[k]) bit-wise or STATE_ERR_NS_OBD_2[k] ) bit-wise
      and C_STATE_NS_OBD_BIT_SEL_MDL ) = 0
      and      LV_ERR_NS_OBD_1[k] = 0
      and      LV_NOX_NS_AUTH[k] = 1
      and      LV_NOX_NS_ACT[k] = 1
then    STATE_RGN_REQ = SENSOR
else    STATE_RGN_REQ unchanged
```

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**endif**

**Static state actions:**

STATE\_RGN\_REQ = **SENSOR**  
LV\_INH\_RGN\_REQ\_NOX\_SENS = 0  
LV\_INH\_NOX\_SENS\_RGN = 0  
LV\_NTLD\_ADJ = 0

STATE\_RGN\_REQ = **MODEL**  
LV\_INH\_RGN\_REQ\_NOX\_SENS = 1  
LV\_INH\_NOX\_SENS\_RGN = 1  
LV\_NTLD\_ADJ = 1

### 7.87.6 Catalyst cooling function

**Application conditions**

**Initialisation:** at reset, at deactivation  
LV\_TNT\_MDL\_MAX\_OFS = 0  
TNT\_MDL\_MAX\_OFS = 0  
T\_VS\_IS\_NT = 0

**Recurrence:** 100ms

**Activation:** LC\_TNT\_MDL\_MAX\_OFS = 1


**Deactivation:** LC\_TNT\_MDL\_MAX\_OFS = 0

**Formula section:**

```
if VS <= C_VS_TNT_MDL_MIN
  and TNT_MDL_H > C_TNT_MDL_H_MAX_OFS
  and NT_SUL >= C_NT_SUL_MIN_OFS
  then if T_VS_IS_NT <= C_T_VS_IS_NT
    then if T_VS_IS_NT < maximum value (FFH)
      then T_VS_IS_NT = T_VS_IS_NT + Recurrence
      else T_VS_IS_NT(n) = T_VS_IS_NT(n-1)
    endif
    TNT_MDL_MAX_OFS = C_TNT_MDL_MAX_OFS
    LV_TNT_MDL_MAX_OFS = 1
  else TNT_MDL_MAX_OFS = 0
    LV_TNT_MDL_MAX_OFS = 0
  endif
else if VS <= C_VS_TNT_MDL_MIN_OFF
  and TNT_MDL_H <= C_TNT_MDL_H_MAX_OFS -
    C_TNT_MDL_H_MAX_OFS_HYS
  then T_VS_IS_NT = 0
    TNT_MDL_MAX_OFS = 0
    LV_TNT_MDL_MAX_OFS = 0
  endif
endif
```

**endif**

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## 7.87.7 Enabling NOx Catalyst regeneration request by model

### Application conditions

**Initialisation:** at reset  
LV\_ADJ\_NOX\_SENS\_RGN = 0

**Recurrence:** 10 ms

**Activation:** at every engine state

**Deactivation:** -

### Formula section:

```

if          LV_ERR_EGR_2 = 1
then       LV_ADJ_NOX_SENS_RGN = 1
else       LV_ADJ_NOX_SENS_RGN = 0
endif
    
```

## 7.87.8 Calculation of full load air mass flow integral

### General information:

The air mass flow integral MAF\_INT\_FL\_ACT is used for detection of short and long full load phases or high engine load phases inside of NOx catalyst management functionality. This classification of full load phases or high engine load phases is required for the decision whether a running NOx regeneration is terminated because of higher full load priority or not.

### Description:

The constant NC\_FAC\_MAF\_INT\_FL includes the recurrence and converts the physical unit of MAF\_KGH from [kg/h] to [g/ms].

$NC\_FAC\_MAF\_INT\_FL = Recurrence/3.6$

Note! The calculation of MAF\_INT\_FL\_ACT shall be stopped if the maximum value of value range is reached. An overflow is not allowed.

### Application conditions

**Initialisation:** at reset, at deactivation:  
MAF\_INT\_FL\_ACT = 0  
LV\_LOAD\_H = 0

**Recurrence:** 100ms


**Activation:** LV\_NT\_ACT = 1

**Deactivation:** LV\_NT\_ACT = 0

### Formula section:

```

if          TQI_SP_MAF > IP_TQI_SP_MAF_LOAD_H(N_32)
then       LV_LOAD_H = 1
else
    if     TQI_SP_MAF < IP_TQI_SP_MAF_LOAD_H(N_32) - C_TQI_SP_MAF_LOAD_H_HYS
    
```

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```

then LV_LOAD_H = 0
else LV_LOAD_H remains unchanged
endif
endif

if LV_FL = 1 OR LV_LOAD_H = 1
then MAF_INT_FL_ACT(n) = MAF_INT_FL_ACT(n-1) + MAF_KGH * NC_FAC_MAF_INT_FL
else MAF_INT_FL_ACT = 0
endif

```

### 7.87.9 Stop/start functionality activation

#### General information:

LV\_NT\_STST = 1 activates into the NOx catalyst control functions special variable calculations in order to handle the stop/start phases.

#### Description:

The special stop/start functionalities into the NOx catalyst control functions are enabled or disabled by LC\_NT\_STST\_ACT.

#### Application conditions

**Initialisation:** at reset, at deactivation:  
LV\_NT\_STST = 0

**Recurrence:** 10ms

**Activation:** LC\_NT\_STST\_ACT = 1

**Deactivation:** LC\_NT\_STST\_ACT = 0

#### Formula section:


```

if ( LV_STST_STOP_CYC = 1 AND N_32 < C_N_32_NT_
STST_ACT )
OR
( LV_STST_PRE_STOP_REQ = 1 AND LC_STST_PRE_STOP_REQ_NT_ACT = 1 )
then LV_NT_STST = 1
else
if T_AST >= C_T_AST_NT_STST_DEAC
( LV_STST_STOP_CYC = 0 OR
( LV_STST_STOP_CYC = 1 AND N_32 > C_N_32_NT_STST_DEAC ) )
then LV_NT_STST = 0
endif
endif
endif

```

### 7.87.10 Request of Lambda=1.0 operation due to missing NOx sensor readiness

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**General information:**

The engine system is able to start with lean engine operation without a ready NOx sensor for NOx emission control. In this case the NOx emission control runs completely model controlled. The aim of this section is the limitation of this system state by requesting Lambda=1.0 engine operation up to the NOx sensor reaches its operation readiness.

**Description:****Application conditions**

**Initialisation:** at reset, at deactivation:  
 LV\_INH\_NT\_AFL\_NS\_READY = 0  
 CTR\_RGN\_MDL\_CTL = 0  
 T\_AFL\_MDL\_CTL = 0  
 T\_AFL\_MDL\_CTL\_SUM = 0  
 TCO\_ST\_NS = 0

**Recurrence:** 100ms

**Activation:** LV\_IGK = 1

**Deactivation:** -

**Formula section:**

*Selection of TCO\_ST signal*

```

if                                LC_TCO_ST_SEL = 1
then      TCO_ST_NS = TCO_ST_DC
else      TCO_ST_NS = TCO_ST
endif

```

*Counting of model controlled NOx regenerations*

```

if                                (LV_NOX_NS_AUTH[k] = 0 OR LC_NOX_
NS_AUTH_CHK = 0)                                AND
      (LV_VLS_NS_AUTH[k] = 0 OR LC_VLS_NS_AUTH_CHK = 0)
      LV_RGN_NT_REQ(n-1) = 1                                AND
      LV_RGN_NT_REQ(n) = 0                                AND
      T_RGN(n-1) >= C_T_RGN_MIN_NS_READY
then      Model controlled NOx regeneration detected
      increment CTR_RGN_MDL_CTL
endif

```


*Measurement of time without NOx sensor readiness*

```

if                                (LV_NOX_NS_AUTH[k] = 0 OR LC_NOX_
NS_AUTH_CHK = 0)                                AND
      (LV_VLS_NS_AUTH[k] = 0 OR LC_VLS_NS_AUTH_CHK = 0)
      (STATE_NOX = "LOAD" OR LC_STATE_NOX_CHK = 0)
      (OPM_AV = "S" OR OPM_AV = "AFL" OR LC_OPM_AV_CHK = 0)
then      Model controlled lean engine operation detected
      increment T_AFL_MDL_CTL_SUM

if                                CTR_RGN_MDL_CTL >= ID_CTR_RGN_MDL_
CTL_MAX(TCO_ST_NS)

```

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```

then           Model controlled lean engine operation time after x model controlled NOx regen-
                erations
                increment T_AFL_MDL_CTL
endif
endif


Request of Lambda=1.0 engine operation
if                               (LV_NOX_NS_AUTH[k] = 0 OR LC_NOX_
NS_AUTH_CHK = 0)                   AND
(LV_VLS_NS_AUTH[k] = 0 OR LC_VLS_NS_AUTH_CHK = 0)
then           Waiting on NOx sensor readiness
                if                               CTR_RGN_MDL_CTL >= ID_
                CTR_RGN_MDL_CTL_MAX(TCO_ST_NS)

                T_AFL_MDL_CTL >= IP_T_AFL_MDL_CTL_MAX(TCO_ST_NS)

                T_AFL_MDL_CTL_SUM >= IP_T_AFL_MDL_CTL_SUM_MAX(TCO_ST_NS)

                T_AST_SAE >= IP_T_AST_SAE_MDL_CTL_MAX(TCO_ST_NS)
then           Maximum model controlled lean engine operation duration is reached
                Set of Lambda=1.0 operation request
                LV_INH_NT_AFL_NS_READY = 1
else           Model controlled lean engine operation is running
                LV_INH_NT_AFL_NS_READY = 0
endif
else           NOx sensor has reached its readiness
if           T_AST_SAE >= C_T_AST_MIN_NS_READY
                Reset of Lambda=1.0 operation request
                LV_INH_NT_AFL_NS_READY = 0
                Reset of counter & timers after NOx sensor readiness
                CTR_RGN_MDL_CTL = 0
                T_AFL_MDL_CTL = 0
                T_AFL_MDL_CTL_SUM = 0
endif
endif

```

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## 7.88 NOx tailpipe emission

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NOX_OUT_MES [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 1023.98437	0.015625	mg/s
Tailpipe NOx emission					
NOX_OUT_MES_INT [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 10485.6	0.16	mg
Absolute tailpipe NOx emission during stratified operation mode					

### Input data:

C_NOX_CONC_COR {p. 2990}	LV_ERR_NS_CAN_MSG_LOST [NC_NOX_SENS_CONF] {p. 991}	LV_ERR_NS_OBD_1 [NC_NOX_SENS_CONF] {p. 4915}	LV_NOX_NS_VLD [NC_NOX_SENS_CONF] {p. 991}
LV_NOX_SENS {p. 2982}	LV_T_NS_VLD {p. 3193}	MAF_FG_CYL {p. 1212}	NC_NOX_SENS_CONF {p. 643}
NOX_NS_AD [NC_NOX_SENS_CONF] {p. 3193}	STATE_ERR_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}	STATE_NOX {p. 2986}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ERR_NS_NOX_OUT_BIT_SEL	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit NOX_OUT_MES... calculations					
LC_NOX_OUT_MES_INT_ACT	-	0... 1H	0 ...1	1	-
Switch to enable calculation of NOx tailpipe emission					

### FUNCTION DESCRIPTION:

LV\_ERR\_NS\_OBD\_2[NC\_NOX\_SENS\_CONF]

### General information

The NOx signal of the NOx sensor is used to calculate the NOx tailpipe emission during lean operation mode.

The NOx concentration measured behind the NOx catalyst is converted into a mass flow. This NOx mass flow is integrated up to the absolute NOx tailpipe emission during a lean phase.


NC\_NOX\_SENS\_CONF is the number of NOx sensors within the system. Therefore the index i represents:

- i = 1 ... signals based on NOx sensor 1, which is mounted at cylinder bank 1 or at a summary tailpipe section of a Y exhaust line configuration
- i = 2 ... signals based on NOx sensor 2, which is mounted at cylinder bank 2

### Application conditions

**Initialisation:** at reset  
NOX\_OUT\_MES\_INT[i] = 0  
NOX\_OUT\_MES[i] = 0

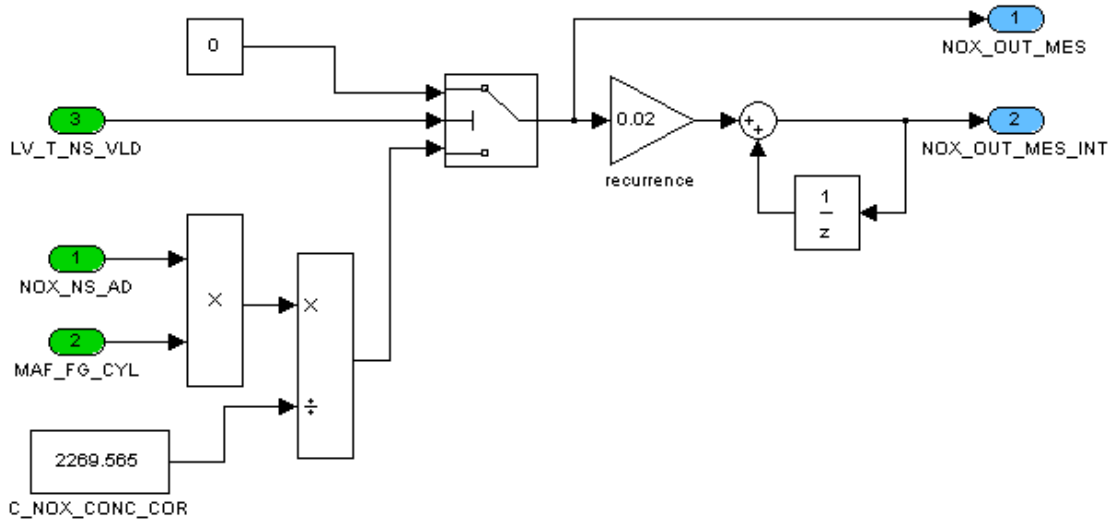
**Recurrence:** 20 ms

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**Activation:**            **if**    NC\_NOX\_SENS\_CONF > 0  
                              **then**   every time  
                              **endif**

**Deactivation:**        NC\_NOX\_SENS\_CONF = 0

**Signal flow diagram:**



This signal flow diagram shows the calculation principle. For details see the "Formula section" below.

**Formula section:**

**if** (1)                                STATE\_NOX(n-1) = STOP  
      STATE\_NOX(n) = **NOT** (STOP)  
**then** (1)       NOX\_OUT\_MES\_INT[i] = 0  
**endif** (1)

**if** (2)        LC\_NOX\_OUT\_MES\_INT\_ACT = 1  
**then** (2)  
      **if** (3)                        STATE\_NOX(n) = LOAD                        **AND**  
          LV\_NOX\_SENS = 1                        **AND**  
          LV\_NOX\_NS\_VLD[i] = 1                        **AND**  
          LV\_ERR\_NS\_CAN\_MSG\_LOST\_[i] = 0                        **AND**  
          LV\_ERR\_NS\_OBD\_1[i] = 0                        **AND**  
          ( STATE\_ERR\_NS\_OBD\_2[i] **bitwise AND**  
            C\_ERR\_NS\_NOX\_OUT\_BIT\_SEL ) != 0

**then** (3)  
      **if** (4)        LV\_T\_NS\_VLD = 0  
      **then** (4)        NOX\_OUT\_MES[i] = 0  
      **else** (4)        NOX\_OUT\_MES[i] = NOX\_NS\_AD[i] \*  
  (MAF\_FG\_CYL / NC\_NOX\_SENS\_CONF) /  
  C\_NOX\_CONC\_COR


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```

endif (4)
NOX_OUT_MES_INT[i] (n) = NOX_OUT_MES_INT[i] (n-1) + NOX_OUT_MES[i] * re-
currence
(Internally calculation with higher resolution)
else (3)      NOX_OUT_MES_INT[i] (n) = NOX_OUT_MES_INT[i] (n-1)
endif (3)
else (2)      NOX_OUT_MES_INT[i] = 0
endif (2)

```

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## 7.89 NOx engine out emission adaptation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_NOX_AD_DYW	O/V	0... 1H	0...1	1	-
Logical value for active limited dynamics					
MAF_FG_CYL_MMV	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Moving mean value of mass air flow					
NOX_COR_S_MMV	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
Moving mean value of NOx emission					

### Input data:

C_MFF_SP_S_NT_AGI_MAX {p. 3108}	C_MFF_SP_S_NT_AGI_MIN {p. 3108}	C_N_32_NT_AGI_MAX {p. 3108}	C_N_32_NT_AGI_MIN {p. 3108}
LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LV_HOM_AFS_REQ {p. 8136}	LV_NOX_NS_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_PUC {p. 1720}
LV_T_NS_VLD {p. 3193}	MAF_FG_CYL {p. 1212}	MFF_SP_S {p. 8243}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}	NOX_COR_S {p. 2976}	STATE_NOX {p. 2986}
VS {p. 1176}			


### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_MAF_FG_CYL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant of air mass flow					
C_CRLC_NOX_AD	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant of NOx emission					
C_LAMB_NOX_AD_DYW	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda lthreshold for limited dynamics					
C_MAF_FG_CYL_DYW	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
air mass flow limit for limited dynamics					
C_MAF_MIN_RGN_NOX_AD	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Minimum mass air flow for use adaptation value					
C_N_32_MIN_RGN_NOX_AD	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for use adaptation value					
C_NOX_AD_DYW	-	0... FFFFH	0... 1023.98437	0.015625	mg/s
NOx emission limit for limited dynamics					
C_VS_MIN_RGN_NOX_AD	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed for use adaptation value					

### FUNCTION DESCRIPTION:

#### General information:

Number of NOx catalyst: NC\_NT\_NR  $i = 1 \dots NC\_NT\_NR$   
 Number of NOx sensors: NC\_NOX\_SENS\_CONF  $k = 1 \dots NC\_NOX\_SENS\_CONF$

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Number of lambda sensors: NC\_CBK\_EX\_NR m = 1...NC\_  
CBK\_EX\_NR

Typical configurations:

[NC\_CBK\_EX\_NR:NC\_NT\_NR:NC\_NOX\_SENS\_CONF] = [1:1:1], [2:2:2], [2:2:1], [2:1:1]

### 7.89.1 Limited Dynamics

Initialisation: -  
Recurrence: 20 ms  
Activation: at any state

#### Formula section:

```
if (1) STATE_NOX = STOP --> ISTOP % initialisation of LV_NOX_AD_DYW
then(1) LV_NOX_AD_DYW = 1
        NOX_COR_S_MMV (n) = NOX_COR_S
endif(1)
```

$$\text{MAF\_FG\_CYL\_MMV (n)} = \text{MAF\_FG\_CYL\_MMV (n-1)} * (1 - \text{C\_CRLC\_MAF\_FG\_CYL}) + \text{C\_CRLC\_MAF\_FG\_CYL} * \text{MAF\_FG\_CYL}$$

Limited dynamics for stratified operation:

```
if(1) STATE_NOX = LOAD and LV_HOM_AFS_REQ = 0 %monitoring limited dynamics during stratified mode
then(1)
NOX_COR_S_MMV (n) = NOX_COR_S_MMV (n-1) * (1 - C_CRLC_NOX_AD) +
                    C_CRLC_NOX_AD * NOX_COR_S
    if(2) |NOX_COR_S - NOX_COR_S_MMV| > C_NOX_AD_DYW or
          (LV_NOX_NS_VLD[k] = 0 and LV_T_NS_VLD = 1)
        % valid if any condition for [k] is true
        or LAMB_LS_UP[m] < C_LAMB_NOX_AD_DYW
        % valid if any condition for [m] is true
    or N_32 <= C_N_32_NT_AGI_MIN
        or N_32 >= C_N_32_NT_AGI_MAX
        or MFF_SP_S <= C_MFF_SP_S_NT_AGI_MIN
        or MFF_SP_S >= C_MFF_SP_S_NT_AGI_MAX
    then(2) LV_NOX_AD_DYW = 0
    else(2) LV_NOX_AD_DYW remains unchanged
    endif(2)
else(1) LV_NOX_AD_DYW remains unchanged
endif(1)
```

Limited dynamics for regeneration:


```
if(1) STATE_NOX = REGENERATION %monitoring limited dynamics during stratified mode
then(1)
    if(2) |MAF_FG_CYL - MAF_FG_CYL_MMV| > C_MAF_FG_CYL_DYW
        or VS C_VS_MIN_RGN_NOX_AD
    or N_32 < C_N_32_MIN_RGN_NOX_AD
    or MAF_FG_CYL < C_MAF_MIN_RGN_NOX_AD
```

```

or          LV_PUC = 1
then(2)     LV_NOX_AD_DYW = 0
else(2)     LV_NOX_AD_DYW remains unchanged
endif(2)
else(1) LV_NOX_AD_DYW remains unchanged
endif(1)

```

*chapter 1.2 and 1.3 deleted*

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## 7.90 NOx catalyst aging

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_NT_AGI_AD	V	0... FEH	0... 254	1	-
counter of aging adaptation attempts (with closed EGR valve)					
CTR_NT_AGI_AD_CMPL	O/V	0... FEH	0... 254	1	-
counter of completed aging adaptation cycles during driving cycle					
CTR_NT_AGI_AD_CMPL_SUM	O/V/S	0... FFFFH	0... 65535	1	-
counter of completed aging adaptation					
CTR_NT_AGI_SO2P_FQ	O/V/S	0... FFFFH	0... 65535	1	-
counter of completed aging adaptation during FQ adaptation					
DIF_CTR_NT_AGI_CMPL_SUM	V	0... FFFFH	0... 65535	1	-
Completed aging adaptation due to FQ adaptation					
FAC_NT_AGI_LIM	O/V/S	0... FFFFH	0... 0.99998474	15.2587e-6	-
Limited NOx trap aging factor					
FAC_NT_AGI_THERMO_SNG [NC_NT_NR]	O/V	0... FFFFH	0... 0.99998474	15.2587e-6	-
Temporary aging factor					
FAC_SU_CONC_FUEL	O/V	0... FFH	0... 255	1	-
Interface factor to sulphur model for calibrating fuel sulphur concentration					
LV_AGI_AD_TRIG	V	0... 1H	0 ...1	1	-
Logical value for the request of adaptaion of aging factor					
LV_AGI_VLD	O/V	0... 1H	0 ...1	1	-
Logical value for completed aging adaption					
LV_CDN_NT_AGI_THERMO_AD	O/V	0... 1H	0 ...1	1	-
flag: thermal aging adaptation enabled (due to low sulphur load)					
LV_EGR_RATIO_SP_AGI_ACT	O/V	0... 1H	0 ...1	1	-
request to close EGR valve for better NT aging adaptation performance					
LV_NOX_NS_SIG_CHK_NT_AGI	V	0... 1H	0 ...1	1	-
Check of the NOx signal shift and gain adaptation					
LV_NT_AFS_REQ_AGI	O/V/S	0... 1H	0 ...1	1	-
Logical value for the request of lambda=1 operation					
LV_NT_AFS_REQ_AGI_TMP_1	V	0... 1H	0 ...1	1	-
Logical value for the request of lambda=1 operation					
LV_NT_AFS_REQ_AGI_TMP_2	V	0... 1H	0 ...1	1	-
Logical value for the request of lambda=1 operation					
LV_NT_AFS_REQ_AGI_TMP_3	O/V/S	0... 1H	0 ...1	1	-
Logical value for the request of lambda =1 operation					
LV_NT_AGI_BAS_ENA	V	0... 1H	0 ...1	1	-
basic aging factor calculation enabled					
LV_NT_AGI_ENA	O/V	0... 1H	0 ...1	1	-
aging factor (sulphur or thermal) calculation enabled					
LV_NT_AGI_ENA_AFS	O/V	0... 1H	0 ...1	1	-
value for HOM_REQ befor aging adaptation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_NT_AGI_ENA_AFS_TMP	O/V	0... 1H	0 ...1	1	-
Temporary value for HOM_REQ before aging adaptation					
LV_NT_AGI_ENA_TMP	V	0... 1H	0 ...1	1	-
temporary value for LV_NT_AGI_ENA calculation					
LV_NT_AGI_ENA_TNT	V	0... 1H	0 ...1	1	-
temperature initialisation condition for aging adaptation given					
LV_NT_AGI_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
External data for NOx trap aging values available					
LV_NT_AGI_EXT_RES	O/V	0... 1H	0 ...1	1	-
External reset of data for NOx trap aging values					
LV_NT_AGI_TRIG_ENA	V	0... 1H	0 ...1	1	-
Enabling of trigger for aging calculation					
LV_SO2P_REQ_1	O/V/S	0... 1H	0 ...1	1	-
Request of a desulfation					
LV_SO2P_REQ_2	O/V/S	0... 1H	0 ...1	1	-
Request of a desulfation (forces catalyst heating)					
LV_SO2P_REQ_FQ	O/V/S	0... 1H	0 ...1	1	-
Logical value for active FQ adaptation					
LV_SWI_MDL_THERMO_AGI_ACT	V	0... 1H	0 ...1	1	-
Switch to modeled aging factor before sulphur aging model calculation active					
NOX_EFF [NC_NT_NR]	V	0... FFFFH	0... 0.99998474	15.2587e-6	-
actual NOx trap efficiency (not defined in binary Lambda-Sensor mode) (bench selective)					
NT_AGI	O/V/S	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx trap aging factor					
NT_AGI_BAS [NC_NT_NR]	O/V	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx trap aging factor base value (not defined in binary Lambda-Sensor mode)					
NT_AGI_NTLD	O/V	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx trap aging factor					
NT_AGI_OBS	O/V	0... FFFFH	0... 0.99998474	15.2587e-6	-
quick aging monitoring value					
NT_AGI_OBS_SNG [NC_NT_NR]	O/V	0... FFFFH	0... 0.99998474	15.2587e-6	-
quick aging monitoring value (bench selective)					
NT_AGI_S_RED	O/V	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx trap aging factor					
NT_AGI_SO2P_FQ	V	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx trap aging factor					
NT_AGI_SO2P_FQ_SUM	O/V/S	0... FFFFFFFH	0... 255.999985	15.2587e-6	-
Sum of NOx trap aging factor during FQ adaptation					
NT_AGI_SUL	O/V/S	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx trap aging factor due to sulphur load					
NT_AGI_SUL_SNG [NC_NT_NR]	O/V/S	0... FFFFFFFFH	0 ...1	232.83e-12	-
NOx trap aging factor due to sulphur load (bench selective)					
NT_AGI_THERMO	O/V/S	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx trap aging factor due to thermal aging					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NT_AGI_THERMO_SNG [NC_NT_NR]	O/V/S	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx trap aging factor due to thermal aging (bench selective)					
NT_SUL_AGI	O/V	0... FFFFH	0... 10485.6	0.16	mg
Interface variable for update of sulphur release model by aging function					
NT_SUL_AGI_SNG [NC_NT_NR]	O/V	0... FFFFH	0... 10485.6	0.16	mg
Interface variable for update of sulphur release model by aging function (bench selective)					
NT_SUL_UPD	O/V	0... FFFFH	0... 10485.6	0.16	mg
interface variable for update of sulphur model by aging function					
NTLD_AGI [NC_NT_NR]	V	0... FFFFH	0... 0.99998474	15.2587e-6	-
"reverse" NOx trap loading degree					
STATE_NOX_OLD_AGI	-	0H 1H 2H 3H 4H 5H	PASSIV LOAD REGENERATION WAIT STOP WARMUP	-	-
Old value of STATE_NOX for edge detection					

**Input data:**

C_NT_STC_BAS_MAX_RNG_H {p. 2991}	CTR_NT_AGI_AD_CMPL_SUM_EXT_ADJ {p. 7679}	CTR_NT_AGI_SO2P_FQ_EXT_ADJ {p. 7679}	DIST_NS_NEW {p. 3193}
DIST_NT {p. 3180}	FAC_NOX_NS_AD [NC_NOX_SENS_CONF] {p. 3189}	FAC_NT_AGI_LIM_EXT_ADJ {p. 7680}	FAC_NT_AGI_MDL_THERMO {p. 3437}
LC_NOX_RGN_CMPL {p. 997}	LV_EF {p. 3614}	LV_ERR_NS_OBD_1 [NC_NOX_SENS_CONF] {p. 4915}	LV_INH_NT_AGI {p. 3107}
LV_INH_NT_AGI_BAS {p. 3107}	LV_INH_NT_AGI_TNT_BAS {p. 3107}	LV_NOX_AD_CMPL {p. 996}	LV_NOX_SENS {p. 2982}
LV_NOX_SENS_NOX_VLD_RGN_ST [NC_NT_NR] {p. 2982}	LV_NT_AFS_REQ_AGI_TMP_3_EXT_ADJ {p. 7680}	LV_NT_AGI_INI_EXT_ADJ_NEW_CAT {p. 804}	LV_NT_AGI_OBS_EGR_ENA {p. 3107}
LV_NT_AGI_OBS_ENA {p. 3107}	LV_NT_HOM_INI {p. 2982}	LV_NT_SO2P_EXT_ADJ_ACT {p. 3144}	LV_RGN_REQ_NOX_SENS {p. 2983}
LV_RGN_REQ_NTLD {p. 2983}	LV_S_ACT {p. 8137}	LV_SO2P_ACT {p. 3129}	LV_SO2P_REQ {p. 3129}
LV_SO2P_REQ_2_EXT_ADJ {p. 7680}	LV_SO2P_REQ_FQ_EXT_ADJ {p. 7680}	LV_SUL_EXT_ADJ {p. 3113}	LV_SUL_EXT_RES {p. 3113}
NC_NOX_SENS_CONF {p. 643}	NC_NT_NR {p. 644}	NOX_CONC_RED_MMV_RGN_ST {p. 2984}	NOX_NS_AD_RGN_ST [NC_NT_NR] {p. 2984}

NT_AGI_AV {p. 2985}	NT_AGI_INC_SO2P [NC_NT_NR] {p. 3113}	NT_AGI_SO2P_FQ_SUM_ EXT_ADJ {p. 7682}	NT_AGI_SUL_SNG_EXT_ ADJ [NC_NT_NR] {p. 7682}
NT_AGI_THERMO_SNG_ EXT_ADJ [NC_NT_NR] {p. 7682}	NT_EFF_COR_RGN_ST {p. 2985}	NT_STC_BAS_RNG_H {p. 2985}	NT_SUL {p. 3113}
NT_SUL_H {p. 3113}	NTL_RGN_ST_NOX {p. 2986}	NTLD {p. 2986}	NTLD_MDL {p. 2986}
RATIO_MMV_NS_SHIFT_ DIAG [NC_NOX_SENS_CONF] {p. 6412}	STATE_ERR_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}	STATE_NOX {p. 2986}	T_AFL {p. 2987}
TNT_MDL_MV {p. 8237}	VS {p. 1176}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_NT_AGI_OBS	-	0... FFFFH	0... 0.99998	15.3e-6	-
filter constant for NT_AGI_OBS calculation					
C_CRLC_NT_AGI_SUL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for the calculation of the aging factor due sulphur load					
C_CRLC_NT_AGI_THERMO_DEC	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for the calculation of the thermal aging factor (decreasing factor)					
C_CRLC_NT_AGI_THERMO_INC	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for the calculation of the thermal aging factor (increasing factor)					
C_CTR_NT_AGI_AD_CMPL_MAX	-	0... FFH	0... 255	1	-
max. number of successful adapt. per cycle					
C_CTR_NT_AGI_AD_MAX	-	0... FFH	0... 255	1	-
max. number of attempts for adaptation (incl. successful attempts)					
C_CTR_NT_AGI_SO2P_FQ_MIN	-	0... FFFFH	0... 65535	1	-
Counter threshold for aging adaptation after FQ-desulfation					
C_DIST_NT_AGI_LIM	-	0... FFFFH	0... 524280	8	km
mileage threshold for limited NOx trap aging factor					
C_DIST_NT_AGI_MDL_1	-	0... FFFFH	0... 524280	8	km
Threshold of distance for switching to modeled factor					
C_DIST_NT_AGI_MDL_2	-	0... FFFFH	0... 524280	8	km
Threshold of distance for switching to modeled factor, included sulfur model					
C_FAC_AGI_THD_SENS_DIF_MDL_1	-	0... FFFFH	0... 0.99998	15.3e-6	-
Threshold for difference between aging factors					
C_FAC_AGI_THD_SENS_DIF_MDL_2	-	0... FFFFH	0... 0.99998	15.3e-6	-
Threshold for difference between aging factors, including sulfur model					
C_FAC_NOX_NS_AD_AGI_MDL_MAX	-	0... FFFFH	0... 127.99804	1.9531e-3	-
Maximal threshold of NOx signal gain adaptation to switch to modeled aging factor					
C_FAC_NOX_NS_AD_AGI_MDL_MIN	-	0... FFFFH	0... 127.99804	1.9531e-3	-
Minimal threshold of NOx signal gain adaptation to switch to modeled aging factor					
C_FAC_NT_AGI_MDL_ACT_1	-	0... FFFFH	0... 0.99998	15.3e-6	-
Threshold of NT aging for switching to modeled factor					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_NT_AGI_MDL_ACT_2	-	0... FFFFH	0... 0.99998	15.3e-6	-
Threshold of NT aging for switching to modeled factor, included sulfur model					
C_FAC_SU_CONC_FUEL	-	0... FFH	0... 255	1	-
Interface factor to sulphur model for calibrating fuel sulphur concentration					
C_NOX_RGN_ST_MAX_AGI	-	0... 05DCH	0... 1500	1	ppm
max. NOx sensor signal threshold for enabling an aging adaptation					
C_NOX_RGN_ST_MIN_AGI	-	0... 05DCH	0... 1500	1	ppm
min. NOx sensor signal threshold for enabling an aging adaptation					
C_NT_AGI_1	-	0... FFFFH	0... 0.99998	15.3e-6	-
NOx trap aging factor threshold for the desulfation request 1					
C_NT_AGI_2	-	0... FFFFH	0... 0.99998	15.3e-6	-
NOx trap aging factor threshold for the desulfation request 2					
C_NT_AGI_3	-	0... FFFFH	0... 0.99998	15.3e-6	-
NOx trap aging factor threshold for the request of lambda=1 operation					
C_NT_AGI_INI [NC_NT_NR]	-	0... FFFFH	0... 0.99998	15.3e-6	-
NOx trap aging factor initializing value (branch selective)					
C_NT_AGI_NTLD_MAN	-	0... FFFFH	0... 0.99998	15.3e-6	-
Manual set of NT_AGI_NTLD					
C_NT_AGI_OBS_MIN	-	0... FFFFH	0... 0.99998	15.3e-6	-
aging monitoring minimum threshold to request lambda=1 operation					
C_NT_AGI_OBS_MIN_2	-	0... FFFFH	0... 0.99998	15.3e-6	-
aging monitoring minimum threshold 2 to request I 1 operation					
C_NT_AGI_OBS_MIN_EGR_ERR	-	0... FFFFH	0... 0.99998	15.3e-6	-
aging monitoring minimum threshold to request I 1 operation if EGR valve stuck close					
C_NT_AGI_OBS_MIN_IS	-	0... FFFFH	0... 0.99998	15.3e-6	-
aging monitoring minimum threshold to request lambda=1 operation during idle speed					
C_NT_AGI_S_RED_MAN	-	0... FFFFH	0... 0.99998	15.3e-6	-
Manual set of NT_AGI_S_RED					
C_NT_AGI_THERMO_SO2P_FQ_INI	-	0... FFFFH	0... 0.99998	15.3e-6	-
Initial aging value after FQ-desulfation					
C_NT_SUL_MAX_1	-	0... FFFFH	0... 10485.6	0.16	mg
sulphur model threshold to request set desulfation request 1					
C_NT_SUL_MAX_DEAC	-	0... FFFFH	0... 10485.6	0.16	mg
sulphur model threshold to request reset desulfation request 2 during active desulfation					
C_NT_SUL_SO2P_FQ	-	0... FFFFH	0... 10485.6	0.16	mg
sulphur model value to start FQ-desulfation					
C_NTLD_SO2P_FQ	-	0... FFFFH	0... 0.99998	15.3e-6	-
NOx loading degree to stop aging adaptation after FQ-desulfation					
C_NTLD_TRIG_AGI_MAX_RGN_NS	-	0... FFFFH	0... 0.99998	15.3e-6	-
Maximum NOx trap loading degree for aging calculation at regeneration request by NOx sensor					
C_NTLD_TRIG_AGI_MAX_RGN_NTLD	-	0... FFFFH	0... 0.99998	15.3e-6	-
Maximum NOx trap loading degree for aging calculation at regeneration request by NTLD threshold					
C_NTLD_TRIG_AGI_MIN_RGN_NS	-	0... FFFFH	0... 0.99998	15.3e-6	-
Minimum NOx trap loading degree for aging calculation at regeneration request by NOx sensor					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NTLD_TRIG_AGI_MIN_RGN_NTLD	-	0... FFFFH	0... 0.99998	15.3e-6	-
Minimum NOx trap loading degree for aging calculation at regeneration request by NTLD threshold					
C_RATIO_NS_SHIFT_AGI_MDL_MAX	-	8000... 7FFFH	-1... 0.99996	30.5e-6	-
Maximal threshold of NOx signal shift to switch to modeled aging factor					
C_RATIO_NS_SHIFT_AGI_MDL_MIN	-	8000... 7FFFH	-1... 0.99996	30.5e-6	-
Minimal threshold of NOx signal shift to switch to modeled aging factor					
C_STATE_ERR_NS_MDL_SWI	-	0... FFFFH	0... 65535	1	-
Choice of OBD 2 diagnosis for switching from sensor to model					
C_STATE_NT_AGI_NTLD	-	0H	ALL	-	-
		1H	THERMO		
		2H	SUL		
		3H	MAN		
		4H	LIM		
Mode to switch NT_AGI_NTLD					
C_STATE_NT_AGI_S_RED	-	0H	ALL	-	-
		1H	THERMO		
		2H	SUL		
		3H	MAN		
		4H	LIM		
Mode to switch NT_AGI_S_RED					
C_SUL_THD_AGI_THERMO	-	0... FFFFH	0... 10485.6	0.16	mg
threshold for reset of thermal aging adaptation /SUL no more neglectable					
C_T_AFL_MAX_AGI_ENA	-	0... FFFFH	0... 1310.7	0.02	s
maximum lean phase time without aging enabling bit yet set					
C_TNT_MDL_AGI_ENA_TNT	-	0... FFH	0... 1020	4	°C
threshold for temperature initialisation condition					
C_TNT_MDL_NT_AGI_OBS_INI	-	0... FFH	0... 1020	4	°C
threshold for resetting the quick aging monitoring values					
C_VS_OBS_MIN	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold to switch aging monitoring					
ID_FAC_NT_AGI_DIF_NS	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_DIST_NS_DIF_ID_FAC_NT_AGI	6	0... FFFFH	0... 524280	8	km
Safety margin for aged NOx sensor for thermal NT aging factor derived from NOx sensor					
IP_FAC_NT_AGI	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_TNT_MDL_MV_IP_FAC_NT_AGI	6	0... FFFFH	0... 1023.98437	0.015625	°C
Correction factor for NT_AGI depending on NOx catalyst temperature					
IP_NT_AGI_NT_SUL	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_NT_SUL_IP_NT_AGI_NT_SUL	6	0... FFFFH	0... 10485.6	0.16	mg
Correlation sulphur loading - aging factor due sulphur load					
IP_NT_SUL_H_MIN	-	0... FFFFH	0... 10485.6	0.16	mg
LDPM_NT_AGI_THERMO	6	0... FFFFH	0... 0.99998	15.3e-6	-
NOx Trap sulphur loading threshold (for high sulphured fuel) for desulfation request 2					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_NT_SUL_MAX_2	-	0... FFFFH	0... 10485.6	0.16	mg
LDPM_NT_AGI_THERMO	6	0... FFFFH	0... 0.99998	15.3e-6	-
sulphur model threshold to request set desulfation request 2					
IP_NT_SUL_MAX_2_DEAC	-	0... FFFFH	0... 10485.6	0.16	mg
LDPM_NT_AGI_THERMO	6	0... FFFFH	0... 0.99998	15.3e-6	-
sulphur model threshold to request reset desulfation request 2					
IP_NT_SUL_MAX_3	-	0... FFFFH	0... 10485.6	0.16	mg
LDPM_NT_AGI_THERMO	6	0... FFFFH	0... 0.99998	15.3e-6	-
sulphur model threshold to request l 1 operation					
IP_NT_SUL_NT_AGI	-	0... FFFFH	0... 10485.6	0.16	mg
LDP_NT_AGI_SUL_IP_NT_SUL_NT_AGI	6	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation aging factor due sulphur load - sulphur loading					
IP_NTLD_AGI	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_NOX_EFF	2	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_TNT_MDL_NOX_NT	2	0... FFFFH	0... 1023.98437	0.015625	°C
NOx trap loading degree , has to be inverse to IP_NT_EFF_BAS					
IP_NTLD_AGI_EF_CLOSE	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_NOX_EFF	2	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_TNT_MDL_NOX_NT	2	0... FFFFH	0... 1023.98437	0.015625	°C
NOx trap loading degree , has to be inverse to IP_NT_EFF_BAS_EF_CLOSE					
LC_AGI_AD_TRIG_MAN	-	0... 1H	0 ...1	1	-
Manual trigger for starting aging adaption					
LC_ENA_SUL_UPD	-	0... 1H	0 ...1	1	-
Logical constant to enable adaptation between sulfur modell and aging factor detemination					
LC_NOX_AD_CMPL_OFF	-	0... 1H	0 ...1	1	-
switch to ignore NOx raw emission adaptation					
LC_NT_AGI_AD_CTR_RST_TNT	-	0... 1H	0 ...1	1	-
switch for resetting the adaptation cycle counters depending on NT temperature					
LC_NT_AGI_EGR_CLOSE	-	0... 1H	0 ...1	1	-
switch: close EGR during aging adaptation					
LC_NT_AGI_INI_MAN	-	0... 1H	0 ...1	1	-
Manual reset of the logical variables for desulfation					
LC_NT_AGI_MAN	-	0... 1H	0 ...1	1	-
Logical constant for manual switch of aging factor determination					
LC_NT_AGI_MIN	-	0... 1H	0 ...1	1	-
Logical constant for selecting NT_AGI					
LC_NT_AGI_NT_SUL_MPG	-	0... 1H	0 ...1	1	-
Logical constant to enable calibration of NT_SUL with aging determination					
LC_NT_AGI_OBS_INI	-	0... 1H	0 ...1	1	-
switch for manual initialisation of quick aging monitoring values					
LC_NT_AGI_SUL_INI	-	0... 1H	0 ...1	1	-
NOx trap aging factor due sulphur load initializing value (branch selective)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_NT_AGI_THERMO_INI	-	0... 1H	0 ...1	1	-
NOx trap aging factor due thermal aging initializing value (branch selective)					
LC_SUL_SWI_1_THERMO_ACT	-	0... 1H	0 ...1	1	-
Manual activation of switching to modeled aging factor at calculation of sulphur aging					
LC_SUL_THERMO_COR	-	0... 1H	0 ...1	1	-
Logical constant for switching between absolut and relativ NT_SUL					
LC_SUL_UPD	-	0... 1H	0 ...1	1	-
Logical constant to enable calibration of NT_AGI_SUL with sulfur modell					

## Action definition

<b>ACTION_NOXM_CleanNTAdaptAgi ()</b>	Mode: O
Initialization of NOx trap adaptation values of aging module	

<b>ACTION_NOXM_WriteAgingExtAdj ()</b>	Mode: O
New external values for aging calculation available	

## General information

The NOx catalyst aging function can handle single branched and twin branched exhaust gas lines with the configuration data NC\_NT\_NR defined in the NOx catalyst management module.

If NC\_NT\_NR=1, just one exhaust line is taken into account, if NC\_NT\_NR=2, the software calculates the twin branch version.

i characterises the variable of branches which can be counted up

The NOx storage catalyst loses its storage capacity due to thermal aging and sulfur poisoning.

The aging is determined by the NOx-signal of a NOx-sensor, mounted downstream the NOx catalyst. The information, which kind of sensor is installed is included in LV\_NOX\_SENS.

The aging state of the catalyst is evaluated by an aging factor NT\_AGI\_SNG\_i. The value of this factor is 1 in the case of a fresh catalyst, a value near zero indicates a destroyed catalyst. The resulting aging factor NT\_AGI is the minimum of all existing NT\_AGI\_SNG\_i.

The aging factors NT\_AGI\_SNG\_i mainly will be decreased by the aging determination in this routine. Due to desulfation, the aging state of the catalyst can be improved (storage capacity increases). This increase is calculated by the desulfation function and passed to the aging function by NT\_AGI\_INC\_SO2P. This value is set to 0 if no desulfation is active, otherwise it includes the incrementation of the aging factor per time step. This increment is added to the aging factor at every call of the aging function.

Handling of the aging states

When the resulting aging factor NT\_AGI falls below the threshold C\_NT\_AGI\_1 the desulfation request bit LV\_SO2P\_REQ\_1 is set.

When the aging factor falls below the threshold C\_NT\_AGI\_2 the desulfation request bit LV\_SO2P\_REQ\_2 is set, this means an active catalyst heating is required.


When the aging factor falls below the threshold C\_NT\_AGI\_3 a desulfation is requested. If this desulfation is not successful lean operation has to be forbidden, the request bit LV\_NT\_AFS\_REQ\_AGI for lambda=1 operation due to aging state is set.

The request for a desulfation or for operation in lambda=1 mode can be manually reseted by LC\_NT\_AGI\_INI\_MAN, in this case NT\_AGI\_SNG\_i is initialized with C\_NT\_AGI\_INI\_i.

The values NT\_AGI, NT\_AGI\_i have to be stored in the non-volatile memory.

Calculation of the base aging factor

The basis aging factor is determined by the NOx-signal of the NOx-Sensor NOX\_PPM\_i and the calculated reduced NOx raw emissions NOX\_CONC\_RED. In the moment the first NOx-Sensor detects

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an inadmissible high NOx concentration downstream the NOx catalyst and as a consequence LV\_RGN\_REQ\_NOX\_SENS is switched from 0 to 1, the actual storage capacity is calculated and compared with the base storage capacity of a fresh catalyst. The aging factor is calculated using the ratio of the actual storage capacity and the base storage capacity NT\_STC. The calculation is carried out once when the regeneration starts.

Signal flow diagram

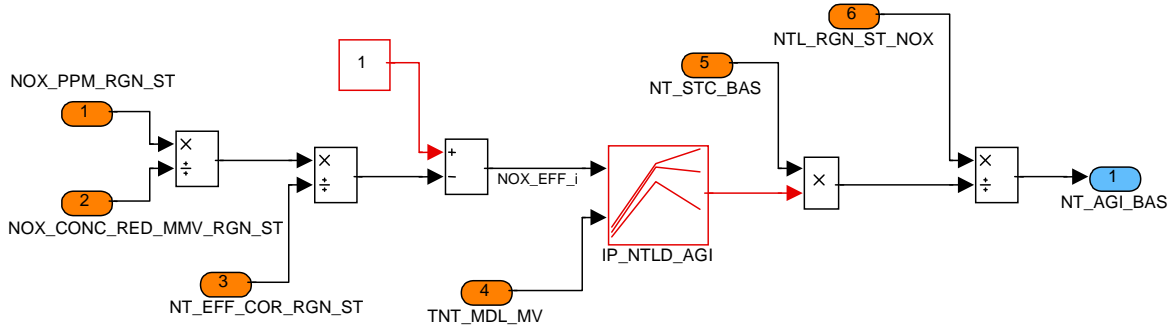


Figure 7.90.1: : Aging factor calculation // NOx- Sensor installed

**Application Condition**

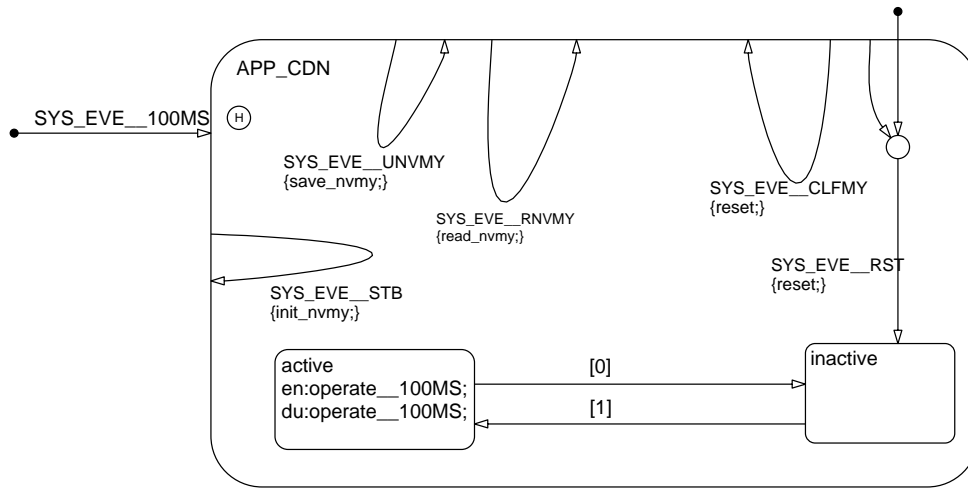


Figure 7.90.2: NOXM\_MODUL703P/APP\_CDN/Chart

**Function Description**

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
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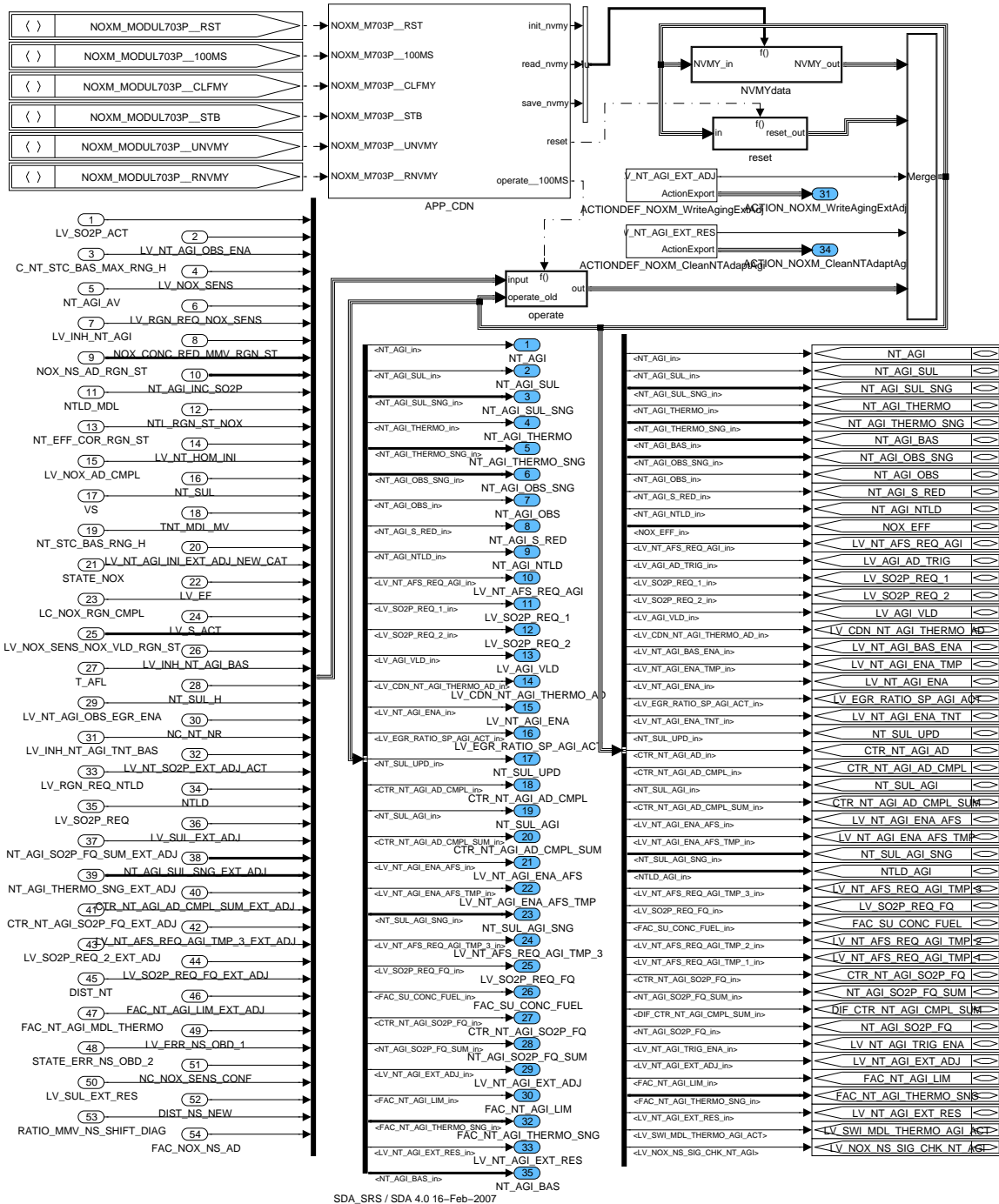



Figure 7.90.3: NOXM\_MODUL703P

### 7.90.1 SUBFUNCTION: ACTIONDEF\_NOXM\_CleanNTAdaptAgi

#### Description for ACTION\_NOXM\_CleanNTAdaptAgi

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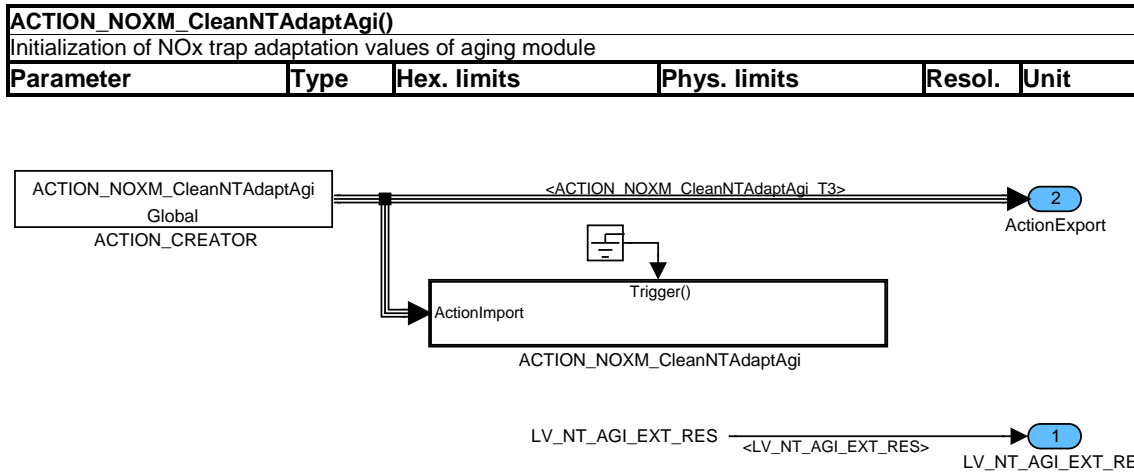


Figure 7.90.4: NOXM\_MODUL703P/ACTIONDEF\_NOXM\_CleanNTAdaptAgi

The flag LV\_NT\_AGI\_EXT\_RES is set by this action. It shows that the non-volatile values have to be reset inside next 100 ms recurrence (if sulfur model values are already set to zero).



Figure 7.90.5:  
NOXM\_MODUL703P/ACTIONDEF\_NOXM\_CleanNTAdaptAgi/ACTION\_NOXM\_CleanNTAdaptAgi

## 7.90.2 SUBFUNCTION: ACTIONDEF\_NOXM\_WriteAgingExtAdj

### Description for ACTION\_NOXM\_WriteAgingExtAdj

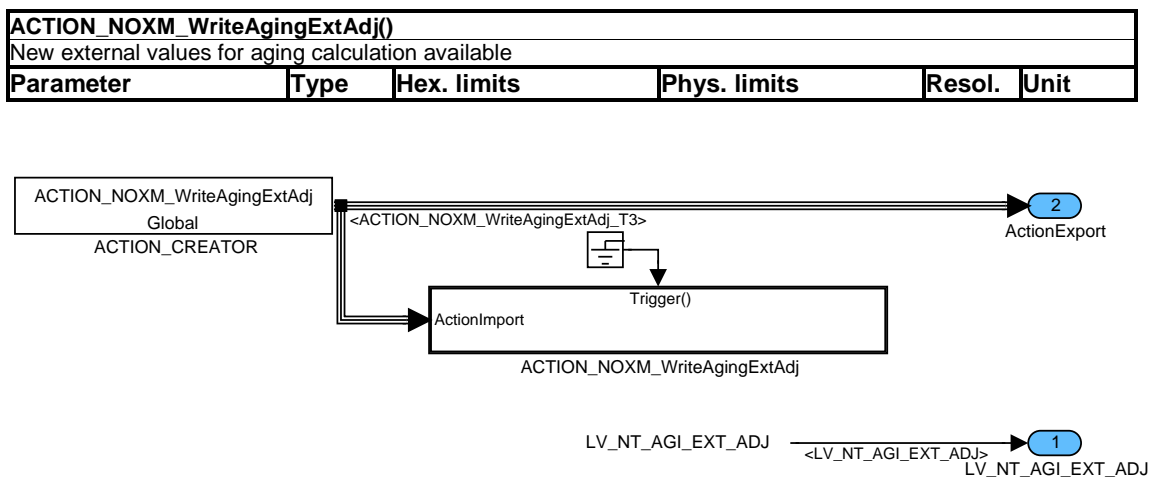


Figure 7.90.6: NOXM\_MODUL703P/ACTIONDEF\_NOXM\_WriteAgingExtAdj



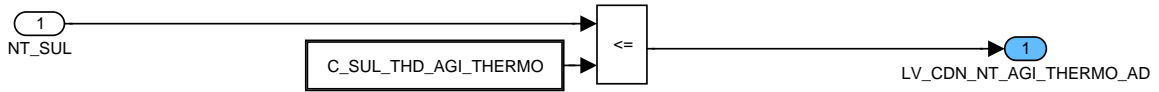


Figure 7.90.9: NOXM\_MODUL703P/operate/START/CLC1

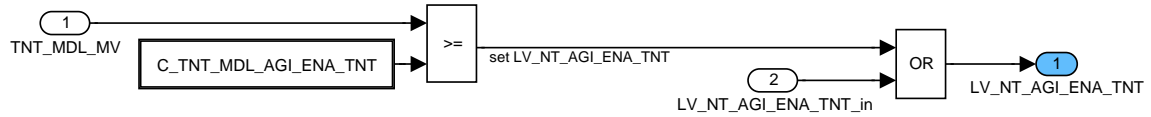


Figure 7.90.10: NOXM\_MODUL703P/operate/START/CLC2

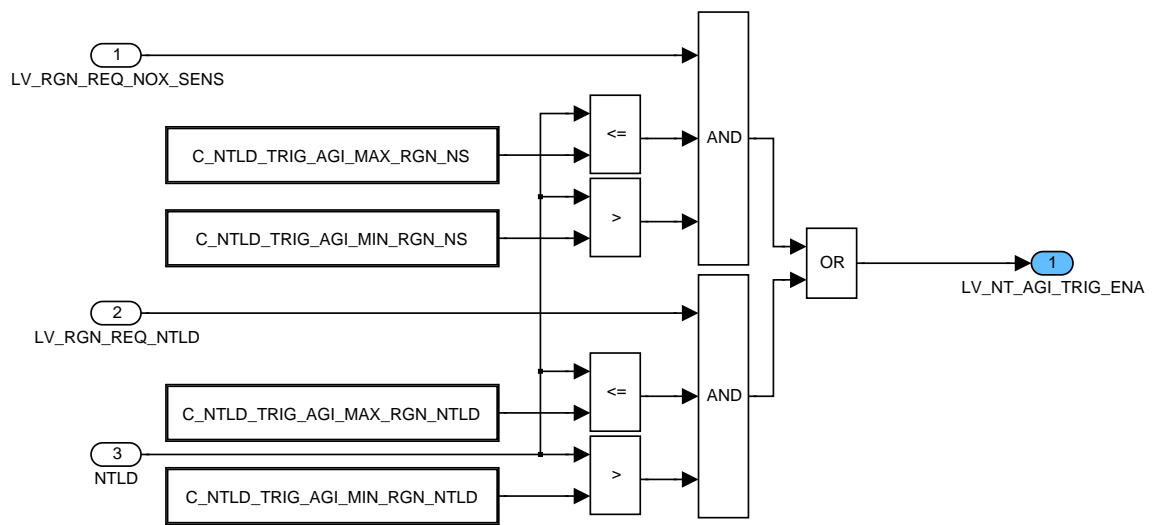


Figure 7.90.11: NOXM\_MODUL703P/operate/START/CLC3

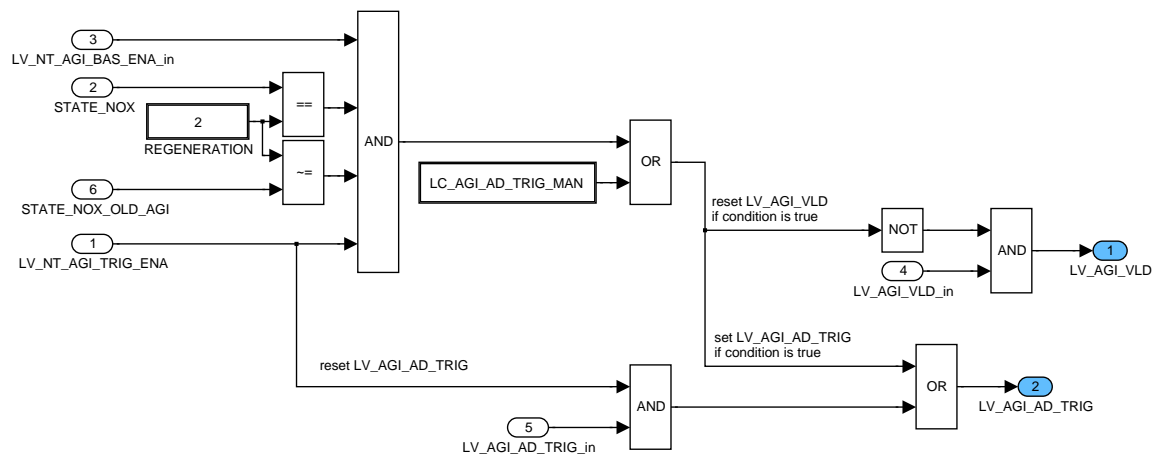


Figure 7.90.12: NOXM\_MODUL703P/operate/START/CLC4

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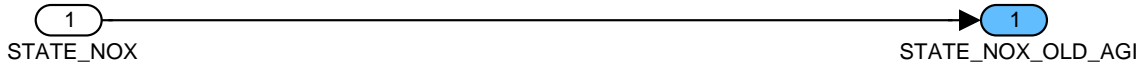


Figure 7.90.13: NOXM\_MODUL703P/operate/START/CLC5

**MANUAL\_INIT: Manual initialisation of sulphur and thermal aging factors**

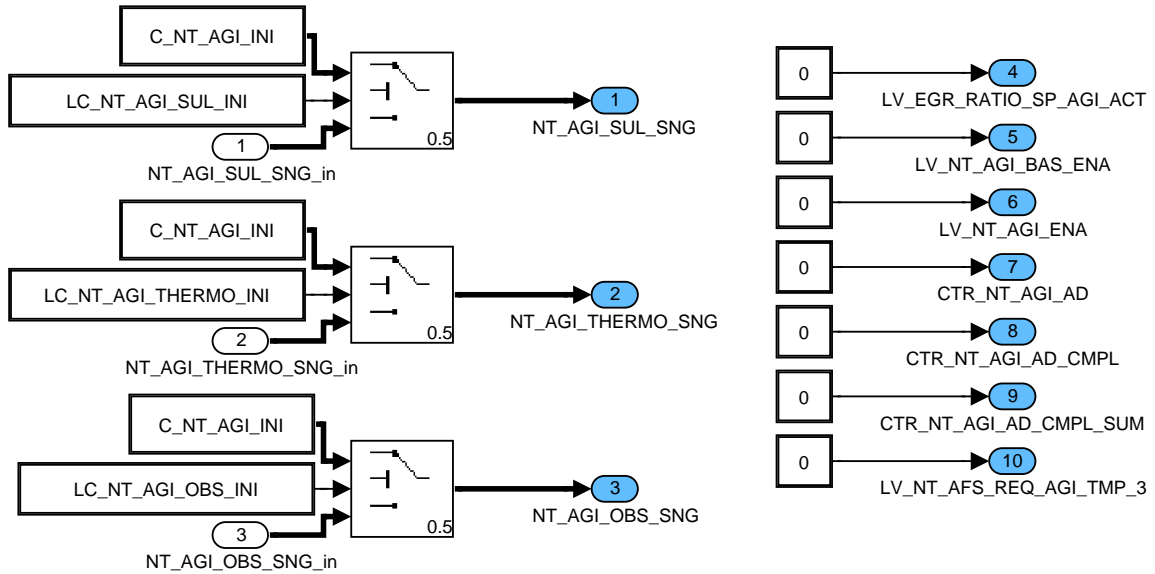


Figure 7.90.14: NOXM\_MODUL703P/operate/MANUAL\_INIT/CLC

**Check result of the NOx signal shift diagnosis an gain adaptation**

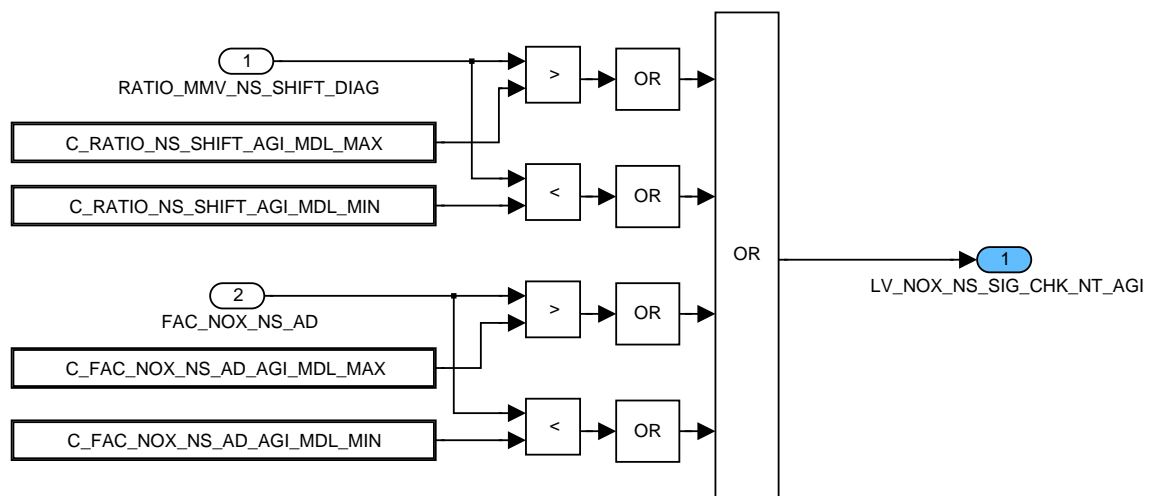


Figure 7.90.15: NOXM\_MODUL703P/operate/MAIN/CBK/CHK\_RATIO

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### Calculation of LV\_SWI\_MDL\_THERMO\_AGI\_ACT

Calculation of Switch to modeled aging factor before sulphur aging model calculation is active

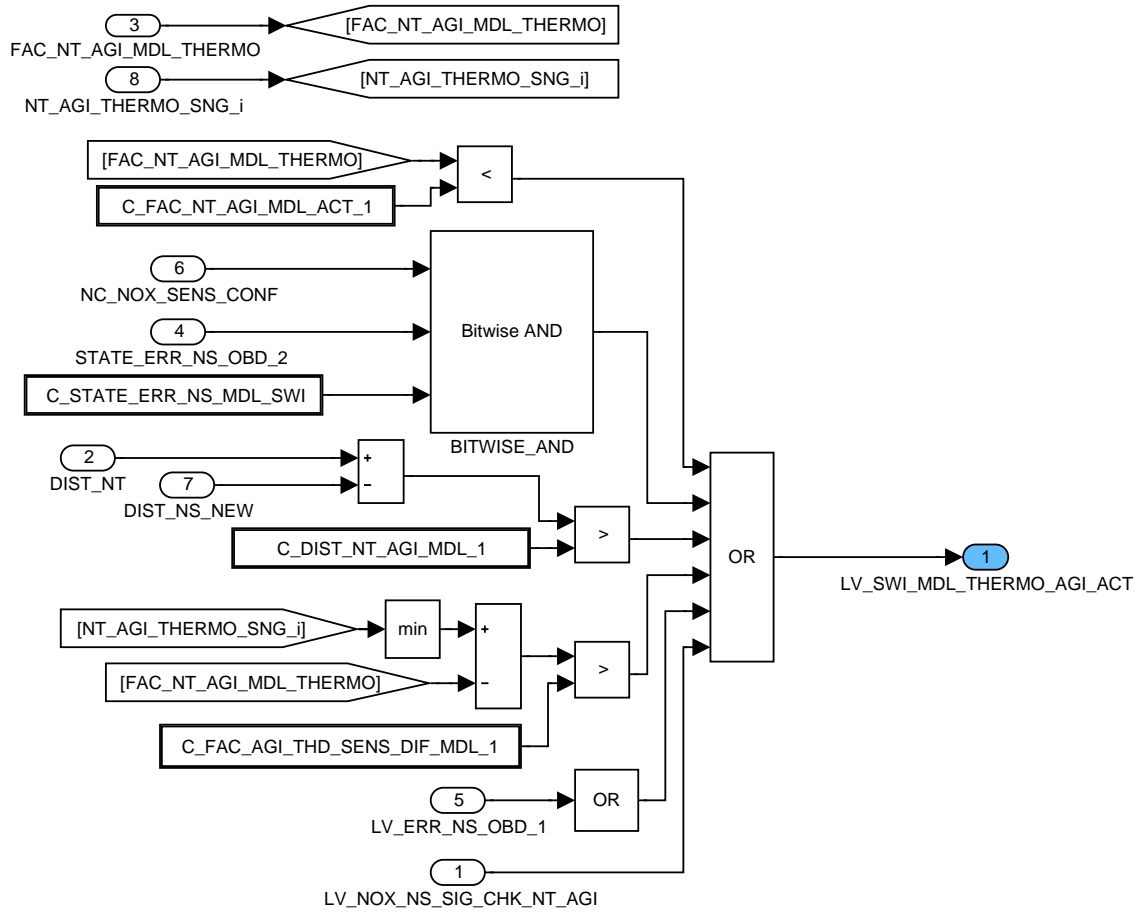


Figure 7.90.16: NOXM\_MODUL703P/operate/MAIN/CBK/CLC\_LV\_SWI

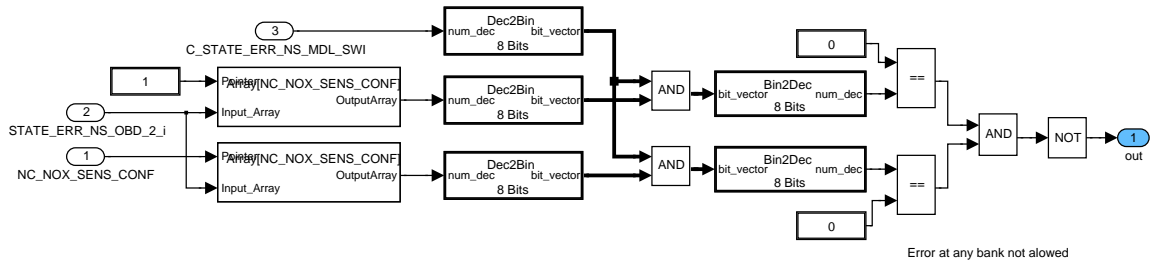


Figure 7.90.17: NOXM\_MODUL703P/operate/MAIN/CBK/CLC\_LV\_SWI/BITWISE\_AND

### MAIN (for each NOx trap)

The following calculation will be done for each NOx trap, controlled by NC\_NT\_NR.

Aging calculation will only be done if a rising edge of the trigger signal LV\_AGI\_AD\_TRIG occurs and the NOx sensor reaches a threshold at start of regeneration.

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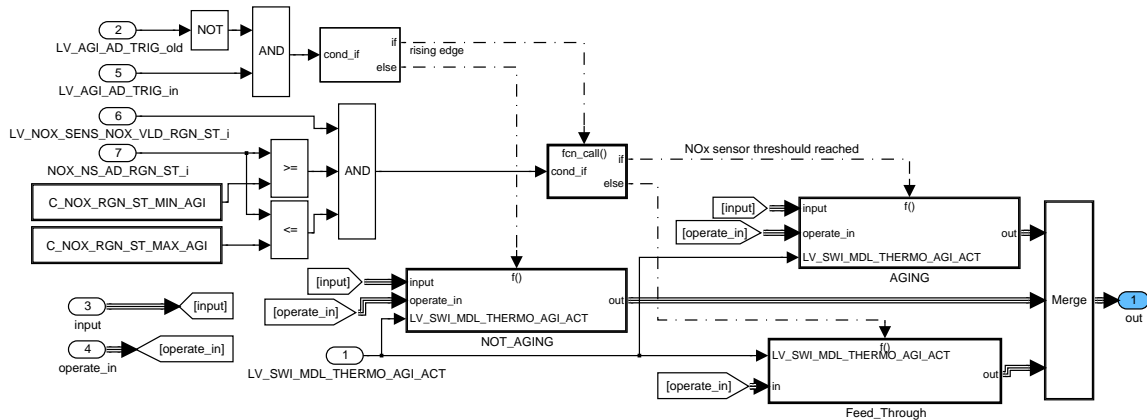


Figure 7.90.18: NOXM\_MODUL703P/operate/MAIN/CBK/SELECT

Calculation of the new base aging factor

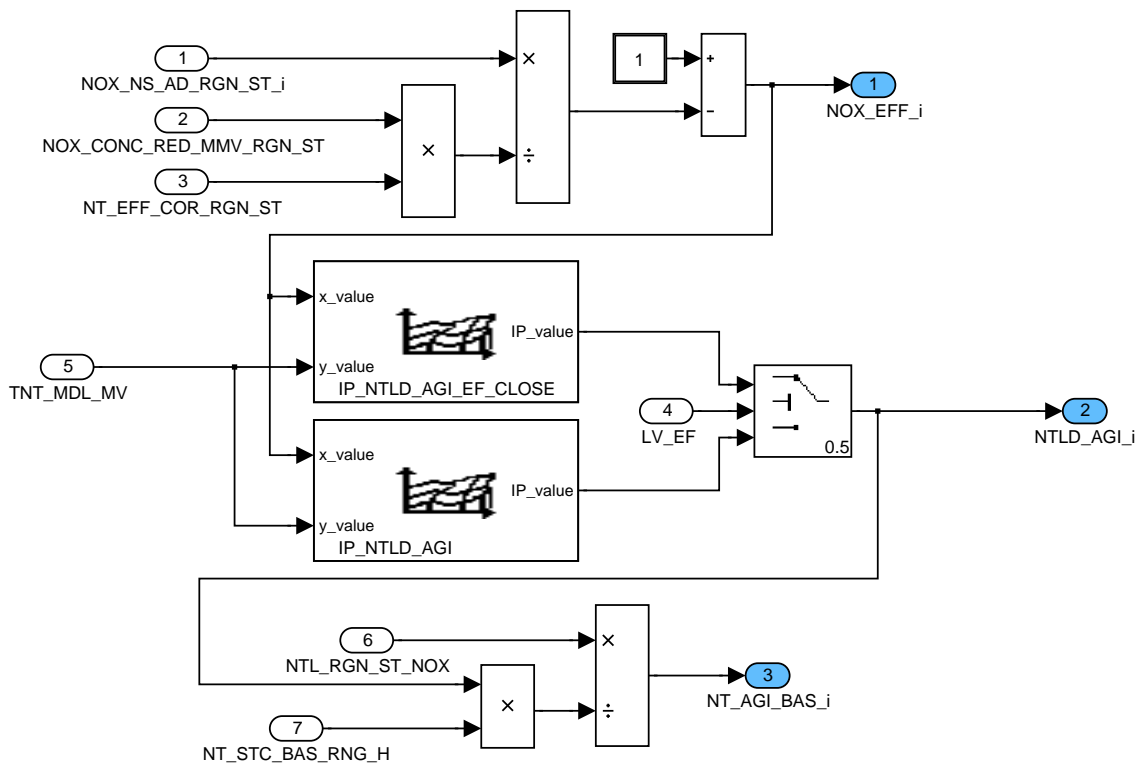


Figure 7.90.19: NOXM\_MODUL703P/operate/MAIN/CBK/SELECT/AGING/CLC1

Calculation of quick aging monitoring factors by filtering of the base aging factor

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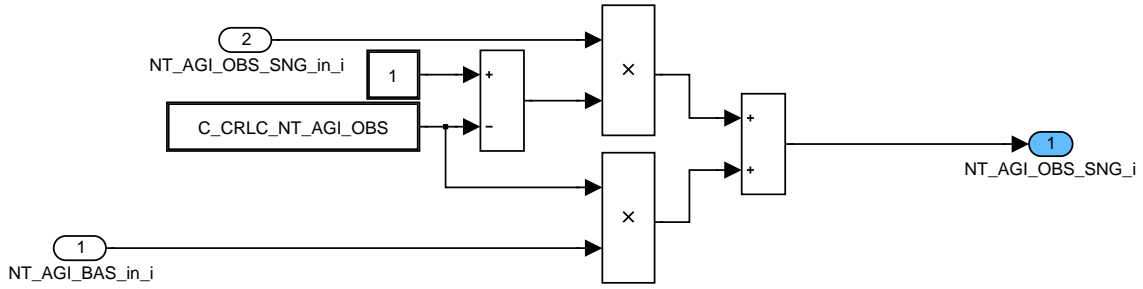


Figure 7.90.20: NOXM\_MODUL703P/operate/MAIN/CBK/SELECT/AGING/CLC2

Depending on sulfur load, either the aging factor due to thermal aging (this picture) or the aging factor due to sulphur load will be calculated (next picture). Both results will be get by filtering of the base aging factor.

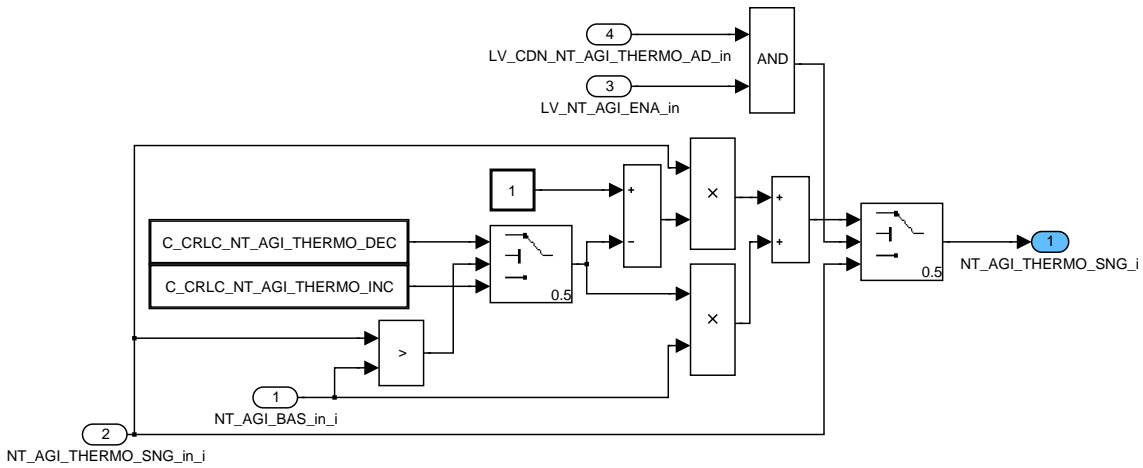


Figure 20 NOXM\_MODUL703P/ operate/ MAIN/ CBK/ SELECT/ AGING/ CLC3

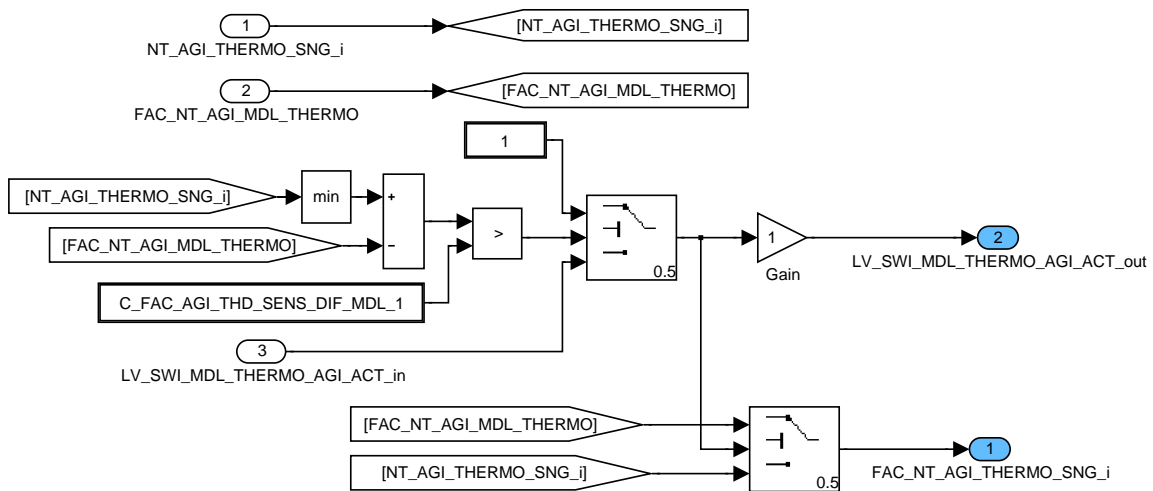


Figure 7.90.21: NOXM\_MODUL703P/operate/MAIN/CBK/SELECT/AGING/CLC4

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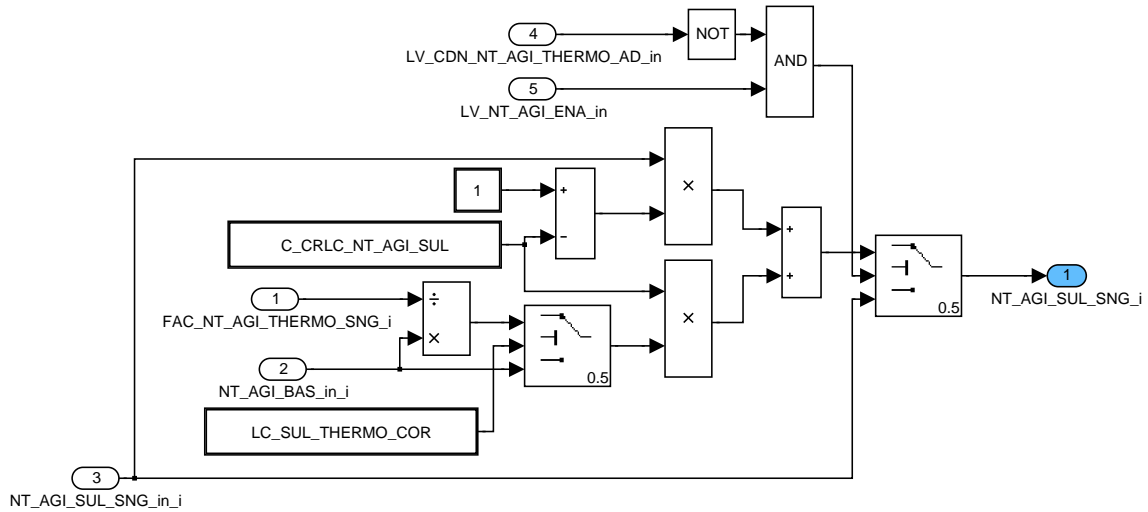


Figure 7.90.22: NOxM\_MODUL703P/operate/MAIN/CBK/SELECT/AGING/CLC5

Update of sulphur aging factor during desulfation (during desulfation, the sulphur load is decreased and the sulphur load aging factor is incremented).

Initialisation of quick aging monitoring factors

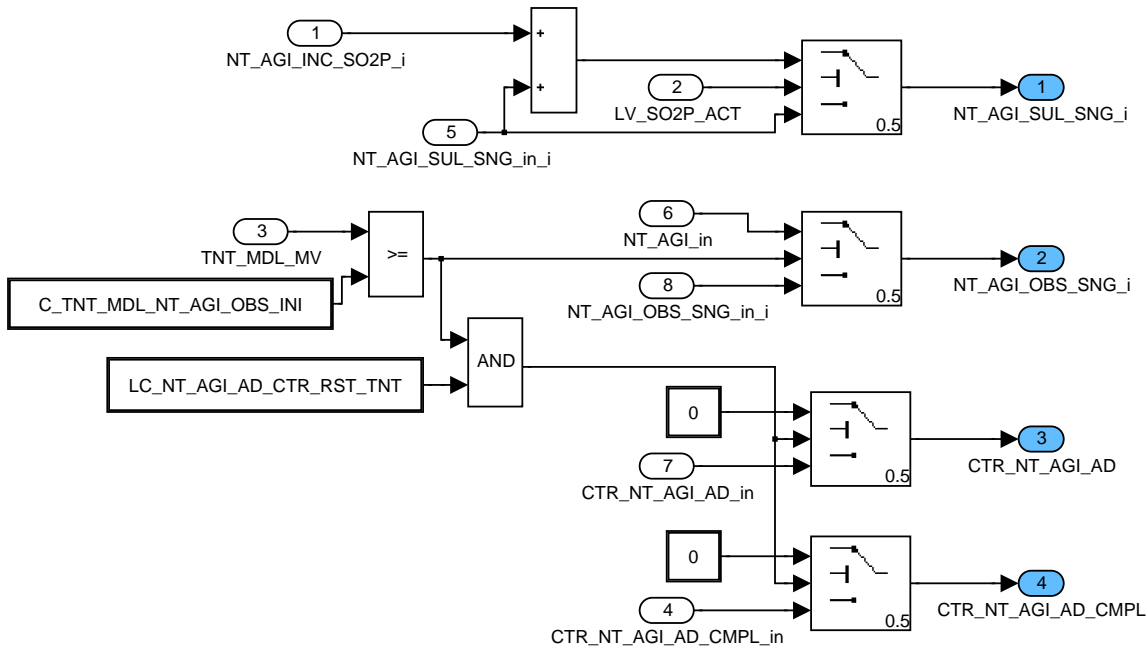


Figure 7.90.23: NOxM\_MODUL703P/operate/MAIN/CBK/SELECT/NOT\_AGING/CLC

### MAIN (after calculations for each NOx trap)

The incrementation of the counters and the integral for the fuel quality calculation have to be calculated once if the condition is true for one bank or both banks.

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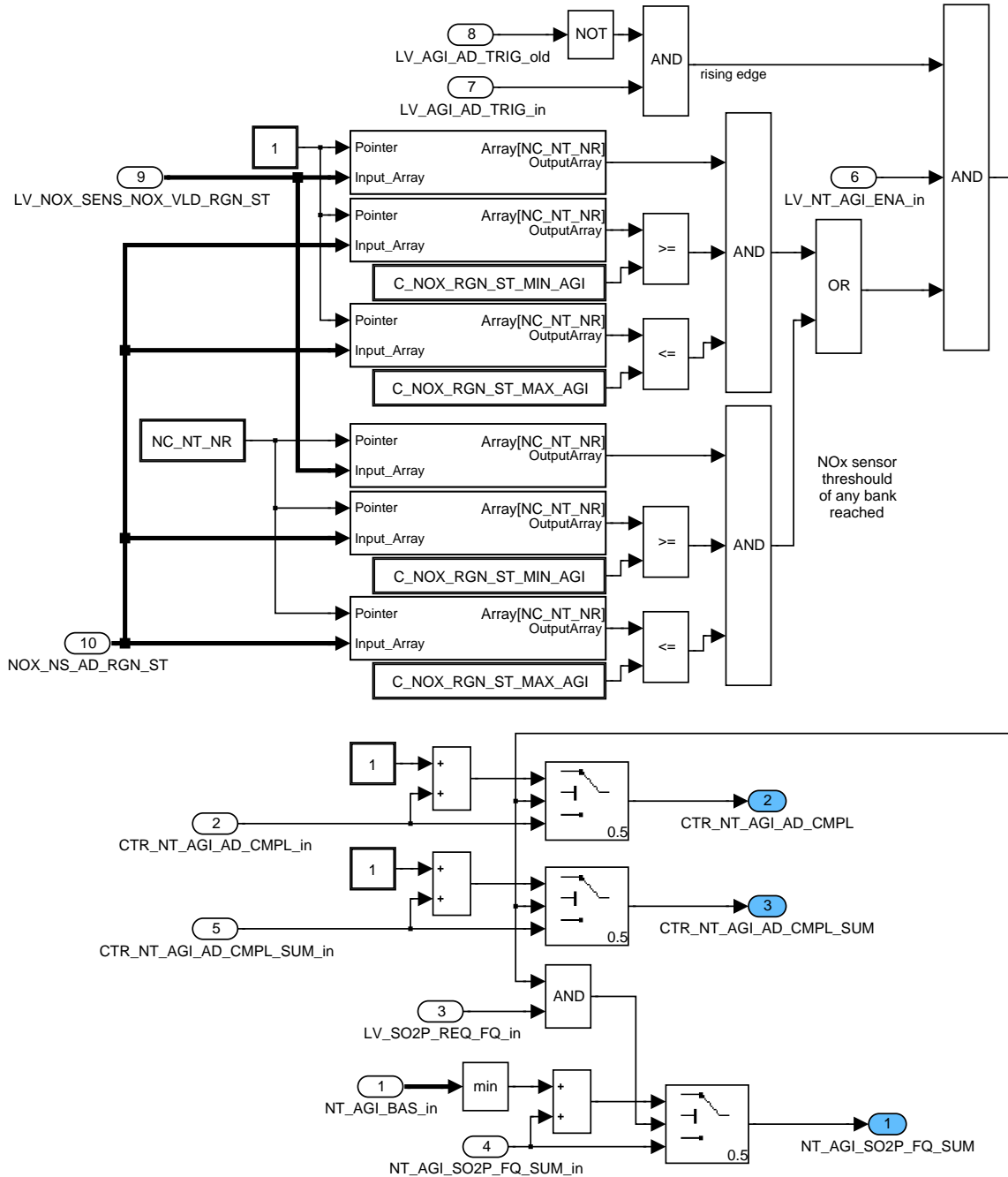


Figure 7.90.24: NOXM\_MODUL703P/operate/MAIN/CTR

### ENABLING\_FLAGS

The calculation of the aging enabling flags is done after the aging calculation, thereby it's possible to reset LV\_NT\_AGI\_ENA in regeneration, the aging calculation is done at the first calculation of the main loop in regeneration.

Conditions to enable base aging factor calculation/quick monitoring

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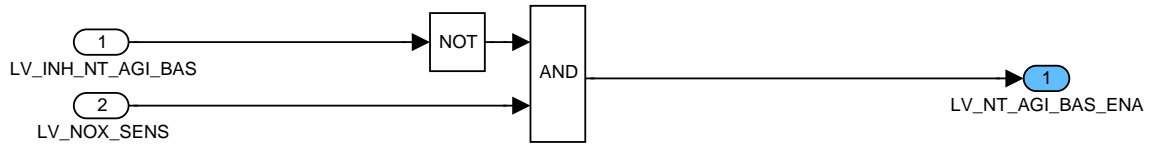


Figure 7.90.25: NOXM\_MODUL703P/operate/ENABLING\_FLAGS/CLC1  
Condition to enable aging factor calculation

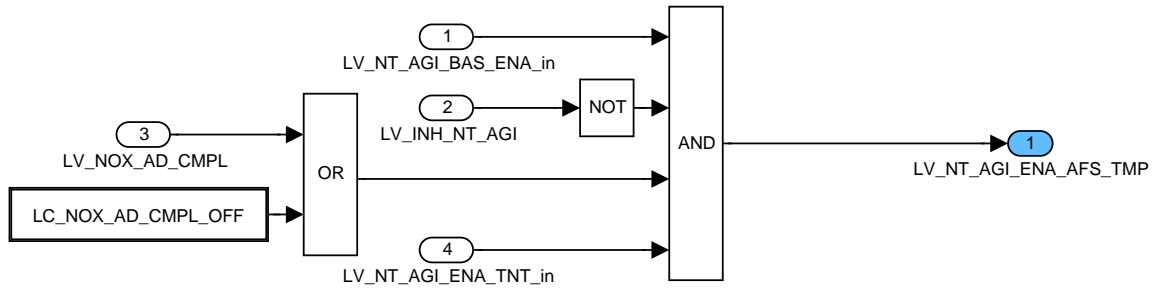


Figure 7.90.26: NOXM\_MODUL703P/operate/ENABLING\_FLAGS/CLC2

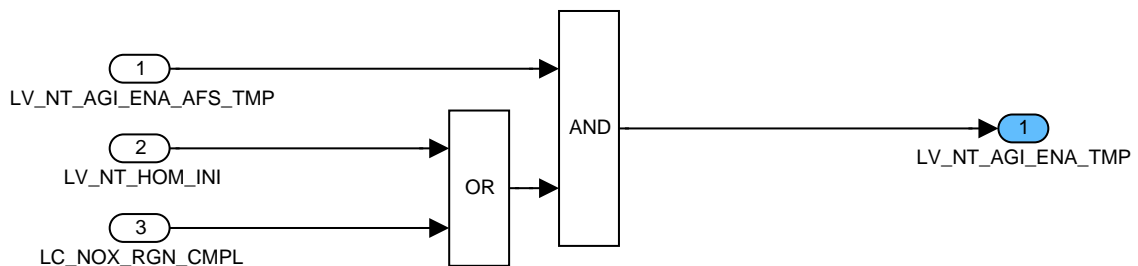


Figure 7.90.27: NOXM\_MODUL703P/operate/ENABLING\_FLAGS/CLC3

The T\_AFL condition uses only lean phases with LV\_NT\_AGI\_ENA given at the beginning of the lean phase; aim is to prevent a closing of the EGR valve in the middle of a lean phase due to aging adaptation conditions given starting there as well as performing an adaptation after a lean phase with adaptation condition given only temporary.

CTR\_NT\_AGI\_AD and CTR\_NT\_AGI\_AD\_CMPL have physical limits from 0 to 254 whereas the corresponding threshold constants C\_CTR\_NT\_AGI\_AD\_MAX & C\_CTR\_NT\_AGI\_AD\_CMPL\_MAX have physical limits from 0 to 255. Thus by setting the constants to their maximum value the condition  $CTR < thd$  is always true and no limitation of the adaptation attempts /adaptation cycles will occur

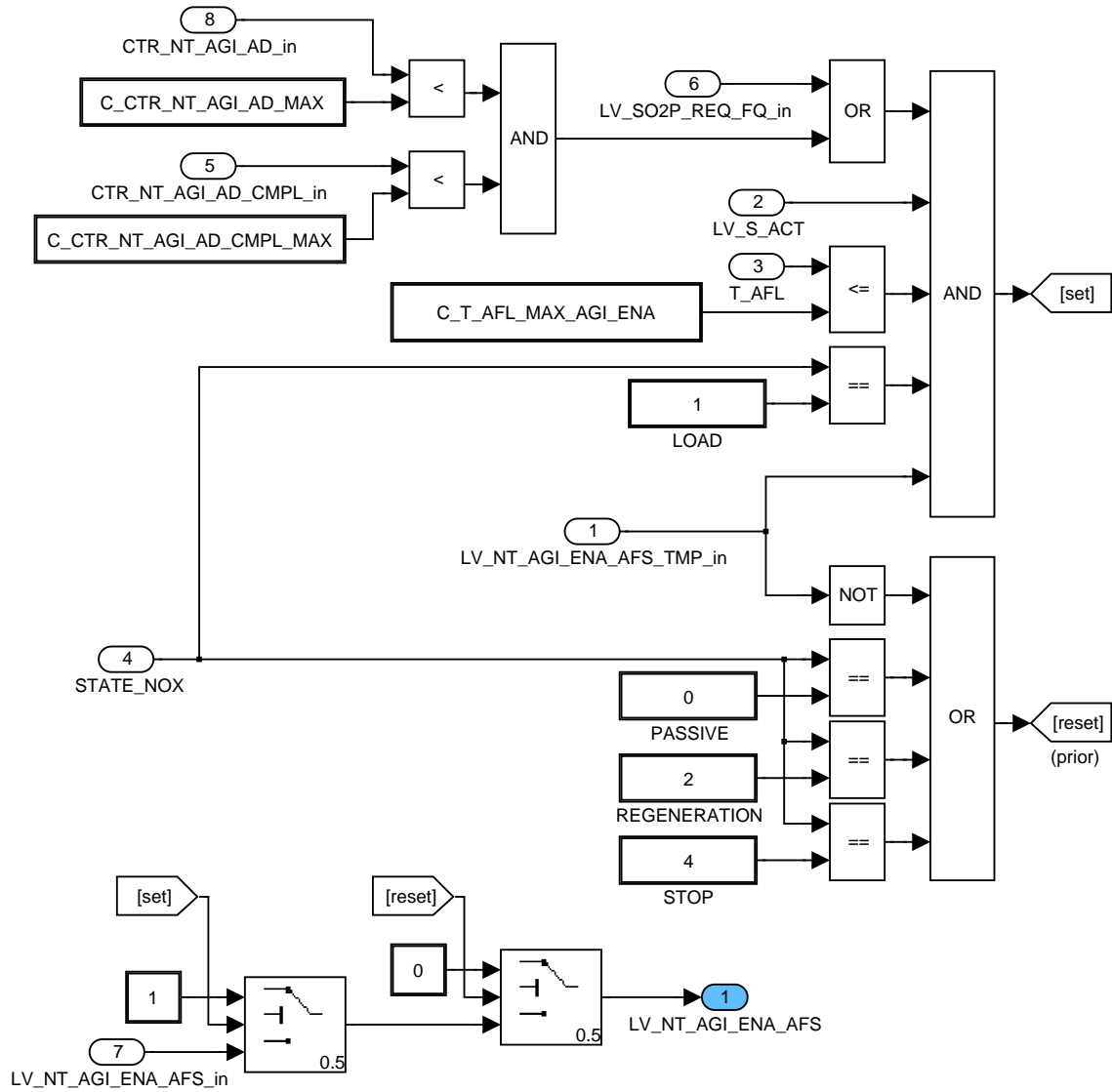


Figure 7.90.28: NOXM\_MODUL703P/operate/ENABLING\_FLAGS/CLC4

Conditions to close EGR valve during aging adaptation

The attempts counter is only calculated if EGR was closed; if the function is calibrated passive (i.e. without closing EGR) the number of attempts is not limited.

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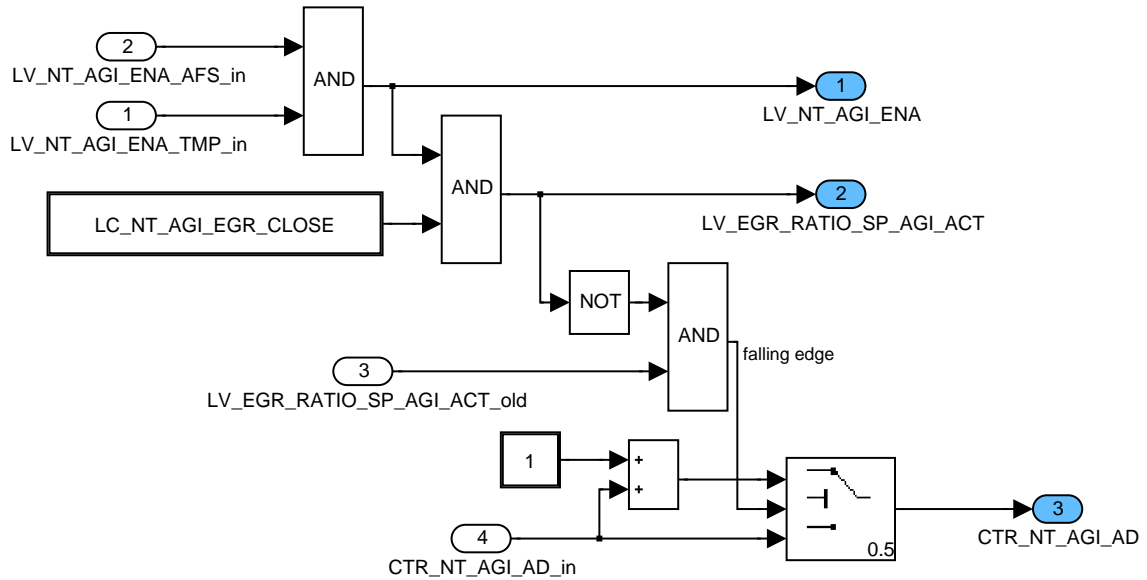


Figure 7.90.29: NOXM\_MODUL703P/operate/ENABLING\_FLAGS/CLC5

**AGING\_FACTOR: Aging factor handling**

NT\_SUL\_AGI\_SNG will be calculated from the aging factor due to sulphur load for each bank, defined by NC\_NT\_NR.

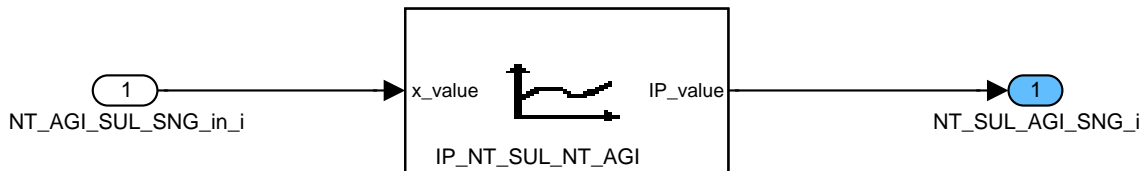


Figure 7.90.30: NOXM\_MODUL703P/operate/AGING\_FACTOR/CBK/CLC1

Bank selective values will be combined: minimum of aging factors and maximum of sulphur load.

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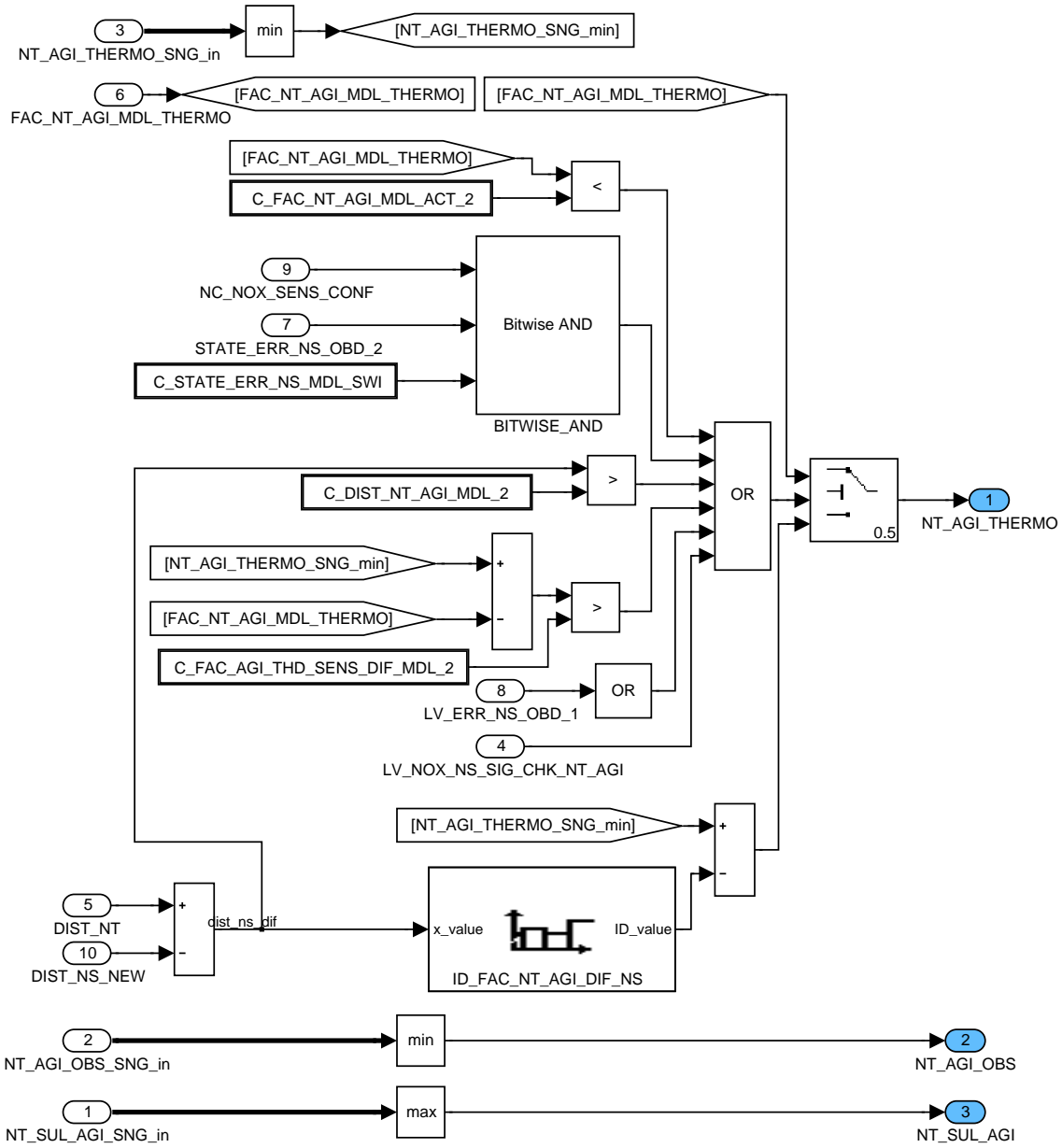
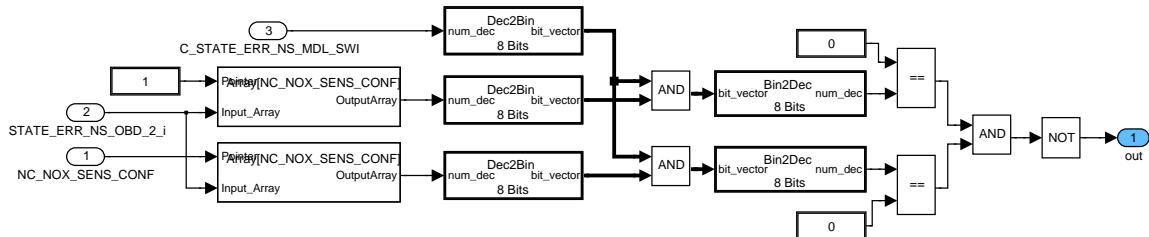



Figure 7.90.31: NOXM\_MODUL703P/operate/AGING\_FACTOR/CLC2



Error at any bank not allowed

Figure 7.90.32: NOXM\_MODUL703P/operate/AGING\_FACTOR/CLC2/BITWISE\_AND

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 3094 of 8404	
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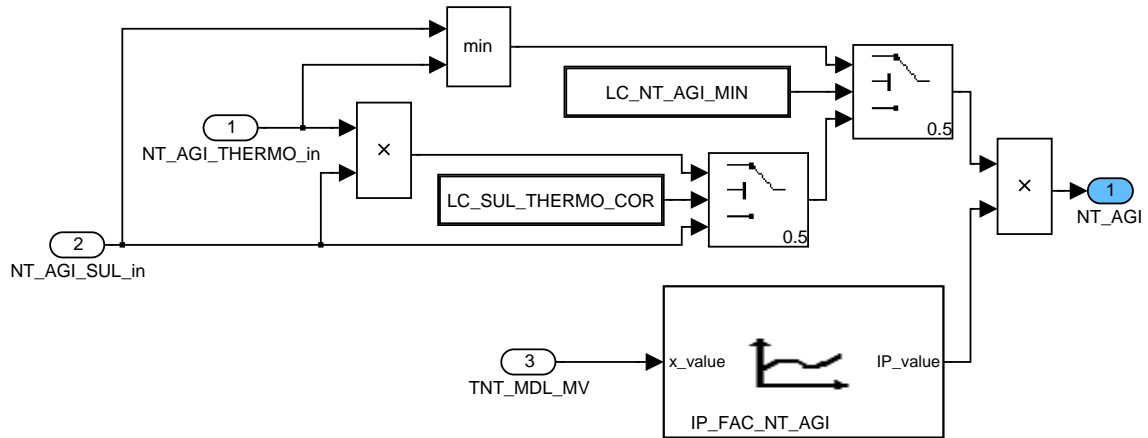


Figure 7.90.35: NOXM\_MODUL703P/operate/AGING\_FACTOR/CLC5

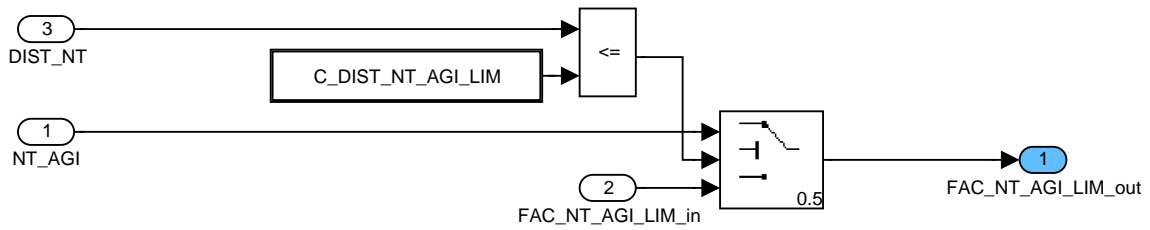


Figure 7.90.36: NOXM\_MODUL703P/operate/AGING\_FACTOR/CLC6

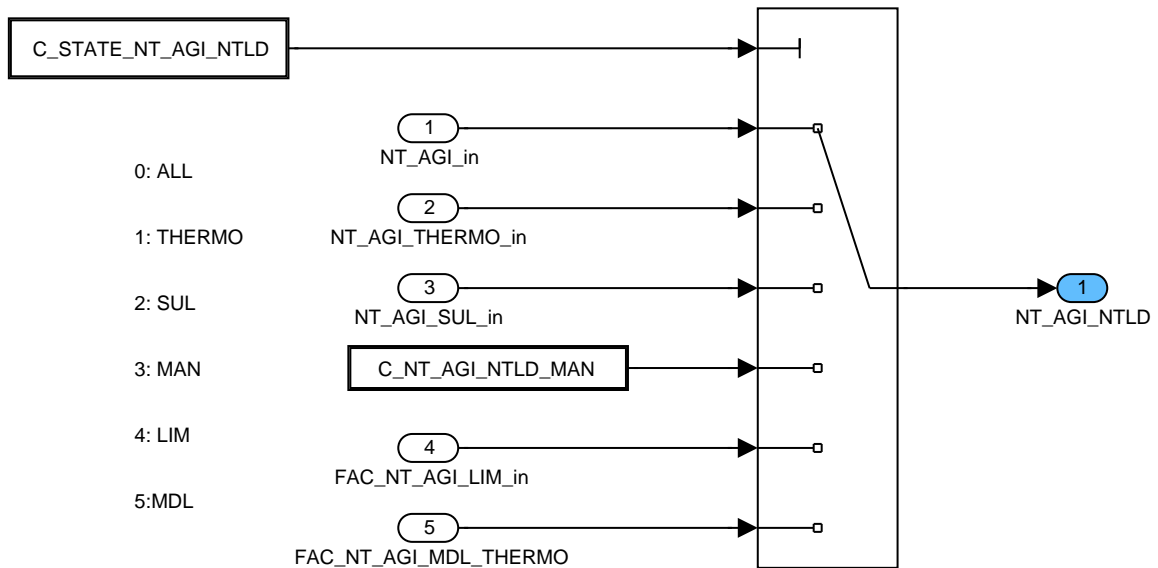


Figure 7.90.37: NOXM\_MODUL703P/operate/AGING\_FACTOR/CLC7

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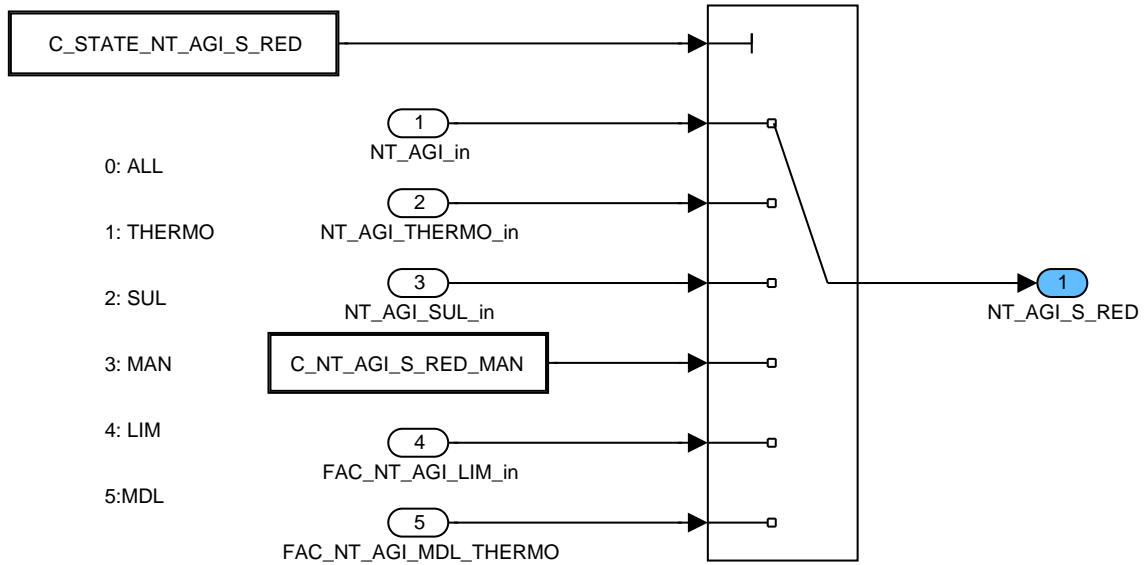


Figure 7.90.38: NOXM\_MODUL703P/operate/AGING\_FACTOR/CLC8

**MANUAL\_RESET: Manual reset of desulfation requests**

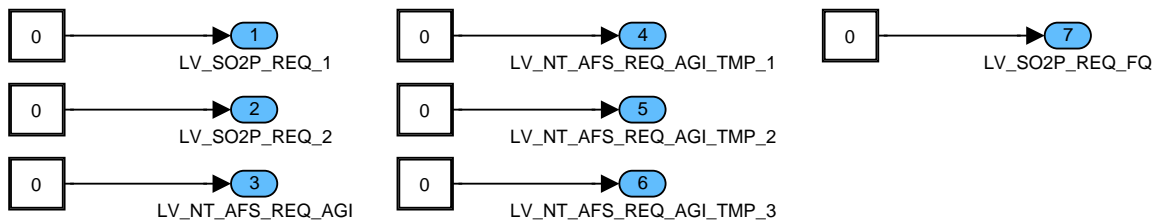


Figure 7.90.39: NOXM\_MODUL703P/operate/MANUAL\_RESET/CLC

**DESULFATION**

If aging factor or sulphur load reaches the first threshold, then the first desulfation request will be set.

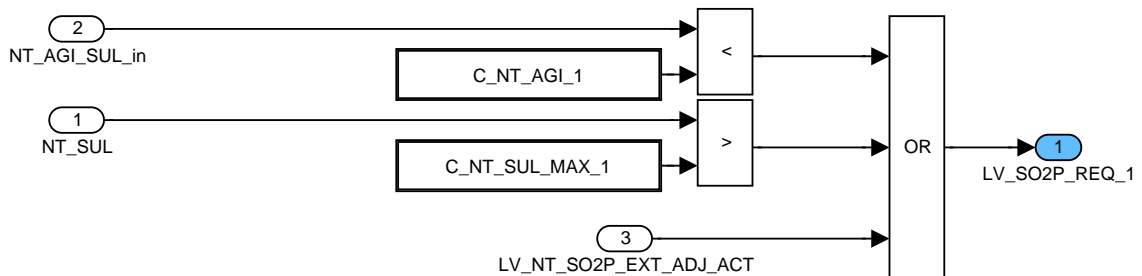


Figure 7.90.40: NOXM\_MODUL703P/operate/DESULFATION/CLC1

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If the values become worse and reach the second threshold, then the second desulfation request will be set. In standard cases with no need of separate reset conditions for LV\_SO2P\_REQ\_2, IP\_NT\_SUL\_MAX\_2\_DEAC and IP\_NT\_SUL\_MAX\_2 have to be calibrated identically

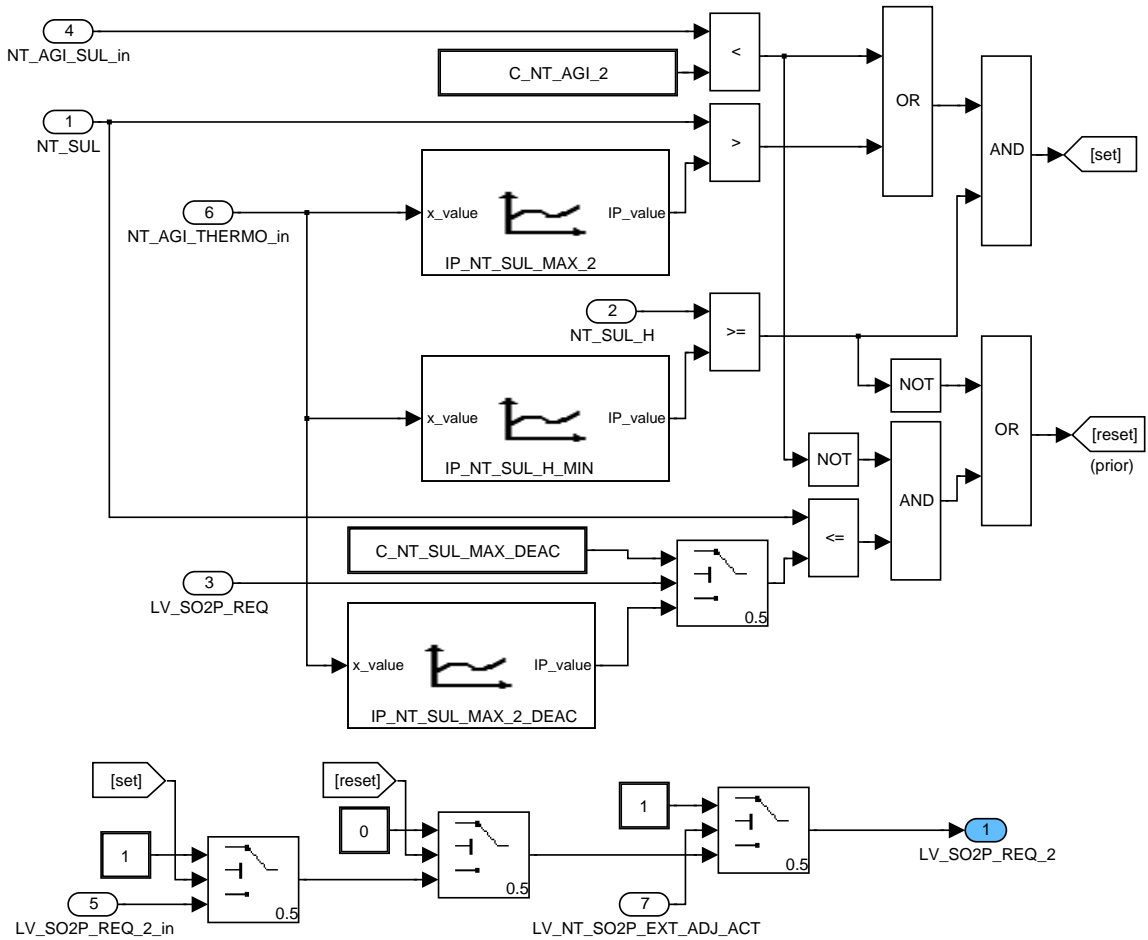


Figure 7.90.41: NOXM\_MODUL703P/operate/DESULFATION/CLC2  
Condition for lambda=1 request

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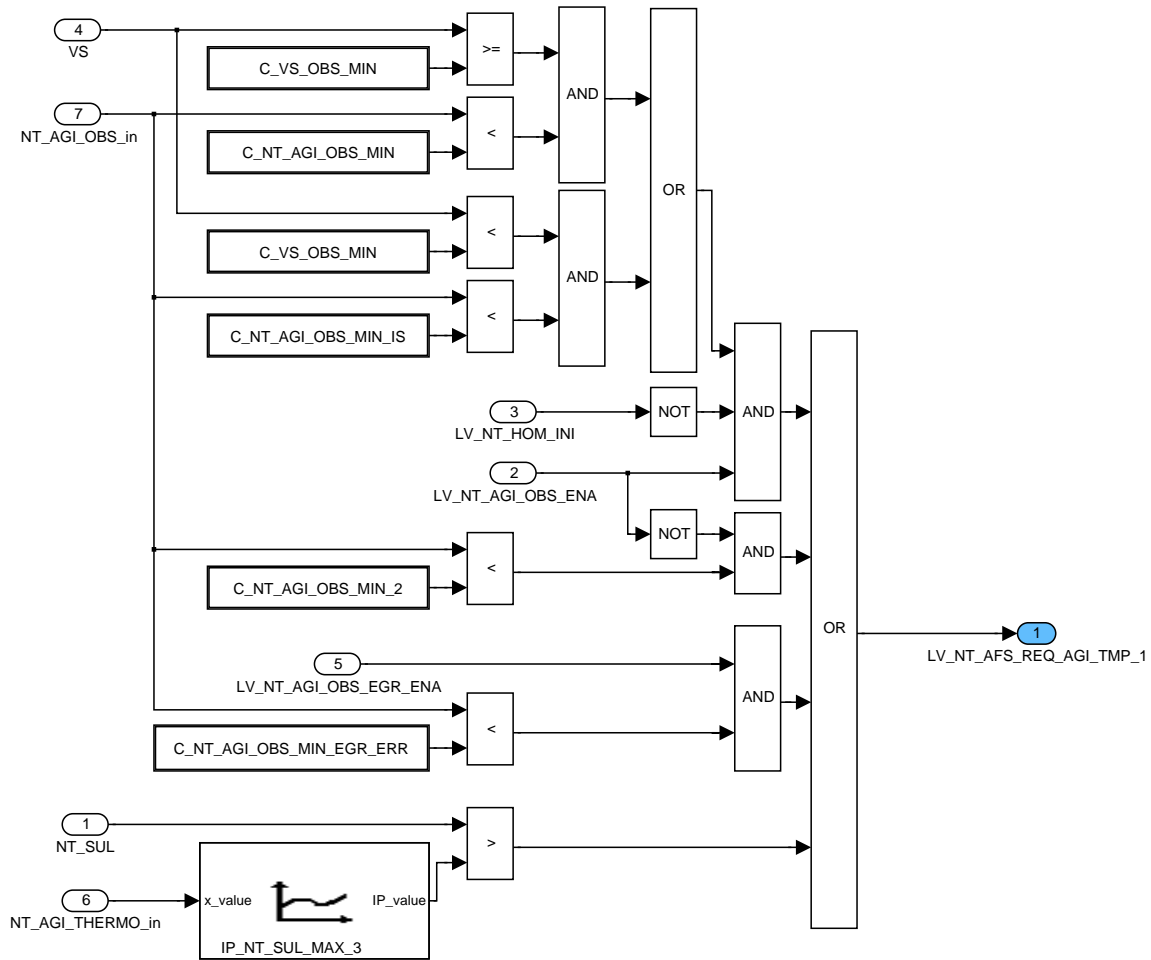


Figure 7.90.42: NOXM\_MODUL703P/operate/DESULFATION/CLC3  
Structure of fuel quality check

If the thermal aging factor reaches the third threshold, then the fuel quality check will be started. In that case a desulfation will be requested and the sulfur model will be calculated with higher sulfur ratio, controlled by FAC\_SU\_CONC\_FUEL.

After desulfation (LV\_SO2P\_REQ\_1=0) the prohibition of stratified mode (LV\_NT\_AFS\_REQ\_AGI\_TMP\_2) will be canceled.

Either the aging factor is OK and the fuel check will be finished immediately (sub-system OK) or after a calibratable number of cycles a decision will be made (sub-system END) whether the NOx trap is OK or not. If OK the fuel quality check will be finished, if not the lambda=1 mode will be forced (LV\_NT\_AFS\_REQ\_AGI\_TMP\_3=1) because the trap is defect.

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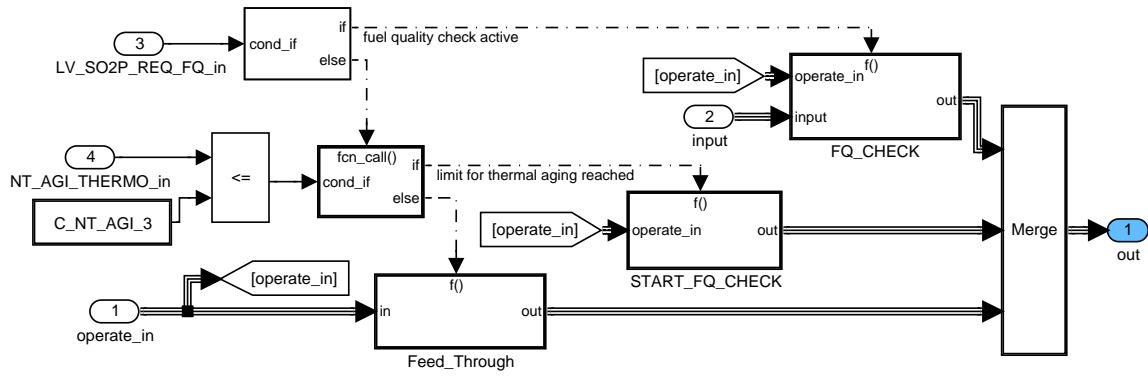


Figure 7.90.43: NOXM\_MODUL703P/operate/DESULFATION/CLC4

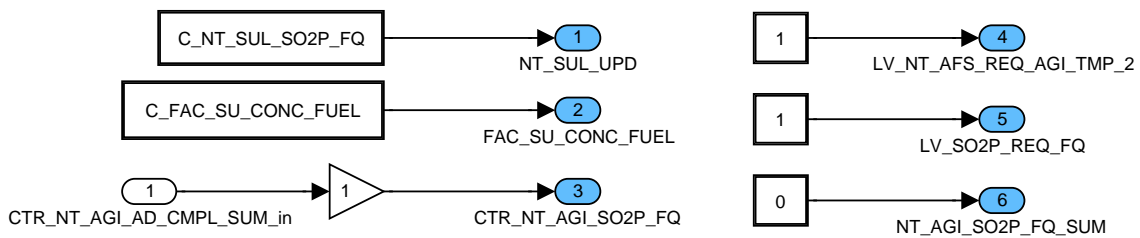


Figure 7.90.44: NOXM\_MODUL703P/operate/DESULFATION/CLC4/START\_FQ\_CHECK/CLC

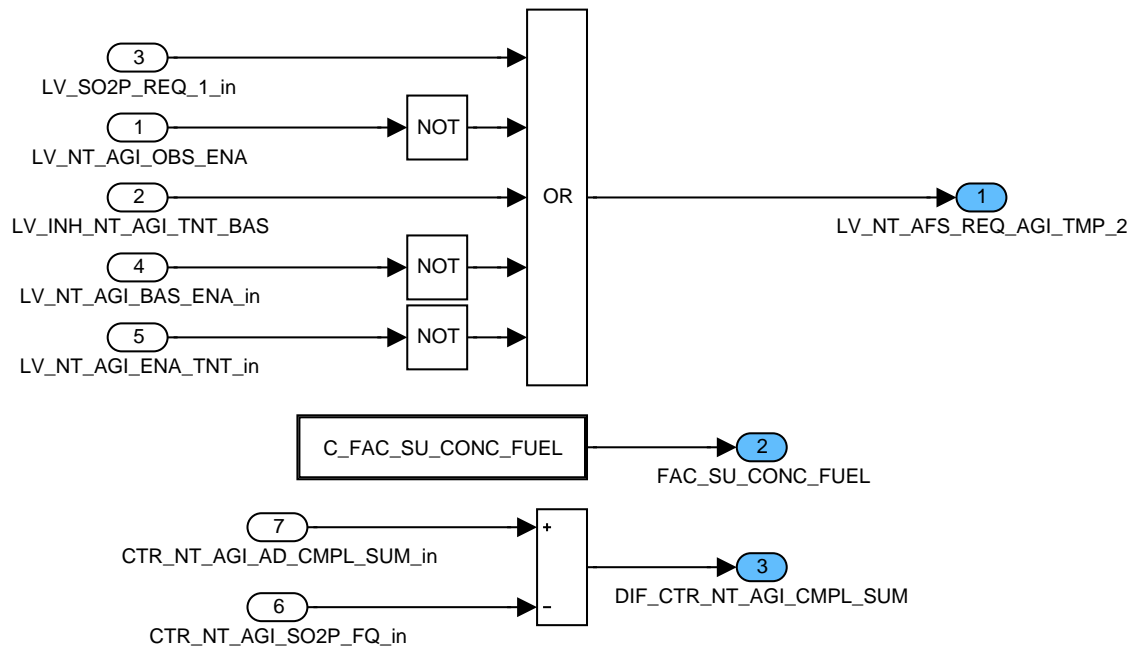


Figure 7.90.45: - NOXM\_MODUL703P/operate/DESULFATION/CLC4/FQ\_CHECK/CLC1

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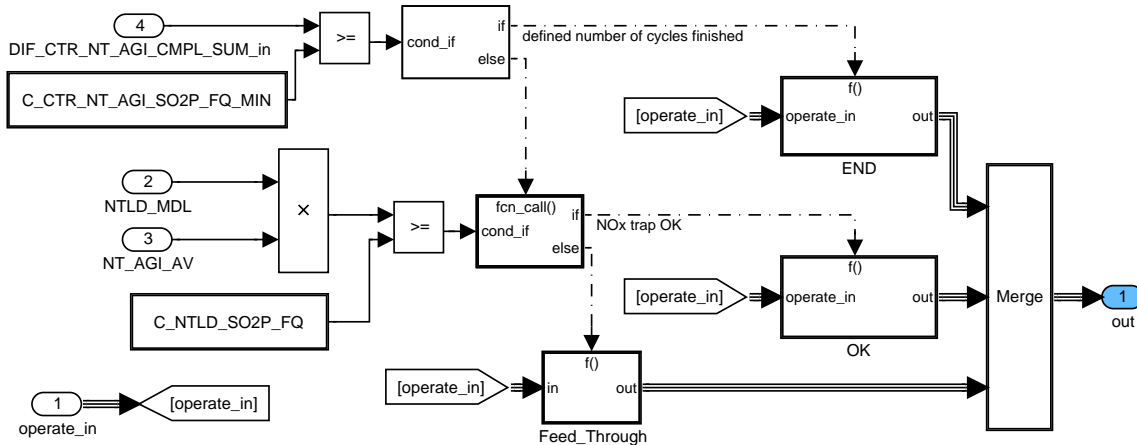


Figure 7.90.46: NOXM\_MODUL703P/operate/DESULFATION/CLC4/FQ\_CHECK/CLC2

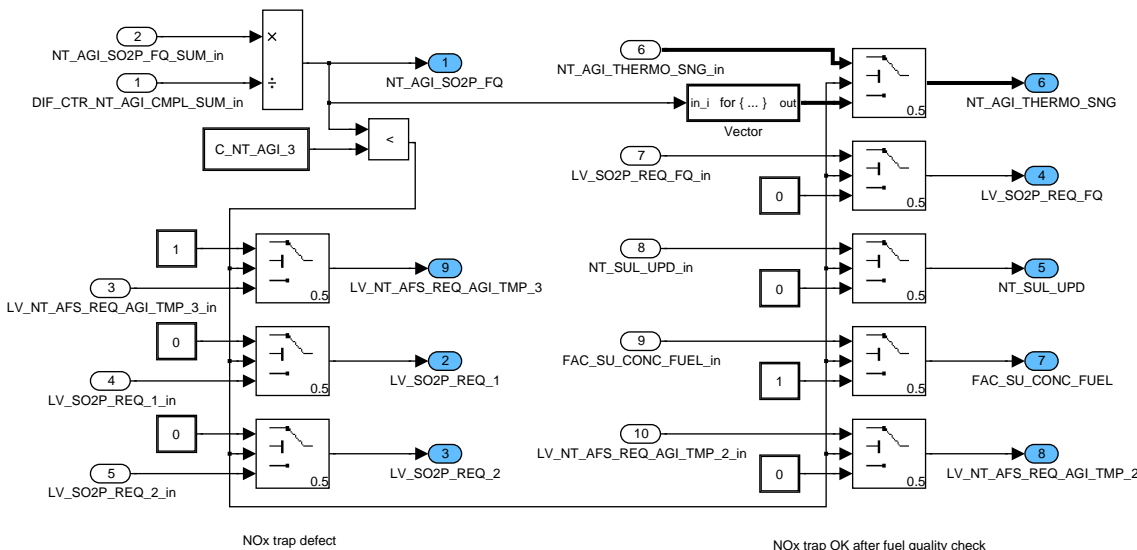


Figure 7.90.47: NOXM\_MODUL703P/operate/DESULFATION/CLC4/FQ\_CHECK/CLC2/END/CLC

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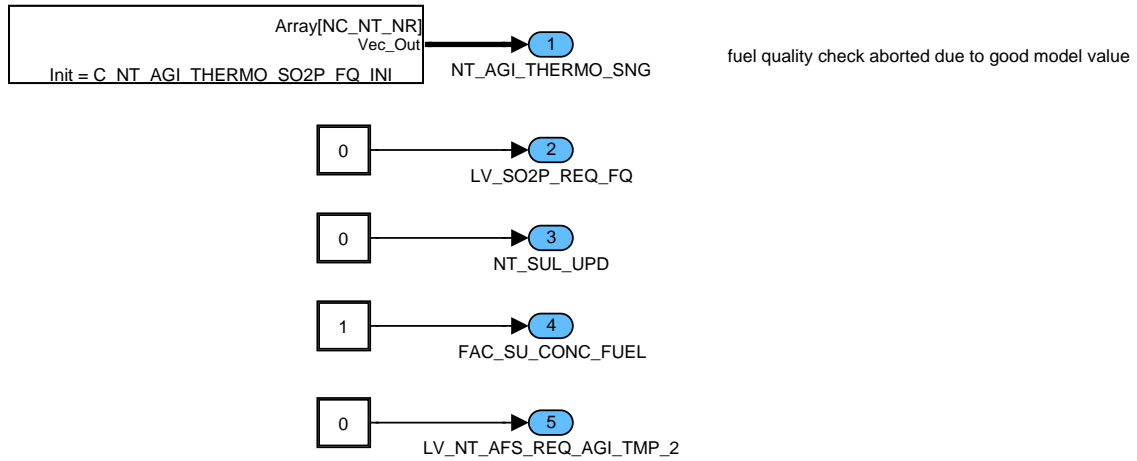


Figure 7.90.48: NOXM\_MODUL703P/operate/DESULFATION/CLC4/FQ\_CHECK/CLC2/OK/CLC  
Collection of all lambda=1 requests.

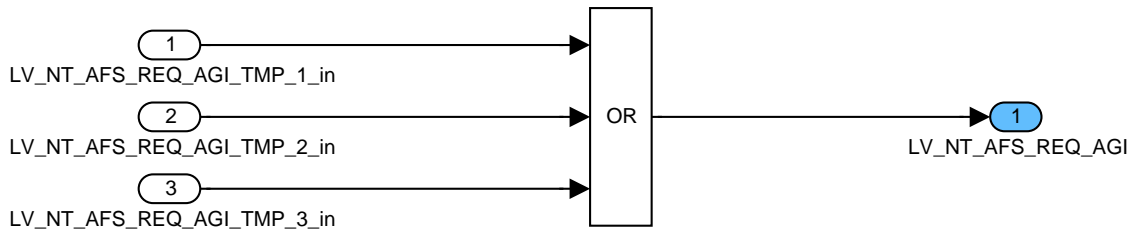


Figure 7.90.49: NOXM\_MODUL703P/operate/DESULFATION/CLC5

**NEW\_DEVICE: Initialisation by scan tool**

If a new NOx trap is built in, then a initialization via a scan tool have to be made.

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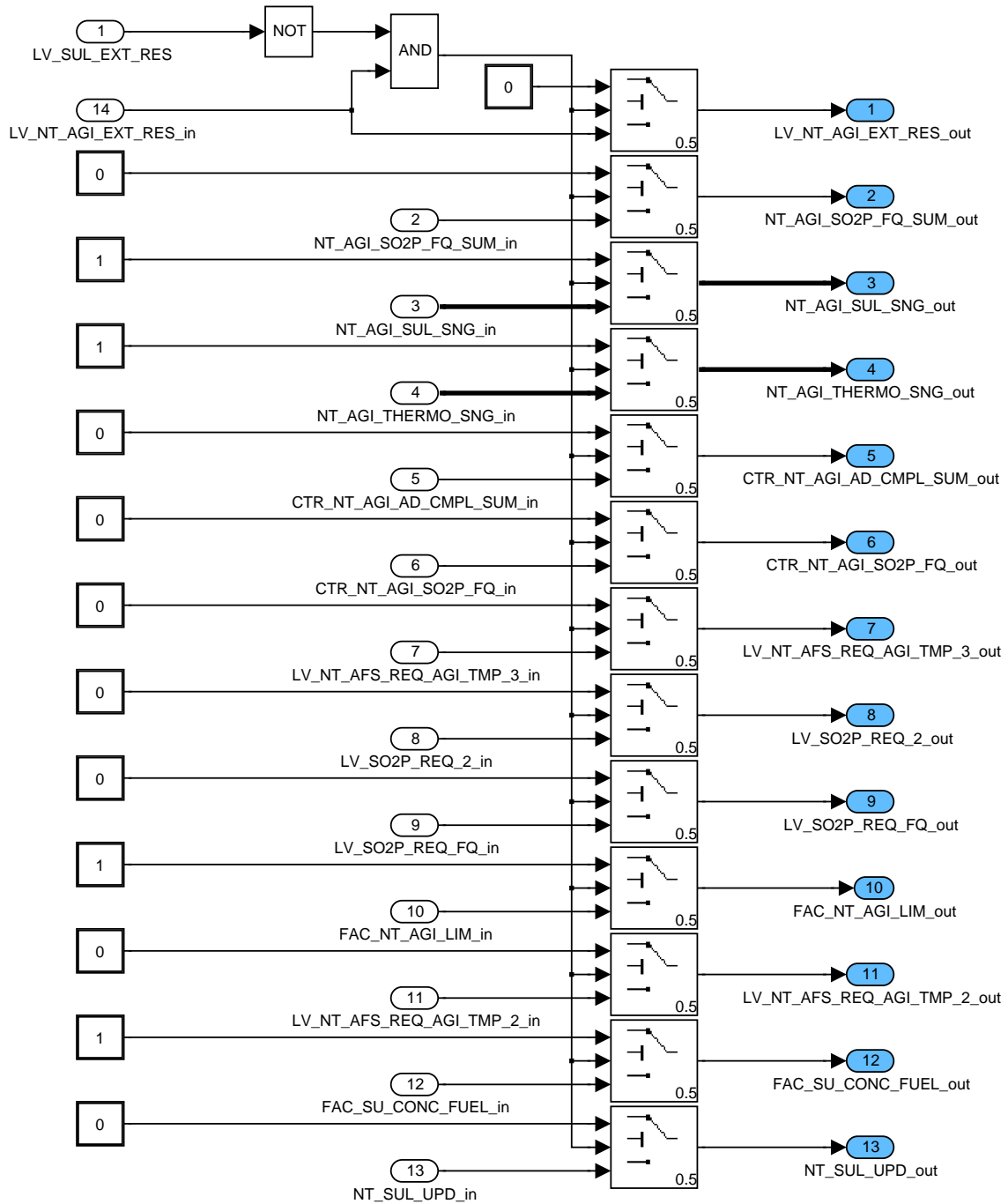


Figure 7.90.50: NOXM\_MODUL703P/operate/NEW\_DEVICE/CLC1

### Update of external adjustment values

If the flag LV\_NT\_AGI\_EXT\_ADJ was set by action ACTION\_NOXM\_WriteAgingExtAdj and the external sulfur model values are already written, then the external values will be used and the flag will be reset.

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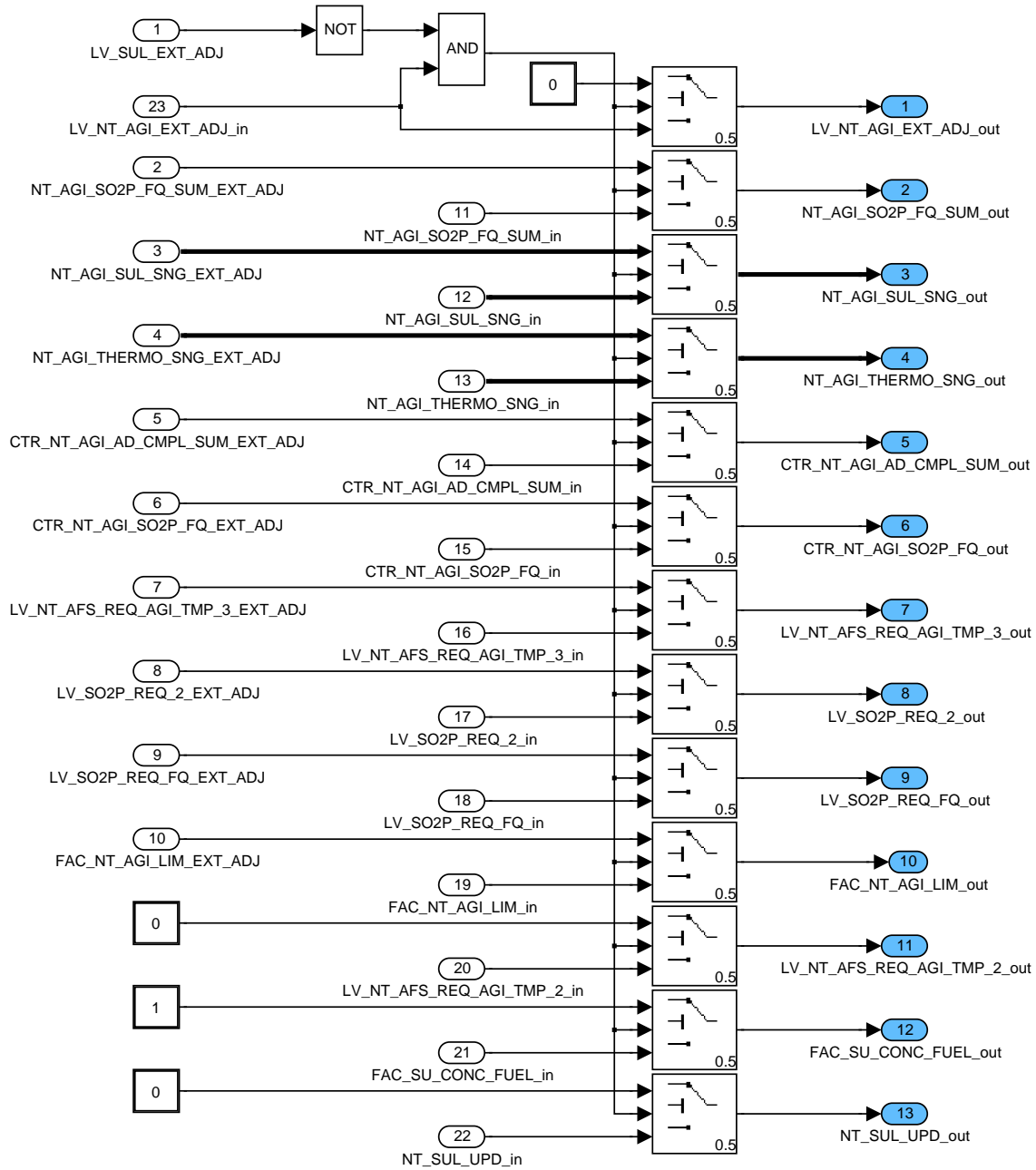



Figure 7.90.51: NOXM\_MODUL703P/operate/NEW\_DEVICE/CLC2

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 3104 of 8404</b>	
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### 7.90.4 RESET

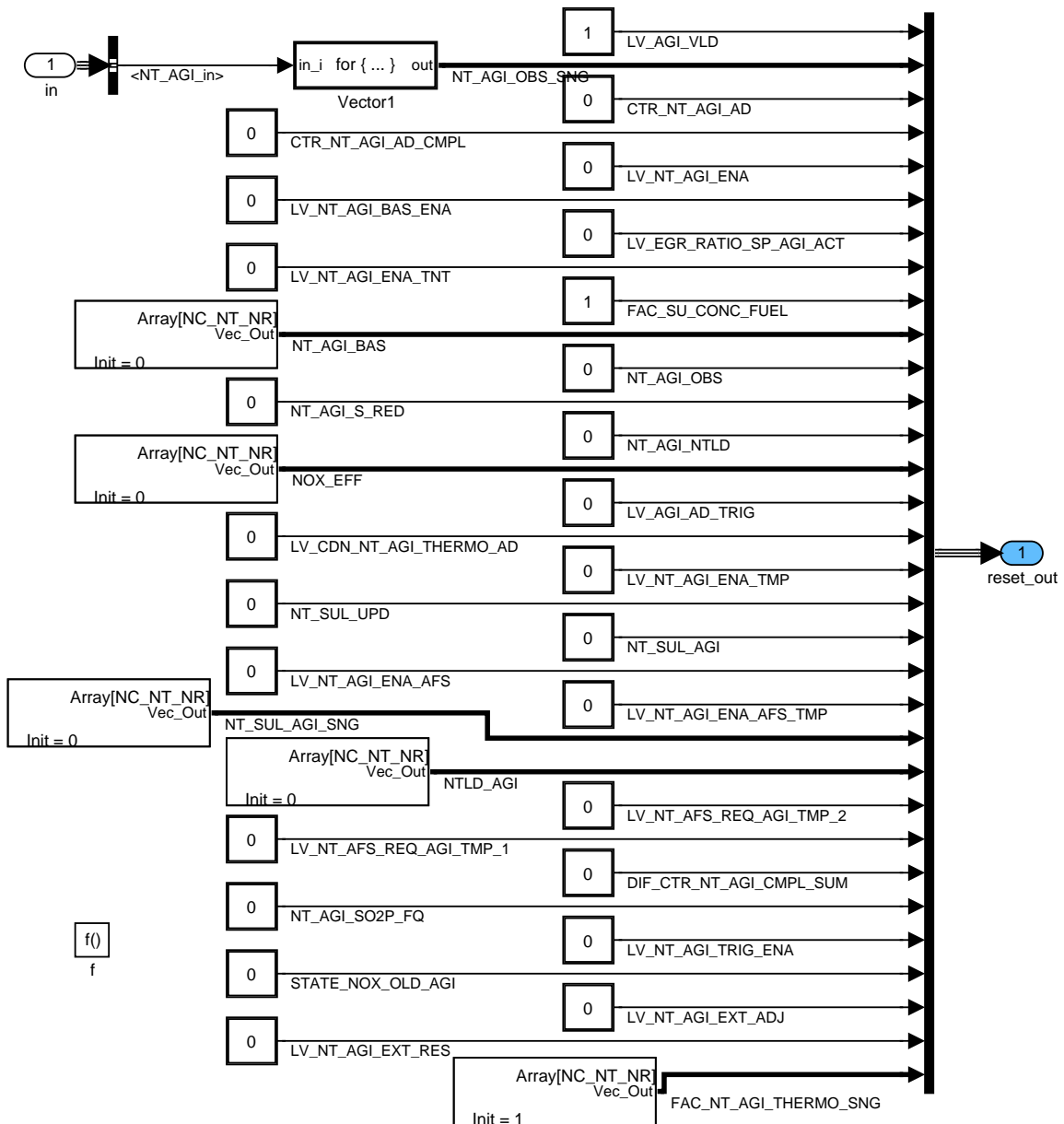


Figure 7.90.52: NOXM\_MODUL703P/reset

### 7.90.5 Handling of non-volatile memory

The non-volatile data will be read out of the memory at the after power-on and stored in the memory before power-off. The initialization of the non-volatile memory is shown in the next picture.

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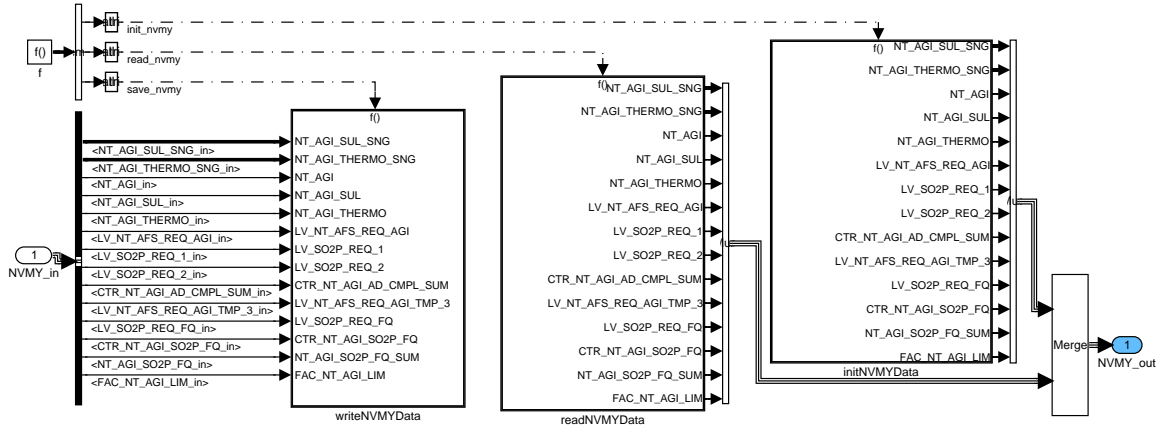


Figure 7.90.53: NOXM\_MODUL703P/NVMYdata

**Initialization of non-volatile memory**

The aging factors will be set to one, that means fresh catalyst. All other values will be initialized to its inactive value.

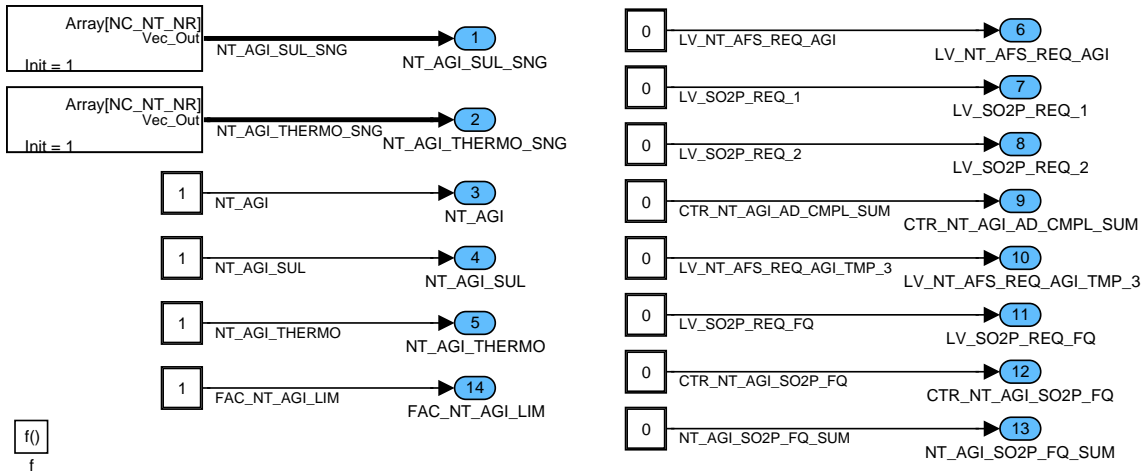


Figure 7.90.54: NOXM\_MODUL703P/NVMYdata/initNVMYData

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## 7.91 NOx catalyst aging (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_KM_CAN_ST	V	0... FFFFH	0... 655350	10	km
vehicle kilometer reading from Kombi at motor start					
LV_INH_NT_AGI	O/V	0... 1H	0 ...1	1	-
flag inhibiting the NOx catalyst aging adaptation					
LV_INH_NT_AGI_BAS	O/V	0... 1H	0 ...1	1	-
flag inhibiting the NOx catalyst aging adaptation					
LV_INH_NT_AGI_ERR	O/V	0... 1H	0 ...1	1	-
inhibition of the NOx catalyst aging adaptation due error on sensor or subsystem					
LV_INH_NT_AGI_THD	V	0... 1H	0 ...1	1	-
inhibition of the NOx catalyst aging adaptation due to MFF or N					
LV_INH_NT_AGI_TNT	V	0... 1H	0 ...1	1	-
inhibition of the NOx catalyst aging adaptation due to temperature window control					
LV_INH_NT_AGI_TNT_BAS	O/V	0... 1H	0 ...1	1	-
inhibition of the NOx catalyst aging adaptation due to temperature window control					
LV_NOX_SENS_MAX_ADJ	O/V	0... 1H	0 ...1	1	-
Flag to enable adjustment of NOx Sensor threshold for regeneration by aging adaptation					
LV_NT_AGI_OBS_EGR_ENA	O/V	0... 1H	0 ...1	1	-
Activation Conditions for continuous Aging Observation					
LV_NT_AGI_OBS_ENA	O/V	0... 1H	0 ...1	1	-
Activation Conditions for continuous Aging Observation					
NT_AGI_THERMO_GRD	O/V/S	8000... 0H	-0.1 ...0	3.0518e-6	1/km
Gradient of NT_AGI_THERMO from motor start to stop of last driving cycle normalized to distance					
NT_AGI_THERMO_ST	V	0... FFFFH	0... 0.99998	15.3e-6	-
NOx trap aging factor due to thermal aging at motor start					
TNT_MDL_NT_AGI_DYW [NC_NT_NR]	V	0... FFFFH	0... 1023.98437	0.015625	°C
NOx trap temperature of limited dynamic window out of TNT_MDL_MV					

### Input data:


AMP {p. 982}	CTR_KM_CAN {p. 1563}	FAC_NT_AGI_LIM {p. 3072}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}
LV_ERR_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}	LV_ERR_CPS {p. 1001}	LV_ERR_EGR {p. 801}	LV_ERR_EGR_2 {p. 987}
LV_ERR_EL_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_ERR_NS_CAN_MSG_ LOST [NC_NOX_SENS_CONF] {p. 991}	LV_ERR_NS_OBD_1 [NC_NOX_SENS_CONF] {p. 4915}
LV_ERR_OBD_LSH_ DOWN [NC_CBK_EX_NR] {p. 5198}	LV_ERR_TEG_PCAT_ DOWN {p. 4713}	LV_ERR_TIA_IM {p. 984}	LV_HOM_AFS_REQ {p. 8136}
LV_NOX_AD_DYW {p. 3069}	LV_NOX_SENS {p. 2982}	LV_NT_AGI_ENA {p. 3072}	MFF_SP_S {p. 8243}
N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}	NC_NT_NR {p. 644}

NT_AGI_THERMO {p. 3073}	STATE_CAT_DIAG [NC_CBK_EX_NR] {p. 5474}	STATE_ERR_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}	STATE_NOX {p. 2986}
TIA_IM {p. 984}	TNT_MDL_1 [NC_NT_NR] {p. 8237}	TNT_MDL_2 [NC_NT_NR] {p. 8237}	TNT_MDL_H {p. 8237}
TNT_MDL_L {p. 8237}	TNT_MDL_MV {p. 8237}	TOIL {p. 8204}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_NT_AGI_MIN	-	0... FFFFH	0... 5434	0.0829175	hPa
Min. Ambient Pressure threshold for enabling /disabling an aging adaptation					
C_CRLC_TNT_MDL_NT_AGI_DYW	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation factor for calculation of TNT of dynamic window limitation					
C_CTR_KM_CAN_DIF_MIN	-	0... FFFFH	0... 655350	10	km
minimum vehicle kilometer for calculation of thermal aging gradient					
C_ERR_EGR_3_REQ_CTR_MIN	-	0... FFH	0... 255	1	-
threshold for enabling aging factor observation considering EGR problems					
C_ERR_NS_NT_AGI_BIT_SEL	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit NOx catalyst aging determination					
C_LAMB_NT_AGI_MIN	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda threshold for enabling /disabling an aging adaptation					
C_MFF_SP_S_NT_AGI_MAX	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass flow threshold for enabling /disabling an aging adaptation					
C_MFF_SP_S_NT_AGI_MIN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass flow threshold for enabling /disabling an aging adaptation					
C_N_32_NT_AGI_MAX	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for enabling /disabling an aging adaptation					
C_N_32_NT_AGI_MIN	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for enabling /disabling an aging adaptation					
C_TIA_NT_AGI_MIN	-	0... FEH	-48... 142.5	0.75	°C
Min. Intake Air Temperature threshold for enabling /disabling an aging adaptation					
C_TNT_MDL_NT_AGI_DELTA	-	0... FFH	0... 1020	4	°C
max. deviation between higher and lower NT temp. for enabling an aging adaptation					
C_TNT_MDL_NT_AGI_DYW	-	0... FFH	0... 1020	4	°C
Temperature threshold for dynamic window limitation					
C_TOIL_NT_AGI_MAX	-	0... C8H	-40 ...160	1	°C
Max. Oil Temperature threshold for enabling /disabling an aging adaptation					
C_TOIL_NT_AGI_MIN	-	0... C8H	-40 ...160	1	°C
Min. Oil Temperature threshold for enabling /disabling an aging adaptation					
ID_TNT_MDL_MV_AGI_MAX	-	0... FFH	0... 1020	4	°C
LDPM_FAC_NT_AGI_LIM_1_NOXM	6	0... FFFFH	0... 0.99998	15.3e-6	-
Temperature threshold for enabling /disabling an aging adaptation					
ID_TNT_MDL_MV_AGI_MIN	-	0... FFH	0... 1020	4	°C
LDPM_FAC_NT_AGI_LIM_1_NOXM	6	0... FFFFH	0... 0.99998	15.3e-6	-
Temperature threshold for enabling /disabling an aging adaptation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_TNT_MDL_NT_AGI_MAX	-	0... FFH	0... 1020	4	°C
LDPM_FAC_NT_AGI_LIM_1_NOXM	6	0... FFFFH	0... 0.99998	15.3e-6	-
Temperature threshold for enabling /disabling an aging adaptation					
ID_TNT_MDL_NT_AGI_MIN	-	0... FFH	0... 1020	4	°C
LDPM_FAC_NT_AGI_LIM_1_NOXM	6	0... FFFFH	0... 0.99998	15.3e-6	-
Temperature threshold for enabling /disabling an aging adaptation					
LC_INH_NT_AGI_MAN	-	0... 1H	0 ...1	1	-
Deactivation flag (for the manual setting of the inhibiting bit NOx trap aging adaptation)					
LC_INH_NT_AGI_OFF	-	0... 1H	0 ...1	1	-
Deactivation flag for the deactivation of inhibiting the NOx trap aging adaptation (1 = disenable deactivation)					
LC_NOX_SENS_MAX_AGI_ADJ_ENA	-	0... 1H	0 ...1	1	-
Switch to enable adjustment of NOx Sensor threshold for regeneration by aging adaptation					

## 7.91.1 Activation Conditions for NOx catalyst aging

### FUNCTION DESCRIPTION:

#### General information:

This flag deactivates the NOx catalyst aging adaptation when errors occur which must not stop the lean operation and the NOx catalyst management, but can cause an inaccuracy in the model, which must not be adapted.

With the calibration data LC\_INH\_NT\_AGI\_MAN it is possible to deactivate the NOx trap aging adaptation manually.

With the calibration data LC\_INH\_NT\_AGI\_OFF it is possible to make the adaptation always working. These bits are useful for the calibration phase.

Number of NOx catalyst: NC\_NT\_NR  $i = 1 \dots NC\_NT\_NR$   
 Number of NOx sensors: NC\_NOX\_SENS\_CONF  $k = 1 \dots NC\_NOX\_SENS\_CONF$   
 Number of lambda sensors: NC\_CBK\_EX\_NR  $m = 1 \dots NC\_CBK\_EX\_NR$

Typical configurations:

[NC\_CBK\_EX\_NR:NC\_NT\_NR:NC\_NOX\_SENS\_CONF] =[1:1:1], [2:2:2], [2:2:1], [2:1:1]

#### Application conditions

**Recurrence:** 10 ms

**Activation:** - -

**Deactivation:** - -


**Initialisation:** - -

#### Formula section:

```

if(0) STATE_NOX = STOP - -> !STOP
then(0) LV_INH_NT_AGI_THD = 0
        LV_INH_NT_AGI_TNT = 0
        TNT_MDL_NT_AGI_DYW[i] = TNT_MDL_1[i]

```

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**endif(0)**

### Application conditions

**Recurrence:** 100 ms has to be calculated before the modul "NOx Catalyst aging"  
xx703P03.00x

**Activation:** - -

**Deactivation:** - -

**Initialisation:** LV\_INH\_NT\_AGI = 0  
TNT\_MDL\_NT\_AGI\_DYW[i] = 0

*% NOx catalyst temperature dynamic window*

TNT\_MDL\_NT\_AGI\_DYW[i]<sub>n</sub> =  
(TNT\_MDL\_NT\_AGI\_DYW[i]<sub>n-1</sub> \* (1 - C\_CRLC\_TNT\_MDL\_NT\_AGI\_DYW))  
+ (TNT\_MDL\_1[i] \* C\_CRLC\_TNT\_MDL\_NT\_AGI\_DYW)

*% NOx catalyst temperature conditions for aging*

**if (1)** | TNT\_MDL\_NT\_AGI\_DYW[i] - TNT\_MDL\_1[i] | > C\_TNT\_MDL\_NT\_AGI\_DYW

*% at least one of the two benches has to fulfill the conditions*

**or** TNT\_MDL\_L <= ID\_TNT\_MDL\_NT\_AGI\_MIN(FAC\_NT\_AGI\_LIM)  
**or** TNT\_MDL\_H >= ID\_TNT\_MDL\_NT\_AGI\_MAX(FAC\_NT\_AGI\_LIM)  
**or** TNT\_MDL\_MV <= ID\_TNT\_MDL\_MV\_AGI\_MIN(FAC\_NT\_AGI\_LIM)  
**or** TNT\_MDL\_MV >= ID\_TNT\_MDL\_MV\_AGI\_MAX(FAC\_NT\_AGI\_LIM)  
**or** TNT\_MDL\_H - TNT\_MDL\_L >= C\_TNT\_MDL\_NT\_AGI\_DELTA  
**or** TIA\_IM < C\_TIA\_NT\_AGI\_MIN  
**or** TOIL <= C\_TOIL\_NT\_AGI\_MIN  
**or** TOIL > C\_TOIL\_NT\_AGI\_MAX  
**or** AMP < C\_AMP\_NT\_AGI\_MIN

**then (1)** LV\_INH\_NT\_AGI\_TNT\_BAS = 1

**else (1)** LV\_INH\_NT\_AGI\_TNT\_BAS = 0

**endif (1)**

**if(2)** STATE\_NOX = LOAD and LV\_HOM\_AFS\_REQ = 0

**then(2)** *% NOx catalyst temperature dynamic window*

*% NOx catalyst temperature conditions for aging*

**if(3)** LV\_INH\_NT\_AGI\_TNT\_BAS = 1

**then(3)** LV\_INH\_NT\_AGI\_TNT = 1

**else(3)** LV\_INH\_NT\_AGI\_TNT remains unchanged

**endif(3)**

*% monitoring of engine speed and Fuel mass flow*

**if(4)** N\_32 <= C\_N\_32\_NT\_AGI\_MIN

**or** N\_32 >= C\_N\_32\_NT\_AGI\_MAX

**or** MFF\_SP\_S <= C\_MFF\_SP\_S\_NT\_AGI\_MIN

**or** MFF\_SP\_S >= C\_MFF\_SP\_S\_NT\_AGI\_MAX

**or** LAMB\_LS\_UP[m] < C\_LAMB\_NT\_AGI\_MIN

*% valid if at least one [m] < C\_LAMB\_NT\_AGI\_MIN*

**then(4)** LV\_INH\_NT\_AGI\_THD = 1

**else(4)** LV\_INH\_NT\_AGI\_THD remains unchanged

**endif(4)**

**else(2)** LV\_INH\_NT\_AGI\_THD remains unchanged

```

        LV_INH_NT_AGI_TNT remains unchanged
endif(2)

if (5)      LC_INH_NT_AGI_OFF = 1
then (5)   LV_INH_NT_AGI_ERR = 0
           LV_INH_NT_AGI = 0

else (5)
  % component error check for aging
  LV_INH_NT_AGI_ERR =
  (
    LV_ERR_TEG_PCAT_DOWN[m] = 1           % valid if at least one [m] = 1
    (error currently present on location  Exh.gas temp.sens.downstr. precat )
  or
    LV_ERR_TIA_IM = 1
    (error currently present on location  temperature sensor intake air )
  or
    LV_ERR_EGR = 1
    (error currently present on exhaust gas recirculation system)
  or
    LV_ERR_EGR_2 = 1
    (EGR valve stuck)
  or
    LV_ERR_CPS = 1
    (electr.error currently present on error location canister purge solenoid)
  or
    LV_ERR_CAT_DIAG[m] = 1               % valid if at least one [m] = 1
    (pre catalyst diagnosis value reached the threshold)

  (Downstream lambda sensor specific errors)
  or
    [LV_NOX_SENS = 0
    and (
      (failure bit for downstream oxygen sensor)
      or
        LV_ERR_EL_LS_DOWN[m] = 1         % valid if at least one [m] = 1
      or
        LV_ERR_LSH_DOWN[m] = 1          % valid if at least one [m] = 1
        (downstr. oxygen sensor heater power stage)
      or
        LV_ERR_OBD_LSH_DOWN[m] = 1) ] % valid if at least one [m] = 1

  (NOx sensor specific errors)
  or
    [LV_NOX_SENS = 1
    and (
      LV_ERR_NS_OBD_1[k] = 1             % valid if at least one [k] = 1
      (OBD I error from smart NOx sensor)
      or
        ( STATE_ERR_NS_OBD_2[k] bitwise AND
          C_ERR_NS_NT_AGI_BIT_SEL ) != 0 % valid if at least one
          [k] = 1
        (OBD II error on NOx sensor)
      or
        LV_ERR_NS_CAN_MSG_LOST[k] = 1
        % valid if at least one [k] = 1
    )
    ]
  )
)

% building the central inhibition flag for aging function
LV_INH_NT_AGI =
  (
    LC_INH_NT_AGI_MAN = 1
    (codeword for manual setting of inhibiting the aging adaptation)
  or
    LV_INH_NT_AGI_TNT = 1
    (NOx trap temperature window control)
  or
    LV_INH_NT_AGI_ERR = 1

```

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```

                (error on adaptation relevant sensors /subsystems present)
    or          LV_NOX_AD_DYW = 0
                (limited dynamics concerning NOx concentration and MAF)
    or          LV_INH_NT_AGI_THD = 1)
endif (5)

LV_INH_NT_AGI_BAS =
    (
        LC_INH_NT_AGI_MAN = 1
        (codeword for manual setting of inhibiting the aging adaptation)
    or
        LV_INH_NT_AGI_ERR = 1)

```

### 7.91.2 Adjustment of NOx Sensor threshold for regeneration

```

If (6)          LC_NOX_SENS_MAX_AGI_ADJ_ENA = 1
    and          STATE_CAT_DIAG[m] = END                % valid if all [m] = END
    and          LV_NT_AGI_ENA = 1
then (6)        LV_NOX_SENS_MAX_ADJ = 1
else (6)        LV_NOX_SENS_MAX_ADJ = 0
endif (6)

```

### 7.91.3 Activation Conditions for continuous Aging Observation

```

if (7)          STATE_CAT_DIAG[m] = END                % valid if all [m] = END
then (7)        LV_NT_AGI_OBS_ENA = 1
                LV_NT_AGI_OBS_EGR_ENA = 0
else (7)        LV_NT_AGI_OBS_ENA = 0
    if (8)          LV_ERR_EGR
then(8)         LV_NT_AGI_OBS_EGR_ENA = 1
endif (8)
endif (7)

```

### 7.91.4 Gradient of NT\_AGI\_THERMO


#### Application conditions

**Recurrence:**           -- --

**Activation:**           -- --

**Deactivation:**       -- --

**Initialisation:**       *at transition 'engine stop to engine run':*  
                           NT\_AGI\_THERMO\_ST = NT\_AGI\_THERMO  
                           CTR\_KM\_CAN\_ST = CTR\_KM\_CAN  
                           *at transition 'engine run to engine stop':*  
**if** (CTR\_KM\_CAN-CTR\_KM\_CAN\_ST) > C\_CTR\_KM\_CAN\_DIF\_MIN  
       **AND** NT\_AGI\_THERMO < NT\_AGI\_THERMO\_ST  
       **then**  
       NT\_AGI\_THERMO\_GRD =  
                           (NT\_AGI\_THERMO - NT\_AGI\_THERMO\_ST) /  
                           (CTR\_KM\_CAN - CTR\_KM\_CAN\_ST)  
       **endif**

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## 7.92 NOx catalyst sulphur model

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_SUL_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
External data for sulfur model available					
LV_SUL_EXT_RES	O/V	0... 1H	0 ...1	1	-
External reset of data for sulfur model					
MFF_OFS_EGR_NT_SUL	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Correction of mass fuel flow setpoint for sulphur model due to unsymmetrical EGR branch					
NT_AGI_INC_SO2P [NC_NT_NR]	O/V	0... FFFFFFFFH	0 ...1	232.83e-12	-
Nox trap ageing factor increment per time step due to sulphur release					
NT_SUL	O/V	0... FFFFH	0... 10485.6	0.16	mg
NOx trap sulphur loading					
NT_SUL_32 [NC_NT_NR]	O/V/S	0... FFFFFFFFH	0... 10485.6	2.44& -6	mg
NOx trap sulphur loading with high resolution					
NT_SUL_AGI_DELTA [NC_NT_NR]	V	80000000... 7FFFFFFFH	-5242.8 ...5242.8	2.44& -6	mg
NT_SUL_AGI delta due to desulfation					
NT_SUL_DELTA [NC_NT_NR]	V	80000000... 7FFFFFFFH	-5242.8 ...5242.8	2.44& -6	mg
NT_SUL delta due to desulfation or loading					
NT_SUL_H	O/V	0... FFFFH	0... 10485.6	0.16	mg
NOx trap sulphur loading for high sulphured fuel					
NT_SUL_H_32 [NC_NT_NR]	O/V/S	0... FFFFFFFFH	0... 10485.6	2.44& -6	mg
NOx trap sulphur loading with high resolution for high sulphured fuel					
NT_SUL_H_DELTA [NC_NT_NR]	V	80000000... 7FFFFFFFH	-5242.8 ...5242.8	2.44& -6	mg
NT_SUL_H delta due to desulfation or loading					
NT_SUL_H_SO2P_BEG [NC_NT_NR]	V	0... FFFFH	0... 10485.6	0.16	mg
NOx trap sulphur loading for high sulphured fuel at desulfation begin					
NT_SUL_MAX [NC_NT_NR]	O/V	0... FFFFH	0... 10485.6	0.16	mg
maximum NOx trap sulphur loading					
NT_SUL_SO2P_BEG [NC_NT_NR]	V	0... FFFFH	0... 10485.6	0.16	mg
NOx trap sulphur loading at desulfation begin					
NT_SUL_UPD_OLD	-	0... FFFFH	0... 10485.6	0.16	mg
old value of interface variable for update of sulphur model by aging function					

### Input data:

C_NT_STC_BAS_MAX_ RNG_H {p. 2991}	EGR_RATIO {p. 8277}	FAC_SU_CONC_FUEL {p. 3072}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}
LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_PUC {p. 1720}	LV_SO2P_ACT {p. 3129}	MFF_SP [NC_CBK_EX_NR] {p. 2151}
N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_NT_NR {p. 644}	NT_AGI_THERMO_SNG [NC_NT_NR] {p. 3074}
NT_SUL_32_EXT_ADJ [NC_NT_NR] {p. 7682}	NT_SUL_AGI_SNG [NC_NT_NR] {p. 3074}	NT_SUL_H_32_EXT_ADJ [NC_NT_NR] {p. 7682}	NT_SUL_UPD {p. 3074}

STATE_NOX {p. 2986}	T_SO2P_DLY {p. 3129}	TNT_MDL_MV_SNG [NC_NT_NR] {p. 8237}	
---------------------	----------------------	--	--

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_SU_NOX	-	0... FFFFH	0... 0.0000000281215	429e-15	-
Correlation constant					
C_LAMB_SP_MIN_SUL	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Lambda threshold for sulphur poisoning in homogenous lambda 1					
C_NT_SUL_INI	-	0... FFFFH	0... 10485.6	0.16	mg
Manual initialisation value for NOx trap sulphur model					
C_STATE_EGR_CBK	-	0... 2H	0 ...2	1	-
Configuration of asymmetrical EGR branch for sulphur model (0: no unsymmetry, 1 or 2: EGR branch on this bank)					
C_SU_CONC_FUEL	-	0... FFH	0... 510	2	ppm
Fuel sulphur concentration					
C_SU_CONC_FUEL_H	-	0... FFH	0... 510	2	ppm
Fuel sulphur concentration for high sulphured fuel					
IP_CRLC_SUL_AFS	-	0... FFFFH	0 ...1	15.259e-6	-
LDP_TNT_MDL_MV_IP_CRLC_SUL_AFS	4	0... FFFFH	0... 1023.98	0.015625	°C
Conversion factor for sulphur poisoning in homogenous lambda 1 according to TNT_MDL_MV					
IP_NT_SUL_DEC_BAS	-	0... FFFFH	0... 40.959375	625e-6	mg
LDPM_LAMB_MV_IP_NT_SUL_DEC_BAS	4	0... 7FFFH	0... 31.9990234	976.563e-6	-
LDP_TNT_MDL_MV_IP_NT_SUL_DEC	4	0... FFFFH	0... 1023.98	0.015625	°C
Basic sulphur loading decrement per time step (layer 1)					
IP_NT_SUL_DEC_FAC_1	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
LDPM_NT_SUL_IP_NT_SUL_DEC_FAC_1	6	0... FFFFH	0... 10485.6	0.16	mg
LDP_NT_SUL_SO2P_BEG_IP_NT_SUL_1	6	0... FFFFH	0... 10485.6	0.16	mg
Correction factor for sulphur release					
IP_NT_SUL_DEC_FAC_2	-	0... FFFFH	0 ...1	15.259e-6	-
LDP_NT_AGI_THERMO_IP_NT_SUL_2	6	0... FFFFH	0... 0.99998474	15.2587e-6	-
Correction factor for sulphur release on all layers on thermal aging factor					
IP_NT_SUL_H_DEC_FAC_1	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
LDPM_NT_SUL_IP_NT_SUL_DEC_FAC_1	6	0... FFFFH	0... 10485.6	0.16	mg
LDP_NT_SUL_SO2P_BEG_IP_NT_SUL_1	6	0... FFFFH	0... 10485.6	0.16	mg
Correction factor for sulphur release for high sulphured fuel					
IP_NT_SUL_MAX	-	0... FFFFH	0... 10485.6	0.16	mg
LDPM_NT_AGI_THERMO	6	0... FFFFH	0... 0.99998474	15.2587e-6	-
maximum sulphur loading for layer 1 respecting NT_AGI_THERMO					
IP_T_SO2P_DLY	-	0... FFFFH	0... 6553.5	0.1	s
LDPM_LAMB_MV_IP_T_SO2P_DLY	4	0... 7FFFH	0... 31.9990234	976.563e-6	-
Delay time before sulfur release					
LC_NT_SUL_INI_MAN	-	0... 1H	0 ...1	1	-
Logical constant for manual initialisation of NOx trap sulphur model					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_NT_SUL_LIM_NOT	-	0... 1H	0 ...1	1	-
Logical constant for continue incrementation of the layer 3 above NT_SUL_MAX_3					

### Action definition

<b>ACTION_NOXM_CleanNTAdaptSul</b> ()	Mode: O
Initialization of NOx trap adaptation values of sulfur module	

<b>ACTION_NOXM_WriteSulfurExtAdj</b> ()	Mode: O
New external values for sulfur model available	

## 7.92.1 NOx catalyst sulphur model (NOXM modul 704G)

### General information:

The NOx catalyst sulphur model can handle single branched and twin branched exhaust gas lines with the configuration data NC\_NT\_NR defined in the NOx catalyst management module.

If NC\_NT\_NR=1, just one exhaust line is taken into account, if NC\_NT\_NR=2, the software calculates the twin branch version.

i belongs to NC\_NT\_NR.

### Description:

The NOx catalyst sulphur model calculates the NOx catalyst sulphur loading.

The sulphur loading is increased only in lean burn phase (-> STATE\_NOX = LOAD). The sulphur loading increment is calculated out of the fuel sulphur concentration and converted to a NOx mass loading equivalent (sulphur load in NO2 mass loading equivalent is loss of NOx storage capacity).

When the desulfation is active, the sulphur which is chemically stored in the NOx-trap is released depending on the NOx-trap monolith temperature, lambda, the modeled sulphur load NT\_SUL on the corresponding layer and the value of NT\_AGI\_THERMO.

During the desulfation the NOx-trap sulphur load is decremented until it reaches 0.


C\_CRLC\_SU\_NOX includes

- the factor for transformation of MFF\_SP \* N\_32 {mg/stk \* 1/min} to a fuel mass flow {mg /TA} =0,1s /2 /60s = 1 /1200)
- and the factor for number of cylinders and number of NOx traps  
= NC\_CYL\_NR /NC\_NT\_NR
- and the factor for transformation of C\_SU\_CONC\_FUEL {ppm} to mass part sulphur in fuel {mg S/mg fuel} = 1E-6
- and the factor for transformation of sulphur load {mg S} to sulphur load NO2 equivalent {mg NO2} = 2 \* 46 /32 = 2,875.

### Example values:

- four cylinder and one NOx trap: 9,5833 E-9
- six cylinder and two NOx traps: 7,1875 E-9

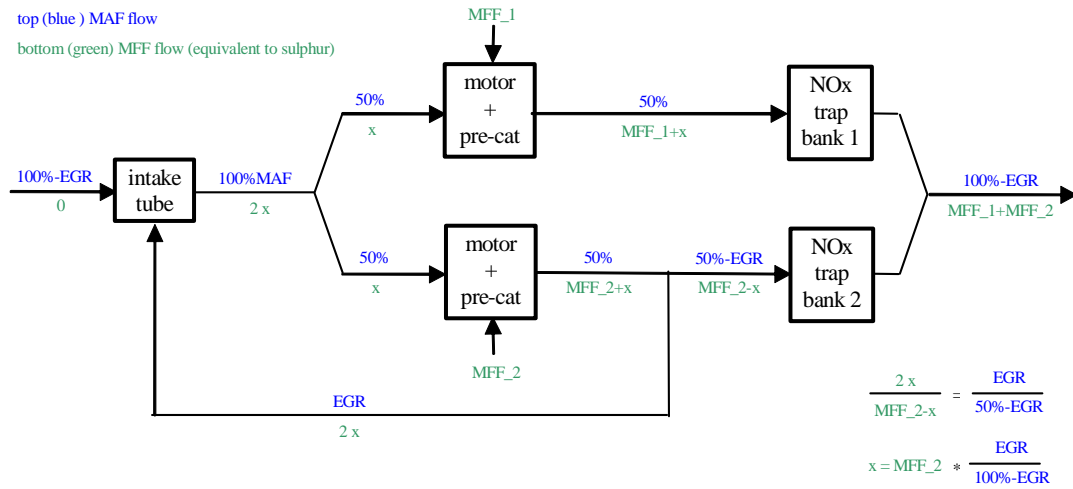
Calculation inside this function is done by high resolution variable NT\_SUL\_32. Valid output to other functions is low resolution variable NT\_SUL.

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### Unsymmetrical EGR branch


If the exhaust gas recirculation is unsymmetrical (exhaust gas is taken from one bank and added to the intake air for both banks) then the different sulfur loading of the NOx traps will be considered by setting C\_STATE\_EGR\_CBK to the bank with the EGR branch. In a symmetrical or a one-bank-system C\_STATE\_EGR\_CBK have to be set to 0.

The splitting of the sulfur to both NOx traps is shown in the following picture. The sulphur is proportional to the fuel flow and the fuel split is controlled by the air flow, which depends from the EGR ratio.



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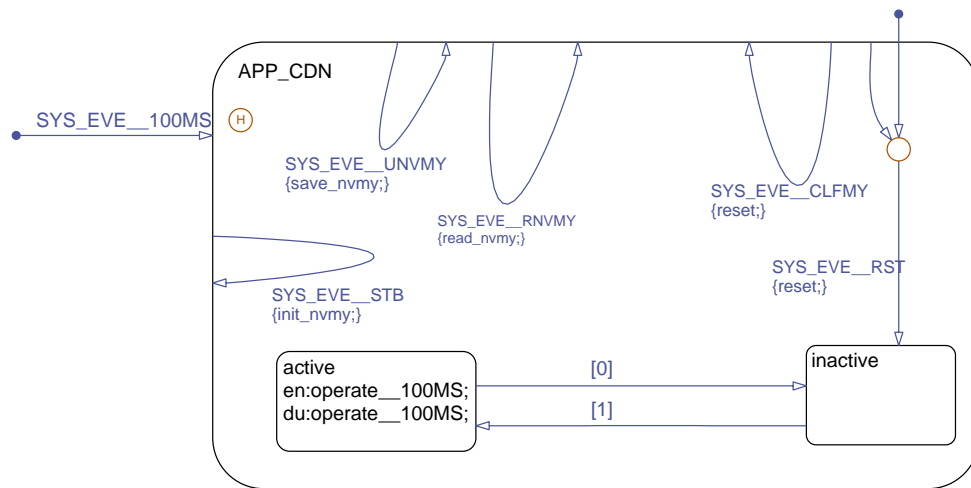



Figure 7.92.1: NOXM\_MODUL704G/APP\_CDN/Chart

### Function Description

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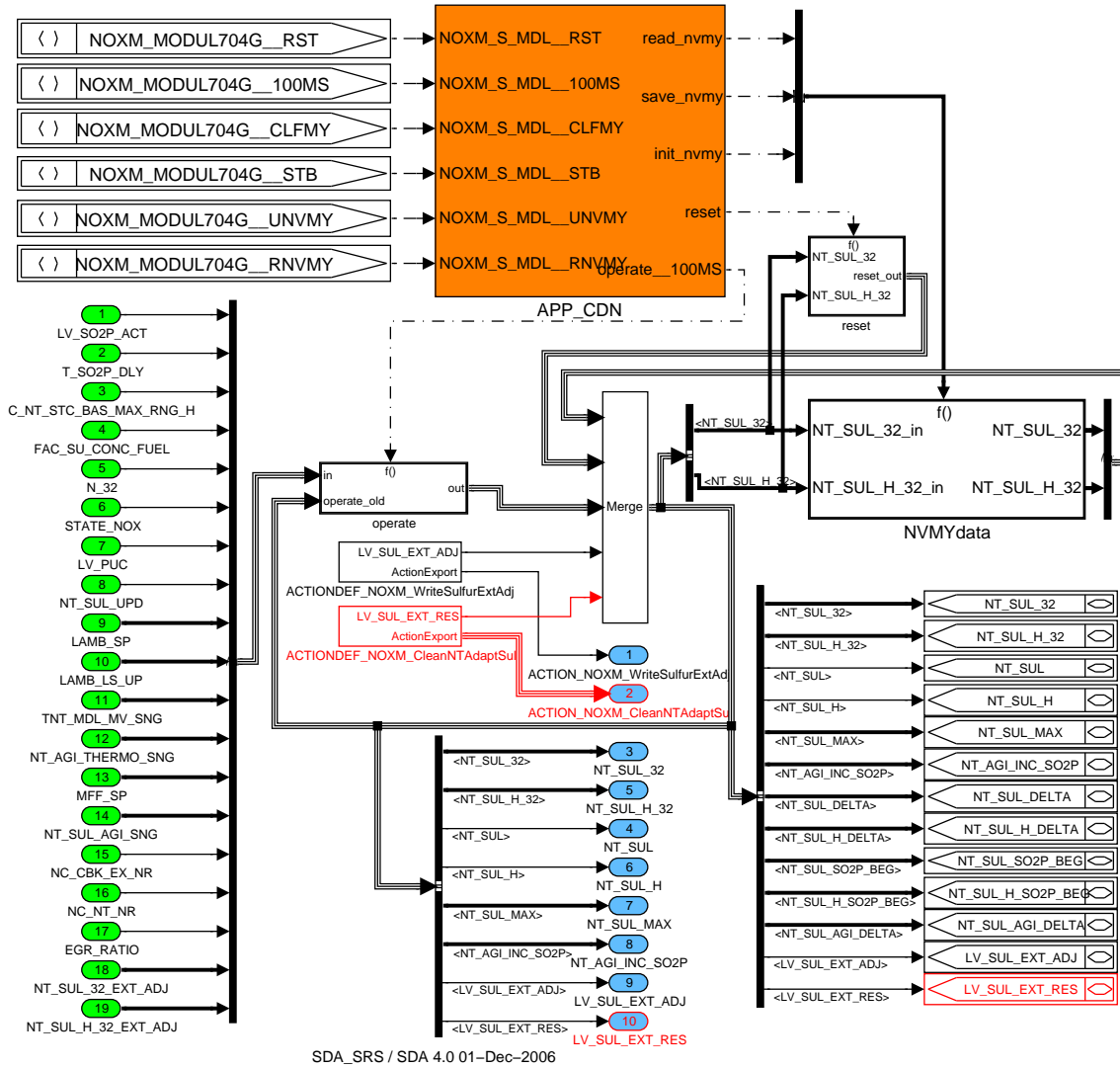


Figure 7.92.2: NOXM\_MODUL704G

### 7.92.1.1 SUBFUNCTION: ACTIONDEF\_NOXM\_CleanNTAdaptSul

#### Description for ACTION\_NOXM\_CleanNTAdaptSul

ACTION_NOXM_CleanNTAdaptSul()					
Initialization of NOx trap adaptation values of sulfur module					
Parameter	Type	Hex. limits	Phys. limits	Resol.	Unit

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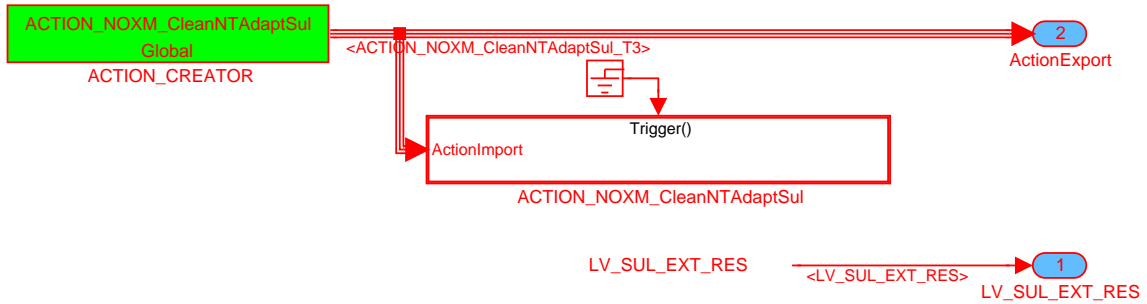


Figure 7.92.3: NOXM\_MODUL704G/ACTIONDEF\_NOXM\_CleanNTAdaptSul

The flag LV\_SUL\_EXT\_RST is set by this action. It shows that the sulfur values have to be reset inside next 100 ms recurrence.

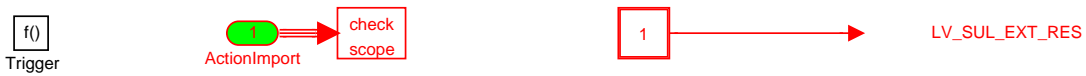


Figure 7.92.4:  
NOXM\_MODUL704G/ACTIONDEF\_NOXM\_CleanNTAdaptSul/ACTION\_NOXM\_CleanNTAdaptSul

### 7.92.1.2 SUBFUNCTION: ACTIONDEF\_NOXM\_WriteSulfurExtAdj

#### Description for ACTION\_NOXM\_WriteSulfurExtAdj

ACTION_NOXM_WriteSulfurExtAdj()					
New external values for sulfur model available					
Parameter	Type	Hex. limits	Phys. limits	Resol.	Unit

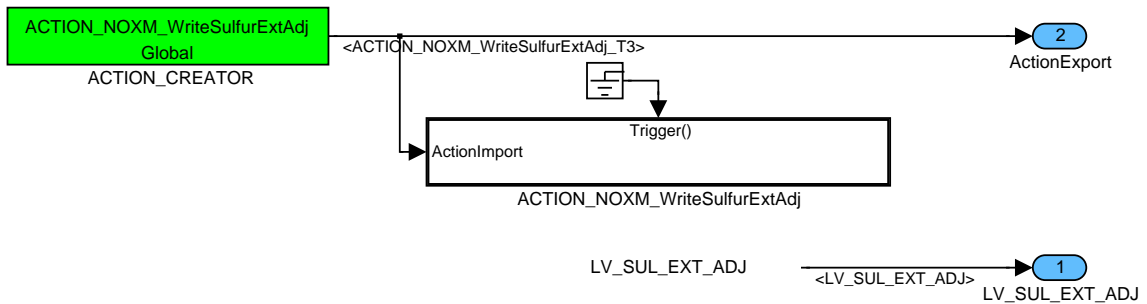


Figure 7.92.5: NOXM\_MODUL704G/ACTIONDEF\_NOXM\_WriteSulfurExtAdj

The flag LV\_SUL\_EXT\_ADJ is set by this action. It shows that the external values have to be used inside next 100 ms recurrence.

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Figure 7.92.6:  
NOXM\_MODUL704G/ACTIONDEF\_NOXM\_WriteSulfurExtAdj/ACTION\_NOXM\_WriteSulfurExtAdj

### 7.92.1.3 OPERATE

#### Calculation before MAIN

Before the MAIN part, which is calculated for each bank, the difference of the fuel due to the unsymmetrical EGR will be calculated. It will be added or subtracted inside MAIN to both banks.

(If MFF\_SP\_2 is not existing caused by NC\_CBK\_EX\_NR = 1, but access demanded by other variables depending on other indices of bigger size, then MFF\_SP\_1 is used.)

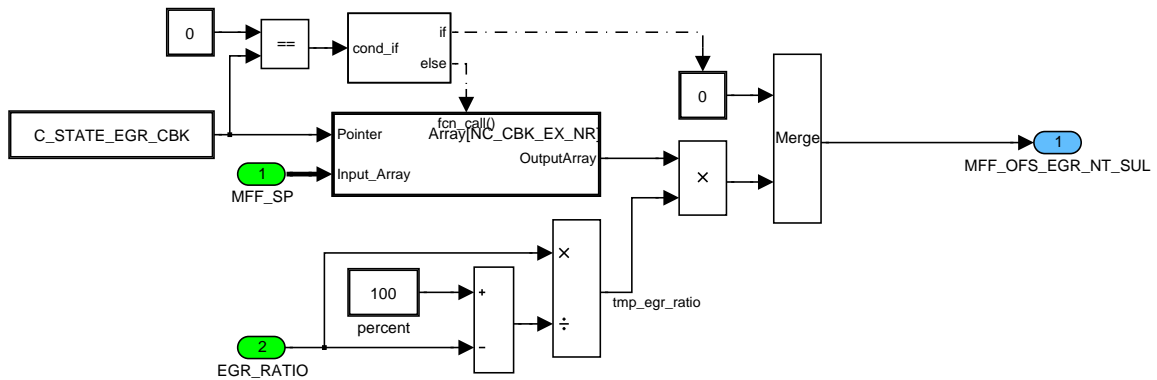


Figure 7.92.7: NOXM\_MODUL704G/operate/BEFORE\_MAIN

#### MAIN (for each NOx trap)

The function consists of the following parts

- manual initialization
  - sulphur load update (from NOx catalyst aging)
  - sulphur loading during LOAD phase
  - sulphur release during desulfation
- (splitted in two parts: before and after T\_SO2P\_DLY)

The for loop of the MAIN part is controlled by the number of NOx traps

NC\_NT\_NR = 1 means one NOx trap (calculation for i = 1)

NC\_NT\_NR = 2 means two NOx traps (calculation for i = 1 and 2)



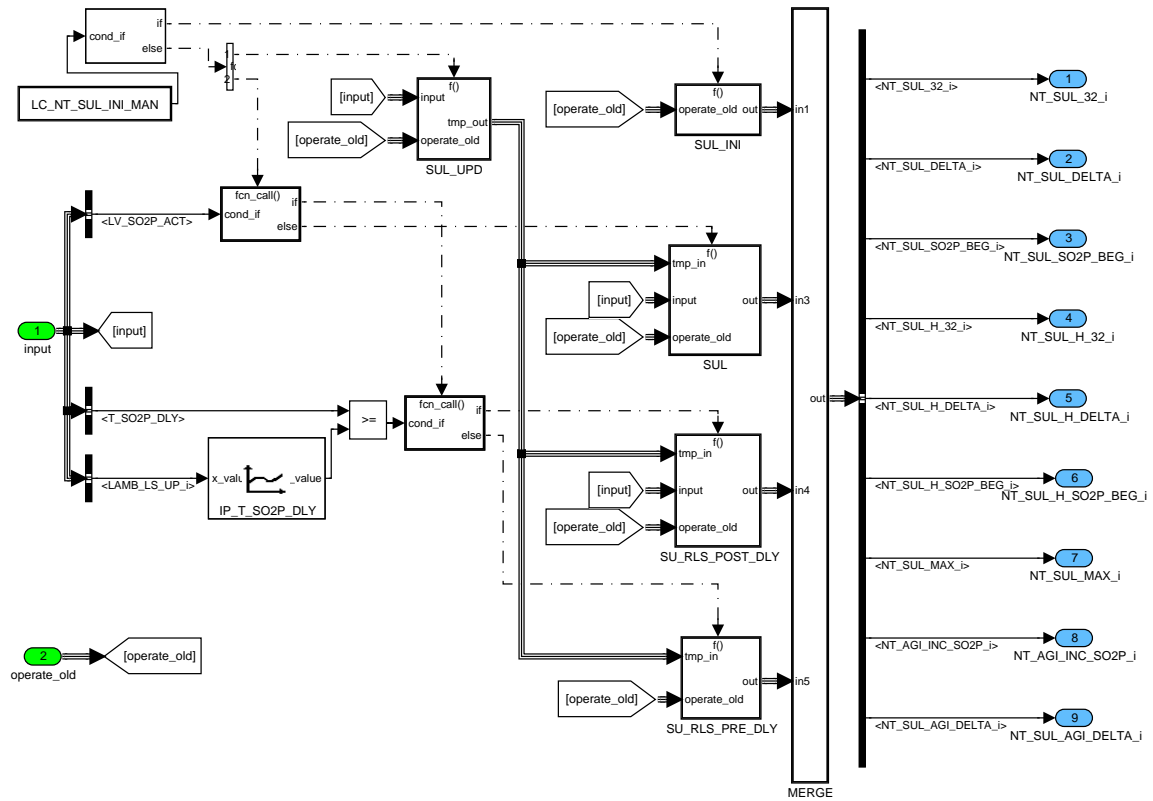


Figure 7.92.8: NOXM\_MODUL704G/operate/CBK\_MNG/MAIN

### Manual initialization

If LC\_NT\_SUL\_INI\_MAN ist set, then the sulfur load of the NOx traps will be initialized with C\_NT\_SUL\_INI.

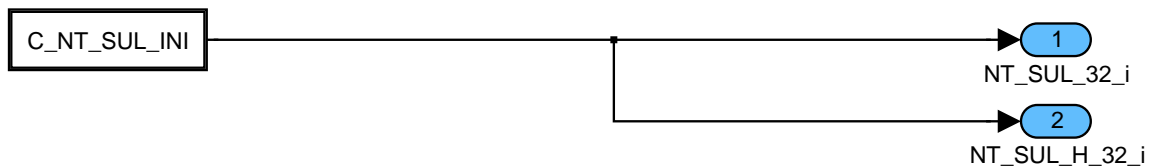


Figure 7.92.9: NOXM\_MODUL704G/operate/CBK\_MNG/MAIN/SUL\_INI/CLC

### Sulphur load update

The update value NT\_SUL\_UPD comes from the aging modul. The update takes place if the value is new and not zero.

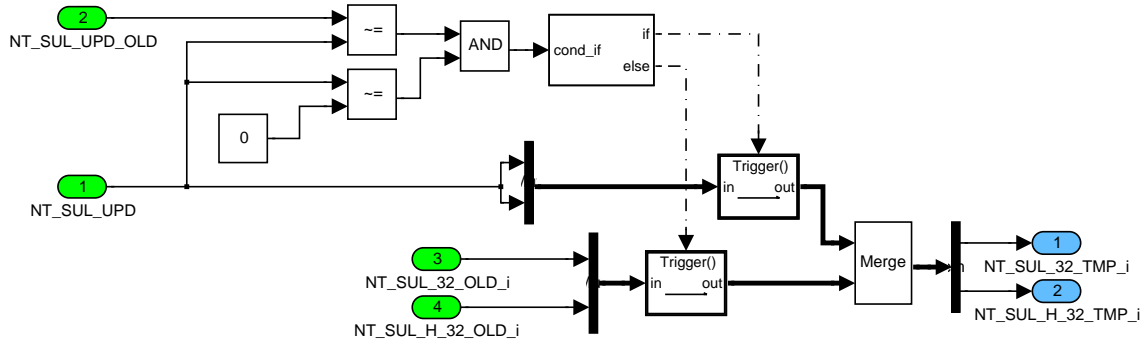


Figure 7.92.10: NOXM\_MODUL704G/operate/CBK\_MNG/MAIN/SUL\_UPD/CLC

### Calculation of sulphur loading increment

The offset of the EGR depending fuel will be added to the bank without EGR branch and subtracted to the bank with EGR. C\_STATE\_EGR\_CBK selects the bank with EGR branch. From these corrected fuel values the sulphur increment for the NOx traps will be calculated.

The temporary variable mff\_sp\_tmp\_i has the same resolution and limits as MFF\_SP.

(If MFF\_SP\_2 is not existing caused by NC\_CBK\_EX\_NR = 1, but access demanded by other variables depending on other indices of bigger size, then MFF\_SP\_1 is used.)

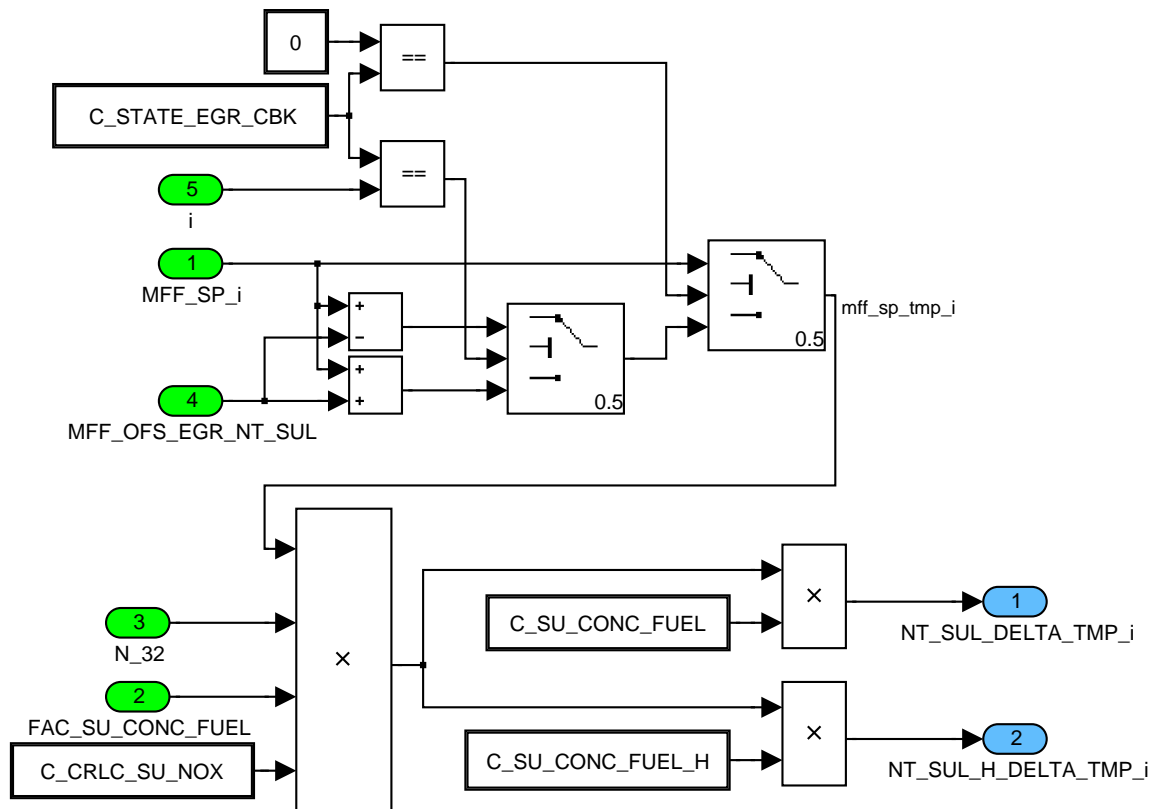


Figure 7.92.11: NOXM\_MODUL704G/operate/CBK\_MNG/MAIN/SUL/CLC/CLC1

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### Selection of sulphur loading increment

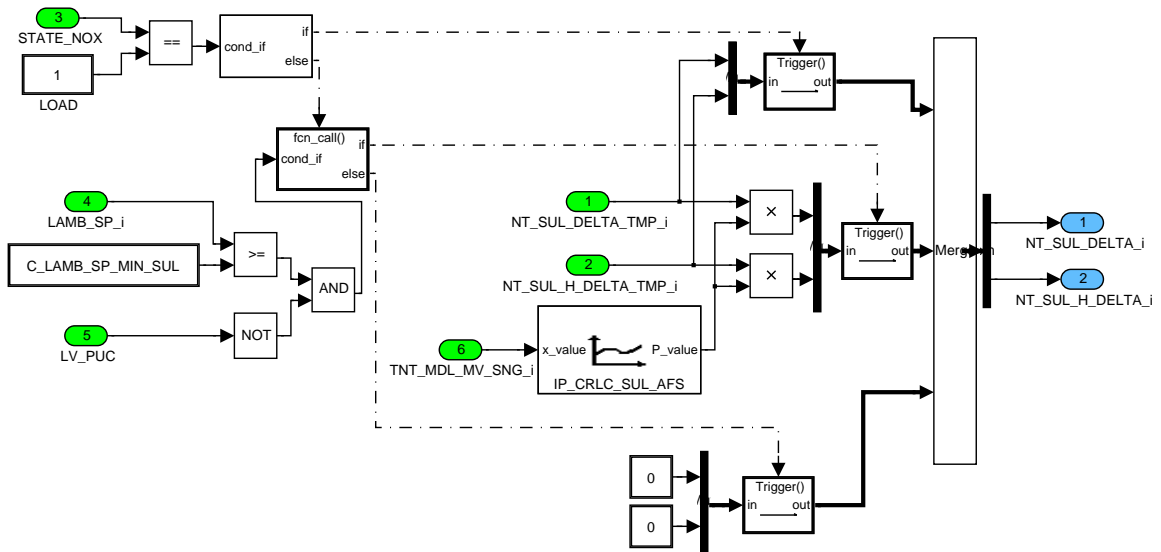



Figure 7.92.12: NOXM\_MODUL704G/operate/CBK\_MNG/MAIN/SUL/CLC/CLC2

### Integral of sulphur

The sulphur increments will be added until a temperature dependent maximum. The limitation may be disabled. by LC\_NT\_SUL\_LIM\_NOT.

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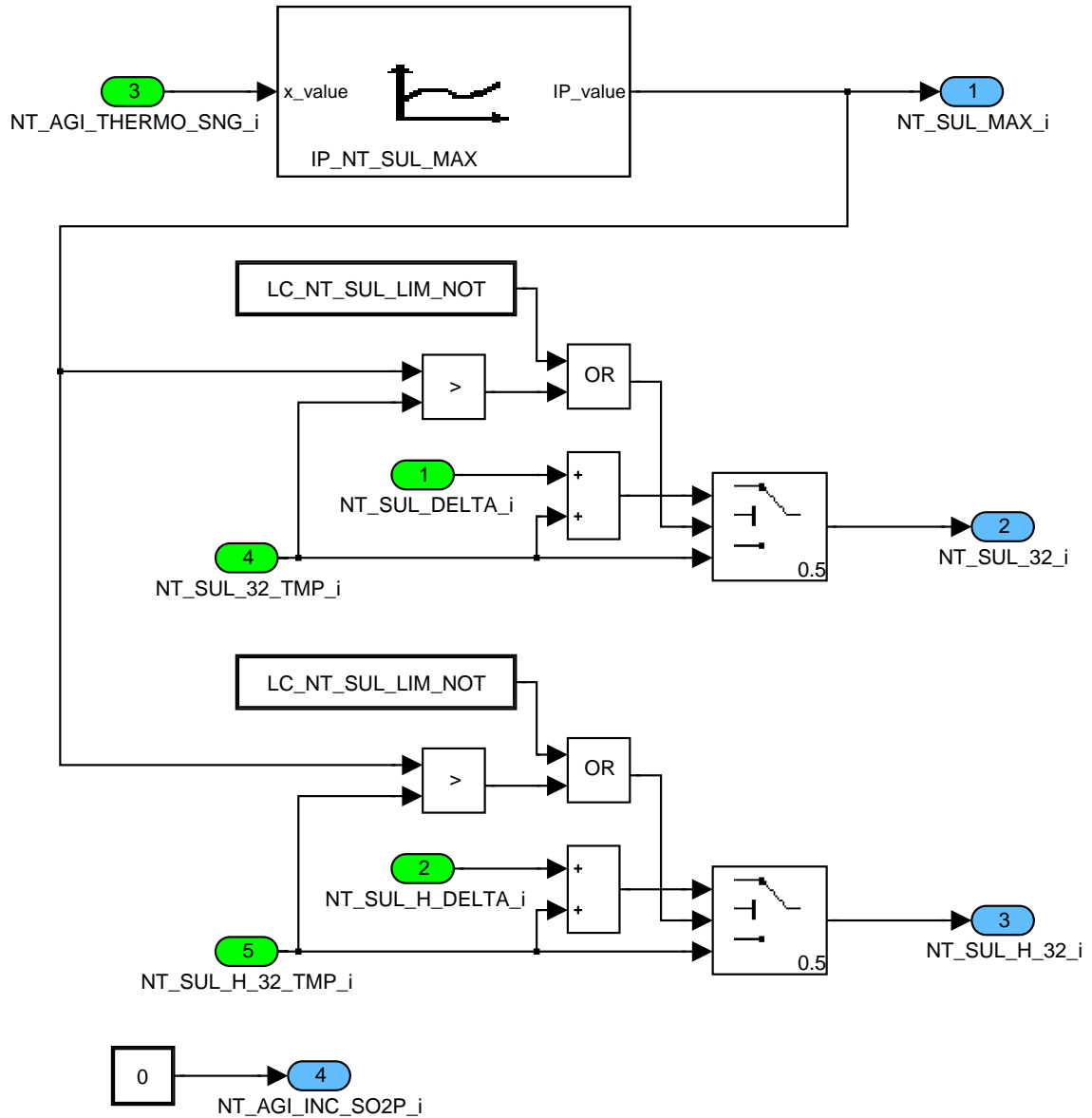


Figure 7.92.13: NOXM\_MODUL704G/operate/CBK\_MNG/MAIN/SUL/CLC/CLC3

### Sulphur release phase post after delay time

The decrement of sulfur during release phase will be calculated by maps. The downward integration is limited to zero.

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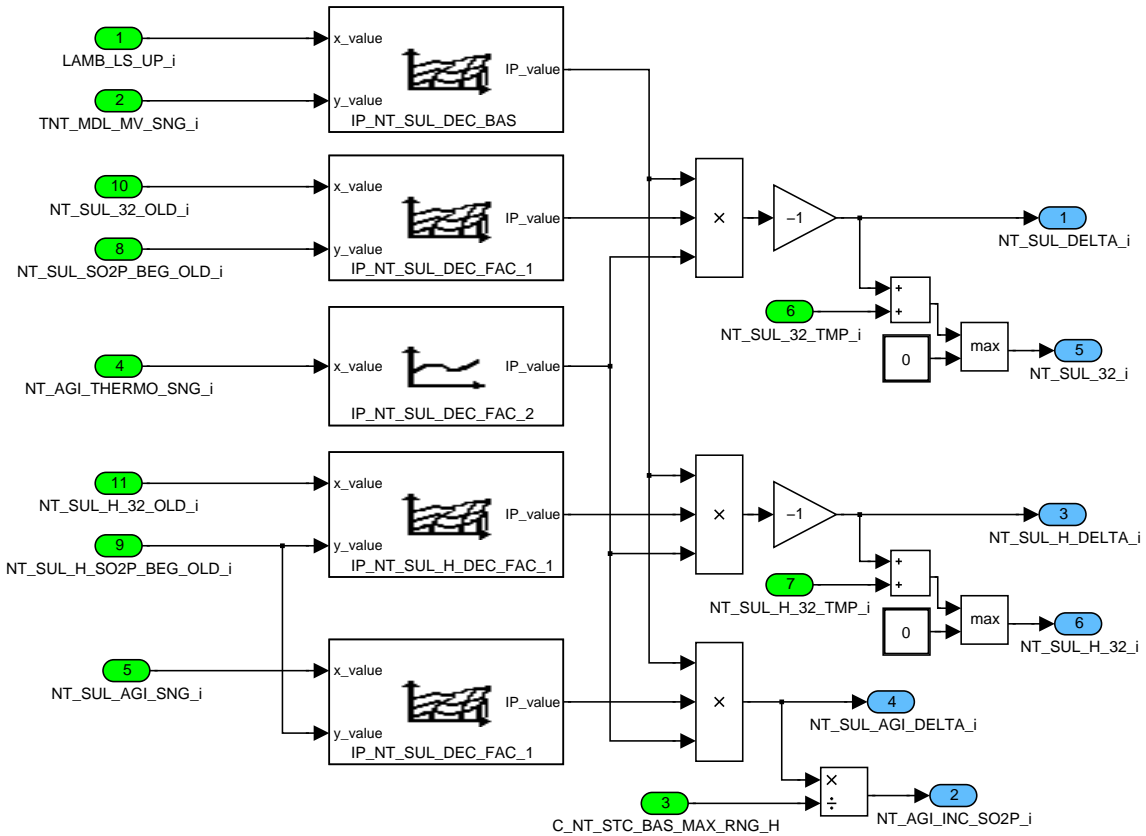


Figure 7.92.14: NOXM\_MODUL704G/operate/CBK\_MNG/MAIN/SU\_RLS\_POST\_DLY/CLC

**Sulphur release phase before delay time**

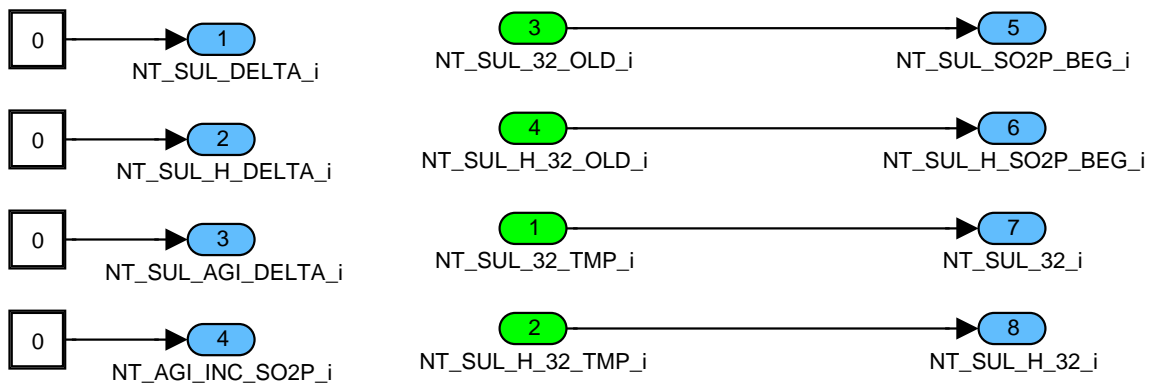


Figure 7.92.15: NOXM\_MODUL704G/operate/CBK\_MNG/MAIN/SU\_RLS\_PRE\_DLY/CLC

**Update of external adjustment values**

If flag LV\_SUL\_EXT\_ADJ was set by action ACTION\_NOXM\_WriteSulfurExtAdj, then the external values will be used and the flag will be reset.

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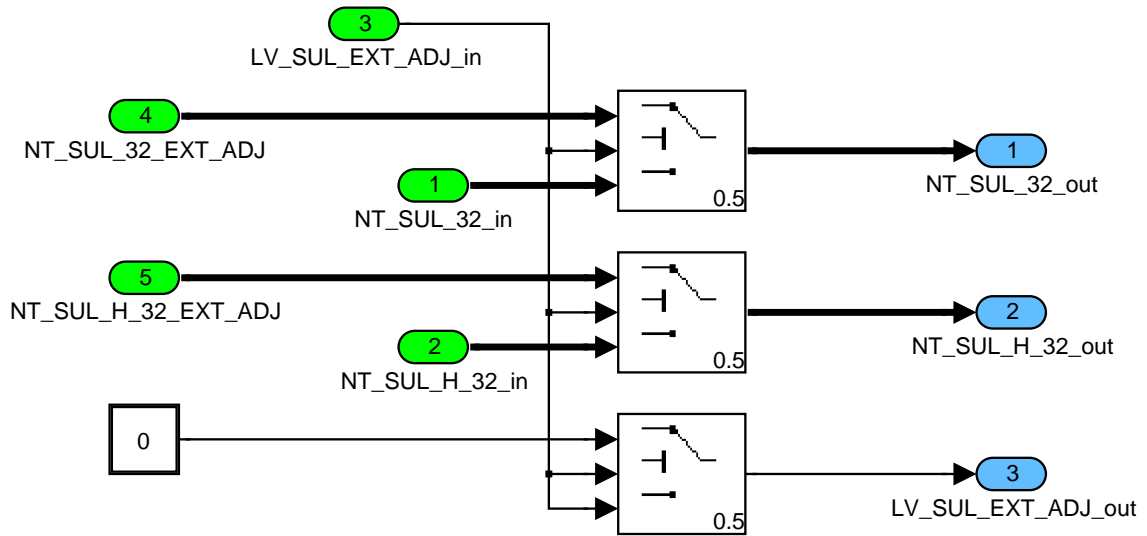


Figure 7.92.16: NOXM\_MODUL704G/operate/AFTER\_MAIN/CLC1

### Reset of sulfur values in case of new NOx traps

If flag LV\_SUL\_EXT\_RES was set by action ACTION\_NOXM\_CleanNTAdaptSul, then the sulfur values will be set to zero and the flag will be reset.

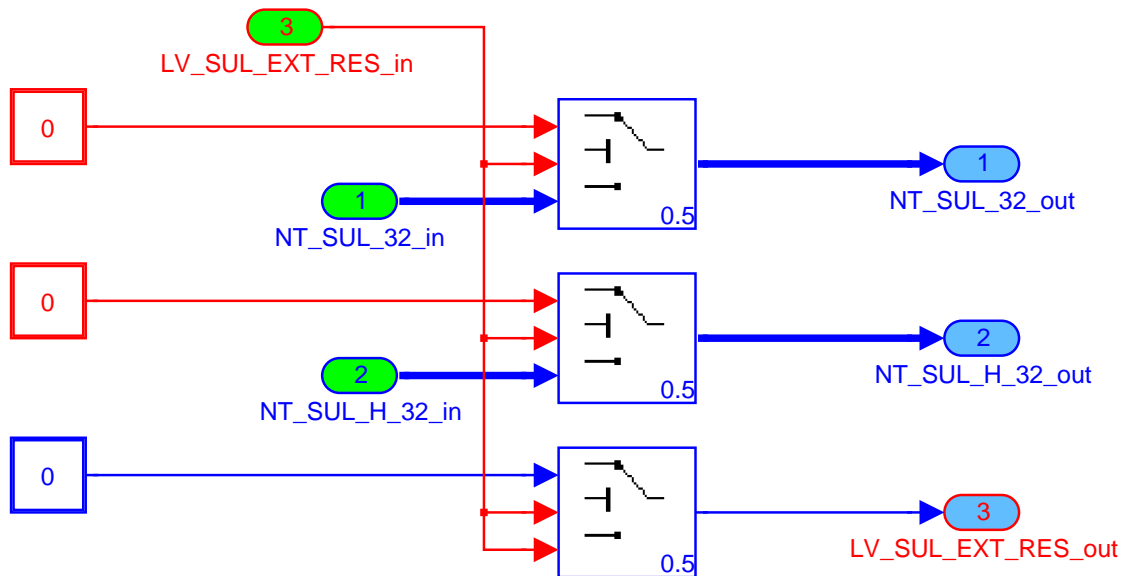



Figure 7.92.17: NOXM\_MODUL704G/operate/AFTER\_MAIN/CLC2

### Maximum calculation

After the MAIN part, which is calculated for each bank, the old value of the input NT\_SUL\_UPD and the maximum of the internal 32-bit values of all banks will be calculated as 16-bit value.

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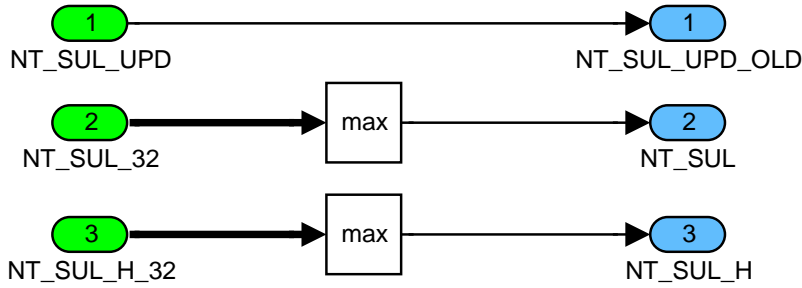


Figure 7.92.18: NOXM\_MODUL704G/operate/AFTER\_MAIN/CLC3

### 7.92.1.4 Handling of non-volatile memory for NT\_SUL\_32 and NT\_SUL\_H\_32

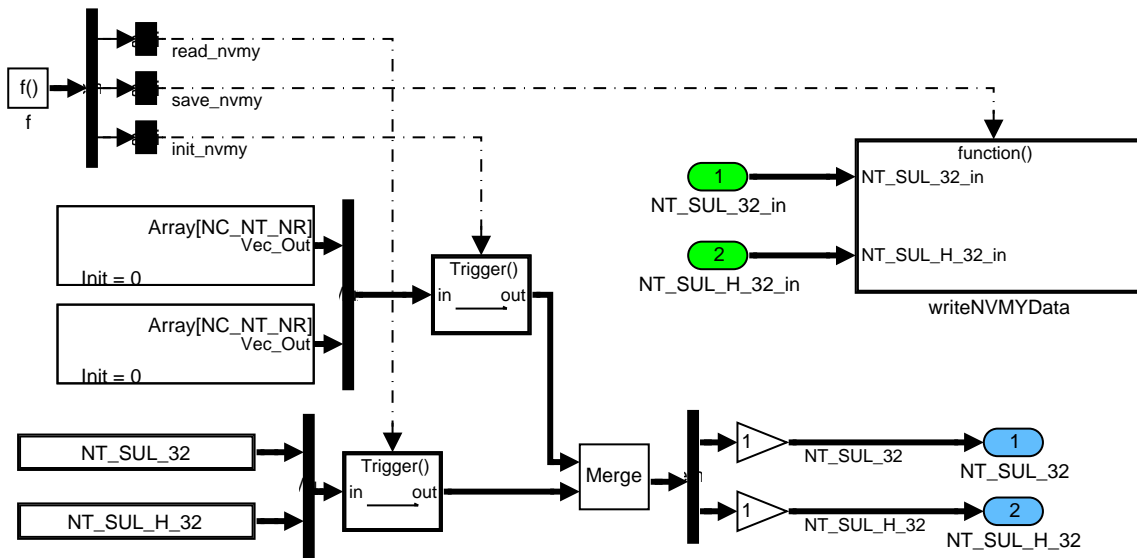


Figure 7.92.19: NOXM\_MODUL704G/NVMYdata

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### 7.92.1.5 SUBFUNCTION: reset

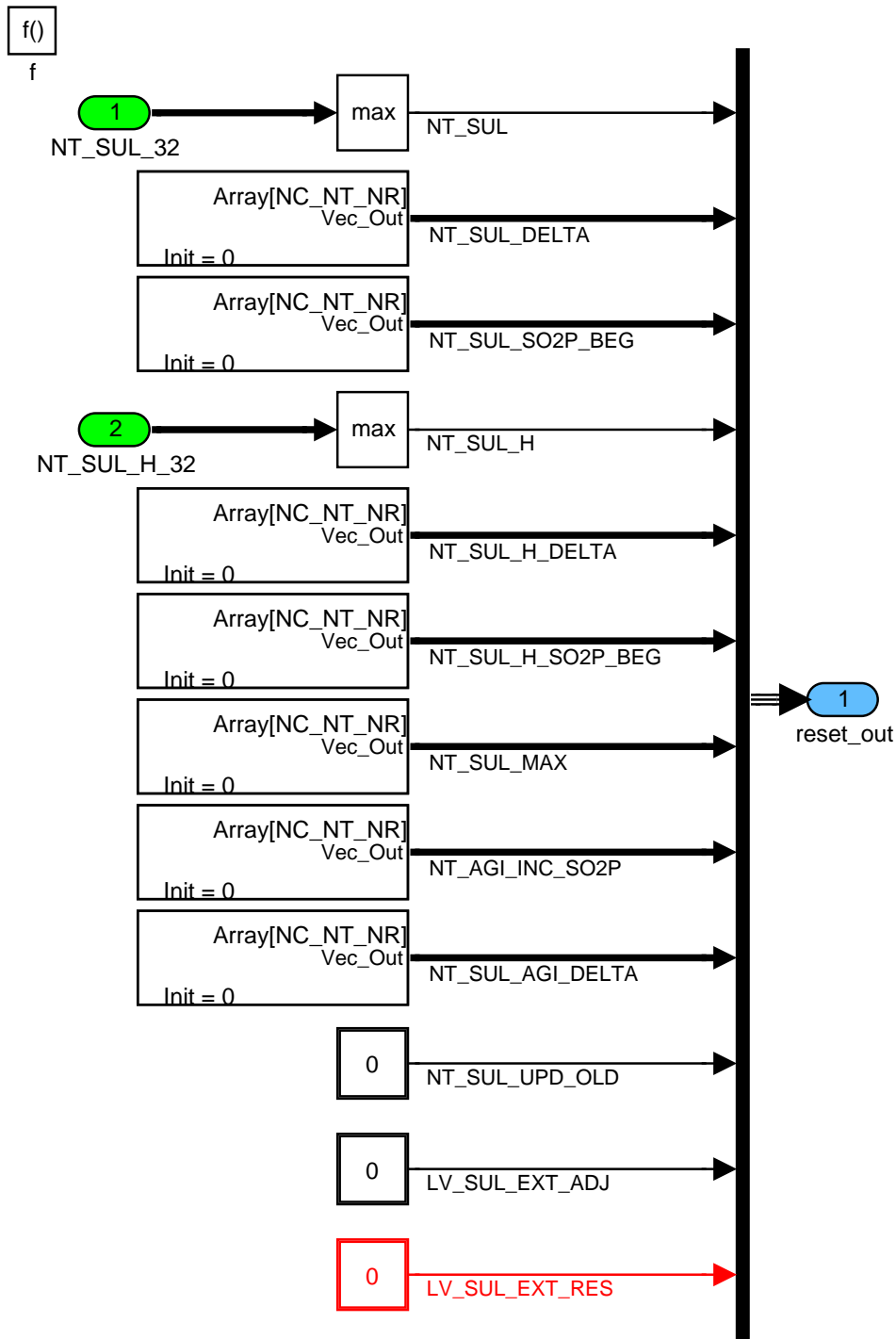


Figure 7.92.20: NOXM\_MODUL704G/reset

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## 7.93 NOx catalyst desulfation


### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_SO2P_PLS	V	0... FFH	0... 255	1	-
Counter for alternating desulfation cycles before activation of fast desulfation					
LAMB_SO2P [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Lambda setpoint for desulfation					
LV_NT_SO2P_INH_IS	V	0... 1H	0 ...1	1	-
Inhibition of desulfation at idle speed					
LV_SO2P_ACT	O/V	0... 1H	0 ...1	1	-
NOx trap desulfation active					
LV_SO2P_ACT_LAMB [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
NOx trap desulfation lambda condition fulfilled					
LV_SO2P_ACT_TNT	O/V	0... 1H	0 ...1	1	-
NOx trap desulfation temperature condition fulfilled					
LV_SO2P_AFR_CORD	O/V	0... 1H	0 ...1	1	-
Rich operation for fast desulfation request					
LV_SO2P_AFR_CTR	V	0... 1H	0 ...1	1	-
Active if any exhaust bank is rich, used for lean-rich edge detection					
LV_SO2P_FAST_REQ	O/V	0... 1H	0 ...1	1	-
Fast desulfation request					
LV_SO2P_LAMB_PULS	O/V	0... 1H	0 ...1	1	-
Lambda alternation request					
LV_SO2P_REQ	O/V	0... 1H	0 ...1	1	-
General desulfation request					
T_SO2P_DLY	O/V	0... FFFFH	0... 6553.5	0.1	s
Delay time counter before sulfur release					
T_SO2P_NOT	O/V	0... FFFFH	0... 6553.5	0.1	s
Time counter for non-desulfation atmosphere					
VLS_REF_SO2P [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Reference signal value for desulfation atmosphere detection					

### Input data:

CL_MMV {p. 3698}	IP_VLS_REF_LAMB_LS_UP {p. 3152}	IP_VLS_REF_LAMB_NS {p. 3152}	IP_VLS_REF_VLS_NS {p. 3152}
LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_NS [NC_NOX_SENS_CONF] {p. 991}	LV_INH_NT_SO2P_REQ {p. 3144}	LV_IS {p. 1720}
LV_NT_SO2P_EXT_ADJ_ACT {p. 3144}	LV_NT_SO2P_FAST_REQ_EXT {p. 3144}	LV_SO2P_AFR [NC_CBK_EX_NR] {p. 3150}	LV_SO2P_REQ_1 {p. 3073}
NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}	NT_AGI_SUL {p. 3073}	NT_SUL {p. 3113}
TNT_MDL_H {p. 8237}	TNT_MDL_MV {p. 8237}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_NS [NC_NOX_SENS_CONF] {p. 992}

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VLS_NT_DOWN [NC_NOX_SENS_CONF] {p. 811}	VS {p. 1176}		
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**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_MMV_SO2P_IS_MAX	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Maximum canister load for NOx trap desulfation at idle speed					
C_LAMB_SO2P_PAS	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Passive lambda value if the desulfation is not active					
C_NT_AGI_SO2P_MAX	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Maximal NOx trap aging factor					
C_NT_AGI_SUL_SO2P_FAST	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
NOx trap aging threshold for fast desulfation					
C_NT_AGI_SUL_SO2P_FAST_HYS	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
NOx trap aging hysteresis for fast desulfation					
C_NT_SUL_SO2P_MAX	-	0... FFFFH	0... 10485.6	0.16	mg
Maximal NOx trap sulphur load out of sulphur model					
C_STATE_SENS_VLS_DOWN_SO2P_ACT [NC_CBK_EX_NR]	-	0H 1H 2H 3H 4H 5H	LAMB_LS_UP VLS_DOWN VLS_NS LAMB_NS VLS_NT_ DOWN MANUAL	-	-
Mode to determine the sensor used for detection of a desulfating atmosphere					
C_T_SO2P_NOT_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Maximal time for desulfation interruption before desulfation timer reset					
C_TNT_MDL_SO2P_FAST	-	0... FFH	0... 1020	4	°C
NOx trap temperature threshold for switching to fast desulfation					
C_TNT_MDL_SO2P_FAST_HYS	-	0... FFH	0... 1020	4	°C
NOx trap temperature hysteresis for switching back to alternating desulfation					
C_TNT_MDL_SO2P_HYS	-	0... FFH	0... 1020	4	°C
NOx trap monolith temperature hysteresis for SO2 purge deactivation					
C_TNT_MDL_SO2P_MIN	-	0... FFH	0... 1020	4	°C
NOx trap monolith temperature threshold for SO2 purge possible					
C_TNT_MDL_SO2P_MIN_EXT	-	0... FFH	0... 1020	4	°C
NOx trap monolith temperature threshold for SO2 purge possible by external request					
C_VLS_REF_SO2P	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Reference signal manual value					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VLS_SO2P_HYS	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
VLS hysteresis for SO2 purge active detection					
C_VLS_SO2P_MIN	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Threshold for SO2 purge activation					
C_VS_SO2P_FAST_HYS	-	0... FFH	0... 255	1	km/h
Vehicle speed hysteresis for switching back to alternating desulfation					
IP_CTR_SO2P_PLS_AGI	-	0... FFH	0... 255	1	-
LDP_AGI_SUL_IP_CTR	4	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Number of alternating desulfation cycles before fast desulfation (depending on sulfur aging)					
IP_CTR_SO2P_PLS_SUL	-	0... FFH	0... 255	1	-
LDP_SUL_IP_CTR	4	0... FFFFH	0... 10485.6	0.16	mg
Number of alternating desulfation cycles before fast desulfation (depending on sulfur load)					
IP_LAMB_SO2P	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDP_TNT_MDL_MV_IP_LAMB_SO2P	8	0... FFFFH	0... 1023.984375	0.015625	°C
Required lambda setpoint during desulfation					
IP_LAMB_SO2P_EXT	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDP_TNT_MDL_MV_IP_LAMB_SO2P_EXT	8	0... FFFFH	0... 1023.984375	0.015625	°C
Required lambda setpoint during desulfation by external request					
IP_VS_SO2P_FAST_THD	-	0... FFH	0... 255	1	km/h
LDP_TNT_MDL_MV_IP_VS_SO2P_FAST	4	0... FFH	0... 1020	4	°C
Vehicle speed threshold for switching to fast desulfation according to TNT_MDL_MV					
LC_SO2P_FAST_MAN	-	0... 1H	0...1	1	-
Manual switch to fast desulfation mode					

## General Information

Gasoline contains sulphur, which is chemically stored in the NOx catalyst. Due to this sulphur compounds, the NOx trap storage capacity and the NOx trap efficiency will decrease. The sulphates can be decomposed under high temperature with rich mixture. This catalyst state (high temperature, rich exhaust gas composition) is called NOx catalyst desulfation.

If a desulfation request is set, the function is able to request catalyst heating. When an enough high monolith-temperature is reached the desulfation is started by switching to a suitable lambda value. This desulfation lambda depends on the actual minimum monolith temperature and on the desulfation mode.


Two desulfation modes are implemented: a fast way with a single, rich lambda value or a way with a lambda alternating around lambda=1 and thereby with two main lambda values, a lower rich value and an upper lean value. This way permits low H2S emissions.

The decision, which desulfation process is chosen, is made dependent on the vehicle speed or a manual application.

It can't be guaranteed the setting of a lambda request is followed immediately by a change of lambda. For this reason, this function contents a detection of a desulfating atmosphere (that means a high temperature level and a rich exhaust gas composition).

## Application Conditions


Initialization: RST

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Recurrence: 100MS  
 Activation: always  
 Deactivation: never

### Function description

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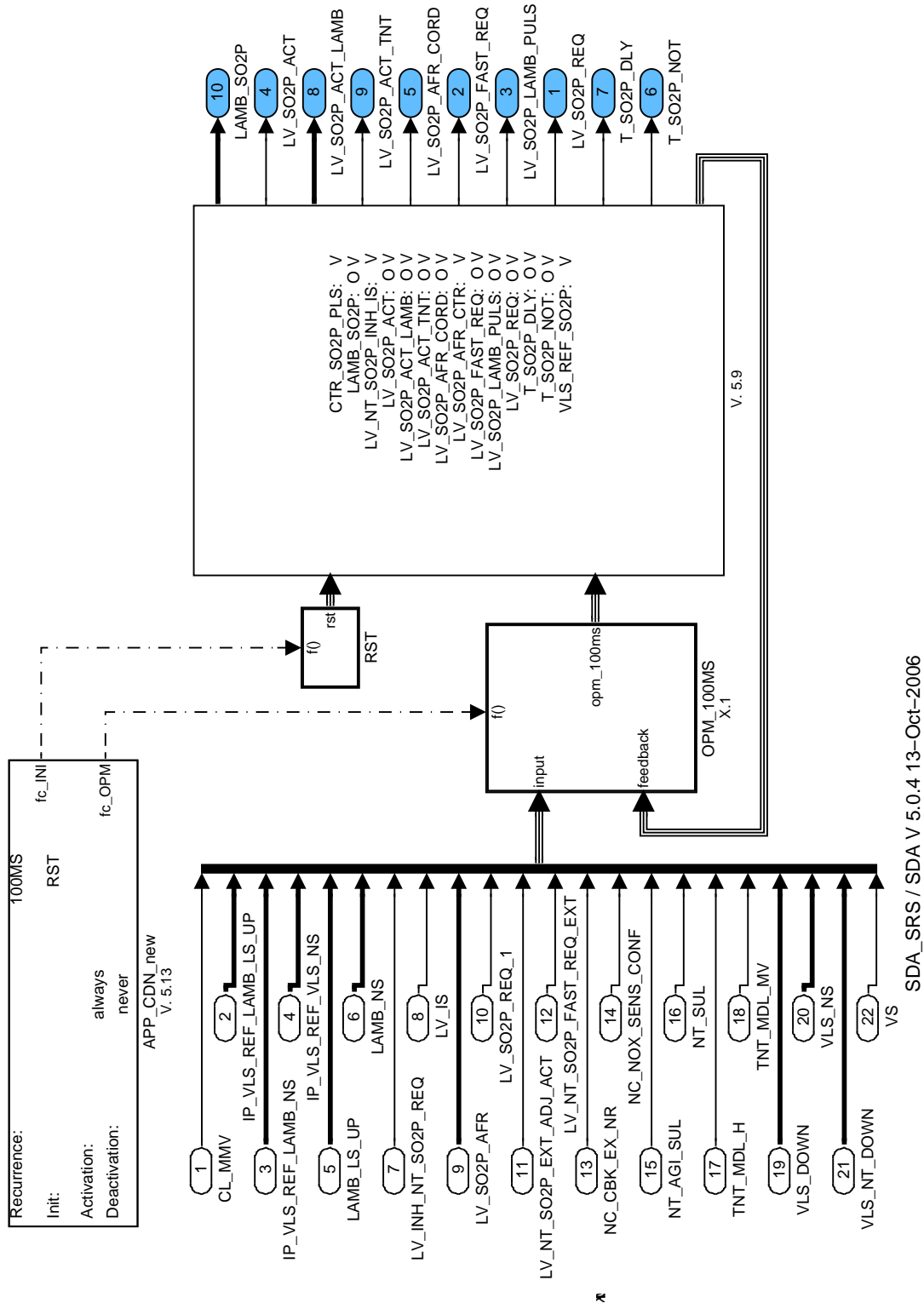


Figure 7.93.1: : Path: NOXM\_REQGNNTD0

### 7.93.1 FORMULA SECTION

The bank specific and bank not specific calculations are done separately.

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First the bank specific calculations are done (SO2P\_ACT\_MNG). This section contains detection of the desulfation atmosphere.

Bank not specific and bank diagonal calculations are included in subsystem REQ\_CLC. In this section the request for desulfation is calculated.

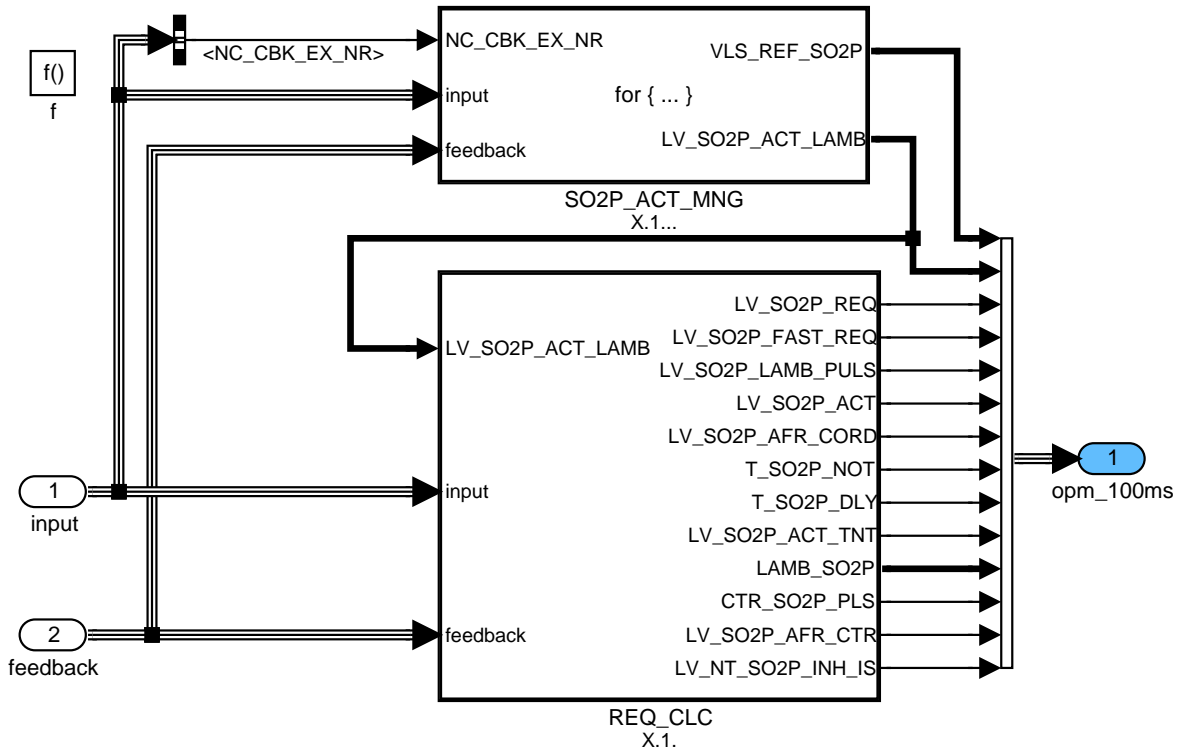


Figure 7.93.2: : Path: NOXM\_REQGNNTD0/OPM\_100MS

### 7.93.1.1 BANK SPECIFIC CALCULATIONS

#### 7.93.1.1.1 Management of different exhaust gas configurations

Index "k" corresponds to number of NOx Sensors in the system. Supported is only configuration where number of NOx Sensors is less or equal to number of exhaust banks. If one NOx Sensor and two banks exist then for both banks shall be taken the same NOx Sensor voltage signal

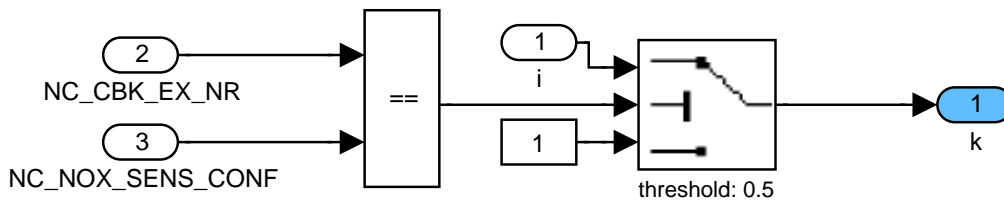


Figure 7.93.3: : Path: NOXM\_REQGNNTD0/OPM\_100MS/SO2P\_ACT\_MNG/CLC\_k

#### 7.93.1.1.2 Detection of a desulfating or non-desulfating atmosphere

For the detection of the exhaust gas composition one of available signals is chosen and converted to binary voltage value of lambda if needed. After that the desulfation atmosphere can be detected using Lambda value.

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### 7.93.1.1.2.1 Selection of sensor signal

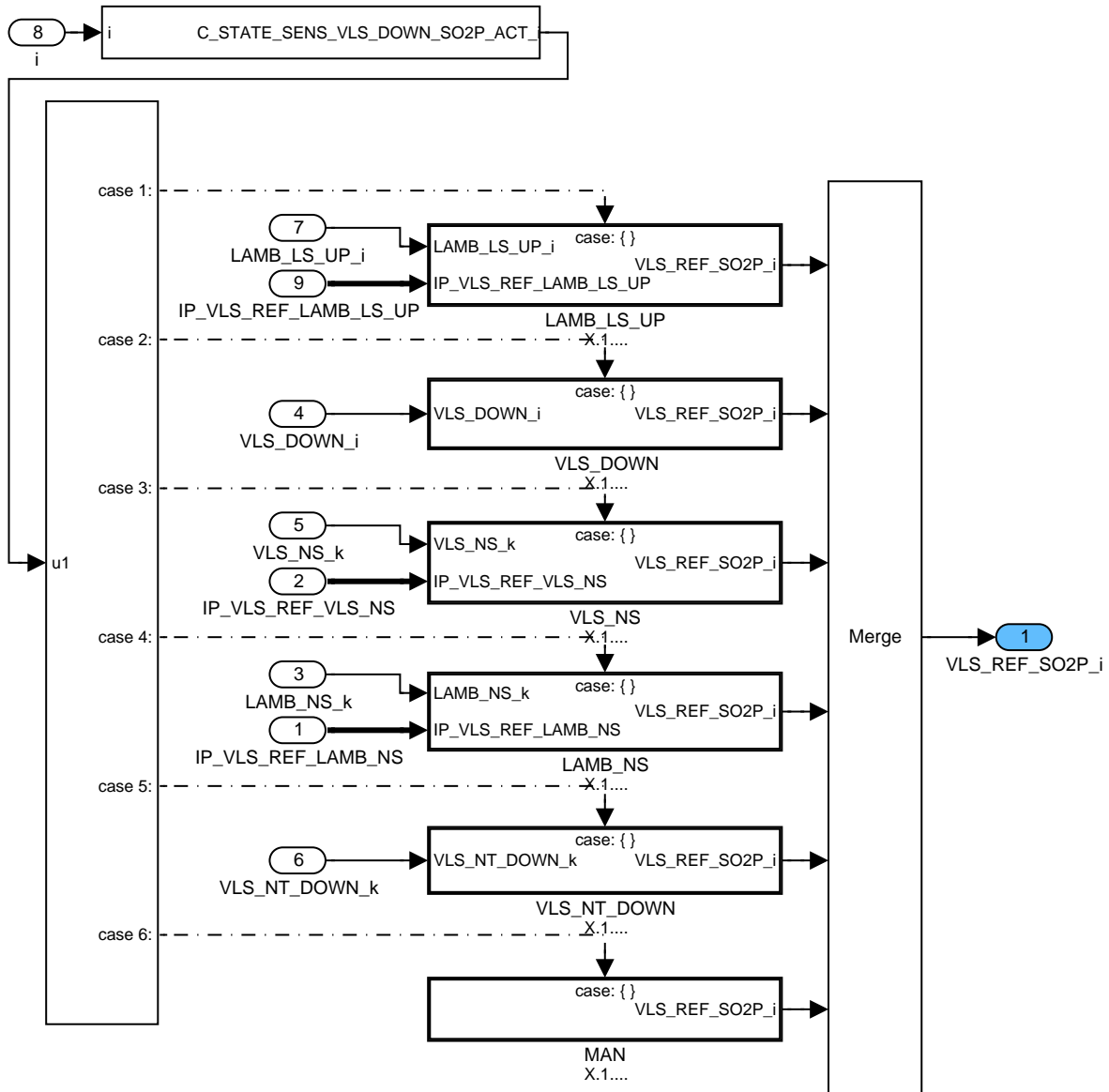


Figure 7.93.4: : Path:  
NOXM\_REQGNNTD0/OPM\_100MS/SO2P\_ACT\_MNG/SO2P\_ACT/CHK\_SEL\_STATE

#### 7.93.1.1.2.1.1 Linear lambda before pre-catalyst

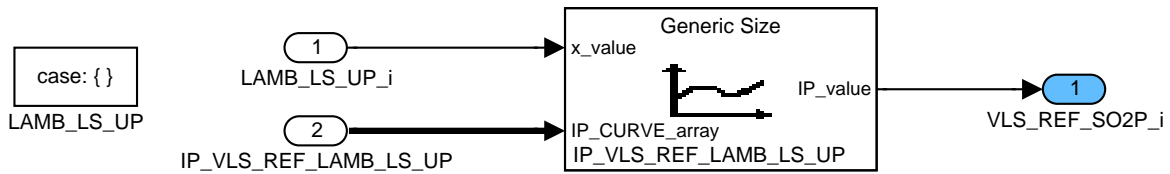


Figure 7.93.5: : Path:  
NOXM\_REQGNNTD0/OPM\_100MS/SO2P\_ACT\_MNG/SO2P\_ACT/CHK\_SEL\_STATE/LAMB\_LS\_UP

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### 7.93.1.1.2.1.2 Binary lambda sensor after pre-catalyst

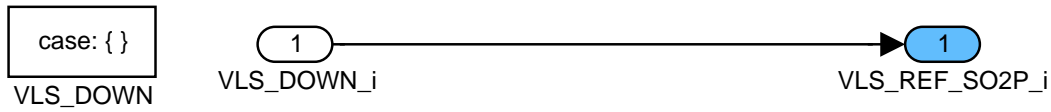


Figure 7.93.6: : Path:  
NOXM\_REQGNNTD0/OPM\_100MS/SO2P\_ACT\_MNG/SO2P\_ACT/CHK\_SEL\_STATE/VLS\_DOWN

### 7.93.1.1.2.1.3 Binary lambda signal of NOx sensor

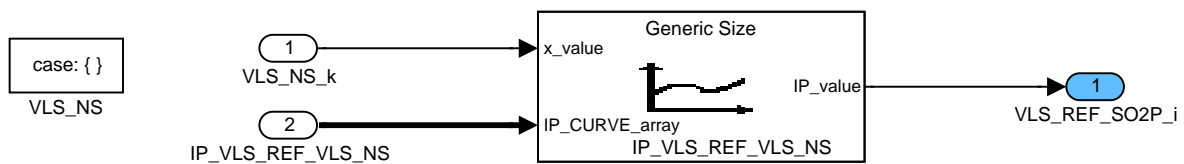


Figure 7.93.7: : Path:  
NOXM\_REQGNNTD0/OPM\_100MS/SO2P\_ACT\_MNG/SO2P\_ACT/CHK\_SEL\_STATE/VLS\_NS

### 7.93.1.1.2.1.4 Linear lambda signal of NOx sensor

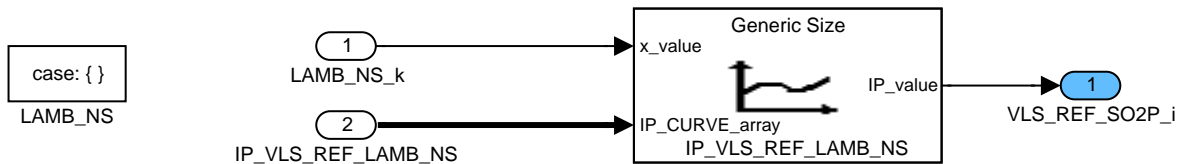


Figure 7.93.8: : Path:  
NOXM\_REQGNNTD0/OPM\_100MS/SO2P\_ACT\_MNG/SO2P\_ACT/CHK\_SEL\_STATE/LAMB\_NS

### 7.93.1.1.2.1.5 Binary lambda sensor after NOx trap

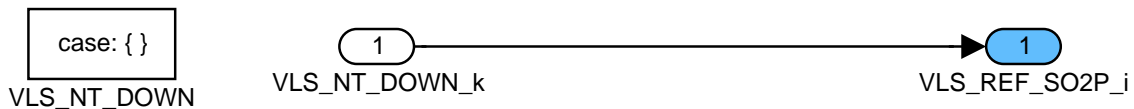


Figure 7.93.9: : Path: NOXM\_REQGNNTD0/OPM\_100MS/SO2P\_ACT\_MNG/SO2P\_ACT/CHK\_SEL\_STATE/VLS\_NT\_DOWN

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### 7.93.1.1.2.1.6 Manuel value

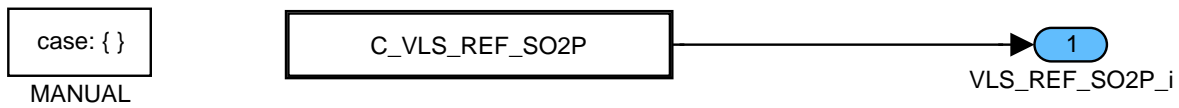


Figure 7.93.10: : Path:  
NOXM\_REQGNNTD0/OPM\_100MS/SO2P\_ACT\_MNG/SO2P\_ACT/CHK\_SEL\_STATE/MAN

### 7.93.1.1.2.2 Detection of suitable lambda for desulfation

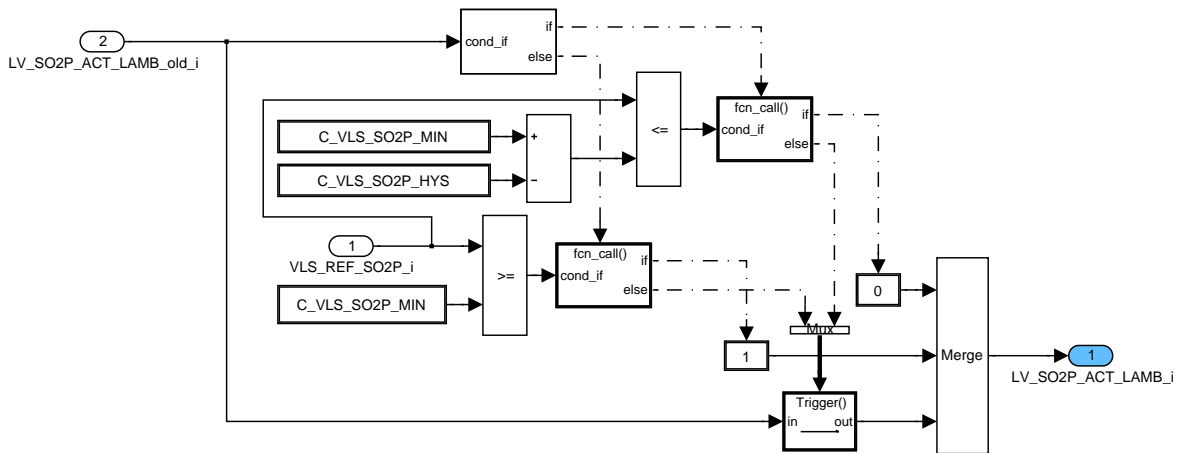


Figure 7.93.11: : Path:  
NOXM\_REQGNNTD0/OPM\_100MS/SO2P\_ACT\_MNG/SO2P\_ACT/CHK\_COMB\_CDN

## 7.93.1.2 BANK NOT SPECIFIC AND BANK DIAGONAL CALCULATIONS

### 7.93.1.2.1 Selection of minimum temperature for desulfation

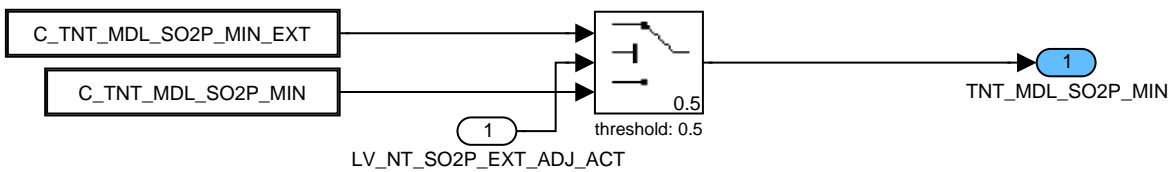


Figure 7.93.12: : Path: NOXM\_REQGNNTD0/OPM\_100MS/REQ\_CLC/TNT\_MDL\_SO2P\_MIN

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### 7.93.1.2.2 Inhibition of desulfation at idle speed

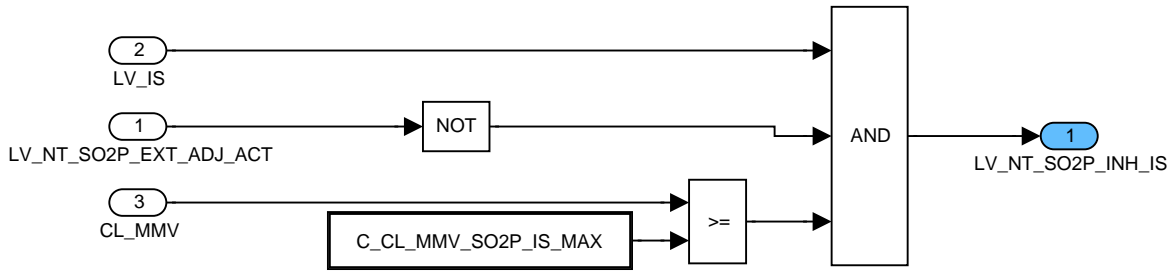


Figure 7.93.13: : Path: NOXM\_REQGNNTD0/OPM\_100MS/REQ\_CLC/SO2P\_INH\_IS

### 7.93.1.2.3 Desulfation request start condition

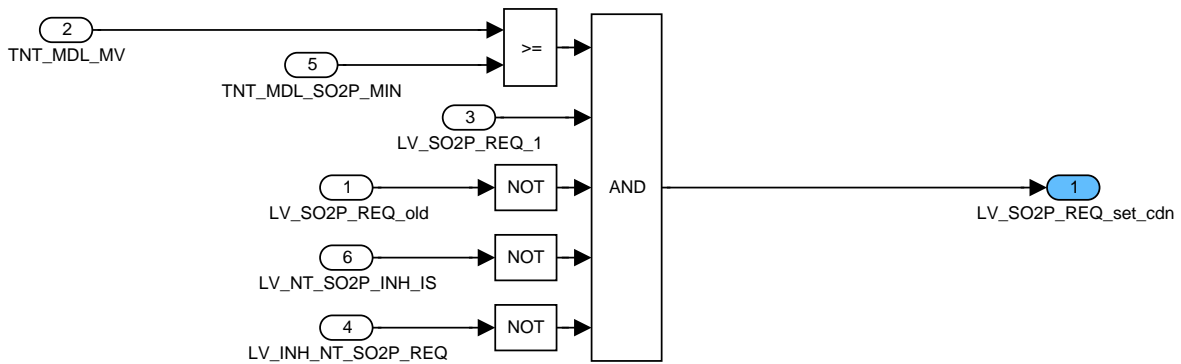


Figure 7.93.14: : Path: NOXM\_REQGNNTD0/OPM\_100MS/REQ\_CLC/SO2P\_REQ\_CDN

### 7.93.1.2.4 Calculation of the desulfation request

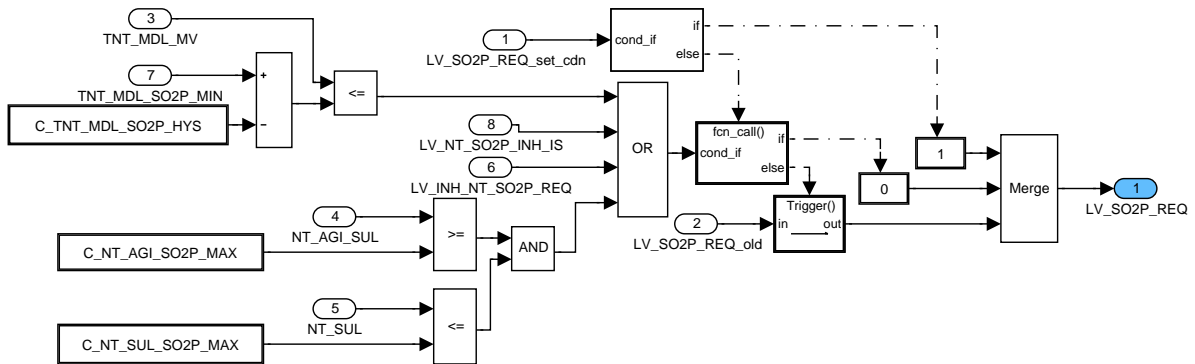


Figure 7.93.15: : Path: NOXM\_REQGNNTD0/OPM\_100MS/REQ\_CLC/SO2P\_REQ

### 7.93.1.2.5 Determination of desulfation mode

Alternating or fast desulfation is used depending on several conditions. Additionally, at the start of a fast desulfation some alternating desulfation cycles may be calibrated.

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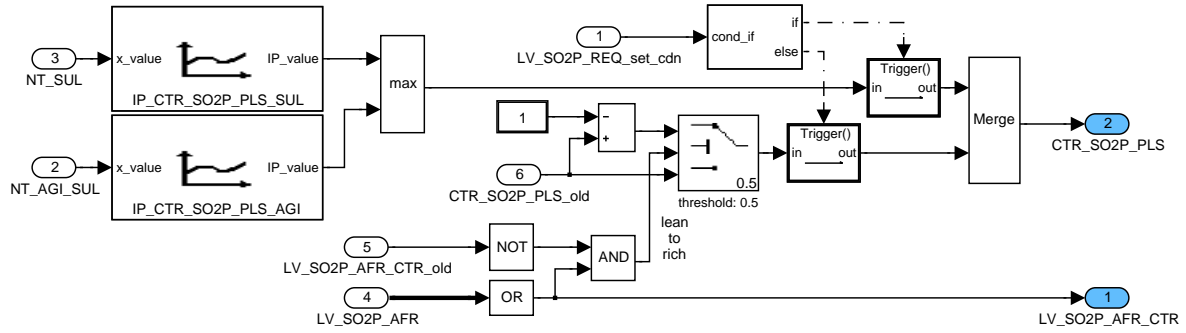


Figure 7.93.16: : Path: NOXM\_REQGNNTD0/OPM\_100MS/REQ\_CLC/CTR\_SO2P

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### 7.93.1.2.6 Fast or alternating desulfation

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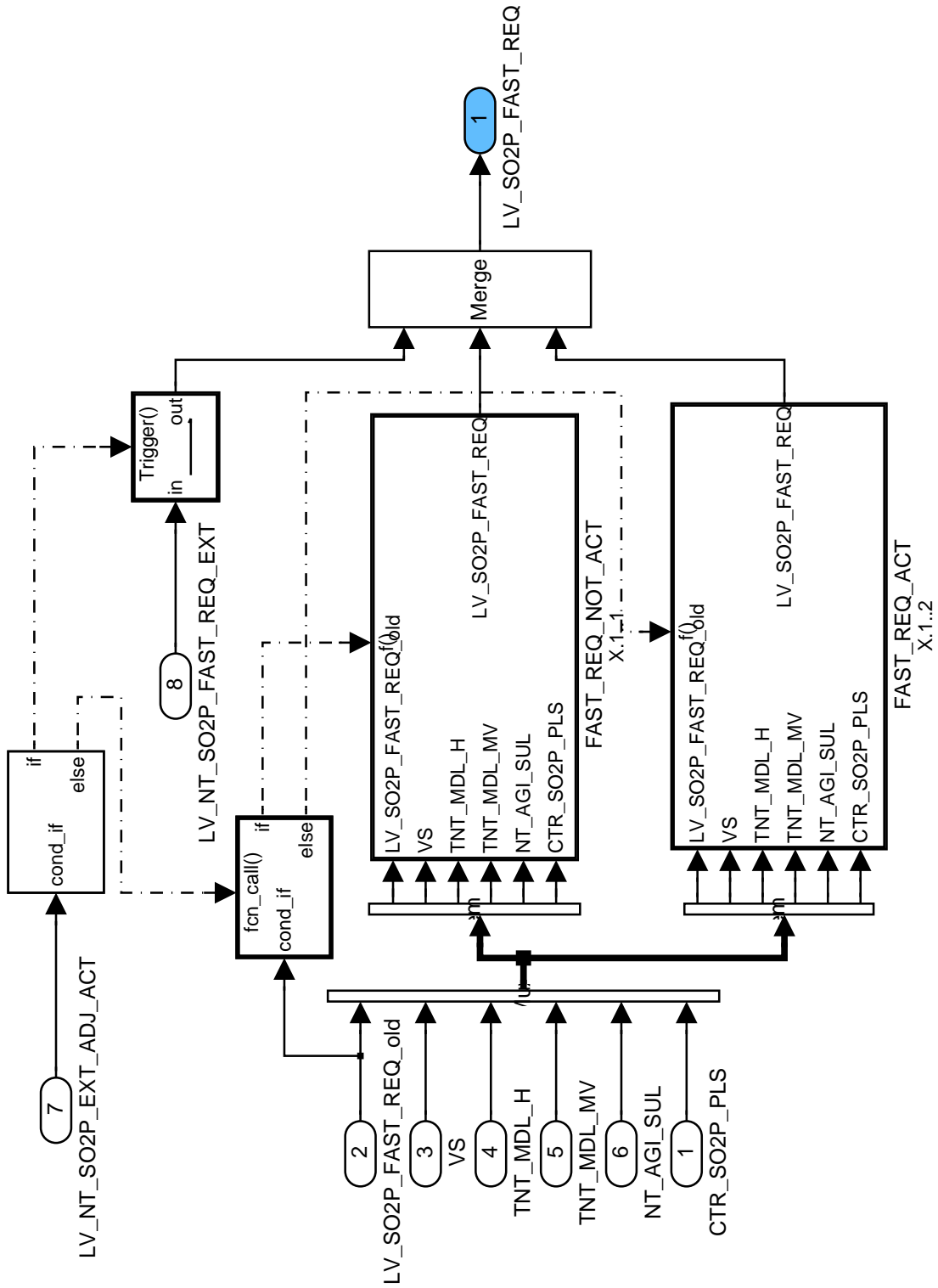


Figure 7.93.17: : Path: NOXM\_REQGNNTD0/OPM\_100MS/REQ\_CLC/SO2P\_FAST\_REQ

### 7.93.1.2.6.1 FAST\_REQ\_NOT\_ACT

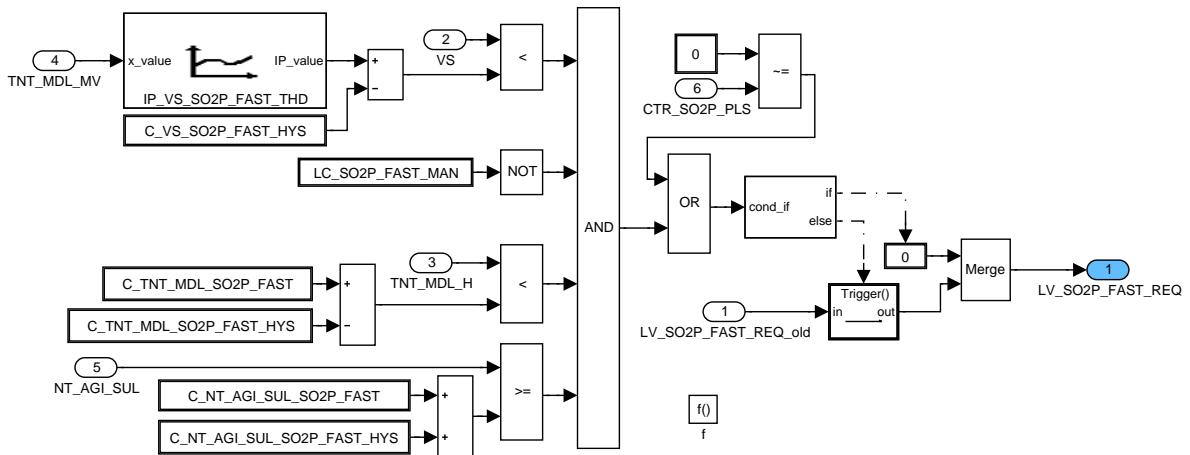


Figure 7.93.18: : Path:  
NOXM\_REQGNNTD0/OPM\_100MS/REQ\_CLC/SO2P\_FAST\_REQ/FAST\_REQ\_NOT\_ACT

### 7.93.1.2.6.2 FAST\_REQ\_ACT

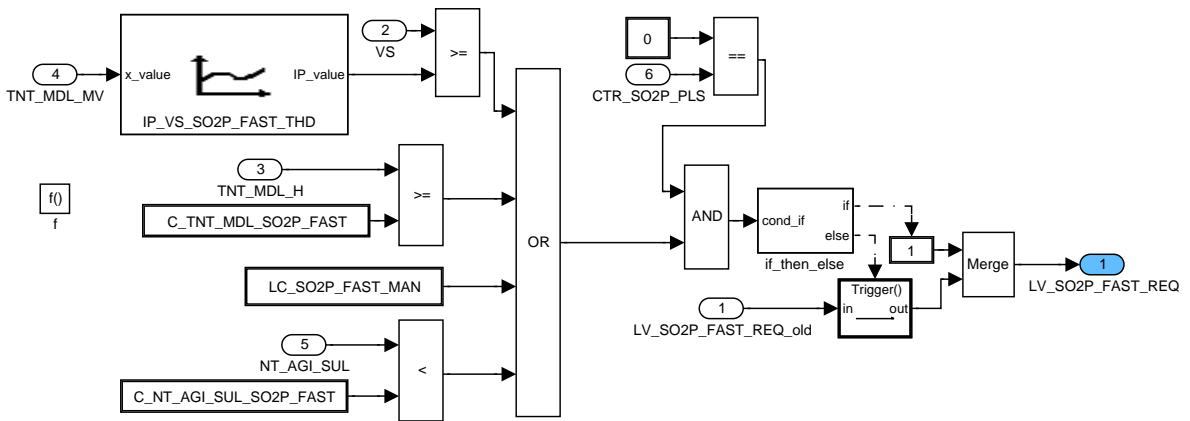


Figure 7.93.19: : Path:  
NOXM\_REQGNNTD0/OPM\_100MS/REQ\_CLC/SO2P\_FAST\_REQ/FAST\_REQ\_ACT

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### 7.93.1.2.7 Determination of the flags for the desulfation lambda alternation and catalyst heating manager

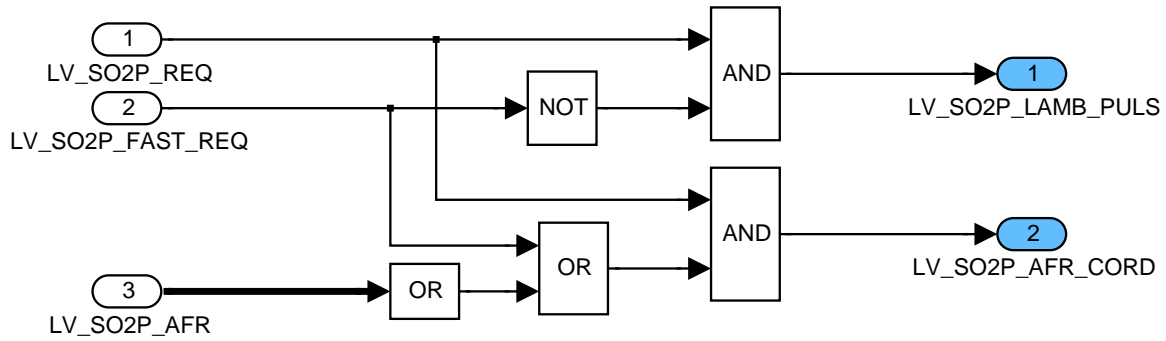


Figure 7.93.20: : Path: NOXM\_REQGNNTD0/OPM\_100MS/REQ\_CLC/SO2P\_LAMB\_PULS

### 7.93.1.2.8 Calculation of activation flag for desulfation regarding modeled NOx trap temperature

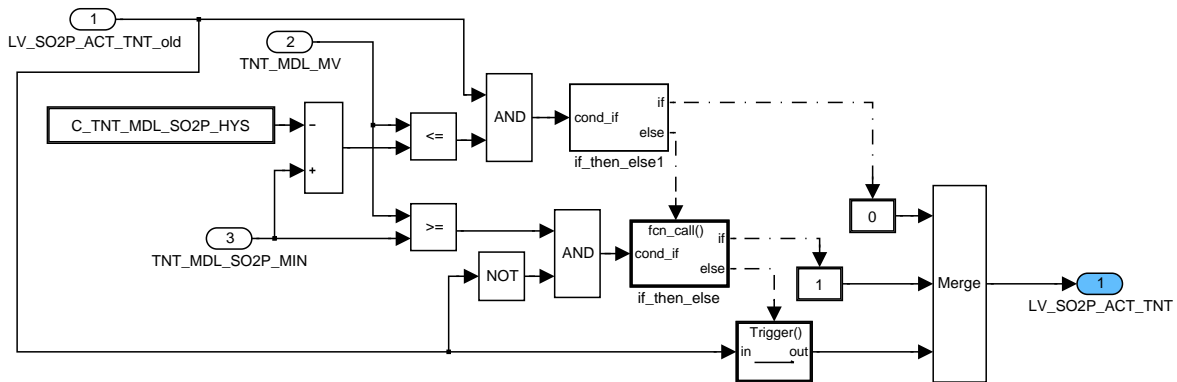


Figure 7.93.21: : Path: NOXM\_REQGNNTD0/OPM\_100MS/REQ\_CLC/SO2P\_ACT\_TNT

### 7.93.1.2.9 Set of desulfation activation indicator and calculation of non-desulfation time

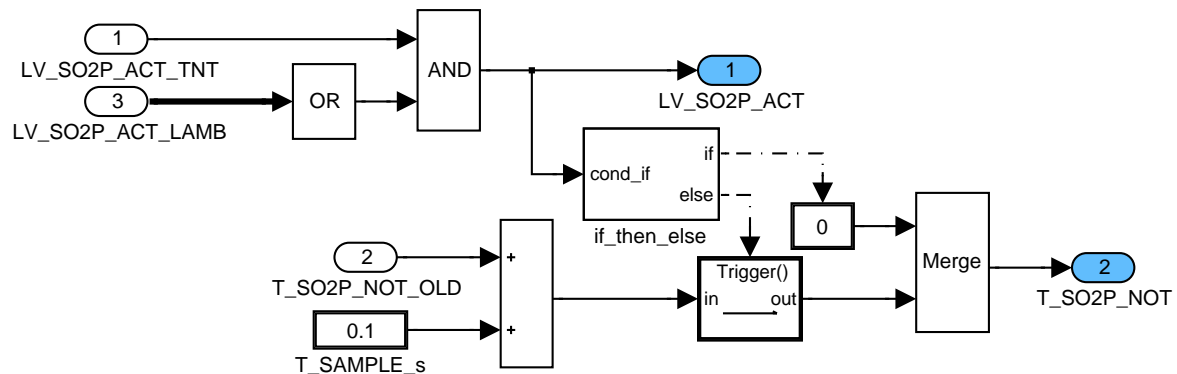


Figure 7.93.22: : Path: NOXM\_REQGNNTD0/OPM\_100MS/REQ\_CLC/SO2P\_ACT

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### 7.93.1.2.10 Calculation of delay time before the sulfur release is active

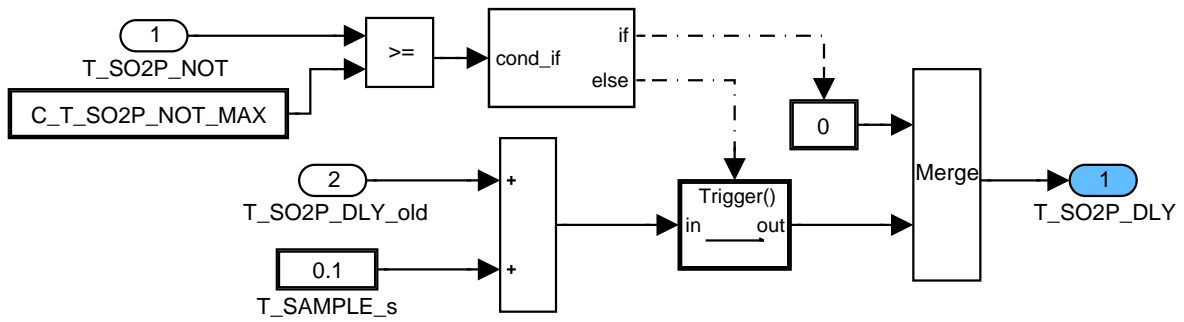


Figure 7.93.23: : Path: NOXM\_REQGNNTD0/OPM\_100MS/REQ\_CLC/SO2P\_DLY

### 7.93.1.2.11 Lambda setpoint for fast NOx Catalyst desulfation

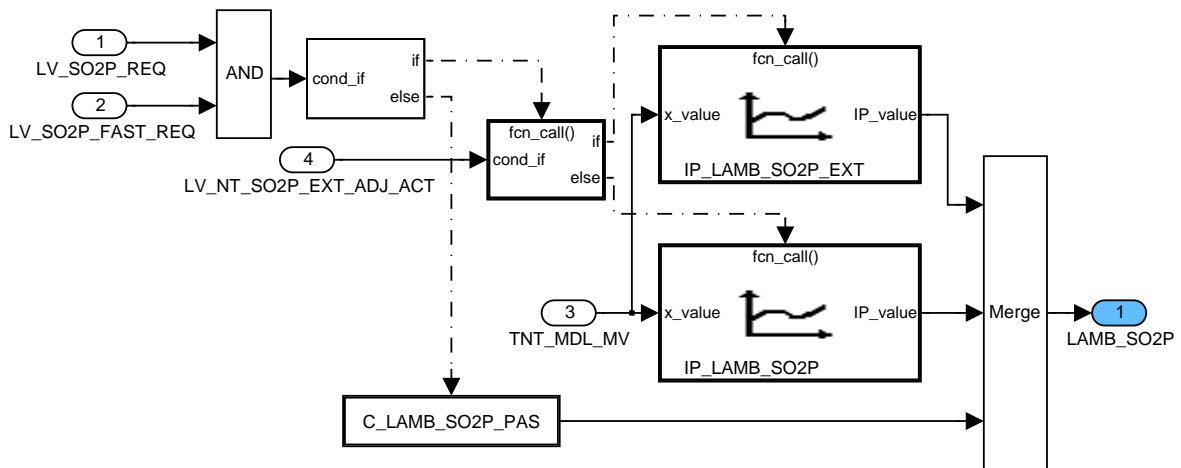


Figure 7.93.24: : Path: NOXM\_REQGNNTD0/OPM\_100MS/REQ\_CLC/CLC\_LAMB\_SO2P

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## 7.94 NOx catalyst desulfation (Appl. Inc)


### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CH_SO2P_WOUT_LIM	O/V/S	0... 1H	0 ...1	1	-
Catalyst heating for desulfation without any limitation due to fuel consumption					
LV_INH_NT_SO2P_REQ	O/V	0... 1H	0 ...1	1	-
Deactivation of desulfation request					
LV_NT_SO2P_EXT_ADJ_ACT	O/V	0... 1H	0 ...1	1	-
NOx trap desulfation started by external adjustment is active					
LV_NT_SO2P_EXT_ADJ_ENA	V	0... 1H	0 ...1	1	-
Condition for enabling desulfation by external request					
LV_NT_SO2P_EXT_ADJ_ST	V	0... 1H	0 ...1	1	-
Start condition for desulfation by external request					
LV_NT_SO2P_EXT_ADJ_STOP	V	0... 1H	0 ...1	1	-
Stop condition for desulfation by external request					
LV_NT_SO2P_FAST_REQ_EXT	O/V	0... 1H	0 ...1	1	-
Fast desulfation request controlled by external request					
STATE_KWP_SO2P	O/V	0H	NOT_START	-	-
		1H	ST_INH		
		2H	PAR_NOT_		
			PLAUS		
		3H	WAIT_REL		
		4H	UNDEF		
		5H	ACT		
		6H	END_WOUT_		
			RESULT		
7H	ABORTED				
8H	END_WOUT_				
	ERR				
9H	END_WITH_				
		ERR			
State variable for desulfation by external request					
STATE_NT_SO2P_EXT_ADJ_ACT	O/V	0H	PASSIVE	-	-
		1H	SPEED-UP		
		2H	HEATING-UP		
		3H	DESULFATION		
Additional status information for desulfation by external request					
T_NT_SO2P_EXT_ADJ_ACT	O/V	0... FFFFH	0... 6553.5	0.1	s
Timer for desulfation by external request					

### Input data:

GEAR {p. 1302}	LV_CLU_SWI {p. 996}	LV_ERR_TEG_PCAT_	LV_NT_SO2P_EXT_ADJ_
		DOWN	REQ_NOT_STOP
		{p. 4713}	{p. 7763}
LV_NT_SO2P_EXT_ADJ_	LV_SO2P_REQ_2 {p. 3073}	N_32 {p. 1525}	NT_SUL {p. 3113}
REQ_ST			
{p. 7763}			

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PV_AV {p. 1269}	STATE_GEAR_REV_AT_ AMT {p. 1302}	STATE_NT_SO2P_EXT_ ADJ {p. 7766}	TNT_MDL_MV {p. 8237}
VS {p. 1176}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_IS_SO2P_MIN	-	0... FFH	0... 8160	32	rpm
Threshold for detecting running engine					
C_N_SO2P_EXT_MIN_DISP	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for change display status from Speed-up to Heating-up					
C_NT_SUL_SO2P_EXT_MIN	-	0... FFFFH	0... 10485.6	0.16	mg
NOx trap sulphur loading limit for end of desulfation by external request					
C_PV_SO2P_EXT_MAX	-	0... FFH	0... 99.60937	0.390625	%
Accelerator pedal threshold for disabling external request for desulfation					
C_STATE_INH_FAST_SO2P_EXT	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode for fast or alternating desulfation at external request					
C_STATE_INH_NT_SO2P_REQ	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of desulfation request					
C_T_SO2P_EXT_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time for desulfation by external request					
C_T_SO2P_EXT_MIN	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time for desulfation by external request					
C_TNT_SO2P_EXT_MIN_DISP	-	0... FFFFH	0... 1023.98437	0.015625	°C
NOx trap temperature threshold for change display status from Speed-up to Heating-up					
C_VS_SO2P_EXT_MAX	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for disabling external request for desulfation					
LC_NT_SO2P_EXT_MAN	-	0... 1H	0...1	1	-
Manual start and stop of external requested desulfation					


**Action definition**

<b>ACTION_NOXM_StartCatHeatDesu</b> ()	Mode: O
Start catalyst heating for desulfation without any limitation due to fuel consumption	

<b>ACTION_NOXM_StopCatHeatDesu</b> ()	Mode: O
Stop catalyst heating for desulfation without any limitation due to fuel consumption	

**FUNCTION DESCRIPTION:****Description for ACTION\_NOXM\_StartCatHeatDesu**

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ACTION_NOXM_StartCatHeatDesu()					
Start catalyst heating for desulfation without any limitation due to fuel consumption					
Parameter	Type	Hex. limits	Phys. limits	Resol.	Unit

**If** LV\_SO2P\_REQ\_2 = 1 % catalyst heating already requested  
**Then** LV\_CH\_SO2P\_WOUT\_LIM = 1 % fuel consumption not limited for CH  
**End If**

#### Description for ACTION\_NOXM\_StopCatHeatDesu

ACTION_NOXM_StopCatHeatDesu()					
Stop catalyst heating for desulfation without any limitation due to fuel consumption					
Parameter	Type	Hex. limits	Phys. limits	Resol.	Unit

LV\_CH\_SO2P\_WOUT\_LIM = 0 % fuel consumption limited for CH

#### Application conditions:

This module controls the desulfation that is forced by an external request.

Initialization : reset all values from output table except LV\_CH\_SO2P\_WOUT\_LIM to zero

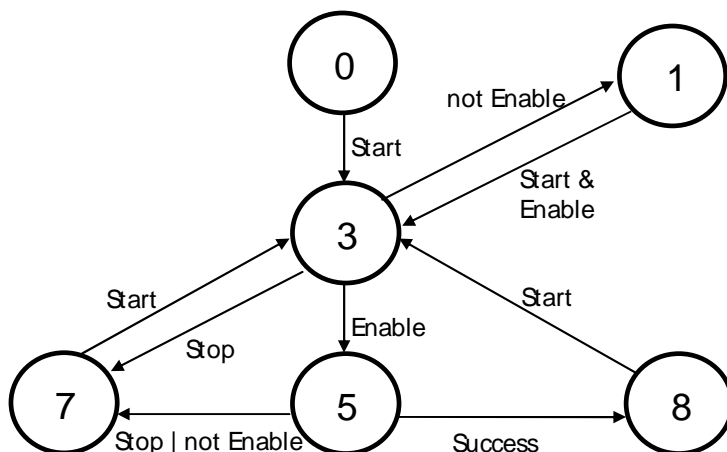
Recurrence : **100** ms

#### Formula section:

*Catalyst heating without limitations due to fuel consumptions*

**If** LV\_SO2P\_REQ\_2 = 0 % desulfation successful finished  
**Then** LV\_CH\_SO2P\_WOUT\_LIM = 0 % fuel consumption limited for CH  
**End If**

*State machine for desulfation by scan tool*



Diagram



STATE\_KWP\_SO2P = 3:  
**If** LV\_NT\_SO2P\_EXT\_ADJ\_STOP = 1 %  
*Stop*  
**Then** STATE\_KWP\_SO2P = 7  
**Else If** LV\_NT\_SO2P\_EXT\_ADJ\_ENA = 1 %  
*Enable*  
**Then** STATE\_KWP\_SO2P = 5  
**Else** STATE\_KWP\_SO2P = 1  
**End If**

STATE\_KWP\_SO2P = 5:  
**If** LV\_NT\_SO2P\_EXT\_ADJ\_STOP = 1 **OR** % *Stop*  
 LV\_NT\_SO2P\_EXT\_ADJ\_ENA = 0 %  
*not Enable*  
**Then** STATE\_KWP\_SO2P = 7  
  
**Else If** T\_NT\_SO2P\_EXT\_ADJ\_ACT > C\_T\_SO2P\_EXT\_MAX **OR** % *Success*  
 (T\_NT\_SO2P\_EXT\_ADJ\_ACT > C\_T\_SO2P\_EXT\_MIN **AND**  
 NT\_SUL <= C\_NT\_SUL\_SO2P\_EXT\_MIN)  
**Then** STATE\_KWP\_SO2P = 8  
**End If**

STATE\_KWP\_SO2P = 7:  
**If** LV\_NT\_SO2P\_EXT\_ADJ\_ST = 1 %  
*Start*  
**Then** STATE\_KWP\_SO2P = 3  
**End If**


STATE\_KWP\_SO2P = 8:  
**If** LV\_NT\_SO2P\_EXT\_ADJ\_ST = 1 %  
*Start*  
**Then** STATE\_KWP\_SO2P = 3  
**End If**

default:  
 STATE\_KWP\_SO2P = 0  
**end case selection**

*Control of idle speed reference, catalyst heating and desulfation*  
**If** STATE\_KWP\_SO2P = 5 % ACT  
**Then** LV\_NT\_SO2P\_EXT\_ADJ\_ACT = 1  
**Else** LV\_NT\_SO2P\_EXT\_ADJ\_ACT = 0  
**End If**

*Desulfation status*  
**If** STATE\_KWP\_SO2P = 5 % ACT  
**Then** **If** N\_32 < C\_N\_SO2P\_EXT\_MIN\_DISP  
**Then** STATE\_NT\_SO2P\_EXT\_ADJ\_ACT = 1 % *SPEED*  
*UP*  
**Else If** TNT\_MDL\_MV < C\_TNT\_SO2P\_EXT\_MIN\_DISP  
**Then** STATE\_NT\_SO2P\_EXT\_ADJ\_ACT = 2 %  
*HEATING-UP*

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```

Else          STATE_NT_SO2P_EXT_ADJ_ACT = 3          %DESU
FATION
End If
Else          STATE_NT_SO2P_EXT_ADJ_ACT = 0          %PAS-
SIVE
End If

```

*Desulfation timer*

```

If          STATE_KWP_SO2P = 5          % ACT
Then      If          STATE_NT_SO2P_EXT_ADJ_ACT = 3
FATION
Then          increment T_NT_SO2P_EXT_ADJ_ACT
End If
Else          T_NT_SO2P_EXT_ADJ_ACT = 0
End If

```

*Control of fast or alternating desulfation at external request*

```

case selection on C_STATE_INH_FAST_SO2P_EXT
    C_STATE_INH_FAST_SO2P_EXT = 0:          % AUTO
        if          STATE_NT_SO2P_EXT_ADJ = 1          % ALTERNATING
        then          LV_NT_SO2P_FAST_REQ_EXT = 0          % ALTERNATING
        else          LV_NT_SO2P_FAST_REQ_EXT = 1          %
FAST
        endif

    C_STATE_INH_FAST_SO2P_EXT = 1:          % DISABLE
        LV_NT_SO2P_FAST_REQ_EXT = 0          % ALTERNATING

    C_STATE_INH_FAST_SO2P_EXT = 2:          % ENABLE
        LV_NT_SO2P_FAST_REQ_EXT = 1          % FAST
end case selection

```

*Inhibition mode of desulfation request*

```


case selection on C_STATE_INH_NT_SO2P_REQ
    C_STATE_INH_NT_SO2P_REQ = 0 ('AUTO'):
        if          LV_ERR_TEG_PCAT_DOWN = 1
        then          LV_INH_NT_SO2P_REQ = 1
        else          LV_INH_NT_SO2P_REQ = 0
        endif

    C_STATE_INH_NT_SO2P_REQ = 1 ('DISABLE'):
        LV_INH_NT_SO2P_REQ = 1

    C_STATE_INH_NT_SO2P_REQ = 2 ('ENABLE'):
        LV_INH_NT_SO2P_REQ = 0
end case selection

```

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## 7.95 NOx catalyst desulfation - lambda stimulation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_VLS_DOWN_AFL_CYC [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Denotes number of AF cycles since lambda controller last activated at LS downstream position					
LAMB_PULS_SO2P [NC_CBK_EX_NR]	O/V	80... 7FH	-0.125... 0.12402344	976.563e-6	-
Delta lambda to pass to the lambda stimulation coordination routine					
LAMB_PULS_SO2P_H_RES [NC_CBK_EX_NR]	V	8000... 7FFFH	-0.125... 0.12499619	3.8147e-6	-
Delta lambda with high resolution					
LV_SO2P_AFR [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Rich phase of alternation					
LV_VLS_DOWN_AFL [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Monitoring sensor has detected "lean"					
LV_VLS_DOWN_TRA [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Transition of Air-Fuel mixture by downstream sensor					
T_AFL_DOWN_LOCK [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer indicating duration of LV_AFL lock at LS downstream position					
T_LAM_DLY_SO2P [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Total LAM -P-jump delay time for transition due to desulfation lambda alternation					
T_VLS_DOWN_CYC_AFL [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Lean mixture cycle time at LS downstream position					
T_VLS_DOWN_CYC_AFR [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Rich mixture cycle time at LS downstream position					
VLS_DOWN_REF [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511719	0.00488281	V
Voltage signal observed for downstream AF cycle evaluation					

### Input data:

LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_NS [NC_NOX_SENS_CONF] {p. 991}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_FL {p. 1759}
LV_INH_LAMB_PULS_ SO2P {p. 3176}	LV_IS {p. 1720}	LV_PL {p. 1720}	LV_PU {p. 1720}
LV_PUC {p. 1720}	LV_S_ACT {p. 8137}	LV_SCC [NC_CBK_EX_NR] {p. 2295}	LV_SO2P_LAMB_PULS {p. 3129}
LV_ST_END {p. 1720}	MAF {p. 8277}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}
NC_NOX_SENS_CONF {p. 643}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_NS [NC_NOX_SENS_CONF] {p. 992}	VLS_NT_DOWN [NC_NOX_SENS_CONF] {p. 811}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DELTA_LAMB_AFL_SO2P	-	8000... 7FFFH	-0.125... 0.12499	3.8147e-6	-
Delta lambda value for lean phase of desulfation					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DELTA_LAMB_AFR_SO2P	-	8000... 7FFFH	-0.125... 0.12499	3.8147e-6	-
Delta lambda value for rich phase of desulfation					
C_DELTA_LAMB_SP_SO2P	-	0... 800H	0 ...2	976.599e-6	-
Permissible deviation of the lambda-controller setpoint for desulfation with lambda alternation					
C_LAMB_SP_SO2P	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Basis lambda setpoint for calculation of activation condition for desulfation					
C_STATE_VLS_SENS_REF [NC_CBK_EX_NR]	-	0H 1H 2H 3H 4H 5H	LAMB_LS_UP VLS_DOWN VLS_NS LAMB_NS VLS_NT_ DOWN MANUAL	-	-
Mode to determine sensor signal in the first sensor position					
C_T_VLS_DOWN_CYC_AFL_MAX	-	0... FFFFH	0... 1310.7	0.02	s
Maximum lean mixture cycle time at LS downstream position					
C_T_VLS_DOWN_CYC_AFR_MAX	-	0... FFFFH	0... 1310.7	0.02	s
Maximum rich mixture cycle time at LS downstream position					
C_VLS_DOWN_AFL	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Threshold for detection of lean mixture at LS downstream position					
C_VLS_DOWN_AFR	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Threshold for detection of rich mixture at LS downstream position					
C_VLS_REF_SO2P_LAMB_SP	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Reference signal manual value					
IP_LAM_SO2P_NEG_I	V	0... 7FH	0... 0.12402	976.599e-6	-
LDPM_N_32_1_LAMB_PULS_SO2P	2	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_LAMB_PULS_SO2P	2	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic value of LAMB_PULS_SO2P integral component when lambda < 1					
IP_LAM_SO2P_NEG_P	V	0... 7FH	0... 0.12402	976.599e-6	-
LDPM_N_32_1_LAMB_PULS_SO2P	2	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_LAMB_PULS_SO2P	2	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic value of the proportional component of delta lambda during transition from lean to rich					
IP_LAM_SO2P_POS_I	V	0... 7FH	0... 0.12402	976.599e-6	-
LDPM_N_32_1_LAMB_PULS_SO2P	2	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_LAMB_PULS_SO2P	2	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic value of LAMB_PULS_SO2P integral component when lambda > 1					
IP_LAM_SO2P_POS_P	V	0... 7FH	0... 0.12402	976.599e-6	-
LDPM_N_32_1_LAMB_PULS_SO2P	2	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_LAMB_PULS_SO2P	2	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic value of the proportional component of delta lambda during transition from rich to lean					
IP_T_AFL_DOWN_LOCK_AFL	V	0... FFFFH	0... 1310.7	0.02	s
LDPM_N_32_1_LAMB_PULS_REF	2	0... FFH	0... 8160	32	rpm
LDPM_MAF_2_LAMB_PULS_REF	2	0... FFFFH	0... 1389	0.0211948	mg/stk
LV_AFL transition lock-out time after transition of AF mixture to lean at LS downstream position					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_T_AFL_DOWN_LOCK_AFR	V	0... FFFFH	0... 1310.7	0.02	s
LDPM_N_32_1_LAMB_PULS_REF	2	0... FFH	0... 8160	32	rpm
LDPM_MAF_2_LAMB_PULS_REF	2	0... FFFFH	0... 1389	0.0211948	mg/stk
LV_AFL transition lock-out time after transition of AF mixture to rich at LS downstream position					
IP_T_LAM_DLY_SO2P_NEG	V	0... FFFFH	0... 1310.7	0.02	s
LDPM_N_32_1_LAMB_PULS_SO2P	2	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_LAMB_PULS_SO2P	2	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic LAM -P-jump delay time from rich to lean transition					
IP_T_LAM_DLY_SO2P_POS	V	0... FFFFH	0... 1310.7	0.02	s
LDPM_N_32_1_LAMB_PULS_SO2P	2	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_LAMB_PULS_SO2P	2	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic LAM -P-jump delay time from lean to rich transition					
IP_VLS_REF_LAMB_LS_UP	-	0... 3FFH	0... 4.99511	4.8828e-3	V
LDP_LAMB_LS_UP_IP_VLS_REF	8	0... 7FFFH	0... 31.99902	976.599e-6	-
Reference map for upstream lambda to binary lambda value					
IP_VLS_REF_LAMB_NS	-	0... 3FFH	0... 4.99511	4.8828e-3	V
LDP_LAMB_NS_IP_VLS_REF_LAMB_NS	8	0... 7FFFH	0... 31.99902	976.599e-6	-
Scaling map for sensor on the first position from NOx Sensor lambda signal to VLS signal					
IP_VLS_REF_VLS_NS	-	0... 3FFH	0... 4.99511	4.8828e-3	V
LDP_VLS_NS_IP_VLS_REF_VLS_NS	8	0... 578H	-200 ...1200	1	mV
Scaling map sensor from NOx Sensor binary signal to VLS					
LC_T_AFL_DOWN_CTL	-	0... 1H	0 ...1	1	-
Consider time thresholds for switching lean to rich or rich to lean					

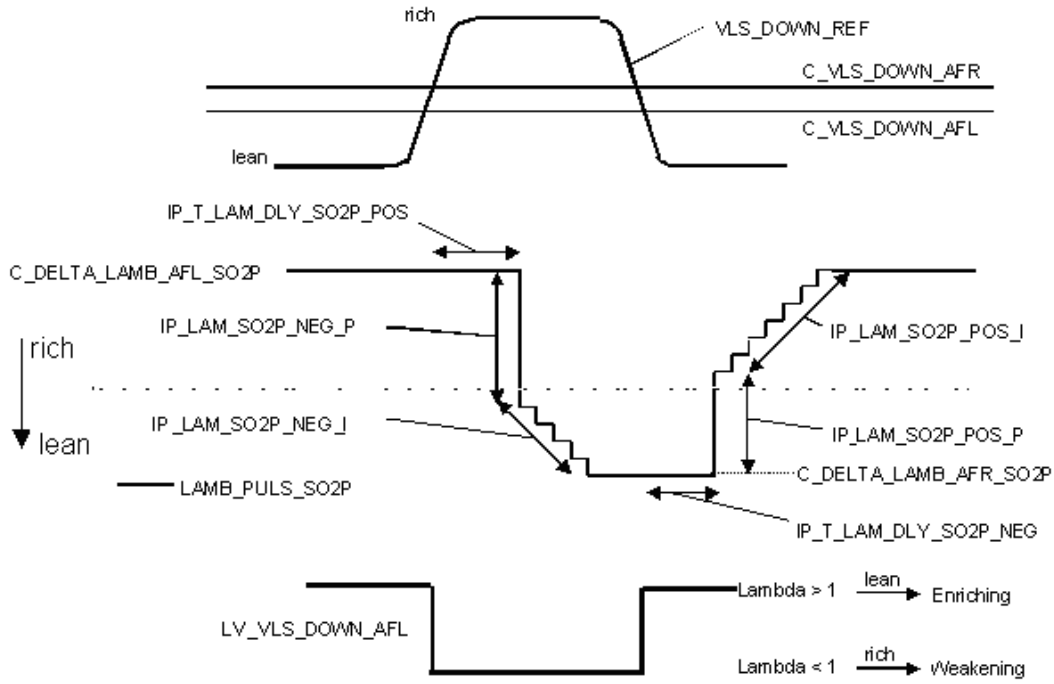
## General information

The sub function *Desulfation controlled lambda alternation* allows a desulfation with an alternating lambda value controlled by the output voltage of the downstream sensor. The deviation of the basic lambda setpoint will only be carried out, if the lambda setpoint is in the range of 1. Alternation is defined by the maximum rich resp. lean lambda shift, the p-jump and the delay time at rich or lean side before p-jump. Gradients are defined according to engine conditions.

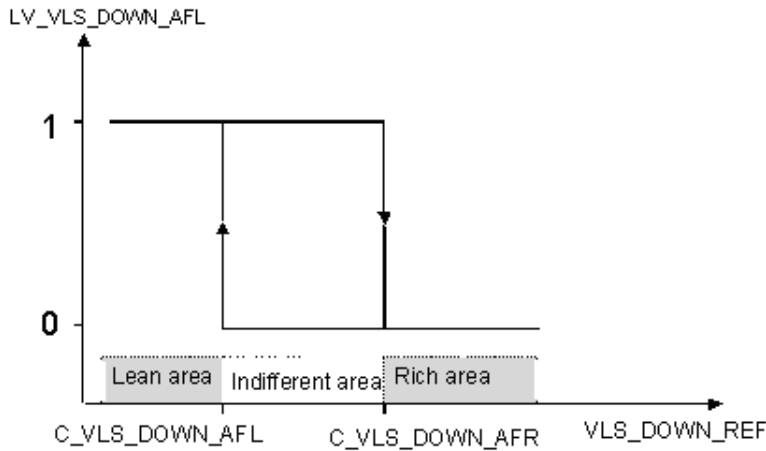
Definition of lambda deviation for lambda controller:

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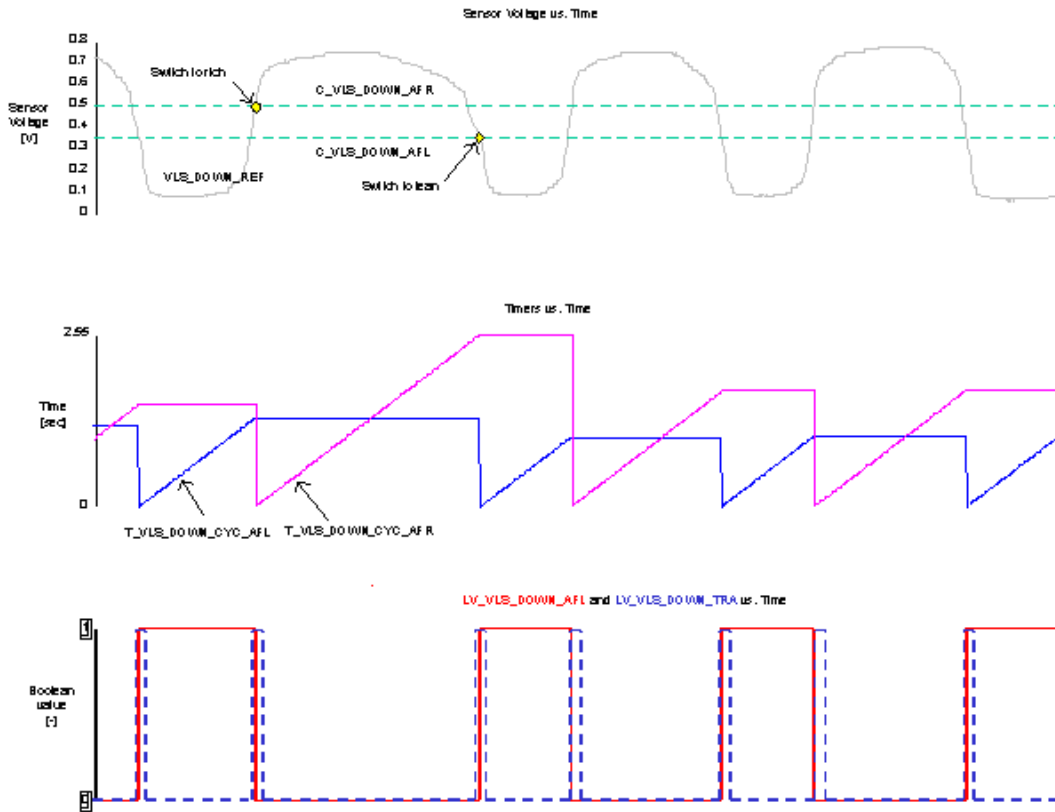


State and hysteresis of LV\_VLS\_DOWN\_AFL as function of VLS\_DOWN:

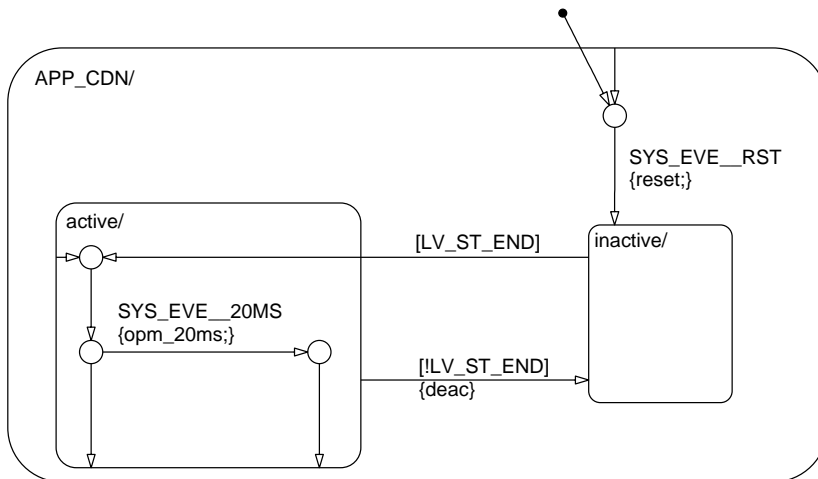


Physical relationship between values, Air-Fuel cycle evaluation at LS downstream:

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**Application Condition**

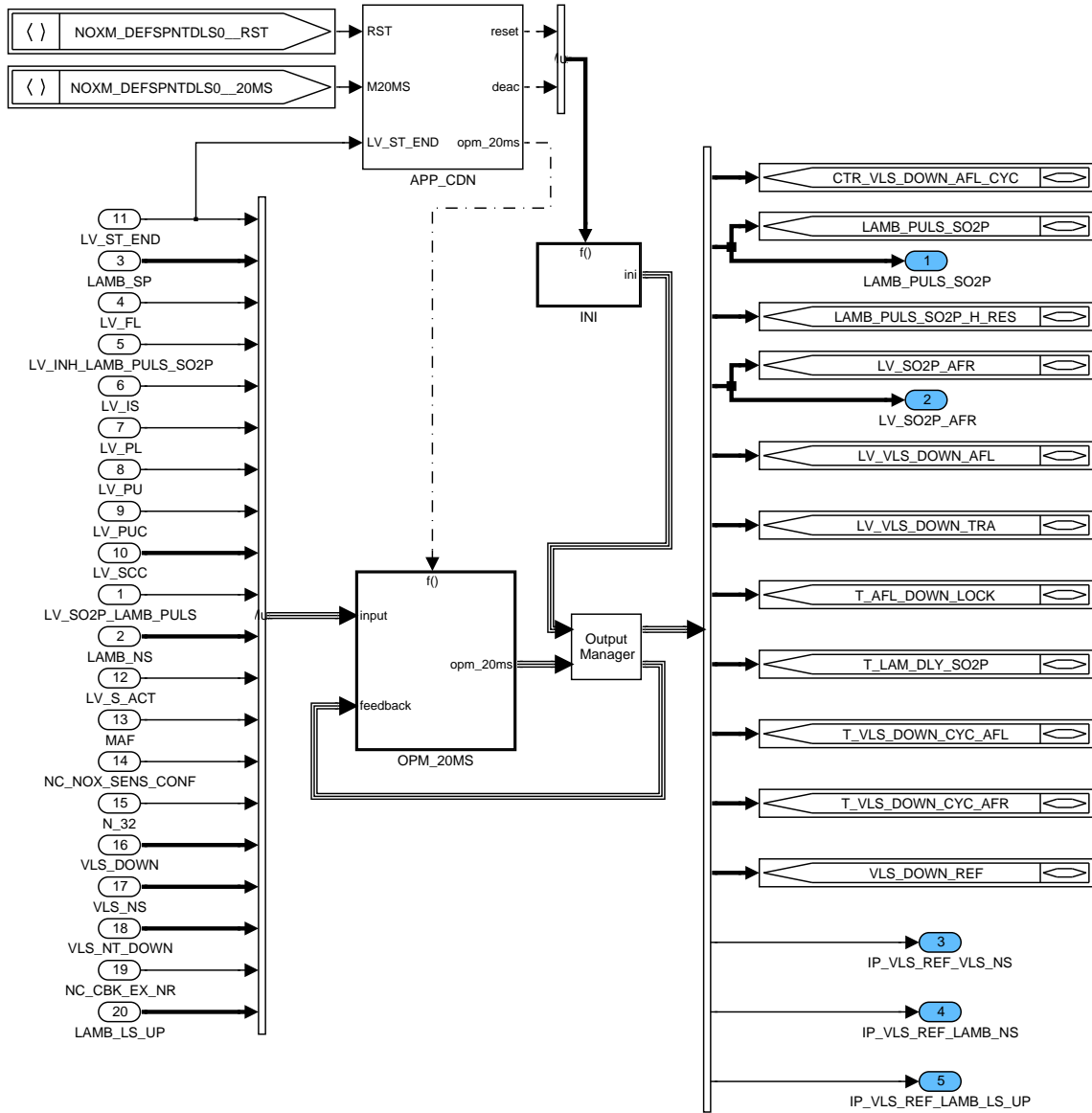


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Figure 7.95.1: NOXM\_DEFSPNTDLS0/APP\_CDN/Chart1

**Function Description**

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SDA\_SRS / SDA 4.0 15-Mar-2005

Figure 7.95.2: NOXM\_DEFSPNTDLS0

### 7.95.1 INITIALIZATION

#### Initialization at reset

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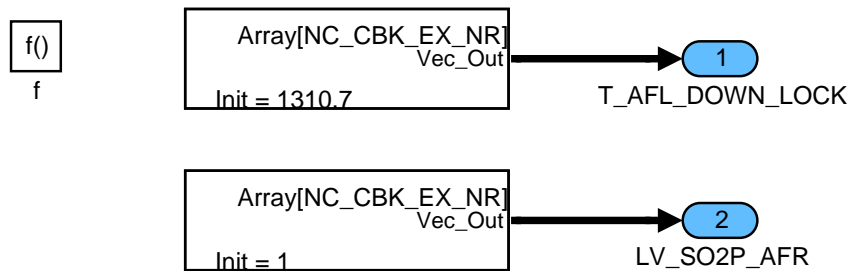


Figure 7.95.3: NOXM\_DEFSPNTDLS0/INI/INI\_reset

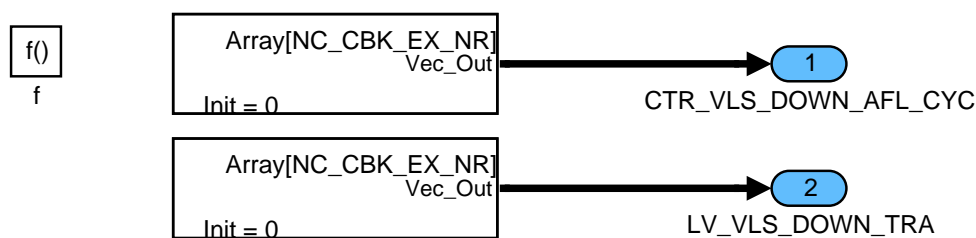
**Initialization at deactivation**

Figure 7.95.4: NOXM\_DEFSPNTDLS0/INI/INI\_deac

**7.95.2 FORMULA SECTION**

The function contains of two main Sections:

SECTION 1: Detection of lean/rich mixture

SECTION 2: Realization of lambda controller deviation

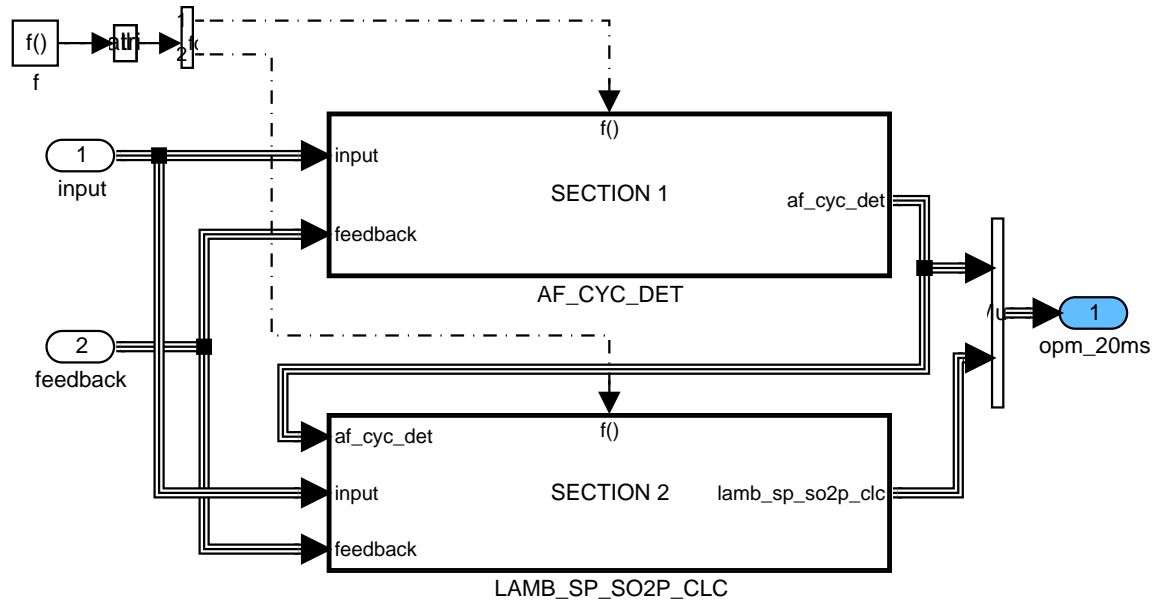


Figure 7.95.5: NOXM\_DEFSPNTDLS0/OPM\_20MS

**SECTION 1: Detection of lean/rich mixture**

The function shall provide an indication of the current Air-Fuel mixture ratio at LS downstream position, i.e. mixture lean or rich, and determine the lean and rich cycle time separately for further evaluation by other functions. This shall be carried out as follows:


AF transition detection:

There are several possibilities as reference for oxygen signal depending on existing sensors and their provided signals: NOx-sensor or binary oxygen sensor. The chosen output signal is scaled if necessary to the reference signal VLS\_DOWN\_REF.

The function shall detect a change in AF mixture from lean to rich or vice versa ignoring possible jitter in the sensor signal. This shall be facilitated by the following method: If the timer T\_AFL\_DOWN\_LOCK falls below the threshold IP\_T\_AFL\_DOWN\_LOCK\_XXX, the timer shall be incremented and the transition flag LV\_VLS\_DOWN\_TRA shall be reset. Should, during following recurrence cycles, the timer equal or exceed the threshold and if the AF mixture flag is currently indicating lean, the function shall observe the VLS\_DOWN\_i signal for a change to rich as indicated by VLS\_DOWN\_i exceeding the threshold C\_VLS\_DOWN\_AFR. Once this has occurred, the LV\_VLS\_DOWN\_AFL flag shall be changed to indicate a rich mixture (LV\_VLS\_DOWN\_AFL = 0), the counter CTR\_VLS\_DOWN\_AFL\_CYC shall be incremented to indicate the number of complete AF cycles since the last activation of the lambda controller, the timer T\_AFL\_DOWN\_LOCK shall be reset and LV\_VLS\_DOWN\_TRA is set to indicate the AF mixture transition. The same procedure, except increment of counter CTR\_VLS\_DOWN\_AFL\_CYC, applies for a currently rich mixture. A transition to a lean mixture shall be detected by VLS\_DOWN falling below threshold C\_VLS\_DOWN\_AFL.

*Remark:* The timer T\_AFL\_DOWN\_LOCK and associated engine operating point dependent threshold IP\_T\_AFL\_DOWN\_LOCK\_XXX reduce the effect of rapid oxygen sensor signal changes, noise generated by cylinder to cylinder AF mixture deviations, that would cause the lambda controller to execute a P-jump. The mapped lock-out time represents the delay between injection of the AF mixture and the burnt AF mixture reaching and being detected by the downstream oxygen sensor. The lock-out time shall not exceed the exhaust gas delay for any particular engine operating point otherwise the lambda controller frequency will be affected. Downstream oxygen sensor signal changes occurring within this delay time may not be considered to be due to the change in controlled lambda but from noise and shall be ignored.

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Timer /counter incrementation:

The function shall increment the respective timer dependent on the current state of the AF mixture, as determined by LV\_VLS\_DOWN\_AFL (lean mixture; increment T\_VLS\_DOWN\_CYC\_AFL. rich mixture; increment T\_VLS\_DOWN\_CYC\_AFR). Should at any time the desulfation control be deactivated, the function shall reset the counter CTR\_VLS\_DOWN\_AFL\_CYC.

As calibrateable back up solution a switch of LV\_VLS\_DOWN\_AFL can also be forced by exceeding the time counter threshold for the corresponding cycle time (C\_T\_VLS\_DOWN\_CYC\_AFL/AFR\_MAX)

Increment T\_VLS\_DOWN\_CYC\_AFL /Increment T\_VLS\_DOWN\_CYC\_AFR

The timers T\_VLS\_DOWN\_CYC\_AFL and T\_VLS\_DOWN\_CYC\_AFR shall be incremented according to their specified conditions until they reach a maximum value of FFFFH at which point they shall no longer be incremented.

Increment CTR\_VLS\_DOWN\_AFL\_CYC

The Air-Fuel cycle counter CTR\_VLS\_DOWN\_AFL\_CYC shall be incremented for every lean to rich AF mixture transition, to indicate that a complete AF cycle has passed. The counter shall be incremented in such manner until it reaches a maximum value of FFFFH at which point it shall no longer be incremented.

Increment T\_AFL\_DOWN\_LOCK

The timer T\_AFL\_DOWN\_LOCK shall be incremented according to the specified conditions until it reaches a maximum value of FFFFH at which point it shall no longer be incremented.

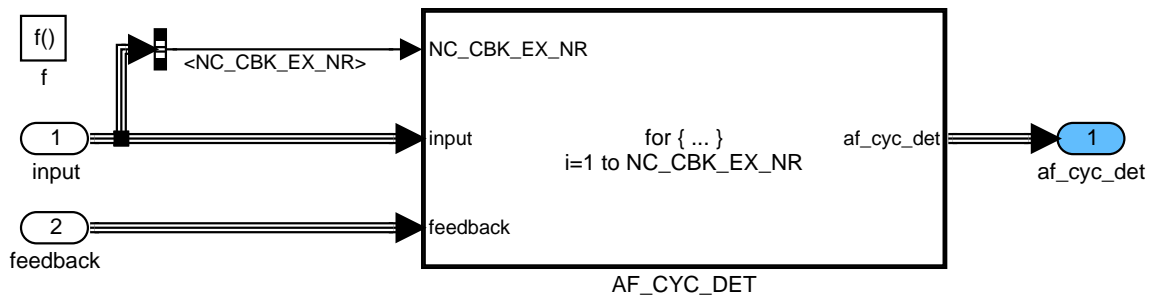


Figure 7.95.6: NOXM\_DEFSPNTDLS0/OPM\_20MS/AF\_CYC\_DET

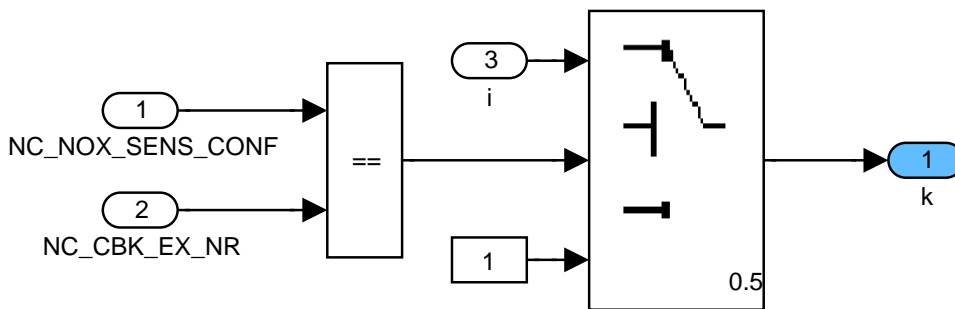


Figure 7.95.7: NOXM\_DEFSPNTDLS0/OPM\_20MS/AF\_CYC\_DET/AF\_CYC\_DET/INPUT/CLC\_k

**Content of SECTION 1**

Section 1 contains of two other sections:

SECTION 1.1: Calculation of a voltage reference signal (CASE\_SEL)

SECTION 1.2: Detection of transition between rich/lean phases and current mixture state (CHK\_AF\_CDN)

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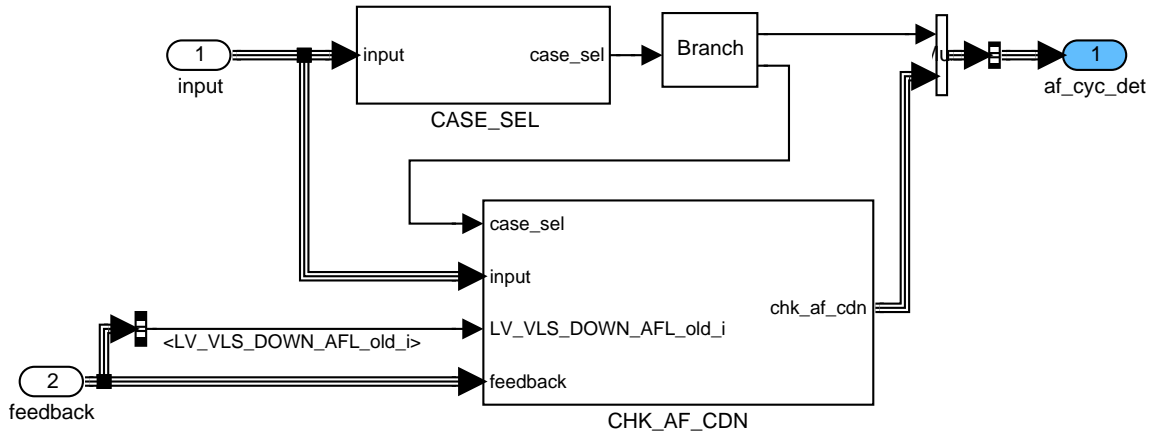



Figure 7.95.8: NOXM\_DEFSPNTDLS0/OPM\_20MS/AF\_CYC\_DET/AF\_CYC\_DET/AF\_CYC\_DET

**SECTION 1.1: Calculation of a voltage reference signal**

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 3159 of 8404</b>	
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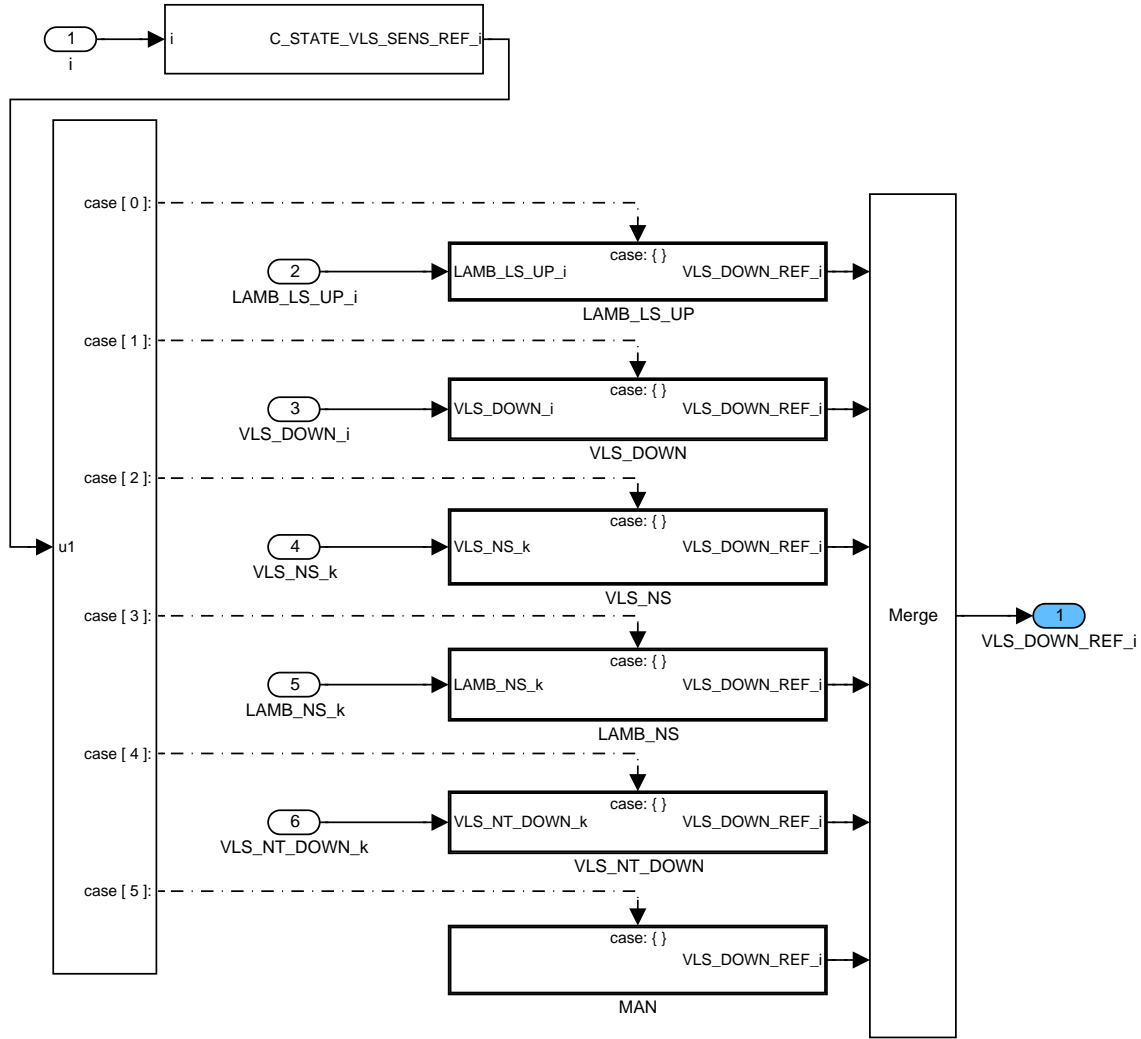


Figure 7.95.9: NOXM\_DEFSPNTDLS0/OPM\_20MS/AF\_CYC\_DET/AF\_CYC\_DET/AF\_CYC\_DET/CASE\_SEL/CASE\_SEL

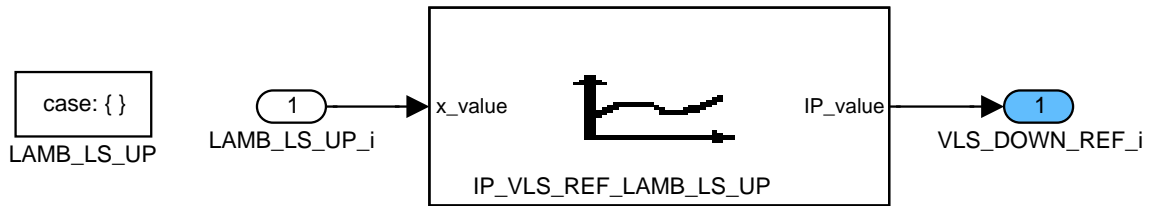


Figure 7.95.10: NOXM\_DEFSPNTDLS0/OPM\_20MS/AF\_CYC\_DET/AF\_CYC\_DET/AF\_CYC\_DET/CASE\_SEL/CASE\_SEL/LAMB\_LS\_UP

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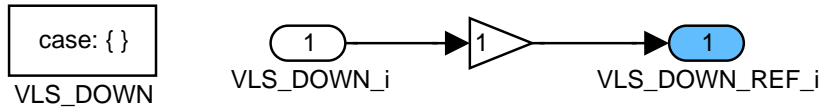


Figure 7.95.11: NOXM\_DEFSPNTDLS0/OPM\_20MS/AF\_CYC\_DET/AF\_CYC\_DET/AF\_CYC\_DET/  
CASE\_SEL/CASE\_SEL/VLS\_DOWN

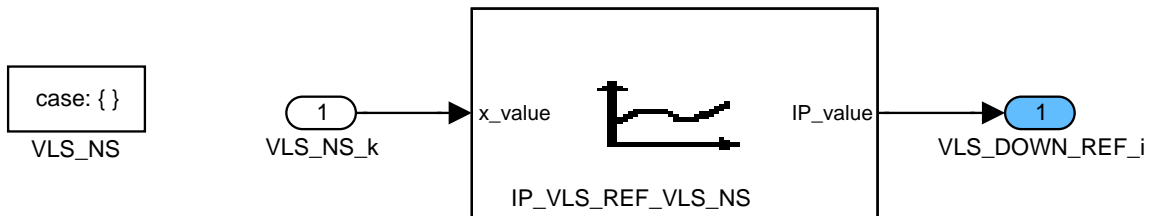


Figure 7.95.12: NOXM\_DEFSPNTDLS0/OPM\_20MS/AF\_CYC\_DET/AF\_CYC\_DET/AF\_CYC\_DET/  
CASE\_SEL/CASE\_SEL/VLS\_NS

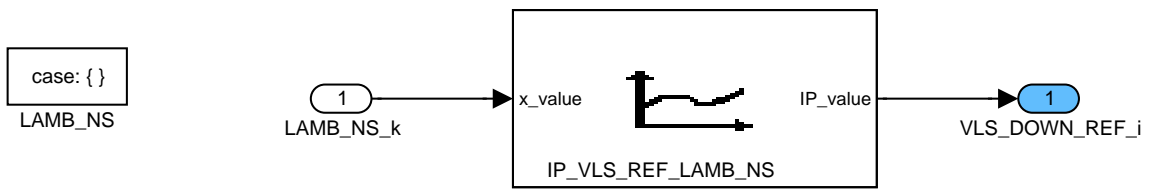


Figure 7.95.13: NOXM\_DEFSPNTDLS0/OPM\_20MS/AF\_CYC\_DET/AF\_CYC\_DET/AF\_CYC\_DET/  
CASE\_SEL/CASE\_SEL/LAMB\_NS

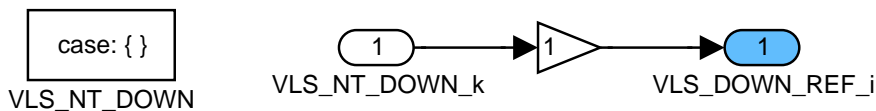


Figure 7.95.14: NOXM\_DEFSPNTDLS0/OPM\_20MS/AF\_CYC\_DET/AF\_CYC\_DET/AF\_CYC\_DET/  
CASE\_SEL/CASE\_SEL/VLS\_NT\_DOWN

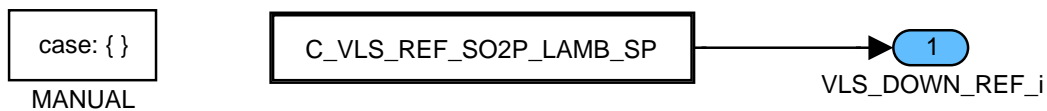


Figure 7.95.15: NOXM\_DEFSPNTDLS0/OPM\_20MS/AF\_CYC\_DET/AF\_CYC\_DET/AF\_CYC\_DET/  
CASE\_SEL/CASE\_SEL/MAN

**SECTION 1.2: Detection of transition between rich/lean phases and current mixture state**

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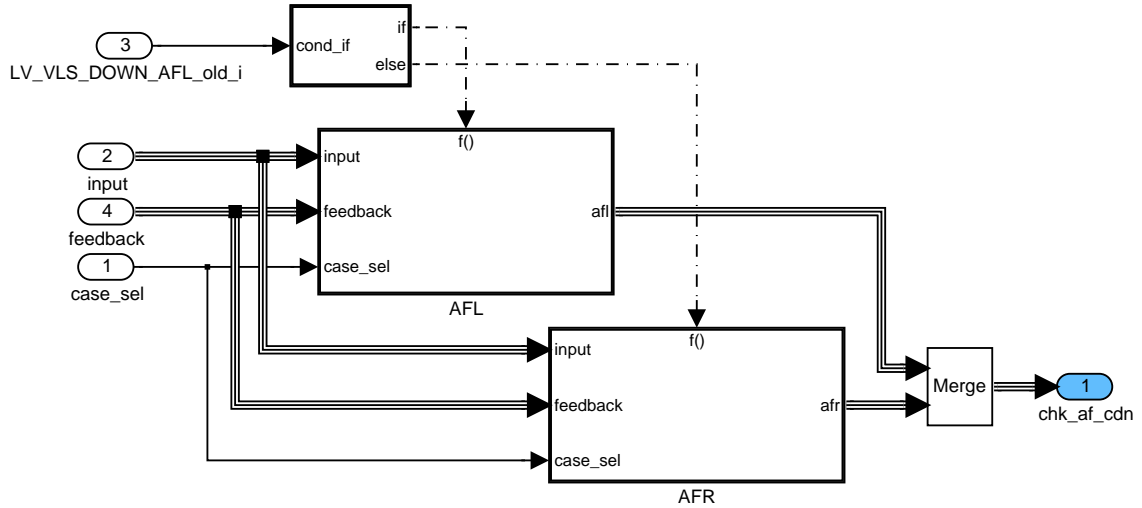


Figure 7.95.16:  
NOXM\_DEFSPNTDLS0/OPM\_20MS/AF\_CYC\_DET/AF\_CYC\_DET/AF\_CYC\_DET/CHK\_AF\_CDN

**SECTION 1.2.1: AFL phase**

**Calculation of timer for lean cycle**

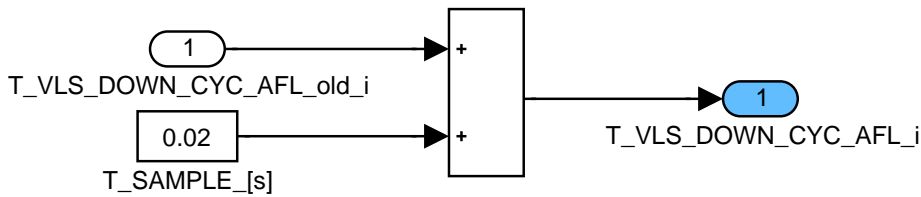


Figure 7.95.17: NOXM\_DEFSPNTDLS0/OPM\_20MS/AF\_CYC\_DET/AF\_CYC\_DET/AF\_CYC\_DET/CHK\_AF\_CDN/AFL/T\_CYC\_AFL\_CLC

**Calculation of transition condition**

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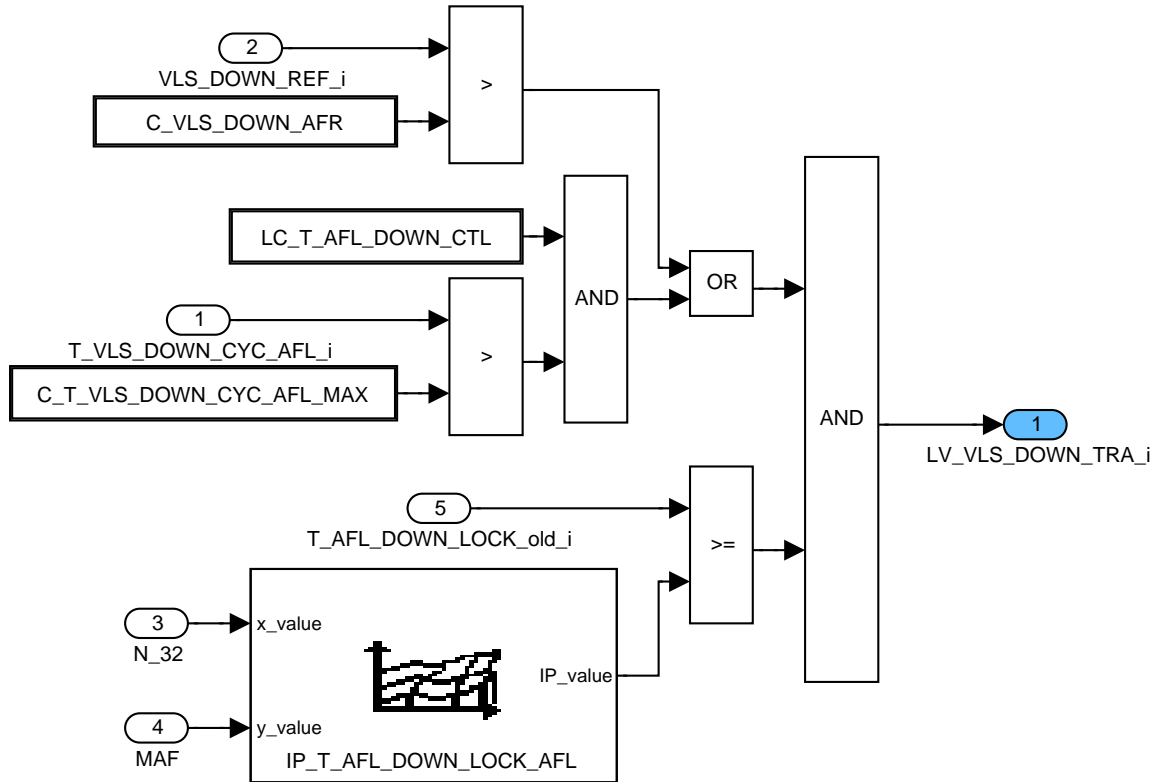


Figure 7.95.18: NOXM\_DEFSPNTDLS0/OPM\_20MS/AF\_CYC\_DET/AF\_CYC\_DET/AF\_CYC\_DET/CHK\_AF\_CDN/AFL/LV\_TRA\_CLC

**Calculation of mixture state**

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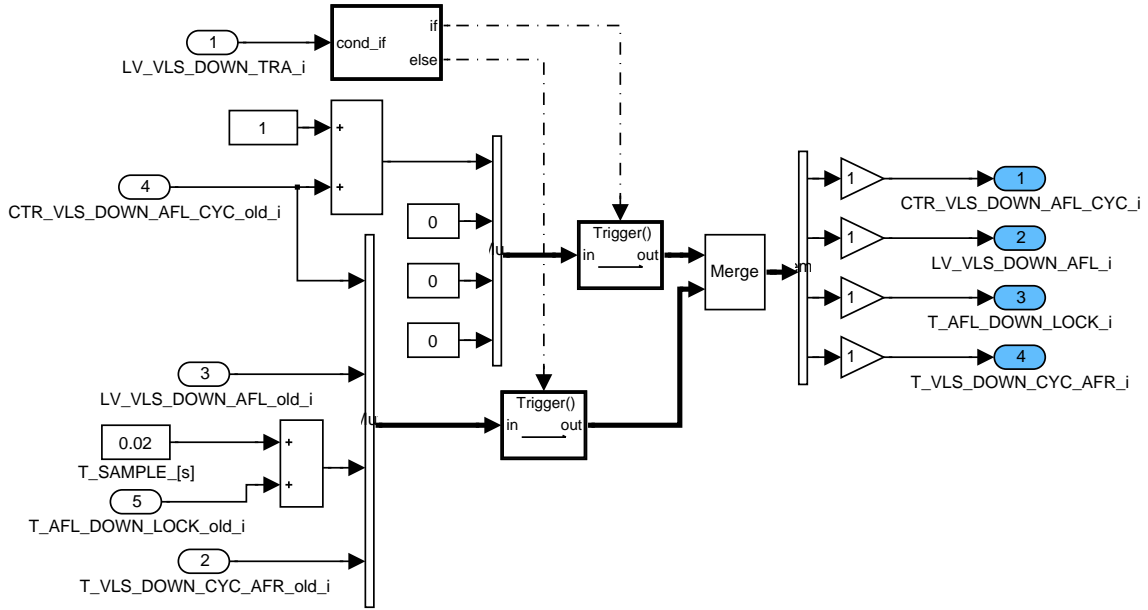


Figure 7.95.19: NOxM\_DEFSPNTDLS0/OPM\_20MS/AF\_CYC\_DET/AF\_CYC\_DET/AF\_CYC\_DET/CHK\_AF\_CDN/AFL/LV\_AFL\_CLC

**SECTION 1.2.2: AFR phase**

**Calculation of timer for rich cycle**

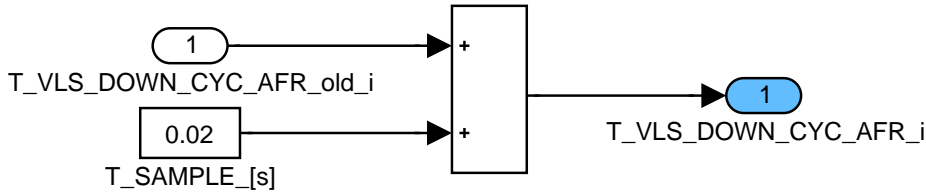


Figure 7.95.20: NOxM\_DEFSPNTDLS0/OPM\_20MS/AF\_CYC\_DET/AF\_CYC\_DET/AF\_CYC\_DET/CHK\_AF\_CDN/AFR/T\_CYC\_AFR\_CLC

**Calculation of transition condition**

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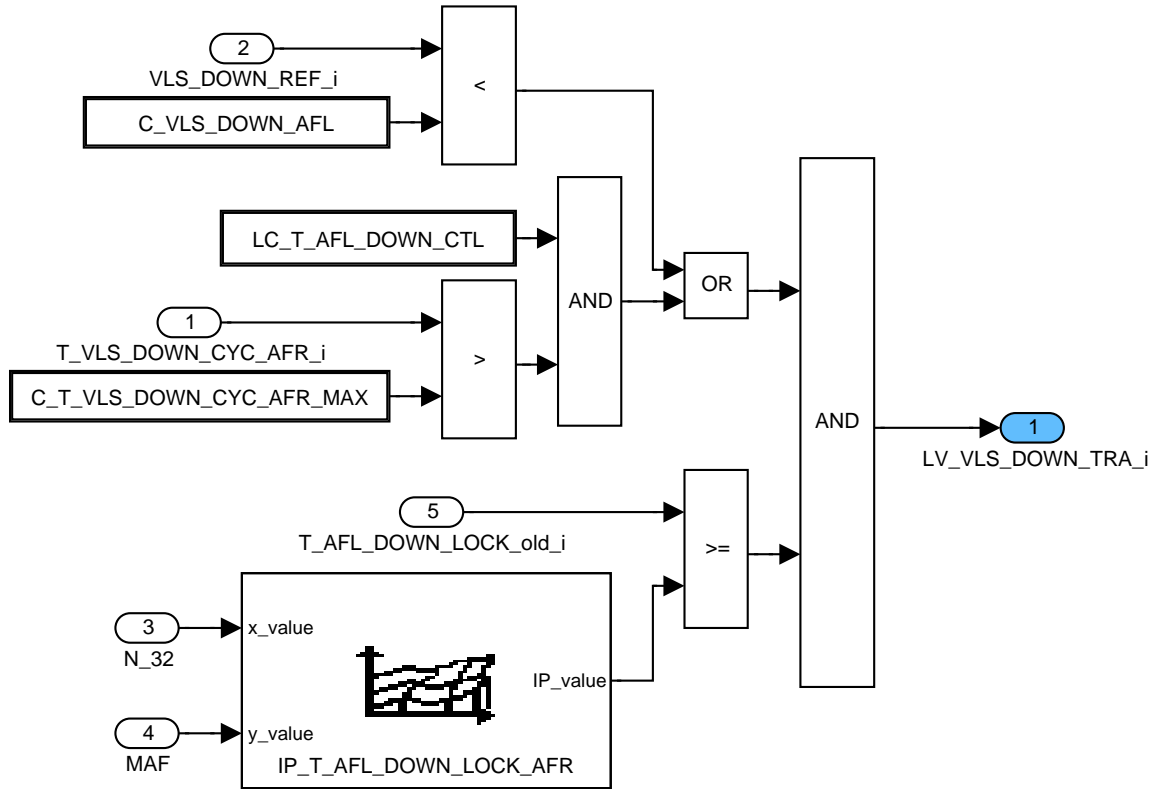



Figure 7.95.21: NOXM\_DEFSPNTDLS0/OPM\_20MS/AF\_CYC\_DET/AF\_CYC\_DET/AF\_CYC\_DET/CHK\_AF\_CDN/AFR/LV\_TRA\_CLC

**Calculation of mixture state**

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 3165 of 8404</b>	
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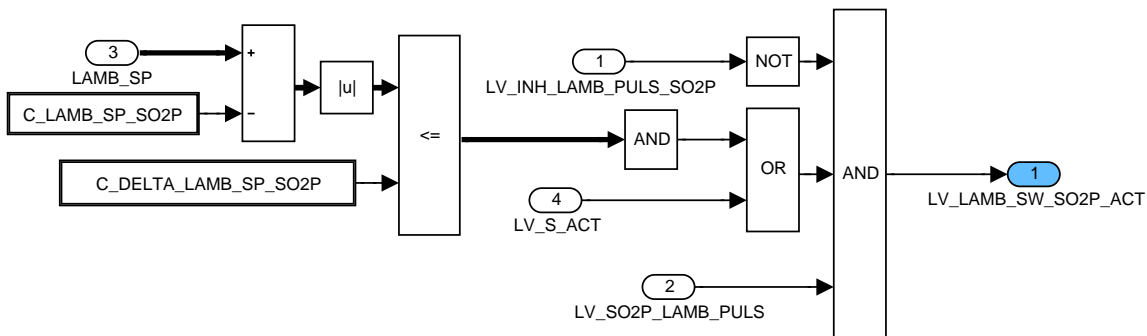


Figure 7.95.23:  
NOXM\_DEFSPNTDLS0/OPM\_20MS/LAMB\_SP\_SO2P\_CLC/ACT\_AFL\_DET/SO2P\_ACT\_CDN

**Check all exhaust banks**

Index "any" means that minimum for one bank the condition is fulfilled.  
Index "all" means that for all banks the condition must be fulfilled.

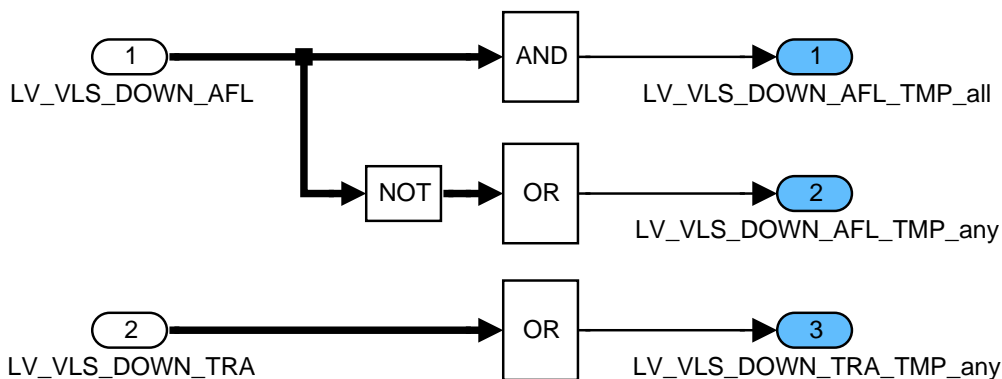


Figure 7.95.24:  
NOXM\_DEFSPNTDLS0/OPM\_20MS/LAMB\_SP\_SO2P\_CLC/ACT\_AFL\_DET/AFL\_DOWN\_DET

**SECTION 2.2: Lambda deviation calculation (for loop)**

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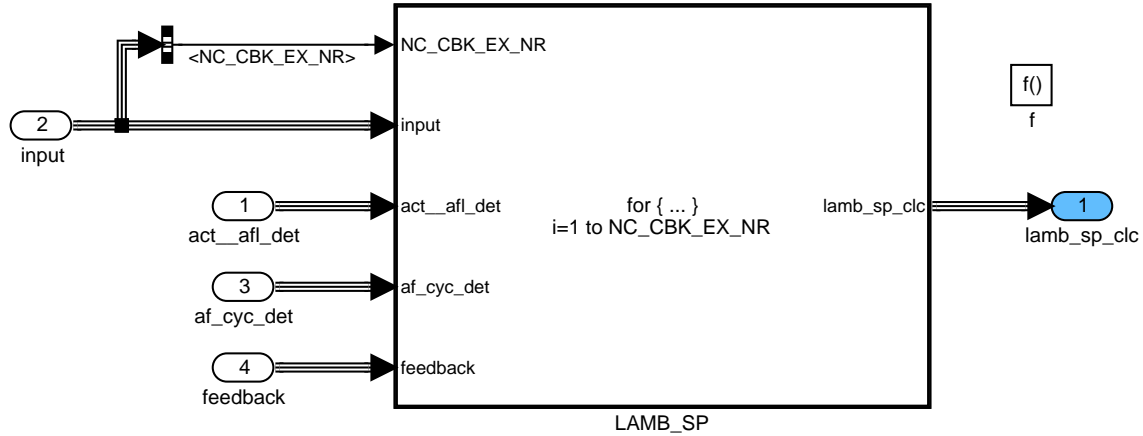


Figure 7.95.25: NOXM\_DEFSPNTDLS0/OPM\_20MS/LAMB\_SP\_SO2P\_CLC/LAMB\_SP

**SECTION 2.2.1: Calculation of lambda deviation for desulfation (H\_RES)**

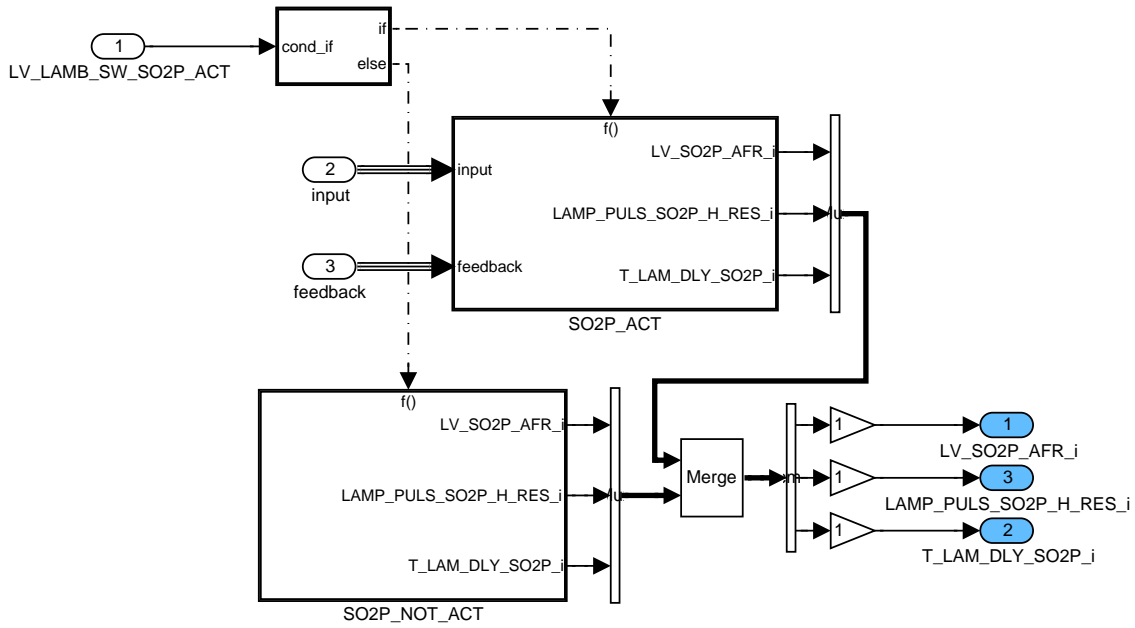


Figure 7.95.26: NOXM\_DEFSPNTDLS0/OPM\_20MS/LAMB\_SP\_SO2P\_CLC/LAMB\_SP/LAMB\_SP/LAMB\_SP/LAMB\_SP\_H\_RES\_CLC

**SECTION 2.2.1.1: Desulfation active (SO2P\_ACT)**

**SECTION 2.2.1.1.1: Check of combustion condition 1:**

Calculation of lambda deviation at trailing throttle fuel cut-off or full load or single cylinder cut off

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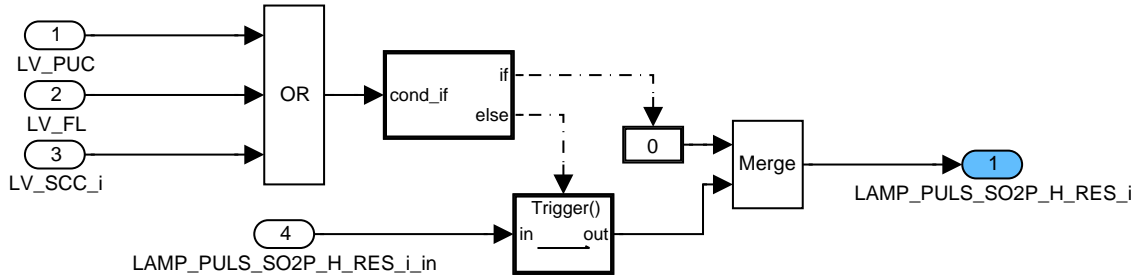


Figure 7.95.27: NOXM\_DEFSPNTDLS0/OPM\_20MS/LAMB\_SP\_SO2P\_CLC/LAMB\_SP/LAMB\_SP/LAMB\_SP/LAMB\_SP\_H\_RES\_CLC/SO2P\_ACT/CMB\_CDN\_1

**SECTION 2.2.1.1.2: Check of combustion condition 2:**

Controller setting at part load or trailing throttle or idle

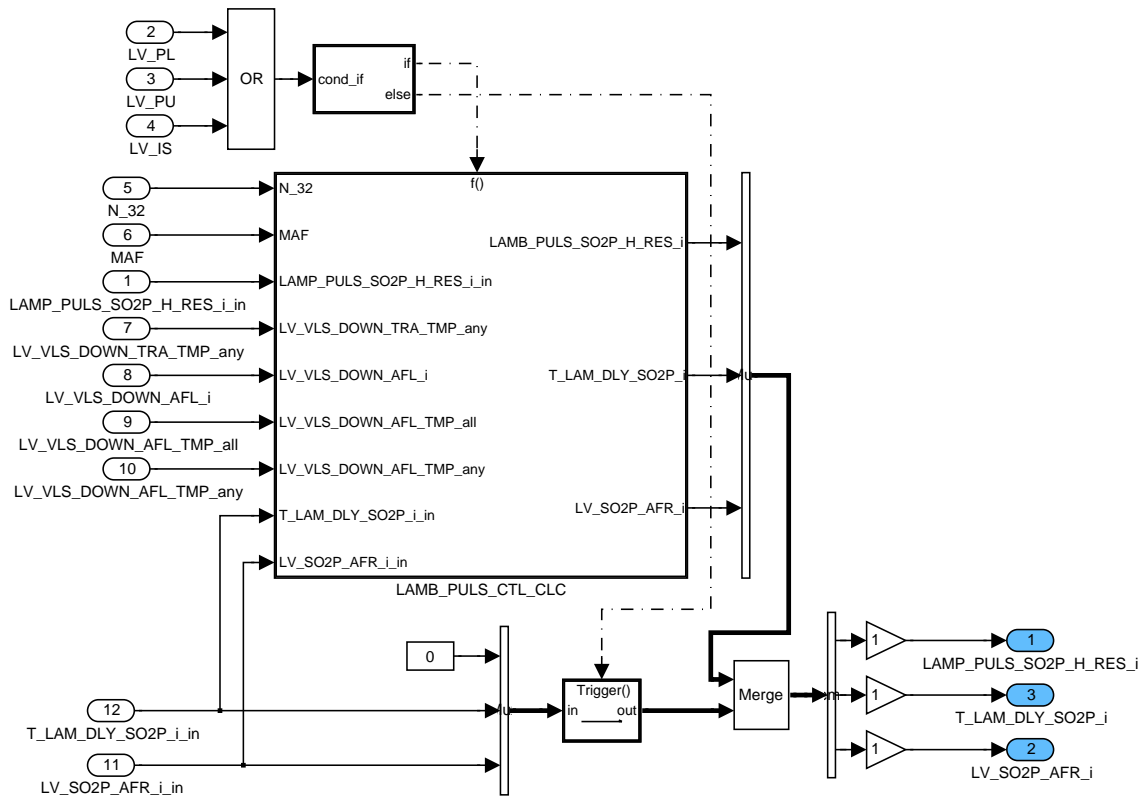



Figure 7.95.28: NOXM\_DEFSPNTDLS0/OPM\_20MS/LAMB\_SP\_SO2P\_CLC/LAMB\_SP/LAMB\_SP/LAMB\_SP/LAMB\_SP\_H\_RES\_CLC/SO2P\_ACT/CMB\_CDN\_2

**SECTION 2.2.1.1.2.1: LAMB\_PULS\_CTL\_CLC**

In this section the controller setting is calculated for transition phase and during rich/lean phase

**SECTION 2.2.1.1.2.1.1: Controller setting for transition phase**

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Initialization of delay time at changing of combustion mixture and calculation which phase is active

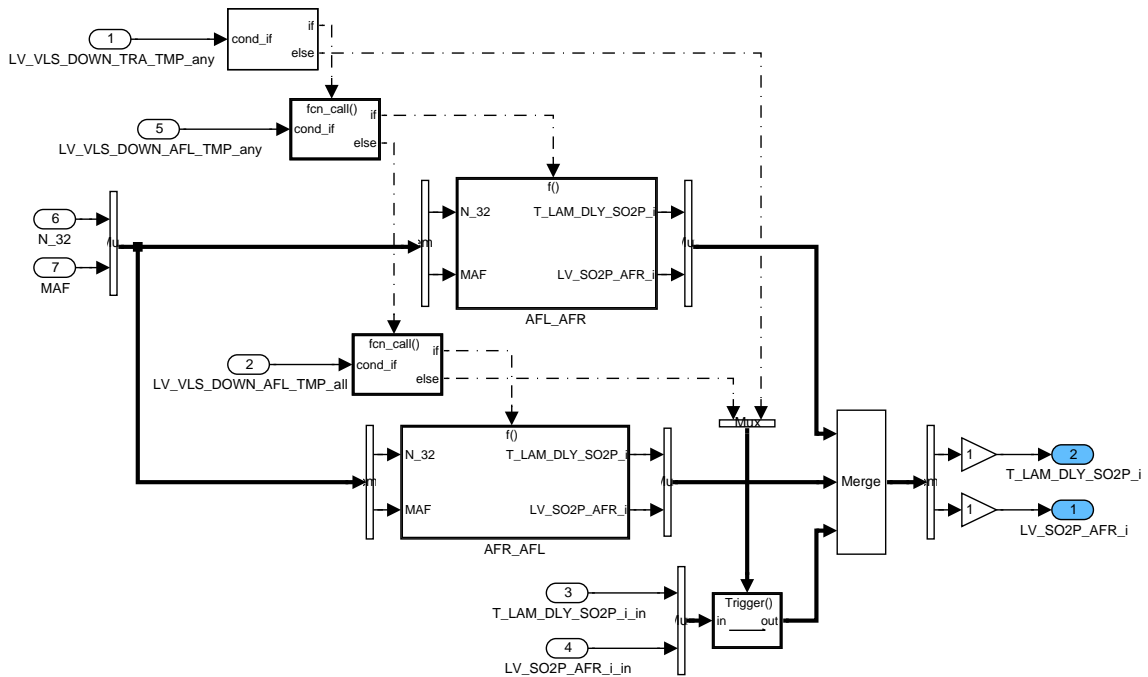


Figure 7.95.29: NOXM\_DEFSPNTDLS0/OPM\_20MS/LAMB\_SP\_SO2P\_CLC/LAMB\_SP/LAMB\_SP/LAMB\_SP/LAMB\_SP\_H\_RES\_CLC/SO2P\_ACT/CMB\_CDN\_2/LAMB\_PULS\_CTL\_CLC/TRA

**AFL to AFR**

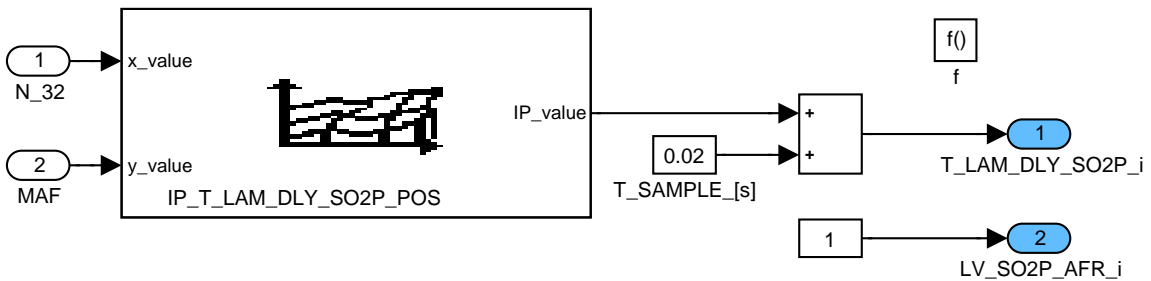


Figure 7.95.30: NOXM\_DEFSPNTDLS0/OPM\_20MS/LAMB\_SP\_SO2P\_CLC/LAMB\_SP/LAMB\_SP/LAMB\_SP/LAMB\_SP\_H\_RES\_CLC/SO2P\_ACT/CMB\_CDN\_2/LAMB\_PULS\_CTL\_CLC/TRA/AFL\_AFR

**AFR to AFL**

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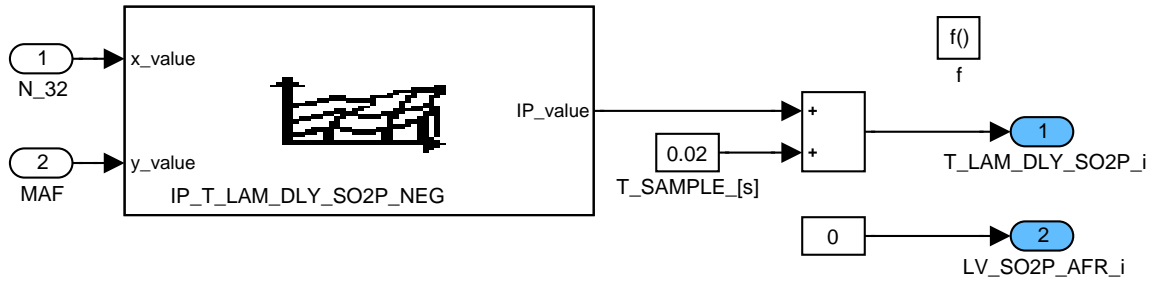


Figure 7.95.31:  
 NOXM\_DEFSPNTDLS0/OPM\_20MS/LAMB\_SP\_SO2P\_CLC/LAMB\_SP/LAMB\_SP/LAMB\_SP/  
 LAMB\_SP\_H\_RES\_CLC/SO2P\_ACT/CMB\_CDN\_2/LAMB\_PULS\_CTL\_CLC/TRA/AFR\_AFL

**SECTION 2.2.1.1.2.1.2: Controller setting for lean/rich phase**

If the delay time has been running over the "I" component of controller is calculated

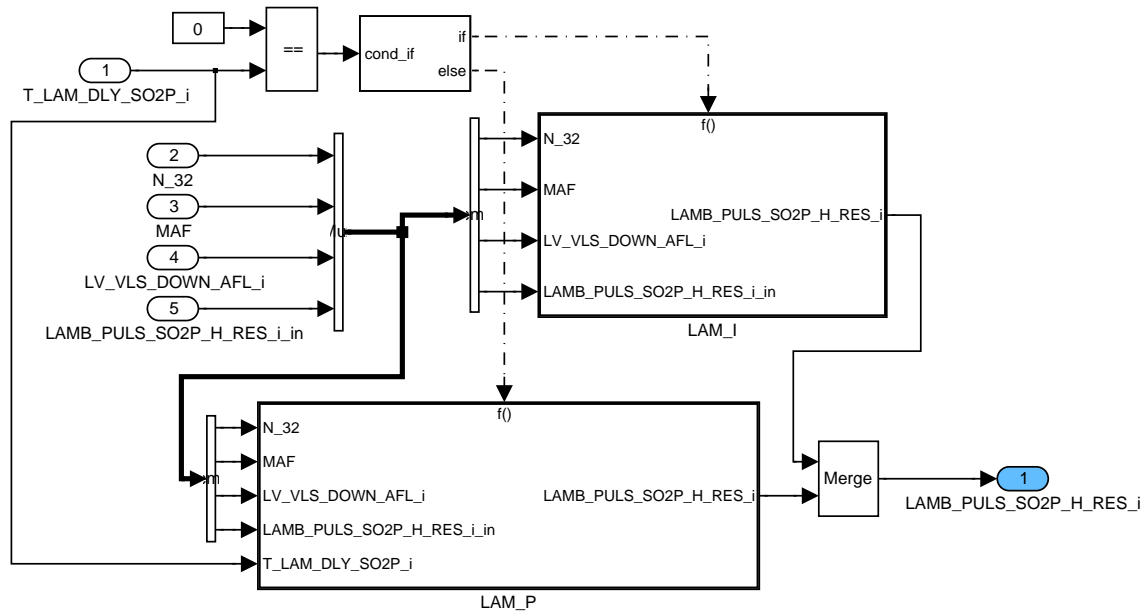


Figure 7.95.32: NOXM\_DEFSPNTDLS0/OPM\_20MS/LAMB\_SP\_SO2P\_CLC/LAMB\_SP/LAMB\_SP/  
 LAMB\_SP/LAMB\_SP\_H\_RES\_CLC/SO2P\_ACT/CMB\_CDN\_2/LAMB\_PULS\_CTL\_CLC/CTL

**LAM\_I**

Calculation of controller "I" component

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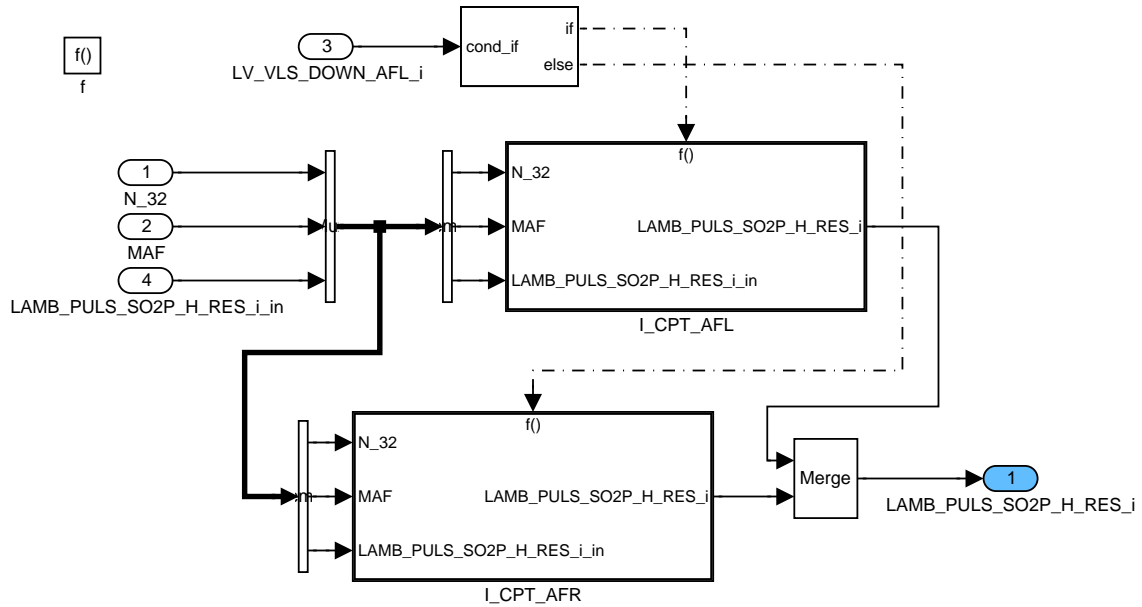


Figure 7.95.33: NOXM\_DEFSPNTDLS0/OPM\_20MS/LAMB\_SP\_SO2P\_CLC/LAMB\_SP/LAMB\_SP/LAMB\_SP/LAMB\_SP\_H\_RES\_CLC/SO2P\_ACT/CMB\_CDN\_2/LAMB\_PULS\_CTL\_CLC/CTL/LAM\_I

**LAM\_I/I\_CPT\_AFL**

Controller "I" component for lean phase

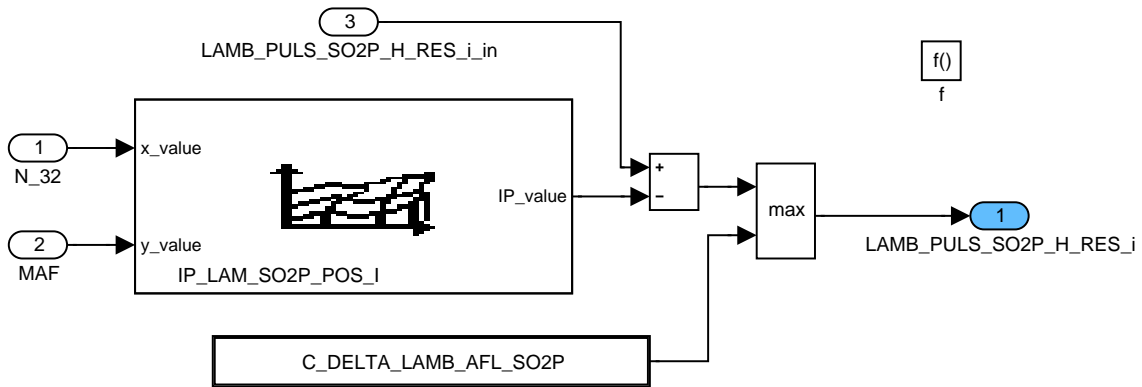


Figure 7.95.34: NOXM\_DEFSPNTDLS0/OPM\_20MS/LAMB\_SP\_SO2P\_CLC/LAMB\_SP/LAMB\_SP/LAMB\_SP/LAMB\_SP\_H\_RES\_CLC/SO2P\_ACT/CMB\_CDN\_2/LAMB\_PULS\_CTL\_CLC/CTL/LAM\_I/I\_CPT\_AFL

**LAM\_I/I\_CPT\_AFR**

Controller "I" component for rich phase

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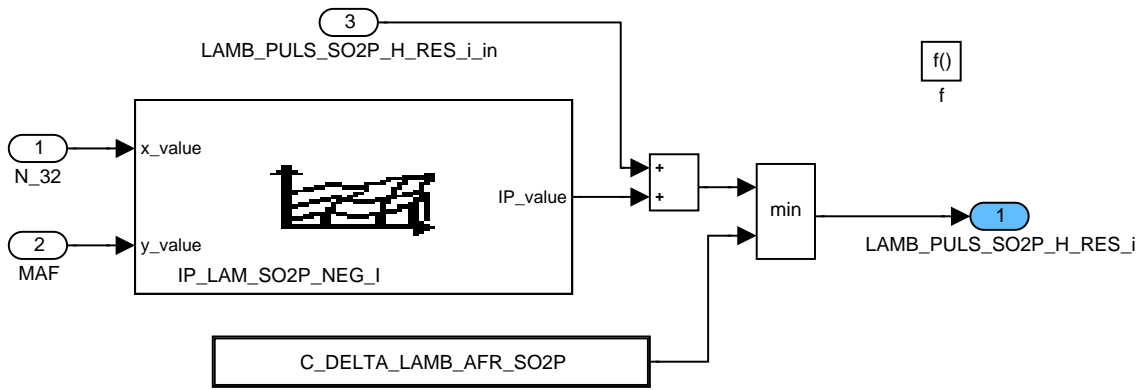


Figure 7.95.35:

NOXM\_DEFSPNTDLS0/OPM\_20MS/LAMB\_SP\_SO2P\_CLC/LAMB\_SP/LAMB\_SP/LAMB\_SP/  
LAMB\_SP\_H\_RES\_CLC/SO2P\_ACT/CMB\_CDN\_2/LAMB\_PULS\_CTL\_CLC/CTL/LAM\_I/I\_CPT\_AFR

**LAM\_P**

Calculation of controller "P" component. At the last cycle before delay time is over the "P" component is calculated for realization of "P" jump

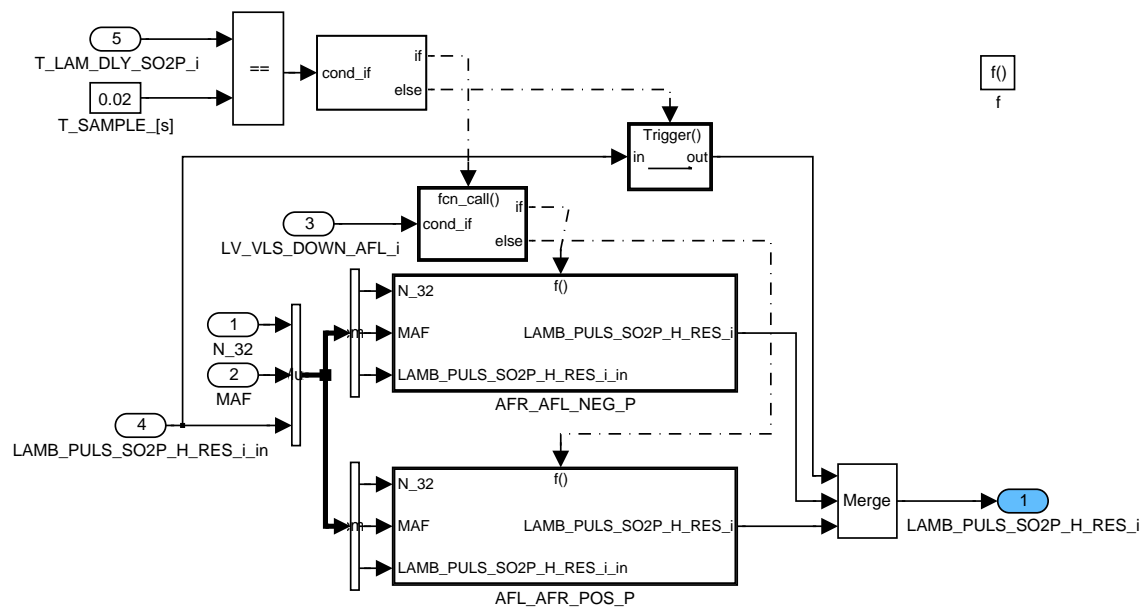


Figure 7.95.36: NOXM\_DEFSPNTDLS0/OPM\_20MS/LAMB\_SP\_SO2P\_CLC/LAMB\_SP/LAMB\_SP/  
LAMB\_SP/LAMB\_SP\_H\_RES\_CLC/SO2P\_ACT/CMB\_CDN\_2/LAMB\_PULS\_CTL\_CLC/CTL/LAM\_P

**LAM\_P/AFR\_AFL\_NEG\_P**

Controller "P" component for lean to rich transition

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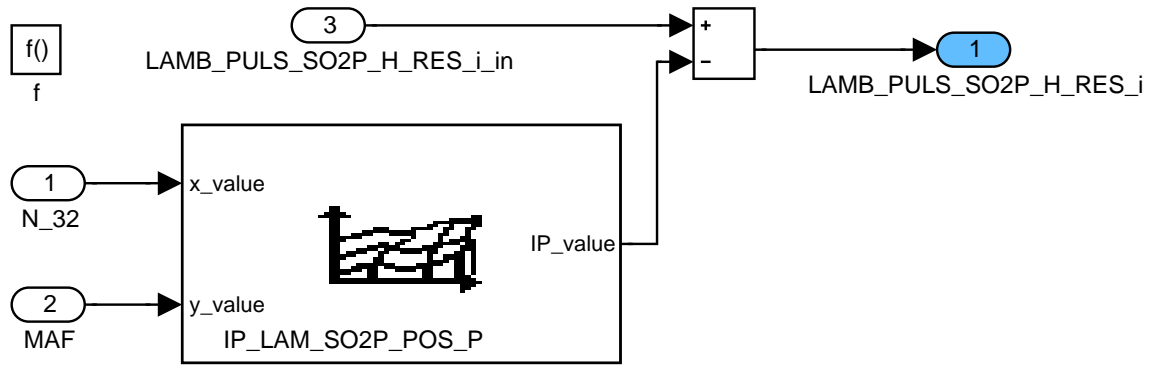


Figure 7.95.37: NOXM\_DEFSPNTDLS0/OPM\_20MS/LAMB\_SP\_SO2P\_CLC/LAMB\_SP/LAMB\_SP/LAMB\_SP/LAMB\_SP\_H\_RES\_CLC/SO2P\_ACT/CMB\_CDN\_2/LAMB\_PULS\_CTL\_CLC/CTL/LAM\_P/AFR\_AFL\_NEG\_P

**LAM\_P/AFL\_AFR\_POS\_P**

Controller "P" component for rich to lean transition

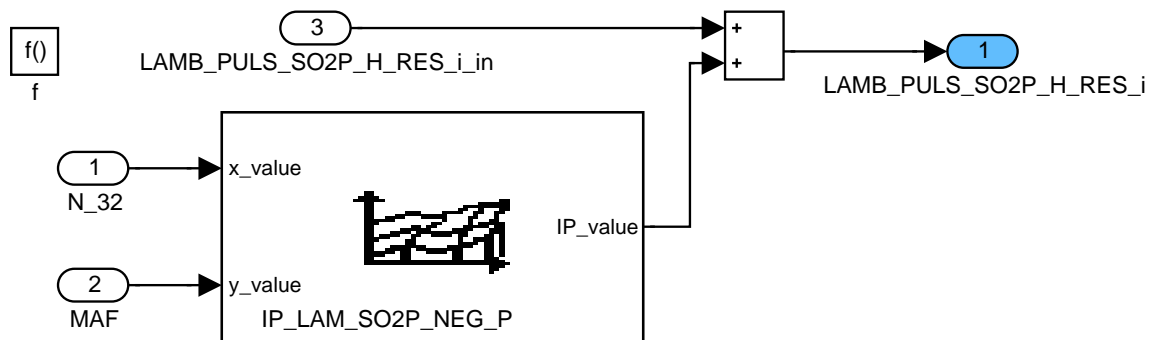


Figure 7.95.38: NOXM\_DEFSPNTDLS0/OPM\_20MS/LAMB\_SP\_SO2P\_CLC/LAMB\_SP/LAMB\_SP/LAMB\_SP/LAMB\_SP\_H\_RES\_CLC/SO2P\_ACT/CMB\_CDN\_2/LAMB\_PULS\_CTL\_CLC/CTL/LAM\_P/AFR\_AFR\_POS\_P

**SECTION 2.2.1.1.3: Calculation of delay time for controller setting**

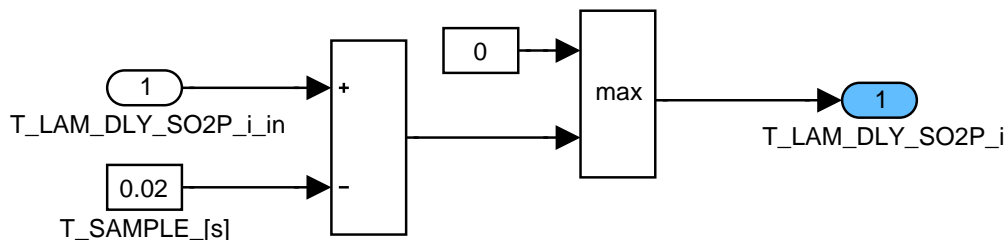


Figure 7.95.39: NOXM\_DEFSPNTDLS0/OPM\_20MS/LAMB\_SP\_SO2P\_CLC/LAMB\_SP/LAMB\_SP/LAMB\_SP/LAMB\_SP\_H\_RES\_CLC/SO2P\_ACT/T\_LAM\_DLY\_CLC

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### SECTION 2.2.1.2: Desulfation not active (SO2P\_NOT\_ACT)

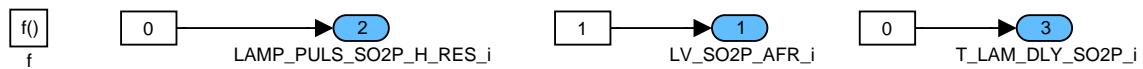


Figure 7.95.40: NOXM\_DEFSPNTDLS0/OPM\_20MS/LAMB\_SP\_SO2P\_CLC/LAMB\_SP/LAMB\_SP/LAMB\_SP/LAMB\_SP\_H\_RES\_CLC/SO2P\_NOT\_ACT

### SECTION 2.2.2: Calculation of lambda deviation for desulfation

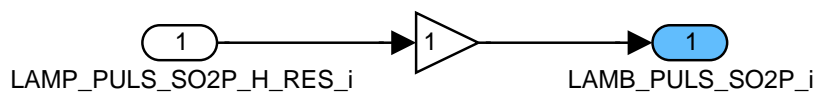



Figure 7.95.41: NOXM\_DEFSPNTDLS0/OPM\_20MS/LAMB\_SP\_SO2P\_CLC/LAMB\_SP/LAMB\_SP/LAMB\_SP/LAMB\_SP\_CLC

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## 7.96 NOx catalyst desulfation - lambda stimulation (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_LAMB_PULS_SO2P	O/V	0... 1H	0 ...1	1	-
flag inhibiting the NOx catalyst desulfation - lambda stimulation					

### Input data:

LV_ERR_LS_DOWN [NC_CBK_EX_NR] {p. 5449}			
---	--	--	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_INH_LAMB_PULS_SO2P_MAN	-	0... 1H	0 ...1	1	-
Codeword for the manual setting of the inhibiting bit NOx trap desulfation by lambda stimulation					
LC_INH_LAMB_PULS_SO2P_OFF	-	0... 1H	0 ...1	1	-
Codeword for the deactivation of inhibiting the NOx trap desulfation by lambda stimulation					

### Description:

This flag deactivates the NOx catalyst desulfation with lambda stimulation.

With the calibration data LC\_INH\_LAMB\_PULS\_SO2P\_MAN it is possible to deactivate the NOx trap desulfation with lambda stimulation.

With the calibration data LC\_INH\_LAMB\_PULS\_SO2P\_OFF it is possible to make the NOx trap desulfation with lambda stimulation always working.

### Application conditions

**Initialisation:** *0 at reset*

**Recurrence:** *100ms*

**Activation:** at every engine state  
**If** LC\_INH\_LAMB\_PULS\_SO2P\_OFF = 1  
**then** LV\_INH\_LAMB\_PULS\_SO2P = 0 % no further calculation  
*necessary*

**endif**

### Formula section:

**If** LV\_ERR\_LS\_DOWN[i] = 1 // at least one  
**or** LC\_INH\_LAMB\_PULS\_SO2P\_MAN = 1  
**then** LV\_INH\_LAMB\_PULS\_SO2P = 1  
**else** LV\_INH\_LAMB\_PULS\_SO2P = 0  
**endif**



## 7.97 NOx catalyst oxygen storage capacity adaptation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DIST_O2_STC_OLD	O/V/S	0... FFFFH	0... 524280	8	km
mileage of last O2_STC adaptation					
LV_NT_O2_STC_LIM	O/V/S	0... 1H	0 ...1	1	-
bit for limitation of OSC adaptation cycle					
LV_NT_O2_STC_REQ	O/V/S	0... 1H	0 ...1	1	-
bit for requesting an OSC adaptation cycle					
LV_NT_O2_STC_VLD	O/V/S	0... 1H	0 ...1	1	-
Flag for valid status of OSC adaptation measurement					
NT_O2_STC_AD	O/V/S	0... FFH	0... 1.99218	0.0078125	-
adaptation factor for NOx catalyst oxygen storage capacity					
NT_O2_STC_OFS	O/V/S	8000... 7FFFH	-10485.76 ...10485.44	0.32	mg
adaptation offset for NOx catalyst oxygen storage capacity					

### Input data:

DIST_NT {p. 3180}	LV_NT_AD_CMPL {p. 996}	LV_NT_AD_VLD {p. 996}	LV_NT_O2_STC_ACT {p. 996}
NT_O2_STC_BAS {p. 2985}	NNTL_DEC_INT_AD {p. 996}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DIST_O2_STC	-	0... FFFFH	0... 524280	8	km
mileage distance to be passed before next O2_STC measurement					
C_DIST_O2_STC_VLD	-	0... FFFFH	0... 524280	8	km
mileage distance to be passed before O2_STC measurement is not valid anymore					
C_NT_O2_STC_AD_MAN	-	0... FFH	0... 1.99218	0.0078125	-
manual initialisation value for oxygen storage capacity adaptation value					
C_NT_O2_STC_DELTA	-	0... 7FFFH	0... 10485.44	0.32	mg
permissible deviation between old and new osc value					
LC_NT_O2_STC_AD_MAN	-	0... 1H	0 ...1	1	-
logical constant for manual initialisation of NT_O2_STC_AD					
LC_NT_O2_STC_REP_OFF	-	0... 1H	0 ...1	1	-
logical constant for disabling a repetition of osc-measurement in case of gradient limitation					
LC_NT_O2_STC_REQ	-	0... 1H	0 ...1	1	-
logical constant for manually requesting an O2_STC adaptation cycle					
LC_NT_O2_STC_VLD	-	0... 1H	0 ...1	1	-
logical constant for manually setting of valid bit of O2_STC value					

### FUNCTION DESCRIPTION:

#### General information:

The oxygen storage capacity adaptation allows an adaptation of the NOx catalyst oxygen storage capacity which will decrease within time due to thermal aging effects.

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## 7.98 NOx catalyst oxygen storage capacity adaptation (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DIST_NT	O/V	0... FFFFH	0... 524280	8	km
mileage counter for NOx trap purposes					

### Input data:

CTR_KM_CAN {p. 1563}			
----------------------	--	--	--

### 7.98.1 General

#### FUNCTION DESCRIPTION:

#### General information:

The range and resolution of CTR\_KM\_CAN and DIST\_NT differ: both are words, resolution of CTR\_KM\_CAN (BMW): 10 km, DIST\_NT: 8km

*Recurrence:* **1000** ms

*Initialisation:* DIST\_NT = CTR\_KM\_CAN *at reset*

*% CTR\_KM\_CAN already read from NVMY*

*Activation:* *at every engine state*

#### Formula section:

DIST\_NT = CTR\_KM\_CAN

% resolution transformation

## 7.99 NOx catalyst monolith temperature model

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_COLD_ST_NT	O/V/S	0... FFH	0... 255	1	-
Number of cold starts for NOx catalyst					
CTR_EGY_DEW_NT	V	0... FFFFH	0... 6553.5	0.1	-
Counter for correction of energy threshold for nox trap dew point detection					
EGY_DEW_END_NT	O/V	0... FFFFFFFFH	0... 536870911.875	0.125	Ws
Total amount of energy until nox trap dew point detection					
EGY_DEW_END_NT_INT	O/V	0... FFFFFFFFH	0... 536870911.875	0.125	Ws
Amount of energy brought into exhaust system for nox trap dew point detection					
EGY_DEW_NT_STOP	O/V/S	0... FFFFFFFFH	0... 536870911.875	0.125	Ws
additional amount of energy for nox trap dew point detection from last engine run without passed dew point					
FAC_EGY_DEW_END_NT	V	0... FFFFH	0... 1.99996	30.5e-6	-
factor for correction of energy threshold for nox trap dew point detection					
FAC_EGY_DEW_NT_STOP	V	0... FFH	-1... 1.55	0.01	-
factor for correction of energy amount that is stored in NVMY					
LV_TNT_MIN_THD_2	O/V	0... 1H	0 ...1	1	-
dew point recognition (second monolith)					
MAF_KGH_MIN_EGY_DEW_NT	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
minimum air-mass flow that has to exceeded for incrementing CTR_EGY_DEW_NT					
RATIO_EGY_DEW_NT	V	0... FFFFH	0... 1.99996	30.5e-6	-
Ratio of energy brought into exhaust system to energy threshold					
TEG_PCAT_DOWN_COR [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Sensor input NOx catalyst monolith temperature					

### Input data:

CAN_HW_NS [NC_NOX_SENS_CONF] {p. 1398}	CAN_R_RATIO_NOX_ SENS [NC_NOX_SENS_CONF] {p. 1398}	EGY_DEW_NT_DOWN {p. 8236}	LV_CHECK_MDL_ST {p. 8236}
LV_ES {p. 1720}	LV_ST {p. 1720}	LV_ST_END {p. 1720}	MAF_KGH {p. 1195}
T_AST {p. 1766}	T_ES_2 {p. 1444}	TAM {p. 1579}	TAM_ST {p. 1214}
TCO_ST {p. 1100}	TEG_PCAT_DOWN [NC_CBK_EX_NR] {p. 1253}	TEG_PCAT_DOWN_ADD {p. 3188}	TEG_WALL_NT_DOWN_ MDL {p. 8237}
TEG_WALL_NT_DOWN_ MDL_ST {p. 8237}			

### Calibration data:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DLY_DEW_NT	-	0... FFH	0... 25.5	0.1	s
time delay for nox trap dew point detection					
C_EGY_DEW_NT_STOP	-	0... FFFFFFFFH	0... 536870911.875	0.125	Ws
Initialization value of energy for nox trap dew point detection from last engine run					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_EGY_DEW_NT_STOP	-	0... FFFH	0... 0.99609	3.9063e-3	-
Weighting factor on restart for nox trap dew point detection					
C_TEG_WALL_NT_HYS	-	0... 1FFFFH	0... 188.393	0.023	°C
Reference temperature hysteresis to set nox trap dew point after cooled exhaust pipe again					
C_TEG_WALL_NT_RED	-	0... FFFFH	-48 ...1	0.023	°C
Reference temperature to erase nox trap dew point at cooled exhaust pipe					
ID_MAF_KGH_MIN_EGY_DEW_NT	-	0... FFFFH	0... 1023.98437	0.015625	kg/h
LDP_TEG_WALL_NT_DOWN_MDL_ID_MAF	8	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
MAF threshold for incrementing CTR_EGY_DEW_END_NT					
IP_EGY_DEW_END_NT	V	0... FFFFFFFFH	0... 536870911.875	0.125	Ws
LDP_TCO_ST_EGY_DEW_END_NT	8	0... FEH	-48... 142.5	0.75	°C
LDP_TEG_WALL_NT_DOWN_MDL_ST	8	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Energy threshold for nox trap dew point detection					
IP_EGY_DEW_NT_MAX	V	0... FFFFFFFFH	0... 536870911.875	0.125	Ws
LDP_TCO_ST_EGY_DEW_NT_MAX	8	0... FEH	-48... 142.5	0.75	°C
LDP_TAM_ST_EGY_DEW_NT_MAX	8	0... FEH	-48... 142.5	0.75	°C
Maximum energy that has to be brought into a full flooded exhaust manifold until all water is condensed					
IP_FAC_EGY_DEW_END_NT	V	0... 7FH	0... 1.98437	0.015625	-
LDP_CTR_EGY_DEW_NT	8	0... FFFFH	0... 6553.5	0.1	-
LDP_MAF_KGH_IP_FAC_EGY_DEW_END	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
factor for correction of energy threshold for nox trap dew point detection					
IP_FAC_EGY_DEW_END_NT_STOP	V	0... FFH	-1... 1.55	0.01	-
LDP_RATIO_EGY_DEW_NT	16	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_TAM_FAC_EGY_DEW_END_NT	2	0... FEH	-48... 142.5	0.75	°C
factor for correction of energy amount that is stored in NVMY					
IP_FAC_EGY_DEW_END_NT_TAM_T_ES	V	0... FFH	-4... 3.96875	0.03125	-
LDP_T_ES_2_IP_FAC_EGY_DEW_END	4	1... FFFFH	1... 65535	1	s
LDP_TAM_IP_FAC_EGY_DEW_END	4	0... FEH	-48... 142.5	0.75	°C
Factor for correction of energy-threshold dependent on TAM and T_ES_2					
IP_R_RATIO_NOX_SENS_MIN_DEW	V	0... FFFFH	-32768 ...32767	1	-
LDP_TAM_IP_R_RATIO_NOX_SENS	8	0... FEH	-48... 142.5	0.75	°C
LDP_NR_CAN_HW_NS	8	0... FFH	0... 255	1	-
Minimum sensor element temperature depended resistance ratio as 1000 * R/R25 for dew point detection dependant on NOx sensor hardware version					
IP_TEG_WALL_NT_DOWN_ST	-	0... FFFFH	-48 ...1	0.023	°C
LDP_TAM_TEG_WALL_NT_DOWN_ST	8	0... FEH	-48... 142.5	0.75	°C
temperature treshold for nox trap dew point detection					

## Action definition

<b>ACTION_EXTD_InitNTEgyStop</b> ()	Mode: O
Initialization of energy for nox trap dew point detection from last engine run	

## Description for ACTION\_EXTD\_InitNTEgyStop

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**Then (1)**

```

if(2)          LV_TNT_MIN_THD_READY_2 == 0          and
                (TEG_WALL_NT_DOWN_MDL > IP_TEG_WALL_NT_DOWN_ST and
                 EGY_DEW_END_NT_INT   EGY_DEW_END_NT) and
                 CAN_R_RATIO_NOX_SENS IP_R_RATIO_NOX_SENS_MIN_DEW
then(2)        LV_TNT_MIN_THD_2 = 1
if(3a)         TEG_WALL_NT_DOWN_MDL   C_TEG_WALL_NT_RED
then(3a)       LV_TNT_MIN_THD_READY_2 = 1
endif(3a)
else(2)        // Hysteresis of dew point during engine run
if(3b)         LV_TNT_MIN_THD_READY_2 == 1
then(3b)
if(4)         TEG_WALL_NT_DOWN_MDL < C_TEG_WALL_NT_RED
then(4)       LV_TNT_MIN_THD_2 = 0
else(4)
if(5)         TEG_WALL_NT_DOWN_MDL >
                C_TEG_WALL_NT_RED + C_TEG_WALL_NT_HYS
then(5)       LV_TNT_MIN_THD_2 = 1
endif(5)
endif(4)
else(3b)      LV_TNT_MIN_THD_2 = 0
endif(3b)
endif(2)
endif (1)
    
```

**7.99.2 Calculation of the NOx catalyst monolith temperature (sensor input)**

**Formula section:**

```

TEG_PCAT_DOWN_COR[NC_CBK_EX_NR]
= TEG_PCAT_DOWN[NC_CBK_EX_NR] + TEG_PCAT_DOWN_ADD
    
```

**7.99.2.1 Calculation of number of cold starts for Nox catalyst**

After leaving the engine state ST the value of CTR\_COLD\_ST\_NT is incremented by the increment one. At the same time dew point state detection is initialized LV\_TNT\_MIN\_THD\_2 = 0, i.e. the exhaust gas temperature is less than the temperature that characterizes the dew point.

The value CTR\_COLD\_ST\_NT is a measure of the number of cold-start tests and has to be stored in the flash-memory when the engine is switched off (LV\_IGK = 0). After a new start of the engine CTR\_COLD\_ST\_NT is initialised with the stored value.

CTR\_COLD\_ST\_NT is set to zero when the dew point of Temp\_Model\_2 is passed (LV\_TNT\_MIN\_THD\_2 = 1). The initialisation depends on Temp\_Model\_2 since it takes the longest for the second part of the Nox catalyst monolith to pass the dew-point.

In that way CTR\_COLD\_ST\_NT is incremented for each engine start if the dew point of Temp\_Model\_2 was not passed before.


**Application conditions**

**Initialisation:** *from nonvolatile memory or = 0 if not possible*

**Recurrence:** *only once per engine run* *%CTR\_COLD\_ST\_NT is only incremented per engine run*

**Activation:** *LV\_ES = 0*

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**Formula section:**

```

if          LV_TNT_MIN_THD_2 = 0          % at each transition from LV_ES = 1 -> 0
then       CTR_COLD_ST_NT ++          % CTR_COLD_ST_NT is incremented; if there is
a
else       CTR_COLD_ST_NT = 0          % a transition of LV_TNT_MIN_THD = 0 -> 1
within the
endif                                % same DC, CTR_COLD_ST_NT has to be set to 0
    
```

**7.99.3 Increasing the required energy**

**Function description:**

On each restart, the amount of condensed water first increases and then decreases until the dew point is reached. To this effect, the energy introduced into the exhaust system EGY\_DEW\_END\_NT\_INT is calculated from the start and saved in the non-volatile memory at "engine stop" and after the latching phase has elapsed.

The amount of energy that has been brought into the exhaust system is weighted with FAC\_EGY\_DEW\_NT\_STOP, a factor dependent on the ambient temperature and the ratio of EGY\_DEW\_END\_NT\_INT and the threshold EGY\_DEW\_END\_NT.

The result of this whole calculation is stored as EGY\_DEW\_NT\_STOP in non volatile memory. If the dewpoint is passed, EGY\_DEW\_NT\_STOP is set to 0.

**Application conditions**

**Initialisation:** *at reset: from nonvolatile memory or = 0 if not possible*

**Recurrence:** only once after transition from LV\_ES 0 ->1

**Activation:** at transition from LV\_ES 0->1

**Formula section:**

```

RATIO_EGY_DEW_NT = EGY_DEW_END_NT_INT /EGY_DEW_END_NT
FAC_EGY_DEW_NT_STOP = IP_FAC_EGY_DEW_END_NT_STOP
if          LV_TNT_MIN_THD_2 = 0
then if     FAC_EGY_DEW_NT_STOP >= 0
              then EGY_DEW_NT_STOP(new) = EGY_DEW_NT_STOP(last)
                + IP_EGY_DEW_END_NT * FAC_EGY_DEW_NT_STOP
              else EGY_DEW_NT_STOP(new) = EGY_DEW_NT_STOP(last)
                + EGY_DEW_NT_STOP(last) * FAC_EGY_DEW_NT_STOP
              endif
else       EGY_DEW_NT_STOP(new) = 0
endif
    
```


**7.99.4 Integration of energy brought into the exhaust system**

**Function description:**

For dew point detection of the NOX-Trap, the energy, that is brought into the exhaust system, has to be integrated.

**Application conditions**

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**Initialisation:**  $EGY\_DEW\_END\_NT\_INT = 0$  at transition  $LV\_ES\ 1 \rightarrow 0$   
**Recurrence:**  $200ms$   
**Activation:**  $LV\_ST\_END = 1$  and  $LV\_ES = 0$   
**Deactivation:**  $LV\_ES = 1$

**Formula section:**

$EGY\_DEW\_END\_NT\_INT = EGY\_DEW\_END\_NT\_INT_{(n-1)} + EGY\_DEW\_NT\_DOWN * 0,2s$

**7.99.5 Calculation of the total energy until end of dew point**

**Application conditions**

**Activation:**  $LV\_CHECK\_MDL\_ST = 1$   
**Deactivation:**  $LV\_ES = 1$   
**Recurrence:**  $100ms$

**Initialisation:**

**Initialisation at engine start:** transition  $LV\_ES = 1 \rightarrow 0$   
 $EGY\_DEW\_END\_NT = FFFFFFFFH$   
 $CTR\_EGY\_DEW\_NT = 0$

**Function description:**

To enable detection end of dew point, the necessary energy that has to be introduced into the exhaust system must be calculated first.

The value for the missing amount of energy is obtained from the map  $IP\_EGY\_DEW\_END\_NT$ . Input for this map is  $TEG\_WALL\_NT\_DOWN\_MDL\_ST$  and  $TCO\_ST$ .

$ID\_MAF\_KGH\_MIN\_EGY\_DEW\_NT$  is a curve versus the wall temperature  $TEG\_WALL\_NT\_DOWN\_MDL$  which describes the minimum mass air flow, that has to exceeded to trigger the incrementing of  $CTR\_EGY\_DEW\_NT$ .

$MAF\_KGH$  and of  $CTR\_EGY\_DEW\_NT$  are inputs for  $IP\_FAC\_EGY\_DEW\_END\_NT$  which will provide another factor for decreasing  $EGY\_DEW\_END\_NT$ .


**Formula section:**

$MAF\_KGH\_MIN\_EGY\_DEW\_NT = ID\_MAF\_KGH\_MIN\_EGY\_DEW\_NT$

**If**  $MAF\_KGH > MAF\_KGH\_MIN\_EGY\_DEW\_NT$   
**Then**  $CTR\_EGY\_DEW\_NT ++$  *% increment by 0.1*  
**Else**  $CTR\_EGY\_DEW\_NT = 0$  *% reset counter*


$FAC\_EGY\_DEW\_END\_NT = IP\_FAC\_EGY\_DEW\_END\_NT$   
 $FAC\_EGY\_DEW\_END\_NT\_TAM\_T\_ES = IP\_FAC\_EGY\_DEW\_END\_NT\_TAM\_T\_ES$

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$$\text{EGY\_DEW\_END\_NT\_TMP} = \text{MIN}\{ [(IP\_EGY\_DEW\_END\_NT * FAC\_EGY\_DEW\_END\_NT\_TAM\_T\_ES + EGY\_DEW\_NT\_STOP) * FAC\_EGY\_DEW\_END\_NT] ; IP\_EGY\_DEW\_NT\_MAX * FAC\_EGY\_DEW\_END\_NT \}$$

$$\text{EGY\_DEW\_END\_NT} = \text{MIN}(\text{EGY\_DEW\_END\_NT\_TMP} ; \text{EGY\_DEW\_END\_NT}_{(n-1)})$$

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## 7.100 NOx catalyst monolith temperature model (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TNT_MIN_COR_n	O/V	0... FFH	0... 1.99219	0.007812	-
Factor to reduce dew-point time of NOx cat. monolith temp. model					
TEG_PCAT_DOWN_ADD	O/V	8000... 7FFFH	-512 ...512	0.015625	°C
Temperature offset to correct the influence of the Exhaust flap and temp. sensor position					

### Input data:

LV_ES {p. 1720}	LV_ST {p. 1720}		
-----------------	-----------------	--	--

### 7.100.1 Additive correction of the input temperature TEG\_PCAT\_DOWN

#### FUNCTION DESCRIPTION:

For systems containing an exhaust flap a correction of the model input temperature TEG\_PCAT\_DOWN can be necessary.

#### Application conditions

**Activation:**

- engine state LV\_ST = 0
- engine state LV\_ES = 0

**Deactivation:** - engine state ES is active (LV\_ES = 1)

**Recurrence:** 100 ms

#### Formula section:

$$\text{TEG\_PCAT\_DOWN\_ADD} = 0$$

$$\begin{aligned} \text{FAC\_TNT\_MIN\_COR\_1} &= 1 && \% \text{ default value, no reduction of dew point time} \\ \text{FAC\_TNT\_MIN\_COR\_2} &= 1 && \% \text{ default value, no reduction of dew point time} \end{aligned}$$

## 7.101 NOx signal gain adaptation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_NS_AD_CYC [NC_NOX_SENS_CONF]	O/V/S	0... FFFFH	0... 65535	1	-
Counter of NOx signal gain adaptations					
DIST_NT_NS_AD [NC_NOX_SENS_CONF]	O/V/S	0... FFFFH	0... 524280	8	km
Current distance from last NOx signal gain adaptation					
FAC_NOX_NS_AD [NC_NOX_SENS_CONF]	O/V/S	0... FFFFH	0... 127.99804	1.9531e-3	-
Adaptation of the NOx sensor characteristic shift					
LV_NS_AD_REQ	O/V	0... 1H	0 ...1	1	-
Request for NOx signal gain adaptation					
STATE_OPM_REQ_NS_AD	O/V	0... FFFFH	0... 65535	1	-
Request for operation mode for executing of NOx sensor adaptation					

### Input data:

NC_NOX_SENS_CONF {p. 643}			
------------------------------	--	--	--

### Action definition

<b>ACTION_NOXD_CleanNSAdapt ()</b>	Mode: O
Initialization of NOx signal shift diagnosis variables	

<b>ACTION_NOXD_WriteNSGainDiagExtAdj ()</b>	Mode: O
Write external adjust values for NOx signal shift diagnosis	

### Description for Actions

<b>ACTION_NOXD_CleanNSAdapt()</b>
Initialization of NOx signal shift diagnosis variables

<b>ACTION_NOXD_WriteNSGainDiagExtAdj()</b>
Write external adjust values for NOx signal shift diagnosis


### FUNCTION DESCRIPTION:

#### General Information

Stub module for recourse optimization

#### Application Conditions

Initialization: at reset  
CTR\_NS\_AD\_CYC[i] = 0

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DIST\_NT\_NS\_AD[i] = 0  
FAC\_NOX\_NS\_AD[i] = 1  
LV\_NS\_AD\_REQ[i] = 0  
STATE\_OPM\_REQ\_NS\_AD[i] = 0

Recurrence:

Activation:

Deactivation:

### 7.101.1 Detailed description for Action: ACTION\_NOXD\_CleanNSAdapt


#### FUNCTION DESCRIPTION:

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### 7.101.2 Detailed description for Action: ACTION\_NOXD\_WriteNSGainDiagExtAdj

#### FUNCTION DESCRIPTION:

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## 7.102 NOx sensor setpoint shift diagnosis - lambda intervention

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAM_ADJ_NS_SHIFT_DIAG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag to switch trim control parameters for NS shift diagnosis					
VLS_DELTA_LAM_ADJ_NS_SHIFT [NC_CBK_EX_NR]	O/V	FC00... 3FFH	-5... 4.99511	4.8828e-3	V
Sensor voltage set point shift in case of NOx sensor shift diagnosis					
VLS_DELTA_TMP_NS_SHIFT [NC_CBK_EX_NR]	V	FC00... 3FFH	-5... 4.99511	4.8828e-3	V
Temporary sensor voltage set point shift for NOx sensor shift diagnosis					

### Input data:

LV_NS_SHIFT_CMB_INT_REQ {p. 6426}	NC_CBK_EX_NR {p. 1829}	OPM_REQ_CUS {p. 8137}	VLS_SP_LAM_ADJ [NC_CBK_EX_NR] {p. 2590}
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### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_NS_SHIFT_CMB_ACT	-	0... FFFFH	0... 65535	1	-
Check if combustion mode for NOx signal internal shift diagnosis is active (FFFFh means check is disabled)					
C_VLS_DELTA_LAM_NS_MAX [NC_CBK_EX_NR]	-	FC00... 3FFH	-5... 4.99511	4.8828e-3	V
Maximum offset for trim controller set-point for NOx sensor shift diagnosis					
C_VLS_DELTA_LAM_NS_MIN [NC_CBK_EX_NR]	-	FC00... 3FFH	-5... 4.99511	4.8828e-3	V
Minimum offset for trim controller set-point for NOx sensor shift diagnosis					
C_VLS_SP_NS_SHIFT [NC_CBK_EX_NR]	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Trim controller set-point for NOx sensor shift diagnosis					
LC_VLS_LAM_ADJ_NS_SHIFT [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Enable offset for trim control at NOx sensor shift diagnosis					

## FUNCTION DESCRIPTION:

### General information:


This module influences the trim control set-point during NOx sensor shift diagnosis by setting an offset to the actual value for the trim controller.

Calculation has to be done for each trim controller:  $i = 1 \dots NC\_CBK\_EX\_NR$

### Application conditions

**Recurrence:** 100 ms

**Activation:** - -

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## 7.103 NOx sensor function

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DIST_NS_NEW	O/V/S	0... FFFFH	0... 524280	8	km
mileage counter value of last exchange of NOx sensor					
FAC_NOX_NS_AD_GAIN [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 127.998047	0.00195313	-
Correction of the NOx sensor signal due to signal shift					
LV_NOX_OFS_LOAD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx minimum observation activation					
LV_T_NS_VLD	O/V	0... 1H	0 ...1	1	-
NOx sensor signal valid after regeneration					
LV_T_NS_VLD_TMP [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor signal valid after regeneration (bank selective)					
NOX_NS_AD [NC_NOX_SENS_CONF]	O/V	0... 5DCH	0... 1500	1	ppm
NOx concentration in the exhaust gas downstream of NOx catalyst					
NOX_NS_AD_ADD [NC_NOX_SENS_CONF]	O/V	FF9C... 5DCH	-100 ...1500	1	ppm
Offset adaptation value for the NOx signal					
NOX_NS_AD_DELTA [NC_NOX_SENS_CONF]	V	FA24... 5DCH	-1500 ...1500	1	ppm
NOx sensor signal gradient (bank selective)					
NOX_NS_AD_DELTA_MMV [NC_NOX_SENS_CONF]	V	FA24... 5DCH	-1500 ...1500	1	ppm
NOx sensor signal gradient moving mean value (bank selective)					
NOX_NS_OFS_AD_MIN [NC_NOX_SENS_CONF]	O/V	FF9C... 5DCH	-100 ...1500	1	ppm
Minimum NOx signal after LOAD phase					
NOX_OFS_LOAD [NC_NOX_SENS_CONF]	O/V/S	FF9C... 5DCH	-100 ...1500	1	ppm
NOx signal offset value, measured after start of a LOAD phase					
NOX_OFS_PUC [NC_NOX_SENS_CONF]	O/V/S	FF9C... 5DCH	-100 ...1500	1	ppm
NOx signal offset value, measured at PUC					
T_NOX_NS_AD_DELTA_VLD [NC_NOX_SENS_CONF]	V	0... FFH	0... 25.5	0.1	s
Timer for NOx sensor signal valid regarding gradient observation					

### Input data:

CTR_NT_AGI_AD_CMLP_ SUM {p. 3072}	DIST_NS_NEW_EXT_ADJ {p. 7679}	DIST_NT {p. 3180}	FAC_NOX_NS_AD [NC_NOX_SENS_CONF] {p. 3189}
LV_NOX_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_NOX_SENS {p. 2982}	LV_NT_HOM_INI {p. 2982}	LV_PUC {p. 1720}
MAF_INT_PUC_ACT {p. 2942}	NC_NOX_SENS_CONF {p. 643}	NC_NT_NR {p. 644}	NOX_NS [NC_NOX_SENS_CONF] {p. 992}

NOX_NS_DIAG [NC_NOX_SENS_CONF] {p. 992}	NT_AGI {p. 3073}	NT_AGI_SUL {p. 3073}	NT_SUL {p. 3113}
RATIO_MMV_NS_SHIFT_DIAG [NC_NOX_SENS_CONF] {p. 6412}	STATE_NOX {p. 2986}	T_AFL {p. 2987}	T_AFL_PUC {p. 2987}
T_NOX_NS_MDL [NC_NOX_SENS_CONF] {p. 992}	T_NOX_NS_OSC [NC_NOX_SENS_CONF] {p. 1381}	TNT_MDL_H {p. 8237}	TNT_MDL_L {p. 8237}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_NOX_NS_AD_DELTA	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
Correlation factor to calculate moving mean value of the NOx sensor signal gradient					
C_CRLC_NOX_OFS_PUC	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
Correlation constant for calculation of PUC offset value					
C_CTR_NT_AGI_AD_CMPL_SUM_AD_MIN	-	0... FFFFH	0... 65535	1	-
Minimum completed sulphur adaptations for set free of NOx signal offset adaptation					
C_FAC_NOX_NS_AD_MAX	-	0... FFFFH	0... 127.998047	0.00195313	-
Maximal allowed correction of characteristic shift down of NOx signal					
C_FAC_NOX_NS_AD_MIN	-	0... FFFFH	0... 127.998047	0.00195313	-
Minimal allowed correction of characteristic shift down of NOx signal					
C_MAF_INT_PUC_MIN_NOX	-	0... FFFFH	0... 2912.67	0.04444444	g
Minimum air mass flow threshold for starting the NOx signal offset adaptation at PUC					
C_NOX_AD_ADD_MAX	-	FF9C... 5DCH	-100 ...1500	1	ppm
Maximum limit of NOx signal offset adaptation value					
C_NOX_AD_ADD_MIN	-	FF9C... 5DCH	-100 ...1500	1	ppm
Minimum limit of NOx signal offset adaptation value					
C_NOX_ADD_ZERO_MAX	-	FF9C... 5DCH	-100 ...1500	1	ppm
Upper NOx signal offset adaptation value threshold to set the adaptation value to 0					
C_NOX_ADD_ZERO_MIN	-	FF9C... 5DCH	-100 ...1500	1	ppm
Lower NOx signal offset adaptation value threshold to set the adaptation value to 0					
C_NOX_NS_AD_ADD [NC_NOX_SENS_CONF]	-	FF9C... 5DCH	-100 ...1500	1	ppm
Manual NOx signal offset					
C_NOX_NS_AD_DELTA_MMV_MAX	-	FA24... 5DCH	-1500 ...1500	1	ppm
Maximum allowed NOx sensor signal gradient					
C_NOX_NS_AD_DELTA_MMV_MIN	-	FA24... 5DCH	-1500 ...1500	1	ppm
Minimum allowed NOx sensor signal gradient					
C_NOX_NS_AD_MAX_SENS_VLD	-	0... 5DCH	0... 1500	1	ppm
Maximum NOx sensor signal to enable gradient observation					
C_NOX_OFS_PUC_MAX	-	FF9C... 5DCH	-100 ...1500	1	ppm
Maximum NOx signal offset value at PUC phase					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NOX_OFS_SEL	-	0H 1H 2H 3H	PUC_OFFSET LOAD_ OFFSET MIN_OFFSET MAN_OFFSET	-	-
Selection of a NOx signal adaptation method					
C_NT_AGI_NOX_OFS_MIN	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx catalyst aging threshold for calculation of a new NOx signal offset value					
C_NT_AGI_SUL_NOX_OFS_AD_MIN	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
Minimum NOx catalyst aging factor due to sulphur for set free of NOx signal offset adaptation					
C_NT_HOM_INI_USE	-	0... 3H	0 ...3	1	-
Configuration of adaptation function					
C_NT_SUL_NOX_OFS_AD_MAX	-	0... FFFFH	0... 10485.6	0.16	mg
Maximum NOx catalyst sulphur load for set free of NOx signal offset adaptation					
C_T_AFL_NOX_OFS_MIN	-	0... FFFFH	0... 1310.7	0.02	s
Min. lean time for calculation of NOx signal offset adaptation value					
C_T_NOX_NS_AD_DELTA_MIN	-	0... FFH	0... 25.5	0.1	s
Minimum time for set NOx-Sensor signal to valid regarding NOx-Signal gradient observation					
C_T_NOX_NS_OFS	-	0... FFFFH	0... 655.35	0.01	s
Min. NOx signal time for enable of NOx signal offset adaptation					
C_T_NOX_NS_OFS_PUC	-	0... FFFFH	0... 655.35	0.01	s
Minimum time NOx-Signal is valid for enable of NOx signal offset adaptation in PUC phase					
C_T_NOX_NS_OSC_OFS	-	0... FFFFH	0... 655.35	0.01	s
Waiting time after last detection of an oscillation of NOx signal for offset adaptation					
C_T_NS_VLD	-	0... FFFFH	0... 1310.7	0.02	s
Minimum lean time to set NOx sensor signal to valid					
C_T_NS_VLD_PUC	-	0... FFFFH	0... 1310.7	0.02	s
Minimum PUC time to set NOx sensor signal to valid					
C_TNT_MDL_NOX_OFS_MAX	-	0... FFFFH	0... 1023.98	0.015625	°C
Maximum temperature of NOx catalyst, at which the NOx signal offset adaptation at LOAD is active					
C_TNT_MDL_NOX_OFS_MIN	-	0... FFFFH	0... 1023.98	0.015625	°C
Minimum temperature of NOx catalyst, at which the NOx signal offset adaptation at LOAD is active					
IP_CRLC_NOX_OFS_LOAD	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
LDP_NOX_NS_OFS_AD_MIN_IP_LOAD	4	0... 640H	-100 ...1500	1	ppm
Correlation constant for calculation of LOAD offset value					
IP_FAC_NOX_NS_AD_COR	-	0... FFFFH	0... 127.998047	0.00195313	-
LDP_NOX_NS_AD_IP_FAC_COR	6	0... 5DCH	0... 1500	1	ppm
LDP_FAC_NOX_NS_AD_IP_FAC_NOX	6	0... FFFFH	0... 127.998047	0.00195313	-
Correction of gain adaptation factor due to non-linearity of the characteristic shift down					
IP_FAC_RATIO_NS_SHIFT_COR	-	0... FFFFH	0... 127.998047	0.00195313	-
LDP_RATIO_NS_SHIFT_IP_FAC_COR	6	0... FFFFH	-1... 0.99996948	30.5175e-6	-
NOx signal correction factor depending on RATIO					

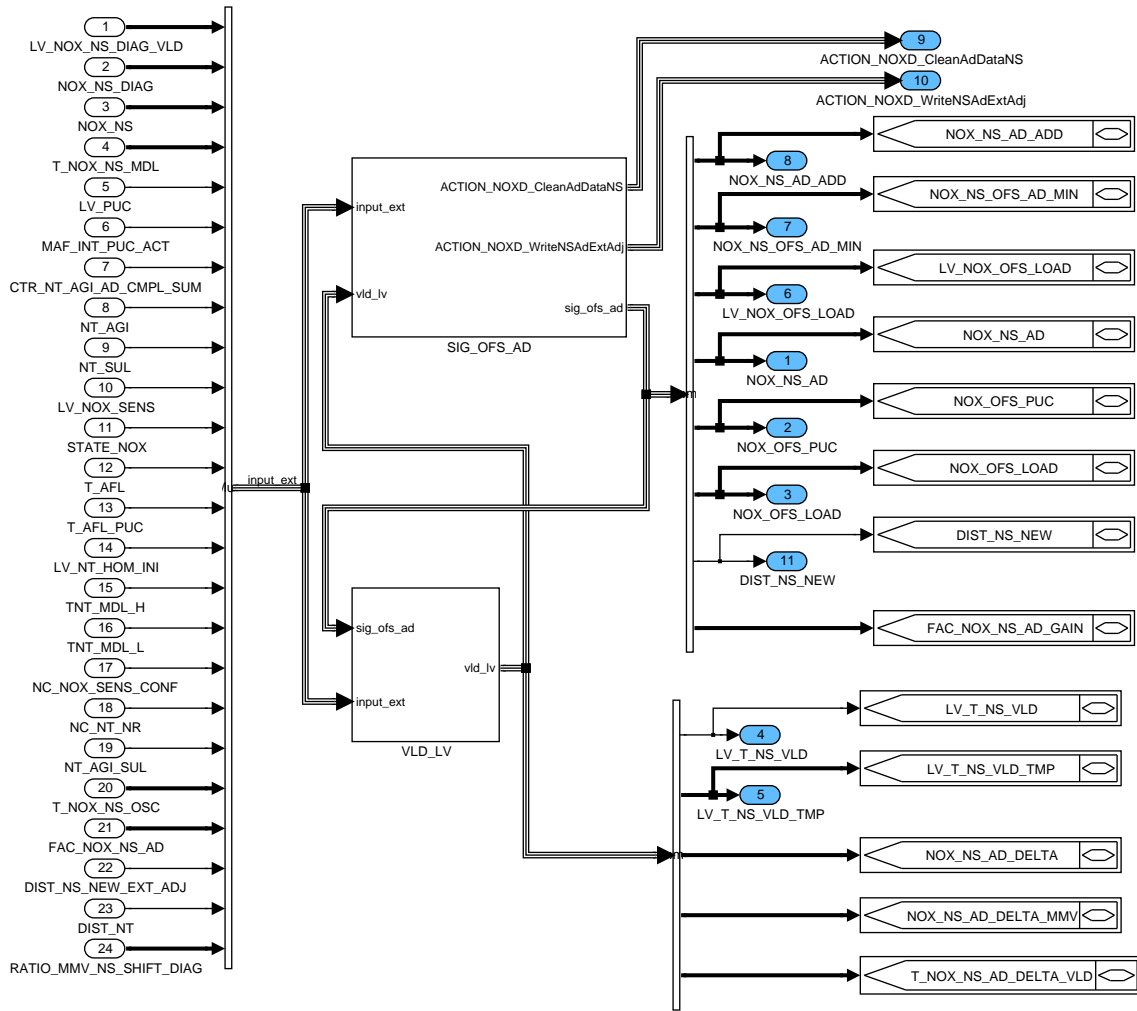
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_NOX_NS_OFS_VLD_ON	-	0... 1H	0 ...1	1	-
Valid NOx-Sensor signal is necessary for this offset adaptation (on/off)					

**Action definition**

<b>ACTION_NOXD_CleanAdDataNS (OUT&lt;trig_CLR_AD&gt;)</b>	Mode: O
Clean adaptation data of NOx Sensor	

<b>ACTION_NOXD_WriteNSAdExtAdj (OUT&lt;trig_EXT_ADJ&gt;)</b>	Mode: O
Write external adjust values for NOx Sensor	

**Overview**



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Figure 7.103.1: NOXD\_MDLADNSFCN0

### 7.103.1 NOx signal offset adaptation

NOx signal offset adaptation can be done at PUC phase. At PUC phase NOx signal is influenced by the humidity cross-sensitivity of NOx-Sensor. The NOx signal is a combination out of signal offset and humidity cross-sensitivity.

Another possibility for NOx signal offset adaptation is after the start of a new NOx catalyst LOAD phase. At this time the NOx catalyst stores the NOx so that the NOx emissions are nearly to 0 [ppm]. Hence the NOx signal is dominated by signal offset. Attention! After an incompletely NOx regeneration or when the NOx catalyst has got a high sulphur load this offset adaptation must be inhibited.

This NOx signal offset adaptation calculates all offset values. Which offset value is used for the NOx signal offset adaptation, is possible to calibrate.

The NOx signal  $NOX\_NS\_i$  is compared with  $C\_NOX\_OFS\_PUC\_MAX$  before a new adaptation value ( $NOX\_OFS\_PUC\_i$ ) is calculated. This check is for prevention of adaptation failures.

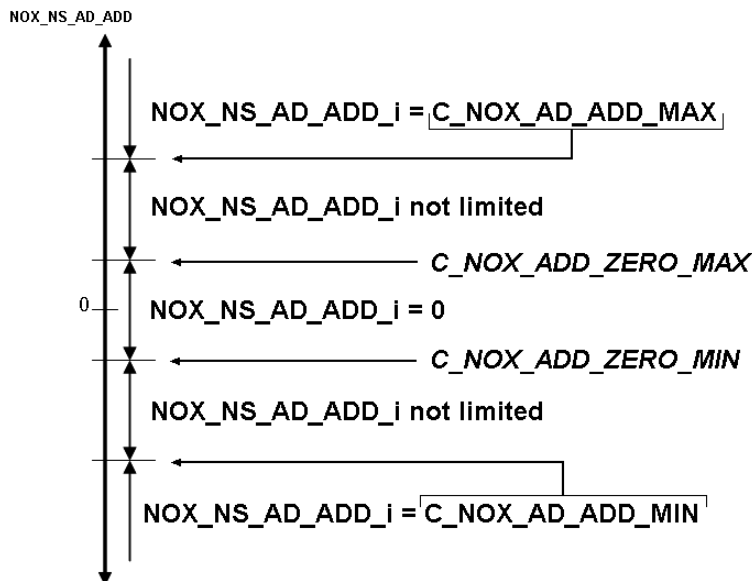
$C\_NOX\_OFS\_PUC\_MAX$  is the sum of the maximum humidity cross-sensitivity and the maximum positive NOx signal offset according to the sensor specification.

The calibration constant  $C\_NT\_HOM\_INI\_USE$  is used for independent configuration of offset calculation at PUC and of offset calculation after start of LOAD phase .

C_NT_HOM_INI_USE	Description
Bit B0	The offset calculation at PUC considers LV_NT_HOM_INI at offset determination (1...on/ 0...off).
Bit B1	The offset calculation after start of "LOAD" phase considers LV_NT_HOM_INI at offset determination (1...on/ 0...off).
Bit B2	not used
Bit B3	not used
Bit B4	not used
Bit B5	not used
Bit B6	not used
Bit B7	not used

The final NOx signal offset adaptation value  $NOX\_NS\_AD\_ADD\_i$  arises out of PUC offset value ( $NOX\_OFS\_PUC\_i$ ), LOAD offset value ( $NOX\_OFS\_LOAD\_i$ ) or manual offset value ( $C\_NOX\_NS\_AD\_ADD\_i$ ). The used value is selected by  $C\_NOX\_OFS\_SEL$ .

After the calculation of  $NOX\_NS\_AD\_ADD\_i$  it is limited (see below).



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Setting NOX\_NS\_AD\_ADD\_i to 0 within the gap  $C\_NOX\_ADD\_ZERO\_MIN < NOX\_NS\_AD\_ADD\_i < C\_NOX\_ADD\_ZERO\_MAX$  was implemented in order to switch off the NOx signal offset adaptation if the calculated offset value is within the specified NOx signal tolerance (see NOx-Sensor specification). NOX\_NS\_AD\_i is the measured signal which is corrected by the signal offset NOX\_NS\_AD\_ADD\_i. The calculation of NOX\_NS\_AD\_i is done with a recurrence, which is in accordance with the NOx catalyst regeneration request calculation.

Additional information:

Suffix "\_cur" is an abbreviation of current and means that the value is calculated in the same recurrence not first time.

Suffix "\_old" means that this value is calculated last time in previous recurrence.

### Application Condition

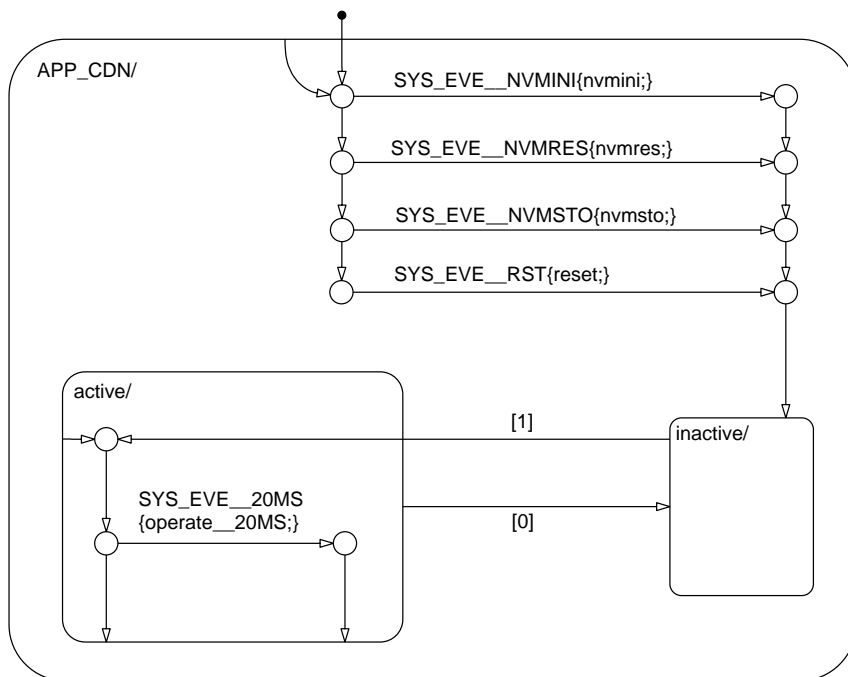


Figure 7.103.2: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/APP\_CDN/Chart

### Function Description

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 3198 of 8404</b>	
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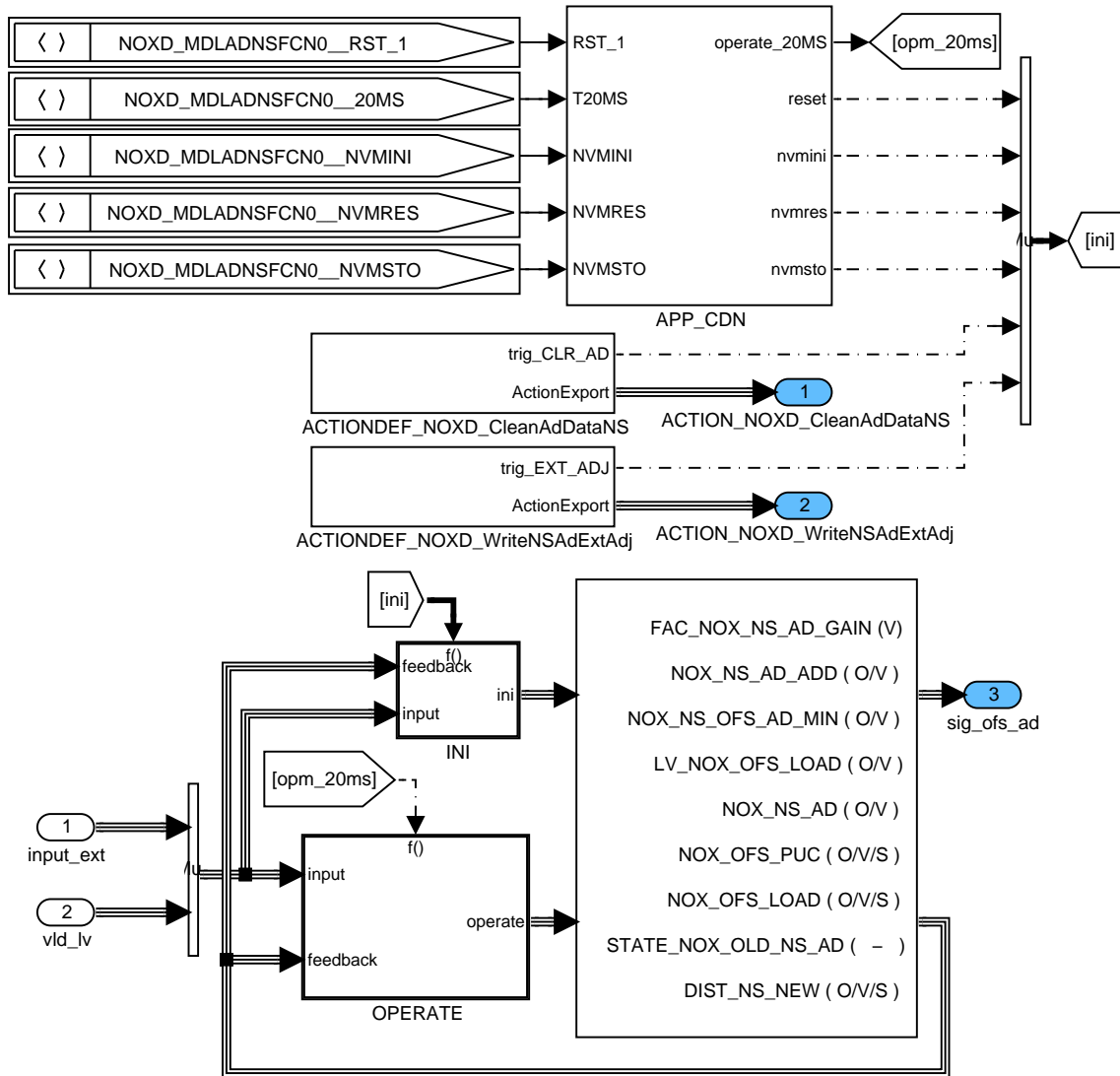


Figure 7.103.3: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD

### 7.103.1.1 SUBFUNCTION: ACTIONDEF\_NOXD\_CleanAdDataNS

#### Description for ACTION\_NOXD\_CleanAdDataNS

ACTION_NOXD_CleanAdDataNS(OUT <trig_CLR_AD>)					
Clean adaptation data of NOx Sensor					
Parameter	Type	Hex. limits	Phys. limits	Resol.	Unit
trig_CLR_AD					

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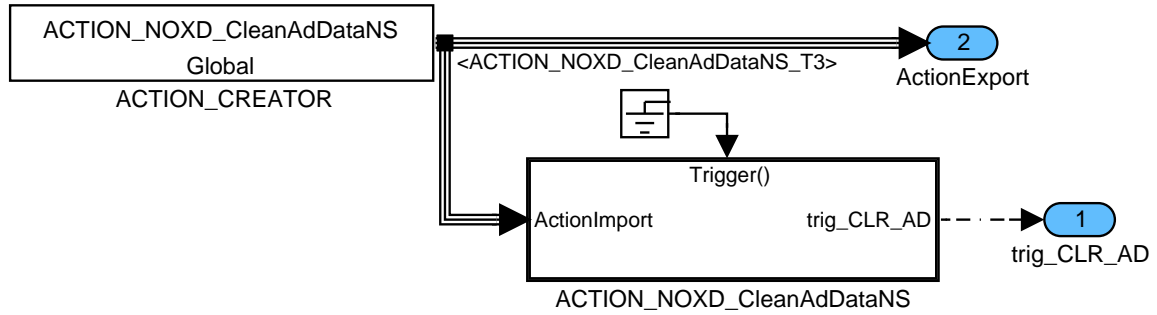


Figure 7.103.4: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/ACTIONDEF\_NOXD\_CleanAdDataNS

**ACTION\_NOXD\_CLEANADDATANS**

This action generates a function call to clear adaptation values.



Figure 7.103.5: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/ACTIONDEF\_NOXD\_CleanAdDataNS/  
ACTION\_NOXD\_CleanAdDataNS

**7.103.1.2 SUBFUNCTION: ACTIONDEF\_NOXD\_WriteNSAdExtAdj**

**Description for ACTION\_NOXD\_WriteNSAdExtAdj**

ACTION_NOXD_WriteNSAdExtAdj(OUT <trig_EXT_ADJ>)					
Write external adjust values for NOx Sensor					
Parameter	Type	Hex. limits	Phys. limits	Resol.	Unit
trig_EXT_ADJ					

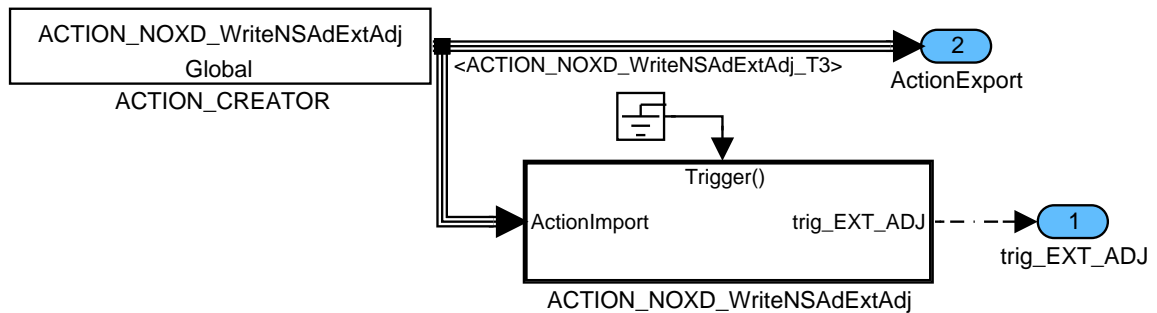


Figure 7.103.6: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/ACTIONDEF\_NOXD\_WriteNSAdExtAdj

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### ACTION\_NOXD\_WRITENSADEXTADJ

This action generates a function call to set adaptation values by external values.

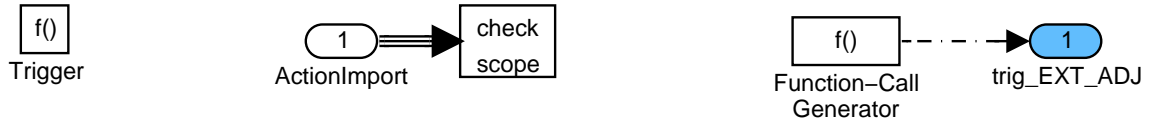


Figure 7.103.7: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/ACTIONDEF\_NOXD\_WriteNSAdExtAdj/  
ACTION\_NOXD\_WriteNSAdExtAdj

### 7.103.1.3 INITIALIZATION

At reset all variables except NVMY data are initialized with "0"

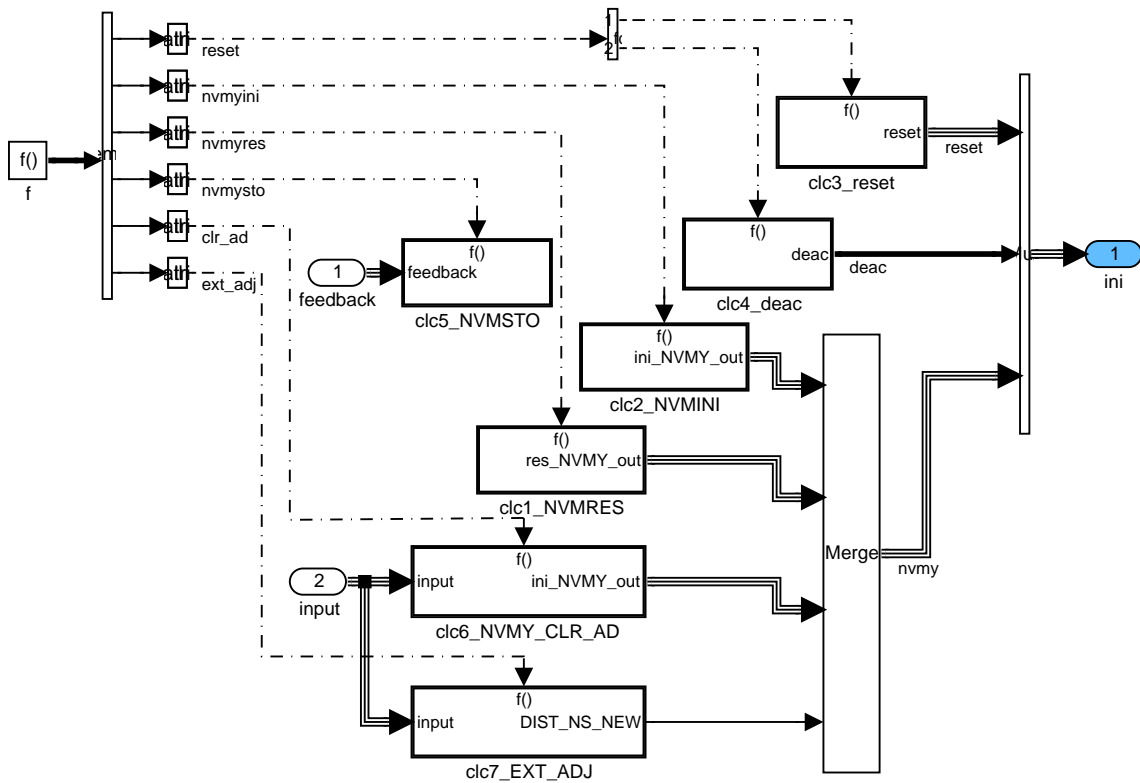



Figure 7.103.8: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/INI

### Initialization of NVMY data

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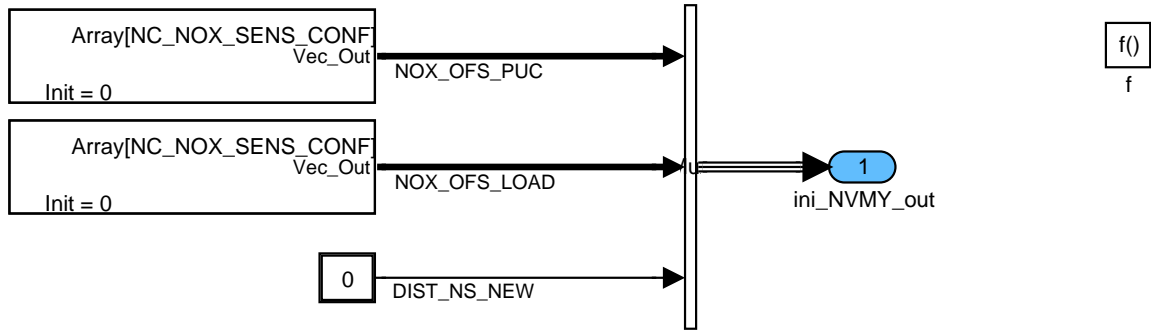


Figure 7.103.9: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/INI/clc2\_NVMINI

**Initialization at deactivation**

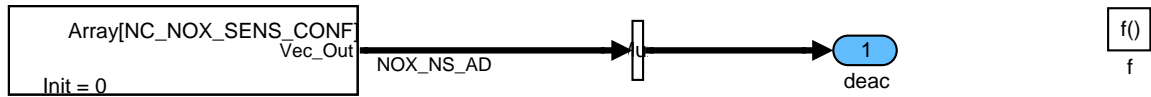


Figure 7.103.10: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/INI/clc4\_deac

**Initialization if new sensor was built-in**

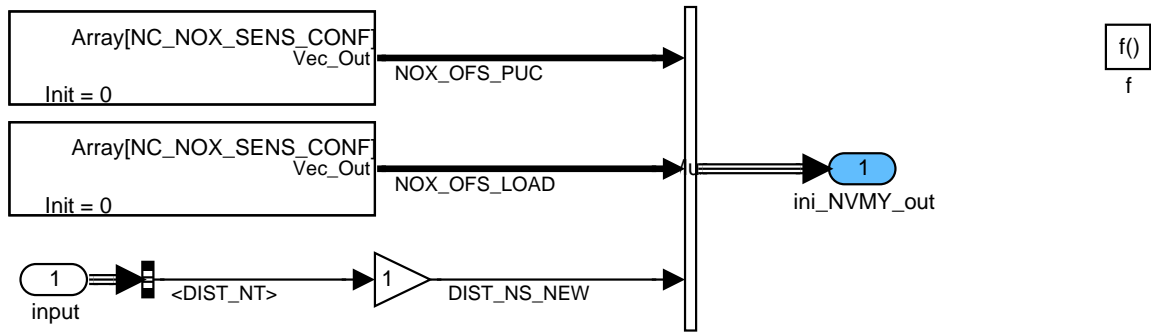


Figure 7.103.11: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/INI/clc6\_NVMY\_CLR\_AD

**Initialization at external adjust**

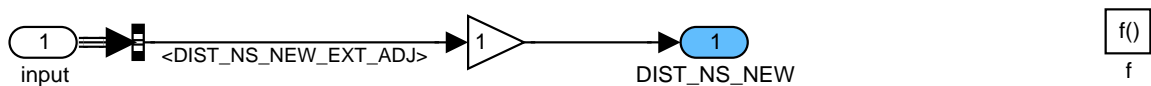


Figure 7.103.12: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/INI/clc7\_EXT\_ADJ

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### 7.103.1.4 FORMULA SECTION

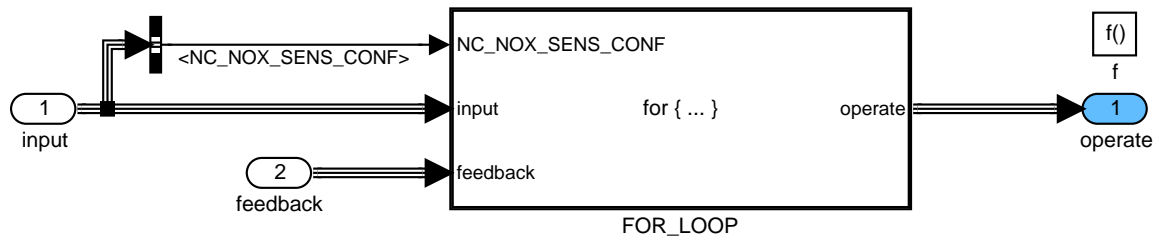


Figure 7.103.13: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/OPERATE

#### For loop realization

For loop is realized using number of NOx Sensors (NC\_NOX\_SENS\_CONF). The index for NOx Specific variables is "i".

#### Formula section for NOx Sensor specific calculations

Formula section contains:

- SECTION 1: Offset value calculation
- SECTION 2: Case selection for finally adaptation value calculation
- SECTION 3: Limitation of chose adaptation value
- SECTION 4: Realization of adaptation on measured signal


#### SECTION 1: Offset value calculation

This section contains:

- SECTION 1.1: Offset calculation at PUC phase
- SECTION 1.2: Offset calculation at LOAD phase

#### SECTION 1.1: Offset calculation at PUC phase

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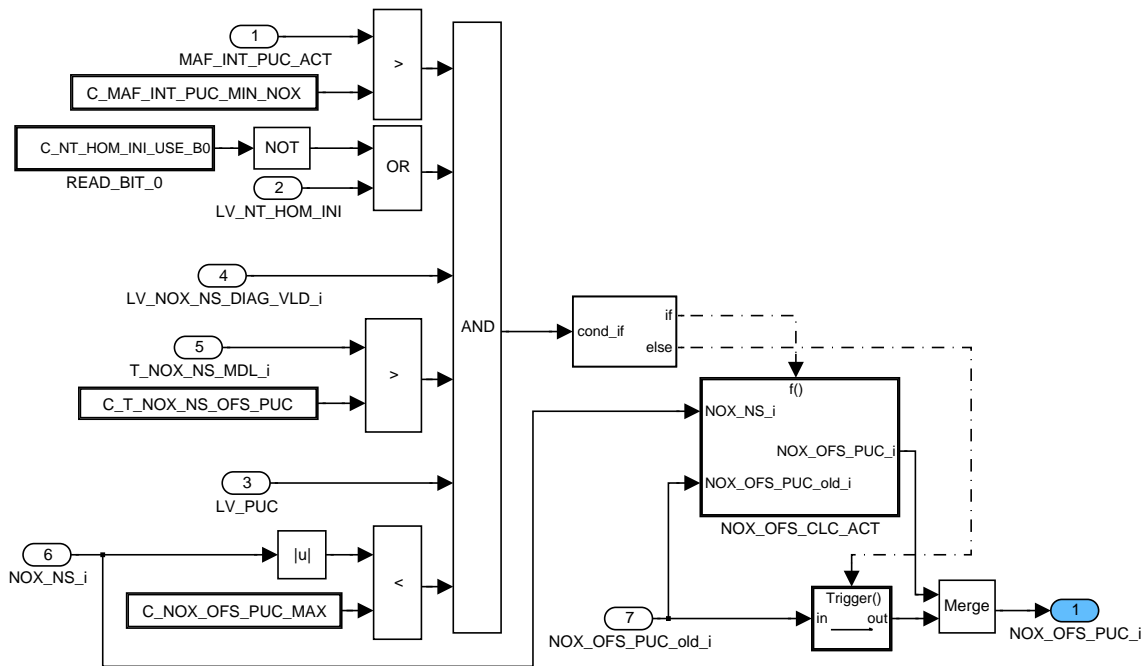


Figure 7.103.14: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/OPERATE/FOR\_LOOP/NS\_SPC\_FCN/CLC1\_OFS/CLC1\_NOX\_OFS\_PUC

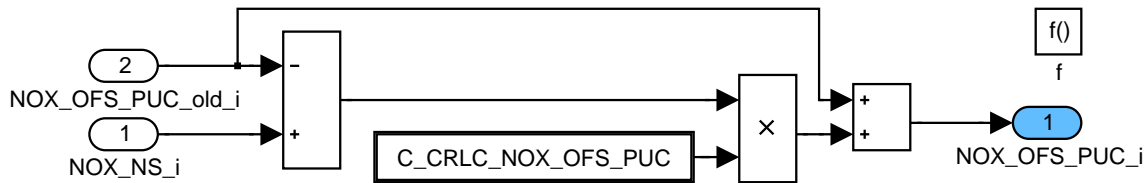


Figure 7.103.15: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/OPERATE/FOR\_LOOP/NS\_SPC\_FCN/CLC1\_OFS/CLC1\_NOX\_OFS\_PUC/NOX\_OFS\_CLC\_ACT

**SECTION 1.2: Offset calculation at LOAD phase**

This section contains:

- SECTION 1.2.1: Activation of NOx minimum observation
- SECTION 1.2.2: Calculation of NOx sensor signal minimum value
- SECTION 1.2.3: Calculation of offset value after left of LOAD phase
- SECTION 1.2.4: Reset of activation flag for NOx signal minimum observation
- SECTION 1.2.5: Calculation of old values

**SECTION 1.2.1: Activation of NOx minimum observation**

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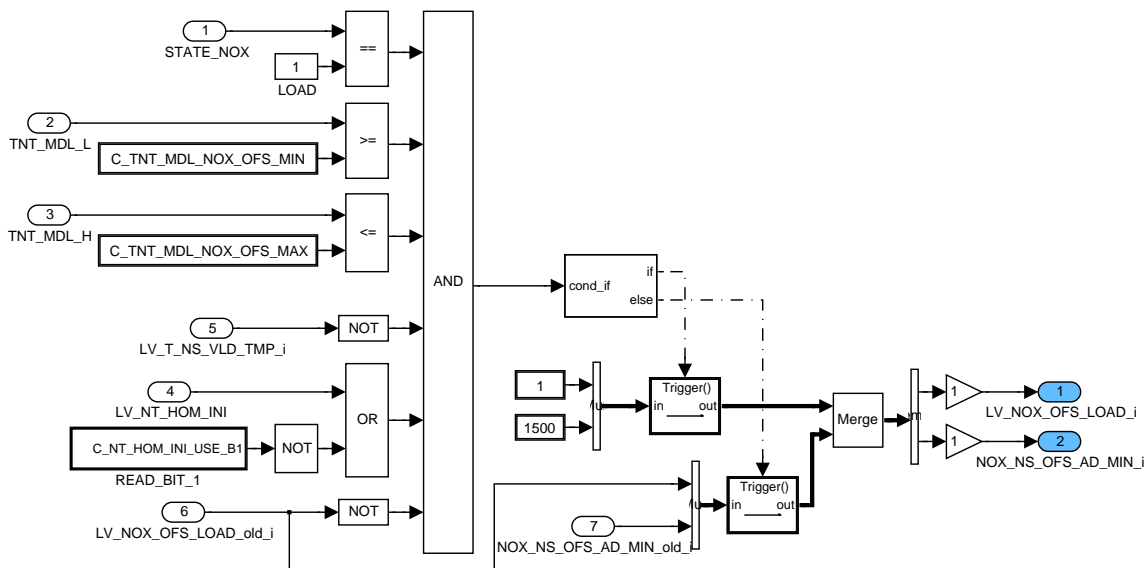


Figure 7.103.16: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/OPERATE/FOR\_LOOP/NS\_SPC\_FCN/CLC1\_OFS/CLC2\_NOX\_OFS\_LOAD/CLC1\_DIAG\_MIN\_OBS\_ACT

**SECTION 1.2.2: Calculation of NOx sensor signal minimum value**

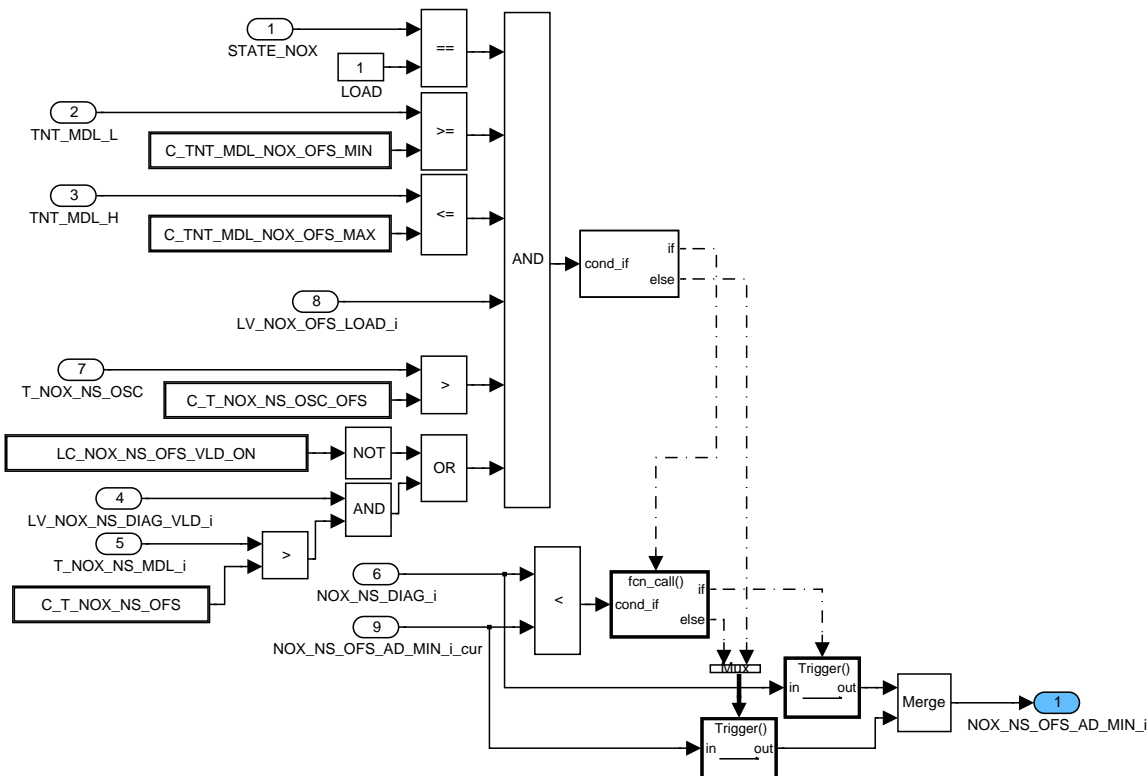


Figure 7.103.17: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/OPERATE/FOR\_LOOP/NS\_SPC\_FCN/CLC1\_OFS/CLC2\_NOX\_OFS\_LOAD/CLC2\_NS\_DIAG\_MIN

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**SECTION 1.2.3: Calculation of offset value after left of LOAD phase**

**Calculation of activation condition for calculation**

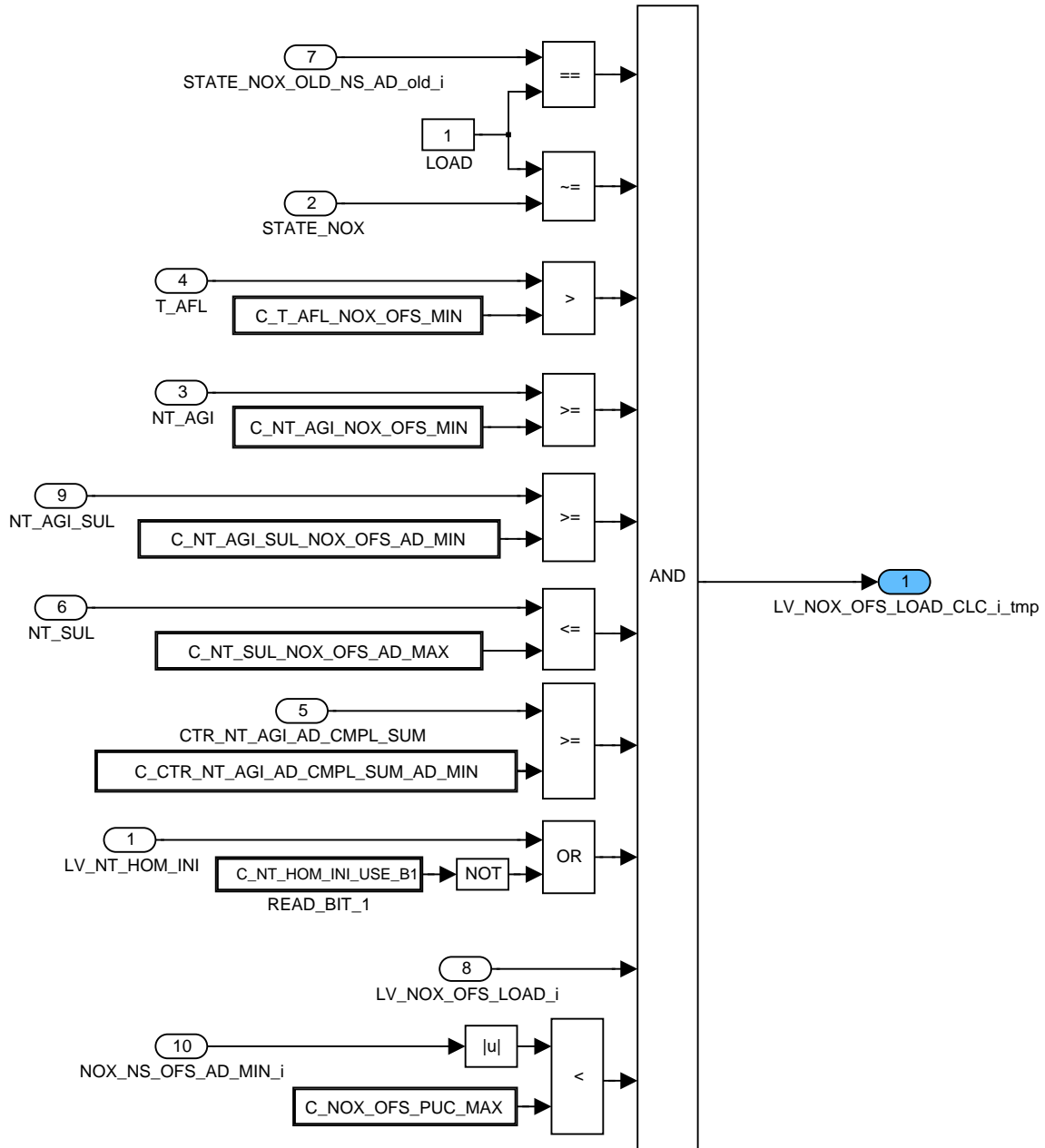


Figure 7.103.18: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/OPERATE/FOR\_LOOP/NS\_SPC\_FCN/CLC1\_OFS/CLC2\_NOX\_OFS\_LOAD/CLC3\_NOX\_OFS\_LOAD/CLC1\_LV\_ACT

**Check of activation condition**

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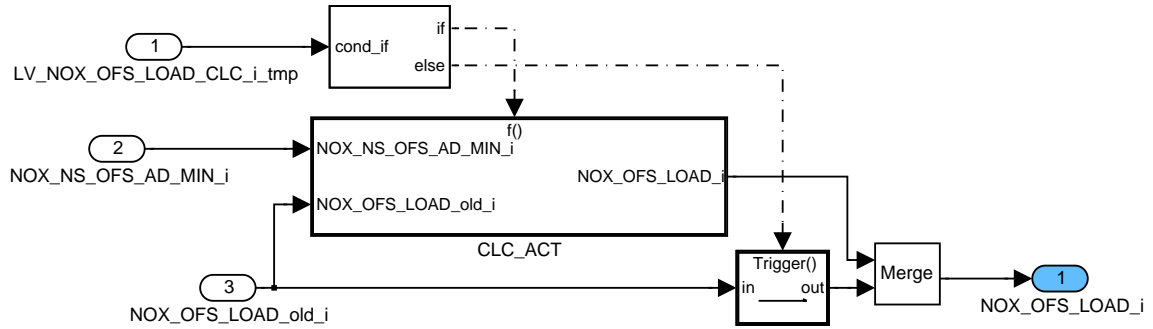


Figure 7.103.19: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/OPERATE/FOR\_LOOP/NS\_SPC\_FCN/CLC1\_OFS/CLC2\_NOX\_OFS\_LOAD/CLC3\_NOX\_OFS\_LOAD/CLC2\_NOX\_OFS\_LOAD

**Calculation if the activation condition is fulfilled**

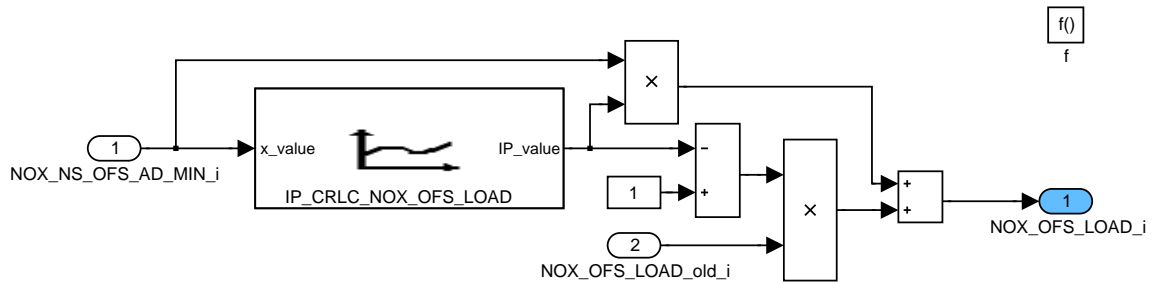
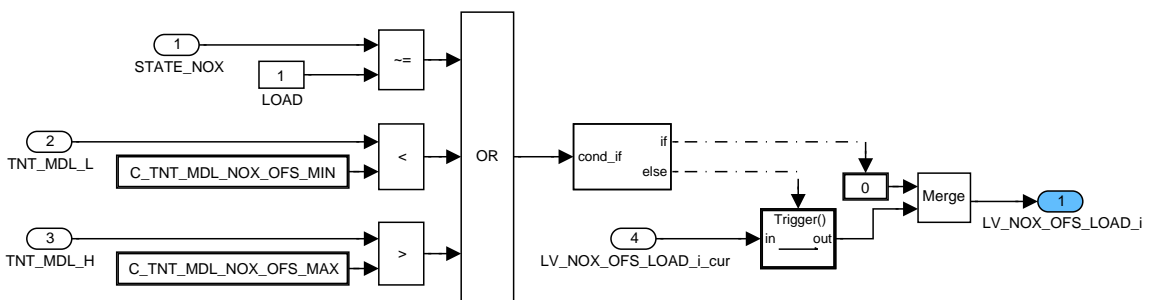


Figure 7.103.20: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/OPERATE/FOR\_LOOP/NS\_SPC\_FCN/CLC1\_OFS/CLC2\_NOX\_OFS\_LOAD/CLC3\_NOX\_OFS\_LOAD/CLC2\_NOX\_OFS\_LOAD/CLC\_ACT

**SECTION 1.2.4: Reset of activation flag for NOx signal minimum observation**



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Figure 21 NOXD\_MDLADNSFCN0/ SIG\_OFS\_AD/ OPERATE/ FOR\_LOOP/ NS\_SPC\_FCN/ CLC1\_OFS/ CLC2\_NOX\_OFS\_LOAD/ CLC4\_LV\_NOX\_OFS\_LOAD

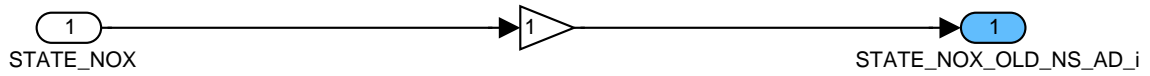


Figure 7.103.21: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/OPERATE/FOR\_LOOP/NS\_SPC\_FCN/ CLC1\_OFS/CLC2\_NOX\_OFS\_LOAD/CLC5\_STATE\_NOX\_OLD\_NS\_AD

**SECTION 2: Case selection for finally adaptation value calculation**

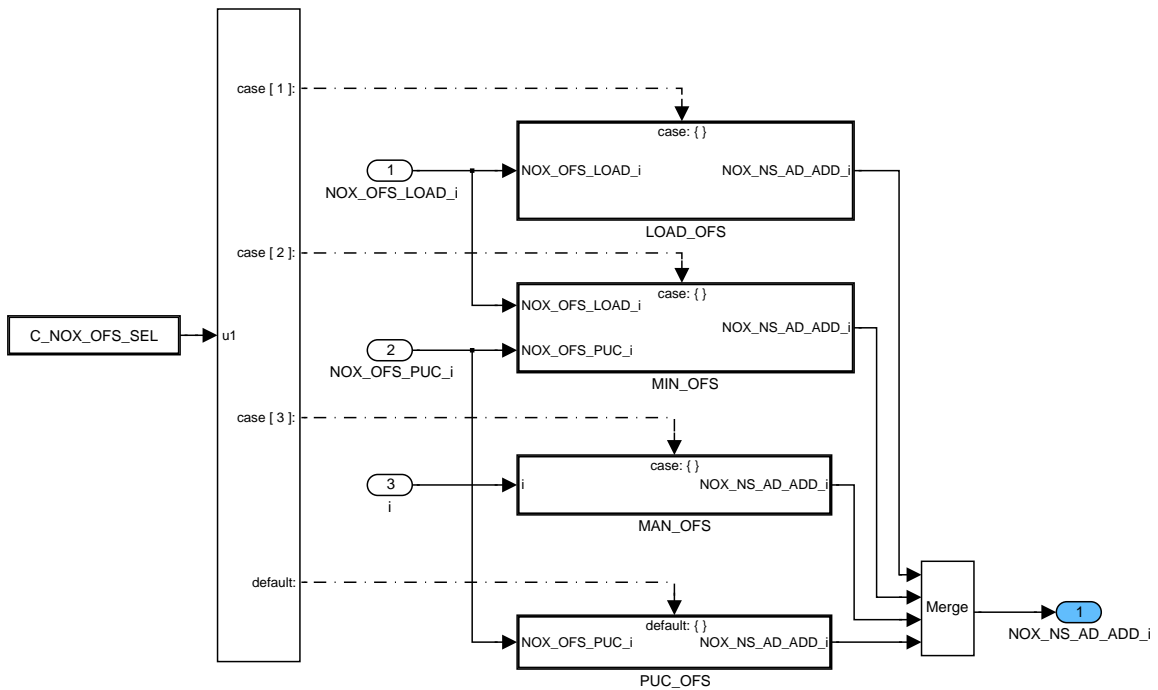


Figure 7.103.22: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/OPERATE/FOR\_LOOP/NS\_SPC\_FCN/ CLC2\_ADD\_VALUE/CLC1\_NOX\_AD\_ADD

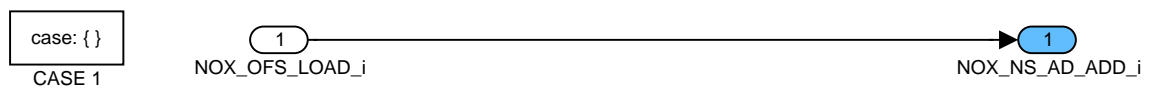


Figure 7.103.23: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/OPERATE/FOR\_LOOP/NS\_SPC\_FCN/ CLC2\_ADD\_VALUE/CLC1\_NOX\_AD\_ADD/LOAD\_OFS

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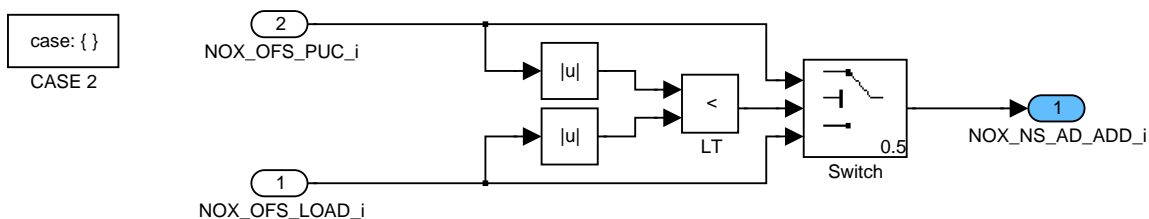


Figure 7.103.24: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/OPERATE/FOR\_LOOP/NS\_SPC\_FCN/CLC2\_ADD\_VALUE/CLC1\_NOX\_AD\_ADD/MIN\_OFS

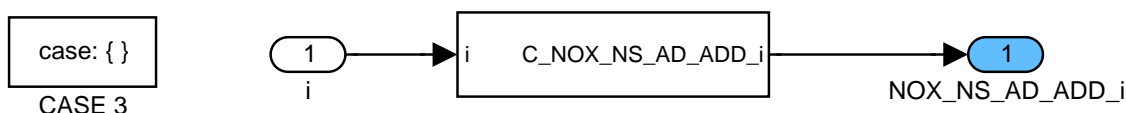


Figure 7.103.25: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/OPERATE/FOR\_LOOP/NS\_SPC\_FCN/CLC2\_ADD\_VALUE/CLC1\_NOX\_AD\_ADD/MAN\_OFS

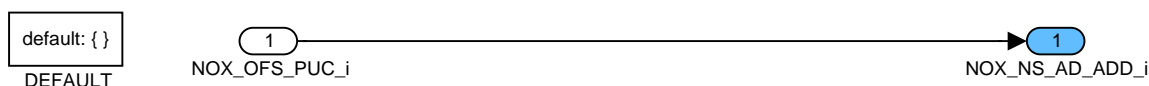


Figure 7.103.26: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/OPERATE/FOR\_LOOP/NS\_SPC\_FCN/CLC2\_ADD\_VALUE/CLC1\_NOX\_AD\_ADD/PUC\_OFS

**SECTION 3: Limitation of chosen adaptation value**

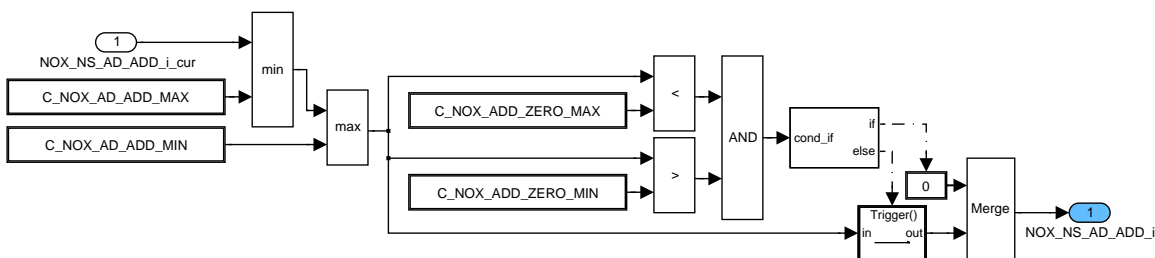


Figure 7.103.27: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/OPERATE/FOR\_LOOP/NS\_SPC\_FCN/CLC3\_ADD\_VALUE\_LIM/NOX\_ADAPT\_CLC

**SECTION 4: Realization of adaptation on measured signal**

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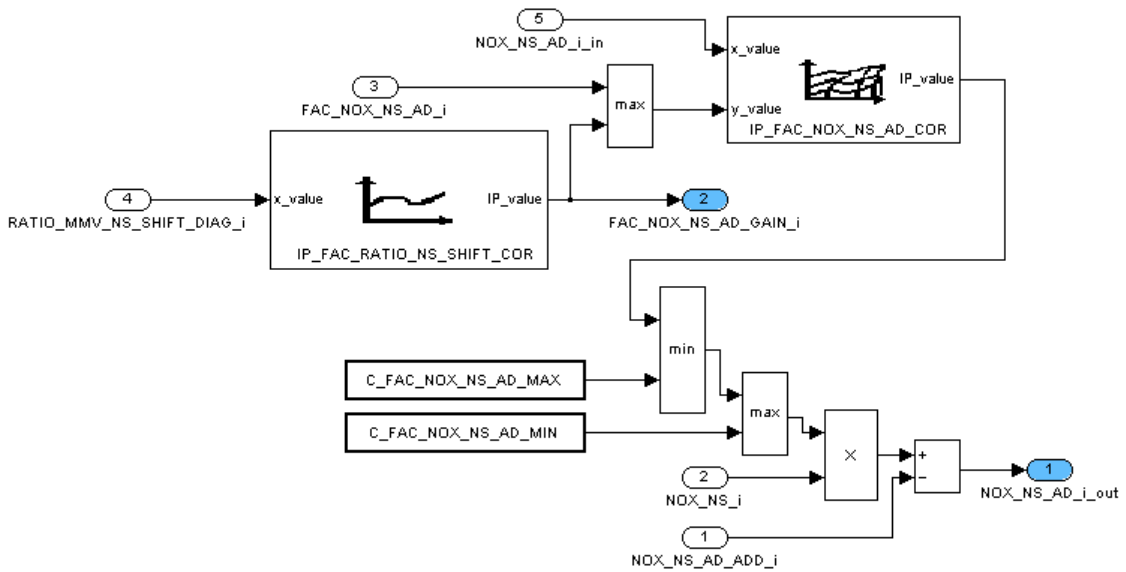


Figure 7.103.28: NOXD\_MDLADNSFCN0/SIG\_OFS\_AD/OPERATE/FOR\_LOOP/NS\_SPC\_FCN/CLC4\_FINAL\_ADD/CLC1\_NOX\_NS\_AD

### 7.103.2 NOx sensor valid flag after regeneration

After regeneration it is prohibited to generate a new regeneration request by the NOx sensor ( $LV\_RGN\_REQ\_NOX\_SENS\_i = 1$ ) if the signal is not valid. This can be triggered by observation of the signal gradient or the time  $C\_T\_NOX\_SENS\_VLD$ . The gradient has to be permanently within a certain range for a continuous time. The time  $C\_T\_NOX\_SENS\_VLD$  is controlled by the timer  $T\_AFL$ .  $T\_AFL$  has to exceed  $C\_T\_NOX\_SENS\_VLD$  before regeneration can be requested by the NOx sensor.

#### Application Condition

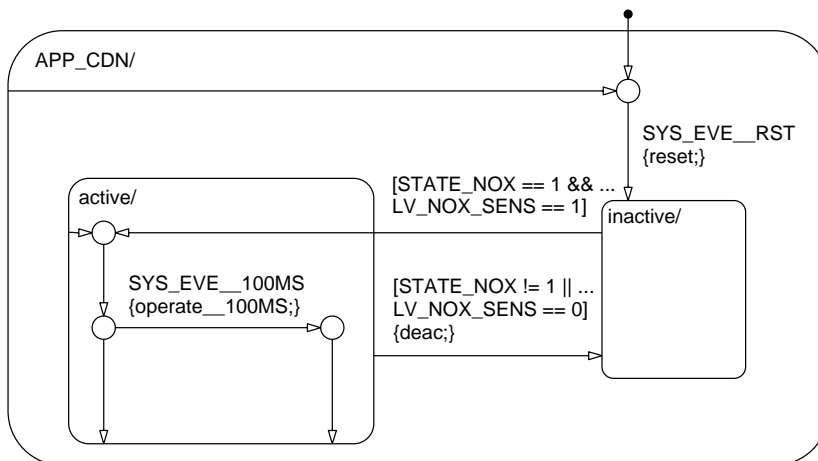


Figure 7.103.29: NOXD\_MDLADNSFCN0/VLD\_LV/APP\_CDN/Chart

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 3210 of 8404</b>	
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### Function Description

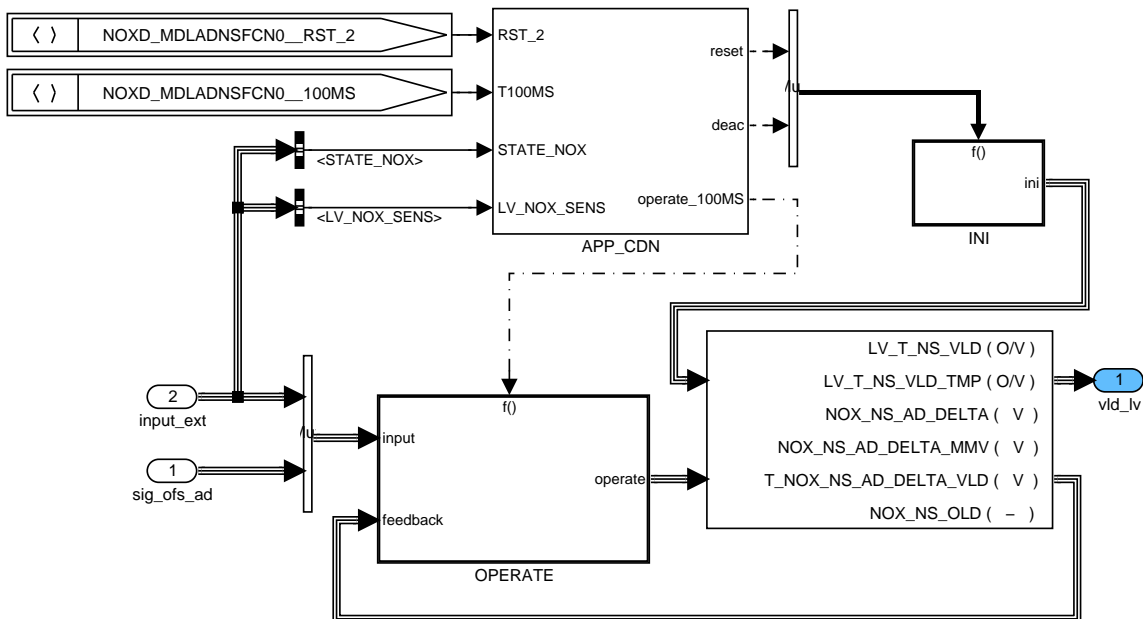


Figure 7.103.30: NOXD\_MDLADNSFCN0/VLD\_LV

#### 7.103.2.1 INITIALIZATION

At reset all variables are initialized with "0"

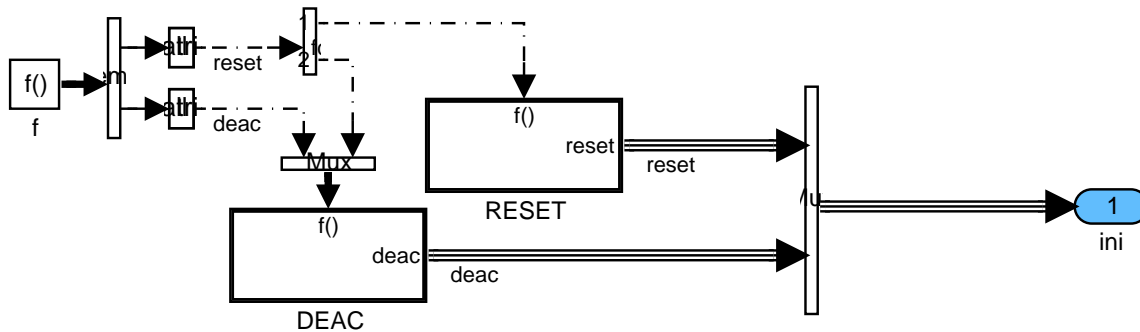


Figure 7.103.31: NOXD\_MDLADNSFCN0/VLD\_LV/INI

#### Initialization at deactivation

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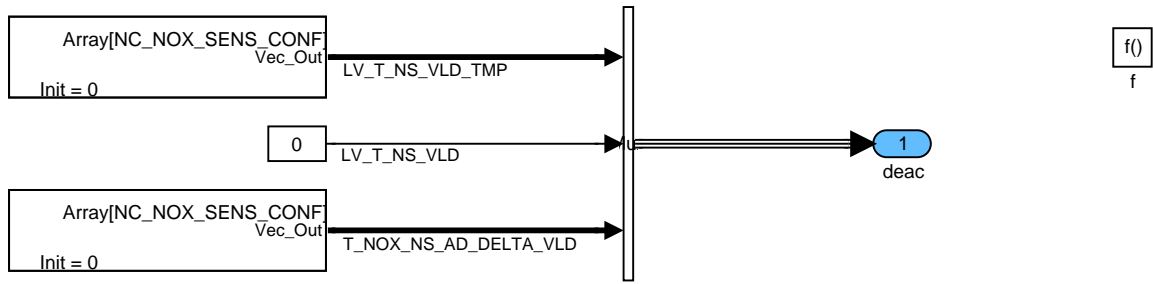


Figure 7.103.32: NOXD\_MDLADNSFCN0/VLD\_LV/INI/DEAC

### 7.103.2.2 FORMULA SECTION

Formula section contains two main sections:  
SECTION 1: NOx sensor specific functionality  
SECTION 2: NOx sensor not specific functionality

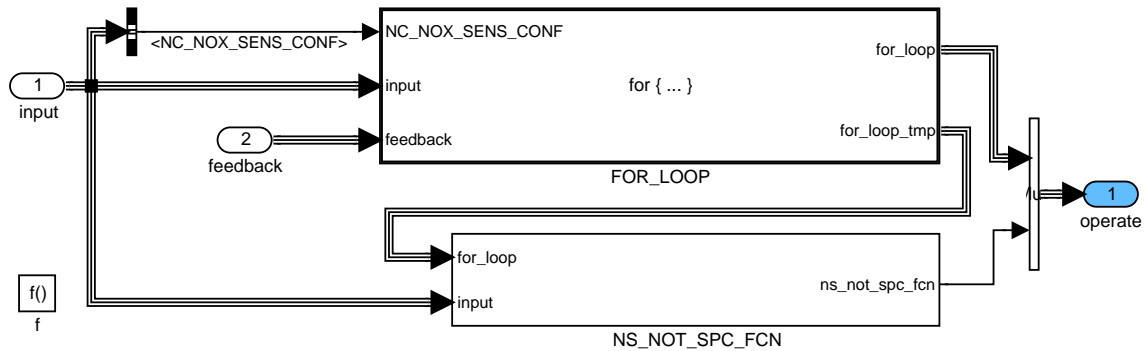


Figure 7.103.33: NOXD\_MDLADNSFCN0/VLD\_LV/OPERATE

### SECTION 1: NOx sensor specific functionality

#### Calculation of NOx sensor signal gradient

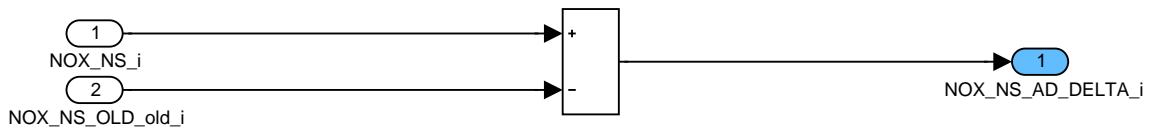


Figure 7.103.34:  
NOXD\_MDLADNSFCN0/VLD\_LV/OPERATE/FOR\_LOOP/NS\_SPC\_FCN/CLC1\_DELTA

#### Filtering of NOx sensor signal gradient

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The NOx signal is going down after regeneration in normal case. The gradient observation process can set the NOx Sensor signal validation flag earlier.

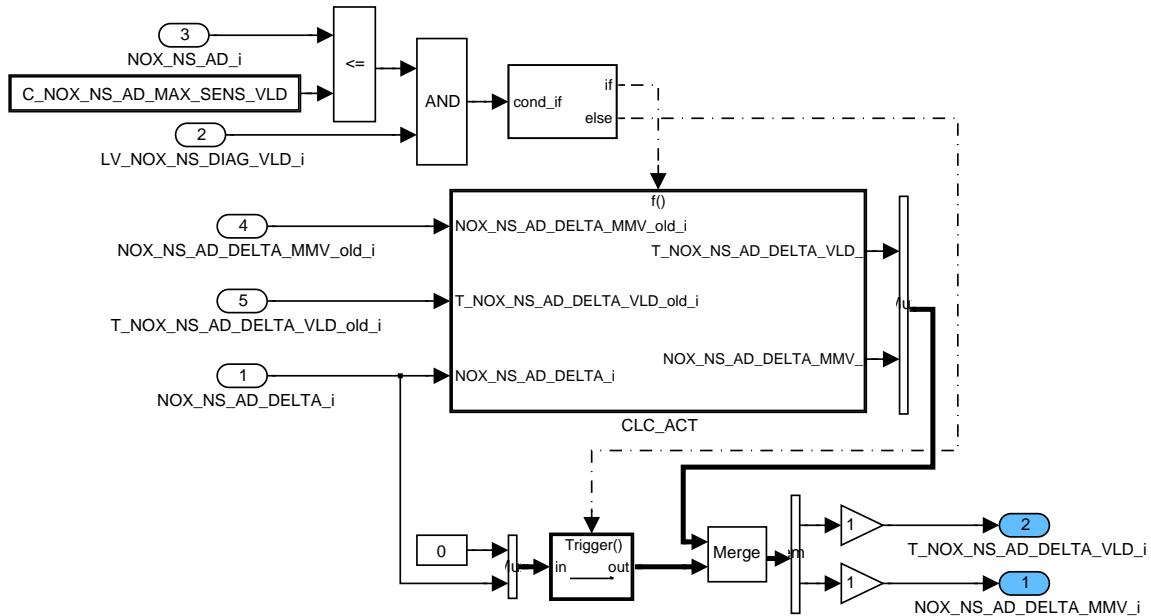


Figure 7.103.35:  
NOXD\_MDLADNSFCN0/VLD\_LV/OPERATE/FOR\_LOOP/NS\_SPC\_FCN/CLC2\_DELTA\_MMV

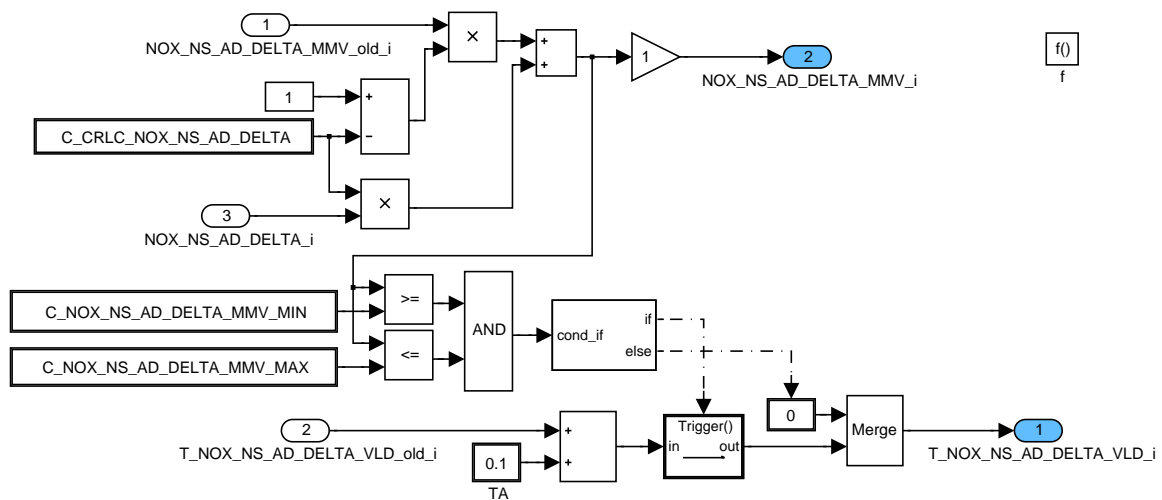


Figure 7.103.36: NOXD\_MDLADNSFCN0/VLD\_LV/OPERATE/FOR\_LOOP/NS\_SPC\_FCN/  
CLC2\_DELTA\_MMV/CLC\_ACT

**Calculation of NOx sensor specific validation bit of NOx sensor signal**

Set of NOx Sensor validation flag is done using gradient observation, check of minimal time after PUC phase or minimal LOAD time.

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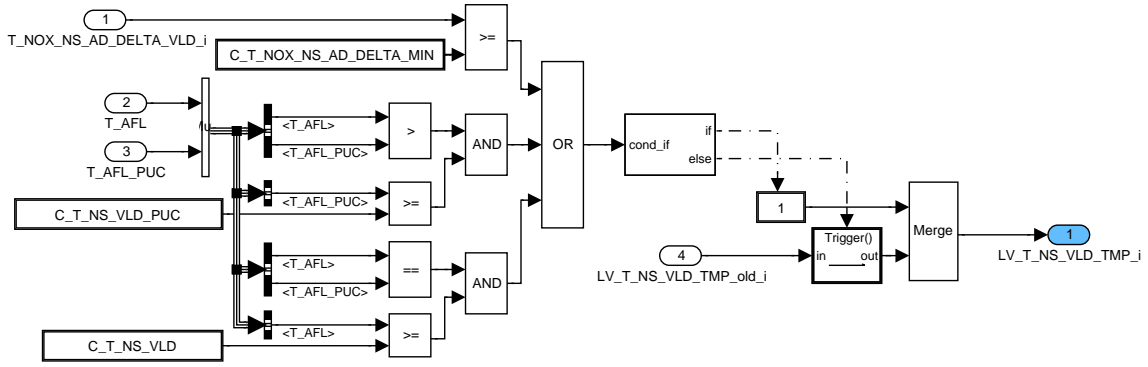


Figure 7.103.37:  
NOXD\_MDLADNSFCN0/VLD\_LV/OPERATE/FOR\_LOOP/NS\_SPC\_FCN/CLC3\_NS\_VLD\_TMP

**Calculation of old values**

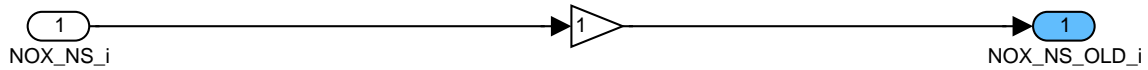


Figure 7.103.38:  
NOXD\_MDLADNSFCN0/VLD\_LV/OPERATE/FOR\_LOOP/NS\_SPC\_FCN/CLC4\_NOX\_NS\_AD\_OLD

**SECTION 2: NOx sensor not specific functionality**

**Calculation of validation bit for all NOx sensors**

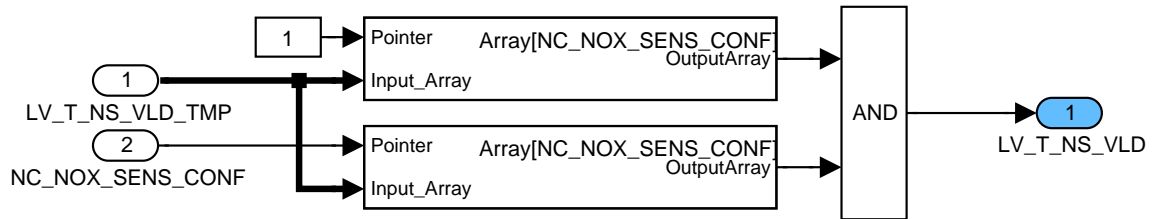


Figure 7.103.39:  
NOXD\_MDLADNSFCN0/VLD\_LV/OPERATE/NS\_NOT\_SPC\_FCN/CLC1\_SENS\_VLD

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## 7.104 Coordination of the injection time correction factors for CYBL

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DLY_TI_BAL_COR_ENA	V	0... FFH	0... 255	1	-
Segment counter to delay cylinder balancing TI correction activation					
CTR_STEP_FAC_TI_BAL [NC_CYL_NR]	V	80... 7FH	0... 127	1	-
Number of cylinder balancing multiple correction steps					
EGY_LEVEL_IV_BAL [NC_CYL_NR]	O/V	E000... 2000H	0... 50	0.00610352	%
Cylinder balancing injection valve energy level, cylinder individual					
EGY_LEVEL_IV_BAL_ADJ [NC_CYL_NR]	V	E000... 2000H	0... 50	0.00610352	%
Cylinder balancing injection valve energy level adjustment					
EGY_LEVEL_IV_BAL_CONV [NC_CYL_NR]	O/V	E000... 2000H	0... 50	0.00610352	%
Cylinder balancing injection valve energy level converter output					
EGY_LEVEL_IV_BAL_CTL [NC_CYL_NR]	V	E000... 2000H	0... 50	0.00610352	%
Cylinder balancing injection valve energy level control					
EGY_LEVEL_IV_BAL_CTL_MAX [NC_CYL_NR]	V	0... FFFFH	0... 65535	1	-
Cylinder balancing injection valve energy level maximum controller output value reached					
EGY_LEVEL_IV_BAL_LIM	V	E000... 2000H	0... 50	0.00610352	%
Cylinder balancing injection valve energy level converter output limited					
FAC_TI_BAL [NC_CYL_NR]	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
Total cylinder balancing multiple correction factor					
FAC_TI_DIF_BAL [NC_CYL_NR]	V	8000... 7FFFH	0... 0.99996948	305.176e3	-
Cylinder balancing multiple correction factor difference					
FAC_TI_SUM_BAL [NC_CYL_NR]	V	8000... 7FFFH	0... 0.99996948	305.176e3	-
Cylinder balancing multiple correction factor summary					
MFF_ADD_BAL [NC_CYL_NR]	O/V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Total cylinder balancing additive MFF correction value					
MFF_ADD_SUM_BAL [NC_CYL_NR]	V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Cylinder balancing additive MFF correction value summary					
NR_CYC_EGY_LEVEL_IV_BAL_CTL_MAX	V	0... FFH	0... 255	1	-
Corresponding segment number of the controller that has reached the maximum limit					

### Input data:

FAC_CYL_LAM_COR [NC_CYL_NR] {p. 2731}	FAC_TI_ER_BAL [NC_CYL_NR] {p. 3298}	LV_S_ACT {p. 8137}	LV_ST_END {p. 1720}
MFF_ADD_CYL_LAM_COR_OUT [NC_CYL_NR] {p. 2733}	MFF_ADD_ER_BAL [NC_CYL_NR] {p. 3269}	MFF_SP_MV {p. 2151}	N {p. 1525}
NC_CYL_NR {p. 1526}	SEG_NR_ER {p. 1454}	STATE_TI_ER_BAL {p. 4006}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_DLY_TI_BAL_COR_INI	-	0... FFH	0... 255	1	-
Segment counter initialization value to delay cylinder balancing TI correction activation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EGY_LEVEL_IV_BAL_MAX_NEG	-	E000... 2000H	0... 50	0.00610352	%
Maximum negative threshold for injection valve energy level value					
C_EGY_LEVEL_IV_BAL_MAX_POS	-	E000... 2000H	0... 50	0.00610352	%
Maximum positive threshold for injection valve energy level value					
C_EGY_LEVEL_IV_BAL_OFS	-	E000... 2000H	0... 50	0.00610352	%
Cylinder balancing injection valve energy level offset					
C_FAC_TI_BAL_ACT_MAN	-	0H 1H 2H 3H	DISABLE ADJUSTMENT CONTROL ADJCTL	-	-
Manual adjustment of activation conditions for injection valve energy level calculation					
C_FAC_TI_DIF_BAL	-	0... FFFFH	0... 1.99996948	305.176e3	-
Threshold for cylinder balancing multiple correction difference					
C_MFF_COR_BAL_MOD_MAN	-	0H 1H 2H 3H 4H 5H	NORM LAM ER TOT ER_ADD LAM_ADD	-	-
Manual switch for cylinder balancing correction mode determination					
IP_EGY_LEVEL_IV_BAL_CONV	-	0... 4000H	0... 50	0.00610352	%
LDP_FAC_TI_SUM_BAL_IP_EGY_BAL	8	0... FFFFH	0... 0.99996948	305.176e3	-
Index table for cylinder balancing injection valve energy level conversion					
IP_FAC_EGY_LEVEL_IV_BAL_COR	-	0... FFFFH	0... 3.99993896	610.352e3	-
LDP_MFF_SP_MV_IP_FAC_EGY_BAL	8	0... FFFFH	0... 1389	0.02119478	mg/stk
Index table for cylinder balancing injection valve energy level correction factor					
IP_FAC_MFF_ADD_ER_BAL	-	0... FFFFH	0... 1.999969	305.176e3	-
LDPM_N_2_CYBL	4	0... 1FE0H	0... 8160	1	rpm
LDPM_MFF_SP_MV_1_CYBL	4	0... FFFFH	0... 1389	0.02119478	mg/stk
Index table for cylinder balancing additive MFF correction factor					
LC_FAC_TI_BAL_RST_MAN	-	0... 1H	0...1	1	-
Manual switch for cylinder balancing multiple correction reset					

## General information

This module coordinates the adaptation and application of the correction factors calculated by the functions "Cylinder Balancing via ER" and "Cylinder Balancing via Lambda Sensor".

The module "Cylinder Balancing via Lambda Sensor" calculates the adaptation values only in homogeneous modes (lean or stoichiometric), while the module "Cylinder Balancing via ER" calculates the adaptation values only in stratified mode. It is possible to apply manually the calculated adaptation values either in homogeneous or stratified or in both combustion modes with a calibration constant.

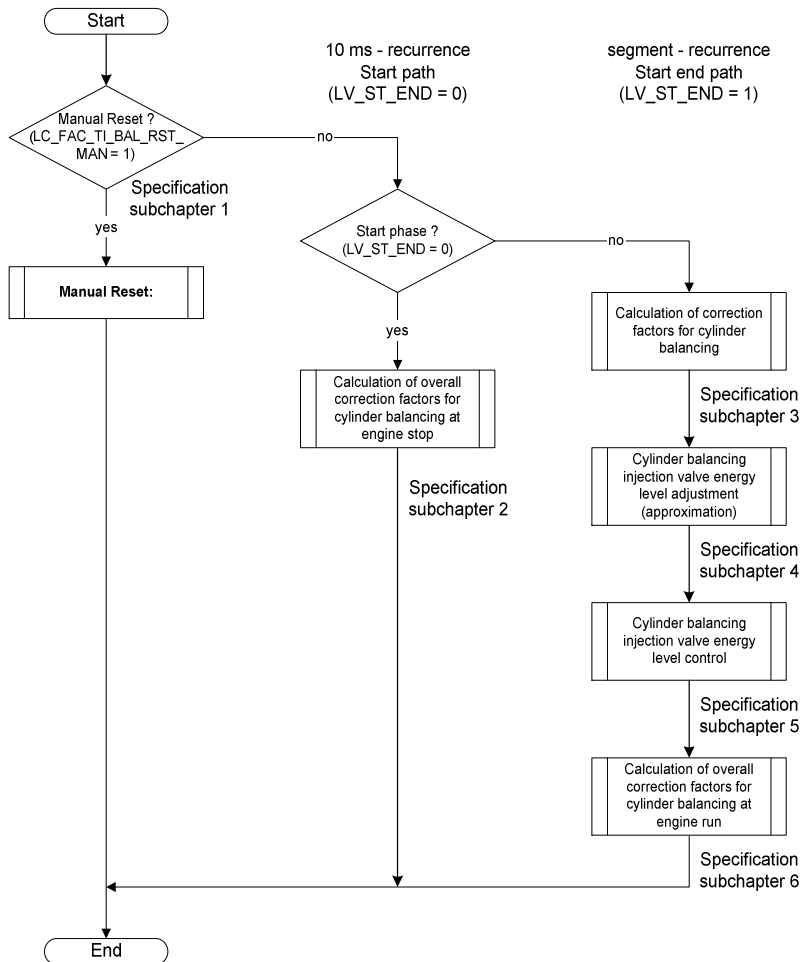
With use of a calibration constant a manual adjustment of the used injector energy level calculation is possible. The complete energy level calculation is disabled and the corresponding output values for the injection path are set to zero if the switch is set to "Disable".

Two different algorithms are existing for the injection valve energy level calculation. While the manual switch is set to "Adjustment", the calculation is based on a step by step approximation until a stable



energy level is reached. In case the manual switch is set to "Control", the energy level is calculated by a converter.

Both calculation routines can be activated in parallel while the manual switch is set to "AJD/CTL". The common energy level then is a summary of the adjustment value with the controller value.



## Application Condition

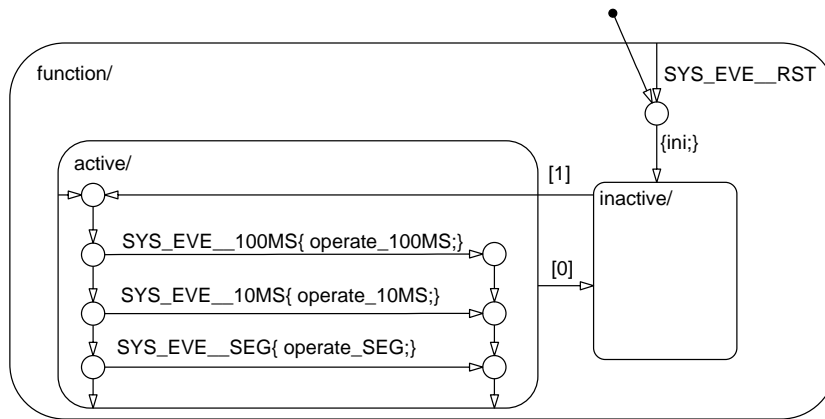



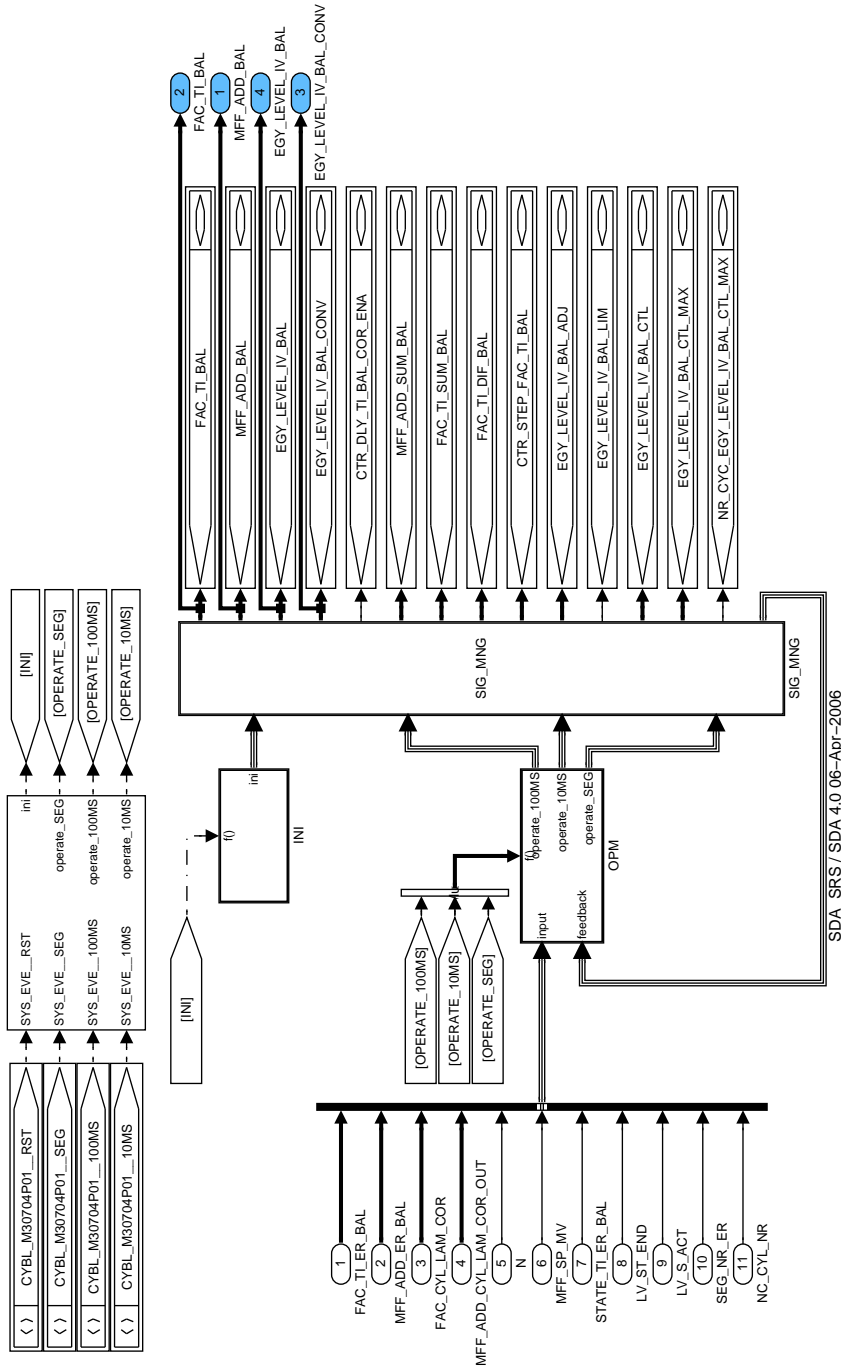
Figure 7.104.1: CYBL\_M30704P01/APP\_CDN/Chart

**Function Description**

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 3218 of 8404</b>	
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SDA\_SRS / SDA 4.0.06-Apr-2006

Figure 7.104.2: CYBL\_M30704P01

### 7.104.1 Calculation of variables at reset

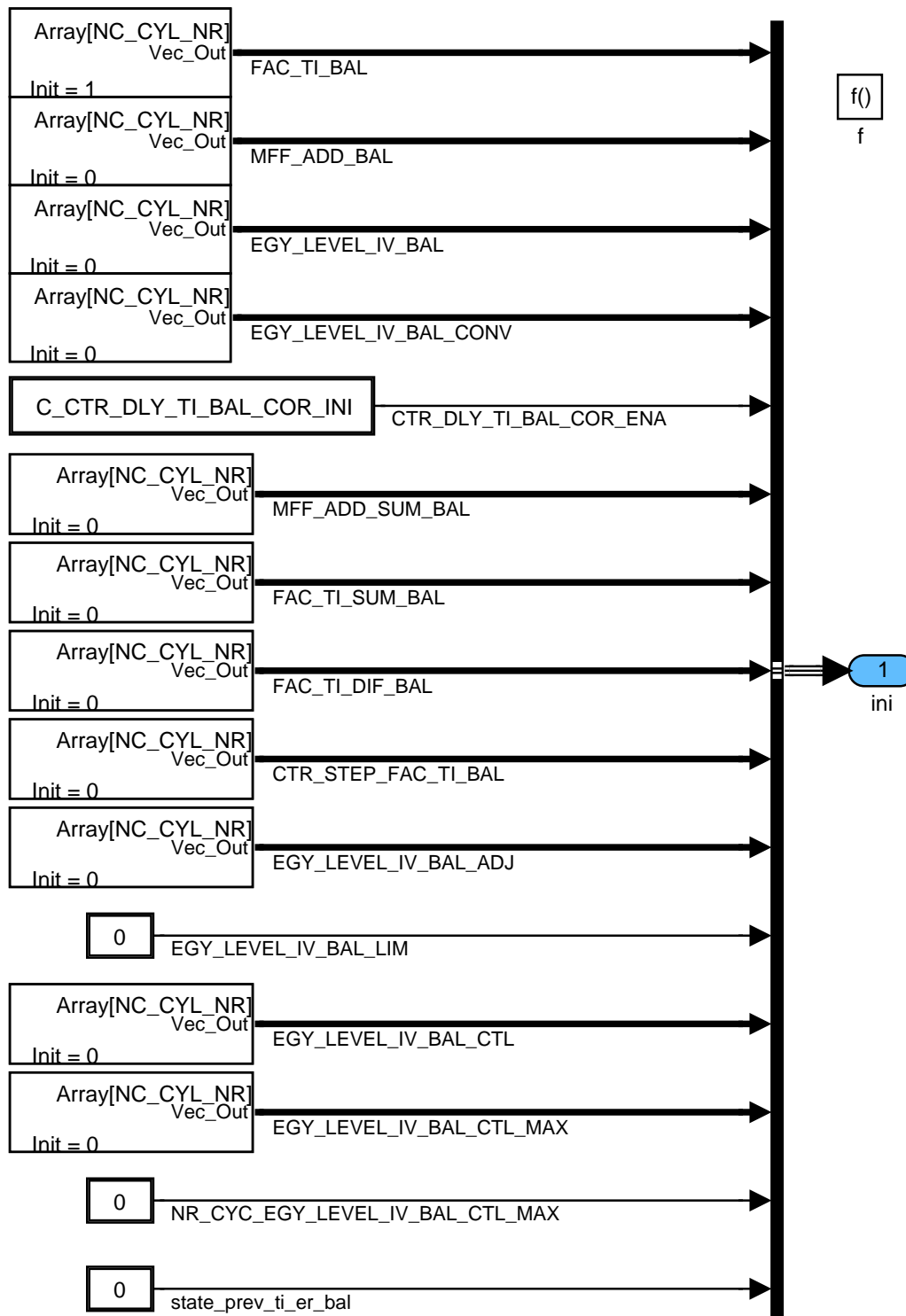


Figure 7.104.3: CYBL\_M30704P01/INI

### 7.104.2 Calculation of 100ms, 10ms and segment synchronous tasks

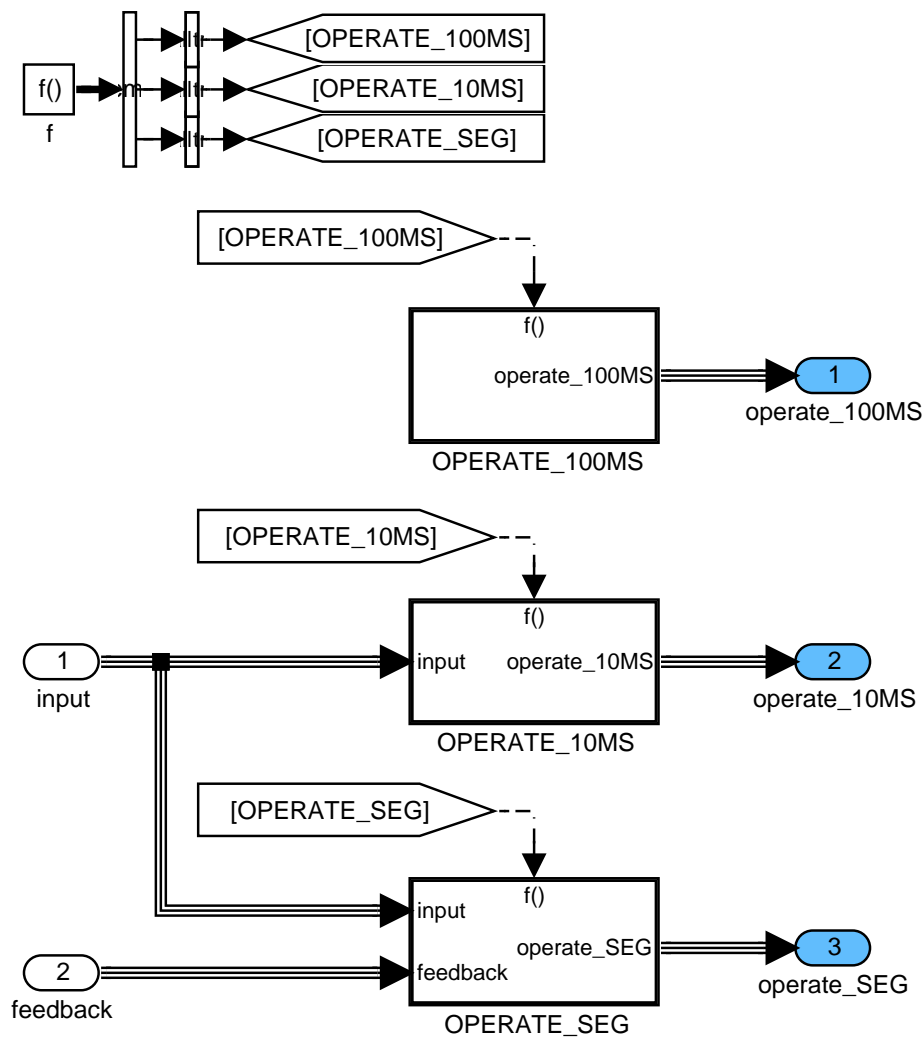


Figure 7.104.4: CYBL\_M30704P01/OPM

#### Manual Reset of cylinder balancing correction values

In case of a manual reset it is possible to adjust the output data to neutral values to make the function test and handling more easier. While the manual function reset is activated, all following subchapters within the module "Coordination of the Injection Time Correction Factors for CYBL" are deactivated during the period.

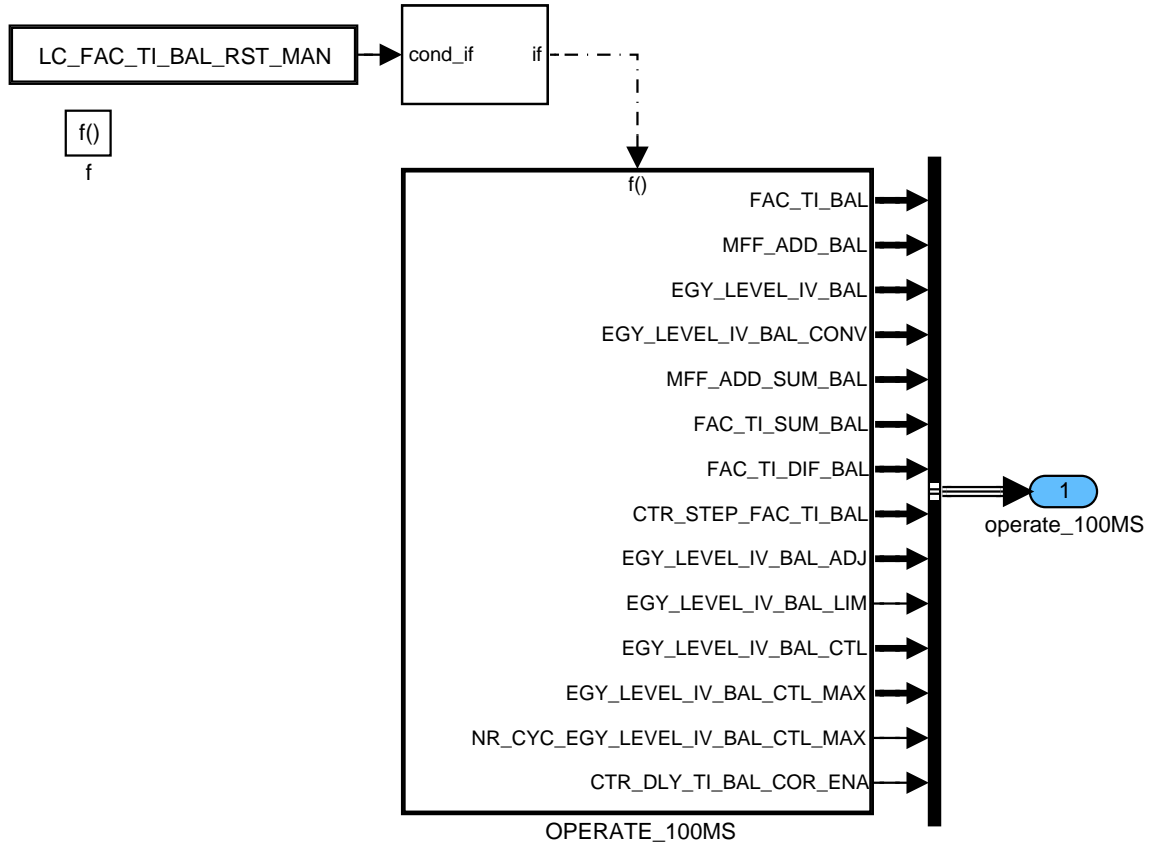


Figure 7.104.5: CYBL\_M30704P01/OPM/OPERATE\_100MS

**Manual Reset of cylinder balancing correction values OPERATE\_100MS**

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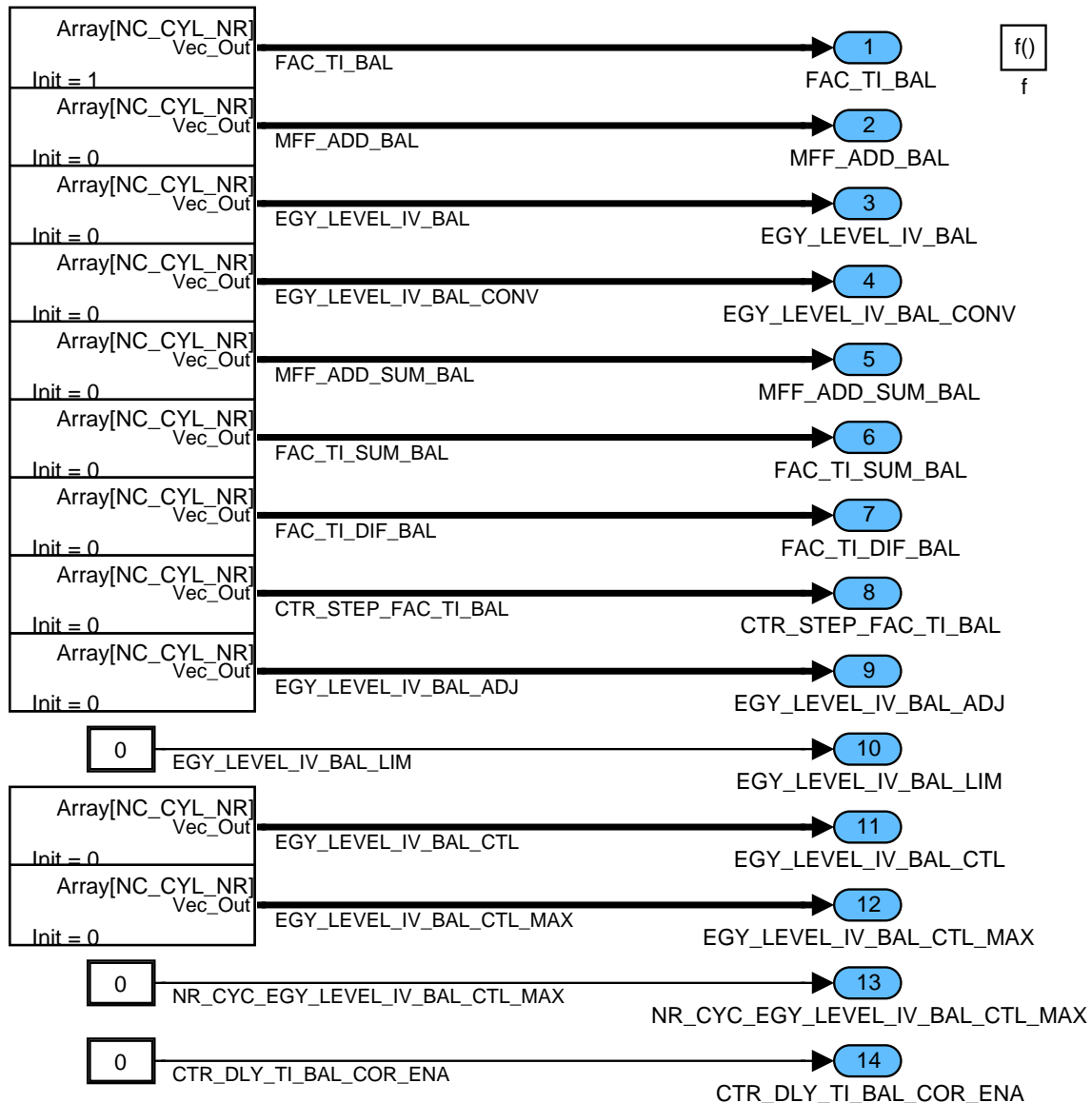


Figure 7.104.6: CYBL\_M30704P01/OPM/OPERATE\_100MS/OPERATE\_100MS

### Calculation of overall correction factors for cylinder balancing at engine stop

The formula section is only activated if the switch for a manual reset is set to "0". In case of a manual reset (refer: "Manual Reset of cylinder balancing correction values"), the calculations are stopped at once.

The calculation of the total cylinder balancing correction output values takes place at engine stop and engine start in fixed time steps. The output values are used to adjust the wanted cylinder individual corrections. All total cylinder correction values (for every cylinder) are calculated within one time step during this period.

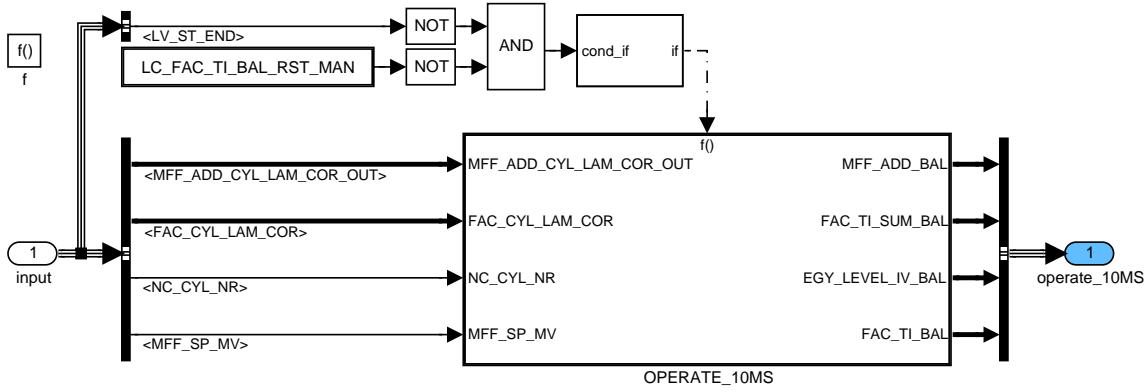


Figure 7.104.7: CYBL\_M30704P01/OPM/OPERATE\_10MS

**Calculation of overall correction factors for cylinder balancing at engine stop OPERATE\_10MS**

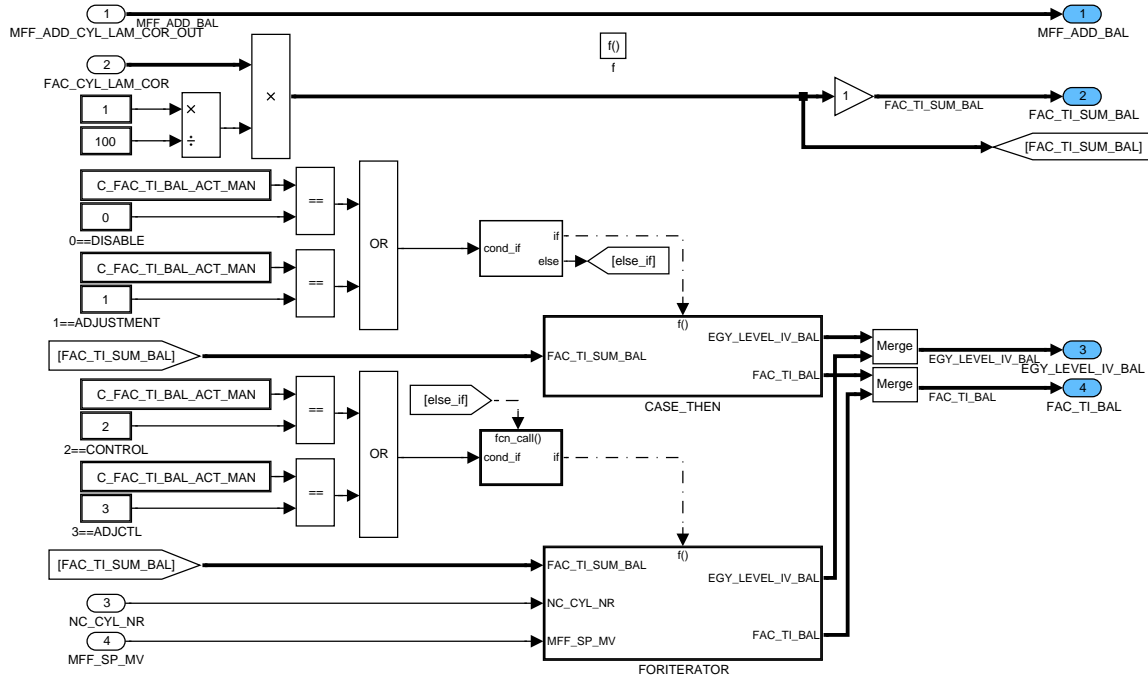


Figure 7.104.8: CYBL\_M30704P01/OPM/OPERATE\_10MS/OPERATE\_10MS

**Calculation of overall correction factors for cylinder balancing at engine stop OPERATE\_10MS CASE\_THEN**

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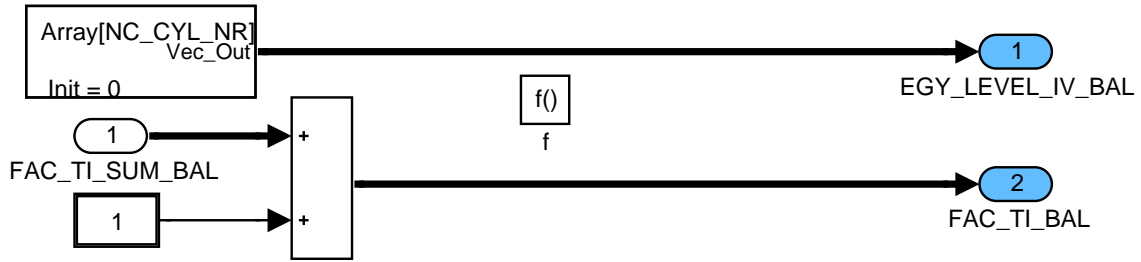


Figure 7.104.9: CYBL\_M30704P01/OPM/OPERATE\_10MS/OPERATE\_10MS/CASE\_THEN

**Calculation of overall correction factors for cylinder balancing at engine stop OPERATE\_10MS FORITERATOR**

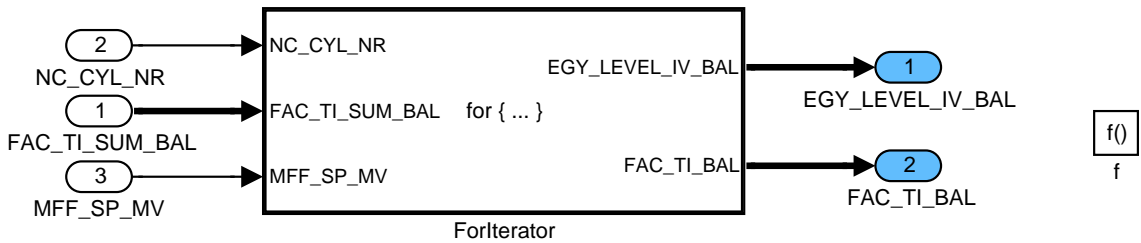


Figure 7.104.10: CYBL\_M30704P01/OPM/OPERATE\_10MS/OPERATE\_10MS/FORITERATOR

**Calculation of overall correction factors for cylinder balancing at engine stop OPERATE\_10MS FORITERATOR FORITERATOR**

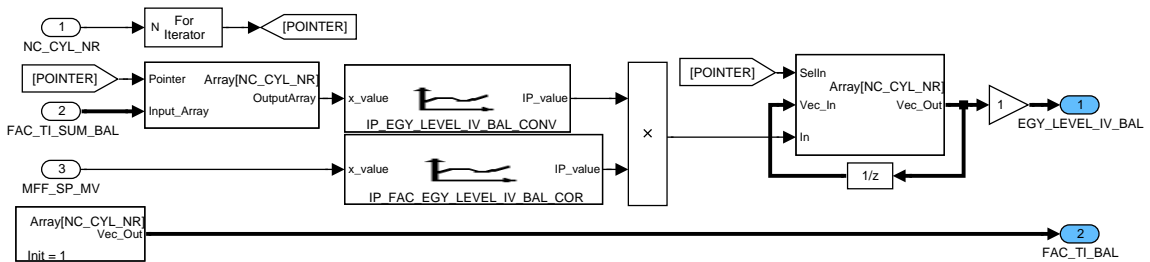



Figure 7.104.11: CYBL\_M30704P01/OPM/OPERATE\_10MS/OPERATE\_10MS/FORITERATOR/Forlterator

**General information for OPERATE\_SEG**

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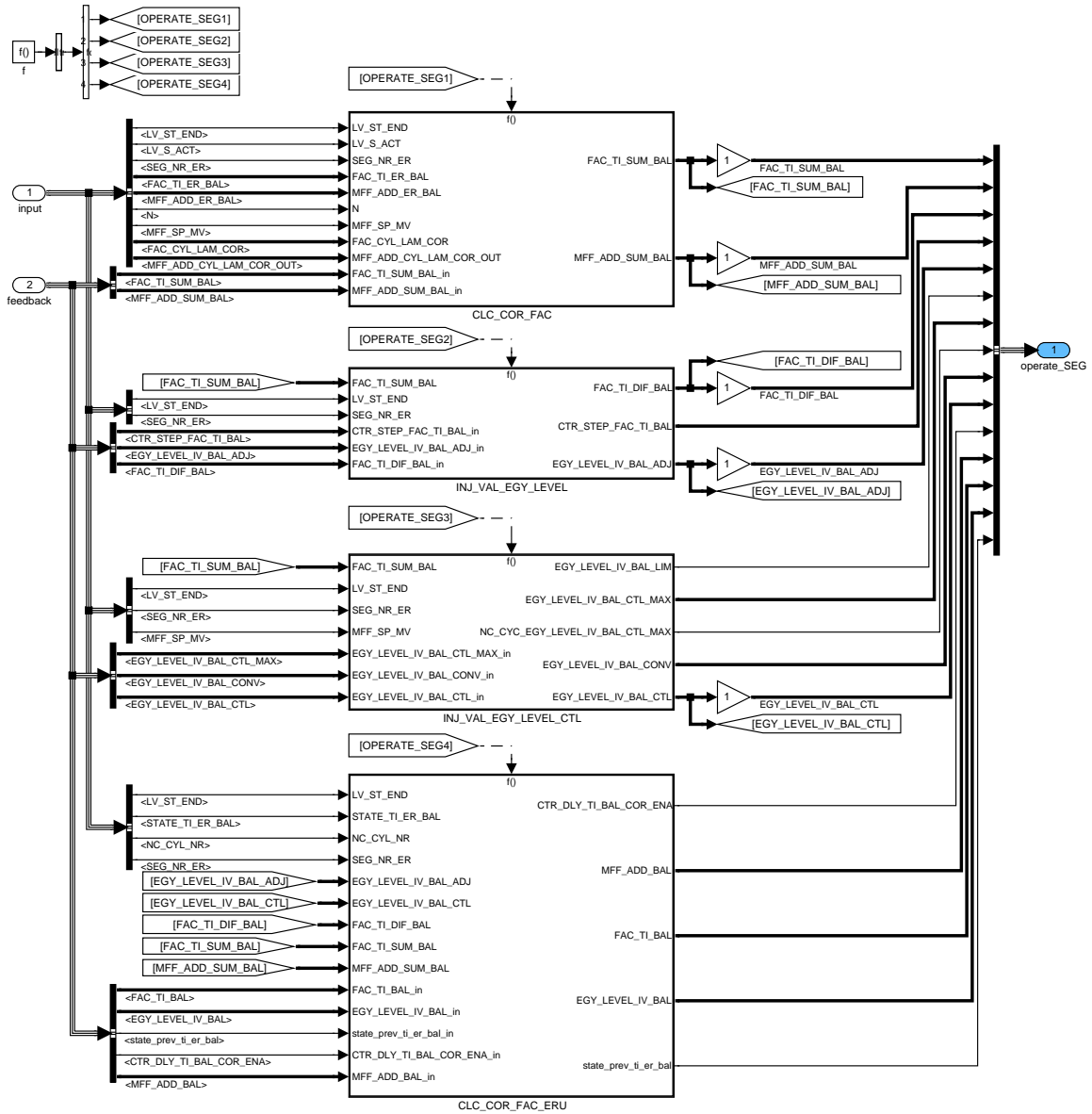


Figure 7.104.12: CYBL\_M30704P01/OPM/OPERATE\_SEG


**Calculation of correction factors for cylinder balancing**

The formula section is only activated if the switch for a manual reset is set to "0". In case of a manual reset (refer: "Manual Reset of cylinder balancing correction values"), the calculations are stopped at once.

The cylinder balancing correction factors for homogenous and stratified combustion mode are built from the input values of the different cylinder balancing adaptation functions. With a manual calibration constant it is possible to adjust the adaptation values at different combustion modes.

Short description of possible settings:

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Constant setting:		CYBL via LAM sensor applied at combustion mode:	CYBL via ER applied at combustion mode:
"NORM"	(0H)	HOM	STR
"LAM"	(1H)	HOM & STR	STR
"ER"	(2H)	HOM	STR & HOM
"TOT"	(3H)	HOM & STR	STR & HOM
"ER_ADD"	(4H)	HOM	STR (additive, multiple) HOM (additive)
"LAM_ADD"	(5H)	HOM & STR	STR (additive, multiple) HOM (additive)

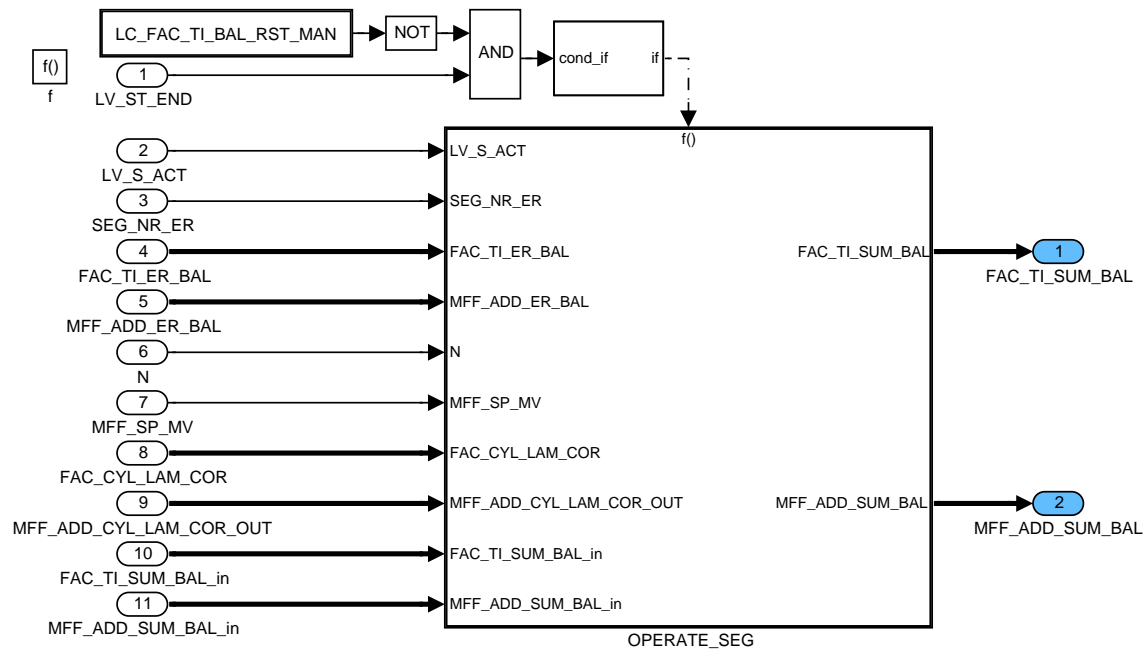


Figure 7.104.13: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC

**Calculation of correction factors for cylinder balancing OPERATE\_SEG**

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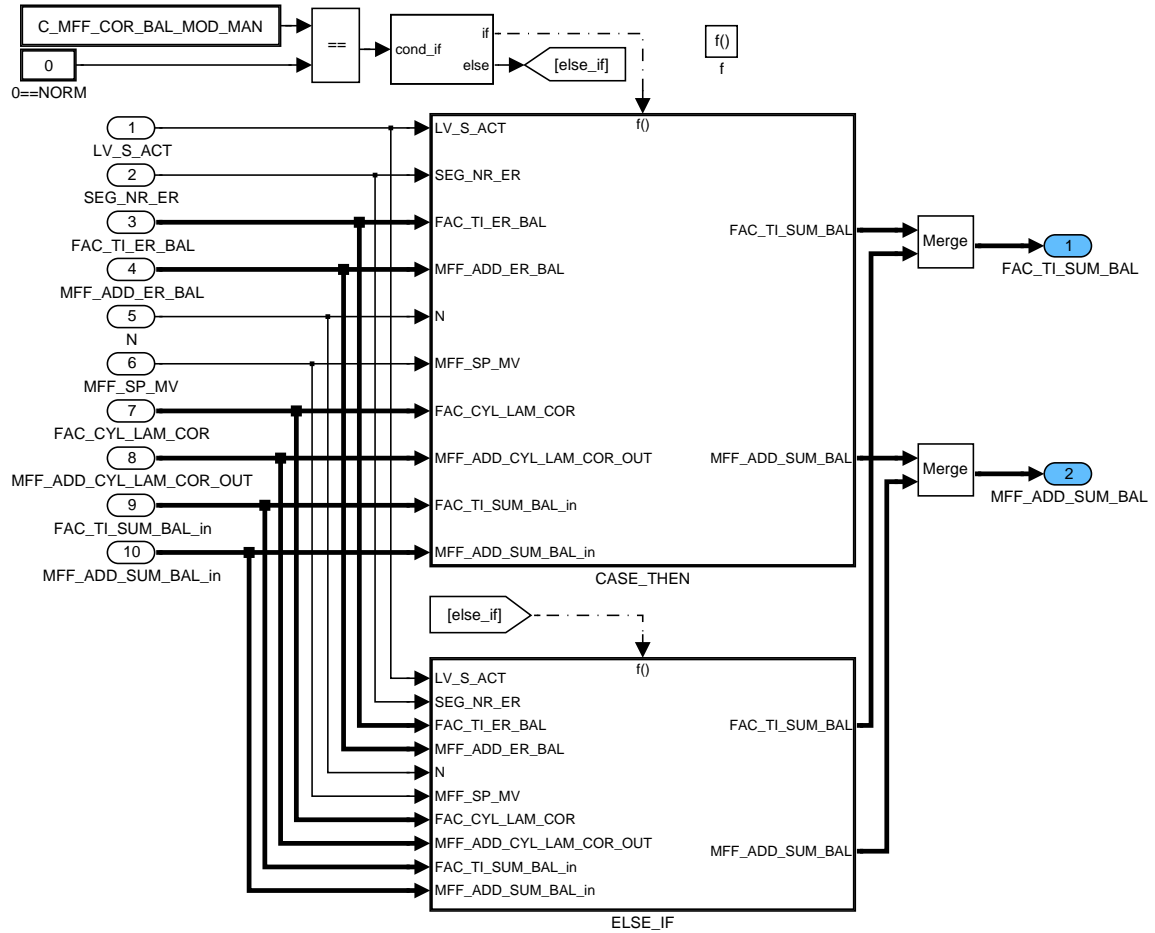


Figure 7.104.14: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC/OPERATE\_SEG

**Calculation of correction factors for cylinder balancing OPERATE\_SEG CASE\_THEN**

//CYBL via LAM only applied in HOM, CYBL via ER only applied in STR

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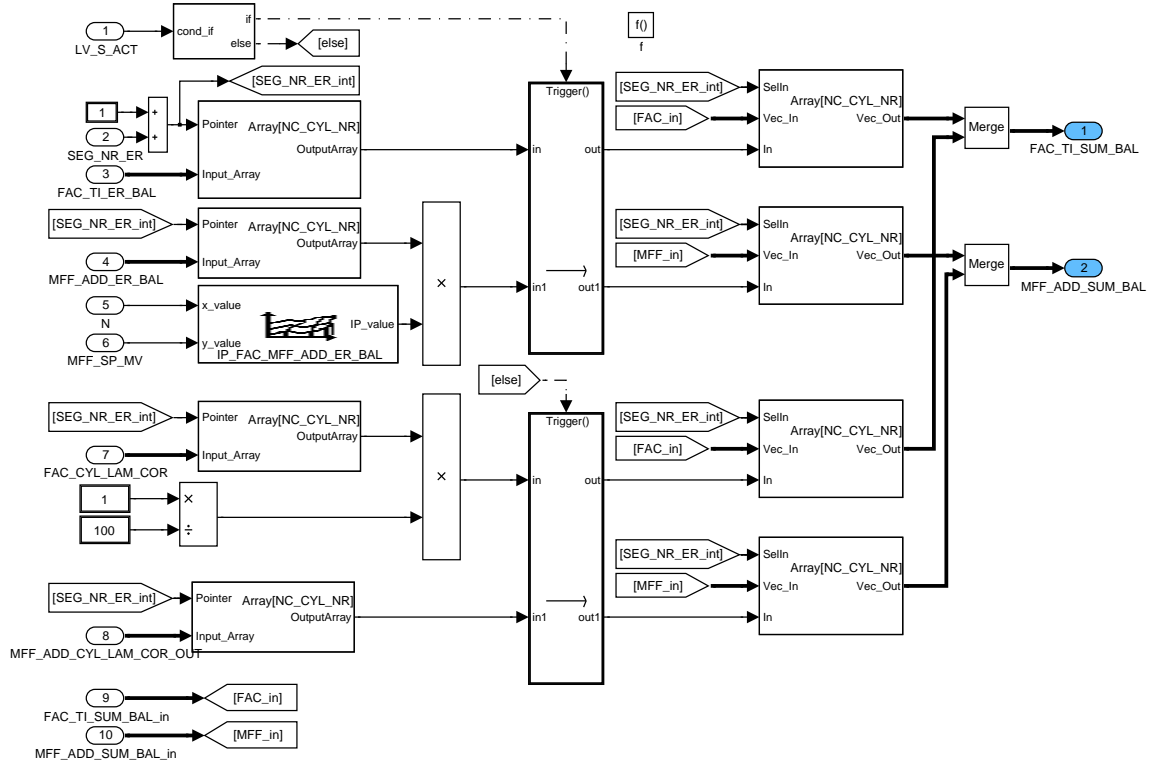


Figure 7.104.15:  
CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC/OPERATE\_SEG/CASE\_THEN

**Calculation of correction factors for cylinder balancing OPERATE\_SEG ELSE\_IF**

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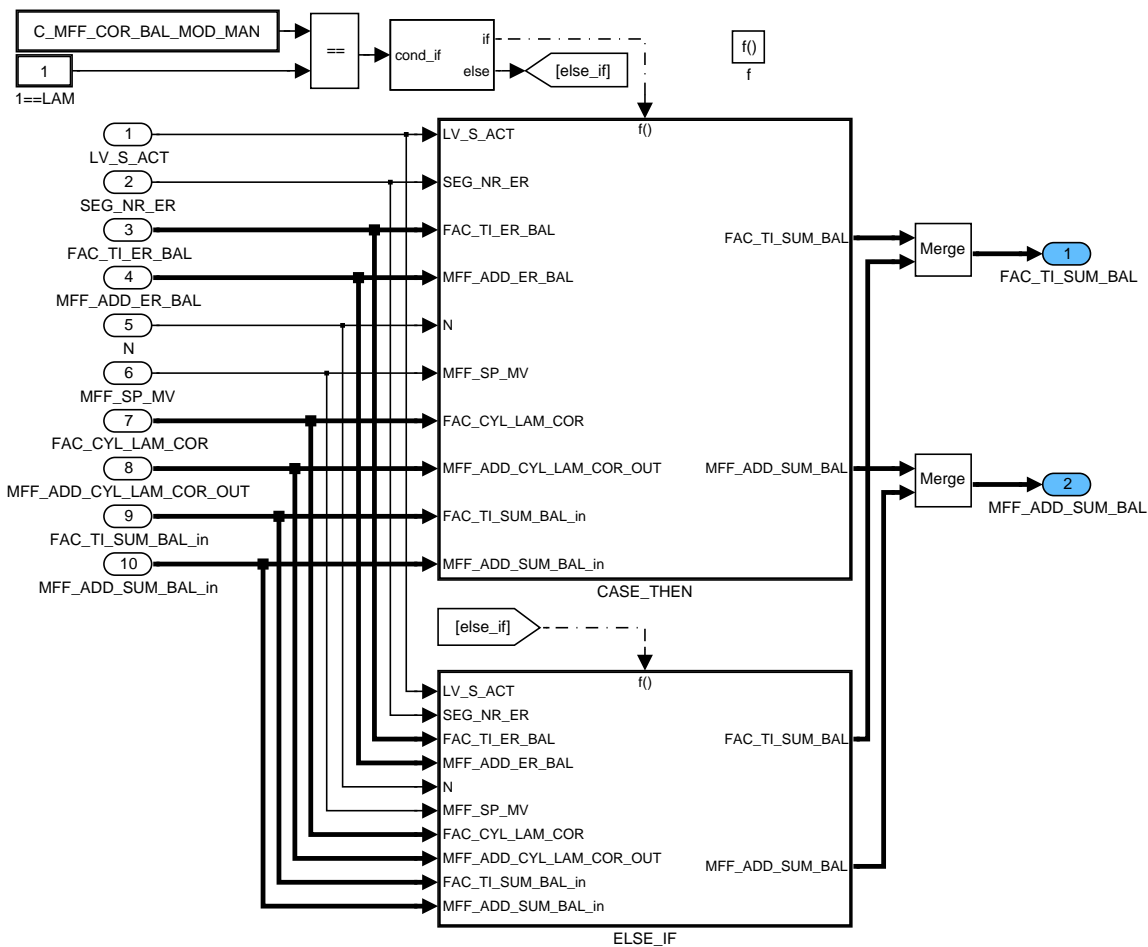


Figure 7.104.16:  
CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC/OPERATE\_SEG/ELSE\_IF

**Calculation of correction factors for cylinder balancing OPERATE\_SEG ELSE\_IF CASE\_THEN**

//CYBL via LAM applied in HOM and STR, CYBL via ER only applied in STR

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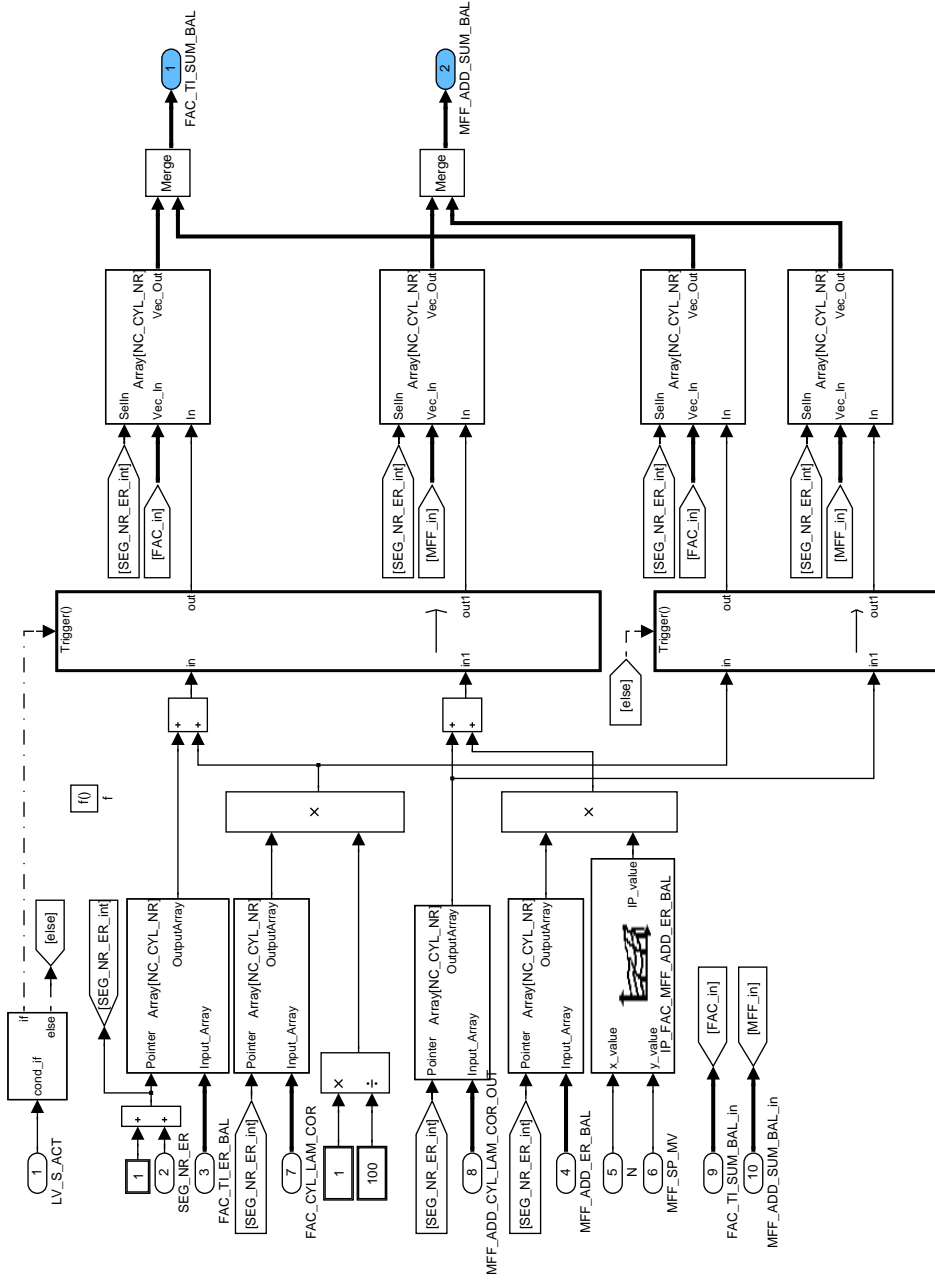



Figure 7.104.17:  
CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC/OPERATE\_SEG/ELSE\_IF/CASE\_THEN

**Calculation of correction factors for cylinder balancing OPERATE\_SEG ELSE\_IF ELSE\_IF**

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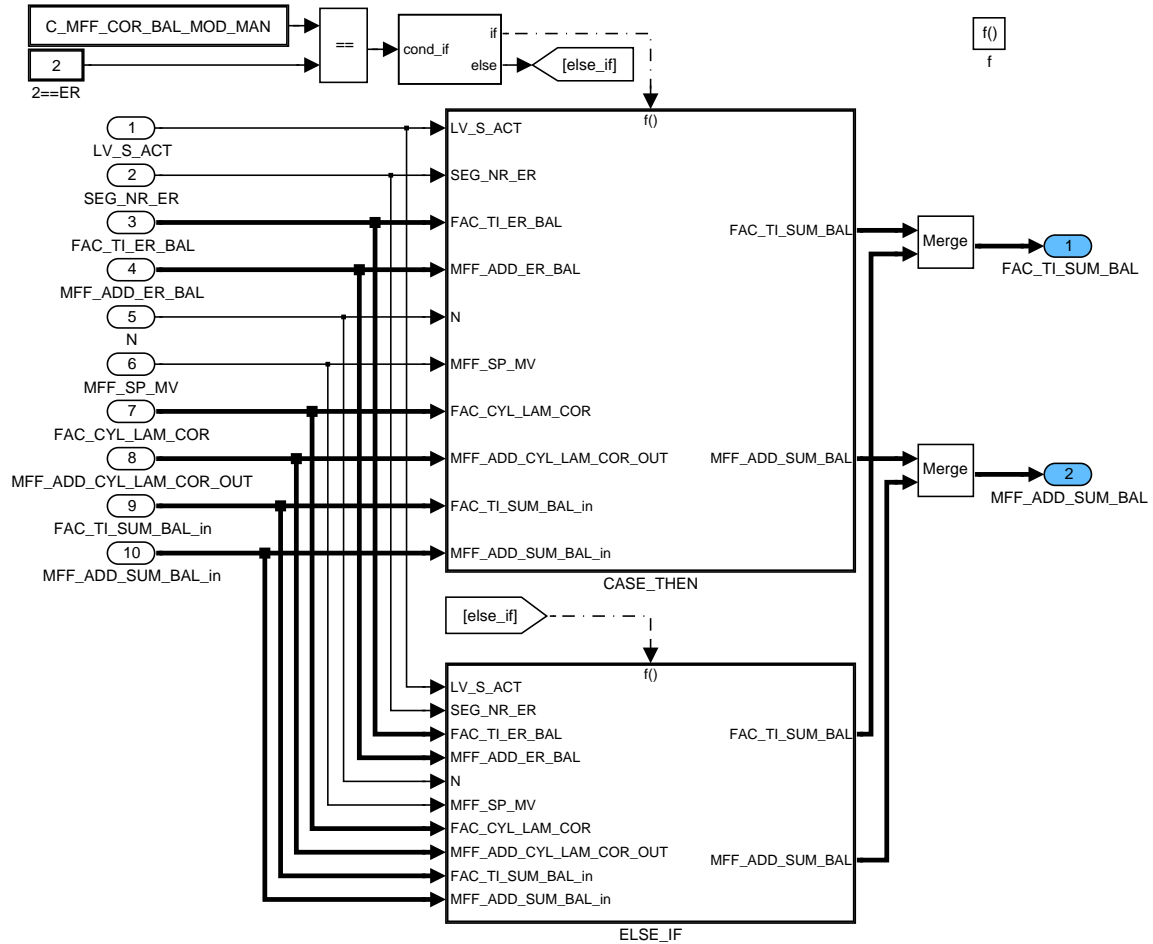


Figure 7.104.18:  
CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC/OPERATE\_SEG/ELSE\_IF/ELSE\_IF

**Calculation of correction factors for cylinder balancing OPERATE\_SEG ELSE\_IF ELSE\_IF CASE\_THEN**

//CYBL via LAM only applied in HOM, CYBL via ER applied in HOM and STR

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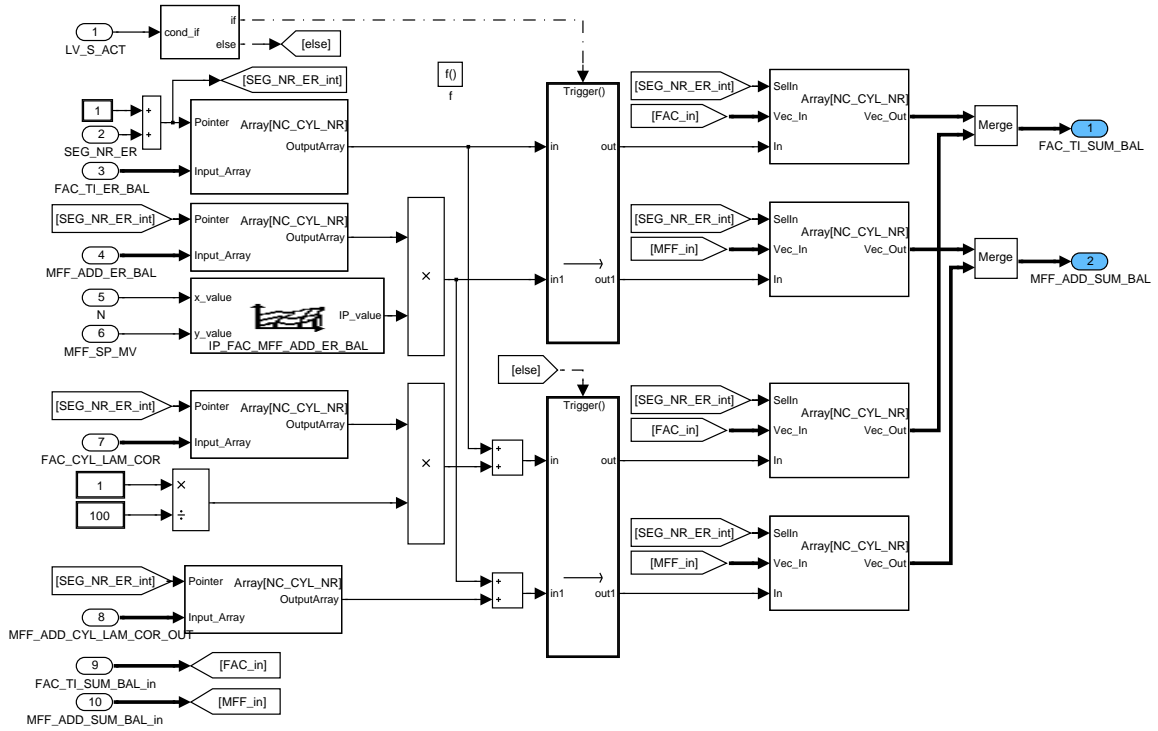


Figure 7.104.19: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC/OPERATE\_SEG/ ELSE\_IF/ELSE\_IF/CASE\_THEN

**Calculation of correction factors for cylinder balancing OPERATE\_SEG ELSE\_IF ELSE\_IF ELSE\_IF**

//no combustion mode restriction

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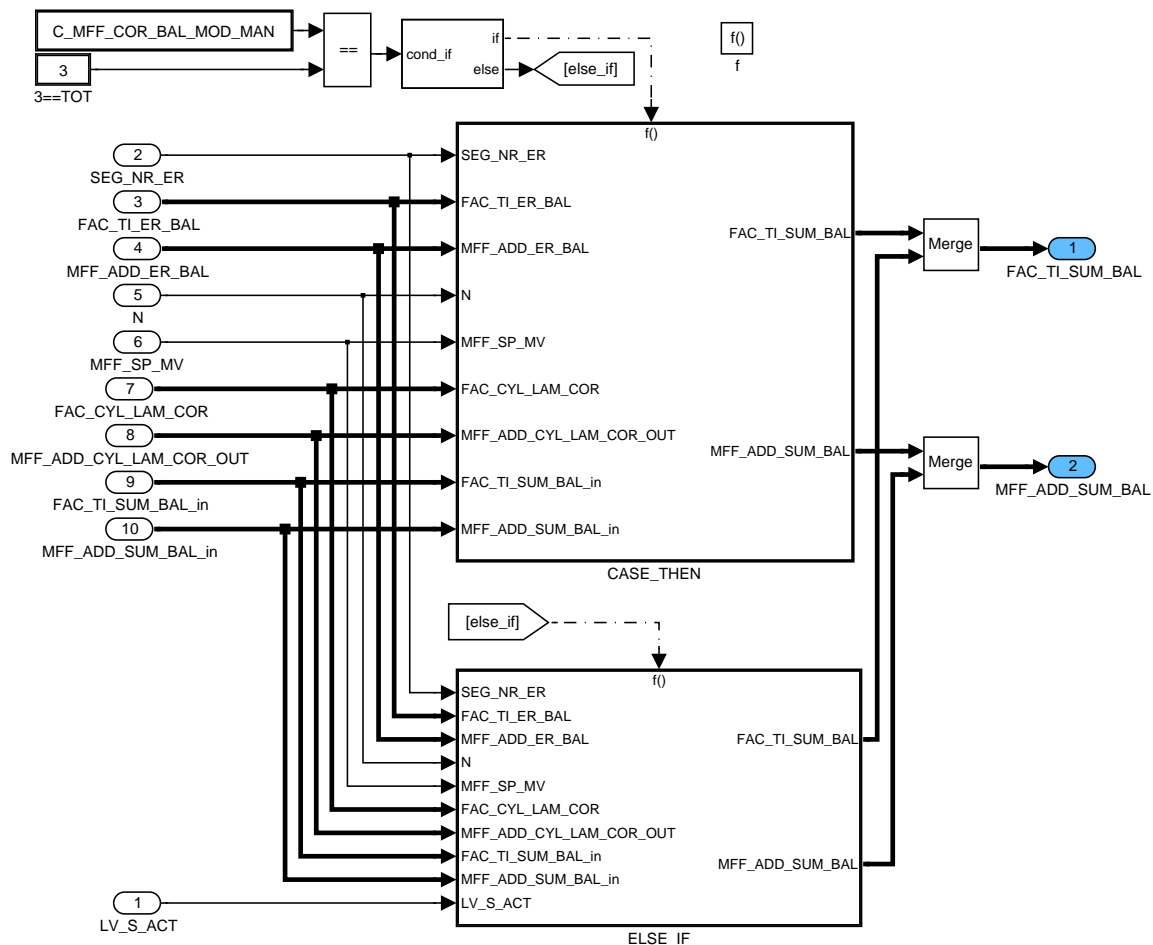


Figure 7.104.20: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC/OPERATE\_SEG/ELSE\_IF/ELSE\_IF/ELSE\_IF

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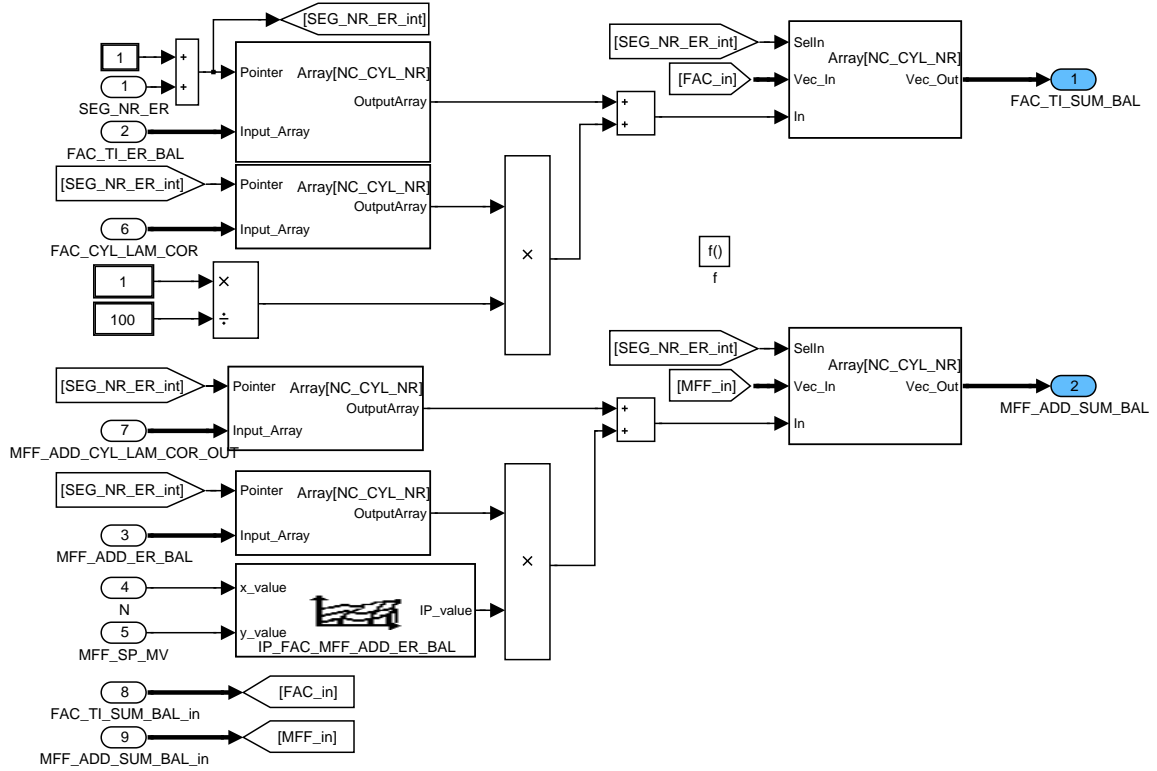


Figure 7.104.21: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC/OPERATE\_SEG/ELSE\_IF/ELSE\_IF/ELSE\_IF/CASE\_THEN

**Calculation of correction factors for cylinder balancing OPERATE\_SEG ELSE\_IF ELSE\_IF ELSE\_IF ELSE\_IF**

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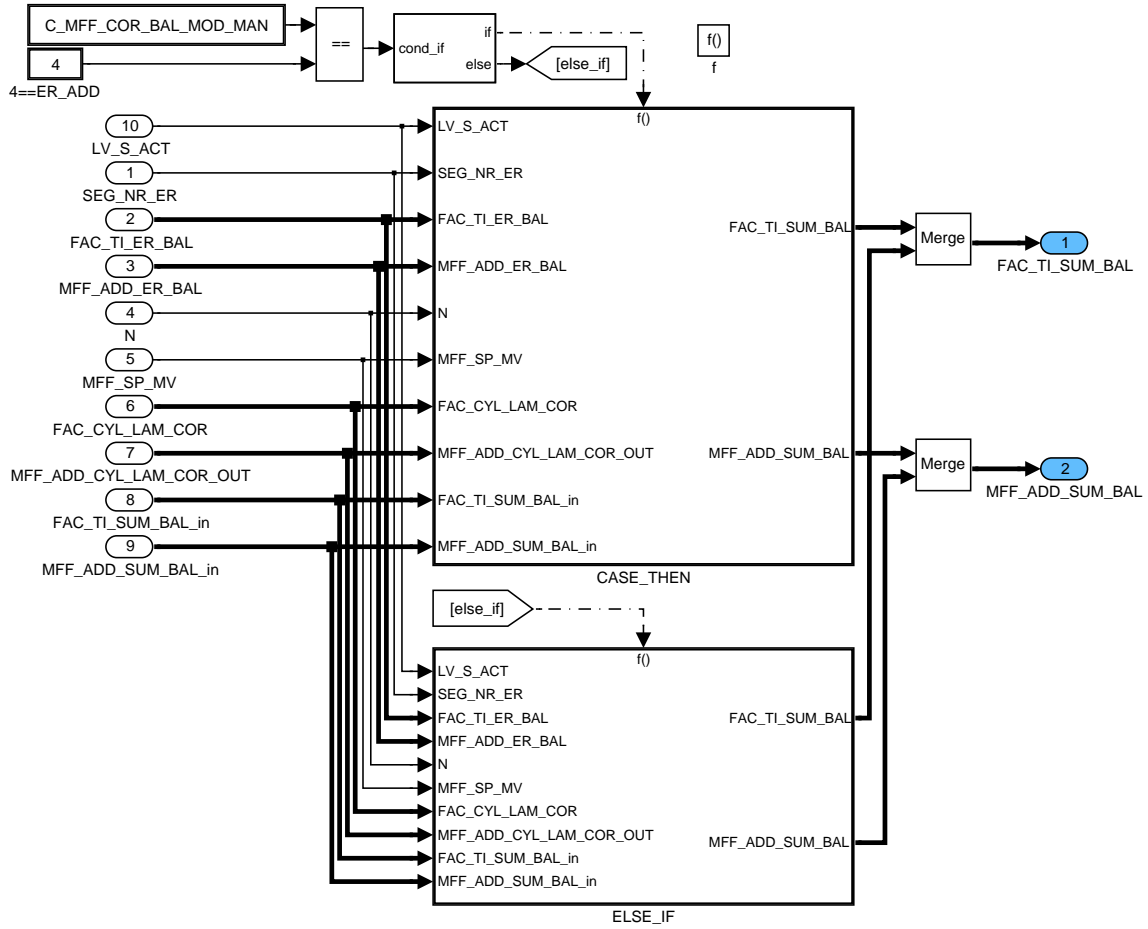


Figure 7.104.22: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC/OPERATE\_SEG/ ELSE\_IF/ELSE\_IF/ELSE\_IF/ELSE\_IF

**Calculation of correction factors for cylinder balancing OPERATE\_SEG ELSE\_IF ELSE\_IF ELSE\_IF ELSE\_IF CASE\_THEN**

//CYBL via LAM only applied in HOM, CYBL via ER applied in STR and partly in HOM

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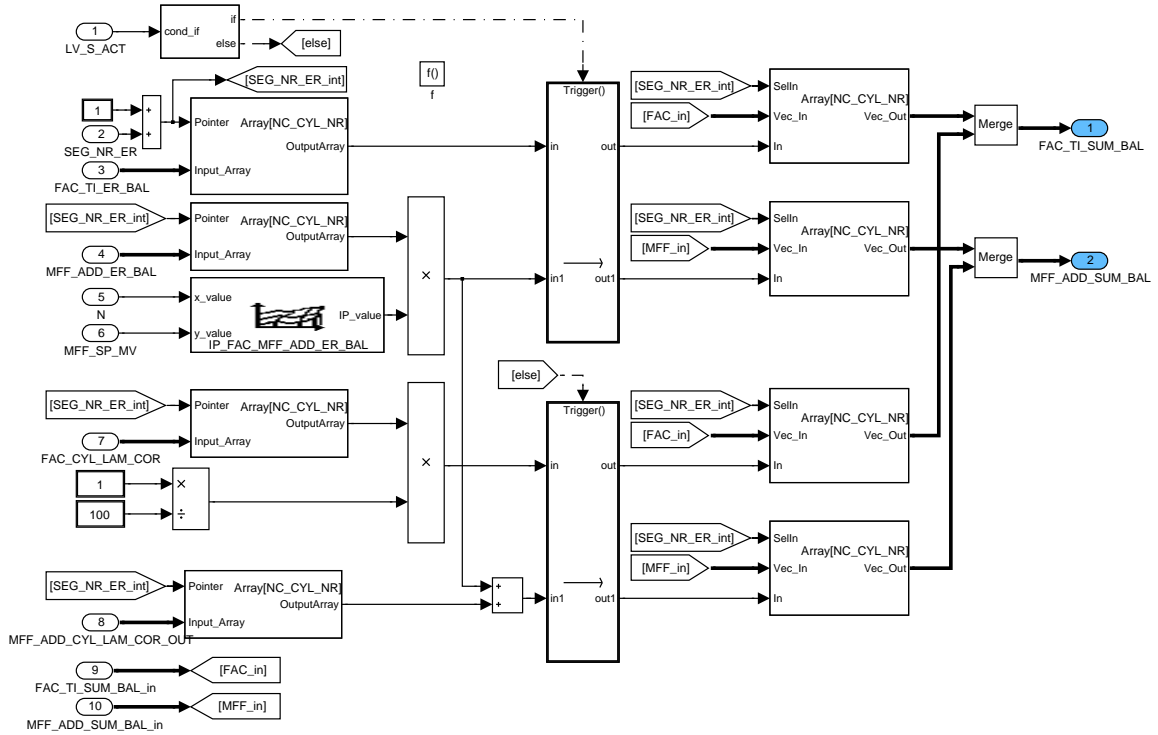


Figure 7.104.23: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC/OPERATE\_SEG/ ELSE\_IF/ELSE\_IF/ELSE\_IF/ELSE\_IF/CASE\_THEN

**Calculation of correction factors for cylinder balancing OPERATE\_SEG ELSE\_IF ELSE\_IF ELSE\_IF ELSE\_IF ELSE\_IF**

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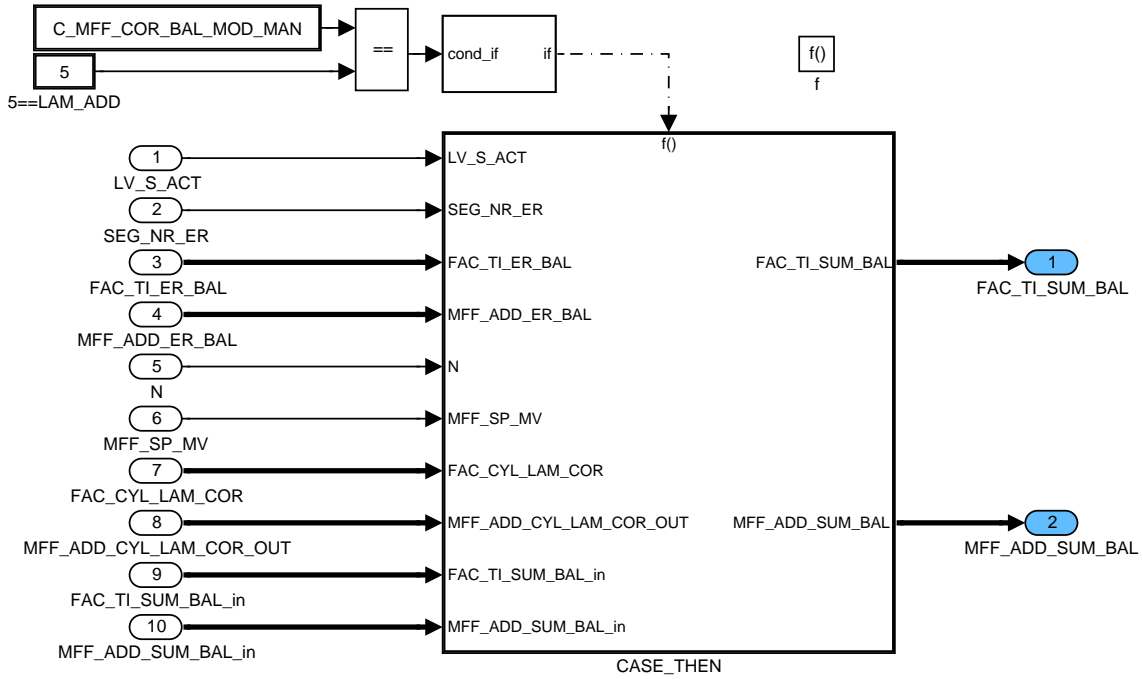



Figure 7.104.24: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC/OPERATE\_SEG/ELSE\_IF/ELSE\_IF/ELSE\_IF/ELSE\_IF/ELSE\_IF

**Calculation of correction factors for cylinder balancing OPERATE\_SEG ELSE\_IF ELSE\_IF ELSE\_IF ELSE\_IF CASE\_THEN**

//CYBL via LAM applied in HOM and STR, CYBL ER applied in STR and partly in HOM

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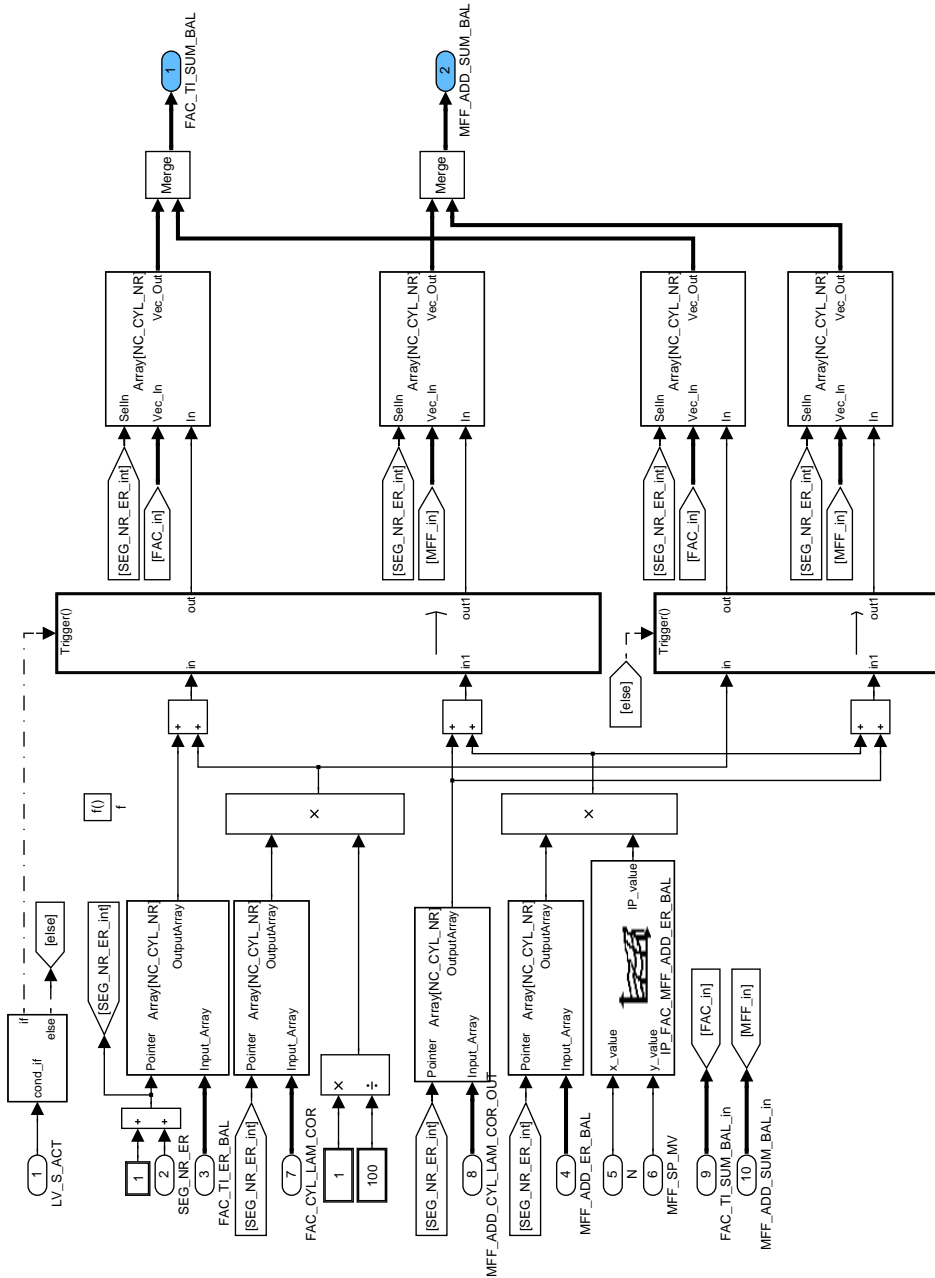


Figure 7.104.25: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC/OPERATE\_SEG/ELSE\_IF/ELSE\_IF/ELSE\_IF/ELSE\_IF/ELSE\_IF/CASE\_THEN

**Cylinder balancing injection valve energy level adjustment (approximation)**

The formula section is only activated if the switch for a manual reset is set to "0". In case of a manual reset (refer: "Manual Reset of cylinder balancing correction values"), the calculations are stopped at once.

The approximation is only enabled while the manual switch for injection valve energy level calculation is set to "Adjustment" or "ADJ& CTL".

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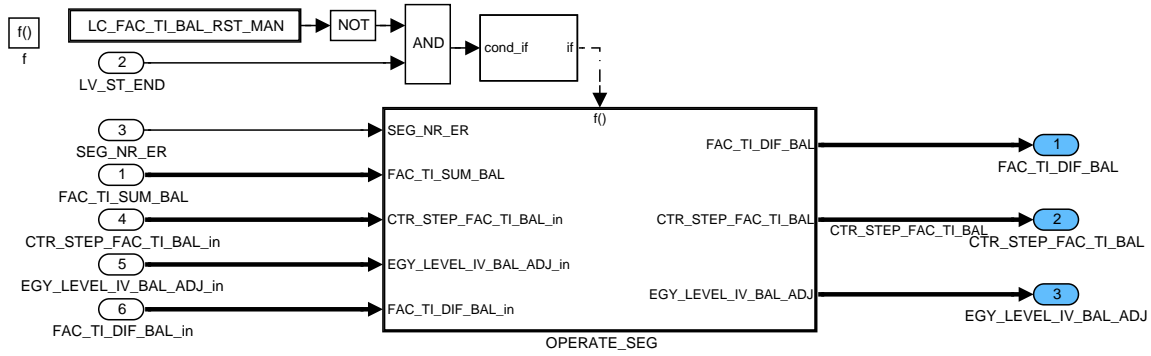


Figure 7.104.26: CYBL\_M30704P01/OPM/OPERATE\_SEG/INJ\_VAL\_EGY\_LEVEL

**Cylinder balancing injection valve energy level adjustment (approximation) OPERATE\_SEG**

("Calculation of the approximation part disabled") for EGY\_LEVEL\_IV\_BAL\_ADJ[m]=0

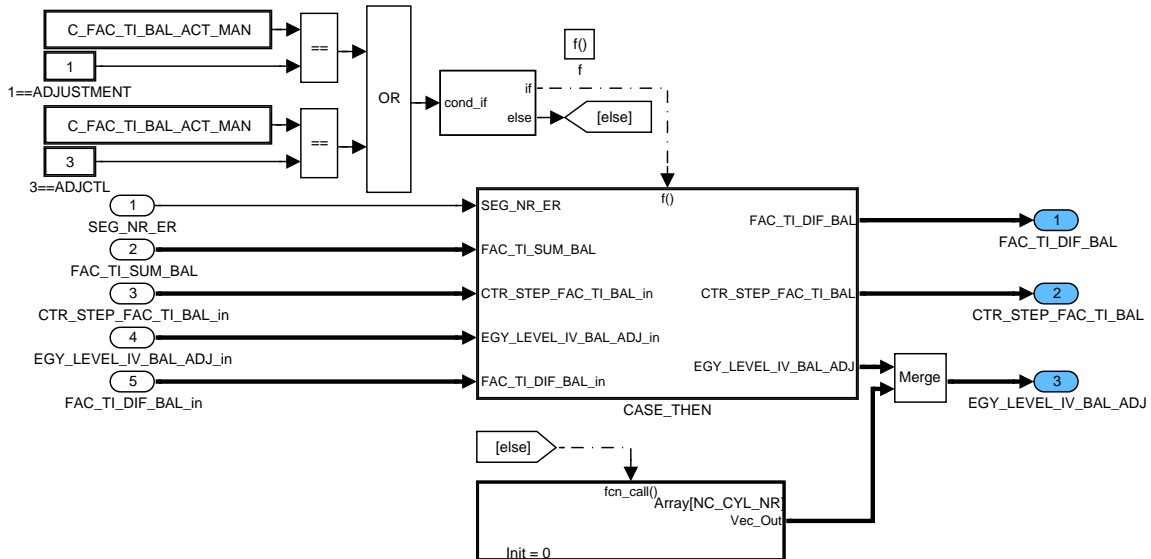


Figure 7.104.27: CYBL\_M30704P01/OPM/OPERATE\_SEG/INJ\_VAL\_EGY\_LEVEL/OPERATE\_SEG

**Cylinder balancing injection valve energy level adjustment (approximation) OPERATE\_SEG CASE\_THEN**

("Calculation of the approximation part enabled")

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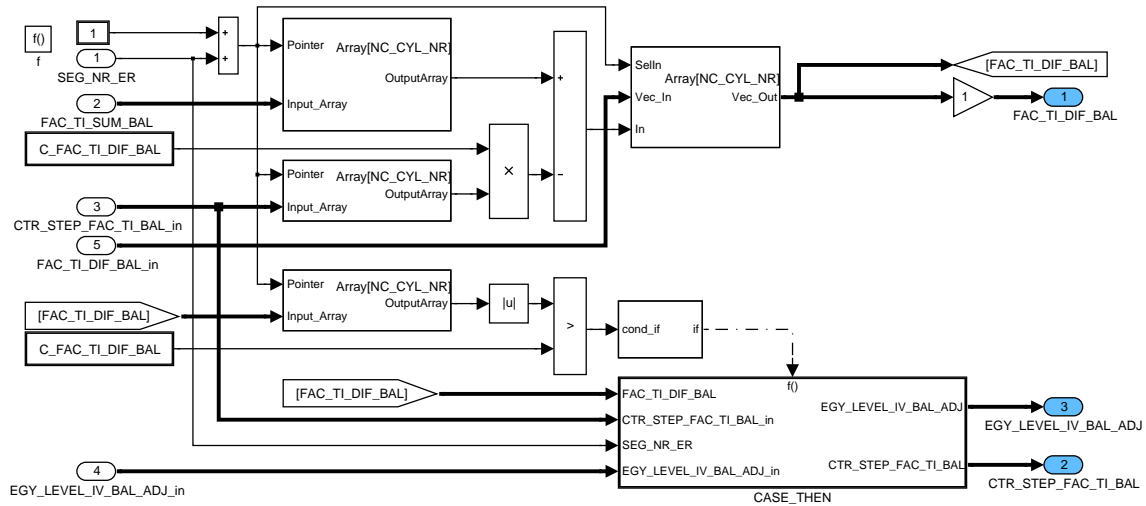


Figure 7.104.28:  
CYBL\_M30704P01/OPM/OPERATE\_SEG/INJ\_VAL\_EGY\_LEVEL/OPERATE\_SEG/CASE\_THEN

**Cylinder balancing injection valve energy level adjustment (approximation) OPERATE\_SEG CASE\_THEN CASE\_THEN**

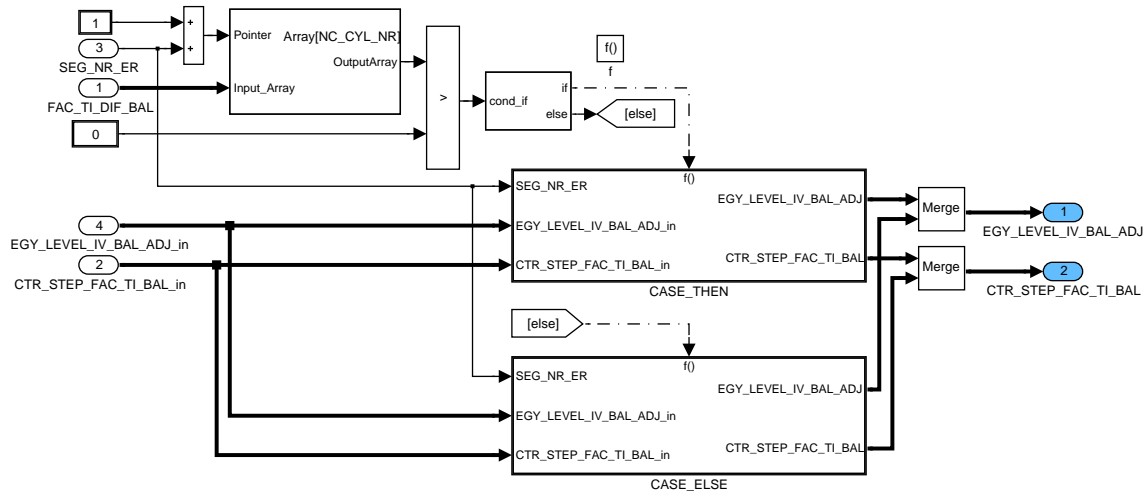


Figure 7.104.29: CYBL\_M30704P01/OPM/OPERATE\_SEG/INJ\_VAL\_EGY\_LEVEL/OPERATE\_SEG/CASE\_THEN/CASE\_THEN

**Cylinder balancing injection valve energy level adjustment (approximation) OPERATE\_SEG CASE\_THEN CASE\_THEN CASE\_THEN**

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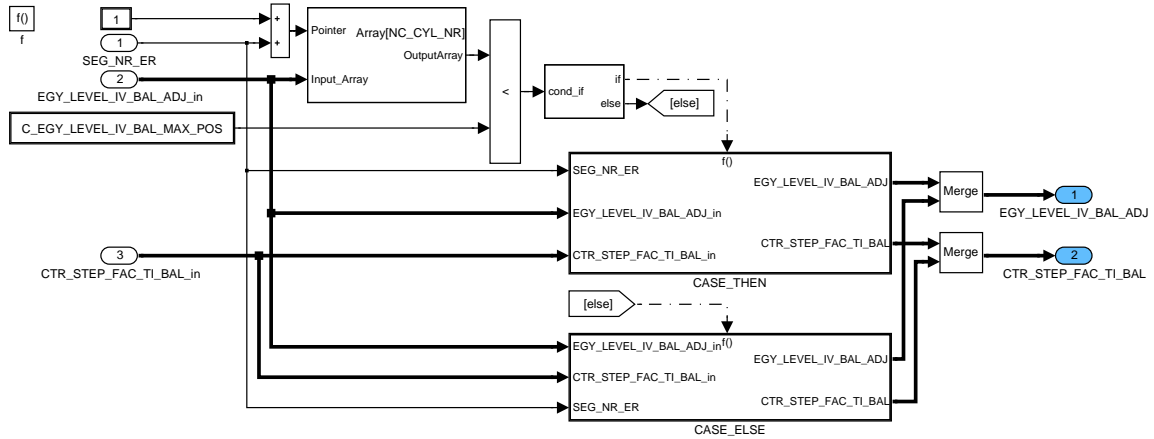


Figure 7.104.30: CYBL\_M30704P01/OPM/OPERATE\_SEG/INJ\_VAL\_EGY\_LEVEL/OPERATE\_SEG/CASE\_THEN/CASE\_THEN/CASE\_THEN

**Cylinder balancing injection valve energy level adjustment (approximation) OPERATE\_SEG CASE\_THEN CASE\_THEN CASE\_THEN**

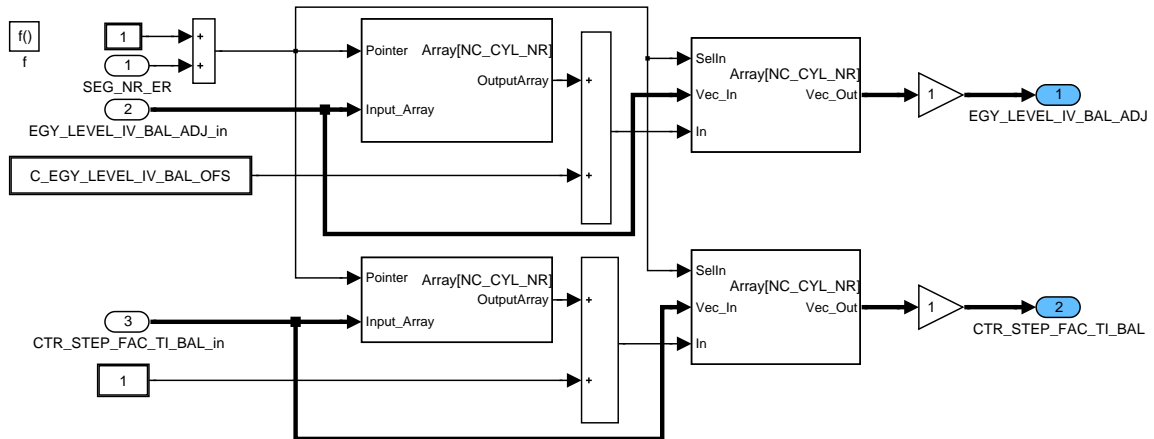


Figure 7.104.31: CYBL\_M30704P01/OPM/OPERATE\_SEG/INJ\_VAL\_EGY\_LEVEL/OPERATE\_SEG/CASE\_THEN/CASE\_THEN/CASE\_THEN/CASE\_THEN

**Cylinder balancing injection valve energy level adjustment (approximation) OPERATE\_SEG CASE\_THEN CASE\_THEN CASE\_ELSE**

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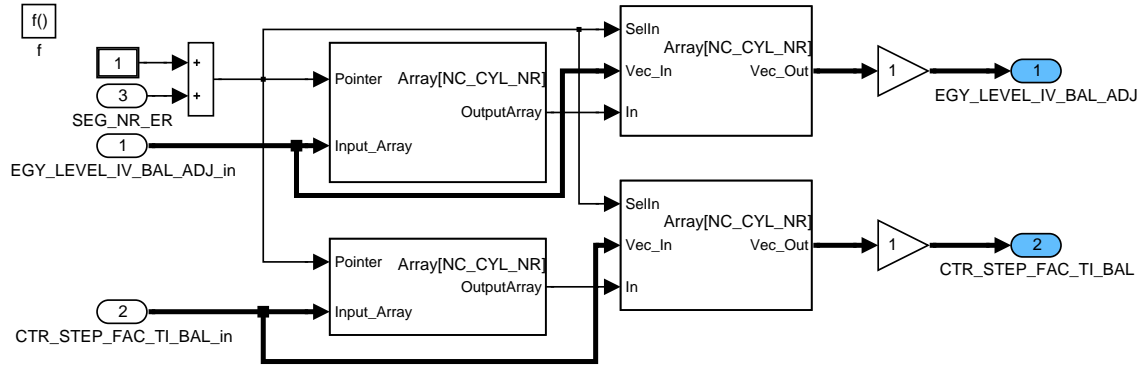


Figure 7.104.32: CYBL\_M30704P01/OPM/OPERATE\_SEG/INJ\_VAL\_EGY\_LEVEL/OPERATE\_SEG/CASE\_THEN/CASE\_THEN/CASE\_THEN/CASE\_ELSE

**Cylinder balancing injection valve energy level adjustment (approximation) OPERATE\_SEG CASE\_THEN CASE\_THEN CASE\_ELSE**

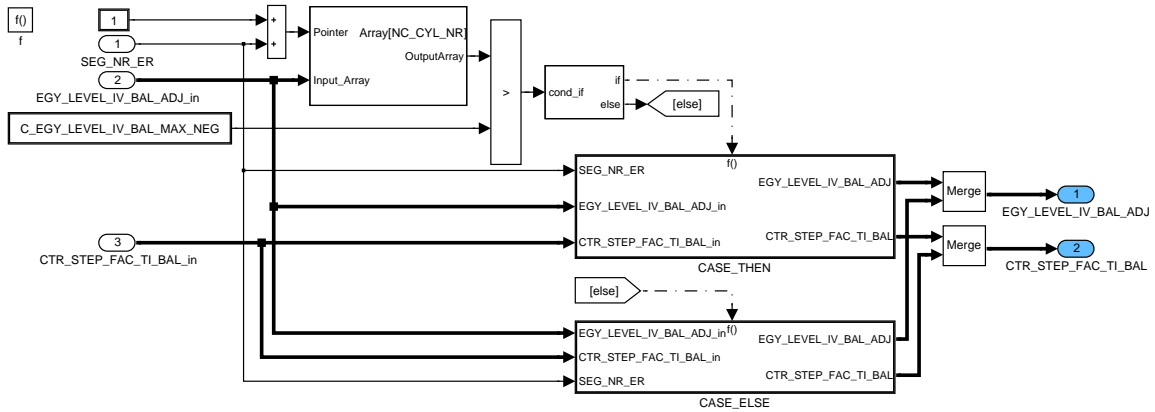


Figure 7.104.33: CYBL\_M30704P01/OPM/OPERATE\_SEG/INJ\_VAL\_EGY\_LEVEL/OPERATE\_SEG/CASE\_THEN/CASE\_THEN/CASE\_ELSE

**Cylinder balancing injection valve energy level adjustment (approximation) OPERATE\_SEG CASE\_THEN CASE\_THEN CASE\_ELSE CASE\_THEN**

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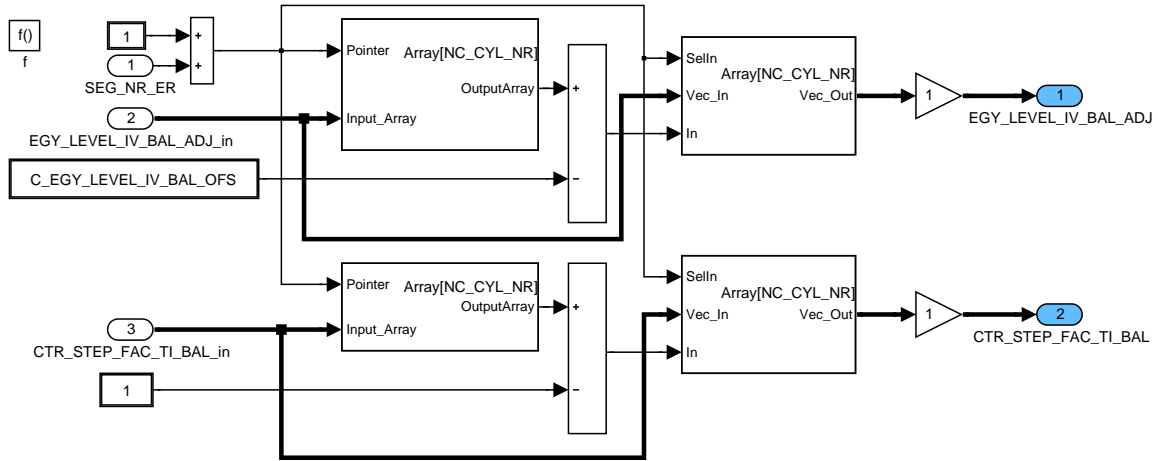


Figure 7.104.34: CYBL\_M30704P01/OPM/OPERATE\_SEG/INJ\_VAL\_EGY\_LEVEL/OPERATE\_SEG/  
CASE\_THEN/CASE\_THEN/CASE\_ELSE/CASE\_THEN

**Cylinder balancing injection valve energy level adjustment (approximation) OPERATE\_SEG CASE\_THEN  
CASE\_THEN CASE\_ELSE CASE\_ELSE**

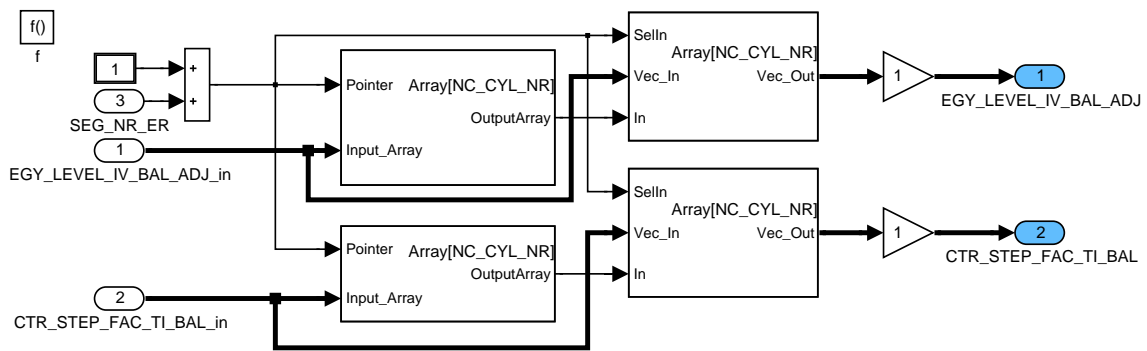


Figure 7.104.35: CYBL\_M30704P01/OPM/OPERATE\_SEG/INJ\_VAL\_EGY\_LEVEL/OPERATE\_SEG/  
CASE\_THEN/CASE\_THEN/CASE\_ELSE/CASE\_ELSE

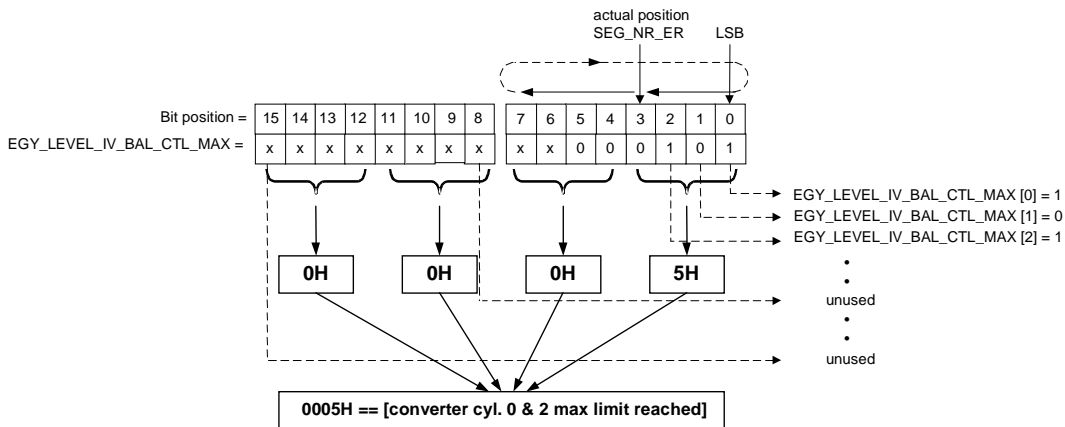
**Cylinder balancing injection valve energy level control**

The formula section is only activated if the switch for a manual reset is set to "0". In case of a manual reset (refer: "Manual Reset of cylinder balancing correction values"), the calculations are stopped at once.

The energy level conversion is only enabled while the manual switch for injection valve energy level calculation is set to "Control" or "ADJ & CTL".

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**Signalization of converter maximum output value reached**



**Note:** always the complete WORD (16BIT) is displayed as visible value

As soon as an energy level conversion of one cylinder is reaching its maximum, a corresponding value is set to "1" to indicate the related cylinder. To save memory resources, the information for all cylinders is located within one output date (WORD). Each BIT information within the WORD is used to indicate one cylinder. It is possible to handle up to 16 cylinders with this method.

For a description more in detail please have a look to the signal flow diagram above. As example, a sixcylinder engine with two converters, which have reached the limits is shown.

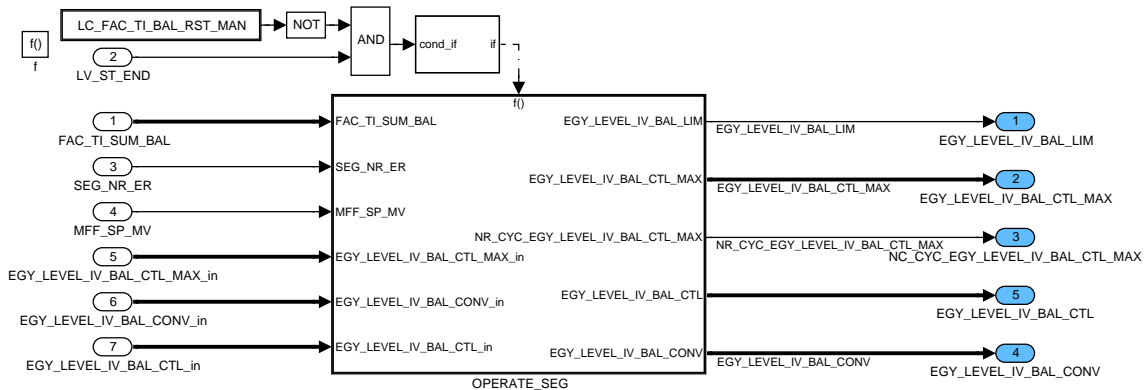


Figure 7.104.36: CYBL\_M30704P01/OPM/OPERATE\_SEG/INJ\_VAL\_EGY\_LEVEL\_CTL

**Cylinder balancing injection valve energy level control OPERATE\_SEG**

("Calculation of the converter part disabled") (CASE\_ELSE)

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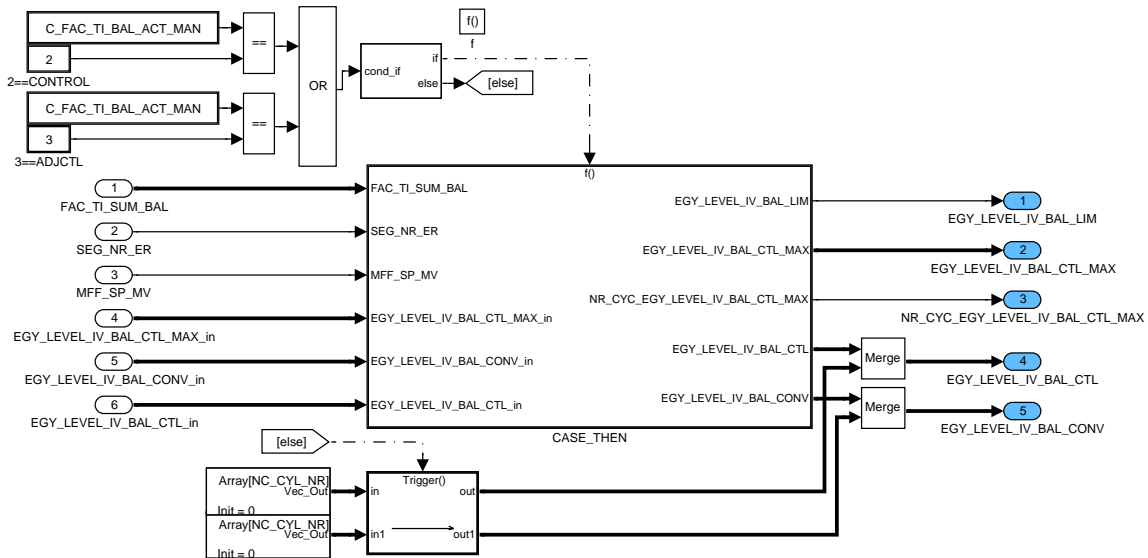


Figure 7.104.37:  
CYBL\_M30704P01/OPM/OPERATE\_SEG/INJ\_VAL\_EGY\_LEVEL\_CTL/OPERATE\_SEG

**Cylinder balancing injection valve energy level control OPERATE\_SEG CASE\_THEN**


("Calculation of the converter part enabled")

Task of this section is to convert the multiple correction factor provided by the cylinder balancing functions into a corresponding energy level value. The energy level signal is used to adjust the injector needle lift.

The outputs of the converter are limited to a calibrateable threshold. If one converter output has reached the limit a flag is set to one and the corresponding segment number is displayed.

The final converter outputs are corrected with a multiple factor out of an interpolation table to compensate different conversion rates for the energy levels at all engine operating areas.

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 3246 of 8404</b>	
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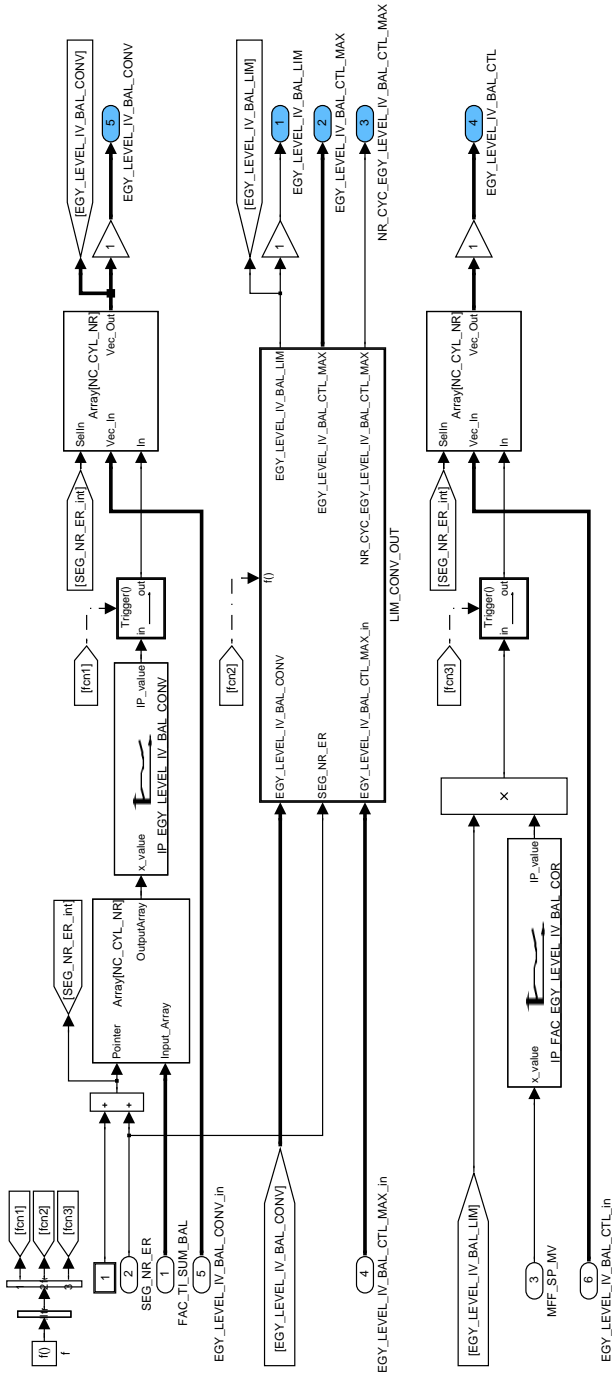



Figure 7.104.38: CYBL\_M30704P01/OPM/OPERATE\_SEG/INJ\_VAL\_EGY\_LEVEL\_CTL/OPERATE\_SEG/CASE\_THEN

**Cylinder balancing injection valve energy level control OPERATE\_SEG CASE\_THEN LIM\_CONV\_OUT**

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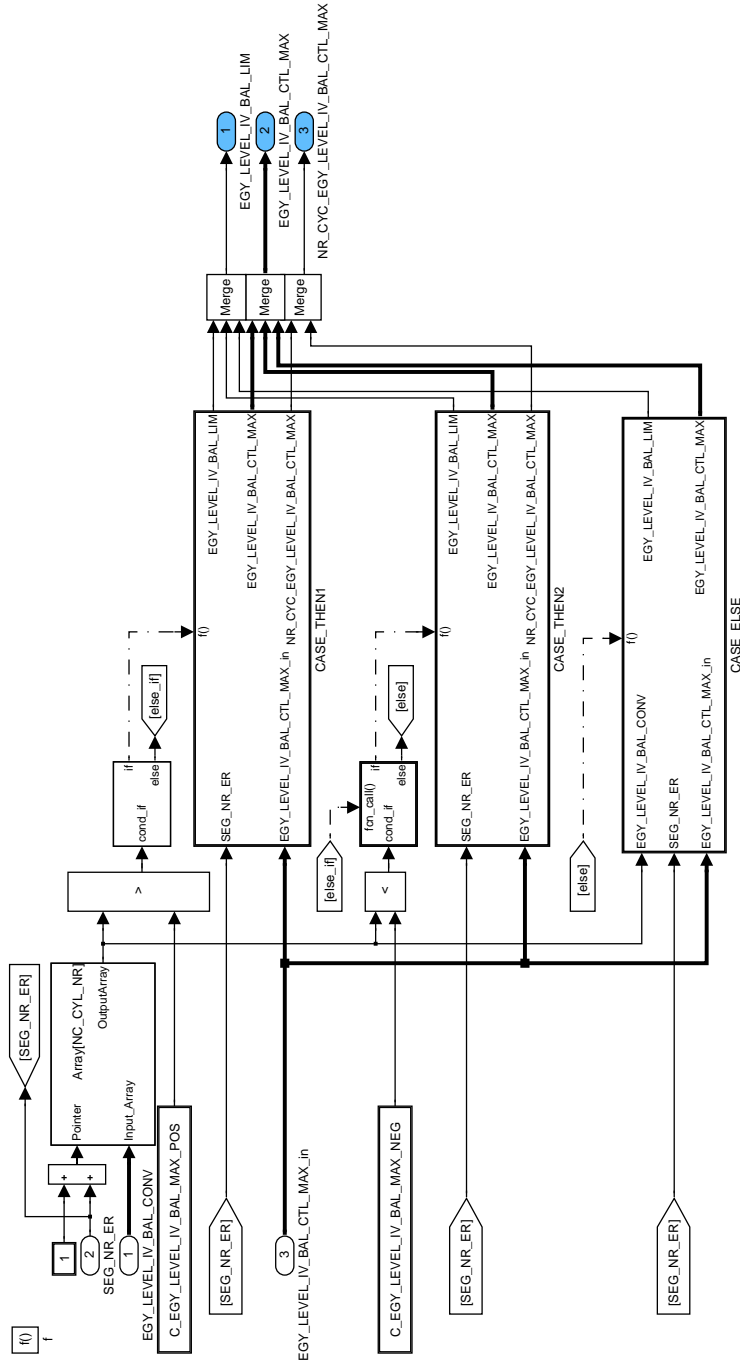



Figure 7.104.39: CYBL\_M30704P01/OPM/OPERATE\_SEG/INJ\_VAL\_EGY\_LEVEL\_CTL/OPERATE\_SEG/CASE\_THEN/LIM\_CONV\_OUT

**Cylinder balancing injection valve energy level control OPERATE\_SEG CASE\_THEN LIM\_CONV\_OUT CASE\_THEN1**

//corresponding segment number where the controller has reached the limit

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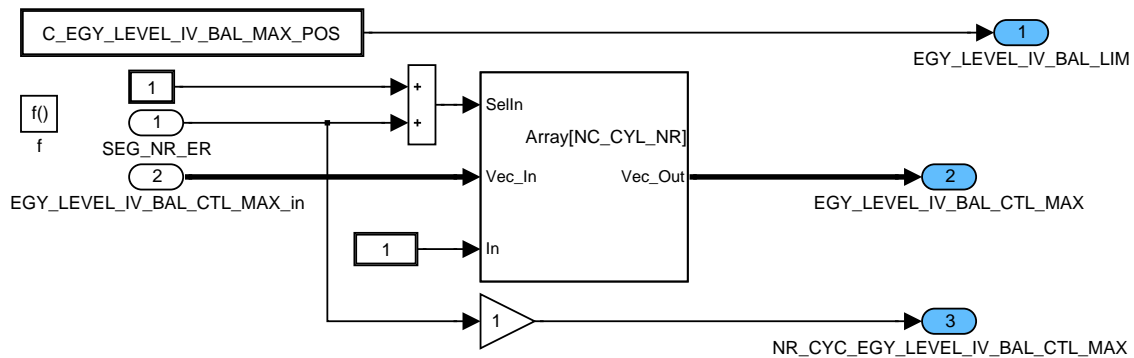


Figure 7.104.40: CYBL\_M30704P01/OPM/OPERATE\_SEG/INJ\_VAL\_EGY\_LEVEL\_CTL/OPERATE\_SEG/CASE\_THEN/LIM\_CONV\_OUT/CASE\_THEN1

### Cylinder balancing injection valve energy level control OPERATE\_SEG CASE\_THEN LIM\_CONV\_OUT CASE\_THEN2

//corresponding segment number where the controller has reached the limit

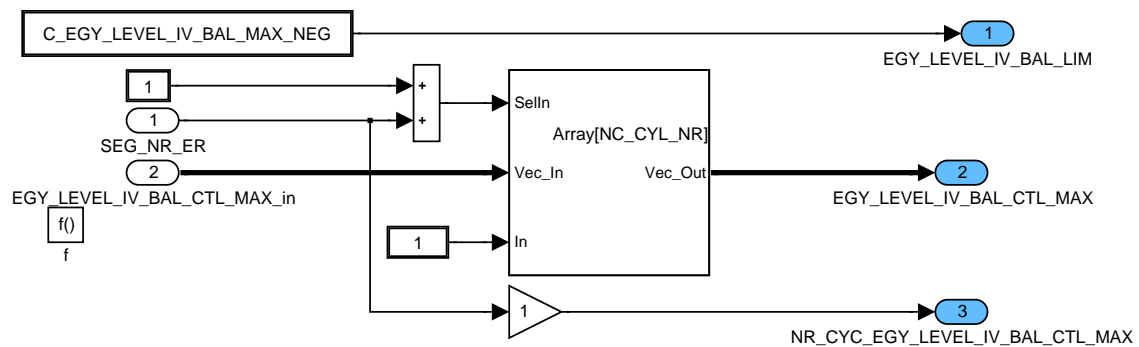


Figure 7.104.41: CYBL\_M30704P01/OPM/OPERATE\_SEG/INJ\_VAL\_EGY\_LEVEL\_CTL/OPERATE\_SEG/CASE\_THEN/LIM\_CONV\_OUT/CASE\_THEN2

### Cylinder balancing injection valve energy level control OPERATE\_SEG CASE\_THEN LIM\_CONV\_OUT CASE\_ELSE

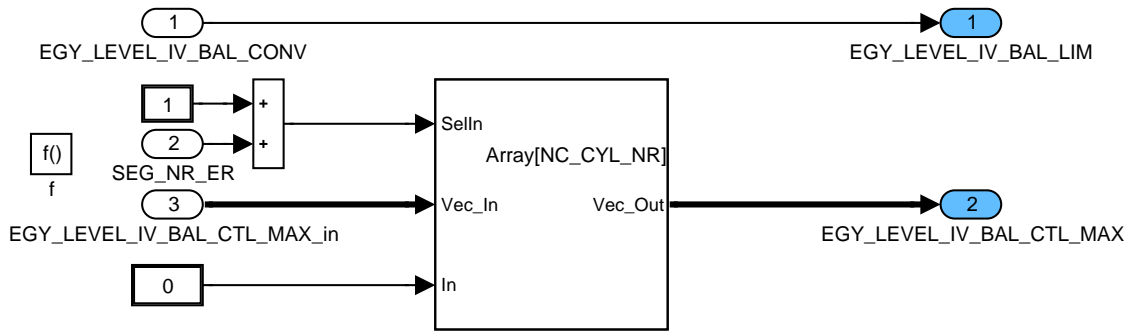


Figure 7.104.42: CYBL\_M30704P01/OPM/OPERATE\_SEG/INJ\_VAL\_EGY\_LEVEL\_CTL/OPERATE\_SEG/CASE\_THEN/LIM\_CONV\_OUT/CASE\_ELSE

**Calculation of overall correction factors for cylinder balancing at engine run**

The formula section is only activated if the switch for a manual reset is set to "0". In case of a manual reset (: "Manual Reset of cylinder balancing correction values"), the calculations are stopped at once.

Finally, the calculation of the total cylinder balancing correction output values takes place. The output values are used to adjust the wanted cylinder individual corrections. All injection valve correction values are calculated at any engine operating area depending of the chosen control strategy.

To avoid high cylinder to cylinder torque differences, especially at first activation after engine start and at cylinder balancing via ER activation, all total cylinder correction values are calculated within one segment. Later on, only the correction values of the current valid segment is calculated. The control is realized by a calibrateable forloop with adjustable "start" and "stop" parameters.

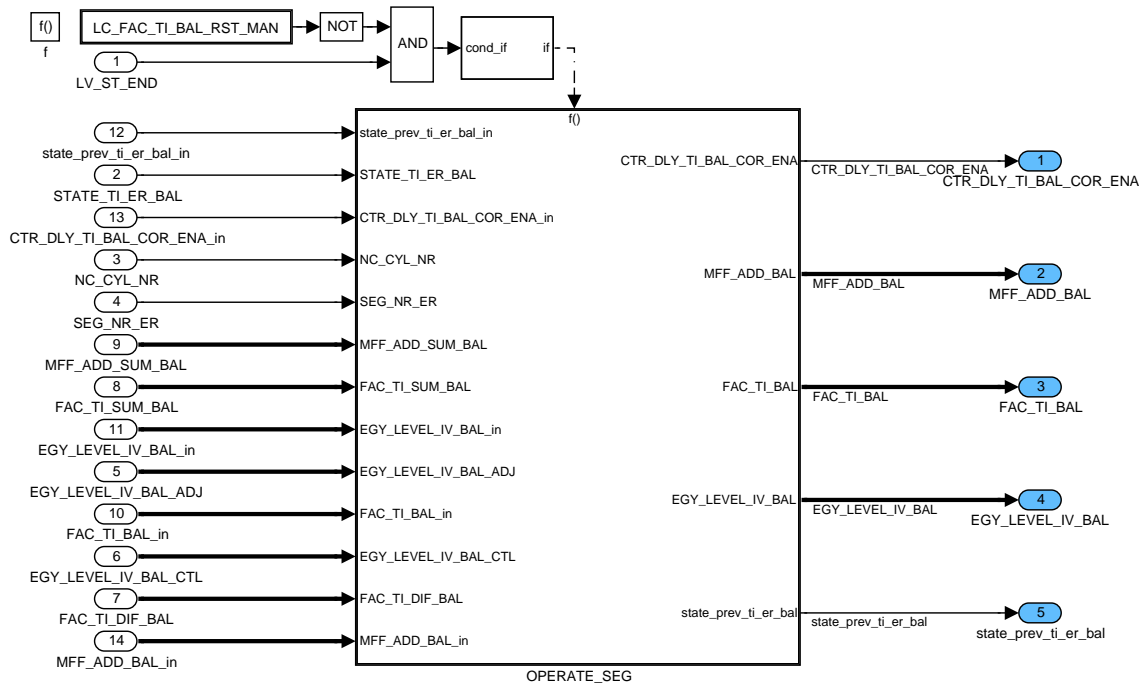


Figure 7.104.43: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC\_ERU

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**Calculation of overall correction factors for cylinder balancing at engine run OPERATE\_SEG**

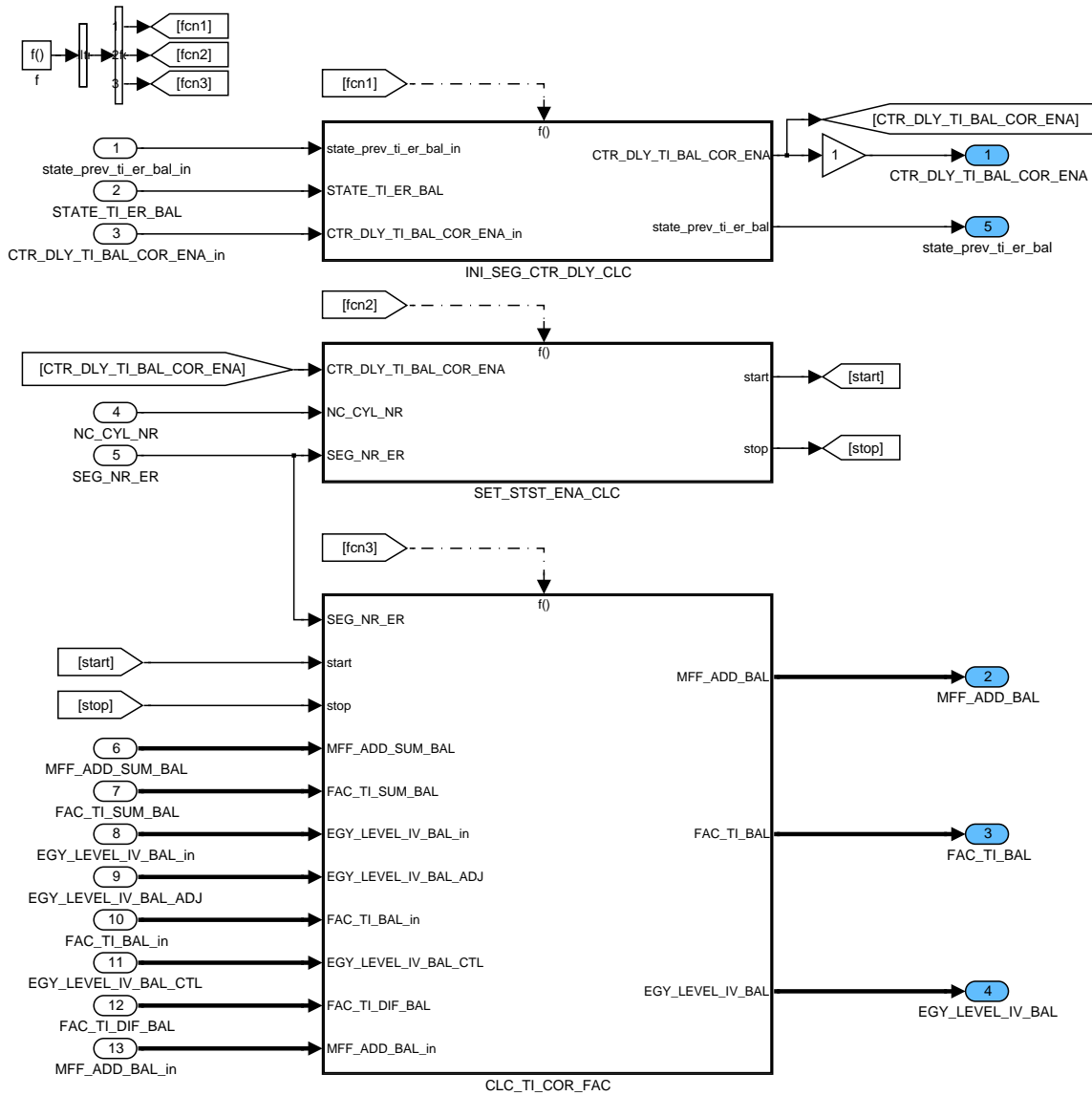


Figure 7.104.44: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC\_ERU/OPERATE\_SEG

**Calculation of overall correction factors for cylinder balancing at engine run OPERATE\_SEG  
INI\_SEG\_CTR\_DLY\_CLC**

Initialization of segment counter to delay calculation of overall TI correction factors at engine run:

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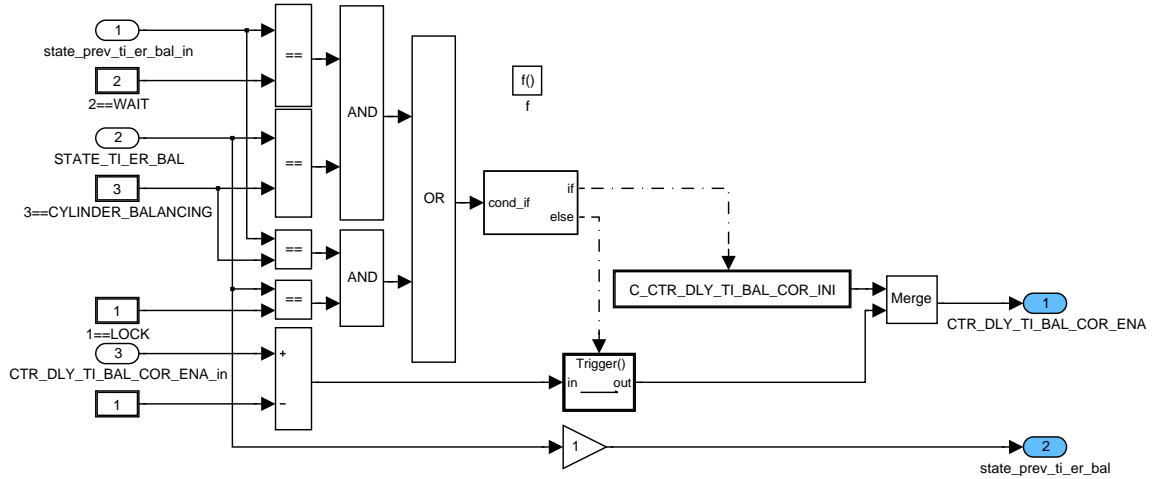


Figure 7.104.45: - CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC\_ERU/OPERATE\_SEG/INI\_SEG\_CTR\_DLY\_CLC

**Calculation of overall correction factors for cylinder balancing at engine run OPERATE\_SEG SET STST\_ENA\_CLC**

Setting of "start - "stop" - parameter to enable calculation of overall TI correction factors at engine run:

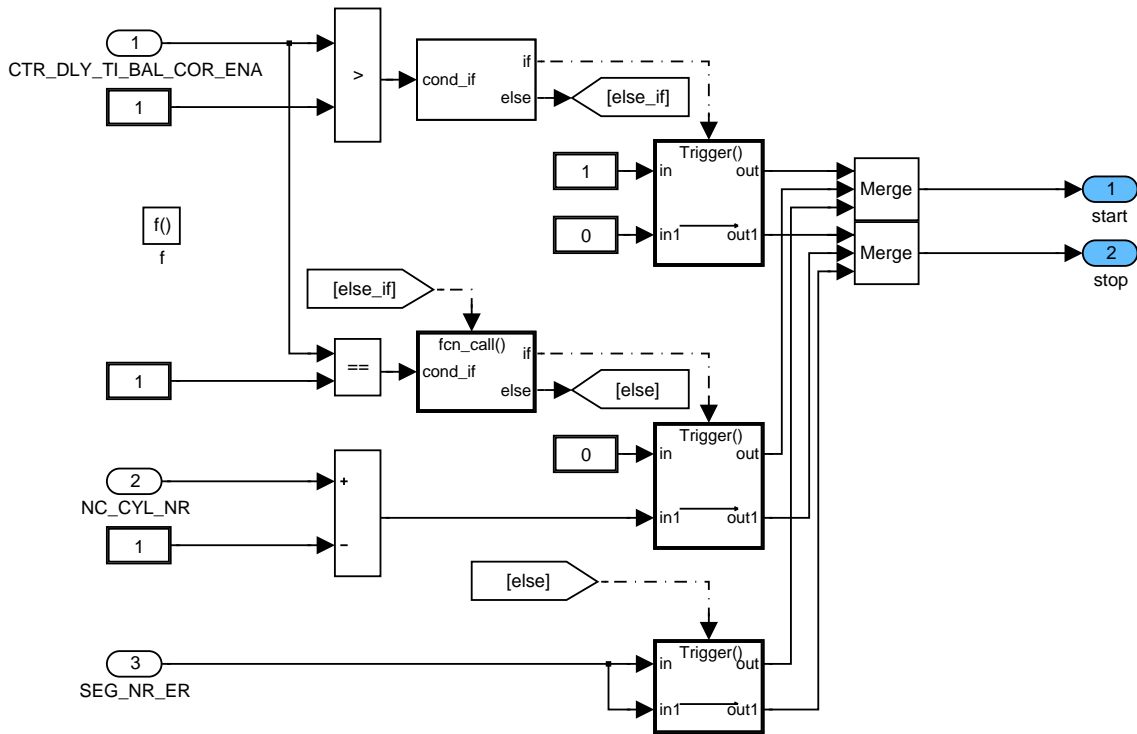



Figure 7.104.46: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC\_ERU/OPERATE\_SEG/SET\_STST\_ENA\_CLC

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## Calculation of overall correction factors for cylinder balancing at engine run OPERATE\_SEG CLC\_TI\_COR\_FAC

Calculation of overall TI correction factors (additive, multiple, energy levels) at engine run:

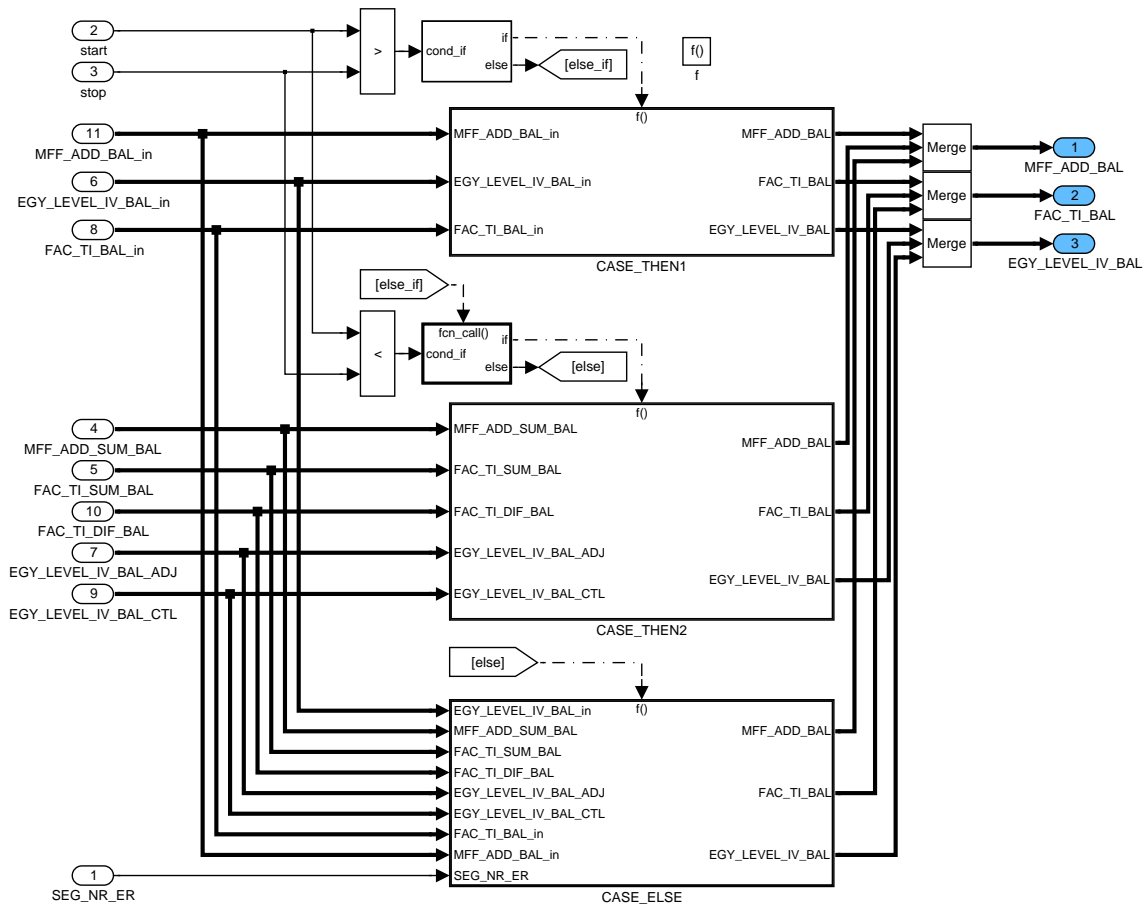


Figure 7.104.47: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC\_ERU/OPERATE\_SEG/CLC\_TI\_COR\_FAC

## Calculation of overall correction factors for cylinder balancing at engine run OPERATE\_SEG CLC\_TI\_COR\_FAC CASE\_THEN1

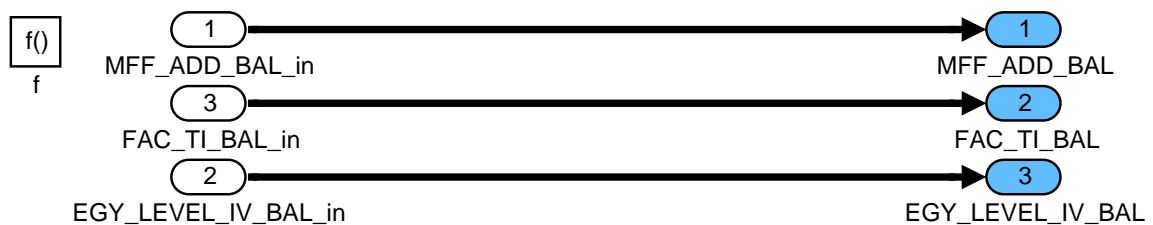


Figure 7.104.48: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC\_ERU/OPERATE\_SEG/CLC\_TI\_COR\_FAC/CASE\_THEN1

## Calculation of overall correction factors for cylinder balancing at engine run OPERATE\_SEG CLC\_TI\_COR\_FAC\_CASE\_THEN2

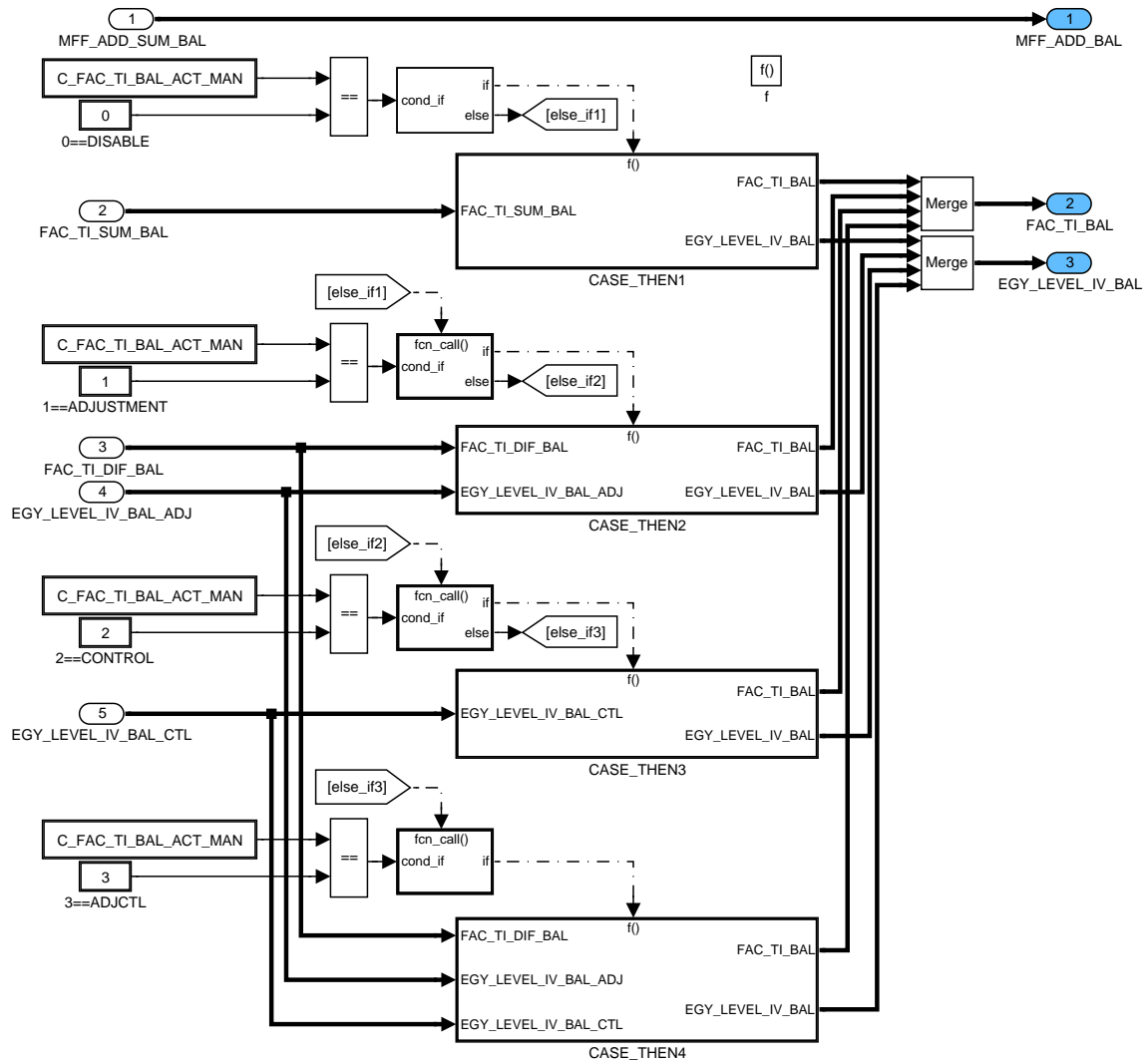


Figure 7.104.49: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC\_ERU/OPERATE\_SEG/CLC\_TI\_COR\_FAC/CASE\_THEN2

## Calculation of overall correction factors for cylinder balancing at engine run OPERATE\_SEG CLC\_TI\_COR\_FAC\_CASE\_THEN2 CASE\_THEN1

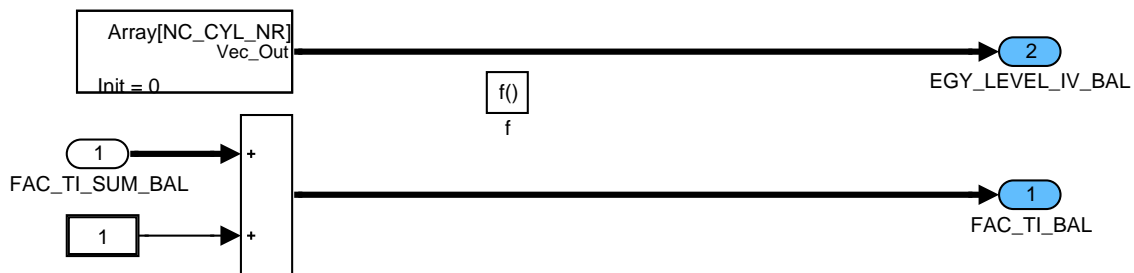


Figure 7.104.50: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC\_ERU/OPERATE\_SEG/CLC\_TI\_COR\_FAC/CASE\_THEN2/CASE\_THEN1

### Calculation of overall correction factors for cylinder balancing at engine run OPERATE\_SEG CLC\_TI\_COR\_FAC CASE\_THEN2 CASE\_THEN2

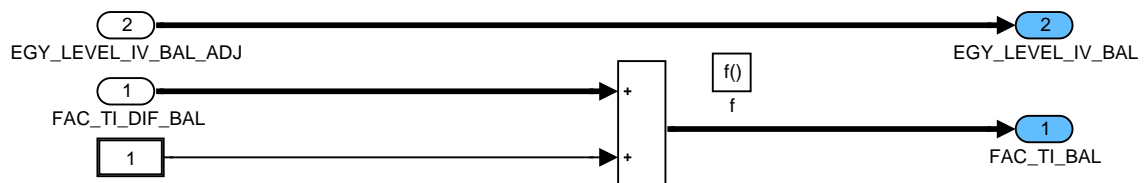


Figure 7.104.51: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC\_ERU/OPERATE\_SEG/CLC\_TI\_COR\_FAC/CASE\_THEN2/CASE\_THEN2

### Calculation of overall correction factors for cylinder balancing at engine run OPERATE\_SEG CLC\_TI\_COR\_FAC CASE\_THEN2 CASE\_THEN3

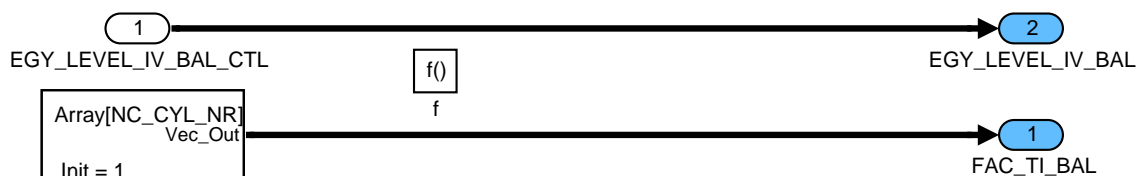


Figure 7.104.52: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC\_ERU/OPERATE\_SEG/CLC\_TI\_COR\_FAC/CASE\_THEN2/CASE\_THEN3

### Calculation of overall correction factors for cylinder balancing at engine run OPERATE\_SEG CLC\_TI\_COR\_FAC CASE\_THEN2 CASE\_THEN4

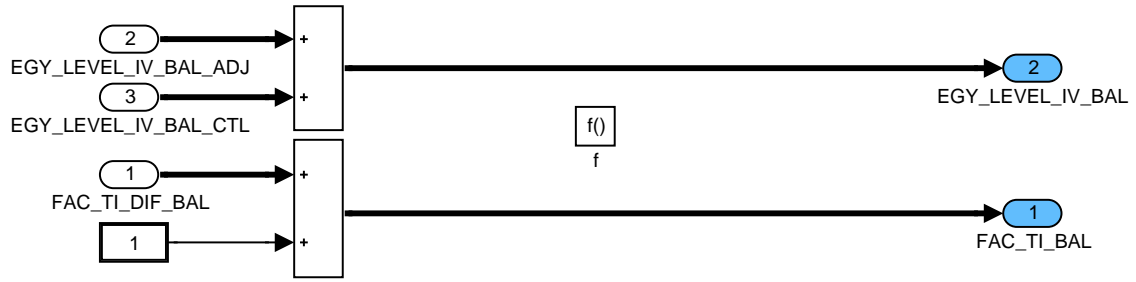



Figure 7.104.53: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC\_ERU/OPERATE\_SEG/CLC\_TI\_COR\_FAC/CASE\_THEN2/CASE\_THEN4

**Calculation of overall correction factors for cylinder balancing at engine run OPERATE\_SEG CLC\_TI\_COR\_FAC CASE\_ELSE**

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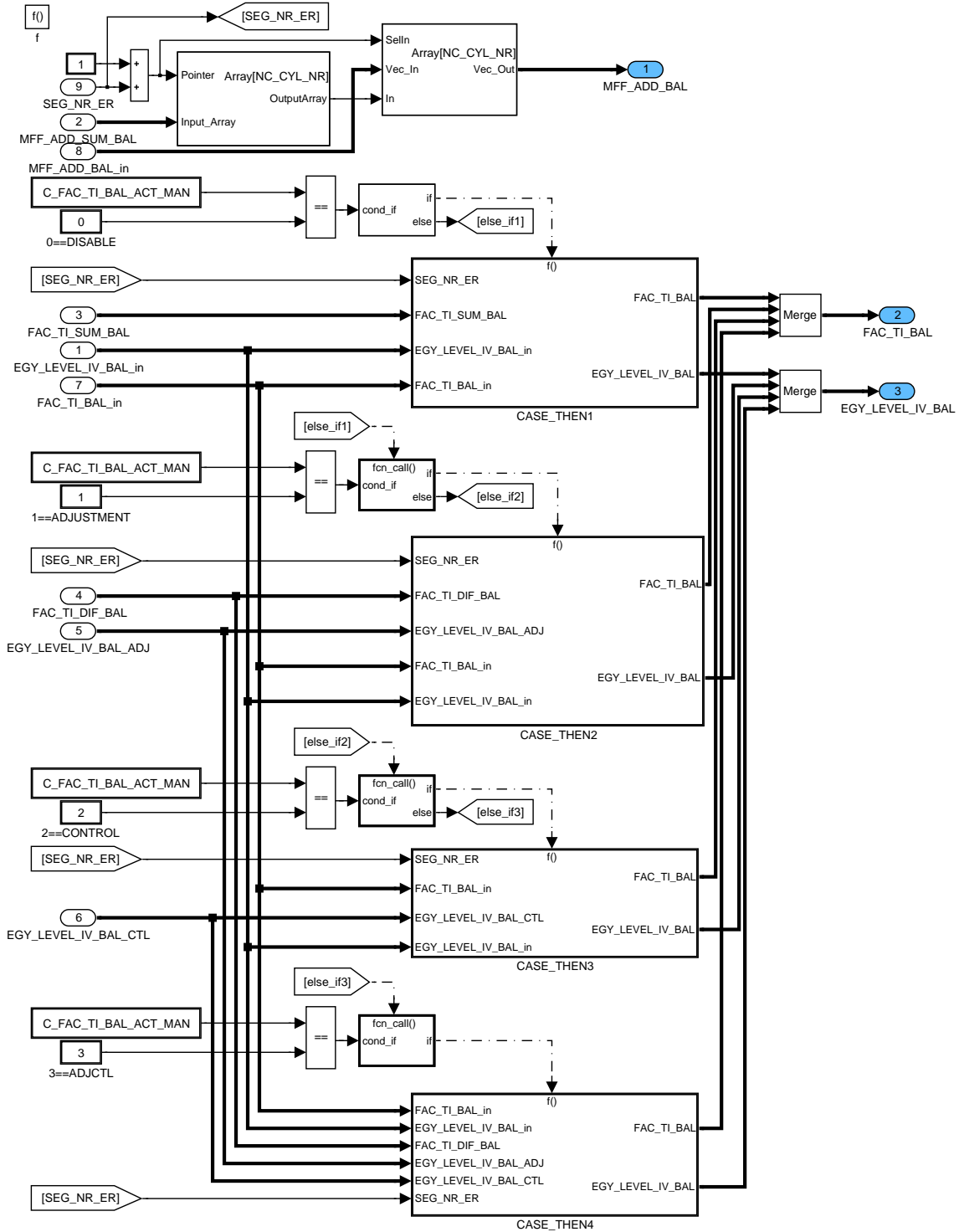


Figure 7.104.54: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC\_ERU/OPERATE\_SEG/CLC\_TI\_COR\_FAC/CASE\_ELSE

**Calculation of overall correction factors for cylinder balancing at engine run OPERATE\_SEG CLC\_TI\_COR\_FAC CASE\_ELSE CASE\_THEN1**

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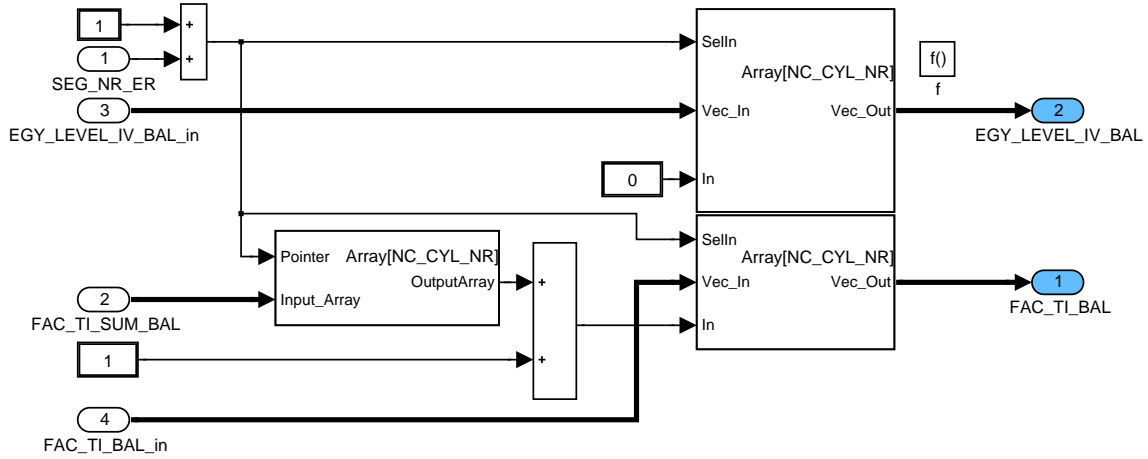


Figure 7.104.55: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC\_ERU/OPERATE\_SEG/CLC\_TI\_COR\_FAC/CASE\_ELSE/CASE\_THEN1

**Calculation of overall correction factors for cylinder balancing at engine run OPERATE\_SEG CLC\_TI\_COR\_FAC CASE\_ELSE CASE\_THEN2**

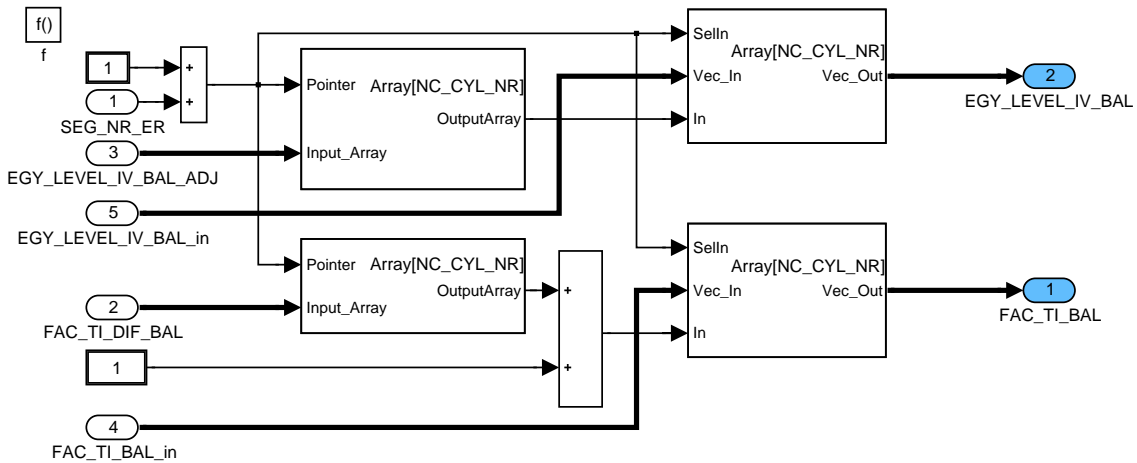


Figure 7.104.56: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC\_ERU/OPERATE\_SEG/CLC\_TI\_COR\_FAC/CASE\_ELSE/CASE\_THEN2

**Calculation of overall correction factors for cylinder balancing at engine run OPERATE\_SEG CLC\_TI\_COR\_FAC CASE\_ELSE CASE\_THEN3**

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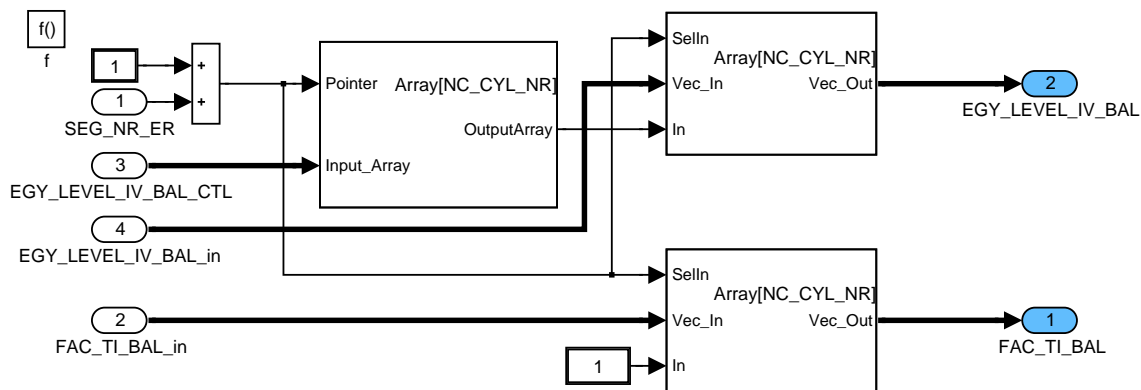


Figure 7.104.57: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC\_ERU/OPERATE\_SEG/CLC\_TI\_COR\_FAC/CASE\_ELSE/CASE\_THEN3

**Calculation of overall correction factors for cylinder balancing at engine run OPERATE\_SEG CLC\_TI\_COR\_FAC CASE\_ELSE CASE\_THEN4**

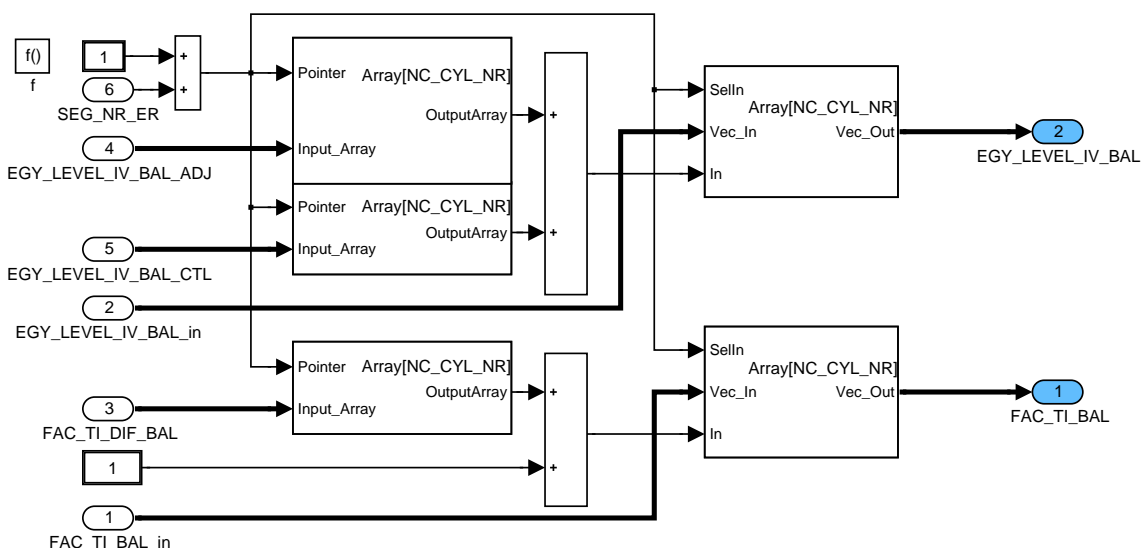


Figure 7.104.58: CYBL\_M30704P01/OPM/OPERATE\_SEG/CLC\_COR\_FAC\_ERU/OPERATE\_SEG/CLC\_TI\_COR\_FAC/CASE\_ELSE/CASE\_THEN4

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### 7.104.3 SUBFUNCTION: SIG\_MNG

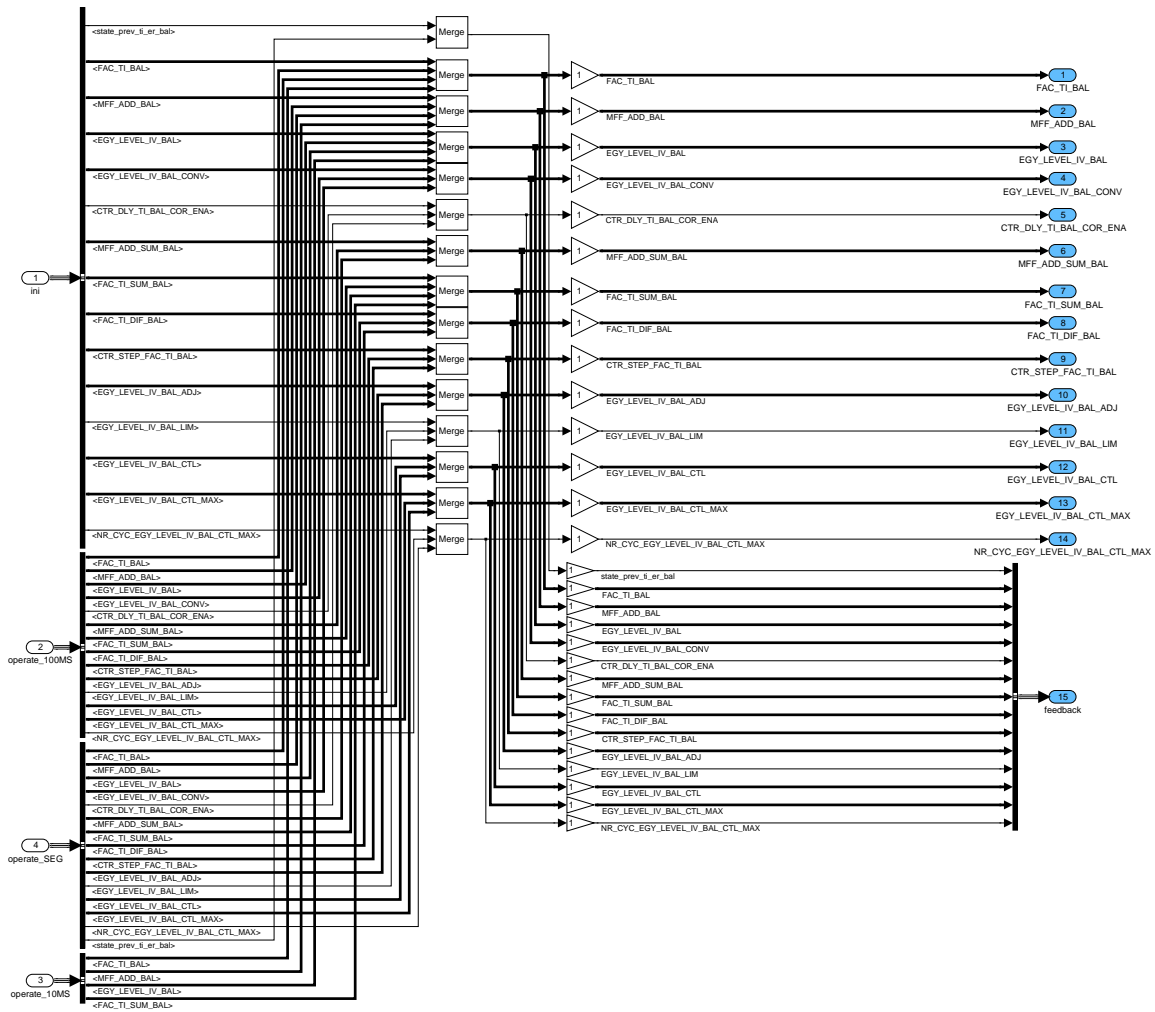


Figure 7.104.59: CYBL\_M30704P01/SIG\_MNG

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## 7.105 Cylinder balancing via engine roughness (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DIST_IV_DIF	-	0... FFFFH	0... 524280	8	km
Difference between actual distance and distance at last injector change					
LV_CYL_BAL_HOM_REQ_EXT	O/V	0... 1H	0 ...1	1	-
External homogenous combustion mode request for cylinder balancing					
MFF_ADD_BAL_EXT [NC_CYL_NR]	O/V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
External cylinder balancing additive MFF correction value					
T_AST_BAL	O/V	0... FFFFH	0... 6553.5	0.1	s
Time after exit start for cylinder balancing					
TCO_ST_BAL	O/V	0... FEH	0... 142.5	0.75	°C
Coolant temperature at start for cylinder balancing					

### Input data:

DIST_IV_CHG [NC_CYL_NR] {p. 2289}	DIST_KWP {p. 1183}	LF_ERR_PLAUS_IV_MFF_ CAL {p. 4790}	LV_CYL_BAL_ER_CDN_ BAS {p. 4022}
LV_CYL_BAL_LAM_AD_ REQ_CUS {p. 1015}	LV_LAM_ORNG_LAM_AD_ REQ [NC_CBK_EX_NR] {p. 6141}	LV_ST_END {p. 1720}	MFF_ABSV_IV_EXT_ADJ [NC_CYL_NR] {p. 7681}
NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	T_AST {p. 1766}	TCO_ST {p. 1100}

### Calibration data:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MFF_ABSV_IV_EXT_ADJ [NC_CYL_NR]	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Default value for external cylinder balancing absolute MFF correction value					
C_MFF_NOM_IV_EXT_ADJ	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Default value for external cylinder balancing nominal MFF correction value					
IP_MFF_ADD_IV_AGI_DIST	-	0... FFFFH	0... 694.489403	0.02119478	mg/stk
LDP_DIST_IV_DIF_IP_MFF_ADD_AGI	16	0... FFFFH	0... 524280	8	km
Additive MFF correction value depending on driving distance for compensation of aging effects					
LC_MFF_ADD_IV_EXT_ADJ_ENA	-	0... 1H	0 ...1	1	-
Logical constant to enable external adjustment of cylinder balancing additive MFF correction					

### General information

This application incidence module is used as interface module between the project specific key word protocol (KWP) and the generic cylinder balancing functionality. The KWP provides for every piezo injector and absolute MFF value, which is determined at end of injector production line and imported to the ECU at vehicle production.

To take the aging of each injector into consideration, the distance since the last injector change is calculated. The determined distance is basic for an additive MFF offset value out of an interpolation table.

It is possible to adjust default values provided by a constant array instead of the input values from the key word protocol (KWP). For this purpose a separate switch (logical constant) is existing to manage the absolute MFF setpoint values. In serial production, always the KWP values have to be used.

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### Application Condition

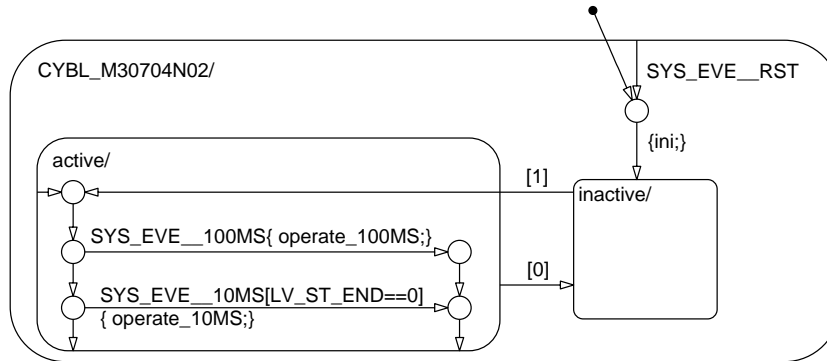

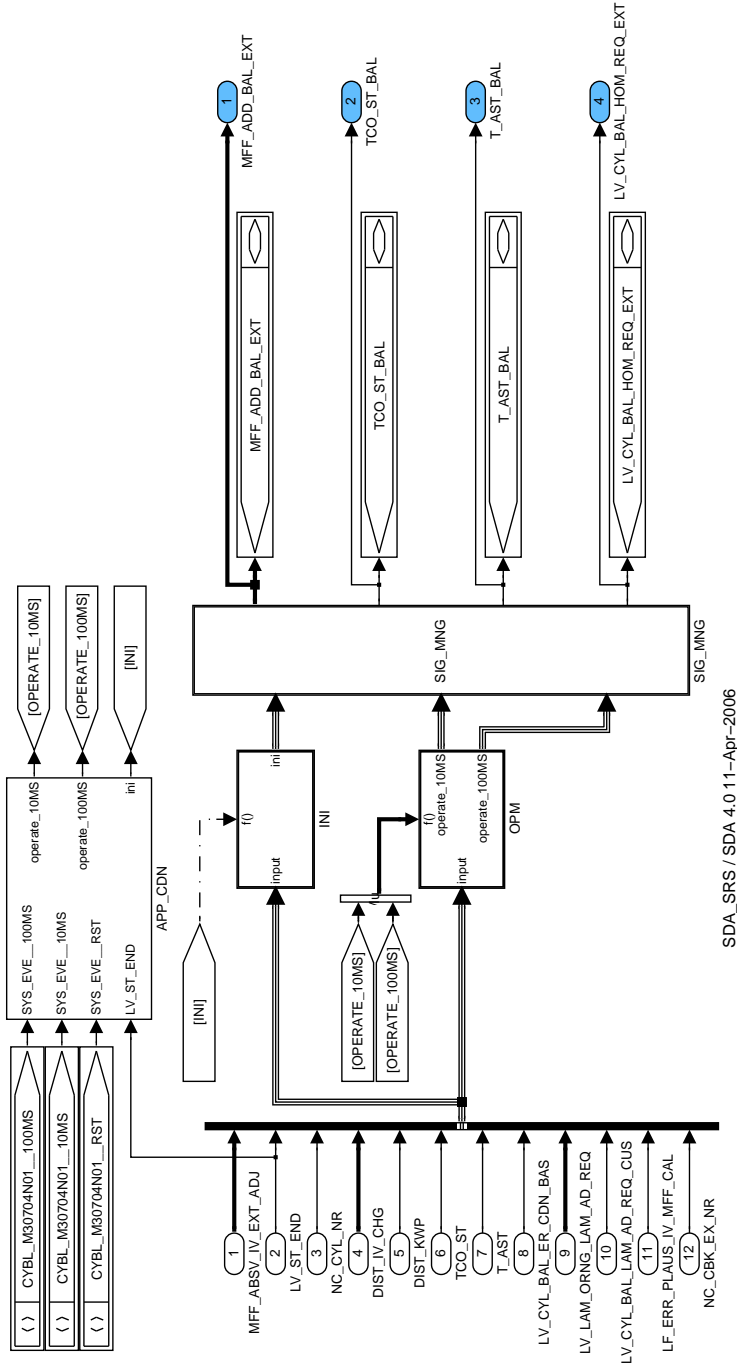


Figure 7.105.1: CYBL\_M30704N01/APP\_CDN/Chart

### Function Description

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 3262 of 8404</b>	
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SDA\_SRS / SDA 4.0 11-Apr-2006

Figure 7.105.2: CYBL\_M30704N01

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### 7.105.1 Calculation of variables at reset

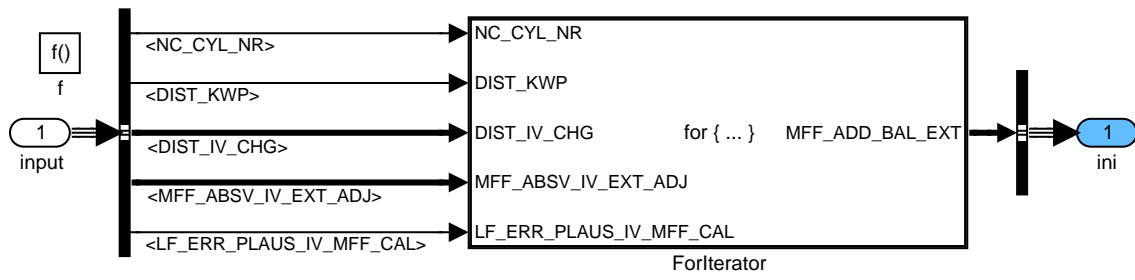


Figure 7.105.3: CYBL\_M30704N01/INI

### Calculation of variables at reset FORITERATOR

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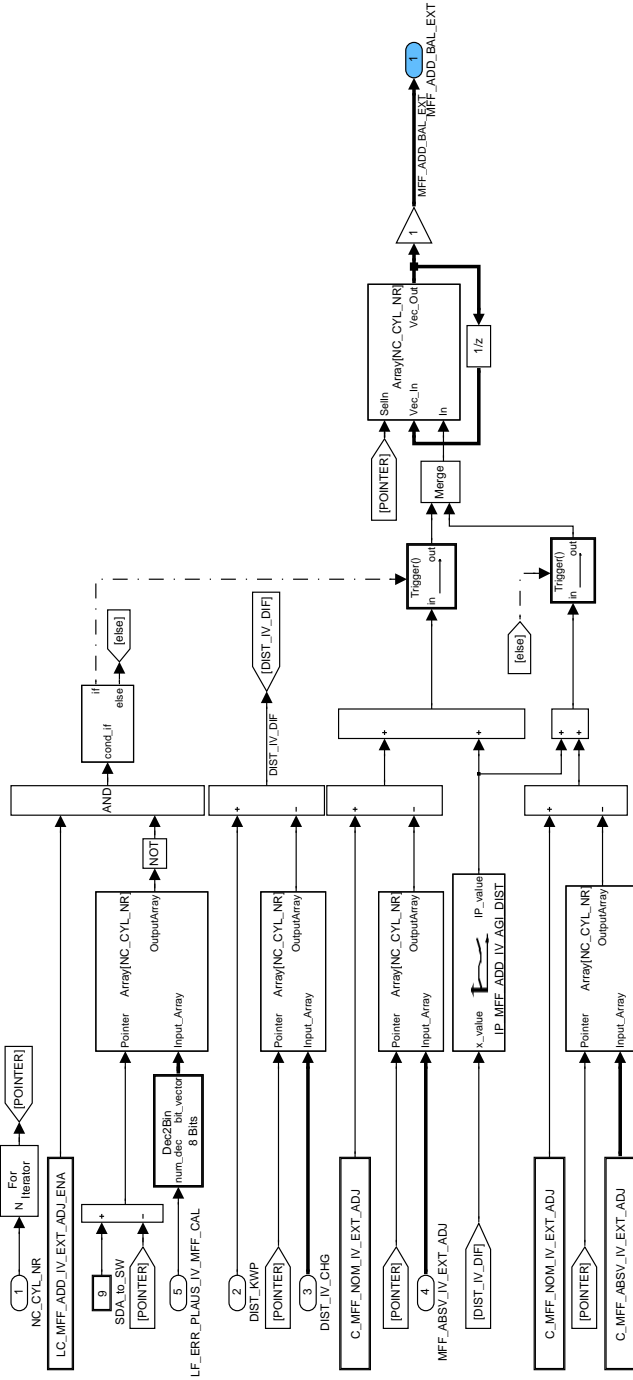



Figure 7.105.4: CYBL\_M30704N01/INI/ForIterator

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### 7.105.2 Calculation of 100ms and 10ms tasks

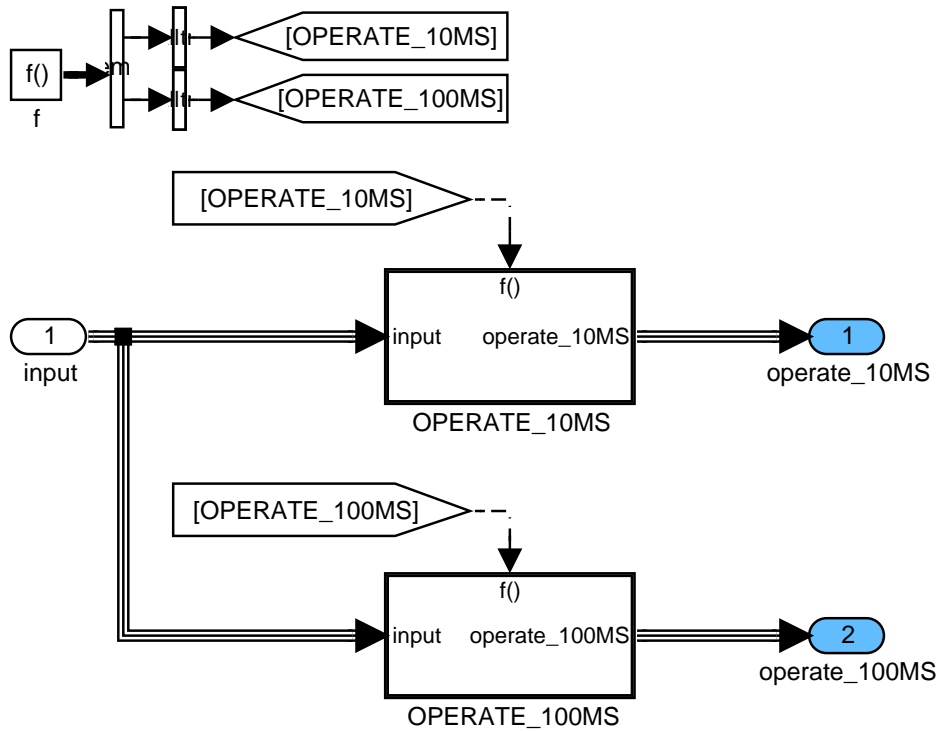


Figure 7.105.5: CYBL\_M30704N01/OPM

### External aging and coding correction values for cylinder balancing

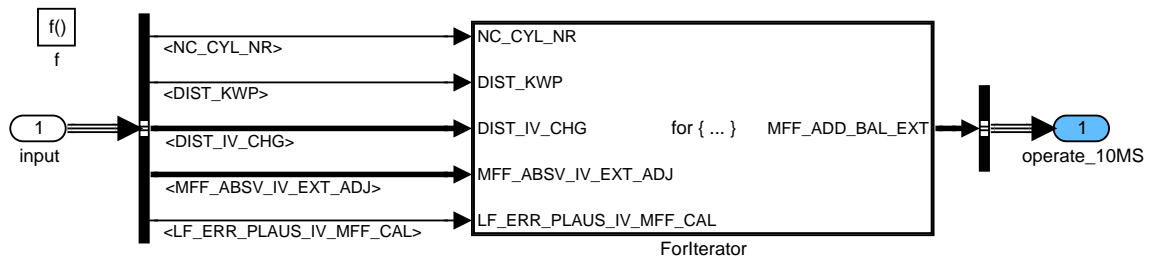


Figure 7.105.6: CYBL\_M30704N01/OPM/OPERATE\_10MS

### Calculation of external additive MFF offset values

```
//calculation of additive MFF offset values with KWP inputs (case then)
//adjustment of default additive MFF offset values from constant array (case then)
```

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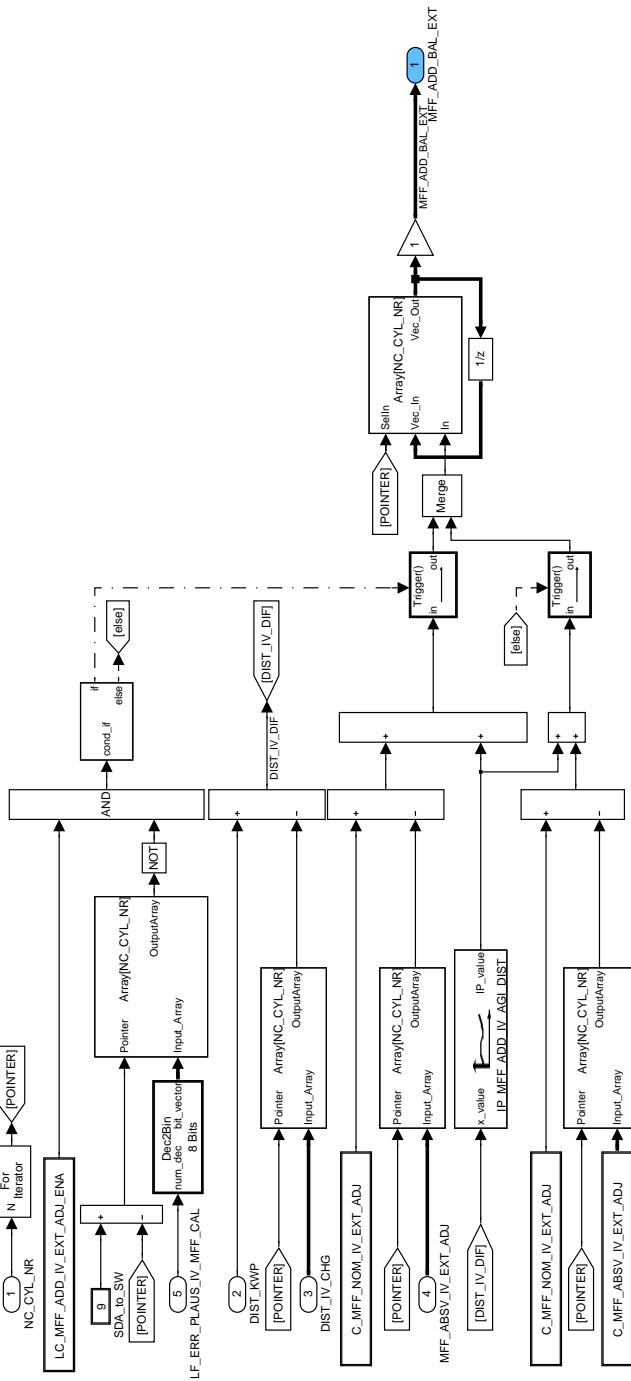



Figure 7.105.7: CYBL\_M30704N01/OPM/OPERATE\_10MS/ForIterator

### Adjustment of interface parameter for cylinder balancing

Goal of this chapter is to adjust interface parameter from other aggregates to cylinder balancing issues. Due to this modification it is possible to use one cylinder balancing version for all projects.

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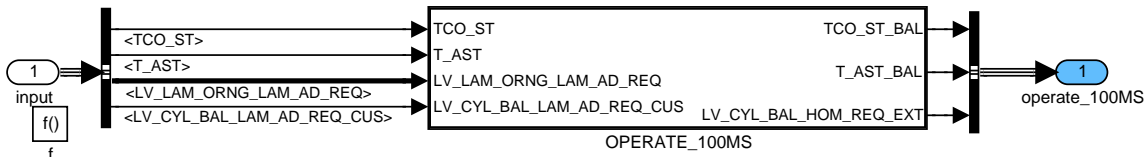


Figure 7.105.8: CYBL\_M30704N01/OPM/OPERATE\_100MS

**Adjustment of interface parameter for cylinder balancing OPERATE\_100MS**

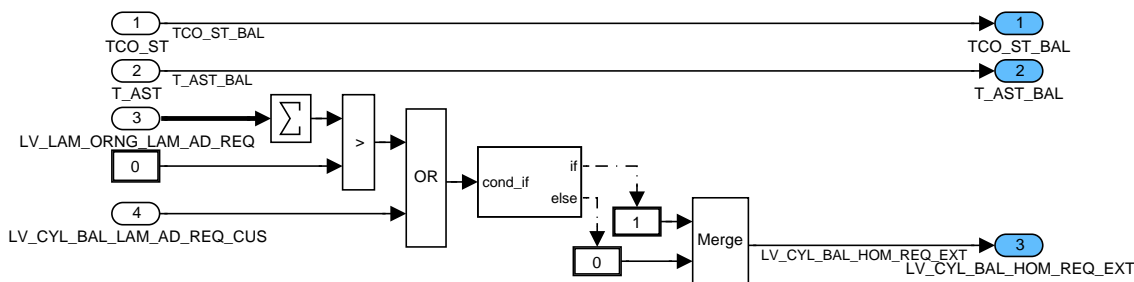


Figure 7.105.9: CYBL\_M30704N01/OPM/OPERATE\_100MS/OPERATE\_100MS

**7.105.3 SUBFUNCTION: SIG\_MNG**

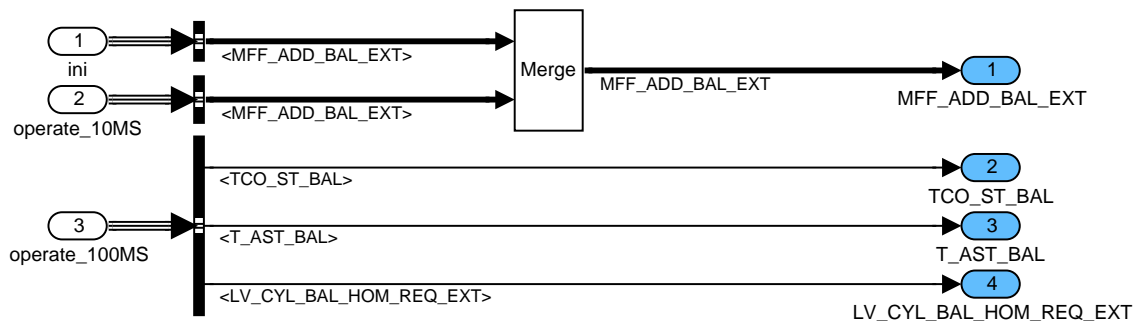


Figure 7.105.10: CYBL\_M30704N01/SIG\_MNG

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## 7.106 Cylinder balancing via additive mass fuel flow intervention

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ER_STND_MFF_ADD_ER_BAL	V	8000... 7FFFH	0... 325.77	0.00994202	1/s**2
Controller input value at additive path of cylinder balancing via MFF intervention					
LV_ER_STND_MFF_ADD_ER_BAL	V	0... 1H	0 ...1	1	-
Flag for controller input at additive path of cylinder balancing via MFF intervention					
LV_MFF_ADD_ER_BAL_OBD_MAX_NEG [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag for minimum OBD limit reached at additive part of engine roughness based cylinder balancing					
LV_MFF_ADD_ER_BAL_OBD_MAX_POS [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag for maximum OBD limit reached at additive part of engine roughness based cylinder balancing					
MFF_ADD_AD_ER_BAL [NC_CYL_NR]	O/V/S	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Additive adaptation value for cylinder balancing via MFF intervention					
MFF_ADD_ER_BAL [NC_CYL_NR]	O/V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Additive correction value for cylinder balancing via MFF intervention					
MFF_ADD_ER_BAL_COR [NC_CYL_NR]	V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Corrected additive correction value for cylinder balancing via MFF intervention					
MFF_ADD_ER_BAL_CTL	V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Controller output value at additive path of cylinder balancing via MFF intervention					
MFF_ADD_ER_BAL_CTL_I [NC_CYL_NR]	V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
I part of the controller output value at additive path of cylinder balancing via MFF intervention					
MFF_ADD_ER_BAL_CTL_MAX	V	0... FFFFH	0... 65535	1	-
Controller output value maximum limit reached at additive path of cylinder balancing via MFF intervention					
MFF_ADD_ER_BAL_CTL_P	V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
P part of the controller output value at additive path of cylinder balancing via MFF intervention					
MFF_ADD_ER_BAL_LIM [NC_CYL_NR]	V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Limited controller output value at additive path of cylinder balancing via MFF intervention					
NR_CYC_MFF_ADD_ER_BAL_CTL_MAX	V	0... FFH	0... 255	1	-
Corresponding segment number of the controller that has reached the maximum limit (additive MFF path)					

### Input data:

ER_STND_MMV_DIF_BAL [NC_CYL_NR] {p. 1489}	LV_MFF_ADD_AD_ER_ BAL_ENA {p. 4006}	LV_MFF_ADD_AD_ER_ BAL_EXT_ADJ {p. 7483}	LV_MFF_ADD_ER_BAL_ ENA {p. 4006}
LV_TI_ER_BAL_ACT {p. 4022}	NC_CYL_NR {p. 1526}	SEG_NR_ER {p. 1454}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CYCNR_MFF_ADD_ER_BAL	-	1... FFH	1... 255	1	-
Number of cycles for calculation of controller output values for cylinder balancing via MFF intervention					
C_ER_STND_THD_NEG_MFF_ADD_BAL	-	8000... 7FFFH	0... 325.77	0.00994202	1/s**2
Negative threshold for ER input value at additive path of cylinder balancing via MFF intervention					
C_ER_STND_THD_POS_MFF_ADD_BAL	-	8000... 7FFFH	0... 325.77	0.00994202	1/s**2
Positive threshold for ER input value at additive path of cylinder balancing via MFF intervention					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MFF_ADD_ER_BAL_CTL_MAX_NEG	-	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Negative maximum limit for controller output at additive path of cylinder balancing via MFF intervention					
C_MFF_ADD_ER_BAL_CTL_MAX_POS	-	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Positive maximum limit for controller output at additive path of cylinder balancing via MFF intervention					
C_MFF_ADD_ER_BAL_OBD_MAX_NEG	-	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Negative maximum OBD limit for additive correction value of cylinder balancing via MFF intervention					
C_MFF_ADD_ER_BAL_OBD_MAX_POS	-	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Positive maximum OBD limit for additive correction value of cylinder balancing via MFF intervention					
C_MFF_ADD_ER_BAL_RST	-	0H 1H 2H	INI_ZERO INI_CTL INI_AD	-	-
Reset of additive correction and adaptation values for cylinder balancing via MFF intervention					
IP_MFF_ADD_I_ER_BAL	-	0... FFFFH	0... 694.489403	0.02119478	mg/stk
LDP_ER_STND_MFF_ADD_IP_I_ER_BAL	8	0... FFFFH	0... 325.77	0.0099313	1/s**2
Controller I part value for additive path of cylinder balancing via MFF intervention					
IP_MFF_ADD_P_ER_BAL	-	0... FFFFH	0... 694.489403	0.02119478	mg/stk
LDP_ER_STND_MFF_ADD_IP_P_ER_BAL	8	0... FFFFH	0... 325.77	0.0099313	1/s**2
Controller P part value for additive path of cylinder balancing via MFF intervention					
LC_MFF_ADD_AD_ER_BAL_RST_MAN	-	0... 1H	0 ...1	1	-
Manual reset of additive adaptation values for cylinder balancing via MFF intervention					
LC_MFF_ADD_ER_BAL_COR	-	0... 1H	0 ...1	1	-
Manual switch for overall correction of controller output values for cylinder balancing via MFF intervention					
LC_MFF_ADD_ER_BAL_RST_MAN	-	0... 1H	0 ...1	1	-
Manual reset of additive correction values for cylinder balancing via MFF intervention					

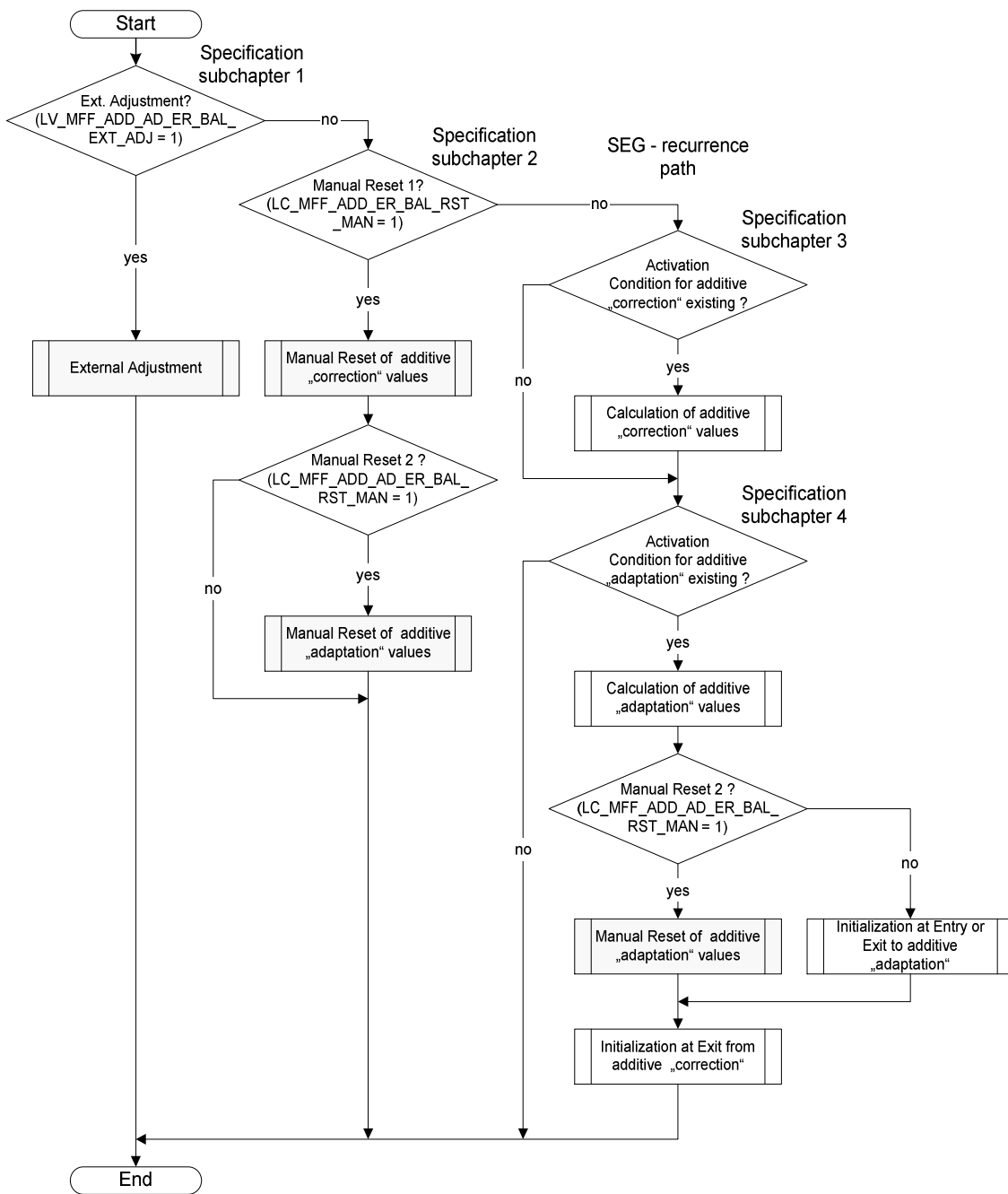
## General information

The calculation of the additive correction or adaptation values is performed, depending on the settings of the corresponding logical activation variable. LV\_MFF\_ADD\_ER\_BAL\_ENA is used to enable the correction path, while LV\_MFF\_ADD\_AD\_ER\_BAL\_ENA enables the adaptation path. As soon as the corresponding logical value is set to 1 in combination with additional activation conditions, the calculation is started.

The calculated additive adaptation value MFF\_ADD\_AD\_ER\_BAL[NC\_CYL\_NR] for each cylinder is stored in the nonvolatile memory to be available for initialization issues at next engine run.


With use of the manual reset it is possible to initialize the additive correction or adaptation values with zero at any time. In this case, the flags which indicate the exceeding of a controller output limitation are set to zero as well (refer: Initialization at Manual Reset )

Signal flow diagram:



**Application Condition**

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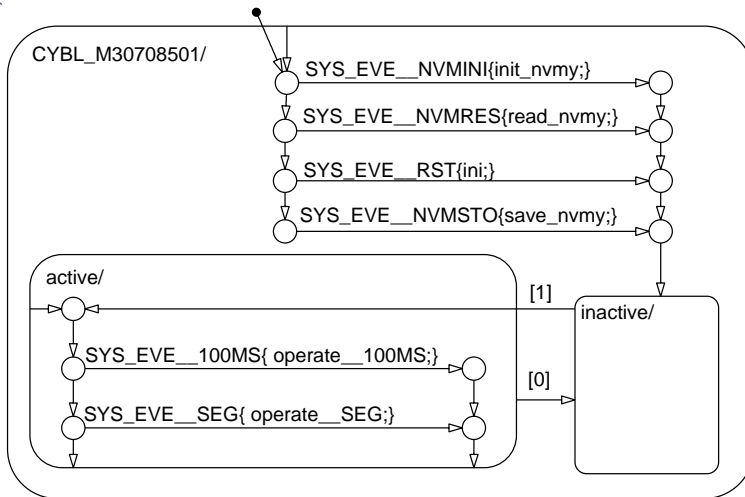



Figure 7.106.1: CYBL\_M30708501/APP\_CDN/Chart

**Function Description**

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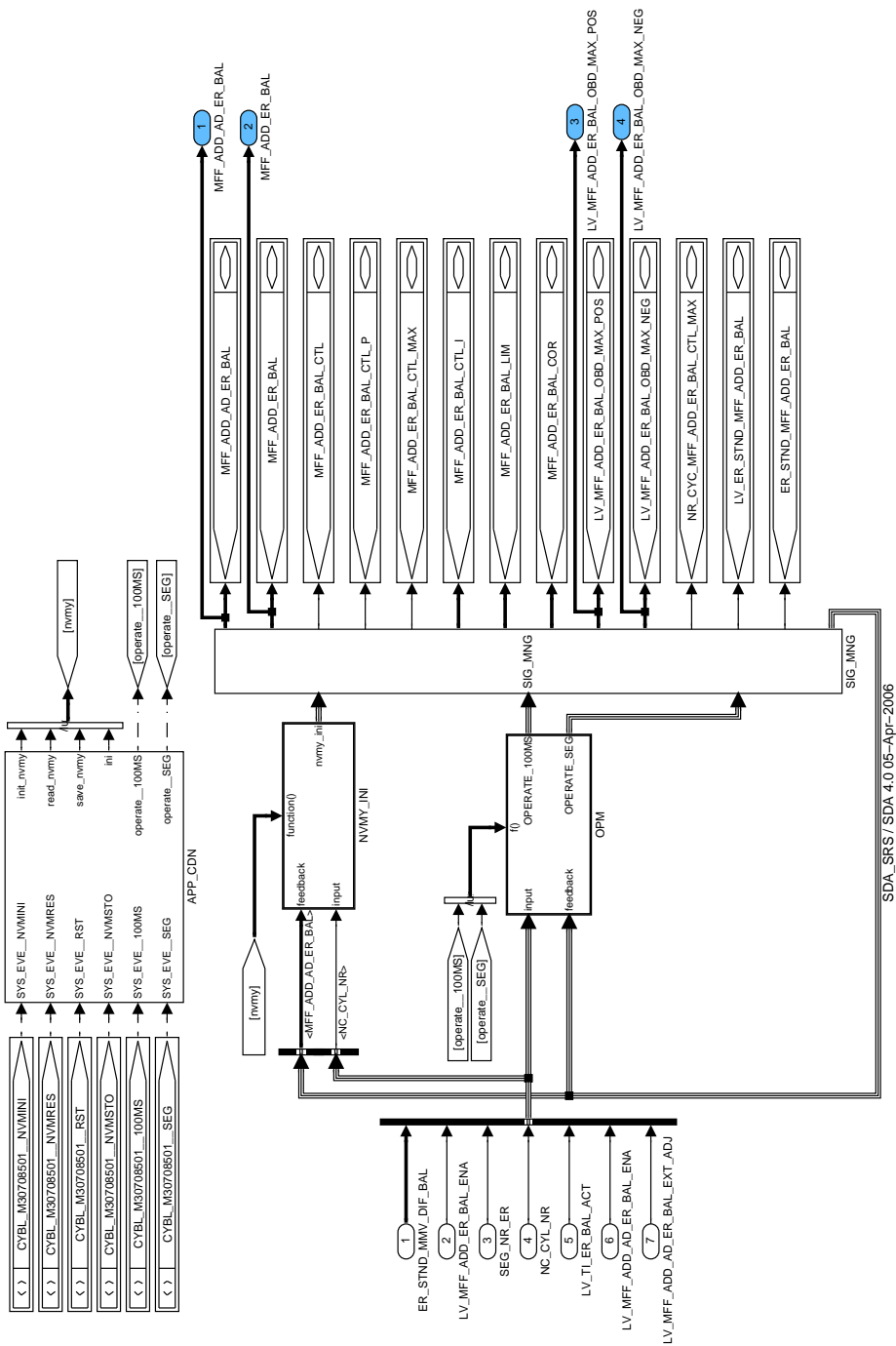


Figure 7.106.2: CYBL\_M30708501

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### 7.106.1 Calculation of non volatile memory tasks

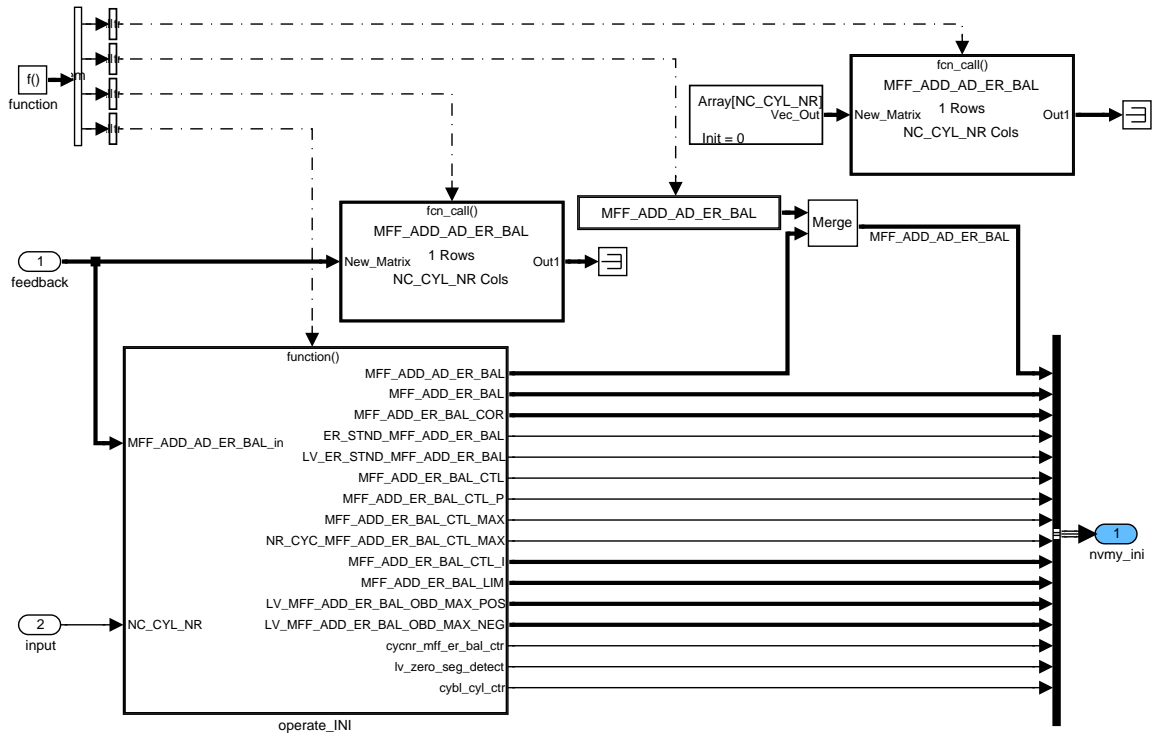



Figure 7.106.3: CYBL\_M30708501/NVMY\_INI

#### Calculation of variables at reset task

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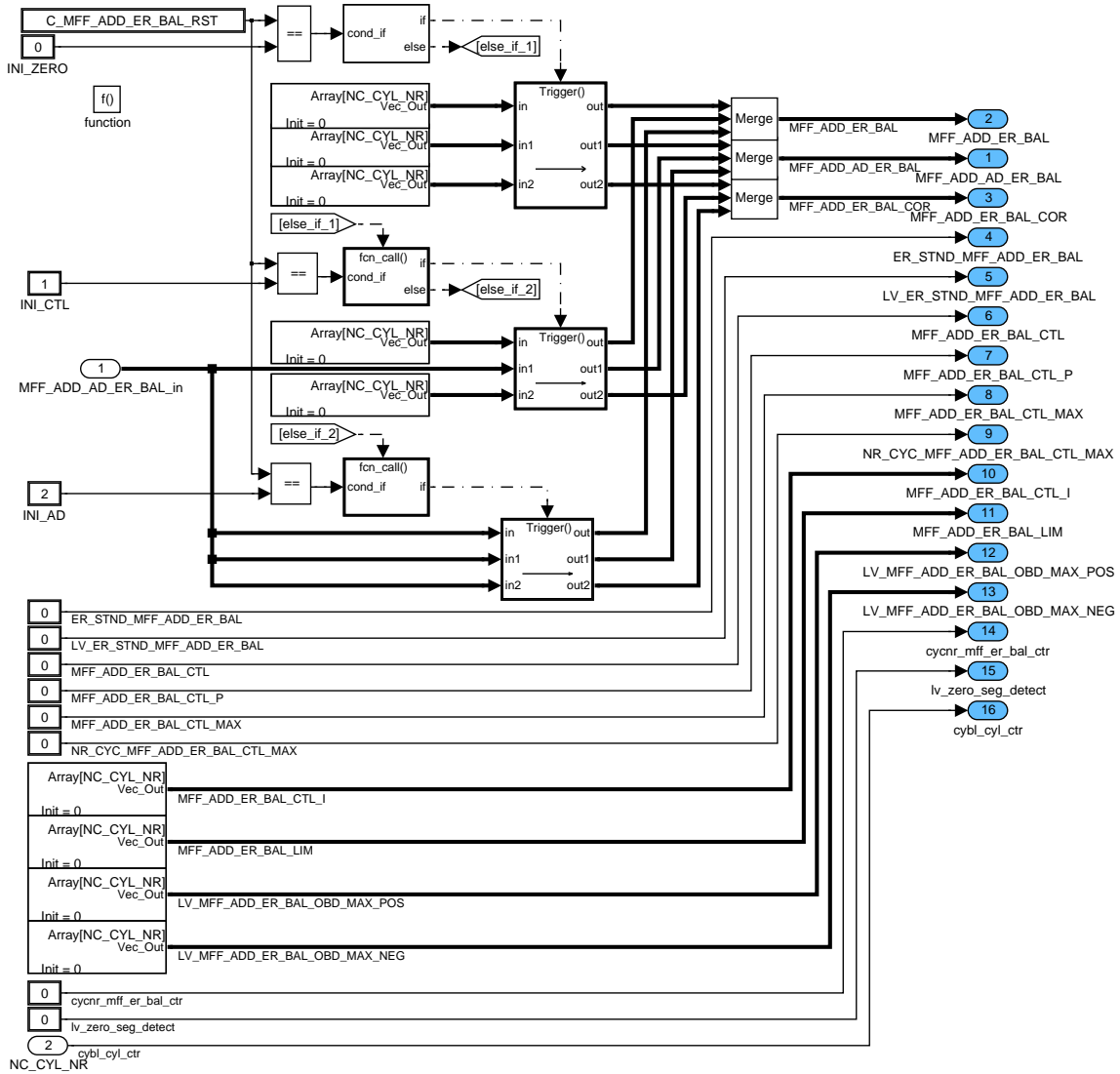


Figure 7.106.4: CYBL\_M30708501/NVMY\_INI/operate\_INI

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### 7.106.2 Calculation of 100ms and segment synchronous tasks

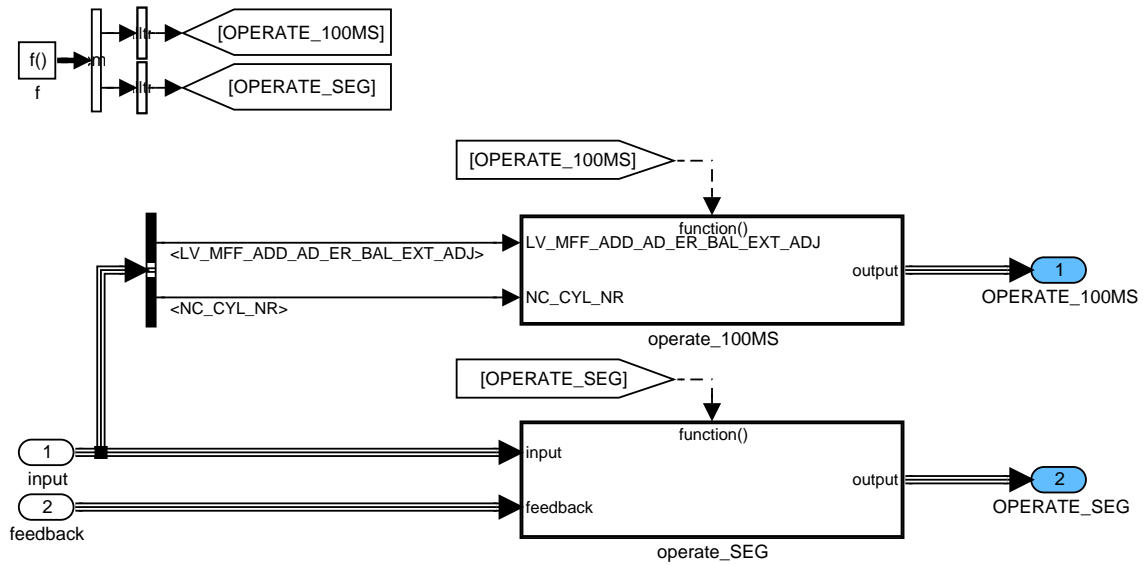


Figure 7.106.5: CYBL\_M30708501/OPM

#### External adjustment of additive correction values

In case of an external adjustment (request from key word protocol) the additive adaptation values for all cylinders are set to zero. While the external adjustment is activated, all following subchapters within the module "Cylinder balancing via additive MFF intervention" are deactivated and the corresponding "Initialization at Deactivation" process for this chapters is blocked during this period.

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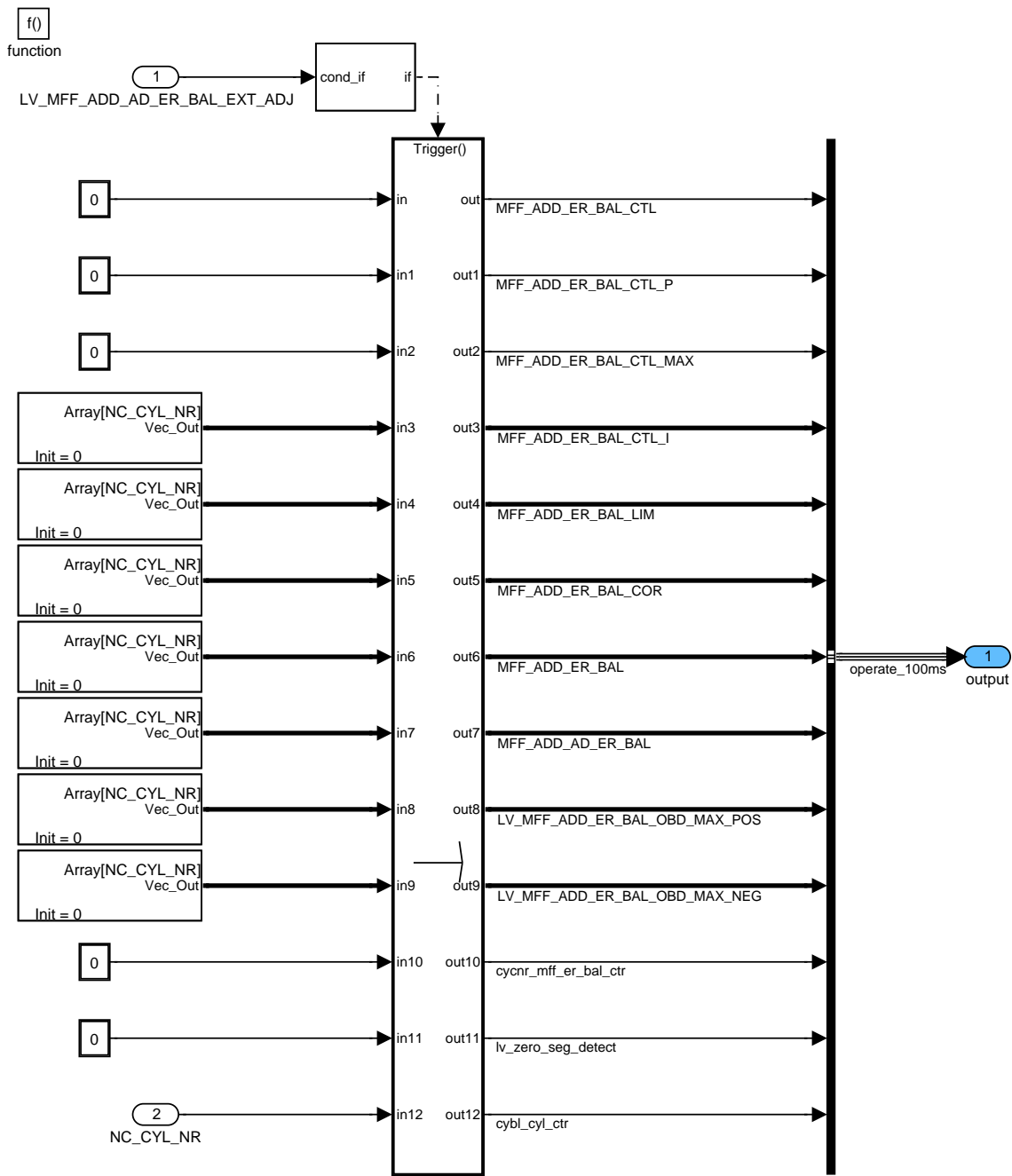


Figure 7.106.6: CYBL\_M30708501/OPM/operate\_100MS

**Calculation of segment task**

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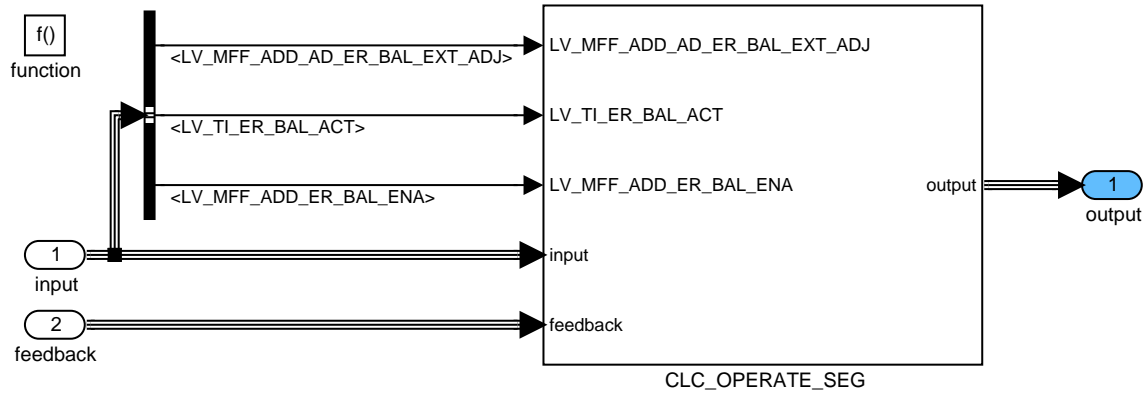


Figure 7.106.7: CYBL\_M30708501/OPM/operate\_SEG

**Calculation of manual reset, injection time correction and injection time adaptation**

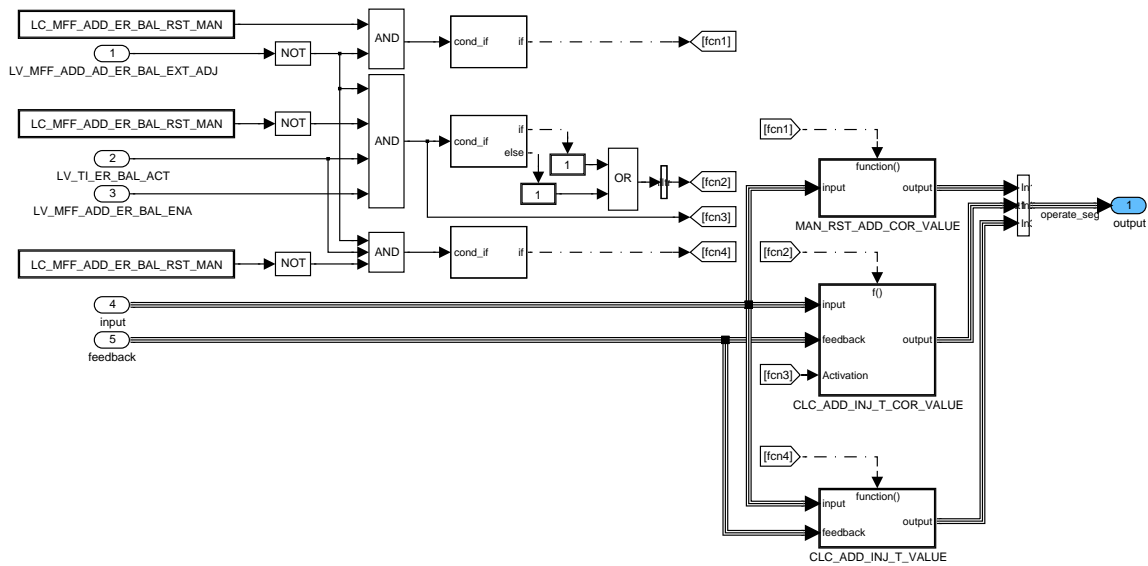


Figure 7.106.8: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG

**Manual reset of additive correction values**

In case of a manual reset it is possible to adjust the exported output data to a wanted value to make the function test and handling more easier. While the manual function reset is activated, all following subchapters within the module "Cylinder balancing via additive MFF intervention" are deactivated and the corresponding "Initialization at Deactivation" process for this chapters is blocked during this period.

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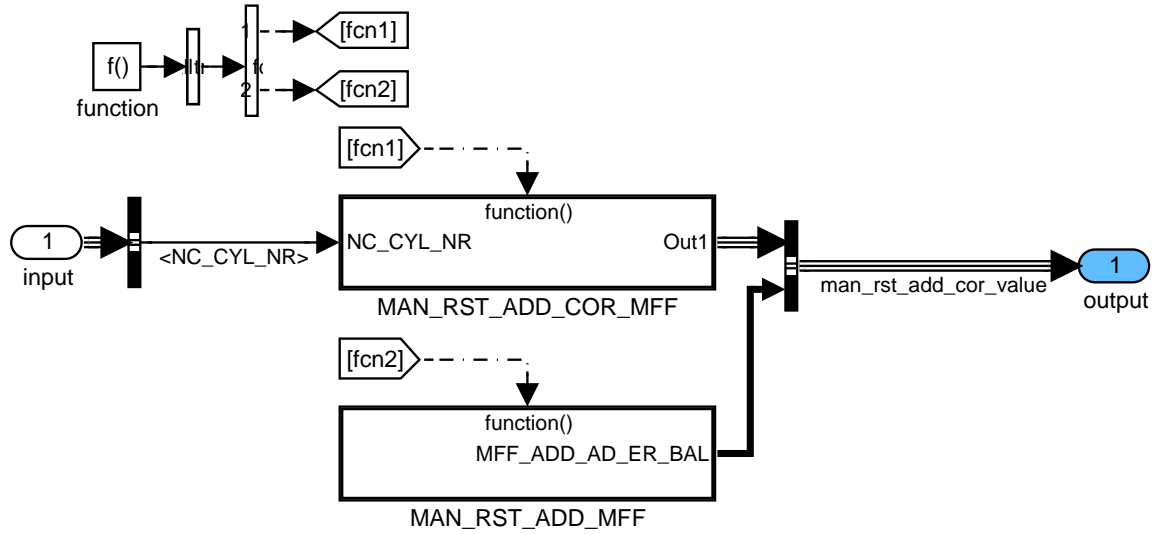

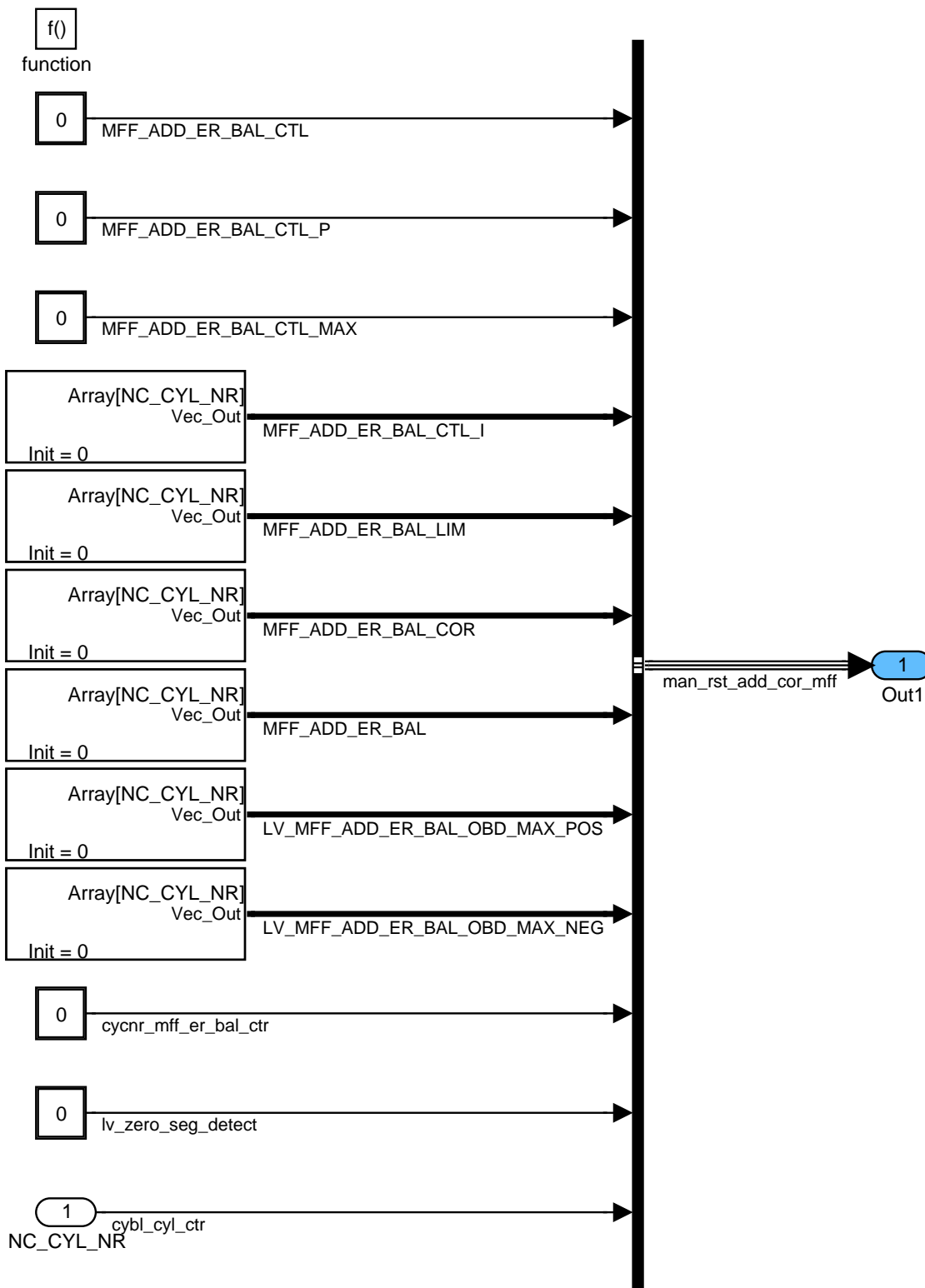


Figure 7.106.9:  
CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/MAN\_RST\_ADD\_COR\_VALUE

**Manual reset of additive correction values for cylinder balancing via MFF intervention**

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Figure 7.106.10: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/  
MAN\_RST\_ADD\_COR\_VALUE/MAN\_RST\_ADD\_COR\_MFF

**Manual reset of additive adaptation values for cylinder balancing via MFF intervention**

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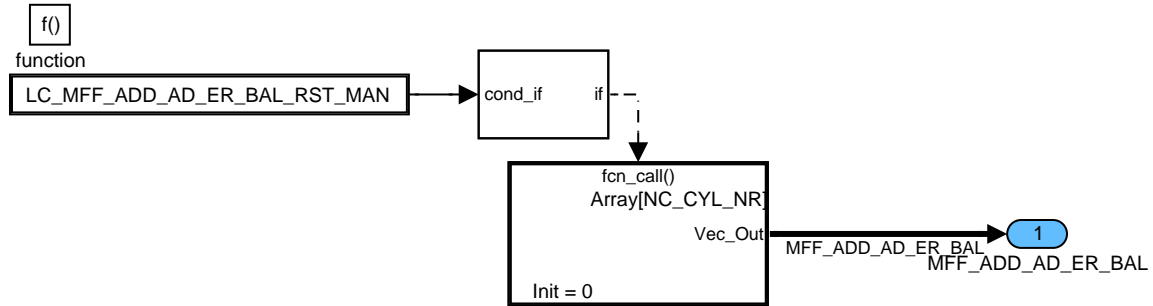


Figure 7.106.11: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/ MAN\_RST\_ADD\_COR\_VALUE/MAN\_RST\_ADD\_MFF

**Calculation of the additive injection time correction values**

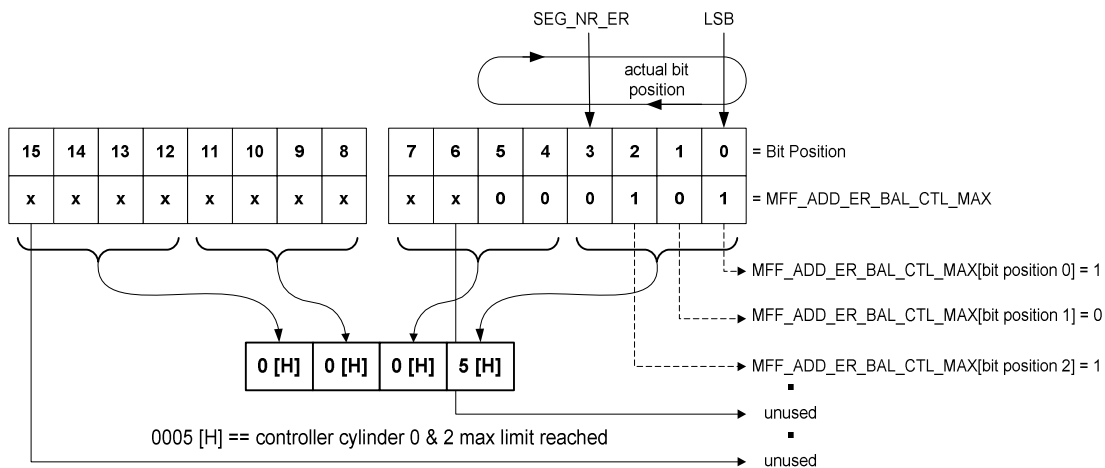
The calculation of the additive injection time correction values are only performed if the corresponding enable bit LV\_MFF\_ADD\_ER\_BAL\_ENA is set to logical 1 in combination with additional activation conditions. In this case, a separate correction value for each cylinder is determined with use of a PIcontroller.

As soon as a PIcontroller of one cylinder is reaching its maximum, a corresponding value is set to 1 to indicate the related cylinder. To save memory resources, the information for all cylinders is located within one output data (WORD). Each BIT information within the WORD is used to indicate one cylinder. It is possible to handle up to 16 cylinders with this method.

For a description more in detail please have a look to the signal flow diagram below. As example, a sixcylinder engine with two PIcontrollers, which have reached the limits is shown.

Signal flow diagram:

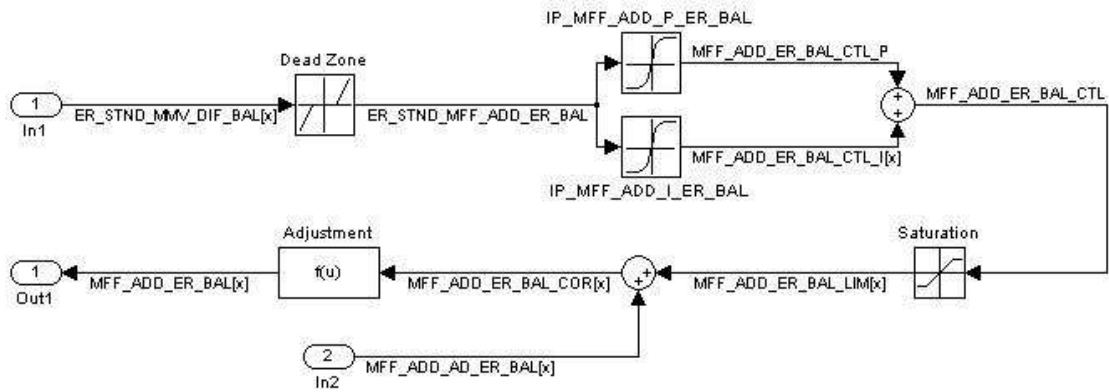
*Signalization of controller max. output value reached for additive path*



**Note:** always the complete WORD (16 BIT) is displayed as visible value


*Calculation of the additive injection time correction /adaptation values in general*

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**Note:** [x] is representing [SEG\_NR\_ER] in the signal flow diagram above

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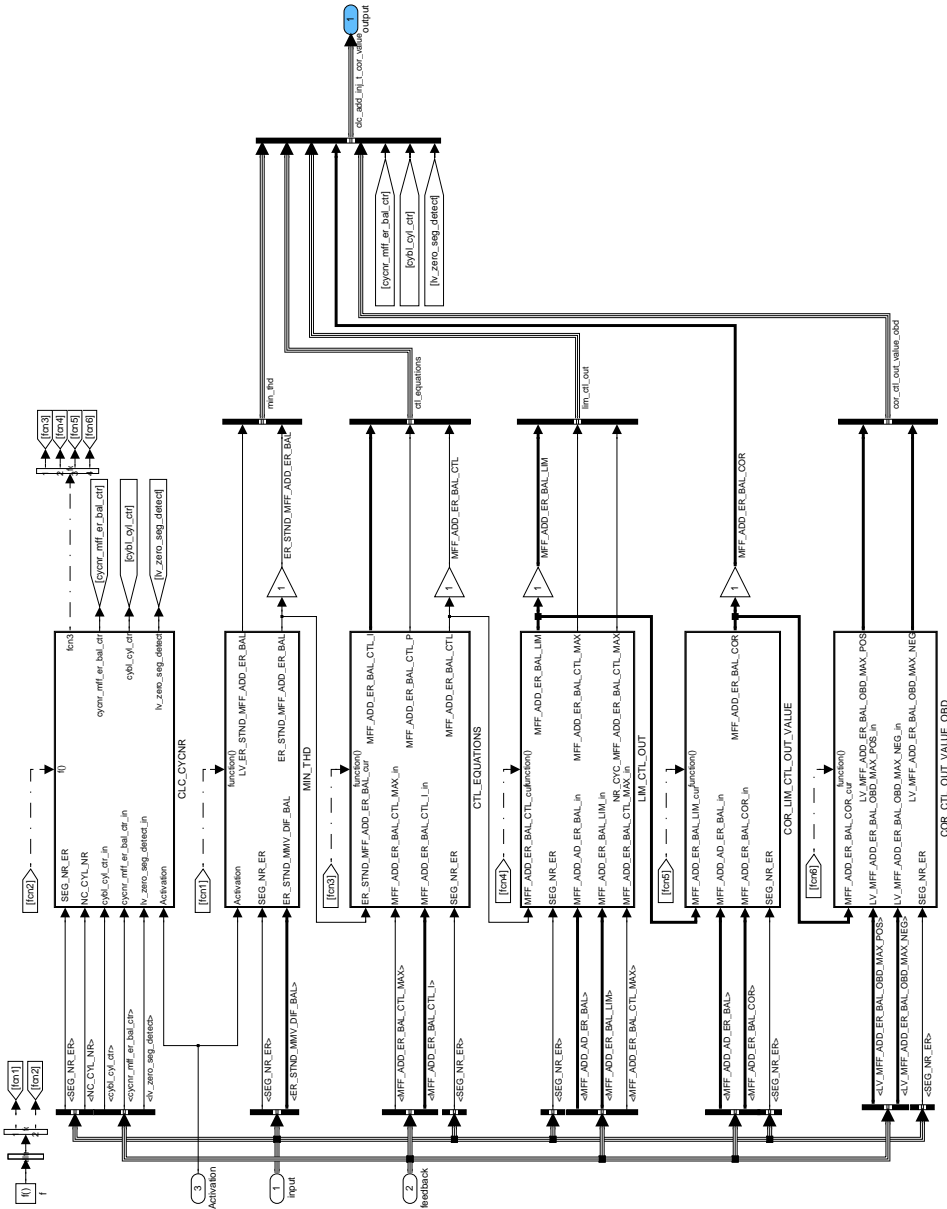



Figure 7.106.12:  
CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_ADD\_INJ\_T\_COR\_VALUE

**Minimum threshold**

If the defined cylinder balancing input values ER\_STND\_MMV\_DIF\_BAL[SEG\_NR\_ER] are outside a calibrateable range, the controller is calculated. Otherwise the controller inputs are set to zero.

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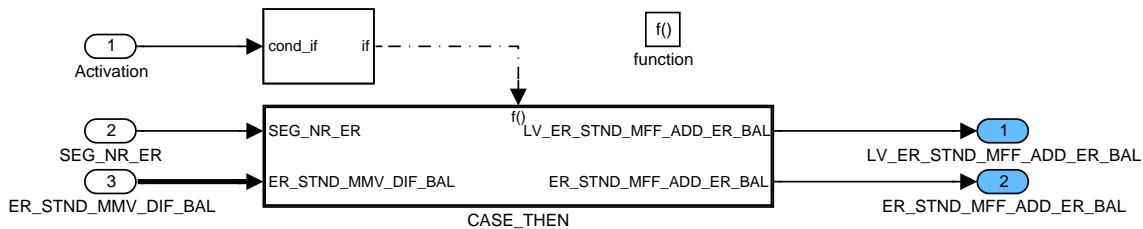


Figure 7.106.13: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_ADD\_INJ\_T\_COR\_VALUE/MIN\_THD

**Minimum threshold CASE\_THEN**

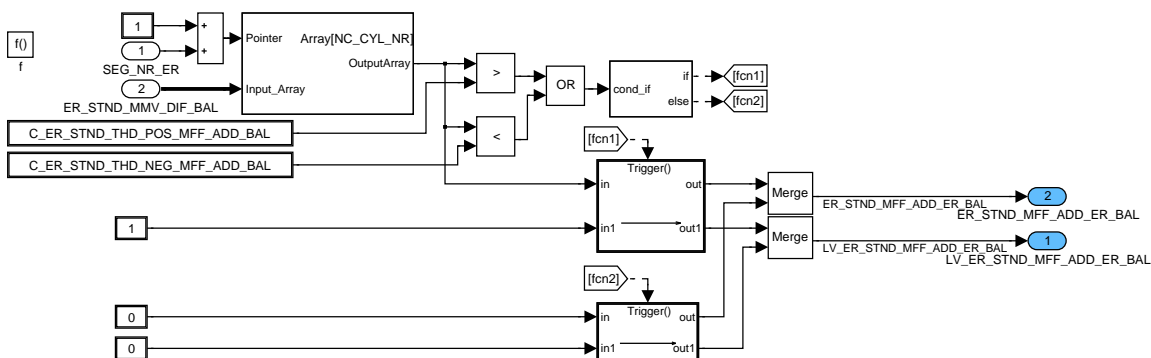


Figure 7.106.14: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_ADD\_INJ\_T\_COR\_VALUE/MIN\_THD/CASE\_THEN

**Calculation of segment tasks CLC\_OPERATE\_SEG CLC\_ADD\_INJ\_T\_COR\_VALUE CLC\_CYCNR**

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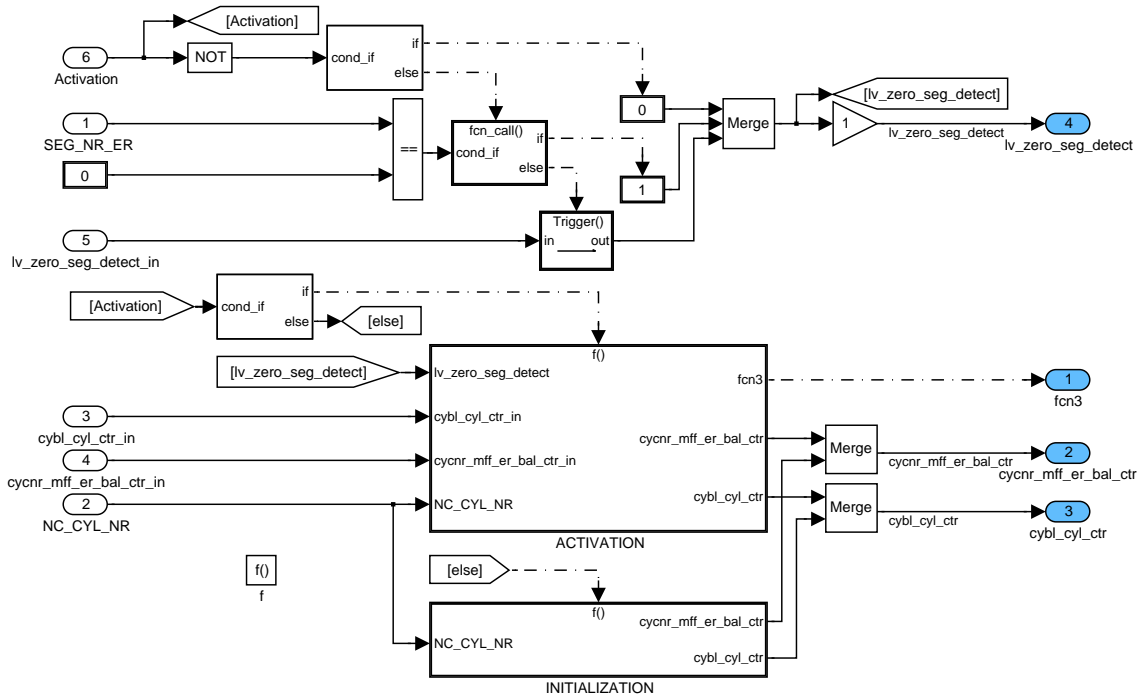


Figure 7.106.15: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_ADD\_INJ\_T\_COR\_VALUE/CLC\_CYCNR

**Calculation of segment tasks CLC\_OPERATE\_SEG CLC\_ADD\_INJ\_T\_COR\_VALUE CLC\_CYCNR ACTIVATION**

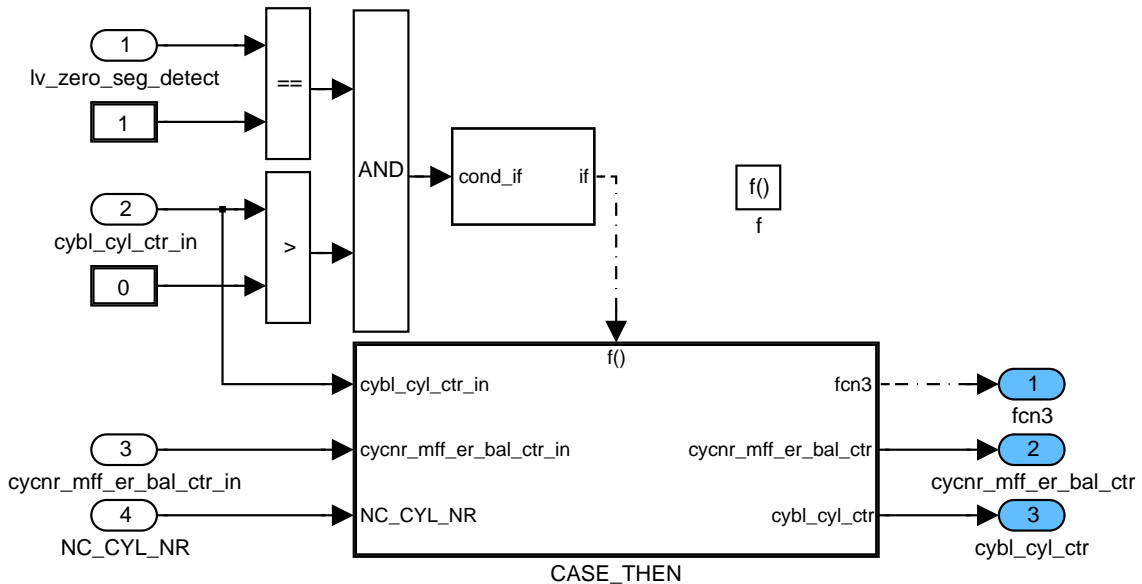


Figure 7.106.16: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_ADD\_INJ\_T\_COR\_VALUE/CLC\_CYCNR/ACTIVATION

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### Calculation of segment tasks CLC\_OPERATE\_SEG CLC\_ADD\_INJ\_T\_COR\_VALUE CLC\_CYCNR ACTIVATION CASE\_THEN

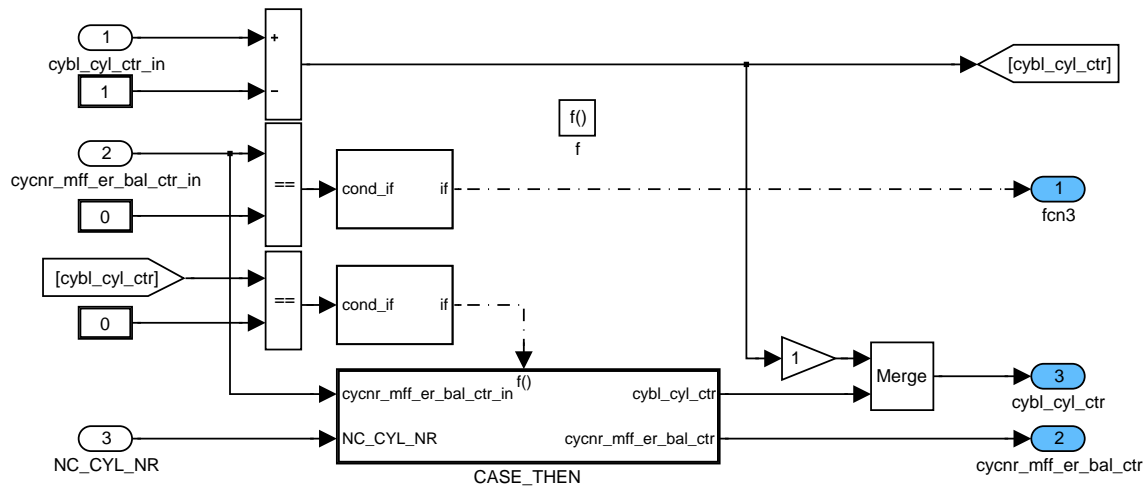


Figure 7.106.17: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_ADD\_INJ\_T\_COR\_VALUE/CLC\_CYCNR/ACTIVATION/CASE\_THEN

### Calculation of segment tasks CLC\_OPERATE\_SEG CLC\_ADD\_INJ\_T\_COR\_VALUE CLC\_CYCNR ACTIVATION CASE\_THEN CASE\_THEN

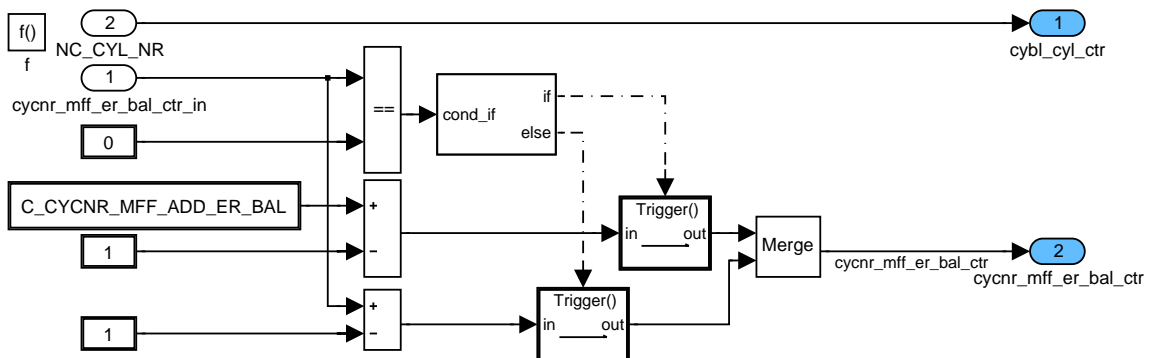


Figure 7.106.18: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_ADD\_INJ\_T\_COR\_VALUE/CLC\_CYCNR/ACTIVATION/CASE\_THEN/CASE\_THEN

### Calculation of segment tasks CLC\_OPERATE\_SEG CLC\_ADD\_INJ\_T\_COR\_VALUE CLC\_CYCNR INITIALIZATION

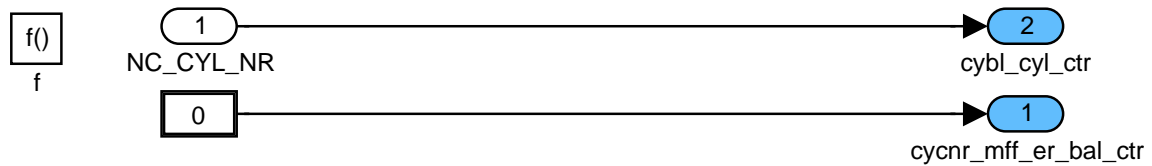


Figure 7.106.19: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/  
CLC\_ADD\_INJ\_T\_COR\_VALUE/CLC\_CYCNR/INITIALIZATION

### Controller Equations

For the additive correction mode, a separate set of NC\_CYL\_NR controllers exists operating in parallel (one controller for each cylinder).

The computation of the output values is carried out every C\_CYCNR\_MFF\_ADD\_ER\_BAL engine cycles (= calibrateable number of engine cycles).

Only in case of C\_CYCNR\_MFF\_ADD\_ER\_BAL = 1, the calculation of the additive path is done without interruption. At every segment the corresponding cylinder specific correction value is built.

If the computation is not done at every engine cycle (C\_CYCNR\_MFF\_ADD\_ER\_BAL > 1), the trigger of the controller output calculation is always related to SEG\_NR\_ER = 0.

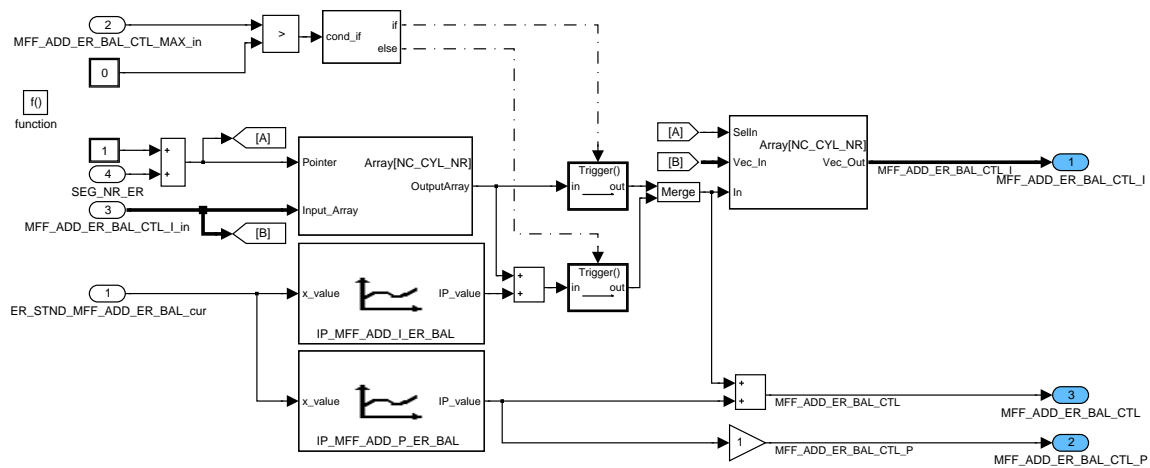


Figure 7.106.20: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/  
CLC\_ADD\_INJ\_T\_COR\_VALUE/CTL\_EQUATIONS

### Limitation of the Controller output

The outputs of the controllers are limited to a calibrateable threshold. If one controller output has reached the limit, a flag is set at one and the corresponding segment number is displayed.

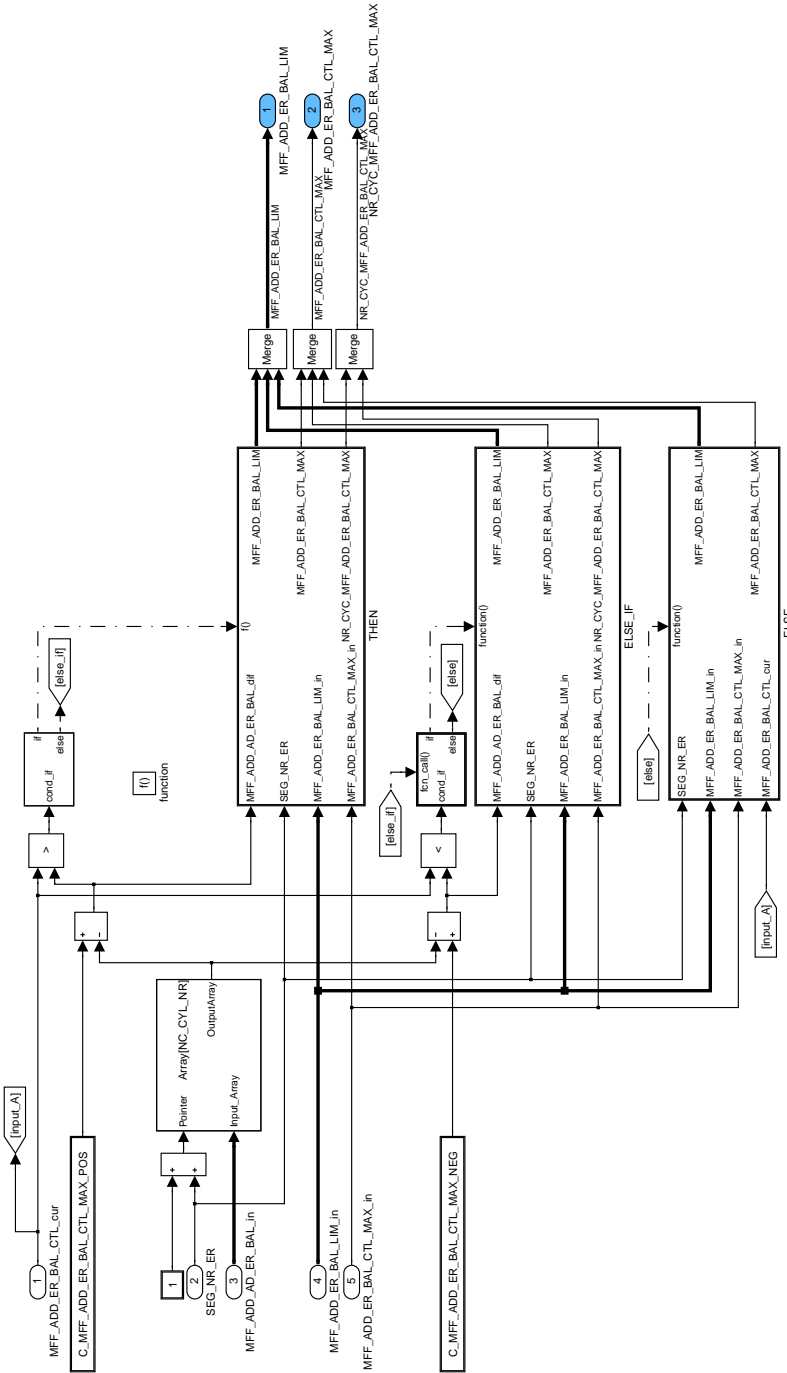



Figure 7.106.21: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_ADD\_INJ\_T\_COR\_VALUE/LIM\_CTL\_OUT

**Limitation of the Controller output THEN**

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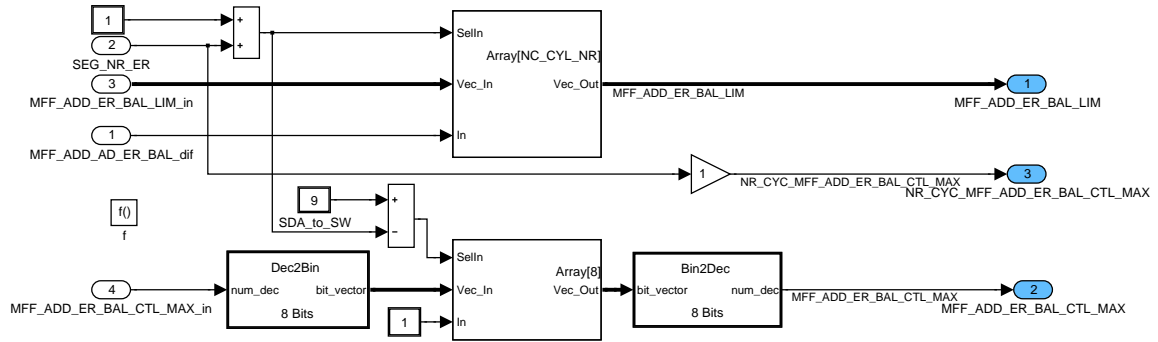


Figure 7.106.22: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_ADD\_INJ\_T\_COR\_VALUE/LIM\_CTL\_OUT/THEN

**Limitation of the Controller output ELSE\_IF**

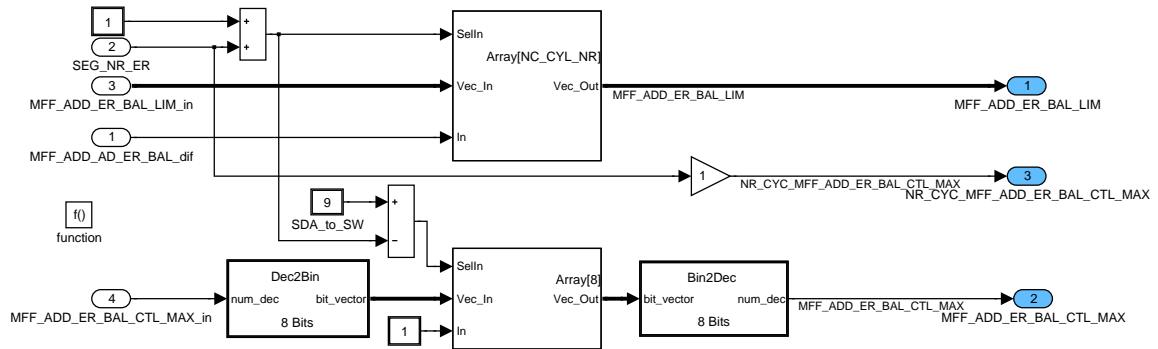


Figure 7.106.23: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_ADD\_INJ\_T\_COR\_VALUE/LIM\_CTL\_OUT/ELSE\_IF

**Limitation of the Controller output ELSE**

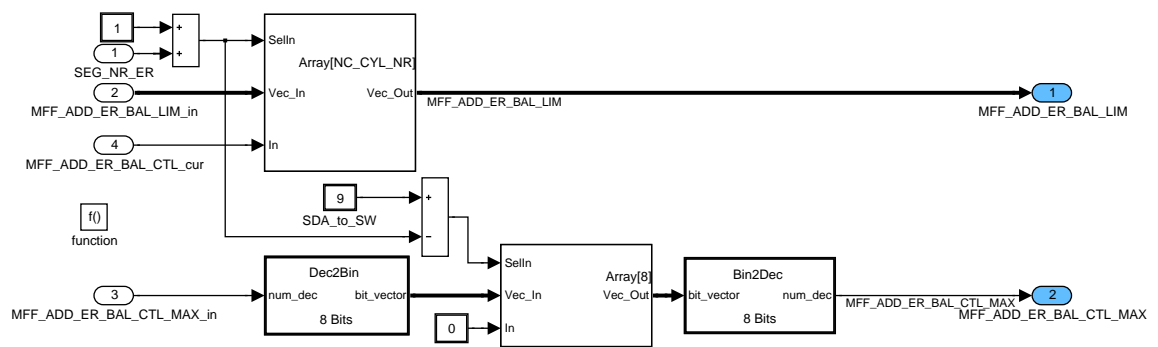


Figure 7.106.24: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_ADD\_INJ\_T\_COR\_VALUE/LIM\_CTL\_OUT/ELSE

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### Correction of limited controller output values with adaptation values

The limited controller output values are corrected with the currently available adaptive correction values, which are saved in the NVMY and updated at Activation or Deactivation of the additive adaptation path (LV\_MFF\_ADD\_AD\_ER\_BAL\_ENA)

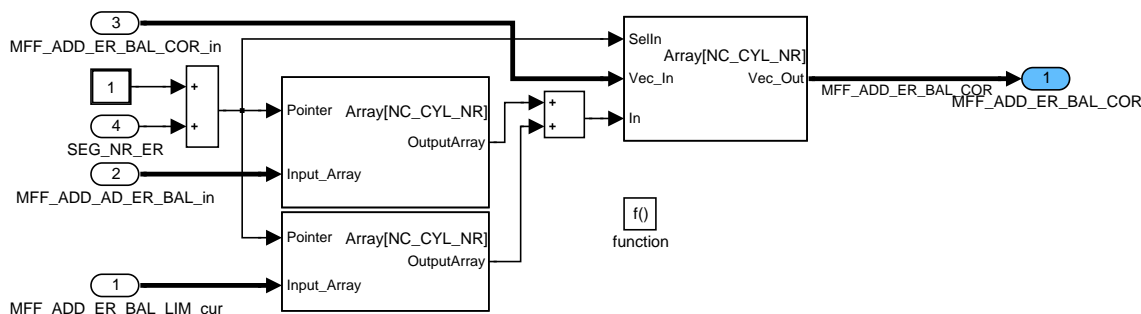



Figure 7.106.25: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_ADD\_INJ\_T\_COR\_VALUE/COR\_LIM\_CTL\_OUT\_VALUE

### Observation of corrected controller output values for OBD issues

The additive correction values out of the correction path are observed for OBD purposes. As soon as the minimum or maximum diagnosis threshold is exceeded, a corresponding flag for the related cylinder is set. In this case the OBD system is indicated to handle the further failure treatment. The diagnosis thresholds have always to be less or equal to the absolute minimum or maximum controller output limits.

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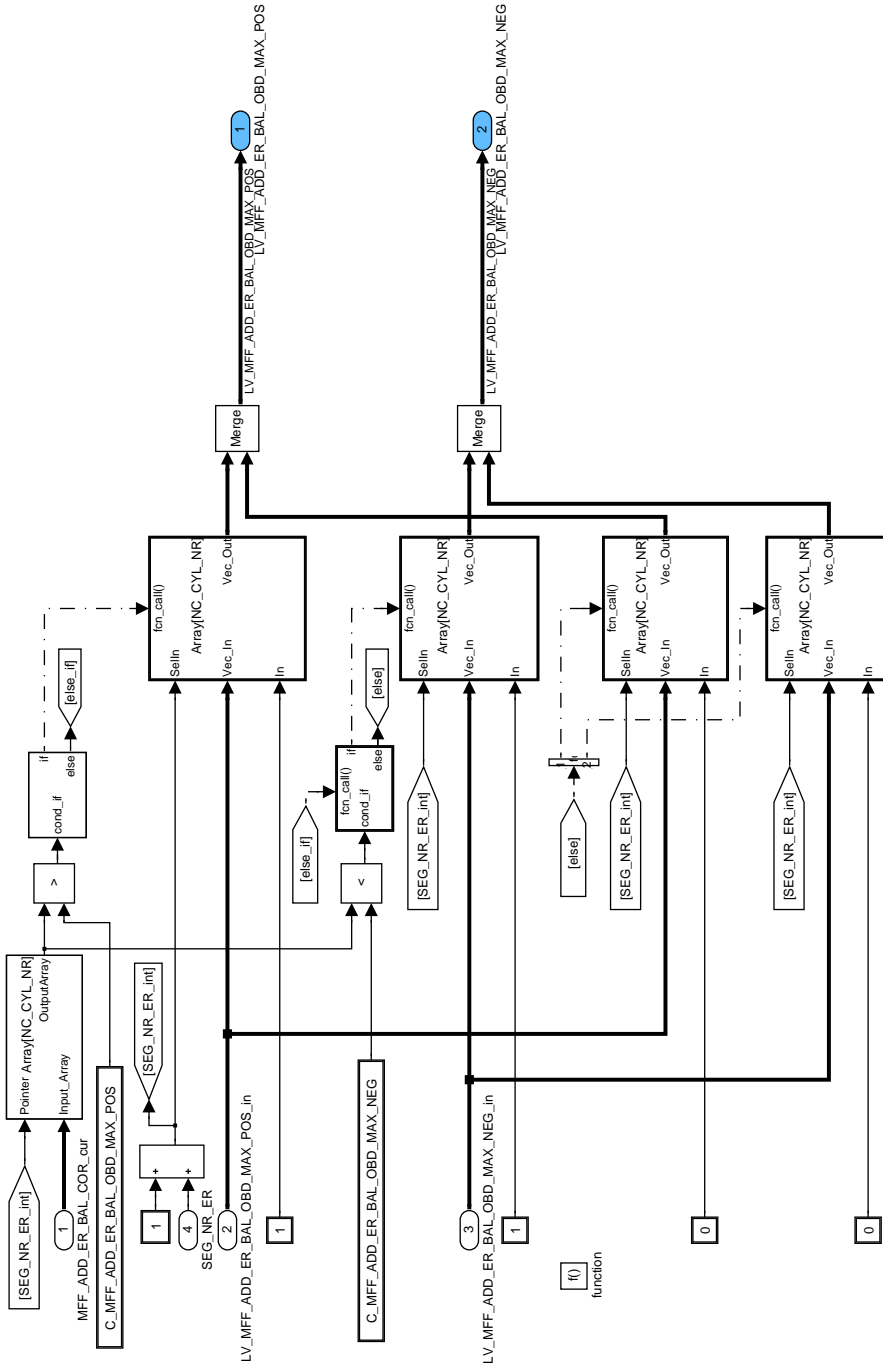


Figure 7.106.26: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_ADD\_INJ\_T\_COR\_VALUE/COR\_CTL\_OUT\_VALUE\_OBD

**Calculation of the additive injection time adaptation values**

The corrected NC\_CYL\_NR controller output values are adjusted dependent on the corresponding segment number SEG\_NR\_ER. During the function is activated, at every new segment the corresponding MFF\_ADD\_ER\_BAL value is updated. Due to this correction the sum of all adaptation output values remains zero to guarantee that the overall injection spreading stays unchanged.

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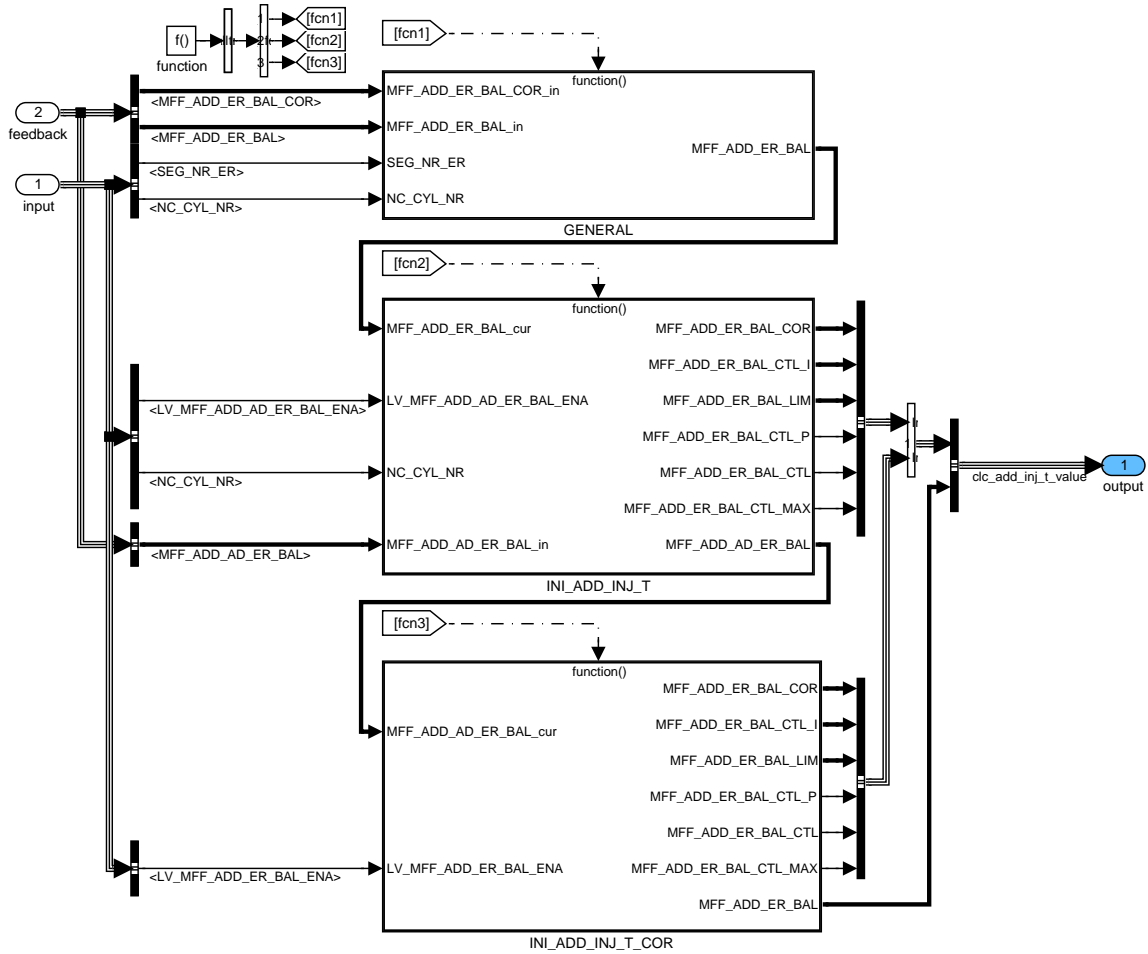


Figure 7.106.27:  
CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_ADD\_INJ\_T\_VALUE

**Calculation of the additive injection time adaptation values GENERAL**

Sum of all NC\_CYL\_NR controller output values /number of cylinders

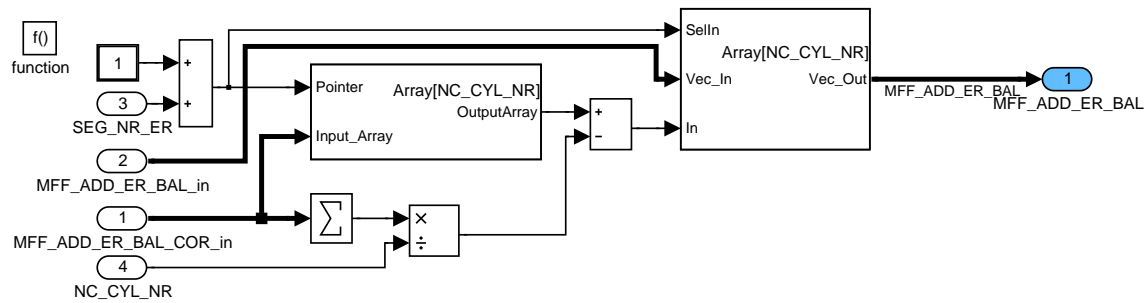



Figure 7.106.28:  
CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_ADD\_INJ\_T\_VALUE/GENERAL

**Initialization at Entry or Exit to additive injection time adaptation**

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As soon as the additive injection time adaptation is enabled or disabled, the stored adaptive correction values are overwritten with the currently present global adaptive value and the controller output values are set to zero.

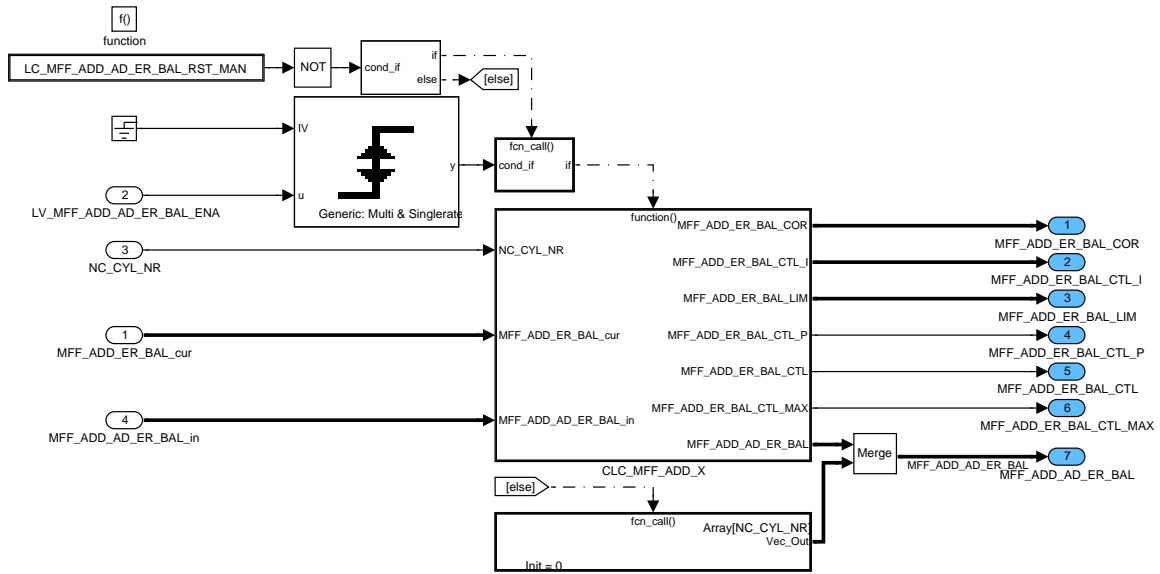


Figure 7.106.29: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_ADD\_INJ\_T\_VALUE/INI\_ADD\_INJ\_T

**Initialization at Entry or Exit to additive injection time adaptation CLC\_MFF\_ADD\_X**

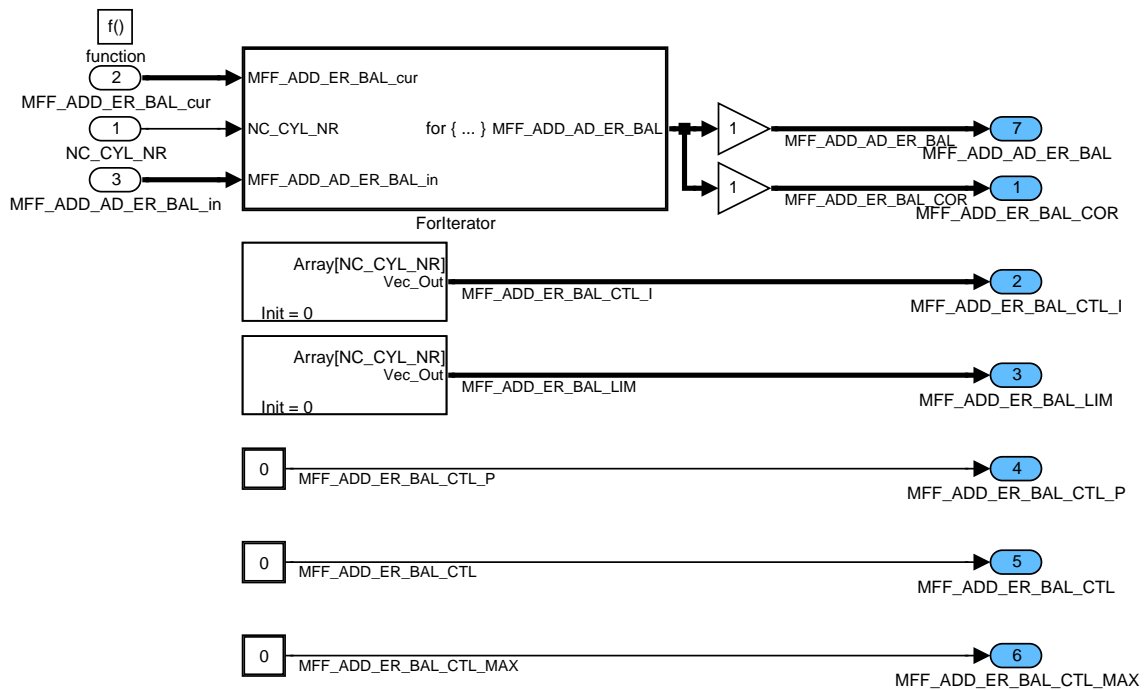


Figure 7.106.30: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_ADD\_INJ\_T\_VALUE/INI\_ADD\_INJ\_T/CLC\_MFF\_ADD\_X

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## Initialization at Entry or Exit to additive injection time adaptation CLC\_MFF\_ADD\_X FORITERATOR

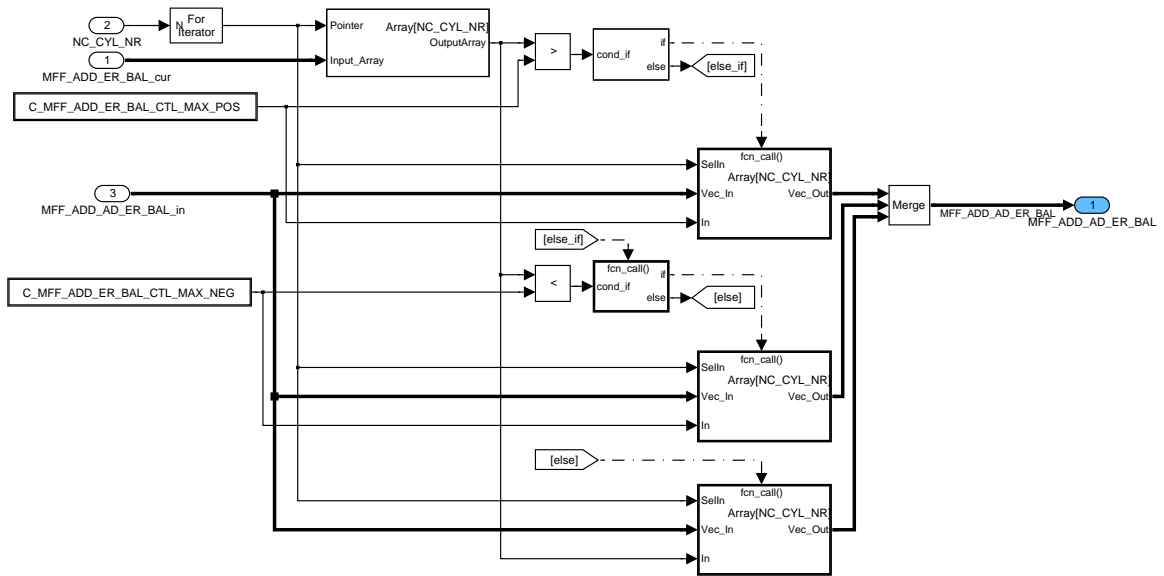


Figure 7.106.31: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/  
CLC\_ADD\_INJ\_T\_VALUE/INI\_ADD\_INJ\_T/CLC\_MFF\_ADD\_X/ForIterator

### Initialization at Exit from additive injection time correction

As soon as the additive injection time correction is disabled in combination with the manual switch to force the overall correction (LC\_MFF\_ADD\_ER\_BAL\_COR), the controller output values are set to zero.

The initialization only takes place, if the logical constant for a manual reset of the additive controller values is set to zero (LC\_MFF\_ADD\_ER\_BAL\_RST\_MAN = 0).

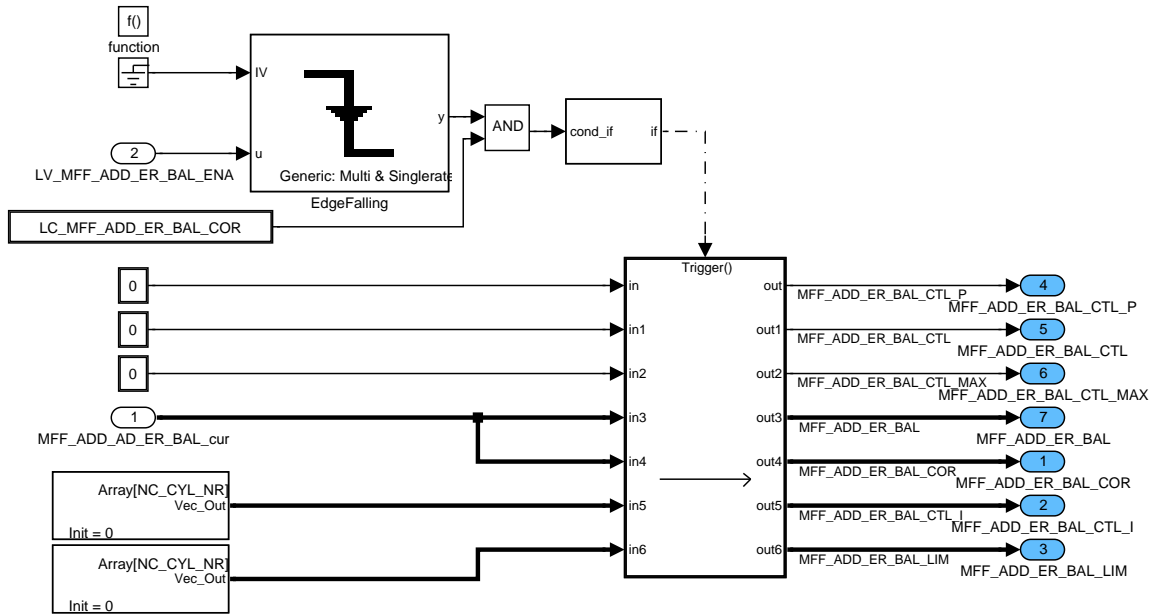


Figure 7.106.32: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_ADD\_INJ\_T\_VALUE/INI\_ADD\_INJ\_T\_COR

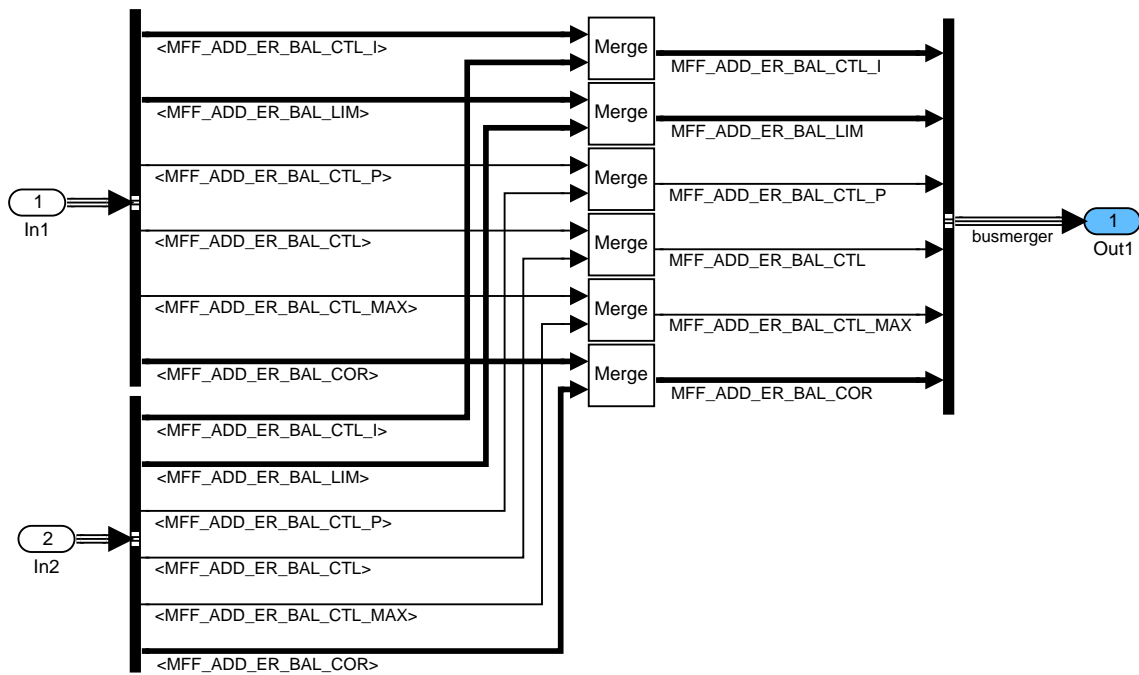


Figure 7.106.33: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_ADD\_INJ\_T\_VALUE/BusMerger

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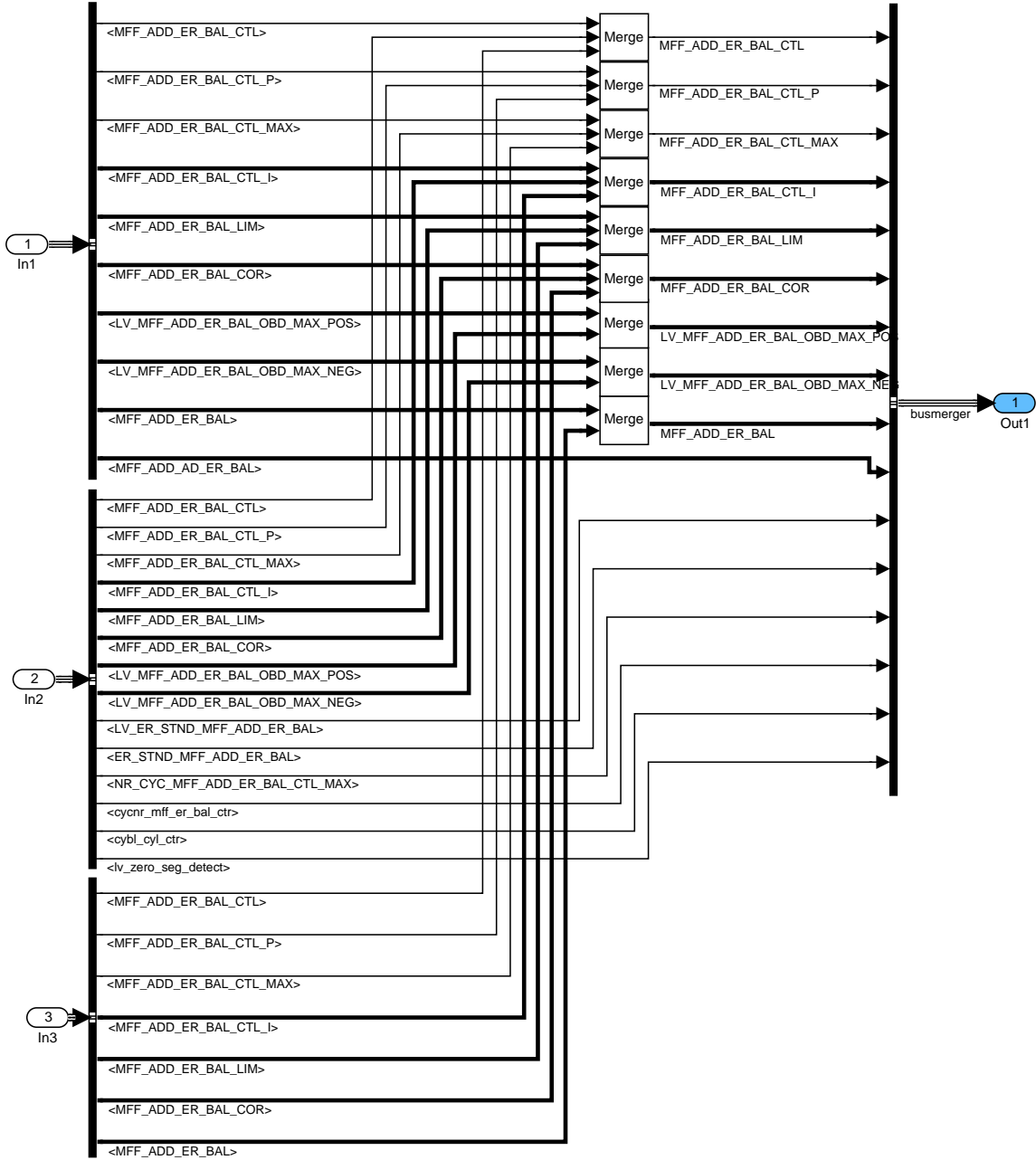


Figure 7.106.34: CYBL\_M30708501/OPM/operate\_SEG/CLC\_OPERATE\_SEG/BusMerger

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### 7.106.3 SUBFUNCTION: SIG\_MNG

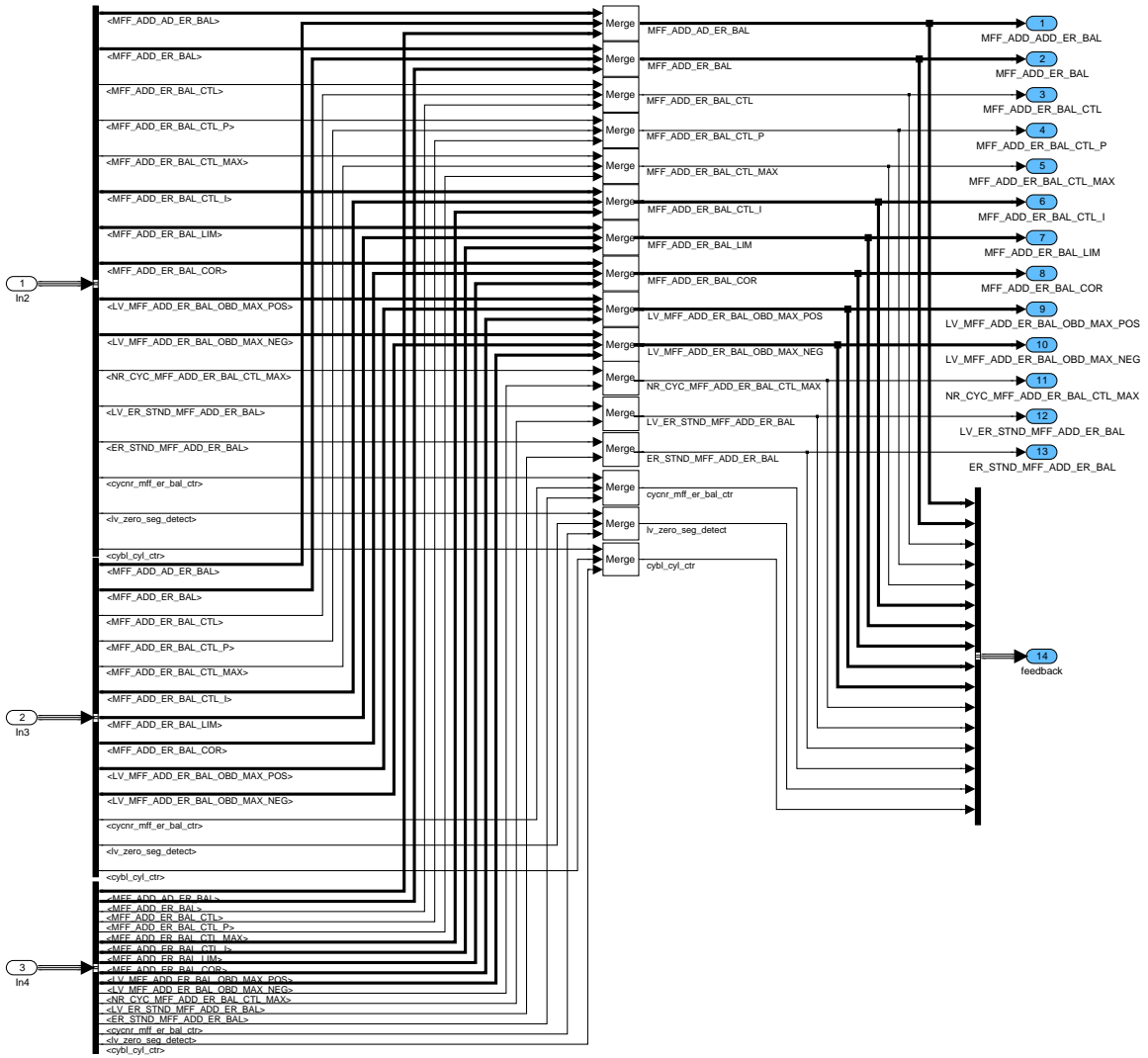


Figure 7.106.35: CYBL\_M30708501/SIG\_MNG

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## 7.107 Cylinder balancing via multiple injection time intervention

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ER_STND_FAC_TI_ER_BAL	V	8000... 7FFFH	0... 325.77	0.00994202	1/s**2
Controller input value at multiple path of cylinder balancing via TI intervention					
FAC_TI_AD_ER_BAL [NC_CYL_NR]	O/V/S	8000... 7FFFH	0... 0.99996948	305.176e3	-
Multiple adaptation value for cylinder balancing via TI intervention					
FAC_TI_ER_BAL [NC_CYL_NR]	O/V	8000... 7FFFH	0... 0.99996948	305.176e3	-
Multiple correction value for cylinder balancing via TI intervention					
FAC_TI_ER_BAL_COR [NC_CYL_NR]	V	8000... 7FFFH	0... 0.99996948	305.176e3	-
Corrected multiple correction value for cylinder balancing via TI intervention					
FAC_TI_ER_BAL_CTL	V	8000... 7FFFH	0... 0.99996948	305.176e3	-
Controller output value at multiple path of cylinder balancing via TI intervention					
FAC_TI_ER_BAL_CTL_I [NC_CYL_NR]	V	8000... 7FFFH	0... 0.99996948	305.176e3	-
I part of the controller output value at multiple path of cylinder balancing via TI intervention					
FAC_TI_ER_BAL_CTL_MAX	V	0... FFFFH	0... 65535	1	-
Controller output value maximum limit reached at multiple path of cylinder balancing via TI intervention					
FAC_TI_ER_BAL_CTL_P	V	8000... 7FFFH	0... 0.99996948	305.176e3	-
P part of the controller output value at multiple path of cylinder balancing via TI intervention					
FAC_TI_ER_BAL_LIM [NC_CYL_NR]	V	8000... 7FFFH	0... 0.99996948	305.176e3	-
Limited controller output value at multiple path of cylinder balancing via TI intervention					
LV_ER_STND_FAC_TI_ER_BAL	V	0... 1H	0 ...1	1	-
Flag for controller input at multiple path of cylinder balancing via TI intervention					
LV_MFF_FAC_ER_BAL_OBD_MAX_NEG [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag for minimum OBD limit reached at multiple part of engine roughness based cylinder balancing					
LV_MFF_FAC_ER_BAL_OBD_MAX_POS [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag for maximum OBD limit reached at multiple part of engine roughness based cylinder balancing					
NR_CYC_FAC_TI_ER_BAL_CTL_MAX	V	0... FFH	0... 255	1	-
Corresponding segment number of the controller that has reached the maximum limit (multiple TI path)					

### Input data:

ER_STND_MMV_DIF_BAL [NC_CYL_NR] {p. 1489}	LV_FAC_TI_AD_ER_BAL_ENA {p. 4006}	LV_FAC_TI_ER_BAL_ENA {p. 4006}	LV_MFF_FAC_AD_ER_BAL_EXT_ADJ {p. 7483}
LV_TI_ER_BAL_ACT {p. 4022}	NC_CYL_NR {p. 1526}	SEG_NR_ER {p. 1454}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CYCNR_FAC_TI_ER_BAL	-	1... FFH	1... 255	1	-
Number of cycles for calculation of controller output values for cylinder balancing via multiple TI intervention					
C_ER_STND_THD_NEG_FAC_TI_BAL	-	8000... 7FFFH	0... 325.77	0.00994202	1/s**2
Negative threshold for ER input value at multiple path of cylinder balancing via TI intervention					
C_ER_STND_THD_POS_FAC_TI_BAL	-	8000... 7FFFH	0... 325.77	0.00994202	1/s**2
Positive threshold for ER input value at multiple path of cylinder balancing via TI intervention					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TI_ER_BAL_CTL_MAX_NEG	-	8000... 7FFFH	0... 0.99996948	305.176e3	-
Negative maximum limit for controller output at multiple path of cylinder balancing via TI intervention					
C_FAC_TI_ER_BAL_CTL_MAX_POS	-	8000... 7FFFH	0... 0.99996948	305.176e3	-
Positive maximum limit for controller output at multiple path of cylinder balancing via TI intervention					
C_FAC_TI_ER_BAL_OBD_MAX_NEG	-	8000... 7FFFH	0... 0.99996948	305.176e3	-
Negative maximum OBD limit for multiple correction value of cylinder balancing via TI intervention					
C_FAC_TI_ER_BAL_OBD_MAX_POS	-	8000... 7FFFH	0... 0.99996948	305.176e3	-
Positive maximum OBD limit for multiple correction value of cylinder balancing via TI intervention					
C_FAC_TI_ER_BAL_RST	-	0H	INI_ZERO	-	-
		1H	INI_CTL		
		2H	INI_AD		
Reset of multiple correction and adaptation values for cylinder balancing via TI intervention					
IP_FAC_TI_I_ER_BAL	-	0... FFFFH	0... 0.99996948	305.176e3	-
LDP_ER_STND_FAC_TI_IP_I_ER_BAL	8	0... FFFFH	0... 325.77	0.0099313	1/s**2
Controller I part value for multiple path of cylinder balancing via TI intervention					
IP_FAC_TI_P_ER_BAL	-	0... FFFFH	0... 0.99996948	305.176e3	-
LDP_ER_STND_FAC_TI_IP_P_ER_BAL	8	0... FFFFH	0... 325.77	0.0099313	1/s**2
Controller P part value for multiple path of cylinder balancing via TI intervention					
LC_FAC_TI_AD_ER_BAL_RST_MAN	-	0... 1H	0 ...1	1	-
Manual reset of multiple adaptation values for cylinder balancing via TI intervention					
LC_FAC_TI_ER_BAL_COR	-	0... 1H	0 ...1	1	-
Manual switch for overall correction of controller output values for cylinder balancing via multiple TI intervention					
LC_FAC_TI_ER_BAL_RST_MAN	-	0... 1H	0 ...1	1	-
Manual reset of multiple correction values for cylinder balancing via TI intervention					

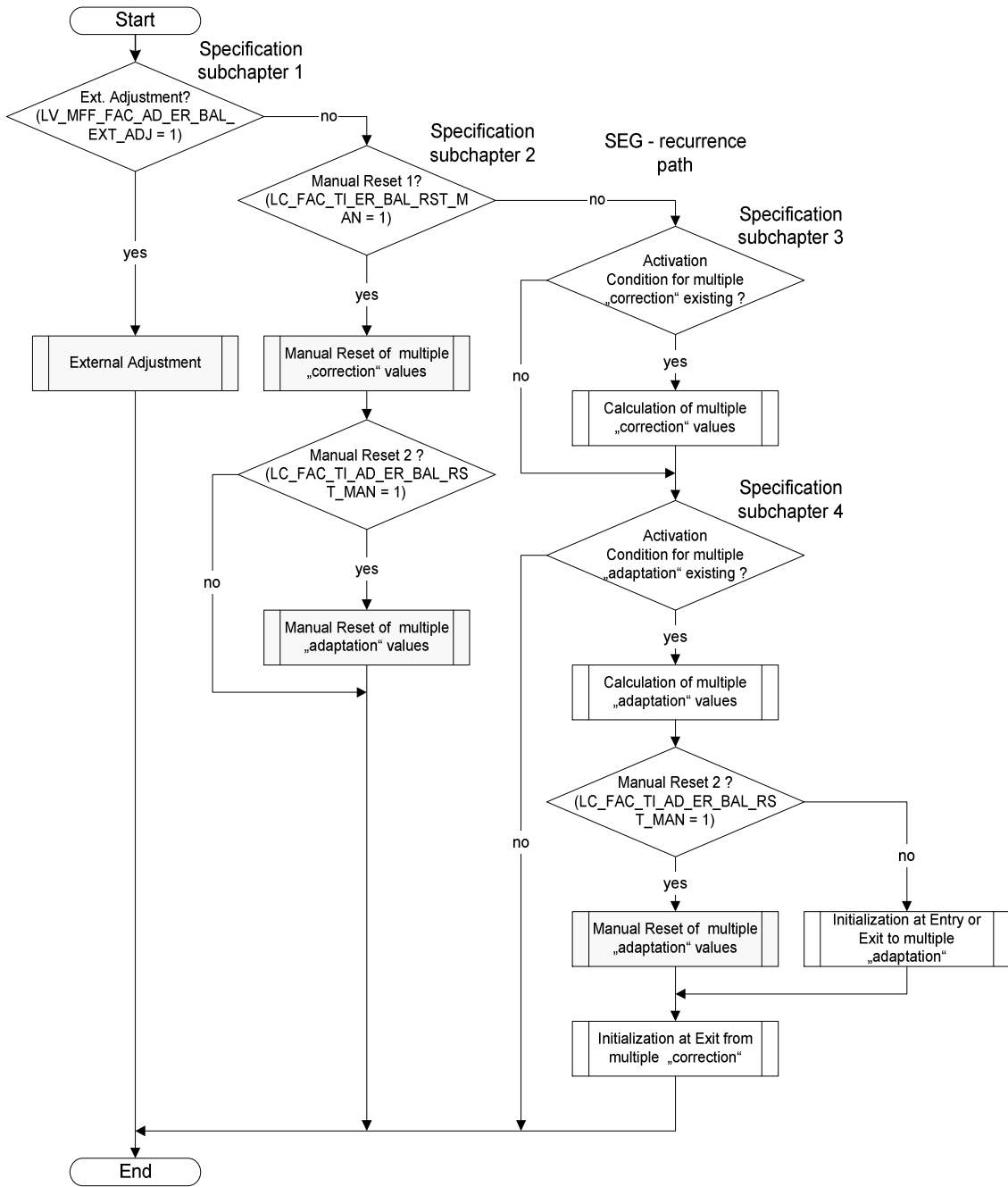
### General information:

The calculation of the multiple correction or adaptation values is performed, depending on the settings of the corresponding logical activation variable. LV\_FAC\_TI\_ER\_BAL\_ENA is used to enable the correction path, while LV\_FAC\_TI\_AD\_ER\_BAL\_ENA enables the adaptation path. As soon as the corresponding logical value is set to "1" in combination with additional activation conditions, the calculation is started.

The calculated additive adaptation value FAC\_TI\_AD\_ER\_BAL[NC\_CYL\_NR] for each cylinder is stored in the nonvolatile memory to be available for initialization issues at next engine run.


With use of the manual reset it is possible to initialize the multiple correction or adaptation values with zero at any time. In this case, the flags which indicate the exceeding of a controller output limitation are set to zero as well (refer: "Initialization at Manual Reset")

Signal flow diagram:



**Application Condition**

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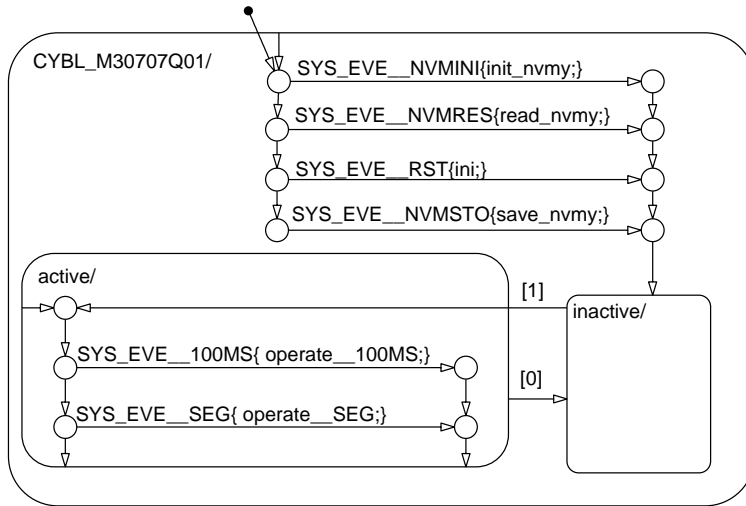



Figure 7.107.1: CYBL\_M30707Q01/APP\_CDN/Chart

**Function Description**

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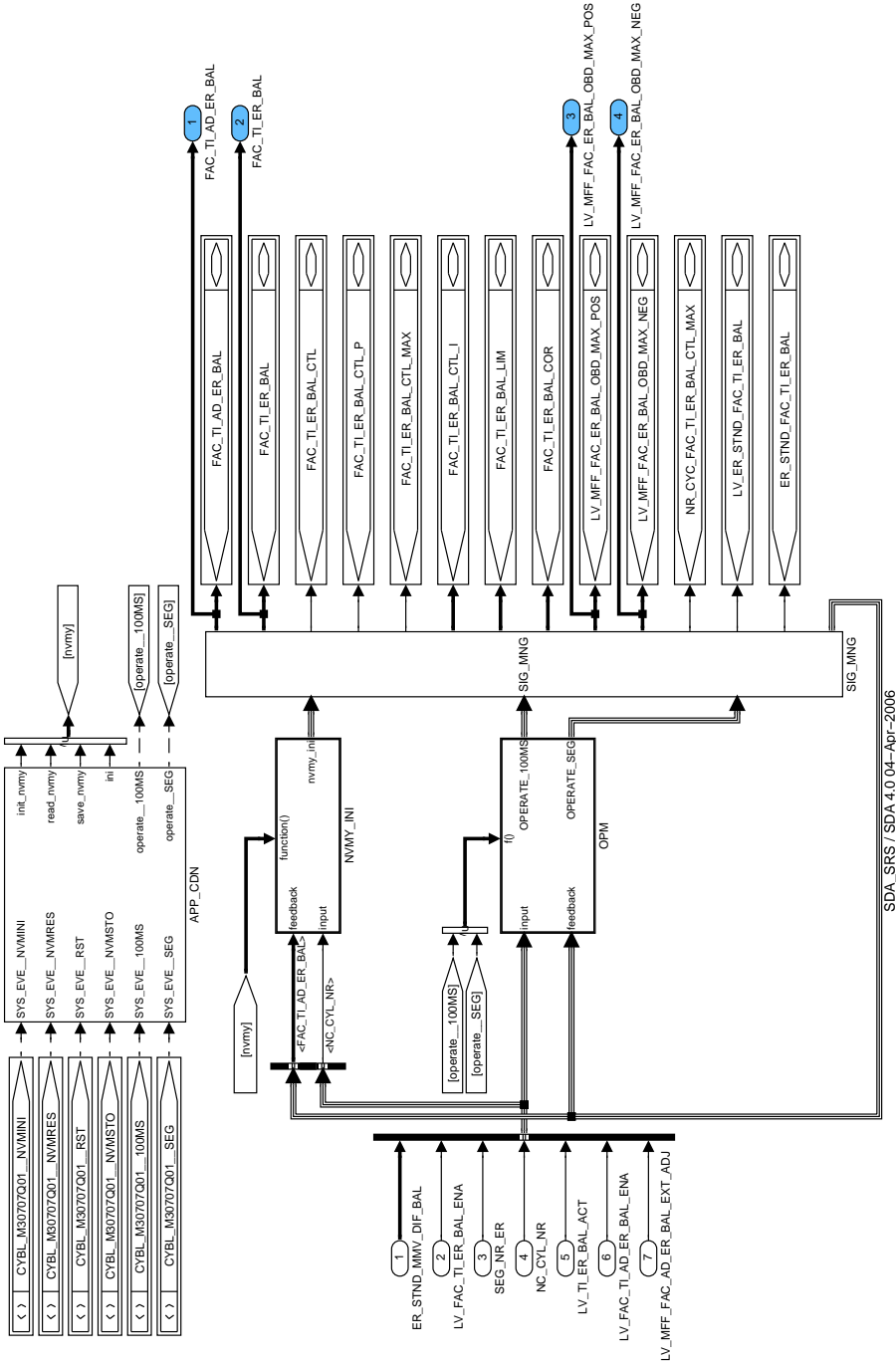


Figure 7.107.2: CYBL\_M3070Q01

### 7.107.1 Calculation of non volatile memory tasks

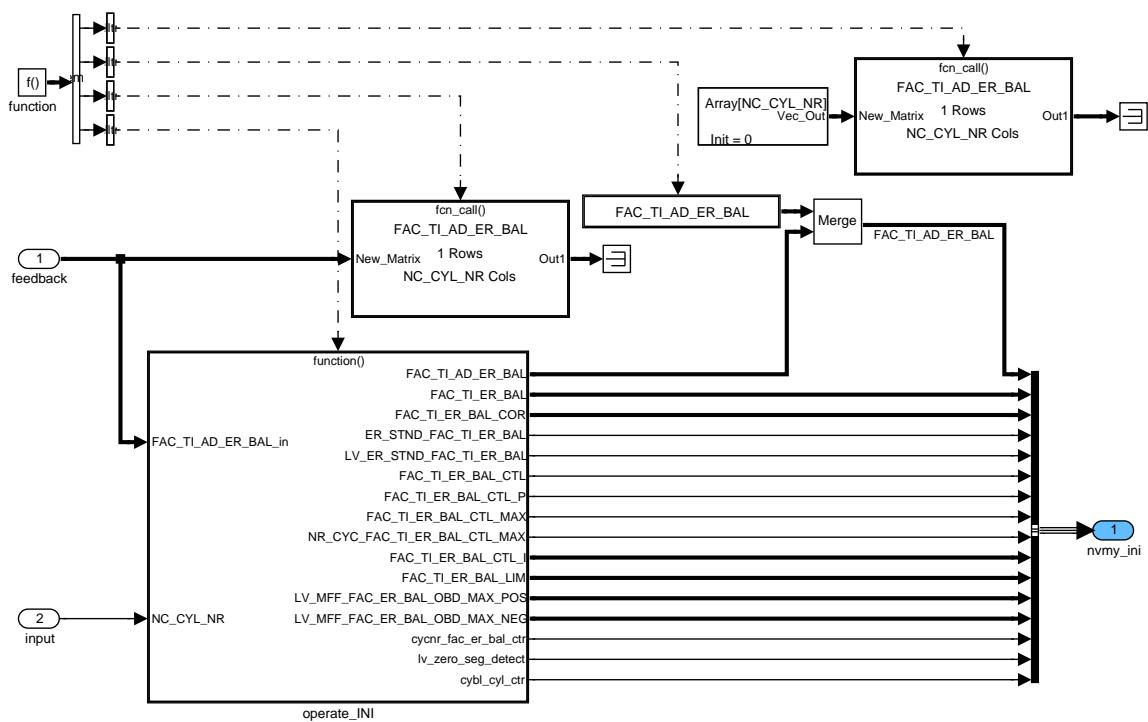


Figure 7.107.3: CYBL\_M30707Q01/NVMY\_INI

#### Calculation of variables at reset task

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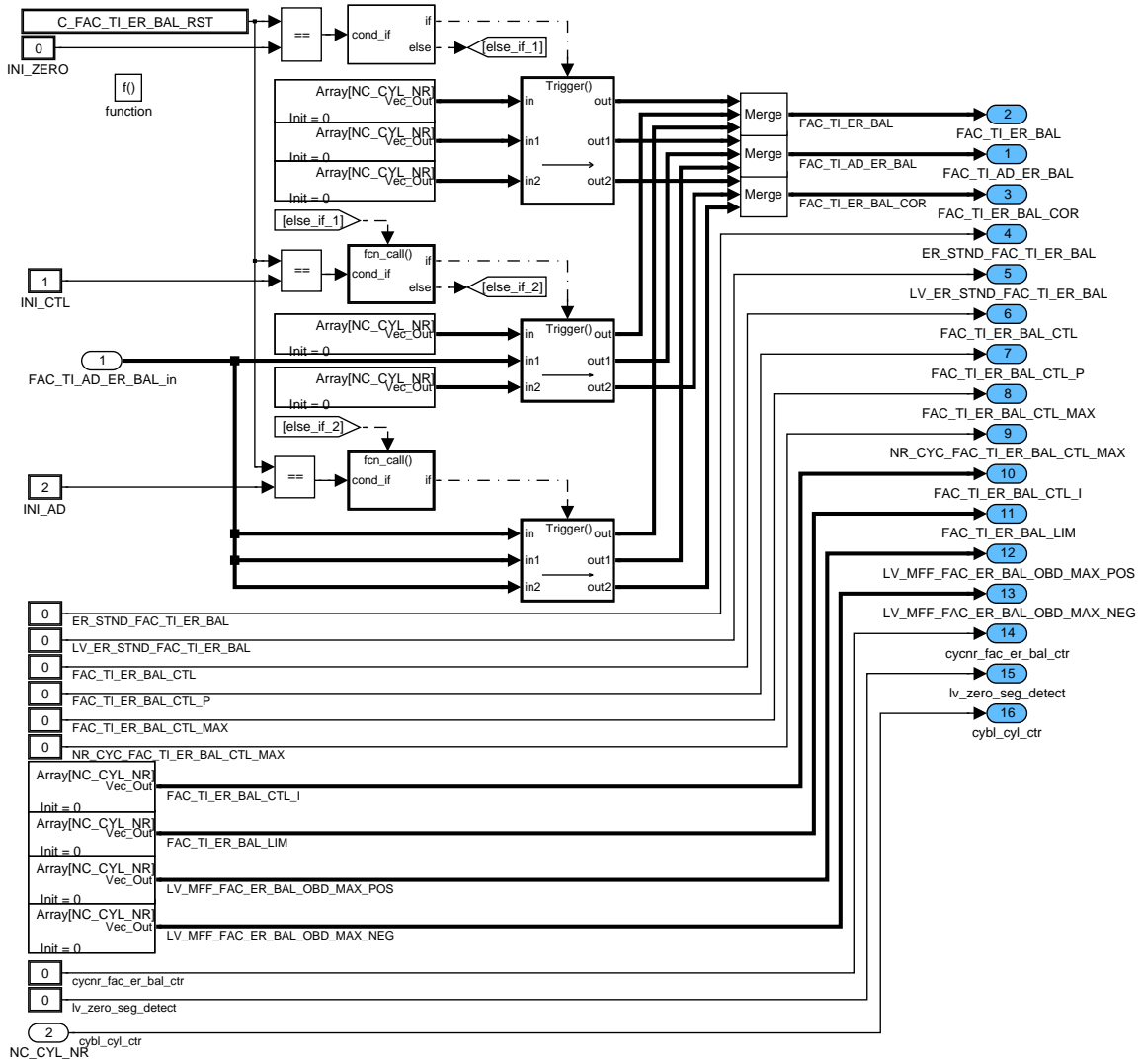


Figure 7.107.4: CYBL\_M30707Q01/NVMY\_INI/operate\_INI

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### 7.107.2 Calculation of 100ms and segment synchronous tasks

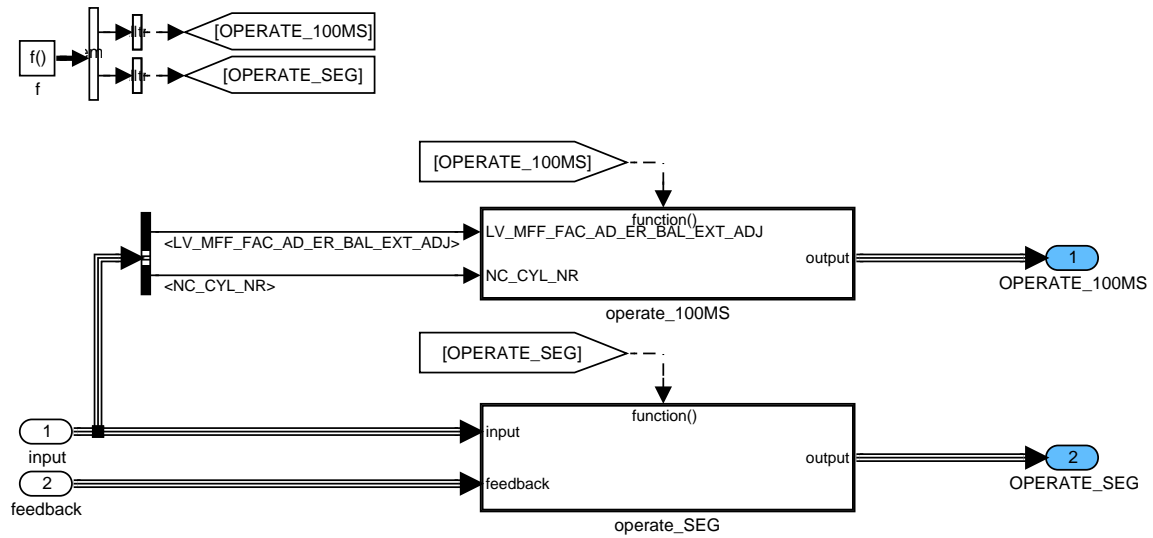



Figure 7.107.5: CYBL\_M30707Q01/OPM

#### External adjustment of multiple correction values

In case of an external adjustment (request from key word protocol) the additive adaptation values for all cylinders are set to zero. While the external adjustment is activated, all following subchapters within the module "Cylinder balancing via multiple TI intervention" are deactivated and the corresponding "Initialization at Deactivation" process for this chapter is blocked during this period.

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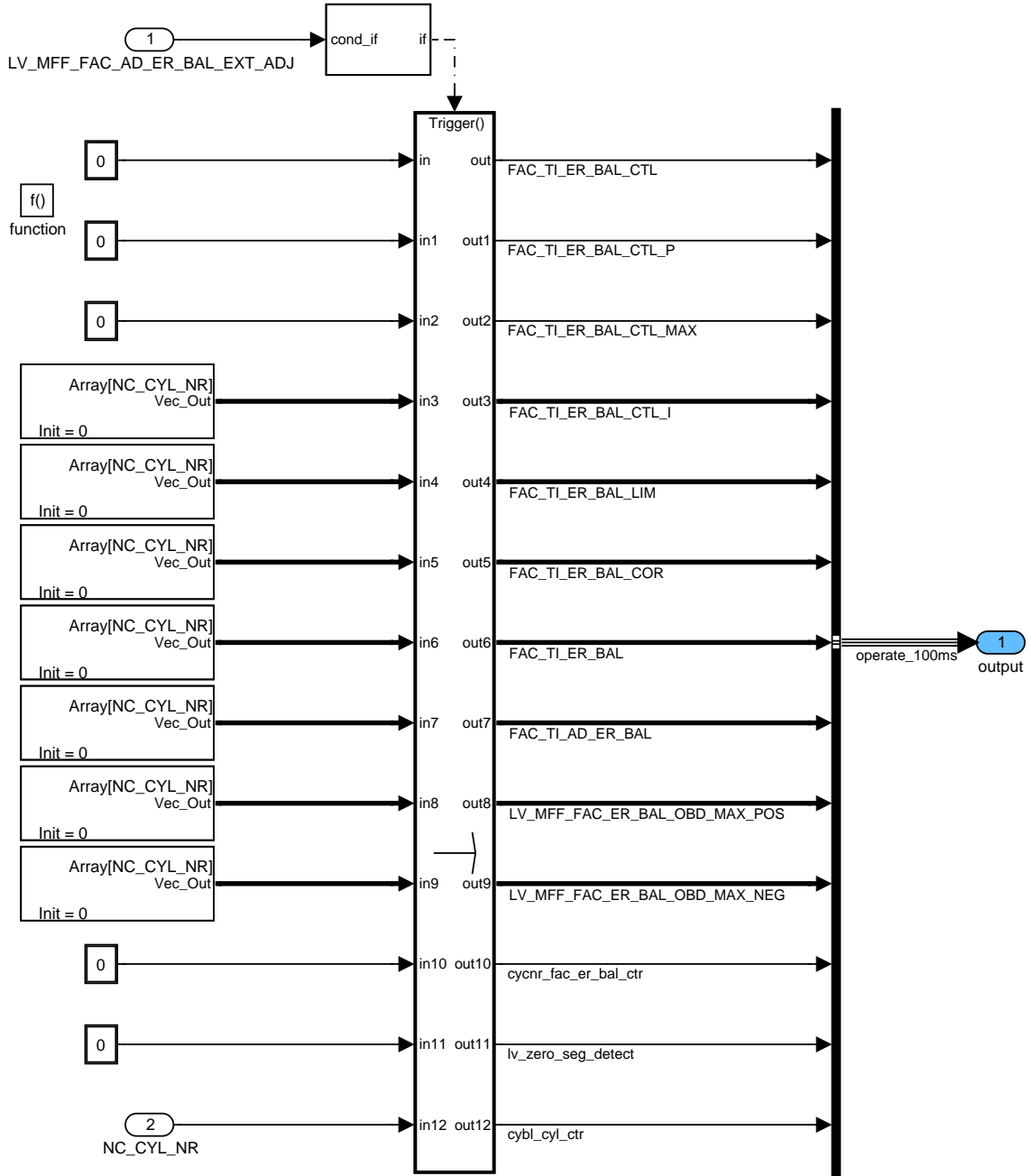


Figure 7.107.6: CYBL\_M30707Q01/OPM/operate\_100MS

**Calculation of segment task**

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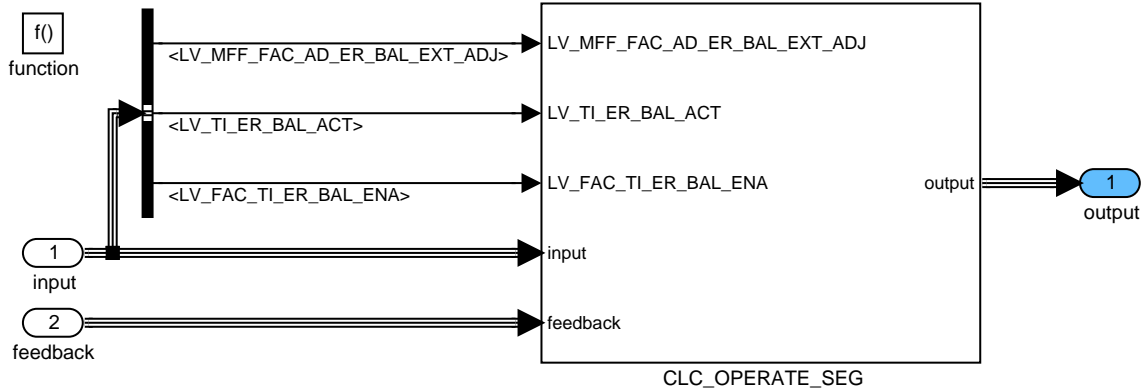


Figure 7.107.7: CYBL\_M30707Q01/OPM/operate\_SEG

**Calculation of manual reset, injection time correction and injection time adaptation**

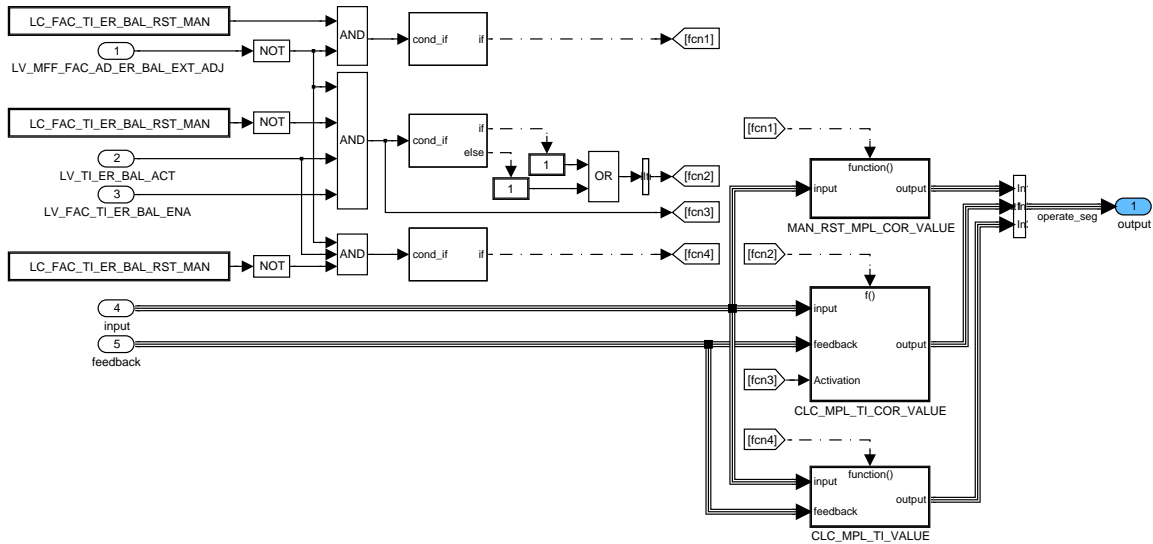


Figure 7.107.8: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG

**Manual reset of multiple correction values**

In case of a manual reset it is possible to adjust the exported output data to a wanted value to make the function test and handling more easier. While the manual function reset is activated, all following subchapters within the module "Cylinder balancing via multiple TI intervention" are deactivated and the corresponding "Initialization at Deactivation" process for this chapters is blocked during this period.

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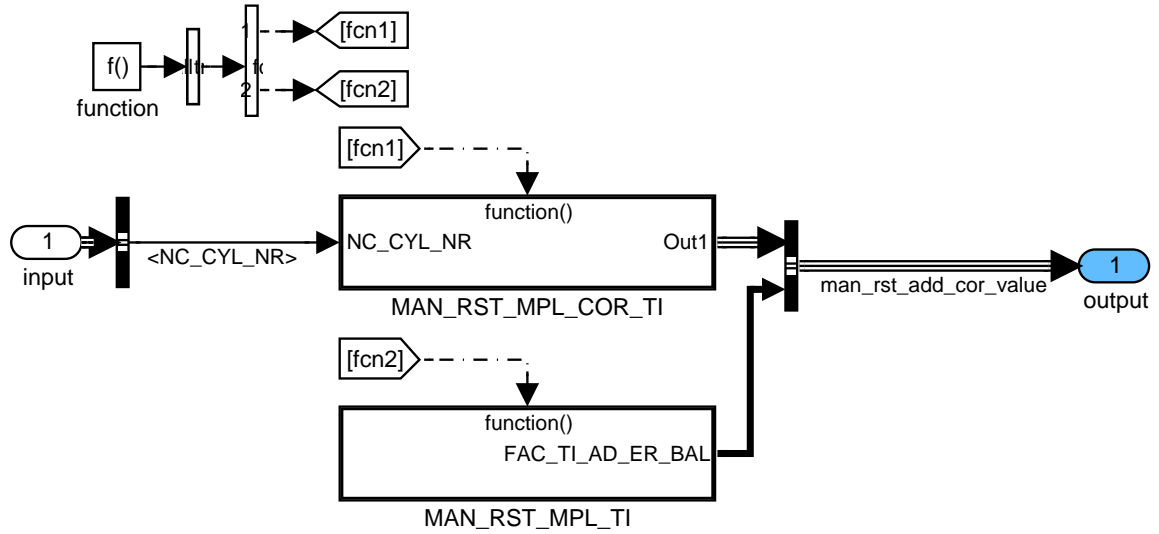

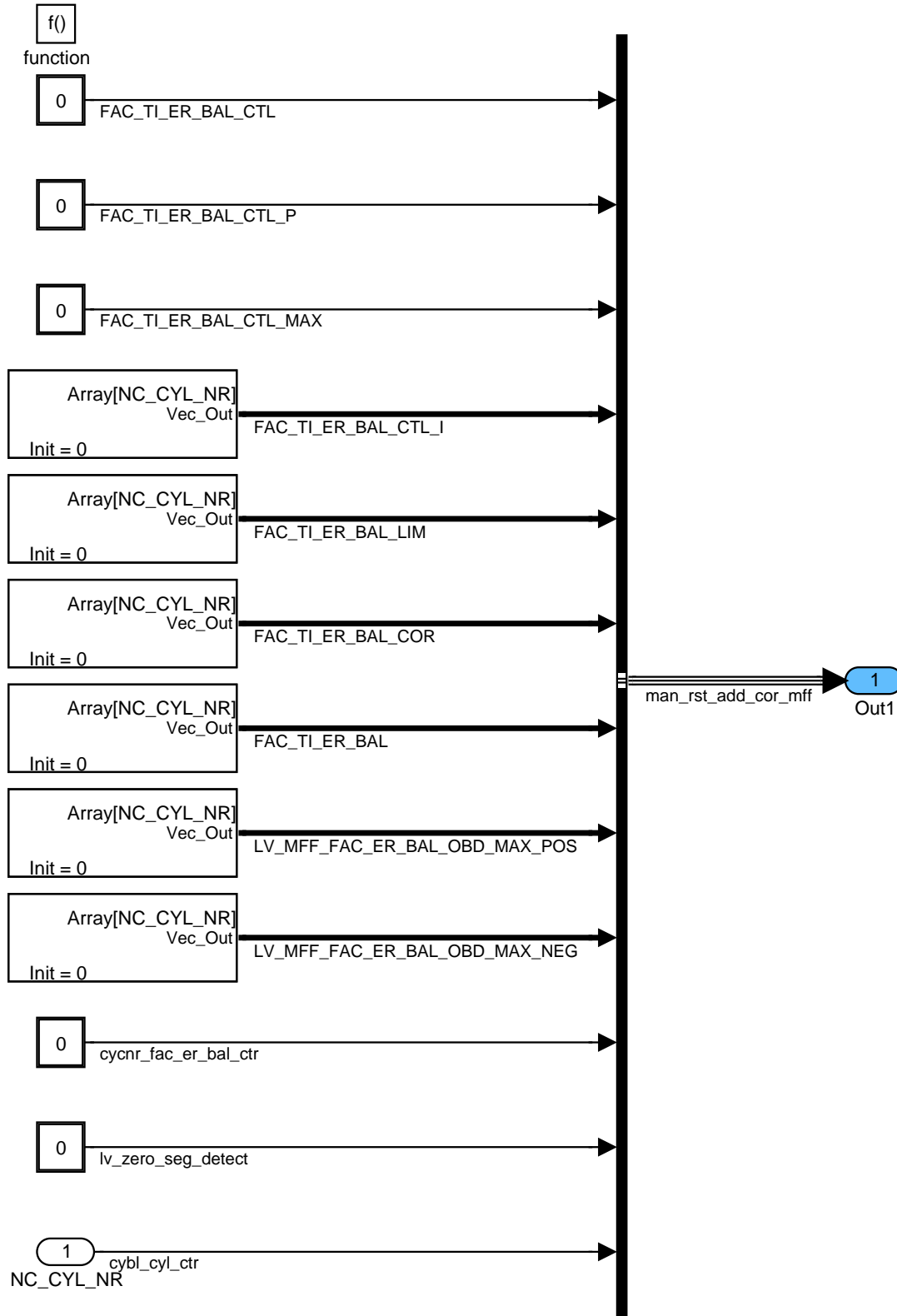


Figure 7.107.9:  
CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/MAN\_RST\_MPL\_COR\_VALUE

**Manual reset of multiple correction values for cylinder balancing via TI intervention**

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Figure 7.107.10: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/ MAN\_RST\_MPL\_COR\_VALUE/MAN\_RST\_MPL\_COR\_TI

**Manual reset of multiple adaptation values for cylinder balancing via TI intervention**

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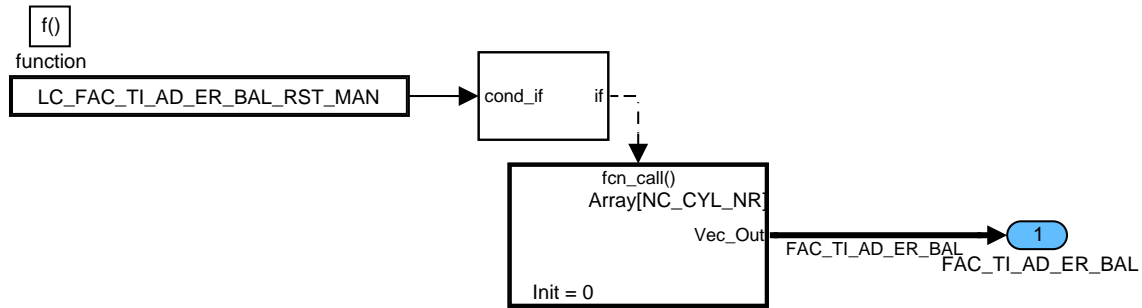


Figure 7.107.11: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/ MAN\_RST\_MPL\_COR\_VALUE/MAN\_RST\_MPL\_TI

**Structure of the multiple injection time correction values**

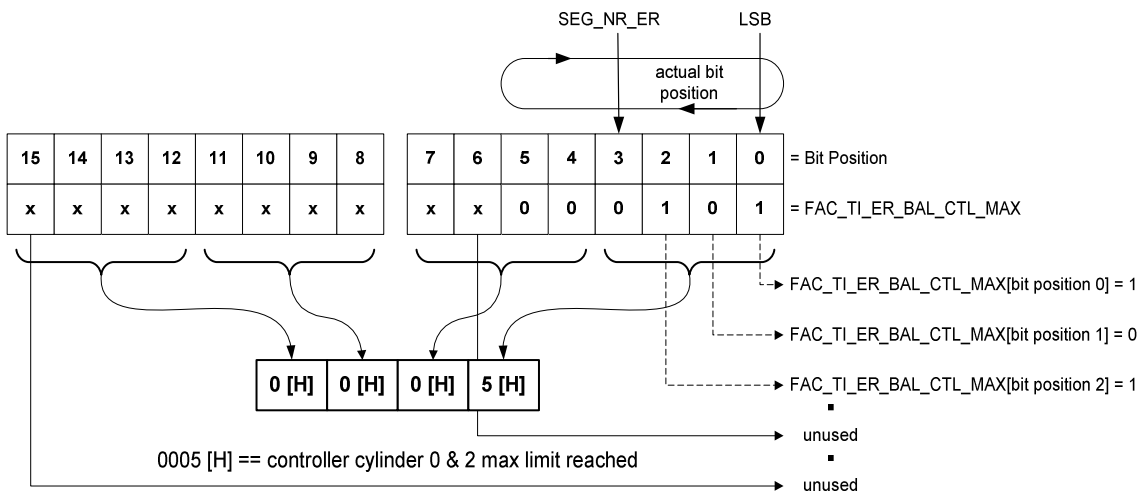
The calculation of the multiple injection time correction values are only performed if the corresponding enable bit LV\_FAC\_TI\_ER\_BAL\_ENA is set to logical "1" in combination with additional activation conditions. In this case, a separate correction value for each cylinder is determined with use of a PIcontroller.

As soon as a PIcontroller of one cylinder is reaching its maximum, a corresponding value is set to "1" to indicate the related cylinder. To save memory resources, the information for all cylinders is located within one output data (WORD) is used to indicate one cylinder. It is possible to handle up to 16 cylinders with this method.

For a description more in detail please have a look to the signal flow diagram below. As example, a sixcylinder engine with two PIcontrollers, which have reached the limits, is shown.

Signal flow diagram:

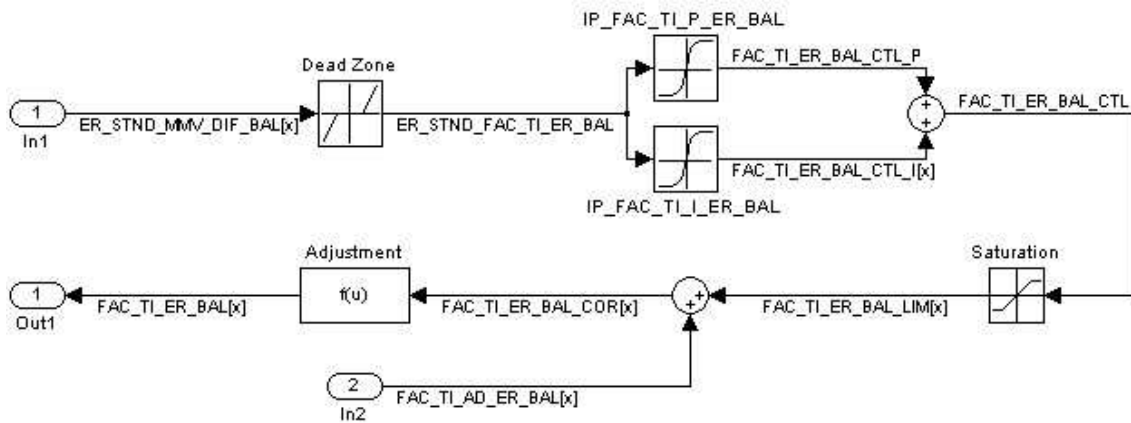
Signalization of controller max. output value reached for multiple path



**Note:** always the complete WORD (16 BIT) is displayed as visible value


*Calculation of the multiple injection time correction /adaptation values in general*

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**Note:** [x] is representing [SEG\_NR\_ER] in the signal flow diagram above

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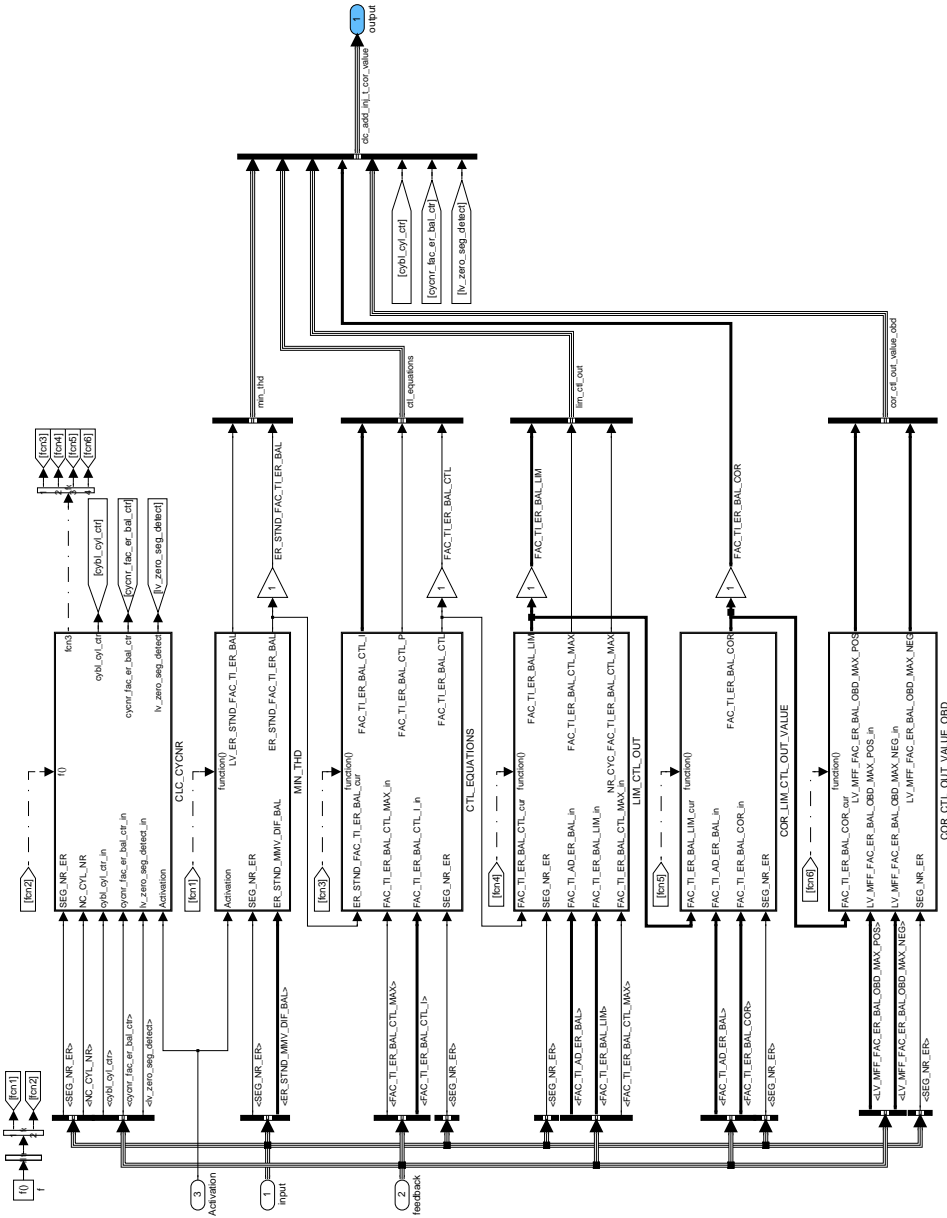



Figure 7.107.12:  
CYBL\_M3070Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_COR\_VALUE

**Minimum threshold**

If defined cylinder balancing input values ER\_STND\_MMV\_DIF\_BAL[SEG\_NR\_ER] are outside a calibratable range, the controller is calculated. Otherwise the controller inputs are set to zero.

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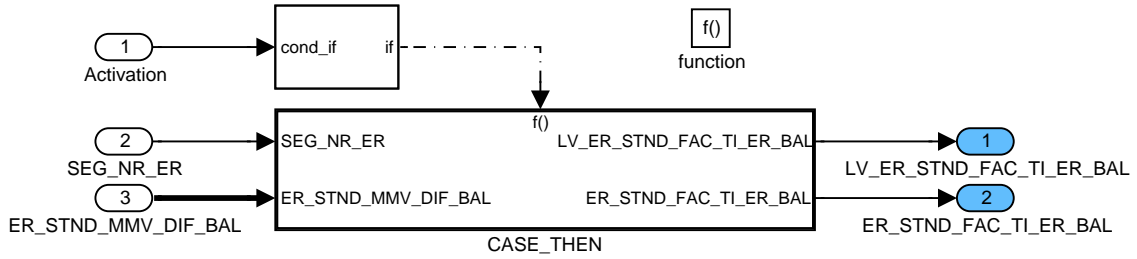


Figure 7.107.13:  
CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_COR\_VALUE/MIN\_THD

**Minimum threshold CASE\_THEN**

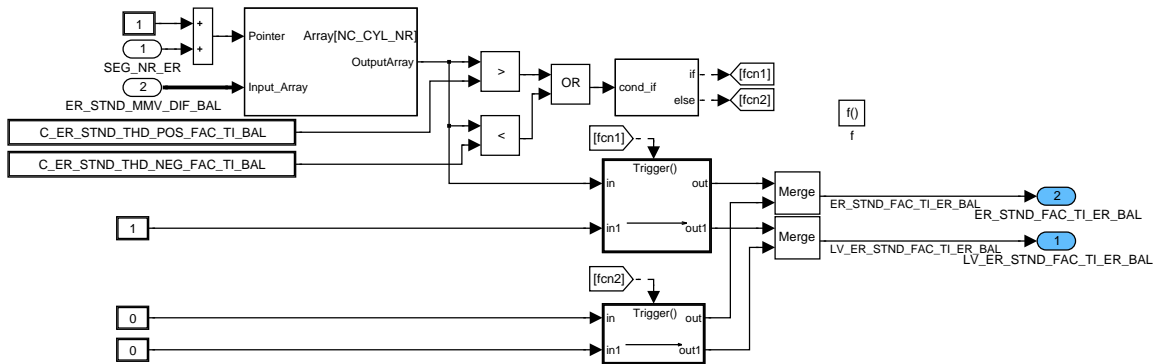


Figure 7.107.14: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_COR\_VALUE/MIN\_THD/CASE\_THEN

**Calculation of segment tasks CLC\_OPERATE\_SEG CLC\_MPL\_TI\_COR\_VALUE CLC\_CYCNR**

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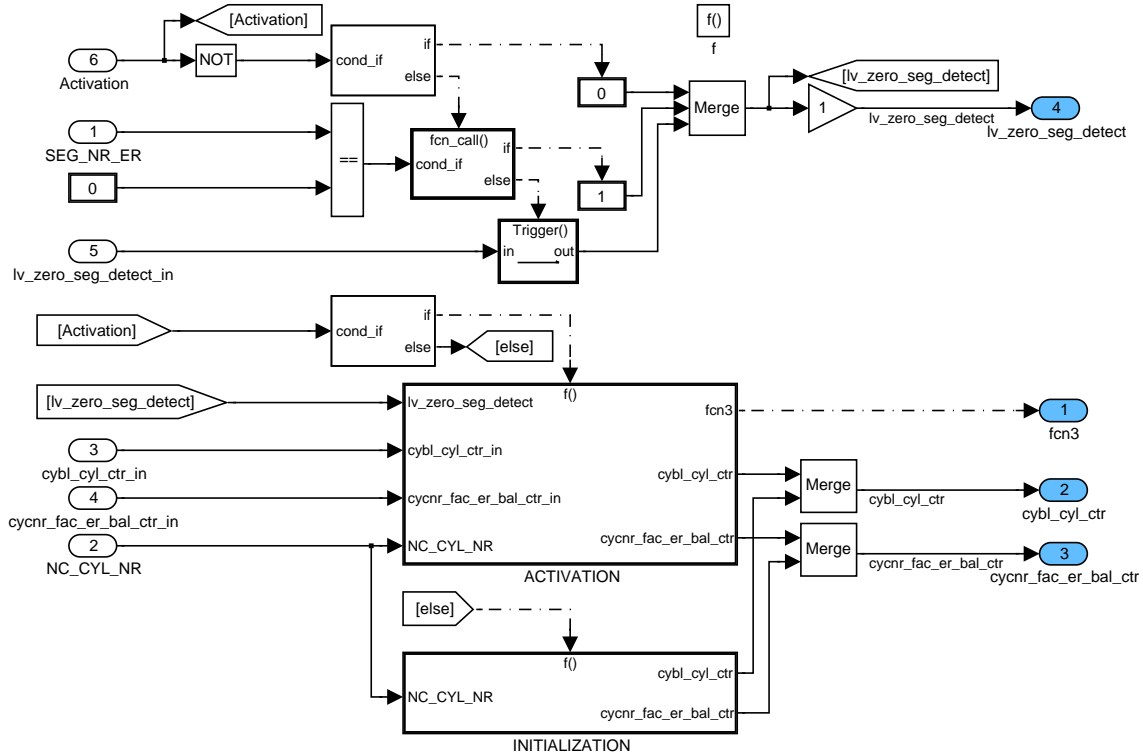


Figure 7.107.15: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_COR\_VALUE/CLC\_CYCNR

**Calculation of segment tasks CLC\_OPERATE\_SEG CLC\_MPL\_TI\_COR\_VALUE CLC\_CYCNR ACTIVATION**

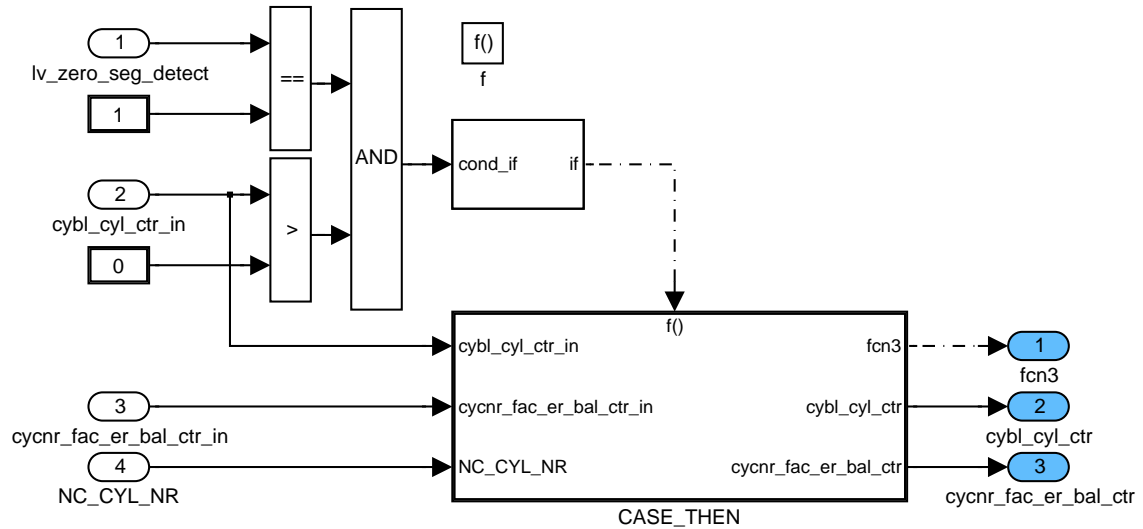


Figure 7.107.16: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_COR\_VALUE/CLC\_CYCNR/ACTIVATION

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**Calculation of segment tasks CLC\_OPERATE\_SEG CLC\_MPL\_TI\_COR\_VALUE CLC\_CYCNR ACTIVATION CASE\_THEN**

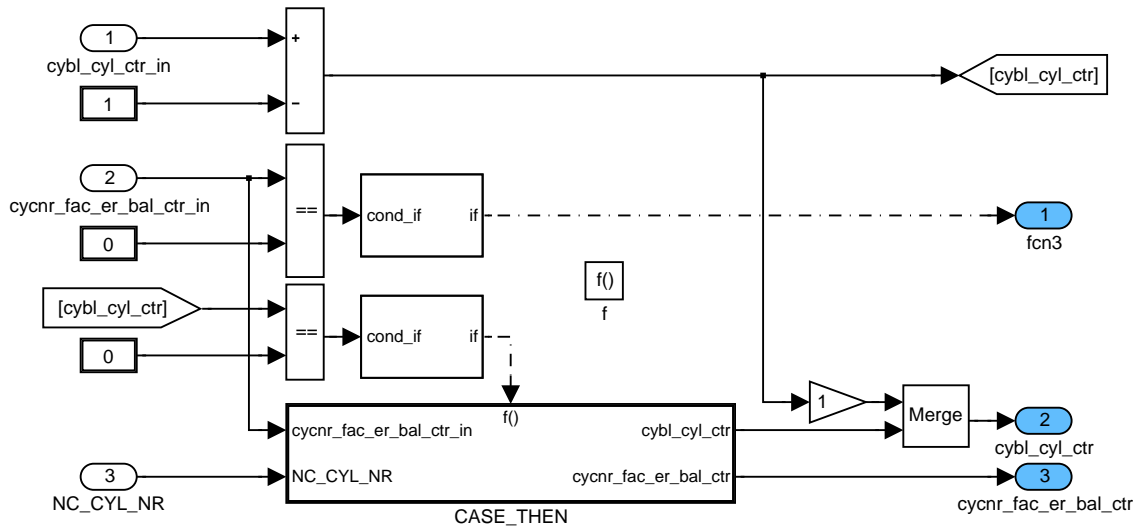


Figure 7.107.17: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_COR\_VALUE/CLC\_CYCNR/ACTIVATION/CASE\_THEN

**Calculation of segment tasks CLC\_OPERATE\_SEG CLC\_MPL\_TI\_COR\_VALUE CLC\_CYCNR ACTIVATION CASE\_THEN CASE\_THEN**

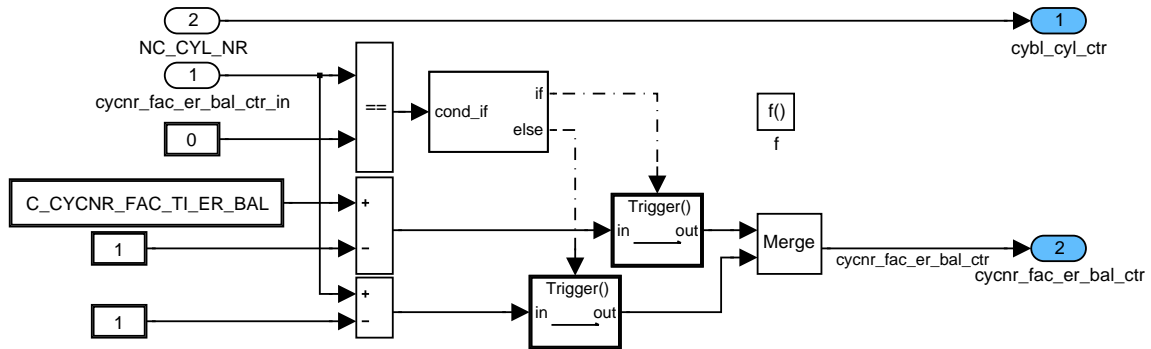


Figure 7.107.18: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_COR\_VALUE/CLC\_CYCNR/ACTIVATION/CASE\_THEN/CASE\_THEN

**Calculation of segment tasks CLC\_OPERATE\_SEG CLC\_MPL\_TI\_COR\_VALUE CLC\_CYCNR INITIALIZATION**

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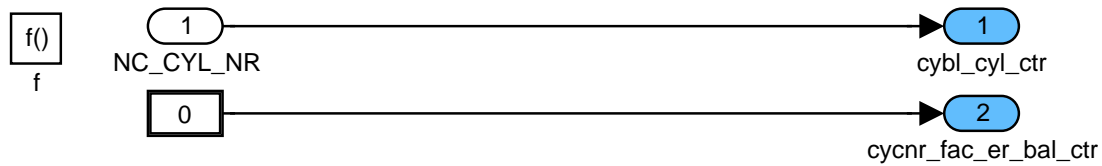


Figure 7.107.19: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_COR\_VALUE/CLC\_CYCNR/INITIALIZATION

### Controller Equations

For the multiple correction mode, a separate set of NC\_CYL\_NR controllers exists operating in parallel (one controller for each cylinder).

The computation of the output values is carried out every C\_CYCNR\_FAC\_TI\_ER\_BAL engine cycles (= calibrateable number of engine cycles).

Only in case of C\_CYCNR\_FAC\_TI\_ER\_BAL = 1, the calculation of the additive path is done without interruption. At every segment the corresponding cylinder correction value is built.

If the computation is not done at every engine cycle (C\_CYCNR\_FAC\_TI\_ER\_BAL > 1), the trigger of the controller output calculation is always related to SEG\_NR\_ER = 0.

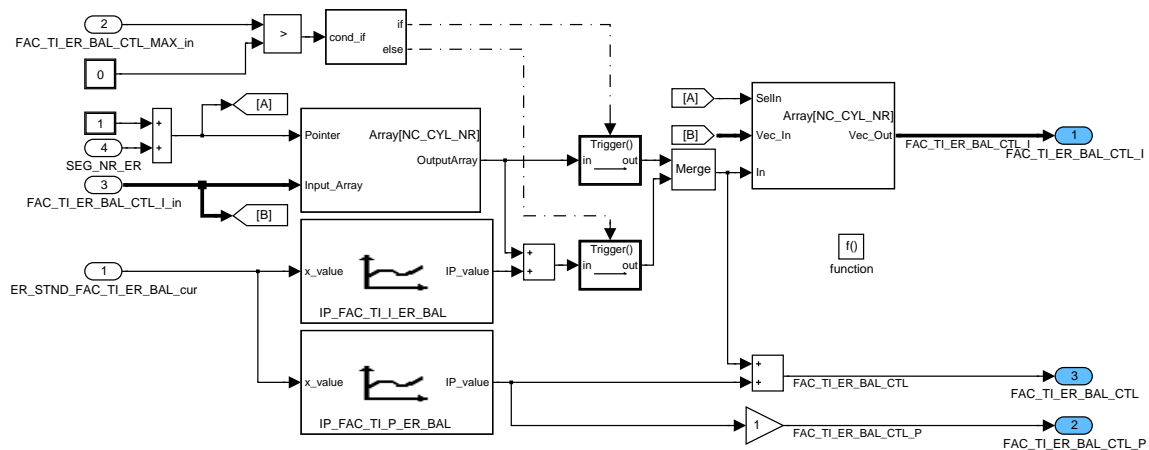


Figure 7.107.20: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_COR\_VALUE/CTL EQUATIONS

### Limitation of the Controller Output

The outputs of the controllers are limited to calibrateable threshold. If one controller output has reached the limit, a flag is set at one and the corresponding segment number is displayed.

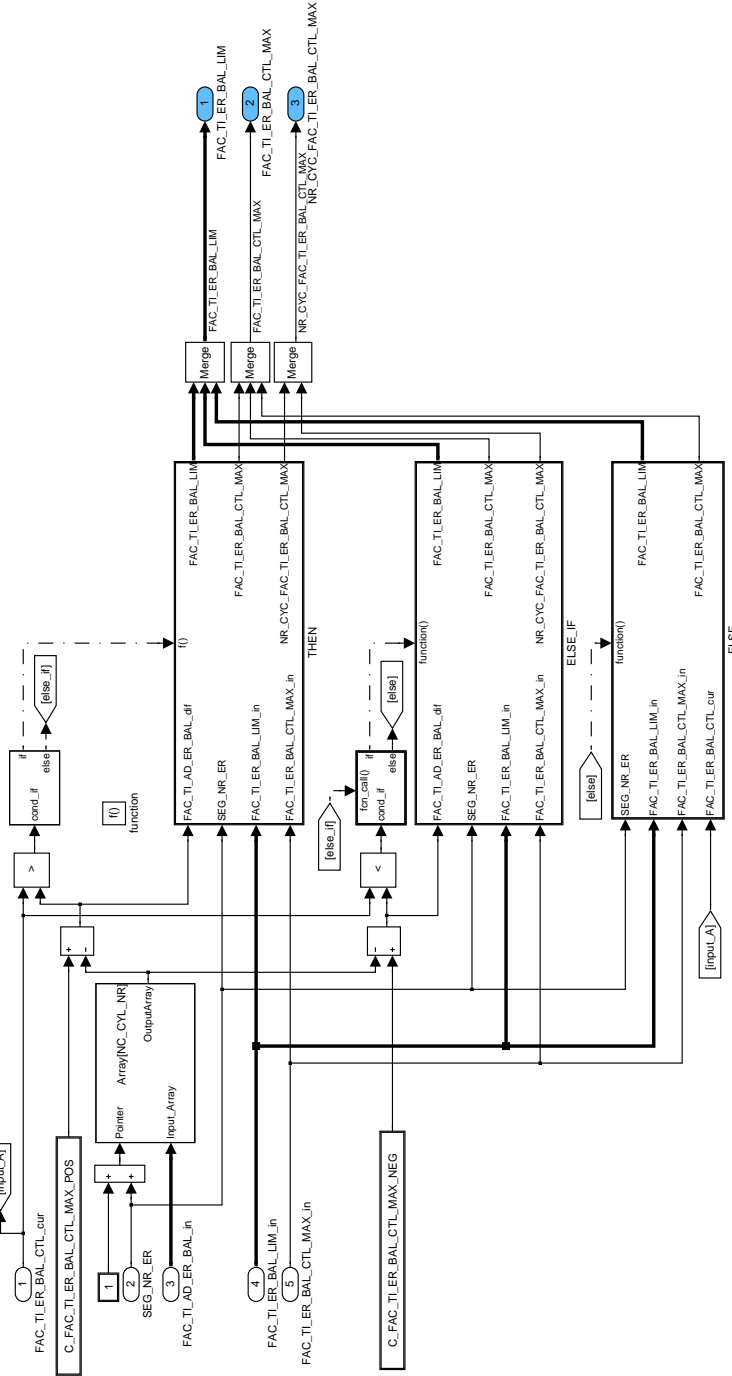



Figure 7.107.21: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_COR\_VALUE/LIM\_CTL\_OUT

**Limitation of the Controller Output - then branch**

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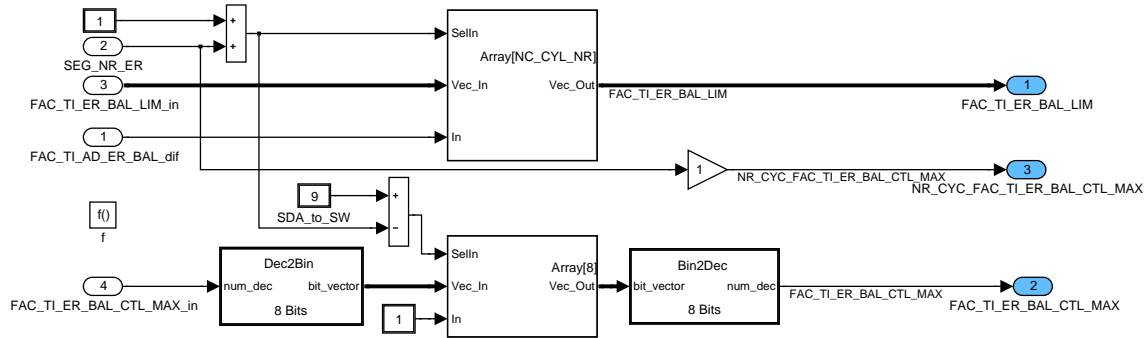


Figure 7.107.22: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_COR\_VALUE/LIM\_CTL\_OUT/THEN

**Limitation of the Controller Output - else if branch**

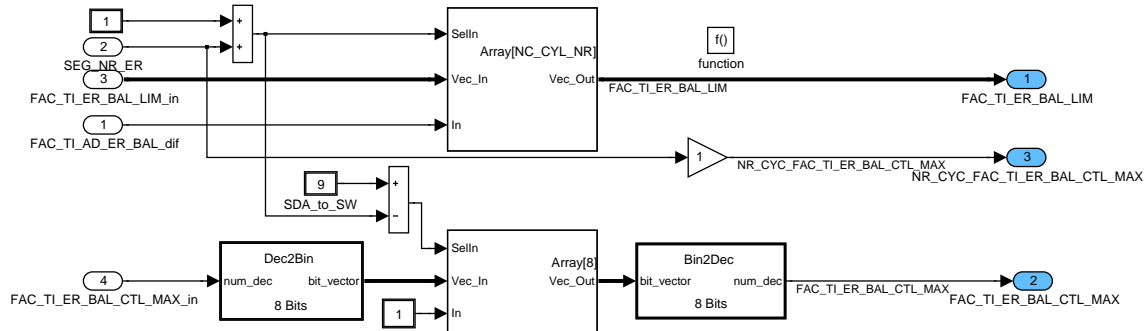


Figure 7.107.23: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_COR\_VALUE/LIM\_CTL\_OUT/ELSE\_IF

**Limitation of the Controller Output - else branch**

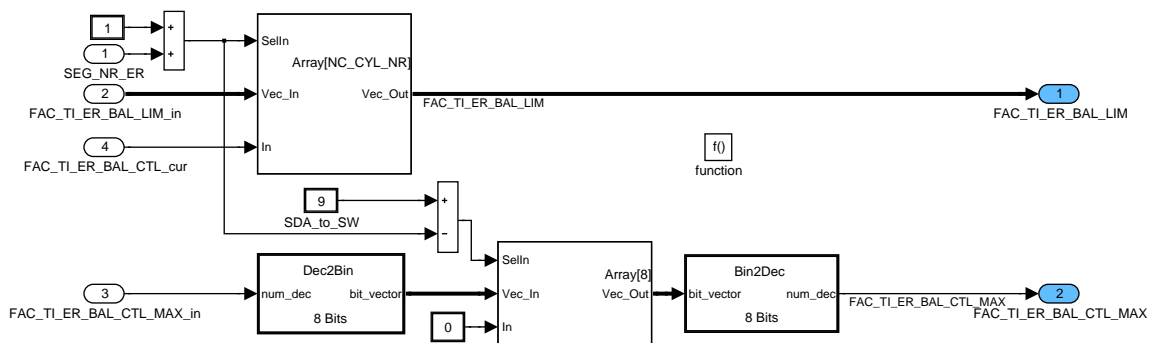


Figure 7.107.24: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_COR\_VALUE/LIM\_CTL\_OUT/ELSE

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### Correction of limited controller output values with adaptation values

The limited controller output values are corrected with the currently available adaptive correction values, which is saved in NVMY and updated at Activation or Deactivation of the multiple adaptation path (LV\_FAC\_TI\_AD\_ER\_BAL\_ENA)

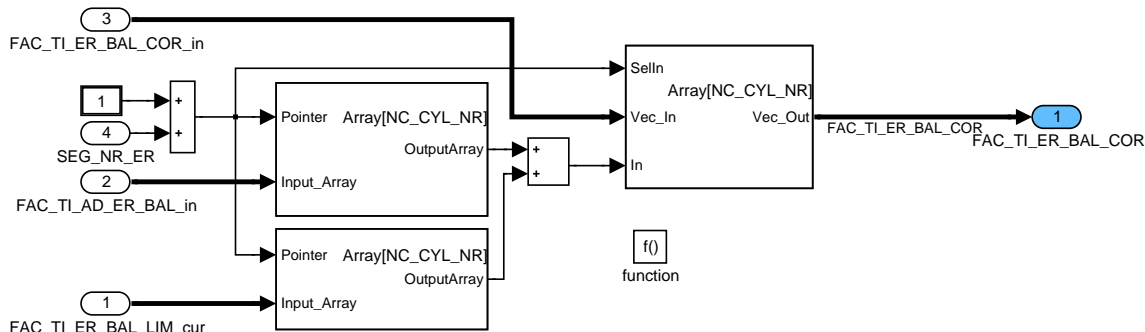



Figure 7.107.25: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_COR\_VALUE/COR\_LIM\_CTL\_OUT\_VALUE

### Observation of corrected controller output values for OBD issues

The multiple correction values out of the correction path are observed for OBD purposes. As soon as the minimum or maximum diagnosis threshold is exceeded, a corresponding flag for the related cylinder is set. In this case the OBD system is indicated to handle the further failure treatment. The diagnosis thresholds have always to be less or equal to the absolute minimum or maximum controller output limits.

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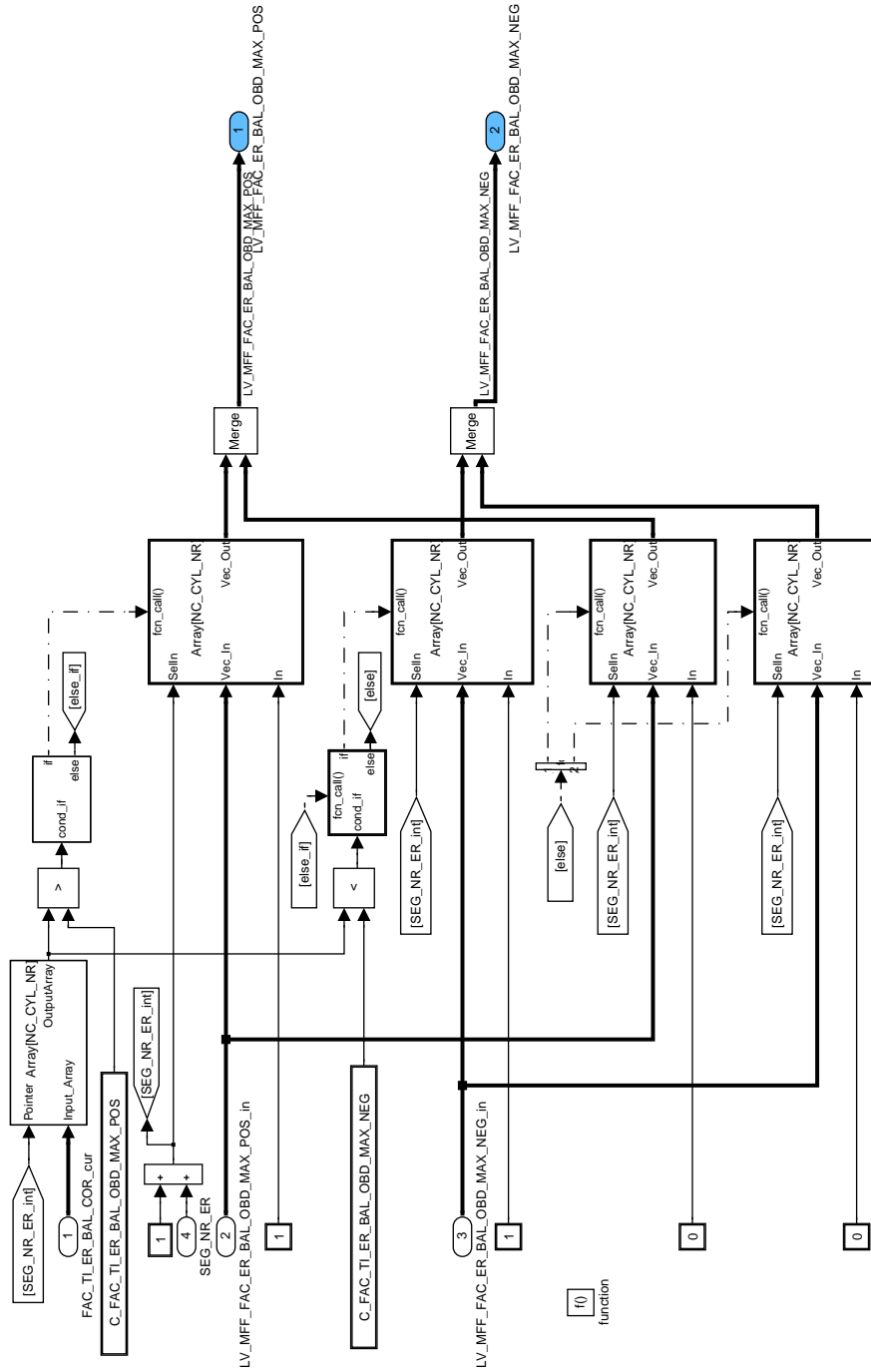



Figure 7.107.26: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_COR\_VALUE/COR\_CTL\_OUT\_VALUE\_OBD

**Calculation of the multiple injection time adaptation values**

The corrected NC\_CYL\_NR controller output values are adjusted dependent on the corresponding segment number SEG\_NR\_ER. During the function is activated, at every new segment the corresponding FAC\_TI\_ER\_BAL value is updated. Due to this correction the sum of all adaptation output values remains zero to guarantee that the overall injection spreading stays unchanged.

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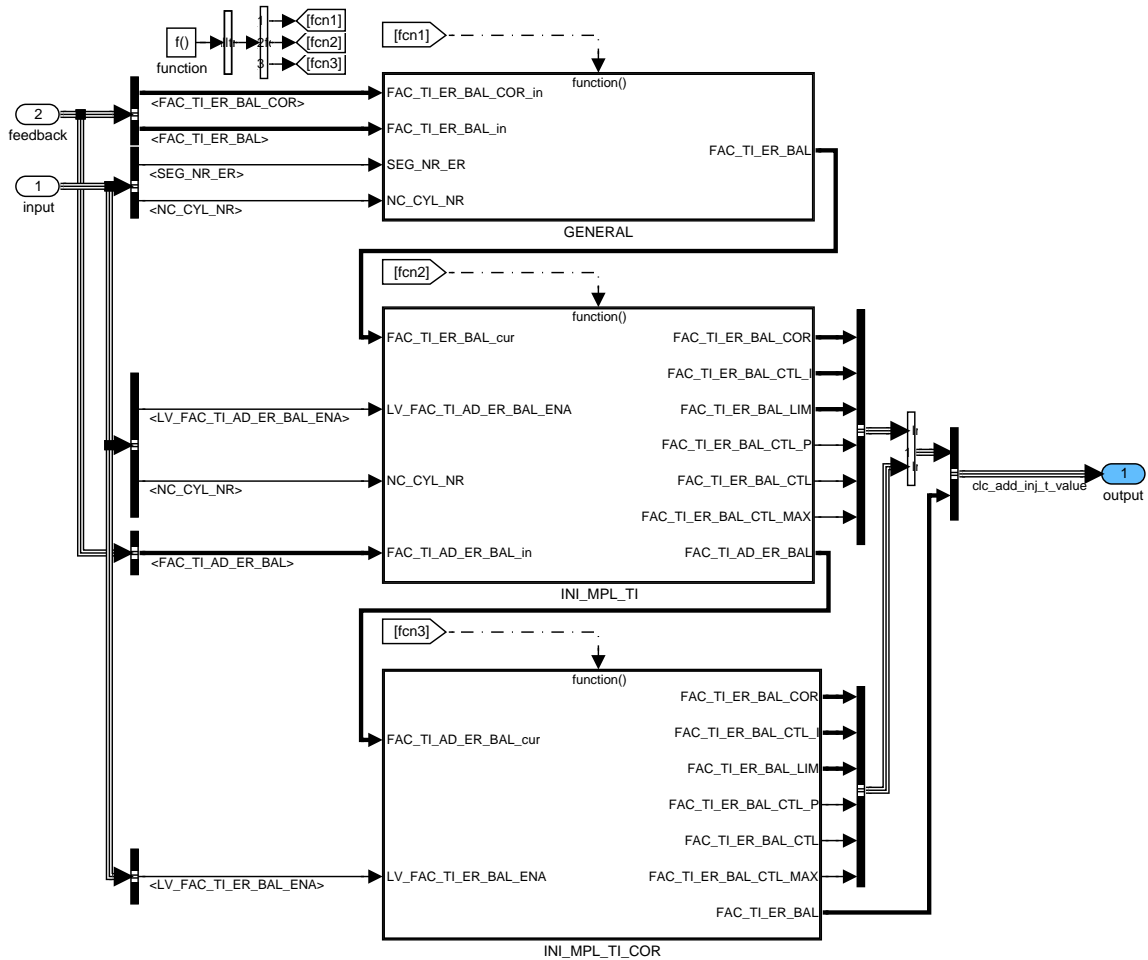


Figure 7.107.27: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_VALUE

**Calculation of the multiple injection time adaptation values General**

Sum of all NC\_CYL\_NR controller output values /number of cylinders

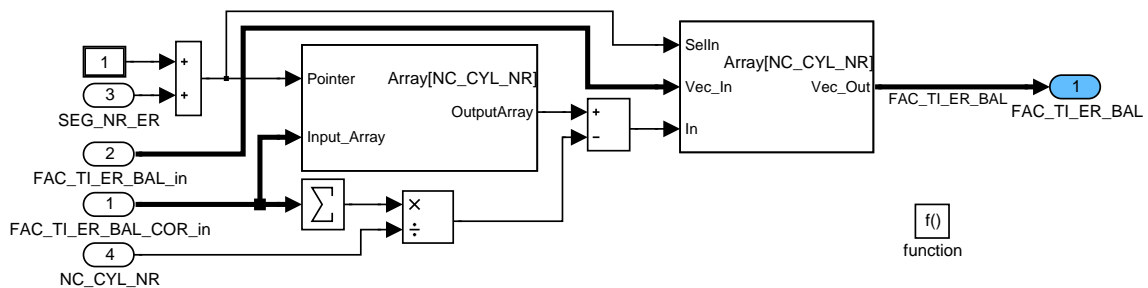


Figure 7.107.28: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_VALUE/GENERAL

**Initialization at Entry or Exit to multiple injection time adaptation**

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As soon as the multiple injection time adaptation is enabled or disabled, the stored adaptive correction values are overwritten with the currently present global adaptive value and the controller output values are set to zero.

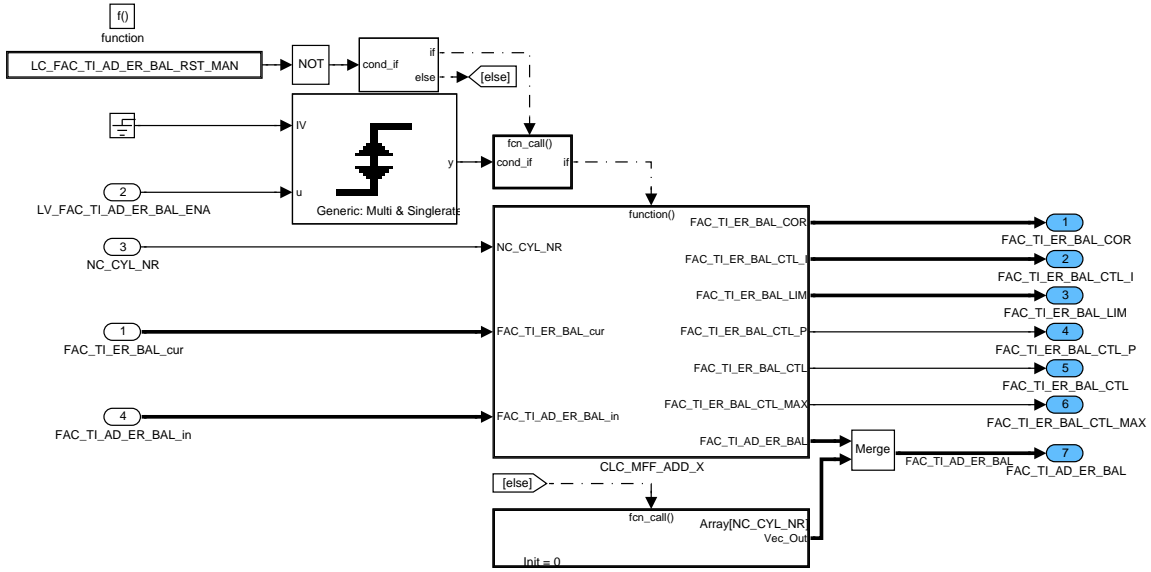


Figure 7.107.29: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_VALUE/INI\_MPL\_TI

**Initialization at Entry or Exit to multiple injection time adaptation - then - then branch**

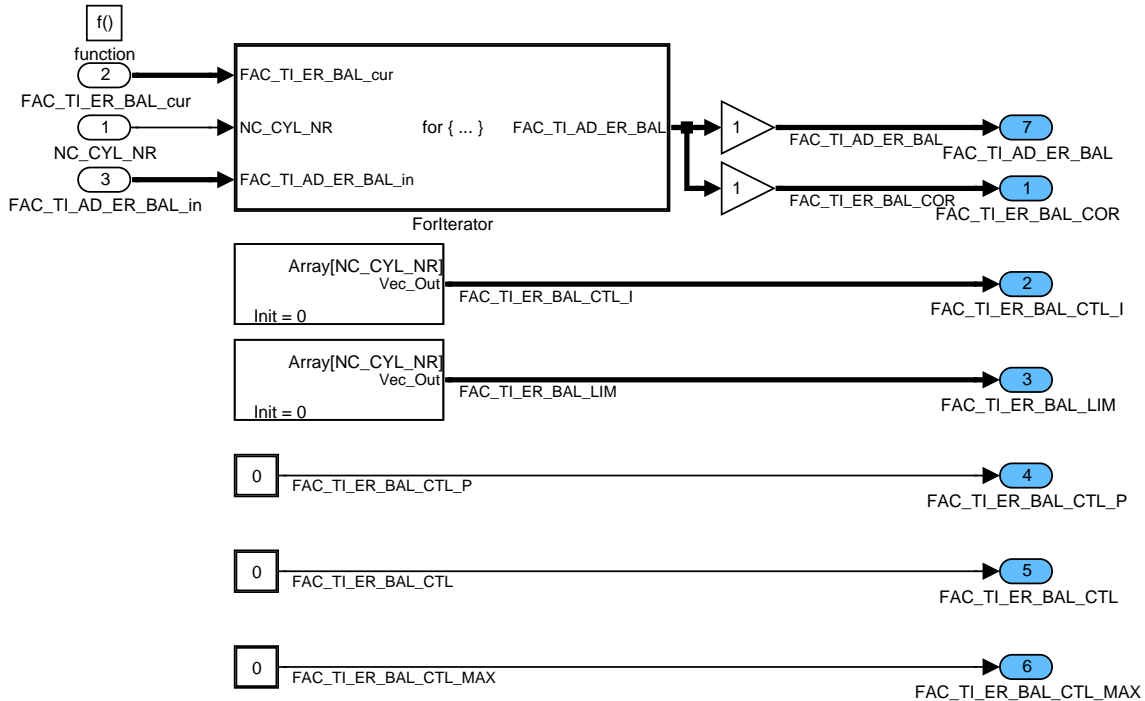


Figure 7.107.30: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_VALUE/INI\_MPL\_TI/CLC\_MFF\_ADD\_X

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**Initialization at Entry or Exit to multiple injection time adaptation - then - then - for iterator branch**

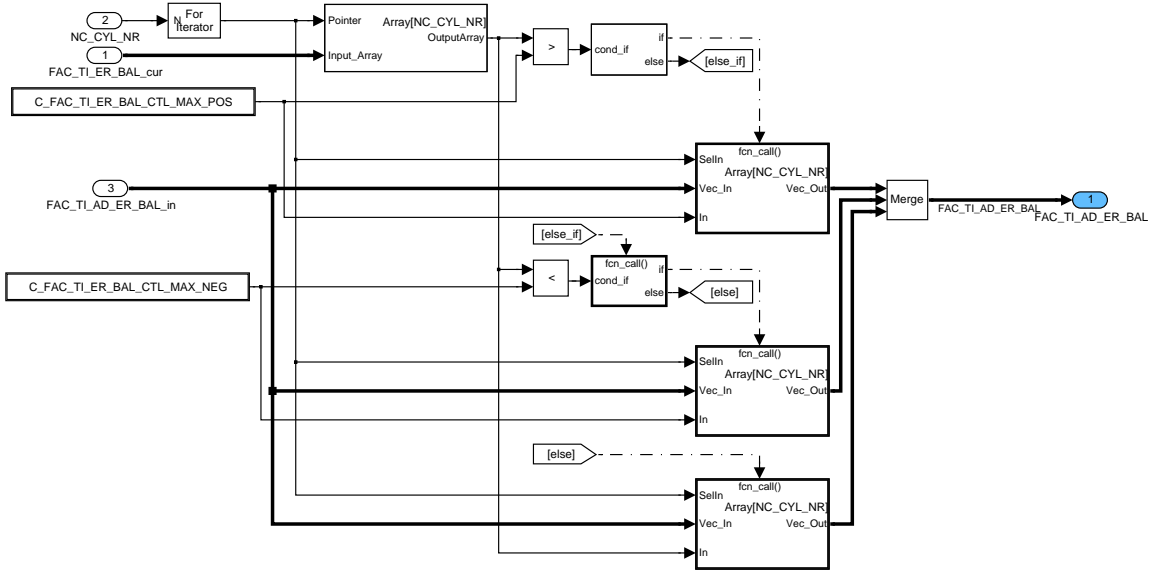



Figure 7.107.31: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_VALUE/INI\_MPL\_TI/CLC\_MFF\_ADD\_X/ForIterator

**Initialization at Exit from multiple injection time correction**

As soon as the multiple injection time correction is disabled in combination with the manual switch to force the overall correction (LC\_FAC\_TI\_ER\_BAL\_COR), the controller output values are set to zero. The initialization only takes place, if the logical constant for a manual reset of the multiple controller values is set to zero (LC\_FAC\_TI\_ER\_BAL\_RST\_MAN =0).

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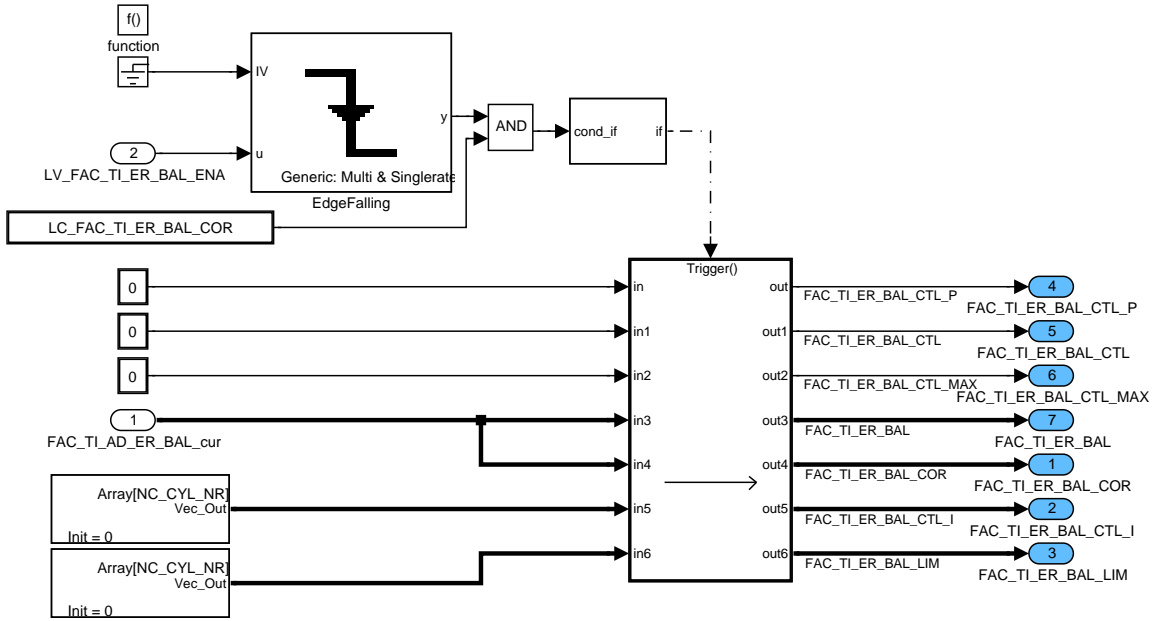


Figure 7.107.32: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_VALUE/INI\_MPL\_TI\_COR

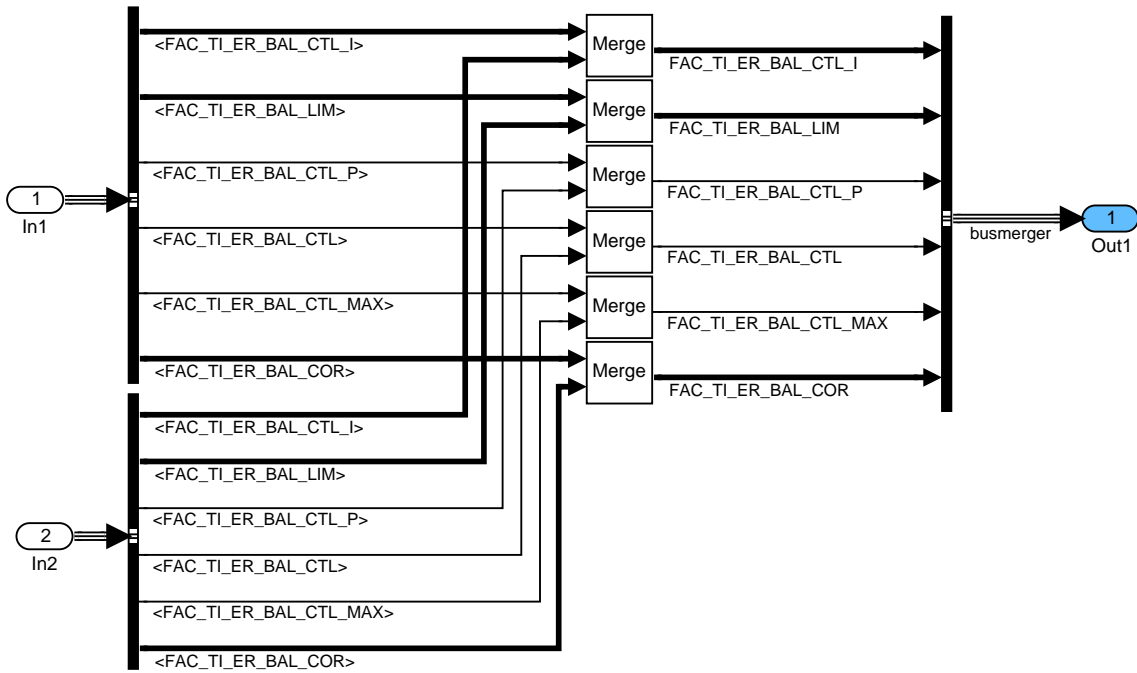


Figure 7.107.33: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/CLC\_MPL\_TI\_VALUE/BusMerger

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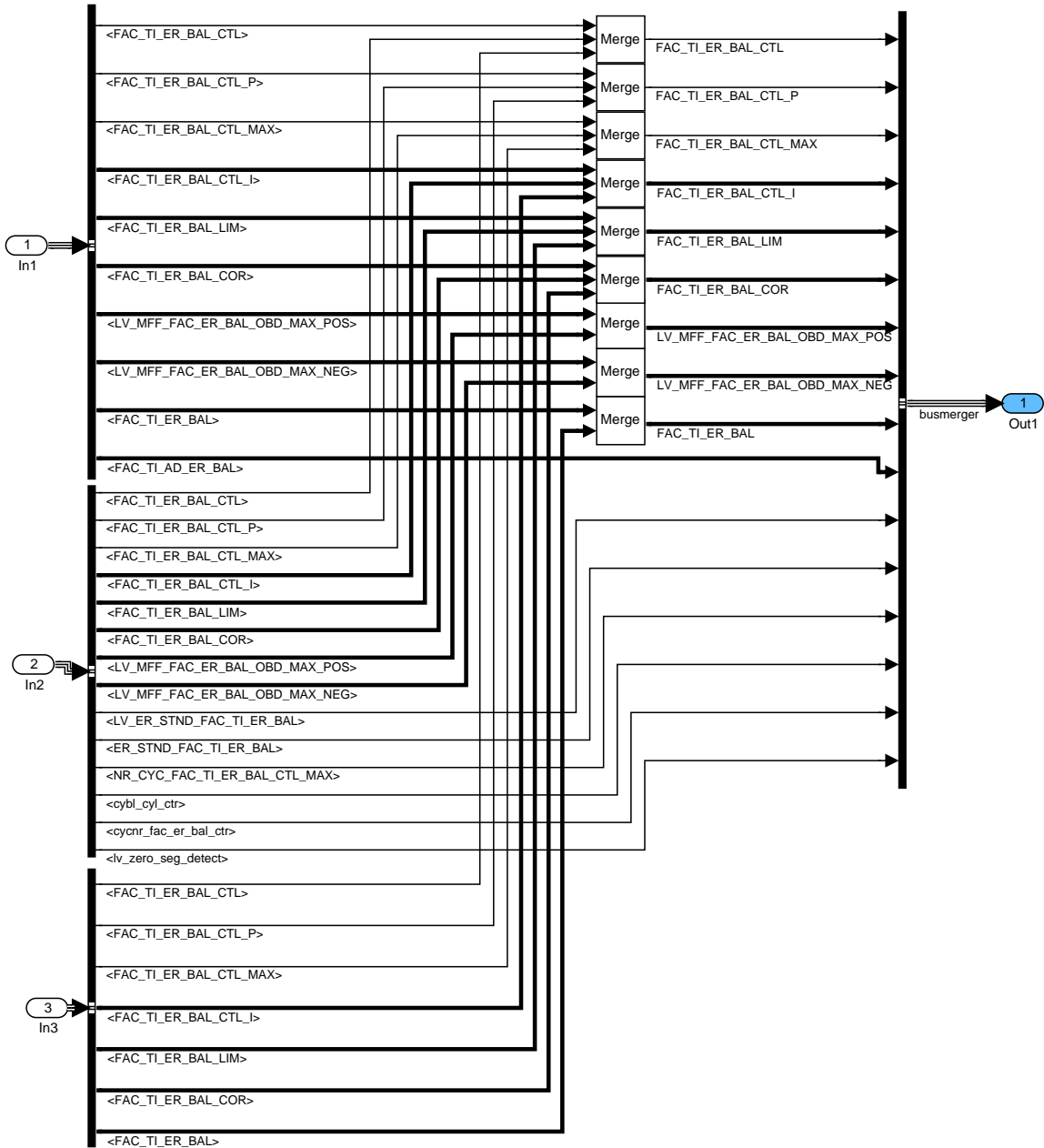



Figure 7.107.34: CYBL\_M30707Q01/OPM/operate\_SEG/CLC\_OPERATE\_SEG/BusMerger

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### 7.107.3 SUBFUNCTION: SIG\_MNG

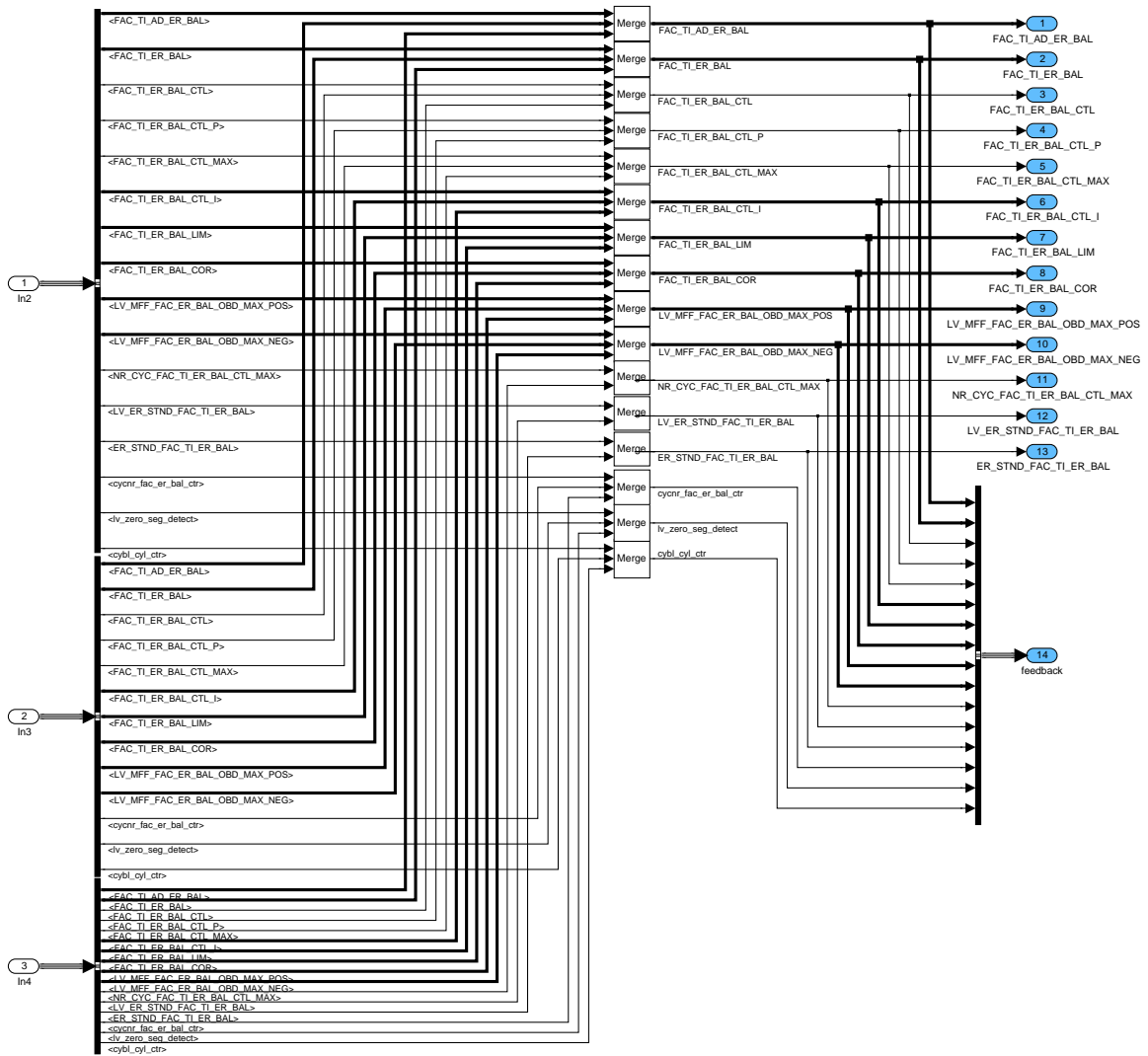


Figure 7.107.35: CYBL\_M30707Q01/SIG\_MNG


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## 7.108 Injection realization (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_PSN_STAT_IGN_UPD_END	O/V	0... 780H	0... 720	0.375	°CRK
End of static ignition update window for ignition/injeciton synchronization					
CRK_PSN_STAT_IGN_UPD_ST	O/V	0... 780H	0... 720	0.375	°CRK
Start of static ignition update window for ignition/injeciton synchronization					
CRK_PSN_STAT_WIN_END	O/V	0... 780H	0... 720	0.375	°CRK
End position of static injection update window					
CRK_PSN_STAT_WIN_ST	O/V	0... 780H	0... 720	0.375	°CRK
Start position of static injection update window					
CTR_CBK_EX_NR_ST_CLC_INJR	O	0... 1H	1 ...2	1	-
Start number of exhaust bank for calculations					
CTR_CBK_EX_NR_STOP_CLC_INJR	O	0... 1H	1 ...2	1	-
Stop number of exhaust bank for calculations					
CTR_CBK_IN_NR_ST_CLC_INJR	O	0... 1H	1 ...2	1	-
Start number of intake bank for calculations					
CTR_CBK_IN_NR_STOP_CLC_INJR	O	0... 1H	1 ...2	1	-
Stop number of intake bank for calculations					
CTR_CYL_NR_ST_CLC_INJR	O/V	0... 7H	0 ...7	1	-
Number of first cylinder in calculation order					
CTR_CYL_NR_STOP_CLC_INJR	V	0... 7H	0 ...7	1	-
Number of last cylinder in calculation order					
CTR_TEST_MOD_IV_EXT [NC_CYL_NR]	O	0... FFH	0... 255	1	-
Counter of number of injection valve actuator test cycles for external use, cylinder individual					
FAC_N	O/V	0... 1FE0H	0... 48.96	0.006	°CRK/ms
Engine speed factor					
FAC_TI_EXT_ADJ	O	0... FFH	0... 1.99218	0.0078125	-
external injection time adjustment factor					
FAC_TI_L_PRS	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Injection time correction factor in case of low pressure					
FUP_H_INJ [NC_CBK_HPP_NR]	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure (high range) for calculation of injection parameters					
FUP_H_SP_S_INJ [NC_CBK_HPP_NR]	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint for stratified mode (high range) for calculation of injection parameters					
IDX_PRS_COR_CYL_CLC_MPLH [NC_CBK_HPP_NR]	O/V	0... 7H	0 ...7	1	-
Index to assign the logical cylinder for calculation of pressure correction for homogeneous multiple mode					
IDX_PRS_COR_CYL_CLC_S [NC_CBK_HPP_NR]	O/V	0... 7H	0 ...7	1	-
Index to assign the logical cylinder for calculation of pressure correction for stratified mode					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INJ_MOD_GLOBAL	O/V	1H	SNGS	-	-
		2H	MPLS		
		3H	MPLS+PLS3		
		4H	PRE_INJ		
		6H	CRASH		
		7H	TEST_PULSE		
		21H	SNGS+MPLP		
		22H	MPLS+MPLP		
		41H	HOMS-SNG		
		42H	HOMS		
		43H	HOMS+PLS3		
		62H	HOMS+MPLP		
		80H	DISABLE		
		81H	SNGH		
82H	MPLH				
83H	MPLH+PLS3				
Global injection mode for all cylinders					
INJ_MOD_SP [NC_CYL_NR]	O/V	1H	SNGS	-	-
		2H	MPLS		
		3H	MPLS+PLS3		
		4H	PRE_INJ		
		6H	CRASH		
		7H	TEST_PULSE		
		21H	SNGS+MPLP		
		22H	MPLS+MPLP		
		41H	HOMS-SNG		
		42H	HOMS		
		43H	HOMS+PLS3		
		62H	HOMS+MPLP		
		80H	DISABLE		
		81H	SNGH		
82H	MPLH				
83H	MPLH+PLS3				
Injection mode set point, cylinder individual					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INJ_MOD_SP_HOM [NC_CYL_NR]	O/V	1H	SNGS	-	-
		2H	MPLS		
		3H	MPLS+PLS3		
		4H	PRE_INJ		
		6H	CRASH		
		7H	TEST_PULSE		
		21H	SNGS+MPLP		
		22H	MPLS+MPLP		
		41H	HOMS-SNG		
		42H	HOMS		
		43H	HOMS+PLS3		
		62H	HOMS+MPLP		
		80H	DISABLE		
		81H	SNGH		
Injection mode set point for homogeneous combustion mode, cylinder individual					
INJ_MOD_SP_HOMS [NC_CYL_NR]	O/V	1H	SNGS	-	-
		2H	MPLS		
		3H	MPLS+PLS3		
		4H	PRE_INJ		
		6H	CRASH		
		7H	TEST_PULSE		
		21H	SNGS+MPLP		
		22H	MPLS+MPLP		
		41H	HOMS-SNG		
		42H	HOMS		
		43H	HOMS+PLS3		
		62H	HOMS+MPLP		
		80H	DISABLE		
		81H	SNGH		
82H	MPLH				
83H	MPLH+PLS3				
Injection mode set point for homogeneous-stratified combustion mode, cylinder individual					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INJ_MOD_SP_S [NC_CYL_NR]	O/V	1H	SNGS	-	-
		2H	MPLS		
		3H	MPLS+PLS3		
		4H	PRE_INJ		
		6H	CRASH		
		7H	TEST_PULSE		
		21H	SNGS+MPLP		
		22H	MPLS+MPLP		
		41H	HOMS-SNG		
		42H	HOMS		
		43H	HOMS+PLS3		
		62H	HOMS+MPLP		
		80H	DISABLE		
		81H	SNGH		
82H	MPLH				
83H	MPLH+PLS3				
Injection mode set point for stratified combustion mode, cylinder individual					
LF_EGY_RNG_HOM_EXT	O/V	0... FFH	0... 255	1	-
Bit coded external injector needle lift set point during HOM mode - 1: high lift; 0: low lift - each bit represents one injection pulse.					
LF_IV_INH_PUC_EXT	O/V	0... FFH	0... 255	1	-
External injection inhibit pattern, which can be applied during PUC-phases					
LF_PRS_COR_HPP_ENA	O/V	0... FFH	0... 255	1	-
Logical field to enable injection pressure correction for each fuel bank; bit coded					
LFT_L_IV_HOM_REQ	O/V	0... FFH	0... 255	1	-
Dynamic injector needle lift selection request for homogeneous combustion mode - bit coded; LSB represents pulse 1, etc.					
LFT_L_IV_HOMS_REQ	V	0... FFH	0... 255	1	-
Dynamic injector needle lift selection request for homs combustion mode - bit coded; LSB represents pulse 1, etc.					
LFT_L_IV_S_REQ	O/V	0... FFH	0... 255	1	-
Dynamic injector needle lift selection request for stratified combustion mode - bit coded; LSB represents pulse 1, etc.					
LV_EGY_RNG_HOM_EXT_ENA	O/V	0... 1H	0 ...1	1	-
Bit to enable external injector needle lift set point for homogeneous mode.					
LV_FAC_TI_EXT_ADJ	O	0... 1H	0 ...1	1	-
Flag for external injection time adjustment factor active					
LV_IDX_CYL_CLC_MPLH_VLD	-	0... 1H	0 ...1	1	-
Flag to indicate, that at least one calculated cylinder requests triple injection					
LV_INJ_CRASH_ACT	O	0... 1H	0 ...1	1	-
Flag to authorize the crash signal reaction of the injection driver					
LV_INJ_PUC_ENA	O/V	0... 1H	0 ...1	1	-
Flag to set inhibit pattern for PUC to external pattern in case of PUC-phases					
LV_IV_TEST_MOD_AUTH	O/V	0... 1H	0 ...1	1	-
Flag to authorize the injection valve actuator test					
LV_MFF_SP_HOM_VLD	V	0... 1H	0 ...1	1	-
Flag which indicates a valid fuel amount of at least one cylinder					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_N_TOOTH_END_ACT	O/V	0... 1H	0 ...1	1	-
Flag for indication that engine speed is over N_TOOTH_END					
LV_PRS_COR_MPLH_ENA	O/V	0... 1H	0 ...1	1	-
Switch to activate pressure pulsation correction for homogeneous multi injection mode					
LV_PRS_COR_SNGH_ENA	O/V	0... 1H	0 ...1	1	-
Switch to activate pressure pulsation correction for the first pulse homogeneous mode					
LV_ST_INJ_REQ	O/V	0... 1H	0 ...1	1	-
Start request flag for the injection driver					
LV_TI_EXT_ADJ [NC_CYL_NR]	O	0... 1H	0 ...1	1	-
Flag for external injection time adjustment					
MAP_INJ [NC_CBK_HPP_NR]	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Intake manifold pressure for calculation of injection parameters					
MFF_ADD_REAC [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Additive fuel amount at reactivation of fuel feed					
N_FAST_INJ	O	0... 1FE0H	0... 8160	1	rpm
Engine Speed- Resolution 1 rpm					
NR_CYL_CLC_RED_INJ	O/V	1... 8H	1 ...8	1	-
Number of calculated cylinders per segment in case of runtime reduction of the aggregate INJR					
NR_CYL_IV_TEST_MOD	O/V	0... 7H	0 ...7	1	-
Logical cylinder number of that cylinder for which the actuator test is in progress					
STATE_INJ_MOD_HOM_REQ	O/V	1H	SNGS	-	-
		2H	MPLS		
		3H	MPLS+PLS3		
		41H	HOMS-SNG		
		42H	HOMS		
		43H	HOMS+PLS3		
		80H	DISABLE		
		81H	SNGH		
		82H	MPLH		
83H	MPLH+PLS3				
Injection mode request for all cylinders for homogeneous combustion mode					
STATE_INJ_MOD_HOMS_REQ	O/V	1H	SNGS	-	-
		2H	MPLS		
		3H	MPLS+PLS3		
		41H	HOMS-SNG		
		42H	HOMS		
		43H	HOMS+PLS3		
		80H	DISABLE		
		81H	SNGH		
		82H	MPLH		
83H	MPLH+PLS3				
Injection mode request for all cylinders for homogeneous-stratified combustion mode					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_INJ_MOD_REQ	O/V	1H	SNGS	-	-
		2H	MPLS		
		3H	MPLS+PLS3		
		41H	HOMS-SNG		
		42H	HOMS		
		43H	HOMS+PLS3		
		80H	DISABLE		
		81H	SNGH		
		82H	MPLH		
		83H	MPLH+PLS3		
Injection mode request for all cylinders for requested combustion mode					
STATE_INJ_MOD_S_REQ	O/V	1H	SNGS	-	-
		2H	MPLS		
		3H	MPLS+PLS3		
		41H	HOMS-SNG		
		42H	HOMS		
		43H	HOMS+PLS3		
		80H	DISABLE		
		81H	SNGH		
		82H	MPLH		
		83H	MPLH+PLS3		
Injection mode request for all cylinders for stratified combustion mode					
STATE_INJ_MOD_SWI_ACT	O/V	0... FFH	0... 255	1	-
State indicates a currently ongoing injection mode change, if not equal to zero					
STATE_INJ_UPD_ENA	O/V	0... FFH	0... 255	1	-
Bitmask to enable/disable injection update calculations					
TFU_INJ	O/V	0... FEH	-48... 142.5	0.75	°C
Fuel temperature for injection system					
TI_EXT_ADJ [NC_CYL_NR]	O	0... FFFFH	0... 65.535	0.001	ms
External injection time adjustment					

**Input data:**


C_N_TOOTH_END {p. 1526}	CTR_CBK_EX_NR_ST_ CLC {p. 1754}	CTR_CBK_EX_NR_STOP_ CLC {p. 1754}	CTR_CBK_IN_NR_ST_ CLC {p. 1754}
CTR_CBK_IN_NR_STOP_ CLC {p. 1754}	CTR_CYL_NR_ST_CLC {p. 1754}	CTR_CYL_NR_STOP_CLC {p. 1754}	FUP_H {p. 1283}
INJ_MOD [NC_CYL_NR] {p. 2037}	INJ_MOD_HOM_REQ {p. 8241}	INJ_MOD_S_REQ {p. 8242}	LFT_L_IV_REQ_HOM_ CUS {p. 8269}
LFT_L_IV_REQ_HOMS_ CUS {p. 8269}	LFT_L_IV_REQ_S_CUS {p. 8269}	LV_ERR_FTL_MIN {p. 4762}	LV_FUP_LIH_L_PRS_ CTL_REQ {p. 4001}
LV_IGA_AND_INJ_SWI {p. 8136}	LV_IGA_AND_INJ_SWI_ HOMS {p. 8136}	LV_LAM_AD_INJ_CUS_ ACK [NC_CBK_EX_NR] {p. 8269}	LV_PRS_COR_MPLH_ ENA_CUS {p. 8270}

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LV_PRS_COR_SNGH_ ENA_CUS {p. 8270}	LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}	LV_ST_INJ {p. 2038}
LV_ST_INJ_AUTH {p. 8242}	MAF_CYL {p. 8277}	MAP {p. 8278}	MFF_SP_1_HOM [NC_CYL_NR] {p. 8242}
N {p. 1525}	N_TOOTH_CUS {p. 1042}	NC_CBK_EX_NR {p. 1829}	NC_CBK_IN_NR {p. 604}
NC_CYL_NR {p. 1526}	NC_INJ_MOD_SINGLE {p. 2045}	NC_NR_IV_PLS {p. 627}	NR_INJ_PLS_HOM_REQ {p. 8243}
NR_INJ_PLS_S_REQ {p. 8243}	PREV_STATE_IV {p. 2039}	SEG_NR {p. 1525}	STATE_EFP_CRASH_CAN {p. 1573}
TAM {p. 1579}	TCYL_MDL_CUS {p. 8270}	TFU_IV {p. 1232}	

**Calibration data:**

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRK_PSN_STAT_IGN_UPD_END	-	0... 780H	0... 720	0.375	°CRK
End of static ignition update window for ignition/injeciton synchronization					
C_CRK_PSN_STAT_IGN_UPD_ST	-	0... 780H	0... 720	0.375	°CRK
Start of static ignition update window for ignition/injeciton synchronization					
C_CRK_PSN_STAT_WIN_ST	-	0... 780H	0... 720	0.375	°CRK
Start position of static injection update window					
C_FAC_MAP_TCYL_MDL	-	0... FFFFH	0... 6553.5	0.1	N/ (kg*K*m**2)
Constant term of ideal gas law to calculate physical model of cylinder pressure.					
C_INJ_MOD_SP_MAN	-	1H	SNGS	-	-
		2H	MPLS		
		3H	MPLS+PLS3		
		41H	HOMS-SNG		
		42H	HOMS		
		43H	HOMS+PLS3		
		80H	DISABLE		
		81H	SNGH		
		82H	MPLH		
83H	MPLH+PLS3				
Injection mode set-point for manual selection					
C_NR_CYL_OFS_CLC_RED_INJ	-	0... 7H	0 ...7	1	-
Segment offset to calculated cylinders for INJR runtime optimization strategy					
CLF_EGY_RNG_LAM_AD_INJ	-	0... FFH	0... 255	1	-
Bit coded injector needle lift set point during active MFMA - 1: high lift; 0: low lift - each bit represents one injection pulse.					
ID_NR_CYL_CLC_RED_INJ	-	1... 8H	1 ...8	1	-
LDP_N_ID_NR_CYL_CLC_RED_INJ	4	0... 1FE0H	0... 8160	1	rpm
Number of calculated cylinders per segment in case of INJR runtime optimization					
IP_FAC_TI_FUP_L_PRS	-	0... FFFFH	0... 15.99975	244.1e-6	-
LDP_FUP_H_INJ_IP_FAC_TI_FUP	4	0... FFFFH	0... 347776	5.3067216	hPa
Injection time correction factor depending on low pressure limp home or minimum fuel tank level error					
IP_FAC_TI_TEMP_L_PRS	V	0... FFFFH	0... 15.99975	244.1e-6	-
LDP_TFU_INJ_IP_FAC_TI_TEMP	6	0... FEH	-48... 142.5	0.75	°C
LDP_TAM_IP_FAC_TI_TEMP	6	0... FEH	-48... 142.5	0.75	°C
Weighted TI correction depending on fuel temperature for injection system and ambient temperature during low pressure limp home or minimum fuel tank level error					
IP_MFF_ADD_REAC	V	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_MFF_SP_HOM_IP_MFF_ADD_REAC	8	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_IP_MFF_ADD_REAC	8	0... 1FE0H	0... 8160	1	rpm
Additive fuel amount at reactivation of fuel feed					
LC_EGY_RNG_LAM_AD_INJ_ENA	-	0... 1H	0 ...1	1	-
Switch to enable manual injector needle lift selection during active MFMA.					
LC_FAC_TI_ENA_FTL_MIN	-	0... 1H	0 ...1	1	-
Switch to enable activation of TI correction in case of low pressure also in case of minimum fuel tank level error					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_INJ_MOD_SP_MAN_ENA	-	0... 1H	0 ...1	1	-
Logical constant to enable manual injection mode selection					
LC_LOAD_CPU_RED_INJ	-	0... 1H	0 ...1	1	-
Switch to enable INJR runtime optimization strategy					
LC_MAP_PHY_CLC_ENA	-	0... 1H	0 ...1	1	-
Switch to enable physical model for cylinder pressure calculation.					
LC_MFF_ADD_REAC_ENA	-	0... 1H	0 ...1	1	-
Switch to enable wallfilm correction on fuel mass					

### Exported actions:

<b>ACTION_INJR_SetStateInjUpdEna(IN &lt;Cyl&gt;, IN &lt;State_Inj_Upd_Ena&gt;)</b>
This action sets the cylinder individual bit <Cyl> of STATE_INJ_UPD_ENA to <State_Inj_Upd_Ena>.

### FUNCTION DESCRIPTION:

#### General information:

This specification is for project specific adaptations.

#### 7.108.1 Runtime reduction

#### Description:

This chapter describes runtime reduction steps. First step is to reduce cylinder dependent calculations from all cylinders to one cylinder, dependent on the engine speed. An additional step is to reduce bank dependent calculations to that intake or exhaust bank, which is allocated to the related cylinder by NC\_IN\_REF and NC\_LAMB\_REF. The control variables for cylinder and bank dependent calculations will be imported via CTR\_CYL\_NR\_xxx and CTR\_CBK\_xxx data.

#### Application conditions


<b>Activation :</b>	<i>every engine state</i>
<b>Deactivation :</b>	-
<b>Initialization:</b>	-
<b>Recurrence :</b>	LV_ST_END = 0: 10 ms LV_ST_END = 1: segment synchronous

#### Formula Section :

#### For loop for runtime optimization:

In this specification the for loop

```
FOR i = 0, i < NR_CYL_CLC_RED_INJ DO
  x = CTR_CYL_NR_ST_CLC_INJR + i
  (1a)IF x >= NC_CYL_NR
  (1a)THEN
```

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```
        x = x - NC_CYL_NR  
(1a)ENDIF  
<loop content>
```

**ENDFOR**

is substituted by

```
FOR cylinder_start to cylinder_stop DO  
    <loop content>
```

**ENDFOR**

**Note:** In the for loops, x will be used as loop variable to indicate the cylinder x!

Determine cylinder and bank numbers for follow up calculations

```
CTR_CYL_NR_ST_CLC_INJR      = CTR_CYL_NR_ST_CLC  
CTR_CYL_NR_STOP_CLC_INJR   = CTR_CYL_NR_STOP_CLC  
CTR_CBK_IN_NR_ST_CLC_INJR  = CTR_CBK_IN_NR_ST_CLC  
CTR_CBK_IN_NR_STOP_CLC_INJR = CTR_CBK_IN_NR_STOP_CLC  
CTR_CBK_EX_NR_ST_CLC_INJR  = CTR_CBK_EX_NR_ST_CLC  
CTR_CBK_EX_NR_STOP_CLC_INJR = CTR_CBK_EX_NR_STOP_CLC
```

**Note:** NR\_CYL\_CLC\_RED\_INJ has to be greater than zero and less or equal than NC\_CYL\_NR;

```
(1)IF LC_LOAD_CPU_RED_INJ = 0  
    OR CTR_CYL_NR_ST_CLC_INJR ≠ 0  
    OR CTR_CYL_NR_STOP_CLC_INJR ≠ (NC_CYL_NR - 1)  
    OR LV_ST_END = 0  
    OR SUM(LV_LAM_AD_INJ_CUS_ACK[ ]) ≠ 0 // sum over all elements; at least one  
                                           exhaust-bank requests MFMA  
(1)THEN  
    NR_CYL_CLC_RED_INJ = CTR_CYL_NR_STOP_CLC_INJR  
                      - CTR_CYL_NR_ST_CLC_INJR + 1
```

**7.108.2 (1)ELSE**

**7.108.3 (2)IF SEG\_NR < C\_NR\_CYL\_OFS\_CLC\_RED\_INJ**

**7.108.4 (2)THEN**

**7.108.5 CTR\_CYL\_NR\_STOP\_CLC\_INJR = NC\_CYL\_NR + SEG\_NR**

**7.108.6 - C\_NR\_CYL\_OFS\_CLC\_RED\_INJ**

**7.108.7 (2)ELSE**



**7.108.8 CTR\_CYL\_NR\_STOP\_CLC\_INJR = SEG\_NR - C\_NR\_CYL\_OFS\_CLC\_RED\_INJ**

**7.108.9 (2)ENDIF**

**7.108.10 NR\_CYL\_CLC\_RED\_INJ = ID\_NR\_CYL\_CLC\_RED\_INJ(Input: N)**

**7.108.11 (3)IF CTR\_CYL\_NR\_STOP\_CLC\_INJR < (NR\_CYL\_CLC\_RED\_INJ - 1)**

**7.108.12 (3)THEN**

CTR\_CYL\_NR\_ST\_CLC\_INJR = NC\_CYL\_NR  
+ CTR\_CYL\_NR\_STOP\_CLC\_INJR - NR\_CYL\_CLC\_RED\_INJ + 1

**(3)ELSE**

**7.108.13 CTR\_CYL\_NR\_ST\_CLC\_INJR = CTR\_CYL\_NR\_STOP\_CLC\_INJR**

**7.108.14 - NR\_CYL\_CLC\_RED\_INJ + 1**

**7.108.15 (3)ENDIF**

**7.108.16 (1)ENDIF**

### 7.108.17 General tasks

#### Application conditions

**Activation :** *every engine state*

**Deactivation :** -

**Initialization:** at reset : FAC\_TI\_EXT\_ADJ = 1  
LV\_TI\_EXT\_ADJ[NC\_CYL\_NR] = 0  
TI\_EXT\_ADJ[NC\_CYL\_NR] = 0

**Recurrence :** LV\_ST\_END = 0: 10 ms  
LV\_ST\_END = 1: segment synchronous

#### Formula Section :

To prevent N\_FAST\_INJ from signal jittering a hysteresis for the calculation is introduced:

**(1) IF** (N >= C\_N\_TOOTH\_END)

**(1) THEN**

LV\_N\_TOOTH\_END\_ACT = 1

```

(1) ELSE
  (2) IF (N < C_N_TOOTH_END - 100)
    (2) THEN
      LV_N_TOOTH_END_ACT = 0
    (2) ENDIF
  (1) ENDIF
(3) IF (LV_N_TOOTH_END_ACT = 1)
(3) THEN
  N_FAST_INJ = N
(3) ELSE
  N_FAST_INJ = N_TOOTH_CUS
(3) ENDIF

(4) IF (LV_ST_INJ = 0)
(4) THEN
LV_MFF_SP_HOM_VLD = 0
(1) FOR x = 0 TO (NC_CYL_NR - 1)
  (2) IF ((Mk_soll_h[x][0] > 0) OR (Mk_soll_h[x][1] > 0) OR (Mk_soll_h[x][2] > 0))
    (2) THEN
      LV_MFF_SP_HOM_VLD = 1
    (2) ENDIF
  (1) END FOR
(5) IF (LV_MFF_SP_HOM_VLD = 1) AND (LV_ST_INJ_AUTH = 1)
(5) THEN
  LV_ST_INJ_REQ = 1
(5) ELSE
  LV_ST_INJ_REQ = 0
(5) ENDIF
(4) ELSE
  LV_ST_INJ_REQ = 0
(4) ENDIF

```

```

TFU_INJ = TFU_IV
FAC_N = N_FAST_INJ * 360 / (1000 * 60)
LV_FAC_TI_EXT_ADJ = 0
FAC_TI_EXT_ADJ = 1
LV_PRS_COR_SNGH_ENA = LV_PRS_COR_SNGH_ENA_CUS
LV_PRS_COR_MPLH_ENA = LV_PRS_COR_MPLH_ENA_CUS
(2)FOR cylinder_start to cylinder_stop DO
  LV_TI_EXT_ADJ[x] = 0
  TI_EXT_ADJ[x] = 0
(2) END FOR

```

```


FUP_H_INJ[0] = FUP_H
FUP_H_SP_S_INJ[0] = FUP_H
LV_INJ_PUC_ENA = 0
LF_IV_INH_PUC_EXT = 255 // all bits must be set to 1

```

```

(6)IF LC_MAP_PHY_CLC_ENA = 1
(6)THEN - physical calculation of cylinder pressure at inlet closing
  The cylinder pressure is calculated by use of the ideal gas law:
  
$$p = m * T * R_S / V$$


```

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$R_S/V$  as well as the unit conversions (1hPa = 100N/m<sup>2</sup> and 1rpm = 30stk/h) is included in C\_FAC\_MAP\_TCYL\_MDL (C\_FAC\_MAP\_TCYL\_MDL =  $R_S/(V*3000)$ ).

MAP\_INJ[0] = MAF\_CYL \* TCYL\_MDL\_CUS \* C\_FAC\_MAP\_TCYL\_MDL / N

**(6)ELSE**

MAP\_INJ[0] = MAP

**(6)ENDIF**

## 7.108.18 Compensation of missing residual-gas amount after PUC

### Description:

This chapter describes the compensation of missing residual-gas amount at restart of fuel feed. This is caused by a inhibit of injection in the past. At restart of fuel feed for the first combustion residual-gas amount is missing. Therefore the calculated fuel amount is wrong. This functionality should compensate this effect.

### Application conditions

**Activation :**  $LV\_ST\_END = 0$

**Deactivation :** -

**Initialization:** -

**Recurrence :**  $10\ ms$

### Formula Section :

**FOR** x = 0 **TO** NC\_CYL\_NR-1

MFF\_ADD\_REAC[x] = 0

**END FOR**

### Application conditions

**Activation :**  $LV\_ST\_END = 1$

**Deactivation :** -

**Initialization:** -

**Recurrence :**  $segment\ synchronous$

### Formula Section :

**(1)IF** LC\_MFF\_ADD\_REAC\_ENA = 1

**(1)THEN**

**FOR** cylinder\_start to cylinder\_stop **DO**

**IF** (Bit-Nr x of PREV\_STATE\_IV = 0)

**THEN**

MFF\_ADD\_REAC[x] = IP\_MFF\_ADD\_REAC

Input for IP\_MFF\_ADD\_REAC is (MFF\_SP\_1\_HOM[x], N)


**ELSE**

MFF\_ADD\_REAC[x] = 0

**ENDIF**

**END FOR**

**(1)ENDIF**

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## 7.108.19 Injector test mode

### Application conditions

**Activation:**  $LV\_ES = 1$   
**Deactivation:** –  
**Initialization:** –  
**Recurrence:** 1 s

This chapter describes the necessary interfaces to the procedure for actuator tests by diagnostic tester.

#### 7.108.19.1 Formula Section:

```
LV_IV_TEST_MOD_AUTH = 0
NR_CYL_IV_TEST_MOD = 0
(1) FOR x = 0 TO (NC_CYL_NR - 1)
    CTR_TEST_MOD_IV_EXT[x] = CTR_TEST_MOD_IV[x]
(1) END FOR
```

**Please note!** This for-loop should be realized in SW with a #define. CTR\_TEST\_MOD\_IV\_EXT[NC\_CYL\_NR] has to be realized also as a #define for CTR\_TEST\_MOD\_IV to preserve resources.

## 7.108.20 Crash signal reaction of injection driver

### Application conditions

**Activation:** *every engine state*  
**Deactivation:** –  
**Initialization:** –  
**Recurrence:** 10 ms

This chapter describes the necessary interfaces to customer signals to react on a vehicle crash.

#### 7.108.20.1 Formula Section:

```
(1) IF STATE_EFP_CRASH_CAN = 2H
(1) THEN
    LV_INJ_CRASH_ACT = 1
(1) ELSE
    LV_INJ_CRASH_ACT = 0
(1) ENDIF
```

## 7.108.21 Select injection mode STATE\_INJ\_MOD\_REQ and copy information of dynamic needle lift selection from customer nomenclature to supplier nomenclature

### Application conditions

**Activation :** *every engine state*  
**Deactivation :** –

**Initialization:**

```

at reset : STATE_INJ_MOD_REQ = 'DISABLE'
           STATE_INJ_MOD_HOM_REQ = 'SNGH'
           STATE_INJ_MOD_S_REQ = 'SNGS'
           STATE_INJ_MOD_HOMS_REQ = 'HOMS-SNG'
           LFT_L_IV_HOM_REQ = 0
           LFT_L_IV_S_REQ = 0
           INJ_MOD_GLOBAL = "DISABLE"
           STATE_INJ_MOD_SWI_ACT = 0

at engine run to engine stop event: INJ_MOD_GLOBAL = "DISABLE"
                                     STATE_INJ_MOD_SWI_ACT = 0

```

**Recurrence :**

```

LV_ST_END = 0: 10 ms
LV_ST_END = 1: segment synchronous

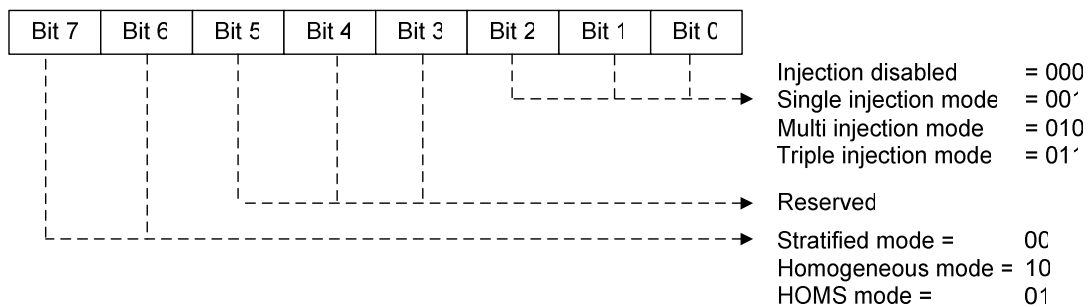
```

### Description:

This section determines the actual set injection mode request.

#### Byte definition

Definitions bit masks for injection modes: STATE\_INJ\_MOD\_REQ, STATE\_INJ\_MOD\_HOM\_REQ, STATE\_INJ\_MOD\_S\_REQ and STATE\_INJ\_MOD\_HOMS\_REQ



Example: homogenous multi injection mode (MPLH)

1	0	0	0	0	0	1	0
---	---	---	---	---	---	---	---

The mapping of the information about injector needle lift selection is done from a bit field as input to bit field as output. Here, the conversion from customer pulse numeration to supplier numeration is done.

**Important note:** For better readability of the specification, the LSB of each bit field, which corresponds to the physically first injection pulse, is referred to as bit 1 (**not** bit 0 as it would be in SW). The next bit would be bit 2 etc.

#### Definition of NC constants

NC\_INJ\_MOD\_SINGLE = 0x01H

### Formula Section :

```

(1) IF (LC_INJ_MOD_SP_MAN_ENA = 1)
THEN
  (2) IF (C_INJ_MOD_SP_MAN = 'SNGH') OR (C_INJ_MOD_SP_MAN = 'DISABLE')
  (2) THEN
    STATE_INJ_MOD_REQ = 'SNGH'
    STATE_INJ_MOD_HOM_REQ = 'SNGH'
    STATE_INJ_MOD_S_REQ = 'SNGS'
    STATE_INJ_MOD_HOMS_REQ = 'HOMS-SNG'

```

```

(2) ENDIF
(3) IF (C_INJ_MOD_SP_MAN = 'MPLH')
(3) THEN
    STATE_INJ_MOD_REQ = 'MPLH'
    STATE_INJ_MOD_HOM_REQ = 'MPLH'
    STATE_INJ_MOD_S_REQ = 'SNGS'
    STATE_INJ_MOD_HOMS_REQ = 'HOMS-SNG'
(3) ENDIF

(4) IF (C_INJ_MOD_SP_MAN = 'MPLH+PLS3')
(4) THEN
    STATE_INJ_MOD_REQ = 'MPLH+PLS3'
    STATE_INJ_MOD_HOM_REQ = 'MPLH+PLS3'
    STATE_INJ_MOD_S_REQ = 'SNGS'
    STATE_INJ_MOD_HOMS_REQ = 'HOMS-SNG'
(4) ENDIF

(5) IF (C_INJ_MOD_SP_MAN = 'SNGS')
(5) THEN
    STATE_INJ_MOD_REQ = 'SNGS'
    STATE_INJ_MOD_HOM_REQ = 'SNGH'
    STATE_INJ_MOD_S_REQ = 'SNGS'
    STATE_INJ_MOD_HOMS_REQ = 'HOMS-SNG'
(5) ENDIF


(6) IF (C_INJ_MOD_SP_MAN = 'MPLS')
(6) THEN
    STATE_INJ_MOD_REQ = 'MPLS'
    STATE_INJ_MOD_HOM_REQ = 'SNGH'
    STATE_INJ_MOD_S_REQ = 'MPLS'
    STATE_INJ_MOD_HOMS_REQ = 'HOMS'
(6) ENDIF

(6a) IF (C_INJ_MOD_SP_MAN = 'MPLS+PLS3')
(6a) THEN
    STATE_INJ_MOD_REQ = 'MPLS+PLS3'
    STATE_INJ_MOD_HOM_REQ = 'SNGH'
    STATE_INJ_MOD_S_REQ = 'MPLS+PLS3'
    STATE_INJ_MOD_HOMS_REQ = 'HOMS+PLS3'
(6a) ENDIF

(6b) IF (C_INJ_MOD_SP_MAN = 'HOMS-SNG')
(6b) THEN
    STATE_INJ_MOD_REQ = 'HOMS-SNG'
    STATE_INJ_MOD_HOM_REQ = 'SNGH'
    STATE_INJ_MOD_S_REQ = 'SNGS'
    STATE_INJ_MOD_HOMS_REQ = 'HOMS-SNG'
(6b) ENDIF

(7) IF (C_INJ_MOD_SP_MAN = 'HOMS')
(7) THEN

```

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```

STATE_INJ_MOD_REQ = 'HOMS'
STATE_INJ_MOD_HOM_REQ = 'SNGH'
STATE_INJ_MOD_S_REQ = 'MPLS'
STATE_INJ_MOD_HOMS_REQ = 'HOMS'

```

**(7) ENDIF**

**(7a) IF** (C\_INJ\_MOD\_SP\_MAN = 'HOMS+PLS3')

**(7a) THEN**

```

STATE_INJ_MOD_REQ = 'HOMS+PLS3'
STATE_INJ_MOD_HOM_REQ = 'SNGH'
STATE_INJ_MOD_S_REQ = 'MPLS+PLS3'
STATE_INJ_MOD_HOMS_REQ = 'HOMS+PLS3'

```

**(7a) ENDIF**

```
LFT_L_IV_HOM_REQ = 0
```

```
LFT_L_IV_S_REQ = 0
```

**(1) ELSE**

**(8) IF** (INJ\_MOD\_HOM\_REQ = NC\_INJ\_MOD\_SINGLE )

**(8) THEN**

```

STATE_INJ_MOD_HOM_REQ = 'SNGH'
Bit 1 of LFT_L_IV_HOM_REQ = Bit 1 of LFT_L_IV_REQ_HOM_CUS
Bit 2 of LFT_L_IV_HOM_REQ = Bit 3 of LFT_L_IV_HOM_REQ = 0

```

**(8) ELSE**

**(9) IF** (NR\_INJ\_PLS\_HOM\_REQ = 3)

**(9) THEN**

```

STATE_INJ_MOD_HOM_REQ = 'MPLH+PLS3'
Bit 1 of LFT_L_IV_HOM_REQ = Bit 1 of LFT_L_IV_REQ_HOM_CUS
Bit 2 of LFT_L_IV_HOM_REQ = Bit 2 of LFT_L_IV_REQ_HOM_CUS
Bit 3 of LFT_L_IV_HOM_REQ = Bit 3 of LFT_L_IV_REQ_HOM_CUS

```

**(9) ELSE**

```

STATE_INJ_MOD_HOM_REQ = 'MPLH'
Bit 1 of LFT_L_IV_HOM_REQ = Bit 1 of LFT_L_IV_REQ_HOM_CUS
Bit 2 of LFT_L_IV_HOM_REQ = Bit 2 of LFT_L_IV_REQ_HOM_CUS
Bit 3 of LFT_L_IV_HOM_REQ = 0

```

**(9) ENDIF**

**(8) ENDIF**

**(10) IF** (INJ\_MOD\_S\_REQ = NC\_INJ\_MOD\_SINGLE )

**(10) THEN**

```

STATE_INJ_MOD_S_REQ = 'SNGS'
STATE_INJ_MOD_HOMS_REQ = 'HOMS-SNG'
Bit 1 of LFT_L_IV_S_REQ = Bit 3 of LFT_L_IV_REQ_S_CUS
Bit 2 of LFT_L_IV_S_REQ = Bit 3 of LFT_L_IV_S_REQ = 0
Bit 1 of LFT_L_IV_HOMS_REQ = Bit 3 of LFT_L_IV_REQ_HOMS_CUS
Bit 2 of LFT_L_IV_HOMS_REQ = Bit 3 of LFT_L_IV_HOMS_REQ = 0


```

**(10) ELSE**

**(10a) IF** (NR\_INJ\_PLS\_S\_REQ = 3)

**(10a) THEN**

```
STATE_INJ_MOD_S_REQ = 'MPLS+PLS3'
```

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```

STATE_INJ_MOD_HOMS_REQ = 'HOMS+PLS3'
Bit 1 of LFT_L_IV_S_REQ = Bit 1 of LFT_L_IV_REQ_S_CUS
Bit 2 of LFT_L_IV_S_REQ = Bit 2 of LFT_L_IV_REQ_S_CUS
Bit 3 of LFT_L_IV_S_REQ = Bit 3 of LFT_L_IV_REQ_S_CUS
Bit 1 of LFT_L_IV_HOMS_REQ = Bit 1 of LFT_L_IV_REQ_HOMS_CUS
Bit 2 of LFT_L_IV_HOMS_REQ = Bit 2 of LFT_L_IV_REQ_HOMS_CUS
Bit 3 of LFT_L_IV_HOMS_REQ = Bit 3 of LFT_L_IV_REQ_HOMS_CUS

```

**(10a) ELSE**

```

STATE_INJ_MOD_S_REQ = 'MPLS'
STATE_INJ_MOD_HOMS_REQ = 'HOMS'
Bit 1 of LFT_L_IV_S_REQ = Bit 2 of LFT_L_IV_REQ_S_CUS
Bit 2 of LFT_L_IV_S_REQ = Bit 3 of LFT_L_IV_REQ_S_CUS
Bit 3 of LFT_L_IV_S_REQ = 0
Bit 1 of LFT_L_IV_HOMS_REQ = Bit 1 of LFT_L_IV_REQ_HOMS_CUS
Bit 2 of LFT_L_IV_HOMS_REQ = Bit 3 of LFT_L_IV_REQ_HOMS_CUS
Bit 3 of LFT_L_IV_HOMS_REQ = 0

```

**(10a) ENDIF****(10) ENDIF****(11) IF** (LV\_IGA\_AND\_INJ\_SWI = 1)**(11) THEN** (HOM)

STATE\_INJ\_MOD\_REQ = STATE\_INJ\_MOD\_HOM\_REQ

**(11) ELSE** (S or HOMS)**(12) IF** (LV\_IGA\_AND\_INJ\_SWI\_HOMS = 1)**(12) THEN**

STATE\_INJ\_MOD\_REQ = STATE\_INJ\_MOD\_HOMS\_REQ

**(12) ELSE**

STATE\_INJ\_MOD\_REQ = STATE\_INJ\_MOD\_S\_REQ

**(12) ENDIF****(11) ENDIF****(13) IF** (LV\_IGA\_AND\_INJ\_SWI\_HOMS = 1)**(13) THEN**

LFT\_L\_IV\_S\_REQ = LFT\_L\_IV\_HOMS\_REQ

**(13) ENDIF****(1) ENDIF****Calculation of injection mode setpoints:****(1)FOR** cylinder\_start to cylinder\_stop **DO**

Bit x of STATE\_INJ\_UPD\_ENA = 1

**(1)IF** LV\_S\_CLC = 1**(1)THEN**


INJ\_MOD\_SP\_S[x] = STATE\_INJ\_MOD\_S\_REQ

INJ\_MOD\_SP\_HOMS[x] = STATE\_INJ\_MOD\_HOMS\_REQ

**(1)ELSE**

INJ\_MOD\_SP\_S[x] = "DISABLE"

INJ\_MOD\_SP\_HOMS[x] = "DISABLE"

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**(1)ENDIF**  
**(1)ENDFOR**

Calculate indices for pressure correction:

IDX\_PRS\_COR\_CYL\_CLC\_S[0] = CTR\_CYL\_NR\_ST\_CLC\_INJR

LF\_PRS\_COR\_HPP\_ENA = 1 // set bit 0 to 1 to indicate that fuel bank 1 has to be calculated

**(1)IF SUM(LV\_LAM\_AD\_INJ\_CUS\_ACK[ ])  $\neq$  0** // sum over all elements; at least one  
exhaust-bank requests MFMA

**AND STATE\_INJ\_MOD\_REQ = "MPLH+PLS3"**

**(1)THEN** - Minimum fuel mass adaptation is requested and at least 1 cylinder requests triple  
injection

LV\_IDX\_CYL\_CLC\_MPLH\_VLD = 0 // this local flag indicates, that at least one cylinder  
within the for-loop requests triple injection

**(2)FOR** cylinder\_start to cylinder\_stop **DO**

**(2)IF** MFF\_SP\_3\_HOM[x] > 0

**(2)THEN** - cylinder x requests triple injection

INJ\_MOD\_SP\_HOM[x] = "MPLH+PLS3"

INJ\_MOD\_SP[x] = "MPLH+PLS3"

IDX\_PRS\_COR\_CYL\_CLC\_MPLH[0] = x

LV\_IDX\_CYL\_CLC\_MPLH\_VLD = 1

**(2)ELSE**

**(3)IF** MFF\_SP\_2\_HOM[x] = 0

**(3)THEN** - cylinder x requests single injection

INJ\_MOD\_SP\_HOM[x] = "SNGH"

INJ\_MOD\_SP[x] = "SNGH"

**(3)ELSE** - cylinder x requests double injection (invalid for MFMA)

INJ\_MOD\_SP\_HOM[x] = "MPLH+PLS3"

INJ\_MOD\_SP[x] = "MPLH+PLS3"

**(4)IF** LV\_IDX\_CYL\_CLC\_MPLH\_VLD = 0

**(4)THEN**

IDX\_PRS\_COR\_CYL\_CLC\_MPLH[0] = x

**(4)ENDIF**

**(3)ENDIF**

**(2)ENDIF**

**(2)ENDFOR**

**(1)ELSE**

**(3)FOR** cylinder\_start to cylinder\_stop **DO**

INJ\_MOD\_SP[x] = STATE\_INJ\_MOD\_REQ

INJ\_MOD\_SP\_HOM[x] = STATE\_INJ\_MOD\_HOM\_REQ

**(3)ENDFOR**

IDX\_PRS\_COR\_CYL\_CLC\_MPLH[0] = CTR\_CYL\_NR\_ST\_CLC\_INJR

**(1)ENDIF**

Calculate activation of external injector needle lift set point for homogeneous mode (in case of active MFMA functionality, the injector needle lift shall be set to a calibratable set point):


**(1)IF** LC\_EGY\_RNG\_LAM\_AD\_INJ\_ENA = 1

**AND SUM(LV\_LAM\_AD\_INJ\_CUS\_ACK[ ])  $\neq$  0** // sum over all elements; at least one  
exhaust-bank requests MFMA

**(1)THEN** // active MFMA - set needle lift to calibratable set point

LV\_EGY\_RNG\_HOM\_EXT\_ENA = 1

**(1)ELSE** // no external needle lift set point

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```

LV_EGY_RNG_HOM_EXT_ENA = 0
(1)ENDIF

```

Calculate variables used by other functionalities (stable interface):

```

INJ_MOD_GLOBAL = STATE_INJ_MOD_REQ
(1)FOR cylinder_start to cylinder_stop DO
  (1)IF INJ_MOD_SP[x] ≠ INJ_MOD[x]
    (1)THEN
      Bit x of STATE_INJ_MOD_SWI_ACT = 1
    (1)ELSE
      Bit x of STATE_INJ_MOD_SWI_ACT = 0
    (1)ENDIF
  (1)ENDFOR

```

## 7.108.22 Calculation of injection fixed update window and ignition update window

### Application conditions

**Activation :** every engine state  
**Deactivation :** -  
**Initialization:** at reset : **calculate Formula Section**  
**Recurrence :** 1s

### Description:

This section calculates the crank windows for ignition and injection update. The initialization routine at reset is the same as the time synchronous routine (1s)!

### Formula Section :

```


CRK_PSN_STAT_WIN_ST = C_CRK_PSN_STAT_WIN_ST
(1)IF CRK_PSN_STAT_WIN_ST >= ((720°/NC_CYL_NR)*1.1)
(1)THEN
  CRK_PSN_STAT_WIN_ST = ((720°/NC_CYL_NR)*1.1)
  CRK_PSN_STAT_WIN_END = 720°
(1)ELSE
  CRK_PSN_STAT_WIN_END = 720° - ((720°/NC_CYL_NR)*1.1
                                - CRK_PSN_STAT_WIN_ST)
(1)ENDIF
CRK_PSN_STAT_IGN_UPD_ST = C_CRK_PSN_STAT_IGN_UPD_ST
CRK_PSN_STAT_IGN_UPD_END = C_CRK_PSN_STAT_IGN_UPD_END

```

Copy calibratable needle lift set point during MFMA to aggregate interface:

```
LF_EGY_RNG_HOM_EXT = CLF_EGY_RNG_LAM_AD_INJ
```

**Note:** Bit 0 of CLF\_EGY\_RNG\_LAM\_AD\_INJ represents the needle lift of the first pulse, bit 1 the lift of the second and bit 2 the lift of the third pulse!

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## 7.108.23 Correction of Injection time in case of low pressure and high temperature

### Description:

This chapter calculates the injection time correction factor depending on fuel pressure, fuel temperature of injection system and ambient temperature.

### Application conditions

**Activation :** every engine state

**Deactivation :** -

**Initialization :** at reset: FAC\_TI\_L\_PRS = 1

**Recurrence :** LV\_ST\_END = 0: 10 ms  
LV\_ST\_END = 1: segment synchronous

### Formula Section :

**(1) IF** (LV\_ERR\_FTL\_MIN **AND** LC\_FAC\_TI\_ENA\_FTL\_MIN)  
**OR** LV\_FUP\_LIH\_L\_PRS\_CTL\_REQ

**(1) THEN**  
FAC\_TI\_L\_PRS = ( IP\_FAC\_TI\_FUP\_L\_PRS(FUP\_H\_INJ) \*  
IP\_FAC\_TI\_TEMP\_L\_PRS(TFU\_INJ, TAM) ) + 1

/\* FUP\_H\_INJ and TFU\_INJ must be calculated before the calculation of  
FAC\_TI\_L\_PRS \*/

**(1) ELSE**  
FAC\_TI\_L\_PRS = 1

**(1) ENDIF**

## 7.108.24 Description of exported actions

### 7.108.24.1 Description of ACTION\_INJR\_SetStateInjUpdEna

ACTION_INJR_SetStateInjUpdEna(IN <Cyl>, IN <State_Inj_Upd_Ena>)					
This action sets the cylinder individual bit <Cyl> of STATE_INJ_UPD_ENA to <State_Inj_Upd_Ena>.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
Cyl	IN	0 ... 7	0 ... 7	1	-
Number of logical cylinder.					
State_Inj_Upd_Ena	IN	0 ... 1	0 ... 1	1	-
Logical value for setting or resetting the corresponding cylinder value.					

### Formula Section:

Bit Cyl of STATE\_INJ\_UPD\_ENA = State\_Inj\_Upd\_Ena

**Note:** The LSB of STATE\_INJ\_UPD\_ENA is referred to as Bit 0 (zero based indication)!

## 7.109 Activation of lambda adaptation via injection mode

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ABC_DET_MIS_LAM_AD_INJ [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for misfire events during lambda adaptation for injection mode					
CTR_AD_COLD_LAM_AD_INJ	O/V/S	0... FFH	0... 255	1	-
Counter for finished adaptation cycles for cold adaptation for lambda adaptation via injection mode					
CTR_AD_HOT_LAM_AD_INJ	O/V/S	0... FFH	0... 255	1	-
Counter for finished adaptation cycles for hot adaptation for lambda adaptation via injection mode					
CTR_MIS_AD_MISS_COLD_LAM_AD_INJ [NC_CYL_NR]	V	0... FFH	0... 255	1	-
Counter for missed adaptation cycles by misfire in a driving cycle at cold temperature for lambda adaptation via injection mode					
CTR_MIS_AD_MISS_HOT_LAM_AD_INJ [NC_CYL_NR]	V	0... FFH	0... 255	1	-
Counter for missed adaptation cycles by misfire in a driving cycle at hot temperature for lambda adaptation via injection mode					
CTR_MIS_DC_COLD_LAM_AD_INJ [NC_CYL_NR]	V/S	0... FFH	0... 255	1	-
Number of driving cycles with not finished adaptations due to misfire at cold temperature for lambda adaptation via injection mode					
CTR_MIS_DC_HOT_LAM_AD_INJ [NC_CYL_NR]	V/S	0... FFH	0... 255	1	-
Number of driving cycles with not finished adaptations due to misfire at hot temperature for lambda adaptation via injection mode					
CTR_MIS_LAM_AD_INJ [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Number of following adaptaions with misfire detection at lambda adaptation via injection mode					
DIST_LAM_AD_INJ_COLD	V/S	0... FFFFH	0... 524280	8	km
Distance threshold for next start of lambda adaptation via injection mode at cold condition					
DIST_LAM_AD_INJ_HOT	V/S	0... FFFFH	0... 524280	8	km
Distance threshold for next start of lambda adaptation via injection mode at hot condition					
FAC_LAM_MV_OFS_LDC_LAM_AD_INJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Filtered lambda controller output offset for limited dynamics calculation of lambda adaptation via injection mode					
FAC_TQ_REQ_OFS_LDC_LAM_AD_INJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	-
Torque scaling factor offset for limited dynamics calculation of lambda adaptation via injection mode					
LV_ERR_MIS_LAM_AD_INJ [NC_CYL_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag indicating a repeating misfire error during lambda adaptation via injection mode					
LV_LAM_AD_INJ_ACT	O/V	0... 1H	0 ...1	1	-
Lambda adaptation via injection mode active					
LV_LAM_AD_INJ_ACT_COLD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation of lambda adaptation via injection mode for lower temperature range					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAM_AD_INJ_ACT_HOT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation of lambda adaptation via injection mode for upper temperature range					
LV_LAM_AD_INJ_EXT_ENA	O/V	0... 1H	0 ...1	1	-
Set the external enable the lambda adaption via injection mode with a test device					
LV_LAM_AD_INJ_INTR	O/V	0... 1H	0 ...1	1	-
Interruption of adaptation for lambda adaptation via injection mode					
LV_LAM_AD_INJ_INTR_2 [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Maximum number of adaptations with misfire reached in adaptation cycle for lambda adaptation via injection mode					
LV_LAM_AD_INJ_INTR_LAM	O/V	0... 1H	0 ...1	1	-
Interruption of adaptation for lambda adaptation via injection mode due to lambda controller threshold					
LV_LAM_AD_INJ_REP	O/V	0... 1H	0 ...1	1	-
Repeat of adaptation for lambda adaptation via injection mode					
LV_LDC_LAM_AD_INJ [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Limited dynamic conditions for lambda adaptation via injection mode					
LV_MIS_LAM_AD_INJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Misfire detected during adaptation for lambda adaptation via injection mode					
MAF_INT_LDC_LAM_AD_INJ [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.41666667	0.0277778	g
Air mass flow integral during limited dynamics for lambda adaptation via injection mode					
MAF_OFS_LDC_LAM_AD_INJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
Air mass flow offset for limited dynamics calculation for lambda adaptation via injection mode					
N_OFS_LDC_LAM_AD_INJ [NC_CBK_EX_NR]	V	E020... 1FE0H	-8160 ...8160	1	rpm
Engine speed offset for limited dynamics calculation of lambda adaptation via injection mode					
TEMP_LAM_AD_INJ	O/V	0... FEH	-48... 142.5	0.75	°C
Temperature for lambda adaptation via injection mode					

**Input data:**


C_CRLC_TQ_DIF_SLOW_ LAM_AD_INJ {p. 3406}	DIST_KWP {p. 1183}	FAC_LAM_MV {p. 1014}	FAC_LAM_MV_DELTA_ LDC [NC_CBK_EX_NR] {p. 2585}
FAC_TQ_REQ_DELTA_ LDC {p. 2585}	LC_MFF_ADD_LAM_AD_ INJ_CLR {p. 3408}	LV_CAT_PURGE_ACT [NC_CBK_EX_NR] {p. 2927}	LV_CYL_BAL_LAM_SEL_ AD_COLD_DC {p. 4066}
LV_CYL_BAL_LAM_SEL_ AD_HOT_DC {p. 4066}	LV_DET_CFM_MIS {p. 6237}	LV_HOM_ACT {p. 8136}	LV_INH_LAM_AD_INJ [NC_CBK_EX_NR] {p. 3398}
LV_LAM_AD_INJ_CLR_ AD_EXT {p. 7483}	LV_LAM_AD_INJ_COLD_ END [NC_CBK_EX_NR] {p. 3379}	LV_LAM_AD_INJ_HOT_ END [NC_CBK_EX_NR] {p. 3379}	LV_LAM_AD_INJ_MV_ CLC_END [NC_CBK_EX_NR] {p. 3405}
LV_MPL_INJ_ACT [NC_CBK_EX_NR] {p. 3379}	LV_SNG_INJ_ACT [NC_CBK_EX_NR] {p. 3379}	MAF_CYL {p. 8277}	MAF_DELTA_LDC {p. 2585}

MFF_SP_MV {p. 2151}	MFF_SP_S_SWI_HOM {p. 8243}	N_32 {p. 1525}	N_DELTA_LDC {p. 2585}
NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NR_CYL_LAM_AD_INJ [NC_CBK_EX_NR] {p. 3379}	SEG_NR_ER {p. 1454}
STATE_IV_CHG {p. 7683}	STATE_LAM_AD_INJ_ACT [NC_CBK_EX_NR] {p. 3379}	T_AST {p. 1766}	TCO {p. 1100}
TCO_ST_DC {p. 1100}	TEMP_CAPA_IV_MV {p. 2241}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	TFU_INJ {p. 3332}
TFU_IV {p. 1232}	TQ_DIF_I_IS {p. 3441}	TQ_DIF_P_D_SLOW_IS {p. 3442}	TQ_IS_SNG_INJ_LAM_ AD_INJ {p. 3406}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_ABC_MAX_MIS_LAM_AD_INJ	-	0... FFH	0... 255	1	-
Threshold of misfire events to interrupt an adaptation for lambda adaptation via injection mode					
C_CTR_MAX_DC_LAM_AD_INJ	-	0... FFH	0... 255	1	-
Number of driving cycles with missed adaptation by misfire to set error flag for lambda adaptation via injection mode					
C_CTR_MIS_AD_MAX_LAM_AD_INJ	-	0... FFH	0... 255	1	-
Maximum number of missed adaptation in a driving cycle to start lambda adaptation via injection mode					
C_CTR_MIS_LAM_DC_MIN_LAM_AD_INJ	-	0... FFH	0... 255	1	-
Number of adaptation cycles with misfire to increment misfire driving cycle counter for lambda adaptation via injection mode					
C_CTR_MIS_MAX_LAM_AD_INJ	-	0... FFH	0... 255	1	-
Maximum number of adaptations with misfire for one cylinder in an adaptation cycle for lambda adaptation via injection mode					
C_FAC_LAM_LDC_MPL_LAM_AD_INJ	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Lambda controller window for limited dynamic conditions at multiple injection for lambda adaptation via injection mode					
C_FAC_LAM_LDC_SNG_LAM_AD_INJ	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Lambda controller window for limited dynamic conditions at single injection for lambda adaptation via injection mode					
C_FAC_LAM_MV_MAX_AD_LAM_AD_INJ	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Maximum lambda controller threshold to interrupt the lambda adaptation via injection mode					
C_FAC_LAM_MV_MAX_LAM_AD_INJ	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Maximum limit on mean value of lambda controller output for lambda adaptation via injection mode					
C_FAC_LAM_MV_MIN_AD_LAM_AD_INJ	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Minimum lambda controller threshold to interrupt the lambda adaptation via injection mode					
C_FAC_LAM_MV_MIN_LAM_AD_INJ	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Minimum limit on mean value of lambda controller output for lambda adaptation via injection mode					
C_FAC_TQ_REQ_DYW_LDC_LAM_AD_INJ	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Torque scaling factor window for limited dynamic conditions Lambda adaptation via injection mode					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_DYW_LDC_LAM_AD_INJ	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Air mass flow window for limited dynamic conditions of lambda adaptation via injection mode					
C_MAF_INT_LDC_LAM_AD_INJ	-	0... FFFFH	0... 1820.4166667	0.0277778	g
Air mass flow integral for duration of violation of limited dynamic conditions for lambda adaptation via injection mode					
C_N_BOL_LAM_AD_INJ	-	0... FFH	0... 8160	32	rpm
Lower limit on engine speed for lambda adaptation via injection mode					
C_N_DYW_LDC_LAM_AD_INJ	-	0... 1FE0H	0... 8160	1	rpm
Engine speed window for limited dynamic conditions trim control					
C_N_TOL_LAM_AD_INJ	-	0... FFH	0... 8160	32	rpm
Upper limit on engine speed for lambda adaptation via injection mode					
C_NR_MIN_AD_LAM_AD_INJ_COLD_ADD	-	0... FFH	0... 255	1	-
Minimum number of hot adaptations before the cold adaptation starts					
C_TCO_MIN_LAM_AD_INJ	-	0... FEH	-48... 142.5	0.75	°C
Minimum TCO to start the lambda adaptation via injection mode					
C_TEMP_CAT_MAX_LAM_AD_INJ	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Maximum catalyst temperature to start the lambda adaptation via injection mode					
C_TEMP_LAM_AD_INJ_ENA	-	0H 1H 2H 3H	TCO TFU_IV TFU_INJ TEMP_CAPA_ IV_MV	-	-
Temperature for calculation in lambda adaptation via injection mode					
C_TEMP_MAX_LAM_AD_INJ_COLD	-	0... FEH	-48... 142.5	0.75	°C
Maximum temperature for cold adaptation range for lambda adaptation via injection mode					
C_TEMP_MAX_LAM_AD_INJ_HOT	-	0... FEH	-48... 142.5	0.75	°C
Maximum temperature for hot adaptation range for lambda adaptation via injection mode					
C_TEMP_MIN_LAM_AD_INJ_COLD	-	0... FEH	-48... 142.5	0.75	°C
Minimum temperature for cold adaptation range for lambda adaptation via injection mode					
C_TEMP_MIN_LAM_AD_INJ_HOT	-	0... FEH	-48... 142.5	0.75	°C
Minimum temperature for hot adaptation range for lambda adaptation via injection mode					
C_TQ_DIF_IS_AD_LAM_AD_INJ	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Idle speed controller threshold to repeat a adaptation of lambda adaptation via injection mode					
ID_MFF_SP_BOL_LAM_AD_INJ	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_MFF_SP_1_MFMA	6	0... FFH	0... 8160	32	rpm
Lower limit on MFF_SP for lambda adaptation via injection mode					
ID_MFF_SP_TOL_LAM_AD_INJ	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_MFF_SP_1_MFMA	6	0... FFH	0... 8160	32	rpm
Upper limit on MFF_SP for lambda adaptation via injection mode					
IP_DIST_LAM_AD_INJ_COLD	V	0... FFFFH	0... 524280	8	km
LDP_CTR_COLD_IP_DIST_LAM_AD_INJ	4	0... FFH	0... 255	1	-
LDPM_DIST_1_LAM_AD_INJ	2	0... FFFFH	0... 524280	8	km
Update of cold distance threshold for lambda adaptaiton via injection mode					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_DIST_LAM_AD_INJ_HOT	V	0... FFFFH	0... 524280	8	km
LDP_CTR_HOT_IP_DIST_LAM_AD_INJ	4	0... FFH	0... 255	1	-
LDPM_DIST_1_LAM_AD_INJ	2	0... FFFFH	0... 524280	8	km
Update of hot distance threshold for lambda adaptaiton via injection mode					
IP_T_AST_ENA_LAM_AD_INJ	-	0... FFFFH	0... 6553.5	0.1	s
LDP_TCO_ST_IP_T_AST_LAM_AD_INJ	8	0... FEH	-48... 142.5	0.75	°C
Minimum time for the activation of lambda adaptation via injection mode depending on TCO_ST					
LC_CTR_MIS_DC_LAM_AD_INJ_CLR	-	0... 1H	0 ...1	1	-
Enable to clear the CTR_MIS_DC_COLD/HOT_LAM_AD_INJ at finished learning of all cylinders					
LC_CYL_BAL_COLD_DEAC_LAM_AD_INJ	-	0... 1H	0 ...1	1	-
Deactivation of CILC condition for cold lambda activation via injection mode					
LC_CYL_BAL_HOT_DEAC_LAM_AD_INJ	-	0... 1H	0 ...1	1	-
Deactivation of CILC condition for hot lambda activation via injection mode					
LC_DIST_CLR_LAM_AD_INJ	-	0... 1H	0 ...1	1	-
Clear the distance threshold counter for lambda adaptation via injection mode					
LC_ERR_CLR_LAM_AD_INJ	-	0... 1H	0 ...1	1	-
Clear the error in lambda adaptation via injection mode					
LC_LAM_AD_INJ_ACT_COLD_MAN	-	0... 1H	0 ...1	1	-
Manual activation of cold conditons for lambda adaptation via injection mode					
LC_LAM_AD_INJ_ACT_HOT_MAN	-	0... 1H	0 ...1	1	-
Manual activation of hot conditons for lambda adaptation via injection mode					

## Action definition

<b>ACTION_MFMA_GetEnableCondition</b> (OUT<PRM_LV_LAM_AD_INJ_EXT_ENA>)	Mode: O
Enable of the lambda adaptation via injection mode	


<b>ACTION_MFMA_SetEnableCondition</b> (IN<PRM_FLAG_PAR_IN>)	Mode: O
Activates lambda adaption via tester	

## Description for Actions

<b>ACTION_MFMA_GetEnableCondition</b> (OUT <PRM_LV_LAM_AD_INJ_EXT_ENA>)					
Enable of the lambda adaptation via injection mode					
Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_LV_LAM_AD_INJ_EXT_ENA	OUT	0... 1H	0... 1	1	[-]
Set the external enable the lambda adaption via injection mode with a test device					

<b>ACTION_MFMA_SetEnableCondition</b> (IN <PRM_FLAG_PAR_IN>)					
Activates lambda adaption via tester					
Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_FLAG_PAR_IN	IN	0... 1H	0... 1	1	[-]
Set the flag FLAG_PAR_IN to 1 if a tester device activate thbe lambda adaptation via injection mode					

## General Information

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This module handles the activation for the upper and lower temperature range for the lambda adaptation via injection mode and the engine speed controller, the lambda controller and the misfire detection are monitored during the adaptation.

### Application Conditions

Initialization: RST, IGKON, NVMINI, NVMRES, NVMSTO


Activation: 20MS: always

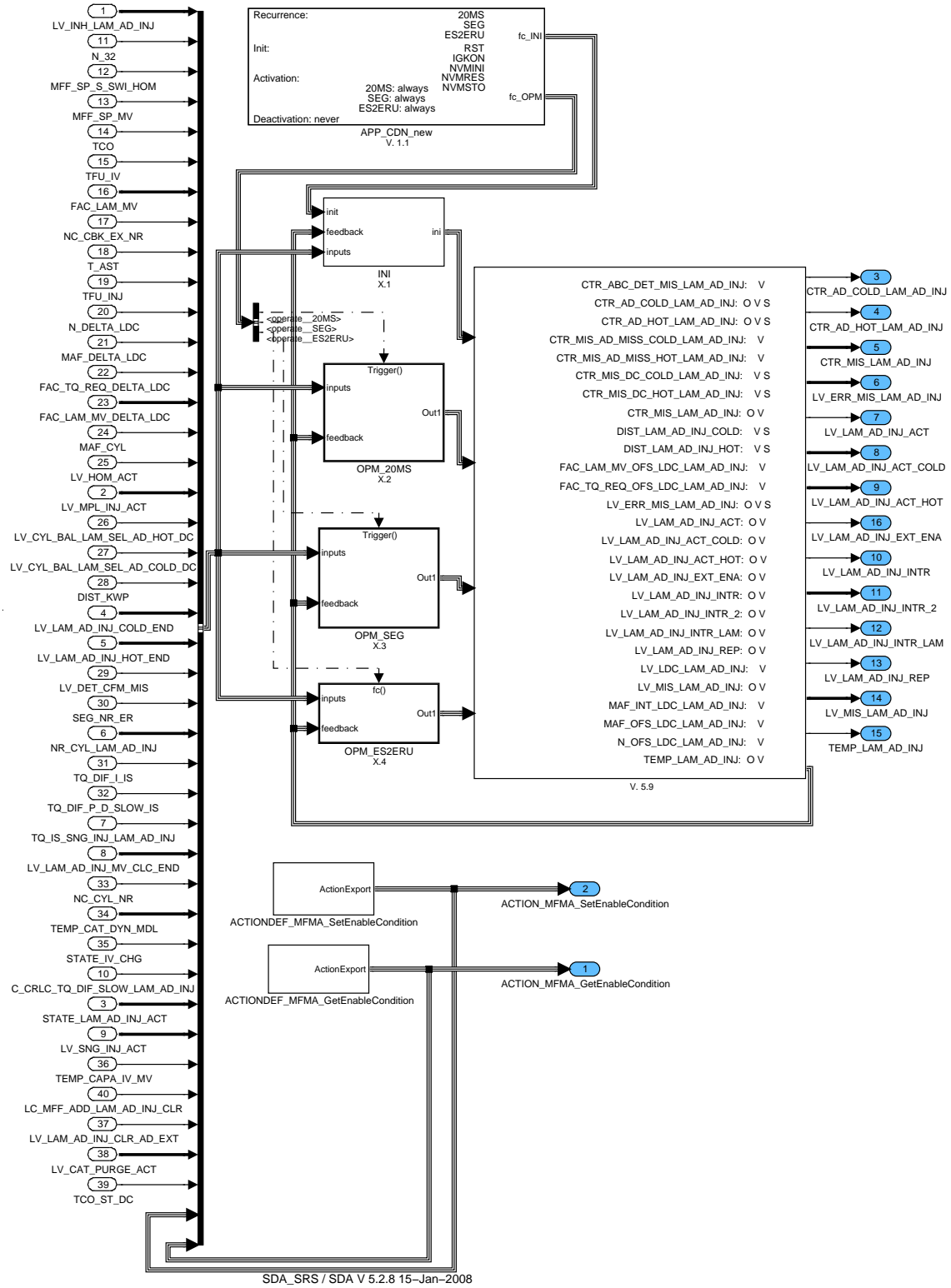
SEG: always

ES2ERU: always

Deactivation: never


### Function description

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Figure 7.109.1 :

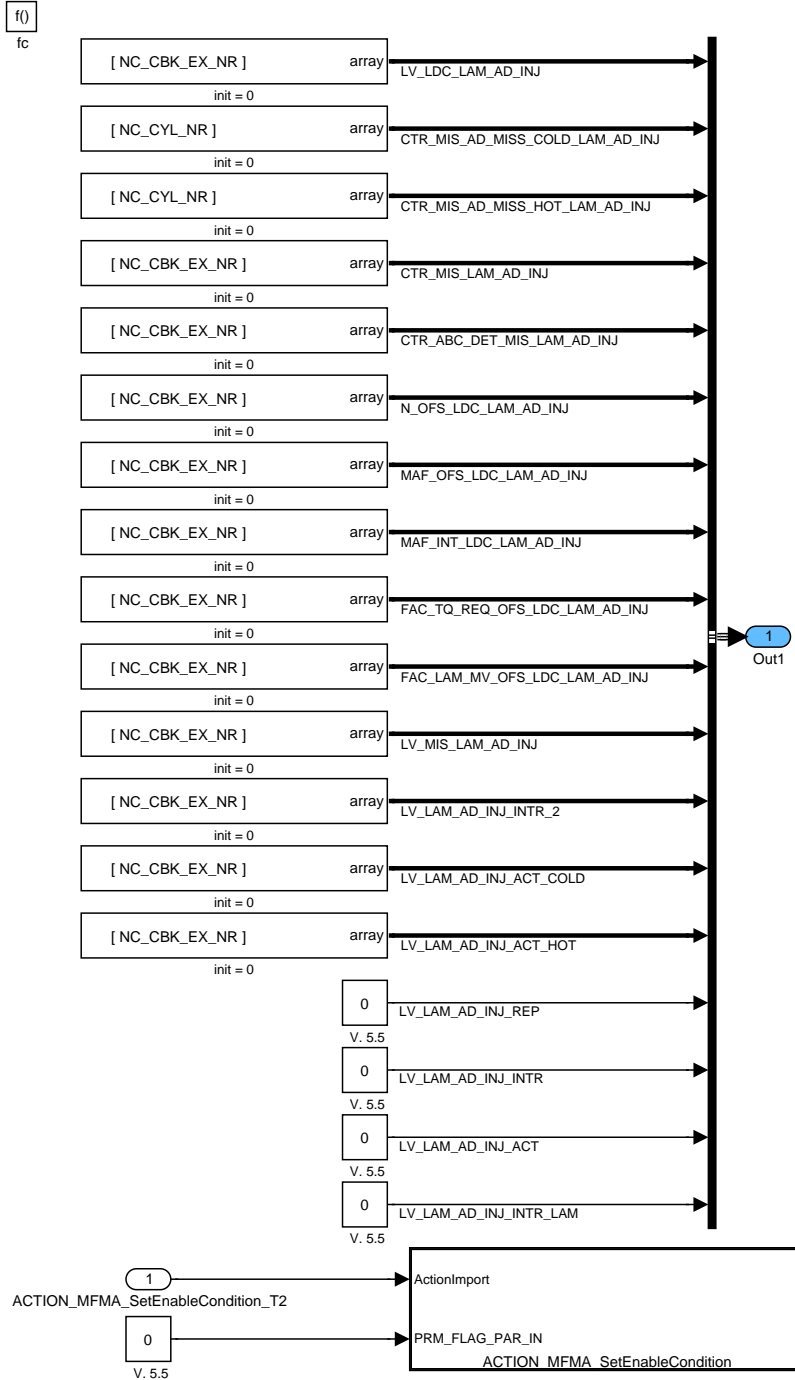
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### 7.109.1 Initialization

Initialization of the variables at ignition on and reading and writing of the variables stored in the non volatile memory.

#### 7.109.1.1 Initialization of the online variables at reset

All variables are initialized with 0 at reset.



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Figure 7.109.2: :

### 7.109.1.2 Initialization of the online variables at IGK on

All values, except CTR\_MIS\_AD\_MISS\_COLD/HOT\_LAM\_AD\_INJ, are initialized with 0 at IGKON.

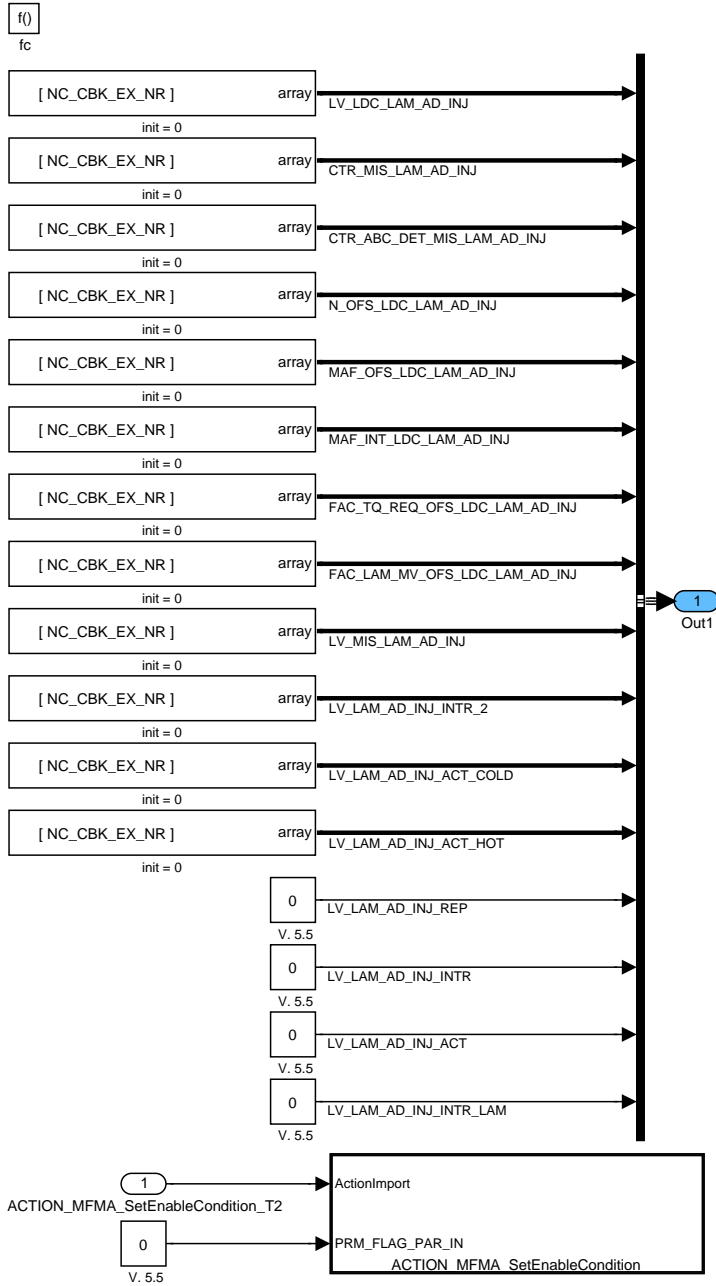


Figure 7.109.3: :

### 7.109.1.3 Initialization and reading of non volatile memory variables

The values are read from the NVMY memory. The first initialization of the values is done in an other subsystem, DIST\_LAM\_AD\_INJ\_COLD/HOT are not initialized with zero.

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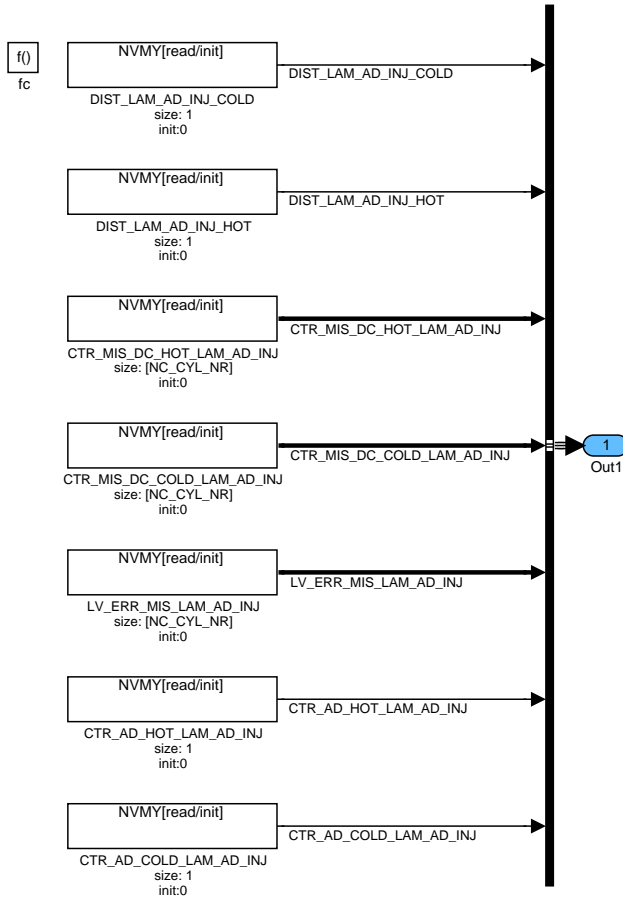


Figure 7.109.4: :

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### 7.109.1.4 Writing of non volatile memory variables

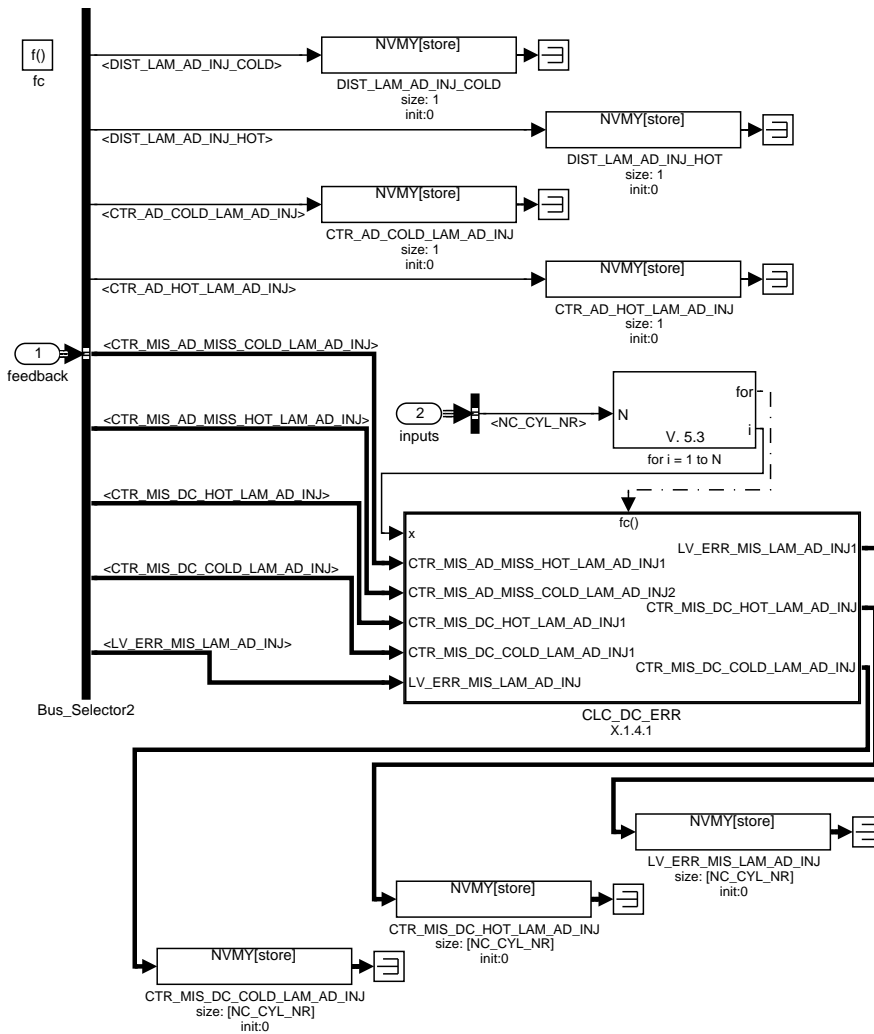


Figure 7.109.5: :

#### 7.109.1.4.1 Calculation of driving cycle counter and creation of error flags

For each cylinder the number of driving cycles with missed adaptation due to misfire are counted. If the counter exceeds a threshold, the error flag will be set at the end of a driving cycle.

##### 7.109.1.4.1.1 Calculation of driving cycle counter and error flags

If the number of missed adaptation cycles due to misfire in a driving cycle exceeds the threshold C\_CTR\_MIS\_LAM\_DC\_MIN\_LAM\_AD\_INJ, the counter for driving cycles with missed adaptation is increased. If the number of driving cycles with failed adaptations reaches the threshold C\_CTR\_MAX\_DC\_LAM\_AD\_INJ, the error flag for the depending cylinder is set.

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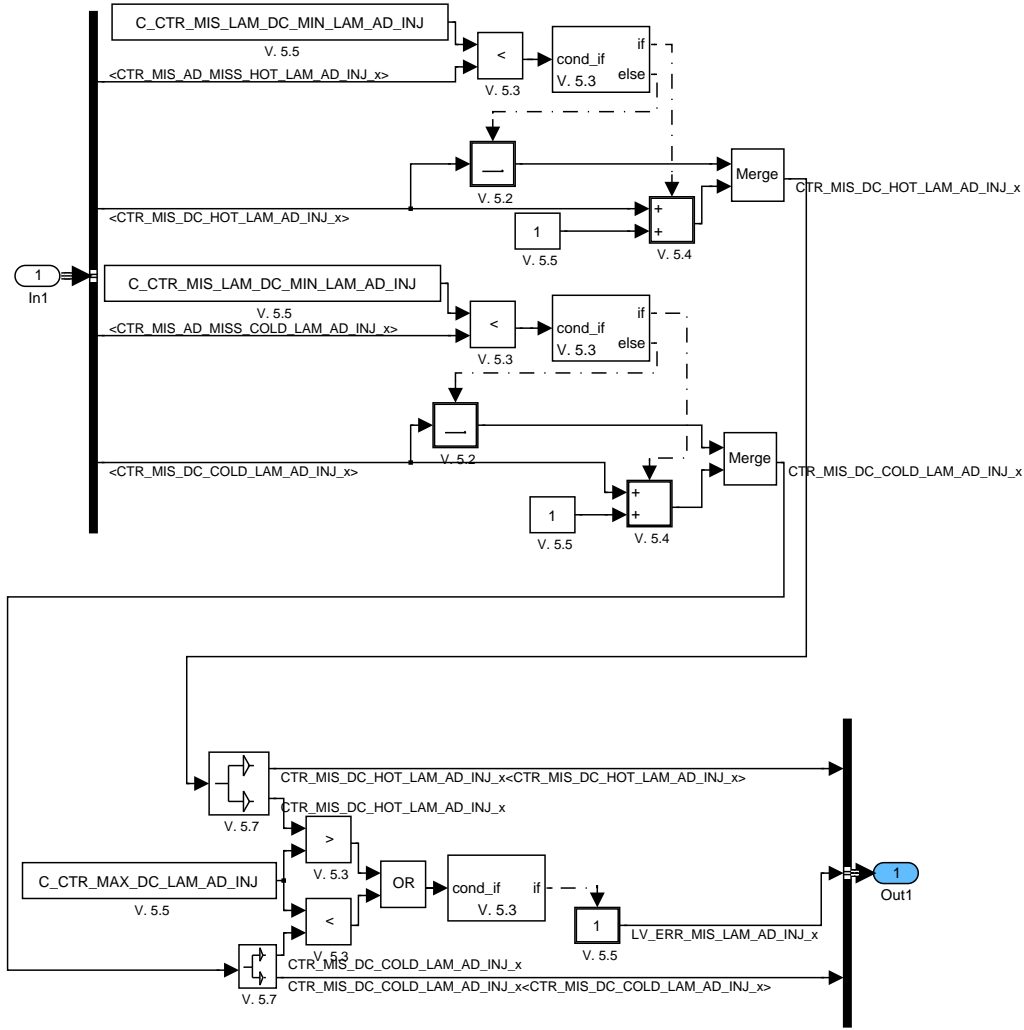



Figure 7.109.6: :

### 7.109.1.5 NVMY initialization

The distance counter is initialized at non volatile memory initialization with the sum of the mileage counter and the output of the map IP\_DIST\_LAM\_AD\_INJ\_HOT/COLD. With this calculation the first adaptation after NVMY initialization will start after a mileage distance defined in the map. All other values are initialized with zero.

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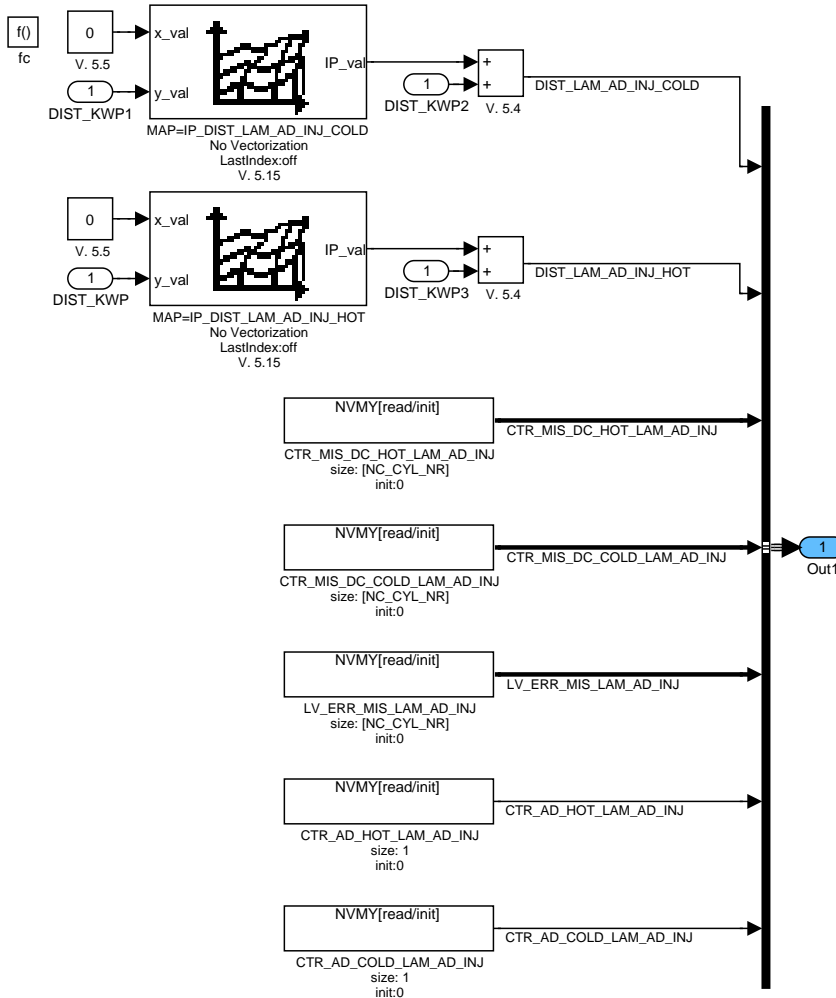


Figure 7.109.7: :

### 7.109.2 Determination of the adaptation conditions

The determination of adaptation conditions is divided into bank specific and bank independent calculations.

#### 7.109.2.1 Bank independent calculations

The bank independent calculations are divided in general calculations, temperature calculations and the clearance of interruption and repeat flags.

##### 7.109.2.1.1 General activation conditions

For activation of the adaptation the fuel mass flow and the engine speed has to be inside limitations. Also a certain time after engine start has to be passed.

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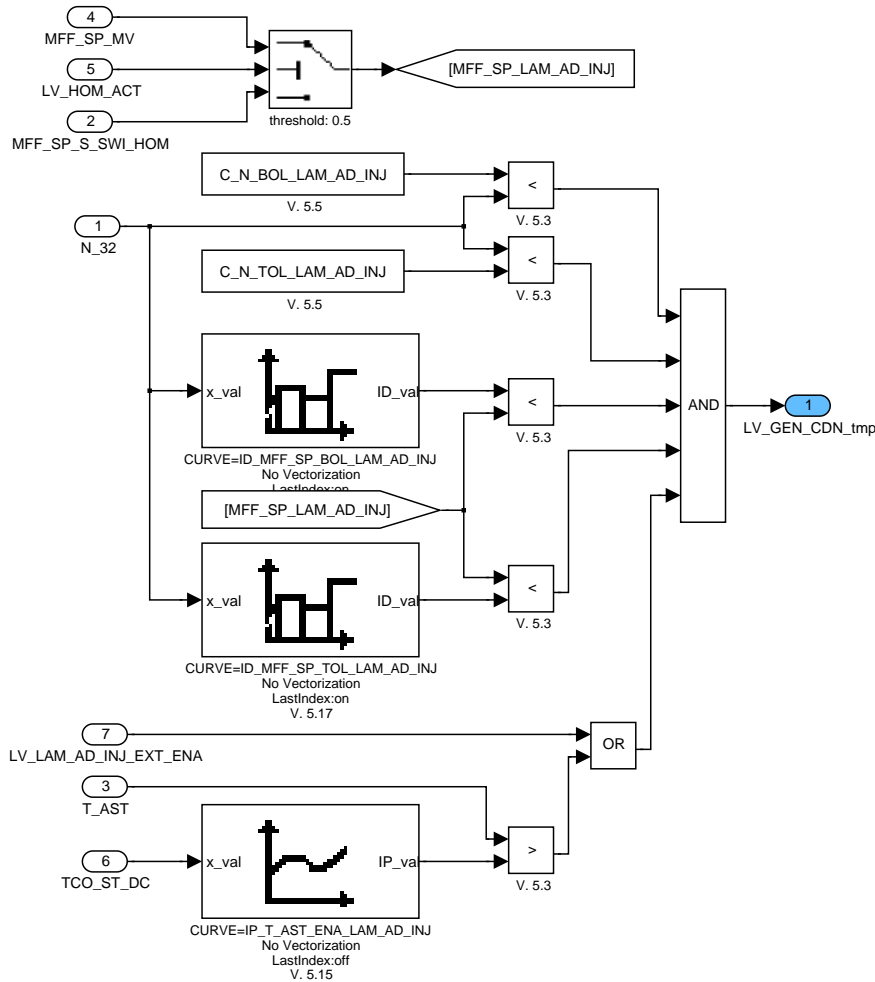


Figure 7.109.8: :

### 7.109.2.1.2 Temperature range activation conditions

To activate the adaptation for cold and hot adaptation range the depending temperature can be chosen between coolant temperature and fuel temperature. For activation the temperature has to be inside limitations, the general conditions has to be fulfilled, the cylinder individual lambda controller has to be ready and the condition for the mileage counter has to be fulfilled. Also the maximum number of adaptation cycles in the driving cycle has not to be reached.

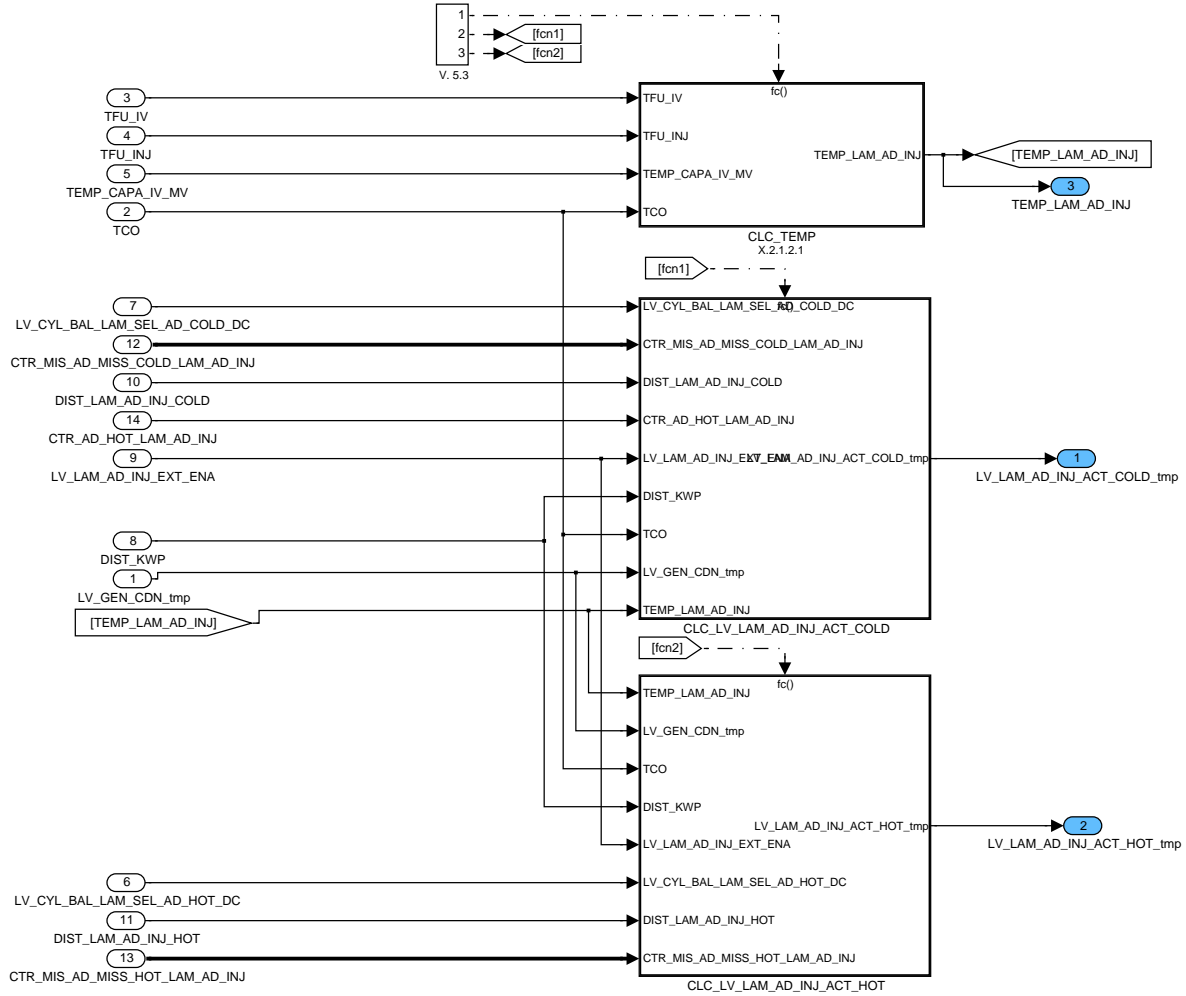


Figure 7.109.9: :

### 7.109.2.1.2.1 Selection of temperature value

Using the calibration C\_TEMP\_LAM\_AD\_INJ\_ENA the temperature for use within the lambda adaptation via injection mode can be chosen.

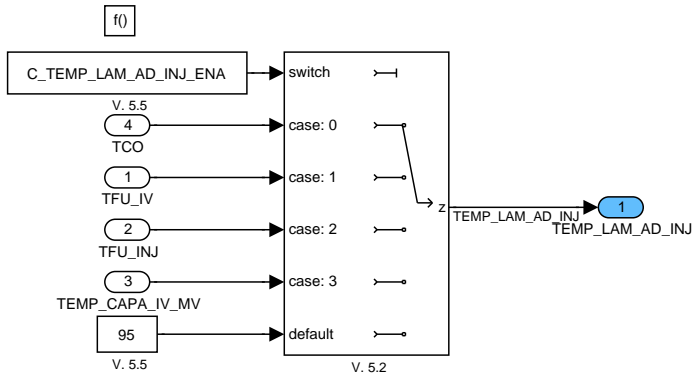


Figure 7.109.10: :

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### 7.109.2.1.2.2 Condition for the lower adaptation range

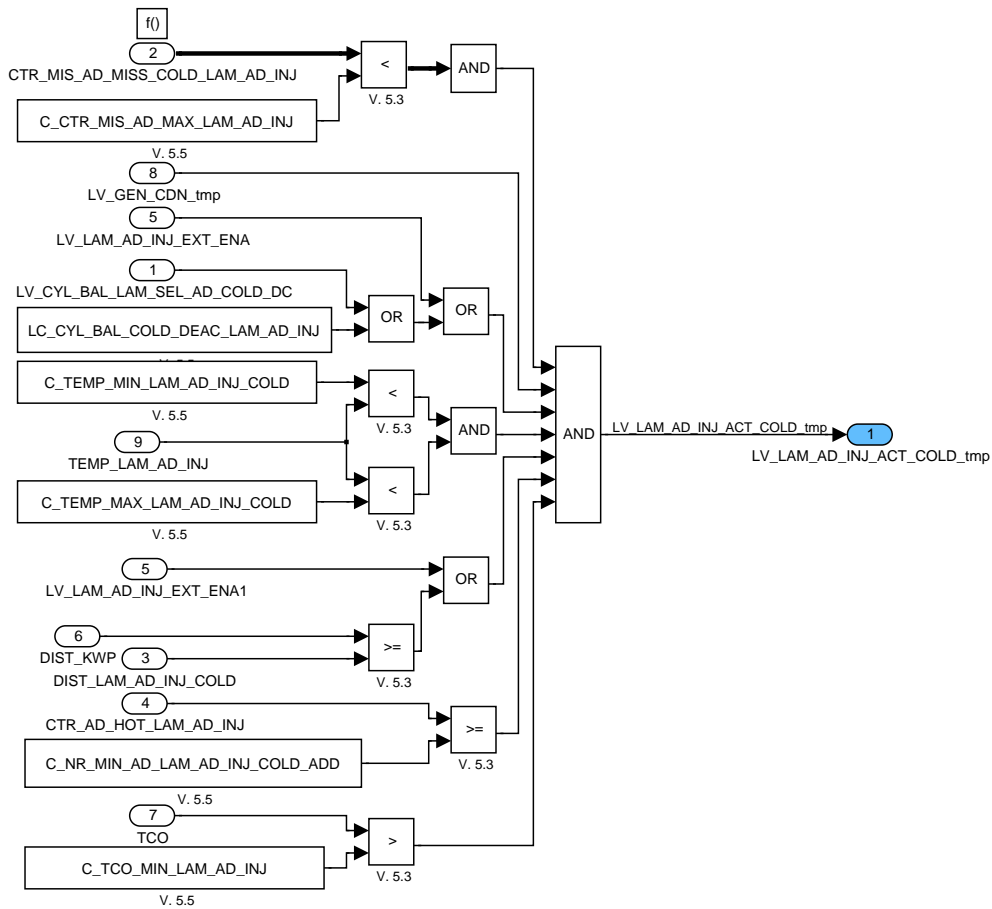


Figure 7.109.11: :

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7.109.2.1.2.3 Condition for the upper adaptation range

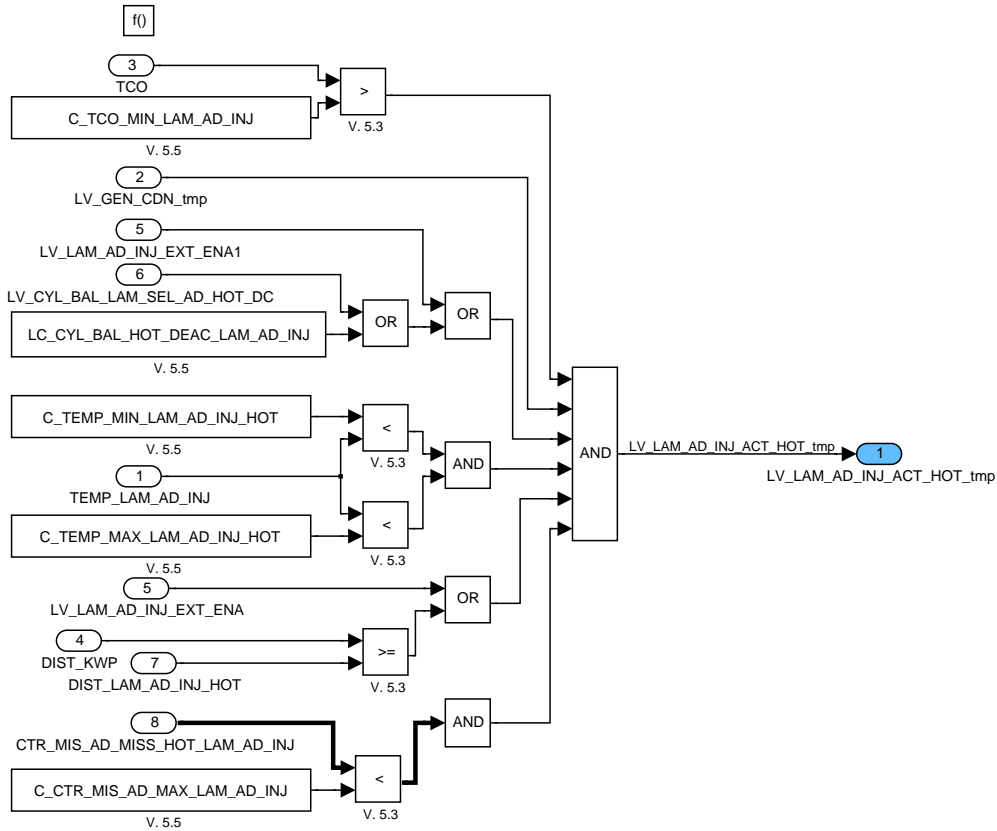


Figure 7.109.12: :

7.109.2.1.3 Clear the values for interruption and repeat

If all banks are not in multiple and not in single injections, the flags to interrupt and repeat the adaptation are reset. In single injection for all banks the flags and counter for misfire are reset.

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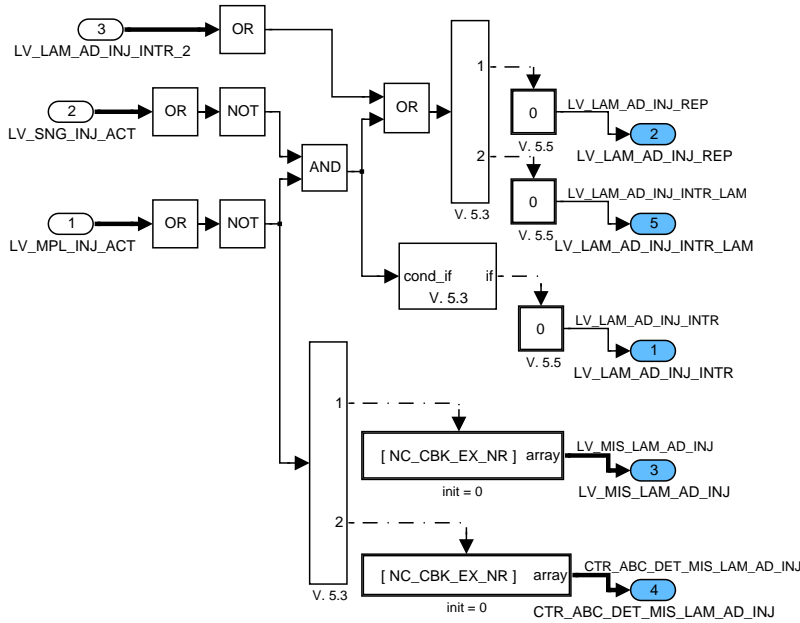


Figure 7.109.13: :

### 7.109.2.1.4 Reset of LV\_LAM\_AD\_INJ\_EXT\_ENA

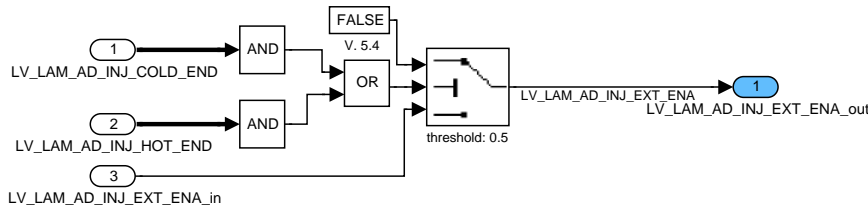


Figure 7.109.14: :


## 7.109.2.2 Bank specific calculations

The following calculations are done for all cylinder banks. Inside the model the bank specific values are denoted with the suffix `_i` whereas in the textual description they are referenced via `[i]`.

### 7.109.2.2.1 Limited dynamics determination

The flag `LV_LDC_LAM_AD_INJ[i]` is calculated using `N`, `MAF`, `FAQ_TQ_REQ` and `FAC_LAM_MV` conditions. During multiple injections the monitoring of `FAC_LAM_MV` can be changed by using different thresholds.

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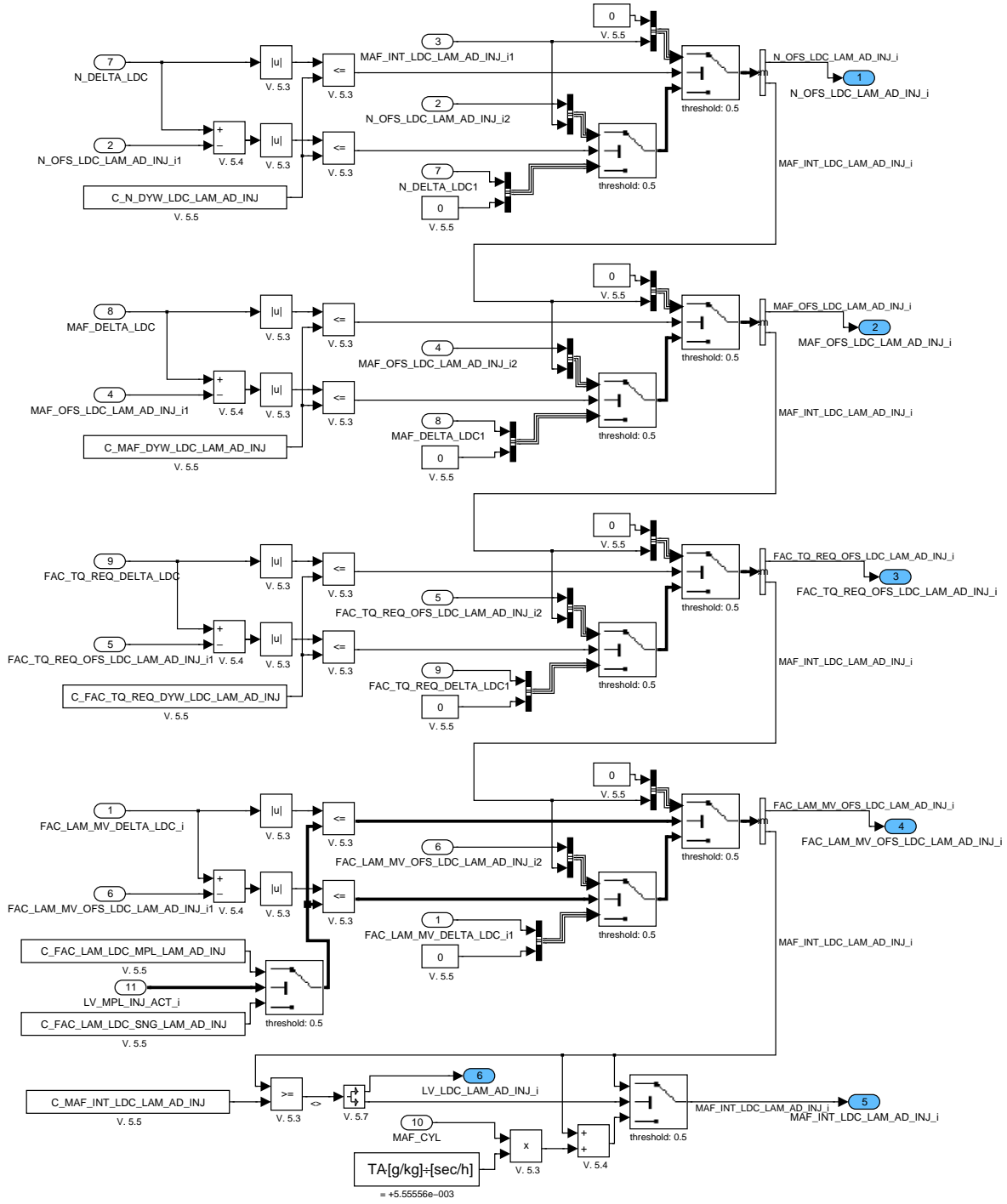



Figure 7.109.15: :

**7.109.2.2.2 Determination of adaptation conditions for upper or lower temperature range**

If the limited dynamics are given and the lambda controller operates within defined limits, depending on the temperature conditions the adaptation for the upper or lower temperature range is enabled, if all banks fulfil these conditions and the catalyst temperature has to be below a threshold. Or the adaptation can be activated manually via calibration value.

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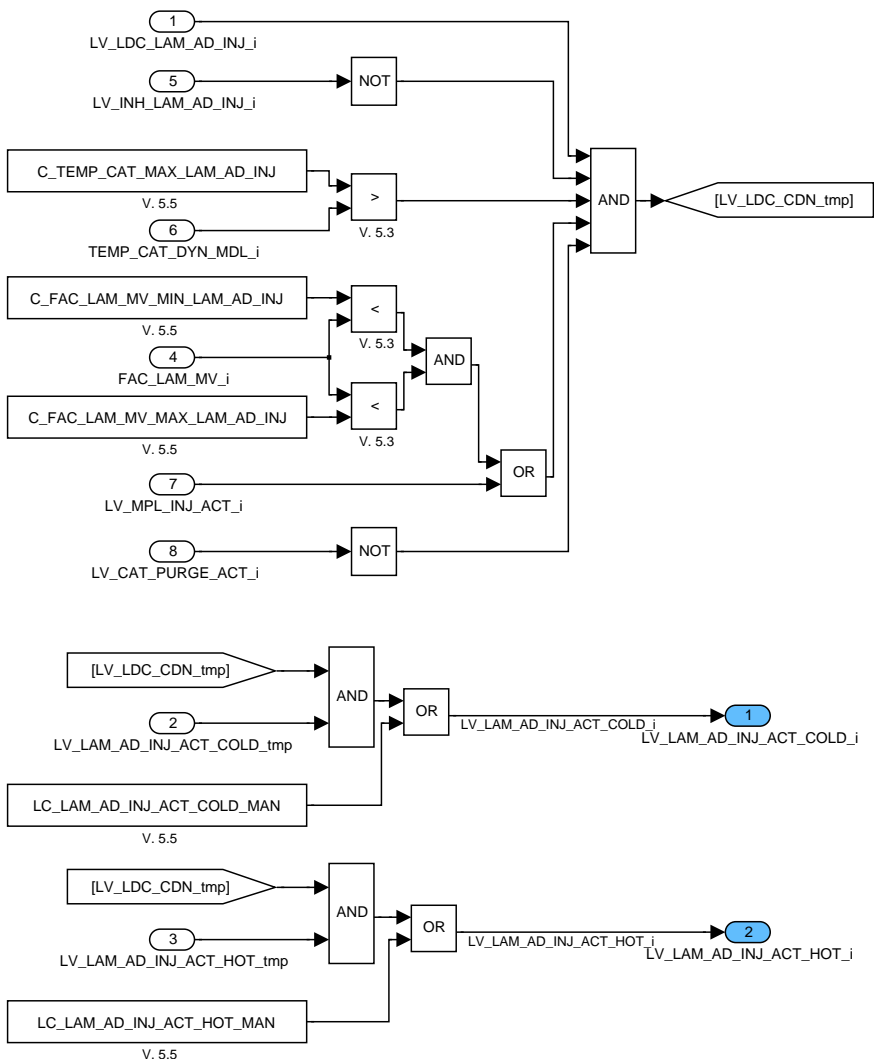


Figure 7.109.16: :

### 7.109.2.2.3 Monitoring of ENSC, LACO and MISF

During the multiple injection phase the output of the engine speed controller, the lambda controller and the misfire detection are monitored. At a certain number of misfire events or at a certain deviation in the lambda controller output the adaptation is interrupted immediately and the adaptation is repeated. For a deviation in the engine speed controller, the adaptation is at first finished and then repeated.

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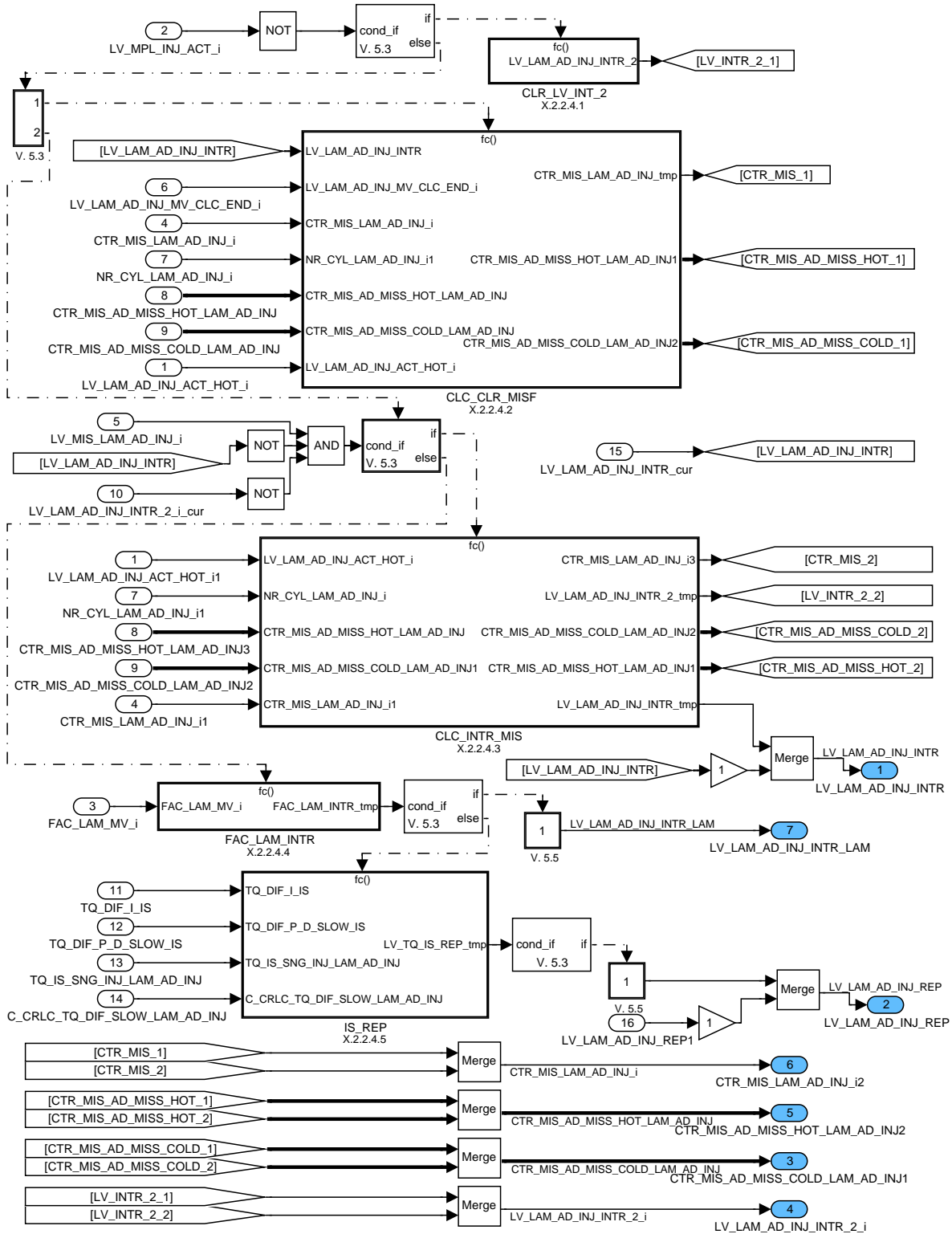


Figure 7.109.17: :



### 7.109.2.2.3.1 Clear interruption flag



Figure 7.109.18: :

### 7.109.2.2.3.2 Clear the counter for misfire handling

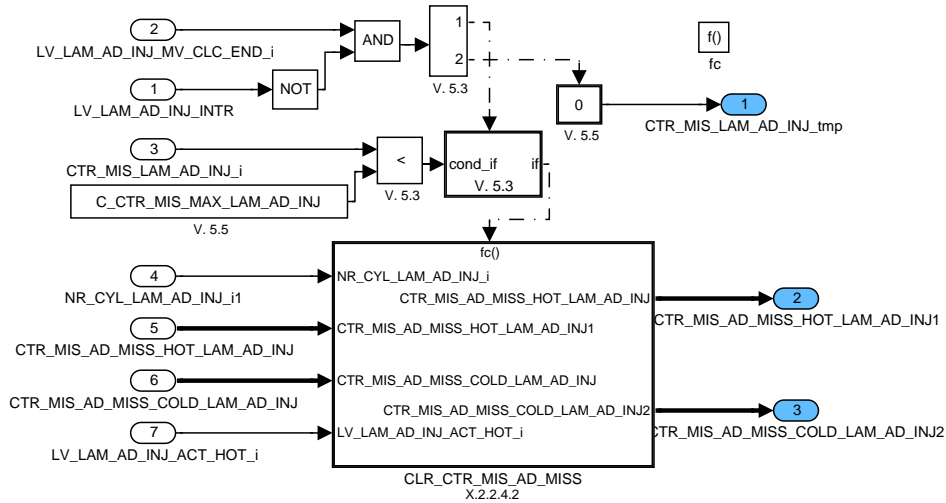


Figure 7.109.19: :

#### 7.109.2.2.3.2.1 Clear temperature depending counters for misfire handling

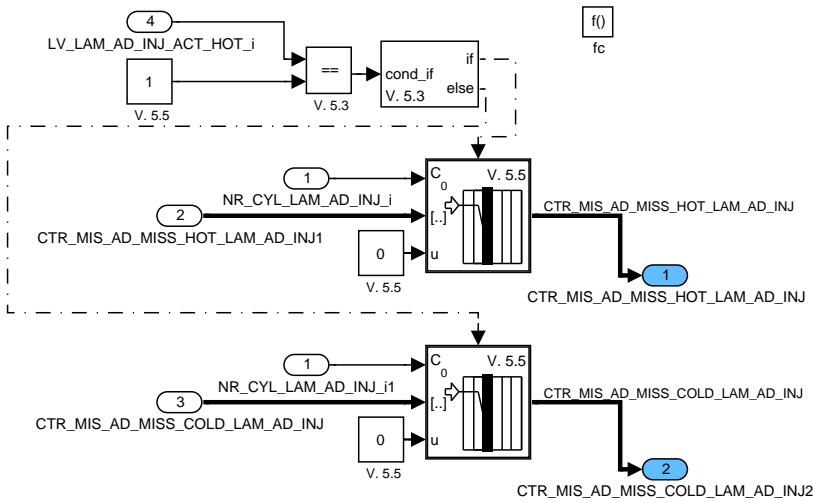


Figure 7.109.20: :

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### 7.109.2.2.3.3 Calculate counter for misfire handling

This calculation are done, if a misfire during multiple injection is detected. At misfire the misfire counter is incremented an the interruption flag is set, which leads to a repeat of the adaptation. If the maximum number of repeated adaptation due to misfire are reached, a second interruption flag is set, a counter is incremented and the adaptation is continued with all left cylinders.

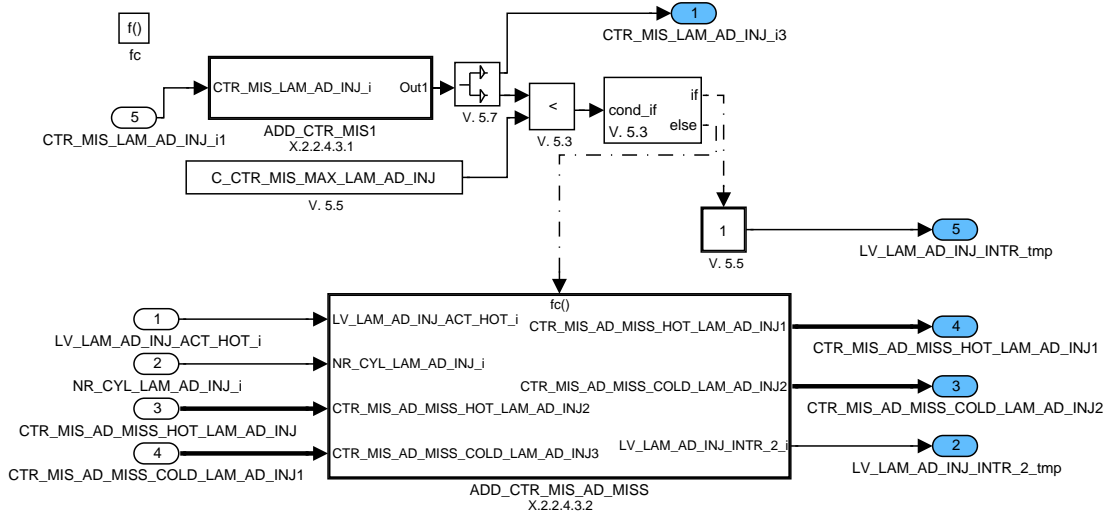


Figure 7.109.21: :

#### 7.109.2.2.3.3.1 Incrementation of CTR\_MIS\_LAM\_AD\_INJ

The counter is incremented and limited.

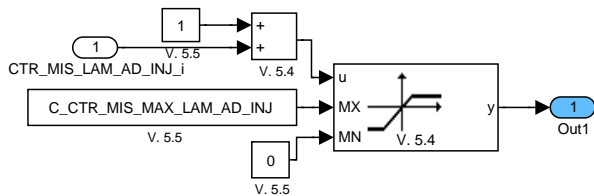


Figure 7.109.22: :

#### 7.109.2.2.3.3.2 Incrementation of of CTR\_MIS\_AD\_MISS\_COLD/HOT\_LAM\_AD\_INJ

Depending on the temperature range the counters are incremented.

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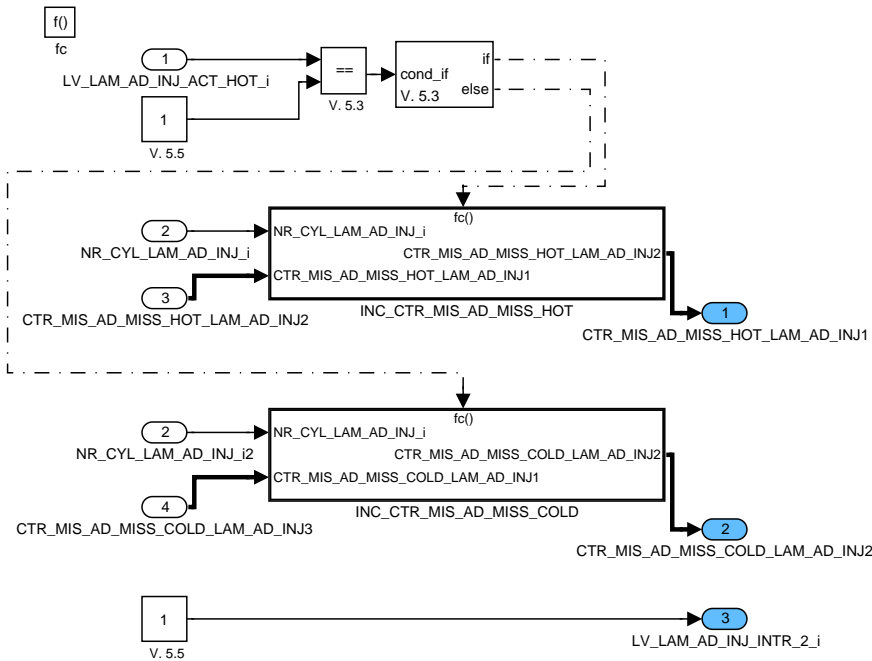


Figure 7.109.23: :

### 7.109.2.2.3.4 Conditions for interruption due to lambda conditions

If the lambda controller output exceeds the limitations, the adaptation is interrupted.

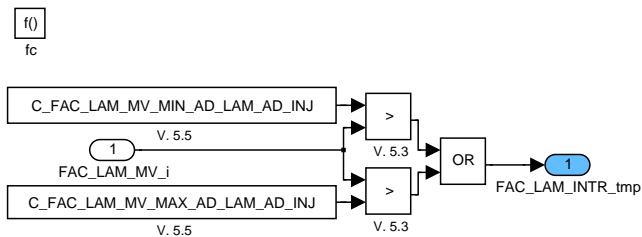


Figure 7.109.24: :

### 7.109.2.2.3.5 Conditions for interruptions due to ENSC controller output deviation

For a big difference in the idle speed controller in single and multiple injection, the adaptation will be finished and repeated.

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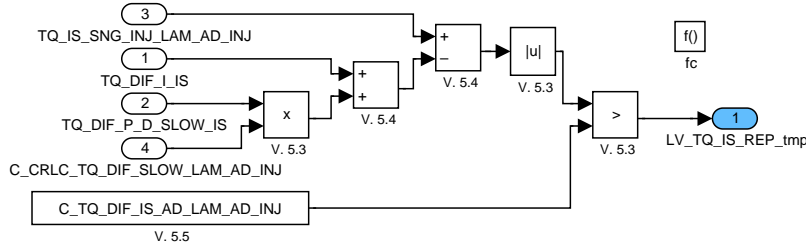


Figure 7.109.25: :

### 7.109.2.3 Calculation of general activation flag and update of the distance counter

The general activation flag is set if the bank specific condition for hot or cold conditions are given. Also the update of the mileage threshold is updated.

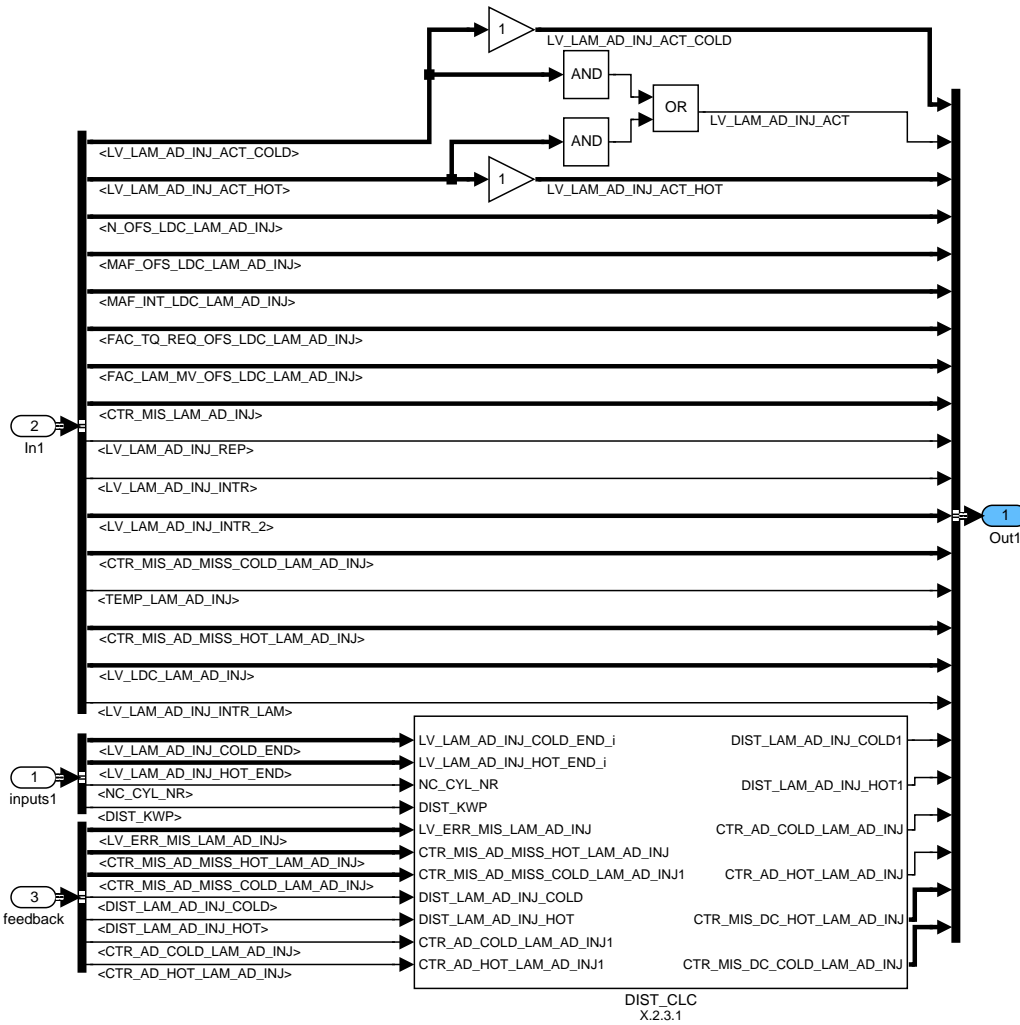


Figure 7.109.26: :

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### 7.109.2.3.1 Update of the mileage threshold

The mileage threshold is separately updated for hot and cold adaptation if the adaptation is finished successfully for all cylinders and no repeat of adaptation due to misfire is necessary.

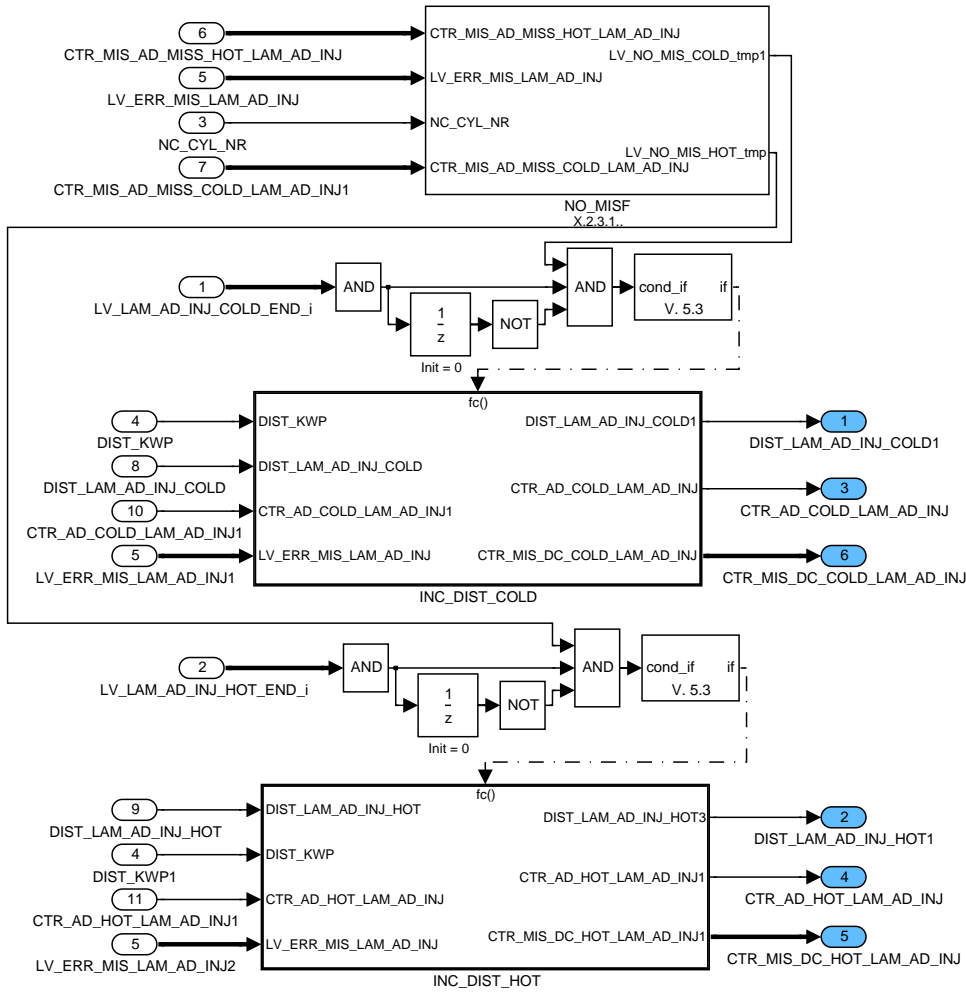


Figure 7.109.27: :

#### 7.109.2.3.1.1 Distance threshold incrementation for cold adaptation

At successful adaptation the distance counter will be incremented; the CTR\_AD\_COLD\_LAM\_AD\_INJ will be incremented and if no error is present and the LC\_CTR\_MIS\_DC\_LAM\_AD\_INJ\_CLR is set the CTR\_MIS\_DC\_COLD\_LAM\_AD\_INJ is cleared.

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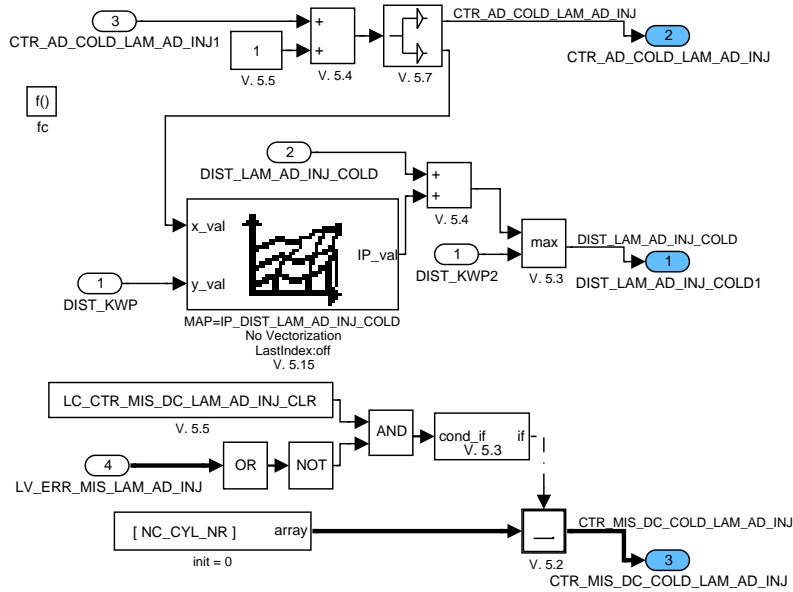


Figure 7.109.28: :

**7.109.2.3.1.2 Distance threshold incrementation for hot adaptation**

At successful adaptation the distance counter will be incremented; the CTR\_AD\_HOT\_LAM\_AD\_INJ will be incremented and if no error is present and the LC\_CTR\_MIS\_DC\_LAM\_AD\_INJ\_CLR is set the CTR\_MIS\_DC\_HOT\_LAM\_AD\_INJ is cleared.

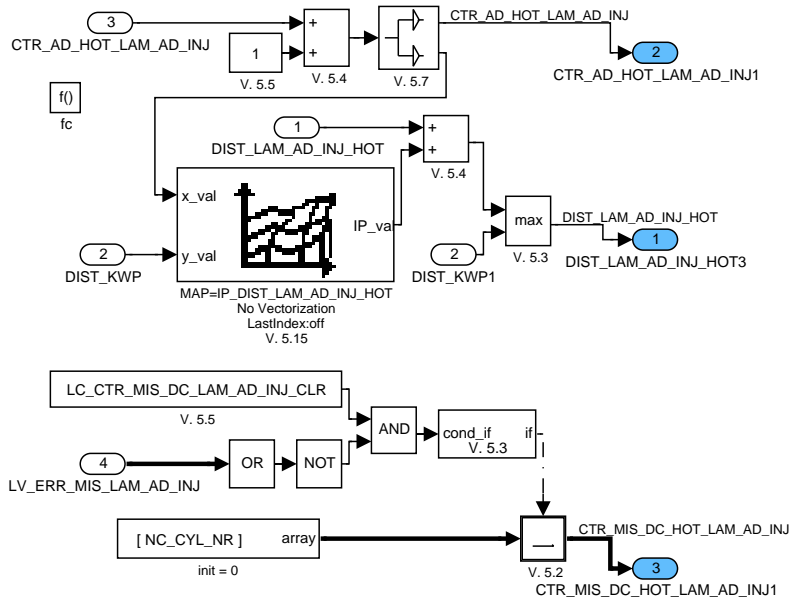


Figure 7.109.29: :

**7.109.2.3.1.3 No misfire condition for mileage threshold update**

The mileage threshold can be updated, if the condition "no misfire" is present for all cylinders.

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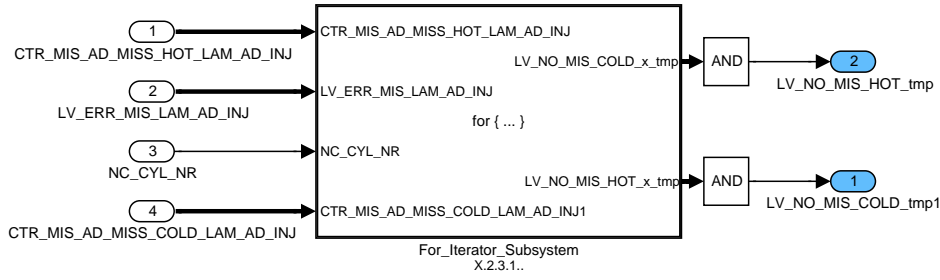


Figure 7.109.30: :

**7.109.2.3.1.3.1 No misfire condition**

For each cylinder it tested, if no misfire was present or the error for misfire is already present.

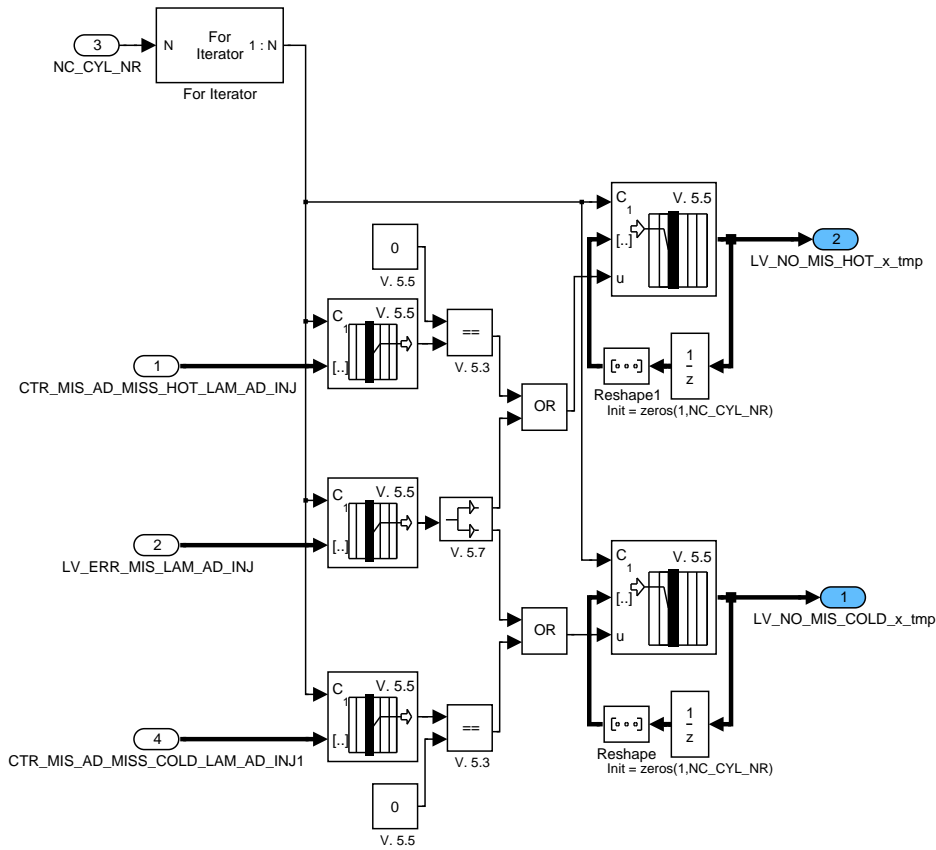



Figure 7.109.31: :

**7.109.3 Segment synchronous calculations to detect misfire**

Calculations to detect misfire with the same recurrence as the misfire calculations. Misfire will be detected only at multiple injection phase, represented by STATE\_LAM\_AD\_INJ\_ACT > 2 (single injection)

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### 7.109.3.1 Detection of misfire

If misfire is detected for the cylinder with multiple injections, a misfire counter is incremented. The flag indicating misfire is set, if the counter reach a threshold.

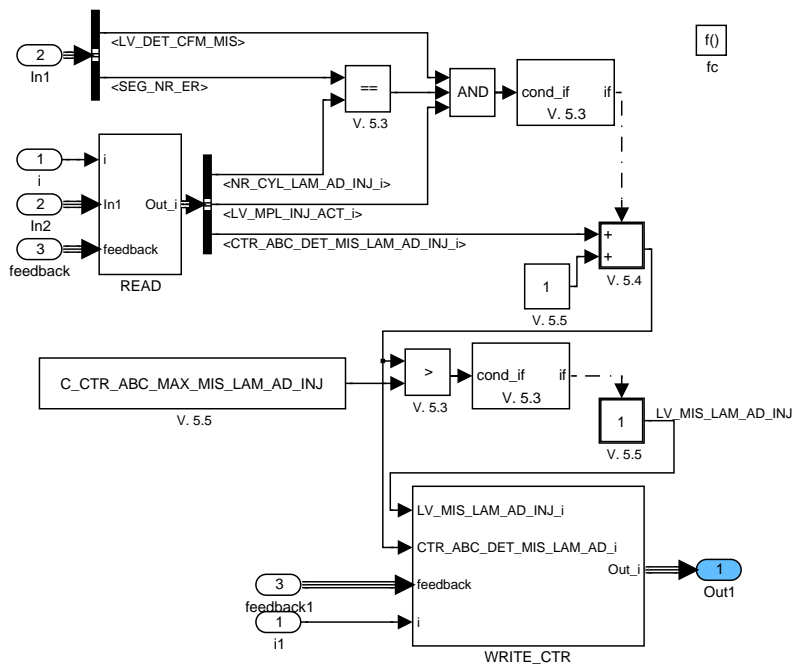


Figure 7.109.32: :

## 7.109.4 Calculations at event engine stop to engine run

Cylinder individual calculations to clear the error flags.

### 7.109.4.1 Clear error flags, distance threshold and counters

At a change of an injector, the CTR\_AD\_HOT/COLD\_LAM\_AD\_INJ and the error flags and counter are cleared. The distance threshold and the error can also be cleared by calibration data.

If a resetting of the NVMY data via service tester is requested with the flag LV\_LAM\_AD\_INJ\_CLR\_AD\_EXT, the counters and the distance thresholds are cleared.



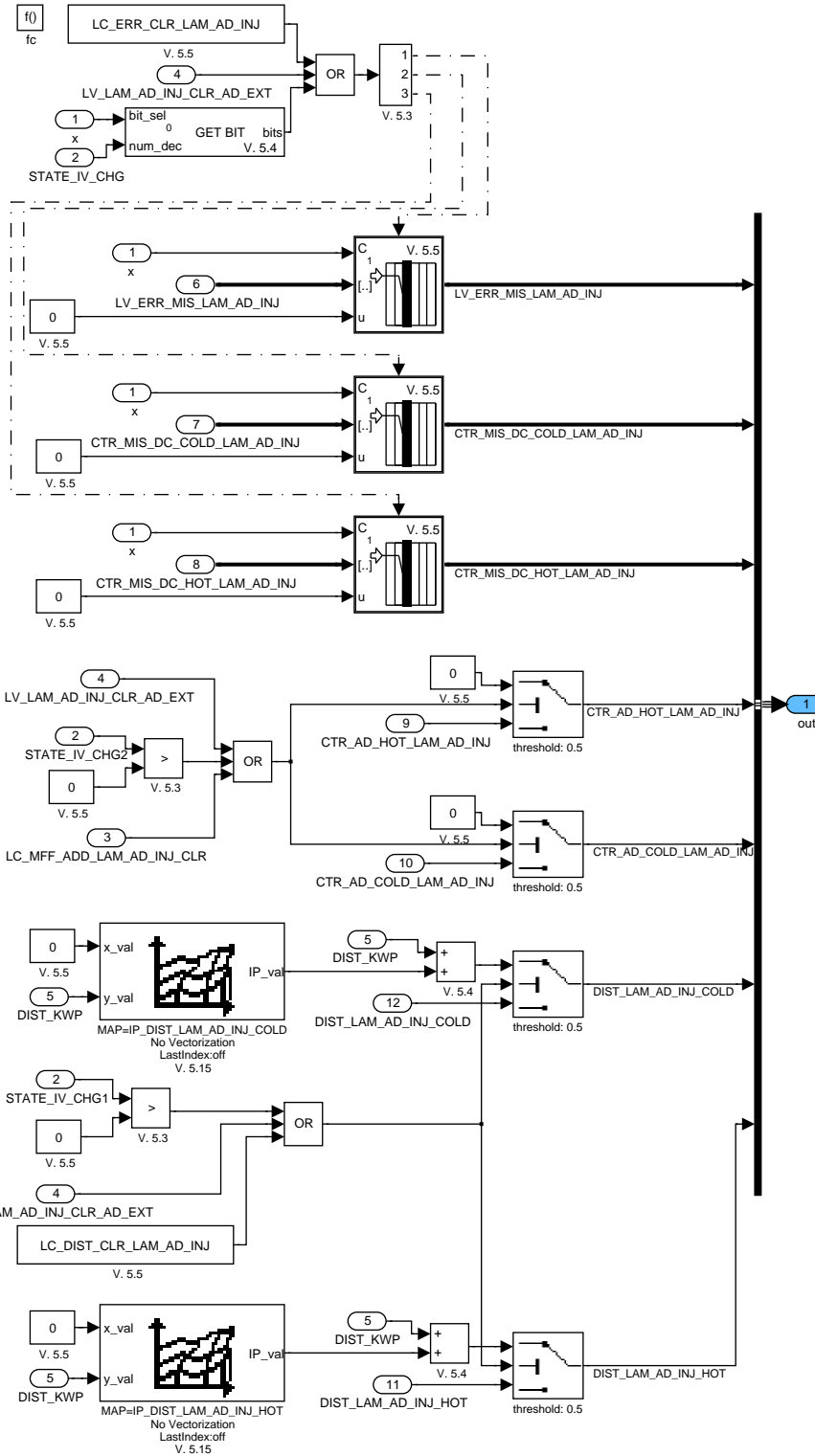


Figure 7.109.33: :

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### 7.109.5 Detailed description for Action: ACTION\_MFMA\_GetEnableCondition

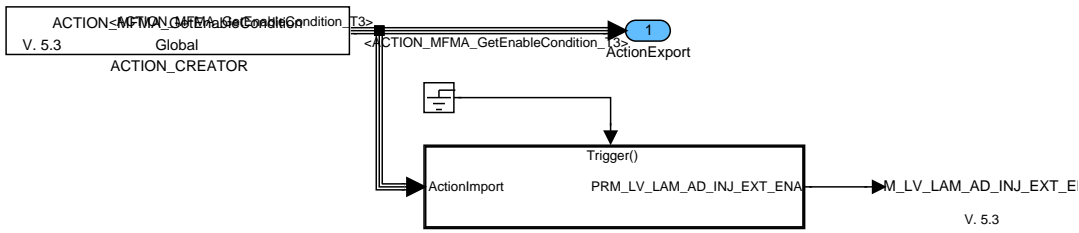


Figure 7.109.34: :

#### 7.109.5.1 No title given

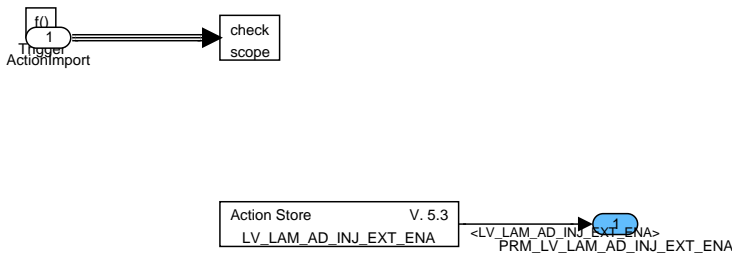


Figure 7.109.35: :

### 7.109.6 Detailed description for Action: ACTION\_MFMA\_SetEnableCondition

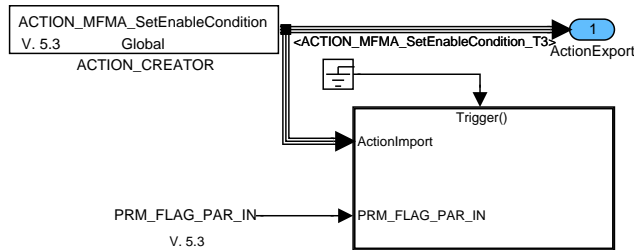


Figure 7.109.36: :

#### 7.109.6.1 No title given

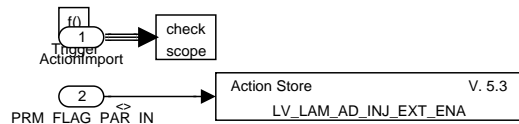



Figure 7.109.37: :

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## 7.110 Coordination of lambda adaptation via injection mode

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAM_AD_INJ_COLD_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that the lambda adaptation via injection mode for the lower temp range is finished					
LV_LAM_AD_INJ_HOT_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that the lambda adaptation via injection mode for the higher temp range is finished					
LV_LAM_AD_INJ_PHA_0 [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag to memorize that first adaptation phase is active					
LV_MPL_INJ_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that multiple injection for lambda adaptation via injection mode is active					
LV_SNG_INJ_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that single injection for lambda adaptation via injection mode is active					
NR_CYL_LAM_AD_INJ [NC_CBK_EX_NR]	O/V	80... 7FH	-128 ...127	1	-
Defines the cylinder that is currently using multiple injections for lambda adaptation					
NR_PHA_LAM_AD_INJ_COLD [NC_CBK_EX_NR]	V/S	0... FH	0... 15	1	-
Currently desired lambda adaptation via injection mode phase for the lower temp range					
NR_PHA_LAM_AD_INJ_HOT [NC_CBK_EX_NR]	V/S	0... FH	0... 15	1	-
Currently desired lambda adaptation via injection mode phase for the upper temp range					
STATE_LAM_AD_INJ_ACT [NC_CBK_EX_NR]	O/V	0H	NOT_ACT	-	-
		1H	SNG_ALL_L		
		2H	SNG_ALL_H		
		3H	MPL_CYL0_L		
		4H	MPL_CYL0_H		
		5H	MPL_CYL1_L		
		6H	MPL_CYL1_H		
		7H	MPL_CYL2_L		
		8H	MPL_CYL2_H		
		9H	MPL_CYL3_L		
		10H	MPL_CYL3_H		
		11H	MPL_CYL4_L		
		12H	MPL_CYL4_H		
		13H	MPL_CYL5_L		
		14H	MPL_CYL5_H		
		15H	MPL_CYL6_L		
16H	MPL_CYL6_H				
17H	MPL_CYL7_L				
18H	MPL_CYL7_H				
Current injection state for each cylinder requested by lambda adaptation via injection mode					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_LAM_AD_INJ_MNG [NC_CBK_EX_NR]	V	0H 1H 2H	NOT_ACT CLC_CYL_ STATE WAIT_LAM_ AD_INJ	-	-
State of the lambda adaptation via injection mode manager					

**Input data:**

LV_ERR_MIS_LAM_AD_INJ [NC_CYL_NR] {p. 3348}	LV_LAM_AD_INJ_ACT_COLD [NC_CBK_EX_NR] {p. 3348}	LV_LAM_AD_INJ_ACT_HOT [NC_CBK_EX_NR] {p. 3349}	LV_LAM_AD_INJ_CLR_AD_EXT {p. 7483}
LV_LAM_AD_INJ_CUS_ACK [NC_CBK_EX_NR] {p. 8269}	LV_LAM_AD_INJ_INTR {p. 3349}	LV_LAM_AD_INJ_INTR_2 [NC_CBK_EX_NR] {p. 3349}	LV_LAM_AD_INJ_INTR_LAM {p. 3349}
LV_LAM_AD_INJ_MV_CLC_END [NC_CBK_EX_NR] {p. 3405}	LV_LAM_AD_INJ_REP {p. 3349}	NC_CBK_EX_NR {p. 1829}	NC_NR_PHA_LAM_AD_INJ {p. 827}
STATE_LS [NC_CBK_EX_NR] {p. 2448}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NR_PHA_LAM_AD_INJ	-	0... FH	0... 15	1	-
Number of adaptation cycles for lambda adaptation via injection mode					
ID_NR_CYL_LAM_AD_INJ [NC_CBK_EX_NR]	-	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H 10H 11H 12H 13H 14H 15H 16H 17H 18H	NOT_ACT SNG_ALL_L SNG_ALL_H MPL_CYL0_L MPL_CYL0_H MPL_CYL1_L MPL_CYL1_H MPL_CYL2_L MPL_CYL2_H MPL_CYL3_L MPL_CYL3_H MPL_CYL4_L MPL_CYL4_H MPL_CYL5_L MPL_CYL5_H MPL_CYL6_L MPL_CYL6_H MPL_CYL7_L MPL_CYL7_H	-	-

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_NR_ID_NR_CYL_LAM_AD_INJ	NC_ NR_ PHA_ LAM_ AD_ INJ	0... FH	0... 15	1	-
Desired injection order for all banks					

### General Information

This module coordinates the usage of single and multiple injections for lambda adaptation via injection mode.

### Application Conditions


Initialization: RST, IGKON, NVMRES, NVMINI, NVMSTO

Activation: 20MS: always

ES2ERU: always

Deactivation: never

### Function description

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 3381 of 8404</b>	
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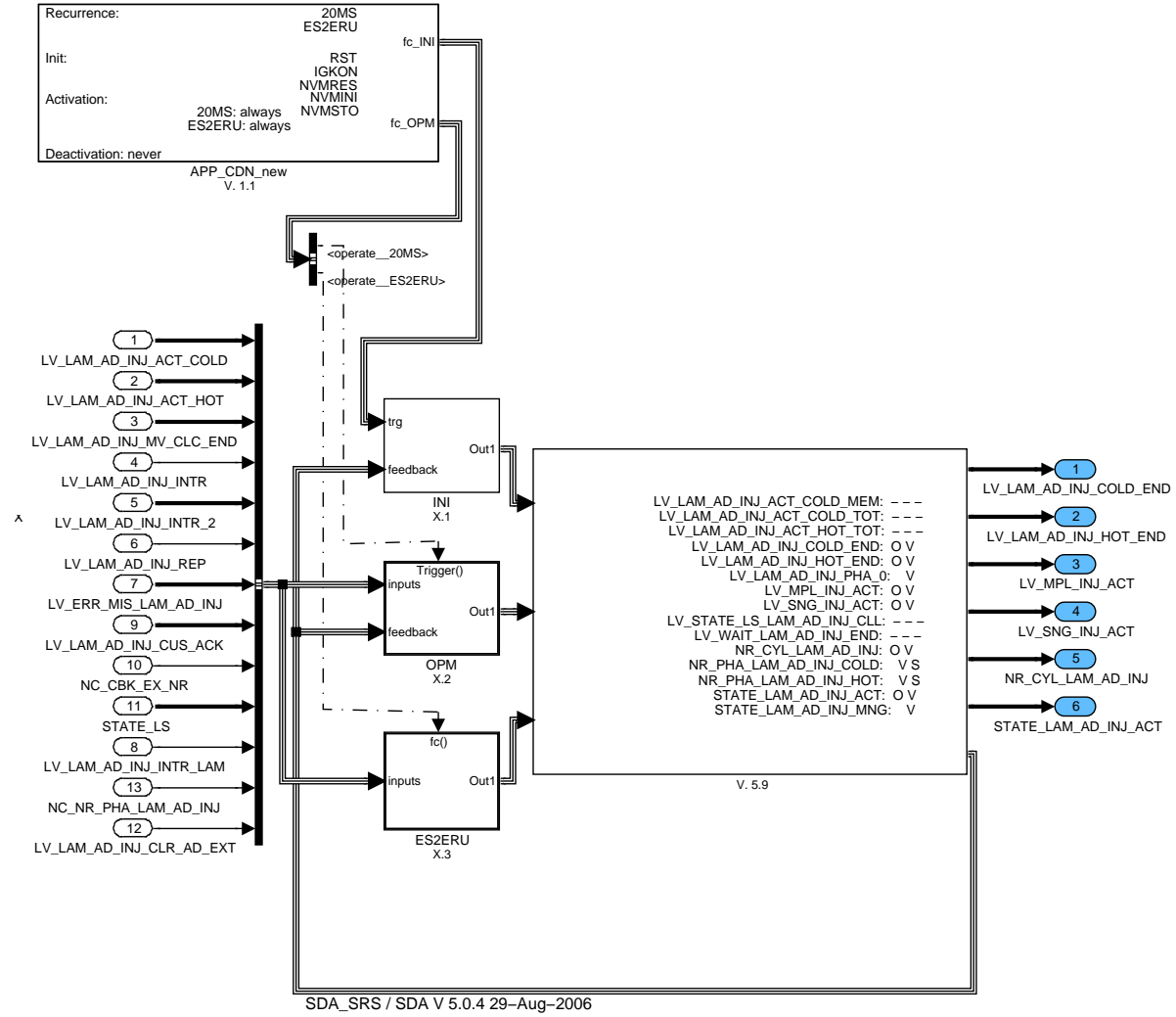


Figure 7.110.1: : Path: MFMA\_REQCOAIMM0

### 7.110.1 Initialization and NVMY management

#### 7.110.1.1 Reading from non-volatile memory

The phase number NR\_PHA\_LAM\_AD\_INJ\_COLD/HOT are initialized from the non-volatile memory.

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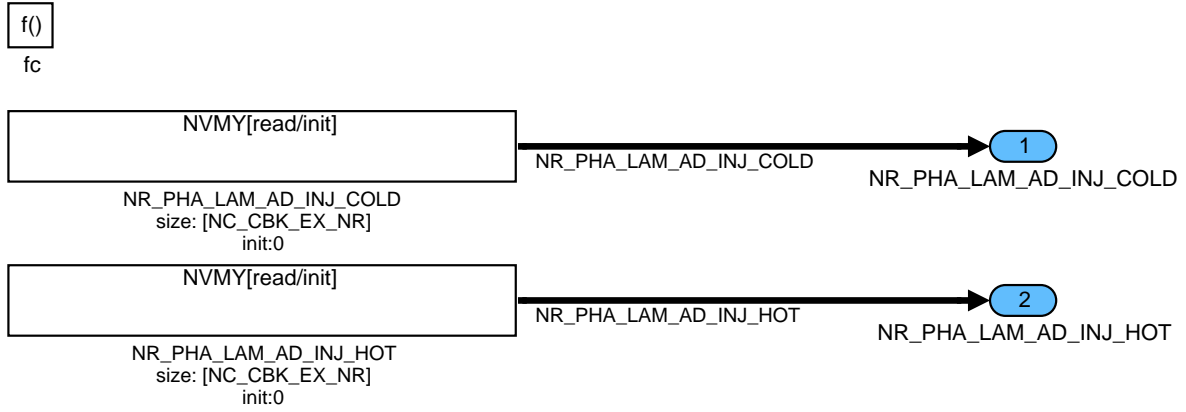


Figure 7.110.2: : Path: MFMA\_REQCOAIMM0/INI/NVMY\_RD

### 7.110.1.2 Writing to the non-volatile memory

After powerlatch the values of NR\_PHA\_LAM\_AD\_INJ\_COLD/HOT are written to the non-volatile memory.

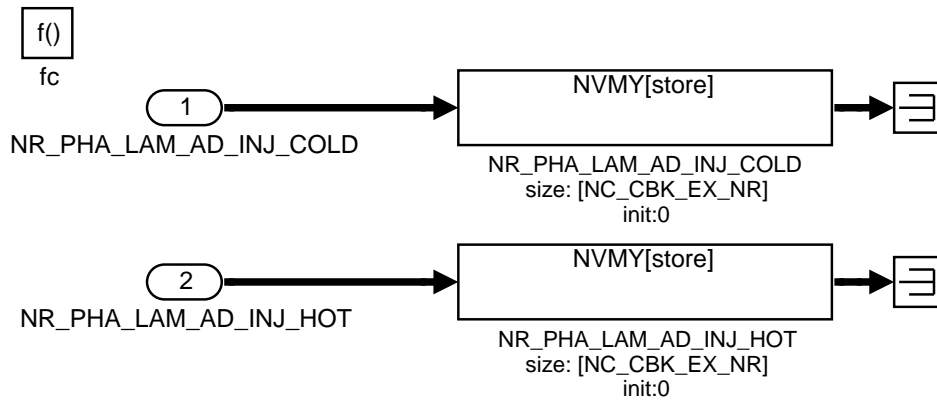


Figure 7.110.3: : Path: MFMA\_REQCOAIMM0/INI/NVMY\_WR

### 7.110.1.3 Initialization

All variables are initialized with 0 at reset or IGKON.

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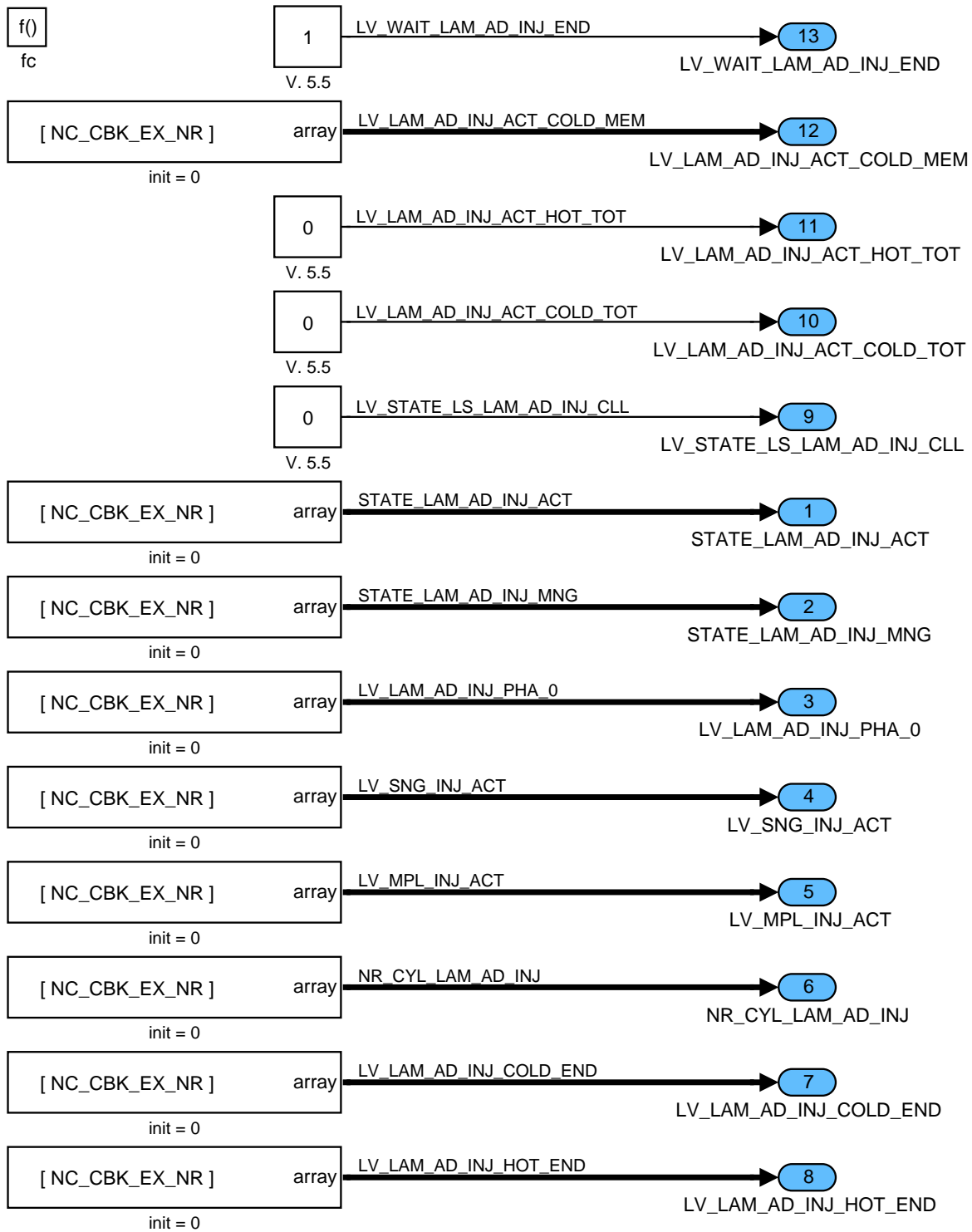


Figure 7.110.4: : Path: MFMA\_REQCOAIMM0/INI/INI

### 7.110.2 Bank specific calculations

All calculations are done for every bank. The value for the specific bank is denoted in the graphical model with the suffix **\_i** whereas in the textual description the bank specific values are referred to with **[i]**.

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## 7.110.2.1 Preliminary calculations

### 7.110.2.1.1 Calculation of LV\_LAM\_AD\_INJ\_ACT\_COLD\_MEM, LV\_WAIT\_LAM\_AD\_INJ\_END and LV\_STATE\_LS\_LAM\_AD\_INJ\_CLL

The flag LV\_WAIT\_LAM\_AD\_INJ\_END is set if the adaptation signals the end of the mean value calculation for both banks. The values of LV\_LAM\_AD\_INJ\_ACT\_COLD are memorized in LV\_LAM\_AD\_INJ\_ACT\_COLD\_MEM as this is used for determination of the phase numbers NR\_PHA\_LAM\_AD\_INJ\_COLD/HOT. To get a bank synchronous switching of the state machine, the activation conditions for the lambda controller are checked for all banks and stored in LV\_STATE\_LS\_LAM\_AD\_INJ\_CLL.

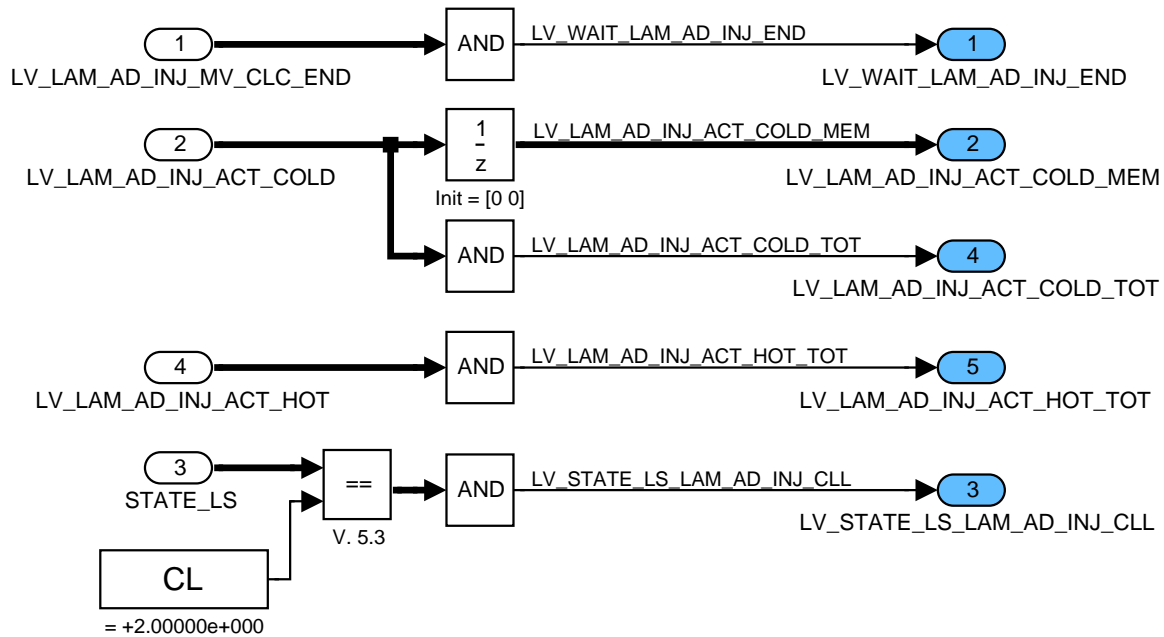


Figure 7.110.5: : Path: MFMA\_REQCOAIMM0/OPM/CLC\_MEM/CLC

## 7.110.2.2 Adaptation manager

The adaptation manager consists of three states STATE\_LAM\_AD\_INJ[i]:

NOT\_ACT: inactive state

CLC\_CYL\_STATE: intermediate state to determine single/multiple injection-mode for the next adaptation phase

WAIT\_LAM\_AD\_INJ: the adaptation enabled for the injection-mode defined in the previous state

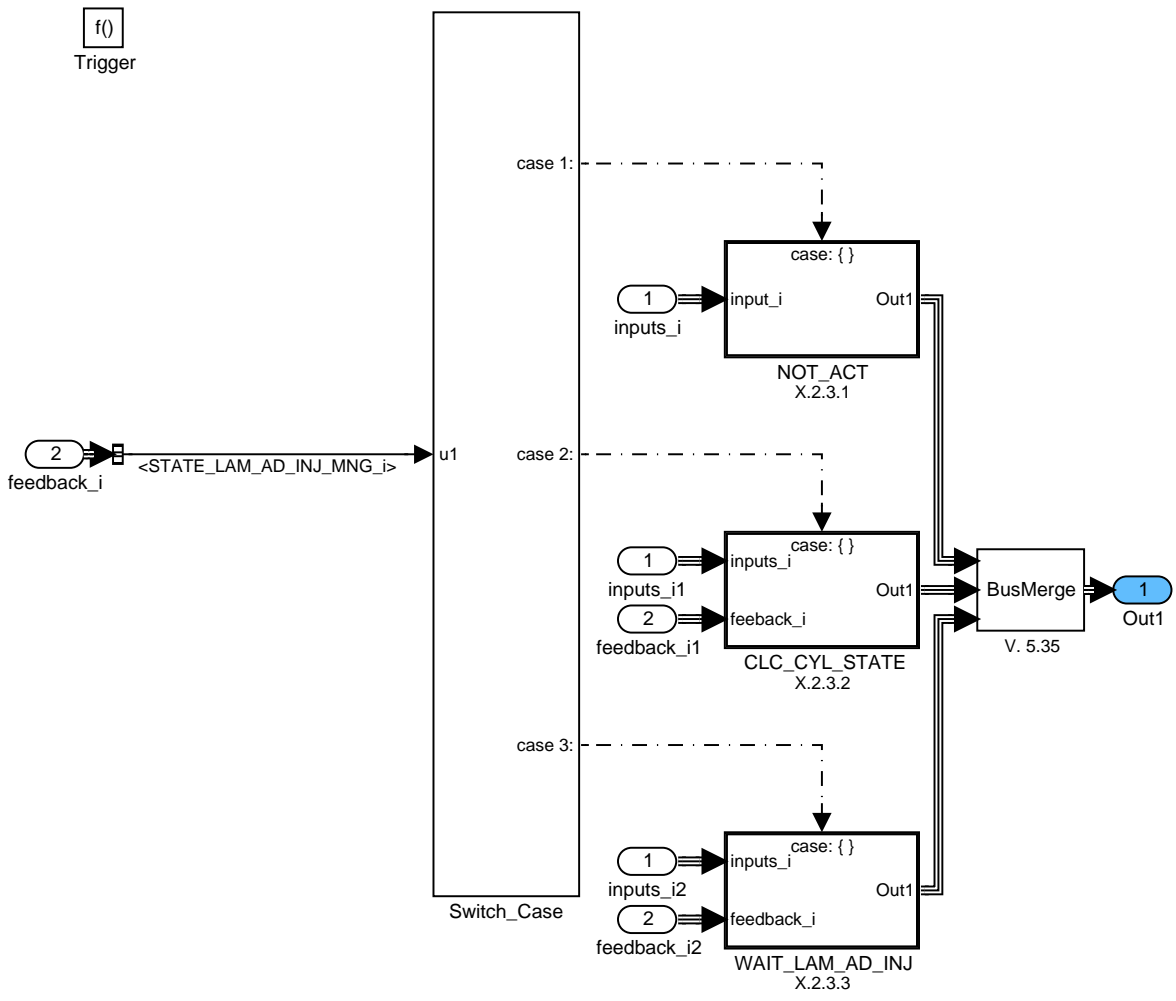


Figure 7.110.6: : Path: MFMA\_REQCOAIMM0/OPM/STATE\_MNG

**7.110.2.2.1 NOT\_ACT**

In this state the adaptation is inactive. If the conditions for the adaptation in the upper or lower temperature range apply, the injection mode control is requested by setting the state STATE\_LAM\_AD\_INJ\_ACT[i] different from zero.

**7.110.2.2.1.1 Transition conditions**

If the adaptation conditions apply the injection mode control is requested and the state is left if it is granted (LV\_LAM\_AD\_INJ\_CUS\_ACK = 1).

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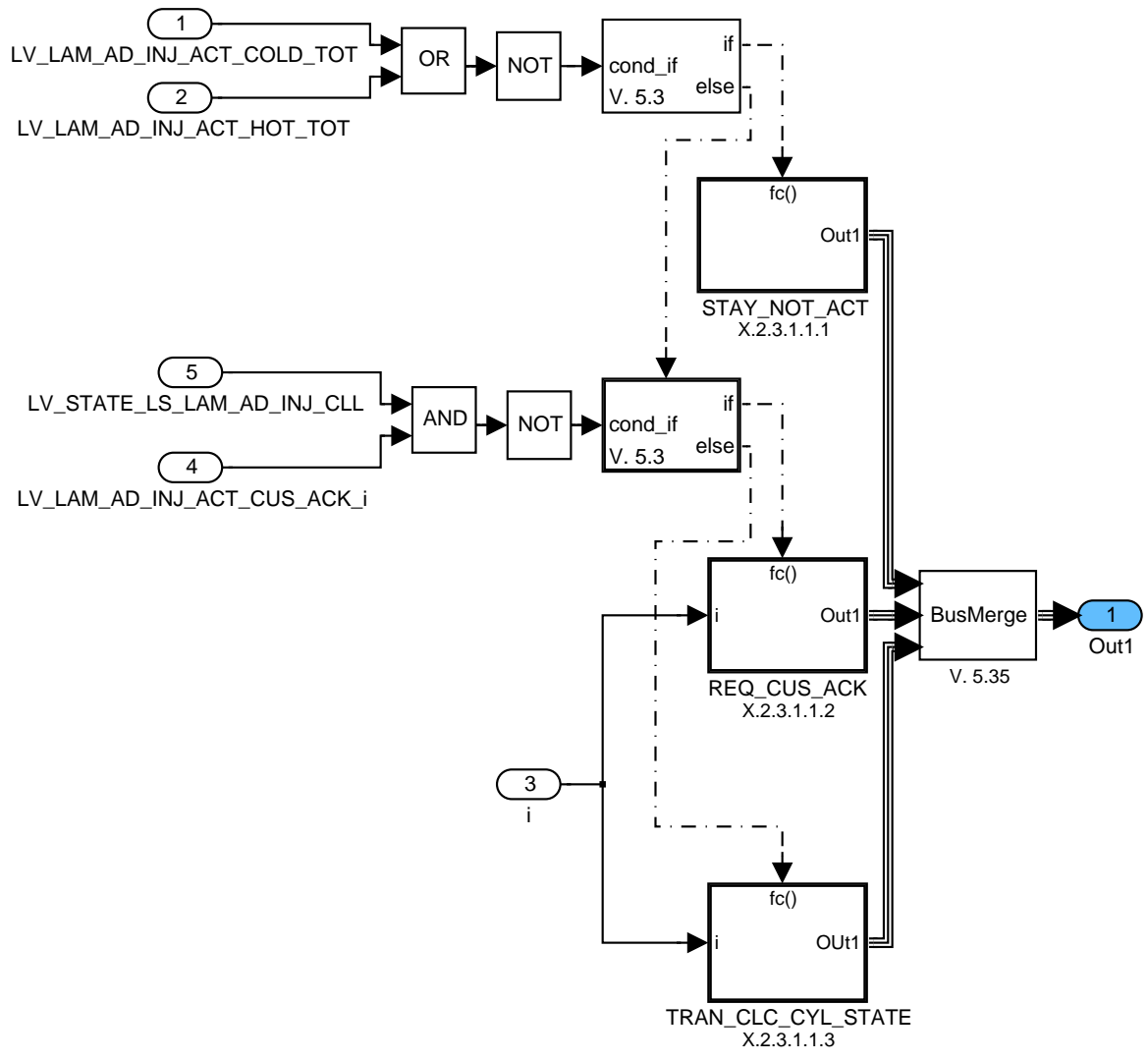


Figure 7.110.7: : Path: MFMA\_REQCOAIMM0/OPM/STATE\_MNG/NOT\_ACT/CLC

**7.110.2.2.1.1.1 Remaining in NOT\_ACT**

**7.110.2.2.1.1.1.1 Reset of the request for the injection mode control**

The request is reset if the conditions are no more fulfilled.

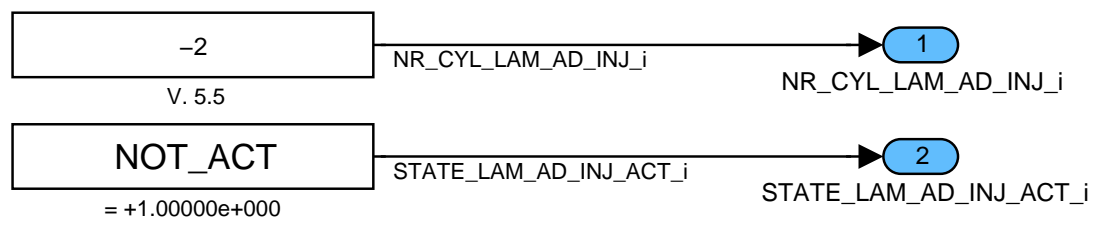


Figure 7.110.8: : Path: MFMA\_REQCOAIMM0/OPM/STATE\_MNG/NOT\_ACT/CLC/STAY\_NOT\_ACT/CLC

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### 7.110.2.2.1.1.2 Start of injection mode control handshake

The injection mode for the bank is requested.

#### 7.110.2.2.1.1.2.1 Request for injection mode control

The control of the injection mode is requested by setting the STATE\_LAM\_AD\_INJ\_ACT[i] to the first element of ID\_NR\_CYL\_LAM\_AD\_INJ[i], which should be set to one or two to request single injections.

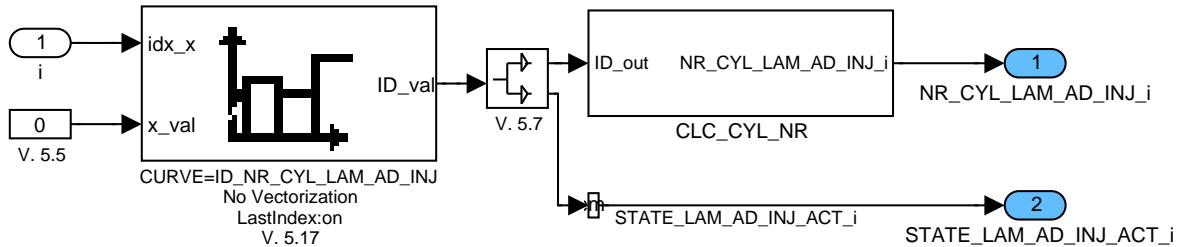


Figure 7.110.9: : Path:  
 MFMA\_REQCOAIMM0/OPM/STATE\_MNG/NOT\_ACT/CLC/REQ\_CUS\_ACK/CLC

### 7.110.2.2.1.1.3 Injection mode control granted

#### 7.110.2.2.1.1.3.1 Transition to CLC\_CYL\_STATE

If the acknowledge bit for injection mode control LV\_LAM\_AD\_INJ\_CUS\_ACK is set, the state is left towards CLC\_CYL\_STATE.

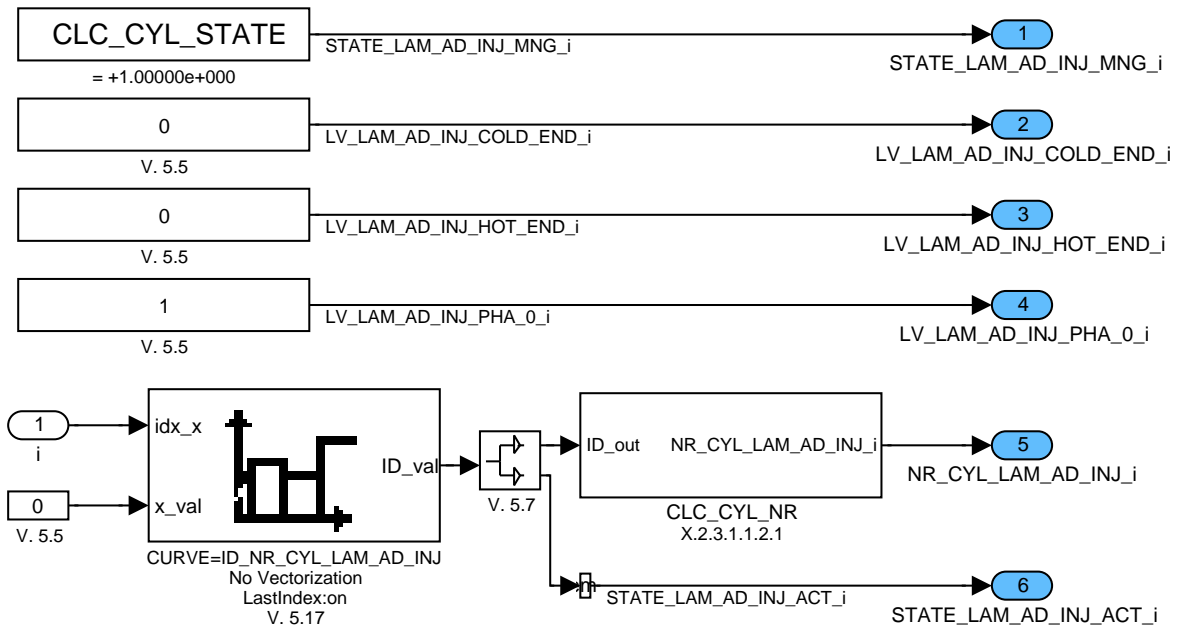


Figure 7.110.10: : Path:  
 MFMA\_REQCOAIMM0/OPM/STATE\_MNG/NOT\_ACT/CLC/TRAN\_CLC\_CYL\_STATE/CLC

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**7.110.2.2.1.1.3.1.1 Calculation of the cylinder number from STATE\_LAM\_AD\_INJ\_ACR**

The conversion from ID\_out[i] to NR\_CYL\_LAM\_AD\_INJ[i] can be done in the code as follows:  
 NR\_CYL\_LAM\_AD\_INJ[i] = (signed)((ID\_out+1) >> 1) - 2;

Therewith the conversion should be done as follows:

ID_OUT	NR_CYL_LAM_AD_INJ
0	-2
1	-1
2	-1
3	0
4	0
...	...
18	7

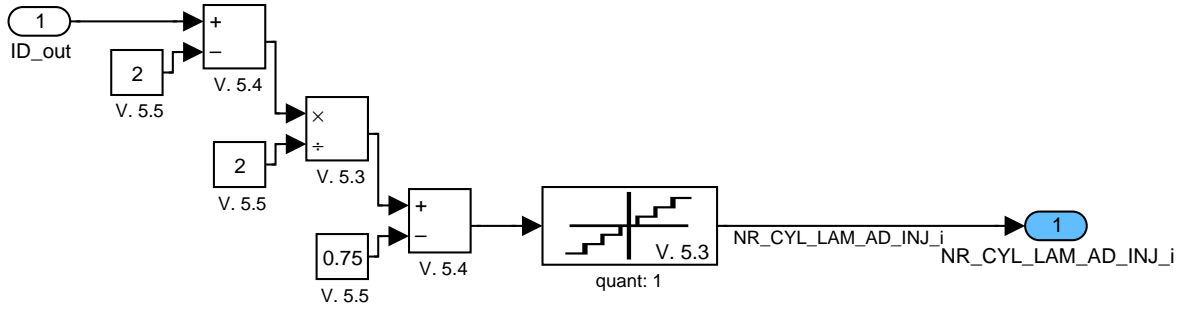


Figure 7.110.11: : Path: MFMA\_REQCOAIMM0/OPM/STATE\_MNG/NOT\_ACT/CLC/TRAN\_CLC\_CYL\_STATE/CLC/CLC\_CYL\_NR

**7.110.2.2.2 CLC\_CYL\_STATE**

This state is used for determination of the injection mode for the next adaptation phase.

**7.110.2.2.2.1 Transition conditions**

If the cylinder number of the current bank NR\_CYL\_LAM\_AD\_INJ[i] is equal to -2, the current adaptation is assumed to be finished and the state is left to NOT\_ACT. If the adaptation is interrupted due to the lack of the necessary conditions, a transition to NOT\_ACT is performed, too. Otherwise the state changes to WAIT\_LAM\_AD\_INJ.

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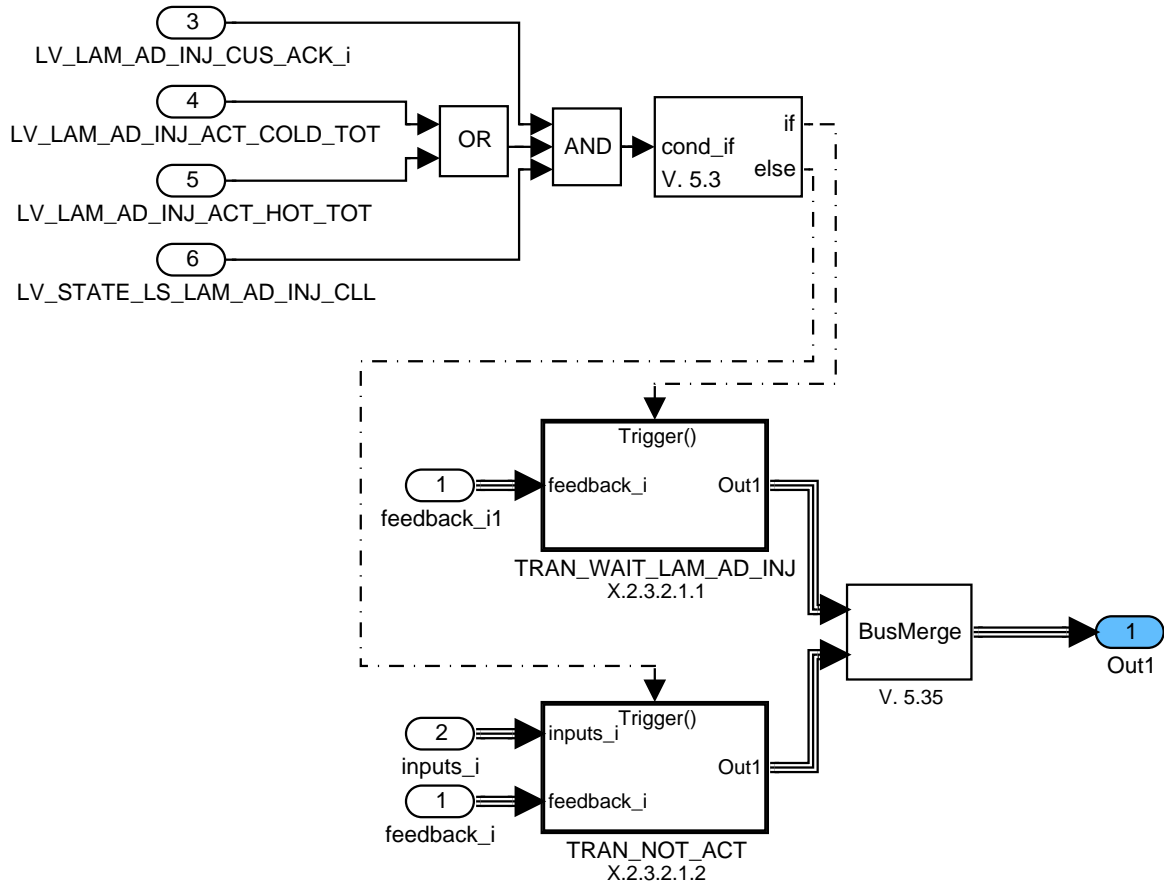


Figure 7.110.12: : Path: MFMA\_REQCOAIMM0/OPM/STATE\_MNG/CLC\_CYL\_STATE/CLC

**7.110.2.2.2.1.1 Transition to WAIT\_LAM\_AD\_INJ**

**7.110.2.2.2.1.1.1 Setting of LV\_SNG/MPL\_ACT**

If the STATE\_LAM\_AD\_INJ\_ACT[i] is bigger than 2, multiple injections for this cylinder number are requested and therefore LV\_MPL\_INJ\_ACT[i] is set. Otherwise LV\_SNG\_INJ\_ACT[i] is set to enable the corresponding adaptation.

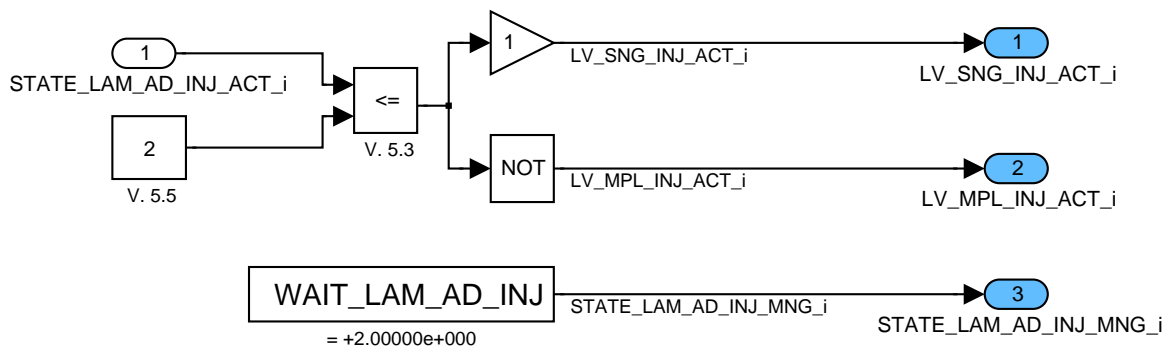



Figure 7.110.13: : Path: MFMA\_REQCOAIMM0/OPM/STATE\_MNG/CLC\_CYL\_STATE/CLC/TRAN\_WAIT\_LAM\_AD\_INJ/CLC

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### 7.110.2.2.2.1.2 Transition to NOT\_ACT due to interruption

#### 7.110.2.2.2.1.2.1 Saving of the last completed phase number

If the adaptation is interrupted, the last completed adaptation phase number is stored in NR\_PHA\_LAM\_AD\_INJ\_COLD/HOT[i], to make sure the adaptation is continued with the correct phase number if the conditions apply again and therefore all cylinders are adapted.

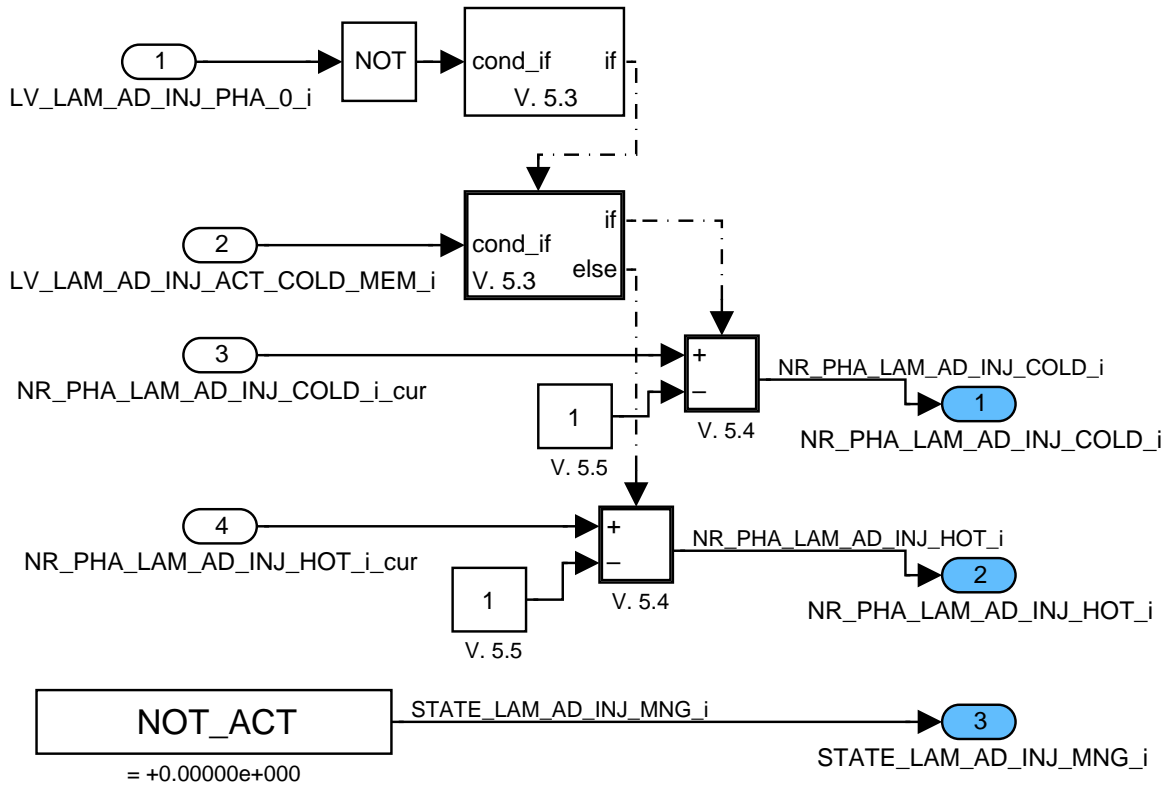


Figure 7.110.14: : Path:  
 MFMA\_REQCOAIMM0/OPM/STATE\_MNG/CLC\_CYL\_STATE/CLC/TRAN\_NOT\_ACT/CLC

### 7.110.2.2.3 WAIT\_LAM\_AD\_INJ

This state waits for the current adaptation phase to be completed or the adaptation conditions to be stopped.

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7.110.2.2.3.1 Transitions conditions

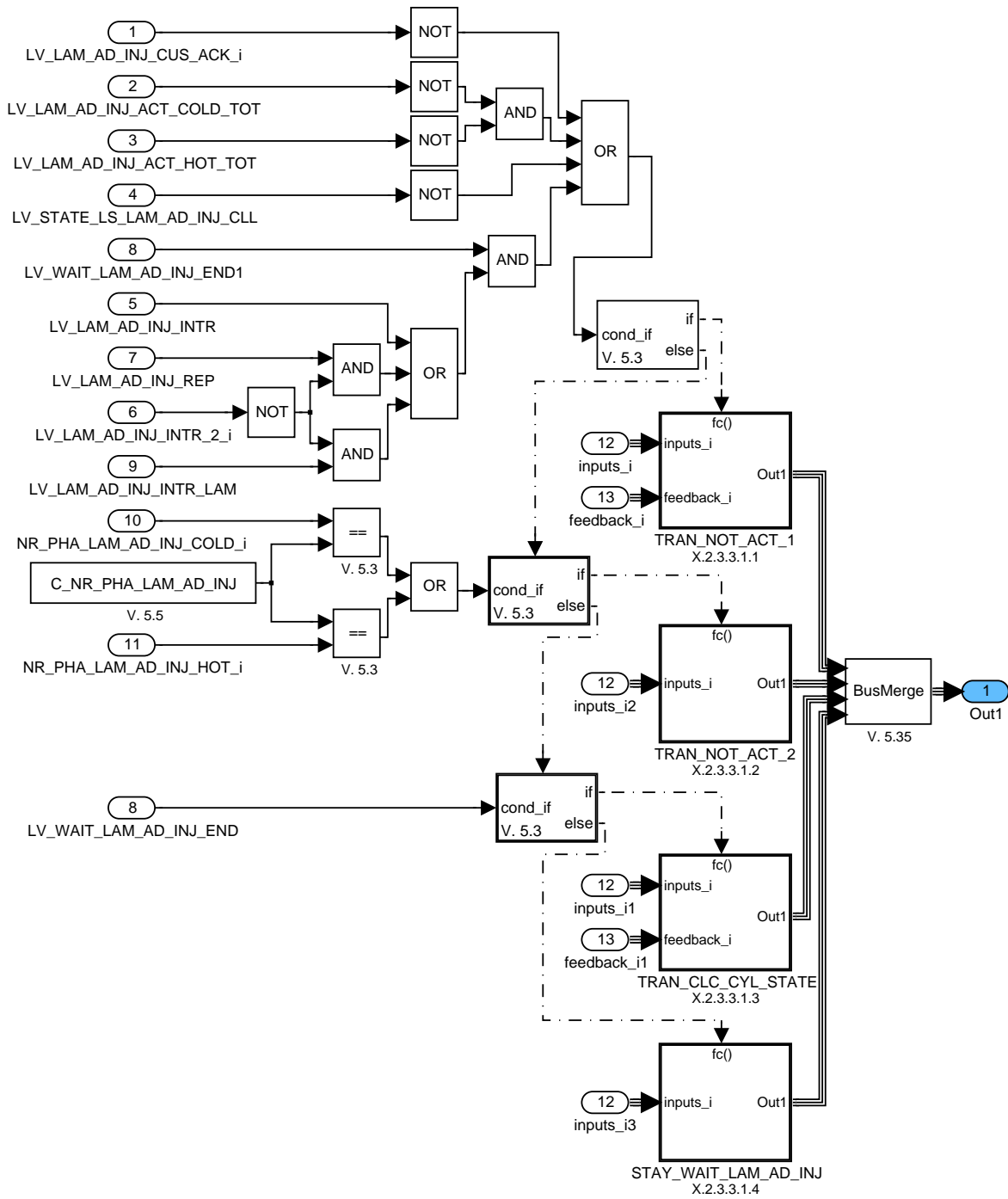


Figure 7.110.15: : Path: MFMA\_REQCOAIMM0/OPM/STATE\_MNG/WAIT\_LAM\_AD\_INJ/CLC

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### 7.110.2.2.3.1.1 Transition to NOT\_ACT due to interruption

#### 7.110.2.2.3.1.1.1 Saving of the last completed phase number

If the adaptation is interrupted, the last completed adaptation phase number is stored in NR\_PHA\_LAM\_AD\_INJ\_COLD/HOT[i], to make sure the adaptation is continued with the correct phase number if the conditions apply again and therefore all cylinders are adapted.

Furthermore the activation flags LV\_SNG/MPL\_ACT[i] are reset, to ensure that the current adaptation phase is stopped.

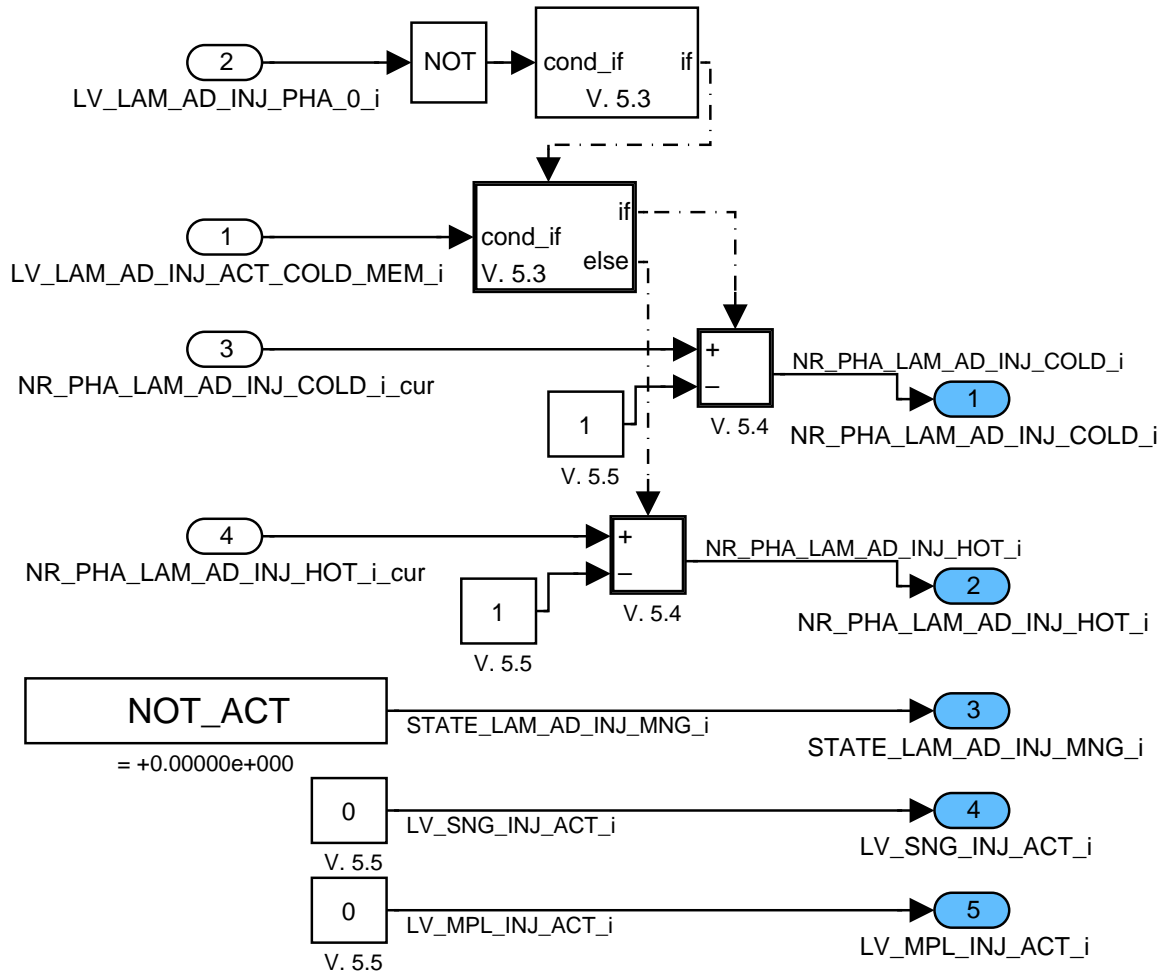


Figure 7.110.16: : Path:  
 MFMA\_REQCOAIMM0/OPM/STATE\_MNG/WAIT\_LAM\_AD\_INJ/CLC/TRAN\_NOT\_ACT\_1/CLC

### 7.110.2.2.3.1.2 Transition to NOT\_ACT due to finished adaptation

#### 7.110.2.2.3.1.2.1 Setting of LV\_LAM\_AD\_INJ\_COLD/HOT\_END

As the adaptation for the current temperature range is finished, the corresponding end-flag is set and the corresponding phase number NR\_PHA\_LAM\_AD\_INJ\_COLD/HOT[i] is reset to 0. Therefore the adaptation starts from the beginning if the conditions apply for the next time.

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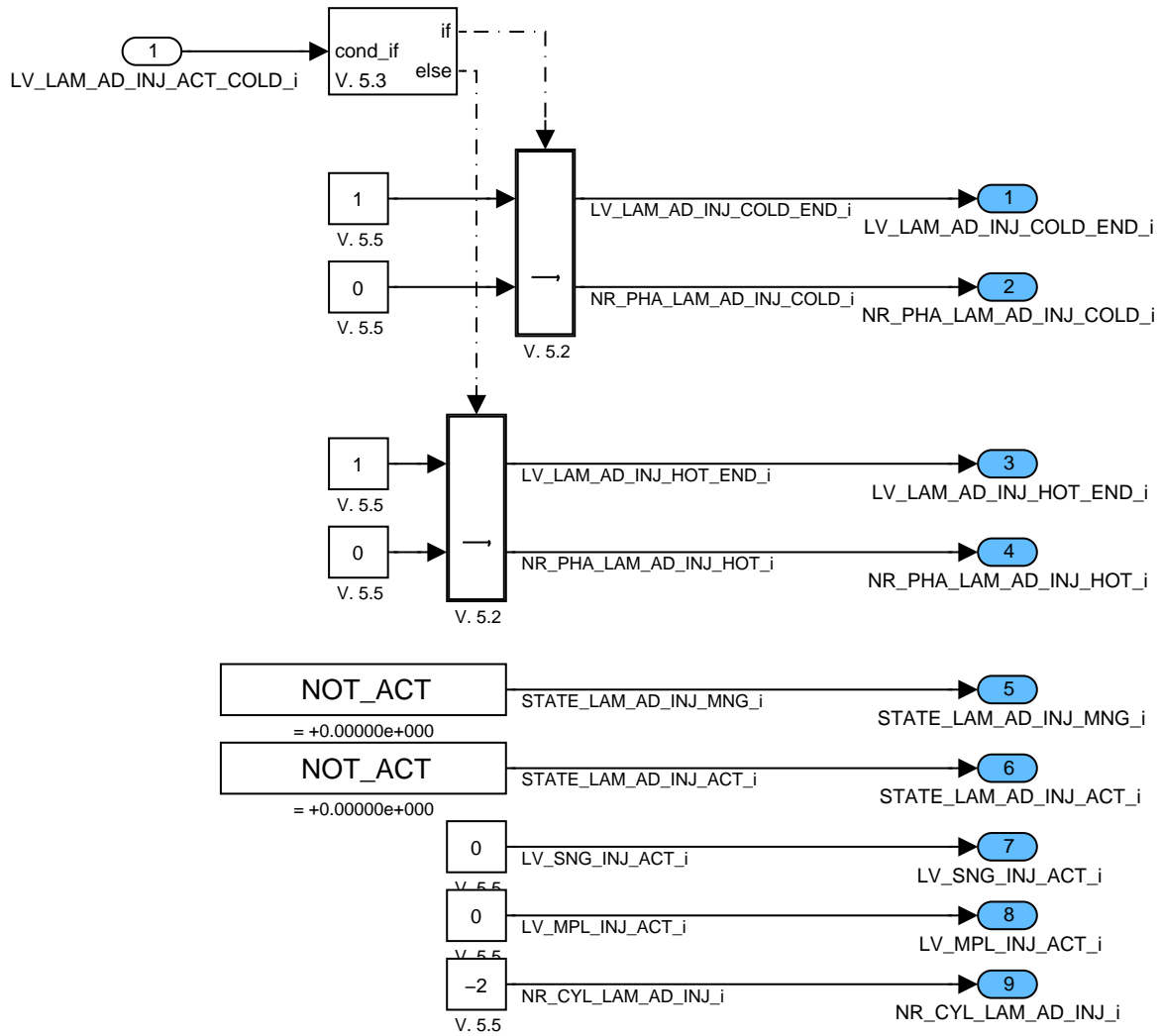


Figure 7.110.17: : Path:  
MFMA\_REQCOAIMM0/OPM/STATE\_MNG/WAIT\_LAM\_AD\_INJ/CLC/TRAN\_NOT\_ACT\_2/CLC

**7.110.2.2.3.1.3 Transition to CLC\_CYL\_STATE**

**7.110.2.2.3.1.3.1 Determination of the injection mode for the next adaptation phase**

The injection mode for the next adaptation phase is determined from the map ID\_NR\_CYL\_LAM\_AD\_INJ[i] and requested via STATE\_LAM\_AD\_INJ\_ACT[i]. If multiple injections for one cylinder of the current bank is requested, the corresponding cylinder number is stored in NR\_CYL\_LAM\_AD\_INJ[i]. Otherwise -1 (single injection) or -2(end of adaptation) is used.

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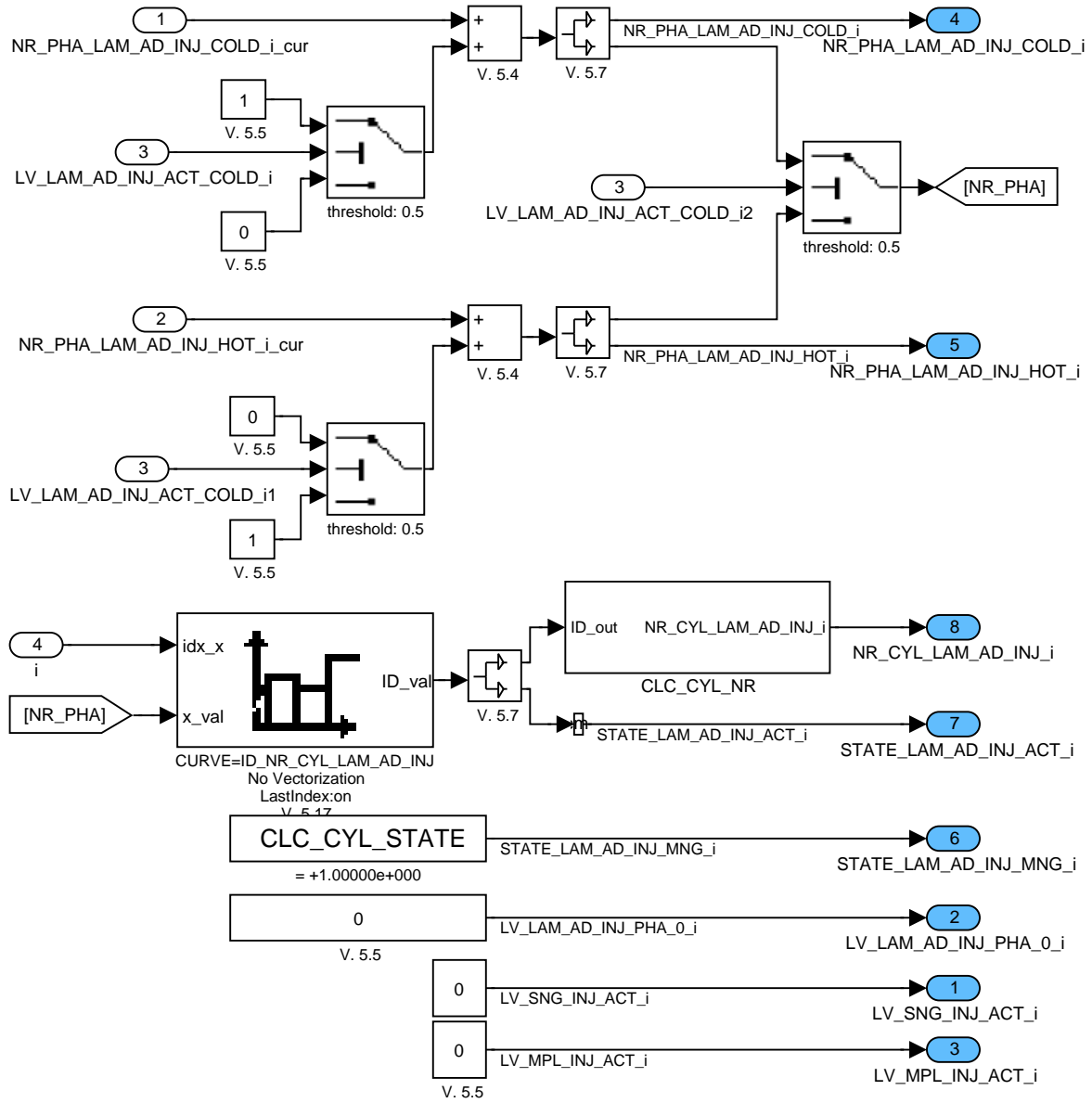


Figure 7.110.18: : Path: MFMA\_REQCOAIMM0/OPM/STATE\_MNG/WAIT\_LAM\_AD\_INJ/CLC/TRAN\_CLC\_CYL\_STATE/CLC\_1

### 7.110.2.2.3.1.3.2 Cancelling of multiple injection due to misfire error

If the flag LV\_ERR\_MIS\_LAM\_AD\_INJ[x] (where x denotes the current cylinder number) is set, i.e. a repeated misfire error is detected, the request for multiple injections is cancelled and another single injection phase will be started to continue with the adaptation of the other cylinders.

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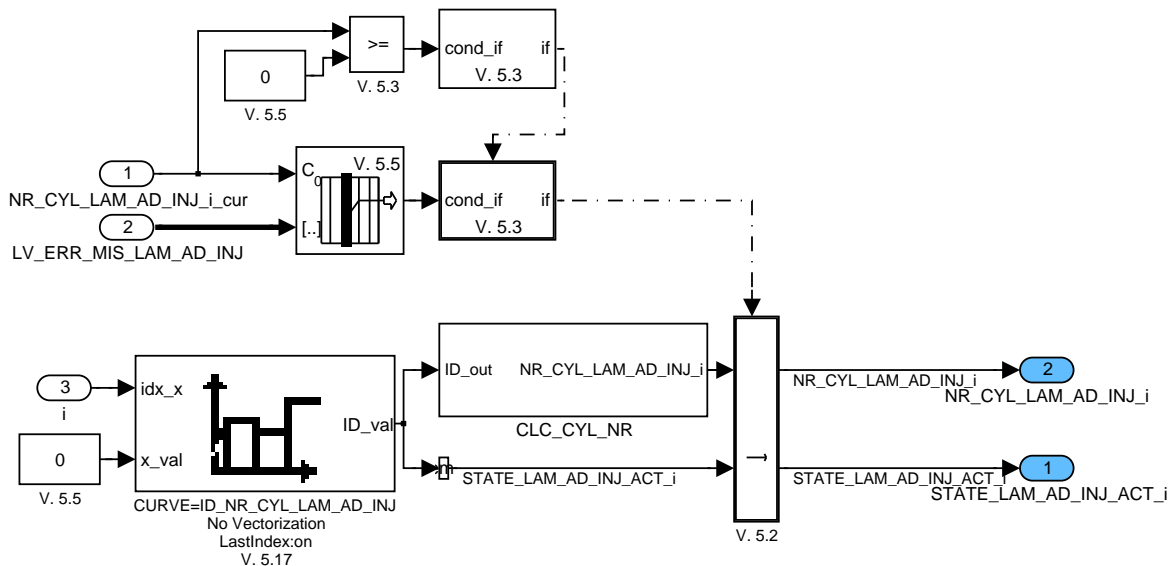


Figure 7.110.19: : Path: MFMA\_REQCOAIMM0/OPM/STATE\_MNG/WAIT\_LAM\_AD\_INJ/CLC/TRAN\_CLC\_CYL\_STATE/CLC\_2

### 7.110.2.2.3.1.4 Waiting for the end of the current adaptation cycle

#### 7.110.2.2.3.1.4.1 Resetting of LV\_SNG/MPL\_INJ\_ACT

If one bank signals the end of its adaptation phase (LV\_LAM\_AD\_INJ\_MV\_CLC\_END[i]), the corresponding activation flags LV\_SNG/MPL\_INJ\_ACT[i] are reset. If the flag LV\_LAM\_AD\_INJ\_INTR\_2[i] is set, repeated misfire is detected on the current cylinder and therefore single injection is requested.

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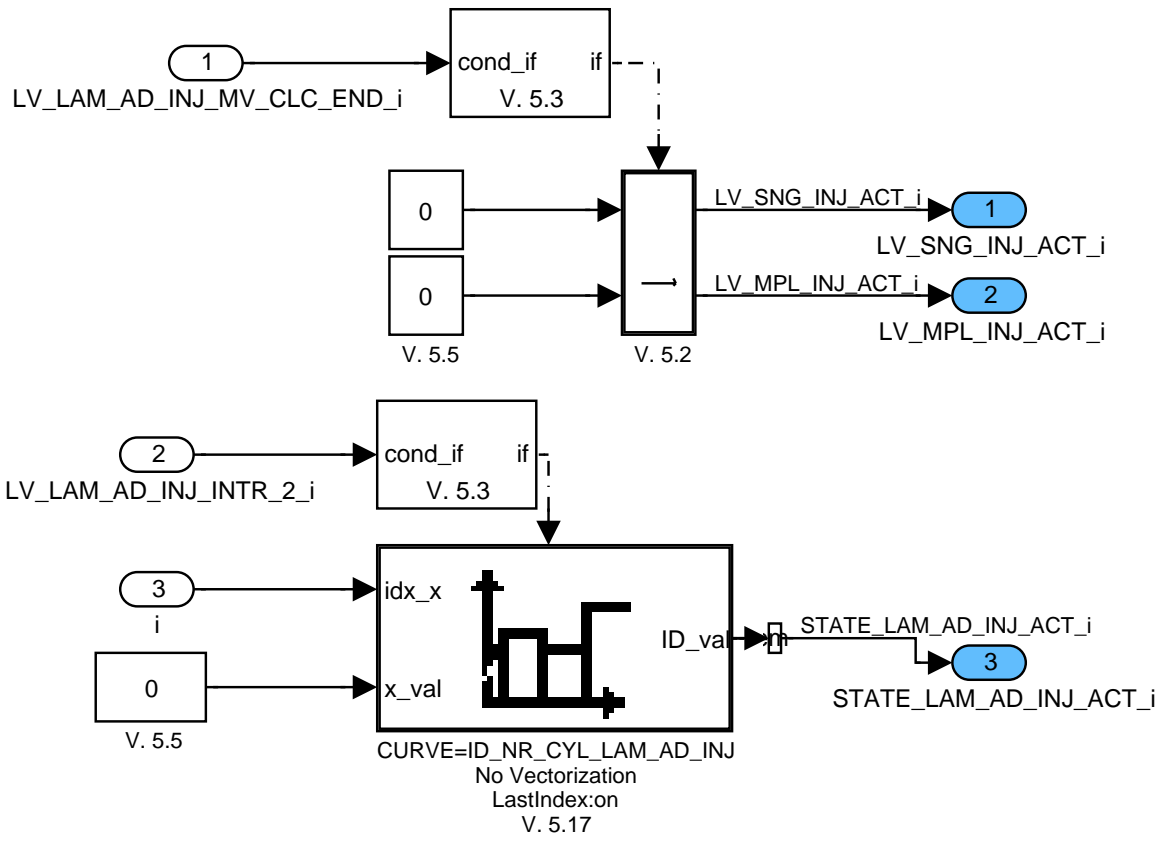


Figure 7.110.20: : Path:  
 MFMA\_REQCOAIMM0/OPM/STATE\_MNG/WAIT\_LAM\_AD\_INJ/CLC/STAY\_WAIT\_LAM\_AD\_INJ/CLC

### 7.110.3 Operations at transition engine stop to engine run

#### 7.110.3.1 Resetting of the phase numbers

If a resetting of the NVMY data via service tester is requested with the flag `LV_LAM_AD_INJ_CLR_AD_EXT`, the phase numbers of both banks for the upper and lower temperature range are reset to 0.

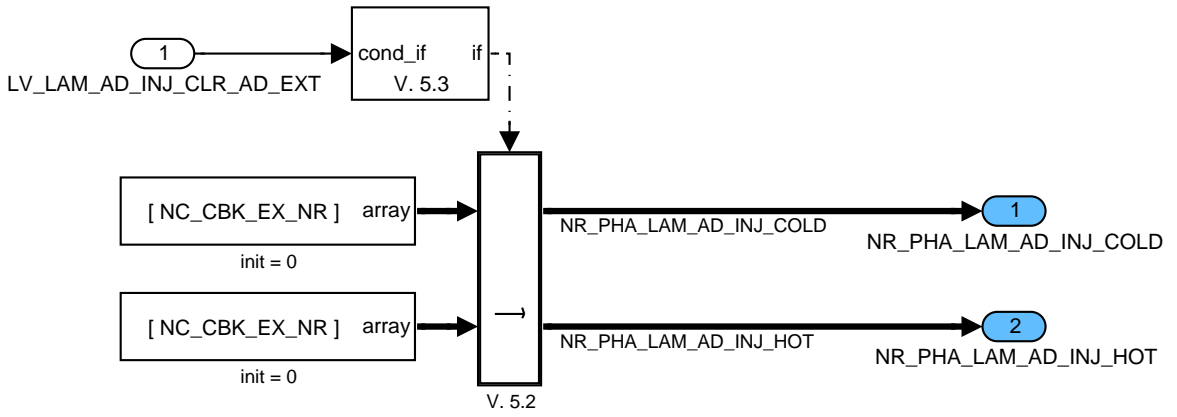


Figure 7.110.21: : Path: MFMA\_REQCOAIMM0/ES2ERU/CLC

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## 7.111 Lambda adaptation via injection mode (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_LAM_AD_INJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Lambda adaption via injection mode inhibition flag					

### Input data:

LV_ACT_DIAGCPS {p. 5926}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAM {p. 1505}
LV_ERR_CAM_DE_IVVT_EX [NC_NR_CBK_IVVT] {p. 800}	LV_ERR_CAM_DE_IVVT_IN [NC_NR_CBK_IVVT] {p. 800}	LV_ERR_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}	LV_ERR_CPS {p. 1001}
LV_ERR_CRK {p. 4455}	LV_ERR_CYL_BAL_LAM [NC_CYL_NR] {p. 5112}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}
LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FTL_MIN {p. 4762}	LV_ERR_FUP {p. 4717}
LV_ERR_FUP_EFP {p. 4733}	LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}
LV_ERR_IVVT {p. 1062}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_ERR_MAF {p. 4815}
LV_ERR_MAP {p. 982}	LV_ERR_MAP_DIP_SHIFT {p. 4824}	LV_ERR_MAP_PLAUS {p. 1062}	LV_ERR_MAP_TPS_PLAUS {p. 1062}
LV_ERR_MEC_OPEN_CPS {p. 1001}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}
LV_ERR_RATIO_CHK {p. 982}	LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TCO {p. 4496}
LV_ERR_TIA_IM {p. 984}	LV_ERR_TIA_THR {p. 984}	LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_TPS {p. 4982}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}
LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_TPS_ST_CHK_1 {p. 4951}
LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VCV {p. 4729}	LV_ERR_VCV_PLAUS {p. 6062}
LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_ERR_WG_DR [NC_CBK_EX_NR]	LV_LIH_ERR_CRK {p. 1505}	LV_MIS_STATE_B1 {p. 6238}

LV_MIS_STATE_B4 {p. 6238}	NC_CBK_EX_NR {p. 1829}	STATE_CAT_DIAG [NC_CBK_EX_NR] {p. 5474}	STATE_LS [NC_CBK_EX_NR] {p. 2448}
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**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_LAM_AD_INJ_INH	-	0... 1H	0 ...1	1	-
Manual inhibition of lambda adaptation via injection mode					

**General Information**

In the application incidence module the inhibition flag LV\_INH\_LAM\_AD\_INJ[i] for every exhaust cylinder bank is calculated.

**Application Conditions**

Initialization: RST, IGKON

Recurrence: 20MS

Activation: always

Deactivation: never

**Function description**

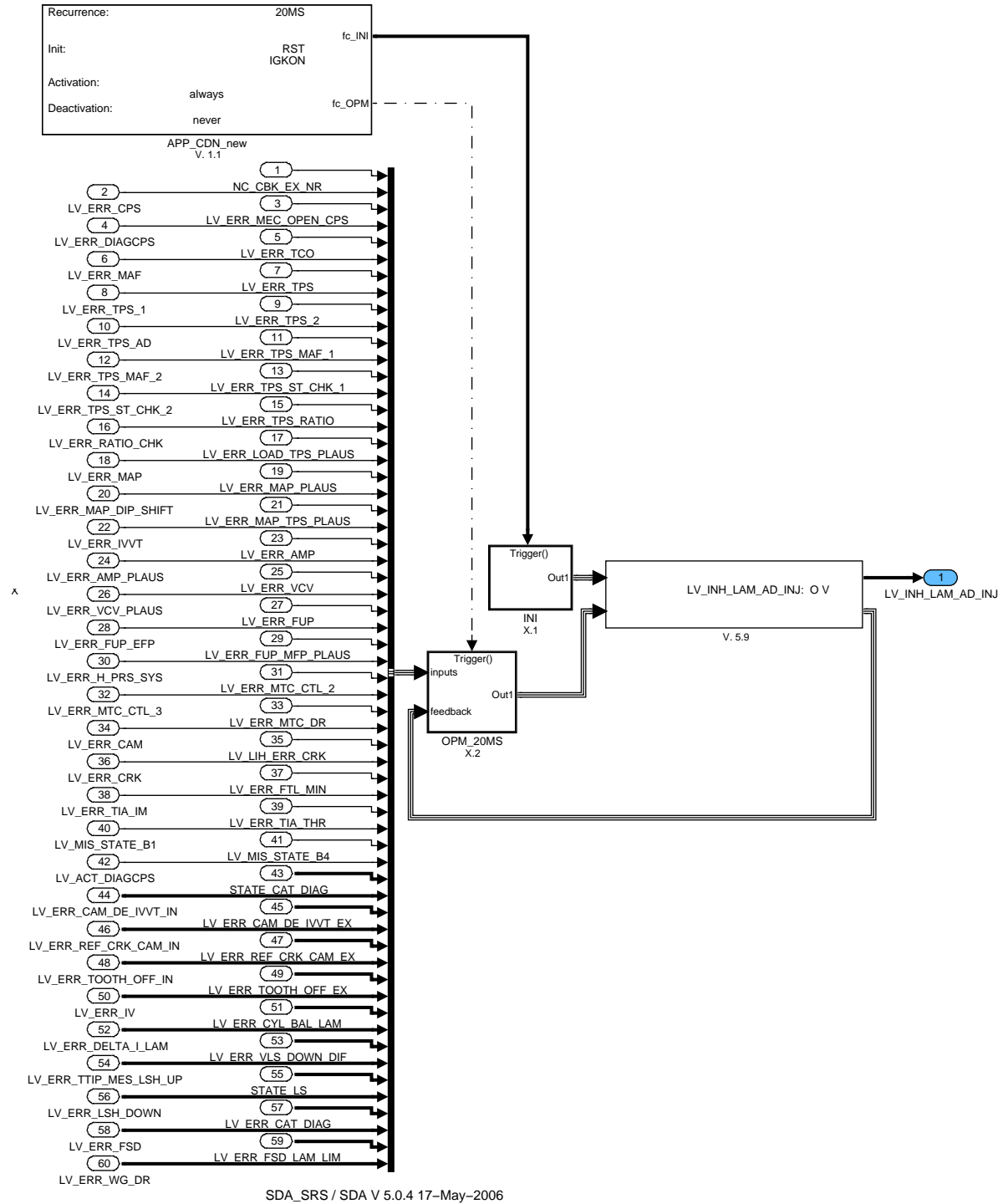


Figure 7.111.1: : Path: MFMA\_ISPCLAIMI0

### 7.111.1 Initialization

The inhibition flag is initialized at reset and at ignition key on.

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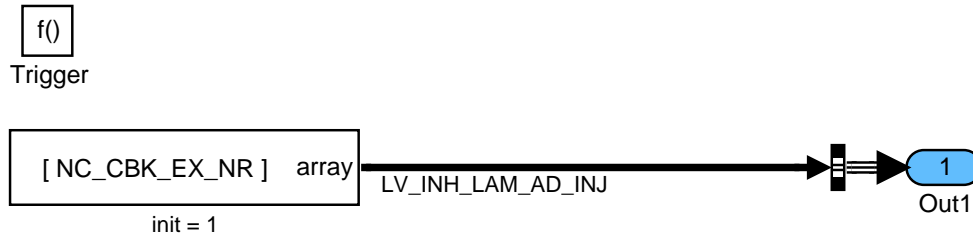



Figure 7.111.2: : Path: MFMA\_ISPCLAIMI0/INI

## 7.111.2 Inhibition conditions calculation

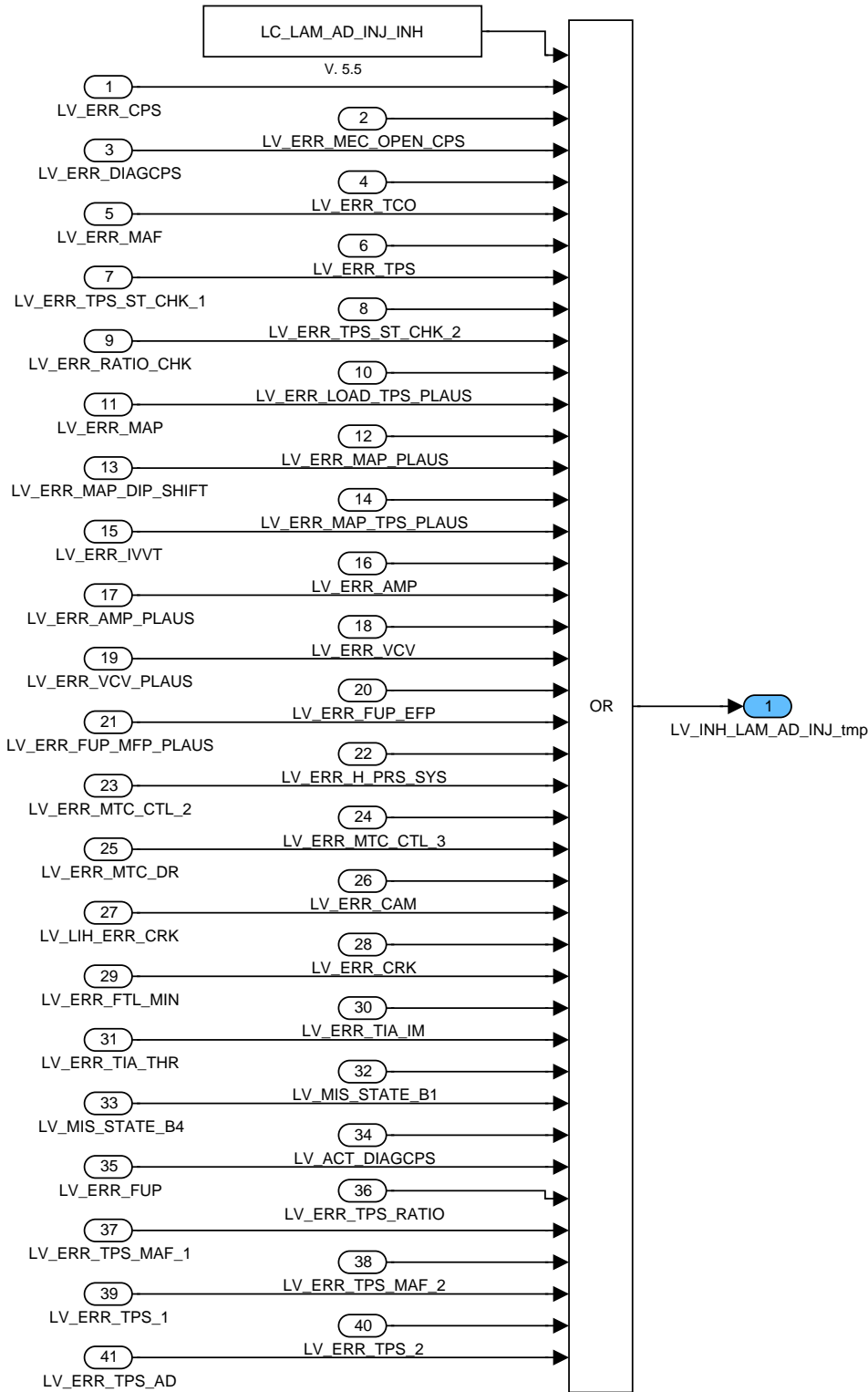
The inhibition conditions calculation is divided into two parts. The first part consists of conditions, which do not depend on a specific exhaust cylinder bank, and therefore any of the conditions will inhibit the adaptation of all banks. The second part consists only of conditions, which depend on a specific bank and will inhibit only the adaptation on the corresponding bank.

### 7.111.2.1 Bank independent conditions

The bank independent conditions are also split in two parts, where the first part uses all scalar conditions/ error flags and the second part uses the non-scalar (array) conditions.

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7.111.2.1.1 Scalar conditions



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Figure 7.111.3: : Path: MFMA\_ISPCLAIMI0/OPM\_20MS/BANK\_INDEP\_CLC/CLC\_1

### 7.111.2.1.2 Non-scalar conditions

In this block the all conditions whose dimension can be bigger than 1 are used for the calculation of the inhibition flag. The OR-blocks with only one input return true if at least one index of the array is set to 1.

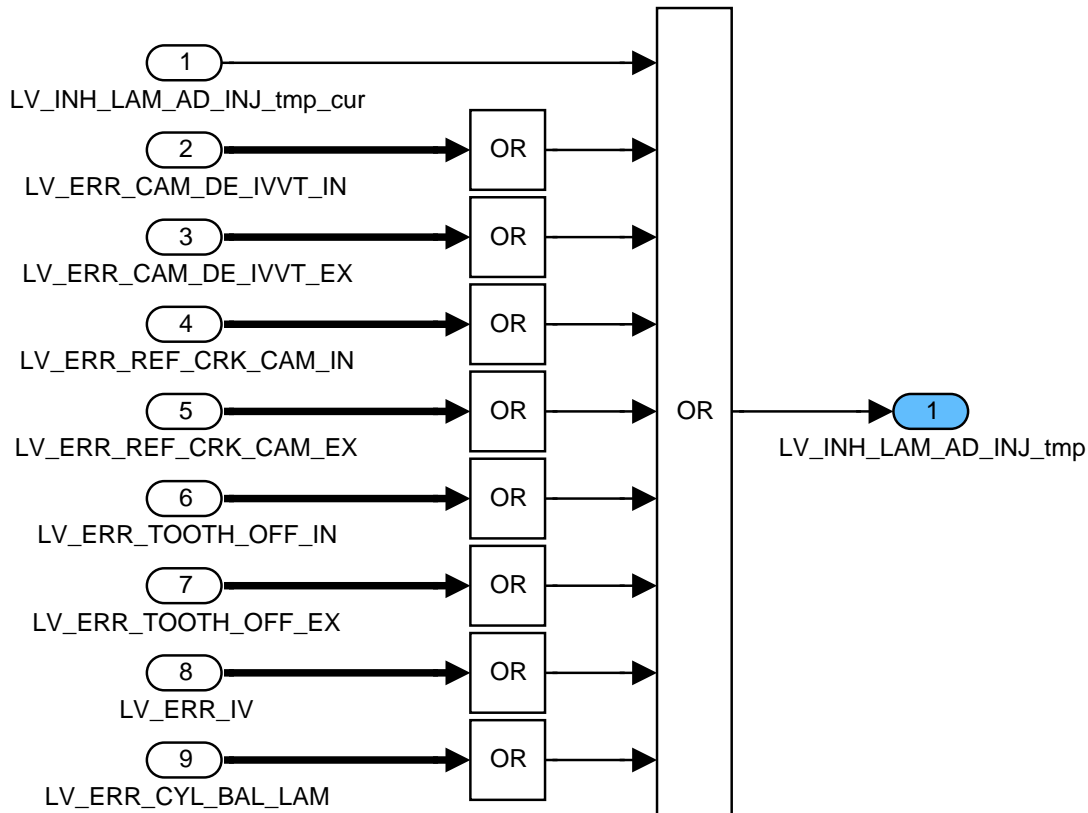


Figure 7.111.4: : Path: MFMA\_ISPCLAIMI0/OPM\_20MS/BANK\_INDEP\_CLC/CLC\_2

### 7.111.2.2 Bank specific calculations

The bank specific calculations are done for every exhaust cylinder bank (1...NC\_CBK\_EX\_NR). The index of the current cylinder bank is denoted with the suffix `_i` in the model whereas in the text square brackets are used (e.g. `LV_INH_LAM_AD_INJ[i]`).

#### 7.111.2.2.1 Bank selective inhibition conditions

If one of the bank selective conditions applies, only the adaptation of the corresponding bank is inhibited. If `LV_INH_LAM_AD_INJ_tmp` (bank independent condition) is set, both banks will be inhibited.

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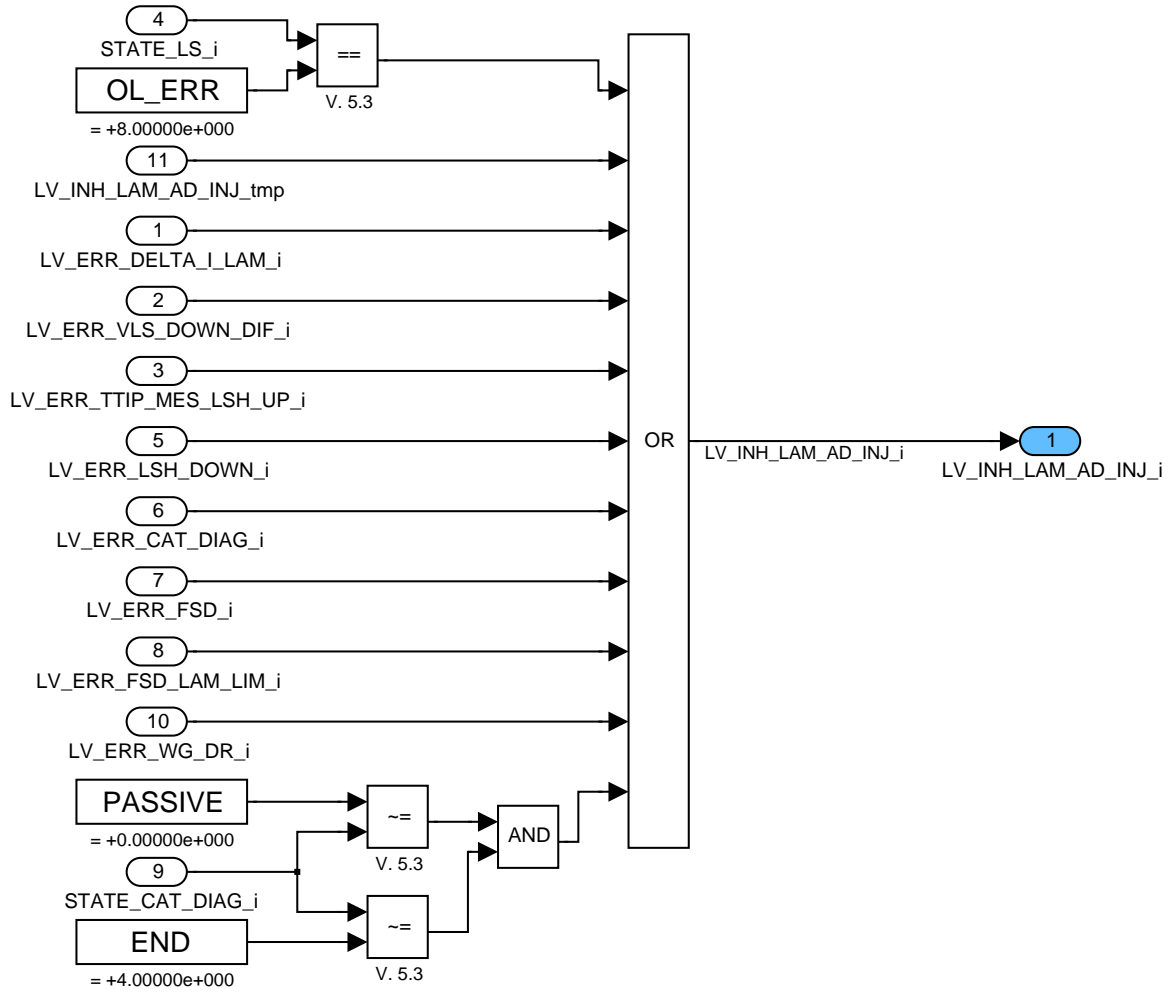


Figure 7.111.5: : Path: MFMA\_ISPCLAIMI0/OPM\_20MS/BANK\_SPECIFIC\_CLC/CLC


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## 7.112 Lambda adaptation via injection mode

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LAM_ADJ_LAM_AD_INJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Lambda controller difference between single injection and multiple injection					
FAC_LAM_MV_LAM_AD_INJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Lamda controller mean value for lambda adaptation via injection mode					
FAC_LAM_MV_MMV_LAM_AD_INJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Lamda controller moving mean value for lambda adaptation via injection mode					
FAC_LAM_MV_MPL_INJ_LAM_AD_INJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Lambda controller mean value at multiple injection					
FAC_LAM_MV_SNG_INJ_LAM_AD_INJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Lambda controller mean value at single injection					
LV_LAM_AD_INJ_MV_CLC_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Lambda mean value calculation for lambda adaptation via injection mode finished					
MAF_INT_LAM_AD_INJ [NC_CBK_EX_NR]	V	0... FFFFH	0... 1023.984375	0.015625	g
MAF integral for lambda adaptation via injection					
MFF_ADD_COLD_LAM_AD_INJ [NC_CYL_NR]	V/S	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
Additional fuel flow at cold condition for lambda adaptation via injection					
MFF_ADD_HOT_LAM_AD_INJ [NC_CYL_NR]	V/S	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
Additional fuel flow at hot condition for lambda adaptation via injection					
MFF_ADD_LAM_AD_INJ [NC_CYL_NR]	O/V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
Additional fuel mass correction for minimum injection					
MFF_ADD_MIS_COLD_LAM_AD_INJ [NC_CYL_NR]	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
Additional fuel mass in case of misfire for lower temperature adaption range					
MFF_ADD_MIS_HOT_LAM_AD_INJ [NC_CYL_NR]	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
Additional fuel mass in case of misfire for upper temperature adaption range					
MFF_DELTA_ADD_LAM_AD_INJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
Fuel mass difference for one injection pulse for multiple injection					
STATE_LAM_AD_INJ [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H	NOT_ACT TRA_PHA MV_CLC LAM_AD	-	-
Lambda adaptation via injection mode state					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_INT_LAM_AD_INJ [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Time integral for lambda adaptation via injection					
TQ_IS_SNG_INJ_LAM_AD_INJ	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Idle speed controller output for monitoring in lambda adaptation via injection mode					

**Input data:**

C_TEMP_MAX_LAM_AD_INJ_COLD {p. 3351}	C_TEMP_MIN_LAM_AD_INJ_HOT {p. 3351}	CTR_AD_COLD_LAM_AD_INJ {p. 3348}	CTR_AD_HOT_LAM_AD_INJ {p. 3348}
CTR_MIS_LAM_AD_INJ [NC_CBK_EX_NR] {p. 3348}	FAC_LAM_LIM [NC_CBK_EX_NR] {p. 2461}	LV_LAM_AD_INJ_ACT_COLD [NC_CBK_EX_NR] {p. 3348}	LV_LAM_AD_INJ_CLR_AD_EXT {p. 7483}
LV_LAM_AD_INJ_INTR {p. 3349}	LV_LAM_AD_INJ_INTR_2 [NC_CBK_EX_NR] {p. 3349}	LV_LAM_AD_INJ_INTR_LAM {p. 3349}	LV_MIS_LAM_AD_INJ [NC_CBK_EX_NR] {p. 3349}
LV_MPL_INJ_ACT [NC_CBK_EX_NR] {p. 3379}	LV_SNG_INJ_ACT [NC_CBK_EX_NR] {p. 3379}	MAF_CYL {p. 8277}	MFF_SP [NC_CBK_EX_NR] {p. 2151}
MFF_SP_1_HOM [NC_CYL_NR] {p. 8242}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_NR_MIS_REP_LAM_AD_INJ {p. 827}
NC_NR_MPL_INJ_LAM_AD_INJ {p. 827}	NR_CYL_LAM_AD_INJ [NC_CBK_EX_NR] {p. 3379}	STATE_IV_CHG {p. 7683}	TEMP_LAM_AD_INJ {p. 3349}
TQ_DIF_I_IS {p. 3441}	TQ_DIF_P_D_SLOW_IS {p. 3442}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FAC_LAM_MMV_LAM_AD_INJ	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlaton constant for lambda controller output moving mean value					
C_CRLC_FAC_LAM_MV_LAM_AD_INJ	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlaton constant for lambda controller output mean value					
C_CRLC_MFF_ADD_COLD_LAM_AD_INJ	-	0... 80H	0 ...1	7.8125e-3	-
Correlation constant for filterd cold adaptation value					
C_CRLC_MFF_ADD_HOT_LAM_AD_INJ	-	0... 80H	0 ...1	7.8125e-3	-
Correlation constant for filterd hot adaptation value					
C_CRLC_TQ_DIF_SLOW_LAM_AD_INJ	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlation constant for use of TQ_DIF_P_D_SLOW_IS in TQ_IS_SNG_INJ_LAM_AD_INJ calculation					
C_FAC_LAM_ADJ_MIN_LAM_AD_INJ	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Min. difference between lambda mean value at SNG and MPL inj. to update the adaptation value					
C_FAC_LAM_FIL_DIF_LAM_AD_INJ	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Threshold for difference of first and second filterd lambda value to detect lambda stabilization					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_MFF_COR_CYL_LAM_AD_INJ [NC_CYL_NR]	-	0... FFH	0... 3.984375	0.015625	-
Weighting factor for each cylinder to map adjust cylinder selective influence on lambda signal					
C_MAF_INT_MV_CLC_LAM_AD_INJ	-	0... FFFFH	0... 1023.984375	0.015625	g
Time integral threshold for mean value phase end					
C_MAF_INT_MV_CLC_LAM_AD_INJ_2	-	0... FFFFH	0... 1023.984375	0.015625	g
Time integral threshold for mean value phase end if LV_LAM_AD_INJ_EXT_ENA = 1					
C_MAF_INT_TRA_PHA_LAM_AD_INJ	-	0... FFFFH	0... 1023.984375	0.015625	g
MAF integral threshold for transient phase end					
C_MAF_INT_TRA_PHA_LAM_AD_INJ_2	-	0... FFFFH	0... 1023.984375	0.015625	g
MAF integral threshold for transient phase end if LV_LAM_AD_INJ_EXT_ENA = 1					
C_MFF_ADD_LAM_AD_MAX	-	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
Maximum limit for adaptation values for lambda adaptation via injection mode					
C_MFF_ADD_LAM_AD_MIN	-	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
Minimum limit for adaptation values for lambda adaptation via injection mode					
C_T_INT_MV_CLC_LAM_AD_INJ	-	0... FFFFH	0... 1310.7	0.02	s
Time integral threshold for mean value phase end					
C_T_INT_MV_CLC_LAM_AD_INJ_2	-	0... FFFFH	0... 1310.7	0.02	s
Time integral threshold for mean value phase end if LV_LAM_AD_INJ_EXT_ENA = 1					
C_T_INT_TRA_PHA_LAM_AD_INJ	-	0... FFFFH	0... 1310.7	0.02	s
Time integral threshold for transient phase end					
C_T_INT_TRA_PHA_LAM_AD_INJ_2	-	0... FFFFH	0... 1310.7	0.02	s
Time integral threshold for transient phase end if LV_LAM_AD_INJ_EXT_ENA = 1					
ID_CRLC_MFF_ADD_COLD_LAM_AD_INJ	-	0... 80H	0 ...1	7.8125e-3	-
LDP_CTR_NR_COLD_ID_CTR	4	0... FFH	0... 255	1	-
Correlation constant for filtered cold adaptation value					
ID_CRLC_MFF_ADD_HOT_LAM_AD_INJ	-	0... 80H	0 ...1	7.8125e-3	-
LDP_CTR_NR_HOT_ID_CTR	4	0... FFH	0... 255	1	-
Correlation constant for filtered hot adaptation value					
ID_MFF_DELTA_MIS_LAM_AD_INJ	S	0... FFFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
LDP_CTR_MIS_ID_MFF_LAM_AD_INJ	NC_ NR_ MIS_ REP_ LAM_ AD_ INJ	0... FFH	0... 255	1	-
Additional fuel mass in case of misfire for lambda adaption via injection mode					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_MFF_ADD_LAM_AD_INJ	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
LDP_MFF_IP_MFF_ADD_LAM_AD_INJ	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Normalization of the adaptation value to the reference fuel mass					
LC_MFF_ADD_LAM_AD_INJ_CLR	-	0... 1H	0 ...1	1	-
Switch to clear adaptation values of lambda adaptation via injection mode					
LC_MFF_CLC_ADD_LAM_COLD_ADD	-	0... 1H	0 ...1	1	-
Activation of MFF correction calculation by using the hot adapt. value for the whole range and the cold adapt. value as offset for the cold area					

### Import actions:

<b>ACTION_MFMA_GetEnableCondition</b> (OUT<PRM_LV_LAM_AD_INJ_EXT_ENA>)
--

### General Information

The adaptation of the additional fuel mass at minimum fuel mass injection is divided in a time slice with single injection and with multiple injections. At the beginning of each phase a certain time is waited in a transient phase for system stabilization. In a second phase the lambda mean value is calculated. At the end of the phase with multiple injections, the additional fuel at minimum injection is calculated from the lambda controller output difference of the single and multiple injection phase.

### Application Conditions

Initialization: RST, IGKON, NVMRES, NVMSTO, NVMINI

Activation: 20MS: always

1S: always

ES2ERU: always

Deactivation: never

### Function description



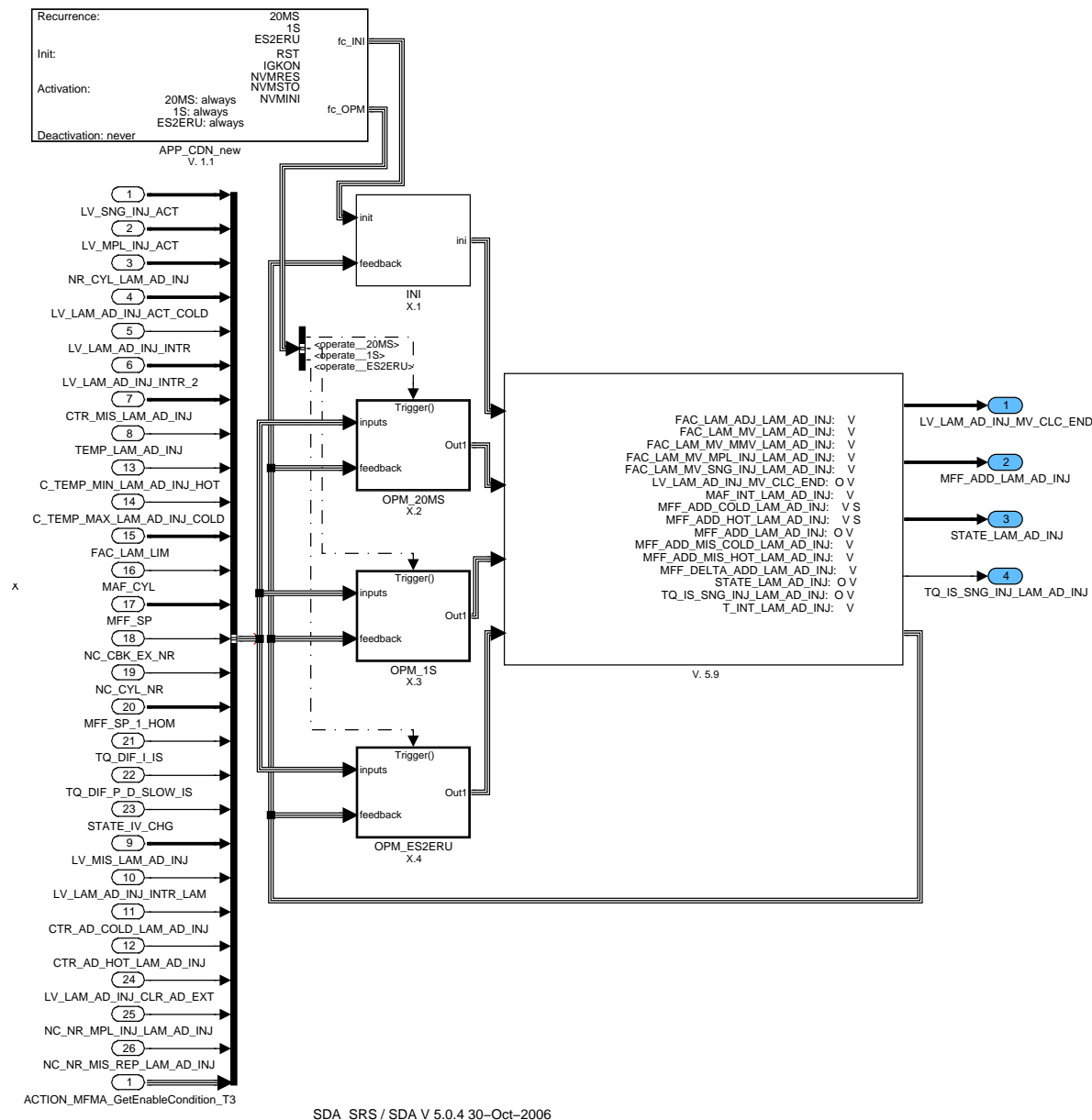
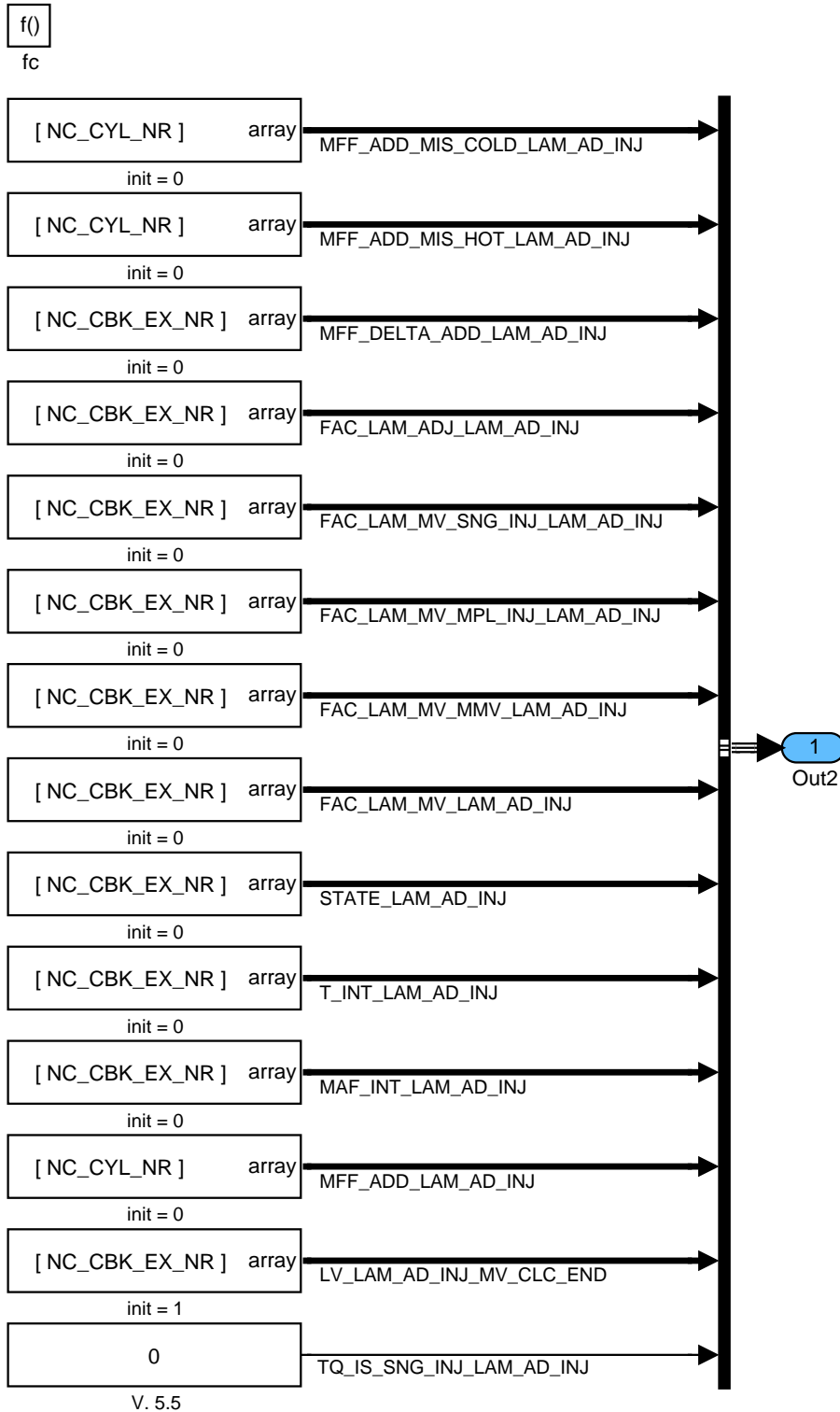


Figure 7.112.1: Path: MFMA\_ISPCLAIM0

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## 7.112.1 Initialization and NVMY management

### 7.112.1.1 Initialization at RST and IGKON



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Figure 7.112.2: : Path: MFMA\_ISPCLAIM0/INI/RST\_IGKON

### 7.112.1.2 Initialization and reading of NVMY values

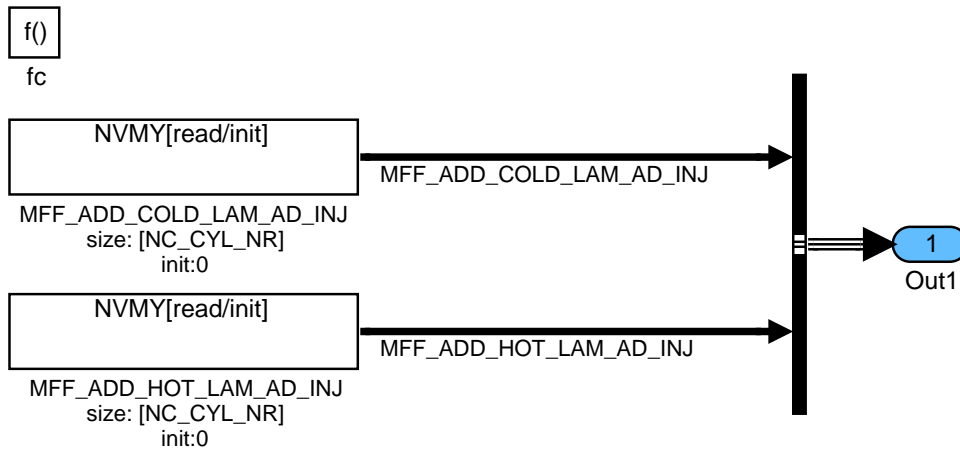


Figure 7.112.3: : Path: MFMA\_ISPCLAIM0/INI/NVMINI\_NVMRES

### 7.112.1.3 Writing of the NVMY values

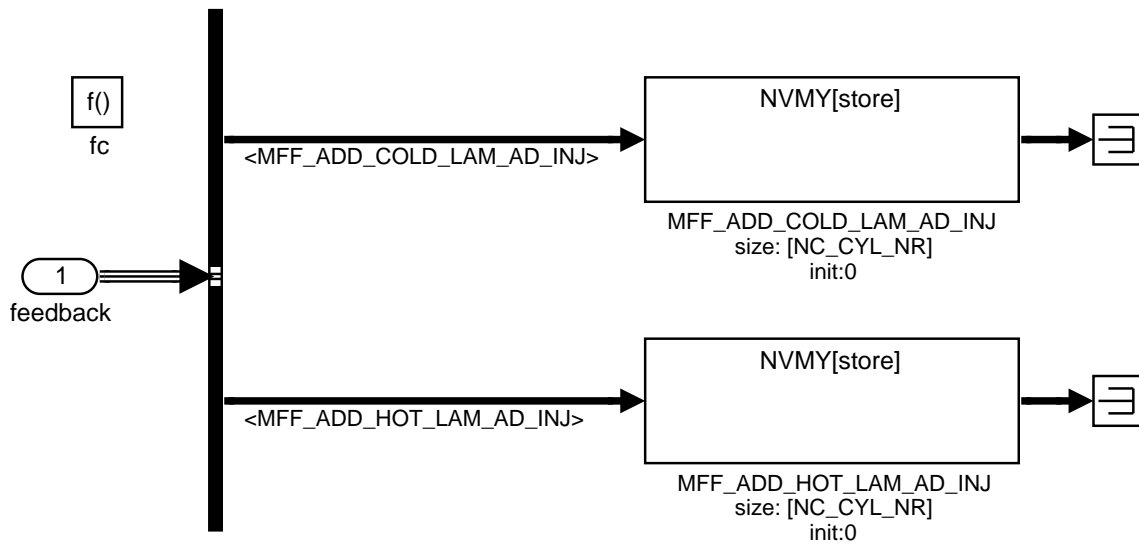


Figure 7.112.4: : Path: MFMA\_ISPCLAIM0/INI/NVMSTO

## 7.112.2 20ms operations

All calculations are done for each exhaust cylinder bank, where the bank specific values are denoted within the graphical model with the suffix *\_i*, in the textual description they are referenced via [i].

### 7.112.2.1 State machine and general calculations

Calculation of state transitions, state actions and general calculations.

### 7.112.2.1.1 State transitions

#### 7.112.2.1.1.1 State selection

##### 7.112.2.1.1.1.1 NOT\_ACT

If the next adaptation cycle starts (either with single or multiple injections), the state is left towards TRA\_PHA.

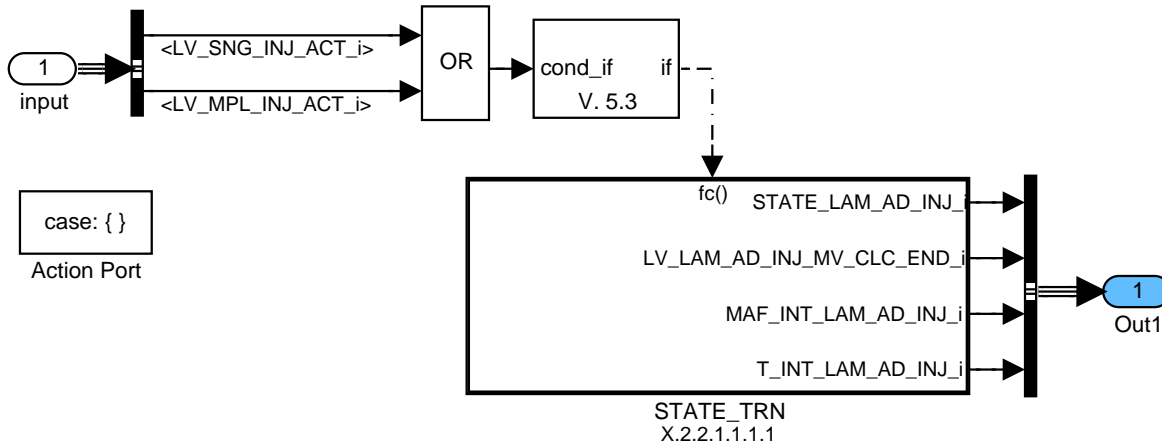


Figure 7.112.5: : Path: MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_TRANSITION/CLC/NOT\_ACT

##### 7.112.2.1.1.1.1.1 Transition to TRA\_PHA

On the transition to TRA\_PHA the MAF and time integrals are set to 0 and furthermore the end flag used in the manager module is reset.

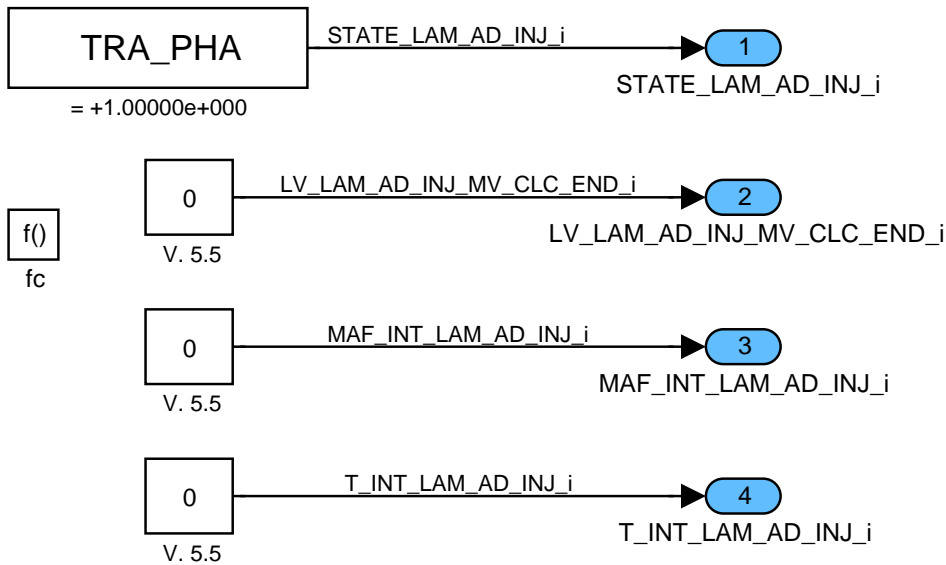


Figure 7.112.6: : Path: MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_TRANSITION/CLC/NOT\_ACT/STATE\_TRN

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### 7.112.2.1.1.2 TRA\_PHA

The state TRA\_PHA is usually left towards MV\_CLC, but if the adaptation is interrupted, the state will change back to NOT\_ACT.

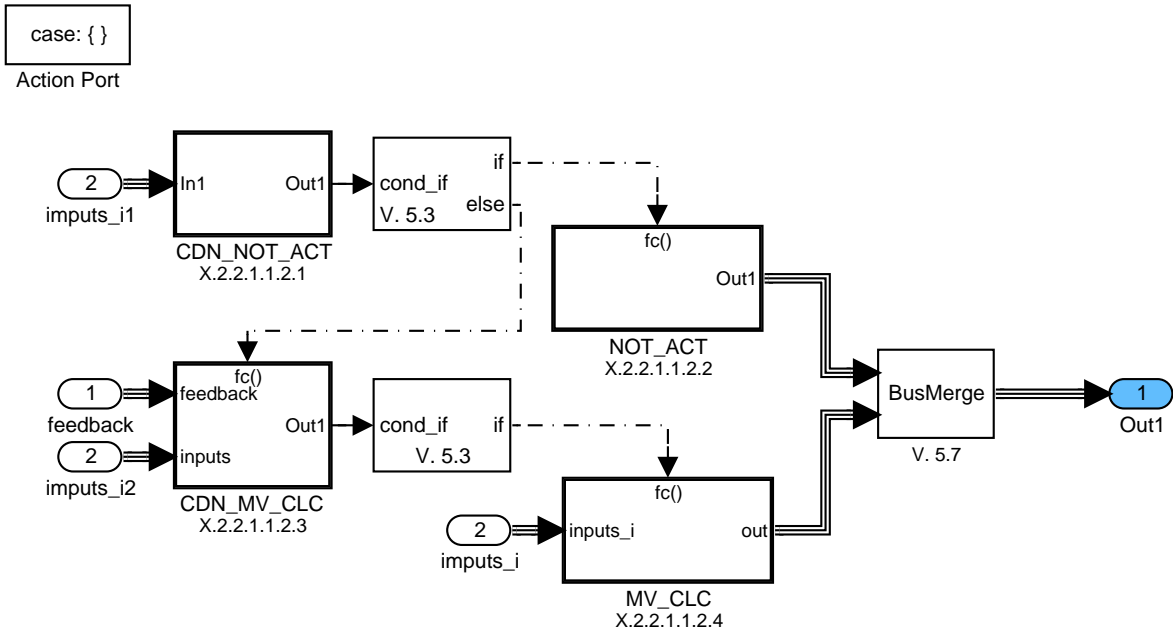


Figure 7.112.7: : Path: MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_TRANSITION/CLC/TRA\_PHA

#### 7.112.2.1.1.2.1 Conditions for NOT\_ACT

If none of the flags LV\_SNG/MPL\_INJ\_ACT is set, the state is left towards NOT\_ACT.

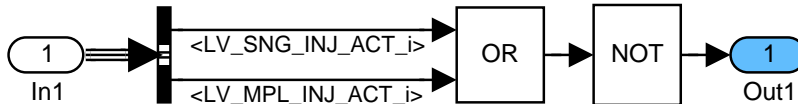


Figure 7.112.8: : Path: MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_TRANSITION/CLC/TRA\_PHA/CDN\_NOT\_ACT

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### 7.112.2.1.1.1.2.2 Transition to NOT\_ACT

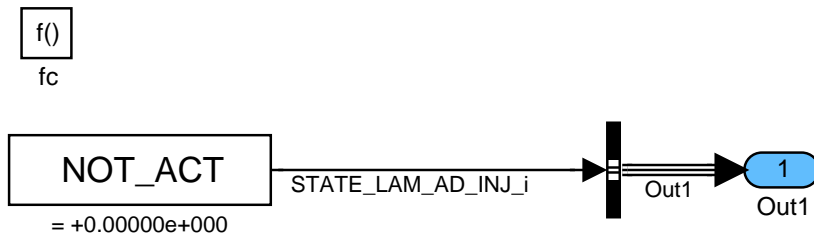


Figure 7.112.9: : Path:  
MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_TRANSITION/CLC/TRA\_PHA/NOT\_ACT

### 7.112.2.1.1.1.2.3 Conditions for MV\_CLC

If the MAF and time integrals have reached a threshold and if the lambda controller output has stabilized, the state is left towards MV\_CLC. Furthermore this transition is done if misfire is detected or the lambda controller had reached its limitations.

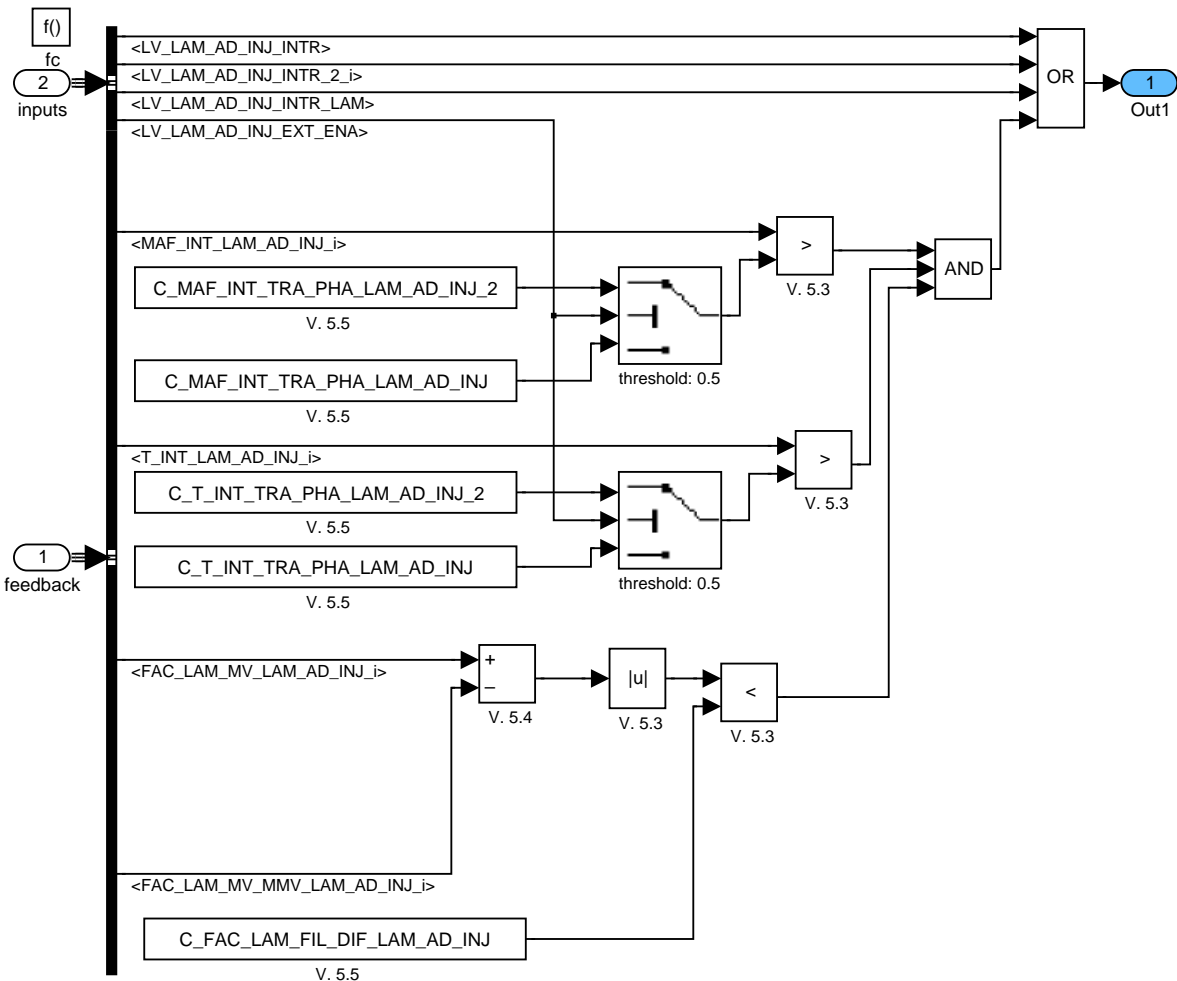



Figure 7.112.10: : Path:  
MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_TRANSITION/CLC/TRA\_PHA/CDN\_MV\_CLC

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### 7.112.2.1.1.1.2.4 Transition to MV\_CLC

On transition to MV\_CLC the MAF and time integrals are reset.

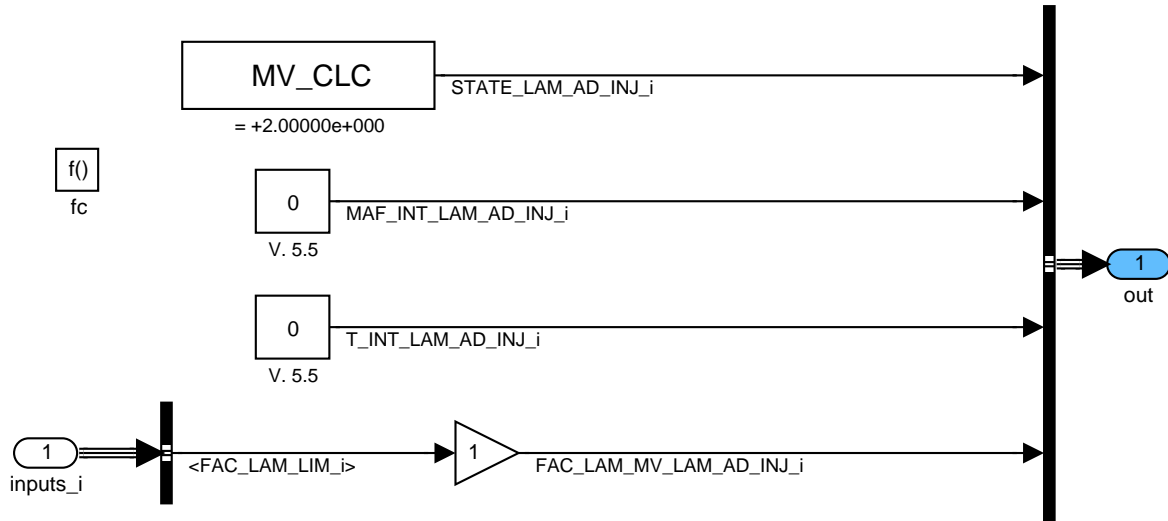


Figure 7.112.11: : Path:  
 MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_TRANSITION/CLC/TRA\_PHA/MV\_CLC

### 7.112.2.1.1.1.3 MV\_CLC

The state MV\_CLC is usually left towards NOT\_ACT after a single injection adaptation phase or due to interruption, and towards LAM\_AD after a multiple injection adaptation phase.

#### 7.112.2.1.1.1.3.1 Interruption of the mean-value calculation

If neither single nor multiple injection adaptation is allowed anymore, the state is left towards NOT\_ACT.

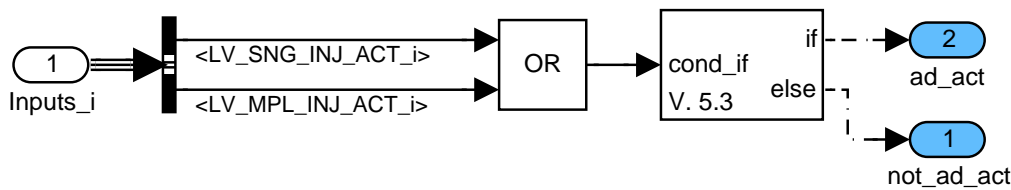


Figure 7.112.12: : Path:  
 MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_TRANSITION/CLC/MV\_CLC/CDN\_AD\_ACT

#### 7.112.2.1.1.1.3.2 Conditions for normal end of MV\_CLC

If the MAF and time integrals reach a threshold, the state is left to NOT\_ACT after single injections and to LAM\_AD after multiple injections. If misfire is detected or the lambda controller had reached its limitations, the state is also left immediately.

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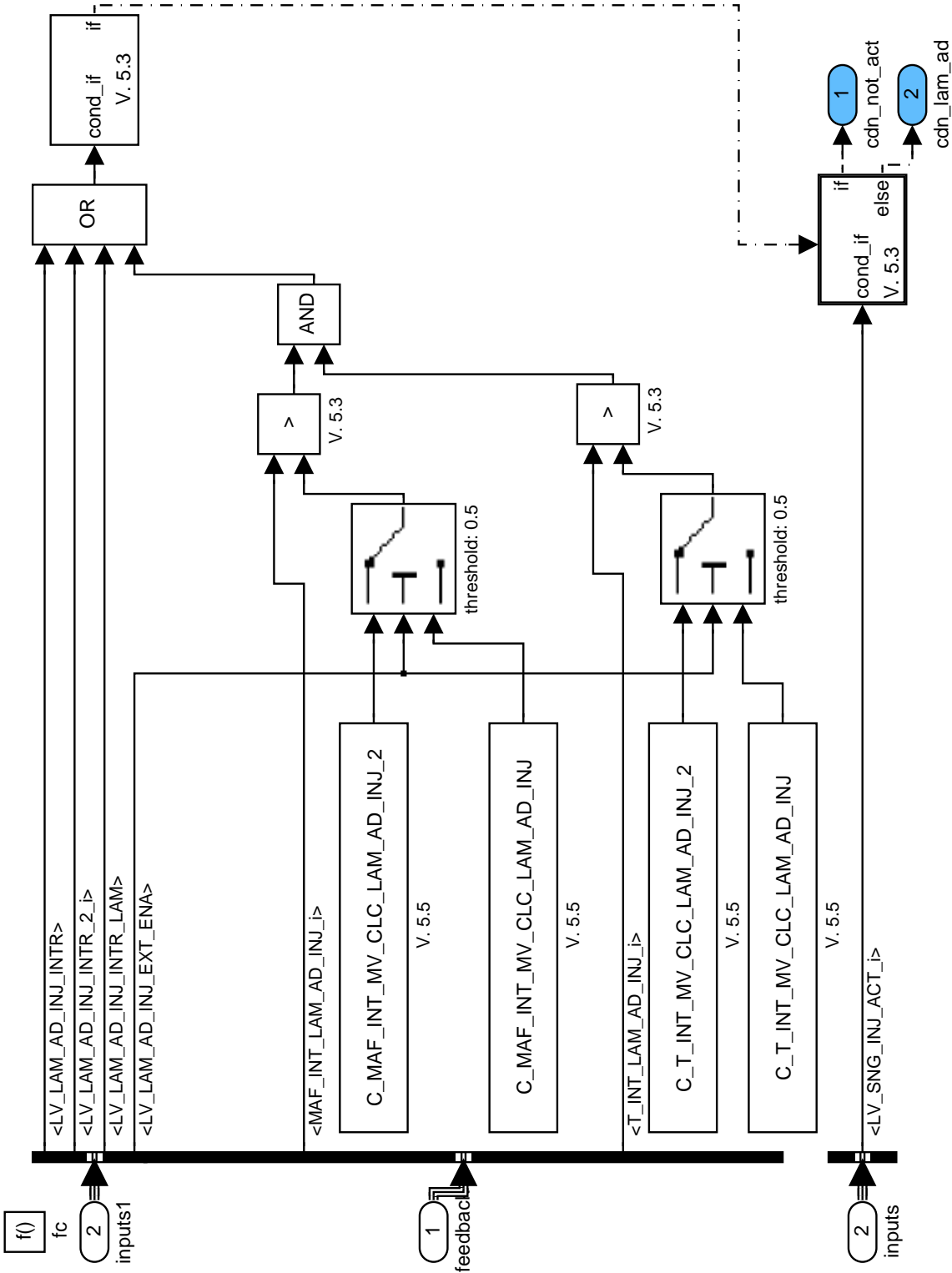



Figure 7.112.13: : Path: MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_TRANSITION/CLC/MV\_CLC/CDN\_INT\_MAX

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### 7.112.2.1.1.1.3.3 Transition to NOT\_ACT due to interruption

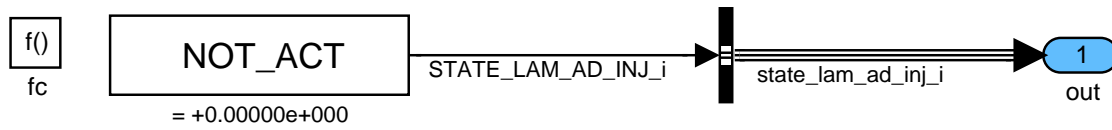


Figure 7.112.14: : Path:  
MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_TRANSITION/CLC/MV\_CLC/NOT\_ACT\_1

### 7.112.2.1.1.1.3.4 Transition to NOT\_ACT due to normal ending

#### 7.112.2.1.1.1.3.4.1 Memorization of lambda and engine speed controller outputs

The lambda and engine speed controller outputs are memorized for comparison after/in the multiple injection adaptation phases.

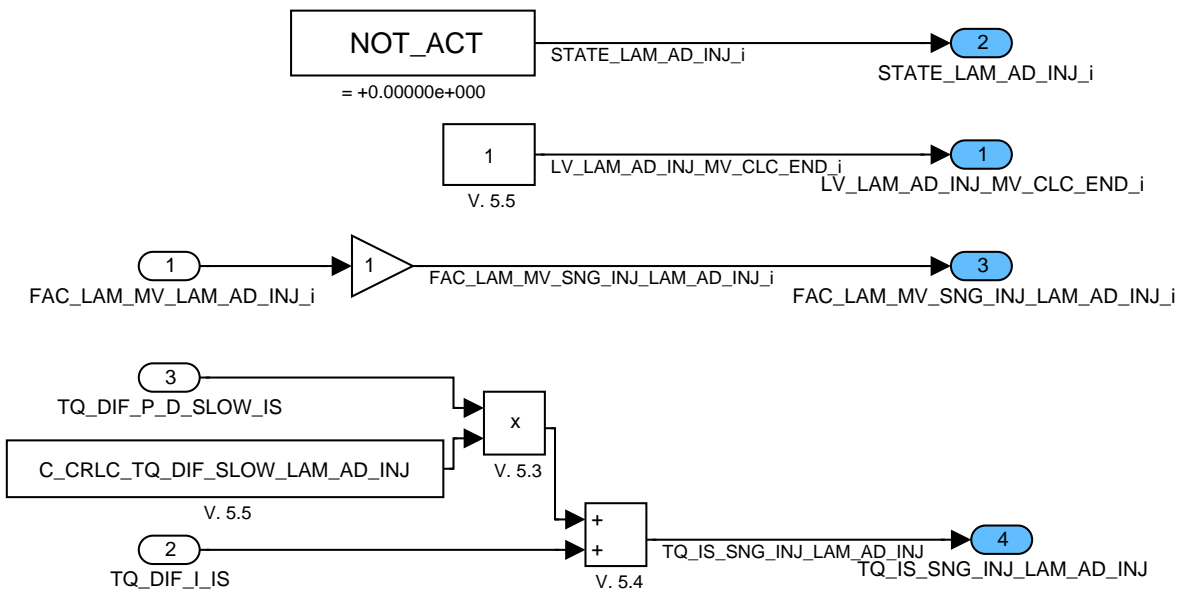


Figure 7.112.15: : Path:  
MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_TRANSITION/CLC/MV\_CLC/NOT\_ACT\_2/CLC

### 7.112.2.1.1.1.3.5 Transition to LAM\_AD

#### 7.112.2.1.1.1.3.5.1 Calculation of FAC\_LAM\_MV\_MPL\_INJ\_LAM\_AD\_INJ[i]

The lambda controller output (mean value) of the multiple injection phase is stored.

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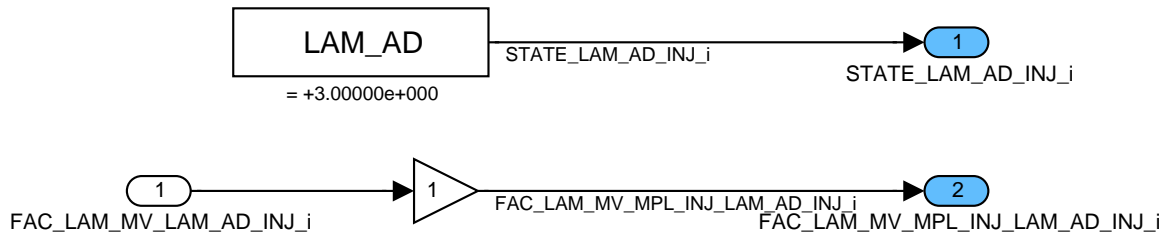


Figure 7.112.16: : Path:  
MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_TRANSITION/CLC/MV\_CLC/LAM\_AD/CLC

#### 7.112.2.1.1.1.4 LAM\_AD

The state LAM\_AD is left immediately towards NO\_ACT after the adaptation value has be calculated.

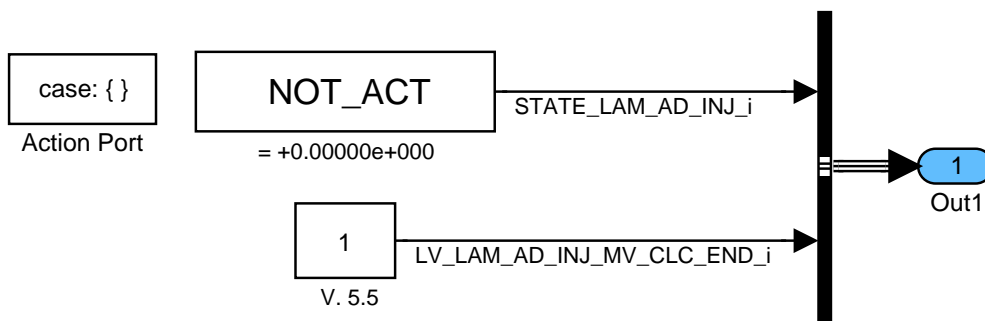


Figure 7.112.17: : Path: MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_TRANSITION/CLC/LAM\_AD

#### 7.112.2.1.2 State actions

##### 7.112.2.1.2.1 State selection

##### 7.112.2.1.2.1.1 TRA\_PHA

##### 7.112.2.1.2.1.1.1 MAF and time integral calculation

During the state TRA\_PHA the MAF and time integrals are calculated.

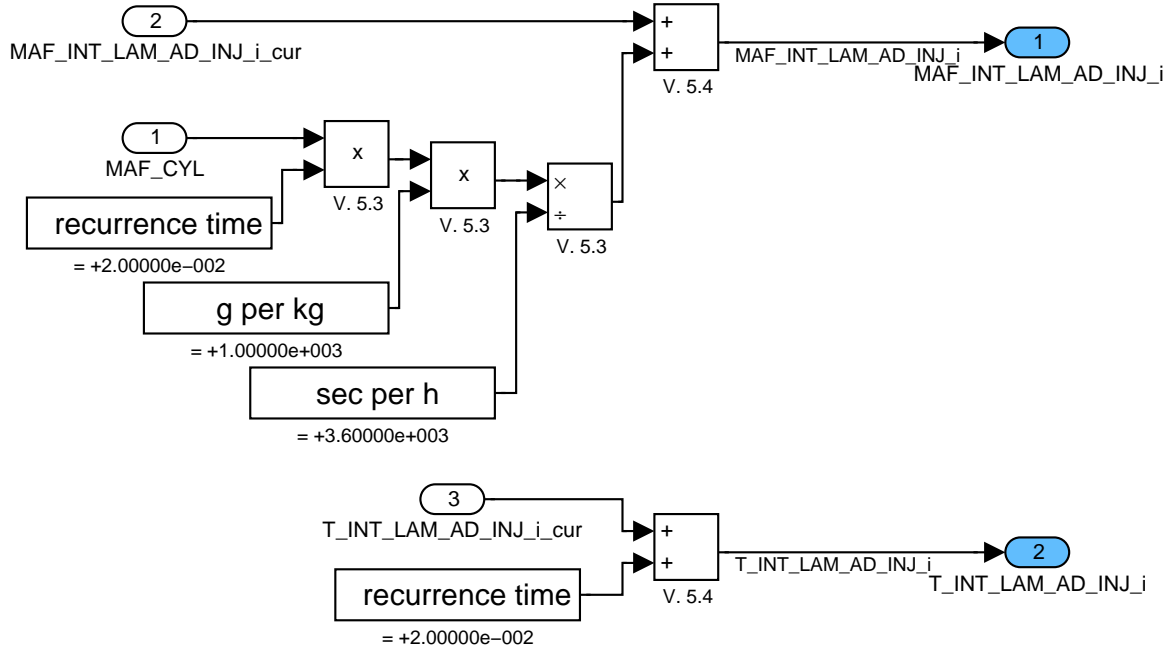


Figure 7.112.18: : Path: MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_ACTION/CLC/TRA\_PHA/CLC

### 7.112.2.1.2.1.2 MV\_CLC

#### 7.112.2.1.2.1.2.1 MAF and time integral calculation

During the state MV\_CLC the MAF and time integrals are calculated.

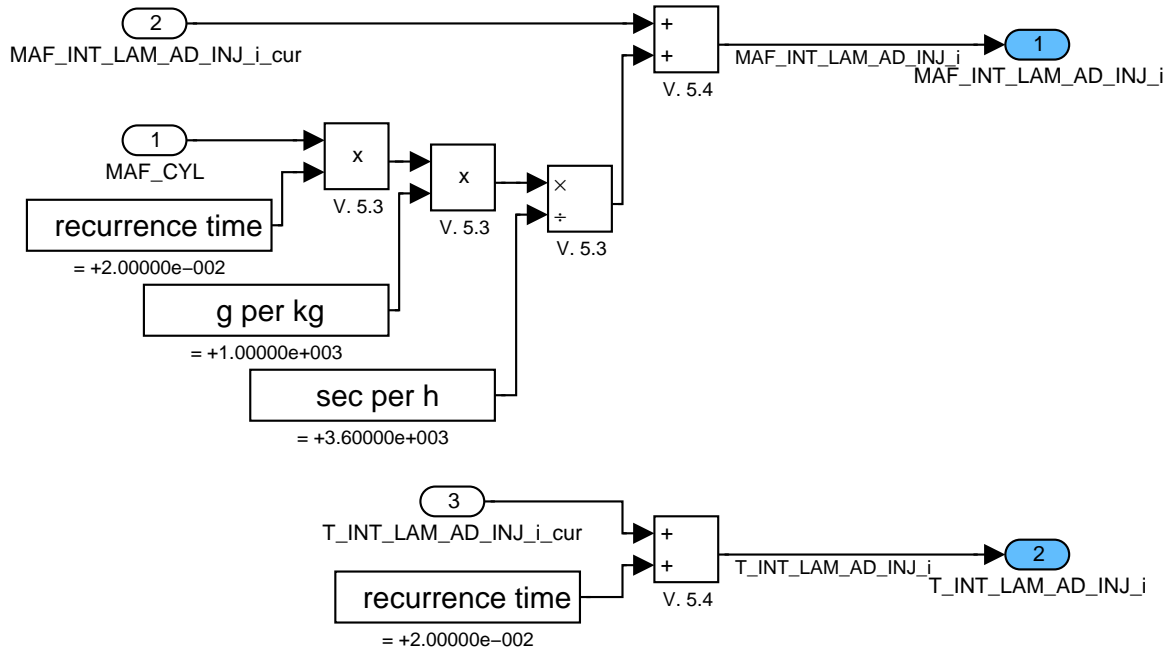


Figure 7.112.19: : Path: MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_ACTION/CLC/MV\_CLC/CLC

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### 7.112.2.1.2.1.3 LAM\_AD

During the state LAM\_AD the lambda controller output difference and the corresponding fuel mass caused by multiple injections are calculated and then stored in the adaptation values of the active temperature range.

#### 7.112.2.1.2.1.3.1 Lambda controller difference and fuel mass calculation

##### 7.112.2.1.2.1.3.1.1 Calculation of FAC\_LAM and MFF\_DELTA

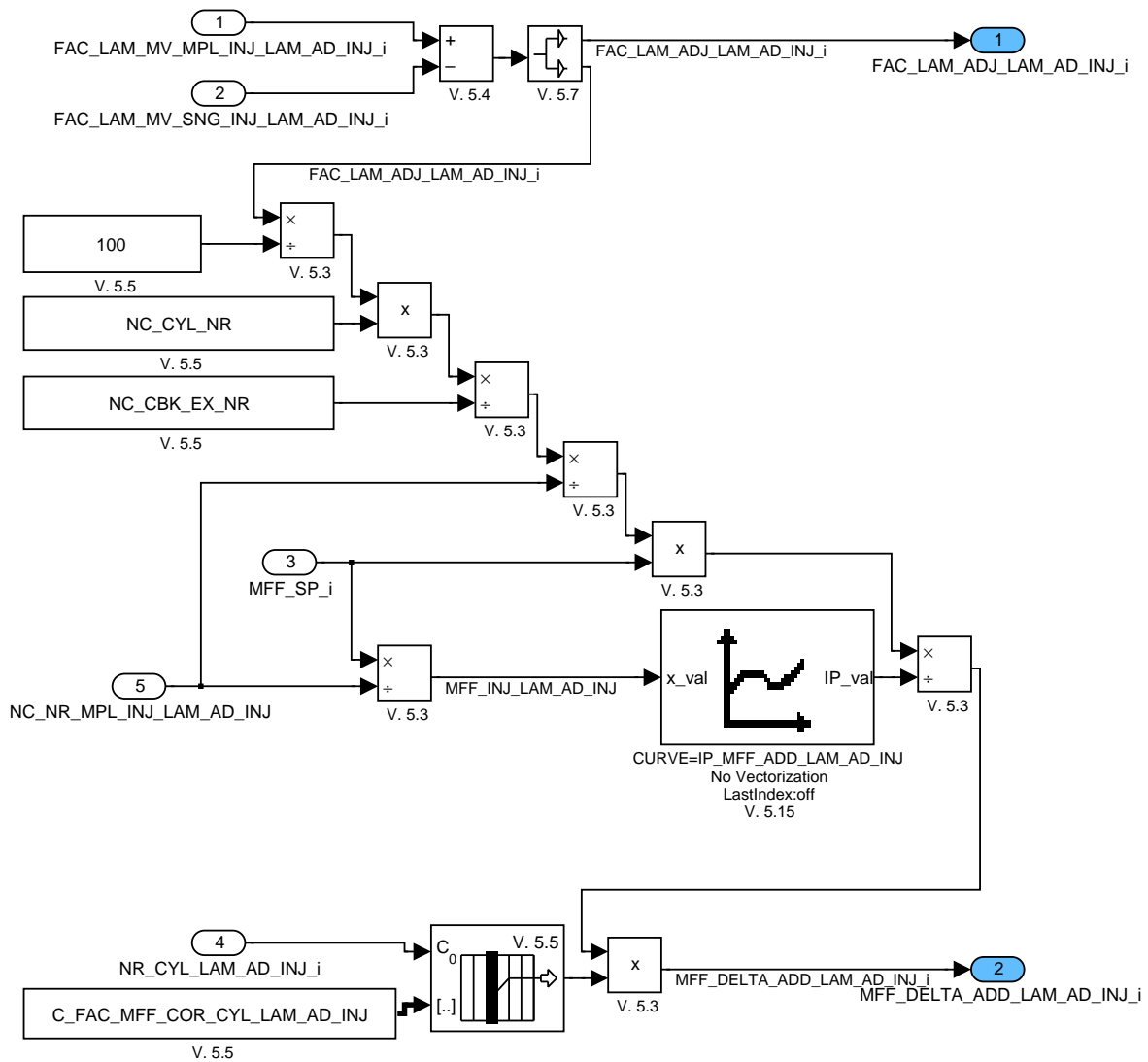


Figure 7.112.20: : Path: MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_ACTION/CLC/LAM\_AD/CLC\_MFF\_DELTA/CLC

#### 7.112.2.1.2.1.3.2 Lower temperature range

If the lower temperature range is active, the adaptation values are written to the corresponding variables.

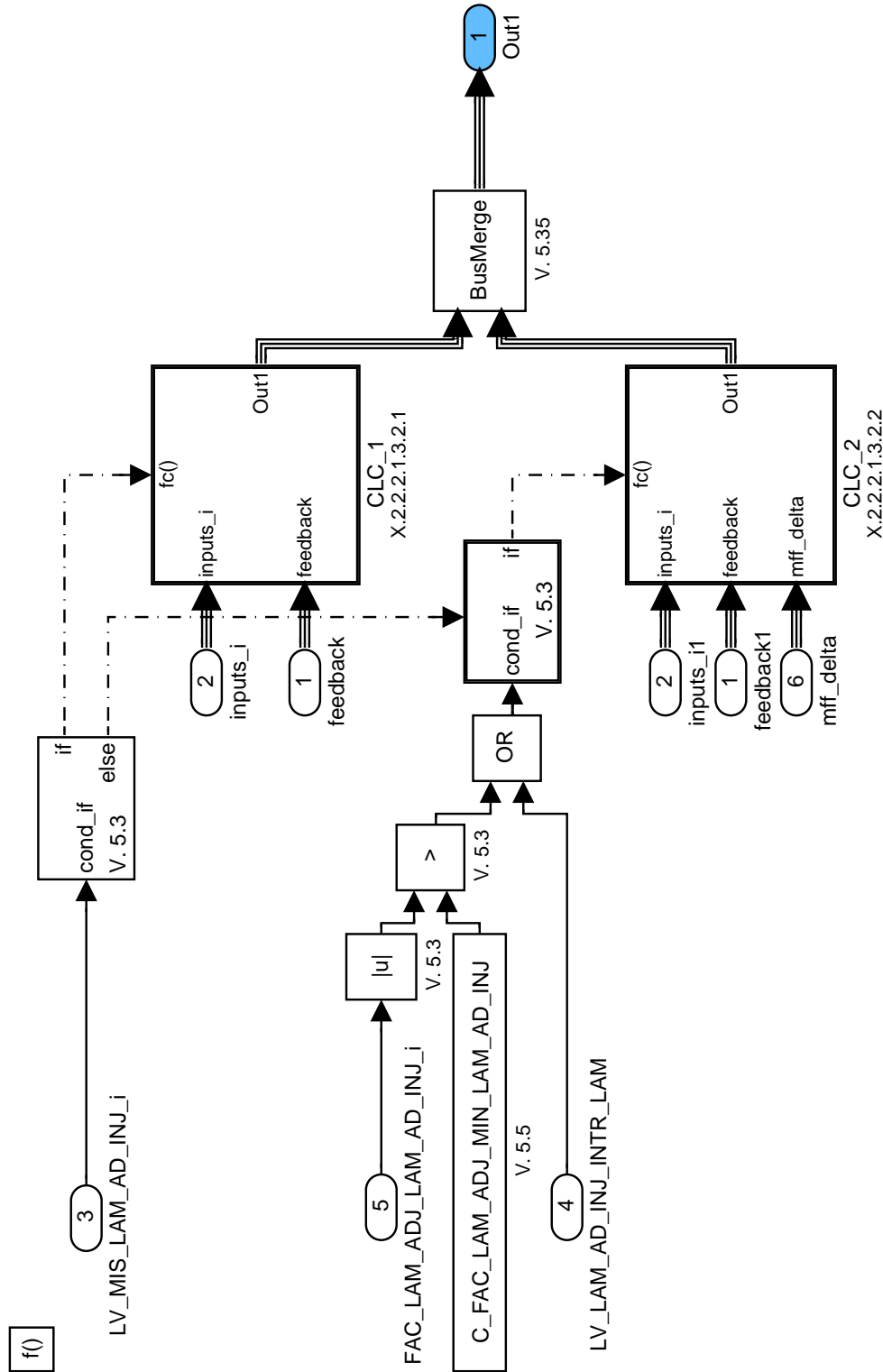



Figure 7.112.21: : Path:  
MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_ACTION/CLC/LAM\_AD/CLC\_COLD

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### 7.112.2.1.2.1.3.2.1 Correction of adaptation values in case of misfire

#### 7.112.2.1.2.1.3.2.1.1 Determination of corrective fuel mass for misfire

In case misfire was detected on the active cylinder during multiple injections, an additional fuel mass is determined from the map ID\_MFF\_DELTA\_MIS\_LAM\_AD\_INJ.

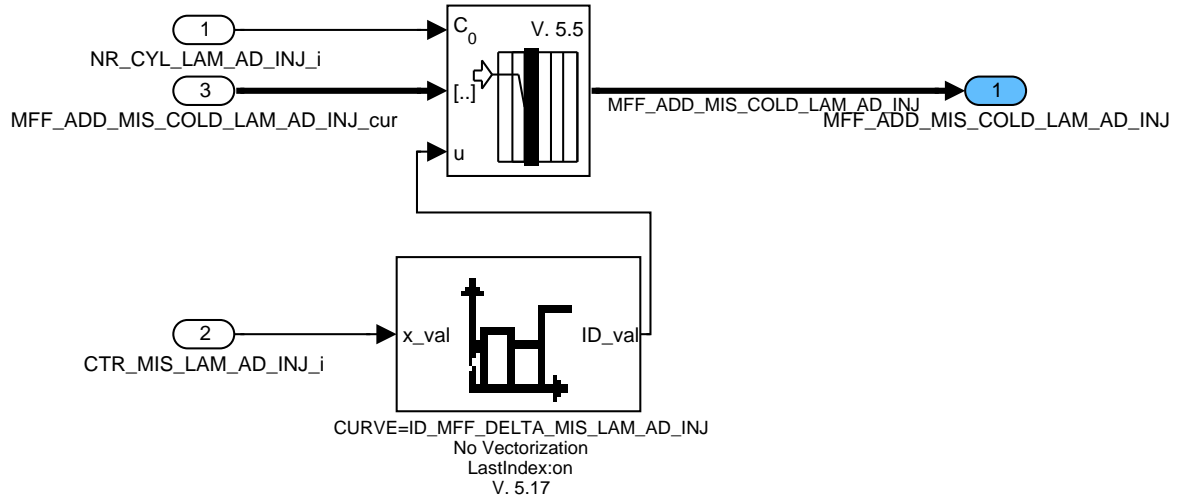


Figure 7.112.22: : Path:  
MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_ACTION/CLC/LAM\_AD/CLC\_COLD/CLC\_1/CLC

### 7.112.2.1.2.1.3.2.2 Calculation of the adaptation value

#### 7.112.2.1.2.1.3.2.2.1 Calculation of MFF\_ADD\_COLD\_LAM\_AD\_INJ

The adaptation value is determined from its old value and the actual calculated difference using the correlation factor C\_CRLC\_MFF\_ADD\_COLD\_LAM\_AD\_INJ. Afterwards the additional misfire fuel mass is reset to 0.

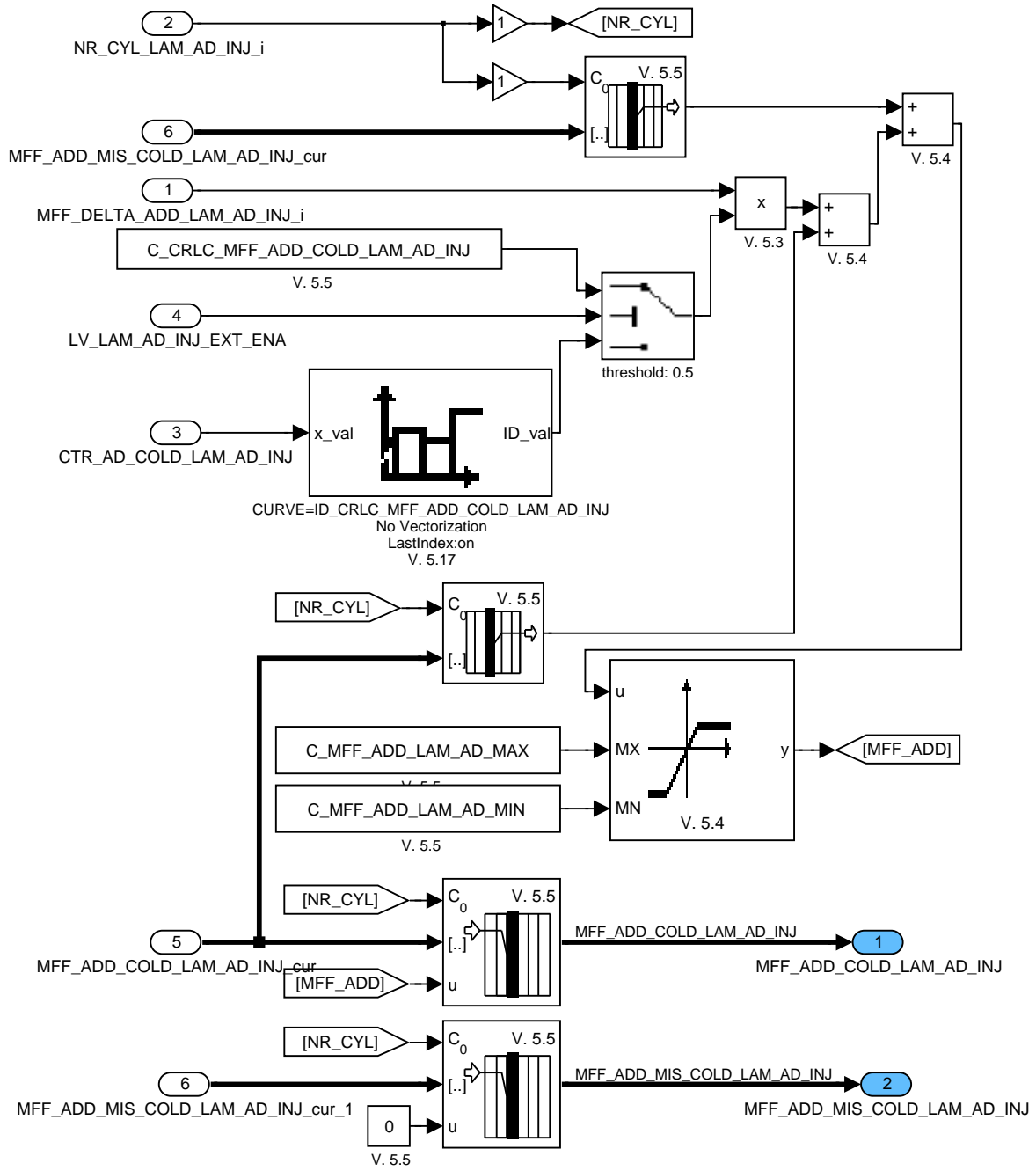
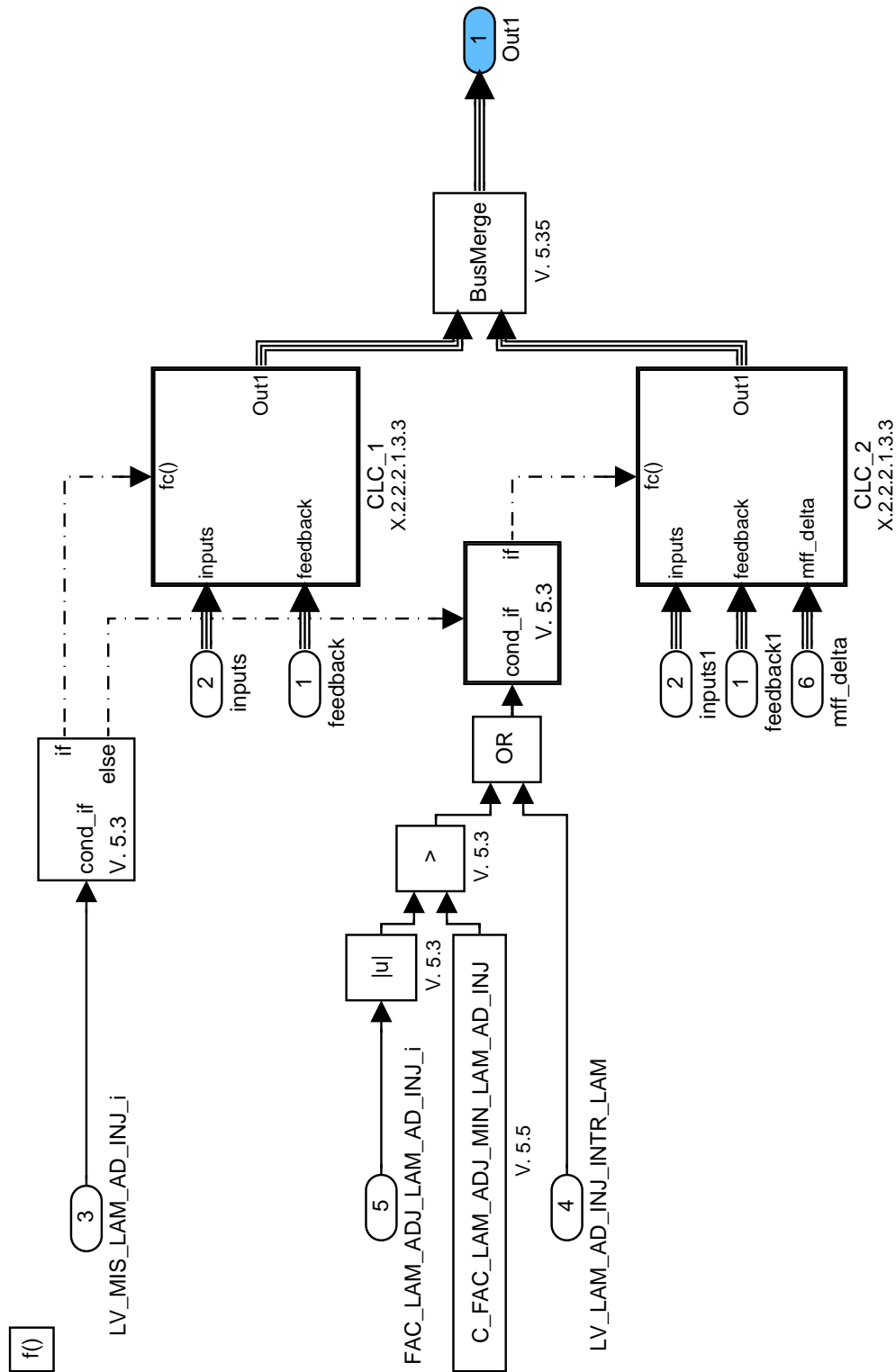


Figure 7.112.23: : Path:  
MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_ACTION/CLC/LAM\_AD/CLC\_COLD/CLC\_2/CLC

### 7.112.2.1.2.1.3.3 Upper temperature range


If the upper temperature range is active, the adaptation values are written to the corresponding variables.

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Figure 7.112.24: : Path:  
MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_ACTION/CLC/LAM\_AD/CLC\_HOT

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### 7.112.2.1.2.1.3.3.1 Correction of adaptation values in case of misfire

#### 7.112.2.1.2.1.3.3.1.1 Determination of corrective fuel mass for misfire

In case misfire was detected on the active cylinder during multiple injections, an additional fuel mass is determined from the map ID\_MFF\_DELTA\_MIS\_LAM\_AD\_INJ.

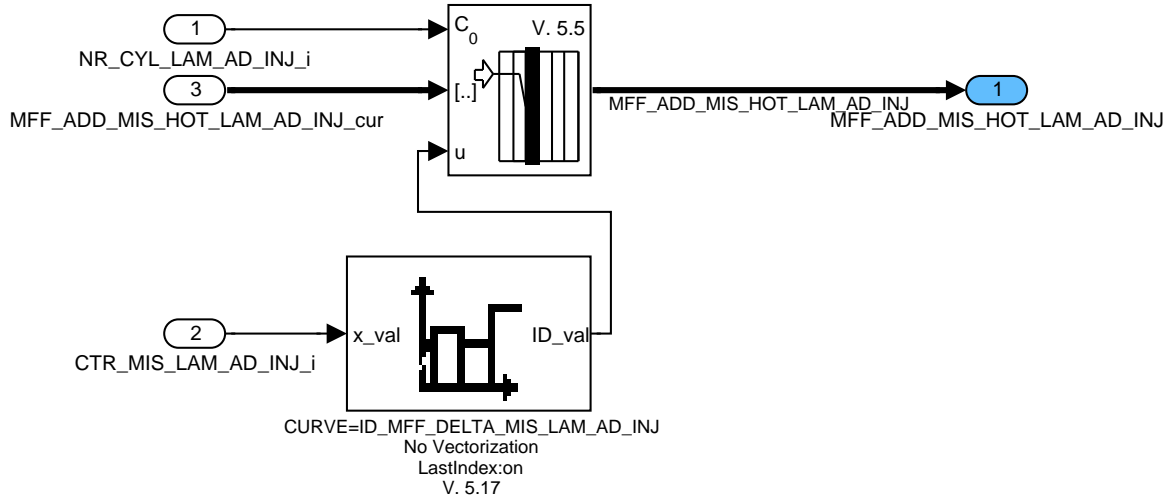


Figure 7.112.25: : Path:  
MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_ACTION/CLC/LAM\_AD/CLC\_HOT/CLC\_1/CLC

### 7.112.2.1.2.1.3.3.2 Calculation of the adaptation value

#### 7.112.2.1.2.1.3.3.2.1 Calculation of MFF\_ADD\_HOT\_LAM\_AD\_INJ

The adaptation value is determined from its old value and the actual calculated difference using the correlation factor  $C\_CRLC\_MFF\_ADD\_HOT\_LAM\_AD\_INJ$ . Afterwards the additional misfire fuel mass is reset to 0.

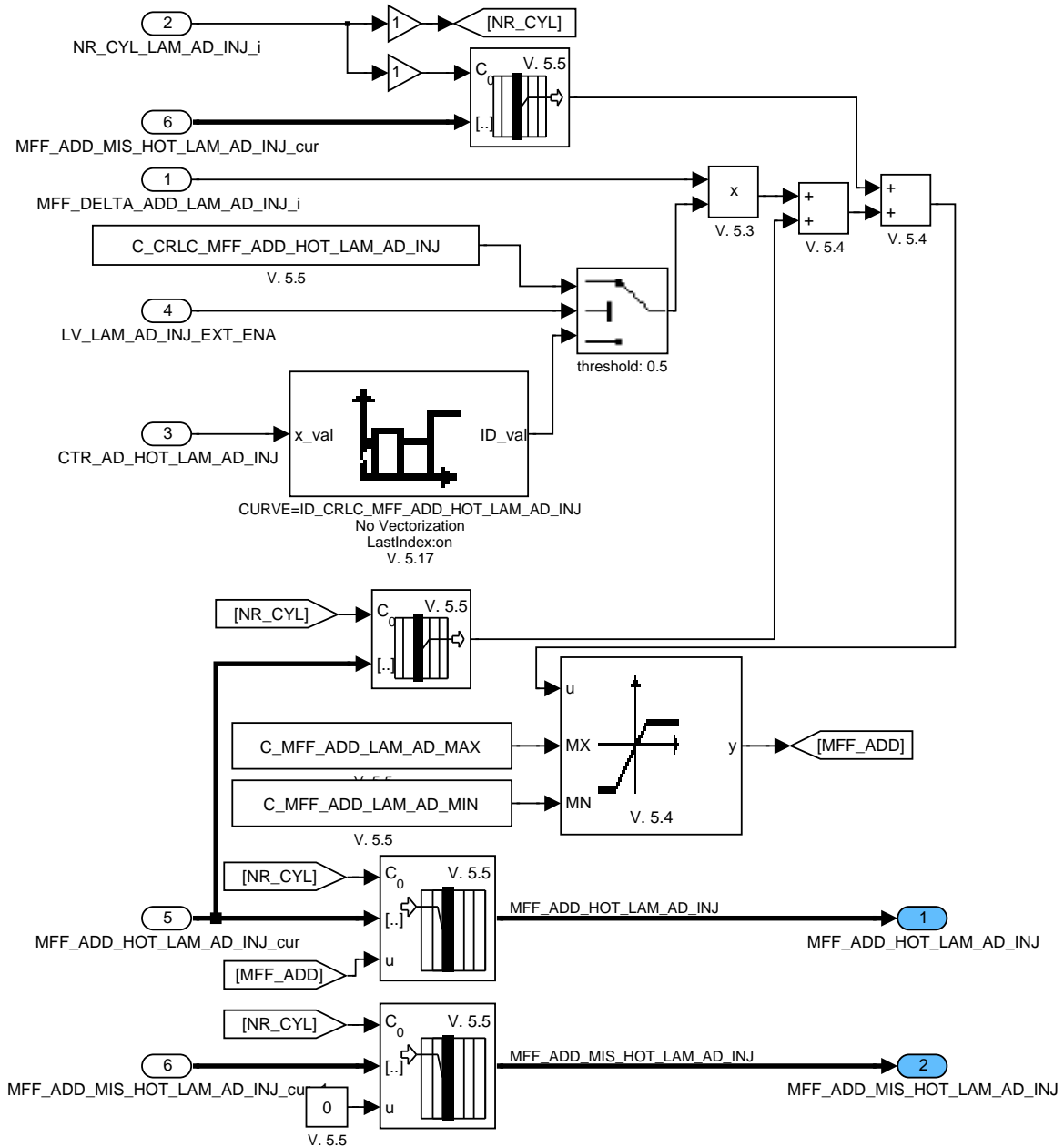


Figure 7.112.26 : Path:  
MFMA\_ISPCLAIM0/OPM\_20MS/CLC/STATE\_ACTION/CLC/LAM\_AD/CLC\_HOT/CLC\_2/CLC

**7.112.2.1.3 General calculations**

The mean value calculations are done for the current active bank(s).

**7.112.2.1.3.1 Mean value calculation**

The mean value calculations are done for the current active bank(s).

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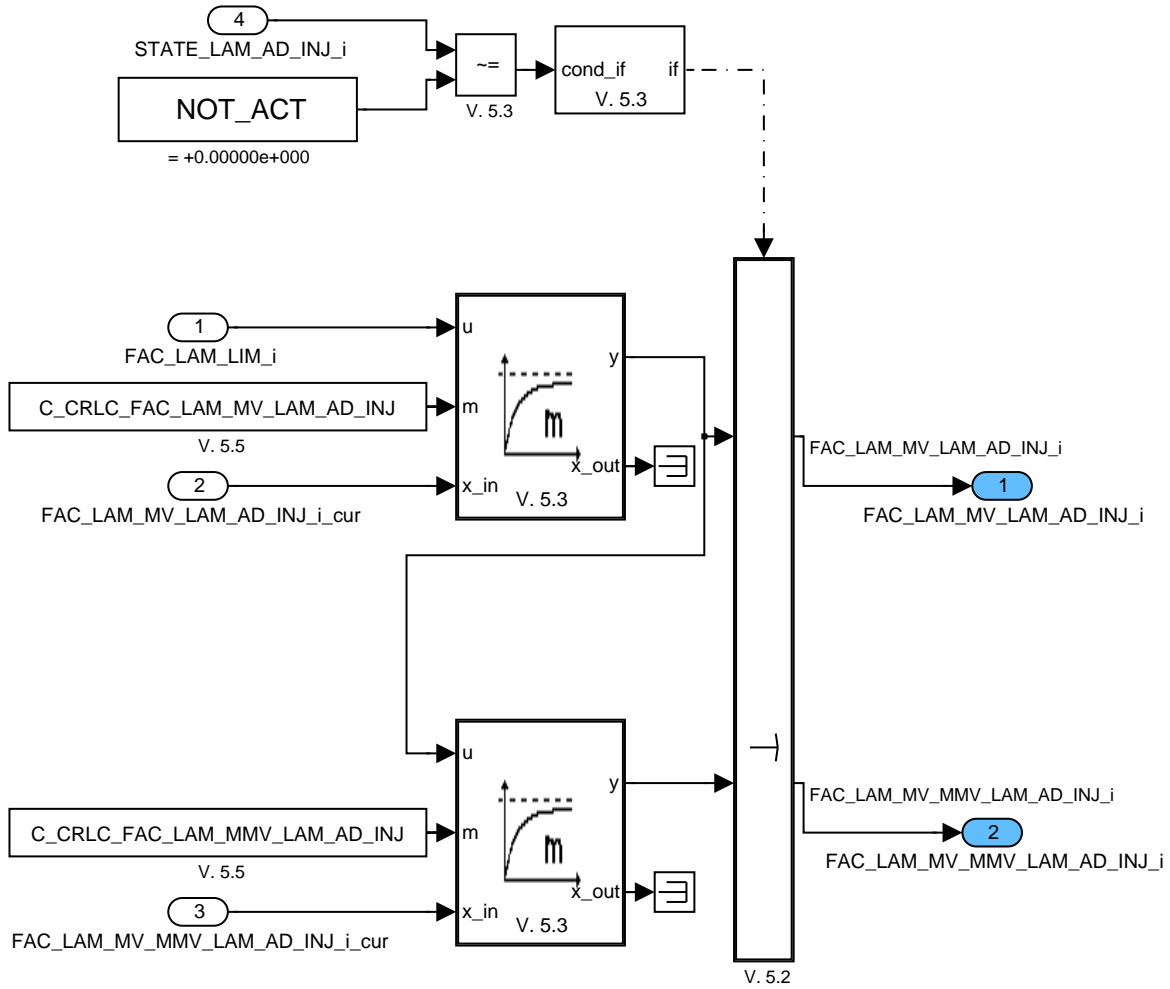


Figure 7.112.27: : Path: MFMA\_ISPCLAIM0/OPM\_20MS/CLC/GEN\_CALC/CLC

### 7.112.3 1s operations

All calculations are done for each cylinder, where the cylinder specific values are denoted within the graphical model with the suffix  $_x$ , in the textual description they are referenced via  $[x]$ .

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### 7.112.3.1 Calculation of the adaptation value

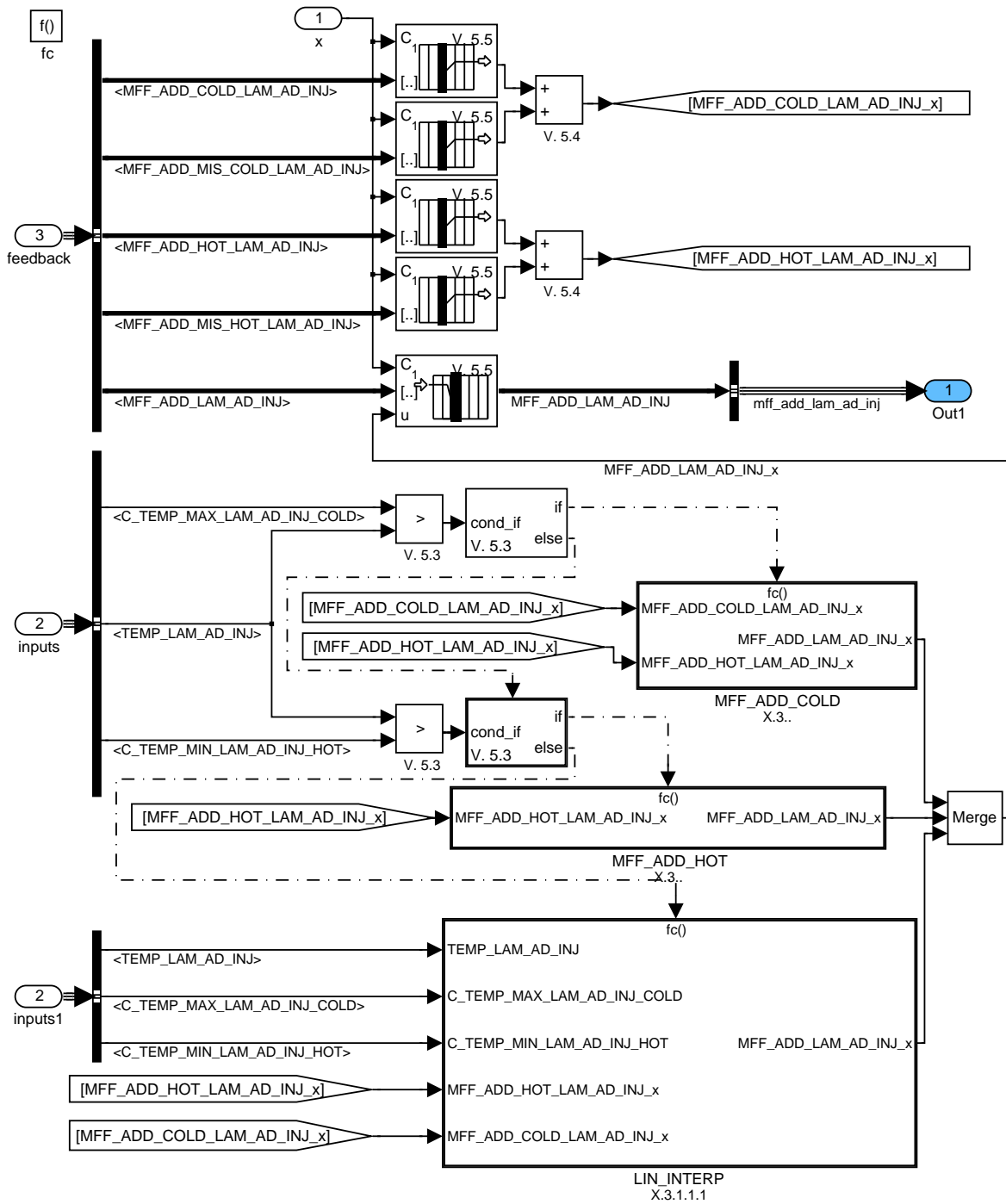


Figure 7.112.28: : Path: MFMA\_ISPCLAIM0/OPM\_1S/CLC\_AD\_VALUE

#### 7.112.3.1.1 Linear interpolation

Depending on the calibration data LC\_MFF\_CLC\_ADD\_LAM\_COLD\_ADD two different ways of calculation for the adaptation value can be chosen. For setting the calibration to zero here is a linear interpolation between the upper and lower temperature range. For one the cold adaptation value is

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added as an offset to the hot adaptation value. The offset is faded out between the upper temperature threshold for the cold area and the lower threshold for the hot area.

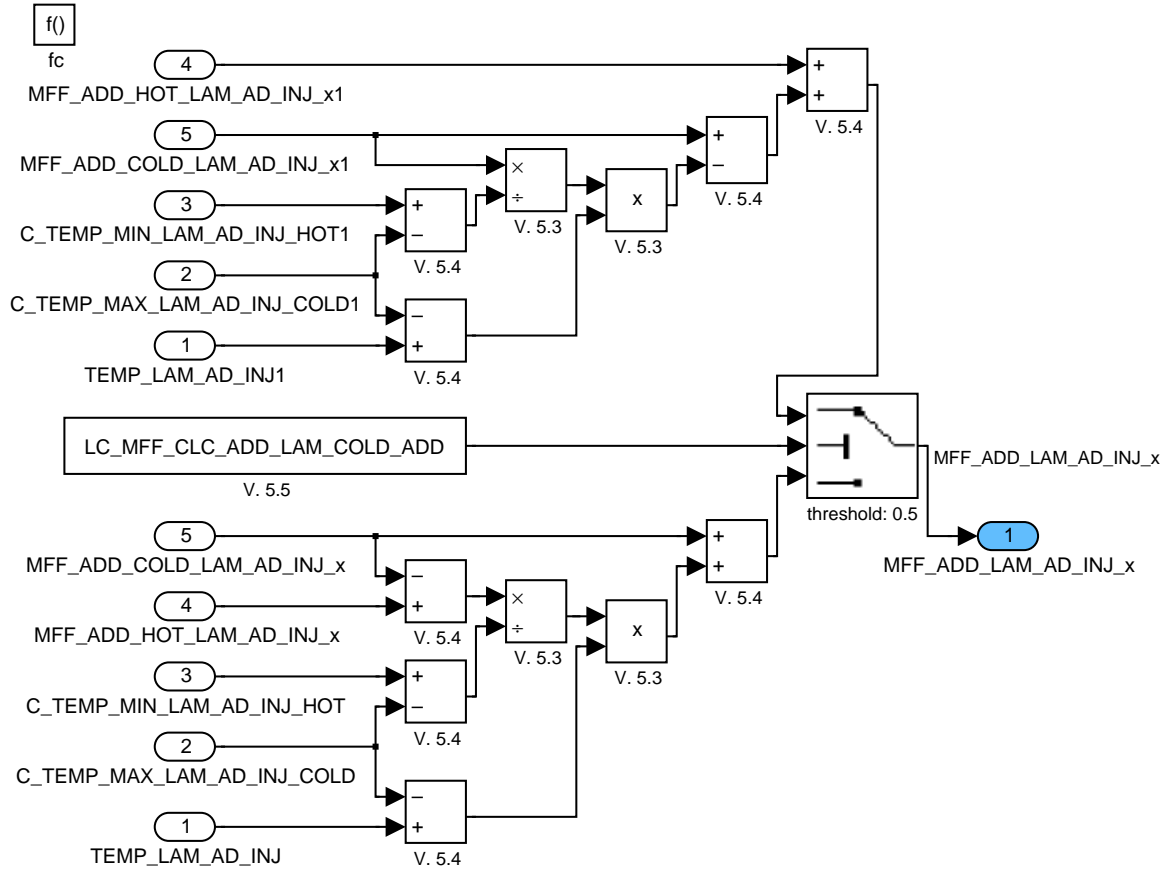


Figure 7.112.29: : Path: MFMA\_ISPCLAIM0/OPM\_1S/CLC\_AD\_VALUE/LIN\_INTERP

**7.112.3.1.2 Cold adaptation value**

Depending on the calibration value LC\_MFF\_CLC\_ADD\_LAM\_COLD\_ADD the adaptation value for the cold range can be used alone or the adaptation of the cold range can be used as an offset for the hot range adaptation value.

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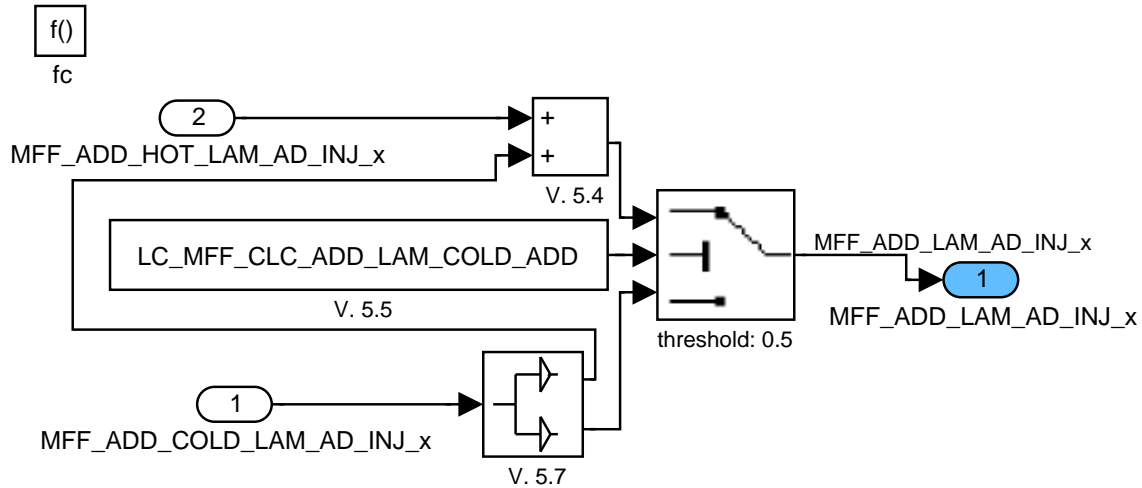


Figure 7.112.30: : Path: MFMA\_ISPCLAIM0/OPM\_1S/CLC\_AD\_VALUE/MFF\_ADD\_COLD

### 7.112.3.1.3 Hot adaptation value

At hot temperature range, the hot adaptation value is valid.

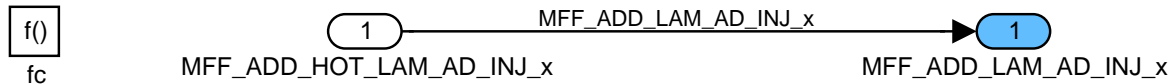


Figure 7.112.31: : Path: MFMA\_ISPCLAIM0/OPM\_1S/CLC\_AD\_VALUE/MFF\_ADD\_HOT

## 7.112.4 Resetting of adaptation values

The need to reset the adaptation values is checked every time at the transition engine off to engine on. The condition is checked for each cylinder, where the cylinder specific values are denoted within the graphical model with the suffix  $_x$ , in the textual description they are referenced via  $[x]$ .

### 7.112.4.1 Reset due to manual request or injector change

If an injector was changed (i.e. the corresponding STATE\_IV\_CHG is set to one), the corresponding adaptation value is reset. If a manual reset is requested via LC\_MFF\_ADD\_LAM\_AD\_INJ\_CLR, all adaptation values are set to 0.

If a resetting of the NVMY data via service tester is requested with the flag LV\_LAM\_AD\_INJ\_CLR\_AD\_EXT, the adaptation values are also reset to 0.

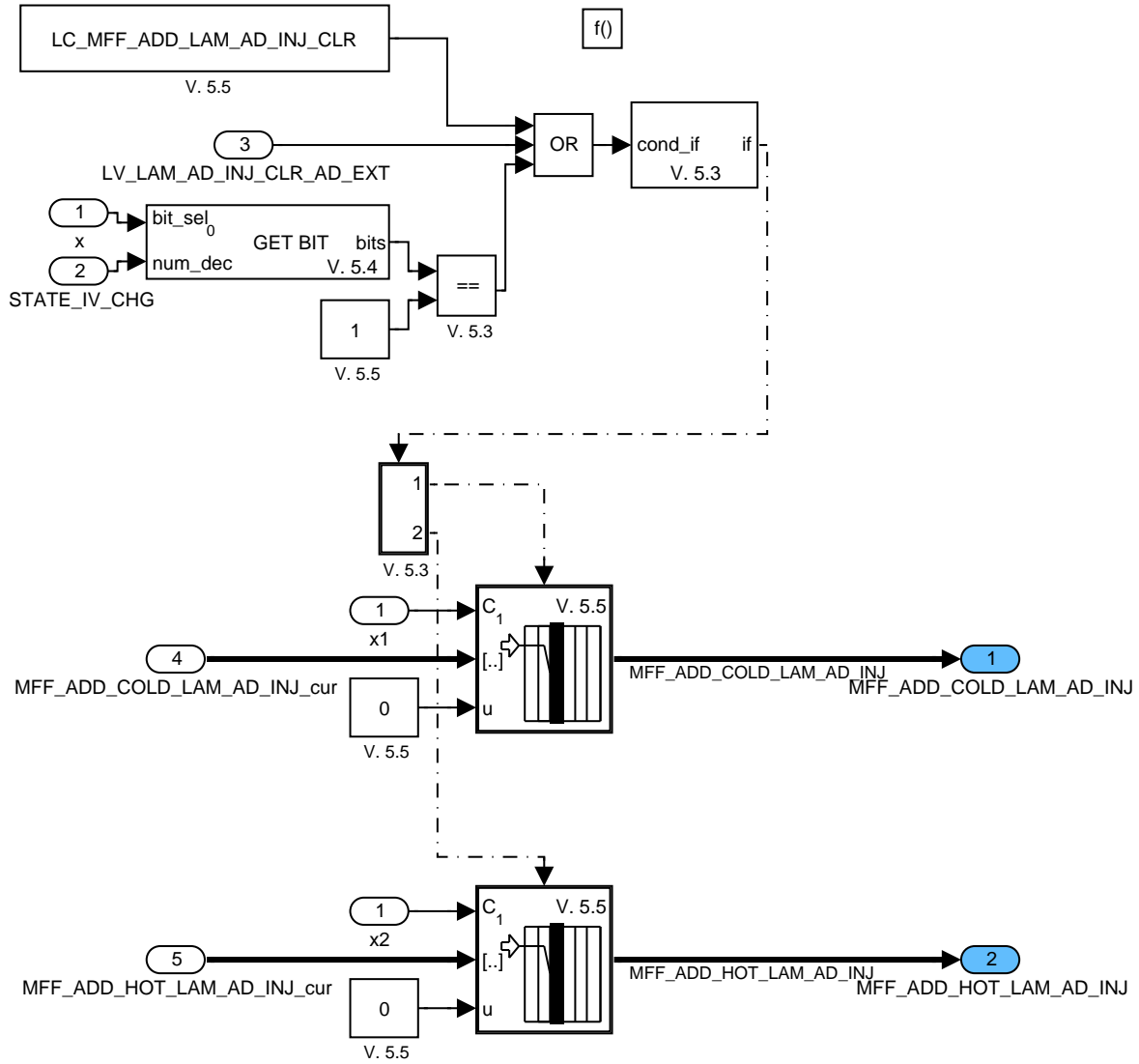


Figure 7.112.32: : Path: MFMA\_ISPCLAIM0/OPM\_ES2ERU/CLC

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## 7.113 Piezo power stage offset cancellation and gain calibration

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CHR_TRIM_DIF_0_FIL [NC_PBK_IV_NR]	V	8000... 7FFFH	-3276.8 ...3276.7	0.1	μAs
Filtered charge difference of the trim values used for offset cancellation					
CHR_TRIM_DIF_1_FIL [NC_PBK_IV_NR]	V	8000... 7FFFH	-3276.8 ...3276.7	0.1	μAs
Filtered charge difference of the trim values used for gain calibration.					
CTR_PLAUS_CHA_CAL	V	0... FFFFFFFFH	0... 4294967295	1	-
Counts the number of positive plausibility checks for gain calibration since last reset.					
CTR_PLAUS_CUR_OFS	V	0... FFFFFFFFH	0... 4294967295	1	-
Counts the number of positive plausibility checks for offset cancellation since last reset.					
CTR_PLAUS_CUR_OFS_TOT	V	0... FFFFFFFFH	0... 4294967295	1	-
Counts the total number of recurrences of offset cancellation /gain calibration calculation since last reset.					
CUR_CHA_OFS_CNL_OUT [NC_PBK_IV_NR]	O/V	8000... 7FFFH	-8.3886 ...8.38835	0.000256	A
Current applied to compensate the integrator offset for charge measurement					
FAC_COR_SLOP_CHA_CAL [NC_PBK_IV_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Correction factor for integrator gain value					
RATIO_PLAUS_CHA_CAL	V	0... FFFFH	0... 1.99996	30.5e-6	-
Ratio of plausible gain calibration input values to total number of input values.					
RATIO_PLAUS_CUR_OFS	V	0... FFFFH	0... 1.99996	30.5e-6	-
Ratio of plausible offset cancellation input values to total number of input values.					

### Input data:

CHR_INJ_TRIM_0 [NC_PBK_IV_NR] {p. 2035}	CHR_INJ_TRIM_1 [NC_PBK_IV_NR] {p. 2035}	CHR_INJ_TRIM_2 [NC_PBK_IV_NR] {p. 2035}	CHR_INJ_TRIM_3 [NC_PBK_IV_NR] {p. 2035}
CUR_CHA_OFS_CNL [NC_PBK_IV_NR] {p. 2036}	INH_INJ {p. 2295}	N {p. 1525}	NC_CHR_INJ_REF {p. 626}
NC_CYL_NR {p. 1526}	NC_PBK_IV_NR {p. 628}	NC_PBK_IV_TYP {p. 628}	PREV_STATE_IV {p. 2039}
STATE_ERR_PBK_IV {p. 4797}	STATE_PBK_IV_INI {p. 2040}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CHR_INJ_REF	-	8000... 7FFFH	-3276.8 ...3276.7	0.1	μAs
Calibratable reference charge value used for integrator gain calibration.					
C_CHR_TRIM_MAX_PLAUS_BEG	-	8000... 7FFFH	-3276.8 ...3276.7	0.1	μAs
Maximum plausible value for trim pulse charge; begin of trim and end of offset cancellation.					
C_CHR_TRIM_MAX_PLAUS_END	-	8000... 7FFFH	-3276.8 ...3276.7	0.1	μAs
Maximum plausible value for trim pulse charge; end of gain calibration.					
C_CHR_TRIM_MIN_PLAUS_BEG	-	8000... 7FFFH	-3276.8 ...3276.7	0.1	μAs
Minimum plausible value for trim pulse charge; begin of trim and end of offset cancellation.					
C_CHR_TRIM_MIN_PLAUS_END	-	8000... 7FFFH	-3276.8 ...3276.7	0.1	μAs
Minimum plausible value for trim pulse charge; end of gain calibration.					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CUR_CHA_OFS_CNL_MAX	-	8000... 7FFFH	-8.3886 ...8.38835	0.000256	A
Maximal threshold for offset cancellation charge current					
C_CUR_CHA_OFS_CNL_MIN	-	8000... 7FFFH	-8.3886 ...8.38835	0.000256	A
Minimal threshold for offset cancellation charge current					
C_CUR_CHA_OFS_PI_CTL_I_LIM_MAX	-	8000... 7FFFH	-8.3886 ...8.38835	0.000256	A
Upper limit for the integral part of the current charge offset cancellation PI controller					
C_CUR_CHA_OFS_PI_CTL_I_LIM_MIN	-	8000... 7FFFH	-8.3886 ...8.38835	0.000256	A
Lower limit for the integral part of the current charge offset cancellation PI controller					
C_FAC_FIL_CHR_TRIM	-	0... FFFFH	0... 0.99998	15.3e-6	-
Filter factor for trim pulse charge difference					
C_KI_PI_CTL_CUR_CHA_OFS_CNL	-	8000... 7FFFH	-0.1... 0.09999	3.0518e-6	1/( $\mu$ s*s)
Coefficient for the integral part of the PI controller used for the offset cancellation charge current					
C_KR_PI_CTL_CUR_CHA_OFS_CNL	-	8000... 7FFFH	-0.1... 0.0999969	3.0518e-6	1/ $\mu$ s
Coefficient for the proportional part of the PI controller used for the offset cancellation charge current					
C_N_MIN_OFS_CNL_CHA_CAL	-	0... 1FE0H	0... 8160	1	rpm
Minimum engine speed to activate offset cancellation and gain calibration.					
LC_CUR_CHA_OFS_CNL_ENA	-	0... 1H	0 ...1	1	-
Enables the PI controller used for the offset cancellation of the charge current					
LC_CUR_CHA_OFS_CNL_RST	-	0... 1H	0 ...1	1	-
Reset the offset cancellation current and the integral part of the pi controller					
LC_CUR_OFS_CNL_CHA_CAL_ENA	-	0... 1H	0 ...1	1	-
Switch to enable piezo power stage offset cancellation and gain calibration					
LC_CUR_SLOP_COR_CHR_REF	-	0... 1H	0 ...1	1	-
Selects between the calibratable (=0) and the configurable (=1) charge reference.					
LC_FAC_COR_SLOP_CHA_CAL_ENA	-	0... 1H	0 ...1	1	-
Activates the correction of the measured charge in relation to a a reference charge					

## Exported actions:

### **ACTION\_INJR\_SetOfsCurlni(IN <Bank>, IN <OfsCurlni>)**

This action initializes the bank individual offset cancellation current of bank <Bank> with the value <OfsCurlni>.

## FUNCTION DESCRIPTION:


### General information:

The value of the piezo charge is determined by an analog integration of the piezo current over time. The integrator output can be converted into a charge value via A/D conversion.

Due to integrator offset currents and drift of integrator gain, the accuracy of the measured charge may differ. Therefore those two effects have to be corrected.

The offset current is corrected by a variable current source. The integrator gain error is measured by applying a known amount of charge (reference charge) to the integrator and by correcting the differences between reference charge and measured charge with use of a correction factor.

This procedure is applied for each electrical bank.

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**Note:** The local variables I\_PI\_TMP and PI\_PI\_TMP as well as the static nonvisible variable I\_PI\_CTL\_CUR\_CHA\_OFS\_CNL should be 32-bit and should have the resolution 1e-6 A (that is, their resolution should be 256-times finer than the one of the output variable CUR\_CHA\_OFS\_CNL\_OUT).

### Signal flow diagram:

### Description:

### Application conditions

#### **Initialisation:**

```

at reset:
  CHR_TRIM_DIF_0_FIL[ ] = 0 // all NC_PBK_IV_NR elements
(1) IF LC_CUR_SLOP_COR_CHR_REF = 1
(1) THEN
  CHR_TRIM_DIF_1_FIL[ ] = NC_CHR_INJ_REF
  // all NC_PBK_IV_NR elements
(1) ELSE
  CHR_TRIM_DIF_1_FIL[ ] = C_CHR_INJ_REF
  // all NC_PBK_IV_NR elements
(1) ENDIF
  FAC_COR_SLOP_CHA_CAL[ ] = 1 // all NC_PBK_IV_NR elements
  CUR_CHA_OFS_CNL_OUT[ ] = 0 // all NC_PBK_IV_NR elements
  I_PI_CTL_CUR_CHA_OFS_CNL[ ] = 0 // all NC_PBK_IV_NR
  elements
  CTR_PLAUS_CUR_OFS_TOT = 0
  CTR_PLAUS_CUR_OFS = 0
  CTR_PLAUS_CHA_CAL = 0
  RATIO_PLAUS_CUR_OFS = 0
  RATIO_PLAUS_CHA_CAL = 0

```

#### **Recurrence:**

1 s

#### **Activation:**

```

LC_CUR_OFS_CNL_CHA_CAL_ENA = 1
AND STATE_PBK_IV_INI = "INIT_FINISHED"
AND STATE_ERR_PBK_IV = 0
AND NC_PBK_IV_TYP = 1 (for ATIC88)
AND N > C_N_MIN_OFS_CNL_CHA_CAL
AND PREV_STATE_IV = (2^NC_CYL_NR) - 1
AND INH_INJ = 0

```

#### **Deactivation:**

*If activation conditions are **not** fulfilled, function must be deactivated.*


### Formula section:

#### **(1)FOR** m = 0 **TO** NC\_PBK\_IV\_NR - 1 **DO**

The compensation of the remaining charge (Offset Cancellation) and the analog integrator gain correction are carried out for each electrical bank.

Low pass filter for measured trim pulses:

Two PT1-filters are applied to the difference of the measured voltage values CHA\_TRIM\_1 - CHA\_TRIM\_0 and to the difference of the measured voltage values CHA\_TRIM\_3 - CHA\_TRIM\_2. The factor of the filter is defined by  $C\_FAC\_FIL\_CHR\_TRIM = 1 - \exp(-2 \cdot \pi \cdot fs \cdot Ts)$ , where  $Ts=1$  s (recurrence of the block) and  $fs$  is the cut off frequency of the filter.

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### 7.113.1 PI-controller for applied offset cancellation current:

Plausibility check:

To track errors within the trimming system and the A/D conversion, a plausibility check of the analogue measured charge values is done. For visualization purposes, the ration between plausible values and the total number of values is calculated for offset cancellation and gain calibration separately.

$$\text{CTR\_PLAUS\_CUR\_OFS\_TOT} = \text{CTR\_PLAUS\_CUR\_OFS\_TOT} + 1$$

**(4)IF** LC\_CUR\_CHA\_OFS\_CNL\_ENA = 1

**(4)THEN**

Plausibility check:

**(4a)IF** (CHR\_INJ\_TRIM\_0[m] < C\_CHR\_TRIM\_MAX\_PLAUS\_BEG  
**AND** CHR\_INJ\_TRIM\_0[m] > C\_CHR\_TRIM\_MIN\_PLAUS\_BEG  
**AND** CHR\_INJ\_TRIM\_1[m] < C\_CHR\_TRIM\_MAX\_PLAUS\_BEG  
**AND** CHR\_INJ\_TRIM\_1[m] > C\_CHR\_TRIM\_MIN\_PLAUS\_BEG)

**(4a)THEN**

Increment plausibility counter and calculate ratio:

$$\text{CTR\_PLAUS\_CUR\_OFS} = \text{CTR\_PLAUS\_CUR\_OFS} + 1$$

$$\text{RATIO\_PLAUS\_CUR\_OFS} = \frac{\text{CTR\_PLAUS\_CUR\_OFS}}{\text{CTR\_PLAUS\_CUR\_OFS\_TOT}}$$

Filter input signal:

$$\begin{aligned} \text{CHR\_TRIM\_DIF\_0\_FIL}[m] &= (\text{C\_FAC\_FIL\_CHR\_TRIM} * \\ & ((\text{CHR\_INJ\_TRIM\_1}[m] - \text{CHR\_INJ\_TRIM\_0}[m]) \\ & - \text{CHR\_TRIM\_DIF\_0\_FIL}[m](n-1))) + \text{CHR\_TRIM\_DIF\_0\_FIL}[m](n-1) \\ \text{I\_PI\_TMP} &= \text{I\_PI\_CTL\_CUR\_CHA\_OFS\_CNL}[m](n-1) \\ & - \text{CHR\_TRIM\_DIF\_0\_FIL}[m] * \text{C\_KI\_PI\_CTL\_CUR\_CHA\_OFS\_CNL} * 1 \text{ s} \\ \text{I\_PI\_TMP} &= \text{MIN}(\text{I\_PI\_TMP}, \text{C\_CUR\_CHA\_OFS\_PI\_CTL\_I\_LIM\_MAX}) \\ \text{I\_PI\_CTL\_CUR\_CHA\_OFS\_CNL}[m] &= \\ & \text{MAX}(\text{I\_PI\_TMP}, \text{C\_CUR\_CHA\_OFS\_PI\_CTL\_I\_LIM\_MIN}) \\ \text{PI\_PI\_TMP} &= \text{C\_KR\_PI\_CTL\_CUR\_CHA\_OFS\_CNL} * \\ & (- \text{CHR\_TRIM\_DIF\_0\_FIL}[m]) + \text{I\_PI\_CTL\_CUR\_CHA\_OFS\_CNL}[m] \\ \text{PI\_PI\_TMP} &= \text{MIN}(\text{PI\_PI\_TMP}, \text{C\_CUR\_CHA\_OFS\_CNL\_MAX}) \\ \text{CUR\_CHA\_OFS\_CNL\_OUT}[m] &= \\ & \text{MAX}(\text{PI\_PI\_TMP}, \text{C\_CUR\_CHA\_OFS\_CNL\_MIN}) \end{aligned}$$

**(4a)ENDIF**

**(4)ELSE**

$$\text{CUR\_CHA\_OFS\_CNL\_OUT}[m] = \text{CUR\_CHA\_OFS\_CNL}[m]$$

**(4)ENDIF**

**(5)IF** LC\_CUR\_CHA\_OFS\_CNL\_RST = 1

**(5)THEN**

$$\text{CUR\_CHA\_OFS\_CNL\_OUT}[m] = 0$$

$$\text{I\_PI\_CTL\_CUR\_CHA\_OFS\_CNL}[m] = 0$$

**(5)ENDIF**

### 7.113.2 Calculation of gain calibration:


The integrator gain factor, used to calculate the charge of the piezoelectric actuator, must be corrected by the factor FAC\_COR\_SLOP\_CHA\_CAL, which is calculated using a configurable reference charge value NC\_CHR\_INJ\_REF or a calibratable reference charge value C\_CHR\_INJ\_REF. The selection between these two reference values is made by LC\_CUR\_SLOP\_COR\_CHR\_REF.

**(6)IF** LC\_FAC\_COR\_SLOP\_CHA\_CAL\_ENA = 1

**(6)THEN**

Plausibility check:

**(6a)IF** (CHR\_INJ\_TRIM\_2[m] < C\_CHR\_TRIM\_MAX\_PLAUS\_BEG

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```

AND CHR_INJ_TRIM_2[m] > C_CHR_TRIM_MIN_PLAUS_BEG
AND CHR_INJ_TRIM_3[m] < C_CHR_TRIM_MAX_PLAUS_END
AND CHR_INJ_TRIM_3[m] > C_CHR_TRIM_MIN_PLAUS_END
(6a)THEN
  Increment plausibility counter and calculate ratio:
  CTR_PLAUS_CHA_CAL = CTR_PLAUS_CHA_CAL + 1
  RATIO_PLAUS_CHA_CAL = CTR_PLAUS_CHA_CAL
                        /CTR_PLAUS_CUR_OFS_TOT

  Filter input signal:
  CHR_TRIM_DIF_1_FIL[m] = (C_FAC_FIL_CHR_TRIM *
                        ((CHR_INJ_TRIM_3[m] - CHR_INJ_TRIM_2[m])
                        - CHR_TRIM_DIF_1_FIL[m](n-1))) + CHR_TRIM_DIF_1_FIL[m](n-1)
(7)IF LC_CUR_SLOP_COR_CHR_REF = 1
(7)THEN
  FAC_COR_SLOP_CHA_CAL[m] = NC_CHR_INJ_REF
                        /CHR_TRIM_DIF_1_FIL[m]

(7)ELSE
  FAC_COR_SLOP_CHA_CAL[m] = C_CHR_INJ_REF
                        /CHR_TRIM_DIF_1_FIL[m]

(7)ENDIF
(6a)ENDIF
(6)ELSE
  FAC_COR_SLOP_CHA_CAL[m] = 1
(6)ENDIF
(1)ENDFOR

```

### 7.113.3 Description of exported actions

#### 7.113.3.1 Description of ACTION\_INJR\_SetOfsCurIni

<b>ACTION_INJR_SetOfsCurIni(IN &lt;Bank&gt;, IN &lt;OfsCurIni&gt;)</b>					
This action initializes the bank individual offset cancellation current of bank <Bank> with the value <OfsCurIni>.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
Bank	IN	0 ... 7	0 ... 7	1	-
Number of injection bank.					
OfsCurIni	IN	8000...7FFFH	-8.38860... 8.38835	0.00025 6	[A]
Initial value of offset cancellation current.					

#### Formula Section:

Set offset cancellation current to initial value, but limit it to the calibratable thresholds. Also set the I-controller value of the PI-controller to 0 (controller reset).

$$\text{CUR\_CHA\_OFS\_CNL\_OUT}[\text{Bank}] = \text{OfsCurIni}$$

$$\text{CUR\_CHA\_OFS\_CNL\_OUT}[\text{Bank}] =$$

$$\text{MIN}(\text{CUR\_CHA\_OFS\_CNL\_OUT}[\text{Bank}], \text{C\_CUR\_CHA\_OFS\_CNL\_MAX})$$

$$\text{CUR\_CHA\_OFS\_CNL\_OUT}[\text{Bank}] =$$

$$\text{MAX}(\text{CUR\_CHA\_OFS\_CNL\_OUT}[\text{Bank}], \text{C\_CUR\_CHA\_OFS\_CNL\_MIN})$$

$$\text{I\_PI\_CTL\_CUR\_CHA\_OFS\_CNL}[\text{Bank}] = \text{CUR\_CHA\_OFS\_CNL\_OUT}[\text{Bank}]$$

## 7.114 NOx catalyst aging model

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_NT_AGI_MDL	O/V	0... FFFFFFFFH	0... 0.99999	232.8e-12	-
Modeled aging of NT					
FAC_NT_AGI_MDL_THERMO	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
Converted modeled aging factor to thermo aging factor					

### Action definition

<b>ACTION_NOXM_CleanNTAdaptAgiMdl ()</b>	Mode: O
External service for Initiaöization of Modelled Aging values	

<b>ACTION_NOXM_WriteAgiMExtAdj ()</b>	Mode: O
Reset of NSC modelled value using external value	

### FUNCTION DESCRIPTION:

#### General information:

This modul has no functionality. It provides only all existing interfaces for other moduls.

#### Application conditions

**Initialisation:** *at reset set all output values to 1 (means new NOx catalyst)*

*Recurrence: no*


*Activation:*

#### Action definition:

Both actions have no functionality.

# 8 - Engine Speed Control

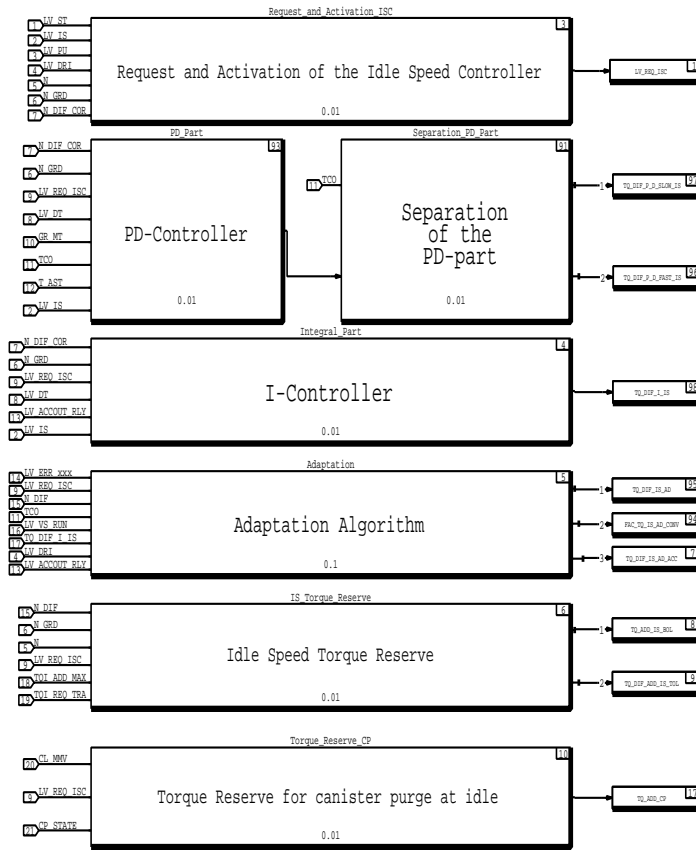
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# 8.1 Idle speed control general

22-FEB-99

Discrete SuperBlock	Sample Period	Sample Skew	Inputs	Outputs	Enable Signal
Idle_Speed_Control_General	0.01	0.	21	10	Parent



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## 8.2 Idle speed control

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_N_GRD_IS	V	0... FFH	0... 1.9921875	0.0078125	-
Factor in dependance of TCO and TOIL for weighting the speed gradient influence on the PD-part (for LV_DT=0)					
FAC_N_GRD_IS_SLOW	V	0... FFH	0... 1.9921875	0.0078125	-
Factor in dependance of TCO and TOIL for weighting the speed gradient influence on the PD-part (for LV_DT=0)					
IP_FAC_P_D_SLOW_TCO_IS	-	0... FFFFH	0... 1.999969	30.5175e-6	-
TCO depending factor for slow-path of torque coordination					
LV_PAS_RAMP_ACT_I_IS	O/V	0... 1H	0 ...1	1	-
Logical value for I-part passive ramp active					
LV_PAS_RAMP_ACT_P_D_IS	O/V	0... 1H	0 ...1	1	-
Logical value for PD-part passive ramp active					
LV_TQ_DIF_I_IS_INI_ACT	O/V	0... 1H	0 ...1	1	-
Flag for activating the re-initialisation of I-Part of idle speed controller (f.e. by LV_DT=1->0)					
LV_TQ_ISC_I_TQ_PSTE	O/V	0... 1H	0 ...1	1	-
Logical variable for limitation due to PSTE					
LV_TQ_P_D_ACT_FAST	V	0... 1H	0 ...1	1	-
Logical variable for PD-part fast active (STATE_P_D_ISC = P_D_NORMAL)					
LV_TQ_P_D_ACT_FAST_TEMP	V	0... 1H	0 ...1	1	-
Flag to activate LV_TQ_P_D_ACT_FAST in case of manual or automatic transmission					
LV_TQ_P_D_ACT_SLOW	V	0... 1H	0 ...1	1	-
Logical variable for PD-part air path active (STATE_P_D_ISC = P_D_NORMAL)					
N_GRD_FAC_P_D	V	80... 7FH	-4096 ...4064	32	rpm/s
output of N_GRD_P_D_IS * FAC_N_GRD_IS; gradient input of the PD-part maps					
N_GRD_FAC_P_D_SLOW	V	80... 7FH	-4096 ...4064	32	rpm/s
output of N_GRD_P_D_IS * FAC_N_GRD_IS_SLOW; gradient input of the PD-slow-part maps					
N_GRD_I_IS	V	80... 7FH	-4096 ...4064	32	rpm/s
Filtered gradient; gradient input of the I-part maps					
N_GRD_P_D_IS	V	80... 7FH	-4096 ...4064	32	rpm/s
Filtered gradient; gradient input of the PD-part maps					
STATE_I_ISC	V	0H 1H 2H 3H	I_PASSIVE I_NORMAL RAMP_TO_ PAS RAMP_TO_LIM	-	-
State of the integral part: I_PASSIVE, I_NORMAL, RAMP_TO_PAS, RAMP_TO_LIM					
STATE_P_D_ISC	V	0H 1H 2H	P_D_PASSIVE P_D_NORMAL RAMP_TO_ ZERO	-	-
State of the PD-part: P_D_PASSIVE, P_D_NORMAL, RAMP_TO_ZERO					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_PAS_RAMP_ACT_I_IS	O/V	0... FFH	0... 255	1	-
Circular buffer for the logical value for I-part passive ramp active					
STATE_PAS_RAMP_ACT_P_D_IS	O/V	0... FFH	0... 255	1	-
Circular buffer for the logical value for PD-part passive ramp active					
TQ_ADD_I_IS	V	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
Increment of limited integrator					
TQ_ADD_I_RAMP	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Increment of the I-part ramps					
TQ_ADD_P_D_RAMP_FAST	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Increment of the PD-part ramps ignition path					
TQ_ADD_P_D_RAMP_SLOW	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Increment of the PD-part ramps air path					
TQ_DIF_I_IS	O/V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I-part					
TQ_DIF_I_IS_1	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I-part at normal out of calculation					
TQ_DIF_I_IS_2	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I-part at normal but ramp operation					
TQ_DIF_P_D_DT_IS_1	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part at drive train into fast path					
TQ_DIF_P_D_DT_IS_1_SLOW	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part at drive train into slow path					
TQ_DIF_P_D_DT_IS_OPM_1	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part at drive train into fast path (mode1)					
TQ_DIF_P_D_DT_IS_OPM_2	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part at drive train into fast path (mode2)					
TQ_DIF_P_D_DT_IS_SEL	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Resulting PD-part at drive train into fast path					
TQ_DIF_P_D_DT_IS_SLOW_OPM_1	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part at drive train into slow path (mode1)					
TQ_DIF_P_D_DT_IS_SLOW_OPM_2	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part at drive train into slow path (mode2)					
TQ_DIF_P_D_DT_IS_SLOW_SEL	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Resulting PD-part at drive train into slow path					
TQ_DIF_P_D_FAST_IS	O/V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part for fast-path of torque coordination					
TQ_DIF_P_D_IS_FAST	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part before separation into fast/slow path					
TQ_DIF_P_D_IS_OPM_1	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part before separation into fast/slow path					
TQ_DIF_P_D_IS_OPM_2	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part before separation into fast/slow path					
TQ_DIF_P_D_IS_SEL	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Resulting PD-part before separation into fast/slow path					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_DIF_P_D_IS_SLOW	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part before separation into fast/slow path					
TQ_DIF_P_D_IS_SLOW_OPM_1	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part before separation into fast/slow path					
TQ_DIF_P_D_IS_SLOW_OPM_2	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part before separation into fast/slow path					
TQ_DIF_P_D_IS_SLOW_SEL	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Resulting PD-part before separation into fast/slow path					
TQ_DIF_P_D_SLOW_IS	O/V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part for slow-path of torque coordination					
TQ_I_DT_IS_OPM_1	V	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
I-part at closed drive train out of calculation (mode1)					
TQ_I_DT_IS_OPM_2	V	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
I-part at closed drive train out of calculation (mode2)					
TQ_I_DT_IS_SEL	V	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
Resulting I-part at closed drive train out of calculation					
TQ_I_IS_OPM_1	V	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
I-part at normal out of calculation (mode1)					
TQ_I_IS_OPM_2	V	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
I-part at normal out of calculation (mode2)					
TQ_I_IS_SEL	V	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
Resulting I-part at normal out of calculation					
TQ_LIM_I_IS	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Actual torque limitation value for integral part					
TQ_PAS_I_ACC_IS_OPM_1	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I-component for idle speed controller at transition out of Passive with air condition (mode1)					
TQ_PAS_I_ACC_IS_OPM_2	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I-component for idle speed controller at transition out of Passive with air condition (mode2)					
TQ_PAS_I_ACC_IS_SEL	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Resulting I-component for idle speed controller at transition out of Passive with air condition					
TQ_PAS_I_IS_OPM_1	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I-component for idle speed controller at transition out of Passive with (mode1)					
TQ_PAS_I_IS_OPM_2	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I-component for idle speed controller at transition out of Passive with (mode2)					
TQ_PAS_I_IS_SEL	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Resulting I-component for idle speed controller at transition out of Passive with					

**Input data:**

FAC_TQ_ADD_IS_OPM_SEL {p. 8212}	GR_AT {p. 1302}	GR_MT {p. 1302}	ID_IDX_OPM_DROF {p. 1112}
ID_TQ_ADD_IS_OPM_AV {p. 3545}	ID_TQ_ADD_IS_OPM_REQ {p. 3545}	LV_ACCOUT_RLY {p. 3589}	LV_AT {p. 654}
LV_CS {p. 8394}	LV_DT {p. 1310}	LV_ES {p. 1720}	LV_IGK {p. 906}
LV_ISC_INH_EXT_ADJ {p. 803}	LV_ISC_OFF_DROF {p. 1112}	LV_REQ_ISC {p. 3501}	LV_VAR_TCT {p. 656}

N {p. 1525}	N_DIF_COR {p. 1122}	N_GRD {p. 1525}	N_SP_IS {p. 1122}
OPM_AV {p. 8137}	OPM_REQ {p. 8137}	T_AST {p. 1766}	TCO {p. 1100}
TQ_ADD_CH {p. 6582}	TQ_ADD_PSTE {p. 6621}	TQ_LOSS_PSTE {p. 6622}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_N_GRD	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
Filter correlation constant					
C_N_DIF_I_IS_INI	-	E020... 1FE0H	-8160 ...8160	1	rpm
engine speed difference to setpoint for re-initialisation of I-Part of idle speed controller					
C_NR_BUF_N_GRD_FIL	-	0... 6H	0 ...6	1	-
number of relevant buffer cells for N_GRD_FIL_1_IS					
C_T_RAMP_LIM_I_DT_IS	-	0... FFFFH	0... 1310.7	0.02	s
Time constant for ramp limit of I-controller output in case of idle speed controller passive and drive train engaged Resolution is directly coupled with update rate					
C_T_RAMP_LIM_I_IS	-	0... FFFFH	0... 1310.7	0.02	s
Time constant for ramp limit of I-controller output in case of idle speed controller passive Resolution is directly coupled with update rate					
C_T_RAMP_LIM_P_D_DT_IS	-	0... FFFFH	0... 655.35	0.01	s
Time constant for ramp limit of P-, D-controller output in case of idle speed controller passive and LV_DT=1					
C_T_RAMP_LIM_P_D_IS	-	0... FFFFH	0... 655.35	0.01	s
Time constant for ramp limit of P-, D-controller output in case of idle speed controller passive					
C_T_TQ_ISC_I_TQ_PSTE_LIM	-	0... FFFFH	0... 1310.7	0.02	s
Delay time to reset the idle speed controller limitation due to PSTE					
C_THD_TQ_ADD_PSTE_I_ISC	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
TQ_ADD_PSTE threshold for calc of I limitation threshold					
C_THD_TQ_ADD_PSTE_I_ISC_HYS	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Hysteresis for TQ_ADD_PSTE threshold to leave I limitation					
C_THD_TQ_LOSS_PSTE_I_ISC	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
TQ_LOSS_PSTE threshold for calc of I limitation threshold					
C_THD_TQ_LOSS_PSTE_I_ISC_HYS	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Hysteresis for TQ_LOSS_PSTE threshold to leave I limitation					
C_TQ_BOL_I_DT_AT_IS	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Bottom limit for I-controller output and drive train closed-Automatic Transmission					
C_TQ_BOL_I_DT_IS	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Bottom limit for I-controller output and drive train closed					
C_TQ_BOL_I_IS	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Bottom limit for I-controller output					
C_TQ_DIF_I_IS_DT_THD	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Threshold value for reset of TQ_DIF_I_IS in case of LV_DT = 0 --> 1					
C_TQ_DIF_I_IS_INI	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Initialization value of TQ_DIF_I_IS in case of LV_DT = 0 --> 1					
C_TQ_ISC_I_MAX_TQ_DROF	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I limitation at drive off					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TQ_ISC_I_MAX_TQ_PSTE	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I limitation max value at PSTE intervention					
C_TQ_ISC_I_MIN_TQ_DROF	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I limitation at drive off					
C_TQ_ISC_I_MIN_TQ_PSTE	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I limitation min value at PSTE intervention					
C_TQ_MAX_ISC_TQ_DROF_FAST	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
P_D Limitation at Drive off					
C_TQ_MAX_ISC_TQ_DROF_SLOW	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
P_D limitation at drive off					
C_TQ_MIN_ISC_TQ_DROF_FAST	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
P_D Limitation at Drive off					
C_TQ_MIN_ISC_TQ_DROF_SLOW	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
P_D limitation at drive off					
C_TQ_TOL_I_DT_IS_OPM_1	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Top limit for I-controller output and drive train closed in operation mode 1					
C_TQ_TOL_I_DT_IS_OPM_2	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Top limit for I-controller output and drive train closed in operation mode 2					
C_TQ_TOL_I_IS	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Top limit for I-controller output					
ID_FAC_AT_P_D_DT_IS	-	0... FFFFH	0... 1.99996948	30.5175e-6	-
LDPM_GR_AT_3	8	0... FFH	0... 255	1	-
Weighting factor for TQ_DIF_P_D_DT_IS_SEL for AT					
ID_FAC_AT_P_D_DT_IS_SLOW	-	0... FFFFH	0... 1.99996948	30.5175e-6	-
LDPM_GR_AT_3	8	0... FFH	0... 255	1	-
Weighting factor for TQ_DIF_P_D_DT_IS_SLOW_SEL for AT					
ID_FAC_MT_P_D_DT_IS	-	0... FFFFH	0... 1.99996948	30.5175e-6	-
LDPM_GR_MT_2	8	0... FFH	0... 255	1	-
Weighting factor for TQ_DIF_P_D_DT_IS_SEL for MT					
ID_FAC_MT_P_D_DT_IS_SLOW	-	0... FFFFH	0... 1.99996948	30.5175e-6	-
LDPM_GR_MT_2	8	0... FFH	0... 255	1	-
Weighting factor for TQ_DIF_P_D_DT_IS_SLOW_SEL for MT					
IP_FAC_N_GRD_IS	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_TCO_IP_FAC_N_GRD_IS	8	0... FEH	-48... 142.5	0.75	°C
LDP_T_AST_IP_FAC_N_GRD_IS	8	0... FFFFH	0... 6553.5	0.1	s
Weighting factor for N_GRD input for IP_P_D_IS					
IP_FAC_N_GRD_IS_SLOW	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_TCO_FAC_N_GRD_IS	8	0... FEH	-48... 142.5	0.75	°C
LDPM_T_AST_FAC_N_GRD_IS	8	0... FFFFH	0... 6553.5	0.1	s
Weighting factor for N_GRD input for IP_P_D_IS					
IP_FAC_P_D_FAST_IS	-	0... FFFFH	0... 1.99996948	30.5175e-6	-
LDPM_TCO_IS_1	8	0... FEH	-48... 142.5	0.75	°C
LDPM_TQ_ADD_CH_IS_1	6	0... FFFFH	-1024... 1023.97	0.03125	Nm
TCO and TQ_ADD_CH depending factor for fast-path of torque coordination					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_P_D_SLOW_IS	-	0... FFFFH	0... 1.99996948	30.5175e-6	-
LDPM_TCO_IS_1	8	0... FEH	-48... 142.5	0.75	°C
LDPM_TQ_ADD_CH_IS_1	6	0... FFFFH	-1024... 1023.97	0.03125	Nm
TCO and TQ_ADD_CH depending factor for slow-path of torque coordination					
IP_FAC_T_AST_I_IS_OPM_1	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
LDPM_TCO__FAC_N_GRD_IS_2	4	0... FEH	-48... 142.5	0.75	°C
LDPM_T_AST__FAC_N_GRD_IS	8	0... FFFFH	0... 6553.5	0.1	s
TQ_ADD_I_IS correction after start in operation mode 1					
IP_FAC_T_AST_I_IS_OPM_2	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_TCO__FAC_N_GRD_IS_2	4	0... FEH	-48... 142.5	0.75	°C
LDPM_T_AST__FAC_N_GRD_IS	8	0... FFFFH	0... 6553.5	0.1	s
TQ_ADD_I_IS correction after start in operation mode 2					
IP_FAC_TCO_PAS_I_IS	-	0... FFH	0... 0.99609	0.0039063	-
LDP_TCO__FAC_TCO_PAS_I_IS	4	0... FEH	-48... 142.5	0.75	°C
TCO correction at entry in I - share calculation					
IP_P_D_DT_IS_OPM_1	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_P_D_DT_IS_OPM_1	12	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_P_D_DT_IS_OPM_1	8	0... FFH	-4096 ...4064	32	rpm/s
P- and D-component for idle speed controller at closed drive train (mode1)					
IP_P_D_DT_IS_OPM_2	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_P_D_DT_IS_OPM_1	12	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_P_D_DT_IS_OPM_1	8	0... FFH	-4096 ...4064	32	rpm/s
P- and D-component for idle speed controller at closed drive train (mode2)					
IP_P_D_DT_IS_SLOW_OPM_1	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_P_D_DT_IS_OPM_1	12	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_P_D_DT_IS_OPM_1	8	0... FFH	-4096 ...4064	32	rpm/s
P- and D-component for idle speed controller at closed drive train (mode1)					
IP_P_D_DT_IS_SLOW_OPM_2	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_P_D_DT_IS_OPM_1	12	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_P_D_DT_IS_OPM_1	8	0... FFH	-4096 ...4064	32	rpm/s
P- and D-component for idle speed controller at closed drive train (mode2)					
IP_P_D_IS_OPM_1	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_P_D_IS_OPM_1	12	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_P_D_IS_OPM_1	8	0... FFH	-4096 ...4064	32	rpm/s
P- and D-component for idle speed controller at open drive train (mode1)					
IP_P_D_IS_OPM_2	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_P_D_IS_OPM_1	12	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_P_D_IS_OPM_1	8	0... FFH	-4096 ...4064	32	rpm/s
P- and D-component for idle speed controller at open drive train (mode2)					
IP_P_D_IS_SLOW_OPM_1	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_P_D_IS_OPM_1	12	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_P_D_IS_OPM_1	8	0... FFH	-4096 ...4064	32	rpm/s
P- and D-component for idle speed controller at open drive train (mode1)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_P_D_IS_SLOW_OPM_2	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_P_D_IS_OPM_1	12	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_P_D_IS_OPM_1	8	0... FFH	-4096 ...4064	32	rpm/s
P- and D-component for idle speed controller at open drive train (mode2)					
IP_TQ_I_DT_IS_OPM_1	-	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
LDPM_N_DIF_COR_TQ_I_DT_IS_OPM_1	12	0... FFFFH	-32768 ...32767	1	rpm
I-component for idle speed controller at closed drive train (mode1)					
IP_TQ_I_DT_IS_OPM_2	-	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
LDPM_N_DIF_COR_TQ_I_DT_IS_OPM_2	12	0... FFFFH	-32768 ...32767	1	rpm
I-component for idle speed controller at closed drive train (mode2)					
IP_TQ_I_IS_OPM_1	-	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
LDPM_N_DIF_COR_TQ_I_IS_1_OPM_1	12	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_TQ_I_IS_1_OPM_1	8	0... FFH	-4096 ...4064	32	rpm/s
I-component for idle speed controller at open drive train (mode1)					
IP_TQ_I_IS_OPM_2	-	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
LDPM_N_DIF_COR_TQ_I_IS_1_OPM_2	12	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_TQ_I_IS_1_OPM_2	8	0... FFH	-4096 ...4064	32	rpm/s
I-component for idle speed controller at open drive train (mode2)					
IP_TQ_PAS_I_ACC_IS_OPM_1	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_TQ_I_IS_OPM_1	4	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_TQ_I_IS_OPM_1	4	0... FFH	-4096 ...4064	32	rpm/s
I-component for idle speed controller at transition out of Passive with air condition (mode1)					
IP_TQ_PAS_I_ACC_IS_OPM_2	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_TQ_I_IS_OPM_2	4	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_TQ_I_IS_OPM_2	4	0... FFH	-4096 ...4064	32	rpm/s
I-component for idle speed controller at transition out of Passive with air condition (mode2)					
IP_TQ_PAS_I_IS_OPM_1	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_TQ_I_IS_OPM_1	4	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_TQ_I_IS_OPM_1	4	0... FFH	-4096 ...4064	32	rpm/s
I-component for idle speed controller at transition out of Passive with (mode1)					
IP_TQ_PAS_I_IS_OPM_2	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_TQ_I_IS_OPM_2	4	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_TQ_I_IS_OPM_2	4	0... FFH	-4096 ...4064	32	rpm/s
I-component for idle speed controller at transition out of Passive with (mode2)					
LC_ISC_INH	-	0... 1H	0 ...1	1	-
Bit for inhibiting the PD- and integral part - default value = 0					
LC_N_GRD_FIL_I_SWI	-	0... 1H	0 ...1	1	-
Logical variable for changing between N_GRD_FIL_1_IS and N_GRD_FIL_IS					
LC_N_GRD_FIL_P_D_SWI	-	0... 1H	0 ...1	1	-
Logical variable for switching between N_GRD_FIL_1_IS and N_GRD_FIL_IS					
LC_P_D_ACT_FAST_AT	-	0... 1H	0 ...1	1	-
Logical variable to activate LV_TQ_P_D_FAST_out for automatic transmission path					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_P_D_ACT_FAST_MT	-	0... 1H	0 ...1	1	-
Logical variable to activate LV_TQ_P_D_FAST_out for manual transmission path					
LC_P_D_SLOW_FAST_SEL_ENA	-	0... 1H	0 ...1	1	-
Enable separation of slow and fast path of TQ_DIF_P_D_IS - default value at initialisation = 0					
LC_TQ_ADD_I_INH_AS	-	0... 1H	0 ...1	1	-
Logical variable for ISC I-part map output deactivation - default value at initialisation = 0					
LC_TQ_DIF_I_INH_AS	-	0... 1H	0 ...1	1	-
Logical variable for ISC I-part deactivation (completely) - default value at initialisation = 0					
LC_TQ_DIF_I_IS_DT_INI	-	0... 1H	0 ...1	1	-
Logical variable to activate the re-initialisation of I-Part of idle speed controller at LV_DT=1->0					
LC_TQ_DIF_P_D_INH_AS	-	0... 1H	0 ...1	1	-
Bit for inhibiting the PD-part - default value = 0					
LC_TQ_P_D_FAST_INH_AS	-	0... 1H	0 ...1	1	-
Logical variable for deactivation of TQ_DIF_P_D_IS - default value at initialisation = 0					
LC_TQ_P_D_SLOW_INH_AS	-	0... 1H	0 ...1	1	-
Logical variable for deactivation of TQ_DIF_P_D_IS - default value at initialisation = 0					

### Local actions:

<b>ACTION_ENSC_OPERATION_MANAGER</b> (IN <IN1>, IN <IN2>, OUT <OUT>, OUT <TQ_DIF_OPM_1>, OUT <TQ_DIF_OPM_2>)
Operation manager

### Overview

The controller consists of three parts:

PD-part

PD-part separation into slow and fast path

I-part

An operation mode manager splits up each controller part (applied for 2 different operation modes) in accordance with the received interpolation factor FAC\_TQ\_ADD\_IS\_OPM\_SEL.

The operation manager for idle speed control operates with the operation mode parameters used in the module *Idle speed torque reserve*.

### Application Condition

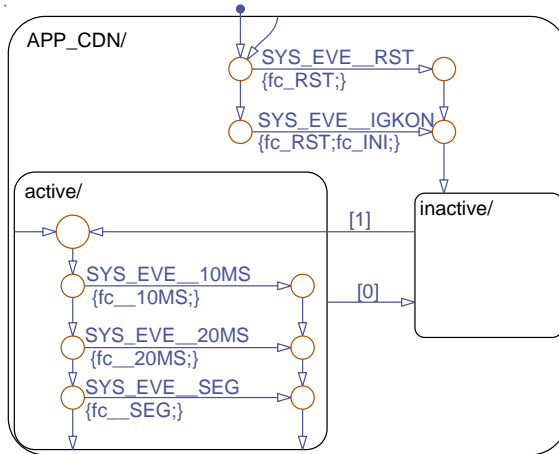



Figure 8.2.1: ENSC\_M8006/APP\_CDND/APPCND

**Function Description**

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 3448 of 8404</b>	
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on the active operation mode. If there is a switch from one mode to another a smooth changeover from one input value to the other is possible by using the interpolation factor FAC\_OPM\_SEL.

A special logic takes care that the needed part is calculated only. That means if OPM\_1 is active and there is no switch requested then the output value of the operation manager = IN\_1 and some part of the algorithm for IN\_2 are not calculated anymore. In this case the bit LV\_OPM\_SEL\_1=1 indicates that only the calculation of the IN\_1-path is done.

The information of the actual and the requested operation mode can be changed by interpretations maps ID\_...OPM\_SEL. The effect of this is, that by calibration the operation mode 1 can be wired to the input 2. That means the belonging for a operation mode to an input value is flexible.

The following tables defines the local variables described above:

Common variables:

OPM_AV (from Layer)	OPM_AV	Input	Actual operation mode
OPM_REQ (from Layer)	OPM_REQ	Input	Requested operation mode
-	OPM_SEL_AV	Internal value	Actual active operation mode after interpretation
-	OPM_SEL_REQ	Internal value	Requested operation mode after interpretation
FAC_TQ_ADD_IS_OPM_SEL (from Layer)	FAC_OPM_SEL	Input	Interpolation factor
LV_TQ_DIF_IS_OPM_SEL_1	LV_OPM_SEL_1	Output	Operation mode 1 active
LV_TQ_DIF_IS_OPM_SEL_2	LV_OPM_SEL_2	Output	Operation mode 2 active
LV_TQ_DIF_IS_OPM_RLS	LV_OPM_RLS	Output	Operation mode within valid range
ID_TQ_ADD_IS_OPM_AV	ID_OPM_AV	cal	Mapping of active operation mode
ID_TQ_ADD_IS_OPM_REQ	ID_OPM_REQ	cal	Mapping of requested operation mode

Controller parameter:

**P\_D\_SLOW:**

TQ_DIF_P_D_IS_SLOW_OPM_1	IN_1	Input	Input value for operation mode 1
TQ_DIF_P_D_IS_SLOW_OPM_2	IN_2	Input	Input value for operation mode 2
TQ_DIF_P_D_IS_SLOW_SEL	OUT	Output	Result of interpolation

**P\_D\_FAST:**

TQ_DIF_P_D_IS_OPM_1	IN_1	Input	Input value for operation mode 1
TQ_DIF_P_D_IS_OPM_2	IN_2	Input	Input value for operation mode 2
TQ_DIF_P_D_IS_SEL	OUT	Output	Result of interpolation

**P\_D\_DT\_SLOW:**

TQ_DIF_P_D_DT_IS_SLOW_OPM_1	IN_1	Input	Input value for operation mode 1
TQ_DIF_P_D_DT_IS_SLOW_OPM_2	IN_2	Input	Input value for operation mode 2
TQ_DIF_P_D_DT_IS_SLOW_SEL	OUT	Output	Result of interpolation

**P\_D\_DT\_FAST:**

TQ_DIF_P_D_DT_IS_OPM_1	IN_1	Input	Input value for operation mode 1
TQ_DIF_P_D_DT_IS_OPM_2	IN_2	Input	Input value for operation mode 2
TQ_DIF_P_D_DT_IS_SEL	OUT	Output	Result of interpolation

**I:**

TQ_I_IS_OPM_1	IN_1	Input	Input value for operation mode 1
TQ_I_IS_OPM_2	IN_2	Input	Input value for operation mode 2
TQ_I_IS_SEL	OUT	Output	Result of interpolation

**I\_DT:**

TQ_I_DT_IS_OPM_1	IN_1	Input	Input value for operation mode 1
TQ_I_DT_IS_OPM_2	IN_2	Input	Input value for operation mode 2
TQ_I_DT_IS_SEL	OUT	Output	Result of interpolation

**I\_PAS:**

TQ_PAS_I_IS_OPM_1	IN_1	Input	Input value for operation mode 1
TQ_PAS_I_IS_OPM_2	IN_2	Input	Input value for operation mode 2
TQ_PAS_I_IS_SEL	OUT	Output	Result of interpolation

**I\_PAS\_ACC:**

TQ_PAS_I_ACC_IS_OPM_1	IN_1	Input	Input value for operation mode 1
TQ_PAS_I_ACC_IS_OPM_2	IN_2	Input	Input value for operation mode 2
TQ_PAS_I_ACC_IS_SEL	OUT	Output	Result of interpolation

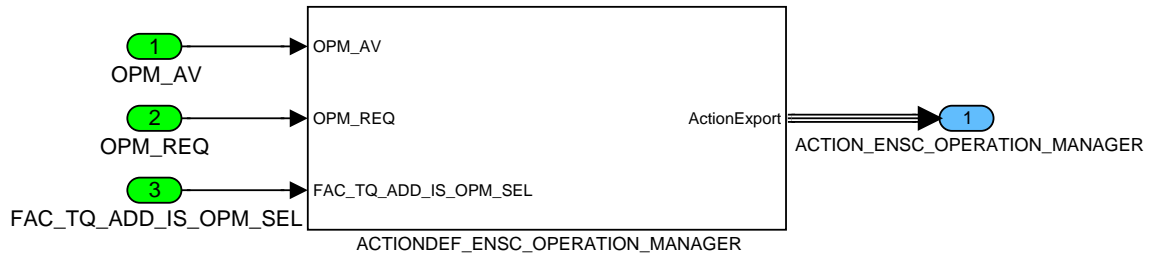


Figure 8.2.3: ENSC\_M8006/ACTION\_CALL

## 8.2.2 Operation Manager Overview

### Description for ACTION\_ENSC\_OPERATION\_MANAGER

ACTION_ENSC_OPERATION_MANAGER(IN <IN1>, IN <IN2>, OUT <OUT>, OUT <TQ_DIF_OPM_1>, OUT <TQ_DIF_OPM_2>)					
Operation manager for idle speed controller					
Parameter	Type	Hex. limits	Phys. limits	Resol.	Unit
IN1	IN	8000...7FFFH	-1.024E+3 ... 1.02397E+3	0.03125	Nm
Input to action manager					
IN2	IN	8000...7FFFH	-1.024E+3 ... 1.02397E+3	0.03125	Nm
Input to action manager					
OUT	OUT	8000...7FFFH	-1.024E+3 ... 1.02397E+3	0.03125	Nm
Output of operation manager					
TQ_DIF_OPM_1	OUT	8000...7FFFH	-1.024E+3 ... 1.02397E+3	0.03125	Nm
Output #1 of operation manager					
TQ_DIF_OPM_2	OUT	8000...7FFFH	-1.024E+3 ... 1.02397E+3	0.03125	Nm
Output #2 of operation manager					

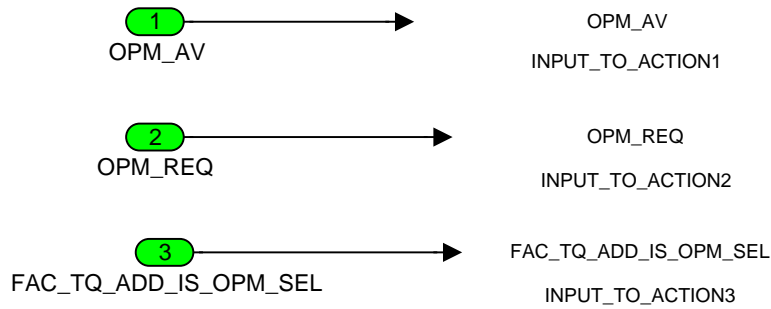
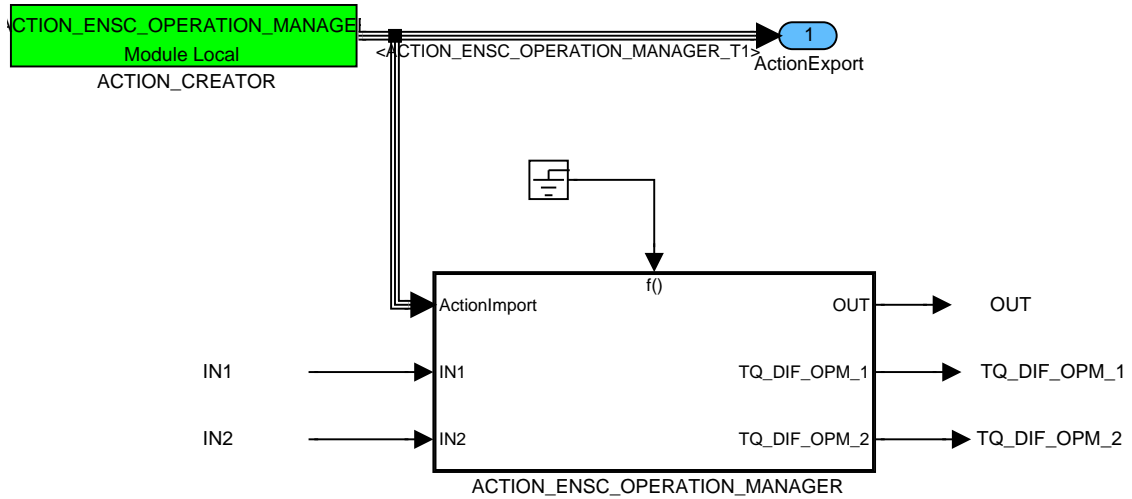


Figure 8.2.4: ENSC\_M8006/ACTION\_CALL/ACTIONDEF\_ENSC\_OPERATION\_MANAGER

**Selection of inputs to operation manager switch**

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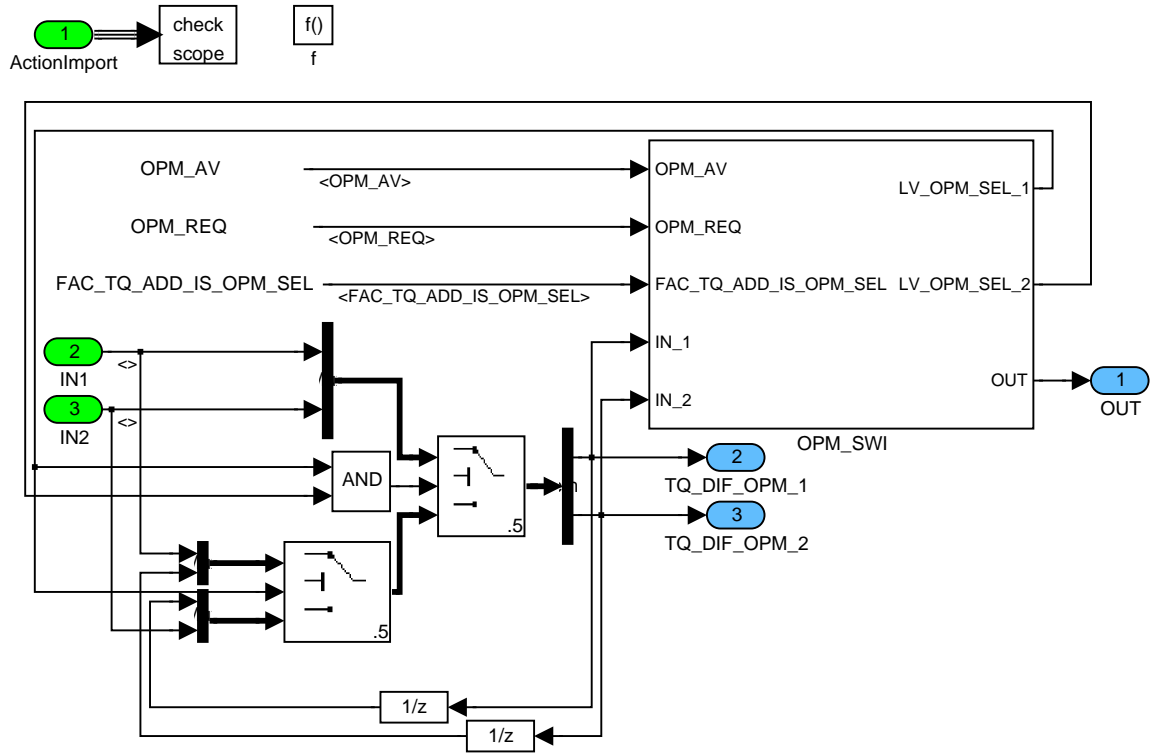



Figure 8.2.5: ENSC\_M8006/ACTION\_CALL/ACTIONDEF\_ENSC\_OPERATION\_MANAGER/ACTION\_ENSC\_OPERATION\_MANAGER

**Operation manager switch**

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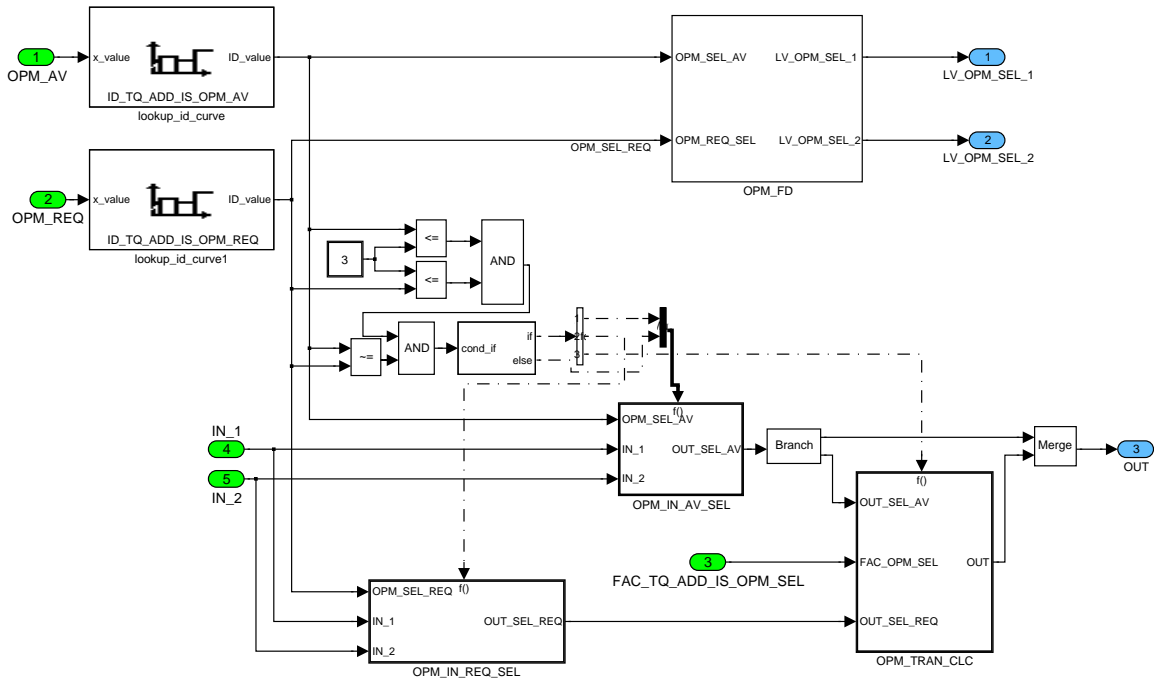


Figure 8.2.6: ENSC\_M8006/ACTION\_CALL/ACTIONDEF\_ENSC\_OPERATION\_MANAGER/ACTION\_ENSC\_OPERATION\_MANAGER/OPM\_SWI

**Operation manager feedback**

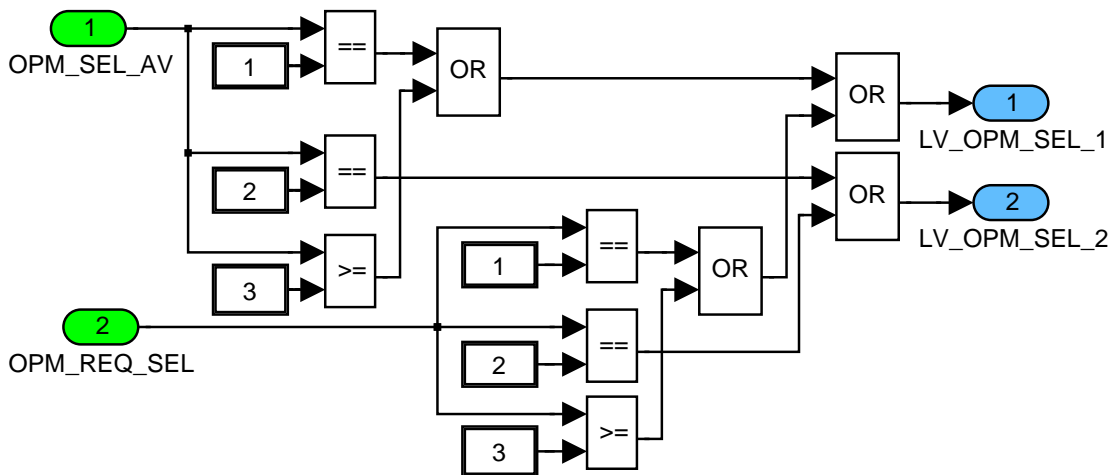


Figure 8.2.7: ENSC\_M8006/ACTION\_CALL/ACTIONDEF\_ENSC\_OPERATION\_MANAGER/ACTION\_ENSC\_OPERATION\_MANAGER/OPM\_SWI/OPM\_FD

**Selection of active operation mode**

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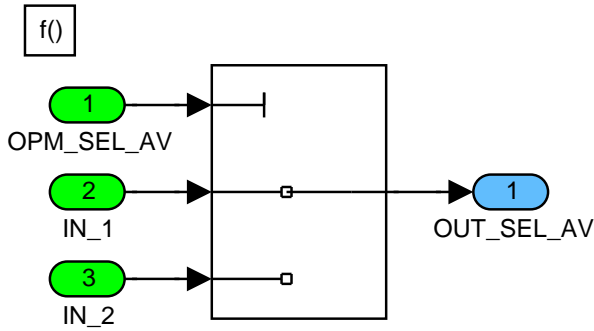


Figure 8.2.8: ENSC\_M8006/ACTION\_CALL/ACTIONDEF\_ENSC\_OPERATION\_MANAGER/ACTION\_ENSC\_OPERATION\_MANAGER/OPM\_SWI/OPM\_IN\_AV\_SEL

**Selection of requested operation mode**

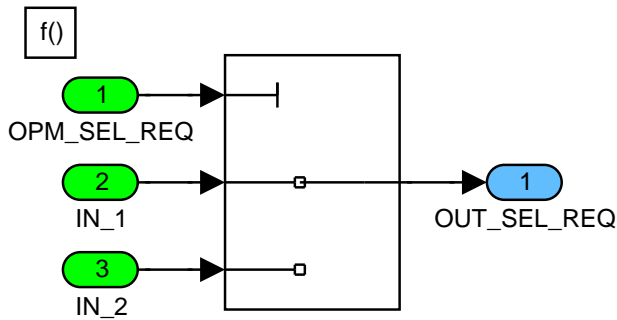


Figure 8.2.9: ENSC\_M8006/ACTION\_CALL/ACTIONDEF\_ENSC\_OPERATION\_MANAGER/ACTION\_ENSC\_OPERATION\_MANAGER/OPM\_SWI/OPM\_IN\_REQ\_SEL

**Output from the operation manager**

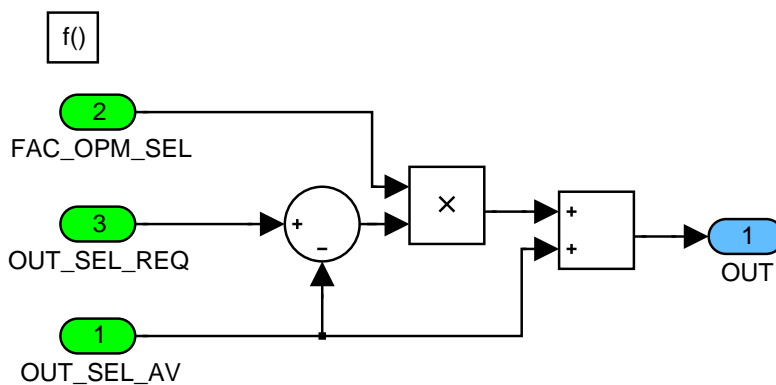


Figure 8.2.10: ENSC\_M8006/ACTION\_CALL/ACTIONDEF\_ENSC\_OPERATION\_MANAGER/ACTION\_ENSC\_OPERATION\_MANAGER/OPM\_SWI/OPM\_TRAN\_CLC

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### 8.2.3 Initialisation at system event reset and igkon

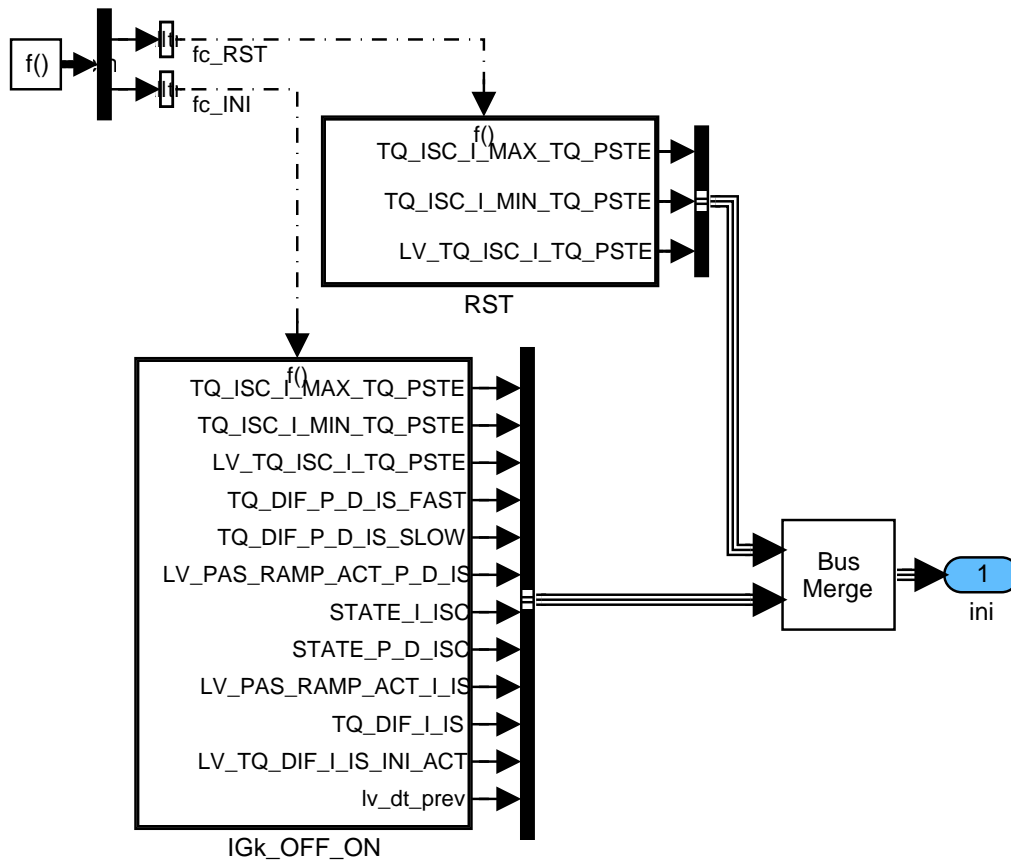


Figure 8.2.11: ENSC\_M8006/INI

#### Initialisation at igkon

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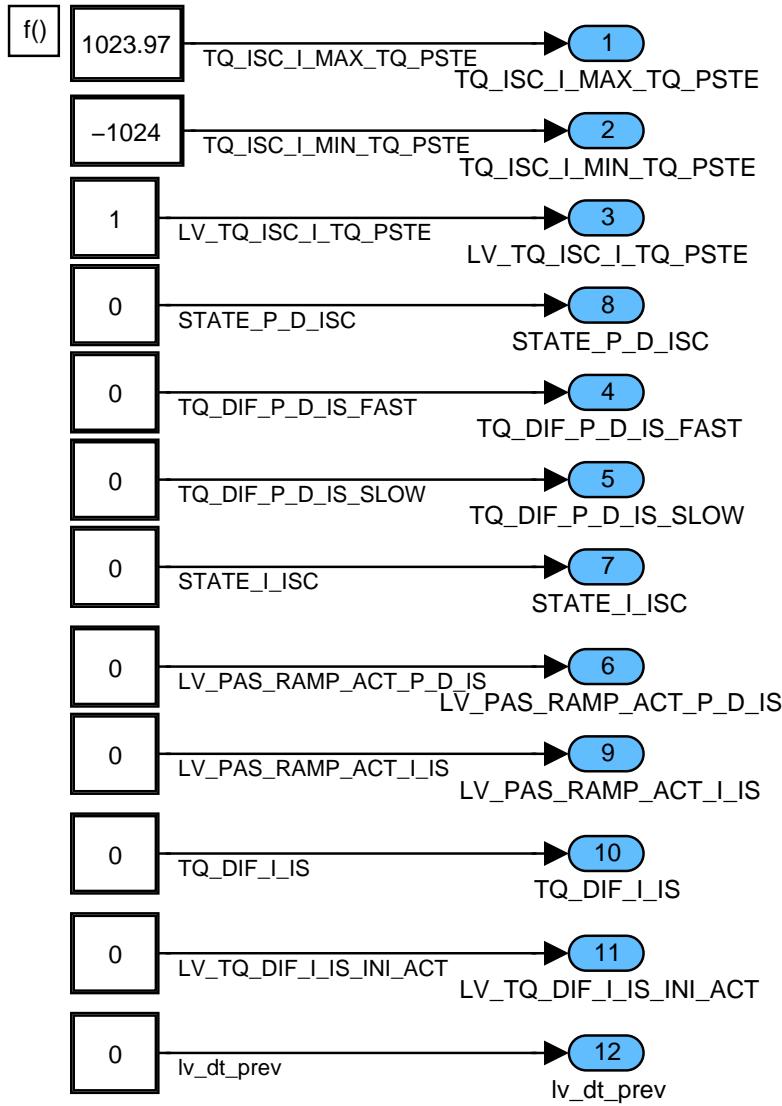


Figure 8.2.12: ENSC\_M8006/INI/IGk\_OFF\_ON

**Initialisation at system event reset**

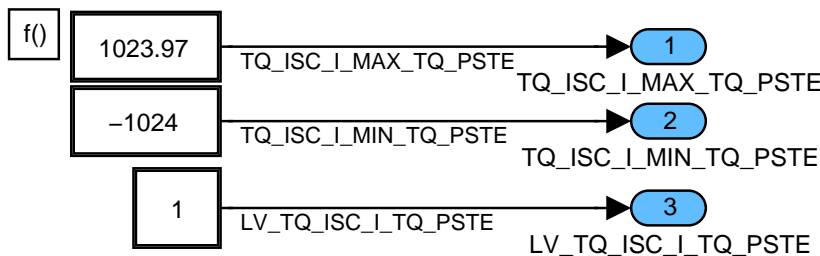


Figure 8.2.13: ENSC\_M8006/INI/RST

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### 8.2.4 Formula section

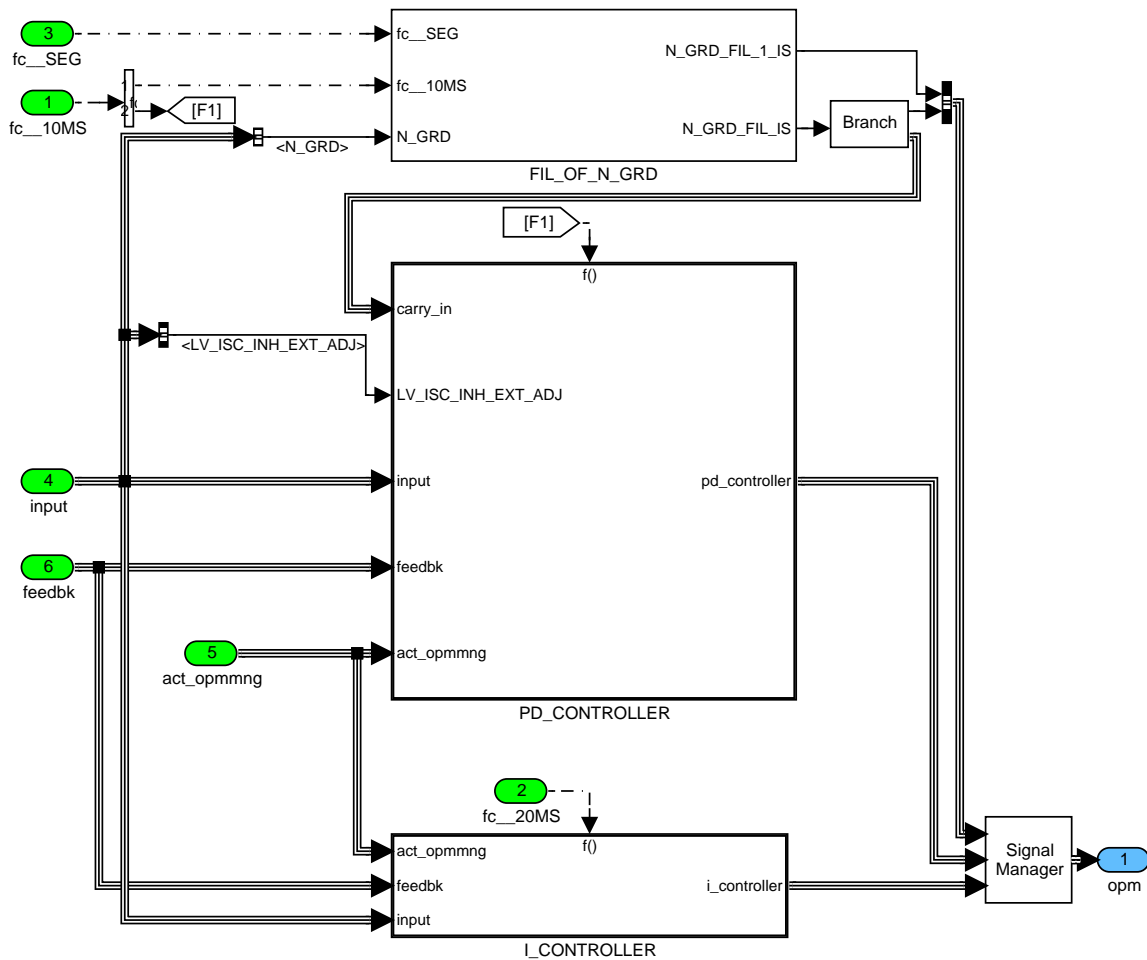


Figure 8.2.14: ENSC\_M8006/OPM

#### Filtering of N\_GRD

General information:

In order to be able to smooth the gradient for the idle speed control, there are 2 options for filtering the raw engine speed gradient `N_GRD`:

- 1) with ring buffer with 1 ... 6 buffers (calibrateable)
- 2) with 1<sup>st</sup> order low-pass filter.

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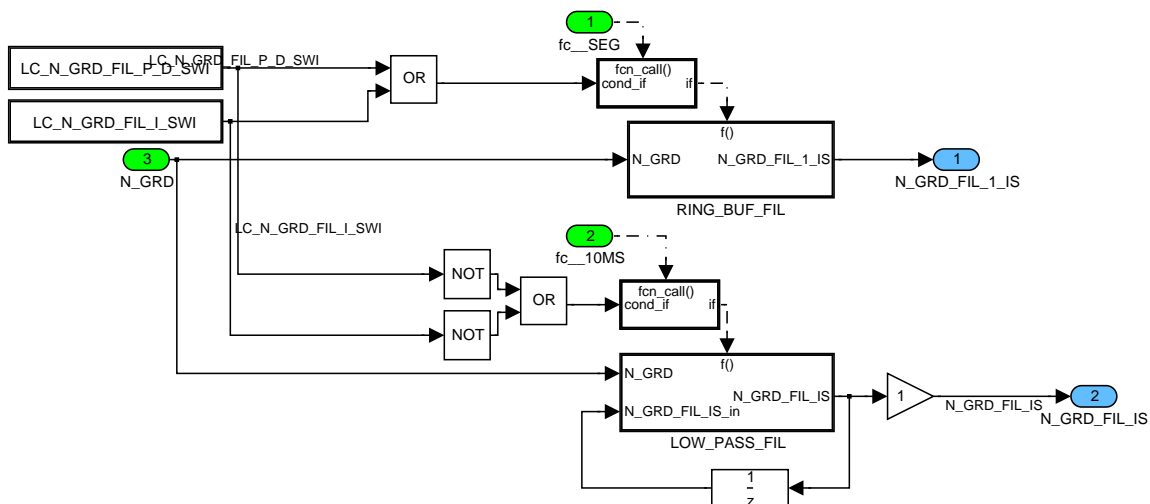


Figure 8.2.15: ENSC\_M8006/OPM/FIL\_OF\_N\_GRD

**Low pass filtering of N\_GRD at 10ms recurrence.**

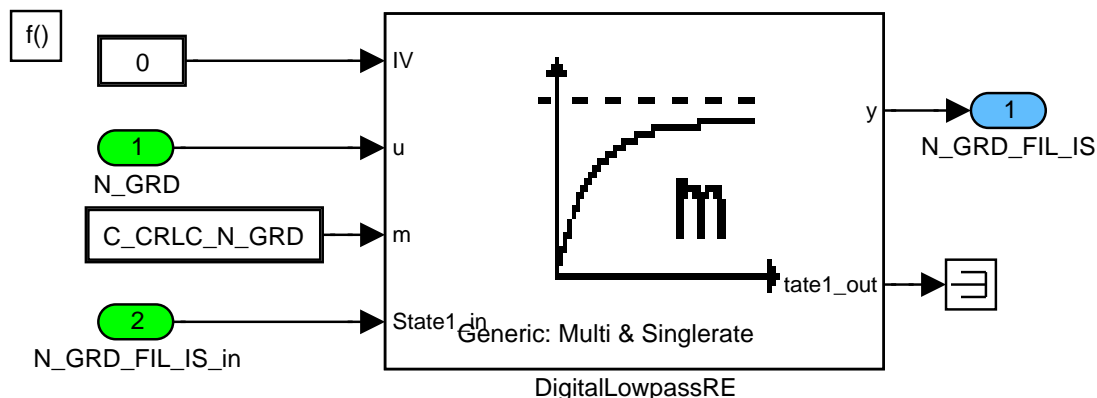


Figure 8.2.16: ENSC\_M8006/OPM/FIL\_OF\_N\_GRD/LOW\_PASS\_FIL

**Ring buffer filter at segment synchronous system recurrence**

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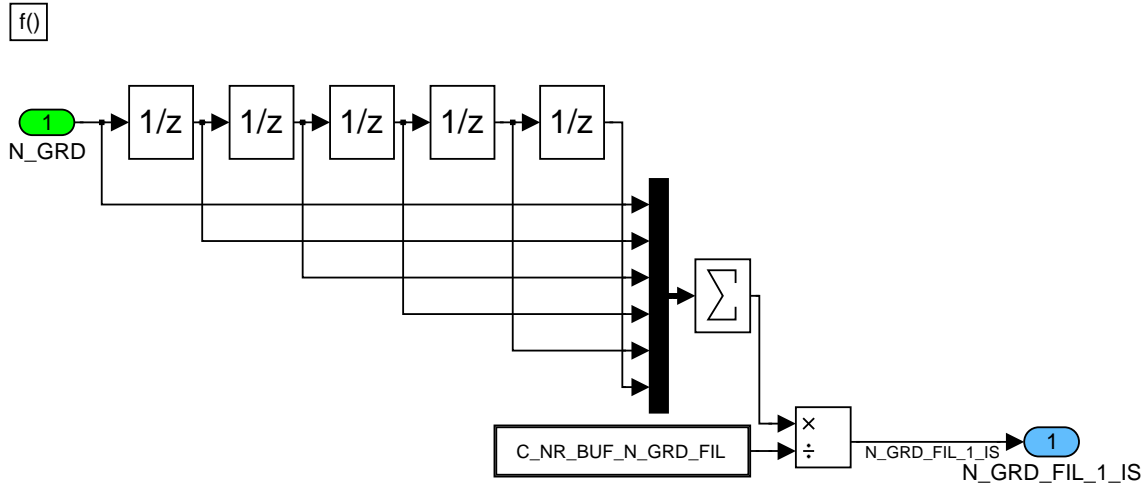


Figure 8.2.17: ENSC\_M8006/OPM/FIL\_OF\_N\_GRD/RING\_BUF\_FIL

**I-Controller**

General information:

**Signal flow diagram:**

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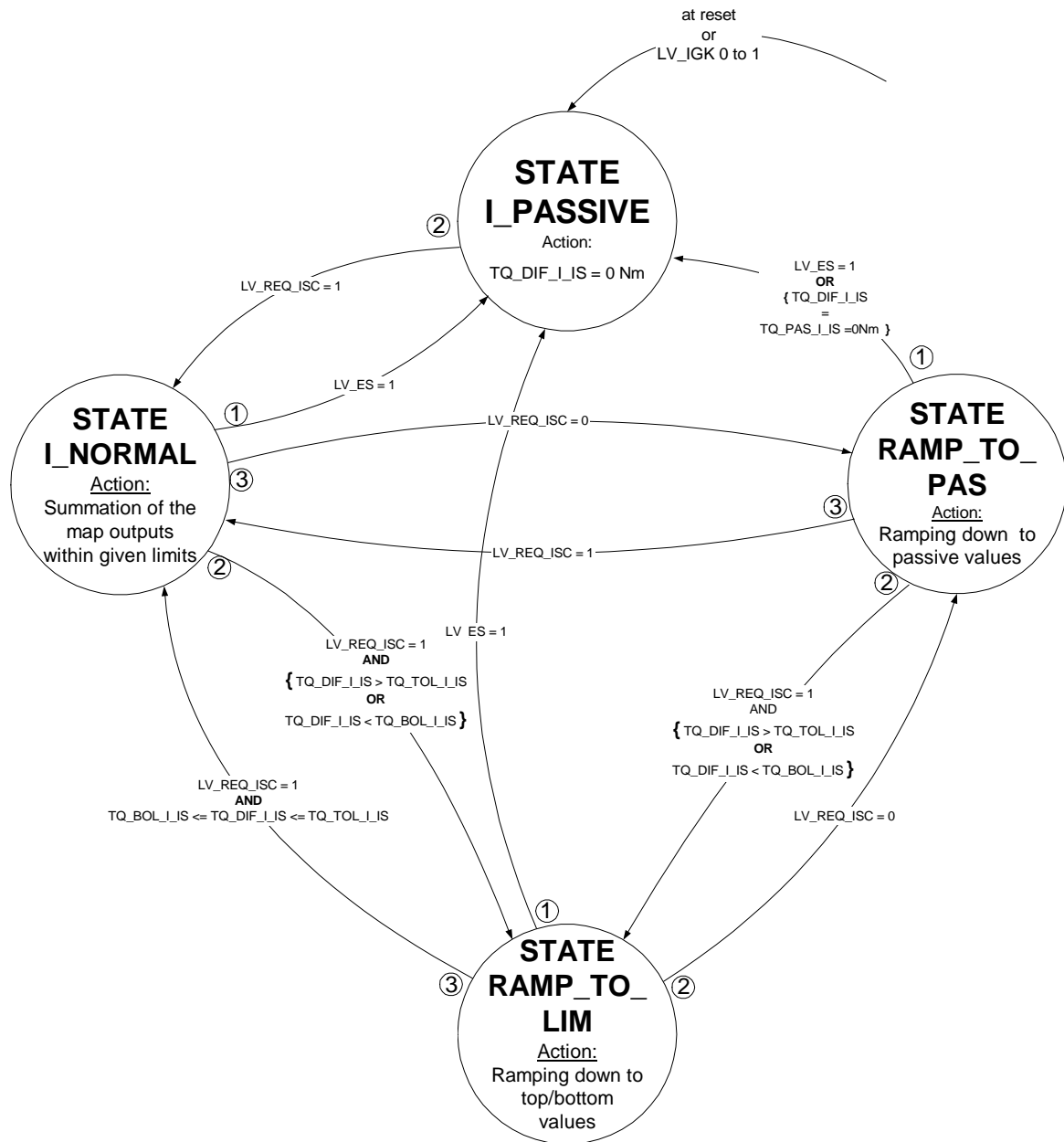


Figure 8.2.18: : State diagram of the integral part

The integral part is divided into four states:

#### STATE\_I\_ISC = I\_PASSIVE:

Initialization (at reset or when  $LV\_IGK = 0$  1; from all other states in case of  $LV\_ES = 1$ )

#### STATE\_I\_ISC = I\_NORMAL:

In this state the evaluation of the controller maps and the "normal" integration takes place.

#### STATE\_I\_ISC = RAMP\_TO\_LIM:

Ramp to limits; in this state the integral part is ramped down to the calibratable top/bottom limit values.

**STATE\_I\_ISC = RAMP\_TO\_PAS:**

Ramp to passive value 0 Nm; in this state the integral part is ramped down to zero in case LV\_REQ\_ISC = 0.

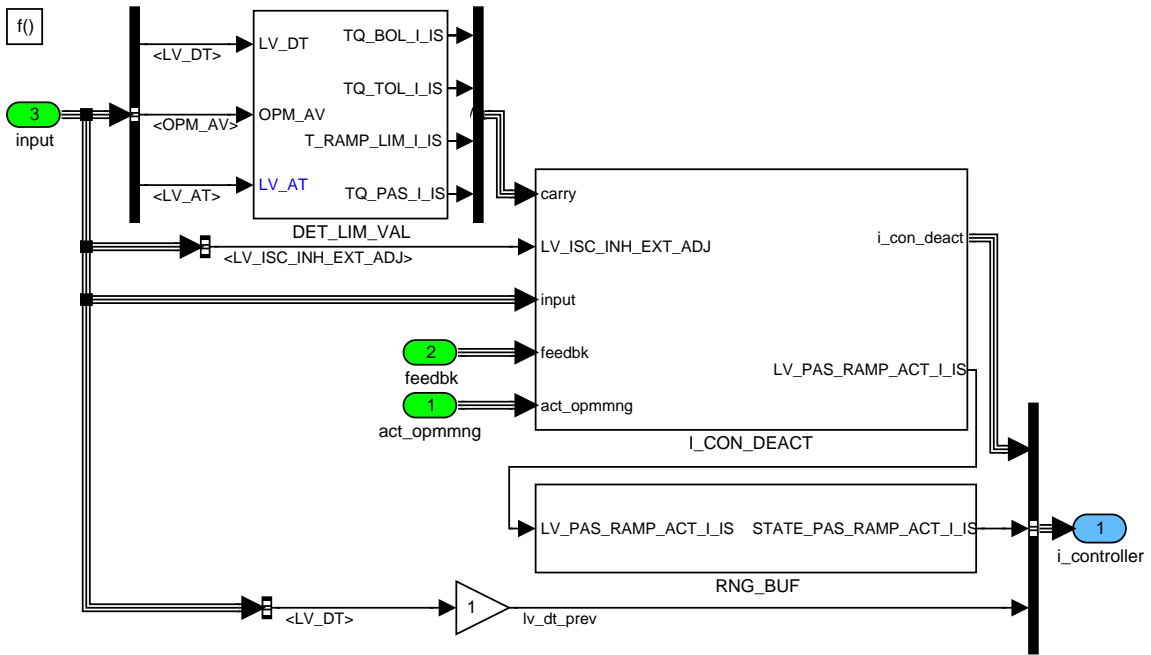


Figure 8.2.19: ENSC\_M8006/OPM/I\_CONTROLLER

**Determination of the top/bottom limit values:**

The passive value (**target value**) of the ramp operation is 0 Nm.  
TQ\_PAS\_I\_ISC = 0Nm

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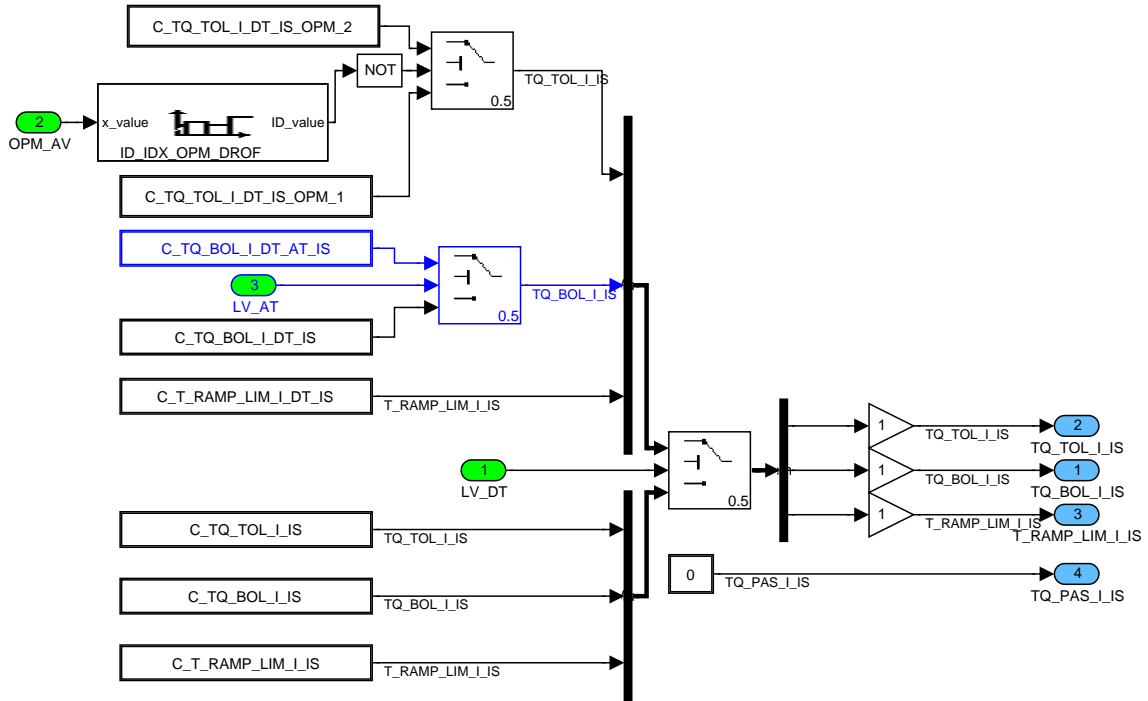


Figure 8.2.20: ENSC\_M8006/OPM/I\_CONTROLLER/DET\_LIM\_VAL

**Activation condition for I controller**

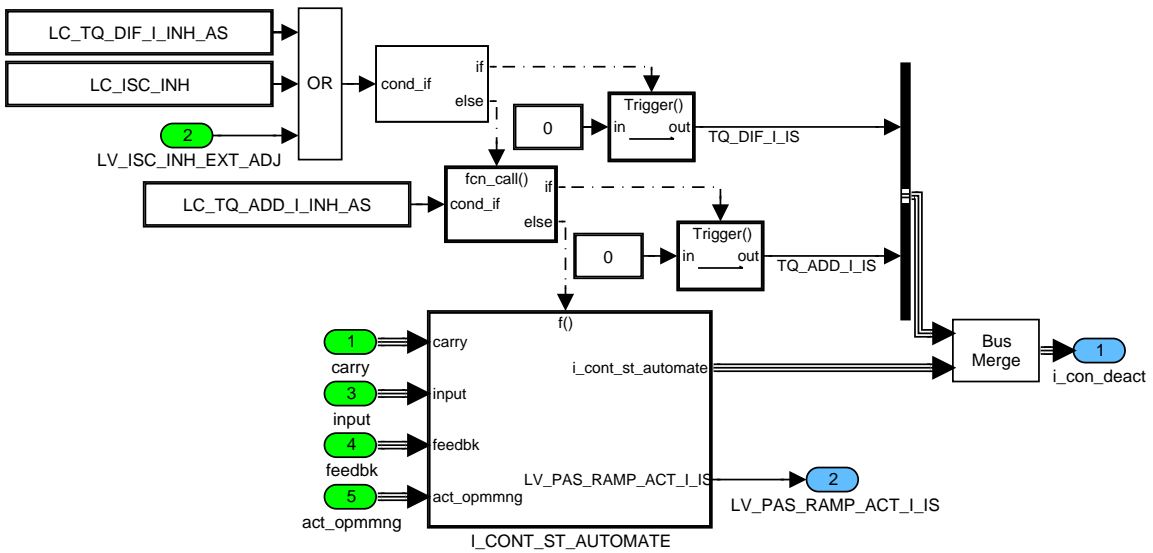


Figure 8.2.21: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT

**I controller overview**

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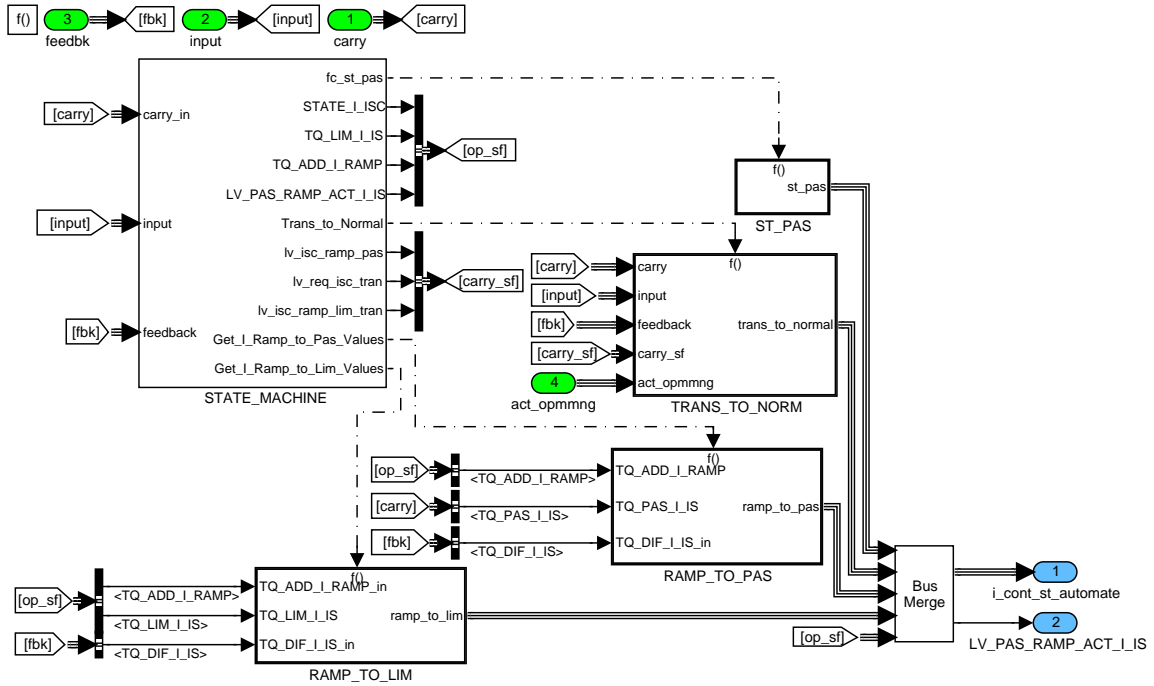



Figure 8.2.22: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE

**State machine of I controller**

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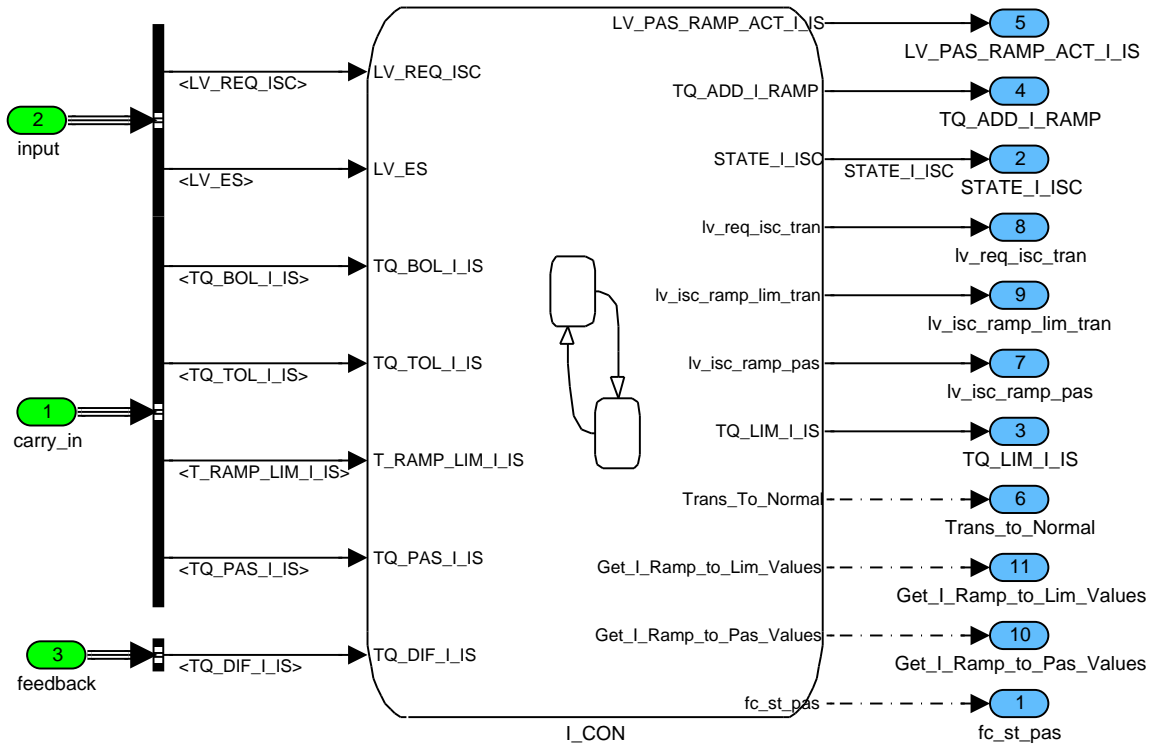


Figure 8.2.23:  
 ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/STATE\_MACHINE

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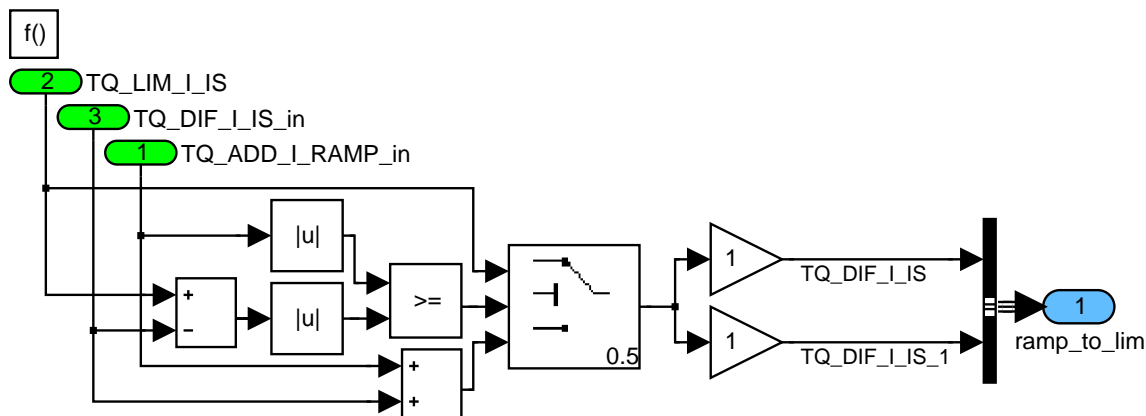


Figure 8.2.25:  
 ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/RAMP\_TO\_LIM

**Calculation at state passive**

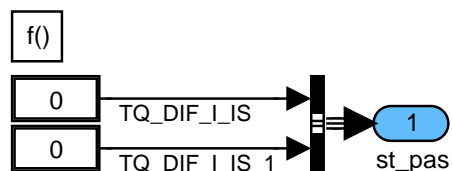


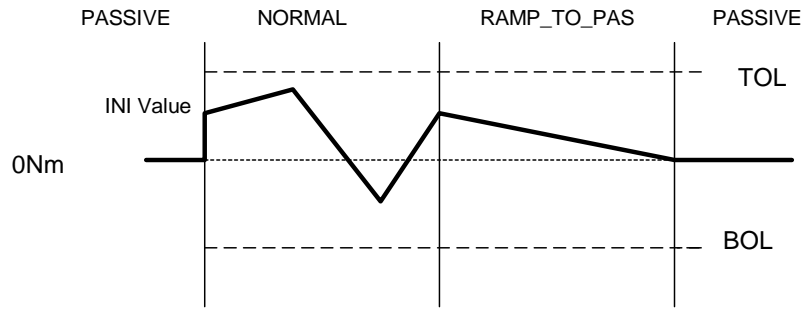
Figure 8.2.26:  
 ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/ST\_PAS

**Overview of calculations at normal state in state machine**

If idle speed control is reactivated during the ramp limit operation then the integrator starts with "first setting of TQ\_DIF\_I\_IS value (see. calculation of I\_NORMAL).

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**Example of I share calculation without limitation**



**Example of I share calculation with limitation**

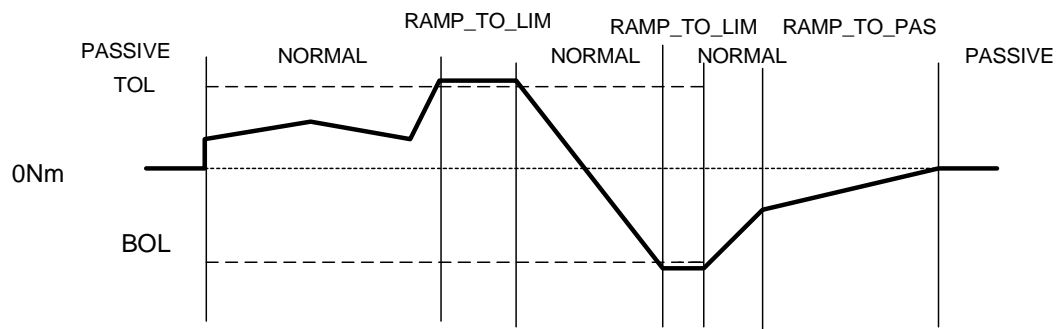


Figure 8.2.27: : Principle operation of I share

**Selection of N\_GRD\_I\_IS**

**Calculation N\_GRD\_I\_IS.**

N\_GRD\_I\_IS is calculated from N\_GRD\_FIL\_IS and N\_GRD\_FIL\_1\_IS.

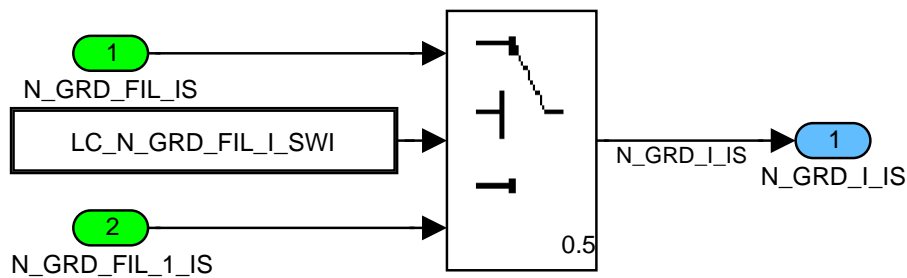



Figure 8.2.28: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/TRANS\_TO\_NORM/CLC\_N\_GRD\_I\_IS/CLC

**Check for transition from ramp to pas**

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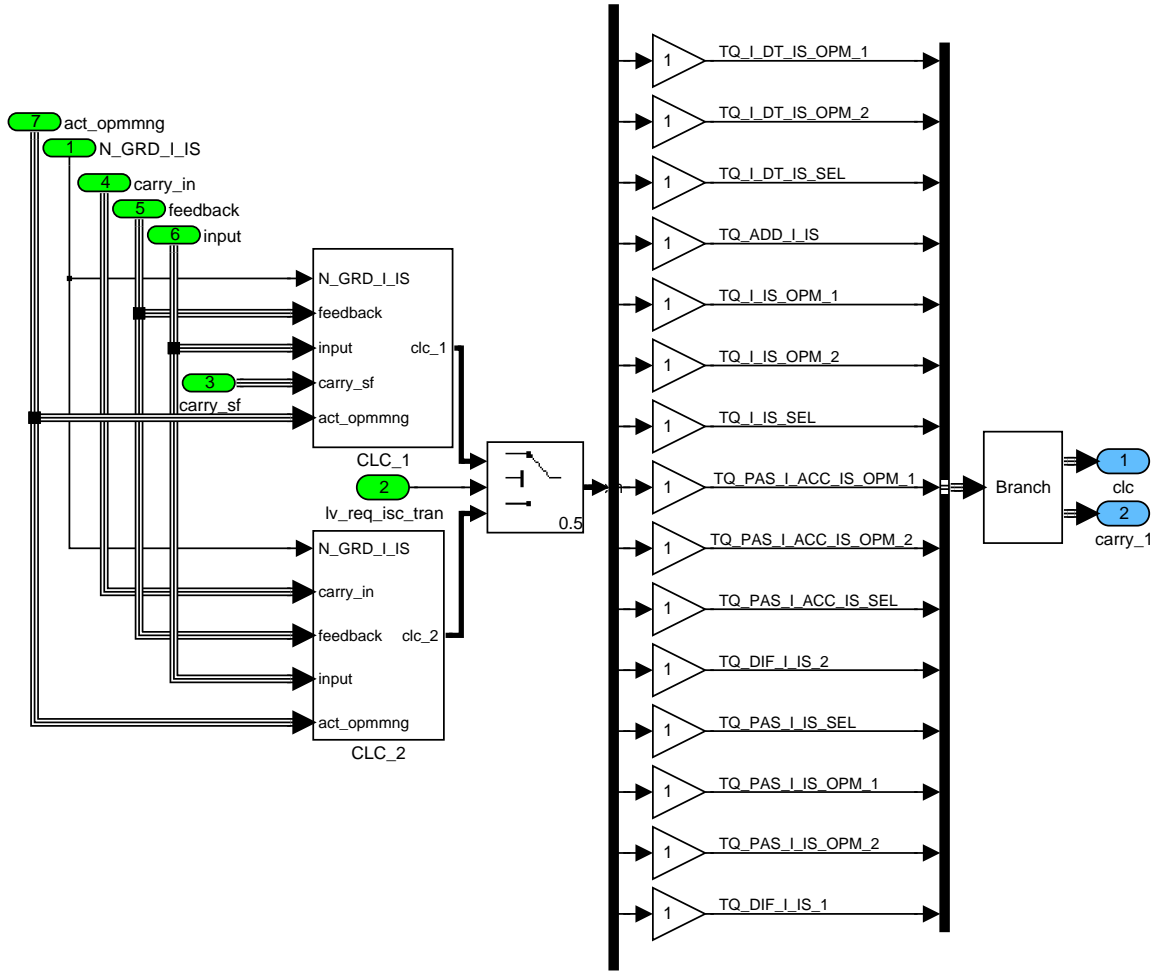


Figure 8.2.29: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/TRANS\_TO\_NORM/CLC

**Initialisaton of I share**

**Feed through**

Old values are passed as it is.

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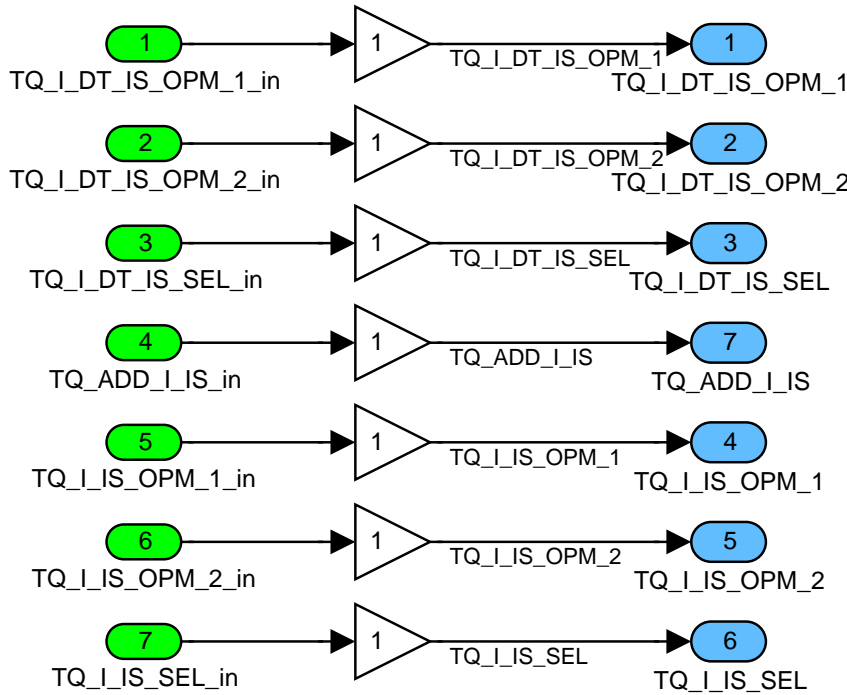


Figure 8.2.30: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/TRANS\_TO\_NORM/CLC/CLC\_1/DEFAULT

**Condition check on LV\_ACCOUT\_RLY variable.**

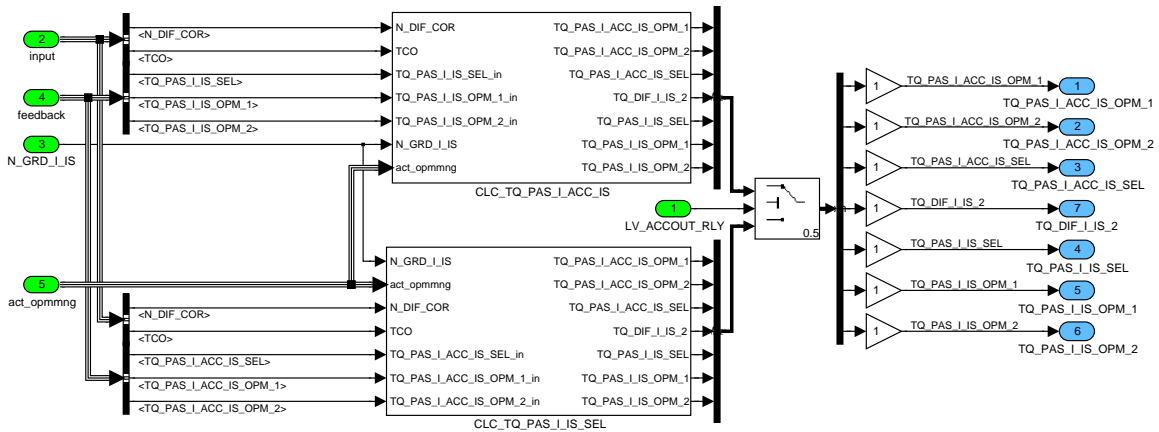


Figure 8.2.31: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/TRANS\_TO\_NORM/CLC/CLC\_1/CLC

**Calculation of TQ\_PAS\_I\_IS\_SEL and TQ\_DIF\_I\_IS\_2 when condition check LV\_ACCOUT\_RLY is false.**

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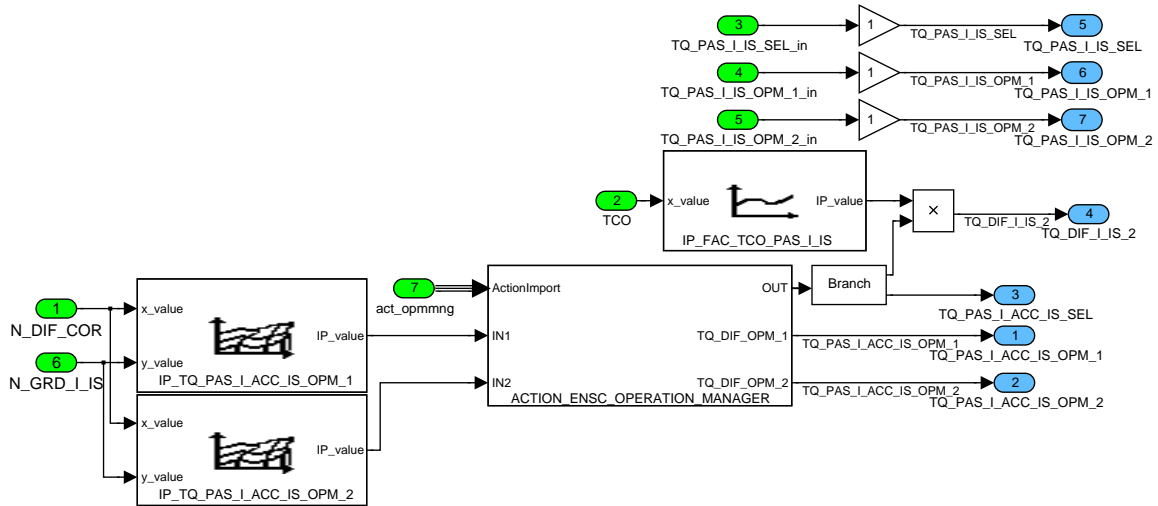


Figure 8.232: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/TRANS\_TO\_NORM/CLC/CLC\_1/CLC/CLC\_TQ\_PAS\_I\_ACC\_IS

**Calculation of TQ\_PAS\_I\_ACC\_IS\_SEL and TQ\_DIF\_I\_IS\_2 when condition check LV\_ACCOUT\_RLY is true.**

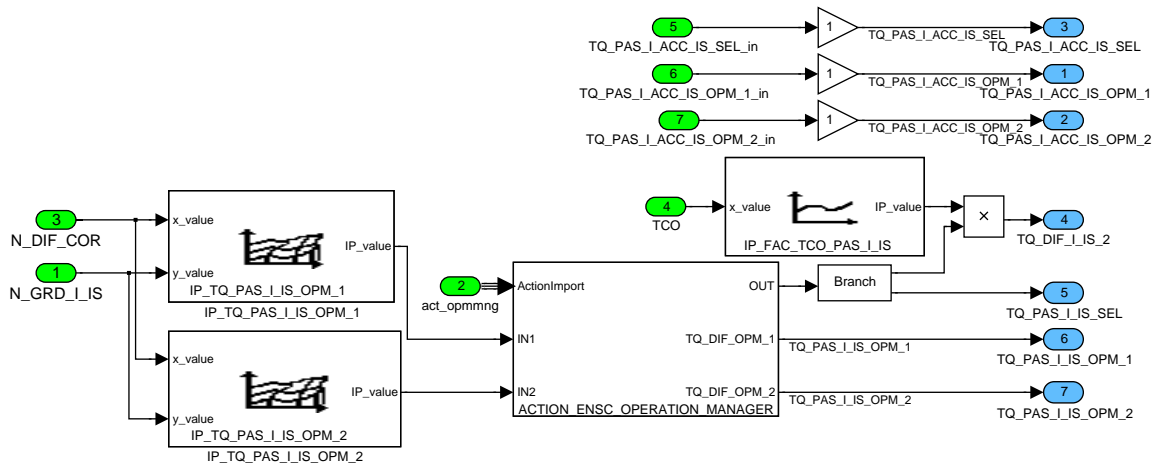


Figure 8.233: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/TRANS\_TO\_NORM/CLC/CLC\_1/CLC/CLC\_TQ\_PAS\_I\_IS\_SEL

**Calculation of TQ\_DIF\_I\_IS\_1**

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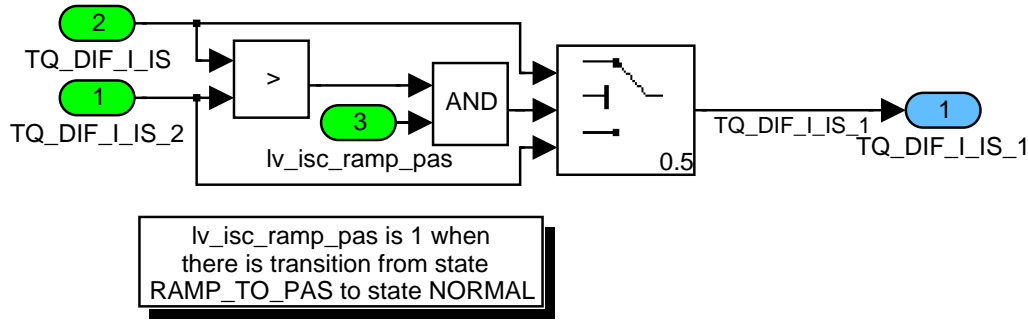


Figure 8.2.34: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/TRANS\_TO\_NORM/CLC/CLC\_1/CLC\_TQ\_DIF\_I\_IS\_1

**Calculation when there is no transition from passive or "ramp to pas" to normal state.**

**Condition check on LV\_DT and determination of TQ\_ADD\_I\_IS**

In STATE I\_NORMAL, see figure 5, the "normal" integration takes place. A torque difference TQ\_ADD\_I\_IS is determined in dependence of the speed deviation N\_DIF\_COR and the speed gradient N\_GRD\_I\_IS (for LV\_DT = 0) and only in dependence of the speed deviation N\_DIF\_COR for LV\_DT = 1 and in addition depending on time after start T\_AST, figure 6.

Considering the operation mode manager there are included separated paths in the functionality for the calculation of the idle speed controller I-share. This enables a proper engine running in throttled and unthrottled mode. Also in after start an additional factor is used for each mode.


To reach two important targets, TQ\_ADD\_I\_IS should be calibrated as follows:

compensation of a speed offset

automatic precalibration of the integral part: if there is a load active after the driver released the gas pedal (ACC, power steering, etc), then speed falls with a higher gradient into idle range than in comparison to the situation without load. This means, that the integral part should carry higher (positive) values to intercept speed. That means, that with the help of the gradient dependency in the integral part an automatic precalibration of the TQ\_ADD\_I\_IS (so TQ\_DIF\_I\_IS) can be reached, which is load dependant. It must be said, that this interception function must be synchronized with the PD-part calibration. With the correct calibration, the passive values are not needed any more.

The integration takes place within calibratable boundaries, figure 7.

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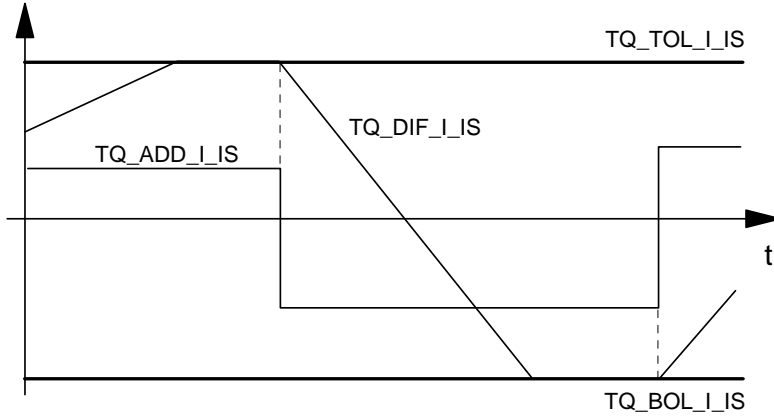


Figure 8.2.35: : Limited integration

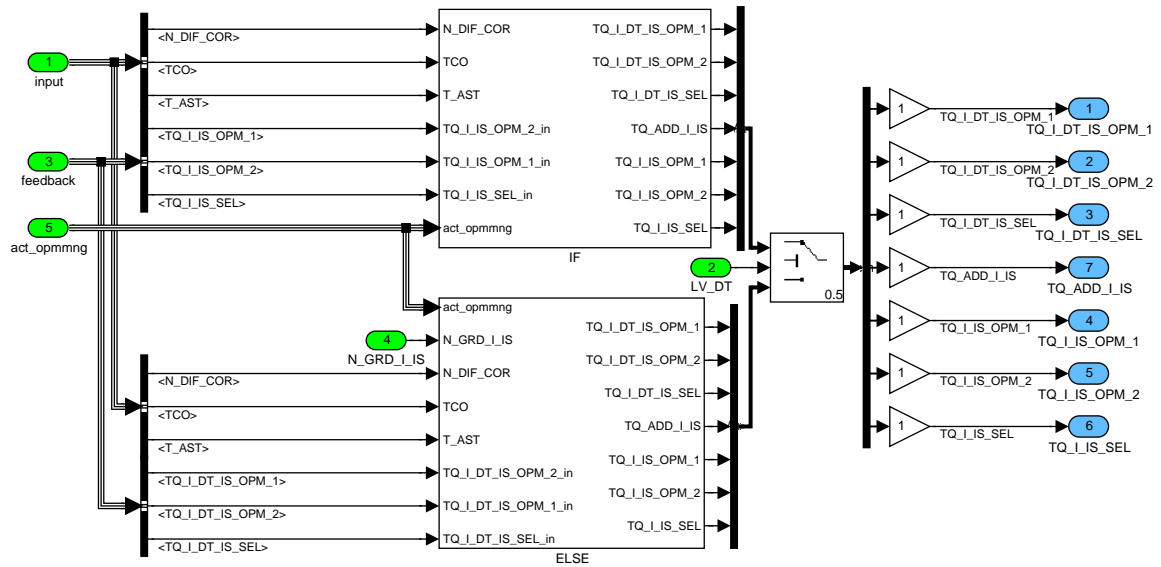


Figure 8.2.36: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/TRANS\_TO\_NORM/CLC/CLC\_2/CLC\_1

**Calculation of TQ\_ADD I IS, TQ I DT IS SEL, TQ I DT IS OPM 1 and TQ I DT IS OPM 2**

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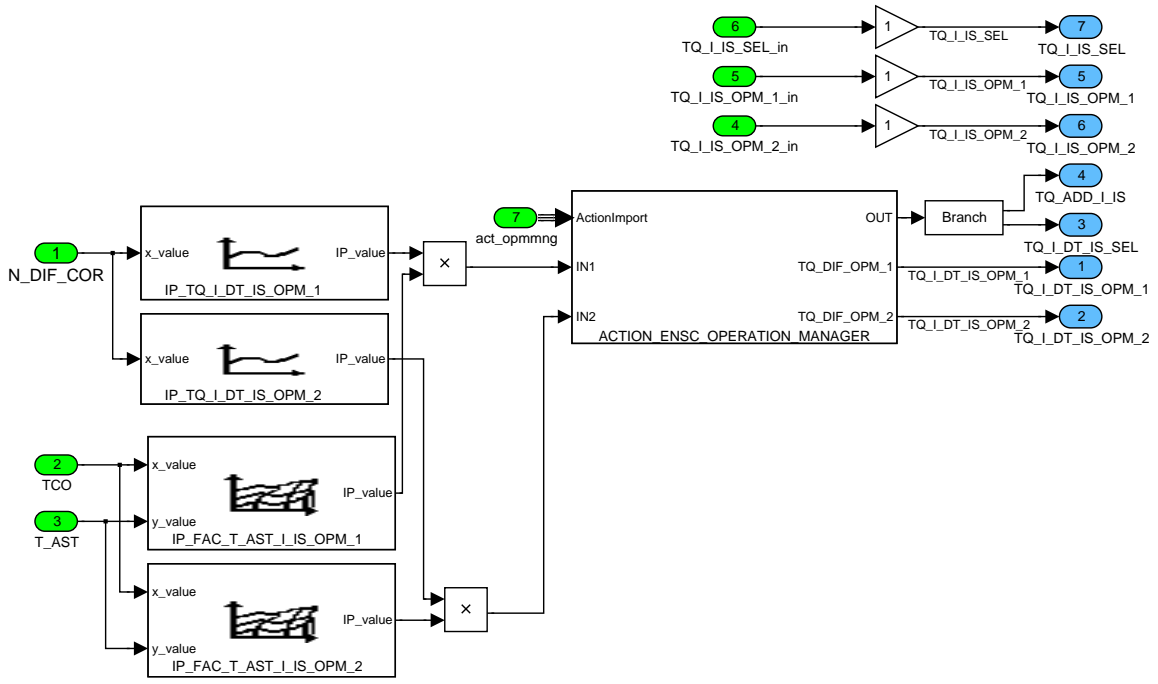



Figure 8.2.37: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/TRANS\_TO\_NORM/CLC/CLC\_2/CLC\_1/IF

**Calculation of TQ\_ADD\_I\_IS, TQ\_I\_IS\_SEL, TQ\_I\_IS\_OPM\_1 and TQ\_I\_IS\_OPM\_2**

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 3475 of 8404</b>	
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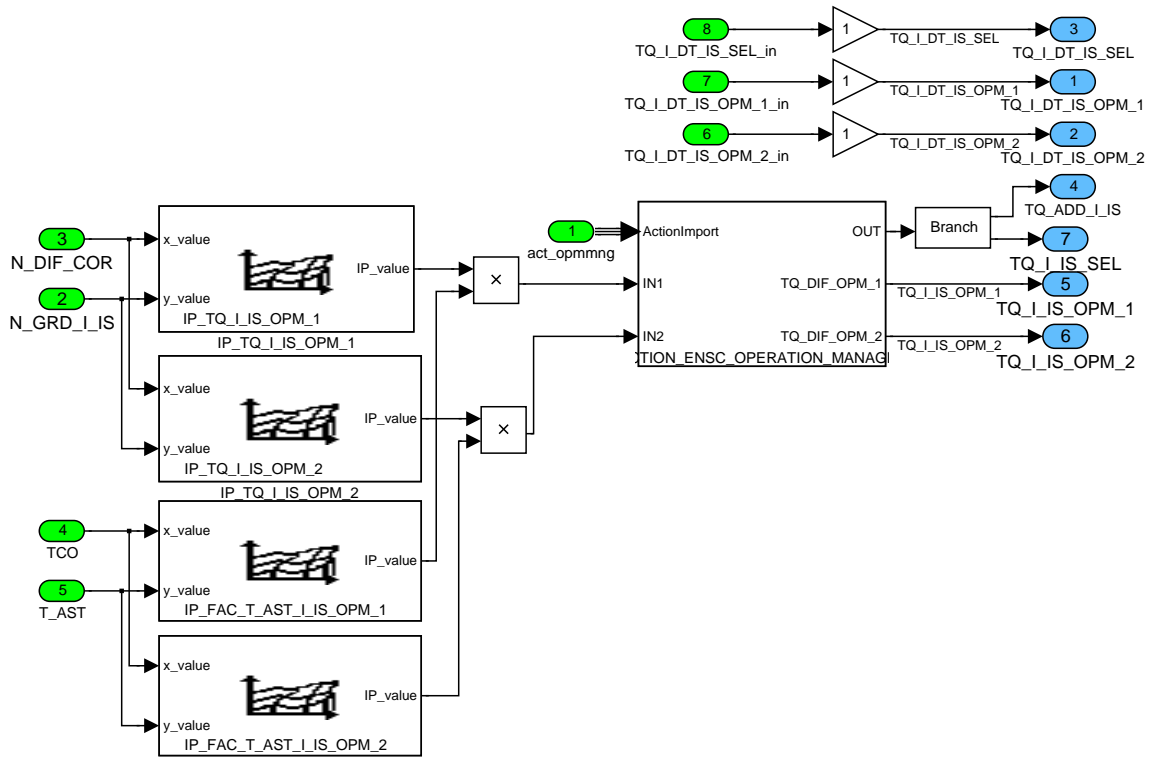


Figure 8.2.38: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/TRANS\_TO\_NORM/CLC/CLC\_2/CLC\_1/ELSE

**Calculation of TQ\_DIF\_I\_IS\_1 as an output of integrator**

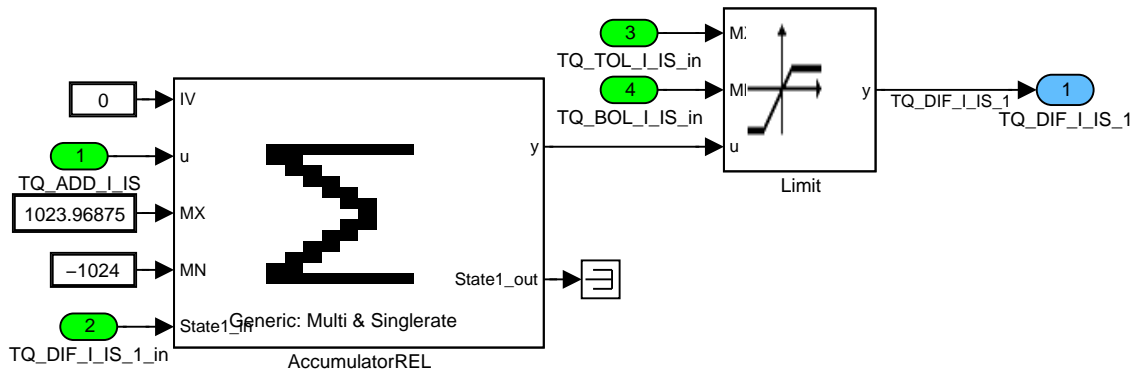


Figure 8.2.39: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/TRANS\_TO\_NORM/CLC/CLC\_2/CLC\_2

**Old value assignment**

No calculations.

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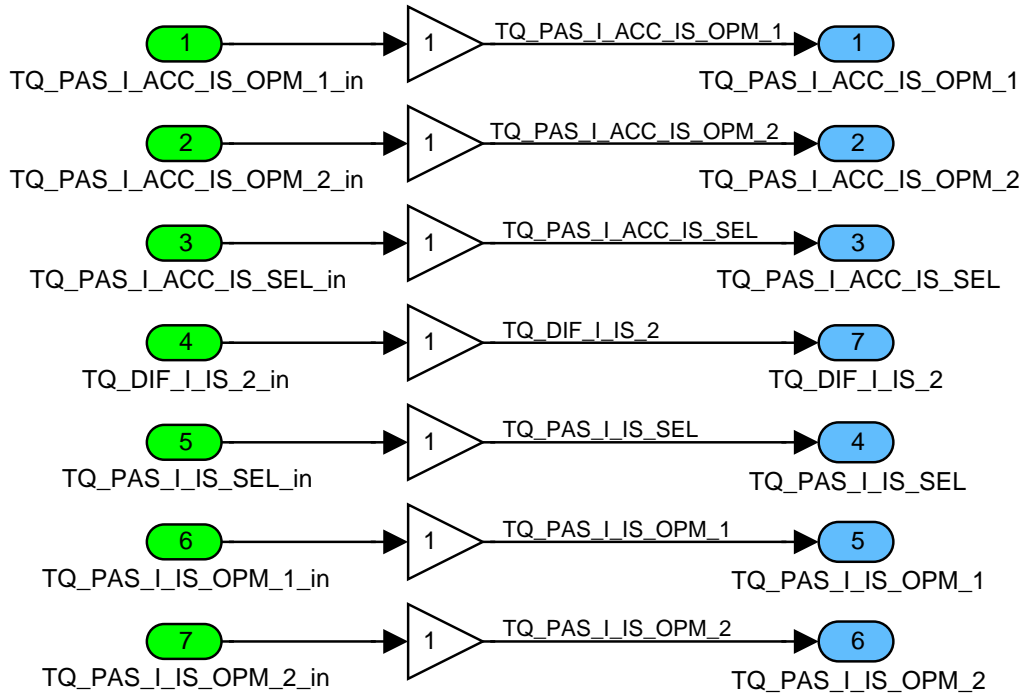


Figure 8.2.40: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/TRANS\_TO\_NORM/CLC/CLC\_2/DEFAULT

**Calculation of PSTE limitation**

**Calculation of T\_TQ\_ISC\_I\_TQ\_PSTE\_LIM**

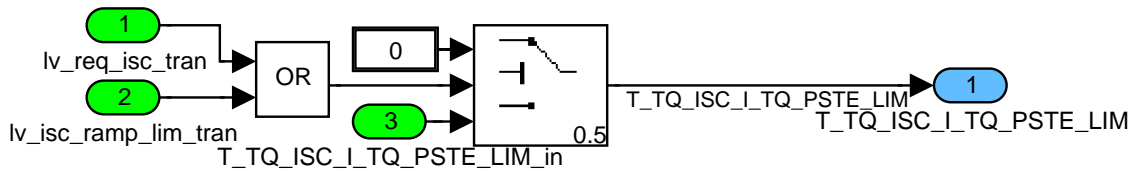


Figure 8.2.41: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/TRANS\_TO\_NORM/CLC\_PSTE\_LIM/CLC

**Condition check for Calculation of TQ\_ISC\_I\_MAX/MIN\_TQ\_PSTE and Lock time for pste limitation**

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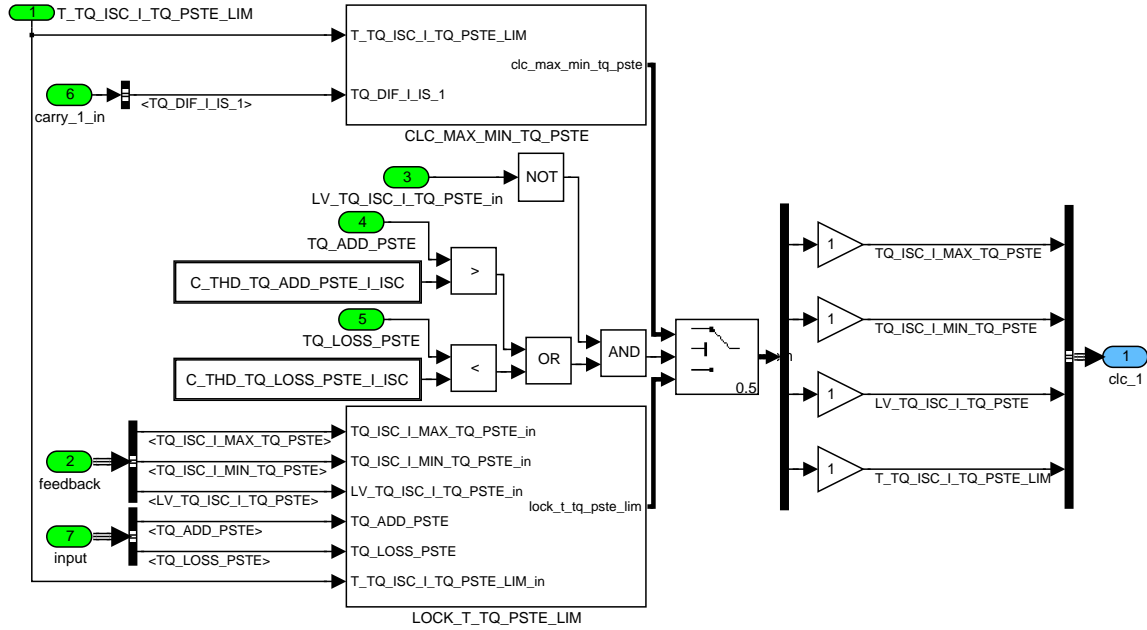


Figure 8.242: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/TRANS\_TO\_NORM/CLC\_PSTE\_LIM/CLC\_1

**Calculation of TQ\_ISC\_I\_MAX/MIN\_TQ\_PSTE**

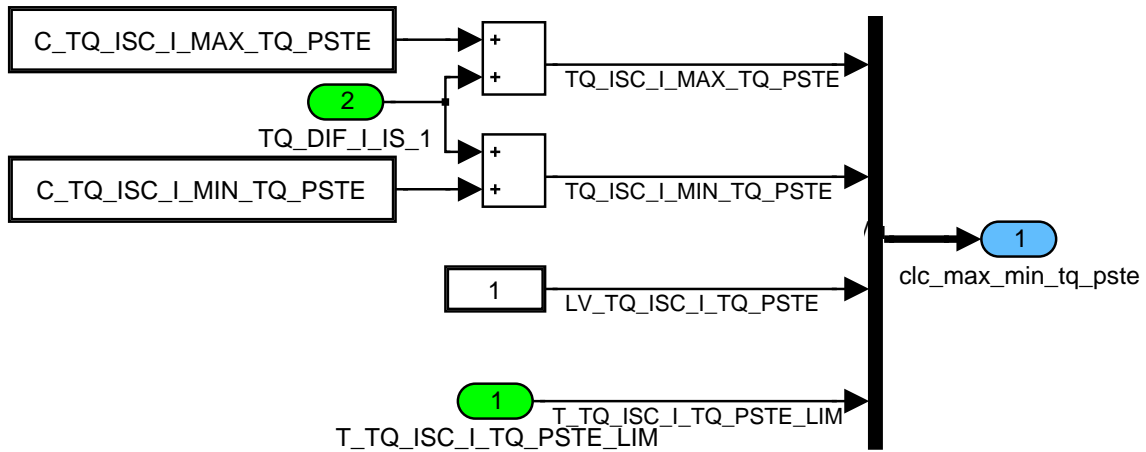


Figure 8.243: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/TRANS\_TO\_NORM/CLC\_PSTE\_LIM/CLC\_1/CLC\_MAX\_MIN\_TQ\_PSTE

**Lock time for pste limitation**

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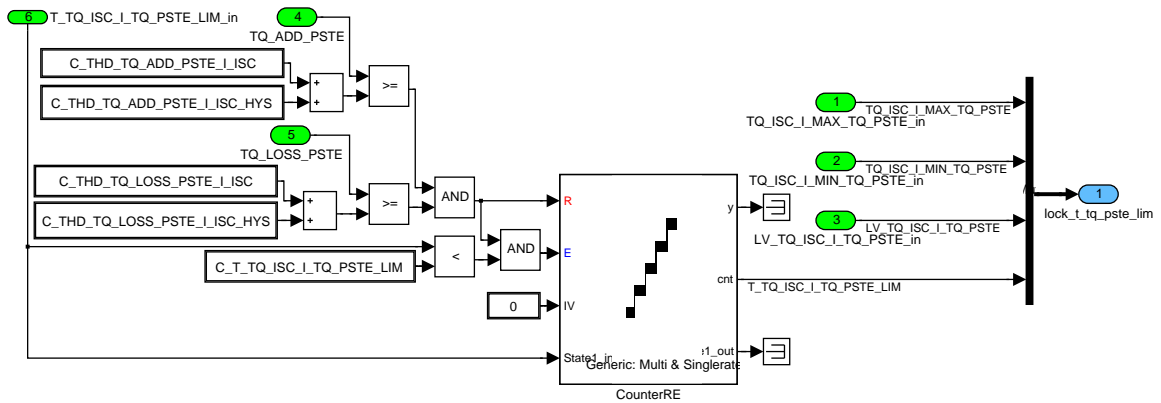


Figure 8.244: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/TRANS\_TO\_NORM/CLC\_PSTE\_LIM/CLC\_1/LOCK\_T\_TQ\_PSTE\_LIM

**Calculation for PSTE and DROF limitation**

**Condition check for calculation at PSTE and DROF limitation**

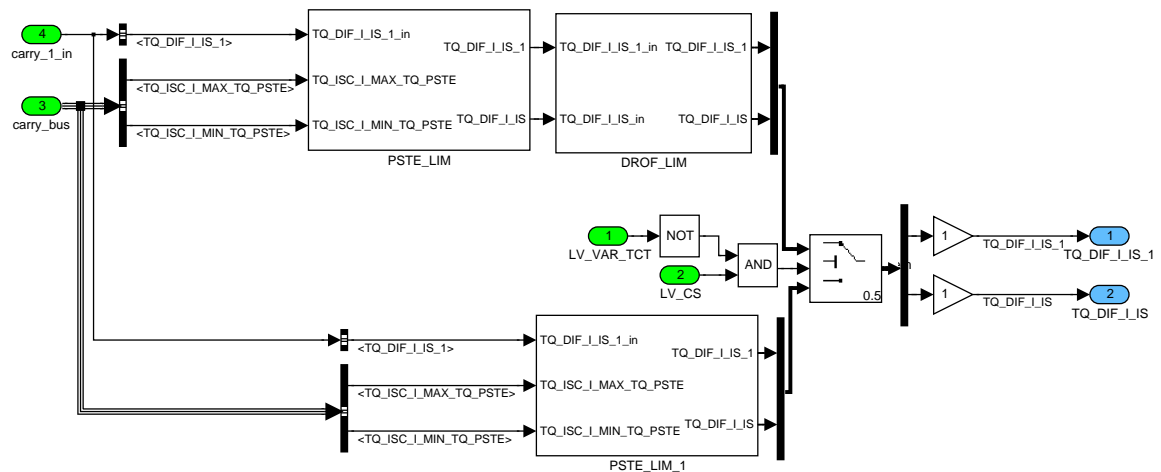


Figure 8.245: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/TRANS\_TO\_NORM/CLC\_PSTE\_DROF\_LIM/CLC

**Condition true- ->PSTE part of PSTE-DROF limitation is applied**

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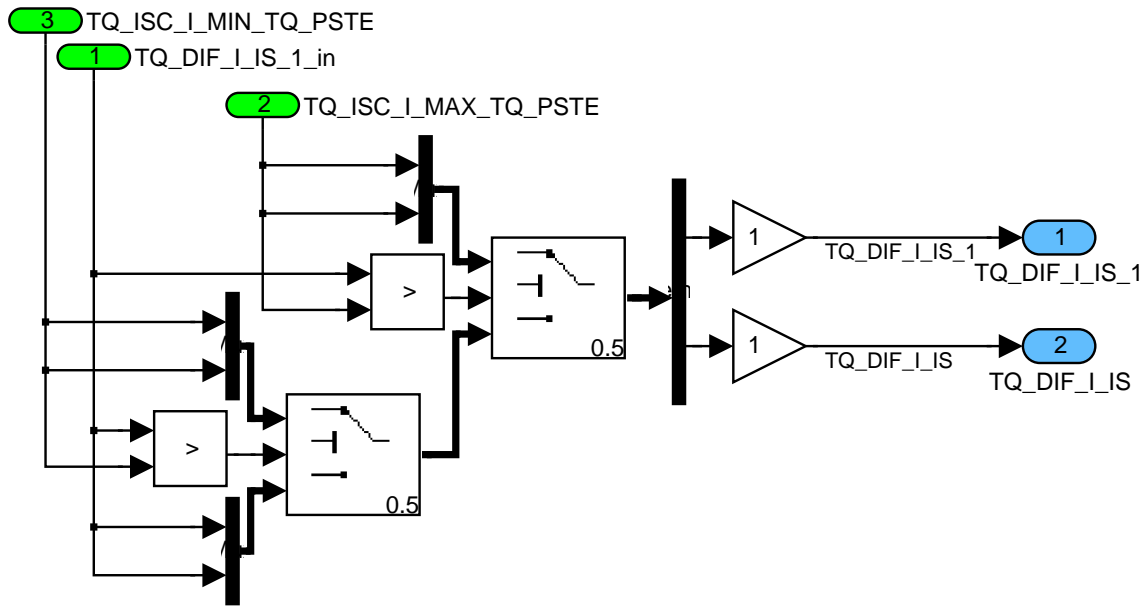


Figure 8.2.46: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/TRANS\_TO\_NORM/CLC\_PSTE\_DROF\_LIM/CLC/PSTE\_LIM

**Condition true- -->DROF part of PSTE-DROF limitation is applied**

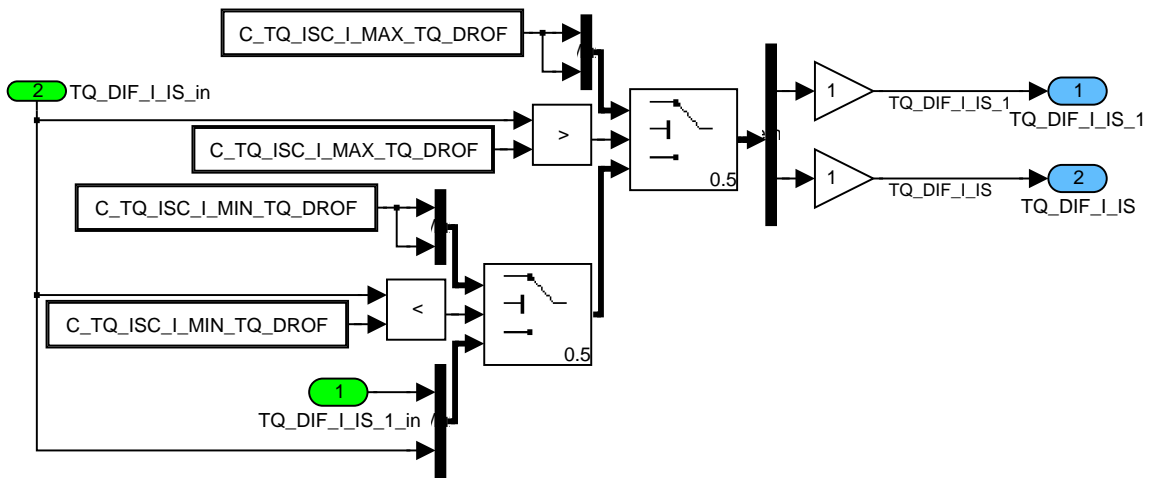


Figure 8.2.47: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/TRANS\_TO\_NORM/CLC\_PSTE\_DROF\_LIM/CLC/DROF\_LIM

**Condition false- --> Only PSTE limitation applied**

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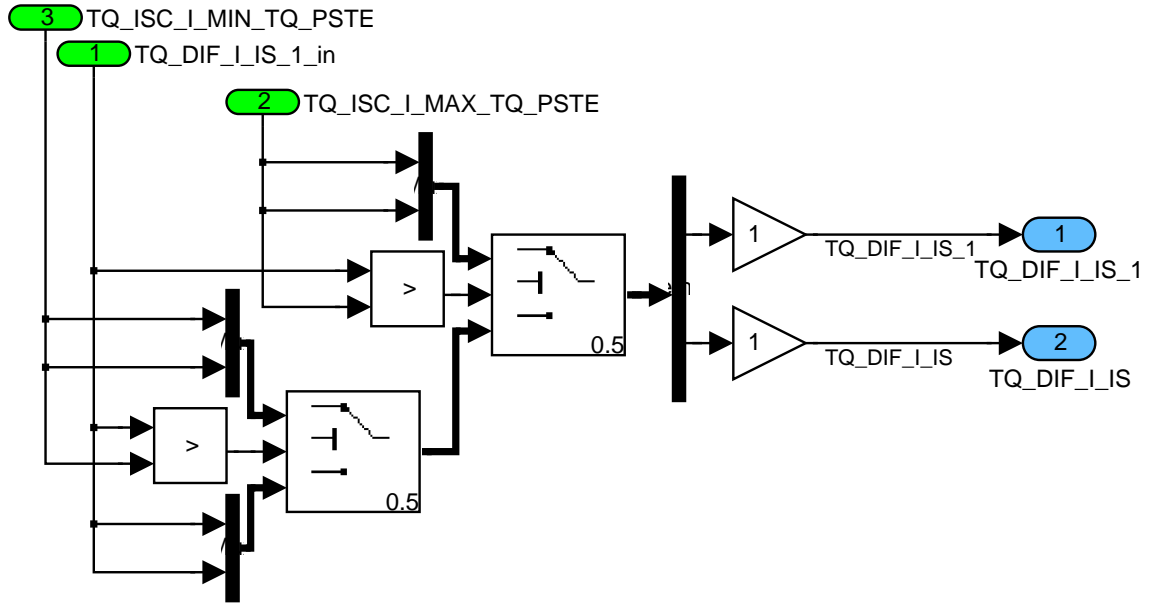


Figure 8.2.48: - ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/TRANS\_TO\_NORM/CLC\_PSTE\_DROF\_LIM/CLC/PSTE\_LIM\_1

**Re-initialization of TQ\_DIF\_I\_IS**

**Calculation of TQ\_DIF\_I\_IS**

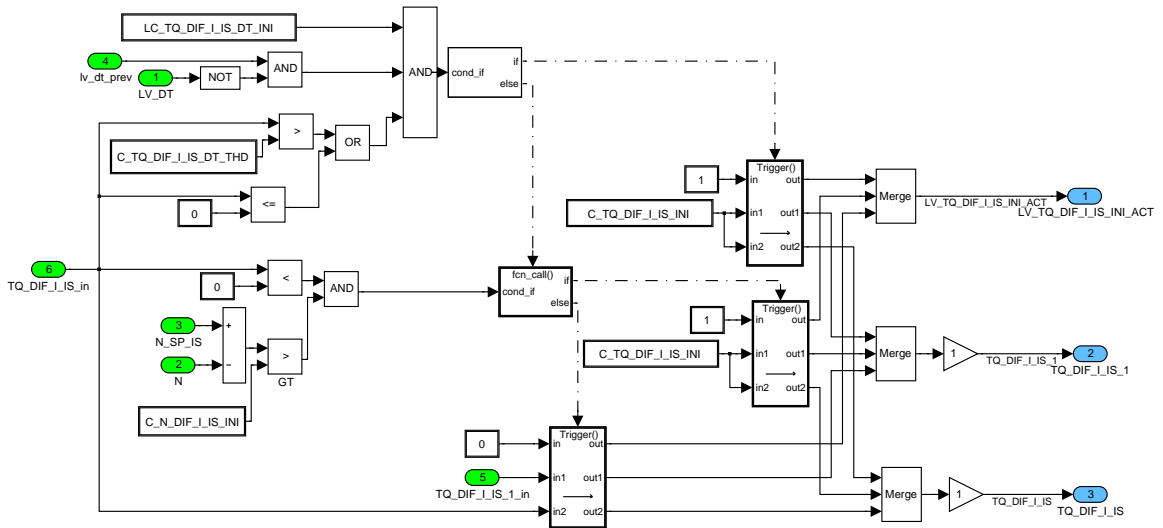


Figure 8.2.49: ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/TRANS\_TO\_NORM/RE\_INI\_TQ\_DIF\_I\_IS/CLC\_TQ\_DIF\_I\_IS

**STATE RAMP\_TO\_PAS**

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At deactivation of ISC the integrator output is controlled to a passive-value by ramp limit activation. The determination of the ramp takes place in the same way as described before for the top/bottom limit ramps.

**Actions:**

The ramp limit operation starts at deactivation of the ISC. The necessary increment (**TQ\_ADD\_I\_RAMP**) to reach the required ramp-slope is **only calculated once while transitioning into this state**. This value is valid until deactivation of the ramp limit operation.

While transition into this state, so while the ramp is active, there could be a change in TQ\_PAS\_I\_IS. If in this case TQ\_ADD\_I\_RAMP is negative for example and the passive value is higher than the actual value, then the new requested passive value can never be reached, because TQ\_ADD\_I\_RAMP is only calculated once. Therefore TQ\_PAS\_I\_IS is fixed while transition into this state to prevent a wrong comparison in the following condition:

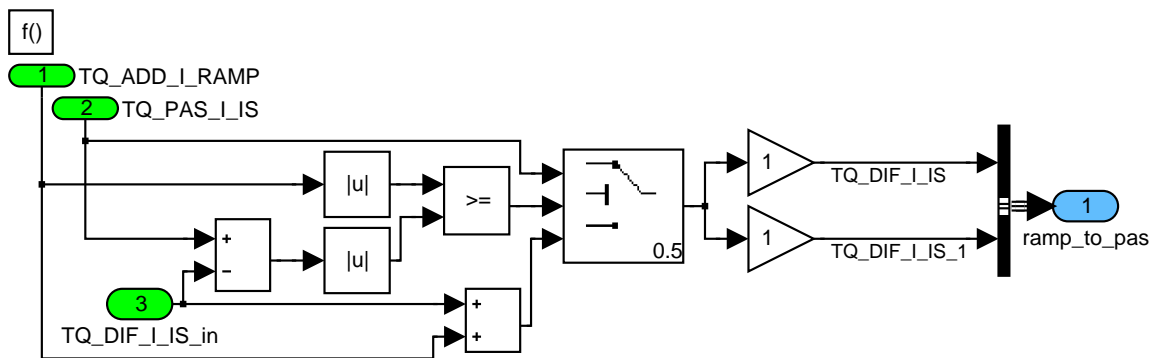
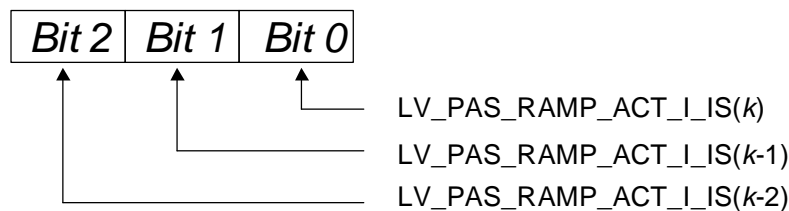


Figure 8.2.50:  
ENSC\_M8006/OPM/I\_CONTROLLER/I\_CON\_DEACT/I\_CONT\_ST\_AUTOMATE/RAMP\_TO\_PAS

**Circular buffer for LV\_PAS\_RAMP\_ACT\_I\_IS**

In the following circular buffer STATE\_PAS\_RAMP\_ACT\_I\_IS, the last three values of LV\_PAS\_RAMP\_ACT\_I\_IS are stored:



This information is needed for the monitoring of the idle speed controller. It is updated every 20ms; the values are shifted from Bit j to Bit j+1, j=0,1.

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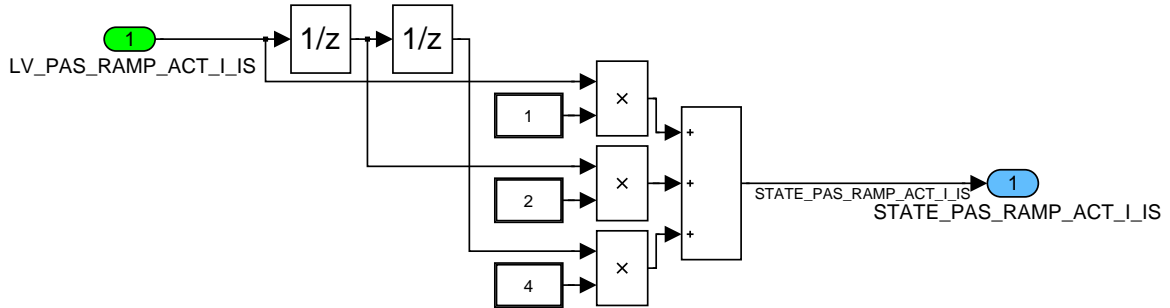
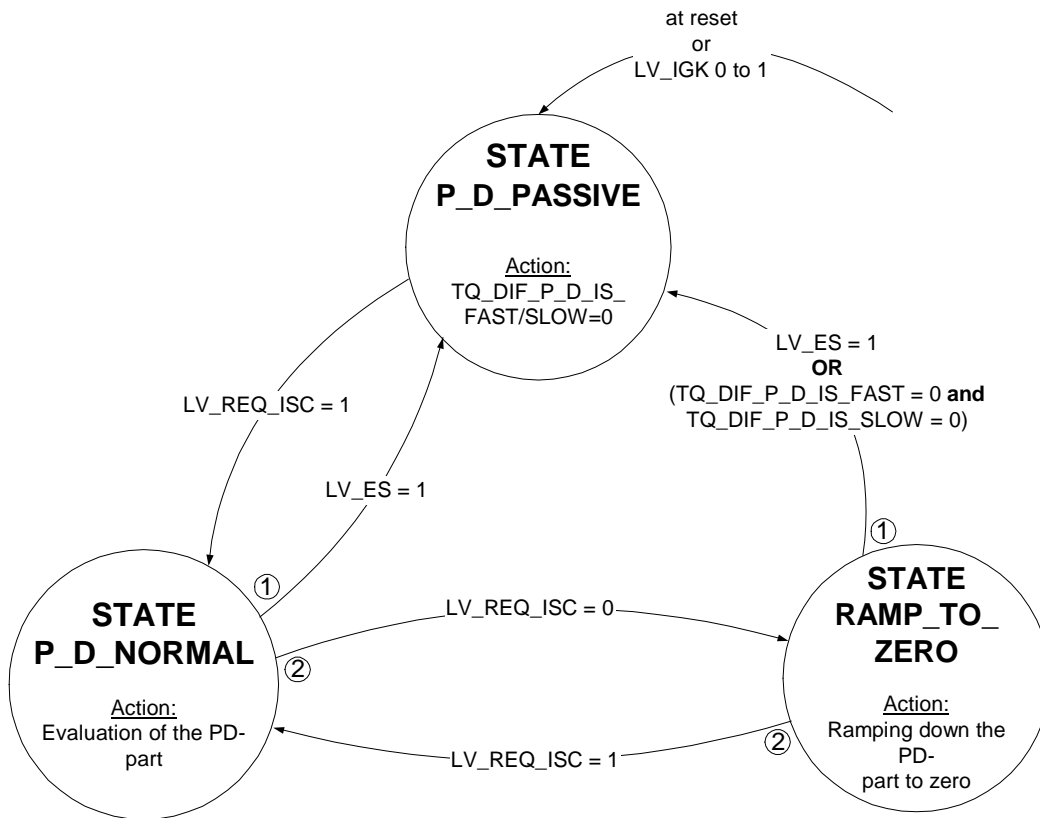


Figure 8.2.51: ENSC\_M8006/OPM/I\_CONTROLLER/RNG\_BUF

**PD- Controller**

General information:  
State Machine



**FUNCTION DESCRIPTION:**

**Figure 2:** State of the PD-part

The PD-part is divided into three states:

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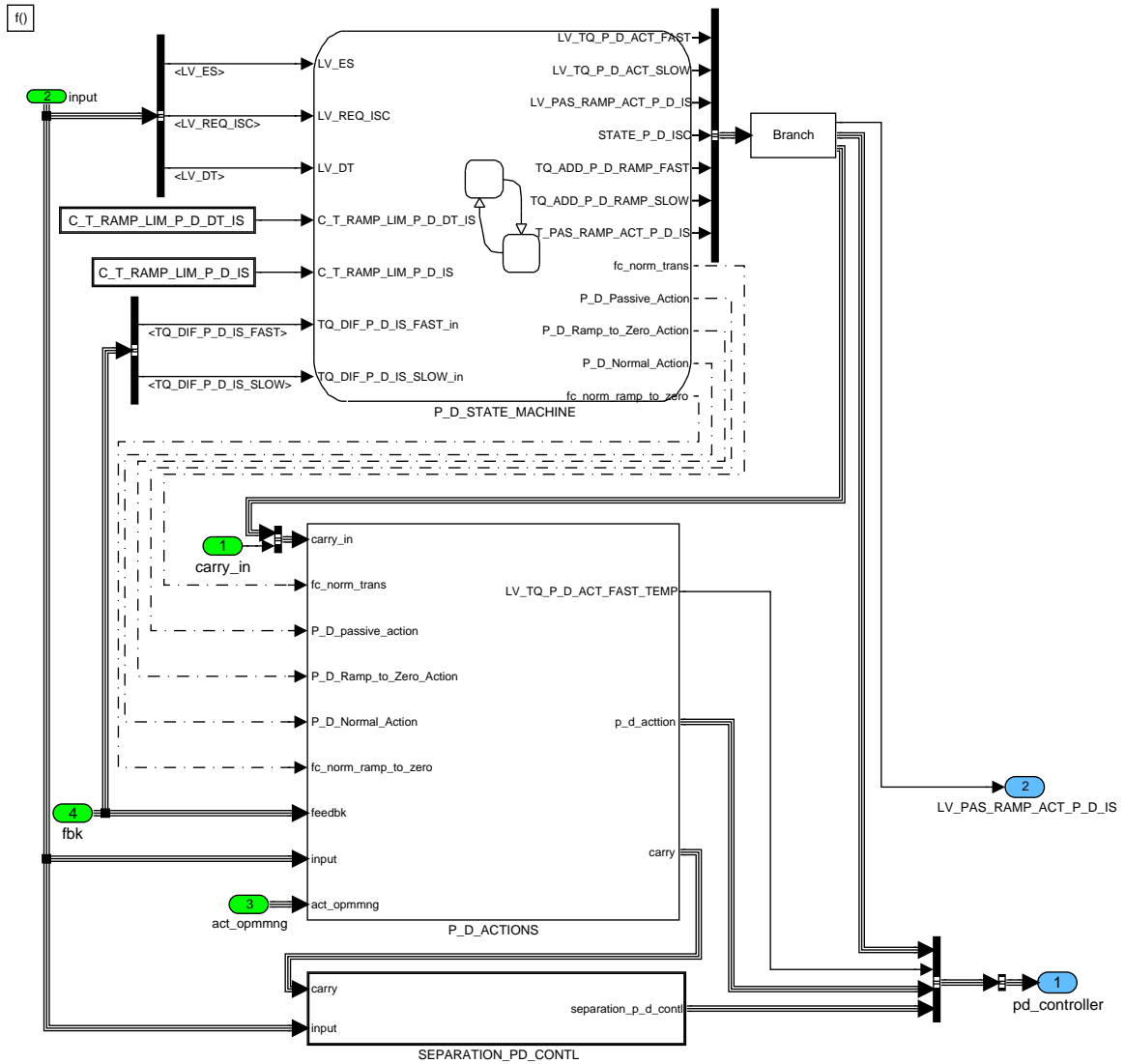


Figure 8.2.53: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER

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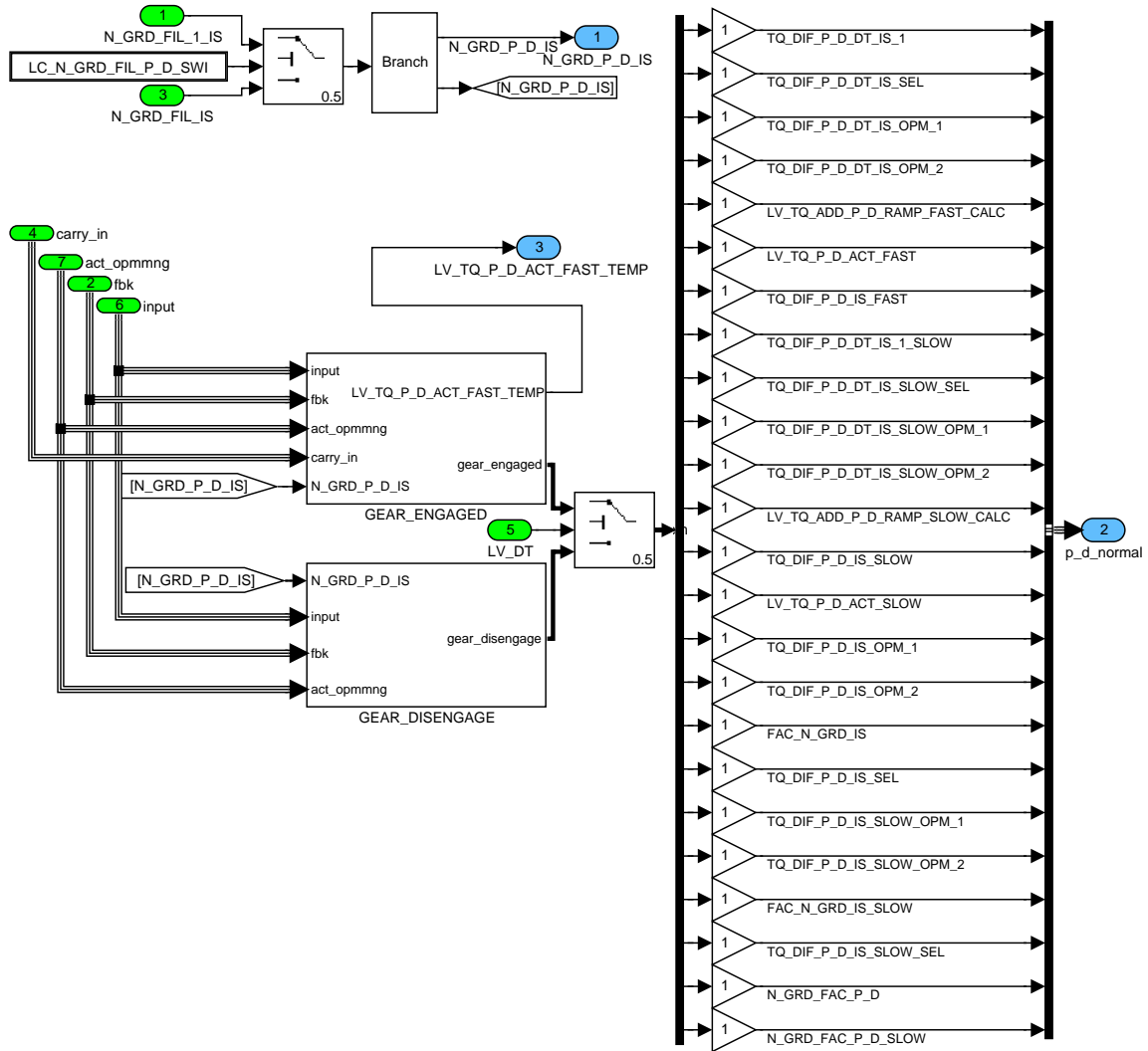


Figure 8.2.55: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/P\_D\_NORMAL/P\_D\_NORMAL


**Calculations at gear engaged**

Gear engaged is calculated when LV\_DT is 1

**Calculations at PD part fast**

**Output from operation manager in PD part fast**

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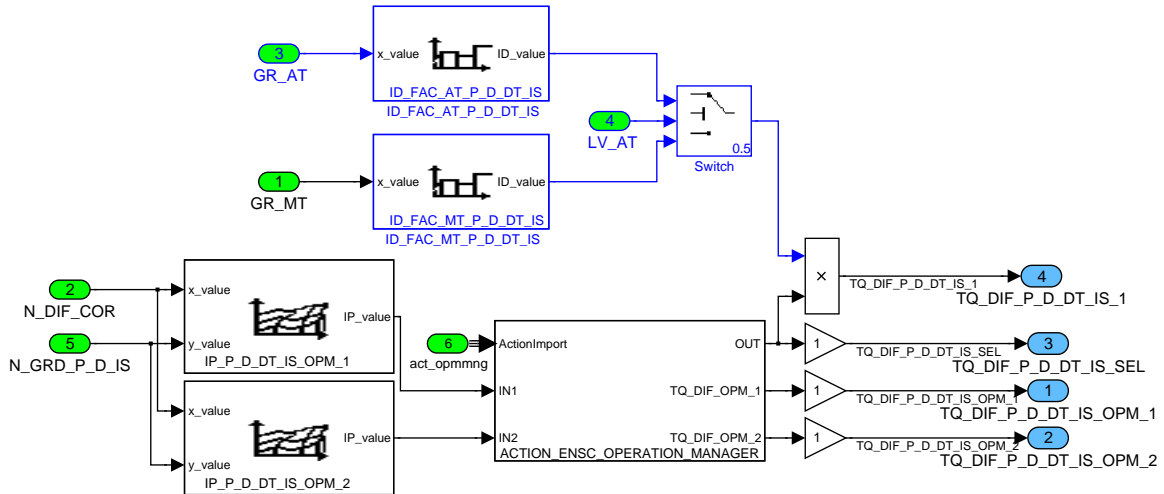


Figure 8.256: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/P\_D\_NORMAL/P\_D\_NORMAL/GEAR\_ENGAGED/PD\_PART\_FAST/CLC\_P\_D\_DT\_IS

**Calculation of TQ\_DIF\_P\_D\_IS\_FAST and LV\_TQ\_P\_D\_ACT\_FAST**

**Calculation of LV\_TQ\_P\_D\_ACT\_FAST**

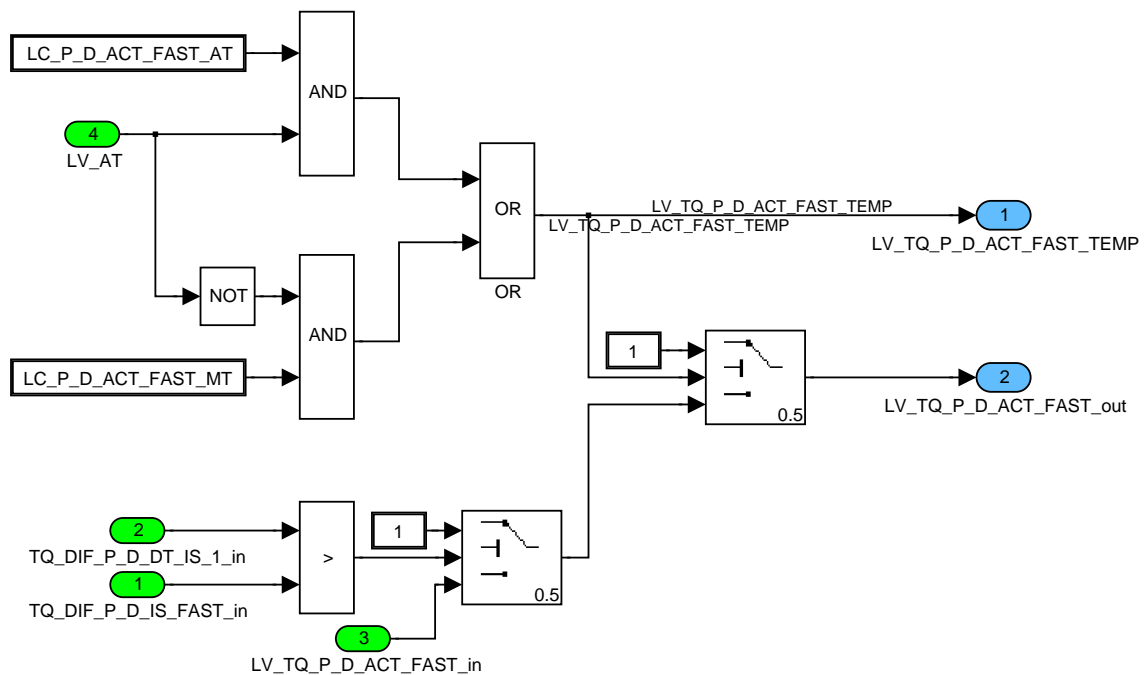


Figure 8.257: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/P\_D\_NORMAL/P\_D\_NORMAL/GEAR\_ENGAGED/PD\_PART\_FAST/CLC\_P\_D\_IS/CLC\_LV\_TQ\_P\_D\_ACT\_FAST

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**Calculation of LV\_TQ\_ADD\_P\_D\_RAMP\_FAST\_CALC and TQ\_DIF\_P\_D\_IS\_FAST**

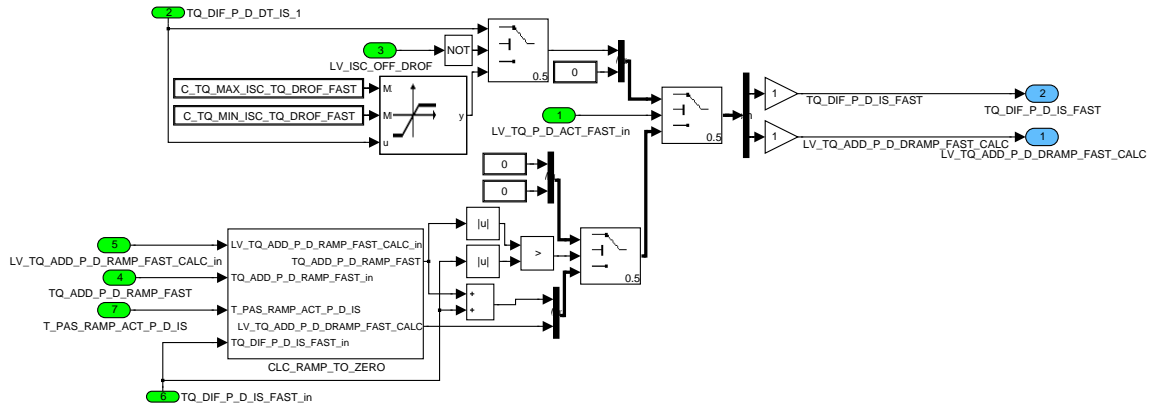


Figure 8.258: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/P\_D\_NORMAL/P\_D\_NORMAL/GEAR\_ENGAGED/PD\_PART\_FAST/CLC\_P\_D\_IS/CLC\_P\_D\_IS

**Calculation of LV\_TQ\_ADD\_P\_D\_RAMP\_FAST\_CALC and TQ\_DIF\_P\_D\_IS\_FAST at ramp\_to\_zero**

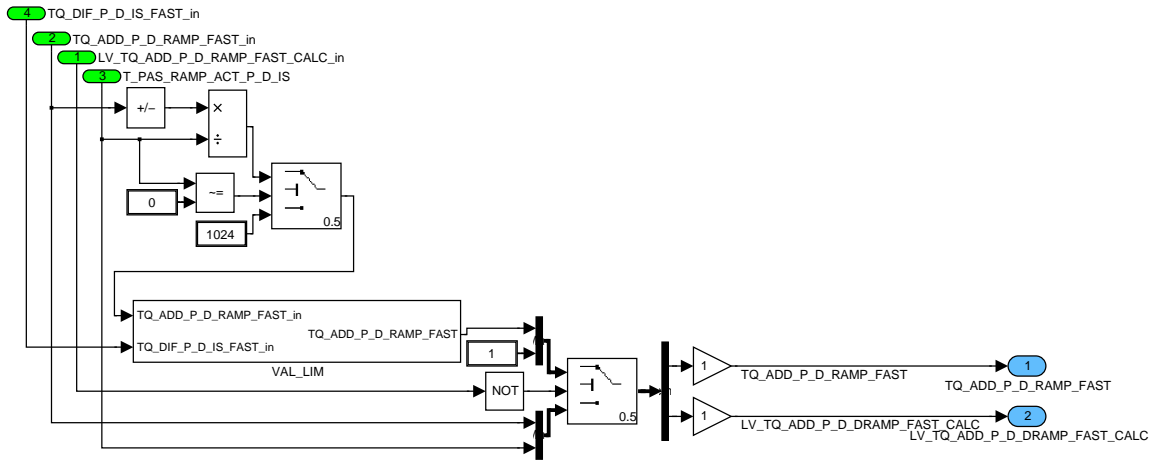


Figure 8.259: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/P\_D\_NORMAL/P\_D\_NORMAL/GEAR\_ENGAGED/PD\_PART\_FAST/CLC\_P\_D\_IS/CLC\_P\_D\_IS/CLC\_RAMP\_TO\_ZERO

**Limiting the value of TQ\_DIF\_P\_D\_IS\_FAST**

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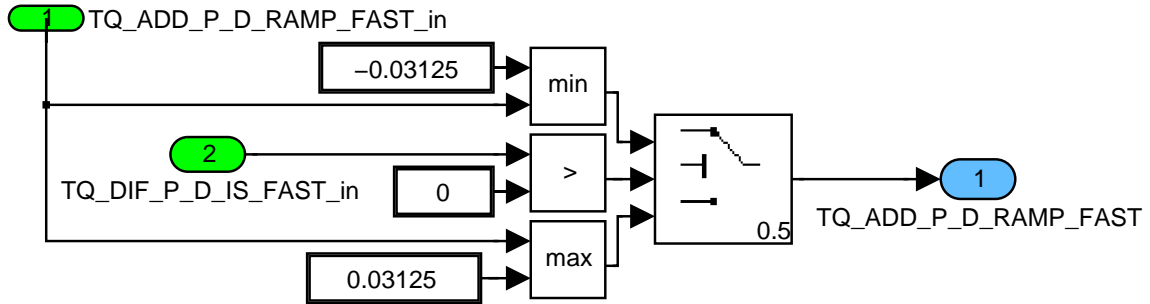


Figure 8.2.60: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/P\_D\_NORMAL/P\_D\_NORMAL/GEAR\_ENGAGED/PD\_PART\_FAST/CLC\_P\_D\_IS/CLC\_P\_D\_IS/CLC\_RAMP\_TO\_ZERO/VAL\_LIM

**Calculation at PD\_slow**

**Output from operation manager in PD slow**

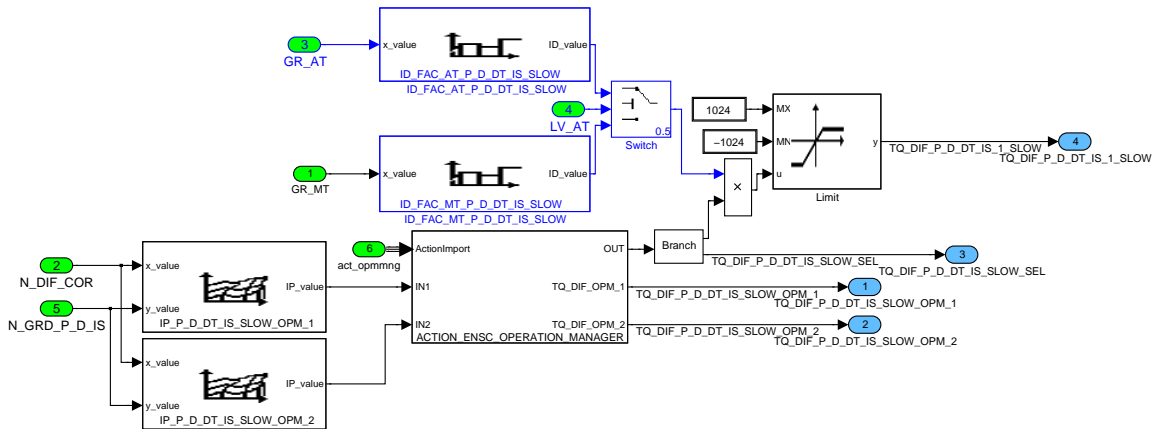


Figure 8.2.61: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/P\_D\_NORMAL/P\_D\_NORMAL/GEAR\_ENGAGED/PD\_PART\_SLOW/CLC\_P\_D\_DT\_IS

**Calculation of LV\_TQ\_PD\_ACT\_SLOW and TQ\_DIF\_P\_D\_IS\_SLOW**

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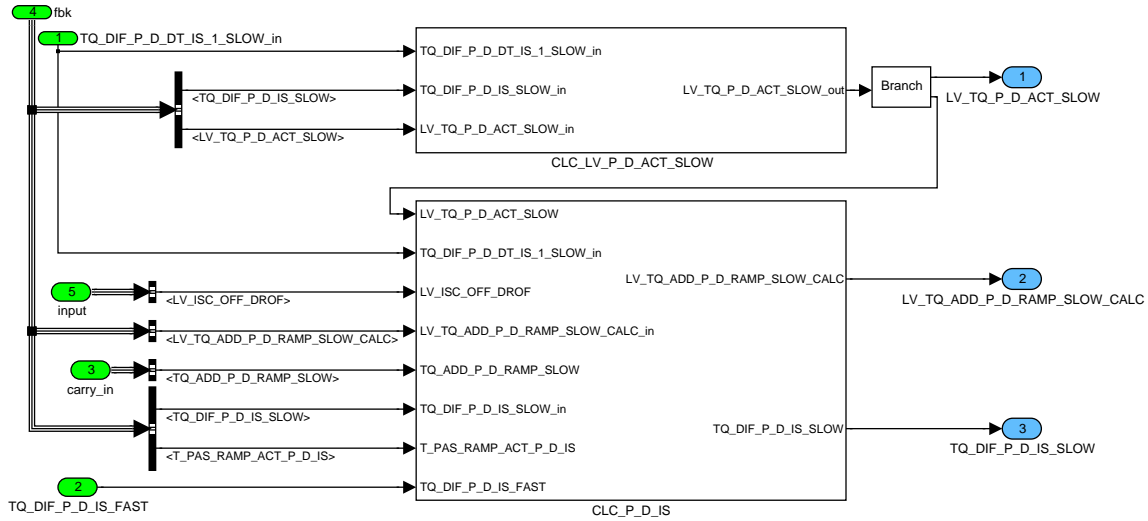


Figure 8.2.62: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/P\_D\_NORMAL/P\_D\_NORMAL/GEAR\_ENGAGED/PD\_PART\_SLOW/CLC\_P\_D\_IS

**Calculation of LV\_ACT\_P\_D\_IS\_SLOW**

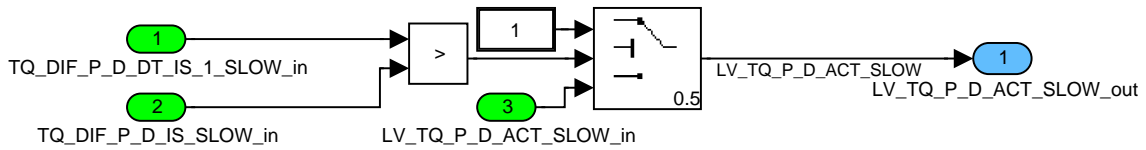


Figure 8.2.63: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/P\_D\_NORMAL/P\_D\_NORMAL/GEAR\_ENGAGED/PD\_PART\_SLOW/CLC\_P\_D\_IS/CLC\_LV\_P\_D\_ACT\_SLOW

**Calculation of TQ\_DIF\_P\_D\_IS\_SLOW and LV\_TQ\_ADD\_P\_D\_RAMP\_SLOW\_CALC**

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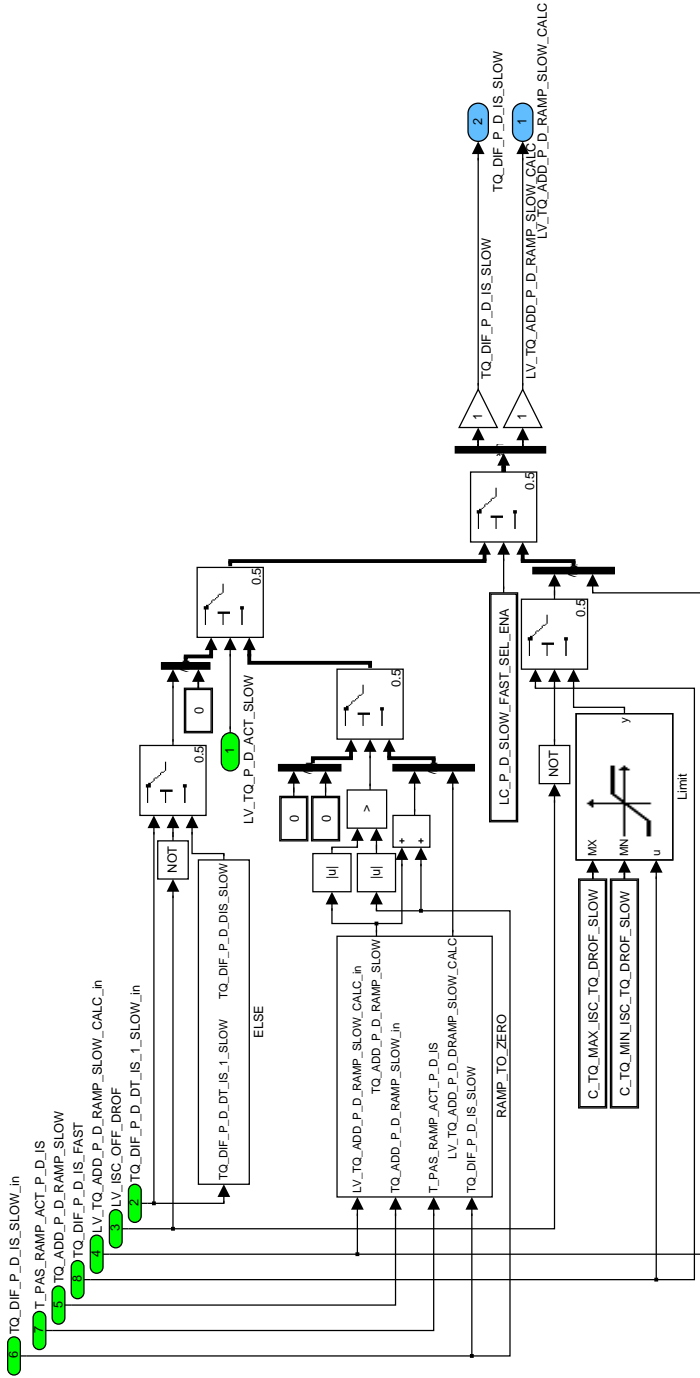



Figure 8.2.64: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/P\_D\_NORMAL/P\_D\_NORMAL/GEAR\_ENGAGED/PD\_PART\_SLOW/CLC\_P\_D\_IS/CLC\_P\_D\_IS

**Limiting the value of TQ\_DIF\_P\_D\_IS\_SLOW**

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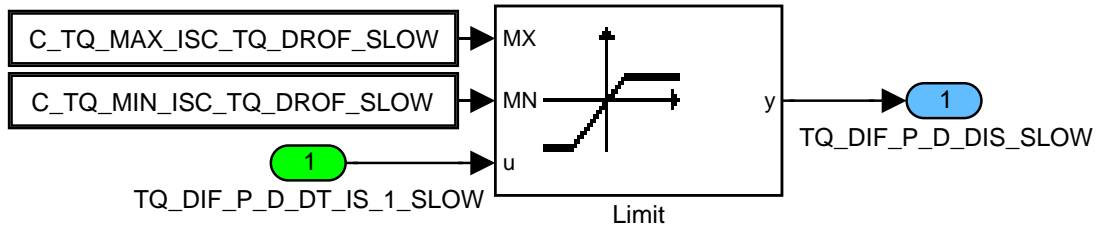


Figure 8.2.65:  
ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/P\_D\_NORMAL/  
P\_D\_NORMAL/GEAR\_ENGAGED/PD\_PART\_SLOW/CLC\_P\_D\_IS/CLC\_P\_D\_IS/ELSE

**Calculation at ramp\_to\_zero**

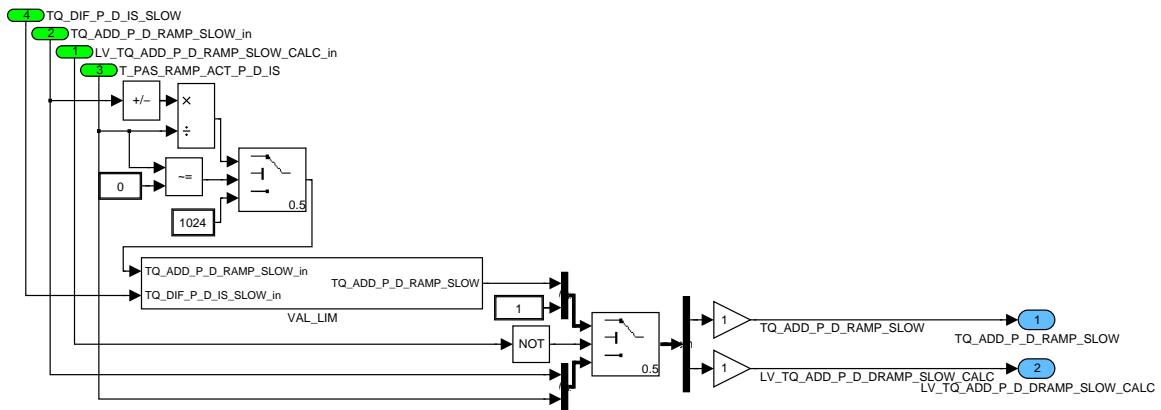


Figure 8.2.66:  
ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/P\_D\_NORMAL/  
P\_D\_NORMAL/GEAR\_ENGAGED/PD\_PART\_SLOW/CLC\_P\_D\_IS/CLC\_P\_D\_IS/RAMP\_TO\_ZERO

**Limiting the value of TQ\_DIF\_P\_IS\_SLOW**

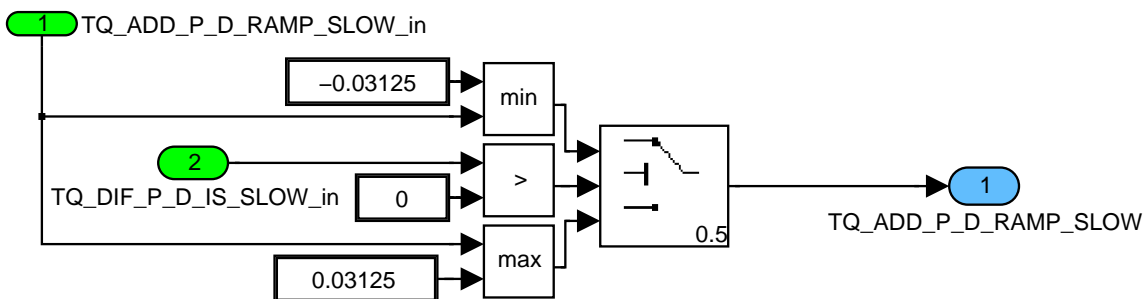


Figure 8.2.67: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/P\_D\_  
NORMAL/P\_D\_NORMAL/GEAR\_ENGAGED/PD\_PART\_SLOW/CLC\_P\_D\_IS/CLC\_P\_D\_IS/  
RAMP\_TO\_ZERO/VAL\_LIM

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**Passing the of old value**

NO calculation

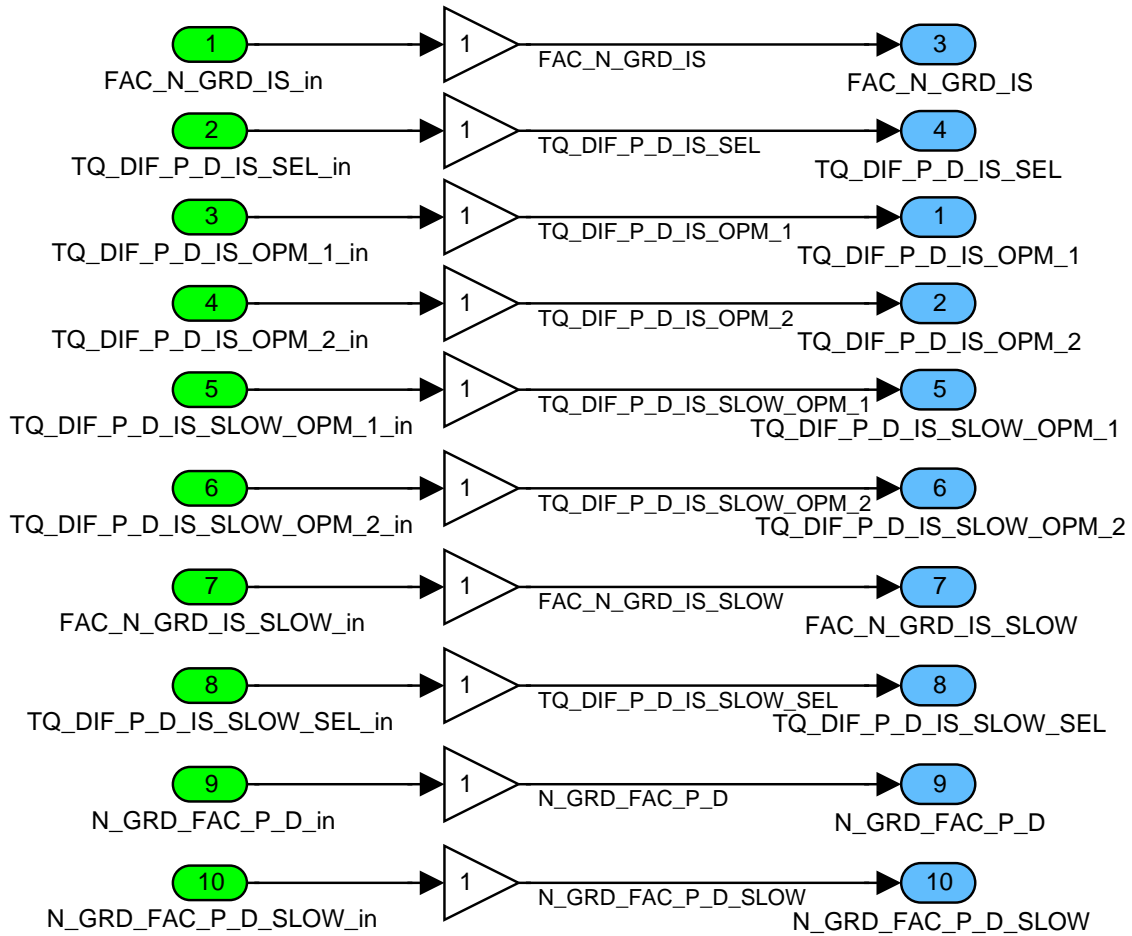


Figure 8.2.68: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/P\_D\_NORMAL/P\_D\_NORMAL/GEAR\_ENGAGED/OLD\_VALUES

**Calculation at gear disengaged.**

Calculations at gear disengaged occurs when LV\_DT = 0;

**Calculation gear disengaged- → PD part fast**

**Output from operation manager in PD part fast**

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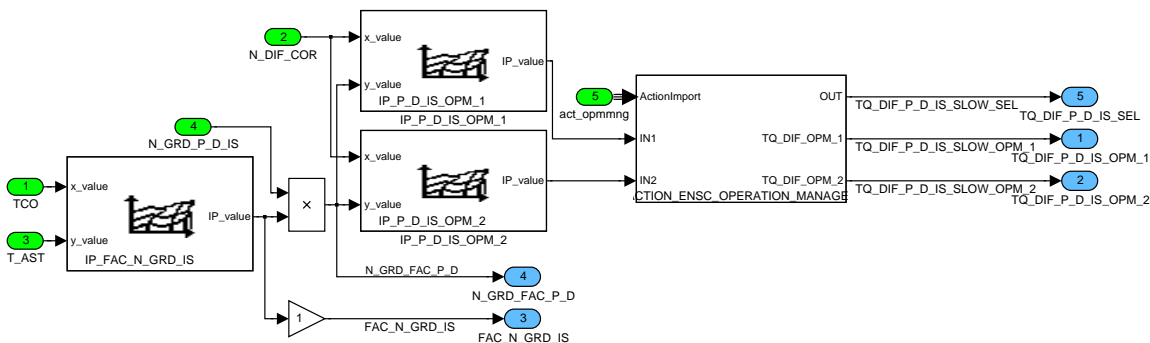


Figure 8.2.69: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/P\_D\_NORMAL/P\_D\_NORMAL/GEAR\_DISENGAGE/PD\_PART\_FAST/CLC\_P\_D\_DT\_IS

**Calculation of LV\_TQ\_ADD\_P\_D\_RAMP\_FAST\_CALC and TQ\_DIF\_P\_D\_IS\_FAST.**

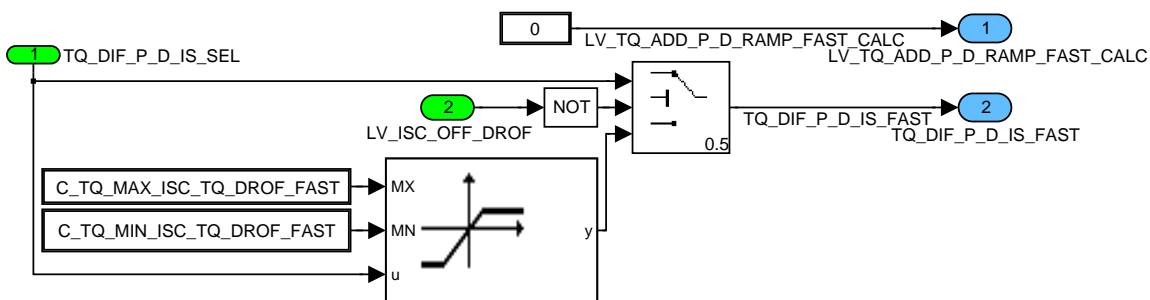


Figure 8.2.70: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/P\_D\_NORMAL/P\_D\_NORMAL/GEAR\_DISENGAGE/PD\_PART\_FAST/CLC\_P\_D\_IS

**Calculation at PD part slow**

**Condition check for calculation in PD part slow**

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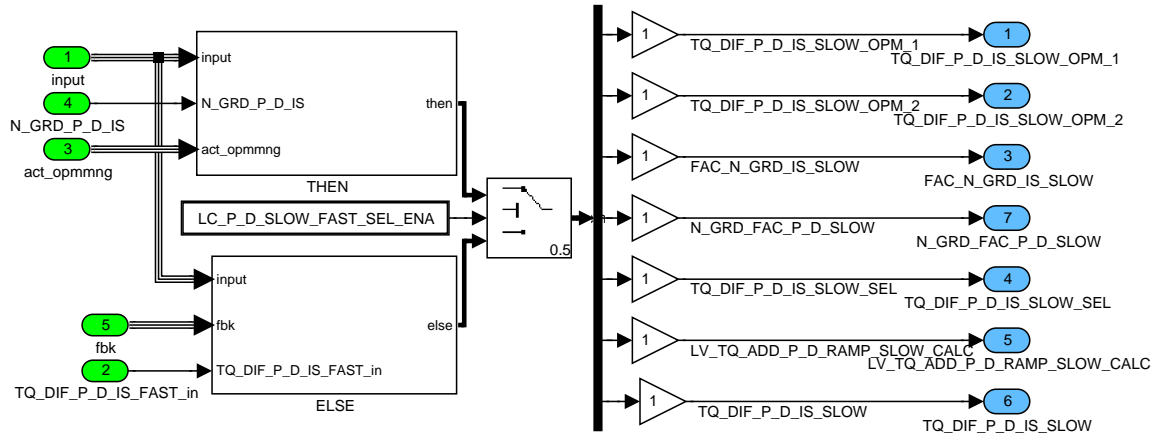


Figure 8.2.71: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/P\_D\_NORMAL/P\_D\_NORMAL/GEAR\_DISENGAGE/PD\_PART\_SLOW/CLC\_P\_D\_IS

**Calculation at pd part slow when condition is true.**

**Output from operation manager**

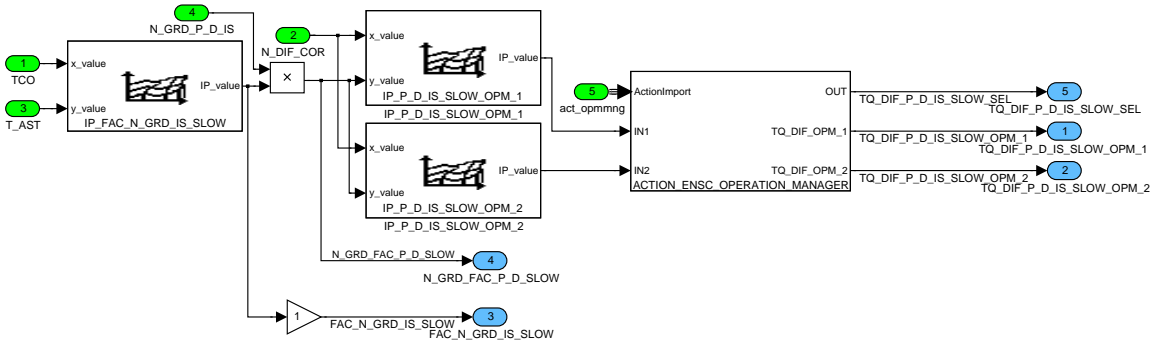


Figure 8.2.72: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/P\_D\_NORMAL/P\_D\_NORMAL/GEAR\_DISENGAGE/PD\_PART\_SLOW/CLC\_P\_D\_IS/THEN/CLC\_P\_D\_DT\_IS

**Calculation of TQ\_DIF\_P\_D\_IS\_SLOW**

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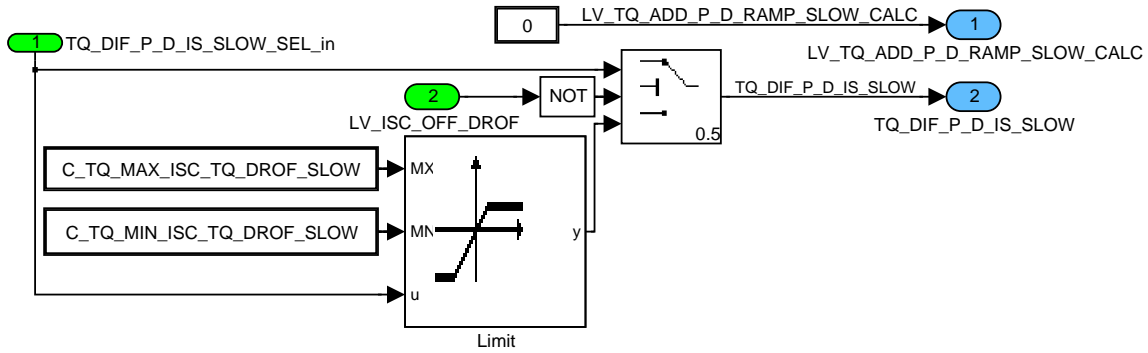


Figure 8.2.73: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/P\_D\_NORMAL/P\_D\_NORMAL/GEAR\_DISENGAGE/PD\_PART\_SLOW/CLC\_P\_D\_IS/THEN/THEN\_TQ\_DIF\_P\_D\_IS\_SLOW

**Calculation at pd part slow when condition is false.**

**Calculation of TQ\_DIF\_P\_D\_IS\_SLOW and LV\_TQ\_ADD\_P\_D\_RAMP\_SLOW\_CALC**

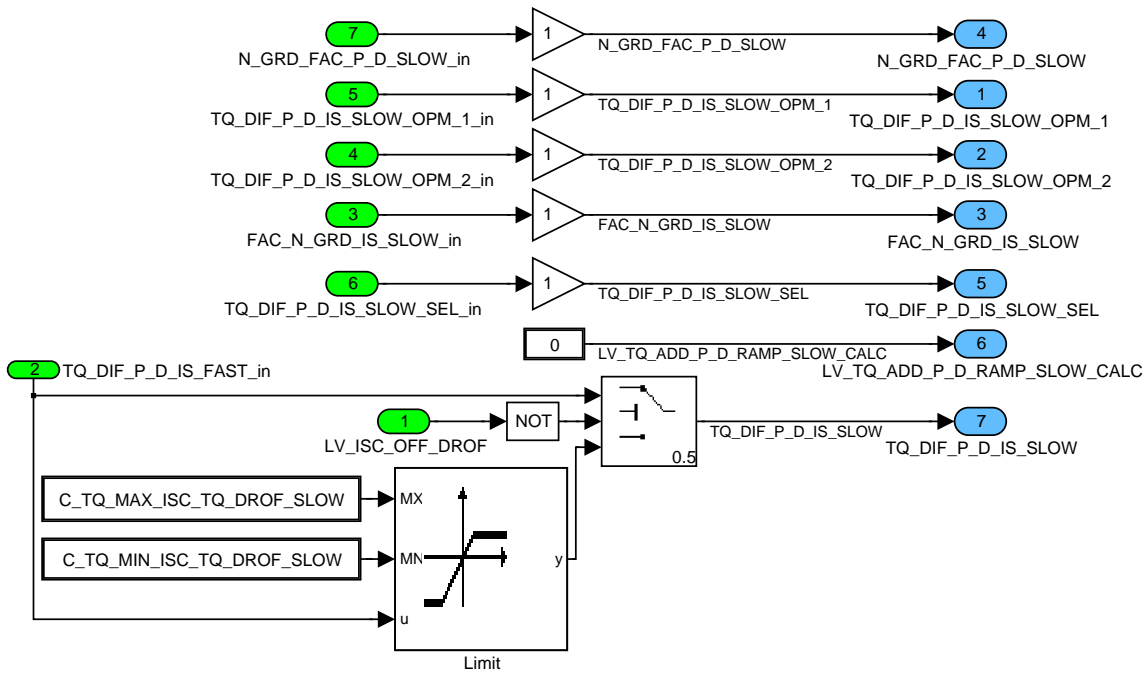


Figure 8.2.74: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/P\_D\_NORMAL/P\_D\_NORMAL/GEAR\_DISENGAGE/PD\_PART\_SLOW/CLC\_P\_D\_IS/ELSE/CLC

**Feed through**

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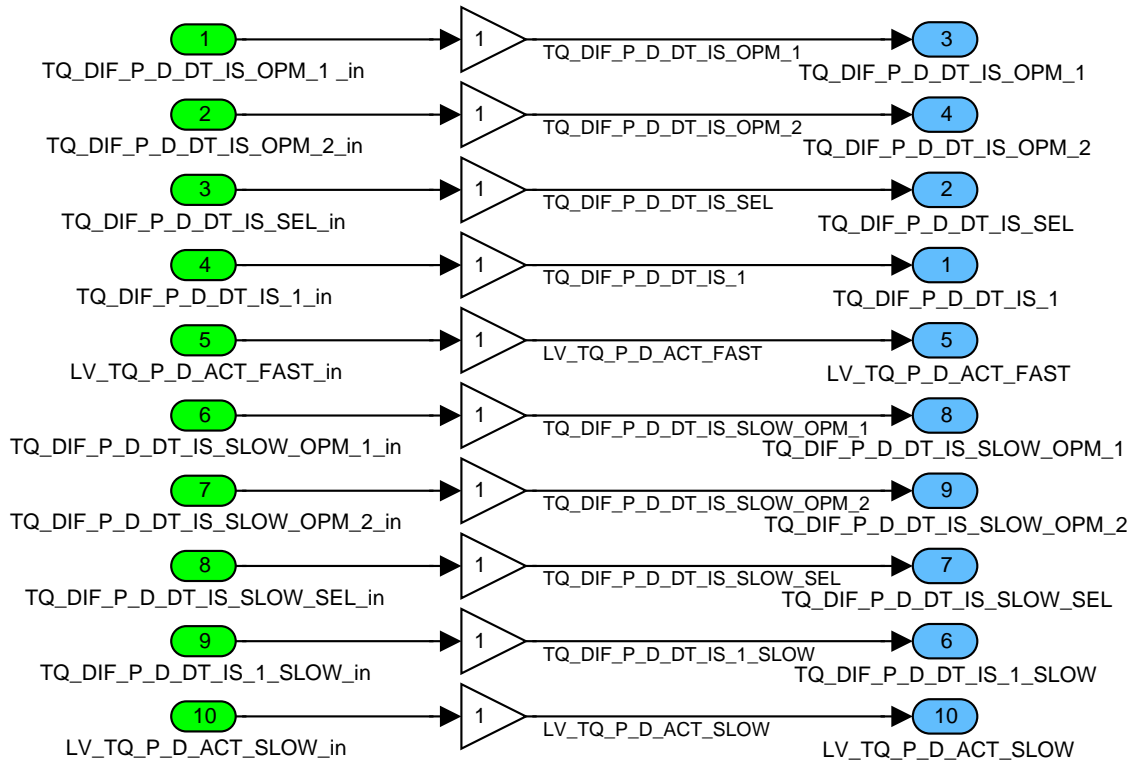


Figure 8.2.75: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/P\_D\_NORMAL/P\_D\_NORMAL/GEAR\_DISENGAGE/OLD\_VALUES

### Calculation at state ramp\_to\_zero

To prevent a torque jump if the PD part is on a certain value and the driver hits the pedal (transition to part load), it's necessary to reduce the PD-part's value by a deactivation ramp. The **target value** of the ramp operation is always  $TQ\_DIF\_P\_D\_IS\_FAST / SLOW = 0$  [Nm].

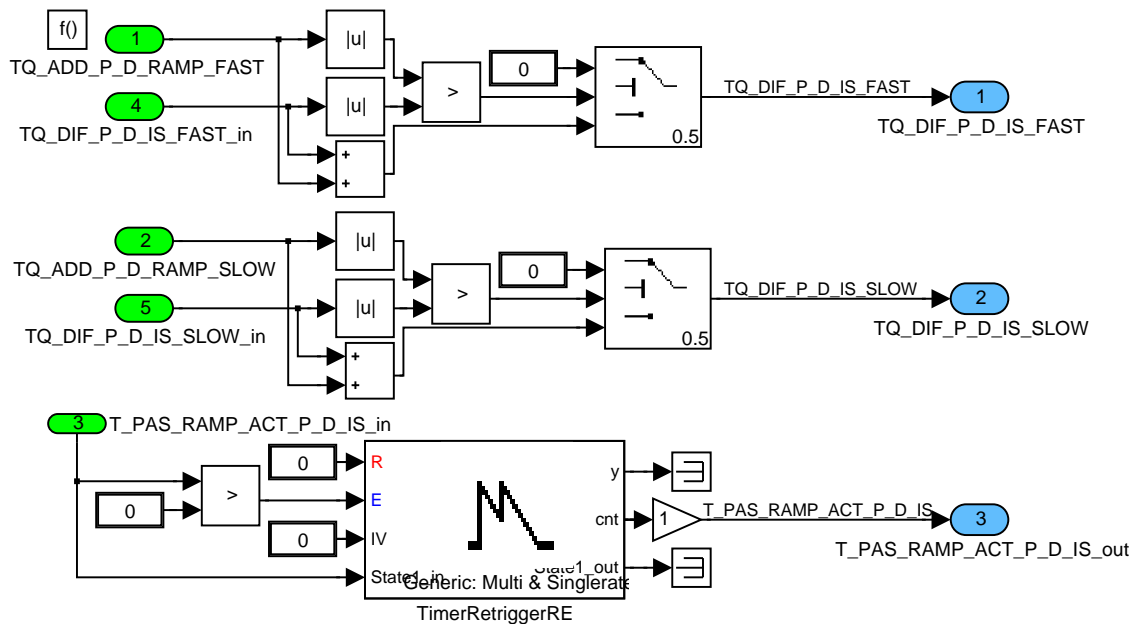


Figure 8.2.76:  
 ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/P\_D\_ACTIONS/RAMP\_TO\_ZERO

**Calculation of TQ\_DIF\_P\_D\_SLOW\_IS**

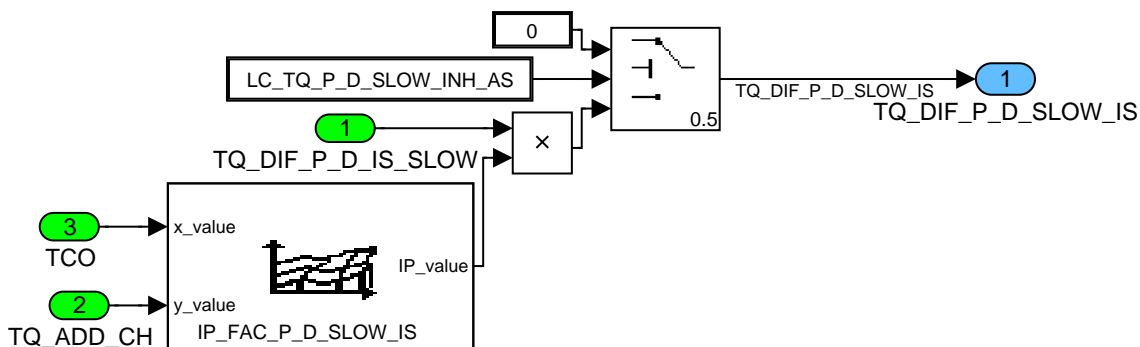


Figure 8.2.77: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/SEPARATION\_PD\_CNTL/DET\_TQ\_DIF\_P\_D\_SLOW\_IS

**Calculation of TQ\_DIF\_P\_D\_SLOW\_IS**

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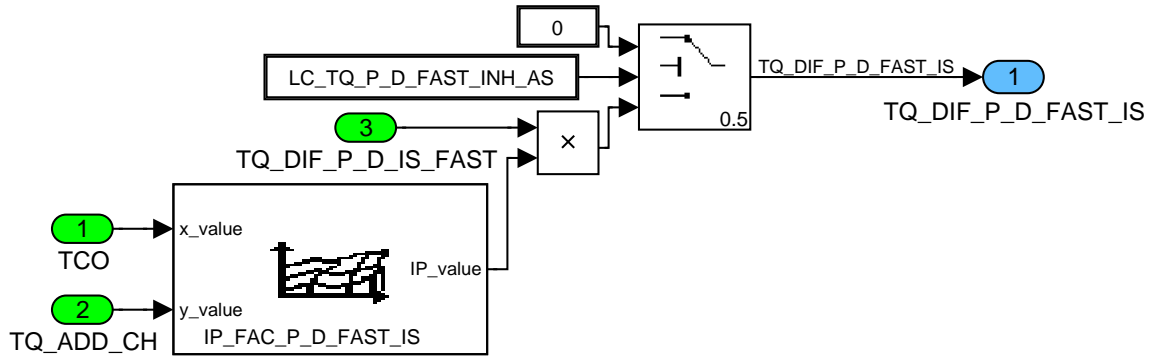
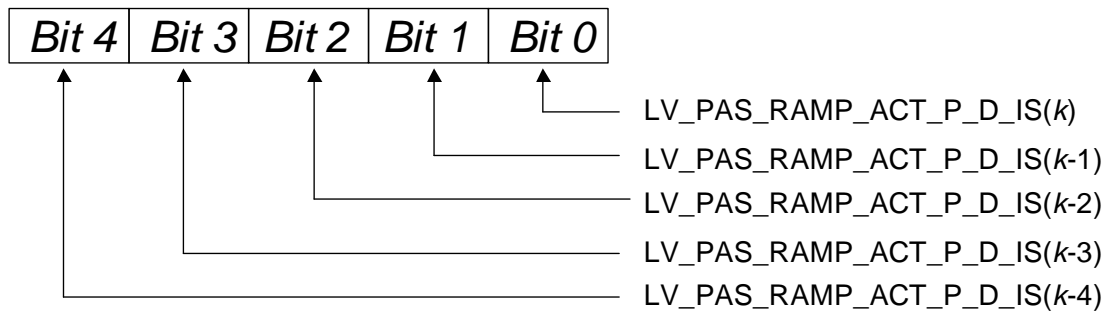


Figure 8.2.78: ENSC\_M8006/OPM/PD\_CONTROLLER/PD\_CONTROLLER/SEPARATION\_PD\_CONTL/DET\_TQ\_DIF\_P\_D\_FAST\_IS

**Circular buffer for LV\_PAS\_RAMP\_ACT\_P\_D\_IS**

In the following circular buffer STATE\_PAS\_RAMP\_ACT\_P\_D\_IS, the last five values of LV\_PAS\_RAMP\_ACT\_P\_D\_IS are stored. This information is needed for the Level 2 which has a recurrency of 40 ms and would not detected a high-low-high flank change inside 40 ms:



This information is needed for the monitoring of the idle speed controller. It is updated every 10ms; the values are shifted from Bit j to Bit j+1, j=0,1,2,3.

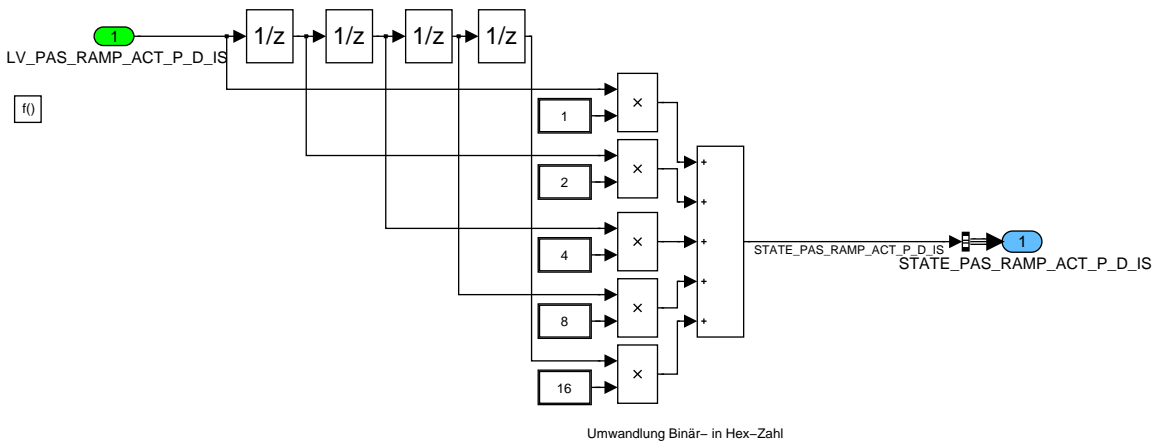


Figure 8.2.79: ENSC\_M8006/OPM/PD\_CONTROLLER/CLC\_LV\_PAS\_RAMP\_ACT\_P\_D\_IS

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## 8.3 Application conditions for idle speed control

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_NEG_N_GRD_FIL_MEM	V	0... 1H	0 ...1	1	-
Memory bit for falling gradient after start					
LV_REQ_ISC	O/V	0... 1H	0 ...1	1	-
Logical variable for idle speed controller activation request					
N_GRD_FIL_ISC_ACT_AST	V	80... 7FH	-4096 ...4064	32	rpm/s
Filtered gradient for ISC after start activation					
STATE_REQ_ISC	V	0H	ISC_PASSIVE	-	-
		1H	AFTER_START		
		2H	NORMAL		
		3H	TRAILING_		
		4H	THR PART_LOAD		
Actual state for ISC request					
T_CTR_PU_ISC_ACT	O/V	0... FFFFH	0... 655.35	0.01	s
Time counter for ISC activation in PU					

### Input data:

LV_AMT_CRAWL_ON {p. 799}	LV_AT {p. 654}	LV_DT {p. 1310}	LV_IS {p. 1720}
LV_N_SP_IS_CS {p. 1122}	LV_PL {p. 1720}	LV_PU {p. 1720}	LV_ST {p. 1720}
N {p. 1525}	N_DIF_COR {p. 1122}	N_GB {p. 1569}	N_GRD {p. 1525}
N_SP_IS {p. 1122}	N_SP_IS_RATIO {p. 1122}	VS {p. 1176}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_N_GRD_FIL_ISC_ACT_AST	-	0... FFFFH	0... 0.99998	15.3e-6	-
Filter correlation factor for speed gradient filtering in connection with after start activation of ISC					
C_N_DIF_ISC_ACT_AST	-	8000... 7FFFH	-32768 ...32767	1	rpm
Additive term to define the low limit for ISC activation after start					
C_N_DIF_ISC_ACT_PL_DOWN	-	8000... 7FFFH	-32768 ...32767	1	rpm
Additive term to define the low limit for ISC activation in PL					
C_N_DIF_ISC_ACT_PL_UP	-	8000... 7FFFH	-32768 ...32767	1	rpm
Additive term to define the upper limit for ISC deactivation in PL					
C_N_GB_DIF_N	-	0... FFFEh	0... 8191.75	0.125	rpm
Difference in input shaft speed turbine/gear box and engine speed					
C_N_SP_IS_MAX_PL_ACT	-	0... 1FE0H	0... 8160	1	rpm
Speed setpoint threshold for part load activation					
C_T_DLY_ISC_ACT_PU	-	0... FFFFH	0... 655.35	0.01	s
Time limit for ISC activation in PU					
IP_N_GRD_N_SP_IS_RATIO	-	0... FFH	-4096 ...4064	32	rpm/s
LDP_N_SP_IS_RATIO	8	0... FFFFH	0... 7.99987	122.1e-6	-
IP for Engine Speed Gradient					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_ISC_ACT_AST_CDN_SWI	-	0... 1H	0 ...1	1	-
Switch for using different after start ISC activation conditions					
LC_ISC_ACT_CDN_SWI	-	0... 1H	0 ...1	1	-
Calibratable logical bit for switching between different activation conditions					
LC_ISC_PL_ACT_INH	-	0... 1H	0 ...1	1	-
Calibratable bit to inhibit ISC activation in part load					

## Application conditions

**Activation:**

```

IF LC_ISC_ACT_CDN_SWI == 1
  THEN
    Use these application incidences
  ELSE IF LV_AMT_CRAWL_ON = 1
    THEN LV_REQ_ISC = 0
  ELSE LV_REQ_ISC = LV_IS
  ENDIF
ENDIF

```

At reset: STATE\_REQ\_ISC = ISC\_PASSIVE  
T\_CTR\_PU\_ISC\_ACT = C\_T\_DLY\_ISC\_ACT\_PU

**Update rate:** 10 ms

**At deactivation:** T\_CTR\_PU\_ISC\_ACT = C\_T\_DLY\_ISC\_ACT\_PU

### 8.3.1 General

The activation of the idle speed controller depends on different driving situations. Five states are distinguished. The actual status of the idle speed activation is stored in STATE\_REQ\_ISC.

**State 0:** Idle speed controller is passive (**STATE\_REQ\_ISC = ISC\_PASSIVE**).

**State 1:** Activation of the ISC after start (**STATE\_REQ\_ISC = AFTER\_START**).

**State 2:** "Normal activation": Activation of the ISC in case of LV\_IS = 1  
(**STATE\_REQ\_ISC = NORMAL**)

**State 3:** Activation of the ISC if speed remains stationary at a certain value in trailing throttle state (**STATE\_REQ\_ISC = TRAILING\_THR**).

**State 4:** Activation of the ISC in part load, in case of underspeed.  
(**STATE\_REQ\_ISC = PART\_LOAD**).

#### Formula section:

#### Action:

**FlipFlop condition (LV\_FF):**

```


IF N > (N_SP_IS + C_N_DIF_ISC_ACT_PL_UP) THEN LV_FF = 0
ELSE IF N < (N_SP_IS - C_N_DIF_ISC_ACT_PL_DOWN) THEN LV_FF = 1

IF      { LV_PL == 1 } AND
          { LV_FF == 1 } AND
          N_SP_IS < C_N_SP_IS_MAX_PL_ACT AND
          { LC_ISC_PL_ACT_INH == 0 }

          OR
          { LV_N_SP_IS_CS AND { NOT LV_IS } AND { NOT LV_ST } }
THEN
  LV_TEMP_PL_CDN = 1
ELSE
  LV_TEMP_PL_CDN = 0

```

The following state diagram illustrates the connection between these five cases, figure 1.

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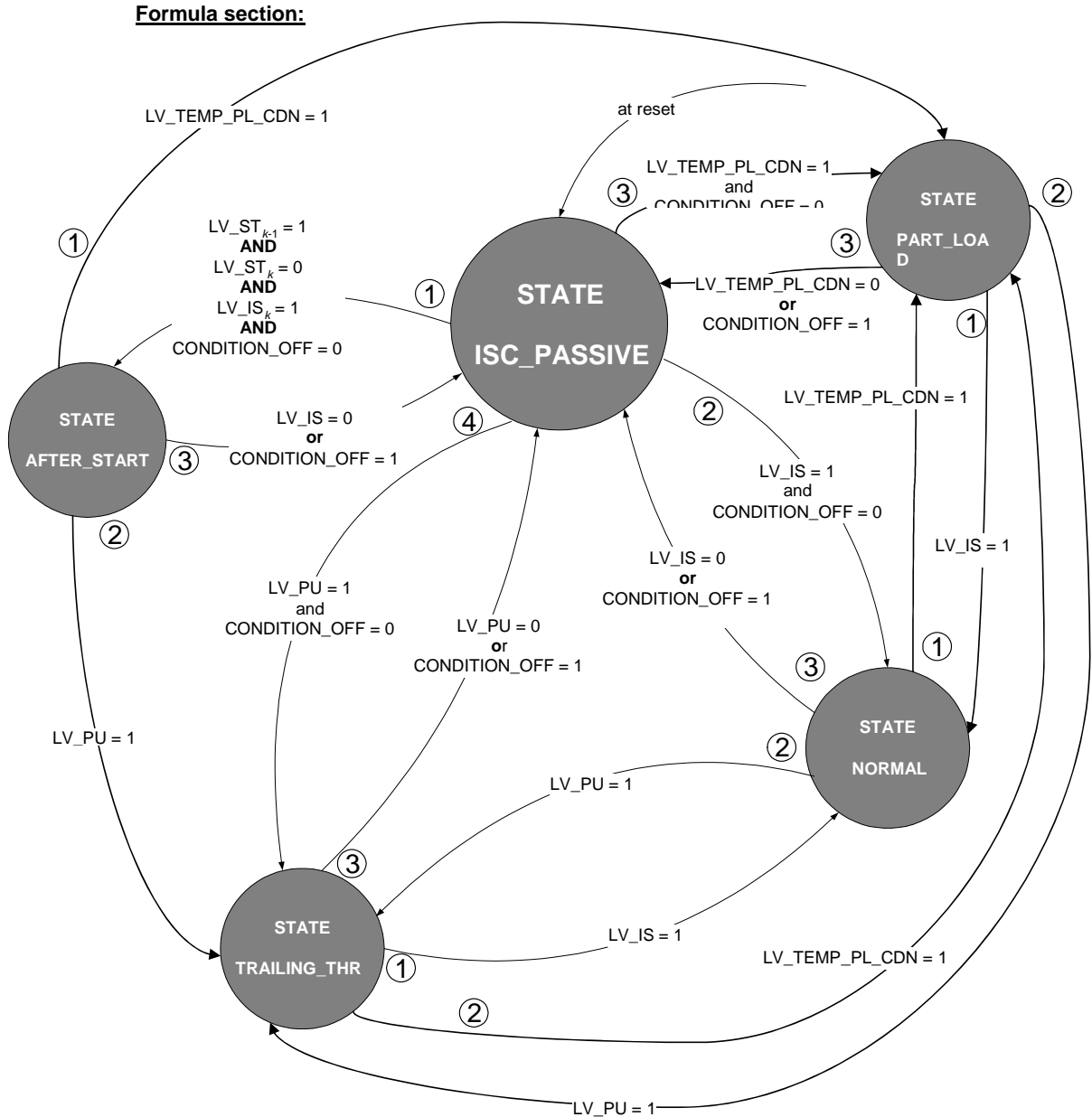


Figure 8.3.1: : State diagram of the ISC activation.

The numbers at different transitions of one state to another represent the priority in which the transitions have to be checked.

### 8.3.2 ISC Passive (STATE ISC\_PASSIVE)

**FUNCTION DESCRIPTION:**

This state is the idle speed controller passive state. The controller is deactivated if there is a transition to this state.

**Formula section:**

**Action:** LV\_REQ\_ISC = 0

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**Transition:** see figure 1

**Action during transition to AFTER\_START:**

$$LV\_NEG\_N\_GRD\_FIL\_MEM = 0$$

$$N\_GRD\_FIL\_ISC\_ACT\_AST = 0$$

### 8.3.3 Checking ISC activation conditions after start (Entry into IS after ST, STATE AFTER\_START)

#### FUNCTION DESCRIPTION:

After transition from engine state ST to IS, the activation of the ISC is requested if speed reaches a calibratable offset from N\_SP\_IS with a negative gradient N\_GRD, figure 2. If speed does not reach this offset after decreasing and increasing again, the controller is also activated.

**Transition:** see figure 1

#### Action:

```

IF    LC_ISC_ACT_AST_CDN_SWI == 1
THEN
    LV_REQ_ISC = 1
ELSE
{
    % Calculation of a filtered gradient for after start activation

    N_GRD_FIL_ISC_ACT_ASTk = N_GRD_FIL_ISC_ACT_ASTk-1 +
        + C_CRLC_N_GRD_FIL_ISC_ACT_AST { N_GRDk - N_GRD_FIL_ISC_ACT_ASTk-1}

    % If N reaches the calibratable offset N_SP_IS + C_N_DIF_ISC_ACT_AST
    % with a negative gradient, then the controller is activated. If
    % speed increases again before reaching N_SP_IS + C_N_DIF_ISC_ACT_AST,
    % then the controller is activated, too. The falling gradient
    % is layed up in LV_NEG_N_GRD_FIL_MEM.

    IF    N_GRD_FIL_ISC_ACT_AST < 0
    THEN
        LV_NEG_N_GRD_FIL_MEM = 1

        IF    { N < N_SP_IS + C_N_DIF_ISC_ACT_AST }
        THEN
            LV_REQ_ISC = 1
        ENDIF

    ELSEIF { N_GRD_FIL_ISC_ACT_AST >= 0 } AND
    { LV_NEG_N_GRD_FIL_MEM == 1 }

    THEN
        LV_REQ_ISC = 1

    ENDIF

```

}

After setting LV\_NEG\_N\_GRD\_FIL\_MEM, its value will not be changed until the after start is left to STATE 0.

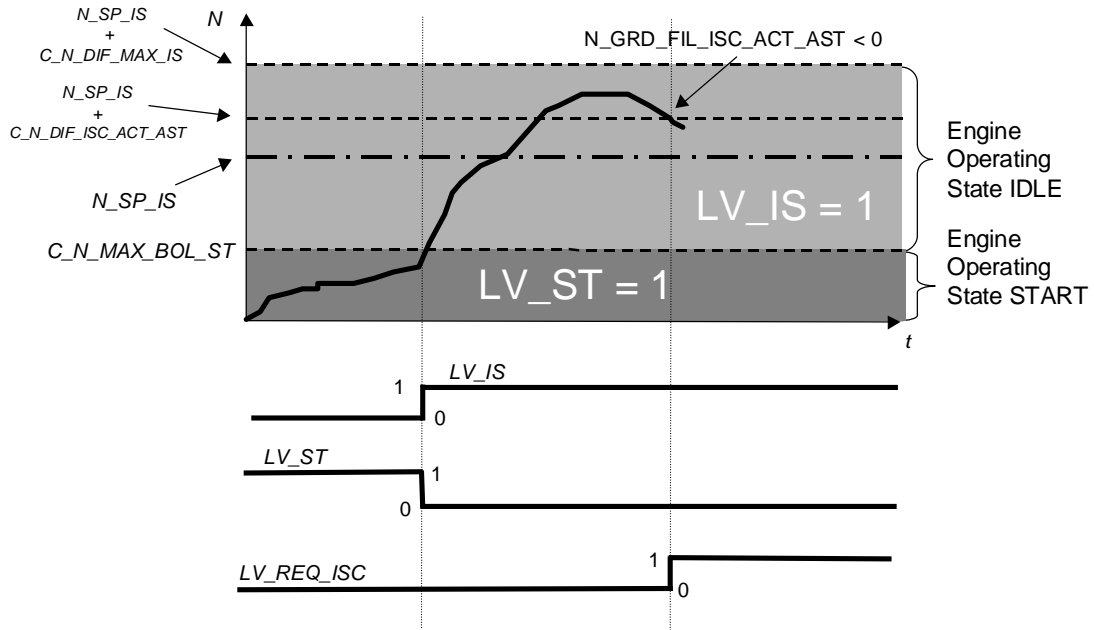



Figure 8.3.2: : ISC activation after start

### 8.3.4 Checking ISC activation conditions for "normal activation", STATE NORMAL)

The idle speed controller is activated on principle in case of  $LV\_IS = 1$  (except STATE 1 is active).

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**Figure 3: Activation of the ISC in case of  $LV\_IS = 1$**

**Formular section:**

**Transition:** see figure 1

**Action:**

```

IF(LV_AT = 1)
THEN IF (LV_DT = 0)
    THEN LV_REQ_ISC = 1
    ELSEIF (N_GB < N - C_N_GB_DIF_N OR N_GRD < IP_N_GRD_N_SP_IS_RATIO OR N_DIF_COR > 0)
        THEN LV_REQ_ISC = 1
ELSE LV_REQ_ISC = 1;
    
```

**8.3.5 ISC activation in case of low engine speed decrease in trailing throttle state ( $LV\_PU = 1$ , STATE TRAILING\_THR)**

If speed decrease in trailing throttle state is very low or speed does not decrease, the idle speed controller is activated after a calibratable time  $C\_T\_DLY\_ISC\_ACT\_PU$ . The condition for that is a standing vehicle ( $VS=0$ ). The counter is started when entering PU ( $LV\_PU_{k-1} = 0$   $LV\_PU_k = 1$ ). The counter is reinitialized with  $C\_T\_DLY\_ISC\_ACT\_PU$  when leaving PU. See figure 4.

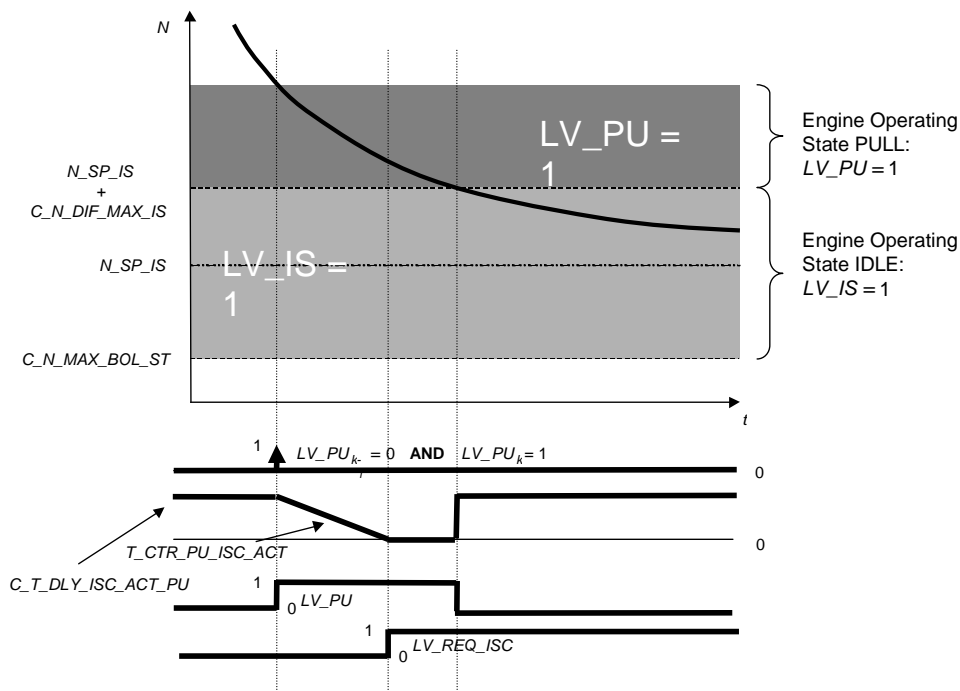


Figure 8.3.3: : Activation of the ISC in PU in case the speed decrease is too low and **the vehicle does not move ( $VS = 0$ )**. The counter starts

from a tunable value  $C\_T\_DLY\_ISC\_ACT\_PU$  and stops at zero.

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**Formular section:****Transition:** see figure 1

**Action:** start toramp down  $T\_CTR\_PU\_ISC\_ACT$  when entering PU  
(the initialization of  $T\_CTR\_PU\_ISC\_ACT$  was already done before)

```

IF { VS == 0 OR LV_DT == 0 } AND { T_CTR_PU_ISC_ACT == 0 }
THEN
    LV_REQ_ISC = 1
ELSE
    LV_REQ_ISC = 0
ENDIF

```

Reinitialize  $T\_CTR\_PU\_ISC\_ACT$  with  $C\_T\_DLY\_ISC\_ACT\_PU$  when leaving state TRAILING\_THR


**8.3.6 Conditions for ISC part load activation (STATE PART\_LOAD)**

In part load, the driver or cruise control torque request can be so small, that the idle speed setpoint  $N\_SP\_IS$  cannot be held and speed is decreasing. In this case, the idle speed controller is used to guaranty  $N\_N\_SP\_IS$ . The conditions for activating the ISC in this case depend on the speed and a calibratable hysteresis, figure 5.

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**Figure 5:** Activating the ISC in part load**Formula section:****Transition:** see figure 1

**Action:**  $LV\_REQ\_ISC = 1$

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### 8.3.7 Checking ISC inhibit interfaces


During AMT shift intervention Phase 1 (LV\_AMT\_CRAWL\_ON = 1) an additional Converter torque is calculated; during this time the ISC is looked State "PASSIVE".

All inhibit interfaces lead to CONDITION\_OFF which is used in the state diagram (figure 1).

```

IF          LV_AMT_CRAWL_ON = 1
THEN       CONDITION_OFF = 1
ELSE       CONDITION_OFF = 0
ENDIF

```

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## 8.4 Idle speed adaptation

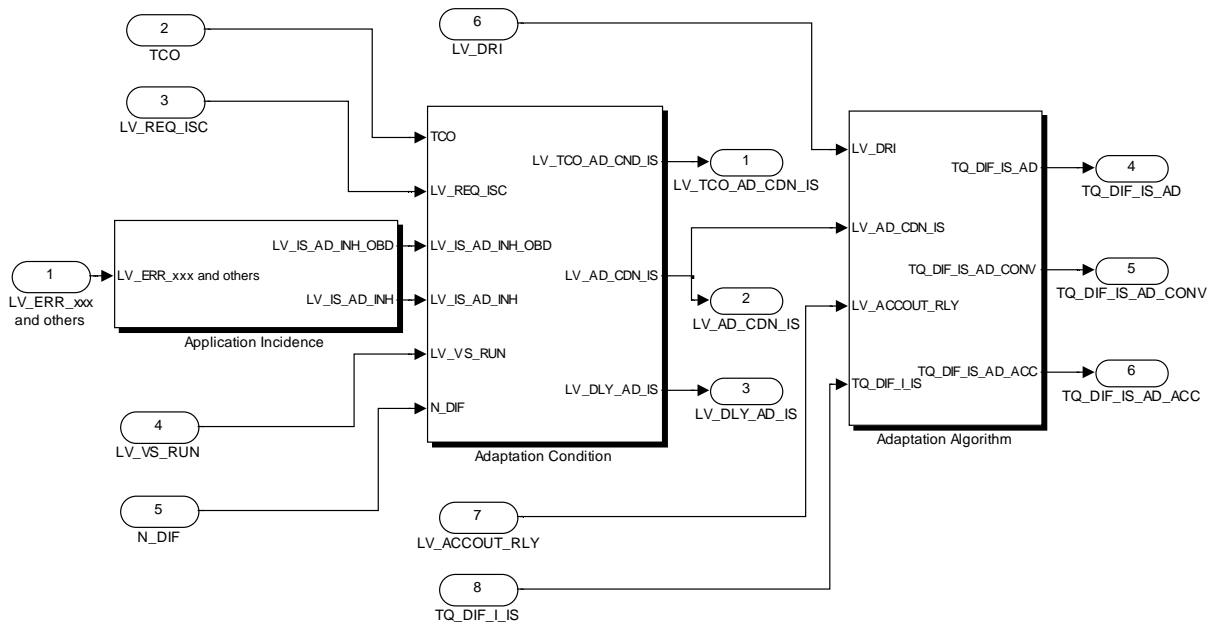


Figure 8.4.1: : Idle Speed Adaptation, Overview

### Functional Description:

The present adaptation is introduced to compensate spread and series variation of engine, air conditioning compressor and hydraulic converter torque losses. It is calculated during idle speed, using the integral part of the idle speed controller for the adaptation of three different parameters:

TQ\_DIF\_IS\_AD is the adaptation of the basic engine torque losses, without taking the drivetrain into account (disengaged gear),

TQ\_DIF\_IS\_AD\_CONV is an adaptation of the hydraulic converter torque request at idle speed (for automatic transmission only),

TQ\_DIF\_IS\_AD\_ACC is an adaptation value which considers two adaptation cases depending on the actual situation:

- air conditioning compressor and converter active at the same time
- only air conditioning compressor active

The function consists of the following blocks:

Application Incidence: Checks whether a relevant error has occurred.


Adaptation Condition: Checks whether the adaptation conditions are fulfilled.

- Adaptation Algorithm: Calculation of the specific adaptation parameters.

These parameters are integrated directly in the specific functions, i.e. the adaptation of the converter torque TQ\_DIF\_IS\_AD\_CONV is used in the function "Converter torque" ...

Adaptation parameters for new torque consuming components should be integrated in the same way into the adaptation algorithm module.

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## 8.5 TQM - Idle speed adaptation (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_IS_AD_INH	O/V	0... 1H	0 ...1	1	-
Application incidence value (additional adaptation inhibition conditions, project specific)					
LV_IS_AD_INH_OBD	O/V	0... 1H	0 ...1	1	-
Application incidence value					

### Input data:

ANG_PSTE {p. 1561}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_BN_VS_TCS {p. 4871}
LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_EL_CPS {p. 4708}	LV_ERR_IGC {p. 4772}
LV_ERR_LOAD_TPS_ PLAUS {p. 1062}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_PVS_DOUBLE {p. 4216}
LV_ERR_TCO {p. 4496}	LV_ERR_TOUT_ASR_1 {p. 802}	LV_ERR_TPS {p. 4982}	LV_ERR_VS {p. 5021}
LV_MIS_STATE_A {p. 6238}	LV_MTC_CUR_OFF {p. 6565}	LV_ST_END {p. 1720}	LV_TQ_ADD_PSTE_IS_ AD_INH {p. 6621}
LV_TQ_DROF_IS_AD_INH {p. 1112}	LV_TQ_LOSS_ARS_IS_ AD_INH {p. 6650}	LV_TQ_LOSS_PSTE_IS_ AD_INH {p. 6621}	LV_VAR_TCT {p. 656}
STATE_ERR_IV {p. 4803}	TCO {p. 1100}	TQ_TCT_CAN {p. 1582}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ANG_PSTE_MAX_IS_AD	V	8000... 7FFFH	-1439.98976 ...1439.945815	0.043945	°STW
Max steering angle threshold to inhibit idle speed adaptation					
C_TQ_TCT_CAN_MAX_IS_AD	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum torque at clutch for TCT for idle speed adaptation					
IP_T_AST_IS_AD_INH	V	0... FFFFH	0... 6553.5	0.1	s
LDP_TCO_IP_T_AST_IS_AD_INH	4	0... FEH	-48... 142.5	0.75	°C
Time after start during which idle speed adaptation is disabled					

### General information

The idle speed adaptation is inhibited if on of the errors described in the formula section occur. Additionally it is possible to inhibit the idle speed adaptation for a certain time after start dependent on the start temperature.

### Description:

If one of these error bits is set, LV\_IS\_AD\_INH\_OBD = 1 and LV\_IS\_AD\_INH = 1. Adaptation is not allowed see application conditions.

### Application conditions:

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**Initialisation:** all 0 at LV\_IGK 0 > 1 and reset  
**Activation:** at every engine state  
**Deactivation:** -  
**Recurrence:** 100 ms

### Function description:

### Formula section:

```

If    LV_ST_END = 0→1
Then  T_AST_IS_AD_INH = IP_T_AST_IS_AD_INH    / *LV_ST_END setting initiates
                                                timer*/
Else  T_AST_IS_AD_INH - -                    / *timer is decremented*/
Endif

```

```

If    abs(ANG_PSTE) > C_ANG_PSTE_MAX_IS_AD          or
        (LV_VAR_TCT = 1 and TQ_TCT_CAN > C_TQ_TCT_CAN_MAX_IS_AD) or
        T_AST_IS_AD_INH > 0                          or
        LV_ERR_MAF = 1                                or
        LV_ERR_PVS_DOUBLE = 1                        or
        STATE_ERR_IV <>                               or
        LV_ERR_IGC                                    or
        LV_ERR_LOAD_TPS_PLAUS = 1                    or
        LV_ERR_TPS = 1                                or
        LV_ERR_EL_CPS = 1                            or
        LV_ERR_DIAGCPS = 1                           or
        LV_MIS_STATE_A = 1                            or
        LV_ERR_TCO = 1                                or
        LV_ERR_AMP = 1                                or
        LV_ERR_AMP_PLAUS = 1                          or
        LV_MTC_CUR_OFF = 1                            or
        LV_TQ_LOSS_PSTE_IS_AD_INH = 1                 or
        LV_TQ_ADD_PSTE_IS_AD_INH = 1                  or
        LV_TQ_LOSS_ARS_IS_AD_INH = 1                  or
        LV_TQ_DROF_IS_AD_INH = 1                      or
        LV_ERR_VS = 1                                  or
        LV_ERR_MAP_TPS_PLAUS                          or
Then  LV_IS_AD_INH = 1
        LV_IS_AD_INH_OBD = 1
Else  LV_IS_AD_INH = 0
        LV_IS_AD_INH_OBD = 0
Endif

```

## 8.6 TQM - Idle speed adaptation conditions

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_AD_CDN_IS	O/V	0... 1H	0 ...1	1	-
Adaptation condition					
LV_DLY_AD_IS	O/V	0... 1H	0 ...1	1	-
Logical bit "Idle speed has settled for a given time delay"					
LV_TCO_AD_CDN_IS	O/V	0... 1H	0 ...1	1	-
Logical bit "Coolant temperature in operating range"					

### Input data:

LV_IS_AD_INH {p. 3512}	LV_IS_AD_INH_OBD {p. 3512}	LV_REQ_ISC {p. 3501}	LV_VS_RUN {p. 1176}
N_DIF {p. 1122}	TCO {p. 1100}		

### Calibration data:

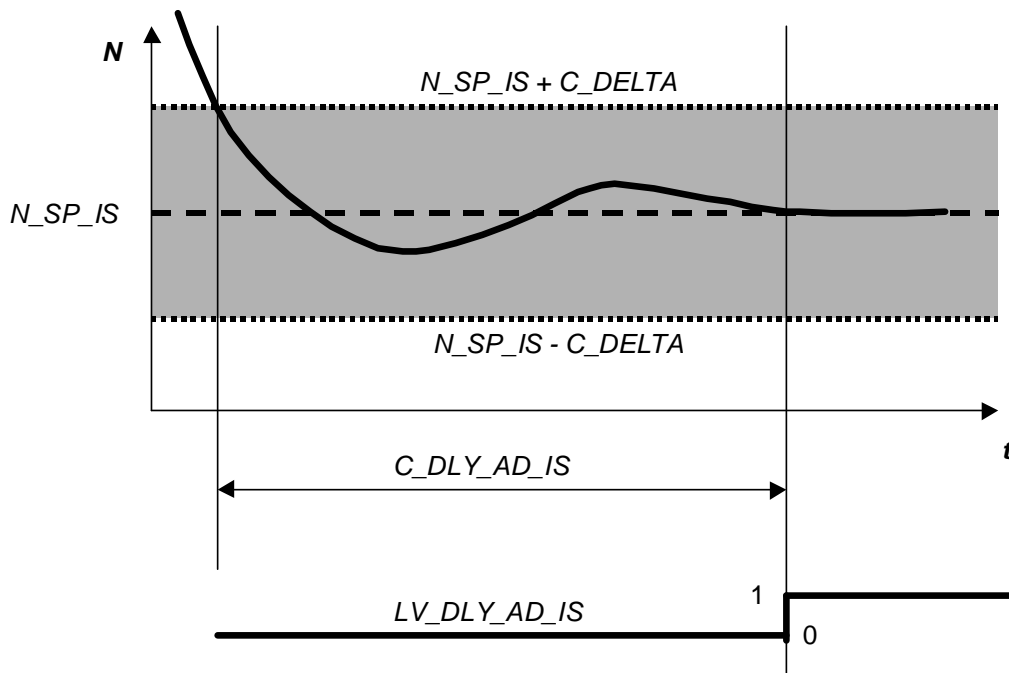
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DLY_AD_IS	-	0... FFH	0... 25.5	0.1	s
time delay for ISC adaptation					
C_N_DELTA	-	0... 1FE0H	0... 8160	1	rpm
engine speed threshold for ISC adaptation					
C_TCO_AD_MAX_IS	-	0... FEH	0... 142.5	0.75	°C
temperature top limit for ISC adaptation					
C_TCO_AD_MIN_IS	-	0... FEH	0... 142.5	0.75	°C
temperature bottom limit for ISC adaptation					

### 8.6.1 Activation conditions for the Idle Speed Adaptation

The adaptation process is released when all of the following conditions are fulfilled (LV\_AD\_CDN\_IS = 1):

engine running in idle state (LV\_REQ\_ISC = 1)

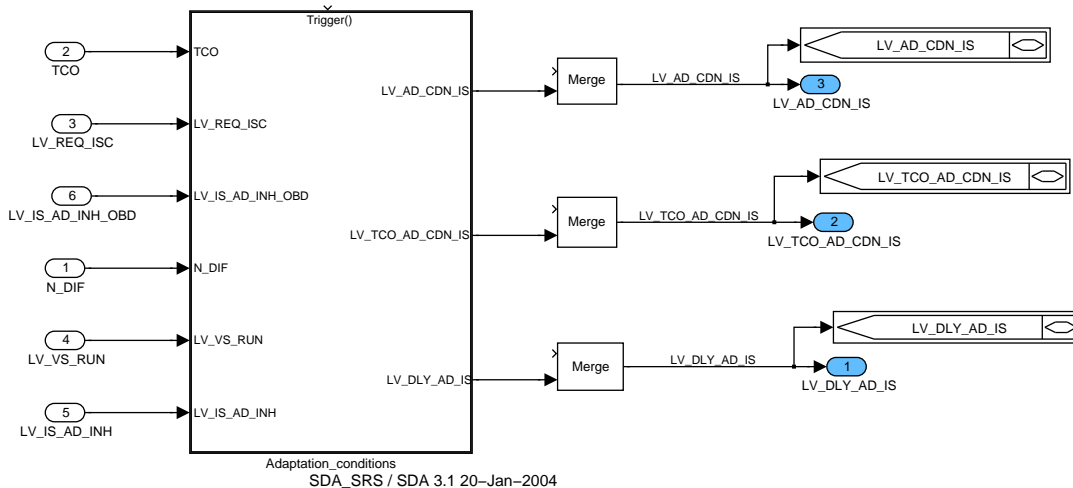
idle speed has settled for a given time delay (T\_DLY\_AD\_IS is the timer value):



Delay timer for idle speed adaptation activation

vehicle stopped (LV\_VS\_RUN = 0)  
 coolant temperature in operating range:  
 LV\_IS\_AD\_INH\_OBD = 0 (see module "Application Incidence")  
 LV\_IS\_AD\_INH = 0 (see module "Application Incidence")

**Function Description**



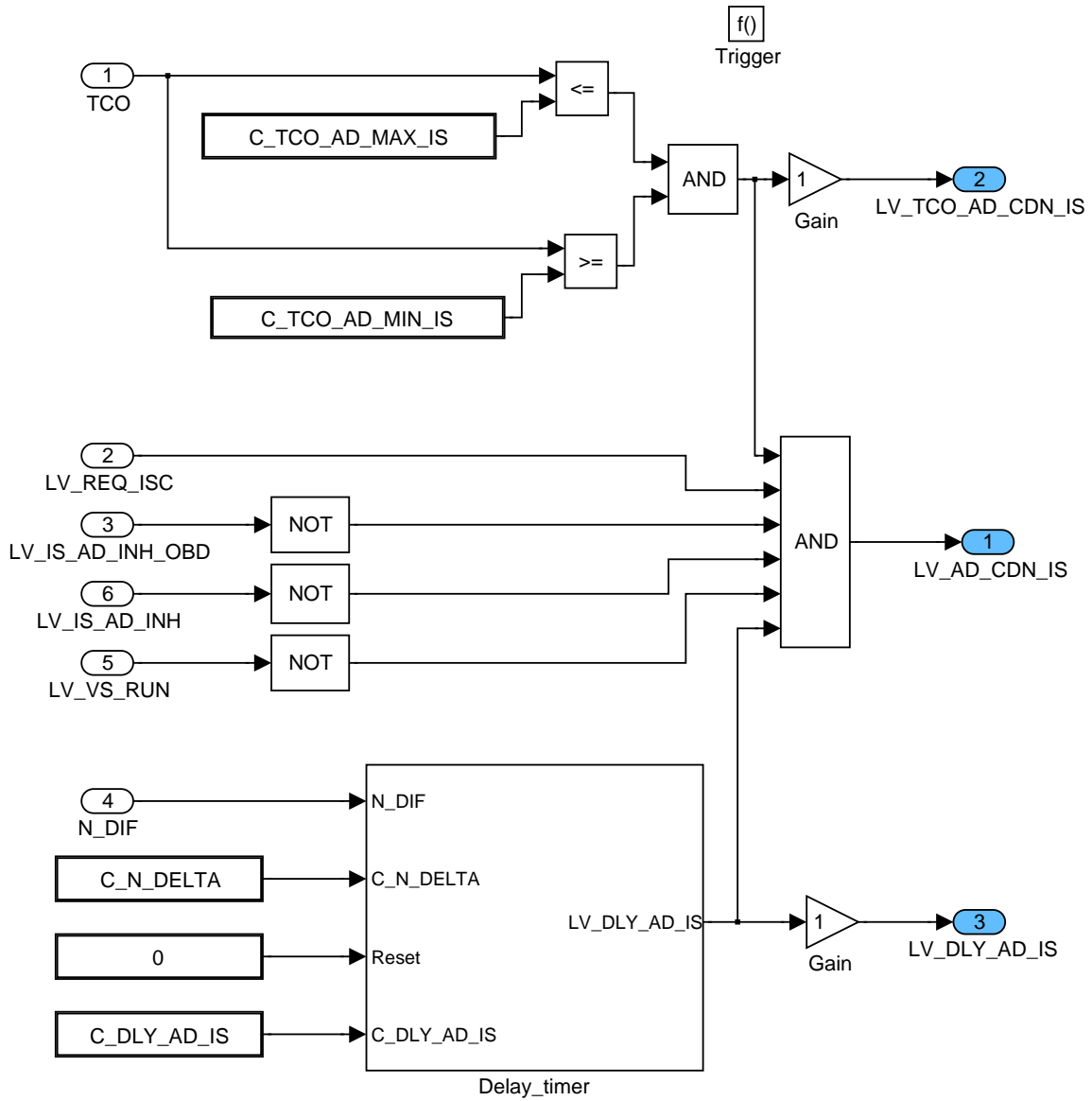
Adaptation\_conditions  
 SDA\_SRS / SDA 3.1 20-Jan-2004

M800M

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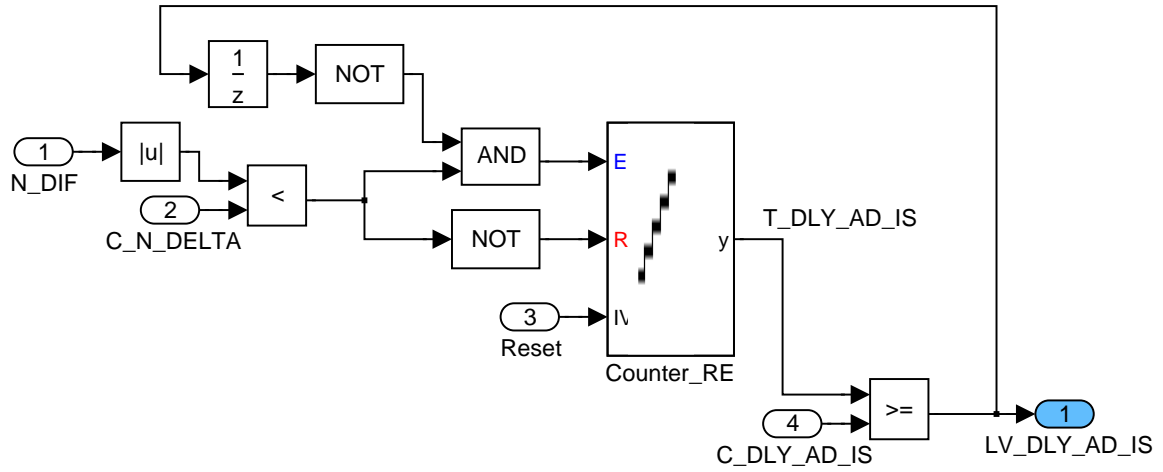
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### 8.6.1.1 SUBFUNCTION: ADAPTATION\_CONDITIONS



M800M/Adaptation\_conditions

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M800M/Adaptation\_conditions/Delay\_timer

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## 8.7 TQM - Idle speed adaptation algorithm

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_DIF_IS_AD	V	0... FFFFH	0... 0.99998474121	15.2588e-6	-
ISC adaptation factor					
LV_AT_NEUT_CTL	V	0... 1H	0 ...1	1	-
Logical variable for neutral control active/passive (drive engaged)					
LV_OPM_SEL_TQ_IS_AD_1	V	0... 1H	0 ...1	1	-
Last operation mode calculation active					
LV_OPM_SEL_TQ_IS_AD_2	V	0... 1H	0 ...1	1	-
Requested value active					
TQ_DIF_IS_AD	O/V/S	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Basic ISC adaptation					
TQ_DIF_IS_AD_ACC	O/V/S	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Low-pass filtered ACC torque adaptation or ACC and Hydraulic converter torque adaptation					
TQ_DIF_IS_AD_ACC_1	O/V/S	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
ACC torque adaptation					
TQ_DIF_IS_AD_ACC_1_INTER	V	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
ACC torque adaptation, intermediate value with high resolution (long signed word)					
TQ_DIF_IS_AD_ACC_1_OPM_1	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
ACC torque adaptation, intermediate value with high resolution (long signed word) OPM1					
TQ_DIF_IS_AD_ACC_1_OPM_2	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
ACC torque adaptation, intermediate value with high resolution (long signed word) OPM2					
TQ_DIF_IS_AD_ACC_CONV	O/V/S	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
ACC and Hydraulic converter torque adaptation					
TQ_DIF_IS_AD_ACC_CONV_INTER	V	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
ACC and Hydraulic converter torque adaptation, intermediate value with high resolution (long signed word)					
TQ_DIF_IS_AD_ACC_CONV_OPM_1	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
ACC and Hydraulic converter torque adaptation, intermediate value with high resolution (long signed word) OPM1					
TQ_DIF_IS_AD_ACC_CONV_OPM_2	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
ACC and Hydraulic converter torque adaptation, intermediate value with high resolution (long signed word) OPM2					
TQ_DIF_IS_AD_ACC_NEUT	O/V/S	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
ACC and Hydraulic converter torque adaptation with neutral control active					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_DIF_IS_AD_ACC_NEUT_INTER	V	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
ACC torque adaptation with neutral control active and drive engaged, intermediate value with high resolution (long signed word)					
TQ_DIF_IS_AD_ACC_NEUT_OPM_1	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
ACC and Hydraulic converter torque adaptation with neutral control active, intermediate value with high resolution (long signed word) OPM1					
TQ_DIF_IS_AD_ACC_NEUT_OPM_2	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
ACC and Hydraulic converter torque adaptation with neutral control active, intermediate value with high resolution (long signed word) OPM2					
TQ_DIF_IS_AD_CONV	O/V/S	8000... 7FFFFH	-1024... 1023.96875	0.03125	Nm
Hydraulic converter adaptation torque					
TQ_DIF_IS_AD_CONV_1	O/V/S	8000... 7FFFFH	-1024... 1023.96875	0.03125	Nm
Hydraulic converter adaptation torque with neutral control passive					
TQ_DIF_IS_AD_CONV_1_INTER	V	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
Adaptation torque for hydraulic converter, intermediate value with high resolution (long signed word)					
TQ_DIF_IS_AD_CONV_1_OPM_1	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
Hydraulic converter adaptation torque with neutral control passive, intermediate value with high resolution (long signed word) OPM1					
TQ_DIF_IS_AD_CONV_1_OPM_2	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
Hydraulic converter adaptation torque with neutral control passive, intermediate value with high resolution (long signed word) OPM2					
TQ_DIF_IS_AD_CONV_NEUT	O/V/S	8000... 7FFFFH	-1024... 1023.96875	0.03125	Nm
Hydraulic converter adaptation torque with neutral control active					
TQ_DIF_IS_AD_CONV_NEUT_INTER	V	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
Hydraulic converter adaptation torque with neutral control active, intermediate value with high resolution (long signed word)					
TQ_DIF_IS_AD_CONV_NEUT_OPM_1	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
Hydraulic converter adaptation torque with neutral control active, intermediate value with high resolution (long signed word) OPM1					
TQ_DIF_IS_AD_CONV_NEUT_OPM_2	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
Hydraulic converter adaptation torque with neutral control active, intermediate value with high resolution (long signed word) OPM2					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_DIF_IS_AD_INTER	V	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
Basic ISC adaptation, intermediate value with high resolution (long signed word)					
TQ_DIF_IS_AD_OPM_1	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
Basic ISC adaptation, intermediate value with high resolution (long signed word) OPM1					
TQ_DIF_IS_AD_OPM_2	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
Basic ISC adaptation, intermediate value with high resolution (long signed word) OPM2					

**Input data:**

FAC_TQ_LOSS_OPM_SEL {p. 8385}	LC_AD_CLR {p. 526}	LV_ACCOUT_RLY {p. 3589}	LV_AD_CDN_IS {p. 3514}
LV_DRI {p. 1302}	LV_TQ_LOSS_AD_CLR_ EXT_ADJ {p. 7483}	N_32 {p. 1525}	OPM_AV {p. 8137}
OPM_REQ {p. 8137}	STATE_MOD_GB {p. 1575}	TQ_DIF_I_IS {p. 3441}	TQ_REQ_CLU {p. 8390}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_TQ_DIF_IS_AD_ACC	-	0... FFH	0... 0.99609375	3.90625e-3	-
Filter constant for LOW_PASS_1 (smoothing of the ACC-adaptation values)					
C_CRLC_TQ_DIF_IS_AD_CONV	-	0... FFH	0... 0.99609375	3.90625e-3	-
Filter constant for smoothing of the converter torque adaptation values					
C_TQ_DIF_IS_AD_ACC_CONV_MAX	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Max. limitation of air conditioning compressor and converter torque adaptation					
C_TQ_DIF_IS_AD_ACC_CONV_MIN	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Min. limitation of air conditioning compressor and converter torque adaptation					
C_TQ_DIF_IS_AD_ACC_MAX	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Max. limitation for ACC torque adaptation					
C_TQ_DIF_IS_AD_ACC_MIN	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Min. limitation for ACC adaptation					
C_TQ_DIF_IS_AD_CONV_MAX	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Max. limitation for converter torque adaptation					
C_TQ_DIF_IS_AD_CONV_MIN	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Min. limitation of converter torque adaptation					
C_TQ_DIF_IS_AD_MAX	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Max. limitation of engine torque losses adaptation					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TQ_DIF_IS_AD_MIN	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Min. limitation of engine torque losses adaptation					
ID_TQ_DIF_IS_AD_OPM_AV	-	1... 8H	1 ...8	1	-
LDP_OPM_AV_TQLO	8	0... 8H	0 ...8	1	-
Table of index OPM_AV					
ID_TQ_DIF_IS_AD_OPM_REQ	-	1... 8H	1 ...8	1	-
LDP_OPM_AV_TQLO	8	0... 8H	0 ...8	1	-
Table of index OPM_REQ					
IP_FAC_TQ_DIF_IS_AD	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
LDP_TQ_DIF_I_IS_FAC_TQ_IS_AD	4	0... 7FFFH	0... 1023.96875	0.03125	Nm
ISC adaptation factor depend on absolut value of TQ_DIF_IS_I					
IP_FAC_TQ_DIF_IS_AD_N_32	-	0... FFH	0 ...1	3.92157e-3	-
LDP_N_32_IP_FAC_TQ_DIF_IS_AD	4	0... FFH	0... 8160	32	rpm
Factor considered for the calculation adapted torque losses					
IP_FAC_TQ_DIF_IS_AD_OPM_MV	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDP_N_32_FAC_TQ_DIF_IS_AD	6	0... FFH	0... 8160	32	rpm
LDP_TQ_REQ_CLU_FAC_TQ_DIF_IS_AD	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Factor for fading between TQ_DIF_IS_AD_INTER and the mean value of the adaptation values TQ_DIF_IS_AD_OPM_1/ 2 in dependency of engine speed/load					

### Action definition:

ACTION_TQLO_OPM_M800N(IN <IN1>, IN <IN2>, OUT <OUT>, OUT <LV_OPM_SEL_TQ_IS_AD_1>, OUT <LV_OPM_SEL_TQ_IS_AD_2>)						Mode: O
OPM with I/O resolution 4.768E-7 and phys limits -1024...1023.9999[Nm]						
Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit	
IN1	IN	80000000... 7FFFFFFFH	-1024 ...1024	476.837e-9	Nm	
Basic ISC adaptation, intermediate value with high resolution (long signed word)						
IN2	IN	80000000... 7FFFFFFFH	-1024 ...1024	476.837e-9	Nm	
Basic ISC adaptation, intermediate value with high resolution (long signed word)						
OUT	OUT	80000000... 7FFFFFFFH	-1024 ...1024	476.837e-9	Nm	
Basic ISC adaptation, intermediate value with high resolution (long signed word)						
LV_OPM_SEL_TQ_IS_AD_1	OUT	0... 1H	0... 1	1	-	
Last operation mode calculation active						
LV_OPM_SEL_TQ_IS_AD_2	OUT	0... 1H	0... 1	1	-	
Requested value active						

### General information:


#### Application conditions:

#### Initialization:

#### E2PROM Variables

At first initialization, after a checksum failure or at service tester request LV\_TQ\_LOSS\_AD\_CLR\_EXT\_ADJ or LC\_AD\_CLR 0 -> 1 , all parameters are set to zero:

TQ\_DIF\_IS\_AD = 0 Nm,

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TQ\_DIF\_IS\_AD\_CONV\_NEUT = 0 Nm,  
 TQ\_DIF\_IS\_AD\_CONV = 0 Nm,  
 TQ\_DIF\_IS\_AD\_CONV\_1 = 0 Nm,  
 TQ\_DIF\_IS\_AD\_ACC\_NEUT = 0 Nm,  
 TQ\_DIF\_IS\_AD\_ACC\_CONV = 0 Nm,  
 TQ\_DIF\_IS\_AD\_ACC = 0 Nm,  
 TQ\_DIF\_IS\_AD\_ACC\_1 = 0 Nm,

TQ\_DIF\_IS\_AD\_OPM\_1 = 0 Nm,  
 TQ\_DIF\_IS\_AD\_OPM\_2 = 0 Nm,  
 TQ\_DIF\_IS\_AD\_ACC\_1\_OPM\_1 = 0 Nm,  
 TQ\_DIF\_IS\_AD\_ACC\_1\_OPM\_2 = 0 Nm,  
 TQ\_DIF\_IS\_AD\_ACC\_CONV\_OPM\_1 = 0 Nm,  
 TQ\_DIF\_IS\_AD\_ACC\_CONV\_OPM\_2 = 0 Nm,  
 TQ\_DIF\_IS\_AD\_CONV\_1\_OPM\_1 = 0 Nm,  
 TQ\_DIF\_IS\_AD\_CONV\_1\_OPM\_2 = 0 Nm,  
 TQ\_DIF\_IS\_AD\_ACC\_NEUT\_OPM\_1 = 0 Nm,  
 TQ\_DIF\_IS\_AD\_ACC\_NEUT\_OPM\_2 = 0 Nm,  
 TQ\_DIF\_IS\_AD\_CONV\_NEUT\_OPM\_1 = 0 Nm,  
 TQ\_DIF\_IS\_AD\_CONV\_NEUT\_OPM\_2 = 0 Nm

Variables initialized after reset and after the E2PROM has been read

TQ\_DIF\_IS\_AD\_ACC\_1\_INTER = TQ\_DIF\_IS\_AD\_ACC\_1,  
 TQ\_DIF\_IS\_AD\_ACC\_NEUT\_INTER = TQ\_DIF\_IS\_AD\_ACC\_NEUT,  
 TQ\_DIF\_IS\_AD\_ACC\_CONV\_INTER = TQ\_DIF\_IS\_AD\_ACC\_CONV,  
 TQ\_DIF\_IS\_AD\_CONV\_NEUT\_INTER = TQ\_DIF\_IS\_AD\_CONV\_NEUT,  
 TQ\_DIF\_IS\_AD\_CONV\_1\_INTER = TQ\_DIF\_IS\_AD\_CONV\_1,  
 LV\_AT\_NEUT\_CTL = 0 [-]

Activation:

always

Deactivation:

-

Update rate:


100 ms

#### FUNCTION DESCRIPTION:

The complete function is calculated every 100ms independent of the status of the adaptation condition. If the adaptation conditions are fulfilled (LV\_AD\_CDN\_IS = 1), the corresponding adaptation value is fed by the I-gain of the idle speed controller value TQ\_DIF\_I\_IS :

The adaptation of ACC and CONV (TQ\_DIF\_IS\_AD\_ACC\_CONV) is calculated if the gear is engaged (LV\_DRI = 1) and the air conditioning compressor is switched on (LV\_ACCOUT\_RLY = 1).

The adaptation of ACC and CONV with neutral control active (TQ\_DIF\_IS\_AD\_ACC\_NEUT) is calculated if the gear is engaged (LV\_DRI = 1), neutral control active (LV\_AT\_NEUT\_CTL = 1) and the air conditioning compressor is switched on (LV\_ACCOUT\_RLY = 1).

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If  $LV\_ACCOUT\_RLY = 1$  and  $LV\_DRI = 0$ , the adaptation of the air conditioning compressor is calculated ( $TQ\_DIF\_IS\_AD\_ACC\_1$ ).

The Hydraulic converter torque adaptation with neutral control passive ( $TQ\_DIF\_IS\_AD\_CONV\_1$ ) is calculated if  $LV\_DRI = 1$ ,  $LV\_AT\_NEUT\_CTL = 0$  and  $LV\_ACCOUT\_RLY = 0$ .

The Hydraulic converter torque adaptation with neutral control active ( $TQ\_DIF\_IS\_AD\_CONV\_NEUT$ ) is calculated if  $LV\_DRI = 1$ ,  $LV\_AT\_NEUT\_CTL = 1$  and  $LV\_ACCOUT\_RLY = 0$ .

The basic adaptation of the idle speed controller ( $TQ\_DIF\_IS\_AD$ ) is calculated if the gear is disengaged ( $LV\_DRI = 0$ ) and the air conditioning compressor is switched off ( $LV\_ACCOUT\_RLY = 0$ ).

Therefore, a fraction of the integral part of the idle speed controller ( $FAC\_TQ\_DIF\_IS\_AD * TQ\_DIF\_I\_IS$ ) is added at each cycle to the concerned adaptation parameter, whose value is limited through a min/max limiter. The adaptation parameters are stored, even after deactivation of the function. These values are used as start values after re-entering into the same adaptation path.

The outputs of the different adaptation paths are always covered with values of the last adaptation, even if the adaptation conditions are not fulfilled or the engine is not in idle. But these values will only be adapted (changed) if the certain adaptation path is activated and they are certainly only considered in the single modules ( Torque Loss and Lead for ACC , Converter Torque ) in conformance with the actual situation (ACC on, drivetrain engaged). Only the basic torque losses ( $TQ\_DIF\_IS\_AD$ ) are always considered in the module Torque Losses .

$TQ\_DIF\_IS\_AD\_CONV$  is considered in the converter torque calculation module,  $TQ\_DIF\_IS\_AD\_ACC$  in the calculation of the air conditioning compressor losses.  $TQ\_DIF\_IS\_AD$  is added in the torque losses.

The integration is done with high resolution values (long signed word).

At the end of the integration the conversion from high resolution (signed long word) to normal resolution (signed word) is done. Only the high word is taken from the signed long word value.

### Application conditions:

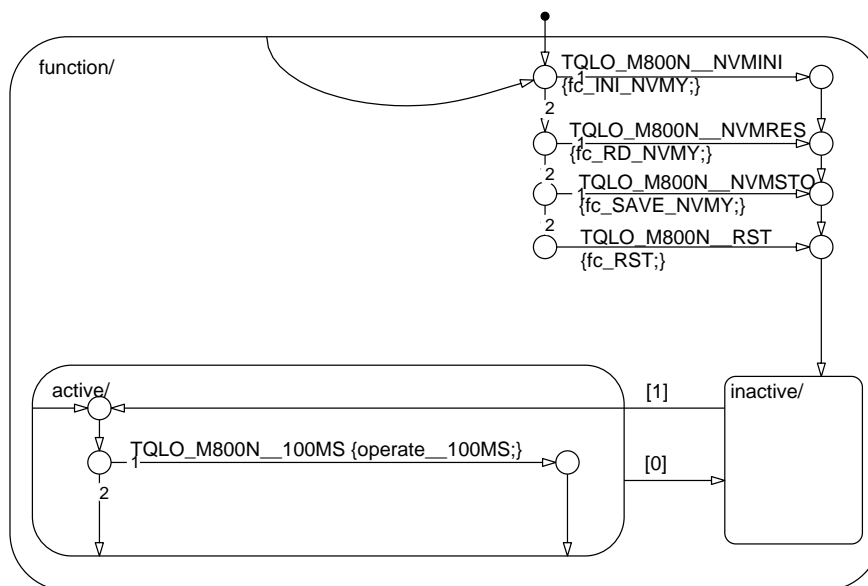


Figure 8.7.1: :

### Function description:

**Formula section:**

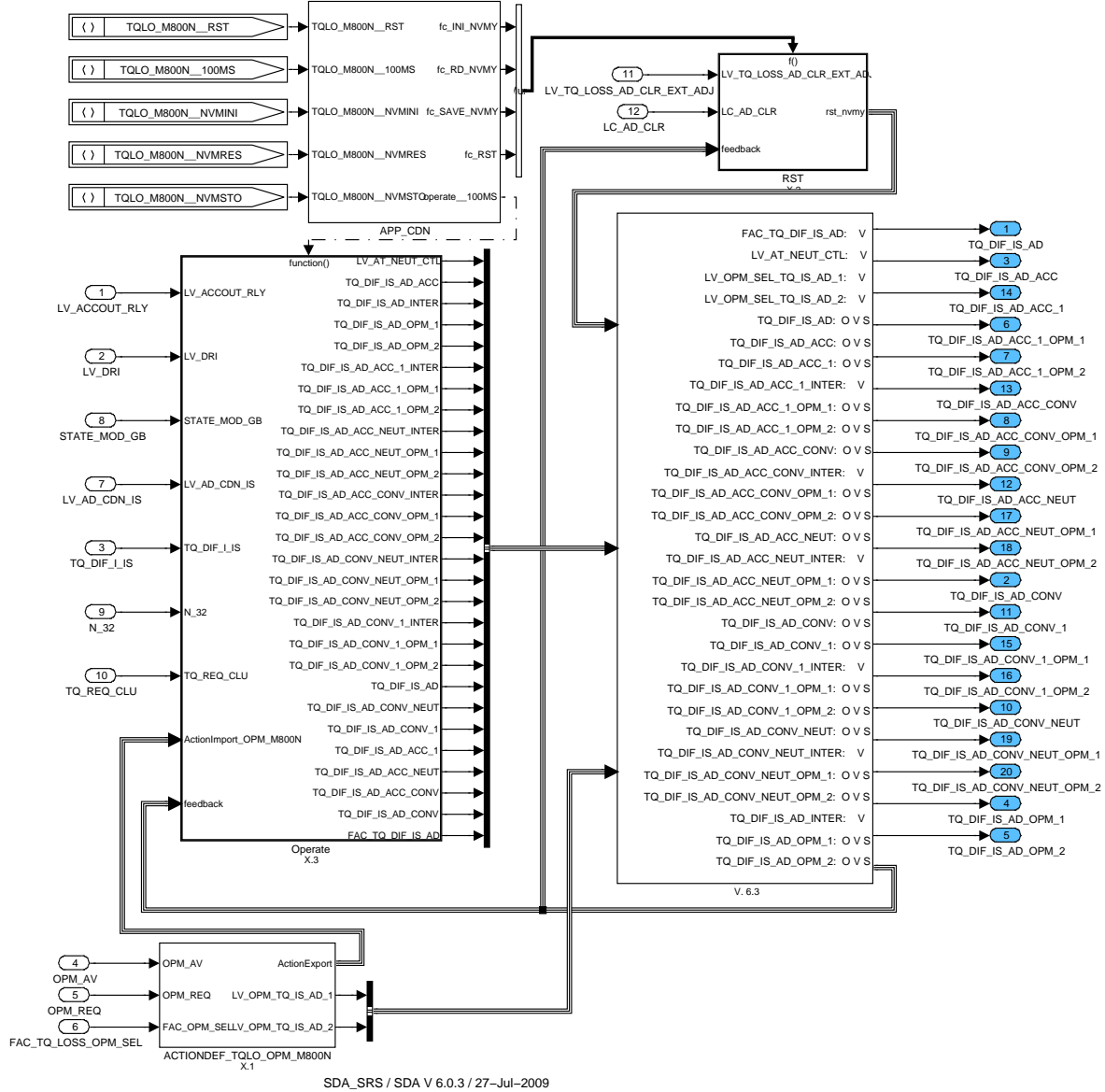


Figure 8.7.2: :

**8.7.1 Detailed description for Action: ACTION\_TQLO\_OPM\_M800N**

The function controls the transition between the operating modes. As the operating mode changes the adaptation values change as well.

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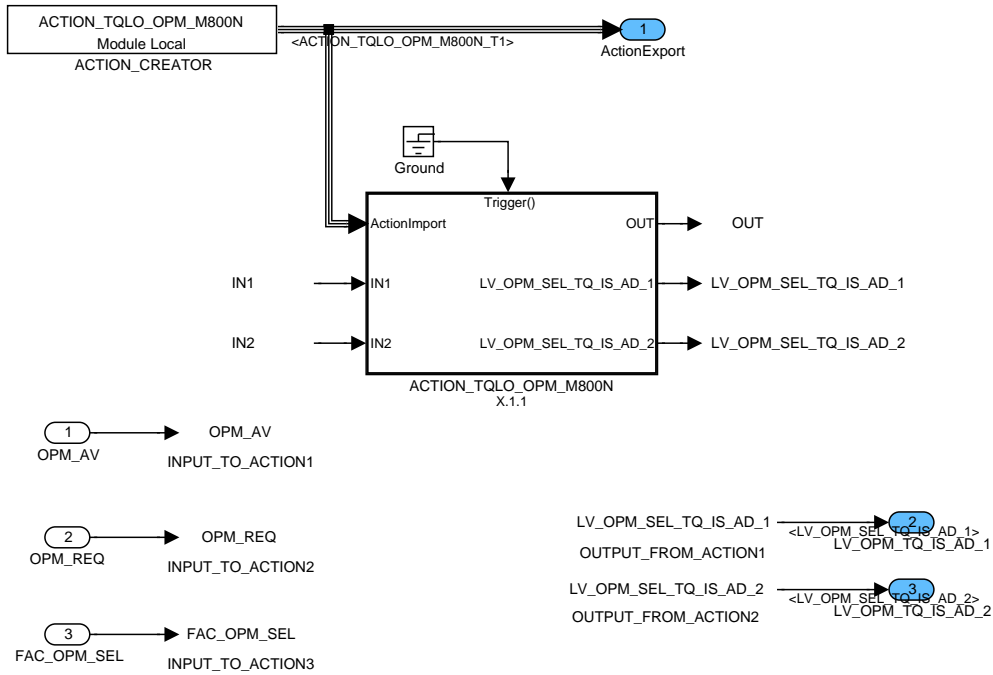


Figure 8.7.3: :

8.7.1.1 No title given

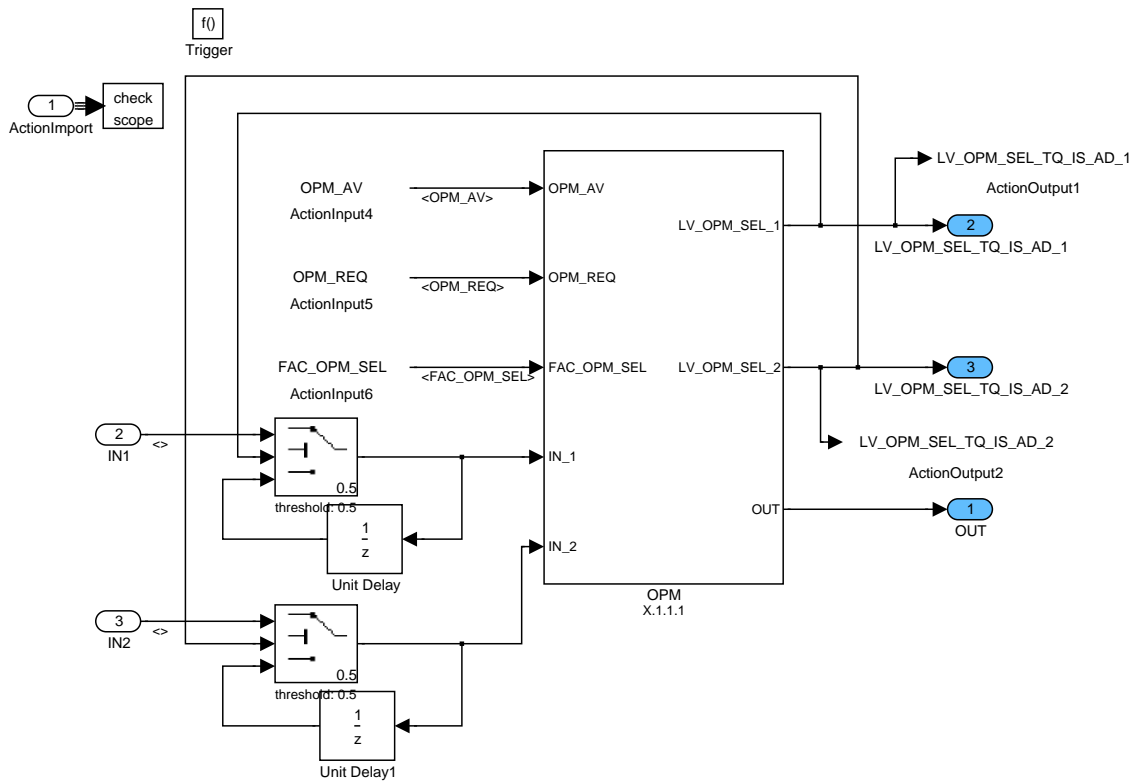



Figure 8.7.4: :

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8.7.1.1.1 No title given

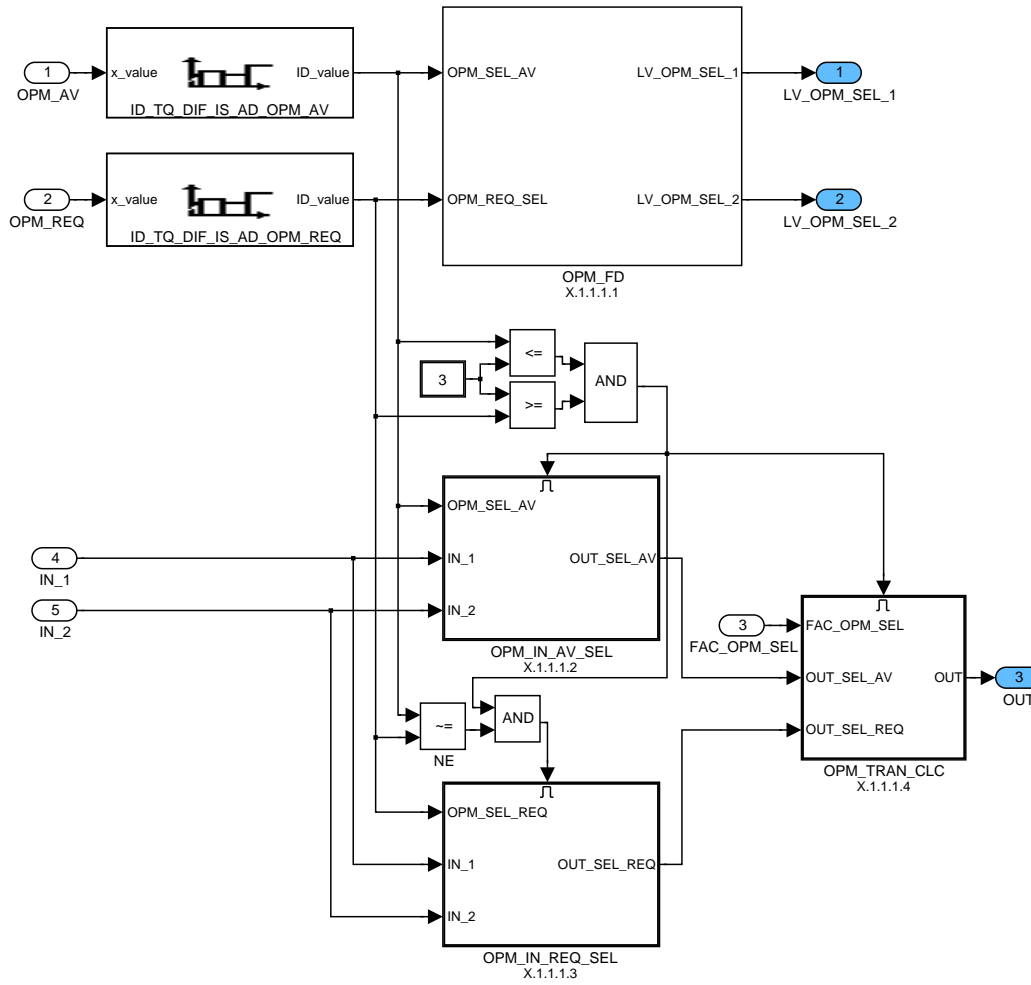


Figure 8.7.5: :

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8.7.1.1.1.1 No title given

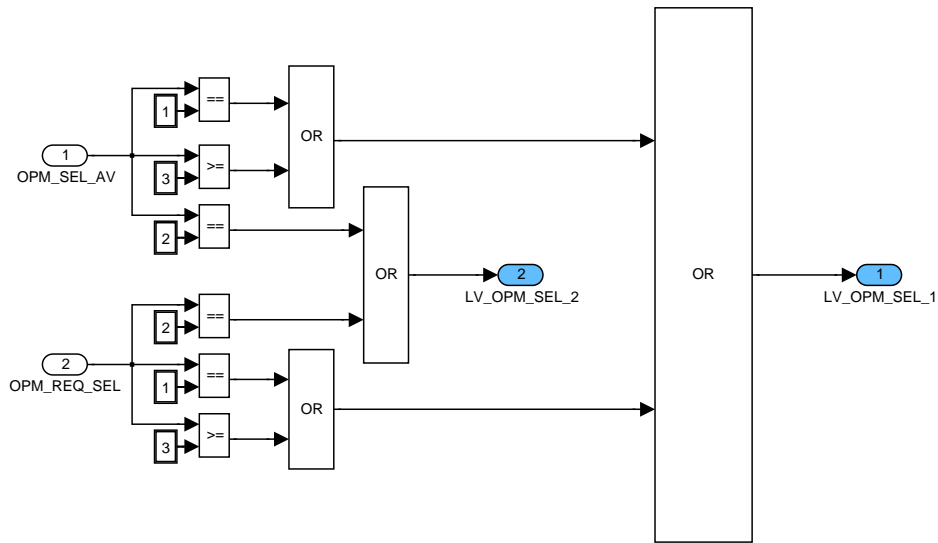


Figure 8.7.6: :

8.7.1.1.1.2 No title given

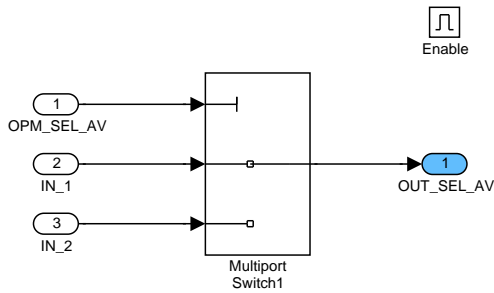


Figure 8.7.7: :

8.7.1.1.1.3 No title given

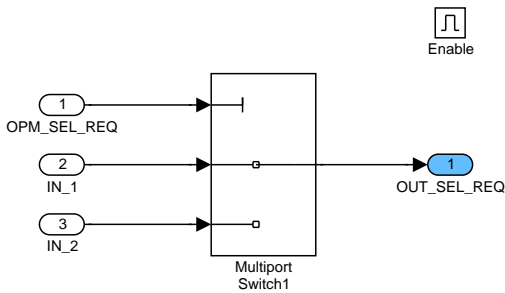


Figure 8.7.8: :

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### 8.7.1.1.1.4 No title given

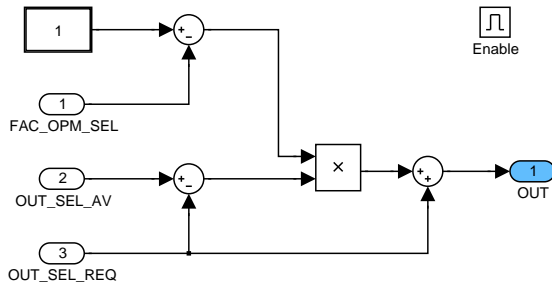


Figure 8.7.9: :

## 8.7.2 Overview Reset and NVMY handling

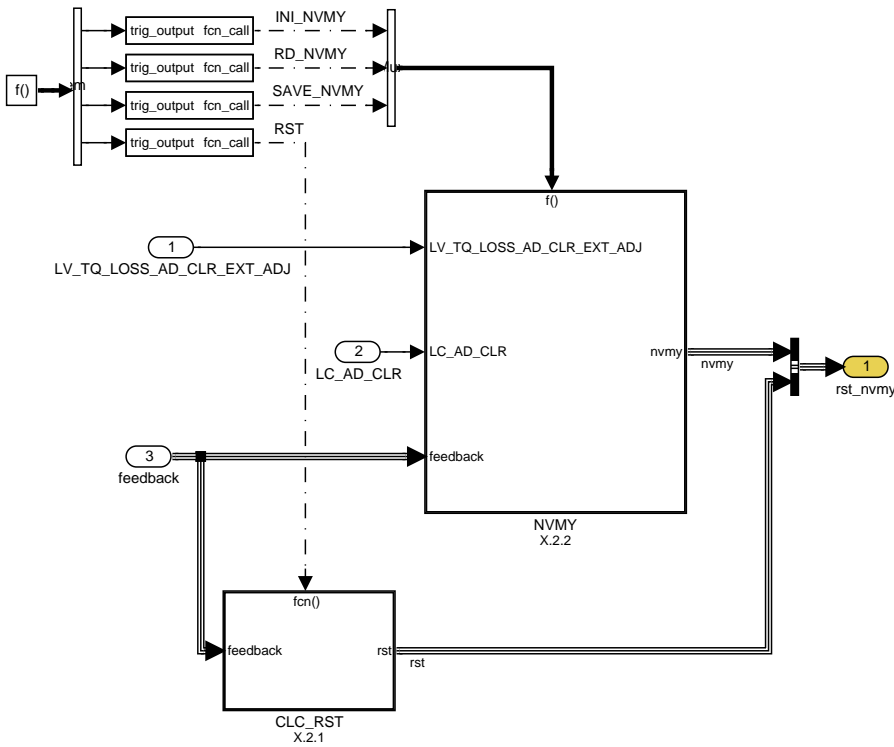


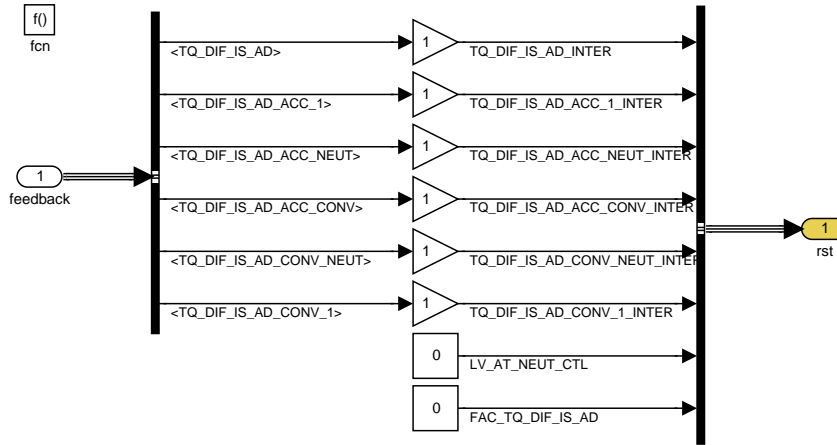
Figure 8.7.10: :

### 8.7.2.1 Initialization after ECU Reset

The following variables are initialized at ECU Reset. Note that this has to be performed after the E2PROB has been read!

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N.B.: The initialization of the variables has to be performed after the E2PROM has been read!

Figure 8.7.11: :

### 8.7.2.2 Overview of NVMY handling

Initialization, Saving and Reading adaptation values out of the E2PROM.

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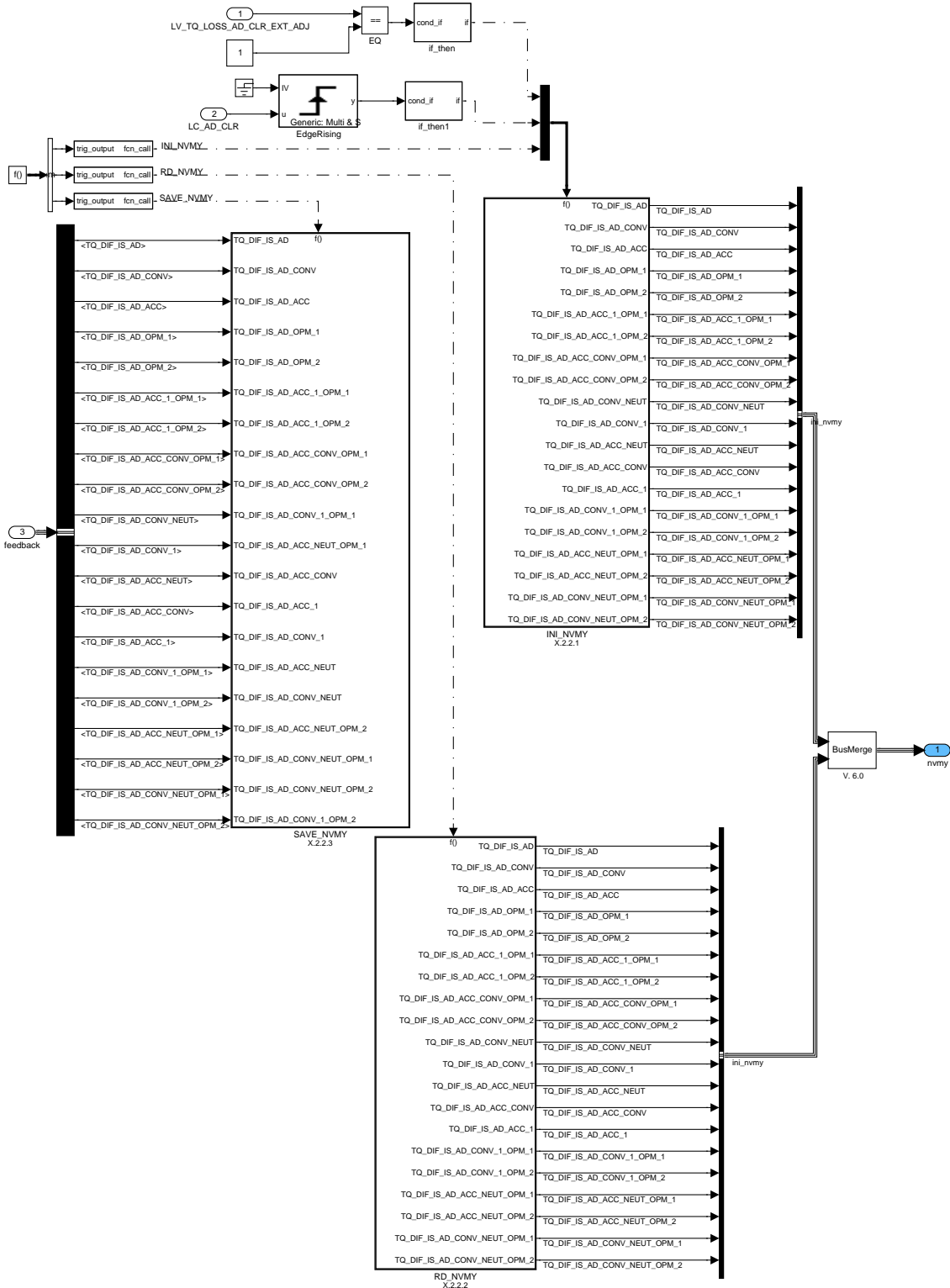



Figure 8.7.12: :

### 8.7.2.2.1 Initialization of NVMY data

Initialization of the NVMY data in the E2PROM in case of:

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- no adaptation values available
- checksum error in E2PROM sector
- cleared E2PROM sector by calibration system or service device

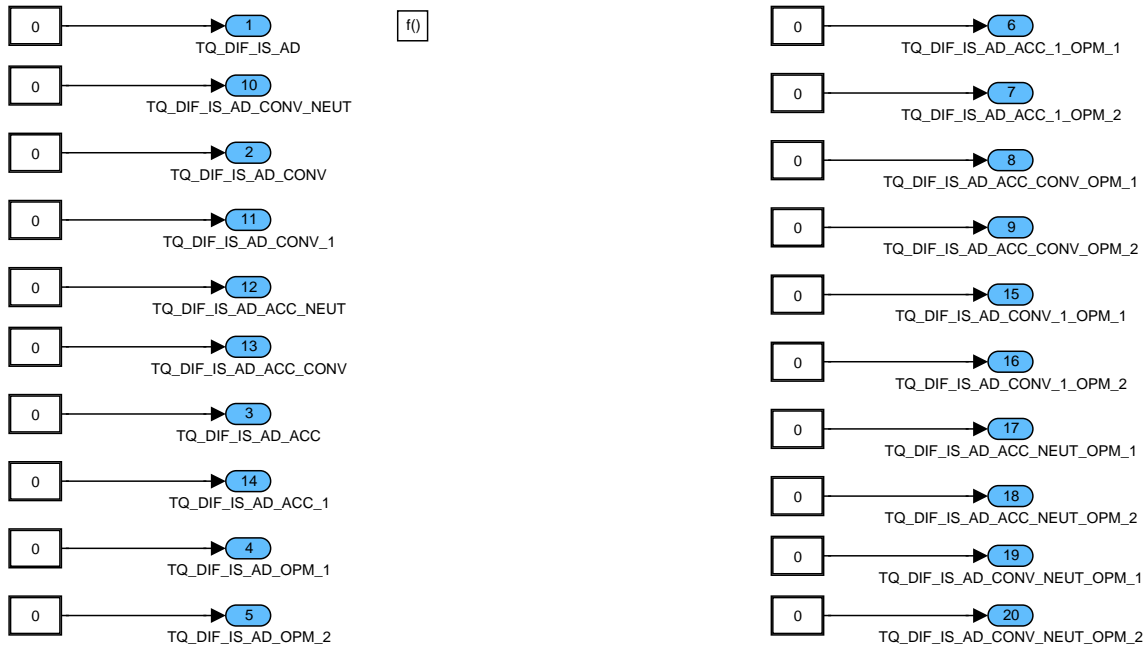


Figure 8.7.13: :

### 8.7.2.2.2 Reading of NVMY data

The following variables are read out of the NVMY after ECU Reset.

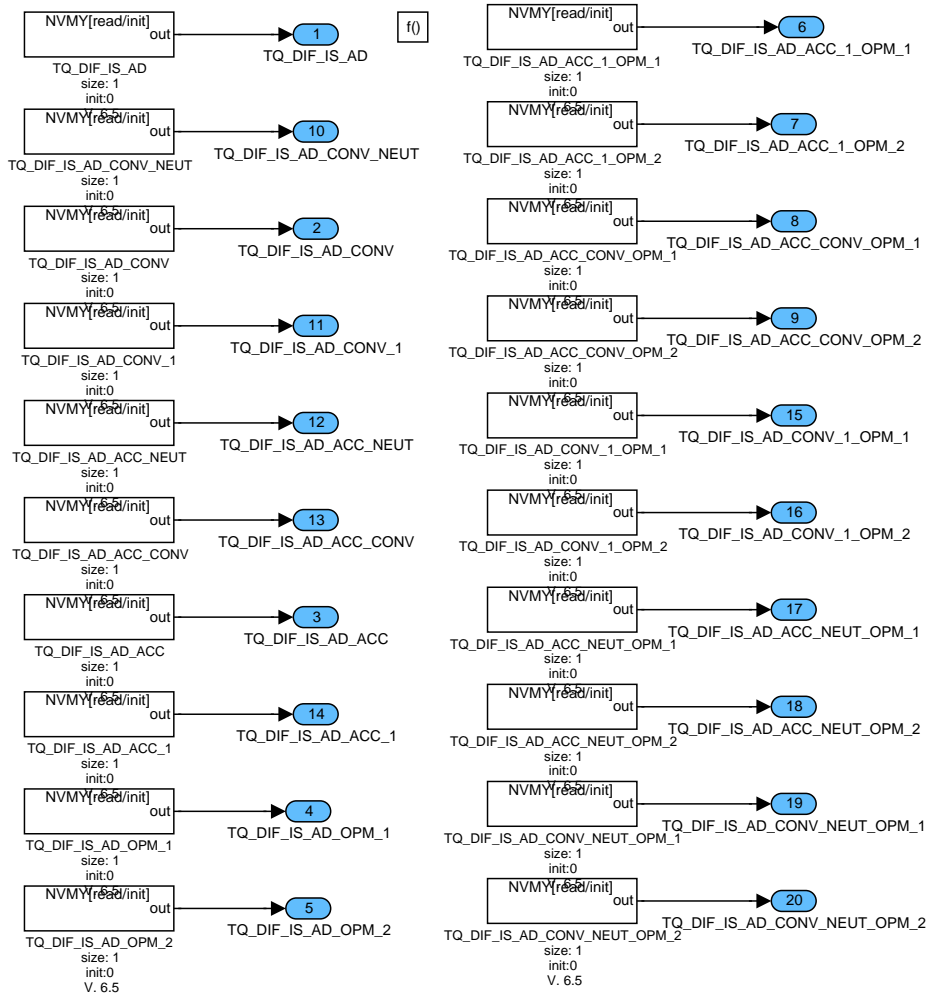


Figure 8.7.14: :

### 8.7.2.2.3 Saving of NVMY data

The following variables are stored in the NVMY.

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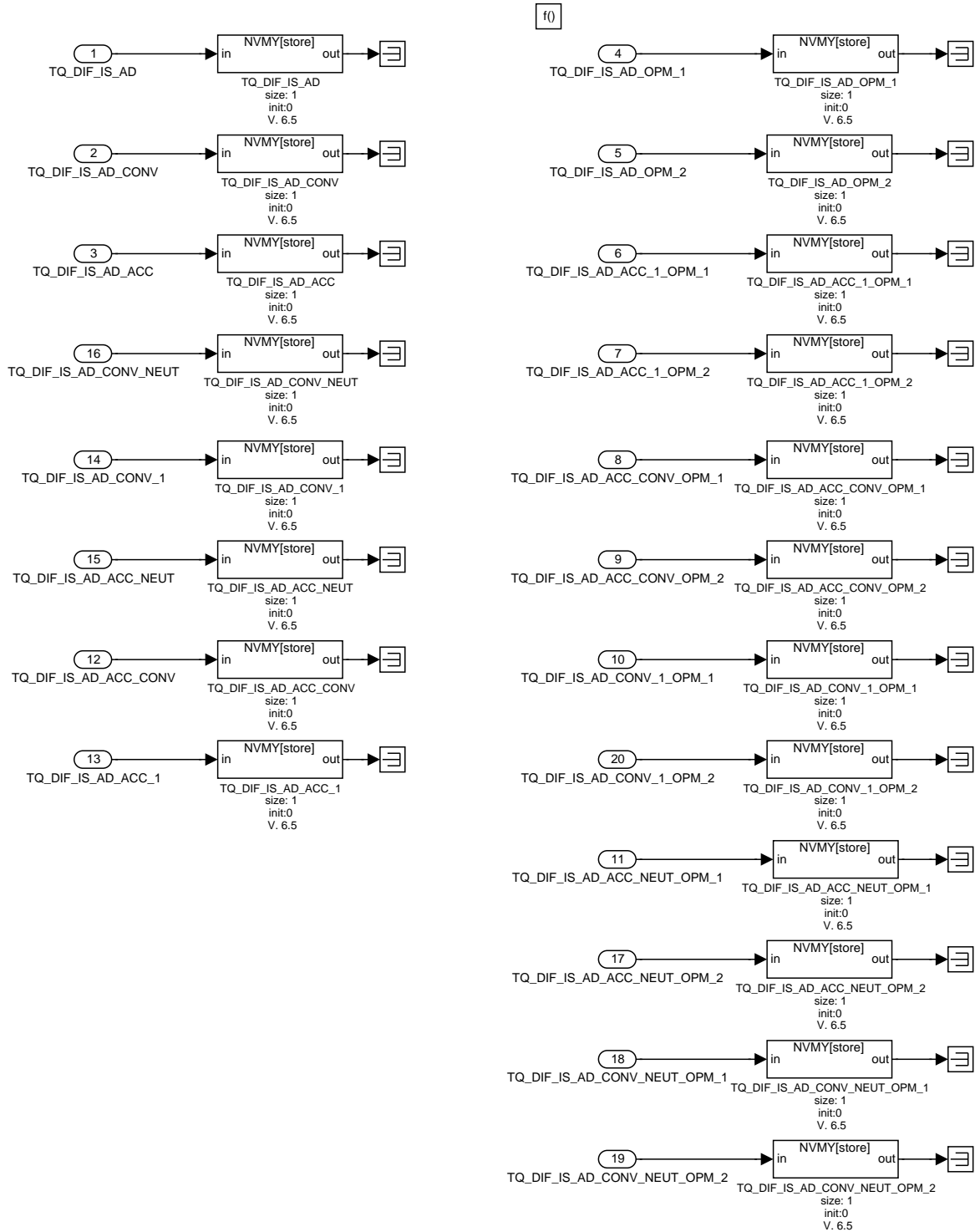



Figure 8.7.15: :

### 8.7.3 Functional overview of the adaptation algorithm

Depending of the status of several logical variables (LV\_DRI, LV\_ACCOUT\_RLY, LV\_AT\_NEUT\_CTL) and the automatic gearbox clutch information STATE\_MOD\_GB the different adaptation paths are cho-

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sen. With the help of the logical field STATE\_MOD\_GB the logical variable LV\_AT\_NEUT\_CTL is created.

A filter first order is used to smooth the adaptation value changes in case of engaging/disengaging the drive w/o neutral control active and/or switching on/off the AC.

### 8.7.3.1 Setting of LV\_AT\_NEUT\_CTL

With the help of the logical field STATE\_MOD\_GB the logical variable LV\_AT\_NEUT\_CTL is created. Depending on that information a separate set of adaptation values is chosen.

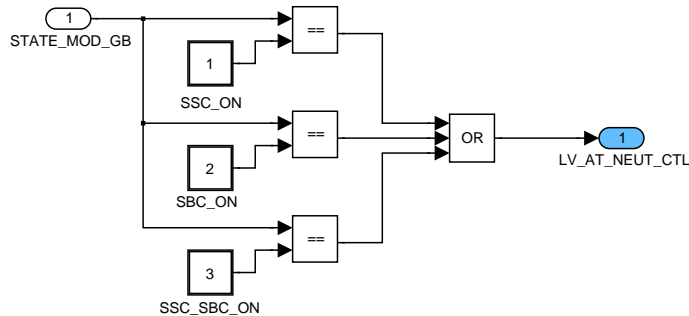


Figure 8.7.16: :

### 8.7.3.2 Calculation of the different adaptation values TQ\_DIF\_IS\_AD\_XXX

Depending of the status of several logical variables (LV\_DRI, LV\_ACCOUT\_RLY, LV\_AT\_NEUT\_CTL) the different adaptation paths are chosen.

To ensure that the adaptation values don't change during the transition from OPM\_1 to OPM\_2 and vice versa the flags LV\_OPM\_SEL\_TQ\_IS\_AD\_1/2 are taken into account. Only if LV\_OPM\_SEL\_TQ\_IS\_AD\_1 is set or LV\_OPM\_SEL\_TQ\_IS\_AD\_2 is set the corresponding integrator out value is routed through.

IP\_FAC\_TQ\_DIF\_IS\_AD\_VS is used to consider the vehicle speed in the adapted torque losses of external devices (ACC, torque converter, SSC and SBC). This factor is not applied to the adapted engine torque losses TQ\_DIF\_IS\_AD.

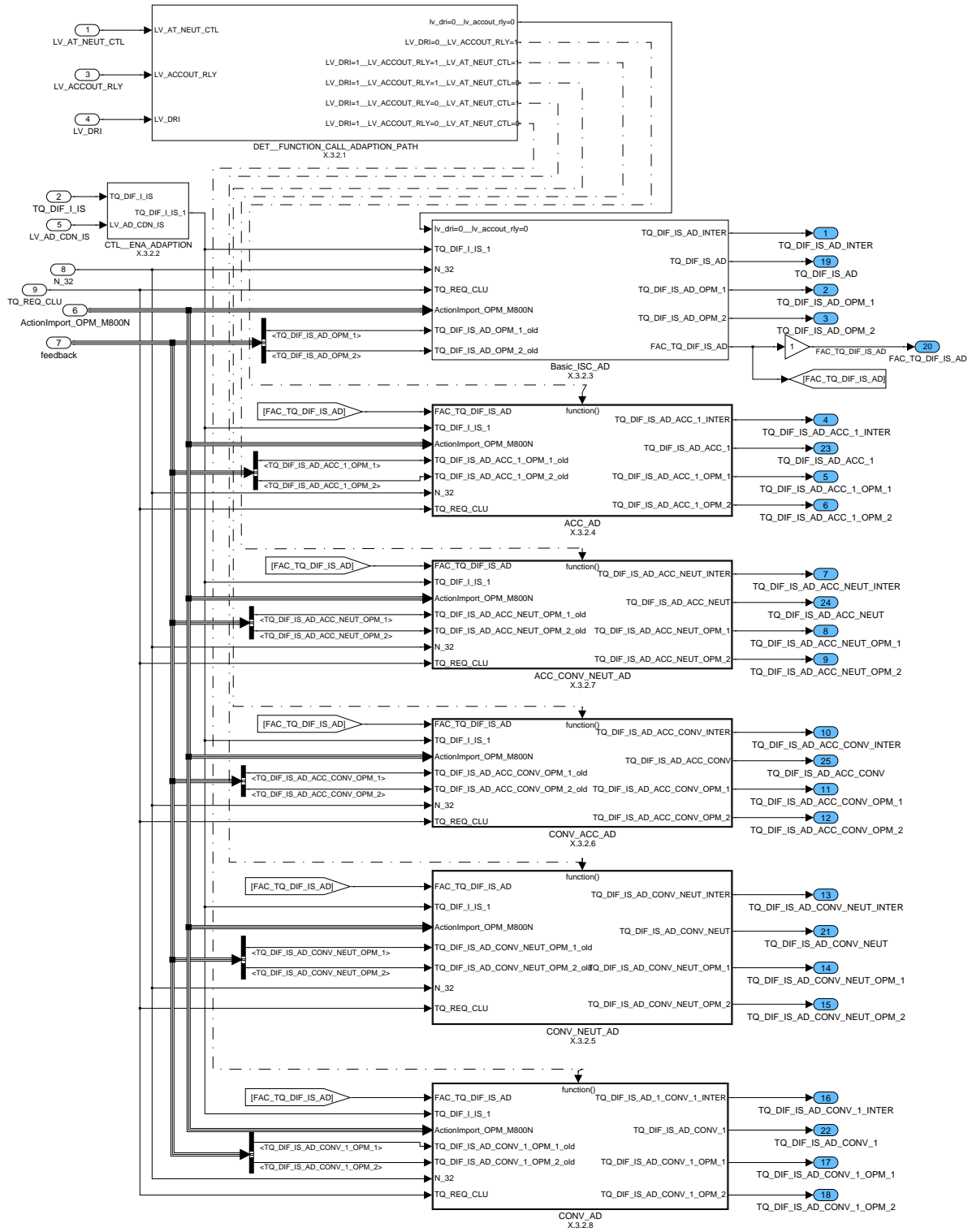



Figure 8.7.17: :

### 8.7.3.2.1 Creation of the function calls for the several adaptation values

Depending on the logical status of the flags LV\_DRI, LV\_AT\_NEUT\_CTL and LV\_ACCOUT\_RLY the corresponding subsystem is triggered. So in total 6 different combinations are possible.

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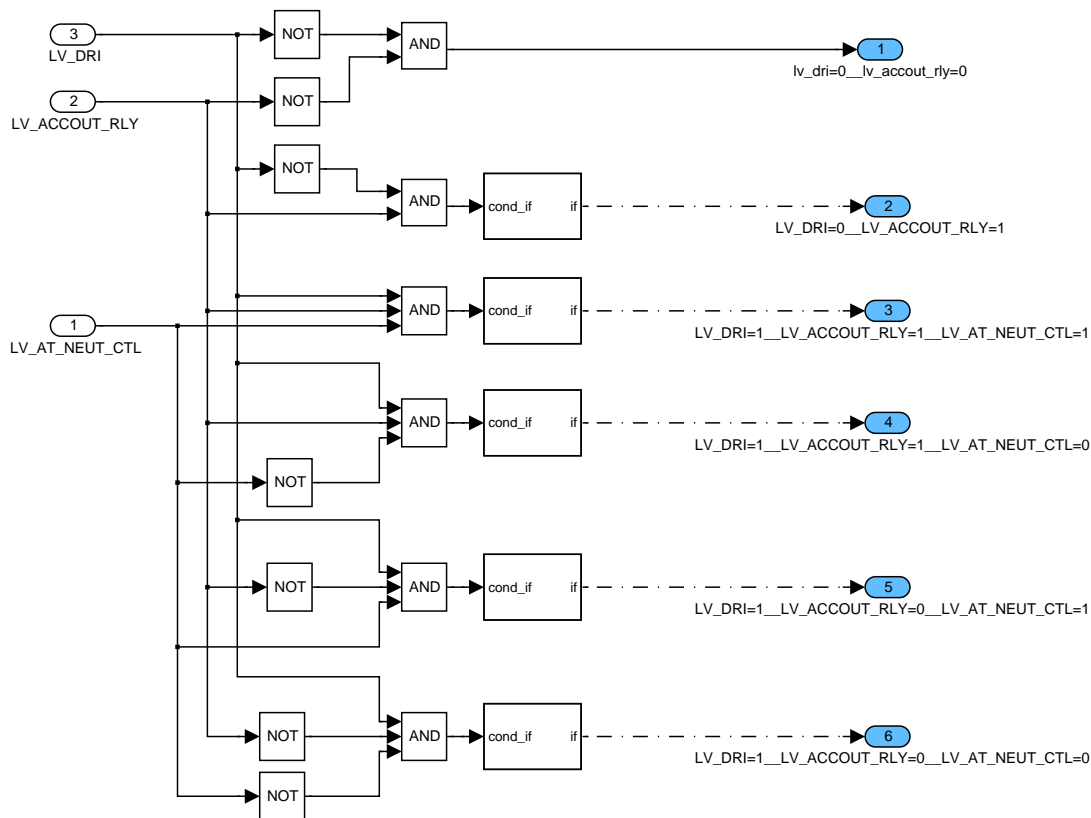
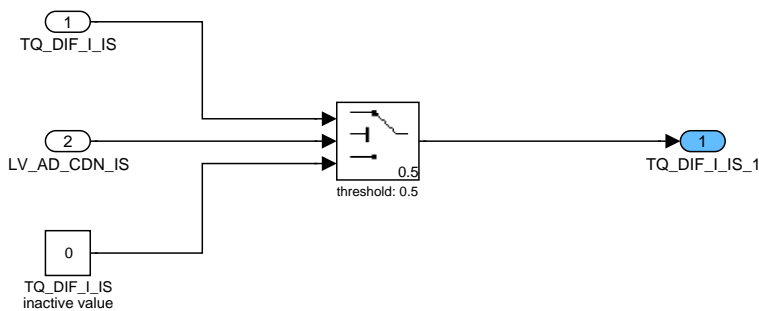


Figure 8.7.18: :

### 8.7.3.2.2 Input for adaptation algorithm TQ\_DIF\_I\_IS

The adaptation algorithm is fed by the I-gain of the idle speed controller. Due to the fact that the whole function is calculated continuously the input into the adaptation algorithm is controlled via the enable flag LV\_AD\_CDN\_IS. If the adaptation condition is not fulfilled the passive value 0 Nm is routed into the adaptation algorithm. Thus no adaptation value change takes place.



This functions controls the input signal into the adation algorithm  
 - if the adaptation conditions are not fulfilled the adaptation is fed by 0Nm  
 - if the adaptation gets active the adaptation is fed by the idle speed controller TQ\_DIF\_I\_IS

Figure 8.7.19: :

### 8.7.3.2.3 Basic adaptation value (TQ\_DIF\_IS\_AD)

This adaptation value is applied for a MT or AT vehicle with drive not engaged.

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The speed of the adaptation process is defined through the calibration parameter  $FAC\_TQ\_DIF\_IS\_AD$  and the function  $s$  update rate. This factor is calculated in the map  $IP\_FAC\_TQ\_DIF\_IS\_AD$ , which is depend on the absolut value of  $TQ\_DIF\_I\_IS$ . This provides a fast or a slow adaptation.

The sign of the input in the integrator function will be inverted because the output of the Subsystem is coordinated into  $TQ\_LOSS$  [neg....0] Nm .

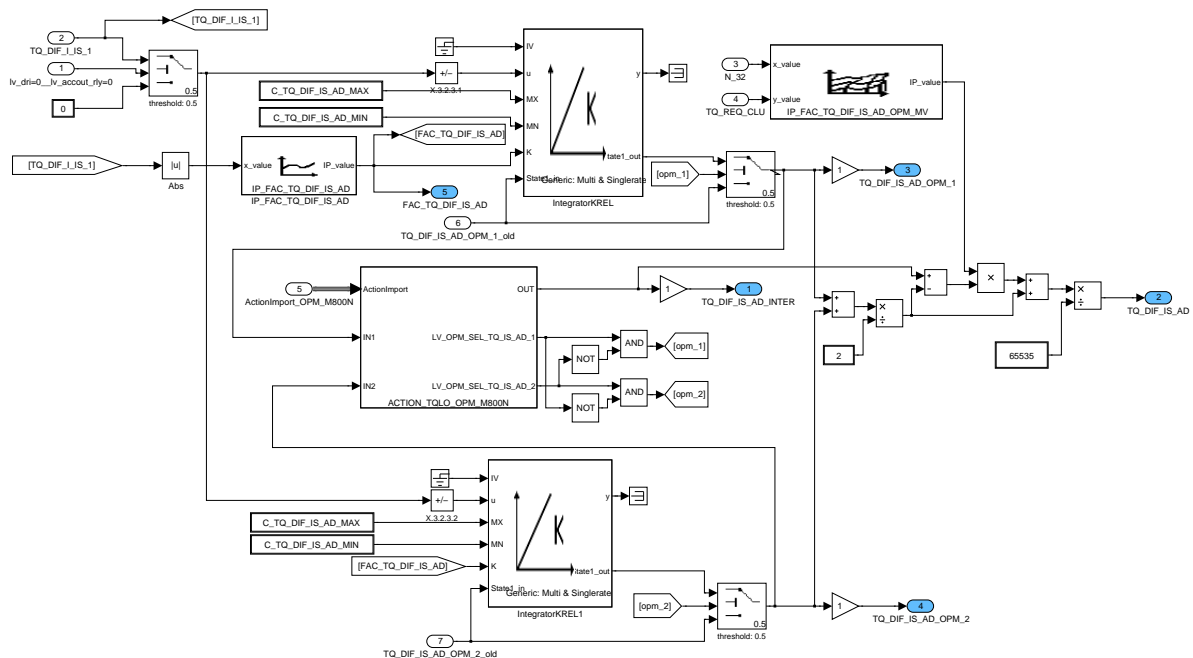


Figure 8.7.20: :

#### 8.7.3.2.4 Adaptation value with AC on (TQ\_DIF\_IS\_AD\_ACC\_1)

This adaptation value is applied for a MT or AT vehicle with drive not engaged and AC ON.

The speed of the adaptation process is defined through the parameter  $FAC\_TQ\_DIF\_IS\_AD$  and the function  $s$  update rate. This factor is calculated in the map  $IP\_FAC\_TQ\_DIF\_IS\_AD$ , which is depend on the absolut value of  $TQ\_DIF\_I\_IS$ . This provides a fast or a slow adaptation.

The sign of the input in the integrator function will be inverted because the output of the Subsystem is coordinated into  $TQ\_LOSS\_ACC$  [neg....0] Nm .

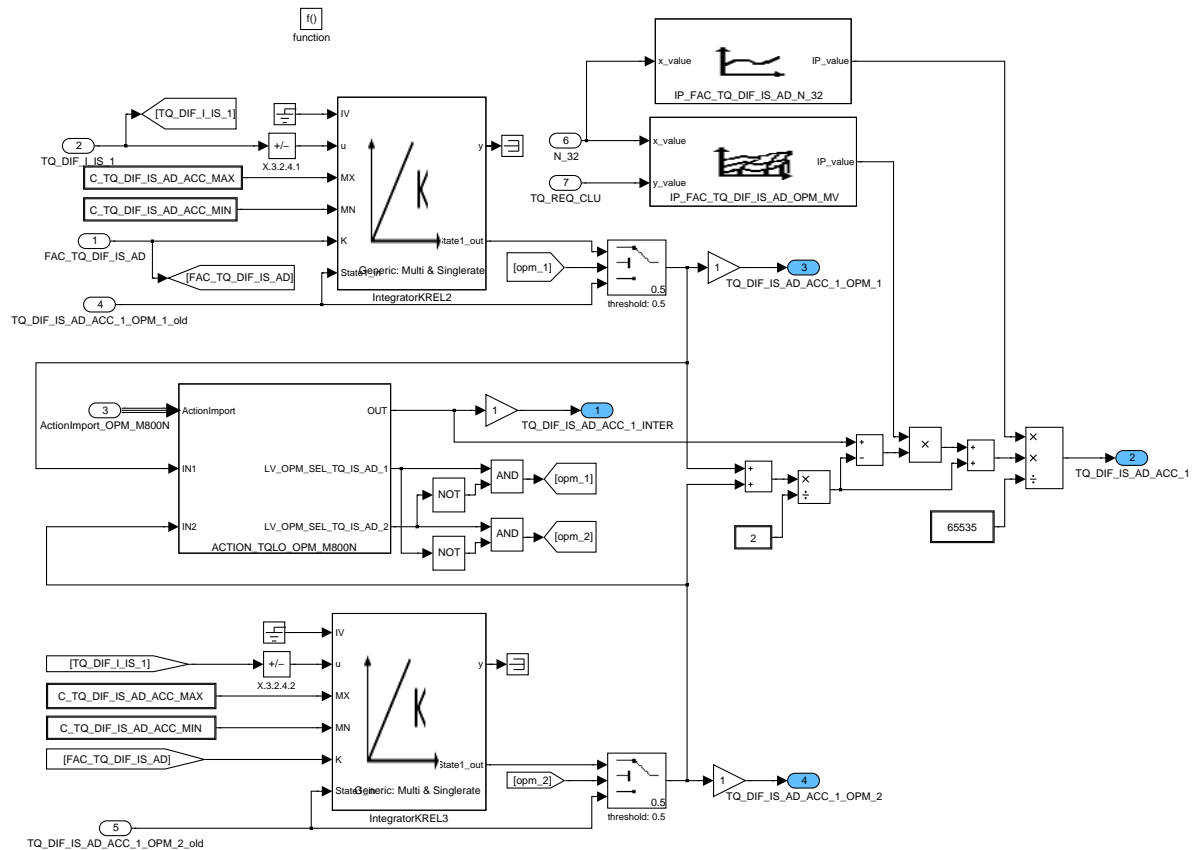


Figure 8.7.21: :

### 8.7.3.2.5 Adaptation value with DRI engaged, Neutral control active and AC off (TQ\_DIF\_IS\_AD\_CONV\_NEUT)

This adaptation value is applied for an AT vehicle with drive engaged, Neutral control active and AC OFF.

The speed of the adaptation process is defined through the parameter FAC\_TQ\_DIF\_IS\_AD and the function s update rate. This factor is calculated in the map IP\_FAC\_TQ\_DIF\_IS\_AD, which is depend on the absolute value of TQ\_DIF\_I\_IS. This provides a fast or a slow adaptation.

The sign of the input in the integrator function will not be changed because the output of the Subsystem is coordinated into TQ\_CONV [0...pos.] Nm .

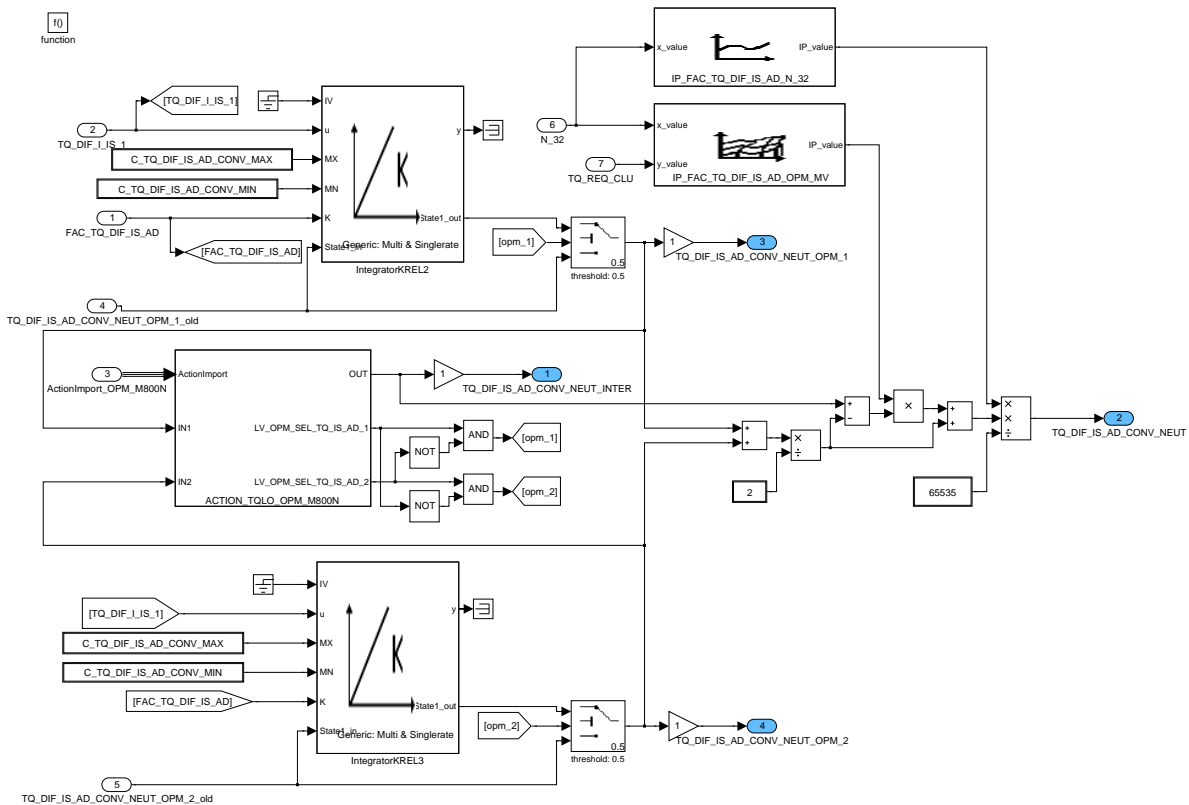


Figure 8.7.22: :

**8.7.3.2.6 Adaptation value with DRI engaged, Neutral control passive and AC on (TQ\_DIF\_IS\_AD\_ACC\_CONV)**

This adaptation value is applied for an AT vehicle with drive engaged, Neutral control passive and AC ON.

The speed of the adaptation process is defined through the calibration parameter. The speed of the adaptation process is defined through the parameter FAC\_TQ\_DIF\_IS\_AD and the function s update rate. This factor is calculated in the map IP\_FAC\_TQ\_DIF\_IS\_AD, which is depend on the absolute value of TQ\_DIF\_I\_IS. This provides a fast or a slow adaptation.

The sign of the input in the integrator function will be inverted because the output of the Subsystem is coordinated into TQ\_LOSS\_ACC [neg....0] Nm .

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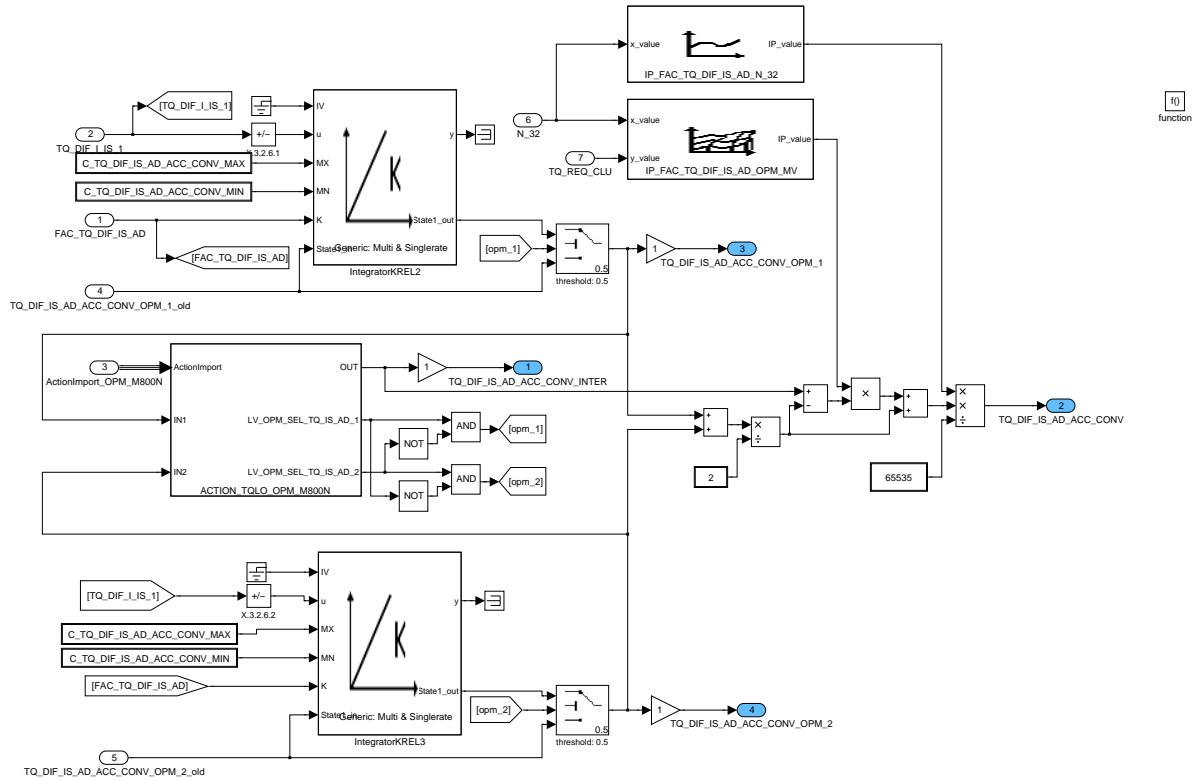


Figure 8.7.23: :

### 8.7.3.2.7 Adaptation value with DRI engaged, Neutral control active and AC on (TQ\_DIF\_IS\_AD\_ACC\_NEUT)

This adaptation value is applied for an AT vehicle with drive engaged, Neutral control active and AC ON.

The speed of the adaptation process is defined through the calibration parameter The speed of the adaptation process is defined through the parameter FAC\_TQ\_DIF\_IS\_AD and the function s update rate. This factor is calculated in the map IP\_FAC\_TQ\_DIF\_IS\_AD, which is depend on the absolut value of TQ\_DIF\_I\_IS. This provides a fast or a slow adaptation.

The sign of the input in the integrator function will be inverted because the output of the Subsystem is coordinated into TQ\_LOSS\_ACC [neg....0] Nm .

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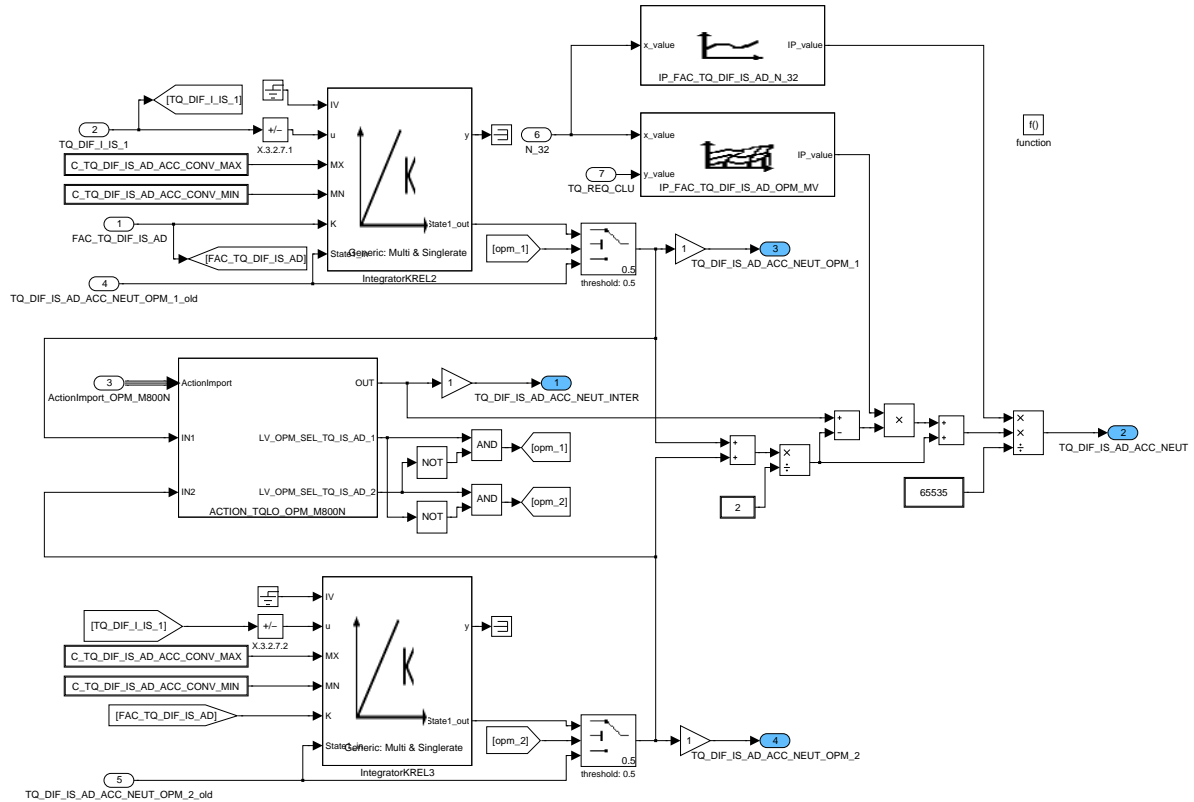


Figure 8.7.24: :

### 8.7.3.2.8 Adaptation value with DRI engaged, Neutral control passive and AC off (TQ\_DIF\_IS\_AD\_CONV\_1)

This adaptation value is applied for an AT vehicle with drive engaged, Neutral control passive and AC OFF.

The speed of the adaptation process is defined through the parameter FAC\_TQ\_DIF\_IS\_AD and the function s update rate. This factor is calculated in the map IP\_FAC\_TQ\_DIF\_IS\_AD, which is depend on the absolut value of TQ\_DIF\_I\_IS. This provides a fast or a slow adaptation.

The sign of the input in the integrator function will not be changed because the output of the Subsystem is coordinated into TQ\_CONV [0...pos.] Nm .

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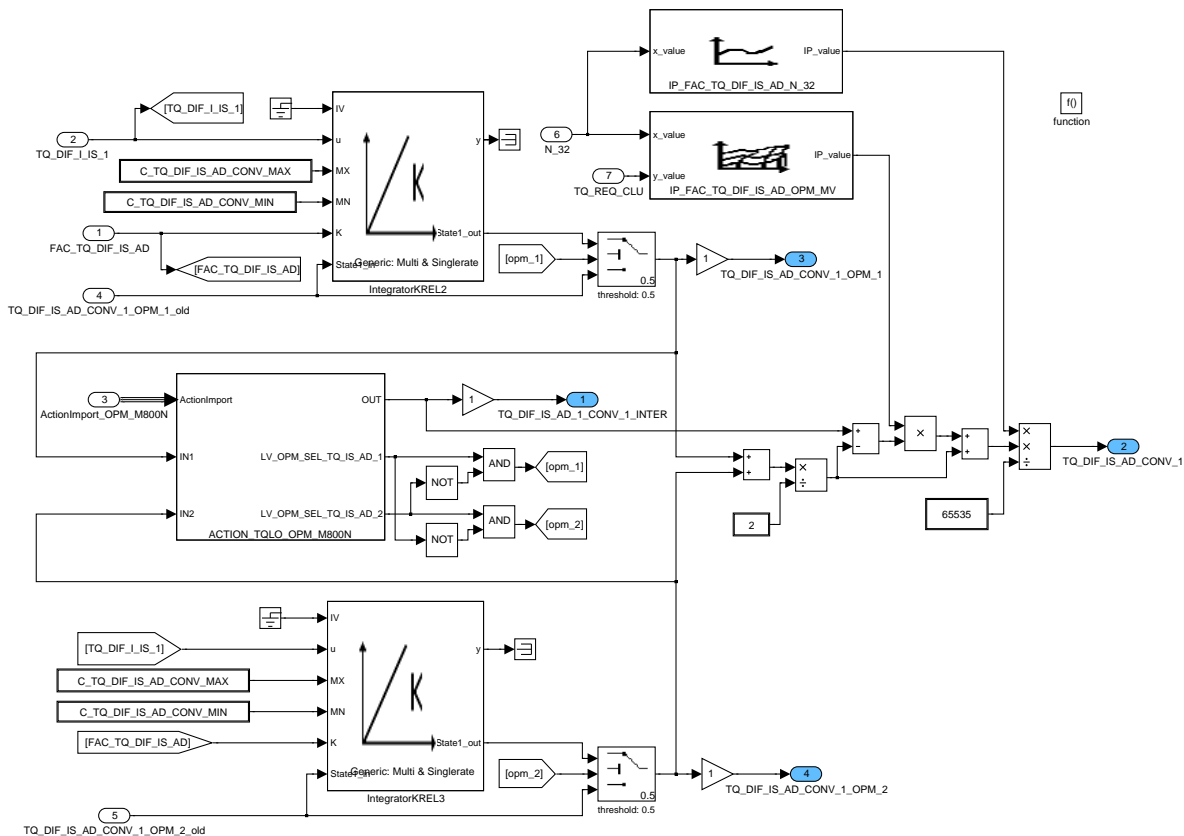



Figure 8.7.25: :

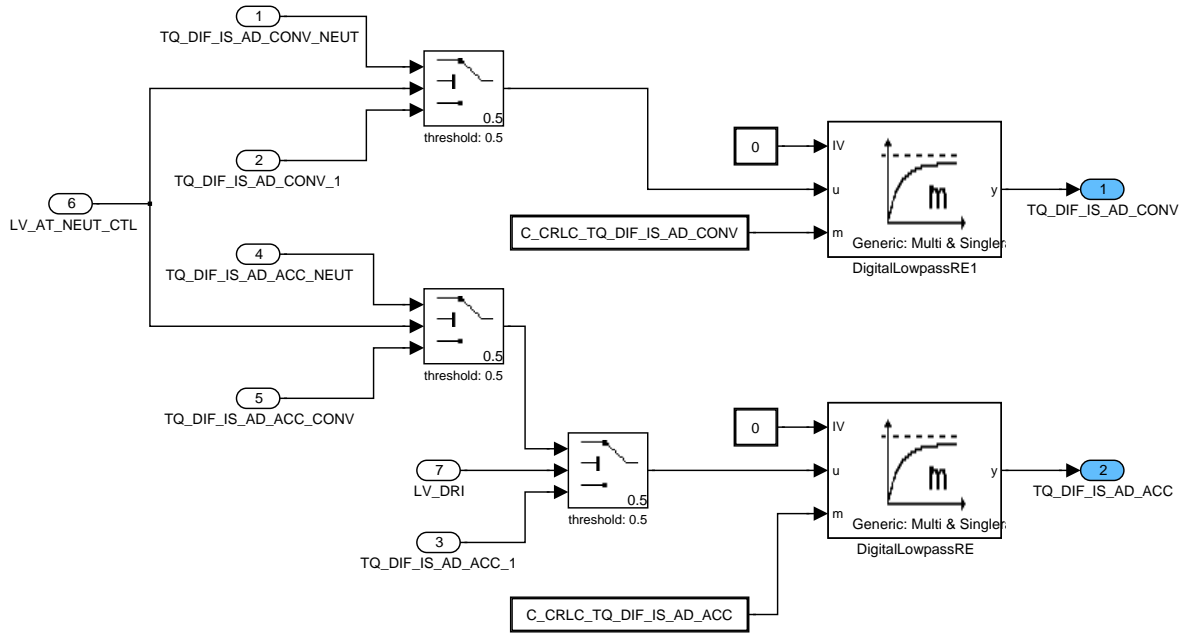
### 8.7.3.3 Filtering of the adaptation values

In order to be able to use one input for the ACC torque losses module and one adaptation value for the converter torque calculation module, switches are introduced to change between TQ\_DIF\_IS\_AD\_ACC\_1, TQ\_DIF\_IS\_AD\_ACC\_CONV and TQ\_DIF\_IS\_AD\_ACC\_NEUT in dependency of the status of the logical inputs. To prevent abrupt changes in TQ\_DIF\_IS\_AD\_ACC (in case of switching between TQ\_DIF\_AD\_IS\_ACC\_CONV to TQ\_DIF\_AD\_IS\_ACC\_NEUT or the TQ\_DIF\_IS\_AD\_ACC\_1), the output value of the final switch is smoothed by a low pass filter. The same strategy is applied in case of a change of the status of the neutral control. The change between TQ\_DIF\_IS\_AD\_CONV\_NEUT and TQ\_DIF\_IS\_AD\_CONV\_1 is also routed via a low pass filter.

During the first ACC adaptations, TQ\_DIF\_IS\_AD\_ACC may be erroneous and should therefore be limited to small values.

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N.B.: This Module has to be calculated even if LV\_AD\_CDN\_IS == 0; if the adaptation is disabled but drive is engaged/disengaged //AC switched on/off the calculation of the corresponding torque adaptation value has to be performed!

Figure 8.7.26: :

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## 8.8 Idle speed torque reserve

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_ADD_IS_BOL_OPM_1	V	0... FFH	0... 7.96875	0.03125	-
Resulting factor for TQ_ADD_IS_BOL_BAS (mode 1)					
FAC_TQ_ADD_IS_BOL_OPM_2	V	0... FFH	0... 7.96875	0.03125	-
Resulting factor for TQ_ADD_IS_BOL_BAS (mode 2)					
N_DIF_OFS_PRED_CS_OPM_1	V	8000... 7FFFH	0... 32767	1	rpm
Predicted engine speed difference for torque reserve calculation at drive off support (mode 1)					
N_DIF_OFS_PRED_CS_OPM_2	V	8000... 7FFFH	0... 32767	1	rpm
Predicted engine speed difference for torque reserve calculation at drive off support (mode 2)					
N_DIF_OFS_PRED_OPM_1	V	8000... 7FFFH	0... 32767	1	rpm
Predicted engine speed difference for torque reserve calculation (mode 1)					
N_DIF_OFS_PRED_OPM_2	V	8000... 7FFFH	0... 32767	1	rpm
Predicted engine speed difference for torque reserve calculation (mode 2)					
N_DIF_PRED_CS_OPM_1	V	8000... 7FFFH	0... 32767	1	rpm
Predicted idle speed control variable at drive off support (mode 1)					
N_DIF_PRED_CS_OPM_2	V	8000... 7FFFH	0... 32767	1	rpm
Predicted idle speed control variable at drive off support (mode 2)					
N_DIF_PRED_OPM_1	V	8000... 7FFFH	0... 32767	1	rpm
Predicted idle speed control variable (mode 1)					
N_DIF_PRED_OPM_2	V	8000... 7FFFH	0... 32767	1	rpm
Predicted idle speed control variable (mode 2)					
T_N_DIF_OFS_PRED_CS_OPM_1	V	0... FFH	0... 7.96875	0.03125	s
Prediction time for engine speed difference at drive off support (mode 1)					
T_N_DIF_OFS_PRED_CS_OPM_2	V	0... FFH	0... 7.96875	0.03125	s
Prediction time for engine speed difference at drive off support (mode 2)					
T_N_DIF_OFS_PRED_OPM_1	V	0... FFH	0... 7.96875	0.03125	s
Prediction time for engine speed difference (mode 1)					
T_N_DIF_OFS_PRED_OPM_2	V	0... FFH	0... 7.96875	0.03125	s
Prediction time for engine speed difference (mode 2)					
TQ_ADD_IS_BOL	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Filtered calculated torque reserve bottom limit at idle					
TQ_ADD_IS_BOL_OPM_1	V	0... 7FFFH	0... 1023.97	0.03125004	Nm
Torque reserve at idle (mode 1)					
TQ_ADD_IS_BOL_OPM_2	V	0... 7FFFH	0... 1023.97	0.03125004	Nm
Torque reserve at idle (mode 2)					
TQ_ADD_IS_BOL_SEL	V	0... 7FFFH	0... 1023.97	0.03125004	Nm
Calculated torque reserve bottom limit at idle					
TQ_DIF_ADD_IS_TOL	O/V	0... 7FFFH	0... 1023.97	0.03125	Nm
Idle speed torque reserve limitation for stabilizing the ISC at high torque reserves					

### Input data:

FAC_TQ_ADD_IS_OPM_SEL {p. 8212}	ID_IDX_OPM_DROF {p. 1112}	LV_AT {p. 654}	LV_DRI {p. 1302}
LV_ES {p. 1720}	LV_IS {p. 1720}	LV_N_SP_IS_CS {p. 1122}	LV_VAR_TCT {p. 656}
MAF {p. 8277}	MAP_DIP_SP_MMV {p. 805}	N {p. 1525}	N_DIF {p. 1122}



N_GRD {p. 1525}	N_SP_IS {p. 1122}	OPM_AV {p. 8137}	OPM_REQ {p. 8137}
TCO {p. 1100}	TIA {p. 1226}	TOIL {p. 8204}	TQI_ADD_MAX_TOL {p. 8391}
TQI_REQ_TRA {p. 8192}	VLFT_MIN {p. 811}	VS_FIL {p. 1176}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TQ_ADD_IS_BOL_CRLC	-	0... FFH	0... 0.99609307	0.00390625	-
Filter constant for torque reserve					
C_TQ_DIF_ADD_IS_TOL_OPM_1	-	0... 7FFFH	0... 1023.97	0.03125	Nm
Idle speed torque reserve limitation for stabilizing the ISC at high torque reserves in OPM_1					
C_TQ_DIF_ADD_IS_TOL_OPM_2	-	0... 7FFFH	0... 1023.97	0.03125	Nm
Idle speed torque reserve limitation for stabilizing the ISC at high torque reserves in OPM_2					
ID_TQ_ADD_IS_OPM_AV	-	1... 8H	1...8	1	-
LDPM_OPM_AV	8	0... 8H	0...8	1	
Operation mode matrix (actual)					
ID_TQ_ADD_IS_OPM_REQ	-	1... 8H	1...8	1	-
LDPM_OPM_REQ	8	0... 8H	0...8	1	
Operation mode matrix (requested)					
IP_FAC_TEMP_TQ_ADD_IS_BAS_OPM_1	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_TIA_IP_FAC_TEMP_TQ_ADD_IS	6	0... FEH	0... 142.5	0.75	°C
LDPM_TOIL_IP_FAC_TEMP_TQ_ADD_IS	6	0... C8H	0... 160	1	°C
Temperature correction for IP_TQ_ADD_IS_BOL_BAS (mode1)					
IP_FAC_TEMP_TQ_ADD_IS_BAS_OPM_2	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_TIA_IP_FAC_TEMP_TQ_ADD_IS	6	0... FEH	0... 142.5	0.75	°C
LDPM_TOIL_IP_FAC_TEMP_TQ_ADD_IS	6	0... C8H	0... 160	1	°C
Temperature correction for IP_TQ_ADD_IS_BOL_BAS (mode2)					
IP_FAC_TQ_ADD_IS_BOL_CS_OPM_1	-	0... FFH	0... 7.96875	0.03125	-
LDP_N_DIF_PRED_CS_OPM_1	8	0... FFFFH	0... 32767	1	rpm
LDPM_MAF_FAC_TQ_ADD_IS	6	0... FFFFH	0... 1389	0.02119478	mg/stk
Factor for basis torque reserve at idle due to N_DIF_PRED and load for drive off support (mode1)					
IP_FAC_TQ_ADD_IS_BOL_CS_OPM_2	-	0... FFH	0... 7.96875	0.03125	-
LDP_N_DIF_PRED_CS_OPM_2	8	0... FFFFH	0... 32767	1	rpm
LDPM_MAF_FAC_TQ_ADD_IS	6	0... FFFFH	0... 1389	0.02119478	mg/stk
Factor for basis torque reserve at idle due to N_DIF_PRED and load for drive off support (mode2)					
IP_FAC_TQ_ADD_IS_BOL_DRI_OPM_1	-	0... FFH	0... 7.96875	0.03125	-
LDPM_N_DIF_PRED_OPM_1	8	0... FFFFH	0... 32767	1	rpm
LDPM_MAF_FAC_TQ_ADD_IS	6	0... FFFFH	0... 1389	0.02119478	mg/stk
Factor for basis torque reserve at idle due to N_DIF_PRED and load with drive (mode 1)					
IP_FAC_TQ_ADD_IS_BOL_DRI_OPM_2	-	0... FFH	0... 7.96875	0.03125	-
LDPM_N_DIF_PRED_OPM_2	8	0... FFFFH	0... 32767	1	rpm
LDPM_MAF_FAC_TQ_ADD_IS	6	0... FFFFH	0... 1389	0.02119478	mg/stk
Factor for basis torque reserve at idle due to N_DIF_PRED and load with drive (mode 2)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_TQ_ADD_IS_BOL_OPM_1	-	0... FFH	0... 7.96875	0.03125	-
LDPM_N_DIF_PRED_OPM_1	8	0... FFFFH	0... 32767	1	rpm
LDPM_MAF_FAC_TQ_ADD_IS	6	0... FFFFH	0... 1389	0.02119478	mg/stk
Factor for basis torque reserve at idle due to N_DIF_PRED and load without drive (mode1)					
IP_FAC_TQ_ADD_IS_BOL_OPM_2	-	0... FFH	0... 7.96875	0.03125	-
LDPM_N_DIF_PRED_OPM_2	8	0... FFFFH	0... 32767	1	rpm
LDPM_MAF_FAC_TQ_ADD_IS	6	0... FFFFH	0... 1389	0.02119478	mg/stk
Factor for basis torque reserve at idle due to N_DIF_PRED and load without drive (mode2)					
IP_FAC_VS_TQ_ADD_IS_BOL_OPM_1	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_VS_FIL_IP_FAC_VS_TQ_ADD_IS	4	0... FFFFH	0... 511.992188	0.0078125	km/h
Factor for IP_FAC_TQ_ADD_IS_BOL_CS_OPM_1 (mode 1)					
IP_FAC_VS_TQ_ADD_IS_BOL_OPM_2	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_VS_FIL_IP_FAC_VS_TQ_ADD_IS	4	0... FFFFH	0... 511.992188	0.0078125	km/h
Factor for IP_FAC_TQ_ADD_IS_BOL_CS_OPM2 (mode 2)					
IP_LGRD_TQ_ADD_IS_BOL	-	0... FFH	0... 7.96875	0.03125	Nm
LDPM_N_LGRD_TQ_ADD_IS_BOL	6	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_LGRD_TQ_ADD_IS_BOL	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Gradient for decrementation of the torque reserve at idle					
IP_LGRD_TQ_ADD_IS_BOL_OPM_2	-	0... FFH	0... 7.96875	0.03125	Nm
LDPM_N_LGRD_TQ_ADD_IS_BOL	6	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_LGRD_TQ_ADD_IS_BOL	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Gradient for decrementation of the torque reserve at idle for OPM 2					
IP_T_N_DIF_OFS_PRED_CS_OPM_1	-	0... FFH	0... 7.96875	0.03125	s
LDPM_N_T_N_DIF_OFS_PRED	8	0... 1FE0H	0... 8160	1	rpm
Time constant for calculation of predicted engine speed deviation at drive off support (mode1)					
IP_T_N_DIF_OFS_PRED_CS_OPM_2	-	0... FFH	0... 7.96875	0.03125	s
LDPM_N_T_N_DIF_OFS_PRED	8	0... 1FE0H	0... 8160	1	rpm
Time constant for calculation of predicted engine speed deviation at drive off support (mode2)					
IP_T_N_DIF_OFS_PRED_OPM_1	-	0... FFH	0... 7.96875	0.03125	s
LDPM_N_T_N_DIF_OFS_PRED	8	0... 1FE0H	0... 8160	1	rpm
Time constant for calculation of predicted engine speed deviation (mode 1)					
IP_T_N_DIF_OFS_PRED_OPM_2	-	0... FFH	0... 7.96875	0.03125	s
LDPM_N_T_N_DIF_OFS_PRED	8	0... 1FE0H	0... 8160	1	rpm
Time constant for calculation of predicted engine speed deviation (mode 2)					
IP_TQ_ADD_IS_BOL_BAS_OPM_1	-	0... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_N_SP_IS_TQ_ADD_IS_BOL_BAS	6	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_TQ_ADD_IS_BOL_BAS	6	0... FEH	0... 142.5	0.75	°C
Basis torque reserve at idle (mode1)					
IP_TQ_ADD_IS_BOL_BAS_OPM_2	-	0... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_N_SP_IS_TQ_ADD_IS_BOL_BAS	6	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_TQ_ADD_IS_BOL_BAS	6	0... FEH	0... 142.5	0.75	°C
Basis torque reserve at idle (mode2)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TQ_ADD_IS_COR_OPM_1	-	0... 7FFFH	0... 1023.97	0.03125	Nm
LDP_VLFT_MIN_IP_TQ_ADD_IS_COR	6	0... FFFFH	0... 65.535	0.001	mm
LDP_MAP_DIP_SP_MMV_IP_TQ_ADD_IS	6	0... FFFFH	0... 1279.96	0.0390625	hPa
Additive torque reserve at idle at VVT mode (mode1)					

## Function description

### General Information:

The module Idle Speed Torque Reserve consists of two parts:

1. Idle speed torque reserve due to low engine speed
2. Idle speed torque reserve limitation for stabilizing the ISC at high torque reserves

#### 1. Idle speed torque reserve due to low engine speed

Depending on the predicted engine speed difference  $N\_DIF\_PRED$  a torque reserve by increasing the load is calculated. If actual engine speed falls it is possible to increase load before the actual engine speed is below the engine speed setpoint for idle speed. At the same time a spark retard compensates the supposed torque increase. So a quick torque increase by spark advance can be realized to stabilize engine speed at its setpoint.

For negative gradients of  $TQ\_ADD\_IS\_BOL\_SEL$  a PT1 filter for  $TQ\_ADD\_IS\_BOL$  calculation is applied to avoid torque jumps caused by fast changes of ignition angle. For positive gradients of the input  $TQ\_ADD\_IS\_BOL\_SEL$  the output value  $TQ\_ADD\_IS\_BOL$  is identical to the input.

#### 2. Idle speed torque reserve limitation for stabilizing the ISC at high torque reserves

At high torque reserve requests (ex.: catalyst heating) the ignition angle can be retarded down to the minimum ignition angle  $IGA\_MIN$ . This may cause problems with idle speed stability. In order to prevent speed from oscillating in case the actual ignition angle is in the near of  $IGA\_MIN$  caused by high torque reserves, the maximum available torque reserve must be limited. In order to reach this, a tunable calibration constant  $C\_TQ\_DIF\_ADD\_IS\_TOL\_OPM\_1/2$  is introduced.  $C\_TQ\_DIF\_ADD\_IS\_TOL\_OPM\_1/2$  has the same influence than  $TQ\_ADD\_IS\_BOL$ : while the last defines a minimum torque reserve,  $C\_TQ\_DIF\_ADD\_IS\_TOL\_OPM\_1/2$  takes influence on the maximum torque reserve in idle. The available torque reserve range is shown in figure 1.

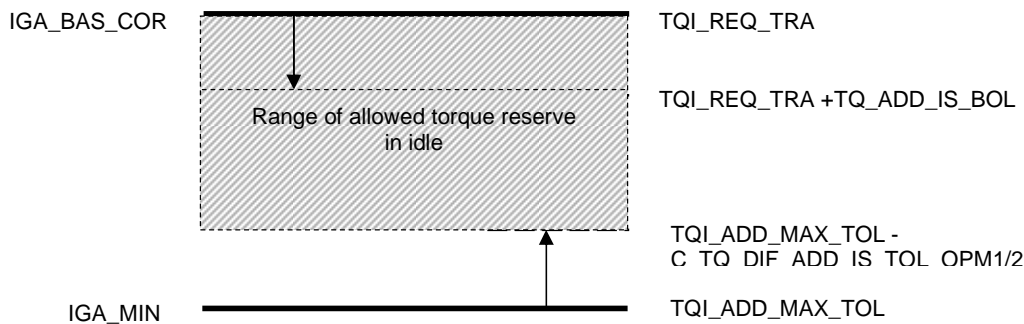


Figure 8.8.1: Available torque reserve range after limiting:

$TQI\_ADD\_MAX\_TOL - C\_TQ\_DIF\_ADD\_IS\_TOL\_OPM\_1/2$  defines the max. idle torque reserve

Since  $C\_TQ\_DIF\_ADD\_IS\_TOL\_OPM\_1/2$  is a calibratable constant, this may cause a conflict situation as shown in figure 2.

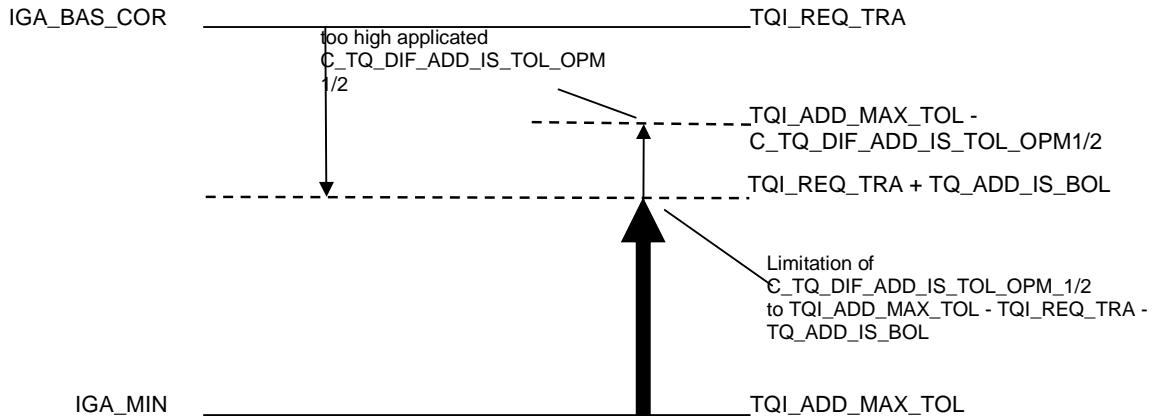


Figure 8.8.2: : Limiting  $C\_TQ\_DIF\_ADD\_IS\_TOL\_OPM\_1/2$  in case of a conflict

In this case  $TQ\_ADD\_IS\_BOL$  has a higher priority than  $C\_TQ\_DIF\_ADD\_IS\_TOL\_OPM\_1/2$ , since the possibility of moving the ignition angle in direction spark advance by building up a torque reserve is more essential than keeping it at a certain point from  $IGA\_MIN$ , which „only“ causes irregular running. The condition for a non-critical situation, figure 1, is

$$TQI\_REQ\_TRA + TQ\_ADD\_IS\_BOL \leq TQI\_ADD\_MAX\_TOL - C\_TQ\_DIF\_ADD\_IS\_TOL\_OPM\_1/2 \quad (1)$$

Solving this relation leads to

$$C\_TQ\_DIF\_ADD\_IS\_TOL\_OPM\_1/2 \leq TQI\_ADD\_MAX\_TOL - TQI\_REQ\_TRA - TQ\_ADD\_IS\_BOL \quad (2)$$

If relation (2) is not fulfilled,  $C\_TQ\_DIF\_ADD\_IS\_TOL\_OPM\_1/2$  is limited, figure 3.

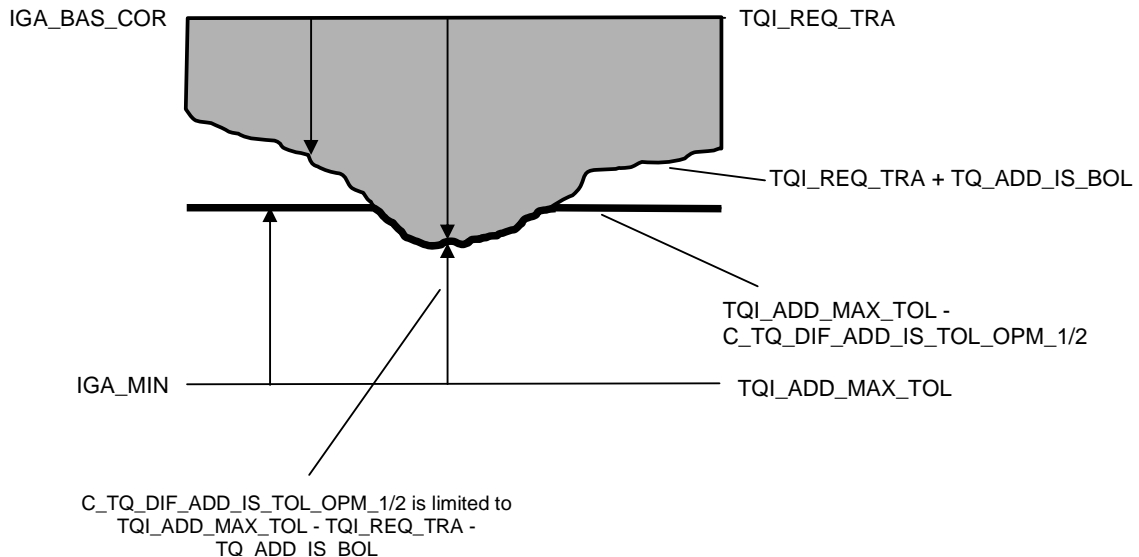


Figure 3: Limiting  $C\_TQ\_DIF\_ADD\_IS\_TOL\_OPM\_1/2$  in case  $TQI\_REQ\_TRA + TQ\_ADD\_IS\_BOL$  is greater than  $TQI\_ADD\_MAX\_TOL - C\_TQ\_DIF\_ADD\_IS\_TOL\_OPM\_1/2$

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### Application Condition

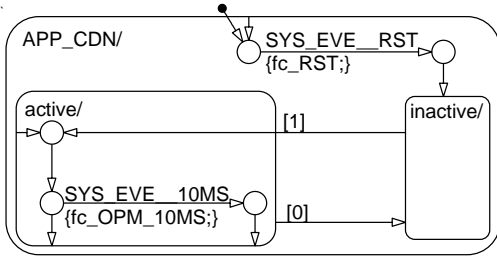
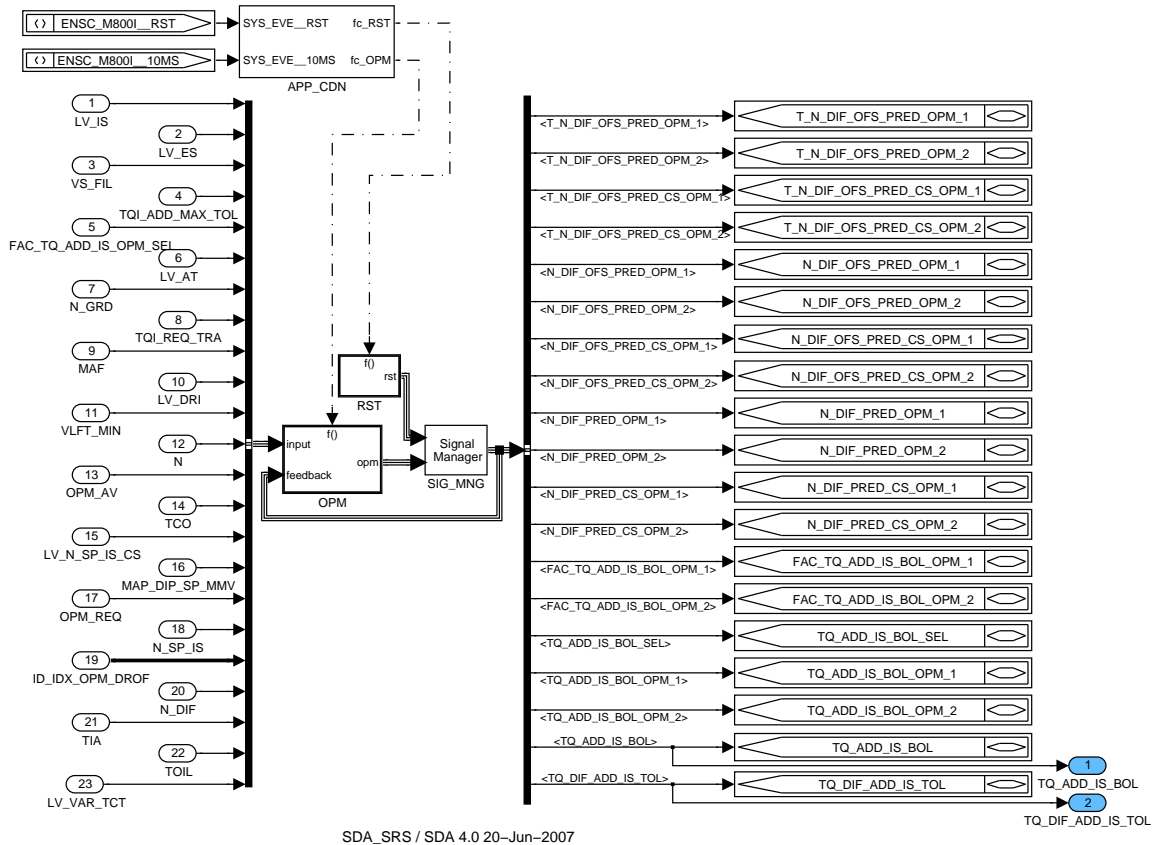


Figure 8.8.3: ENSC\_M800I/APP\_CDN/APP\_CDN

### Function Description



SDA\_SRS / SDA 4.0 20-Jun-2007

Figure 8.8.4: ENSC\_M800I

### 8.8.1 Initialization at Reset event

The following variables are initialized to zero.

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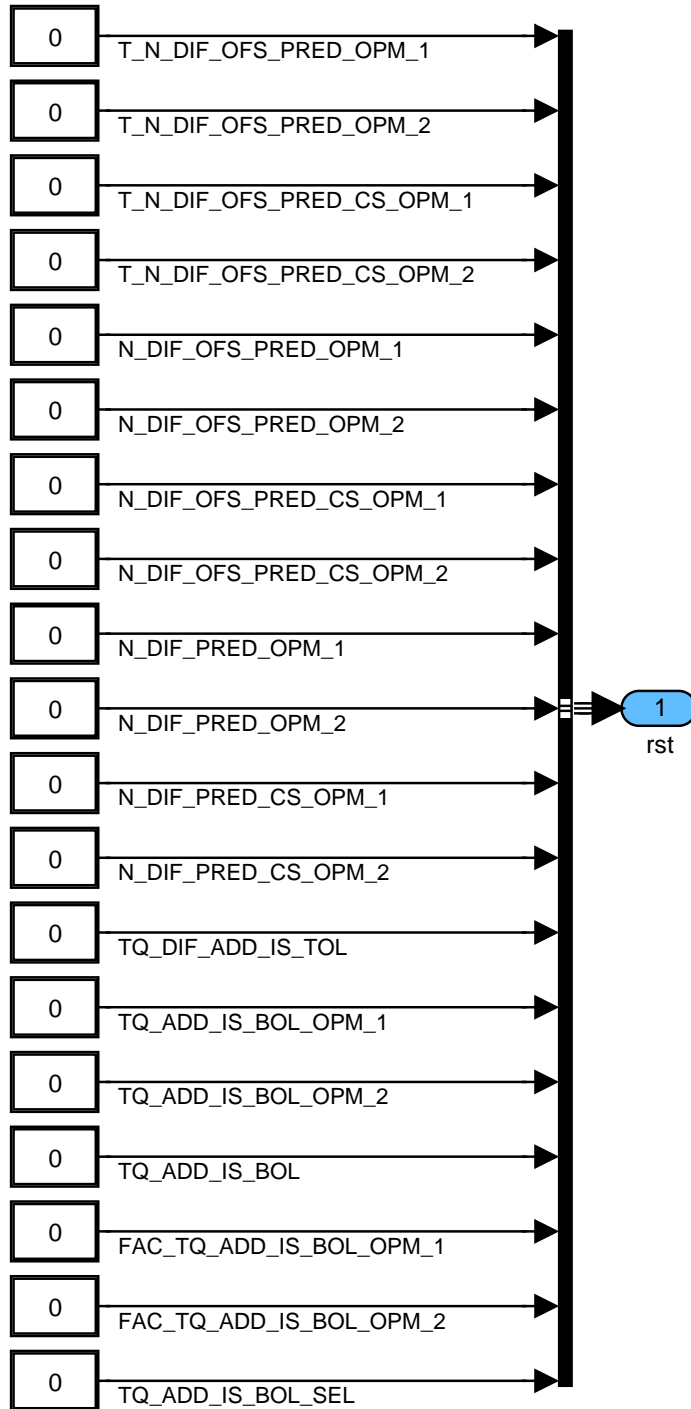


Figure 8.8.5: ENSC\_M800I/RST/INI

## 8.8.2 Formula section

Check for activation

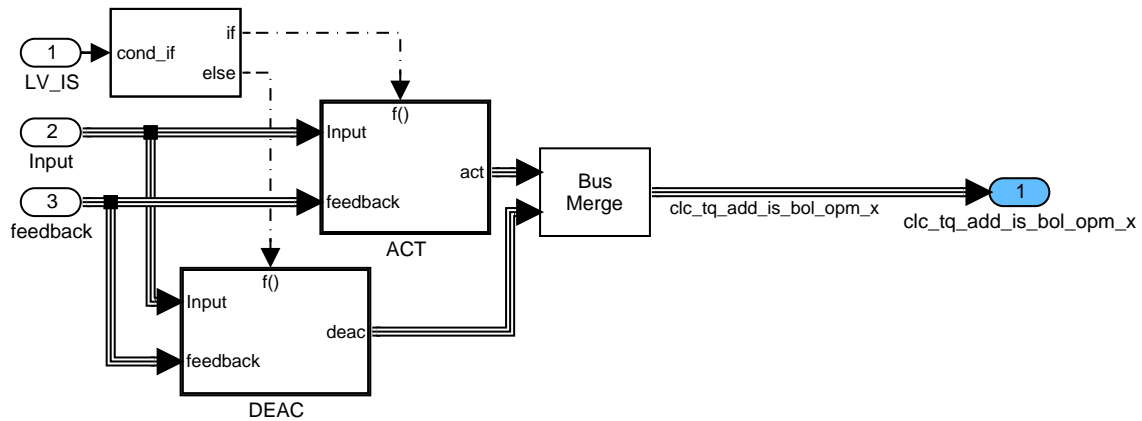


Figure 8.8.6: ENSC\_M800I/OPM/CLC\_TQ\_ADD\_IS\_BOL\_OPM\_x

Activation

### Operation mode manager

There are two input values IN\_1, IN\_2. Each input value belongs to a special operation mode OPM\_1, OPM\_2. Moreover the value OPM\_SEL\_AV indicates the active and OPM\_SEL\_REQ indicates the requested operation mode. The aim of the operation manager is to create an output value depending on the active operation mode. If there is a switch from one mode to another a smooth changeover from one input value to the other is possible by using the interpolation factor FAC\_OPM\_SEL.

A special logic takes care that the needed part is calculated only. That means if OPM\_1 is active and there is no switch requested then the output value of the operation manager = IN\_1 and some part of the algorithm for IN\_2 are not calculated anymore. In this case the bit LV\_OPM\_SEL\_1=1 indicates that only the calculation of the IN\_1 path is done.

The information of the actual and the requested operation mode can be changed by interpretations maps ID\_...OPM\_SEL. The effect of this is, that by calibration the operation mode 1 can be wired to the input 2. That means the belonging for a operation mode to an input value is flexible.

The following table defines the local variable described above:

TQ_ADD_IS_BOL_OPM_1	IN_1	Input	Input value for operation mode 1
TQ_ADD_IS_BOL_OPM_2	IN_2	Input	Input value for operation mode 2
OPM_AV (from Layer)	OPM_AV	Input	Actual operation mode
OPM_REQ (from Layer)	OPM_REQ	Input	Requested operation mode
-	OPM_SEL_AV	Internal value	Actual active operation mode after interpretation
-	OPM_SEL_REQ	Internal value	Requested operation mode after interpretation
FAC_TQ_ADD_IS_OPM_SEL (from Layer)	FAC_OPM_SEL	Input	Interpolation factor
LV_TQ_ADD_IS_OPM_SEL_1	LV_OPM_SEL_1	Output	Operation mode 1 active
LV_TQ_ADD_IS_OPM_SEL_2	LV_OPM_SEL_2	Output	Operation mode 2 active
TQ_ADD_IS_BOL_SEL_1	OUT	Output	Result of interpolation
LV_TQ_ADD_IS_OPM_RLS	LV_OPM_RLS	Output	Operation mode within valid range
ID_TQ_ADD_IS_OPM_AV	ID_OPM_AV	cal	Mapping of active operation mode
ID_TQ_ADD_IS_OPM_REQ	ID_OPM_REQ	cal	Mapping of requested operation mode

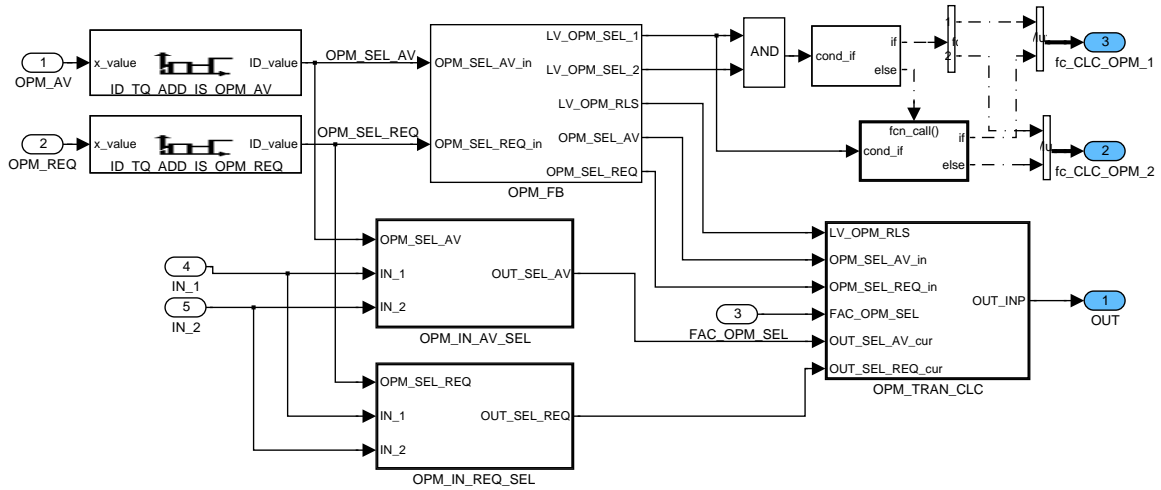



Figure 8.8.7: ENSC\_M800I/OPM/CLC\_TQ\_ADD\_IS\_BOL\_OPM\_x/ACT/OPM\_SWI

**Check for activation of operation mode 1 and 2**

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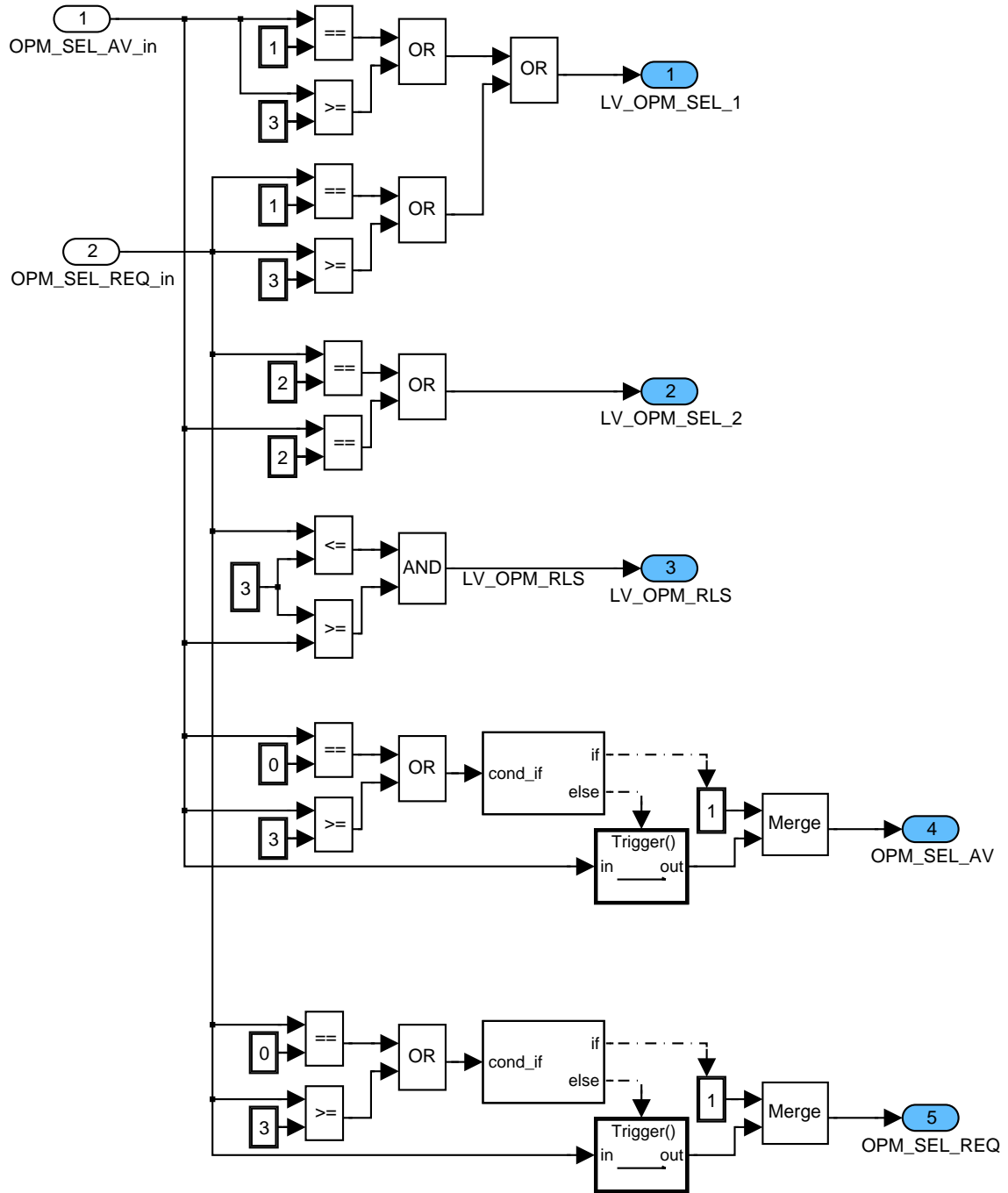



Figure 8.8.8: ENSC\_M800I/OPM/CLC\_TQ\_ADD\_IS\_BOL\_OPM\_x/ACT/OPM\_SWI/OPM\_FB

**Actual active operation mode after interpretation**

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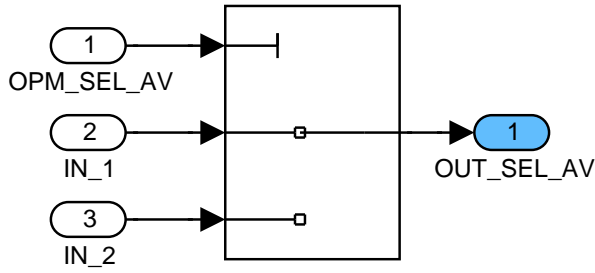


Figure 8.8.9: ENSC\_M800I/OPM/CLC\_TQ\_ADD\_IS\_BOL\_OPM\_x/ACT/OPM\_SWI/OPM\_IN\_AV\_SEL

**Requested operation mode after interpretation**

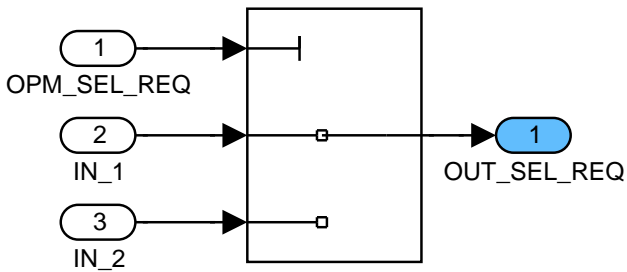



Figure 8.8.10:  
ENSC\_M800I/OPM/CLC\_TQ\_ADD\_IS\_BOL\_OPM\_x/ACT/OPM\_SWI/OPM\_IN\_REQ\_SEL

**Calculation of TQ\_ADD\_IS\_BOL\_SEL\_1**

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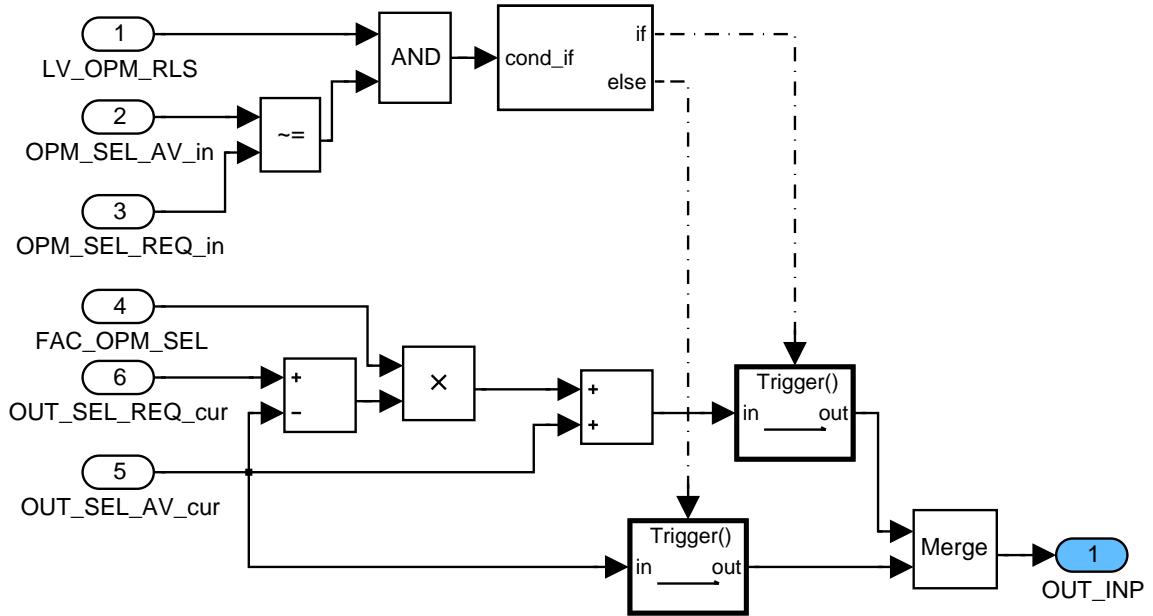


Figure 8.8.11:  
 ENSC\_M800I/OPM/CLC\_TQ\_ADD\_IS\_BOL\_OPM\_x/ACT/OPM\_SWI/OPM\_TRAN\_CLC

**TQ\_ADD\_IS\_BOL\_OPM\_1 calculation**

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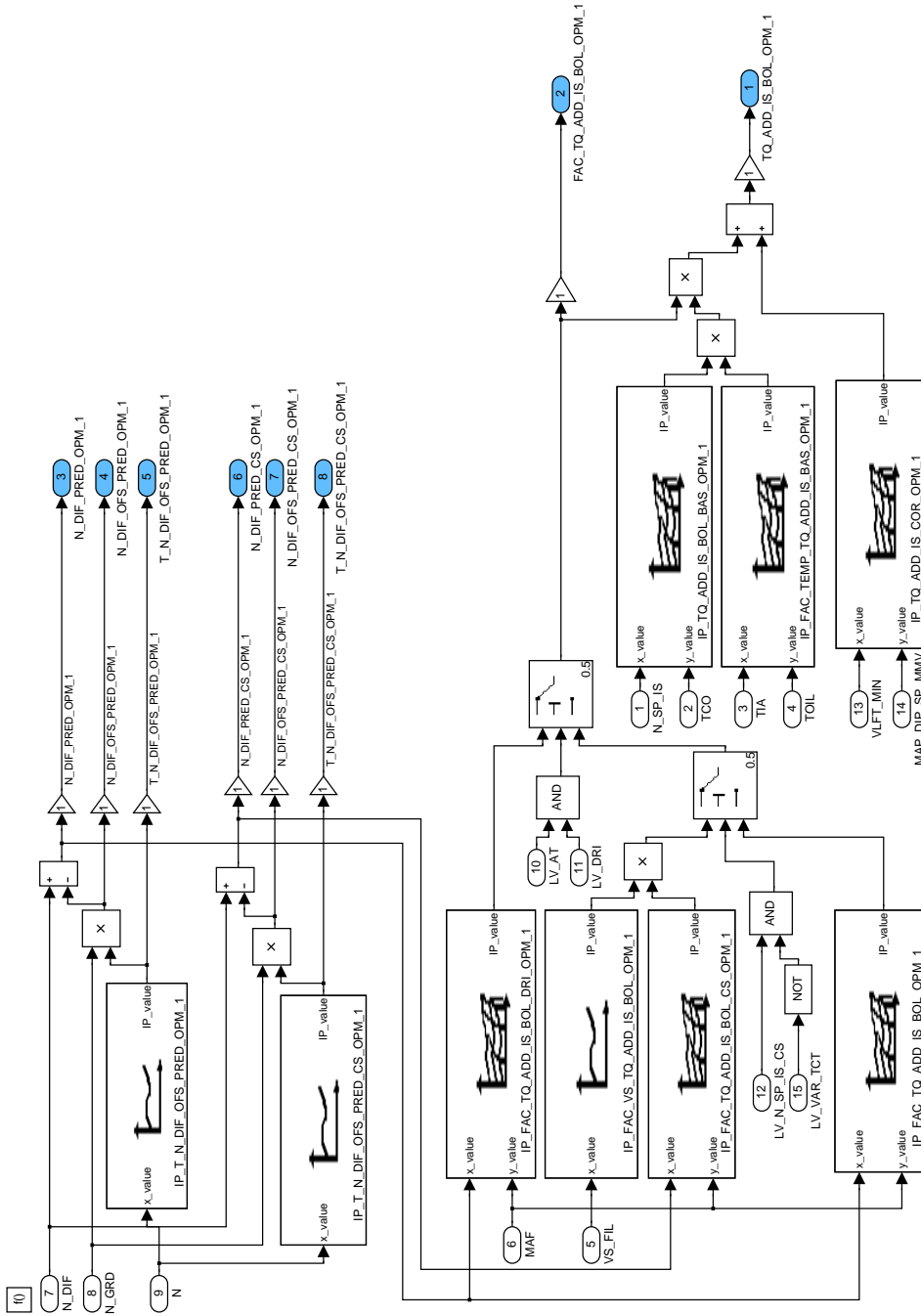



Figure 8.8.12: ENSC\_M800I/OPM/CLC\_TQ\_ADD\_IS\_BOL\_OPM\_x/ACT/CLC\_OPM\_1

**TQ\_ADD\_IS\_BOL\_OPM\_2 calculation**

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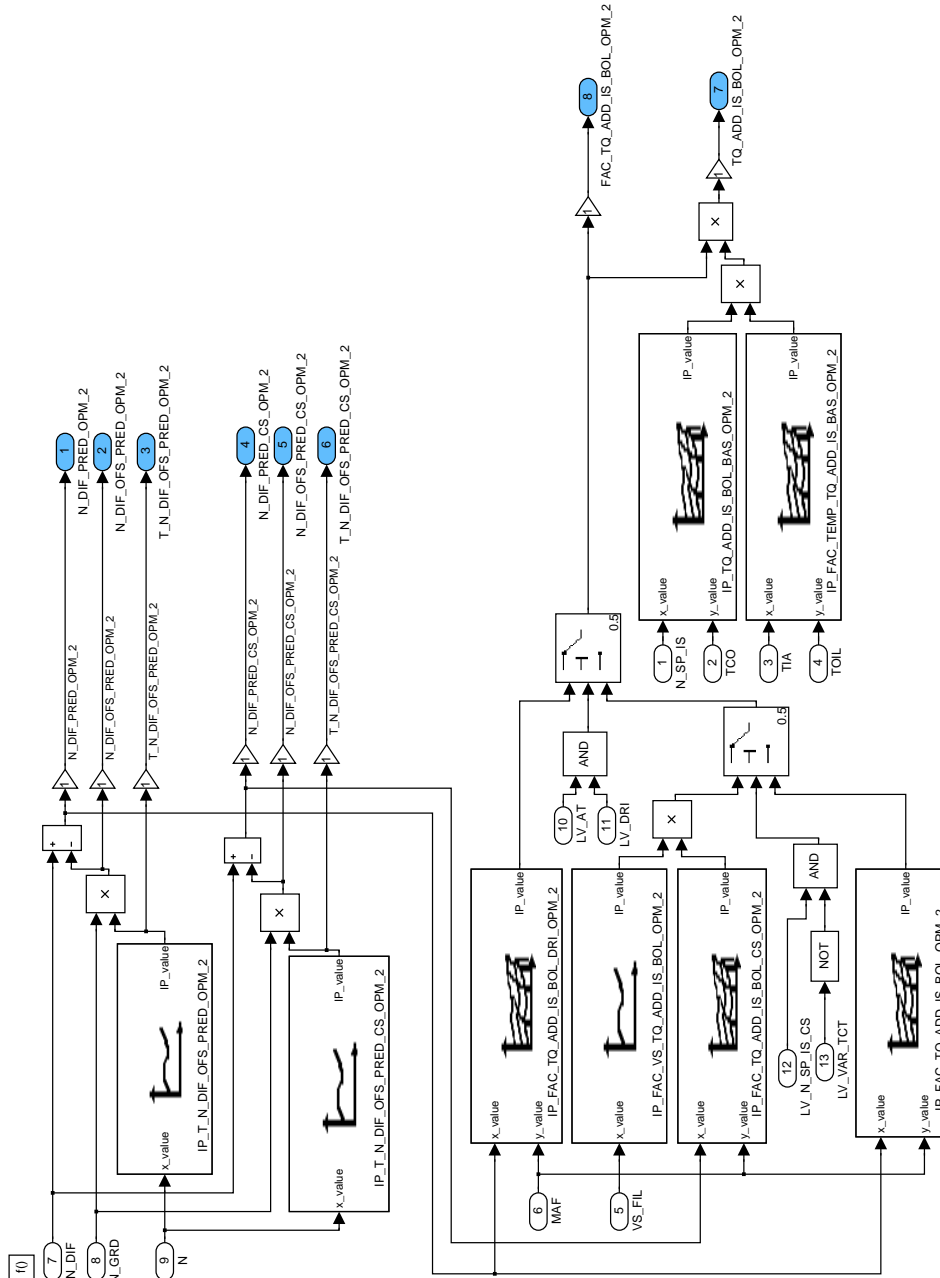



Figure 8.8.13: ENSC\_M800I/OPM/CLC\_TQ\_ADD\_IS\_BOL\_OPM\_x/ACT/CLC\_OPM\_2

**Deactivation**

**Check for Deactivation**

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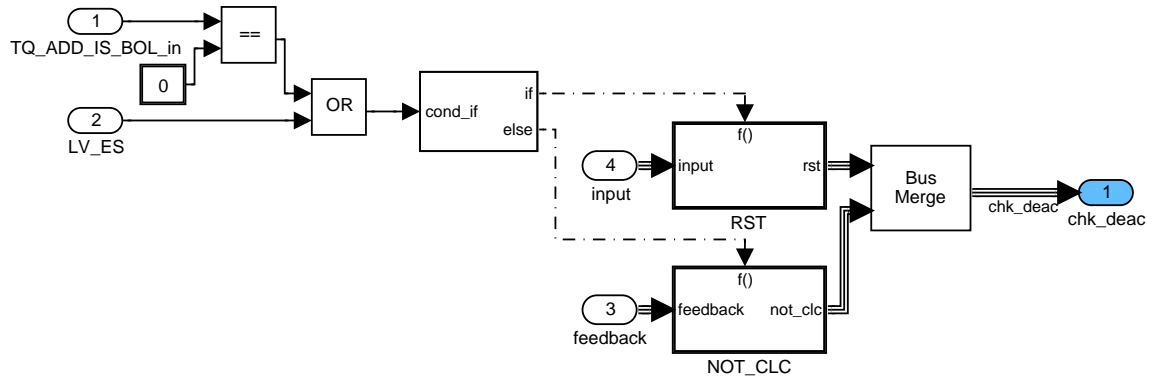



Figure 8.8.14: ENSC\_M800I/OPM/CLC\_TQ\_ADD\_IS\_BOL\_OPM\_x/DEAC/CHK\_DEAC

**Reset variables during Deactivation**

The following variables are initialized during event deactivation

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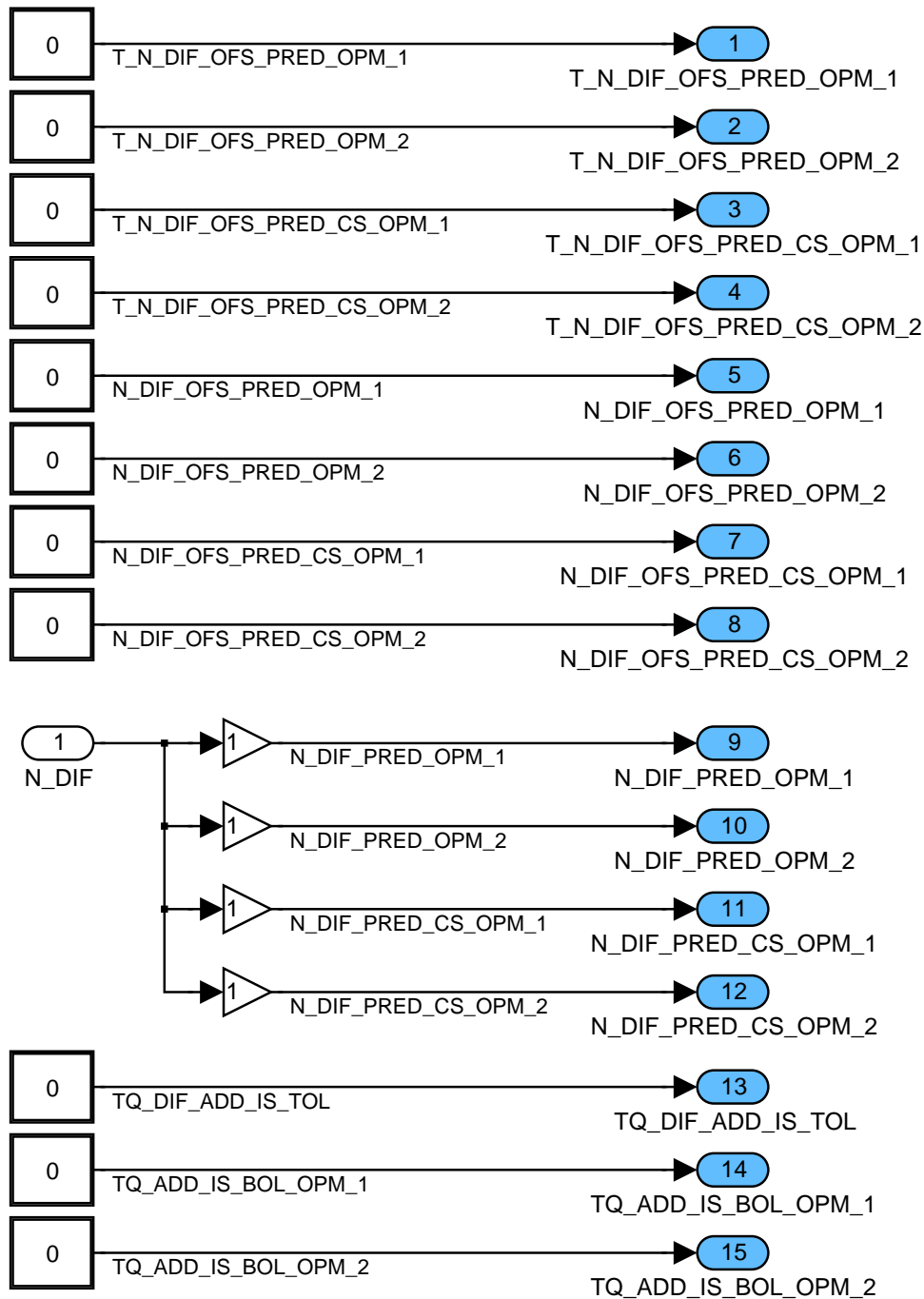


Figure 8.8.15: ENSC\_M800I/OPM/CLC\_TQ\_ADD\_IS\_BOL\_OPM\_x/DEAC/CHK\_DEAC/RST/CLC

**NOT\_CLC**

No calculations

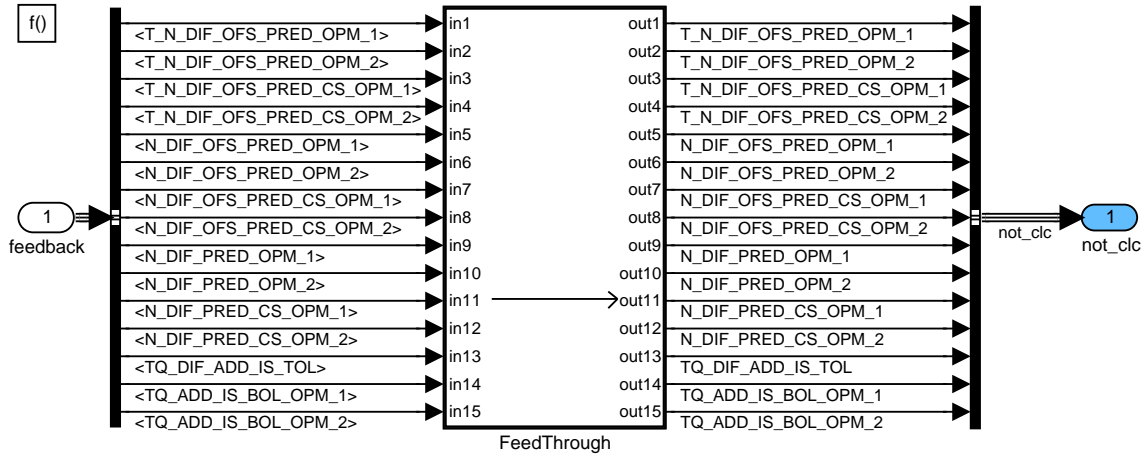


Figure 8.8.16: ENSC\_M800I/OPM/CLC\_TQ\_ADD\_IS\_BOL\_OPM\_x/DEAC/CHK\_DEAC/NOT\_CLC

**Ramp down TQ\_ADD\_IS\_BOL\_SEL**

Calculations for TQ\_ADD\_IS\_BOL\_SEL

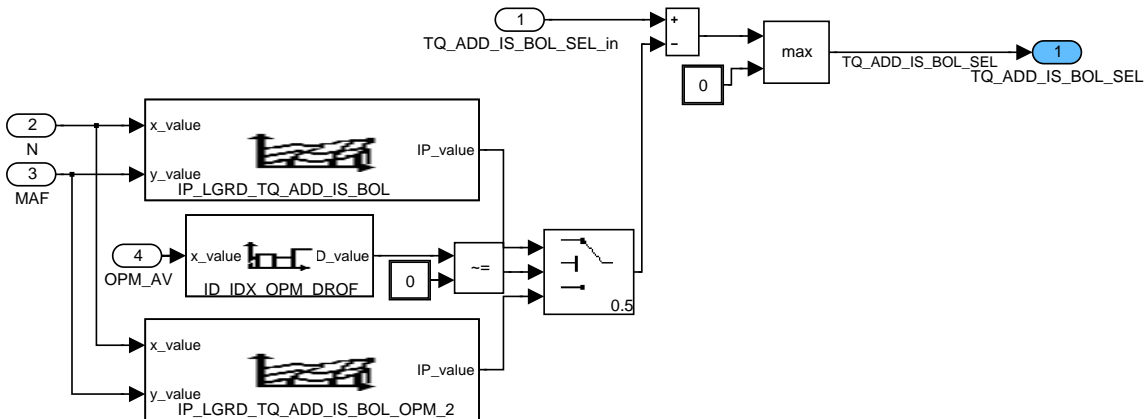


Figure 8.8.17: ENSC\_M800I/OPM/CLC\_TQ\_ADD\_IS\_BOL\_OPM\_x/DEAC/RAMP\_DOWN\_TQ\_ADD\_IS\_BOL\_SEL/CLC

**PT1 Filter to limit negative gradient**

For negative gradients of TQ\_ADD\_IS\_BOL\_SEL a PT1 filter for TQ\_ADD\_IS\_BOL calculation is applied to avoid torque jumps caused by fast changes of ignition angle. For positive gradients of the input TQ\_ADD\_IS\_BOL\_SEL the output value TQ\_ADD\_IS\_BOL is identical to the input.

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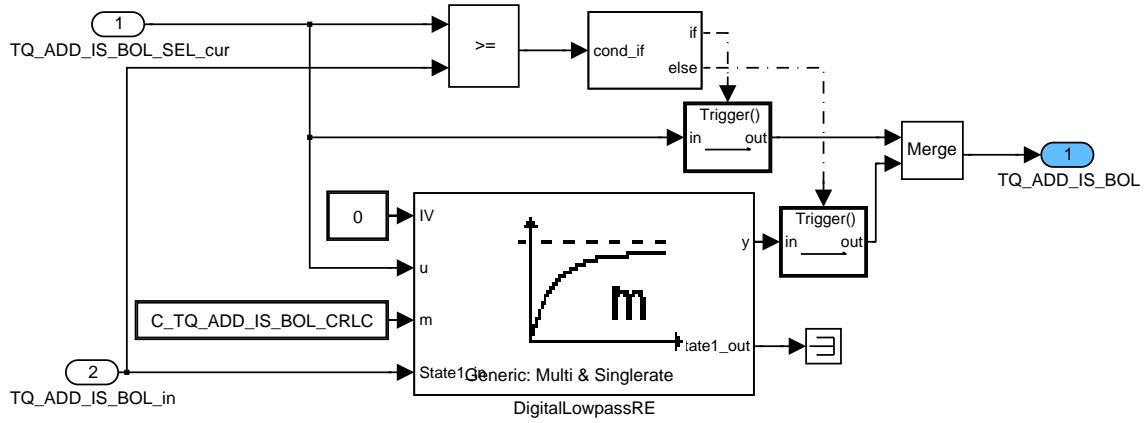


Figure 8.8.18: ENSC\_M800I/OPM/PT1\_FIL/CLC

**Limitation of idle speed torque reserve**

Idle speed torque reserve for stabilizing the ISC at high torque reserves

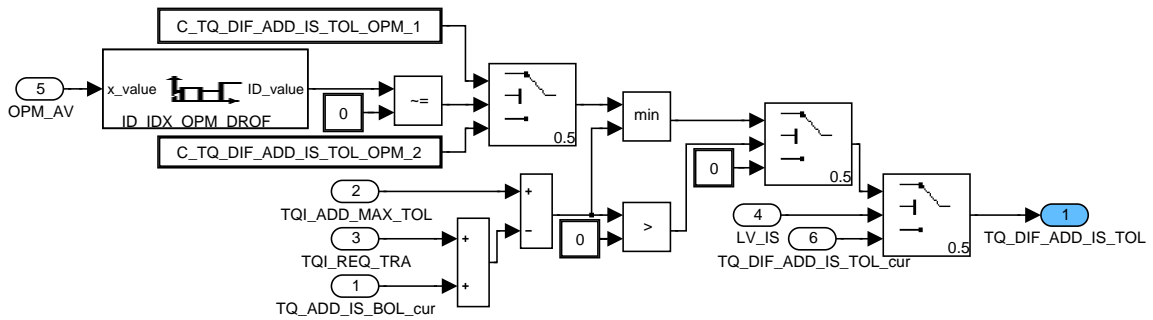


Figure 8.8.19: ENSC\_M800I/OPM/LIM\_IS\_TQ/CLC

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## 8.9 Torque reserve for canister purge at idle

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_ADD_CP	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for canister purge at idle					

### Input data:

CL_MMV {p. 3698}	LV_HOM_RUN {p. 8136}	LV_IS {p. 1720}	STATE_CP {p. 3637}
------------------	----------------------	-----------------	--------------------

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_TQ_ADD_CP	-	0... FFH	0... 0.99609	3.91e-3	-
Filter constant for canister purge torque reserve					
IP_TQ_ADD_CP	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_CL_MMV_IP_TQ_ADD_CP	8	0... FFH	0... 1.99218	0.0078125	-
Map for determination of TQ_ADD_CP in dependence of CL_MMV					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_TQ_ADD_CP_INH	-	0... 1H	0 ...1	1	-
Logical variable for inhibiting the torque reserve for canister purge in idle					

Input data table order: External inputs - Inputs from other EVAC modules

### General Information:

The torque reserve for canister purge in idle should be active, when the canister purge function is in a controlled mode, so if STATE\_CP = MAX\_PURGE.

By increasing the engine load without increasing the torque output, a higher purge rate is possible.

### Signal flow diagram:

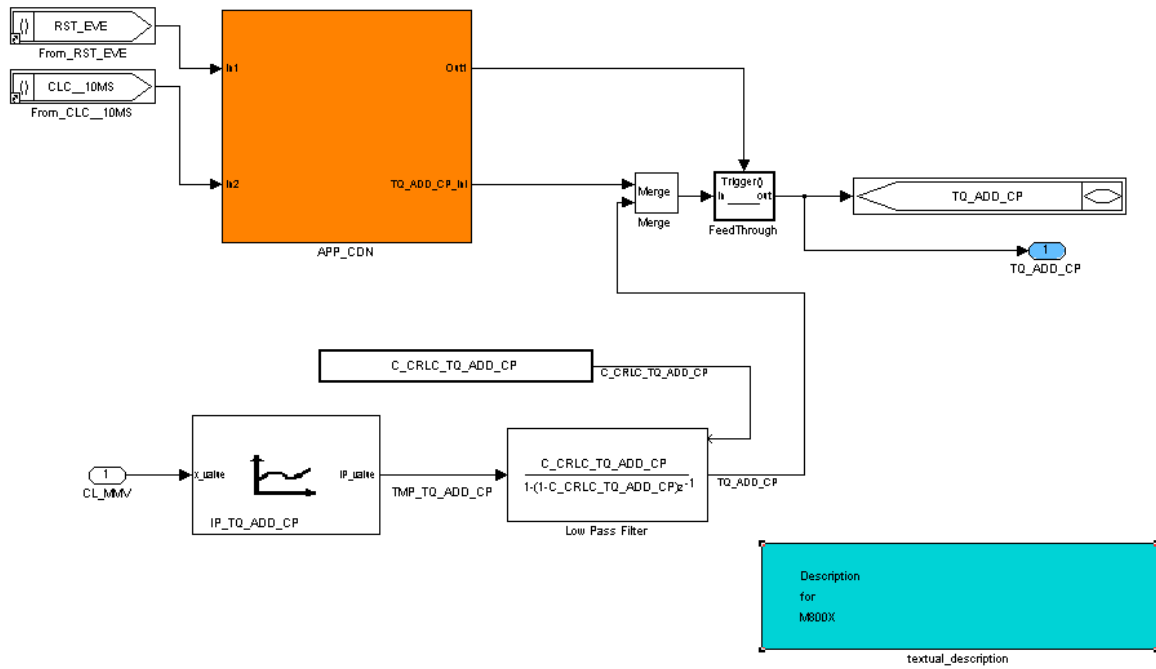


Figure 8.9.1: : Torque reserve for canister purge at idle

**FUNCTION DESCRIPTION:**

General information:

*Activation:*

- LV\_IS = 1
- and STATE\_CP = MAX\_PURGE
- and LC\_TQ\_ADD\_CP\_INH = 0
- and LV\_HOM\_RUN = 1

*Deactivation:*

- LV\_IS = 0
- or STATE\_CP MAX\_PURGE
- or LC\_TQ\_ADD\_CP\_INH = 1
- or LV\_HOM\_RUN = 0

*Initialization:* at reset or deactivation

TQ\_ADD\_CP = 0

*Recurrency:* 20 ms


**Formula section:**

$$TMP\_TQ\_ADD\_CP = IP\_TQ\_ADD\_CP (CL\_MMV)$$

$$TQ\_ADD\_CP_n = TQ\_ADD\_CP_{n-1} + C\_CRLC\_TQ\_ADD\_CP * (TMP\_TQ\_ADD\_CP - TQ\_ADD\_CP_{n-1})$$

// filtered value of TMP\_TQ\_ADD\_CP

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## 8.10 Idle speed setpoint for catalyst heating

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_N_SP_IS_CH_DRI	V	0... 1H	0 ...1	1	-
Logical variable for driving position engaged (switch for N_SP_IS_CH maps)					
N_SP_IS_CH	O/V	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint for catalyst heating					

### Input data:

GEAR {p. 1302}	LV_AT {p. 654}	LV_DLY_N_SP_IS {p. 6710}	LV_ST_END {p. 1720}
STATE_CH {p. 1777}	STATE_CH_MOD {p. 1796}	T_AST {p. 1766}	TCO_ST {p. 1100}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_SP_IS_CH_AST_MPLP	-	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint for stratified catalyst heating with post injection					
C_N_SP_IS_CH_AST_MPLP_DRI	-	0... 1FE0H	0... 8160	1	rpm
idle speed setpoint for stratified catalyst heating with post injection, engaged gear					
C_N_SP_IS_CH_L_HOM	-	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint for homogenous low load CH					
C_N_SP_IS_CH_L_S	-	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint for stratified low load CH					
IP_N_SP_IS_CH_AST_HOM	V	0... 1FE0H	0... 8160	1	rpm
LDPM_T_AST_5_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_5_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint for homogeneous catalyst heating					
IP_N_SP_IS_CH_AST_HOM_DRI	V	0... 1FE0H	0... 8160	1	rpm
LDPM_T_AST_5_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_5_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint for homogeneous catalyst heating, engaged gear					
IP_N_SP_IS_CH_AST_HOM_DRI_REV	V	0... 1FE0H	0... 8160	1	rpm
LDPM_T_AST_5_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_5_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint for homogeneous catalyst heating, engaged reverse gear					
IP_N_SP_IS_CH_AST_MPLH	V	0... 1FE0H	0... 8160	1	rpm
LDPM_T_AST_5_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_5_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint for homogeneous catalyst heating with multiple injection					
IP_N_SP_IS_CH_AST_MPLH_DRI	V	0... 1FE0H	0... 8160	1	rpm
LDPM_T_AST_5_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_5_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint for homogeneous catalyst heating with multiple injection, engaged gear					
IP_N_SP_IS_CH_AST_MPLH_DRI_REV	V	0... 1FE0H	0... 8160	1	rpm
LDPM_T_AST_5_EXTC	8	0... FFFFH	0... 6553.5	0.1	s

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_TCO_ST_5_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint for homogeneous catalyst heating with multiple injection, engaged reverse gear					
IP_N_SP_IS_CH_AST_MPLP_DRI_REV	V	0... 1FE0H	0... 8160	1	rpm
LDPM_T_AST_5_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_5_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint for stratified catalyst heating with post injection, engaged reverse gear					
LC_DRI_ACT_MT	-	0... 1H	0 ...1	1	-
Usage of gear-dependency of N_SP_IS_CH-maps for manual transmission					

Overview

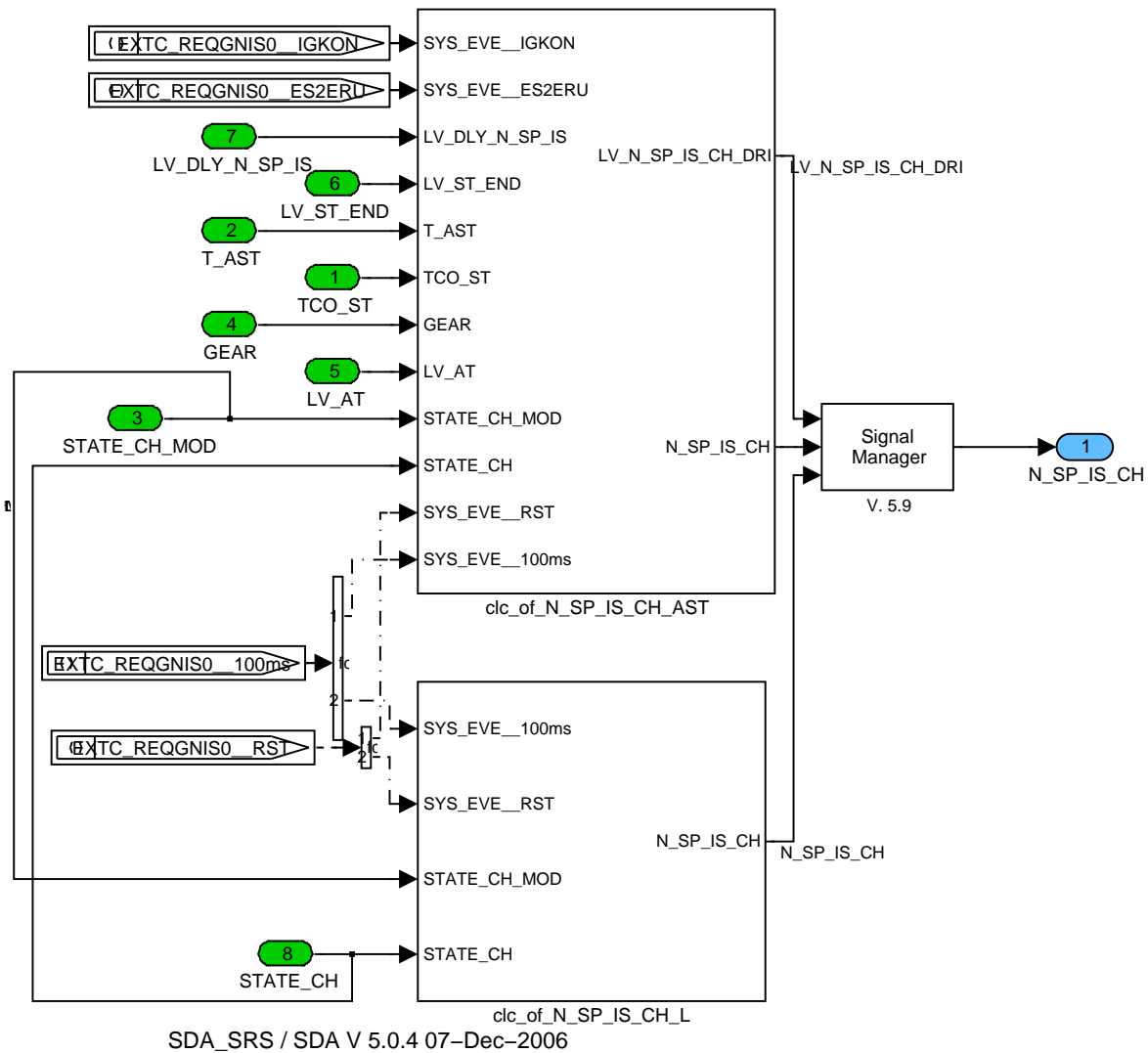


Figure 8.10.1: : Path: EXTC\_REQGNIS0

General Information

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For catalyst heating an increased idle speed is needed. In this modul there is a setpointcalculation for each strategy which is only calculated if actually needed.

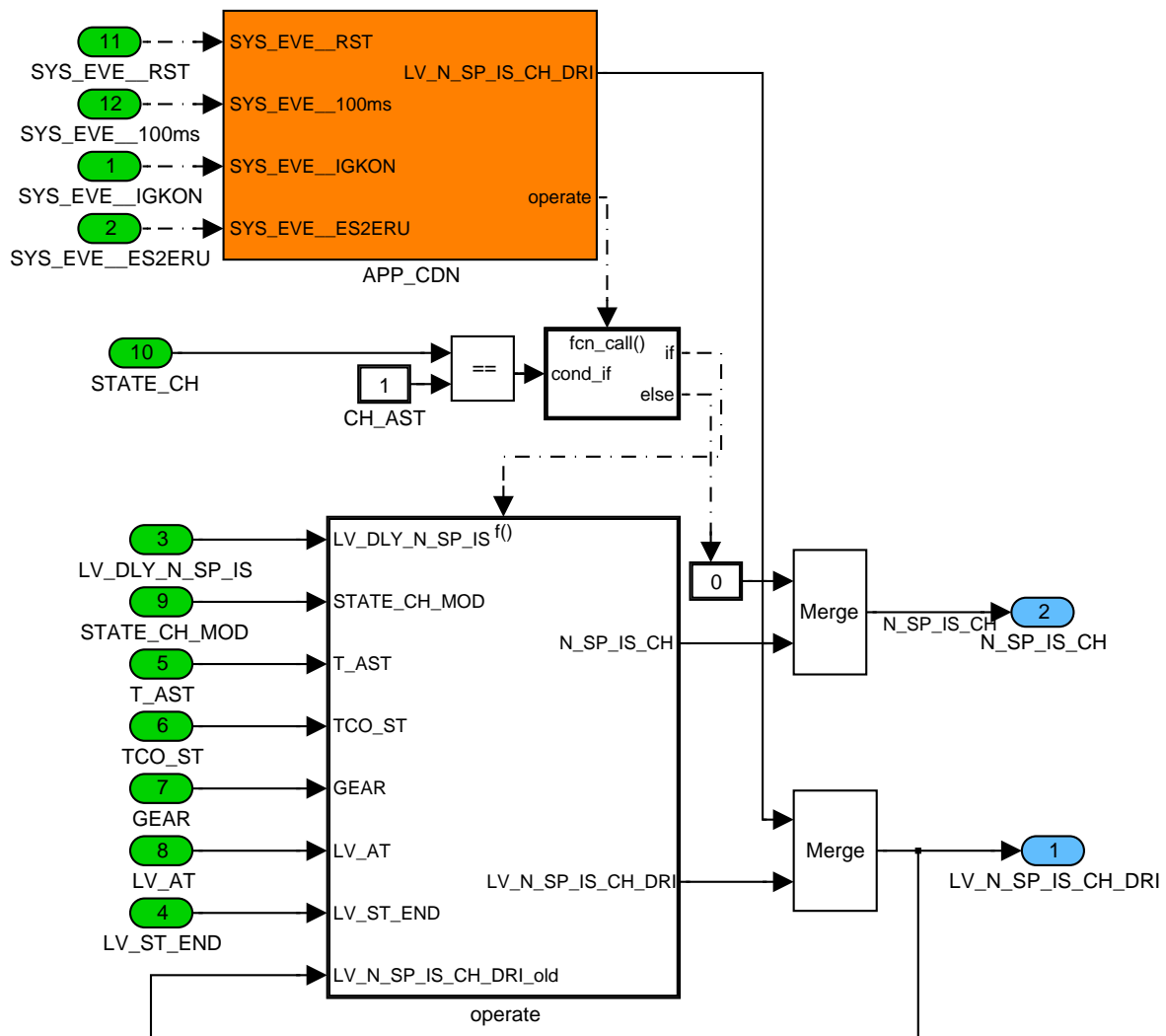
N\_SP\_IS\_CH is initialized with 0 because N\_SP\_IS is generated by a maximum-selection.

### 8.10.1 After start catalyst heating

There are several maps for engaged gear and not engaged. Via LC it is possible to use this dependency also for manual transmission.

#### Application Conditions

#### Function description



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Figure 8.10.2: Path: EXTC\_REQGNIS0/clc\_of\_N\_SP\_IS\_CH\_AST

### 8.10.1.1 Operate subsystem: after start catalyst heating

For Gear > 0 there are several maps. With LC\_DRI\_ACT\_MT it is possible to use the duplicated maps also for manual transmission. If these maps are used once they will be used until next engine start.

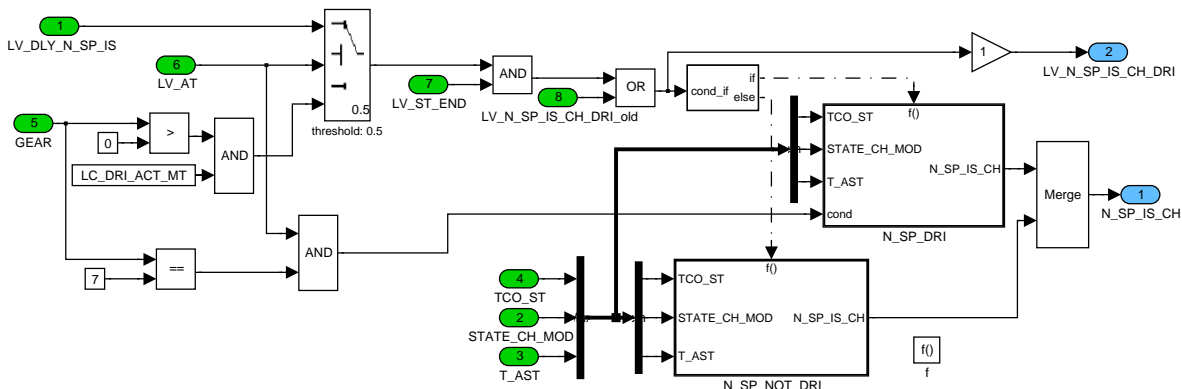


Figure 8.10.3: : Path: EXTC\_REQGNIS0/clc\_of\_N\_SP\_IS\_CH\_AST/operate

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### 8.10.1.1.1 Calculation of N\_SP\_IS\_CH

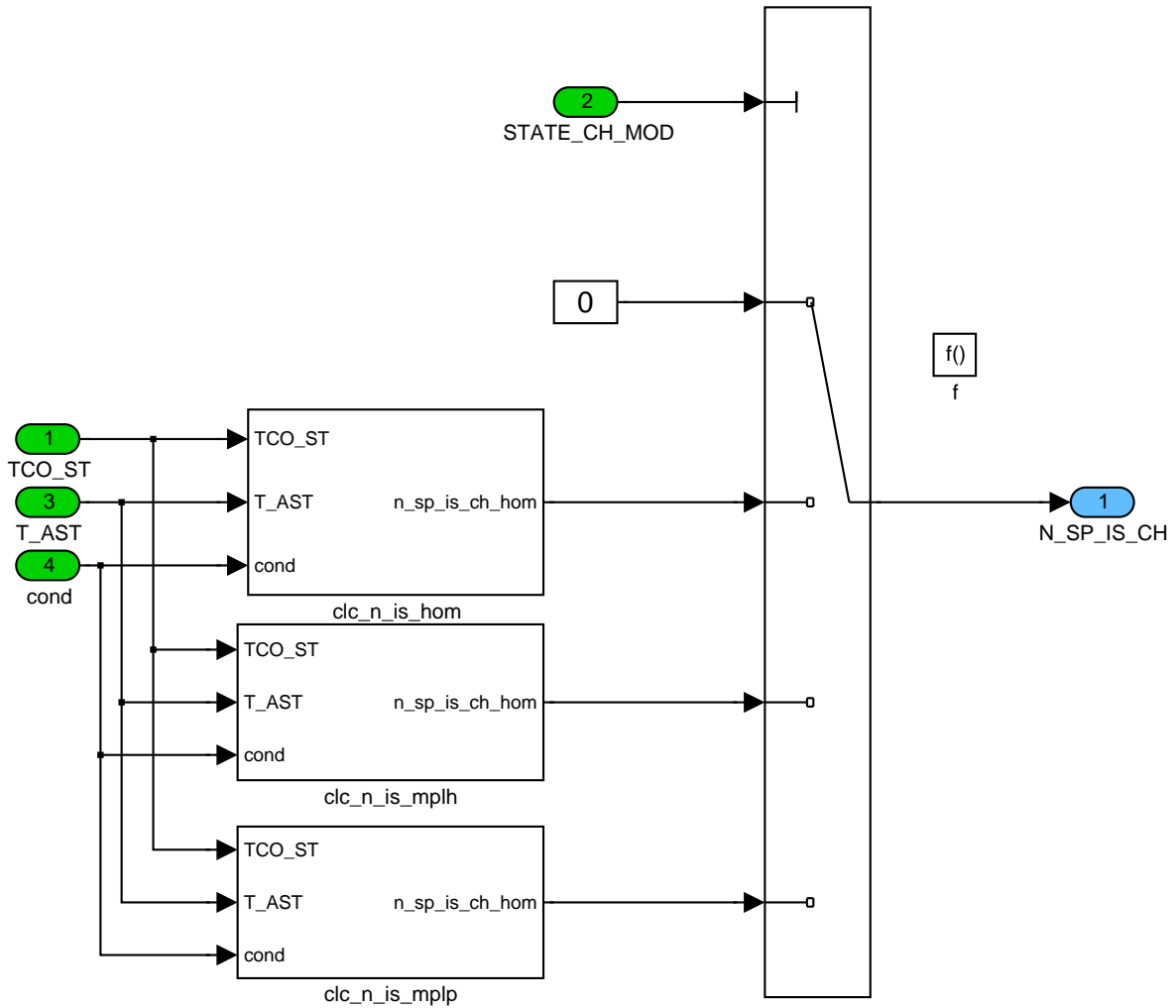


Figure 8.10.4: : Path: EXTC\_REQGNIS0/clc\_of\_N\_SP\_IS\_CH\_AST/operate/N\_SP\_DRI

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### 8.10.1.1.1 Calculation of N\_IS\_HOM

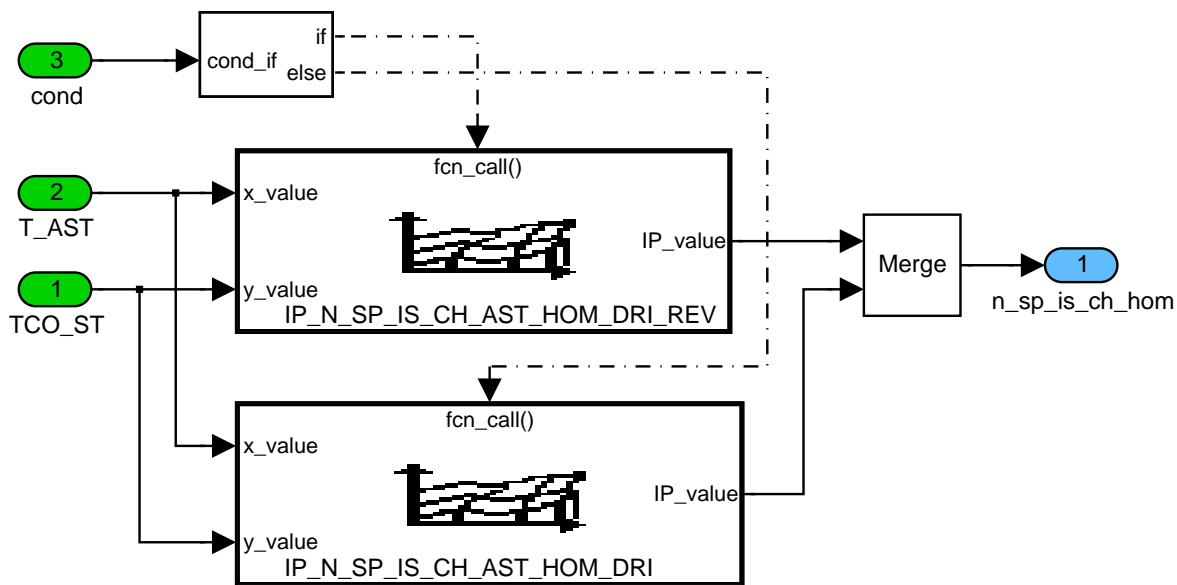


Figure 8.10.5: : Path:  
EXTC\_REQGNIS0/clc\_of\_N\_SP\_IS\_CH\_AST/operate/N\_SP\_DRI/clc\_n\_is\_hom

### 8.10.1.1.2 Calculation of N\_IS\_MPLH

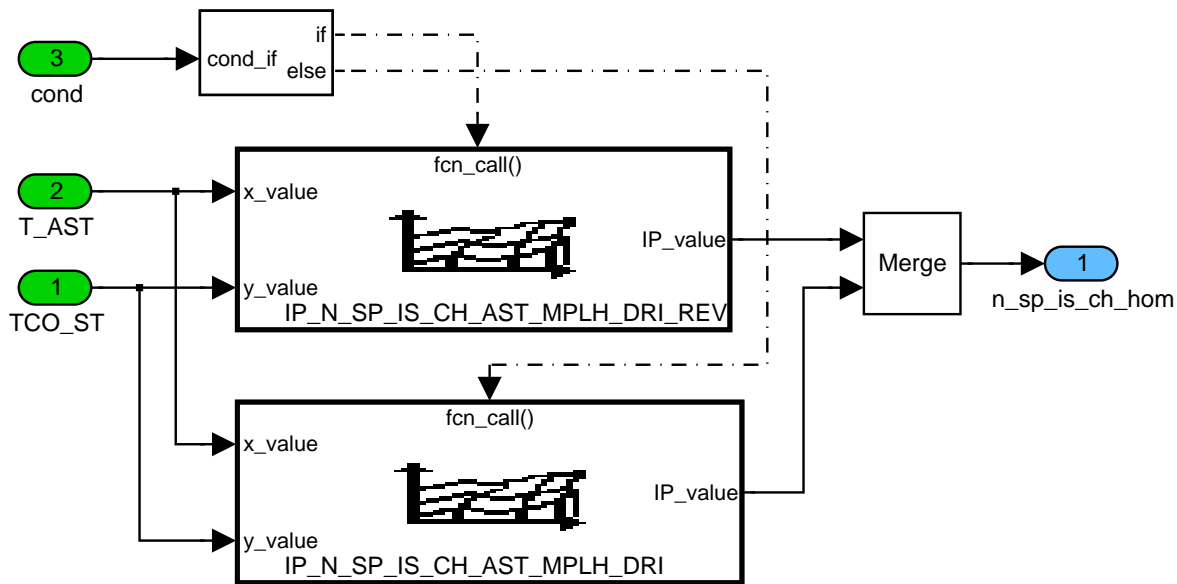


Figure 8.10.6: : Path:  
EXTC\_REQGNIS0/clc\_of\_N\_SP\_IS\_CH\_AST/operate/N\_SP\_DRI/clc\_n\_is\_mplh

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### 8.10.1.1.1.3 Calculation of N\_IS\_MPLP

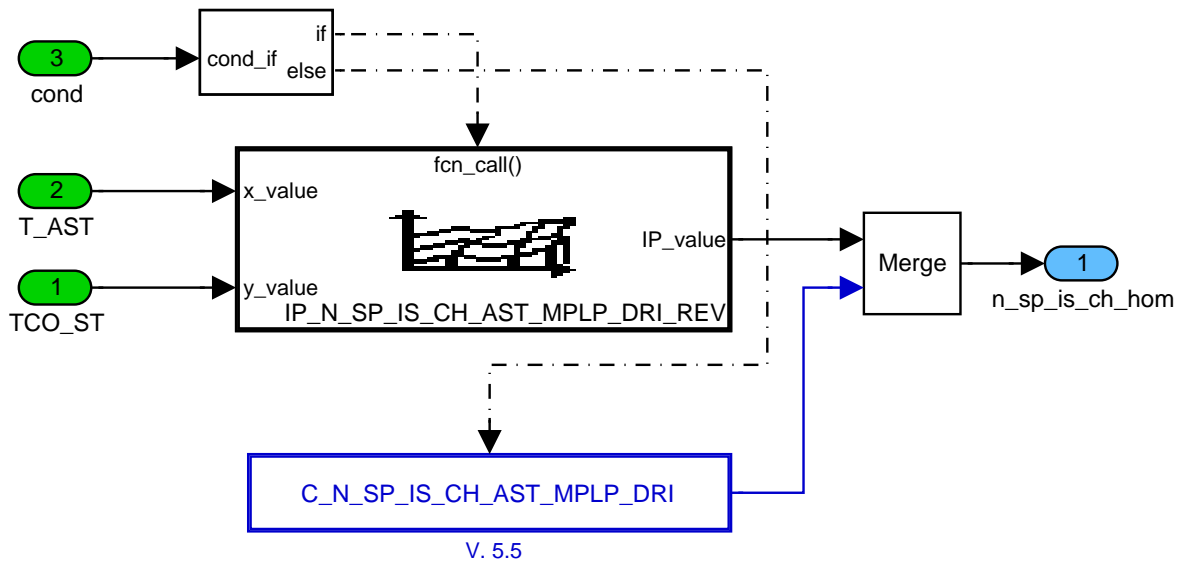


Figure 8.10.7: : Path: EXTC\_REQGNIS0/clc\_of\_N\_SP\_IS\_CH\_AST/operate/N\_SP\_DRI/clc\_n\_is\_mplp

### 8.10.1.1.2 Calculation of N\_SP\_IS\_CH\_AST

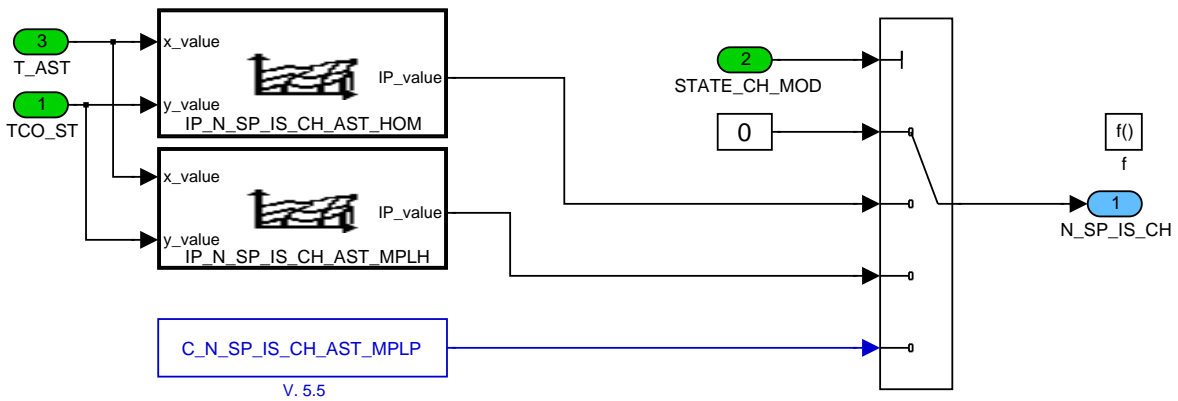


Figure 8.10.8: : Path: EXTC\_REQGNIS0/clc\_of\_N\_SP\_IS\_CH\_AST/operate/N\_SP\_NOT\_DRI


## 8.10.2 Low load catalyst heating

During low load catalyst heating there is no multiple injection in homogeneous mode.

### Application Conditions

### Function description

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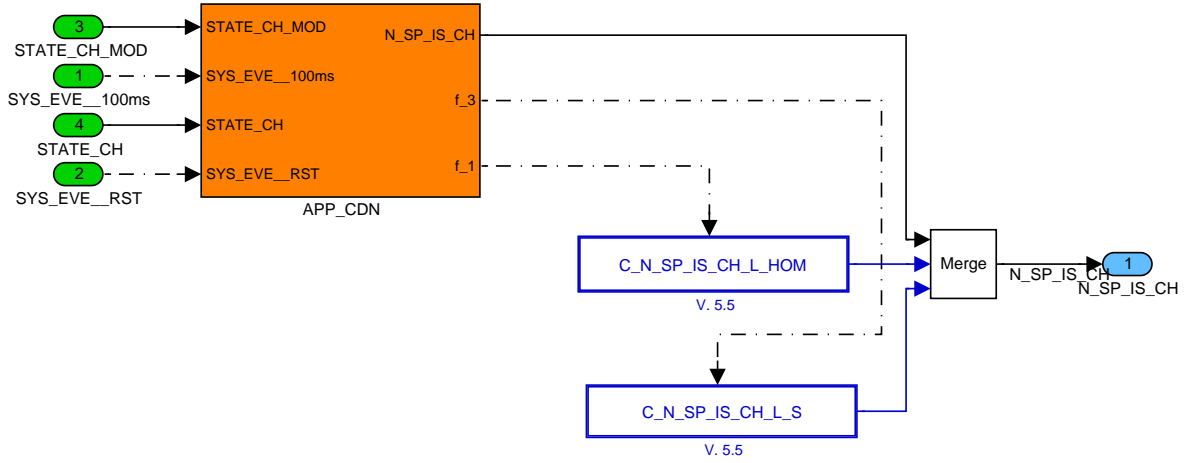




Figure 8.10.9: : Path: EXTC\_REQGNIS0/clc\_of\_N\_SP\_IS\_CH\_L

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# 9 - Auxiliary functions

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# 9.1 Actuator setpoint selection

**Data definition:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
OPG_SP_ACR	O/V	0... FFFH	0... 99.9756	0.02441	%
Setpoint request after limitation for actuator position control					
OPG_SP_SEL_ACR	V	0... FFFH	0... 99.9756	0.02441	%
Setpoint request after setpoint selection for actuator position control					

**Input data:**

LV_OPG_SP_AD_ACR {p. 4320}	LV_OPG_SP_EXT_ACR {p. 3576}	LV_OPG_SP_LIH_ACR {p. 3576}	LV_OPG_SP_POP_ACR {p. 3576}
OPG_SP_AD_ACR {p. 4320}	OPG_SP_EXT_ACR {p. 3576}	OPG_SP_LIH_ACR {p. 3576}	OPG_SP_POP_ACR {p. 3576}
OPG_SP_REQ_ACR {p. 8197}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_OPG_SP_MAX_ACR	-	0... FFFH	0... 99.9756	0.02441	%
Upper limitation threshold of the actuator position setpoint					
C_OPG_SP_MIN_ACR	-	0... FFFH	0... 99.9756	0.02441	%
Lower limitation threshold of the actuator position setpoint					

**General information**

This module describes the generation of the actuator valve position setpoint for closed - loop digital position control. All setpoint requests delivered from the remaining software system are gathered, coordinated and finally limited in the physical limits of the actuator valve. At the end of the module the position setpoint is provided for the digital position controller directly.

**Application Condition**

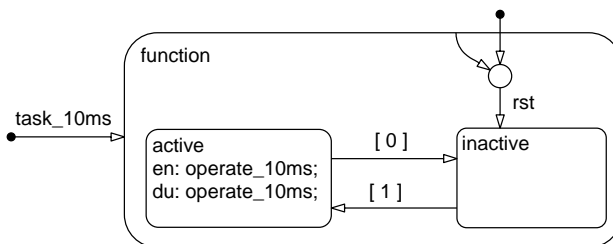


Figure 9.1.1: ACRC\_setpoint\_selection/APP\_CDN/APP\_CDN

**Function Description**

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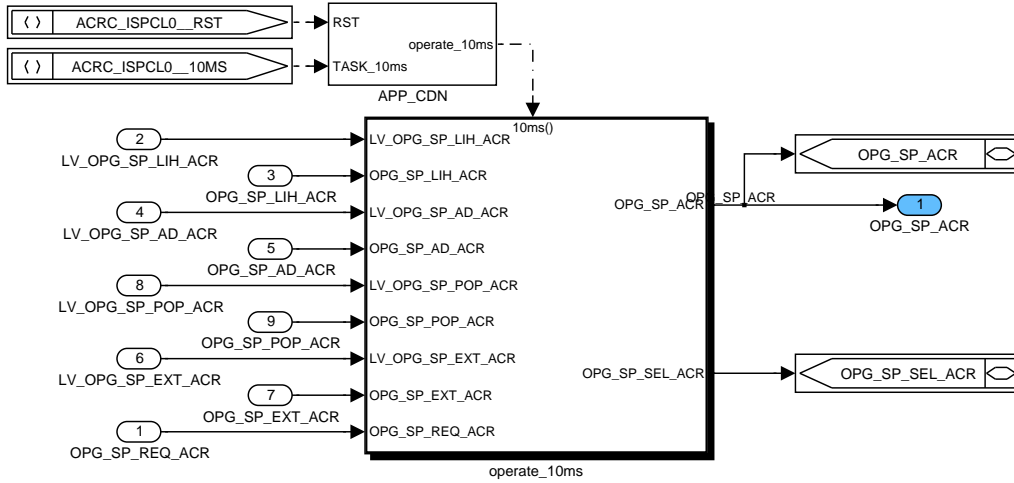


Figure 9.1.2: ACRC\_setpoint\_selection

### 9.1.1 ACRC setpoint functionality

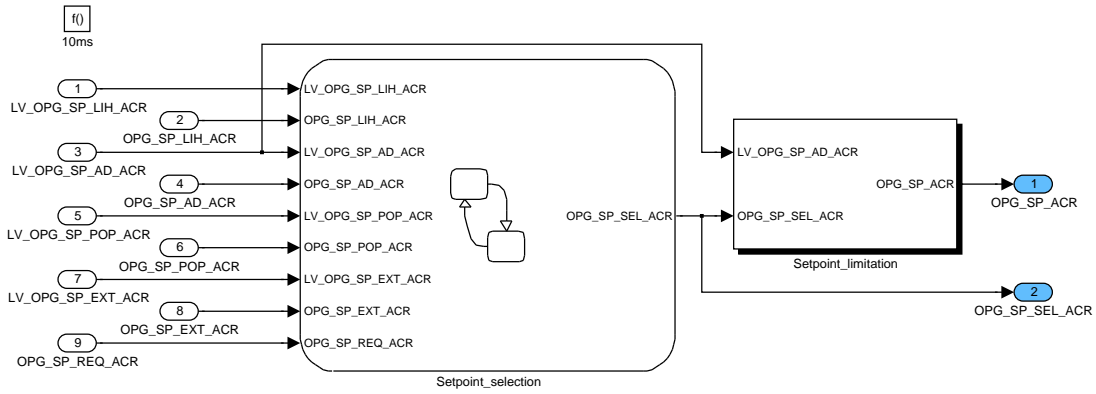


Figure 9.1.3: ACRC\_setpoint\_selection/operate\_10ms

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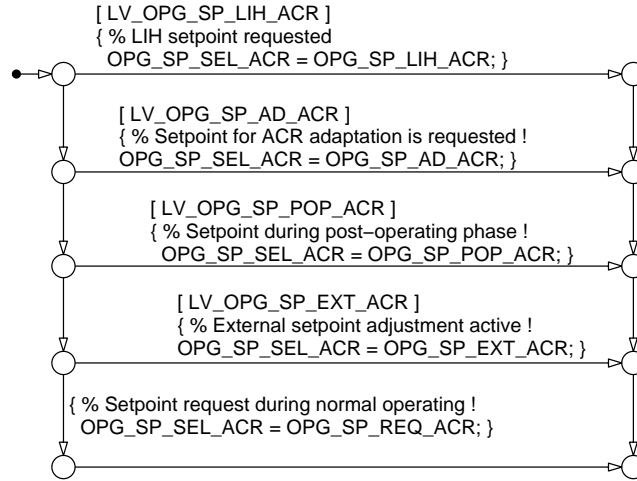


Figure 9.1.4: ACRC\_setpoint\_selection/operate\_10ms/Setpoint\_selection

Setpoint limitation

During the setpoint request from the actuator adaptation function the setpoint is not limited in increasing direction, the maximum value is 100 %.

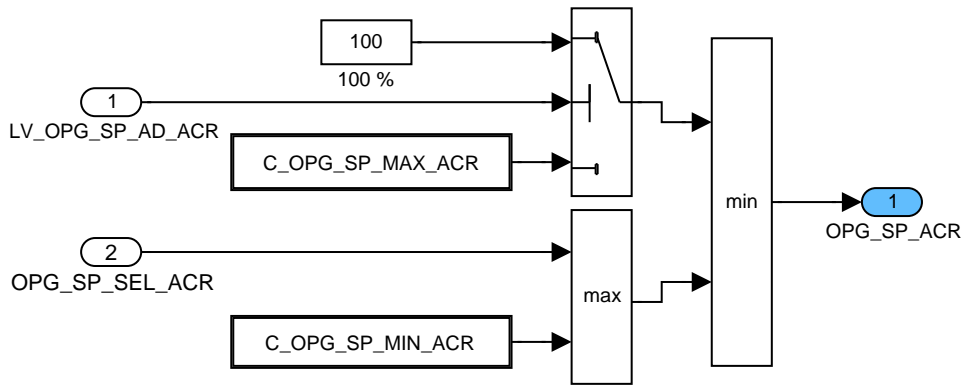


Figure 9.1.5: ACRC\_setpoint\_selection/operate\_10ms/Setpoint\_limitation

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## 9.2 Actuator setpoint selection (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_OPG_SP_EXT_ACR	O/V	0... 1H	0 ...1	1	-
Logical variable indicates a external setpoint request for actuator position control					
LV_OPG_SP_LIH_ACR	O/V	0... 1H	0 ...1	1	-
Logical variable indicates a LIH setpoint request for actuator position control					
LV_OPG_SP_POP_ACR	O/V	0... 1H	0 ...1	1	-
Logical variable indicates a setpoint request during the post operating phase for actuator position control					
OPG_SP_EXT_ACR	O/V	0... FFFH	0... 99.9755859	0.02441	%
External position setpoint for actuator position control					
OPG_SP_LIH_ACR	O/V	0... FFFH	0... 99.9755859	0.02441	%
Limp home position setpoint for actuator position control					
OPG_SP_POP_ACR	O/V	0... FFFH	0... 99.9755859	0.02441	%
Position setpoint during post operating phase for actuator position control					
STATE_ACR_CTL_REQ	O/V	0H 1H 2H	PWM_OFF PWM_STAT PWM_CTL	-	-
The state variable indicates the request for digital actuator control					

### Input data:


LV_ES {p. 1720}	LV_IGK {p. 906}	LV_INH_ACR_CTL_AD {p. 4320}	LV_OPG_SP_ACR_EXT_ADJ {p. 7434}
LV_OPG_SP_AD_ACR {p. 4320}	OPG_SP_ACR_EXT_ADJ {p. 7435}	OPG_SP_REQ_ACR {p. 8197}	STATE_ACR_CTL {p. 3587}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_DLY_ACR_CTL	-	0... FFH	0... 255	1	-
Time delay for the deactivation of the actuator position control					
C_CTR_OPG_SP_POP_ACR	-	0... FFH	0... 255	1	-
Delay counter for the deactivation of the position controller in the post operating phase					
C_OPG_SP_EXT_ACR	-	0... FFFH	0... 99.9755859	0.02441	%
External position setpoint requested from the calibration system					
C_OPG_SP_LIH_ACR	-	0... FFFH	0... 99.9755859	0.02441	%
Position setpoint request during limp home mode has been activated					
C_OPG_SP_MIN_ACR_CTL	-	0... FFFH	0... 99.9755859	0.02441	%
Deactivation threshold for actuator position control in normal operation					
C_OPG_SP_POP_ACR	-	0... FFFH	0... 99.9755859	0.02441	%
Position setpoint request in the post operating phase					
LC_OPG_SP_EXT_ACR	-	0... 1H	0 ...1	1	-
Activation of the external setpoint adjustment made with the calibration system					

### General information

The following module shall provide all remaining actuator valve position setpoint requests for all engine operating states. At the end of the function the power stage activation condition according to position setpoint request is calculated.

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### Application Condition

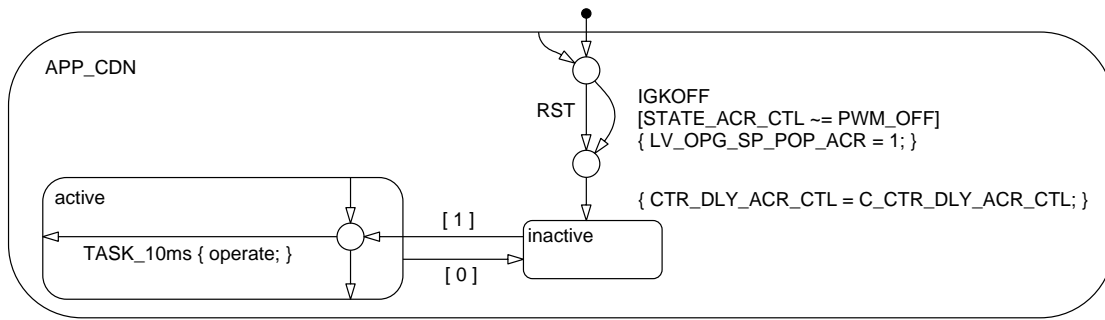


Figure 9.2.1: ACRC\_setpoint\_selection\_ai/APP\_CDN/APP\_CDN

### Function Description

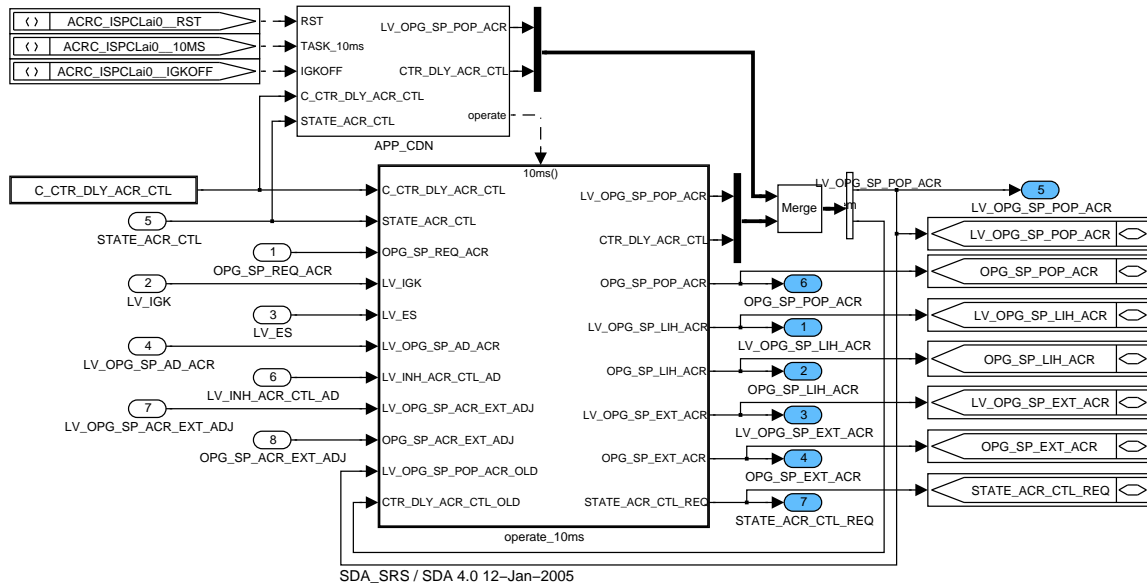


Figure 9.2.2: ACRC\_setpoint\_selection\_ai

### 9.2.1 Setpoint generation

The module defines the following setpoint requests: Limp home position setpoint request active with deactivated power stage, external position setpoint request made with the calibration system and the setpoint request setpoint during post operating phase after ignition off. During the post operating phase the setpoint is set to C\_OPG\_SP\_POP\_ACR and will be removed first after a defined calibration time.

At the end of the function the power stage activation request is performed. In normal operating the transition between active and passive closed loop control is calculated here. Closed loop control will be finished after a defined delay time and position setpoint requests lower than C\_OPG\_SP\_EXT\_ACR. With passive closed loop control it is possible to deactivate the power stage via disable line or to close the actuator valve with output of a constant PWM duty cycle. The decision will be done with the logical configuration constant LC\_PWM\_ACR\_OFF\_ENA !

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 3577 of 8404	
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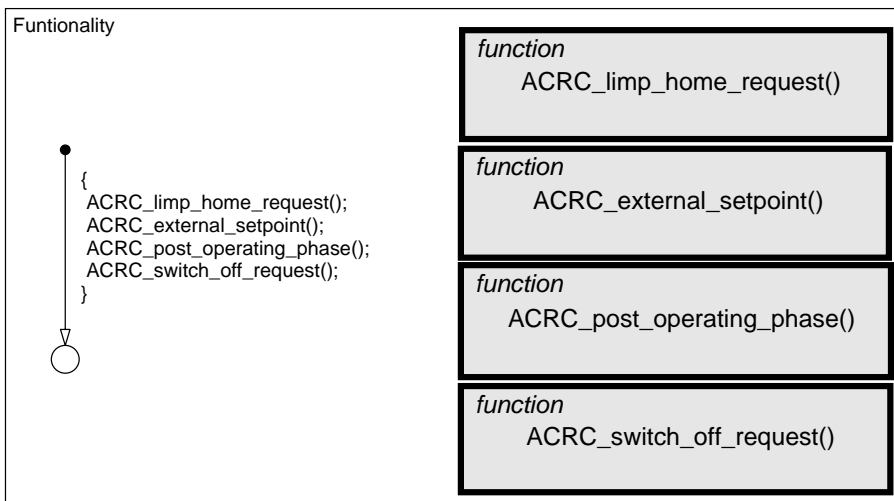


Figure 9.2.3: ACRC\_setpoint\_selection\_ai/operate\_10ms/Chart

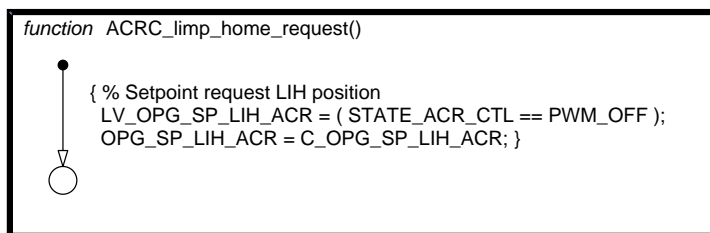


Figure 9.2.4:  
ACRC\_setpoint\_selection\_ai/operate\_10ms/Chart/Funtionality/ACRC\_limp\_home\_request

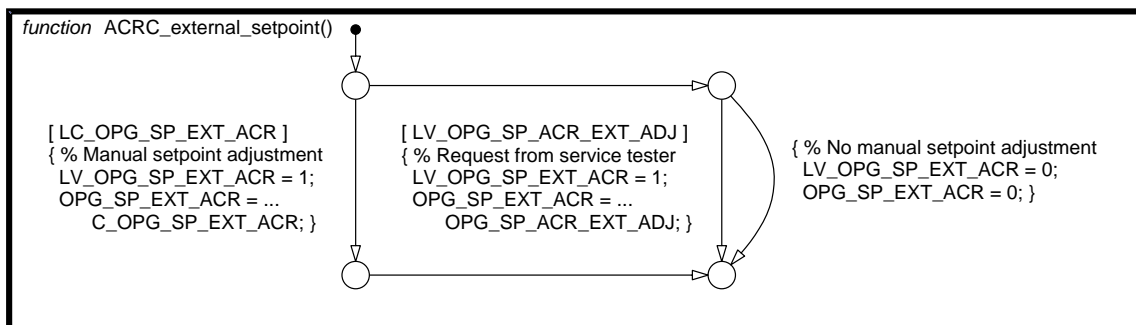


Figure 9.2.5: ACRC\_setpoint\_selection\_ai/operate\_10ms/Chart/Funtionality/ACRC\_external\_setpoint

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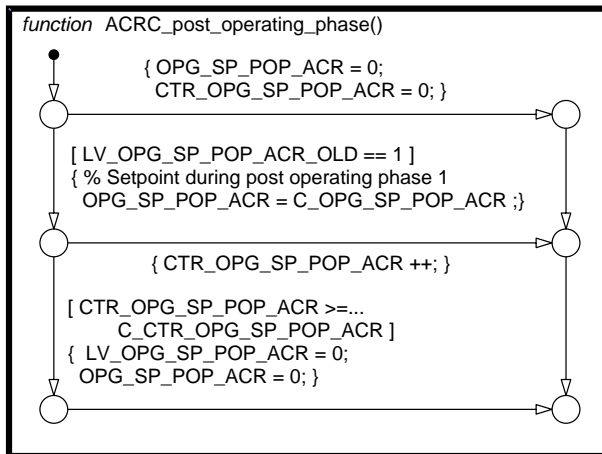


Figure 9.2.6: ACRC\_setpoint\_selection\_ai/operate\_10ms/Chart/Funtionality/ACRC\_post\_operating\_phase

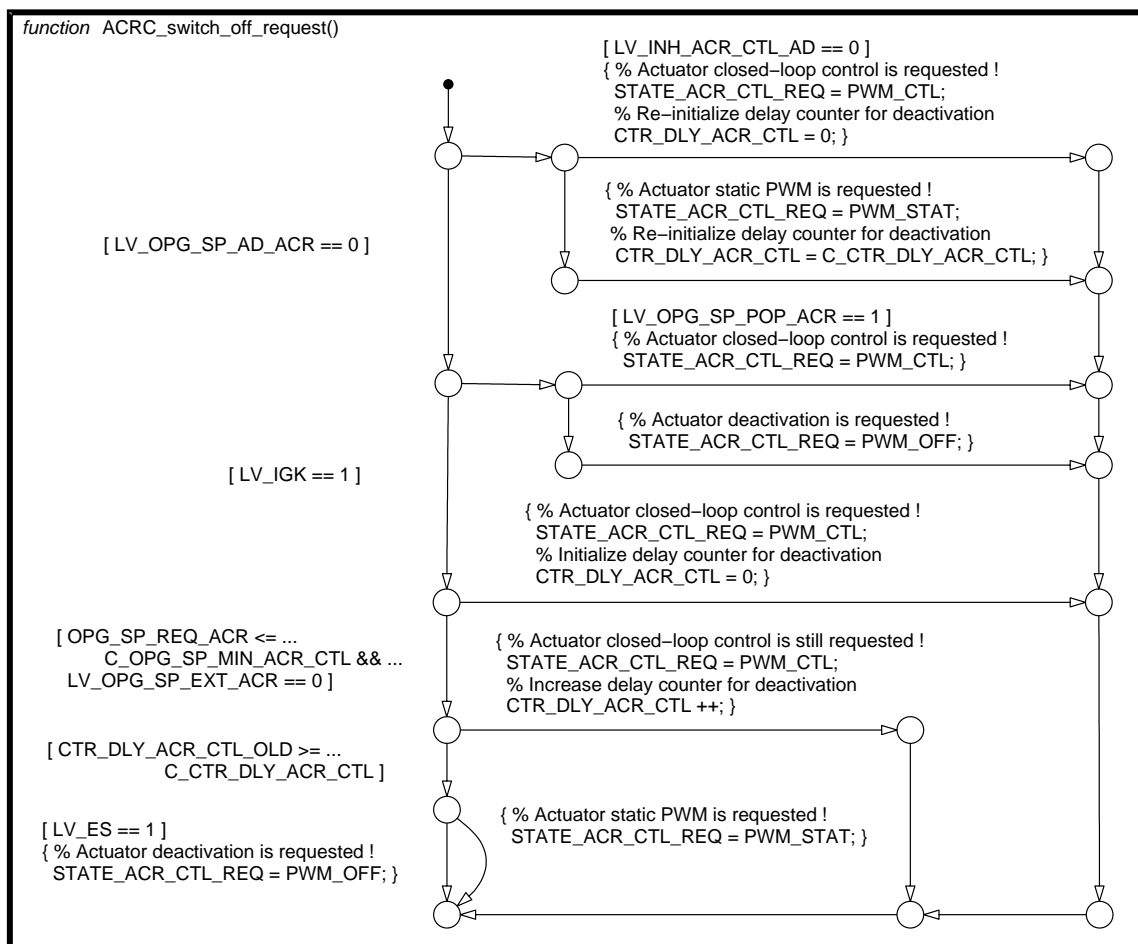


Figure 9.2.7: ACRC\_setpoint\_selection\_ai/operate\_10ms/Chart/Funtionality/ACRC\_switch\_off\_request

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## 9.3 Actuator position controller

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_VB_PWM_ACR	V	0... 800H	0 ...2	97.65599e3	-
Factor for battery voltage correction					
OPG_DIF_ACR	O/V	F000... FFFH	0... 99.9756	0.02441	%
Control deviation of the digital actuator control					
OPG_SP_CTL_ACR	V	0... FFFH	0... 99.9755859	0.02441	%
Setpoint after prefilter for digital actuator control					
PWM_ACR	O/V	8000... 7FFFH	0... 99.9969	0.003052	%
Finally duty cycle of digital actuator control					

### Input data:

LV_ACR_AD_ACT {p. 4333}	OPG_ACR {p. 1097}	OPG_SP_ACR {p. 3573}	STATE_ACR_CTL {p. 3587}
VB_MMV {p. 1185}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_C_1_ACR_CTL	-	8000... 7FFFH	0... 3.99987793	12.20699e3	-
Filter parameter c1 of the ACR position controller					
C_FAC_C_2_ACR_CTL	-	8000... 7FFFH	0... 3.99987793	12.20699e3	-
Filter parameter c2 of the ACR position controller					
C_FAC_C_3_ACR_CTL	-	8000... 7FFFH	0... 3.99987793	12.20699e3	-
Filter parameter c3 of the ACR position controller					
C_FAC_F_1_ACR_CTL	-	8000... 7FFFH	0... 3.99987793	12.20699e3	-
Filter parameter f1 of the ACR position controller					
C_FAC_F_2_ACR_CTL	-	8000... 7FFFH	0... 3.99987793	12.20699e3	-
Filter parameter f2 of the ACR position controller					
C_FAC_F_3_ACR_CTL	-	8000... 7FFFH	0... 3.99987793	12.20699e3	-
Filter parameter f3 of the ACR position controller					
C_FAC_K_FIL_ACR_CTL	-	0... FFFFH	0... 0.99998474	152.59e3	-
Pre filter amplification of the ACR position controller					
C_FAC_OPG_SP_ACR	-	0... FFH	0... 0.99609375	0.003906	-
Weigthing factor for setpoint rate limitation of the ACR position controller					
C_FRQ_PWM_ACR	-	0... FFFFH	0... 6553.5	0.1	Hz
Frequency of the PWM signal used for closed loop actuator control					
C_KP_ACR_CTL	-	0... 400H	0... 64	0.0625	-
Amplification factor of the ACR position controller					
C_PWM_ACR_CLOSE	-	8000... 7FFFH	0... 99.9969	0.003052	%
Static PWM duty cycle for the closing of the actuator					
C_PWM_MAX_ACR_AD	-	8000... 7FFFH	0... 99.9969	0.003052	%
Maximum value of the position controller output during actuator adaptation					
C_PWM_MAX_ACR_CTL	-	8000... 7FFFH	0... 99.9969	0.003052	%
Upper limitation threshold of the ACR position controller					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_PWM_MIN_ACR_CTL	-	8000... 7FFFH	0... 99.9969	0.003052	%
Lower limitation threshold of the ACR position controller					
C_RATE_OPG_SP_ACR	-	0... FFFH	0... 99.9755859	0.02441	%
Setpoint rate limitation threshold of the ACR position controller					
IP_FAC_VB_PWM_ACR	-	0... 800H	0 ...2	97.65599e3	-
LDP_VB_MMV_IP_FAC_VB_PWM_ACR	4	0... FFH	0... 25.8984375	0.1015625	V
Factor for battery voltage correction					
IP_PWM_ACR_STAT	-	0... FFFFH	0... 99.9969	0.003052	%
LDP_OPG_SP_ACR_IP_PWM_ACR_STAT	4	0... FFFH	0... 99.9755859	0.02441	%
Feedforward control of the ACR position controller					

### Import actions:

<b>ACTION_INFR_SetPwmDucyAcr</b> (IN<Pwm_acr>)
<b>ACTION_INFR_SetPwmFrqAcr</b> (IN<Frq_pwm_acr>)

### General information

This module describes the digital position controller used for the closedloop control of an electrical actuator. The position controller is carried out as a digital robust position controller. Calibration data are determined according to SiemensVDO internal position controller design algorithms. The controller algorithm is split in a 2 ms functionality for closedloop position control and a 10 ms functionality for static preload, battery voltage correction and position setpoint rate limitation.

### Application Condition

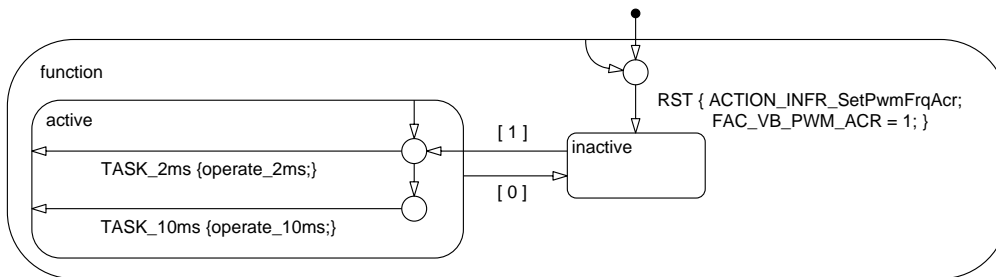


Figure 9.3.1: ACRC\_position\_controller/APP\_CDN/APP\_CDN

### Function Description

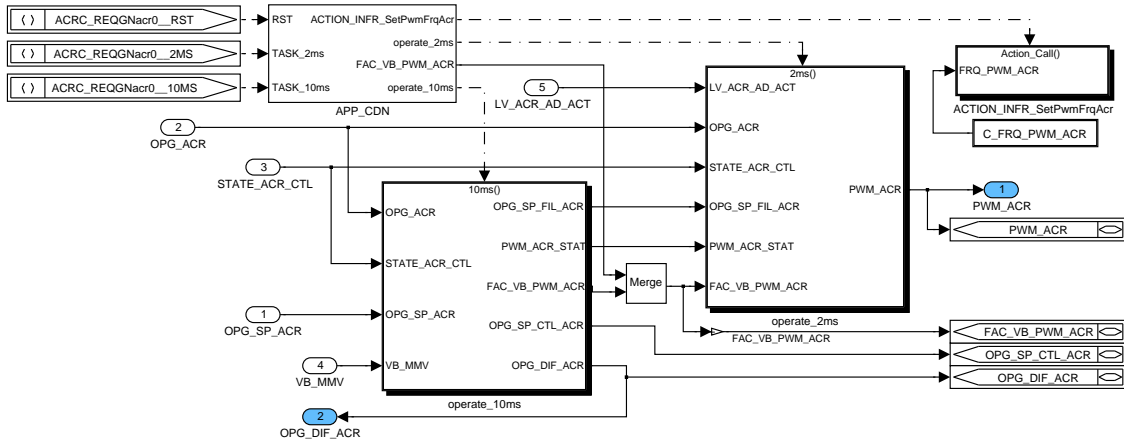


Figure 9.3.2: ACRC\_position\_controller

### 9.3.1 Functional part of 10ms

The 10 ms functionality of the position controller is only calculated if the closedloop position control has been requested. Closedloop position control will be indicated by the state PWM\_CTL (= 2) of the state variable STATE\_ACR\_CTL.

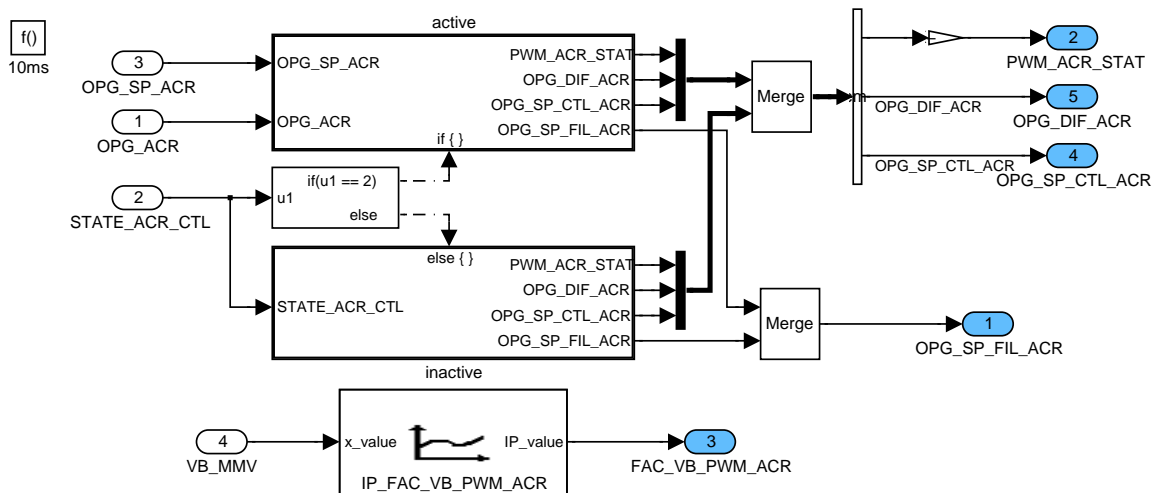


Figure 9.3.3: ACRC\_position\_controller/operate\_10ms

### ACR position controller

This function part contains the calculation of the battery correction factor, the static pre load of the position controller output and a final position setpoint filter function as a part of the closed loop position control. In the inactive state of the position control algorithm the battery voltage correction factor is set to 1, the static preload is set to C\_PWM\_ACR\_CLOSE and all other values are set to zero.

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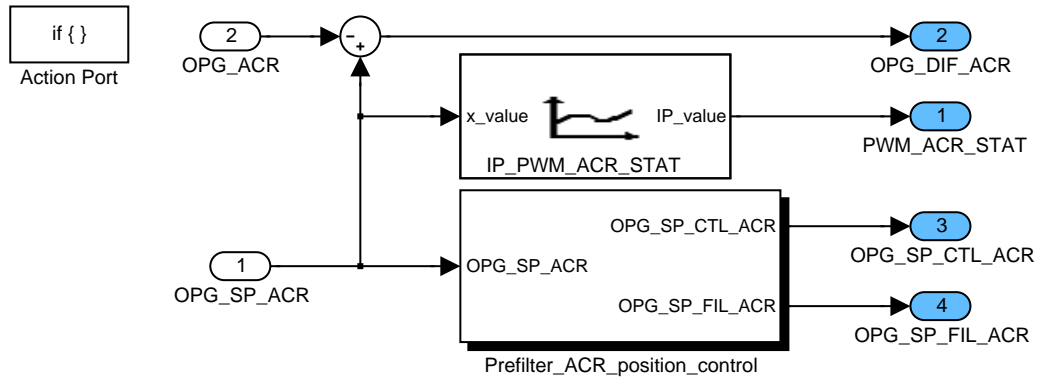


Figure 9.3.4: ACRC\_position\_controller/operate\_10ms/active

**Pre-filter functionality**

The position setpoint filter function consists of a rate limitation functionality and a weighting between the described setpoint rate limitation and the direct setpoint request. The weighting can be chosen by the calibration constant C\_FAC\_OPG\_SP\_ACR. Finally the setpoint request for the digital position controller is corrected by the static transfer amplification factor C\_FAC\_K\_FIL\_ACR\_CTL of the position controller filter function.

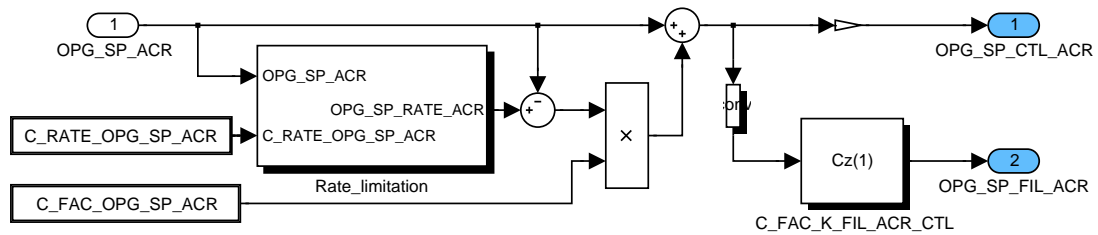


Figure 9.3.5: ACRC\_position\_controller/operate\_10ms/active/Prefilter\_ACR\_position\_control

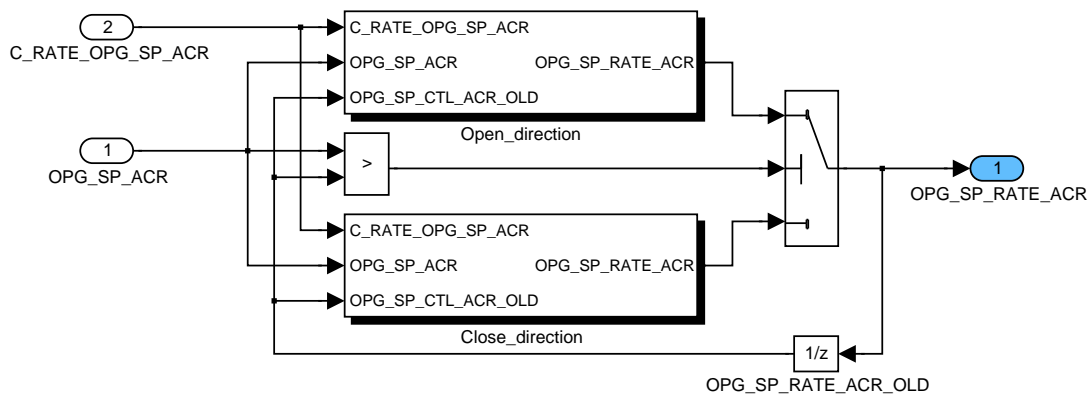


Figure 9.3.6:  
ACRC\_position\_controller/operate\_10ms/active/Prefilter\_ACR\_position\_control/Rate\_limitation

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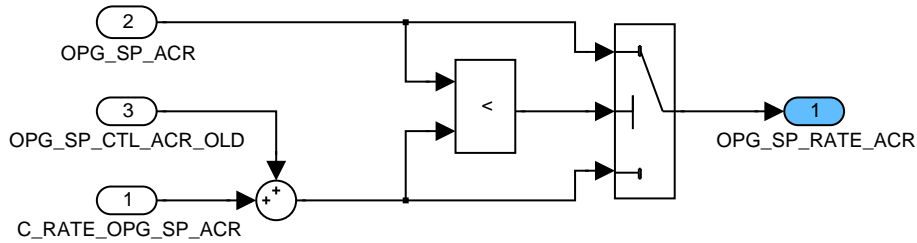


Figure 9.3.7: ACRC\_position\_controller/operate\_10ms/active/Prefilter\_ACR\_position\_control/Rate\_limitation/Open\_direction

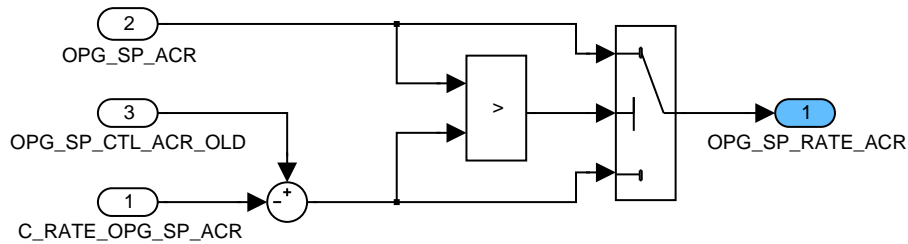
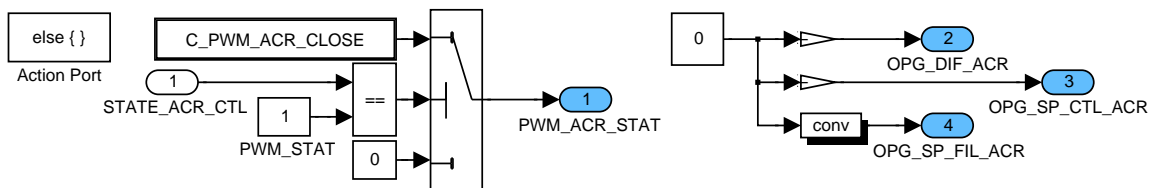


Figure 9.3.8: ACRC\_position\_controller/operate\_10ms/active/Prefilter\_ACR\_position\_control/Rate\_limitation/Close\_direction



**Note: The state variable OPG\_SP\_RATE\_ACR\_OLD from the active part is also set to zero !**

Figure 9.3.9: ACRC\_position\_controller/operate\_10ms/inactive

### 9.3.2 Functional part of 2ms

The 2 ms functionality of the position controller is only calculated if the closedloop position control has been requested. Closedloop position control will be indicated by the state PWM\_CTL (= 2) of the state variable STATE\_ACR\_CTL.

After the calculation of the position controller the static preload and the battery voltage correction are considered. Finally the PWM duty cycle of the position controller output will be limited between 100 % and 100 %.

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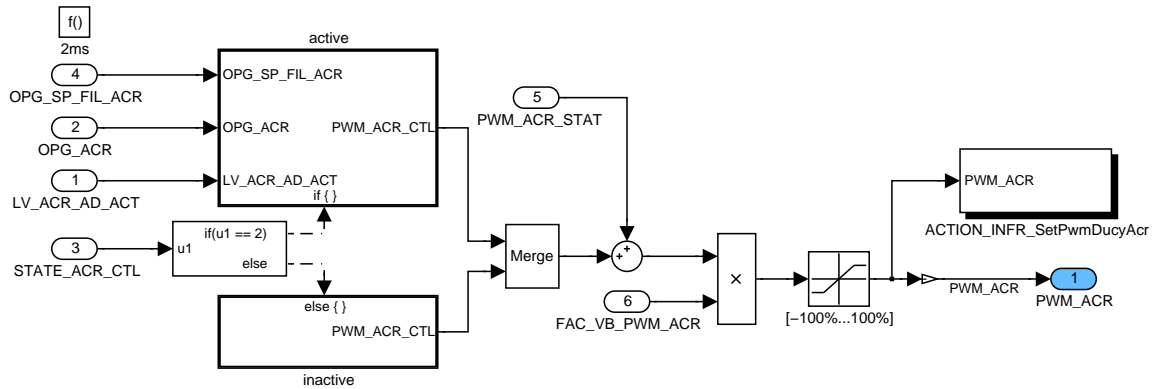
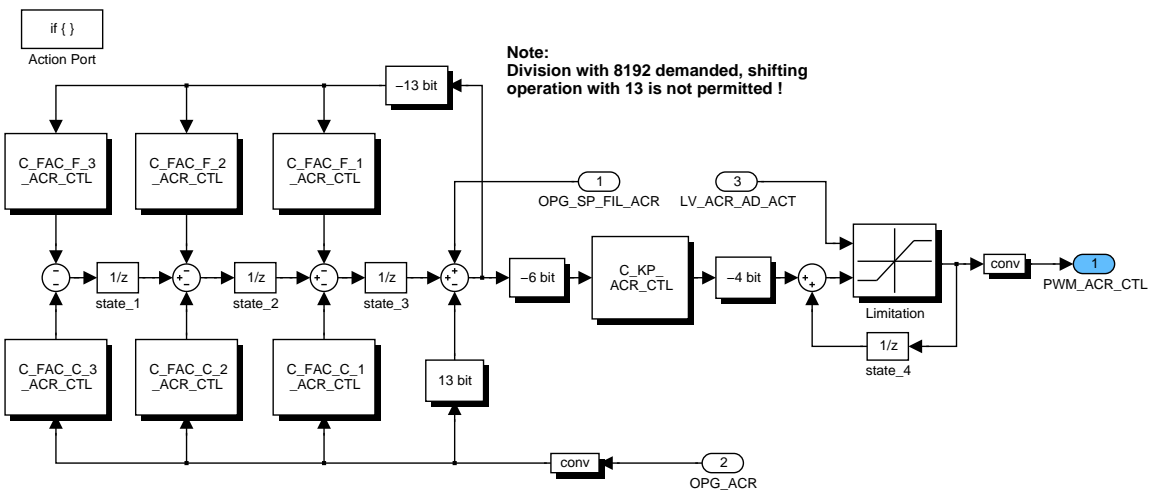


Figure 9.3.10: ACRC\_position\_controller/operate\_2ms

### ACR position controller

The position control algorithm is a robust digital position controller and based on the pole placement design. The position controller consists of a filter function third order in backwards direction and a amplification factor with integrated integrator in forward direction. The output of the integrator is limited between a lower and upper limitation threshold. In the inactive state of the controller algorithm all state variables (state\_x, x = 1...4) and the controller output are set to zero.

Calibration data are determined according to SiemensVDO internal position controller design algorithms.



$$PWM\_ACR = KP * z / (z - 1) * [ C(1) / F(1) * OPG\_SP\_ACR - C(z) / F(z) * OPG\_ACR ]$$

C\_FAC\_x\_y\_ACR\_CTL : HEX = 8000...7FFFH, DEC = -4...4, RES = 2<sup>n</sup>-13 = 1.2207e-4  
 C\_KP\_ACR\_CTL : HEX = 0...400H, DEC = 0...64, RES = 2<sup>n</sup>-4 = 0.0625

Figure 9.3.11: ACRC\_position\_controller/operate\_2ms/active

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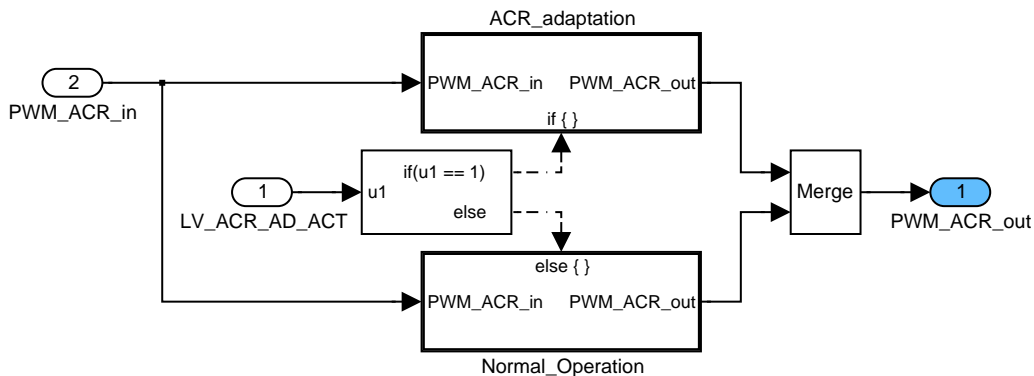


Figure 9.3.12: ACRC\_position\_controller/operate\_2ms/active/Limitation

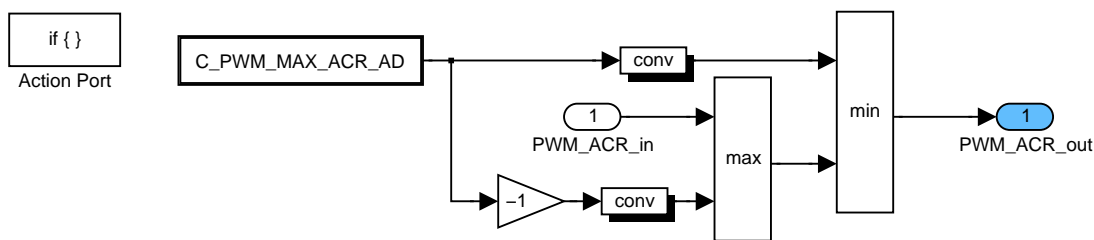


Figure 9.3.13: ACRC\_position\_controller/operate\_2ms/active/Limitation/ACR\_adaptation

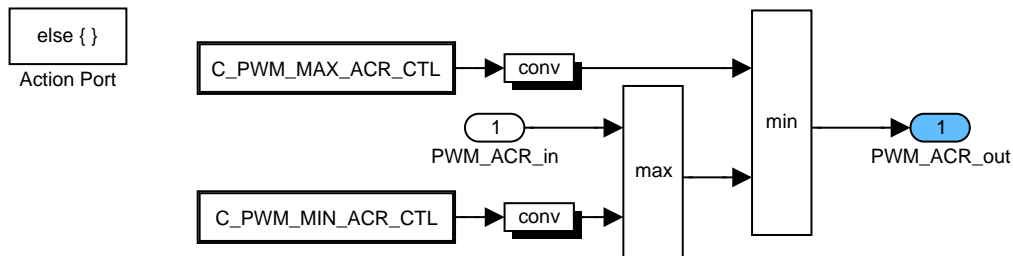
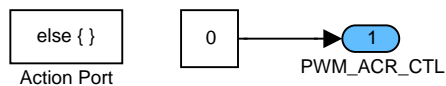


Figure 9.3.14: ACRC\_position\_controller/operate\_2ms/active/Limitation/Normal\_Operation



**Note: All state variables ( state\_1...4 ) from the ACR position controller are set to zero in the inactive state !**

Figure 9.3.15: ACRC\_position\_controller/operate\_2ms/inactive

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## 9.4 Actuator position controller (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_ACR_CTL	O/V	0H 1H 2H	PWM_OFF PWM_STAT PWM_CTL	-	-
The state variable indicates the state of the ACR position control					

### Input data:

LV_PWM_ACR_OFF_REQ {p. 4345}	STATE_ACR_CTL_REQ {p. 3576}		
---------------------------------	--------------------------------	--	--

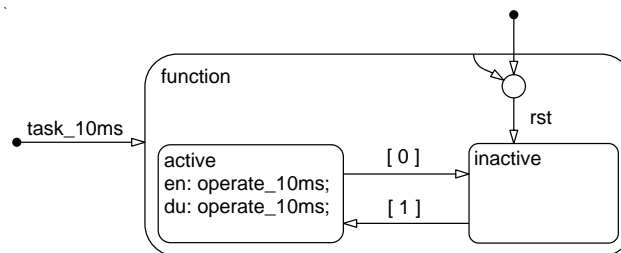
### Import actions:

ACTION_INFR_DisableAcrDr ()
ACTION_INFR_EnableAcrDr ()

### General information

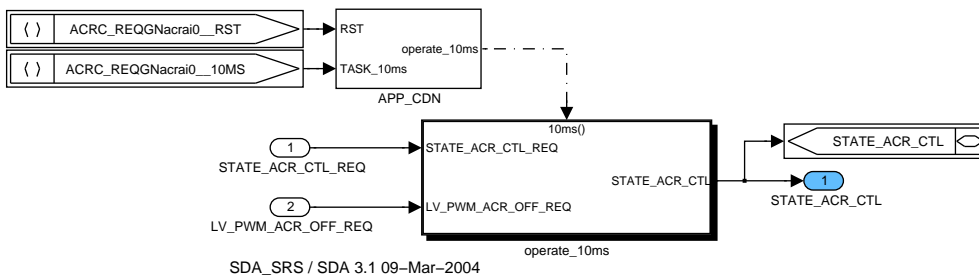
The propose of this module is to coordinate all states of closed - loop position control. The state variable STATE\_ACR\_CTL indicates the current state of the actuator systems. The operating can be divided in the power stage is deactivated via disable line, the actuator is controlled means of static PWM dutycycle for active valve closing and the closed - loop position control.

### Application Condition



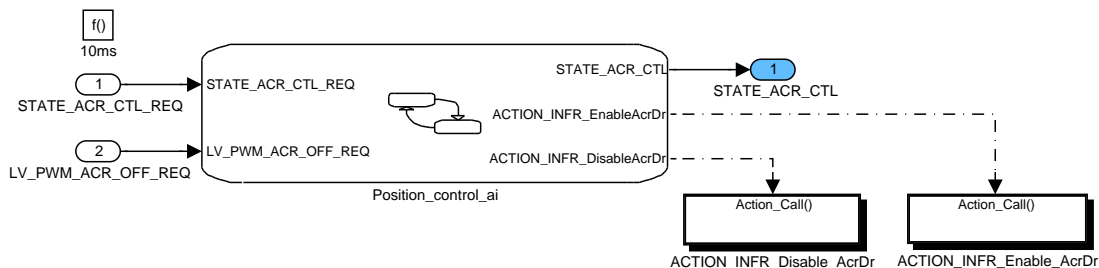
ACRC\_position\_controller\_ai/APP\_CDN/APP\_CDN

### Function Description

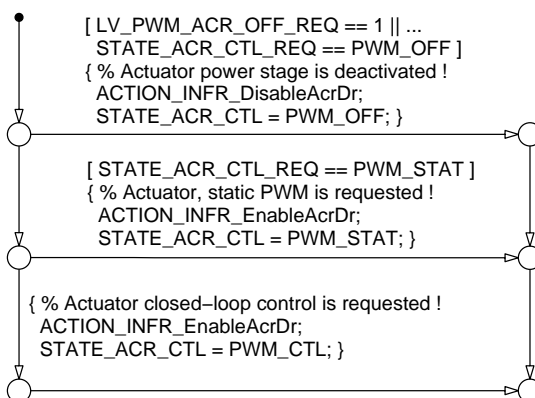


ACRC\_position\_controller\_ai

9.4.1 Power stage coordination



ACRC\_position\_controller\_ai/operate\_10ms



ACRC\_position\_controller\_ai/operate\_10ms/Position\_control\_ai

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## 9.5 Control of air conditioner compressor (AT/MT no difference)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ACCOUT_RLY	O/V	0... 1H	0 ...1	1	-
Air conditioning compressor clutch signal is enable					
LV_ACCOUT_RLY_ENA	O/V	0... 1H	0 ...1	1	-
LV indicating that the conditions for activating the ACC-relay are fulfilled					
LV_TOUT_ACC	O/V	0... 1H	0 ...1	1	-
logical variable to start deactivation of torque reserve and condition for switch off TQ_LOSS_ACC calculation					
T_ACC	O/V	0... FFFFH	0... 655.35	0.01	s
Timer for duration of transient TQ_LOSS_ACC correction					
T_ACC_DLY	O/V	0... FFH	0... 2.55	0.01	s
delay time for start of TQ_LOSS_ACC-calculation & de-/activation of the ACC-relay					

### Input data:

LV_ACCIN {p. 1564}	LV_ACCOUT_RLY_ENA {p. 3589}	LV_ACCOUT_RLY_EXT_ ADJ {p. 7431}	LV_ACT_ACCOUT_RLY_ EXT_ADJ {p. 7432}
LV_ERR_BN_ACC {p. 4869}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_TOUT_ICL_3 {p. 802}	LV_ES {p. 1720}
LV_ST {p. 1720}	LV_SUPP_ACCIN_ DIAGCPS {p. 5927}	LV_VAR_RLY_ACCOUT {p. 656}	N_32 {p. 1525}
PV_AV {p. 1269}	T_AST {p. 1766}	VS {p. 1176}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ACCIN_DLY_1	-	1... FFFFH	0.01... 655.35	0.01	s
Delay for ACC suppression in transition after full load					
C_ACCIN_DLY_1_LOCK_FL	-	1... FFFFH	0.01... 655.35	0.01	s
Blocking time for renewed triggering of the ACC suppression at high load					
C_ACCIN_DLY_4	-	1... FFFFH	0.1... 6553.5	0.1	s
Delay in transition from start					
C_ACCIN_DLY_5	-	1... FFFFH	0.01... 655.35	0.01	s
Delay before renewed reactivation of the ACC					
C_PVS_FL_ACCIN	-	0... FFH	0... 99.60937	0.390625	%
PV-threshold for ACC suppression					
C_T_TOUT_ACC	-	0... FFFFH	0... 655.35	0.01	s
calibration constant to start deactivation of ACC torque reserve					
C_VS_MAX_ACCIN	-	0... FFH	0... 255	1	km/h
Speed condition for ACC suppression at high load					
IP_T_ACC_DLY_OFF__N_32	-	0... FFH	0... 2.55	0.01	s
LDPM_N_32__T_ACC	3	0... FFH	0... 8160	32	rpm
Turn-Off-Delay for start of T_ACC depending on N_32					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_T_ACC_DLY_ON__N_32	-	0... FFH	0... 2.55	0.01	s
LDPM_N_32__T_ACC	3	0... FFH	0... 8160	32	rpm
Turn-On-Delay for start of T_ACC depending on N_32					

### Import actions:

<b>ACTION_INFR_SetACCOUT</b> (IN<lv_accout_rly>)
--

## 9.5.1 Enabling the activation of the ACC-relay

### FUNCTION DESCRIPTION:

#### General information:

The activation of the ACC-relay is controlled by the logical value LV\_ACCOUT\_RLY which is handled by this module. The A/C-ECU requests to switch the ACC-relay by LV\_ACCIN. Under certain conditions the activation will be suppressed (LV\_ACCOUT\_RLY\_ENA = 0). These conditions are


- engine stopped or start
- during time after transition from start
- during time after detecting high torque request when vehicle speed is low
- during time after last ACC-relay switch off
- CAN-Timeout (CAN11H) INSTR3-message: LV\_ERR\_TOUT\_ICL\_3
- CAN-Timeout (BN2000) IHKA-message: LV\_ERR\_BN\_ACC
- CAN-Busoff

*Activation* : at every engine operating state  
*Deactivation* : -  
*Initialization* : LV\_ACCOUT\_RLY\_ENA = 0 at reset  
*Update rate* : 10 ms

#### Formula section:

- a) If LV\_ES = 1 or LV\_ST = 1, then LV\_ACCOUT\_RLY\_ENA = 0  
b) If T\_AST C\_ACCIN\_DLY\_4 then LV\_ACCOUT\_RLY\_ENA = 0  
c) If PV\_AV becomes C\_PVS\_FL\_ACCIN when VS C\_VS\_MAX\_ACCIN  
**then** LV\_ACCOUT\_RLY\_ENA = 0 for the time C\_ACCIN\_DLY\_1 **and**  
a timer (C\_ACCIN\_DLY\_1\_LOCK\_FL) is started;  
a renewed triggering of ACC-suppression due to condition c) is not possible:
- during the time C\_ACCIN\_DLY\_1\_LOCK\_FL
  - if time C\_ACCIN\_DLY\_1\_LOCK\_FL has passed but the state FL has not been exited since last triggering due to c)
- d) If time after last ACC-relay switch off C\_ACCIN\_DLY\_5  
then LV\_ACCOUT\_RLY\_ENA = 0

This condition d) is not valid, if a blocking due to condition c) ends.

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
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- h) If LV\_ERR\_BN\_ACC = 1            then            LV\_ACCOUT\_RLY\_ENA = 0
- i) If LV\_ERR\_TOUT\_ICL\_3 = 1            then            LV\_ACCOUT\_RLY\_ENA = 0
- j) If LV\_ERR\_CAN\_BOFF = 1            then            LV\_ACCOUT\_RLY\_ENA = 0

In all other cases :                            LV\_ACCOUT\_RLY\_ENA = LV\_ACCIN

## 9.5.2 Turn-On-/Turn-Off-Delay ACC-relay

**Note:** The imported actions are defined in the HVAC - IRS (infrastructure requirement specification).

### FUNCTION DESCRIPTION:

#### General information:

If the enabling conditions for activating the ACC-relay are fulfilled (LV\_ACCOUT\_RLY\_ENA = 01) then the ACC-relay is activated (LV\_ACCOUT\_RLY = 01) via a turn-on-delay. The same way the ACC-relay is deactivated (LV\_ACCOUT\_RLY = 10) via a turn-off-delay if LV\_ACCOUT\_RLY\_ENA = 10.

If LV\_SUPP\_ACCIN\_DIAGCPS = 1 due to functional check CPS then the state of LV\_ACCOUT\_RLY is frozen.

For test purpose at assembling line or workshop the ACC-relay can be switched by a serial communication tool, if available (external adjustment). These switchings are done without the turn-on-delay, so the engine speed will show a clear reaction.

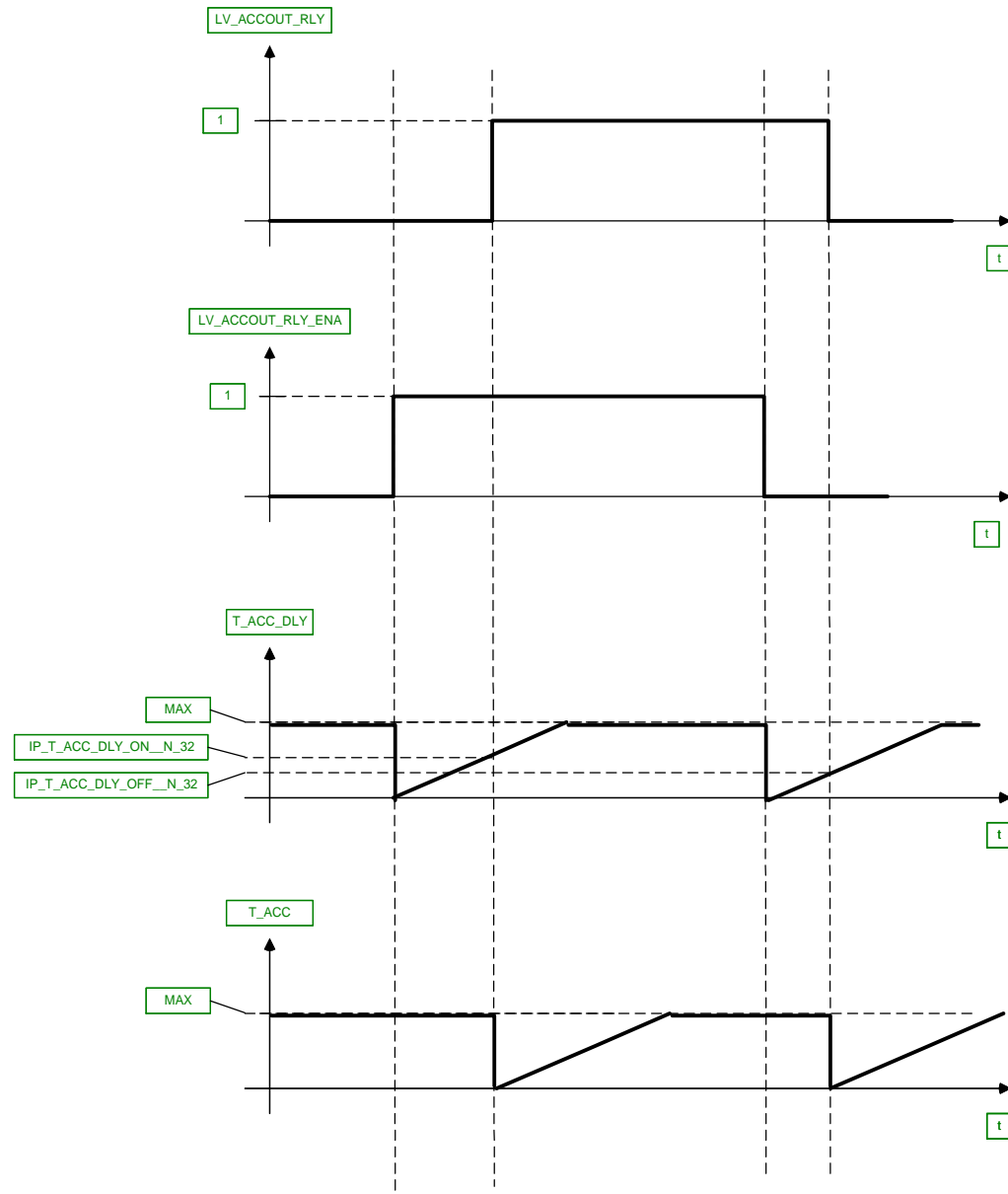
*Activation :*                                    at every engine operating state

*Deactivation :*                                -

*Initialization :*                            LV\_ACCOUT\_RLY = 0    at reset  
     LV\_TOUT\_ACC = 1  
     T\_ACC = FFFFH  
     T\_ACC\_DLY = FFH

*Update rate :*                                10 ms

#### Signal flow diagram:



Valid, if external adjustment is not active

**Formula section:**

Timer T\_ACC\_DLY:

```


IF LV_ACCOUT_RLY_ENAN <> LV_ACCOUT_RLY_ENAN-1
THEN T_ACC_DLY = 0
ELSE IF T_ACC_DLY < FFH
THEN T_ACC_DLY = T_ACC_DLY + 10 ms
ENDIF
ENDIF
    
```

Turn-on-delay:

```

IF LV_ACCOUT_RLY_ENA = 1 AND
T_ACC_DLY = IP_T_ACC_DLY_ON_N_32
    
```

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```

THEN      LV_ACCOUT_RLY = 1
ENDIF

```

Turn-off-delay:

```

IF          LV_ACCOUT_RLY_ENA = 0          AND
            T_ACC_DLY = IP_T_ACC_DLY_OFF__N_32
THEN      LV_ACCOUT_RLY = 0
ENDIF

```

T\_ACC for ramping torque loss:

```

IF          LV_ACCOUT_RLY_N <> LV_ACCOUT_RLY_{N-1}
THEN      T_ACC = 0
            LV_TOUT_ACC = 0
ELSE     IF      T_ACC < FFFFH
THEN      T_ACC = T_ACC + 10ms
ENDIF
IF      T_ACC < C_T_TOUT_ACC
THEN     LV_TOUT_ACC = 0
ELSE     LV_TOUT_ACC = 1
ENDIF
ENDIF

```

Freezing the state of LV\_ACCOUT\_RLY due to activation of DIAGCPS:

```

if          LV_SUPP_ACCIN_DIAGCPS = 1,
then       the status of LV_ACCOUT_RLY is frozen
until     LV_SUPP_ACCIN_DIAGCPS = 0

```

LV\_ACCOUT\_RLY during external adjustment:

```

if          LV_ACCOUT_RLY_EXT_ADJ = 1
then       LV_ACCOUT_RLY = LV_ACT_ACCOUT_RLY_EXT_ADJ
else       LV_ACCOUT_RLY determined as described before (external adjustment passive)
endif

```

```

If LV_VAR_RLY_ACCOUT = 1
then
After LV_ACCOUT_RLY calculation,
ACTION_INFR_SetACCOUT(IN < LV_ACCOUT_RLY >)

```

## 9.6 Engine cooling system control

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_RAS	V	0... 1H	0 ...1	1	-
Bit used to determine if the radiator shutter should be open or closed (1 = shutter open, power off for the magnetic clamp; 0 = shutter closed, power on for the magnetic clamp)					
LV_RAS_OUT	O/V	0... 1H	0 ...1	1	-
Bit that is sent to the PIN that controls the magnetic clamp for the radiator shutter					

### Input data:

LV_ACT_RAS_EXT_ADJ {p. 7432}	LV_ECRAS_UP {p. 8225}	LV_RAS_EXT_ADJ {p. 7434}	
---------------------------------	-----------------------	-----------------------------	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_RAS_ACT	-	0... 1H	0 ...1	1	-
Manual switch to activate or deactivate the functionality for the Radiator Shutter (RAS)					

### Import actions:

ACTION_INFR_SetRas (IN<Lv_ras_out>)
-------------------------------------

### FUNCTION DESCRIPTION:

#### Description:

This module contains the functionality for the control of the radiator shutter via a magnetic clamp. The output LV\_RAS\_OUT is sent to the PIN that controls the magnetic clamp for the radiator shutter.

#### Application conditions

**Initialisation:** *at reset all 0*

**Recurrence:** *100 ms*

**Activation:** *LC\_RAS\_ACT = 1*

**Deactivation:** *LC\_RAS\_ACT = 0*

#### Formula section:

```

if          LV_ECRAS_UP = 1
then       LV_RAS = 1
else       LV_RAS = 0
endif

```

```

if          LV_RAS_EXT_ADJ = 1

```

```


then           LV_RAS_OUT = LV_ACT_RAS_EXT_ADJ
else           LV_RAS_OUT = LV_RAS
endif

```

```

ACTION_INFR_SetRas(LV_RAS_OUT)

```

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## 9.7 Cooling and condenser fan control

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ECFPWM [NC_ECF_NR]	O/V	0... FFH	0... 99.60937	0.390625	%
Pulse width modulated output signal for the electronic controlled cooling fan(s)					
ECFPWM_IGK_OFF	O/V	0... FFH	0... 99.60937	0.390625	%
Electric fan pulse width modulation in the self-holding phase					
T_N_PERC_ECF_ACT	V	0... FFH	0... 51	0.2	s
Time condition for electric fan during self diagnostic					

### Input data:

ECFPWM_ECF_EXT_ADJ {p. 7431}	ECU_STATE {p. 1091}	LV_ECFPWM_ECF_EXT_ADJ {p. 7433}	LV_ERR_ECF [NC_ECF_NR] {p. 3861}
LV_IGK {p. 906}	N_PERC_ECF {p. 8225}	NC_ECF_NR {p. 576}	T_PWL {p. 3776}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ECFPWM_ACT_ECF	-	0... FFH	0... 99.60937	0.390625	%
Min limitation ECFPWM_ECF from speed stage C_N_PERC_ACT_ECF					
C_ECFPWM_ECF_MAN	-	0... FFH	0... 99.60937	0.390625	%
Setpoint of ECFPWM_ECF; manual control					
C_N_PERC_ACT_ECF	-	0... FFH	0... 99.60937	0.390625	%
Set value for N_PERC_ECF					
C_T_ECFPWM_PWL	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time ECFPWM is sent at PWL					
C_T_N_PERC_ECF_ACT	-	0... FFH	0... 51	0.2	s
Time duration for electric fan during self diagnosis					
LC_ECFPWM_ECF_MAN	-	0... 1H	0 ...1	1	-
Constant to switch to manual ECFPWM_ECF activation					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ECFPWM_ECF_SUB_DIAG	-	0... FFH	0... 99.60937	0.390625	%
Configuration constant for ECFPWM in case of active failure					


### 9.7.1 Control of ECFPWM[NC\_ECF\_NR] with ignition key on

#### FUNCTION DESCRIPTION:

#### General information:

The electric fan is controlled with a 100 Hz PWM signal to regulate its rotational speed. The calculated pulse width modulation depends on various components which are handled by the BMW "Wärmemanagementkoordinator".

#### Application conditions

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**Initialisation:**           all = 0 at reset  
                                  T\_N\_PERC\_ECF\_ACT = C\_T\_N\_PERC\_ECF\_ACT

**Recurrence:**             200ms

**Activation:**             LV\_IGK = 1

(see: "ENTE scheduler")

### 9.7.1.1 Calculation of PWM-signal for the electric cooling fan

#### Description:

All calculations which are necessary for the computation of the overall cooling fan speed are done by the BMW "Wärmemanagementkoordinator". Via layer BMW hands over the final cooling fan speed N\_PERC\_ECF which is already standardized to percentage.

Self-diagnosis runs each time the electric fan is switched on. The electric fan should be operated with constant, low speed stage for this.

```

If            N_PERC_ECF > C_N_PERC_ACT_ECF and
                  T_N_PERC_ECF_ACT > 0 sec.
Then        T_N_PERC_ECF_ACT is decremented
              ECFPWM[0] = C_N_PERC_ACT_ECF
Else        ECFPWM[0] = N_PERC_ECF
Endif
    
```

#### Formula section:

```

if (1)        LV_ERR_ECF[0] = 1
then (1)     ECFPWM[0] = NC_ECFPWM_ECF_SUB_DIAG
else (1)
              if (2)        LV_ECFPWM_ECF_EXT_ADJ = 1
              then (2)     ECFPWM[0] = ECFPWM_ECF_EXT_ADJ
              else (2)
                  if (3)        LC_ECFPWM_ECF_MAN = 1
                  then (3)     ECFPWM[0] = C_ECFPWM_ECF_MAN
                  endif (3)
              endif (2)
              endif (1)
    
```


Default-value for NC\_ECFPWM\_ECF\_SUB\_DIAG = 2.37%

### 9.7.2 Control with ignition key off up to detection of ES and in the self-holding phase

#### General information:

With ignition key off until ES and in the self-holding phase of the control unit, the control frequency is switched over to 10Hz and a pulse width modulation ECFPWM\_IGK\_OFF is set. The power latch time is defined in Chapter Basic Software Inputs and Outputs.


#### Application conditions

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```

Recurrence:           100 ms
Activation:         ECU_STATE = PWL
                        If          T_PWL < C_T_ECFPWM_PWL
then                 ECFPWM_IGK_OFF = N_PERC_ECF
                        else        ECFPWM_IGK_OFF = 0
endif

```

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## 9.8 Exhaust gas recirculation (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ACR_CTL_ENA	O/V	0... 1H	0 ...1	1	-
Logical variable for the release of ACR valve digital position control					

### Input data:

LV_ERR_ACR_AD {p. 4320}	LV_ERR_ACR_CTL {p. 4337}	LV_ERR_ACR_DR {p. 4347}	LV_ERR_KNKS [NC_NR_SENS_KNK] {p. 4903}
LV_ERR_LOAD_TPS_ PLAUS {p. 1062}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP {p. 982}	LV_ERR_MAP_DIP_SHIFT {p. 4824}
LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}
LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_BOL {p. 4951}
LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_TPS_ST_CHK_2 {p. 4951}
LV_FL {p. 1759}	LV_IS {p. 1720}	LV_PL {p. 1720}	LV_PWM_ACR_OFF_REQ {p. 4345}
N {p. 1525}	T_AST {p. 1766}	TCO {p. 1100}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_AST_EGR	-	0... FFFFH	0... 6553.5	0.1	s
Time delay for EGR active after start					
C_TCO_MIN_EGR	-	0... FEH	-48... 142.5	0.75	°C
Minimum temperature for EGR-control active					
LC_ACR_CTL_ENA	-	0... 1H	0 ...1	1	-
Logical constant for the activation of actuator position control					

### General information:

The EGR-Control is activated (LV\_ACR\_CTL\_ENA = 1), if the coolant temperature TCO is higher than a threshold value C\_TCO\_MIN\_EGR and the engine is running at part load or idle speed (LV\_FL=0). If idle speed is detected the EGR-function is activated after the time  $T\_AST > C\_T\_AST\_EGR$ .

### Application conditions


<b>Initialisation:</b>	<i>at RST set LV_ACR_CTL_ENA to zero !</i>
<b>Recurrence:</b>	<i>20ms</i>
<b>Activation:</b>	<i>at all engine operating states</i>
<b>Deactivation:</b>	<i>no deactivation</i>

**Formula section:**

```

if      TCO > C_TCO_MIN_EGR                and
          LV_ERR_MAF == 0                    and
          LV_ERR_MAP == 0                    and
          LV_ERR_KNKS_i == 0                 and
          LV_FL == 0                          and
          LV_PWM_ACR_OFF_REQ == 0            and
          LV_ERR_MAP_DIP_SHIFT == 0         and
          LV_ERR_TPS_1 == 0                  and
          LV_ERR_TPS_2 == 0                  and
          LV_ERR_TPS_RATIO == 0             and
          LV_ERR_TPS_AD == 0                 and
          LV_ERR_TPS_AD_BOL == 0            and
          LV_ERR_TPS_MAF_1 == 0             and
          LV_ERR_TPS_MAF_2 == 0             and
          LV_ERR_TPS_ST_CHK_2 == 0          and
          LV_ERR_LOAD_TPS_PLAUS == 0        and
          LV_ERR_MTC_CTL_2 == 0             and
          LV_ERR_MTC_CTL_3 == 0            and
          LV_ERR_MTC_DR == 0
          and
          LV_ERR_ACR_AD == 0
          and
          LV_ERR_ACR_CTL == 0
          and
          LV_ERR_ACR_DR == 0
          and
          LV_ERR_MAP_TPS_PLAUS == 0
          and
          [ (LV_IS == 1 and T_AST > C_T_AST_EGR) or LV_PL==1 ] or
          LC_ACR_CTL_ENA == 1
then   LV_ACR_CTL_ENA = 1
else   LV_ACR_CTL_ENA = 0
endif

```

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## 9.9 Camshaft setpoint for catalyst heating

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CAM_SP_CH_EX	O/V	8000... 7FFFH	-768... 767.9765625	0.0234375	°CRK
Camshaft position setpoint during cat heating; exhaust					
CAM_SP_CH_IN	O/V	8000... 7FFFH	-768... 767.9765625	0.0234375	°CRK
Camshaft position setpoint during cat heating; inlet					
FAC_EFF_IGA_CH_SP	O/V	0... FFH	0... 0.99609375	3.90625e-3	-
Setpoint of factor for fading ignition angle efficiency in case of catalyst heating					
STATE_OPM_IVVT_CH	O/V	0... 2H	0 ...2	1	-
IVVT - strategy request; 0 = no request ; 1 = engine roughness-optimal ; 2 = emission-optimal					

### Input data:

FAC_CAM_CH {p. 8379}	FAC_EFF_IGA_CH {p. 8379}	FAC_MAF_REL_EGR_ COR {p. 8232}	LV_IS {p. 1720}
LV_SO2P_LAMB_PULS {p. 3129}	N {p. 1525}	STATE_CH {p. 1777}	STATE_CH_MOD {p. 1796}
STATE_CH_MOD_REQ {p. 1796}	T_AST {p. 1766}	TCO {p. 1100}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_OPM_IVVT_CH_L	-	0... 2H	0 ...2	1	-
IVVT - strategy request for low load catalyst heating					
ID_STATE_OPM_IVVT_CH_HOM_SO2P	V	0... 2H	0 ...2	1	-
LDP_N_ID_OPM_IVVT_CH_HOM_SO2P	6	0... 1FE0H	0... 8160	1	rpm
LDP_FAC_MAF_EGR_ID_CH_HOM_SO2P	6	0... BB8H	0... 300	0.1	%
IVVT - strategy request for catalyst heating for desulfation					
ID_STATE_OPM_IVVT_CH_MPLH_SO2P	V	1... 2H	1 ...2	1	-
LDP_N_ID_OPM_IVVT_CH_MPLH_SO2P	6	0... 1FE0H	0... 8160	1	rpm
LDP_FAC_MAF_EGR_ID_CH_MPLH_SO2P	6	0... BB8H	0... 300	0.1	%
IVVT - strategy request for catalyst heating for desulfation, multiple injection					
IP_CAM_CH_COLD_EX	V	0... FFH	-40... -135.625	-0.375	°CRK
LDPM_N_2_EXTC	10	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_2_EXTC	10	0... BB8H	0... 300	0.1	%
Outlet camshaft setpoint for catalyst heating					
IP_CAM_CH_COLD_EX_IS	V	0... FFH	-40... -135.625	-0.375	°CRK
LDPM_N_4_EXTC	8	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_4_EXTC	10	0... BB8H	0... 300	0.1	%
Outlet camshaft setpoint for catalyst heating in idle					
IP_CAM_CH_COLD_IN	V	0... FFH	60... 155.625	0.375	°CRK
LDPM_N_2_EXTC	10	0... 1FE0H	0... 8160	1	rpm

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_FAC_MAF_REL_EGR_COR_2_EXTC	10	0... BB8H	0... 300	0.1	%
Inlet camshaft setpoint for catalyst heating					
IP_CAM_CH_COLD_IN_IS	V	0... FFH	60... 155.625	0.375	°CRK
LDPM_N_4_EXTC	8	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_4_EXTC	10	0... BB8H	0... 300	0.1	%
Inlet camshaft setpoint for catalyst heating in idle					
IP_CAM_CH_HOM_HOT_EX	V	0... FFH	-40... -135.625	-0.375	°CRK
LDPM_N_1_EXTC	16	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_1_EXTC	10	0... BB8H	0... 300	0.1	%
Outlet camshaft setpoint for catalyst heating with single injection					
IP_CAM_CH_HOM_HOT_EX_IS	V	0... FFH	-40... -135.625	-0.375	°CRK
LDPM_N_3_EXTC	8	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_3_EXTC	10	0... BB8H	0... 300	0.1	%
Outlet camshaft setpoint for catalyst heating with single injection in idle					
IP_CAM_CH_HOM_HOT_IN	V	0... FFH	60... 155.625	0.375	°CRK
LDPM_N_1_EXTC	16	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_1_EXTC	10	0... BB8H	0... 300	0.1	%
Inlet camshaft setpoint for catalyst heating with single injection					
IP_CAM_CH_HOM_HOT_IN_IS	V	0... FFH	60... 155.625	0.375	°CRK
LDPM_N_3_EXTC	8	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_3_EXTC	10	0... BB8H	0... 300	0.1	%
Inlet camshaft setpoint for catalyst heating with single injection in idle					
IP_CAM_CH_MPLH_HOT_EX	V	0... FFH	-40... -135.625	-0.375	°CRK
LDPM_N_1_EXTC	16	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_1_EXTC	10	0... BB8H	0... 300	0.1	%
Outlet camshaft setpoint for catalyst heating with multiple injection					
IP_CAM_CH_MPLH_HOT_EX_IS	V	0... FFH	-40... -135.625	-0.375	°CRK
LDPM_N_3_EXTC	8	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_3_EXTC	10	0... BB8H	0... 300	0.1	%
Outlet camshaft setpoint for catalyst heating with multiple injection in idle					
IP_CAM_CH_MPLH_HOT_IN	V	0... FFH	60... 155.625	0.375	°CRK
LDPM_N_1_EXTC	16	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_1_EXTC	10	0... BB8H	0... 300	0.1	%
Inlet camshaft setpoint for catalyst heating with multiple injection					
IP_CAM_CH_MPLH_HOT_IN_IS	V	0... FFH	60... 155.625	0.375	°CRK
LDPM_N_3_EXTC	8	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_3_EXTC	10	0... BB8H	0... 300	0.1	%
Inlet camshaft setpoint for catalyst heating with multiple injection in idle					
IP_FAC_EFF_IGA_CH_SP	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_T_AST_6_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_6_EXTC	8	0... FEH	-48... 142.5	0.75	°C
Setpoint of factor for fading ignition angle efficiency in case of catalyst heating					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_EFF_I_GA_CH_SP_MPLH	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_T_AST_6_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_6_EXTC	8	0... FEH	-48... 142.5	0.75	°C
Setpoint of factor for fading ignition angle efficiency in case of catalyst heating with multiple injection					

**General Information**

In this module setpoints for the camshafts during catalyst heating are generated.

**Application Conditions**

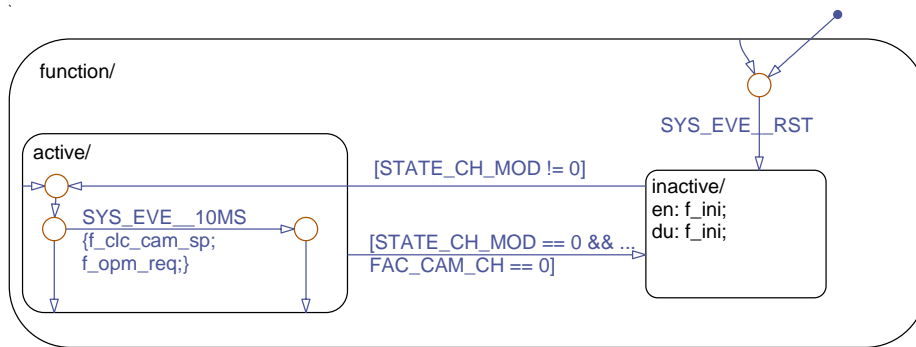
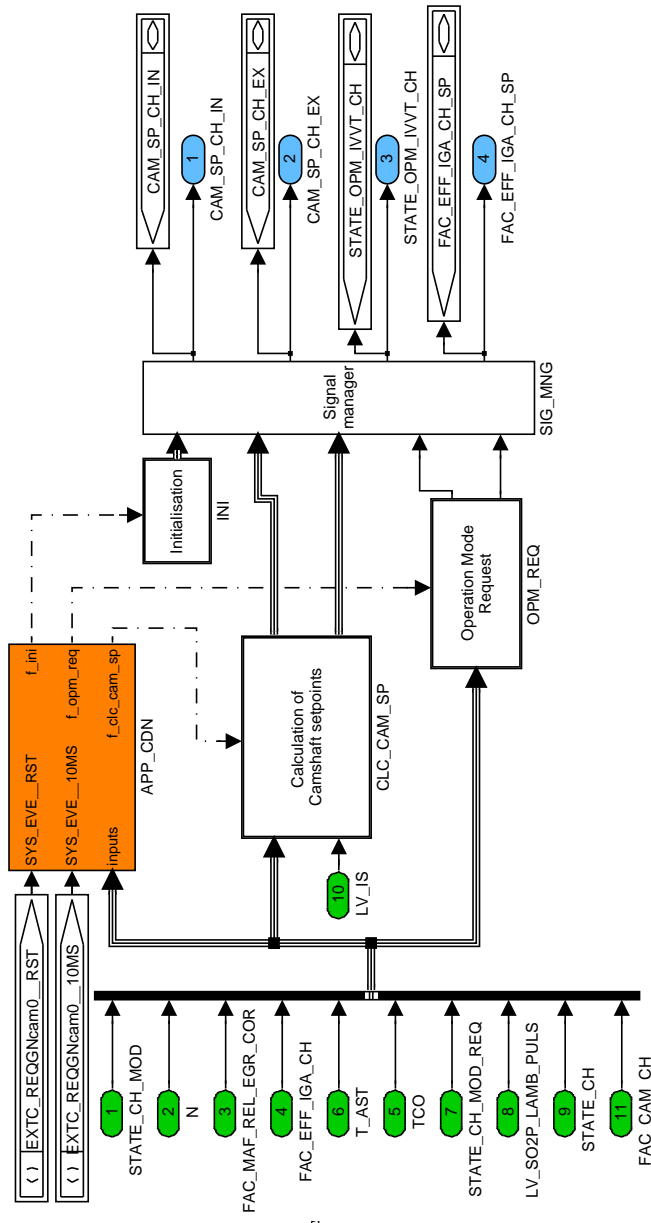


Figure 9.9.1: : Path: EXTC\_REQGNcam0/APP\_CDN/Chart

**Function description**


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Figure 9.9.2: Path: EXTC\_REQGNcam0

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## 9.9.1 Initialisation

### 9.9.1.1 Initialisation subsystem

The camshaft positions are initialised at reset and deactivated function with extreme-position-values

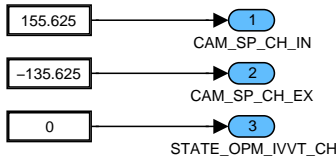


Figure 9.9.3: : Path: EXTC\_REQGNcam0/INI/INI\_SUB

## 9.9.2 Calculation of camshaft setpoints

All maps for camshaft setpoints are twice available for idle and for part load.

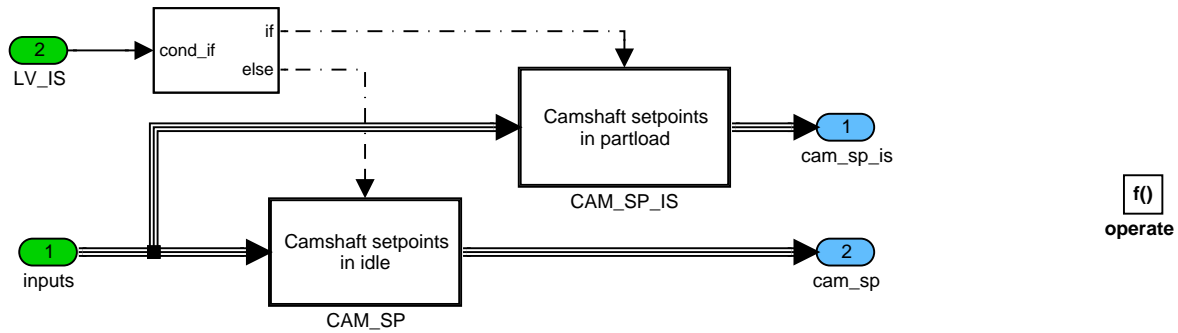


Figure 9.9.4: : Path: EXTC\_REQGNcam0/CLC\_CAM\_SP

### 9.9.2.1 EXTC\_REQGNCAM0/CLC\_CAM\_SP/CAM\_SP\_IS

#### 9.9.2.1.1 Camshaft setpoints in idle

There are 4 maps for camshaft-setpoints for catalyst heating which shall be used for emission-optimal calibration (2 for single and 2 for multiple injection). FAC\_EFF\_IGA\_CH interpolates between the map-outputs and the outputs of 2 COLD -maps which are engine-roughness-optimal calibrated.

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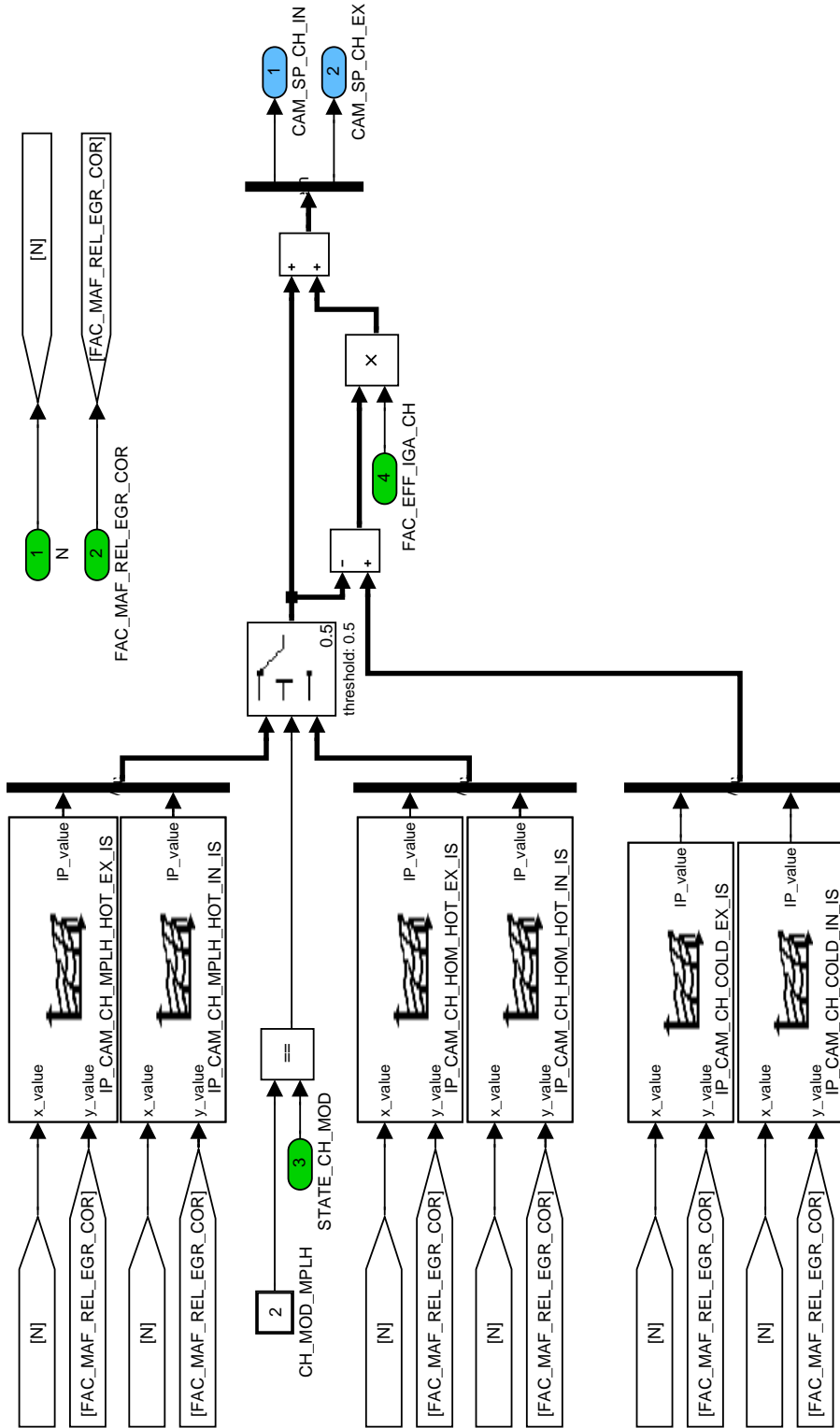


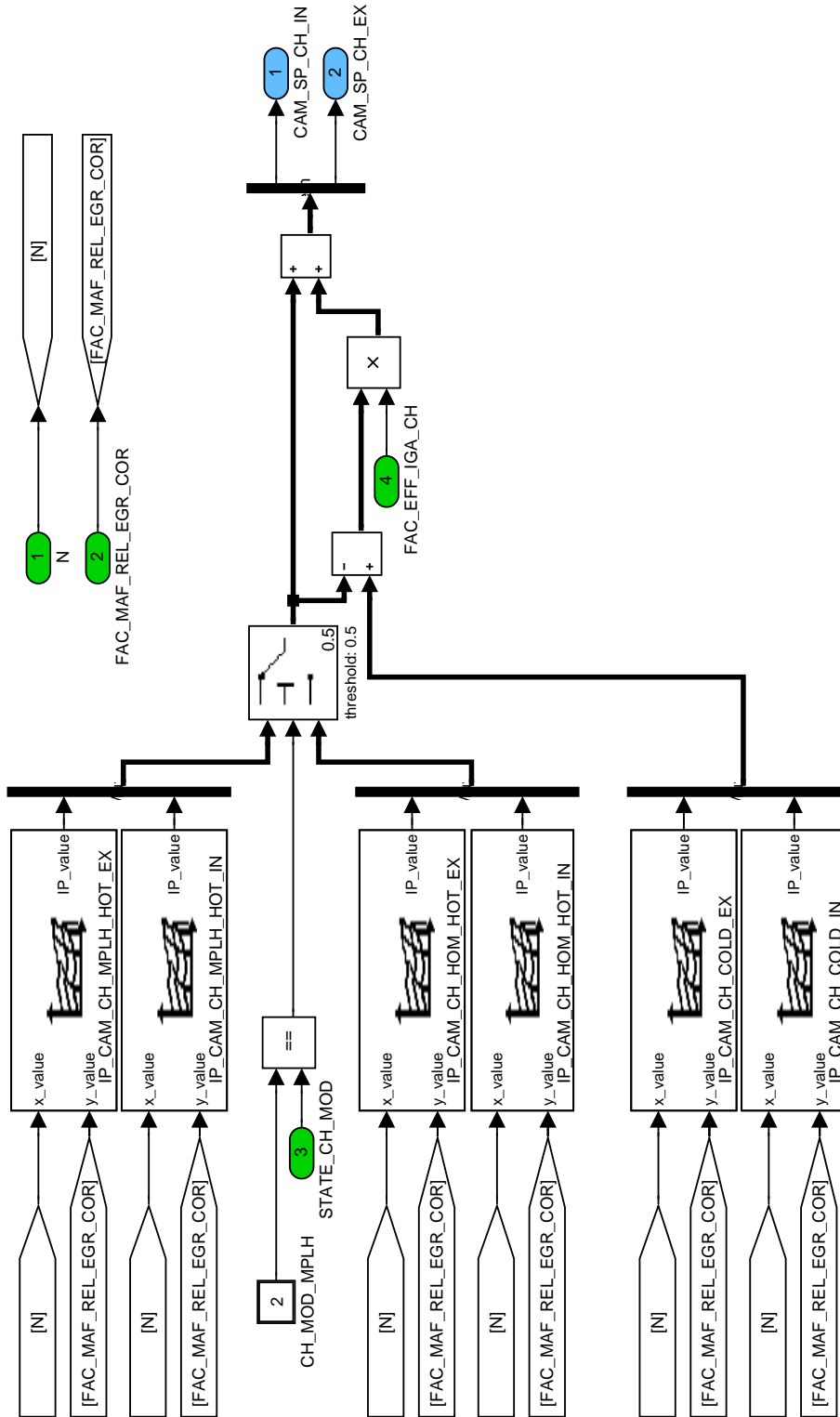
Figure 9.9.5: : Path: EXTC\_REQNcam0/CLC\_CAM\_SP/CAM\_SP\_IS/SUB

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### 9.9.2.2 EXTC\_REQGNCAM0/CLC\_CAM\_SP/CAM\_SP


#### 9.9.2.2.1 Camshaft setpoints in partload

The function is duplicated from idle-speed-function.



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Figure 9.9.6: : Path: EXTC\_REQGncam0/CLC\_CAM\_SP/CAM\_SP/SUB

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## 9.9.3 Operation mode request

### 9.9.3.1 Calculation

Depending on STATE\_CH the calculation is separated for after start, low load and desulfation catalyst heating.

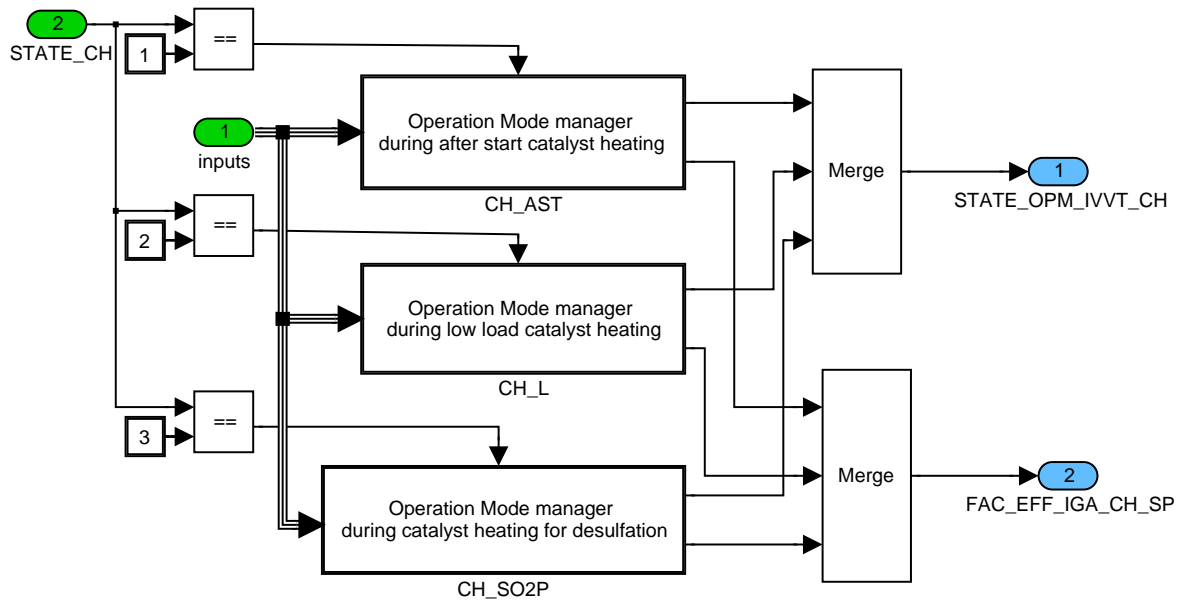


Figure 9.9.7: : Path: EXTC\_REQGNcam0/OPM\_REQ/SUB

#### 9.9.3.1.1 EXTC\_REQNCAM0/OPM\_REQ/SUB/CH\_AST

##### 9.9.3.1.1.1 Operation Mode manager during after start catalyst heating

FAC\_EFF\_IGA\_CH\_SP = 0 means that emission-optimal settings are to be chosen. FAC\_EFF\_IGA\_CH\_SP = 1 means that engine-roughness-optimal settings of camshafts shall be chosen. This setpoint value shall result in FAC\_EFF\_IGA\_CH which is used for interpolation between emission- and engine-roughness-optimal maps. STATE\_OPM\_IVVT\_CH contains the same information in logical way. 2 means emission-optimum, 1 means engine-roughness-optimum, 0 means no request from catalyst heating side.



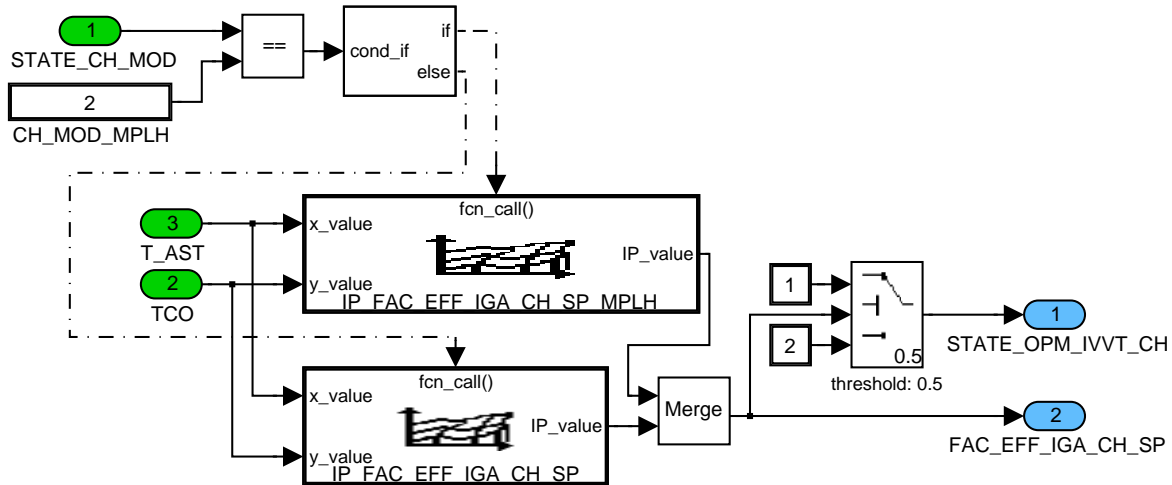


Figure 9.9.8: : Path: EXTC\_REQGNcam0/OPM\_REQ/SUB/CH\_AST/SUB

### 9.9.3.1.2 EXTC\_REQNCAM0/OPM\_REQ/SUB/CH\_L

#### 9.9.3.1.2.1 Operation Mode manager during low load catalyst heating

Only for homogeneous mode with single injection the setting of the operation mode request is calibratable. In all other cases '0' that means no alternation in camshaft setpoints is generated. FAC\_EFF\_IGA\_CH\_SP is set depending on the STATE so no values between 0 and 1 are possible.

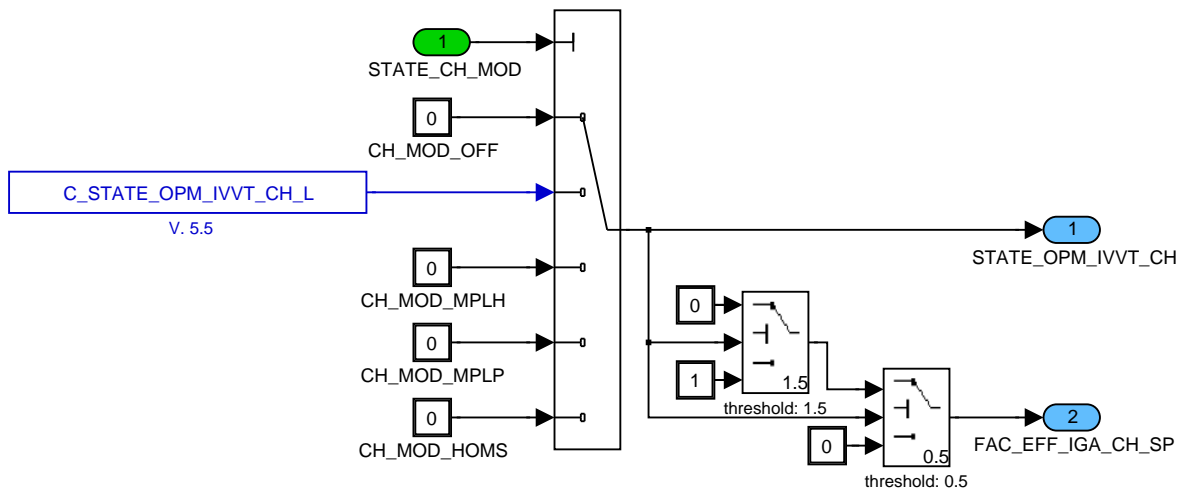


Figure 9.9.9: : Path: EXTC\_REQGNcam0/OPM\_REQ/SUB/CH\_L/SUB

### 9.9.3.1.3 EXTC\_REQNCAM0/OPM\_REQ/SUB/CH\_SO2P

#### 9.9.3.1.3.1 Operation Mode manager during catalyst heating for desulfation

For homogenous mode with single and with multiple injection the setting of the operation mode request is calibratable. In all other cases '0' that means no alternation in camshaft setpoints is generated. FAC\_EFF\_IGA\_CH\_SP is set depending on the STATE so no values between 0 and 1 are possible.

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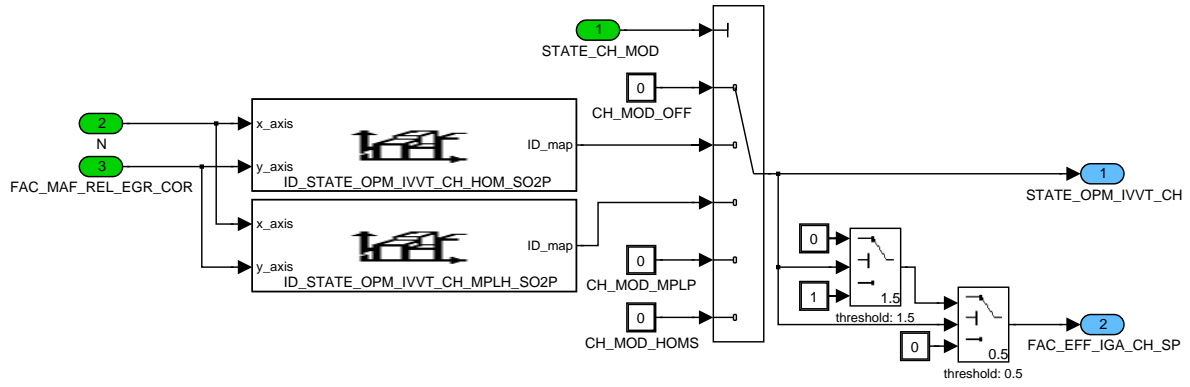



Figure 9.9.10: : Path: EXTC\_REQGNcam0/OPM\_REQ/SUB/CH\_SO2P/SUB

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## 9.10 Fuel pressure for catalyst heating

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FUP_SP_CH	O/V	0... FFFFH	0... 347776	5.306722	hPa
Fuel pressure setpoint for catalyst heating					

### Input data:

LV_MPLH_ACT {p. 8269}	N_32 {p. 1525}	STATE_CH_MOD {p. 1796}	STATE_CH_MOD_REQ {p. 1796}
T_AST {p. 1766}	TCO_ST {p. 1100}	TQI_REQ_TRA {p. 8192}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUP_SP_CH_PAS	-	0... FFFFH	0... 347776	5.306722	hPa
Passive value for fuel pressure setpoint for catalyst heating					
IP_FAC_FUP_SP_CH	-	0... FFH	0... 0.9960931	3.9063e-3	-
LDP_TCO_ST_IP_FAC_FUP_SP_CH	4	0... FEH	-48... 142.5	0.75	C
LDP_T_AST_IP_FAC_FUP_SP_CH	6	0... FFFFH	0... 6554	0.1	s
Factor for fuel pressure setpoint during (MPLH) - catalyst heating					
IP_FUP_SP_CH	-	0... FFFFH	0... 347776	5.306722	hPa
LDP_N_32_IP_FUP_SP_CH	6	0... FFH	0... 8160	32	rpm
LDP_TQI_REQ_TRA_IP_FUP_SP_CH	6	0... 7FFFH	0... 1024	0.03125	Nm
Fuel pressure setpoint for catalyst heating					

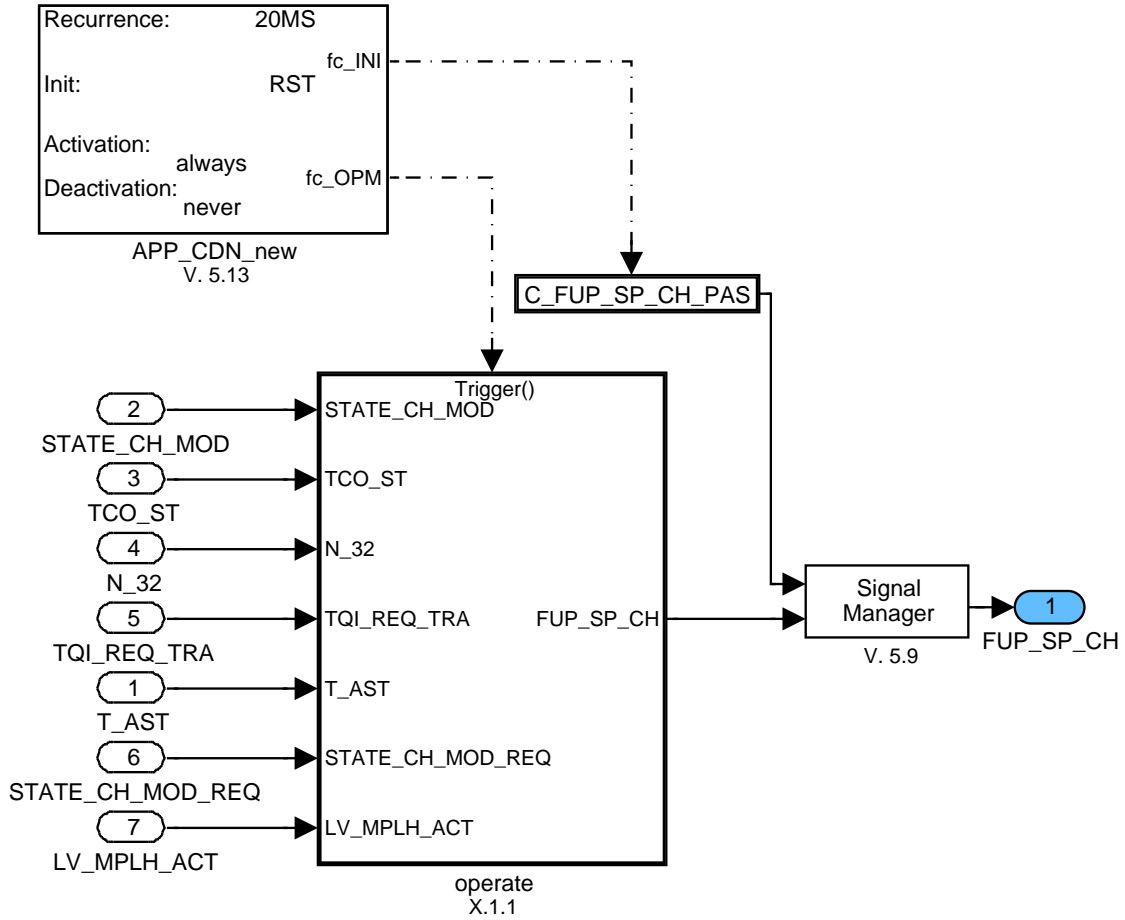
### General Information

During homogeneous mode with double injection (MPLH mode) it is necessary to use a higher fuel pressure due to the 2nd "stratified" injection.

### Application Conditions

Initialization: RST  
 Recurrence: 20MS  
 Activation: always  
 Deactivation: never

### Function description



SDA\_SRS / SDA V 5.0.1 02-Dec-2005

Figure 9.10.1: : Path: EXTC\_REQGNFUP0

### 9.10.1 Operate Subsystem

If catalyst heating in MPLH-mode is active STATE\_CH\_MOD OR STATE\_CH\_MOD\_REQ = 2 = CH\_MOD\_MPLH the IP values are used. This can be during after start catalyst heating or catalyst heating for desulfation. In all other cases the passive value C\_FUP\_SP\_CH\_PAS is used.

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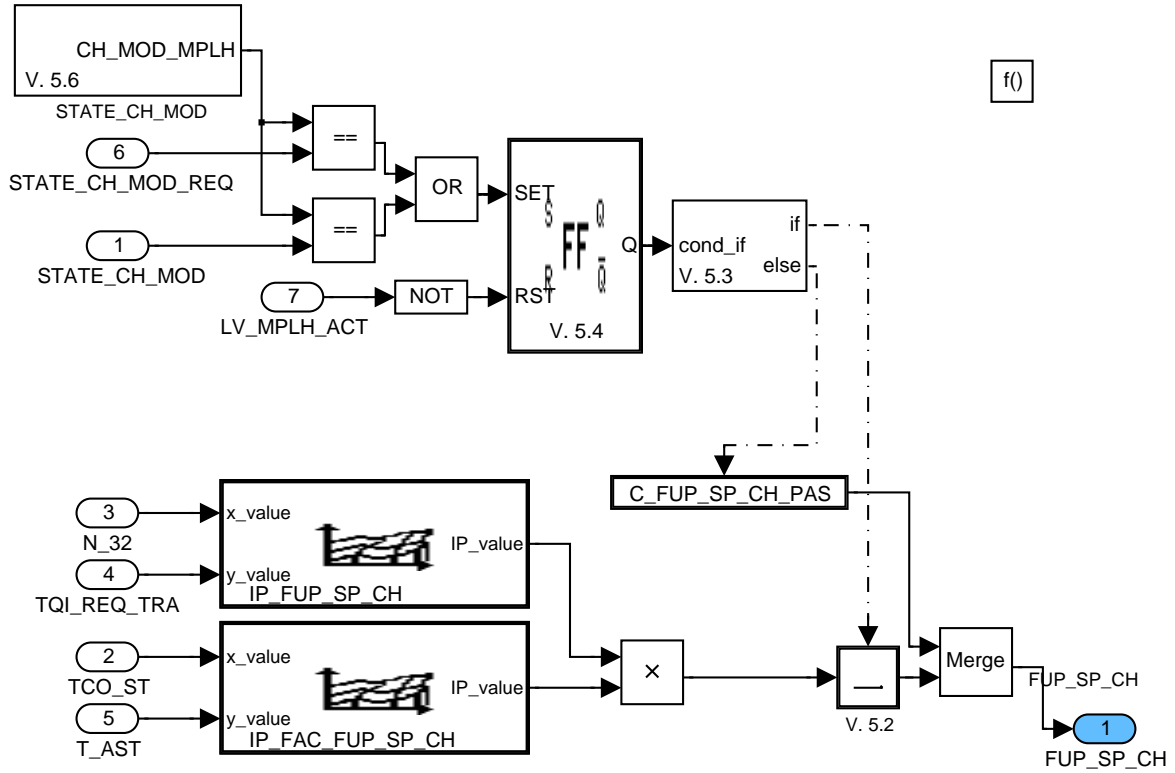


Figure 9.10.2: : Path: EXT\_C\_REQGNFUP0/operate

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## 9.11 Exhaust gas sound flap

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_EF_THD	V	0... FFFFH	0... 1.99996	30.5e-6	-
Switching threshold for exhaust flap					
FAC_TQ_EF_THD_CTOP	V	0... FFFFH	0... 1.99996	30.5e-6	-
Switching threshold for exhaust flap without hysteresis					
LV_CDN_AC_VS	-	0... 1H	0 ...1	1	-
Logical value minimum speed AC exceeded					
LV_EF	O/V	0... 1H	0 ...1	1	-
Logical value exhaust flap, 1 = closed flap					
LV_EF_AC	V	0... 1H	0 ...1	1	-
Exhaust flap for accelerated passing by active via pedal value condition					
LV_EF_AC_ACT	O/V	0... 1H	0 ...1	1	-
Boolean for accelerated passing by active					
LV_EF_AC_CDN	V	0... 1H	0 ...1	1	-
Boolean condition for detection of accelerated passing-by met					
N_EF	V	0... FFH	0... 8160	32	rpm
N for exhaust flap					
PV_AV_THD_EF_AC	V	0... FFH	0... 99.60937	0.390625	%
Pedal value threshold for activation of accelerated passing by					
T_DLY_EF	V	0... FFH	0... 25.5	0.1	s
Time delay for closing exhaust flap					
T_DLY_EF_AC	V	0... FFFFH	0... 655.35	0.01	s
delay time to start TQ change calculation					
T_VS_CDN_EF_AC	V	0... FFFFH	0... 655.35	0.01	s
Minimum time condition for detection of accelerated passing by					
TQI_REQ_EF_AC_THD	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque start value accelerated passing by					
TQI_REQ_SLOW_EF_AC	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque request during accelerated passing by for deactivation					
VAR_GB_EF_AC	V	0... 1H	0 ...1	1	-
Indication for gearbox variant: 0 = manual, 1 = automatic					

### Input data:

FAC_TQ_REQ {p. 6706}	GEAR_EF {p. 1302}	GR_AT {p. 1302}	GR_MT {p. 1302}
LV_ACT_EF_EXT_ADJ {p. 7432}	LV_AT {p. 654}	LV_CH_N_SP_IS {p. 1775}	LV_CTOP {p. 1565}
LV_EF_EXT_ADJ {p. 7434}	LV_ES {p. 1720}	LV_FL {p. 1759}	LV_ST {p. 1720}
LV_VAR_EF {p. 655}	N_32 {p. 1525}	PV_AV {p. 1269}	T_AST {p. 1766}
TCO {p. 1100}	TQ_LOSS {p. 8385}	TQ_REQ_CLU {p. 8390}	TQI_REQ_SLOW {p. 8391}
VS {p. 1176}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_END_EF_AC	-	0... FFH	0 ...1	3.9216e-3	-
Calibration factor to end detection for accelerated passing by					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQ_EF_THD_HYS	-	8000... 7FFFH	-2... 1.99993	61e-6	-
Hysteresis for switching threshold					
C_GR_AT_EF_1	-	0... FFH	0... 255	1	-
Automatic gearbox: accelerated pass gear 1					
C_GR_AT_EF_2	-	0... FFH	0... 255	1	-
Automatic gearbox: accelerated pass gear 2					
C_GR_MT_EF_1	-	0... FFH	0... 255	1	-
Manual gearbox: accelerated pass gear 1					
C_GR_MT_EF_2	-	0... FFH	0... 255	1	-
Manual gearbox: accelerated pass gear 2					
C_N_EF_HYS	-	0... FFH	0... 8160	32	rpm
Hysteresis for switching threshold					
C_PV_AV_THD_EF_AC	-	0... FFH	0... 99.60937	0.390625	%
Pedal value threshold for activation of accelerated passing by					
C_PV_AV_THD_EF_AC_AT	-	0... FFH	0... 99.60937	0.390625	%
Pedal value threshold for activation of accelerated passing by for AT					
C_T_DLY_EF_AC	-	0... FFFFH	0... 655.35	0.01	s
delay time to start TQ change calculation					
C_T_EF_AST	-	0... F8H	0... 62	0.25	s
Cranking time for EF actuation active					
C_T_VS_CDN_EF_AC	-	0... FFFFH	0... 655.35	0.01	s
Minimum time condition for detection of accelerated passing by					
C_TCO_EF_AC	-	0... FEH	-48... 142.5	0.75	°C
TCO threshold for detection of accelerated passing by					
C_TQI_REQ_EF_AC_THD_GR_1	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque request limit during accelerated passing by in selected gear 1					
C_TQI_REQ_EF_AC_THD_GR_2	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque request limit during accelerated passing by in selected gear 2					
C_TQI_REQ_EF_AC_THD_GR_AT	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque request limit during accelerated passing by for AT					
C_VS_MAX_EF_AC_1	-	0... FFH	0... 255	1	km/h
Upper vehicle speed tight threshold for detection of accelerated passing by					
C_VS_MAX_EF_AC_2	-	0... FFH	0... 255	1	km/h
Upper vehicle speed wide threshold for detection of accelerated passing by					
C_VS_MIN_EF_AC_1	-	0... FFH	0... 255	1	km/h
Lower vehicle speed tight threshold for detection of accelerated passing by					
C_VS_MIN_EF_AC_2	-	0... FFH	0... 255	1	km/h
Lower vehicle speed wide threshold for detection of accelerated passing by					
C_VS_MIN_EF_AT	-	0... FFH	0... 255	1	km/h
Speed threshold for continuously opened exhaust flap, automatically shifted transmission					
C_VS_MIN_EF_MT	-	0... FFH	0... 255	1	km/h
Speed threshold for continuously opened exhaust flap, manually shifted transmission					
ID_FAC_TQ_EF_THD_CTOP_CLOSE_AT	V	0... FFFFH	0... 1.99996	30.5e-6	-

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_N_EF	6	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Switching threshold FAC_TQ_EF for convertible top closed AT					
ID_FAC_TQ_EF_THD_CTOP_CLOSE_MT	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_N_EF	6	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Switching threshold FAC_TQ_EF for convertible top closed MT					
ID_FAC_TQ_EF_THD_CTOP_OPEN_AT	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_N_EF	6	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Switching threshold FAC_TQ_EF for convertible top open AT					
ID_FAC_TQ_EF_THD_CTOP_OPEN_MT	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_N_EF	6	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Switching threshold FAC_TQ_EF for convertible top open MT					
IP_T_DLY_EF	-	0... FFH	0... 25.5	0.1	s
LDP_N_32_IP_T_DLY_EF	8	0... FFH	0... 8160	32	rpm
Time delay for closing exhaust flap					
IP_TQI_REQ_SLOW_EF_AC	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDP_VAR_GB_EF_AC	2	0... 1H	0 ...1	1	-
LDP_VS_EF_AC	6	0... FFH	0... 255	1	km/h
Torque request during accelerated passing by for deactivation					
LC_EF_CONF	-	0... 1H	0 ...1	1	-
Switch for inverted exhaust flap; = 0 normal flap; = 1 inverted flap					
LC_STATE_CH_EF	-	0... 1H	0 ...1	1	-
Exhaust flap actuation in case catalyst heating with increased idle speed					
LC_STATE_EF_AST	-	0... 1H	0 ...1	1	-
State exhaust flap after start					
LC_STATE_VS_MIN_EF_AT	-	0... 1H	0 ...1	1	-
Exhaust flap actuation in case of vs < C_VS_MIN_EF_AT for AT version					
LC_STATE_VS_MIN_EF_MT	-	0... 1H	0 ...1	1	-
Exhaust flap actuation in case of vs < C_VS_MIN_EF_MT for MT version					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_EF_NR	-	1... 4H	1 ...4	1	-
Number of the exhaust flaps in system					


**Import actions:**

<b>ACTION_INFR_SetEf</b> (IN<ef_nr>,IN<Lv_ef>)
--

**General information:**

To optimize the vehicle noise behaviour, an exhaust flap can be activated depending on the engine speed (N\_EF) and the load (FAC\_TQ\_REQ). The exhaust flap is closed below a FAC\_TQ\_REQ value threshold, it is opened above the threshold.

The exhaust flap activation is only activated after the time C\_T\_EF\_AST after the transition from Start.

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The switching threshold (FAC\_TQ\_EF\_THD) is depending on enginespeed (N\_EF), the selected gear (GEAR\_EF), the transmission (manuell or automatic) and the convertible top (LV\_CTOP = 0 closed, or LV\_CTOP = 1 open).

To prevent the exhaust flap from switching continuously during constant driving at the switching threshold, two hysteresises (C\_N\_EF\_HYS and C\_FAC\_TQ\_EF\_THD\_HYS) are introduced for the switching process.

The closing of the exhaust flap is delayed depending on the enginespeed (N\_32).

During catalyst heating with increased idle speed setpoint, the state of the exhaust flap is adjustable by C\_STATE\_CH\_EF.

At low vehicle speeds the state of the exhaust flap is adjustable by C\_STATE\_VS\_MIN\_EF\_xx, but C\_STATE\_CH\_EF has higher priority as C\_STATE\_VS\_MIN\_EF\_xx (xx = MT/AT).

For MSD85 is NC\_EF\_NR=2 and for all other projects is NC\_EF\_NR=1.

### Application conditions

**Initialisation:** all variables are initialised with 0 at deactivation

**Recurrence:** 100 ms

**Activation:** LV\_IGK = 1 and (LV\_VAR\_EF = 1 **or** LV\_EF\_EXT\_ADJ = 1)

*Deactivation:* LV\_IGK = 0;

at Deactivation LV\_EF = LC\_EF\_CONF // is still calculated during PWL;

### Formula section:

Control of sound exhaust flap by external adjustment

**If** LV\_EF\_EXT\_ADJ = 1

**Then** LV\_EF = LV\_ACT\_EF\_EXT\_ADJ

**Else** external adjustment passive/standard function active

Flap during start and engine stopped

**If** LV\_ST = 1 or LV\_ES = 1

**Then** LV\_EF = LC\_EF\_CONF // flap opened; in case of LC\_EF\_CONF = 1 flap closed

**Endif**

Highest priority is 'time after start', P1

**If** VS > C\_VS\_MIN\_EF\_AC\_2

**Then** LV\_CDN\_AC\_VS = 1 \*\*\* initialised at deactivation\*\*\*

**Endif;**

**If** T\_AST ≤ C\_T\_EF\_AST **AND** LV\_CDN\_AC\_VS = 0

**then** LV\_EF = LC\_STATE\_EF\_AST see next priority P2

**endif**


Next priority is 'catalyst heating with increased idle speed setpoint', P2

**If** LV\_CH\_N\_SP\_IS = 1

**then** LV\_EF = LC\_STATE\_CH\_EF see next priority P3

**endif**

Next priority is 'Accelerated passing by', P3

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```

If LV_EF_AC_ACT = 1
LV_EF = LV_EF_AC_ACT
endif

```

see next priority P4

Next priority is 'vehicle speed dependency', P4  
Automatic transmission vehicle (LV\_AT = 1):

```

If VS < C_VS_MIN_EF_AT
  then LV_EF = LC_STATE_VS_MIN_EF_AT
endif

```

see next priority P5

Manual transmission vehicle (LV\_AT = 0):

```

If VS < C_VS_MIN_EF_MT
  then LV_EF = LC_STATE_VS_MIN_EF_MT
endif

```

see next priority P5

Next priority is 'convertible top', P5 \\ calculation of thresholdvalues  
- enginespeed hysteresis

```

If LV_EF = 0
  Then N_EF = N_32 + C_N_EF_HYS
  Else N_EF = N_32

```

- Calculation switching threshold (FAC\_TQ\_EF\_THD\_CTOP)

```

IF (1) LV_AT = 0
  IF LV_CTOP = 0
    Then FAC_TQ_EF_THD_CTOP =
      ID_FAC_TQ_EF_THD_CTOP_CLOSE_MT (N_EF; GEAR_EF)
  Else FAC_TQ_EF_THD_CTOP =
    ID_FAC_TQ_EF_THD_CTOP_OPEN_MT (N_EF; GEAR_EF)
ELSE (1)
  IF LV_CTOP = 0
    Then FAC_TQ_EF_THD_CTOP =
      ID_FAC_TQ_EF_THD_CTOP_CLOSE_AT (N_EF; GEAR_EF)
  Else FAC_TQ_EF_THD_CTOP =
    ID_FAC_TQ_EF_THD_CTOP_OPEN_AT (N_EF; GEAR_EF)

```

\\ manuel transmission  
\\ convertibel top closed  
\\ automatic transmission  
\\ convertibel top closed

- Calculation switching threshold hysteresis

```

If LV_EF = 0
  Then FAC_TQ_EF_THD = FAC_TQ_EF_THD_CTOP - C_FAC_TQ_EF_THD_HYS
  Else FAC_TQ_EF_THD = FAC_TQ_EF_THD_CTOP

```

\\ flap opened; in case of LC\_EF\_CONF = 1 flap closed

- Compare threshold and actual value with close delay

```

IF FAC_TQ_REQn < FAC_TQ_EF_THDn and FAC_TQ_REQn-1 ≥ FAC_TQ_EF_THDn-1
  Then T_DLY_EF = IP_T_DLY_EF
  Else T_DLY_EF ---

```

\\ (decremenet T\_DLY\_EF)

**Endif**

```

If FAC_TQ_REQ ≥ FAC_TQ_EF_THD
  Then LV_EF = 0
  Else IF T_DLY_EF = 0
    Then LV_EF = 1

```

```

                Else    LV_EF = 0
            Endif
    Endif

```

The output stage is energized to close the normal NC\_EF\_NR exhaust flaps and to open the inverted NC\_EF\_NR exhaust flaps (depending on LC\_EF\_CONF).

### Switch Hardware PIN

For i=0...NC\_EF\_NR-1

```

IF LC_EF_CONF = 0
    THEN Switch Pin (I/O Software) with LV_EF
    ACTION_INFR_SetEf(IN<ef_nr>, IN <Lv_ef>)
    ELSE Switch Basic (I/O Software) with not LV_EF
    ACTION_INFR_SetEf(IN<ef_nr>, IN <Lv_ef>)

```

## 9.11.1 Torque limitation for accelerated passing-by

### FUNCTION DESCRIPTION:

#### Application conditions

Recurrence: 10 ms

Initialisation at reset: all = 0

#### 9.11.1.1 Detection of accelerated passing by

#### Application conditions

```

Activation/Deactivation: if          { (LV_AT = 0    and (C_GR_MT_EF_1 <= GR_MT <= C_
GR_MT_EF_2) )                          or
(LV_AT = 1    and (C_GR_AT_EF_1 <= GR_AT <= C_GR_AT_EF_2) ) }
and
TCO > C_TCO_EF_AC
then          Formula section below
else          LV_EF_AC_CDN          = 0
LV_EF_AC      = 0
LV_EF_AC_ACT  = 0
T_VS_CDN_EF_AC is reset
T_DLY_EF_AC   = 0

```

endif


#### Formula section:

- calculation of TQI\_REQ\_EF\_AC\_THD:

```

if          LV_AT = 0
then        VAR_GB_EF_AC = 0
    if          GR_MT = C_GR_MT_EF_1
    then        TQI_REQ_EF_AC_THD = C_TQI_REQ_EF_AC_THD_GR_1
    else        TQI_REQ_EF_AC_THD = C_TQI_REQ_EF_AC_THD_GR_2

```

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```

endif
else    VAR_GB_EF_AC = 1
          TQI_REQ_EF_AC_THD = C_TQI_REQ_EF_AC_THD_GR_AT
endif

```

- Vehicle speed condition LV\_EF\_AC\_CDN:

```

if      TQI_REQ_SLOW < TQI_REQ_EF_AC_THD
          and
          (LV_AT = 0 or (GR_AT > C_GR_AT_EF_1))
          and
          LV_EF_AC_ACT = 0
then if  VS > C_VS_MIN_EF_AC_1 and
          VS < C_VS_MAX_EF_AC_1
          % => tight range for VS-condition fulfilled %
          then if T_VS_CDN_EF_AC < C_T_VS_CDN_EF_AC
                  then    T_VS_CDN_EF_AC is incremented
                          LV_EF_AC_CDN = 0
                  else    LV_EF_AC_CDN = 1
          endif
          else
          LV_EF_AC_CDN = 0
          if      VS > C_VS_MIN_EF_AC_2 and
                  VS < C_VS_MAX_EF_AC_2
                  % => wide range for VS-condition fulfilled %
          then    T_VS_CDN_EF_AC(n) = T_VS_CDN_EF_AC(n-1)
          else    T_VS_CDN_EF_AC is reset
          endif
          endif
else if  TQI_REQ_SLOW >= TQI_REQ_EF_AC_THD and
          (LV_AT = 0 or (GR_AT > C_GR_AT_EF_1)) and
          LV_EF_AC_CDN = 0
          then    T_VS_CDN_EF_AC is reset
          endif
endif

```

**endif**

- Activation via pedal value LV\_EF\_AC:

```


if      LV_AT = 1
then    PV_AV_THD_EF_AC = C_PV_AV_THD_EF_AC_AT
else    PV_AV_THD_EF_AC = C_PV_AV_THD_EF_AC
endif

if      LV_EF_AC_CDN = 1 and
          {LV_FL = 1 or PV_AV > PV_AV_THD_EF_AC}
then    LV_EF_AC = 1
else    LV_EF_AC = 0
endif

```

### 9.11.1.2 Torque limitation for accelerated passing by

#### Application conditions

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**Activation:** LV\_EF\_AC = 1

**Deactivation:** LV\_EF\_AC = 0  
 at deactivation:  
 TQI\_REQ\_SLOW\_EF\_AC = 7FFF hex / 1024Nm  
 LV\_EF\_AC\_ACT = 0  
 T\_DLY\_EF\_AC = 0  
 LV\_EF\_AC\_CDN = 0


### Formula section:

- Torque limitation is active LV\_EF\_AC\_ACT:

```

if LV_EF_AC_ACT = 0
then
if TQI_REQ_SLOW > TQI_REQ_EF_AC_THD
  then TQI_REQ_SLOW_EF_AC = TQI_REQ_EF_AC_THD
        T_DLY_EF_AC = 0
        LV_EF_AC_ACT = 1
  endif
else T_DLY_EF_AC is incremented
  if T_DLY_EF_AC >= C_T_DLY_EF_AC
  then TQI_REQ_SLOW_EF_AC = MIN(TQ_REQ_CLU - TQ_LOSS;
                                IP_TQI_REQ_SLOW_EF_AC)
  endif

  if TQI_REQ_SLOW_EF_AC >= C_FAC_END_EF_AC * (TQ_REQ_CLU - TQ_LOSS)
  then LV_EF_AC_ACT = 0
        LV_EF_AC = 0
        LV_EF_AC_CDN = 0
        T_VS_CDN_EF_AC is reset
        T_DLY_EF_AC = 0
        TQI_REQ_SLOW_EF_AC = 7FFF hex /1024Nm
  endif
endif
  
```

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## 9.12 Variable intake manifold

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_SWI_VIM_PAS	V	0... 1H	0 ...1	1	-
Logical variable to set VIM in passive mode					
LV_VIM	O/V	0... 1H	0 ...1	1	-
Logical value VIM power stage (2-stage-DISA); 0 passive, 1 active					
LV_VIM_1	O/V	0... 1H	0 ...1	1	-
setpoint VIM flap 1, 0: closed, 1: opened					
LV_VIM_2	O/V	0... 1H	0 ...1	1	-
setpoint VIM flap 2, 0: closed, 1: opened					
LV_VIM_RLS	O/V	0... 1H	0 ...1	1	-
conditions for release of VIM function are met					
LV_VIM_RLS_TMP	V	0... 1H	0 ...1	1	-
LV_VIM_RLS temporal value					
N_VIM	V	0... 1FE0H	0... 8160	1	rpm
corrected engine speed for VIM application					
T_DLY_VIM_OPEN_1	V	0... FFH	0... 2.55	0.01	s
Delay timer to open VIM flap 1					
T_DLY_VIM_OPEN_2	V	0... FFH	0... 2.55	0.01	s
Delay timer to open VIM flap 2					
T_OPEN_VIM_DEAC	V	0... FFH	0... 2.55	0.01	s
timer to open the VIM flaps before deactivating the VIM function					
T_VIM_CLOSE_MIN_1	V	0... FFH	0... 2.55	0.01	s
Timer to close VIM flap 1					
T_VIM_CLOSE_MIN_2	V	0... FFH	0... 2.55	0.01	s
Timer to close VIM flap 2					
T_VIM_LIH_MIN	V	0... FFH	0... 2.55	0.01	s
Limp-home timer for VIM function					
VIM_AV	O/V	0... FFFFH	0... 199.99694	3.0518e-3	%
actual position variable intake manifold					
VIMPWM_1	O/V	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
pulse width modulated signal for actuator DISA_1					
VIMPWM_2	O/V	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
pulse width modulated signal for actuator DISA_2					

### Input data:

FAC_MAF_MAX {p. 1212}	LV_ACT_VIM_1_EXT_ADJ {p. 7433}	LV_ACT_VIM_2_EXT_ADJ {p. 7433}	LV_ERR_VIM_1 {p. 5065}
LV_ERR_VIM_2 {p. 5065}	LV_IGK {p. 906}	LV_ST_END {p. 1720}	LV_STST_STOP_CYC {p. 805}
LV_VIM_1_CUS {p. 8277}	LV_VIM_1_EXT_ADJ {p. 7435}	LV_VIM_2_CUS {p. 8277}	LV_VIM_2_EXT_ADJ {p. 7435}
LV_VIM_INH_CUS {p. 8277}	N {p. 1525}	N_32 {p. 1525}	TCO {p. 1100}
TIA {p. 1226}	VB {p. 1185}	VS {p. 1176}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_MAF_MAX_VIM	-	0... FFFFH	0... 1.99996	30.5e-6	-
load threshold					
C_FAC_MAF_MAX_VIM_HYS	-	0... FFFFH	0... 1.99996	30.5e-6	-
load threshold hysteresis					
C_N_VIM_H	-	0... 1FE0H	0... 8160	1	rpm
higher engine speed threshold					
C_N_VIM_HYS	-	0... 1FE0H	0... 8160	1	rpm
engine speed threshold hysteresis					
C_N_VIM_L	-	0... 1FE0H	0... 8160	1	rpm
lower engine speed threshold					
C_N_VIM_MID	-	0... 1FE0H	0... 8160	1	rpm
medium engine speed threshold					
C_PWM_VIM_CLOSE	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
PWM to close VIM flap					
C_PWM_VIM_DEAC	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
PWM-signal to deactivate VIM flap					
C_PWM_VIM_LIH	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
PWM for VIM limp home mode					
C_PWM_VIM_OPEN	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
PWM to open VIM flap					
C_STATE_VIM_1_SP_MAN	-	0... 1H	0 ...1	1	-
manual setting of the setpoint VIM flap 1 by calibration system, 0: closed, 1: opened					
C_STATE_VIM_2_SP_MAN	-	0... 1H	0 ...1	1	-
manual setting of the setpoint VIM flap 2 by calibration system, 0: closed, 1: opened					
C_T_DLY_PARK_PSN	-	0... FFH	0... 2.55	0.01	s
delay timer to open the VIM flaps before deactivating the VIM function (park position)					
C_T_DLY_VIM_OPEN	-	0... FFH	0... 2.55	0.01	s
delay timer to open the VIM flaps					
C_T_OPEN_VIM_DEAC	-	0... FFH	0... 2.55	0.01	s
time to open the VIM flaps before deactivating the VIM function					
C_T_VIM_CLOSE_MIN	-	0... FFH	0... 2.55	0.01	s
minimum time to close VIM flaps					
C_T_VIM_LIH_MIN	-	0... FFH	0... 2.55	0.01	s
minimum time to VIM limp home mode					
C_VB_MAX_VIM	-	0... FFH	0... 25.89843	0.1015625	V
maximum battery voltage to release VIM function					
C_VB_MIN_VIM	-	0... FFH	0... 25.89843	0.1015625	V
minimum battery voltage to release VIM function					
C_VIM_AV_1	-	0... FFFFH	0... 199.99694	3.0518e-3	%
VIM_AV for both flaps opened					
C_VIM_AV_2	-	0... FFFFH	0... 199.99694	3.0518e-3	%
VIM_AV for both flaps closed					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VIM_AV_3	-	0... FFFFH	0... 199.99694	3.0518e-3	%
VIM_AV for flap 1 opened, flap 2 closed					
C_VIM_AV_4	-	0... FFFFH	0... 199.99694	3.0518e-3	%
VIM_AV for flap 1 closed, flap 2 opened					
C_VIM_AV_DEAC	-	0... FFFFH	0... 199.99694	3.0518e-3	%
VIM_AV during deactivation					
C_VIM_AV_PAS	-	0... FFFFH	0... 199.99694	3.0518e-3	%
VIM_AV during passive function					
C_VIMPWM_PARK_PSN	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
PWM adjustment in case of park position					
C_VIMPWM_PAS	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
VIMPWM "passive"					
C_VIMPWM_PRE_PRK_PSN	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
PWM adjustment in case of pre-park position					
ID_STATE_RLS_VIM	-	0... 1H	0 ...1	1	-
temperature condition for VIM function is met (1) or not met (0)					
ID_STATE_VIM_1_SP	-	0... 1H	0 ...1	1	-
Table defining the setpoint VIM flap 1, 0: closed, 1: opened					
ID_STATE_VIM_2_SP	-	0... 1H	0 ...1	1	-
Table defining the setpoint VIM flap 2, 0: closed, 1: opened					
ID_SWI_VIM_PAS_N_VS	V	0... 1H	0 ...1	1	-
LDP_N_32_SWI_VIM_PAS	6	1... FFH	32... 8160	32	rpm
LDP_VS_SWI_VIM_PAS	6	0... FFH	0... 255	1	km/h
VIM Passive mode dependent on vehicle speed and motor speed					
IP_FAC_N_VIM	V	0... FFH	0... 1.99218	0.0078125	-
LDP_N_32_FAC_N_VIM	8	0... FFH	0... 8160	32	rpm
LDP_FAC_MAF_MAX_IP_FAC_N_VIM	6	0... FFFFH	0... 1.99996	30.5e-6	-
N_32 correction for VIM switch thresholds					
IP_FAC_TIA_N_VIM	-	0... FFH	0... 1.99218	0.0078125	-
LDP_TIA_FAC_TIA_N_VIM	8	0... FEH	-48... 142.5	0.75	°C
TIA correction for VIM switch thresholds					
LC_PWM_VIM_CUS	-	0... 1H	0 ...1	1	-
Logical constant to enable setting of customer VIM setpoint					
LC_PWM_VIM_MAN	-	0... 1H	0 ...1	1	-
Logical constant to enable manual setting of VIMPWM_1/2 by calibration system					

### General information:

This function is used to control an open loop, 2- or 3-stage variable intake manifold. The output VIM\_AV is generated to be used for the volumetric efficiency of the engine which is influenced by the VIM position. For a 2-stage variable intake manifold VIM\_AV should be set to 0% /100% in order to facilitate the application of the volumetric efficiency.

For test purpose at assembling line or workshop the VIM can be switched by a serial communication tool, if available (external adjustment).

### Signal flow diagram:

Determination of the used range



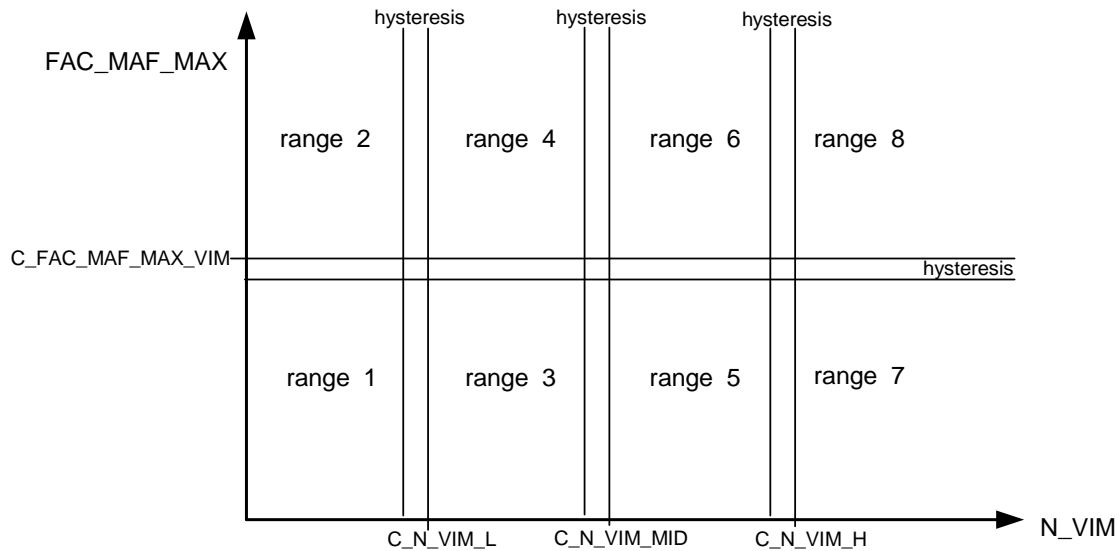


Diagram is valid if external adjustment is inactive.

### Application conditions

**Initialisation:**

```

VIMPWM_1 = C_VIMPWM_PAS    at ECU initialisation    VIMPWM_
2 = C_VIMPWM_PAS           and at function deactivation
VIM_AV = C_VIM_AV_1
T_OPEN_VIM_DEAC = C_T_OPEN_VIM_DEAC
all others: physical 0
at LV_IGK 0->1 or at reset : LV_VIM_RLS_TMP = 0

```

**Recurrence:** 10 ms

**Activation:** at every engine operating state

**Deactivation:** -

### Formula section:

#### Condition for release of VIM function

```

if      LV_ST_END = 1                and
          C_VB_MIN_VIM ≤ VB ≤ C_VB_MAX_VIM    and
          ID_STATE_RLS_VIM = 1                and
          LV_ERR_VIM_1 = 0                    and
          LV_ERR_VIM_2 = 0
then    LV_VIM_RLS = 1
else    LV_VIM_RLS = 0
endif

```

#### Corrected engine speed for VIM function:

```

if      LV_VIM_RLS = 1
then    N_VIM = N * IP_FAC_N_VIM * IP_FAC_TIA_N_VIM
endif

```

Hysteresis for switching thresholds:

Valid for all 4 thresholds, C\_N\_VIM\_L, C\_N\_VIM\_MID, C\_N\_VIM\_H and C\_FAC\_MAF\_MAX\_VIM: when increasing the input value (N\_VIM /FAC\_MAF\_MAX) then switch at input value > threshold ,  
when decreasing the input value then switch back at input value < threshold - hysteresis .

threshold	C_N_VIM_L / -_MID / -_H	C_FAC_MAF_MAX_VIM
hysteresis	C_N_VIM_HYS	C_FAC_MAF_MAX_VIM_HYS

Determination of desired flap position

i = 1...2

```

if(1)   LC_PWM_VIM_MAN = 1
then(1)  LV_VIM_1 = C_STATE_VIM_1_SP_MAN
          LV_VIM_2 = C_STATE_VIM_2_SP_MAN
else(1)
  if(2)   LV_VIM_i_EXT_ADJ = 1
  then(2)  LV_VIM_i = LV_ACT_VIM_i_EXT_ADJ
  else(2)
    if(3)   LV_VIM_RLS = 1
    then(3)
      if(4)   LC_PWM_VIM_CUS = 1
      then(4)  LV_VIM_1 = LV_VIM_1_CUS
                LV_VIM_2 = LV_VIM_2_CUS
    else(4)  LV_VIM_1 = ID_STATE_VIM_1_SP           0: closed or 1: opened, accord-
ing                                               ing
                LV_VIM_2 = ID_STATE_VIM_2_SP the determined range, see above
                diagram
    endif(4)
  else(3) LV_VIM_1 = 1
          LV_VIM_2 = 1
  endif(3)
  endif(2)
endif(1)

```

Hint: the tables ID\_STATE\_VIM\_1/2\_SP contain 8 values which are divided in the 8 ranges, see above diagram. The lists of data points are fixed, not calibrateable. According the display conversion of the calibration system 'INCA', the table that can be seen on the INCA-screen is analogous the diagram above.

		LDPM_IDX_1_SP_VIM_1_VIMA			
		0	1	2	3
LDPM_IDX_2_SP_VIM_1_VIMA	0	flap setpoint range 2	flap setpoint range 4	flap setpoint range 6	flap setpoint range 8
	1	flap setpoint range 1	flap setpoint range 3	flap setpoint range 5	flap setpoint range 7

Calculation of VIMPWM\_1 and \_2:

i = 1...2

**if(1)** LC\_PWM\_VIM\_MAN = 1

**then(1)**

**if(2a)** LV\_VIM\_i = 1

**then(2a)** VIMPWM\_i = C\_PWM\_VIM\_OPEN

**else(2a)** VIMPWM\_i = C\_PWM\_VIM\_CLOSE

**endif(2a)**

**else(1)**

**if(2b)** LV\_VIM\_i\_EXT\_ADJ = 1

**then(2b)**

**if(3a)** LV\_VIM\_i = 1

**then(3a)** VIMPWM\_i = C\_PWM\_VIM\_OPEN

**else(3a)** VIMPWM\_i = C\_PWM\_VIM\_CLOSE

**endif(3a)**

**else(2b)**

**if(3b)** LV\_VIM\_INH\_CUS = 0

**then(3b)**

T\_VIM\_LIH\_MIN = 0

**if(4a)** (LV\_VIM\_RLS = 1 and LV\_IGK=1)

**then(4a)** T\_OPEN\_VIM\_DEAC = 0 s

LV\_VIM\_RLS\_TMP = 1

**if(5a)** LV\_VIM\_i = 1 /\* output adjustment

**then(5a)** T\_VIM\_CLOSE\_MIN\_i = 0

**if** T\_DLY\_VIM\_OPEN\_i < C\_T\_DLY\_VIM\_OPEN

**then**

T\_DLY\_VIM\_OPEN\_i = T\_DLY\_VIM\_OPEN\_i + 10ms

VIMPWM\_i = C\_PWM\_VIM\_CLOSE

**else**

VIMPWM\_i = C\_PWM\_VIM\_OPEN

**Endif**

**else(5a)** T\_DLY\_VIM\_OPEN\_i = 0

/\* torque adjustment

**if (6a)** T\_VIM\_CLOSE\_MIN\_i < C\_T\_VIM\_CLOSE\_MIN

**then**

T\_VIM\_CLOSE\_MIN\_i = T\_VIM\_CLOSE\_MIN\_i + 10ms


```

        VIMPWM_i = C_PWM_VIM_CLOSE /*Torque adjustment for safe run up
else (6a)
        LV_SWI_VIM_PAS = ID_SWI_VIM_PAS_N_VS (N, VS)
        /* see Calibration hints (1 , (2

        if (7a)      LV_SWI_VIM_PAS = 1
        then        VIMPWM_i = C_VIMPWM_PAS
        else (7a)
                VIMPWM_i = C_PWM_VIM_CLOSE
        endif (7a)
endif (6a)
        endif(5a)
        else(4a)    T_OPEN_VIM_DEAC = T_OPEN_VIM_DEACn-1 + 10 ms
        if(5b)      T_OPEN_VIM_DEAC < C_T_OPEN_VIM_DEAC
        then(5b)    VIMPWM_i = C_PWM_VIM_DEAC
        else(5b)
                if (6b) T_OPEN_VIM_DEAC < C_T_DLY_PARK_PSN
        then        VIMPWM_i = C_VIMPWM_PAS
        else (6b)
                if (7b) LV_STST_STOP_CYC = 1      or
                        LV_ERR_VIM_1 = 1 or
                        LV_ERR_VIM_2 = 1 or
                        LV_VIM_RLS_TMP = 0
                then    VIMPWM_i = C_VIMPWM_PRE_PRK_PSN
                else (7b)
                        T_DLY_VIM_OPEN_i = 0
                        /* parking position,
                        VIMPWM_i = C_VIMPWM_PARK_PSN
                        /* see Calibration hints (3
                        T_VIM_CLOSE_MIN_i = 0 /* needed for restart from PWL phase
                endif (7b)
        endif (6b)
endif(5b)
        endif(4a)

else(3b)
        T_DLY_VIM_OPEN_i = 0
        LV_SWI_VIM_PAS = 0
        /* Limp home active, therefore VIMPWM_i = C_PWM_VIM_LIH
        T_VIM_CLOSE_MIN_i = 0
        /* limp home reappears :
        if (4b) T_VIM_LIH_MIN < C_T_VIM_LIH_MIN
        then
                T_VIM_LIH_MIN = T_VIM_LIH_MIN + 10ms
                VIMPWM_i = C_PWM_VIM_LIH /*see Calibration hints (4
                /*Desired adjustment for safe run up
        else (4b)
                VIMPWM_1 = C_VIMPWM_PAS
                VIMPWM_2 = C_VIMPWM_PAS
        endif(4b)
endif(3b)
endif(2b)

```

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**endif(1)**

Calculation of VIM\_AV:

```

if(1)    VIMPWM_1 = VIMPWM_2 = C_VIMPWM_PAS
then(1)
    if(2a)    LV_SWI_VIM_PAS = 1
    then      VIM_AV = VIM_AV (n-1) /* VIM flap remains in the old position*/
    else(2a) VIM_AV = C_VIM_AV_PAS
    endif(2a)
else(1)
    if(2)    VIMPWM_1 = VIMPWM_2 = C_PWM_VIM_DEAC
    then(2)    VIM_AV = C_VIM_AV_DEAC
    if(3)      VIMPWM_1 = VIMPWM_2 = C_PWM_VIM_OPEN
    then(3)    VIM_AV = C_VIM_AV_1
    else(3)
        if(4)    VIMPWM_1 = VIMPWM_2 = C_PWM_VIM_CLOSE
        then(4)    VIM_AV = C_VIM_AV_2
        else(4)
            if(5)    VIMPWM_1 = C_PWM_VIM_OPEN           and
                    VIMPWM_2 = C_PWM_VIM_CLOSE
            then(5)    VIM_AV = C_VIM_AV_3
            else(5)    VIM_AV = C_VIM_AV_4
            endif(5)
        endif(4)
    endif(3)
    endif(2)
endif(1)

```

**In case of inhibition of VIM by customer:**

```

if      LC_PWM_VIM_MAN = 0           and
        LV_VIM_i_EXT_ADJ = 0         and
        LV_VIM_INH_CUS = 1
then    VIM_AV = C_VIM_AV_1
endif

```

LV\_VIM:


```

if    VIMPWM_1    C_PWM_VIM_CLOSE
then    LV_VIM = 1
else    LV_VIM = 0
endif

```

**Calibration hints:**

1. ID\_SWI\_VIM\_PAS\_N\_VS out of 3000 rpm, ID\_SWI\_VIM\_PAS\_N\_VS==0 (67% PWM isn't allowed after 15% PWM)
2. ID\_SWI\_VIM\_PAS\_N\_VS : Passive Mode for N < 3000U/min
3. C\_VIMPWM\_PARK\_PSN: At parking position (15%- ->67%): PWM= 67%
4. C\_PWM\_VIM\_LIH = 33 %

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## 9.13 EVAC flow setpoints

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_FLOW_COR_CLL_CP	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
Flow target correction factor					
FAC_FLOW_SP_MIN_PURGE	V	0... FFFFH	0... 3.99993	61e-6	-
correction factor for the flow setpoint in MIN_PURGE when CL_MMV known					
FLOW_CPS_SP_MIN_PURGE	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Setpoint value for the flow through the CPS for MIN_PURGE mode					
FLOW_MAX_CPS	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Maximum setpoint value for the flow through the CPS					
FLOW_MAX_PHY_CPS	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Physical limit: flow at 100% opened valve					
MFF_KGH_MAX_CP	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Fuel flow max from the ACF					
MFF_MAX_CP	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Maximum limit on the fuel flow mass					
RATIO_FUEL_SP_MAX_PURGE	V	0... FFFFH	0... 0.99998	15.3e-6	-
Setpoint value for the relative part of fuel from CPS compared to total fuel in cylinder for normal operation					

### Input data:

AMP {p. 982}	AMP_DELTA_IT_CP {p. 3698}	CL_MMV {p. 3698}	FTL {p. 1564}
LC_LAM_CBK_CPS {p. 3706}	LV_CL_CLC_VLD {p. 3635}	LV_CP_ACT {p. 3679}	LV_CP_ENA {p. 3737}
LV_HOM_ACT {p. 8136}	MAF_CYL {p. 8277}	MFF_SP_HOM_ENG [NC_CBK_EX_NR] {p. 2151}	MFF_SP_MV {p. 2151}
N_32 {p. 1525}	NC_CYL_NR {p. 1526}	PRS_CPS {p. 1540}	STATE_OPM_ENG_CP {p. 3680}
TCO {p. 1100}	TQI_SP_S {p. 8391}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_MAX_MIN_PURGE	-	0... FFFFH	0... 1.99996	30.5e-6	-
on this worst case CL is based the base calibration of MIN_PURGE flow setpoint					
C_FAC_FLOW_COR_FTL_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
Flow correction factor if fuel tank level condition is fulfilled					
C_FAC_FLOW_SP_MIN_PURGE_MAX	-	0... FFFFH	0... 3.99993	61e-6	-
maximum correction of MIN_PURGE flow setpoint					
C_FTL_MIN_FLOW_COR_CP	-	0... 7FH	0... 127	1	l
Lower fuel tank level threshold for flow correction					
C_MFF_MIN_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
Minimum limit on mass fuel flow					
IP_FAC_FLOW_COR_AMP_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_AMP_IP_FAC_FLOW_COR_CP	8	0... FFFFH	0... 5434	0.0829175	hPa
Flow correction factor via AMP					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_FLOW_COR_AMP_DELTA_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_AMP_DELTA_IP_FAC_FLOW_COR	8	0... FFFFH	-2717.04145 ...2716.95854	0.0829175	hPa
Flow correction factor via AMP_DELTA_IT_CP					
IP_FAC_FLOW_SP_MIN_PURGE	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_CL_MMV_IP_FAC_FLOW_MIN	6	0... FFFFH	0... 1.99996	30.5e-6	-
weighting factor for the CL deviation from the worstcase CL					
IP_FLOW_CPS	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_PRS_CPS_1_EVAC	16	0... FFFFH	-2717... 2716.91708	0.0829163	hPa
FLOW_CPS for fully opened CPS (CPPWM=100%)					
IP_FLOW_CPS_ENG_MOD_0	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_N_32_2_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MAF_2_EVAC	12	0... FFH	0... 1389	5.4470588	mg/stk
flow setpoint for MIN_PURGE at ENG_MOD_0					
IP_FLOW_CPS_ENG_MOD_1	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_N_32_2_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_TQI_SP_S_3_EVAC	12	0... 7FFFH	0... 1023.97	0.03125	Nm
flow setpoint for MIN_PURGE at ENG_MOD_1					
IP_FLOW_CPS_ENG_MOD_2	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_N_32_2_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_TQI_SP_S_3_EVAC	12	0... 7FFFH	0... 1023.97	0.03125	Nm
flow setpoint for MIN_PURGE at ENG_MOD_2					
IP_FLOW_MAX_2_CPS	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_N_32_2_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MFF_EVAC	12	0... FFFFH	0... 1389	0.0211948	mg/stk
flow setpoint for MAX_PURGE in stratifid mode					
IP_FLOW_MAX_CPS	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_N_32_2_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MAF_2_EVAC	12	0... FFH	0... 1389	5.4470588	mg/stk
flow setpoint for MAX_PURGE					
IP_RATIO_FUEL_MAX_CP_COR	-	0... FFH	0... 0.99609	3.9063e-3	-
LDP_TCO_IP_RATIO_FUEL_MAX_CP	5	0... FEH	-48... 142.5	0.75	°C
Correction factor for MFF_MAX_CP					
IP_RATIO_FUEL_MAX_CP_MOD_0	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_N_32_2_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MAF_2_EVAC	12	0... FFH	0... 1389	5.4470588	mg/stk
Maximum fuel flow through the CPS at MOD_0					
IP_RATIO_FUEL_MAX_CP_MOD_1	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_N_32_2_EVAC	12	0... FFH	0... 8160	32	rpm
LDP_TQI_SP_S_IP_RATIO_FUEL_MAX	12	0... 7FFFH	0... 1023.96875	0.03125	Nm
Maximum fuel flow through the CPS at MOD_1					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_RATIO_FUEL_MAX_CP_MOD_2	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_N_32_2_EVAC	12	0... FFH	0... 8160	32	rpm
LDP_TQI_SP_S_IP_RATIO_FUEL_MAX	12	0... 7FFFH	0... 1023.96875	0.03125	Nm
Maximum fuel flow through the CPS at MOD_2					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_FAC_FLOW_SP_MIN_PURGE	-	0... 1H	0 ...1	1	-
switch to activate /deactiate "intelligent MIN_PURGE"					

**DI version**

Input data table order: External inputs - Inputs from other EVAC modules

**General information:**

This module provides the flow setpoint for MIN\_PURGE and the FUEL\_FLOW setpoint for closed loop purge ("normal purge").

**Application conditions****Initialisation:**

*on activation and on deactivation:*

```

FLOW_CPS_SP_MIN_PURGE = 0
RATIO_FUEL_SP_MAX_PURGE = 0
MFF_MAX_CP = 0
FLOW_MAX_CPS = 0
FLOW_MAX_PHY_CPS = 0

```

**Recurrence:**

*100 ms*

**Activation:**

*LV\_CP\_ACT = 1*

**Deactivation**

*LV\_CP\_ACT = 0*

**Formula section:**

// Flow setpoint for MIN\_PURGE & fuel flow ratio for closed loop

**case selection of STATE\_OPM\_ENG\_CP****ENG\_MOD\_0:**

```

FLOW_CPS_SP_MIN_PURGE =
    IP_FLOW_CPS_ENG_MOD_0 (N_32, MAF_SP_TQI)
RATIO_FUEL_SP_MAX_PURGE =
    IP_RATIO_FUEL_MAX_CP_ENG_MOD_0 (N_32, MAF_SP_TQI)

```

**ENG\_MOD\_1:**

```

FLOW_CPS_SP_MIN_PURGE =
    IP_FLOW_CPS_ENG_MOD_1 (N_32, TQI_SP_S)
RATIO_FUEL_SP_MAX_PURGE =
    IP_RATIO_FUEL_MAX_CP_ENG_MOD_1 (N_32, TQI_SP_S)


```

**ENG\_MOD\_2:**

```

FLOW_CPS_SP_MIN_PURGE =
    IP_FLOW_CPS_ENG_MOD_2 (N_32, TQI_SP_S)
RATIO_FUEL_SP_MAX_PURGE =
    IP_RATIO_FUEL_MAX_CP_ENG_MOD_2 (N_32, TQI_SP_S)

```

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**End case selection**

```

if    LC_LAM_CBK_CPS=0                                // cylinder bank selection
then  TMP_MFF_SP = MFF_SP_HOM_ENG[1]
else  TMP_MFF_SP = MFF_SP_HOM_ENG[2]
endif
end

// Flow setpoint for MAX_PURGE
FLOW_MAX_PHY_CPS      = IP_FLOW_CPS (PRS_CPS)


if FTL < C_FTL_MIN_FLOW_COR_CP
then
FAC_FLOW_COR_CLL_CP =
IP_FAC_FLOW_COR_AMP_CP(AMP)
* IP_FAC_FLOW_COR_AMP_DELTA_CP(AMP_DELTA_IT_CP)
else
FAC_FLOW_COR_CLL_CP =
IP_FAC_FLOW_COR_AMP_CP(AMP)
* IP_FAC_FLOW_COR_AMP_DELTA_CP(AMP_DELTA_IT_CP)
* C_FAC_FLOW_COR_FTL_CP
endif

if    STATE_OPM_ENG_CP = 0
then  FLOW_MAX_CPS      = min [ IP_FLOW_MAX_CPS (N_32, MAF_SP_TQI),
                                FLOW_MAX_PHY_CPS] * FAC_FLOW_COR_CLL_CP
else   FLOW_MAX_CPS      = min [ IP_FLOW_MAX_2_CPS (N_32, MFF_SP_MV),
                                FLOW_MAX_PHY_CPS] * FAC_FLOW_COR_CLL_CP
endif

// "intelligent MIN_PURGE"
if    LV_CL_CLC_VLD                                = 1
and   LC_FAC_FLOW_SP_MIN_PURGE                    = 1
then  FAC_FLOW_SP_MIN_PURGE =
        min [ C_FAC_FLOW_SP_MIN_PURGE_MAX,
              C_CL_MAX_MIN_PURGE /CL_MMV
              * IP_FAC_FLOW_SP_MIN_PURGE (CL_MMV) ]
else  FAC_FLOW_SP_MIN_PURGE                    = 1
endif
FLOW_CPS_SP_MIN_PURGE =
        min [ FLOW_CPS_SP_MIN_PURGE * FAC_FLOW_SP_MIN_PURGE,
              FLOW_MAX_CPS]

moved here from EVAC management
// maximum CP fuel mass for closed loop
MFF_KGH_MAX_CP = [TMP_MFF_SP - C_MFF_MIN_CP] * (N_32 * NC_CYL_NR * 3) /105
mff_min from FMSP or INJR to be included according to old formula:
MFF_MAX_CP= [TMP_MFF_SP - C_MFF_MIN_CP - MFF_MIN_CP]
MFF_MAX_CP =
        min [MFF_SP_MV * RATIO_FUEL_SP_MAX_PURGE *


```

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IP\_RATIO\_FUEL\_MAX\_CP\_COR (TCO), MFF\_KGH\_MAX\_CP]

end

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## 9.14 Evaporative emission control


### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CL_MMV_CLC_END	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Canister load at the end of MAX_PURGE operation					
FAC_TIA_AMP_CP	V	0... FFH	0... 1.99218	0.0078125	-
Flow correction versus air temperature and ambient pressure					
FLOW_COR_CPS	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
CPS flow setpoint, ambient conditions corrected, passed to valve control					
FLOW_CPS	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
CPS flow, pseudo-feedback value (limited to physical maximum)					
FLOW_CPS_OLD_1	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Old value (n-1) of FLOW_CPS for Pad Filter calculation for FLOW_DLY_CP					
FLOW_CPS_OLD_2	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Old value (n-2) of FLOW_CPS for Pad Filter calculation for FLOW_DLY_CP					
FLOW_CTL_CPS	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
CPS flow setpoint, EVAC internal setpoint					
FLOW_CTL_CPS_DI	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Flow through the CPS for disabled NORMAL_PURGE operation					
FLOW_DLY_CP	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Pad filter: filtered value of FLOW_CPS					
FLOW_DLY_MMV_CP	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Lowpass filter: filtered value of FLOW_DLY_CP					
FLOW_DLY_OLD_1_CP	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Old value (n-1) of FLOW_DLY_CP for Pad Filter calculation for FLOW_DLY_CP					
FLOW_DLY_OLD_2_CP	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Old value (n-2) of FLOW_DLY_CP for Pad Filter calculation for FLOW_DLY_CP					
FLOW_FAC_CP	V	0... FFFFH	0... 3.99993	61e-6	-
correction factor for flow decrementation during RAMP_CLOSE ramp					
FLOW_GRD_CPS	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Flow gradient (flow change /20ms) to be applied (may be added or subtracted)					
FLOW_INC_CTR_TMP	-	0... FFH	0... 255	1	-
temporary variable: counter of incrementation steps during RAMP_OPEN & RAMP_OPEN_FAST					
FLOW_SP_CPS	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
CPS flow setpoint, after merge of all flow requests					
FLOW_TAR_CPS	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
CPS flow setpoint, target flow setpoint to be reached after ramping					
FLOW_TOT_CPS	V	0... FFFFFFFFH	0... 1455.99999	339e-9	g
Total of FLOW_CPS during emission cycle					
LV_CL_CLC_AVL	O/V	0... 1H	0 ...1	1	-
interface flag to cat.diag.: cl known;					
LV_CL_CLC_VLD	O/V	0... 1H	0 ...1	1	-
actual CL value usable for "intelligent MIN_PURGE"					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CL_MDL_CAT_PURGE_ACT_CP	O/V	0... 1H	0 ...1	1	-
Max purge state active at catalyst purge with canister load model					
LV_CP_ACT_REQ	O/V	0... 1H	0 ...1	1	-
Request to inhibit Catalyst and O2 sensor diagnosis for allowing purge canister activation					
LV_CP_AFL_IT	-	0... 1H	0 ...1	1	-
temporary variable: internal copy of lv_afl (0: rich; 1: lean)					
LV_CP_CDN_RAMP_OPEN	O/V	0... 1H	0 ...1	1	-
RAMP_OPEN now possible					
LV_CP_CDN_RAMP_OPEN_FAST	V	0... 1H	0 ...1	1	-
RAMP_OPEN_FAST now possible					
LV_CP_CLL	O/V	0... 1H	0 ...1	1	-
=1: CP currently in close loop operation (=NORMAL_PURGE)					
LV_CP_RAMP_OPEN_ACT	O/V	0... 1H	0 ...1	1	-
Logical value for active RAMP_OPEN operation					
LV_DLY_GAS_CP	V	0... 1H	0 ...1	1	-
=0: waiting for gas transfer time before further flow incrementation in RAMP_OPEN /RAMP_OPEN_FAST					
LV_RAMP_OPEN_ACT	O/V	0... 1H	0 ...1	1	-
Logical value for active RAMP_OPEN operation					
LV_STATE_MEM_CP_CLL	O/V	0... 1H	0 ...1	1	-
=1: last STATE_CP is a NORMAL_PURGE state					
LV_T_DLY_REQ_CP	V	0... 1H	0 ...1	1	-
C_T_DLY_REQ_CP time elapsed					
MAF_CP	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
(MAF_KGH throttle) MAF_KGH_THR + (Mass air flow through the canister purge valve) MAF_CPS					
MAF_CP_OLD_1	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Old value (n-1) of MAF_CP for Pad Filter calculation for MAF_DLY_CP					
MAF_CP_OLD_2	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Old value (n-2) of MAF_CP for Pad Filter calculation for MAF_DLY_CP					
MAF_CPS	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
MAF through the CPS					
MAF_CPS_OLD_1	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Old value (n-1) of MAF_CPS for Pad Filter calculation for MAF_DLY_CPS					
MAF_CPS_OLD_2	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Old value (n-2) of MAF_CPS for Pad Filter calculation for MAF_DLY_CPS					
MAF_DLY_CP	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Pad filter: filtered value of MAF_CP					
MAF_DLY_CPS	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Pad filter: filtered value of MAF_CPS					
MAF_DLY_MMV_CP	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Lowpass filter: filtered value of MAF_DLY_CP					
MAF_DLY_MMV_CPS	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Lowpass filter: filtered value of MAF_DLY_CPS					
MAF_DLY_OLD_1_CP	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Old value (n-1) of MAF_DLY_CP for Pad Filter calculation for MAF_DLY_CP					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MAF_DLY_OLD_1_CPS	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Old value (n-1) of MAF_DLY_CPS for Pad Filter calculation for MAF_DLY_CPS					
MAF_DLY_OLD_2_CP	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Old value (n-2) of MAF_DLY_CP for Pad Filter calculation for MAF_DLY_CP					
MAF_DLY_OLD_2_CPS	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Old value (n-2) of MAF_DLY_CPS for Pad Filter calculation for MAF_DLY_CPS					
MAF_INT_CP	V	0... FFFFH	0... 1820.42	0.0277778	g
MAF integral for lambda controller stabilisation in Wait Ramp Open					
PQ_CP_SP	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
PQ-setpoint for canister purge					
PQ_SP_CP_TMP	-	0... FFFFH	0... 0.99998	15.3e-6	-
temporary variable for PQ_SP_CP calculation					
STATE_CLL_DEAC_CP	O/V	0H 1H 2H 3H undef:1H	CP_NO_DEAC RAMP_OPEN_ DEAC MAX_PURGE_ DEAC RAMP_FAST_ DEAC	-	-
Deactivation states of the Evaporative Emission Control					
STATE_CP	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H AH BH	CP_NOT_ACT NO_PURGE RAMP_TO_ NO_PURGE WAIT_RAMP_ OPEN MIN_PURGE - - - RAMP_OPEN RAMP_OPEN_ FAST MAX_PURGE RAMP_CLOSE	-	-
State of Evaporative Emission Control Function					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_LOCK_CP	O/V	0H 1H 2H undef:1H	UNLOCKED NO_PURGE_ LOCKED MIN_PURGE_ LOCKED	-	-
STATE_CP locked in this state					
T_DI_CP	V	0... FFFFH	0... 6553.5	0.1	s
time counter for disabled RAMP_OPEN, RAMP_OPEN_FAST or MAX_PURGE					
T_DLY_CL_MDL	O/V	0... FFFFH	0... 6553.5	0.1	s
Time counter to activate CL-Model if lambda gradient greater than a threshold					
T_DLY_CP	V	0... FFFFH	0... 6553.5	0.1	s
lambda controller stabilisation time counter					
T_DLY_CP_OPEN	V	0... FFFFH	0... 6553.5	0.1	s
Time counter for gas transfer time waiting in RAMP_OPEN and RAMP_OPEN_FAST					
T_DLY_MAX_CP	O/V	0... FFFFH	0... 6553.5	0.1	s
Time counter between the end of a MAX_PURGE and a new learning request (distinction between RAMP_OPEN and RAMP_OPEN_FAST)					
T_DLY_REQ_CP_TMP	-	0... FFFFH	0... 65535	1	s
temporary variable: timer for LV_T_DLY_REQ_CP calculation					
T_LOCK_CP_TMP	V	0... FFFFH	0... 1310.7	0.02	s
Time counter for locking MIN_PURGE or NO_PURGE after canister empty detection					
T_MAF_INT_CP	V	0... FFFFH	0... 6553.5	0.1	s
Time limitation for MAF integration at state Wait Ramp Open					

**Input data:**

AMP {p. 982}	CL {p. 3698}	CL_MMV {p. 3698}	FAC_FLOW_COR_CLL_CP {p. 3630}
FAC_FLOW_COR_CP_EXT {p. 3679}	FAC_FLOW_TAR_COR_CP {p. 3679}	FLOW_CPS_SP_MIN_PURGE {p. 3630}	FLOW_MAX_CPS {p. 3630}
FLOW_MAX_PHY_CPS {p. 3630}	FLOW_SP_CPS_EVAP {p. 1001}	LC_CP_CLL_INH_MAN {p. 1544}	LV_CL_MDL_ACT {p. 3728}
LV_CL_MDL_ENA {p. 3728}	LV_CP_ACT {p. 3679}	LV_CP_AFL {p. 3699}	LV_CP_CAT_PURGE {p. 1540}
LV_CP_CDN_MIN_PURGE_FAST {p. 1540}	LV_CP_CLOSE_1 {p. 3679}	LV_CP_CLOSE_2 {p. 3679}	LV_CP_CLOSE_REQ {p. 1540}
LV_CP_CMU_CMB {p. 1540}	LV_CP_ENA {p. 3737}	LV_CP_NEW_RAMP_OPEN {p. 3699}	LV_CP_NEW_RAMP_OPEN_FAST {p. 3699}
LV_CPS_AD_ACT {p. 3756}	LV_DIAGCP_CPS_ACT {p. 1001}	LV_FAC_LAM_SHIFT_CP_AVL {p. 3699}	LV_FLOW_TAR_COR_CP {p. 3679}
LV_HOM_ACT {p. 8136}	LV_HOM_AFL_ACT {p. 8136}	LV_N_MAX_CP {p. 1540}	MAF {p. 8277}
MAF_CYL {p. 8277}	MAF_KGH_FG_PRED_COR_CP {p. 3692}	MAF_THR {p. 8278}	MFF_BUF_CP {p. 3692}

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MFF_CP {p. 3700}	MFF_MAX_CP {p. 3630}	MFF_SP_MV {p. 2151}	N_32 {p. 1525}
NC_CYL_NR {p. 1526}	PRS_CPS {p. 1540}	STATE_CDN_CP {p. 1541}	STATE_OPM_ENG_CP {p. 3680}
T_RAMP_OPEN_STAB {p. 3701}	TIA_THR {p. 984}	TQI_SP_S {p. 8391}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_CAT_DIAG	-	0... FFFFH	0... 1.99996	30.5e-6	-
Canister load threshold to enable cat.diag. in MIN_PURGE (if cl < thd)					
C_CL_MMV_PQ	-	0... FFFFH	0... 1.99996	30.5e-6	-
CL_MMV threshold to force PQ in Max purge during strat. or Hom. lean burn modes					
C_CL_MMV_REQ	-	0... FFFFH	0... 1.99996	30.5e-6	-
CL_MMV limit value to give priority to purge canister					
C_CRLC_PQ_SP_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
correlation constant to calculate PQ_SP_CP					
C_FAC_DEC_COR_1_CP	-	0... FFFFH	0... 3.99993	61e-6	-
correction factor for closing ramp speed when high closing speed requested from OBD sequencer					
C_FAC_DEC_COR_2_CP	-	0... FFFFH	0... 3.99993	61e-6	-
correction factor for closing ramp speed when medium closing speed requested from OBD sequencer					
C_FAC_DEC_COR_CMU_CP	-	0... FFFFH	0... 3.99993	61e-6	-
correction factor for closing ramp speed when combustion commutation requested					
C_FAC_FLOW_CAT_PURGE_CP	-	0... FFFFH	0... 3.99993	61e-6	-
Flow reduction factor at MaxPurge at Cat-purge with CL-Model activation					
C_FAC_FLOW_CAT_PURGE_INI_CP	-	0... FFFFH	0... 3.99993	61e-6	-
Flow reduction factor at reentry of MaxPurge at Cat-purge with CL-Model activation					
C_FAC_FLOW_MAX_INI_CP	-	0... FFH	0... 0.99609	3.9063e-3	-
Factor to limit FLOW_CTL_CPS at re-entering MAX_PURGE for low canister load					
C_FAC_T_DLY_PURGE_TUBE_CP	-	0... FFFFH	0... 3.99993	61e-6	-
Factor for Gas delay time in Wait Ramp Open					
C_FLOW_CPS_AS	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
FLOW_SP_CPS correction of application system					
C_FLOW_CPS_GRD_PURGE_TUBE	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Flow gradient for tube purging in WAIT_RAMP_OPEN					
C_FLOW_CPS_GRD_PURGE_TUBE_CLOSE	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Flow gradient for tube purging in WAIT_RAMP_OPEN (at closing cps)					
C_FLOW_CPS_SP_PURGE_TUBE	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Flow setpoint for tube purging in WAIT_RAMP_OPEN					
C_FLOW_DLY_CRLC_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for FLOW_DLY_CP-filter					
C_FLOW_INI_CPS	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
FLOW_CTL_CPS initialization value					
C_MAF_DLY_CRLC_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for MAF_DLY_CP-filter					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_DLY_CRLC_CPS	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for MAF_CPS_DLY-filter					
C_MAF_INT_MAX_CP_0	-	0... FFFFH	0... 1820.42	0.0277778	g
MAF integral threshold for lambda controller stabilisation in Wait Ramp Open (ENG_MODE = 0)					
C_MAF_INT_MAX_CP_1	-	0... FFFFH	0... 1820.42	0.0277778	g
MAF integral threshold for lambda controller stabilisation in Wait Ramp Open (ENG_MODE != 0)					
C_MFF_MAX_CPS_DI	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Max. MFF for flow through cps on reentering MAX_PURGE					
C_MFF_RATIO_FLOW_INI_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
Fuel Ratio for calculation of flow setpoint at re-entry in Max Purge					
C_T_CP_PURGE_TUBE	-	0... FFFFH	0... 6553.5	0.1	s
Time at the start of WAIT_RAMP_OPEN wherein the purge tube may be purged itself					
C_T_DI_MAX_CP_0	-	1... FFFFH	0.1... 6553.5	0.1	s
Maximum time for disabling MAX_PURGE operation (ENG_MODE = 0)					
C_T_DI_MAX_CP_1	-	1... FFFFH	0.1... 6553.5	0.1	s
Maximum time for disabling MAX_PURGE operation (ENG_MODE != 0)					
C_T_DI_RAMP_FAST_CP_0	-	1... FFFFH	0.1... 6553.5	0.1	s
Maximum time for disabling RAMP_OPEN_FAST operation (ENG_MODE = 0)					
C_T_DI_RAMP_FAST_CP_1	-	1... FFFFH	0.1... 6553.5	0.1	s
Maximum time for disabling RAMP_OPEN_FAST operation (ENG_MODE != 0)					
C_T_DI_RAMP_OPEN_CP_0	-	1... FFFFH	0.1... 6553.5	0.1	s
Maximum time for disabling RAMP_OPEN operation (ENG_MODE = 0)					
C_T_DI_RAMP_OPEN_CP_1	-	1... FFFFH	0.1... 6553.5	0.1	s
Maximum time for disabling RAMP_OPEN operation (ENG_MODE != 0)					
C_T_DLY_CL_MDL	-	0... FFFFH	0... 6553.5	0.1	s
Time to activate CL-Model					
C_T_DLY_CP	-	1... FFFFH	0.1... 6553.5	0.1	s
Time for lambda control stabiliztion before to start RAMP_OPEN or RAMP_OPEN_FAST					
C_T_DLY_MAX_CP_0	-	0... FFFFH	0... 6553.5	0.1	s
Time between two MAX_PURGE operation for RAMP_OPEN_FAST activation (ENG_MODE = 0)					
C_T_DLY_MAX_CP_1	-	0... FFFFH	0... 6553.5	0.1	s
Time between two MAX_PURGE operation for RAMP_OPEN_FAST activation (ENG_MODE != 0)					
C_T_DLY_REQ_CP	-	0... FFFFH	0... 65535	1	s
Time to set LV_T_DLY_REQ_CP					
C_T_LOCK_CP	-	0... FFFFH	0... 1310.7	0.02	s
Locking time for locking MIN_PURGE or NO_PURGE after canister empty detection					
C_T_MAX_MAF_INT_CP_0	-	0... FFFFH	0... 6553.5	0.1	s
Maximum runtime of MAF integration as stabilisation time for the lambda controller (ENG_MODE = 0)					
C_T_MAX_MAF_INT_CP_1	-	0... FFFFH	0... 6553.5	0.1	s
Maximum runtime of MAF integration as stabilisation time for the lambda controller (ENG_MODE != 0)					
C_T_MIN_MAF_INT_CP_0	-	0... FFFFH	0... 6553.5	0.1	s
Minimum runtime of MAF integration as stabilisation time for the lambda controller (ENG_MODE = 0)					
C_T_MIN_MAF_INT_CP_1	-	0... FFFFH	0... 6553.5	0.1	s
Minimum runtime of MAF integration as stabilisation time for the lambda controller (ENG_MODE != 0)					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_FLOW_INC_NR_CP	-	1... FFH	1... 255	1	-
LDP_N_32_ID_FLOW_INC_NR_CP	4	0... FFH	0... 8160	32	rpm
Increment number for FLOW_CTL_CPS calculation during RO and ROF (steps 20ms)					
IP_FAC_AMP_CP	-	0... FFH	0... 1.99218	0.0078125	-
LDPM_AMP_1_EVAC	6	0... FFFFH	0... 5434	0.0829175	hPa
Correction factor for ambient pressure					
IP_FAC_TIA_CP	-	0... FFH	0... 1.99218	0.0078125	-
LDP_TIA_THR_IP_FAC_TIA_CP	6	0... FEH	-48... 142.5	0.75	°C
Correction factor for intake air temperature					
IP_FLOW_CPS_DEC	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_MFF_SP_MV_1_EVAC	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Decrement value on FLOW_CTL_CPS during MAX_PURGE					
IP_FLOW_CPS_INC	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_MFF_SP_MV_1_EVAC	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Increment value on FLOW_CTL_CPS during MAX_PURGE					
IP_FLOW_DEC_CP	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_MFF_SP_MV_1_EVAC	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Decrement value for ramp decrease of FLOW_CTL_CPS					
IP_FLOW_FAC_CP	-	0... FFFFH	0... 3.99993	61e-6	-
LDP_CL_IP_FLOW_FAC	6	0... FFFFH	0... 1.99996	30.5e-6	-
Correction factor for ramp increase of FLOW_CTL_CPS					
IP_FLOW_INC_COR_HOM_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Correction of FLOW_GRD_CPS in homogen mode					
IP_FLOW_INC_CP	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_MFF_SP_MV_1_EVAC	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Increment value for ramp increase of FLOW_CTL_CPS in Ramp open mode					
IP_FLOW_INC_FAST_CP	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_MFF_SP_MV_1_EVAC	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Increment value for ramp increase of FLOW_CTL_CPS in Ramp Open Fast mode					
IP_FLOW_MAX_OPEN_CPS	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_N_32_2_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MAF_2_EVAC	12	0... FFH	0... 1389	5.4470588	mg/stk
Maximum limit for FLOW_CTL_CPS value for RAMP_OPEN & RAMP_OPEN_FAST					
IP_FLOW_MAX_OPEN_CPS_2	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_N_32_2_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_MV_2_EVAC	12	0... FFFFH	0... 1389	0.0211948	mg/stk
Max. limit for FLOW_CTL_CPS value for RAMP_OPEN & RAMP_OPEN_FAST with STATE_OPM_ENG_CP = 1					
IP_PQ_CP_SP	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_N_32_1_EVAC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_SP_S_2_EVAC	6	0... 7FFFH	0... 1023.97	0.03125	Nm
Forced PQ during stratified mode for RAMP_OPEN & MAX_PURGE					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_T_DLY_CL_MMV_DYW	-	1... FFFFH	0.1... 6553.5	0.1	s
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Stabilization delay on CL_MMV value during RAMP_OPEN					
IP_T_DLY_CP	-	0... FFFFH	0... 63.99902	976.599e-6	-
LDPM_MAF_KGH_COR_IP_T_DLY_CP	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Time delay for MAF_CYL (delay time (s) /time recurrence(0.1s))					
IP_T_DLY_CP_2	-	0... FFFFH	0... 63.99902	976.599e-6	-
LDPM_MAF_KGH_COR_IP_T_DLY_CP	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Time delay for MAF_CYL (delay time (s) /time recurrence(0.1s)) with STATE_OPM_ENG_CP = 1					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_MOD_SEL_CP	-	0H	SEL_NO_PURGE	-	-
		1H	SEL_MIN_PURGE		
		2H	SEL_MAX_PURGE		
		3H	SEL_RAMP_CLOSE		
		undef:1H	CLOSE		
selection of the purge mode with empty canister detected at end of RAMP_OPEN					
LC_CP_CAT_PURGE_MDL_ACT	-	0... 1H	0 ...1	1	-
transition to Wait-RO at cat-purge will inhibited due to usage of CL modell					
LC_CP_FLOW_LIM_OPEN_FAST	-	0... 1H	0 ...1	1	-
enable old calc. of FLOW_TAR_CPS during ROF: fuel mass based					
LC_CP_TRA_MAX_MIN_CDN_ENA	-	0... 1H	0 ...1	1	-
enable transition MAX_PURGE ( MIN_PURGE with STATE_CDN_CP = NO_CDN					
LC_CP_TRA_MIN_PURGE_DFT_ENA	-	0... 1H	0 ...1	1	-
1: enable transition NO_PURGE ( MIN_PURGE with STATE_CDN_CP = NO_CDN					
LC_CP_TRA_MIN_RAMP_OPEN_DIS	-	0... 1H	0 ...1	1	-
enable trans. NO_PURGE ( MIN_PURGE, if no RO or ROF is possible although STATE_CDN_CP=RO or ROF					
LC_CP_TRA_OPL_CDN_CLL_NOT	-	0... 1H	0 ...1	1	-
enable transition WAIT_RAMP_OPEN ( NO_PURGE if LV_CP_CDN_RAMP_OPEN, _FAST no more given					
LC_CP_TRA_OPL_CDN_NOT	-	0... 1H	0 ...1	1	-
enable transition WAIT_RAMP_OPEN ( NO_PURGE if STATE_CDN_CP = NO_CDN					
LC_CP_TRAN_DEAC_CLL	-	0... 1H	0 ...1	1	-
1: enable transition back to RAMP_OPEN_FAST after interruption					
LC_CP_TRAN_OPEN_MAX_ENA	-	0... 1H	0 ...1	1	-
enable transition RO ( MaxP if flow target reached					
LC_FLOW_CPS_AS	-	0... 1H	0 ...1	1	-
C_FLOW_CPS_AS activation					
LC_LAM_LIN_CPS	-	0... 1H	0 ...1	1	-
Type of O2 sensor (0 -> binary sensor , 1 -> linear sensor)					
LC_PQ_SP_CP_HOM_AFL	-	0... 1H	0 ...1	1	-
switch to enable forced pq during hom_afl operation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**Import actions:**

ACTION_EVAM_Purge ()
----------------------

**Should be calculated before LACO calculation!**


Input data table order: External inputs - Inputs from other EVAC modules

**Hint:** For each operating point, the corresponding value of IP\_FLOW\_MAX\_OPEN\_CPS and IP\_FLOW\_MAX\_OPEN\_CPS\_2 must not exceed the corresponding value of IP\_FLOW\_MAX\_CPS.

**General information****General information:**

The evaporative emissions of the fuel tank system are stored in an activated charcoal filter ACF to prevent an escape of the gas to the environment. The loading capacity of the filter is limited, so the filter must be purged temporarily. Therefore the canister purge solenoid CPS, that is positioned between the charcoal filter and the intake manifold is opened by the engine management system. To prevent driveability and emission problems, the opening of the CPS and so the purge flow MFF\_CP must be controlled.

With the Evaporative Emission Control function, the opening of the CPS is controlled in dependence with the fuel mass stored in the canister. Therefore the canister load cl is calculated using the measured mass air flow MAF, the deviation of the lambda-control when the CPS is opened, the mass flow through the CPS and the stoichiometric constant of the fuel (14.7). The opening of the CPS is controlled in dependence with the canister load CL.

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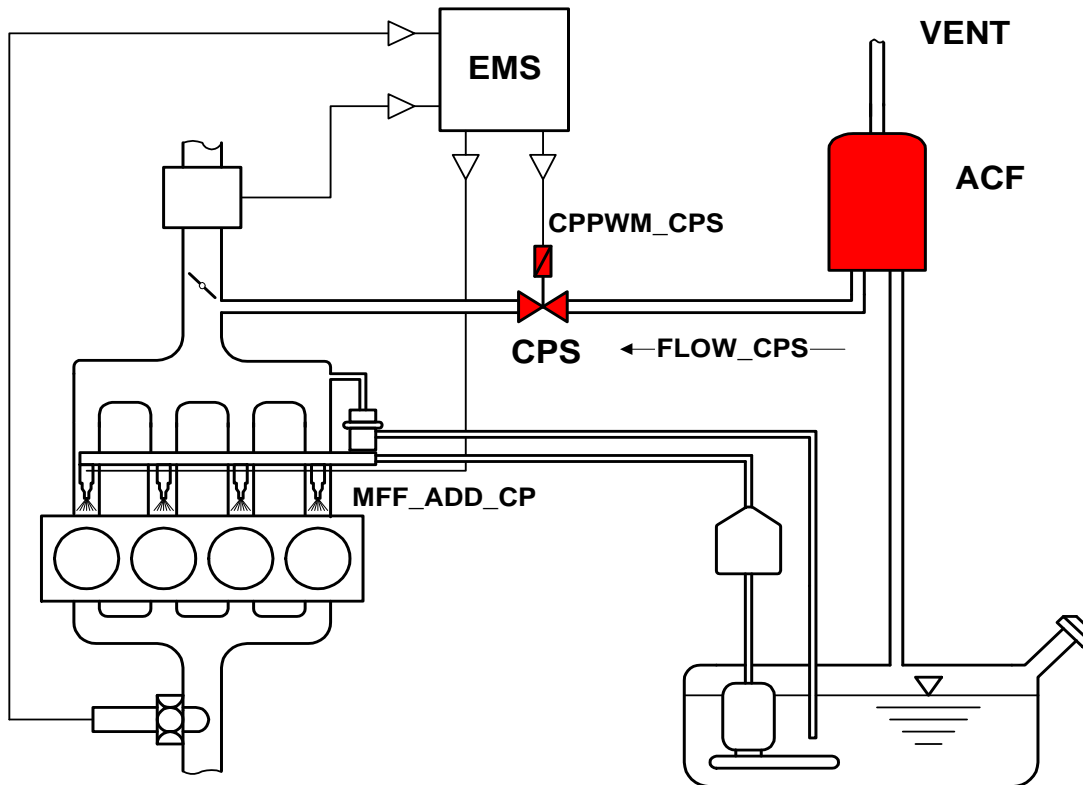


Figure 9.14.1: : evaporative emission control system

### Application conditions

**Initialisation:** at RST, IGKON or transition to CP\_NOT\_ACT:

```

PQ_CP_SP      = 1
STATE_CP      = CP_NOT_ACT
STATE_CLL_DEAC_CP = CP_NO_DEAC
STATE_LOCK_CP = UNLOCKED
all other values = 0

```

**Recurrence:** 20 ms

**Activation:** - -

**Deactivation:** - -

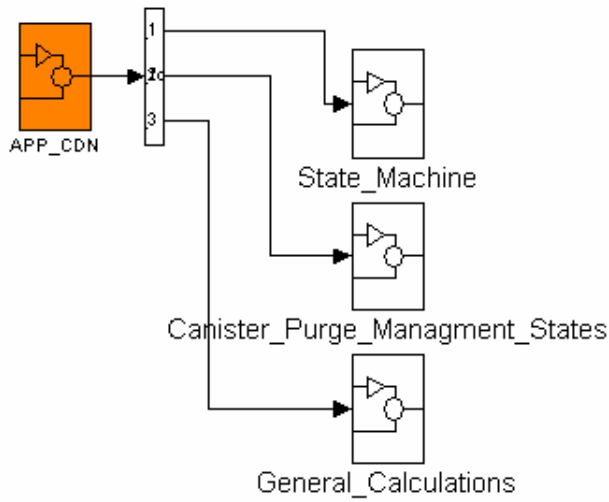


Figure 9.14.2: : structure of the evaporative emission control

#### Formula section:

```

call "State machine"
call "Canister purge management states"
call "General calculations"
end

```

#### **Temporary adaptation flags :**

```
LV_RAMP_OPEN_ACT = LV_CP_RAMP_OPEN_ACT
```

### 9.14.1 State machine

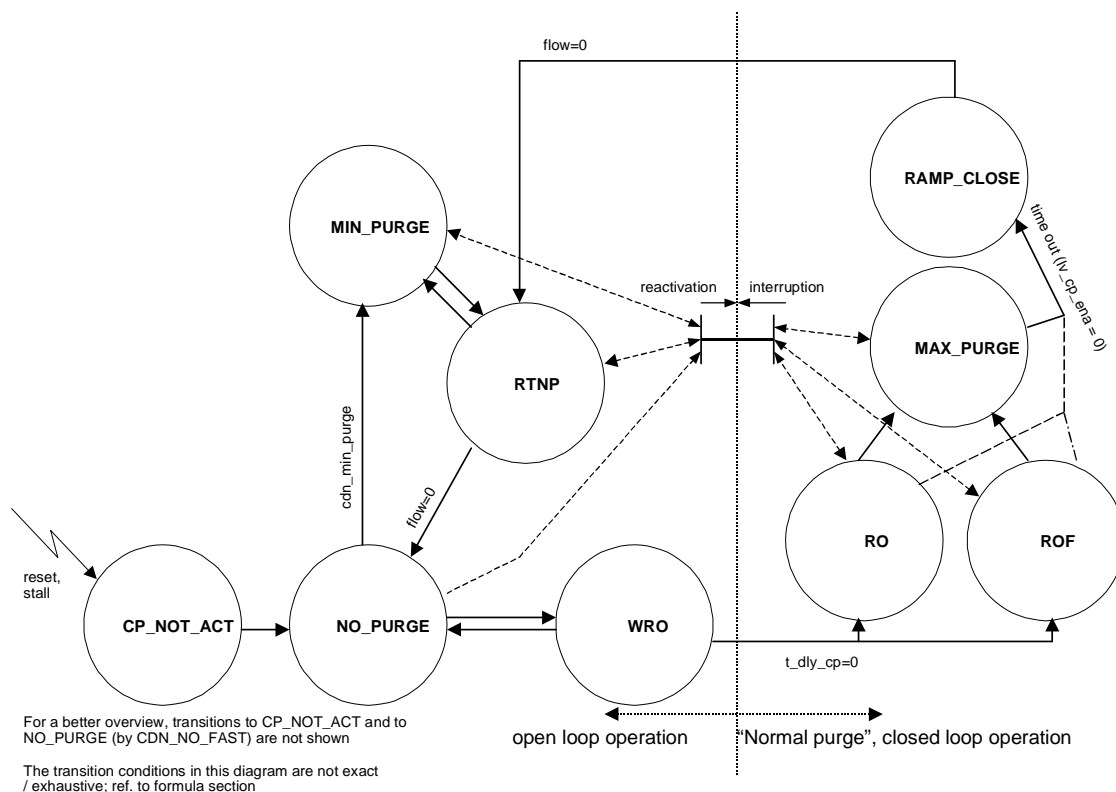


Figure 9.14.3: : State machine (simplified)

The canister purge control has the following states:

- CP\_NOT\_ACT                                 function inactive, initial state
- NO\_PURGE                                    Valve closed, no purging.
- RAMP\_TO\_NO\_PURGE                       Flow is currently ramped down from purging level to zero
- MIN\_PURGE                                 open loop purge with low flow
- WAIT\_RAMP\_OPEN                         waiting for lambda control stabilisation before leaning mode
- RAMP\_OPEN                                 Slow opening of the valve, learning mode
- RAMP\_OPEN\_FAST                         Faster opening of the valve; cl known from previous purge
- MAX\_PURGE                                 Controlled canister purge with high flow through the ACF
- RAMP\_CLOSE                                Closing of the valve at the end of controlled operation

#### 9.14.1.1 Brief description of the activation conditions of the different states

##### General information:

In the following, a brief description of the conditions of each state is given, this description is only for information and is not precise. In general, if the conditions below are met, the state described will be active.

The detailed conditions for transitions from each state to each other possible state and the actions to be done on the transitions are described in the next chapter “State Transitions”.

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The “controlled states” are RAMP\_OPEN, RAMP\_OPEN\_FAST, MAX\_PURGE & RAMP\_CLOSE.  
The “non-controlled states” are NO\_PURGE, RAMP\_TO\_NO\_PURGE, MIN\_PURGE and WAIT\_RAMP\_OPEN.

**NORMAL\_PURGE Operation (closed loop operation)**

If the conditions for NORMAL\_PURGE are fulfilled, the NORMAL\_PURGE operation is proceeded in the following sequences:

RAMP\_OPEN                      MAX\_PURGE                      RAMP\_CLOSE  
or RAMP\_OPEN\_FAST              MAX\_PURGE                      RAMP\_CLOSE

These sequences can change, if one of the phases is disabled for a short time and the interrupt is not longer than an applicable time constant

- C\_T\_DI\_RAMP\_OPEN\_CP\_0/\_1 (STATE\_CLL\_DEAC\_CP = RAMP\_OPEN\_DEAC) **or**
- C\_T\_DI\_MAX\_CP\_0/\_1 (STATE\_CLL\_DEAC\_CP = MAX\_PURGE\_DEAC) **or**
- C\_T\_DI\_RAMP\_FAST\_CP\_0/\_1 (STATE\_CLL\_DEAC\_CP = RAMP\_FAST\_DEAC)

If RAMP\_OPEN, RAMP\_OPEN\_FAST or MAX\_PURGE operation was interrupted (any non-controlled state active) and the interruption time is lower than the adjustable times C\_T\_DI\_RAMP\_OPEN\_CP\_0/\_1, C\_T\_DI\_RAMP\_FAST\_CP\_0/\_1 resp. C\_T\_DI\_MAX\_CP\_0/\_1, RAMP\_OPEN, RAMP\_OPEN\_FAST or MAX\_PURGE operation starts immediately with the values which were stored when the operation was interrupted.

When the interruption times are longer than the corresponding constants, NORMAL\_PURGE states are re-started with a new RAMP\_OPEN /RAMP\_OPEN\_FAST phase. (FLOW\_CTL\_CPS starts with zero.)

**CP\_NOT\_ACT**

Function inactive, initial state

1. Engine stopped or stalled
2. coolant temperature threshold not once exceeded

**NO\_PURGE**

Valve closed, no purging.

1. STATE\_CDN\_CP = CDN\_NO\_PURGE or CDN\_NO\_FAST **and**
2. [Fast shut-off necessary] **or**
3. ramp from purge states to NO\_PURGE finished ]

**RAMP\_TO\_NO\_PURGE**

Flow is currently ramped down from purging level to zero

If fast shut-off is necessary, the state machine will directly switch to NO\_PURGE (immediate valve closing without ramp), otherwise, RAMP\_TO\_NO\_PURGE will be active as long as the valve is closed by a ramp

1. STATE\_CDN\_CP = CDN\_NO\_PURGE **and**
2. Fast shut-off not necessary **and**
3. Ramp from purge states to NO\_PURGE not finished **and**
4. [Previous state was MIN\_PURGE or WAIT\_RAMP\_OPEN] **and** time  
out from time scheduler LV\_CP\_ENA = 0 ]

An immediate switch to NO\_PURGE without ramp is requested by STATE\_CDN\_CP = CDN\_NO\_FAST. In this case, FLOW\_CTL\_CPS is directly set to 0, no ramping down will occur.

**MIN\_PURGE**


No controlled purge possible, open loop purge with low flow, thus low disturbance of lambda contro.

1. STATE\_CDN\_CP = CDN\_MIN\_PURGE **or**
2. Empty canister detected at the end of RAMP\_OPEN

**RAMP\_OPEN**

Slow opening of the valve, canister load not known, will be learned during RAMP\_OPEN

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1. STATE\_CDN\_CP = CDN\_RAMP\_OPEN **and**
2. Long time since the last MAX\_PURGE (old cl value no more useable) **and**
3. The time delay for lambda control stabilization is elapsed or not necessary (due to MAX\_PURGE or RAMP\_OPEN disabling). nec-

#### RAMP\_OPEN\_FAST

Faster opening of the valve than in RAMP\_OPEN; cl known from previous normal purge operation

1. STATE\_CDN\_CP = CDN\_RAMP\_FAST **and**
2. Short time since the last MAX\_PURGE (old cl value still useable) **and**
3. The time delay for lambda control stabilization is elapsed or not necessary (due to MAX\_PURGE or RAMP\_OPEN disabling) nec-

#### MAX\_PURGE

Controlled canister purge with high flow through the ACF

1. NO\_PURGE /RAMP\_TO\_NO\_PURGE /MIN\_PURGE not requested **and**
2. RAMP\_OPEN or RAMP\_OPEN\_FAST normally finished **and**
3. Can be directly reached from the non-controlled states, if MAX\_PURGE was previously disabled and disabling time was lower than a threshold (STATE\_CLL\_DEAC\_CP = MAX\_PURGE\_DEAC) dis-
4. Can be entered at catalyst purge with canister load model running MAX\_

#### RAMP\_CLOSE

Closing of the valve at the end of controlled operation

1. NO\_PURGE /RAMP\_TO\_NO\_PURGE /MIN\_PURGE not requested **and**
2. Canister purge time slice elapsed /Lambda adaption time active

### 9.14.1.2 Preliminary calculations

```
LV_CP_CDN_RAMP_OPEN_FAST =
    { [ T_DLY_MAX_CP > 0 // cl from prev. purge useable
or STATE_CLL_DEAC_CP = RAMP_FAST_DEAC ] // re-entry with T_.. = 0
and [ STATE_CDN_CP = CDN_RAMP_FAST
or STATE_CDN_CP = CDN_RAMP_OPEN ]
and LV_CP_NEW_RAMP_OPEN = 0}
// CDN_RAMP_OPEN may be given, although RAMP_OPEN_FAST is preferable
```

```
LV_CP_CDN_RAMP_OPEN =
    [ T_DLY_MAX_CP = 0
and STATE_CDN_CP = CDN_RAMP_OPEN ]
end
```

### 9.14.1.3 CP\_NOT\_ACT

```
if LV_CP_ACT = 0
then STATE_CP = CP_NOT_ACT
else call "INITIALIZATION-VALUES on entering NO_PURGE"
STATE_CP = NO_PURGE
endif
end
```

### 9.14.1.4 NO\_PURGE

```
if LV_CP_ACT = 0
then STATE_CP = CP_NOT_ACT

elseif STATE_CDN_CP = CDN_NO_PURGE
or STATE_CDN_CP = CDN_NO_FAST
```



```

or          LV_CP_ENA      = 0
then       STATE_CP      = NO_PURGE                // stay in NO_PURGE

elseif          STATE_CDN_CP = CDN_MIN_PURGE
then           call "INITIALIZATION-VALUES on leaving NO_PURGE"
                call "INITIALIZATION-VALUES on entering MIN_PURGE"
                STATE_CP      = MIN_PURGE

                // re-entry in Max Purge with activated canister load model at catalyst purge
elseif          STATE_CDN_CP = CDN_RAMP_OPEN
                and LV_CP_CAT_PURGE = 1
                and LV_CL_MDL_ACT = 1
then           call "INITIALIZATION-VALUES on leaving NO_PURGE"
                call "INITIALIZATION-VALUES on entering MAX_PURGE"
                STATE_CP      = MAX_PURGE

                // re-entry in normal purge states after short deactivation
elseif          STATE_CLL_DEAC_CP ≠ CP_NO_DEAC
                and LV_CP_NEW_RAMP_OPEN = 0
                and LV_CP_NEW_RAMP_OPEN_FAST = 0
then case selection on STATE_CLL_DEAC_CP
    RAMP_OPEN_DEAC:
    if          LV_CP_CDN_RAMP_OPEN
    then call   "INITIALIZATION-VALUES on leaving NO_PURGE"
                call "INITIALIZATION-VALUES on entering RAMP_OPEN"
                STATE_CP = RAMP_OPEN
    endif

    RAMP_FAST_DEAC:
    if          [ LV_CP_CDN_RAMP_OPEN_FAST
    and LC_CP_TRAN_DEAC_CLL ] // switch to enable old functionality
    then call   "INITIALIZATION-VALUES on leaving NO_PURGE"
                call "INITIALIZATION-VALUES on entering RAMP_OPEN_FAST"
                STATE_CP = RAMP_OPEN_FAST
    endif


    MAX_PURGE_DEAC:
    call "INITIALIZATION-VALUES on leaving NO_PURGE"
    call "INITIALIZATION-VALUES on entering MAX_PURGE"
    STATE_CP      = MAX_PURGE
end case selection

elseif          (LV_CP_CDN_RAMP_OPEN_FAST or LV_CP_CDN_RAMP_OPEN)
and (!LV_CP_CAT_PURGE or !LC_CP_CAT_PURGE_MDL_ACT)
then           call "INITIALIZATION-VALUES on leaving NO_PURGE"
                call "INITIALIZATION-VALUES on entering WAIT_RAMP_OPEN"
                STATE_CP      = WAIT_RAMP_OPEN

```

No RO possible:

imagine: turn on engine and stay in idle for a long time; STATE\_CDN\_CP = CDN\_RAMP\_OPEN\_FAST (idle), but only RAMP\_OPEN possible as no RO occurred before; we would never purge anything as we would wait in NoPurge.

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New: Possibility to switch to min\_purge in this case (configurable).

Ref. to Thäder-mail 29.04.02

no consideration of lambda control (LV\_LSCL\_i = 1, both benches) necessary, as STATE\_CDN\_CP will be cdn\_min\_purge anyway, if at least one lambda controller is not active

NO\_CDN-management:

As STATE\_CDN\_CP=NO\_CDN is quite new, this state was previously not considered everywhere. If STATE\_CDN\_CP = NO\_CDN, NO\_PURGE is not forced and NORMAL\_PURGE is not possible (except the re-entry in maxpurge after deac), so we may switch to MIN\_PURGE (configurable)

```

elseif      {[STATE_CDN_CP = CDN_RAMP_FAST      // No RO possible
                and          LC_CP_TRA_MIN_RAMP_OPEN_DIS ]
or         [ STATE_CDN_CP = NO_CDN              // NO_CDN-management
                and          LC_CP_TRA_MIN_PURGE_DFT_ENA ]}
and        (!LV_CP_CAT_PURGE or !LC_CP_CAT_PURGE_MDL_ACT)
then        call  "INITIALIZATION-VALUES on leaving NO_PURGE"
                call  "INITIALIZATION-VALUES on entering MIN_PURGE"
                STATE_CP      = MIN_PURGE

else        STATE_CP      = NO_PURGE                // default
endif
end
    
```

**9.14.1.5 RAMP\_TO\_NO\_PURGE**

```

if          LV_CP_ACT      = 0
then        STATE_CP      = CP_NOT_ACT

elseif      STATE_CDN_CP = CDN_NO_FAST
or          FLOW_CTL_CPS = 0                // flow reduction finished
then        call  "INITIALIZATION-VALUES on leaving RAMP_TO_NO_PURGE"
                call  "INITIALIZATION-VALUES on entering NO_PURGE"
                STATE_CP      = NO_PURGE
    
```

if flow\_ctl\_cps reaches 0 in the same moment than a switch to min\_purge would be possible, the switch to no\_purge has now priority. In the next recurrence, a switch from no\_purge to min\_purge will occur. This 20ms delay is seen as neglectable. (The high-end solution would be to check the flow\_ctl\_cps condition only if STATE\_CDN\_CP = cdn\_no\_purge)


```

elseif      STATE_CDN_CP = CDN_NO_PURGE
or          LV_CP_ENA      = 0
then        STATE_CP      = RAMP_TO_NO_PURGE        // stay in actual state

elseif      STATE_CDN_CP = CDN_MIN_PURGE
then        call  "INITIALIZATION-VALUES on leaving RAMP_TO_NO_PURGE"
                call  "INITIALIZATION-VALUES on entering MIN_PURGE"
                STATE_CP      = MIN_PURGE

                // re-entry in normal purge states after short deactivation
elseif      STATE_CLL_DEAC_CP ≠ CP_NO_DEAC
                and  LV_CP_NEW_RAMP_OPEN = 0
                and  LV_CP_NEW_RAMP_OPEN_FAST = 0
then case selection on STATE_CLL_DEAC_CP
                RAMP_OPEN_DEAC:
                if    LV_CP_CDN_RAMP_OPEN
    
```

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```

then call "INITIALIZATION-VALUES on leaving RAMP_TO_NO_PURGE"
           call "INITIALIZATION-VALUES on entering RAMP_OPEN"
           STATE_CP = RAMP_OPEN
endif

```

```

RAMP_FAST_DEAC:
if [ LV_CP_CDN_RAMP_OPEN_FAST
and LC_CP_TRAN_DEAC_CLL ] //switch to enable old functionality
then call "INITIALIZATION-VALUES on leaving RAMP_TO_NO_PURGE"
           call "INITIALIZATION-VALUES on entering RAMP_OPEN_FAST"
           STATE_CP = RAMP_OPEN_FAST
endif

```

```

MAX_PURGE_DEAC:
call "INITIALIZATION-VALUES on leaving RAMP_TO_NO_PURGE"
call "INITIALIZATION-VALUES on entering MAX_PURGE"
STATE_CP = MAX_PURGE

```

**end case selection**

```

elseif [ STATE_CDN_CP = NO_CDN // NO_CDN-management
and LC_CP_TRA_MIN_PURGE_DFT_ENA ]
then call "INITIALIZATION-VALUES on leaving RAMP_TO_NO_PURGE"
      call "INITIALIZATION-VALUES on entering MIN_PURGE"
      STATE_CP = MIN_PURGE

```

```

else STATE_CP = RAMP_TO_NO_PURGE // default
endif
end

```

#### 9.14.1.6 MIN\_PURGE

```

if LV_CP_ACT = 0
then STATE_CP = CP_NOT_ACT

```

```

elseif STATE_CDN_CP = CDN_NO_FAST
then call "INITIALIZATION-VALUES on leaving MIN_PURGE"
      call "INITIALIZATION-VALUES on entering NO_PURGE"
      STATE_CP = NO_PURGE

```

```

elseif STATE_CDN_CP = CDN_NO_PURGE
or LV_CP_ENA = 0
or [ STATE_CLL_DEAC_CP = CP_NO_DEAC // "wait ramp open"
and (LV_CP_CDN_RAMP_OPEN_FAST
or LV_CP_CDN_RAMP_OPEN) ]
then call "INITIALIZATION-VALUES on leaving MIN_PURGE"
      call "INITIALIZATION-VALUES on entering RAMP_TO_NO_PURGE"
      STATE_CP = RAMP_TO_NO_PURGE

```

```

elseif STATE_CDN_CP = CDN_MIN_PURGE
then STATE_CP = MIN_PURGE // stay in MIN_PURGE

```

// re-entry in normal purge states after short deactivation

```

elseif STATE_CLL_DEAC_CP ≠ CP_NO_DEAC

```

```

    and LV_CP_NEW_RAMP_OPEN = 0
    and LV_CP_NEW_RAMP_OPEN_FAST = 0
then case selection on STATE_CLL_DEAC_CP
  RAMP_OPEN_DEAC:
  if LV_CP_CDN_RAMP_OPEN
  then call "INITIALIZATION-VALUES on leaving MIN_PURGE"
        call "INITIALIZATION-VALUES on entering RAMP_OPEN"
        STATE_CP = RAMP_OPEN
  endif

  RAMP_FAST_DEAC:
  if [ LV_CP_CDN_RAMP_OPEN_FAST
  and LC_CP_TRAN_DEAC_CLL ] //switch to enable old functionality
  then call "INITIALIZATION-VALUES on leaving MIN_PURGE"
        call "INITIALIZATION-VALUES on entering RAMP_OPEN_FAST"
        STATE_CP = RAMP_OPEN_FAST
  endif

  MAX_PURGE_DEAC:
  The following two lines had to be inserted to prevent oscillation in case of a forced transition from max_
  purge to min_purge on STATE_CDN_CP = NO_CDN
  if [ STATE_CDN_CP ≠ NO_CDN
  or LC_CP_TRA_MAX_MIN_CDN_ENA = 0 ]
  then call "INITIALIZATION-VALUES on leaving MIN_PURGE"
        call "INITIALIZATION-VALUES on entering MAX_PURGE"
        STATE_CP = MAX_PURGE
  endif
end case selection

else STATE_CP = MIN_PURGE // default
endif
end

```

#### 9.14.1.7 WAIT\_RAMP\_OPEN

```


if LV_CP_ACT = 0
then STATE_CP = CP_NOT_ACT

elseif STATE_CDN_CP = CDN_NO_FAST
or STATE_CDN_CP = CDN_NO_PURGE
or STATE_CDN_CP = CDN_MIN_PURGE
or LV_CP_ENA = 0
or [ STATE_CDN_CP = NO_CDN
and LC_CP_TRA_OPL_CDN_NOT ]
or [ LV_CP_CDN_RAMP_OPEN = 0
and LV_CP_CDN_RAMP_OPEN_FAST = 0
and LC_CP_TRA_OPL_CDN_CLL_NOT ]
then call "INITIALIZATION-VALUES on leaving WAIT_RAMP_OPEN"
        call "INITIALIZATION-VALUES on entering NO_PURGE"
        STATE_CP = NO_PURGE

elseif { (MAF_INT_CP < C_MAF_INT_MAX_CP_0
and T_MAF_INT_CP < C_T_MAX_MAF_INT_CP_0

```

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```

        and STATE_OPM_ENG_CP = ENG_MODE_0)
    or (MAF_INT_CP < C_MAF_INT_MAX_CP_1
        and T_MAF_INT_CP < C_T_MAX_MAF_INT_CP_1
        and STATE_OPM_ENG_CP != ENG_MODE_0)}}
    or T_DLY_CP > 0
    or (T_MAF_INT_CP < C_T_MIN_MAF_INT_CP_0
        and STATE_OPM_ENG_CP = ENG_MODE_0)
    or (T_MAF_INT_CP < C_T_MIN_MAF_INT_CP_1
        and STATE_OPM_ENG_CP != ENG_MODE_0)
    or LV_CPS_AD_ACT = 1
then STATE_CP = WAIT_RAMP_OPEN // stay in WRO

elseif LV_CP_CDN_RAMP_OPEN
then call "INITIALIZATION-VALUES on leaving WAIT_RAMP_OPEN"
      call "INITIALIZATION-VALUES on entering RAMP_OPEN"
      STATE_CP = RAMP_OPEN

elseif LV_CP_CDN_RAMP_OPEN_FAST
then call "INITIALIZATION-VALUES on leaving WAIT_RAMP_OPEN"
      call "INITIALIZATION-VALUES on entering RAMP_OPEN_FAST"
      STATE_CP = RAMP_OPEN_FAST

else call "INITIALIZATION-VALUES on leaving WAIT_RAMP_OPEN"
      call "INITIALIZATION-VALUES on entering NO_PURGE"
      STATE_CP = NO_PURGE // default, robustness

endif
end

```

### 9.14.1.8 RAMP\_OPEN

```

if LV_CP_ACT = 0
then STATE_CP = CP_NOT_ACT

elseif STATE_CDN_CP = CDN_NO_FAST
then call "INITIALIZATION-VALUES on leaving RAMP_OPEN"
      call "INITIALIZATION-VALUES on entering NO_PURGE"
      STATE_CP = NO_PURGE

elseif STATE_CDN_CP = CDN_NO_PURGE
then call "INITIALIZATION-VALUES on leaving RAMP_OPEN"
      call "INITIALIZATION-VALUES on entering RAMP_TO_NO_PURGE"
      STATE_CP = RAMP_TO_NO_PURGE

```


LV\_CP\_CDN\_RAMP\_OPEN = 1 if STATE\_CDN\_CP = CDN\_RAMP\_OPEN, else it is = 0, also if STATE\_CDN\_CP = CDN\_RAMP\_OPEN\_FAST

As CDN\_NO\_PURGE is checked one paragraph above, it's sufficient to check here for LV\_CP\_CDN\_RAMP\_OPEN

```

elseif LV_CP_CDN_RAMP_OPEN = 0
    or LV_CP_NEW_RAMP_OPEN = 1
    or LV_CP_NEW_RAMP_OPEN_FAST = 1
then call "INITIALIZATION-VALUES on leaving RAMP_OPEN"
      call "INITIALIZATION-VALUES on entering MIN_PURGE"
      STATE_CP = MIN_PURGE

```

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```

elseif          LV_CP_ENA      = 0
then            call  "Storage of Values for OBDII EVAP-System Monitoring"
                call  "INITIALIZATION-VALUES on leaving RAMP_OPEN"
                call  "INITIALIZATION-VALUES on entering RAMP_CLOSE"
                STATE_CP      = RAMP_CLOSE

elseif          [ ( FLOW_CTL_CPS >= FLOW_TAR_CPS
and LC_CP_TRAN_OPEN_MAX_ENA = 1)
or  MFF_CP >= MFF_MAX_CP
or  T_RAMP_OPEN_STAB = 0 ] // time counter for RO elapsed
and LV_FLOW_TAR_COR_CP = 0
then // RAMP_OPEN finished
    LV_CL_CLC_AVL = [CL_MMV <= C_CL_CAT_DIAG]
    LV_CL_CLC_VLD = 1
    if  [ LV_FAC_LAM_SHIFT_CP_AVL = 0 // no lambda contr. shift done
and  T_RAMP_OPEN_STAB = 0 ] // but time out
    then call "Selection of purge mode with empty canister"
    else // regular transition to MAX_PURGE
        call "INITIALIZATION-VALUES on leaving RAMP_OPEN"
        call "INITIALIZATION-VALUES on entering MAX_PURGE"
        STATE_CP = MAX_PURGE
    endif

else           STATE_CP      = RAMP_OPEN // default
endif
end

```

#### 9.14.1.8.1 Selection of purge mode with empty canister

**case selection on C\_STATE\_MOD\_SEL\_CP:**

**NO\_PURGE:**

```

    STATE_LOCK_CP      = NO_PURGE
    call "INITIALIZATION-VALUES on leaving RAMP_OPEN"
    call "INITIALIZATION-VALUES on entering RAMP_TO_NO_PURGE"
    STATE_CP           = RAMP_TO_NO_PURGE

```

**MIN\_PURGE:**

```

    STATE_LOCK_CP      = MIN_PURGE
    call "INITIALIZATION-VALUES on leaving RAMP_OPEN"
    call "INITIALIZATION-VALUES on entering MIN_PURGE"
    STATE_CP           = MIN_PURGE

```

**MAX\_PURGE:**

```

    call "INITIALIZATION-VALUES on leaving RAMP_OPEN"
    call "INITIALIZATION-VALUES on entering MAX_PURGE"
    STATE_CP           = MAX_PURGE

```

**RAMP\_CLOSE:**

```

    call "INITIALIZATION-VALUES on leaving RAMP_OPEN"
    call "INITIALIZATION-VALUES on entering RAMP_CLOSE"
    STATE_CP           = RAMP_CLOSE

```

**end case selection**

**end**

### 9.14.1.9 RAMP\_OPEN\_FAST

```

if          LV_CP_ACT      = 0
             STATE_CP      = CP_NOT_ACT

elseif     STATE_CDN_CP = CDN_NO_FAST
then       call "INITIALIZATION-VALUES on leaving RAMP_OPEN_FAST"
             call "INITIALIZATION-VALUES on entering NO_PURGE"
             STATE_CP      = NO_PURGE

elseif     STATE_CDN_CP = CDN_NO_PURGE
then       call "INITIALIZATION-VALUES on leaving RAMP_OPEN_FAST"
             call "INITIALIZATION-VALUES on entering RAMP_TO_NO_PURGE"
             STATE_CP      = RAMP_TO_NO_PURGE

elseif     STATE_CDN_CP = CDN_MIN_PURGE
or         STATE_CDN_CP = NO_CDN
or         LV_CP_NEW_RAMP_OPEN = 1
or         LV_CP_NEW_RAMP_OPEN_FAST = 1
then       call "INITIALIZATION-VALUES on leaving RAMP_OPEN_FAST"
             call "INITIALIZATION-VALUES on entering MIN_PURGE"
             STATE_CP      = MIN_PURGE

elseif     LV_CP_ENA      = 0
then       call "Storage of Values for OBDII EVAP-System Monitoring"
             call "INITIALIZATION-VALUES on leaving RAMP_OPEN_FAST"
             call "INITIALIZATION-VALUES on entering RAMP_CLOSE"
             STATE_CP      = RAMP_CLOSE

elseif     [ FLOW_CTL_CPS >= FLOW_TAR_CPS
or         MFF_CP >= MFF_MAX_CP ]
and       LV_FLOW_TAR_COR_CP = 0
then       call "INITIALIZATION-VALUES on leaving RAMP_OPEN_FAST"
             call "INITIALIZATION-VALUES on entering MAX_PURGE"
             STATE_CP      = MAX_PURGE

else       STATE_CP      = RAMP_OPEN_FAST // stay in current state
endif
Up to here, all possible states_cdn_cp except cdn_ramp_open & cdn_rof are checked, so RO or ROF
conditions must be given
end

```

### 9.14.1.10 MAX\_PURGE

```

if          LV_CP_ACT      = 0
then       STATE_CP      = CP_NOT_ACT

elseif     STATE_CDN_CP = CDN_NO_FAST
then       call "INITIALIZATION-VALUES on leaving MAX_PURGE"
             call "INITIALIZATION-VALUES on entering NO_PURGE"
             STATE_CP      = NO_PURGE

elseif     STATE_CDN_CP = CDN_NO_PURGE

```



```

then      call  "INITIALIZATION-VALUES on leaving MAX_PURGE"
           if    LV_CP_CLOSE_REQ
           then call "Storage of Values for OBDII EVAP-System Monitoring"
           endif
           call  "INITIALIZATION-VALUES on entering RAMP_TO_NO_PURGE"
           STATE_CP      = RAMP_TO_NO_PURGE

elseif    STATE_CDN_CP = CDN_MIN_PURGE
           and [ LV_CL_MDL_ENA = 0                               // CL-mdl not enabled
           or  LV_CP_CDN_MIN_PURGE_FAST = 1 ]                 // "hard" conditions for MIN_PURGE
           or  [ STATE_CDN_CP = NO_CDN                         // NO_CDN-management
           and LC_CP_TRA_MAX_MIN_CDN_ENA ]
           or  LV_CP_NEW_RAMP_OPEN = 1
           or  LV_CP_NEW_RAMP_OPEN_FAST = 1
           or  [ LV_CL_MDL_CAT_PURGE_ACT_CP = 1
           and { LV_CL_MDL_ACT = 0 or LV_CP_CAT_PURGE = 0 } ]
           then call  "INITIALIZATION-VALUES on leaving MAX_PURGE"
           call  "INITIALIZATION-VALUES on entering MIN_PURGE"
           STATE_CP      = MIN_PURGE

elseif    LV_CP_ENA      = 0
           then call  "Storage of Values for OBDII EVAP-System Monitoring"
           call  "INITIALIZATION-VALUES on leaving MAX_PURGE"
           call  "INITIALIZATION-VALUES on entering RAMP_CLOSE"
           STATE_CP      = RAMP_CLOSE

else      STATE_CP      = MAX_PURGE                               // stay in current state
endif
end

```

#### 9.14.1.11 RAMP\_CLOSE

```

if      LV_CP_ACT      = 0
then    STATE_CP      = CP_NOT_ACT

elseif    STATE_CDN_CP = CDN_NO_FAST
           then call  "INITIALIZATION-VALUES on leaving RAMP_CLOSE"
           call  "INITIALIZATION-VALUES on entering NO_PURGE"
           STATE_CP      = NO_PURGE


elseif    FLOW_CTL_CPS = 0                               // RAMP_CLOSE finished
           or  STATE_CDN_CP = CDN_NO_PURGE
           or  STATE_CDN_CP = CDN_MIN_PURGE
           then call  "INITIALIZATION-VALUES on leaving RAMP_CLOSE"
           call  "INITIALIZATION-VALUES on entering RAMP_TO_NO_PURGE"
           STATE_CP      = RAMP_TO_NO_PURGE

else    STATE_CP      = RAMP_CLOSE                               // stay in current state
endif

```

#### 9.14.1.12 INITIALIZATIONS on transitions

The following submodules are called on transitions between the different states of canister purge control

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### 9.14.1.12.1 Storage of Values for OBDII EVAP-System Monitoring (RO, ROF, MaxP)

This submodule is called, if RAMP\_OPEN, RAMP\_OPEN\_FAST or MAX\_PURGE is left due to purge time elapsed (LV\_CP\_ENA = 0).

In this case, the last calculated value of the canister load CL\_MMV is stored as CL\_MMV\_CLC\_END before RAMP\_CLOSE operation starts. This value is used as input for the OBDII EVAP-System Monitoring.

In addition, this subroutine may be called if MAX\_PURGE is left due to a valve closing request from OBD II function.

```
CL_MMV_CLC_END = CL_MMV
end
```

### 9.14.1.12.2 INITIALIZATION-VALUES on entering NO\_PURGE

This submodule is called at every possible transition from any state to NO\_PURGE except the transition CP\_NOT\_ACT NO\_PURGE.

On entering NO\_PURGE, the initialisations listed below are done.

```
// Initialisation of the time counter for lambda controller stabilisation
FLOW_GRD_CPS      = 0
FLOW_TAR_CPS      = 0
FLOW_CTL_CPS      = 0
LV_CP_CLL         = 0
LV_STATE_MEM_CP_CLL = 0
PQ_CP_SP          = 1           // In this mode no forced PQ is required
end
```

### 9.14.1.12.3 INITIALIZATION-VALUES on leaving NO\_PURGE

If the NO\_PURGE operation is left towards any other state, the following initialisations are done.

```
--
end
```

### 9.14.1.12.4 INITIALIZATION-VALUES on entering RAMP\_TO\_NO\_PURGE

This submodule is called at every possible transition from any state to RAMP\_TO\_NO\_PURGE.

On entering RAMP\_TO\_NO\_PURGE, the initialisations listed below are done.

As cl is not updated during RAMP\_TO\_NO\_PURGE, it's sufficient to define the correction factor for closing speed FLOW\_FAC\_CP on transition from any state to RAMP\_TO\_NO\_PURGE.

The start value of FLOW\_CTL\_CPS for the ramp has to be defined.

```
LV_CP_CLL      = 0
FLOW_TAR_CPS   = 0
FLOW_CTL_CPS   = min [FLOW_CTL_CPS, FLOW_MAX_CPS]
PQ_CP_SP       = 1           // In this mode no forced PQ is required
if STATE_CP    = MIN_PURGE
then FLOW_FAC_CP = 1           // ramp decrement cor. factor
else FLOW_FAC_CP = IP_FLOW_FAC_CP (CL)
endif
end
```

### 9.14.1.12.5 INITIALIZATION-VALUES on leaving RAMP\_TO\_NO\_PURGE

If the RAMP\_TO\_NO\_PURGE operation is left towards any other state, the following initialisations are done.

--  
**end**

#### 9.14.1.12.6 INITIALIZATION-VALUES on entering MIN\_PURGE

This submodule is called at every possible transition from any state to MIN\_PURGE.  
On entering MIN\_PURGE, the initialisations listed below are done.  
The start value of FLOW\_CTL\_CPS for the ramp has to be defined.

```
LV_CP_CLL          = 0
FLOW_CTL_CPS      = min [FLOW_CTL_CPS, FLOW_MAX_CPS]
PQ_CP_SP          = 1           // In this mode no forced PQ is required
end
```

#### 9.14.1.12.7 INITIALIZATION-VALUES on leaving MIN\_PURGE

If the MIN\_PURGE operation is left towards any other state, the following initialisations are done.

--  
**end**

#### 9.14.1.12.8 INITIALIZATION-VALUES on entering WAIT\_RAMP\_OPEN

This submodule is called at every possible transition from any state to WAIT\_RAMP\_OPEN.  
On entering WAIT\_RAMP\_OPEN, the initialisations listed below are done.  
The only way to enter WRO is from NO\_PURGE, so FLOW\_CTL\_CPS, LV\_CP\_CLL & PQ\_CP\_SP have not to be set on the entrance of this state

```
T_DI_CP           = 0           // reset of time counter for disabled normal purge
STATE_CLL_DEAC_CP = CP_NO_DEAC
T_DLY_CP          = C_T_CP_PURGE_TUBE+ IP_T_DLY_CP(MAF_KGH_FG_PRED_COR_
CP) * C_FAC_T_DLY_PURGE_TUBE_CP
MAF_INT_CP        = 0
T_MAF_INT_CP      = 0
```

The only scenario of having state\_cll\_deac\_cp <> no\_deac on entry of wait\_ramp\_open is the following:

A ROF was disabled; during the disabling time, the time T\_DLY\_MAX\_CP reaches 0, so in the following only RO is possible. So although LV\_CDN\_RAMP\_OPEN may be given, no entry in deactivated RO or ROF will occur; then, the state machine will switch to WRO; to have STATE\_CLL\_DEAC\_CP on a reasonable value after WRO & RO, it has to be reset here

**end**


#### 9.14.1.12.9 INITIALIZATION-VALUES on leaving WAIT\_RAMP\_OPEN

If the WAIT\_RAMP\_OPEN operation is left towards any other state, the following initialisations are done.

**end**

#### 9.14.1.12.10 INITIALIZATION-VALUES on entering RAMP\_OPEN

This submodule is called at every possible transition from any state to RAMP\_OPEN.  
If the RAMP\_OPEN operation was disabled (Conditions for RAMP\_OPEN were not fulfilled) for a time < C\_T\_DI\_RAMP\_OPEN\_CP\_0/\_1 (T\_DI\_CP > 0, STATE\_CLL\_DEAC\_CP = RAMP\_OPEN\_DEAC), initialisations for disabled RAMP\_OPEN are done, otherwise the standard initialisations for RAMP\_OPEN are done.

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```

if STATE_CLL_DEAC_CP = RAMP_OPEN_DEAC
then // Initialisations for disabled RAMP_OPEN
      FLOW_CTL_CPS = FLOW_CTL_CPS_DI
else // Standard-initialisations for RAMP_OPEN
      FLOW_CTL_CPS = C_FLOW_INI_CPS
endif
LV_CP_CLL = 1
LV_CP_RAMP_OPEN_ACT = 1
LV_DLY_GAS_CP = 0
LV_CP_AFL_IT = 1 // lean
STATE_CLL_DEAC_CP = CP_NO_DEAC
T_DI_CP = 0
if STATE_OPM_ENG_CP = ENG_MODE_0
then T_DLY_CP_OPEN =
      max[IP_T_DLY_CP (MAF_KGH_FG_PRED_COR_CP),1hex]
else T_DLY_CP_OPEN =
      max[IP_T_DLY_CP_2 (MAF_KGH_FG_PRED_COR_CP),1hex]
endif
FLOW_CPS = FLOW_CTL_CPS
FLOW_CPS_OLD_1 = FLOW_CTL_CPS
FLOW_CPS_OLD_2 = FLOW_CTL_CPS
FLOW_DLY_OLD_1_CP = FLOW_CTL_CPS
FLOW_DLY_OLD_2_CP = FLOW_CTL_CPS
MAF_CP_OLD_1 = MAF_CP
MAF_CP_OLD_2 = MAF_CP
MAF_DLY_OLD_1_CP = MAF_CP
MAF_DLY_OLD_2_CP = MAF_CP
MAF_CPS_OLD_1 = MAF_CPS
MAF_CPS_OLD_2 = MAF_CPS
MAF_DLY_OLD_1_CPS = MAF_CPS
MAF_DLY_OLD_2_CPS = MAF_CPS
end

```


#### 9.14.1.12.11 INITIALIZATION-VALUES on leaving RAMP\_OPEN

If the RAMP\_OPEN operation is left towards any other state, the following actual values for FLOW\_CTL\_CPS\_DI are stored before the interruption of the operation:

```

LV_CP_RAMP_OPEN_ACT = 0
LV_STATE_MEM_CP_CLL = 1
FLOW_CTL_CPS_DI = FLOW_CTL_CPS
if (LV_CP_NEW_RAMP_OPEN = 0
      and LV_CP_NEW_RAMP_OPEN_FAST = 0)
and STATE_LOCK_CP = UNLOCKED
then STATE_CLL_DEAC_CP = RAMP_OPEN_DEAC
      if STATE_OPM_ENG_CP = ENG_MODE_0
      then T_DI_CP = C_T_DI_RAMP_OPEN_CP_0
      else T_DI_CP = C_T_DI_RAMP_OPEN_CP_1
      endif
else if STATE_LOCK_CP ≠ UNLOCKED
      then T_LOCK_CP_TMP = C_T_LOCK_CP
      endif

```

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**endif**  
**end**

#### 9.14.1.12.12 INITIALIZATION-VALUES on entering RAMP\_OPEN\_FAST

This submodule is called at every possible transition from any state to RAMP\_OPEN\_FAST.  
If the RAMP\_OPEN\_FAST operation was disabled (Conditions for RAMP\_OPEN were not fulfilled) for a time < C\_T\_DI\_RAMP\_FAST\_CP\_0/\_1 (T\_DI\_CP > 0, STATE\_CLL\_DEAC\_CP = RAMP\_FAST\_DEAC), initialisations for disabled RAMP\_OPEN\_FAST are done, otherwise the standard initialisations for RAMP\_OPEN are done.

```

if STATE_CLL_DEAC_CP = RAMP_FAST_DEAC
then // Initialisations for disabled RAMP_OPEN_FAST
    FLOW_CTL_CPS = FLOW_CTL_CPS_DI
else // Standard-initialisations for RAMP_OPEN_FAST
    FLOW_CTL_CPS = C_FLOW_INI_CPS
endif
LV_CP_CLL = 1
LV_CP_RAMP_OPEN_ACT = 1
LV_DLY_GAS_CP = 0
LV_CP_AFL_IT = 1 // lean
STATE_CLL_DEAC_CP = CP_NO_DEAC
T_DI_CP = 0
if STATE_OPM_ENG_CP = ENG_MODE_0
then T_DLY_CP_OPEN =
    max[IP_T_DLY_CP (MAF_KGH_FG_PRED_COR_CP),1hex]
else T_DLY_CP_OPEN =
    max[IP_T_DLY_CP_2 (MAF_KGH_FG_PRED_COR_CP),1hex]
endif
FLOW_CPS = FLOW_CTL_CPS
FLOW_CPS_OLD_1 = FLOW_CTL_CPS
FLOW_CPS_OLD_2 = FLOW_CTL_CPS
FLOW_DLY_OLD_1_CP = FLOW_CTL_CPS
FLOW_DLY_OLD_2_CP = FLOW_CTL_CPS
MAF_CP_OLD_1 = MAF_CP
MAF_CP_OLD_2 = MAF_CP
MAF_DLY_OLD_1_CP = MAF_CP
MAF_DLY_OLD_2_CP = MAF_CP
MAF_CPS_OLD_1 = MAF_CPS
MAF_CPS_OLD_2 = MAF_CPS
MAF_DLY_OLD_1_CPS = MAF_CPS
MAF_DLY_OLD_2_CPS = MAF_CPS
end

```

#### 9.14.1.12.13 INITIALIZATION-VALUES on leaving RAMP\_OPEN\_FAST

If the RAMP\_OPEN\_FAST operation is left towards any other state, the following initialisations are done.

```

LV_CP_RAMP_OPEN_ACT = 0
LV_STATE_MEM_CP_CLL = 1
FLOW_CTL_CPS_DI = FLOW_CTL_CPS
if (LV_CP_NEW_RAMP_OPEN = 0
    and LV_CP_NEW_RAMP_OPEN_FAST = 0 )

```

```

then STATE_CLL_DEAC_CP      = RAMP_FAST_DEAC
      if   STATE_OPM_ENG_CP = ENG_MODE_0
      then T_DI_CP            = C_T_DI_RAMP_FAST_CP_0
      else T_DI_CP            = C_T_DI_RAMP_FAST_CP_1
      endif
endif
end

```

#### 9.14.1.12.14 INITIALIZATION-VALUES on entering MAX\_PURGE

This submodule is called at every possible transition from any state to MAX\_PURGE.

On entering MAX\_PURGE, the initialisations listed below are done.

If the MAX\_PURGE operation was disabled (Conditions for MAX\_PURGE were not fulfilled) for a time  $t < C\_T\_DI\_MAX\_CP\_0/_1$  ( $T\_DI\_CP > 0$ ,  $STATE\_CLL\_DEAC\_CP = MAX\_PURGE\_DEAC$ ), the initialisations for disabled MAX\_PURGE are done additionally to the standard initialisations for MAX\_PURGE.

```

if   STATE_CLL_DEAC_CP      = MAX_PURGE_DEAC
then FLOW_CTL_CPS           = MIN (FLOW_CTL_CPS_DI;
                                FLOW_MAX_CPS * C_FAC_FLOW_MAX_INI_CP;
                                MFF_SP_MV * C_MFF_RATIO_FLOW_INI_CP
                                * [N_32 * NC_CYL_NR * 3] / 105 ] / CL_MMV)
                                // [mg/stk] -> [kg/h]


else ACTION_EVAM_Purge ()
endif
// standard initialisations
LV_CP_CLL                = 1
STATE_CLL_DEAC_CP        = CP_NO_DEAC
T_DI_CP                   = 0
if   STATE_CP = RAMP_OPEN
then T_DLY_REQ_CP_TMP      = C_T_DLY_REQ_CP
elseif STATE_CP = NO_PURGE
      and LV_CP_CAT_PURGE = 1
      and LV_CL_MDL_ENA = 1
then LV_CL_MDL_CAT_PURGE_ACT_CP = 1
      FLOW_CTL_CPS         = MIN (FLOW_MAX_CPS * C_FAC_FLOW_MAX_INI_CP;
                                MFF_SP_MV * C_MFF_RATIO_FLOW_INI_CP
                                * [N_32 * NC_CYL_NR * 3] / 105 ] / CL_MMV)
                                * C_FAC_FLOW_CAT_PURGE_INI_CP
                                // [mg/stk] -> [kg/h]
endif

// Additional initialization in case of RAMP_OPEN_FAST to MAX_PURGE transition:
if   STATE_CP = RAMP_OPEN_FAST
then FLOW_CPS_OLD_1        = FLOW_CPS
      FLOW_CPS_OLD_2        = FLOW_CPS
      FLOW_DLY_OLD_1_CP     = FLOW_CPS
      FLOW_DLY_OLD_2_CP     = FLOW_CPS
endif
end

```

#### 9.14.1.12.15 INITIALIZATION-VALUES on leaving MAX\_PURGE

If the MAX\_PURGE operation is disabled or ends, the following actual values for FLOW\_CTL\_CPS\_DI are stored before the interruption of the operation:

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```

LV_STATE_MEM_CP_CLL          = 1
FLOW_CTL_CPS_DI              = FLOW_CTL_CPS
T_DLY_REQ_CP_TMP             = 0
if (LV_CP_NEW_RAMP_OPEN      = 0
    and LV_CP_NEW_RAMP_OPEN_FAST = 0
    and LV_CL_MDL_CAT_PURGE_ACT_CP = 0)
then STATE_CLL_DEAC_CP       = MAX_PURGE_DEAC
    if STATE_OPM_ENG_CP = MODE_0
    then T_DI_CP               = C_T_DI_MAX_CP_0
    else T_DI_CP               = C_T_DI_MAX_CP_1
    endif
endif
LV_CL_MDL_CAT_PURGE_ACT_CP    = 0
end

```

#### 9.14.1.12.16 INITIALIZATION-VALUES on entering RAMP\_CLOSE

This submodule is called at every possible transition from any state to RAMP\_CLOSE.

On entering RAMP\_CLOSE, the initialisations listed below are done.

The Initialization value of FLOW\_CTL\_CPS for RAMP\_CLOSE is the last calculated value of min (FLOW\_CTL\_CPS, FLOW\_MAX\_CPS) if the preceding operation was MAX\_PURGE. If the RAMP\_OPEN operation was preceding the Initialization value is the last calculated value of FLOW\_CTL\_CPS of the RAMP\_OPEN operation.

The only way to enter RC is from another normal\_purge state, so LV\_CP\_CLL has not to be set on the entrance of this state

```

STATE_CLL_DEAC_CP           = CP_NO_DEAC
T_DI_CP                     = 0
PQ_CP_SP                    = 1           // In this mode no forced PQ is required
FLOW_TAR_CPS                = 0
if STATE_CP                  = MAX_PURGE
then FLOW_CTL_CPS            = min [FLOW_CTL_CPS, FLOW_MAX_CPS]
endif
end

```

#### 9.14.1.12.17 INITIALIZATION-VALUES on leaving RAMP\_CLOSE

If the RAMP\_CLOSE operation is left towards any other state, the following initialisations are done.

```

LV_STATE_MEM_CP_CLL = 1
end

```

### 9.14.2 Canister purge management states

#### 9.14.2.1 NO\_PURGE

##### General information:

In the NO\_PURGE state of the Evaporative Emission Control no calculation of the CPS flow set point flow\_ctl\_cps, the fuel flow from the activated charcoal filter (ACF) MFF\_CP, the Canister Load cl and the additive fuel flow for injection correction will be done.

##### Formula section:

```
call "Time counter for disabled RAMP_OPEN or MAX_PURGE"
end
```

### 9.14.2.2 RAMP\_TO\_NO\_PURGE

#### Formula section:

```
FLOW_GRD_CPS = IP_FLOW_DEC_CP (MFF_SP_MV) * FLOW_FAC_CP
if LV_CP_CMU_CMB
then FLOW_GRD_CPS = FLOW_GRD_CPS * C_FAC_DEC_COR_CMU_CP
elseif LV_CP_CLOSE_1
then FLOW_GRD_CPS = FLOW_GRD_CPS * C_FAC_DEC_COR_1_CP
elseif LV_CP_CLOSE_2
then FLOW_GRD_CPS = FLOW_GRD_CPS * C_FAC_DEC_COR_2_CP
endif
call "FLOW_CTL_CPS ramping"
call "Time counter for disabled RAMP_OPEN or MAX_PURGE"
end
```

### 9.14.2.3 MIN\_PURGE

#### General information:

In the MIN\_PURGE state, the CPS flow is calculated from calibration datas depending on combustion mode.

```
FLOW_TAR_CPS = FLOW_CPS_SP_MIN_PURGE * FAC_FLOW_TAR_COR_CP
if FLOW_CTL_CPSn-1 > FLOW_TAR_CPS // actual value higher than
SP
then FLOW_GRD_CPS = IP_FLOW_DEC_CP (MFF_SP_MV) // decreasing flow
else if LV_HOM_ACT = 1
then FLOW_GRD_CPS = IP_FLOW_INC_CP (MFF_SP_MV)
* IP_FLOW_INC_COR_HOM_CP (MAF_CYL) // increasing flow
else FLOW_GRD_CPS = IP_FLOW_INC_CP (MFF_SP_MV) // increasing flow
endif
LV_STATE_MEM_CP_CLL = 0 // transition from normal purge finished
endif
call "FLOW_CTL_CPS ramping"
call "Time counter for disabled RAMP_OPEN or MAX_PURGE"
end
```


### 9.14.2.4 WAIT\_RAMP\_OPEN

#### General information:

The WAIT\_RAMP\_OPEN state is reached if the conditions for normal entry in RAMP\_OPEN or RAMP\_OPEN\_FAST are given but the time counter for lambda controller stabilisation is not yet elapsed or CPS adaptation is active. It can only be reached by NO\_PURGE.

To speed up the reaction of the lambda sensor in RAMP\_OPEN or RAMP\_OPEN\_FAST, the purge tube may be purged itself for a short instance in WAIT\_RAMP\_OPEN. Using this functionality, the purge valve is opened rapidly and wide for a very short time to purge the diluted gas in the tubes and fill the purge tubes with "fresh" gas from the ACF.

For the calculation of the air mass flow integral the unit conversion:

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$[g] = [kg/h] * [ms] * [(g*h)/(kg*ms)] / 3600$   
has to be considered.

**Formula section:**

```

if    LV_CPS_AD_ACT = 0
then
MAF_INT_CP = MAF_INT_CP + (MAF_CYL * TA / 3600) // MAF Integral for Lambda
                                                    controller stabilisation
T_MAF_INT_CP = T_MAF_INT_CP + TA // Total time of the MAF integration
                                                    for min/max limitation
T_DLY_CP = max [T_DLY_CPn-1 - TA, 0] // Purge tube time counter
// "purging the purge tube"
endif
    if    T_MAF_INT_CP < C_T_CP_PURGE_TUBE
then
        FLOW_TAR_CPS = C_FLOW_CPS_SP_PURGE_TUBE
        FLOW_GRD_CPS = C_FLOW_CPS_GRD_PURGE_TUBE
else
        FLOW_TAR_CPS = 0
        FLOW_GRD_CPS = C_FLOW_CPS_GRD_PURGE_TUBE_CLOSE
endif
call  "FLOW_CTL_CPS ramping"
end
    
```

**9.14.2.5 RAMP\_OPEN**

**General information:**

After a reset, an engine stall or if a certain time since the last MAX\_PURGE operation has passed, the load cl of the canister is considered as not known. In this case the canister load value cl is initialized to a constant value c\_cl\_st\_cp and the CPS is opened slowly, using a ramp function. So a high deviation of the lambda control shall be prevented.

The RAMP\_OPEN operation is finished when the fuel flow MFF\_CP is greater than a maximum value MFF\_MAX\_CP or when the CL\_MMV value stay in a dynamic window. Then the MAX\_PURGE operation starts, if the cl is above a threshold, otherwise the reaction of the system is configurable.

At the end of the RAMP\_OPEN operation the remaining time of purge is reevaluated versus Canister Load cl is reevaluated.

**Formula section:**

```


call  "calculation of PQ_CP_SP"                (common)
call  "calculation of the flow setpoint"       (common)
end
    
```

**9.14.2.6 RAMP\_OPEN\_FAST Operation**

**General information:**

After a short interruption of the MAX\_PURGE operation the load cl of the ACF stay around the last value calculated. In this case the flow\_ctl\_cps is calculated as a function of the actual FLOW\_CTL\_CPS value and the objective value.

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The RAMP\_OPEN\_FAST operation is finished. when one of the following conditions is set:

- FLOW\_CTL\_CPS is greater or equal to the value FLOW\_TAR\_CPS
- The fuel flow MFF\_CP is greater than a maximum value MFF\_MAX\_CP

Then the MAX\_PURGE operation starts. If the purge time is elapsed (LV\_CP\_ENA=0), the RAMP\_OPEN\_FAST operation ends. the RAMP\_CLOSE operation starts immediately.

At the end of the RAMP\_OPEN\_FAST operation the purge time is reevaluated (see chapter "time scheduler").

**Formula section:**

```
PQ_CP_SP = 1 // In this mode no forced PQ is required by canister purge
call "calculation of the flow setpoint" (common)
end
```

**9.14.2.7 MAX\_PURGE Operation**

**General information:**

The MAX\_PURGE operation is started when the RAMP\_OPEN operation or the RAMP\_OPEN\_FAST operation is finished.

The MAX\_PURGE operation ends when the purge time is elapsed. Then the RAMP\_CLOSE operation starts.

During MAX\_PURGE, the time counter T\_DLY\_MAX\_CP is initialised to C\_T\_DLY\_MAX\_CP\_0/\_1. When the MAX\_PURGE operation ends or when the MAX\_PURGE is disabled, the time T\_DLY\_MAX\_CP starts to count backwards down to 0.


Calculation of FLOW\_CTL\_CPS for MAX\_PURGE

The value of FLOW\_CTL\_CPS during MAX\_PURGE operation is calculated as a function of the filtered canister load CL\_MMV and the maximum allowable fuel flow from the CPS MFF\_MAX\_CP (see flow setpoints module).

**Formula section:**

```
call "calculation of PQ_CP_SP" (common)
call "Calculation of LV_T_DLY_REQ_CP"
FLOW_TAR_CPS = min [MFF_MAX_CP /CL_MMV, FLOW_MAX_CPS] *
                    FAC_FLOW_TAR_COR_CP
if FLOW_CTL_CPSn-1 > FLOW_TAR_CPS // actual value higher than
SP
then FLOW_GRD_CPS = IP_FLOW_CPS_DEC (MFF_SP_MV) // decreasing flow
else if LV_HOM_ACT = 1
then FLOW_GRD_CPS = IP_FLOW_CPS_INC (MFF_SP_MV)
                    * IP_FLOW_INC_COR_HOM_CP (MAF_CYL)// increasing flow
else FLOW_GRD_CPS = IP_FLOW_CPS_INC (MFF_SP_MV) // increasing flow
endif
endif
(gradient limitation moved here from flow calculation chain)
call "FLOW_CTL_CPS ramping"
Should be limited by ip_..._inc; as mff_max_cp is now moved to flow_sp spec, it may be at a very high
value on entrance of a disabled max_purge; in addition, a reasonable fuel_flow_max_cp will we available
after latest 100ms ( recurrence changed), so for this first 100ms, we should not have flow_ctl_cps being
unreasonably high
end
```

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### 9.14.2.7.1 Calculation of LV\_T\_DLY\_REQ\_CP

This management is useful essentially during an emission cycle. The aim is to stop the purge in case of request from the catalyst diagnosis (or an other OBD2 diagnosis), one time during the cycle.

LV\_T\_DLY\_REQ\_CP is set C\_T\_DLY\_REQ\_CP seconds after a Ramp\_Open and stay to 1 until next trip or engine stalling.

The flag is set after having been for a time C\_T\_DLY\_REQ\_CP in an un-interrupted MAX\_PURGE coming from RAMP\_OPEN and stay to 1 until next trip or engine stalling .

When coming from any other state than RAMP\_OPEN, the flag is not calculated.

#### Signal flow diagram:

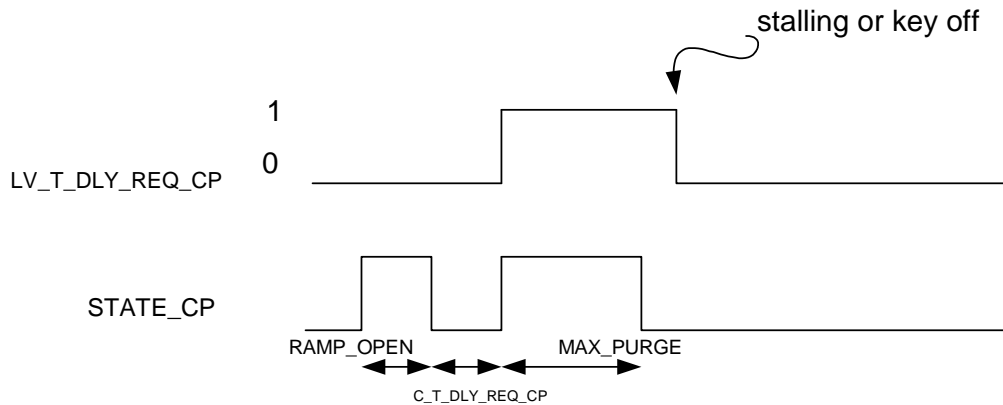


Figure 9.14.4: : LV\_T\_DLY\_REQ\_CP

#### Formula section:

```

if    T_DLY_REQ_CP_TMP > 1h
then  T_DLY_REQ_CP_TMP = max (1h, T_DLY_REQ_CP_TMP - TA)
endif
if    T_DLY_REQ_CP_TMP = 1h
then  LV_T_DLY_REQ_CP   = 1
endif
end
    
```

### 9.14.2.8 RAMP\_CLOSE Operation

#### General information:

The RAMP\_CLOSE operation starts if the purge time is elapsed.  
The RAMP\_CLOSE operation ends when the value of FLOW\_CTL\_CPS is equal to 0.

#### Calculation of FLOW\_CTL\_CPS for RAMP\_CLOSE

When the RAMP\_CLOSE operation is activated FLOW\_CTL\_CPS is decremented. The decrement value depends on the map values of IP\_FLOW\_DEC\_CP. The closing speed of the CPS is so controlled by the mass fuel flow setpoint MFF\_SP\_MV.

**Formula section:**

```
FLOW_GRD_CPS = IP_FLOW_DEC_CP (MFF_SP_MV) * IP_FLOW_FAC_CP (CL)
call "FLOW_CTL_CPS ramping"
end
```

**9.14.3 Common submodules**

The keywords in brackets at the end of the headline of each following submodule indicates, by which STATE\_CP the corresponding submodule is called. If STATE\_CP = CP\_NOT\_ACT, none of the following submodules is called. The following abbreviations are used:

```
NP      NO_PURGE
RTNP    RAMP_TO_NO_PURGE
MinP    MIN_PURGE
WRO     WAIT_RAMP_OPEN
RO      RAMP_OPEN
ROF     RAMP_OPEN_FAST
MaxP    MAX_PURGE
RC      RAMP_CLOSE
```

**9.14.3.1 Time counter for disabled RAMP\_OPEN or MAX\_PURGE (NP, RTNP, MinP)**

**General information:**

This calculation is called in NO\_PURGE, RAMP\_TO\_NO\_PURGE and MIN\_PURGE.  
 If the RAMP\_OPEN or the MAX\_PURGE operation was interrupted (NO\_PURGE, RAMP\_TO\_NO\_PURGE or MIN\_PURGE active) and the time counter T\_DI\_CP is greater than zero which means that the interrupt-time is lower than the adjustable times C\_T\_DI\_RAMP\_OPEN\_CP\_0/\_1 (RAMP\_OPEN) or C\_T\_DI\_MAX\_CP\_0/\_1 (MAX\_PURGE), a direct switch back to the previous state RAMP\_OPEN or MAX\_PURGE is possible, if the conditions for this previous state are once again given.  
 Otherwise (time counter T\_DI\_CP reached zero), NORMAL\_PURGE has to restart with RAMP\_OPEN.  
 TA = recurrence


**Formula section:**

```
If (LV_CP_NEW_RAMP_OPEN = 0
    and LV_CP_NEW_RAMP_OPEN_FAST = 0
then T_DI_CPn = max [0, T_DI_CPn-1 - TA]
else T_DI_CP = 0
endif
T_LOCK_CPn = max [0, T_LOCK_CPn-1 - TA]
if T_DI_CP = 0
then STATE_CLL_DEAC_CP = CP_NO_DEAC
endif
if T_LOCK_CP = 0
then STATE_LOCK_CP = UNLOCKED
endif
end
```

**9.14.3.2 Calculation of PQ\_CP\_SP ( RO, MaxP)**

**General information:**

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This calculation is called only in Ramp\_Open and MAX\_PURGE, and available only in stratified and homogeneous lean burn modes.

In this mode a forced PQ is required by canister purge in order to increase PRS\_CPS and to purge with more efficiency. IP\_PQ\_CP\_SP is depending on engine speed and torque setpoint.

**Formula section:**

```

if [(LV_HOM_ACT = 0)
or (LV_HOM_AFL_ACT = 1 and LC_PQ_SP_CP_HOM_AFL=1) ]
then if (CL_MMV > C_CL_MMV_PQ)
then PQ_SP_CP_TMP = IP_PQ_CP_SP (N_32, TQI_SP_S)
else PQ_SP_CP_TMP = 1
endif
PQ_CP_SPn = PQ_CP_SPn-1 +
(PQ_SP_CP_TMP - PQ_CP_SPn-1) * C_CRLC_PQ_SP_CP
else PQ_CP_SPn = 1
endif
    
```

**9.14.3.3 Calculation of the flow setpoint (RO, ROF)**

**General information:**

This calculation is called in RAMP\_OPEN and RAMP\_OPEN\_FAST.  
 Old spec: "An additional delay is performed if a linear O2 sensor is used."  
 Not defined in SW and spec; should an c\_offset be defined?

The opening of the CPS is controlled by the value of FLOW\_CTL\_CPS. This value describes the flow requested through the CPS. So a too high deviation of the lambda control at transient engine operation should be avoided. The opening sequence is as follows:

- When entering RAMP\_OPEN or RAMP\_OPEN\_FAST, FLOW\_CTL\_CPS is initialised
- After start or re-start of RAMP\_OPEN or RAMP\_OPEN\_FAST, the system waits for the gas transfer time between CPS valve and upstream lambda sensor (IP\_T\_DLY\_CP).
- When this delay is elapsed or when using a binary lambda control and a transition rich to lean occurs, the next period of increment steps starts. The number of increment steps for this phase is defined from ID\_FLOW\_INC\_NR\_CP. This number is defined once at the beginning of the phase. For each increment the FLOW\_CTL\_CPS increase is fixed by IP\_FLOW\_INC\_CP corrected by IP\_FLOW\_FAC\_CP. The opening speed of the CPS is so controlled by the mass air flow MAF\_CYL and the load CL of the activated charcoal canister ACF to avoid lambda regulation deviation.
- After the increment steps are carried out, the function waits again for gas transfer time or binary lambda sensor rich-lean transition.
- FLOW\_CTL\_CPS is limited to FLOW\_TAR\_CPS, the target flow setpoint.


The Pjumps used depends of the bank selected (see canister load and lambda deviation module). The Pjump is related to gas enrichment.

The aim is to increase the FLOW\_CTL\_CPS with incremented values to prevent unexpected lambda deviation due to the lambda controller.

The increment number ID\_FLOW\_INC\_NR\_CP carried out is tuneable and depending on engine speed. The time delay will allow to synchronize the flow variation, the gas transfer and the lambda control. As long as the maximum flow FLOW\_TAR\_CPS is not reached the sequence will start over.

**Signal flow diagram:**

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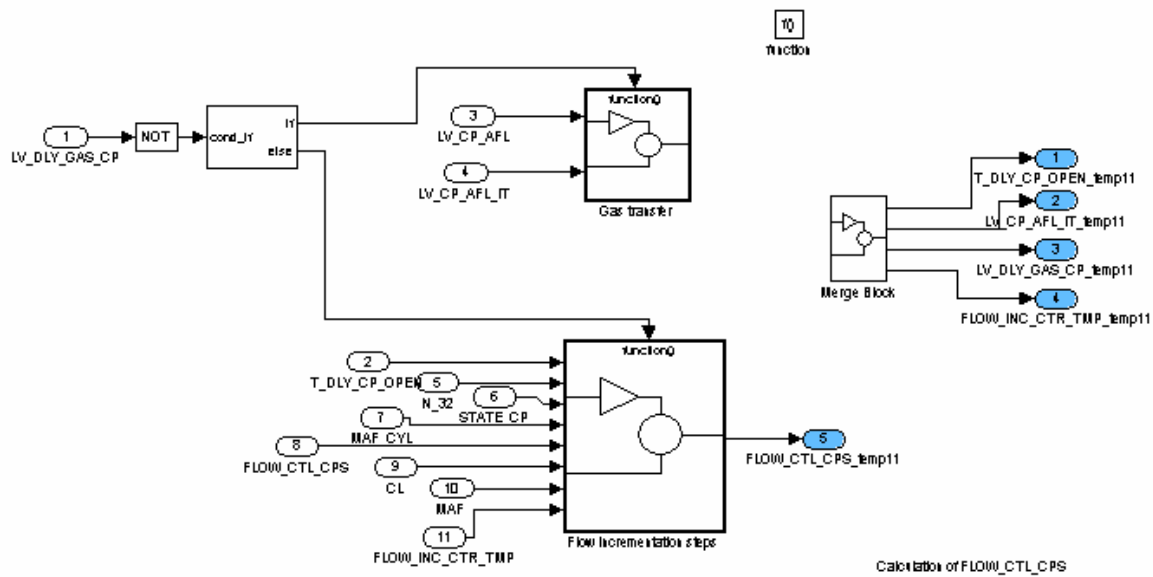


Figure 9.14.5: : calculation of FLOW\_CTL\_CPS for RAMP\_OPEN\_FAST

**Formula section:**

```

if LV_DLY_GAS_CP = 0
then call "Gas transfer" // waiting for gas transfer timer
else call "Flow incrementation steps"
endif
end

```

**9.14.3.3.1 Gas transfer**

```

T_DLY_CP_OPEN = max [ 0, T_DLY_CP_OPEN - TA]
if LC_LAM_LIN_CPS = 0 // binary lambda control
then LV_CP_AFL_IT = LV_CP_AFL
else LV_CP_AFL_IT = 1 // lean

```

```

endif
if T_DLY_CP_OPEN = 0
or LV_CP_AFL_IT 0 1 // rich lean
then LV_DLY_GAS_CP = 1
FLOW_INC_CTR_TMP = ID_FLOW_INC_NR_CP (N_32)
endif
end

```

**9.14.3.3.2 Flow incrementation steps**

```

if STATE_CP = RAMP_OPEN
then if LV_HOM_ACT = 1
then FLOW_GRD_CPS = IP_FLOW_INC_CP (MFF_SP_MV) *
IP_FLOW_INC_COR_HOM_CP (MAF_CYL) // RO
else FLOW_GRD_CPS = IP_FLOW_INC_CP (MFF_SP_MV) // RO
endif
endif

```

```

else if LV_HOM_ACT = 1
  then FLOW_GRD_CPS = IP_FLOW_INC_FAST_CP (MFF_SP_MV) *
        IP_FLOW_INC_COR_HOM_CP (MAF_CYL) // ROF
  else FLOW_GRD_CPS = IP_FLOW_INC_FAST_CP (MFF_SP_MV) // ROF
  endif
endif
FLOW_GRD_CPS = FLOW_GRD_CPS * IP_FLOW_FAC_CP (CL)

if STATE_CP = RAMP_OPEN_FAST
and LC_CP_FLOW_LIM_OPEN_FAST = 0
then FLOW_TAR_CPS = min [MFF_MAX_CP /CL_MMV, FLOW_MAX_CPS]
else [If STATE_OPM_ENG_CP = ENG_MODE_0
  then FLOW_TAR_CPS = IP_FLOW_MAX_OPEN_CPS (N_32, MAF)
        * FAC_FLOW_COR_CLL_CP
  else FLOW_TAR_CPS = IP_FLOW_MAX_OPEN_CPS_2 (N_32,
        MFF_SP_MV) * FAC_FLOW_COR_CLL_CP
  endif]
endif
FLOW_TAR_CPS = FLOW_TAR_CPS * FAC_FLOW_TAR_COR_CP
call "FLOW_CTL_CPS ramping"
FLOW_INC_CTR_TMP = max [ 0, FLOW_INC_CTR_TMP - 1]

if FLOW_INC_CTR_TMP = 0
then // gas delay timer init
  LV_DLY_GAS_CP = 0
  If STATE_OPM_ENG_CP = ENG_MODE_0
  then T_DLY_CP_OPEN =
    max[IP_T_DLY_CP (MAF_KGH_FG_PRED_COR_CP),1hex]
  else T_DLY_CP_OPEN =
    max[IP_T_DLY_CP_2 (MAF_KGH_FG_PRED_COR_CP),1hex]
  endif
  // T_DLY_CP_OPEN will be set to IP_T_DLY_CP /10
  LV_CP_AFL_IT = 1 // lean
  FLOW_GRD_CPS = 0

```

This line is not needed: with `lc_lam_lin_cps`, the variable is always =1 (is initialised to 1 at entry of ro, rof), so no transition can occur.

With `lc_lam_lin_cps=0` and lambda control lean `lv_cp_afl_it=1`; if at the exit of this passage (flow incrementation) `lv_cp_afl_it=0`, a direct jump again to flow incrementation will occur; not critical as this can just appear with empty canister (otherwise lambda control rich)

Intake manifold model Rbg,. empty canister: lambda control at lean side, perhaps better to wait for 1xrich side, 1x lean side

```

endif
end

```

### 9.14.3.4 FLOW\_CTL\_CPS ramping


The ramping up and down of the internal flow setpoint `FLOW_CTL_CPS` is defined by the target (final setpoint to be reached) `FLOW_TAR_CPS` and the flow gradient (increment resp. decrement) `FLOW_GRD_CPS`.

This calculation is applied in all states with any flow ramps.

```

if FLOW_CTL_CPSn-1 > FLOW_TAR_CPS // actual value higher than target
then FLOW_CTL_CPSn = // decreasing flow
    max [FLOW_TAR_CPS, FLOW_CTL_CPSn-1 - FLOW_GRD_CPS]

```

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```

else FLOW_CTL_CPSn = // increasing flow
      min [FLOW_TAR_CPS, FLOW_CTL_CPSn-1 + FLOW_GRD_CPS]
endif

```

## 9.14.4 General calculations

### General information:

This submodule is calculated in every state\_cp except CP\_NOT\_ACT

When the maximum engine speed limitation is reached (LV\_N\_MAX\_CP) some of the calculations for the injection correction must be stopped to decrease the CPU load. If LV\_N\_MAX\_CP is active then the normal calculations of the following variables are not done and the values of these variables are set to 0.

### Application conditions

**Initialisation:** *at RST or IGKON. values are set to zero.*

**Recurrence:** *called by superior block*

**Activation:** *- -*

**Deactivation:** *- -*

### Formula section:

```

call "Time counter for time after MAX_PURGE operation"
if LV_N_MAX_CP = 1
then call "Default values for disabled calculations"
else call "Commutation on diagnosis detection"
      call "OBD2 diagnosis activation"
      call "Calculation of FLOW_CPS and FLOW_COR_CPS"
endif
if LC_CP_CLL_INH_MAN = 0
then call "Pade-filter and PT1-Filter calculations"
endif
end

```

#### 9.14.4.1 Time counter for time after MAX\_PURGE operation


Depending on this time counter, RAMP\_OPEN (counter=0) or RAMP\_OPEN\_FAST (>0) are activated for CL learning. As long as the counter has not reached zero, the CL used in the previous MAX\_PURGE phase is considered as usable.

### Formula section:

```

if STATE_CP = MAX_PURGE
then if STATE_OPM_ENG_CP = ENG_MOD_0
      then T_DLY_MAX_CP = C_T_DLY_MAX_CP_0 // counter init
      else T_DLY_MAX_CP = C_T_DLY_MAX_CP_1
      T_DLY_CL_MDL = max [0, T_DLY_CL_MDL - TA]
elseif LV_CP_CLL = 0
then T_DLY_MAX_CP = max [0, T_DLY_MAX_CP - TA]
      T_DLY_CL_MDL = C_T_DLY_CL_MDL
else T_DLY_MAX_CPn = T_DLY_MAX_CPn-1

```

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$$T\_DLY\_CL\_MDL_n = T\_DLY\_CL\_MDL_{n-1}$$

**Endif**

```

if    LV_CP_NEW_RAMP_OPEN = 1
then  T_DLY_MAX_CP = 0
endif

```

```

if    T_DLY_MAX_CP      = 0
then  LV_CL_CLC_VLD     = 0           // switch off int. MIN_PURGE
endif
end

```

### 9.14.4.2 Default values for disabled calculations

When the maximum engine speed limitation is reached (LV\_N\_MAX\_CP) some of the calculations for the injection correction must be stopped to decrease the CPU load. If LV\_N\_MAX\_CP is active then the normal calculations of the following variables are not done and the values of these variables are set to 0.

#### Formula section:

```

FLOW_SP_CPS           = 0
FLOW_COR_CPS          = 0
FLOW_CPS              = 0
FLOW_TOT_CPS         = 0
MAF_CPS               = 0
end

```

### 9.14.4.3 OBD2 diagnosis activation

#### General information:

In order to manage the priority between canister purge and catalyst diagnosis or between canister purge and O2 sensor diagnosis, the bit information LV\_CP\_ACT\_REQ will be sent to the diagnosis OBD2 manager. Two cases are possible :

- first of all, when the conditions to purge are set in order to learn the canister load (RAMP\_OPEN phase).
- when LV\_T\_DLY\_REQ\_CP=1 if the canister load (CL\_MMV) is greater than a calibrated value C\_CL\_MMV\_REQ.

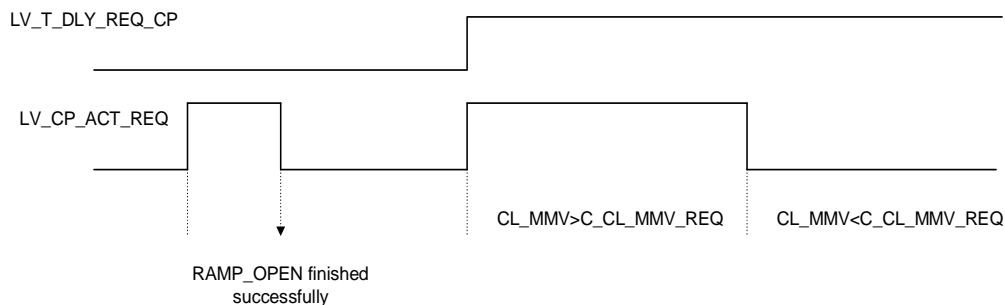



Figure 9.14.6: : LV\_CP\_ACT\_REQ

#### Formula section:

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```

LV_CP_ACT_REQ =
    [ LV_T_DLY_REQ_CP and (CL_MMV > C_CL_MMV_REQ) ]
or STATE_CP = RAMP_OPEN
end
    
```

#### 9.14.4.4 Calculation of FLOW\_CPS and FLOW\_COR\_CPS

The setpoint of the mass flow through the CPS (FLOW\_COR\_CPS) is calculated using the actual calculated values of FLOW\_CTL\_CPS, a ramp gradient depending on MAF\_CYL and the correction factors on ambient pressure and ambient temperature.

If the OBD II evaporative system monitoring (vaccum method) function is active (LV\_DIAGCP\_CPS\_ACT=1), the opening of the CPS is controlled by the value of FLOW\_SP\_CPS\_EVAP (see chapter OBDII functions).

The opening of the CPS can also be controlled by the application system using the switch LC\_FLOW\_CPS\_AS and C\_FLOW\_CPS\_AS.

The calculation of FLOW\_SP\_CPS is limited using a gradient value.


In RAMP\_OPEN, RAMP\_OPEN\_FAST, NO\_PURGE and RAMP\_TOP\_NO\_PURGE, the gradient limitation is no more applied.

The flow request through the CPS is limited by the physical maximum flow at fully openend valve defined in FLOW\_MAX\_PHY\_CPS (depending on pressure difference ambient air - intake manifold)

The value FLOW\_TOT\_CPS permits to measure the quantity of flow during an emission cycle.

#### Signal flow diagrams:

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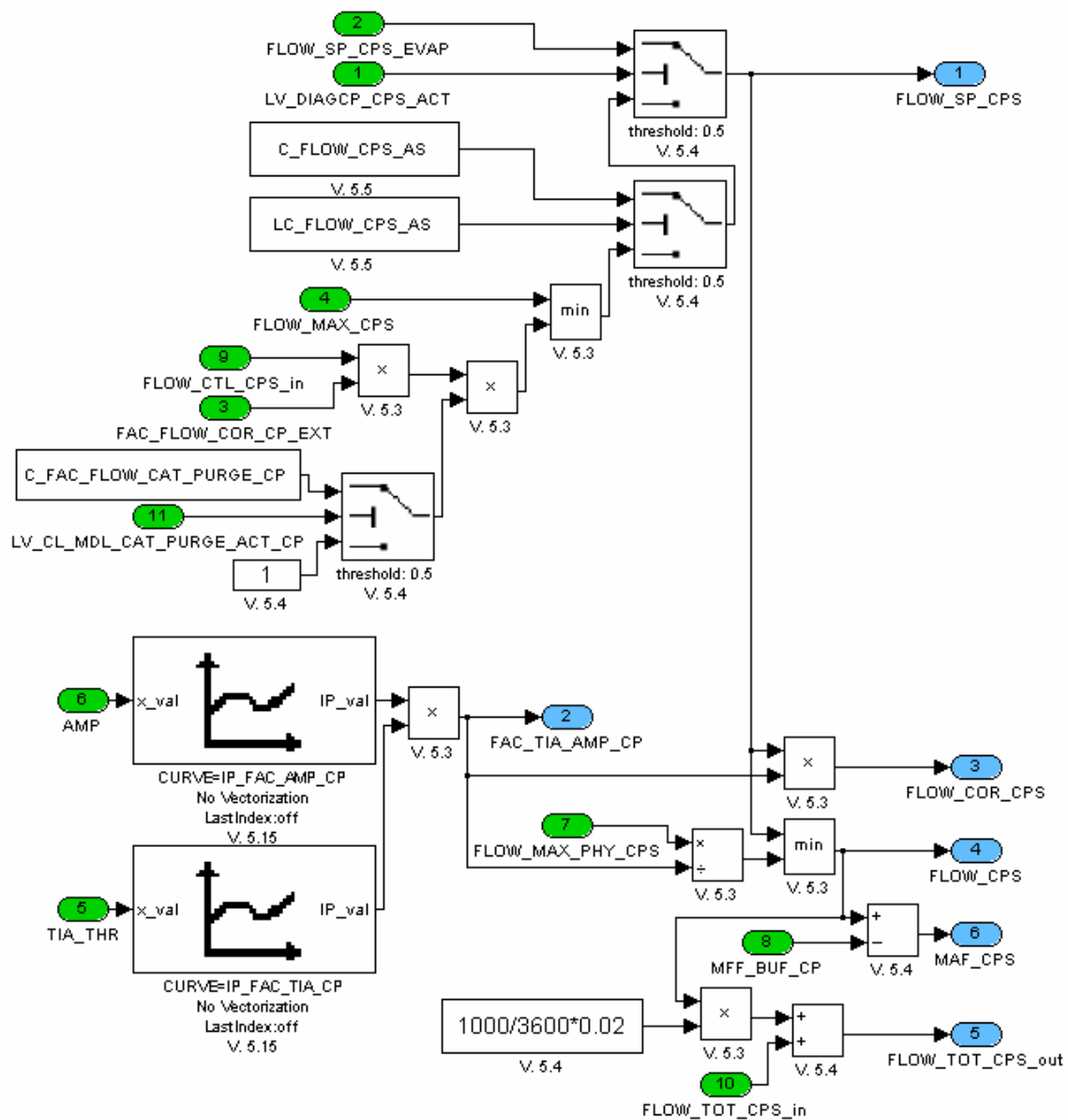


Figure 9.14.7: : Calculation of FLOW\_CPS, FLOW\_COR\_CPS

**Formula section:**

```

if          LV_DIAGCP_CPS_ACT           // Interface with leak detection by vaccum method
then       FLOW_SP_CPS = FLOW_SP_CPS_EVAP
elseif    LC_FLOW_CPS_AS              // manual setting of flow_sp_cps
then       FLOW_SP_CPS = C_FLOW_CPS_AS
else
if LV_CL_MDL_CAT_PURGE_ACT_CP = 0
then FLOW_SP_CPS = min
      [FLOW_CTL_CPS * FAC_FLOW_COR_CP_EXT, FLOW_MAX_CPS]
else FLOW_SP_CPS = min

```

```

                [FLOW_CTL_CPS * FAC_FLOW_COR_CP_EXT *
FAC_FLOW_CAT_PURGE_CP, FLOW_MAX_CPS]
endif
    
```

// correction factor for ambient air temperature and ambient air pressure

```

FAC_TIA_AMP_CP =
    IP_FAC_AMP_CP    (AMP)
    * IP_FAC_TIA_CP  (TIA_THR)
    
```

```

FLOW_COR_CPS = FLOW_SP_CPS * FAC_TIA_AMP_CP
FLOW_CPS = min [
    FLOW_SP_CPS,
    FLOW_MAX_PHY_CPS / FAC_TIA_AMP_CP]
    
```

```

FLOW_TOT_CPS    = FLOW_TOT_CPS + FLOW_CPS / 360
MAF_CPS         = FLOW_CPS - MFF_BUF_CP
end
    
```

#### 9.14.4.5 Pad - and Low pass filter calculations

(Calculation of FLOW\_DLY\_CP, FLOW\_DLY\_MMV\_CP, MAF\_CP, MAF\_DLY\_CP and MAF\_DLY\_MMV\_CP)

#### Application conditions


**Initialisation:**            -- --

**Recurrence:**                *100 ms*

**Activation:**                -- --

**Deactivation:**              -- --

#### Signal flow diagram:

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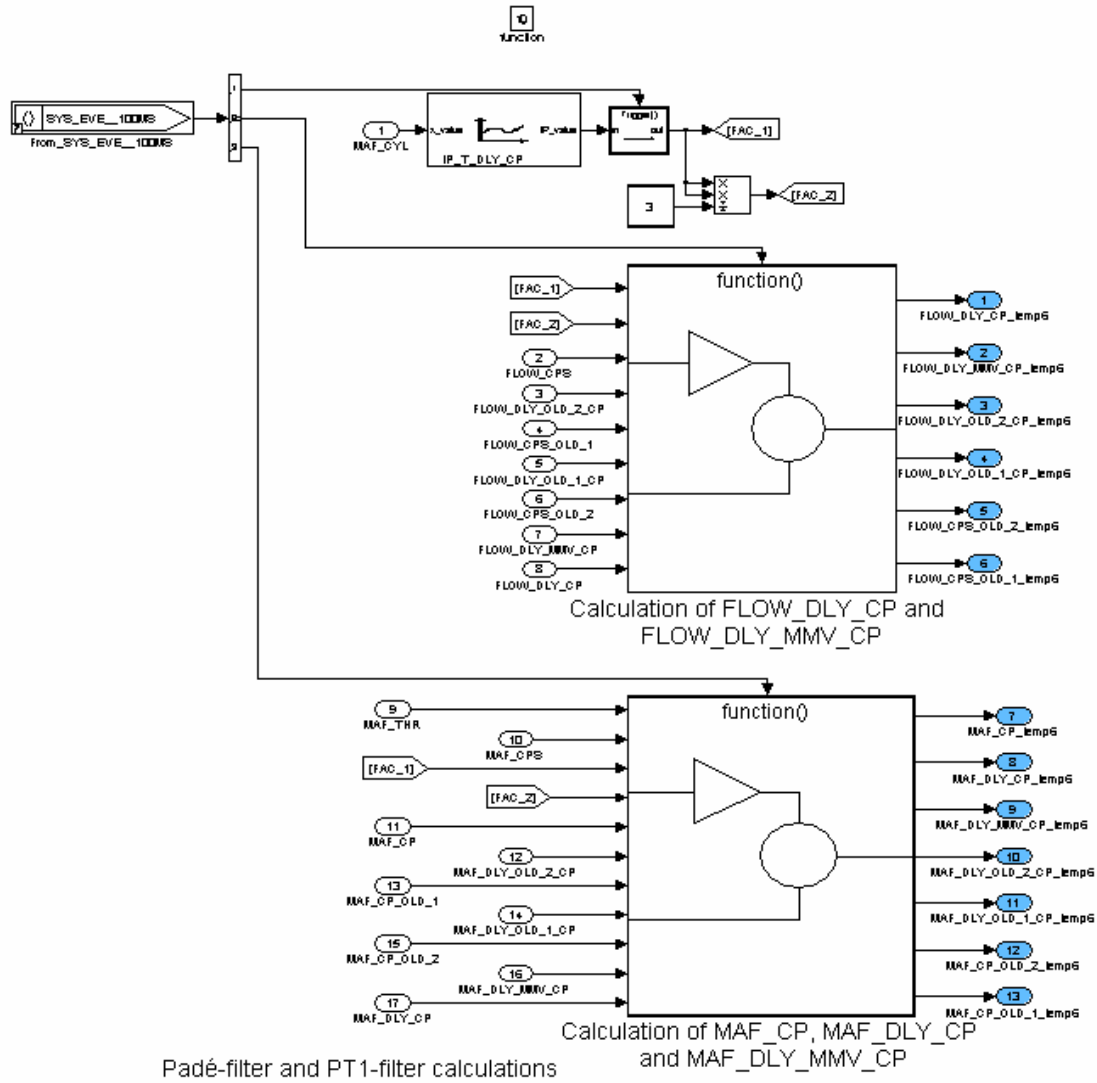


figure 9: Padé- and low pass filters

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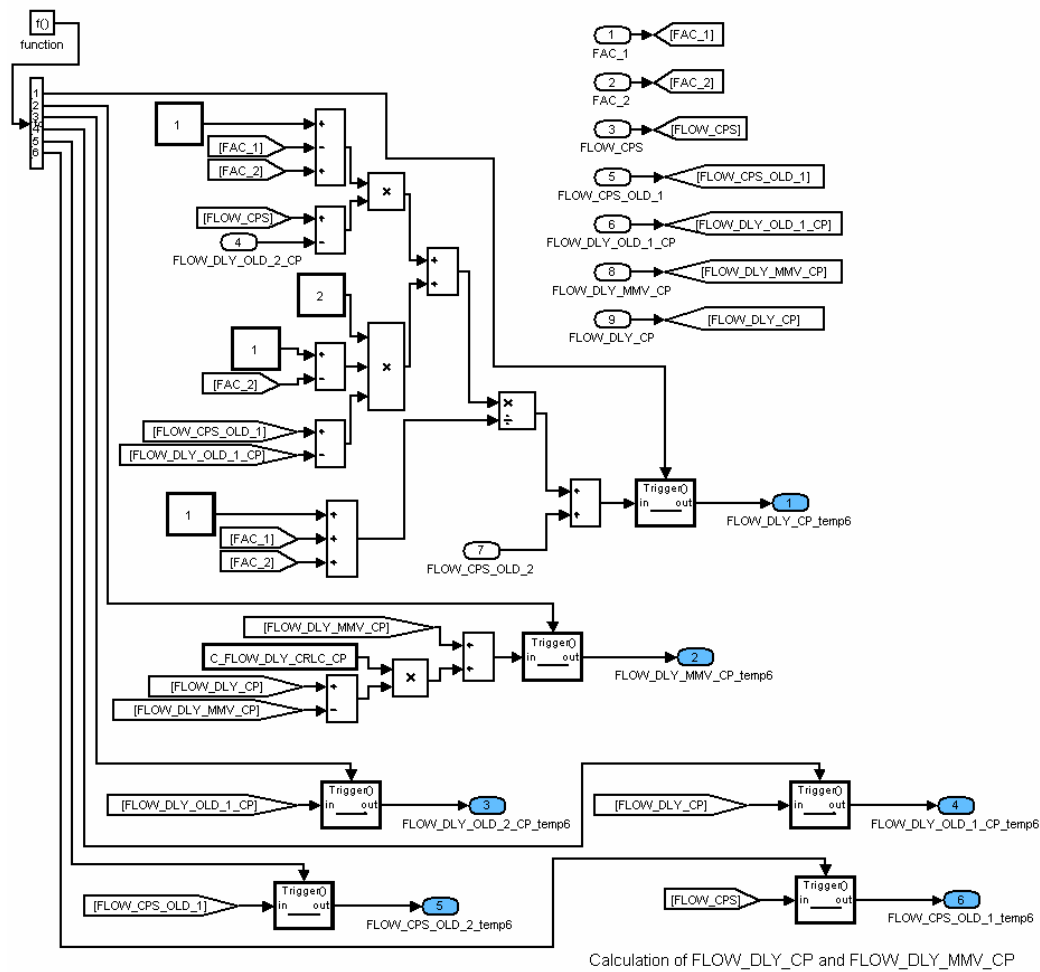


Figure 9.14.8: : calculation of FLOW\_DLY\_CP and FLOW\_DLY\_MMV\_CP

*the calc. of MAF\_DLY\_CP and MAF\_DLY\_MMV\_CP is done following the same scheme*

### Formula section:

#### Padefilter-parameters

```

if STATE_OPM_ENG_CP = ENG_MODE_0
then FAC_1 = IP_T_DLY_CP (MAF_KGH_FG_PRED_COR_CP)
else FAC_1 = IP_T_DLY_CP_2 (MAF_KGH_FG_PRED_COR_CP)
FAC_2 = FAC_1 * FAC_1 / 3
  
```

#### Calculation of FLOW\_DLY\_CP and FLOW\_DLY\_MMV\_CP:

```
// Pade-filter
```

```
FLOW_DLY_CP=
```

```

1 / (1 + FAC_1 + FAC_2)
* (1 - FAC_1 + FAC_2)
* (FLOW_CPS - FLOW_DLY_OLD_2_CP)
+ 2 * (1 - FAC_2) * (FLOW_CPS_OLD_1 - FLOW_DLY_OLD_1_CP)
+ FLOW_CPS_OLD_2
  
```

```
// Low pass-filter
```

$$\text{FLOW\_DLY\_MMV\_CP}_n = \text{FLOW\_DLY\_MMV\_CP}_{n-1} + (\text{FLOW\_DLY\_CP}_n - \text{FLOW\_DLY\_MMV\_CP}_{n-1}) * \text{C\_FLOW\_DLY\_CRLC\_CP}$$

// memorization for next recurrence

```
FLOW_DLY_OLD_2_CP = FLOW_DLY_OLD_1_CP
FLOW_DLY_OLD_1_CP = FLOW_DLY_CP
FLOW_CPS_OLD_2 = FLOW_CPS_OLD_1
FLOW_CPS_OLD_1 = FLOW_CPS
```

Calculation of MAF\_CP, MAF\_DLY\_CP and MAF\_DLY\_MMV\_CP:

MAF\_CP = MAF\_THR + MAF\_CPS

Better: MAF\_CP, only visible, no output

// Pade-filter

```
MAF_DLY_CP(n)=
  1/(1 + FAC_1 + FAC_2)
  * (1 - FAC_1 + FAC_2)
  * (MAF_CP_n - MAF_DLY_OLD_2_CP)
  + 2 * (1 - FAC_2) * (MAF_CP_OLD_1 - MAF_DLY_OLD_1_CP)
  + MAF_CP_OLD_2
```

// Lowpass-filter

$$\text{MAF\_DLY\_MMV\_CP}_n = \text{MAF\_DLY\_MMV\_CP}_{n-1} + (\text{MAF\_DLY\_CP}_n - \text{MAF\_DLY\_MMV\_CP}_{n-1}) * \text{C\_MAF\_DLY\_CRLC\_CP}$$

// memorization for next recurrence

```
MAF_DLY_OLD_2_CP = MAF_DLY_OLD_1_CP
MAF_DLY_OLD_1_CP = MAF_DLY_CP
MAF_CP_OLD_2 = MAF_CP_OLD_1
MAF_CP_OLD_1 = MAF_CP
```

Calculation of MAF\_DLY\_CPS and MAF\_DLY\_MMV\_CPS:

// Pade-filter

```
MAF_DLY_CPS(n)=
  1/(1 + FAC_1 + FAC_2)
  * (1 - FAC_1 + FAC_2)
  * (MAF_CPS_n - MAF_DLY_OLD_2_CPS)
  + 2 * (1 - FAC_2) * (MAF_CPS_OLD_1 - MAF_DLY_OLD_1_CPS)
  + MAF_CPS_OLD_2
```

// Lowpass-filter

$$\text{MAF\_DLY\_MMV\_CPS}_n = \text{MAF\_DLY\_MMV\_CPS}_{n-1} + (\text{MAF\_DLY\_CPS}_n - \text{MAF\_DLY\_MMV\_CPS}_{n-1}) * \text{C\_MAF\_DLY\_CRLC\_CPS}$$

// memorization for next recurrence

```
MAF_DLY_OLD_2_CPS = MAF_DLY_OLD_1_CPS
MAF_DLY_OLD_1_CPS = MAF_DLY_CPS
MAF_CPS_OLD_2 = MAF_CPS_OLD_1
MAF_CPS_OLD_1 = MAF_CPS
```


**end**

## 9.15 Evaporative emission control (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DLY_CLL_IS_S_CP	V	0... FFFFH	0... 65535	1	-
counter to disabled CLL at IS at unknown CL					
FAC_FLOW_COR_CP_EXT	O/V	0... FFH	0... 3.98437	0.015625	-
External factor to modify absolute flow					
FAC_FLOW_COR_CP_MIN_PURGE	O/V	0... FFH	0... 3.98437	0.015625	-
External factor to modify absolute flow for OPM_AV_CP = 1					
FAC_FLOW_TAR_COR_CP	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
Reduction factor for the flow target at close engine mode switch					
LV_C_FAC_LAM_0_CP_WIDE	O/V	0... 1H	0...1	1	-
Set the limitations of C_FAC_LAM_0_CP to wide threshold					
LV_CP_ACT	O/V	0... 1H	0...1	1	-
Logical value for EVAP-Control active					
LV_CP_CLOSE_1	O/V	0... 1H	0...1	1	-
Request to inhibit the canister purge function with high closing speed					
LV_CP_CLOSE_2	O/V	0... 1H	0...1	1	-
Request to inhibit the canister purge function with medium closing speed					
LV_CP_CLOSE_3	O/V	0... 1H	0...1	1	-
Request to inhibit the canister purge function with normal closing speed					
LV_CP_DYW_EXT	O/V	0... 1H	0...1	1	-
flag collecting project specific dynamic window conditions					
LV_CPS_AD_INH	O/V	0... 1H	0...1	1	-
CPS adaptation inhibited					
LV_FLOW_TAR_COR_CP	O/V	0... 1H	0...1	1	-
Reduction for the flow target at close engine mode switch					
LV_INH_CLL_IS_S_CP	O/V	0... 1H	0...1	1	-
Flag for disabled CLL at IS at unknown CL					
LV_INH_CP	O/V	0... 1H	0...1	1	-
Inhibits any purge operation, forces NO_PURGE (via a ramp)					
LV_INH_CP_CLL	O/V	0... 1H	0...1	1	-
Inhibits closed loop operation, leads to MIN_PURGE, if no other reasons force NO_PURGE					
LV_INH_CP_FAST	O/V	0... 1H	0...1	1	-
Inhibits any purge operation, forces a direct jump to NO_PURGE					
LV_INH_CP_SDL	O/V	0... 1H	0...1	1	-
flag collecting project specific reasons to inhibit CP via time control /permanently enable CP					
LV_INH_LAM_AD_SDL	O/V	0... 1H	0...1	1	-
flag collecting project specific reasons to inhibit LAM_AD via time control /permanently enable LAM_AD					
LV_STATE_OPM_CHG_HOM_CP	O/V	0... 1H	0...1	1	-
Engine mode change ENG_MODE_0 <-> ENG_MODE_1or2					
LV_STATE_OPM_CHG_S_CP	O/V	0... 1H	0...1	1	-
Engine mode change ENG_MODE_1 <-> ENG_MODE_2					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_STATE_T_SDL_CP_LAM_AD_EXT	O/V	0... 1H	0 ...1	1	-
External condition to force the time management to switch to lambda adaptation time					
LV_T_DLY_CP_LAMB_CH	-	0... 1H	0 ...1	1	-
flag indicating that delay time to enable NO_PURGE after LAMB_CH has finished was started					
LV_T_SDL_EXT_REQ	O/V	0... 1H	0 ...1	1	-
flag collecting project specific reasons to temporarily disabling CP and lambda adaptation					
MFF_GRD_CP	V	0... FFFFH	0... 1389	0.0211948	mg/stk
MFF gradient for canister purge					
MFF_GRD_MMV_CP	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Filtered MFF gradient for canister purge					
MFF_RED_OPM_THD_CP	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Area around the engine mode switch threshold to reduce the flow					
PRS_CPS_EXT	O/V	8000... 7FFFH	-2717.041... 2716.95854	0.0829175	hPa
Pressure difference environment over CP line					
STATE_OPM_ENG_CP	O/V	0H 1H 2H	ENG_MODE_0 ENG_MODE_1 ENG_MODE_2	-	-
Engine mode for CP					
T_AST_CP	O/V	0... FFFFH	0... 6553.5	0.1	s
Time after first start in driving cycle					
T_DLY_CP_LAMB_CH	V	0... FFFFH	0... 1310.7	0.02	s
Delay time after LAMB_CH has finished to enable NO_PURGE					
T_DLY_CP_OPM_AV	V	0... FFFFH	0... 1310.7	0.02	s
Delay time after OPM_AV change					
T_LAM_DEV_CHK_CP	V	0... FFFFH	0... 1310.7	0.02	s
Time counter for lambda deviation check					
T_LAM_DEV_SYM_CP	V	0... FFFFH	0... 1310.7	0.02	s
Time counter for the symptom in lambda deviation check					

**Input data:**

AMP {p. 982}	CL_MMV {p. 3698}	ERR_SYM_DMTLS {p. 4624}	FAC_LAM_AD_CUS [NC_CBK_EX_NR] {p. 8308}
FAC_LAM_AD_OUT [NC_CBK_EX_NR] {p. 2461}	FAC_LAM_LIM [NC_CBK_EX_NR] {p. 2461}	FAC_MFF_ADD_LAM_AD_ OUT [NC_CBK_EX_NR] {p. 2641}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}
LC_LAM_CBK_CPS {p. 3706}	LV_ACT_SA_EOL {p. 7763}	LV_ACT_SAP_EXT_ADJ {p. 7432}	LV_ACT_SAV_EXT_ADJ {p. 7433}
LV_ACT_VLS_EOL_EXT_ ADJ {p. 7763}	LV_AST {p. 1766}	LV_CP_CLL {p. 3636}	LV_CP_INH_CUS {p. 8229}
LV_CYL_BAL_LAM_AD_ EOL {p. 4043}	LV_CYL_BAL_LAM_AD_ REQ_CUS {p. 1015}	LV_DIAG_OPL_REQ_CBK [NC_CBK_EX_NR] {p. 5407}	LV_DIAGCPS_MIN_MOD {p. 5926}
LV_ENA_CHK_FUC_ ROUGH_LEAK {p. 5964}	LV_ERR_AMP {p. 4822}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_DIAGCPS {p. 5926}

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LV_ERR_EL_CPS {p. 4708}	LV_ERR_IGC {p. 4772}	LV_ERR_LAM_ADJ [NC_CBK_EX_NR] {p. 5216}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}
LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_DIP_ PLAUS {p. 1062}	LV_ERR_MAP_DIP_SENS {p. 4824}
LV_ERR_MAP_DIP_SHIFT {p. 4824}	LV_ERR_PVS_DOUBLE {p. 4216}	LV_ERR_TIA {p. 4200}	LV_ERR_TPS {p. 4982}
LV_ES {p. 1720}	LV_LAM_AD_EXT {p. 1016}	LV_LAM_AD_EXT_ADJ {p. 7763}	LV_LAM_LIM_LAM_AD [NC_CBK_EX_NR] {p. 6141}
LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_MIS_STATE_A {p. 6238}	LV_NO_PURGE_DMTL {p. 5966}	LV_SA_END {p. 804}
LV_ST {p. 1720}	LV_ST_END {p. 1720}	LV_TI_CH {p. 1775}	LV_TLDV_REQ {p. 1001}
LV_VAR_LSH_UP {p. 656}	MAP_DIP_MES_BAS_ 2SEG {p. 1198}	MAP_MES {p. 1198}	MFF_MAX_HOMS_CUS {p. 8229}
MFF_MAX_S_CUS {p. 8229}	MFF_SP_MV {p. 2151}	OPM_AV {p. 8137}	STATE_CP {p. 3637}
STATE_ERR_IV {p. 4803}	T_AST {p. 1766}	TCO {p. 1100}	TCO_ST {p. 1100}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_MMV_CLL_IS_S_MAX	-	0... FFFFH	0... 1.99996	30.5e-6	-
Maximum allowed CL_MMV for closed loop operation in stratified engine operation mode at idle speed					
C_CRLC_MFF_GRD_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation factor for MFF_GRD_CP calculation					
C_CTR_DLY_CLL_IS_S_DEC_CP	-	0... FFFFH	0... 65535	1	-
Decrement step for counter for to disabled CLL at IS at unknown CL					
C_CTR_DLY_CLL_IS_S_INC_CP	-	0... FFFFH	0... 65535	1	-
Increment step for counter to disabled CLL at IS at unknown CL					
C_CTR_DLY_CLL_IS_S_MAX_CP	-	0... FFFFH	0... 65535	1	-
Max value for counter to disabled CLL at IS at unknown CL					
C_FAC_FLOW_TAR_COR_MIN_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
Lower threshold for the flow correction factor					
C_STATE_CONF_CAT_CP	-	0... 3H	0 ...3	1	-
Configuration byte for closing speed of canister purge before catalyst monitor test started					
C_STATE_CONF_TLDV_CP	-	0... 3H	0 ...3	1	-
Configuration byte for closing speed of canister purge before leak detection test started					
C_T_AST_MAX_INH_CP_SDL	-	0... FFFFH	0... 6553.5	0.1	s
Max time after start to reset LV_INH_CP_SDL					
C_T_DLY_CP_LAMB_CH	-	0... FFFFH	0... 1310.7	0.02	s
Calibrateable delay time after LAMB_CH has finished to enable NO_PURGE					
C_T_DLY_CP_OPM_AV	-	0... FFFFH	0... 1310.7	0.02	s
Calibrateable time delay for NO_PURGE after STATE_OPM_AV changed					
C_T_LAM_DEV_CHK_MAX_CP	-	0... FFFFH	0... 1310.7	0.02	s
Time to detect the possibility of an error in the fuel system					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_LAM_DEV_SYM_MAX_CP	-	0... FFFFH	0... 1310.7	0.02	s
Threshold time for the symptom to detect the possibility of an error in the fuel system					
C_TCO_MAX_INH_CP_SDL	-	0... FEH	-48... 142.5	0.75	°C
Max cooling water temperature to reset LV_INH_CP_SDL					
ID_STATE_OPM_ENG_CP	-	0... 2H	0 ...2	1	-
LDPM_OPM_AV	8	0... 8H	0 ...8	1	-
Mode selection for canister purge depending on engine operation mode					
IP_FAC_LAM_DEV_MAX_CP	-	0... FFFFH	-100... 99.99694	3.0518e-3	%
LDPM_LAMB_SP_CP	4	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambdacontroller maximum threshold for possibility of fuel system error dependend on LAMB_SP[i]					
IP_FAC_LAM_DEV_MIN_CP	-	0... FFFFH	-100... 99.99694	3.0518e-3	%
LDPM_LAMB_SP_CP	4	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambdacontroller minimum threshold for possibility of fuel system error dependend on LAMB_SP[i]					
IP_FAC_REL_FLOW_CPS_WOUT_CAT	V	0... FFH	0... 3.98437	0.015625	-
LDPM_N_32_IP_REL_FLOW_MAX_CPS	12	0... FFH	0... 8160	32	rpm
LDPM_MAF_IP_REL_FLOW_MAX_CPS	12	0... FFH	0... 1389	5.4470588	mg/stk
Factor for CP MIN_PURGE					
IP_MFF_RED_OPM_CP	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_MFF_SP_MV_IP_MFF_RED_CP	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Area around the engine mode switch threshold to reduce the flow					
IP_T_ST_AST_TCO_ST_CPS_MIN	-	1... FFFFH	0.1... 6553.5	0.1	s
LDP_TCO_ST_IP_T_ST	6	0... FEH	-48... 142.5	0.75	°C
Minimum temperature for EVAP-Control active					
LC_CP_ACT	-	0... 1H	0 ...1	1	-
central switch for activation /deactivation of canister purge functions					
LC_CP_AST_ACT	-	0... 1H	0 ...1	1	-
Use of LV_AST for activation of evaporative emission control function					
LC_ERR_AMP_INH_CLL	-	0... 1H	0 ...1	1	-
Inhibits the EVAC to be in close loop if an AMP error is detected					
LC_ERR_MAP_MIN_PURGE_CP	-	0... 1H	0 ...1	1	-
Enables Min Purge operation at MAP error, otherwise switched to No Purge					
LC_LAM_DEV_RESU_CP	-	0... 1H	0 ...1	1	-
Resume the lambda deviation detection					
LC_LAM_LIM_AD_ENA	-	0... 1H	0 ...1	1	-
switch to enable forced lambda adaptation					
LC_TLDV_NOT_SEQ	-	0... 1H	0 ...1	1	-
Configuration bit to select if the OBD2 sequencer is present (0) or not (1)					

### 9.15.1 Project specific definition for "Time after start"


#### General information:

T\_AST\_CP has to be written in general with T\_AST. Only special configurations, e.g. for stop-start functionality, T\_AST\_CP has to be written with other values (e.g. T\_AST\_DC).

#### Application conditions

**Initialisation:**  $T_{AST\_CP} = 0$  after reset

**Recurrence:** 100ms

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**Activation:** *all engine states*

**Deactivation:** - -

**Formula section:**

$T\_AST\_CP = T\_AST$

## 9.15.2 Activation of the Evaporative Emission Control Function

**General information:**

The Evaporative Emission Control function is activated (LV\_CP\_ACT=1), if the time after start exceeds IP\_T\_ST\_AST\_TCO\_ST\_CPS\_MIN, which depends on coolant temperature after start. The function is active during all engine operating states except the following states:

- engine stopped (LV\_ES=1)
- engine start (LV\_ST=1)

For the MSA stop/start functionality it is necessary to calculate a separate T\_AST\_CP, which represents the time after first start in an driving cycle.

**Application conditions**

**Initialisation:** LV\_CP\_ACT = 0 after reset or stalling

**Recurrence:** 20ms

**Activation:**

**Deactivation:** - -

**Formula section:**

LV\_CP\_ACT =  
 [ T\_AST\_CP > IP\_T\_ST\_AST\_TCO\_ST\_CPS\_MIN(TCO\_ST)  
 and LV\_ES = 0  
 and LV\_ST = 0  
 and [LV\_AST = 0 or LC\_CP\_AST\_ACT = 0]  
 and LC\_CP\_ACT = 1 ]


## 9.15.3 Cross-locking table

**General information:**

This chapter describes the evaporative emission control inhibition.

**Application conditions**

**Initialisation:** at reset:  
 LV\_INH\_CP = 1  
 LV\_INH\_CP\_FAST = 0  
 LV\_INH\_CP\_CLL = 0  
 LV\_CP\_DYW\_EXT = 1 (never changed after initialisation)  
 LV\_INH\_LAM\_AD\_SDL = 0 (never changed after initialisation)  
 LV\_INH\_CP\_SDL = 0

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```

LV_T_DLY_CP_LAMB_CH = 0
T_DLY_CP_LAMB_CH = 0
LV_CPS_AD_INH          = 0      (never changed after initialisation)
T_DLY_CP_OPM_AV = 0
at LV_IGK 0 -> 1
LV_T_DLY_CP_LAMB_CH = 0
T_DLY_CP_LAMB_CH = 0
CTR_DLY_CLL_IS_S_CP = C_CTR_DLY_CLL_IS_S_MAX_CP
LV_INH_CLL_IS_S_CP = 1
T_DLY_CP_OPM_AV = 0

```

**Recurrence:** 20 ms

**Activation:** LV\_ST\_END = 1

**Deactivation:** LV\_ST\_END = 0

### Formula section:

```

If          LV_SA_END = 1          and
LV_TI_CH = 0          and
LV_T_DLY_CP_LAMB_CHn = 0
Then       LV_T_DLY_CP_LAMB_CHn-1 = 1
            T_DLY_CP_LAMB_CH = C_T_DLY_CP_LAMB_CH
Endif

```

```

If          LV_SA_END = 1          and
LV_TI_CH = 0          and
T_DLY_CP_LAMB_CH > 0
Then       T_DLY_CP_LAMB_CH = T_DLY_CP_LAMB_CHn-1 - 20 ms
Endif

```

```

If          OPM_AVn != OPM_AVn-1
Then       T_DLY_CP_OPM_AV = C_T_DLY_CP_OPM_AV
Else      T_DLY_CP_OPM_AVn = T_DLY_CP_OPM_AVn-1 - 20 ms
Endif

```

Counter to prevent RO/ROF at idle speed and stratified engine mode at unknown CL\_MMV

```

If          LV_CP_CLL = 1
Then       CTR_DLY_CLL_IS_S_CP = max(0,CTR_DLY_CLL_IS_S_CP -
                                C_CTR_DLY_CLL_IS_S_DEC_CP)
            If          CTR_DLY_CLL_IS_S_CP = 0
            Then       LV_INH_CLL_IS_S_CP = 0
            endif
Else      CTR_DLY_CLL_IS_S_CP =
            min(C_CTR_DLY_CLL_IS_S_MAX_CP,CTR_DLY_CLL_IS_S_CP +
              C_CTR_DLY_CLL_IS_S_INC_CP)
            If          CTR_DLY_CLL_IS_S_CP = C_CTR_DLY_CLL_IS_S_MAX_CP
            Then       LV_INH_CLL_IS_S_CP = 1
            endif

```


**endif**

For activation of **NO\_PURGE (via a ramp)** and setting of the flag LV\_INH\_CP the following conditions must be fulfilled:

```

If          LV_ERR_EL_CPS = 1          or

```

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```

LV_ERR_DIAGCPS = 1                                or
{(LV_ERR_MAP_DIP_PLAUS                            or
LV_ERR_MAP_DIP_SENS                               or
LV_ERR_MAP_DIP_SHIFT)                            and
LC_ERR_MAP_MIN_PURGE_CP = 0}                    or
LV_ACT_SAV_EXT_ADJ = 1                            or
LV_ACT_SAP_EXT_ADJ = 1                            or
LV_ACT_SA_EOL = 1                                or
LV_NO_PURGE_DMTL = 1                              or
ERR_SYM_DMTLS = SYM_1                            or
LV_MIS_STATE_A = 1                                or
T_DLY_CP_OPM_AV > 0                               or
LV_SA_END = 0                                     or
LV_TI_CH = 1                                      or
LV_ENA_CHK_FUC_ROUGH_LEAK = 1                   or
LV_CP_INH_CUS = 1                                 or
(LV_SA_END = 1                                    and
LV_TI_CH = 0                                     and
T_DLY_CP_LAMB_CH > 0 )
Then LV_INH_CP = 1
Else LV_INH_CP = 0
Endif

```

```

If LV_DIAG_OPL_REQ_CBK[i] = 1                    or //for any i
LV_ACT_VLS_EOL_EXT_ADJ = 1
Then LV_INH_CP_FAST = 1
Else LV_INH_CP_FAST = 0
Endif

```

```

If (LV_CYL_BAL_LAM_AD_EOL = 1                    or
T_AST > C_T_AST_MAX_INH_CP_SDL                 or
TCO > C_TCO_MAX_INH_CP_SDL)                   and
LV_LAM_AD_EXT_ADJ = 0
Then LV_INH_CP_SDL = 0
Else LV_INH_CP_SDL = 1
Endif


```

For activation of **MIN\_PURGE** and setting of the flag LV\_INH\_CP\_CLL the following conditions must be fulfilled:

```

If LV_ERR_MAF = 1                                or
LV_ERR_TPS = 1                                  or
LV_ERR_TIA = 1                                  or
(LV_ERR_AMP = 1                                  and
LC_ERR_AMP_INH_CLL = 1)                         or
STATE_ERR_IV 0                                  or
LV_ERR_LS_UP[i] = 1                             or
LV_ERR_PVS_DOUBLE = 1                           or
LV_ERR_IGC = 1                                  or
LV_ERR_LOAD_TPS_PLAUS = 1                       or

```

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```

LV_ERR_LAM_ADJ[i] = 1                or
LV_ERR_CHG_LS_UP = 1                or
LV_DIAGCPS_MIN_MOD = 1              or
{(LV_ERR_MAP_DIP_PLAUS              or
LV_ERR_MAP_DIP_SENS                  or
LV_ERR_MAP_DIP_SHIFT)               and
LC_ERR_MAP_MIN_PURGE_CP = 1}        or
// only open loop at idle speed and stratified engine mode and unknown CL
// If CL is known, closed loop only for low CL_MMV
[(LV_IS = 1                           and
STATE_OPM_ENG_CP != ENG_MODE_0 and
{LV_INH_CLL_IS_S_CP = 1
or CL_MMV > C_CL_MMV_CLL_IS_S_MAX } ) ]

```

```

Then    LV_INH_CP_CLL = 1
Else    LV_INH_CP_CLL = 0
Endif

```

### 9.15.4 Project specific factor for MIN purge flow

#### General information:

With this function, the MIN\_PURGE flow can be varied by a factor from 0 to 4 for vehicles without catalyst and lambda sensors or in case of using different engine operation modes (STATE\_OPM\_ENG\_CP).

#### Application conditions

```

Initialisation:    FAC_FLOW_COR_CP_EXT = 1   at reset   FAC_FLOW_COR_CP_MIN_PURGE
                      = 1 at reset

Recurrence:       100ms

Activation:       LV_ST_END = 1

Deactivation:     LV_ST_END = 0

```


#### Formula section:

```

If (1)    LV_VAR_LSH_UP = 1
Then (1)
    If (2) STATE_OPM_ENG_CP = 0
    Then (2) FAC_FLOW_COR_CP_MIN_PURGE = 1
    Else (2) FAC_FLOW_COR_CP_MIN_PURGE =
                IP_FAC_REL_FLOW_CPS_WOUT_CAT
    Endif (2)
    FAC_FLOW_COR_CP_EXT = 1
Else (1)    FAC_FLOW_COR_CP_EXT = IP_FAC_REL_FLOW_CPS_WOUT_CAT
                FAC_FLOW_COR_CP_MIN_PURGE = 1
Endif (1)

```

### 9.15.5 External calculations

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**General information:**

With this function, it is possible to supply the Evaporative emission control variables function with a measured canister purge differential pressure. For further information on the use of this external differential pressure please refer to chapter Evaporative emission control variables .

**Application conditions**

**Initialisation:** *PRS\_CPS\_EXT= 0 at reset*  
**Recurrence:** *20ms*  
**Activation:** *LV\_ST\_END = 1*  
**Deactivation:** *LV\_ST\_END = 0*

**Formula section:**

$PRS\_CPS\_EXT = MAP\_DIP\_MES\_BAS\_2SEG$

**9.15.6 Management of LV\_CP\_CLOSE\_CP\_x with no OBD sequencer****General information:**

This chapter describes the recommendations for evaporative emission control inhibition when no OBD sequencer is used. In this case the flags LV\_CP\_CLOSE\_1, LV\_CP\_CLOSE\_2, and LV\_CP\_CLOSE\_3 must be managed within this module.

Examples that need to close purge are OBD diagnostics for leak detection and catalyst monitor.

Normally the flags LV\_CP\_CLOSE\_CP\_x are managed and defined by the OBD sequencer, if there is no sequencer it is recommended to set LC\_TLDV\_NOT\_SEQ =1 and define and calculate these flags in the application inc. spec.

C\_STATE\_CONF\_TLDV\_CP and C\_STATE\_CONF\_CAT\_CP are used to configure the closing ramp of the CPS valve to inhibit purge during an OBD test.

Values of C\_STATE\_CONF\_TLDV\_CP and C\_STATE\_CONF\_CAT\_CP:

- 0: Canister purge remains active, no request to close the valve
- 1: Canister purge closed with highest speed closing ramp
- 2: Canister purge closed with medium speed closing ramp
- 3: Canister purge closed with normal speed closing ramp


**Application conditions**

**Initialisation:** *at reset or power loss:*  
*LV\_CP\_CLOSE\_1 = 0 (never changed after initialisation)*  
*LV\_CP\_CLOSE\_2 = 0 (never changed after initialisation)*  
*LV\_CP\_CLOSE\_3 = 0 (never changed after initialisation)*

**Recurrence:** *only initialisation*

**9.15.7 Selection of STATE\_OPM\_ENG\_CP in case of engine operation mode change (OPM\_AV)****General information:**

This chapter describes the canister purge behaviour in case of changing engine operation mode (OPM\_AV).

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**Application conditions**

**Initialisation:** *at reset or power loss STATE\_OPM\_ENG\_CP = 0*

**Recurrence:** 100 ms

**Activation:** *every engine state*

**Formula Section:**

STATE\_OPM\_ENG\_CP = ID\_STATE\_OPM\_ENG\_CP

Setting of the flag LV\_STATE\_OPM\_CHG\_HOM\_CP to detect the engine mode change from homogeneous (ENG\_MODE\_0) to stratified (ENG\_MODE\_1/2) and vice versa and the flag LV\_STATE\_OPM\_CHG\_S\_CP to detect the change of the stratified engine mode (ENG\_MODE\_1 to ENG\_MODE\_2 and vice versa).

```

if      [(STATE_OPM_ENG_CPn = ENG_MODE_0
and STATE_OPM_ENG_CPn-1 != ENG_MODE_0)
or (STATE_OPM_ENG_CPn != ENG_MODE_0
and STATE_OPM_ENG_CPn-1 = ENG_MODE_0)]
then    LV_STATE_OPM_CHG_HOM_CP = 1
else    LV_STATE_OPM_CHG_HOM_CP = 0
endif

```

```

if      [(STATE_OPM_ENG_CPn = ENG_MODE_1
and STATE_OPM_ENG_CPn-1 = ENG_MODE_2)
or (STATE_OPM_ENG_CPn = ENG_MODE_2
and STATE_OPM_ENG_CPn-1 = ENG_MODE_1)]
then    LV_STATE_OPM_CHG_S_CP = 1
else    LV_STATE_OPM_CHG_S_CP = 0

```

endif

**9.15.8 end****9.15.9 Flow Reduction near engine operation mode switch****General information:**


The two thresholds for an engine operating mode change is given by the two input values. Around this fuel mass point the flow through the CPS valve is reduced, to prevent disturbances at engine mode change by canister purge.

**Application conditions**

**Initialisation:** all values = 0 at reset

**Recurrence:** 20 ms

**Activation:** *every engine state*

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**Formula Section:**

$$\text{MFF\_GRD\_CP} = \text{abs}(\text{MFF\_SP\_MV}_{n-1} - \text{MFF\_SP\_MV}_n)$$

$$\text{MFF\_GRD\_MMV\_CP}_n =$$

$$\text{MFF\_GRD\_MMV\_CP}_{n-1} + (\text{MFF\_GRD\_CP} - \text{MFF\_GRD\_MMV\_CP}_{n-1}) * \text{C\_CRLC\_MFF\_GRD\_CP}$$

$$\text{MFF\_RED\_OPM\_THD\_CP} = \text{IP\_MFF\_RED\_OPM\_CP}(\text{MFF\_GRD\_MMV\_CP})$$

```

if          abs(MFF_SP_MV-MFF_MAX_S_CUS) < MFF_RED_OPM_THD_CP // HOMS<->S
then       LV_FLOW_TAR_COR_CP = 1
            FAC_FLOW_TAR_COR_CP = max{ C_FAC_FLOW_TAR_COR_MIN_CP,
            abs(MFF_SP_MV-MFF_MAX_S_CUS)/MFF_RED_OPM_THD_CP}
elseif    abs(MFF_SP_MV-MFF_MAX_HOMS_CUS) < MFF_RED_OPM_THD_CP
            // HOMS<->HOM
then       LV_FLOW_TAR_COR_CP = 1
            FAC_FLOW_TAR_COR_CP = max{ C_FAC_FLOW_TAR_COR_MIN_CP,
            abs(MFF_SP_MV-MFF_MAX_HOMS_CUS)/MFF_RED_OPM_THD_CP}
else       LV_FLOW_TAR_COR_CP = 0
            FAC_FLOW_TAR_COR_CP = 1
endif

end

```

**9.15.10 Calculation of LV\_C\_FAC\_LAM\_0\_CP\_WIDE****General information:**

At the start of each driving cycle the lambda deviation has to be monitored to detect the possibility of an error in the fuel system. If the possibility of an error is detected, the flag LV\_C\_FAC\_LAM\_0\_CP\_WIDE is set. This will open the limitations of FAC\_LAM\_0\_CP.

TA = recurrence

**Application conditions**

```


Initialisation:      at RST or LV_IGK=1
                        T_LAM_DEV_CHK_CP = C_T_LAM_DEV_CHK_MAX_CP
                        T_LAM_DEV_SYM_CP = 0
                        LV_C_FAC_LAM_0_CP_WIDE = 0
                        if      LC_LAM_CBK_CPS=0
                        then    idx_cp = 0
                        else    idx_cp = 1
                        endif

```

**Recurrence:** 20ms

**Activation:** *every engine state*

**Deactivation:** - -

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**Formula section:**

```

if    LC_LAM_DEV_RESU_CP = 1
      and STATE_CP = MAX_PURGE
then    T_LAM_DEV_CHK_CP = C_T_LAM_DEV_CHK_MAX_CP
      T_LAM_DEV_SYM_CP = 0
      LV_C_FAC_LAM_0_CP_WIDE = 0
endif

if    LV_LAM_LSCL[idx_cp] = 1           // lambda controller acting
      and T_LAM_DEV_CHK_CP > 0
      and (STATE_CP = CP_NOT_ACT
           or STATE_CP = NO_PURGE)
then    T_LAM_DEV_CHK_CP = max (0, T_LAM_DEV_CHK_CP - TA)
if {LV_LAM_AD_EXT = 0
    and  [(FAC_LAM_LIM[idx_cp] + FAC_LAM_AD_OUT[idx_cp] + FAC_MFF_ADD_LAM_
AD_OUT[idx_cp]) >= IP_FAC_LAM_DEV_MAX_CP(LAMB_SP))
    or((FAC_LAM_LIM[idx_cp] + FAC_LAM_AD_OUT[idx_cp] + FAC_MFF_ADD_LAM_AD_
OUT[idx_cp]) <= IP_FAC_LAM_DEV_MIN_CP(LAMB_SP))]}
    or
    {LV_LAM_AD_EXT = 1
    and  [(FAC_LAM_LIM[idx_cp] + FAC_LAM_AD_CUS[idx_cp]) >= IP_FAC_LAM_DEV_
MAX_CP(LAMB_SP))
    or((FAC_LAM_LIM[idx_cp] + FAC_LAM_AD_CUS[idx_cp]) <= IP_FAC_LAM_DEV_MIN_
CP(LAMB_SP))]}
then T_LAM_DEV_SYM_CP ++
      if T_LAM_DEV_SYM_CP = C_T_LAM_DEV_SYM_MAX_CP
        then    LV_C_FAC_LAM_0_CP_WIDE = 1
        endif
      endif
endif
end

```

**9.15.11 External request for Time slice "Lambda adaption"****General information:**

With the flag LV\_STATE\_T\_SDL\_CP\_LAM\_AD\_EXT the time management for lambda adaptation and canister purge can be forced to change and stay in one of the lambda adaptation time slices.

**Application conditions**

**Initialisation:** *LV\_STATE\_T\_SDL\_CP\_LAM\_AD\_EXT = 0 after reset*

**Recurrence:** *20ms*

**Activation:** *all engine states*


**Deactivation:** *- -*

**Formula section:**

```

if    ( LV_LAM_LIM_LAM_AD [i] = 1           // shall be true, if at least one bench is true
      and  LC_LAM_LIM_AD_ENA = 1)           // immediate lambda adaptation required


```

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```

    or LV_CYL_BAL_LAM_AD_REQ_CUS = 1
then   LV_STATE_T_SDL_CP_LAM_AD_EXT = 1
else   LV_STATE_T_SDL_CP_LAM_AD_EXT = 0

```

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## 9.16 Evaporative emission control - Injection correction

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
BUF_INP_CP	V	0... FFFFH	0... 0.99998	15.3e-6	-
Input for the fuel delay buffer					
BUF_OUT_CP	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Output of the fuel delay buffer					
IDX_CP	-	0... FFH	0... 255	1	-
Current position within the ring buffer					
IDX_RD_CP	-	0... FFH	0... 255	1	-
Reading position within the ring buffer					
IDX_STEP_CP	-	0... FFH	0... 255	1	-
number of elements to fill with actual input beginning with actual position					
MAF_KGH_FG_PRED_COR_CP	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Predicted fresh gas out of manifold corrected by MAP and TIA for CP					
MFF_ADD_BUF [NC_NR_CP_BUF]	V	0... FFFFH	0... 0.99998	15.3e-6	-
Array of MFF_ADD_CP_KGH values [NC_NR_CP_BUF elements default value= 20]					
MFF_ADD_CYL_CP	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass from the canister in the cylinder					
MFF_ADD_LAM_CP	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Additive adaptive correction of the mass fuel flow injection with active canister purge					
MFF_BUF_CP	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Fuel flow from the CPS to the Cylinder					
MFF_CPS	V	0... FFFFH	0... 1389	0.0211948	mg/stk
fuel mass calculation for torque correction in stratified combustion					
MFF_TOT_CP	V	0... FFFFFFFFH	0... 1455.99999	339e-9	g
Total of MFF_BUF_CP during emission cycle					
TQI_ADD_CP	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Canister purge torque gain					

### Input data:

LC_CP_CLL_INH_MAN {p. 1544}	LV_CP_ACT {p. 3679}	LV_FAC_LAM_SHIFT_CP {p. 3699}	LV_HOM_ACT {p. 8136}
LV_N_MAX_CP {p. 1540}	MAF {p. 8277}	MAF_CPS {p. 3636}	MAF_CYL {p. 8277}
MAF_KGH_FG_PRED {p. 8278}	MAP {p. 8278}	MFF_ADD_CP_KGH {p. 3700}	N_32 {p. 1525}
NC_CYL_NR {p. 1526}	STATE_OPM_ENG_CP {p. 3680}	TIA {p. 1226}	TQI_SP_S {p. 8391}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_THR_MIN_BUF_CP	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Minimum MAF_THR value for Ringbuffer input calculation.					
IP_CRLOC_MFF_BUF_CP	-	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Ratio for MFF_BUF_CP calculation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_IDX_STEP_CP	-	0... FFH	0... 255	1	-
LDPM_MAF_KGH_CLC_ID_IDX_STEP_CP	12	0... FFFFH	0... 2047.96875	0.03125	kg/h
number of elements+1 to fill with actual input beginning with actual position					
IP_IDX_STEP_CP_2	-	0... FFH	0... 255	1	-
LDPM_MAF_KGH_CLC_ID_IDX_STEP_CP	12	0... FFFFH	0... 2047.96875	0.03125	kg/h
number of elements+1 to fill with actual input beginning with actual position at STATE_OPM_ENG_CP = 1					
IP_MAF_KGH_PRED_COR_MAP_TIA	V	0... FFFFH	0... 7.99987	122.1e-6	-
LDPM_MAP_1_EVAC	6	0... FFFFH	0... 5434	0.0829175	hPa
LDPM_TIA_1_EVAC	3	0... FEH	-48... 142.5	0.75	°C
Correction factor for MAF_KGH_FG_PRED (MAP and TIA)					
IP_MAF_KGH_PRED_COR_MAP_TIA_2	V	0... FFFFH	0... 7.99987	122.1e-6	-
LDPM_MAP_1_EVAC	6	0... FFFFH	0... 5434	0.0829175	hPa
LDPM_TIA_1_EVAC	3	0... FEH	-48... 142.5	0.75	°C
Correction factor for MAF_KGF_FG_PRED (MAP and TIA) with of STATE_OP_ENG_CP = 1					
IP_MFF_DLY_CP	-	0... FFH	0... 255	1	-
LDPM_MAF_CYL_1_EVAC_MFF_DLY_CP	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Delay for MFF_BUF_CP calculation; maximum allowed calibration value is NC_NR_CP_BUF-1					
IP_MFF_DLY_CP_2	-	0... FFH	0... 255	1	-
LDPM_MAF_CYL_1_EVAC_MFF_DLY_CP	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Delay for MFF_BUF_CP calculation with STATE_OPM_ENG_CP = 1					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_FLOW_CPS_CAL	-	0... 1H	0...1	1	-
Choice of recurrence for MFF_ADD_LAM_CP calculation					
LC_MAF_COR_ACT_CP	-	0... 1H	0...1	1	-
Activate the usage of the corrected MAF for reading the buffer					
NC_NR_CP_BUF	-	0... FFH	0... 255	1	-
Size of the fuel buffer FUEL_FLOW_ADD_BUF					

Input data table order: External inputs - Inputs from other EVAC modules

**General information:**

When the Evaporative Emission Control is active, the fuel injection is corrected by an additive value MFF\_ADD\_LAM\_CP to avoid emission and driveability problems caused by the fuel flow through the CPS. This correction is done all the time.

During RAMP\_OPEN when the lambda control is shifted the buffer will be initialized to the last MFF\_ADD\_CP\_KGH value.

The MFF\_BUF\_CP value is calculated to take into account the distance between the CPS VALVE and the injectors.


The value MFF\_ADD\_LAM\_CP is added with a minus sign to the total formula of the injection calculation (see chapter INJECTION).

The value MFF\_TOT\_CP allow to measure the quantity of fuel during an emission cycle.

After the initialization phase the buffer must be calculated all the time, in order to have the buffer empty when the evaporative function is stopped.

**Application conditions****Initialisation:**

at reset and engine stop  
MFF\_TOT\_CP = 0

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```

        at reset, engine stop and deactivation
MFF_ADD_BUF[all]           = 0
MFF_BUF_CP                 = 0
MFF_ADD_LAM_CP            = 0
MFF_CPS                   = 0
MFF_ADD_CYL_CP           = 0
TQI_ADD_CP                = 0
BUF_INP_CP                = 0
BUF_OUT_CP                = 0
IDX_CP                    = pointer at MFF_ADD_BUF[0]

```

**Recurrence:** 20 ms

**Activation:** [LV\_CP\_ACT = 1 **and** LC\_CP\_CLL\_INH\_MAN = 0]

**Deactivation:** [LV\_CP\_ACT = 0 **or** LC\_CP\_CLL\_INH\_MAN = 1]

### Formula section:

```

if LV_N_MAX_CP = 1
then call "Default values for disabled calculations"
else call "handling of the ring buffer"
    if LV_HOM_ACT = 1
    then call "Injection correction calculation"
    else call "Torque Correction calculation"
    endif
    MFF_TOT_CP = MFF_TOT_CP + MFF_BUF_CP /360
    360 = transformation factor for [kg/h] [g/10ms]
endif
end

```

### 9.16.1 Default values for disabled calculations

When the maximum engine speed limitation is reached (LV\_N\_MAX\_CP) some of the calculations for the injection correction must be stopped to decrease the CPU load. If LV\_N\_MAX\_CP is active then the normal calculations of the following variables are not done and the values of these variables are set to 0.

### Formula section:

```

MFF_ADD_BUF           = 0 (all values of the array)
MFF_BUF_CP           = 0
MFF_ADD_LAM_CP       = 0
TQI_ADD_CP           = 0
BUF_INP_CP           = 0
MFF_CPS              = 0
BUF_OUT_CP           = 0
MFF_ADD_CYL_CP       = 0
end

```

## 9.16.2 Handling of the ring buffer

The recurrence of this subchapter is configurable by LC\_FLOW\_CPS\_CAL:

**if** LC\_FLOW\_CPS\_CAL=0 then recurrence **20** ms

**if** LC\_FLOW\_CPS\_CAL=1 then recurrence **40** ms

The buffer MFF\_ADD\_BUF has NC\_NR\_CP\_BUF elements

IDX\_CP, IDX\_RD\_CP and IDX\_STEP\_CP are pointers within the ring buffer; they have to be checked for exceeding the limits of the ring buffer.

IDX\_CP is the current position within the ring buffer MFF\_ADD\_BUF. This position is incremented every 20 resp. 40 ms, depending on LC\_FLOW\_CPS\_CAL

### Formula section:

#### Correction of MAF\_KGH\_FG\_PRED (MAP and TIA)

```

if STATE_OPM_ENG_CP = ENG_MODE_0
    Then MAF_KGH_FG_PRED_COR_CP = MAF_KGH_FG_PRED * IP_
    MAF_KGH_PRED_COR_MAP_TIA(MAP,TIA)
    Else MAF_KGH_FG_PRED_COR_CP = MAF_KGH_FG_PRED * IP_
    MAF_KGH_PRED_COR_MAP_TIA_2(MAP,TIA)
  
```

// The overflow handling of the buffer indices is not described here and has to be done software-internal

// reading

**if** LC\_MAF\_COR\_ACT\_CP = 0

**then**

**if** STATE\_OPM\_ENG\_CP = ENG\_MODE\_0

**then** IDX\_RD\_CP = IDX\_CP - IP\_MFF\_DLY\_CP (MAF\_CYL)

**else** IDX\_RD\_CP = IDX\_CP - IP\_MFF\_DLY\_CP\_2 (MAF\_CYL)

**endif**

**else**

**if** STATE\_OPM\_ENG\_CP = ENG\_MODE\_0

**then** IDX\_RD\_CP = IDX\_CP -

IP\_MFF\_DLY\_CP (MAF\_KGH\_FG\_PRED\_COR\_CP)

**else** IDX\_RD\_CP = IDX\_CP -

IP\_MFF\_DLY\_CP\_2 (MAF\_KGH\_FG\_PRED\_COR\_CP)

**endif**

**endif**

BUF\_OUT\_CP = MFF\_ADD\_BUF[IDX\_RD\_CP] \* MAF \* N\_32 \* NC\_CYL\_NR \* 3 / 10<sup>5</sup>

// writing IDX\_STEP\_CP elements are filled

**if** MFF\_ADD\_CP\_KGH = 0

**then** BUF\_INP\_CP = 0

**else** BUF\_INP\_CP = MFF\_ADD\_CP\_KGH /

(max(MAF\_THR,C\_MAF\_THR\_MIN\_BUF\_CP) + MAF\_CPS)


**endif**

**if** LV\_FAC\_LAM\_SHIFT\_CP = 1

**then** MFF\_ADD\_BUF [all] = BUF\_INP\_CP

BUF\_OUT\_CP = MFF\_ADD\_CP\_KGH

MFF\_BUF\_CP = MFF\_ADD\_CP\_KGH

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```

else if STATE_OPM_ENG_CP = ENG_MODE_0
  then IDX_STEP_CP = IP_IDX_STEP_CP (MAF_KGH_FG_PRED_COR_CP)
  else IDX_STEP_CP =
    IP_IDX_STEP_CP_2 (MAF_KGH_FG_PRED_COR_CP)
  endif
  for k = IDX_CP to IDX_CP + IDX_STEP_CP do
    MFF_ADD_BUF[k] = BUF_INP_CP
  endfor
endif
// moving the position index
IDX_CP = IDX_CP + IDX_STEP_CP + 1

// final filtered buffer output
MFF_BUF_CPn = [MFF_BUF_CPn-1 + IP_CRLC_MFF_BUF_CP (MAF_CYL)
               * (BUF_OUT_CP - MFF_BUF_CPn-1)]
end

```

### calibration hint:

If a modification of the recurrence of the ring buffer is done (modification on LC\_FLOW\_CPS\_CAL), the delay times, which are calibrated as index, have to be updated according to the new recurrence.

### 9.16.3 Injection correction calculation

This correction is applied for homogeneous mode only. In stratified mode, correction is applied by torque (see next paragraph)

```

init of TQI_ADD_CP for robustness reasons
is engine speed check for >0 necessary? if engine speed = 0, canister purge will be deactivated!
if N_32 > 0
then MFF_ADD_LAM_CP = (MFF_BUF_CP * 105) / (N_32 * NC_CYL_NR * 3)
else MFF_ADD_LAM_CP = 0
endif
MFF_ADD_CYL_CP = MFF_ADD_LAM_CP
TQI_ADD_CP = 0
end

```

### 9.16.4 Torque Correction calculation


During stratified combustion, the impact of the premixed fuel flow coming from the CPS has to be compensated in an alternative way. It was demonstrated that the torque increase due to canister purge is dependent on the mass fuel flow from the CPS, the engine speed, and, additionally, on the mass flow of fuel that originates from the injector. The corrective torque will be calculated in the project specific Torque coordination.

#### Formula section:

```

if N_32 > 0
then MFF_CPS = MFF_BUF_CP * 105 / (N_32 * NC_CYL_NR * 3)
else MFF_CPS = 0
endif
MFF_ADD_CYL_CP = MFF_CPS

```


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```

MFF_ADD_LAM_CP      = 0
TQI_ADD_CP          = 0
end

```

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## 9.17 EVAC lambda deviation and canister load

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_LAMB_AFS_AMP_CP	V	8000... 7FFFH	-32768 ...32767	1	-
anti bounce counter for setting LV_LAMB_AFS_CP depending on AMP					
ABC_LAMB_AFS_T_AST_CP	V	8000... 7FFFH	-32768 ...32767	1	-
anti bounce counter for setting LV_LAMB_AFS_CP depending on T_AST					
AMP_DELTA_IT_CP	O/V	8000... 7FFFH	-2717.04145 ...2716.95854	0.0829175	hPa
Ambient pressure difference between AMP and AMP at reset					
AMP_ST_PRS_MEM_CP	V	0... FFFFH	0... 5434	0.0829175	hPa
Ambient pressure after reset					
CL	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Canister load					
CL_MMV	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Moving mean value of the canister load CL					
CL_MMV_DYW_MAX	V	0... FFFFH	0... 1.99996	30.5e-6	-
Maximum value of the dynamic window during RAMP_OPEN					
CL_MMV_DYW_MIN	V	0... FFFFH	0... 1.99996	30.5e-6	-
Minimum value of the dynamic window during RAMP_OPEN					
CL_MMV_MEM_CL_MDL	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Last stored CL_MMV value before FAC_LAM_GRD_MMV exceeds a threshold					
CL_MMV_MEM_CL_MDL_OLD	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Old stored CL_MMV value before FAC_LAM_GRD_MMV exceeds a threshold					
CRLC_CL	V	0... FFFFH	0... 0.99998	15.3e-6	-
temporary variable: correlation constant for CL_MMV calculation					
CRLC_CL_TMP_0	-	0... FFFFH	0... 0.99998	15.3e-6	-
temporary variable: target value for CRLC_CL in RAMP_OPEN					
CRLC_CL_TMP_INI	-	0... FFFFH	0... 0.99998	15.3e-6	-
temporary variable: init value for CRLC_CL_TMP in RAMP_OPEN					
CRLC_FAC_LAM_MV_MMV_CP	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Filter constant for FAC_LAM_MV_MMV_CP calculation					
FAC_CRLC_CL	V	0... FFFFH	0... 0.99998	15.3e-6	-
Reduction factor at CL filter constant determination					
FAC_LAM_0_CP	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Start value of the lambda control correction FAC_LAM_CP before the CPS is opened					
FAC_LAM_CP	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Lambda control correction value used for canister load calculation					
FAC_LAM_DIF_CP	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Lambda control deviation with active canister purge					
FAC_LAM_GRD	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Gradient of lambda control output					
FAC_LAM_GRD_MMV	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Moving mean value of lambda gradient					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LAM_SHIFT_CP	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Correction value for lambda control correction during RAMP_OPEN operation					
LAMB_LPF_0_CP	V	0... 7FFFH	0... 31.99902	976.599e-6	-
Low pass filter Lambda for canister purge at start of RO					
LAMB_LPF_CP	V	0... 7FFFH	0... 31.99902	976.599e-6	-
Low pass filter Lambda for canister purge					
LAMB_LPF_DIF_IT_CP	V	0... 7FFFH	0... 31.99902	976.599e-6	-
Low pass filter Lambda for canister purge at start of RO					
LAMB_MMV_0_CP	V	0... 7FFFH	0... 31.99902	976.599e-6	-
Filtered value of Lambda for canister purge at start of RO					
LAMB_MMV_0_GRD_CP	V/S	0... FFFFH	0... 1.99996	30.5e-6	-
Sampling point for straight line for correction of FAC_LAM_0_CP					
LAMB_MMV_0_GRD_NEW_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
Actually lambda value for correction of FAC_LAM_0_CP					
LAMB_MMV_0_TMP_CP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Temp. sampling point for calculation of LAMB_MMV_COR_CP					
LAMB_MMV_COR_CP	V	0... 7FFFH	0... 31.99902	976.599e-6	-
Estimated lambda value for correction of FAC_LAM_0_CP					
LAMB_MMV_CP	V	0... 7FFFH	0... 31.99902	976.599e-6	-
Filtered value of Lambda for canister purge					
LV_CL_GRD_CHK_MAX	V	0... 1H	0 ...1	1	-
CL value conformity check exceeds					
LV_CL_MMV_CAL_ACT	O/V	0... 1H	0 ...1	1	-
Conditions for calculation of CL_MMV are fulfilled					
LV_CP_AFL	O/V	0... 1H	0 ...1	1	-
copy of (bench-selective) LV_AFL (0: rich; 1: lean)					
LV_CP_NEW_RAMP_OPEN	O/V	0... 1H	0 ...1	1	-
Request for new Ramp Open, exit of normal purge					
LV_CP_NEW_RAMP_OPEN_FAST	O/V	0... 1H	0 ...1	1	-
Request for new Ramp Open Fast or Ramp Open, exit of normal purge					
LV_CP_OPP_WIN_1	O/V	0... 1H	0 ...1	1	-
Operating point exceed small window					
LV_CP_OPP_WIN_2	O/V	0... 1H	0 ...1	1	-
Operating point exceed large window					
LV_CP_PER_END_REQ_S_CP	V	0... 1H	0 ...1	1	-
Request to change to no purge					
LV_CRLC_CL_TRA	-	0... 1H	0 ...1	1	-
flag: transition of fast to slow filter in MAX_PURGE ongoing					
LV_FAC_LAM_DIF_CP_TMP	-	0... 1H	0 ...1	1	-
temporary variable: FAC_LAM_DIF_CP limits reached in RAMP_OPEN					
LV_FAC_LAM_SHIFT_CP	O/V	0... 1H	0 ...1	1	-
Logical value for lambda control correction during RAMP_OPEN operation					
LV_FAC_LAM_SHIFT_CP_AVL	O/V	0... 1H	0 ...1	1	-
=1: At least one lambda control shift during RAMP_OPEN done					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAMB_AFS_AMP_CP	O/V	0... 1H	0 ...1	1	-
Homogeneous lambda 1 combustion request by threshold f(delta_AMP)					
LV_LAMB_AFS_CP	O/V	0... 1H	0 ...1	1	-
Homogeneous lambda 1 combustion request					
LV_LAMB_AFS_T_AST_CP	O/V	0... 1H	0 ...1	1	-
Homogeneous lambda 1 combustion request by threshold f(T_AST)					
MFF_ADD_CP_KGH	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Additive adaptive fuel flow from the ACF for the injection fuel mass correction					
MFF_ADD_CP_OLD	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
stored value of MFF_ADD_CP_OLD on disabled RAMP_OPEN					
MFF_CP	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Fuel flow from the ACF					
MFF_LAM_CP	V	8000... 7FFFH	-4... 3.99987	122.1e-6	kg/h
Fuel flow lambda control part from the ACF					
MFF_SP_0_CP	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint at initialisation of FAC_LAM_0_CP					
N_32_0_CP	V	0... FFH	0... 8160	32	rpm
Engine speed at initialisation of FAC_LAM_0_CP					
RATE_FLOW_DLY	V	0... FFFFH	0... 0.99998	15.3e-6	-
Relative flow delay (FLOW_DLY_CP /MAF_DLY_MMV_CP)					
STATE_CLL_DEAC_CP_MEM	-	0H 1H 2H 3H undef:1H	CP_NO_DEAC RAMP_OPEN_ DEAC MAX_PURGE_ DEAC RAMP_FAST_ DEAC	-	-
locally memorised version of STATE_CLL_DEAC_CP					
STATE_CP_MEM	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H AH BH	CP_NOT_ACT NO_PURGE RAMP_TO_ NO_PURGE WAIT_RAMP_ OPEN MIN_PURGE - - - RAMP_OPEN RAMP_OPEN_ FAST MAX_PURGE RAMP_CLOSE	-	-
locally memorised version of STATE_CP					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_CP_PER_RUN_CP	V	1... FFFFH	0.02... 1310.7	0.02	s
Time of actual purge period					
T_LAMB_AFS_AMP_VLD_CP	V	0... FFFFH	0... 1310.7	0.02	s
Timer that limits homogeneous request by CL_MMV evaluation for AMP					
T_LAMB_AFS_T_AST	V	0... FFFFH	0... 1310.7	0.02	s
Time for homogenous engine mode request					
T_LAMB_AFS_T_AST_VLD_CP	V	0... FFFFH	0... 1310.7	0.02	s
Timer that limits homogeneous request by CL_MMV evaluation for T_AST					
T_LAMB_MMV_COR_UPD_CP	V	1... FFFFH	0.02... 1310.7	0.02	s
Timer since last adaption of correction straight line for FAC_LAM_0_CP					
T_RAMP_OPEN_STAB	V	0... FFFFH	0... 6553.5	0.1	s
Time counter for cl stabilisation during RAMP_OPEN					

**Input data:**

AMP {p. 982}	CL_MDL {p. 3728}	CPPWM_CPS {p. 3749}	ERR_SYM_EL_CPS {p. 4708}
FAC_LAM_MV_MMV_CP [NC_CBK_EX_NR] {p. 2462}	FLOW_CPS {p. 3635}	FLOW_DLY_CP {p. 3635}	FLOW_DLY_MMV_CP {p. 3635}
IP_T_DLY_CL_MMV_DYW {p. 3642}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_SP_FIL_S [NC_CBK_EX_NR] {p. 2462}	LAMB_SP_HOM [NC_CBK_EX_NR] {p. 8340}
LV_AFL [NC_CBK_EX_NR] {p. 2439}	LV_C_FAC_LAM_0_CP_WIDE {p. 3679}	LV_CL_MDL_ACT {p. 3728}	LV_CL_MDL_ENA {p. 3728}
LV_CP_ACT {p. 3679}	LV_CP_CLL {p. 3636}	LV_CP_DYW {p. 1540}	LV_CPS_AD_HOM_REQ {p. 3756}
LV_END_DIAG_AMP {p. 4822}	LV_ERR_AMP {p. 4822}	LV_FAC_LAM_SHIFT_CP_END [NC_CBK_EX_NR] {p. 2463}	LV_FLOW_TAR_COR_CP {p. 3679}
LV_HOM_ACT {p. 8136}	LV_HOM_AFL_ACT {p. 8136}	LV_STATE_MEM_CP_CLL {p. 3636}	LV_STATE_OPM_CHG_HOM_CP {p. 3679}
LV_STATE_OPM_CHG_S_CP {p. 3679}	MAF_CYL {p. 8277}	MAF_DLY_MMV_CP {p. 3636}	MFF_SP_MV {p. 2151}
N_32 {p. 1525}	PRS_CPS {p. 1540}	STATE_CLL_DEAC_CP {p. 3637}	STATE_CP {p. 3637}
STATE_OPM_ENG_CP {p. 3680}	T_AST_CP {p. 3680}	VS {p. 1176}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_LAMB_AFS_AMP_CP	-	0... 8000H	0... 32768	1	-
anti bounce counter decrementation for setting LV_LAMB_AFS_CP					
C_ABC_DEC_LAMB_AFS_T_AST_CP	-	0... 8000H	0... 32768	1	-
anti bounce counter decrementation for setting LV_LAMB_AFS_CP					
C_ABC_INC_LAMB_AFS_AMP_CP	-	0... 8000H	0... 32768	1	-
anti bounce counter incrementation for setting LV_LAMB_AFS_CP					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_LAMB_AFS_T_AST_CP	-	0... 8000H	0... 32768	1	-
anti bounce counter incrementation for setting LV_LAMB_AFS_CP					
C_CL_DYW_MAX_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
Maximum limit for canister load cl difference					
C_CL_FAC_LAM_DIF_MAX	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Upper limit on FAC_LAM_DIF_CP value variation					
C_CL_FAC_LAM_DIF_MIN	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Lower limit on FAC_LAM_DIF_CP value variation					
C_CL_MAX_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
Maximum limit for canister load CL					
C_CL_MMV_DYW	-	0... FFFFH	0... 1.99996	30.5e-6	-
Dynamic window on CL_MMV value during RAMP_OPEN					
C_CL_ST_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
Initialization value for canister load CL					
C_CL_ST_FAC_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
Weight the CL_MMV deviation for initialization of CL/CL_MMV at entering RO					
C_CL_ST_MAX_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
Maximum initialization value for canister load CL					
C_CL_ST_MIN_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
Minimum Initialization value for canister load CL					
C_CPPWM_MIN_CL	-	0... FFH	0... 99.60937	0.390625	%
minimum valve pwm signal to enable CL calculation					
C_CRLC_FAC_LAM_GRD	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for lambda gradient					
C_CRLC_LAMB_MMV_0_GRD_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for straight line for FAC_LAM_0_CP correction					
C_FAC_LAM_0_MAX	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Maximum limit for FAC_LAM_0_CP					
C_FAC_LAM_0_MAX_WIDE	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Maximum limit for FAC_LAM_0_CP to sharpen FSD					
C_FAC_LAM_0_MIN	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Minimum limit for FAC_LAM_0_CP					
C_FAC_LAM_0_MIN_WIDE	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Minimum limit for FAC_LAM_0_CP to sharpen FSD					
C_FAC_LAM_DIF_CP_AS	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Application system value to apply a lambda deviation					
C_FAC_LAM_DIF_MAX_CP	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Maximum lambda deviation for injection time correction during RAMP_OPEN					
C_FAC_LAM_THD_CL_MEM	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Threshold for FAC_LAM_GRD to save the last CL_MMV value					
C_FAC_OPP_CP_1	-	0... FFFFH	0 ...1	15.3e-6	-
Factor to reduce the MFF and N thresholds for the smaller OPP window					
C_FLOW_MIN_CPS	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Limit on FLOW_CPS value for CL_MMV calculation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FLOW_MIN_CPS_RO	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Limit on FLOW_CPS value for CL_MMV calculation (during RO and ROF)					
C_LAMB_AFS_AMP_MAX_CP	-	0... 8000H	0... 32768	1	-
Maximum value for the anti bounce counter for setting LV_LAMB_AFS_CP					
C_LAMB_AFS_T_AST_MAX_CP	-	0... 8000H	0... 32768	1	-
Maximum value for the anti bounce counter for setting LV_LAMB_AFS_CP					
C_LAMB_LPF_AD_MAX_CP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Maximum value of LAMB_LPF_AD for learning the straight line for LAMB_MMV_0_CP					
C_LAMB_LPF_AD_MIN_CP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Minimum value of LAMB_LPF_AD for learning the straight line for LAMB_MMV_0_CP					
C_LAMB_LPF_CLC_GRD_MIN_CP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Threshold for low pass filter Lambda for canister purge to activate adaption of the correction for FAC_LAM_0_CP					
C_MFF_SP_MIN_OPP_WIN_CP	-	0... FFFFH	0... 1389	0.0211948	mg/stk
MFF threshold below the usage of CL model for operation window is not used					
C_N_32_MIN_OPP_WIN_CP	-	0... FFH	0... 8160	32	rpm
N threshold below the usage of CL model for operation window is not used					
C_PRS_MAX_2_CPS	-	8000... 7FFFH	-2717.04145 ...2716.95854	0.0829175	hPa
Pressure difference limit (environment-intake manifold) for reactivation of the canister purge					
C_PRS_MAX_2_CPS_1	-	8000... 7FFFH	-2717.04145 ...2716.95854	0.0829175	hPa
Pressure diff. limit (environment-intake manifold) for reactivation of the canister purge for ENG_MODE not 0					
C_RAF_CLC_CP	-	0... FFFFH	0... 255.99609	3.9063e-3	-
stoichiometric fuel constant: ca. 14,7					
C_T_DLY_MAX_RAMP_OPEN	-	1... FFFFH	0.1... 6553.5	0.1	s
Time out value during RAMP_OPEN operation					
C_T_LAMB_AFS_AMP_VLD_CP	-	0... FFFFH	0... 1310.7	0.02	s
Maximum time for homogeneous request by CL_MMV evaluation for AMP					
C_T_LAMB_AFS_T_AST	-	0... FFFFH	0... 1310.7	0.02	s
Minimum time for homogenous engine mode request at low CL					
C_T_LAMB_AFS_T_AST_VLD_CP	-	0... FFFFH	0... 1310.7	0.02	s
Maximum time for homogeneous request by CL_MMV evaluation for T_AST					
C_VS_MIN_LAMB_AFS	-	0... FFH	0... 255	1	km/h
Minimum speed for homogenous engine mode request					
ID_CL_MMV_HOM_T_AST_DOWN_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_T_AST_CP_IP_CL	3	0... FFFFH	0... 6553.5	0.1	s
Limit on canister load to stay in homogenous mode depending on T_AST					
ID_CL_MMV_HOM_T_AST_UP_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_T_AST_CP_ID_CL	3	0... FFFFH	0... 6553.5	0.1	s
Limit on canister load to stay in homogenous mode depending on rising ambient pressure difference					
IP_CL_CRCLC	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Correlation constant for CL-filter for MAX_PURGE /RAMP_CLOSE					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_CL_CRLC_2	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Correlation constant for CL-filter for MAX_PURGE at STATE_OPM_ENG_CP != MODE0					
IP_CL_CRLC_INI	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_CL_MMV_1_EVAC	3	0... FFFFH	0... 1.99996	30.5e-6	-
Initialization value for correlation factor value in MAX_PURGE					
IP_CL_CRLC_INI_2	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_CL_MMV_1_EVAC	3	0... FFFFH	0... 1.99996	30.5e-6	-
Initialization value for correlation factor value in MAX_PURGE at STATE_OPM_ENG_CP != MODE0					
IP_CL_CRLC_OPEN_FAST	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Correlation constant for CL-filter for RAMP_OPEN_FAST					
IP_CL_CRLC_OPEN_FAST_2	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Correlation constant for CL-filter for RAMP_OPEN_FAST at STATE_OPM_ENG_CP != MODE0					
IP_CL_CRLC_RAMP_OPEN	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Correlation constant for CL-filter for RAMP_OPEN					
IP_CL_CRLC_RAMP_OPEN_2	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Correlation constant for CL-filter for RAMP_OPEN at STATE_OPM_ENG_CP != MODE0					
IP_CL_MMV_HOM_PRS_DOWN_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_AMP_DELTA_CP_IP_CL	4	8000... 7FFFH	-2717.04145 ...2716.95854	0.0829175	hPa
Limit on canister load to go to stratified mode depending on falling ambient pressure difference					
IP_CL_MMV_HOM_PRS_UP_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_AMP_DELTA_CP_IP_CL	4	8000... 7FFFH	-2717.04145 ...2716.95854	0.0829175	hPa
Limit on canister load to stay in homogenous mode depending on rising ambient pressure difference					
IP_CRLC_FAC_LAM_MV_MMV_CP_CLL	-	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
correlation constant for FAC_LAM_MV_MMV_CP calculation in case of Purge in closed loop					
IP_CRLC_FAC_LAM_MV_MMV_CP_OPL	-	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
correlation constant for FAC_LAM_MV_MMV_CP calculation in case of Purge in open loop					
IP_CRLC_LAMB_LPF_CP	-	0... FFH	0... 0.99609	3.9063e-3	-
LDP_LAMB_LPF_CP_IP_CRLC_CP	6	0... 7FFFH	0... 31.99902	976.599e-6	-
Correlation constant for LAMB_MMV_CP calculation					
IP_CRLC_MMV_CP	-	0... FFH	0... 0.99609	3.9063e-3	-
LDP_LAMB_MMV_CP_IP_CRLC_CP	6	0... 7FFFH	0... 31.99902	976.599e-6	-
Correlation constant for LAMB_MMV_CP calculation					
IP_FAC_CPPWM	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_CPPWM_IP_FAC_CPPWM	6	0... FFH	0... 99.60937	0.390625	%
Reduction Factor at very low flow rates, dependent on CPPWM					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_CRLC_CL	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_RATE_IP_FAC_CRLC_CL	6	0... FFFFH	0... 0.99998	15.3e-6	-
Reduction Factor at very low flow rates					
IP_FAC_LAM_GRD_MMV	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_FAC_IP_FAC_LAM_GRD_MMV	6	0... FFFFH	-50... 49.99847	1.5259e-3	%
Reduction Factor dependent on mean value of gradient of lambda control output					
IP_MFF_SP_OPP_MAX	V	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_32_4_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_3_EVAC	12	0... FFFFH	0... 1389	0.0211948	mg/stk
Upper MFF_SP threshold for operating point window					
IP_MFF_SP_OPP_MAX_1	V	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_32_4_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_3_EVAC	12	0... FFFFH	0... 1389	0.0211948	mg/stk
Upper MFF_SP threshold for operating point window for 2nd operation mode					
IP_MFF_SP_OPP_MIN	V	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_32_4_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_3_EVAC	12	0... FFFFH	0... 1389	0.0211948	mg/stk
Lower MFF_SP threshold for operating point window					
IP_MFF_SP_OPP_MIN_1	V	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_32_4_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_3_EVAC	12	0... FFFFH	0... 1389	0.0211948	mg/stk
Lower MFF_SP threshold for operating point window for 2nd operation mode					
IP_N_32_OPP_MAX	V	0... FFH	0... 8160	32	rpm
LDPM_N_32_4_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_3_EVAC	12	0... FFFFH	0... 1389	0.0211948	mg/stk
Upper N_32 threshold for operating point window					
IP_N_32_OPP_MAX_1	V	0... FFH	0... 8160	32	rpm
LDPM_N_32_4_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_3_EVAC	12	0... FFFFH	0... 1389	0.0211948	mg/stk
Upper N_32 threshold for operating point window for 2nd operation mode					
IP_N_32_OPP_MIN	V	0... FFH	0... 8160	32	rpm
LDPM_N_32_4_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_3_EVAC	12	0... FFFFH	0... 1389	0.0211948	mg/stk
Lower N_32 threshold for operating point window					
IP_N_32_OPP_MIN_1	V	0... FFH	0... 8160	32	rpm
LDPM_N_32_4_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_3_EVAC	12	0... FFFFH	0... 1389	0.0211948	mg/stk
Lower N_32 threshold for operating point window for 2nd operation mode					
IP_NR_STEP_CL	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_CL_MMV_1_EVAC	3	0... FFFFH	0... 1.99996	30.5e-6	-
Number of step to change of correlation factor value					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_T_CP_PER_END_COR_CP	-	0... FFH	0... 1.99218	0.0078125	-
LDPM_CL_MMV_1_EVAC	3	0... FFFFH	0... 1.99996	30.5e-6	-
Canister load correction of maximum time to run a purge period in stratified mode					
IP_T_CP_PER_END_CP	V	1... FFFFH	0.02... 1310.7	0.02	s
LDP_LAMB_DIF_IP_T_END_CP	4	0... 7FFFH	0... 31.99902	976.599e-6	-
LDP_T_LAMB_COR_UPD_IP_T_END_CP	4	0... FFFFH	0... 1310.7	0.02	s
Maximum time to run a purge period in stratified mode					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_LAMB_SEL_S_CP	-	0H 1H 2H	BANK_0 BANK_1 MEAN_VALUE	-	-
Lambda controller selection for stratified mode					
LC_CL_FIL_INI_TRA_DEAC_CLL	-	0... 1H	0 ...1	1	-
Correlation factor calculation in case of NO_PURGE or MIN_PURGE -> MAX_PURGE transition					
LC_FAC_LAM_0_COR_ACT_CP	-	0... 1H	0 ...1	1	-
Enables the FAC_LAM_0_CP correction for stratified engine operation					
LC_INIT_CL_CRCL_RAMP_OPEN_FAST	-	0... 1H	0 ...1	1	-
Correlation factor calculation in case of RAMP_OPEN_FAST -> MAX_PURGE transition					
LC_LAM_CBK_CPS	-	0... 1H	0 ...1	1	-
Lambda controller selection (0 -> bank 0, 1 -> bank1)					
LC_LAMB_AFS_CP_CPS_SCG	-	0... 1H	0 ...1	1	-
switch to force hom1 operation if cps valve short circuit to ground error present					
LC_STATE_OPM_CHG_HOM_CP	-	0... 1H	0 ...1	1	-
Enables setting of LV_CP_NEW_RAMP_OPEN at LV_STATE_OPM_CHG_HOM_CP =1					
LC_STATE_OPM_CHG_S_CP	-	0... 1H	0 ...1	1	-
Enables setting of LV_CP_NEW_RAMP_OPEN at LV_STATE_OPM_CHG_S_CP =1					

**DI version**

Input data table order: External inputs - Inputs from other EVAC modules

**General information:**

This module calculates the lambda deviation caused by the opening of the CPS valve and a canister load value using the lambda deviation value. The canister load is the concentration of fuel vapors within the mixture flow coming from the ACF.

The opening period ccppwm of the CPS is controlled in dependence with the canister load CL.

**Application conditions****Initialisation:**

at RST, IGKON or deactivation  
all values = 0  
CL = C\_CL\_ST\_CP  
CL\_MMV = C\_CL\_ST\_CP  
At first initialisation or NVMY error: LAMB\_MMV\_0\_GRD\_  
CP= 1

**Recurrence:**


20 ms

**Activation:**

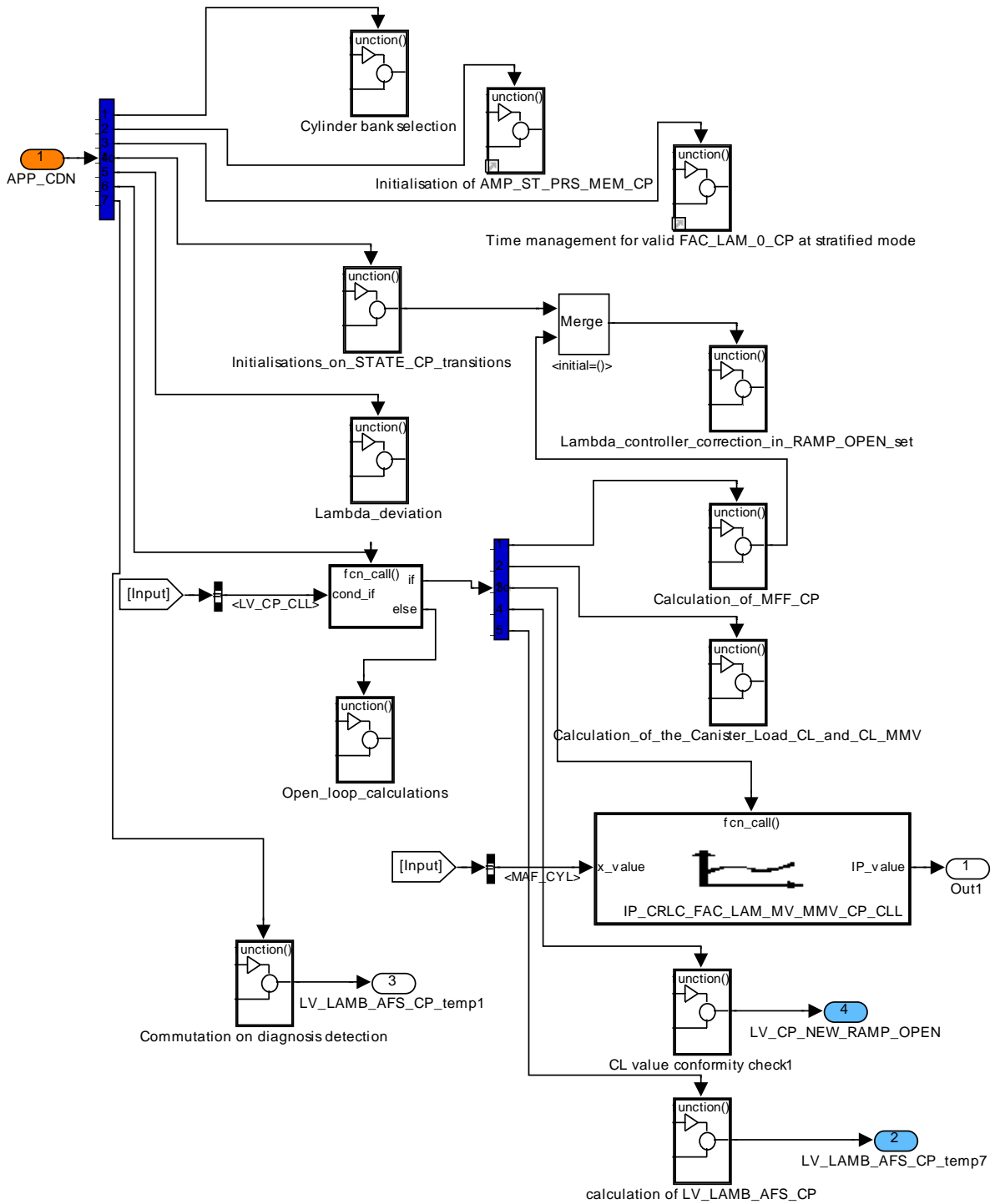
LV\_CP\_ACT = 1

**Deactivation:**

LV\_CP\_ACT = 0

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**Signal flow diagram:**




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**Formula section:**

```

if    LC_LAM_CBK_CPS=0
then idx_cp = 1
else  idx_cp = 2
endif
    
```

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```

call "Initialisation of AMP_ST_PRS_MEM_CP"
call "Initialisations on STATE_CP transitions"
call "Lambda deviation"
T_LAMB_MMV_COR_UPD_CPn = T_LAMB_MMV_COR_UPD_CPn-1 + 0.02
if LV_CP_CLL = 1 // "Normal purge" active
and LV_CL_MDL_ACT = 0
then call "Time management for valid FAC_LAM_0_CP at stratified mode"
    call "calculation of MFF_CP"
    call "calculation of the Canister Load CL, CL_MMV"
    (moved to lambda deviation)
    call "CL value conformity check"
else call "Open loop calculations"
endif
if LV_CP_CLL = 1
    call "CL_MMV evaluation for homogeneous engine operation mode request"
endif
call "Calculation of LV_LAMB_AFS_CP"
call "Engine operating point window"
call "Request for new RAMP OPEN and RAMP OPEN FAST"
end

```

### 9.17.1 INITIALIZATION of AMP\_ST\_PRS\_MEM\_CP

Save the first valid ambient pressure AMP once after reset:

#### Application conditions

```

Initialisation:      AMP_ST_PRS_MEM_CP = 0      at RST
Recurrence:       100 ms
Activation:       - - -
Deactivation:     - - -
if LV_ERR_AMP = 0 and LV_END_DIAG_AMP = 1 and AMP_
ST_PRS_MEM_CP = 0
then AMP_ST_PRS_MEM_CP = AMP
end

```

### 9.17.2 INITIALIZATIONS on STATE\_CP transitions

The following submodules are to be calculated on transitions between the different states of canister purge control.

To follow a transition in CP control module, STATE\_CP and STATE\_CLL\_DEAC\_CP have to be memorised in this module.

At the case of STATE\_OPM\_ENG\_CP != MODE\_0 the initialization value for CL and CL\_MMV is corrected in the direction of the last known CL\_MMV. The correction can be weighted and limited.

Problem: in cp-ctrl spec, STATE\_CLL\_DEAC\_CP is reset after performing the inits of the entered state, so this reset of STATE\_CLL\_DEAC\_CP will occur before the check of STATE\_CLL\_DEAC\_CP in cl-spec. Therefore, a local copy of STATE\_CLL\_DEAC\_CP STATE\_DEAC\_CP\_MEM is needed!

#### Formula section:

```

if STATE_CP STATE_CP_MEM // transition detected
then if STATE_CP_MEM = RAMP_OPEN
    then call "INITIALIZATION-VALUES on leaving RAMP_OPEN"
    if STATE_CP = MAX_PURGE
    and FAC_LAM_DIF_CP > 0

```

```

    then call "lambda controller correction in RAMP_OPEN (set)"
  endif
endif
case selection on STATE_CP:
RAMP_OPEN:      call "INITIALIZATION-VALUES on entering RAMP_OPEN"
RAMP_OPEN_FAST: call "INITIALIZATION-VALUES on ent. RAMP_OPEN_FAST"
MAX_PURGE:      call "INITIALIZATION-VALUES on entering MAX_PURGE"
end case selection
endif
// memorisation for next recurrence
STATE_CP_MEM      = STATE_CP
STATE_CLL_DEAC_CP_MEM = STATE_CLL_DEAC_CP
end

```

### 9.17.2.1 INITIALIZATION-VALUES on leaving RAMP\_OPEN

```

MFF_ADD_CP_OLD = MFF_ADD_CP_KGH
end

```


### 9.17.2.2 INITIALIZATION-VALUES on entering RAMP\_OPEN

```

if STATE_CLL_DEAC_CP_MEM = RAMP_OPEN_DEAC
then // Initialisations for disabled RAMP_OPEN
  CL = CL_MMV
  MFF_ADD_CP_KGH = MFF_ADD_CP_OLD
else // Standard-initialisations for RAMP_OPEN
  if STATE_OPM_ENG_CP = STATE_ENG_0
  then CL = C_CL_ST_CP
       CL_MMV = C_CL_ST_CP
  else CL_MMV = MAX[MIN[C_CL_ST_CP+(CL_MMV-C_CL_ST_CP)
    *C_CL_ST_FAC_CP, C_CL_ST_MAX_CP],C_CL_ST_MIN_CP]
       CL = CL_MMV
  endif
  CL_0_0 = CL_MMV
  CL_0_1 = 0
  CL_MMV_DYW_MAX = 0
  CL_MMV_DYW_MIN = FFFFH
  MFF_ADD_CP_KGH = 0
  LV_FAC_LAM_SHIFT_CP_AVL = 0
  LV_FAC_LAM_SHIFT_CP = 0

  if LV_HOM_ACT = 1
  then
    if LV_C_FAC_LAM_0_CP_WIDE = 1
    then FAC_LAM_0_CP = max[C_FAC_LAM_0_MIN_WIDE, min[C_FAC_LAM_0_
MAX_WIDE, FAC_LAM_CP]]
    else FAC_LAM_0_CP =
max[C_FAC_LAM_0_MIN, min[C_FAC_LAM_0_MAX, FAC_LAM_CP]]
    endif
    LAMB_MMV_CP = LAMB_LS_UP [idx_cp]
    LAMB_LPF_CP = LAMB_SP_FIL_S [idx_cp]
  else
    N_32_0_CP = N_32
  end

```

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```

MFF_SP_0_CP          = MFF_SP_MV
Case selection of C_STATE_LAMB_SEL_S_CP:
BANK_0:
    LAMB_MMV_CP          = LAMB_LS_UP [0]
    LAMB_LPF_CP          = LAMB_SP_FIL_S [0]
BANK_1:
    LAMB_MMV_CP          = LAMB_LS_UP [1]
    LAMB_LPF_CP          = LAMB_SP_FIL_S [1]
MEAN_VALUE:
    LAMB_MMV_CP          = SUM{LAMB_LS_UP [i=0 to NC_CBK_EX_
NR]} /NC_CBK_EX_NR
    LAMB_LPF_CP          = SUM{LAMB_SP_FIL_S [i=0 to NC_CBK_
EX_NR]} /NC_CBK_EX_NR
End of case
call "Initialisation at RO and ROF for FAC_LAM_0_CP correction
      at stratified mode"
call "Calculation of the straight line for LAMB_MMV_COR_CP"
call " Calculation of corrected FAC_LAM_0_CP in stratified"
endif
// RAMP_OPEN time out initialization
T_RAMP_OPEN_STAB      = C_T_DLY_MAX_RAMP_OPEN
LAMB_SP_FIL_S is also defined in homogeneous, only differs in resolution from LAMB_SP_FIL_HOM
endif
end

```

### 9.17.2.3 INITIALIZATION-VALUES on entering RAMP\_OPEN\_FAST

```

if STATE_CLL_DEAC_CP_MEM = RAMP_FAST_DEAC
then -- // Initialisations for disabled RAMP_OPEN_FAST
else // Standard-initialisations for RAMP_OPEN_FAST
    CL_0_0          = CL_MMV
    CL_0_1          = 0
    if LV_HOM_ACT = 1
    then
        if LV_C_FAC_LAM_0_CP_WIDE = 1
        then FAC_LAM_0_CP = max[C_FAC_LAM_0_MIN_WIDE, min[C_FAC_LAM_0_
MAX_WIDE, FAC_LAM_CP]]
        else FAC_LAM_0_CP =
max[C_FAC_LAM_0_MIN, min[C_FAC_LAM_0_MAX, FAC_LAM_CP]]
        endif
    else
        N_32_0_CP          = N_32
        MFF_SP_0_CP          = MFF_SP_MV
        call "Initialisation at RO and ROF for FAC_LAM_0_CP correction
              at stratified mode"
        call "Calculation of the straight line for LAMB_MMV_COR_CP"
        call " Calculation of corrected FAC_LAM_0_CP in stratified"
    endif
endif
CL          = CL_MMV
end

```

### 9.17.2.4 INITIALIZATION-VALUES on entering MAX\_PURGE

```

if STATE_CLL_DEAC_CP_MEM = MAX_PURGE_DEAC
then CL = CL_MMV
endif
end

```

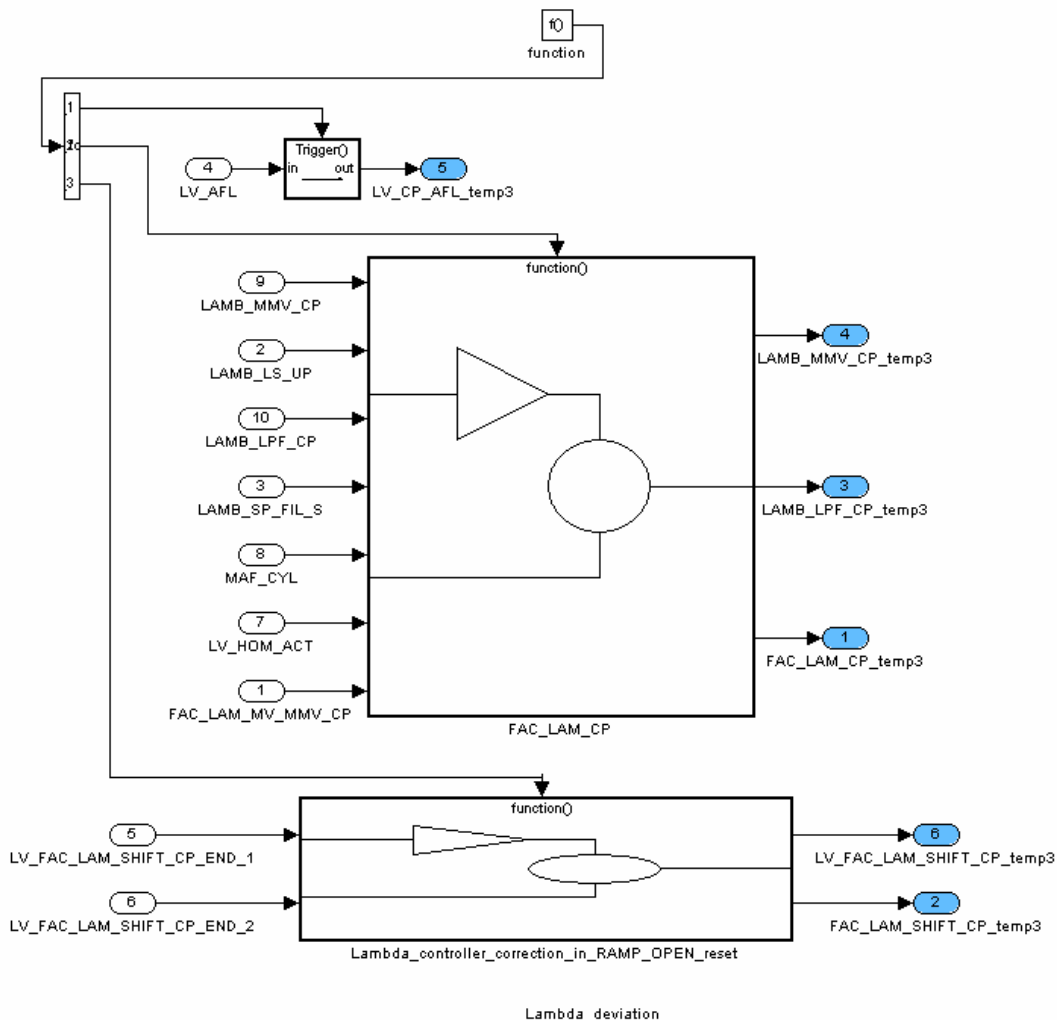
### 9.17.3 Lambda deviation

In case of two bank exhaust line configuration, the master-exhaust bank for evaporative emission control has to be defined using LC\_LAM\_CBK\_CPS.

The additive constant C\_FAC\_LAM\_DIF\_CP\_AS should be set to 0 in normal operation; it is only provided for validation purposes

The calculation of the filtered mean value of lambda controller output FAC\_LAM\_MV\_MMV\_CP is done inside LACO aggregate. Indeed, the filter constant for this calculation - CRLC\_FAC\_LAM\_MV\_MMV\_CP - is provided by this module, depending on the STATE\_CP.

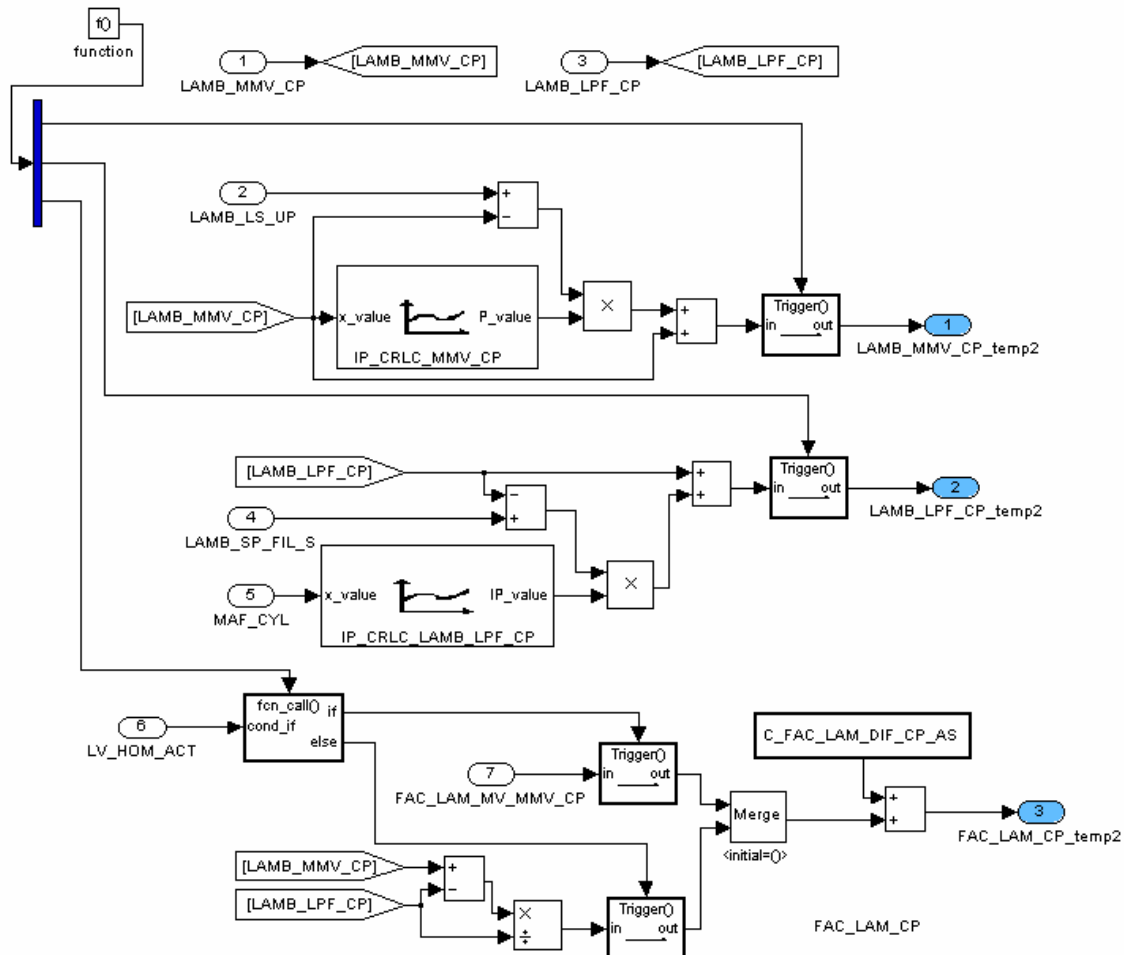
In open loop, a strong filtering is desired to obtain a stable value for FAC\_LAM\_0\_CP on entering the closed loop. Within the closed loop operation, the filtering should be less severe in order to enable a quick learning of CL and fast reactions on lambda deviations caused by canister purge.



**Formula section:**

```
// determination of the filter constant for FAC_LAM_MV_MMV_CP
// this value is passed to LACO
if    LV_CP_CLL = 1                                // "Normal purge" active
then  CRLC_FAC_LAM_MV_MMV_CP = IP_CRLC_FAC_LAM_MV_MMV_CP_CLL (MAF_CYL)
else  CRLC_FAC_LAM_MV_MMV_CP = IP_CRLC_FAC_LAM_MV_MMV_CP_OPL (MAF_CYL)
endif
LV_CP_AFL = LV_AFL [idx_cp]
```

```
// determination of the lambda deviation
// FAC_LAM_MV_MMV_CP is received from LACO where it is calculated using the filter constant defined
// above
call  "FAC_LAM_CP"
call  "lambda controller correction in RAMP_OPEN (reset)" // check in every state_cp
end
```

**9.17.3.1 FAC\_LAM\_CP**

```
if    LV_HOM_ACT = 1
then
```



```

LAMB_MMV_CPn = LAMB_MMV_CPn-1 +
    (LAMB_LS_UP [idx_cp] - LAMB_MMV_CPn-1) *
    IP_CRLC_MMV_CP (LAMB_MMV_CP)
LAMB_LPF_CPn = LAMB_LPF_CPn-1 +
    (LAMB_SP_FIL_S [idx_cp] - LAMB_LPF_CPn-1) *
    IP_CRLC_LAMB_LPF_CP (MAF_CYL)
FAC_LAM_CP = FAC_LAM_MV_MMV_CP [idx_cp]

```

**else**

**case selction of C\_STATE\_LAM\_SEL\_S\_CP:**

**BANK\_0:**

```

LAMB_MMV_CPn = LAMB_MMV_CPn-1 +
    (LAMB_LS_UP [0] - LAMB_MMV_CPn-1) *
    IP_CRLC_MMV_CP (LAMB_MMV_CP)
LAMB_LPF_CPn = LAMB_LPF_CPn-1 +
    (LAMB_SP_FIL_S [0] - LAMB_LPF_CPn-1) * IP_CRLC_LAMB_LPF_CP (MAF_CYL)

```

**BANK\_1:**

```

LAMB_MMV_CPn = LAMB_MMV_CPn-1 +
    (LAMB_LS_UP [1] - LAMB_MMV_CPn-1) *
    IP_CRLC_MMV_CP (LAMB_MMV_CP)
LAMB_LPF_CPn = LAMB_LPF_CPn-1 +
    (LAMB_SP_FIL_S [1] - LAMB_LPF_CPn-1) *
    IP_CRLC_LAMB_LPF_CP (MAF_CYL)

```

**MEAN\_VALUE:**

```

LAMB_MMV_CPn = LAMB_MMV_CPn-1 +
    (SUM[LAMB_LS_UP [i=0 to NC_CBX_EX_NR]]/NC_CBX_EX_NR
    - LAMB_MMV_CPn-1) * IP_CRLC_MMV_CP (LAMB_MMV_CP)
LAMB_LPF_CPn = LAMB_LPF_CPn-1 +
    (SUM[LAMB_SP_FIL_S [i=0 to NC_CBX_EX_NR]]/NC_CBX_EX_NR - LAMB_LPF_
    CPn-1) * IP_CRLC_LAMB_LPF_CP (MAF_CYL)

```

**end of case**

FAC\_LAM\_CP = (LAMB\_MMV\_CP - LAMB\_LPF\_CP) / LAMB\_LPF\_CP

**endif**

FAC\_LAM\_CP = FAC\_LAM\_CP + C\_FAC\_LAM\_DIF\_CP\_AS

**end**

### 9.17.3.2 Lambda controller correction in RAMP\_OPEN (reset)

The flag requesting a shift of the lambda controller LV\_FAC\_LAM\_SHIFT\_CP is reset after all acknowledge flags from lambda controller are received.

#### Formula section:


```

if    LV_FAC_LAM_SHIFT_CP_END [i] = 1           // all benches have to be =1
then  LV_FAC_LAM_SHIFT_CP                     = 0
        FAC_LAM_SHIFT_CP                       = 0
endif
end

```

### 9.17.4 Calculation of MFF\_CP

#### General information:

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This calculation is calculated in RAMP\_OPEN, RAMP\_OPEN\_FAST, MAX\_PURGE and RAMP\_CLOSE. The fuel flow from the ACF when the CPS is opened causes a deviation of the lambda control. This fuel flow can be calculated as a function of the difference of the lambda control values with closed /opened CPS, the mass air flow MAF\_DLY\_MMV\_CP, the lambda value LAMB\_LPF\_CP and a constant taking into account the stoichiometric ratio C\_RAF\_CLC\_CP.

The mass air flow MAF\_DLY\_MMV\_CP is the filtered value of maf\_cp using a Pade-filter and a moving mean value calculation to consider the delay time between the mass air flow maf\_cp and the FAC\_LAM\_CP calculation. The fuel flow calculation MFF\_LAM\_CP is the result of the lambda control deviation.

The additive adaptive fuel mass flow MFF\_ADD\_CP\_KGH caused by the canister purge is also regarded in the calculation.

When the deviation of the lambda control FAC\_LAM\_DIF\_CP exceeds C\_FAC\_LAM\_DIF\_MAX\_CP during RAMP\_OPEN operation or when the RAMP\_OPEN operation is finished successfully, the fuel injection time is corrected by an additive correction value and the lambda controller value FAC\_LAM\_CP is corrected by the value of FAC\_LAM\_DIF\_CP. FAC\_LAM\_DIF\_CP is then set to 0 because the lambda deviation is corrected.

During MAX\_PURGE, RAMP\_OPEN\_FAST and RAMP\_CLOSE operation there is a continuous additive adaptive correction of the fuel. The additive fuel flow MFF\_ADD\_CP\_KGH is calculated from the calculated mass flow through the CPS FLOW\_CPS and the filtered canister load CL\_MMV.

During RAMP\_OPEN, the MFF\_ADD\_CP\_KGH is updated as soon as FAC\_LAM\_DIF\_CP exceeds the threshold C\_FAC\_LAM\_DIF\_MAX\_CP and a last time on the transition RAMP\_OPEN to MAX\_PURGE, so MFF\_ADD\_CP\_KGH will change periodically during RAMP\_OPEN. If RAMP\_OPEN is disabled for a short time, the current value of MFF\_ADD\_CP\_KGH is stored in MFF\_ADD\_CP\_OLD on leaving RAMP\_OPEN and restored on re-entering RAMP\_OPEN (see initialisations).

#### Formula section:

```

if LV_HOM_ACT = 0
then call " Calculation of corrected FAC_LAM_0_CP in stratified"
endif
FAC_LAM_DIF_CP = FAC_LAM_0_CP - FAC_LAM_CP // calculation of FAC_LAM_DIF_CP
if STATE_CP = RAMP_OPEN // lambda controller correction
then if LV_HOM_ACT = 1
    then if FAC_LAM_DIF_CP > C_FAC_LAM_DIF_MAX_CP
        then MFF_ADD_CP_KGH = CL_MMV * FLOW_CPS
            call "Lambda controller correction in RAMP_OPEN (set)"
        endif
    else MFF_ADD_CP_KGH = CL_MMV * FLOW_CPS
        if FAC_LAM_DIF_CP > C_FAC_LAM_DIF_MAX_CP
            then LV_FAC_LAM_SHIFT_CP_AVL = 1
        endif
    endif
else MFF_ADD_CP_KGH = CL_MMV * FLOW_CPS
endif
call "MFF_LAM_CP"
MFF_CP = MFF_LAM_CP + MFF_ADD_CP_KGH
end

```

#### 9.17.4.1 Lambda controller correction in RAMP\_OPEN (set)

Called by:

- by RAMP\_OPEN actions, when FAC\_LAM\_DIF\_CP exceeds threshold
- On transition RAMP\_OPEN to MAX\_PURGE, if FAC\_LAM\_DIF\_CP > 0

#### Formula section:

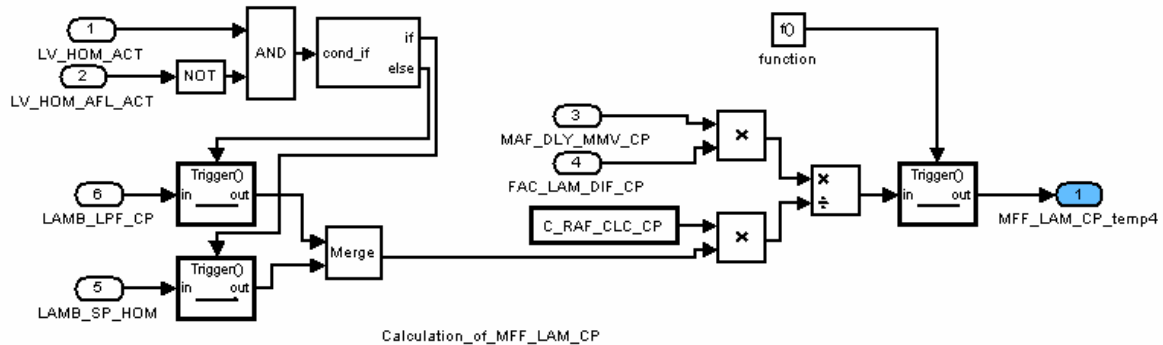
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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
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```

if    LV_FAC_LAM_SHIFT_CP    = 0
then  LV_FAC_LAM_SHIFT_CP    = 1
        FAC_LAM_SHIFT_CP      = FAC_LAM_DIF_CP
endif
FAC_LAM_DIF_CP                = 0
LV_FAC_LAM_SHIFT_CP_AVL      = 1
end

```

### 9.17.4.2 MFF\_LAM\_CP



```

if    LV_HOM_ACT = 1 and LV_HOM_AFL_ACT= 0
then  MFF_LAM_CP =
        (MAF_DLY_MMV_CP * FAC_LAM_DIF_CP) / (C_RAF_CLC_CP * LAMB_SP_HOM)
else  MFF_LAM_CP =
        (MAF_DLY_MMV_CP * FAC_LAM_DIF_CP) / (C_RAF_CLC_CP * LAMB_LPF_CP)
endif
end

```

### 9.17.5 Calculation of the Canister Load CL, CL\_MMV

#### General information:

This calculation is called in RAMP\_OPEN, RAMP\_OPEN\_FAST, MAX\_PURGE and RAMP\_CLOSE. The load CL of the ACF is calculated as the ratio of the fuel flow MFF\_LAM\_CP and the flow FLOW\_DLY\_MMV\_CP added to the ratio of the fuel flow MFF\_ADD\_CP\_KGH and the flow FLOW\_CPS. The flow FLOW\_DLY\_MMV\_CP is the filtered value of FLOW\_CPS using a Pade-filter and a moving mean value calculation to consider the delay between the FLOW\_CPS and the MFF\_LAM\_CP calculation. Those calculations are described in a separate chapter. The minimum and maximum values of this ratio are limited by 0 and C\_CL\_MAX\_CP. The value of CL is filtered using a moving mean value calculation. The value of CL is only calculated when the engine is operated at limited dynamics (LV\_CP\_DYW=1).

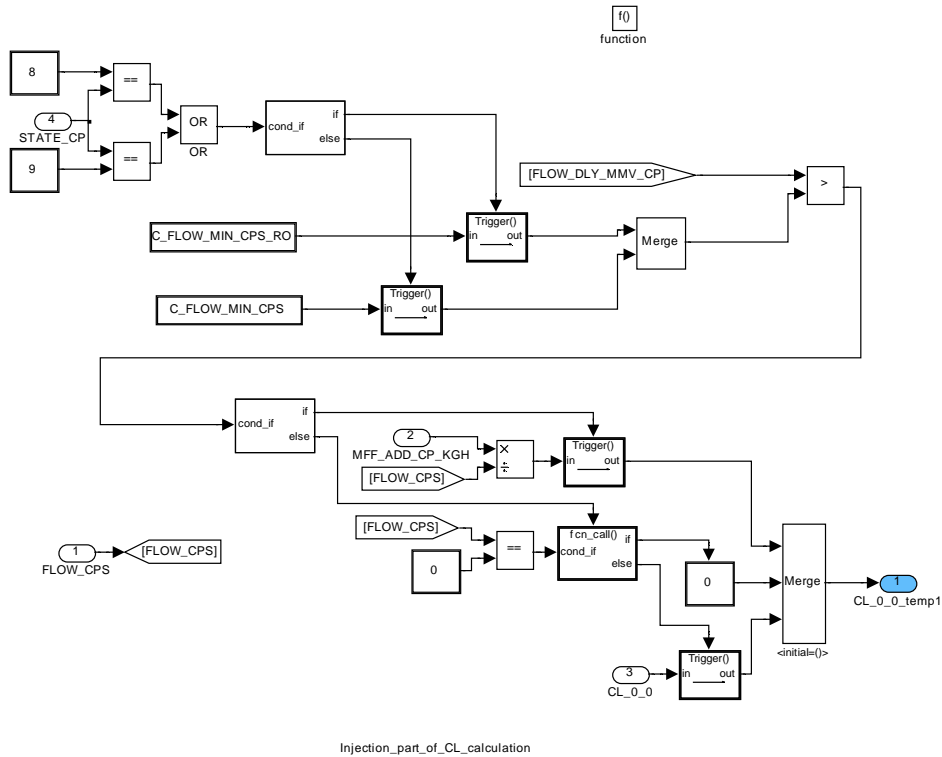
#### Application conditions

**Initialisation:** *all values = 0 at RST or IGKON*

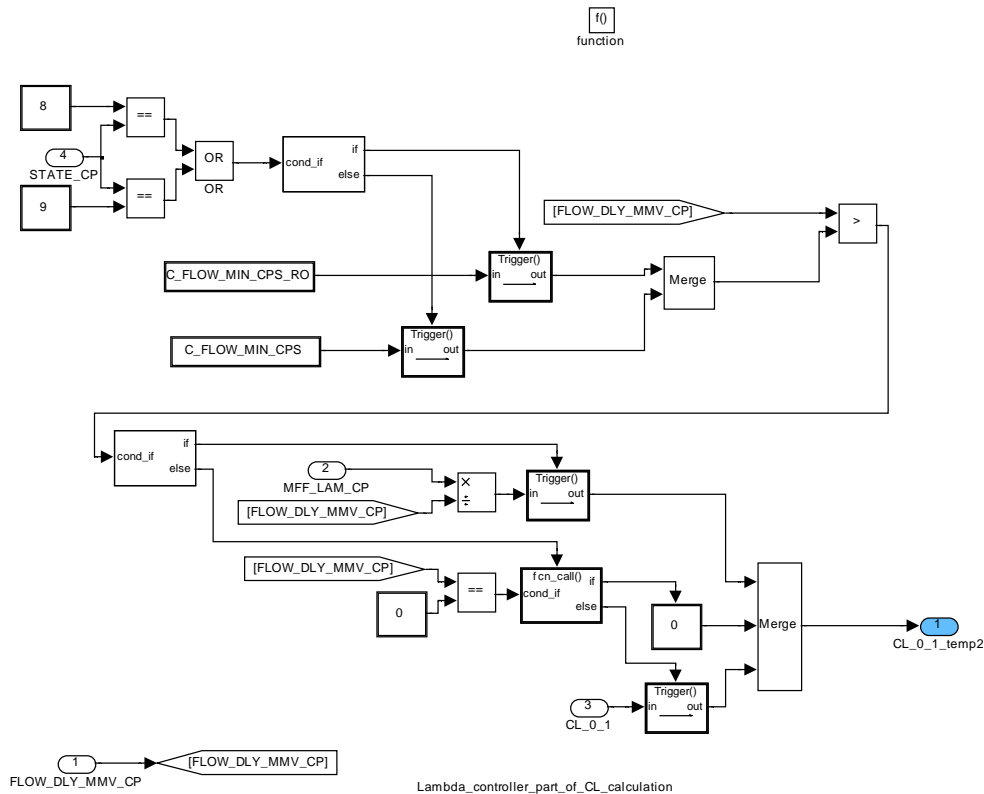
**Recurrence:** *100 ms*

**Activation:** *- - (called by superior block)*

**Deactivation:** - - (called by superior block)



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### Formula section:

**if** STATE\_CP = RAMP\_OPEN or RAMP\_OPEN\_FAST  
**then**

**if** [ LV\_CP\_DYW = 1 //limited dynamics  
**and** [(STATE\_OPM\_ENG\_CP = ENG\_MODE\_0  
**and** PRS\_CPS > C\_PRS\_MAX\_2\_CPS) //minimum pressure difference  
**or** (STATE\_OPM\_ENG\_CP != ENG\_MODE\_0  
**and** PRS\_CPS > C\_PRS\_MAX\_2\_CPS\_1)] //minimum pressure diff.  
**and** FLOW\_CPS > C\_FLOW\_MIN\_CPS\_RO //min. FLOW\_CPS for RO/ROF  
**and** FLOW\_DLY\_MMV\_CP > C\_FLOW\_MIN\_CPS\_RO // min FLOW at lambda  
sensor for RO and ROF  
**and** CPPMW\_CPS > C\_CPPWM\_MIN\_CL ] // min valve opening  
**then** LV\_CL\_MMV\_CAL\_ACT = 1 // calculation of CL/CL\_MMV active  
CL\_0\_0 = MFF\_ADD\_CP\_KGH /FLOW\_CPS // injection part of CL  
CL\_0\_1 = MFF\_LAM\_CP /FLOW\_DLY\_MMV\_CP // lambda ctl. part of CL  
CL = **min** [CL\_0\_0 + CL\_0\_1, C\_CL\_MAX\_CP] // limitation of CL  
**call** "CL filter constant determination" // CRLC\_CL calculation  
CL\_MMV<sub>n</sub> = CL\_MMV<sub>n-1</sub> + (CL - CL\_MMV<sub>n-1</sub>) \* CRLC\_CL  
**call** "calculation of time out"  
**else** LV\_CL\_MMV\_CAL\_ACT = 0  
CL\_MMV<sub>n</sub> = CL\_MMV<sub>n-1</sub>  
**endif**

**else**

**if** [ LV\_CP\_DYW = 1 // limited dynamics

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```

and [(STATE_OPM_ENG_CP = ENG_MODE_0
      and PRS_CPS > C_PRS_MAX_2_CPS) //minimum pressure difference
      or (STATE_OPM_ENG_CP != ENG_MODE_0
      and PRS_CPS > C_PRS_MAX_2_CPS_1)] //minimum pressure diff.
and FLOW_CPS > C_FLOW_MIN_CPS // minimum FLOW_CPS
and FLOW_DLY_MMV_CP > C_FLOW_MIN_CPS // minimum FLOW_CPS at lambda
sensor
and CPPMW_CPS > C_CPPWM_MIN_CL ] // minimum valve opening
then LV_CL_MMV_CAL_ACT = 1 // calculation of CL/CL_MMV active
      CL_0_0 = MFF_ADD_CP_KGH /FLOW_CPS // injection part of CL
      CL_0_1 = MFF_LAM_CP /FLOW_DLY_MMV_CP // lambda control part of CL
      CL = min [CL_0_0 + CL_0_1, C_CL_MAX_CP] // limitation of CL
      call "CL filter constant determination" // CRLC_CL calculation
      CL_MMVn = CL_MMVn-1 + (CL - CL_MMVn-1) * CRLC_CL
      call "calculation of time out"
else LV_CL_MMV_CAL_ACT = 0
      CL_MMVn = CL_MMVn-1
endif
endif
end

```

### 9.17.5.1 Calculation of time out

(moved here from EVAC mng.)

```

if LV_FLOW_TAR_COR_CP = 0
then T_RAMP_OPEN_STAB = max [0, T_RAMP_OPEN_STAB-TA ]
endif
if LV_FAC_LAM_SHIFT_CP_AVL
and [ CL_MMV < CL_MMV_DYW_MIN
      or CL_MMV > CL_MMV_DYW_MAX ]
then CL_MMV_DYW_MIN = CL_MMV - C_CL_MMV_DYW
      CL_MMV_DYW_MAX = CL_MMV + C_CL_MMV_DYW
      // timer re-initialisation
      T_RAMP_OPEN_STAB= IP_T_DLY_CL_MMV_DYW (MAF_CYL)
endif
end

```

### 9.17.5.2 CL filter constant determination

```

FAC_LAM_GRD = (FAC_LAM_CP - FAC_LAM_CPn-1)
FAC_LAM_GRD_MMV = FAC_LAM_GRD_MMVn-1 + (FAC_LAM_GRD -
      FAC_LAM_GRD_MMVn-1) * C_CRLC_FAC_LAM_GRD
if FAC_LAM_GRD < C_FAC_LAM_THD_CL_MEM
then CL_MMV_MEM_CL_MDL_OLD = CL_MMV_MEM_CL_MDL
      CL_MMV_MEM_CL_MDL = CL_MMV
      RATE_FLOW_DLY = FLOW_DLY_CP /MAF_DLY_MMV_CP
      FAC_CRLC_CL = IP_FAC_CRLC_CL (RATE_FLOW_DLY) * IP_FAC_CPPWM (CPPWM_CPS) * IP_
      FAC_LAM_GRD (FAC_LAM_GRD_MMV)
case selection on STATE_CP:
RAMP_OPEN:
if STATE_OPM_ENG_CP = ENG_MODE_0
then CRLC_CL = IP_CL_CRLC_RAMP_OPEN (MAF_CYL) * FAC_CRLC_CL
else CRLC_CL = IP_CL_CRLC_RAMP_OPEN_2 (MAF_CYL) * FAC_CRLC_CL
RAMP_OPEN_FAST:

```

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```

if STATE_OPM_ENG_CP = ENG_MODE_0
then CRLC_CL = IP_CL_CRLC_OPEN_FAST (MAF_CYL) * FAC_CRLC_CL
else CRLC_CL = IP_CL_CRLC_OPEN_FAST_2 (MAF_CYL) * FAC_CRLC_CL
RAMP_CLOSE:
  CRLC_CL = IP_CL_CRLC (MAF_CYL) * FAC_CRLC_CL
MAX_PURGE:
if STATE_OPM_ENG_CP = ENG_MODE_0
then CRLC_CL_TMP_0 = IP_CL_CRLC (MAF_CYL) * FAC_CRLC_CL
      CRLC_CL_TMP_INI = IP_CL_CRLC_INI (CL_MMV)
else CRLC_CL_TMP_0 = IP_CL_CRLC_2 (MAF_CYL) * FAC_CRLC_CL
      CRLC_CL_TMP_INI = IP_CL_CRLC_INI_2 (CL_MMV)
endif
LV_FAC_LAM_DIF_CP_TMP =
  [(FAC_LAM_DIF_CP > C_CL_FAC_LAM_DIF_MAX)
or (FAC_LAM_DIF_CP < C_CL_FAC_LAM_DIF_MIN)]

if STATE_CP_MEM = RAMP_OPEN // switch to init map
or [ STATE_CP_MEM = RAMP_OPEN_FAST and
    LC_INIT_CL_CRLC_RAMP_OPEN_FAST = 1]
or [( STATE_CP_MEM = NO_PURGE
    or STATE_CP_MEM = RAMP_TO_NO_PURGE
    or STATE_CP_MEM = MIN_PURGE)
    and LC_CL_FIL_INI_TRA_DEAC_CLL=1]
or [(LV_FAC_LAM_DIF_CP_TMPn-1 = 0) and (LV_FAC_LAM_DIF_CP_TMPn = 1)]
then CRLC_CLn = CRLC_CL_TMP_INI
      LV_CRLC_CL_TRA = 1
else if LV_CRLC_CL_TRA = 0
then CRLC_CLn = CRLC_CL_TMP_0
else CRLC_CLn = CRLC_CLn-1
      - (CRLC_CL_TMP_INI - CRLC_CL_TMP_0)
      * IP_NR_STEP_CL (CL_MMV)
      if CRLC_CL ≤ CRLC_CL_TMP_0
      then CRLC_CL = CRLC_CL_TMP_0
          LV_CRLC_CL_TRA = 0
      endif
endif
endif
end case selection
end

```

**Note:** All values of IP\_CL\_CRLC\_INI have to be bigger than the highest value of IP\_CL\_CRLC; otherwise, the filter constant CRLC\_CL will be unstable.


### 9.17.5.3 CL value conformity check :

#### General information:

This calculation is called in RAMP\_OPEN, RAMP\_OPEN\_FAST and MAX\_PURGE.

When the calculation of the canister load create a high difference between the previous value  $CL_{n-1}$  and the new value  $CL_n$  a transition to MIN\_PURGE is requested by setting of LV\_CL\_GRD\_CHK\_MAX.

#### Formula section:

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```
LV_CL_GRD_CHK_MAX = [abs [CLn-1 - CLn] > C_CL_DYW_MAX_CP ]
end
```

### 9.17.6 CL\_MMV evaluation for homogeneous engine operation mode request

Homogeneous lambda one combustion is requested by setting of the bit information LV\_LAMB\_AFS\_CP (see chapter "Calculation of LV\_LAMB\_AFS\_CP"). Two possibilities are given. If the canister load CL\_MMV is greater then the threshold IP\_CL\_MMV\_HOM\_PRS\_UP\_CP. The threshold is taken from a map depending on the difference between the ambient pressure at reset and the actual ambient pressure. The bit information is reset if the canister load falls below the threshold IP\_CL\_MMV\_HOM\_PRS\_DOWN\_CP. The setting and resetting of the bit LV\_LAMB\_AFS\_CP is debounced by the counters ABS\_LAMB\_AFS\_CP.

The other possibility is given for lower CL\_MMV values, if the vehicle drives not in the city. There is the increasement for purge flow much bigger then driving in the city. During driving in the city the fuel consumption increase is too high to request homogenous mode.

#### Application conditions

**Initialisation:** *all values = 0 at RST or IGTKON*

**Recurrence:** *100 ms*


**Activation:** *-- (called by superior block)*

**Deactivation:** *-- (called by superior block)*

#### Formula section:

```
if LV_ERR_AMP = 0 and L_END_DIAG_AMP = 1
then AMP_DELTA_IT_CP = AMP - AMP_ST_PRS_MEM_CP
else AMP_DELTA_IT_CP = 0
endif
```

```
if CL_MMV <= IP_CL_MMV_HOM_PRS_DOWN_CP(AMP_DELTA_IT_CP)
then // under the lower threshold, count ABC down
  ABC_LAMB_AFS_AMP_CP = MAX[(-1)*C_LAMB_AFS_AMP_MAX_CP,
    ABC_LAMB_AFS_AMP_CP - C_ABC_DEC_LAMB_AFS_AMP_CP]
  if ABC_LAMB_AFS_AMP_CP <= (-1)*C_LAMB_AFS_AMP_MAX_CP
  then LV_LAMB_AFS_AMP_CP = 0
  endif
else if CL_MMV > IP_CL_MMV_HOM_PRS_UP_CP(AMP_DELTA_IT_CP)
then // above the upper threshold, count ABC up
  ABC_LAMB_AFS_AMP_CP = MIN[C_LAMB_AFS_AMP_MAX_CP,
    ABC_LAMB_AFS_AMP_CP + C_ABC_INC_LAMB_AFS_AMP_CP]
  if ABC_LAMB_AFS_AMP_CP >= C_LAMB_AFS_AMP_MAX_CP
  then LV_LAMB_AFS_AMP_CP = 1
  endif
else // between the thresholds, count ABC to zero
  if ABC_LAMB_AFS_AMP_CP > 0
  then ABC_LAMB_AFS_AMP_CP =
    MAX[0, ABC_LAMB_AFS_AMP_CP - C_ABC_DEC_LAMB_AFS_AMP_CP]
  else if ABC_LAMB_AFS_AMP_CP < 0
  then ABC_LAMB_AFS_AMP_CP =
    MIN[0, ABC_LAMB_AFS_AMP_CP +
```

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```


                C_ABC_INC_LAMB_AFS_AMP_CP]
            endif
        endif
    endif
endif

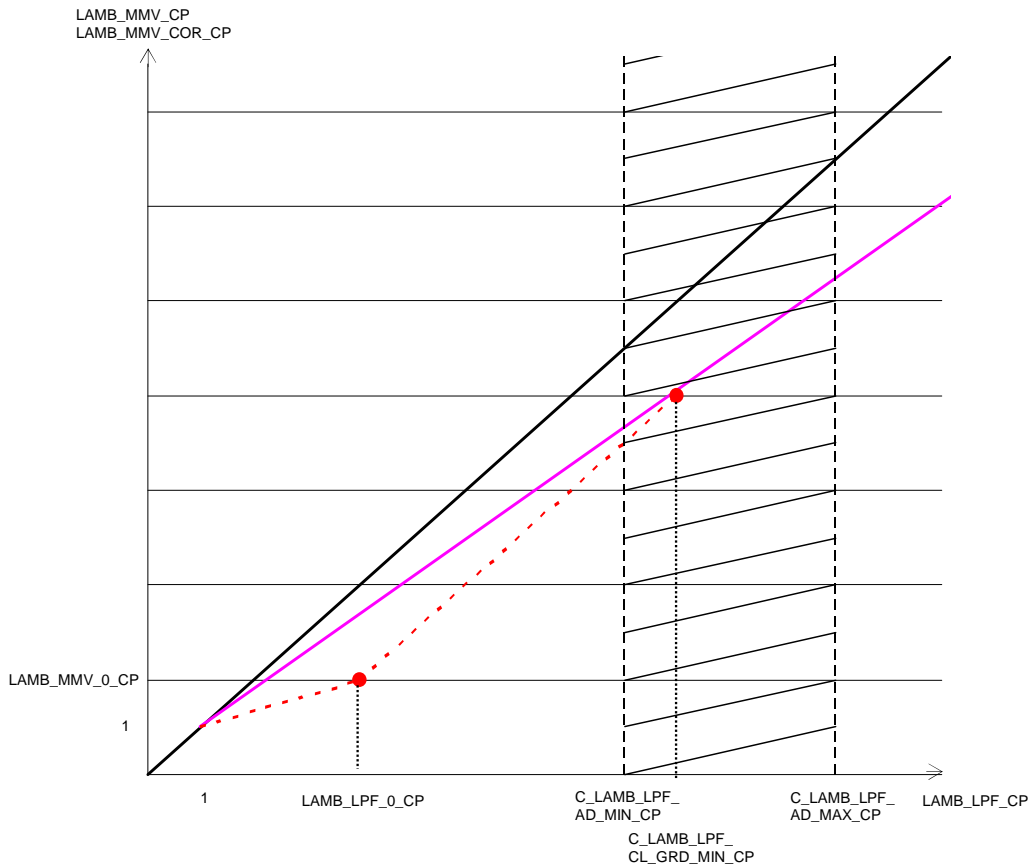
if CL_MMV <= ID_CL_MMV_HOM_T_AST_DOWN_CP(T_AST_CP)
then // under the lower threshold, count ABC down
    ABC_LAMB_AFS_T_AST_CP = MAX[(-1)*C_LAMB_AFS_T_AST_MAX_CP,
        ABC_LAMB_AFS_T_AST_CP- C_ABC_DEC_LAMB_AFS_T_AST_CP]
    if ABC_LAMB_AFS_T_AST_CP <= (-1)*C_LAMB_AFS_T_AST_MAX_CP
    then LV_LAMB_AFS_T_AST_CP = 0
    endif
else if CL_MMV > ID_CL_MMV_HOM_T_AST_UP_CP(T_AST_CP)
then // above the upper threshold, count ABC up
    ABC_LAMB_AFS_T_AST_CP = MIN[C_LAMB_AFS_T_AST_MAX_CP ,
        ABC_LAMB_AFS_T_AST_CP+ C_ABC_INC_LAMB_AFS_T_AST_CP]
    if ABC_LAMB_AFS_T_AST_CP >= C_LAMB_AFS_T_AST_MAX_CP
    then LV_LAMB_AFS_T_AST_CP = 1
    endif
else // between the thresholds, count ABC to zero
    if ABC_LAMB_AFS_T_AST_CP > 0
    then ABC_LAMB_AFS_T_AST_CP =
        MAX[0,ABC_LAMB_AFS_T_AST_CP- C_ABC_DEC_LAMB_AFS_T_AST_CP]
    else if ABC_LAMB_AFS_T_AST_CP < 0
    then ABC_LAMB_AFS_T_AST_CP =
        MIN[0 , ABC_LAMB_AFS_T_AST_CP+
            C_ABC_INC_LAMB_AFS_T_AST_CP]
    endif
endif
endif
endif
end

```

### 9.17.7 Adaptation of FAC\_LAM\_0\_CP in stratified mode

In stratified mode it is necessary to adapt the start value of the lambda deviation concerning to the lambda setpoint during canister purge. The deviation between lambda setpoint and measured lambda value is component specific. Therefore a straight line is approximated at every start of RO or ROF. If the lambda setpoint is in a defined window, the straight line will be adapted to the actual start value. Out of this straight line, a corrected lambda value LAMB\_MMV\_COR\_CP will be calculated.

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### 9.17.7.1 Initialisation at RO and ROF for FAC\_LAM\_0\_CP correction at stratified mode

At initialization of RO or ROF the filtered lambda and lambda setpoint are stored.

```
LAMB_MMV_0_CP = LAMB_MMV_CP
LAMB_LPF_0_CP = LAMB_LPF_CP
T_CP_PER_RUN_CP = 0
```

### 9.17.7.2 Calculation of the straight line for LAMB\_MMV\_COR\_CP

If LAMB\_LPF\_CP is in the window of C\_LAMB\_LPF\_AD\_MIN\_CP and C\_LAMB\_LPF\_AD\_MAX\_CP the straight line will be learned. The straight line is defined by the sampling point [LAMB\_LPF\_CP=1; LAMB\_MMV\_CP=1] and the gradient LAMB\_MMV\_0\_GRD\_CP.

```
if ((LAMB_LPF_CP > C_LAMB_LPF_AD_MIN_CP)
and (LAMB_LPF_CP < C_LAMB_LPF_AD_MAX_CP))
then
```

```
// new gradient calculated by the sampling points 1;1
and LAMB_MMV_0_CP; LAMB_LPF_0_CP //
LAMB_MMV_0_GRD_NEW_CP = (LAMB_MMV_CP-1)/(LAMB_LPF_CP-1)
```

```
// Filter for the gradient of the straight line //
LAMB_MMV_0_GRD_CPn = LAMB_MMV_0_GRD_CPn-1 +
(LAMB_MMV_0_GRD_NEW_CP - LAMB_MMV_0_GRD_CPn-1)
*C_CRLC_LAMB_MMV_0_GRD_CP
```

```
T_LAMB_MMV_COR_UPD_CP = 0
```

**endif**

### 9.17.7.3 Calculation of corrected FAC\_LAM\_0\_CP in stratified

In stratified mode the value FAC\_LAM\_0\_CP has to be corrected if the lambda setpoint changes. The calculation of the straight line depends on LAMB\_LPF\_CP and the start value LAMB\_LPF\_0\_CP. If the start value is bigger then C\_LAMB\_LPF\_AD\_MIN\_CP, the LAMB\_MMV\_COR\_CP value will be on the solid line. If the start value is smaller then C\_LAMB\_LPF\_AD\_MIN\_CP the value LAMB\_MMV\_COR\_CP will be on the dotted line for LAMB\_LPF\_CP smaller then > C\_LAMB\_LPF\_CLC\_GRD\_MIN\_CP.

```

if LC_FAC_LAM_0_COR_ACT_CP = 1
then
  if (LAMB_LPF_0_CP > C_LAMB_LPF_AD_MIN_CP or
      LAMB_LPF_CP > C_LAMB_LPF_CLC_GRD_MIN_CP)
  then // LAMB_MMV_COR_CP is on the solid straight line //
    LAMB_MMV_COR_CP = 1 + [LAMB_MMV_0_GRD_CP *(LAMB_LPF_CP - 1)]
    // linear equation with the sampling points 1;1 and the gradient
    // LAMB_MMV_0_GRD_CP
  elseif LAMB_LPF_CP > LAMB_LPF_0_CP
  then LAMB_MMV_0_TMP_CP =
    1+ [LAMB_MMV_0_GRD_CP * (C_LAMB_LPF_CLC_GRD_MIN_CP - 1)]
    // y-value for the sampling point C_LAMB_LPF_CLC_GRD_MIN_CP,
    // needed for the calculation of the dotted straight line
    LAMB_MMV_COR_CP = LAMB_MMV_0_CP +
      [(LAMB_MMV_0_TMP_CP - LAMB_MMV_0_CP) *
       (LAMB_LPF_CP - LAMB_LPF_0_CP) /
       (C_LAMB_LPF_CLC_GRD_MIN_CP - LAMB_LPF_0_CP)]
    // linear equation with the sampling points LAMB_LPF_0_CP;LAMB_MMV_0_CP
    // and C_LAMB_LPF_CLC_GRD_MIN_CP; LAMB_MMV_0_TMP_CP
  else LAMB_MMV_COR_CP =
    1 + [(LAMB_MMV_0_CP-1) * (LAMB_LPF_CL-1) / (LAMB_LPF_0_CP-1)]
    // linear equation with the sampling points 1;1 and
    // LAMB_LPF_0_CP;LAMB_MMV_0_CP
  endif
  endif
  FAC_LAM_0_CP = (LAMB_MMV_COR_CP - LAMB_LPF_CP) / LAMB_LPF_CP
else FAC_LAM_0_CP = (LAMB_MMV_0_CP - LAMB_LPF_0_CP) / LAMB_LPF_0_CP
endif

```


### 9.17.7.4 Time management for valid FAC\_LAM\_0\_CP at stratified mode

The run time of the current purge period is measured in T\_CP\_PER\_RUN\_CP. This time is compared with a threshold calculated on the time since the last adaption of the straight line T\_LAMB\_MMV\_COR\_UPD\_CP and the difference between the lambda setpoint at start of the purge period and the current setpoint. The threshold is weighted with a factor depending on the canister load.

```

T_CP_PER_RUN_CP = T_CP_PER_RUN_CP + 0.2
LAMB_LPF_DIF_IT_CP = ABS(LAMB_LPF_0_CP - LAMB_LPF_CP)
if (LV_HOM_ACT = 0)
  & (T_CP_PER_RUN_CP >
    (IP_T_CP_PER_END_CP(LAMB_LPF_DIF_IT_CP,T_LAMB_MMV_COR_UPD_CP)
    *IP_T_CP_PER_END_COR_CP(CL_MMV)))
then LV_CP_PER_END_REQ_S_CP = 1
else LV_CP_PER_END_REQ_S_CP = 0
endif

```

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```

if    LV_CP_CLL = 1
then  T_LAMB_AFS_AMP_VLD_CP    = C_T_LAMB_AFS_AMP_VLD_CP
        T_LAMB_AFS_T_AST_VLD_CP = C_T_LAMB_AFS_T_AST_VLD_CP
end

```

```
// sum of the conditions for LV_LAMB_AFS_CP
```

```

LV_LAMB_AFS_CP =
  [(ERR_SYM_EL_CPS = 2h and LC_LAMB_AFS_CP_CPS_SCG = 1)   or
   LV_CPS_AD_HOM_REQ = 1                                     or
   (LV_LAMB_AFS_AMP_CP = 1 and T_LAMB_AFS_AMP_VLD_CP > 0) or
   (T_LAMB_AFS_T_AST > 0 and T_LAMB_AFS_T_AST_VLD_CP > 0)]

```

```
end
```

### 9.17.10 Engine operating point window

#### General information:

If the operating point (N,MFF) has a big distance to the operating point stored at entering RO or ROF at stratified engine mode, it is useful to start a new purge phase, due to imprecision in the lambda signal. If the engine operating point will exceed a small window (window\_1), the CL-model will be activated, if the CL-model is not valid, a new RO or ROF will be requested. If the operating point will exceed a large window (window\_2), a new RO or ROF will be requested.

#### Formula section:

```

if1    LV_CP_CLL = 1
then1 if2 STATE_OPM_ENG_CP = ENG_MODE_2
        then2    if3 [(N_32_0_CP - N_32) >
                    (IP_N_32_OPP_MIN(N_32_0_CP, MFF_SP_0_CP) * C_FAC_OPP_CP_1)
                    or (N_32 - N_32_0_CP) >
                    (IP_N_32_OPP_MAX(N_32_0_CP, MFF_SP_0_CP) * C_FAC_OPP_CP_1)
                    or (MFF_SP_0_CP - MFF_SP_MV) >
                    (IP_MFF_SP_OPP_MIN(N_32_0_CP, MFF_SP_0_CP) * C_FAC_OPP_CP_1)
                    or (MFF_SP_MV - MFF_SP_0_CP) >
                    (IP_MFF_SP_OPP_MAX(N_32_0_CP, MFF_SP_0_CP) * C_FAC_OPP_CP_1)]
                then3    LV_CP_OPP_WIN_1 = 1
                    if4 (N_32 < C_N_32_MIN_OPP_WIN_CP
                        and MFF_SP_MV < C_MFF_SP_MIN_OPP_WIN_CP)
                        or [(N_32_0_CP - N_32) >
                            IP_N_32_OPP_MIN(N_32_0_CP, MFF_SP_0_CP)
                            or (N_32 - N_32_0_CP) >
                            IP_N_32_OPP_MAX(N_32_0_CP, MFF_SP_0_CP)
                            or (MFF_SP_0_CP - MFF_SP_MV) >
                            IP_MFF_SP_OPP_MIN(N_32_0_CP, MFF_SP_0_CP)
                            or (MFF_SP_MV - MFF_SP_0_CP) >
                            IP_MFF_SP_OPP_MAX(N_32_0_CP, MFF_SP_0_CP)]
                        then4    LV_CP_OPP_WIN_2 = 1
                        else4    LV_CP_OPP_WIN_2 = 0
                        endif4
                    else3    LV_CP_OPP_WIN_1 = 0

```

```

        LV_CP_OPP_WIN_2 = 0
    endif3
else2 if3 STATE_OPM_ENG_CP = ENG_MODE_1
    then3 if4 [(N_32_0_CP - N_32) >
        (IP_N_32_OPP_MIN_1(N_32_0_CP, MFF_SP_0_CP) * C_FAC_OPP_CP_1)
        or (N_32 - N_32_0_CP) >
        (IP_N_32_OPP_MAX_1(N_32_0_CP, MFF_SP_0_CP) * C_FAC_OPP_CP_1)
        or (MFF_SP_0_CP - MFF_SP_MV) >
        (IP_MFF_SP_OPP_MIN_1(N_32_0_CP, MFF_SP_0_CP) * C_FAC_OPP_CP_1)
        or (MFF_SP_MV - MFF_SP_0_CP) >
        (IP_MFF_SP_OPP_MAX_1(N_32_0_CP, MFF_SP_0_CP) * C_FAC_OPP_CP_
1)]
    Then4 LV_CP_OPP_WIN_1 = 1
    If5 (N_32 < C_N_32_MIN_OPP_WIN_CP
        and MFF_SP_MV < C_MFF_SP_MIN_OPP_WIN_CP)
    or [(N_32_0_CP - N_32) >
        IP_N_32_OPP_MIN_1(N_32_0_CP, MFF_SP_0_CP)
        or (N_32 - N_32_0_CP) >
        IP_N_32_OPP_MAX_1(N_32_0_CP, MFF_SP_0_CP)
        or (MFF_SP_0_CP - MFF_SP_MV) >
        IP_MFF_SP_OPP_MIN_1(N_32_0_CP, MFF_SP_0_CP)
        or (MFF_SP_MV - MFF_SP_0_CP) >
        IP_MFF_SP_OPP_MAX_1(N_32_0_CP, MFF_SP_0_CP)]
    Then5 LV_CP_OPP_WIN_2 = 1
    Else5 LV_CP_OPP_WIN_2 = 0
    Endif5
    Else4 LV_CP_OPP_WIN_1 = 0
        LV_CP_OPP_WIN_2 = 0
    Endif4
Else1 LV_CP_OPP_WIN_1 = 0
    LV_CP_OPP_WIN_2 = 0
Endif1

end

```

### 9.17.11 Request for new RAMP OPEN and RAMP OPEN FAST :

#### General information:


When the "CL value conformity check" detects a non plausible CL value or when the "Time management for valid FAC\_LAM\_0\_CP at stratified mode" requests a new RAMP Open or the engine operating mode switches or the engine operating point exceeds a window a transition to MIN\_PURGE is requested by setting of LV\_CP\_NEW\_RAMP\_OPEN.

In this case no re-entering in the normal purge is possible, instead, WAIT\_RAMP\_OPEN is activated when the conditions are fulfilled and the transition to RAMP\_OPEN or RAMP\_OPEN\_FAST is done after WAIT\_RAMP\_OPEN.

#### Formula section:

LV\_CP\_NEW\_RAMP\_OPEN = LV\_CL\_GRD\_CHK\_MAX


LV\_CP\_NEW\_RAMP\_OPEN\_FAST =

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```

[LV_CP_PER_END_REQ_S_CP
or (LV_STATE_OPM_CHG_HOM_CP and LC_STATE_OPM_CHG_HOM_CP)
or (LV_STATE_OPM_CHG_S_CP and LC_STATE_OPM_CHG_S_CP)
or (LV_CL_MDL_ENA = 0 and LV_CP_OPP_WIN_1 = 1)
or LV_CP_OPP_WIN_2]
end

```

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## 9.18 EVAC canister load model

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CL_MDL	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Value of Canister Load Model					
CL_MDL_SLOP	V	0... FFFFH	0... 1.99996	30.5e-6	-
slope of CL_MMV					
CL_MDL_SLOP_FAC	V	0... FFFFH	0... 0.99998	15.3e-6	-
final CL-model correction factor on CL_MMV					
CL_MDL_SLOP_INT	V	0... FFFFH	0... 1.99996	30.5e-6	-
Integral of CL_MDL_SLOP					
CL_MMV_MEM_MDL	V	0... FFFFH	0... 1.99996	30.5e-6	-
stored value of CL_MMV					
LV_CL_MDL_ACT	O/V	0... 1H	0 ...1	1	-
CL model active					
LV_CL_MDL_ENA	O/V	0... 1H	0 ...1	1	-
Activation of the CL model enabled					
LV_CL_MDL_END_CAT_PURGE	O/V	0... 1H	0 ...1	1	-
CL-model used in Cat-Purge phase					
LV_LAM_THD	V	0... 1H	0 ...1	1	-
Lambda gradient exceeds threshold					
STATE_CL_MDL	V	0H 1H 2H	DISABLED ENABLED ACTIVE	-	-
state of the CL model, if switched on					
STATE_CL_MDL_0	V	0H 1H	CL_MDL_OFF CL_MDL_ON	-	-
global state of the CL model (on/off)					
T_CL_MDL_ACT	V	0... FFFFH	0... 6553.5	0.1	s
Time counter for canister load usage time (counting forward)					
T_CL_MDL_CAT_PURGE_ENA	V	0... FFFFH	0... 6553.5	0.1	s
Time counter to allow activation the model in Cat-Purge phase					
T_CL_MDL_CLL_ENA	V	0... FFFFH	0... 6553.5	0.1	s
Time counter in CP closed loop operation to enable canister load model usage (counting backward)					


### Input data:

CL_MMV {p. 3698}	CL_MMV_MEM_CL_MDL {p. 3698}	CL_MMV_MEM_CL_MDL_OLD {p. 3698}	FAC_LAM_GRD_MMV {p. 3698}
LV_CP_ACT {p. 3679}	LV_CP_CAT_PURGE {p. 1540}	LV_CP_CDN_MIN_PURGE_FAST {p. 1540}	LV_CP_CLL {p. 3636}
LV_CP_OPP_WIN_1 {p. 3699}	STATE_CDN_CP {p. 1541}	STATE_CP {p. 3637}	T_DLY_CL_MDL {p. 3638}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_CL_MDL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for CL_MDL filtering					

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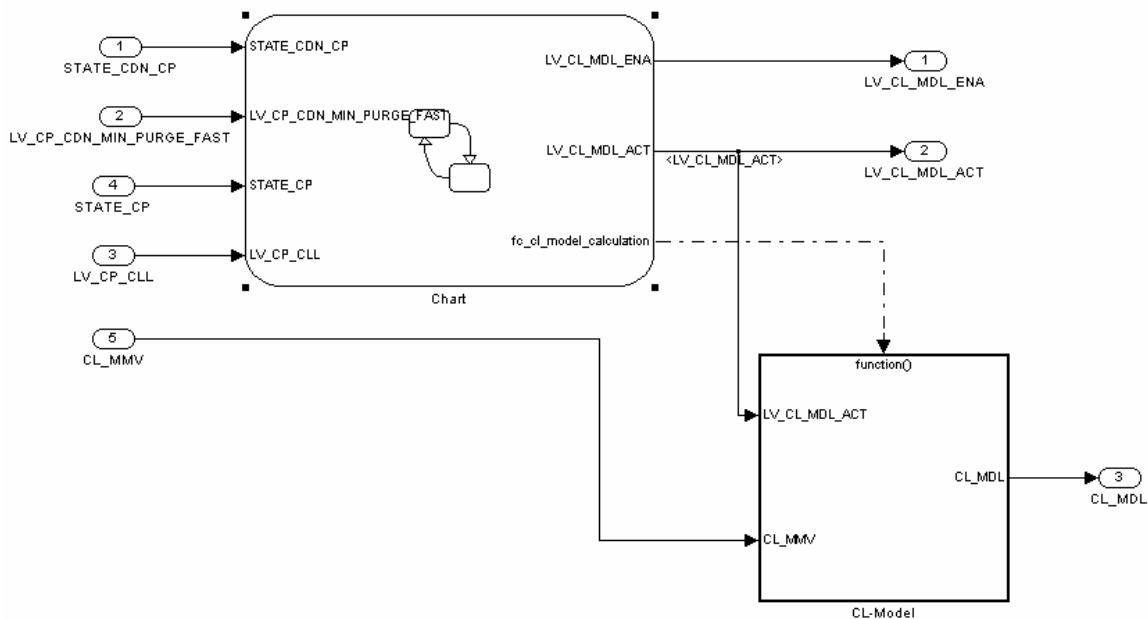
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_LAM_THD	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Upper threshold for lamgda control output gradient					
C_FAC_T_CL_MDL_ACT	-	0... FFFFH	0... 3.99993	61e-6	-
correction factor for re-init of CL mdl ena time counter after regular leaving of active mode					
C_T_CL_MDL_ACT_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time of CL model usage					
C_T_CL_MDL_ACT_MAX_CAT_PURGE	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time of CL model usage at Catalyst purge					
C_T_CL_MDL_ACT_OFS	-	0... FFFFH	0... 6553.5	0.1	s
offset for re-init of CL mdl ena time counter after regular leaving of active mode					
C_T_CL_MDL_CAT_PURGE_ENA	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time in open loop for activation of the model in Cat-Purge phase					
C_T_CL_MDL_CLL_ENA_INC	-	0... FFFFH	0... 6553.5	0.1	s
Increment for enable time counter if not in CP closed loop operation					
C_T_CL_MDL_ENA	-	0... FFFFH	0... 6553.5	0.1	s
Time for enabled CL-Model after closed loop operation					
IP_CL_MDL_SLOP	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_CL_MDL_SLOP_0_IP_CL_SLOP	8	0... FFFFH	0... 1.99996	30.5e-6	-
Timeshape over CL_MDL_SLOP					
IP_CL_MDL_VALUE	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_CL_MDL_SLOP_INT_IP_CL_VALUE	6	0... FFFFH	0... 1.99996	30.5e-6	-
Increment value on FLOW_SP_CPS					
IP_T_CL_MDL_CLL_ENA	-	0... FFFFH	0... 6553.5	0.1	s
LDP_CL_IP_T_CL_MDL_CLL_ENA	6	0... FFFFH	0... 1.99996	30.5e-6	-
Minimum time in CP closed loop operation to enable CL model usage					
LC_CL_MDL_ACT	-	0... 1H	0 ...1	1	-
Switch for activation of CL model calculation					
LC_CL_MDL_ENA	-	0... 1H	0 ...1	1	-
Switch for enabling CL model usage					
LC_FAC_LAM_GRD	-	0... 1H	0 ...1	1	-
Switch for enabling lambda control output gradient check					

### General information:

The evaporative emissions of the fuel tank system are stored in an activated charcoal filter ACF to prevent an escape of the gas to the environment. The loading capacity of the filter is limited, so the filter must be purged temporarily. Therefore the canister purge solenoid CPS, that is positioned between the charcoal filter and the intake manifold is opened by the engine management system. To prevent driveability and emission problems, the opening of the CPS and the purge flow MFF\_CP must be controlled.

With the canister load modelling function (CL-Model), the continuity of the CL factor over time during phases of disturbed calculation is guaranteed. Therefore the canister load CL will be substituted with the output of a SIMULINK model, which is a calculation result of a normalized exponential function.

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**Application conditions**

**Initialisation:** at RST, IGKON or deactivation  
 STATE\_CL\_MDL\_0 = CL\_MDL\_OFF  
 STATE\_CL\_MDL = DISABLED  
 all other values = 0

**Recurrence:** 100 ms

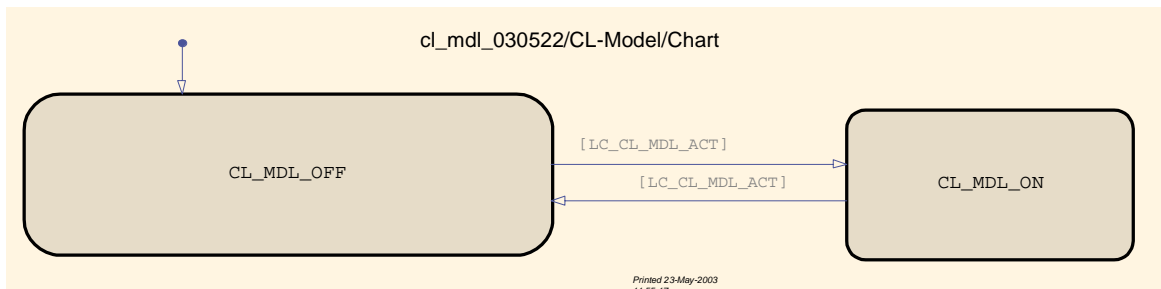
**Activation:** LV\_CP\_ACT = 1

**Deactivation:** LV\_CP\_ACT = 0

**Formula section:**

call "CL model state machine 0 (superstate)"  
 end

**9.18.1 CL model state machine 0 (superstate)**



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### 9.18.1.1 CL\_MDL\_OFF

#### Transitions:

```

if          LC_CL_MDL_ACT      = 1
then       STATE_CL_MDL_0     = CL_MDL_ON
          STATE_CL_MDL       = DISABLED

endif
end
    
```

#### Actions:

```

LV_CL_MDL_ACT      = 0
LV_CL_MDL_ENA      = 0
T_CL_MDL_CLL_ENA = IP_T_CL_MDL_CLL_ENA(CL_MMV) // init
T_CL_MDL_ACT       = 0

end
    
```

### 9.18.1.2 CL\_MDL\_ON

#### Transitions:

```

if          LC_CL_MDL_ACT      = 0
then       STATE_CL_MDL_0     = CL_MDL_OFF

endif
end
    
```

#### Actions:

```

if
    STATE_CP = Max_Purge
then If LV_CP_CAT_PURGE = 0
    then T_CL_MDL_CLL_ENA      = max [0, T_CL_MDL_CLL_ENA - TA]
        LV_CL_MDL_END_CAT_PURGE = 0
    endif
    T_CL_MDL_CAT_PURGE_ENA = C_T_CL_MDL_CAT_PURGE_ENA
else T_CL_MDL_CLL_ENA      = min [IP_T_CL_MDL_CLL_ENA(CL_MMV),
    T_CL_MDL_CLL_ENA + TA * C_T_CL_MDL_CLL_ENA_INC]
    T_CL_MDL_CAT_PURGE_ENA = max[0, T_CL_MDL_CAT_PURGE_ENA - TA]
endif
if (T_DLY_CL_MDL = 0
and FAC_LAM_GRD_MMV > C_FAC_LAM_THD)
and LC_FAC_LAM_GRD

    then LV_LAM_THD = 1
    else LV_LAM_THD = 0

endif

call "CL model state machine"
call "canister load modelling"

end
    
```

## 9.18.2 CL model state machine

### 9.18.2.1 DISABLED

#### Transitions:

```

if      {(T_CL_MDL_CLL_ENA      = 0
           and LV_CP_CAT_PURGE = 0
           or ( LV_CP_CAT_PURGE  = 1
               and T_CL_MDL_CAT_PURGE_ENA > 0
               and LV_T_CL_MDL_END_CAT_PURGE = 0)}
           and      LC_CL_MDL_ENA      = 1
then    STATE_CL_MDL      = ENABLED           // switch to enable CL model us-
age
endif
end
    
```

#### Actions:

```

LV_CL_MDL_ACT      = 0
LV_CL_MDL_ENA     = 0
T_CL_MDL_ACT      = 0
end
    
```

### 9.18.2.2 ENABLED

#### Transitions:

```

if      T
           (T_CL_MDL_CLL_ENA      > 0
            or LV_CP_CAT_PURGE = 1)
           and (LV_CP_CAT_PURGE = 0
                or T_CL_MDL_CAT_PURGE_ENA = 0)
then    STATE_CL_MDL      = DISABLED

elseif  [STATE_CP          = MAX_PURGE
           and {(STATE_CDN_CP = CDN_MIN_PURGE
                and LV_CP_CDN_MIN_PURGE_FAST = 0)
            or  LV_LAM_THD = 1
            or  LV_CP_OPP_WIN_1 = 1}]
           or [LV_CP_CAT_PURGE = 1
                and {STATE_CDN_CP = CDN_RAMP_OPEN
                    or STATE_CDN_CP = CDN_RAMP_FAST}]
then    STATE_CL_MDL      = ACTIVE
endif
end
    
```

#### Actions:

```

LV_CL_MDL_ACT      = 0
LV_CL_MDL_ENA     = 1
end
    
```

### 9.18.2.3 ACTIVE

#### Transitions:

```
// canister purge closed loop operation abandoned
if          T_CL_MDL_CLL_ENA > C_T_CL_MDL_ENA
            and LV_CP_CAT_PURGE = 0
then       STATE_CL_MDL          = DISABLED

// max. time of CL model usage elapsed
elseif     (T_CL_MDL_ACT C_T_CL_MDL_ACT_MAX and LV_CP_CAT_PURGE = 0)
            or (T_CL_MDL_ACT C_T_CL_MDL_ACT_MAX_CAT_PURGE
            and LV_CP_CAT_PURGE = 1)
then       T_CL_MDL_CLL_ENA = IP_T_CL_MDL_CLL_ENA(CL_MMV)    // init
            if LV_CP_CAT_PURGE = 1
            then LV_CL_MDL_END_CAT_PURGE = 1
            endif
            STATE_CL_MDL          = DISABLED

// no more usage of CL model necessary; switch to "normal" MAX_PURGE
elseif     [(STATE_CDN_CP ≠ CDN_MIN_PURGE and LV_LAM_THD = 0
            and LV_CP_OPP_WIN_1 = 0)
            and {LV_CP_CAT_PURGE = 0
            or (STATE_CDN_CP ≠ CDN_RAMP_OPEN
            and STATE_CDN_CP ≠ CDN_RAMP_FAST)}}]
then       T_CL_MDL_CLL_ENA = min [IP_T_CL_MDL_CLL_ENA(CL_MMV),
            T_CL_MDL_ACT * C_FAC_T_CL_MDL_ACT +
            C_T_CL_MDL_ACT_OFS]
            if LV_CP_CAT_PURGE = 1
            then LV_CL_MDL_END_CAT_PURGE = 1
            endif
            STATE_CL_MDL          = DISABLED

endif
end
```

#### Actions:

```
LV_CL_MDL_ACT          = 1
LV_CL_MDL_ENA          = 1
T_CL_MDL_ACT           = T_CL_MDL_ACT + TA
end
```

### 9.18.3 Canister Load modelling

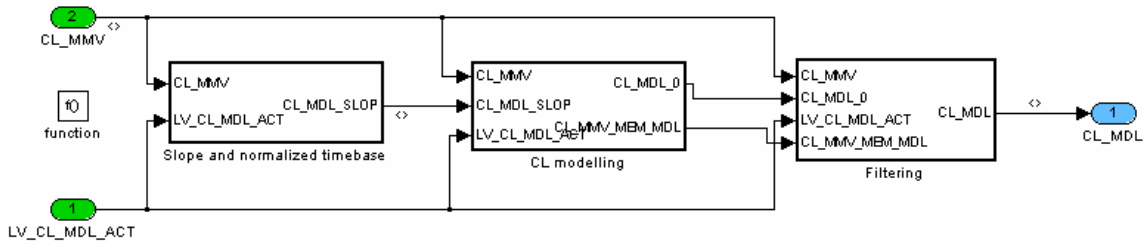


Figure 9.18.1: : structure of the canister load model

#### Formula section:

```

call "Slope and normalized timebase"
call "Modelling and output of CL_MDL"
call "Evaluation CL versus CL_MDL"
end
    
```

#### Calculation information:

The overview shows that the complete function is divided into three submodules, the used inputs are the recurrence time described in chapter Application conditions, the logical value LV\_CL\_MDL\_VALUE\_ACT indicating instationary driving conditions it is the result of the Data Type Conversion block with STATE\_CDN\_CL\_MDL as input and the value of Canister Load.

The outgoing CL\_MDL value is chosen via a switch block between either the Canister Load during stationary driving conditions at the one hand and the modelled Canister Load Load during instationary driving conditions at the other hand indicated by the variable LV\_CL\_MDL\_VALUE\_ACT.

#### 9.18.3.1 Slope and normalized timebase

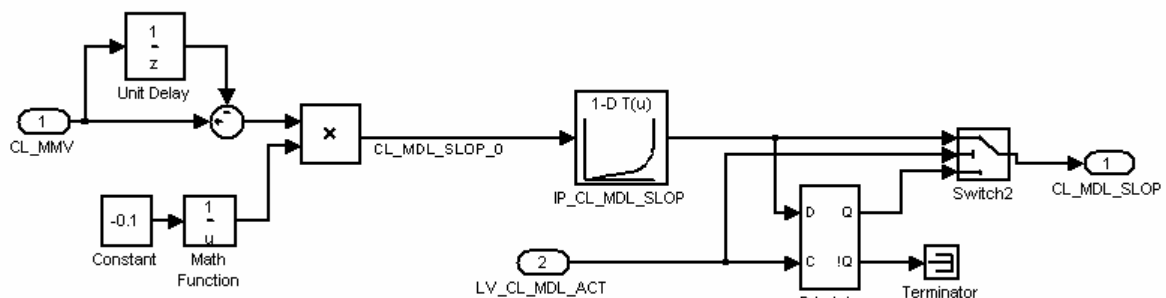



Figure 9.18.2: : slope and normalized timebase

This submodule calculates the (inverted) slope of CL\_MMV by building the difference  $CL\_MMV_n$  minus  $CL\_MMV_{n-1}$ . The slope is used with the Map IP\_CL\_MDL\_SLOP to read out the normalized time

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constant CL\_MDL\_SLOP which indicates the time position on a exponential function using the slope as an input. The outgoing CL\_MDL\_SLOP value is frozen when LV\_CL\_MDL\_ACT=1.

**Formula section:**

```

if    LV_CL_MDL_ACT    = 0
then  CL_MDL_SLOP_0    = -(CL_MMV_MEM_CL_MDL-CL_MMV_MEM_CL_MDL_OLD)
        CL_MDL_SLOP      = IP_CL_MDL_SLOP (CL_MDL_SLOP_0)
else  CL_MDL_SLOP_n    = CL_MDL_SLOP_{n-1}
endif
end
    
```

**9.18.3.2 Modelling and output of CL\_MDL**

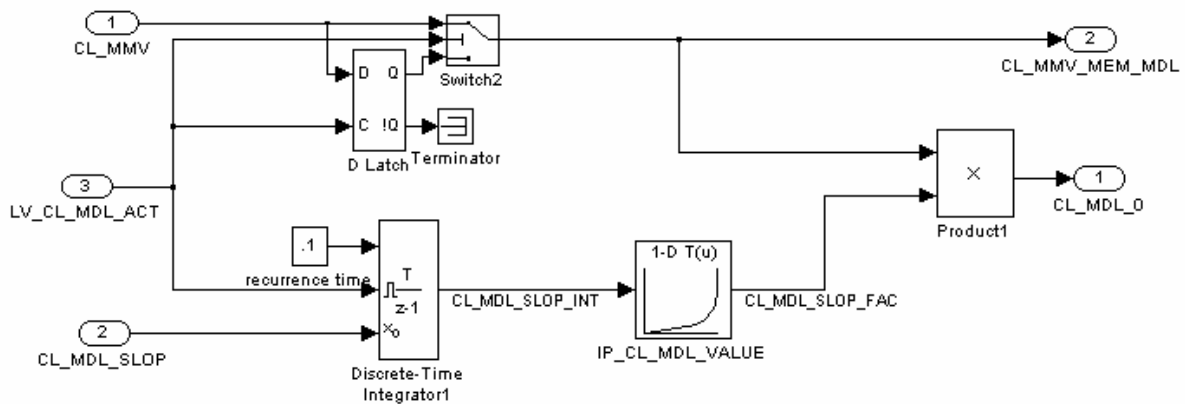


Figure 9.18.3: : modelling and output of CL\_MDL

The output of IP\_CL\_MDL\_VALUE is the normalized value of CL\_MDL over CL\_MDL\_SLOP<sub>integral</sub>. The input of IP\_CL\_MDL\_VALUE is calculated with the Discrete-Time Integrator block. The starting point of integration is CL\_MDL\_SLOP.

**Formula section:**

```

if    LV_CL_MDL_ACT    = 0
then  CL_MDL_0          = CL_MMV_MEM_CL_MDL
        CL_MMV_MEM_MDL   = CL_MMV_MEM_CL_MDL
        CL_MDL_SLOP_INT  = 0
else  CL_MDL_SLOP_INT  = CL_MDL_SLOP_INT_{n-1} + CL_MDL_SLOP
        CL_MDL_SLOP_FAC  = IP_CL_MDL_VALUE (CL_MDL_SLOP_INT)
        CL_MDL_0          = CL_MMV_MEM_MDL * CL_MDL_SLOP_FAC
end
    
```

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### 9.18.3.3 Evaluation CL\_MMV versus CL\_MDL

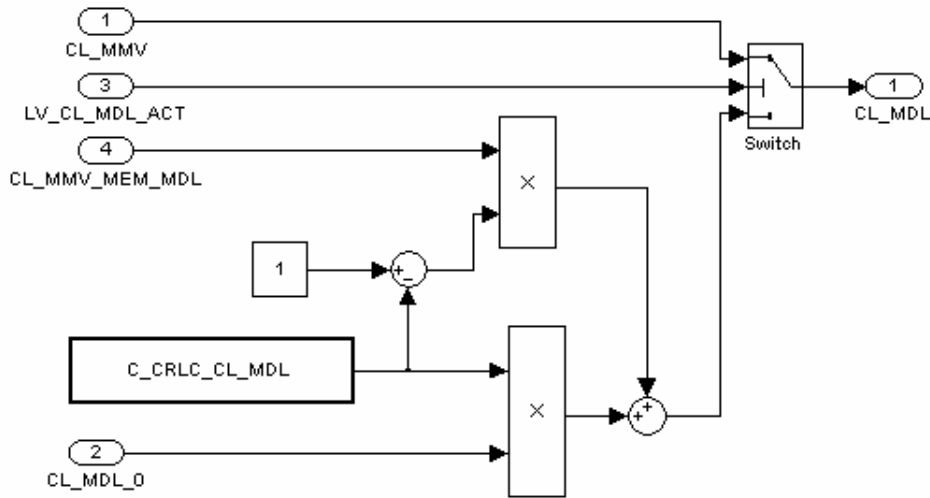


Figure 9.18.4: : evaluation CL versus CL\_MDL

This submodul evaluates the CL\_MMV\_MEM\_MDL value (frozen if LV\_CL\_MDL\_ACT) versus the CL\_MDL\_0 value by using the filter constant C\_CRLC\_CL\_MDL.

#### Formula section:

```

if    LV_CL_MDL_ACT    = 0
then CL_MDL           = CL_MMV
else CL_MDL           = CL_MDL_0 * C_CRLC_CL_MDL
                          + CL_MMV_MEM_MDL * (1-C_CRLC_CL_MDL)

end
    
```



## 9.19 Time control between evaporative system and lambda adaptation


### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CP_ENA	O/V	0... 1H	0 ...1	1	-
Canister purge enabled					
LV_INH_SDL_CP	-	0... 1H	0 ...1	1	-
flag: normal scheduling disabled					
LV_LAM_AD_ENA	O/V	0... 1H	0 ...1	1	-
Lambda adaptation enabled					
LV_STATE_SDL_LOCK_CP	V	0... 1H	0 ...1	1	-
Fixed lambda adaptation is left due to finished lambda adaptation					
LV_T_SDL_NEW_RAMP_OPEN_CP	V	0... 1H	0 ...1	1	-
Flag: new Ramp Open after a lambda adaptation					
LV_TCO_ST_STAT_SDL_CP	V	0... 1H	0 ...1	1	-
Time slice for canister purge after start at hot conditions					
STATE_T_SDL_CP	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H	PASSIVE CP_FIXED LAM_FIXED WAIT_LAM LAM_DYN CP_DYN WAIT_CP OFF_CP EXT_REQ	-	-
State of Time Control Function					
T_AD	V	0... FFFFH	0... 6553.5	0.1	s
Time of actual lambda adaption time range					
T_CP	V	0... FFFFH	0... 6553.5	0.1	s
Time of actual CP time range					
T_MAX_AD	V	0... FFFFH	0... 6553.5	0.1	s
Maximum adaption time; used to disable CP when canister is detected empty					
T_TCO_ST_STAT_SDL_CP	V	0... FFFFH	0... 6553.5	0.1	s
Time counter for canister purge after start at hot conditions					

### Input data:

CL_MMV {p. 3698}	LV_CP_ACT {p. 3679}	LV_CP_CLOSE_ACT {p. 3749}	LV_CYL_BAL_LAM_AD_ENA_DC {p. 4066}
LV_ES {p. 1720}	LV_IGK {p. 906}	LV_INH_CP_SDL {p. 3679}	LV_INH_LAM_AD_SDL {p. 3679}
LV_LAM_AD_CDN {p. 2642}	LV_LAM_AD_END {p. 2642}	LV_STATE_T_SDL_CP_LAM_AD_EXT {p. 3680}	LV_T_SDL_EXT_REQ {p. 3680}
NC_CBK_EX_NR {p. 1829}	STATE_CP {p. 3637}	T_AST_CP {p. 3680}	T_PRI_TOT_LAM_AD {p. 2643}
TCO {p. 1100}			

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**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_MMV_T_BOL	-	0... FFFFH	0... 1.99996	30.5e-6	-
Time management canister load bottom limit					
C_CL_MMV_T_TOL	-	0... FFFFH	0... 1.99996	30.5e-6	-
Time management canister load top limit					
C_CL_MMV_T_WAIT_LAM	-	0... FFFFH	0... 1.99996	30.5e-6	-
CL threshold to switch off CP during WAIT_LAM					
C_T_2_CP	-	1... FFFFH	0.1... 6553.5	0.1	s
Duration of purge phase					
C_T_DI_CP	-	1... FFFFH	0.1... 6553.5	0.1	s
Disable time of purge phase when canister detected empty					
C_T_MFF_AD_MAX	-	1... FFFFH	0.1... 6553.5	0.1	s
Time out for adaption phase					
C_T_SDL_EXT_REQ	-	1... FFFFH	0.1... 6553.5	0.1	s
Time for external request					
C_T_TCO_ST_STAT_SDL_CP	-	0... FFFFH	0... 6553.5	0.1	s
Time for canister purge after start at hot conditions					
C_TCO_COLD_DYN_T_CTL_CP	-	0... FEH	-48... 142.5	0.75	°C
Maximum cold temperatur to activate the dynamic time slices at start of DC					
C_TCO_DYN_T_CTL	-	0... FEH	-48... 142.5	0.75	°C
Minimum temperature for activation of dynamic time control between EVAP and lambda adaptation					
ID_T_SET_T_AST_LAM_CP	-	1H 2H 3H	CP_FIXED LAM_FIXED DYN_SDL	-	-
LDP_T_AST_SET_ID_T_AST	NC_ NR_ CP_ LAM_ AD	0... FFFFH	0... 6553.5	0.1	s
Indexiation for fixed time slices					
IP_T_MAX_CP	-	1... FFFFH	0.1... 6553.5	0.1	s
LDP_CL_MMV_IP_T_MAX_CP	6	0... FFFFH	0... 1.99996	30.5e-6	-
Duration of maximum purge versus Canister Load					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_MAN_SDL_CP	-	0H 1H 2H 3H	AUTOMATIC SDL_NONE SDL_CP LAM_AD	-	-
selection of manual scheduling mode					
LC_CL_CP_DYN_END_ENA	-	0... 1H	0 ...1	1	-
switch to enable end of CP phase when reaching low canister load					
LC_CP_ENA_WAIT_LAM	-	0... 1H	0 ...1	1	-
switch to permanently enable canister purge in WAIT_LAM					
LC_CYL_BAL_LAM_AD_INH_CP	-	0... 1H	0 ...1	1	-
Inhibition of: transition to LAM_DYN controlled by CYBL					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_MFF_AD_ENA_PAS	-	0... 1H	0 ...1	1	-
switch to enable lambda adaptation while cp passive					
LC_SDL_LAM_AD_CDN_OFF	-	0... 1H	0 ...1	1	-
switch to ignore LV_LAM_AD_CDN (adapt. ongoing) for end of lambda adapt. time slice calculation					
NC_NR_CP_LAM_AD	-	0... FFH	0... 255	1	-
Number of fixed CP /Lambda adaptation slices after engine start					

Input data table order: External inputs - Inputs from other EVAC modules

**General information:**

Lambda adaption and canister purge both use a lambda deviation for their purposes. Indeed, as the canister purge itself causes a certain lambda deviation, both functions can not work simultaneous. As a consequence, a time management has to be installed partitioning the engine operating time and enabling either canister purge or lambda adaptation while disabling the other function.

**Signal flow diagram:**

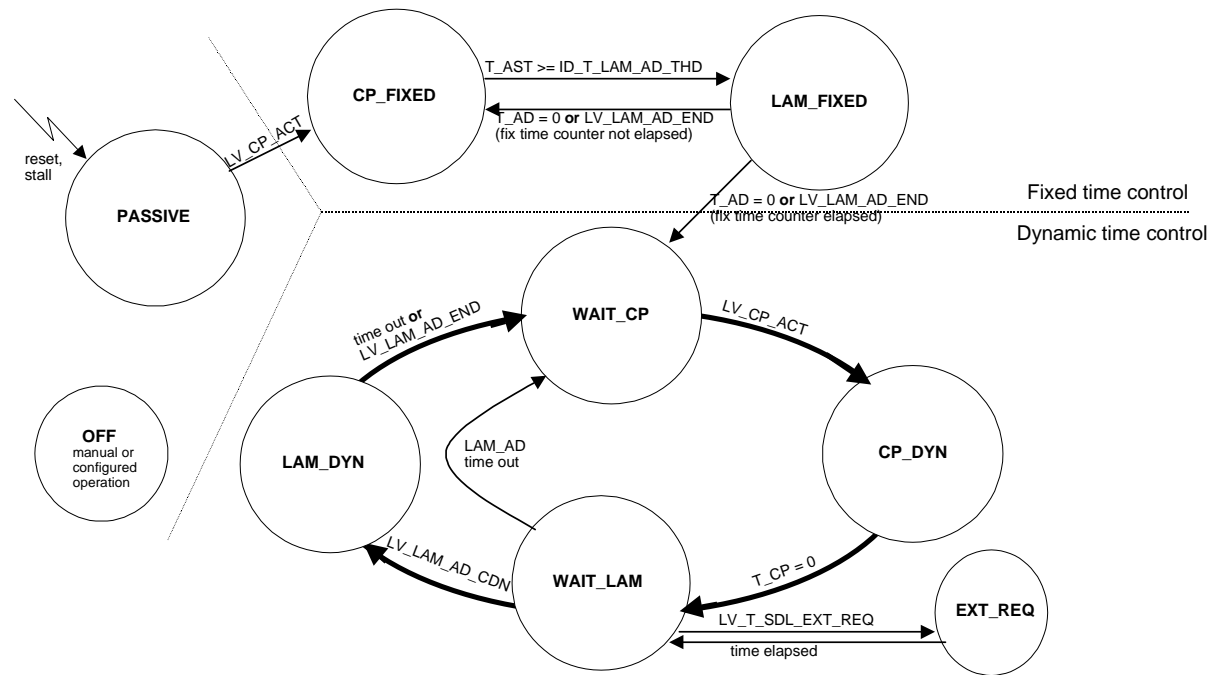


Figure 9.19.1: : time scheduler state diagram

The state diagram above only contains the recent transitions; all possible transitions are listed in the formula section below.

The following table indicates whether canister purge or lambda adaptation is enabled/disabled depending on the state STATE\_T\_SDL\_CP of the time scheduler.

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<u>STATE_T_SDL_CP</u>	<u>CP</u>	<u>LAM_AD</u>
PASSIVE	✗	C
CP_FIXED	✓	✗
CP_DYN	✓	✗
WAIT_LAM	✓	✗
LAM_FIXED	✗	✓
LAM_DYN	✗	✓
WAIT_CP	✗	✓
EXT_REQ	✗	✗

configurable

C

Lambda adaptation is enabled in the corresponding states after the CPS is closed

CP is enabled in WAIT\_LAM for a calibratable time

Figure 9.19.2: : enabling of canister purge or lambda adaptation depending on state

In general the time control is splitted into two main parts:

- At leaving start the time split between lambda adaption and canister purge is defined by a certain number of fixed time frames. The number of these fixed time frames is given by NC\_NR\_CP\_LAM\_AD -1 (last defines the start of dynamic time slices).
- After performing the fixed time frames, the time periods of canister purge and lambda adaption are depending on canister load and the necessity of lambda adaption, indicated by their corresponding functions, so dynamic time frames will be applied.
- For Hybrid and Stop/Start configurations the timers for the dynamic time slices are stopped during engine off time.

After the start phase has ended and canister purge is possible (LV\_CP\_ACT = 1), the manager starts with a time slice depending on TCO. For very cold condition, the dynamic time slices will be performed immediatly. For a mid range temperature, the fixed slices defined in ID\_T\_SET\_T\_AST\_LAM\_CP are done and for a high temperature at first one fixed canister purge time frame will perfaomed. After a defined time the manager will switch to the dynamic time slices.

During CP\_FIXED period the canister purge is possible if the conditions for the function are fulfilled. If they're not fulfilled, neither canister purge nor lambda adaptation will be active.

During LAM\_FIXED period the canister purge is disabled and the lambda adaptation is enabled. During this period and after the canister purge valve is closed, the lambda adaptation is possible if the conditions for the function are fulfilled. If they're not fulfilled, neither canister purge nor lambda adaptation will be active.

If the lambda adaptation sends its ready bit LV\_LAM\_AD\_END, the lambda adaptation time will immediately end and the state switches to CP\_FIXED.

This sequence (canister purge /lambda adaption) is repeated until ID\_T\_SET\_T\_AST\_LAM\_CP defines dynamic slices; for each period, the start time is defined by the corresponding value of the indexation table ID\_T\_SET\_T\_AST\_LAM\_CP.

The dynamic time frames start with WAIT\_CP after the fixed time frames are elapsed, see description of the different states below.

#### Description of the different time control states

##### PASSIVE

After each reset or engine stalling the time control starts with state PASSIVE and switches to CP\_FIXED or WAIT\_CP depending on TCO and when canister purge starts to be active, i.e. LV\_CP\_ACT = 1 is fulfilled. Lambda adaptation can be activated during this state (configurable)

**CP\_FIXED**

Only canister purge is enabled. This state is active as long as no lambda adaptation is triggered by the corresponding time threshold. If a lambda adaptation is urgently requested, LAM\_FIXED is selected.

**LAM\_FIXED**

Only lambda adaption is enabled. This state is left, if the adaptation is finished or the next fixed or dynamic slice starts. If immediate lambda adpatation is requested via the flag LV\_STATE\_T\_SDL\_CP\_LAM\_AD\_EXT, this state is not left until these flags have been reset. Afterwards, the fixed time slices are resumed.

**CP\_DYN**

Canister purge is enabled. This state is left, if the timecounter T\_CP elapses or an urgent lambda adaptation is requested.

**LAM\_DYN**

Lambda adaption is enabled. To leave this state, a time counter initialised when detecting an empty canister has to have elapsed. The state is left, if the standard adaptation time counter has elapsed and no adaptation is currently ongoing or if the end of an adaptation cycle is signaled by lambda adaptation itself.

**WAIT\_LAM**

Within WAIT\_LAM, canister purge is enabled; this enabling may expire after a calibratable time. As soon as the conditions for a lambda adaptation are given, this state is left towards LAM\_DYN and lambda adaptation starts. If the time counter for lambda adaptation C\_T\_MFF\_AD\_MAX is elapsed, WAIT\_CP is selected and canister purge is enabled.

**WAIT\_CP**

Within WAIT\_CP, lambda adaptation is enabled. As soon as canister purge function is active (LV\_CP\_ACT = 1), this state is left towards CP\_DYN and canister purge is enabled.

**EXT\_REQ**

If functions other than canister purge and lambda adaptation request a certain time slice with both, lambda adaptation and canister purge deactivated, the time scheduler may switch to the state EXT\_REQ for a calibratable time.


In all states with enabled lambda adaptation, the enabling starts when the canister purge valve is closed (LV\_CP\_CLOSE\_ACT = 1).

At the "regular" entry of MAX\_PURGE (i.e. not a re-entry after a short deactivation but an entry after finishing canister load learning phases RAMP\_OPEN or RAMP\_OPEN\_FAST) the time slices for CP and lambda adaptation are re-evaluated; remaining time for canister purge is the minimum of IP\_T\_MAX\_CP (depending on canister load) and the lambda adaption prioritisation time T\_PRI\_TOT\_LAM\_AD. A small time T\_PRI\_TOT\_LAM\_AD from lambda adaptation is related to a high priority for lambda adaptation as the canister purge time will be decreased.

Three cases are handled:

**High canister load**

If the canister is detected full at the end of the learning phase the time control gives priority to the evaporative emission control by increasing the remaining purge time in order to decrease the canister load. The purge time IP\_T\_MAX\_CP is used to purge the canister.

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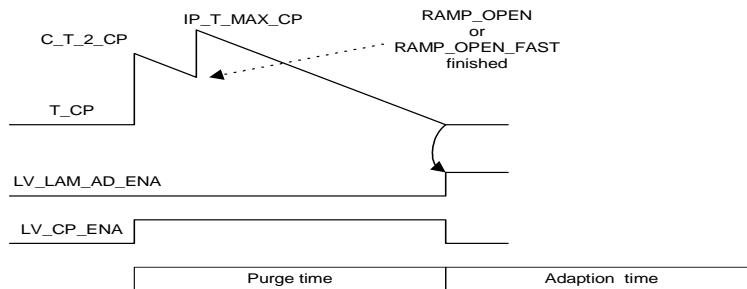


Figure 9.19.3: : canister purge time at high canister load

**Medium canister load**

If the canister is detected with a medium load, the purge time is calculated as the minimum value between the needs of the lambda adaption and canister purge using the lambda adaption prioritisation time  $T\_PRI\_TOT\_LAM\_AD$ . A small time  $T\_PRI\_TOT\_LAM\_AD$  from lambda adaptation is related to a high priority for lambda adaptation as the canister purge time will be decreased.

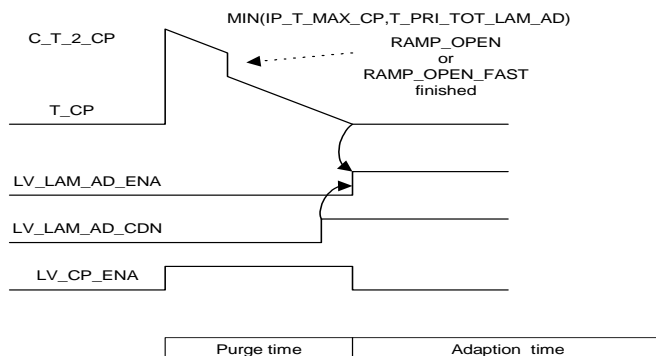


Figure 9.19.4: : canister purge time at medium canister load

**Empty canister**

If the canister is detected empty at the end of the learning phase, the canister purge is disabled for a time  $C\_T\_DI\_CP$  and the lambda adaptation is enabled.

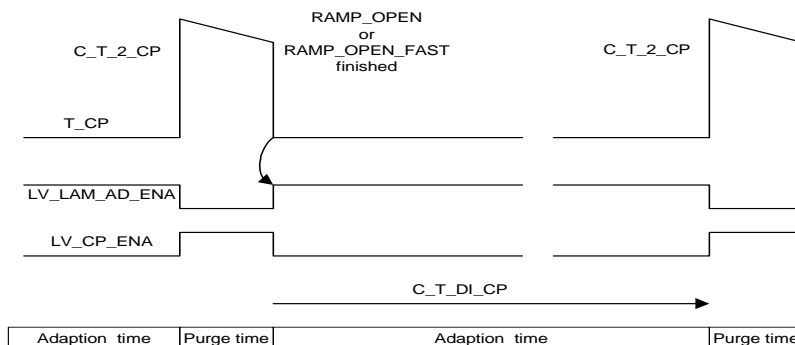



Figure 9.19.5: : canister purge time at low canister load

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## Application conditions

**Initialisation:** at RST or IGKON:  
                           STATE\_T\_SDL\_CP = PASSIVE  
                           all other values = 0

**Recurrence:** 100 ms

**Activation:** LV\_IGK = 1

**Deactivation:** - -

## Formula section:

```
LV_INH_SDL_CP =
  [ LV_INH_LAM_AD_SDL = 1
or  LV_INH_CP_SDL = 1
or  C_STATE_MAN_SDL_CP ≠ AUTOMATIC ]

call "Time control states" (corresponding transition part)
call "Time control states" (corresponding action part)

if LV_INH_SDL_CP = 0
then call "Calculation of the time slices for canister purge and lambda adaption"
else STATE_T_SDL_CP = OFF_CP // transition possible from all states
endif
end
```

### 9.19.1 Time control states

#### 9.19.1.1 PASSIVE

#### Transitions:

```
if LV_CP_ACT = 1
then if1 TCO < C_TCO_COLD_DYN_T_CTL_CP
  then1 STATE_T_SDL_CP = WAIT_CP
  else1 if2 TCO < C_TCO_DYN_T_CTL
    then2 if3 ID_T_SET_T_AST_LAM_CP (T_AST_CP) = DYN_SDL
      then3 STATE_T_SDL_CP = WAIT_CP
      else3 STATE_T_SDL_CP = CP_FIXED
    endif3
    else2 T_TCO_ST_STAT_SDL_CP = C_T_TCO_ST_STAT_SDL_CP
      LV_TCO_ST_STAT_SDL_CP = 1
      STATE_T_SDL_CP = CP_FIXED
    endif2
  endif1
endif
```

#### Actions:

```
LV_CP_ENA = 0 // inits
LV_LAM_AD_ENA = [ LC_MFF_AD_ENA_PAS and LV_CP_CLOSE_ACT ]
T_CP = 0
```

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```

T_AD                                = 0
T_MAX_AD                            = 0
end

```

### 9.19.1.2 CP\_FIXED

#### Transitions:

```

if      LV_CP_ACT                    = 0
then    STATE_T_SDL_CP              = PASSIVE

elseif      LV_STATE_T_SDL_CP_LAM_AD_EXT = 1 // immediate lam. adapt. required
or          (ID_T_SET_T_AST_LAM_CP (T_AST_CP) = LAM_FIXED
and LV_STATE_SDL_LOCK_CP = 0
and LV_TCO_ST_STAT_SDL_CP = 0)
then    STATE_T_SDL_CP              = LAM_FIXED
elseif      LV_TCO_ST_STAT_SDL_CP = 1
and T_TCO_ST_STAT_SDL_CP = 0
then    STATE_T_SDL_CP              = WAIT_LAM
elseif      ID_T_SET_T_AST_LAM_CP (T_AST_CP) = DYN_SDL
then    STATE_T_SDL_CP              = WAIT_CP
endif
end

```

#### Actions:

```

LV_CP_ENA                            = 1
LV_LAM_AD_ENA                        = 0
T_TCO_ST_STAT_SDL_CP = max(0, T_TCO_ST_STAT_SDL_CP - TA)
if      ID_T_SET_T_AST_LAM_CP (T_AST_CP) = CP_FIXED
then    LV_STATE_SDL_LOCK_CP = 0
endif
end

```

### 9.19.1.3 LAM\_FIXED


#### Transitions:

```

if      LV_STATE_T_SDL_CP_LAM_AD_EXT = 0
then if      ID_T_SET_T_AST_LAM_CP (T_AST_CP) = DYN_SDL
then        STATE_T_SDL_CP          = WAIT_CP
elseif      ID_T_SET_T_AST_LAM_CP (T_AST_CP) = CP_FIXED
then        STATE_T_SDL_CP          = CP_FIXED
elseif      LV_LAM_AD_END = 1
then        STATE_T_SDL_CP          = CP_FIXED
LV_STATE_SDL_LOCK_CP = 1
endif
endif
end

```

#### Actions:

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```

LV_CP_ENA                = 0
LV_LAM_AD_ENA            = LV_CP_CLOSE_ACT
endif
end

```

### 9.19.1.4 WAIT\_CP

#### Transitions:

```

if      LV_CP_ACT          = 1
then    T_CP                = C_T_2_CP
        STATE_T_SDL_CP    = CP_DYN
endif
end

```

#### Actions:

```

if LV_T_SDL_NEW_RAMP_OPEN_CP      = 1
then LV_CP_ENA                    = 0
endif
LV_LAM_AD_ENA                    = LV_CP_CLOSE_ACT
LV_T_SDL_NEW_RAMP_OPEN_CP        = 0
end

```

### 9.19.1.5 CP\_DYN

#### Transitions:

```

if      LV_STATE_T_SDL_CP_LAM_AD_EXT = 1 // immediate lam. adapt. required
or      LV_CP_ACT                    = 0 // CP disabled
or      T_CP                          = 0 // regular end of CP time
or      [ CL_MMV <= C_CL_MMV_T_BOL // canister empty
and     STATE_CP = MAX_PURGE
and     LC_CL_CP_DYN_END_ENA = 1 ]
then    T_AD                          = C_T_MFF_AD_MAX
        T_MAX_AD                    = 0
        STATE_T_SDL_CP              = WAIT_LAM
endif
end

```

#### Actions:


```

LV_CP_ENA                = 1
LV_LAM_AD_ENA            = 0
if LV_ES = 0
then T_CP                  = max [0, T_CP - TA]
endif

```

### 9.19.1.6 WAIT\_LAM

#### Transitions:

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```

if          LV_STATE_T_SDL_CP_LAM_AD_EXT = 1 // immediate lam. adapt. required
then       STATE_T_SDL_CP      = LAM_DYN

elseif     LV_T_SDL_EXT_REQ = 1
then       T_CP                = C_T_SDL_EXT_REQ
            STATE_T_SDL_CP      = EXT_REQ

elseif     (LV_LAM_AD_CDN      = 1
and (LV_CYL_BAL_LAM_AD_ENA_DC = 1
      or LC_CYL_BAL_LAM_AD_INH_CP = 1))
then       STATE_T_SDL_CP      = LAM_DYN

elseif     [ T_AD              = 0
and T_MAX_AD                  = 0 ]
insert switch to enable this transition; then (when disabling this transition), scheduler will stay in wait_lam
(with possibility to purge) until next lambda adaptation is requested.
then       STATE_T_SDL_CP      = WAIT_CP
endif
end

```

**Actions:**

```

LV_CP_ENA          = [CL_MMV  C_CL_MMV_T_WAIT_LAM]
LV_LAM_AD_ENA     = 0
if LV_ES = 0
then T_AD          = max [0, T_AD - TA]
      T_MAX_AD      = max [0, T_MAX_AD - TA]
endif
end

```

**9.19.1.7 LAM\_DYN****Transitions:**

```

if          T_MAX_AD          = 0          // CP disabling time after low cl detection
and         LV_STATE_T_SDL_CP_LAM_AD_EXT = 0
and [ LV_LAM_AD_END      = 1          // adapt. finished
      or ( T_AD              = 0          // time out
and { LV_LAM_AD_CDN      = 0          // and adapt. not ongoing
      or LC_SDL_LAM_AD_CDN_OFF = 1} ) ]
then       STATE_T_SDL_CP      = WAIT_CP
endif
end

```

**Actions:**

```

LV_CP_ENA          = 0
LV_LAM_AD_ENA     = LV_CP_CLOSE_ACT
if LV_ES = 0
then T_AD          = max [0, T_AD - TA]
      T_MAX_AD      = max [0, T_MAX_AD - TA]
Endif

```

```
LV_T_SDL_NEW_RAMP_OPEN_CP = 1
end
```

### 9.19.1.8 EXT\_REQ

#### Transitions:

```
if      LV_STATE_T_SDL_CP_LAM_AD_EXT = 1 // immediate lam. adapt. required
or      T_CP                          = 0          // regular end of CP time
or      LV_T_SDL_EXT_REQ = 0          // no more external request
then    STATE_T_SDL_CP   = WAIT_LAM
endif
end
```

#### Actions:

```
LV_CP_ENA                = 0
LV_LAM_AD_ENA           = 0
if LV_ES = 0
then T_CP                = max [0, T_CP - TA]
endif
// T_CP is used as counter to economize on a special counter T_EXT_REQ
end
```

### 9.19.1.9 OFF\_CP

#### Transitions:

```
if      LV_INH_SDL_CP   = 0
then    STATE_T_SDL_CP = PASSIVE
endif
end
```

#### Actions:

```
T_CP          = 0          // inits
T_AD          = 0
T_MAX_AD      = 0
```

#### **case selection on C\_STATE\_MAN\_SLD\_CP**

SDL\_NONE:

```
LV_CP_ENA                = 0
LV_LAM_AD_ENA           = 0
```

SDL\_CP:

```
LV_CP_ENA                = 1
LV_LAM_AD_ENA           = 0
```

LAM\_AD:

```
LV_CP_ENA                = 0
LV_LAM_AD_ENA           = LV_CP_CLOSE_ACT
```

```

AUTOMATIC:
if    LV_INH_LAM_AD_SDL = 1           // both inhibited
and   LV_INH_CP_SDL      = 1
then  LV_CP_ENA          = 0
        LV_LAM_AD_ENA     = 0

elseif LV_INH_CP_SDL      = 0
then   LV_CP_ENA          = 1
        LV_LAM_AD_ENA     = 0

elseif LV_INH_LAM_AD_SDL = 0
then   LV_CP_ENA          = 0
        LV_LAM_AD_ENA     = LV_CP_CLOSE_ACT
endif

end case selection
end

```

### 9.19.2 Calculation of the time slices for canister purge and lambda adaption

```

// also to be called with empty canister and C_STATE_MOD_SEL_CP = SEL_MAX_PURGE
if    ( STATE_CP n-1           = RAMP_OPEN
or    STATE_CP n-1           = RAMP_OPEN_FAST)
and   STATE_CP n             = MAX_PURGE
and   STATE_T_SDL_CP        > LAM_FIXED
then call "time slices calculation"
endif
end

```

#### 9.19.2.1 time slices calculation

```

// high canister load
if    CL_MMV                C_CL_MMV_T_TOL
then   T_CP                  = IP_T_MAX_CP (CL_MMV)

// medium canister load
elseif CL_MMV                C_CL_MMV_T_BOL
then   T_CP                  = min [IP_T_MAX_CP (CL_MMV),
                                     T_PRI_TOT_LAM_AD]

// low canister load
else   STATE_T_SDL_CP        = WAIT_LAM
by this, the fixed time slices are left and the dynamic operation starts!
to be discussed or to be made configurable
        T_AD                  = C_T_MFF_AD_MAX
        T_MAX_AD              = C_T_DI_CP
        T_CP                  = 0
endif
end

```

## 9.20 Canister purge valve control

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CPPWM	V	0... FFH	0... 99.60937	0.390625	%
PWM signal for CPS opening					
CPPWM_CPS	O/V	0... FFH	0... 99.60937	0.390625	%
Corrected PWM signal for CPS opening					
FRQ_REQ_CP	O/V	0... FFH	0... 255	1	Hz
CPS Output frequency					
LV_CP_CLOSE_ACT	O/V	0... 1H	0 ...1	1	-
Logical value for CPS valve closed					
LV_FRQ_1_CPS	V	0... 1H	0 ...1	1	-
Logical value for CPS PWM frequency					

### Input data:

CPPWM_ADD_AD {p. 3756}	CPPWM_EXT_ADJ {p. 7431}	CPPWM_LIH {p. 4708}	FLOW_COR_CPS {p. 3635}
FRQ_CPS_AD {p. 3756}	LV_CPPWM_EXT_ADJ {p. 7433}	LV_CPS_AD_ACT {p. 3756}	LV_ERR_EL_CPS {p. 4708}
LV_N_MAX_CP {p. 1540}	N_32 {p. 1525}	PRS_CPS {p. 1540}	VB {p. 1185}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CPPWM_AS	-	80... 7FH	-100... 99.21875	0.78125	%
Application system value for CPS opening					
C_CPPWM_FRQ_1	-	0... FFH	0... 255	1	Hz
First CPS output frequency					
C_CPPWM_FRQ_1_CPS	-	0... FFH	0... 99.60937	0.390625	%
Threshold on CPPWM to shift CPS frequency output					
C_CPPWM_FRQ_2	-	0... FFH	0... 255	1	Hz
Second CPS output frequency					
C_CPPWM_FRQ_2_CPS	-	0... FFH	0... 99.60937	0.390625	%
Threshold on CPPWM to shift CPS frequency output					
C_CPPWM_FRQ_HYS_CPS	-	0... FFH	0... 99.60937	0.390625	%
Hysteresis threshold on CPPWM to shift CPS frequency output					
C_CPPWM_MAX_FRQ_1_LIM_CP	-	0... FFH	0... 99.60937	0.390625	%
CPPWM_CPS maximum limit to assure the diagnosis with frequency 1					
C_CPPWM_MAX_FRQ_2_LIM_CP	-	0... FFH	0... 99.60937	0.390625	%
CPPWM_CPS maximum limit to assure the diagnosis with frequency 2					
C_CPPWM_MIN_FRQ_1_LIM_CP	-	0... FFH	0... 99.60937	0.390625	%
CPPWM_CPS minimum limit to assure the diagnosis with frequency 1					
C_CPPWM_MIN_FRQ_2_LIM_CP	-	0... FFH	0... 99.60937	0.390625	%
CPPWM_CPS minimum limit to assure the diagnosis with frequency 2					
C_N_FRQ_1_CPS	-	0... FFH	0... 8160	32	rpm
Threshold on engine speed to shift CPS frequency output					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_FRQ_2_CPS	-	0... FFH	0... 8160	32	rpm
Threshold on engine speed to shift CPS frequency output					
C_N_FRQ_HYS_CPS	-	0... FFH	0... 8160	32	rpm
Hysteresis threshold on engine speed to shift CPS frequency output					
IP_CPPWM	V	0... FFH	0... 99.60937	0.390625	%
LDP_FLOW_COR_CPS_IP_CPPWM	16	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_PRS_CPS_1_EVAC	16	0... FFFFH	-2717... 2716.91708	0.0829163	hPa
CPS valve characteristic					
IP_CPPWM_COR_FRQ	-	0... FFH	0... 1.99218	0.0078125	-
LDP_CPPWM_IP_CPPWM_COR_FRQ	8	0... FFH	0... 99.60937	0.390625	%
PWM correction following frequency value					
IP_CPPWM_VB_ADD_1	-	0... FFH	-50... 49.60937	0.390625	%
LDPM_VB_1_EVAC	8	0... FFH	0... 25.89843	0.1015625	V
Additive VB correction for CPPWM and frequency 1					
IP_CPPWM_VB_ADD_2	-	0... FFH	-50... 49.60937	0.390625	%
LDPM_VB_1_EVAC	8	0... FFH	0... 25.89843	0.1015625	V
Additive VB correction for CPPWM and frequency 2					
IP_CPPWM_VB_FAC	-	0... FFH	0... 1.99218	0.0078125	-
LDPM_VB_1_EVAC	8	0... FFH	0... 25.89843	0.1015625	V
Multiplicative VB correction for CPPWM					
IP_CPPWM_VB_FAC_PRS_CPS	-	0... FFH	0... 3.98437	0.015625	-
LDP_PRS_CPS_IP_CPPWM_VB_FAC	6	0... FFFFH	-2717... 2716.91708	0.0829163	hPa
Multiplicative VB correction for CPPWM					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_CPPWM_AS	-	0... 1H	0 ...1	1	-
C_CPPWM_AS activation					
LC_CPPWM_LIM_DIAG	-	0... 1H	0 ...1	1	-
Selection of diagnosis limit values on CPPWM_CPS					

**Import actions:**

<b>ACTION_INFR_SetPWMDucyCPS</b> (IN<Cpwwm_cp>)
<b>ACTION_INFR_SetPWMrqCPS</b> (IN<Frq_req_cp>)


Input data table order: External inputs - Inputs from other EVAC modules

**General information:**

The PWM-setpoint to control the opening of the canister purge valve CPPWM is calculated from a map as a function of the flow setpoint and the pressure difference. This flow setpoint is delivered from evaporative emission control module.

The influence of the battery voltage VB on the opening of the CPS is corrected by the additive value IP\_CPPWM\_VB\_1\_ADD or IP\_CPPWM\_VB\_2\_ADD and multiplicative value IP\_CPPWM\_VB\_FAC.

Two frequencies of the CPS are possible; the selection of the current frequency is dependent on engine speed and valve opening.

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An additional PWM offset can be applied using C\_CPPWM\_AS (the offset) and LC\_CPPWM\_AS (the switch to turn the consideration of the offset on).

The term CPPWM\_ADD\_AD includes the valve adaptation value delivered from the canister purge valve characteristic adaptation function (if included).

An external setpoint CPPWM\_EXT\_ADJ is applied, if LV\_CPPWM\_EXT\_ADJ is true.

If a fault is detected on the canister purge valve (LV\_ERR\_EL\_CPS=1), the opening of the CPS is controlled by the value of CPPWM\_LIH (see chapter OBDI functions).

In case of high CPU load /high engine speed (LV\_N\_MAX\_CP=1), the regular control of the valve is stopped to save CPU load.

The physical range for the frequency request FRQ\_REQ\_CP is 5 to 32 Hz.

### Application conditions

**Initialisation:** *LV\_CP\_CLOSE\_ACT=1 and all other values =0 at reset or stalling*

**Recurrence:** *20 ms*

**Activation:** *every engine state*

**Deactivation** *- -*

### Signal flow diagrams:

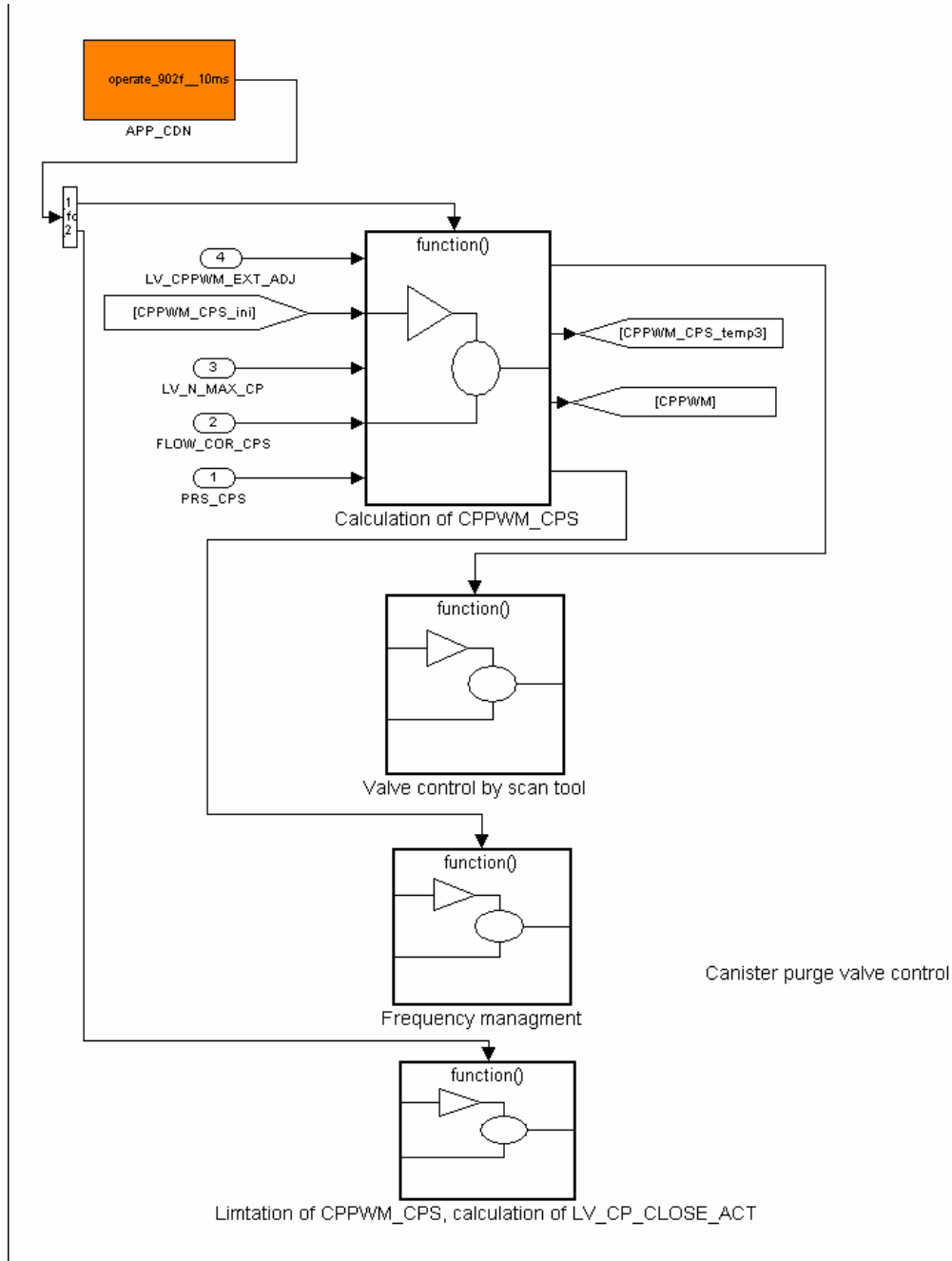



Figure 9.20.1: : overview valve control

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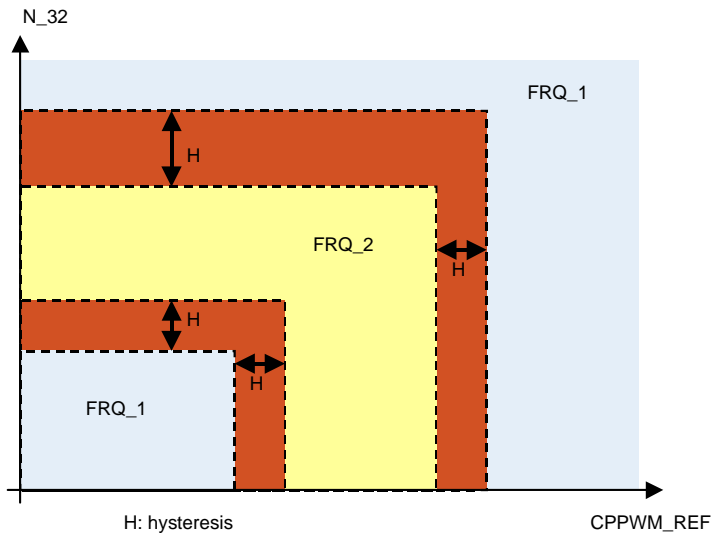


Figure 9.20.2: : frequency management

**Formula section:****Calculation of CPPWM\_CPS**

```

if LV_CPPWM_EXT_ADJ = 1
then call "Valve control by scan tool"
else if LV_N_MAX_CP = 1
then CPPWM_CPS = 0
else if LV_ERR_EL_CPS = 1
then CPPWM = CPPWM_LIH
elseif LV_CPS_AD_ACT = 1
then CPPWM = CPPWM_ADD_AD
elseif FLOW_COR_CPS = 0
then CPPWM = 0
else CPPWM = max [0, IP_CPPWM (FLOW_COR_CPS, PRS_CPS)
+ CPPWM_ADD_AD]
endif
if LC_CPPWM_AS = 1
then CPPWM = CPPWM + C_CPPWM_AS
endif

call "Frequency management"
endif

```

**endif****call** "Limitation of CPPWM\_CPS, calculation of LV\_CP\_CLOSE\_ACT"**end****9.20.1 Valve control by scan tool**

```

if LV_CPPWM_EXT_ADJ = 1
then FRQ_REQ_CP = C_CPPWM_FRQ_2
LV_FRQ_1_CPS = 0
CPPWM = CPPWM_EXT_ADJ

```

```

CPPWM_CPS          = CPPWM_EXT_ADJ
TMP_MAX_CPS_DIAG = C_CPPWM_MAX_FRQ_2_LIM_CP
TMP_MIN_CPS_DIAG  = C_CPPWM_MIN_CPS_DIAG_FRQ_2

```

```
endif
```

```
end
```

## 9.20.2 Frequency management

### frequency selection

```

if LV_CPS_AD_ACT = 1
then FRQ_REQ_CP = FRQ_CPS_AD
    LV_FRQ_1_CPS = 0

if LV_FRQ_1_CPS = 1
then if (CPPWM < C_CPPWM_FRQ_2_CPS)
    and (N_32 < C_N_FRQ_2_CPS)
    and [(CPPWM > C_CPPWM_FRQ_1_CPS + C_CPPWM_FRQ_HYS_CPS)
    or (N_32 > C_N_FRQ_1_CPS + C_N_FRQ_HYS_CPS)]
    then FRQ_REQ_CP = C_CPPWM_FRQ_2
        LV_FRQ_1_CPS = 0
    else FRQ_REQ_CP = C_CPPWM_FRQ_1
        LV_FRQ_1_CPS = 1
    endif
else if (CPPWM > C_CPPWM_FRQ_2_CPS + C_CPPWM_FRQ_HYS_CPS)
    or (N_32 > C_N_FRQ_2_CPS + C_N_FRQ_HYS_CPS)
    or [(CPPWM < C_CPPWM_FRQ_1_CPS)
    and (N_32 < C_N_FRQ_1_CPS)]
    then FRQ_REQ_CP = C_CPPWM_FRQ_1
        LV_FRQ_1_CPS = 1
    else FRQ_REQ_CP = C_CPPWM_FRQ_2
        LV_FRQ_1_CPS = 0
    endif
endif
endif

```

### battery voltage correction & diagnosis limit determination

```

if CPPWM > 0
then if LV_FRQ_1_CPS = 1
    then CPPWM_CPS =
        CPPWM
        * IP_CPPWM_COR_FRQ (CPPWM)
        * IP_CPPWM_VB_FAC (VB)
        + IP_CPPWM_VB_ADD_1 (VB) * IP_CPPWM_VB_FAC_PRS_CPS (PRS_CPS)
        TMP_MIN_CPS_DIAG = C_CPPWM_MIN_FRQ_1_LIM_CP
        TMP_MAX_CPS_DIAG = C_CPPWM_MAX_FRQ_1_LIM_CP
    else CPPWM_CPS =
        CPPWM
        * IP_CPPWM_VB_FAC (VB)
        + IP_CPPWM_VB_ADD_2 (VB) * IP_CPPWM_VB_FAC_PRS_CPS (PRS_CPS)
        TMP_MIN_CPS_DIAG = C_CPPWM_MIN_FRQ_2_LIM_CP
        TMP_MAX_CPS_DIAG = C_CPPWM_MAX_FRQ_2_LIM_CP
    endif
else CPPWM_CPS = 0

```

```

    TMP_MIN_CPS_DIAG = C_CPPWM_MIN_FRQ_2_LIM_CP
    // TMP_MIN_CPS_DIAG is used for calculation of LV_CP_CLOSE_ACT, should be defined al-
    though CPPWM_CPS=0.

```

```

endif
end

```

### 9.20.3 Limitation of CPPWM\_CPS, calculation of LV\_CP\_CLOSE\_ACT

```

if    LC_CPPWM_LIM_DIAG = 1
then if    CPPWM_CPS > 0
      then CPPWM_CPS = min [ max [
        CPPWM_CPS, TMP_MIN_CPS_DIAG], TMP_MAX_CPS_DIAG]
      endif
      LV_CP_CLOSE_ACT = [CPPWM_CPS <= TMP_MIN_CPS_DIAG]
else LV_CP_CLOSE_ACT = [CPPWM_CPS = 0]
endif
end


```

Call infrastructure to update the PWM duty-cycle

```
ACTION_INFR_SetPWMDucyCPS(CPPWM_CPS)
```

Call infrastructure to update the PWM frequency

```
ACTION_INFR_SetPWMFrqCPS(FRQ_REQ_CP)
```

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## 9.21 Canister purge valve adaptation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CPPWM_ADD_AD	O/V	0... 7FFFH	0... 99.996948	0.00305176	%
Additive adaptive CPPWM correction					
CPPWM_ADD_AD_MEM	V/S	0... FFFFH	0... 99.998474	0.00152588	%
final output of function: additive STO parameter written to non volatile memory					
CTR_1_CPS_AD	V	0... FFFFH	0... 1310.7	0.02	s
function duration time (in APP_CDN)					
CTR_2_CPS_AD	V	0... FFFFH	0... 1310.7	0.02	s
internal time counter for wait states and ramps					
CTR_CPS_AD_HOM_REQ	V	0... FFH	0... 255	1	-
Number of homogeneous operation mode requests from CPS adaptation.					
CTR_CYCNR_CPS_AD	V	0... FFH	0... 255	1	-
number of successful adaptation cycles during driving cycle					
FAC_FLOW_CPS_AD	V	0... FFH	0... 0.99609375	0.00390625	-
STO weighting factor depending on FLOW_COR_CPS					
FAC_LAMB_START_CPS_AD	V	8000... 7FFFH	0... 49.9984741	0.00152588	%
lambda deviation at begin of CPS_AD to eliminate a constant lambda offset					
FAC_PRS_CPS_AD	V	0... FFH	0... 1.9921875	0.0078125	-
STO weighting factor depending on PRS_CPS					
FAC_PWM_CPS_AD	V	0... FFH	0... 0.99609375	0.00390625	-
STO weighting factor depending on CPPWM_CPS					
FRQ_CPS_AD	O/V	0... FFH	0... 255	1	Hz
current CPS frequency for adaptation					
LV_CL_OK_CPS_AD	V	0... 1H	0 ...1	1	-
CL is sufficient for adaptation					
LV_CPS_AD_ACT	O/V	0... 1H	0 ...1	1	-
if positive: adaptation is active or waiting					
LV_CPS_AD_HOM_REQ	O/V	0... 1H	0 ...1	1	-
Flag to request homogeneous engine operation mode for CPS adaptation					
LV_CPS_AD_RUN_CDN_OK	O/V	0... 1H	0 ...1	1	-
all conditions for adaptation (including counter) fulfilled, adaptation can run					
LV_CPS_AD_ST_CDN_OK	V	0... 1H	0 ...1	1	-
all conditions for adaptation (including CL) fulfilled, adaptation can start					
LV_CPS_OK_CPS_AD	V	0... 1H	0 ...1	1	-
CP Sytem is ready for adaptation (STATE_CP etc.)					
LV_CTR_OK_CPS_AD	V	0... 1H	0 ...1	1	-
CPS_AD has not yet successfully finished the required number of cycles					
LV_ENG_OK_CPS_AD	V	0... 1H	0 ...1	1	-
engine conditions (N, etc.) are OK for adaptation					
LV_ERR_CPS_AD	V	0... 1H	0 ...1	1	-
during current driving cycle one or more adaptations of CPS have failed					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_T_OK_CPS_AD	V	0... 1H	0 ...1	1	-
all relevant time counters are OK for adaptation					
RATIO_FRQ	V	0... FFH	0... 15.9375	0.0625	-
ratio FRQ used for adaptation /minimum purge frequency					
STATE_CPS_AD	V	0H 1H 2H 4H 5H 6H	INACTIVE WAITING LEARNING INTERRUPTED FAILED FINISHED	-	-
current state of CPS adaptation reported by function					
STATE_CPS_AD_REQ	V	0H 1H 2H 4H 5H 6H	INACTIVE WAITING LEARNING INTERRUPTED FAILED FINISHED	-	-
state of CPS adaptation requested by APP_CDN (=activate etc.)					
T_CPS_AD_HOM_REQ	V	0... FFFFH	0... 1310.7	0.02	s
For this time homogeneous operation mode is requested (LV_CPS_AD_HOM_REQ = 1)					
T_DLY_CPS_AD_HOM_REQ	V	0... FFFFH	0... 1310.7	0.02	s
Time until the next homogeneous engine operation mode requests by CPS adaptation is possible					


**Input data:**

CL_MMV {p. 3698}	CPPWM_CPS {p. 3749}	FAC_LAM_MV {p. 1014}	FLOW_COR_CPS {p. 3635}
LV_CL_CLC_VLD {p. 3635}	LV_CP_CLOSE_REQ {p. 1540}	LV_CPS_AD_INH {p. 3679}	LV_HOM_ACT {p. 8136}
N {p. 1525}	PRS_CPS {p. 1540}	STATE_CP {p. 3637}	T_AST_CP {p. 3680}
TQI_AV {p. 981}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_MIN_CPS_AD	-	0... FFFFH	0... 1.999969	305.176e3	-
minimum canister load for CPS adaptation					
C_CPPWM_AD_RATIO	-	0... FFH	0... 0.99609375	0.00390625	-
ratio new measured /old memorized value for new memorized CPPWM_ADD_AD_MEM					
C_CPPWM_ADD_AD_MEM_NVMI_INI	-	0... FFFFH	0... 99.9984741	0.00152588	%
First value of the additive STO parameter written to non volatile memory at NVMI_INI					
C_CPPWM_DELTA_AD	-	0... FFFFH	0... 99.998474	0.00152588	%
PWM distance to old STO for start adaptation					
C_CPPWM_DLY_LAM	-	0... FFFFH	0... 99.998474	0.00152588	%
delta PWM between STO and lambda reaction (time delay compensation)					
C_CPPWM_INC_AD	-	0... FFFFH	0... 99.998474	0.00152588	%
PWM increment for stop after aborted adaptation					
C_CPPWM_INC_STOP_AD	-	0... FFFFH	0... 99.998474	0.00152588	%
PWM increment for stop after aborted adaptation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CPPWM_MAX_AD	-	0... FFFFH	0... 99.998474	0.00152588	%
maximum PWM for CPS adaptation					
C_CPPWM_MIN_AD	-	0... FFFFH	0... 99.998474	0.00152588	%
minimum PWM threshold for CPS adaptation					
C_CTR_CPS_AD_HOM_REQ_MAX	-	0... FFH	0... 255	1	-
Maximum number of homogeneous operation mode requests from CPS adaptation.					
C_CYCNR_CPS_AD	-	0... FFH	0... 255	1	-
maximum number of adaption cycles per driving cycle					
C_FAC_LAMB_DELTA_MIN_CPS_AD	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
lowest detectable lambda deviation					
C_FAC_LAMB_MAX_CPS_AD	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
threshold for CPS adaptation abortion					
C_FLOW_CLC_DIF_CPS_AD	-	0... FFFFH	0... 7.99987793	12.20699e3	kg/h
Difference between C_FLOW_CLC_MAX_CPS_AD and begin of ramp					
C_FLOW_CLC_MAX_CPS_AD	-	0... FFFFH	0... 7.99987793	12.20699e3	kg/h
Maximum FLOW threshold for weighting STO ramp					
C_FRQ_CLC_1_CPS_AD	-	0... FFH	0... 255	1	Hz
numerator for adaptation frequency calculation					
C_FRQ_CLC_2_CPS_AD	-	80... 7FH	0... 127	1	Hz
offset for adaptation frequency calculation					
C_FRQ_MAX_MEC_CPS	-	0... FFH	0... 255	1	Hz
maximum allowed mechanical frequency for CPS					
C_FRQ_MIN_CPS_AD	-	0... FFH	0... 255	1	Hz
start frequency for finding adaptation frequency					
C_N_MAX_CPS_AD	-	0... 1FE0H	0... 8160	1	rpm
upper threshold of dynamic idle window for CPS adaptation					
C_N_MIN_CPS_AD	-	0... 1FE0H	0... 8160	1	rpm
lower threshold of dynamic idle window for CPS adaptation					
C_PRS_CPS_MAX_CPS_AD	-	8000... 7FFFH	0... 2716.96	0.08291752	hPa
Maximum PRS_CPS threshold for CPS adaptation					
C_PWM_CLC_DIF_CPS_AD	-	0... FFH	0... 99.609375	0.390625	%
Difference between CL_PWM_CLC_MAX_CPS_AD and begin of ramp					
C_PWM_CLC_MAX_CPS_AD	-	0... FFH	0... 99.609375	0.390625	%
Maximum CPPWM_CPS threshold for weighting STO ramp					
C_T_AST_DEAC_CPS_AD	-	0... FFFFH	0... 6553.5	0.1	s
Maximum start time for adaptation					
C_T_CPS_AD_HOM_REQ	-	0... FFFFH	0... 1310.7	0.02	s
Time while hom request is maintained (even if due to operation mode change not all CPS adaptation conditions are met)					
C_T_DLY_CPS_AD_HOM_REQ	-	0... FFFFH	0... 1310.7	0.02	s
Minimum time between two homogeneous engine operation mode requests by CPS adaptation					
C_T_DLY_FAC_LAMB_CPPWM_AD	-	0... FFFFH	0... 6553.5	0.1	s
time delay after change of fuel massflow during detectable lambda deviation (expecting 0 or above)					
C_T_INC_CPS_CLOSE	-	0... FFFFH	0... 6553.5	0.1	s
time increment between cps closing steps					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MAX_CPS_AD	-	0... FFFFH	0... 6553.5	0.1	s
maximum function duration time					
C_T_ST_CPS_AD	-	0... FFFFH	0... 6553.5	0.1	s
minimum time after start engine to allow CPS adaptation					
C_T_WAIT_CPS_AD	-	0... FFFFH	0... 6553.5	0.1	s
time delay after function call until start open CPS					
C_T_WAIT_LAMB_RGN	-	0... FFFFH	0... 6553.5	0.1	s
time after adaptation for "regeneration" of lambda regulation					
C_TQI_AV_MAX_CPS_AD	-	8000... 7FFFH	0... 1023.97	0.03125	Nm
upper threshold of dynamic idle window for CPS adaptation					
C_TQI_AV_MIN_CPS_AD	-	8000... 7FFFH	0... 1023.97	0.03125	Nm
lower threshold of dynamic idle window for CPS adaptation					
IP_CPPWM_OPEN_CPS	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_PRS_CPS_IP_CPPWM_OPEN_CPS	6	8000... 7FFFH	0... 2716.96	0.08291752	hPa
Weighting factor for STO according to CPS characteristic					
LC_CPS_AD_CHK	-	0... 1H	0 ...1	1	-
Run adaptation for check, overriding conditions					

## General information

The purpose of the CPS\_AD function is to find the STO(starttoopenpoint) of the canisterpurgesolenoid (CPS): The PWMvalue (valid for the default frequency C\_FRQ\_MIN\_CPS\_AD) at which the CPS (canisterpurgesolenoidvalve) has reached the end of its mechatronical delay time and starts to open (STO). Therefore the CPS is opened using a ramp, meanwhile monitoring the lambdaadaptation (FAC\_LAMB) to detect a deviation caused by fuel purged through the CPS. Due to the fact that at a low canisterload (CL\_MMV) the adaptation is getting less accurate or even impossible the purgemassflow during adaptation can be increased by rising the frequency (to have more openingperiods per second). The frequency is calculated according to CL\_MMV. For PWM is a relative value (valid only for a special frequency) all PWMvalues have to be corrected after computing the frequency.

The function CPS\_AD (CPSadaptation) is part of the EVACaggregate. To allow a fast purge of the ACF the PWMramp for opening the CPS has to start at the STO.

## APP\_CDN:


This chart is the function s internal statemachine.

When the conditions (i.e. engine speed, canister load) are sufficient (checked by the function START\_CDN\_OK), the state active (substate adaptation) is entered.

For transparency the conditions are split into the flags: LV\_CPS\_AD\_ST\_CDN\_OK, LV\_CPS\_AD\_RUN\_CDN\_OK, LV\_ENG\_OK\_CPS\_AD, LV\_CPS\_OK\_CPS\_AD, LV\_T\_OK\_CPS\_AD, LV\_CL\_OK\_CPS\_AD, LV\_CTR\_OK\_CPS\_AD. For details see APP\_CDNblock.

The function LEARN\_STO ist triggered during state active (by triggering the containing subsystem LEARN\_STO). The output value STATE\_CPS\_AD\_REQ is used to control the function s internal state while STATE\_CPS\_AD is the reporting value from the function. After an interrupt or failed adaptation the flag LV\_ERR\_CPS\_AD is set. After that in state closing the valve is closed and in state waiting there is time to compensate any lambda deviation caused by the function.

The value LC\_CPS\_AD\_CHK allws an override of the CPS\_ADconditions.

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If maybe once a LEARN\_SLOPE function will be added, the state active will have to be divided into the substates LEARN\_STO\_active and LEARN\_SLOPE\_active.

At abortion (to avoid a lambda step by suddenly closing the CPS) the function has to be shutdown by entering state CLOSE. This can be caused by changing conditions like N or by flags like LV\_CPS\_AD\_INH. In this case the function goes into state CLOSING to prevent any further influence on the engine.

A decreasing CL\_MMV value during adaptation is normal but - after a sufficient CL value has been assured before function start - does not require a shutdown; the value LV\_CPS\_AD\_RUN\_CDN\_OK is still 1.


If all conditions for CPS adaptation are met but the engine is not in homogeneous operation mode, this mode is requested via the flag LV\_CPS\_AD\_HOM\_REQ.

This request is hold up for the time C\_T\_CPS\_AD\_HOM\_REQ or if the engine mode changes until the adaptation is finished or was interrupted. After a nonsuccessful request or after the adaptation is finished /was interrupted, for the time C\_T\_DLY\_CPS\_AD\_HOM\_REQ no request for homogeneous operation mode is allowed.

After a nonsuccessful request or after the adaptation is finished/was interrupted, for the time C\_T\_DLY\_CPS\_AD\_HOM\_REQ no requests for homogeneous mode are allowed.

Per driving cycle only C\_CTR\_CPS\_AD\_HOM\_REQ requests are allowed, afterwards CPS adaptation can only take place if the engine is in homogeneous operation mode due to other conditions.

### Application Condition

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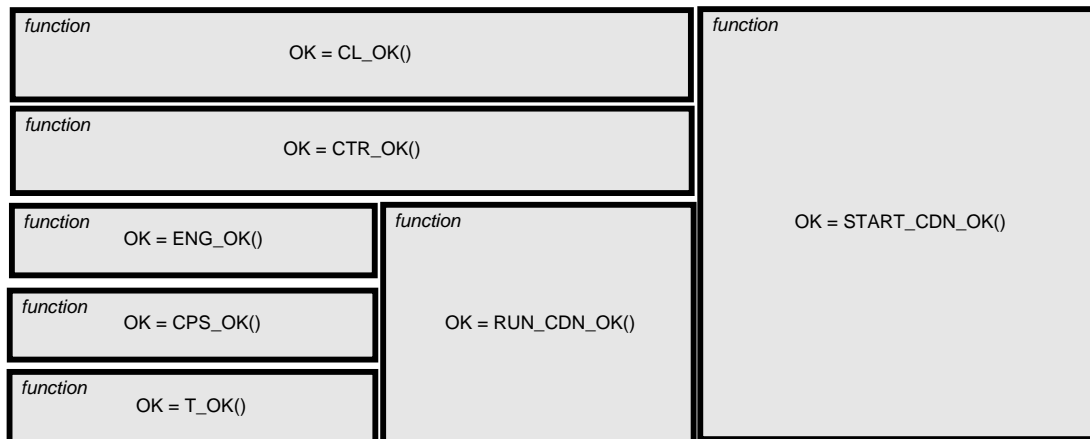
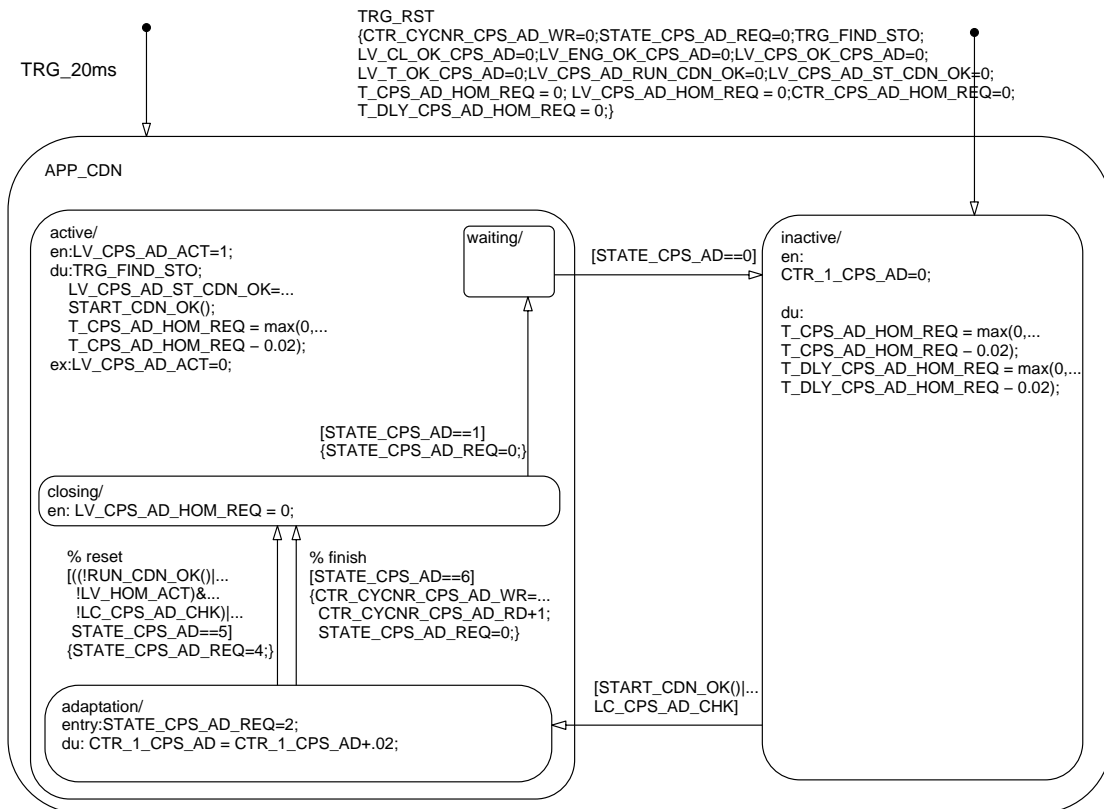


Figure 9.21.1: EVAC\_CPS\_AD/APP\_CDN/APP\_CDN\_CHART

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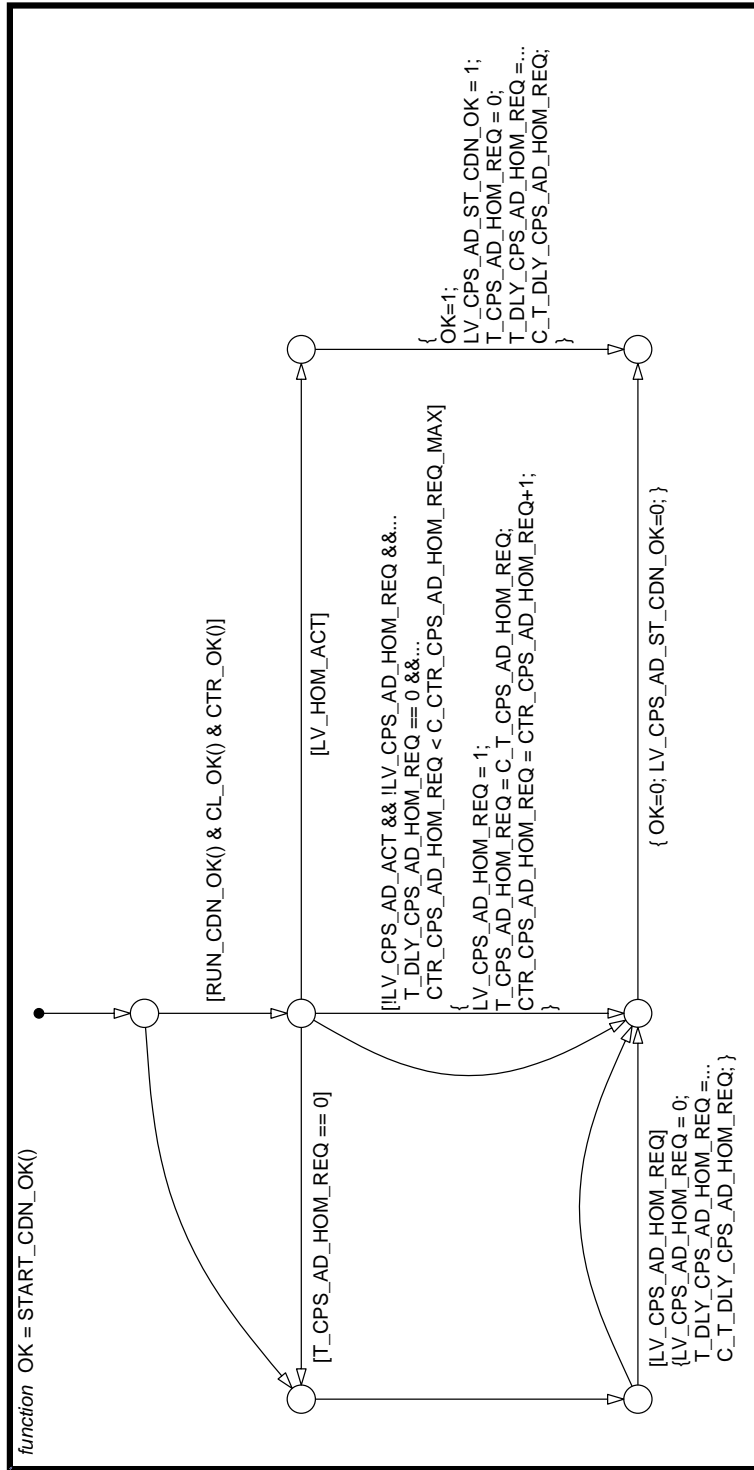



Figure 9.21.2: EVAC\_CPS\_AD/APP\_CDN/APP\_CDN\_CHART/START\_CDN\_OK

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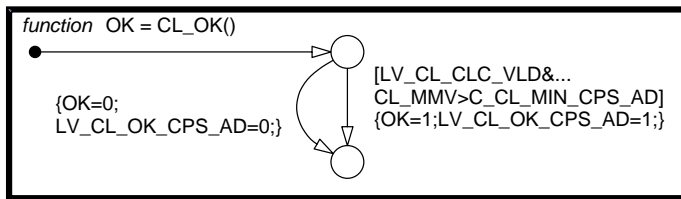


Figure 9.21.3: EVAC\_CPS\_AD/APP\_CDN/APP\_CDN\_CHART/CL\_OK

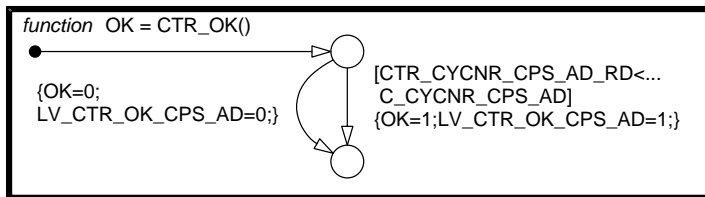


Figure 9.21.4: EVAC\_CPS\_AD/APP\_CDN/APP\_CDN\_CHART/CTR\_OK

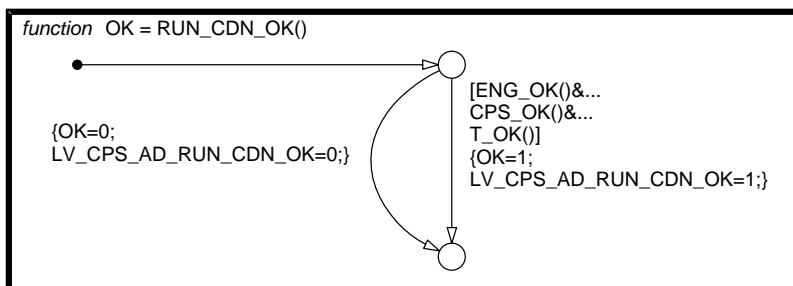


Figure 9.21.5: EVAC\_CPS\_AD/APP\_CDN/APP\_CDN\_CHART/RUN\_CDN\_OK

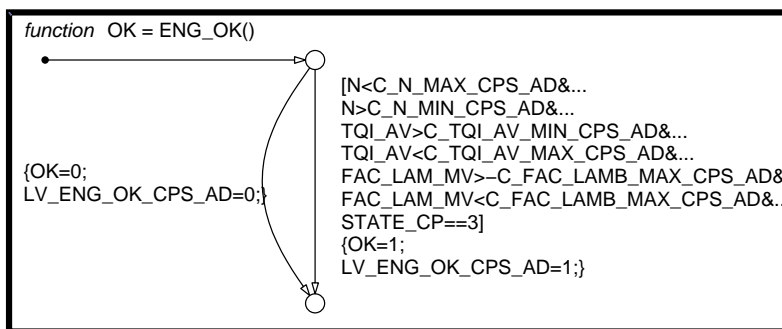


Figure 9.21.6: EVAC\_CPS\_AD/APP\_CDN/APP\_CDN\_CHART/ENG\_OK

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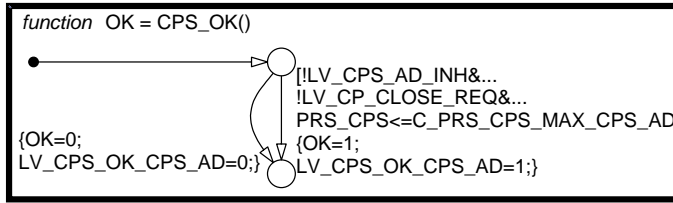


Figure 9.21.7: EVAC\_CPS\_AD/APP\_CDN/APP\_CDN\_CHART/CPS\_OK

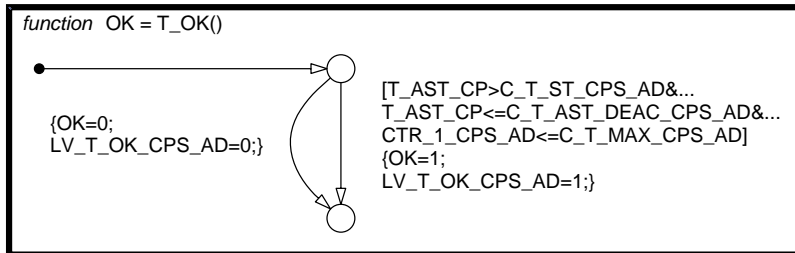



Figure 9.21.8: EVAC\_CPS\_AD/APP\_CDN/APP\_CDN\_CHART/T\_OK

**Function Description**

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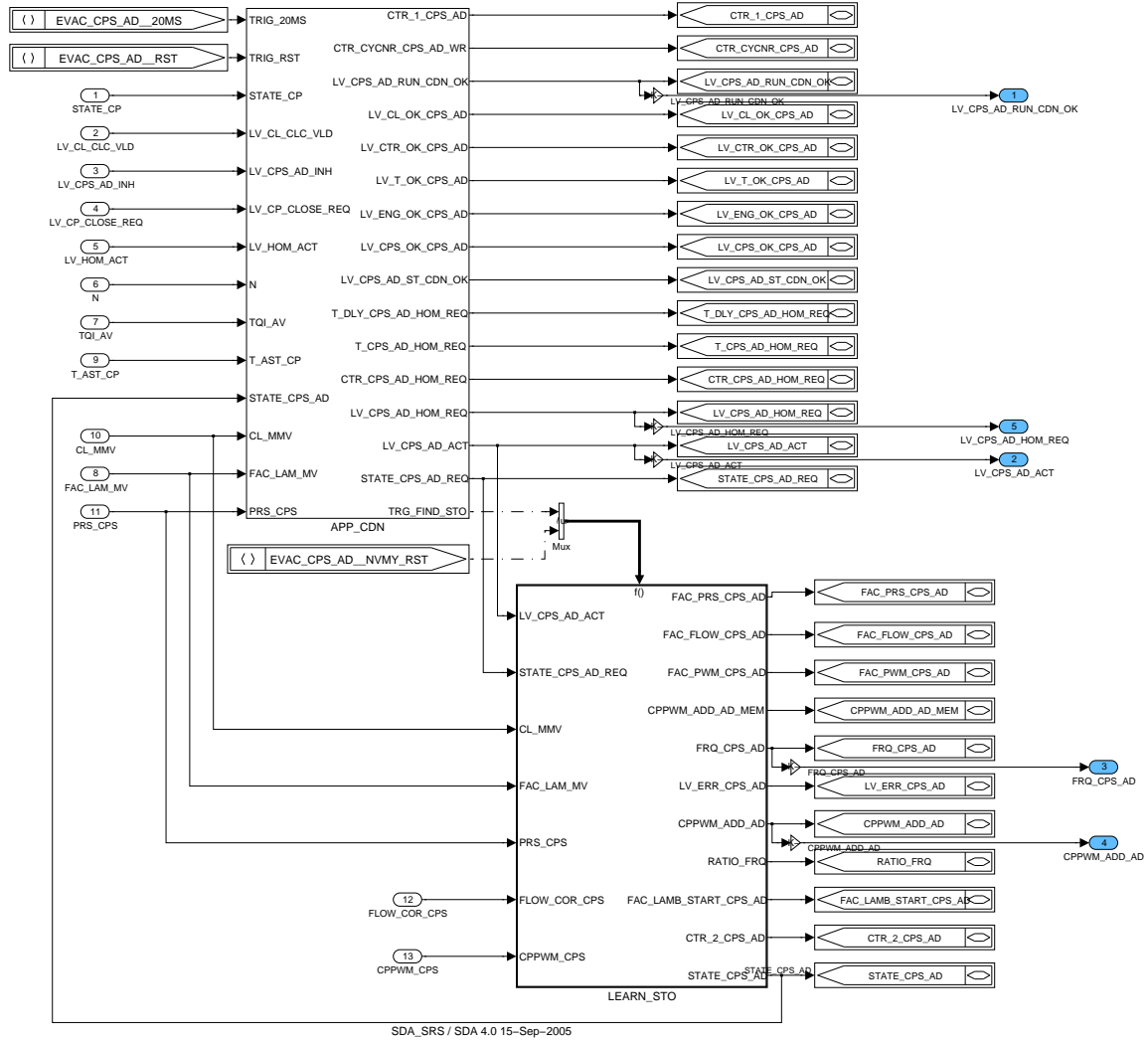


Figure 9.21.9: EVAC\_CPS\_AD

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### 9.21.1 SUBFUNCTION: LEARN\_STO

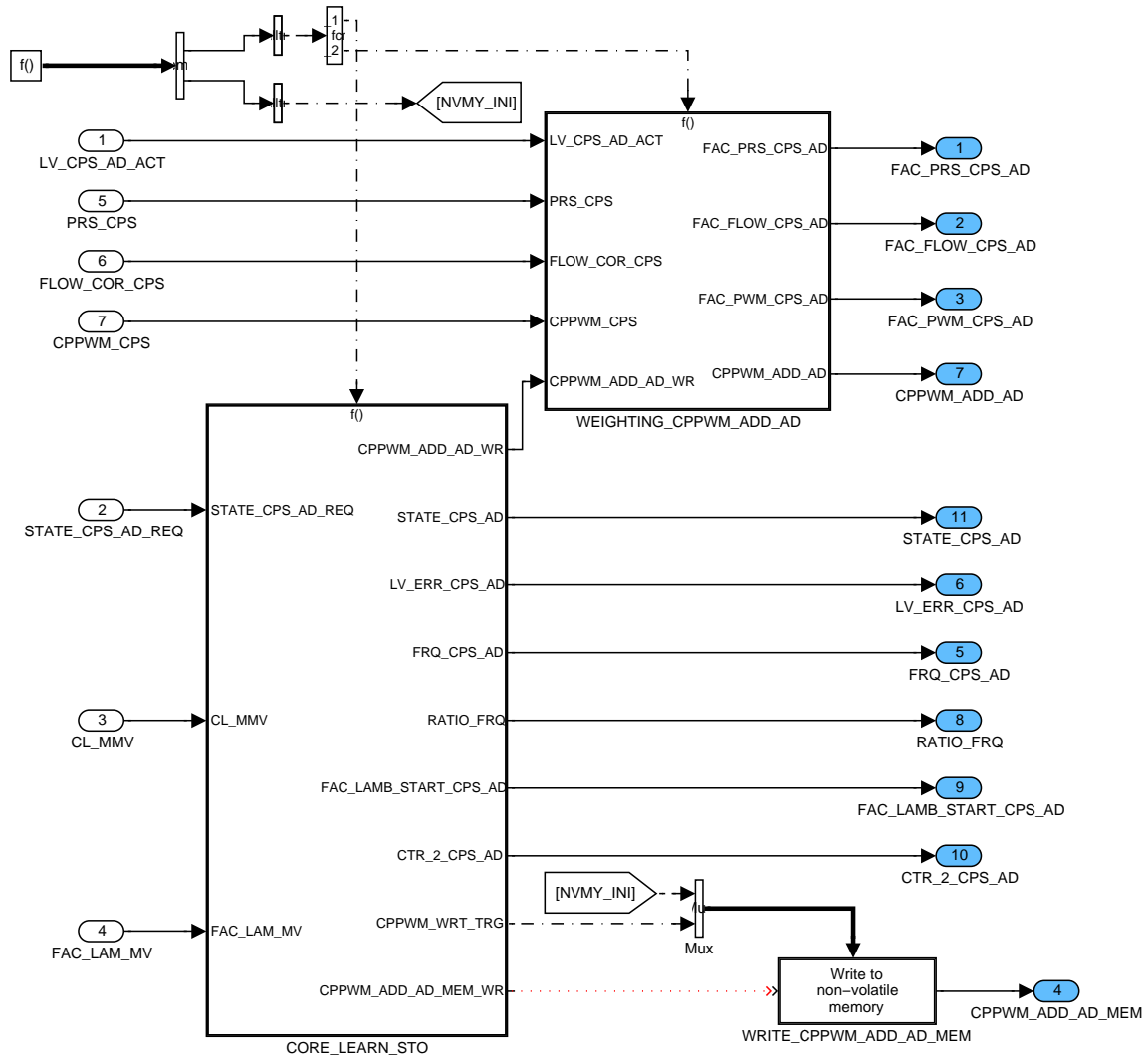


Figure 9.21.10: EVAC\_CPS\_AD/LEARN\_STO

#### EVAC\_CPS\_AD/LEARN\_STO/CORE LEARN\_STO

This chart is the core of the CPS\_ADfunction. The states are:

**Entry:**

When entering the chart outputs are set to default values.

In case of a CPPWM\_ADD\_AD\_MEM > maximum threshold (danger of engine disturbance) the memory value is set to minimum threshold.

**CHECK\_CONDITIONS:**

This first substate is to prevent a new initialisation (state INIT) of the chart at the last trigger before it s state machine (APP\_CDN) is leaving the state active. If PWMadaptation is demanded by APP\_CDN, the state CHECK\_CONDITION will be left because of STATE\_CPS\_AD\_REQ==2.

**INIT\_WAIT:**

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STATE\_CPS\_AD is set to 1 reporting that the function is in a waitstate (to allow manipulations during implementation using T\_WAIT or provide some additional time for lambda recreation after any disturbance in the past).

CPPWM\_ADD\_AD\_MEM\_WR (output variable for CPPWM\_ADD\_AD\_MEM in the nonvolatile memory) is set to the last known value of CPPWM\_ADD\_AD\_MEM.

#### calculations:

FAC\_LAMB\_START is the memory for the current FAC\_LAMBvalue to calculate a lambda deviation caused by the function eliminating a constant lambda offset.

To minimize the measuring error during STO adaptation the adaptation has to be done at highest possible frequency to measure the highest possible fuel massflow. This is the frequency where the lambda deviation caused by the opening increment (CPPWM\_INC\_AD) is just small enough not to disturb the engine. CPPWM\_INC\_AD just as several other values are here adapted to the new frequency, using RATIO\_FRQ which is calculated using the canister load CL\_MMV.

Before entering INCREASE\_PWM STATE\_CPS is set to 7 reporting that PWM adaptation is in process.

The two junctions are to avoid a calculated FRQ which is above C\_FRQ\_MAX\_MEC\_CPS.

#### IMPORTANT:

The code  $\{FRQ=abs(\dots$  is paid to a stateflow-bug for  $abs()$  in stateflow is really  $abs(\text{fix}()$  and there ain't no  $\text{fix}()$  in stateflow. The correct mathematical expression here is  $\{FRQ=\text{fix}(\dots$  to cut out the comma.

#### INCREASE\_PWM:

Here the STO is detected. Frequent entering of the junction beside allows the monitoring of the lambda deviation while opening the CPS. The time delay C\_T\_DLY\_FAC\_LAMB is to let the lambda sensor detect the HC purged into the manifold.

If the function is interrupted (STATE\_CPS\_AD\_REQ==4), the state is left to go directly to CLOSE.

#### CLOSE:

The state CLOSE can be reached from INCREASE\_PWM via regular ( success ) or error transition. Here the measured value is checked against calibration thresholds. Each transition reports via STATE\_CPS. The success transition calculates the memorized STO (for FRQ\_MIN\_CPS\_AD) and mixes it with the old one using C\_CPPWM\_AD\_RATIO.

The CPS is closed using a ramp until STO is reached (assuming a massflow=0 at STO), then the CPS is completely closed.

#### WAIT\_CLOSE:

This state is to provide a time delay (time increment) for the closing ramp.

#### WAIT\_LAMB\_RGN:


The state gives the engine some time to recover (C\_T\_WAIT\_LAMB\_RGN) from the lambda deviation caused by the adaptation, i.e. to preserve a calm idle state for the next adaptation cycle.

#### WRITE\_CPPWM\_ADD\_AD\_MEM:

This block defines the write to nonvolatile memory of CPPWM\_ADD\_AD\_MEM.

Due to change requirements the INTERNAL value CPPWM\_ADD\_AD has been deleted in this chart; there rests only the output CPPWM\_ADD\_AD\_WR which is now replacing CPPWM\_ADD\_AD in the internal calculations.

At NVMY\_INI, i.e. when the ECU is flashed with a new software, the adaptation value CPPWM\_ADD\_AD\_MEM is initialized with the value C\_CPPWM\_ADD\_AD\_MEM\_NVMY\_INI and this value is written to the nonvolatile memory. By this it can be assured that a reasonable start to open point is used for the purging cycles before the first CPS adaptation could be done.

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For correct processing, the check of CPPWM\_ADD\_AD\_MEM has been transferred from state CHECK\_CONDITIONS to chart entry.

At NVMY\_INI, i.e. when the ECU is flashed with a new software, the adaptation value CPPWM\_ADD\_AD\_MEM is initialized with the value C\_CPPWM\_ADD\_AD\_MEM\_NVMY\_INI and this value is written to the nonvolatile memory. By this it can be assured that a reasonable starttoopen point is used for the purging cycles before the first CPS adaptation could be done.

10

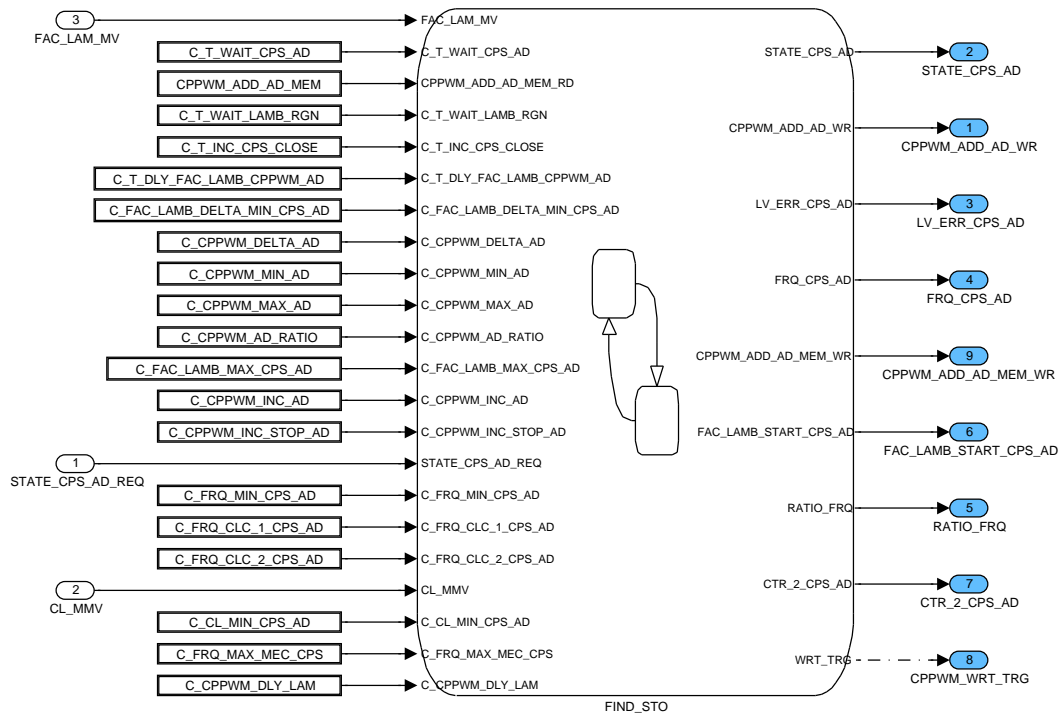


Figure 9.21.11: EVAC\_CPS\_AD/LEARN\_STO/CORE\_LEARN\_STO

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This submodule does a weighting of the STO CPPWM\_ADD\_AD\_WR to calculate the output CPPWM\_ADD\_AD. The PRS\_CPS-weighting is to pay respect to a nonlinear behaviour of the CPS (to be defined by manufacturer, used for calibration of IP\_CPPWM\_OPEN\_CPS). The FLOW- and PWM-weighting is to 'softly' eliminate the factor when reaching an operating state where STO is of almost no influence.

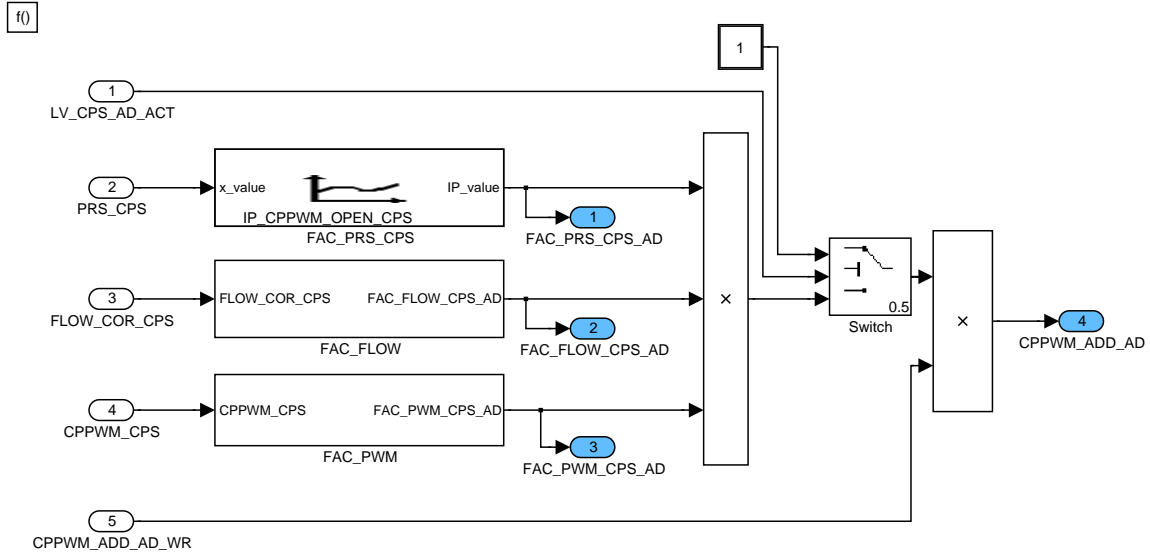


Figure 9.21.13: EVAC\_CPS\_AD/LEARN\_STO/WEIGHTING\_CPPWM\_ADD\_AD

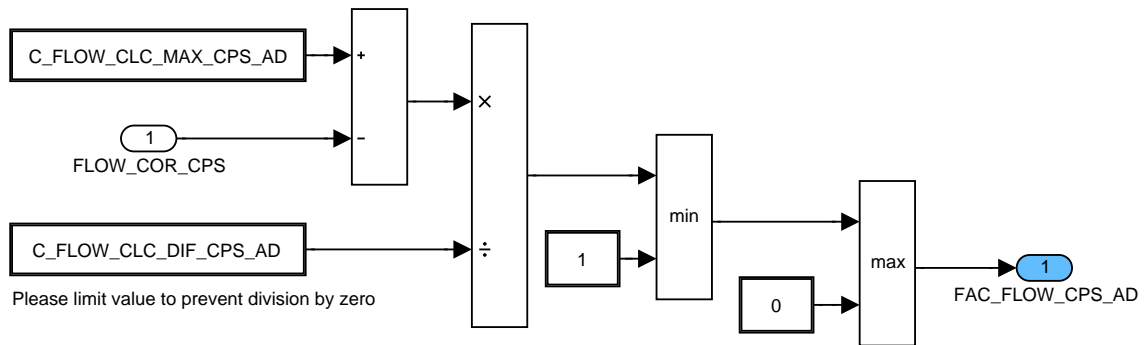


Figure 9.21.14: EVAC\_CPS\_AD/LEARN\_STO/WEIGHTING\_CPPWM\_ADD\_AD/FAC\_FLOW

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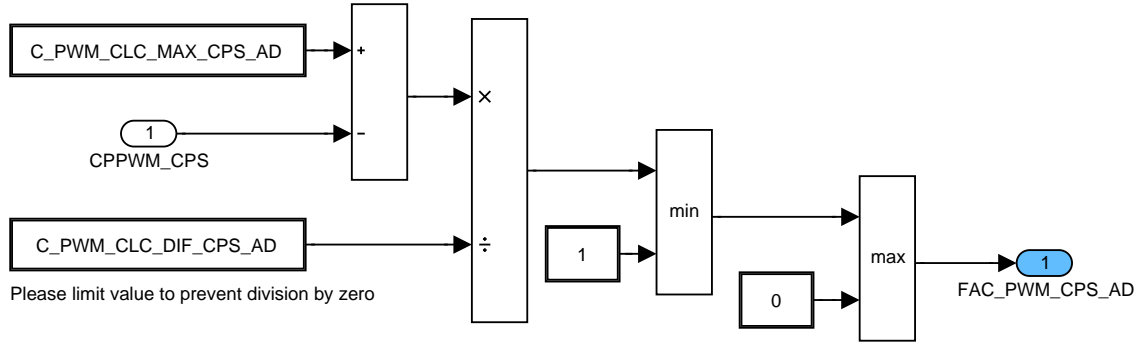


Figure 9.21.15: EVAC\_CPS\_AD/LEARN\_STO/WEIGHTING\_CPPWM\_ADD\_AD/FAC\_PWM

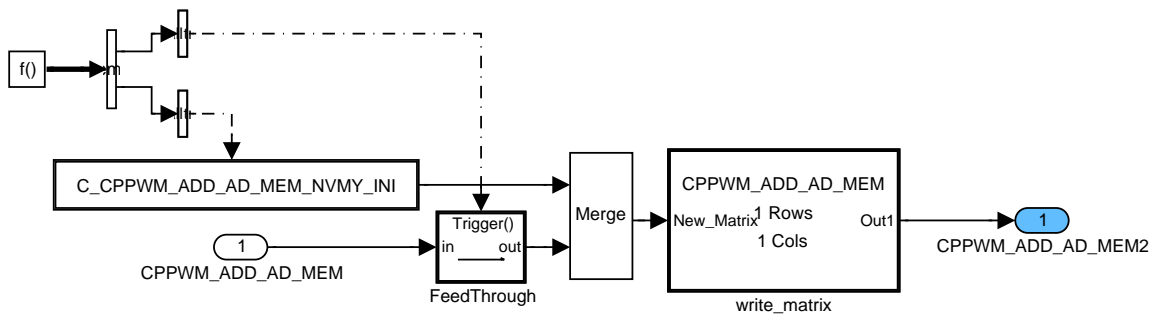


Figure 9.21.16: EVAC\_CPS\_AD/LEARN\_STO/WRITE\_CPPWM\_ADD\_AD\_MEM

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## 9.22 Main relay control

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_IGK_OFF_ACK	O/V	0... 1H	0 ...1	1	-
Acknowledge IGK off state (0H = Pin level shall be switched to High, 1H = Pin level shall be switched to Low)					
LV_RLY_MAIN	O/V	0... 1H	0 ...1	1	-
Main relay control command state (0H = relay shall be switched off, 1H = relay shall be switched on)					
LV_RLY_MAIN_SYS	V	0... 1H	0 ...1	1	-
System depending main relay control command state (0H = off, 1H = on)					
T_ACK_IGK_OFF	V	0... 1FEH	0... 5.1	0.01	s
Timer for setting pin level to Low in case of acknowledge IGK off					
T_IGK_OFF_ACK_DIAG_PLS	V	0... FFH	0... 2.55	0.01	s
Timer for diagnosis pulse, in which acknowledge IGK off pin level is set to Low					

### Input data:

C_T_MIN_PWL {p. 3776}	ECU_STATE {p. 1091}	LV_ACT_RLY_MAIN_EXT_ADJ {p. 7432}	LV_CUR_VCV_CTL_PRE_RUN {p. 3954}
LV_DC {p. 5746}	LV_ES {p. 1720}	LV_IGK {p. 906}	LV_RLY_MAIN_EXT_ADJ {p. 7434}
LV_RLY_ST_STST {p. 804}	LV_VAR_STST {p. 805}	PWL_LOCK_CDN {p. 3776}	STATE_ACK_IGK_OFF {p. 1570}
T_PWL {p. 3776}			


### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_ACK_IGK_OFF	-	0... 1FEH	0... 5.1	0.01	s
Timer calibration for control of LV_IGK_OFF_ACK-pin in case of IGK shutdown request					
C_T_IGK_OFF_ACK_DIAG_PLS	-	0... FFH	0... 2.55	0.01	s
Timer constant for diagnosis pulse, in which acknowledge IGK off pin level is set to Low					
LC_IGK_OFF_ACK	-	0... 1H	0 ...1	1	-
LC for switching on/off functionality acknowledge IGK off (1= active)					
LC_IGK_OFF_DIAG_PLS	-	0... 1H	0 ...1	1	-
LC for activate diagnosis pulse (1= activated)					
LC_IGK_OFF_DIAG_PLS_SWI	-	0... 1H	0 ...1	1	-
LC for switch on diagnosis pulse in first start in DC or every start (1= diagnosis pulse activated every start)					
LC_RLY_MAIN_MAN_ADJ	-	0... 1H	0 ...1	1	-
LC for switching main relay (1 = active)					
LC_RLY_MAIN_MAN_REQ	-	0... 1H	0 ...1	1	-
LC for activation of manual switching of main relay (1 = active)					

### Import actions:

**ACTION\_INFR\_SetIGK\_OFF** (IN<lv\_igk\_off\_ack>)

### 9.22.1 Main relay control

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**FUNCTION DESCRIPTION:**

**General information:**

Purpose of this module is to get an entry point to switch on or off the main relay and get a status of the control command through LV\_RLY\_MAIN.

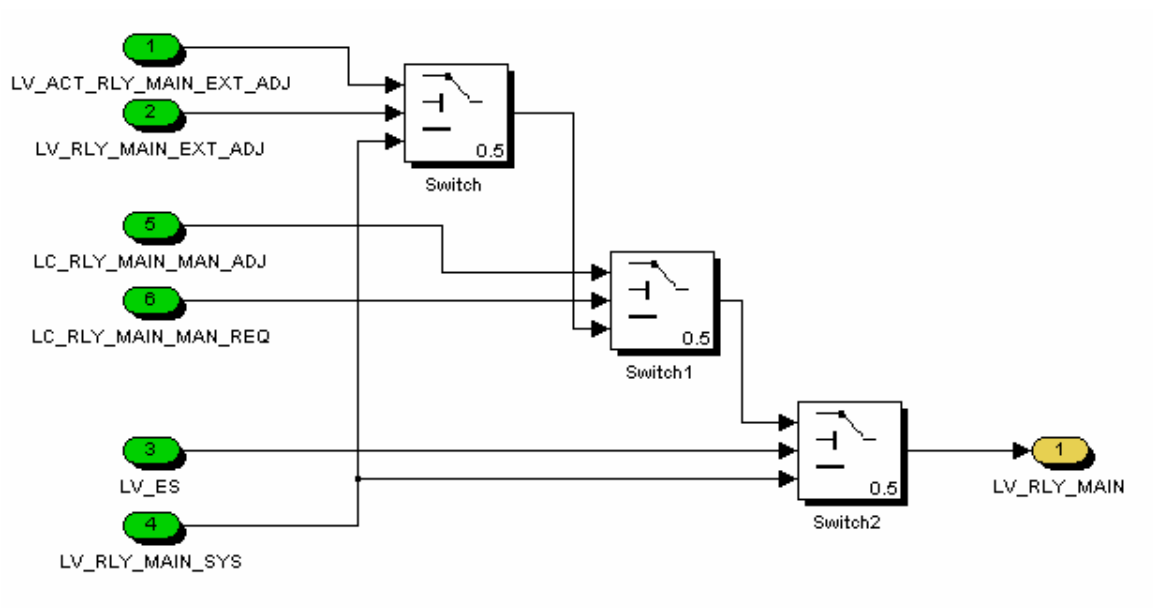
Upon ignition key transition from OFF to ON, the ECU voltage regulator is set to ON and the core microprocessor is reset. Then, so as to power up the system (system = ECU + actuators + sensors), the main relay has to be switched ON (most of actuators are supplied by the main relay).

Upon ignition key transition from ON to OFF, the ECU enters in the post-operating phase. At its end, the system shutdown is obtained by disabling the power supply on sensors and actuators. For that it is necessary to switch off the main relay. Then, the ECU can be switched off too.

To summarize, the main relay is switched on as soon as the ignition key is turned in the ON position and it remains ON until the ECU voltage regulator is switched off.

The system depending switching state is stored in the flag LV\_RLY\_MAIN\_SYS. This request can be overruled by the request of the calibration system or tester (serial communication). To prevent destruction of components (actuators which are supplied via main relay), switching is only allowed when engine stopped (LV\_ES = 1). While engine is running, always the system depending switching state is used.

**Signal flow diagram:**




**Application conditions**

- Initialisation:** all 0
- Recurrence:** 10 ms
- Activation:** at reset

**Formula section:**

**IF** (ECU\_STATE = WAKE\_UP and LV\_CUR\_VCV\_CTL\_PRE\_RUN = 0) **or**

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```

(   LV_IGK = 0           and
    T_PWL > C_T_MIN_PWL and
    PWL_LOCK_CDN = 0 (mask out: NC_PWL_LOCK_CDN_NVMY,
    NC_PWL_LOCK_CDN_RLY_MAIN,
    NC_PWL_LOCK_CDN_BN2000,
    NC_PWL_LOCK_CDN_CUS)
)

THEN   LV_RLY_MAIN_SYS = 0
ELSE   LV_RLY_MAIN_SYS = 1

IF(1)   LV_ES = 0
THEN(1) LV_RLY_MAIN = LV_RLY_MAIN_SYS
ELSE(1) IF(2)   LC_RLY_MAIN_MAN_REQ = 1
          THEN(2) LV_RLY_MAIN = LC_RLY_MAIN_MAN_ADJ
          ELSE(2) IF(3)   LV_RLY_MAIN_EXT_ADJ = 1
                    THEN(3) LV_RLY_MAIN = LV_ACT_RLY_MAIN_EXT_ADJ
                    ELSE(3) LV_RLY_MAIN = LV_RLY_MAIN_SYS
          ENDIF(3)
        ENDIF(2)
ENDIF(1)

```

```

If   LV_RLY_MAIN = 1
Then
    Switch ON main relay           {set the status of the control command to ON }
Else
    Switch OFF main relay          {set the status of the control command to OFF}
End

```

## 9.22.2 Acknowledge IGK off

### FUNCTION DESCRIPTION:

#### General information:

Purpose of this module is to send the acknowledge info via HW line for switching off KL15. The same pin is used in case of active engine start stop automatic (STST) in order to control the starter relay.

#### Application conditions

**Initialisation:**            *at reset all 0*  
**Recurrence:**                *10 ms*  
**Activation:**                 *at every engine state*  
**Deactivation:**              -


#### Formula section:

Definition of timer for pin control in case of diagnosis test pulse

```

If   LC_IGK_OFF_DIAG_PLS = 1   and   //switch for diagnosis pulse activated


```

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```

    [LV_DC = 0 -> 1          or          //diagnosis pulse only at first DC
start
    (LC_IGK_OFF_DIAG_PLS_SWI = 1      and          //switch for diagnosis pulse
mode
    LV_ST_END = 0 -> 1)]          // diagnosis pulse at every start
then    T_IGK_OFF_ACK_DIAG_PLS = C_T_IGK_OFF_ACK_DIAG_PLS
endif
if      LV_ST_END = 1
then    T_IGK_OFF_ACK_DIAG_PLS = T_IGK_OFF_ACK_DIAG_PLS -10ms
else    T_IGK_OFF_ACK_DIAG_PLS = 0
endif
Defintion of timer for pin control in case of acknowledge IGK off
if      STATE_ACK_IGK_OFF(n-1) = 0    and
          STATE_ACK_IGK_OFF(n) = 1
then    T_ACK_IGK_OFF = C_T_ACK_IGK_OFF
endif
if      STATE_ACK_IGK_OFF = 1
then    T_ACK_IGK_OFF = T_ACK_IGK_OFF - 10ms
else    T_ACK_IGK_OFF = 0
endif
if      [(T_ACK_IGK_OFF > 0          or
          T_IGK_OFF_ACK_DIAG_PLS > 0) and
          LC_IGK_OFF_ACK = 1]          or
          (LV_VAR_STST = 1            and
          LV_RLY_ST_STST = 1)
then    LV_IGK_OFF_ACK = 1
else    LV_IGK_OFF_ACK = 0
endif
Control of HW-pin
ACTION_INFR_SetIGK_OFF(IN < LV_IGK_OFF_ACK >)

```

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## 9.23 Power latch management

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_PWL_TRAN_ES_EL	O/V	0... 1H	0 ...1	1	-
flag active in shutdown-phase: IGK on is not accepted without reset					
LV_PWL_ACT	O/V	0... 1H	0 ...1	1	-
power latch phase active (Do not use as Output)					
PWL_LOCK_CDN	O/V	0... FFFFH	0... 65535	1	-
Power latch extension by project-specific configuration:see configuration-values in bitmask NC_PWL_LOCK_CDN_XXX					
T_PWL	O/V	0... FFFFH	0... 6553.5	0.1	s
incrementing timer during PWL phase active					

### Input data:

LV_DIAG_END_RLY_ MAIN_DLY {p. 4933}	NC_PWL_LOCK_CDN_ XXX	STATE_LRN_ECU {p. 657}	
---	-------------------------	------------------------	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MAX_PWL	-	0... FFFFH	0... 6553.5	0.1	s
maximum power-latch time for ECU switch off (if reached => not saved data will be lost)					
C_T_MIN_PWL	-	0... FFFFH	0... 6553.5	0.1	s
minimum power-latch time for ECU switch off					

### Action definition

<b>ACTION_FCTM_ClrPwlLockCdn</b> (IN<Param1>)	Mode: O
Clear related flag at pwl_lock_cdn	
<b>ACTION_FCTM_SetPwlLockCdn</b> (IN<Param1>)	Mode: O
Set related flag at pwl_lock_cdn	

### FUNCTION DESCRIPTION:

#### Initialisations:

T\_PWL = 0 at RST or EXIT\_PWL  
 LV\_PWL\_ACT = 0  
 LV\_PWL\_ACT = 1 at TO\_PWL

Recurrence: 100 ms  
 Activation: LV\_PWL\_ACT = 1

#### General information:

The relevant informations for setting PWL\_LOCK\_CDN are transferred with the help of the action call.



The ECU keeps active for a minimum time after entering the powerlatch-phase.

The minimum ECU power latch time (C\_T\_MIN\_PWL) can only be extended by other functions locking a PWL-resource using the bitword PWL\_LOCK\_CDN (see project specific list of PWL configuration data (definition of NC\_PWL\_LOCK\_CDN\_XXX) ). If the maximum powerlatch time C\_T\_PWL\_MAX is reached the ECU will be shut down and all not saved data will be lost.

Bit-position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
PWL_LOCK_CDN																

Each other function is responsible itself to lock /unlock its own PWL-resource at entering /leaving the powerlatch-phase !

**Formula section:**

$$T\_PWL = T\_PWL + 100ms$$

```

If          (T_PWL > C_T_MIN_PWL          and
              PWL_LOCK_CDN = 0)
Or          (T_PWL > C_T_MAX_PWL          and
              atPWL_LOCK_CDN no NVMY Bit is set)
Or          LV_INH_PWL_TRAN_ES_EL = 1 (already in shut down)
Then       activate shut-down mechanism
Else       do nothing
Endif
    
```

**Actions for shut-down mechanism:**

reactivation by switching IGK on is forbidden

- LV\_INH\_PWL\_TRAN\_ES\_EL = 1
- disable Monitoring-unit (MU)
- wait until MU-disable is confirmed **or** Communication with MU failed **or** LV\_DIAG\_END\_RLY\_MAIN\_DLY = 0
- all function specific initializations with end of power latch phase are done.
- The power-supply-pin of the ECU is switched off.
- Call 5V reset detection.

**Requirements for ACTION\_FCTM\_SetPwlLockCdn(<param>):**

param: NC\_PWL\_LOCK\_CDN\_xxx (see Appl. INCI)

Set related flag at pwl\_lock\_cdn

pwl\_lock\_cdn |= 1 shifted left by <param>

**Requirements for ACTION\_FCTM\_ClrPwlLockCdn (IN <Param1> )**

param: NC\_PWL\_LOCK\_CDN\_xxx (see Appl. INCI)

Clear related flag at pwl\_lock\_cdn

pwl\_lock\_cdn & = not (1 shifted left by <param>)

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## 9.24 Power latch management (Appl. Inc.)

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PWL_LOCK_CDN_BN2000	-	0... FFH	0... 255	1	-
PWL for BN2000					
NC_PWL_LOCK_CDN_CUS	-	0... FFH	0... 255	1	-
PWL for CUS functions required					
NC_PWL_LOCK_CDN_DMTL	-	0... FFH	0... 255	1	-
PWL for DMTL diagnosis					
NC_PWL_LOCK_CDN_EGR_AD	-	0... FFH	0... 255	1	-
PWL for EGR adaptation					
NC_PWL_LOCK_CDN_HPDI	-	0... FFH	0... 255	1	-
PWL for HPDI					
NC_PWL_LOCK_CDN_NVMY	-	0... FFH	0... 255	1	-
PWL for NVMY storage					
NC_PWL_LOCK_CDN_RLY_MAIN	-	0... FFH	0... 255	1	-
PWL for main relay diagnosis					
NC_PWL_LOCK_CDN_ROM_CHK	-	0... FFH	0... 255	1	-
PWL for ROM check					

### General information:

The bitmask `PWL_LOCK_CDN` shows all functions by a defined bit-position, which has locked a PWL resource for PWL extension.

Bit-position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
PWL_LOCK_CDN																

It's also possible, that more than one function has locked the PWL.

Here all functions must unlock its request before the ECU is switched off.

Bitmask-name	Bitposition	PWL-lock-configuration-Description
NC_PWL_LOCK_CDN_XXX	0...15	
Values for project		
NC_PWL_LOCK_CDN_NVMY	0	PWL for NVMY storage
NC_PWL_LOCK_CDN_RLY_MAIN	1	PWL for main relay diagnosis
NC_PWL_LOCK_CDN_EGR_AD	2	PWL for EGR adaptation
NC_PWL_LOCK_CDN_BN2000	3	PWL for BN2000
NC_PWL_LOCK_CDN_DMTL	4	PWL for DMTL diagnosis
NC_PWL_LOCK_CDN_ROM_CHK	5	PWL for ROM check
NC_PWL_LOCK_CDN_CUS	6	PWL for CUS functions required
NC_PWL_LOCK_CDN_HPDI	7	PWL for HPDI (shaker function)
project-specific configuration of PWL resources, which can be locked		

## 9.25 Engine speed limitation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_N_MAX	O/V	0... 1H	0 ...1	1	-
Logical variable engine speed limitation active					
LV_N_MAX_REQ_FCUT	O/V	0... 1H	0 ...1	1	-
Logical variable fuel cut off of all cylinder requested for engine speed limitation					
N_DIF_MAX_LIM	V	E020... 1FE0H	0... 8160	1	rpm
Engine speed difference as an input for PI controller					
N_GRD_FIL	V	80... 7FH	0... 4064	32	rpm/s
Engine speed gradient pre selection for low pass filter					
N_GRD_FIL_FIL	V	80... 7FH	0... 4064	32	rpm/s
Low pass filtered engine speed gradient for predicted engine speed					
N_PRED_MAX_LIM	V	0... 1FE0H	0... 8160	1	rpm
Predicted engine speed					
TQ_N_MAX_DIF	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Torque output of N_MAX PI Controller					
TQ_N_MAX_DIF_I	V	80000000... 7FFFFFFFH	0... 1024	47.6837e6	Nm
Torque output of N_MAX I Controller					
TQ_N_MAX_DIF_P	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Torque output of VS_MAX P Controller					
TQ_N_MAX_INP_I	V	8000... 7FFFH	0... 3.99987793	12.20699e3	Nm
Torque input for N_MAX I controller					
TQI_N_MAX	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Indicated engine torque setpoint for N_MAX limitation					
TQI_N_MAX_1	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Intermediate value 1 for indicated engine torque after considering PI controller output					
TQI_N_MAX_2	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Intermediate value 2 indicated engine torque after considering PI controller output					
TQI_N_MAX_REF	V	0... 7FFFH	0... 1023.97	0.03125	Nm
Reference indicated engine torque on which controller output is applied					

### Input data:

GEAR {p. 1302}	LV_AT {p. 654}	LV_INH_GP_SUP {p. 1566}	LV_VAR_BN {p. 655}
LV_VAR_TCT {p. 656}	N {p. 1525}	N_32 {p. 1525}	N_GRD {p. 1525}
N_MAX_THD {p. 1148}	STATE_ETCU_PROG_ INFO {p. 1574}	TQI_AV {p. 981}	TQI_REQ_TRA {p. 8192}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ADD_N_MAX_FCUT	-	0... 1FE0H	0... 8160	1	rpm
Additive threshold to maximum engine speed for activation fuel cut off all cylinders					
C_CRLC_N_GRD_FIL_1	-	0... FFFFH	0... 0.99998474	152.588e3	-
N_GRD_FIL low pass filter constant if LV_N_MAX = 0					
C_CRLC_N_GRD_FIL_2	-	0... FFFFH	0... 0.99998474	152.588e3	-
N_GRD_FIL low pass filter constant if LV_N_MAX = 1					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_GRD_HYS	-	80... 7FH	0... 4064	32	rpm/s
Hysteresis for N_GRD Filtering					
C_TQI_MAX_PAS	-	0... 7FFFH	0... 1023.97	0.03125	Nm
Passive value for TQI_N_MAX if engine speed limitation is passive					
C_TQI_N_MAX_INC	-	0... 7FFFH	0... 1023.97	0.03125	Nm
Maximum increment for the output when limiting increasing rate					
ID_FAC_N_MAX_I_AT_GEAR	-	0... FFFFH	0... 7.99987793	12.20699e3	Nm/rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
I control parameter for N_MAX controller automatic transmission and AMT					
ID_FAC_N_MAX_I_MT_GEAR	-	0... FFFFH	0... 7.99987793	12.20699e3	Nm/rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
I control parameter for N_MAX controller manual transmission					
ID_FAC_N_MAX_P_AT_GEAR	-	0... FFH	0... 7.96875	0.03125	Nm/rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
P control parameter for N_MAX controller automatic transmission and AMT					
ID_FAC_N_MAX_P_MT_GEAR	-	0... FFH	0... 7.96875	0.03125	Nm/rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
P control parameter for N_MAX controller manual transmission					
ID_FAC_TQI_N_MAX_REF	-	0... FFH	0... 0.99609375	0.00390625	-
LDPM_GEAR	9	0... FFH	0... 255	1	-
Factor on TQI_N_MAX_REF value to init. I controller					
ID_T_N_MAX_PRED_AT_GEAR	-	0... FFH	0... 7.96875	0.03125	s
LDPM_GEAR	9	0... FFH	0... 255	1	-
Prediction time for predicted engine speed for automatic transmission and AMT					
ID_T_N_MAX_PRED_AT_MAN	-	0... FFH	0... 7.96875	0.03125	s
LDPM_GEAR	9	0... FFH	0... 255	1	-
Prediction time for predicted engine speed for AT in manual mode M					
ID_T_N_MAX_PRED_MT_GEAR	-	0... FFH	0... 7.96875	0.03125	s
LDPM_GEAR	9	0... FFH	0... 255	1	-
Prediction time for predicted engine speed for manual transmission					
IP_N_GRD_THD_N_32	-	0... FFH	0... 4064	32	rpm/s
LDP_N_32_N_GRD_THD	6	0... FFH	0... 8160	32	rpm
Engine speed gradient threshold for filtering of basic engine speed gradient					
LC_VAR_ETCU_SPT_SWI	-	0... 1H	0...1	1	-
LC indicating version of AT or TCT transmission (0 = ETCU without sport switch, 1 = ETCU with sport switch)					

## Function description

### General information:

The objective of this function is to protect the engine against overspeed and therefore to control the engine speed. A PI controller is used to hold the engine speed at the engine speed limit setpoint, which derives from the module 'Engine speed limit coordination' from chapter 4. Engine overspeed mainly is controlled by reduction of engine torque. The output value of this module is TQI\_N\_MAX, which is an input in the torque coordination module. Different tasks are designed in this module:

prediction of engine speed to avoid great engine speed overshoots, especially in the first phase of controlling

activation of speed limit controller due to speed deviation between predicted engine speed and engine speed limit

PI controller

activation of fuel cut off for exceeding the engine speed limit for more than a calibratable difference

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rate limiter for the output in increasing direction to avoid uncomfortable jumps in the torque demand

**Application Condition**

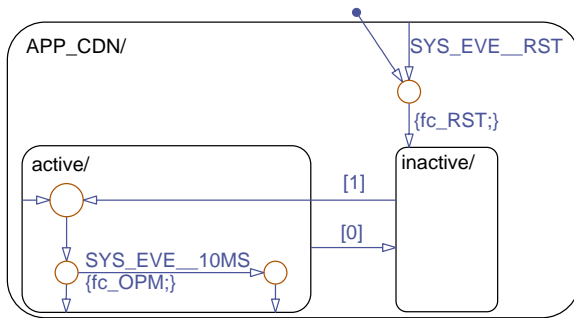

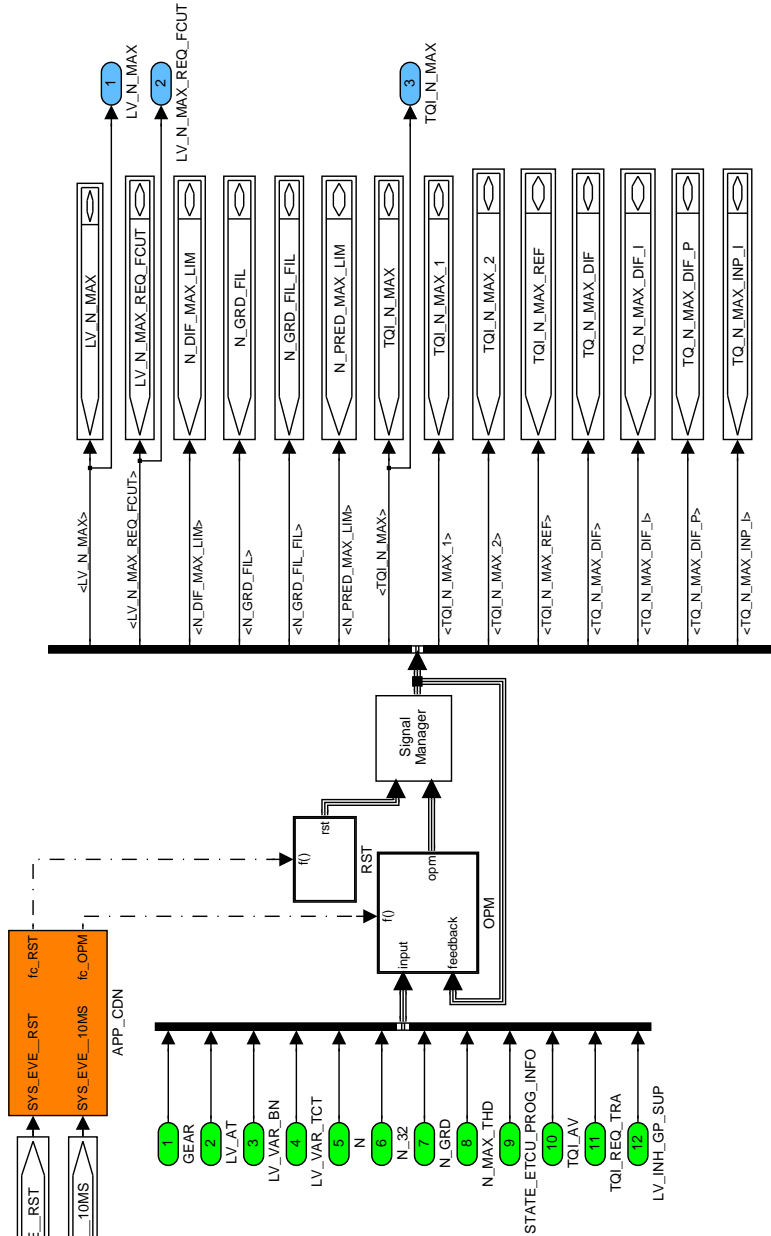


Figure 9.25.1: ENSL\_M901E/APP\_CDN/APPCND

**Function Description**

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Figure 9.25.2: ENSL\_M901E

### 9.25.1 Initialisation at system event reset

All output variables are initialised here.

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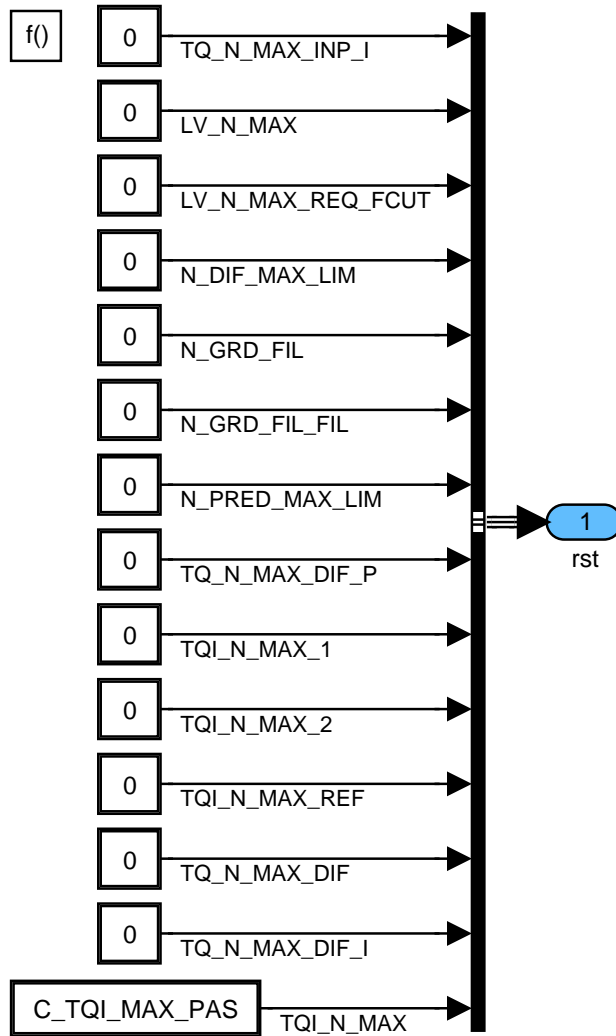


Figure 9.25.3: ENSL\_M901E/RST

### 9.25.2 Formula section

#### Calculation of predicted engine speed

The engine speed prediction shall activate the engine speed limitation controller before the real engine speed reaches the threshold  $N\_MAX\_THD$ . Therefore the complete controller has a PID behaviour at activation, to prevent high engine speed overshoot.


The prediction is deactivated, if the controller has stopped the engine speed increase. During the following period the PI controller can guarantee the engine speed limitation up to  $N\_MAX\_THD$  without predicting the engine speed.

Due to a bad resolution of  $N\_GRD$ , the prediction is only calculated, if a clear high engine speed gradient is detected. This is possible by comparing the gradient  $N\_GRD$  with an engine speed depending threshold  $IP\_N\_GRD\_THD\_N\_32$ .

The prediction is stopped latest, if the real engine speed is no longer increasing ( $N\_GRD \leq 0$ ).

To prevent sudden changes for the engine speed limit controller input at activation or deactivation, it is necessary to have a PT1 filter for the engine speed controller input. So a negative feed back of the controller output to the real engine speed is prevented.

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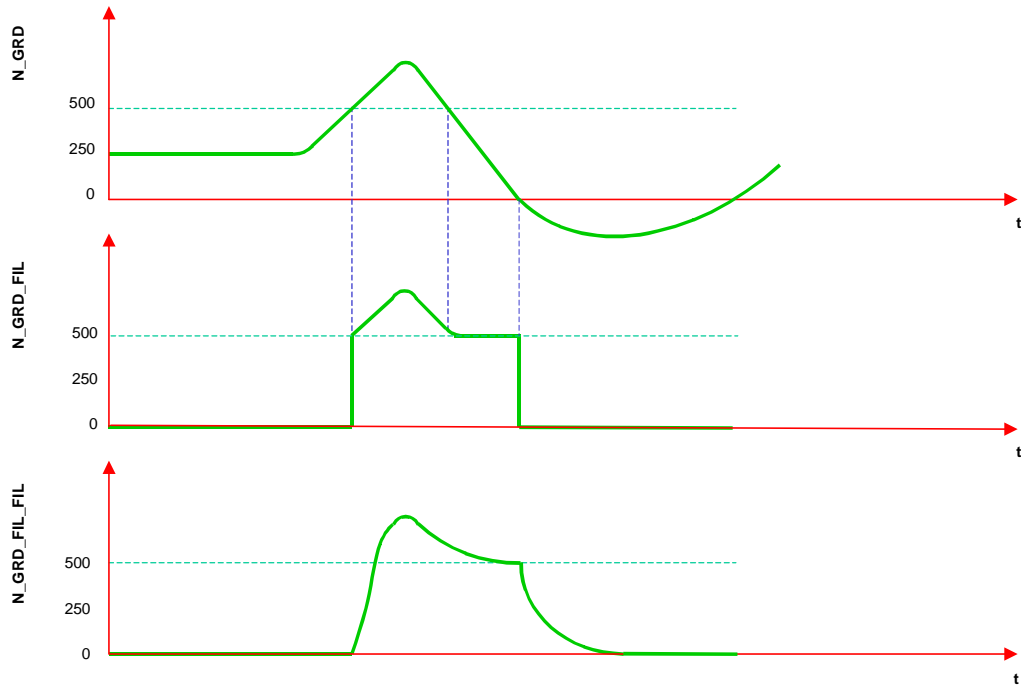


Figure 9.25.4: : Filtering of engine speed gradient



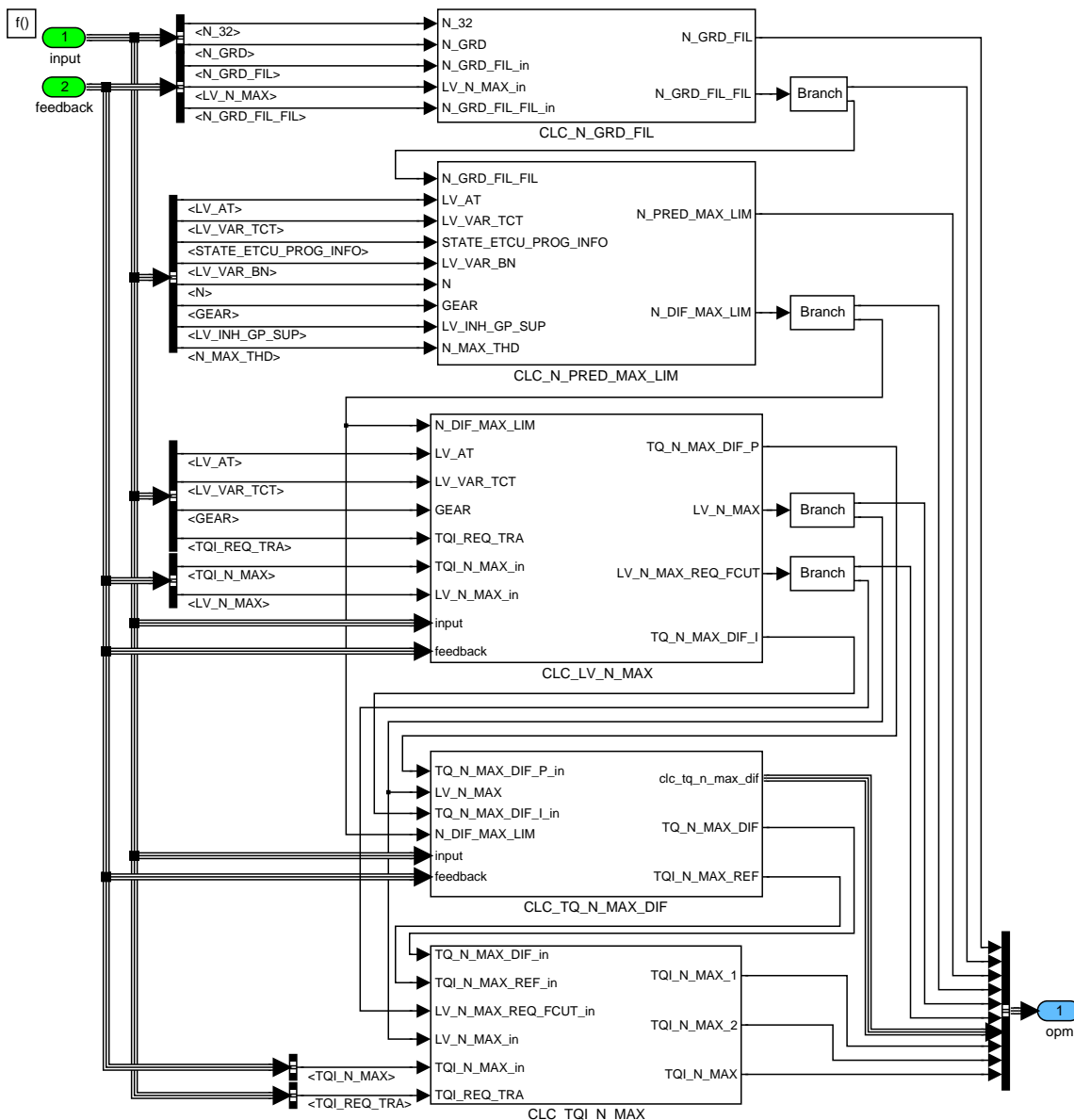


Figure 9.25.5: ENSL\_M901E/OPM

**Calculation of engine speed gradient pre selection and low pass filtered engine speed gradient for predicted engine speed**

N\_GRD\_FIL and N\_GRD\_FIL\_FIL are calculated.

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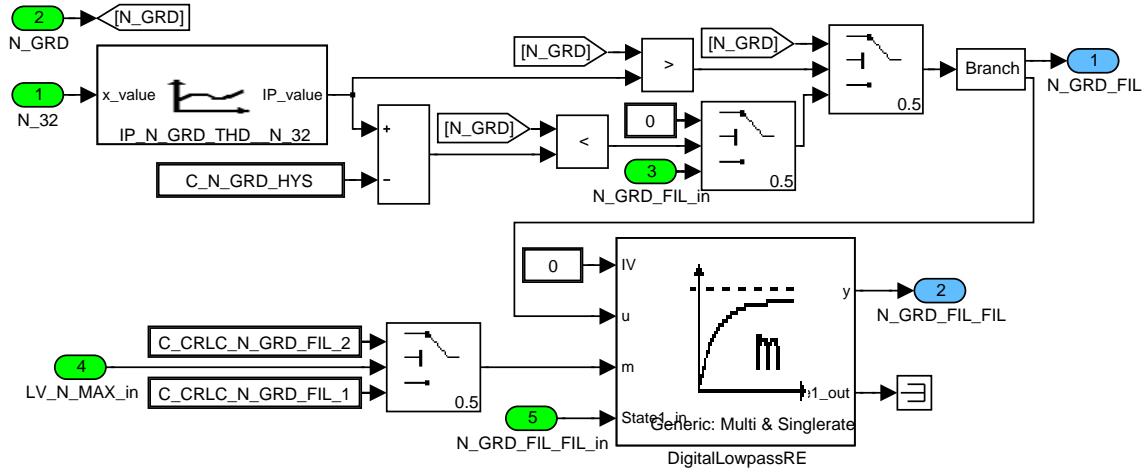


Figure 9.25.6: ENSL\_M901E/OPM/CLC\_N\_GRD\_FIL

**Calculation of predicted engine speed and engine speed deviation from threshold**

N\_PRED\_MAX\_LIM and N\_DIF\_MAX\_LIM are calculated

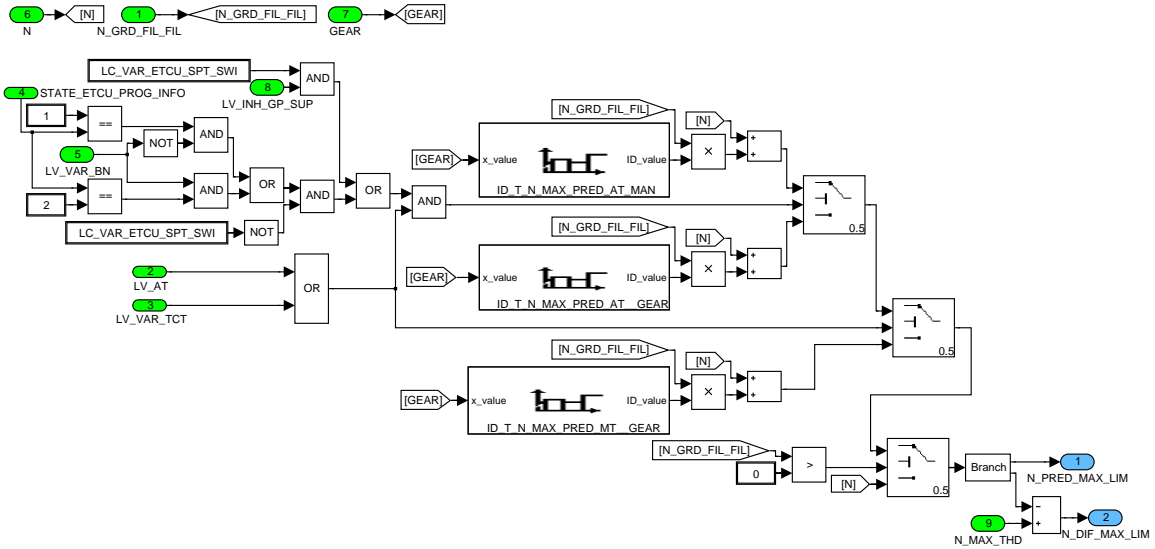


Figure 9.25.7: ENSL\_M901E/OPM/CLC\_N\_PRED\_MAX\_LIM

**Calculation of TQ\_N\_MAX\_DIF\_P, LV\_N\_MAX and LV\_N\_MAX\_REQ\_FCUT**

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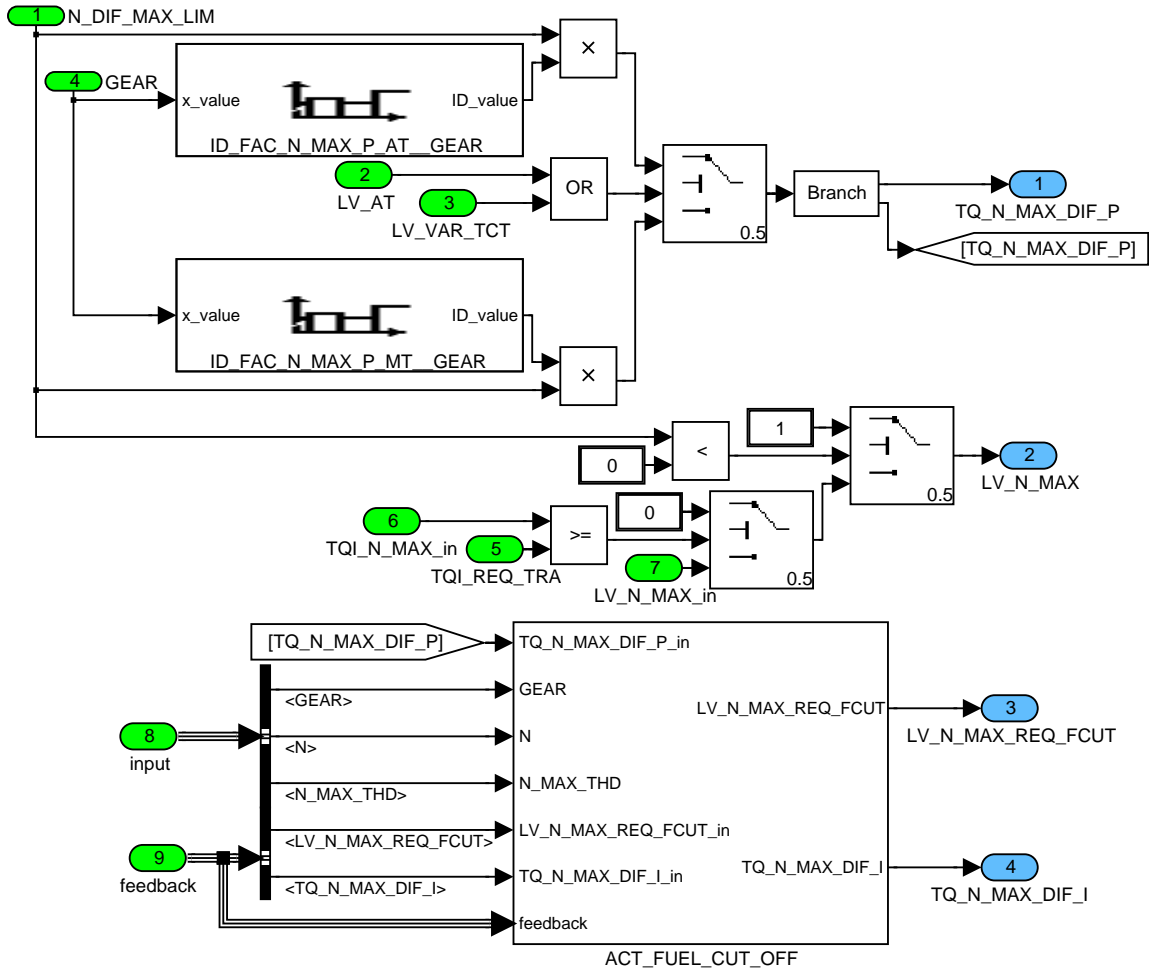


Figure 9.25.8: ENSL\_M901E/OPM/CLC\_LV\_N\_MAX

**Calculation of logical variable for fuel cut off.**

LV\_N\_MAX\_REQ\_FCUT is calculated.

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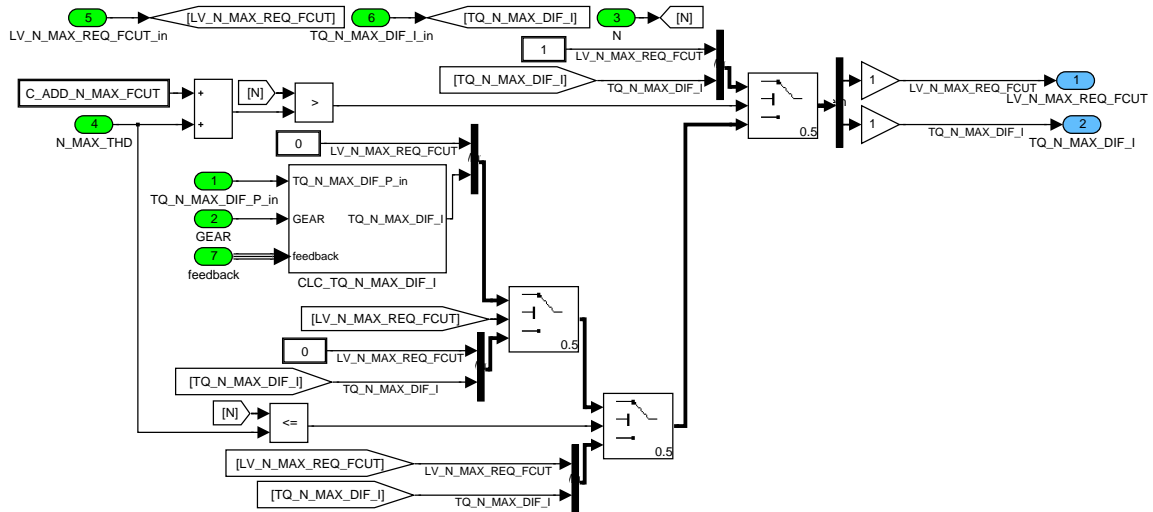


Figure 9.25.9: ENSL\_M901E/OPM/CLC\_LV\_N\_MAX/ACT\_FUEL\_CUT\_OFF

**Initialisation of N MAX integrator.**

**Calculation of TQ\_N\_MAX\_DIF\_I**

The integrator has to be initialized for the transition of LV\_N\_MAX from 0 to 1 and for the transition of LV\_N\_MAX\_REQ\_FCUT from 1 to 0. In the first case the integrator output is set to zero and in the second case the integrator output has to ensure that the TQI\_N\_MAX does not show a step (during LV\_N\_MAX\_REQ\_FCUT active the TQI\_N\_MAX is set to zero).

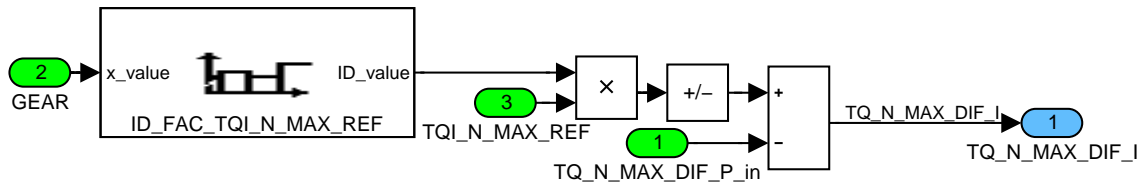


Figure 9.25.10: ENSL\_M901E/OPM/CLC\_LV\_N\_MAX/ACT\_FUEL\_CUT\_OFF/CLC\_TQ\_N\_MAX\_DIF\_I/CLC\_TQ\_N\_MAX\_DIF\_I

**Determination n\_max limitation TQ\_N\_MAX\_DIF using N\_MAX\_PI controller**

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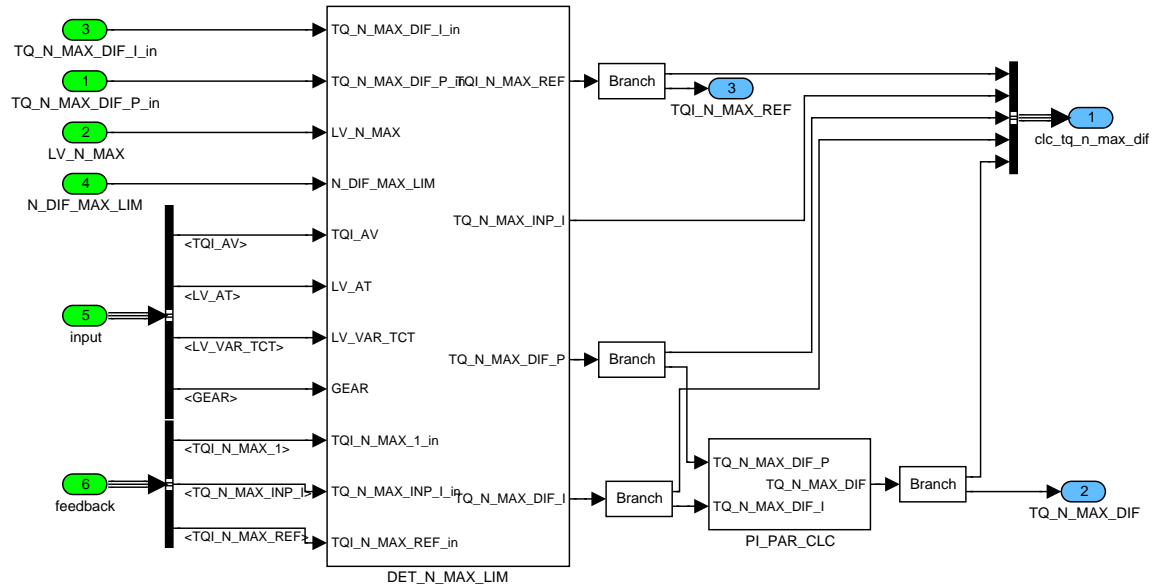


Figure 9.25.11: ENSL\_M901E/OPM/CLC\_TQ\_N\_MAX\_DIF

**Determination of TQ\_N\_MAX\_REF, TQ\_N\_MAX\_DIF\_P, TQ\_N\_MAX\_DIF\_I and TQ\_N\_MAX\_INP\_I**

The integrator input has to be set to zero, when the TQ\_N\_MAX\_1 is smaller than zero and the calculated input TQ\_N\_MAX\_INP\_1 is smaller than or equal to zero. This avoids a steadily decrease of the integrator output which could cause problems when re entering the controller.

TQ\_N\_MAX\_REF, TQ\_N\_MAX\_DIF\_P, TQ\_N\_MAX\_DIF\_I and TQ\_N\_MAX\_INP\_I are calculated here.

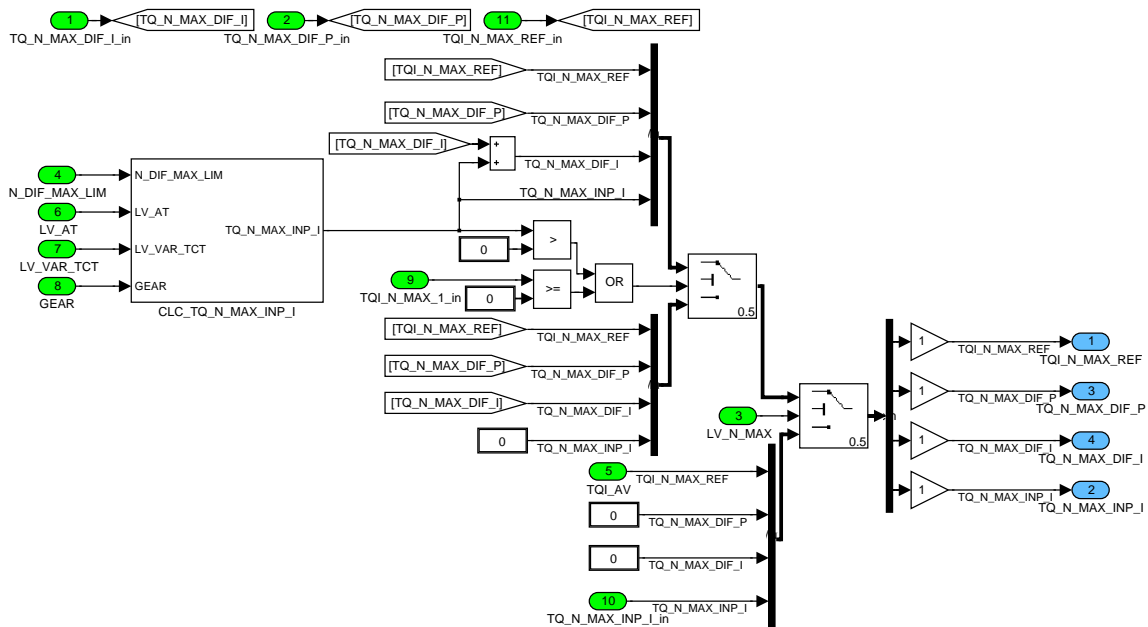


Figure 9.25.12: ENSL\_M901E/OPM/CLC\_TQ\_N\_MAX\_DIF/DET\_N\_MAX\_LIM

**Calculation of TQ\_N\_MAX\_INP\_I**

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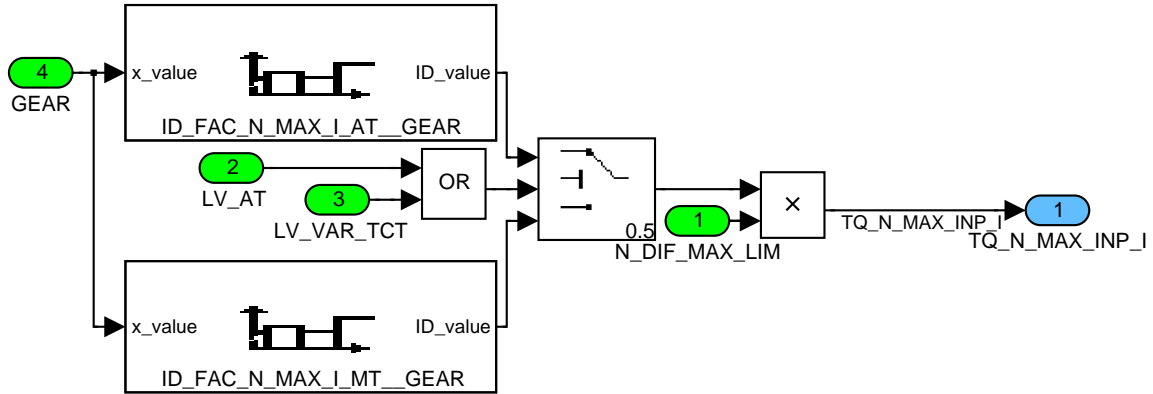


Figure 9.25.13:  
ENSL\_M901E/OPM/CLC\_TQ\_N\_MAX\_DIF/DET\_N\_MAX\_LIM/CLC\_TQ\_N\_MAX\_INP\_I

**Calculation of TQ\_N\_MAX\_DIF**

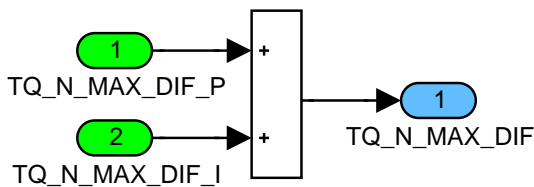


Figure 9.25.14: ENSL\_M901E/OPM/CLC\_TQ\_N\_MAX\_DIF/PI\_PAR\_CLC

**Determination of indicated engine torque setpoint for N\_MAX limitation**

TQ\_N\_MAX\_1, TQ\_N\_MAX\_2 and TQI\_N\_MAX are calculated here.

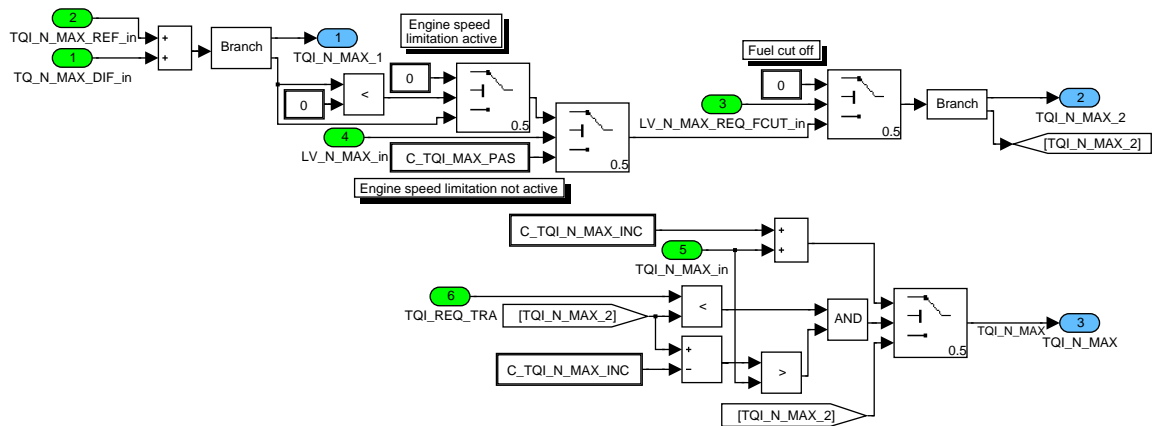


Figure 9.25.15: ENSL\_M901E/OPM/CLC\_TQI\_N\_MAX

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## 9.26 CAN protocol

The Software contains a CAN calibration protocol in accordance with the Spec

CAN-Calibration Protocol  
Draft Version 2.1, 03-june-98

*Remark:* Online Data acquisition with CCP is also possible with connected ETK, but calibration with these ECUs is only possible via ETK.

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## 9.27 Fuel pressure setpoint of low pressure pump

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FUP_EFP_SP	O/V	0... FFFFH	0... 173888	2.6533608	hPa
Fuel pressure setpoint of electrical fuel pump					
FUP_EFP_SP_TMP	V	0... FFFFH	0... 173888	2.6533608	hPa
Temporary value of fuel pressure setpoint of electrical fuel pump before limitation					

### Input data:

LV_FUP_EFP_SP_EXT_REQ {p. 988}	LV_FUP_LIH_L_PRS_CTL_REQ {p. 4001}	LV_PU {p. 1720}	LV_PUC {p. 1720}
MFF_SP_FUP_CTL {p. 2151}	N_32 {p. 1525}	STATE_EFP {p. 3797}	T_AST {p. 1766}
TCO_ST {p. 1100}	TFU {p. 1232}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUP_EFP_SP_EXT_REQ	-	0... FFFFH	0... 173888	2.6533608	hPa
External FUP_EFP_SP					
C_FUP_EFP_SP_HPP_LIH	-	0... FFFFH	0... 173888	2.6533608	hPa
Fuel pressure setpoint for high pressure pump limp home					
C_FUP_EFP_SP_LIM_DEC	-	0... FFFFH	0... 173888	2.6533608	hPa
Decrement for fuel pressure setpoint limitation					
C_FUP_EFP_SP_LIM_INC	-	0... FFFFH	0... 173888	2.6533608	hPa
Increment for fuel pressure setpoint limitation					
C_FUP_EFP_SP_MAN	-	0... FFFFH	0... 173888	2.6533608	hPa
Manual FUP_EFP_SP					
C_FUP_EFP_SP_PUC	-	0... FFFFH	0... 173888	2.6533608	hPa
Low fuel pressure setpoint in PU/PUC					
C_FUP_EFP_SP_PWL	-	0... FFFFH	0... 173888	2.6533608	hPa
Low fuel pressure setpoint during power latch phase of EFP					
IP_FUP_EFP_SP	V	0... FFFFH	0... 173888	2.6533608	hPa
LDP_MFF_SP_FUP_CTL_IP_EFP_SP	4	0... FFFFH	0... 1389	0.0211948	mg
LDP_N_32_IP_FUP_EFP_SP	4	0... FFH	0... 8160	32	rpm
Fuel pressure setpoint of low pressure pump for normal operation					
IP_FUP_EFP_SP_HST	-	0... FFFFH	0... 173888	2.6533608	hPa
LDP_MFF_SP_FUP_CTL_IP_EFP_MIN	8	0... FFFFH	0... 1389	0.0211948	mg
Map with the FUP_EFP setpoint for the hot start					
IP_FUP_EFP_SP_MIN	-	0... FFFFH	0... 173888	2.6533608	hPa
LDP_TFU_IP_FUP_EFP_SP	8	0... FEH	-48... 142.5	0.75	°C
Minimum fuel pressure setpoint of low pressure pump					
IP_T_FUP_EFP_SP_HST	-	1... FFFFH	0.01... 655.35	0.01	s
LDP_TCO_ST_IP_T_FUP_EFP_SP_HST	3	0... FEH	-48... 142.5	0.75	°C
Map with the time for the FUP_EFP setpoint for the hot start					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_FUP_EFP_SP_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual FUP_EFP_SP					

### General information:

The module fuel pressure setpoint of electrical fuel pump delivers a fuel setpoint to the module fuel pressure control.

The fuel pressure setpoint of the low pressure pump is normally taken out of a map depending on engine speed and injected fuel mass. Exemptions are power latch phase of the electrical fuel pump and the pull mode. Additionally a testbench function is included. In order to avoid to big fuel pressure setpoint gradients a certain gradient limitation is included.

### Application conditions:

<i>Initialisation:</i>	RST
<i>Recurrence:</i>	100MS
<i>Activation:</i>	always
<i>Deactivation:</i>	never

### Function description:

### Formula section:

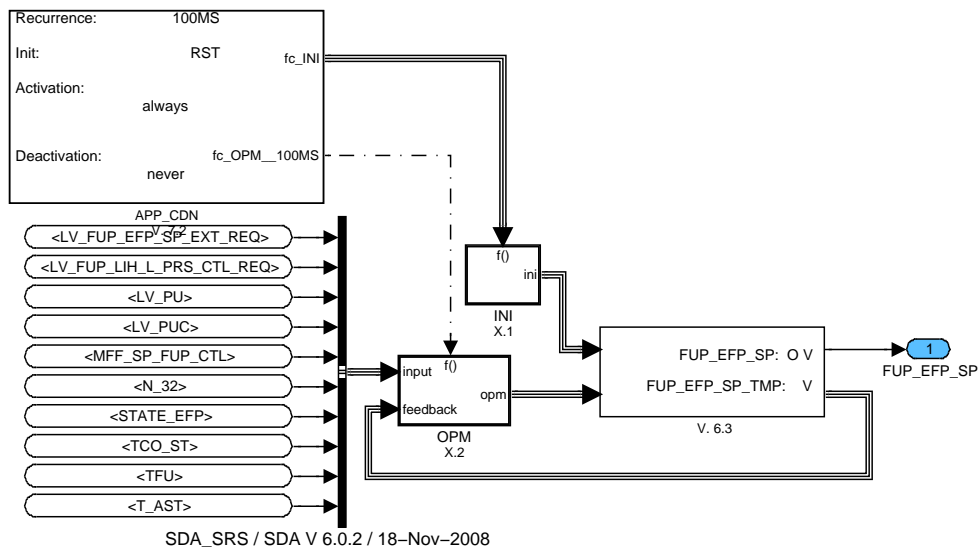


Figure 9.27.1: :

### 9.27.1 Initialization

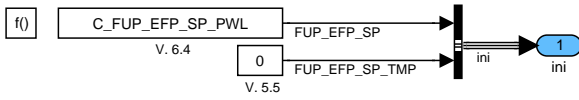


Figure 9.27.2: :

### 9.27.2 Formula Section:

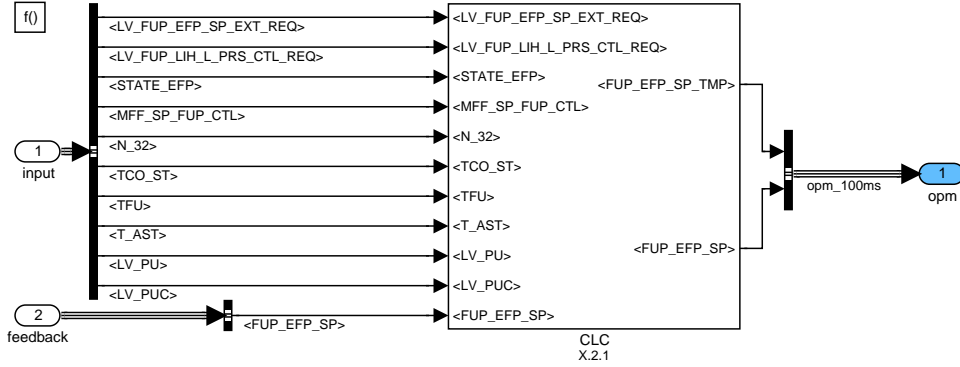


Figure 9.27.3: :

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### 9.27.2.1 Fuel pressure setpoint calculation

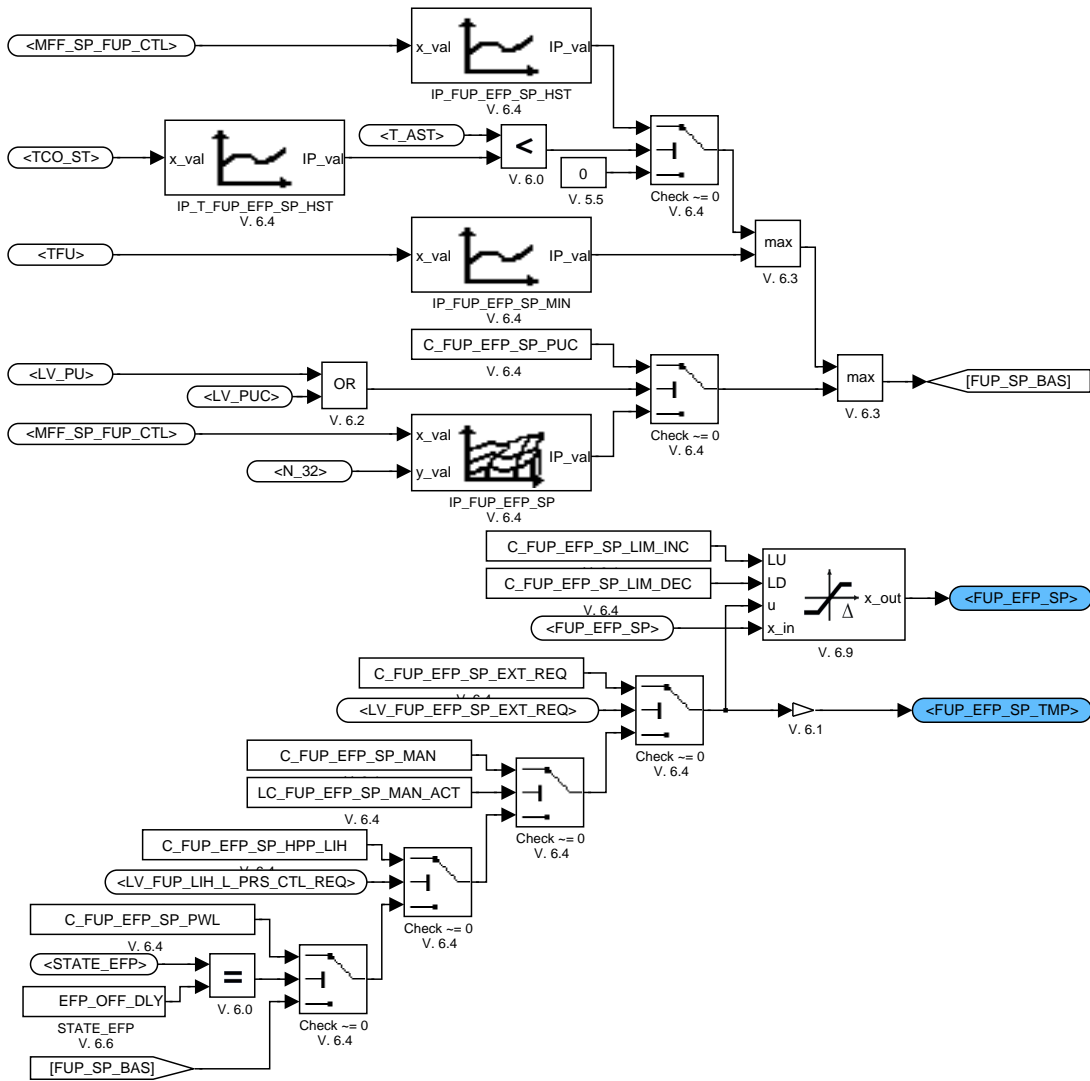


Figure 9.27.4: :

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## 9.28 Fuel pump low pressure control

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_SEG_EFPPWM_I_AD	V	0... FFFFH	0... 65535	1	-
Segment counter before I-part adaptation is allowed					
CTR_SEG_EFPPWM_MIN_AD	V	0... FFFFH	0... 65535	1	-
Segment counter before minimum PWM adaptation is allowed					
EFPPWM	O/V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Pump speed of the electrical fuel pump as PWM signal					
EFPPWM_BAS	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Precontroller value of EFPPWM					
EFPPWM_I	O/V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
I-Part of the controller					
EFPPWM_I_AD	O/V/S	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Adaptive I-Part of the controller					
EFPPWM_I_AD_DIF	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Adaptive I-Part difference of the controller					
EFPPWM_I_TMP	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Temporary I-Part of the controller					
EFPPWM_MIN_AD	O/V/S	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Minimum pump speed of the electrical fuel pump as PWM signal					
EFPPWM_P	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
P-Part of the controller					
FUP_EFP_DIF	V	8000... 7FFFH	-869... 86942.67	2.6533608	hPa
Deviation of the fuel pressure after fuel pump from the setpoint					
FUP_EFP_GRD	V	8000... 7FFFH	-869... 86942.67	2.6533608	hPa/10ms
Calculated requested amount of fuel from the pump					
LV_EFP	O/V	0... 1H	0 ...1	1	-
Logical variable for electrical fuel pump active					
LV_EFPPWM_AD_STOP	O/V	0... 1H	0 ...1	1	-
Logical variable for adaptation stop					
LV_EFPPWM_CTL_RST	V	0... 1H	0 ...1	1	-
Logical variable for controller reset					
LV_EFPPWM_CTL_STOP	V	0... 1H	0 ...1	1	-
Logical variable for I-part freeze					
LV_EFPPWM_I_AD_VLD	O/V/S	0... 1H	0 ...1	1	-
Logical variable showing valid adaptive I-Part of EFPPWM					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_EFPPWM_MIN_AD_ACT	V	0... 1H	0 ...1	1	-
Logical variable showing active minimum EFPPWM adaptation					
LV_EFPPWM_MIN_VLD	O/V/S	0... 1H	0 ...1	1	-
Logical variable showing valid minimum of EFPPWM					
LV_FUP_EFP_LIM	V	0... 1H	0 ...1	1	-
Logical variable indicating VFF limitation for the EFP					
STATE_EFP	O/V	0H	EFP_OFF	-	-
		1H	EFP_ACR_TEST		
		2H	EFP_ON		
		3H	EFP_OFF_DLY		
		4H	EFP_EXT_ADJ		
		5H	EFP_CRASH		
States of electrical fuel pump function					
VFF_EFP_CLC	V	0... FFFFH	0... 255	3.89105e-3	l/h
Calculated requested amount of fuel from the pump					
VFF_EFP_COR	V	0... FFFFH	0... 255	3.89105e-3	l/h
Volume fuel flow for correction of the EFP volume fuel flow					
VFF_EFP_REQ	O/V	0... FFFFH	0... 255	3.89105e-3	l/h
Requested amount of fuel from the pump					

**Input data:**

EFPPWM_EXT_ADJ {p. 7431}	ERR_SYM_FUP_EFP {p. 4733}	FUP_DIF {p. 3909}	FUP_EFP {p. 1290}
FUP_EFP_SP {p. 3792}	FUP_SP_TMP {p. 3868}	LV_EFP_CTL_AD_CLR_EXT_REQ {p. 7483}	LV_EFP_MAX_REQ {p. 3822}
LV_EFP_RUN_WKU {p. 3822}	LV_EFPPWM_EXT_ADJ {p. 800}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_EFP {p. 4733}
LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_FUP_LIH_HOM_VCV_OPEN_REQ {p. 4001}	LV_FUP_LIH_L_PRS_CTL_REQ {p. 4001}
LV_PIN_ICH {p. 988}	LV_PUC {p. 1720}	LV_ST_END {p. 1720}	MFF_SP_FUP_CTL {p. 2151}
N_32 {p. 1525}	STATE_EFP_TRAN {p. 3822}	T_AST {p. 1766}	T_EFP_RUN_WKU {p. 3823}
T_SEG_AV {p. 1525}	TCO {p. 1100}	TFU {p. 1232}	TFU_EFP {p. 1232}
VFF_EFP_ADD {p. 3823}	VFF_VCV {p. 3956}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_EFPPWM_I_AD	V	0... FFH	0... 0.99609375	3.90625e-3	-
Correlation constant for I-part adaptation					
C_CTR_FUP_SP_LIM_VFF_EFP_COR	V	0... FFFFH	0... 65535	1	-
Counter for duration of the limitation for VFF_EFP					
C_CTR_SEG_EFPPWM_I_AD_MAX	V	0... FFFFH	0... 65535	1	-
Maximum segment counter for the I-part adaptation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_SEG_EFPWPM_MIN_AD_MAX	V	0... FFFFH	0... 65535	1	-
Maximum segment counter for the minimum EFPPWM adaptation					
C_EFPPWM_ACR_TEST_INC	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Increment for the actuator test					
C_EFPPWM_CRASH	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Min. electrical fuel pump speed at state EFP_CRASH					
C_EFPPWM_DEAC	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Minimum EFPPWM at ACR_TEST					
C_EFPPWM_I_AD_MAX	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Max. value for the adaptive I-part of the controller					
C_EFPPWM_I_AD_MIN	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Min. value for the adaptive I-part of the controller					
C_EFPPWM_I_MAX	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Max. value for the I-part of the controller					
C_EFPPWM_I_MAX_LIH_HOM_VCV_OPEN	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Max. value for the I-part of the controller in case of VCV open limp home					
C_EFPPWM_I_MIN	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Min. value for the I-part of the controller					
C_EFPPWM_I_MIN_LIH_HOM_VCV_OPEN	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Min. value for the I-part of the controller in case of VCV open limp home					
C_EFPPWM_LIH	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
EFP actuation in case of LIH					
C_EFPPWM_LIH_ADD	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Additive EFPPWM in case of limp home					
C_EFPPWM_MAN_ACT	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Manual value for the EFPPWM					
C_EFPPWM_MAX	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Max. electrical fuel pump speed					
C_EFPPWM_MIN_1	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Min. electrical fuel pump speed at state EFP_ON					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EFPPWM_MIN_2	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Min. electrical fuel pump speed at state EFP_OFF					
C_EFPPWM_MIN_AD_INI	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Initial value for the EFPPWM_MIN adaptation					
C_EFPPWM_MIN_AD_TOL	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Maximum value for the EFPPWM_MIN adaptation					
C_EFPPWM_MIN_COR	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Correction value for the EFPPWM to reach zero delivery					
C_EFPPWM_MIN_LIH_HOM_VCV_OPEN	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Min. electrical fuel pump speed in case of VCV open limphome					
C_FUP_EFP_DIF_MAX_EFPPWM_AD	V	8000... 7FFFH	-869... 86942.67	2.6533608	hPa
Maximum deviation of the fuel pressure after fuel pump from the setpoint for adaptation					
C_FUP_EFP_GRD_MAX	V	8000... 7FFFH	-869... 86942.67	2.6533608	hPa/10ms
Fuel pressure gradient for freezing EFPPWM during PUC					
C_FUP_EFP_SP_MAX_EFPPWM_MIN_AD	V	0... FFFFH	0... 173888	2.6533608	hPa
Maximum FUP EFP setpoint for the minimum adaptation of EFPPWM					
C_FUP_EFP_SP_MIN_EFPPWM_MIN_AD	V	0... FFFFH	0... 173888	2.6533608	hPa
Minimum FUP EFP setpoint for the minimum adaptation of EFPPWM					
C_FUP_RHO_FUEL_EFP	V	153B... FFFFH	74.6395056077 ...900	0.0% ■331	mg/cm**3
Density of the fuel					
C_FUP_SP_DIF_LIM_VFF_EFP_COR	V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint difference threshold for activation of the VFF_EFP correction					
C_MFF_SP_MAX_EFPPWM_I_AD	V	0... FFFFH	0... 1389	0.0211948	mg
Maximum injected fuel mass for allowing I-part adaptation					
C_MFF_SP_MAX_EFPPWM_MIN_AD	V	0... FFFFH	0... 1389	0.0211948	mg
Maximum injected fuel mass for allowing minimum EFPPWM adaptation					
C_MFF_SP_MIN_EFPPWM_I_AD	V	0... FFFFH	0... 1389	0.0211948	mg
Minimum injected fuel mass for allowing I-part adaptation					
C_MFF_SP_MIN_EFPPWM_MIN_AD	V	0... FFFFH	0... 1389	0.0211948	mg
Minimum injected fuel mass for allowing minimum EFPPWM adaptation					
C_N_MAX_EFPPWM_I_AD	V	0... FFH	0... 8160	32	rpm
Maximum engine speed for allowing I-part adaptation					
C_N_MAX_EFPPWM_MIN_AD	V	0... FFH	0... 8160	32	rpm
Maximum engine speed for allowing minimum EFPPWM adaptation					
C_N_MIN_EFPPWM_I_AD	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for allowing I-part adaptation					
C_N_MIN_EFPPWM_MIN_AD	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for allowing minimum EFPPWM adaptation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_AST_EFPPWM_MIN_AD	V	0... FFFFH	0... 6553.5	0.1	s
Time after engine start to allow minimum EFPPWM adaptation					
C_TCO_MAX_EFPPWM_AD	V	0... FEH	-48... 142.5	0.75	°C
Maximum coolant temperature for allowing adaptation					
C_TCO_MIN_EFPPWM_AD	V	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature for allowing adaptation					
C_VFF_DIF_LIM_VFF_EFP_COR	V	0... FFFFH	0... 255	3.89105e-3	l/h
Constant for manual VFF difference for VFF_EFP correction					
C_VFF_EFP_COR_GRD_DEC	V	0... FFFFH	0... 255	3.89105e-3	l/h
Decrement gradient limitation for VFF_EFP_COR					
C_VFF_EFP_REQ_LIH	V	0... FFFFH	0... 255	3.89105e-3	l/h
EFP volume fuel flow value for limp home of the fuel low pressure system					
CLF_EFP_AD_RST_L_PRS_LIH	V	0... FFFFH	0... 65535	1	-
Bit field used to define if low pressure adaptation values are individually reset on fuel low pressure control limphome					
IP_EFPPWM_BAS_L_POW	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
LDP_VFF_EFP_REQ_IP_EFPPWM_BAS	8	0... FFFFH	0... 255	3.89105e-3	l/h
Basic value of the EFPPWM for low power version					
IP_EFPPWM_I	V	0... FFFFH	-50... 49.9984741211	1.52588e-3	%
LDP_FUP_EFP_DIF_IP_EFPPWM_I	8	0... FFFFH	-869... 86942.67	2.6533608	hPa
I-part of the controller					
IP_EFPPWM_I_VCV_LIH	V	0... FFFFH	-50... 49.9984741211	1.52588e-3	%
LDP_FUP_DIF_IP_EFPPWM_I_VCV_LIH	8	0... FFFFH	-173890 ...173884	5.3066911	hPa
I part of the controller in case of VCV open limphome					
IP_EFPPWM_P	V	0... FFFFH	-50... 49.9984741211	1.52588e-3	%
LDP_FUP_EFP_DIF_IP_EFPPWM_P	8	0... FFFFH	-869... 86942.67	2.6533608	hPa
P-part of the controller					
IP_EFPPWM_P_VCV_LIH	V	0... FFFFH	-50... 49.9984741211	1.52588e-3	%
LDP_FUP_DIF_IP_EFPPWM_P_VCV_LIH	8	0... FFFFH	-173890 ...173884	5.3066911	hPa
P part of the controller					
IP_EFPPWM_WKU	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
LDP_T_EFP_RUN_WKU_IP_EFPPWM_WKU	4	0... FFFFH	0... 655.35	0.01	s
PWM duty cycle for electrical fuel pump after ECU wake-up					
IP_FAC_EFPPWM_BAS_L_POW	V	0... FFFFH	0... 1.99996948242	30.5176e-6	-
LDP_TFU_EFP_IP_FAC_EFPPWM_BAS	6	0... FEH	-48... 142.5	0.75	°C
LDP_FUP_EFP_SP_IP_FAC_EFPPWM	8	0... FFFFH	0... 173888	2.6533608	hPa
Correction factor for the basic value of the EFPPWM for low power version					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FUP_EFP_SP_COR_VCV_OPEN	V	8000... 7FFFH	-869... 86942.67	2.6533608	hPa
LDP_TFU_IP_FUP_EFP_SP_COR_VCV	8	0... FFH	-50 ...205	1	°C
Correction for EFP in case of VCV open lih					
LC_EFPPWM_CTL_RST_ON_ERR	V	0... 1H	0 ...1	1	-
Switch to define if fuel pump low pressure controller is reset on raw error symptom (= 0) or on debounced error symptom (= 1) of fuel low pressure sensor					
LC_EFPPWM_I_AD_CLR	V	0... 1H	0 ...1	1	-
Logical variable to clear the adaptive I-Part of the controller					
LC_FUP_EFP_AVL	V	0... 1H	0 ...1	1	-
Logical variable indicating ' fuel pressure sensor for low pressure line available					
LC_VFF_DIF_LIM_VFF_EFP_COR_MAN	V	0... 1H	0 ...1	1	-
Logical constant for switch to manual VFF_DIF for VFF_EFP correction					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_T_DLY_EFP_ACR_TEST_MAX	V	0... FFFFH	0... 655.35	0.01	s
Duration time for the actuator test at EFPPWM = 100 % till switch off (value: 5 s)					

**General information:**

The electrical fuel pump is controlled by the EFPPWM.

The PI-controller is used to compensate deviations from the nominal fuel pressure after the fuel pump. If no sensor is applied the EFPPWM is only calculated with the help of the precontrol map, which corresponds to the pump data.

In order to control also deviations caused by external influences or aging two adaptation strategies are applied. One adaptation is used in a nominal operating point where the I-part of the controller is taken as an adaptive I-part. The other adaptation gives the minimum EFPPWM for ensuring the correct fuel pressure for the jet pumps without increasing the fuel pressure to the level where the overpressure release valve opens.

**Application conditions:**

*Initialisation:* RST, NVMRES, NVMINI, NVMSTO  
*Recurrence:* 10MS, SEG  
*Activation:* always  
*Deactivation:* never

**Function description:****Formula section:**

Released by Tettenborn Frank		Date 2013-02-13	File 6X901401.00E
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 3801 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

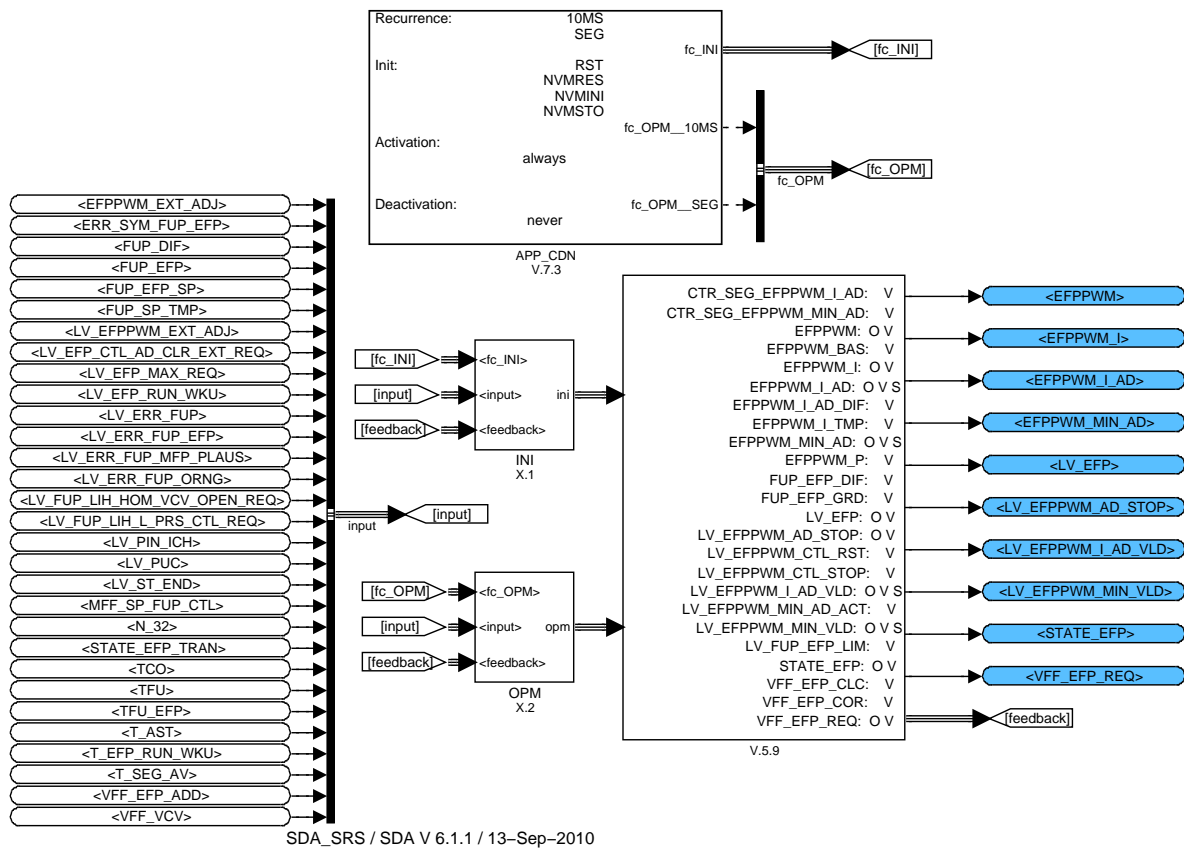


Figure 9.28.1: :

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## 9.28.1 Initialization

### 9.28.1.1 Initialisation of values at Reset

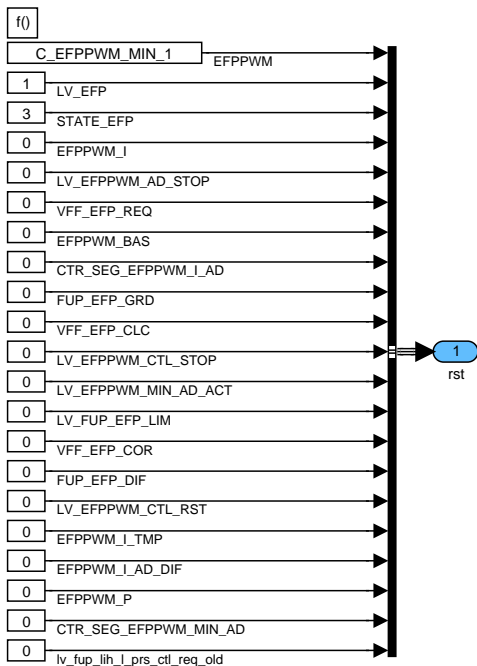


Figure 9.28.2: :

### 9.28.1.2 Initialisation at event "NVMY"

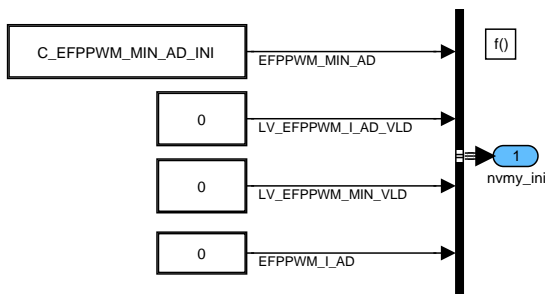


Figure 9.28.3: :

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### 9.28.1.3 Initialisation at "NVM\_RES"

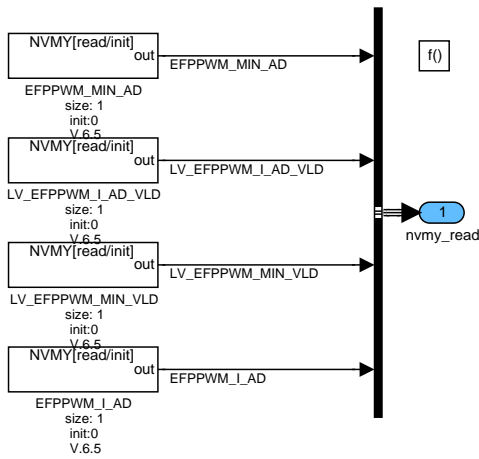


Figure 9.28.4: :

### 9.28.1.4 Initialisation at "NVMSTO"

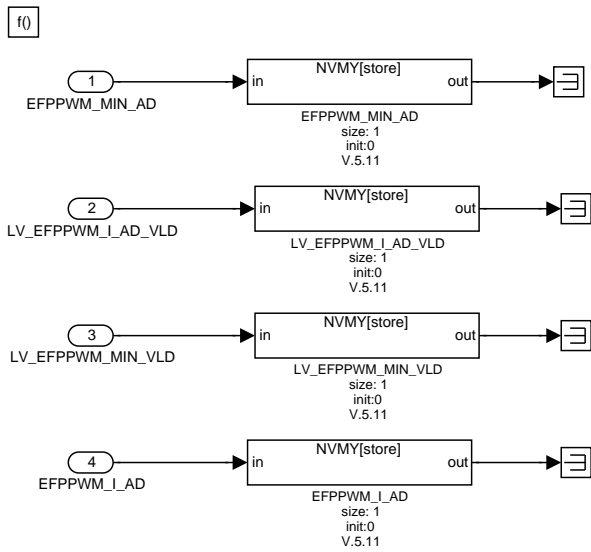


Figure 9.28.5: :

## 9.28.2 Electrical fuel pump main

This picture shows an overview of the structure.

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 3804 of 8404</b>	
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### 9.28.2.1 10 ms task

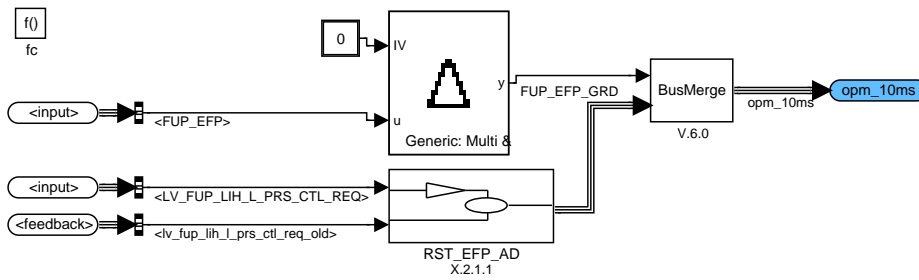


Figure 9.28.6: :

#### 9.28.2.1.1 Reset of low pressure adaptation values depending on low pressure limp home request

The low pressure adaptation values are individually reset on rising edge of low pressure limp home request depending on CLF\_EFP\_AD\_RST\_L\_PRS\_LIH.

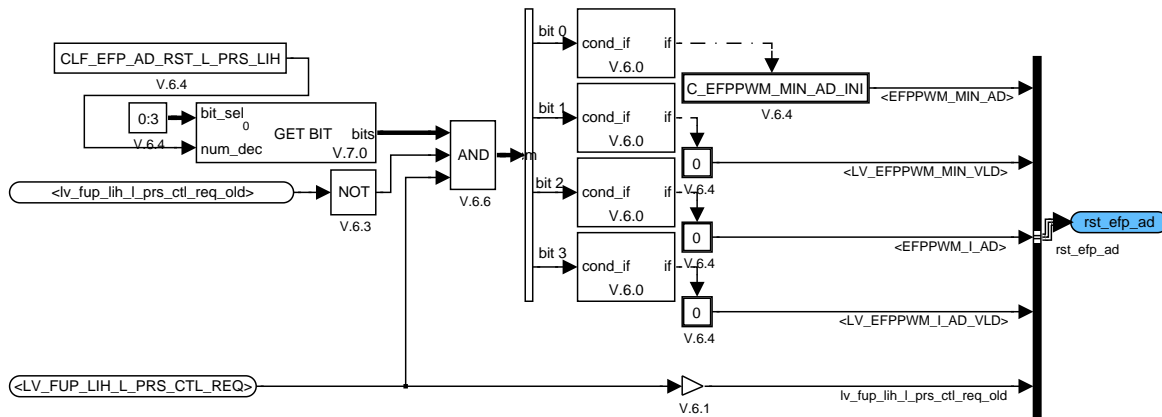


Figure 9.28.7: :

#### 9.28.2.2 Electrical fuel pump calculation (calculated with 10 ms recurrence on LV\_ST\_END == 0 or with segment recurrence on LV\_ST\_END == 1)

Calculation of the main function of the electrical fuel pump controller. The function is split into four parts corresponding to the calculated state.

##### STATE\_EFP\_CLC:

The different modules have to be calculated due to state diagram below. The input STATE\_EFP\_TRAN will be produced in the file Electrical fuel pump (Appl. Inc.).

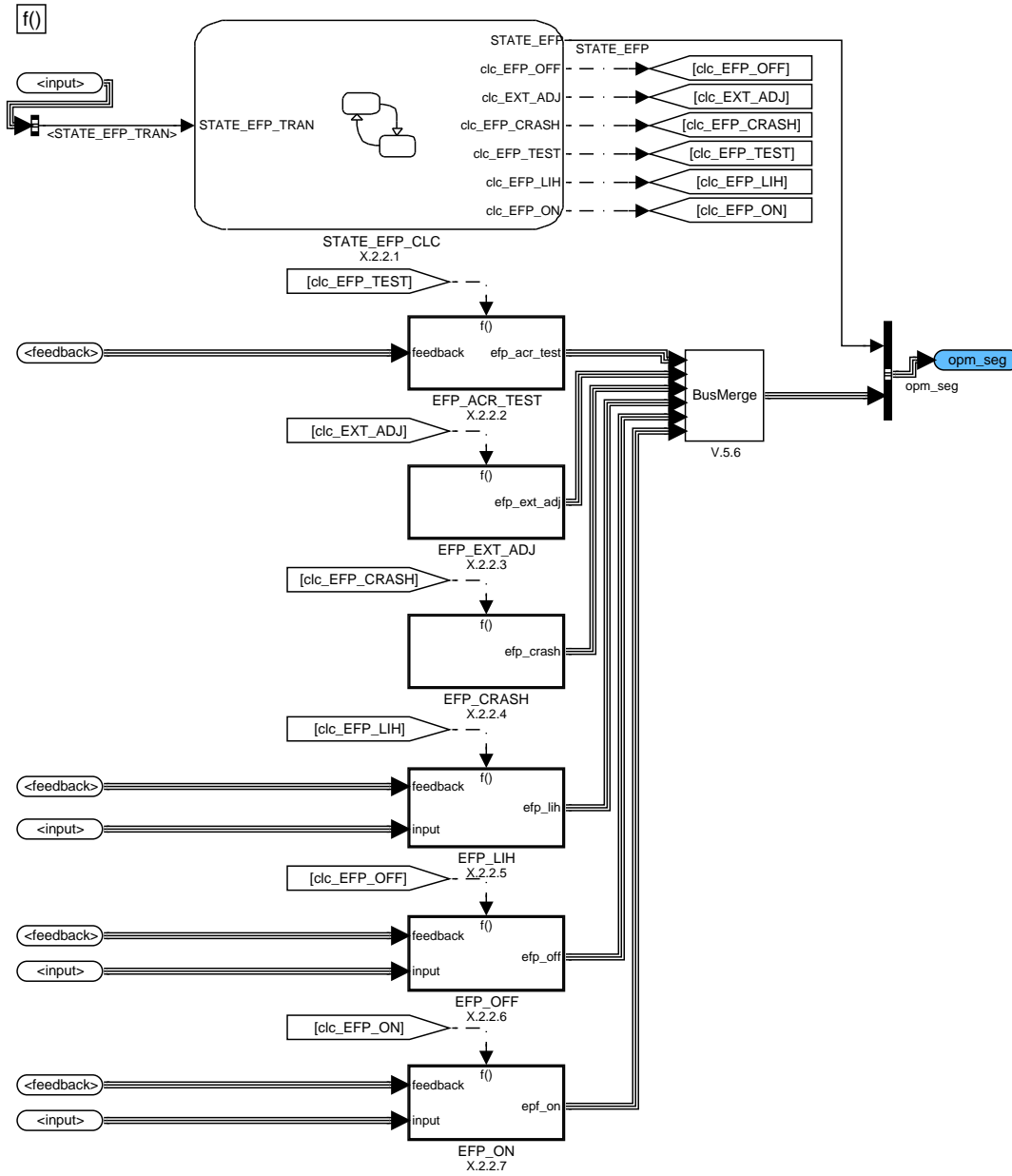


Figure 9.28.8: :

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### 9.28.2.2.1 STATE\_EFP\_CLC

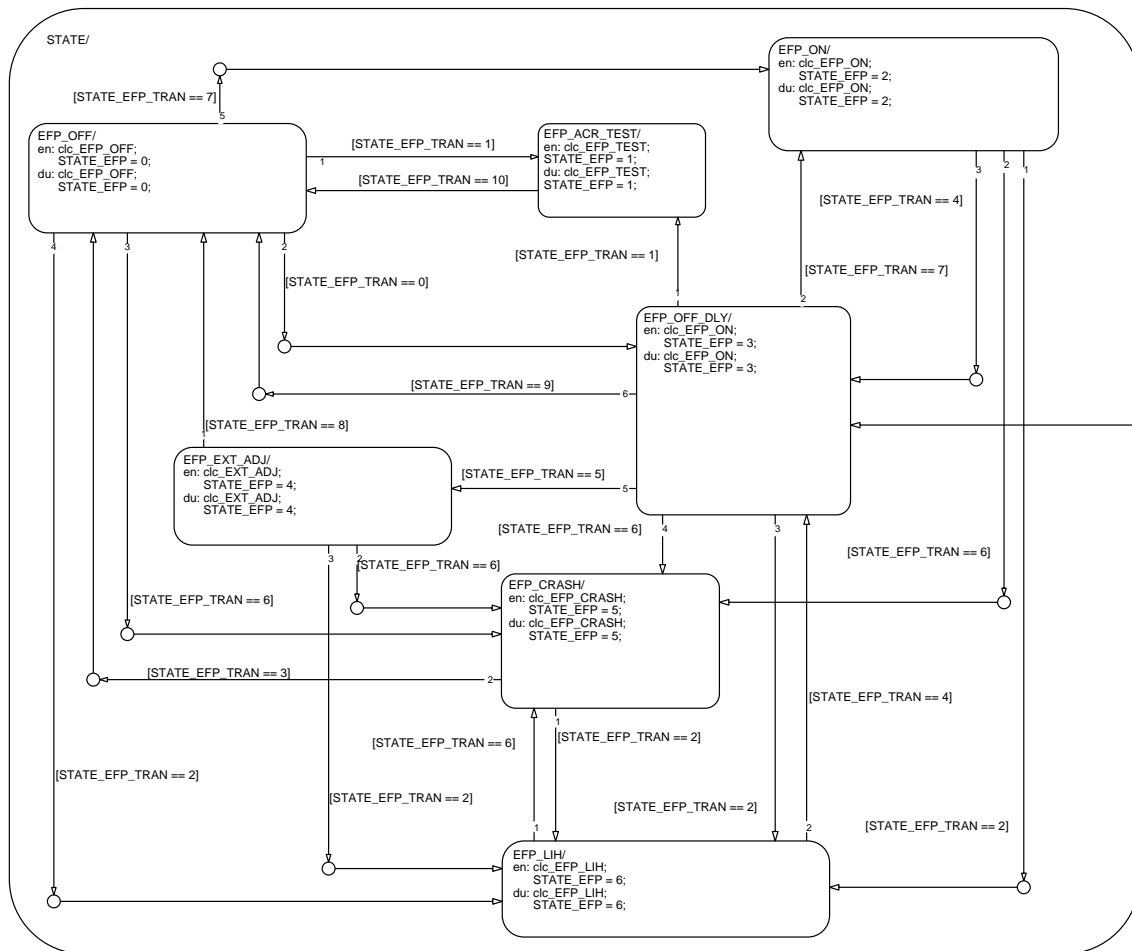


Figure 9.28.9: :

### 9.28.2.2.2 Electrical fuel pump actuator test

#### 9.28.2.2.2.1 Actuator test

This testmode is request by an external customer test device. It forces the EFPWM to have a certain testpattern defined in that function.

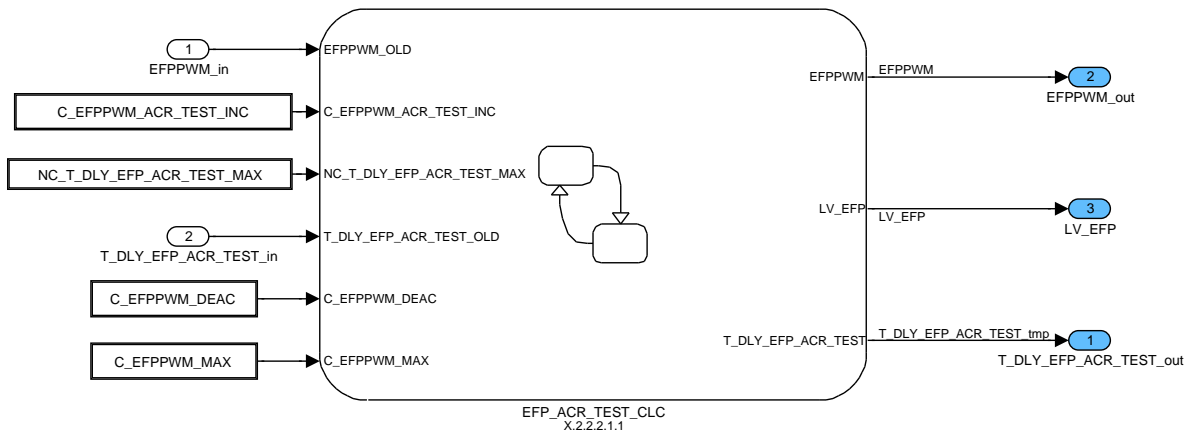


Figure 9.28.10: :

9.28.2.2.2.1 EFP\_ACR\_TEST\_CLC

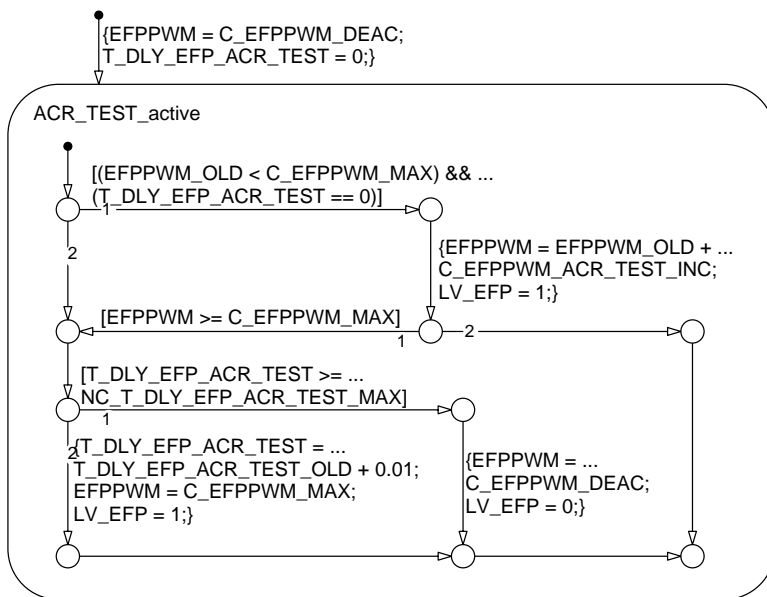


Figure 9.28.11: :

9.28.2.2.3 Electrical fuel pump external adjustment

9.28.2.2.3.1 External adjustment of the EFP\_PWM

For testing reasons this module can generate a manual EFP\_PWM.

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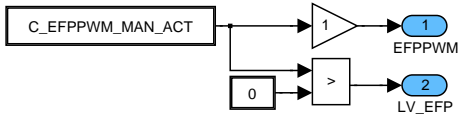


Figure 9.28.12: :

9.28.2.2.4 Electrical fuel pump crash

9.28.2.2.4.1 Calculation of EFPPWM in state "crash"

In case of crash a special EFPPWM should be given.

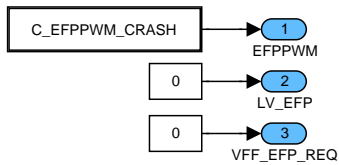


Figure 9.28.13: :

9.28.2.2.5 Electrical fuel pump limp home

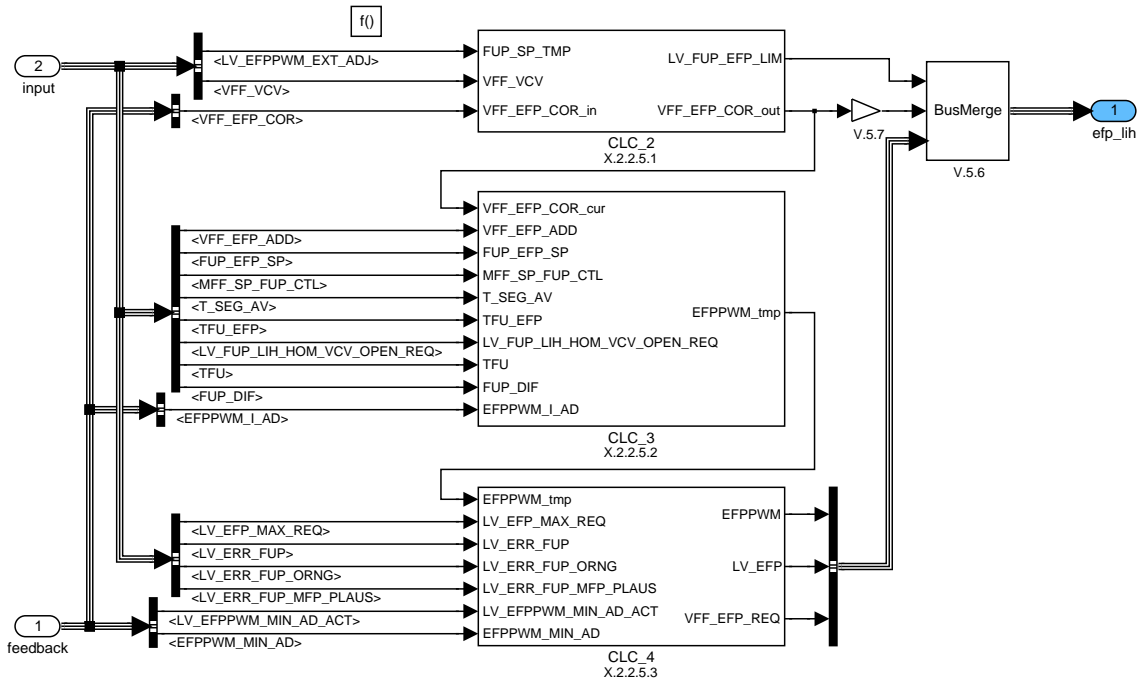


Figure 9.28.14: :

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### 9.28.2.2.5.1 Calculation of VFF\_EFP\_COR

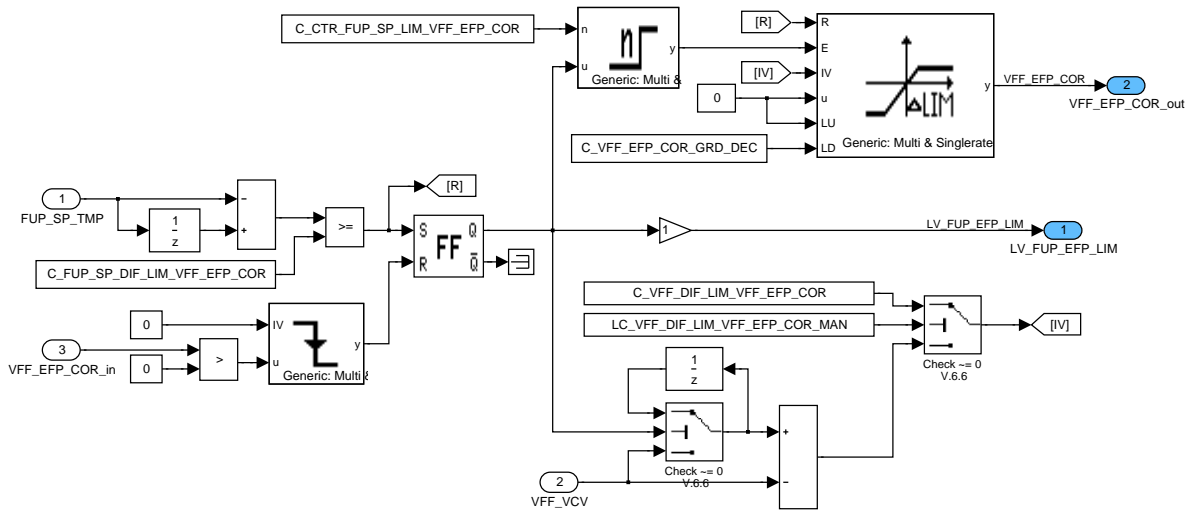


Figure 9.28.15: :

### 9.28.2.2.5.2 Calculation of Temporary Flag

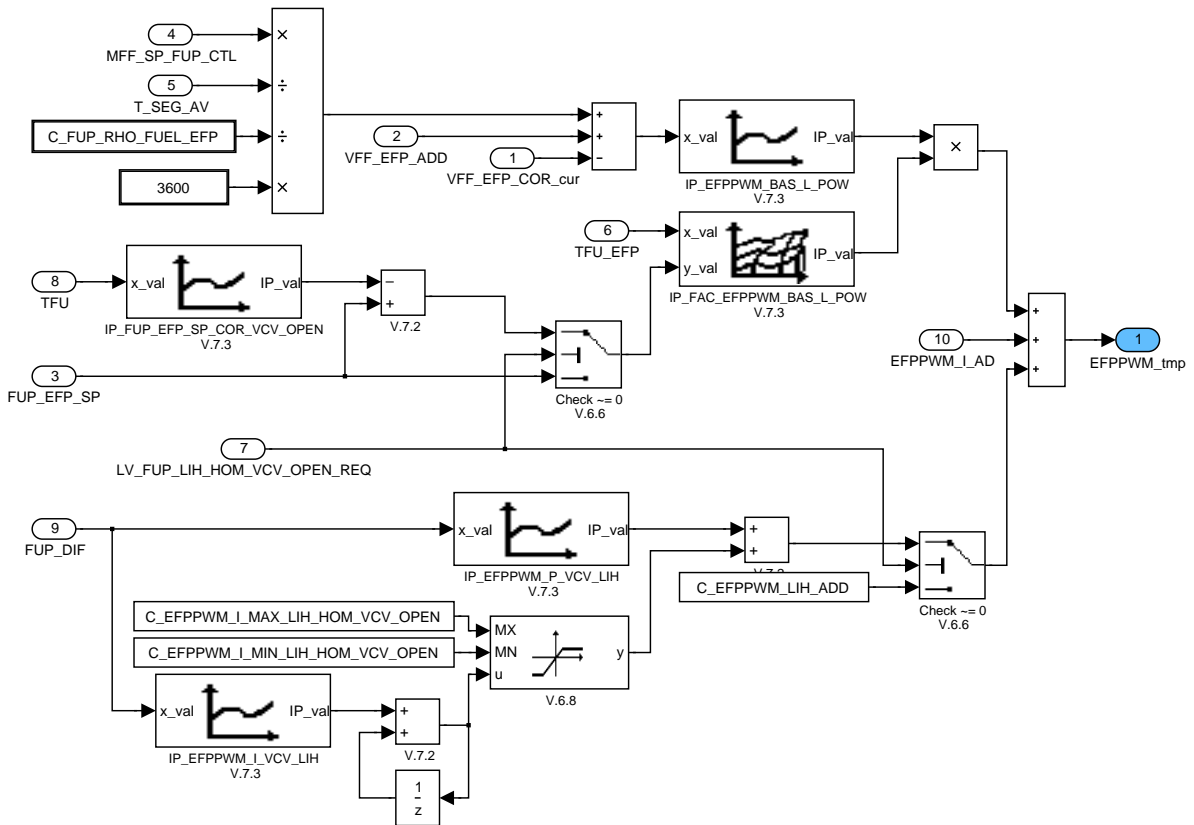


Figure 9.28.16: :

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### 9.28.2.2.5.3 Calculation

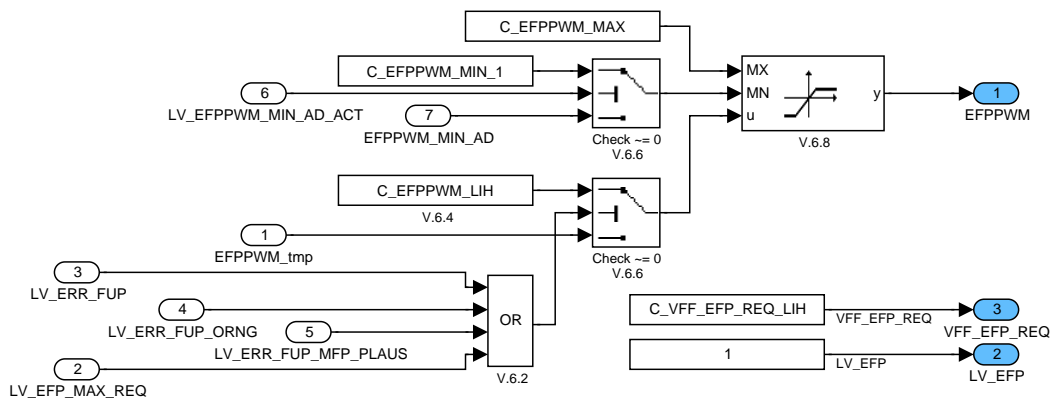


Figure 9.28.17: :

### 9.28.2.2.6 Electrical fuel pump off

#### 9.28.2.2.6.1 Calculation of the controller in state "off"

If no fuel delivery is required the ECU has to give a minimum EFPPWM. The only operating point where this rule can not be applied is at request from the independent car heater. At this point the adapted minimum PWM is applied to the pump.

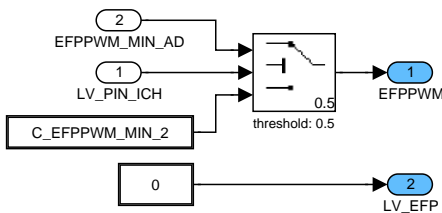


Figure 9.28.18: :

### 9.28.2.2.7 Electrical fuel pump on

#### Calculation of the Controller in state "on"

The functionality for the electrical fuel pump in status "on" is given here. It is split into a precontrol calculation part, a limitation signal generating part (mainly for PUC), an EFPPWM calculation part and the controller output part.

#### 9.28.2.2.7.1 Electrical fuel pump on pre-control

##### Calculation of the precontroller

The precontrol part calculated the precontroller value out of the required fuel mass for the injection. Within the given two maps the basic controller output is calculated.

9.28.2.2.7.1.1 Electrical fuel pump on pre-control

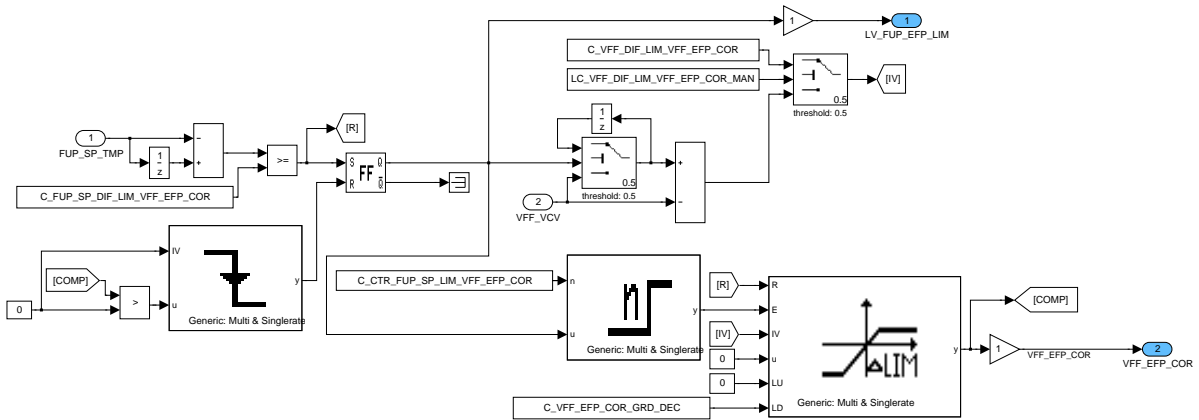


Figure 9.28.19: :

9.28.2.2.7.1.2 Calculation

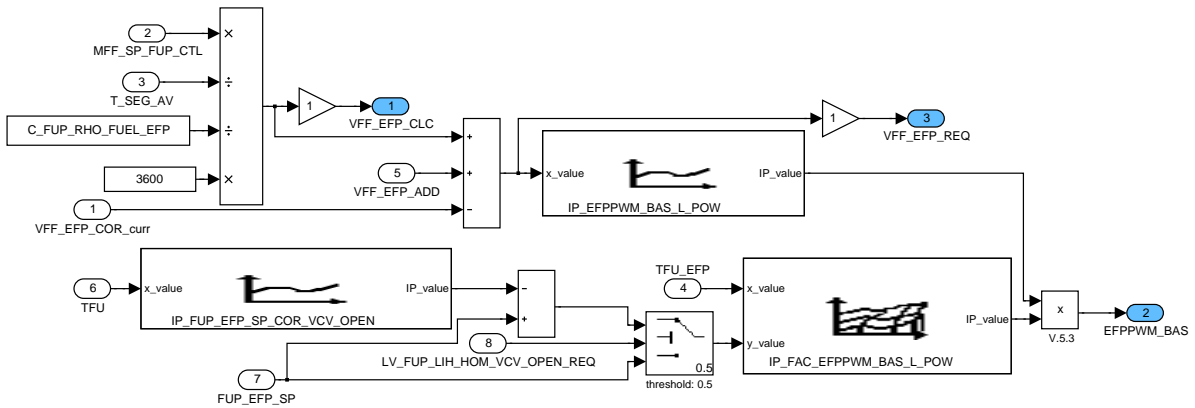


Figure 9.28.20: :

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### 9.28.2.2.7.2 Electrical fuel pump pwm signal limitation pull calculation

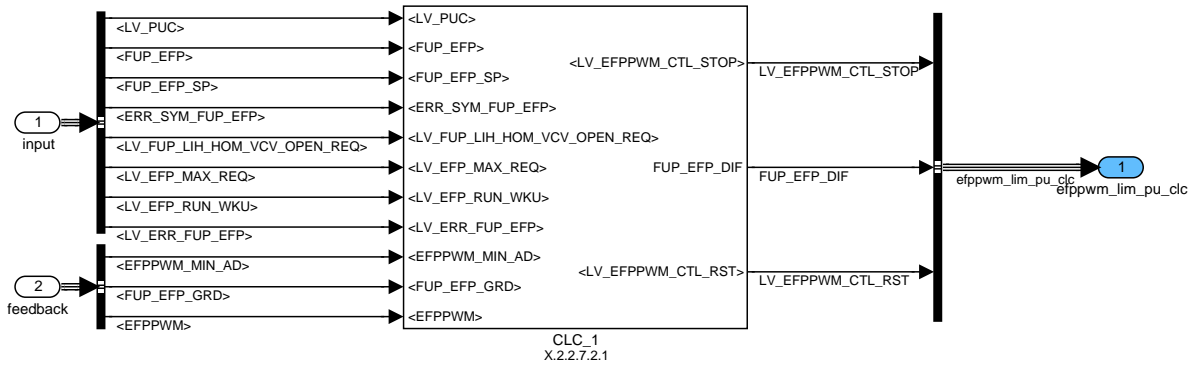


Figure 9.28.21 :

#### 9.28.2.2.7.2.1 Limitation of the controller

Given by special conditions the controller is stopped. This is done within PUC when a too high fuel pressure gradient is measured and the fuel pressure is over the setpoint. Also the total reset of the controller output can be necessary when there is a sensor error or no sensor is available (given by the flag).

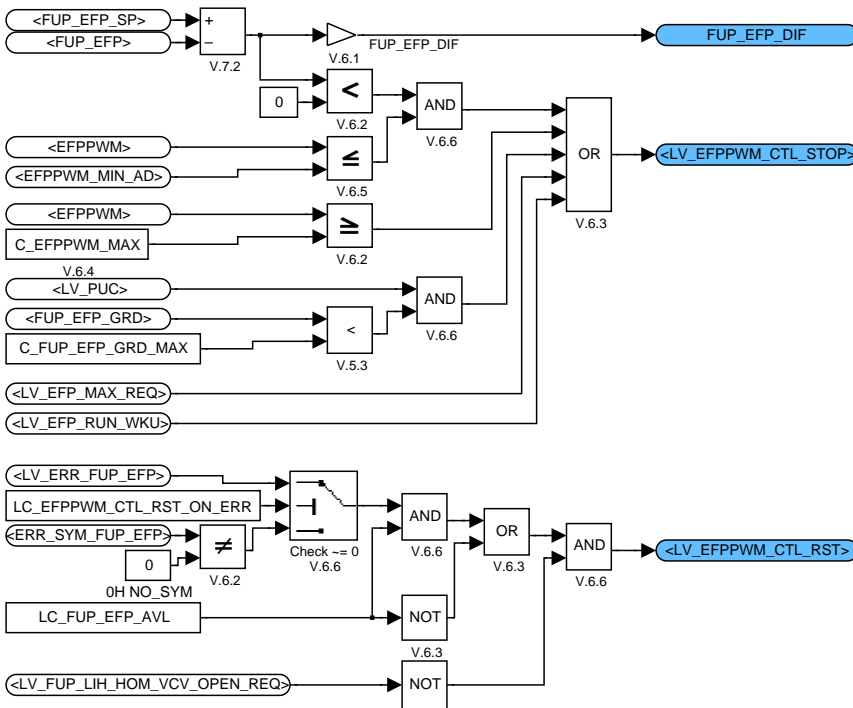


Figure 9.28.22 :

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### 9.28.2.2.7.3 Electrical fuel pump on control

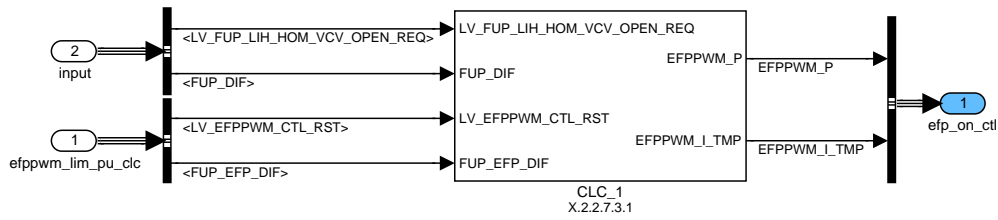


Figure 9.28.23: :

#### 9.28.2.2.7.3.1 Calculation of the controller

The controller part gives the output of the controller maps for the I part. In case of given reset flag the I part and the P part are zero.

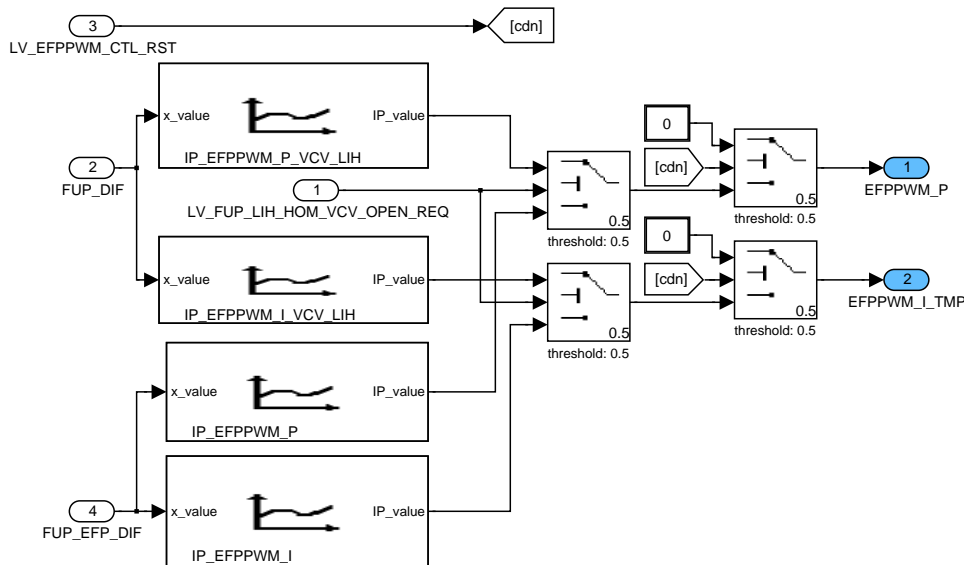


Figure 9.28.24: :

#### 9.28.2.2.7.4 Electrical fuel pump pwm signal calculation

Calculation of the final output signal.

The EFPPWM calculation part is split into two parts. One is calculating the adaptation and the other part calculate the final EFPPWM output.

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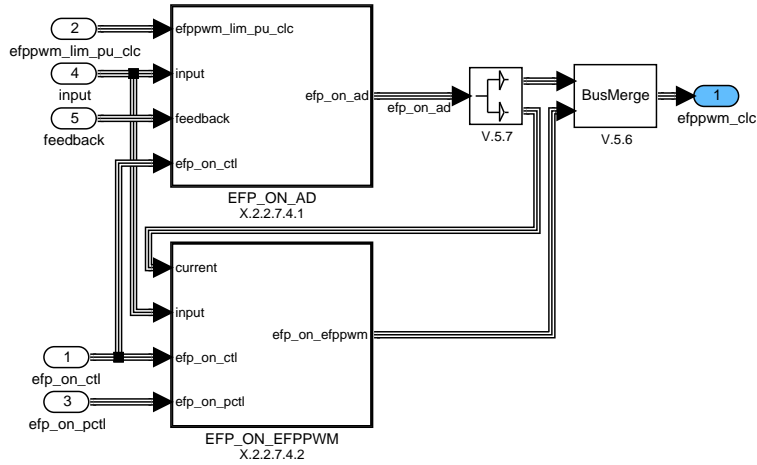


Figure 9.28.25: :

### 9.28.2.2.7.4.1 Electrical fuel pump on adaptive

#### Calculation of the adaptation

The adaptation part is split into the main adaptation inhibit flag calculating module, the calculation part for the minimum EFPPWM adaptation part and two modules for the I part adaptation.

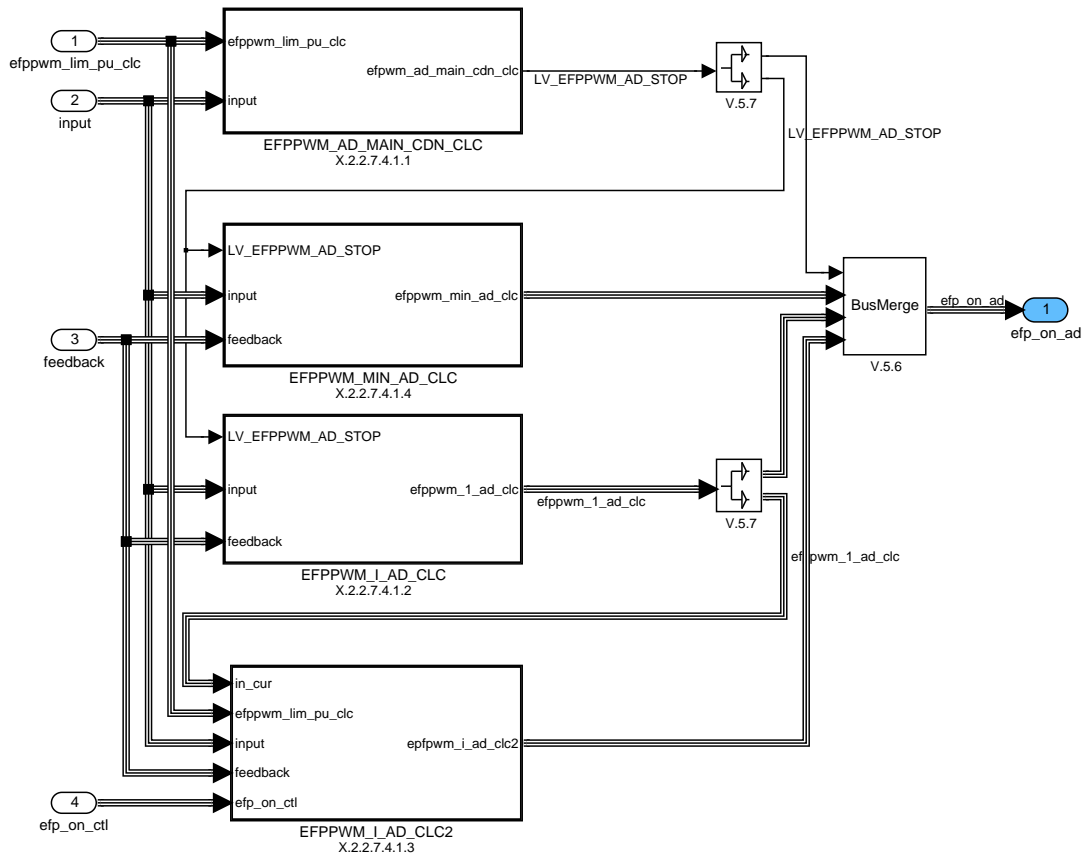



Figure 9.28.26: :

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 3815 of 8404	
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9.28.2.2.7.4.1.1 Electrical fuel pump pwm signal adaptive main condition calculation

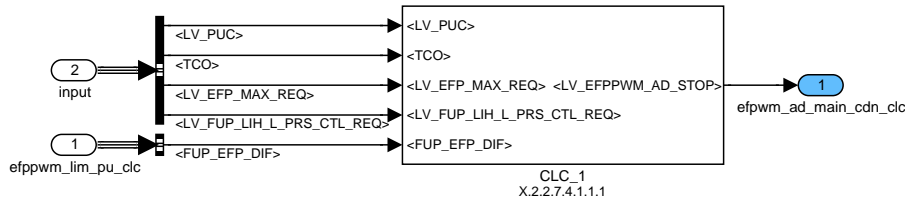


Figure 9.28.27: :

9.28.2.2.7.4.1.1.1 Main conditions for the adaptation

Within this module the inhibition flag for the adaptation is created.

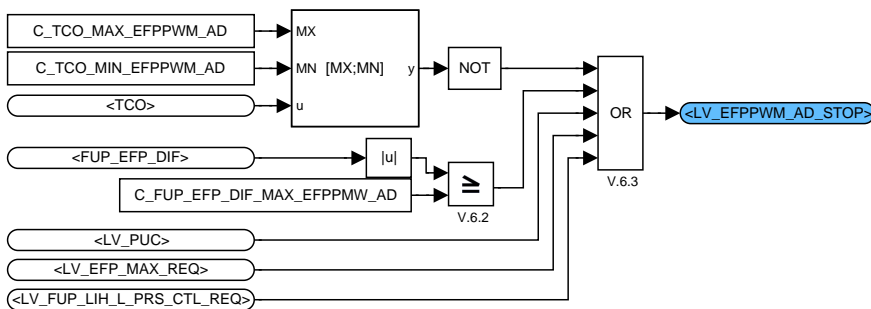


Figure 9.28.28: :

9.28.2.2.7.4.1.2 Electrical fuel pump pwm signal integral part of a control structure adaptive calculation

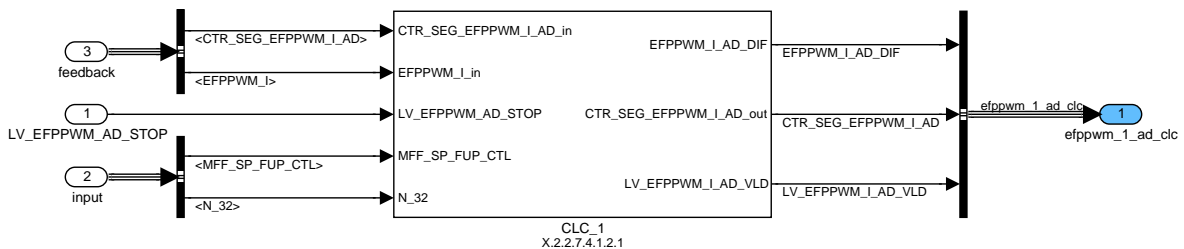


Figure 9.28.29: :

9.28.2.2.7.4.1.2.1 Calculation of the adaptation via I- part

The calculation of the adaptation via I- part of the controller is calculated within that module. The main function is described in the state diagram.

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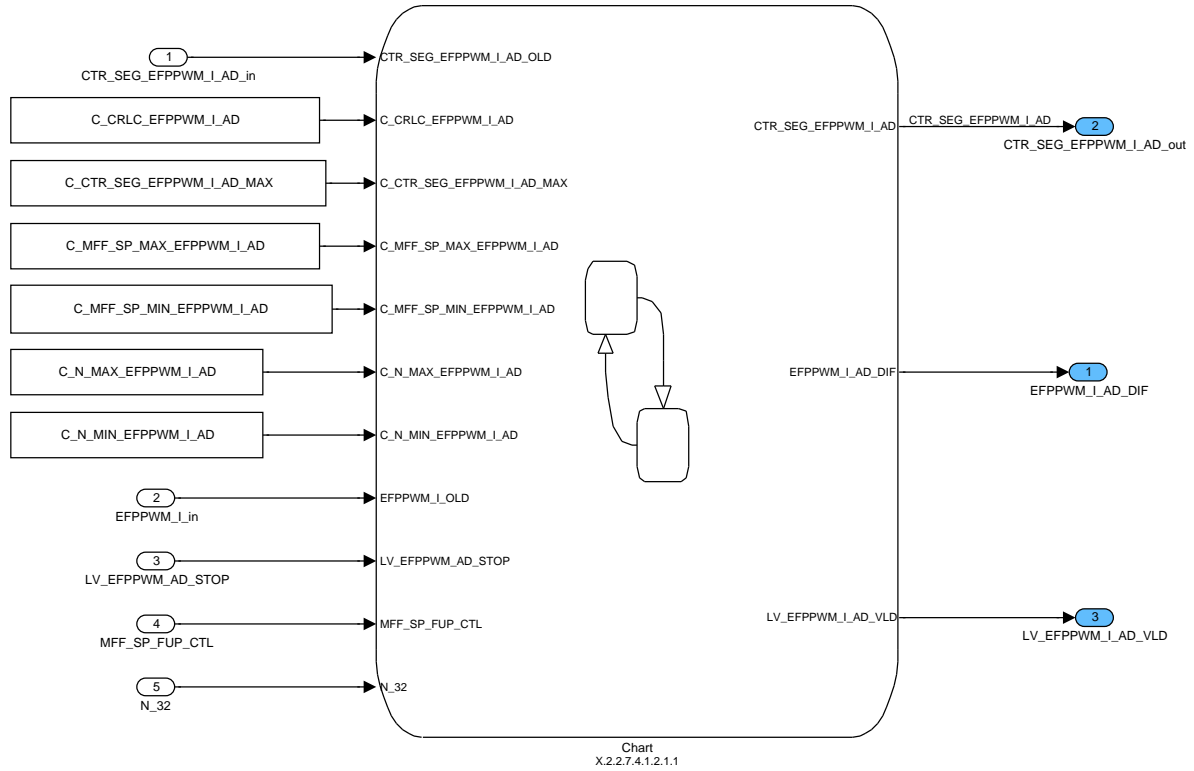


Figure 9.28.30: :

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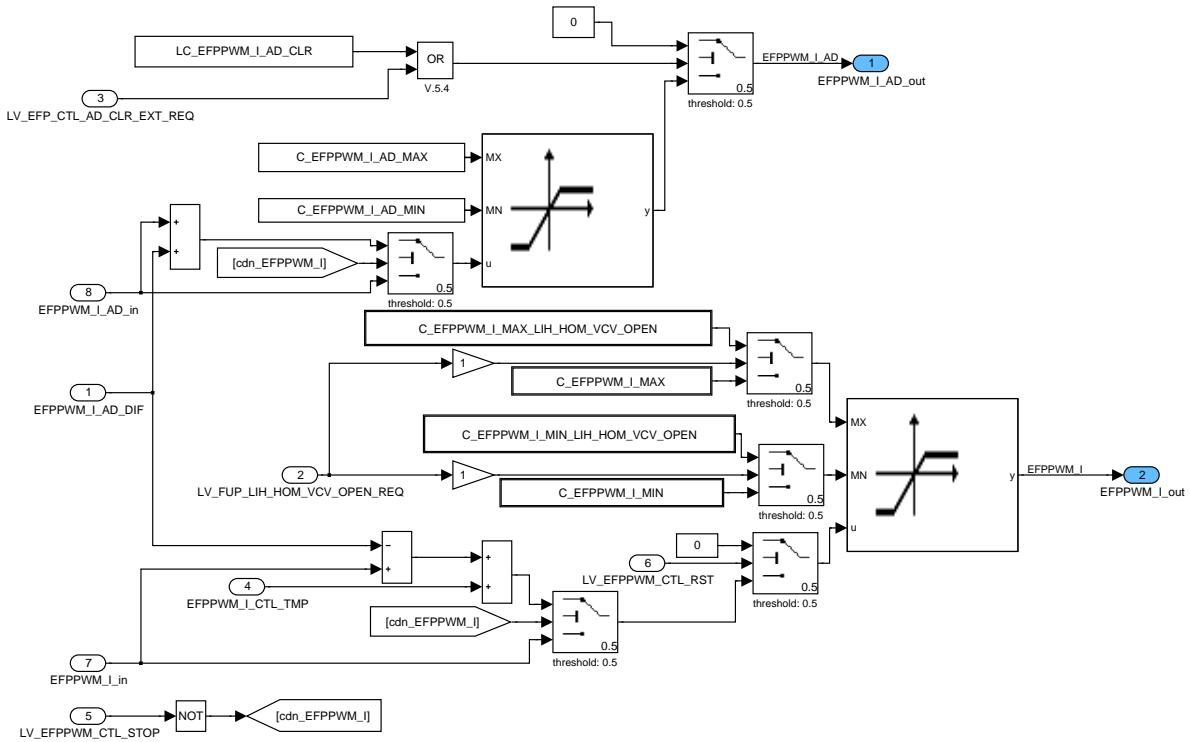


Figure 9.28.33: :

9.28.2.2.7.4.1.4 Electrical fuel pump pwm signal minimum adaptive calculation

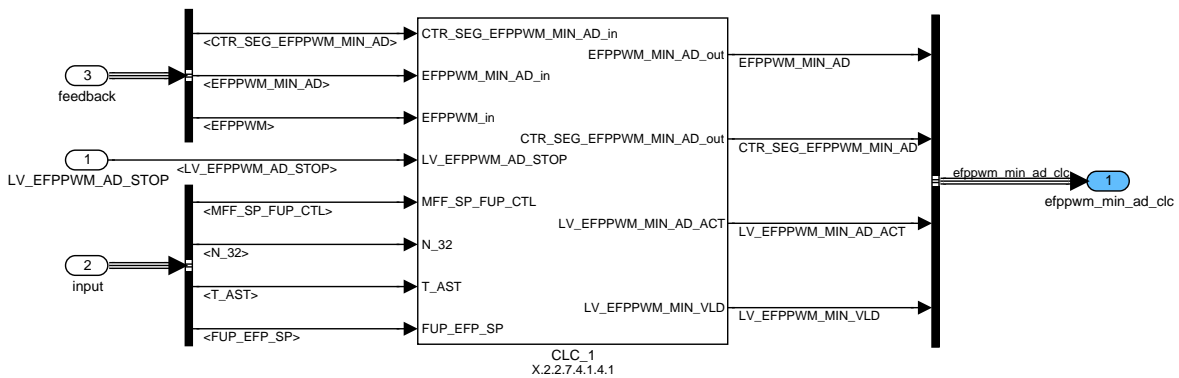


Figure 9.28.34: :

9.28.2.2.7.4.1.4.1 Calculation of the minimum EFPPWM

The minimum EFPPWM for the pump enabling the correct function of the jet pump is adapted within that function. The base is described in the state diagram.

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9.28.2.2.7.4.2 Electrical fuel pump on electrical fuel pump pwm signal

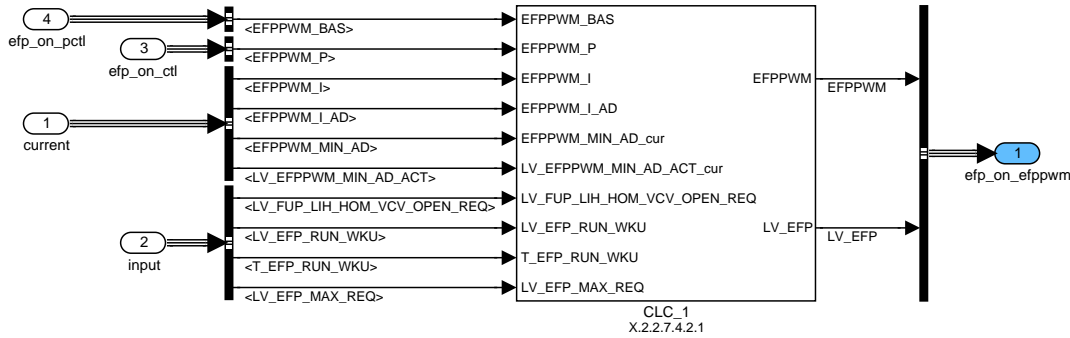


Figure 9.28.37: :

9.28.2.2.7.4.2.1 Calculation of the final output for the EFPPWM

In this module the final EFPPWM is calculated.

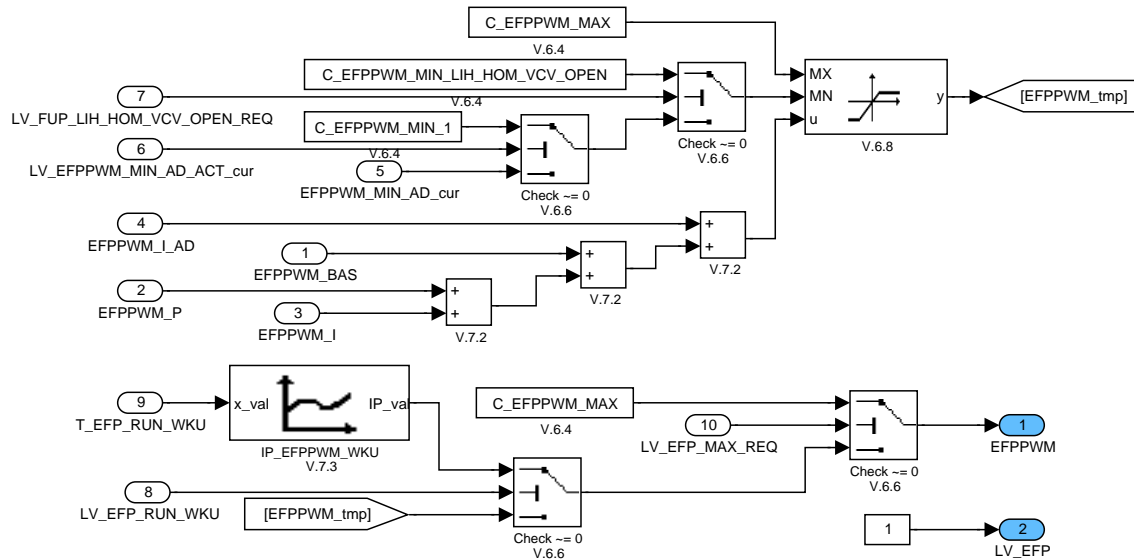


Figure 9.28.38: :

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## 9.29 Fuel pump low pressure control (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_EFP_RUN_WKU	O/V/S	0... FFH	0... 255	1	-
Variable is used to count ECU wake-up events without engine operation.					
FUP_EFP_ST_H	O/V/S	0... FFFFH	0... 173888	2.65336079	hPa
Pressure at observation start for the pressure increase					
FUP_EFP_ST_L	O/V/S	0... FFFFH	0... 173888	2.65336079	hPa
Pressure at observation start for the pressure decrease					
FUP_EFP_STOP_H	O/V/S	0... FFFFH	0... 173888	2.65336079	hPa
Pressure at observation stop for the pressure increase					
FUP_EFP_STOP_L	O/V/S	0... FFFFH	0... 173888	2.65336079	hPa
Pressure at observation stop for the pressure decrease					
FUP_EFP_TMP_H	V	0... FFFFH	0... 173888	2.65336079	hPa
Temporay pressure at observation start for the pressure increase					
FUP_EFP_TMP_L	V	0... FFFFH	0... 173888	2.65336079	hPa
Temporay pressure at observation start for the pressure decrease					
LV_EFP_MAX_REQ	O/V	0... 1H	0 ...1	1	-
Flag for requesting the maximum operation mode of the electrical fuel pump					
LV_EFP_RUN_WKU	O/V	0... 1H	0 ...1	1	-
Flag for requesting electrical fuel pump operation after ECU wake-up					
LV_ERR_FUP_EFP_LIH	V	0... 1H	0 ...1	1	-
Logical bit indicating limp home of EFP pump requested					
LV_PUMP_PRE_RUN_STOP	V	0... 1H	0 ...1	1	-
Logical bit indicating pre run of the pump stopped					
STATE_EFP_TRAN	O/V	0H	OFF_DLY	-	-
		1H	ACR_TEST		
		2H	LIH		
		3H	CRASH2OFF		
		4H	ON2OFF_DLY		
		5H	ON2EXT_ADJ		
		6H	CRASH		
		7H	OFF_DLY2ON		
		8H	EXT_ADJ2OFF		
		9H	OFF_DLY2OFF		
AH	ACR_TEST2OFF				
States of electrical fuel pump function					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_EFP	V	0... FFFFH	0... 655.35	0.01	s
Time counter for activated EFP					
T_EFP_ACT_H	V	0... FFFFH	0... 655.35	0.01	s
Timer for the pressure increase					
T_EFP_ACT_L	V	0... FFFFH	0... 655.35	0.01	s
Timer for the pressure decrease					
T_EFP_MEM_H	O/V/S	0... FFFFH	0... 655.35	0.01	s
Time for the pressure increase					
T_EFP_MEM_L	O/V/S	0... FFFFH	0... 655.35	0.01	s
Time for the pressure decrease					
T_EFP_RUN_WKU	O/V	0... FFFFH	0... 655.35	0.01	s
Timer used for electric fuel pump operation after ECU reset					
TCO_MEM_FUP_EFP_H	O/V/S	0... FEH	-48... 142.5	0.75	°C
Coolant temperature for the pressure increase					
TCO_MEM_FUP_EFP_L	O/V/S	0... FEH	-48... 142.5	0.75	°C
Coolant temperature for the pressure decrease					
TCO_TMP_H	V	0... FEH	-48... 142.5	0.75	°C
Temporary coolant temperature for the pressure increase					
TCO_TMP_L	V	0... FEH	-48... 142.5	0.75	°C
Temporary coolant temperature for the pressure decrease					
VFF_EFP_ADD	O/V	0... FFH	0... 255	1	l/h
Additive value for the amount of fuel from the pump					

**Input data:**

CLF_EFP_AD_RST_L_PRS_LIH {p. 3800}	CTR_KM_CAN {p. 1563}	ERR_SYM_FUP_EFP {p. 4733}	FTL {p. 1564}
FUP {p. 1283}	FUP_EFP {p. 1290}	FUP_EFP_MES {p. 1290}	FUP_EFP_SP {p. 3792}
LC_FUP_EFP_AVL {p. 3801}	LV_ACR_EFPPWM_TEST_REQ {p. 988}	LV_EFP_CTL_AD_CLR_EXT_REQ {p. 7483}	LV_ENG_OFF_N_CON {p. 988}
LV_ERR_EFPPWM_PLAUS {p. 6050}	LV_ERR_FTL_MIN {p. 4762}	LV_ERR_FUP_EFP {p. 4733}	LV_ES {p. 1720}
LV_FIRST_VLD_TOOTH {p. 1505}	LV_FUP_LIH_L_PRS_CTL_REQ {p. 4001}	LV_FUP_LIH_REQ {p. 988}	LV_IGK {p. 906}
LV_PIN_ICH {p. 988}	LV_RLY_ST_CAN {p. 1567}	LV_ST_END {p. 1720}	N_32 {p. 1525}
STATE_EFP {p. 3797}	STATE_EFP_CRASH_CAN {p. 1573}	T_AST {p. 1766}	T_ES {p. 1444}
TCO {p. 1100}	TCO_ST {p. 1100}	TIA {p. 1226}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_DLY_EFP_MAX_REQ	-	0... FFH	0... 255	1	-
Delay counter to activate maximum operation of the electrical fuel pump after first valid tooth detection					
C_CTR_KM_EFP_RUN_WKU	-	0... FFFFH	0... 655350	10	km
Activation threshold for electrical fuel pump operation during ECU wake-up					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_MAX_EFP_RUN_WKU	-	0... FFH	0... 255	1	-
Counter to define the maximum number of ECU wake-up events without engine operation.					
C_FUP_EFP_MEM_L_DIF	-	0... FFFFH	0... 173888	2.65336079	hPa
Fuel pressure difference to store values for start pressure decrease observation					
C_FUP_EFP_ST_H_MIN	-	0... FFFFH	0... 173888	2.65336079	hPa
Start fuel pressure level to store values for start pressure increase observation in any case					
C_FUP_EFP_THD_PRE_RUN	-	0... FFFFH	0... 173888	2.65336079	hPa
Threshold for activation of EFP pre run					
C_FUP_MAX_EFP_RUN_WKU	-	0... FFFFH	0... 347776	5.30672159	hPa
Fuel pressure threshold to deactivate the electrical fuel pump during ECU wake-up					
C_N_MIN_EFP_MAX_REQ	-	0... FFH	0... 8160	32	rpm
Engine speed threshold to confirm EFP maximum fuel flow operation					
C_T_AST_EFP_MAX_REQ	-	0... FFFFH	0... 6553.5	0.1	s
Deactivation threshold for EFP maximum fuel flow operation dependent on time after engine start					
C_T_DLY_EFP_RUN_WKU	-	0... FFFFH	0... 655.35	0.01	s
Delay time to deactivate EFP wake-up function when the fuel pressure reach the defined limit					
C_T_EFP	-	0... FFFFH	0... 2621.4	0.04	s
Pre- and post operation time for the electrical fuel pump					
C_T_MAX_EFP_RUN_WKU	-	0... FFFFH	0... 655.35	0.01	s
Maximum time of electric fuel pump operation after ECU reset					
C_T_MIN_EFP_RUN_WKU	-	0... FFFFH	0... 655.35	0.01	s
Maximum time of electric fuel pump operation after ECU reset					
C_TCO_MEM_FUP_EFP_L_TOL	-	0... FEH	-48... 142.5	0.75	°C
Coolant temperature threshold to start fuel pressure decrease observation					
C_TCO_ST_EFP_MAX_REQ	-	0... FEH	-48... 142.5	0.75	°C
Activation threshold dependent on engine start temperature used for EFP maximum fuel flow request					
C_TIA_FUP_EFP_L_HYS	-	0... FEH	0... 190.5	0.75	°C
Intake temperature hysteresis for fuel pressure decrease observation					
C_VFF_EFP_ADD	-	0... FFH	0... 255	1	l/h
Additive value for the amount of fuel from the pump					
IP_IDX_EFP_RUN_WKU	-	0... 1H	0 ...1	1	-
LDP_T_ES_ID_IDX_EFP_RUN_WKU	4	0... FFFFH	0... 65535	1	min
LDP_TCO_ST_ID_IDX_EFP_RUN_WKU	6	0... FEH	-48... 142.5	0.75	°C
Deactivation condition for electrical fuel pump operation during ECU wake-up					
LC_EFPPWM_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual EFPPWM					
LC_FUP_EFP_LIH_ON_SYM	-	0... 1H	0 ...1	1	-
Switch to define if limp home of EFP pump is requested on raw error symptom of fuel low pressure sensor, additionally					


### General information:

The electrical fuel pump is controlled by the EFPPWM.

The PI-controller is used to compensate deviations from the nominal fuel pressure after the fuel pump.

In this module the switching conditions for the main module are calculated. This includes also limp home and crash reactions. Application Condition

### Application conditions:

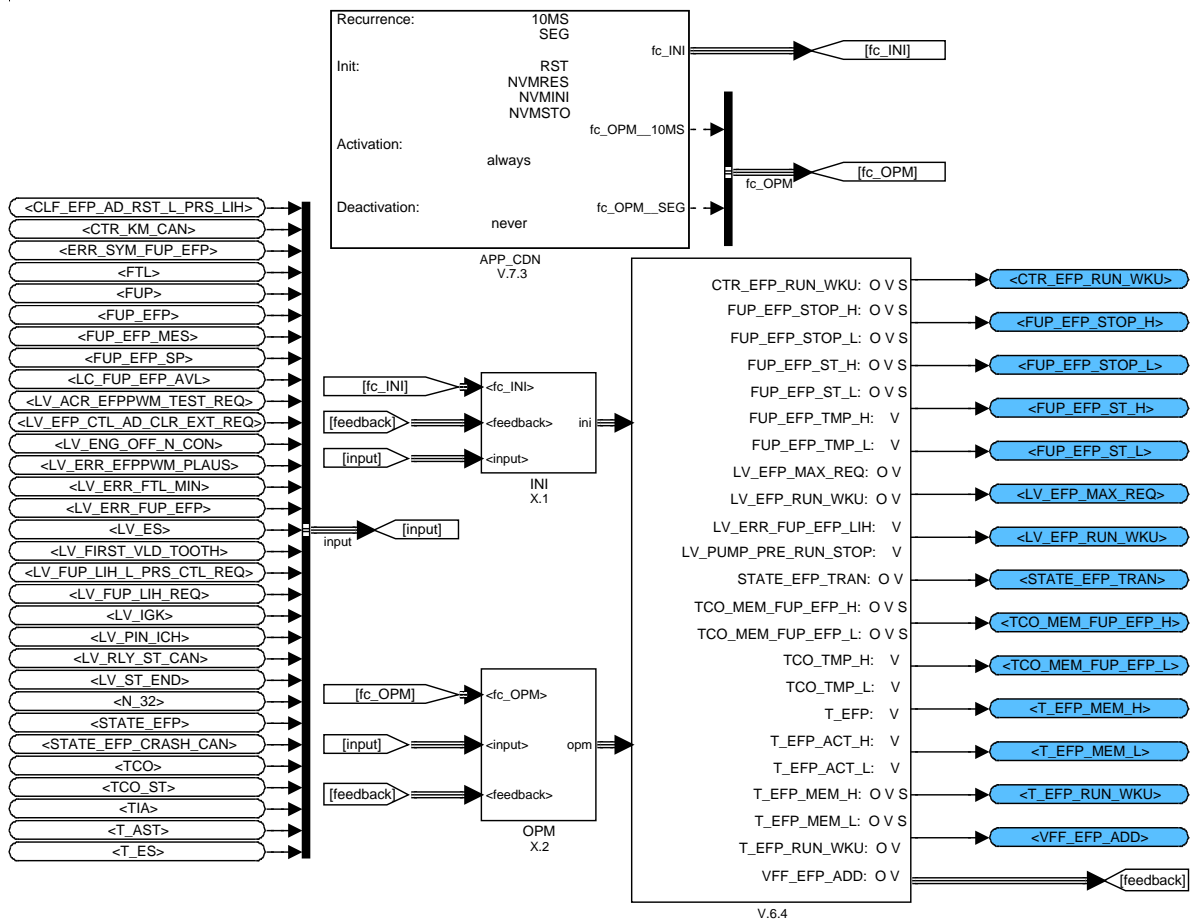
Released by Tetenborn Frank		Date 2013-02-13	File 6X904I01.001
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 3824 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11



**Initialisation:** RST, NVMRES, NVMINI, NVMSTO  
**Recurrence:** 10MS, SEG  
**Activation:** always  
**Deactivation:** never

**Function description:**

**Formula section:**



SDA\_SRS / SDA V 6.1.1 / 25-Feb-2011

Figure 9.29.1: :

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### 9.29.1 Initialization

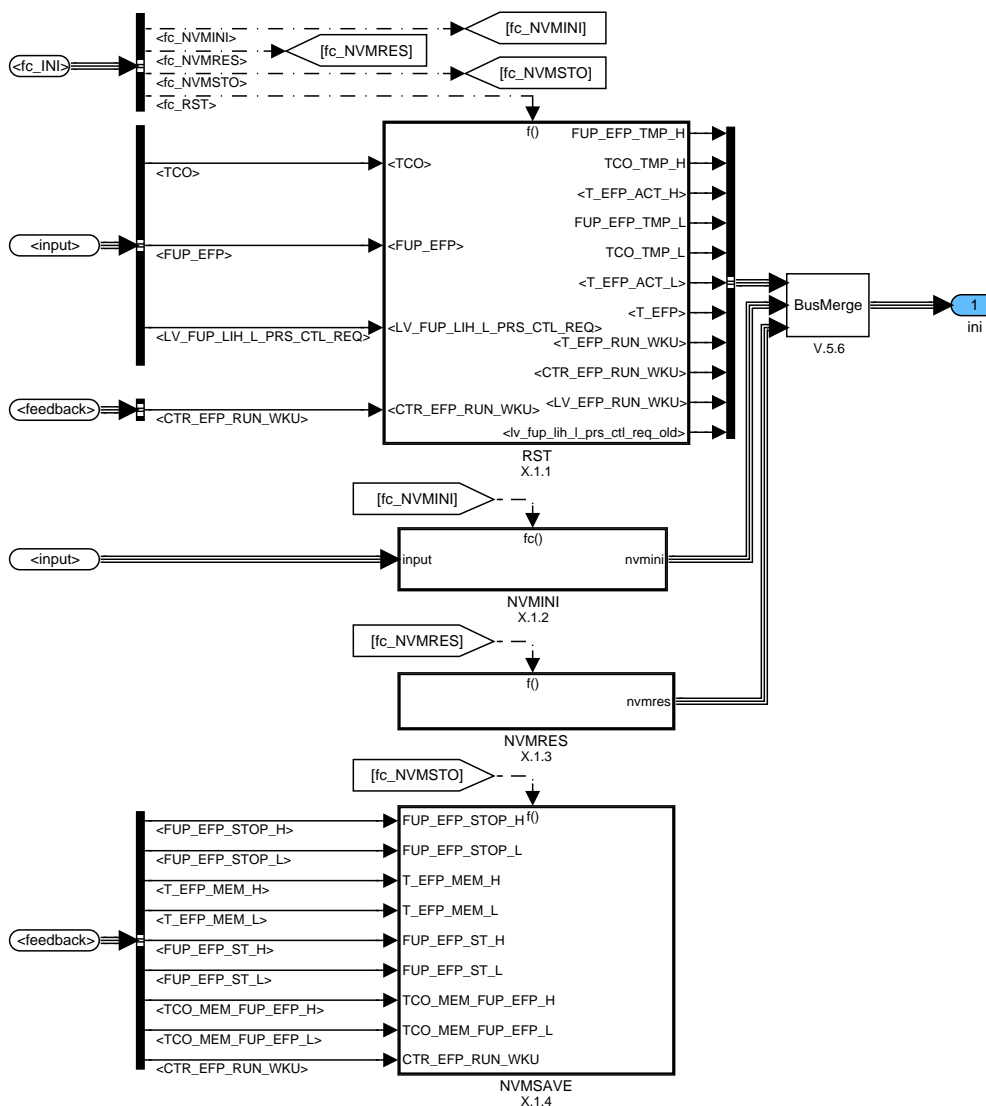


Figure 9.29.2: :

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### 9.29.1.1 Initialization during Reset

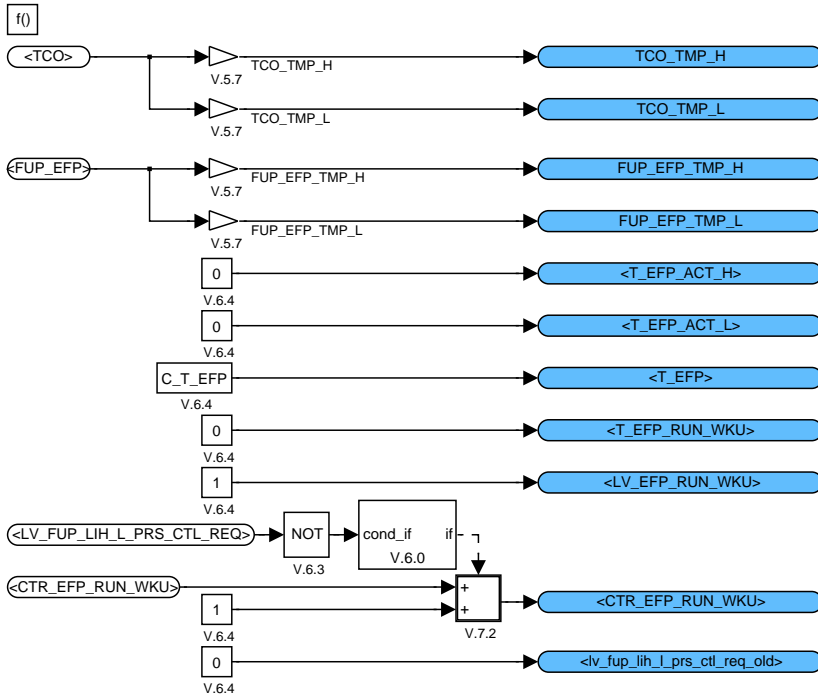


Figure 9.29.3: :

### 9.29.1.2 NVMY Initialization

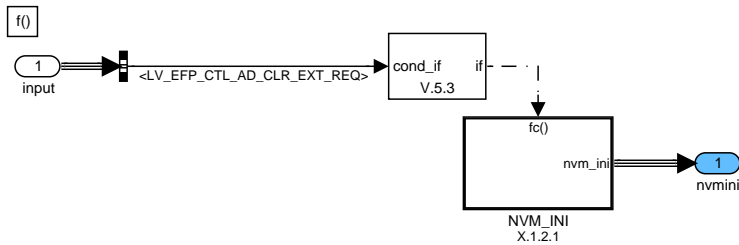


Figure 9.29.4: :

#### 9.29.1.2.1 Initialization with FFFFH or FEH

If EEPROM error or ECU brandnew or cleared by service tool then the outputs are initialised with FFFFH or FEH

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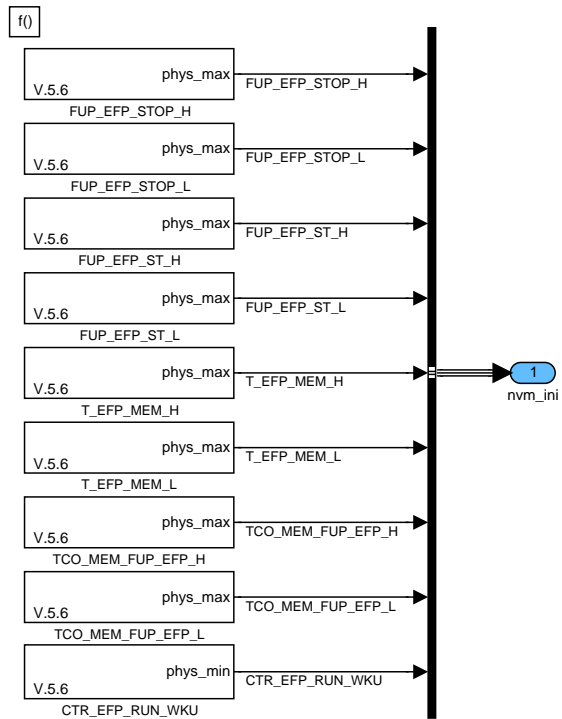


Figure 9.29.5: :

### 9.29.1.3 NVMY Restore

In this part outputs are initialised by EEPROM value.

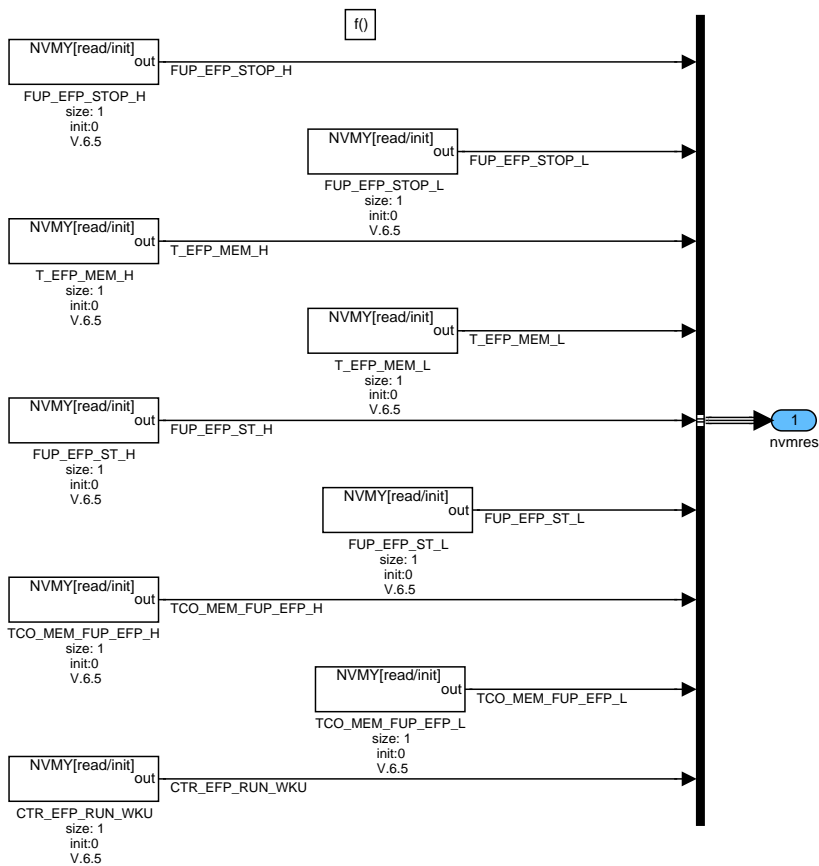


Figure 9.29.6: :

### 9.29.1.4 NVMY Save

In this part outputs are saved on the EEPROM

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	Document key 10171571 SPE 000 AO	Pages Page 3829 of 8404	
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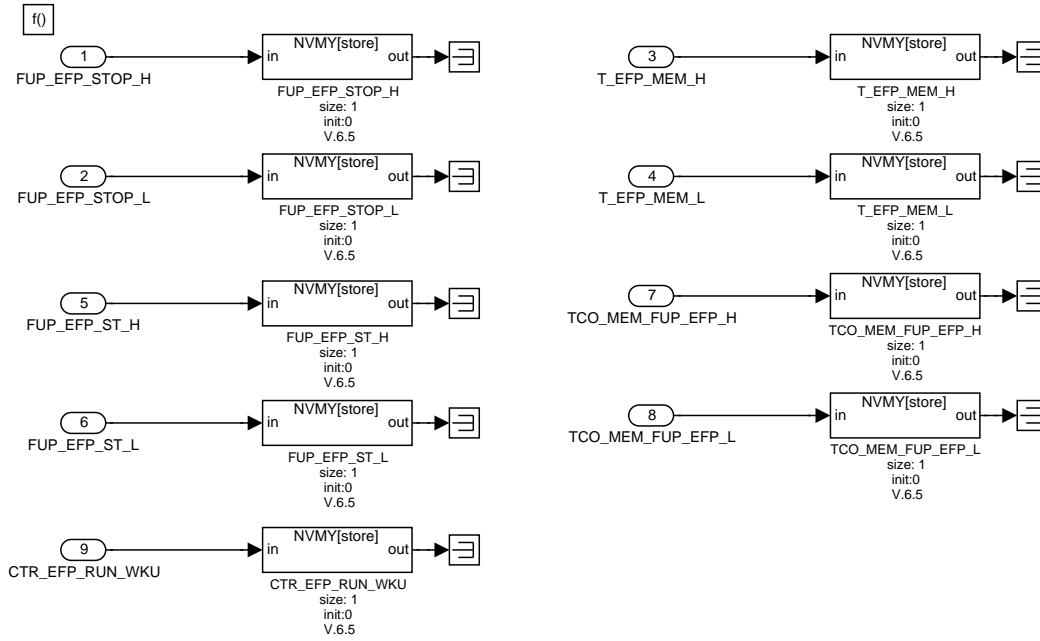



Figure 9.29.7: :

### 9.29.2 Electrical fuel pump control transition

The function is consisting out of the timer calculation for the EFP and the transition and limp home calculation. Additionally a calculation part for pressure increase and decrease observation is included

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 3830 of 8404</b>	
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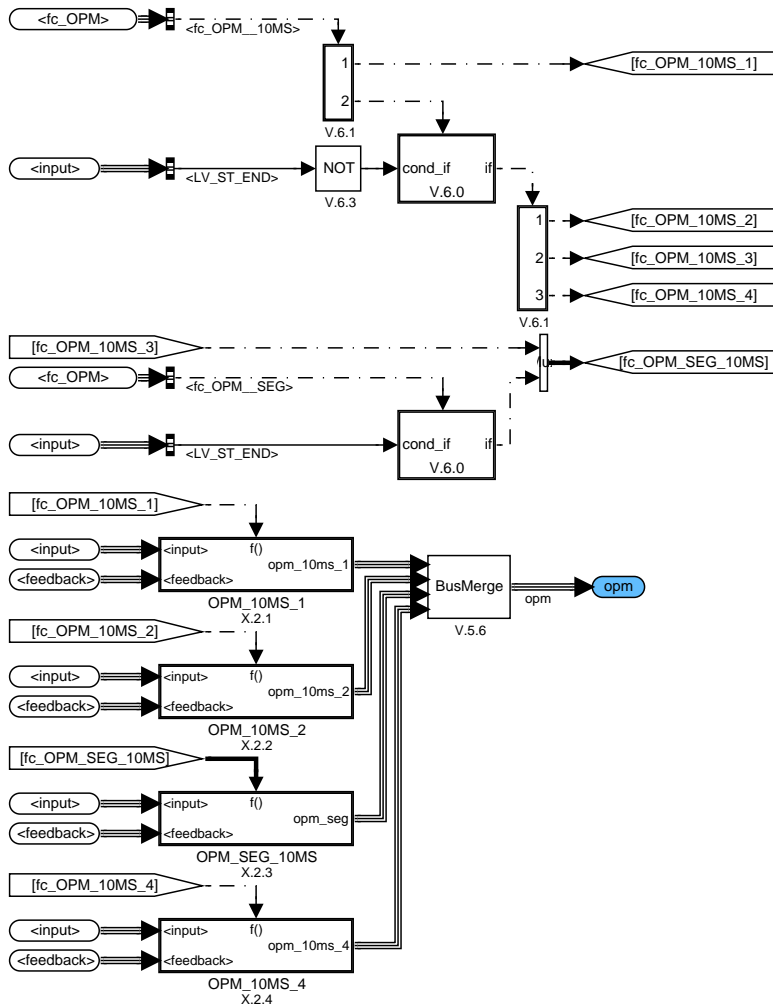


Figure 9.29.8: :

### 9.29.2.1 10ms task (always active)

The calculation of the low pressure system observation is split into a calculation for the high part and on calculation for the low part. Each part has an output for the start pressure, stop pressure, coolant temperature and the time for rising/falling pressure.

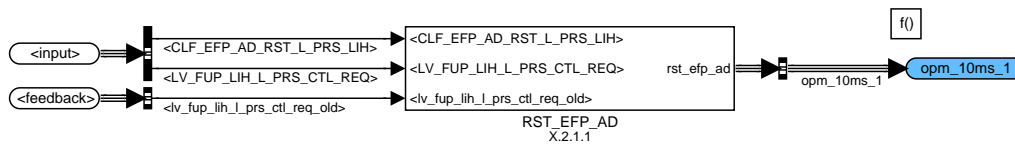



Figure 9.29.9: :

#### 9.29.2.1.1 Reset of low pressure adaptation values depending on low pressure limp home request

The low pressure adaptation values are individually reset on rising edge of low pressure limp home request depending on CLF\_EFP\_AD\_RST\_L\_PRS\_LIH.

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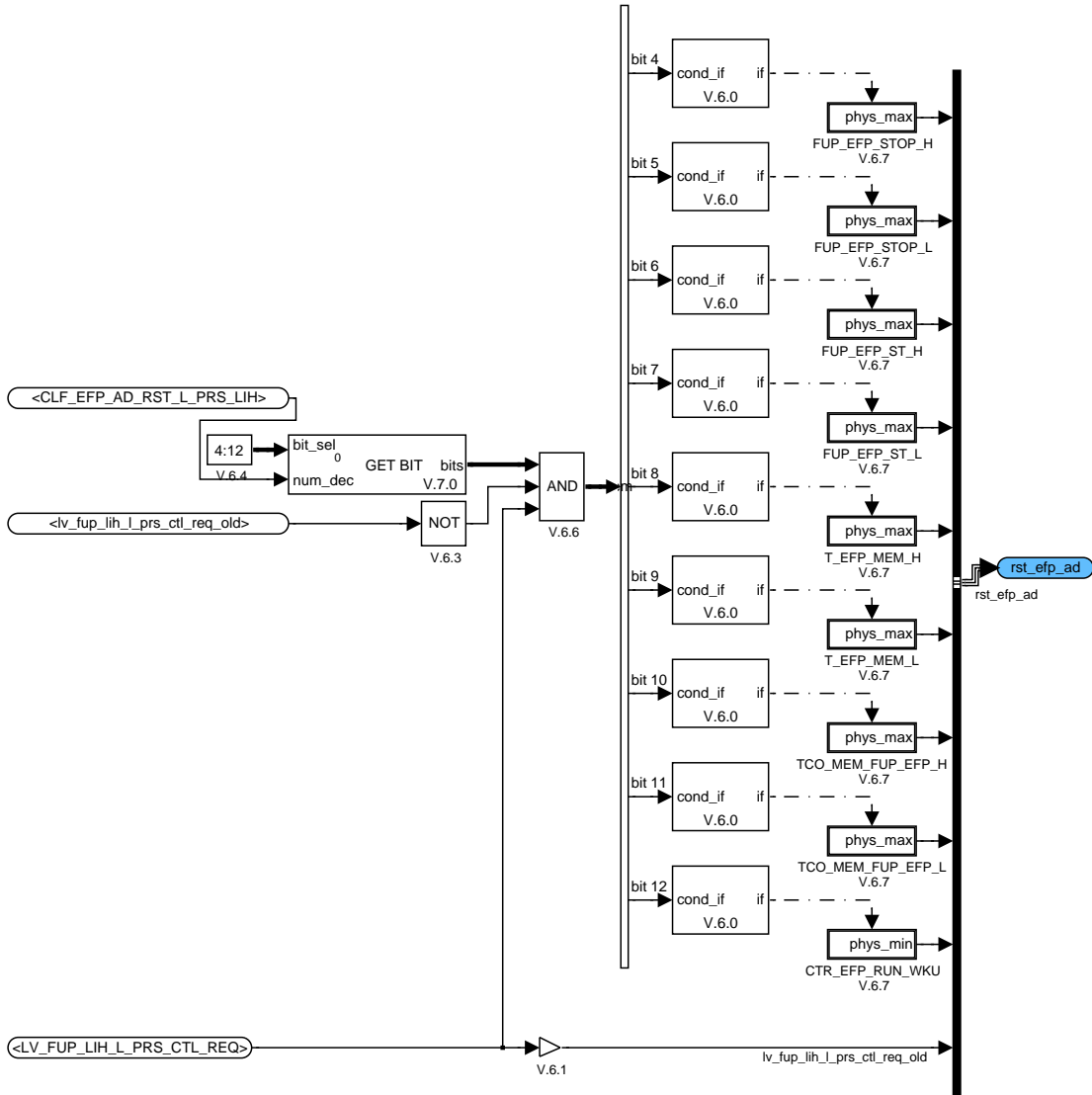


Figure 9.29.10: :

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### 9.29.2.2 10ms task (active on LV\_ST\_END == 0)

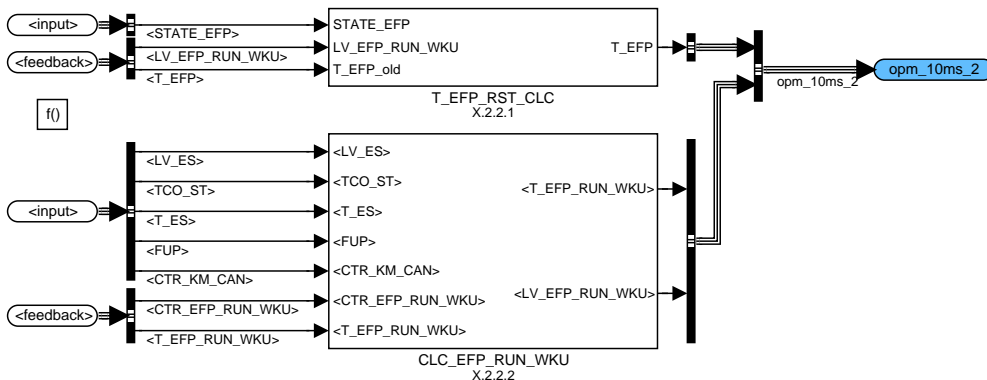


Figure 9.29.11: :

#### 9.29.2.2.1 Reset of the timer

The reset of the timer is calculated according to the following module.

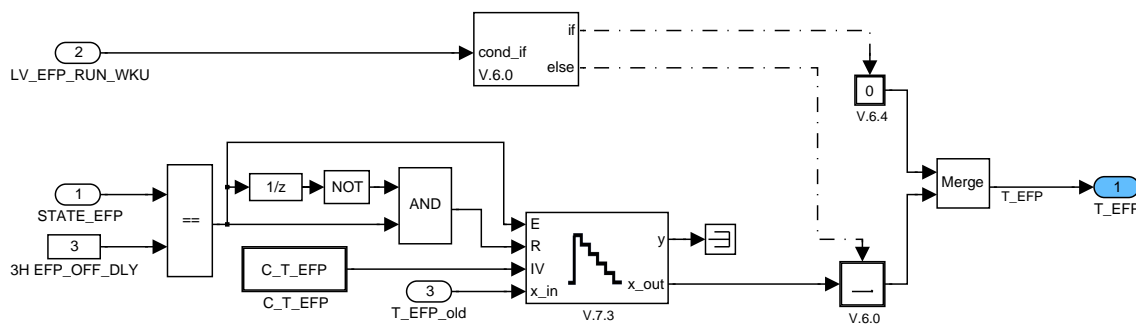


Figure 9.29.12: :

#### 9.29.2.2.2 Activation of electrical fuel pump during ECU wake-up

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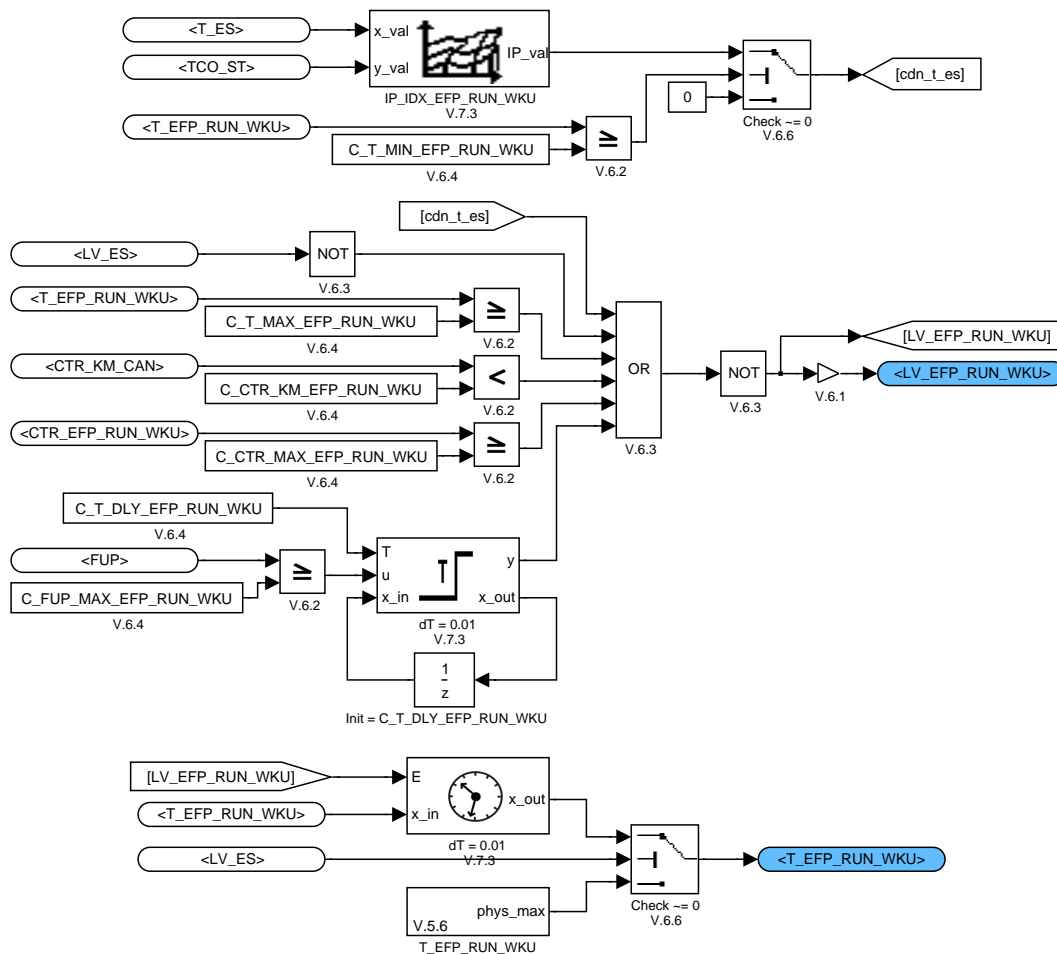



Figure 9.29.13: :

### 9.29.2.3 Segment task (active on LV\_ST\_END == 1) or 10ms task (active on LV\_ST\_END == 0)

This module is consisting out of the transition condition calculation, the addition flow calculation and the limp home determination

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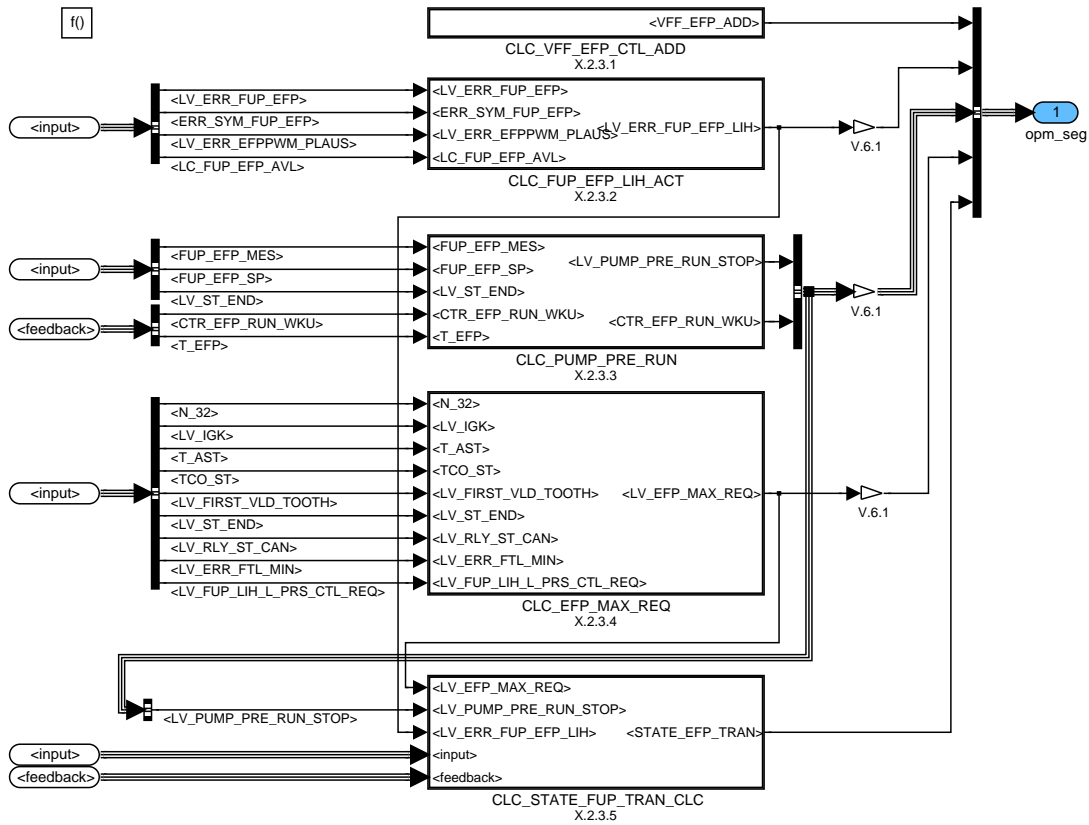


Figure 9.29.14: :

### 9.29.2.3.1 Volume fuel flow

An additional offset for the requested flow by the low pressure pump can be adjusted with the following constant.

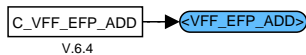


Figure 9.29.15: :

### 9.29.2.3.2 Limp home active

The limp home for the low pressure fuel pump is triggered by different error flags.

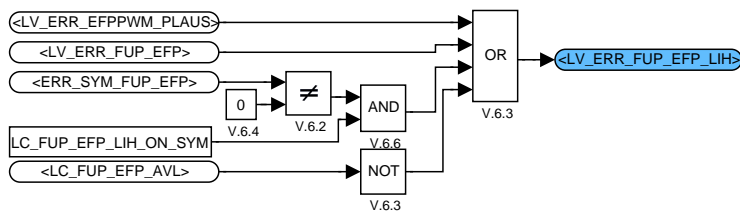



Figure 9.29.16: :

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### 9.29.2.3.3 Pump pre-run calculation

The pre-run of the low pressure pump is stopped when the fuel pressure set point of the low pressure pump has been reached by the measured fuel pressure (without filtering) or the timer has expired.

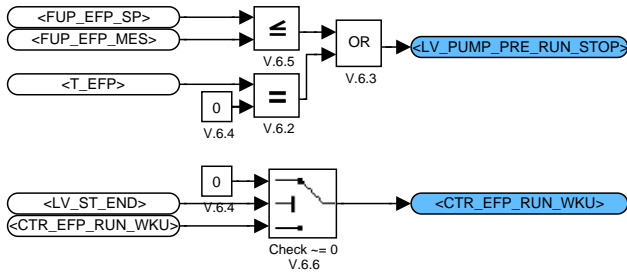


Figure 9.29.17: :

### 9.29.2.3.4 Calculation of maximum request for electrical fuel pump

Maximum fuel flow by electrical fuel pump is requested in case of hot start conditions.

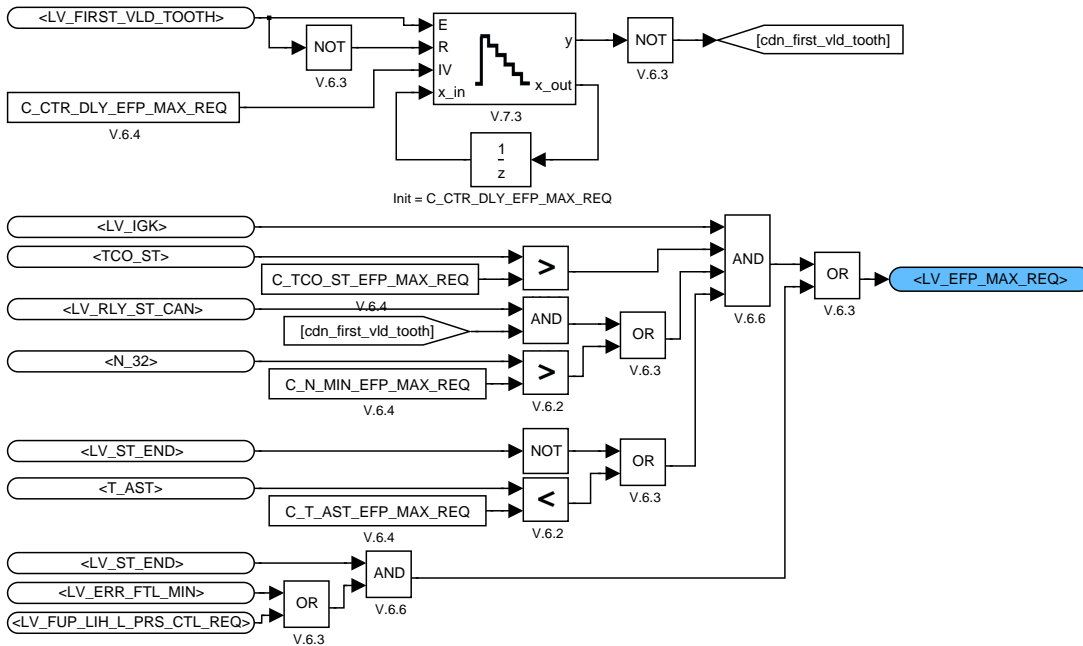


Figure 9.29.18: :

### 9.29.2.3.5 State fuel pressure transition calculation

The transition conditions are split into two parts due to a better overview.

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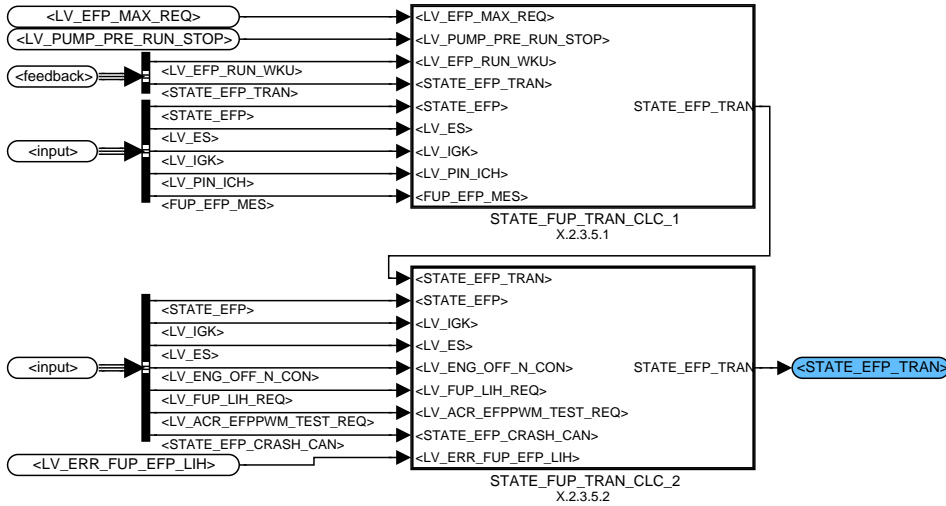


Figure 9.29.19: :

### 9.29.2.3.5.1 State fuel pressure transition calculation 1

In this part the first part of the transition conditions for the EFP state diagram are calculated.

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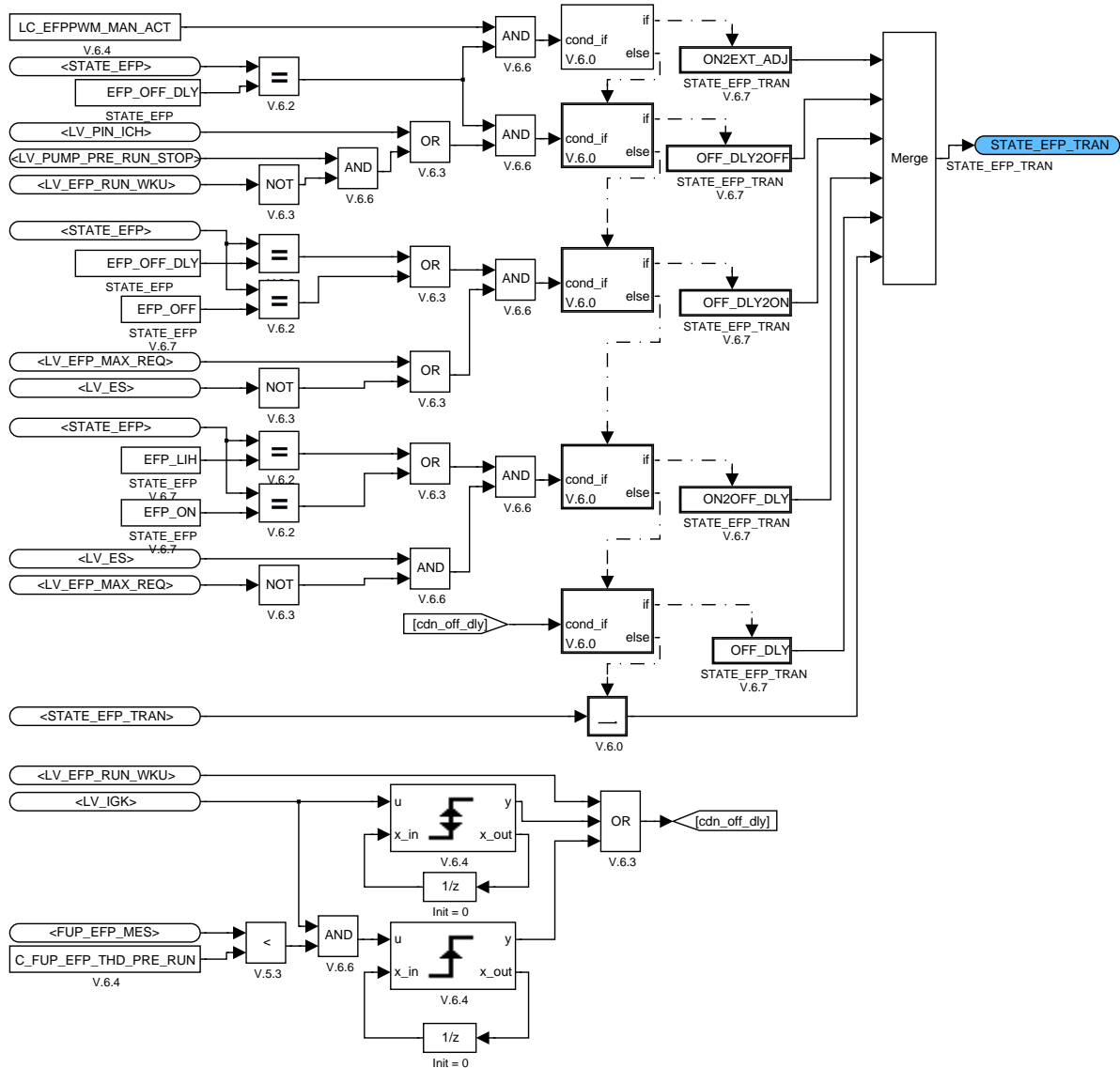


Figure 9.29.20: :

### 9.29.2.3.5.2 State fuel pressure transition calculation 2

In this part the first part of the transition conditions for the EFP state diagram are calculated. Main parts are the limp home conditions and the safety and security reasons.

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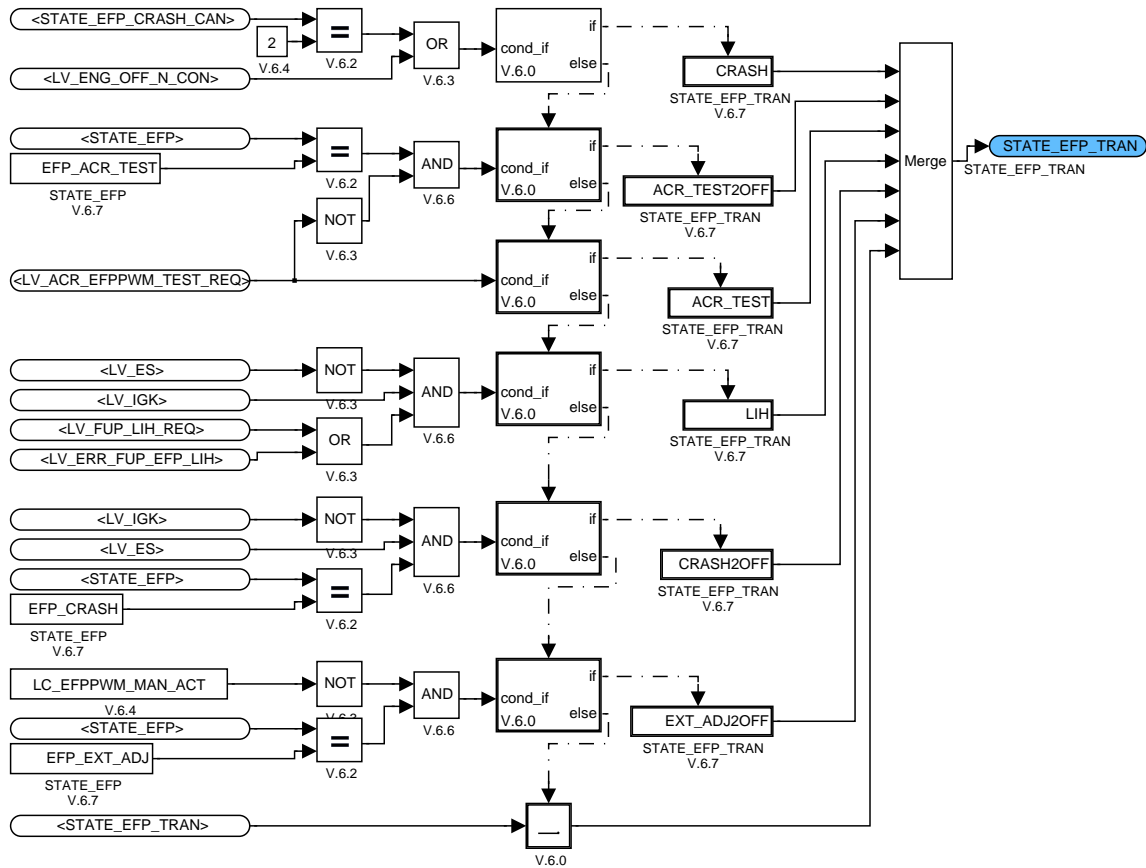


Figure 9.29.21: :

### 9.29.2.4 10m task (active on LV\_ST\_END == 0)

The calculation of the low pressure system observation is split into a calculation for the high part and on calculation for the low part. Each part has an output for the start pressure, stop pressure, coolant temperature and the time for rising/falling pressure.

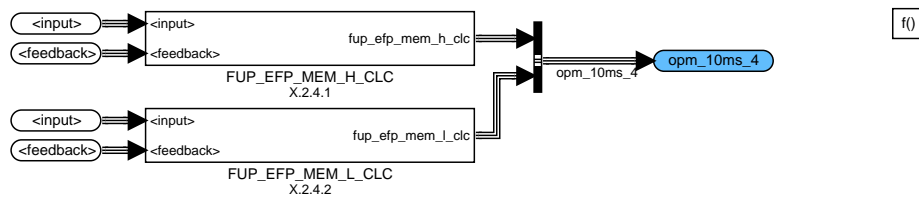


Figure 9.29.22: :

#### 9.29.2.4.1 Electrical fuel pump memorize high calculation

In this part the high signals are calculated

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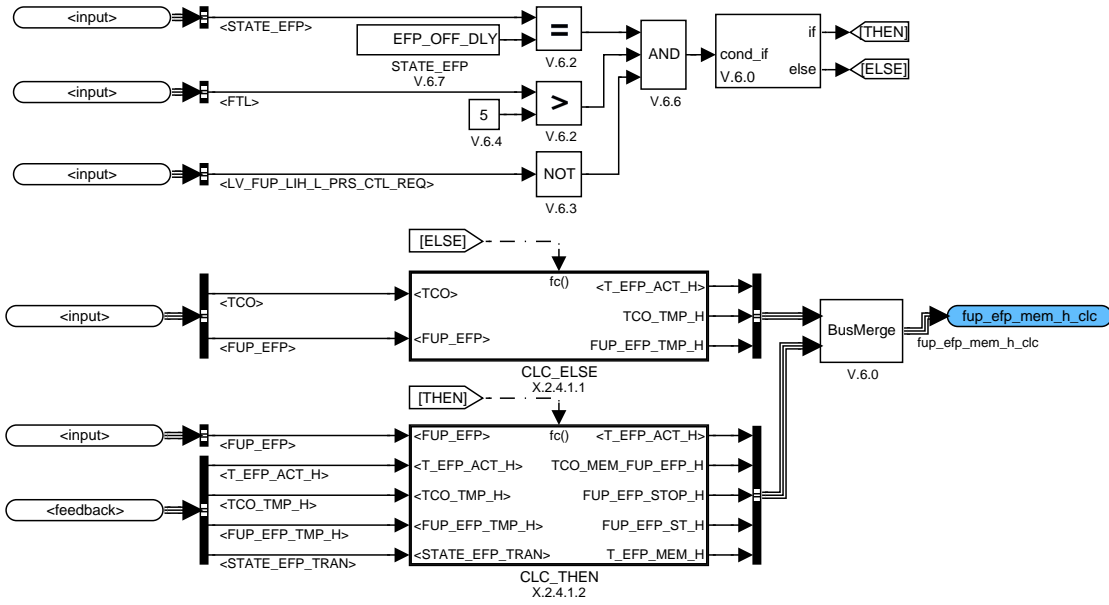


Figure 9.29.23: :

9.29.2.4.1.1 ELSE

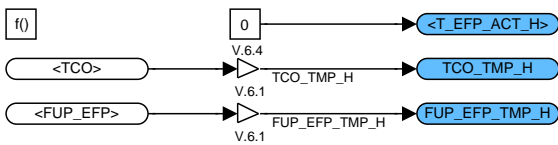


Figure 9.29.24: :

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9.29.2.4.1.2 THEN

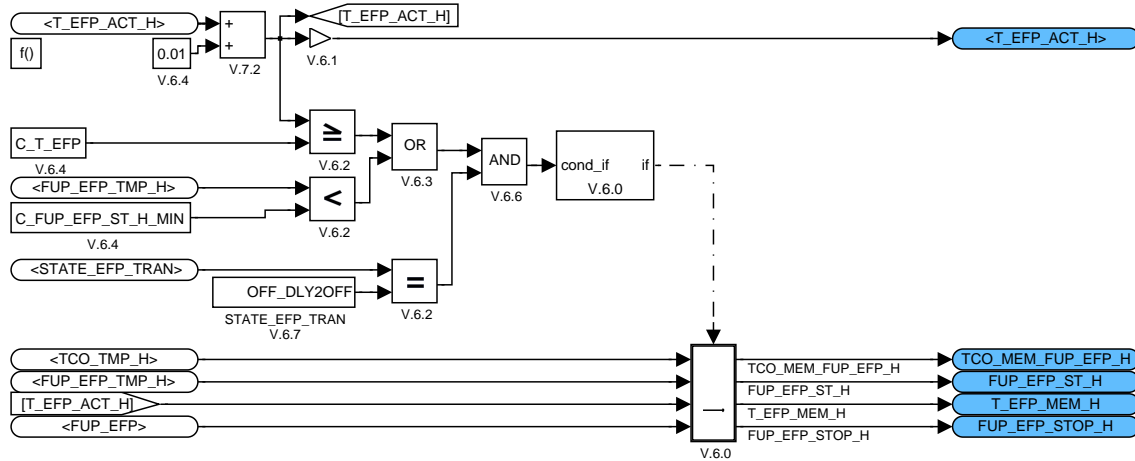


Figure 9.29.25 :

9.29.2.4.2 Electrical fuel pump memorize low calculation

In this part the low signals are calculated.

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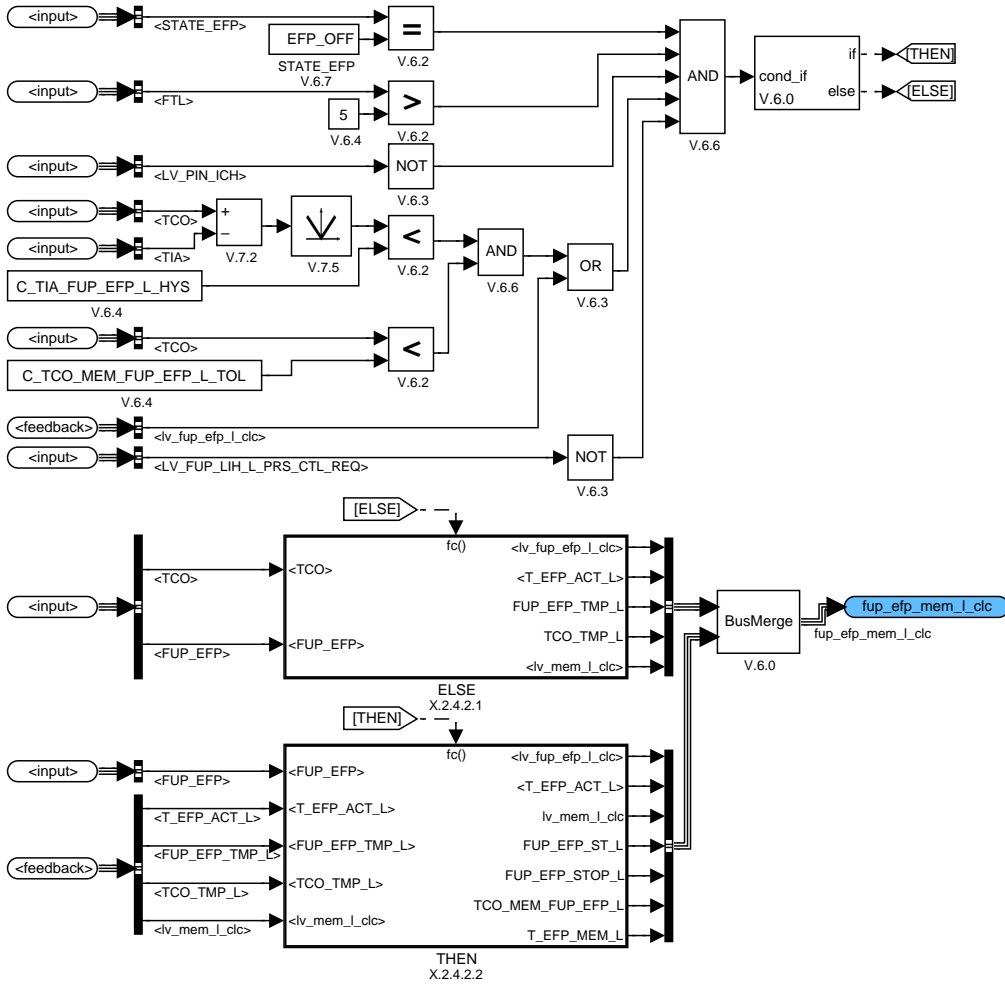


Figure 9.29.26: :

9.29.2.4.2.1 ELSE

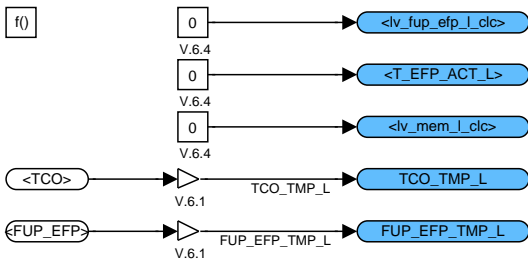


Figure 9.29.27: :

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9.29.2.4.2.2 THEN

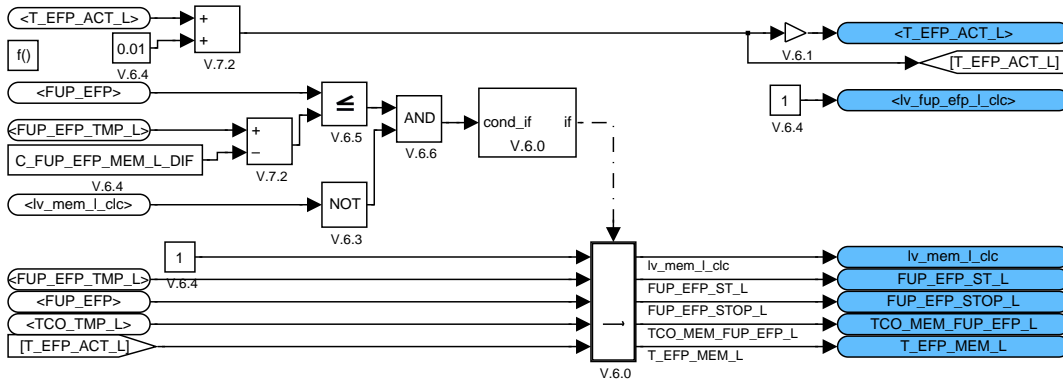



Figure 9.29.28: :

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## 9.30 Starter relay control

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_RLY_ST	O/V	0... 1H	0 ...1	1	-
Starter relay output					

### Input data:

LV_ACT_RLY_ST_EXT_ADJ {p. 7432}	LV_RLY_ST_EXT_ADJ {p. 7434}	N_32 {p. 1525}	TCO {p. 1100}
------------------------------------	--------------------------------	----------------	---------------

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_N_MAX_TOL_STR	-	0... FFH	0... 8160	32	rpm
LDPM_TCO_9	9	0... FEH	0... 142.5	0.75	°C
Top level end of starter relay control					

### General information:

The function is defined to switch the starter relay output, dependent on the engine speed. An interface for external adjustment is offered. Through the action call is the ECU pin level "Starter Relay " set.

### Application Condition

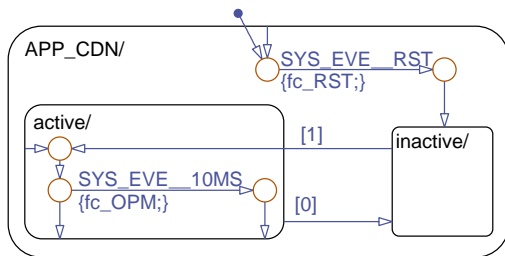


Figure 9.30.1: ENSS\_M9015/APP\_CDN/Chart

### Function Description

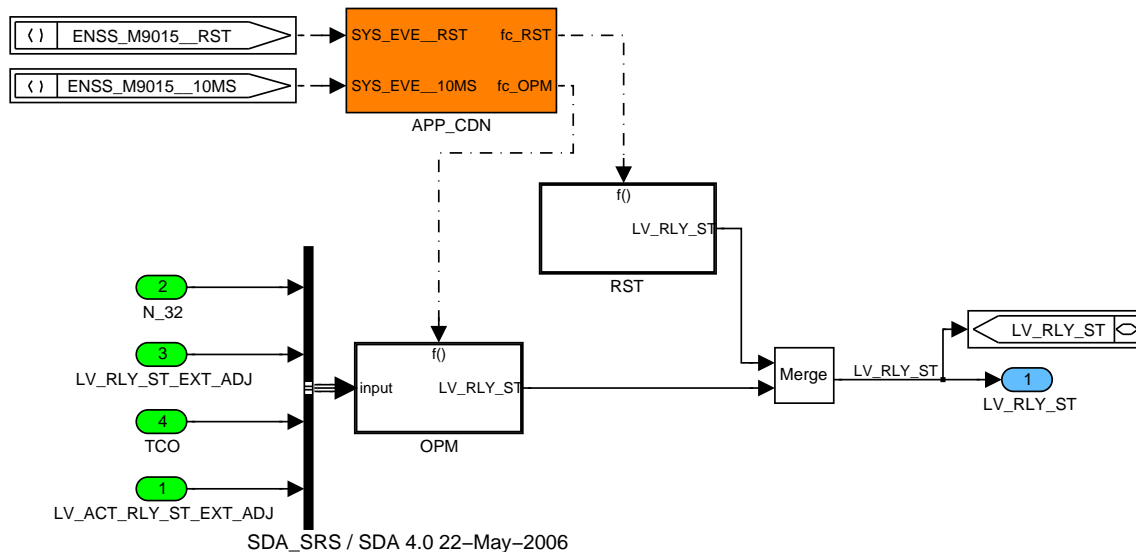


Figure 9.30.2: ENSS\_M9015

### 9.30.1 Initialization at Reset



Figure 9.30.3: ENSS\_M9015/RST

### 9.30.2 Formula section

#### Activation of Starter Relay

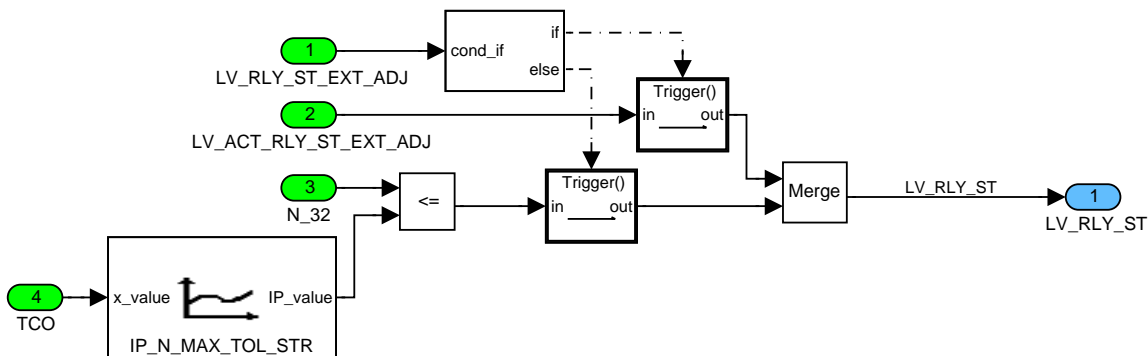



Figure 9.30.4: ENSS\_M9015/OPM/CLC\_LV\_RLY\_ST

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## 9.31 Fuel consumption calculation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_VS_MIN_FCO	V	0... FFH	0... 255	1	-
Counter indicating time since VS is below threshold					
FAC_FCO_FIL [2]	V	0... FFFFH	0... 0.99998	15.3e-6	-
Filter factor for FCO filter					
FCO	O/V	0... FFFFFFFFH	0... 4294967295	1	μl
integrated fuel consumption					
FCO_AV	V	0... FFFFH	0... 65535	1	μl
actual fuel consumption					
FCO_AV_1	O/V	0... FFFFH	0... 65535	1	μl
actual fuel consumption					
FCO_AV_2	O/V	0... FFFFH	0... 65535	1	μl
actual fuel consumption					
FCO_AV_FIL [2]	V	0... FFFFFFFFH	0... 65535	15.3e-6	μl
actual fuel consumption filtered					
FCO_AV_MMV	O/V	0... FFFFH	0... 65535	1	μl
Moving mean value of the actual fuel consumption					
FCO_DMTL	O/V	0... FFFFFFFFH	0... 4294967295	1	μl
integrated fuel consumption DMTL					
FCO_FIL_DIF	V	7FFFFFFFH 80000000... H	2147483647 -2147483648...	-	μl
difference of actual and filtered actual fuel consumption					
FCO_FIL_DIF_FB	V	7FFFFFFFH 80000000... H	2147483647 -2147483648...	-	μl
Feedback part to FCO calculation of difference of actual and filtered actual fuel consumption					
FCO_MFF_ADD_CYL_CP	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass from the canister in the cylinder, temp. value for FCO calculation					
T_FAC_FCO_FIL [2]	V	0... FFH	0... 25.5	0.1	s
Filter time for FCO filter					
T_RAMP_FCO_FIL	V	0... FFFFH	0... 655.35	0.01	s
Timer to ramp down the FCO-filter					

### Input data:

EFF_SCC_AV {p. 6665}	FAC_FCO_KWP {p. 7541}	LV_AMT_ACT {p. 6658}	LV_DCC_INC_ACT {p. 6731}
LV_DCC_PUC_INH {p. 1565}	LV_ES {p. 1720}	LV_FCO_COR_REQ {p. 8242}	LV_GS_INC_ACT {p. 6718}
LV_IGK {p. 906}	LV_INH_PUC_CUS {p. 8209}	LV_LDM_PUC_INH {p. 6615}	LV_PUC {p. 1720}
LV_PUC_INH_TEMP_CAT {p. 8233}	LV_PUC_LOCK_TNT {p. 8199}	LV_PUC_REQ {p. 1720}	LV_PUC_SA_INH {p. 804}
LV_REQ_ISC {p. 3501}	MFF_ADD_CYL_CP {p. 3692}	MFF_SP [NC_CBK_EX_NR] {p. 2151}	MFF_SP_BAS {p. 8243}


MFF_SP_FCO_COR {p. 8243}	N_32 {p. 1525}	NC_CYL_NR {p. 1526}	NC_LAMB_REF [NC_CYL_NR] {p. 812}
OPM_AV {p. 8137}	SEG_NR {p. 1525}	VS {p. 1176}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FCO_AV	-	0... FFH	0... 0.99609	3.9063e-3	-
Correlation constant for moving mean value calculation of FCO					
C_CTR_VS_MIN_FCO	-	0... FFH	0... 255	1	-
Threshold of a counter (used in FCO calculation)					
C_FAC_MFF_FCO	-	0... FFFFH	0... 0.99998	15.3e-6	-
Transition factor MFF to FCO					
C_FAC_MFF_FCO_LAM_AD	-	0... FFH	0... 0.99609	3.9063e-3	-
weighting factor for using or not of lambda adaptation value for calculation of FCO					
C_FCO_DIF_GAIN	-	0... FFFFH	0 ...1	15.3e-6	-
Gain for P-controller					
C_FCO_DIF_MAX	-	0... FFFFH	0... 65535	1	µl
threshold to activate balance controller					
C_FCO_FIL_DIF_FB_MAX	-	7FFFFFFFH 80000000... H	2147483647 -2147483648...	-	µl
Maximum value of FCO_FIL_DIF_FB					
C_FCO_FIL_DIF_FB_MIN	-	7FFFFFFFH 80000000... H	2147483647 -2147483648...	-	µl
Minimum value of FCO_FIL_DIF_FB					
C_T_FAC_FCO_FIL_CUS [2]	-	0... FFH	0... 25.5	0.1	s
Filter constant for FCO filter during customer corrected fuel mass setpoint					
C_T_FAC_FCO_FIL_ISC [2]	-	0... FFH	0... 25.5	0.1	s
Filter constant for FCO filter during active idle speed controller in stratified mode					
C_T_RAMP_FCO_FIL	-	0... FFFFH	0... 655.35	0.01	s
Constant indicating speed of ramping down the FCO-filter					
C_VS_MIN_FCO	-	0... FFH	0... 255	1	km/h
Threshold for VS used in FCO calculation					
LC_FCO_COR_REQ_ENA	-	0... 1H	0 ...1	1	-
use corrected MFF_SP during NOx Trap regeneration and desulfurization for FCO calculation					
LC_FCO_COR_REQ_PUC	-	0... 1H	0 ...1	1	-
Freeze FCO calculation on LV_PUC = 1					
LC_FCO_COR_REQ_PUC_INH	-	0... 1H	0 ...1	1	-
Freeze FCO calculation on LV_PUC_REQ = 1 and inhibit LV_PUC					
LC_FCO_MFF_ADD_CYL_CP	-	0... 1H	0 ...1	1	-
use Canister fuel flow for FCO calculation					

**General information:**

The actual fuel consumption value ( FCO\_AV\_1 ) is calculated from MFF\_SP (incl. Lambdaadaptation) or MFF\_SP\_BAS (without Lam-ad) and several factors. During NOx regeneration additional FCO\_AV\_2 is calculated. This is not the real fuel mass, but it is used to avoid strong peaks in the FCO\_AV signal. If NOx regeneration, desulfurization or the idle speed controller during stratified mode is active, FCO\_AV is additionally filtered to avoid high gradients in the FCO signal. To ensure that the integrated fuel consumption (FCO) is still correct despite of the filtering and the use of FCO\_AV\_2 (-> FCO\_FIL\_DIF = 0), a balance controller (C\_FCO\_DIF\_GAIN) is activated to balance FCO over a certain time.

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## Application conditions

**Initialisation:** at reset **or** LV\_IGK 0->1: all = 0, except FCO\_DMTL = 0 only  
at reset and  
FCO\_FIL\_DIF = 0 only at reset

**Recurrence:** every segment,  
except calculation of T\_RAMP\_FCO\_FIL and FCO\_FIL\_DIF\_FB, 10ms  
recurrence

**Activation:** LV\_ES = 0

## Formula section:

```
// calculate FCO_AV_1
if          LC_FCO_MFF_ADD_CYL_CP = 1 // use Canister fuel flow for FCO calculation?
then       FCO_MFF_ADD_CYL_CP = MFF_ADD_CYL_CP
else       FCO_MFF_ADD_CYL_CP = 0
endif

// calculate FCO_AV_1 using MFF_SP with Lambda adaption (C_FAC_MFF_FCO_LAM_AD=1) or with-
// out
FCO_AV_1 = (MFF_SP[NC_LAMB_REF[SEG_NR]] * C_FAC_MFF_FCO_LAM_AD + MFF_SP_BAS *
(1 - C_FAC_MFF_FCO_LAM_AD) + FCO_MFF_ADD_CYL_CP) * C_FAC_MFF_FCO * 46 * EFF_SCC_
AV * (1 + FAC_FCO_KWP)
```

*// calculate a second FCO during regeneration and desulfurization (not real mass fuel flow, used for filtering strong amplitudes due to regeneration):*

```
if          LV_FCO_COR_REQ = 1          and
          LC_FCO_COR_REQ_ENA = 1

Then       FCO_AV_2 = MFF_SP_FCO_COR * C_FAC_MFF_FCO * 46 * EFF_SCC_AV * (1 +
FAC_FCO_KWP)
          FCO_AV = FCO_AV_2

Else       FCO_AV = FCO_AV_1
          FCO_AV_2 = FCO_AV_1

Endif
```

```
// calculate FCO_DMTL and FCO_AV_MMV
FCO_DMTLn      = FCO_DMTL(n-1) + FCO_AV
FCO_AV_MMV(n)   = FCO_AV_MMV(n-1)
          + C_CRLC_FCO_AV * (FCO_AV - FCO_AV_MMV(n-1))
```

*// initialize filter factors if requested*

```
if          LV_FCO_COR_REQ = 1

Then       //activation of filter in case of customer corrected fuel mass setpoint:
          T_FAC_FCO_FIL[i] = C_T_FAC_FCO_FIL_CUS[i]

Elseif     (OPM_AV = 1 or OPM_AV = 3) and LV_REQ_ISC = 1

Then       //activation of filter in case of active idle speed controller in stratified mode:
          T_FAC_FCO_FIL[i] = C_T_FAC_FCO_FIL_ISC[i]

Endif
```

*// calculate filter outputs:*

```
if          T_FAC_FCO_FIL[1] > 0 or T_FAC_FCO_FIL[2] > 0
Then       if          LV_FCO_COR_REQ = 0          and
```



```

                [(OPM_AV != 1 and OPM_AV != 3) or LV_REQ_ISC = 0]
then // ramp filter time/factors -> until FAC_FCO_FIL[i] = 0:
if     T_RAMP_FCO_FIL >= C_T_RAMP_FCO_FIL
then   T_RAMP_FCO_FIL = 0
        T_FAC_FCO_FIL[i] = T_FAC_FCO_FIL[i] - 0,1s
else   do nothing
endif

Endif
// calculate filter factor FAC_FCO_FIL from filter time T_FAC_FCO and segment time (cal-
// culated from N_32):
FAC_FCO_FIL[i] = 1 / ( 1 + T_FAC_FCO_FIL[i] / (120 / (N_32 * NC_CYL_NR)) )
// calculate filter outputs:
FCO_AV_FIL[1](n)    =    FAC_FCO_FIL[1] * FCO_AV
                    + (1 - FAC_FCO_FIL[1]) * FCO_AV_FIL[1](n-1)
FCO_AV_FIL[2](n)    =    FAC_FCO_FIL[2] * FCO_AV_FIL[1](n)
                    + (1 - FAC_FCO_FIL[2]) * FCO_AV_FIL[2](n-1)
Else   FCO_AV_FIL[i]    =    FCO_AV //converted
Endif

// calculate FCO:
if     [LV_PUC = 1 and LC_FCO_COR_REQ_PUC = 1] or
        // no FCO display on fuel cut off


        [LV_PUC_REQ = 1 and LV_PUC = 0 and LC_FCO_COR_REQ_PUC_INH = 1 and
        (LV_PUC_INH_TEMP_CAT = 1 or LV_PUC_LOCK_TNT = 1) and
        LV_LDM_PUC_INH = 0 and LV_DCC_PUC_INH = 0 and LV_AMT_ACT = 0 and LV_
        PUC_SA_INH = 0 and LV_DCC_INC_ACT = 0 and LV_GS_INC_ACT = 0 and LV_INH_
        PUC_CUS = 0]
        // no FCO display on requested but inhibited fuel cut off

Then
        // fuel consumption display in instrument cluster is deactivated
        FCO(n) = FCO(n-1)
        FCO_FIL_DIF(n) = FCO_FIL_DIF(n-1) + FCO_AV_1

Else
if     abs( FCO_FIL_DIF ) > C_FCO_DIF_MAX or
        LV_FCO_COR_REQ = 1 or
        [(OPM_AV = 1 or OPM_AV = 3) and LV_REQ_ISC = 1]

Then
        //check speed of vehicle, in case VS < threshold -> fuel consumption display in instrument
        cluster is deactivated -> thus complete adding of FCO difference (FCO_FIL_DIF) to FCO
        signal can be done:
IF     VS < C_VS_MIN_FCO
THEN   CTR_VS_MIN_FCO ++
ELSE   CTR_VS_MIN_FCO = 0
ENDIF
        // for the following calculations FCO_AV_FIL[2] has to be converted!
IF     CTR_VS_MIN_FCO <= C_CTR_VS_MIN_FCO
THEN
        // calculate integrated fuel consumption with filter output and controller output:
        FCO(n) = FCO(n-1) + FCO_AV_FIL[2] + FCO_FIL_DIF_FB

```

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*//calculate fuel difference between FCO\_AV\_1 and filter+controller output (integrated):*

```
FCO_FIL_DIF(n)      = FCO_FIL_DIF(n-1)
                    + [ FCO_AV_1 - FCO_AV_FIL[2] ]
                    - FCO_FIL_DIF_FB
```

*//reset of FCO\_FIL\_DIF\_FB:*

```
FCO_FIL_DIF_FB = 0
```

**ELSE**

*// calculate integrated fuel consumption with FCO\_AV\_1 (real FCO) and add complete FCO difference:*

```
FCO(n) = FCO(n-1) + FCO_AV_1 + FCO_FIL_DIF
```

*//reset FCO\_FIL\_DIF:*

```
FCO_FIL_DIF(n) = 0
```

*//reset of FCO\_FIL\_DIF\_FB:*

```
FCO_FIL_DIF_FB = 0
```

**ENDIF**

**Else** *// calculate integrated fuel consumption with FCO\_AV:*

```
FCO(n) = FCO(n-1) + FCO_AV
```

*// initialize values:*

```
FCO_FIL_DIF = 0
```

**Endif**

**Endif**

Calculation of Timer T\_RAMP\_FCO\_FIL (calculation with 10ms recurrence!):

**If** T\_RAMP\_FCO\_FIL < 655,35 s

**Then** T\_RAMP\_FCO\_FIL = T\_RAMP\_FCO\_FIL + 0,01s

**Else** do nothing

**Endif**

Calculation of FCO\_FIL\_DIF\_FB (calculation with 10ms recurrence!):

**IF** abs(FCO\_FIL\_DIF) > 0

**Then** **if** abs(FCO\_FIL\_DIF) < C\_FCO\_FIL\_DIF\_FB\_MIN

**Then**

```
FCO_FIL_DIF_FB = FCO_FIL_DIF
```

**Else**

*//calculate FCO\_FIL\_DIF\_FB and apply min/max check:*

```
FCO_FIL_DIF_FB_1 = min(C_FCO_FIL_DIF_FB_MAX,
                      abs(FCO_FIL_DIF)* C_FCO_DIF_GAIN)
```

```
FCO_FIL_DIF_FB = max(C_FCO_FIL_DIF_FB_MIN,
                    FCO_FIL_DIF_FB_1)
```

*//add correct sign to FCO\_FIL\_DIF\_FB:*

**If** FCO\_FIL\_DIF < 0

**Then** FCO\_FIL\_DIF\_FB = - FCO\_FIL\_DIF\_FB

**Else** unchanged

**Endif**

**Endif**

**Endif**

## 9.32 Sound flap

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_SOF_THD	V	0... FFFFH	0... 1.99996	30.5e-6	-
Switching threshold for sound flap					
FAC_TQ_SOF_THD_CTOP	V	0... FFFFH	0... 1.99996	30.5e-6	-
Switching threshold for sound flap without hysteresis					
LV_SOF	O/V	0... 1H	0 ...1	1	-
logical value sound flap (1 = activated)					
LV_SOF_SWI	O/V	0... 1H	0 ...1	1	-
Sport-mode switch acting					
LV_SOF_SWI_AMT	O/V	0... 1H	0 ...1	1	-
Sport-mode switch AMT acting					
LV_SOF_SWI_AMT_REQ	O/V	0... 1H	0 ...1	1	-
Sport-mode AMT required by switch					
LV_SOF_SWI_REQ	O/V	0... 1H	0 ...1	1	-
Sport-mode required by switch					
N_SOF	V	0... FFH	0... 8160	32	rpm
N for sound flap					
T_DLY_SOF	V	0... FFH	0... 25.5	0.1	s
Time delay for closing sound flap					
T_DLY_SOF_OPEN	V	0... FFH	0... 5.1	0.02	s
Time delay for opening sound flap					

### Input data:

CONF_SOF_SWI {p. 654}	FAC_TQ_REQ {p. 6706}	GEAR_EF {p. 1302}	LV_ACT_SOF_EXT_ADJ {p. 7433}
LV_AT {p. 654}	LV_CITY {p. 799}	LV_CTOP {p. 1565}	LV_ERR_BN_GEAR_REV {p. 4870}
LV_ERR_BN_VEH_MOD {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_SOF_INH_MON {p. 6790}	LV_ERR_SOF_REQ {p. 4911}
LV_ES {p. 1720}	LV_IGK {p. 906}	LV_SOF_EXT_ADJ {p. 7435}	LV_ST {p. 1720}
LV_VAR_BN {p. 655}	LV_VAR_SOF {p. 656}	N_32 {p. 1525}	STATE_SPT_DISP_CAN {p. 8289}
STATE_VEH_MOD {p. 1578}	T_AST {p. 1766}	V_SOF_SWI {p. 831}	VS {p. 1176}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQ_SOF_THD_HYS	-	8000... 7FFFH	-2... 1.99993	61e-6	-
Hysteresis for switching threshold sound flap					
C_N_SOF_HYS	-	0... FFH	0... 8160	32	rpm
N hysteresis SOF					
C_T_SOF_AST	-	0... FFH	0... 25.5	0.1	s
cranking time for SOF actuation active					
C_V_SOF_SWI_AMT_ON_TOL	-	0... 3FFFH	0... 4.99511	4.8828e-3	V
Voltage-threshold top limit for sport switch mode ON (AMT)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_V_SOF_SWI_ON_BOL	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Voltage-threshold bottom limit for sport switch mode ON					
C_V_SOF_SWI_ON_TOL	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Voltage-threshold top limit for sport switch mode ON					
C_VS_MIN_SOF_AT	-	0... FFH	0... 255	1	km/h
Speed threshold for continuously opened sound flap (automatic transmission)					
C_VS_MIN_SOF_MT	-	0... FFH	0... 255	1	km/h
Speed threshold for continuously opened sound flap (manuel transmission)					
ID_FAC_TQ_SOF_THD_CTOP_CLOSE_AT	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_N_SOF	10	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Switching threshold FAC_TQ_SOF for convertible top closed (automatic transmission)					
ID_FAC_TQ_SOF_THD_CTOP_CLOSE_MT	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_N_SOF	10	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Switching threshold FAC_TQ_SOF for convertible top closed (manuel transmission)					
ID_FAC_TQ_SOF_THD_CTOP_OPEN_AT	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_N_SOF	10	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Switching threshold FAC_TQ_SOF for convertible top open (automatic transmission)					
ID_FAC_TQ_SOF_THD_CTOP_OPEN_MT	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_N_SOF	10	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Switching threshold FAC_TQ_SOF for convertible top open (manuel transmission)					
ID_T_DLY_SOF_OPEN_CTOP_CLOSE_AT	V	0... FFH	0... 5.1	0.02	s
LDPM_N_SOF	10	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Time delay for opening sound flap for convertible top closed (automatic transmission)					
ID_T_DLY_SOF_OPEN_CTOP_CLOSE_MT	V	0... FFH	0... 5.1	0.02	s
LDPM_N_SOF	10	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Time delay for opening sound flap for convertible top closed (manuel transmission)					
ID_T_DLY_SOF_OPEN_CTOP_OPEN_AT	V	0... FFH	0... 5.1	0.02	s
LDPM_N_SOF	10	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Time delay for opening sound flap for convertible top open (automatic transmission)					
ID_T_DLY_SOF_OPEN_CTOP_OPEN_MT	V	0... FFH	0... 5.1	0.02	s
LDPM_N_SOF	10	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Time delay for opening sound flap for convertible top open (manuel transmission)					
IP_T_DLY_SOF	-	0... FFH	0... 25.5	0.1	s
LDP_N_32	8	0... FFH	0... 8160	32	rpm
Time delay for closing sound flap					

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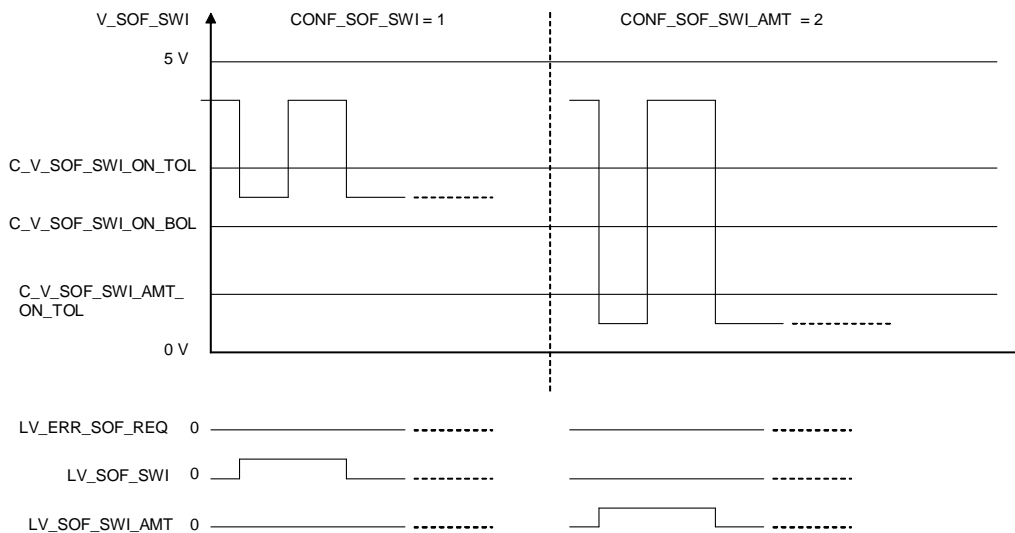
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_CONF_CITY_ENA	-	0... 1H	0 ...1	1	-
Enable condition regarding LV_CITY (1=on /0=off)					
LC_STATE_SOF_AST	-	0... 1H	0 ...1	1	-
State sound flap during C_T_SOF_AST					
LC_STATE_VS_MIN_SOF_AT	-	0... 1H	0 ...1	1	-
State sound flap in case of VS < C_VS_MIN_SOF_AT (automatic transmission)					
LC_STATE_VS_MIN_SOF_MT	-	0... 1H	0 ...1	1	-
State sound flap in case of VS < C_VS_MIN_SOF_MT (manuel transmission)					
LC_VAR_SOF_SWI	-	0... 1H	0 ...1	1	-
Calibration switch for sport switch (1=on /0=off)					
LC_VAR_SOF_SWI_AMT	-	0... 1H	0 ...1	1	-
Calibration switch for sport switch in AMT vehicles (1=on /0=off)					

### 9.32.1 Acquisition of sport-mode-switch

#### General information:

Calculation of the sport-mode request by taking the voltage of the sport-mode-switch.  
The request acts according to the rising edge of the voltage signal.  
There must be for 3 cycles the same result of LV\_SOF\_SWI(\_AMT) to accept the level.

#### Signal flow diagram:



In case of failure LV\_ERR\_SOF\_REQ =1 inhibition of LV\_SOF\_SWI(\_AMT):

#### Application conditions

**Initialisation:** all variables are initialised with 0 at:  
reset or LV\_ES = 0- ->1

**Recurrence:** 10ms  
**Activation:** every engine state

**Formula section:**

**If (1)** LV\_VAR\_BN = 0

**Then (1)**

**If(2)** LV\_ERR\_SOF\_REQ = 0

**Then(2)**

**If(3)** (V\_SOF\_SWI > C\_V\_SOF\_SWI\_ON\_TOL) changes to  
(C\_V\_SOF\_SWI\_ON\_BOL V\_SOF\_SWI C\_V\_SOF\_SWI\_ON\_TOL)  
(equal to 0 ->1)

**And** this result is valid for 3 evaluations

**Then(3)** LV\_SOF\_SWI = ! LV\_SOF\_SWI

**Endif(3)**

**If(4)** (V\_SOF\_SWI > C\_V\_SOF\_SWI\_AMT\_ON\_TOL) changes to  
SOF\_SWI C\_V\_SOF\_SWI\_AMT\_ON\_TOL)  
(equal to 0 ->1)

**And** this result is valid for 3 evaluations

**Then(4)** LV\_SOF\_SWI\_AMT = ! LV\_SOF\_SWI\_AMT

**Endif(4)**

**Else(2)** LV\_SOF\_SWI = 0  
LV\_SOF\_SWI\_AMT = 0

**Endif(2)**

**Else (1)**

**If (5)** LV\_VAR\_BN = 1 **And**  
LV\_ERR\_BN\_VEH\_MOD = 0 **And**  
LV\_ERR\_CAN\_BOFF = 0 **And**  
LV\_ERR\_BN\_GEAR\_REV = 0 **And**  
((STATE\_VEH\_MOD = 2H) **Or**  
(LC\_VAR\_SPT\_SWI = 1) **And**  
(STATE\_SPT\_DISP\_CAN = 1H)))

**Then (5)** LV\_SOF\_SWI = 1

**Else (5)** LV\_SOF\_SWI = 0

**Endif(5)**

**Endif (1)**

Calculation of LV\_SOF\_SWI\_REQ and LV\_SOF\_SWI\_AMT\_REQ:

**If** (LV\_CITY = 0 **Or**  
LC\_CONF\_CITY\_ENA = 1) **And**  
CONF\_SOF\_SWI = 2 **And**  
LC\_VAR\_SOF\_SWI = 1 **And**  
LV\_SOF\_SWI = 1 **And**  
LV\_ERR\_SOF\_INH\_MON = 0

**Then** LV\_SOF\_SWI\_REQ = 1

```

Else      LV_SOF_SWI_REQ      = 0
Endif

If        LV_CITY = 0
          CONF_SOF_SWI      = 2
          LC_VAR_SOF_SWI_AMT = 1
          LV_SOF_SWI_AMT    = 1
Then      LV_SOF_SWI_AMT_REQ = 1
Else      LV_SOF_SWI_AMT_REQ = 0
Endif
    
```

### 9.32.2 Acquisition of sound-flap

#### General information:

To optimize the vehicle noise behaviour, an sound flap can be activated depending on the engine speed (N\_SOF) and the load (FAC\_TQ\_REQ). The sound flap is closed below a FAC\_TQ\_REQ threshold, it is opened above the threshold.

The sound flap is only activ after the time C\_T\_SOF\_AST after the transition from Start.

The switching threshold (FAC\_TQ\_SOF\_THD) is depending on enginespeed (N\_SOF), the selected gear (GEAR\_EF), the transmission (manuell or automatic) and the convertible top (LV\_CTOP = 0 closed, or LV\_CTOP = 1 open).

To prevent the sound flap from switching continuously during constant driving at the switching threshold, two hysteresises (C\_N\_SOF\_HYS and C\_FAC\_TQ\_SOF\_THD\_HYS) are introduced for the switching process.

The closing of the sound flap is delayed depending on the engine speed (N\_32). The opening of the sound flap is delayed depending on the engine speed (N\_SOF), the selected gear (GEAR\_EF), the transmission (manuell or automatic) and the convertible top (LV\_CTOP = 0 closed, or LV\_CTOP = 1 open).

At low vehicle speeds the state of the sound flap is adjustable by C\_STATE\_VS\_MIN\_SOF\_xx (xx = MT/AT).

The sound flap can be tested via KWP protocol at EOL or at service station by setting LV\_SOF\_EXT\_ADJ = 1.

#### Application conditions

**Initialisation:** *all variables are initialised with 0 at deactivation*

**Recurrence:** *20ms*

**Activation:** *LV\_VAR\_SOF = 1 or LV\_SOF\_EXT\_ADJ = 1*

**Deactivation:** *LV\_IGK = 0*

#### Formula section:


Control of sound-flap by external adjustment:

```

IF      LV_SOF_EXT_ADJ = 1
THEN    LV_SOF = LV_ACT_SOF_EXT_ADJ
Endif
    
```

Control of sound-flap

**SOF during start and engine stopped**

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```

If LV_ST = 1 or LV_ES = 1
Then LV_SOF = 0           \\ flap closed
Endif

```

Highest priority is time after start , P1

```

If T_AST ≤ C_T_SOF_AST
then LV_SOF = LC_STATE_SOF_AST           see next priority P2
endif

```

Next priority is vehicle speed dependency , P2  
Automatic transmission vehicle (LV\_AT = 1):

```

If VS < C_VS_MIN_SOF_AT
then LV_SOF = LC_STATE_VS_MIN_SOF_AT     see next priority P3
endif

```

Manual transmission vehicle (LV\_AT = 0):

```

If VS < C_VS_MIN_SOF_MT
then LV_SOF = LC_STATE_VS_MIN_SOF_MT     see next priority P3
endif

```

Next priority is 'convertible top' , P3 \\ calculation of thresholdvalues  
- enginespeed hysteresis

```

If LV_SOF = 0
Then N_SOF = N_32 + C_N_SOF_HYS
Else N_SOF = N_32
Endif

```

- Calculation switching threshold(FAC\_TQ\_SOF\_THD\_CTOP)

```

IF (1) LV_AT = 0           \\ manuel transmission
IF LV_CTOP = 0           \\ convertibel top closed
Then FAC_TQ_SOF_THD_CTOP =
      ID_FAC_TQ_SOF_THD_CTOP_CLOSE_MT (N_SOF; GEAR_EF)
Else FAC_TQ_SOF_THD_CTOP =           \\ convertibel top open
      ID_FAC_TQ_SOF_THD_CTOP_OPEN_MT (N_SOF; GEAR_EF)
ELSE (1)           \\ automatic transmission
IF LV_CTOP = 0           \\ convertibel top closed
Then FAC_TQ_SOF_THD_CTOP =
      ID_FAC_TQ_SOF_THD_CTOP_CLOSE_AT (N_SOF; GEAR_EF)
Else FAC_TQ_SOF_THD_CTOP =           \\ convertibel top open
      ID_FAC_TQ_SOF_THD_CTOP_OPEN_AT (N_SOF; GEAR_EF)

```

- Calculation switching threshold hysteresis

```

If LV_SOF = 0           \\ flap closed
Then FAC_TQ_SOF_THD = FAC_TQ_SOF_THD_CTOP - C_FAC_TQ_SOF_THD_HYS
Else FAC_TQ_SOF_THD = FAC_TQ_SOF_THD_CTOP           \\ flap open

```

- Compare threshold and actual value with close delay

```

IF FAC_TQ_REQn < FAC_TQ_SOF_THDn           and
      FAC_TQ_REQn-1 ≥ FAC_TQ_SOF_THDn-1           and
      T_DLY_SOF_OPEN = 0
Then T_DLY_SOF = IP_T_DLY_SOF

```



**Else** T\_DLY\_SOF -- \\ (decremenet T\_DLY\_SOF in 5 cycles by 100ms)

**Endif**

**IF** FAC\_TQ\_REQ<sub>n</sub> ≥ FAC\_TQ\_SOF\_THD<sub>n</sub> **and**  
 FAC\_TQ\_REQ<sub>n-1</sub> < FAC\_TQ\_SOF\_THD<sub>n-1</sub> **and**  
 T\_DLY\_SOF = 0

**Then if** LV\_AT = 0

**then** **if** LV\_CTOP = 0  
**then** T\_DLY\_SOF\_OPEN =  
 ID\_T\_DLY\_SOF\_OPEN\_CTOP\_CLOSE\_MT(N\_SOF; GEAR\_EF)  
**else** T\_DLY\_SOF\_OPEN =  
 ID\_T\_DLY\_SOF\_OPEN\_CTOP\_OPEN\_MT(N\_SOF; GEAR\_EF)  
**endif**  
**else if** LV\_CTOP = 0  
**then** T\_DLY\_SOF\_OPEN =  
 ID\_T\_DLY\_SOF\_OPEN\_CTOP\_CLOSE\_AT(N\_SOF; GEAR\_EF)  
**else** T\_DLY\_SOF\_OPEN =  
 ID\_T\_DLY\_SOF\_OPEN\_CTOP\_OPEN\_AT(N\_SOF; GEAR\_EF)  
**endif**  
**endif**

**Else** T\_DLY\_SOF\_OPEN -- \\ (decremenet T\_DLY\_SOF\_OPEN every cycle by 20ms)

**Endif**


**IF** FAC\_TQ\_REQ ≥ FAC\_TQ\_SOF\_THD  
**Then** **if** T\_DLY\_SOF\_OPEN = 0  
**then** LV\_SOF = 1 \\ flap open  
**else** LV\_SOF = 0  
**endif**

**Else** **If** T\_DLY\_SOF = 0  
**then** LV\_SOF = 0 \\ flap closed  
**else** LV\_SOF = 1 \\ flap open  
**endif**

**Endif**

**Endif**

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## 9.33 Electronically controlled thermostat

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ECTPWM	O/V	0... FFFFH	0... 99.99847	1.53e-3	%
Pulse width modulated output signal for the electronic controlled thermostat					
T_ECTPWM_AST	-	0... FFH	0... 255	1	s
time for ECTPWM-calculation after start					

### Input data:

ECTPWM_CLC {p. 8225}	ECTPWM_EXT_ADJ {p. 7431}	LV_ECTPWM_EXT_ADJ {p. 7433}	LV_ERR_ECT_EL {p. 4530}
LV_ERR_ECT_EL_OC {p. 4530}	LV_ERR_ECT_EL_SCP {p. 4530}	LV_ES {p. 1720}	LV_ST_END {p. 1720}
TCO {p. 1100}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ECTPWM_AST	-	0... FFFFH	0... 99.99847	1.5259e-3	%
calibratable ECTPWM after start					
C_ECTPWM_MAN	-	0... FFFFH	0... 99.99847	1.53e-3	%
Manual adjustable PWM output signal for the electronic controlled thermostat					
C_T_ECTPWM_AST	-	0... FFH	0... 255	1	s
time for ECTPWM-calculation after start					
C_TCO_ECTPWM	-	0... FEH	-48... 142.5	0.75	°C
calibratable TCO-threshold for ECTPWM after start					
LC_ECTPWM_MAN	-	0... 1H	0 ...1	1	-
Configuration bit for activation of manual PWM output signal adjustment					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ECTPWM_MAX	-	0... FFFFH	0... 99.99847	1.53e-3	%
Maximum PWM output signal for the electronic controlled thermostat					
NC_ECTPWM_MIN	-	0... FFFFH	0... 99.99847	1.53e-3	%
Minimum PWM output signal for the electronic controlled thermostat					
NC_ECTPWM_SUB_DIAG	-	0... FFFFH	0... 99.99847	1.53e-3	%
PWM output signal for the electronic controlled thermostat in case of a failure					

### 9.33.1 Adjustment of the pulse width modulated output signal (ECTPWM)

#### FUNCTION DESCRIPTION:

#### General information:

For calibration issues and service tool operations the calculated pulse width modulated signal (ECTPWM\_CLC) has to be adjusted manually before it is sent to the power stage of the electronic controlled thermostat (ECTPWM). Two possibilities for the manual adjustment are existing. With the logical constant LC\_ECTPWM\_MAN it is possible to adjust the calibratable value C\_ECTPWM\_MAN to the PWM output with use of the calibration system. The service tool allows the adjustment of the PWM signal as

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well. In this case the logical variable LV\_ECTPWM\_EXT\_ADJ is set from logical low (0) to logical high (1) and the adjustable value ECTPWM\_EXT\_ADJ is used as output signal (ECTPWM).

As soon as the thermostat failure algorithm detects a electrical thermostat failure, the PWM output signal is set to a calibratable value (NC\_ECTPWM\_SUB\_DIAG) at once and the ECT control state "LIH" is activated.

### Application conditions

#### Initialisation:

all 0 at reset,

Except: T\_ECTPWM\_AST :

at reset or at transition LV\_ES 0 -> 1: T\_ECTPWM\_AST = 0

// the time condition C\_T\_ECTPWM\_AST is reset each time the engine state "engine stop" is reached or ecu is reset

#### Recurrence:

1000 ms

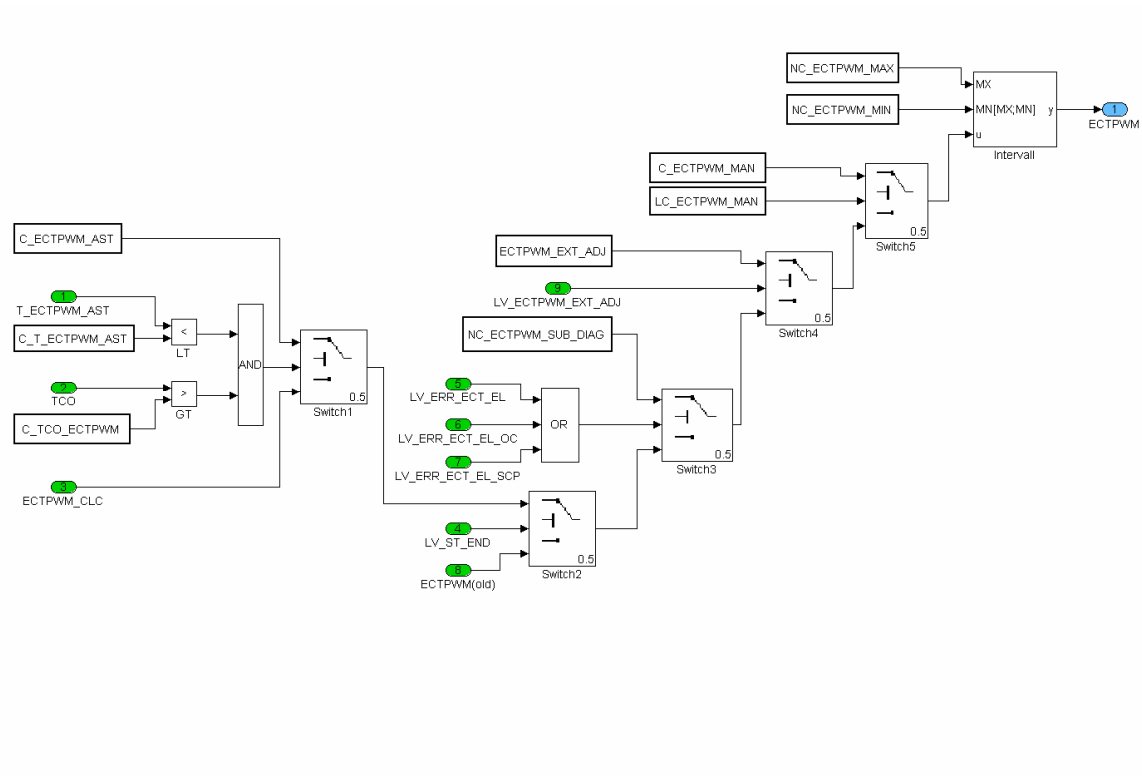
#### Activation:

at every engine operating state

#### Deactivation:


-

### Signal flow diagram:



### Formula section:

**If** LV\_ST\_END = 1 and T\_ECTPWM\_AST < C\_T\_ECTPWM\_AST  
**Then** T\_ECTPWM\_AST = ++  
**Endif**

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```

If (1)      LC_ECTPWM_MAN = 1
Then (1)   ECTPWM = C_ECTPWM_MAN
Else (1)   If (2)  LV_ECTPWM_EXT_ADJ = 1
              Then(2)ECTPWM = ECTPWM_EXT_ADJ
              Else (2)If(3) LV_ERR_ECT_EL = 1      OR
                  LV_ERR_ECT_EL_OC = 1  OR
                  LV_ERR_ECT_EL_SCP = 1
              Then(3)ECTPWM = NC_ECTPWM_SUB_DIAG
                  Else(3)If(4)      LV_ST_END = 1
                      Then(4)
                          If(5)  0 <= T_ECTPWM_AST < C_T_ECTPWM_AST
                                  // time C_T_ECTPWM_AST has not elapsed
                                  and
                                  TCO < C_TCO_ECTPWM
                          Then(5)   ECTPWM = C_ECTPWM_AST
                                  // for time C_T_ECTPWM_AST
                          Else (5) ECTPWM = ECTPWM_CLC
                      Endif (5)
                  Endif(4)
              Endif(3)
          Endif (2)
Endif (1)

```

### 9.33.2 Limitation of the pulse width modulated output signal (ECTPWM)

#### FUNCTION DESCRIPTION:

##### General information:

The limits of the pulse width modulated output signal for the electronic controlled thermostat are fixed to NC\_ECTPWM\_MIN for the lower and NC\_ECTPWM\_MAX for the upper value. The controller output signal must be limited as soon as the amount of the controller is reaching the limits.

The power stage output signal for the electronic controlled thermostat is limited to a minimum and a maximum value to guarantee a continuous working electrical diagnosis of the power stage.

##### Application conditions

**Initialisation:**            *all 0 at reset*

**Recurrence:**                *1000 ms*

**Activation:**                *at every engine operating state*

**Deactivation:**              *-*

##### Formula section:

$$NC\_ECTPWM\_MIN \leq ECTPWM \leq NC\_ECTPWM\_MAX$$

## 9.34 ENTE scheduler

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_ECF [NC_ECF_NR]	O/V	0... 1H	0 ...1	1	-
Boolean for electronic controlled cooling fan error					
POW_OUT_ECF	O/V	0... FFH	0... 99.61	0.39	%
Cooling fan power output of all available fan(s) at the vehicle					

### Input data:

ECFPWM [NC_ECF_NR] {p. 3596}	ECFPWM_IGK_OFF {p. 3596}	LV_ERR_ECF_EL [NC_ECF_NR] {p. 4507}	NC_ECF_CONF {p. 576}
NC_ECF_NR {p. 576}			

### FUNCTION DESCRIPTION:

#### General information:

This manager specifies the sequencing of project specific ENTE tasks.

#### Description:

Within the aggregate ENTE, the cooling fan functions (acquisition, control, diagnosis, torque loss) are handled project specific with use of HOOK modules. Because different projects use different update rates for the functions, it is necessary to handle the function calls specific within this module.

#### Application conditions

**Recurrence:** *see formula section below*

**Activation:** *at every engine operating state*

**Deactivation:** -

#### Formula section:

**#IF NC\_ECF\_CONF = 0** ( control of cooling fan(s) only by Relay(s) )

<b>Tasks</b>
No action

**#ENDIF**

**#IF NC\_ECF\_CONF = 1** ( control of cooling fan(s) only by PWM(s) )

<b>RESET - Task</b>
POW_OUT_ECF = 0%
LV_ERR_ECF[NC_ECF_NR] = 0
<b>10ms - Task</b>
ENTE_ACCTLECT1 (Electronically controlled Thermostat (Appl. Inc.) - "Conversion from ECTPWM to LV_ECTPWM_STAT" chapter 1.1.1)
<b>100ms - Task</b>
<b>if (LV_IGK = 0) then ENTE_ACCTLECF1</b> (Cooling and condenser fan control - "Control with ignition key off up to detection of ES and in the self-holding phase" chapter 1.2)
<b>if (LV_IGK = 1 AND LV_ES = 0) then ENTE_REQGNTQECF1</b> (Torque Loss - Electronic cooling fan PWM)

<b>200ms - Task</b>
<b>if (LV_IGK = 1) then ENTE_ACCTLECF1</b> (Cooling and condenser fan control - "Control of ECFPWM[NC_ECF_NR] with ignition key on" chapter 1.1)
ENTE_IFINFECF1 (Acquisition of electronically controlled cooling fan signal) Note: When using ISR-action, this spec does not need to appear in the calculation order!

<b>1000ms - Task</b>
<b>if (LV_ES = 0) then ENTE_ACCTLECF1</b> (Cooling and condenser fan control - "Calculation of TEMP_MMV_SUB_CAT_ECF" chapter 1.1.2)
<b>if (LV_IGK = 1) then POW_OUT_ECF = ECFPWM[1]</b>
<b>if (LV_IGK = 0) then POW_OUT_ECF = ECFPWM_IGK_OFF</b>
ENTE_OUTDGEF1 (Cooling fan diagnosis)
LV_ERR_ECF[NC_ECF_NR] = LV_ERR_ECF_EL[NC_ECF_NR]

**#ENDIF**

**#IF NC\_ECF\_CONF = 2** ( control of cooling fan(s) by Relay(s) or PWM(s) )

<b>Tasks</b>
No action

**#ENDIF**

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## 9.35 Electronically controlled radiator shutter

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ECRAS_EOL	V	0... FFH	0... 255	1	-
Counter for stopping ECRAS system test (EOL)					
ECRASPWM	O/V	0... FFH	0... 99.60937	0.390625	%
PWM for electrical radiator shutter					
LV_ECRAS_DOWN_1	O/V	0... 1H	0 ...1	1	-
Bit used to determine ECRASPWM (input for ID)					
LV_ECRAS_EOL	V	0... 1H	0 ...1	1	-
Bit for determining ECRASPWM during ECRAS system test (EOL)					
LV_ECRAS_EOL_END	V	0... 1H	0 ...1	1	-
Bit indicating finished ECRAS system test (EOL)					
LV_ECRAS_EOL_INH	O/V	0... 1H	0 ...1	1	-
Bit indicating inhibition or ECRAS EOL (if = 1 EOL stopped)					
LV_ECRAS_UP_1	O/V	0... 1H	0 ...1	1	-
Bit used to determine ECRASPWM (input for ID)					
LV_ERR_ECRAS_EOL	O/V	0... 1H	0 ...1	1	-
Bit indicating ECRAS error during EOL ECRAS system test					
STATE_ECRAS_SYS	O/V	0... FFFFH	0... 65535	1	-
State of ECRAS system					
T_ECRAS_UP_DET	V	0... FFH	0... 25.5	0.1	-
Timer indicating time until learning stopped (if no variant recognised)					
T_WAIT_ECRAS_EOL	V	0... FFH	0... 25.5	0.1	s
Timer for switch ECRAS control output					

### Input data:

LC_AD_CLR_VAR {p. 528}	LV_ACT_ECRAS_DOWN_EXT_ADJ {p. 7432}	LV_ACT_ECRAS_EOL_EXT_ADJ {p. 7763}	LV_ACT_ECRAS_UP_EXT_ADJ {p. 7432}
LV_CDN_VB_MIN_DIAG {p. 1185}	LV_DIAG_ECRAS {p. 4515}	LV_DIAG_ECRAS_END {p. 4515}	LV_DIAG_ECRAS_ERR_END {p. 4515}
LV_ECRAS_DOWN {p. 8225}	LV_ECRAS_DOWN_DET_ACT {p. 4515}	LV_ECRAS_DOWN_DET_SET {p. 4515}	LV_ECRAS_DOWN_EXT_ADJ {p. 7433}
LV_ECRAS_UP {p. 8225}	LV_ECRAS_UP_EXT_ADJ {p. 7433}	LV_END_DIAG_ECRAS_DOWN_FB {p. 4515}	LV_END_DIAG_ECRAS_EL {p. 4515}
LV_END_DIAG_ECRAS_UP_FB {p. 4515}	LV_ERR_ECRAS {p. 4515}	LV_ERR_ECRAS_DOWN_FB {p. 4515}	LV_ERR_ECRAS_EL {p. 4515}
LV_ERR_ECRAS_UP_FB {p. 4515}	LV_IGK {p. 906}	LV_VAR_ECRAS_DOWN {p. 4515}	LV_VAR_ECRAS_UP {p. 655}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_ECRAS_EOL	-	0... FFH	0... 255	1	-
Counter threshold for stopping ECRAS system test (EOL)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ECRASPWM_10	-	0... FFH	0... 99.60937	0.390625	%
ECRASPWM for diagnosis mode of ECRAS control unit (10% PWM)					
C_ECRASPWM_90	-	0... FFH	0... 99.60937	0.390625	%
ECRASPWM for learning of ECRAS_DOWN (90% PWM)					
C_ECRASPWM_DIAG	-	0... FFH	0... 99.60937	0.390625	%
PWM for radiator shutter for diagnosis readiness					
C_ECRASPWM_MAN	-	0... FFH	0... 99.60937	0.390625	%
Manually given ECRASPWM					
C_T_ECRAS_UP_DET	-	0... FFH	0... 25.5	0.1	s
Timer threshold for learning ECRAS_UP					
C_T_WAIT_ECRAS_EOL	-	0... FFH	0... 25.5	0.1	s
Timer threshold for switch ECRAS control output					
ID_ECRASPWM	V	0... FFH	0... 99.60937	0.390625	%
LDP_LV_ECRAS_UP_1	2	0... 1H	0 ...1	1	-
LDP_LV_ECRAS_DOWN_1	2	0... 1H	0 ...1	1	-
Map for determining ECRASPWM					
LC_ECRASPWM_MAN	-	0... 1H	0 ...1	1	-
Switch for manual setting of ECRASPWM					

## FUNCTION DESCRIPTION:

### Description:

This modul consists of three parts.

- End of line Sytem test functionality
- Calculation of ECRASPWM
- Setting of STATE\_ECRAS\_SYS

EOL-System test: the system test is activated by LV\_ACT\_ECRAS\_EOL\_EXT\_ADJ which is set by tester ( see "Services for EOL tests" chapter). During this EOL test several ECRASPWM will be set for a certain time. This allows that every possible failure can be detected by the ECRAS feedback diagnosis.


Calculation of ECRASPWM: The ECRAS PWM signal will be claculated. ECRASPWM requests will be prioritised.

Setting of STATE\_ECRAS\_SYS: A State STATE\_ECRAS\_SYS is created which displays specific information about the whole ECRAS system (eg. diagnosis, EOL etc.).

### Application conditions

<b>Initialisation:</b>	<i>reset or LV_IGK = 0 -&gt; 1 all 0, except ECRASPWM = C_ECRASPWM_DIAG</i>
<b>Recurrence:</b>	<i>100 ms</i>
<b>Activation:</b>	<i>always</i>
<b>Deactivation:</b>	<i>none</i>

### Formula section:

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**EOL System test**

```

if LV_ACT_ECRAS_EOL_EXT_ADJ = 1
then // if activation by tester request recognised reset values
    if LV_ACT_ECRAS_EOL_EXT_ADJ 0->1
    then LV_ECRAS_EOL_END = 0
        T_WAIT_ECRAS_EOL = 0
        CTR_ECRAS_EOL = 0
        LV_ECRAS_EOL = 0
        LV_ERR_ECRAS_EOL = 0
    endif

    // increment timer
    if LV_DIAG_ECRAS_END = 1 and
        LV_ECRAS_DOWN_DET_ACT = 0
    then T_WAIT_ECRAS_EOL = T_WAIT_ECRAS_EOL + 100ms
    endif

    // toggle control of ECRAS flaps (see also calculation of ECRASPWM to enable diagno-
    sis
    if T_WAIT_ECRAS_EOL >= C_T_WAIT_ECRAS_EOL
    then if LV_ECRAS_EOL = 0
        then LV_ECRAS_EOL = 1
        else LV_ECRAS_EOL = 0
        endif
        T_WAIT_ECRAS_EOL = 0
        CTR_ECRAS_EOL = CTR_ECRAS_EOL + 1
    endif

    // set end of EOL system test
    if CTR_ECRAS_EOL >= C_CTR_ECRAS_EOL or LV_DIAG_ECRAS_ERR_
    END = 1
    then LV_ECRAS_EOL_INH = 1
        LV_ECRAS_EOL_END = 1
    endif

    // set LV_ERR_ECRAS_EOL if during EOL error is occurred or present
    if LV_ERR_ECRAS = 1
    then LV_ERR_ECRAS_EOL = 1
    endif

else
    LV_ECRAS_EOL_INH = 0
endif


```

**Calculation of ECRASPWM**

```

if LV_VAR_ECRAS_UP = 1
then // prioritisation of ECRASPWM requests
    if LC_ECRASPWM_MAN = 1
    then ECRASPWM = C_ECRASPWM_MAN
    elseif LV_ECRAS_DOWN_DET_ACT = 1
    then ECRASPWM = C_ECRASPWM_90
    elseif LV_DIAG_ECRAS = 1

```


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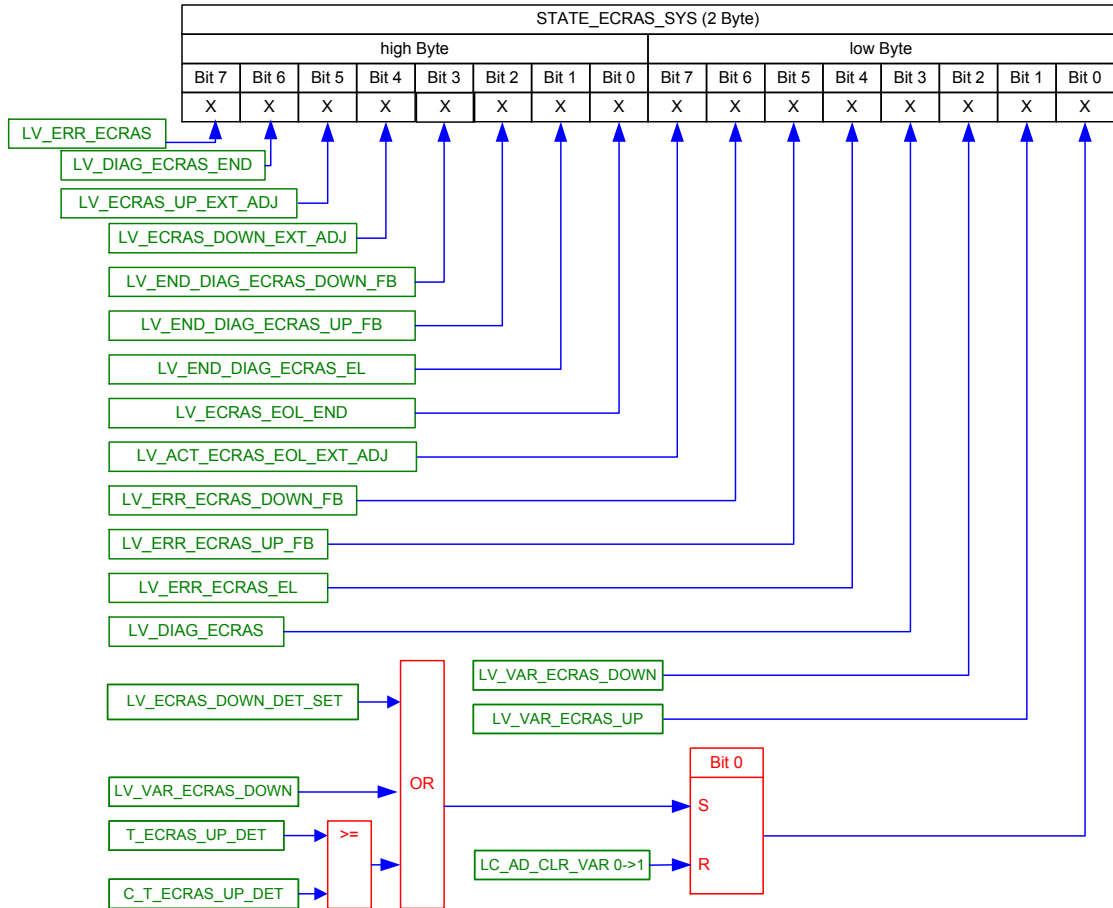
```

then ECRASPWM = C_ECRASPWM_10
else if LV_ACT_ECRAS_EOL_EXT_ADJ = 1
then LV_ECRAS_UP_1 = LV_ECRAS_EOL
      LV_ECRAS_DOWN_1 = LV_ECRAS_EOL
else if LV_ECRAS_UP_EXT_ADJ = 1
then LV_ECRAS_UP_1 = LV_ACT_ECRAS_UP_EXT_ADJ
else LV_ECRAS_UP_1 = LV_ECRAS_UP
endif
if LV_ECRAS_DOWN_EXT_ADJ = 1
then LV_ECRAS_DOWN_1 =
      LV_ACT_ECRAS_DOWN_EXT_ADJ
else if LV_VAR_ECRAS_DOWN = 1
      then LV_ECRAS_DOWN_1 = LV_ECRAS_DOWN
      else LV_ECRAS_DOWN_1 = 0
      endif
endif
endif
      ECRASPWM = ID_ECRASPWM
endif
else
if LV_CDN_VB_MIN_DIAG = 1
then T_ECRAS_UP_DET = T_ECRAS_UP_DET + 100ms
else freeze timer
endif
if T_ECRAS_UP_DET >= C_T_ECRAS_UP_DET
then ECRASPWM = 0
else // waiting, learning of LV_VAR_ECRAS_UP still possible
      ECRASPWM = C_ECRASPWM_DIAG
endif
endif

```

### Setting of STATE\_ECRAS\_SYS

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## 9.36 Fuel pressure setpoint calculation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FUP_H_SP_S	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint for stratified mode, high range					
FUP_RNG_H_SP	O/V	0... FFFFH	0... 255.99609375	3.90625e-3	MPa
Fuel pressure setpoint					
FUP_RNG_H_SP_S	O/V	0... FFFFH	0... 255.99609375	3.90625e-3	MPa
Fuel pressure setpoint for stratified mode					
FUP_SP	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint					
FUP_SP_GRD_ACT	V	0... FH	0... 15	1	-
Indicator for gradient limitation out of start active					
FUP_SP_ST	V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure for start					
FUP_SP_TMP	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint (before limitation)					
FUP_SP_TMP_1	V	0... FFFFH	0... 347776	5.3067216	hPa
Intermediate value for FUP_SP filter					
LV_FUP_SP_ADD	O/V	0... 1H	0...1	1	-
Logical variable indicating that the additional fuel pressure setpoint in the PUC phase is enable					

### Input data:

C_CTR_MIN_VFF_VCV_MIN_AD_SWI {p. 3957}	CTR_MIN_VFF_VCV_MIN_AD_SWI {p. 3953}	FUP_H_SP_S_EXT {p. 8262}	FUP_RNG_H_SP_CH {p. 988}
FUP_RNG_H_SP_OHP {p. 988}	FUP_SP_EXT {p. 8262}	LV_ES {p. 1720}	LV_FIRST_VLD_TOOTH {p. 1505}
LV_FUP_LIH_HOM_REQ {p. 4001}	LV_FUP_LIH_HOM_VCV_OPEN_REQ {p. 4001}	LV_FUP_LIH_L_PRS_CTL_REQ {p. 4001}	LV_FUP_SP_EXT_REQ {p. 8262}
LV_FUP_SP_SWI {p. 8136}	LV_IGK {p. 906}	LV_PU {p. 1720}	LV_PUC {p. 1720}
LV_ST_END {p. 1720}	LV_ST_H_PRS {p. 8242}	MFF_SP_FUP_CTL {p. 2151}	N_32 {p. 1525}
NC_NR_MFF_SP_FUP_SP {p. 989}	NC_NR_N_FUP_SP {p. 989}	NR_CYL_VVL_H_ACT {p. 988}	STATE_CH {p. 1777}
STATE_MPLH_MOD {p. 988}	T_AST {p. 1766}	TCO_ST {p. 1100}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_FUP_SP_VVL_LGRD	-	0... FFH	0... 255	1	-
Counter for fuel pressure setpoint gradient limitation after switching of VVL					
C_FAC_FUP_SP	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Factor for the fuel pressure setpoint temp change influence to the FUP_SP					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUP_SP_ADD	-	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Additional fuel pressure setpoint in the PUC phase					
C_FUP_SP_CRLC_2	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlation constant for the FUP_SP					
C_FUP_SP_IGK_NOT	-	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint at IGK off					
C_FUP_SP_IGK_NOT_LIM_DEC	-	0... FFFFH	0... 347776	5.3067216	hPa
Gradient limitation for fuel pressure setpoint decrement during IGK off					
C_FUP_SP_IGK_NOT_LIM_INC	-	0... FFFFH	0... 347776	5.3067216	hPa
Gradient limitation for fuel pressure setpoint increment during IGK off					
C_FUP_SP_L_PRS_ST	-	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint for low pressure start					
C_FUP_SP_LIH_HOM	-	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint for homogenous limphome					
C_FUP_SP_LIH_VCV_OPEN	-	0... FFFFH	0... 347776	5.3067216	hPa
FUP setpoint for VCV open limphome					
C_FUP_SP_LIM_DEC	-	0... FFFFH	0... 347776	5.3067216	hPa
Gradient limitation for fuel pressure setpoint decrement during normal operation					
C_FUP_SP_LIM_INC	-	0... FFFFH	0... 347776	5.3067216	hPa
Gradient limitation for fuel pressure setpoint increment during normal operation					
C_FUP_SP_MAN	-	0... FFFFH	0... 347776	5.3067216	hPa
Manual fuel pressure setpoint					
C_FUP_SP_MPLH_OPP	-	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint for double injection mode					
C_FUP_SP_PU_LIM_DEC	-	0... FFFFH	0... 347776	5.3067216	hPa
Gradient limitation for fuel pressure setpoint decrement during PU/PUC					
C_FUP_SP_PU_LIM_INC	-	0... FFFFH	0... 347776	5.3067216	hPa
Gradient limitation for fuel pressure setpoint increment during PU/PUC					
C_FUP_SP_ST_LGRD_DEC	-	0... FFFFH	0... 347776	5.3067216	hPa
Gradient limitation for fuel pressure setpoint decrement out of start					
C_FUP_SP_ST_LGRD_INC	-	0... FFFFH	0... 347776	5.3067216	hPa
Gradient limitation for fuel pressure setpoint increment till st end					
C_FUP_SP_VVL_LGRD	-	0... FFFFH	0... 347776	5.3067216	hPa
Gradient limitation for fuel pressure setpoint increment and decrement after switching of VVL					
C_T_AST_FUP_SP_GRD_SWI	-	0... FFFFH	0... 6553.5	0.1	s
Time after start to switch the fuel pressure gradient					
C_T_FUP_SP_ADD_1	-	0... FFFFH	0... 655.35	0.01	s
Time of counter number 1 for additional fuel pressure setpoint in the PUC phase					
C_T_FUP_SP_ADD_2	-	0... FFFFH	0... 655.35	0.01	s
Time of counter number 2 for additional fuel pressure setpoint in the PUC phase					
IP_FUP_SP_HOM	V	0... FFFFH	0... 347776	5.3067216	hPa
LDPM_N_32_2_FUSL	8	0... FFH	0... 8160	32	rpm

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_MFF_SP_FUP_CTL_1_FUSL	10	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel pressure setpoint for homogenous engine operation					
IP_FUP_SP_PU	V	0... FFFFH	0... 347776	5.3067216	hPa
LDPM_N_32_2_FUSL	8	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_FUP_CTL_1_FUSL	10	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel pressure setpoint for PU and PUC engine operation					
IP_FUP_SP_S	V	0... FFFFH	0... 347776	5.3067216	hPa
LDPM_N_32_2_FUSL	8	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_FUP_CTL_1_FUSL	10	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel pressure setpoint for stratified engine operation					
IP_FUP_SP_ST	V	0... FFFFH	0... 347776	5.3067216	hPa
LDPM_TCO_ST_1_FUSL	6	0... FEH	-48... 142.5	0.75	°C
LDP_N_32_IP_FUP_SP_ST	6	0... FFH	0... 8160	32	rpm
Fuel pressure setpoint for the start					
LC_FUP_SP_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual fuel pressure setpoint					

## General Information

There are maps for homogeneous mode and stratified mode according to the variable, which shows the actual engine mode. In PU and PUC a different map for the fuel pressure setpoint is selected.

Additionally a testbench function is also included. In order to avoid too big fuel pressure setpoint gradients a certain gradient limitation is included. That limitation is consisting out of a increment and decrement limitation. For PU and PUC a different limitation for increment and decrement is selected.

## Application Conditions

Initialization: RST, ERU2ES

Recurrence: SEG activated if LV\_ST\_END==1

10MS activated if LV\_ST\_END==0

Deactivation: !LV\_ST\_END

## Function description

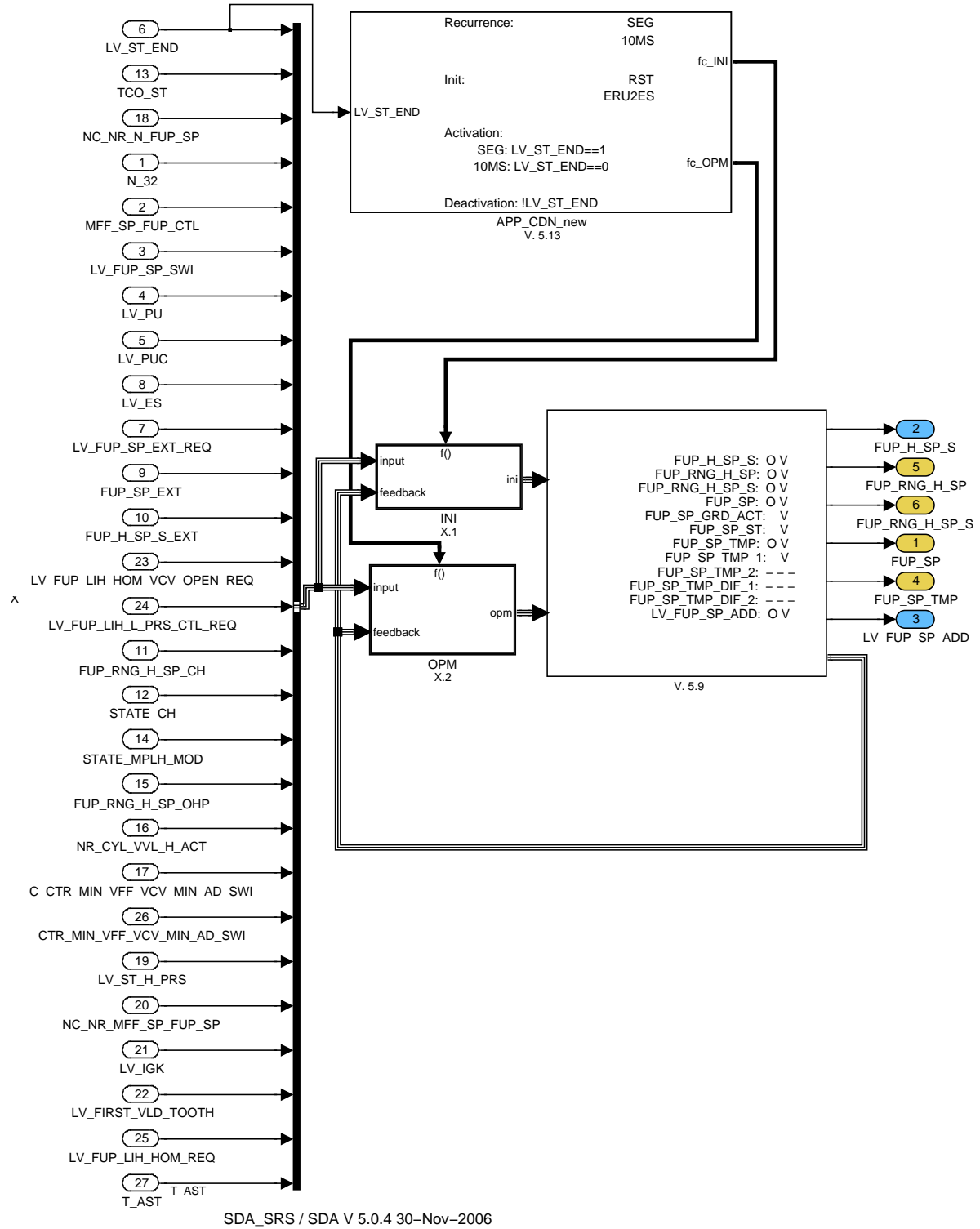



Figure 9.36.1: : Path: FUSL\_M904A

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### 9.36.1 Calculation overview for initialisation

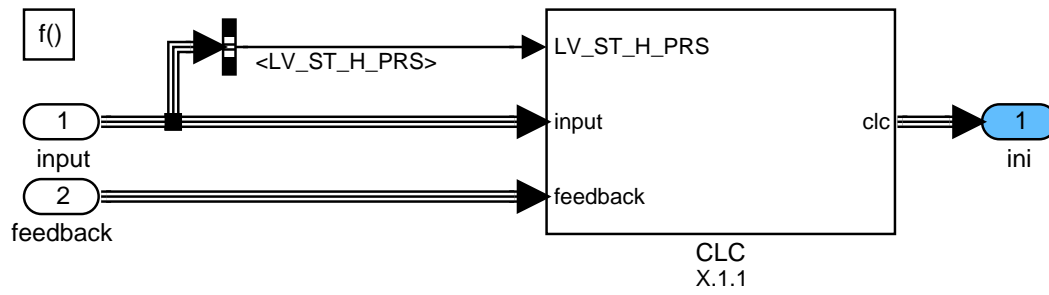



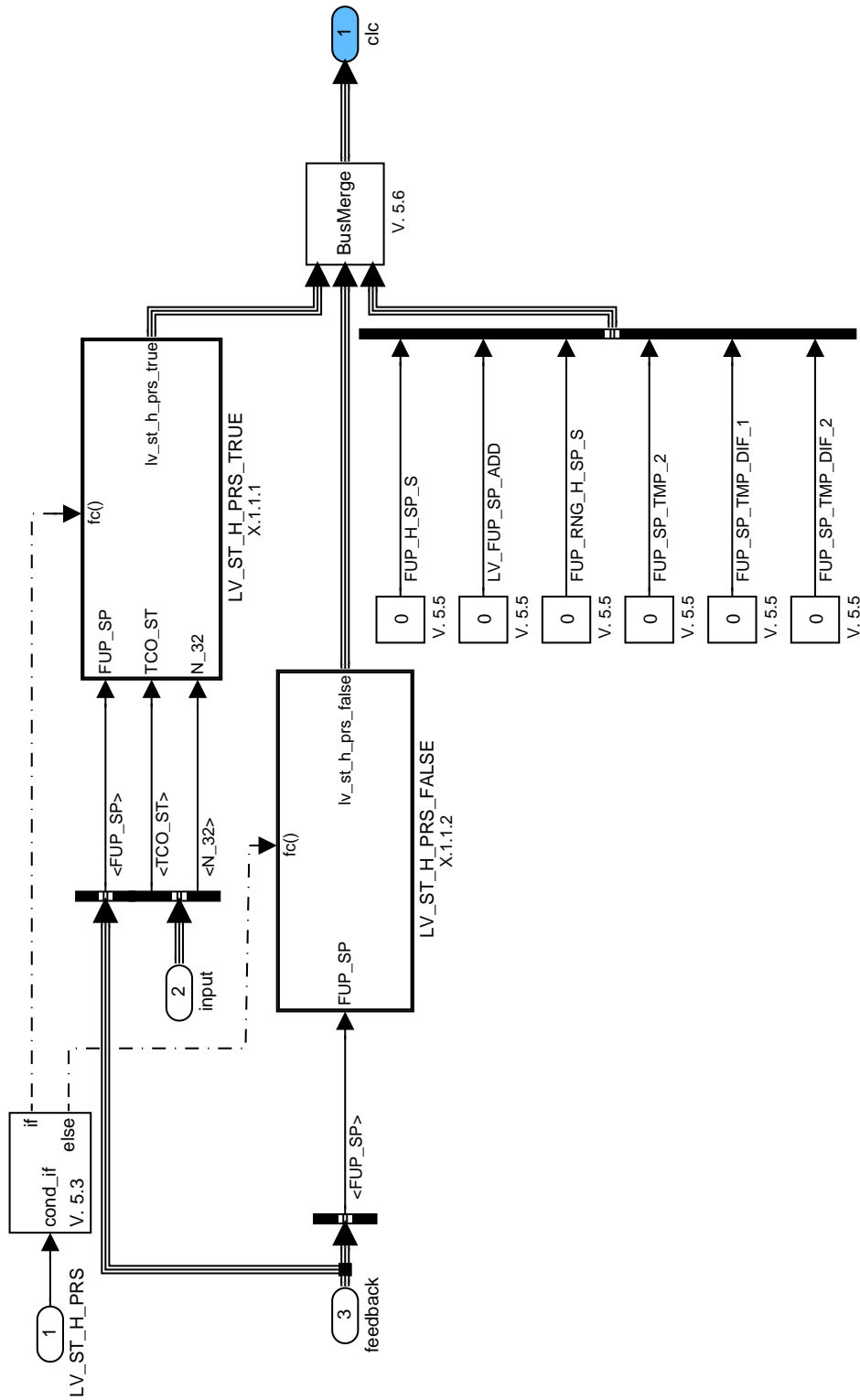
Figure 9.36.2: : Path: FUSL\_M904A/INI

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### 9.36.1.1 Initialisation



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Figure 9.36.3: : Path: FUSL\_M904A/INI/CLC

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9.36.1.1.1 Initialisation if LV\_ST\_H\_PRS is false

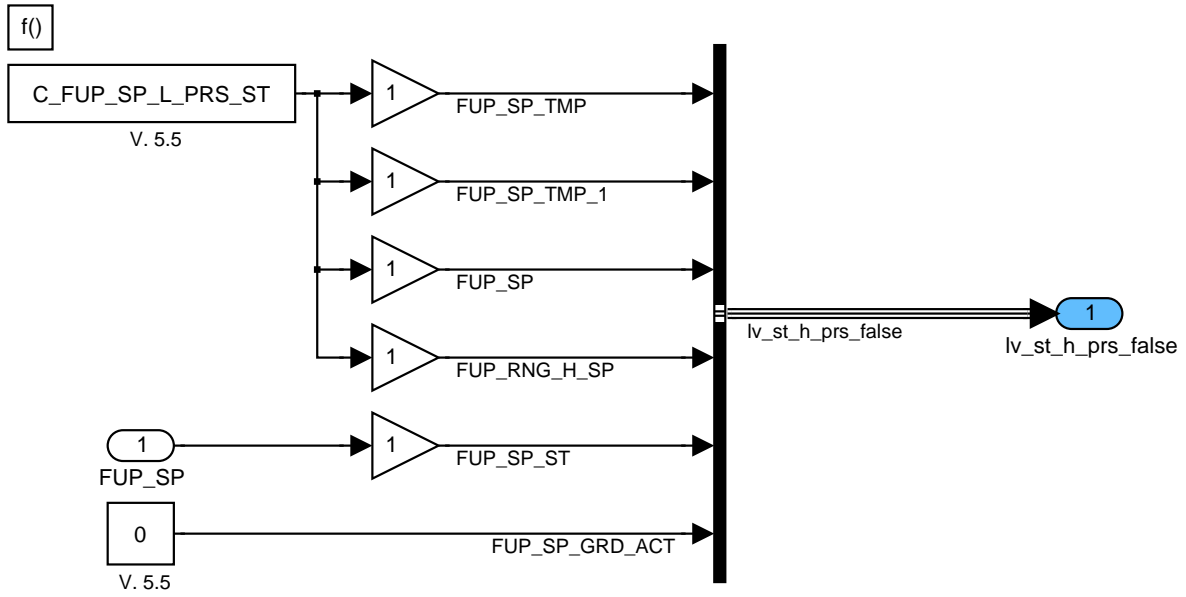


Figure 9.36.4: : Path: FUSL\_M904A/INI/CLC/LV\_ST\_H\_PRS\_FALSE

9.36.1.1.2 Initialisation if LV\_ST\_H\_PRS is true

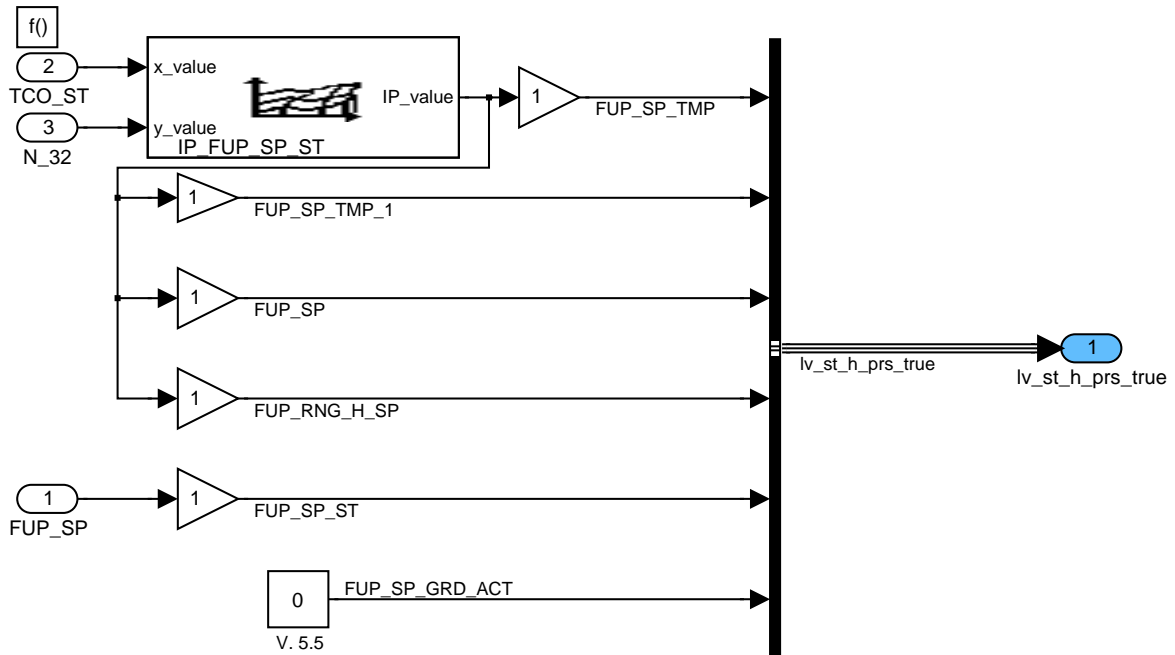


Figure 9.36.5: : Path: FUSL\_M904A/INI/CLC/LV\_ST\_H\_PRS\_TRUE

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### 9.36.2 Formula section

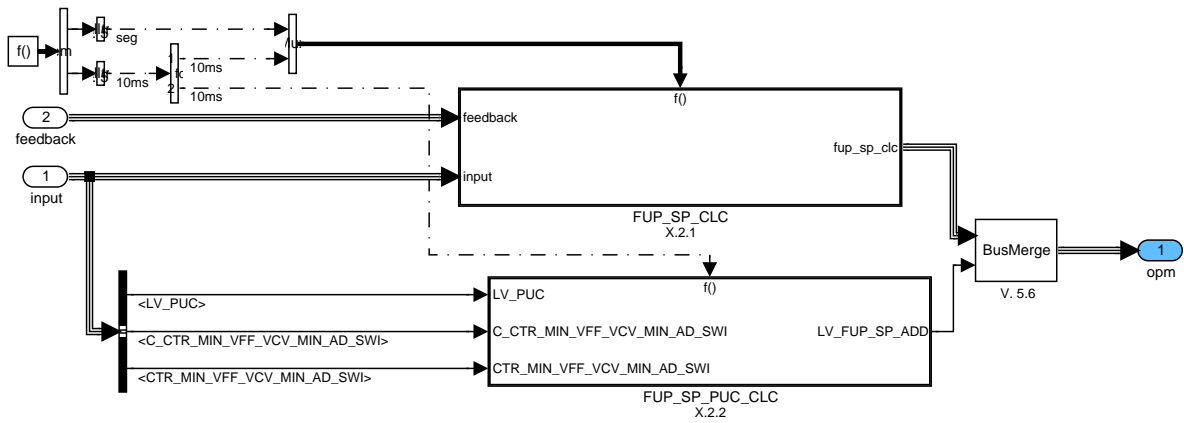

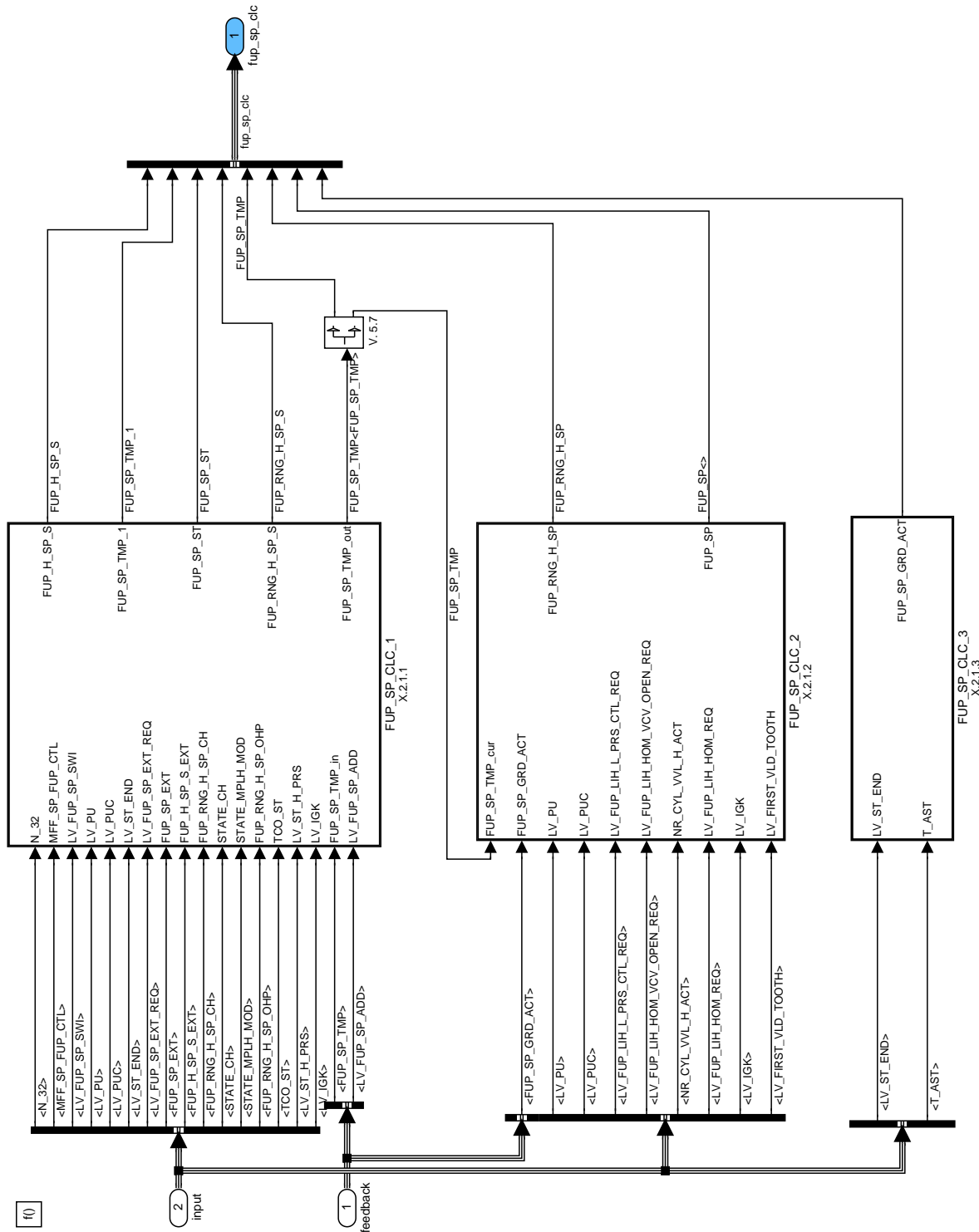


Figure 9.36.6: : Path: FUSL\_M904A/OPM

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### 9.36.2.1 Fuel pressure setpoint calculation overview




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Figure 9.36.7: : Path: FUSL\_M904A/OPM/FUP\_SP\_CLC

#### 9.36.2.1.1 Calculation of fuel pressure high setpoint

The actual fuel pressure setpoint is taken out the two maps. Only for PU and PUC mode different fuel pressure setpoints can be selected due to injector requirement.

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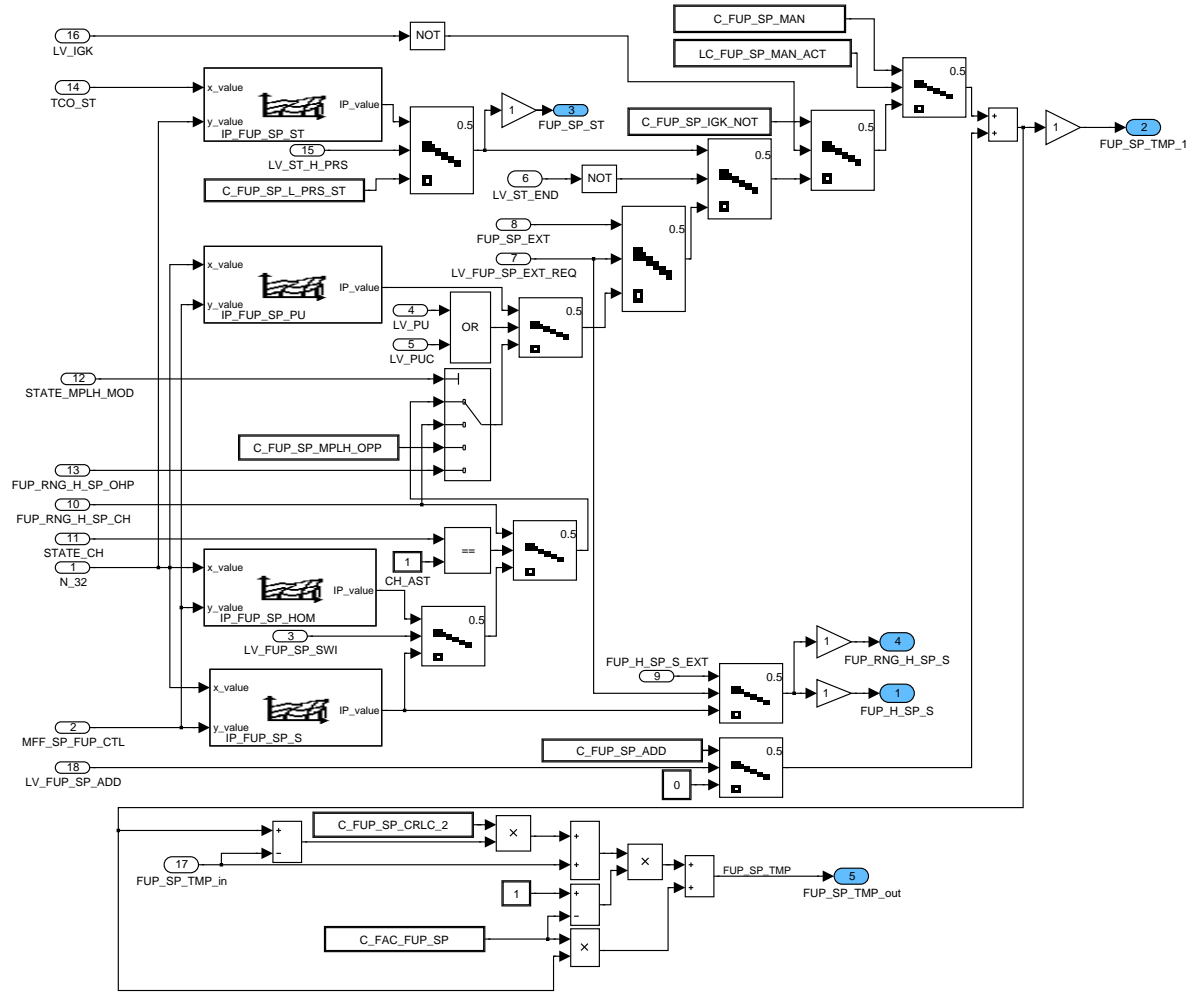


Figure 9.36.8: : Path: FUSL\_M904A/OPM/FUP\_SP\_CLC/FUP\_SP\_CLC\_1

### 9.36.2.1.2 Calculation of fuel pressure setpoint

For the gradient limitation the calibration should be started with the highest value for all gradient limitations. The values should be lowered by applying jumps the FUP\_SP via manual intervention.

The internal value in the difference limiter has to be initialised with FUP\_SP\_TMP at reset.

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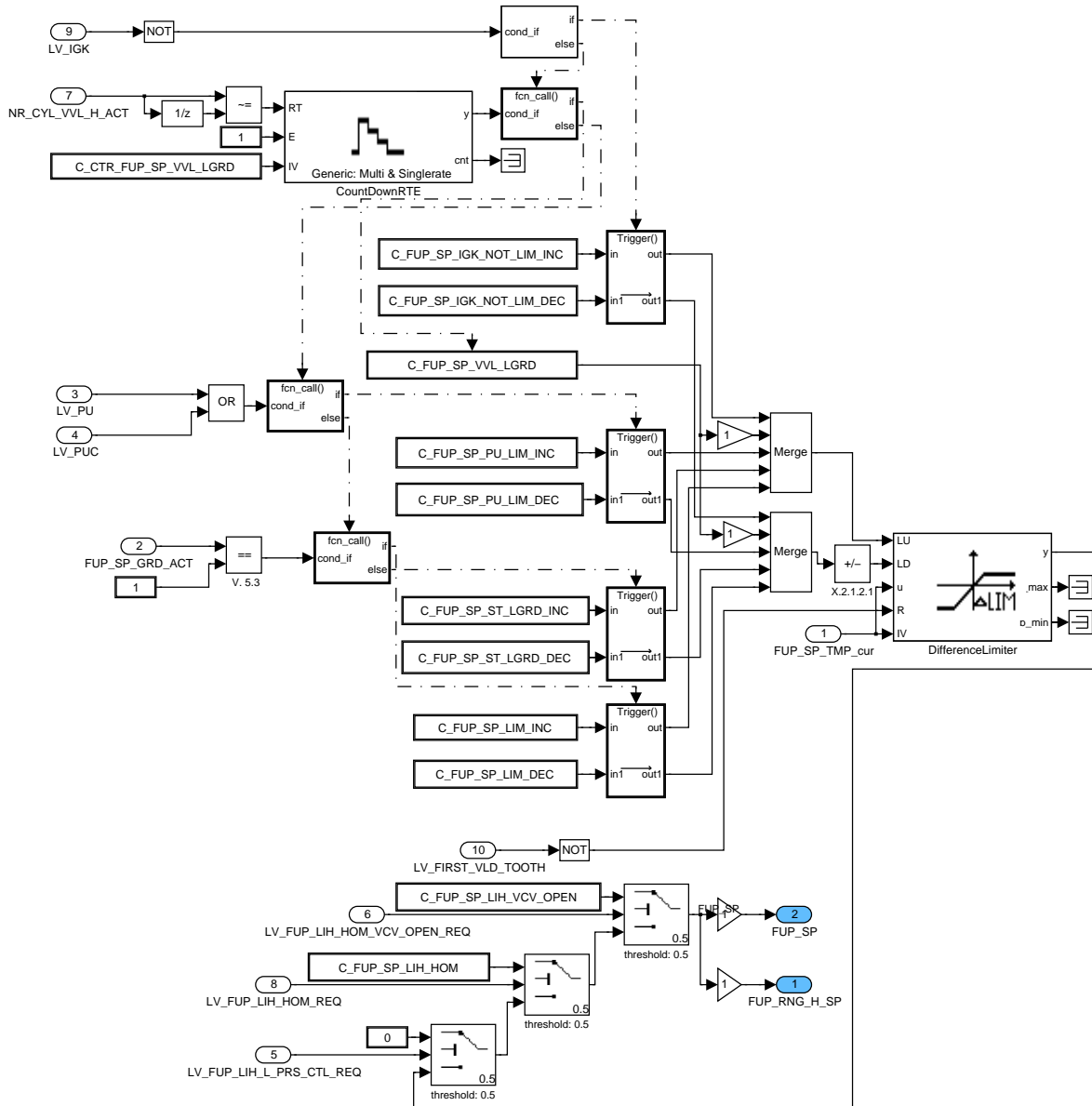


Figure 9.36.9: : Path: FUSL\_M904A/OPM/FUP\_SP\_CLC/FUP\_SP\_CLC\_2

### 9.36.2.1.3 Fuel pressure setpoint gradient calculation

The gradient limitation out the start phase will be stopped until the FUP\_SP is reached.

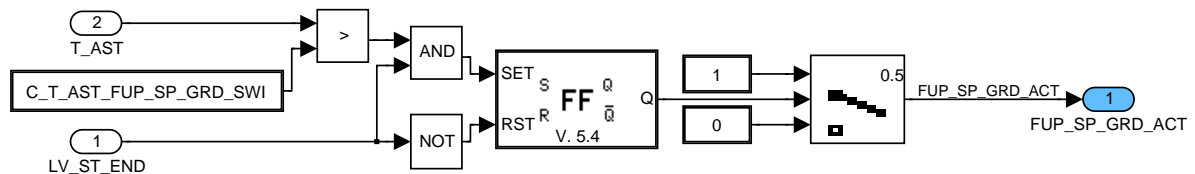


Figure 9.36.10: : Path: FUSL\_M904A/OPM/FUP\_SP\_CLC/FUP\_SP\_CLC\_3

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### 9.36.2.2 Calculation of LV\_FUP\_SP\_AD

This block is triggered every time at 10ms without the LV\_ST\_END == 0 condition.

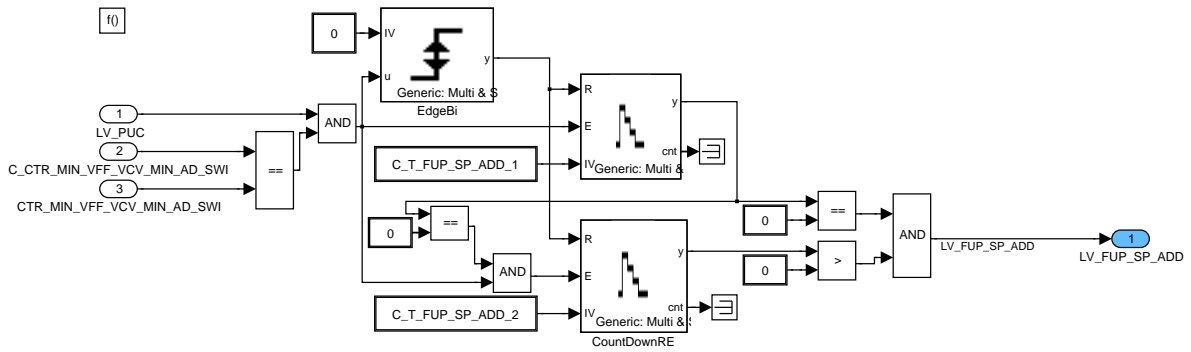



Figure 9.36.11: : Path: FUSL\_M904A/OPM/FUP\_SP\_PUC\_CLC

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## 9.37 Fuel pressure control coordination

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_FUP_PRS	V	0... FFFFH	0... 65535	1	-
Counter for maximum segment cycles for setting of the pressure controller in the intervention mode					
CTR_SEG_FUP_OFS_BOL	V	0... FFH	0... 255	1	-
Counter for forced leaving of pressure control					
CTR_SEG_FUP_OFS_TOL	V	0... FFH	0... 255	1	-
Counter for forced leaving of flow control					
CUR_VCV_BAS_AD_VAR_2_ADD_SET	O/V	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Setting value due to intervention mode for additive component of second variant of VCV flow adaptation					
FPA_MFF	O/V	0... FFFFH	0... 255	3.89105e-3	l/h
Fuel flow through the regulator					
FUEL_MASS_REQ_I_CTL_SET	O/V	80000000... 7FFFFFFFH	-694.510597391 ...694.489402609	323.402e-9	mg
Setting value of the I-part of the flow controller in intervention mode					
FUP_DIF_FUEL_MASS_REQ_SET	V	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Deviation of fuel pressure for setting of the I-part of the flow controller					
FUP_DIF_FUP_REQ_FPA_RST	O/V	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Fuel pressure difference at switching from pressure to flow control in intervention mode					
FUP_DIF_ST_FUEL_MASS_REQ_SET	-	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Deviation of fuel pressure for setting of the I-part of the flow controller					
FUP_ST_PRS	V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure in the beginning of the pressure control phase for the intervention mode					
FUP_STOP_PRS	V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure in the end of the pressure control phase for the intervention mode					
LV_FUEL_MASS_AD_STOP	O/V	0... 1H	0 ...1	1	-
Logical variable requesting adaption stop of controller for demand control					
LV_FUEL_MASS_CTL_RST	O/V	0... 1H	0 ...1	1	-
Logical variable requesting I-part reset of controller for flow control					
LV_FUEL_MASS_CTL_STOP	O/V	0... 1H	0 ...1	1	-
Logical variable requesting I-part freeze of controller for flow control					
LV_FUEL_MASS_REQ_RST_FUP	V	0... 1H	0 ...1	1	-
Logical variable indicating resetting of the I-Part of the flow controller because of overpressure					
LV_FUP_DIF_FUP_REQ_FPA_RST	O/V	0... 1H	0 ...1	1	-
Logical variable indicating the setting of the pressure I-part of the controller in intervention mode					
LV_FUP_PRS_CTL_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable requesting pressure control mode					
LV_FUP_REQ_FPA_RST	O/V	0... 1H	0 ...1	1	-
Logical variable requesting I-part reset of controller for pressure control					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_FUP_REQ_FPA_STOP	O/V	0... 1H	0 ...1	1	-
Logical variable requesting I-part freeze of controller for pressure control					
LV_VFF_VCV_MIN	V	0... 1H	0 ...1	1	-
Logical variable indicating volume flow through VCV reaches limit					
STATE_FUP_CTL	O/V	0H 1H 2H 3H	FLOW_ CONTROL FLOW2PRS PRESSURE_ CONTROL PRS2FLOW	-	-
Operating state for the global fuel pressure regulation strategy					
STATE_FUP_CTL_TRAN	V	0H 1H 2H 3H	FLOW_REQ FLOW2PRS_ REQ PRS_REQ PRS2FLOW_ REQ	-	-
Transition conditions for the STATE_FUP_CTL					
T_FUEL_MASS_REQ_I_CTL_SET	V	0... FFFFH	0... 655.35	0.01	s
Maximum time in the flow control mode for setting of the I-part of the flow controller					
VFF_MFF_SP_FUP_CTL	O/V	0... FFFFH	0... 255	3.89105e-3	l/h
Volume fuel flow through the injectors					
VFF_TMP	-	0... FFFFH	0... 255	3.89105e-3	l/h
Temporary value for volume fuel flow					
VFF_VCV_FUEL_MASS_REQ_SET	V	0... FFFFH	0... 255	3.89105e-3	l/h
Setting volume fuel flow for the I-part of the flow controller					

**Input data:**

C_RHO_FUEL {p. 3960}	FAC_CLC_FUEL_MASS_FUP {p. 3908}	FUEL_MASS_REQ_I_CTL_H_RES {p. 3908}	FUP {p. 1283}
FUP_DIF {p. 3909}	FUP_SP {p. 3868}	LV_ES {p. 1720}	LV_FUEL_MASS_CTL_RST_REQ {p. 3954}
LV_FUEL_MASS_CTL_STOP_DIAG {p. 4001}	LV_FUEL_MASS_CTL_STOP_REQ {p. 3954}	LV_FUP_DIF_FUP_REQ_FPA_RST_ACT {p. 3930}	LV_FUP_REQ_FPA_RST_ACT {p. 3930}
LV_IS {p. 1720}	LV_PUC {p. 1720}	MFF_SP_FUP_CTL {p. 2151}	N_32 {p. 1525}
STATE_PWM_VCV {p. 3955}	STATE_VFF_VCV_MIN {p. 3955}	T_AST {p. 1766}	T_SEG_AV {p. 1525}
VFF_VCV {p. 3956}	VFF_VCV_MIN {p. 3956}		


**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_FUP_PRS	-	0... FFFFH	0... 65535	1	-
Constant for maximal segment cycle number for setting of the pressure controller in the intervention mode					
C_CTR_SEG_FUP_OFS_BOL_MAX	-	0... FFH	0... 255	1	-
Max. value for the counter for forced leaving of pressure control					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_SEG_FUP_OFS_TOL_MAX	-	0... FFH	0... 255	1	-
Max. value for the counter for forced leaving of flow control					
C_CUR_VCV_BAS_AD_VAR_2_ADD_SET	-	0... FFFFH	-32.768 ...32.767	1e-3	A
Setting value for the adaptation at setting of the flow controller					
C_FUP_CTL_MOD	-	0H 1H 2H	AUTOMATIC FLOW_ CONTROL PRESSURE_ CONTROL	-	-
Request for operating state of the global fuel pressure regulation strategy					
C_FUP_OFS_BOL	-	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Offset to the FUP for the forced leaving of pressure control					
C_FUP_OFS_TOL	-	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Offset to the FUP for the forced leaving of flow control					
C_FUP_SP_DEC_TOL	-	0... FFFFH	0... 347776	5.3067216	hPa
Offset to the FUP for the forced leaving of flow control					
C_T_AST_MIN_I_CTL_SET	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time after start for enabling the setting of the flow controller and adaptation value					
C_T_FUEL_MASS_REQ_I_CTL_SET	-	0... FFFFH	0... 655.35	0.01	s
Constant for the maximum time in the flow control mode for setting of the I-part of the flow controller					
C_VFF_MFF_SP_VCV_BAS_AD_SET_LIM	-	0... FFFFH	0... 255	3.89105e-3	l/h
Limit VFF_MFF_SP_FUP_CTL value for setting of the I-part of the flow controller					
C_VFF_SWI_THD	-	0... FFFFH	0... 255	3.89105e-3	l/h
Switch threshold selecting VFF_VCV or VFF_MFF_SP_FUP_CTL as input for struc. change					
C_VFF_VCV_BAS_AD_SET_LIM	-	0... FFFFH	0... 255	3.89105e-3	l/h
Limit VFF_VCV value for setting of the I-part of the flow controller					
C_VFF_VCV_MIN_BOL_HYS	-	0... FFFFH	0... 255	3.89105e-3	l/h
Hysteresis to the lower switch limit					
C_VFF_VCV_MIN_TOL_HYS	-	0... FFFFH	0... 255	3.89105e-3	l/h
Hysteresis to the upper switch limit					
IP_FAC_FUEL_MASS_REQ_SET_N	-	0... FFFFH	0... 31.999	488.273e-6	mg/(l/h)
LDP_IP_FAC_FUEL_MASS_SET	8	0... FFH	0... 8160	32	rpm
Calculation of the mg value for setting of the I-part of the flow controller due to engine speed					
IP_FUP_DIF_FUP_REQ_FPA_RST	-	0... FFFFH	-173890 ...173884	5.3066911	hPa
LDP_FUP_DIF_IP_FUP_REQ_FPA_RST	8	0... FFFFH	-173890 ...173884	5.3066911	hPa
Interpolation curve for setting of the pressure controller in the intervention mode					
IP_VFF_VCV_I_CTL_SET	-	0... FFFFH	-255 ...0	3.89105e-3	l/h
LDP_VFF_VCV_IP_VFF_VCV_CTL_SET	6	0... FFFFH	0... 255	3.89105e-3	l/h
Calculation map for the setting value of the I-part of the flow controller due to fuel volume flow					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_FUEL_MASS_CTL_RST	-	0... 1H	0 ...1	1	-
Logical switch requesting I-part reset of controller for flow control at leaving pressure control					
LC_FUP_REQ_FPA_RST	-	0... 1H	0 ...1	1	-
Logical switch requesting I-part reset of controller for pressure control at leaving flow control					
LC_INH_SWI_THD_PUC	-	0... 1H	0 ...1	1	-
Logical constant for inhibit of the fuel pressure intervention mode in PUC					
LC_VFF_SWI	-	0... 1H	0 ...1	1	-
Logical switch selecting VFF_VCV or VFF_MFF_SP_FUP_CTL as input for struc. Change (1:VFF_VCV)					

## Overview

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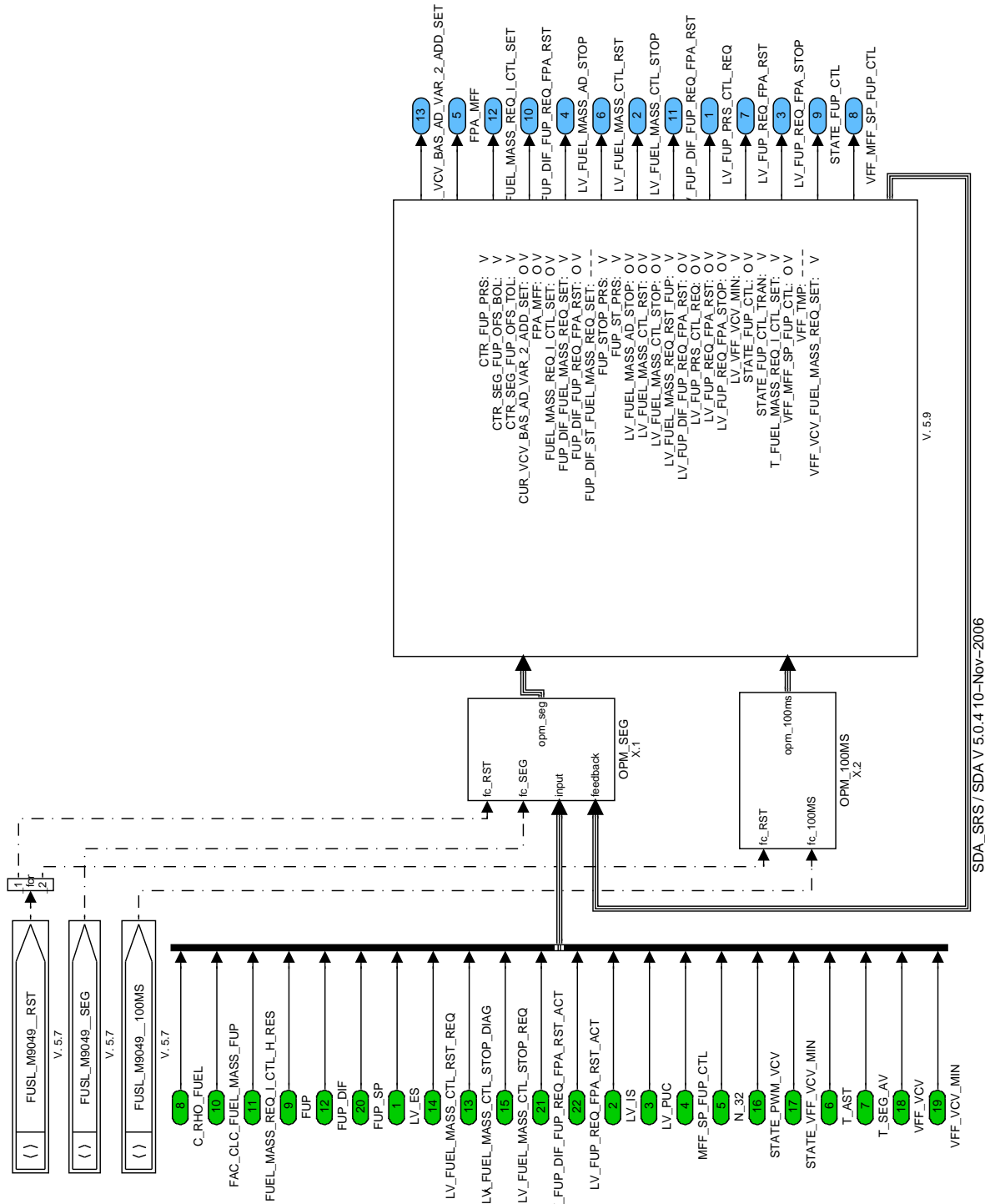



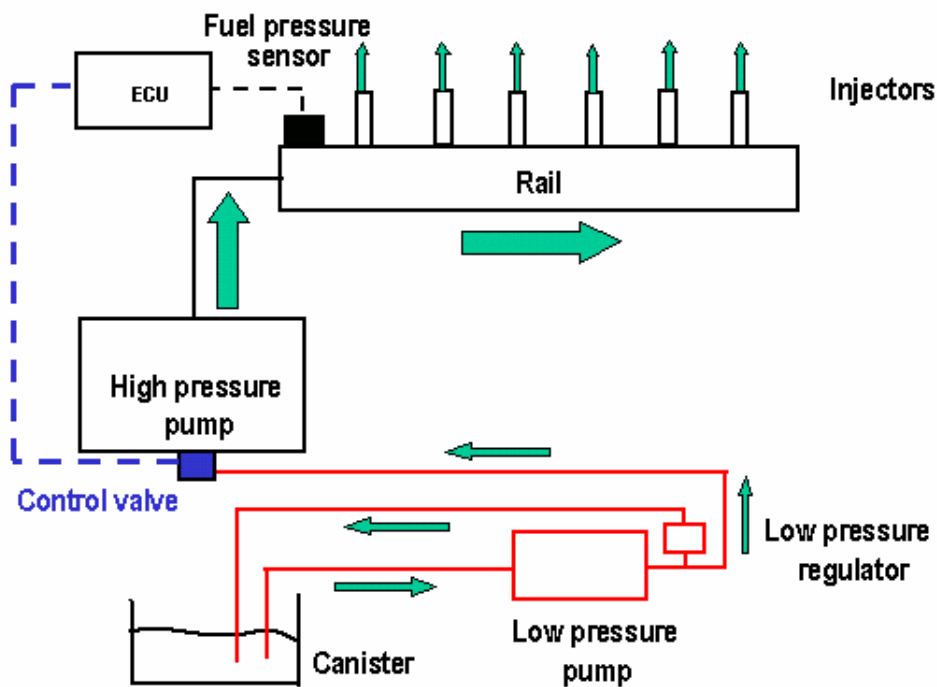
Figure 9.37.1: Path: FUSL\_M9049

**General Information**

A variant of the fuel pressure control system is a threewayvalve as a control mode, which combines the volume control valve and the regulator functionality. In that case the regulator is obsolete.

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### General scheduling

#### Segment synchronous tasks:


1. Fuel pressure of low pressure pump
2. Fuel pressure
3. {Injection related parts of SW}
4. Electrical fuel pump control (Appl. Inc.)
5. Electrical fuel pump
6. Fuel supply general
7. Fuel pressure setpoint calculation
8. Fuel pressure control
9. High pressure pump control

#### 1 ms tasks:

1. Fuel pressure of low pressure pump

#### 10 ms tasks:

1. Fuel pressure of low pressure pump
2. Fuel pressure
3. {Injection related parts of SW}
4. Electrical fuel pump control (Appl. Inc.)
5. Electrical fuel pump
6. Fuel pressure setpoint calculation
7. Fuel pressure control (Appl. Inc.)
8. Fuel pressure control

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9. High pressure pump control (Appl. Inc.)
10. High pressure pump control

20 ms tasks:

1. Fuel system pressure diagnosis for low pressure (Appl. Inc)
2. Fuel system pressure diagnosis for low pressure
3. Fuel system pressure diagnosis (Appl. Inc.)
4. Fuel system pressure diagnosis

40 ms tasks:

1. Fuel pressure sensor diagnosis for low pressure (Appl. Inc.)
2. Fuel pressure sensor diagnosis for low pressure
3. Fuel pressure sensor diagnosis (Appl. Inc.)
4. Fuel pressure sensor diagnosis

100 ms tasks:

1. Electrical diagnosis of fuel pressure actuator (Appl. Inc.)
2. Electrical diagnosis of fuel pressure actuator
3. Fuel pressure setpoint of electrical fuel pump
4. Fuel pressure control (Appl. Inc.)
5. Fuel pressure control
6. High pressure pump control
7. Fuel supply general

1000 ms tasks:

Fuel pressure actuator temperature calculation

Management of the pressure and flow controllers in the intervention mode

Condition VFF\_VCV under the C\_VFF\_SWI\_THD


In idle speed:

Reset of the I part of the flow controller  
 Set of the I part of the pressure controller  
 No reset of the I part of the pressure controller  
 No Execution of the adaptations

In PUC:

No reset of the I part of the flow controller  
 Set of the I part of the pressure controller  
 Reset of the I part of the pressure controller depending on the reset LC's  
 Alternative execution of the pressure /leakage adaptations

In PU:

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No reset of the I part of the flow controller  
 Set of the I part of the pressure controller  
 Reset of the I part of the pressure controller depending on the reset LC's  
 No Execution of the adaptations.

### 9.37.1 Function description of 100MS task

#### Application Conditions

Initialization: RST  
 Recurrence: 100MS  
 Activation: always  
 Deactivation: never

#### Function description

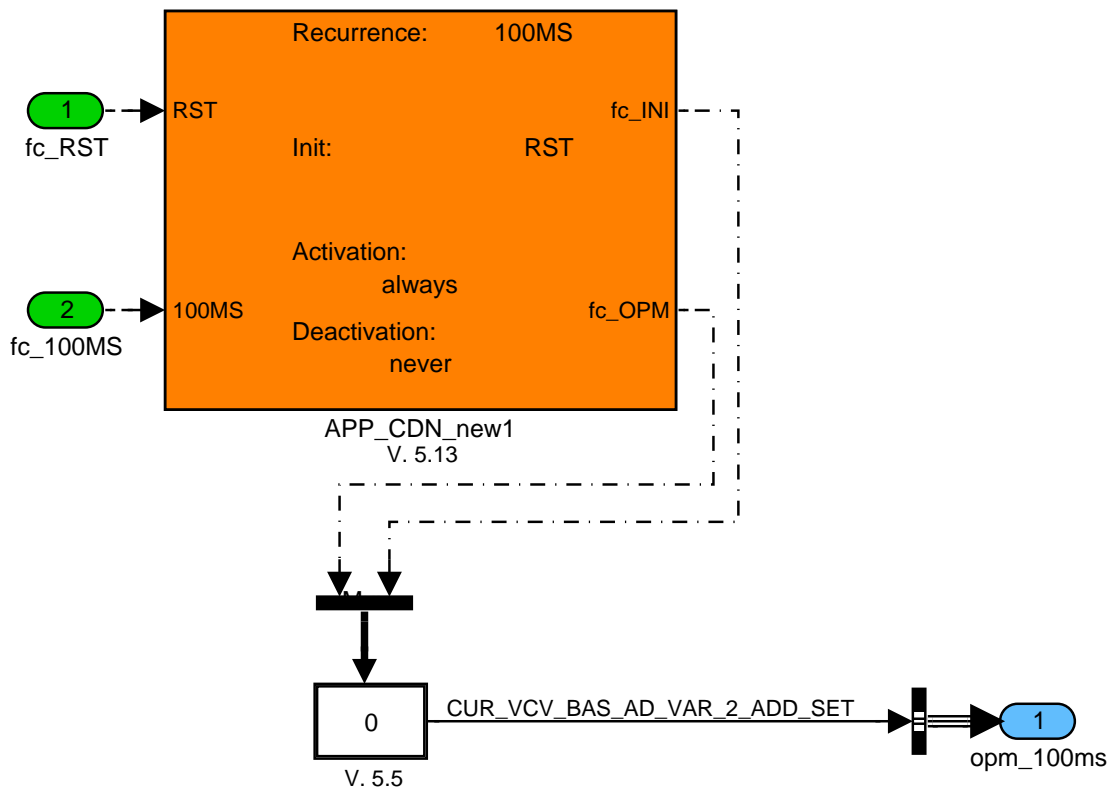
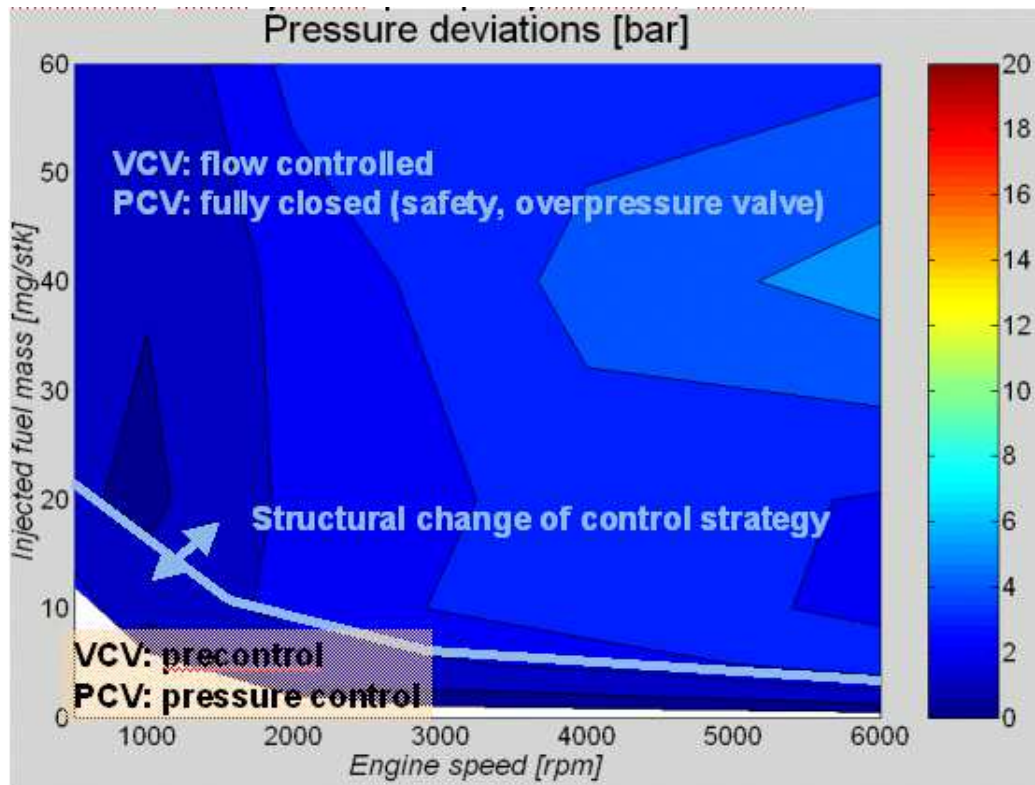


Figure 9.37.2: : Path: FUSL\_M9049/OPM\_100MS

### 9.37.2 Function Description of segment synchronous task

The fuel supply general organizes the different fuel pressure control possibilities. It can be achieved an automatic mode where the flow control and pressure control mode is chosen by the flow through the volume control valve. Also only flow control or pressure control can be selected. The pressure control part can be divided into pressure control with or without flow precontrol and the flow control can be combined with or without pressure control.



### Application Conditions

Initialization: RST


Recurrence: SEG

Activation: LV\_ES == 0

Deactivation: LV\_ES == 1

### Function description

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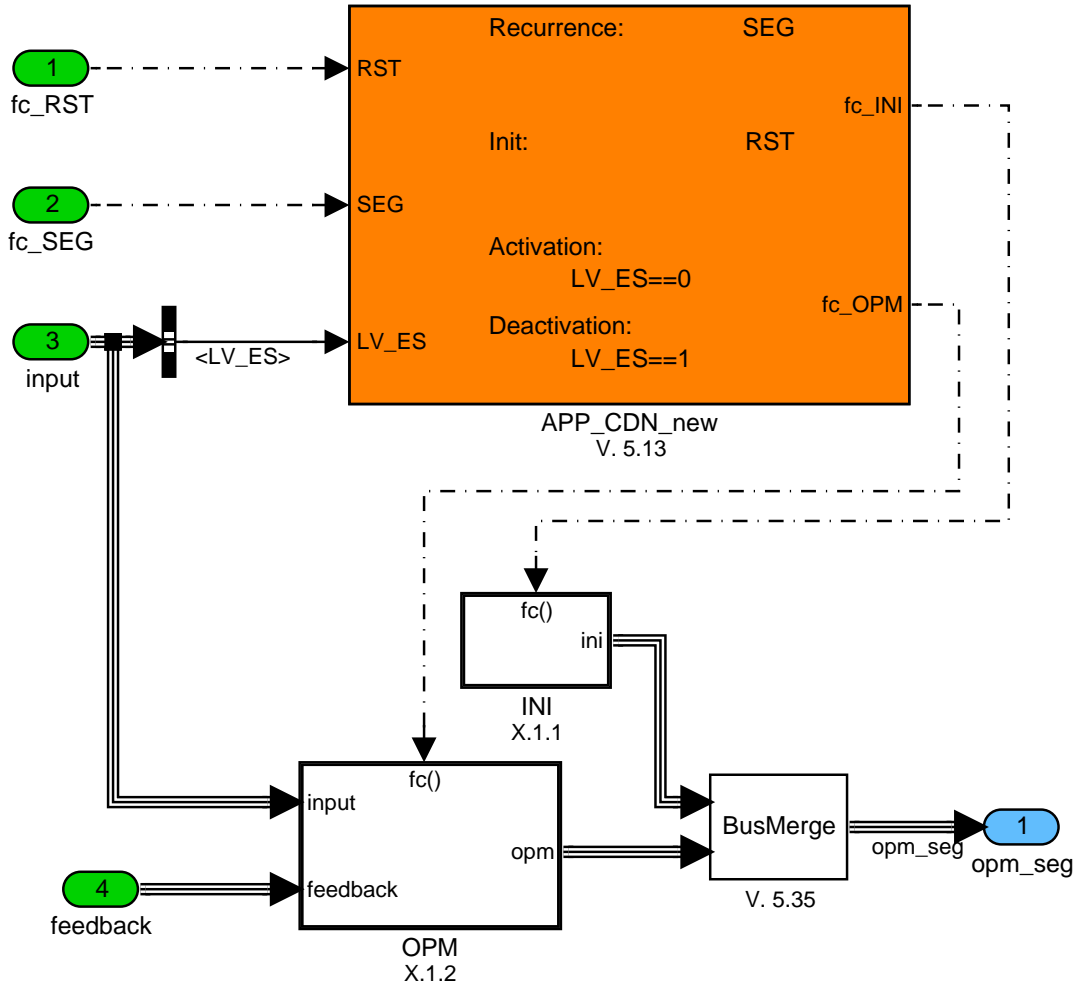


Figure 9.37.3: : Path: FUSL\_M9049/OPM\_SEG

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### 9.37.2.1 Initialisation at reset event

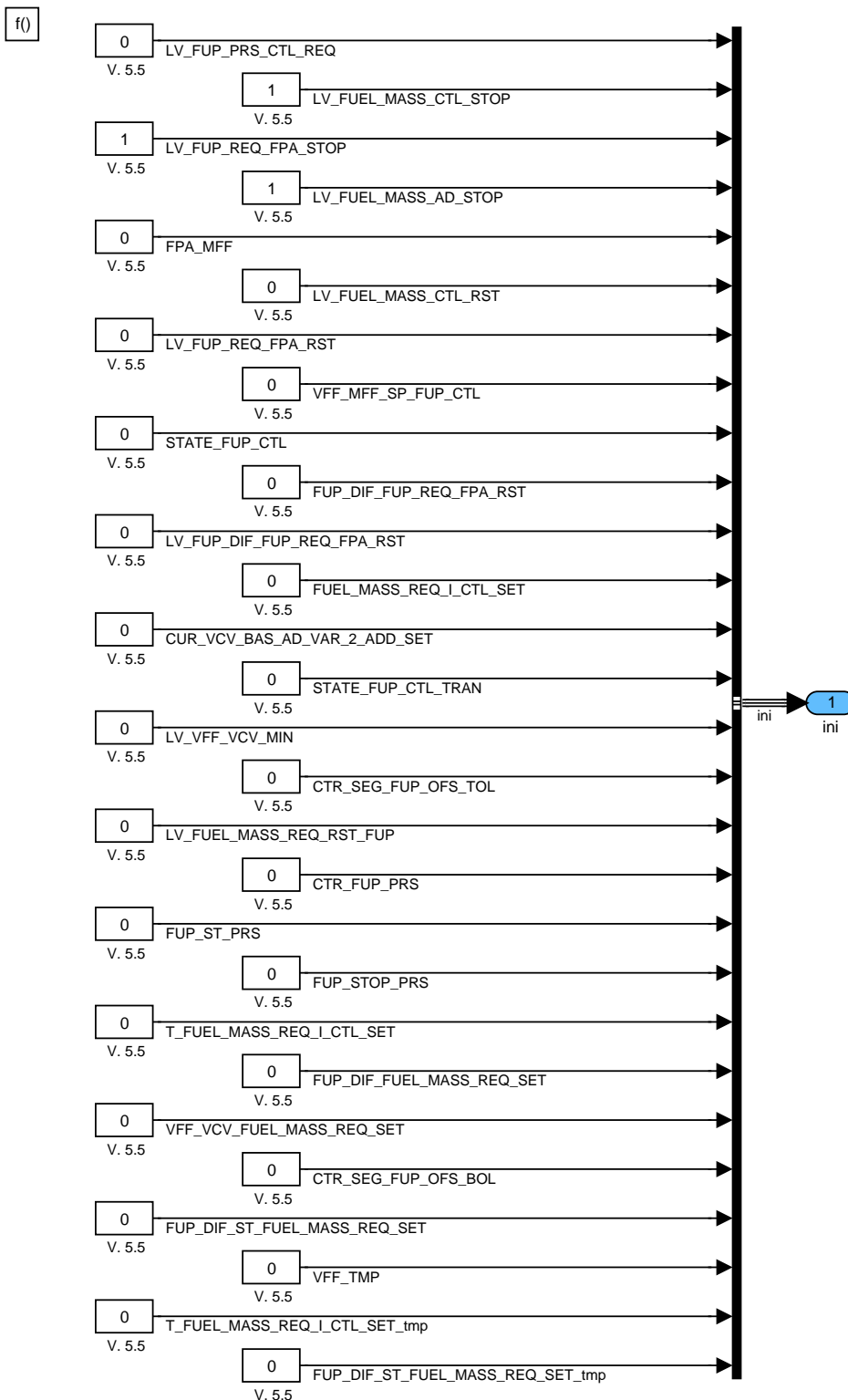


Figure 9.37.4: : Path: FUSL\_M9049/OPM\_SEG/INI

### 9.37.2.2 Calculation

For better visibility the functionality is split into three subsystems

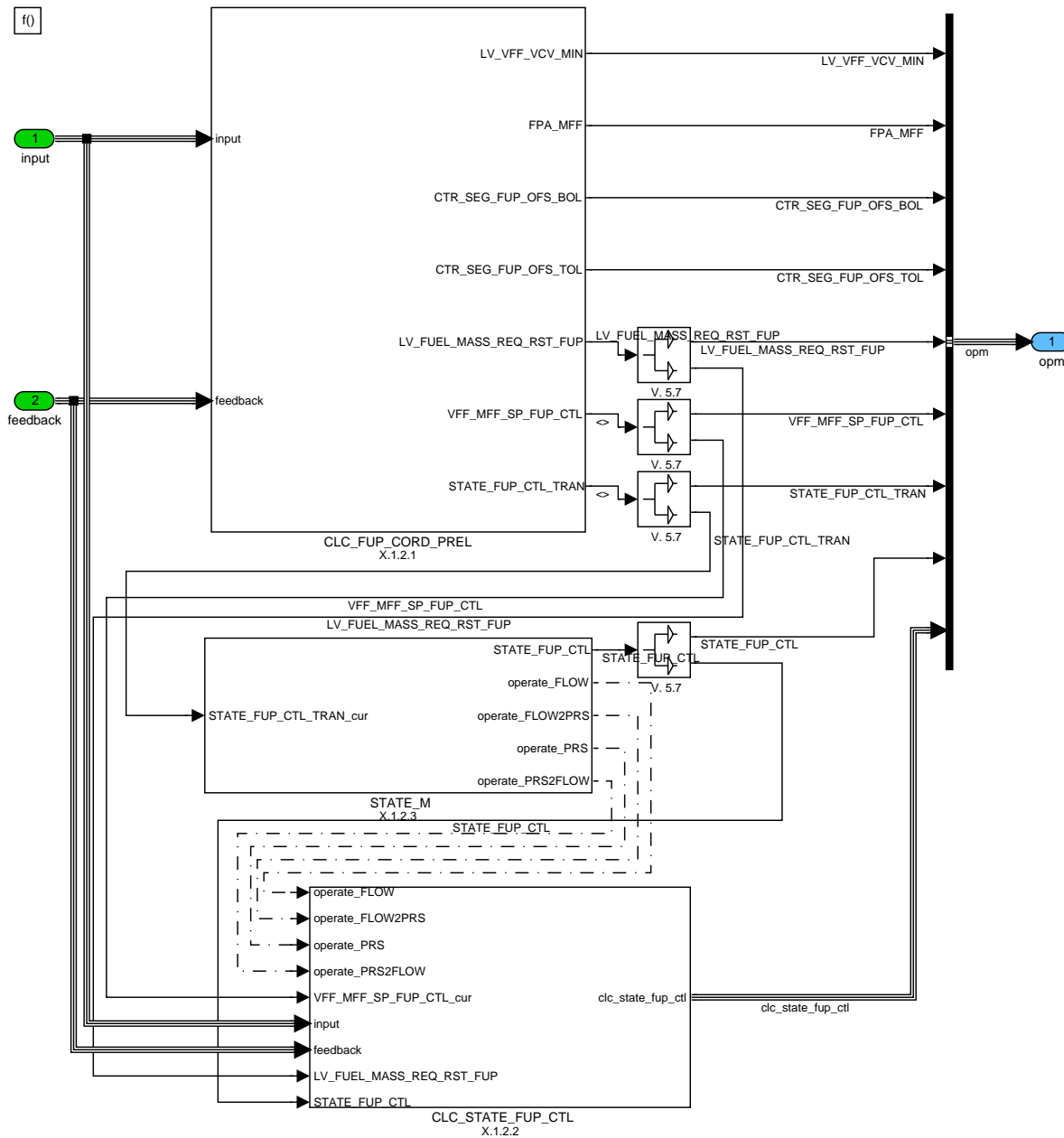


Figure 9.37.5: : Path: FUSL\_M9049/OPM\_SEG/OPM

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### 9.37.2.2.1 Preliminary fuel pressure co-ordination

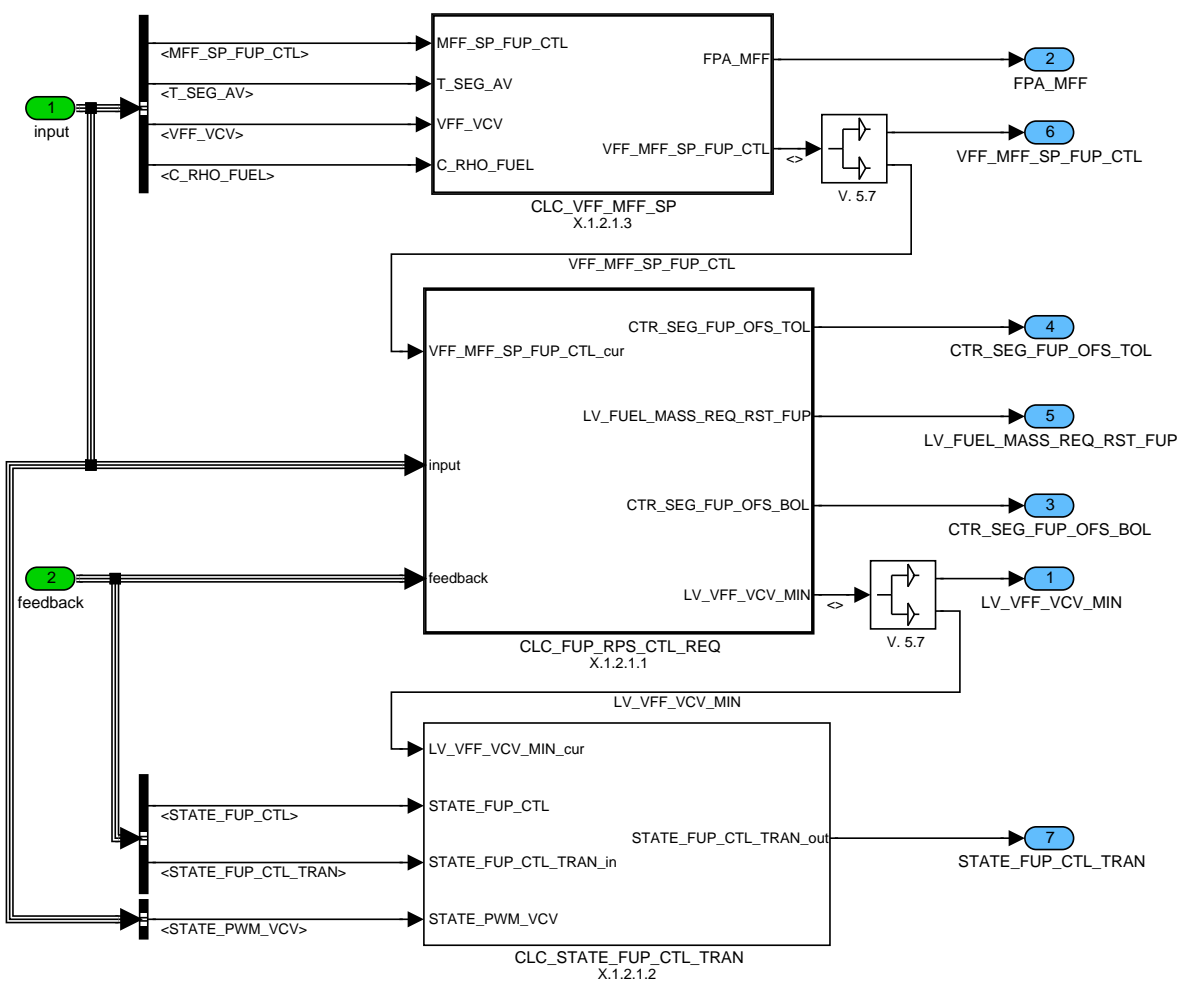


Figure 9.37.6: : Path: FUSL\_M9049/OPM\_SEG/OPM/CLC\_FUP\_CORD\_PREL

#### 9.37.2.2.1.1 Fuel pressure request control

The following blocks calculate the switching between pressure and flow control mode

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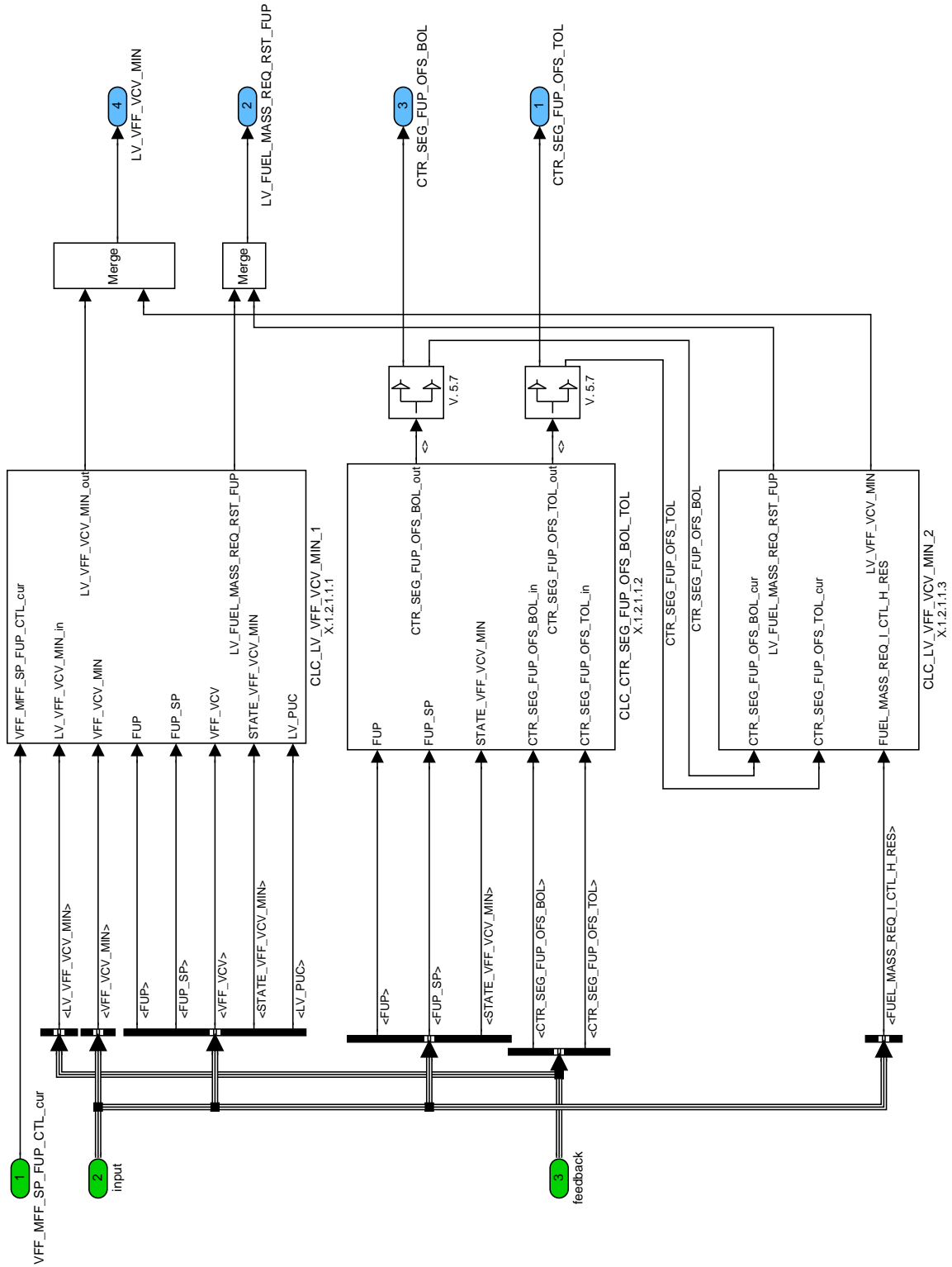



Figure 9.37.7: : Path:  
 FUSL\_M9049/OPM\_SEG/OPM/CLC\_FUP\_CORD\_PREL/CLC\_FUP\_RPS\_CTL\_REQ

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9.37.2.2.1.1.1 Calculation of fuel pressure limits

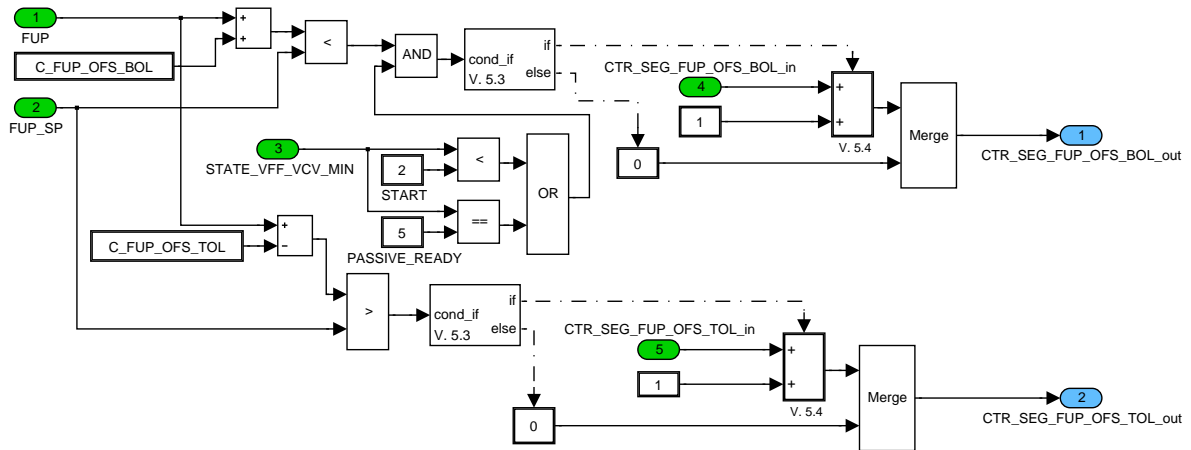


Figure 9.37.8: : Path: FUSL\_M9049/OPM\_SEG/OPM/CLC\_FUP\_CORD\_PREL/CLC\_FUP\_RPS\_CTL\_REQ/CLC\_CTR\_SEG\_FUP\_OFS\_BOL\_TOL

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9.37.2.2.1.1.2 Minimum volumetric fuel flow calculation

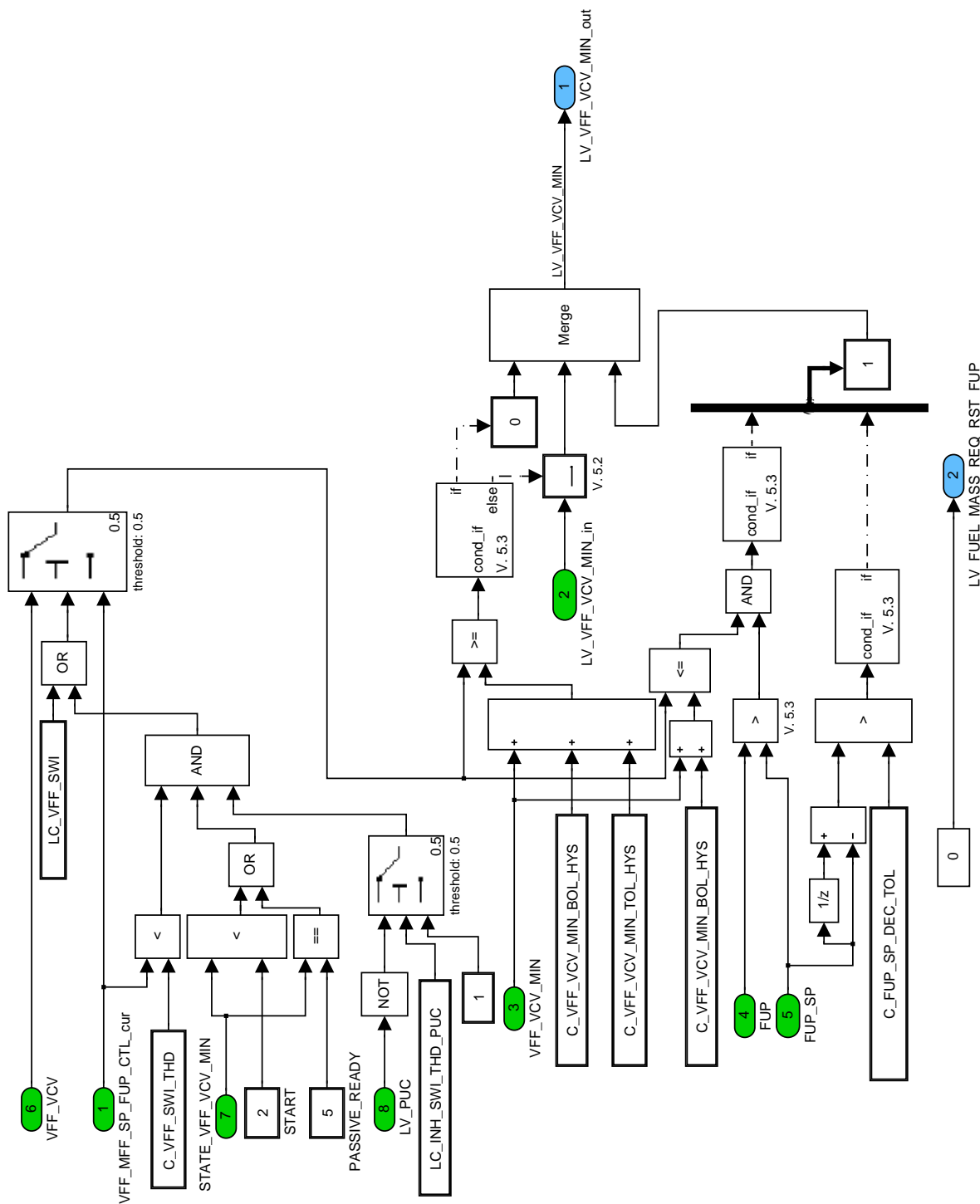



Figure 9.37.9: : Path: FUSL\_M9049/OPM\_SEG/OPM/CLC\_FUP\_CORD\_PREL/CLC\_FUP\_RPS\_CTL\_REQ/CLC\_LV\_VFF\_VCV\_MIN\_1

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9.37.2.2.1.1.3 Minimum fuel flow based on fuel pressure offset

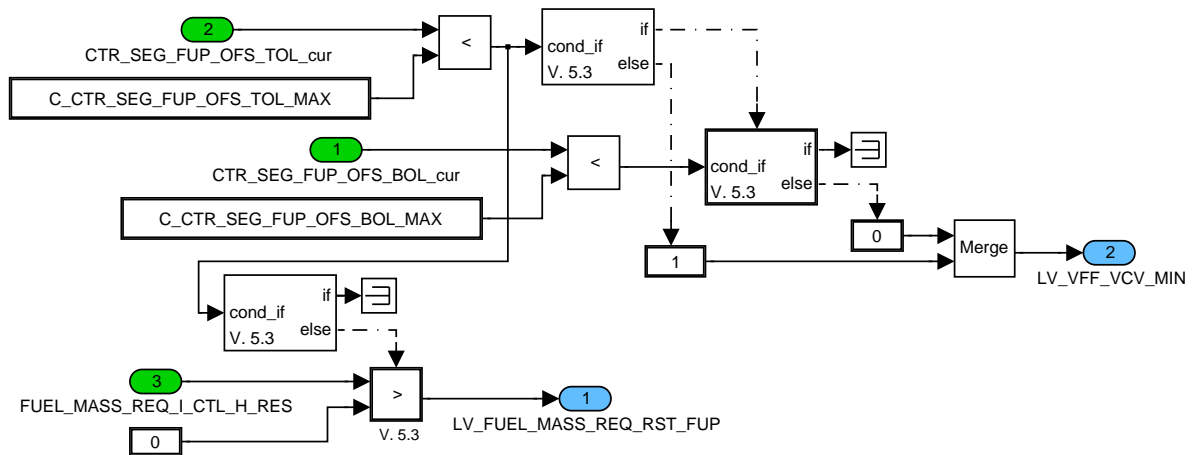



Figure 9.37.10: : Path: FUSL\_M9049/OPM\_SEG/OPM/CLC\_FUP\_CORD\_PREL/CLC\_FUP\_RPS\_CTL\_REQ/CLC\_LV\_VFF\_VCV\_MIN\_2

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9.37.2.2.1.2 Fuel pressure control transition

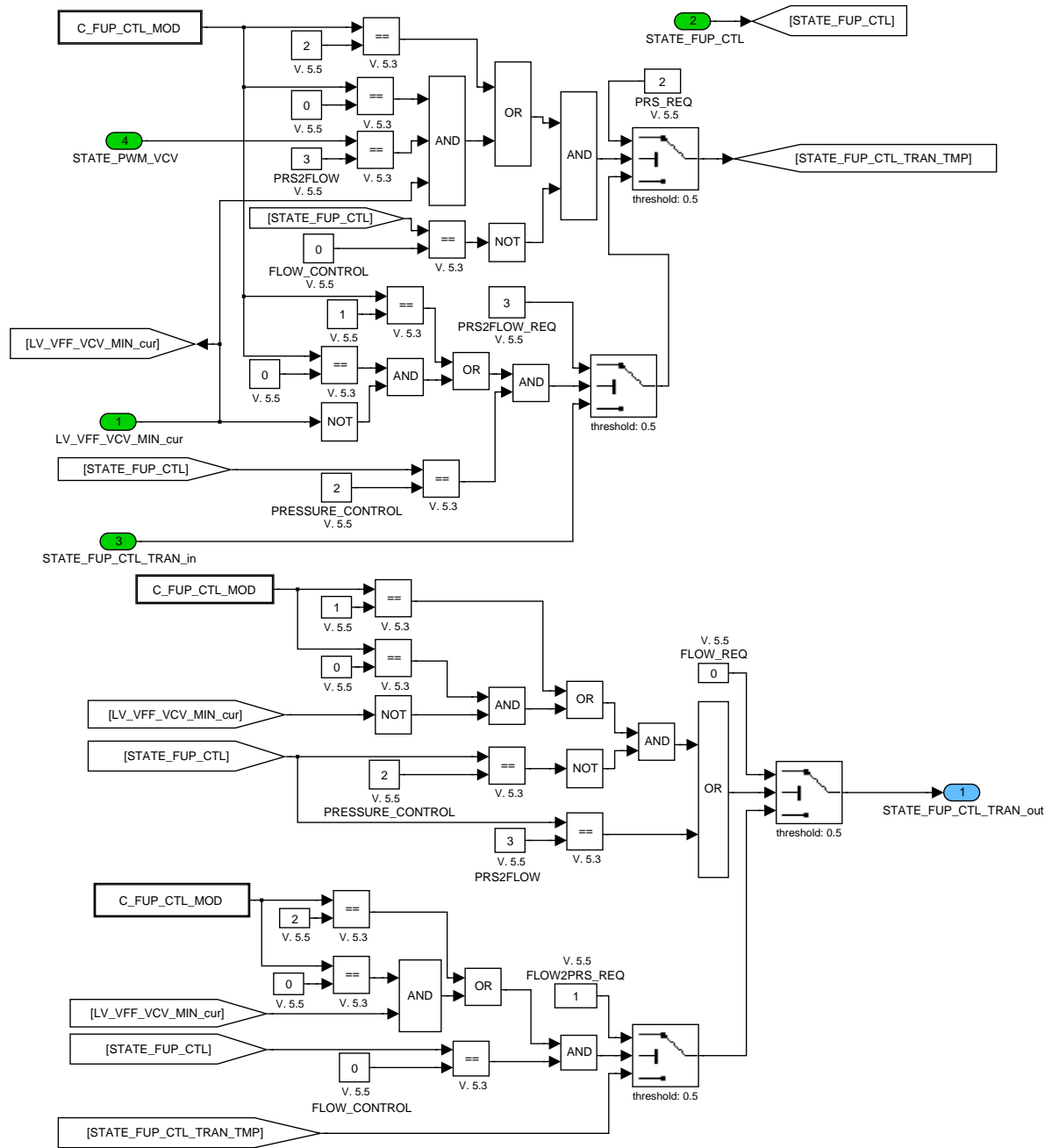


Figure 9.37.11: Path: FUSL\_M9049/OPM\_SEG/OPM/CLC\_FUP\_CORD\_PREL/CLC\_STATE\_FUP\_CTL\_TRAN

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9.37.2.2.1.3 Calculation of Fuel pressure control

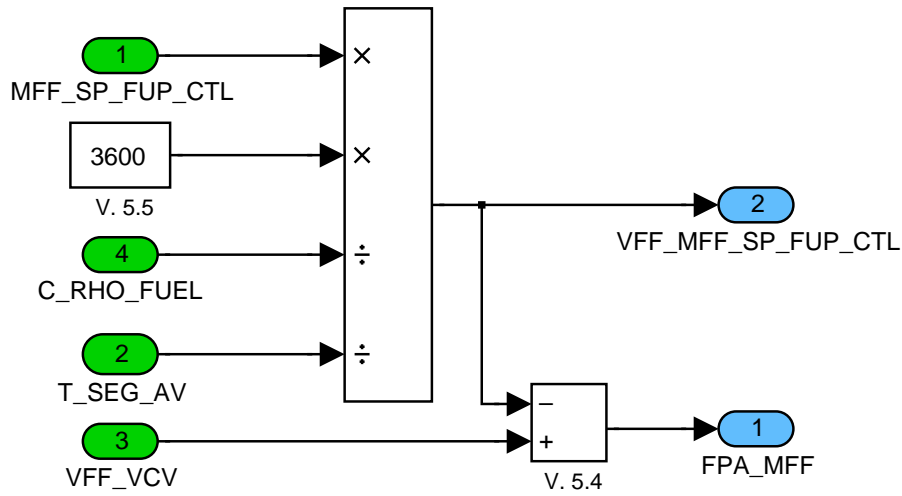


Figure 9.37.12: : Path: FUSL\_M9049/OPM\_SEG/OPM/CLC\_FUP\_CORD\_PREL/CLC\_VFF\_MFF\_SP

9.37.2.2.2 State Machine

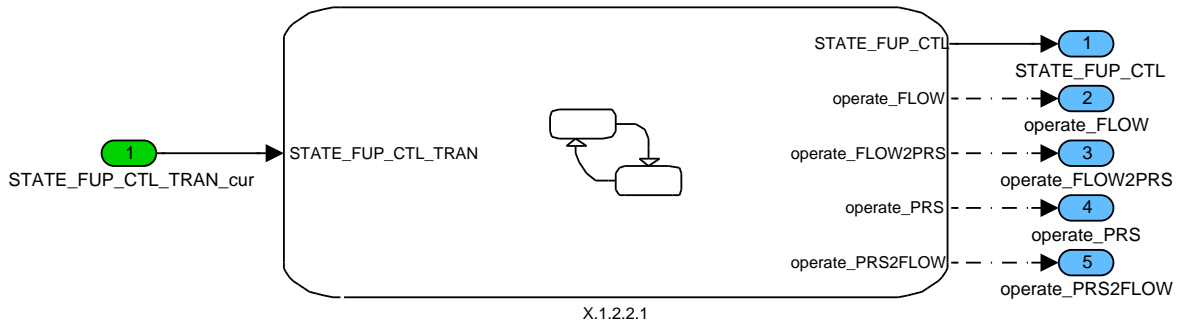


Figure 9.37.13: : Path: FUSL\_M9049/OPM\_SEG/OPM/STATE\_M

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9.37.2.2.1 Chart

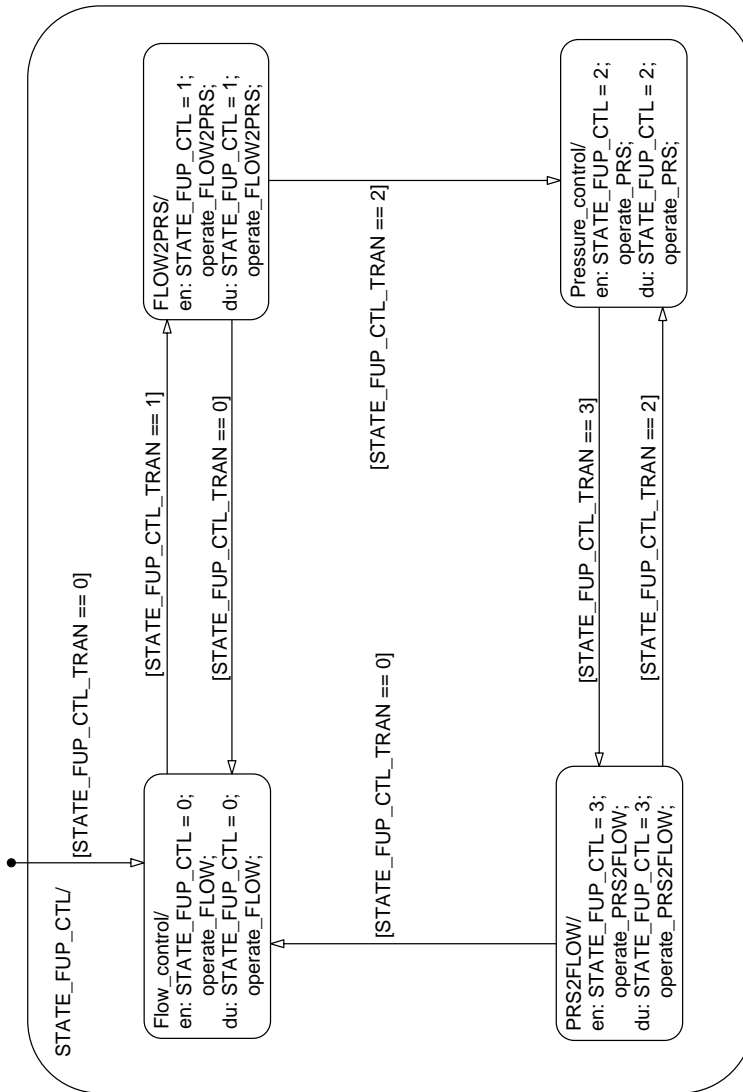



Figure 9.37.14: : Path: FUSL\_M9049/OPM\_SEG/OPM/STATE\_M/Chart

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9.37.2.2.3.1 Calculation

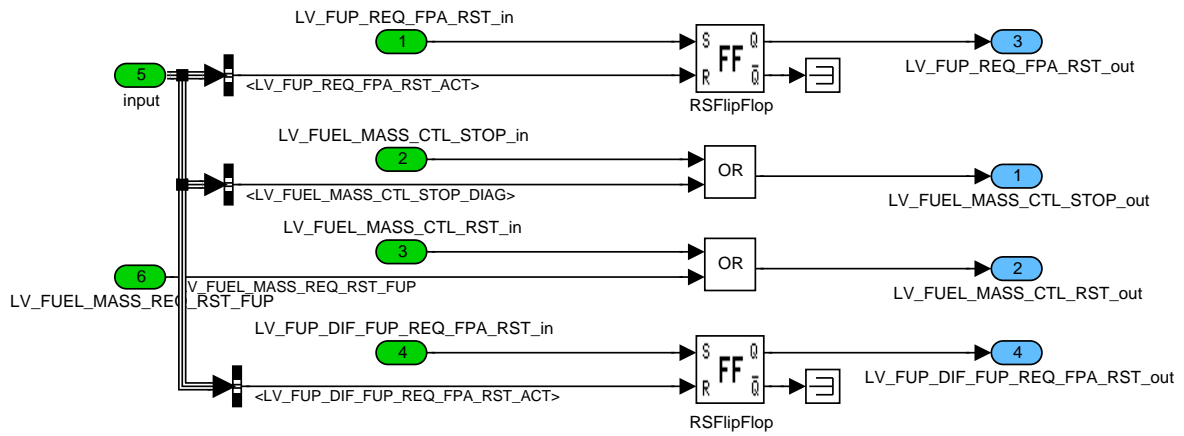

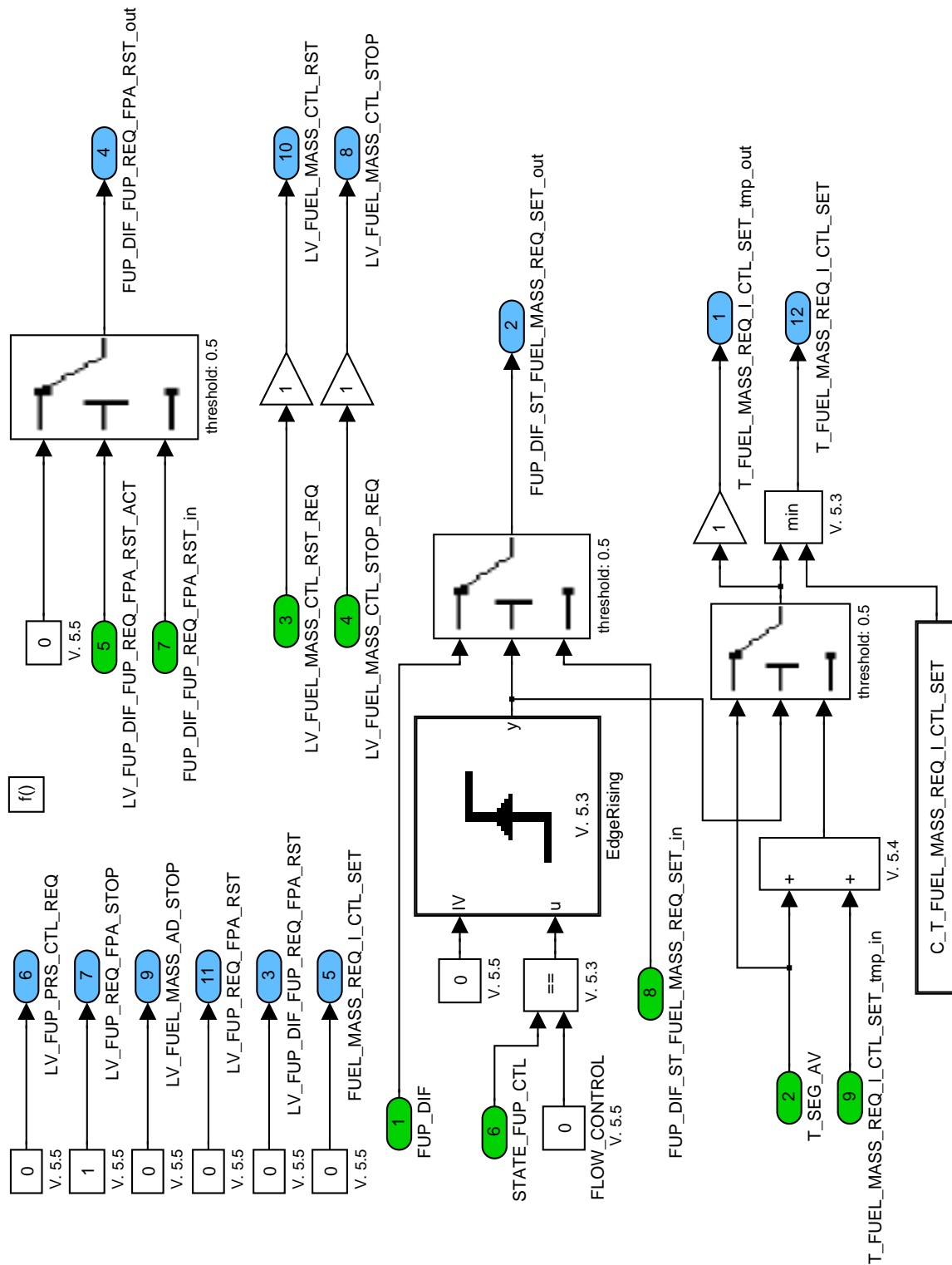


Figure 9.37.16: : Path: FUSL\_M9049/OPM\_SEG/OPM/CLC\_STATE\_FUP\_CTL/CLC

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9.37.2.2.3.2 Flow calculation



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Figure 9.37.17: Path: FUSL\_M9049/OPM\_SEG/OPM/CLC\_STATE\_FUP\_CTL/CLC\_FLOW

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### 9.37.2.2.3.3 Flow to pressure calculation overview

For better visibility the functionality is divided into two different systems

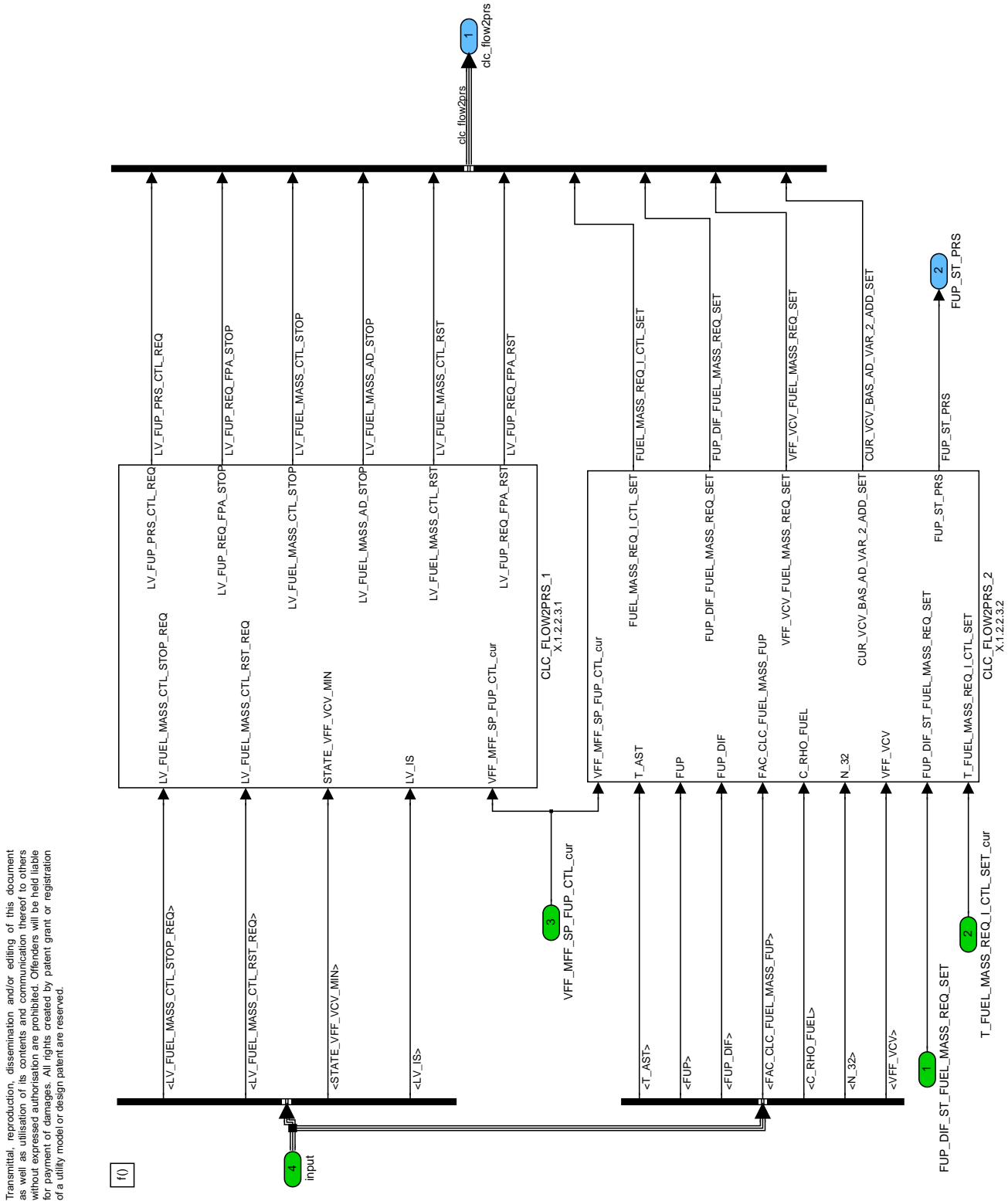


Figure 9.37.18: Path: FUSL\_M9049/OPM\_SEG/OPM/CLC\_STATE\_FUP\_CTL/CLC\_FLOW2PRS

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9.37.2.2.3.3.1 Fuel pressure actuator reset calculation

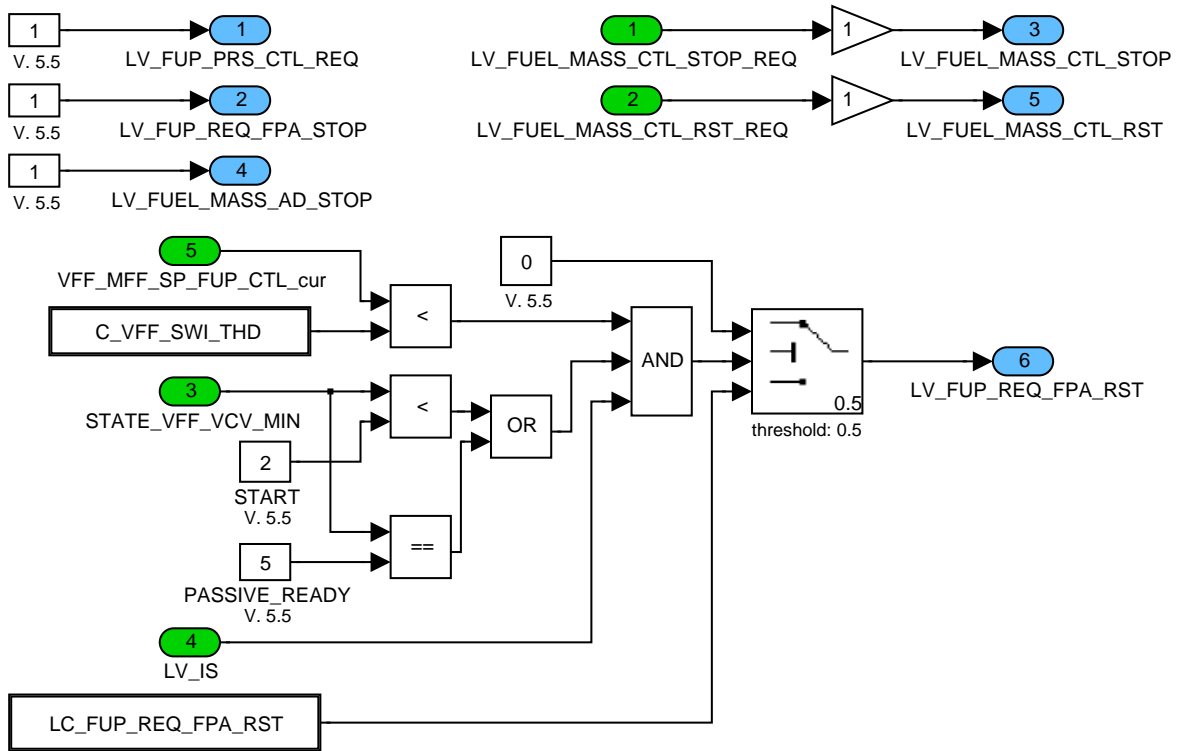


Figure 9.37.19: : Path:  
FUSL\_M9049/OPM\_SEG/OPM/CLC\_STATE\_FUP\_CTL/CLC\_FLOW2PRS/CLC\_FLOW2PRS\_1

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9.37.2.2.3.3.2 Fuel mass request control & set calculation

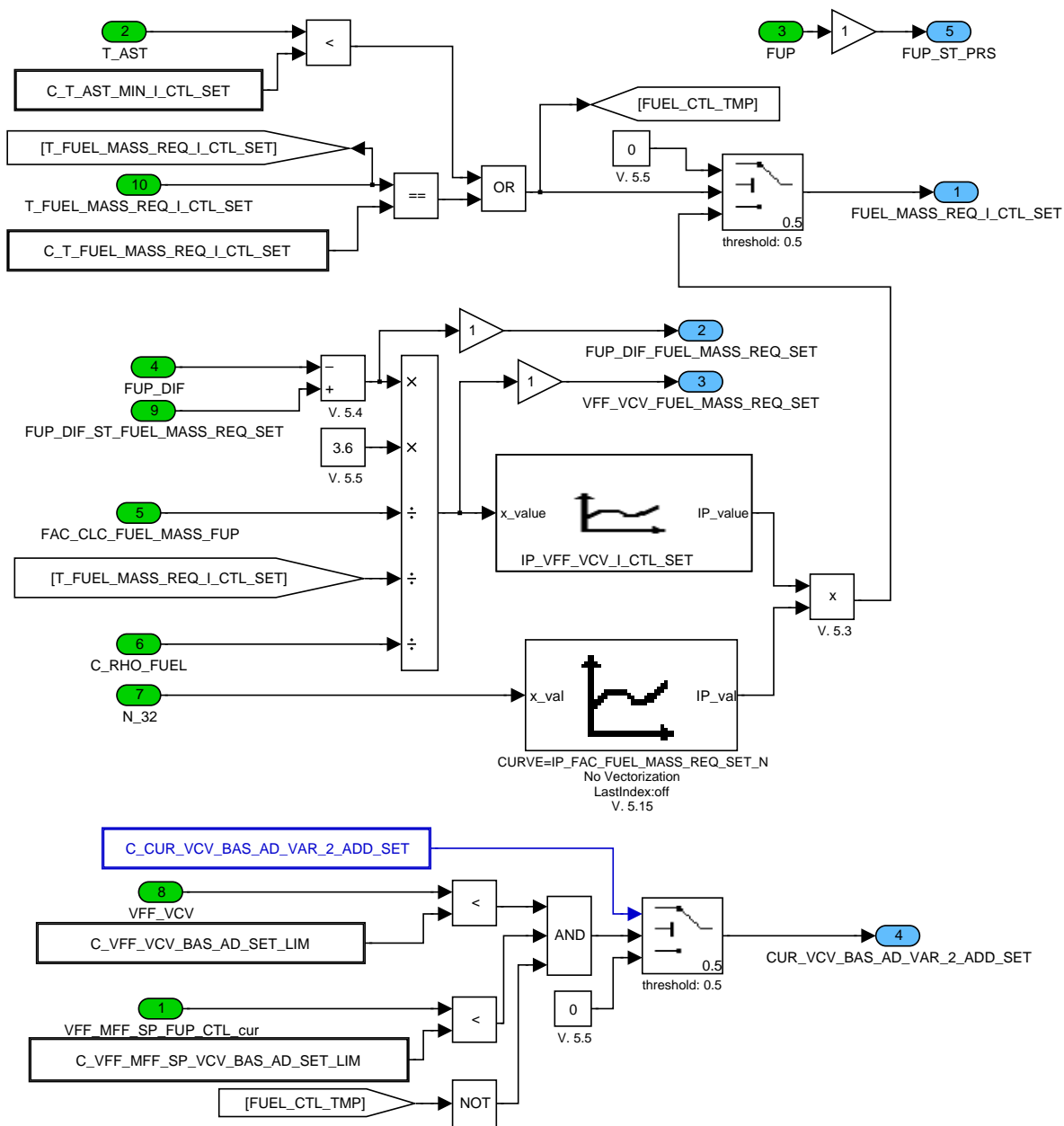


Figure 9.37.20: : Path:  
FUSL\_M9049/OPM\_SEG/OPM/CLC\_STATE\_FUP\_CTL/CLC\_FLOW2PRS/CLC\_FLOW2PRS\_2

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9.37.2.2.3.4 Pressure calculation

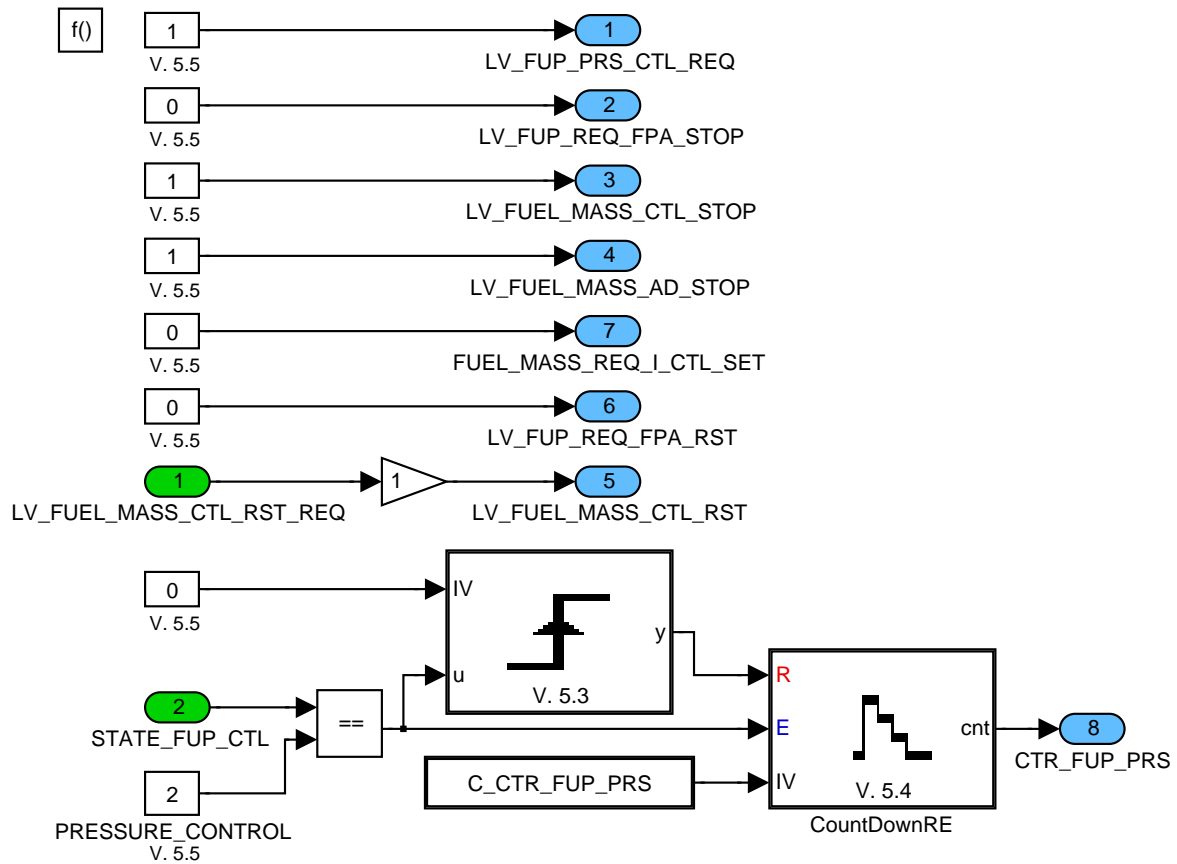


Figure 9.37.21: Path: FUSL\_M9049/OPM\_SEG/OPM/CLC\_STATE\_FUP\_CTL/CLC\_PRS

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### 9.37.2.2.3.5 Pressure to flow calculation

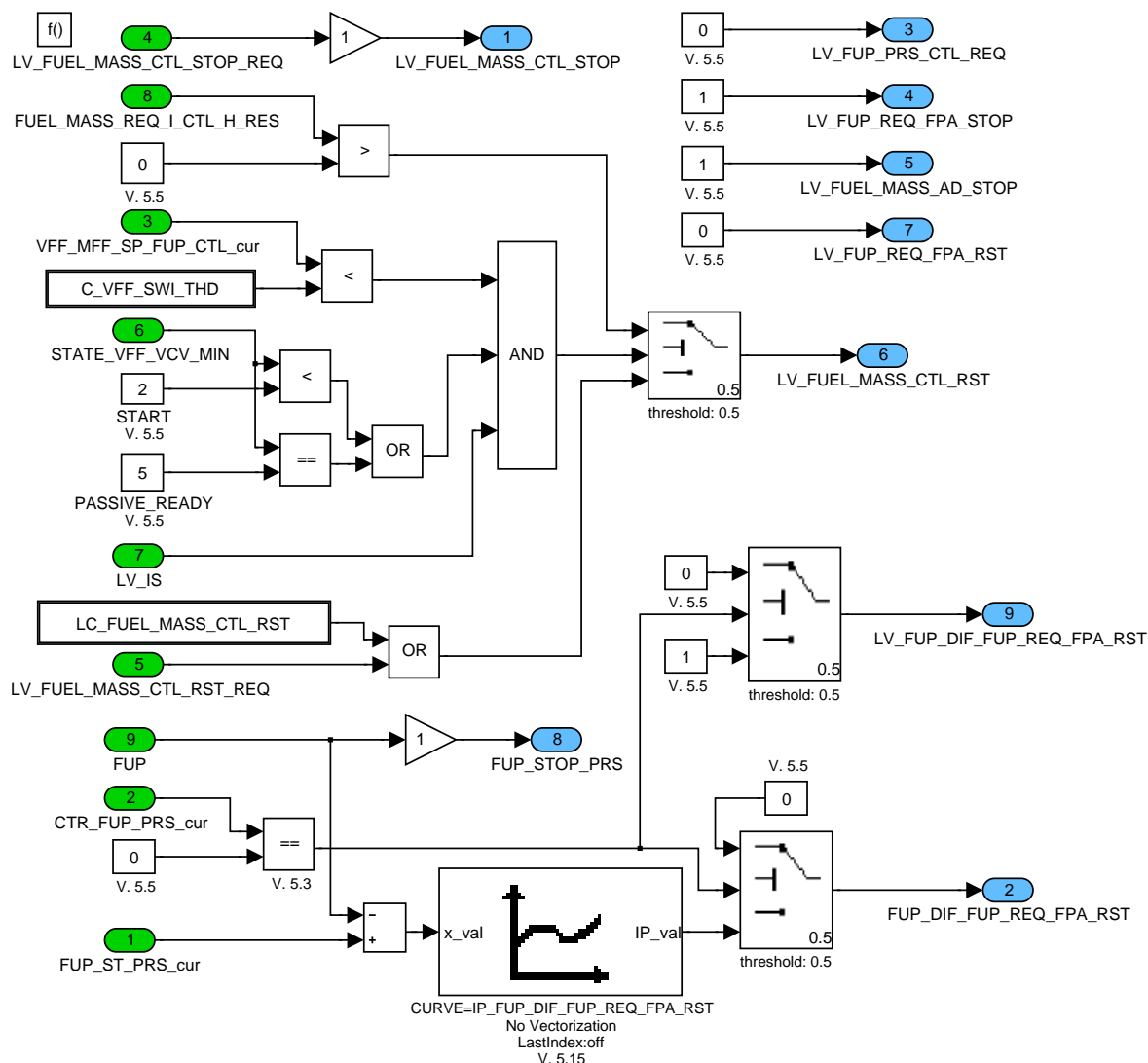


Figure 9.37.22: : Path: FUSL\_M9049/OPM\_SEG/OPM/CLC\_STATE\_FUP\_CTL/CLC\_PRS2FLOW

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## 9.38 Fuel pressure control

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_CLC_FUEL_MASS_FUP	O/V	0... FFH	0... 510	2	hPa/mg
Factor for compressibility and density of gasoline and rail					
FAC_FUEL_MASS_REQ_PCTL	V	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Weighting factor for the precontroller					
FUEL_MASS_AD	O/V/S	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Adaptive fuel mass					
FUEL_MASS_AD_DIF	O/V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Deviation of the fuel mass for the adaption					
FUEL_MASS_REQ	O/V	0... FFFFH	0... 1389	0.0211948	mg
Requested fuel mass from the pump					
FUEL_MASS_REQ_CTL	O/V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Controller output					
FUEL_MASS_REQ_D_CTL	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
D-part of controller					
FUEL_MASS_REQ_I_CTL_H_RES	O/V	8000000... 7FFFFFFFH	-694.510597391 ...694.489402609	323.402e-9	mg
I-part of the controller					
FUEL_MASS_REQ_I_CTL_MMV	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Mean value of the I-part of the controller					
FUEL_MASS_REQ_MFF	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Additive fuel mass (DT1) due to injection fuel mass					
FUEL_MASS_REQ_P_CTL	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
P-part of the controller					
FUEL_MASS_REQ_PCTL	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Requested fuel mass from the precontroller					
FUEL_MASS_REQ_PCTL_TMP	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Requested fuel mass from the precontroller (without the influence of the weighting factor)					
FUEL_MASS_REQ_TQ	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Additive fuel mass (DT1) due to Torque request					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FUP_DIF	O/V	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Deviation of fuel pressure setpoint and measured fuel pressure					
FUP_DIF_CTL	V	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Deviation of measured fuel pressure and FUP_MDL or FUP_SP (depending on LC_USE_FUP_MDL_CTL)					
FUP_DIF_MMV	O/V	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Deviation of fuel pressure setpoint and measured fuel pressure moving mean value					
FUP_DIF_PCTL	V	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Deviation of fuel pressure setpoint and FUP_MDL or FUP (depending on LC_USE_FUP_MDL_PCTL)					
FUP_GRD	V	8000... 7FFFH	-869... 86942.67	2.6533608	hPa/10ms
Fuel pressure gradient					
LV_FUEL_ADD_ACT	V	0... 1H	0 ...1	1	-
Logical variable indicating that additional fuel mass is added to precontrol					
SEG_CTR_FUEL_MASS_AD	V	0... FFFFH	0... 65535	1	-
Segment counter before adaptation is allowed					
TQ_REQ_CLU_LIM	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Limited requested torque at clutch for FUSL DT1 activation					

**Input data:**

FUEL_MASS_REQ_I_CTL_SET {p. 3880}	FUP {p. 1283}	FUP_SP {p. 3868}	LV_ERR_FUP_MFP_PLAUS {p. 6062}
LV_ES {p. 1720}	LV_FUEL_MASS_AD_STOP {p. 3880}	LV_FUEL_MASS_CTL_RST {p. 3880}	LV_FUEL_MASS_CTL_STOP {p. 3880}
LV_ST_END {p. 1720}	MFF_SP_FUP_CTL {p. 2151}	N_32 {p. 1525}	PV_AV {p. 1269}
PV_AV_GRD {p. 1269}	STATE_PWM_VCV {p. 3955}	T_SEG_AV {p. 1525}	TFU {p. 1232}
TQ_MAX_CLU {p. 8380}	TQ_REQ_CLU {p. 8390}	VFF_VCV {p. 3956}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CLC_FUEL_PUMP_CTL	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Amount of segments of calculation recurrency of high pressure pump control					
C_CRLC_FUP_DIF_MMV	-	0... FFH	0... 0.99609375	3.90625e-3	-
Filter constant for the fuel pressure difference					
C_CTR_CYC_FUEL_ADD	-	0... FFFFH	0... 65535	1	-
Number of segments where adding additional fuel mass to precontrol is active					
C_DLY_FUP_SP	-	1... 6H	1 ...6	1	-
Delay of the FUP_SP in calculation cycles					
C_FAC_FUEL_MASS_TQ	-	0... FFFFH	0... 1.99996948242	30.5176e-6	mg/Nm
Correlation factor from Nm to mg/stk					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQ_REQ_FUEL_MASS	-	0... FFFFH	0... 1.9996948242	30.5176e-6	-
Factor to limit the TQ_REQ_CLU to the real value (no over Request)					
C_FUEL_MASS_AD_COR_CRLC	-	0... FFH	0... 0.99609375	3.90625e-3	-
Filter constant for the fuel mass adaptation					
C_FUEL_MASS_AD_MAX	-	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Maximum adaptive fuel mass					
C_FUEL_MASS_AD_MIN	-	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Minimum adaptive fuel mass					
C_FUEL_MASS_REQ_ADD	-	0... FFFFH	0... 1389	0.0211948	mg
Additive fuel mass depending on engine speed.					
C_FUEL_MASS_REQ_I_CTL_INI	-	0... FFFFH	-694.5... 694.478806	0.02119-	mg
Initialisation of the I-part of the flow controller depending on the fuel temperature					
C_FUEL_MASS_REQ_I_CTL_MAX	-	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Maximum I-part of the controller					
C_FUEL_MASS_REQ_I_CTL_MIN	-	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Minimum I-part of the controller					
C_FUEL_MASS_REQ_I_CTL_MMV_CRLC	-	0... FFH	0... 0.99609375	3.90625e-3	-
Filter constant for moving mean value calculation of the I-part					
C_N_FUEL_MASS_AD_MAX	-	0... FFH	0... 8160	32	rpm
Maximum engine speed threshold for allowing fuel mass adaption					
C_N_FUEL_MASS_AD_MIN	-	0... FFH	0... 8160	32	rpm
Minimum engine speed threshold for allowing fuel mass adaption					
C_PV_GRD_THD_FUEL_ADD	-	0... FFH	-1250... 1240.234375	9.765625	%/s
Pedal value gradient threshold for adding fuel mass					
C_PV_THD_FUEL_ADD	-	0... FFH	0... 99.609375	0.390625	%
Pedal value threshold for adding fuel mass					
C_SEG_CTR_FUEL_MASS_AD_MAX	-	0... FFFFH	0... 65535	1	-
Number of segments with stable conditions before an adaptation occurs					
C_VFF_VCV_I_CTL_STOP_MAX	-	0... FFFFH	0... 255	3.89105e-3	l/h
Last breakpoint of the characteristic line of the VCV					
C_VFF_VCV_I_CTL_STOP_MIN	-	0... FFFFH	0... 255	3.89105e-3	l/h
First breakpoint of the characteristic line of the VCV					
ID_DLY_FUP_GRD	-	1... 5H	1...5	1	-
LDP_N_32_ID_DLY_FUP_GRD	8	0... FFH	0... 8160	32	rpm
Number of filtersteps for FUP_GRD calculation					
IP_FAC_CLC_FUEL_MASS_FUP	-	0... FFH	0... 510	2	hPa/mg
LDP_TFU_IP_FAC_CLC_FUEL_MASS	3	0... FEH	-48... 142.5	0.75	°C
Factor for compressibility and density of gasoline and rail					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_FUEL_MASS_REQ_D_CTL	-	0... FFH	0... 3.984375	0.015625	-
LDPM_N_32_FUSL_1	8	0... FFH	0... 8160	32	rpm
Weighting factor for the controller					
IP_FAC_FUEL_MASS_REQ_I_CTL	-	0... FFH	0... 3.984375	0.015625	-
LDPM_N_32_FUSL_1	8	0... FFH	0... 8160	32	rpm
Weighting factor for the controller					
IP_FAC_FUEL_MASS_REQ_P_CTL	-	0... FFH	0... 3.984375	0.015625	-
LDPM_N_32_FUSL_1	8	0... FFH	0... 8160	32	rpm
Weighting factor for the controller					
IP_FAC_FUEL_MASS_REQ_PCTL	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
LDP_FUP_DIF_PCTL_IP_FAC_FUEL	8	0... FFFFH	-173890 ...173884	5.3066911	hPa
Weighting factor for the precontroller					
IP_FAC_N_MASS_FUEL_REQ_PCTL	-	0... FFH	0... 9.9609375	0.0390625	-
LDP_N_32_IP_FAC_N_FUEL_REQ_PCTL	8	0... FFH	0... 8160	32	rpm
Factor for the precontroller depending on engine speed					
IP_FUEL_MASS_REQ_ADD_MFF_SP	-	0... FFH	0... 255	1	seg
LDPM_MFF_SP_FUP_CTL_2_FUSL	8	0... FFFFH	0... 1389	0.0211948	mg/stk
DT1 factor (output = input*K/T1) depending on injection fuel mass					
IP_FUEL_MASS_REQ_ADD_TQ	-	0... FFH	0... 255	1	seg
LDPM_TQ_REQ_CLU_LIM_1_FUSL	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
DT1 Factor (output = input*K/T1) depending on Torque request					
IP_FUEL_MASS_REQ_D_CTL	V	0... FFFFH	-694.5... 694.478806	0.02119-	mg
LDP_FUP_GRD_IP_FUEL_MASS_REQ	12	0... FFFFH	-869... 86942.67	2.6533608	hPa/10ms
LDP_FUP_DIF_CTL_IP_FUEL_MASS	12	0... FFFFH	-173890 ...173884	5.3066911	hPa
D-part of the controller					
IP_FUEL_MASS_REQ_I_CTL	-	0... FFFFH	-694.5... 694.478806	0.02119-	mg
LDPM_FUP_DIF_CTL_1_FUSL	8	0... FFFFH	-173890 ...173884	5.3066911	hPa
I-part of the controller					
IP_FUEL_MASS_REQ_P_CTL	-	0... FFFFH	-694.5... 694.478806	0.02119-	mg
LDPM_FUP_DIF_CTL_1_FUSL	8	0... FFFFH	-173890 ...173884	5.3066911	hPa
P-part of the controller					
IP_T1_FUEL_MASS_ADD_MFF_SP	-	0... FFH	0... 255	1	seg
LDPM_MFF_SP_FUP_CTL_2_FUSL	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Constant time (in segment) for additive fuel mass (DT1) depending on injection fuel mass					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_T1_FUEL_MASS_ADD_TQ	-	0... FFH	0... 255	1	seg
LDPM_TQ_REQ_CLU_LIM_1_FUSL	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Constant time (in segment) for additive fuel mass (DT1) depending on Torque request					
LC_AD_CLR_FUEL_MASS_AD	-	0... 1H	0 ...1	1	-
Switch for resetting the fuel mass adaptation					
LC_FUEL_MASS_REQ_CTL_CLR	-	0... 1H	0 ...1	1	-
Switch for enabling CTL/AD part reset at fast pressure decrease					
LC_USE_FUEL_MASS_REQ_CTL	-	0... 1H	0 ...1	1	-
Switch for using the controller output for the fuel mass requested calculation					
LC_VFF_VCV_I_CTL_RST	-	0... 1H	0 ...1	1	-
Enabling of I-Part controller reset if the first or last breakpoint of the characteristic line for the VCV is reached					

### General information:

The control algorithm can be used for all kind of flow controlled pump. This function is the interface of the fuel pressure acquisition and the fuel pressure setpoint calculation to the fuel pump control.

It calculates basically a requested fuel mass to be delivered into the fuel rail by the HP pump. This calculation is based on the fuel pressure setpoint, measured fuel pressure, the fuel mass flow setpoint and the feedback of the pump interface, which is the fuel mass delivered by the pump. Additionally there is the input fuel temperature, which is needed to correct the calculation of the fuel mass in the rail.

### Signal flow diagram:



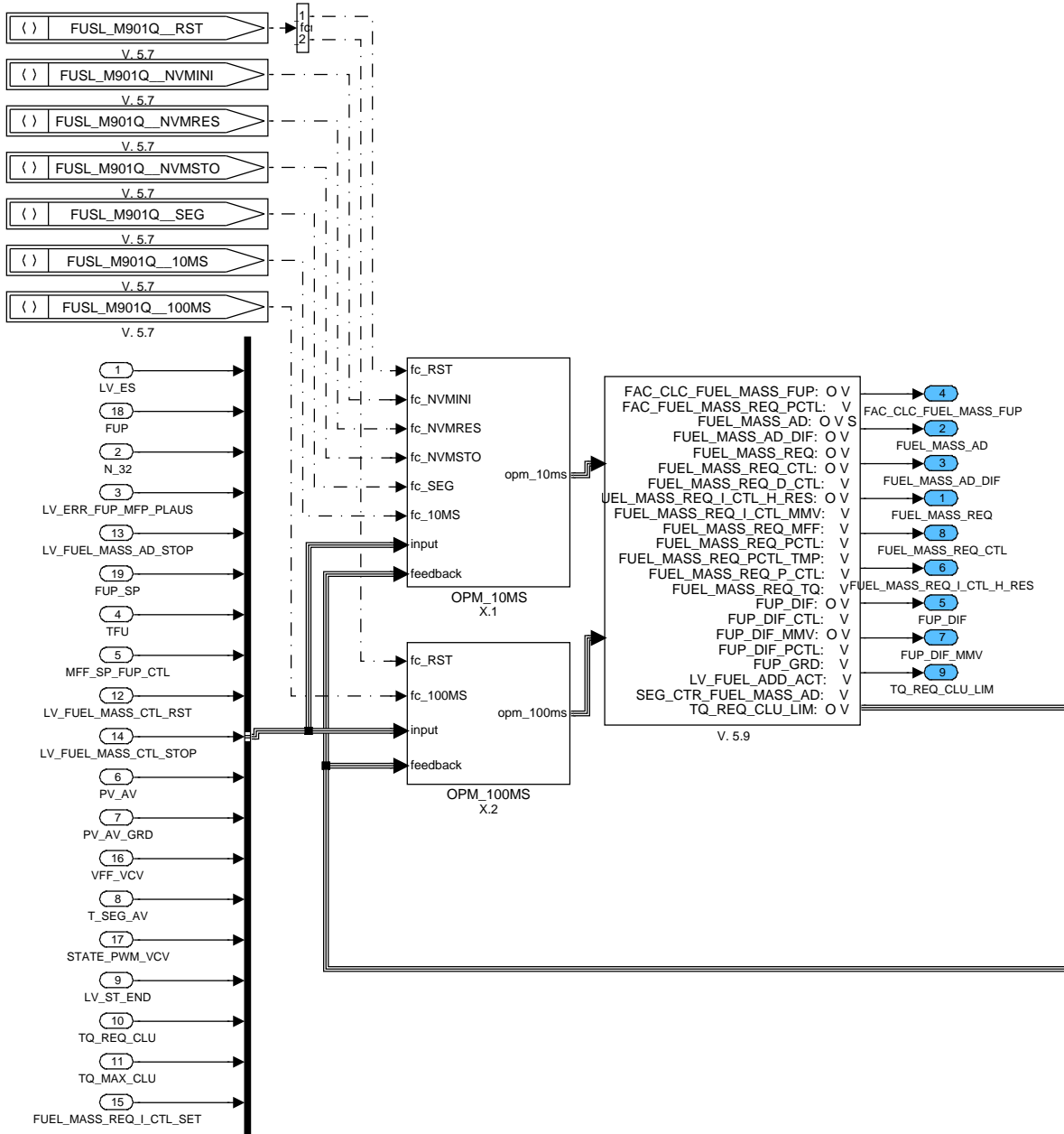



Figure 9.38.1: :

### 9.38.1 Function Description of 10MS

**General information:**

The functionality is split into several parts. First part is the precalculation of the fuel mass. In this module first the deviation between the fuel pressure setpoint and the measured fuel pressure is calculated. This deviation is the basis for the calculation of the requested fuel mass from the precontroller. This input will be corrected by a weighting factor and a conversion factor, which includes the density of the fuel and the compressibility of the rail and the fuel.

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To get a correct input for the mass fuel flow this will be corrected within the module mass fuel flow setpoint for fuel pressure control with the effective fuel cut off ratio.

The controller is split into the fuel mass adaptation and the actual controller. The calculated fuel mass adaptation takes as a basis the old value to the adaptive fuel mass and uses a actual calculated fuel mass adaption deviation. The adaptive fuel mass is min/max limited. The fuel mass adaption deviation is only calculated if the engine speed and the pump fuel mass is within certain limits. Another criteria is a segment counter, which allows the adaptation only after a certain amount of segments with stable conditions. The basis for the adaption is a filtered I-part of the controller.

The input of the actual controller is also a fuel pressure deviation. This time the deviation is calculated out of the measured fuel pressure fuel pressure setpoint. Out of this deviation the P part and the I part of the controller is calculated out of maps. After that calculation the P part can be reseted by certain conditions. The I part taken out of the map will be added up with the old value. This value can be 'frozen or reseted. Anyway there is limitation to min/max values. The I part and the P part are finally added up to the controller output.


With this controller output, the precalculation and the corrected mass fuel flow setpoint value the requested fuel mass is calculated.

### Application conditions:

*Initialisation:* RST, NVMINI, NVMRES, NVMSTO  
*Recurrence:* SEG, 10MS  
*Activation:* SEG: LV\_ES == 0 && LV\_ST\_END == 1 10MS: LV\_ES == 0 &&  
 LV\_ST\_END == 0  
*Deactivation:* LV\_ES == 1

### Function description:

### Formula section:

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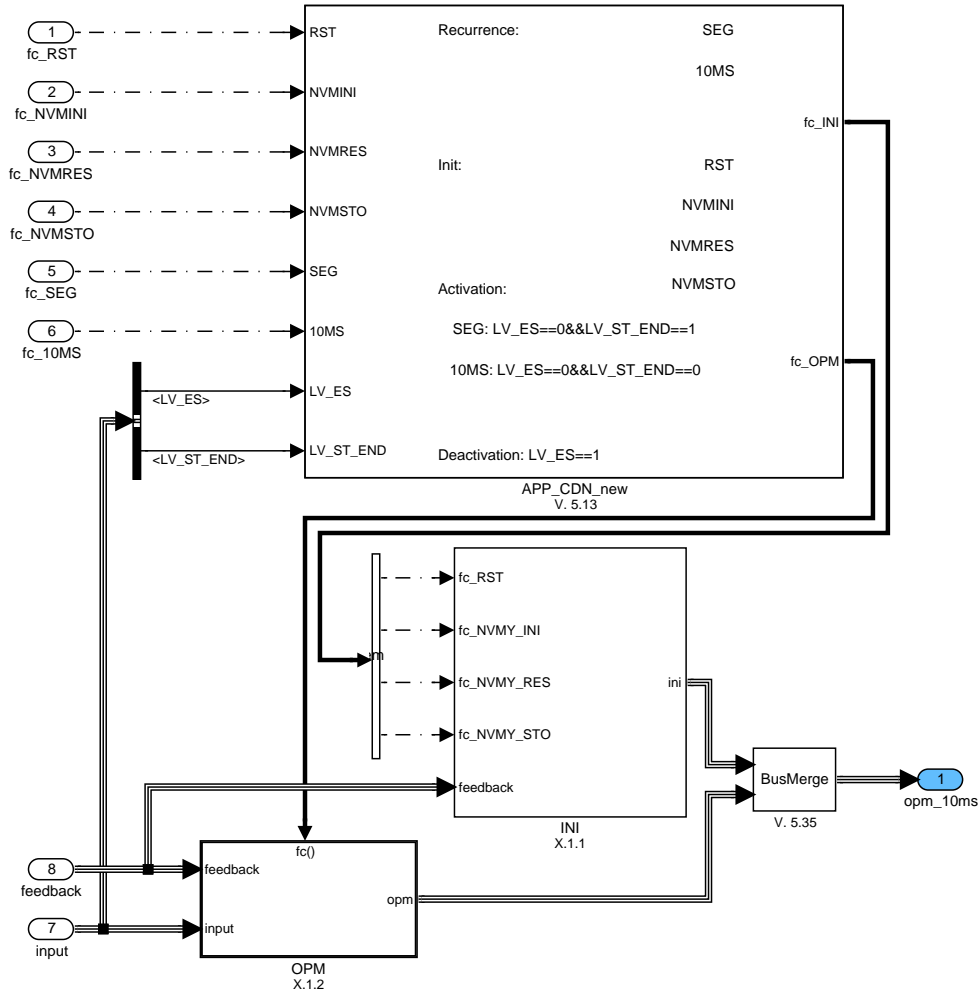


Figure 9.38.2: :

### 9.38.1.1 Initialisation

Initialisation at reset event & Non volatile memory management is done here.

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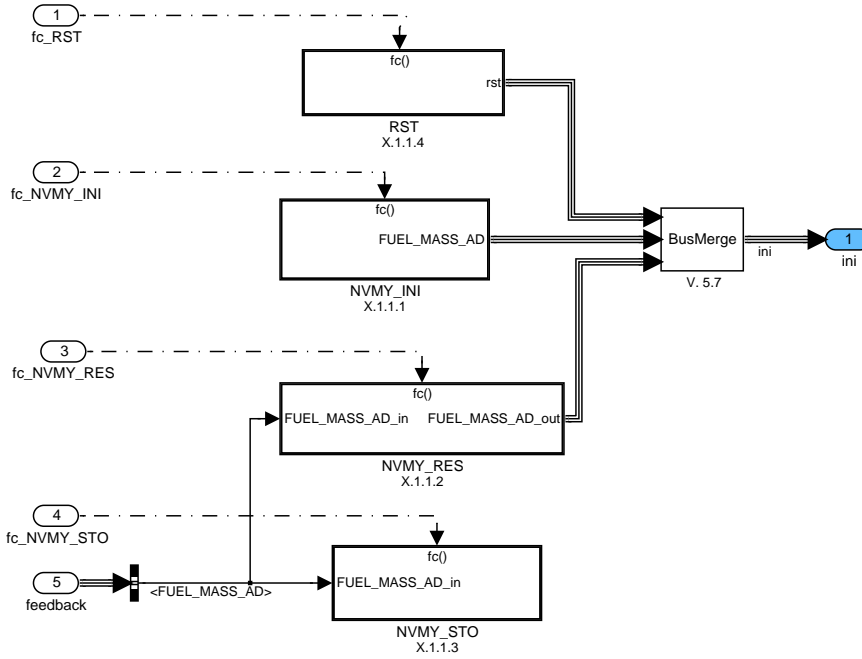


Figure 9.38.3: :

### 9.38.1.1.1 Initialisation at Non-Volatile memory

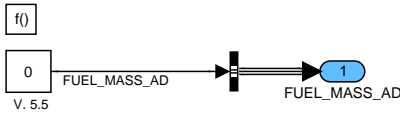


Figure 9.38.4: :

### 9.38.1.1.2 Restore management at Non-Volatile memory

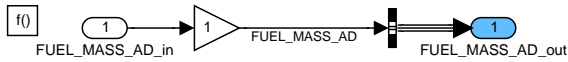


Figure 9.38.5: :

### 9.38.1.1.3 Store management at Non-Volatile memory

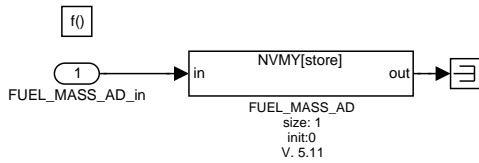

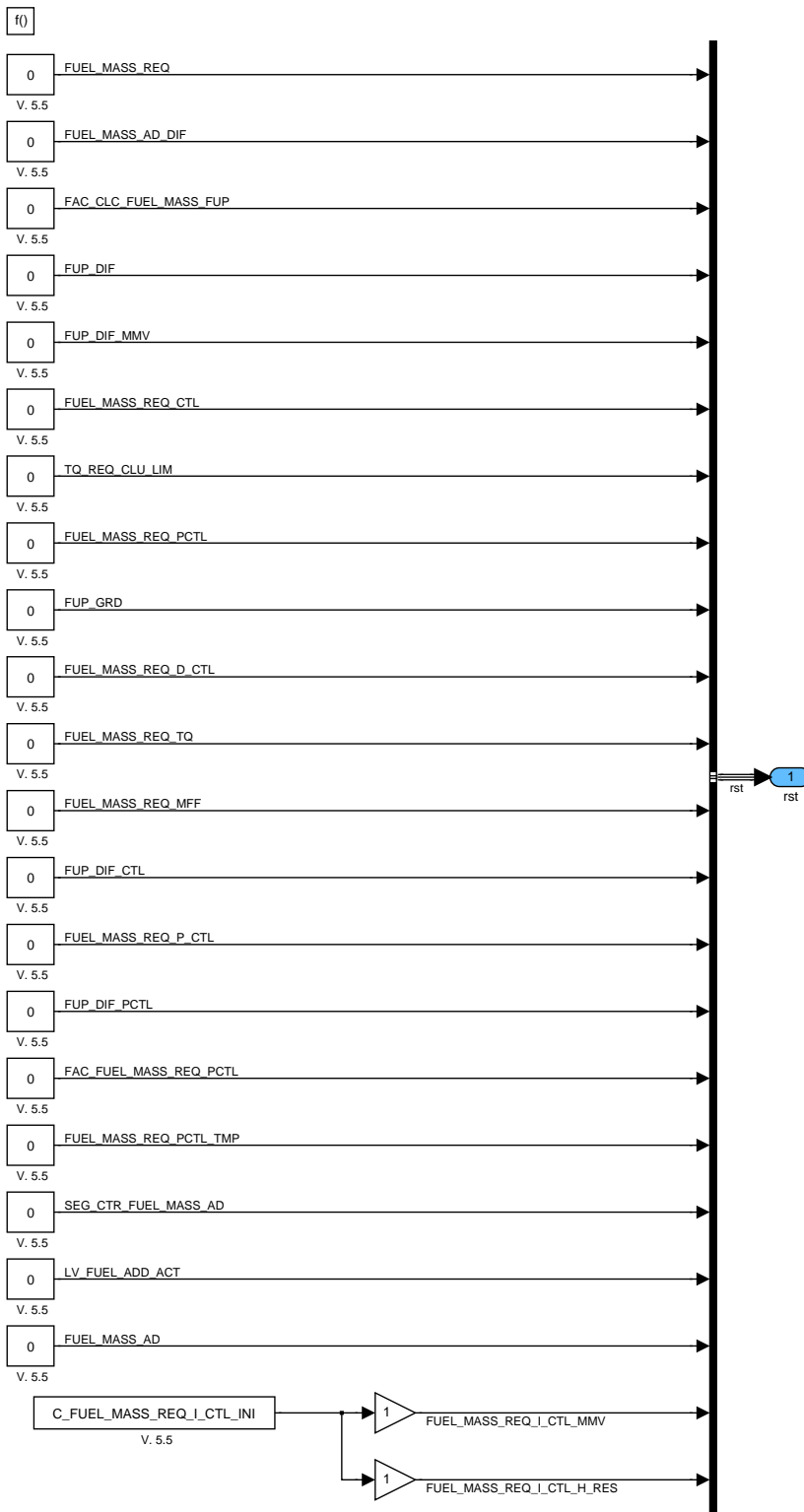


Figure 9.38.6: :

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9.38.1.1.4 Initialisaion at reset event



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Figure 9.38.7: :

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### 9.38.1.2 Fuel mass & fuel pressure control

For better visibility of the function the calculation is split into 3 parts.

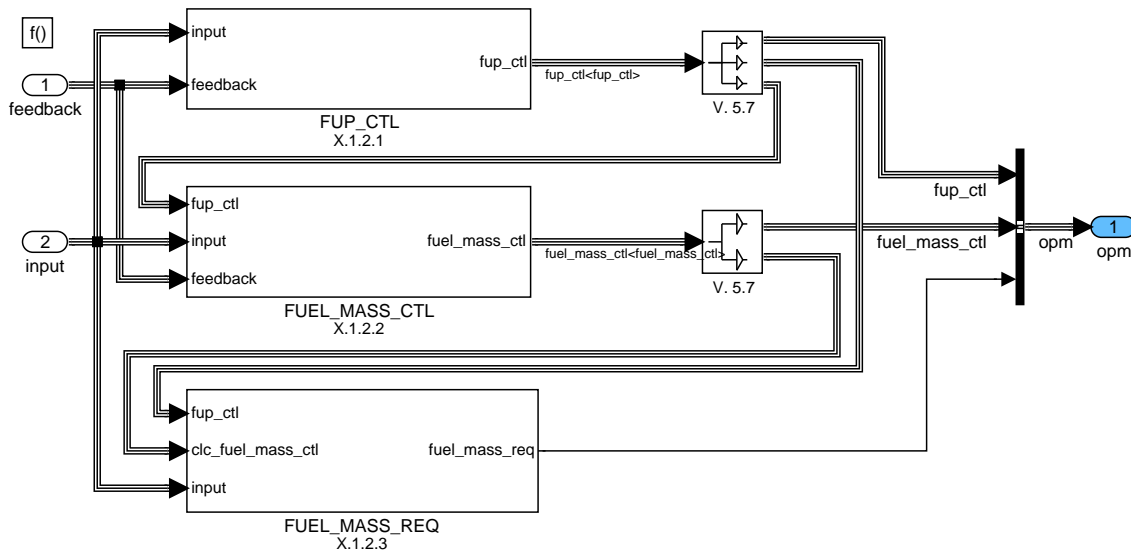


Figure 9.38.8: :

#### 9.38.1.2.1 Calculation of Fuel pressure control

This subblock is split into three other blocks in which the precontrol, the adaptive parts and the conditions for a additive fuel mass for the precontrol are calculated

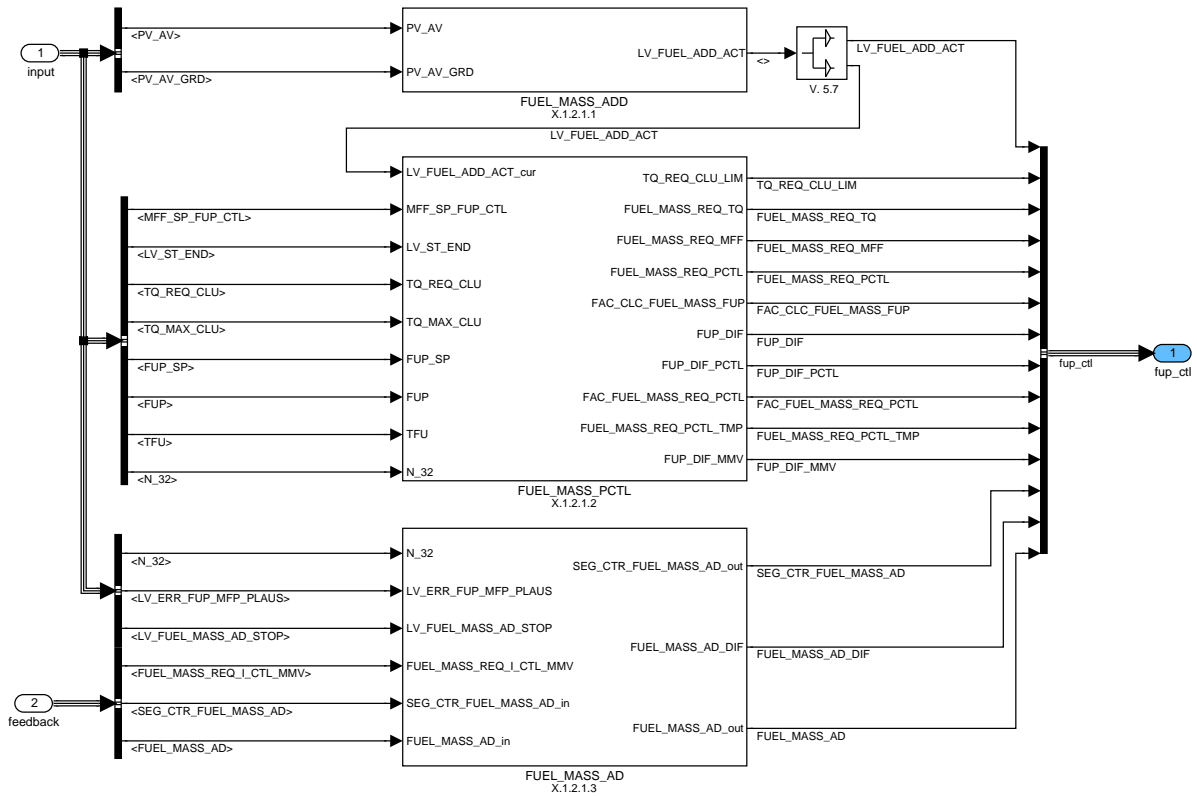


Figure 9.38.9: :

9.38.1.2.1.1 Additional fuel mass active

Depending on the pedal value and the pedal value gradient a fuel mass is added to the precontroller for a certain amount of cycles. This is indicated by a flag.

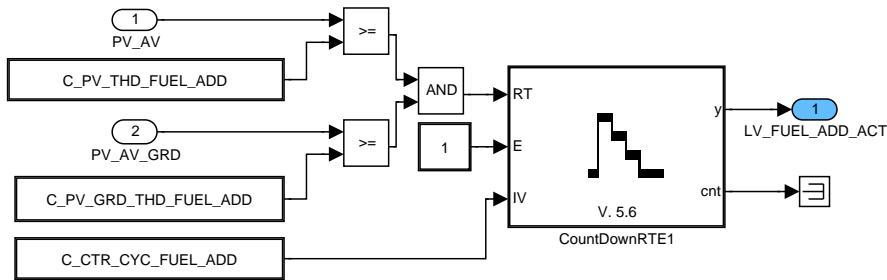


Figure 9.38.10: :

9.38.1.2.1.2 Calculation

Out of the fuel pressure deviation related to the used fuel pressure the precontrol value is calculated. This value can be modified by the weighting factor given by the map. Out of this calculated precontrol fuel pressure value a precontrol fuel mass must be chosen. This is done by the second map. Additionally to that a fuel mass can be added to the precontrol.

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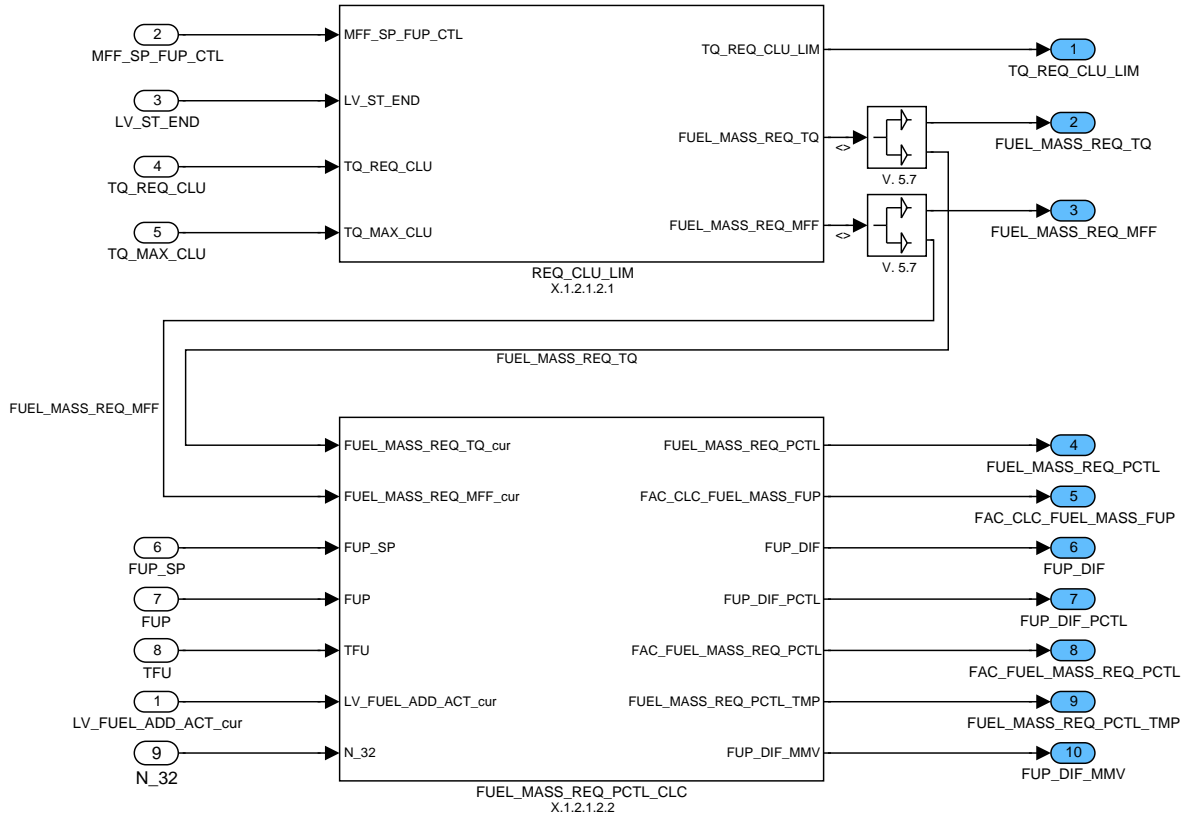


Figure 9.38.11: :

9.38.1.2.1.2.1 Calculation of Mass fuel flow

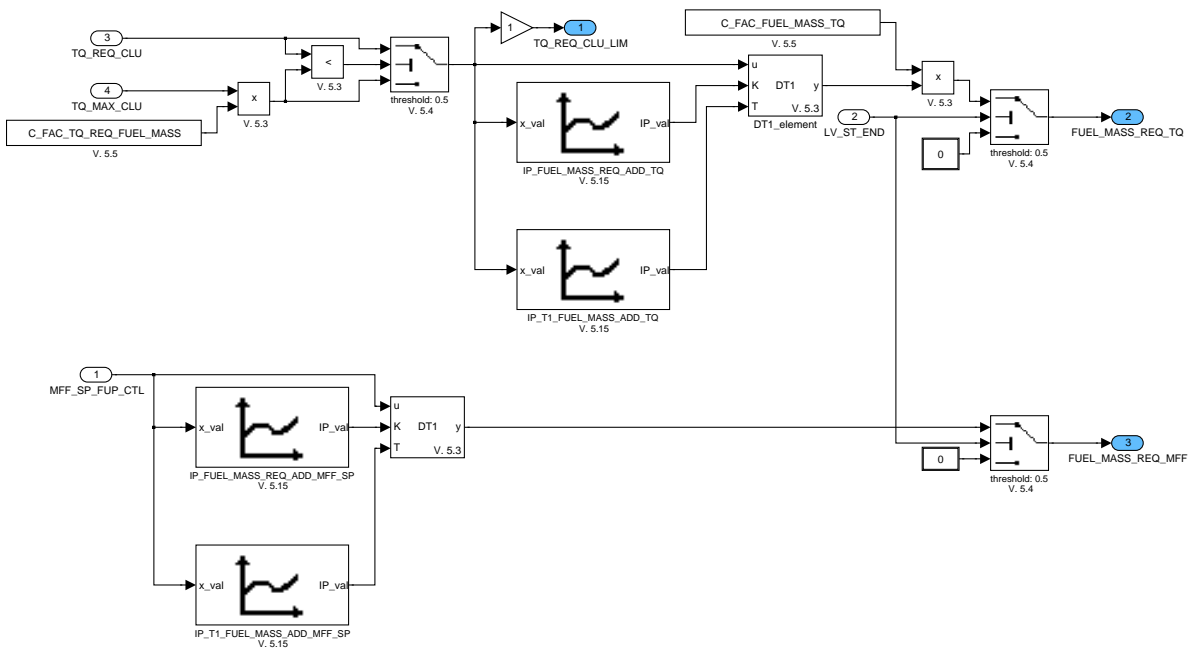



Figure 9.38.12: :

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### 9.38.1.2.1.2.2 Calculation of requested fuel mass from precontroller

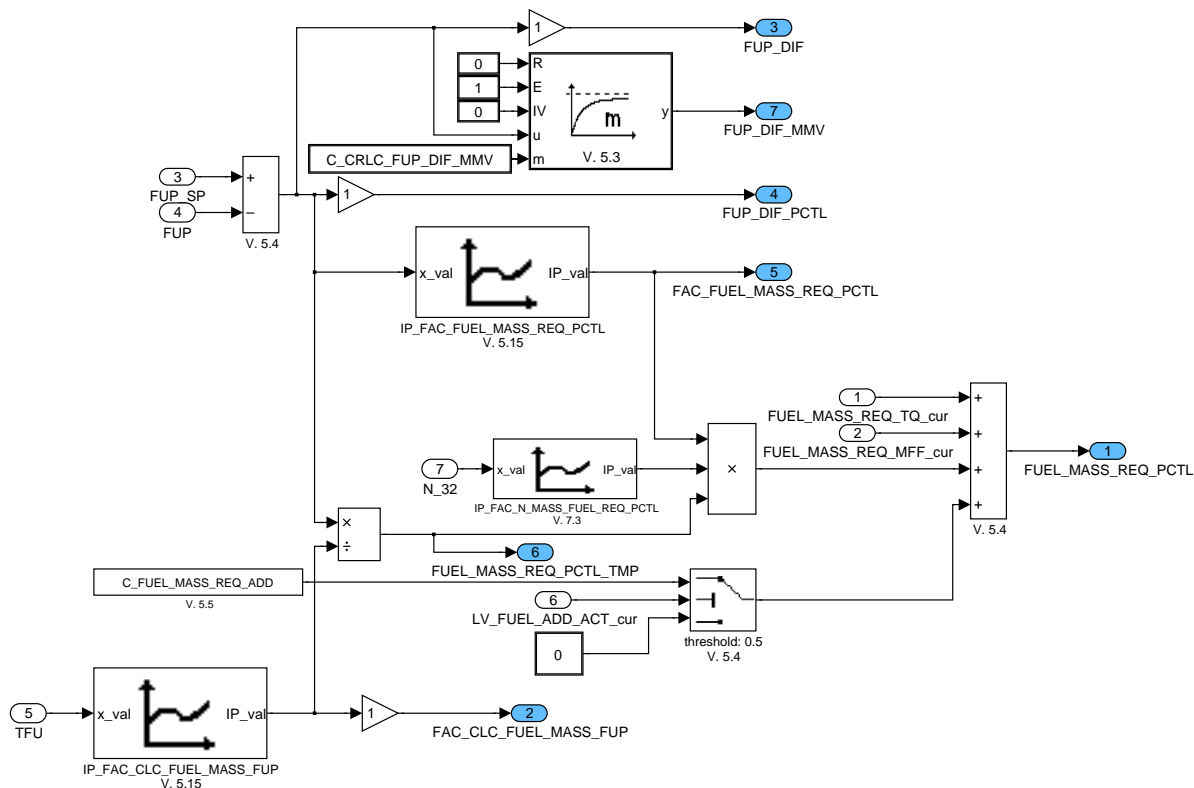


Figure 9.38.13: :

### 9.38.1.2.1.3 Calculation of fuel mass adaptation

The adaptation is split into two parts. One is calculated the adaptive fuel mass difference and one is responsible for the actual fuel mass determination

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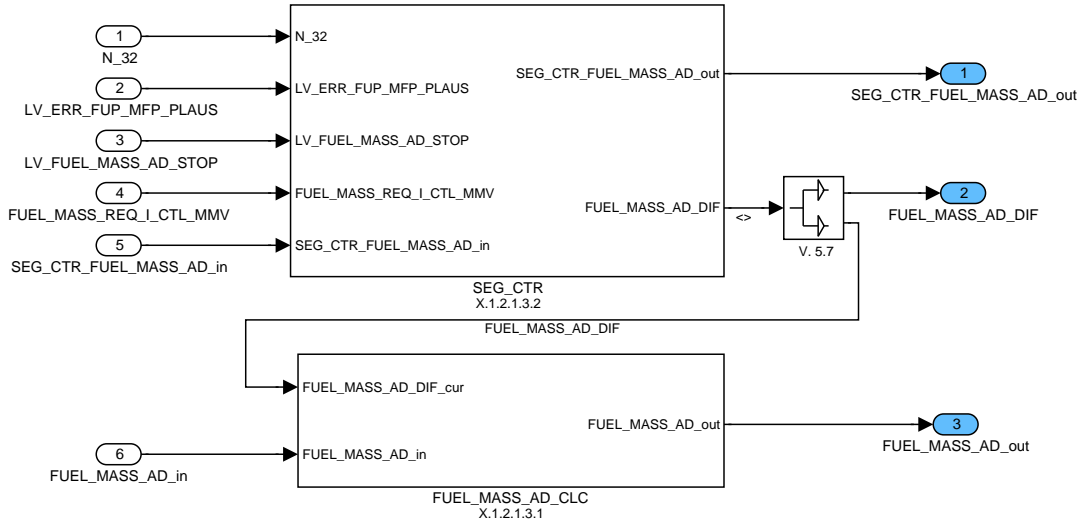


Figure 9.38.14: :

**9.38.1.2.1.3.1 Calculation of adaptive fuel mass**

The adaption value should not be above a maximum value and below a minimum value.

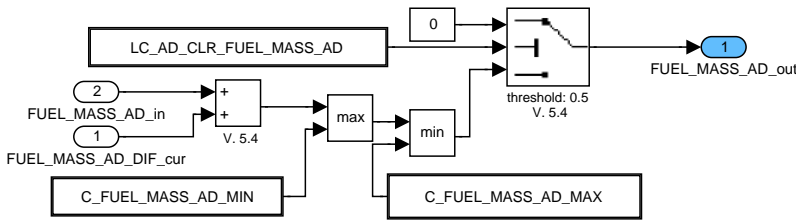


Figure 9.38.15: :

**9.38.1.2.1.3.2 Calculation of adaptive fuel mass condition**

In this block the adaptation condition are determined

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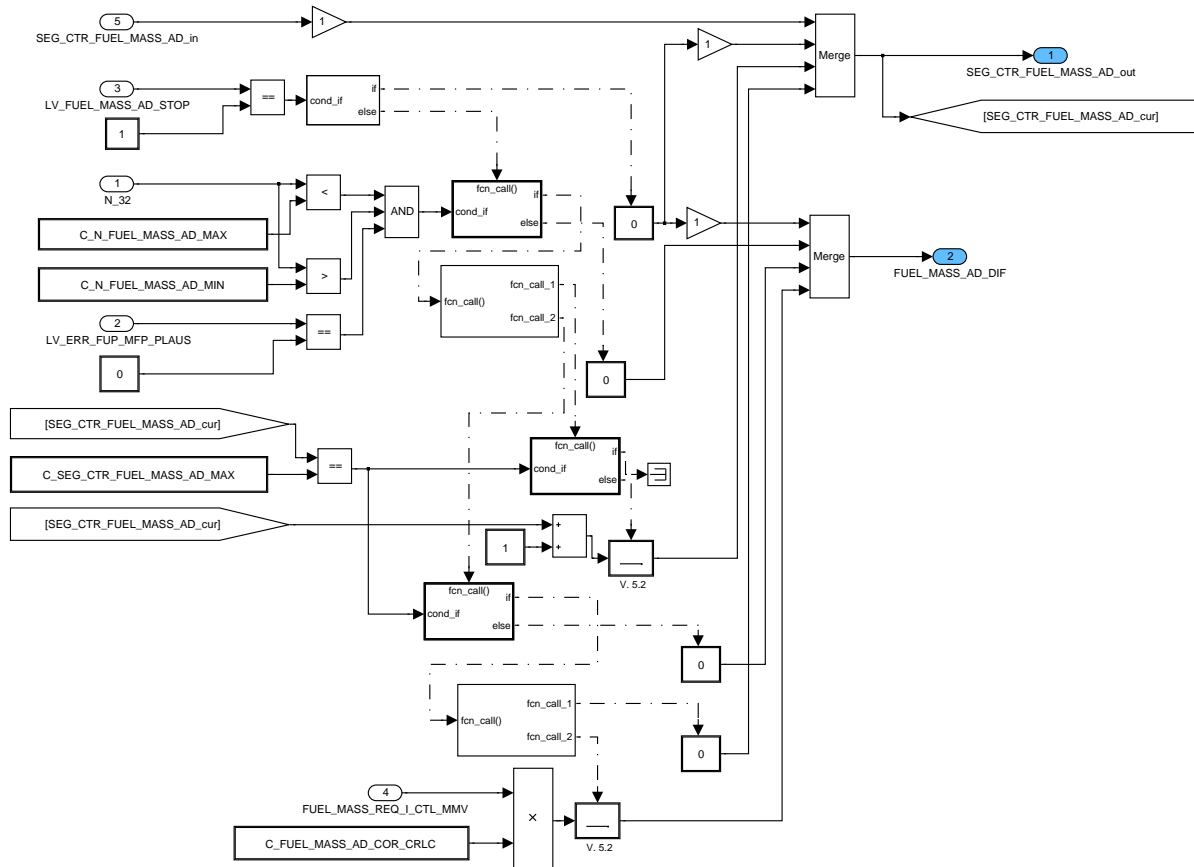



Figure 9.38.16: :

### 9.38.1.2.2 Fuel mass control

For a better overview the controller is split into two parts.

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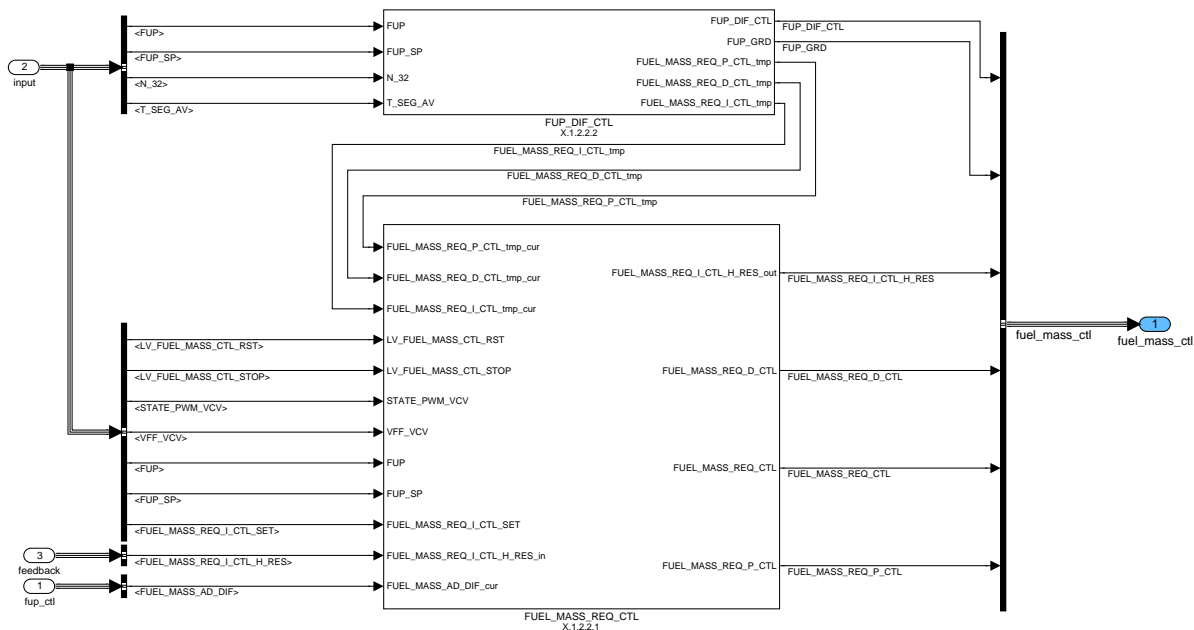


Figure 9.38.17: :

9.38.1.2.2.1 Calculation of requested fuel mass by controller

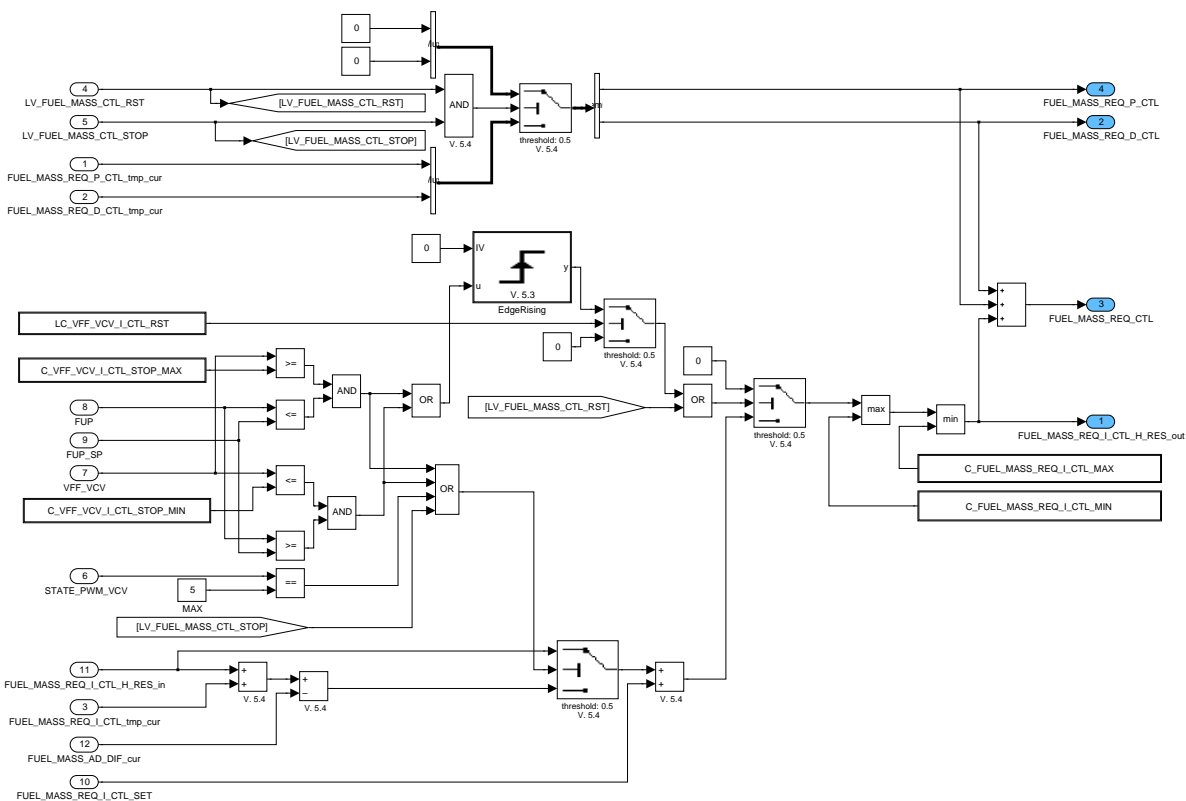


Figure 9.38.18: :

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### 9.38.1.2.2.2 Calculation of fuel pressure deviation

The controller values are calculated out of the fuel pressure setpoint value with a delay and the fuel pressure.

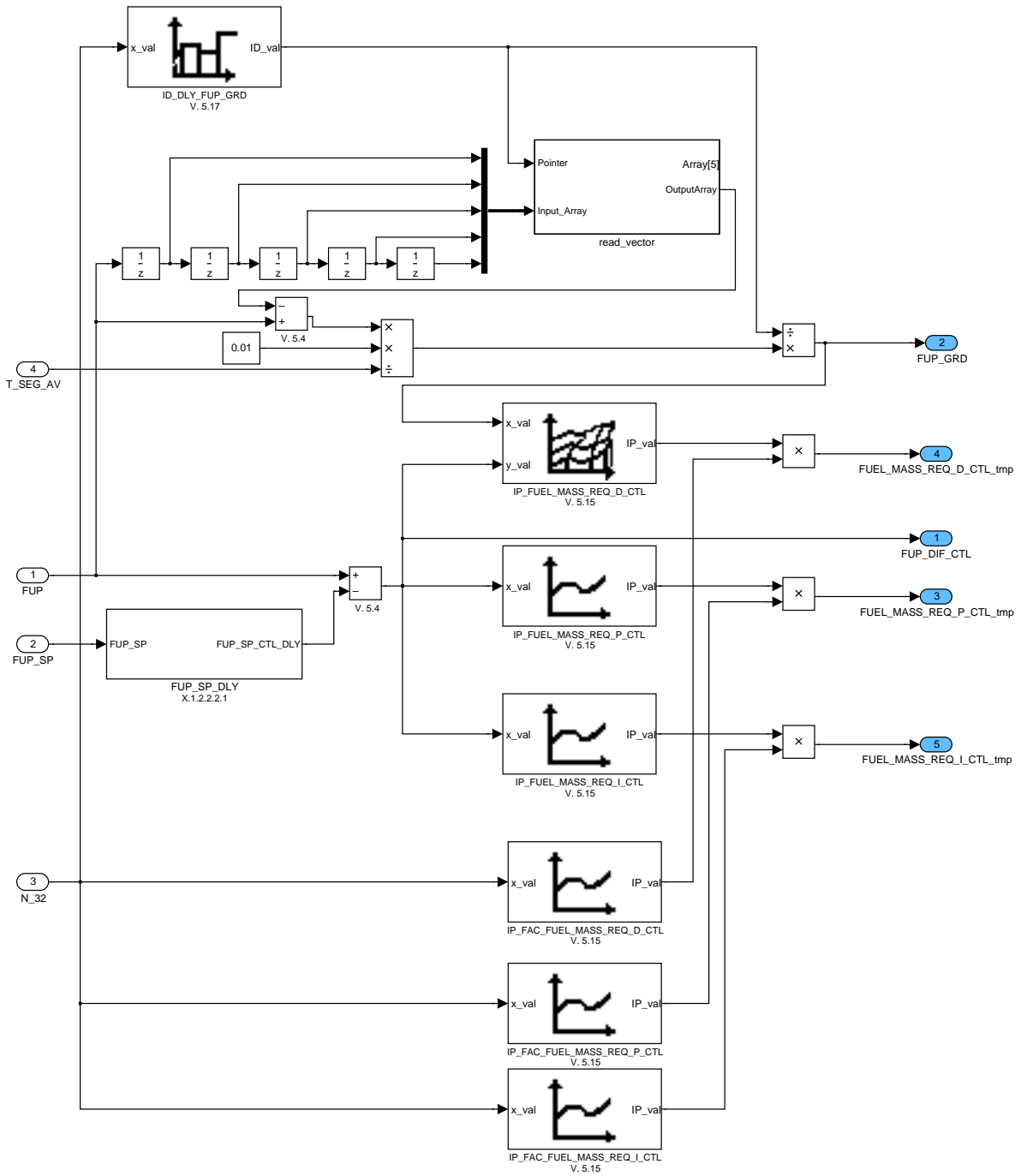


Figure 9.38.19: :

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### 9.38.1.2.2.1 Calculation of fuel pressure setpoint with delay

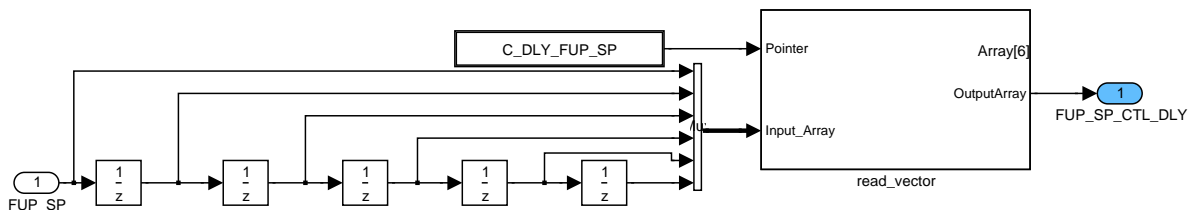


Figure 9.38.20: :

### 9.38.1.2.3 Calculation of fuel mass request

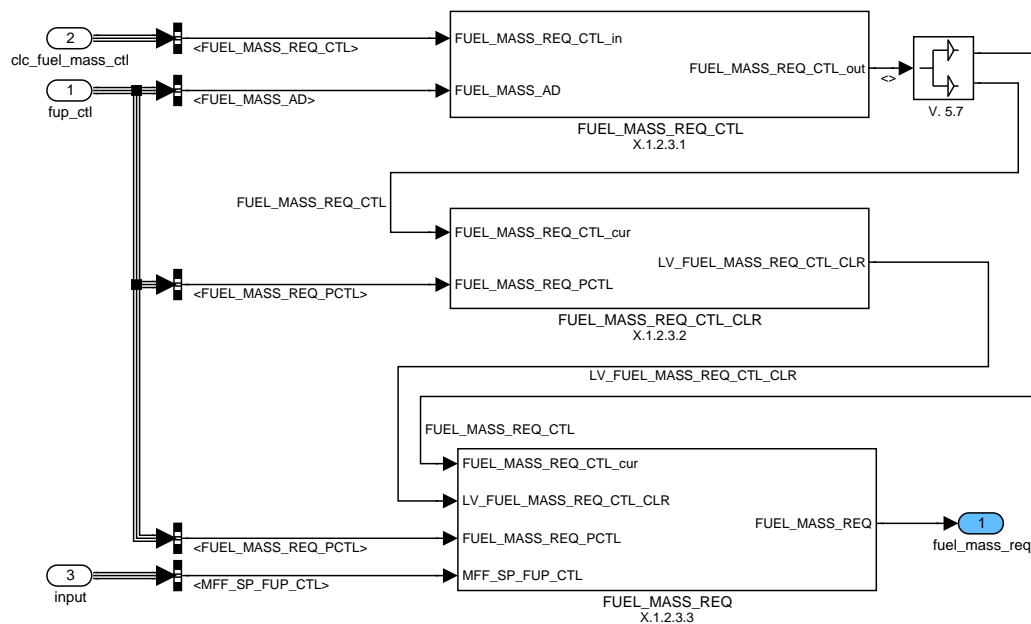


Figure 9.38.21: :

#### 9.38.1.2.3.1 Calculation of Fuel mass request control

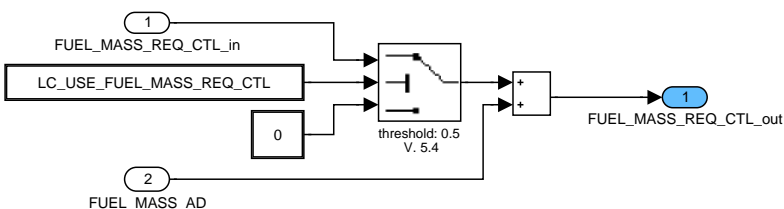


Figure 9.38.22: :

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**9.38.1.2.3.2 Calculation of logical variable for reset of CTL/AD part of fast pressure**

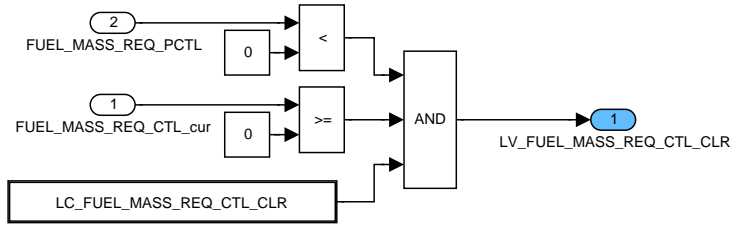


Figure 9.38.23: :

**9.38.1.2.3.3 Calculation of fuel mass request**

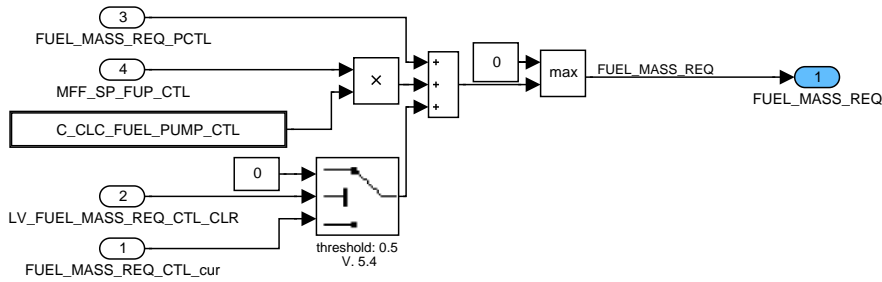


Figure 9.38.24: :

**9.38.2 Function Description of 100MS**

**General information:**

Only the module FUEL\_MASS\_MDL\_DIF\_I\_MMV\_CLC will be calculated every 100 ms.


**Application conditions:**

- Initialisation:* RST
- Recurrence:* 100MS
- Activation:* LV\_ES == 0
- Deactivation:* LV\_ES == 1

**Function description:**

**Formula section:**

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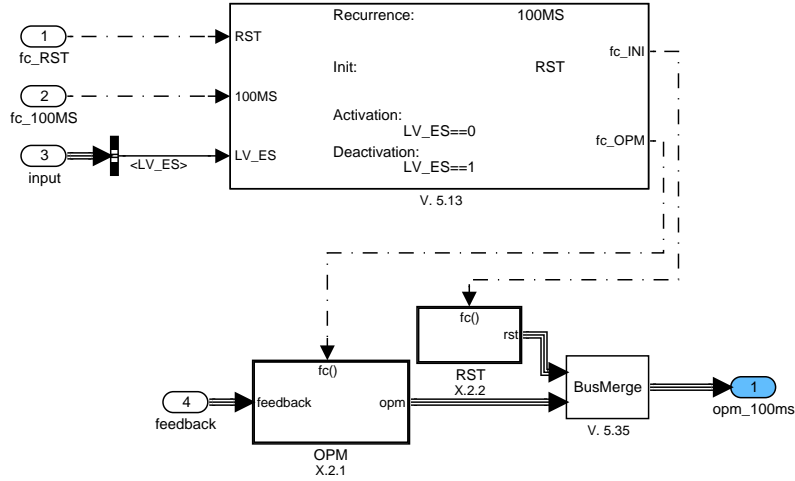


Figure 9.38.25: :

9.38.2.1 Formula Section

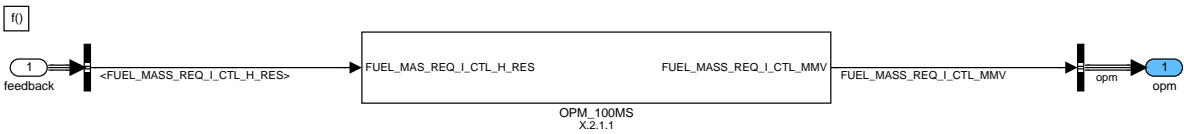


Figure 9.38.26: :

9.38.2.1.1 Moving mean value of fuel mass request control

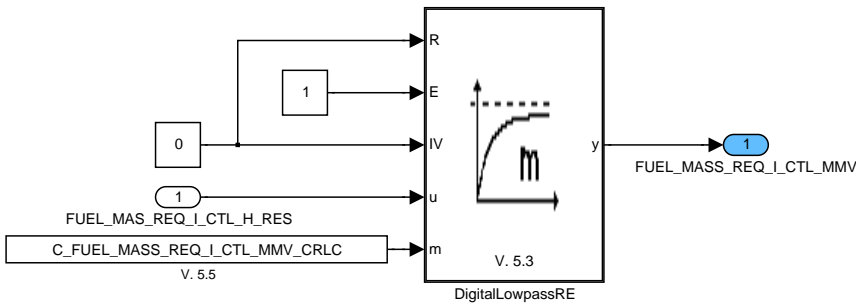


Figure 9.38.27: :

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### 9.38.2.2 Initialisation at reset event

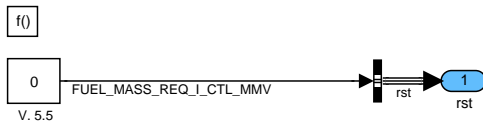



Figure 9.38.28: :

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 3929 of 8404</b>	
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## 9.39 Fuel pressure control (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FUP_DIF_DLY	V	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Deviation of FUP_SP and FUP with the delay of FUP_SP					
FUP_REQ_FPA	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Required fuel pressure from the FPA					
FUP_REQ_FPA_I	O/V	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
I-part of FUP_REQ_FPA					
FUP_REQ_FPA_I_TMP	V	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Temporary I-part of FUP_REQ_FPA					
FUP_REQ_FPA_P	V	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
P-part of FUP_REQ_FPA					
FUP_REQ_FPA_PCTL	V	0... FFFFH	0... 347776	5.3067216	hPa
Requested fuel pressure by the precontrol					
FUP_SP_FIL	V	0... FFFFH	0... 347776	5.3067216	hPa
Filtered fuel pressure setpoint					
LV_DLY_FPA_CLL_REQ	V	0... 1H	0 ...1	1	-
Logical variable for closed-loop control request to avoid overheating					
LV_FUP_DIF_FUP_REQ_FPA_RST_ACT	O/V	0... 1H	0 ...1	1	-
Logical variable indicating that the setting of the pressure I-part of the controller in intervention mode is active					
LV_FUP_REQ_FPA_AD_INH	V	0... 1H	0 ...1	1	-
Logical variable requesting inhibition of the adaptation of the controller					
LV_FUP_REQ_FPA_RST_ACT	O/V	0... 1H	0 ...1	1	-
Logical variable indicating resetting of the I-part of the pressure controller					
STATE_FUP	O/V	0H 1H 2H 3H 4H 5H	LOW_ PRESSURE_ STATE FAST_ PRESSURE_ INCREASE PRESSURE_ CONTROL OVER_ PRESSURE OPEN_LOOP EMERGENCY	-	-
State of the fuel pressure controller					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_FUP_TRAN	V	0H	EMERGENCY	-	-
		1H	LP		
		2H	LP_FPLN		
		3H	FPLN_PCTL		
		4H	OPL		
		5H	PCTL_OVP		
		6H	OVP_PCTL		
		7H	OPL_PCTL		
8H	PCTL_FPLN				
Transition conditions for the state of the fuel pressure controller					
T_DLY_ERR_FUP	V	0... FFFFH	0... 655.35	0.01	s
Delay time for a fuel pressure error to start controller invention					
T_DLY_FPA_CLL_REQ	V	0... FFFFH	0... 655.35	0.01	s
Delay time for closed loop control to avoid overheating					
T_DLY_FPA_PROT	V	0... FFFFH	0... 655.35	0.01	s
Delay time for protection of the component					
T_DLY_FUP_MAX	V	0... FFFFH	0... 655.35	0.01	s
Delay time for the maximum fuel pressure to start controller invention					
T_FUP_VCV_MOVE_ACT	V	0... FFFFH	0... 655.35	0.01	s
Time for activation of VCV shake function at sticking VCV					
T_FUP_VCV_MOVE_DET	V	0... FFFFH	0... 655.35	0.01	s
Time for detection of sticking VCV at shake function					
T_FUP_VCV_MOVE_READY	V	0... FFFFH	0... 655.35	0.01	s
Time between detection and activation of shake function at sticking VCV					

**Input data:**

FUP {p. 1283}	FUP_DIF {p. 3909}	FUP_DIF_FUP_REQ_FPA_RST {p. 3880}	FUP_SP {p. 3868}
LV_ERR_CRASH_SIG {p. 801}	LV_ERR_EFP {p. 4721}	LV_ERR_FPA {p. 801}	LV_ERR_FUP {p. 4717}
LV_ERR_TCO {p. 4496}	LV_ERR_VB {p. 802}	LV_ES {p. 1720}	LV_FIRST_VLD_TOOTH {p. 1505}
LV_FUP_DIF_FUP_REQ_FPA_RST {p. 3880}	LV_FUP_REQ_FPA_RST {p. 3880}	LV_FUP_REQ_FPA_STOP {p. 3881}	LV_IGK {p. 906}
LV_RLY_ST {p. 3844}	LV_ST_H_PRS {p. 8242}	N_32 {p. 1525}	STATE_ERR_IV {p. 4803}
STATE_PWM_VCV {p. 3955}	STATE_VFF_VCV_MIN {p. 3955}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_FUP_SP_PCTL	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Factor for fuel pressure setpoint change influence to the feed forward controller					
C_FUP_DIF_VCV_MOVE_MIN	-	0... FFFFH	0... 347776	5.3067216	hPa
Threshold for difference between FUP and FUP_SP for the VCV shake function					
C_FUP_MAX	-	0... FFFFH	0... 347776	5.3067216	hPa
Maximum fuel pressure without controller intervention					

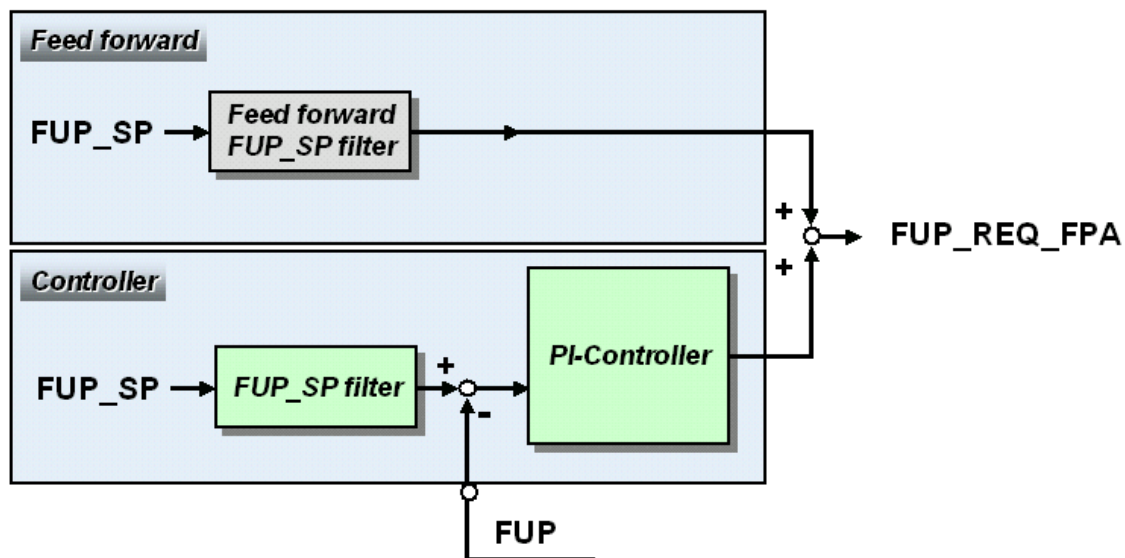
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUP_OFS_CTL	-	0... FFFFH	0... 347776	5.3067216	hPa
Offset to the fuel pressure setpoint for controller strategy switch					
C_FUP_OFS_ST	-	0... FFFFH	0... 347776	5.3067216	hPa
Offset to the fuel pressure setpoint for controller strategy switch out of start					
C_FUP_REQ_FPA_I_MAX	-	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Maximum value for integral part of FUP_REQ_FPA					
C_FUP_REQ_FPA_I_MIN	-	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Minimum value for integral part of FUP_REQ_FPA					
C_FUP_REQ_FPA_I_VCV_MOVE_MIN	-	0... FFFFH	0... 347776	5.3067216	hPa
Threshold for I-part of the pressure controller for the VCV shake function					
C_FUP_REQ_FPA_INI	-	0... FFFFH	0... 347776	5.3067216	hPa
Initial value for FUP_REQ_FPA					
C_FUP_REQ_FPA_MAX	-	0... FFFFH	0... 347776	5.3067216	hPa
Maximum value for FUP_REQ_FPA					
C_FUP_REQ_FPA_MIN	-	0... FFFFH	0... 347776	5.3067216	hPa
Minimum value for FUP_REQ_FPA					
C_FUP_REQ_FPA_VCV_MOVE_MAX	-	0... FFFFH	0... 347776	5.3067216	hPa
Maximum FUP_REQ_FPA value for shake function					
C_FUP_SP_CRLC	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlation constant for the FUP_SP for the PI-control					
C_FUP_SP_PCTL_CRLC	-	0... FFH	0... 0.99609375	3.90625e-3	-
FUP_SP correlation constant for the precontrol of FPA_REQ_FPA					
C_FUP_VCV_MOVE_MIN	-	0... FFFFH	0... 347776	5.3067216	hPa
Threshold for comparison of FUP and FUP_old for the VCV shake function					
C_FUP_VCV_MOVE_OFS	-	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Offset for FUP for the shake function in case of sticking VCV					
C_N_32_FPA	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for leaving low pressure state					
C_T_DLY_ERR_FUP	-	0... FFFFH	0... 655.35	0.01	s
Delay time for a fuel pressure error to start controller invention					
C_T_DLY_FPA_CLL_REQ	-	0... FFFFH	0... 655.35	0.01	s
Delay time for closed loop control to avoid overheating					
C_T_DLY_FPA_PROT	-	0... FFFFH	0... 655.35	0.01	s
Delay time for protection of the component					
C_T_DLY_FUP_MAX	-	0... FFFFH	0... 655.35	0.01	s
Delay time for the maximum fuel pressure to start controller invention					
C_T_FUP_VCV_MOVE_ACT	-	0... FFFFH	0... 655.35	0.01	s
Time for activation of VCV shake function at sticking VCV					
C_T_FUP_VCV_MOVE_DET	-	0... FFFFH	0... 655.35	0.01	s
Time for detection of sticking VCV at shake function					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_FUP_VCV_MOVE_READY	-	0... FFFFH	0... 655.35	0.01	s
Time between detection and activation of shake function at sticking VCV					
IP_FUP_REQ_FPA_I	-	0... FFFFH	-173890 ...173884	5.3066911	hPa
LDPM_FUP_DIF_DLY_FUSL_1	8	0... FFFFH	-173890 ...173884	5.3066911	hPa
Integral parameter of FUP_REQ_FPA					
IP_FUP_REQ_FPA_P	-	0... FFFFH	-173890 ...173884	5.3066911	hPa
LDPM_FUP_DIF_DLY_FUSL_1	8	0... FFFFH	-173890 ...173884	5.3066911	hPa
Proportional parameter of FUP_REQ_FPA					

## General Information

Application hint: NC\_CLC\_FUEL\_PUMP\_CTL = 1 for inlet controlled multi piston pump

The fuel pressure control (Appl. Inc.) provides a fuel pressure demand for the regulator. It is depending on fuel pressure setpoint and the fuel pressure. The structure is consisting out of a feed forward and a controller part.



## Application Conditions

Initialization: RST  
 Recurrence: 10MS  
 Activation: 1  
 Deactivation: 0

## Function description

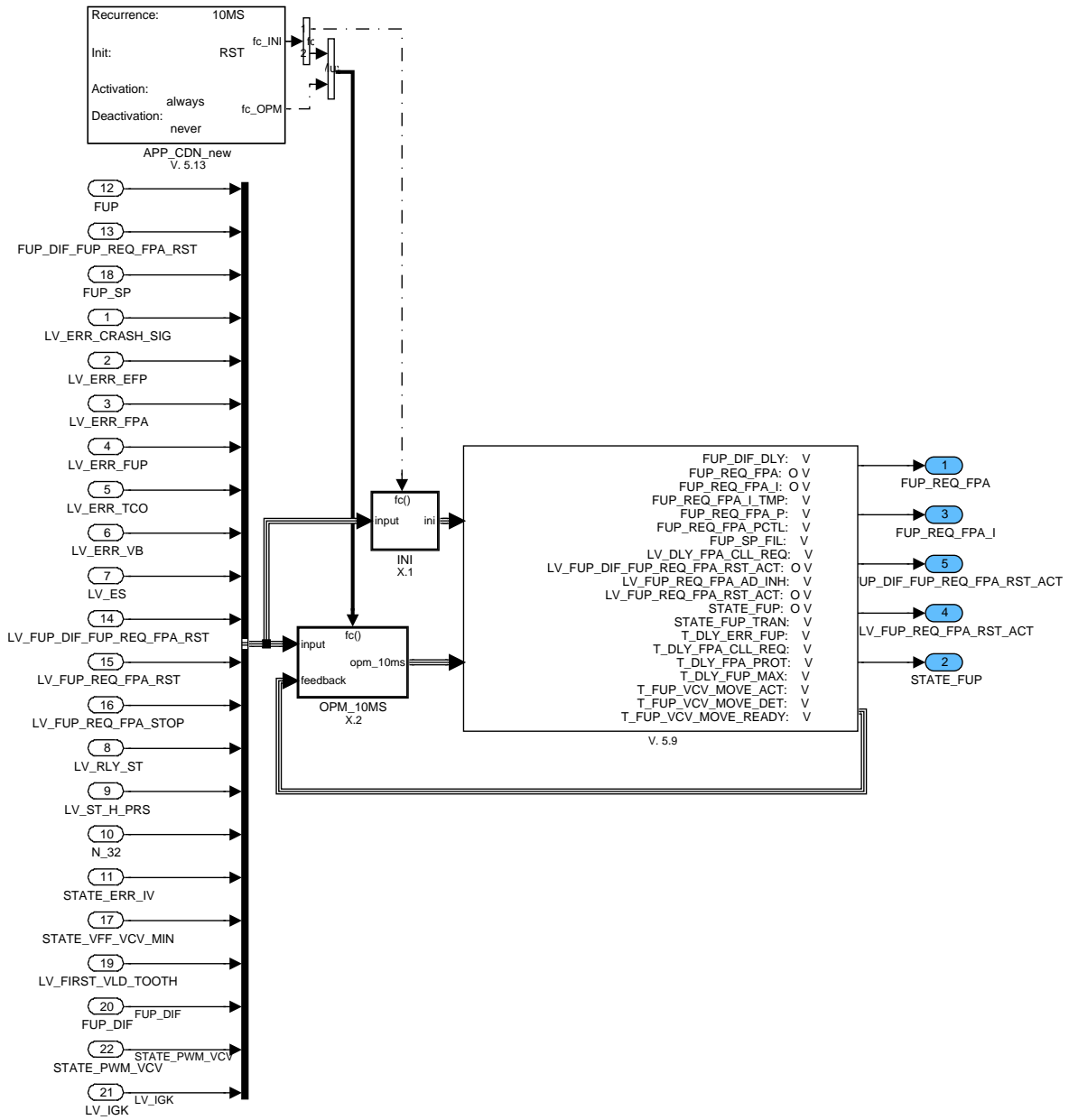


Figure 9.39.1: : Path: FUSL\_M903W

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### 9.39.1 INITILISATION of Variables at Reset

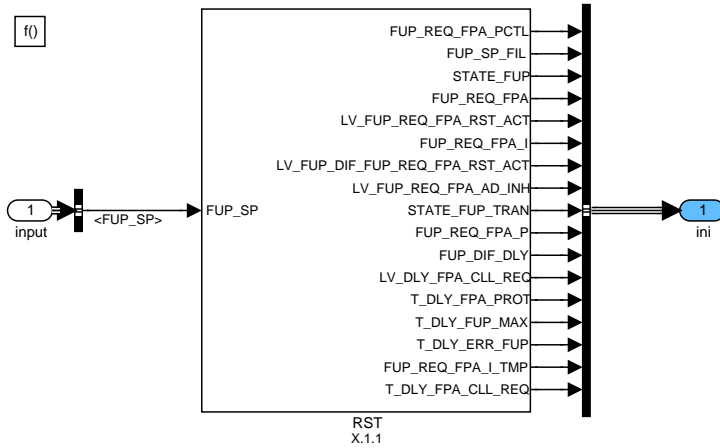


Figure 9.39.2: : Path: FUSL\_M903W/INI

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### 9.39.1.1 Initilisation

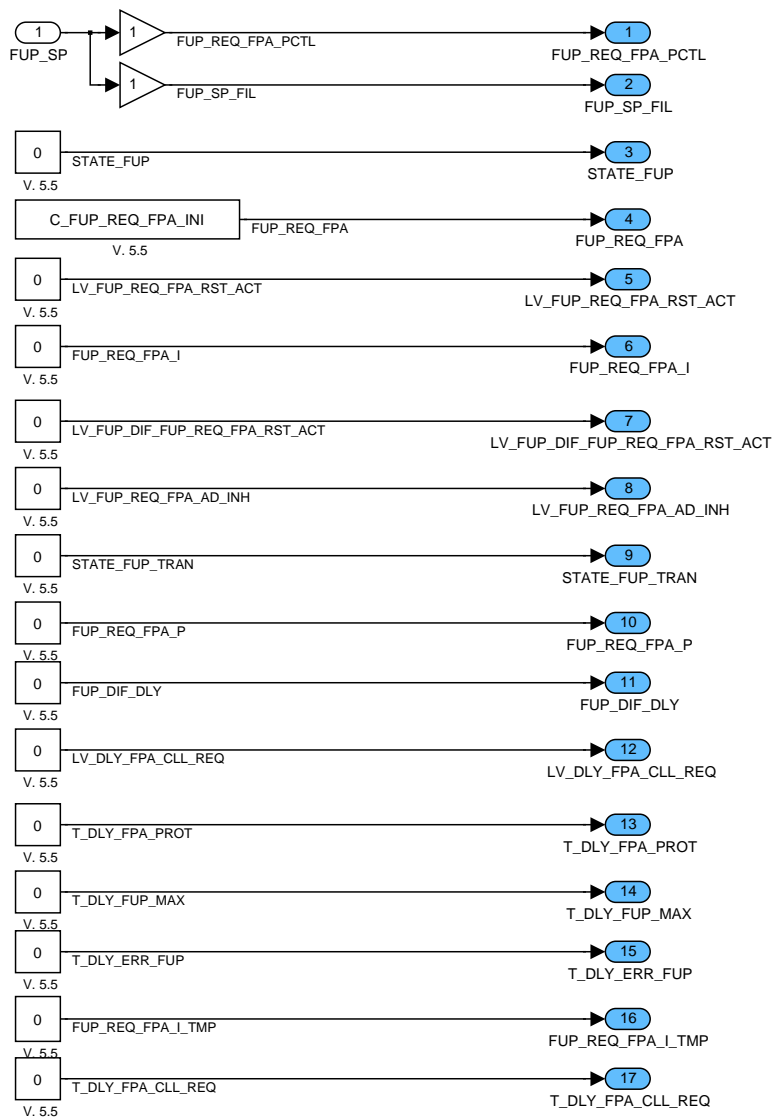


Figure 9.39.3: : Path: FUSL\_M903W/INI/RST

### 9.39.2 Formula Section

The functionality is consisting mainly out of transition calculation part and a controller part.

The transition are calculated out of several external inputs and the controller is taken into account this external influences.



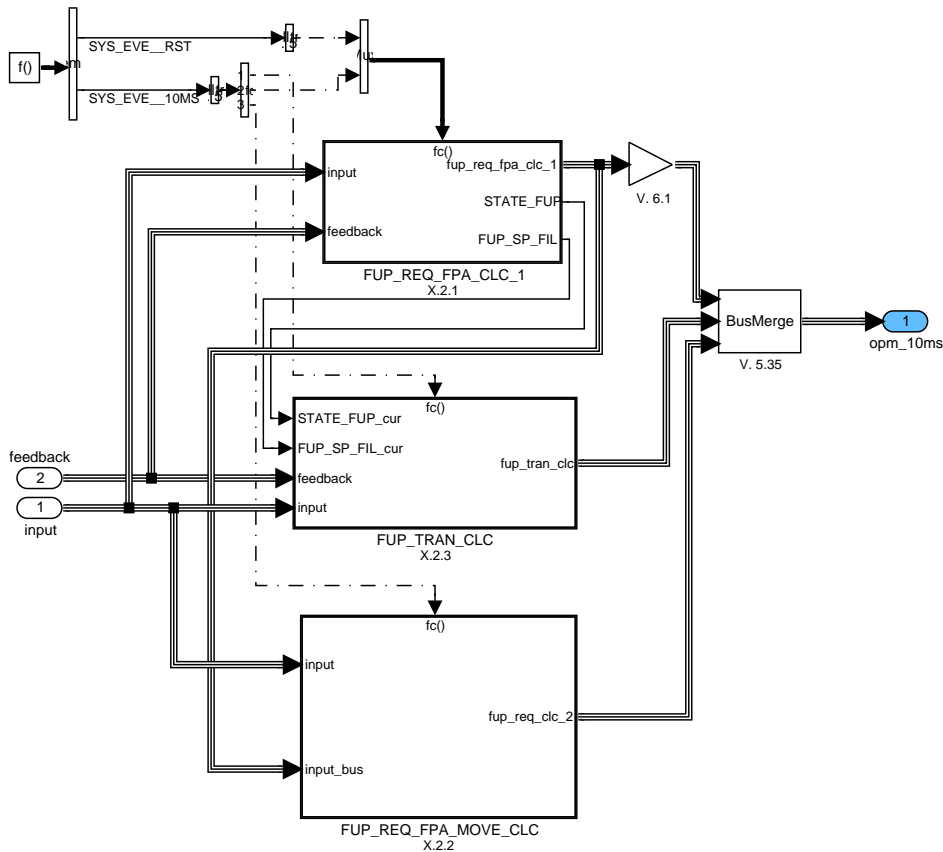


Figure 9.39.4: : Path: FUSL\_M903W/OPM\_10MS

### 9.39.2.1 Calculation

Out of the result of the state diagram a certain PWM is calculated within that subblocks.

The state diagram is corresponding to the different states of the controller. All the transition conditions are defined in the application incidence of fuel pressure control.

In **Low pressure state** the FPAPWM signal has minimum value. Also all the initialization is done in this state. Then in order to reach the fuel pressure setpoint the transition is done to **Fast pressure increase**. In this state the regulator has its maximum FPAPWM value in order to ensure the maximum pressure increase. In the state **Pressure control** the feed forward controller and the PI controller are active. The state **Overpressure** is selected when the pressure in the rail is too high. Here the FPAPWM signal has minimum value. In the state **Limp home** the control loop is opened and only the feed forward controller is active.

When a low pressure start is required the controller starts in **Low pressure state** until `STATE_FUP_TRAN = 2`. This variable is defined in application incidences. After the start phase the fuel pressure should reach the setpoint in state **Fast pressure increase**. After fulfilling `STATE_FUP_TRAN = 3` (setpoint is reached) the state **Pressure control** will be entered.

In case of a high pressure start the controller remains in **Low pressure state** until `STATE_FUP_TRAN = 2` (starter relay is activated). This is done for security reasons in order to protect the regulator for overheating. In state **Fast pressure increase** the fasted pressure increase is performed. After fulfilling `STATE_FUP_TRAN = 3` (setpoint is reached) the state **Pressure control** will be activated.

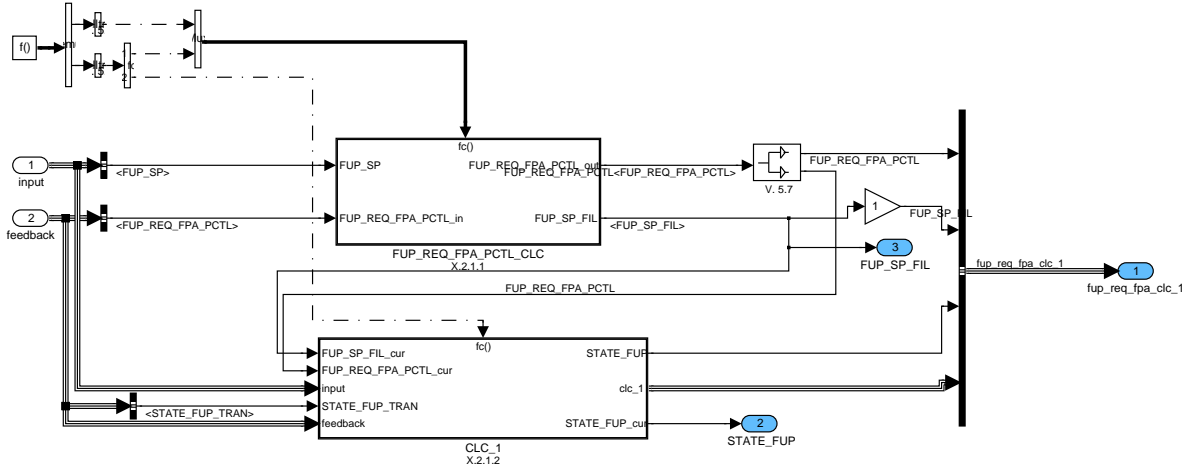


Figure 9.39.5: : Path: FUSL\_M903W/OPM\_10MS/FUP\_REQ\_FPA\_CLC\_1

9.39.2.1.1 FUSL\_M903W/OPM\_10MS/FUP\_REQ\_FPA\_CLC\_1/CLC\_1

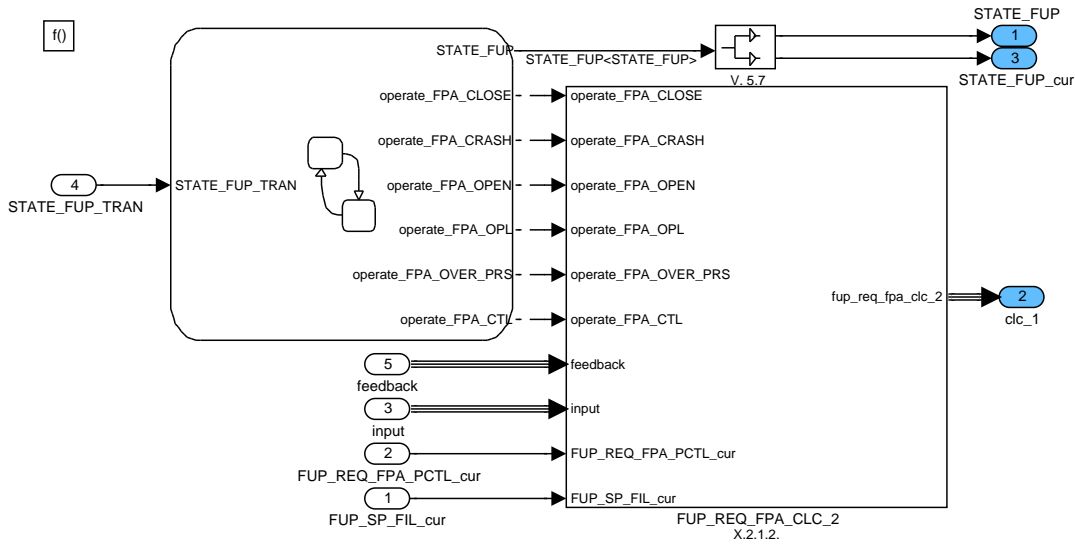



Figure 9.39.6: : Path: FUSL\_M903W/OPM\_10MS/FUP\_REQ\_FPA\_CLC\_1/CLC\_1

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9.39.2.1.1.1 Chart

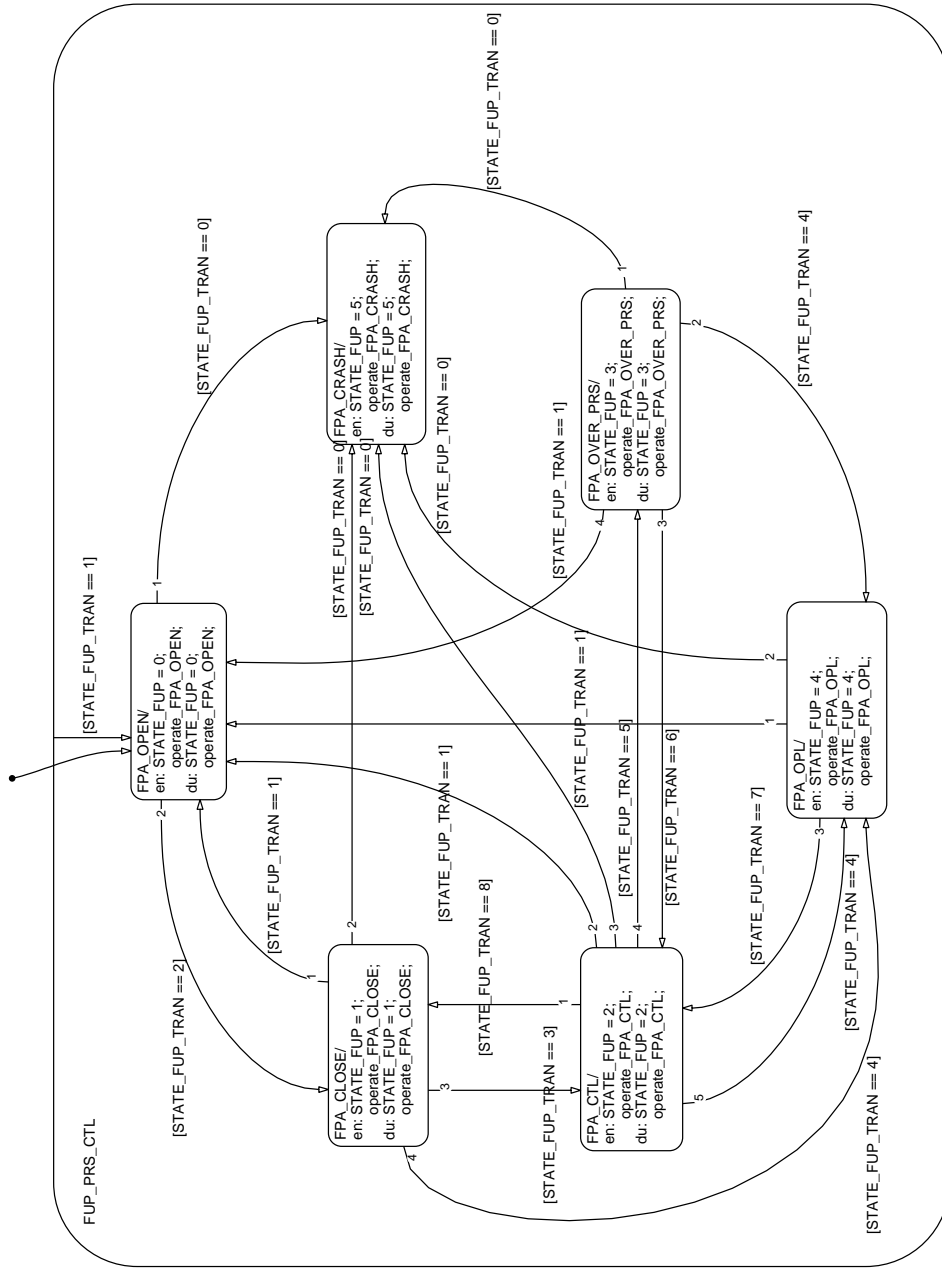


Figure 9.39.7: : Path: FUSL\_M903W/OPM\_10MS/FUP\_REQ\_FPA\_CLC\_1/CLC\_1/Chart

9.39.2.1.1.2 Calculation of Variables based on State Variables

Within that blocks the different signals are calculated depending on the state of the state diagram

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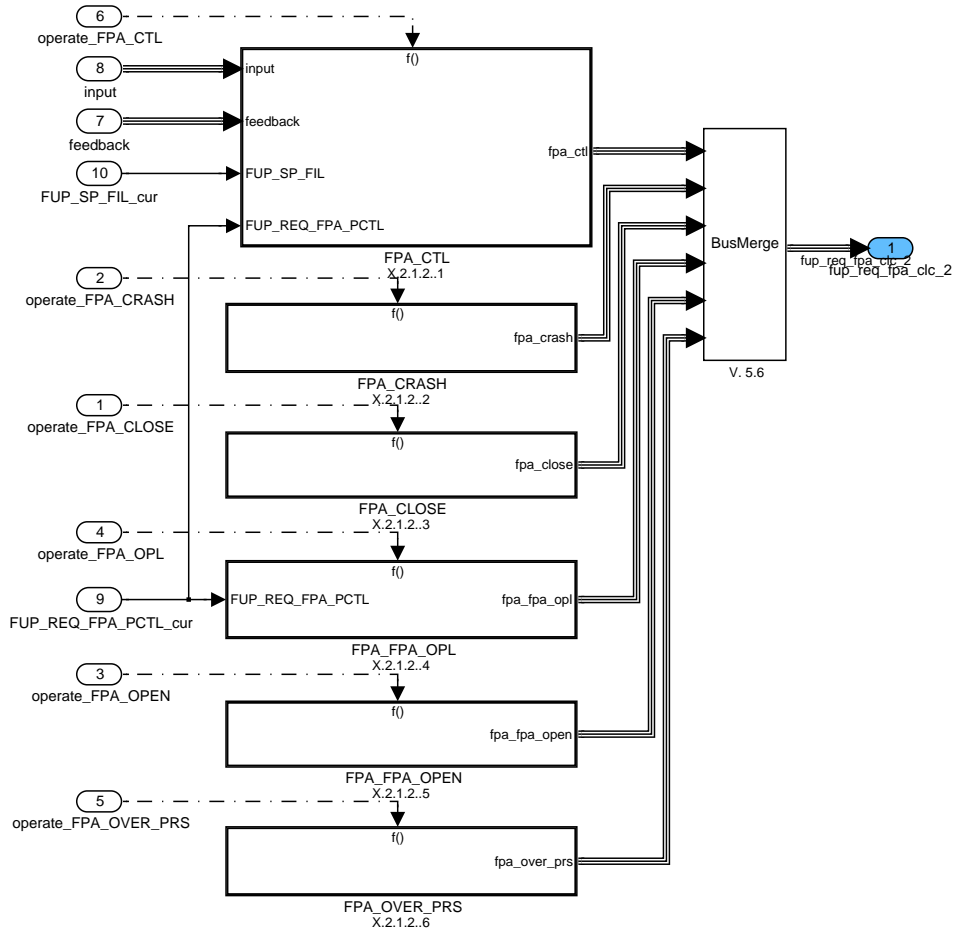


Figure 9.39.8: : Path:  
FUSL\_M903W/OPM\_10MS/FUP\_REQ\_FPA\_CLC\_1/CLC\_1/FUP\_REQ\_FPA\_CLC\_2

9.39.2.1.1.2.1 Calculation at FPA\_CLOSE

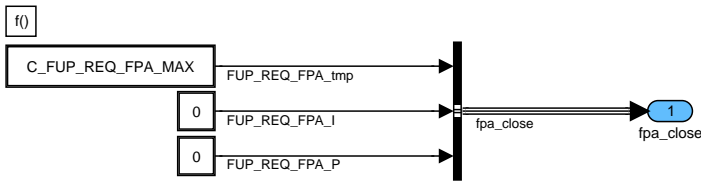


Figure 9.39.9: : Path:  
FUSL\_M903W/OPM\_10MS/FUP\_REQ\_FPA\_CLC\_1/CLC\_1/FUP\_REQ\_FPA\_CLC\_2/FPA\_CLOSE

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### 9.39.2.1.1.2.2 Calculation at FUP\_CRASH

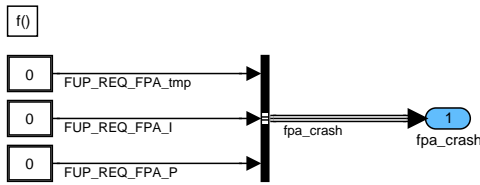


Figure 9.39.10: : Path:  
FUSL\_M903W/OPM\_10MS/FUP\_REQ\_FPA\_CLC\_1/CLC\_1/FUP\_REQ\_FPA\_CLC\_2/FPA\_CRASH

### 9.39.2.1.1.2.3 Calculation

Withing that two blocks the adaptation and the fuel pressure request for the FPA are calculated.

The calculation of the I and Ppart is done with the help of the fuel pressure deviation and two maps. The Ipart is not allowed to be outside of certain limits. Out of the precontrol, Ipart and Ppart the final fuel pressure demand for the high pressure pump control is generated.

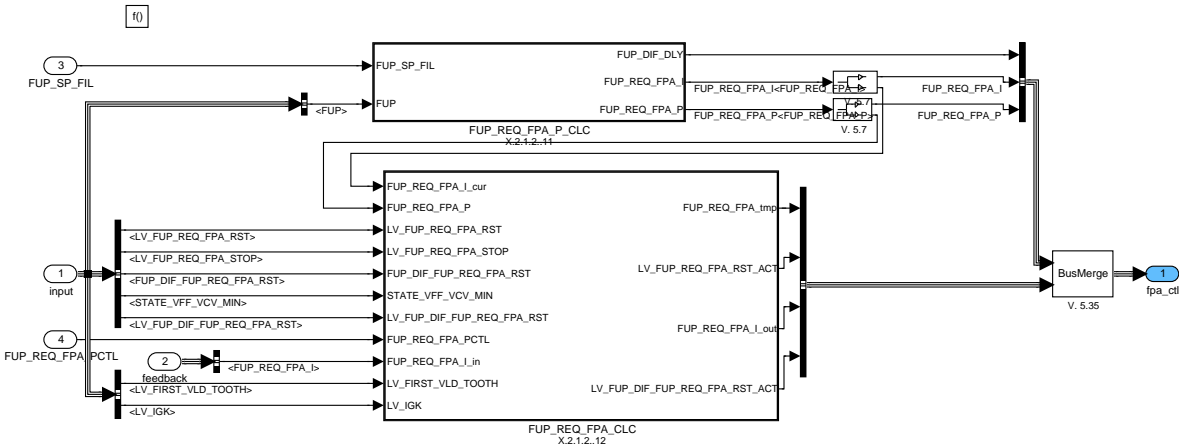


Figure 9.39.11: : Path:  
FUSL\_M903W/OPM\_10MS/FUP\_REQ\_FPA\_CLC\_1/CLC\_1/FUP\_REQ\_FPA\_CLC\_2/FPA\_CTL

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9.39.2.1.1.2.3.1 Calculation of FUP and LV variables

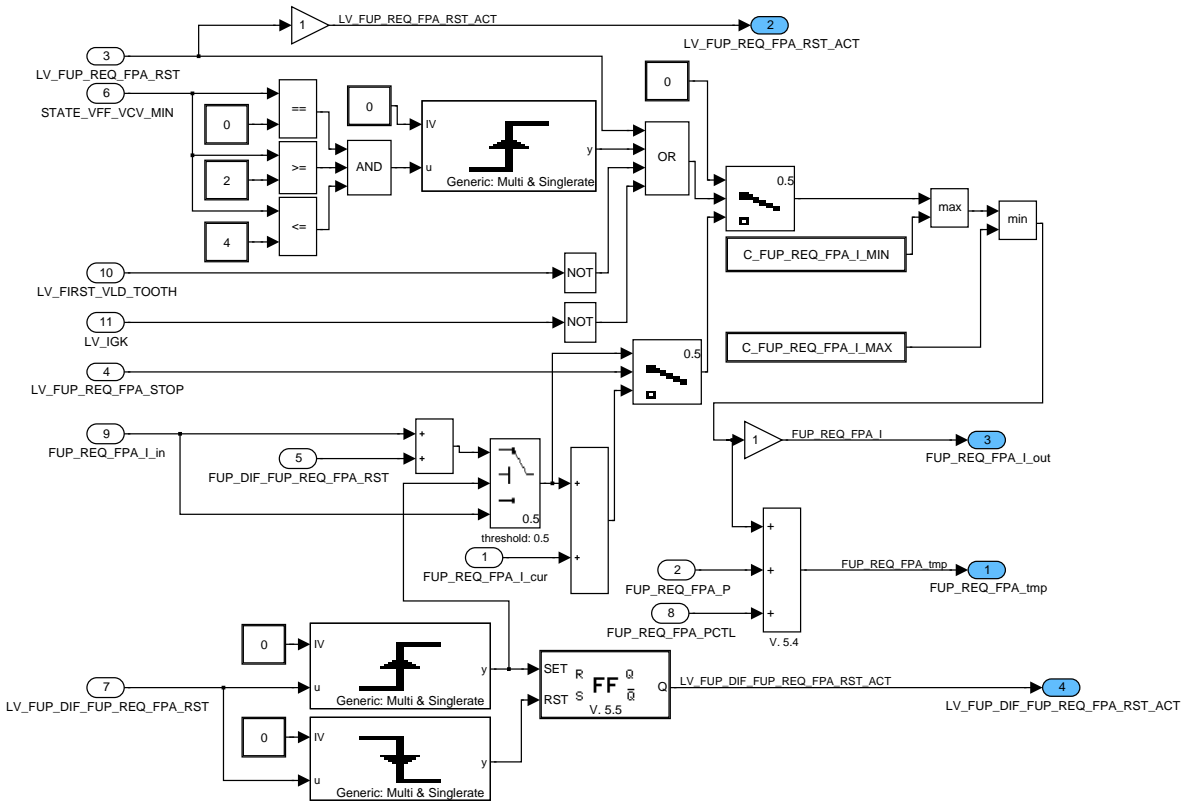


Figure 9.39.12: : Path: FUSL\_M903W/OPM\_10MS/FUP\_REQ\_FPA\_CLC\_1/CLC\_1/FUP\_REQ\_FPA\_CLC\_2/FPA\_CTL/FUP\_REQ\_FPA\_CLC

9.39.2.1.1.2.3.2 Calculation of FUP variables

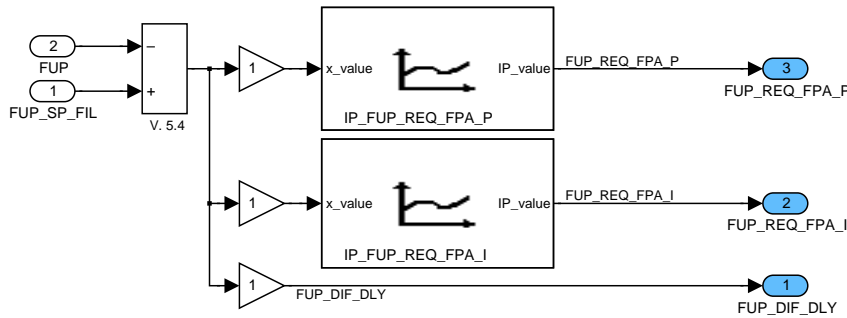


Figure 9.39.13: : Path: FUSL\_M903W/OPM\_10MS/FUP\_REQ\_FPA\_CLC\_1/CLC\_1/FUP\_REQ\_FPA\_CLC\_2/FPA\_CTL/FUP\_REQ\_FPA\_P\_CLC

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### 9.39.2.1.1.2.4 Calculation at FPA\_FPA\_OPEN

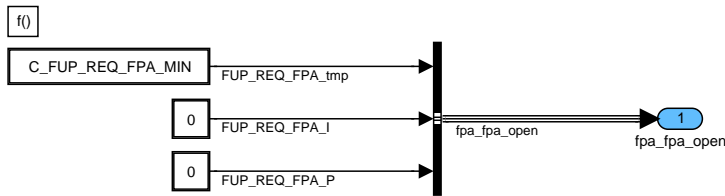


Figure 9.39.14: : Path: FUSL\_M903W/OPM\_10MS/FUP\_REQ\_FPA\_CLC\_1/CLC\_1/  
FUP\_REQ\_FPA\_CLC\_2/FPA\_FPA\_OPEN

### 9.39.2.1.1.2.5 Calculation at FPA\_FPA\_OPL

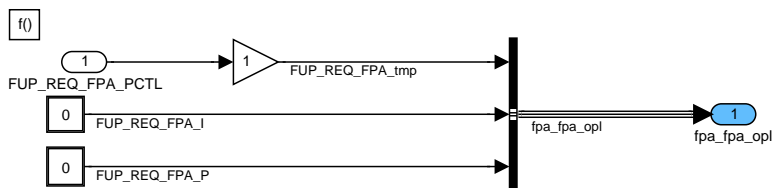


Figure 9.39.15: : Path: FUSL\_M903W/OPM\_10MS/FUP\_REQ\_FPA\_CLC\_1/CLC\_1/FUP\_REQ\_FPA\_CLC\_2/FPA\_FPA\_OPL

### 9.39.2.1.1.2.6 Calculation at FPA\_OVER\_PRS

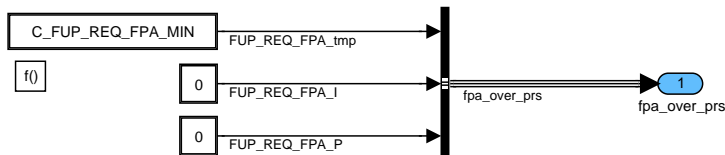
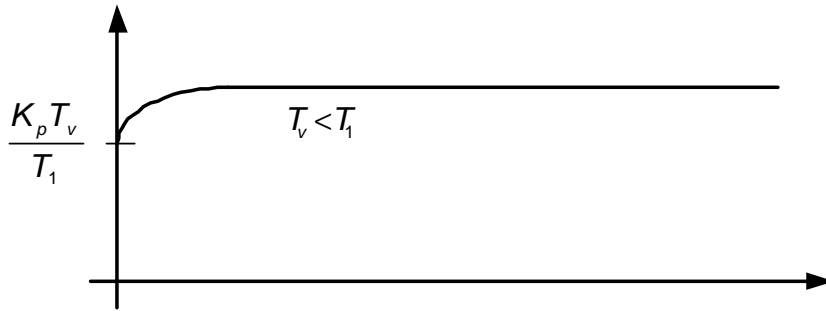


Figure 9.39.16: : Path: FUSL\_M903W/OPM\_10MS/FUP\_REQ\_FPA\_CLC\_1/CLC\_1/  
FUP\_REQ\_FPA\_CLC\_2/FPA\_OVER\_PRS

## 9.39.2.1.2 Set point calculation

Within this subblock the filtered fuel pressure setpoint and the precontroller is calculated.

The aim of the precontroller is to prevent overshoots or undershoots of the fuel pressure at big fuel pressure setpoint slopes. This whole block is basically representing a PPT1block.



Source: PPT1-response.vsd

The factor  $K_p T_v / T_1$  is represented by `FAC_FUP_SP_PCTL`. This factor is depending on the `FUP_SP` change. This factor will be multiplied with `FUP_SP`, which is the basis for the `FPAPWM` value. The `FUP_SP` value is also filtered with a modified PT1filter.

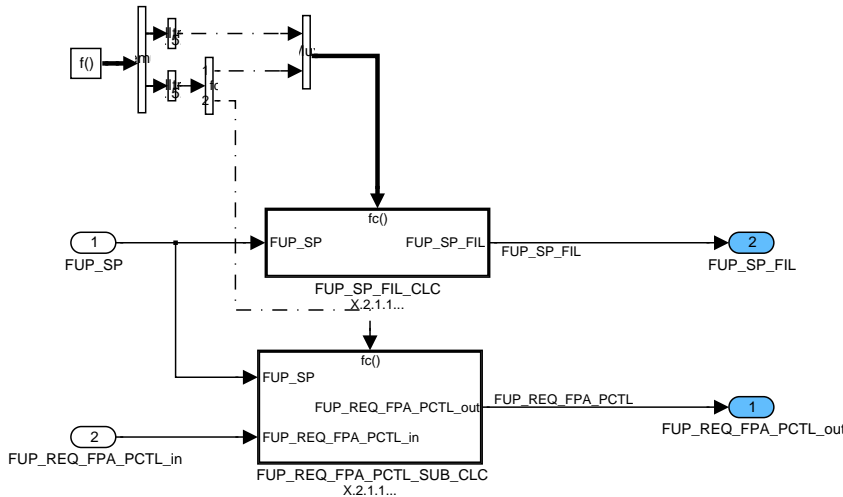


Figure 9.39.17: Path: FUSL\_M903W/OPM\_10MS/FUP\_REQ\_FPA\_CLC\_1/FUP\_REQ\_FPA\_PCTL\_CLC

9.39.2.1.2.1 Calculation

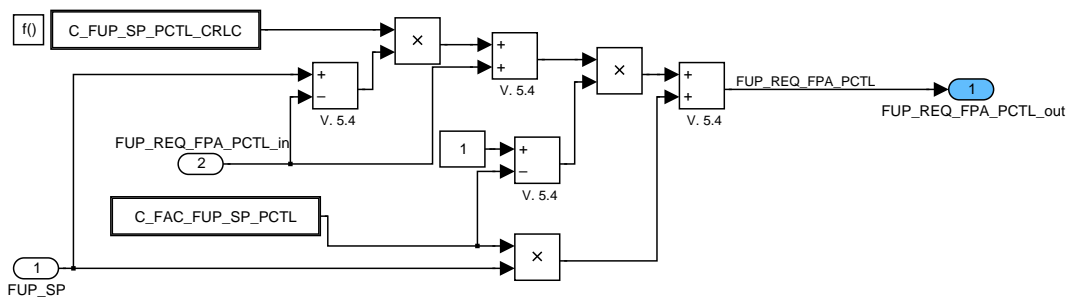


Figure 9.39.18: Path: FUSL\_M903W/OPM\_10MS/FUP\_REQ\_FPA\_CLC\_1/FUP\_REQ\_FPA\_PCTL\_CLC/FUP\_REQ\_FPA\_PCTL\_SUB\_CLC

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### 9.39.2.1.2.2 Filter

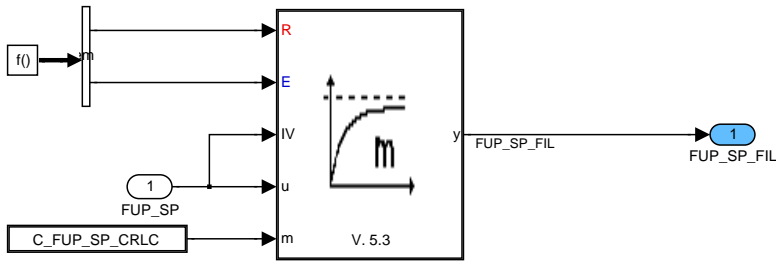


Figure 9.39.19: Path: FUSL\_M903W/OPM\_10MS/FUP\_REQ\_FPA\_CLC\_1/FUP\_REQ\_FPA\_PCTL\_CLC/FUP\_SP\_FIL\_CLC

### 9.39.2.2 VCV movement functionality

At Reset the timers have to be initialized with the corresponding constants.

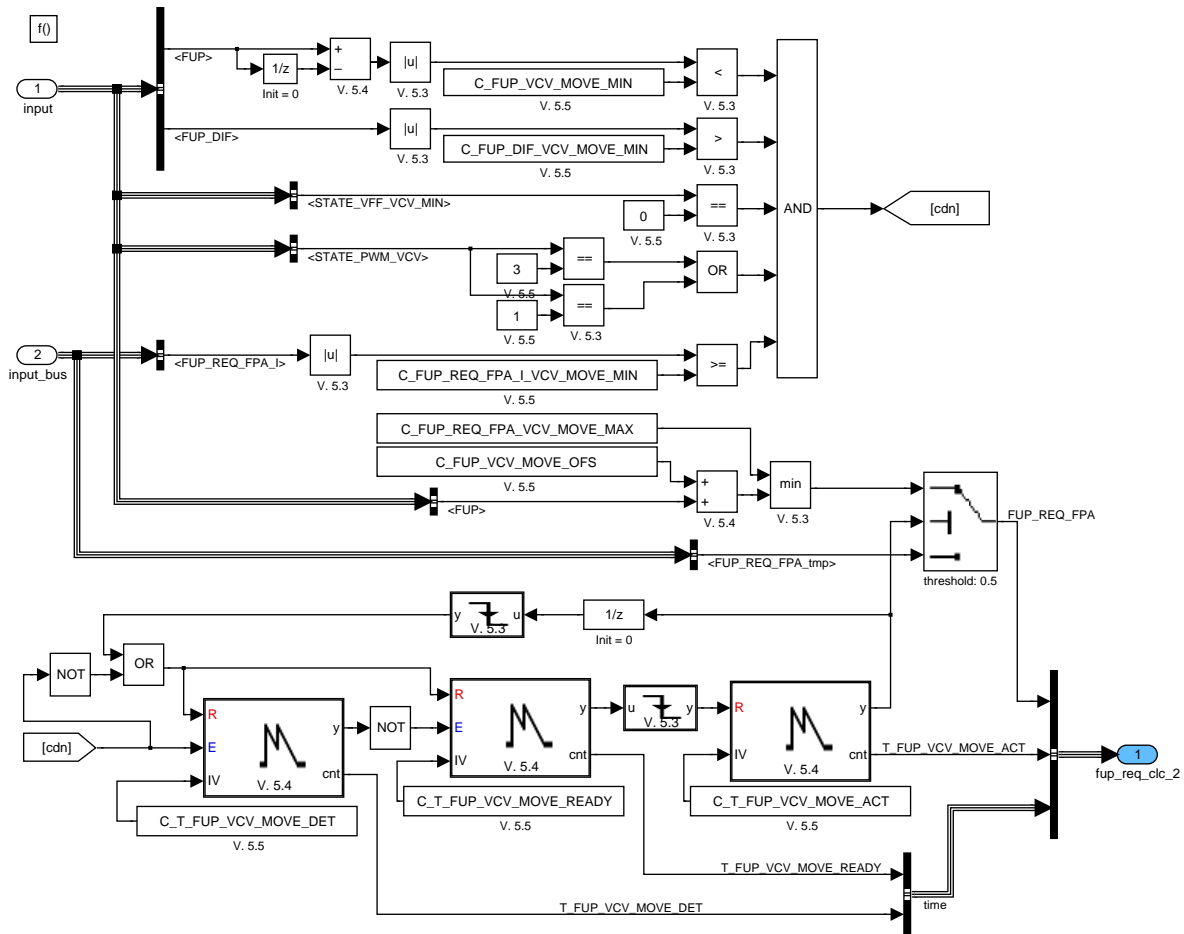


Figure 9.39.20: Path: FUSL\_M903W/OPM\_10MS/FUP\_REQ\_FPA\_MOVE\_CLC

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### 9.39.2.3 Calculation of FUP\_TRAN\_CLC

In this overview the calculation blocks of the transitions, the adaptation inhibition and the different timers for component protections are listed

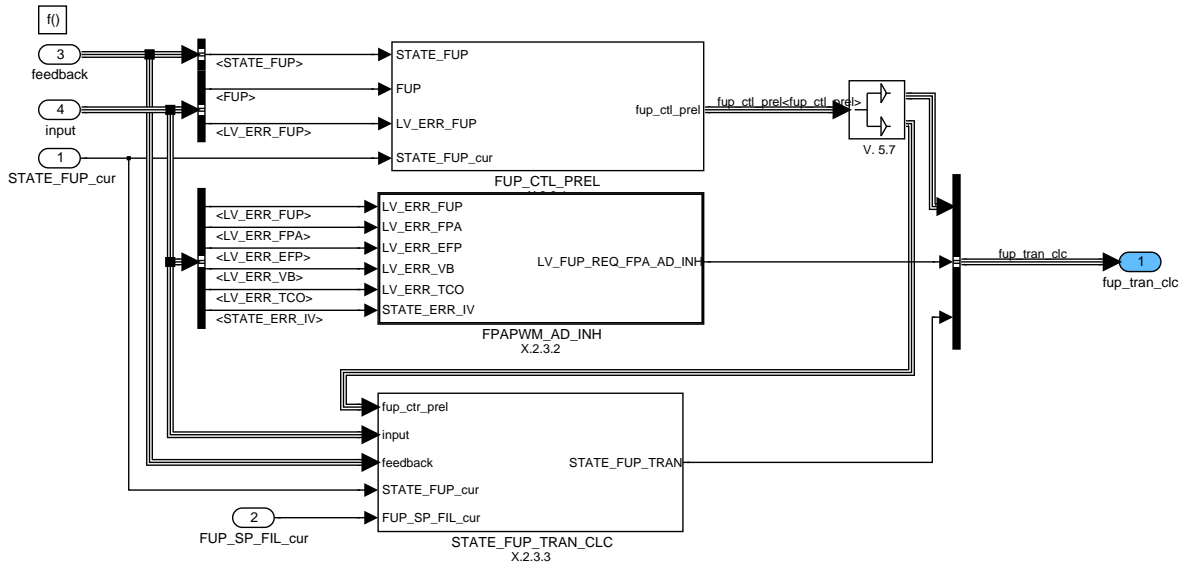


Figure 9.39.21: : Path: FUSL\_M903W/OPM\_10MS/FUP\_TRAN\_CLC

#### 9.39.2.3.1 Calculation of FPAPWM\_AD\_INH

Several external errors can forbid the adaptation

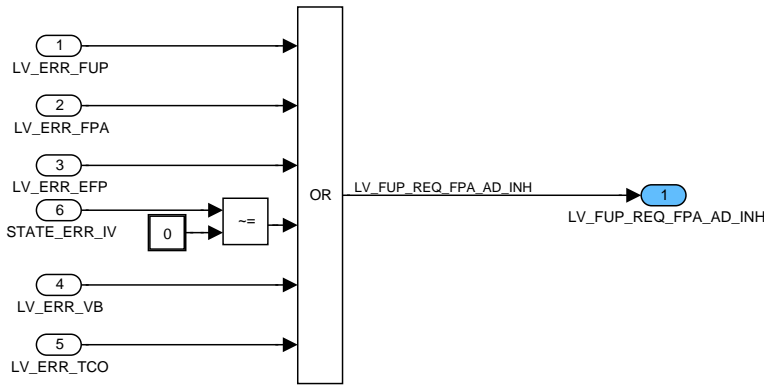


Figure 9.39.22: : Path: FUSL\_M903W/OPM\_10MS/FUP\_TRAN\_CLC/FPAPWM\_AD\_INH

#### 9.39.2.3.2 Timer Calculation

The different timers for the component protection are calculated within that subblock

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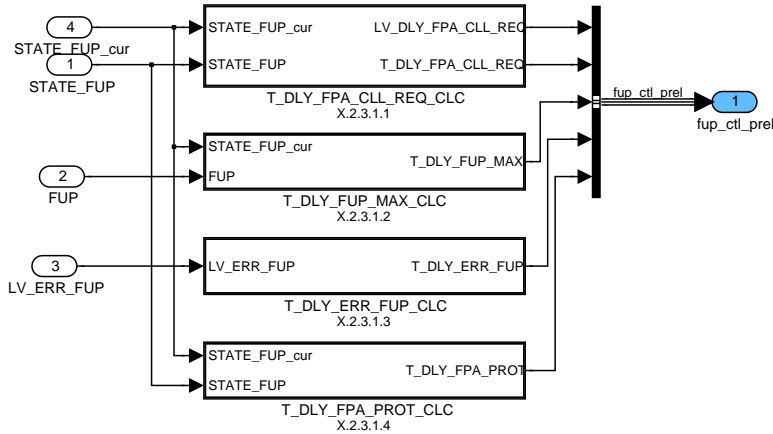


Figure 9.39.23: : Path: FUSL\_M903W/OPM\_10MS/FUP\_TRAN\_CLC/FUP\_CTL\_PREL

9.39.2.3.2.1 Timer Calculation

In case of a fuel pressure error a timer is started

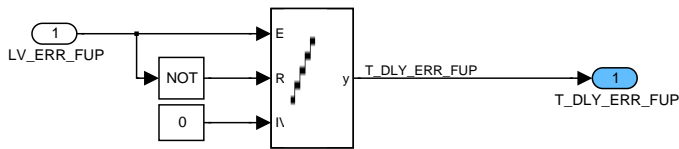


Figure 9.39.24: : Path: FUSL\_M903W/OPM\_10MS/FUP\_TRAN\_CLC/FUP\_CTL\_PREL/T\_DLY\_ERR\_FUP\_CLC

9.39.2.3.2.2 Calculation of Timer and LV variables

For the start a higher PWM than allowed can be requested to enable a fast pressure increase. This timer prevents a severe component damage due to overheating

Note: Due to the functionality high pressure pump control the regulator can maybe not respond to that strategy!

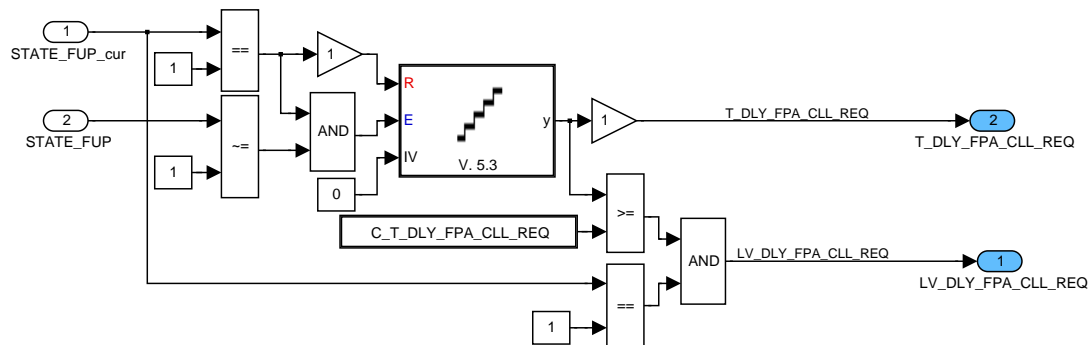


Figure 9.39.25: : Path: FUSL\_M903W/OPM\_10MS/FUP\_TRAN\_CLC/FUP\_CTL\_PREL/T\_DLY\_FPA\_CLC\_REQ\_CLC

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### 9.39.2.3.2.3 Timer Calculation

Corresponding to the timer before a certain time has to be waited until reaching high PWM again.

Note: Due to the functionality high pressure pump control the regulator can maybe not respond to that strategy!

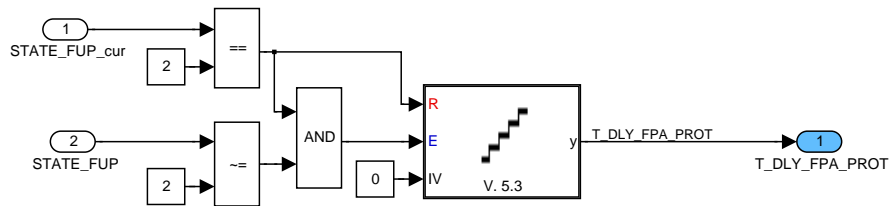


Figure 9.39.26: : Path:  
FUSL\_M903W/OPM\_10MS/FUP\_TRAN\_CLC/FUP\_CTL\_PREL/T\_DLY\_FPA\_PROT\_CLC

### 9.39.2.3.2.4 Timer Calculation

This timer is observing to overpressure and gives signals to the state diagram.

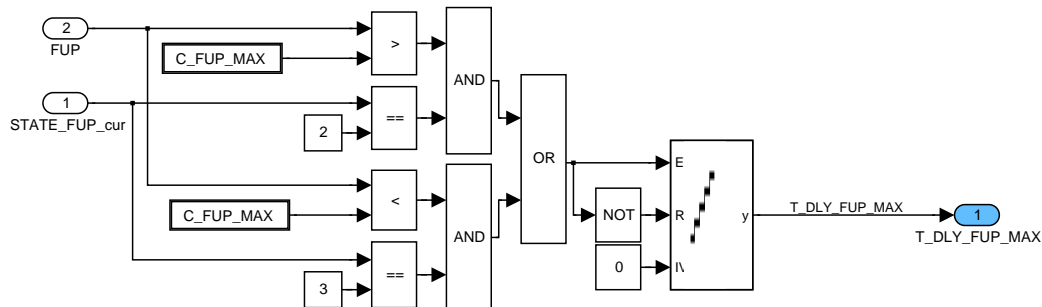


Figure 9.39.27: : Path:  
FUSL\_M903W/OPM\_10MS/FUP\_TRAN\_CLC/FUP\_CTL\_PREL/T\_DLY\_FUP\_MAX\_CLC

### 9.39.2.3.3 Calculation

Due to complexity of the transition calculation this function part is split into three parts.

In the first part the crash state will be achieved in case of crash event. When the engine stops the low pressure state will be selected. In case of overpressure more than a certain time the overpressure state should be reached. After disappearing of the overpressure more than a certain time this state will be left. In case of fuel pressure sensor failure the open loop state should be selected.

The second part gives possibilities to reach close state. This state might be not valid due to external influences at the actual actuator control done in high pressure pump control.

In the third part mainly start conditions are mentioned. In case of required high pressure start the high request for the FPA control is given as soon as the starter relay has closed. Otherwise a certain engine speed has to be reached.

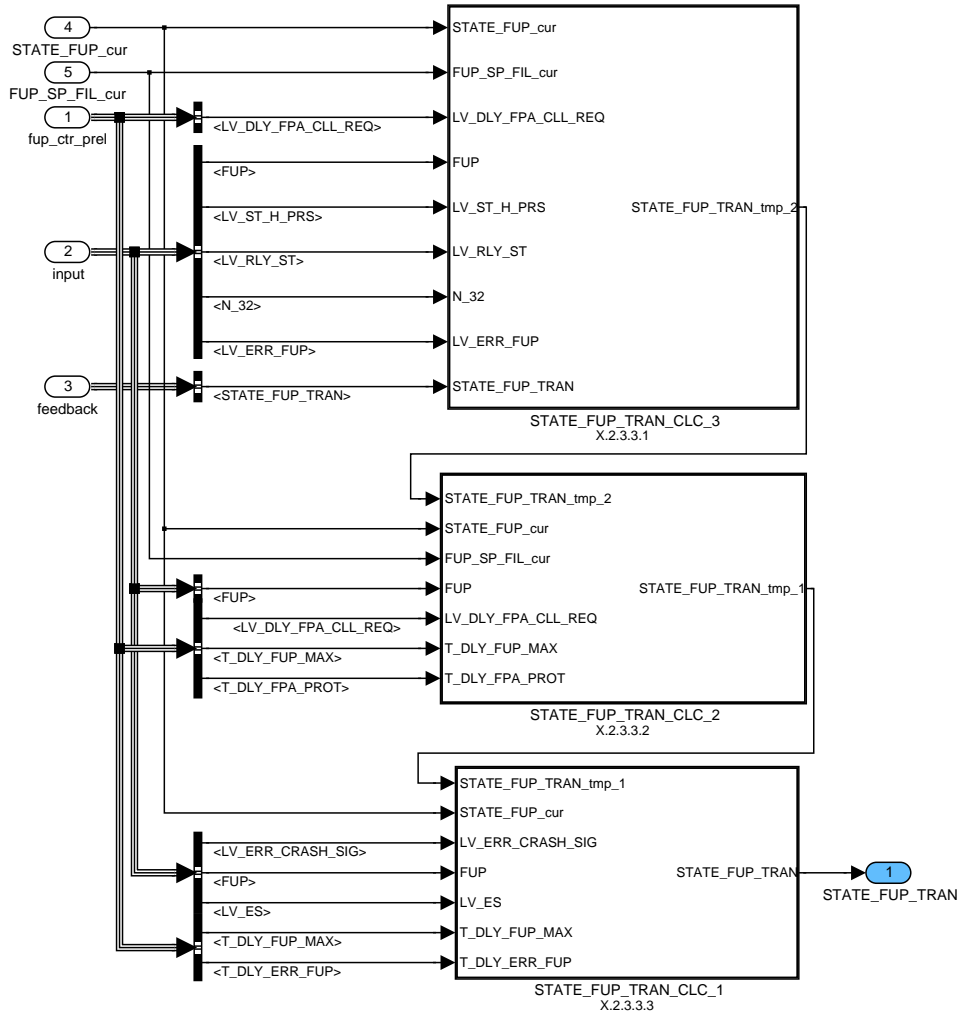


Figure 9.39.28: : Path: FUSL\_M903W/OPM\_10MS/FUP\_TRAN\_CLC/STATE\_FUP\_TRAN\_CLC

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9.39.2.3.3.1 Calculation at STATE\_FUP\_TRAN\_CLC\_1

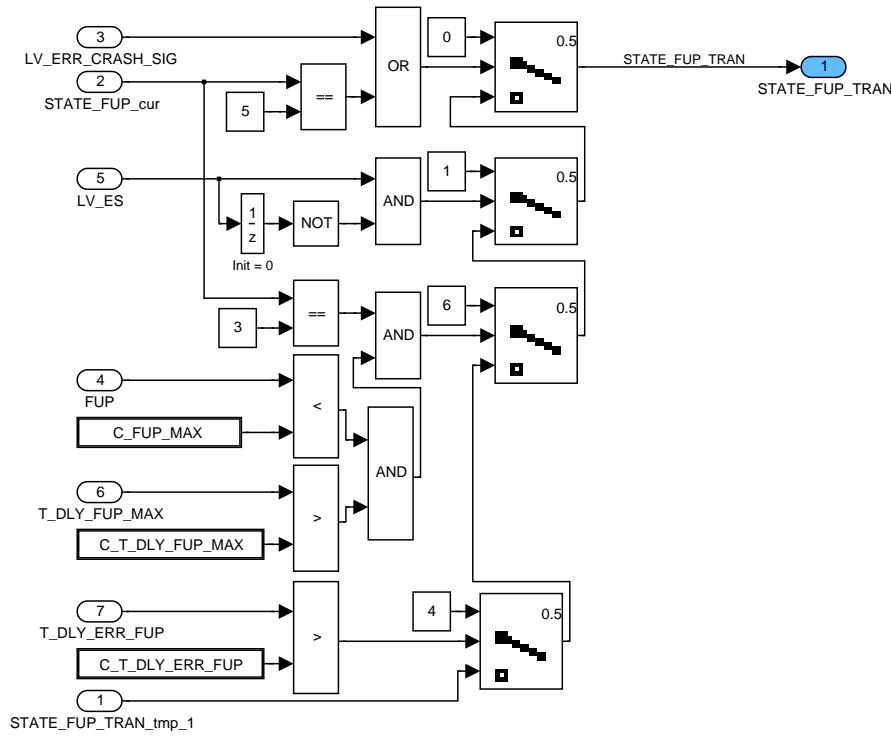



Figure 9.39.29: Path: FUSL\_M903W/OPM\_10MS/FUP\_TRAN\_CLC/STATE\_FUP\_TRAN\_CLC/STATE\_FUP\_TRAN\_CLC\_1

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 3950 of 8404</b>	
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9.39.2.3.3.2 Calculation at STATE\_FUP\_TRAN\_CLC\_2

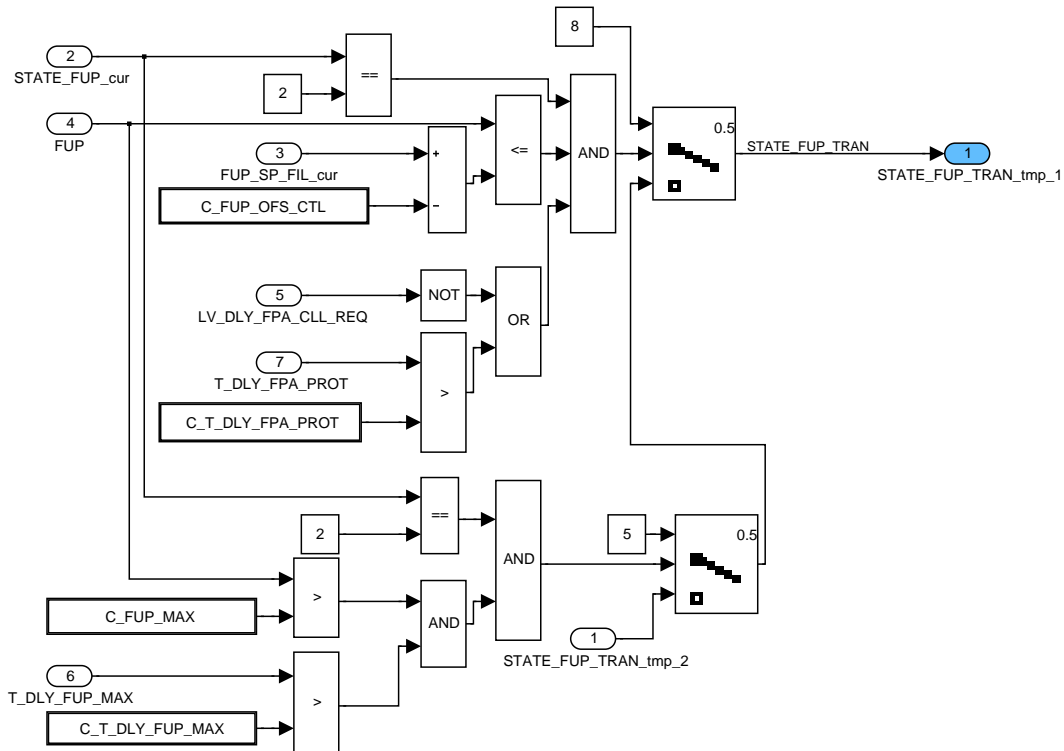



Figure 9.39.30: : Path:  
FUSL\_M903W/OPM\_10MS/FUP\_TRAN\_CLC/STATE\_FUP\_TRAN\_CLC/STATE\_FUP\_TRAN\_CLC\_2

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 3951 of 8404</b>	
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9.39.2.3.3.3 Calculation at STATE\_FUP\_TRAN\_CLC\_3

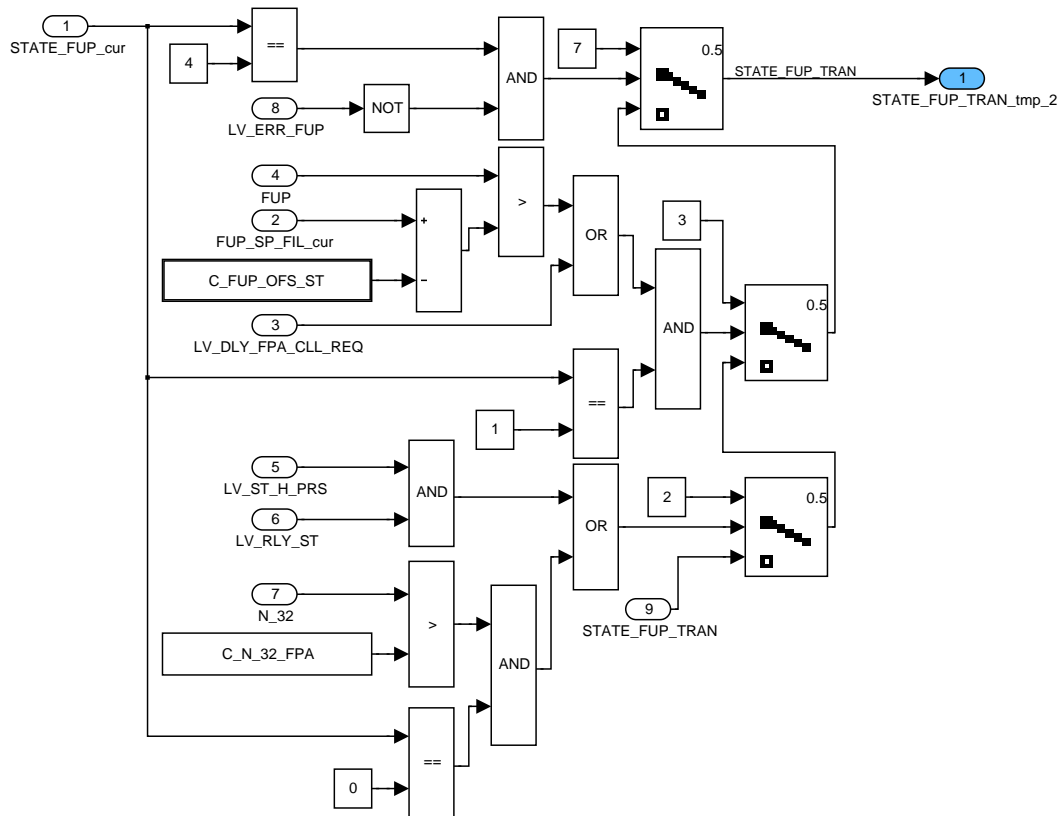



Figure 9.39.31: Path:  
FUSL\_M903W/OPM\_10MS/FUP\_TRAN\_CLC/STATE\_FUP\_TRAN\_CLC/STATE\_FUP\_TRAN\_CLC\_3

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 3952 of 8404	
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## 9.40 Fuel pressure actuator control

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CUR_VCV_AST_MOVE_ACT	V	0... FFH	0... 255	1	-
Countdown for CUR pulses to move the VCV after engine stop					
CTR_CUR_VCV_MAX	V	0... FFH	0... 255	1	-
Counter in Operation max mode					
CTR_MIN_VFF_VCV_MIN_AD_SWI	O/V	0... FFH	0... 255	1	-
Variable indicating the cycle of the frequency of the leakage adaptation					
CUR_VCV	V	0... FFFFH	0... 65.535	1e-3	A
Actual current of the VCV					
CUR_VCV_BAS	O/V	0... FFFFH	0... 65.535	1e-3	A
Desired value for the current of the VCV					
CUR_VCV_BAS_AD_VAR_2_ADD	O/V/S	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Additive component of second variant of VCV flow adaptation					
CUR_VCV_CTL	V	0... FFFFH	0... 65.535	1e-3	A
Requested current for the VCV in CTL mode					
CUR_VCV_DIF	V	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Current difference of VCV current controller					
CUR_VCV_DIF_REL	O/V	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Relative current deviation of VCV current controller					
CUR_VCV_DIF_REL_MMV	V	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Filtered relative deviation of the VCV current controller					
CUR_VCV_MAX	V	0... FFFFH	0... 65.535	1e-3	A
Maximum allowed current for the VCV					
CUR_VCV_MIN	V	0... FFFFH	0... 65.535	1e-3	A
Requested for the VCV in pressure control mode					
CUR_VCV_MIN_AD	O/V	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Adapted current of VCV in pressure control mode					
CUR_VCV_MIN_AD_1	O/V/S	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Adapted CUR of the first point pressure control part					
CUR_VCV_MIN_AD_2	O/V/S	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Adapted CUR of the second point pressure control part					
CUR_VCV_REQ	V	0... FFFFH	0... 65.535	1e-3	A
Requested current for the VCV					
FAC_CUR_VCV_BAS_AD_VAR_2	O/V/S	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Multiplicative component of second variant of VCV flow adaptation					
FAC_CUR_VCV_BAS_AD_VAR_2_TMP	O/V/S	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Temporary variable for the multiplicative component of second variant of VCV flow adaptation					

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	Document key 10171571 SPE 000 AO	Pages Page 3953 of 8404	
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_CUR_VCV_CTL	V	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Output of VCV current controller					
FAC_CUR_VCV_MIN_AD	V	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	A/hPa
Factor for the correction of the pressure control part					
FAC_V_SLOP_CUR_VCV	O/V	0... FFFFH	0... 3.99993896484	61.0352e-6	-
Slope/factor value of the VCV current measurement					
FAC_VFF_FPA	V	0... FFH	0... 0.99609375	3.90625e-3	-
Factor for the flow through the regulator part of 3W-valve (depending on VFF_VCV_MIN)					
FAC_VFF_VCV_MIN	O/V	0... FFH	0... 9.9609375	0.0390625	-
Correction factor for the leakage adaptation					
FRQ_REQ_VCV	O/V	0... 3FFFH	0... 1023	1	Hz
Required frequency for the volume control valve (typical range 10 - 1023 Hz)					
FUP_CUR_VCV_MIN_AD_1	O/V/S	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure first adaptation point pressure control					
FUP_CUR_VCV_MIN_AD_2	O/V/S	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure second adaptation point pressure control					
FUP_SP_VFF_VCV_MIN_AD_END	V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint level for ending the VFF_VCV_MIN adaptation					
FUP_SP_VFF_VCV_MIN_AD_ST	V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint level for starting the VFF_VCV_MIN adaptation					
FUP_VFF_VCV_MIN_AD_ST	V	0... FFFFH	0... 347776	5.3067216	hPa
Initial fuel pressure where the VCV_MIN calculation starts at					
LV_CUR_VCV_AST_MOVE_ACT	V	0... 1H	0 ...1	1	-
Logical value for move VCV after engine stop active					
LV_CUR_VCV_CTL_AD_ENA	V	0... 1H	0 ...1	1	-
Logical value to enable VCV PWM adaption due to CUR CTL					
LV_CUR_VCV_CTL_PRE_RUN	O/V	0... 1H	0 ...1	1	-
Logical value for VCV_PRE_RUN					
LV_CUR_VCV_CTL_PRE_RUN_ACT	V	0... 1H	0 ...1	1	-
Logical value for VCV_PRE_RUN active					
LV_CUR_VCV_CTL_PRE_RUN_EDGE	V	0... 1H	0 ...1	1	-
Logical value for start of VCV_PRE_RUN					
LV_CUR_VCV_ST_ACT	V	0... 1H	0 ...1	1	-
Logical value for setting of CUR_VCV at start					
LV_FUEL_MASS_CTL_RST_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable for resetting P and I-part of the controller					
LV_FUEL_MASS_CTL_STOP_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable requesting freezing the I-part of the controller					
LV_PWL_LOCK_CDN_HPDI	V	0... 1H	0 ...1	1	-
Power latch extension for CUR pulses to move the VCV after engine stop					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_STATE_VFF_VCV_MIN_RST	V	0... 1H	0 ...1	1	-
Logical bit requesting STATE_VFF_VCV_MIN reset					
LV_V_CUR_VCV_BOOT_NOT_VLD	O/V	0... 1H	0 ...1	1	-
Bit indicating out of bounce trim values.					
LV_VFF_VCV_MIN_AD_ENA	V	0... 1H	0 ...1	1	-
Adaptation conditions for the minimum flow through the VCV are fulfilled					
PWM_VCV	O/V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
PWM signal for the VCV					
PWM_VCV_BAS	V	0... FFFFH	0... 99.998474	1.52588e-3	%
Base PWM signal for the VCV					
PWM_VCV_MAX	V	0... FFFFH	0... 99.998474	1.52588e-3	%
Maximum PWM signal for the VCV					
STATE_PWM_VCV	O/V	0H 1H 2H 3H 4H 5H 6H	VCV_TEST START MFP_CTL VCV_CLOSE VCV_CRASH MFP_MAX VCV_LIH	-	-
State diagram for the VCV control					
STATE_PWM_VCV_TRAN	V	0H 1H 2H 3H 4H 5H 6H 7H	CRASH OPEN CLOSE CONTROL MANUAL MANUAL_ OPEN MAXIMUM VCV_LIH	-	-
Transition state diagram for the VCV control					
STATE_VFF_VCV_MIN	O/V	0H 1H 2H 3H 4H 5H	PASSIVE READY START ACTIVE END PASSIVE_ READY	-	-
Minimum VCV adaptation state					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_CUR_VCV_CTL_PRE_RUN	V	0... FFH	0... 25.5	0.1	s
Time for VCV_PRE_RUN active					
T_VFF_VCV_LIM	V	0... FFFFH	0... 655.35	0.01	s
Maximum time for leakage adaption					
T_VFF_VCV_MIN	V	0... FFFFH	0... 655.35	0.01	s
Time measured for the pressure increase during adaptation					
T_VFF_VCV_MIN_AD_READY	O/V	0... FFFFH	0... 655.35	0.01	s
Time for waiting in the Passive_ready state of the leakage adaptation					
T_VFF_VCV_MIN_AD_ST	O/V	0... FFFFH	0... 655.35	0.01	s
Timer to start the pressure increase during adaptation					
V_CUR_VCV_MES_MV	V	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Measured voltage of shunt for VCV current control					
V_OFS_CUR_VCV	O/V	8000... 7FFFH	-5... 4.99984741211	152.588e-6	V
Offset value of the VCV current measurement					
VB_VCV_MMV	V	0... FFH	0... 25.8984375	0.1015625	V
Filtered battery voltage for VCV control					
VFF_VCV	O/V	0... FFFFH	0... 255	3.89105e-3	l/h
Requested volume fuel flow through the VCV					
VFF_VCV_MIN	O/V	0... FFFFH	0... 255	3.89105e-3	l/h
Adapted minimum volume fuel flow through the VCV					
VFF_VCV_MIN_BAS	O/V/S	0... FFFFH	0... 255	3.89105e-3	l/h
Adapted minimum volume fuel flow through the VCV (normalized value)					
VFF_VCV_MIN_MMV	V	0... FFFFH	0... 255	3.89105e-3	l/h
Adapted minimum volume fuel flow through the VCV after filter					
VFF_VCV_MIN_MMV_INI	V	0... FFFFH	0... 255	3.89105e-3	l/h
Adapted minimum volume fuel flow through the VCV (normalized value), Ini value for VFF_VCV_MIN_MMV					

**Input data:**

C_FUP_SP_ADD {p. 3869}	C_IDX_TRIM {p. 989}	C_V_CUR_VCV_BOOT_H	C_V_CUR_VCV_BOOT_H_CMPL
C_V_CUR_VCV_BOOT_L	C_V_CUR_VCV_BOOT_L_CMPL	CUR_VCV_BAS_AD_VAR_2_ADD_SET {p. 3880}	ECU_STATE {p. 1091}
FAC_CLC_FUEL_MASS_FUP {p. 3908}	FUEL_MASS_REQ {p. 3908}	FUEL_MASS_REQ_I_CTL_H_RES {p. 3908}	FUP {p. 1283}
FUP_DIF {p. 3909}	FUP_REQ_FPA {p. 3930}	FUP_REQ_FPA_I {p. 3930}	FUP_SP {p. 3868}
LV_EFP_RUN_WKU {p. 3822}	LV_ERR_CRASH_SIG {p. 801}	LV_ERR_FUP_STOP {p. 6062}	LV_ES {p. 1720}
LV_FIRST_VLD_TOOTH {p. 1505}	LV_FUP_LIH_HOM_REQ {p. 4001}	LV_FUP_LIH_HOM_VCV_OPEN_REQ {p. 4001}	LV_FUP_LIH_L_PRS_CTL_REQ {p. 4001}
LV_FUP_PRS_CTL_REQ {p. 3880}	LV_FUP_SP_ADD {p. 3868}	LV_HPP_CTL_AD_CLR_EXT_REQ {p. 7483}	LV_IGK {p. 906}

LV_PUC {p. 1720}	LV_ST_END {p. 1720}	LV_ST_H_PRS {p. 8242}	LV_VCV_RLY {p. 988}
MFF_SP_FUP_CTL {p. 2151}	N {p. 1525}	NC_PWL_LOCK_CDN_ HPDI {p. 3778}	NC_V_CUR_VCV_MES {p. 653}
STATE_FUP_CTL {p. 3881}	T_SEG_AV {p. 1525}	TCO {p. 1100}	TCO_ST {p. 1100}
TECU {p. 1256}	TFU {p. 1232}	V_CUR_VCV_MES_ ACTION_INFR	VB {p. 1185}
VFF_MFF_SP_FUP_CTL {p. 3881}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FUP_CUR_VCV_MIN_AD	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlation constant for the MMV calculation of FUP for the adaptation					
C_CRLC_VB_VCV_MMV	-	0... FFH	0... 0.99609375	3.90625e-3	-
Averaging constant of VB filter for VCV control					
C_CRLC_VFF_VCV_MIN_BAS_MMV	-	0... FFH	0... 0.99609375	3.90625e-3	-
Filter constant for moving mean value calculation of the VFF_VCV_MIN_BAS					
C_CRLC_VFF_VCV_MIN_MMV	-	0... FFH	0... 0.99609375	3.90625e-3	-
Filter constant for moving mean value calculation of the VFF_VCV_MIN					
C_CTR_CUR_VCV_AST_MOVE_ACT	-	0... FFH	0... 255	1	-
Number of CUR pulses to move the VCV after engine stop					
C_CTR_CUR_VCV_BAS_AD_VAR_2_MAX	-	0... FFH	0... 255	1	-
Counter for the second variant of the flow control adaptation					
C_CTR_CUR_VCV_CTL_STOP	-	0... FFFFH	0... 65535	1	-
Counter for stopping the VCV current control in intervention mode					
C_CTR_CUR_VCV_MAX	-	0... FFH	0... 255	1	-
Calibration for Counter in Operation max mode					
C_CTR_CUR_VCV_MIN_AD_MAX	-	0... FFH	0... 255	1	-
Counter for the pressure control part adaptation					
C_CTR_MIN_VFF_VCV_MIN_AD_INI	-	0... FFH	0... 255	1	-
Constant for initialisation of counter for frequency of the leakage adaptation					
C_CTR_MIN_VFF_VCV_MIN_AD_SWI	-	0... FFH	0... 255	1	-
Constant deciding the frequency of the leakage adaptation					
C_CUR_BAS_CUR_VCV_CTL_MAX	-	0... FFFFH	0... 65.535	1e-3	A
Maximum current to enable VCV current controller					
C_CUR_BAS_CUR_VCV_CTL_MIN	-	0... FFFFH	0... 65.535	1e-3	A
Minimum current to enable VCV current controller					
C_CUR_VCV_AD_CORD_2	-	0... FFFFH	0... 0.0000999984	1.52588e-9	A/hPa
Correlation constant for transferring the I-part into the PWM_VCV_BAS curve					
C_CUR_VCV_AD_VAR_2_CORD_1	-	0... FFFFH	0... 0.049999237	762.939e-9	A/mg
Correlation constant for transferring the I-part into the flow control curve for second variant of the VCV flow adaptation					
C_CUR_VCV_AST_MOVE	-	0... FFFFH	0... 65.535	1e-3	A
PWM for moving the VCV after engine stop					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CUR_VCV_AST_MOVE_MIN	-	0... FFFFH	0... 65.535	1e-3	A
VCV current threshold to activate the VCV after engine stop movement without LV_ERR_FUP_STOP					
C_CUR_VCV_BAS_AD_VAR_2_ADD_INI	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Initialisation value for the additive component of the second variant of the VCV flow adaptation					
C_CUR_VCV_BAS_AD_VAR_2_ADD_MAX	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Maximum value for the additive component in the second variant of the VCV flow adaptation					
C_CUR_VCV_BAS_AD_VAR_2_ADD_MIN	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Minimum value for the additive component in the second variant of the VCV flow adaptation					
C_CUR_VCV_CRASH	-	0... FFFFH	0... 65.535	1e-3	A
CUR for VCV in CRASH					
C_CUR_VCV_CTL_AD_MAX	-	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Maximum allowed current deviation to enable PWM adaption					
C_CUR_VCV_DIF_REL_PRE_RUN_MIN	-	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Deviation of the VCV current controller to enable VCV_PRE_RUN					
C_CUR_VCV_LIH	-	0... FFFFH	0... 65.535	1e-3	A
CUR for VCV in limphone					
C_CUR_VCV_LIM_INC	-	0... FFFFH	0... 65.535	1e-3	A
Gradient limitation for increment of CUR_VCV					
C_CUR_VCV_MAN	-	0... FFFFH	0... 65.535	1e-3	A
Manual CUR signal for the VCV					
C_CUR_VCV_MIN_AD_1_INI	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Initialisation value CUR_VCV first point of pressure control part					
C_CUR_VCV_MIN_AD_1_MAX	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Maximum value for the adaptation of point 1 of the pressure control part					
C_CUR_VCV_MIN_AD_1_MIN	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Minimum value for the adaptation of point 1 of the pressure control part					
C_CUR_VCV_MIN_AD_2_INI	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Initialisation value CUR_VCV second point of pressure control part					
C_CUR_VCV_MIN_AD_2_MAX	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Maximum value for the adaptation of point 2 of the pressure control part					
C_CUR_VCV_MIN_AD_2_MIN	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Minimum value for the adaptation of point 2 of the pressure control part					
C_CUR_VCV_MIN_AD_MAX	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Maximum value for the adaptation of the pressure control part					
C_CUR_VCV_MIN_AD_MIN	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Minimum value for the adaptation of the pressure control part					
C_CUR_VCV_MIN_OPL	-	0... FFFFH	0... 65.535	1e-3	A
Minimum CUR signal for the VCV in open loop (at engine stop)					
C_CUR_VCV_MIN_TOL	-	0... FFFFH	0... 65.535	1e-3	A
Maximum value for CUR_VCV_MIN					
C_CUR_VCV_PRE_RUN	-	0... FFFFH	0... 65.535	1e-3	A
Current for VCV_PRE_RUN					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CUR_VCV_SP_MAX	-	0... FFFFH	0... 65.535	1e-3	A
Maximum allowed current for VCV					
C_CUR_VCV_VFF_VCV_MIN_AD	-	0... FFFFH	0... 65.535	1e-3	A
CUR value for the leakage adaptation					
C_FAC_CUR_VCV_AD_VAR_2_CORD_2	-	1... FFH	0.000392157 ...0.100000035	392.157e-6	1/mg
Correlation constant for transferring the I-part into the CUR_VCV_BAS curve for second variant of the VCV flow adaptation					
C_FAC_CUR_VCV_BAS_AD_2_TMP_INI	-	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Initialisation value for the temporary variable for the multiplicative component of the second variant of the VCV flow adaptation					
C_FAC_CUR_VCV_BAS_AD_VAR_2_MAX	-	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Maximum value for the multiplicative component of the second variant of VCV flow adaptation					
C_FAC_CUR_VCV_BAS_AD_VAR_2_MIN	-	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Minimum value for the multiplicative component of the second variant of VCV flow adaptation					
C_FAC_CUR_VCV_CTL_MAX	-	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Maximum output of VCV current controller					
C_FAC_CUR_VCV_CTL_MIN	-	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Minimum output of VCV current controller					
C_FAC_PWM_VCV_MIN	-	0... FFH	0... 9.9609375	0.0390625	-
Correction factor for the PWM_VCV_MIN by the flow through the regulator part					
C_FRQ_PWM_VCV_OPL	-	0... 3FFH	0... 1023	1	Hz
Required frequency for the VCV for open position (typical 10 - 1023 Hz); Initialisation with 100Hz					
C_FRQ_PWM_VCV_PRE_RUN	-	0... 3FFH	0... 1023	1	Hz
Required frequency for the VCV for pre run (typical 10 - 1023 Hz); Initialisation with 100Hz					
C_FRQ_REQ_VCV_AST_MOVE	-	0... 3FFH	0... 1023	1	Hz
Required frequency for moving the VCV after engine stop (typical 10 - 1023 Hz)					
C_FUP_CUR_VCV_MIN_AD_1	-	0... FFFFH	0... 347776	5.3067216	hPa
Mean fuel pressure for adaptation of point 1 of pressure control part					
C_FUP_CUR_VCV_MIN_AD_1_INI	-	0... FFFFH	0... 347776	5.3067216	hPa
Initialisation value for the fuel pressure first adaptation point pressure control part					
C_FUP_CUR_VCV_MIN_AD_2	-	0... FFFFH	0... 347776	5.3067216	hPa
Mean fuel pressure for adaptation of point 2 of pressure control part					
C_FUP_CUR_VCV_MIN_AD_2_INI	-	0... FFFFH	0... 347776	5.3067216	hPa
Initialisation value for the fuel pressure second adaptation point pressure control part					
C_FUP_CUR_VCV_MIN_HYS_1	-	0... FFFFH	0... 347776	5.3067216	hPa
Hysteresis of fuel pressure for adaptation of point 1 of pressure control part					
C_FUP_CUR_VCV_MIN_HYS_2	-	0... FFFFH	0... 347776	5.3067216	hPa
Hysteresis of fuel pressure for adaptation of point 2 of pressure control part					
C_FUP_DIF_CUR_VCV_AD	-	0... FFFFH	0... 347776	5.3067216	hPa
Max. fuel pressure deviation to allow adaptation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUP_DIF_CUR_VCV_AD_VAR_2	-	0... FFFFH	0... 347776	5.3067216	hPa
Max. fuel pressure deviation to allow the second variant of the flow adaptation					
C_FUP_DIF_MAX_VFF_VCV_MIN_AD	-	0... FFFFH	0... 347776	5.3067216	hPa
Maximum pressure deviation allowed for adaptation of VFF_VCV_MIN					
C_FUP_MAX_PRE_RUN_ACT	-	0... FFFFH	0... 347776	5.3067216	hPa
Maximum fuel pressure for activation of prerun					
C_FUP_OFS_MFP_MAX	-	0... FFFFH	-173890 ...173884	5.3066911	hPa
FUP offset for high pressure start					
C_FUP_SP_VFF_VCV_MIN_AD_END	-	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint additional value for ending the VFF_VCV_MIN adaptation					
C_FUP_VCV_AST_MOVE_MAX	-	0... FFFFH	0... 347776	5.3067216	hPa
FUP threshold to activate the VCV after engine stop movement without LV_ERR_FUP_STOP					
C_FUP_VFF_VCV_MIN_AD_HYS	-	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure difference for VFF_VCV_MIN adaptation					
C_FUP_VFF_VCV_MIN_AD_RED	-	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure reduction value due to temperature for VFF_VCV_MIN adaptation					
C_FUP_VFF_VCV_MIN_AD_ST	-	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure value for VFF_VCV_MIN adaptation start					
C_MFF_SP_VCV_BAS_AD_MAX	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Maximum mass fuel flow to allow the VCV flow adaptation					
C_PWM_VCV_MIN_OPL	-	0... FFFFH	0... 99.998474	1.52588e-3	%
Minimum PWM signal for the VCV in open loop (at engine stop)					
C_RHO_FUEL	-	153B... FFFFH	74.6395056077 ...900	0.0& %■331	mg/cm**3
Density of the fuel					
C_T_CUR_VCV_AST_MOVE	-	0... FFFFH	0... 655.35	0.01	s
Time for the CUR to move the VCV after engine stop					
C_T_CUR_VCV_CTL_PRE_RUN	-	0... FFH	0... 25.5	0.1	s
Time for the VCV_PRE_RUN					
C_T_CUR_VCV_CTL_PRE_RUN_ACT_MIN	-	0... FFFFH	0... 655.35	0.01	s
Minimum time for VCV pre run duration					
C_T_DLY_CUR_VCV_AST_MOVE	-	0... FFFFH	0... 655.35	0.01	s
Delaytime for the CUR to move the VCV after engine stop					
C_T_FIRST_DLY_CUR_VCV_AST_MOVE	-	0... FFFFH	0... 655.35	0.01	s
First delaytime for the CUR to move the VCV after engine stop					
C_T_VFF_VCV_LIM_MAX	-	0... FFFFH	0... 655.35	0.01	s
Maximum time for the leakage adaptation					
C_T_VFF_VCV_MIN_AD_READY	-	0... FFFFH	0... 655.35	0.01	s
Maximum time for the leakage adaptation					
C_T_VFF_VCV_MIN_AD_ST_MAX	-	0... FFFFH	0... 655.35	0.01	s
Time for VFF_VCV_MIN adaptation start					
C_TFU_CUR_VCV_AD_MAX	-	0... FEH	-48... 142.5	0.75	°C
Maximum temperature for the adaptation					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TFU_CUR_VCV_AD_MIN	-	0... FEH	-48... 142.5	0.75	°C
Minimum temperature for the adaptation					
C_TFU_VFF_VCV_MIN_CLC_MAX	-	0... FEH	-48... 142.5	0.75	°C
Maximum temperature for the leakage adaptation					
C_TFU_VFF_VCV_MIN_CLC_MIN	-	0... FEH	-48... 142.5	0.75	°C
Minimum temperature for the leakage adaptation					
C_V_CUR_VCV_BOOT_H_INI	-	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Measured voltage at high current					
C_V_CUR_VCV_BOOT_H_MAX	-	8000... 7FFFH	-5... 4.99984741211	152.588e-6	V
Maximum threshold for VCV trim value					
C_V_CUR_VCV_BOOT_H_MIN	-	8000... 7FFFH	-5... 4.99984741211	152.588e-6	V
Minimum threshold for VCV trim value					
C_V_CUR_VCV_BOOT_H_STD	-	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Measured voltage at high current standard value					
C_V_CUR_VCV_BOOT_L_INI	-	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Measured voltage at low current initial value					
C_V_CUR_VCV_BOOT_L_MAX	-	8000... 7FFFH	-5... 4.99984741211	152.588e-6	V
Maximum threshold for VCV trim value					
C_V_CUR_VCV_BOOT_L_MIN	-	8000... 7FFFH	-5... 4.99984741211	152.588e-6	V
Minimum threshold for VCV trim value					
C_V_CUR_VCV_BOOT_L_STD	-	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Measured voltage at low current standard value					
C_VB_CUR_VCV_CTL_AD_MAX	-	0... FFH	0... 25.8984375	0.1015625	V
Maximum battery voltage to enable PWM adaption					
C_VB_CUR_VCV_CTL_AD_MIN	-	0... FFH	0... 25.8984375	0.1015625	V
Minimum battery voltage to enable PWM adaption					
C_VB_CUR_VCV_CTL_PRE_RUN_MAX	-	0... FFH	0... 25.8984375	0.1015625	V
Maximum battery voltage to enable VCV_PRE_RUN					
C_VB_CUR_VCV_CTL_PRE_RUN_MIN	-	0... FFH	0... 25.8984375	0.1015625	V
Minimum battery voltage to enable VCV_PRE_RUN					
C_VFF_CUR_VCV_BAS_AD_2_BOL_1	-	0... FFFFH	0... 255	3.89105e-3	l/h
VFF bottom limit to allow the adaptation of the additive component in the second variant of the VCV flow adaptation					
C_VFF_CUR_VCV_BAS_AD_2_BOL_2	-	0... FFFFH	0... 255	3.89105e-3	l/h
VFF bottom limit to allow the adaptation of the multiplicative component in the second variant of the VCV flow adaptation					
C_VFF_CUR_VCV_BAS_AD_2_TOL_1	-	0... FFFFH	0... 255	3.89105e-3	l/h
VFF top limit to allow the adaptation of the additive component in the second variant of the VCV flow adaptation					

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 3961 of 8404	
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VFF_CUR_VCV_BAS_AD_2_TOL_2	-	0... FFFFH	0... 255	3.89105e-3	l/h
VFF top limit to allow the adaptation of the multiplicative component in the second variant of the VCV flow adaptation					
C_VFF_VCV_MIN_BOL	-	0... FFFFH	0... 255	3.89105e-3	l/h
VFF_VCV_MIN adaptation bottom value					
C_VFF_VCV_MIN_INI	-	0... FFFFH	0... 255	3.89105e-3	l/h
VFF_VCV_MIN_BAS initial value					
C_VFF_VCV_MIN_TOL	-	0... FFFFH	0... 255	3.89105e-3	l/h
VFF_VCV_MIN adaptation top value					
ID_FRQ_PRS_PWM_VCV_STND	-	0... 3FFH	0... 1023	1	Hz
LDP_N_ID_FRQ_PRS_PWM_VCV_STND	8	0... 1FE0H	0... 8160	1	rpm
Required frequency for the VCV for standard operation in pressure mode					
ID_FRQ_PWM_VCV_STND	-	0... 3FFH	0... 1023	1	Hz
LDP_N_ID_FRQ_PRS_PWM_VCV_STND	8	0... 1FE0H	0... 8160	1	rpm
Required frequency for the VCV for standard operation (typical range 10 - 1023 Hz)					
IP_CRLC_CUR_VCV_DIF_REL	-	0... FFH	0... 0.99609375	3.90625e-3	-
LDP_CUR_DIF_REL_IP_CRLC_CUR	6	0... FFFFH	-32.768 ...32.767	1e-3	A
Corelation value for filtering of relative current deviation VCV current control					
IP_CUR_SP_FLOW_CTL_VCV	-	0... FFFFH	0... 65.535	1e-3	A
LDP_VFF_VCV_IP_CUR_SP_FLOW	16	0... FFFFH	0... 255	3.89105e-3	l/h
Current setpoint of VCV in flow controll					
IP_CUR_SP_PRS_CTL_VCV	-	0... FFFFH	0... 65.535	1e-3	A
LDP_FUP_REQ_FPA_IP_CUR_SP_PRS	16	0... FFFFH	0... 347776	5.3067216	hPa
Current setpoint of VCV in pressure controll					
IP_CUR_VCV_LIM_DEC	V	0... FFFFH	0... 65.535	1e-3	A
LDP_FUP_IP_CUR_VCV_LIM_DEC	4	0... FFFFH	0... 347776	5.3067216	hPa
LDP_CUR_VCV_BAS_IP_CUR_VCV_LIM	4	0... FFFFH	0... 65.535	1e-3	A
Gradient limitation for decrement of CUR_VCV					
IP_CUR_VCV_MES	-	0... FFFFH	0... 65.535	1e-3	A
LDP_V_CUR_IP_V_CUR_VCV_MES	6	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Transfer from measured voltage to current of the VCV					
IP_CUR_VCV_ST	-	0... FFFFH	0... 65.535	1e-3	A
LDPM_TCO_ST_1_FUSL	6	0... FEH	-48... 142.5	0.75	°C
CUR_VCV for the start after the event 1TOOTH					
IP_FAC_CUR_VCV_I_CTL	-	0... FFFFH	-2... 1.99993896484	61.0352e-6	-
LDP_CUR_DIF_MMV_IP_CUR_I_CTL	8	0... FFFFH	-2... 1.99993896484	61.0352e-6	-
I- share of VCV current controller					
IP_FAC_FRQ_V_CUR_VCV_MES	-	0... FFFFH	0... 3.99993896484	61.0352e-6	-
LDP_FRQ_REQ_V_CUR_VCV_MES	8	0... 3FFH	0... 1023	1	Hz
Frequency correction of the measured feedback					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_PWM_VCV_TFU	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_TFU_IP_FAC_PWM_VCV	8	0... FEH	-48... 142.5	0.75	°C
Correction factor for the PWM_VCV by the fuel temperature					
IP_FAC_PWM_VCV_VB	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDPM_VB_FUSL	8	0... FFH	0... 26	0.1019608	V
Correction factor for the PWM_VCV by the battery voltage					
IP_FAC_TECU_V_CUR_VCV_MES	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_TECU_IP_FAC_V_CUR_VCV_MES	8	0... FEH	-48... 142.5	0.75	°C
Temperature correction of the measured feedback					
IP_FAC_VB_PWM_V_CUR_VCV_MES	V	0... FFFFH	0... 7.99987792969	122.07e-6	-
LDP_VB_IP_FAC_V_CUR_VCV_MES	9	0... FFH	0... 26	0.1019608	V
LDP_PWM_VCV_IP_FAC_V_CUR_VCV	8	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Correction factor for current feedback VB vs PWM					
IP_FAC_VFF_VCV_MIN	-	0... FFH	0... 9.9609375	0.0390625	-
LDP_TFU_IP_FAC_VFF_VCV_MIN	4	0... FEH	-48... 142.5	0.75	°C
Correction factor for the leakage adaptation					
IP_PWM_VCV_STND	-	0... FFFFH	0... 99.9984741211	1.52588e-3	%
LDP_CUR_VCV_IP_PWM_BAS	6	0... FFFFH	0... 65.535	1e-3	A
Transfer from desired current to standard PWM					
IP_VCV_STATE_CUR_VCV_MAX	-	0... FFFFH	0... 65.535	1e-3	A
LDPM_TCO_ST_1_FUSL	6	0... FEH	-48... 142.5	0.75	°C
CUR signal for VCV in STATE_PWM_VCV = Max					
LC_CUR_VCV_CTL_RST	-	0... 1H	0 ...1	1	-
Switch to reset the VCV current controller					
LC_CUR_VCV_CTL_STOP	-	0... 1H	0 ...1	1	-
Switch to stop the VCV current controller					
LC_CUR_VCV_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual CUR_VCV					
LC_HPP_CTL_AD_CLR	-	0... 1H	0 ...1	1	-
Clearing of adaptation values of high pressure pump control					
LC_PRS_H_ST	-	0... 1H	0 ...1	1	-
Logical constant for selecting the high pressure start					
LC_V_CUR_VCV_BOOT_INI_MAN	-	0... 1H	0 ...1	1	-
Switch to use INI values for current measurement					
LC_VCV_AST_MOVE_ACT_MAN	-	0... 1H	0 ...1	1	-
Logical variable to activate the VCV after engine stop movement without LV_ERR_FUP_STOP					
LC_VCV_ST_CLOSE_TRAN	-	0... 1H	0 ...1	1	-
Logical constant enabling transition from start to close VCV state					

### General information:

The fuel pressure in the rail can be controlled by an volume control valve at the inlet side. Depending on the requested fuel mass to be delivered by the fuel pump the inlet valve to the pump has to be controlled.



```

IF LV_PWL_LOCK_CDN_HPDI(n-1) AND
NOT (LV_PWL_LOCK_CDN_HPDI(n))
THEN ACTION_FCTM_ClrPwlLockCdn(IN <nc_pwl_lock_cdn_hpdi>)
END

```

```

by final calculation of pwm_vcv and frq_req_vcv
ACTION_INFR_SetPwmVcv(IN<ducy>)
ACTION_INFR_SetFrqPwmVcv(IN<frq>)
ELSE call at segment
IF NC_V_CUR_VCV_MES > 0 (Shunt for VCV current is present in ECU)
THEN ACTION_INFR_GetVVcvCurMes(OUT <v_cur_vcv_mes>)
ELSE
END

```

```

by final calculation of pwm_vcv and frq_req_vcv
ACTION_INFR_SetPwmVcv(IN<ducy>)
ACTION_INFR_SetFrqPwmVcv(IN<frq>)
END

```


V\_CUR\_VCV\_MES\_ACTION\_INFR isn't a real input and isn't generated by an other specification. It is only the voltage from the ACTION\_INFR\_GetVVcvCurMes(OUT <v\_cur\_vcv\_mes>)

### Application conditions:

*Initialisation:* RST, NVMINI, NVMRES, NVMSTO  
*Recurrence:* 10MS activated if LV\_ST\_END==0 100MS activated if always SEG activated if LV\_ST\_END==1  
*Activation:* -  
*Deactivation:* never or if activation-condition of other event is true

### Function description:

### Formula section:

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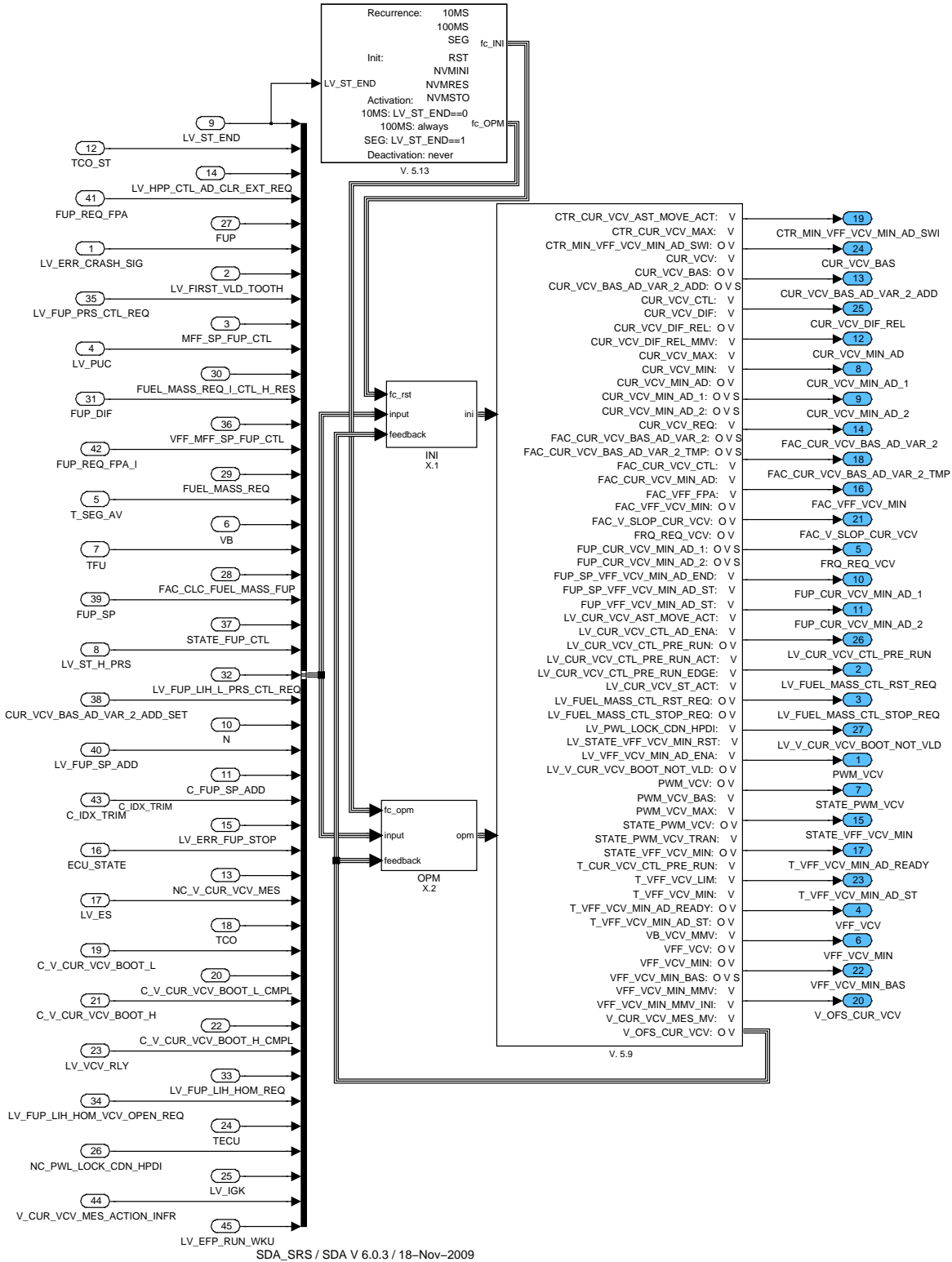


Figure 9.40.2: :

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### 9.40.1 Initialization:

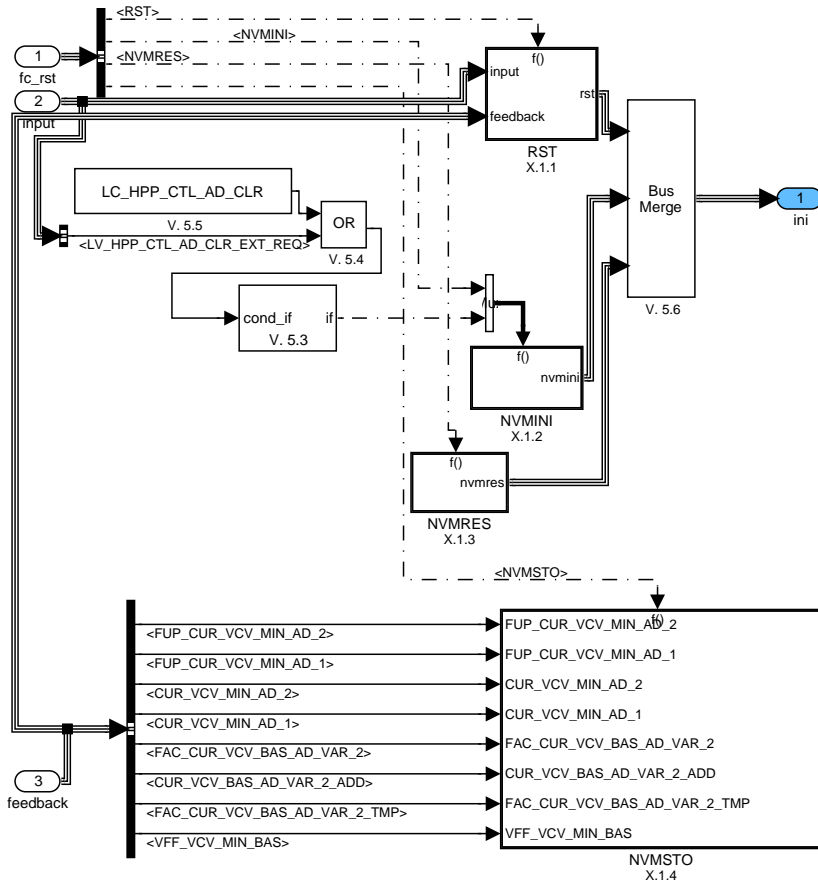


Figure 9.40.3: :

#### 9.40.1.1 Reset

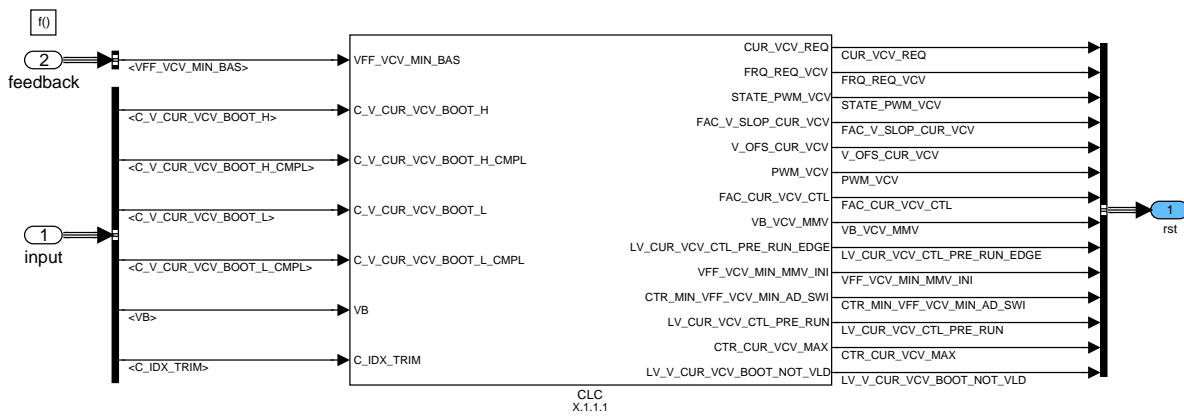
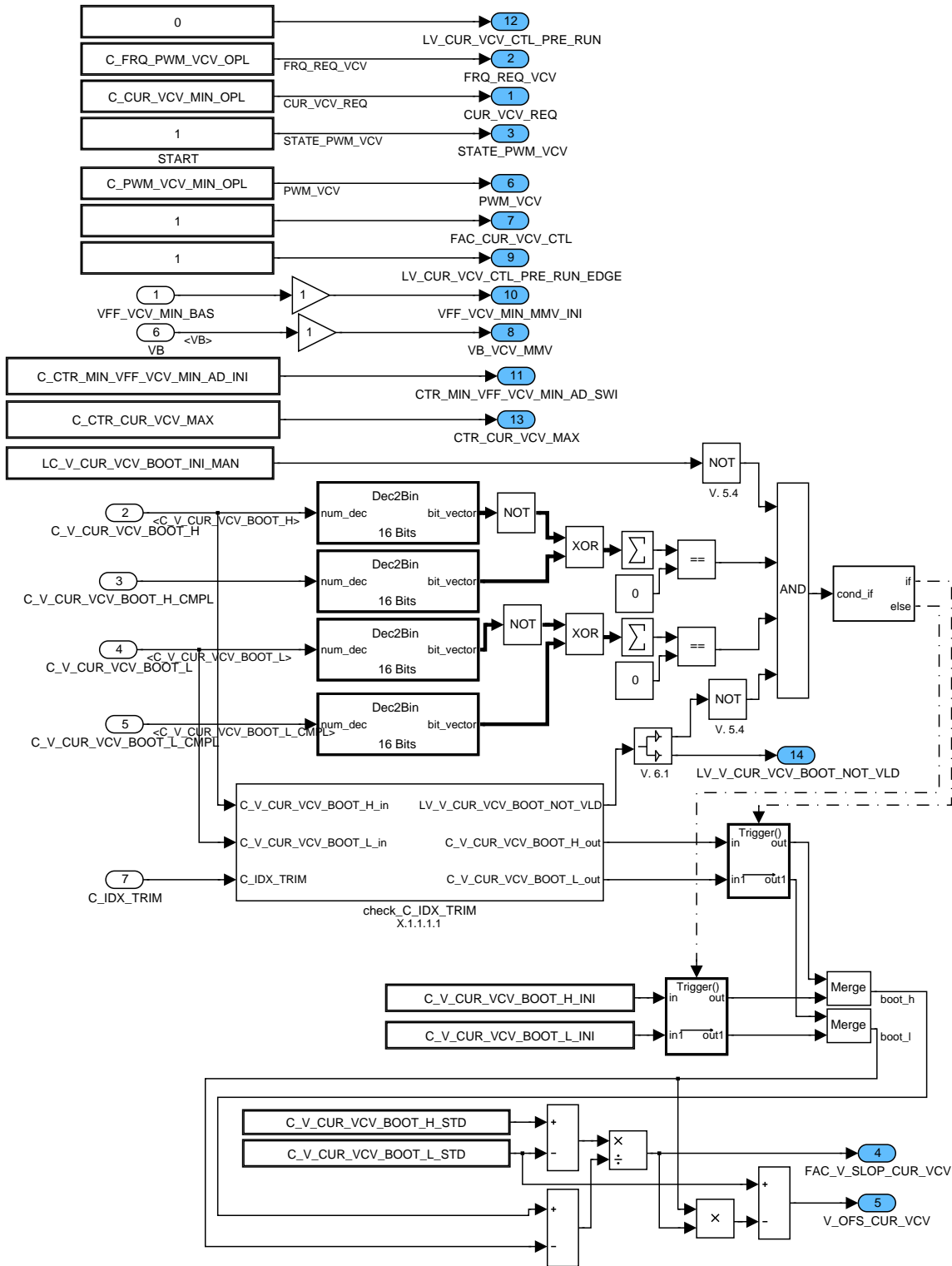


Figure 9.40.4: :

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9.40.1.1.1 Calculation:



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Figure 9.40.5: :



### 9.40.1.1.1.1 Check of C\_IDX\_TRIM and range check

Here the trim-ID is checked additional a range check of the trim values is done. In the case that the trim values are out of a defined range the use of the trim-values is inhibited (via LV\_V\_CUR\_VCV\_BOOT\_NOT\_VLD). Via LV\_V\_CUR\_VCV\_BOOT\_NOT\_VLD also an error entry can be triggered.

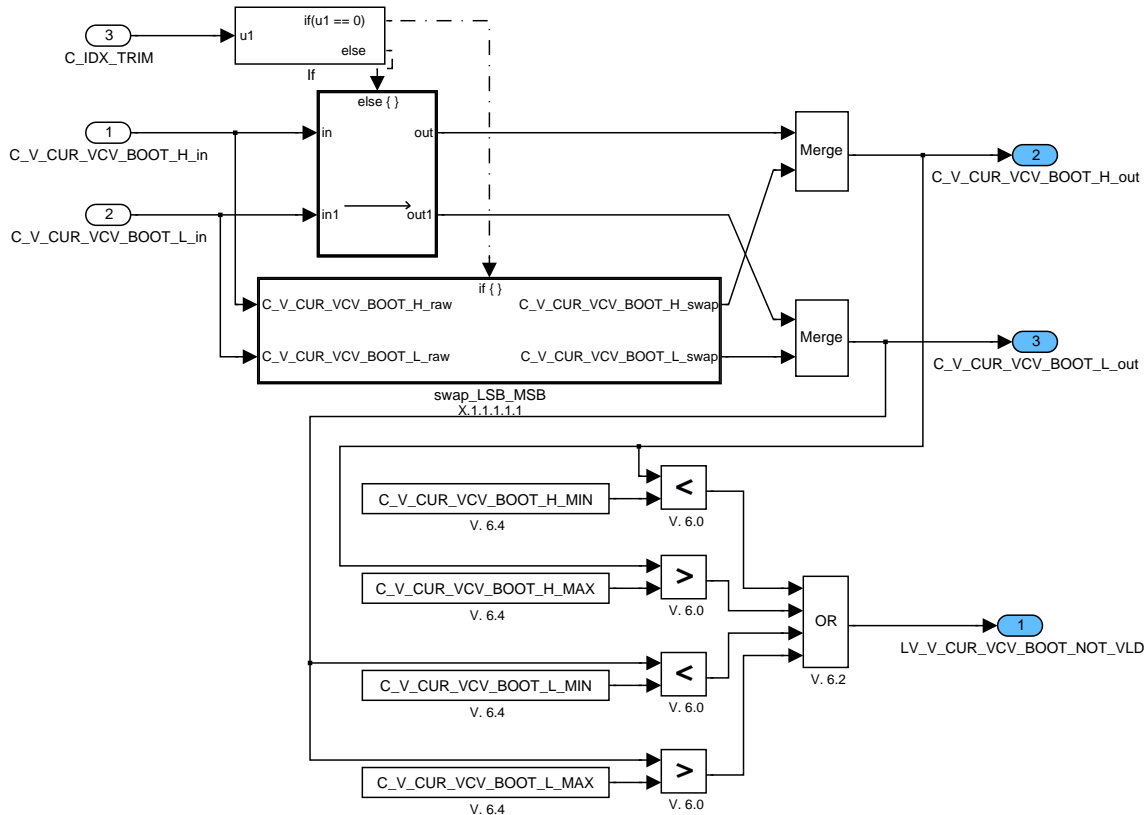


Figure 9.40.6: :

#### 9.40.1.1.1.1.1 Swap of lower and upper bytes

LSB\_MSB\_swap and the Trim ID C\_IDX\_TRIM

C\_V\_CUR\_VCV\_BOOT\_H/L are voltages that are measured during production phase and stored along with their complements in the logistic area. They are the trim values for the volume control valve (VCV) of the high pressure pump. The ASW reads those values during initialisation. The values are stored in HEX-format. For MSD87-6 there are different ways the HEX values are stored (order of MostSignificantByte/LeastSignificantByte). To distinguish the different HEX-conventions used during trim process a trim ID was introduced. It has the label name C\_IDX\_TRIM.

Example:

analog voltages are digitised

3,1061V=20356digits

(hint: HexValue 4F84 in Microsoft- Windows Calculator;

the value which is stored in the logistic area in the MSD80 project is 844F)

the value which is stored in the logistic area in the MSD87-6 project differs depending on the Trim ID C\_IDX\_TRIM

ECUs with TrimmID 0 use the format 4F84

ECUs with TrimmID 1 use the format 844F

The ASW has to take care of the LSB/MSB\_order of the HEX values when it reads them back. LSB/MSB need to be swapped or not, depending on the trimID. Complement values use the same format as the trim values that is why the LSB\_MSB swap has only to be done for the calculation in the formula section.

see also 'logistic concept for production line test'

Trim\_VCV order:

0x00 =

(only sample production)

adr. n = MSB,

adr (n+1)=LSB

0x01 =

(serial production)

adr. n = LSB,

adr (n+1)=MSB

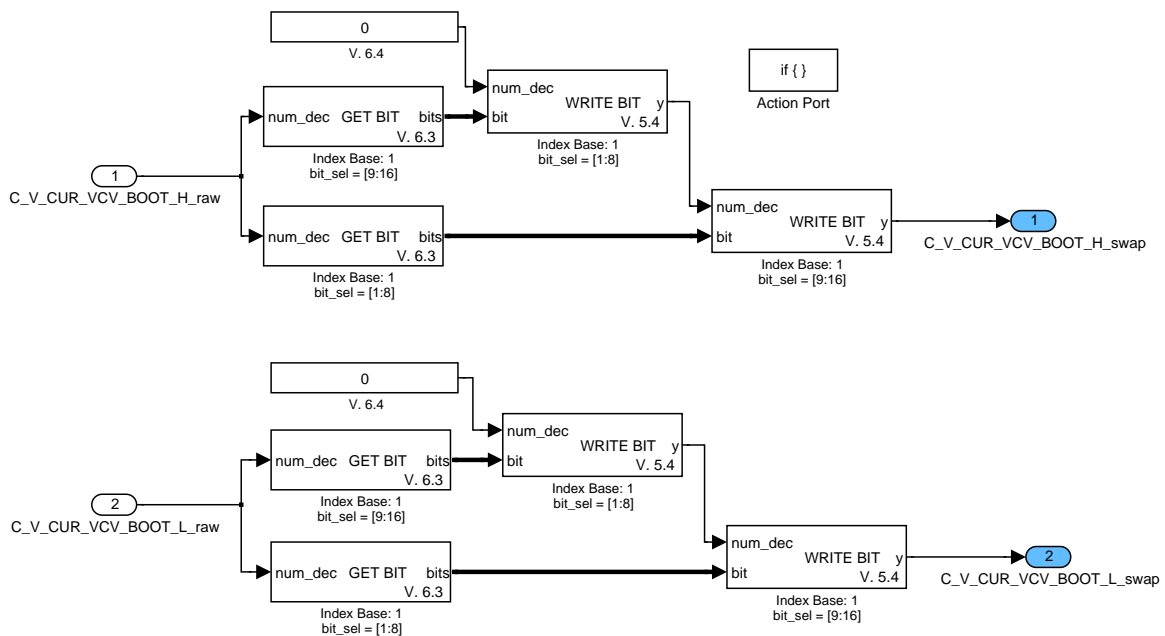


Figure 9.40.7: :

### 9.40.1.2 NVMY Initialization:

Please note: the Constant blocks that have been terminated are to indicate the init values of the variables at NVMY initialisation.

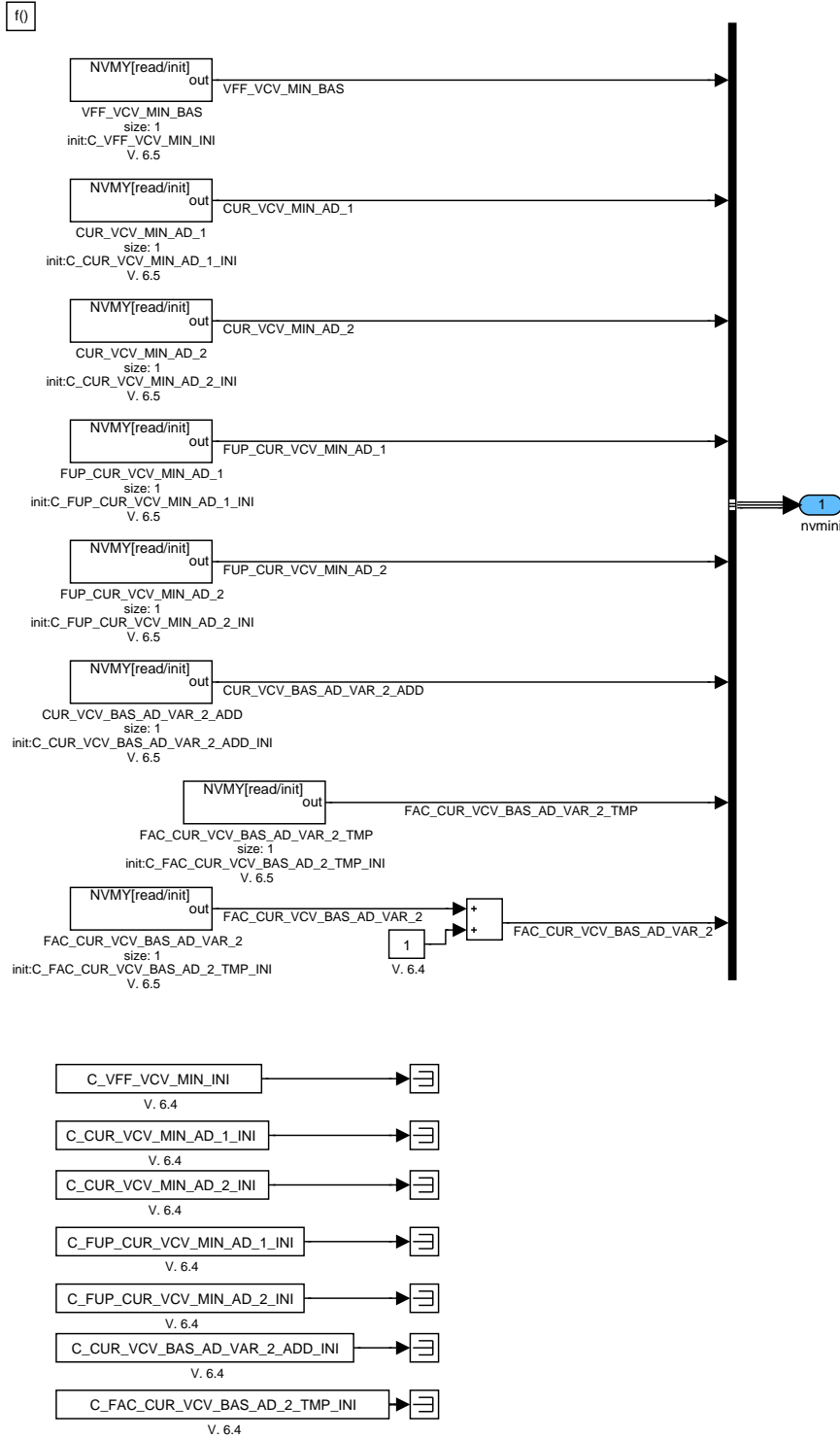


Figure 9.40.8: :

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### 9.40.1.3 NVMY Restore

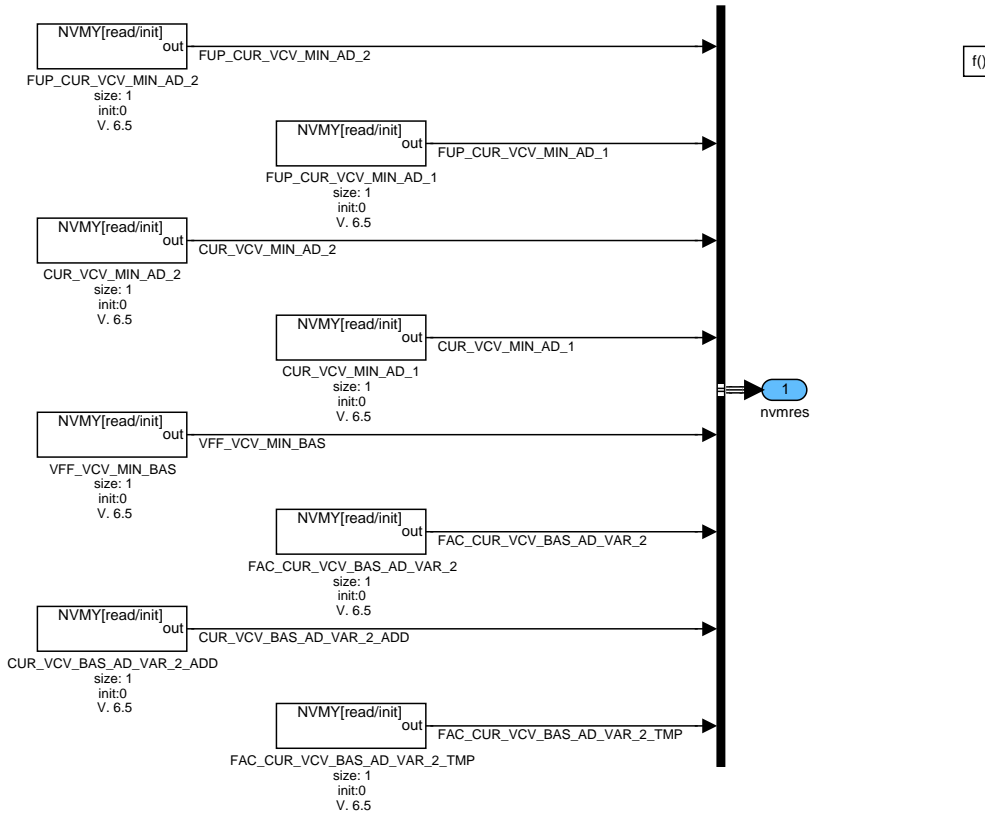



Figure 9.40.9: :

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### 9.40.1.4 NVMY Store

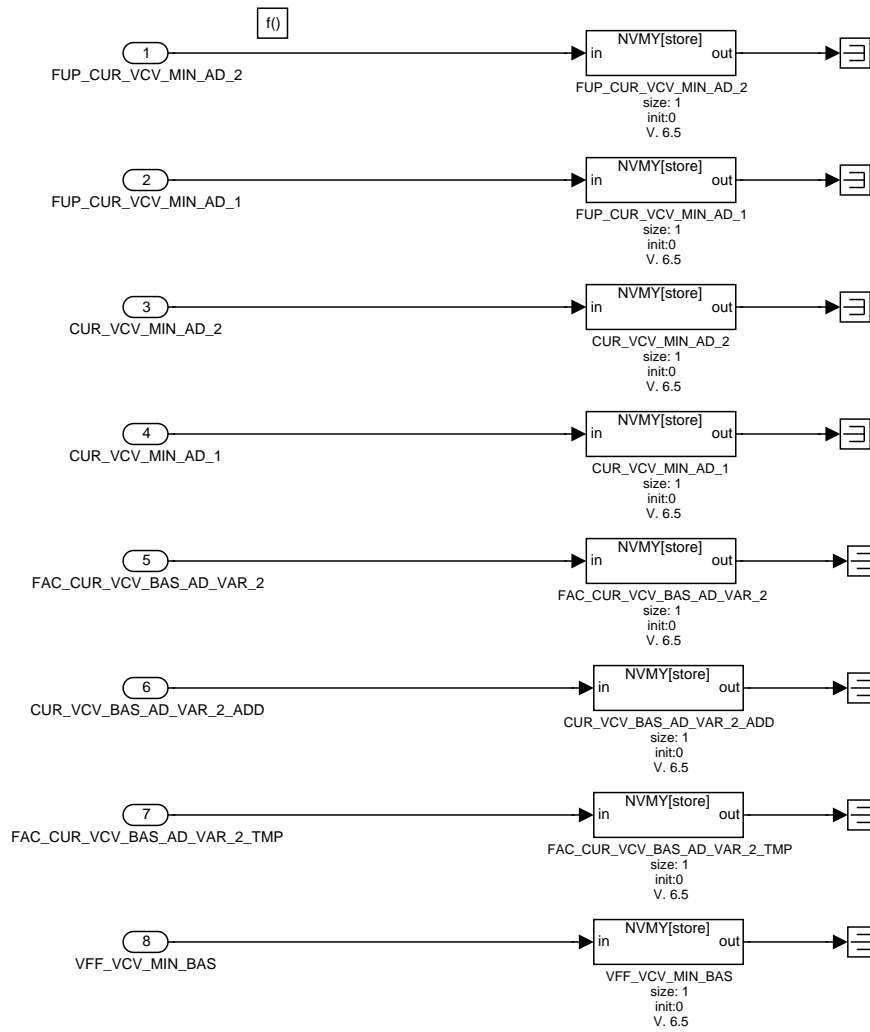


Figure 9.40.10: :

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### 9.40.2 Formula Section

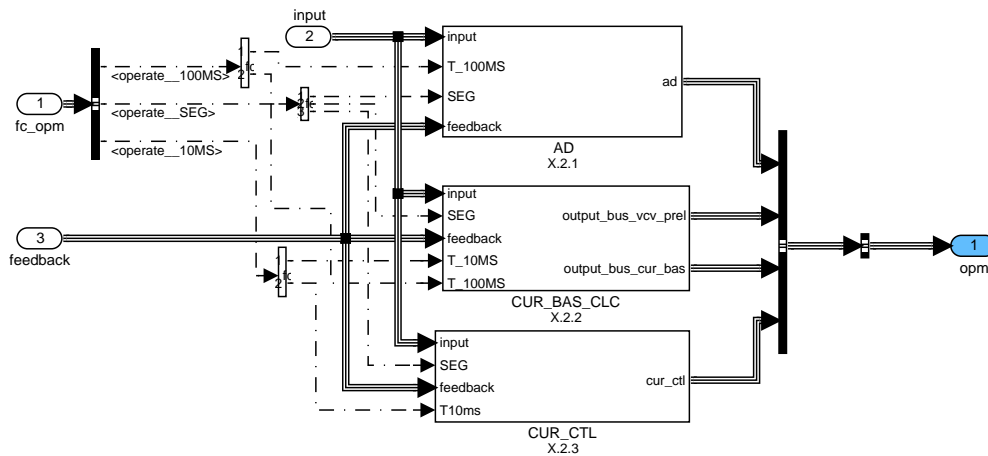


Figure 9.40.11: :

#### 9.40.2.1 Adaptation

This function part provides the adaptation values of the VCV.

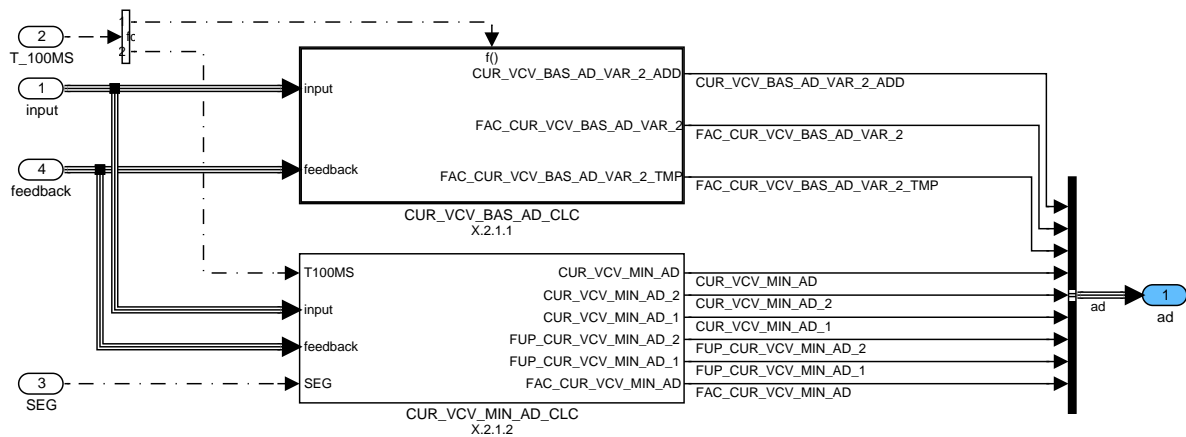


Figure 9.40.12: :

##### 9.40.2.1.1 Adaptation of valve characteristics:

In this block the factor of the second variant of the VCV\_BAS adaptation is calculated.

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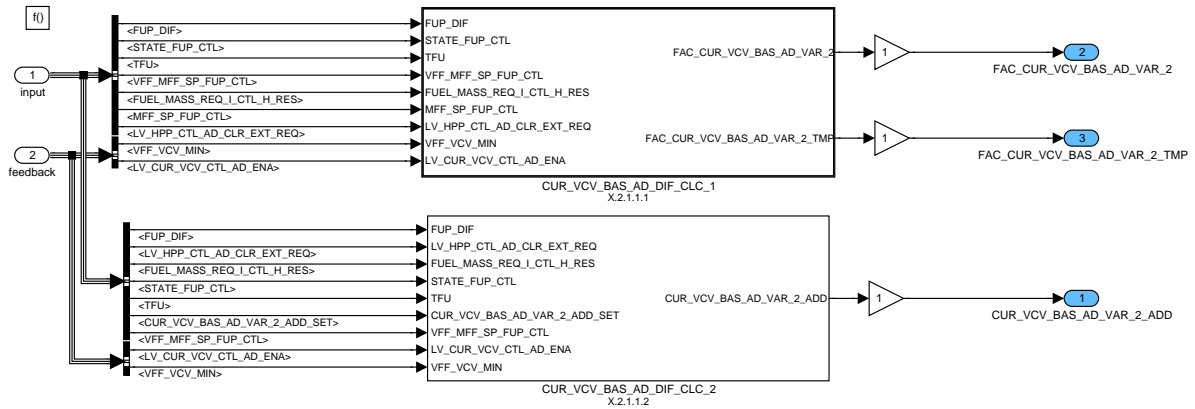


Figure 9.40.13: :

### 9.40.2.1.1.1 Additive component calculation

In this block the additive component of the second variant of the VCV\_BAS adaptation is calculated.

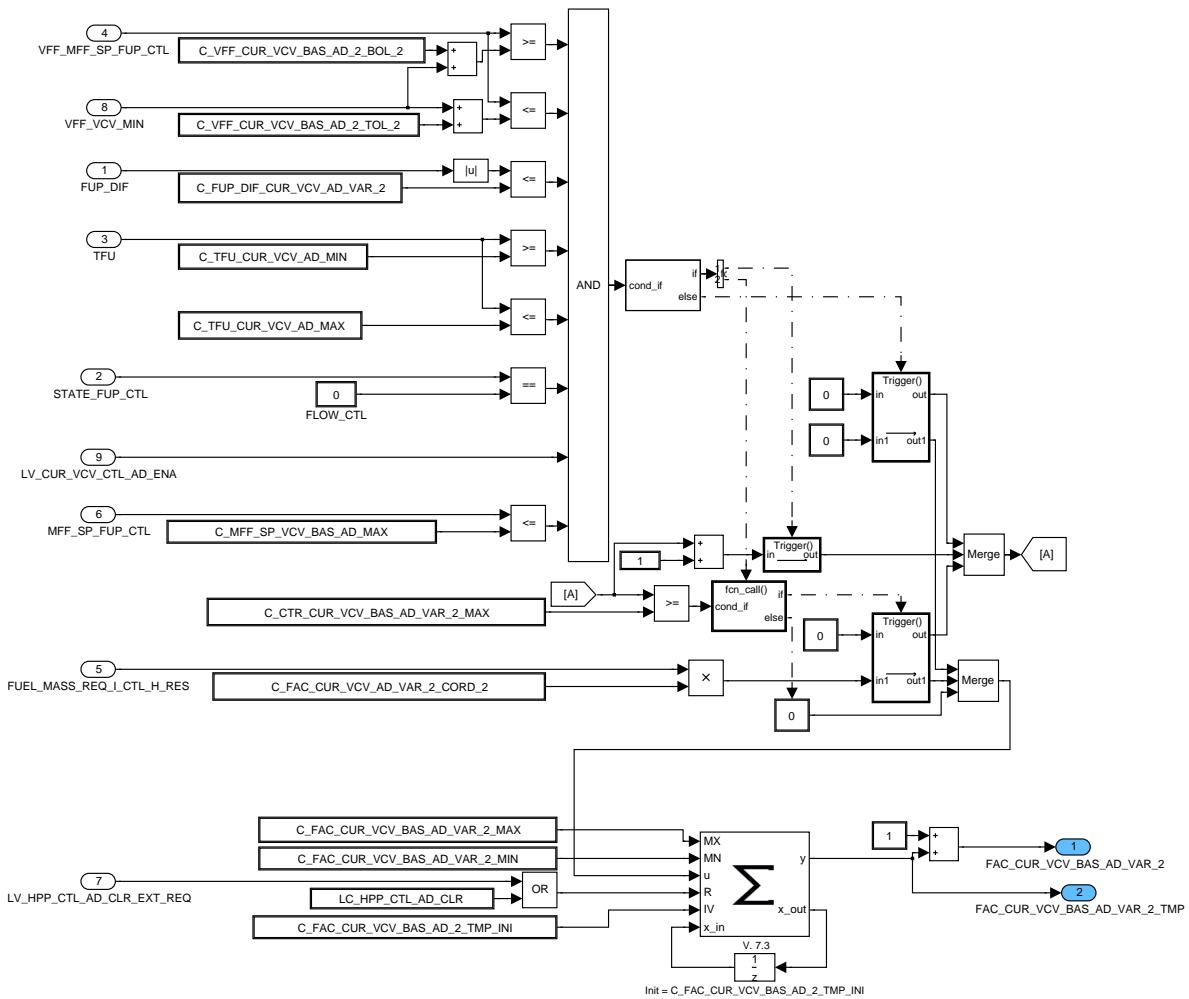


Figure 9.40.14: :

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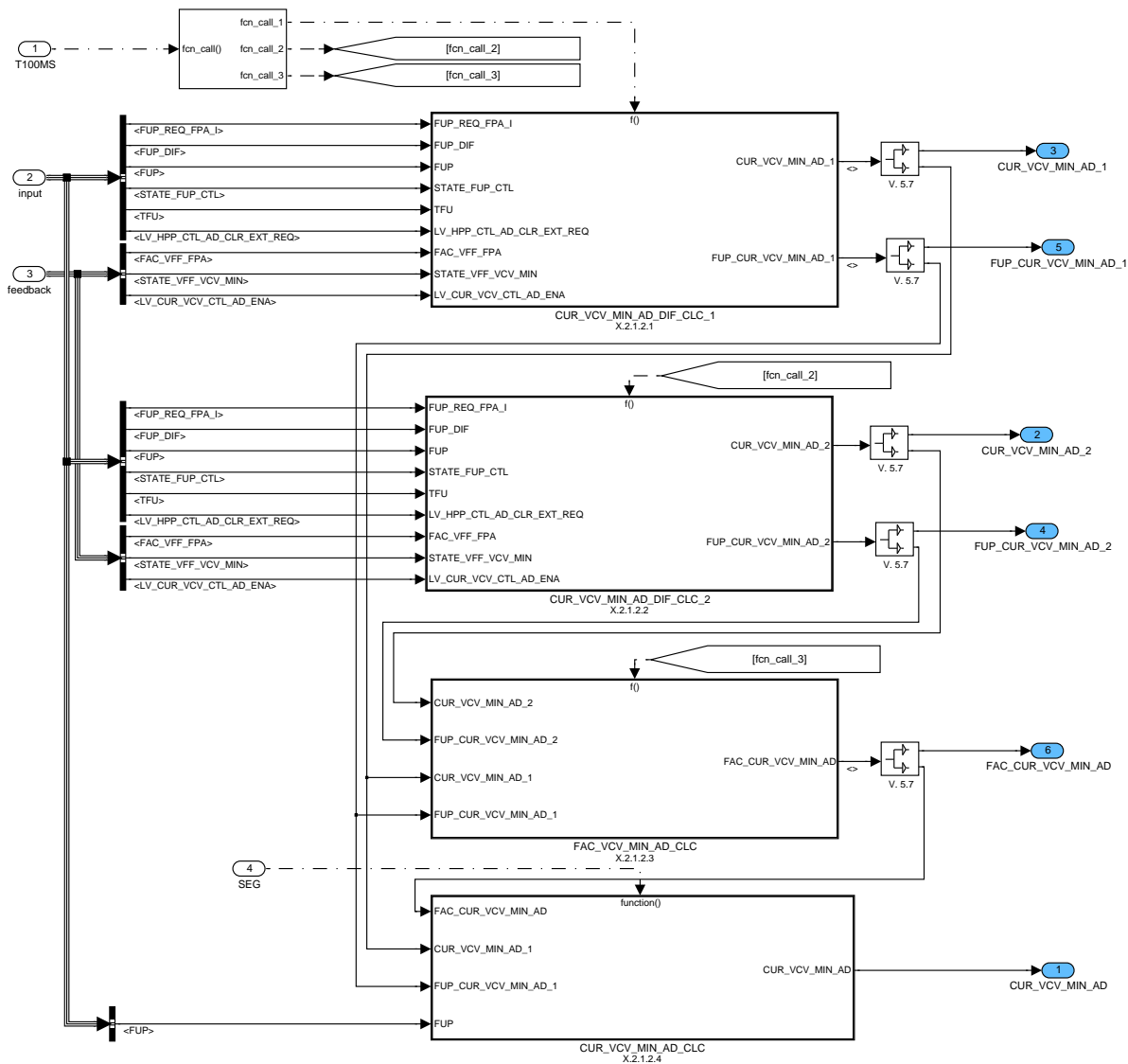


Figure 9.40.16: :

### 9.40.2.1.2.1 Adaptation of point 2 of pressure control line

The calculation of the first point of the adaptation of the pressure control line is consisting out of a MMV calculation of the flow and the corresponding state chart

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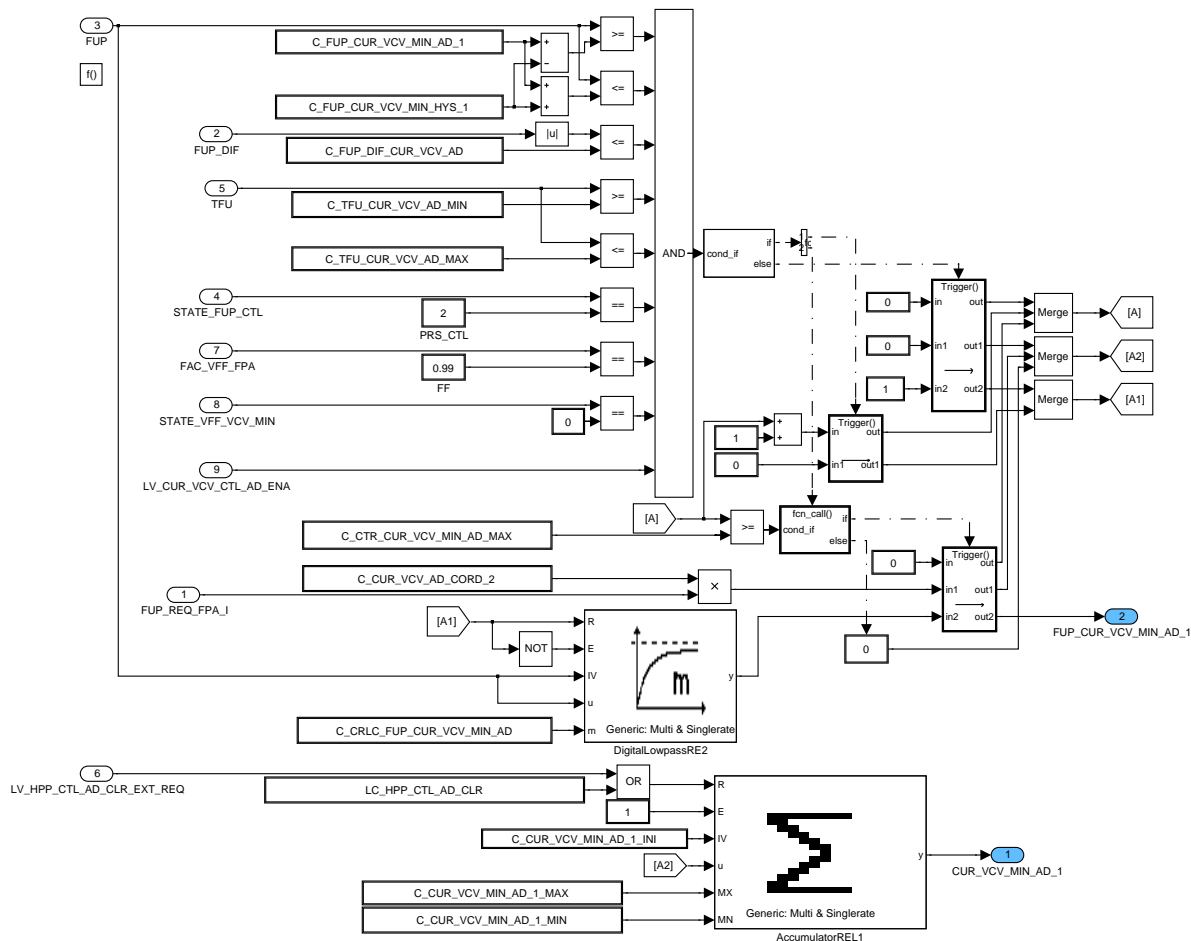


Figure 9.40.17 :

9.40.2.1.2.2 Calculation of point 1 of pressure control line

The calculation of the second point of the adaptation of the pressure control line is consisting out of a MMV calculation of the flow and the corresponding state chart.

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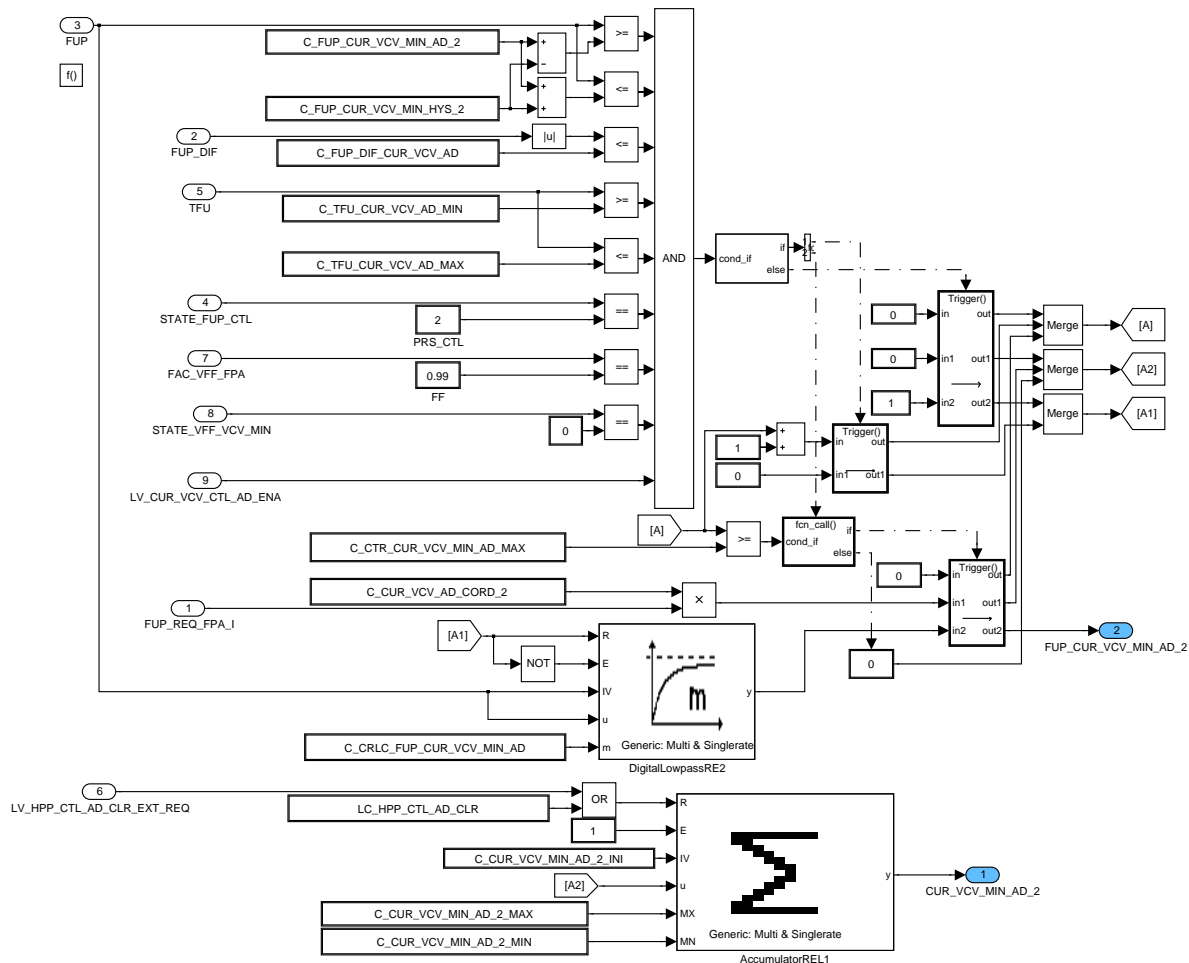


Figure 9.40.18: :

### 9.40.2.1.2.3 Calculation of the slope of the pressure control line

In this block the slope for the correction of the pressure control part of the valve is calculated.

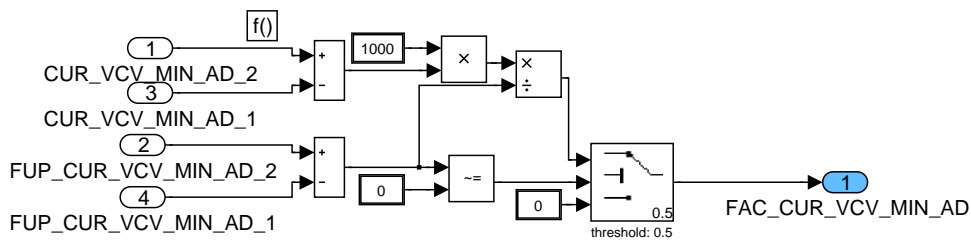


Figure 9.40.19: :

### 9.40.2.1.2.4 Calculation of the final pressure control line adaptation value

The final adaptation value for the pressure control part of the valve is calculated in that block.

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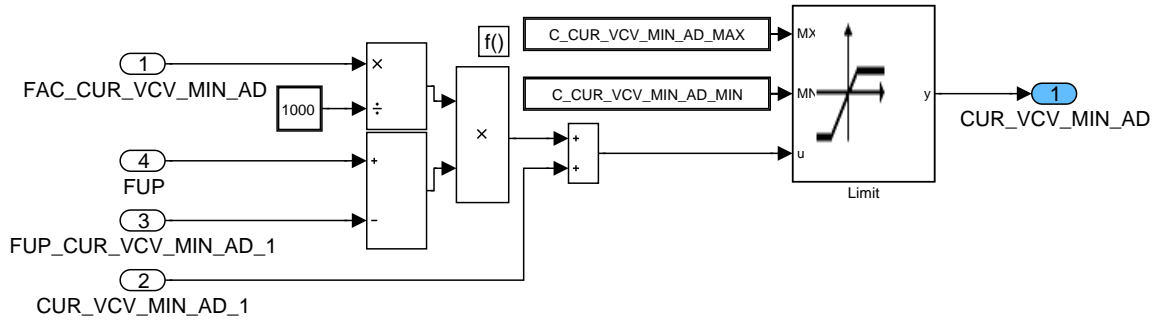


Figure 9.40.20 :

### 9.40.2.2 Basic VCV Current Calculation

Overview of basic VCV current calculation. This function part provides the desired VCV current.

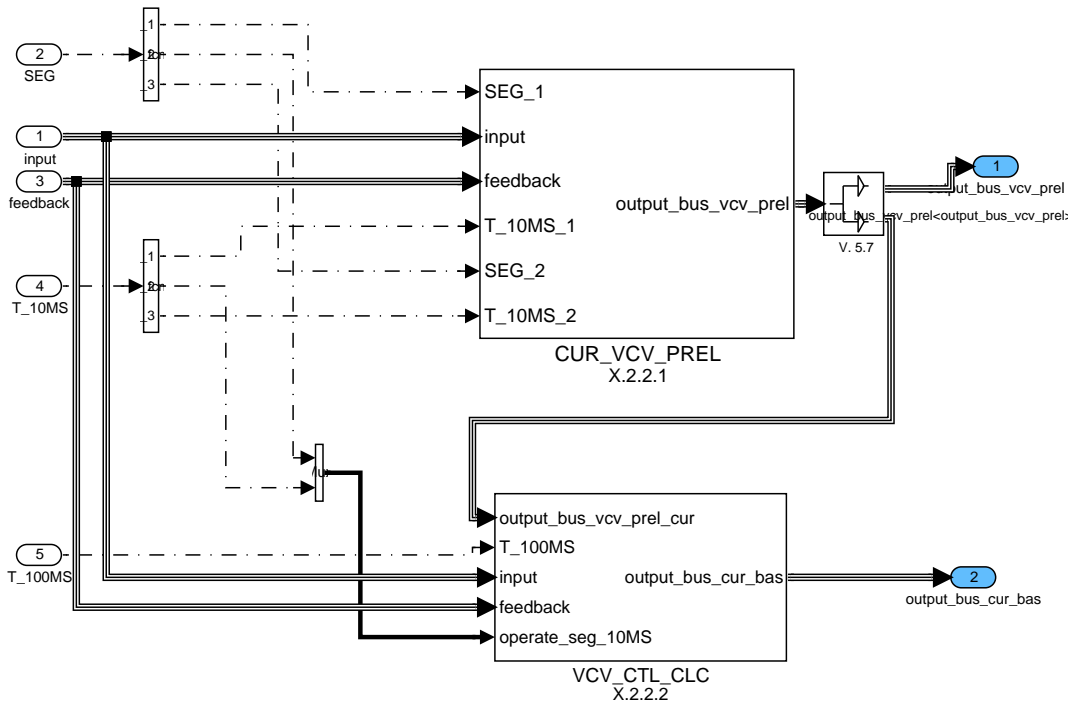


Figure 9.40.21 :

#### 9.40.2.2.1 Calculation of the basic fuel flows through the valve

The requested volume fuel flow through the volume control valve is calculated by the requested fuel mass and a conversion calculation taken into account the segment time and the density of the fuel. The real pumped fuel flow volume is calculated out of the calculated pump fuel mass.

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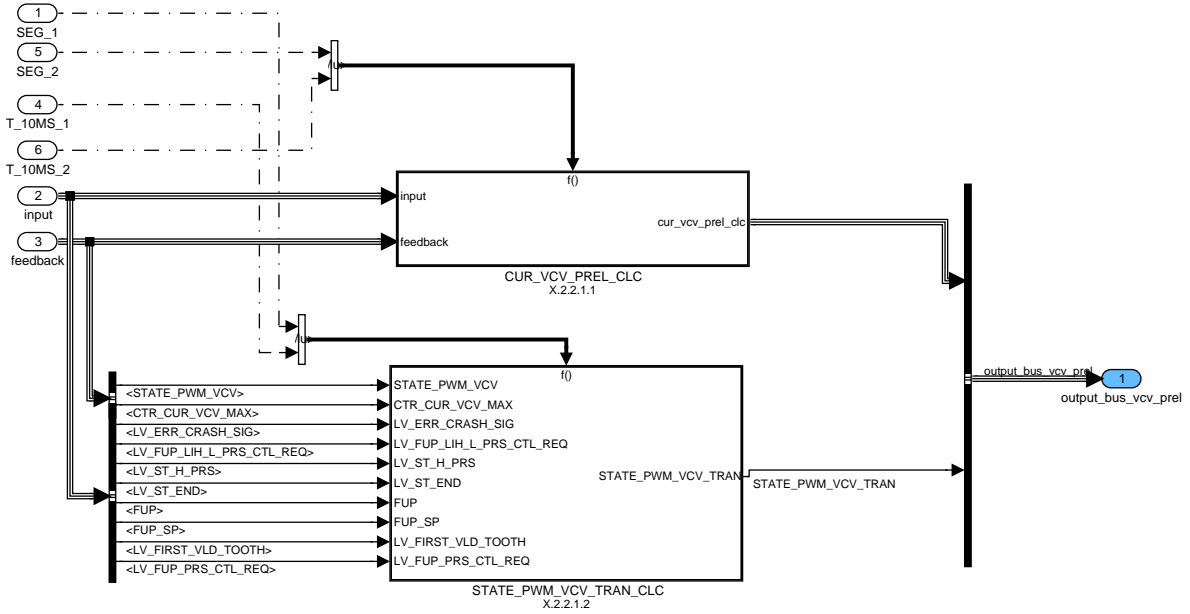


Figure 9.40.22: :

### 9.40.2.2.1.1 CUR\_VCV\_PREL\_CLC

This part has been divided into 3 parts

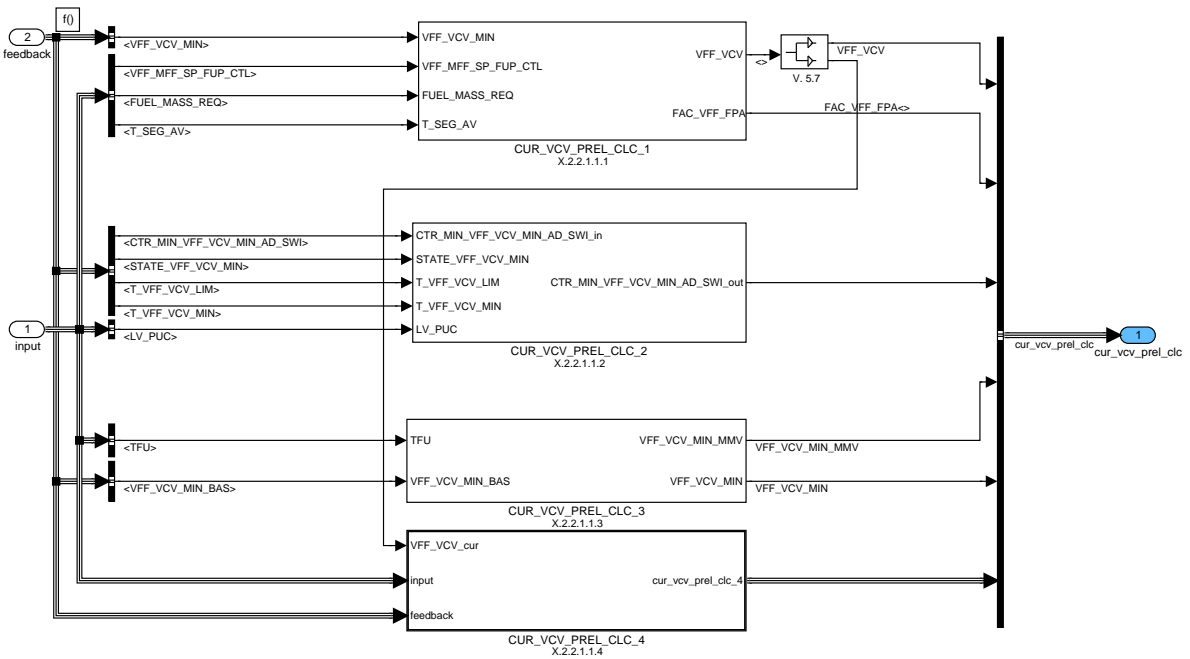


Figure 9.40.23: :

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9.40.2.2.1.1.1 CUR\_VCV\_PREL\_CLC\_1

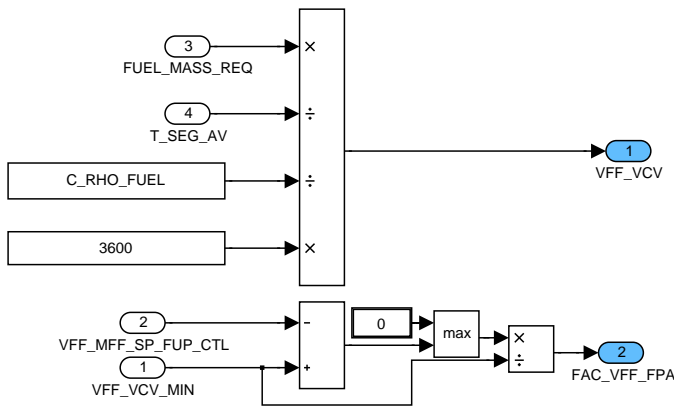


Figure 9.40.24: :

9.40.2.2.1.1.2 CUR\_VCV\_PREL\_CLC\_2

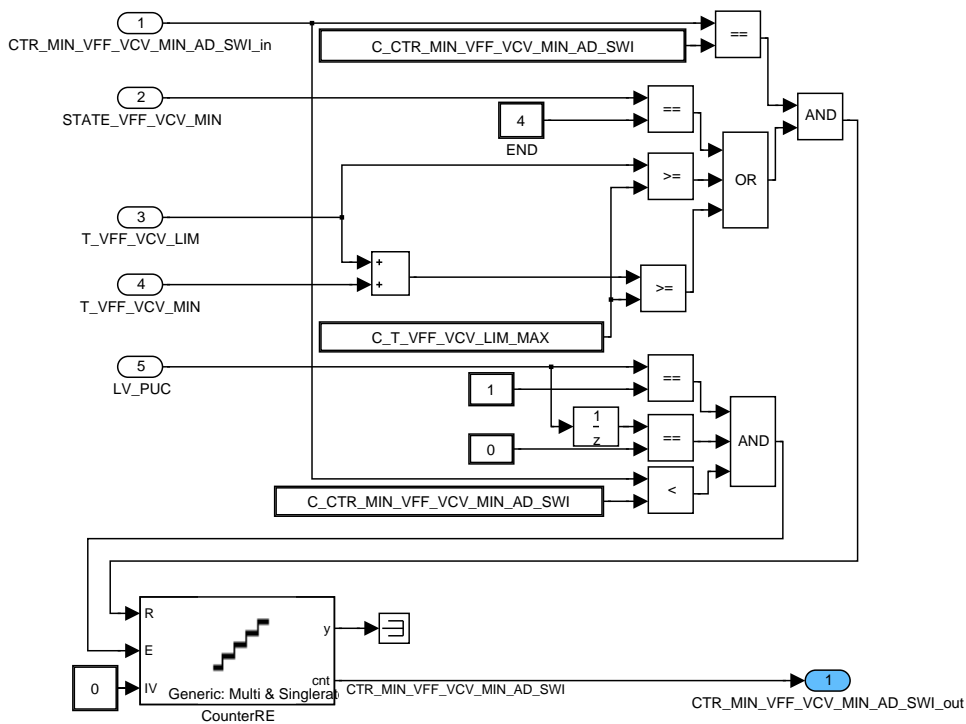


Figure 9.40.25: :

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open. Manual operation can be selected by a flag. If none of the above mentioned cases are valid the normal operation mode can be done.

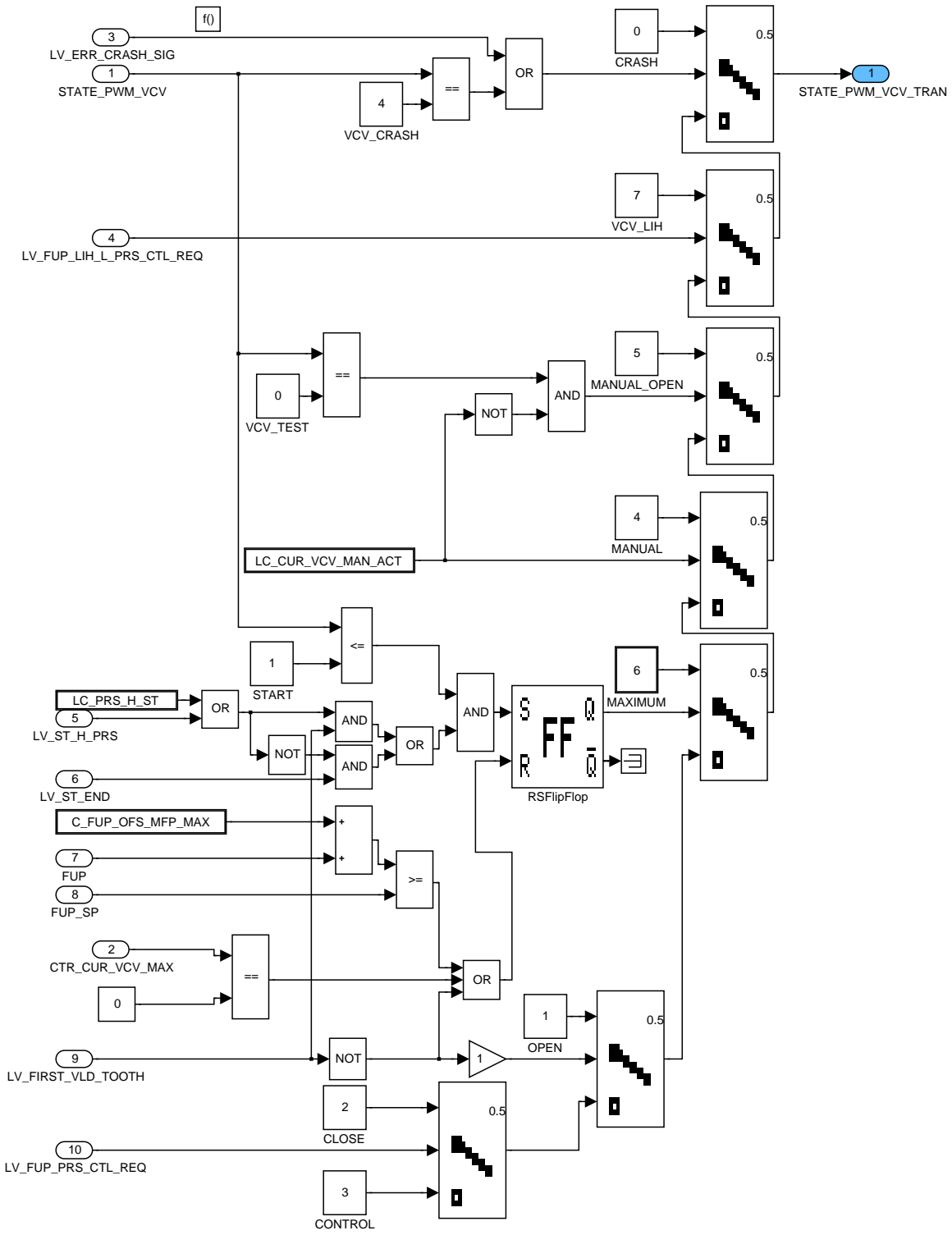


Figure 9.40.29: :

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### 9.40.2.2.2 Final calculation of the output signals

In the state diagram the states are set corresponding to the transition conditions defined before. Out of the conditions the PWM can be calculated with the two blocks following the state diagram.

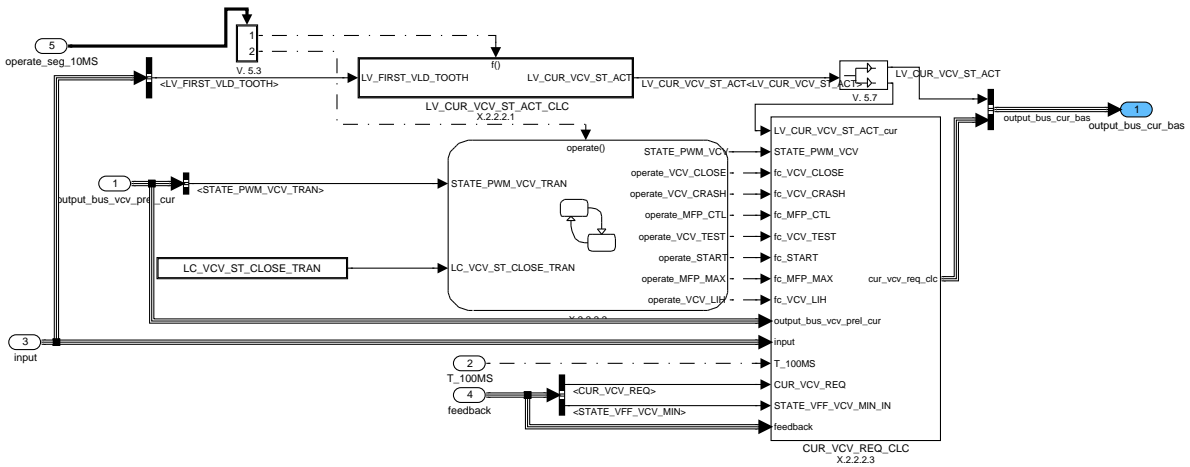


Figure 9.40.30: :

#### 9.40.2.2.2.1 Calculation of LV\_CUR\_VCV\_ST\_ACT\_CLC

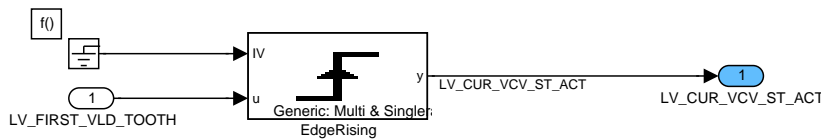


Figure 9.40.31: :

#### 9.40.2.2.2.2 Chart1

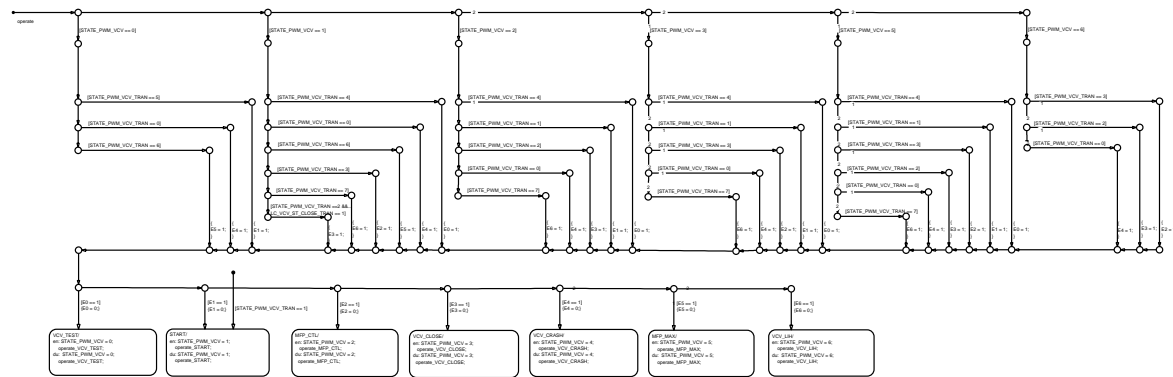


Figure 9.40.32: :

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### 9.40.2.2.3 Calculation of CUR\_VCV\_REQ\_CLC

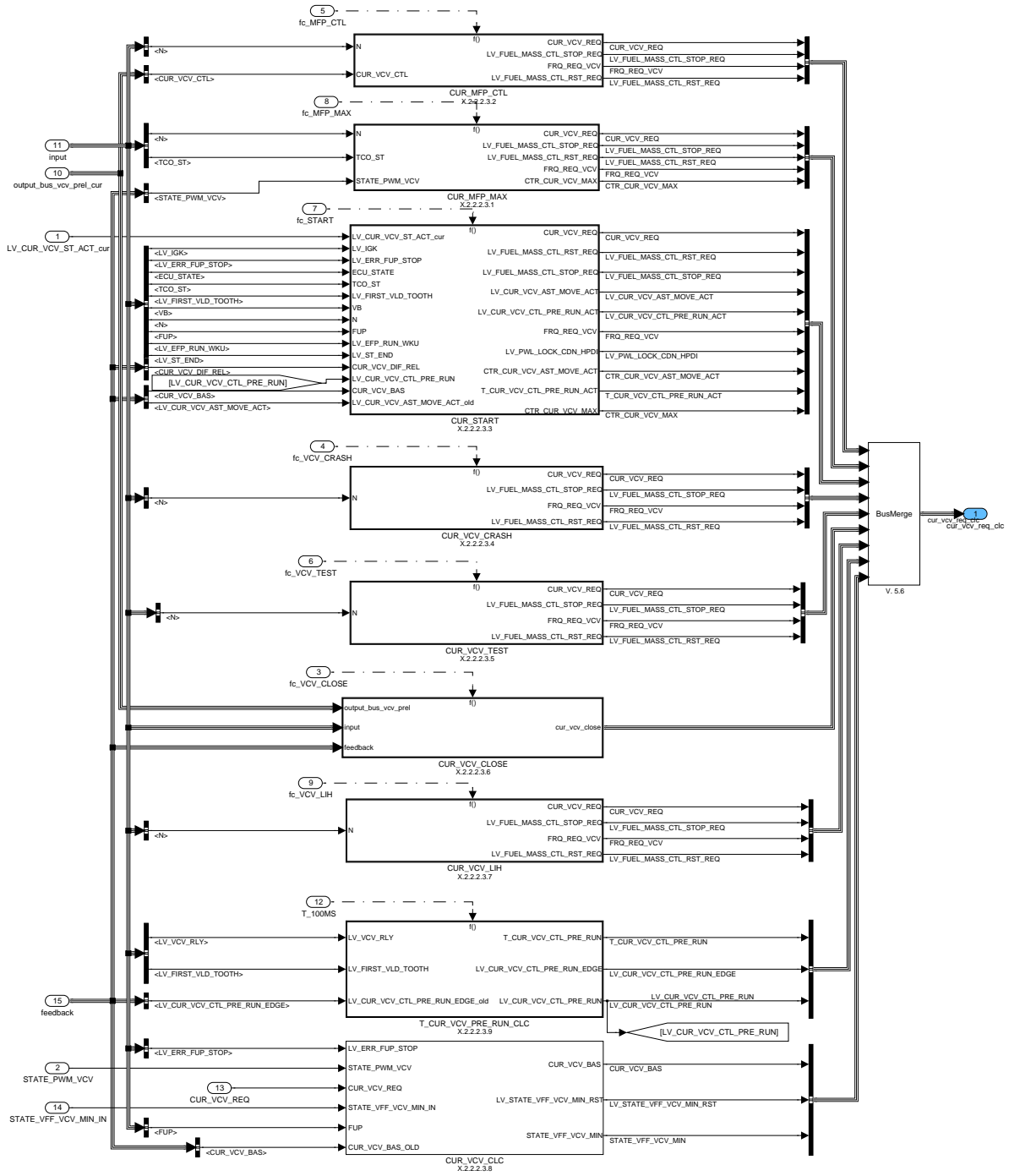


Figure 9.40.33: :

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9.40.2.2.2.3.1 CUR\_MFP\_MAX

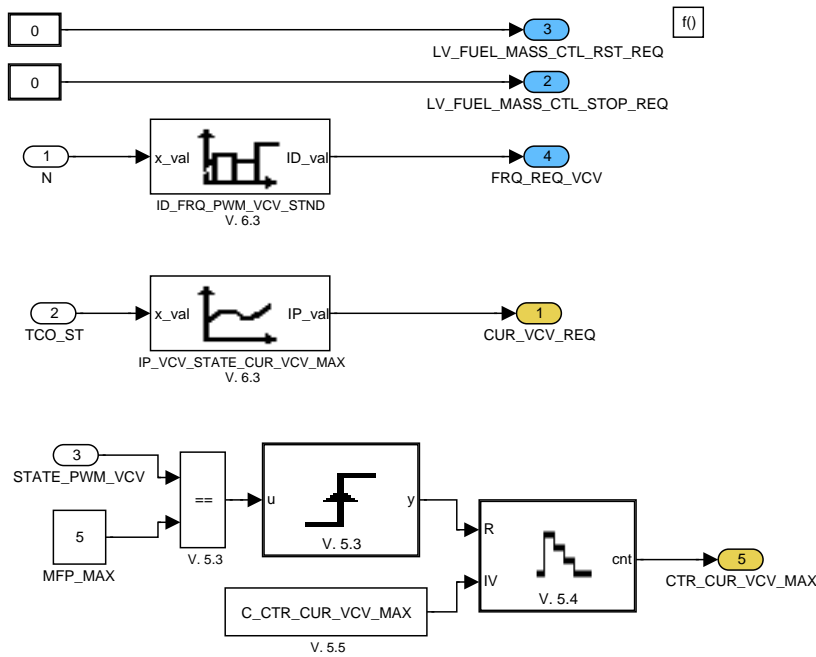


Figure 9.40.34: :

9.40.2.2.2.3.2 CUR\_MFP\_CTL

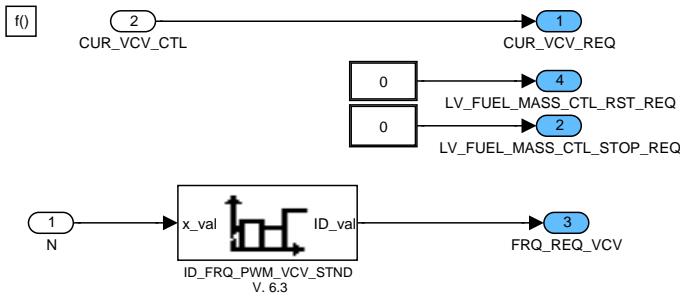


Figure 9.40.35: :

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9.40.2.2.2.3.3 CUR\_START

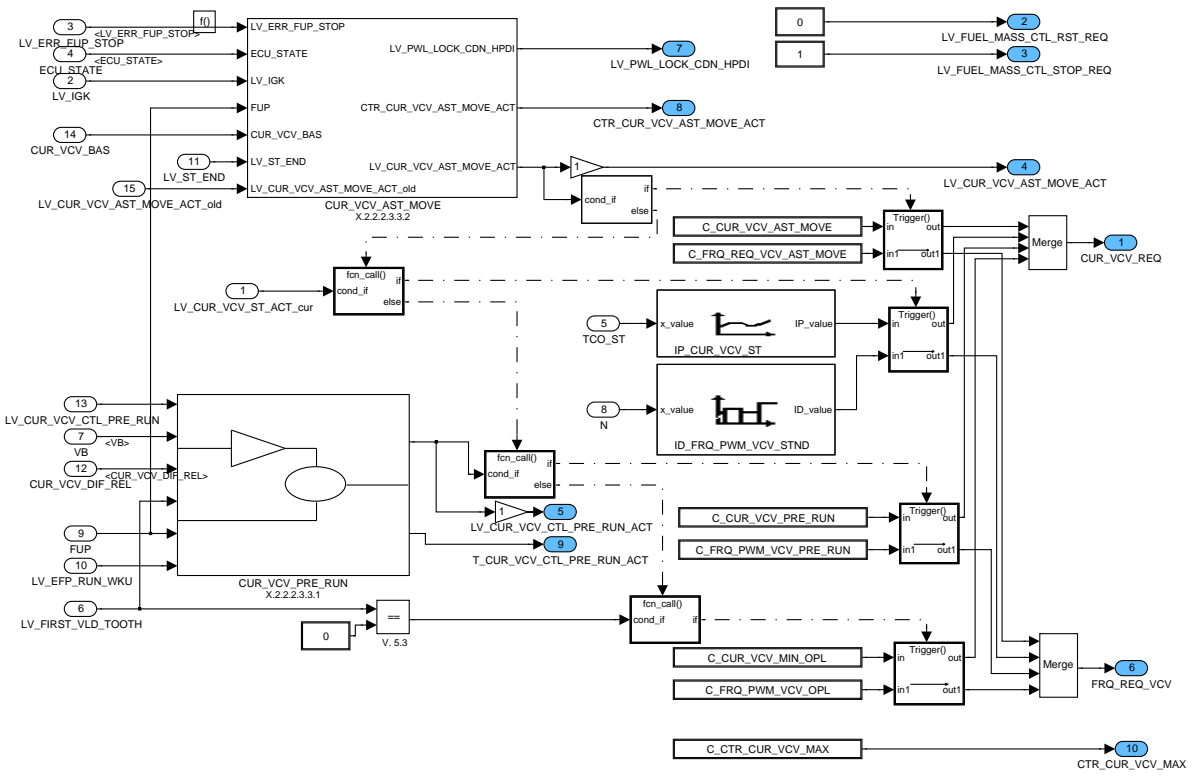


Figure 9.40.36: :

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9.40.2.2.2.3.1 Calculation of LV\_CUR\_VCV\_CTL\_PRE\_RUN\_ACT

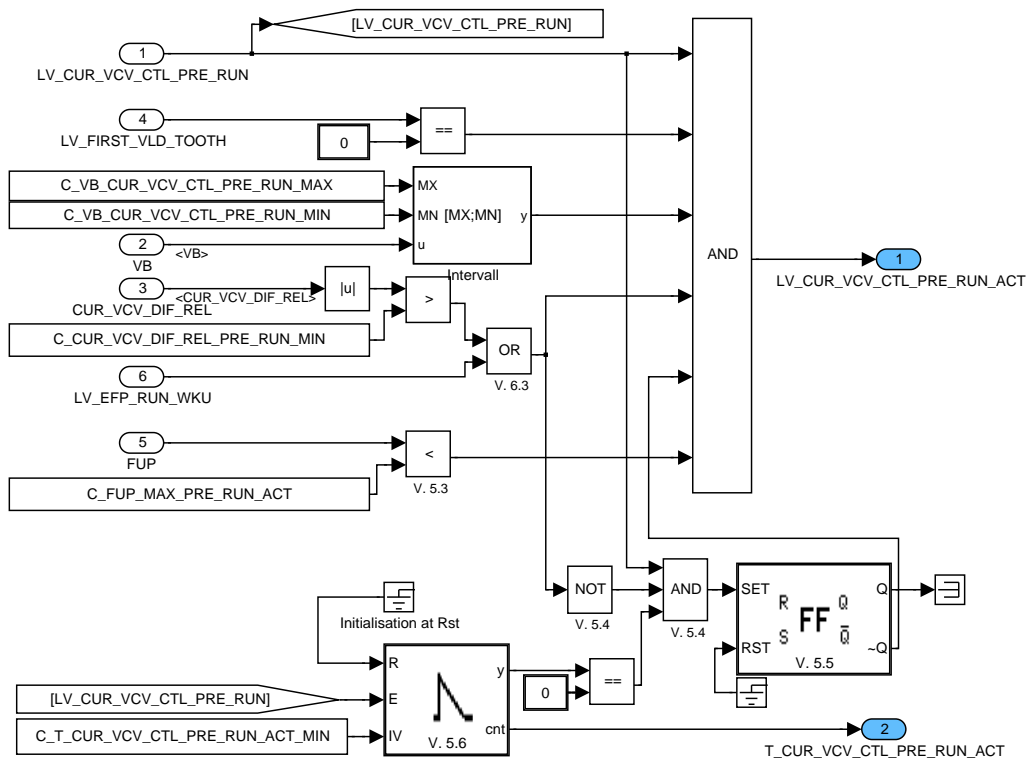


Figure 9.40.37: :

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9.40.2.2.3.3.2 Movement of VCV after engine stop.

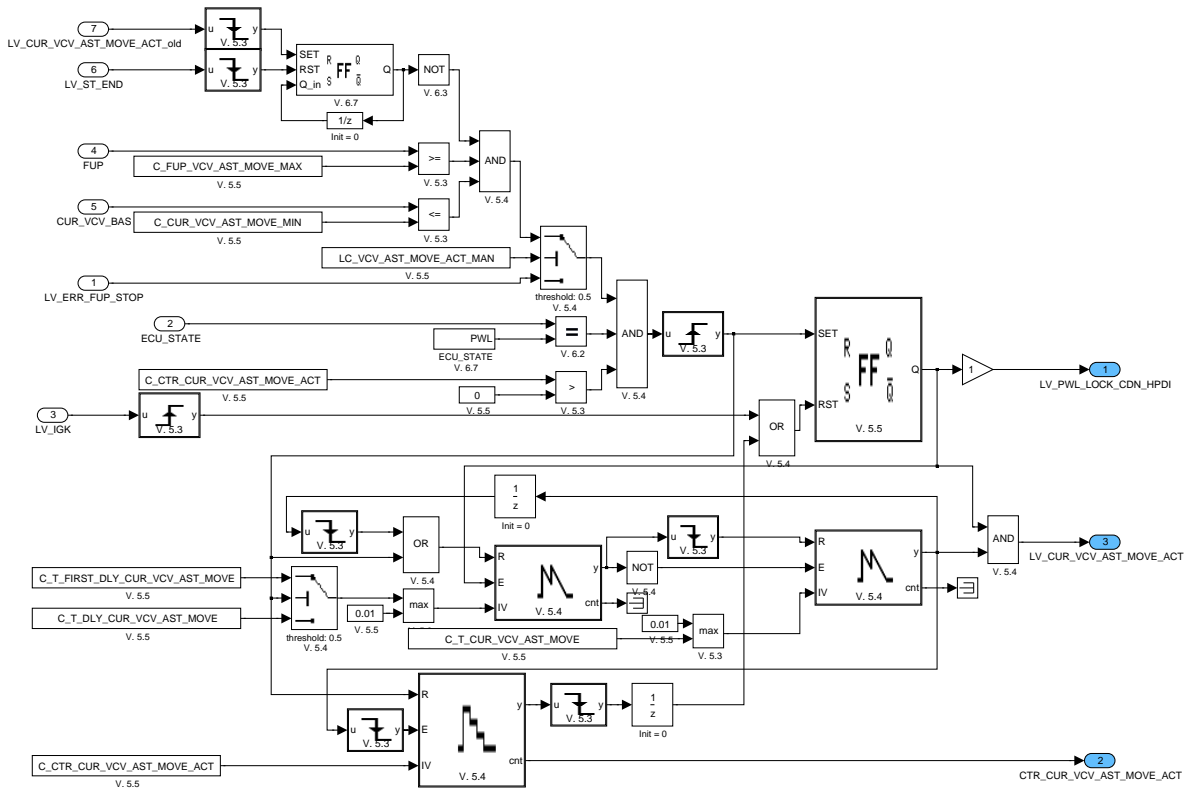


Figure 9.40.38: :

9.40.2.2.3.4 CUR\_VCV\_CRASH

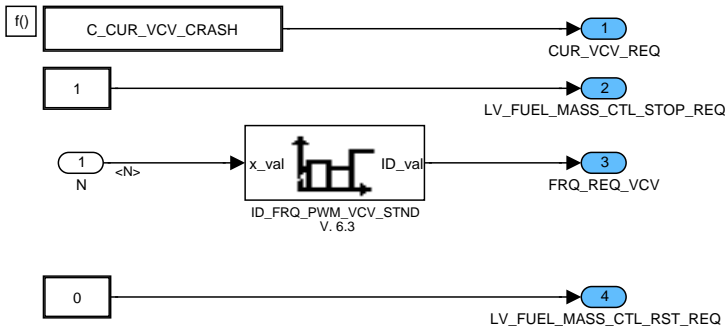


Figure 9.40.39: :

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9.40.2.2.2.3.5 CUR\_VCV\_TEST

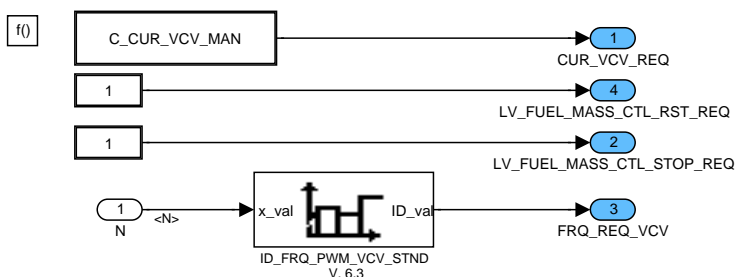


Figure 9.40.40: :

9.40.2.2.2.3.6 Leakage adaptation in the state 'close'

The minimum flow through the VCV can be adapted by the following principle.

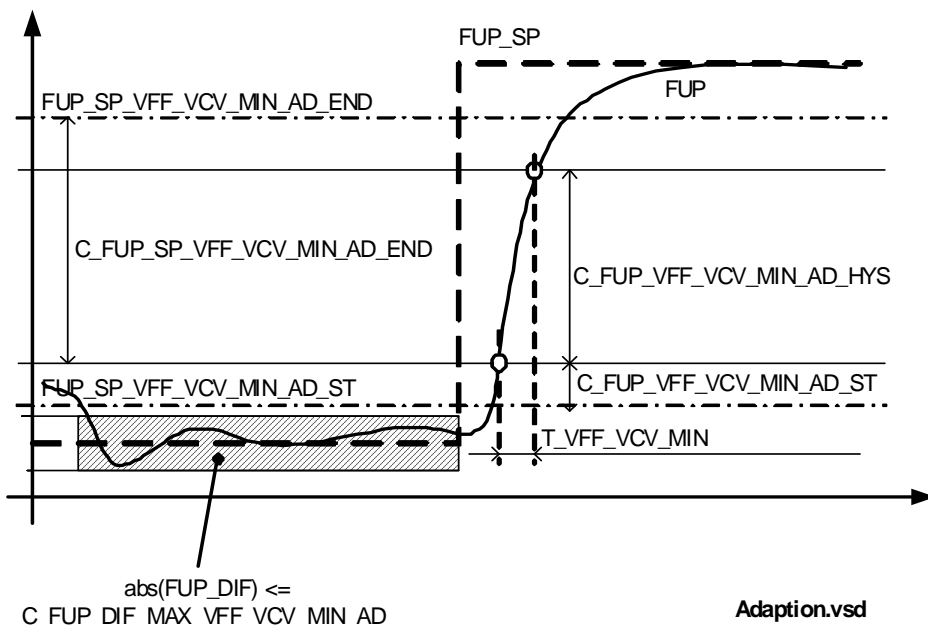


Figure 9.40.41: :

! The internal value of VFF\_VCV\_MIN\_BAS digital lowpass filter has to be initialised by VFF\_VCV\_MIN\_BAS value at reset.

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 3991 of 8404	
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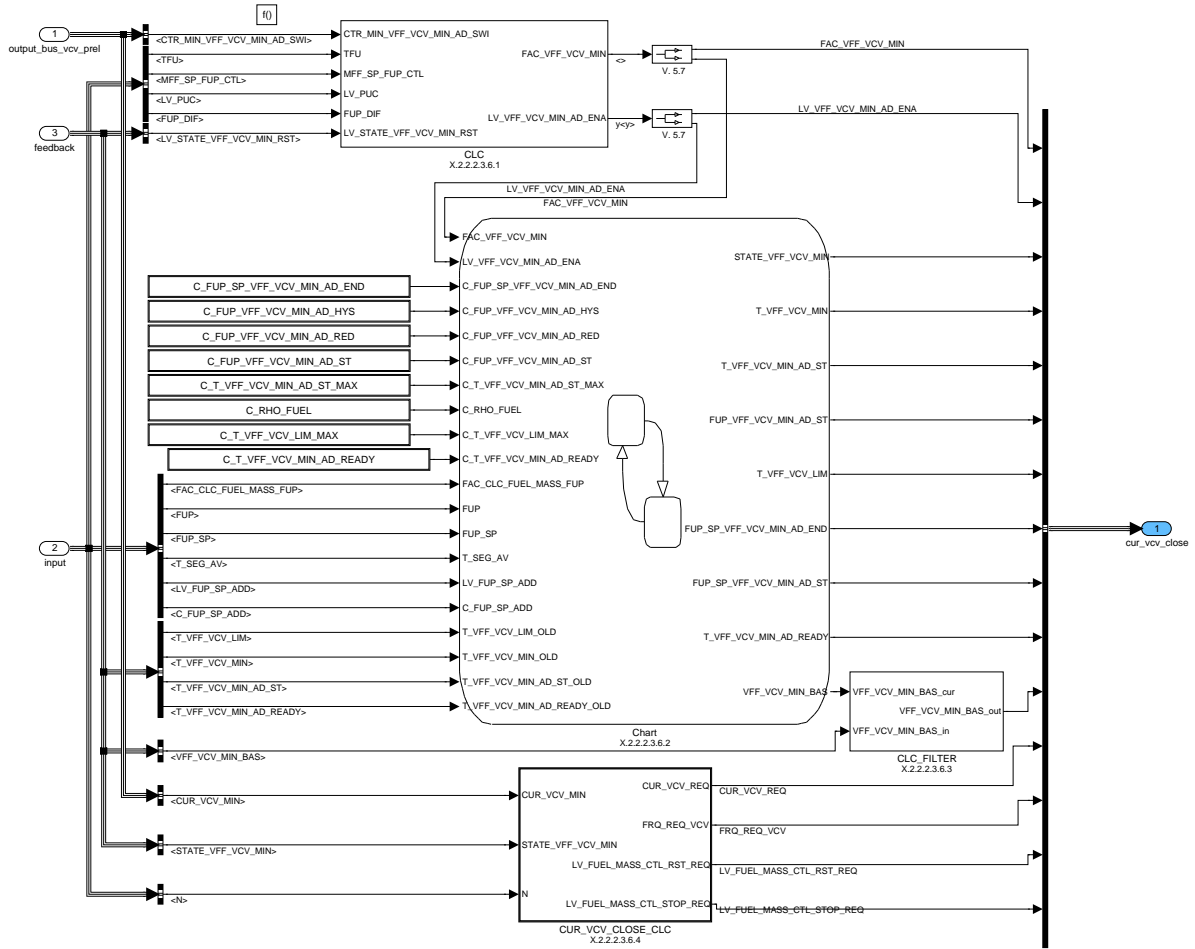



Figure 9.40.42: :

**9.40.2.2.3.6.1 FUSL\_M904B/OPM/CUR\_BAS\_CLC/VCV\_CTL\_CLC/CUR\_VCV\_REQ\_CLC/CUR\_VCV\_CLOSE/CLC**

**CONTENT**

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 3992 of 8404	
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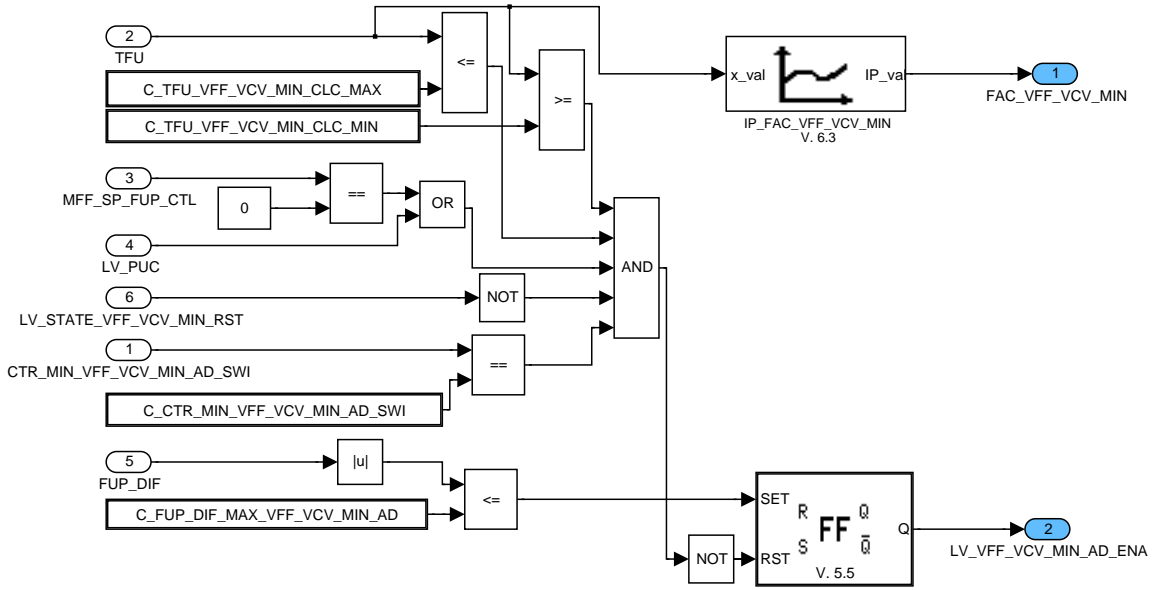


Figure 9.40.43: :

9.40.2.2.2.3.6.2 Chart

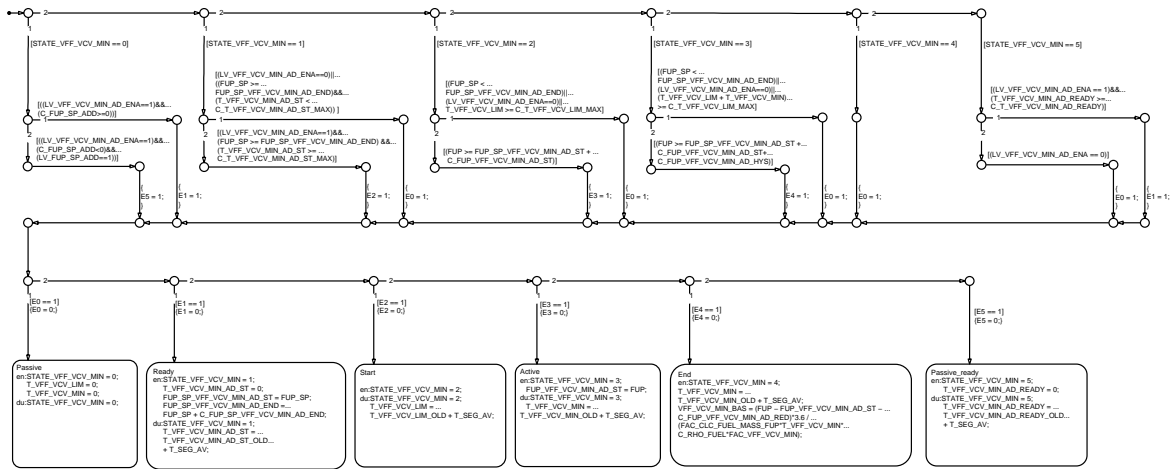


Figure 9.40.44: :

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 3993 of 8404	
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**9.40.2.2.2.3.6.3 FUSL\_M904B/OPM/CUR\_BAS\_CLC/VCV\_CTL\_CLC/CUR\_VCV\_REQ\_CLC/CUR\_VCV\_CLOSE/CLC\_FILTER**

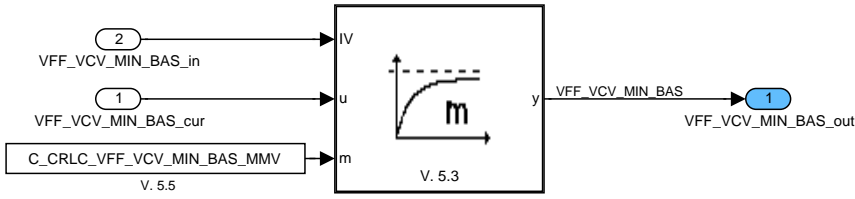


Figure 9.40.45: -:

**9.40.2.2.2.3.6.4 FUSL\_M904B/OPM/CUR\_BAS\_CLC/VCV\_CTL\_CLC/CUR\_VCV\_REQ\_CLC/CUR\_VCV\_CLOSE/CLC\_FILTER**

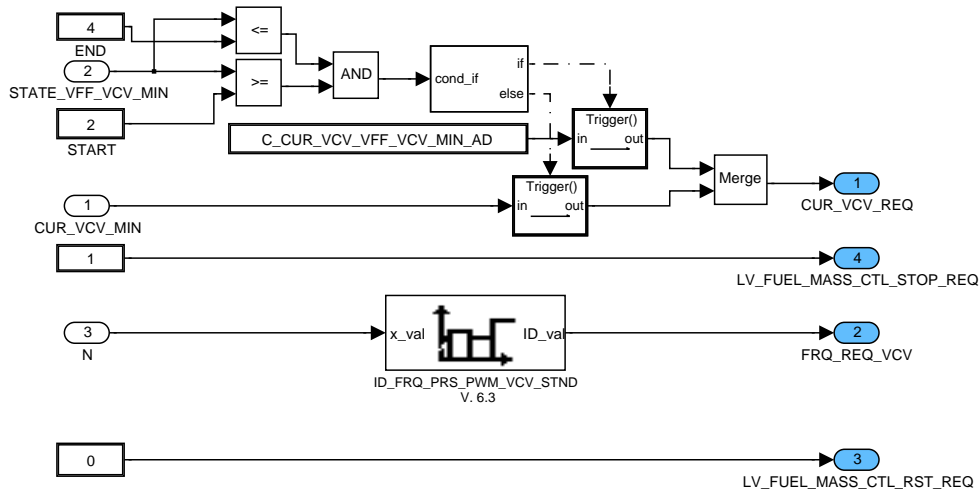


Figure 9.40.46: :

**9.40.2.2.2.3.7 CUR\_VCV\_LIH**

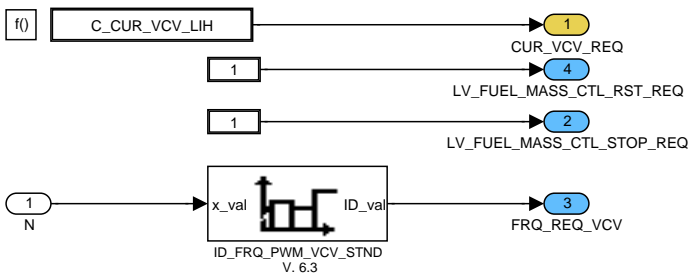


Figure 9.40.47: :

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### 9.40.2.2.2.3.8 Final calculation of the CUR\_VCV

The gradient limitation will only be applied at special states to avoid big PWM jumps. There are several constants for positive PWM change and negative PWM change.

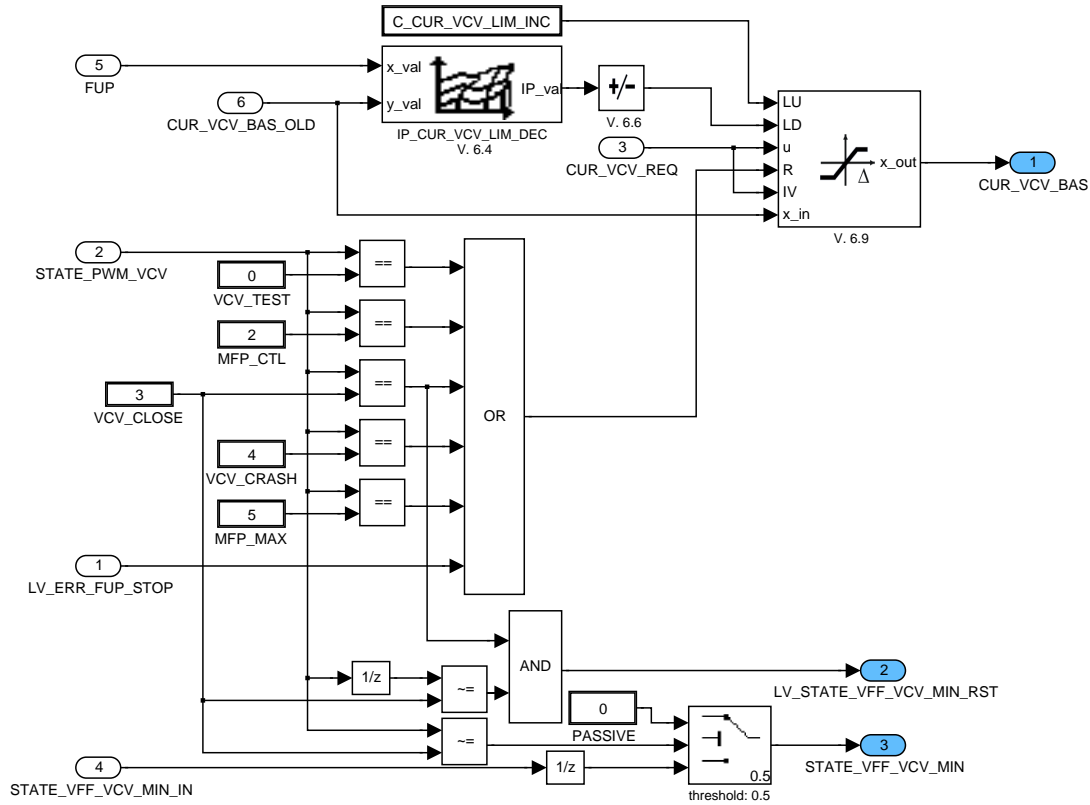


Figure 9.40.48: :

### 9.40.2.2.2.3.9 T\_CUR\_VCV\_PRE\_RUN\_CLC

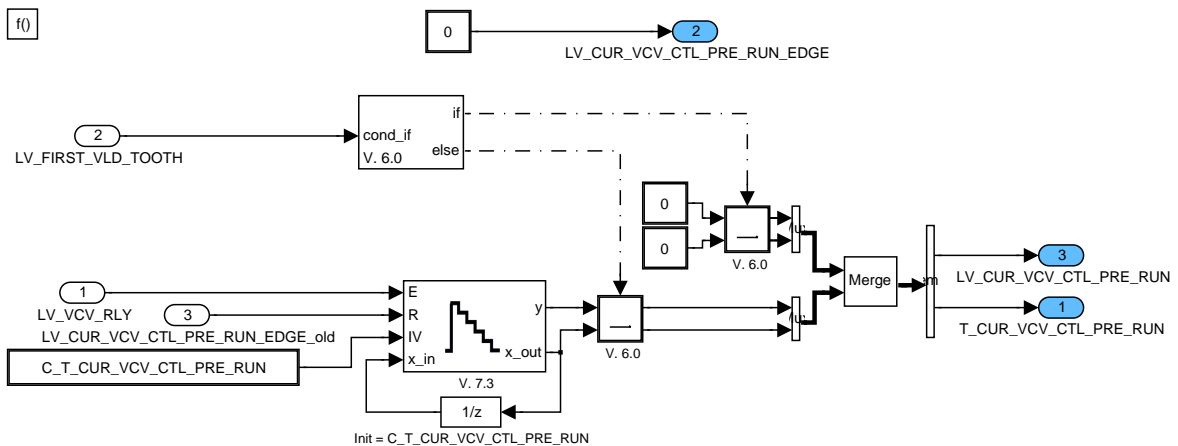


Figure 9.40.49: :

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### 9.40.2.3 Overview of VCV current controller

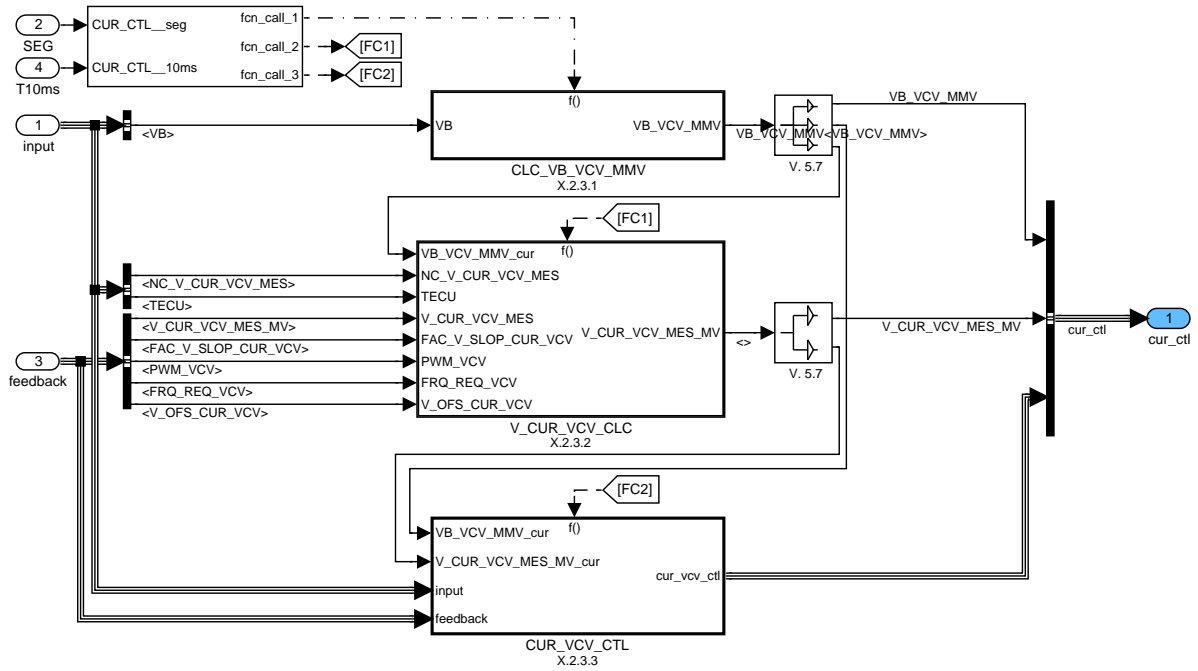


Figure 9.40.50: :

#### 9.40.2.3.1 Calculation of VB\_VCV\_MMV

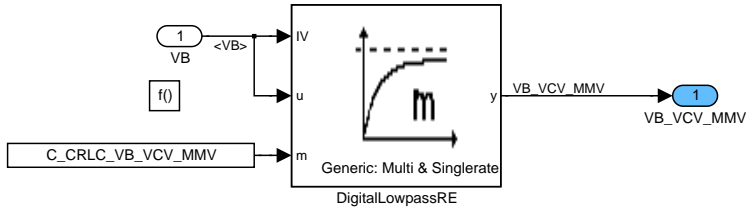


Figure 9.40.51: :

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### 9.40.2.3.2 Calculation of V\_CUR\_VCV\_CLC

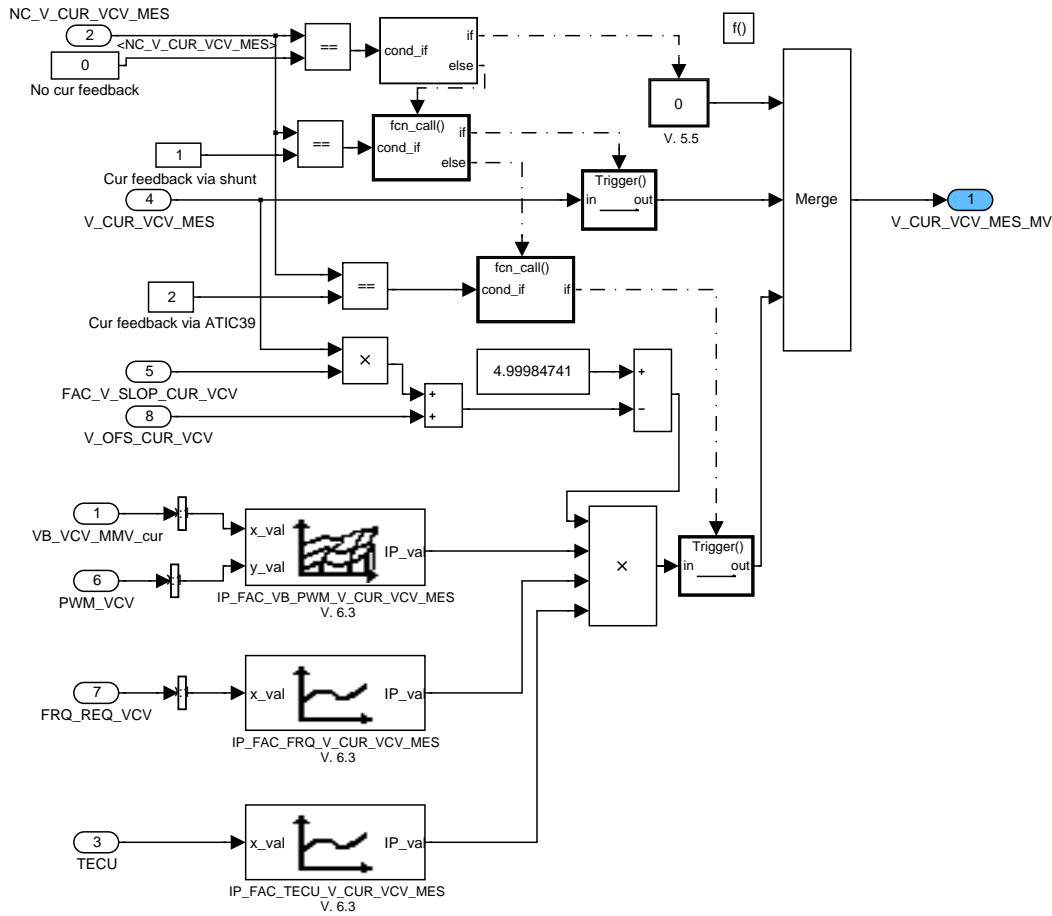


Figure 9.40.52: :

### 9.40.2.3.3 FUSL\_M904B/OPM/CUR\_CTL/CUR\_VCV\_CTL

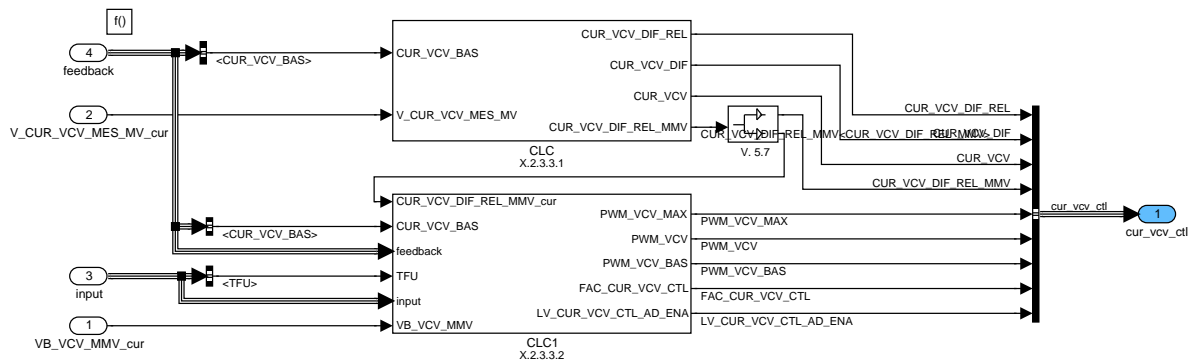


Figure 9.40.53: :

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### 9.40.2.3.3.1 FUSL\_M904B/OPM/CUR\_CTL/CUR\_VCV\_CTL/CLC

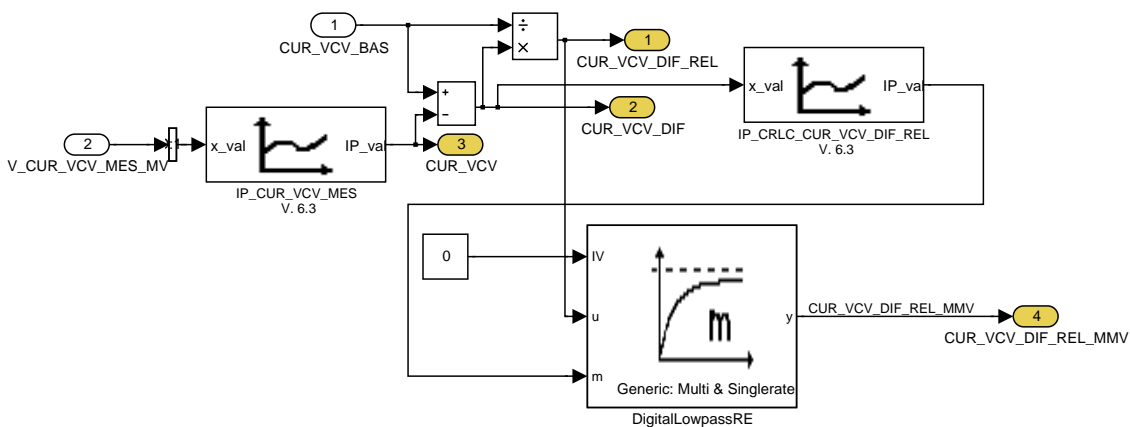


Figure 9.40.54: :

### 9.40.2.3.3.2 Calculation 1

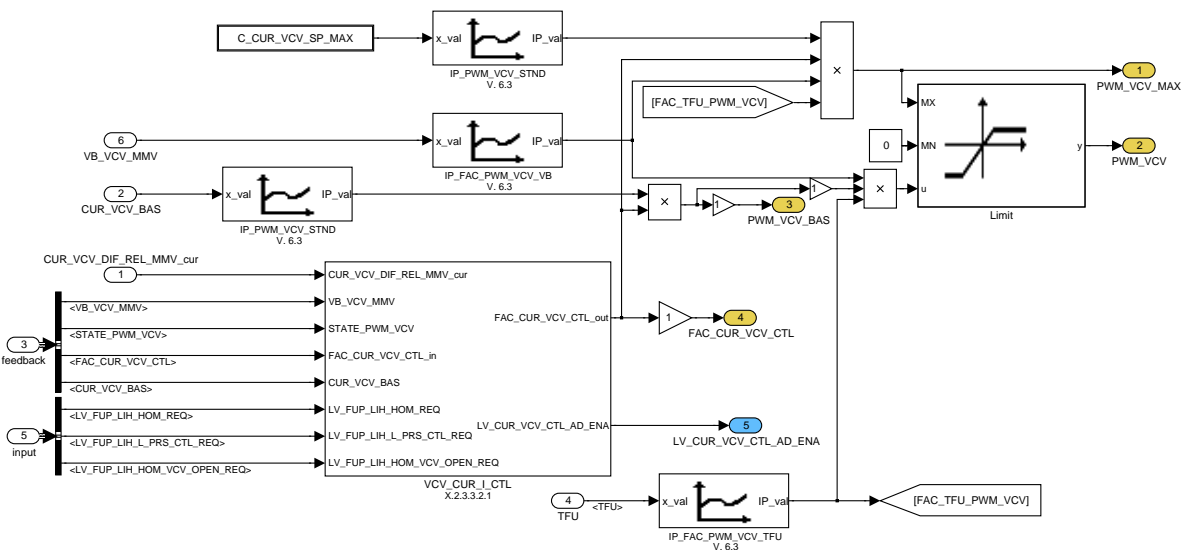


Figure 9.40.55: :

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9.40.2.3.3.2.1 VCV\_CUR\_I\_CTL

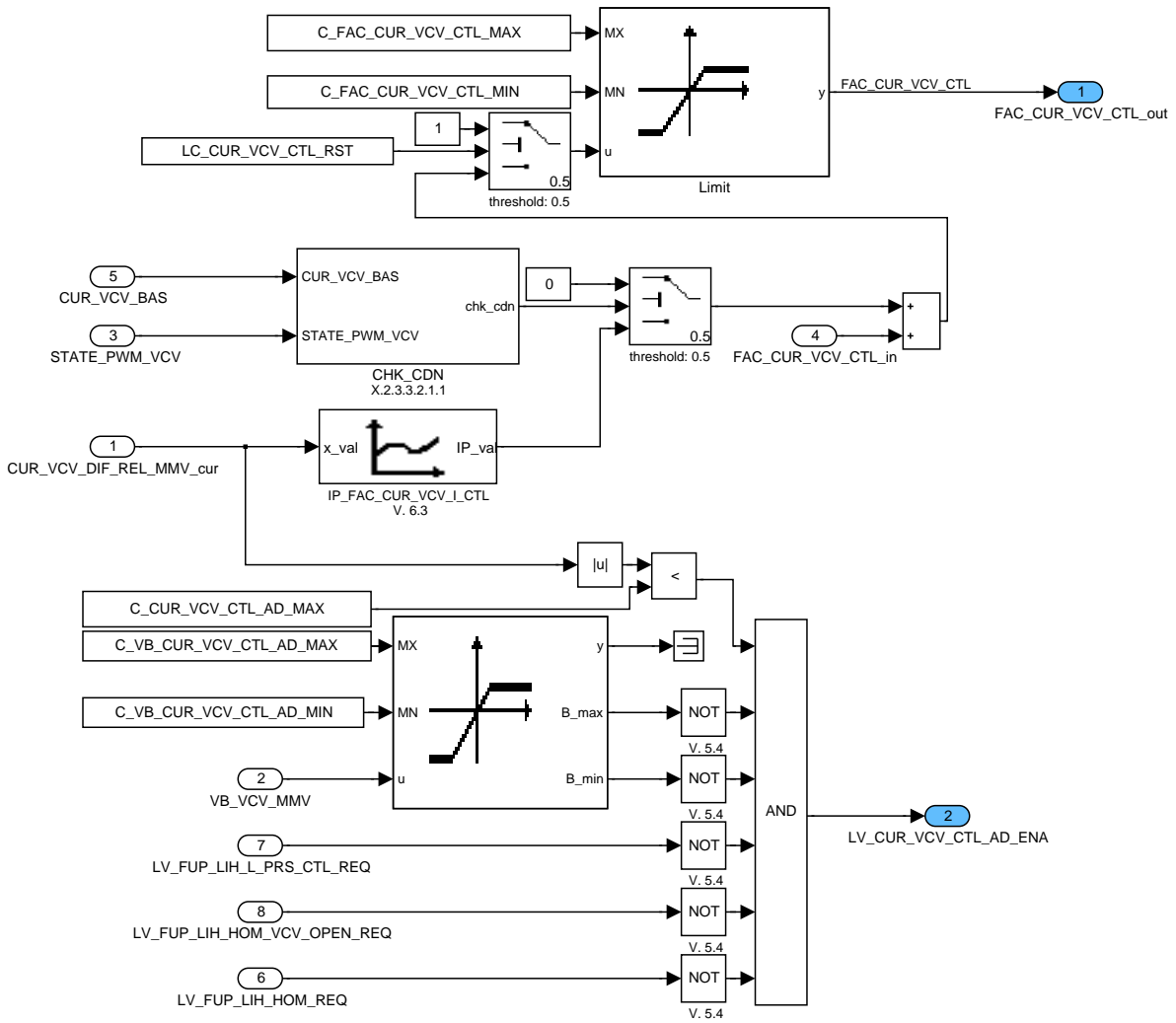


Figure 9.40.56: :

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9.40.2.3.3.2.1.1 Condition Check

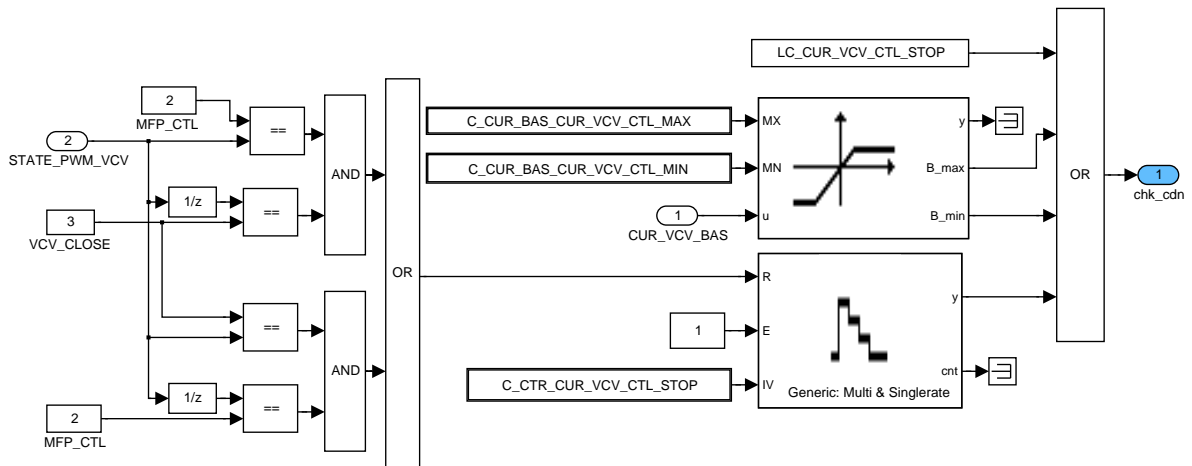


Figure 9.40.57: :

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## 9.41 Fuel pressure actuator control (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_FUEL_MASS_CTL_STOP_DIAG	O/V	0... 1H	0 ...1	1	-
Logical variable freeze the controller while the limphome phase					
LV_FUP_LIH_HOM_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable indicating LIH mode for HPP requested					
LV_FUP_LIH_HOM_VCV_OPEN_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable requesting limphome for VCV open					
LV_FUP_LIH_L_PRS_CTL_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable requesting fuel low pressure control limphome					

### Input data:

ERR_SYM_FUP_CH {p. 6102}	ERR_SYM_H_PRS_SYS_ PRE {p. 6060}	FUP {p. 1283}	LV_ERR_CRASH_SIG {p. 801}
LV_ERR_FUP {p. 4717}	LV_ERR_FUP_CH {p. 6102}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_H_PRS_SYS_ PRE {p. 6062}	LV_ERR_VCV {p. 4729}	LV_ERR_VCV_PLAUS {p. 6062}	LV_ES {p. 1720}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUP_LIH_VCV_OPEN	V	0... FFFFH	0... 347776	5.30672159	hPa
Fuel pressure threshold for switching to VCV open limphome mode					
C_T_FUP_LIH_HOM_VCV_OPEN_REQ	V	0... FFFFH	0... 655.35	0.01	s
Timer for activation of the VCV open limphome					
C_T_FUP_LIH_L_PRS_CTL_REQ	V	0... FFFFH	0... 655.35	0.01	s
Timer for freeze the controller in FUP_LIH_L_PRS_CTL					
LC_T_FUP_LIH_L_PRS_CTL_REQ	V	0... 1H	0 ...1	1	-
Switch for enabling of the timer for freeze the controller in FUP_LIH_L_PRS_CTL					

### General information:

In this module the limphome bits for the high pressure pump control are calculated.

### Application conditions:

*Initialisation:* all outputs to zero at RST  
*Recurrence:* 10MS  
*Activation:* always  
*Deactivation:* never

### Function description:

**Formula section:**

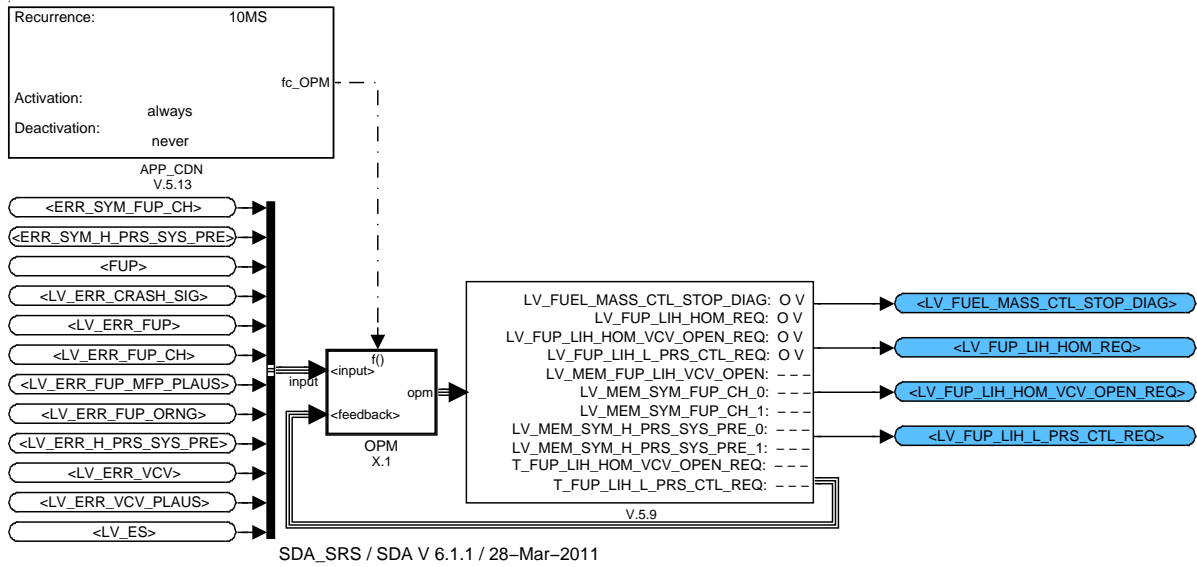


Figure 9.41.1: :

**9.41.1 Formula Section**

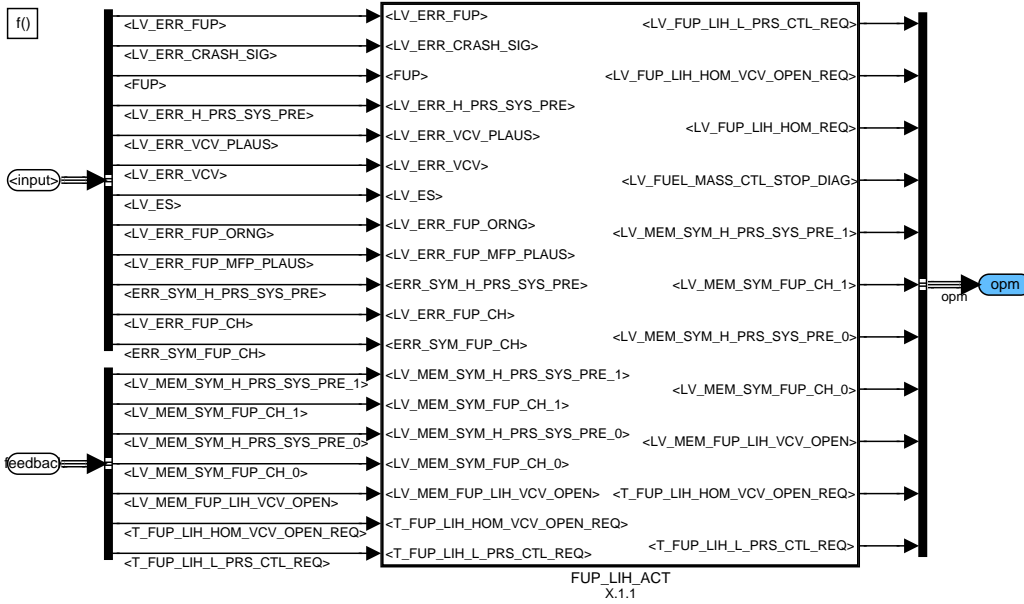


Figure 9.41.2: :

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### 9.41.1.1 FUP\_LIH\_ACT

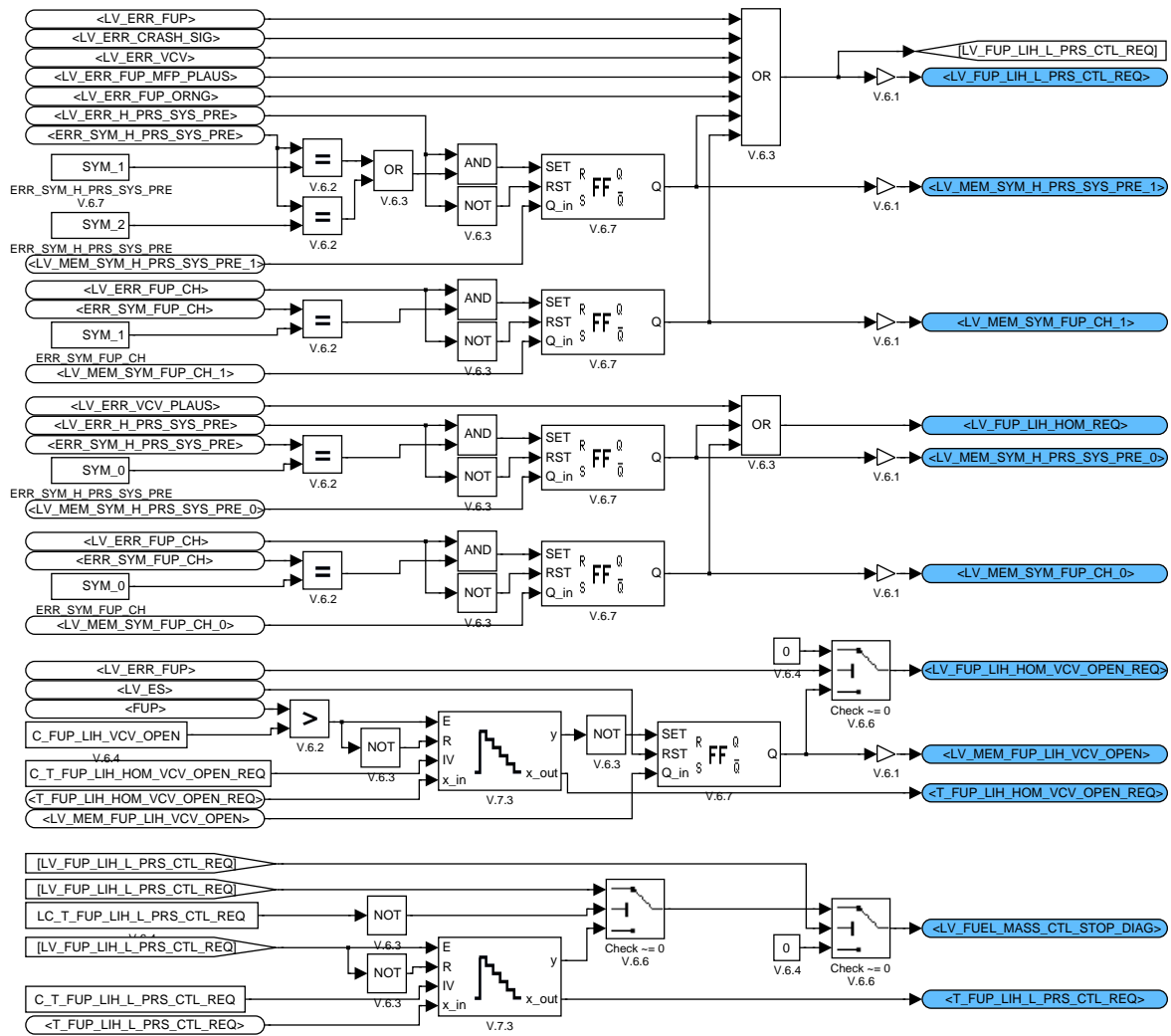


Figure 9.41.3: :

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## 9.42 Fuel supply system temperatures

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TFPA	O/V	0... FEH	-48... 142.5	0.75	°C
Fuel pressure actuator temperature					

### Input data:

TFU {p. 1232}			
---------------	--	--	--

### 9.42.1 Fuel pressure actuator temperature at available fuel temperature

#### General Information

In case of an available temperature of the fuel either modelled or measured this temperature is taken as a substitute for the temperature for the fuel pressure actuator

#### Application conditions

**Initialisation:** *at reset: TFPA = TFU*

**Recurrence:** *1 s*

**Activation:** *every engine state*

#### FUNCTION DESCRIPTION:

SIEMENS VDO

Automotive


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<b>Name:</b>	Fuel pressure actuator temperature	<b>Developer:</b>	Mallejac, Patrice	<b>Page:</b>	1 / 1
<b>Description:</b>	Based on 03903F01.00A	<b>Last User:</b>	Mallejac, Patrice		
<b>File:</b>	03903F01.00C				
<b>Date:</b>	2/10/00	<b>State:</b>	WB TLS		

Released by Tettenborn Frank		Date 2013-02-13	File 02903F02.00A
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 4005 of 8404	
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## 9.43 Cylinder balancing manager

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_TI_ER_BAL_ENA	V	0... FFFFH	0... 65535	1	-
Engine cycle counter to delay TI intervention at entry to state cylinder balancing					
LV_ER_STD_MMV_MAX_TI_ER_BAL	V	0... 1H	0 ...1	1	-
Flag for maximum ER_STD_MMV_BAL value for cylinder balancing via TI intervention					
LV_ER_STND_MMV_MAX_TI_ER_BAL	V	0... 1H	0 ...1	1	-
Flag for maximum ER_STND_MMV_BAL value for cylinder balancing via TI intervention					
LV_FAC_TI_AD_ER_BAL_ENA	O/V	0... 1H	0 ...1	1	-
Flag for multiple cylinder balancing TI adaptation active					
LV_FAC_TI_ER_BAL_ENA	O/V	0... 1H	0 ...1	1	-
Flag for multiple cylinder balancing TI correction active					
LV_MFF_ADD_AD_ER_BAL_ENA	O/V	0... 1H	0 ...1	1	-
Flag for additive cylinder balancing MFF adaptation active					
LV_MFF_ADD_ER_BAL_ENA	O/V	0... 1H	0 ...1	1	-
Flag for additive cylinder balancing MFF correction active					
LV_TI_ER_BAL_ENA	V	0... 1H	0 ...1	1	-
Flag for cylinder balancing via TI intervention enabled					
STATE_CTL_TI_ER_BAL	O/V	0H 1H 2H 3H 4H	NON ADDITIVE ADDITIVE_AD MULTIPLE MULTIPLE_AD	-	-
State of cylinder balancing via TI intervention					
STATE_TI_ER_BAL	O/V	0H 1H 2H 3H	INITIALIZATION LOCK WAIT CYLINDER_ BALANCING	-	-
State of cylinder balancing via TI intervention					

### Input data:

ER_STD_MMV_BAL [NC_CYL_NR] {p. 1489}	ER_STND_MMV_BAL [NC_CYL_NR] {p. 1489}	LC_TI_ER_BAL_STOP_ MAN {p. 4023}	LV_DRV1_STND_BAL_ FDOUT {p. 1489}
LV_IS {p. 1720}	LV_MFF_ADD_AD_ER_ BAL_ENA_EXT {p. 4022}	LV_MFF_COR_ER_BAL_ ENA_EXT {p. 4022}	LV_MFF_FAC_AD_ER_ BAL_ENA_EXT {p. 4022}
MFF_SP_S {p. 8243}	N_32 {p. 1525}	NC_CYL_NR {p. 1526}	SEG_NR_ER {p. 1454}
TCO {p. 1100}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ER_STD_MMV_MAX_TI_ER_BAL	-	8000... 7FFFH	0... 325.77	0.00994202	1/s**2
Maximum ER_STD_MMV_BAL value for cylinder balancing via TI intervention					
C_ER_STND_MMV_MAX_TI_ER_BAL	-	8000... 7FFFH	0... 325.77	0.00994202	1/s**2
Maximum ER_STND_MMV_BAL value for cylinder balancing via TI intervention					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MFF_SP_MAX_FAC_TI_AD_ER_BAL	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Maximum mass fuel flow setpoint for cylinder balancing multiple TI adaptation					
C_MFF_SP_MAX_FAC_TI_ER_BAL	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Maximum mass fuel flow setpoint for cylinder balancing multiple TI correction					
C_MFF_SP_MAX_MFF_ADD_AD_ER_BAL	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Maximum mass fuel flow setpoint for cylinder balancing additive MFF adaptation					
C_MFF_SP_MAX_MFF_ADD_ER_BAL	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Maximum mass fuel flow setpoint for cylinder balancing additive MFF correction					
C_MFF_SP_MIN_FAC_TI_AD_ER_BAL	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Minimum mass fuel flow setpoint for cylinder balancing multiple TI adaptation					
C_MFF_SP_MIN_FAC_TI_ER_BAL	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Minimum mass fuel flow setpoint for cylinder balancing multiple TI correction					
C_MFF_SP_MIN_MFF_ADD_AD_ER_BAL	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Minimum mass fuel flow setpoint for cylinder balancing additive MFF adaptation					
C_MFF_SP_MIN_MFF_ADD_ER_BAL	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Minimum mass fuel flow setpoint for cylinder balancing additive MFF correction					
C_N_32_MAX_FAC_TI_AD_ER_BAL	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for cylinder balancing multiple TI adaptation					
C_N_32_MAX_FAC_TI_ER_BAL	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for cylinder balancing multiple TI correction					
C_N_32_MAX_MFF_ADD_AD_ER_BAL	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for cylinder balancing additive MFF adaptation					
C_N_32_MAX_MFF_ADD_ER_BAL	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for cylinder balancing additive MFF correction					
C_N_32_MIN_FAC_TI_AD_ER_BAL	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for cylinder balancing multiple TI adaptation					
C_N_32_MIN_FAC_TI_ER_BAL	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for cylinder balancing multiple TI correction					
C_N_32_MIN_MFF_ADD_AD_ER_BAL	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for cylinder balancing additive MFF adaptation					
C_N_32_MIN_MFF_ADD_ER_BAL	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for cylinder balancing additive MFF correction					
C_TCO_MAX_TI_ER_BAL	-	0... FEH	0... 142.5	0.75	°C
Maximum coolant temperature value for cylinder balancing via TI intervention					
C_TCO_MIN_FAC_TI_AD_ER_BAL	-	0... FEH	0... 142.5	0.75	°C
Minimum coolant temperature value for cylinder balancing multiple TI adaptation					
C_TCO_MIN_MFF_ADD_AD_ER_BAL	-	0... FEH	0... 142.5	0.75	°C
Minimum coolant temperature value for cylinder balancing additive MFF adaptation					
C_TCO_MIN_TI_ER_BAL	-	0... FEH	0... 142.5	0.75	°C
Minimum coolant temperature value for cylinder balancing via TI intervention					
IP_CTR_TI_ER_BAL_ENA_INI	-	0... FFFFH	0... 65535	1	-
LDP_N_32_IP_CTR_TI_ER_BAL_INI	4	0... FFH	0... 8160	32	rpm
Engine cycle counter start value to delay TI intervention at entry to state cylinder balancing					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_MFF_ADD_ER_BAL_ENA	-	0... 1H	0 ...1	1	-
Logical constant to enable additive MFF intervention out of idle					

**General information:**

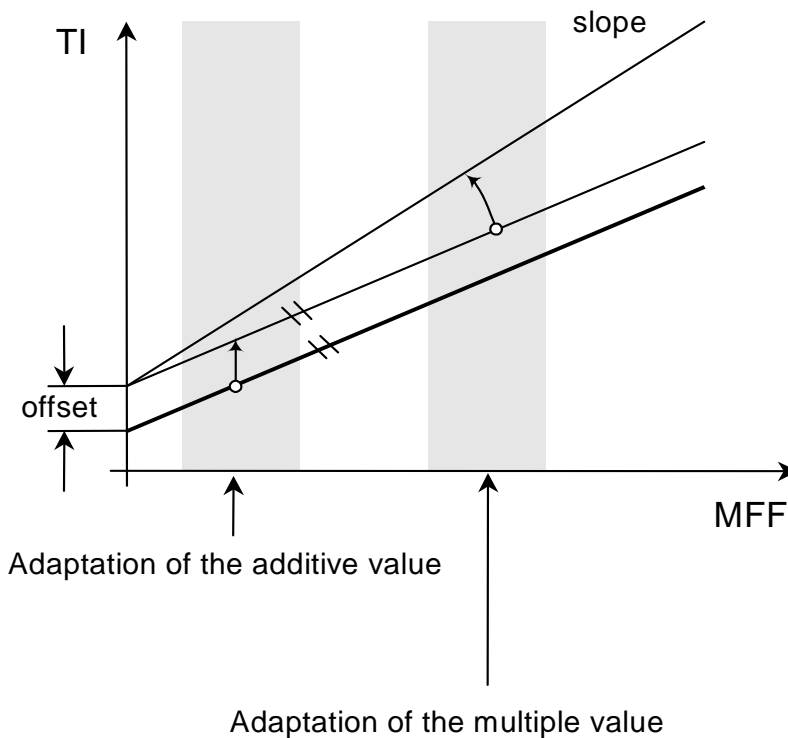
Cylinder balancing via TI intervention means a correction of the cylinder individual injection time values to achieve a balancing of the indicated torque between the single cylinders based on engine roughness calculation. Target is to achieve a smooth engine running.

The "Balancing Manager" is realized with a state machine. Different states with a defined setting of corresponding output variables are existing as well as clear conditions to change from one state to another. The calculation of adaptation values is controlled by the states of the state machine.

By means of the logical constant LC\_MFF\_ADD\_ER\_BAL\_ENA it is possible to enable (LC\_MFF\_ADD\_ER\_BAL\_ENA = 1) or disable (LC\_MFF\_ADD\_ER\_BAL\_ENA = 0) the additive adaptation in part load. At idle speed the additive adaptation is always enabled.


In order to compensate torque differences, e.g. caused by manufacturing tolerances of the injection valves, either an additive or a multiple adaptation correction of the injection times is carried out at state "Cylinder Balancing" depending on the current mass fuel flow setpoint.

The additive adaptation value, which influences the offset of the injection valve characteristic line is learned at low mass fuel flow values. The multiple adaptation factor however, which influences the slope of the injector characteristic line, is learned at higher mass fuel flow values (refer: figure).



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**Application Condition**

Released by Tettenborn Frank		Date 2013-02-13	File 30907L03.00B
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 4008 of 8404	
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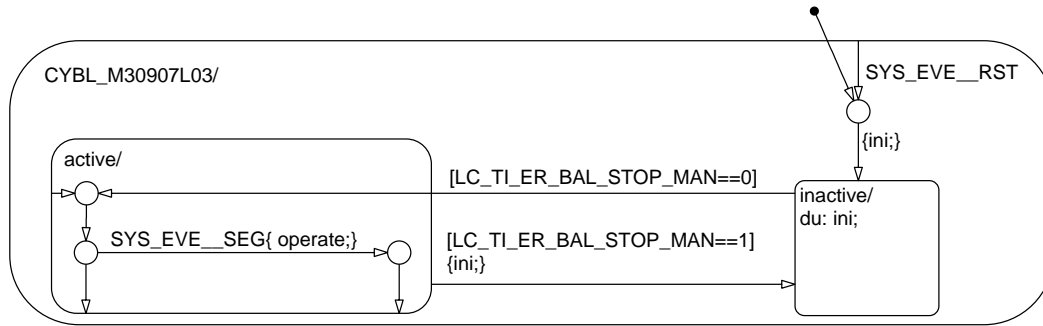



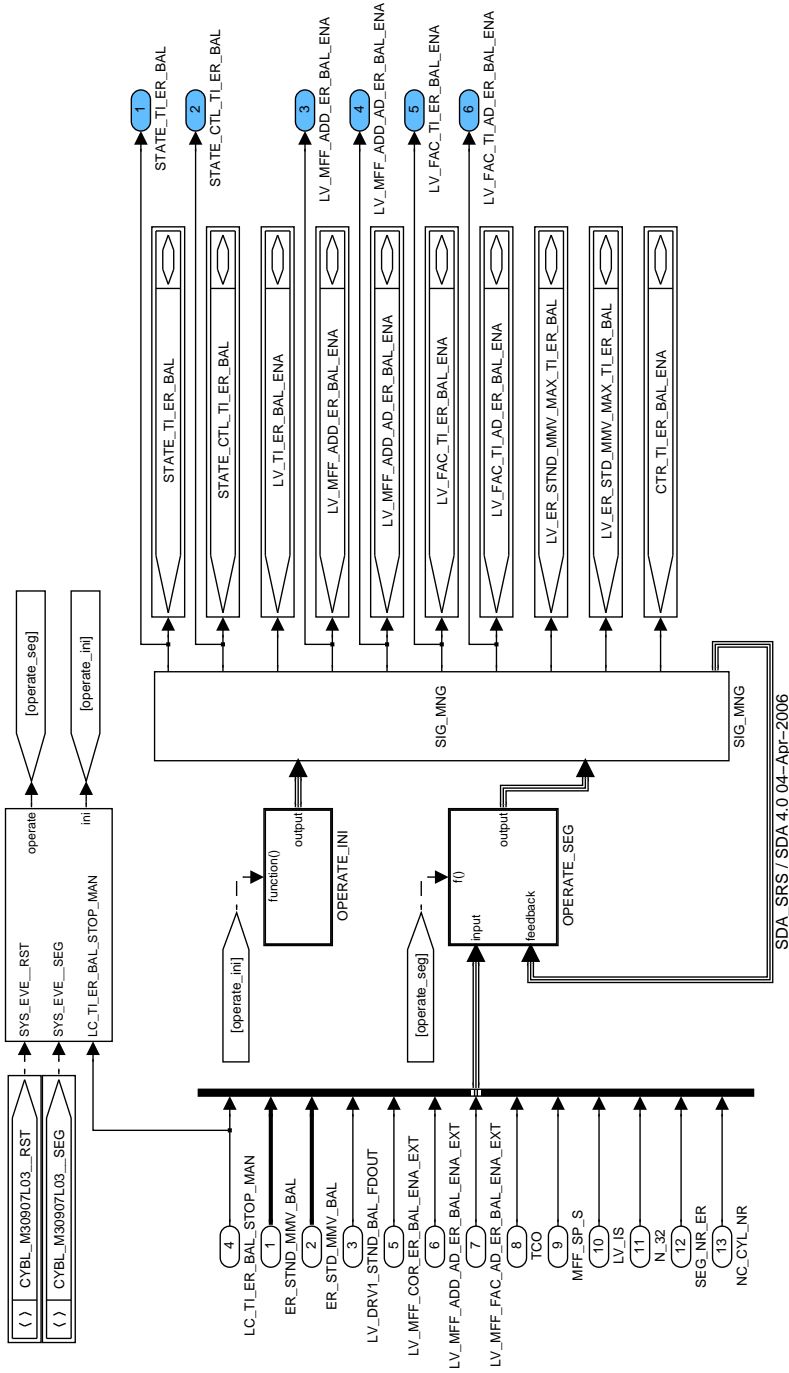
Figure 9.43.1: CYBL\_M30907L03/APP\_CDN/Chart

### Function Description

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SDA\_SRS / SDA 4.0 04-Apr-2006

Figure 9.43.2: CYBL\_M30907L03

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4010 of 8404</b>	
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### 9.43.1 Initialization of variables

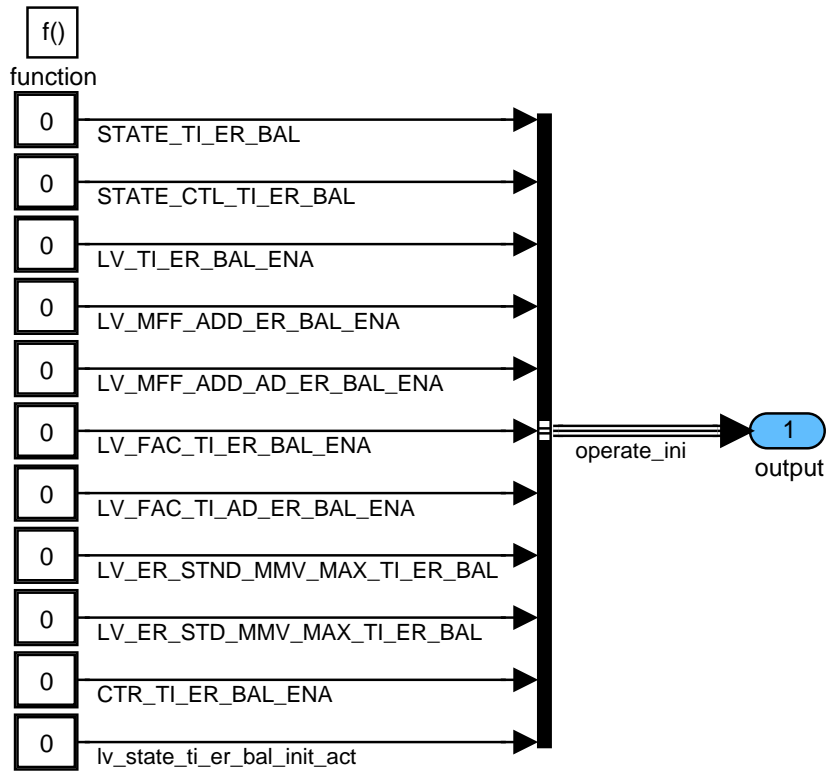


Figure 9.43.3: CYBL\_M30907L03/OPERATE\_INI

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### 9.43.2 Calculation of segment task

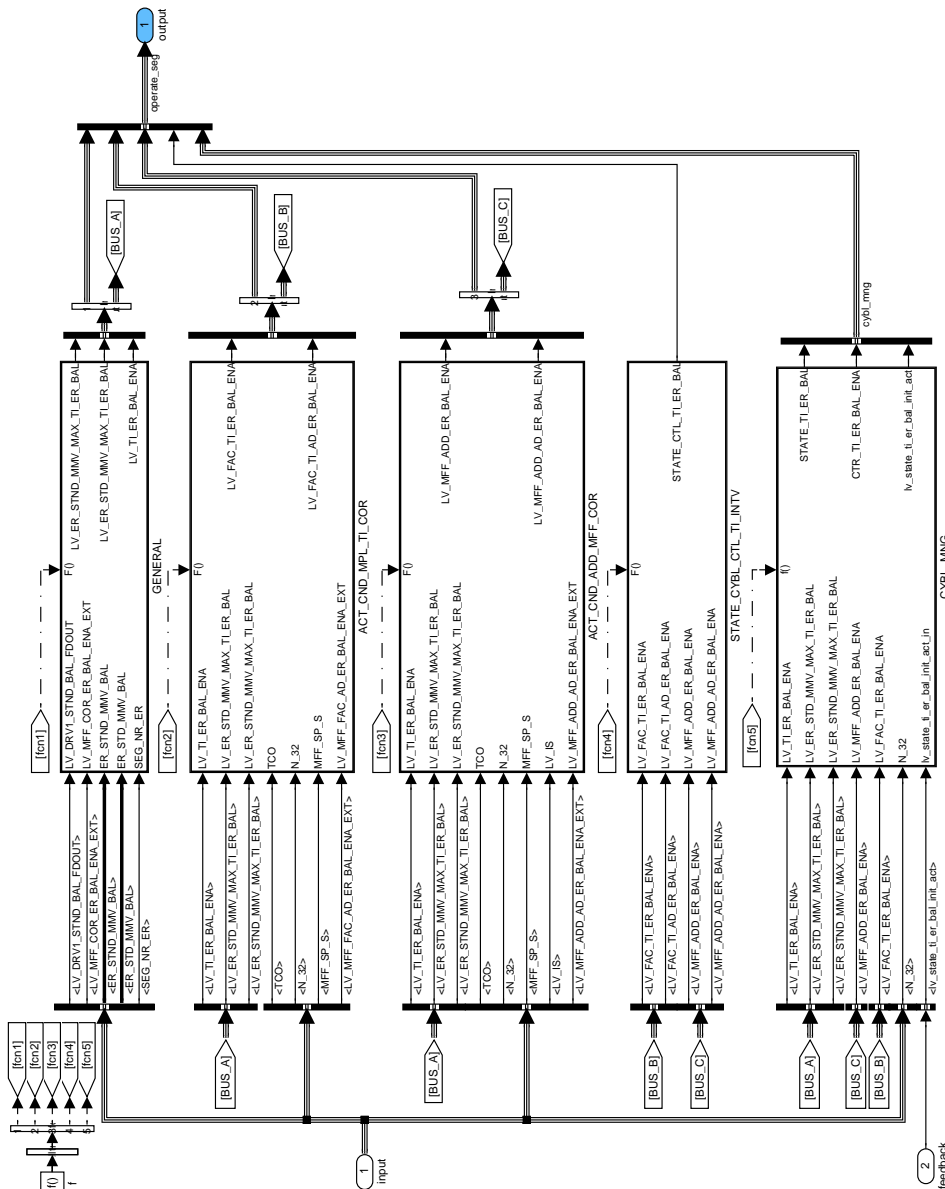


Figure 9.43.4: CYBL\_M30907L03/OPERATE\_SEG

#### Calculation of general tasks

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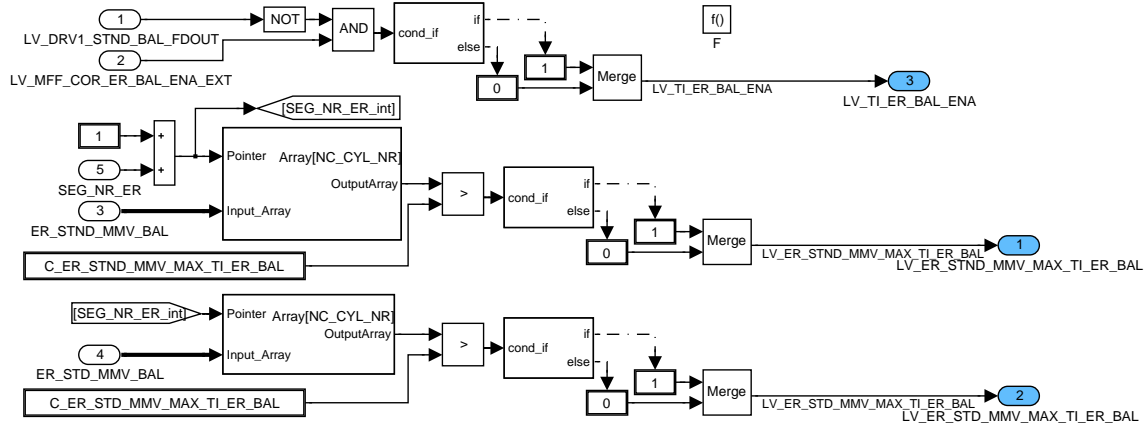


Figure 9.43.5: CYBL\_M30907L03/OPERATE\_SEG/GENERAL

**Action condition for multiple cylinder balancing TI correction:**

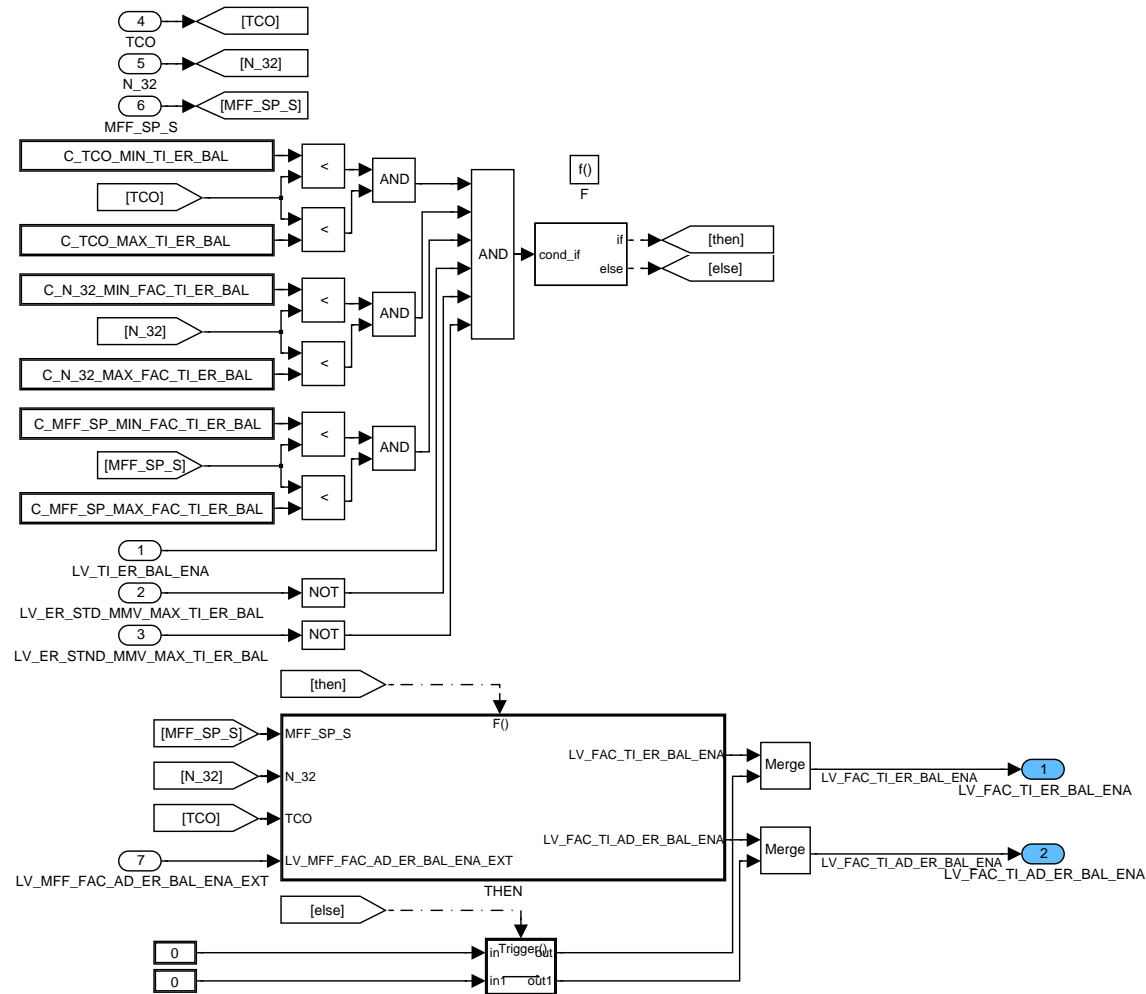


Figure 9.43.6: CYBL\_M30907L03/OPERATE\_SEG/ACT\_CND\_MPL\_TI\_COR

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**Action condition for multiple cylinder balancing TI correction - THEN branch**

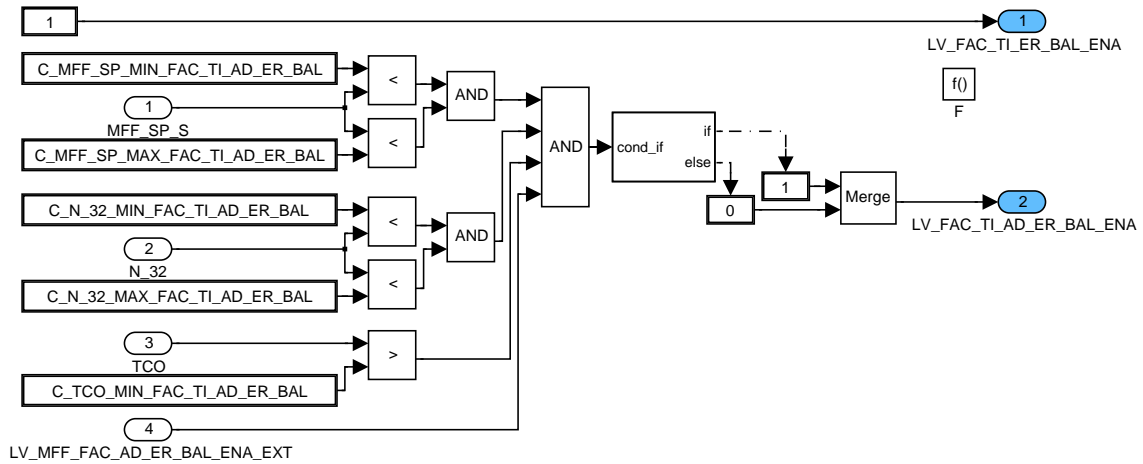


Figure 9.43.7: CYBL\_M30907L03/OPERATE\_SEG/ACT\_CND\_MPL\_TI\_COR/THEN

**Action condition for additive cylinder balancing MFF correction:**

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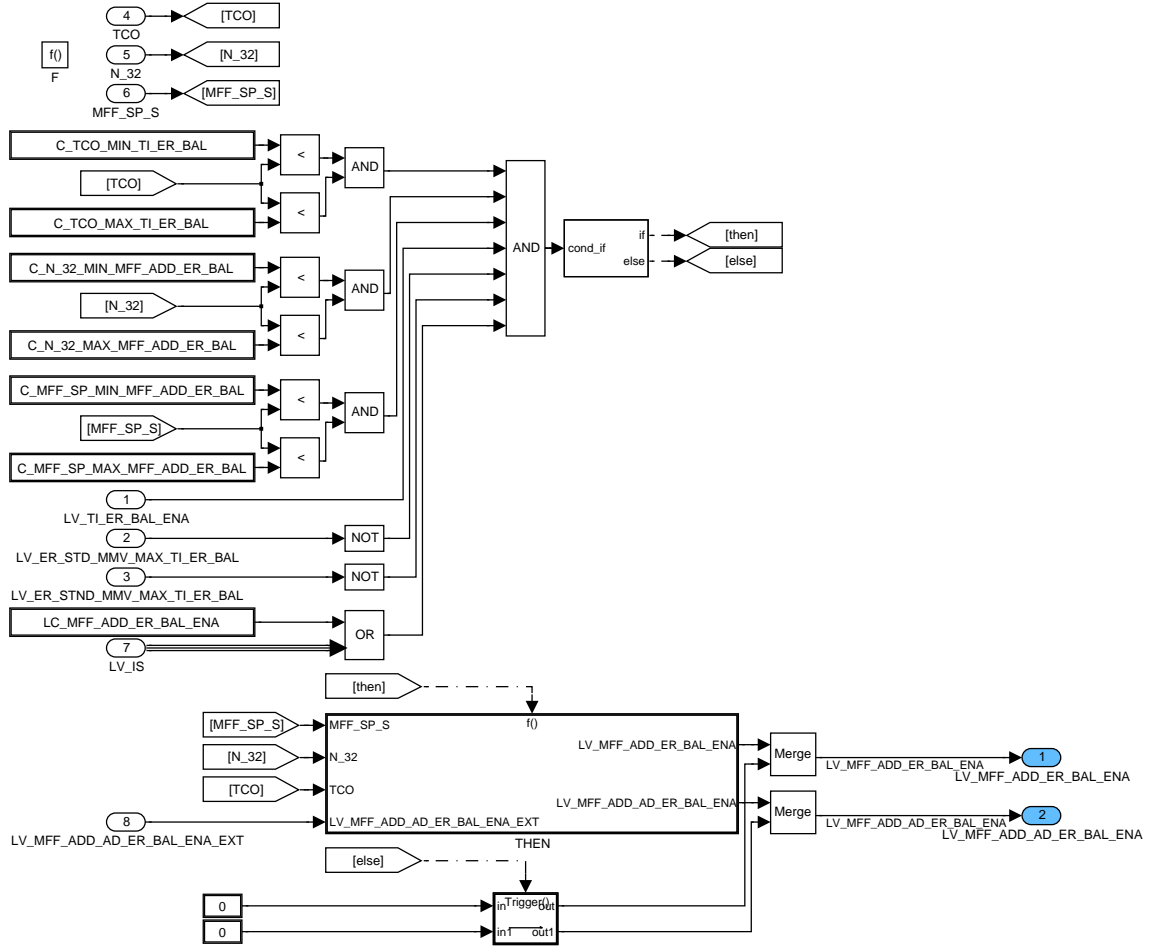


Figure 9.43.8: CYBL\_M30907L03/OPERATE\_SEG/ACT\_CND\_ADD\_MFF\_COR

**Action condition for additive cylinder balancing MFF correction THEN branch**

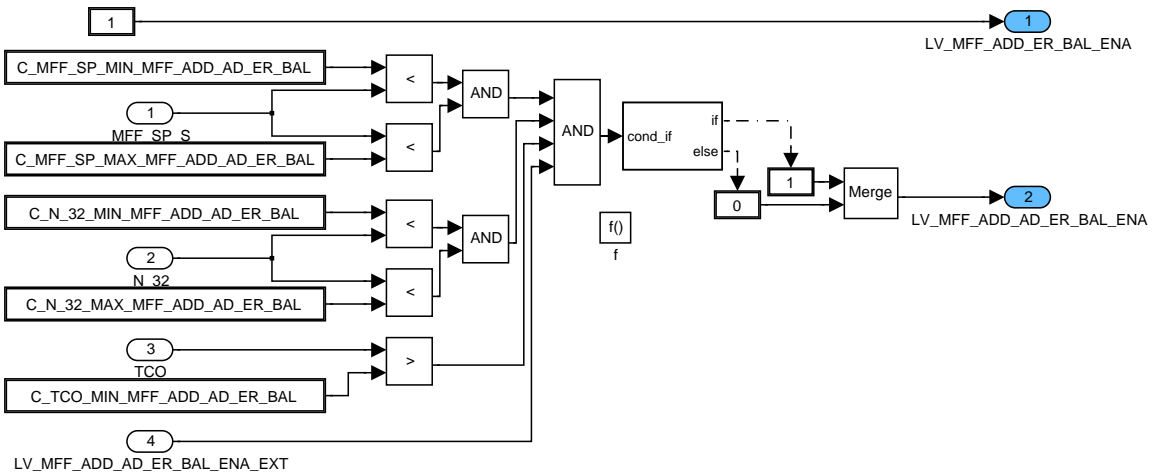


Figure 9.43.9: CYBL\_M30907L03/OPERATE\_SEG/ACT\_CND\_ADD\_MFF\_COR/THEN

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**State of cylinder balancing control via TI intervention:**

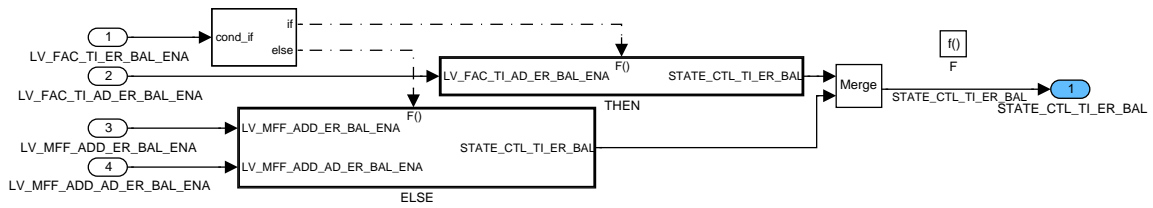


Figure 9.43.10: CYBL\_M30907L03/OPERATE\_SEG/STATE\_CYBL\_CTL\_TI\_INTV

**State of cylinder balancing control via TI intervention - THEN branch**

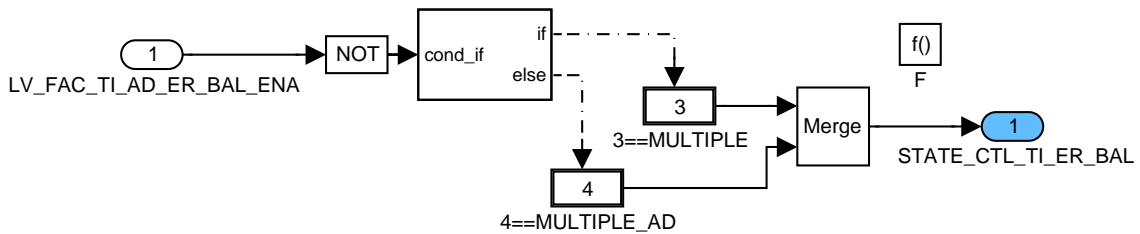


Figure 9.43.11: CYBL\_M30907L03/OPERATE\_SEG/STATE\_CYBL\_CTL\_TI\_INTV/THEN

**State of cylinder balancing control via TI intervention - ELSE branch**

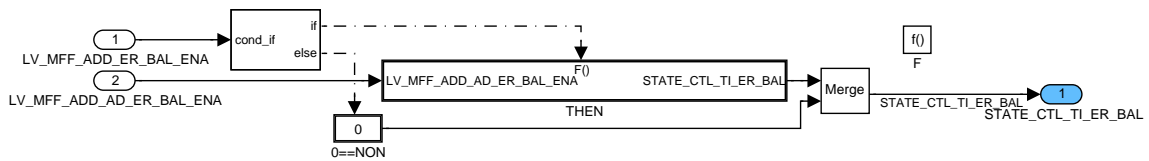


Figure 9.43.12: CYBL\_M30907L03/OPERATE\_SEG/STATE\_CYBL\_CTL\_TI\_INTV/ELSE

**State of cylinder balancing control via TI intervention - ELSE THEN branch**

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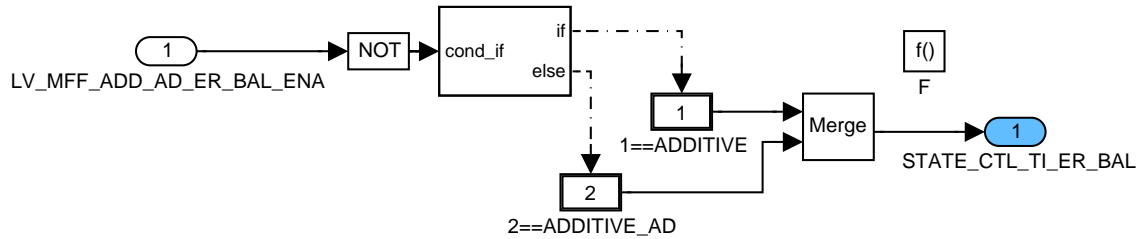
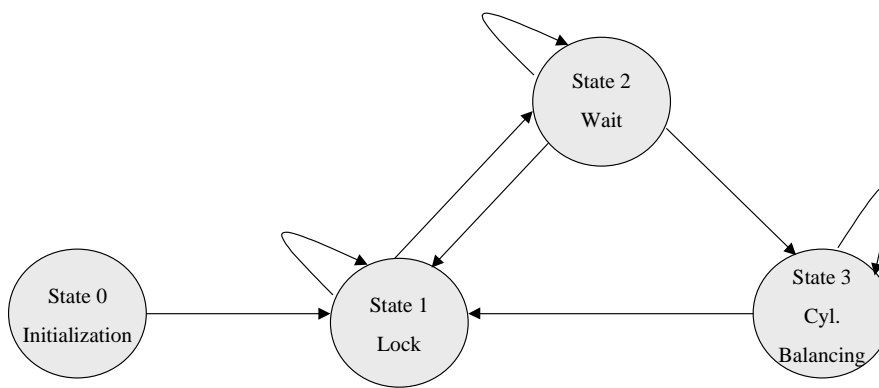


Figure 9.43.13: CYBL\_M30907L03/OPERATE\_SEG/STATE\_CYBL\_CTL\_TI\_INTV/ELSE/THEN

## Description of the Cylinder Balancing Manager

State diagram:



### Cylinder Balancing Manager: State 0H - Initialization

At reset the state of cylinder balancing changes at once to state "Initialization". The state "Initialization" is active for one recurrence (first segment after reset). As soon as the next segment (second segment after reset) is valid, the state changes immediately to state "Lock".

### Cylinder Balancing Manager: State 1[H] - Lock

The algorithm stays in this state until the flags LV\_TI\_ER\_BAL\_ENA is set to 1. This flag is set when certain conditions for controlling and adaptation are fulfilled.

### Cylinder Balancing Manager: State 2[H] - Wait

The counter CTR\_TI\_ER\_BAL\_ENA starts to run. It counts down from its calibrate able initial value IP\_CTR\_TI\_ER\_BAL\_ENA\_INI to zero (decrease of 1 every engine cycle).

Furthermore the input values ER\_STND\_MMV\_BAL[SEG\_NR\_ER] and ER\_STD\_MMV\_BAL[SEG\_NR\_ER] have to below a certain limit:

### Cylinder Balancing Manager: State [3] - Cylinder Balancing

The input values ER\_STND\_MMV\_BAL[SEG\_NR\_ER] and ER\_STD\_MMV\_BAL[SEG\_NR\_ER] have to below a certain limit (analogue to state 2).

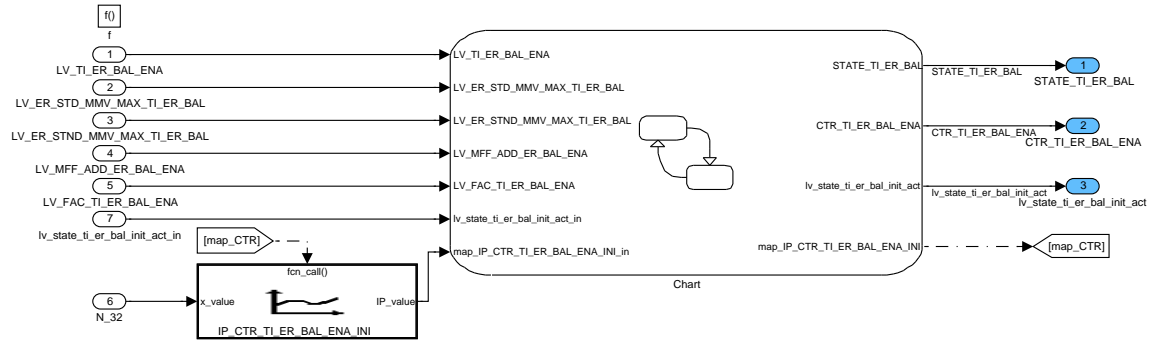



Figure 9.43.14: CYBL\_M30907L03/OPERATE\_SEG/CYBL\_MNG

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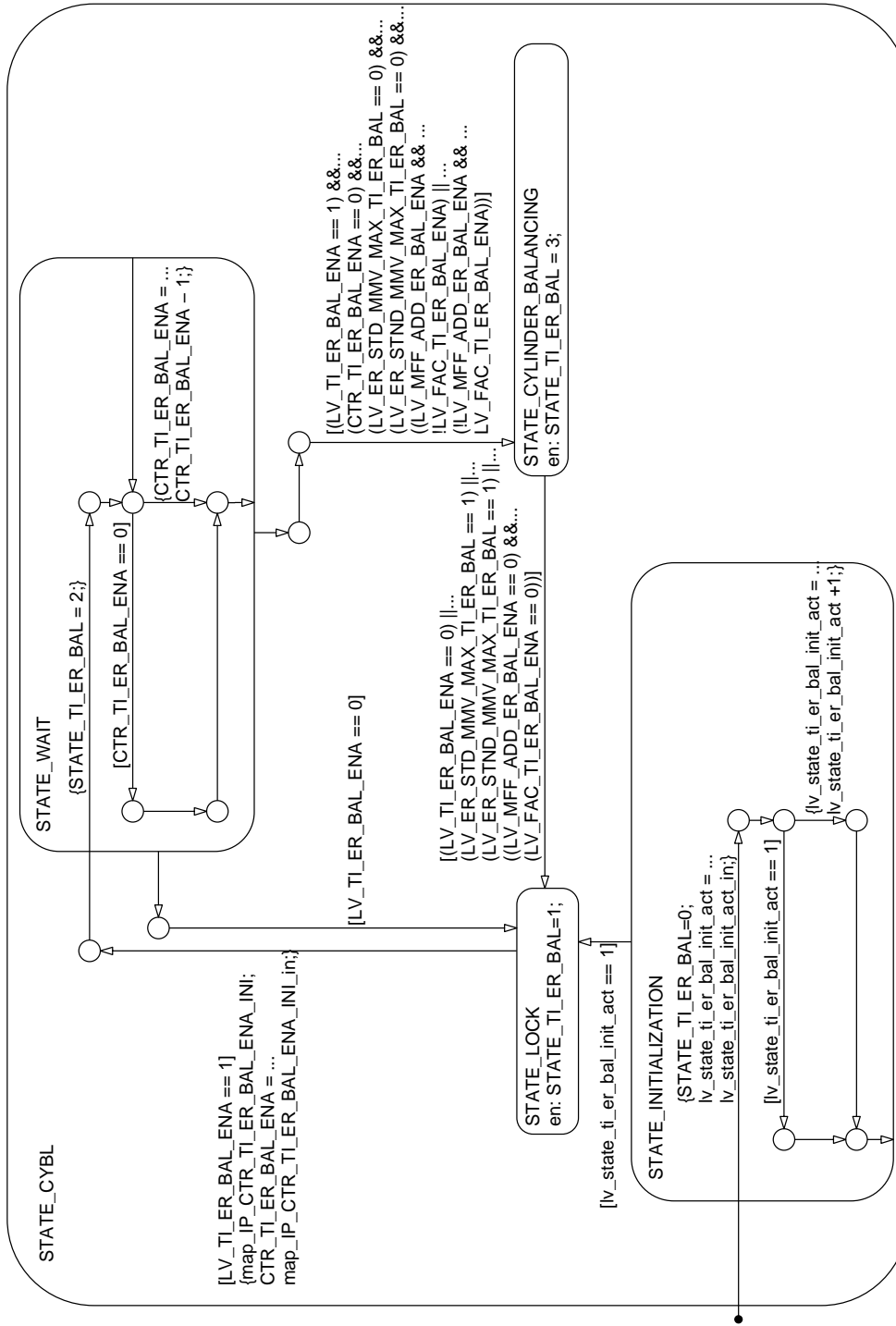


Figure 9.43.15: CYBL\_M30907L03/OPERATE\_SEG/CYBL\_MNG/Chart

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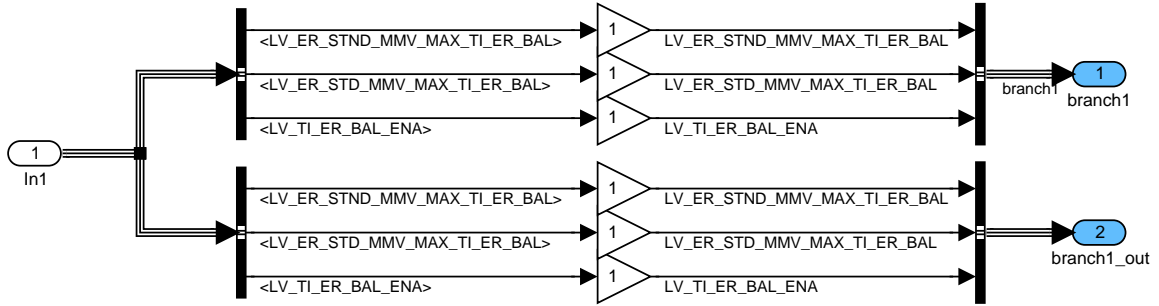


Figure 9.43.16: CYBL\_M30907L03/OPERATE\_SEG/BRANCH1

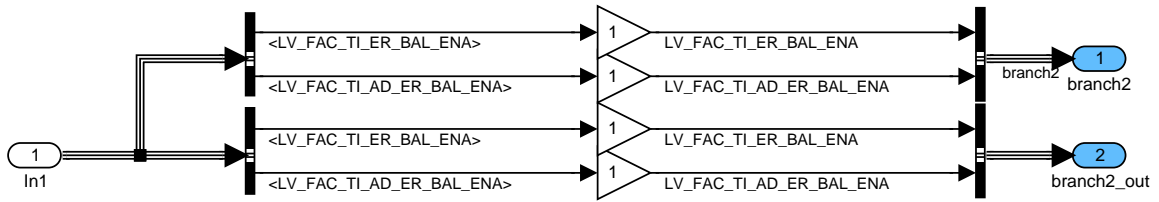


Figure 9.43.17: CYBL\_M30907L03/OPERATE\_SEG/BRANCH2

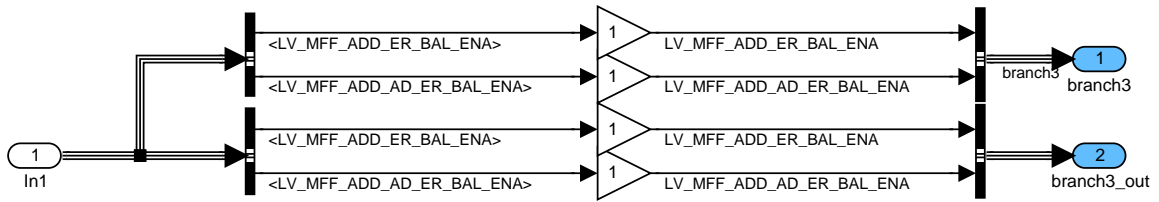


Figure 9.43.18: CYBL\_M30907L03/OPERATE\_SEG/BRANCH3

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### 9.43.3 SUBFUNCTION: SIG\_MNG

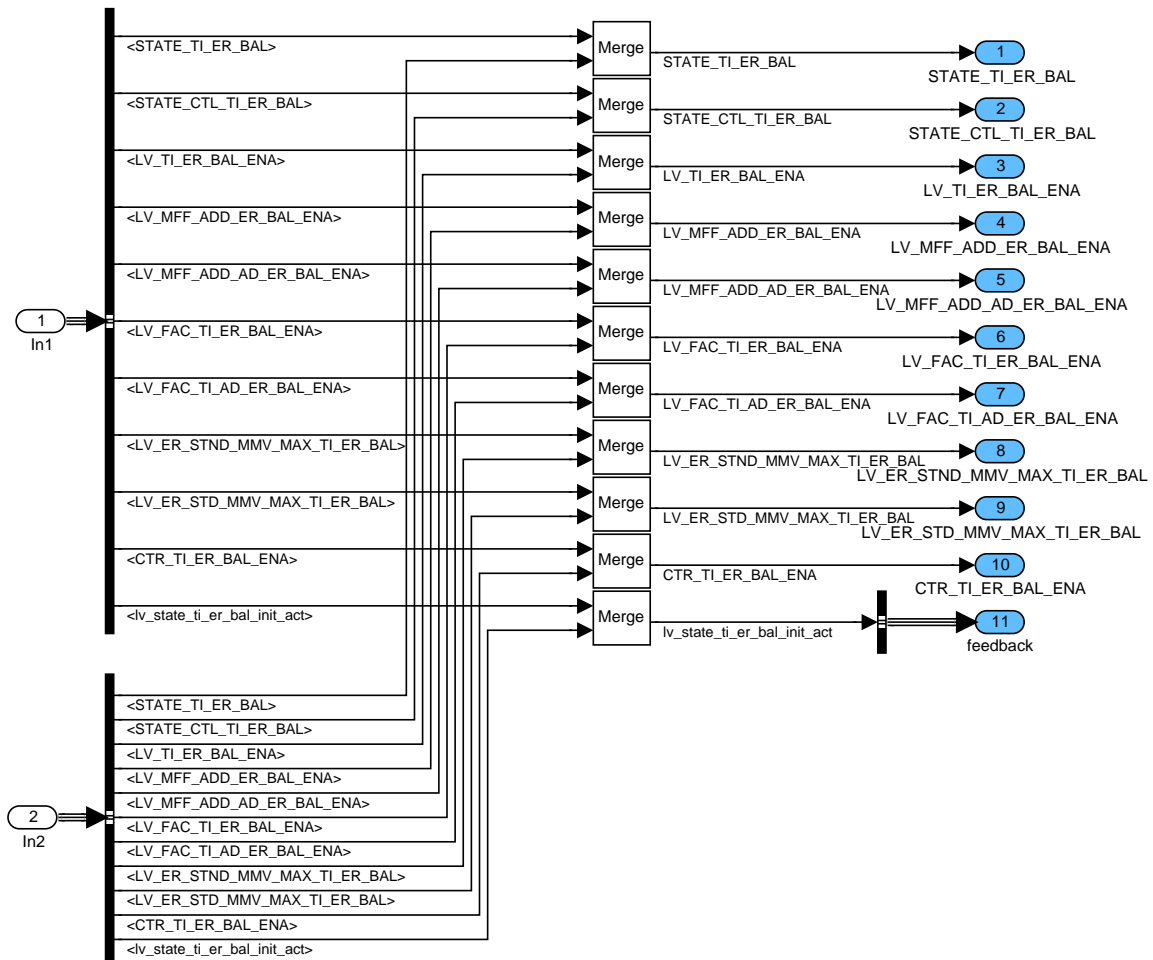


Figure 9.43.19: CYBL\_M30907L03/SIG\_MNG

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## 9.44 Cylinder balancing manager (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CYL_BAL_ER_CDN_BAS	O/V	0... 1H	0 ...1	1	-
Basic condition to enable cylinder balancing calculations					
LV_DRV1_ER_BAL_ACT	O/V	0... 1H	0 ...1	1	-
Activation condition to enable cylinder balancing fade out calculation					
LV_ER_STND_ER_BAL_ACT	O/V	0... 1H	0 ...1	1	-
Activation condition to enable cylinder balancing signal preparation calculation					
LV_MFF_ADD_AD_ER_BAL_ENA_EXT	O/V	0... 1H	0 ...1	1	-
External condition to enable cylinder balancing additive adaptation manager calculations					
LV_MFF_COR_ER_BAL_ENA_EXT	O/V	0... 1H	0 ...1	1	-
External condition to enable cylinder balancing manager calculations					
LV_MFF_FAC_AD_ER_BAL_ENA_EXT	O/V	0... 1H	0 ...1	1	-
External condition to enable cylinder balancing multiple adaptation manager calculations					
LV_TI_CYL_BAL_ER_ACT	O/V	0... 1H	0 ...1	1	-
Flag for cylinder balancing (TI intervention) via engine roughness activated					
LV_TI_CYL_BAL_LAM_ACT	O/V	0... 1H	0 ...1	1	-
Flag for cylinder balancing (TI intervention) via lambda sensor activated					
LV_TI_ER_BAL_ACT	O/V	0... 1H	0 ...1	1	-
Activation condition to enable cylinder balancing TI intervention calculation					

### Input data:

LV_CH {p. 8232}	LV_DET_MIS {p. 6276}	LV_ENA_ER {p. 1454}	LV_ER_FDOUT {p. 987}
LV_ERR_CAM {p. 1505}	LV_ERR_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}	LV_ERR_CRK {p. 4455}	LV_ERR_CYL_BAL_ER [NC_CYL_NR] {p. 5112}
LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}
LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}	LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_SEG_AD_ER {p. 4367}
LV_ERR_T_SEG_ER {p. 4367}	LV_ERR_TCO {p. 4496}	LV_ERR_TPS {p. 4982}	LV_ERR_VCV {p. 4729}
LV_FCUT_IND {p. 2295}	LV_FL {p. 1759}	LV_INH_BAL_CUS {p. 8187}	LV_INH_CYL_BAL_ER_ LIH_CTL {p. 803}
LV_INH_CYL_BAL_LAM_ LIH_CTL {p. 803}	LV_MIS_STATE_A {p. 6238}	LV_MIS_STATE_B4 {p. 6238}	LV_PUC {p. 1720}
LV_RGN_NT_REQ {p. 2983}	LV_S_ACT {p. 8137}	LV_SEG_AD_AVL_ER {p. 1473}	LV_SEG_AD_LIM_ER {p. 1473}
LV_STATE_RR {p. 6301}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	STATE_ERR_IV {p. 4803}
STATE_TI_ER_BAL {p. 4006}	T_AST {p. 1766}	TQI_AV_S {p. 8380}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DRV1_ER_BAL_ACT_MAN	-	0H 1H 2H	NEUTRAL ENABLE DISABLE	-	-
Manual adjustment of activation conditions for cylinder balancing fade out					
C_ER_STND_ER_BAL_ACT_MAN	-	0H 1H 2H	NEUTRAL ENABLE DISABLE	-	-
Manual adjustment of activation conditions for cylinder balancing signal preparation					
C_T_AST_MIN_TI_ER_BAL	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time after engine start for cylinder balancing via TO intervention					
C_TI_ER_BAL_ACT_MAN	-	0H 1H 2H	NEUTRAL ENABLE DISABLE	-	-
Manual adjustment of activation conditions for cylinder balancing via TI intervention					
C_TQI_MAX_TI_ER_BAL	-	8000... 7FFFH	0... 1023.97	0.03125	Nm
Maximum engine torque for cylinder balancing via TI intervention					
C_TQI_MIN_TI_ER_BAL	-	8000... 7FFFH	0... 1023.97	0.03125	Nm
Minimum engine torque for cylinder balancing via TI intervention					
LC_TI_ER_BAL_STOP_MAN	-	0... 1H	0 ...1	1	-
Logical constant for manual stop (=1) of all cylinder balancing functions (TI intervention)					

**General information**


The Appl. Inc. module is used to keep the cylinder balancing functions modular. Therefore the activation conditions for the signal preparation functions, the balancing manager and the cylinder balancing adaptation functions are set within this module. The cylinder balancing functions are activated as soon as the corresponding activation condition is enabled (=1).

With the logical variable LV\_MFF\_COR\_ER\_BAL\_ENA\_EXT it is possible to adapt the main enable condition (to start cylinder balancing via TI intervention) with additional external requirements. The flag is used as input signal for the cylinder balancing manager.

With the logical variable LV\_MFF\_ADD\_AD\_ER\_BAL\_ENA\_EXT it is possible to adapt the main adaptation condition (to start cylinder balancing additive adaptation) with additional external requirements. The flag is used as input signal for the cylinder balancing manager.

A logical calibration constant is available to stop all cylinder balancing interventions at once. In case of LC\_TI\_ER\_BAL\_STOP\_MAN = 1, several activation conditions for the cylinder balancing functions are disabled (=0). If the logical constant is enabled (=1), a reinitialisation ("0"[hex]) of all output values occurs.

**Application Condition**

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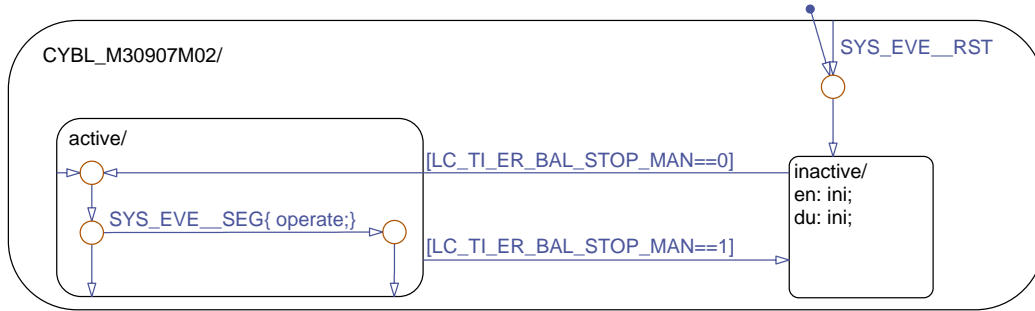



Figure 9.44.1: CYBL\_M30907M02/APP\_CDN/Chart

**Function Description**

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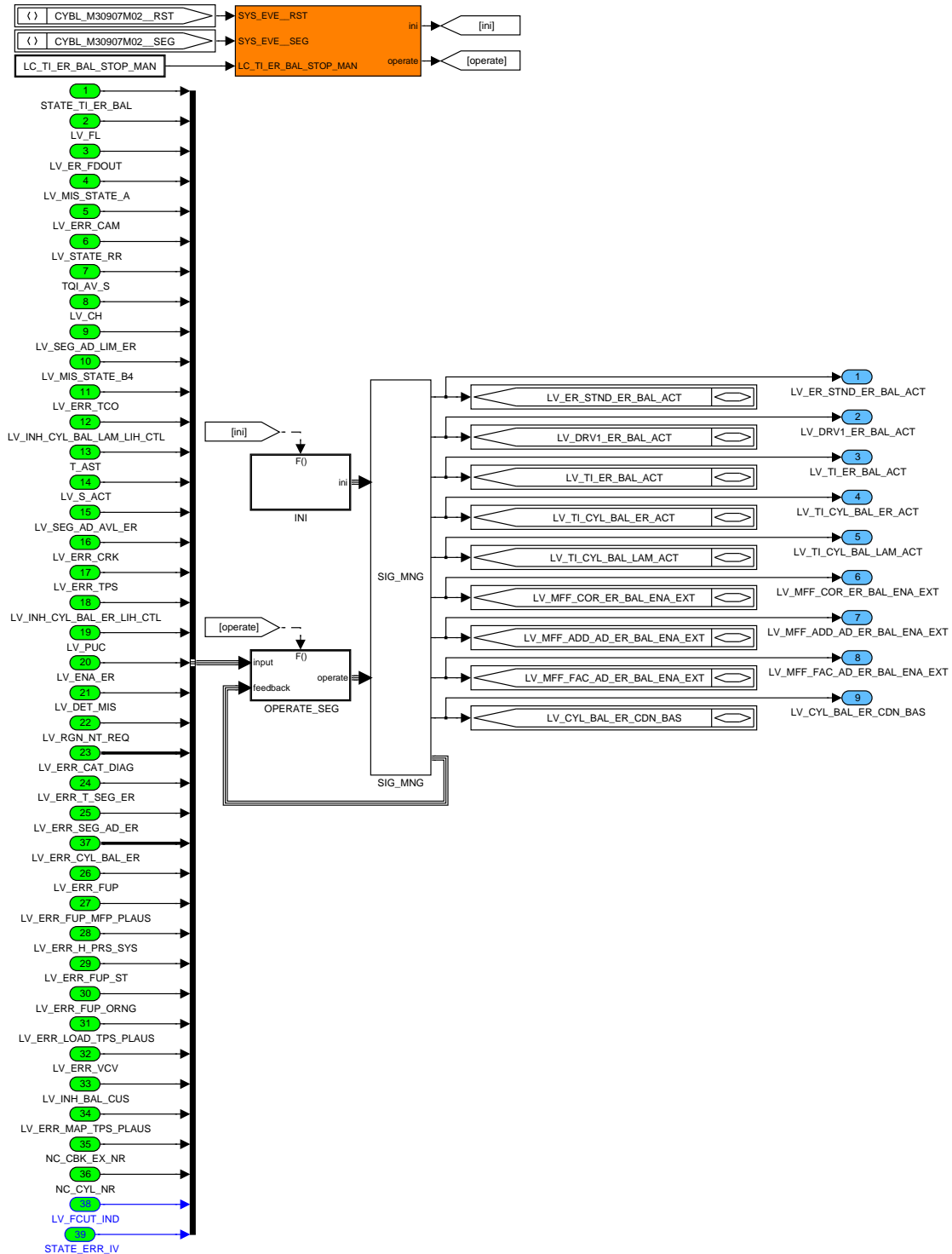


Figure 9.44.2: CYBL\_M30907M02

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### 9.44.1 Calculation of all variables at reset task or LC\_TI\_ER\_BAL\_STOP\_MAN = 1

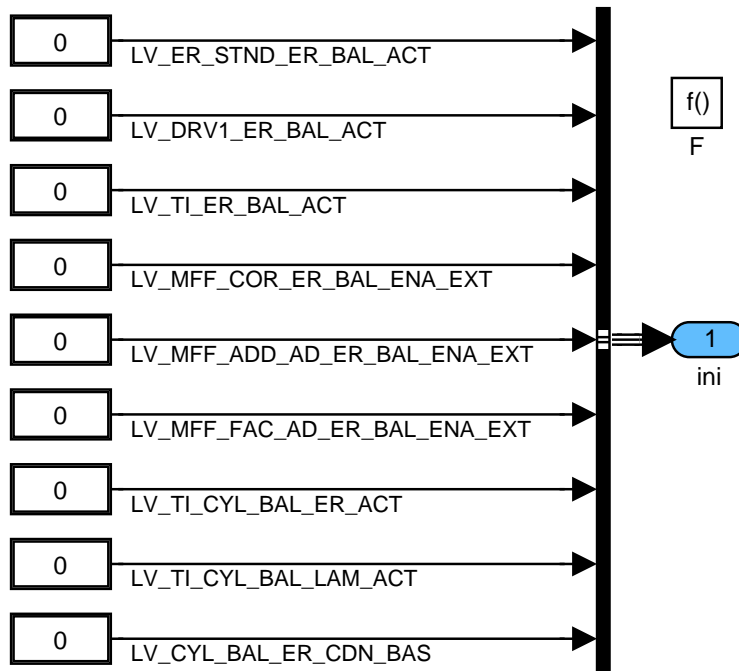


Figure 9.44.3: CYBL\_M30907M02/INI

### 9.44.2 Calculation of segment task

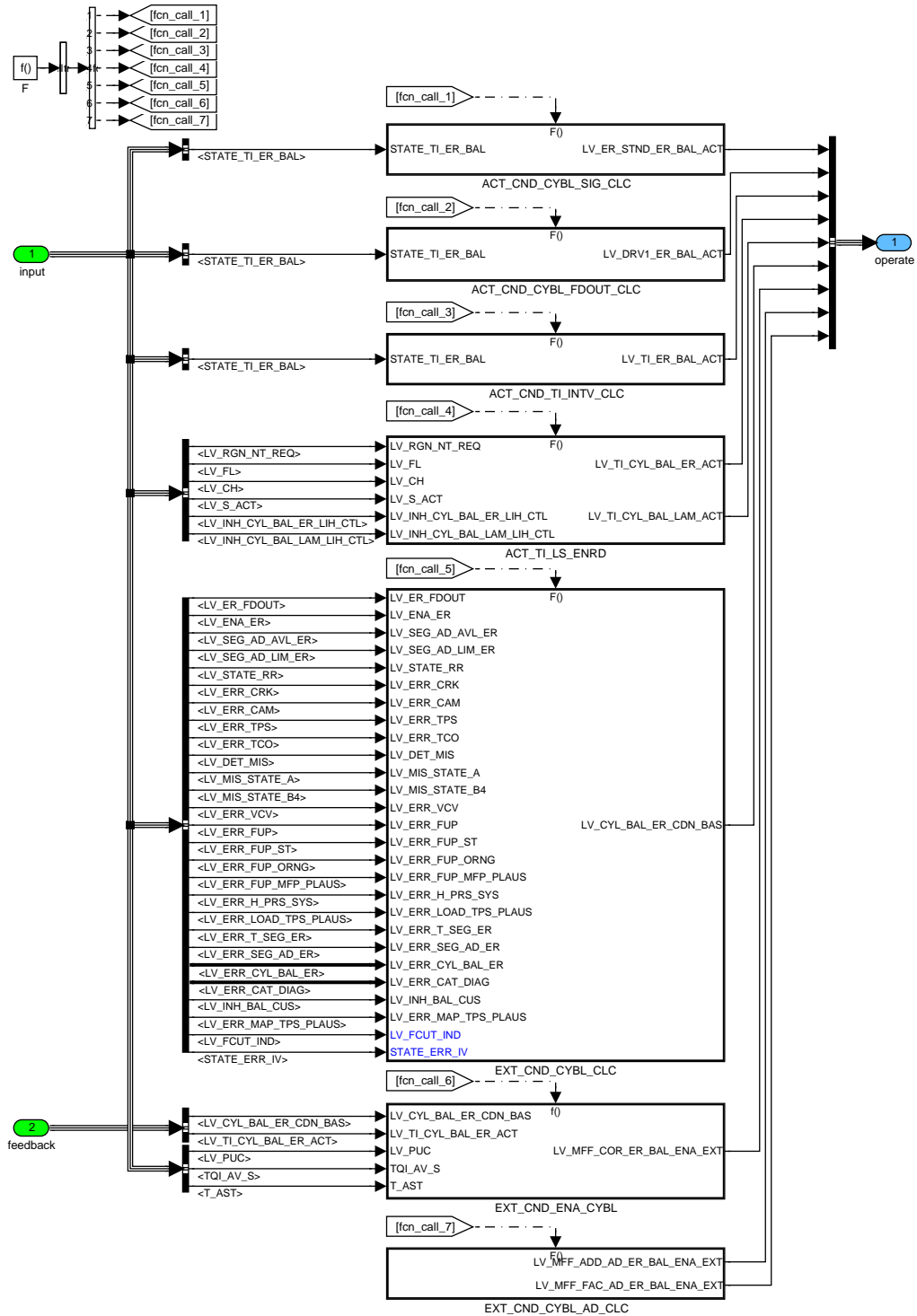



Figure 9.44.4: CYBL\_M30907M02/OPERATE\_SEG

### Activation conditions for cylinder balancing signal preparation calculation

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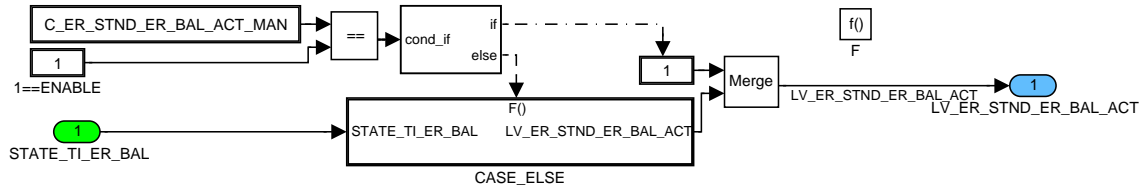


Figure 9.44.5: CYBL\_M30907M02/OPERATE\_SEG/ACT\_CND\_CYBL\_SIG\_CLC

**ACT\_CND\_CYBL\_SIG\_CLC - elseif branch**

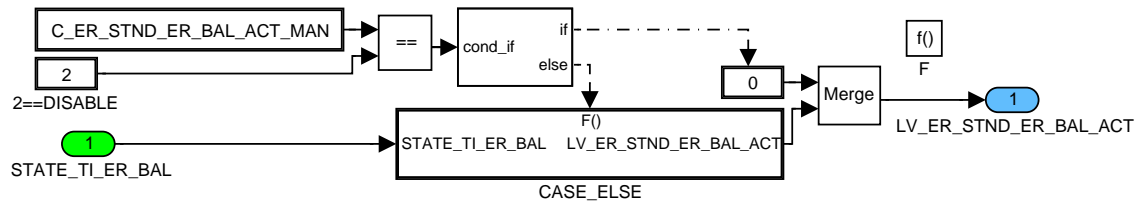


Figure 9.44.6: CYBL\_M30907M02/OPERATE\_SEG/ACT\_CND\_CYBL\_SIG\_CLC/CASE\_ELSE

**ACT\_CND\_CYBL\_SIG\_CLC - elseif branch - else branch**

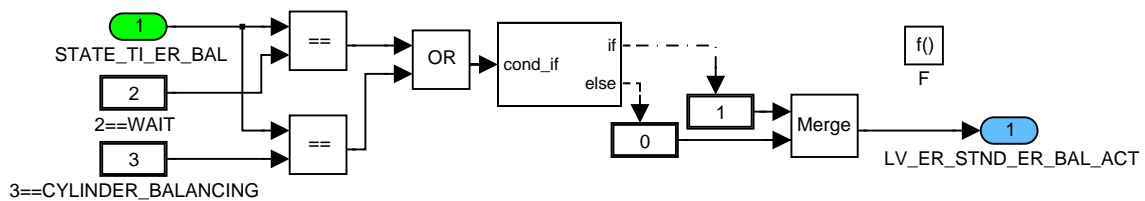


Figure 9.44.7:  
CYBL\_M30907M02/OPERATE\_SEG/ACT\_CND\_CYBL\_SIG\_CLC/CASE\_ELSE/CASE\_ELSE

**Activation conditions for cylinder balancing fade out calculation**

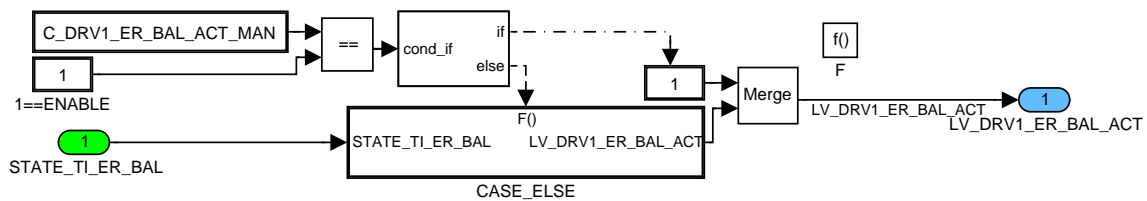


Figure 9.44.8: CYBL\_M30907M02/OPERATE\_SEG/ACT\_CND\_CYBL\_FDOUT\_CLC

**ACT\_CND\_CYBL\_FDOUT\_CLC - elseif branch**

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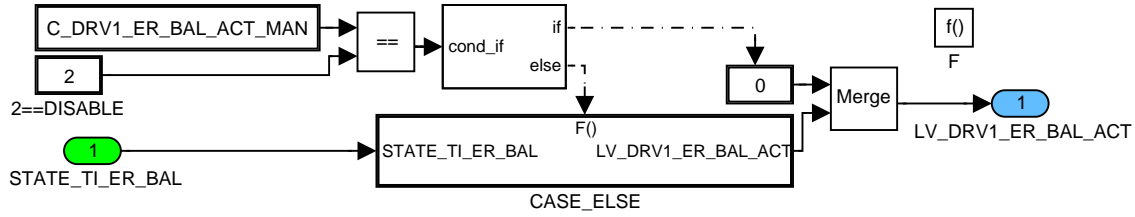


Figure 9.44.9: CYBL\_M30907M02/OPERATE\_SEG/ACT\_CND\_CYBL\_FDOUT\_CLC/CASE\_ELSE

**ACT\_CND\_CYBL\_FDOUT\_CLC - elseif branch - else branch**

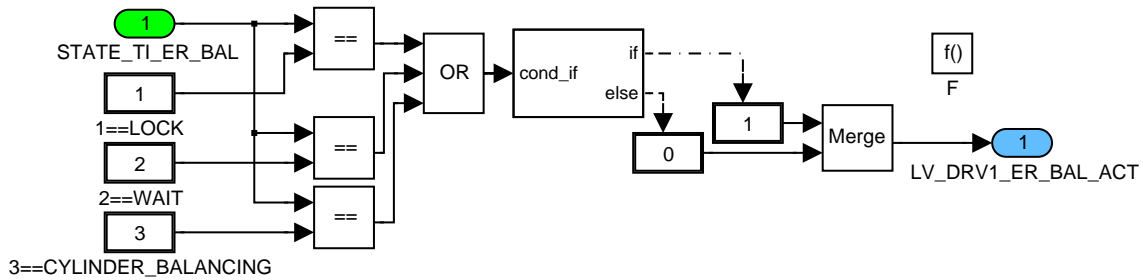


Figure 9.44.10:  
CYBL\_M30907M02/OPERATE\_SEG/ACT\_CND\_CYBL\_FDOUT\_CLC/CASE\_ELSE/CASE\_ELSE

**Activation conditions for cylinder balancing TI intervention calculation**

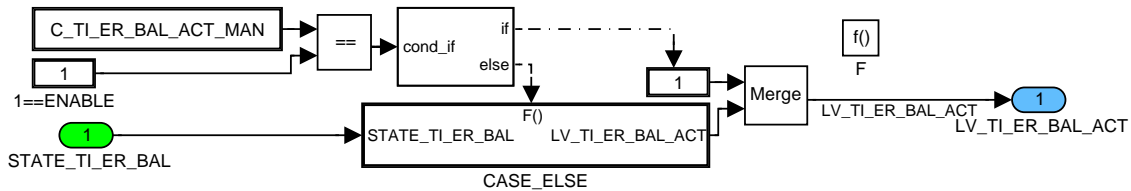


Figure 9.44.11: CYBL\_M30907M02/OPERATE\_SEG/ACT\_CND\_TI\_INTV\_CLC

**ACT\_CND\_TI\_INTV\_CLC - elseif branch**

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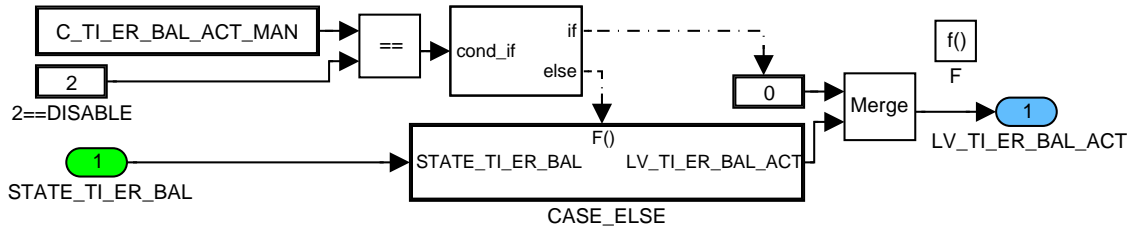


Figure 9.44.12: CYBL\_M30907M02/OPERATE\_SEG/ACT\_CND\_TI\_INTV\_CLC/CASE\_ELSE

**ACT\_CND\_TI\_INTV\_CLC - elseif branch - else branch**

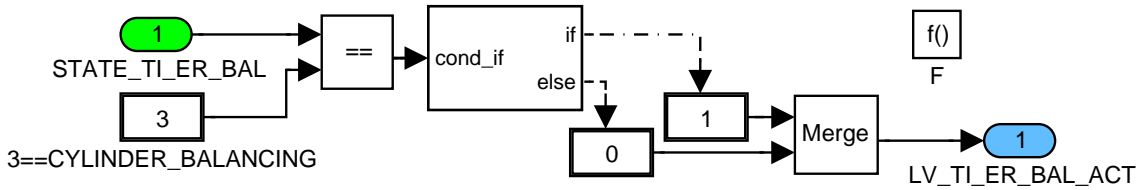


Figure 9.44.13:  
CYBL\_M30907M02/OPERATE\_SEG/ACT\_CND\_TI\_INTV\_CLC/CASE\_ELSE/CASE\_ELSE

**Activation of cylinder balancing (TI intervention) via lambda sensor or engine roughness**

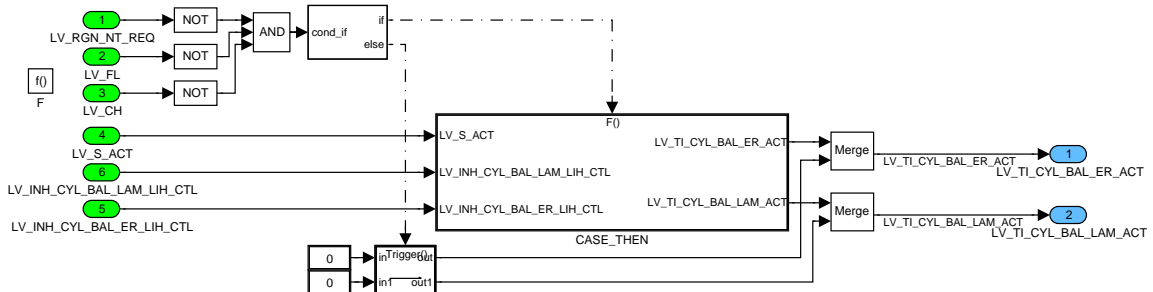


Figure 9.44.14: CYBL\_M30907M02/OPERATE\_SEG/ACT\_TI\_LS\_ENRD

**ACT\_TI\_LS\_ENRD - thenif branch**

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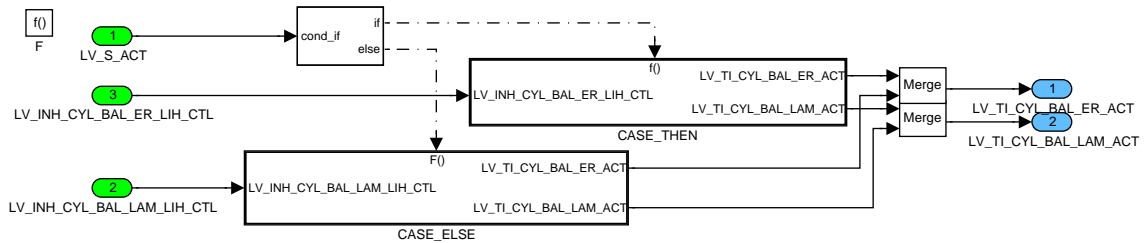


Figure 9.44.15: CYBL\_M30907M02/OPERATE\_SEG/ACT\_TI\_LS\_ENRD/CASE\_THEN

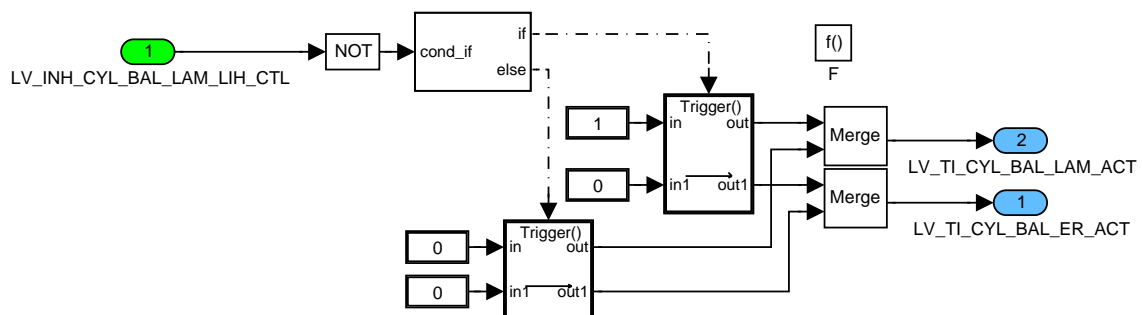
**ACT\_TI\_LS\_ENRD - thenif branch - else branch**

Figure 9.44.16: CYBL\_M30907M02/OPERATE\_SEG/ACT\_TI\_LS\_ENRD/CASE\_THEN/CASE\_ELSE

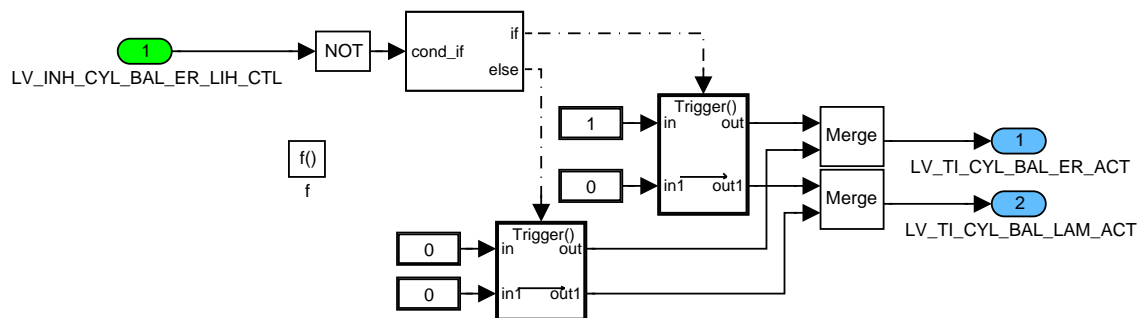

**ACT\_TI\_LS\_ENRD - thenif branch CASE\_THEN**

Figure 9.44.17: CYBL\_M30907M02/OPERATE\_SEG/ACT\_TI\_LS\_ENRD/CASE\_THEN/CASE\_THEN

**Basic condition to enable cylinder balancing manager calculations**

- LV\_ER\_FDOOUT (flag for engine roughness fade out condition)
- LV\_ENA\_ER (calculation of engine roughness (ER) values valid)
- LV\_SEG\_AD\_AVL\_ER (segment adaptation process achieved at least one time)
- LV\_SEG\_AD\_LIM\_ER (engine roughness (ER) adaptation values not out of range)
- LV\_STATE\_RR (no rough road detected)

LV\_ERR\_CRK (no failure present on crankshaft sensor)  
 LV\_ERR\_CAM (no failure present on camshaft sensor)  
 LV\_ERR\_TPS (flag for throttle position error)  
 LV\_ERR\_TCO (flag for TCO sensor error)  
 LV\_ERR\_VCV (flag for voltage supply error)  
 LV\_ERR\_FUP (flag for fuel pressure sensor error)  
 LV\_ERR\_FUP\_ST (flag for "fuel pressure at start to low" error)  
 LV\_ERR\_FUP\_ORNG (flag for "fuel pressure out of range" error)  
 LV\_ERR\_FUP\_MFP\_PLAUS (flag for "FUPmass fuel pump relation" error)  
 LV\_ERR\_H\_PRS\_SYS (flag for abnormal fuel pressure error)  
 LV\_ERR\_LOAD\_TPS\_PLAUS (flag for "LOADthrottle position relation" error)  
 LV\_ERR\_T\_SEG\_ER (flag for "segment time adaptive value" error)  
 LV\_ERR\_SEG\_AD\_ER (flag for "ER segment time adaptation" error)  
 LV\_ERR\_CYL\_BAL\_ER[x] (flag for cylinder balancing error, AND condition over all cylinders  
 [x] is representing each cylinder separately [1...NC\_CYL\_NR])  
 LV\_ERR\_CAT\_DIAG[i] (flag for cat diagnosis error, AND condition over all exhaust banks  
 [i] is representing each exhaust bank separately [1...NC\_CBK\_EX\_NR])  
 LV\_INH\_BAL\_CUS (customer request to inhibit the function)  
 LV\_ERR\_MAP\_TPS\_PLAUS (flag for MAPthrottle position plausibility error)  
 LV\_DET\_MIS (status for actual detected misfire)  
 LV\_MIIS\_STATE\_A (no CARB A[200 CRK] misfire failure present)  
 LV\_MIS\_STATE\_B4 (no CARB B4[1000 CRK] misfire failure present)  
 LV\_FCUT\_IND (flag for cylinder shut off)  
 STATE\_ERR\_IV (error pattern for injection valve failure)

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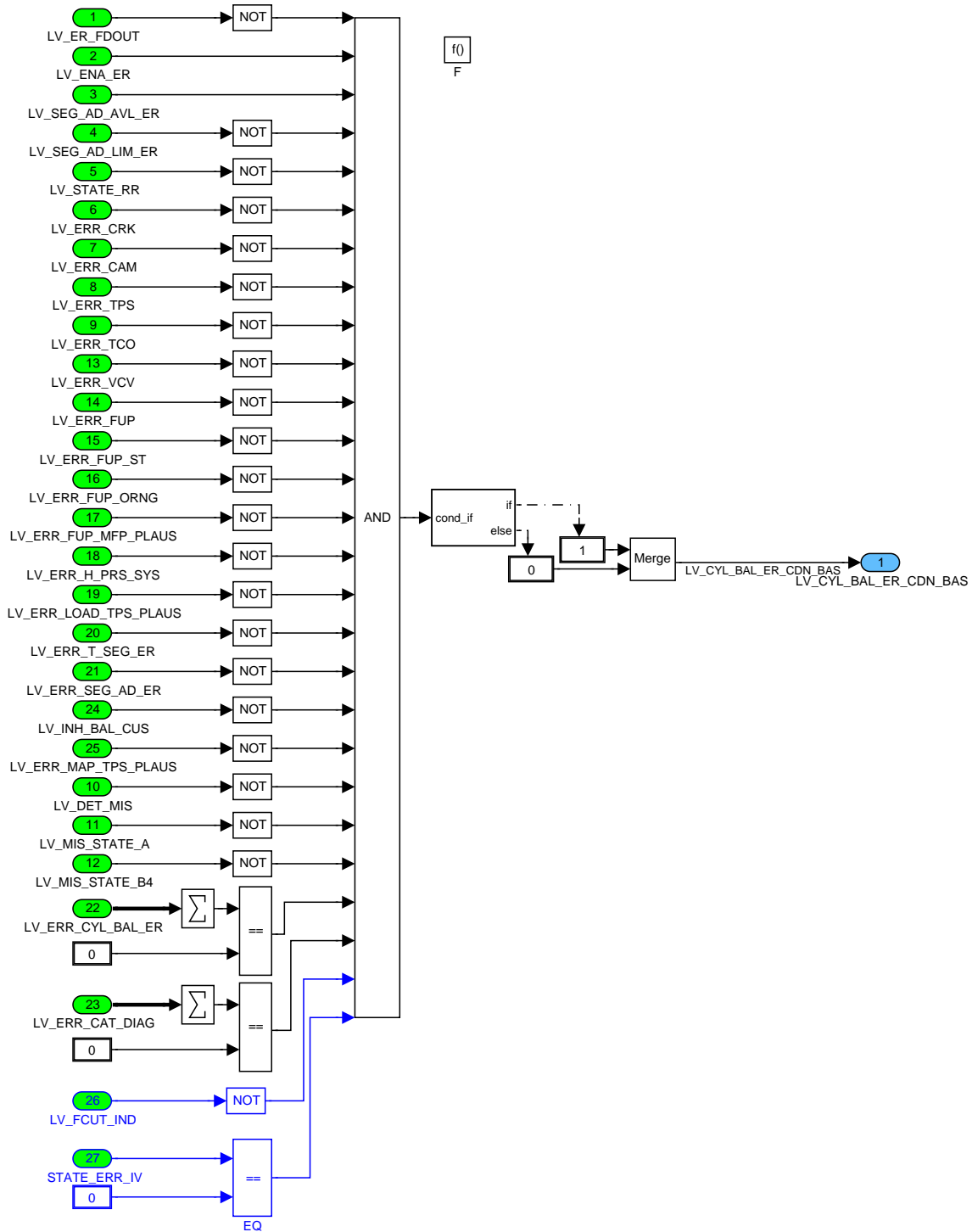



Figure 9.44.18: CYBL\_M30907M02/OPERATE\_SEG/EXT\_CND\_CYBL\_CLC

**External condition to enable cylinder balancing manager calculations**

- LV\_CYL\_BAL\_ER\_CND\_BAS (Flag for basic condition to enable cylinder balancing calculations)
- LV\_TI\_CYL\_BAL\_ER\_ACT (Flag for cylinder balancing (TI intervention) via ER activated)
- LV\_PUC (flag for trailing throttle fuel cut off)

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C\_TQI\_MIN\_TI\_ER\_BAL (minimum indicated engine torque for cylinder balancing)  
 C\_TQI\_MAX\_TI\_ER\_BAL (maximum indicated engine torque for cylinder balancing)  
 C\_T\_AST\_MIN\_TI\_ER\_BAL (minimum time after start for cylinder balancing)

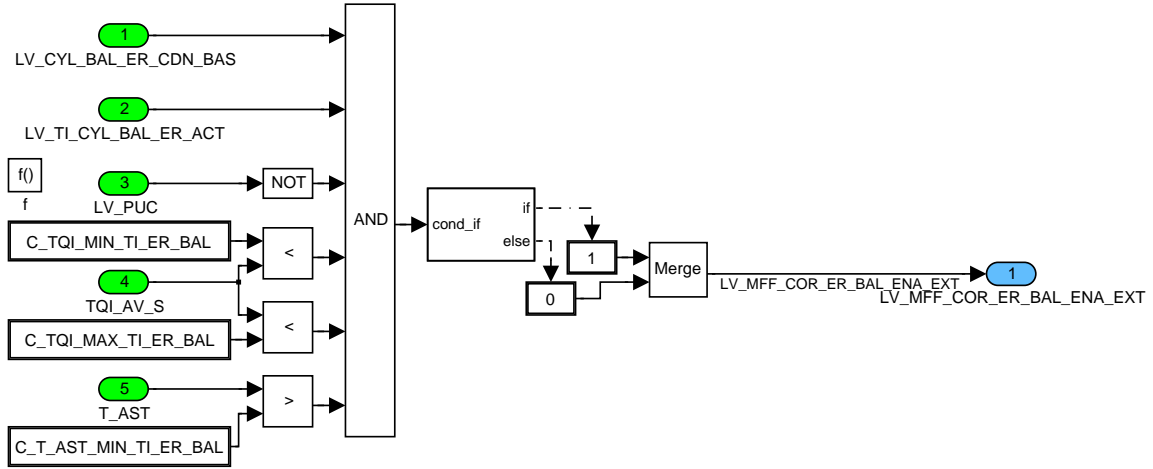


Figure 9.44.19: CYBL\_M30907M02/OPERATE\_SEG/EXT\_CND\_ENA\_CYBL

**External conditions to enable cylinder balancing adaptation manager calculations**

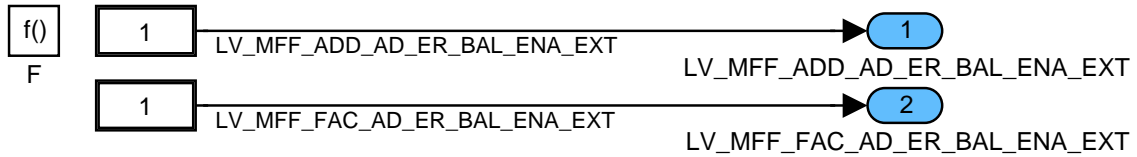


Figure 9.44.20: CYBL\_M30907M02/OPERATE\_SEG/EXT\_CND\_CYBL\_AD\_CLC

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### 9.44.3 SUBFUNCTION: SIG\_MNG

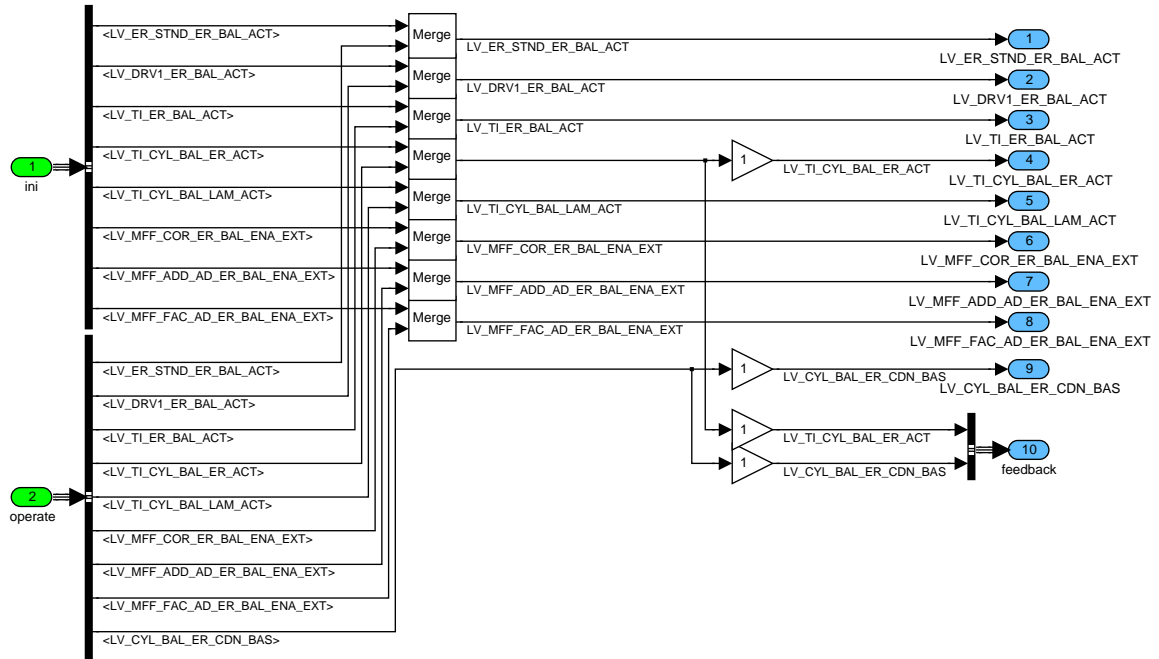



Figure 9.44.21: CYBL\_M30907M02/SIG\_MNG

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## 9.45 CYBL scheduler

### Input data:

ER_STD_MMV_BAL [NC_CYL_NR] {p. 1489}	ER_STND_MMV_BAL [NC_CYL_NR] {p. 1489}	ER_STND_MMV_STD_ BAL [NC_CYL_NR] {p. 1489}	FAC_TI_AD_ER_BAL [NC_CYL_NR] {p. 3298}
LC_CYL_BAL_AD_DC_ RST {p. 4070}	LC_CYL_BAL_AD_EOL_ RST {p. 4046}	LC_CYL_BAL_CORD_DC_ STOP_MAN {p. 4070}	LC_CYL_BAL_CORD_ EOL_STOP_MAN {p. 4046}
LC_FAC_TI_AD_ER_BAL_ RST_MAN {p. 3299}	LC_FAC_TI_BAL_RST_ MAN {p. 3216}	LC_FAC_TI_ER_BAL_ RST_MAN {p. 3299}	LC_MFF_ADD_AD_ER_ BAL_RST_MAN {p. 3270}
LC_MFF_ADD_ER_BAL_ RST_MAN {p. 3270}	LC_TI_ER_BAL_STOP_ MAN {p. 4023}	LV_CYL_BAL_ER_AD_ ADD_EOL {p. 4043}	LV_CYL_BAL_ER_AD_ FAC_EOL {p. 4043}
LV_CYL_BAL_LAM_AD_ ADD [NC_CBK_EX_NR] {p. 4043}	LV_CYL_BAL_LAM_AD_ ADD_DC [NC_CBK_EX_NR] {p. 4066}	LV_CYL_BAL_LAM_AD_ DC {p. 4066}	LV_CYL_BAL_LAM_AD_ EOL {p. 4043}
LV_CYL_BAL_LAM_AD_ FAC [NC_CBK_EX_NR] {p. 4043}	LV_CYL_BAL_LAM_AD_ FAC_H_DC [NC_CBK_EX_NR] {p. 4066}	LV_CYL_BAL_LAM_AD_ FAC_L_DC [NC_CBK_EX_NR] {p. 4066}	LV_CYL_BAL_LAM_SEL_ AD_COLD [NC_CBK_EX_NR] {p. 4043}
LV_CYL_BAL_LAM_SEL_ AD_COLD_DC {p. 4066}	LV_CYL_BAL_LAM_SEL_ AD_COLD_EOL {p. 4043}	LV_CYL_BAL_LAM_SEL_ AD_HOT_DC {p. 4066}	LV_CYL_BAL_LAM_SEL_ AD_HOT_EOL {p. 4043}
LV_CYL_BAL_LAM_SEL_ AD_RNG_H [NC_CBK_EX_NR] {p. 4043}	LV_CYL_BAL_LAM_SEL_ AD_RNG_H_DC [NC_CBK_EX_NR] {p. 4066}	LV_CYL_BAL_LAM_SEL_ AD_RNG_L [NC_CBK_EX_NR] {p. 4043}	LV_CYL_BAL_LAM_SEL_ AD_RNG_L_DC [NC_CBK_EX_NR] {p. 4067}
LV_CYL_BAL_LAM_SEL_ RNG_COLD_DC [NC_CBK_EX_NR] {p. 4067}	MFF_ADD_AD_ER_BAL [NC_CYL_NR] {p. 3269}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}
T_CYL_BAL_LAM_AD_DC {p. 4068}	T_CYL_BAL_LAM_SEL_ DC {p. 4068}		

### FUNCTION DESCRIPTION:

#### General information:

This manager specifies the sequencing of all CYBL tasks.

#### Description:


Within the cylinder balancing package (CYBL), all functions for Cylinder balancing via engine roughness" (CYBL\_ER) are included. This scheduler has to manage the coordination of all involved parts.

#### Application conditions

**Recurrence:** *see formula section below*  
**Activation:** *at every engine operating state*  
**Deactivation:** -

**Formula section:**

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### 9.45.1 Non volatile memory tasks (CYBL\_ER):

<b>NVMY_STB</b>	
NVMY_STB	Engine roughness signal preparation for Cylinder balancing (402U) /* ER_STND_MMV_BAL[x] (NVMY) = 0 /* ER_STND_MMV_STD_BAL[x] (NVMY) = 0 /* ER_STD_MMV_BAL[x] (NVMY) = 0
NVMY_STB	Cylinder balancing via additive MFF intervention (7085) /* MFF_ADD_AD_ER_BAL[x] (NVMY) = 0
NVMY_STB	Cylinder balancing via multiple TI intervention (707Q) /* FAC_TI_AD_ER_BAL[x] (NVMY) = 0
NVMY_STB	Cylinder balancing coordination at EOL (908O) /* LV_CYL_BAL_LAM_AD_EOL (NVMY) = 0 /* LV_CYL_BAL_LAM_SEL_AD_COLD_EOL (NVMY) = 0 /* LV_CYL_BAL_LAM_SEL_AD_HOT_EOL (NVMY) = 0 /* LV_CYL_BAL_ER_AD_FAC_EOL (NVMY) = 0 /* LV_CYL_BAL_ER_AD_ADD_EOL (NVMY) = 0 /* LV_CYL_BAL_LAM_SEL_AD_COLD[m] (NVMY) = 0 /* LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] (NVMY) = 0 /* LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] (NVMY) = 0 /* LV_CYL_BAL_LAM_AD_FAC[m] (NVMY) = 0 /* LV_CYL_BAL_LAM_AD_ADD[m] (NVMY) = 0
NVMY_STB	Cylinder balancing coordination at DC (908P) /* T_CYL_BAL_LAM_SEL_DC (NVMY) = 0 /* T_CYL_BAL_LAM_AD_DC (NVMY) = 0 /* LV_CYL_BAL_LAM_AD_DC (NVMY) = 0 /* LV_CYL_BAL_LAM_SEL_AD_HOT_DC (NVMY) = 0 /* LV_CYL_BAL_LAM_SEL_AD_COLD_DC (NVMY) = 0 /* LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] (NVMY) = 0 /* LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] (NVMY) = 0 /* LV_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] (NVMY) = 0 /* LV_CYL_BAL_LAM_AD_ADD_DC[m] (NVMY) = 0 /* LV_CYL_BAL_LAM_AD_FAC_L_DC[m] (NVMY) = 0 /* LV_CYL_BAL_LAM_AD_FAC_H_DC[m] (NVMY) = 0
<b>NVMY_RST</b>	
NVMY_RST	Engine roughness signal preparation for Cylinder balancing (402U) /* ER_STND_MMV_BAL[x] (NVMY) --> (RAM) /* ER_STND_MMV_STD_BAL[x] (NVMY) --> (RAM) /* ER_STD_MMV_BAL[x] (NVMY) --> (RAM)
NVMY_RST	Cylinder balancing via additive MFF intervention (7085) /* MFF_ADD_AD_ER_BAL[x] (NVMY) --> (RAM)
NVMY_RST	Cylinder balancing via multiple TI intervention (707Q) /* FAC_TI_AD_ER_BAL[x] (NVMY) --> (RAM)
NVMY_RST	Cylinder balancing coordination at EOL (908O) /* LV_CYL_BAL_LAM_AD_EOL (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_SEL_AD_COLD_EOL (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_SEL_AD_HOT_EOL (NVMY) --> (RAM) /* LV_CYL_BAL_ER_AD_FAC_EOL (NVMY) --> (RAM) /* LV_CYL_BAL_ER_AD_ADD_EOL (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_SEL_AD_COLD[m] (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_AD_FAC[m] (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_AD_ADD[m] (NVMY) --> (RAM)
NVMY_RST	Cylinder balancing coordination at DC (908P) /* T_CYL_BAL_LAM_SEL_DC (NVMY) --> (RAM) /* T_CYL_BAL_LAM_AD_DC (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_AD_DC (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_SEL_AD_HOT_DC (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_SEL_AD_COLD_DC (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] (NVMY) --> (RAM)

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	/* LV_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_AD_ADD_DC[m] (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_AD_FAC_L_DC[m] (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_AD_FAC_H_DC[m] (NVMY) --> (RAM)
<b>NVMY_UPD</b>	
NVMY_UPD	Engine roughness signal preparation for Cylinder balancing (402U) /* ER_STND_MMV_BAL[x] (RAM) --> (NVMY) /* ER_STND_MMV_STD_BAL[x] (RAM) --> (NVMY) /* ER_STD_MMV_BAL[x] (RAM) --> (NVMY)
NVMY_UPD	Cylinder balancing via additive MFF intervention (7085) /* MFF_ADD_AD_ER_BAL[x] (RAM) --> (NVMY)
NVMY_UPD	Cylinder balancing via multiple TI intervention (707Q) /* FAC_TI_AD_ER_BAL[x] (RAM) --> (NVMY)
NVMY_UPD	Cylinder balancing coordination at EOL (908O) /* LV_CYL_BAL_LAM_AD_EOL (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_SEL_AD_COLD_EOL (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_SEL_AD_HOT_EOL (RAM) --> (NVMY) /* LV_CYL_BAL_ER_AD_FAC_EOL (RAM) --> (NVMY) /* LV_CYL_BAL_ER_AD_ADD_EOL (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_SEL_AD_COLD[m] (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_AD_FAC[m] (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_AD_ADD[m] (RAM) --> (NVMY)
NVMY_UPD	Cylinder balancing coordination at DC (908P) /* T_CYL_BAL_LAM_SEL_DC (RAM) --> (NVMY) /* T_CYL_BAL_LAM_AD_DC (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_AD_DC (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_SEL_AD_HOT_DC (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_SEL_AD_COLD_DC (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_AD_ADD_DC[m] (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_AD_FAC_L_DC[m] (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_AD_FAC_H_DC[m] (RAM) --> (NVMY)
/* ***** Description ***** /* NVMY_STB: --> Initialization of NVMY cells at first engine run or NVMY error /* NVMY_RST: --> Initialization of RAM cells with NVMY cells at RESET /* NVMY_UPD: --> Initialization of NVMY cells with RAM cells at ECU power latch /* [x] is representing [NC_CYL_NR] at the task definition above /* [m] is representing [NC_CBK_EX_NR] at the task definition above	

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### 9.45.2 Initialization tasks (CYBL\_ER):

<b>RESET (no sequencing behind - only for info)</b>	
RST	/* the RESET of aggregate ENTE has to be performed before CYBL RESET tasks
RST	Cylinder balancing via ER (Appl. Inc.) (704N)
RST	Cylinder balancing manager (Appl. Inc.) (907M)
RST	Engine roughness signal preparation for Cylinder balancing (402U)
RST	Cylinder balancing manager (907L)
RST	Cylinder balancing via multiple TI intervention (707Q)
RST	Cylinder balancing via additive MFF intervention (7085)
RST	Coord. of the injection time correction factors for cylinder balancing (704P)
RST	Cylinder balancing coordination at DC (908P)
RST	Cylinder balancing coordination at EOL (908O)
<b>EXIT_ST (no sequencing behind - only for info)</b>	
EXIT_ST	Cylinder balancing coordination at EOL (908O - chapter 1.3)
<b>STOP_MAN (no system event , section located within SW code- only for info)</b>	
# IF (LC_TI_ER_BAL_STOP_MAN = 1)	
STOP_MAN	Cylinder balancing manager (Appl. Inc.) (907M) /* Initialization at manual stop of function
STOP_MAN	Cylinder balancing manager (907L) /* Initialization at manual stop of function
# ENDIF	
# IF (LC_CYL_BAL_CORD_EOL_STOP_MAN = 1)	
STOP_MAN	Cylinder balancing coordination at EOL (908O - chapter 1.4, 1.5, 1.6) /* Initialization at manual stop of functions
# ENDIF	
# IF (LC_CYL_BAL_CORD_DC_STOP_MAN = 1)	
STOP_MAN	Cylinder balancing coordination at DC (908P - chapter 1.2, 1.3, 1.4, 1.5, 1.6) /* Initialization at manual stop of function
# ENDIF	
<b>RESET_MAN (no system event, section located within SW code - only for info)</b>	
# IF (LC_FAC_TI_BAL_RST_MAN = 1)	
RST_MAN	Coord. of the injection time correction factors for cylinder balancing (704P) /* Manual reset of injector energy correction values
# ENDIF	
# IF (LC_MFF_ADD_ER_BAL_RST_MAN = 1)	
RST_MAN	Cylinder balancing via additive MFF intervention (7085) /* Manual reset of additive correction values
# ENDIF	
# IF (LC_MFF_ADD_AD_ER_BAL_RST_MAN = 1)	
RST_MAN	Cylinder balancing via additive MFF intervention (7085) /* Manual reset of additive adaptation correction values
# ENDIF	
# IF (LC_FAC_TI_ER_BAL_RST_MAN = 1)	
RST_MAN	Cylinder balancing via multiple TI intervention (707Q) /* Manual reset of multiple correction values
# ENDIF	
# IF (LC_FAC_TI_AD_ER_BAL_RST_MAN = 1)	
RST_MAN	Cylinder balancing via multiple TI intervention (707Q) /* Manual reset of multiple adaptation correction values

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# ENDIF	
# IF (LC_CYL_BAL_AD_EOL_RST = 1)	
RST_MAN	Cylinder balancing coordination at EOL (908O) /* Manual reset of cylinder balancing adaptation flags at end of line (EOL)
# ENDIF	
# IF (LC_CYL_BAL_AD_DC_RST = 1)	
RST_MAN	Cylinder balancing coordination at DC (908P) /* Manual reset of cylinder balancing adaptation flags at active driving cycle (DC)
# ENDIF	
<b>RESET_DEAC (no system event , section located within SW code - only for info)</b>	
RST_DEAC	Cylinder balancing coordination at EOL (908O - chapter 1.4, 1.5, 1.6) /* Initialization at function deactivation
RST_DEAC	Cylinder balancing coordination at DC (908P - chapter 1.2, 1.3, 1.4, 1.5, 1.6) /* Initialization at function deactivation
/* ***** Description *****	
/* RST: --> ECU RESET	
/* RST_MAN: --> Initialization with use of a logical constant for setting of the wanted values	
/* RST_DEAC: --> Initialization at function deactivation	
/* STOP_MAN: --> Initialization at manual stop of function	
/* EXIT_ST: --> Initialization at exit start	

### 9.45.3 Recurring tasks(CYBL\_ER):

<b>SEG Task</b>	
CYBL_ER	Cylinder balancing manager (Appl. Inc.) (907M)
CYBL_ER	Engine roughness signal preparation for Cylinder balancing (402U)
CYBL_ER	Cylinder balancing manager (907L)
CYBL_ER	Cylinder balancing via multiple TI intervention (707Q)
CYBL_ER	Cylinder balancing via additive MFF intervention (7085)
CYBL_ER	Coord. of the injection time correction factors for cylinder balancing (704P)
<b>10ms - Task</b>	
CYBL_ER	Cylinder balancing via ER (Appl. Inc.) (704N)
CYBL_ER	Coord. of the injection time correction factors for cylinder balancing (704P)
<b>20ms - Task</b>	
CYBL_ER	Cylinder balancing coordination at DC (908P)
CYBL_ER	Cylinder balancing coordination at EOL (908O)
<b>100ms - Task</b>	
CYBL_ER	Cylinder balancing via ER (Appl. Inc.) (704N)
CYBL_ER	Cylinder balancing via multiple TI intervention (707Q)
CYBL_ER	Cylinder balancing via additive MFF intervention (7085)
CYBL_ER	Coord. of the injection time correction factors for cylinder balancing (704P)
CYBL_ER	Cylinder balancing coordination at DC (908P)
CYBL_ER	Cylinder balancing coordination at EOL (908O)
/* ***** Description *****	

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### 9.45.4 Main interfering AGGR tasks for CYBL\_ER:

<b>AGGR Task before CYBL_ER</b>	
AGGR_xx	
ENSD	Engine Position and Speed Determination
ENRD	Engine Roughness Determination
FMSP	Fuel Mass Setpoint
LACO	Lambda Control
CILC	Cylinder Individual Lambda Control
AGGR_xx	
<b>CYBL_ER Task</b>	
CYBL_ER	Cylinder balancing via engine roughness
<b>AGGR - Task after CYBL_ER</b>	
AGGR_xx	
INJR	Injection Realisation
IGRE	Ignition Realisation
AGGR_xx	
/* ***** Description *****	

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## 9.46 Cylinder balancing coordination at EOL

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CYL_BAL_LAM_CBK_AD [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Counter for cylinder balancing lambda adaptation at end of line within limits					
ER_STND_MMV_DIF_BAL_DYW	V	8000... 7FFFH	-325.78 ...325.77	0.00994	1/s <sup>2</sup>
Dynamic window value for cylinder balancing engine roughness adaptation at end of line					
ER_STND_MMV_DIF_BAL_MAX_DYW	V	8000... 7FFFH	-325.78 ...325.77	0.00994	1/s <sup>2</sup>
Maximum ER_STND_MMV_BAL value for dynamic window calculation at end of line					
ER_STND_MMV_DIF_BAL_MIN_DYW	V	8000... 7FFFH	-325.78 ...325.77	0.00994	1/s <sup>2</sup>
Minimum ER_STND_MMV_BAL value for dynamic window calculation at end of line					
LV_CYL_BAL_AD_WG_OPEN_REQ_EOL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag for waste gate open requested for cylinder balancing adaptation at end of line					
LV_CYL_BAL_AD_WG_OPEN_TMP_EOL [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for temporary waste gate open request for cylinder balancing adaptation at end of line					
LV_CYL_BAL_ER_AD_ADD_EOL	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing additive engine roughness adaptation at end of line finished					
LV_CYL_BAL_ER_AD_FAC_EOL	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing multiple engine roughness adaptation at end of line finished					
LV_CYL_BAL_LAM_AD_ADD [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation (additive) exhaust bank specific					
LV_CYL_BAL_LAM_AD_EOL	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation at end of line finished					
LV_CYL_BAL_LAM_AD_FAC [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation (multiple) exhaust bank specific					
LV_CYL_BAL_LAM_SEL_AD_COLD [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation (cold) exhaust bank specific					
LV_CYL_BAL_LAM_SEL_AD_COLD_EOL	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation (cold) at end of line finished					
LV_CYL_BAL_LAM_SEL_AD_HOT_EOL	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation (hot) at end of line finished					
LV_CYL_BAL_LAM_SEL_AD_RNG_H [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation (high range) exhaust bank specific					
LV_CYL_BAL_LAM_SEL_AD_RNG_L [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation (low range) exhaust bank specific					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_STATE_CYL_BAL_LAM_CHG_AD	V	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation to state adaptation requested					
LV_STATE_CYL_BAL_LAM_CHG_WAIT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation to state wait requested					
LV_STATE_CYL_BAL_SEL_CHG_AD	V	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation to state adaptation requested					
LV_STATE_CYL_BAL_SEL_CHG_WAIT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation to state wait requested					
STATE_CYL_BAL_ER_AD_EOL	V	0H 1H 2H	Ready Wait Adaptation	-	-
State of cylinder balancing engine roughness adaptation at end of line					
STATE_CYL_BAL_LAM_AD_EOL	V	0H 1H 2H	Ready Wait Adaptation	-	-
State of cylinder balancing lambda adaptation at end of line					
STATE_CYL_BAL_LAM_SEL_AD_EOL	V	0H 1H 2H	Ready Wait Adaptation	-	-
State of cylinder balancing cylinder selective lambda adaptation at end of line					
T_CYL_BAL_ER_AD	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing engine roughness adaptation at end of line					
T_CYL_BAL_ER_AD_DYW	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing engine roughness adaptation at end of line within limits					
T_CYL_BAL_LAM_AD	V	0... FFFFH	0... 1310.7	0.02	s
Time for cylinder balancing lambda adaptation at end of line					
T_CYL_BAL_LAM_SEL_AD	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing cylinder selective lambda adaptation at end of line					
T_CYL_BAL_LAM_SEL_CBK_AD [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing cylinder selective lambda adaptation at end of line within limits					

**Input data:**


DIST_KWP {p. 1183}	ER_STND_MMV_DIF_BAL [NC_CYL_NR] {p. 1489}	FAC_CYL_LAM_ABSV_ SUM [NC_CBK_EX_NR] {p. 2730}	FAC_L_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}
FAC_LAM_ADJ_LAM_AD [NC_CBK_EX_NR] {p. 2641}	FAC_LAM_CYL_SEL_ ADJ_CST [NC_CYL_NR] {p. 2731}	FAC_LAM_CYL_SEL_ ADJ_H_RNG [NC_CYL_NR] {p. 2731}	FAC_LAM_CYL_SEL_ ADJ_L_RNG [NC_CYL_NR] {p. 2731}
FAC_TI_AD_ER_BAL [NC_CYL_NR] {p. 3298}	LC_TCHA_CONF {p. 658}	LV_CYL_BAL_AD_EOL_ EXT_ADJ {p. 7483}	LV_FAC_L_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}
LV_FAC_TI_AD_ER_BAL_ ENA {p. 4006}	LV_LAM_AD_STOP [NC_CBK_EX_NR] {p. 2642}	LV_LAM_CYL_ENA_CYL_ BAL_DC [NC_CBK_EX_NR] {p. 2864}	LV_LAM_CYL_SEL_ADJ_ VLD [NC_CBK_EX_NR] {p. 2732}

LV_MFF_ADD_AD_ER_BAL_ENA {p. 4006}	LV_MFF_ADD_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2642}	LV_TI_CYL_BAL_ER_ACT {p. 4022}	LV_TI_CYL_BAL_LAM_ACT {p. 4022}
MFF_ADD_AD_ER_BAL [NC_CYL_NR] {p. 3269}	MFF_ADD_LAM_AD [NC_CBK_EX_NR] {p. 2642}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}
NC_CYL_NR {p. 1526}	STATE_LAM_CYL_SEL_ADJ [NC_CBK_EX_NR] {p. 2733}	STATE_TI_ER_BAL {p. 4006}	T_AST_BAL {p. 3261}
TCO {p. 1100}	TCO_ST_BAL {p. 3261}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_DEC_CYL_BAL_LAM_CBK_AD	-	0... FFFFH	0... 65535	1	-
Counter decrement value for cylinder balancing lambda adaptation within limits at end of line					
C_CTR_MIN_CYL_BAL_LAM_AD_ADD	-	0... FFFFH	0... 65535	1	-
Minimum counter value for cylinder balancing lambda adaptation (additive) within limits at end of line					
C_CTR_MIN_CYL_BAL_LAM_AD_FAC	-	0... FFFFH	0... 65535	1	-
Minimum counter value for cylinder balancing lambda adaptation (multiple) within limits at end of line					
C_CYL_BAL_AD_EOL_RST	-	0H	ZERO	-	-
		1H	ON		
		2H	LAM_AD		
		3H	SEL_COLD		
		4H	SEL_HOT		
		5H	ER_FAC		
		6H	ER_ADD		
7H	WG_OPEN				
Reset of cylinder balancing adaptation readiness flags at end of line					
C_CYL_BAL_LAM_AD_EOL_CONF	-	0H	ZERO	-	-
		1H	ADD		
		2H	FAC_L		
		3H	ADD_FAC_L		
Configuration of lambda adaptation correction values for cylinder balancing at end of line					
C_CYL_BAL_LAM_SEL_HOT_EOL_CONF	-	0H	ZERO	-	-
		1H	LOW		
		2H	HIGH		
		3H	LOW_HIGH		
Configuration of cylinder selectiv lambda adaptation correction values (hot) for cylinder balancing at end of line					
C_T_DEC_CYL_BAL_ER_AD_DYN	-	0... FFFFH	0... 6553.5	0.1	s
Time decrement value for cylinder balancing engine roughness adaptation within limits at end of line					
C_T_DEC_CYL_BAL_LAM_SEL_CBK_AD	-	0... FFFFH	0... 6553.5	0.1	s
Time decrement value for cylinder balancing cylinder selectiv lambda adaptation within limits at end of line					
C_T_MAX_CYL_BAL_ER_AD	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time for cylinder balancing engine roughness adaptation at end of line					
C_T_MAX_CYL_BAL_LAM_AD	-	0... FFFFH	0... 1310.7	0.02	s
Maximum time for cylinder balancing lambda adaptation at end of line					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MAX_CYL_BAL_LAM_SEL_AD_COLD	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time for cylinder balancing cylinder selective lambda adaptation (cold) at end of line					
C_T_MAX_CYL_BAL_LAM_SEL_AD_HOT	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time for cylinder balancing cylinder selective lambda adaptation (hot) at end of line					
C_T_MIN_CYL_BAL_ER_AD_DYN	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time for cylinder balancing engine roughness adaptation within limits at end of line					
C_T_MIN_CYL_BAL_LAM_SEL_AD_COLD	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time for cylinder balancing cylinder selective lambda adaptation (cold) within limits at end of line					
C_T_MIN_CYL_BAL_LAM_SEL_AD_HOT	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time for cylinder balancing cylinder selective lambda adaptation (hot) within limits at end of line					
C_TCO_MAX_CYL_BAL_WG_OPEN	-	0... FEH	-48... 142.5	0.75	°C
Maximum coolant temperature for cylinder balancing waste gate open request at end of line					
IP_ER_STND_MMV_DIF_BAL_DYW	-	0... FFFFH	-325.78 ...325.77	0.00994	1/s <sup>2</sup>
LDP_N_32_IP_ER_STND_MMV_DIF_DYW	6	0... FFH	0... 8160	32	rpm
LDP_DIST_KWP_IP_ER_STND_DIF_DYW	6	0... FFFFH	0... 524280	8	km
Dynamic window threshold for cylinder balancing engine roughness adaptation within limits at end of line					
IP_FAC_CYL_LAM_ABSV_SUM_CYL_BAL	-	0... 7FFFH	0... 49.998474	1.5259e-3	%
LDP_DIST_KWP_IP_FAC_CYL_LAM_BAL	4	0... FFFFH	0... 524280	8	km
Threshold for cylinder balancing cylinder selective lambda adaptation within limits at end of line					
IP_FAC_L_LAM_ADJ_DIF_CYL_BAL	-	0... FFFFH	-50... 49.998474	1.5259e-3	%
LDP_DIST_KWP_IP_FAC_L_LAM_BAL	4	0... FFFFH	0... 524280	8	km
Lambda factor threshold for cylinder balancing lambda adaptation within limits at end of line					
IP_FAC_MFF_LAM_ADJ_DIF_CYL_BAL	-	0... FFFFH	-50... 49.998474	1.5259e-3	%
LDP_DIST_KWP_IP_FAC_MFF_LAM_BAL	4	0... FFFFH	0... 524280	8	km
Lambda additive threshold for cylinder balancing lambda adaptation within limits at end of line					
IP_T_AST_MAX_CYL_BAL_WG_OPEN	-	0... FFFFH	0... 6553.5	0.1	s
LDP_TCO_ST_BAL_IP_T_AST_WG_OPEN	4	0... FEH	-48... 142.5	0.75	°C
Maximum time after start for cylinder balancing waste gate open request at end of line					
LC_CYL_BAL_AD_EOL_RST	-	0... 1H	0 ...1	1	-
Manual switch for cylinder balancing adaptation reset at end of line					
LC_CYL_BAL_CORD_EOL_STOP_MAN	-	0... 1H	0 ...1	1	-
Logical constant for manual stop (=1) of cylinder balancing coordination at end of line					

## FUNCTION DESCRIPTION:

### General information:

Task of the cylinder balancing coordination is to observe the balancing adaptation functions at end of line test and to set a readiness information as soon as a defined adaptation limit for each adaptation has been reached.


### Application conditions

#### Initialization at first Engine run or NVMY-error:

```

LV_CYL_BAL_LAM_AD_EOL = 0                               (first initialization)
LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = 0                       (first initialization)
LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 0                       (first initialization)
LV_CYL_BAL_ER_AD_FAC_EOL = 0                            (first initialization)
LV_CYL_BAL_ER_AD_ADD_EOL = 0                            (first initialization)
FOR m = 0 to NC_CBK_EX_NR - 1

```

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LV_CYL_BAL_LAM_SEL_AD_COLD[m] = 0           (first initialization)
LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] = 0         (first initialization)
LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] = 0         (first initialization)
LV_CYL_BAL_LAM_AD_FAC[m] = 0               (first initialization)
LV_CYL_BAL_LAM_AD_ADD[m] = 0               (first initialization)

```

**END FOR**

### Initialization at Reset:

```

LV_CYL_BAL_LAM_AD_EOL = LV_CYL_BAL_LAM_AD_EOL      (NVMY)
LV_CYL_BAL_ER_AD_FAC_EOL = LV_CYL_BAL_ER_AD_FAC_EOL (NVMY)
LV_CYL_BAL_ER_AD_ADD_EOL = LV_CYL_BAL_ER_AD_ADD_EOL (NVMY)
LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = LV_CYL_BAL_LAM_SEL_AD_COLD_
EOL (NVMY)
LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = LV_CYL_BAL_LAM_SEL_AD_HOT_
EOL (NVMY)

```

### FOR m = 0 to NC\_CBK\_EX\_NR - 1

```

LV_CYL_BAL_LAM_SEL_AD_COLD[m] = LV_CYL_BAL_LAM_SEL_AD_COLD[m]      (NVMY)
LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] = LV_CYL_BAL_LAM_SEL_AD_RNG_L[m]    (NVMY)
LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] = LV_CYL_BAL_LAM_SEL_AD_RNG_H[m]    (NVMY)
LV_CYL_BAL_LAM_AD_FAC[m] = LV_CYL_BAL_LAM_AD_FAC[m]                 (NVMY)
LV_CYL_BAL_LAM_AD_ADD[m] = LV_CYL_BAL_LAM_AD_ADD[m]                 (NVMY)

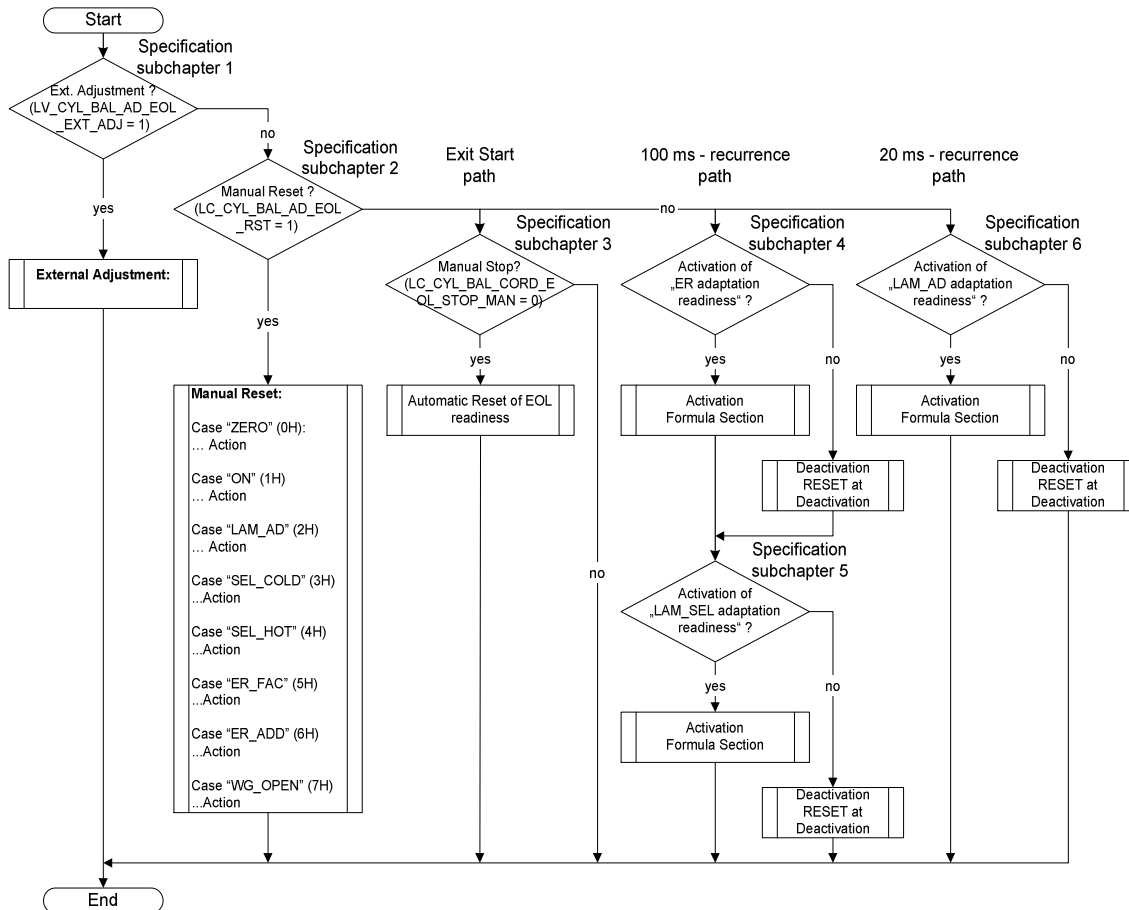
```

**END FOR**

(NVMY: values stored in the non-volatile memory)

**Recurrence:** See separate chapters  
**Activation:** See separate chapters  
**Deactivation:** See separate chapters

### Signal flow diagram:



### 9.46.1 External adjustment of cylinder balancing readiness at end of line (EOL):

#### FUNCTION DESCRIPTION:

#### General information:

In case of an external adjustment (request from key word protocoll) the readiness bits for all cylinder balancing adaptation functions at EOL are set to zero. While the external adjustment is activated, all following subchapters within the module "Cylinder balancing coordination at EOL" are deactivated and the corresponding "Initialization at Deactivation" process for this chapters is blocked during the period.

#### Application conditions


**Recurrence:** 100 ms

**Activation:**  $LV\_CYL\_BAL\_AD\_EOL\_EXT\_ADJ = 1$

**Deactivation:**  $LV\_CYL\_BAL\_AD\_EOL\_EXT\_ADJ = 0$

#### Formula section:

$LV\_CYL\_BAL\_LAM\_AD\_EOL = 0$

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```

LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = 0
LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 0
LV_CYL_BAL_ER_AD_FAC_EOL = 0
LV_CYL_BAL_ER_AD_ADD_EOL = 0
FOR m = 0 to NC_CBK_EX_NR - 1
    LV_CYL_BAL_LAM_SEL_AD_COLD[m] = 0
    LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] = 0
    LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] = 0
    LV_CYL_BAL_LAM_AD_FAC[m] = 0
    LV_CYL_BAL_LAM_AD_ADD[m] = 0
END FOR

```

## 9.46.2 Manual reset of cylinder balancing readiness at end of line (EOL):

### FUNCTION DESCRIPTION:

#### General information:

In case of a manual reset it is possible to adjust the exported output data to a wanted value to make the function test and handling more easier. While the manual function reset is activated, all following subchapters within the module "Cylinder balancing coordination at EOL" are deactivated and the corresponding "Initialization at Deactivation" process for this chapters is blocked during the period.

#### Application conditions

**Recurrence:** 100 ms

**Activation:** LV\_CYL\_BAL\_AD\_EOL\_EXT\_ADJ = 0    **and**  
LC\_CYL\_BAL\_AD\_EOL\_RST = 1

**Deactivation:** LV\_CYL\_BAL\_AD\_EOL\_EXT\_ADJ = 0    **and**  
[ LC\_CYL\_BAL\_AD\_EOL\_RST = 0 ]


#### Formula section:

```

IF          C_CYL_BAL_AD_EOL_RST = ZERO (0H)
THEN       LV_CYL_BAL_LAM_AD_EOL = 0
              LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = 0
              LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 0
              LV_CYL_BAL_ER_AD_FAC_EOL = 0
              LV_CYL_BAL_ER_AD_ADD_EOL = 0
              FOR m = 0 to NC_CBK_EX_NR - 1
                  LV_CYL_BAL_LAM_SEL_AD_COLD[m] = 0
                  LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] = 0
                  LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] = 0
                  LV_CYL_BAL_LAM_AD_FAC[m] = 0
                  LV_CYL_BAL_LAM_AD_ADD[m] = 0
                  LV_CYL_BAL_AD_WG_OPEN_REQ_EOL[m] = 0
              END FOR

ELSEIF     C_CYL_BAL_AD_EOL_RST = ON (1H)
THEN       LV_CYL_BAL_LAM_AD_EOL = 1

```

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```

LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = 1
LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 1
LV_CYL_BAL_ER_AD_FAC_EOL = 1
LV_CYL_BAL_ER_AD_ADD_EOL = 1
FOR m = 0 to NC_CBK_EX_NR - 1
    LV_CYL_BAL_LAM_SEL_AD_COLD[m] = 1
    LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] = 1
    LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] = 1
    LV_CYL_BAL_LAM_AD_FAC[m] = 1
    LV_CYL_BAL_LAM_AD_ADD[m] = 1
    LV_CYL_BAL_AD_WG_OPEN_REQ_EOL[m] = 1
END FOR

```

```

ELSEIF C_CYL_BAL_AD_EOL_RST = LAM_AD (2H)
THEN LV_CYL_BAL_LAM_AD_EOL = 1

```

```

ELSEIF C_CYL_BAL_AD_EOL_RST = SEL_COLD (3H)
THEN LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = 1

```

```

ELSEIF C_CYL_BAL_AD_EOL_RST = SEL_HOT (4H)
THEN LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 1

```

```

ELSEIF C_CYL_BAL_AD_EOL_RST = ER_FAC (5H)
THEN LV_CYL_BAL_ER_AD_FAC_EOL = 1

```

```

ELSEIF C_CYL_BAL_AD_EOL_RST = ER_ADD (6H)
THEN LV_CYL_BAL_ER_AD_ADD_EOL = 1

```

```

ELSEIF C_CYL_BAL_AD_EOL_RST = WG_OPEN (7H)
THEN

```

```

    FOR m = 0 to NC_CBK_EX_NR - 1
        LV_CYL_BAL_AD_WG_OPEN_REQ_EOL[m] = 1
    END FOR

```

```

ENDIF

```

### 9.46.3 Automatic reset of cylinder balancing end of line (EOL) readiness:

#### FUNCTION DESCRIPTION:

#### General information:

In case of lost adaptation values due to a manual reset at the garage or faulty non-volatile memory entries, the system detects the changes and the corresponding end of line readiness is reset automatically.


#### Application conditions:

*Initialization at exit start (EXIT\_ST):*

```

IF LC_CYL_BAL_CORD_EOL_STOP_MAN = 0 and
   LC_CYL_BAL_AD_EOL_RST = 0 and
   LV_CYL_BAL_AD_EOL_EXT_ADJ = 0

```

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**THEN**

Reset of cylinder balancing global lambda adaptation readiness:

**IF (1)** LV\_CYL\_BAL\_LAM\_AD\_EOL = 1

**THEN (1)**

**IF (2)** ( C\_CYL\_BAL\_LAM\_AD\_EOL\_CONF = FAC\_L (2H) **or**

C\_CYL\_BAL\_LAM\_AD\_EOL\_CONF = ADD\_FAC\_L (3H)) **and**

$$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} |FAC\_L\_RNG\_LAM\_AD[m]| = 0$$

**THEN (2)** LV\_CYL\_BAL\_LAM\_AD\_EOL = 0

**FOR** m = 0 to NC\_CBK\_EX\_NR - 1

LV\_CYL\_BAL\_LAM\_AD\_FAC[m] = 0

**END FOR**

**ENDIF (2)**

**IF (2)** ( C\_CYL\_BAL\_LAM\_AD\_EOL\_CONF = ADD (1H) **or**

C\_CYL\_BAL\_LAM\_AD\_EOL\_CONF = ADD\_FAC\_L (3H)) **and**

$$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} |MFF\_ADD\_LAM\_AD[m]| = 0$$

**THEN (2)** LV\_CYL\_BAL\_LAM\_AD\_EOL = 0

**FOR** m = 0 to NC\_CBK\_EX\_NR - 1

LV\_CYL\_BAL\_LAM\_AD\_ADD[m] = 0

**END FOR**

**ENDIF (2)**

**ENDIF (1)**

Reset of cylinder balancing lambda selective (cold condition) adaptation readiness:

**IF (1)** LV\_CYL\_BAL\_LAM\_SEL\_AD\_COLD\_EOL = 1

**THEN (1)**

**IF (2)**  $\sum_{i=0}^{i=NC\_CYL\_NR-1} |FAC\_LAM\_CYL\_SEL\_ADJ\_CST[i]| = 0$

**THEN (2)** LV\_CYL\_BAL\_LAM\_SEL\_AD\_COLD\_EOL = 0

**FOR** m = 0 to NC\_CBK\_EX\_NR - 1

LV\_CYL\_BAL\_LAM\_SEL\_AD\_COLD[m] = 0

**END FOR**

**ENDIF (2)**


**ENDIF (1)**

Reset of cylinder balancing lambda selective (hot condition) adaptation readiness:

**IF (1)** LV\_CYL\_BAL\_LAM\_SEL\_AD\_HOT\_EOL = 1

**THEN (1)**

**IF (2)** ( C\_CYL\_BAL\_LAM\_SEL\_HOT\_EOL\_CONF = LOW (1H) **or**  
C\_CYL\_BAL\_LAM\_SEL\_HOT\_EOL\_CONF = LOW\_HIGH (3H)) **and**

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$$\sum_{i=0}^{i=NC\_CYL\_NR-1} |FAC\_LAM\_CYL\_SEL\_ADJ\_L\_RNG[i]| = 0$$

```

THEN      (2)      LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 0
FOR m = 0 to NC_CBK_EX_NR - 1
    LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] = 0
END FOR
ENDIF (2)
IF (2)    ( C_CYL_BAL_LAM_SEL_HOT_EOL_CONF = HIGH (2H) or
C_CYL_BAL_LAM_SEL_HOT_EOL_CONF = LOW_HIGH (3H) ) and

```

$$\sum_{i=0}^{i=NC\_CYL\_NR-1} |FAC\_LAM\_CYL\_SEL\_ADJ\_H\_RNG[i]| = 0$$

```

THEN      (2)      LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 0
FOR m = 0 to NC_CBK_EX_NR - 1
    LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] = 0
END FOR
ENDIF (2)

```

ENDIF (1)

*Reset of cylinder balancing multiple engine roughness adaptation readiness:*

```

IF (1)    LV_CYL_BAL_ER_AD_FAC_EOL = 1
THEN (1)

```

```

IF (2)     $\sum_{i=0}^{i=NC\_CYL\_NR-1} |FAC\_TI\_AD\_ER\_BAL[i]| = 0$ 

```

```

THEN      (2)      LV_CYL_BAL_ER_AD_FAC_EOL = 0
ENDIF (2)

```

ENDIF (1)

*Reset of cylinder balancing additive engine roughness adaptation readiness:*

```

IF (1)    LV_CYL_BAL_ER_AD_ADD_EOL = 1
THEN (1)

```

```

IF (2)     $\sum_{i=0}^{i=NC\_CYL\_NR-1} |MFF\_ADD\_AD\_ER\_BAL[i]| = 0$ 

```

```

THEN      (2)      LV_CYL_BAL_ER_AD_ADD_EOL = 0
ENDIF (2)


```

ENDIF (1)

ENDIF

## 9.46.4 Calculation of cylinder balancing engine roughness adaptation readiness (EOL):

### FUNCTION DESCRIPTION:

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## General information:

After activation of the corresponding adaptation function (multiple or additive) at stratified combustion mode, a timer is started to observe the filtered engine roughness values used as input for the adaptation controllers. As soon as all controller input values are within a defined range for a specific time interval, readiness is indicated. The function is controlled by a state machine.

## Application conditions:

### *Initialization at Reset or Deactivation*

```
STATE_CYL_BAL_ER_AD_EOL = "Ready" (0[H])
T_CYL_BAL_ER_AD = 0.0[s]
T_CYL_BAL_ER_AD_DYW = 0.0[s]
ER_STND_MMV_DIF_BAL_DYW = 0.0[1/s^2]
ER_STND_MMV_DIF_BAL_MIN_DYW = 0.0[1/s^2]
ER_STND_MMV_DIF_BAL_MAX_DYW = 0.0[1/s^2]
```

*Recurrence:* 100 ms

*Activation:*

```
LC_CYL_BAL_AD_EOL_RST = 0
LV_CYL_BAL_AD_EOL_EXT_ADJ = 0
LC_CYL_BAL_CORD_EOL_STOP_MAN = 0
LC_TCHA_CONF = 0
LV_TI_CYL_BAL_ER_ACT = 1
( LV_CYL_BAL_ER_AD_FAC_EOL = 0
  LV_CYL_BAL_ER_AD_ADD_EOL = 0 )
```

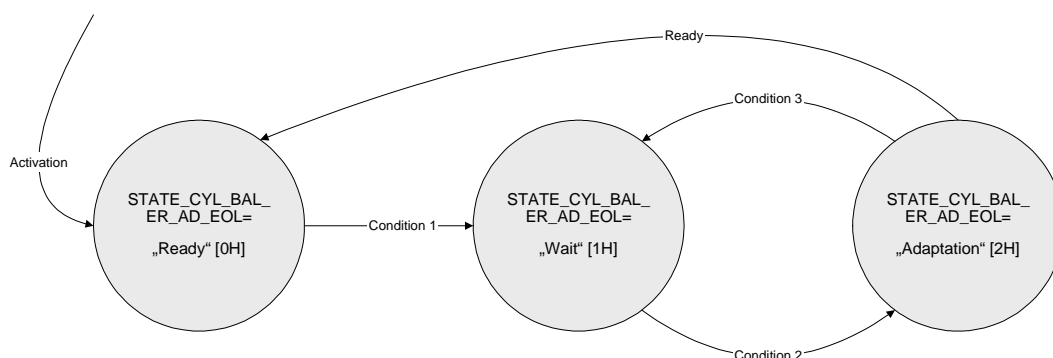
and  
and  
and  
and  
and  
or

*Deactivation:*

```
LC_CYL_BAL_AD_EOL_RST = 0
LV_CYL_BAL_AD_EOL_EXT_ADJ = 0
[ LC_CYL_BAL_CORD_EOL_STOP_MAN = 1
  LC_TCHA_CONF = 1
  LV_TI_CYL_BAL_ER_ACT = 0
  ( LV_CYL_BAL_ER_AD_FAC_EOL = 1 and
    LV_CYL_BAL_ER_AD_ADD_EOL = 1 ) ]
```

and  
and  
or  
or  
and  
]

## Signal flow diagram:



## Formula section:

Note: At function activation always State "Ready" is entered

### Cylinder balancing engine roughness adaptation at EOL: State 0[H] - Ready

Assignments at entry to state Ready :

STATE\_CYL\_BAL\_ER\_AD\_EOL = "Ready" (0[H])

Actions during state "Ready":

Transition to State 1[H] Wait (Condition 1)

*// at least one cylinder balancing engine roughness adaptation at EOL not yet finished*

```
IF          ( LV_CYL_BAL_ER_AD_FAC_EOL = 0 or LV_CYL_BAL_ER_AD_ADD_EOL = 0
)

```

Assignments at exit from state Ready :

No assignments

### Cylinder balancing engine roughness adaptation at EOL: State 1[H] - Wait

Assignments at entry to state Wait :

STATE\_CYL\_BAL\_ER\_AD\_EOL = "Wait" (1[H])

Actions during state "Wait":

Transition to State 2[H] Adaptation (Condition 2)

*// conditions for cylinder balancing engine roughness adaptation achieved (multiple or additive)*

```
IF          ( STATE_TI_ER_BAL = Cylinder Balancing (3[H])          and
              LV_FAC_TI_AD_ER_BAL_ENA = 1                          and
              LV_CYL_BAL_ER_AD_FAC_EOL = 0 )
OR
              ( STATE_TI_ER_BAL = Cylinder Balancing (3[H])          and
              LV_MFF_ADD_AD_ER_BAL_ENA = 1                          and
              LV_CYL_BAL_ER_AD_ADD_EOL = 0 )

```

Assignments at exit from state Wait :

T\_CYL\_BAL\_ER\_AD = 0.0[s]

T\_CYL\_BAL\_ER\_AD\_DYW = 0.0[s]

ER\_STND\_MMV\_DIF\_BAL\_MAX\_DYW = 0.0[1/s<sup>2</sup>]

ER\_STND\_MMV\_DIF\_BAL\_MIN\_DYW = 0.0[1/s<sup>2</sup>]

### Cylinder balancing engine roughness adaptation at EOL: State 2[H] - Adaptation

Assignments at entry to state Adaptation :

STATE\_CYL\_BAL\_ER\_AD\_EOL = "Adaptation" (2[H])

Actions during state "Adaptation":

Calculations:

*// incrementation of cylinder balancing engine roughness adaptation time with 0.1[s]*

T\_CYL\_BAL\_ER\_AD(n) = T\_CYL\_BAL\_ER\_AD(n-1) + 0.1[s]

*// determination of MIN- and MAX-dynamic window values for overall filtered engine roughness values*

FOR i = 0 to NC\_CYL\_NR - 1

```
IF          ER_STND_MMV_DIF_BAL[i] > ER_STND_MMV_DIF_BAL_MAX_DYW
THEN
ER_STND_MMV_DIF_BAL_MAX_DYW = ER_STND_MMV_DIF_BAL[i]
ELSEIF
ER_STND_MMV_DIF_BAL[i] < ER_STND_MMV_DIF_BAL_MIN_DYW
THEN
ER_STND_MMV_DIF_BAL_MIN_DYW = ER_STND_MMV_DIF_BAL[i]
ENDIF

```

END FOR


*// calculation of dynamic window based on MIN- and MAX-dynamic window values*

ER\_STND\_MMV\_DIF\_BAL\_DYW = ER\_STND\_MMV\_DIF\_BAL\_MAX\_DYW -  
ER\_STND\_MMV\_DIF\_BAL\_MIN\_DYW

*// calculation of cylinder balancing engine roughness adaptation time within dynamic window*

```
IF          ER_STND_MMV_DIF_BAL_DYW < IP_ER_STND_MMV_DIF_BAL_DYW

```

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```

THEN      T_CYL_BAL_ER_AD_DYW(n) = T_CYL_BAL_ER_AD_DYW(n-1) + 0.1[s]
ELSE      T_CYL_BAL_ER_AD_DYW(n) = T_CYL_BAL_ER_AD_DYW(n-1) -
              C_T_DEC_CYL_BAL_ER_AD_DYN
              // counter value limited to zero, no timer underrun possible

ENDIF
// calculation of cylinder balancing engine roughness adaptation readiness at end of line
IF (1)     T_CYL_BAL_ER_AD ≥ C_T_MAX_CYL_BAL_ER_AD or
              T_CYL_BAL_ER_AD_DYW ≥ C_T_MIN_CYL_BAL_ER_AD_DYN
THEN (1)
    IF (2)     LV_FAC_TI_AD_ER_BAL_ENA = 1
    THEN (2)    LV_CYL_BAL_ER_AD_FAC_EOL = 1
    ELSE (2)   LV_CYL_BAL_ER_AD_ADD_EOL = 1
    ENDIF(2)
ENDIF (1)
// initialization of MIN- and MAX-dynamic window values for next dynamic window calculation
ER_STND_MMV_DIF_BAL_MAX_DYW = 0.0[1/s^2]
ER_STND_MMV_DIF_BAL_MIN_DYW = 0.0[1/s^2]
Transition to State 0[H] "Ready (Ready)
// cylinder balancing engine roughness adaptation at EOL finished
IF         ( LV_CYL_BAL_ER_AD_FAC_EOL = 1 and LV_CYL_BAL_ER_AD_ADD_EOL = 1
)
Transition to State 1[H] Wait (Condition 3)
// conditions for cylinder balancing engine roughness adaptation not achieved
IF         STATE_TI_ER_BAL ≠ Cylinder Balancing (3[H])
    OR
    ( LV_FAC_TI_AD_ER_BAL_ENA = 0 and LV_MFF_ADD_AD_ER_BAL_ENA = 0 )
    OR
    ( LV_FAC_TI_AD_ER_BAL_ENA = 1 and LV_CYL_BAL_ER_AD_FAC_EOL = 1 )
    OR
    ( LV_MFF_ADD_AD_ER_BAL_ENA = 1 and LV_CYL_BAL_ER_AD_ADD_EOL = 1
)
Assignments at exit from state Adaptation :
No assignments

```

### 9.46.5 Calculation of cylinder balancing selective lambda adaptation readiness (EOL):

#### FUNCTION DESCRIPTION:

#### General information:

After activation of the corresponding adaptation function (hot or cold) at homogenous combustion mode, a timer is started to observe the characteristic quantity of estimated cylinder individual lambda deviation. As soon as the deviation values are within a defined range for a specific time interval, readiness is indicated. The function is controlled by a state machine.

#### Application conditions:

*Initialization at Reset or Deactivation*

```

FOR m = 0 to NC_CBK_EX_NR - 1
    LV_STATE_CYL_BAL_SEL_CHG_WAIT[m] = 0

```

```

LV_CYL_BAL_AD_WG_OPEN_REQ_EOL[m] = 0
LV_CYL_BAL_AD_WG_OPEN_TMP_EOL[m] = 0
T_CYL_BAL_LAM_SEL_CBK_AD[m] = 0.0[s]
END FOR
T_CYL_BAL_LAM_SEL_AD = 0.0[s]
LV_STATE_CYL_BAL_SEL_CHG_AD = 0
STATE_CYL_BAL_LAM_SEL_AD_EOL = "Ready" (0[H])

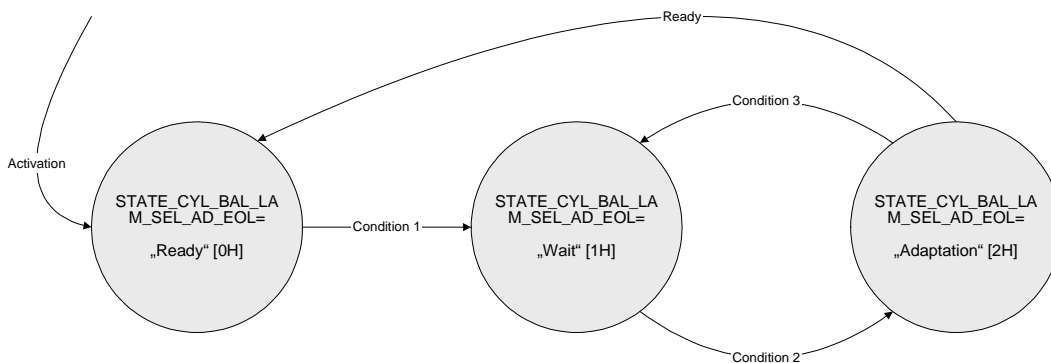
```

Recurrence: 100 ms

Activation:                   LC\_CYL\_BAL\_AD\_EOL\_RST = 0                   **and**  
                                  LV\_CYL\_BAL\_AD\_EOL\_EXT\_ADJ = 0                   **and**  
                                  LC\_CYL\_BAL\_CORD\_EOL\_STOP\_MAN = 0                   **and**  
                                  LV\_TI\_CYL\_BAL\_LAM\_ACT = 1                   **and**  
                                  ( LV\_CYL\_BAL\_LAM\_SEL\_AD\_COLD\_EOL = 0                   **or**  
                                  LV\_CYL\_BAL\_LAM\_SEL\_AD\_HOT\_EOL = 0 )                   **or**

Deactivation:                   LC\_CYL\_BAL\_AD\_EOL\_RST = 0                   **and**  
                                  LV\_CYL\_BAL\_AD\_EOL\_EXT\_ADJ = 0                   **and**  
                                  [            LC\_CYL\_BAL\_CORD\_EOL\_STOP\_MAN = 1                   **or**  
  LV\_TI\_CYL\_BAL\_LAM\_ACT = 0                   **or**  
  ( LV\_CYL\_BAL\_LAM\_SEL\_AD\_COLD\_EOL = 1 **and**  
  LV\_CYL\_BAL\_LAM\_SEL\_AD\_HOT\_EOL = 1 )                   **]**

### Signal flow diagram:



### Formula section:

```

// calculation of request for waste gate open for turbo engine (LC_TCHA_CONF=1)
IF                    LC_TCHA_CONF=1
THEN                // for turbo engine
                      FOR m = 0 to NC_CBK_EX_NR - 1
                      IF            LV_LAM_CYL_ENA_CYL_BAL_DC[m] = 1
                      AND
                      T_AST_BAL < IP_T_AST_MAX_CYL_BAL_WG_OPEN
                      AND
                      ( [ TCO < C_TCO_MAX_CYL_BAL_WG_OPEN                   and
                      LV_CYL_BAL_LAM_SEL_AD_COLD[m] = 0                   ]

```



```

OR
  [ TCO > C_TCO_MAX_CYL_BAL_WG_OPEN                and
    { LV_CYL_BAL_LAM_SEL_AD_RNG_L[m]                = 0    or
      LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] = 0          }      ]
THEN LV_CYL_BAL_AD_WG_OPEN_TMP_EOL[m] = 1
ELSE LV_CYL_BAL_AD_WG_OPEN_TMP_EOL[m] = 0
ENDIF
END FOR
FOR m = 0 to NC_CBK_EX_NR - 1

IF  $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_AD\_WG\_OPEN\_TMP\_EOL[m] > 0$ 

THEN LV_CYL_BAL_AD_WG_OPEN_REQ_EOL[m] = 1
ELSE LV_CYL_BAL_AD_WG_OPEN_REQ_EOL[m] = 0
ENDIF
END FOR
ELSE // for non turbo engine
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_AD_WG_OPEN_REQ_EOL[m] = 0
END FOR
ENDIF

```

// calculation of state machine cylinder balancing selective lambda adaptation readiness at EOL

Note: At function activation always State "Ready" is entered

#### Cylinder balancing selective lambda adaptation at EOL: State 0[H] - Ready

Assignments at entry to state Ready :

STATE\_CYL\_BAL\_LAM\_SEL\_AD\_EOL = "Ready" (0[H])

Actions during state "Ready":

Transition to State 1[H] Wait (Condition 1)

// at least one cylinder balancing selective lambda adaptation at EOL not yet finished

```

IF LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = 0 or
LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 0

```

Assignments at exit from state Ready :

No assignments

#### Cylinder balancing selective lambda adaptation at EOL: State 1[H] - Wait

Assignments at entry to state Wait :

STATE\_CYL\_BAL\_LAM\_SEL\_AD\_EOL = "Wait" (1[H])

Actions during state "Wait":

// calculation of logical value to change state to adaptation

```

FOR m = 0 to NC_CBK_EX_NR - 1

```

```

IF ( STATE_LAM_CYL_SEL_ADJ[m] = ADJ_ENG_COLD (2[H]) and
LV_CYL_BAL_LAM_SEL_AD_COLD[m] = 0 )

```

OR

```

( STATE_LAM_CYL_SEL_ADJ[m] = ADJ_NOM_L_RNG (4[H]) and
LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] = 0 )

```

OR

```

( STATE_LAM_CYL_SEL_ADJ[m] = ADJ_NOM_H_RNG (5[H]) and
LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] = 0 )

```

```

THEN LV_STATE_CYL_BAL_SEL_CHG_AD = 1

```

```

ENDIF

```

**END FOR**

Transition to State 2[H] Adaptation (Condition 2)

*// conditions for cylinder selective lambda adaptation achieved (cold or hot)*

**IF** LV\_STATE\_CYL\_BAL\_SEL\_CHG\_AD = 1

Assignments at exit from state Wait :

T\_CYL\_BAL\_LAM\_SEL\_AD = 0.0[s]

LV\_STATE\_CYL\_BAL\_SEL\_CHG\_AD = 0

**FOR** m = 0 to NC\_CBK\_EX\_NR - 1

T\_CYL\_BAL\_LAM\_SEL\_CBK\_AD[m] = 0.0[s]

**END FOR****Cylinder balancing selective lambda adaptation at EOL: State 2[H] - Adaptation**

Assignments at entry to state Adaptation :

STATE\_CYL\_BAL\_LAM\_SEL\_AD\_EOL = "Adaptation" (2[H])

Actions during state "Adaptation":

Calculations:

*// calculation of logical value to change state to wait*

**FOR** m = 0 to NC\_CBK\_EX\_NR - 1

**IF** ( STATE\_LAM\_CYL\_SEL\_ADJ[m] <> ADJ\_ENG\_COLD (2[H]) **and**  
 STATE\_LAM\_CYL\_SEL\_ADJ[m] <> ADJ\_NOM\_L\_RNG (4[H]) **and**  
 STATE\_LAM\_CYL\_SEL\_ADJ[m] <> ADJ\_NOM\_H\_RNG (5[H]) )

**OR**  
 ( STATE\_LAM\_CYL\_SEL\_ADJ[m] = ADJ\_ENG\_COLD (2[H]) **and**  
 LV\_CYL\_BAL\_LAM\_SEL\_AD\_COLD[m] = 1 )

**OR**  
 ( STATE\_LAM\_CYL\_SEL\_ADJ[m] = "ADJ\_NOM\_L\_RNG (4[H]) **and**  
 LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_L[m] = 1 )

**OR**  
 ( STATE\_LAM\_CYL\_SEL\_ADJ[m] = "ADJ\_NOM\_H\_RNG (5[H]) **and**  
 LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_H[m] = 1 )

**THEN** LV\_STATE\_CYL\_BAL\_SEL\_CHG\_WAIT[m] = 1

T\_CYL\_BAL\_LAM\_SEL\_CBK\_AD[m] = 0.0[s]

**ELSE** LV\_STATE\_CYL\_BAL\_SEL\_CHG\_WAIT[m] = 0

**ENDIF**

**END FOR**

*// incrementation of cylinder selective lambda adaptation time with 0.1[s]*

T\_CYL\_BAL\_LAM\_SEL\_AD(n) = T\_CYL\_BAL\_LAM\_SEL\_AD(n-1) + 0.1[s]

*// determination of characteristic quantity of estimated cylinder individual lambda deviation values*

**FOR** (1) m = 0 to NC\_CBK\_EX\_NR - 1

**IF** (2) LV\_LAM\_CYL\_SEL\_ADJ\_VLD[m] = 1

**THEN** (2)


**IF** FAC\_CYL\_LAM\_ABSV\_SUM[m] < IP\_FAC\_CYL\_LAM\_ABSV\_SUM\_CYL\_BAL

**THEN** T\_CYL\_BAL\_LAM\_SEL\_CBK\_AD[m](n) =  
 T\_CYL\_BAL\_LAM\_SEL\_CBK\_AD[m](n-1) + 0.1[s]  
*// timer incrementation with 0.1[s]*

**ELSE** T\_CYL\_BAL\_LAM\_SEL\_CBK\_AD[m](n) =  
 T\_CYL\_BAL\_LAM\_SEL\_CBK\_AD[m](n-1) -  
 C\_T\_DEC\_CYL\_BAL\_LAM\_SEL\_CBK\_AD  
*// timer value limited to zero, no timer underrun possible*

**ENDIF**

**ENDIF** (2)

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**END FOR (1)**

*// calculation of cylinder selective lambda adaptation readiness at end of line (exhaust bank specific)*

**FOR** m = 0 to NC\_CBK\_EX\_NR - 1

**IF (1a)** STATE\_LAM\_CYL\_SEL\_ADJ[m] = ADJ\_ENG\_COLD (2[H]) **and**  
LV\_CYL\_BAL\_LAM\_SEL\_AD\_COLD[m] = 0

**THEN (1a)**

**IF** T\_CYL\_BAL\_LAM\_SEL\_CBK\_AD[m] >  
C\_T\_MIN\_CYL\_BAL\_LAM\_SEL\_AD\_COLD **or**  
T\_CYL\_BAL\_LAM\_SEL\_AD >  
C\_T\_MAX\_CYL\_BAL\_LAM\_SEL\_AD\_COLD  
**THEN** LV\_CYL\_BAL\_LAM\_SEL\_AD\_COLD[m] = 1  
**ENDIF**

**ELSEIF (1b)** STATE\_LAM\_CYL\_SEL\_ADJ[m] = "ADJ\_NOM\_L\_RNG (4[H]) **and**

LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_L[m] = 0

**THEN (1b)**

**IF** T\_CYL\_BAL\_LAM\_SEL\_CBK\_AD[m] >  
C\_T\_MIN\_CYL\_BAL\_LAM\_SEL\_AD\_HOT **or**  
T\_CYL\_BAL\_LAM\_SEL\_AD >  
C\_T\_MAX\_CYL\_BAL\_LAM\_SEL\_AD\_HOT  
**THEN** LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_L[m] = 1  
**ENDIF**

**ELSEIF (1c)** STATE\_LAM\_CYL\_SEL\_ADJ[m] = "ADJ\_NOM\_H\_RNG (5[H]) **and**

LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_H[m] = 0

**THEN (1c)**

**IF** T\_CYL\_BAL\_LAM\_SEL\_CBK\_AD[m] >  
C\_T\_MIN\_CYL\_BAL\_LAM\_SEL\_AD\_HOT **or**  
T\_CYL\_BAL\_LAM\_SEL\_AD >  
C\_T\_MAX\_CYL\_BAL\_LAM\_SEL\_AD\_HOT  
**THEN** LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_H[m] = 1  
**ENDIF**

**ENDIF (1)**

**END FOR**

*// calculation of cylinder selective lambda adaptation readiness (hot condition) at end of line (global)*

**IF (1a)** C\_CYL\_BAL\_LAM\_SEL\_HOT\_EOL\_CONF = ZERO (0H)

**THEN (1a)**

**FOR** m = 0 to NC\_CBK\_EX\_NR - 1

LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_L[m] = 1

LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_H[m] = 1

**END FOR**

LV\_CYL\_BAL\_LAM\_SEL\_AD\_HOT\_EOL = 1

*// adaptation of all exhaust banks finished at EOL*

**ELSEIF (1b)** C\_CYL\_BAL\_LAM\_SEL\_HOT\_EOL\_CONF = LOW (1H)

**THEN (1b)**

**FOR** m = 0 to NC\_CBK\_EX\_NR - 1

LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_H[m] = 1


**END FOR**

**IF**  $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_L[m] = NC\_CBK\_EX\_NR$

**THEN**

LV\_CYL\_BAL\_LAM\_SEL\_AD\_HOT\_EOL = 1

*// adaptation of all exhaust banks (low range) are finished at EOL*

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```

ENDIF
ELSEIF (1c)          C_CYL_BAL_LAM_SEL_HOT_EOL_CONF = HIGH (2H)
THEN (1c)
  FOR m = 0 to NC_CBK_EX_NR - 1
    LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] = 1
  END FOR

  IF  $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_H[m] = NC\_CBK\_EX\_NR$ 

    THEN
      LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 1
      // adaptation of all exhaust banks (high range) are finished at EOL
    ENDIF
  ELSEIF (1d)          C_CYL_BAL_LAM_SEL_HOT_EOL_CONF = LOW_HIGH (3H)
  THEN (1d)

    IF  $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_L[m] = NC\_CBK\_EX\_NR$ 
      and
       $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_H[m] = NC\_CBK\_EX\_NR$ 

      THEN
        LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 1
        // ad. of all exhaust banks (low and high range) are finished at EOL
      ENDIF
    ENDIF (1)
    // calculation of cylinder selective lambda adaptation readiness (cold condition) at end of line (global)


    IF  $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_SEL\_AD\_COLD[m] = NC\_CBK\_EX\_NR$ 

      THEN
        LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = 1
        // cold adaptation of all exhaust banks are finished at end of line
      ENDIF
    Transition to State 0[H] "Ready (Ready)
    // cylinder selective lambda adaptation at EOL finished
    IF
      LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = 1 and
      LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 1
    Transition to State 1[H] Wait (Condition 3)
    // conditions for cylinder selective lambda adaptation not achieved

    IF  $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_STATE\_CYL\_BAL\_SEL\_CHG\_WAIT[m] = NC\_CBK\_EX\_NR$ 

      // adaptation condition for all exhaust banks are not fulfilled
    Assignments at exit from state Adaptation :
    FOR m = 0 to NC_CBK_EX_NR - 1
      LV_STATE_CYL_BAL_SEL_CHG_WAIT[m] = 0

```

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**END FOR****9.46.6 Calculation of cylinder balancing lambda adaptation readiness (EOL):****FUNCTION DESCRIPTION:****General information:**

After activation of the corresponding adaptation function at homogenous combustion mode, a timer is started to observe the deviation between the actual and the last learned lambda deviation value. As soon as the deviation values are within a defined range for a specific time interval, readiness is indicated. The function is controlled by a state machine.

**Application conditions:***Initialization at Reset or Deactivation*

```

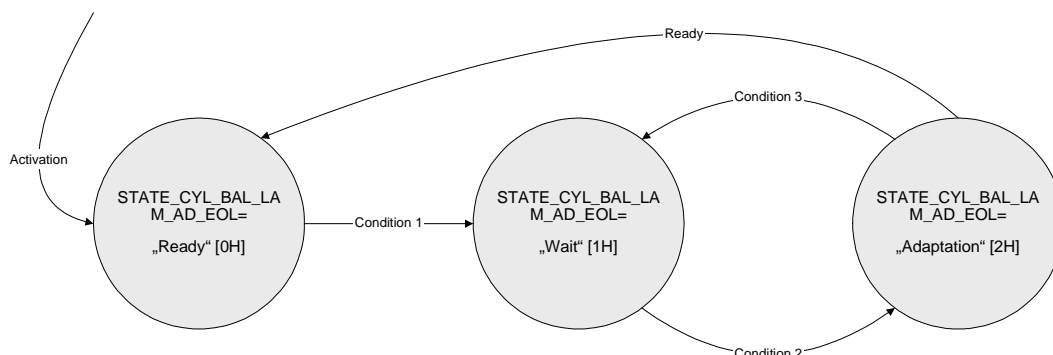
FOR m = 0 to NC_CBK_EX_NR - 1
    LV_STATE_CYL_BAL_LAM_CHG_WAIT[m] = 0
    CTR_CYL_BAL_LAM_CBK_AD[m] = 0
END FOR
T_CYL_BAL_LAM_AD = 0.00[s]
LV_STATE_CYL_BAL_LAM_CHG_AD = 0
STATE_CYL_BAL_LAM_AD_EOL = "Ready" (0[H])

```

*Recurrence:* 20 ms

*Activation:* LC\_CYL\_BAL\_AD\_EOL\_RST = 0 **and**  
 LV\_CYL\_BAL\_AD\_EOL\_EXT\_ADJ = 0 **and**  
 LC\_CYL\_BAL\_CORD\_EOL\_STOP\_MAN = 0 **and**  
 LV\_CYL\_BAL\_LAM\_AD\_EOL = 0

*Deactivation:* LC\_CYL\_BAL\_AD\_EOL\_RST = 0 **and**  
 LV\_CYL\_BAL\_AD\_EOL\_EXT\_ADJ = 0 **and**  
 [ LC\_CYL\_BAL\_CORD\_EOL\_STOP\_MAN = 1 **or**  
 LV\_CYL\_BAL\_LAM\_AD\_EOL = 1 ]

**Signal flow diagram:**

**Formula section:**

Note: At function activation always State "Ready" is entered

**Cylinder balancing lambda adaptation at EOL: State 0[H] - Ready**

Assignments at entry to state Ready :

STATE\_CYL\_BAL\_LAM\_AD\_EOL = "Ready" (0[H])

Actions during state "Ready":

Transition to State 1[H] Wait (Condition 1)

// global lambda adaptation for at least one exhaust bank at EOL not yet finished

IF LV\_CYL\_BAL\_LAM\_AD\_EOL = 0

Assignments at exit from state Ready :

No assignments

**Cylinder balancing lambda adaptation at EOL: State 1[H] - Wait**

Assignments at entry to state Wait :

STATE\_CYL\_BAL\_LAM\_AD\_EOL = "Wait" (1[H])

Actions during state "Wait":

// calculation of logical value to change state to adaptation

FOR m = 0 to NC\_CBK\_EX\_NR - 1

IF ( LV\_FAC\_L\_RNG\_LAM\_AD[m] = 1 and LV\_CYL\_BAL\_LAM\_AD\_FAC[m] = 0 )

OR

( LV\_MFF\_ADD\_RNG\_LAM\_AD[m] = 1 and LV\_CYL\_BAL\_LAM\_AD\_ADD[m] = 0 )

THEN LV\_STATE\_CYL\_BAL\_LAM\_CHG\_AD = 1

ENDIF

END FOR

Transition to State 2[H] Adaptation (Condition 2)

// conditions for global lambda adaptation achieved (multiple or additive)

IF LV\_STATE\_CYL\_BAL\_LAM\_CHG\_AD = 1

Assignments at exit from state Wait :

T\_CYL\_BAL\_LAM\_AD = 0.00[s]

LV\_STATE\_CYL\_BAL\_LAM\_CHG\_AD = 0

FOR m = 0 to NC\_CBK\_EX\_NR - 1

CTR\_CYL\_BAL\_LAM\_CBK\_AD[m] = 0

END FOR

**Cylinder balancing lambda adaptation at EOL: State 2[H] - Adaptation**

Assignments at entry to state Adaptation :

STATE\_CYL\_BAL\_LAM\_AD\_EOL = "Adaptation" (2[H])

Actions during state "Adaptation":

Calculations:

// calculation of logical value to change state to wait

FOR m = 0 to NC\_CBK\_EX\_NR - 1

IF ( LV\_FAC\_L\_RNG\_LAM\_AD[m] = 0 and LV\_MFF\_ADD\_RNG\_LAM\_AD[m] = 0 )

OR

( LV\_FAC\_L\_RNG\_LAM\_AD[m] = 1 and LV\_CYL\_BAL\_LAM\_AD\_FAC[m] = 1 )

OR

( LV\_MFF\_ADD\_RNG\_LAM\_AD[m] = 1 and LV\_CYL\_BAL\_LAM\_AD\_ADD[m]

= 1 )


THEN LV\_STATE\_CYL\_BAL\_LAM\_CHG\_WAIT[m] = 1

CTR\_CYL\_BAL\_LAM\_CBK\_AD[m] = 0

ELSE LV\_STATE\_CYL\_BAL\_LAM\_CHG\_WAIT[m] = 0

ENDIF


END FOR

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```

// incrementation of lambda adaptation time with 0.02[s]
T_CYL_BAL_LAM_AD(n) = T_CYL_BAL_LAM_AD (n-1) + 0.02[s]
// determination of deviation between the actual and the last learned lambda adaptation values
FOR m = 0 to NC_CBK_EX_NR - 1
  IF (1)          Transition LV_LAM_AD_STOP[m] = "0" -> "1"
  THEN (1)
    IF (2a)      LV_FAC_L_RNG_LAM_AD[m] = 1
    THEN (2a)
      IF (3a)    | FAC_LAM_ADJ_LAM_AD[m] | <
                 IP_FAC_L_LAM_ADJ_DIF_CYL_BAL
      THEN (3a)  CTR_CYL_BAL_LAM_CBK_AD[m](n) =
                 CTR_CYL_BAL_LAM_CBK_AD[m](n-1) + 1
                 // counter incrementation with 1
      ELSE (3a)  CTR_CYL_BAL_LAM_CBK_AD[m](n) =
                 CTR_CYL_BAL_LAM_CBK_AD[m](n-1) -
                 C_CTR_DEC_CYL_BAL_LAM_CBK_AD
                 // counter value limited to zero, no counter underrun possible
      ENDIF (3a)
    ELSEIF (2b)  LV_MFF_ADD_RNG_LAM_AD[m] = 1
    THEN (2b)
      IF (3b)    | FAC_LAM_ADJ_LAM_AD[m] | <
                 IP_FAC_MFF_LAM_ADJ_DIF_CYL_BAL
      THEN (3b)  CTR_CYL_BAL_LAM_CBK_AD[m](n) =
                 CTR_CYL_BAL_LAM_CBK_AD[m](n-1) + 1
                 // counter incrementation with 1
      ELSE (3b)  CTR_CYL_BAL_LAM_CBK_AD[m](n) =
                 CTR_CYL_BAL_LAM_CBK_AD[m](n-1) -
                 C_CTR_DEC_CYL_BAL_LAM_CBK_AD
                 // counter value limited to zero, no counter underrun possible
      ENDIF (3b)
    ENDIF (2)
  ENDIF (1)
END FOR
// calculation lambda adaptation readiness at end of line (exhaust bank specific)
FOR m = 0 to NC_CBK_EX_NR - 1
  IF (1a)      LV_FAC_L_RNG_LAM_AD[m] = 1          and
               LV_CYL_BAL_LAM_AD_FAC[m] = 0
  THEN (1a)
    IF         T_CYL_BAL_LAM_AD > C_T_MAX_CYL_BAL_LAM_AD          or
               CTR_CYL_BAL_LAM_CBK_AD[m] > C_CTR_MIN_CYL_BAL_LAM_AD_FAC
    THEN       LV_CYL_BAL_LAM_AD_FAC[m] = 1
    ENDIF
  ELSEIF (1b)  LV_MFF_ADD_RNG_LAM_AD[m] = 1          and
               LV_CYL_BAL_LAM_AD_ADD[m] = 0
  THEN (1b)
    IF         T_CYL_BAL_LAM_AD(n) > C_T_MAX_CYL_BAL_LAM_AD          or
               CTR_CYL_BAL_LAM_CBK_AD[m] > C_CTR_MIN_CYL_BAL_LAM_AD_ADD
    THEN       LV_CYL_BAL_LAM_AD_ADD[m] = 1
    ENDIF
  ENDIF (1)
END FOR
// calculation of lambda adaptation readiness at end of line (global)

```

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```

IF (1a)           C_CYL_BAL_LAM_AD_EOL_CONF = ZERO (0H)
THEN (1a)
    FOR m = 0 to NC_CBK_EX_NR - 1
        LV_CYL_BAL_LAM_AD_FAC[m] = 1
        LV_CYL_BAL_LAM_AD_ADD[m] = 1
    END FOR
    LV_CYL_BAL_LAM_AD_EOL = 1
    // adaptation of all exhaust banks finished at EOL
ELSEIF (1b)      C_CYL_BAL_LAM_AD_EOL_CONF = ADD (1H)
THEN (1b)
    FOR m = 0 to NC_CBK_EX_NR - 1
        LV_CYL_BAL_LAM_AD_FAC[m] = 1
    END FOR

    IF  $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_AD\_ADD[m] = NC\_CBK\_EX\_NR$ 

        THEN
            LV_CYL_BAL_LAM_AD_EOL = 1
            // adaptation of all exhaust banks (additive) are finished at EOL

        ENDIF
ELSEIF (1c)      C_CYL_BAL_LAM_AD_EOL_CONF = FAC_L (2H)
THEN (1c)
    FOR m = 0 to NC_CBK_EX_NR - 1
        LV_CYL_BAL_LAM_AD_ADD[m] = 1
    END FOR

    IF  $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_AD\_FAC[m] = NC\_CBK\_EX\_NR$ 


        THEN
            LV_CYL_BAL_LAM_AD_EOL = 1
            // adaptation of all exhaust banks (multiple) are finished at EOL or time out

        ENDIF
ELSEIF (1d)      C_CYL_BAL_LAM_AD_EOL_CONF = ADD_FAC_L (3H)
THEN (1d)

    IF  $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_AD\_FAC[m] = NC\_CBK\_EX\_NR$  and
         $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_AD\_ADD[m] = NC\_CBK\_EX\_NR$ 

        THEN
            LV_CYL_BAL_LAM_AD_EOL = 1
            // ad. of all exhaust banks (multiple and additive) are finished at EOL or time
out
        ENDIF
ENDIF (1)
Transition to State 0[H] "Ready (Ready)
// global lambda adaptation at EOL finished (multiple and additive)
IF LV_CYL_BAL_LAM_AD_EOL = 1

```

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Transition to State 1[H] Wait (Condition 3)

// conditions for global lambda adaptation (multiple or additive) not achieved

$$\text{IF} \quad \sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_STATE\_CYL\_BAL\_LAM\_CHG\_WAIT[m] = NC\_CBK\_EX\_NR$$


// adaptation condition for all exhaust banks are not fulfilled

Assignments at exit from state Adaptation :

**FOR** m = 0 to NC\_CBK\_EX\_NR - 1

    LV\_STATE\_CYL\_BAL\_LAM\_CHG\_WAIT[m] = 0

**END FOR**

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## 9.47 Cylinder balancing coordination at DC

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CYL_BAL_AD_HOM_REQ_DC	O/V	0... 1H	0 ...1	1	-
Flag for homogenous combustion mode for cylinder balancing adaptation requested at active driving cycle					
LV_CYL_BAL_AD_WG_OPEN_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag for waste gate open requested for cylinder balancing adaptation					
LV_CYL_BAL_AD_WG_OPEN_REQ_DC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for waste gate open requested for cylinder balancing adaptation at active driving cycle					
LV_CYL_BAL_HOM_REQ_INT_DC	V	0... 1H	0 ...1	1	-
Flag for homogenous combustion mode requested internal at active driving cycle					
LV_CYL_BAL_LAM_AD_ADD_DC [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation (additive) exhaust bank specific at active driving cycle					
LV_CYL_BAL_LAM_AD_DC	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation at active driving cycle					
LV_CYL_BAL_LAM_AD_ENA_DC	O/V	0... 1H	0 ...1	1	-
Flag for EVAC time controller to enable lambda adaptation area for active driving cycle					
LV_CYL_BAL_LAM_AD_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag to indicate end of lambda adaptation cycle for cylinder balancing at active driving cycle					
LV_CYL_BAL_LAM_AD_FAC_H_DC [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation (multiple high) exhaust bank specific at active driving cycle					
LV_CYL_BAL_LAM_AD_FAC_L_DC [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation (multiple low) exhaust bank specific at active driving cycle					
LV_CYL_BAL_LAM_AD_HOM_REQ_DC	V	0... 1H	0 ...1	1	-
Flag for HOM request for cylinder balancing lambda adaptation at active driving cycle					
LV_CYL_BAL_LAM_AD_REQ_DC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation request at active driving cycle					
LV_CYL_BAL_LAM_SEL_AD_COLD_DC	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation (cold) at active driving cycle					
LV_CYL_BAL_LAM_SEL_AD_HOT_DC	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation (hot) at active driving cycle					
LV_CYL_BAL_LAM_SEL_AD_REQ_DC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for cylinder balancing selective lambda adaptation request at active driving cycle					
LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation (high range) bank specific at active driving cycle					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation (low range) bank specific at active driving cycle					
LV_CYL_BAL_LAM_SEL_HOM_REQ_DC	V	0... 1H	0 ...1	1	-
Flag for HOM request for cylinder balancing selective lambda adaptation at active driving cycle					
LV_CYL_BAL_LAM_SEL_RNG_COLD_DC [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation (cold range) bank specific at active driving cycle					
LV_STATE_LAM_AD_DC_CHG_REQ	O/V	0... 1H	0 ...1	1	-
Flag for stage change to "request" for cylinder balancing lambda adaptation at active driving cycle					
LV_STATE_LAM_AD_DC_CHG_WAIT	V	0... 1H	0 ...1	1	-
Flag for stage change to "wait" for cylinder balancing lambda adaptation at active driving cycle					
LV_STATE_LAM_SEL_DC_CHG_REQ	V	0... 1H	0 ...1	1	-
Flag for stage change to "request" for cylinder balancing selective lambda adaptation at active driving cycle					
LV_STATE_LAM_SEL_DC_CHG_WAIT	V	0... 1H	0 ...1	1	-
Flag for stage change to "wait" for cylinder balancing selective lambda adaptation at active driving cycle					
LV_T_STEP_CYL_BAL_LAM_AD_DC	O/V	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation fixed time steps enabled at active driving cycle					
LV_T_STEP_CYL_BAL_LAM_SEL_DC	V	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation fixed time steps enabled at active driving cycle					
STATE_CYL_BAL_LAM_AD [NC_CBK_EX_NR]	V	0H	INIT	-	-
		1H	WAIT		
		2H	CDN_FAC_L		
		3H	CDN_FAC_H		
		4H	CDN_ADD		
		5H	ADAPT_FAC_L		
		6H	ADAPT_FAC_H		
7H	ADAPT_ADD				
Cylinder balancing lambda adaptation state					
STATE_CYL_BAL_LAM_AD_DC	V	0H	Wait	-	-
		1H	Request		
		2H	Adaptation		
State of cylinder balancing lambda adaptation at active driving cycle					
STATE_CYL_BAL_LAM_SEL_AD_DC	V	0H	Wait	-	-
		1H	Request		
		2H	Adaptation		
State of cylinder balancing cylinder selective lambda adaptation at active driving cycle					
T_CYL_BAL_HOM_REQ_INT_DC	V	0... FFFFH	0... 6553.5	0.1	s
Time intervals for internal homogenous combustion mode request at active driving cycle					
T_CYL_BAL_HOM_REQ_INT_DC_STOP	V	0... FFFFH	0... 6553.5	0.1	s
Time interval for internal homogenous combustion mode request at engine stop conditions					
T_CYL_BAL_LAM_AD_ADD_DC [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing lambda adaptation (additive) exhaust bank specific at active driving cycle					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_CYL_BAL_LAM_AD_DC	O/V/S	0... FFFFFFFFH	0... 429496729.5	0.1	s
Time gap between cylinder balancing lambda adaptation parts at active driving cycle					
T_CYL_BAL_LAM_AD_FAC_H_DC [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing lambda adaptation (multiple high) exhaust bank specific at active driving cycle					
T_CYL_BAL_LAM_AD_FAC_L_DC [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing lambda adaptation (multiple low) exhaust bank specific at active driving cycle					
T_CYL_BAL_LAM_AD_REQ_DC [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing lambda adaptation request at active driving cycle					
T_CYL_BAL_LAM_AD_WAIT_DC	V	0... FFFFH	0... 6553.5	0.1	s
Waiting time for cylinder balancing lambda adaptation activation at active driving cycle					
T_CYL_BAL_LAM_SEL_AD_REQ_DC [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing selective lambda adaptation request at active driving cycle					
T_CYL_BAL_LAM_SEL_AD_RNG_H_DC [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing cylinder selective lambda adaptation (high range) bank specific at active driving cycle					
T_CYL_BAL_LAM_SEL_AD_RNG_L_DC [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing cylinder selective lambda adaptation (low range) bank specific at active driving cycle					
T_CYL_BAL_LAM_SEL_AD_WAIT_DC	V	0... FFFFH	0... 6553.5	0.1	s
Waiting time for cylinder balancing selective lambda adaptation activation at active driving cycle					
T_CYL_BAL_LAM_SEL_DC	O/V/S	0... FFFFFFFFH	0... 429496729.5	0.1	s
Time gap between cylinder balancing cylinder selective lambda adaptation parts at active driving cycle					
T_CYL_BAL_LAM_SEL_RNG_COLD_DC [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing cylinder selective lambda adaptation (cold range) bank specific at active driving cycle					

**Input data:**


FAC_CYL_LAM_ABSV_SUM [NC_CBK_EX_NR] {p. 2730}	GEAR {p. 1302}	LC_CYL_BAL_CORD_EOL_STOP_MAN {p. 4046}	LC_TCHA_CONF {p. 658}
LV_AT {p. 654}	LV_CYL_BAL_AD_WG_OPEN_REQ_EOL [NC_CBK_EX_NR] {p. 4043}	LV_CYL_BAL_HOM_REQ_EXT {p. 3261}	LV_FAC_H_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}
LV_FAC_L_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	LV_LAM_AD_ENA {p. 3737}	LV_LAM_AD_END_CBK [NC_CBK_EX_NR] {p. 2642}	LV_LAM_AD_STOP [NC_CBK_EX_NR] {p. 2642}
LV_LAM_CYL_SEL_ADJ_VLD [NC_CBK_EX_NR] {p. 2732}	LV_MFF_ADD_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2642}	LV_NT_RGN_REQ {p. 996}	LV_ST_END {p. 1720}
NC_CBK_EX_NR {p. 1829}	NT_AGI {p. 3073}	STATE_CDN_LAM_CYL_SEL_ADJ_RNG [NC_CBK_EX_NR] {p. 2864}	STATE_LAM_AD [NC_CBK_EX_NR] {p. 2643}

STATE_LAM_CYL_SEL_ADJ [NC_CBK_EX_NR] {p. 2733}	T_AST_BAL {p. 3261}	TCO {p. 1100}	TCO_ST_BAL {p. 3261}
VS {p. 1176}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CYL_BAL_AD_DC_RST	-	0H	ZERO	-	-
		1H	ON		
		2H	LAM_AD		
		3H	SEL_HOT		
		4H	WG_REQ		
		5H	HOM_REQ		
Reset of cylinder balancing adaptation readiness flags at active driving cycle					
C_CYL_BAL_LAM_AD_DC_CONF	-	0H	ADD	-	-
		1H	FAC_L		
		2H	ADD_FAC_L		
		3H	ADD_FAC_ALL		
Configuration of lambda adaptation correction values for cylinder balancing at active driving cycle					
C_CYL_BAL_LAM_SEL_HOT_DC_CONF	-	0H	LOW	-	-
		1H	HIGH		
		2H	LOW_HIGH		
Configuration of cylinder selective lambda adaptation correction values for cylinder balancing at driving cycle					
C_FAC_CYL_LAM_ABSV_SUM_BAL_DC	-	0... 7FFFH	0... 49.998474	1.5259e-3	%
Threshold for cylinder balancing cylinder selective lambda adaptation within limits at active driving cycle					
C_GEAR_MIN_CYL_BAL_AD_REQ_DC	-	0... FH	0... 15	1	-
Minimum gear required to enable cylinder balancing lambda adaptation request at active driving cycle					
C_T_AST_MAX_2_CYL_BAL_AD_DC	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time after start for control of cybl selective lambda adaptation at active driving cycle ( time slot Japan)					
C_T_AST_MAX_CYL_BAL_AD_DC	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time after start for control of cylinder balancing selective lambda adaptation at active driving cycle					
C_T_AST_MAX_CYL_BAL_AD_DC_STOP	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time after start for control of cybl selective lambda adaptation at active driving cycle ( stop conditions)					
C_T_AST_MIN_2_CYL_BAL_AD_DC	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time after start for control of cybl selective lambda adaptation at active driving cycle ( time slot Japan)					
C_T_ES_MAX_CYL_BAL_HOM_REQ_INT	-	0... FFH	0... 255	1	min
This is a ES time maximum T_ES for internal homogenous combustion mode request at active driving cycle					
C_T_MAX_CYL_BAL_LAM_AD_DC	-	0... FFFFFFFFH	0... 429496729.5	0.1	s
Maximum time to enable cylinder balancing lambda adaptation part at active driving cycle					
C_T_MAX_CYL_BAL_LAM_SEL_DC	-	0... FFFFFFFFH	0... 429496729.5	0.1	s
Maximum time to enable cylinder balancing cylinder selective lambda adaptation part at active driving cycle					
C_T_MIN_CYL_BAL_AD_REQ_DC	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time for cylinder balancing adaptation conditions within limits at active driving cycle					
C_T_MIN_CYL_BAL_AD_WAIT_DC	-	0... FFFFH	0... 6553.5	0.1	s
Minimum waiting time at entry to state adaptation for cylinder balancing adaptation at active driving cycle					

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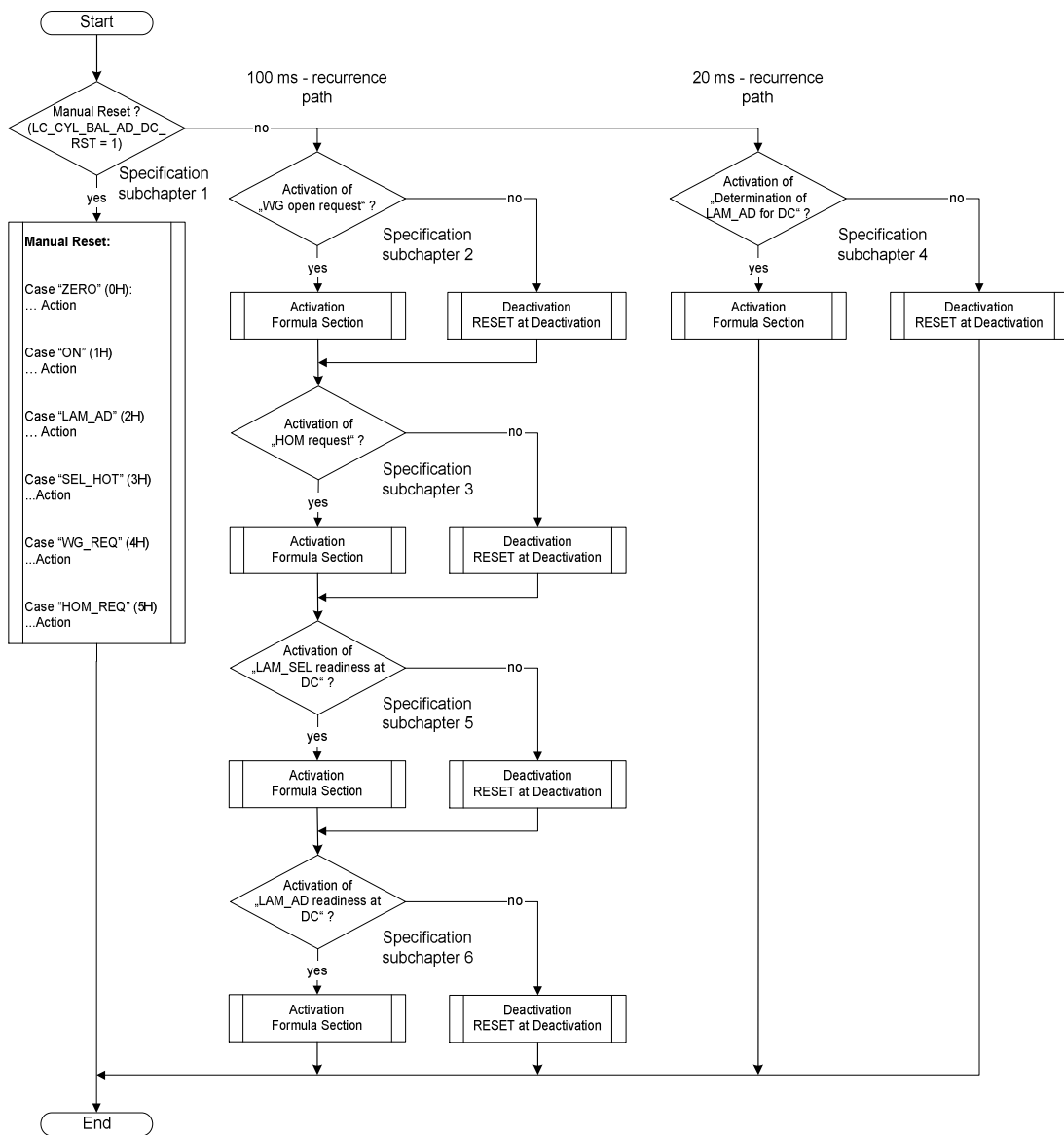
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MIN_CYL_BAL_LAM_AD_DC	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time to enable cylinder balancing lambda adaptation part at active driving cycle					
C_T_MIN_CYL_BAL_LAM_SEL_DC	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time to enable cylinder balancing cylinder selective lambda adaptation part at active driving cycle					
C_TCO_ST_MAX_CYL_BAL_AD_DC	-	0... FEH	-48... 142.5	0.75	°C
Maximum TCO_ST start for control of cylinder balancing selective lambda adaptation at active driving cycle					
C_TCO_ST_MAX_ES_CYL_BAL_AD_DC	-	0... FEH	-48... 142.5	0.75	°C
Maximum TCO_ST at ES for control of cylinder balancing selective lambda adaptation at active driving cycle					
C_TCO_ST_MIN_CYL_BAL_AD_DC	-	0... FEH	-48... 142.5	0.75	°C
Minimum TCO_ST start for control of cylinder balancing selective lambda adaptation at active driving cycle					
C_TCO_ST_MIN_ES_CYL_BAL_AD_DC	-	0... FEH	-48... 142.5	0.75	°C
Minimum TCO_ST at ES for control of cylinder balancing selective lambda adaptation at active driving cycle					
C_TCO_THD_CYL_BAL_LAM_SEL_DC	-	0... FEH	-48... 142.5	0.75	°C
TCO threshold for control of cylinder balancing selective lambda adaptation at active driving cycle					
C_VS_MAX_CYL_BAL_AD_REQ_DC	-	0... FFH	0... 255	1	Km/h
Maximum VS required to enable cylinder balancing lambda adaptation request at active driving cycle					
C_VS_MIN_CYL_BAL_AD_REQ_DC	-	0... FFH	0... 255	1	Km/h
Minimum VS required to enable cylinder balancing lambda adaptation request at active driving cycle					
ID_IDX_CYL_BAL_HOM_REQ_INT_AT	-	0... 4H	0 ...4	1	-
LDP_NT_AGI_ID_IDX_REQ_INT_DC	6	0... FFFFH	0... 0.99998	15.3e-6	-
NOx trap aging index value for internal homogenous combustion mode request at active driving cycle for AT					
ID_IDX_CYL_BAL_HOM_REQ_INT_MT	-	0... 4H	0 ...4	1	-
LDP_NT_AGI_ID_IDX_REQ_INT_DC	6	0... FFFFH	0... 0.99998474	1.52588E- 5	-
NOx trap aging index value for internal homogenous combustion mode request at active driving cycle					
ID_T_CYL_BAL_HOM_REQ_INT_DC_AT [5]	-	0... FFFFH	0... 6553.5	0.1	s
LDPM_T_AST_BAL_ID_T_REQ_INT_DC [5]	14	0... FFFFH	0... 6553.5	0.1	s
Time intervals for internal homogenous combustion mode request at active driving cycle for AT					
ID_T_CYL_BAL_HOM_REQ_INT_DC_MT [5]	-	0... FFFFH	0... 6553.5	0.1	s
LDPM_T_AST_BAL_ID_T_REQ_INT_DC [5]	14	0... FFFFH	0... 6553.5	0.1	s
Time intervals for internal homogenous combustion mode request at active driving cycle for MT					
ID_T_CYL_BAL_HOM_REQ_INT_STOP [5]	-	0... FFFFH	0... 6553.5	0.1	s
LDP_T_AST_BAL_ID_T_REQ_INT_STOP [5]	8	0... FFFFH	0... 6553.5	0.1	s
Time interval maps for internal homogenous combustion mode request at engine stop conditions					
ID_T_CYL_BAL_LAM_AD_DC	-	0... FFFFH	0... 6553.5	0.1	s
LDP_T_AST_BAL_ID_T_LAM_AD_DC	8	0... FFFFH	0... 6553.5	0.1	s
Time intervals for control of cylinder balancing lambda adaptation at active driving cycle					
ID_T_CYL_BAL_LAM_SEL_AD_DC	-	0... FFFFH	0... 6553.5	0.1	s
LDP_T_AST_BAL_ID_T_LAM_SEL_DC	8	0... FFFFH	0... 6553.5	0.1	s
Time intervals for control of cylinder balancing selective lambda adaptation at active driving cycle					
LC_CYL_BAL_AD_DC_RST	-	0... 1H	0 ...1	1	-
Manual switch for cylinder balancing adaptation reset at active driving cycle					
LC_CYL_BAL_CORD_DC_STOP_MAN	-	0... 1H	0 ...1	1	-
Logical constant for manual stop (=1) of cylinder balancing coordination at driving cycle					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**FUNCTION DESCRIPTION:**

Task of the cylinder balancing coordination at DC is to control the adaptation functions during the current driving cycle.

**Signal flow diagram:**



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**Application conditions**

**Initialisation:** See separate chapters

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**Recurrence:** *See separate chapters*  
**Activation:** *See separate chapters*  
**Deactivation:** *See separate chapters*

### 9.47.1 Manual reset of cylinder balancing readiness at active driving cycle (DC):

#### FUNCTION DESCRIPTION:

#### General information:

In case of a manual reset it is possible to adjust the exported output data to a wanted value to make the function test and handling more easier. While the manual function reset is activated, all following subchapters within the module "cylinder balancing coordination at DC" are deactivated and the corresponding "Initialization at Deactivation" process for this chapters is blocked during this period.

#### Application conditions

**Recurrence:** *100 ms*  
**Activation:** *LC\_CYL\_BAL\_AD\_DC\_RST = 1*  
**Deactivation:** *LC\_CYL\_BAL\_AD\_DC\_RST = 0*

#### Formula section:


```
IF          C_CYL_BAL_AD_DC_RST = ZERO (0H)
THEN       LV_CYL_BAL_LAM_AD_DC = 0
           LV_CYL_BAL_LAM_SEL_AD_HOT_DC = 0
           LV_CYL_BAL_LAM_SEL_AD_COLD_DC = 0
           LV_CYL_BAL_AD_HOM_REQ_DC = 0
           FOR m = 0 to NC_CBK_EX_NR - 1
             LV_CYL_BAL_AD_WG_OPEN_REQ[m] = 0
           END FOR
```

```
ELSEIF     C_CYL_BAL_AD_DC_RST = ON (1H)
THEN       LV_CYL_BAL_LAM_AD_DC = 1
           LV_CYL_BAL_LAM_SEL_AD_HOT_DC = 1
           LV_CYL_BAL_LAM_SEL_AD_COLD_DC = 1
           LV_CYL_BAL_AD_HOM_REQ_DC = 1
           FOR m = 0 to NC_CBK_EX_NR - 1
             LV_CYL_BAL_AD_WG_OPEN_REQ[m] = 1
           END FOR
```

```
ELSEIF     C_CYL_BAL_AD_DC_RST = LAM_AD (2H)
THEN       LV_CYL_BAL_LAM_AD_DC = 1
```

```
ELSEIF     C_CYL_BAL_AD_DC_RST = SEL_HOT (3H)
THEN       LV_CYL_BAL_LAM_SEL_AD_HOT_DC = 1
```

```
ELSEIF     C_CYL_BAL_AD_DC_RST = WG_REQ (4H)
THEN       FOR m = 0 to NC_CBK_EX_NR - 1
```

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```

                LV_CYL_BAL_AD_WG_OPEN_REQ[m] = 1
            END FOR

```

```

ELSEIF      C_CYL_BAL_AD_DC_RST = HOM_REQ (5H)
THEN        LV_CYL_BAL_AD_HOM_REQ_DC = 1

```

```

ELSEIF      C_CYL_BAL_AD_DC_RST = SEL_COLD (6H)
THEN        LV_CYL_BAL_LAM_SEL_AD_COLD_DC = 1
ENDIF

```

## 9.47.2 Waste gate open request for cylinder balancing adaptation:

### FUNCTION DESCRIPTION:

#### General information:

For a turbo engine, the cylinder individual lambda control is only possible while the waste gate is sufficient opened to identify the exhaust package for each cylinder. In case of a planned adaptation, a request to open the waste gate is carried out for each turbine before.

#### Application conditions:

*Initialization at Reset or Deactivation:*

```

FOR m = 0 to NC_CBK_EX_NR - 1
    LV_CYL_BAL_AD_WG_OPEN_REQ[m] = 0
END FOR

```

*Recurrence:* 100 ms

*Activation:*

```

    LC_CYL_BAL_AD_DC_RST = 0
    LC_TCHA_CONF = 1
    ( LC_CYL_BAL_CORD_DC_STOP_MAN = 0
      LC_CYL_BAL_CORD_EOL_STOP_MAN = 0 )

```

and  
and  
or

*Deactivation:*

```

    LC_CYL_BAL_AD_DC_RST = 0
    [
        LC_TCHA_CONF = 0
        ( LC_CYL_BAL_CORD_DC_STOP_MAN = 1 and
          LC_CYL_BAL_CORD_EOL_STOP_MAN = 1 )
    ]

```

and  
or

#### Formula section:

```

FOR m = 0 to NC_CBK_EX_NR - 1
    IF      LV_CYL_BAL_AD_WG_OPEN_REQ_EOL[m] = 1
            LV_CYL_BAL_AD_WG_OPEN_REQ_DC[m] = 1
    THEN    LV_CYL_BAL_AD_WG_OPEN_REQ[m] = 1
    ELSE    LV_CYL_BAL_AD_WG_OPEN_REQ[m] = 0
    ENDIF
END FOR

```

or

### 9.47.3 Homogenous combustion mode request for cylinder balancing adaptation:

#### FUNCTION DESCRIPTION:

##### General information:

For a stratified combustion engine, the cylinder individual lambda control as well as the global lambda adaptation are only possible while the engine is running in homogenous combustion mode with activated lambda control. In case of a planned adaptation, a request to switch to homogenous combustion is carried out before.

##### Application conditions:

*Initialization at Reset or Deactivation:*

LV\_CYL\_BAL\_AD\_HOM\_REQ\_DC = 0

*Recurrence:* 100 ms

*Activation:* LC\_CYL\_BAL\_AD\_DC\_RST = 0 **and**  
 LC\_TCHA\_CONF = 0 **and**  
 LC\_CYL\_BAL\_CORD\_DC\_STOP\_MAN = 0

*Deactivation:* LC\_CYL\_BAL\_AD\_DC\_RST = 0 **and**  
 [ LC\_TCHA\_CONF = 1 **or**  
 LC\_CYL\_BAL\_CORD\_DC\_STOP\_MAN = 1 ]

##### Formula section:

*// determination of NOx aging for homogenous combustion mode request at active driving cycle*

```

IF LV_ST_END = 0
THEN
IF LV_AT = 1
THEN IDX = ID_IDX_CYL_BAL_HOM_REQ_INT_AT(NT_AGI)
ELSE IDX = ID_IDX_CYL_BAL_HOM_REQ_INT_MT(NT_AGI)
ENDIF

```

*// NOx aging for homogenous combustion mode request at active driving cycle*

**ENDIF**

*// calculation of internal homogenous combustion mode request at active driving cycle*

```

IF LV_AT = 1
THEN T_CYL_BAL_HOM_REQ_INT_DC =
      ID_T_CYL_BAL_HOM_REQ_INT_DC_AT[IDX](T_AST_BAL)
ELSE T_CYL_BAL_HOM_REQ_INT_DC =
      ID_T_CYL_BAL_HOM_REQ_INT_DC_MT[IDX](T_AST_BAL)
ENDIF

```

```

T_CYL_BAL_HOM_REQ_INT_DC_STOP =
  ID_T_CYL_BAL_HOM_REQ_INT_STOP[IDX](T_AST_BAL)

```

**IF**

```

[[//EU   /Japan1
T_AST_BAL < C_T_AST_MAX_CYL_BAL_AD_DC           and // max time
TCO_ST_BAL < C_TCO_ST_MAX_CYL_BAL_AD_DC         and // TCO_ST_MAX
TCO_ST_BAL > C_TCO_ST_MIN_CYL_BAL_AD_DC         and // TCO_ST_MIN
T_AST_BAL < T_CYL_BAL_HOM_REQ_INT_DC           // time shape
]
OR
[[//   Japan 2
T_AST_BAL > C_T_AST_MIN_2_CYL_BAL_AD_DC         and // 2.time intervall
T_AST_BAL < C_T_AST_MAX_2_CYL_BAL_AD_DC         and // 2.time intervall
TCO_ST_BAL < C_TCO_ST_MAX_CYL_BAL_AD_DC         and // TCO_ST_MAX
TCO_ST_BAL > C_TCO_ST_MIN_CYL_BAL_AD_DC         and // TCO_ST_MIN
T_AST_BAL < T_CYL_BAL_HOM_REQ_INT_DC           // time shape
]
OR
[[// Stop Condition
T_AST_BAL < C_T_AST_MAX_CYL_BAL_AD_DC_STOP     and // max time
T_ES_CUS < C_T_ES_MAX_CYL_BAL_HOM_REQ_INT     and // stop time
TCO_ST_BAL < C_TCO_ST_MAX_ES_CYL_BAL_AD_DC     and // TCO_ST_MAX
TCO_ST_BAL > C_TCO_ST_MIN_ES_CYL_BAL_AD_DC     and // TCO_ST_MIN
T_AST_BAL < T_CYL_BAL_HOM_REQ_INT_DC_STOP     // time shape
]]
THEN      LV_CYL_BAL_HOM_REQ_INT_DC = 1
          // internal homogen combustion mode request at active driving cycle
ELSE      LV_CYL_BAL_HOM_REQ_INT_DC = 0
ENDIF

// calculation of overall homogen combustion mode request at active driving cycle
IF      LV_CYL_BAL_LAM_SEL_HOM_REQ_DC = 1           or
        LV_CYL_BAL_LAM_AD_HOM_REQ_DC = 1           or
        LV_CYL_BAL_HOM_REQ_INT_DC = 1             or
        LV_CYL_BAL_HOM_REQ_EXT = 1
THEN    LV_CYL_BAL_AD_HOM_REQ_DC = 1
ELSE    LV_CYL_BAL_AD_HOM_REQ_DC = 0
ENDIF

```

## 9.47.4 Determination of lambda adaptation cycle for cylinder balancing at DC

### FUNCTION DESCRIPTION:

#### General information:


Because the lambda adaptation function is running with a higher recurrence in comparison to cylinder balancing coordination at DC, the determination of a finished lambda adaptation cycle has to be carried out faster to avoid signal under-sampling.

#### Initialization at Reset *or* Deactivation:

```

FOR m = 0 to NC_CBK_EX_NR - 1
    LV_CYL_BAL_LAM_AD_END[m] = 0

```

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```
STATE_CYL_BAL_LAM_AD[m] = "INIT" (0[H])
END FOR
```

Recurrence: 20 ms

Activation: LC\_CYL\_BAL\_AD\_DC\_RST = 0 **and**  
 LC\_TCHA\_CONF = 0 **and**  
 LC\_CYL\_BAL\_CORD\_DC\_STOP\_MAN = 0

Deactivation: LC\_CYL\_BAL\_AD\_DC\_RST = 0 **and**  
 [ LC\_TCHA\_CONF = 1 **or**  
 LC\_CYL\_BAL\_CORD\_DC\_STOP\_MAN = 1 ]

#### Formula section:

```
FOR m = 0 to NC_CBK_EX_NR - 1
  IF LV_LAM_AD_STOP[m] = 0 -> 1
  THEN LV_CYL_BAL_LAM_AD_END[m] = LV_LAM_AD_END_CBK[m]
  STATE_CYL_BAL_LAM_AD[m] = STATE_LAM_AD[m]
  ENDIF
END FOR
```

### 9.47.5 Calculation of cylinder balancing selective lambda adaptation readiness (DC):

#### FUNCTION DESCRIPTION:

##### General information:

A periodic request for homogenous combustion mode is carried out in defined time intervals to allow the start of the cylinder selective adaptation functions, which are only activated in homogenous combustion mode. In case of a turbo engine, a periodic request to open the waste gate is carried out.

##### Application conditions:


*Initialization at first Engine run or NVMY-error:*

T\_CYL\_BAL\_LAM\_SEL\_DC = 0.0[s] *(first initialization)*  
 LV\_CYL\_BAL\_LAM\_SEL\_AD\_HOT\_DC = 0 *(first initialization)*  
 LV\_CYL\_BAL\_LAM\_SEL\_AD\_COLD\_DC = 0 *(first initialization)*  
 FOR m = 0 to NC\_CBK\_EX\_NR - 1  
 LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_L\_DC[m] = 0 *(first initialization)*  
 LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_H\_DC[m] = 0 *(first initialization)*  
 LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_COLD\_DC[m] = 0 *(first initialization)*

END FOR

*Initialization at Reset:*

T\_CYL\_BAL\_LAM\_SEL\_DC = T\_CYL\_BAL\_LAM\_SEL\_DC (NVMY)  
 LV\_CYL\_BAL\_LAM\_SEL\_AD\_HOT\_DC = LV\_CYL\_BAL\_LAM\_SEL\_AD\_HOT\_DC (NVMY)  
 LV\_CYL\_BAL\_LAM\_SEL\_AD\_COLD\_DC = LV\_CYL\_BAL\_LAM\_SEL\_AD\_COLD\_DC (NVMY)  
 FOR m = 0 to NC\_CBK\_EX\_NR - 1  
 LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_L\_DC[m] =

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```

                LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] (NVMY)
LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] =
                LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] (NVMY)
LV_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] =
                LV_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] (NVMY)

```

**END FOR**

(NVMY: values stored in the non-volatile memory)

**FOR** m = 0 to NC\_CBK\_EX\_NR - 1

```

    IF                C_CYL_BAL_LAM_SEL_HOT_DC_CONF = LOW (0H)
    THEN              LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] = 1
    ELSEIF           C_CYL_BAL_LAM_SEL_HOT_DC_CONF = HIGH (1H)
    THEN              LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] = 1
    ENDIF

```

**END FOR**

*Initialization at Reset or Deactivation:*

```

LV_CYL_BAL_LAM_SEL_HOM_REQ_DC = 0
STATE_CYL_BAL_LAM_SEL_AD_DC = "Wait" (0[H])
LV_STATE_LAM_SEL_DC_CHG_REQ = 0
LV_STATE_LAM_SEL_DC_CHG_WAIT = 0
T_CYL_BAL_LAM_SEL_AD_WAIT_DC = 0.0[s]
LV_T_STEP_CYL_BAL_LAM_SEL_DC = 0
FOR m = 0 to NC_CBK_EX_NR - 1
    T_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] = 0.0[s]
    T_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] = 0.0[s]
    T_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] = 0.0[s]
    LV_CYL_BAL_LAM_SEL_AD_REQ_DC[m] = 0
    T_CYL_BAL_LAM_SEL_AD_REQ_DC[m] = 0.0[s]
    LV_CYL_BAL_AD_WG_OPEN_REQ_DC[m] = 0

```

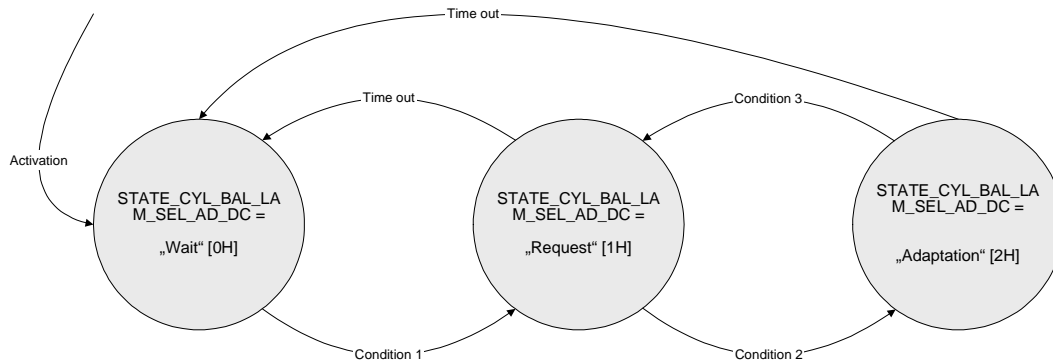
**END FOR**

*Recurrence:* 100 ms

*Activation:* LC\_CYL\_BAL\_AD\_DC\_RST = 0 **and**  
 LV\_ST\_END = 1 **and**  
 LC\_CYL\_BAL\_CORD\_DC\_STOP\_MAN = 0

*Deactivation:* LC\_CYL\_BAL\_AD\_DC\_RST = 0 **and**  
 [ LV\_ST\_END = 0 **or**  
 LC\_CYL\_BAL\_CORD\_DC\_STOP\_MAN = 1 ]

**Signal flow diagram:**



### Formula section:

#### IF(1)

```
[[//EU /Japan1
```

```
T_AST_BAL < C_T_AST_MAX_CYL_BAL_AD_DC           and // max time
TCO_ST_BAL < C_TCO_ST_MAX_CYL_BAL_AD_DC         and // TCO_ST_MAX
TCO_ST_BAL > C_TCO_ST_MIN_CYL_BAL_AD_DC         // TCO_ST_MIN
```

```
]
```

#### OR

```
[[ // Japan 2
```

```
T_AST_BAL > C_T_AST_MIN_2_CYL_BAL_AD_DC         and // 2.time intervall
T_AST_BAL < C_T_AST_MAX_2_CYL_BAL_AD_DC         and // 2.time intervall
TCO_ST_BAL < C_TCO_ST_MAX_CYL_BAL_AD_DC         and // TCO_ST_MAX
TCO_ST_BAL > C_TCO_ST_MIN_CYL_BAL_AD_DC         // TCO_ST_MIN
```

```
]
```

#### OR

```
[[ // Stop Condition
```

```
T_AST_BAL < C_T_AST_MAX_CYL_BAL_AD_DC_STOP     and // max time
T_ES_CUS < C_T_ES_MAX_CYL_BAL_HOM_REQ_INT     and // stop time
TCO_ST_BAL < C_TCO_ST_MAX_ES_CYL_BAL_AD_DC    and // TCO_ST_MAX
TCO_ST_BAL > C_TCO_ST_MIN_ES_CYL_BAL_AD_DC    // TCO_ST_MIN
```

```
]]
```

```
THEN (1) // DC adaptation requests controlled by fix time steps
```

```
IF (2) T_AST_BAL < ID_T_CYL_BAL_LAM_SEL_AD_DC // time shape
```

```
THEN (2) LV_STATE_LAM_SEL_DC_CHG_REQ = 1
```

```
LV_STATE_LAM_SEL_DC_CHG_WAIT = 0
```

```
LV_T_STEP_CYL_BAL_LAM_SEL_DC = 1
```

```
ELSE (2) LV_STATE_LAM_SEL_DC_CHG_REQ = 0
```

```
LV_STATE_LAM_SEL_DC_CHG_WAIT = 1
```

```
LV_T_STEP_CYL_BAL_LAM_SEL_DC = 0
```

```
ENDIF (2)
```

```
ELSE (1) // DC adaptation requests for controlled by flexible time steps
```

```
LV_T_STEP_CYL_BAL_LAM_SEL_DC = 0
```

```
IF (2) T_CYL_BAL_LAM_SEL_DC < C_T_MAX_CYL_BAL_LAM_SEL_DC
```

```
THEN (2) T_CYL_BAL_LAM_SEL_DC(n) = T_CYL_BAL_LAM_SEL_DC(n-1) + 0.1[s]
```

```
// waiting time incrementation, flexible time steps running
```

```
IF (3) (LV_CYL_BAL_LAM_SEL_AD_COLD_DC = 0
```

```
TCO < C_TCO_THD_CYL_BAL_LAM_SEL_DC )
```

```
OR
```

```
and
```

```

( LV_CYL_BAL_LAM_SEL_AD_HOT_DC = 0          and
TCO ≥ C_TCO_THD_CYL_BAL_LAM_SEL_DC      )
THEN (3)      // enable conditions to change adaptation state from "Wait" to "Re-
quest"

LV_STATE_LAM_SEL_DC_CHG_REQ = 1
LV_STATE_LAM_SEL_DC_CHG_WAIT = 0
ELSE (3)      // enable conditions to change adaptation state from "Request" to
"Wait"

LV_STATE_LAM_SEL_DC_CHG_REQ = 0
LV_STATE_LAM_SEL_DC_CHG_WAIT = 1
ENDIF (3)
ELSE (2)      // reset of waiting time, new beginning of flexible time steps
T_CYL_BAL_LAM_SEL_DC = 0.0[s]
LV_CYL_BAL_LAM_SEL_AD_HOT_DC = 0
LV_CYL_BAL_LAM_SEL_AD_COLD_DC = 0
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] = 0
T_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] = 0.0[s]
IF          C_CYL_BAL_LAM_SEL_HOT_DC_CONF = LOW (0H)
THEN          LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] = 0
              T_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] = 0.0[s]
ELSEIF
(1H)          C_CYL_BAL_LAM_SEL_HOT_DC_CONF = HIGH
THEN          LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] = 0
              T_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] = 0.0[s]
ELSEIF
HIGH (2H)    C_CYL_BAL_LAM_SEL_HOT_DC_CONF = LOW_
THEN          LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] = 0
              LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] = 0
              T_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] = 0.0[s]
              T_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] = 0.0[s]
ENDIF
END FOR
ENDIF (2)
ENDIF (1)

```

Note: At function activation always State "Wait" is entered  
**Cylinder balancing adaptation at DC: State 0[H] - Wait**

**Assignments at entry to state Wait :**

```

STATE_CYL_BAL_LAM_SEL_AD_DC = "Wait" (0[H])
LV_CYL_BAL_LAM_SEL_HOM_REQ_DC = 0
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_AD_WG_OPEN_REQ_DC[m] = 0
END FOR

```

**Action during state "Wait":**

```

Transition to State 1[H] Request (Condition 1)
// Lambda Adaptation manager request for change of state
IF          LV_STATE_LAM_SEL_DC_CHG_REQ = 1

```

**Assignments at exit from state Wait :**

No assignments

**Cylinder balancing adaptation at DC: State 1[H] - Request****Assignments at entry to state Request :**

STATE\_CYL\_BAL\_LAM\_SEL\_AD\_DC = "Request" (1[H])

**Action during state "Request":**

Transition to State 0[H] Wait (Time out)

// Lambda Adaptation manager request for change of state

**IF** LV\_STATE\_LAM\_SEL\_DC\_CHG\_WAIT = 1

Calculations:

// conditions for cylinder balancing selective lambda adaptation achieved

**FOR** m = 0 to NC\_CBK\_EX\_NR - 1

**IF** ( STATE\_CDN\_LAM\_CYL\_SEL\_ADJ\_RNG[m] = LOW\_RNG (1[H]) **and**  
 [ LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_L\_DC[m] = 0 **or**  
 LV\_T\_STEP\_CYL\_BAL\_LAM\_SEL\_DC = 1 ] )  
**OR**  
 ( STATE\_CDN\_LAM\_CYL\_SEL\_ADJ\_RNG[m] = HIGH\_RNG (2[H]) **and**  
 [ LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_H\_DC[m] = 0 **or**  
 LV\_T\_STEP\_CYL\_BAL\_LAM\_SEL\_DC = 1 ] )  
**OR**  
 ( STATE\_CDN\_LAM\_CYL\_SEL\_ADJ\_RNG[m] = COLD\_RNG (3[H]) **and**  
 [ LV\_CYL\_BAL\_LAM\_SEL\_RNG\_COLD\_DC[m] = 0 **or**  
 LV\_T\_STEP\_CYL\_BAL\_LAM\_SEL\_DC = 1 ] )

**THEN** T\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m](n) =  
 T\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m](n-1) + 0.1[s]

**ELSE** T\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m](n) = 0.0[s]

**ENDIF****END FOR**

// calculation of request for bank specific homogenous combustion mode switch

**FOR** m = 0 to NC\_CBK\_EX\_NR - 1

**IF** ( T\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m] ≥ C\_T\_MIN\_CYL\_BAL\_AD\_REQ\_DC  
 AND GEAR ≥ C\_GEAR\_MIN\_CYL\_BAL\_AD\_REQ\_DC  
 AND VS ≥ C\_VS\_MIN\_CYL\_BAL\_AD\_REQ\_DC )

**THEN** LV\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m] = 1

**ELSE** LV\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m] = 0

**ENDIF****END FOR**

// calculation of request for homogenous combustion mode switch for non turbo engine

**IF (1)** LC\_TCHA\_CONF = 0**THEN (1)**

**IF (2)**  $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m] > 0$


// homogenous switch after waiting time

**OR**

( [ LV\_NT\_RGN\_REQ = 1 **or** LV\_T\_STEP\_CYL\_BAL\_LAM\_SEL\_DC = 1 ] **and**

$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} T\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m] > 0.0[s]$  )

// immediate homogenous switch in case of NT request or fixed time steps

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```

THEN (2)      LV_CYL_BAL_LAM_SEL_HOM_REQ_DC = 1
ENDIF (2)
ELSE (1)
// calculation of request for waste gate open for turbo engine (LC_TCHA_CONF=1)
FOR (2) m = 0 to NC_CBK_EX_NR - 1

IF (3)       $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m] > 0$ 

// waste gate open after waiting time
OR
(LV_T_STEP_CYL_BAL_LAM_SEL_DC = 1 and
 $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} T\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m] > 0.0[s]$  )

// immediate waste gate open in case of fixed time steps
THEN (3)      LV_CYL_BAL_AD_WG_OPEN_REQ_DC[m] = 1
ENDIF (3)
END FOR (2)
ENDIF (1)

```

Transition to State 2[H] Adaptation (Condition 2)

// conditions for combustion mode switch to homogenous or waste gate open achieved

**IF** LV\_CYL\_BAL\_LAM\_SEL\_HOM\_REQ\_DC = 1 **or**

$$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_AD\_WG\_OPEN\_REQ\_DC[m] > 0$$

**Assignments at exit from state Request :**

```

FOR m = 0 to NC_CBK_EX_NR - 1
    LV_CYL_BAL_LAM_SEL_AD_REQ_DC[m] = 0
    T_CYL_BAL_LAM_SEL_AD_REQ_DC[m] = 0.0[s]
END FOR

```

**Cylinder balancing adaptation at DC: State 2[H] - Adaptation**

**Assignments at entry to state Adaptation :**

```

STATE_CYL_BAL_LAM_SEL_AD_DC = "Adaptation" (2[H])
T_CYL_BAL_LAM_SEL_AD_WAIT_DC = C_T_MIN_CYL_BAL_AD_WAIT_DC
FOR m = 0 to NC_CBK_EX_NR - 1
    T_CYL_BAL_LAM_SEL_AD_REQ_DC[m] = C_T_MIN_CYL_BAL_AD_WAIT_DC
END FOR

```

**Actions during state "Adaptation":**

Transition to State 0[H] Wait (Time out)


// Lambda Adaptation manager request for change of state

**IF** LV\_STATE\_LAM\_SEL\_DC\_CHG\_WAIT = 1

Transition to State 1[H] Request (Condition 3)

// conditions for combustion mode switch to homogenous or waste gate open not achieved

**IF** (LC\_TCHA\_CONF = 0 **and** LV\_CYL\_BAL\_LAM\_SEL\_HOM\_REQ\_DC = 0) **or**

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$$( LC\_TCHA\_CONF = 1 \text{ and } \sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_AD\_WG\_OPEN\_REQ\_DC[m] = 0 )$$
Calculations:

// calculation of waiting time after entry in homogenous combustion mode or waste gate open

**IF (1)** T\_CYL\_BAL\_LAM\_SEL\_AD\_WAIT\_DC = 0.0 [s]

*// waiting time after switch to homogenous combustion mode elapsed*

**THEN (1)**

**FOR (2)** m = 0 to NC\_CBK\_EX\_NR - 1

**IF (3)** ( STATE\_LAM\_CYL\_SEL\_ADJ[m] <> ADJ\_NOM\_L\_RNG

(4[H])

**and**

STATE\_LAM\_CYL\_SEL\_ADJ[m] <> ADJ\_NOM\_H\_RNG (5[H])

**and**

STATE\_LAM\_CYL\_SEL\_ADJ[m] <> "ADJ\_ENG\_COLD (2[H]) )

*// low range, high range, cold range CILC adaptation area not active*

**THEN (3)**

T\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m](n) =

T\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m](n-1) - 0.1[s]

**ELSE (3)**

T\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m](n) =

C\_T\_MIN\_CYL\_BAL\_AD\_WAIT\_DC

**ENDIF (3)**

**IF (3)**

T\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m] = 0.0 [s]

*// time with no CILC adaptation area active elapsed*

**OR**

( STATE\_LAM\_CYL\_SEL\_ADJ[m] = ADJ\_NOM\_L\_RNG (4[H]) **and**

LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_L\_DC[m] = 1 )

*// low range CILC adaptation active - adaptation result achieved*

**OR**

( STATE\_LAM\_CYL\_SEL\_ADJ[m] = ADJ\_NOM\_H\_RNG (5[H]) **and**

LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_H\_DC[m] = 1 )

*// high range CILC adaptation active - adaptation result achieved*

**OR**

( STATE\_LAM\_CYL\_SEL\_ADJ[m] = "ADJ\_ENG\_COLD (2[H]) **and**

LV\_CYL\_BAL\_LAM\_SEL\_RNG\_COLD\_DC[m] = 1 )

*// cold range CILC adaptation active - adaptation result achieved*

**THEN (3)**

LV\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m] = 0

*// conditions for CILC adaptation no longer present*

**ELSE (3)**

LV\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m] = 1

*// conditions for CILC adaptation still present*

**ENDIF (3)**

**END FOR (2)**

**IF (2)**

LC\_TCHA\_CONF = 0 *//no turbo engine*

**THEN (2)**

**IF (3)**

$$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m] = 0$$

*// conditions for CILC no longer achieved for all exhaust banks*

**THEN (3)**


LV\_CYL\_BAL\_LAM\_SEL\_HOM\_REQ\_DC = 0

*// reset of homogenous combustion mode request*

**ENDIF (3)**

**ELSE (2)**

*// turbo engine*

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```

FOR (3) m = 0 to NC_CBK_EX_NR - 1

  IF (4)  $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m] = 0$ 

    THEN (4) LV_CYL_BAL_AD_WG_OPEN_REQ_DC[m] = 0
    ENDIF (4)
  END FOR (3)
ENDIF (2)
ELSE (1)
  IF (2) LV_T_STEP_CYL_BAL_LAM_SEL_DC = 0
  THEN (2) T_CYL_BAL_LAM_SEL_AD_WAIT_DC(n) =
    T_CYL_BAL_LAM_SEL_AD_WAIT_DC(n-1) - 0.1[s]
    // decrementation of waiting time after switch to homogenous combustion
  mode
  ENDIF (2)
ENDIF (1)
// determination of cylinder individual lambda adaptation quality at active driving cycle and
// determination of minimum adaptation time reached for cylinder individual lambda adaptation areas
FOR m = 0 to NC_CBK_EX_NR - 1
  IF (1) STATE_LAM_CYL_SEL_ADJ[m] = ADJ_NOM_L_RNG (4[H])
  THEN (1)
    IF (2) LV_LAM_CYL_SEL_ADJ_VLD[m] = 1 and
      FAC_CYL_LAM_ABSV_SUM[m] <
      C_FAC_CYL_LAM_ABSV_SUM_BAL_DC
    THEN (2) LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] = 1
    ENDIF (2)
    IF (2) T_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] ≥
      C_T_MIN_CYL_BAL_LAM_SEL_DC
      // minimum adaptation time for CILC (low range) elapsed
    THEN (2) LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] = 1
    ELSE (2) T_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m](n) =
      T_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m](n-1) + 0.1[s]
      // incrementation of minimum adaptation time for CILC (low range)
    ENDIF (2)
  ELSEIF (1) STATE_LAM_CYL_SEL_ADJ[m] = ADJ_NOM_H_RNG (5[H])
  THEN (1)
    IF (2) LV_LAM_CYL_SEL_ADJ_VLD[m] = 1 and
      FAC_CYL_LAM_ABSV_SUM[m] <
      C_FAC_CYL_LAM_ABSV_SUM_BAL_DC
    THEN (2) LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] = 1
    ENDIF (2)
    IF (2) T_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] ≥
      C_T_MIN_CYL_BAL_LAM_SEL_DC
      // minimum adaptation time for CILC (high range) elapsed
    THEN (2) LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] = 1
    ELSE (2) T_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m](n) =
      T_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m](n-1) + 0.1[s]
      // incrementation of minimum adaptation time for CILC (high range)
    ENDIF (2)
  ELSEIF (1) STATE_LAM_CYL_SEL_ADJ[m] = "ADJ_ENG_COLD (2[H])
  THEN (1)

```

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```

IF (2)          LV_LAM_CYL_SEL_ADJ_VLD[m] = 1 and
                 FAC_CYL_LAM_ABSV_SUM[m] <
                 C_FAC_CYL_LAM_ABSV_SUM_BAL_DC
THEN (2)      LV_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] = 1
ENDIF (2)
IF (2)          T_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] ≥
                 C_T_MIN_CYL_BAL_LAM_SEL_DC
                 // minimum adaptation time for CILC (cold range) elapsed
THEN (2)      LV_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] = 1
ELSE (2)      T_CYL_BAL_LAM_SEL_RNG_COLD_DC[m](n) =
                 T_CYL_BAL_LAM_SEL_RNG_COLD_DC[m](n-1) + 0.1[s]
                 // incrementation of minimum adaptation time for CILC (cold range)
ENDIF (2)
ENDIF (1)
END FOR
// calculation of cylinder individual lambda adaptation readiness (hot) at active driving cycle (global)

IF          (  $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_L\_DC[m] = NC\_CBK\_EX\_NR$  and
                 $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_H\_DC[m] = NC\_CBK\_EX\_NR$  )

THEN      LV_CYL_BAL_LAM_SEL_AD_HOT_DC = 1
                // hot adaptation values of all exhaust banks are within limits at active DC
ENDIF
// calculation of cylinder individual lambda adaptation readiness (cold) at active driving cycle (global)

IF           $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_SEL\_RNG\_COLD\_DC[m] = NC\_CBK\_EX\_NR$ 

THEN      LV_CYL_BAL_LAM_SEL_AD_COLD_DC = 1
                // cold adaptation values of all exhaust banks are within limits at active DC
ENDIF

```

#### Assignments at exit from state Adaptation :


```

LV_CYL_BAL_LAM_SEL_HOM_REQ_DC = 0
T_CYL_BAL_LAM_SEL_AD_WAIT_DC = 0.0[s]
FOR m = 0 to NC_CBK_EX_NR - 1
    T_CYL_BAL_LAM_SEL_AD_REQ_DC[m] = 0.0 [s]
    LV_CYL_BAL_LAM_SEL_AD_REQ_DC[m] = 0
    LV_CYL_BAL_AD_WG_OPEN_REQ_DC[m] = 0
END FOR

```

### 9.47.6 Calculation of cylinder balancing lambda adaptation readiness (DC):

#### FUNCTION DESCRIPTION:

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**General information:**

A periodic request for homogenous combustion mode is carried out in defined time intervals to allow the start of the lambda adaptation functions, which are only activated in homogenous combustion mode.

**Application conditions:**

*Initialization at first Engine run or NVMY-error:*

```
T_CYL_BAL_LAM_AD_DC = 0.0[s] (first initialization)
LV_CYL_BAL_LAM_AD_DC = 0 (first initialization)
FOR m = 0 to NC_CBK_EX_NR - 1
    LV_CYL_BAL_LAM_AD_ADD_DC[m] = 0 (first initialization)
    LV_CYL_BAL_LAM_AD_FAC_L_DC[m] = 0 (first initialization)
    LV_CYL_BAL_LAM_AD_FAC_H_DC[m] = 0 (first initialization)
END FOR
```

*Initialization at Reset:*

```
T_CYL_BAL_LAM_AD_DC = T_CYL_BAL_LAM_AD_DC (NVMY)
LV_CYL_BAL_LAM_AD_DC = LV_CYL_BAL_LAM_AD_DC (NVMY)
FOR m = 0 to NC_CBK_EX_NR - 1
    LV_CYL_BAL_LAM_AD_ADD_DC[m] = LV_CYL_BAL_LAM_AD_ADD_DC[m] (NVMY)
    LV_CYL_BAL_LAM_AD_FAC_L_DC[m] = LV_CYL_BAL_LAM_AD_FAC_L_DC[m] (NVMY)
    LV_CYL_BAL_LAM_AD_FAC_H_DC[m] = LV_CYL_BAL_LAM_AD_FAC_H_DC[m] (NVMY)
END FOR
```

**END FOR**

*(NVMY: values stored in the non-volatile memory)*

```
FOR m = 0 to NC_CBK_EX_NR - 1
    IF C_CYL_BAL_LAM_AD_DC_CONF = ADD (0H)
    THEN LV_CYL_BAL_LAM_AD_FAC_L_DC[m] = 1
        LV_CYL_BAL_LAM_AD_FAC_H_DC[m] = 1
    ELSEIF C_CYL_BAL_LAM_AD_DC_CONF = FAC_L (1H)
    THEN LV_CYL_BAL_LAM_AD_ADD_DC[m] = 1
        LV_CYL_BAL_LAM_AD_FAC_H_DC[m] = 1
    ELSEIF C_CYL_BAL_LAM_AD_DC_CONF = ADD_FAC_L (2H)
    THEN LV_CYL_BAL_LAM_AD_FAC_H_DC[m] = 1
    ENDIF
END FOR
```


**END FOR**

*Initialization at Reset or Deactivation:*

```
LV_CYL_BAL_LAM_AD_HOM_REQ_DC = 0
STATE_CYL_BAL_LAM_AD_DC = "Wait" (0[H])
LV_STATE_LAM_AD_DC_CHG_REQ = 0
LV_STATE_LAM_AD_DC_CHG_WAIT = 0
T_CYL_BAL_LAM_AD_WAIT_DC = 0.0[s]
LV_T_STEP_CYL_BAL_LAM_AD_DC = 0
FOR m = 0 to NC_CBK_EX_NR - 1
    LV_CYL_BAL_LAM_AD_REQ_DC[m] = 0
    T_CYL_BAL_LAM_AD_ADD_DC[m] = 0.0[s]
    T_CYL_BAL_LAM_AD_FAC_L_DC[m] = 0.0[s]
    T_CYL_BAL_LAM_AD_FAC_H_DC[m] = 0.0[s]
    T_CYL_BAL_LAM_AD_REQ_DC[m] = 0.0[s]
END FOR
```

**END FOR**

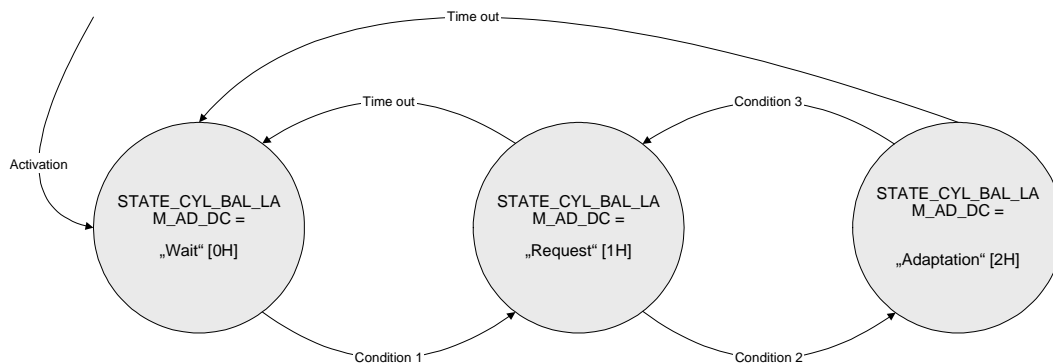
*Recurrence:* 100 ms

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Activation:                    LC\_CYL\_BAL\_AD\_DC\_RST = 0                    **and**  
                                   LV\_ST\_END = 1                                    **and**  
                                   LC\_TCHA\_CONF = 0                                **and**  
                                   LC\_CYL\_BAL\_CORD\_DC\_STOP\_MAN = 0

Deactivation:                LC\_CYL\_BAL\_AD\_DC\_RST = 0                    **and**  
                                   [            LV\_ST\_END = 0                                **or**  
     LC\_TCHA\_CONF = 1                                **or**  
     LC\_CYL\_BAL\_CORD\_DC\_STOP\_MAN = 1            **] ]**

### Signal flow diagram:



### Formula section:

#### IF (1)

[[//EU /Japan1

T\_AST\_BAL < C\_T\_AST\_MAX\_CYL\_BAL\_AD\_DC                    **and** // max time  
 TCO\_ST\_BAL < C\_TCO\_ST\_MAX\_CYL\_BAL\_AD\_DC                **and** // TCO\_ST\_MAX  
 TCO\_ST\_BAL > C\_TCO\_ST\_MIN\_CYL\_BAL\_AD\_DC                // TCO\_ST\_MIN  
 ]

#### OR

[[// Japan 2

T\_AST\_BAL > C\_T\_AST\_MIN\_2\_CYL\_BAL\_AD\_DC                **and** // 2.time intervall  
 T\_AST\_BAL < C\_T\_AST\_MAX\_2\_CYL\_BAL\_AD\_DC                **and** // 2.time intervall  
 TCO\_ST\_BAL < C\_TCO\_ST\_MAX\_CYL\_BAL\_AD\_DC                **and** // TCO\_ST\_MAX  
 TCO\_ST\_BAL > C\_TCO\_ST\_MIN\_CYL\_BAL\_AD\_DC                // TCO\_ST\_MIN  
 ]

#### OR

[[// Stop Condition

T\_AST\_BAL < C\_T\_AST\_MAX\_CYL\_BAL\_AD\_DC\_STOP            **and** // max time  
 T\_ES\_CUS < C\_T\_ES\_MAX\_CYL\_BAL\_HOM\_REQ\_INT            **and** // stop time  
 TCO\_ST\_BAL < C\_TCO\_ST\_MAX\_ES\_CYL\_BAL\_AD\_DC            **and** // TCO\_ST\_MAX  
 TCO\_ST\_BAL > C\_TCO\_ST\_MIN\_ES\_CYL\_BAL\_AD\_DC            // TCO\_ST\_MIN  
 ]]


**THEN (1)**                    // DC adaptation requests controlled by fix time steps

```

IF (2)          T_AST_BAL < ID_T_CYL_BAL_LAM_AD_DC // time shape
THEN (2)       LV_STATE_LAM_AD_DC_CHG_REQ = 1
                LV_STATE_LAM_AD_DC_CHG_WAIT = 0
                LV_T_STEP_CYL_BAL_LAM_AD_DC = 1
ELSE (2)       LV_STATE_LAM_AD_DC_CHG_REQ = 0
                LV_STATE_LAM_AD_DC_CHG_WAIT = 1
                LV_T_STEP_CYL_BAL_LAM_AD_DC = 0
ENDIF (2)
ELSE (1)       // DC adaptation requests for controlled by flexible time steps
LV_T_STEP_CYL_BAL_LAM_AD_DC = 0
IF (2)          T_CYL_BAL_LAM_AD_DC < C_T_MAX_CYL_BAL_LAM_AD_DC
THEN (2)       T_CYL_BAL_LAM_AD_DC(n) = T_CYL_BAL_LAM_AD_DC(n-1) + 0.1[s]
                // waiting time incrementation, flexible time steps running
IF (3)          LV_CYL_BAL_LAM_AD_DC = 0
THEN (3)       // enable conditions to change adaptation state from "Wait" to "Re-
quest"
                LV_STATE_LAM_AD_DC_CHG_REQ = 1
                LV_STATE_LAM_AD_DC_CHG_WAIT = 0
ELSE (3)       // enable conditions to change adaptation state from "Request" to
"Wait"
                LV_STATE_LAM_AD_DC_CHG_REQ = 0
                LV_STATE_LAM_AD_DC_CHG_WAIT = 1
ENDIF (3)
ELSE (2)       // reset of waiting time, new beginning of flexible time steps
T_CYL_BAL_LAM_AD_DC = 0.0[s]
LV_CYL_BAL_LAM_AD_DC = 0
FOR m = 0 to NC_CBK_EX_NR - 1
IF              C_CYL_BAL_LAM_AD_DC_CONF = ADD (0H)
THEN            LV_CYL_BAL_LAM_AD_ADD_DC[m] = 0
                T_CYL_BAL_LAM_AD_ADD_DC[m] = 0.0[s]
ELSEIF         C_CYL_BAL_LAM_AD_DC_CONF = FAC_L (1H)
THEN            LV_CYL_BAL_LAM_AD_FAC_L_DC[m] = 0
                T_CYL_BAL_LAM_AD_FAC_L_DC[m] = 0.0[s]
ELSEIF         C_CYL_BAL_LAM_AD_DC_CONF = ADD_FAC_L
(2H)
THEN            LV_CYL_BAL_LAM_AD_ADD_DC[m] = 0
                LV_CYL_BAL_LAM_AD_FAC_L_DC[m] = 0
                T_CYL_BAL_LAM_AD_ADD_DC[m] = 0.0[s]
                T_CYL_BAL_LAM_AD_FAC_L_DC[m] = 0.0[s]
EISEIF        C_CYL_BAL_LAM_AD_DC_CONF = ADD_FAC_
ALL (3H)
THEN            LV_CYL_BAL_LAM_AD_ADD_DC[m] = 0
                LV_CYL_BAL_LAM_AD_FAC_L_DC[m] = 0
                LV_CYL_BAL_LAM_AD_FAC_H_DC[m] = 0
                T_CYL_BAL_LAM_AD_ADD_DC[m] = 0.0[s]
                T_CYL_BAL_LAM_AD_FAC_L_DC[m] = 0.0[s]
                T_CYL_BAL_LAM_AD_FAC_H_DC[m] = 0.0[s]
ENDIF
END FOR
ENDIF (2)
ENDIF (1)

```

Note: At function activation always State "Wait" is entered

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**Cylinder balancing adaptation at DC: State 0[H] - Wait****Assignments at entry to state Wait :**

```
STATE_CYL_BAL_LAM_AD_DC = "Wait" (0[H])
LV_CYL_BAL_LAM_AD_HOM_REQ_DC = 0
```

**Action during state "Wait":**

```
Transition to State 1[H] Request (Condition 1)
// Lambda Adaptation manager request for change of state
IF          LV_STATE_LAM_AD_DC_CHG_REQ = 1
```

**Assignments at exit from state Wait :**

No assignments

**Cylinder balancing adaptation at DC: State 1[H] - Request****Assignments at entry to state Request :**

```
STATE_CYL_BAL_LAM_AD_DC = "Request" (1[H])
```

**Action during state "Request":**

```
Transition to State 0[H] Wait (Time out)
// Lambda Adaptation manager request for change of state
IF          LV_STATE_LAM_AD_DC_CHG_WAIT = 1
```

**Calculations:**

// conditions for cylinder balancing global lambda adaptation achieved

```
FOR m = 0 to NC_CBK_EX_NR - 1
  IF      ([ STATE_LAM_AD[m] = "CDN_FAC_L" (2[H])
            STATE_LAM_AD[m] = "ADAPT_FAC_L" (5[H])
            [ LV_CYL_BAL_LAM_AD_FAC_L_DC[m] = 0
              LV_T_STEP_CYL_BAL_LAM_AD_DC = 1
            ]
          ]
        or
        and
        or
        )
  OR
  ([ STATE_LAM_AD[m] = "CDN_FAC_H" (3[H])
    STATE_LAM_AD[m] = "ADAPT_FAC_H" (6[H])
    [ LV_CYL_BAL_LAM_AD_FAC_H_DC[m] = 0
      LV_T_STEP_CYL_BAL_LAM_AD_DC = 1
    ]
  ]
  or
  and
  or
  )
  OR
  ([ STATE_LAM_AD[m] = "CDN_ADD" (4[H]) ]
   STATE_LAM_AD[m] = "ADAPT_ADD" (7[H])
   [ LV_CYL_BAL_LAM_AD_ADD_DC[m] = 0
     LV_T_STEP_CYL_BAL_LAM_AD_DC = 1
   ]
  ]
  THEN   T_CYL_BAL_LAM_AD_REQ_DC[m](n) =
          T_CYL_BAL_LAM_AD_REQ_DC[m](n-1) + 0.1[s]
  ELSE   T_CYL_BAL_LAM_AD_REQ_DC[m](n) = 0.0[s]
  ENDIF
END FOR
```

// calculation of request for bank specific homogenous combustion mode switch

```
FOR m = 0 to NC_CBK_EX_NR - 1
  IF      [T_CYL_BAL_LAM_AD_REQ_DC[m] ≥ C_T_MIN_CYL_BAL_AD_REQ_DC]
    AND
    [(
      GEAR ≥ C_GEAR_MIN_CYL_BAL_AD_REQ_DC
      VS ≥ C_VS_MIN_CYL_BAL_AD_REQ_DC
    )
    AND
```



```

OR
VS <= C_VS_MAX_CYL_BAL_AD_REQ_DC
]

THEN      LV_CYL_BAL_LAM_AD_REQ_DC[m] = 1
ELSE      LV_CYL_BAL_LAM_AD_REQ_DC[m] = 0
ENDIF

END FOR
// calculation of request flag for EVAC controller to allow activation of lambda adaptation

```

```

IF (1)       $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} T\_CYL\_BAL\_LAM\_AD\_REQ\_DC[m] > 0.0[s]$ 

THEN (1)    LV_CYL_BAL_LAM_AD_ENA_DC = 1
ELSE (1)    LV_CYL_BAL_LAM_AD_ENA_DC = 0
ENDIF (1)

// calculation of request for homogenous combustion mode switch
IF (1)      ( LV_CYL_BAL_LAM_AD_ENA_DC = 1                                and
              LV_NT_RGN_REQ = 1                                           and
              LV_LAM_AD_ENA = 1                                           )
OR
              ( LV_LAM_AD_ENA = 1                                           and
               $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_AD\_REQ\_DC[m] > 0$  )
THEN (1)    LV_CYL_BAL_LAM_AD_HOM_REQ_DC = 1
ENDIF (1)

```

Transition to State 2[H] Adaptation (Condition 2)

*// conditions for combustion mode switch to homogenous*

```
IF      LV_CYL_BAL_LAM_AD_HOM_REQ_DC = 1
```

**Assignments at exit from state Request :**

```
LV_CYL_BAL_LAM_AD_ENA_DC = 0
```

```
FOR m = 0 to NC_CBK_EX_NR - 1
```

```
    LV_CYL_BAL_LAM_AD_REQ_DC[m] = 0
```

```
    T_CYL_BAL_LAM_AD_REQ_DC[m] = 0
```

```
END FOR
```

**Cylinder balancing adaptation at DC: State 2[H] - Adaptation**

**Assignments at entry to state Adaptation :**


```
STATE_CYL_BAL_LAM_AD_DC = "Adaptation" (2[H])
```

```
T_CYL_BAL_LAM_AD_WAIT_DC = C_T_MIN_CYL_BAL_AD_WAIT_DC
```

```
FOR m = 0 to NC_CBK_EX_NR - 1
```

```
    T_CYL_BAL_LAM_AD_REQ_DC[m] = C_T_MIN_CYL_BAL_AD_WAIT_DC
```

```
END FOR
```

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**Actions during state "Adaptation":**

Transition to State 0[H] Wait (Time out)

// Lambda Adaptation manager request for change of state

**IF** LV\_STATE\_LAM\_AD\_DC\_CHG\_WAIT = 1

Transition to State 1[H] Request (Condition 3)

// conditions for combustion mode switch to homogenous or waste gate open not achieved

**IF** LV\_CYL\_BAL\_LAM\_AD\_HOM\_REQ\_DC = 0 **or**  
LV\_LAM\_AD\_ENA = 0**Calculations:**

// calculation of waiting time after entry in homogenous combustion mode for non turbo engine

**IF (1)** T\_CYL\_BAL\_LAM\_AD\_WAIT\_DC = 0.0[s]

// waiting time after switch to homogenous combustion mode elapsed

**THEN (1)****FOR (2)** m = 0 to NC\_CBK\_EX\_NR - 1**IF (3)** ( LV\_MFF\_ADD\_RNG\_LAM\_AD[m] = 0 **and**  
LV\_FAC\_L\_RNG\_LAM\_AD[m] = 0 **and**  
LV\_FAC\_H\_RNG\_LAM\_AD[m] = 0 )

// neither low range, nor high range, nor add range lambda adaptation

area active**THEN (3)** T\_CYL\_BAL\_LAM\_AD\_REQ\_DC[m](n) =  
T\_CYL\_BAL\_LAM\_AD\_REQ\_DC[m](n-1) - 0.1 [s]**ELSE (3)** T\_CYL\_BAL\_LAM\_AD\_REQ\_DC[m](n) =  
C\_T\_MIN\_CYL\_BAL\_AD\_WAIT\_DC**ENDIF (3)****IF (3)** T\_CYL\_BAL\_LAM\_AD\_REQ\_DC[m] = 0.0 [s]  
// time with no lambda adaptation area active elapsed**OR**( LV\_MFF\_ADD\_RNG\_LAM\_AD[m] = 1 **and**  
LV\_CYL\_BAL\_LAM\_AD\_ADD\_DC[m] = 1 )

// additive range lambda adaptation active - adaptation result achieved

**OR**( LV\_FAC\_L\_RNG\_LAM\_AD[m] = 1 **and**  
LV\_CYL\_BAL\_LAM\_AD\_FAC\_L\_DC[m] = 1 )

// low range lambda adaptation active - adaptation result achieved

**OR**( LV\_FAC\_H\_RNG\_LAM\_AD[m] = 1 **and**  
LV\_CYL\_BAL\_LAM\_AD\_FAC\_H\_DC[m] = 1 )

// high range lambda adaptation active - adaptation result achieved


**THEN (3)** LV\_CYL\_BAL\_LAM\_AD\_REQ\_DC[m] = 0

// conditions for lambda adaptation no longer present

**ELSE (3)** LV\_CYL\_BAL\_LAM\_AD\_REQ\_DC[m] = 1

// conditions for lambda adaptation still present

**ENDIF (3)****END FOR (2)****IF (2)**  $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_AD\_REQ\_DC[m] = 0$ 


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```

// conditions for lambda adaptation no longer achieved for all exhaust banks

THEN (2)      LV_CYL_BAL_LAM_AD_HOM_REQ_DC = 0
               // reset of homogenous combustion mode request
ENDIF (2)
ELSE (1)
  IF (2)      LV_T_STEP_CYL_BAL_LAM_AD_DC = 0
  THEN (2)    T_CYL_BAL_LAM_AD_WAIT_DC(n) = T_CYL_BAL_LAM_AD_WAIT_DC(n-
1) - 0.1[s]
               // decrementation of waiting time after switch to homogenous combustion
mode
ENDIF (2)
ENDIF (1)
// determination of learned lambda adaptation values
FOR m = 0 to NC_CBK_EX_NR - 1
  IF (1)      LV_CYL_BAL_LAM_AD_END[m] = 1
  THEN (1)
    LV_CYL_BAL_LAM_AD_END[m] = 0
    IF (2a)   STATE_CYL_BAL_LAM_AD[m] = "ADAPT_ADD" (7[H])
    THEN (2a) LV_CYL_BAL_LAM_AD_ADD_DC[m] = 1
    ELSEIF (2b) STATE_CYL_BAL_LAM_AD[m] = "ADAPT_FAC_L" (5[H])
    THEN (2b) LV_CYL_BAL_LAM_AD_FAC_L_DC[m] = 1
    ELSEIF (2c) STATE_CYL_BAL_LAM_AD[m] = "ADAPT_FAC_H" (6[H])
    THEN (2c) LV_CYL_BAL_LAM_AD_FAC_H_DC[m] = 1
    ENDIF (2)
  ENDIF (1)
END FOR
// determination of minimum adaptation time reached for lambda adaptation areas
FOR m = 0 to NC_CBK_EX_NR - 1
  IF (1a)     LV_MFF_ADD_RNG_LAM_AD[m] = 1
  THEN (1a)
    IF (2a)   T_CYL_BAL_LAM_AD_ADD_DC[m] ≥ C_T_MIN_CYL_BAL_LAM_
AD_DC
               // minimum adaptation time for lambda adaptation (add range) elapsed
    THEN (2a) LV_CYL_BAL_LAM_AD_ADD_DC[m] = 1
    ELSE (2a) T_CYL_BAL_LAM_AD_ADD_DC[m](n) =
               T_CYL_BAL_LAM_AD_ADD_DC[m](n-1) + 0.1[s]
               // incrementation of min. adaptation time for LAM_AD (add range)
    ENDIF (2a)
  ELSEIF (1b) LV_FAC_L_RNG_LAM_AD[m] = 1
  THEN (1b)
    IF (2b)   T_CYL_BAL_LAM_AD_FAC_L_DC[m] ≥ C_T_MIN_CYL_BAL_LAM_
AD_DC
               // minimum adaptation time for lambda adaptation (fac low range) elapsed
    THEN (2b) LV_CYL_BAL_LAM_AD_FAC_L_DC[m] = 1
    ELSE (2b) T_CYL_BAL_LAM_AD_FAC_L_DC[m](n) =
               T_CYL_BAL_LAM_AD_FAC_L_DC[m](n-1) + 0.1[s]
               // incrementation of min. adaptation time for LAM_AD (fac low range)
    ENDIF (2b)
  ELSEIF (1c) LV_FAC_H_RNG_LAM_AD[m] = 1
  THEN (1c)
    IF (2c)   T_CYL_BAL_LAM_AD_FAC_H_DC[m] ≥ C_T_MIN_CYL_BAL_LAM_
AD_DC

```

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```

// minimum adaptation time for lambda adaptation (fac high range) elapsed
THEN (2c)      LV_CYL_BAL_LAM_AD_FAC_H_DC[m] = 1
ELSE (2c)      T_CYL_BAL_LAM_AD_FAC_H_DC[m](n) =
                  T_CYL_BAL_LAM_AD_FAC_H_DC[m](n-1) + 0.1[s]
// incrementation of min. adaptation time for LAM_AD (fac high range)
ENDIF (2c)
ENDIF (1)
END FOR
// calculation of lambda adaptation readiness at active driving cycle (global)

```

```

IF  $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_AD\_ADD\_DC[m] = NC\_CBK\_EX\_NR$  and

```

```

 $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_AD\_FAC\_L\_DC[m] = NC\_CBK\_EX\_NR$  and

```

```

 $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_AD\_FAC\_H\_DC[m] = NC\_CBK\_EX\_NR$ 

```

```

THEN      LV_CYL_BAL_LAM_AD_DC = 1
// adaptation values of all exhaust banks are within limits at active driving cycle
ENDIF

```

Assignments at exit from state Adaptation :

```
LV_CYL_BAL_LAM_AD_HOM_REQ_DC = 0
```


```
T_CYL_BAL_LAM_AD_WAIT_DC = 0.0[s]
```

```
FOR m = 0 to NC_CBK_EX_NR - 1
```

```
    T_CYL_BAL_LAM_AD_REQ_DC[m] = 0.0 [s]
```

```
    LV_CYL_BAL_LAM_AD_REQ_DC[m] = 0
```

```
END FOR
```

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## 9.48 Bit serial data component driver

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ALTER_COD_0	O/V	0... 7H	0 ...7	1	-
manufacturer identifier					
ALTER_COD_1	O/V	0... 1FH	0... 31	1	-
type identifier alternator					
ALTER_COD_2	O/V	0... 3H	0 ...3	1	-
controller version alternator					
ALTER_COD_3	O/V	0... FH	0... 15	1	-
chip version alternator					
B_OZFBSD	O/V	0... 1H	0 ...1	1	-
failure in oil-BSD-bevice					
BSD_SENS_BAT_SMT_ADR	O/V	0... FFH	0... 255	1	-
Actual register number					
BSD_SENS_BAT_SMT_INFO	O/V	0... FFH	0... 255	1	-
Content of register					
CTR_ALTER_EVE_WR	V	0... FFH	0... 255	1	-
eo-write counter					
CTR_BSD_CPT_COM_OK	-	0... FFH	0... 255	1	-
Number of "ok" communications between ECU and BSD devices per scheduling timing table list					
CTR_T_RD_PER_ALTER_TBL_2	-	0... FFH	0... 10.2	0.04	s
Time for reading register 2					
CTR_T_RD_PER_ALTER_TBL_5	-	0... FFH	0... 10.2	0.04	s
Time for reading register 5					
CTR_T_WR_PER_ALTER_TBL_0	-	0... FFH	0... 10.2	0.04	s
Time for write register 0					
CTR_T_WR_PER_ALTER_TBL_1	-	0... FFH	0... 10.2	0.04	s
Time for write register 1					
CUR_ALTER_EXCT	O/V	0... 3EH	0... 7.75	0.125	A
actual value exciting current alternator					
CUR_ALTER_EXCT_LIM	O/V	0... 1FH	0... 7.75	0.25	A
actual value exciting current limitation alternator					
CUR_CNS_CWP	O/V	0... FFH	0... 127.5	0.5	A
Register 4 (ewpi) /required current of the el. Water pump					
IDX_BSD_SDL_TBL	-	0... FFH	0... 255	1	-
Index of the timing scheduler for the BSD devices					
LF_ALTER_EVE_WR	V	0... FFH	0... 255	1	-
Logical field for eo-write operation					
LF_BSD_CPT_AVL	O/V	0... FFH	0... 255	1	-
Logical data field displaying the learnt and configured BSD devices					
LF_BSD_SENS_BAT_SMT_CTL	O/V	0... FFH	0... 255	1	-
Communication coordination byte (logical field)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LF_CWP_INFO_COD	O/V	0... FFH	0... 255	1	-
Register 5 Bit 5...7 <<5 /Supplier information (Pierburg /SiemensVDO)					
LF_POW_CWP_COD	O/V	0... FFH	0... 255	1	-
Register 5 Bit 0...4 /CWP power HW version (200W or 350/400W)					
LV_ALTER_BSD_PROT_2	O/V	0... 1H	0 ...1	1	-
condition for BSD protocol controller type 2					
LV_ALTER_COM_ACT	-	0... 1H	0 ...1	1	-
Flag indication communication on BSD to alternator disturbed					
LV_ALTER_ERR_EL	O/V	0... 1H	0 ...1	1	-
electrical fault alternator					
LV_ALTER_ERR_IF	O/V	0... 1H	0 ...1	1	-
Alternator interface failure.					
LV_ALTER_ERR_MEC	O/V	0... 1H	0 ...1	1	-
mechanical fault alternator					
LV_ALTER_ERR_TEMP	O/V	0... 1H	0 ...1	1	-
(excess) temperature fault alternator					
LV_ALTER_EVE_RD	O/V	0... 1H	0 ...1	1	-
condition: eo-read					
LV_ALTER_EVE_WR	O/V	0... 1H	0 ...1	1	-
condition: eo-write					
LV_ALTER_IF_ACT	O/V	0... 1H	0 ...1	1	-
condition alternator interface activ					
LV_CWP_BLOCK_DEAC	O/V	0... 1H	0 ...1	1	-
Register 6 Bit 7 (ewpdblck) /automatic de-blocking active					
LV_CWP_COM_ACT	-	0... 1H	0 ...1	1	-
Flag indication communication on BSD to coolant water pump disturbed					
LV_CWP_HW_LIH_IN_CHK	O/V	0... 1H	0 ...1	1	-
Register 6 Bit 2 /Supply voltage to CWP (HW PIN) connected correctly - LIH strategy in case of BSD com. error					
LV_CWP_LOCK	O/V	0... 1H	0 ...1	1	-
Register 6 Bit 4 (ewpblk1) /CWP blocked or requests a too high current					
LV_CWP_PRE_LOCK	O/V	0... 1H	0 ...1	1	-
Register 6 Bit 5 (ewptlf) /CWP running dry					
LV_CWP_TEMP_HIGH	O/V	0... 1H	0 ...1	1	-
Register 6 Bit 3 (ewpft) /over-temperature shut down					
LV_CWP_VCC_PLAUS	O/V	0... 1H	0 ...1	1	-
Register 6 Bit 6 (ewpfu) /voltage supply not in the correct range					
LV_EXC_CUR_ALTER_EXCT_LIM_SP	-	0... 1H	0 ...1	1	-
Indicates "B_chexc" condition					
LV_EXC_T_LOAD_RESP_ALTER_SP_0	-	0... 1H	0 ...1	1	-
Indicates "B_chtrgen" condition					
LV_EXC_V_ALTER_SP	-	0... 1H	0 ...1	1	-
Indicates "B_chugen" condition					
LV_LOAD_RESP_ALTER_CND_1	O/V	0... 1H	0 ...1	1	-
alternator load response condition for register 1 activ					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LOAD_RESP_ALTER_THD_ACT	O/V	0... 1H	0 ...1	1	-
shut of the load response threshold for alternator (copy of SP)					
LV_N_MON_CWP_DEAC	O/V	0... 1H	0 ...1	1	-
Register 6 Bit 1 (ewpnoff) /no CWP speed monitoring active					
LV_QOIL_COM_ACT	-	0... 1H	0 ...1	1	-
Flag indication communication on BSD to oil quality sensor disturbed					
LV_REQ_GEN_RD_REG2	-	0... 1H	0 ...1	1	-
Request read register 2					
LV_REQ_GEN_RD_REG5	-	0... 1H	0 ...1	1	-
Request read register 5					
LV_REQ_GEN_WR_REG0	-	0... 1H	0 ...1	1	-
Request write register 0					
LV_REQ_GEN_WR_REG1	-	0... 1H	0 ...1	1	-
Request write register 1					
LV_REQ_GEN_WR_REG3	-	0... 1H	0 ...1	1	-
Request write register 3					
LV_SENS_BAT_SMT_ACT	O/V	0... 1H	0 ...1	1	-
Communication to IBS has been detected as alive					
LV_SENS_BAT_SMT_COM_ACT	-	0... 1H	0 ...1	1	-
Flag indication communication on BSD to intelligent battery sensor disturbed					
LV_SENS_BAT_SMT_DET	O/V/S	0... 1H	0 ...1	1	-
IBS has been detected					
LV_STEP_BSD_ALTER	-	0... 1H	0 ...1	1	-
Request action on "ablaufwr"					
N_REL_CWP	O/V	0... FFH	0... 255	1	-
Register 1 Bit 0 (ewpiwbsd) /actual rpm stage of the el. water pump					
NR_ALTER_EVE_WR	V	0... FFH	0... 255	1	-
Number of eo-write event					
ozleitr_w	O/V	0... FFFFH	0... 27	0.000412	-
ÖZS: oil sensor raw value of oil resistance					
oznivpr_w	O/V	0... FFFFH	0... 65535	1	-
ÖZS: oil sensor raw value of oil level calculated out of permittivity					
oznivr	O/V	0... FFH	0... 255	1	mm
signal oil level					
Ozoelkm	O/V	0... FFFFH	0... 655350	10	km
Ölkilometer					
ozpermr_w	O/V	0... FFFFH	0... 1024	1	-
signal oil quality					
OZSTATUS	O/V	0... FFH	0... 255	1	-
status of oil sensor					
OZTEMPR	O/V	0... FFH	0... 255	1	°C
signal oil temperature					
POW_REL_ALTER	O/V	0... 1FH	0... 96.875	3.125	%
Exitation of the alternator					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
POW_REL_ALTER_L_RES	O/V	0H	DF<50%	-	-
		1H	50%<DF<75%		
		2H	75%<DF<100%		
		3H	100%		
DF rough value (occupancy factor) from alternator					
STATE_ALTER_VALUE_WR	V	0... FFH	0... 255	1	-
State for selection of eo-write value					
STATE_BSD_COM	-	0... FFH	0... 255	1	-
Actual status of the communication between ECU and BSD devices					
STATE_BSD_CPT	-	0H	SENS_BAT_	-	-
		3H	SMT		
		4H	CWP		
		6H	QOIL ALTER		
Actually communicating BSD device					
T_FIL_CUR_EXCT_ALTER	O/V	0... FFH	0... 2.55	0.01	s
Calibratable filter time constant for exciting current of the alternator (Powermanagement)					
T_LOAD_RESP_ALTER	O/V	0... 3H	0... 15	0	s
actual value from alternator load response time					
TEMP_ALTER_MC	O/V	0... 1FH	-32 ...216	8	°C
chip temperature alternator					
TEMP_EL_CWP	O/V	0... FFH	-50 ...205	1	°C
electronic temperature coolant water pump /Register 3 (ewpt)					
V_ALTER	O/V	0... 3FH	10.6 ...16.9	0.1	V
received voltage alternator					
V_ALTER_NOM	O/V	0H	14V	-	-
		1H	42V		
Nominal voltage alternator /bord net version 14/42V					
V_CWP	O/V	0... FFH	0... 25.5	0.1	V
Register 2 (ewpu) /Supply voltage at el. Water pump					

**Input data:**

C_CTR_MAX_ALTER_ COM_STOP {p. 4835}	C_CTR_MAX_CWP_COM_ STOP {p. 4835}	C_CTR_MAX_QOIL_COM_ STOP {p. 4835}	C_CTR_MAX_SENS_BAT_ SMT_COM_STOP {p. 4835}
C_T_WR_PER_ALTER_ TBL_0 {p. 4097}	C_T_WR_PER_ALTER_ TBL_1 {p. 4097}	CTR_ABC_SENS_BAT_ SMT_COM {p. 4832}	CTR_MSG_SENS_BAT_ SMT_COM_DIAG {p. 4832}
CUR_ALTER_EXCT_LIM {p. 4093}	ECU_STATE {p. 1091}	LV_ERR_ALTER_COM {p. 4834}	LV_ERR_BSD {p. 4834}
LV_ERR_CWP_COM {p. 4834}	LV_ERR_QOIL_COM {p. 4834}	LV_ERR_SENS_BAT_ SMT_COM {p. 4834}	LV_IGK {p. 906}
LV_LOAD_RESP_ALTER_ THD_ACT_SP {p. 8368}	LV_VAR_BN {p. 655}	LV_VAR_VEH {p. 656}	N_REL_CWP_SP {p. 8225}



POW_REL_ALTER_CLC {p. 8368}	STATE_BSD_MSG_COM_ STOP {p. 4834}	T_LOAD_RESP_ALTER {p. 4096}	V_ALTER {p. 4096}
VB {p. 1185}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_BSD_CPT_DET	-	0... FFH	0... 255	1	-
Number of required consecutive positive acknowledges to get a component learnt					
C_STATE_BSD_CPT_AVL	-	0... FFH	0... 255	1	-
Actual used BSD devices (bit coded! 1 = used)					
C_STATE_BSD_CPT_DET	-	0... FFH	0... 255	1	-
BSD devices, which are set by default (bit coded! 1 = not to be learnt)					
C_T_FIL_CUR_EXCT_ALTER	-	0... FFH	0... 2.55	0.01	s
calibratable filter time for exciting current (alternator powermanagement)					
C_T_RD_PER_ALTER_TBL_2	-	0... FFH	0... 10.2	0.04	s
calibratable time period for reading register 2 (alternator powermanagement)					
C_T_RD_PER_ALTER_TBL_5	-	0... FFH	0... 10.2	0.04	s
calibratable time period for reading register 5 (alternator powermanagement)					
C_T_WR_PER_ALTER_TBL_0	-	0... FFH	0... 10.2	0.04	s
calibratable time period for write register 0 (alternator powermanagement)					
C_T_WR_PER_ALTER_TBL_1	-	0... FFH	0... 10.2	0.04	s
calibratable time period for write register 0 (alternator powermanagement)					
C_VB_MIN_BSD_DIAG	-	0... FFH	0... 25.89843	0.1015625	V
Battery Voltage threshold of power management diagnosis					
ID_NR_ALTER_EVE_WR	-	0... 7H	0 ...7	1	-
LDP_IDX_LF_ALTER_EVE_WR	32	0... 7FH	0... 127	1	-
Map for selection of eo-write event					
ID_STATE_ALTER_VALUE_WR	-	0... 3H	0 ...3	1	-
LDP_IDX_NR_ALTER_EVE_WR	8	0... 7H	0 ...7	1	-
LDP_IDX_CTR_ALTER_EVE_WR	3	0... 2H	0 ...2	1	-
Map for selection of eo-write value					
ID_STATE_BSD_SDL_TBL	-	0... FFH	0... 255	1	-
LDP_IDX_BSD_SDL_TBL	32	0... FFH	0... 255	1	-
BSD component device scheduling timing table					
LC_ALTER_BSD_PROT_2	-	0... 1H	0 ...1	1	-
logical constant: software switch to choose BSD protocol					
LC_POW_CORD_INH	-	0... 1H	0 ...1	1	-
Configuration switch of alternator powermanagement					
S_RDGENTYP	-	0... FFH	0... 255	1	-
Switch of generatur identify					

**Import actions:**

<b>ACTION_COMS_SetBsdGlobalCom</b> (IN<CTR_BSD_CPT_COM_OK>)
<b>ACTION_COMS_SetBsdSingleCom</b> (IN<STATE_BSD_CPT>,IN<STATE_BSD_COM>)

## 9.48.1 BSD-Drivers

### 9.48.1.1 Device-detection algorithm

#### FUNCTION DESCRIPTION:

##### General information:

There is an algorithm installed to detect the single component devices connected to the ECU via BSD. At every ECU reset the learning algorithm is started and for each possible device it is checked whether the device is available or not. In case the consecutive positive acknowledges of the device reach the calibratable threshold `C_CTR_BSD_CPT_DET` the corresponding device has been learnt. Once a device has been detected it is assumed that it is installed for ever and for this specific device the learning algorithm is deactivated. To realise this the flag indicating whether a device is learnt or not is stored in the NVMY. The learnt devices can solely be deleted via tester tool. They can be read via KWP job. Alternator, QLT and electronically controlled water pump are assumed to be there in every case, resulting in a fulltime activation of the corresponding device drivers. In addition each device can be set by a SW constant as to be available (`C_STATE_BSD_CPT_AVL`) and if the available devices should be learnt or not (`C_STATE_BSD_CPT_DET`) (set as loc. True!)

##### Description:

The following bit-coding is applied to the calibration constants `C_STATE_BSD_CPT_AVL`, `C_STATE_BSD_CPT_DET` and the status byte `LF_BSD_CPT_AVL` (set as loc. True!)

The logical data field `LF_BSD_CPT_AVL` displays the configured and learnt BSD components. In case there is a mismatch between `C_STATE_BSD_CPT_AVL` and `LF_BSD_CPT_AVL` obviously a problem occurred in the BSD components learning session. The by the constant `C_STATE_BSD_CPT_DET` configured BSD components are directly set in the logical data field `LF_BSD_CPT_AVL`. The BSD components which have to be learnt are set after the learning process has been finished. In case the BSD component has been successfully learnt the corresponding bit is set to 1 in the logical data field `LF_BSD_CPT_AVL`. Otherwise the corresponding device bit stays 0.

Bit position	BSD device
0	SENS_BAT_SMT -- Intelligent battery sensor (IBS)
1	-- O3 Sensor
2	-- el. waterpump electronics
3	CWP -- electrical coolant water pump
4	QOIL - oil quality sensor (QLT)
5	-- alternator 2
6	ALTER - alternator
7	-- glow plug control unit

##### Application conditions

**Initialisation:** *all variables are initialised out of NVMY*

**Recurrence:** *once after `LV_IGK = 1`*

**Activation:** *`LV_IGK = 1`*

**Deactivation:** *`LV_IGK = 0`*

**Formula section:**

```

If          KT_IBS_VAR = 1 (ASW, BSW Interface)
Then       LV_SENS_BAT_SMT_DET = 1
Else       LV_SENS_BAT_SMT_DET = 0
Endif

```

```

If          LV_SENS_BAT_SMT_DET = 0
Then       Device-detection algorithm for IBS is activated
Else       Device-detection algorithm for IBS is deactivated
Endif


```

```

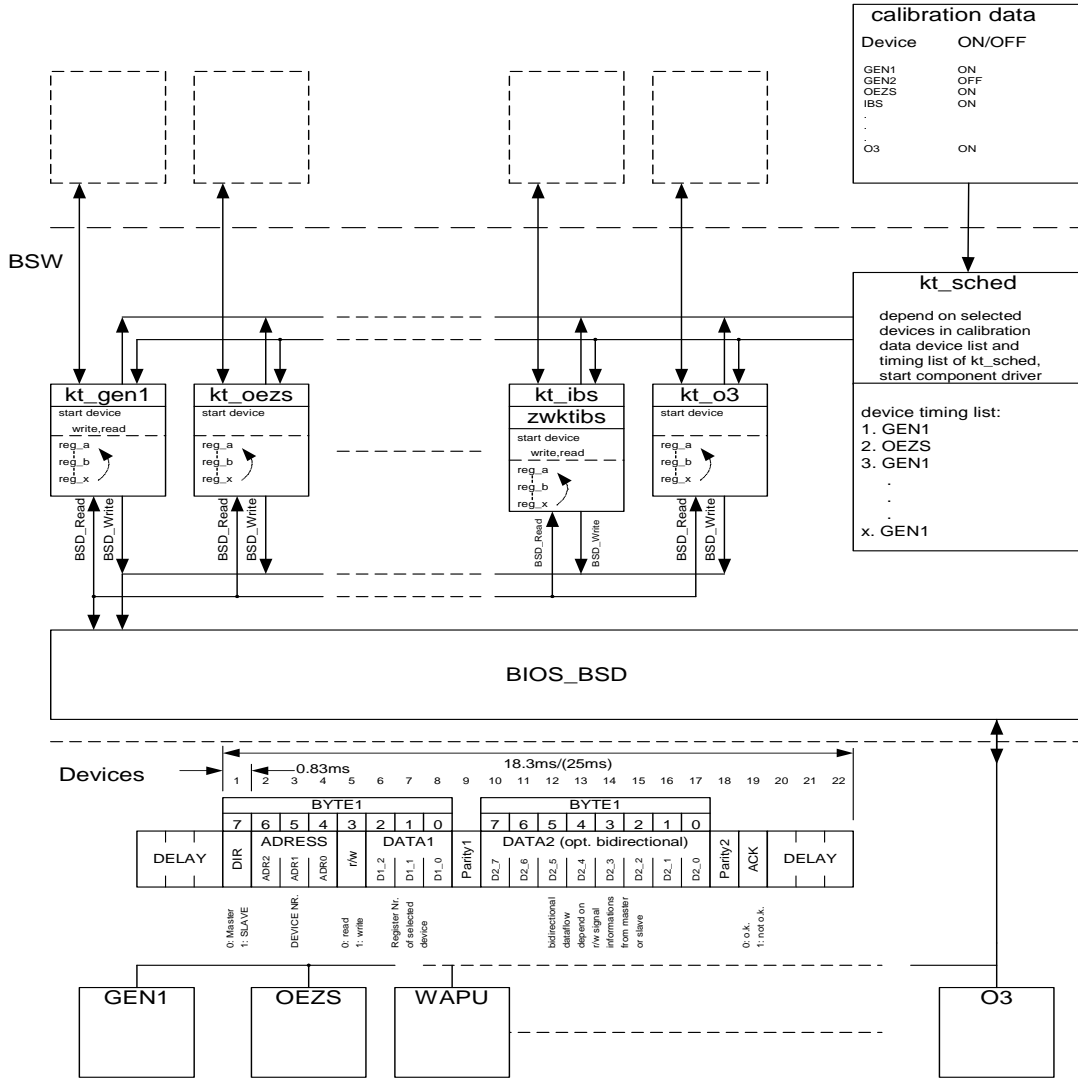
If          LV_SENS_BAT_SMT_DET = 1                /*IBS learnt in this or in any former
driving cycle*/
Then       Component driver for IBS is activated
Else       Component driver for IBS is deactivated
Endif

```

**Signal flow diagram:**

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ASW



9.48.1.2 BSD-Timing coordinaton and BSD timing table

Description for actions:

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**Description:**

The driver of a certain device is only called if the device has been learnt. Some BSD device drivers are not called (writing only!) if the message to be written has not changed. So if it is not necessary for the device driver to send (e.g. if the values did not change), this is reported to the timing coordinator. The timing coordinator can then pass on this time slot to the next BSD device in the scheduling timing table.

**Design of the scheduling timing table of the BSD devices:****ID\_STATE\_BSD\_SDL\_TBL**

IDX_BSD_SDL_TBL	Bit 7 not used	Bit 6 not used	Bit 5 'wake up' ECU_STATE = 6H	Bit 4 'engine running' ECU_STATE = 0H V FFH	Bit 3 'power latch' ECU_STATE = 4H	Bit 2	Bit 1	Bit 0
0	0	0	0	1	0	1	1	0
1	0	0	1	1	0	0	0	0
2	0	0	1	1	1	0	1	1
.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.
17	1	1	1	1	1	1	1	1
.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.
30	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0

e.g. Alternator  
**SetBsdSingleCom**

e.g. Battery sensor  
**SetBsdSingleCom**

e.g. Coolant water pump  
**SetBsdSingleCom**

FFH - End of table; goto begin of table  
**SetBsdGlobalCom**

The BSD device is coded in Bit 0...2.

**Application conditions**

**Initialisation:** 0at WakeUp  
*Recurrence:* 20ms (optional 25ms in MS-)

**Activation:** WakeUp

**Deactivation:** Sleeping

**Formula section:**

**Handling of the single /global BSD com error /counter CTR\_BSD\_CPT\_COM\_OK:**

**If**        IDX\_BSD\_SDL\_TBL < IDX\_BSD\_SDL\_TBL(ID\_STATE\_BSD\_SDL\_TBL = FFH)  
              //Pointer of the BSD timing coordinator is between the starting point of the scheduling timing  
table  
              and the end of the Scheduling timing table//

**Then**

**If**        LV\_MSG\_xxx\_COM\_STOP = 0 (STATE\_BSD\_MSG\_COM\_STOP)  
**Then**       **If**        ECU receives no positive acknowledge from slave device  
              **Then**        LV\_xxx\_COM\_ACT = 0                       **and**  
                          Send a 22 synchronisation pulse phase  
                          in next corresponding time slot followed by  
                          LV\_xxx\_COM\_ACT == 0  
              **Else**        LV\_xxx\_COM\_ACT = 1  
              **Endif**  
              **If**        LV\_xxx\_COM\_ACT = 1  
                          With: xxx - corresponding to the actual time slot device  
              **Then**        CTR\_BSD\_CPT\_COM\_OK ++  
              **Endif**  
              // the end of the timing table is not reached-transmit single message error status//  
              Call ACTION\_COMS\_SetBsdSingleCom (IN <STATE\_BSD\_CPT>, IN <STATE\_BSD\_COM>)  
              IDX\_BSD\_SDL\_TBL++  
**Else**        stop communication to device xxx in the corresponding time slot  
              STATE\_BSD\_COM = FFH  
              Call ACTION\_COMS\_SetBsdSingleCom (IN <STATE\_BSD\_CPT>, IN <STATE\_BSD\_COM>)  
              IDX\_BSD\_SDL\_TBL++

**Endif**

              //Counter is reset to 0 at the end of the Scheduling timing table after the action has been  
called//

              // the end of the timing table is reached-transmit global BSD error status//  
**Else**        Call ACTION\_COMS\_SetBsdGlobalCom(IN <CTR\_BSD\_CPT\_COM\_ACT>)                       CTR\_  
BSD\_CPT\_COM\_OK = 0                        // reset communication counter//  
              IDX\_BSD\_SDL\_TBL = 0                        // re-started BSD timing table//  
              LV\_CWP\_COM\_ACT = 0                                        // Table is re-started ; reset communica-  
tion flags//  
              LV\_ALTER\_COM\_ACT = 0  
              LV\_QOIL\_COM\_ACT = 0  
              LV\_SENS\_BAT\_SMT\_COM\_ACT = 0

**Endif**


**Control of the communication after an communication error has been detected:**

**If**        C\_CTR\_MAX\_xxx\_COM\_STOP <> FFFFH                       **and**  
              LV\_ERR\_xxx\_COM = 1  
**Then**        stop communication with this device for this DC (LV\_IGK 1- ->0)  
**Else**        communication with the corresponding device to be continued

With:

STATE\_BSD\_CPT                                       = STATE\_BSD\_SDL\_TBL(bit0...2)  
STATE\_BSD\_COM                                      = LV\_xxx\_COM\_ACT

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STATE\_BSD\_MSG\_COM\_STOP = LV\_MSG\_xxx\_COM\_STOP

STATE_BSD_CPT	STATE_BSD_COM
0H --SENS_BAT_SMT-intelligent battery sensor	1H = LV_SENS_BAT_SMT_COM_ACT=0
3H -- CWP- electrical coolant water pump	8H = LV_CWP_COM_ACT = 0
4H - QOIL - oil quality sensor (QLT)	10H = LV_QOIL_COM_ACT = 0
6H -- ALTER - alternator	40H = LV_ALTER_COM_ACT = 0

Figure 9.48.1: STATE\_BSD\_CPT

STATE_BSD_CPT	STATE_BSD_MSG_COM_STOP
0H --SENS_BAT_SMT-intelligent battery sensor	1H = LV_MSG_SENS_BAT_SMT_COM_STOP=1
3H -- CWP- electrical coolant water pump	8H = LV_MSG_CWP_COM_STOP = 1
4H - QOIL - oil quality sensor (QLT)	10H = LV_MSG_QOIL_COM_STOP = 1
6H -- ALTER - alternator	40H = LV_MSG_ALTER_COM_STOP = 1

### 9.48.1.3 Component driver

#### FUNCTION DESCRIPTION:

##### General information:

Basics that should be implemented in a device driver:

##### Description:

To be translated:

Wenn Werte geschrieben werden sollen, soll abgeprüft werden ob der Wert gleich dem zuletzt gesendeten Wert ist. Ist dieses der Fall, kann die Funktion für diesen Buszyklus wieder verlassen werden.

Diese Funktionalität dient dazu, die Busbelastung niedrig zu halten.

Der nächste Teilnehmer laut Timing-Liste kann dann diesen Zeitslot nutzen.

Nach dem Lernprozess wird das angeschlossene Gerät vom BSD-Timing-Koordinator als vorhanden markiert. Jetzt wird die eigentliche BSD-Kommunikation mit dem ausgewähltem Gerät gestartet. Dabei läuft innerhalb des Komponententreibers wiederum ein Schreib-Lese-Koordinator, welcher in seiner Abfolge frei definiert werden kann. Getaktet wird dieser Vorgang durch den Aufruf des BSD-Timing-Koordinators.

#### Application conditions

**Recurrence:** wird durch BSD-Timingcoordinator generiert

**Activation:** WakeUp

**Deactivation:** Sleeping



## 9.48.2 Component Driver for BSD-alternator

### 9.48.2.1 Identification of the controller type

#### FUNCTION DESCRIPTION:

This function allows to identify the controller type of the alternator that is installed and to choose the communication protocol via code word. Possible controller types:

#### General information:

BSD-controller II measures and limits the exciting current. Additionally a detection of the chip temperature. It provides information about the actual alternator torque for a torque model. The communication of the BSD-controller type I is different to the BSD-controller type II. In the first phase BSD-controller type I or type II can be installed. At init., register 7 provides information about controller- and chip version and the nominal voltage. Address 6 communicates with type I and type II. Later on a mix of type I and type II assembly is impossible.

#### Description:

Detection of the controller type (Register 7, Bit 6/7):

Type	ALTER_COD_2
BSD-controller I	00
BSD-controller II	01

Choosing the communication protocol via code word:

Type	LC_ALTER_BSD_PROT_2
BSD-controller I	0
BSD-controller II	1

Combinations and possible BSD protocol:

ALTER_COD_2	LC_ALTER_BSD_PROT_2	LV_ALTER_BSD_PROT_2
00	0	0
00	1	0
01	0	0
01	1	1

Conditions to be chosen by software switch:

sw-switch / codeword	condition	meaning	BMW naming
LC_ALTER_BSD_PROT_2	LV_ALTER_BSD_PTOT_2	BSD-prot 1 or 2	CW_GENPROT

### 9.48.2.2 BSD controller I

Id. for address 0x06 (BSD component driver controller typ I)

Part: electr. alternator, electronic: address: 6

**Remark:** address 6 must communicate with type I and type II (depending of the detection what type is installed).

### Specification only for BSD-controller type I !!

Id	Parameter	LS Bit	Bit Anz.	w(rite) r(ead)	unit	function
0	V_ALTER_SP	0	6	r/w	V	Alternator voltage / without control XX00 0000 = 10,6V limited XX11 0110 = 16,0V XX11 1111 = 16,0V
	T_LOAD_RESP_ALTER_SP	6	2	r/w	s	Load Response (LR) 00XX XXXX = 0s 01XX XXXX = 3s 10XX XXXX = 6s 11XX XXXX = 9s
1	--	--	--		--	not used
2	POW_REL_ALTER	0	5	-/r	%	DF-monitor XXX0 0000 = 0% capacity XXX1 1111 = 96,875% capacity
	LV_ALTER_ERR_EL	5	1	-/r	-	electrical alternator error XX0X XXXX = no error XX1X XXXX = error present
	LV_ALTER_ERR_MEC	6	1	-/r		mec. Alternator error X0XX XXXX = no error X1XX XXXX = error present
	LV_ALTER_ERR_TEMP	7	1	-/r	-	High temperature protection 0XXX XXXX = no error 1XXX XXXX = error present
3	--	--	--		--	not used
4	--	--	--		--	not used
5	--	--	--		--	not used
6	ALTER_COD_0	5	3	-/r	-	manufacturer ID 000X XXXX = Bosch 001X XXXX = Valeo
	ALTER_COD_1	0	5	-/r	-	alternator type coding XXX0 0000
7	ALTER_COD_2	6	2	-/r	-	BSD-controller version 00XX XXXX = BSD1 01XX XXXX = BSD2
	V_ALTER_NOM	4	2	-/r	V	nominal voltage alternator controller XX01 XXXX = 14V
	ALTER_COD_3	0	4	-/r	-	Chip-version BSD controller (Index) XXXX 0000 = 0 XXXX 1111 = 15

### Formula section:

```


If          LC_ALTER_BSD_PROT_2      = 1      And
            ALTER_COD_2              = 1
Then       LV_ALTER_BSD_PROT_2      = 1
Else       LV_ALTER_BSD_PROT_2      = 0
Endif

```

```

IF          (BSD status is ok, BSD device send an answer to alternator)
Then       LV_ALTER_ERR_IF = 0

```

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```

Else      LV_ALTER_ERR_IF = 1 (communication BSD device alternator was incorrect)
Endif
If        LV_ALTER_EVE_WR      Or
          LV_ALTER_EVE_RD      = 1
Then      T_FIL_CUR_EXCT_ALTER = C_T_FIL_CUR_EXCT_ALTER * 2
Endif

```

## FUNCTION DESCRIPTION:

### General information:

**V\_ALTER\_SP** will be limited to the upper threshold 16.0 V. After that it will be provided to the BSW for the BSD interface.

**T\_LOAD\_RESP\_ALTER** will be converted to 3 s resolution, limited between 0 and 9 seconds and provided to the BSW for the BSD interface as well.

**ALTER\_COD\_1** delivers the type of alternator

**ALTER\_COD\_0** delivers the manufactory of alternator

This both information is necessary to identify the alternator. Depending on this information the power management is able to switch different calibrations.

### Application conditions:

*Activation:* at every engine operating state

*Deactivation:* -

*Initialization:* all outputs 0 (LV\_GEN\_xx = FALSE)

ALTER\_COD\_1 = 1F H /\*initialisation to max value\*/

ALTER\_COD\_0 = 7 H /\*initialisation to max value\*/

*Update-Rate:* 50 ms

### Formula section:

if no valid message was received during a timeout :  $T\_LOAD\_RESP\_ALTER = 3\text{ s}$   
 $V\_ALTER = 14.3\text{ V}$

else : POW\_REL\_ALTER\_CLC, T\_LOAD\_RESP\_ALTER and V\_ALTER are received via BSD interface.

The failure-bits LV\_GEN\_xx are received via BSD interface.

### 9.48.2.3 BSD controller II


**Id. for address 0x06 (BSD component driver controller typ II)**

Part: electr. alternator, electronic: address:6

**Remark: Specification only for BSD-controller type II !!**

Id	Parameter	LS Bit	Bit Anz.	w(rite) r(ead)	unit	function
0	V_ALTER_SP	0	6	r/w	V	Alternator voltage / without control XX00 0000 = 10,6V limited XX11 0110 = 16,0V XX11 1111 = 16,0V
1	LV_LOAD_RESP_ALTE R_THD_ACT_SP	0	1	r/w	-	Shut of speed threshold (s.o.s.t.) for LR-function. at 0 more than approx. 3000 alternator revolutions 0 = s.o.s.t. akt. (def.) 1 = s.o.s.t. deactivated
	LV_LOAD_RESP_ALTE R_CND_1	4	1	r/w	-	condition LR register 1 aktiv 0 = LR in reg. 0 act. (def.) 1 = LR in reg. 1 aktiv
	T_LOAD_RESP_ALTER _SP	5	3	r/w	s	LR- value 000X XXXX = 0s 001X XXXX = 0,2s 010X XXXX = 0,4s 011X XXXX = 3s 100X XXXX = 6s 101X XXXX = 9s 110X XXXX = 12s 111X XXXX = 15s
2	POW_REL_ALTER	0	5	r/-	%	DF-monitor XXX0 0000 = 0% capacity XXX1 1111 = 96,875% capacity
	LV_ALTER_ERR_EL	5	1	r/-	-	electrical alternator error XX0X XXXX = no error XX1X XXXX = error present
	LV_ALTER_ERR_MEC	6	1	r/-	-	mec. Alternator error X0XX XXXX = no error X1XX XXXX = error present
	LV_ALTER_ERR_TEMP	7	1	r/-	-	High temperature protection 0XXX XXXX = no error 1XXX XXXX = error present
3	CUR_ALTER_EXCT	0	6	r/-	A	read exciting current step 125mA XX00 0000 = 0A XX11 1110 = 7,75A XX11 1111 = 7,75A
	CUR_ALTER_EXCT_LI M_SP	1	5	-/w	A	exciting current limit. XX00 0000 = no limitation up to XX00 0010 = lim. to act. value up to XX00 0100 = lim. to 2A up to XX01 0000 = lim. to 2A up to XX01 0010 = lim. to 2,25A up to XX11 1110 = lim. to 7,75A

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	POW_REL_ALTER_LR ES	6	2	r/-	%	DF-rough value 00XX XXXX = DF < 50% 01XX XXXX = 50% < DF < 75% 10XX XXXX = 75% < DF < 100% 11XX XXXX = 100%
4	--	--	--		--	--
5	TEMP_ALTER_MC	1	5	r/-	°C	Chiptemperature XX00 000(0) = < -32°C Up to XX10 111(0) = ≤ 152°C XX11 001(0) = > 152°C (Bit 0=1/0 depending on Gen type. no info. about temp.)
6	ALTER_COD_0	5	3	r/-	-	manufacturer ID 000X XXXX = Bosch 001X XXXX = Valeo
	ALTER_COD_1	0	5	r/-	-	alternator type coding XXX0 0000
7	ALTER_COD_2	6	2	r/-	-	BSD-controller version 00XX XXXX = BSD1 01XX XXXX = BSD2
	V_ALTER_NOM	4	2	r/-	V	nominal voltage alternator controller (bord net version 14/42V) XX00 XXXX = 14V XX01 XXXX = 42V
	ALTER_COD_3	0	4	r/-	-	Chip-version BSD controller (Index) XXXX 0000 = 0 XXXX 1111 = 15

I

## FUNCTION DESCRIPTION:

### General information:

**LF\_ALTER\_EVE\_WR** is a status flag, which is generated by comparison of the variables CUR\_ALTER\_EXCT\_LIM, T\_LOAD\_RESP\_ALTER, V\_ALTER and the corresponding setpoints.

**NR\_ALTER\_EVE\_WR** is the output of the map ID\_NR\_ALTER\_EVE\_WR and describes the number of the eo-write event. In case of equality of LF\_ALTER\_EVE\_WR and the datapoint of ID\_NR\_ALTER\_EVE\_WR one of 8 possible write events is selected, otherwise the output of ID\_NR\_ALTER\_EVE\_WR is 0.

**CTR\_ALTER\_EVE\_WR** is the counter for the eo-write event process.

**STATE\_ALTER\_VALUE\_WR** is the output of the map ID\_STATE\_ALTER\_VALUE\_WR and selects dependant on CTR\_ALTER\_EVE\_WR and NR\_ALTER\_EVE\_WR the next value to write on the bus.

#### 9.48.2.3.1 Additional information for the BSD controller II protocol.

Writing only after a value has changed (after events) therefore comparison of value and reference value (for example Tirgen -> Tirfgen).

#### register 1:

Tirgen (LR-value) should be round down to the next value of tn. For more details see 1.2.3.5 table writing reg 1. When writing the LR-value then the bit B\_Irreg1ak = 1.

Writing of the set points to the alternator register 0 only in a defined time schedule (depending on C\_T\_WR\_PER\_ALTER\_TBL\_0)

**register 2:**

Reading of the values only in a defined time schedule (depending on C\_T\_RD\_PER\_ALTER\_TBL\_2).

**register 3:**

Read of register 3 as often as possible without eo-communication (defined in the flow chart 1.2.3.2). Minimum every second time slot = read register 3. At successfully communication the variable lerrfgrenz is written.

**register 5:**

Reading of the values only in a defined time schedule (depending on C\_T\_RD\_PER\_ALTER\_TBL\_5)

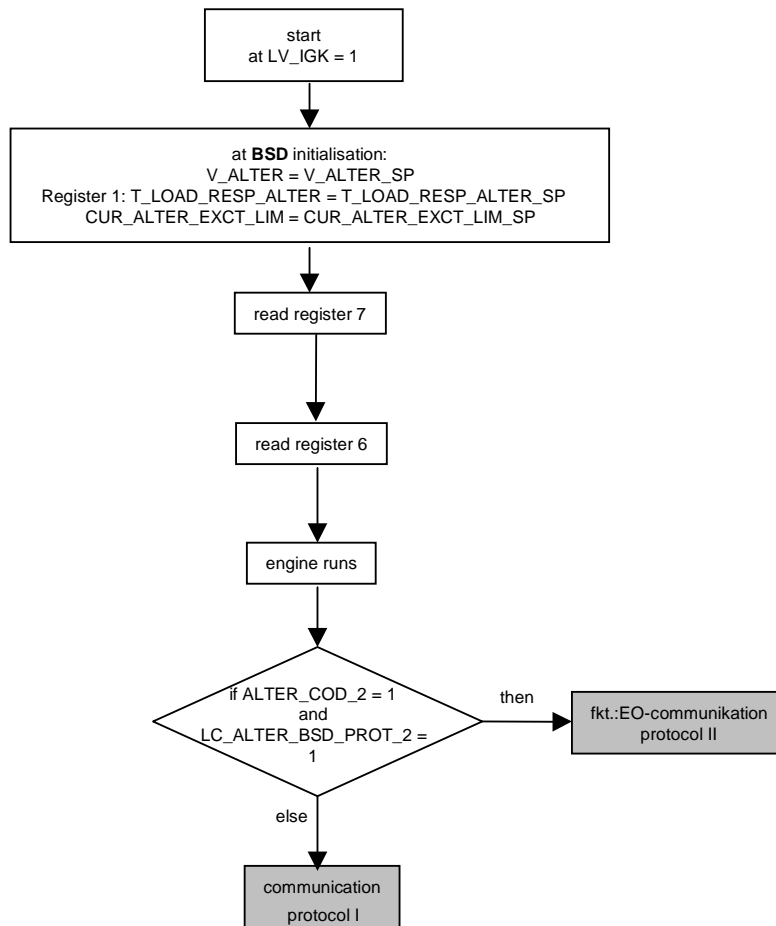
**register 6:**

Reading once at start communication BSD

**register 7:**

Reading once at start communication BSD

**General flowchart KT\_Gen BSD controller II**



### 9.48.2.3.2 Flow chart for function EO-communication BSD controller II

#### Superior function KT\_Sched (time scheduler)

only for example, content of time slots not describe the software !!!

20 ms	20 ms	20 ms	20 ms	20 ms	20 ms	20 ms	20 ms	20 ms	20 ms	20 ms
alter-nator	battery sensor	electr. cwp	QLT	alter-nator	battery sensor	electr. cwp	QLT	alter-nator	battery sensor	.....

By a time scheduler every 20 ms a new communication is triggered. During this time one register can be in progress (sending a protocol and call a driver). If KT\_Gen is triggered, then the progress shown below is started.

#### Subordinated function EO communication KT\_GEN

##### Application conditions

**Initialisation:** *only if LV\_ALTER\_BSD\_PROT\_2 = 1*

**Recurrence:** *40 ms*

**Activation:** *at every engine state*

**Deactivation:** *-*

Following flow charts are only a functional description of EO-communication BSD controller II. Due to the fact, that it is not possible to do action on BSD immediately for the requested device (for e.g. Generator), the requested jobs has to be stored in circular buffer (FIFO).

In case of GEN slot is carry out the jobs in the buffer will be executed according the FIFO principle.

In case of "V\_ALTER\_SP (U\_gen)" goes to 10,6V, immediately write of REG 0 and delete all other Jobs in the queue.

In case of "wrablauf > 0", immediately execute function "ablaufwr" and delete all other Jobs in the queue. New entries can be done after the last requested job from "ablaufwr" was executed.

Was a deleting of the queue performed and there are still jobs for reading Reg. 2 or Reg. 5 in the buffer, the jobs are lost.

Due to the fact, there is no positive response for reading Reg.2 or Reg.5, therefore set the timers for Reg.2 and Reg.5 again.

The recurrence of calculation "Generator BSD Controller II function" (40ms) could be higher than the BSD-Driver execute the Generator components (best case 20ms, worst case more than 40ms).

To avoid multiple entries for the same job in the buffer (because there was no update yet), the job entry in the buffer is locked till this job was performed by the BSD Driver.

The locking of the Register will be indicated with following flags:

- LV\_REQ\_GEN\_WR\_REG0
- LV\_REQ\_GEN\_WR\_REG 1
- LV\_REQ\_GEN\_WR\_REG 3
- LV\_REQ\_GEN\_RD\_REG 2

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- LV\_REQ\_GEN\_RD\_REG 5
- LV\_STEP\_BSD\_ALTER

the corresponding flags will be set to "0" after job has been performed.

Following locks in the buffer could be possible:

wrablauf = 0


Lock requested writing Reg. 0, 1, 3 till this job is done.

wrablauf > 0

Immediately execute function "ablaufwr", writing all jobs that are defined in ID\_STATE\_ALTER\_VALUE\_WR and lock new entry in the queue.

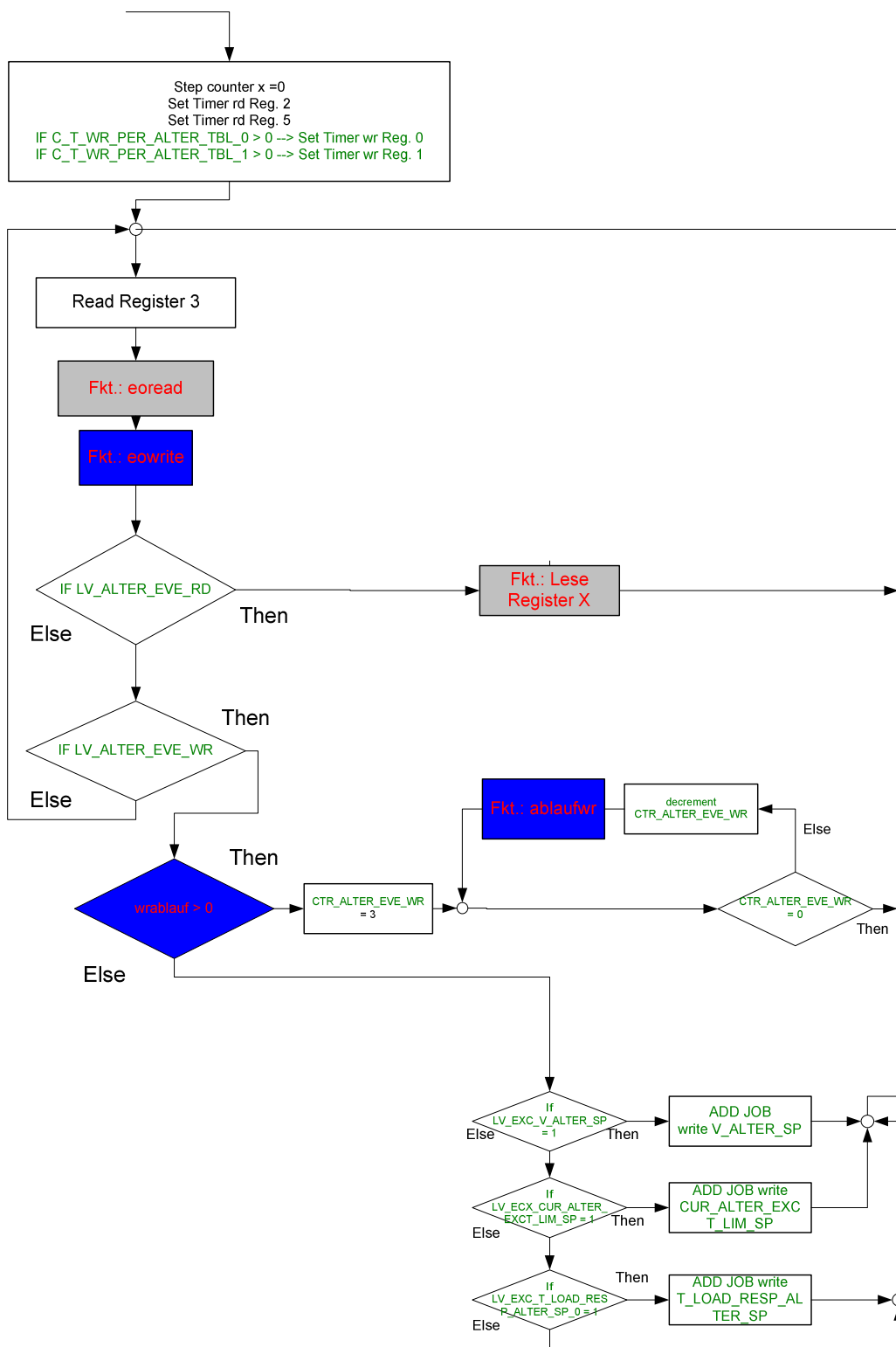
Lock reading Reg. 2 or Reg. 5 till reading was successfully executed.

In case of C\_T\_WR\_PER\_ALTER\_TBL\_0 /1 are set to "0" not time triggert write to REG 0 /1 will be executed, only event triggert action can be performed.

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Fkt.: EO-Kommunikation



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**9.48.2.3.3 Flow chart for the function eowrite**

**Application conditions**

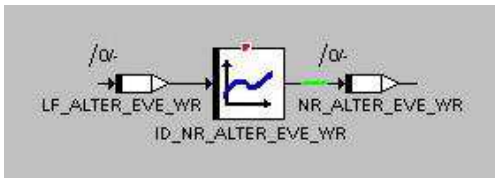
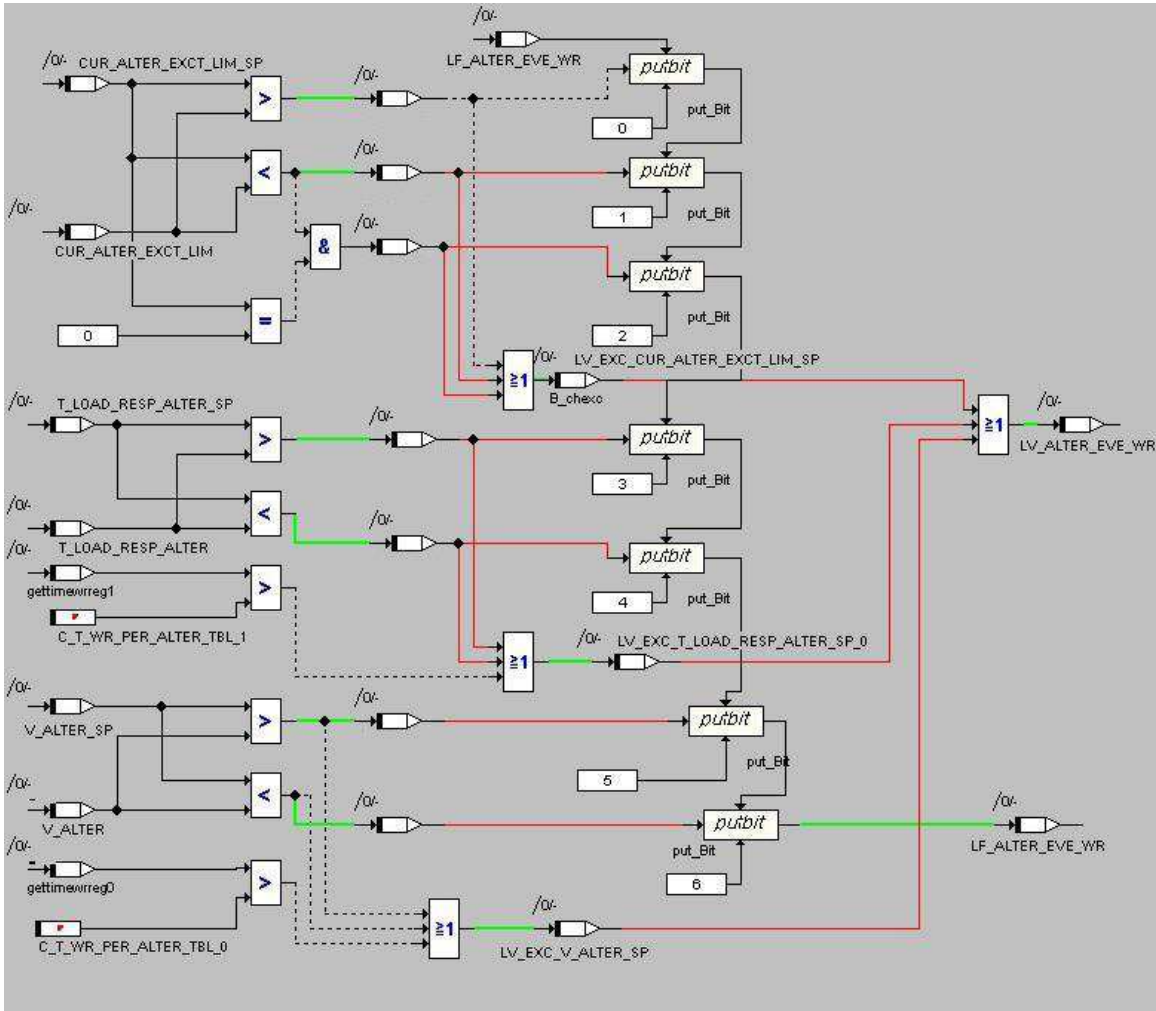
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**Initialisation:** *only if LV\_ALTER\_BSD\_PROT\_2 = 1*

**Recurrence:** *40 ms*

**Activation:** *at every engine state*

**Deactivation:** *-*




**9.48.2.3.4 Flow chart for the function eoread**

**Application conditions**

**Initialisation:** *only if LV\_ALTER\_BSD\_PROT\_2 = 1*

**Recurrence:** *40 ms*

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**Activation:** *at every engine state*

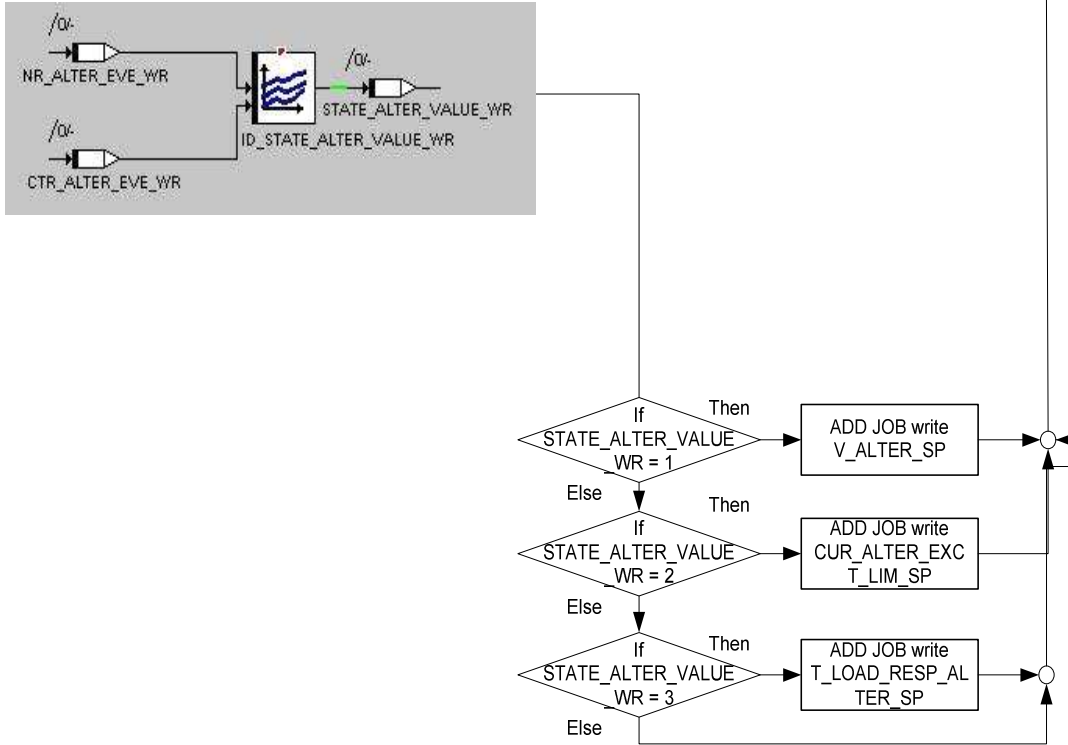
**Deactivation:** -



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**9.48.2.3.5 Flow charts for the functions ablaufwr /LR-write /read reg.x /calculation of the filter time**


*Fkt.: ablaufwr*

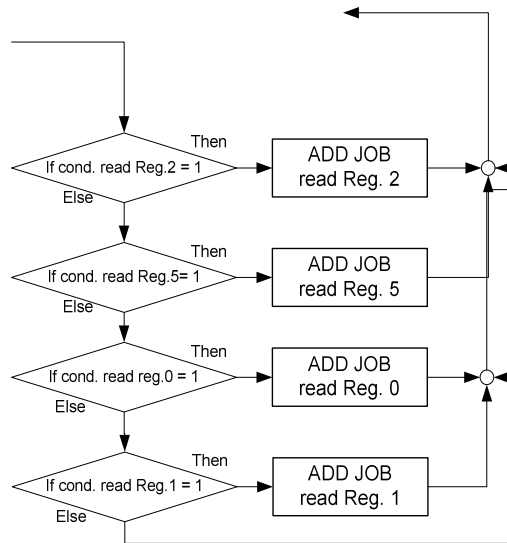
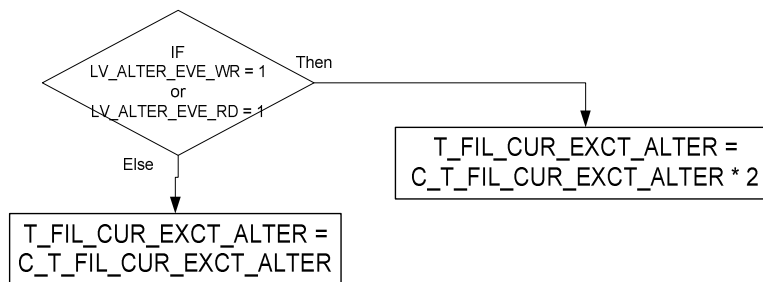


**Fkt.: LR-write**

The translation table for the fkt.: LR-write are shown in the AGGR-Spec PWSL!!

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Fkt.: read register XFkt.: calculation of the filter  
time**9.48.2.4 State machine Component Driver for BSD-alternator Type I****FUNCTION DESCRIPTION:****General information:**

Der Komponententreiber wird durch einen Zustandsautomaten der im Aufrufaster des BSD-Timing-Koordinator läuft dargestellt. Wie der **Abbildung 1-1** zu entnehmen ist besteht der KT aus mehreren Zuständen die im folgenden näher beschrieben werden.

**Signal flow diagram:**



Abbildung 1-1: State machine KT-Treiber Generator

## Description:

### A) Allgemeiner Zustand:


In jedem Zustand des KT werden folgende Fehler geprüft:

Überschreitet der **timeout counter for valid message** die Schwelle **KT\_GEN\_VALID\_MESSAGE\_TIMEOUT** so wird die Größe **V\_ALTER** auf den Applikationswert **UGENTYP** (13.8V entspricht den Notlaufwert des Generators) bzw. die Größe **T\_LOAD\_RESP\_ALTER** auf den Applikationswert **TL-RDEFAULT** (0x1E entspricht den Notlaufwert des Generators) gesetzt ansonsten wird der **timeout counter for valid message** inkrementiert (bei gültigen Daten wird dieser durch die Call\_Back-Funktion zurückgesetzt).

Anschließend wird geprüft ob das Generatorinterface aktiv ist d.h. Bedingung **B\_genactiv** = True, wenn ja wird der **timeout send counter** und der **timeout read counter** inkrementiert (bei gültigen Daten wird dieser durch die jeweilige Call\_Back-Funktion zurückgesetzt).

Desweiteren wird in jedem Zustand geprüft ob der **timeout send counter** die Schwelle **KT\_GEN\_SEND\_TIMEOUT** bzw. der **timeout read counter** die Schwelle **KT\_GEN\_SEND\_TIMEOUT** überschritten hat. Wurde einer dieser Schwellen überschritten geht der KT in den Zustand **kt\_GenStatus = KT\_GEN\_ST\_INI** über.

### B) Zustand KT\_GEN\_ST\_INI:

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Zu Beginn wird der KT initialisiert d.h.

```
V_ALTER = 0;
  T_LOAD_RESP_ALTER = 0;
  LV_GEN_ERR_EL = FALSE;
  LV_GEN_ERR_TEMP = FALSE;
  LV_GEN_ERR_MEC = FALSE;
  LV_GEN_IF_OFF = FALSE;
  POW_REL_ALTER_CLC = 0;
```

und andere diverse Größen wie Fehlerzähler usw..

Nach der Initialisierung befindet sich der KT im Zustand *kt\_GenStatus = KT\_GEN\_ST\_INI*. In diesem Zustand wird zyklisch ein **initialization timeout counter** hochgezählt und dem Hardwaretreiber (HWT) Initialisierungsdaten übergeben und anschließend der HWT gestartet. Als Initialisierungsdaten werden dem HWT folgende Größen übergeben:

period length

- low\_time Sync pulse
- low\_time of sended LOW Bit
- low\_time of sended HIGH Bit
- pointer to callback function for read register when result is ready
- pointer to callback function for send register when quit from peripherie is OK
- pointer to error handler

Wie oben zu sehen ist, werden dem HWT unter anderem zwei Pointer für die Call-Back-Funktion übergeben genaueres hierzu folgt etwas später.

Nun wird der **initialization timeout counter** inkrementiert. Anschließend wird geprüft ob der **initialization timeout counter** die Initialisierungsschwelle **KT\_GEN\_INI\_TIMEOUT** überschritten hat, wenn ja geht der KT in dem Zustand *kt\_GenStatus = KT\_GEN\_ST\_IDLE* über und der **initialization timeout counter** wird zurückgesetzt.

Nachdem der HWT gestartet worden ist, geht der KT in dem Zustand *kt\_GenStatus = KT\_GEN\_ST\_WAIT* über.

**C) Zustand KT\_GEN\_ST\_WAIT:**


In diesem Zustand wird gewartet bis der HWT den Status `work` mitteilt. Hier muß durch den BSD-Timing-Koordinator angezeigt werden ob sich der Treiber noch im Lernmodus befindet . Ist dieser Lernprozess abgeschlossen wird der **initialization timeout counter** , **timeout counter send message** und der **timeout counter read message** zurückgesetzt und die Bedingung **B\_genactiv** auf True gesetzt (generator interface is active). Anschließend geht der KT in den Status über welcher vom internen Schreib-Lese-Koordinator vorgegeben wird.

**D) Zustand KT\_GEN\_ST\_IDLE:**

Befindet sich der KT im Zustand *kt\_GenStatus = KT\_GEN\_ST\_IDLE* wird dem HWT ein `generator interface off` mitgeteilt, d.h. die Kommunikation auf der BSD-Schnittstelle bzgl. Generator wird eingestellt. Anschließend wird gewartet bis der HWT ein `generator interface off` mitteilt.

Nachdem vom HWT ein `generator interface off` mitgeteilt wurde wird die Bedingung **B\_genactiv** auf False gesetzt, die Bedingung **LV\_GEN\_IF\_OFF** auf True gesetzt und in diesem Zustand verharret. Die Bedingung **LV\_GEN\_IF\_OFF** wird nur oberhalb einer Batterie Spannungsschwelle  $VB >= C\_VB\_MIN\_POW\_DIAG$  aktiviert.

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**E) Zustand KT\_GEN\_ST\_WRITE\_REG0:**

Die Generatorsollspannung **V\_ALTER\_SP** zwischen den beiden Applikationswerten **UGMN** und **UGMX** begrenzt. Ist **V\_ALTER\_SP** kleiner gleich **UGMN** wird als Generatorsollspannung der Applikationswert **OUIINIGEN** verwendet.

Nach einer Umquantisierung des Sollwerts Load- Response- Zeit Generator **T\_LOAD\_RESP\_ALTER\_SP** wird diese zwischen den beiden Applikationswerten **TLRMN** und **TLRMX** begrenzt.

Anschließend wird dem HWT über einen Funktionsaufruf die Generatorsollspannung **V\_ALTER\_SP** und der Sollwert der Load-Response-Zeit **T\_LOAD\_RESP\_ALTER\_SP** mitgeteilt. Wurden diese Werte vom HWT über die BSD-Schnittstelle gesendet, wird die Call-Back-Funktion **KT\_gen\_sendErgHandler** über einen Pointer aufgerufen.

Nachdem die Werte dem HWT übergeben worden sind, geht der KT in den nächsten angeforderten Zustand **kt\_GenStatus** über.

**F) Zustand KT\_GEN\_ST\_READ\_REG0:**

Es werden HWT Daten von der BSD-Schnittstelle bzw. vom Generator durch einen Funktionsaufruf des HWT mit gültiger Generatoradresse angefordert.

Liegen Daten vom BSD-Generator dem HWT vor, so ruft der HWT durch einen Pointer die Call-Back-Funktion **KT\_gen\_readErgHandler** auf.

Nachdem die Werte durch den HWT übernommen worden sind, geht der KT in den nächsten angeforderten Zustand **kt\_GenStatus** über.

**G) Zustand KT\_GEN\_ST\_READ\_REG2:**

Es werden HWT Daten von der BSD-Schnittstelle bzw. vom Generator durch einen Funktionsaufruf des HWT mit gültiger Generatoradresse angefordert.

Liegen Daten vom BSD-Generator dem HWT vor, so ruft der HWT durch einen Pointer die Call-Back-Funktion **KT\_gen\_readErgHandler** auf.

Nachdem die Werte durch den HWT übernommen worden sind, geht der KT in den nächsten angeforderten Zustand **kt\_GenStatus** über.

**H) Call-Back-Funktion KT\_gen\_sendErgHandler:**

Wie bereits im Kapitel erwähnt, wird bei einer erfolgreichen Übertragung der Generatorsollspannung **V\_ALTER\_SP** bzw. des Sollwerts Load- Response- Zeit **T\_LOAD\_RESP\_ALTER\_SP** durch den HWT die Call-Back-Funktion **KT\_gen\_sendErgHandler** über einen Pointer durch den HWT aufgerufen.

In dieser Call-Back-Funktion wird der **timeout counter for valid message** sowie der **timeout send counter** zurückgesetzt.


**I) Call-Back-Funktion KT\_gen\_readErgHandler:**

Liegen Daten vom BSD-Generator dem HWT vor, so ruft der HWT durch einen Pointer die Call-Back-Funktion **KT\_gen\_readErgHandler** and the flag **LV\_ALTER\_ERR\_IF** is reset.

In dieser Call-Back-Funktion wird zunächst der **timeout counter for valid message** sowie der **timeout read counter** zurückgesetzt. Anschließend werden die vom HWT übergebenen Daten ausgewertet bzw. nach einer entsprechenden Umquantisierung abgespeichert.

**J) Fehler-Handler-Funktion KT\_gen\_errHandler:**

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Erkennt der HWT Fehler auf der BSD-Schnittstelle, geht der KT in den Zustand *kt\_GenStatus = KT\_GEN\_ST\_INI* über and the flag *LV\_ALTER\_ERR\_IF* is set.

### 9.48.3 Component Driver (Interface) for Intelligent Battery Sensor IBS - %ZWK-TIBS 1.20

#### FUNCTION DESCRIPTION:

Beschreibung der Schnittstelle HW-Treiber - Komponententreiber für die Verbindung IBS - DME

#### General information:

Der intelligente Batteriesensor bietet eine Reihe unterschiedlicher Einsatzmöglichkeiten und wird darum auf längere Sicht Gegenstand der Entwicklung sein. Dabei ist abzusehen, dass bei den unterschiedlichen Nutzungen auch wechselnde Variablen, Parameter und sonstige Datenstrukturen von und zum Sensor übertragen werden müssen. Es ist daher sinnvoll, in der Kommunikation zwischen Host und Sensor eine invariante Schnittstelle zu definieren, die die variablen Schichten des Komponententreibers und der Anwendersoftware vom Hardwaretreiber trennt, der nur einmal implementiert wird.

#### Description:

##### A) Realisierung Schnittstelle

Zum Datenaustausch in beiden Richtungen werden 3 Variable vom Typ unsigned char verwendet.: *BSD\_SENS\_BAT\_SMT\_INFO*, *BSD\_SENS\_BAT\_SMT\_ADR* und *LF\_BSD\_SENS\_BAT\_SMT\_CTL*. Sie sind im Modul des Hardwaretreibers global vereinbart.


*BSD\_SENS\_BAT\_SMT\_INFO* überträgt den Inhalt eines der acht BSD Register.

*BSD\_SENS\_BAT\_SMT\_ADR* (0 .. 7) adressiert das gewünschte Register.

*LF\_BSD\_SENS\_BAT\_SMT\_CTL* enthält 7 Flags, die als Anforderung, Quittung, Fehlermeldung etc. die Kommunikation zwischen Komponententreiber (KT) und Hardwaretreiber (HT) koordinieren.

Um eine möglichst schnelle Übertragung zu erreichen, müssen der KT und der HT nacheinander in dieser Reihenfolge von der gleichen zyklischen Task aufgerufen werden.

##### B) Flags zur Kommunikation Hardware-/Komponententreiber, in *LF\_BSD\_SENS\_BAT\_SMT\_CTL*

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<b>Name</b>	<b>Bit</b>	<b>gesetzt durch</b>	<b>gelöscht durch</b>	<b>Bedeutung</b>
<b>BSDHTOK</b> LV_SENS_BAT_SMT_BSD_DR_OK	0	HT	HT	Hardware Treiber ist bereit zur Übertragung; Flag bleibt an solange kein Fehlerzustand
<b>BSDWRITE</b> LV_SENS_BAT_SMT_BSD_WR	1	KT	KT	Richtung, hi: Register im Sensor schreiben
<b>BSDDO</b> LV_SENS_BAT_SMT_BSD_RUN	2	KT	HT	Anforderung von Komponenten- an Hardwaretreiber zum Start einer Übertragung
<b>BSDBSY</b> LV_SENS_BAT_SMT_BSD_WORK	3	HT	HT	Übertragung aktiv, Hardwaretreiber busy; Flag wird z.Zt. vom KT nicht benutzt
<b>BSDRXRDY</b> LV_SENS_BAT_SMT_BSD_TRM_END_AVL	4	HT	KT	Übertragung beendet, eingelesenes Byte ist verfügbar; Flag von Handler () im HT gesetzt
<b>BSDTXOK</b> LV_SENS_BAT_SMT_BSD_TRM_END_OK	5	HT	KT	Übertragung beendet, Byte wurde erfolgreich gesendet; Flag von Handler () im HT gesetzt
<b>BSDERR</b> LV_SENS_BAT_SMT_BSD_ERR_IT	7	HT	HT	BSD Fehler


Nur die fett gedruckten Flags werden für die laufende Kommunikation zwischen Komponenten- und Hardwaretreiber benötigt.

### C) Ablauf der Übertragung eines BSD Telegramms

1. Nach KL15 an löscht die Hardwaretreiber- Initialisierung alle Flags in LF\_BSD\_SENS\_BAT\_SMT\_CTL.
2. Der Hardwaretreiber baut die Verbindung zur Schnittstellen- Hardware auf. Nach erfolgreicher Verbindung und bei Funktionsbereitschaft setzt der HT das Flag LV\_SENS\_BAT\_SMT\_BSD\_DR\_OK.
3. Ist ausschließlich das Bit LV\_SENS\_BAT\_SMT\_BSD\_DR\_OK in LF\_BSD\_SENS\_BAT\_SMT\_CTL gesetzt, interpretiert der KT dies als Startbedingung und setzt seine zyklische Kommunikation zum Sensor auf.
4. Der Komponententreiber prüft LV\_SENS\_BAT\_SMT\_BSD\_DR\_OK vor jeder Aktion. Ist der HT bereit, wird das gewünschte Register in BsdReg adressiert. Bei Schreiboperationen wird das Bit LV\_SENS\_BAT\_SMT\_BSD\_WR und das Datenbyte BSD\_SENS\_BAT\_SMT\_INFO belegt. Der KT setzt das Bit LV\_SENS\_BAT\_SMT\_BSD\_RUN.
5. Der Hardwaretreiber erkennt an LV\_SENS\_BAT\_SMT\_BSD\_RUN die Anforderung zur Übertragung. Soll gesendet werden, übermittelt er das Datenbyte an die Hardware und startet die Sendung zum gewünschten Register, andernfalls veranlasst er den Empfang eines Bytes aus dem Sensor. Der HT löscht dann die Anforderung LV\_SENS\_BAT\_SMT\_BSD\_RUN und setzt statt dessen das Flag LV\_SENS\_BAT\_SMT\_BSD\_WORK.
6. Das Ende einer Übertragung wird je nach Implementierung durch schnelles Polling oder per Interrupt festgestellt, der HT enthält eine entsprechende Handler Routine. Diese löscht LV\_SENS\_BAT\_SMT\_BSD\_WORK, kopiert nach einem Lesevorgang das eingelesene Byte nach BSD\_SENS\_BAT\_SMT\_INFO und setzt das Flag LV\_SENS\_BAT\_SMT\_BSD\_TRM\_END\_AVL

zum Zeichen, dass der Komponententreiber ein empfangenes Byte auslesen kann. Nach einem erfolgreichen Schreibvorgang wird nur das Flag LV\_SENS\_BAT\_SMT\_BSD\_TRM\_END\_OK gesetzt.

7. Der Komponententreiber liest LV\_SENS\_BAT\_SMT\_BSD\_TRM\_END\_AVL bzw. LV\_SENS\_BAT\_SMT\_BSD\_TRM\_END\_OK und löscht diese Flags, nachdem er ggf. das eingelesene Byte übernommen hat. Nach einem erneuten Test auf LV\_SENS\_BAT\_SMT\_BSD\_DR\_OK kann die nächste Übertragung durch Setzen von LV\_SENS\_BAT\_SMT\_BSD\_RUN gestartet werden, s. 4).

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**Bemerkungen:**

Das Flag LV\_SENS\_BAT\_SMT\_BSD\_WORK wird z.Zt. nur HT- intern verwendet, der KT greift nicht darauf zurück.

Bei interruptgesteuerten Handler Routinen muss die Möglichkeit einer Unterbrechung von HT oder KT durch den Interrupt berücksichtigt werden. Im Komponententreiber wird darum eine lokale Kopie von LF\_BSD\_SENS\_BAT\_SMT\_CTL verwendet.

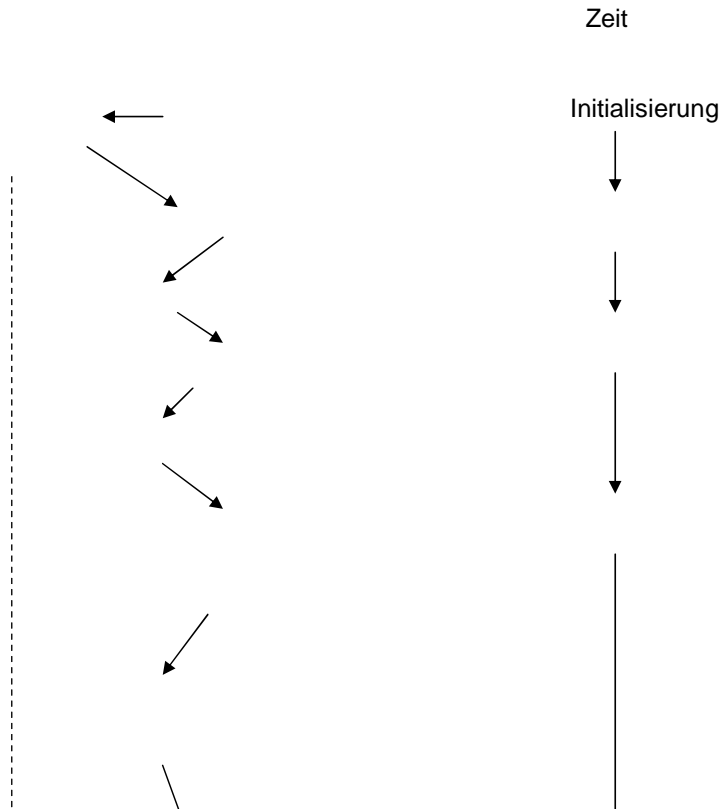
**D) Fehlerbehandlung durch den HT**


Wenn der Hardwaretreiber initial die Verbindung nicht herstellen kann oder wenn zwischenzeitlich die Verbindung abreisst, wird das Flag LV\_SENS\_BAT\_SMT\_BSD\_DR\_OK nicht gesetzt bzw. gelöscht.

In der Folge werden laufend neue Versuche zur Verbindung unternommen. Ist nach Ablauf einer entsprechenden Wartezeit lbs\_Ht\_TimeOut keine Verbindung zustande gekommen, wird das Flag LV\_SENS\_BAT\_SMT\_BSD\_ERR\_IT gesetzt und alle anderen Flags gelöscht. Der HT nimmt anschliessend einen Idle- Zustand ein, aus dem er nach der Zeit lbs\_Ht\_IdleTime erwacht und wieder für lbs\_Ht\_TimeOut weitere Initialisierungen versucht. Bei Erfolg kann wieder LV\_SENS\_BAT\_SMT\_BSD\_DR\_OK gesetzt und alle anderen Flags gelöscht werden, andernfalls bleibt die Fehlermeldung stehen.

lbs\_Ht\_TimeOut: 20 Lese/ Schreibversuche

lbs\_Ht\_IdleTime: applizierbar, vorgelegt 100s

**E) Schema Flagtausch zwischen Komponenten- und Hardwaretreiber****Application conditions**

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4.	Time slot for CWP	KT_WE_ST_READ_REG1	Actual Speed
5.	Time slot for CWP	KT_WE_ST_READ_REG6	Error Section
6.	Time slot for CWP	KT_WE_ST_WRITE_REG0	Speed Setpoint
7.	Time slot for CWP	KT_WE_ST_READ_REG3	Temperature Elec-
	tronics		
8.	Time slot for CWP	KT_WE_ST_READ_REG2	Supply Voltage
9.	Time slot for CWP	KT_WE_ST_READ_REG1	Actual Speed
10.	Time slot for CWP	KT_WE_ST_READ_REG4	Current consump-
	tion		
1.	.	.	
	.	.	
	.	.	

### Identifikationsbeschreibung für Adresse 0x03 (Wasserpumpe Elektronik)

Bauteil: elektr. Wasserpumpe, Elektronik, Adresse: 3

Ident	Parameter	LS Bit	Bit Anz.	w(rite) r(ead)	Ein- heit	Funktion
0	WE_PDZS	0	8	-/w	[-]	Setpoint speed CWP ewpswbsd) 0...250 setpoint stages 251...254 power latch request 255 delete powerlatch reqest
						<b>N_REL_CWP_SP (u8)</b>
1	WE_PDZI	0	8	r/-	[-]	Actual speed CWP (ewpiwbsd)
						<b>N_REL_CWP</b>
2				r/-	[V]	Supply voltage CWP (ewpu)
						<b>V_CWP (u8)</b>
3				r/-	[°C]	Temperature of CWP electronics (ewpt)
						<b>TEMP_EL_CWP (u8)</b>
4				r/-	[A]	current consumption CWP
						<b>CUR_CNS_CWP (u8)</b>
5	WE_VAR	0	5	r/-	[-]	Mounted CWP type (0 = 200Watt or 1= 350/400Watt)
						<b>LF_POW_CWP_COD</b>
						5
						<b>LF_CWP_INFO_COD</b>
6	WE_ERR2	1	1	r/-	-	rpm monitoring CWP deactivated
						<b>LV_N_MON_CWP_DEAC (flag)</b>
	WE_ERR3	2	1	r/-	-	Continuous monitoring of HW power supply of the CWP; used for LIH strategy in case of BSD communication faulty (CWP)
						<b>LV_CWP_HW_LIH_IN_CHK (flag)</b>
	WE_ERR4	3	1	r/-	-	Electronics CWP overttemperature (ewpft)
						<b>LV_CWP_TEMP_HIGH (flag)</b>
	WE_ERR5	4	1	r/-	-	CWP blocked / Current consumption too high (ewpblk1)
<b>LV_CWP_LOCK (flag)</b>						
WE_ERR6	5	1	r/-	-	CWP running dry	
					<b>LV_CWP_PRE_LOCK (flag)</b>	

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	WE_ERR7	6	1	r/-	-	Voltage supply too high(ewpfu)
						<b>LV_CWP_VCC_PLAUS (flag)</b>
	WE_ERR8	7	1	r/-	-	Automatic de-blocking active
						<b>LV_CWP_BLOCK_DEAC (flag)</b>
<b>7</b>	WE_RES	0	8	r/-	-	Reserved for supplier

### 9.48.5 Aquisition values for QLT - sensor

#### FUNCTION DESCRIPTION:

##### General information:

The oil sensor (QLT = Quality Level Temperature) delivers information about the oil temperature, the oil level and the oil quality. This sensor is located in oil pan. The communication between this oil sensor and the engine management system (ECU) is done via BSD-interface.

##### Description:

#### **A) Description of communication of the BSD-Interface**

On the SW-side in the ECU the recieved BSD-messages are treated with a "component driver".

5 Registers are relevant:

- 0 Oiltemperatur
- 1 Oilniveau
- 2,3 Permittivity
- 6 Status /Variant

this values are updated every 200ms

In case of a BSD-communication error the bit B\_ozfbsd is set

#### **B) Description of the registers**





Plausibler Bereich:	0 bis 75 mm	Messwertebereich = 75 mm
Messbereichsverletzung:	00 h	Messbereichsunterschreitung
	FF h	Messbereichsüberschreitung
Fehlerkennzeichnung:	DATA2 = 2 h	Sensorfehler Ölstandsmessung
Auflösung:	8 bit	

#### Signal Ölzustand (Permittivitätszahl<sub>r</sub>):

Label :	OZ_PERMM /OZ_PERML	
Skalierungsbereich:	1 bis 6 = 0001 h bis 03FE h	
Plausibler Bereich:	1 bis 6	Messwertebereich = 5
Messbereichsverletzung:	0000 h	Messbereichsunterschreitung
	03FF h	Messbereichsüberschreitung
Fehlerkennzeichnung:	DATA2 = 1 h	Sensorfehler Permittivitätsmessung
Auflösung:	10 bit	

#### Application conditions

**Initialisation:** *all 0 at reset*

**Recurrence:** *200ms*

**Activation:** *at every engine state*

## 9.49 Alternator management

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_STATE_TBL_ALTER_INH	V	0... 1H	0 ...1	1	-
Bit indicating that writing of STATE_TBL_ALTER_DC is stopped					
STATE_TBL_ALTER [7][5][5]	O/V/S	0... FFH	0... 99.60937	0.390625	%
Table with profile of alternator over alternator chip-temperature, load and speed (saved in NVMY)					
STATE_TBL_ALTER_DC [7][5][5]	O/V	0... FFFFH	0... 65535	1	s
Table with profile of alternator over alternator chip-temperature, load and speed during driving cycle (in s)					
T_STATE_TBL_ALTER	O/V/S	0... FFFFFFFFH	0... 4294967295	1	s
Time since starting to write STATE_TBL_ALTER (saved in NVMY)					
T_STATE_TBL_ALTER_DC	V	0... FFFFH	0... 65535	1	s
Time since starting to write STATE_TBL_ALTER_DC					

### Input data:

LC_AD_CLR {p. 526}	LC_AD_CLR_ALTER {p. 526}	LV_ES {p. 1720}	LV_ST_END {p. 1720}
N_ALTER {p. 8368}	POW_REL_ALTER {p. 4095}	TEMP_ALTER_MC {p. 4096}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_STATE_LOAD_ALTER	-	1... 5H	1 ...5	1	-
LDP_POW_REL_ALTER	5	0... 1FH	0... 96.875	3.125	%
Table with y-axis for STATE_TBL_ALTER and STATE_TBL_ALTER_DC					
ID_STATE_N_ALTER	-	1... 5H	1 ...5	1	-
LDP_N_ALTER	5	0... FFFFH	-32768 ...32767	1	rpm
Table with z-axis for STATE_TBL_ALTER and STATE_TBL_ALTER_DC					
ID_STATE_TEMP_ALTER	-	1... 7H	1 ...7	1	-
LDP_TEMP_ALTER_MC	7	0... 1FH	-32 ...216	8	°C
Table with x-axis for STATE_TBL_ALTER and STATE_TBL_ALTER_DC					

### FUNCTION DESCRIPTION:


This function delivers a alternator use profile over alternator load, alterantor chip temperatur and alterantor speed.

During a driving cycle (LV\_ES = 0 and LV\_ST\_END = 1) the absolute temporary use profile STATE\_TBL\_ALTER\_DC is calculated. It is a accumulated time of the related alternator operating points. Additional an timer is incremented (T\_STATE\_TBL\_ALTER\_DC) during calculation of STATE\_TBL\_ALTER\_DC.

After a driving cycle (LV\_ES 0->1) the relative use profile STATE\_TBL\_ALTER is calculated out of STATE\_TBL\_ALTER\_DC, the old profile STATE\_TBL\_ALTER and the timer T\_STATE\_TBL\_ALTER / DC. This profile is saved in non volatile memory. The timer is calculated out of it's old value and the new timer T\_STATE\_TBL\_ALTER\_DC and is saved in non volatile memory. The timer T\_STATE\_TBL\_ALTER and the profile STATE\_TBL\_ALTER show the behaviour of the alternator during the lifetime of the vehicle.

T\_STATE\_TBL\_ALTER and STATE\_TBL\_ALTER are saved in NVMY during power latch phase.

### Application conditions

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**Initialisation:** STATE\_TBL\_ALTER and T\_STATE\_TBL\_ALTER from NVMY, all other = 0 at reset,  
at LC\_AD\_CLR 0->1 **or** LC\_AD\_CLR\_ALTER 0->1, T\_STATE\_TBL\_ALTER = 0 and STATE\_TBL\_ALTER = 0

**Recurrence:** 1s

**Activation:** at every engine state

**Formula section:**

// Calculation of alternator profile during driving cycle:

```

If LV_ES = 0 and LV_ST_END = 1 and LV_STATE_TBL_ALTER_INH = 0
Then // calculation of STATE_TBL_ALTER_DC with x = ID_STATE_TEMP_ALTER, // y =
ID_STATE_LOAD_ALTER, z = ID_STATE_N_ALTER:
STATE_TBL_ALTER_DC[x][y][z] = STATE_TBL_ALTER_DC[x][y][z] + 1
// increment timer:
T_STATE_TBL_ALTER_DC ++
// stop calculation if limit reached:
If T_STATE_TBL_ALTER_DC = 65335s
Then LV_STATE_TBL_ALTER_INH = 1
Endif
Else do nothing - calculation of STATE_TBL_ALTER_DC stopped
Endif

```

// Calculation of alterantor profile for NVMY:

```

If LV_ES 0 ->1
Then //write STATE_TBL_ALTER_DC in STATE_TBL_ALTER:
For x=1:7
{
For y=1:5
{
For z=1:5
{ STATE_TBL_ALTER[x][y][z] =
( STATE_TBL_ALTER[x][y][z] * T_STATE_TBL_ALTER
+ STATE_TBL_ALTER_DC[x][y][z] )
/( T_STATE_TBL_ALTER + T_STATE_TBL_ALTER_DC )
}
}
}
}
//calculate new time since starting to write STATE_TBL_ALTER:
T_STATE_TBL_ALTER = T_STATE_TBL_ALTER + T_STATE_TBL_ALTER_DC
//reset of temporary values:
T_STATE_TBL_ALTER_DC = 0
STATE_TBL_ALTER_DC[ ][ ][ ] = 0 // complete map = 0
LV_STATE_TBL_ALTER_INH = 0
Endif

```

## 9.50 E-box cooling fan

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_EBOX_CFA	O/V	0... 1H	0 ...1	1	-
Control bit EBOX cooling fan					

### Input data:

LV_ACT_EBOX_CFA_EXT_ADJ {p. 7432}	LV_EBOX_CFA_EXT_ADJ {p. 7433}	LV_END_DIAG_EBOX_CFA {p. 4626}	LV_ERR_EBOX_CFA {p. 4627}
LV_IGK {p. 906}	LV_VAR_EBOX_CFA {p. 655}	N {p. 1525}	TECU {p. 1256}
TIA {p. 1226}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_THD_EBOX_CFA_ACT	-	0... 1FE0H	0... 8160	1	rpm
N threshold for activation of EBOX_CFA after KI.15 on (For diagnosis)					
C_T_MAX_EBOX_CFA_ACT	-	0... FFH	0... 255	1	s
Maximum time for activation of EBOX_CFA after KI.15 on (for diagnosis)					
C_TECU_HYS_EBOX_CFA	-	0... FEH	0... 190.5	0.75	°C
TECU hysteresis for EBOX cooling fan					
C_TECU_THD_EBOX_CFA	-	0... FEH	-48... 142.5	0.75	°C
TECU threshold for EBOX cooling fan ON					
C_TIA_HYS_EBOX_CFA	-	0... FEH	0... 190.5	0.75	°C
TIA hysteresis for EBOX cooling fan					
C_TIA_THD_EBOX_CFA	-	0... FEH	-48... 142.5	0.75	°C
TIA threshold for EBOX cooling fan ON					

### General information:

The function should prevent a overheating of the ECUs in the EBOX. For that, a cooling fan is controlled in dependency of the ECU temperature and the intake air temperature.

### Application conditions

#### Initialisation:

```
LV_EBOX_CFA = 0 ,
T_MAX_EBOX_CFA_ACT = 0 at transition LV_IGK 0 - ->1
LV_EBOX_CFA_ACT_TEST_END = 0 at transition LV_IGK 0 - ->1
```


#### Recurrence:

1000 ms

#### Activation:

at every engine operating states and  
LV\_VAR\_EBOX\_CFA = 1

### FUNCTION DESCRIPTION:

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**Description:**

There are two operating states for the activation of the Ebox-cooling-fan:

1) for power stage diagnosis:

the Ebox-cooling-fan has to be briefly activated at every transition LV\_IGK 0 -> 1 in order to be able to perform a complete diagnosis cycle. After LV\_IGK 0 -> 1 and the exceeding of a calibratable N-threshold the Ebox-CFA is activated either until LV\_END\_DIAG\_EBOX\_CFA is set to 1 (diagnosis completed) or the maximum time C\_T\_MAX\_EBOX\_CFA\_ACT has been reached.

2) normal operation:

activation via external adjustment or due to cooling request because of high TIA or TECU

**Formula section:**

*// Activation of Ebox-cooling-fan - for diagnosis (at every transition LV\_IGK 0 -> 1):*

```

if (1)    LV_IGK = 1    and
           N > C_N_THD_EBOX_CFA_ACT    and
           LV_EBOX_CFA_EXT_ADJ = 0    and
           LV_EBOX_CFA_ACT_TEST_END = 0
then (1)  if (2)    (T_MAX_EBOX_CFA_ACT < C_T_MAX_EBOX_CFA_ACT) and
                   LV_END_DIAG_EBOX_CFA <> 1
           then (2)    T_MAX_EBOX_CFA_ACT = ++
                   LV_EBOX_CFA = 1
           else (2)    LV_EBOX_CFA = 0
                   LV_EBOX_CFA_ACT_TEST_END = 1
           endif (2)
else (1)


```

*// Activation of Ebox-cooling-fan - normal operation:*

```

           if (4)    LV_IGK = 1    and
                   (N > C_N_THD_EBOX_CFA_ACT    or
                   EBOX_CFA_EXT_ADJ = 1)
           then (4)
                   if (5)    LV_EBOX_CFA_EXT_ADJ = 1
                   Then (5)    LV_EBOX_CFA = LV_ACT_EBOX_CFA_EXT_ADJ
                   Else(5)
                   if(6) LV_EBOX_CFA_ACT_TEST_END = 1    and
                           LV_ERR_EBOX_CFA = 0
                   Then(6)
                   if (7)    TECU > C_TECU_THD_EBOX_CFA    and
                           TIA > C_TIA_THD_EBOX_CFA
                   Then (7)    LV_EBOX_CFA = 1
                   Else (7)
                   if (8)    TECU > (C_TECU_THD_EBOX_CFA
                           - C_TECU_HYS_EBOX_CFA)    and
                           TIA > (C_TIA_THD_EBOX_CFA
                           - C_TIA_HYS_EBOX_CFA)    and
                           LV_EBOX_CFA = 1
                   Then (8)    LV_EBOX_CFA = 1
                   Else (8)    LV_EBOX_CFA = 0
                   Endif (8)
                   Endif (7)
                   Else(6)
                   LV_EBOX_CFA = 0


```

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```

                Endif (6)
            Endif(5)
        Else (4)    LV_EBOX_CFA = 0
    Endif (4)
endif(1)

```

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## 9.51 Active engine brackets

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_SWI_AEB	O/V	0... 1H	0 ...1	1	-
switch to control the active engine brackets					

### Input data:

LV_ES {p. 1720}	LV_IGK {p. 906}	LV_IGK_PREL {p. 906}	LV_ST {p. 1720}
LV_STST_ES {p. 804}	LV_STST_PRE_STOP_REQ {p. 8220}	LV_STST_ST_REQ {p. 804}	LV_SWI_AEB_ACT_EXT_ADJ {p. 7435}
LV_SWI_AEB_EXT_ADJ {p. 7435}	LV_VAR_AEB {p. 655}	N_32 {p. 1525}	OPM_AV {p. 8137}
VS {p. 1176}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_32_SWI_AEB_HOM_AFL	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for switching active engine brackets in HOM_AFL mode					
C_N_32_SWI_AEB_HOM_AFS	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for switching active engine brackets in HOM_AFS mode					
C_N_32_SWI_AEB_HYS	-	0... FFH	0... 8160	32	rpm
Engine speed hysteresis for switching active engine brackets					
C_N_32_SWI_AEB_S	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for switching active engine brackets in S mode					
C_VS_SWI_AEB_HOM_AFL	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for switching active engine brackets in HOM_AFL mode					
C_VS_SWI_AEB_HOM_AFS	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for switching active engine brackets in HOM_AFS mode					
C_VS_SWI_AEB_HYS	-	0... FFH	0... 255	1	km/h
Vehicle speed hysteresis for switching active engine brackets					
C_VS_SWI_AEB_S	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for switching active engine brackets in S mode					
LC_SWI_AEB_IGK_PREL_ENA	-	0... 1H	0 ...1	1	-
Engine brackets stop position enabled to preliminary ignition shut off					
LC_SWI_AEB_ST	-	0... 1H	0 ...1	1	-
Active engine brackets for engine start					
LC_SWI_AEB_STOP	-	0... 1H	0 ...1	1	-
Active engine brackets for engine stop					
LC_SWI_AEB_STST_PRE_STOP_ENA	-	0... 1H	0 ...1	1	-
Enable switch for pre stop request					
LC_SWI_AEB_TYP	-	0... 1H	0 ...1	1	-
Active engine brackets switch for different engine type					

### 9.51.1 MISC\_M905G

The functionality active engine bracket supports the controllable engine suspension. To improve the driveability of the vehicle and to decrease the transmission of engine vibrations, it is possible to switch the engine bracket from the state stiff to the state soft .



To compensate the more rough combustion in stratified mode the engine brackets are switched into a soft characteristic.

**Application Condition**

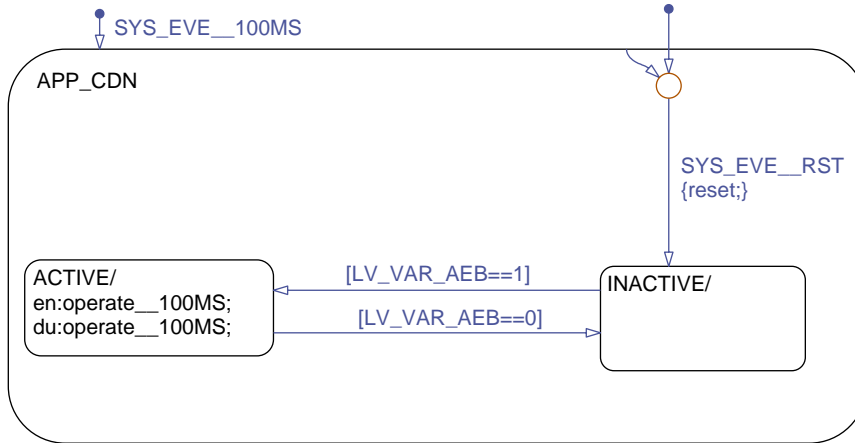



Figure 9.51.1: MISC\_M905G/APP\_CDN/Chart1

**Function Description**

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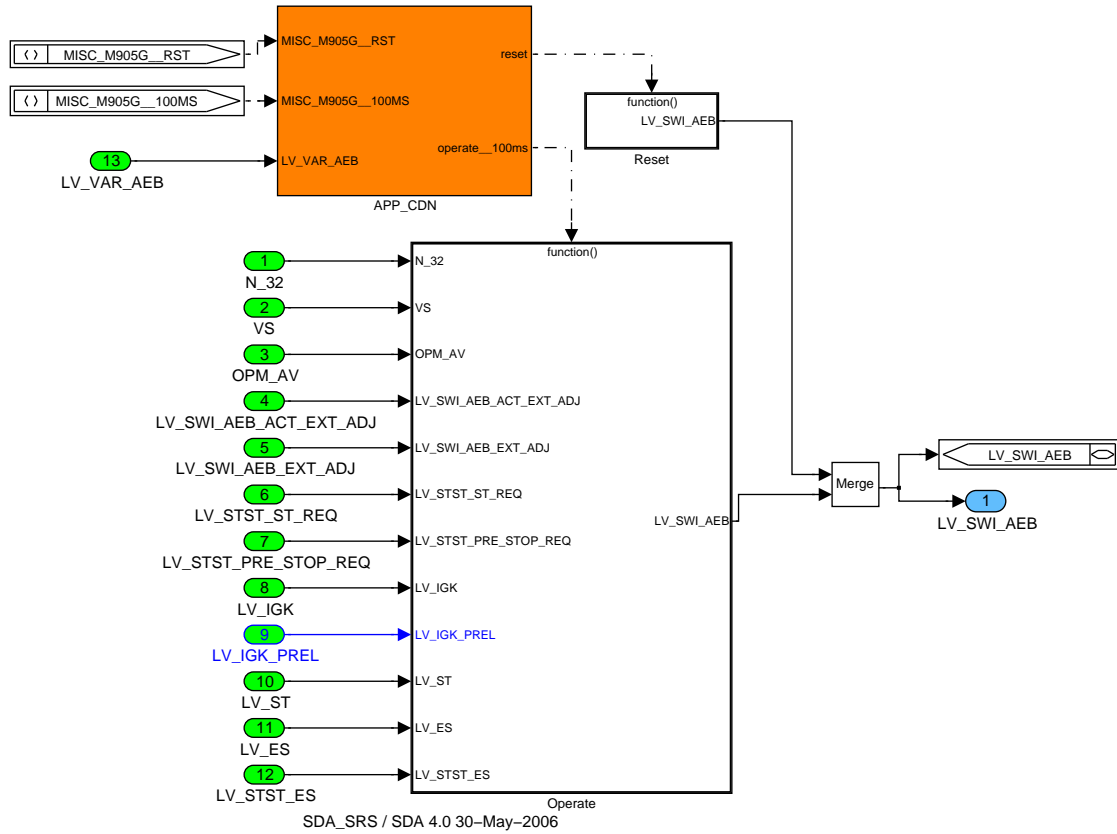



Figure 9.51.2: MISC\_M905G

### 9.51.1.1 MISC\_M905G/OPERATE

Dependent on engine speed and vehicle speed in each combustion mode, the logical variable LV\_SWI\_AEB is set to 1 and the corresponding ECUPin is set under current. In this case the engine bracket is switched to the state soft. Otherwise the "stiff" mode of the engine brackets is active. There is a hysteresis for engine speed and vehicle speed (common for all combustion modes) to avoid toggling of LV\_SWI\_AEB. The logical constant LC\_SWI\_AEB\_TYP is introduced to take the different engine bracket types into account, which are provided from different suppliers.

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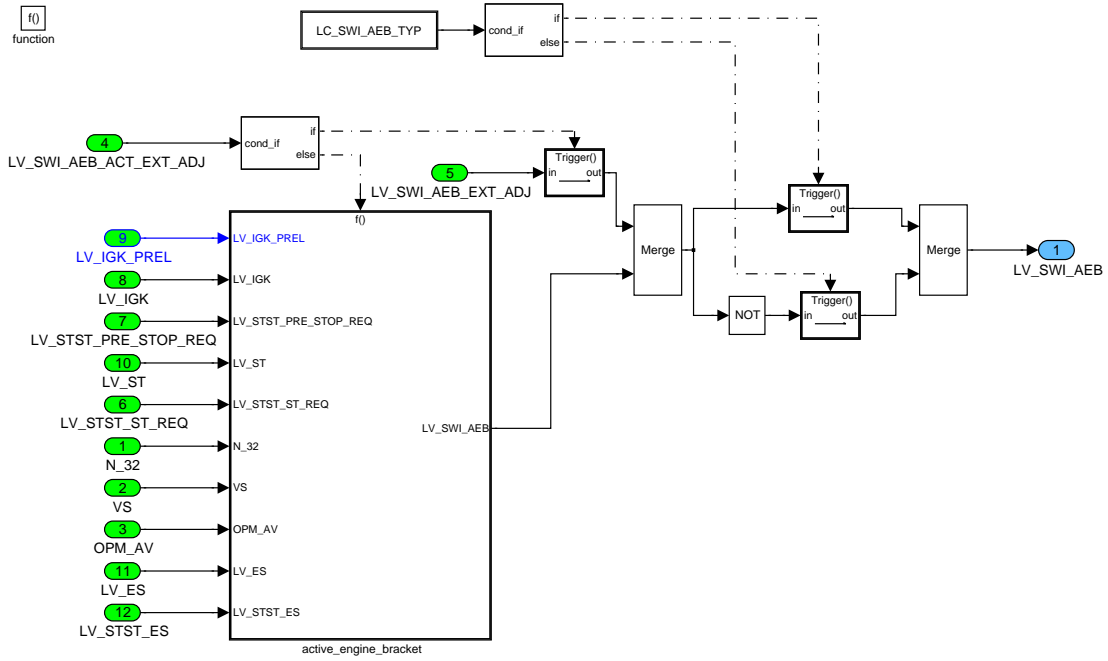


Figure 9.51.3: MISC\_M905G/Operate

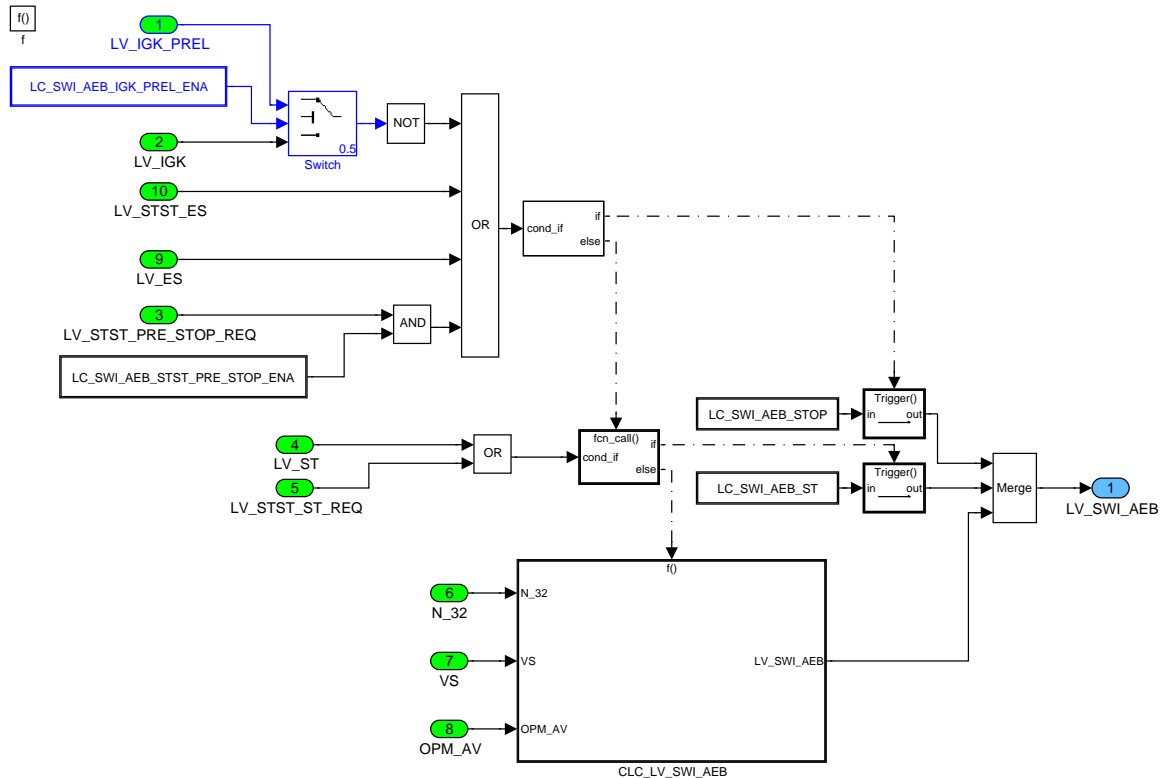


Figure 9.51.4: MISC\_M905G/Operate/active\_engine\_bracket

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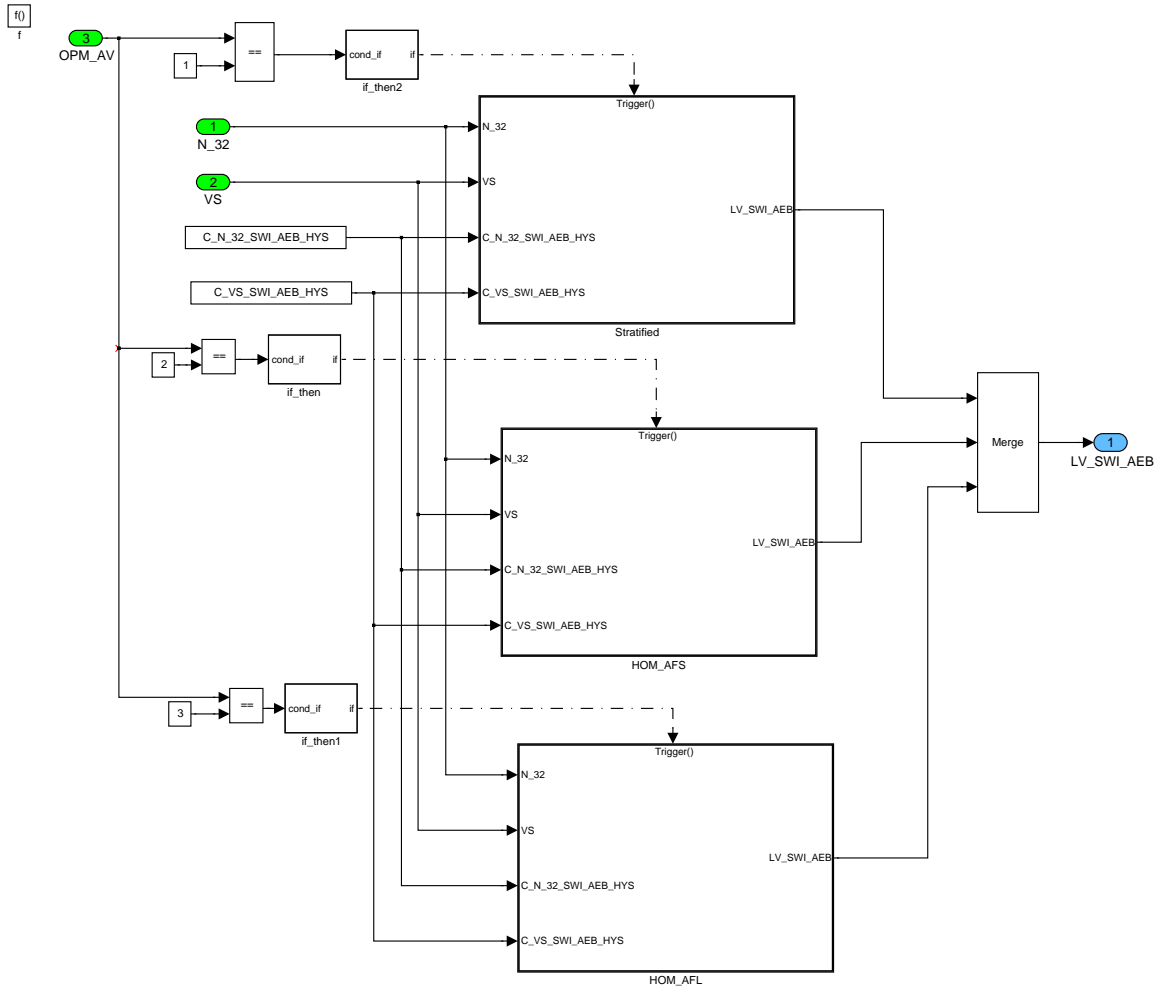


Figure 9.51.5: MISC\_M905G/Operate/active\_engine\_bracket/CLC\_LV\_SWI\_AEB

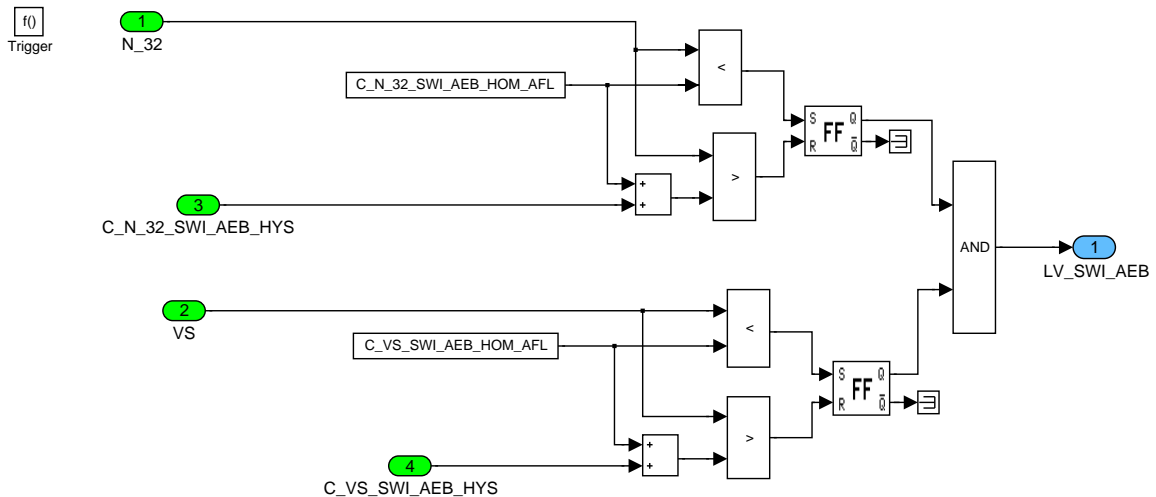


Figure 9.51.6: MISC\_M905G/Operate/active\_engine\_bracket/CLC\_LV\_SWI\_AEB/HOM\_AFL

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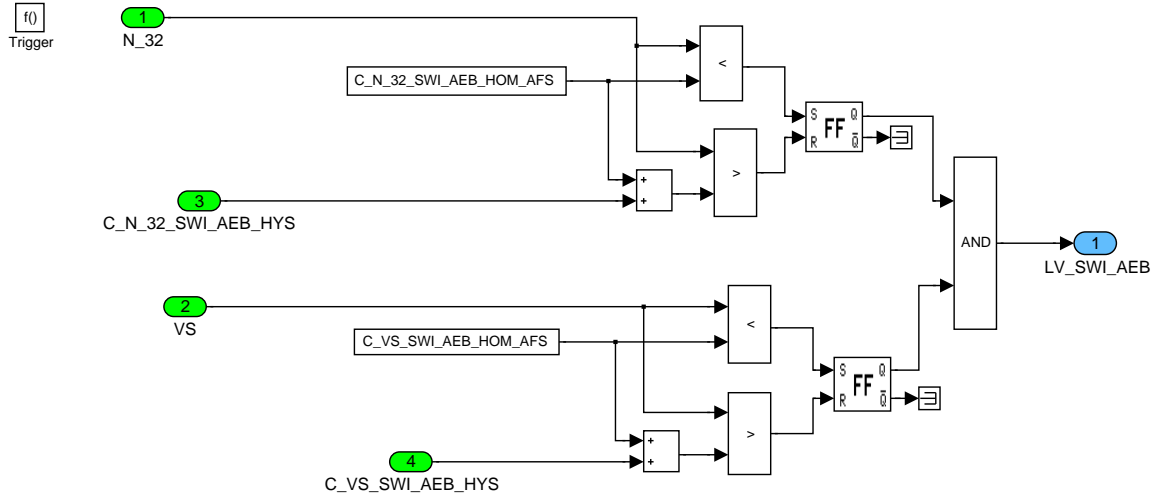


Figure 9.51.7: MISC\_M905G/Operate/active\_engine\_bracket/CLC\_LV\_SWI\_AEB/HOM\_AFS

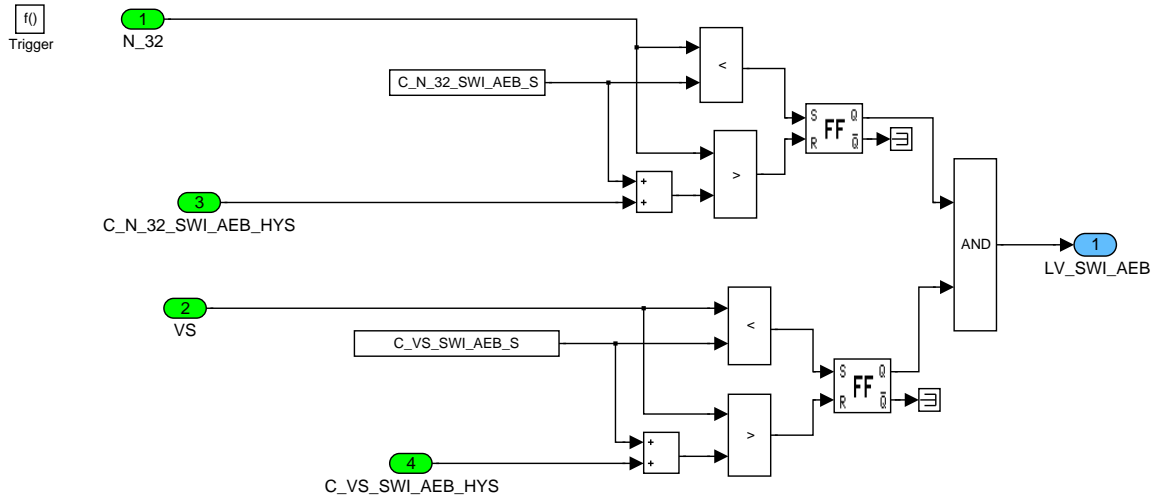


Figure 9.51.8: MISC\_M905G/Operate/active\_engine\_bracket/CLC\_LV\_SWI\_AEB/Stratified

### 9.51.1.2 SUBFUNCTION: Reset

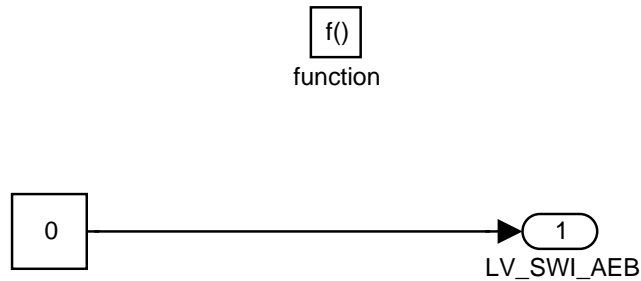


Figure 9.51.9: MISC\_M905G/Reset

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## 9.52 Crankcase ventilation heater control (HVAC)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_RLY_CRCV_HEAT	O/V	0... 1H	0 ...1	1	-
Crankcase ventilation heater relay (1:activated, 0:deactivated)					

### Input data:

LV_ACT_RLY_CRCV_ HEAT_EXT_ADJ {p. 7432}	LV_ERR_RLY_CRCV_ HEAT {p. 4627}	LV_IGK {p. 906}	LV_RLY_CRCV_HEAT_ EXT_ADJ {p. 7434}
T_AST {p. 1766}	TIA {p. 1226}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_AST_MIN_RLY_CRCV_HEAT	-	0... FFFFH	0... 6553.5	0.1	s
Minimal time after start for CRCV_HEAT activation (default: 60s)					
C_TIA_HYS_RLY_CRCV_HEAT	-	0... FEH	-48... 142.5	0.75	°C
intake air temperature hysteresis between activation and deactivation of CRCV_HEAT (default: 3°C)					
C_TIA_MAX_RLY_CRCV_HEAT	-	0... FEH	-48... 142.5	0.75	°C
Maximal intake air temperature for CRCV_HEAT activation (default: 0°C)					

### 9.52.1 Import Actions

<b>ACTION_INFR_SetCRCVHEAT(IN &lt;lv_rly_crcv_heat&gt;)</b>
This action sets the output pin for the "CRCV_HEAT Switch"

**Note:** The imported actions are defined in the HVAC - IRS (infrastructure requirement specification).

### General information:

To prevent crankcase ventilation from fouling under cold conditions it is necessary to heat the ventilation rail. For the power stage of this heating an external relay plus heating foil is introduced. The control stage is realised by the engine management system using the below statemachine.

### Application conditions

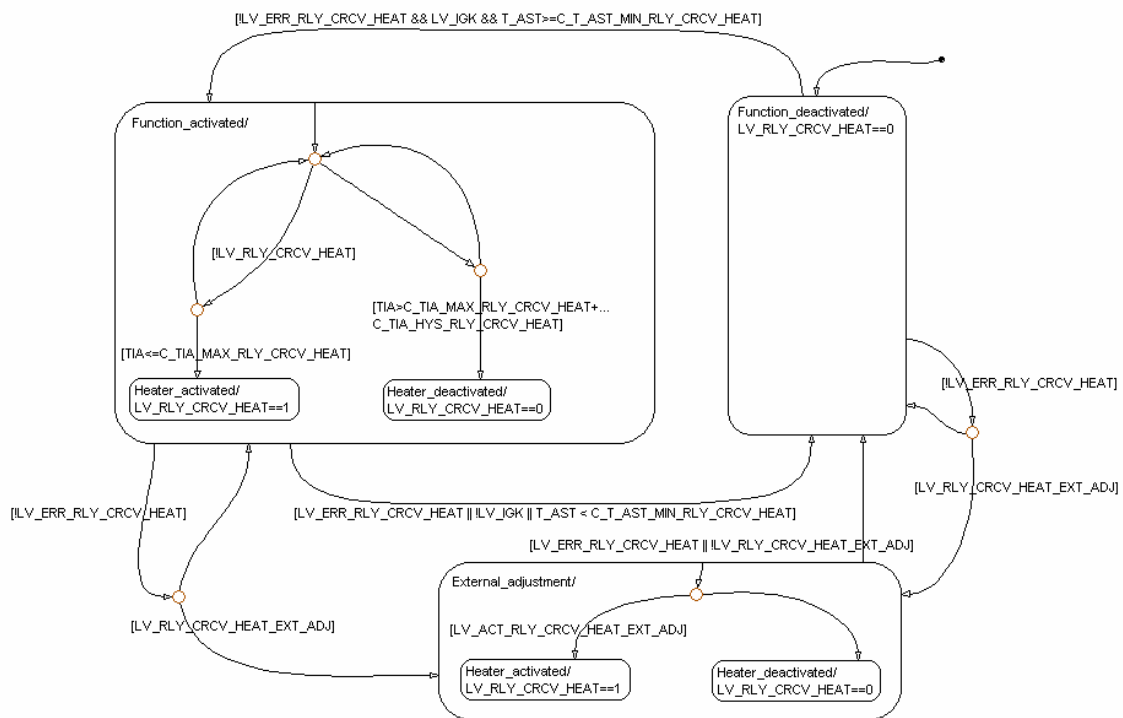
**Initialisation:** *at reset and deactivation all var. are initialised with 0*

**Recurrence:** *1000ms*

**Activation:** *see signal flow diagram*

**Deactivation:** *see signal flow diagram*

### Signal flow diagram:



### Formula section:

(redundant information to signal flow diagram - only for a better understanding)

#### External adjustment:

**If(1)**  $LV\_ERR\_RLY\_CRCV\_HEAT = 0$

**Then(1)** **If(2)**  $LV\_RLY\_CRCV\_HEAT\_EXT\_ADJ = 1$

**Then(2)**

**If(3)**  $LV\_ACT\_RLY\_CRCV\_HEAT\_EXT\_ADJ = 1$

**Then(3)**  $LV\_RLY\_CRCV\_HEAT = 1$

**Else(3)**  $LV\_RLY\_CRCV\_HEAT = 0$

**Else(2)** either stay in the actual operation mode or (if external adjustment was activated before) firstly deactivate function and check if it has to be reactivated again

**Else(1)** Function is deactivated

**ACTION\_INFR\_SetCRCVHEAT(IN < LV\_RLY\_CRCV\_HEAT >)**

#### "Normal" operation:

**If(1)**  $LV\_ERR\_RLY\_CRCV\_HEAT = 0$  **and**  
 $LV\_IGK = 1$  **and**  
 $T\_AST \geq C\_T\_AST\_MIN\_RLY\_CRCV\_HEAT$

**Then(1)**


**If(2)**  $LV\_RLY\_CRCV\_HEAT = 0$

**Then(2)**

```

If(3)          TIA <= C_TIA_MAX_RLY_CRCV_HEAT
Then(3)       LV_RLY_CRCV_HEAT = 1
Else(2)
If(4)          TIA > C_TIA_MAX_RLY_CRCV_HEAT +
                  C_TIA_HYS_RLY_CRCV_HEAT
Then(4)       LV_RLY_CRCV_HEAT = 0
Else(1)       Function is deactivated
ACTION_INFR_SetCRCVHEAT(IN < LV_RLY_CRCV_HEAT >)

```

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## 9.53 Fuel research octane number statistical quantification

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_STC_ROM_HIGH	O/V/S	0... FFFFH	0... 65535	1	-
Statistical counter for high quality fuel.					
CTR_STC_ROM_LOW	O/V/S	0... FFFFH	0... 65535	1	-
Statistical counter for low quality fuel.					
CTR_STC_ROM_MEDIUM	O/V/S	0... FFFFH	0... 65535	1	-
Statistical counter for medium quality fuel.					
DIST_ROM_STC [NC_NR_ROM_KWP]	O/V/S	0... FFFFH	0... 524280	8	km
Distance covered by vehicle after last refuel for tester.					
LV_ROM_STC_DEACT	V	0... 1H	0 ...1	1	-
RON statistic deactivation flag (0 = no activation so far, 1 = deactivated)					
STATE_ROM [NC_NR_ROM_KWP]	O/V/S	0... 3H	0 ...3	1	-
Fuel quality after last refuel for tester (0 = undefined, 1 = low, 2 = medium, 3 = high).					
STATE_ROM_TMP	V	0... 3H	0 ...3	1	-
Fuel quality after last refuel, temporary value (0 = undefined, 1 = low, 2 = medium, 3 = high).					

### Input data:

DIST_KWP {p. 1183}	FAC_ROM {p. 798}	IGA_MV_ADJ_KNK_ROM {p. 8304}	KNK_CTL_DIS {p. 1952}
LC_AD_CLR_STC_ROM {p. 527}	LV_REFU {p. 5966}	LV_ROM_STC_CLR_KWP {p. 7483}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_ROM_LOW	V	0... FFH	0 ...1	0.00392156	-
Upper limit for low quality fuel based on FAC_ROM.					
C_FAC_ROM_MEDIUM	V	0... FFH	0 ...1	0.00392156	-
Upper limit for medium quality fuel based on FAC_ROM.					
C_IGA_MV_ADJ_KNK_ROM_LOW	V	FE0C... 258H	-50 ...60	0.1	°CRK
Upper limit for low quality fuel based on IGA_MV_ADJ_KNK_ROM.					
C_IGA_MV_ADJ_KNK_ROM_MEDIUM	V	FE0C... 258H	-50 ...60	0.1	°CRK
Upper limit for medium quality fuel based on IGA_MV_ADJ_KNK_ROM.					
LC_IGA_MV_ADJ_KNK_ROM_SEL	V	0... 1H	0 ...1	1	-
Switch to select input for RON quantification (0 = FAC_ROM, 1 = IGA_MV_ADJ_KNK_ROM)					
LC_ROM_STC_ENA	V	0... 1H	0 ...1	1	-
Switch to enable RON quantification functionality (0 = disabled, 1 = enabled)					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_ROM_KWP	-	1... FFH	1... 255	1	-
Number of data to be sent to tester.					

### General information

#### 9.53.1 Calculation of statistical data

### General information:

This functionality provides a statistical quantification of the fuel quality, or RON, used in the vehicle over a long period of time. In addition, the fuel quality and the covered distance at the last five refuels is captured. This information can be accessed via a workshop tester and it provides the engineer/mechanic with information that could assist in analysing customer complaints hinting towards poor driveability etc. This functionality requires the detection of a refuel (LV\_REFU = 1) which is provided by the DMTL module, hence the functionality is only operable in vehicles with DMTL.

The parameter used for the statistical analysis is, depending on system architecture, either IGA\_MV\_ADJ\_KNK\_RON or FAC\_RON (= DZW\_ANNM or F\_OCTAN respectively, obtained from BMW layer). The parameter to be used is configurable via the switch LC\_IGA\_MV\_ADJ\_KNK\_RON\_SEL. A low-, medium- and high RON-range is configurable via calibratable constants. Each time a vehicle refuelling is detected, IGA\_MV\_ADJ\_KNK\_RON or FAC\_RON is allocated to the applicable range and the corresponding statistical counter is incremented. At the same time the covered distance is captured. The three RON-range statistical counters together with the last five captured RON-ranges with corresponding covered distance are provided to the workshop tester via diagnostic communication.

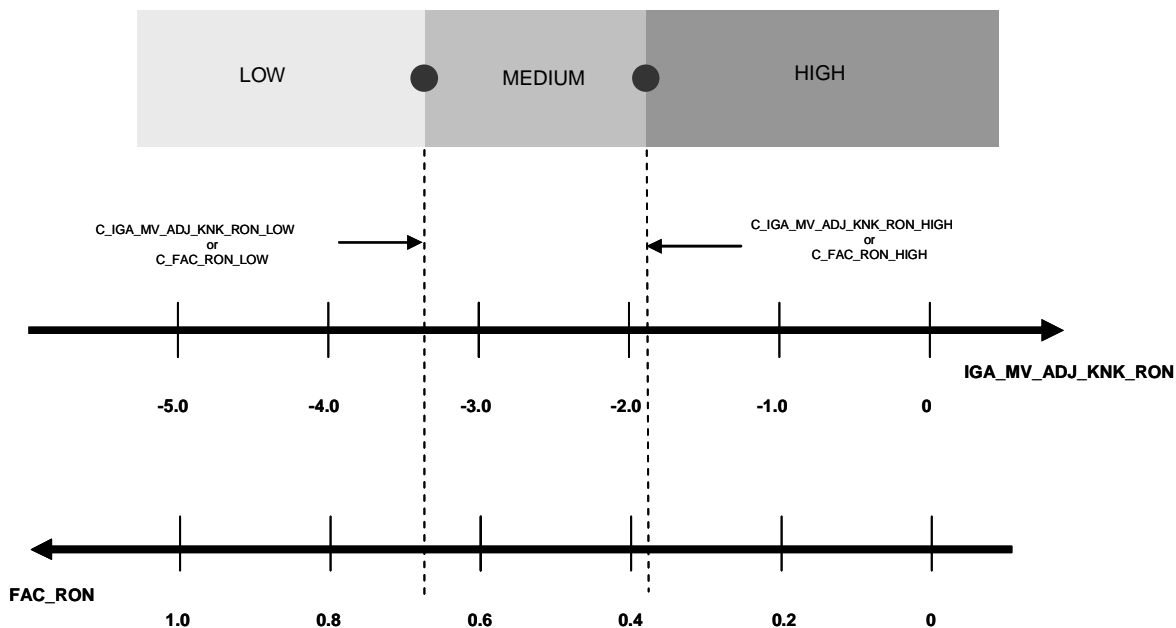


Figure 9.53.1:

### Application conditions:

#### **Initialisation:**

All 0 at ECU reset, except:

CTR\_STC\_RON\_xx from NVMY.

STATE\_RON[NC\_NR\_RON\_KWP] from NVMY.

DIST\_RON\_STC[NC\_NR\_RON\_KWP] from NVMY.

Non-volatile data are initialized with 0 at first run of new ECU or in case of NVRAM error. Otherwise they are reprogramming-pro

#### **Activation:**

LC\_RON\_STC\_ENA = 1 and // at end-of-refuelling detection.


LV\_REFU = 1

#### **Deactivation:**

LV\_RON\_STC\_DEACT = 1

#### **Recurrence:**

1000ms

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**Function description:****Formula section:**

NC\_NR\_RON\_KWP = 5

//            *Calculation of applicable fuel quality range:*

```

If (1)    KNK_CTL_DIS == 0
Then (1) If (2)    LC_IGA_MV_ADJ_KNK_RON_SEL = 1
          Then (2) If (3)    IGA_MV_ADJ_KNK_RON < C_IGA_MV_ADJ_KNK_RON_LOW
                  Then (3) STATE_RON_TMP = 1
                  Else (3) If (4)    IGA_MV_ADJ_KNK_RON < ...
                                  C_IGA_MV_ADJ_KNK_RON_MEDIUM
                                  Then (4) STATE_RON_TMP = 2
                                  Else (4) STATE_RON_TMP = 3
                                  Endif (4)
                  Endif (3)
          Else (2) If (3)    FAC_RON > C_FAC_RON_LOW
                  Then (3) STATE_RON_TMP = 1
                  Else (3) If (4)    FAC_RON > C_FAC_RON_MEDIUM
                                  Then (4) STATE_RON_TMP = 2
                                  Else (4) STATE_RON_TMP = 3
                                  Endif (4)
                  Endif (3)
          Endif (2)
Else (1) STATE_RON_TMP = 0
Endif (1)

```

//            *Increment of fuel quality range statistical counters:*

```

If            STATE_RON_TMP = 1
Then            CTR_STC_RON_LOW ++
Endif
If            STATE_RON_TMP = 2
Then            CTR_STC_RON_MEDIUM ++
Endif
If            STATE_RON_TMP = 3
Then            CTR_STC_RON_HIGH ++
Endif

```

//            *Capture of last five instances of fuel quality range and covered distance:*

```

STATE_RON[1] = STATE_RON[2]
.....
STATE_RON[NC_NR_RON_KWP] = STATE_RON_TMP

```

```

DIST_RON_STC[1] = DIST_RON_STC[2]
.....
DIST_RON_STC[NC_NR_RON_KWP] = DIST_KWP

```


//            *Deactivation of RON statistical calculation:*

```

LV_RON_STC_DEACT = 1

```

**9.53.2 Reset of statistical data**

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 4147 of 8404	
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**General information:**

All non-volatile-data are **reprogramming proof**, i.e. they are NOT reset when the ECU is reprogrammed. However, they can be reset by application tool or workshop tester, via LC\_AD\_CLR\_STC\_ROM or LV\_ROM\_STC\_CLR\_KWP respectively.

**Application conditions:**

**Initialisation:** -

**Activation:** LC\_ROM\_STC\_ENA = 1     **and**  
LV\_IGK = 1

**Deactivation:** -


**Recurrence:** 1000ms

**Function description:****Formula section:**

**If**       LC\_AD\_CLR\_STC\_ROM = 1                     **or**  
          LV\_ROM\_STC\_CLR\_KWP = 1

**Then**     CTR\_STC\_ROM\_xx                             = 0  
          STATE\_ROM[NC\_NR\_ROM\_KWP] (Whole array)     = 0  
          DIST\_ROM\_STC[NC\_NR\_ROM\_KWP] (Whole array)   = 0

**Endif**

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## 9.54 Sweeping technology

### Input data:

KWP_IO_VIN	LV_AUTH_L3_ENA {p. 7482}	LV_ECU_SLA {p. 800}	LV_LOCK_IMOB
SERIAL_NUMBER [ ]	STATE_IMOB_2_ERR	VIN_CAN [NC_VIN_CAN_LEN] {p. 1582}	

### 9.54.1 SWT-Module

### Outputs:

STATE_KWP_IMOB_STORE_K_EWS_ENA	O	0...FFH	0..255	1	[-]
State calculation and storage of K_EWS4					
PTR_FSC_CONFIG_EWS4	O	0..FFFFFFFH	0..4294967295	1	[-]
u8-Pointer in FSC to specific EWS functions					
rs_FSC_ews4_A[100]	O	0...FFH[100]	0..255[100]	1	[-]
EEPROM Buffer, store in NVMY (IMOB FSC first 100Byte)					
cs_ee_FSC_ews4_A[100]	O	0...FFH[100]	0..255[100]	1	[-]
EEPROM Buffer, read from NVMY(IMOB FSC first 100Byte)					
FSC_XMAX_WR[200]	O/S	0...FFH[200]	0..255[200]	1	[-]
EEPROM Buffer, store in NVMY (Vmax /Pmax FSC 200Byte)					
FSC_XMAX_RD[200]	O	0...FFH[200]	0..255[200]	1	[-]
EEPROM Buffer, read from NVMY (Vmax/Pmax FSC 200Byte)					
SWT_FSC_XMAX_STATUS	V	0..FFH	0..255	1	[-]
Status of stored FSC in EEPROM					
LOC_IMOB_FSC.*VERSION	-	0..FFH	0..255	1	[-]
LOC_IMOB_FSC.*SWID_TYPE		0..FFH	0..255		
LOC_IMOB_FSC.*SWID		0..FFH	0..255		
LOC_IMOB_FSC.*SUPPLIER_NR		0..FFH	0..255		
LOC_IMOB_FSC.*REQUESTER_TYPE		0..FFH	0..255		
LOC_IMOB_FSC.*ORDER_NR		0..FFH	0..255		
LOC_IMOB_FSC.*REQUESTER_ID		0..FFH	0..255		
LOC_IMOB_FSC.*INDIVIDUAL_ATTR_TYPE		0..FFH	0..255		
LOC_IMOB_FSC.*INDIVIDUAL_ATTR		0..FFH	0..255		
LOC_IMOB_FSC.*VALIDITY		0..FFH	0..255		
LOC_IMOB_FSC.*FSCS_ID		0..FFH	0..255		
LOC_IMOB_FSC.*DATE		0..FFH	0..255		
LOC_IMOB_FSC.*EXTENDED		0..FFH	0..255		
LOC_IMOB_FSC.*SIGNATURE		0..FFH	0..255		
Struct of pointer to IMOB FSC Field definitions					
LOC_VMAX_FSC.*SIZE	-	0..FFH	0..255	1	[-]
LOC_VMAX_FSC.*STATUS		0..FFH	0..255		
LOC_VMAX_FSC.*VERSION		0..FFH	0..255		
LOC_VMAX_FSC.*SWID_TYPE		0..FFH	0..255		
LOC_VMAX_FSC.*SWID		0..FFH	0..255		
LOC_VMAX_FSC.*SUPPLIER_NR		0..FFH	0..255		
LOC_VMAX_FSC.*REQUESTER_TYPE		0..FFH	0..255		
LOC_VMAX_FSC.*ORDER_NR		0..FFH	0..255		
LOC_VMAX_FSC.*REQUESTER_ID		0..FFH	0..255		
LOC_VMAX_FSC.*INDIVIDUAL_ATTR_TYPE		0..FFH	0..255		
LOC_VMAX_FSC.*INDIVIDUAL_ATTR		0..FFH	0..255		
LOC_VMAX_FSC.*VALIDITY		0..FFH	0..255		
LOC_VMAX_FSC.*FSCS_ID		0..FFH	0..255		
LOC_VMAX_FSC.*DATE		0..FFH	0..255		
LOC_VMAX_FSC.*EXTENDED		0..FFH	0..255		
LOC_VMAX_FSC.*SIGNATURE		0..FFH	0..255		
Struct of pointer to VMAX FSC Field definitions read from EEPROM					

LOC_VMAX_DIAG_FSC.*SIZE	-	0..FFH	0..255	1	[-]
LOC_VMAX_DIAG_FSC.*STATUS		0..FFH	0..255		
LOC_VMAX_DIAG_FSC.*VERSION		0..FFH	0..255		
LOC_VMAX_DIAG_FSC.*SWID_TYPE		0..FFH	0..255		
LOC_VMAX_DIAG_FSC.*SWID		0..FFH	0.. 255		
LOC_VMAX_DIAG_FSC.*SUPPLIER_NR		0..FFH	0.. 255		
LOC_VMAX_DIAG_FSC.*REQUESTER_TYPE		0..FFH	0.. 255		
LOC_VMAX_DIAG_FSC.*ORDER_NR		0..FFH	0.. 255		
LOC_VMAX_DIAG_FSC.*REQUESTER_ID		0..FFH	0.. 255		
LOC_VMAX_DIAG_FSC.*INDIVIDUAL_ATTR_TYPE		0..FFH	0.. 255		
LOC_VMAX_DIAG_FSC.*INDIVIDUAL_ATTR		0..FFH	0.. 255		
LOC_VMAX_DIAG_FSC.*VALIDITY		0..FFH	0.. 255		
LOC_VMAX_DIAG_FSC.*FSCS_ID		0..FFH	0.. 255		
LOC_VMAX_DIAG_FSC.*DATE		0..FFH	0.. 255		
LOC_VMAX_DIAG_FSC.*EXTENDED		0..FFH	0.. 255		
LOC_VMAX_DIAG_FSC.*SIGNATURE		0..FFH	0.. 255		
Struct of pointer to VMAX FSC Field definitions read from Diagnosis					
LOC_PMAX_FSC.*SIZE	-	0..FFH	0..255	1	[-]
LOC_PMAX_FSC.*STATUS		0..FFH	0..255		
LOC_PMAX_FSC.*VERSION		0..FFH	0..255		
LOC_PMAX_FSC.*SWID_TYPE		0..FFH	0..255		
LOC_PMAX_FSC.*SWID		0..FFH	0.. 255		
LOC_PMAX_FSC.*SUPPLIER_NR		0..FFH	0.. 255		
LOC_PMAX_FSC.*REQUESTER_TYPE		0..FFH	0.. 255		
LOC_PMAX_FSC.*ORDER_NR		0..FFH	0.. 255		
LOC_PMAX_FSC.*REQUESTER_ID		0..FFH	0.. 255		
LOC_PMAX_FSC.*INDIVIDUAL_ATTR_TYPE		0..FFH	0.. 255		
LOC_PMAX_FSC.*INDIVIDUAL_ATTR		0..FFH	0.. 255		
LOC_PMAX_FSC.*VALIDITY		0..FFH	0.. 255		
LOC_PMAX_FSC.*FSCS_ID		0..FFH	0.. 255		
LOC_PMAX_FSC.*DATE		0..FFH	0.. 255		
LOC_PMAX_FSC.*EXTENDED		0..FFH	0.. 255		
LOC_PMAX_FSC.*SIGNATURE		0..FFH	0.. 255		
Struct of pointer to PMAX FSC Field definitions read from EEPROM					
LOC_PMAX_DIAG_FSC.*SIZE	-	0..FFH	0..255	1	[-]
LOC_PMAX_DIAG_FSC.*STATUS		0..FFH	0..255		
LOC_PMAX_DIAG_FSC.*VERSION		0..FFH	0..255		
LOC_PMAX_DIAG_FSC.*SWID_TYPE		0..FFH	0..255		
LOC_PMAX_DIAG_FSC.*SWID		0..FFH	0.. 255		
LOC_PMAX_DIAG_FSC.*SUPPLIER_NR		0..FFH	0.. 255		
LOC_PMAX_DIAG_FSC.*REQUESTER_TYPE		0..FFH	0.. 255		
LOC_PMAX_DIAG_FSC.*ORDER_NR		0..FFH	0.. 255		
LOC_PMAX_DIAG_FSC.*REQUESTER_ID		0..FFH	0.. 255		
LOC_PMAX_DIAG_FSC.*INDIVIDUAL_ATTR_TYPE		0..FFH	0.. 255		
LOC_PMAX_DIAG_FSC.*INDIVIDUAL_ATTR		0..FFH	0.. 255		
LOC_PMAX_DIAG_FSC.*VALIDITY		0..FFH	0.. 255		
LOC_PMAX_DIAG_FSC.*FSCS_ID		0..FFH	0.. 255		
LOC_PMAX_DIAG_FSC.*DATE		0..FFH	0.. 255		
LOC_PMAX_DIAG_FSC.*EXTENDED		0..FFH	0.. 255		
LOC_PMAX_DIAG_FSC.*SIGNATURE		0..FFH	0.. 255		
Struct of pointer to PMAX FSC Field definitions read from Diagnosis					
LOC_FSC_BYTES_RCV	-	0..FFFFH	0..65535	1	[-]
Counter of received bytes by KWP messages					
LOC_FSC_EXP_LEN	-	0..FFFFH	0..65535	1	[-]
Expected length in bytes of complete message					
LOC_SWT_FSC_BUF[292]	-	0..FFH[292]	0..255[292]	1	[-]
Internal Buffer for complete FSC					
LOC_SWT_FSC_SIG_BUF[196]	-	0..FFH[196]	0..255[196]	1	[-]
Internal Buffer for IMOB FSC Sig Reversed					
LV_SWT_CHK_FSC_ENA	-	0..1H	0..1	1	[-]
Flag which makes ACTION_SWT_ChkFsc() executable without L3 Authentication.					

TMP_U8_FSC_HASH_MD5 [16]	-	0..FFH	0..255	1	[-]
Temporary MD5 Result of FSC header					
STATE_SWT_CHK_FSC	V	0..FFH	0..255	1	[-]
State of the actual FSC calculation Check					
SWT_CALC_CYCLE_COUNT	-	0..FFH	0..255	1	[-]
calculation of x cycles during one function call					
LV_SWT_VMAX_ENA	O/V	0..1H	0..1	1	[-]
Flag shows if V MAX functionality is activated					
LV_SWT_PMAX_ENA	O/V	0..1H	0..1	1	[-]
Flag shows if P MAX functionality is activated					
LV_SWT_CHK_VMAX_FINISHED	V	0..1H	0..1	1	[-]
Flag shows if Periodical Check of VMAX FSC is finished					
LV_SWT_CHK_PMAX_FINISHED	O/V	0..1H	0..1	1	[-]
Flag shows if Periodical Check of PMAX FSC is finished					
TMP_U32_FSC_CHK[33]	-	0..FFFFFFFFH	0..4294967295	1	[-]
Result of signature check 1x FSC-signature + 4 Byte length (132 Byte)					
SWT_CRYPT_SIG_BUFFER[65]	-	0..FFFFFFFFH	0..4294967295	1	[-]
Buffer for CR_A_NewAaMExp which stores 2x FSC-signature + 4Byte length (260 Byte)					
LV_SWT_FSC_PARSED	-	0..1H	0..1	1	[-]
Flag shows if EEPROM FSC is parsed					
LOC_SWID_KWP_FIRST_MSG	-	0..FFFFFFFFH	0..4294967295	1	[-]
Delivered SWID in SET_LEN message					
VIN_CAN_NVMY_WR[7]	O/S	0..FFH[7]	0..255[7]	1	[-]
Store short VIN in NVMY which is received from CAS					
VIN_CAN_NVMY_RD[7]	O/S	0..FFH[7]	0..255[7]	1	[-]
Read short VIN from NVMY which is received from CAS					

LV\_AUTH\_L3\_ENA has to be calculated before every use.

### 9.54.1.1 Calibration Data

LC_SWT_CHK_VIN_CAS_ENA	1	0..1H	0..1	1	[-]
enable the check of VIN CAS: during "FSC_CHK" the VIN from CAS will be compared with VIN ECU (dataset)					
LC_SWT_CHK_FSC_STATUS_DENIED_ENA	1	0..1H	0..1	1	[-]
enable the check FSC in state denied					
C_SWT_SWID_APPNO	1	0..FFFFH	0..65535	1	[-]
application number which is part of the SWID					

Initialisation of calibration data:

LC\_SWT\_CHK\_VIN\_CAS\_ENA = 1;  
 LC\_SWT\_CHK\_FSC\_STATUS\_DENIED\_ENA = 0;  
 C\_SWT\_SWID\_APPNO = 0;

### Exported actions:



<b>ACTION_SWT_SwidToCallid(IN&lt;32bit SWID&gt;, OUT&lt;16bit CALL ID&gt;)</b>
Converts a 32bit SWID representation to a 16 bit CALL ID representation
<b>ACTION_SWT_CallidToSwid(IN&lt;16bit CALL ID&gt;, OUT&lt;32bit SWID&gt;)</b>
Converts a 16bit SWID representation to a 32 bit CALL ID representation
<b>ACTION_SWT_SetFscLen(IN&lt;32bit SWID&gt;, IN&lt;FSC_LEN&gt;, OUT&lt;SWT Returncode&gt;)</b>
Used by KWP to Set the complete length of the message <u>Input Parameter:</u> SWID: Software ID of the FSC which will be delivered FSC_LEN: Total Length of the FSC which will be delivered <u>Output Parameter:</u> SWT Returncode: <b>0x00:</b> Processing successfully; *) <b>0xFF:</b> Unknown failure; <b>0xFE:</b> SWID not in ECU/Invalid SWID; *) <b>0xD9:</b> No L3 authentication; <b>0xD6:</b> Wrong Parameter; *) <b>0xD3:</b> No free space for storing FSC *) used at Immobilizer FSC, too
<b>ACTION_SWT_RcvFsc(IN&lt;32bit SWID&gt;, IN&lt;u8ptr FSC&gt;, IN&lt;FRAME_LEN&gt;, OUT&lt;SWT Returncode&gt;)</b>
Used by KWP and UDS to overgive the FSC to the SWT Interface. Contains the complete FSC by calling from UDS. By calling from KWP the Action is called for every delivered segment. The Immobilizer FSC will be saved here temporary only in RAM. After successfully check "ACTION_SWT_ChkFsc", this informations will be stored in EEPROM and Flash. All other FSC will be stored here immediately into EEPROM without "Signature Check". The FSC-Status will be set to: <b>0x00:</b> nicht vorhanden; <b>0x01:</b> eingespielt; <u>Input Parameter:</u> SWID: Software ID of the FSC which will be delivered FSC: u8 Pointer to the beginning of the FSC segment FRAME_LEN: Total Length of the FSC Segment <u>Output Parameter:</u> SWT Returncode: <b>0x00:</b> Processing successfully; *) <b>0xFF:</b> Unknown failure; <b>0xFE:</b> SWID not in ECU/Invalid SWID; *) (KWP must send back 0xD6) <b>0xF8:</b> Invalid FSC Date; <b>0xE0:</b> Flash write error; <b>0xD9:</b> No L3 authentication; <b>0xD6:</b> Wrong Parameter; *) <b>0xD3:</b> No free space for storing FSC; <b>0xD1:</b> parser structure wrong / (IMOB FSC: Wrong); *) used at Immobilizer FSC, too
<b>ACTION_SWT_ChkFsc(IN&lt;32bit SWID&gt;, OUT&lt;SWT Returncode&gt;)</b>

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Checks an overgiven FSC.Immobilizer FSC: After successfully check, this information will be stored in EEPROM and Flash. All other FSC are already stored in EEPROM and will be checked here.

The information about this check will be stored in EEPROM: **0x02**:akzeptiert;  
**0x03**:abgelehnt;0x00:nicht vorhanden; 0x01:eingespielt; 0x04:storniert;

Input Parameter:

SWID: Software ID of the FSC was delivered by ACTION\_SWT\_StrFSc and needs to be checked

Output Parameter:

SWT Returncode:

- 0x00**: Processing successfully; \*)
  - 0xFF**: Unknown failure;
  - 0xFE**: SWID not in ECU/Invalid SWID; \*)
  - 0xFC**: wrong SWID inside FSC;
  - 0xF9**: Signature invalid;\*)
  - 0xF8**: Invalid FSC Date; \*\*)
  - 0xF6**: FSC is not available;
  - 0xF5**: FSC is rejected;
  - 0xF4**: FSC is cancelled;
  - 0xDF**: Flash read error; \*)
  - 0xDE**: VIN check failed
  - 0xD9**: No L3 authentication;
  - 0xD2**: VIN can not be found in ECU; ( VIN is 0x00...)
  - 0xD1**: IMOB FSC: Wrong; \*\*)
- \*) used at Immobilizer FSC, too  
\*\*) used at Immobilizer FSC only

**ACTION\_SWT\_GetSoftwareIdFunc(OUT<u8ptr NUMBER\_OF\_SWID>, OUT<SWID>, OUT<SWT Returncode>)**

Returns all SWID's which are available in this SW (without IMOB-SWID)

Input: Parameter:

none

Output Parameter:

NumberOfSwids:

SWID: Software ID's of the FSC which are available

SWT Returncode:

- 0x00**: Processing successfully;
- 0xFF**: Unknown failure;
- 0xD6**: Wrong Parameter

**ACTION\_SWT\_GetStatus(IN<32bit SWID>, OUT<u8ptr STATUS>, OUT<SWT Returncode>)**

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<p>Returns the status of the FSC which is selected by the SWID (without IMOB-SWID)  <u>Input: Parameter:</u>                  SWID: Software ID of the FSC which status should be checked  <u>Output Parameter:</u>                  Status: Status of the stored FSC:  <b>0x00</b>:nicht vorhanden; <b>0x01</b>:eingespielt; <b>0x02</b>:akzeptiert; <b>0x03</b>:abgelehnt; <b>0x04</b>:storniert                  SWT Returncode:  <b>0x00</b>: Processing successfully;  <b>0xFF</b>: Unknown failure; (also used by Flash read error)  <b>0xFE</b>: SWID not in ECU/Invalid SWID; (KWP must send back 0xFF only if all requests are invalid)</p>
<p><b>ACTION_SWT_DisableFsc(IN&lt;32bit SWID&gt;, OUT&lt;SWT Returncode&gt;)</b></p> <p>Reverse an valid FSC (without IMOB-FSC)                  The information about the disabled FSC will be stored in EEPROM: <b>0x04</b>:storniert;  <u>Input: Parameter:</u>                  SWID: Software ID of the FSC which status should be checked  <u>Output Parameter:</u>                  SWT Returncode:  <b>0x00</b>: Processing successfully;  <b>0xFF</b>: Unknown failure; (also used by Flash read/write error)  <b>0xFE</b>: SWID not in ECU/Invalid SWID;  <b>0xF6</b>: FSC is not available;  <b>0xF4</b>: FSC is already disabled;  <b>0xD9</b>: No L3 authentication;</p>
<p><b>ACTION_SWT_GetFscLen(IN&lt;32bit SWID&gt;, OUT&lt;u8ptr LENGTH&gt;, OUT&lt;SWT Returncode&gt;)</b></p> <p>Returns the length of the FSC which is selected by the SWID (without IMOB-SWID)  <u>Input: Parameter:</u>                  SWID: Software ID of the FSC which length should be checked  <u>Output Parameter:</u>                  Length: Length of the selected FSC                  SWT Returncode:  <b>0x00</b>: Processing successfully;  <b>0xFF</b>: Unknown failure;  <b>0xFE</b>: SWID not in ECU/Invalid SWID;  <b>0xF6</b>: FSC is not available;  <b>0xDF</b>: Flash read error;</p>
<p><b>ACTION_SWT_GetFsc(IN&lt;32bit SWID&gt;, OUT&lt;u8ptr FSC&gt;, OUT&lt;SWT Returncode&gt;)</b></p>

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<p>Returns the complete FSC which is selected by the SWID (without IMOB-SWID)  <u>Input: Parameter:</u>                  SWID: Software ID of the FSC which should be read  <u>Output Parameter:</u>                  FSC: Freischaltcode (Header + Signature)                  SWT Returncode:  <b>0x00</b>: Processing successfully;  <b>0xFF</b>: Unknown failure;  <b>0xFE</b>: SWID not in ECU/Invalid SWID; (KWP must send back <b>0xD6</b>: Wrong Parameter)  <b>0xD6</b>: Wrong Parameter; (also used for "FSC is not available")</p>
<p><b>ACTION_SWT_GetVin(OUT&lt;u8ptr VIN&gt;, OUT&lt;SWT Returncode&gt;)</b>                  Returns the Vehical Identification Number (Fahrgestellnummer)  <u>Input: Parameter:</u>                  none  <u>Output Parameter:</u>                  VIN: Vehical Identification Number (7 Byte)                  SWT Returncode:  <b>0x00</b>: Processing successfully;  <b>0xFF</b>: Unknown failure;</p>
<p><b>ACTION_SWT_SetVin(IN&lt;u8ptr VIN&gt;, OUT&lt;SWT Returncode&gt;)</b>                  This action is simulating the storage of a new "VIN" into the ECU  <u>Input: Parameter:</u>                  VIN: Vehical Identification Number (7 Byte)  <u>Output Parameter:</u>                  SWT Returncode:  <b>0x00</b>: Processing successfully;  <b>0xFF</b>: Unknown failure;  <b>0xE0</b>: Flash write error; (VIN in ECU is not the received VIN)  <b>0xD9</b>: No L3 authentication;  <b>0xD6</b>: Wrong Parameter</p>

<b>ACTION_IMOB_WrNvmyFscEws4A()</b>
Stores a IMOB FSC in EEPROM
<b>ACTION_IMOB_ChkSigFsc()</b>
Checks if a IMOB FSC Signature is valid
<b>ACTION_INTC_NO_VECH_REQ()</b>
Trigger CAS to send new VIN over CAN (VIN_CAN)

**FSC Format for Parsing FSC**

**General information:**

Fields 1-3 are for all possible FSCs the same;

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Nr	Field name	FSC Offset (byte)	Value xx / Analysis: Yes/No
1	Version	0	IMOB: 0x02: Version 2 SWT: VMAX/PMAX: 0x01 / No
2	SWID Type	1	IMOB: 0x02: Application SWT: VMAX/PMAX: 0x01 / No
3	SWID	2 3 4 5	App Nr Highbyte App Nr Lowbyte Upgrade Index Highbyte Upgrade Index Lowbyte / Yes

## Special Format for Immobilizer FSC:

Nr	Field name	FSC Offset (byte)	
4	SupplierNr	6 7 8 9 10 11 12 13	8 bytes ASCII - not relevant -
5	RequesterType	14	- not relevant -
6	OrderNr	15 16 17 18 19 20 21 22	8 bytes ASCII -not relevant -
7	RequesterID	23 24 25 26 27	5 bytes ASCII - not relevant -
8	IndividualAttributeType	28	0x04:ECUSNR
9	IndividualAttribute	29 30 31 32 33 34 35 36 37	9bytes ASCII serialnumber*
10	Validity	38 39 40 41	-not relevant-
11	FSCS_ID	42 43 44 - 46 47 48 49	-not relevant-

12	Date	50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67	18 bit Zero terminated ASCII-String e.g."200212312000+0000" YYYYMMDDHHMM+Timezone*
13	Extended	68 69 70 71 72 73 74 75	EWS config byte * EWS config byte * EWS config byte * EWS config byte * 0 0 0 0
14	Signature	76 .. 267	192 bytes Signature


- EWS config byte: 0x00, 0x00,0x00,0x01: secret development key  
0x00, 0x00,0x00,0x02: unlock  
0x00,0x00,0x00,0x00: secret key
- Serialnumber: Always 9 bytes in FSC. Compare with serial number in ECU: Bytes 0..8 for L4, bytes Bytes 1..9 for L6
- Date stored in ASCII-values, Format YYYYMMDDHHMMSSHHMM, S means: + or - as sign for the Timezone, e.g +0100

Special Format for VMAX /PMAX FSC

Nr	Field name	Length	Value xx / Analysis: Yes/No
4	SupplierNr	8	8 bytes ASCII / No
5	RequesterType	1	0x01: Werk 2Byte requesterID / Yes 0x02: Händler 5Byte requester ID / Yes
6	OrderNr	8	8 bytes ASCII / No
7	RequesterID	2, 5	2 / 5 bytes ASCII /No
8	IndividualAttributeType	1	0x01: VIN / No
9	IndividualAttribute	7	7 bytes VIN / Yes
10	Validity	4	0x01,0x00,0x00,0x00 / No
11	FSCS_ID	8	0xXX..0xXX / No
12	Date		14 bit Zero terminated ASCII-String e.g."200212312000Z" YYYYMMDDHHMMZ* /Yes
13	Extended	1	0x00 / No
14	Signature	128	128 bytes Signature /Yes

Definitions of SWT returncodes


General information:

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
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Nr	Return code	Value	Description
	SWT_RC_OK	0x00	- Processing successfully -
	SWT_RC_UNKNOWN_ERROR	0xFF	- Unknown failure -
	SWT_RC_SW_NOT_EXISTENT	0xFE	- SWID not in ECU/Invalid SWID -
	SWT_RC_NOT_ACTIVATED	0xFD	- not used -
	SWT_RC_SWID_CHECK_FAILURE	0xFC	- wrong SWID inside FSC -
	SWT_RC_SWSIG_REJECTED	0xFB	- not used -
	SWT_RC_SWSIG_CHECK_FAILURE	0xFA	- not used -
	SWT_RC_SIG_CHECK_FAILURE	0xF9	-Signature invalid-
	SWT_RC_INVALID_FSC_CREATION_DATE	0xF8	- Invalid FSC Date -
	SWT_RC_WRONG_FSCS_ID_IN_FSC	0xF7	- not used -
	SWT_RC_FSC_NOT_EXISTENT	0xF6	- FSC is not available -
	SWT_RC_FSC_REJECTED	0xF5	- FSC is rejected -
	SWT_RC_FSC_CANCELLED	0xF4	- FSC is cancelled -
	SWT_RC_FSC_CHECK_FAILURE	0xF3	- not used -
	SWT_RC_CERT_NOT_EXISTENT	0xF2	- not used -
	SWT_RC_CERT_REJECTED	0xF1	- not used -
	SWT_RC_ROOT_CERT_NOT_EXISTENT	0xF0	- not used -
	SWT_RC_ROOT_CERT_NOT_READABLE	0xEF	- not used -
	SWT_RC_ROOT_CERT_CORRUPT	0xEE	- not used -
	SWT_RC_ROOT_CERT_REJECTED	0xED	- not used -
	SWT_RC_ROOT_CERT_INVALID	0xEC	- not used -
	SWT_RC_SIGS_CERT_NOT_EXISTENT	0xEB	- not used -
	SWT_RC_SIGS_CERT_NOT_CHECKED	0xEA	- not used -
	SWT_RC_SIGS_CERT_INVALID	0xE9	- not used -
	SWT_RC_SIGS_CERT_CHECK_FAILURE	0xE8	- not used -
	SWT_RC_FSCS_CERT_NOT_EXISTENT	0xE7	- not used -
	SWT_RC_FSCS_CERT_NOT_CHECKED	0xE6	- not used -
	SWT_RC_FSCS_CERT_INVALID	0xE5	- not used -
	SWT_RC_FSCS_CERT_CHECK_FAILURE	0xE4	- not used -
	SWT_RC_WRONG_CERT_CONTENT_VALIDITY	0xE3	- not used -
	SWT_RC_WRONG_CERT_CONTENT_ISSUER	0xE2	- not used -
	SWT_RC_WRONG_CERT_CONTENT_KEYUSAGE	0xE1	- not used -
	SWT_RC_FLASH_WRITE_ERROR	0xE0	- Flash write error -
	SWT_RC_FLASH_READ_ERROR	0xDF	- Flash read error -
	SWT_RC_FGN_CHECK_FAILURE	0xDE	- VIN check failed -
	SWT_RC_FGN_INVALID	0xDD	- VIN not valid -
	SWT_RC_VALIDITY_CHECK_FAILURE	0xDC	- not used -
	SWT_RC_SIGSID_AND_CERT_NOT_COMPATIBLE	0xDB	- not used -
	SWT_RC_BAD_FINGERPRINT	0xDA	- not used -
	SWT_RC_NOT_AUTHENTICATED	0xD9	- No L3 authentication -
	SWT_RC_MISSING_SG_DATA	0xD8	- not used -
	SWT_RC_FSCS_CERT_REJECTED	0xD7	- not used -
	SWT_RC_BAD_PARAM	0xD6	- Wrong Parameter -
	SWT_RC_BAD_FSC_CONTENT	0xD5	- not used -
	SWT_RC_WRONG_CERT_CONTENT_CRIT_ELEM	0xD4	- not used -
	SWT_RC_NO_FREE_SPACE	0xD3	- No free space for storing FSC -
	SWT_RC_FGN_ACCESS_FAILURE	0xD2	- VIN can not be found in ECU -
	SWT_RC_INVALID_FSC	0xD1	- parser structure wrong / IMOB FSC: Wrong - serialnumber-

	SWT_RC_EXTENSION_CHECK_FAILURE	0xD0	- not used -
	SWT_RC_LAST_MSG_NOT_RECEIVED_SFNS	0x12	RC only for UDS/KWP: subFunctionNotSupported
	SWT_RC_CALC_STILL_IN_WORK	0x78	RC only for UDS/KWP: calculation is still in work

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4159 of 8404</b>	
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## Definition of SWID and CALLID

### General information:

The Software ID (SWID) is a 32 bit data type which contains 4 8bit fields. The CALL ID is a 16 bit short format used by KWP which is generated by 2 of the 4 SWID 8bit fields.

Project	FSC function	16 bit CALLID	32 bit SWID
	CALLID_IMOB_DME1 / SWID_IMOB_DME1	Highbyte #1: 0x07 Lowbyte #0: 0x40	AppNr Highbyte #3: 0x00 AppNr Lowbyte #2: <b>0x07</b> Upgr Idx Highbyte #1: <b>0x40</b> Upgr idx DA #0 : 0x00
	CALLID_IMOB_DME2 / SWID_IMOB_DME2	Highbyte #1: 0x09 Lowbyte #0: 0x12	AppNr Highbyte #3: 0x00 AppNr Lowbyte #2: <b>0x09</b> Upgr Idx Highbyte #1: <b>0x12</b> Upgr idx DA#0 : 0x00
Used @ MSD85.3 (4DS) only	CALLID_VMAX_DME1 / SWID_VMAX_DME1	Highbyte #1: 0x70 Lowbyte #0: 0x01	AppNr Highbyte #3: 0x00 AppNr Lowbyte #2: <b>0x70</b> Upgr Idx Highbyte #1: 0x00 Upgr idx DA #0 : <b>0x01</b>
Used @ MSD81 (4DC) only	CALLID_PMAX_DME1 / SWID_PMAX_DME1	Highbyte #1: C_SWT_SWID_APPN O: lobyte Lowbyte #0: 0x01 (Pmax only) or 0x02 (Pmax + Vmax)	AppNr Highbyte #3: C_SWT_SWID_APPNO: highbyte AppNr Lowbyte #2: C_SWT_SWID_APPNO: lobyte Upgr Idx Highbyte #1: 0x00 Upgr idx DA #0 : <b>0x01 (Pmax only)</b> <b>or 0x02 (Pmax + Vmax)</b>
Used @ MSD85.1 (4D8) only	CALLID_PMAX_DME1 / SWID_PMAX_DME1	Highbyte #1: 0x85 Lowbyte #0: 0x01	AppNr Highbyte #3: 0x00 AppNr Lowbyte #2: <b>0x85</b> Upgr Idx Highbyte #1: 0x00 Upgr idx DA #0 : <b>0x01</b>

### General parser for VMAX (Data from EEPROM):

```

TMP_U8_CTR = 0
LOC_VMAX_FSC.SIZE=(U8*)&FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_VMAX_SIZE_LEN /*2BYTE*/
LOC_VMAX_FSC.STATUS=(U8*)&FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_VMAX_STATUS_LEN /*2BYTE*/
LOC_VMAX_FSC.VERSION=(U8*)&FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_VMAX_VERSION_LEN /*1BYTE*/
LOC_VMAX_FSC.SWID_TYPE=(U8*)&FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_VMAX_SWIDTYPE_LEN /*1BYTE*/
LOC_VMAX_FSC.SWID=(SWT_SWID*)(VOID*)&FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_SWID_LEN /*4BYTE*/
LOC_VMAX_FSC.SUPPLIER_NR=(U8*)&FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_SUPPLIERNR_LEN /*8BYTE*/
LOC_VMAX_FSC.REQUESTER_TYPE=(U8*)&FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_REQUESTERTYPE_LEN /*1BYTE*/
LOC_VMAX_FSC.ORDER_NR=(U8*)&FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_ORDERNR_LEN /*8BYTE*/
LOC_VMAX_FSC.REQUESTER_ID=(U8*)&FSC_XMAX_RD[TMP_U8_CTR]
If(6) LOC_VMAX_FSC.REQUESTER_TYPE = 1
Then(6)TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_REQUSERID_1_LEN /*2BYTE*/

Else(6) TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_REQUSERID_2_LEN /*5BYTE*/
    
```



**Endif(6)**

```

LOC_VMAX_FSC.INDIVIDUAL_ATTR_TYPE=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_INDIV_ATTR_TYPE_LEN /*1BYTE*/
LOC_VMAX_FSC.INDIVIDUAL_ATTR=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_INDIV_ATTR_LEN /*7BYTE*/
LOC_VMAX_FSC.VALIDITY=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_VALIDITY_LEN /*4BYTE*/
LOC_VMAX_FSC.FSCS_ID=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_FSCSID_LEN /*8BYTE*/
LOC_VMAX_FSC.DATE=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_DATE_LEN /*14BYTE*/
LOC_VMAX_FSC.EXTENDED=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_EXTENDED_LEN /*1BYTE*/
LOC_VMAX_FSC.SIGNATURE=(U8*) & FSC_XMAX_RD[TMP_U8_CTR]
LV_SWT_FSC_PARSED = 1
    
```

**General parser for VMAX (Data from Diagnosis):**

```

TMP_U8_CTR = 0
LOC_VMAX_DIAG_FSC.VERSION=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_VMAX_VERSION_LEN /*1BYTE*/
LOC_VMAX_DIAG_FSC.SWID_TYPE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_VMAX_SWIDTYPE_LEN /*1BYTE*/
LOC_VMAX_DIAG_FSC.SWID=(SWT_SWID*)(VOID*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_SWID_LEN /*4BYTE*/
LOC_VMAX_DIAG_FSC.SUPPLIER_NR=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_SUPPLIERNR_LEN /*8BYTE*/
LOC_VMAX_DIAG_FSC.REQUESTER_TYPE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_REQUESTERTYPE_LEN /*1BYTE*/
LOC_VMAX_DIAG_FSC.ORDER_NR=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_ORDERNR_LEN /*8BYTE*/
LOC_VMAX_DIAG_FSC.REQUESTER_ID=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
If(6) LOC_VMAX_DIAG_FSC.REQUESTER_TYPE = 1
Then(6) TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_REQUSTERID_1_LEN /*2BYTE*/

Else(6) TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_REQUSTERID_2_LEN /*5BYTE*/
    
```


**Endif(6)**

CTR]

```

LOC_VMAX_DIAG_FSC.INDIVIDUAL_ATTR_TYPE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_INDIV_ATTR_TYPE_LEN /*1BYTE*/
LOC_VMAX_DIAG_FSC.INDIVIDUAL_ATTR=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_INDIV_ATTR_LEN /*7BYTE*/
LOC_VMAX_DIAG_FSC.VALIDITY=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_VALIDITY_LEN /*4BYTE*/
LOC_VMAX_DIAG_FSC.FSCS_ID=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_FSCSID_LEN /*8BYTE*/
LOC_VMAX_DIAG_FSC.DATE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_DATE_LEN /*14BYTE*/
LOC_VMAX_DIAG_FSC.EXTENDED=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_EXTENDED_LEN /*1BYTE*/
LOC_VMAX_DIAG_FSC.SIGNATURE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
    
```

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	Document key 10171571 SPE 000 AO	Pages Page 4161 of 8404	
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**General parser for PMAX (Data from EEPROM):**

```

TMP_U8_CTR = 0
LOC_PMAX_FSC.SIZE=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_PMAX_SIZE_LEN /*2BYTE*/
LOC_PMAX_FSC.STATUS=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_PMAX_STATUS_LEN /*2BYTE*/
LOC_PMAX_FSC.VERSION=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_PMAX_VERSION_LEN /*1BYTE*/
LOC_PMAX_FSC.SWID_TYPE=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_PMAX_SWIDTYPE_LEN /*1BYTE*/
LOC_PMAX_FSC.SWID=(SWT_SWID*)(VOID*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_SWID_LEN /*4BYTE*/
LOC_PMAX_FSC.SUPPLIER_NR=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_SUPPLIERNR_LEN /*8BYTE*/
LOC_PMAX_FSC.REQUESTER_TYPE=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_REQUESTERTYPE_LEN /*1BYTE*/
LOC_PMAX_FSC.ORDER_NR=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_ORDERNR_LEN /*8BYTE*/
LOC_PMAX_FSC.REQUESTER_ID=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
If(6) LOC_PMAX_FSC.REQUESTER_TYPE = 1
Then(6)TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_REQUSERID_1_LEN /*2BYTE*/

Else(6) TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_REQUSERID_2_LEN /*5BYTE*/


Endif(6)
LOC_PMAX_FSC.INDIVIDUAL_ATTR_TYPE=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_INDIV_ATTR_TYPE_LEN /*1BYTE*/
LOC_PMAX_FSC.INDIVIDUAL_ATTR=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_INDIV_ATTR_LEN /*7BYTE*/
LOC_PMAX_FSC.VALIDITY=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_VALIDITY_LEN /*4BYTE*/
LOC_PMAX_FSC.FSCS_ID=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_FSCSID_LEN /*8BYTE*/
LOC_PMAX_FSC.DATE=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_DATE_LEN /*14BYTE*/
LOC_PMAX_FSC.EXTENDED=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_EXTENDED_LEN /*1BYTE*/
LOC_PMAX_FSC.SIGNATURE=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
LV_SWT_FSC_PARSED = 1
    
```

**General parser for PMAX (Data from Diagnosis):**

```

TMP_U8_CTR = 0
LOC_PMAX_DIAG_FSC.VERSION=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_PMAX_VERSION_LEN /*1BYTE*/
LOC_PMAX_DIAG_FSC.SWID_TYPE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_PMAX_SWIDTYPE_LEN /*1BYTE*/
LOC_PMAX_DIAG_FSC.SWID=(SWT_SWID*)(VOID*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_SWID_LEN /*4BYTE*/
LOC_PMAX_DIAG_FSC.SUPPLIER_NR=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_SUPPLIERNR_LEN /*8BYTE*/
LOC_PMAX_DIAG_FSC.REQUESTER_TYPE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
    
```

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```

TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_REQUESTERTYPE_LEN /*1BYTE*/
LOC_PMAX_DIAG_FSC.ORDER_NR=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_ORDERNR_LEN /*8BYTE*/
LOC_PMAX_DIAG_FSC.REQUESTER_ID=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
If(6) LOC_PMAX_DIAG_FSC.REQUESTER_TYPE = 1
Then(6)TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_REQUSERID_1_LEN /*2BYTE*/

Else(6) TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_REQUSERID_2_LEN /*5BYTE*/

Endif(6)
LOC_PMAX_DIAG_FSC.INDIVIDUAL_ATTR_TYPE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_
CTR]


TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_INDIV_ATTR_TYPE_LEN /*1BYTE*/
LOC_PMAX_DIAG_FSC.INDIVIDUAL_ATTR=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_INDIV_ATTR_LEN /*7BYTE*/
LOC_PMAX_DIAG_FSC.VALIDITY=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_VALIDITY_LEN /*4BYTE*/
LOC_PMAX_DIAG_FSC.FSCS_ID=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_FSCSID_LEN /*8BYTE*/
LOC_PMAX_DIAG_FSC.DATE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_DATE_LEN /*14BYTE*/
LOC_PMAX_DIAG_FSC.EXTENDED=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_EXTENDED_LEN /*1BYTE*/
LOC_PMAX_DIAG_FSC.SIGNATURE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
    
```

**General parser for IMOB (Data from Diagnosis):**

```

TMP_U8_CTR = 0
LOC_IMOB_FSC.VERSION=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_IMOB_VERSION_LEN /*1BYTE*/
LOC_IMOB_FSC.SWID_TYPE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_IMOB_SWIDTYPE_LEN /*1BYTE*/
LOC_IMOB_FSC.SWID=(SWT_SWID*)(VOID*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_SWID_LEN /*4BYTE*/
LOC_IMOB_FSC.SUPPLIER_NR=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_SUPPLIERNR_LEN /*8BYTE*/
LOC_IMOB_FSC.REQUESTER_TYPE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_REQUESTERTYPE_LEN /*1BYTE*/
LOC_IMOB_FSC.ORDER_NR=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_ORDERNR_LEN /*8BYTE*/
LOC_IMOB_FSC.REQUESTER_ID=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_REQUSERID_LEN /*5BYTE*/
LOC_IMOB_FSC.INDIVIDUAL_ATTR_TYPE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_INDIV_ATTR_TYPE_LEN /*1BYTE*/
LOC_IMOB_FSC.INDIVIDUAL_ATTR=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_INDIV_ATTR_LEN /*9BYTE*/
LOC_IMOB_FSC.VALIDITY=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_VALIDITY_LEN /*4BYTE*/
LOC_IMOB_FSC.FSCS_ID=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_FSCSID_LEN /*8BYTE*/
LOC_IMOB_FSC.DATE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_DATE_LEN /*18BYTE*/
    
```

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```
LOC_IMOB_FSC.EXTENDED=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_EXTENDED_LEN /*8BYTE*/
LOC_IMOB_FSC.SIGNATURE=(U8*)LOC_SWT_FSC_SIG_BUF
```

**ACTION\_SWT\_SwidToCallid(IN <32bit SWID>, OUT <16bit CALL ID>)**

**General Information:**

This function converts a 32bit SWID into a 16bit CALLID for KWP\_Frames.  
32bit SWID is separated in Byte 0(LSB)...Byte 3(MSB)  
16bit CALLID is separated in Byte 0(LSB)...Byte 1(MSB)

**Formula section:**

```
If      SWID == Swid definition for Imob DME1 OR
      SWID == Swid definition for Imob DME2
Then
      /* Immobilizer only: Upgrade Index is switched here */
      CALLID Byte 0 (Low Byte) = SWID Byte 1 (Upgrade Index HIGHBYTE)
      CALLID Byte 1 (High Byte) = SWID Byte 2 (AppNr. Low Byte)
Else    /* Standard SWID like described in SWT Classic Light */
      CALLID Byte 0 (Low Byte) = SWID Byte 0 (Upgrade index DA)
      CALLID Byte 1 (High Byte) = SWID Byte 2 (AppNr. Low Byte)

Endif
```

**ACTION\_SWT\_CallidToSwid(IN <16bit CALL ID>, OUT <32bit SWID>)**

**General Information:**


This function converts a 16bit CALLID from KWP\_Frames into a 32bit SWID.  
32bit SWID is separated in Byte 0(LSB)...Byte 3(MSB)  
16bit CALLID is separated in Byte 0(LSB)...Byte 1(MSB)

**Formula section:**

```
If      CALLID == CALLID definition for Imob DME1 OR
      CALLID == CALLID definition for Imob DME2
Then    /* Immobilizer FSC only: Upgrade Index is switched here */
      SWID Byte 0 = 0x0
      SWID Byte 1 = CALLID Byte 0
      SWID Byte 2 = CALLID Byte 1
      SWID Byte 3 = 0x0

Else    /* for all other FSC */
      SWID Byte 0 = CALLID Byte 0
      SWID Byte 1 = 0x0
      SWID Byte 2 = CALLID Byte 1
      SWID Byte 3 = 0x0
```

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## Endif

**ACTION\_SWT\_SetFscLen(IN <32bit SWID>, <FSC\_LEN>,OUT <SWT Returncode>)**

### General Information:

This action sets the expected FSC length at the SWT\_Interface. It needs to be called only if the FSC is transmitted via KWP Frames (L4) because the FSC is delivered in segments. This function stores the expected message length and its SWID to the SWT Interface.

Returnvalues are defined in the action tables.

### Formula section:

LOC\_FSC\_BYTES\_RCV=0

**If** FSC\_LEN > NC\_SIZE\_FSC\_BUFFER (296 bytes)

**Then**

LOC\_FSC\_EXP\_LEN = 0  
LOC\_SWID\_KWP\_FIRST\_MSG = 0  
*exit with Error Code SWT\_RC\_BAD\_PARAM*

**Endif**

**If**(1) LV\_ECU\_SLA /\* slave ecu \*/

**Then**(1)**if**(2) SWID == *Swid definition for Imob DME2*

**Then**(2)LOC\_FSC\_EXP\_LEN=FSC\_LEN  
LOC\_SWID\_KWP\_FIRST\_MSG = SWID  
*exit with Return Code SWT\_RC\_OK*

0

**Else**(2) LOC\_FSC\_EXP\_LEN =

LOC\_SWID\_KWP\_FIRST\_MSG = 0  
*exit with Error Code SWT\_RC\_SW\_NOT\_EXISTENT*

**Endif**(2)

**Else**(1) /\* master ecu \*/

**If**(3) SWID == *Swid definition for Imob DME1*

**Then**(3)LOC\_FSC\_EXP\_LEN=FSC\_LEN  
LOC\_SWID\_KWP\_FIRST\_MSG = SWID  
*exit with Return Code SWT\_RC\_OK*

**Else if**(3) (SWID == *Swid definition for Vmax only* and NC\_SWT\_MOD defined for Vmax only ) **OR**

(SWID == *Swid definition Pmax* and NC\_SWT\_MOD defined for Pmax + opt. Vmax

)

*/\* Initialisation is needed in case of EEPROM error at startup  
(callback routine was called) \*/*


LV\_SWT\_FSC\_WR\_FINISHED = 0

**If**(4) (LV\_AUTH\_L3\_ENA)

*/\*Level3 Authentication\*/*

**Then**(4)**if**(5) FSC\_LEN < BUFFER FOR FSC IN EEPROM (200Byte)

**Then**(5)LOC\_FSC\_EXP\_LEN=FSC\_LEN  
LOC\_SWID\_KWP\_FIRST\_MSG = SWID

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```

        exit with Return Code SWT_RC_OK
    Else(5)      LOC_FSC_EXP_LEN = 0
                LOC_SWID_KWP_FIRST_MSG = 0
                exit with Error Code SWT_RC_NO_FREE_SPACE
    Endif(5)
Else(4)      LOC_FSC_EXP_LEN = 0
             LOC_SWID_KWP_FIRST_MSG = 0
             exit with Error Code SWT_RC_NOT_AUTHENTICATED
Endif(4)
Else(3)      LOC_FSC_EXP_LEN = 0
             LOC_SWID_KWP_FIRST_MSG = 0
             exit with Error Code SWT_RC_SW_NOT_EXISTENT
Endif(3)
Endif(1)

```

**ACTION\_SWT\_RcvFsc(IN <32bit SWID>, <u8ptr FSC>, <FSC\_FRAME\_LEN>, OUT <SWT Returncode>)**

**General Information:**

IMOB FSC: This action stores the given FSC in RAM or returns an Error code. For KWP\_frames this ACTION is called for every segment.

It will return:        SWT\_RC\_OK if successful  
                       SWT\_RC\_SW\_NOT\_EXISTENT if invalid SWID  
                       SWT\_RC\_BAD\_PARAM if FRAME\_LEN is invalid

**Formula section:**

STATE\_KWP\_IMOB\_STORE\_K\_EWS\_ENA=0


```

If(1)      UDS is active
Then(1)If(2)  LV_ECU_SLA /* SLAVE ECU */
    Then(2)If(3)  SWID == Swid definition for Imob DME2
        Then(3)If(4)  FSC_FRAME_LEN <= NC_SIZE_FSC_BUFFER (296 bytes)
            Then(4)STATE_KWP_IMOB_STORE_K_EWS_ENA=1
                    LOC_SWT_FSC_BUF = FSC
                    exit with Return Code SWT_RC_OK
            Else(4)
                exit with Error Code SWT_RC_BAD_PARAM
            Endif(4)
        Else(3)
            exit with Error Code SWT_RC_SW_NOT_EXISTENT
        Endif(3)
    Else(2)      /* master ecu */
        If(3)      SWID == Swid definition for Imob DME1
            Then(3)If(4)  FSC_FRAME_LEN <= NC_SIZE_FSC_BUFFER
                Then(4)STATE_KWP_IMOB_STORE_K_EWS_ENA=1
                        LOC_SWT_FSC_BUF = FSC //COPY FRAME_LEN BYTESTO BUFFER

                exit with Return Code SWT_RC_OK

```

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```

Else(4)
    exit with Error Code SWT_RC_BAD_PARAM
Endif(4)
Else(3)      exit with Error Code SWT_RC_SW_NOT_EXISTENT
Endif(3)
Endif(2)
Endif(1)

If (1)KWP is active
Then(1)If(2) LOC_SWID_KWP_FIRST_MSG==SWID
    Then(2) If(3) SWID == Swid definition for Imob DME1
        Then(3) If(4) LOC_FSC_BYTES_RCV+FSC_FRAME_LEN >
            LOC_FSC_EXP_LEN
            Then(4) exit with Error Code SWT_RC_BAD_PARAM
            Else(4)      set the storage position of loc_swt_fsc_buf
                to a offset of loc_fsc_bytes_rcv
                FOR i=0 to FSC_FRAME_LEN; i++
                LOC_SWT_FSC_BUF[i+LOC_FSC_BYTES_RCV]
                = FSC[i]
                ENDFOR
                LOC_FSC_BYTES_RCV =
                LOC_FSC_BYTES_RCV + FSC_FRAME_LEN
                If LOC_FSC_BYTES_RCV=LOC_FSC_EXP_LEN
                Then
                /* Enable Check Diag */
                STATE_KWP_IMOB_STORE_K_EWS_ENA=1
                Endif
                exit with Return Code SWT_RC_OK
            Endif(4)
        Else If(3) (SWID == Swid definition for Vmax only
            and NC_SWT_MOD defined for Vmax only ) OR
            (SWID == Swid definition Pmax
            and NC_SWT_MOD defined for Pmax + opt. Vmax )
            If(A) (!LV_SWT_FSC_WR_IN_WORK)
            Then (A)
            If(B) (LV_SWT_FSC_WR_FINISHED & & (LOC_FSC_EXP_LEN >
0))
                Then(B)      LV_SWT_FSC_WR_FINISHED = 0;
                If(C)      LV_FSC_XMAX_WR_OK
                Then(C)    SWT_FSC_XMAX_STATUS=1 /*eingespiel*/
                    exit with Return Code SWT_RC_OK
                Else(C)      exit with Error Code SWT_RC_FLASH_WRITE_
ERROR
                Endif(C)
            Else(B)
            If(4) LOC_FSC_BYTES_RCV+FSC_FRAME_LEN > LOC_FSC_EXP_
LEN
                Then(4) exit with Error Code SWT_RC_BAD_PARAM
                Else(4)      set the storage position of loc_swt_fsc_buf
                    to a offset of loc_fsc_bytes_rcv
                    FOR i=0 to FSC_FRAME_LEN; i++
                    LOC_SWT_FSC_BUF[i+LOC_FSC_BYTES_RCV] = FSC[i]

```


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```

ENDFOR
LOC_FSC_BYTES_RCV =
LOC_FSC_BYTES_RCV + FSC_FRAME_LEN
If(5)(LOC_FSC_BYTES_RCV == LOC_FSC_EXP_LEN)
Then(5)
/* FSC is complete received */
If(6) (LV_AUTH_L3_ENA) /*Level3 Authentication*/
Then(6)
If(7) LOC_FSC_BYTES_RCV < BUFFER FOR FSC IN EEPROM
(200Byte)
Then(7)
If(8) NC_SWT_MOD defined for VMAX
Then(8)
Call general parser for VMAX (EEPROM);
/* Read DATE FROM STORED FSC IN EEPROM */
If(9) (LOC_VMAX_FSC.SIZE == 188 and
VMAX_FSC.REQUESTER_TYPE == 1 /*Werk*/)
Then(9) /* FSC structure is correct */
Else If(9) (LOC_VMAX_FSC.SIZE == 191 and
VMAX_FSC.REQUESTER_TYPE == 2 /*Händler*/)
Then(9) /* FSC structure is correct */
Else(9) /*No or wrong FSC in EEPROM: No Date is available*/
LOC_VMAX_FSC.DATE = 0x0000000000000000;
Endif(9)
/* Read DATE FROM RECEIVED DIAG MESSAGE */
Call general parser for VMAX (Diagnosis);
If(10) (LOC_FSC_EXP_LEN == 188 and
VMAX_DIAG_FSC.REQUESTER_TYPE == 1)
Then(10) /* FSC structure is correct */
Else If(10) (LOC_FSC_EXP_LEN == 191 and
VMAX_DIAG_FSC.REQUESTER_TYPE == 2 )
Then(10) /* FSC structure is correct */
Else(10) exit with Error Code SWT_RC_INVALID_FSC
Endif(10)
If(D)
(LOC_VMAX_FSC.STATUS = 0X04/* DISABLED*/
AND (LOC_VMAX_DIAG_FSC.DATE
is valid and is newer LOC_VMAX_FSC.DATE))
OR
(LOC_VMAX_FSC.STATUS != 0X04/* DISABLED*/
AND( LOC_VMAX_DIAG_FSC.DATE
is valid and is (newer or equal) than
LOC_VMAX_FSC.DATE ))
Then(D)
/* copy the Length to Buffer for EEPROM writing */
FSC_XMAX_WR[0] = LOC_FSC_EXP_LEN
FSC_XMAX_WR[1] = 0
FSC_XMAX_WR[2] = 1 /* FSC Status: "eingespielt" */
FSC_XMAX_WR[3] = 0
/* copy complete FSC (188 Byte or 191 Byte) to Buffer for EEPROM writing */
FSC_XMAX_WR[4... LOC_FSC_EXP_LEN +3] =
SWT_FSC_BUF[0...LOC_FSC_EXP_LEN -1]

```

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```

/*start store FSC in EEPROM */
ACTION_SWT_WrNvmyFscXMAX( )
    exit with ErrorCode SWT_RC_CALC_STILL_IN_WORK

    Else(D) exit with ErrorCode SWT_RC_INVALID_FSC_CREATION_
DATE
    Endif(D)


    Else If(8) NC_SWT_MOD defined for Pmax + opt. Vmax
    Call general parser for PMAX (EEPROM);
    /* Read DATE FROM STORED FSC IN EEPROM */
    If(E) ( LOC_PMAX_FSC.SIZE == 188 and
PMAX_FSC.REQUESTER_TYPE == 1 /*Werk*/)
        Then(E) /* FSC structure is correct */
        Else If(E) ( LOC_PMAX_FSC.SIZE == 191 and
PMAX_FSC.REQUESTER_TYPE == 2 /*Händler*/)
            Then(E) /* FSC structure is correct */
            Else(E) /*No or wrong FSC in EEPROM: No Date is available*/
                LOC_PMAX_FSC.DATE = 0x0000000000000000;
            Endif(E)
            /* Read DATE FROM RECEIVED DIAG MESSAGE */
            Call general parser for PMAX (Diagnosis);
            If(F) (LOC_FSC_EXP_LEN == 188 and
PMAX_DIAG_FSC.REQUESTER_TYPE == 1)
                Then(F) /* FSC structure is correct */
                Else If(F) (LOC_FSC_EXP_LEN == 191 and
PMAX_DIAG_FSC.REQUESTER_TYPE == 2 )
                    Then(F) /* FSC structure is correct */
                    Else(F) exit with Error Code SWT_RC_INVALID_FSC
                Endif(F)
                If(H) (SWID received as function parameter == SWID of
the FSC to store)
                Then(H) /* SWIDs are equal */
                Else(H) exit with Error Code SWT_RC_INVALID_FSC
                If(G) (LOC_PMAX_FSC.STATUS = 0X04/* DISABLED*/

                    AND (LOC_PMAX_DIAG_FSC.DATE
is valid and is newer LOC_PMAX_FSC.DATE))
                    OR
                    (LOC_PMAX_FSC.STATUS != 0X04/* DISABLED*/
AND( LOC_PMAX_DIAG_FSC.DATE
is valid and is (newer or equal) than
                    LOC_PMAX_FSC.DATE ))

                Then(G)
                /* copy the Length to Buffer for EEPROM writing */
                FSC_XMAX_WR[0] = LOC_FSC_EXP_LEN
                FSC_XMAX_WR[1] = 0
                FSC_XMAX_WR[2] = 1 /* FSC Status: "eingespielt" */
                FSC_XMAX_WR[3] = 0
                /* copy complete FSC (188 Byte or 191 Byte) to Buffer for EEPROM writing */

```

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```

FSC_XMAX_WR[4... LOC_FSC_EXP_LEN +3] =
SWT_FSC_BUF[0...LOC_FSC_EXP_LEN -1]
/*start store FSC in EEPROM */
ACTION_SWT_WrNvmyFscXMAX( )
    exit with ErrorCode SWT_RC_CALC_STILL_IN_WORK

    Else(G) exit with ErrorCode SWT_RC_INVALID_FSC_CREATION_
DATE
    Endif(G)
    Else(8) exit with Error Code unknown error
    Endif(8)
    Else(7)          exit with Error Code SWT_RC_NO_FREE_SPACE
    Endif(7)
    Else(6)          exit with Error Code SWT_RC_NOT_AUTHENTICATED
    Endif(6)
    Endif(5) exit with Return Code SWT_RC_OK
Endif(4)
Endif(B)
Else(A) exit with Error Code SWT_CALC_STILL_IN_WORK
Endif(A)
Else(3) exit with Error Code SWT_RC_SW_NOT_EXISTENT
Endif(3)
Else(2) exit with Error Code SWT_RC_SW_NOT_EXISTENT
Endif(2)
Endif(1)

```

**ACTION\_SWT\_ChkFsc (IN <32bit SWID>,OUT <SWT Returncode>)**

**General Information:**

**IMOB SWT:**

This action checks the delivered FSC by valid serial\_number, FSC creation date, SWID and enables the storage of the FSC into EEPROM and Flash.

General SWT:

This action checks the delivered FSC by valid VIN and SWID.

The Variable "LV\_FSC\_XMAX\_RD\_OK" is defined in "anvmswt.c" which doesn't need a specification.


**Formula section:**

```

If(1)          SWID == Swid definition for Imob DME1 OR
                SWID == Swid definition for Imob DME2
Then(1)If(2)          STATE_KWP_IMOB_STORE_K_EWS_ENA=1
                Then(2)If(3)          NOT(STATE_IMOB_2_ERR & MASK_ERR_SYM_1)
                exit with value of subroutine: specific immobilizer check (see below)
                Else(3)          exit with Error Code SWT_RC_FLASH_READ_ERROR
                Endif(3)
                Else(2)          exit with Error Code SWT_RC_LAST_MSG_NOT_RECEIVED_SFNS
                Endif(2)
Else If(1) (SWID == Swid definition for Vmax only and NC_SWT_MOD defined for Vmax only )
Then(1) exit with value of subroutine: specific vmax check (see below)

```

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```

Elseif(1) (SWID == Swid definition Pmax and NC_SWT_MOD defined for Pmax + opt. Vmax )
Then(1) exit with value of subroutine: specific pmax check (see below)
Else(1) exit with Error Code SWT_RC_SW_NOT_EXISTENT
Endif(1)
    
```

**Subroutine: Store FSC Status in EEPROM**

```

/* copy the Length to Buffer for EEPROM writing */
FSC_XMAX_WR[0] = FSC_XMAX_RD[0]
FSC_XMAX_WR[1] = 0
FSC_XMAX_WR[2] = SWT_FSC_XMAX_STATUS /* new FSC Status*/
FSC_XMAX_WR[3] = 0
/* copy complete FSC (188 Byte or 191 Byte) to Buffer for EEPROM writing */
FSC_XMAX_WR[4... 199] = FSC_XMAX_RD [4...199]
/*store FSC in EEPROM */
ACTION_SWT_WrNvmyFscVMAX( )
/* New Status is needed for FSC_XMAX_RD too */
FSC_XMAX_RD[2] = SWT_FSC_XMAX_STATUS /* new FSC Status */
    
```

**Subroutine: Specific checks for Immobilizer FSC**

TMP\_U8PTR\_FSC\_DATE = cs\_ee\_FSC\_ews4\_A #Byte 50-67

```

copy sig in reverse order + lengthbyte
/* NC_IMOB_SIG_BUF_LEN 192 Byte */
/* NC_SIZE_STREAM_FSC_LEN_BYTE 4 Byte */
/* NC_IMOB_SIG_BUF_LEN = NC_IMOB_FSC_SIG_LEN +NC_SIZE_STREAM_FSC_LEN_BYTE */
    
```

```

FOR TMP_U8_CTR=0 to NC_IMOB_FSC_SIG_LEN; TMP_U8_CTR++ //192 byte
LOC_SWT_FSC_SIG_BUF[NC_IMOB_SIG_BUF_LEN-1-TMP_U8_CTR] = LOC_SWT_FSC_BUF[NC_
IMOB_FSC_HEADER_LEN+TMP_U8_CTR]
ENDFOR
    
```

```

LOC_SWT_FSC_SIG_BUF[0]=48 /* 192 BYTE = 48X32BIT */
LOC_SWT_FSC_SIG_BUF[1]=0
LOC_SWT_FSC_SIG_BUF[2]=0
LOC_SWT_FSC_SIG_BUF[3]=0
    
```

**Call general parser for IMOB (Diagnosis);**

```

If(1) SWID == LOC_IMOB_FSC.SWID
Then(1)If(2) (LOC_IMOB_FSC.DATE is valid and is newer than TMP_U8PTR_FSC_DATE)
    
```

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```

                OR TMP_U8PTR_FSC_DATE is invalid*           // see date representation above
Then(2)If(3)      LOC_IMOB_FSC.INDIVIDUAL_ATTR_TYPE==0x04                                Then(3)
If(4)
                LOC_IMOB_FSC.INDIVIDUAL_ATTR==SERIAL_NUMBER                                Then(4)
If(5)      ( ACTION_IMOB_ChkSigFsc
                (loc_swf_fsc_buf,loc_imob_fsc.signature) ==1 )
                Then(5) PTR_FSC_CONFIG_EWS4=
                LOC_IMOB_FSC.EXTENDED+3
                //copy first 100 bytes
                RS_FSC_EWS4_A=LOC_SWT_FSC_BUF
                ACTION_IMOB_WrNvmyFscEws4A
                /* ENABLE STORING IN FLASH */
                STATE_KWP_IMOB_STORE_K_EWS_ENA=2
                exit with Return Code SWT_RC_OK
                Else(5)      exit with Error Code
                SWT_RC_SIG_CHECK_FAILURE
                Endif(5)
                Else(4)      exit with Error Code SWT_RC_INVALID_FSC;
                Endif(4)
                Else(3)      exit with Error Code SWT_RC_INVALID_FSC;
                Endif(3)
                Else(2)      exit with Error Code  SWT_RC_INVALID_FSC_CREATION_DATE
                Endif(2)
Else(1) exit with Error Code  SWT_RC_SW_NOT_EXISTENT
Endif(1)

```

\*Remark:

IMOB-FSC:

A Date is valid if the 18 byte representation contains only reasonable ASCII-Chars and the resulting Date is between 01.01.1997 and 31.12.2499

SWT-FSC:

A Date is valid if the 14 byte representation contains only reasonable ASCII-Chars and the resulting Date is between 01.01.1997 and 31.12.2499

### Subroutine: Specific checks für VMAX

```

If(1)      (LV_AUTH_L3_ENA or (LV_SWT_CHK_FSC_ENA)) /*Level3 Authentication*/
Then(1)      /* Read FSC from EEPROM */
If(3)      ( STATE_SWT_CHK_FSC == 0 )
Then(3) /* Start FSC Header Check*/
                If(4)      (LV_FSC_XMAX_RD_OK)
                Then(4) /* FSC is restored correct from EEPROM */
                Call general parser for VMAX;
                Else(4) exit with Error Code SWT_RC_FLASH_READ_ERROR
                Endif(4)
                /* Check if FSC is valid and stored in EEPROM */
                If(7) (LOC_VMAX_FSC.STATUS == 0X00) /*nicht vorhanden*/
                Then(7)/* No FSC is stored in EEPROM */
                        SWT_FSC_XMAX_STATUS = 0x00 /*nicht vorhanden*/
                        exit with Error Code SWT_RC_FSC_NOT_EXISTENT
                Else If(7) (LOC_VMAX_FSC.STATUS = 0X01 /*eingespielt*/
                Then(7) /*CHECK OK*/

```

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```

        SWT_FSC_XMAX_STATUS = 0x01 /*eingespielt*/
Else If(7) LOC_VMAX_FSC.STATUS = 0X02 /*akzeptiert*/
Then(7)/*CHECK OK*/
        SWT_FSC_XMAX_STATUS = 0x02 /*akzeptiert*/
Else If(7) (LOC_VMAX_FSC.STATUS == 0X03) /*abgelehnt*/
Then(7)/* FSC is rejected */
        SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
If(8)          (LC_SWT_CHK_FSC_STATUS_DENIED_ENA == 1)
Then(8)  exit with Error Code SWT_RC_FSC_REJECTED
Else(8)   /* check also FSC in status denied */
Endif(8)
Else If(7) (LOC_VMAX_FSC.STATUS == 0X04) /*storniert*/
Then(7)/* FSC is cancelled */
        SWT_FSC_XMAX_STATUS = 0x04 /*storniert*/
        exit with Error Code SWT_RC_FSC_CANCELLED
Else(7)     /* invalid FSC */
        SWT_FSC_XMAX_STATUS = 0x00 /*nicht vorhanden*/
        exit with Error Code SWT_RC_UNKNOWN_ERROR
Endif(7)


/* check if SWID inside FSC which is stored in EEPROM is correct*/
If(5)          (LOC_VMAX_FSC.SWID == Swid definition for Vmax only )
Then(5) /*CHECK OK*/
Else(5)SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
        call "Store FSC Status in EEPROM"
        LV_SWT_VMAX_ENA = 0;
        exit with Error Code SWT_RC_SWID_CHECK_FAILURE
Endif(5)

/* Check if Requester-Type is correct */
If(8) (LOC_VMAX_FSC.REQUESTER_TYPE == 1 OR LOC_VMAX_FSC.REQUESTER_
TYPE == 2)
Then(8)          /*CHECK OK*/
Else(8)SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
        call "Store FSC Status in EEPROM"
        LV_SWT_VMAX_ENA = 0;
        exit with Error Code SWT_RC_UNKNOWN_ERROR
Endif(8)

/* Check if "individual_attr_type" is set to VIN short (FGN kurz) */
If(9) (LOC_VMAX_FSC.INDIVIDUAL_ATTR_TYPE == 1)
Then(9)          /*CHECK OK*/
Else(9)SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
        call "Store FSC Status in EEPROM"
        LV_SWT_VMAX_ENA = 0;
        exit with Error Code SWT_RC_UNKNOWN_ERROR
Endif(9)

/* Check if VIN is stored correct in ECU */
If(A) (kwp_io_vin[10..16] != 0x00,00,00,00,00,00,00)
Then(A)          /*CHECK OK*/
Else(A)SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/

```

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```


        call "Store FSC Status in EEPROM"
        LV_SWT_VMAX_ENA = 0;
        exit with Error Code SWT_RC_FGN_ACCESS_FAILURE
    Endif(A)

    /* Compare VIN FSC with VIN-ECU (VIN which is stored in Dataset) (kwp_io_vin[10..16])
*/
    If(B)      (LOC_VMAX_FSC.INDIVIDUAL_ATTR[0..6] ==
io_vin[NC_KWP_IO_VIN_2_LEN..NC_KWP_IO_VIN_2_LEN+6] )
    Then(B) /* Compare VIN-ECU (VIN which is stored in Dataset) with VIN CAS */
        If(C)      ( LC_SWT_CHK_VIN_CAS_ENA == 1 )
        Then(C) If(D)      ( VIN_CAN_NVMY_RD[0..6] ==
            kwp_io_vin[NC_KWP_IO_VIN_2_LEN..NC_KWP_IO_VIN_2_LEN+6]
        )
            Then(D) /*CHECK OK*/
            Else(D) exit with Error Code SWT_RC_FGN_CHECK_FAILURE
                SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
                call "Store FSC Status in EEPROM"
                LV_SWT_VMAX_ENA = 0;
            Endif(D)
            Else(C) /*CHECK OK*/
            Endif(C)
        Else(B) exit with Error CodeSWT_RC_FGN_CHECK_FAILURE
            SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
            call "Store FSC Status in EEPROM"
            LV_SWT_VMAX_ENA = 0;
        Endif(B)
        Copy sig in reverse order + lengthbyte:
        /* NC_XMAX_SIG_LEN 128 Byte */
        /* NC_SIZE_STREAM_FSC_LEN_BYTE 4 Byte */
        /* NC_XMAX_SIG_BUF_LEN = NC_XMAX_FSC_SIG_LEN +
* NC_SIZE_STREAM_FSC_LEN_BYTE */
        copy lengthbyte
        LOC_SWT_FSC_SIG_BUF[0]=32 /* 128 BYTE = 32X32BIT */
        LOC_SWT_FSC_SIG_BUF[1]=0
        LOC_SWT_FSC_SIG_BUF[2]=0
        LOC_SWT_FSC_SIG_BUF[3]=0
        /* reverse Signature*/
        FOR TMP_U8_CTR=0 to NC_XMAX_FSC_SIG_LEN-1; TMP_U8_CTR++ //128 byte
        LOC_SWT_FSC_SIG_BUF[NC_XMAX_SIG_BUF_LEN-1-TMP_U8_CTR]=
VMAX_FSC.SIGNATURE+TMP_U8_CTR
        ENDFOR
        STATE_SWT_CHK_FSC = 1; /* start signature check */
    Else(3) /*do nothing */
    Endif(3)

    If(4) (LV_SWT_FSC_PARSED == 0)
    Then(4)      STATE_SWT_CHK_FSC = 0
                exit with Error Code SWT_RC_UNKNOWN_ERROR
    Endif(4)

    If(A) ( STATE_SWT_CHK_FSC == 1)
    Then(A) /* Calculation is still in work */

```

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```

        exit with Error Code SWT_RC_CALC_STILL_IN_WORK
    Else If(A) ( STATE_SWT_CHK_FSC == 2)
    Then(A) /* Calculation is still in work */
        exit with Error Code SWT_RC_CALC_STILL_IN_WORK
    Else If(A) ( STATE_SWT_CHK_FSC == 3)
    Then(A) /* SIGNATURE CHECK SUCCESFULL */
        SWT_FSC_XMAX_STATUS = 0x02 /*akzeptiert*/
        If(D) (SWT_FSC_XMAX_STATUS != LOC_VMAX_FSC.STATUS )
        Then(D) /* FSC status has changed -> store new status in EEPROM */
            call "Store FSC Status in EEPROM"
        Else(D) /*Nothing to store*/
        Endif(D)
        STATE_SWT_CHK_FSC == 0; /* reset state*/
        exit with Return Code SWT_RC_OK
    Else If(A) ( STATE_SWT_CHK_FSC == 4)
    Then(A) /* SIGNATURE CHECK FAILED */
        SWT_FSC_XMAX_STATUS = 0x03 /*abgelehnt*/
        If(E) (SWT_FSC_XMAX_STATUS!= LOC_VMAX_FSC.STATUS )
        Then(E) /* FSC status has changed -> store new status in EEPROM */
            call "Store FSC Status in EEPROM"
        Else(E) /*Nothing to store*/
        Endif(E)
        STATE_SWT_CHK_FSC == 0; /* reset state*/
        exit with Error Code SWT_RC_SIG_CHECK_FAILURE
    Else(A) /* STATE NOT POSSIBLE */
        STATE_SWT_CHK_FSC == 0; /* reset state*/
        exit with Error Code SWT_RC_UNKNOWN_ERROR
    Endif(A)
Else(1) exit with Error Code SWT_RC_NOT_AUTHENTICATED
Endif(1)

```

#### Subroutine: Specific checks für PMAX

```

If(1) (LV_AUTH_L3_ENA or (LV_SWT_CHK_FSC_ENA)) /*Level3 Authentication*/
Then(1) /* Read FSC from EEPROM */
If(3) ( STATE_SWT_CHK_FSC == 0)
Then(3) /* Start FSC Header Check*/
    If(4) (LV_FSC_XMAX_RD_OK)
    Then(4) /* FSC is restored correct from EEPROM */
        Call general parser for PMAX;
    Else(4) exit with Error Code SWT_RC_FLASH_READ_ERROR
    Endif(4)
    /* Check if FSC is valid and stored in EEPROM */
    If(7) (LOC_PMAX_FSC.STATUS == 0X00) /*nicht vorhanden*/
    Then(7)/* No FSC is stored in EEPROM */
        SWT_FSC_XMAX_STATUS = 0x00 /*nicht vorhanden*/
        exit with Error Code SWT_RC_FSC_NOT_EXISTENT
    Else If(7) (LOC_PMAX_FSC.STATUS = 0X01 /*eingespielt*/
    Then(7) /*CHECK OK*/
        SWT_FSC_XMAX_STATUS = 0x01 /*eingespielt*/
    Else If(7) LOC_PMAX_FSC.STATUS = 0X02 /*akzeptiert*/
    Then(7)/*CHECK OK*/

```



```

        SWT_FSC_XMAX_STATUS = 0x02 /*akzeptiert*/
Else If(7) (LOC_PMAX_FSC.STATUS == 0X03) /*abgelehnt*/
Then(7)/* FSC is rejected */
        SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
        If(8)          (LC_SWT_CHK_FSC_STATUS_DENIED_ENA == 1)
        Then(8)   exit with Error Code SWT_RC_FSC_REJECTED
        Else(8)   /* check also FSC in status denied */
        Endif(8)
Else If(7) (LOC_PMAX_FSC.STATUS == 0X04) /*storniert*/
Then(7)/* FSC is cancelled */
        SWT_FSC_XMAX_STATUS = 0x04 /*storniert*/
        exit with Error Code SWT_RC_FSC_CANCELLED
Else(7)      /* invalid FSC */
        SWT_FSC_XMAX_STATUS = 0x00 /*nicht vorhanden*/
        exit with Error Code SWT_RC_UNKNOWN_ERROR
Endif(7)


/* check if SWID inside FSC which is stored in EEPROM is correct*/
If(5)      (LOC_PMAX_FSC.SWID == Swid definition Pmax)
Then(5)   /*CHECK OK*/
Else(5)SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
        call "Store FSC Status in EEPROM"
        LV_SWT_PMAX_ENA = 0;
        exit with Error Code SWT_RC_SWID_CHECK_FAILURE
Endif(5)

/* Check if Requester-Type is correct */
If(8) (LOC_PMAX_FSC.REQUESTER_TYPE == 1 OR LOC_PMAX_FSC.REQUESTER_
TYPE == 2)
Then(8)      /*CHECK OK*/
Else(8)SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
        call "Store FSC Status in EEPROM"
        LV_SWT_PMAX_ENA = 0;
        exit with Error Code SWT_RC_UNKNOWN_ERROR
Endif(8)

/* Check if "individual_attr_type" is set to VIN short (FGN kurz) */
If(9) (LOC_PMAX_FSC.INDIVIDUAL_ATTR_TYPE == 1)
Then(9)      /*CHECK OK*/
Else(9)SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
        call "Store FSC Status in EEPROM"
        LV_SWT_PMAX_ENA = 0;
        exit with Error Code SWT_RC_UNKNOWN_ERROR
Endif(9)

/* Check if VIN is stored correct in ECU */
If(A) (kwp_io_vin[10..16] != 0x00,00,00,00,00,00,00)
Then(A)      /*CHECK OK*/
Else(A)SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
        call "Store FSC Status in EEPROM"
        LV_SWT_PMAX_ENA = 0;
        exit with Error Code SWT_RC_FGN_ACCESS_FAILURE

```

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```


Endif(A)

/* Compare VIN FSC with VIN-ECU (VIN which is stored in Dataset) (kwp_io_vin[10..16])
*/
If(B) (LOC_PMAX_FSC.INDIVIDUAL_ATTR[0..6] ==
io_vin[NC_KWP_IO_VIN_2_LEN..NC_KWP_IO_VIN_2_LEN+6] )
Then(B) /* Compare VIN-ECU (VIN which is stored in Dataset) with VIN CAS */
If(C) ( LC_SWT_CHK_VIN_CAS_ENA == 1 )
Then(C) If(D) ( VIN_CAN_NVMY_RD[0..6] ==
kwp_io_vin[NC_KWP_IO_VIN_2_LEN..NC_KWP_IO_VIN_2_LEN+6]
)
Then(D) /*CHECK OK*/
Else(D) exit with Error Code SWT_RC_FGN_CHECK_FAILURE
SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
call "Store FSC Status in EEPROM"
LV_SWT_PMAX_ENA = 0;
Endif(D)
Else(C) /*CHECK OK*/
Endif(C)
Else(B) exit with Error CodeSWT_RC_FGN_CHECK_FAILURE
SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
call "Store FSC Status in EEPROM"
LV_SWT_PMAX_ENA = 0;
Endif(B)
Copy sig in reverse order + lengthbyte:
/* NC_XMAX_SIG_LEN 128 Byte */
/* NC_SIZE_STREAM_FSC_LEN_BYTE 4 Byte */
/* NC_XMAX_SIG_BUF_LEN = NC_XMAX_FSC_SIG_LEN +
* NC_SIZE_STREAM_FSC_LEN_BYTE */
copy lengthbyte
LOC_SWT_FSC_SIG_BUF[0]=32 /* 128 BYTE = 32X32BIT */
LOC_SWT_FSC_SIG_BUF[1]=0
LOC_SWT_FSC_SIG_BUF[2]=0
LOC_SWT_FSC_SIG_BUF[3]=0
/* reverse Signature*/
FOR TMP_U8_CTR=0 to NC_XMAX_FSC_SIG_LEN-1; TMP_U8_CTR++ //128 byte
LOC_SWT_FSC_SIG_BUF[NC_XMAX_SIG_BUF_LEN-1-TMP_U8_CTR] =
PMAX_FSC.SIGNATURE+TMP_U8_CTR
ENDFOR
STATE_SWT_CHK_FSC = 1; /* start signature check */
Else(3) /*do nothing */
Endif(3)

If(4) (LV_SWT_FSC_PARSED == 0)
Then(4) STATE_SWT_CHK_FSC = 0
exit with Error Code SWT_RC_UNKNOWN_ERROR
Endif(4)

If(A) ( STATE_SWT_CHK_FSC == 1)
Then(A) /* Calculation is still in work */
exit with Error Code SWT_RC_CALC_STILL_IN_WORK
Else If(A) ( STATE_SWT_CHK_FSC == 2)
Then(A) /* Calculation is still in work */

```

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```

                exit with Error Code SWT_RC_CALC_STILL_IN_WORK
Else If(A) ( STATE_SWT_CHK_FSC == 3)
Then(A) /* SIGNATURE CHECK SUCCESFULL */
    SWT_FSC_XMAX_STATUS = 0x02 /*akzeptiert*/
    If(D) (SWT_FSC_XMAX_STATUS!= LOC_PMAX_FSC.STATUS )
    Then(D) /* FSC status has changed -> store new status in EEPROM */
        call "Store FSC Status in EEPROM"
    Else(D) /*Nothing to store*/
    Endif(D)
    STATE_SWT_CHK_FSC == 0; /* reset state*/
    exit with Return Code SWT_RC_OK
Else If(A) ( STATE_SWT_CHK_FSC == 4)
Then(A) /* SIGNATURE CHECK FAILED */
    SWT_FSC_XMAX_STATUS = 0x03 /*abgelehnt*/
    If(E) (SWT_FSC_XMAX_STATUS!= LOC_PMAX_FSC.STATUS )
    Then(E) /* FSC status has changed -> store new status in EEPROM */
        call "Store FSC Status in EEPROM"
    Else(E) /*Nothing to store*/
    Endif(E)
    STATE_SWT_CHK_FSC == 0; /* reset state*/
    exit with Error Code SWT_RC_SIG_CHECK_FAILURE
Else(A) /* STATE NOT POSSIBLE */
    STATE_SWT_CHK_FSC == 0; /* reset state*/
    exit with Error Code SWT_RC_UNKNOWN_ERROR
Endif(A)
Else(1) exit with Error Code SWT_RC_NOT_AUTHENTICATED
Endif(1)

```

## FUNCTION\_FOR\_SIGNATUR\_CHECK

Recurrence: 5 ms  
 Activation: every ECU state  
 Deactivation: NC\_SWT\_MOD: No VMAX and No PMAX functionality

### General Information:

This Function is checking the FSC signature  
 Base for CR\_A\_NewAaMExp is the signature from the FSC (last 128byte of FSC)  
 The result is compared with the MD5-hashed FSC, excluded signature.


**Attention:** The Cryptofunction "CR\_A\_NewAaMExp" is used over a long time (ms), during this time it is not allowed to called this function a second time (e.g. for DH-KF-Calculation). At the moment there is no locking mechanism implemented, because projects with DH-KF-Calculation are not using VMAX, PMAX).

### Formula section:

```

If(1) (( STATE_SWT_CHK_FSC == 1 || STATE_SWT_CHK_FSC == 2 )
    & & LV_SWT_FSC_PARSED ==1)
Then(1) If(2) ( STATE_SWT_CHK_FSC == 1)
    Then(2) /* First calculation: Calculatate MD5 of FSC-data */

```


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```

CR_C_md5init( );
If(3) NC_SWT_MOD defined for Vmax only
CR_C_md5hash(
(u16 *) 0,
(u8 *) LOC_VMAX_FSC.VERSION, /* set Pointer to start of FSC */
(u32) (LOC_VMAX_FSC.SIZE - 128), /*FSC-data length:(e.g. 60 or 63 Byte)*/
(s8 *) 0 );
Else If(3)NC_SWT_MOD defined for Pmax + opt. Vmax
CR_C_md5hash(
(u16 *) 0,
(u8 *) LOC_PMAX_FSC.VERSION, /* set Pointer to start of FSC */
(u32) (LOC_PMAX_FSC.SIZE - 128), /*FSC-data length:(e.g. 60 or 63 Byte)*/
(s8 *) 0 );
Else(3) /* should not be reached */
Endif(3)
CR_C_md5end( (u8 *)&TMP_U8_FSC_HASH_MD5[0] ) /*MD5 Result */
SWT_CALC_CYCLE_COUNT = 6;
STATE_SWT_CHK_FSC = 2;
/* Initialize Cryptofunction returncode */
TMP_S8_CR_C_RC = CR_C_RC_NF; /* initialize tmp_s8_cr_c_rc */
Else If(2) ( STATE_SWT_CHK_FSC == 2)
Then(2)
If(3) (LV_ES == 0)
Then(3) /*Engine is Running*/
SWT_CALC_CYCLE_COUNT = 1;
Else(3)
SWT_CALC_CYCLE_COUNT = 6;
End If(3)

/* Second calculation: Calculate "MOD EXP" of FSC-signature */
If(4) (TMP_S8_CR_C_RC == CR_C_RC_NF)
Then(4)
TMP_S8_CR_C_RC = CR_A_NewAaMExp(
SWT_CALC_CYCLE_COUNT, /* CycleCount intr. */
LOC_SWT_FSC_SIG_BUF, /* Basis: swt_getSignaturOffset() */
E_SIG_VMAX, /* Exponent: (given by BMW) */
TMP_U32_FSC_CHK, /* Result: */
N_SIG_VMAX, /* Modulus: (given by BMW) */
SWT_CRYPT_SIG_BUFFER, /* Buffer */
SWT_PSTATE[CR_DEF_AA_MEXP_STATESIZE_TOTAL] /*Actual State */
);
Else(4)
If(5) (TMP_S8_CR_C_RC == CR_C_RC_OK )
Then(5)
Compare result of first calculation with result of second calculation:
If(6) (TMP_U8_FSC_HASH_MD5[15...0] !=
U32_FSC_CHK(u32) [0...3]
(byte[0...15])(+1 u32 offset, excluding length information) )
Then(6) STATE_SWT_CHK_FSC = 4; /*Signature is not valid*/
LV_SWT_VMAX_ENA = 0;
LV_SWT_PMAX_ENA = 0;
Else(6) STATE_SWT_CHK_FSC = 3; /*Signature is valid*/
If(7) NC_SWT_MOD defined for Vmax only

```

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```

                Then(7) LV_SWT_VMAX_ENA = 1;
            Else If(7) NC_SWT_MOD defined for Pmax + opt. Vmax
                Then(7)
                    4D8 project: LV_SWT_PMAX_ENA = 1;
                    All other projects (default):
                If(8) Upgrade Index of SWID = 0x01
                    LV_SWT_VMAX_ENA = 0
                Else
                    If(9) Upgrade Index of SWID = 0x02
                        LV_SWT_VMAX_ENA = 1
                    Else(9) LV_SWT_PMAX_ENA = 0
                        LV_SWT_VMAX_ENA = 0
                Endif(7)
            Endif(6)
        Else(5) /* Calculation is still in work */
            Endif(5)
        Endif(4)
    Else(2) /* not possible*/
        Endif(2)
Else(1) /* do nothing */
Endif(1)

```

SWT\_PMAX\_ENA = 1

LV\_SWT\_PMAX\_ENA = 1

**ACTION\_SWT\_GetSoftwareIdFunc(OUT<u8ptr NUMBER\_OF\_SWID>, OUT<SWID>, OUT<SWT Returncode>)**

Deactivation: NC\_SWT\_MOD: No VMAX and No PMAX functionality

**General Information:**

This action returns all defined SWID's (except IMOB SWID).

**Formula section:**

NUMBER\_OF\_SWID = 0x00;

```

If(1) NC_SWT_MOD defined for Vmax only
Then(1)
    NUMBER_OF_SWID = NUMBER_OF_SWID +1;
    SWID= SWID_VMAX_DME1
    Prepare Outbuffer for next SWID
    return code SWT_RC_OK Else(1)
Endif(1)

```

```

If(2) ) NC_SWT_MOD defined for Pmax + opt. Vmax
Then(2)
    NUMBER_OF_SWID = NUMBER_OF_SWID +1;
    SWID= SWID_PMAX_DME1

```

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*Prepare Outbuffer for next SWID*  
*return code SWT\_RC\_OK***Else(2)** *return code SWT\_RC\_UNKNOWN\_ERROR***Endif(2)**

**ACTION\_SWT\_GetStatus(IN<32bit SWID>, OUT<u8ptr STATUS>, OUT<SWT Returncode>)**

Deactivation: NC\_SWT\_MOD: No VMAX and No PMAX functionality

**General Information:**

This action returns the "STATUS" of the selected FSC-SWID.

**Formula section:**

**If(1)** (SWID == Swid definition for Vmax only **and** NC\_SWT\_MOD defined for Vmax only ) **OR**  
(SWID == Swid definition Pmax **and** NC\_SWT\_MOD defined for Pmax + opt. Vmax )

**Then(1)** **If(2)** (LV\_FSC\_XMAX\_RD\_OK)  
    **Then(2)** /\* FSC is restored correct from EEPROM \*/  
        **If(3)** SWID == Swid definition for Vmax only  
            **Then(3)** **Call general parser for VMAX (EEPROM);**  
                STATUS = LOC\_VMAX\_FSC.STATUS;  
                *exit with Return Code SWT\_RC\_OK*  
            **Else If(3)** SWID == Swid definition Pmax  
                **Then(3)** **Call general parser for PMAX (EEPROM);**  
                    STATUS = LOC\_PMAX\_FSC.STATUS;  
                    *exit with Return Code SWT\_RC\_OK*  
                **Else(3)** /\* should not be reached\*/  
    **Endif(3)**  
  
    **Else(2)** /\*BMW: instead of Flash Read ERROR UNKOWN ERROR must send back \*/  
        *exit with Error Code SWT\_RC\_UNKNOWN\_ERROR*  
    **Endif(2)**  
**Else(1)** *exit with Error Code SWT\_RC\_SW\_NOT\_EXISTENT*  
**Endif(1)**

**ACTION\_SWT\_DisableFsc(IN<32bit SWID>, OUT<SWT Returncode>)**

Deactivation: NC\_SWT\_MOD: No VMAX and No PMAX functionality

**General Information:**


This action is disabling the selected FSC-SWID

**Formula section:**

TMP\_STATUS = 0

**If(1)** (SWID == Swid definition for Vmax only **and** NC\_SWT\_MOD defined for Vmax only ) **OR**

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(SWID == Swid definition Pmax **and** NC\_SWT\_MOD defined for Pmax + opt. Vmax )

```

Then(1) If(2)      (LV_AUTH_L3_ENA)      /*Level3 Authentication*/
  Then(2) If(3)    (LV_FSC_XMAX_RD_OK)
    Then(3) /* FSC is restored correct from EEPROM */
      If(4) SWID == Swid definition for Vmax only DME1
        Then(4) Call general parser for VMAX (EEPROM);
          TMP_STATUS = LOC_VMAX_FSC.STATUS;
        Else If(4)SWID == Swid definition Pmax
          Then(4) Call general parser for PMAX (EEPROM);
            TMP_STATUS = LOC_PMAX_FSC.STATUS;
          Else(4) exit with Error Code SWT_RC_UNKOWN_ERROR
        Endif(4)
        If(5)      (TMP_STATUS == 0)
          Then(5) exit with Error Code SWT_RC_FSC_NOT_EXISTENT
          Else If(5) (TMP_STATUS == 4)
            Then(5) exit with Error Code SWT_RC_FSC_CANCELLED
          Else If(5) (TMP_STATUS == 1 OR TMP_STATUS == 2 OR
                            TMP_STATUS == 3 )
            Then(5)
              FSC_XMAX_WR[0..199] = FSC_XMAX_RD[0.199]
              FSC_XMAX_WR[2] = 4;
              /*store FSC with new status in EEPROM */
              ACTION_SWT_WrNvmyFscXMAX( )
              SWT_FSC_XMAX_STATUS = 0x04 /* canceled */
              LV_SWT_VMAX_ENA = 0; /* deactivate VMAX_ENA */
              LV_SWT_PMAX_ENA = 0; /* deactivate PMAX_ENA */
              exit with Return Code SWT_RC_OK
            Else(5) exit with Error Code SWT_RC_UNKNOWN_ERROR
          Endif(5)
        Else(3)      exit with Error Code SWT_RC_FLASH_READ_ERROR
      Endif(3)
    Else(2)      exit with Error Code  SWT_RC_NOT_AUTHENTICATED
  Endif(2)
Else(1) exit with Error Code  SWT_RC_SW_NOT_EXISTENT
Endif(1)

```

**ACTION\_SWT\_GetFscLen(IN<32bit SWID>, OUT<u8ptr LENGTH>, OUT<SWT Returncode>)**

Deactivation: NC\_SWT\_MOD: No VMAX and No PMAX functionality

**General Information:**


This action returns the "SIZE" of the selected FSC-SWID.

**Formula section:**

**If(1) (SWID == Swid definition for Vmax only **and** NC\_SWT\_MOD defined for Vmax only ) OR**  
**(SWID == Swid definition Pmax **and** NC\_SWT\_MOD defined for Pmax + opt. Vmax )**

**Then(1) /\* Read FSC from EEPROM \*/**  
**If(2) (LV\_FSC\_XMAX\_RD\_OK)**

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```

Then(2) /* FSC is restored correct from EEPROM */
    TMP_U8_CTR = 0
If(4) SWID == Swid definition for Vmax only
    Then(4) LOC_VMAX_FSC.SIZE =(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
        If(5) (LOC_VMAX_FSC.SIZE != 0)
            Then(5) LENGTH =LOC_VMAX_FSC.SIZE
                exit with Return Code SWT_RC_OK
            Else(5) exit with Error Code SWT_RC_FSC_NOT_EXISTENT
            Endif(5)
        Else If(4)SWID == Swid definition Pmax
            Then(4)
                LOC_PMAX_FSC.SIZE =(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
                If(5) (LOC_PMAX_FSC.SIZE != 0)
                    Then(5) LENGTH =LOC_PMAX_FSC.SIZE
                        exit with Return Code SWT_RC_OK
                    Else(5) exit with Error Code SWT_RC_FSC_NOT_EXISTENT
                    Endif(5)
                Else(4) exit with Error Code SWT_RC_UNKOWN_ERROR
                Endif(4)
            Else(2) exit with Error Code SWT_RC_FLASH_READ_ERROR
        Endif(2)
Else(1) exit with Error Code SWT_RC_SW_NOT_EXISTENT
Endif(1)
    
```

**ACTION\_SWT\_GetFsc(IN<32bit SWID>, OUT<u8ptr FSC>, OUT<SWT Returncode>)**

Deactivation: NC\_SWT\_MOD: No VMAX and No PMAX functionality

**General Information:**

This action returns the "FSC" of the selected FSC-SWID.


**Formula section:**

**If(1)** (SWID == Swid definition for Vmax only **and** NC\_SWT\_MOD defined for Vmax only ) **OR**  
(SWID == Swid definition Pmax **and** NC\_SWT\_MOD defined for Pmax + opt. Vmax )

```

Then(1) /* Read FSC from EEPROM */
If(2) (LV_FSC_XMAX_RD_OK)
Then(2) /* FSC is restored correct from EEPROM */
If(3) SWID == Swid definition for Vmax only
    Then(3) Call general parser for VMAX (EEPROM);
        If(4) (LOC_VMAX_FSC.SIZE != 0)
            Then(4) FSC[0..196] = FSC_XMAX_RD[4..200]
                exit with Return Code SWT_RC_OK
            Else(4) exit with Error Code SWT_RC_FSC_NOT_EXISTENT
            Endif(4)
        Else If(3)SWID == Swid definition Pmax
            Then(3) Call general parser for PMAX (EEPROM);
                If(4) (LOC_PMAX_FSC.SIZE != 0)
                    Then(4) FSC[0..196] = FSC_XMAX_RD[4..200]
                
```

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```

                exit with Return Code SWT_RC_OK
            Else(4)      exit with Error Code SWT_RC_FSC_NOT_EXISTENT
            Endif(4)
        Else(3) exit with Error Code SWT_RC_UNKOWN_ERROR
        Endif(3)

    Else(2)      exit with Error Code SWT_RC_FLASH_READ_ERROR
    Endif(2)
Else(1) exit with Error Code  SWT_RC_SW_NOT_EXISTENT
Endif(1)

```

**ACTION\_SWT\_GetVin(OUT<u8ptr VIN>, OUT<SWT Returncode>)**

Deactivation: NC\_SWT\_MOD: No VMAX and No PMAX functionality

**General Information:**

This action returns the "VIN" of the ECU  
It doesn't matter if VIN is stored correct in ECU. This will not be checked here.  
If VIN is 0x00,00,00,00,00,00,00,00 this value must be send back.

**Formula section:**

```

VIN = kwp_io_vin[10..16];
exit with Return Code SWT_RC_OK

```

**ACTION\_SWT\_SetVin(IN<u8ptr VIN>, OUT<SWT Returncode>)**

Deactivation: NC\_SWT\_MOD: No VMAX and No PMAX functionality

**General Information:**

This action is simulating the storage of a new "VIN" into the ECU  
It doesn't matter if VIN is stored correct in ECU. This will not be checked here.

**Formula section:**


```

If(1)      (LV_AUTH_L3_ENA)      /* Level3 Authentication */
Then(1)
    If(2)      (VIN == kwp_io_vin[10..16])
    Then(2) /*CHECK OK*/
        exit with Return Code SWT_RC_OK
    Else(2) exit with Error Code SWT_RC_FLASH_WRITE_ERROR
    Endif(2)

```

Else(1) exit with Error Code SWT\_RC\_NOT\_AUTHENTICATED

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## Endif(1)

### PERIODICAL\_SIGNATUR\_CHECK VMAX:

Recurrence: 5 ms  
Activation: every ECU state  
Deactivation: NC\_SWT\_MOD: No VMAX functionality

#### General Information:

This Function is starting the FSC signature check one time after reset

#### Formula section:

```
If(1)      (!LV_SWT_CHK_VMAX_FINISHED)
Then(1)
LV_SWT_CHK_FSC_ENA = 1; /* enable CHK_FSC without L3 authentication */
TMP_U8 = ACTION_SWT_ChkFsc(SWID_VMAX_DME1)
    If(2)      (TMP_U8 == SWT_RC_CALC_STILL_IN_WORK)
    Then(2) /* Calculation is still in work */
    Else(2) LV_SWT_CHK_VMAX_FINISHED == 1;
            LV_SWT_CHK_FSC_ENA = 0; /* disable CHK_FSC without L3 authentication */
    Endif(2)
Endif(1)
```

### PERIODICAL\_SIGNATUR\_CHECK PMAX:

Recurrence: 5 ms  
Activation: every ECU state  
Deactivation: NC\_SWT\_MOD: No PMAX functionality

#### General Information:

This Function is starting the FSC signature check one time after reset

#### Formula section:

```
If(1)      (!LV_SWT_CHK_PMAX_FINISHED)
Then(1)
LV_SWT_CHK_FSC_ENA = 1; /* enable CHK_FSC without L3 authentication */
TMP_U8 = ACTION_SWT_ChkFsc(SWID_PMAX_DME1) /* hint: The SWID is different between the
projects (e.g. 4DC /4D8) */
    If(2)      (TMP_U8 == SWT_RC_CALC_STILL_IN_WORK)
    Then(2) /* Calculation is still in work */
    Else(2) LV_SWT_CHK_PMAX_FINISHED == 1;
            LV_SWT_CHK_FSC_ENA = 0; /* disable CHK_FSC without L3 authentication */
    Endif(2)
Endif(1)
```

### ACTION\_SWT\_WrNvmyFscXMAX( )

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**General Information:**

/\* This Action is only a locally defined function which is triggered by functioncall \*/

**Formula section:**

```

If(1)          (!LV_SWT_FSC_WR_IN_WORK)
Then(1)       Start EEPROM Storage
                LV_SWT_FSC_WR_IN_WORK = 1;
                LV_SWT_FSC_WR_FINISHED = 0;
Endif(1)

/* EEPROM Storage is finished when Callback-Function is called in anvmswt.c*/
If(2)          ("EEPROM Storage finished")
Then(2)       LV_SWT_FSC_WR_FINISHED = 1;
                LV_SWT_FSC_WR_IN_WORK = 0;
                If(3) ("Storage successfull")
                Then(3)          FSC_XMAX_RD[0..199] = FSC_XMAX_WR[0..199]
                                LV_FSC_XMAX_WR_OK = 1;
                                LV_FSC_XMAX_RD_OK = 1;
                Else(3)          LV_FSC_XMAX_WR_OK = 0;
                Endif(3)
Endif(2)
    
```

**ACTION\_SWT\_WrNvmyVIN\_CAN( )**

**General Information:**

/\* This Action is only a locally defined function which is triggered by functioncall \*/

**Formula section:**

```

If(1)          (!LV_SWT_VIN_CAN_WR_IN_WORK)
Then(1)       VIN_CAN_NVMY_WR[0..6] = VIN_CAN[0..6]
                Start EEPROM Storage
                LV_SWT_VIN_CAN_WR_IN_WORK = 1;
                LV_SWT_VIN_CAN_WR_FINISHED = 0;
Else(1)       /* nothing to do */
Endif(1)

/* EEPROM Storage is finished when Callback-Function is called in anvmswt.c*/
If(2)          ("EEPROM Storage finished")
Then(2)       LV_SWT_VIN_CAN_WR_FINISHED = 1;
                LV_SWT_VIN_CAN_WR_IN_WORK = 0;
                If(3) ("Storage successfull")
                Then(3)          VIN_CAN_NVMY_RD[0..6] = VIN_CAN_NVMY_WR[0..6]
                                LV_SWT_VIN_CAN_WR_OK = 1;
                                LV_SWT_VIN_CAN_RD_OK = 1;
                Else(3)          LV_SWT_VIN_CAN_WR_OK = 0;
                Endif(3)
Endif(2)
    
```

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## FUNCTION\_FOR\_VIN\_STORAGE

Recurrence: 100 ms  
 Activation: every ECU state  
 Deactivation: NC\_SWT\_MOD: No VMAX and No PMAX functionality

### General Information:

This Function is storing the VIN which is received from CAS into EEPROM


### Formula section:

```

If(1) ( VIN_CAN[0..6] != 0x00,00,00,00,00,00,00 )
Then(1)
    If(2) (VIN_CAN[0..6] != VIN_CAN_NVMY_RD[0..6])
    Then(2) /* store only changed VIN into CAN */
        If(3) ( !LV_LOCK_IMOB )
        Then(3) /* store only new VIN into EEPROM if IMOB is authenticated */
            ACTION_SWT_WrNvmyVIN_CAN( )
        Else(3) /* nothing to do */
        Endif(3)
    Else(2) /* nothing to do */
    Endif(2)
Else(1)
    Trigger CAS to send the VIN again:
    ACTION_INTC_NO_VECH_REQ( )
Endif(1)
    NC_SWT_MOD is now defined in 17106601.00x; ( x >= .00C)
    
```

# A - Diagnosis and Emergency Operation

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## A.1 Charge air temperature sensor diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TIA_TCHA_UP	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom TIA_TCHA_UP					
LV_CDN_DIAG_TIA_TCHA_UP	V	0... 1H	0 ...1	1	-
Diagnosis condition TIA_TCHA_UP					
LV_END_DIAG_TIA_TCHA_UP	O/V	0... 1H	0 ...1	1	-
End of Diagnosis cycle TIA_TCHA_UP					
LV_ERR_TIA_TCHA_UP	O/V	0... 1H	0 ...1	1	-
Electrical TIA_TCHA_UP error					

### Input data:

C_T_DLY_TIA_DIAG {p. 4195}	LV_IGK {p. 906}	LV_VAR_TCHA {p. 656}	NC_IDX_DIAG_TIA_TCHA_UP
T_AST_DIAG {p. 1766}	VP_TIA_TCHA {p. 1226}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TIA_TCHA_UP	-	0... FFH	0... 255	1	-
Anti bounce increment					
C_ABC_MAX_TIA_TCHA_UP	-	1... FFH	1... 255	1	-
Anti bounce maximum					
C_VP_TIA_TCHA_UP_MAX_DIAG	-	0... 7FFFH	0... 4.99984741	15.25879e3	V
TIA threshold for short to ground TIA_TCHA_UP diagnosis					
C_VP_TIA_TCHA_UP_MIN_DIAG	-	0... 7FFFH	0... 4.99984741	15.25879e3	V
TIA threshold for short to VB or line break TIA_TCHA_UP diagnosis					

### Import actions:

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>,OUT<LV_END_DIAG>)
<b>ACTION_ERRM_GetLvErr</b> (IN<IDX_DIAG>,OUT<LV_ERR>)

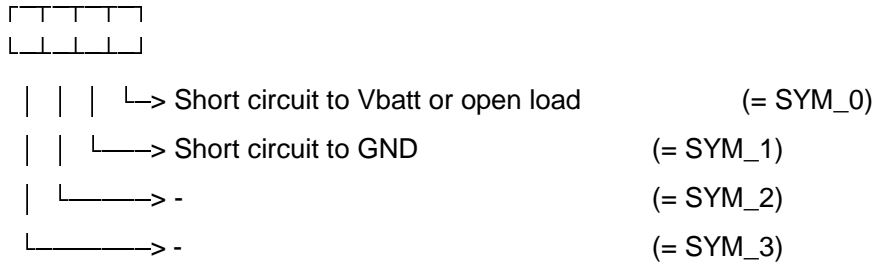
### Function Description

#### General information:

The purpose of the diagnosis shall be to detect electrical faults as defined by OBD I requirements. The input signal is analog from a NTC located at the Mass air flow meter.

#### Description:

Error symptoms are defined for this diagnosis function as:



**Function Description**

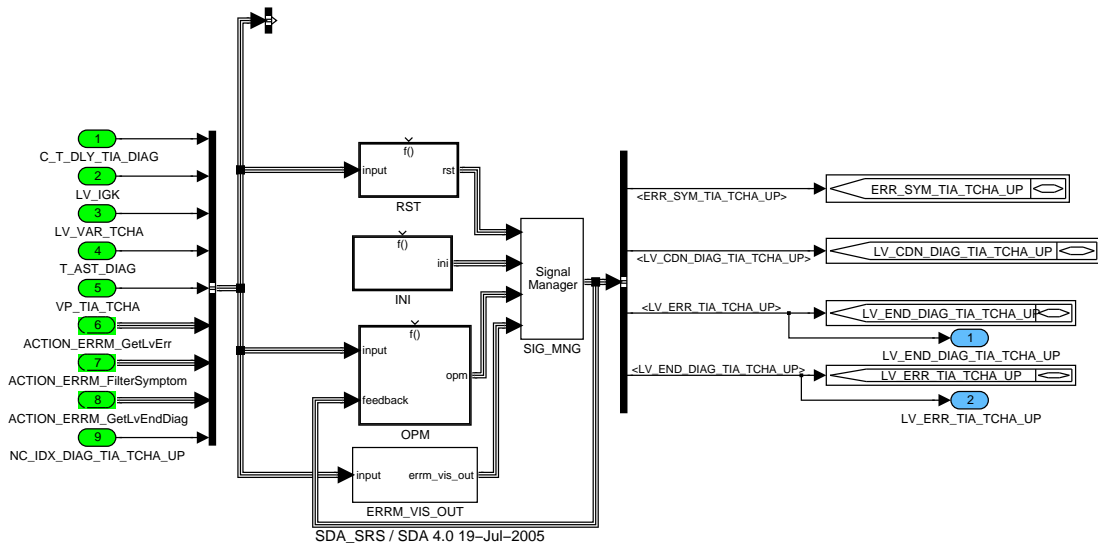


Figure A.1.1: AIRT\_MA0C8

**A.1.1 Initialisation at system event RESET and IGKON**

**Initialisation**

LV\_ERR\_TIA\_TCHA\_UP is initialised.

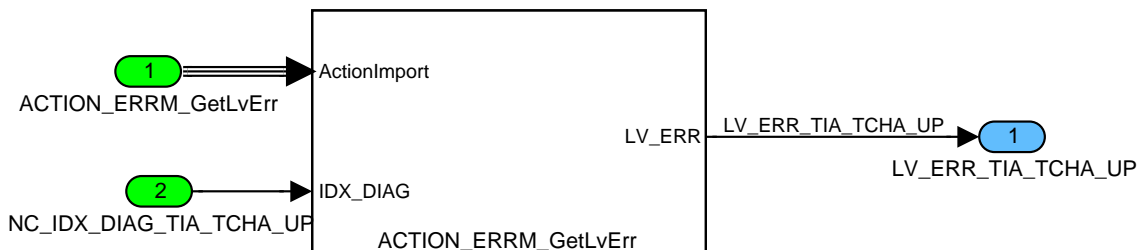


Figure A.1.2: AIRT\_MA0C8/RST/INI

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## A.1.2 At deactivation

At deactivation LV\_END\_DIAG\_TIA\_TCHA\_UP is initialised to 1.




Figure A.1.3: AIRT\_MA0C8/INI

## A.1.3 Formula section

### Diagnosis

Short circuit to ground , short circuit to Vbatt or open load are detected.

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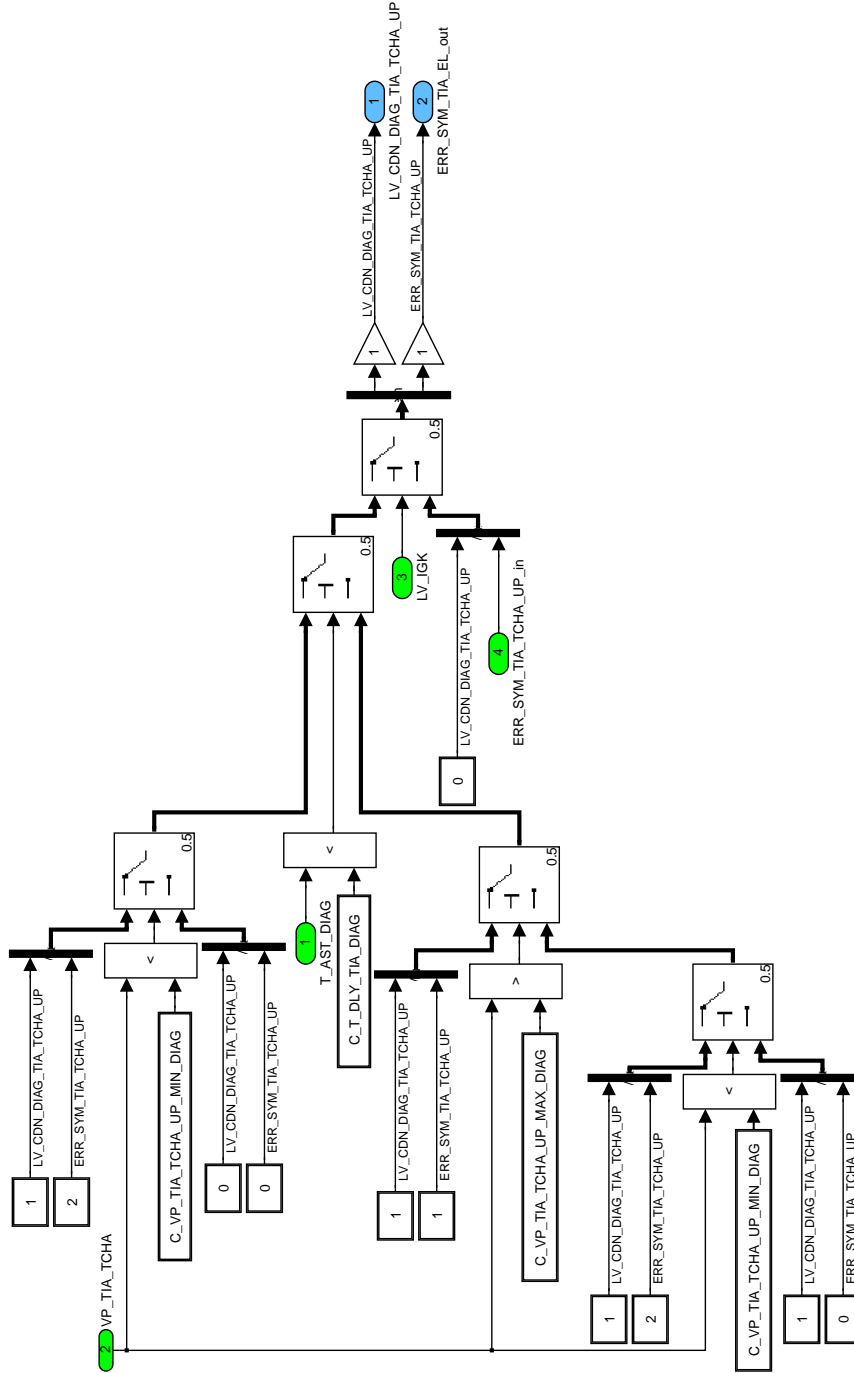



Figure A.1.4: AIRT\_MA0C8/OPM/DIAG

**ERRM interface**

Calculation of present error and end of diagnosis. LV\_ERR\_TIA\_TCHA\_UP and LV\_END\_DIAG\_TIA\_TCHA\_UP are calculated by error management.

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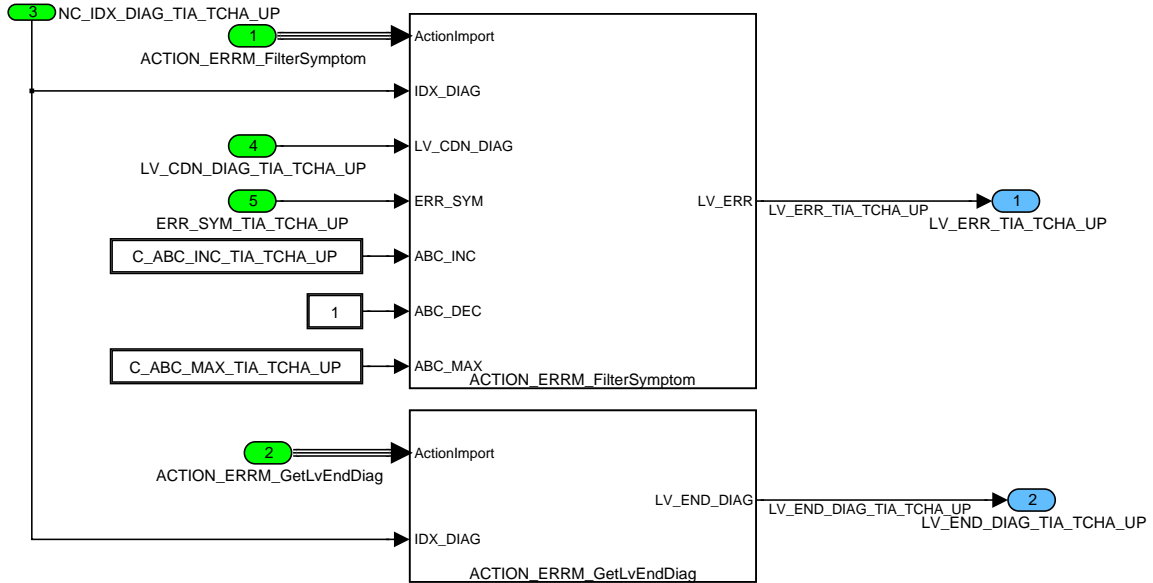


Figure A.1.5: AIRT\_MA0C8/OPM/ERRM\_IF

### A.1.4 Visual mode output calculation

#### Error symptom and condition calculation

ERR\_SYM\_TIA\_TCHA\_UP and LV\_CDN\_DIAG\_TIA\_TCHA\_UP are calculated by error management in visual mode.

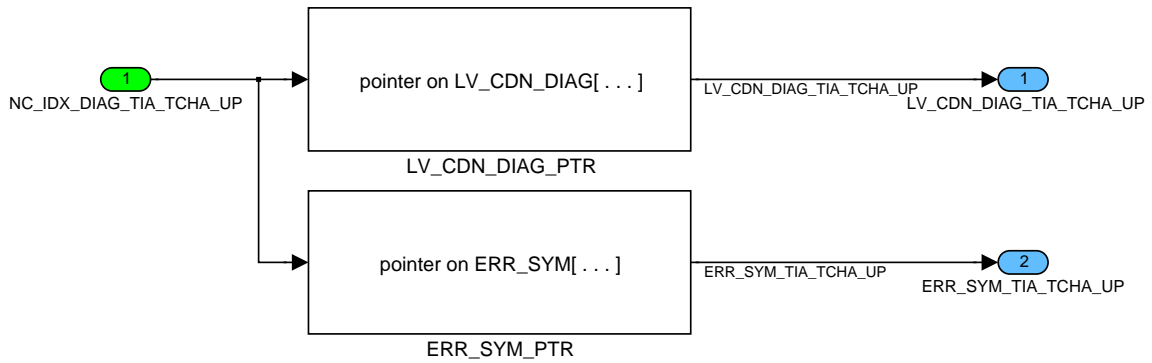


Figure A.1.6: AIRT\_MA0C8/ERRM\_VIS\_OUT/SUB\_CLC

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## A.2 Intake air temperature sensor diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TIA_EL	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom TIA_EL					
ERR_SYM_TIA_GRD	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom TIA gradient					
LV_CDN_DIAG_TIA_EL	O/V	0... 1H	0 ...1	1	-
Diagnosis condition TIA_EL					
LV_CDN_DIAG_TIA_GRD	O/V	0... 1H	0 ...1	1	-
Diagnosis condition TIA gradient					
LV_END_DIAG_TIA_EL	O/V	0... 1H	0 ...1	1	-
End of Diagnosis cycle TIA_EL					
LV_END_DIAG_TIA_GRD	O/V	0... 1H	0 ...1	1	-
End of Diagnosis cycle TIA_GRD					
LV_ERR_TIA_EL	O/V	0... 1H	0 ...1	1	-
Electrical TIA error					
LV_ERR_TIA_GRD	O/V	0... 1H	0 ...1	1	-
Boolean for intake air temperature signal gradient error					


### Input data:

LV_IGK {p. 906}	LV_INH_DIAG_TIA_EL {p. 4200}	LV_INH_DIAG_TIA_GRD {p. 4200}	NC_IDX_DIAG_TIA_EL
NC_IDX_DIAG_TIA_GRD	T_AST_DIAG {p. 1766}	TAM {p. 1579}	TCO {p. 1100}
TIA_MES {p. 1226}	VP_TIA {p. 1226}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_TIA_GRD	-	0... FFH	0... 255	1	-
Anti-bounce decrement					
C_ABC_INC_TIA_EL	-	0... FFH	0... 255	1	-
Anti-bounce increment					
C_ABC_INC_TIA_GRD	-	0... FFH	0... 255	1	-
Anti-bounce increment					
C_ABC_MAX_TIA_EL	-	1... FFH	1... 255	1	-
Anti-bounce maximum					
C_ABC_MAX_TIA_GRD	-	1... FFH	1... 255	1	-
Anti-bounce maximum					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DLY_TIA_DIAG	-	0... FFFFH	0... 32767.5	0.5	s
Delay time for diagnosis activation					
C_T_DLY_TIA_GRD	-	0... FFFFH	0... 32767.5	0.5	s
Delay time for intake air temperature gradient					
C_TIA_MAX_DIAG_GRD_1	-	0... FEH	0... 190.5	0.75	°C
Maximum intake temperature gradient for TIA diagnosis part 1					
C_TIA_MAX_DIAG_GRD_2	-	0... FEH	0... 190.5	0.75	°C
Maximum intake temperature gradient for TIA diagnosis part 2					
C_TIA_RNG_TCO_DIAG_H	-	0... FEH	-48... 142.5	0.75	°C
High range for the detection of engine at cold operating temperature					
C_TIA_RNG_TCO_DIAG_L	-	0... FEH	-48... 142.5	0.75	°C
Low range for the detection of engine at cold operating temperature					
C_TIA_RNG_TCO_DIAG_THD	-	0... FEH	-48... 142.5	0.75	°C
Threshold range for the detection of tuning manipulation					
C_VP_TIA_MAX_DIAG	-	0... 7FFFH	0... 4.99984741211	152.588e-6	V
upper threshold for range check of VP_TIA					
C_VP_TIA_MIN_DIAG	-	0... 7FFFH	0... 4.99984741211	152.588e-6	V
lower threshold for range check of VP_TIA					

### Import actions:

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>,OUT<LV_END_DIAG>)
<b>ACTION_ERRM_GetLvErr</b> (IN<IDX_DIAG>,OUT<LV_ERR>)

### General Information

#### General information:

The purpose of the diagnosis shall be to detect electrical faults as defined by OBD I requirements. The input signal is analog from a NTC.

#### Description:

Error symptoms are defined for this diagnosis function as:

- > Short circuit to Vbatt or open load (= SYM\_0)
- > Short circuit to GND (= SYM\_1)
- > - (= SYM\_2)
- > - (= SYM\_3)


### Application Conditions

Initialization: RST, IGKON

Recurrence: 100MS

Activation: always

Deactivation: never

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**Function description**

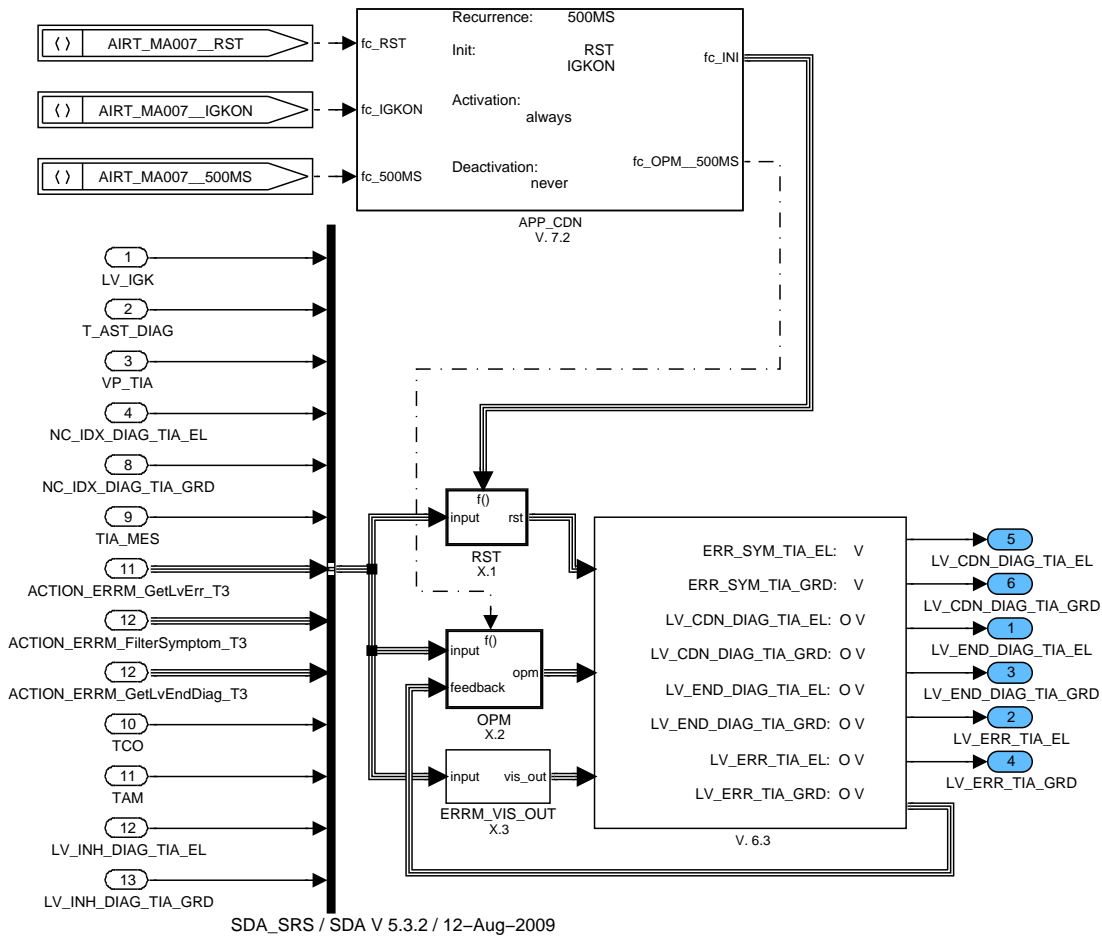


Figure A.2.1: :

**A.2.1 Reset**

**A.2.1.1 Calculation at reset**

All output data are according to ABC configuration "STD\_INI"

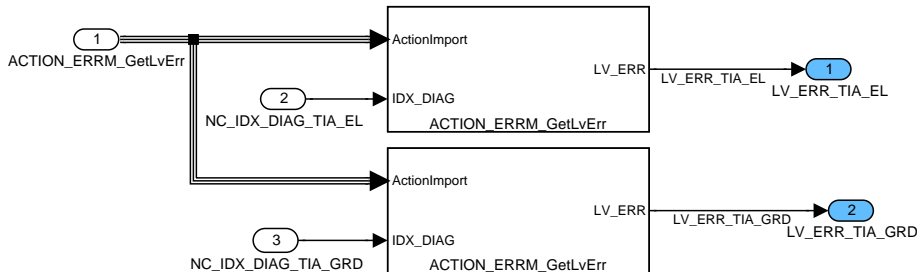


Figure A.2.2: :

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## A.2.2 Formula section

### A.2.2.1 Diagnosis

#### A.2.2.1.1 Electrical diagnosis

Short circuit to ground, short circuit to battery or open load can be detected

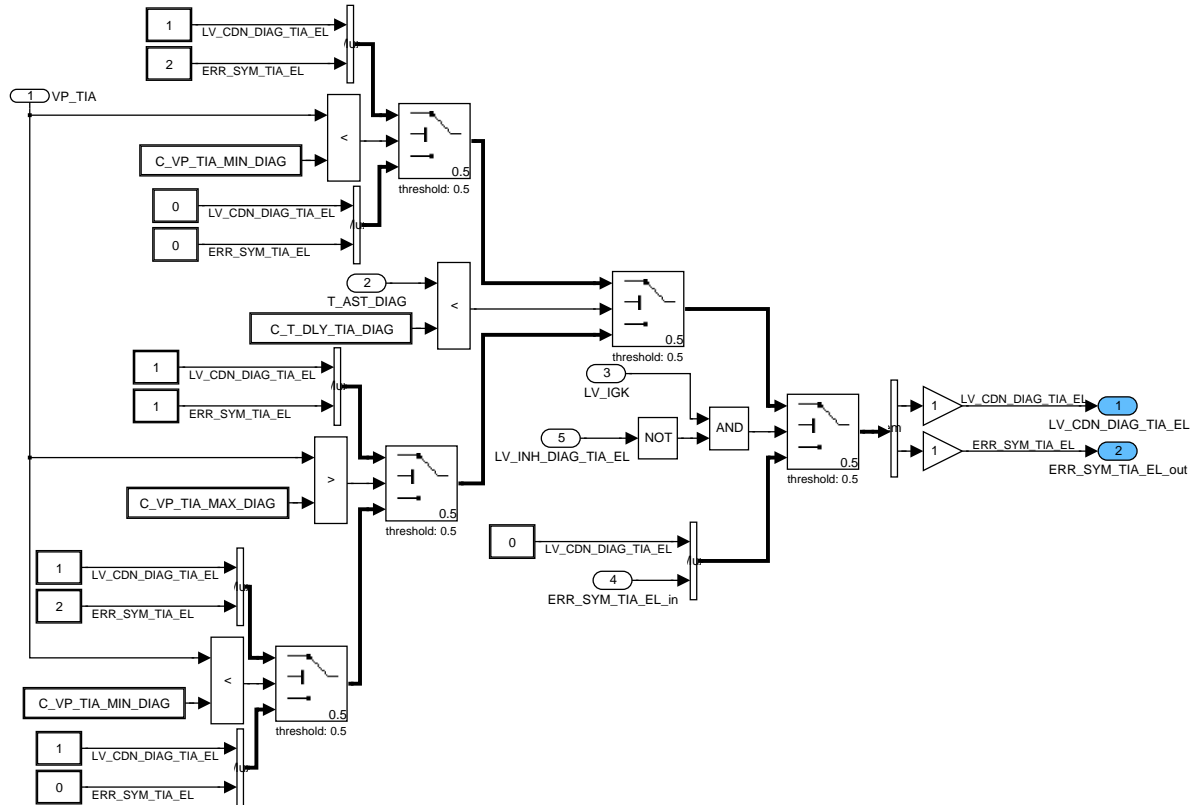


Figure A.2.3: :

#### A.2.2.1.2 Intake air temperature signal gradient diagnosis

The purpose of the signal gradient diagnosis is to detect a not plausible gradient on the intake air temperature signal. The monitoring is based on a comparison between the actual and the last intake air temperature value. The symptom of the error code is handled by anti-bouncing.

Error-symptoms are defined to this diagnosis function as following:

- > (= SYM\_0)
- > (= SYM\_1)
- > -Intake air temperature range check error (= SYM\_2)
- > -Intake air temperature signal gradient error (= SYM\_3)



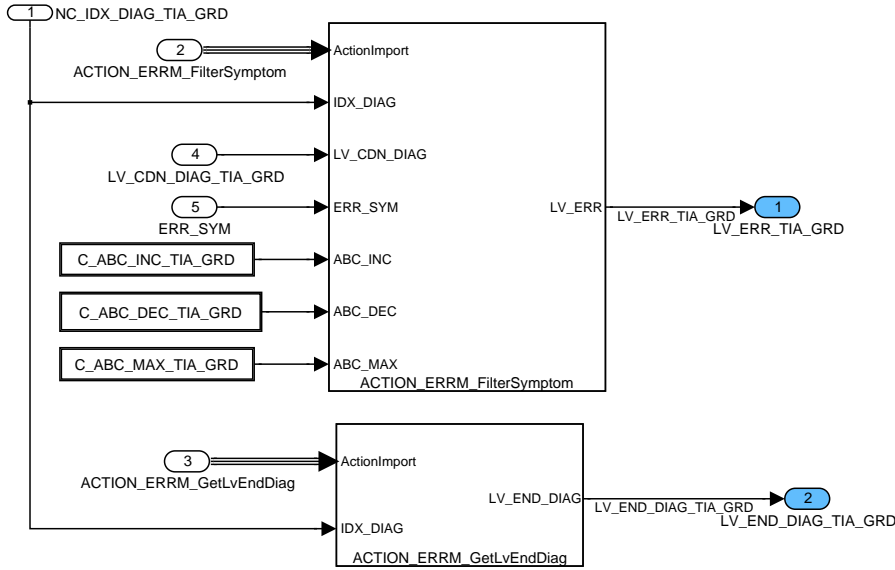


Figure A.2.6: :

### A.2.3 ERRM\_VIS\_OUT

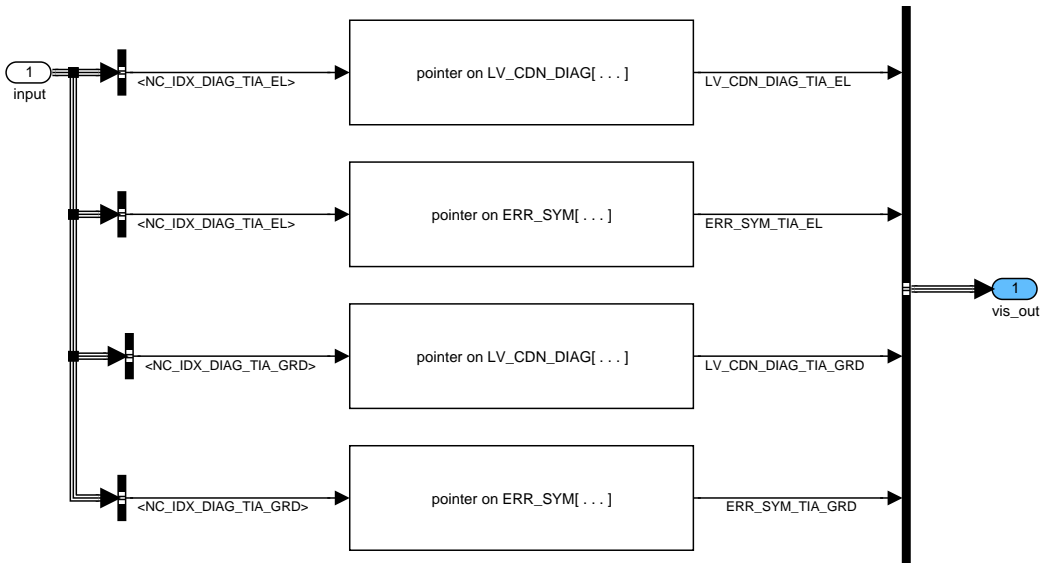


Figure A.2.7: :

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## A.3 Intake air temperature sensor diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_TIA	O/V	0... 1H	0 ...1	1	-
TIA error present					
LV_INH_DIAG_TIA_EL	O/V	0... 1H	0 ...1	1	-
Inhibition flag for the diagnosis of TIA_EL					
LV_INH_DIAG_TIA_GRD	O/V	0... 1H	0 ...1	1	-
Inhibition flag for the diagnosis of TIA_GRD					

### Input data:

LV_ERR_BN_T_ICL {p. 4870}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_COM_2_BOFF {p. 801}	LV_ERR_COM_2_TAM_ICL
LV_ERR_TAM_CAN {p. 5076}	LV_ERR_TAM_PLAUS {p. 5076}	LV_ERR_TCO_EL {p. 4496}	LV_ERR_TCO_GRD {p. 4496}
LV_ERR_TCO_PLAUS {p. 5682}	LV_ERR_TCO_STUCK {p. 5691}	LV_ERR_TCO_STUCK_RNG {p. 5675}	LV_ERR_TIA_EL {p. 4194}
LV_ERR_TIA_GRD {p. 4194}	LV_ERR_TIA_PLAUS {p. 5093}	LV_IGK {p. 906}	

### General information:

#### General information:

The global error flag LV\_ERR\_TIA can be used for inhibition. It is set if a electrical or a plausibility TIA error occur.

### Application conditions:

*Initialisation:* RST, CLRFRMY, IGKON  
*Recurrence:* 500MS  
*Activation:* LV\_IGK == 1  
*Deactivation:* never

### Function description:

### Formula section:



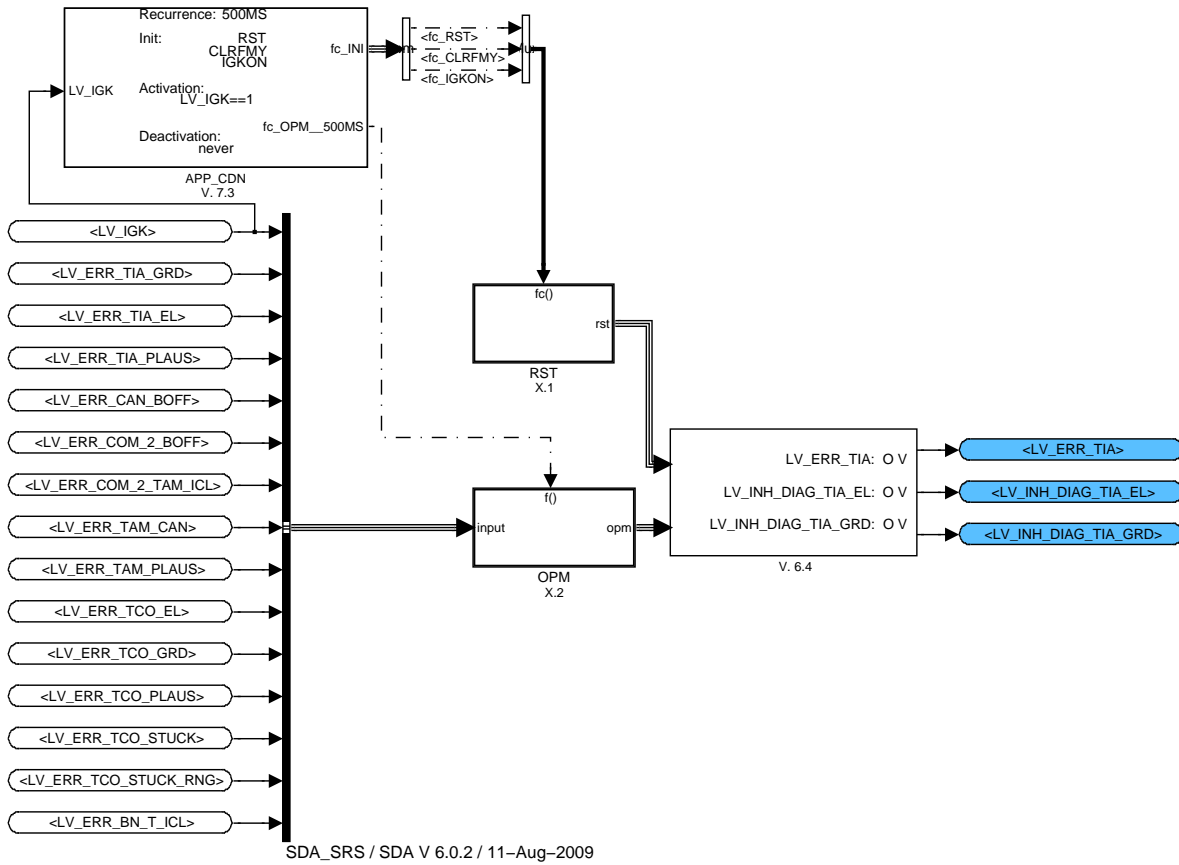


Figure A.3.1: :

### A.3.1 Initilisation of LV\_ERR\_TIA

LV\_ERR\_TIA is initialised to 0.

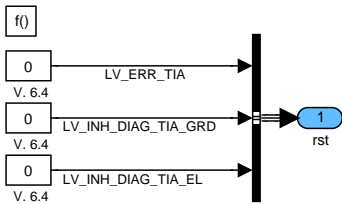


Figure A.3.2: :

### A.3.2 Formula Section

Output is calculated at 500ms recurrence.

#### A.3.2.1 Calculation of LV\_ERR\_TIA

If LV\_ERR\_TIA\_PLAUS or LV\_ERR\_TIA\_EL or LV\_ERR\_TIA\_GRD is set, then LV\_ERR\_TIA flag is set.

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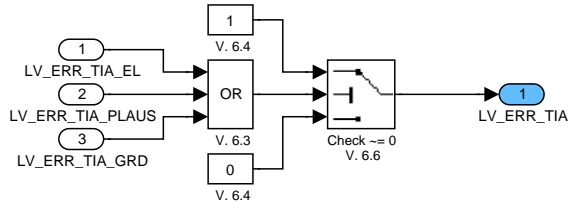


Figure A.3.3: :

### A.3.2.2 Calculation of LV\_INH\_DIAG\_TIA\_GRD

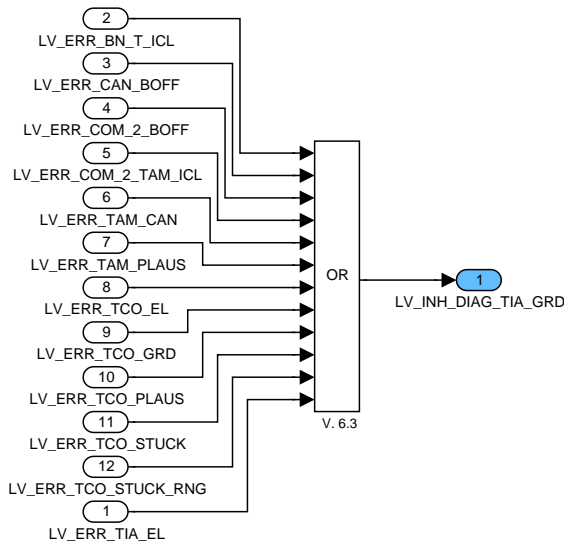


Figure A.3.4: :

### A.3.2.3 Calculation of LV\_INH\_DIAG\_TIA\_EL



Figure A.3.5: :

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## A.4 Recirculation flap diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_RFP_DR	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of RFP_DR bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
ERR_DIAG_RFP_DR	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for RFP_DR(only parameter)					
ERR_SYM_RFP_DR	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom recirculation flap driver					
LV_CDN_DIAG_RFP_DR	O/V	0... 1H	0 ...1	1	-
Diagnosis condition recirculation flap driver fullyfied					
LV_END_DIAG_RFP_DR	O/V	0... 1H	0 ...1	1	-
End of diagnosis recirculation flap driver reached					
LV_ERR_RFP_DR	O/V	0... 1H	0 ...1	1	-
recirculation flap driver error detected					
LV_INH_DIAG_RFP_DR	O/V	0... 1H	0 ...1	1	-
recirculation flap driver diagnosis inhibition activ					

### Input data:

LV_CDN_VB_OBD1 {p. 1185}	LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}	LV_VAR_TCHA {p. 656}
RFPPWM {p. 8140}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_RFP_DR	-	0... FFH	0... 255	1	-
Debounce counter increment - recirculation flap driver					
C_ABC_MAX_RFP_DR	-	1... FFH	1... 255	1	-
Debounce counter maximum value - recirculation flap driver					
C_RFP_DR_PWM_DIAG_MAX_SCG	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Maximum threshold for SCG diagnosis window recirculation flap driver					
C_RFP_DR_PWM_DIAG_MIN_OC	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Minimum threshold for OC diagnosis window recirculation flap driver					
C_RFP_DR_PWM_DIAG_MIN_SCB	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Minimum threshold for SCB diagnosis window recirculation flap driver					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

## FUNCTION DESCRIPTION:

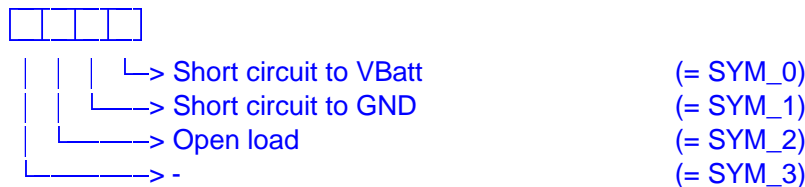
### General information:

The purpose of the diagnosis is to detect electrical faults in the recirculation flap.  
The input signal is a modulated control pulse (PWM).

### Description:

For error detection algorithm see "Electrical diagnosis of powerstage outputs ATIC39".  
The diagnosis condition calculation is done according "Open range" duty cycle, thus a definition of the PWM diagnosis windows is necessary (see calibration data).

Error-symptoms are defined to this diagnosis function as following :



### Application conditions

**Initialisation:** according Filter-type **MPL\_STD\_INI**  
(reset of variables at LV\_IGK 0 -> 1 or ECU reset)

**Recurrence:** 100ms

**Activation:** LV\_VAR\_TCHA = 1

**Deactivation:** **If** LV\_VAR\_TCHA = 0  
**Then** LV\_END\_DIAG\_RFP\_DR = 1  
**Endif**

### Formula section:

If diagnosis is not inhibited (LV\_INH\_DIAG\_RFP\_DR = 0 ) the diagnosis conditions are set according infrastructure information: CDN\_DIAG\_RFP\_DR.

Failure symptoms (raw value) are set according infrastructure information: ERR\_DIAG\_RFP\_DR.

### Failure debouncing and error management treatment:


For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN\_DIAG\_RFP\_DR and ERR\_DIAG\_RFP\_DR.

This algorithm determines:

ERR\_SYM\_RFP\_DR (detected error symptom)

LV\_ERR\_RFP\_DR (Error flag for debounced error)

LV\_CDN\_DIAG\_RFP\_DR (Diagnosis condition information)

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LV\_END\_DIAG\_RFP\_DR (End of diagnosis information)

Diagnosis inhibition:

```

IF          LV_IGK = 1                AND
              LV_CDN_VB_OBD1 = 1      AND
              LV_ERR_SPI_MPS = 0
THEN       LV_INH_DIAG_RFP_DR = 0
ELSE       LV_INH_DIAG_RFP_DR = 1
ENDIF

```

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4205 of 8404</b>	
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## A.5 Waste gate electrical diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_WG_1_DR	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of WG_1_DR bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
CDN_DIAG_WG_2_DR	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of WG_2_DR bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
ERR_DIAG_WG_1_DR	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for WG_1_DR (only parameter)					
ERR_DIAG_WG_2_DR	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for WG_2_DR (only parameter)					
ERR_SYM_WG_1_DR	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom Waste gate driver cylinder bank 1					
ERR_SYM_WG_2_DR	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom Waste gate driver					
LV_CDN_DIAG_WG_1_DR	O/V	0... 1H	0 ...1	1	-
Diagnosis condition Waste gate driver cylinder bank 1					
LV_CDN_DIAG_WG_2_DR	O/V	0... 1H	0 ...1	1	-
Diagnosis condition Waste gate driver cylinder bank 2					
LV_END_DIAG_WG_1_DR	O/V	0... 1H	0 ...1	1	-
End of diagnosis Waste gate driver cylinder bank 1					
LV_END_DIAG_WG_2_DR	O/V	0... 1H	0 ...1	1	-
End of diagnosis Waste gate driver cylinder bank 2					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_WG_1_DR	O/V	0... 1H	0 ...1	1	-
Waste gate driver error cylinder bank 1 detected					
LV_ERR_WG_2_DR	O/V	0... 1H	0 ...1	1	-
Waste gate driver error cylinder bank 2 detected					
LV_INH_DIAG_WG_1_DR	O/V	0... 1H	0 ...1	1	-
Waste gate driver diagnosis inhibition cylinder bank 1					
LV_INH_DIAG_WG_2_DR	O/V	0... 1H	0 ...1	1	-
Waste gate driver diagnosis inhibition cylinder bank 2					

**Input data:**

LV_CDN_VB_OBD1 {p. 1185}	LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}	LV_VAR_TCHA {p. 656}
WGPWM [NC_CBK_EX_NR] {p. 8140}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_WG_DR	-	0... FFH	0... 255	1	-
Debounce counter increment - Waste gate 1					
C_ABC_MAX_WG_DR	-	1... FFH	1... 255	1	-
Debounce counter maximum value - Waste gate					
C_WG_DR_PWM_DIAG_MAX_SCG	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Maximum threshold for SCG diagnosis window					
C_WG_DR_PWM_DIAG_MIN_OC	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Minimum threshold for OC diagnosis window					
C_WG_DR_PWM_DIAG_MIN_SCB	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Minimum threshold for SCB diagnosis window					

**FUNCTION DESCRIPTION:****General information:**

The purpose of the diagnosis is to detect electrical faults in the waste gate. There are one for each exhaust bank (x = 1 or 2). All calibration data will be copied into SW internal CBK specific calibration data. Example:

C\_ABC\_INC\_WG\_DR = C\_ABC\_INC\_WG\_1\_DR = C\_ABC\_INC\_WG\_2\_DR


The input signal is a modulated control pulse (PWM).

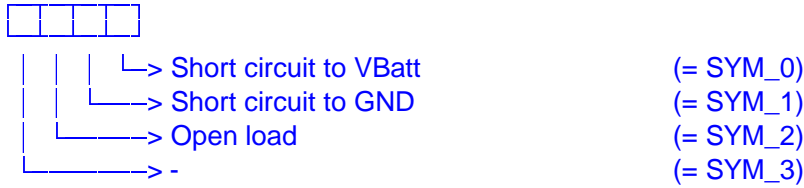
**Description:**

For error detection algorithm see "Electrical diagnosis of powerstage outputs ATIC39".

The diagnosis condition calculation is done according "**Open range**" duty cycle, thus a definition of the PWM diagnosis windows is necessary (see calibration data).

Error-symptoms are defined to this diagnosis function as following :

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### Application conditions

**Initialisation:** according Filter-type **MPL\_STD\_INI**  
(reset of variables at LV\_IGK 0 -> 1 or ECU reset)

**Recurrence:** 100ms

**Activation:** LV\_VAR\_TCHA =1 at every engine operating state

**Deactivation:** **If** LV\_VAR\_TCHA =0  
**Then** LV\_END\_DIAG\_WG\_X\_DR = 1  
**Endif**

### Formula section:

If diagnosis is not inhibited (LV\_INH\_DIAG\_WG\_X\_DR = 0 ) the diagnosis conditions are set according infrastructure information: CDN\_DIAG\_WG\_X\_DR.

Failure symptoms (raw value) are set according infrastructure information: ERR\_DIAG\_WG\_X\_DR.

### Failure debouncing and error management treatment:

For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN\_DIAG\_WG\_X\_DR and ERR\_DIAG\_WG\_X\_DR.

This algorithm determines:

ERR\_SYM\_WG\_X\_DR (detected error symptom)  
LV\_ERR\_WG\_X\_DR (Error flag for debounced error)  
CDN\_DIAG\_WG\_X\_DR (Diagnosis condition information)  
LV\_END\_DIAG\_WG\_X\_DR (End of diagnosis information)

### Diagnosis inhibition:

**IF** LV\_IGK = 1 **AND**  
LV\_CDN\_VB\_OBD1 = 1 **AND**  
LV\_ERR\_SPI\_MPS = 0  
**THEN** LV\_INH\_DIAG\_WG\_X\_DR = 0  
**ELSE** LV\_INH\_DIAG\_WG\_X\_DR = 1  
**ENDIF**



## A.6 Brake switch diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_IM_BLS_PLAUS	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BLS					
ERR_SYM_IM_BTS_PLAUS	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BTS					
LV_BLS_EDGE	V	0... 1H	0 ...1	1	-
LV_BLS_EDGE					
LV_BRAKE_DET	O/V	0... 1H	0 ...1	1	-
LV_IM_BLS or _BTS detected					
LV_BTS_EDGE	V	0... 1H	0 ...1	1	-
LV_BTS_EDGE					
LV_CDN_DIAG_IM_BLS_PLAUS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BLS					
LV_CDN_DIAG_IM_BTS_PLAUS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BTS					
LV_END_DIAG_IM_BLS_PLAUS	O/V	0... 1H	0 ...1	1	-
End of Diagnosis BLS					
LV_END_DIAG_IM_BTS_PLAUS	O/V	0... 1H	0 ...1	1	-
End of Diagnosis BTS					
LV_ERR_BLS_PLAUS	O/V	0... 1H	0 ...1	1	-
Brake plausibility information flag					
LV_ERR_IM_BLS_PLAUS	O/V	0... 1H	0 ...1	1	-
BLS plausibility error BLS					
LV_ERR_IM_BTS_PLAUS	O/V	0... 1H	0 ...1	1	-
BTS plausibility error flag					
T_BTS_PLAUS	V	0... FFFFH	0... 6553.5	0.1	s
T_BTS_PLAUS					

### Input data:

LV_CDN_VB_MIN_DIAG {p. 1185}	LV_IGK {p. 906}	LV_IM_BLS {p. 852}	LV_IM_BTS {p. 852}
---------------------------------	-----------------	--------------------	--------------------

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_IM_BLS_PLAUS	-	0... FFH	0... 255	1	-
BLS debounce counter increment					
C_ABC_INC_IM_BTS_PLAUS	-	0... FFH	0... 255	1	-
BTS debounce counter increment					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_IM_BLS_PLAUS	-	1... FFH	1... 255	1	-
BLS debounce counter maximum value					
C_ABC_MAX_IM_BTS_PLAUS	-	1... FFH	1... 255	1	-
BTS debounce counter maximum value, error debounce					
C_T_BTS_PLAUS_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Maximum value of the time counter for debounce					

## FUNCTION DESCRIPTION:

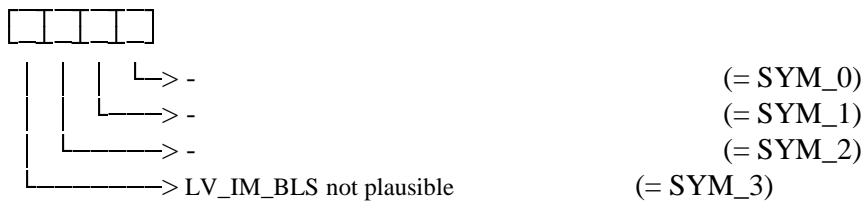
### General information:

In principle both brake light switch and brake test switch must be active at each braking. An edge mismatch between the brake light switch and brake test switch signal of +/- 20 µs can occur. A defective BTS is therefore detected by means of the following function.

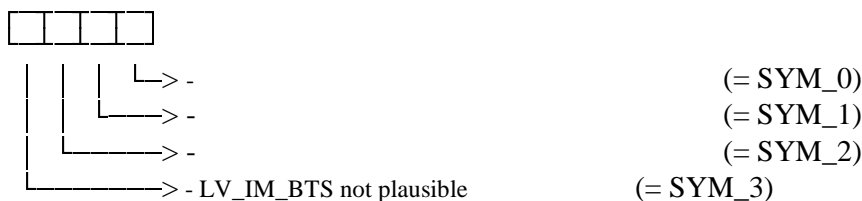
### Description:

The following errors can be detected:

- BLS implausible



- BTS implausible



## Application conditions

**Initialisation:** according filter type: "STD-INI"

**Recurrence:** 100 ms (note: the formula section is not calculated during the first recurrence, when the activation conditions are fulfilled for the first time)

**Activation:** LV\_CDN\_VB\_MIN\_DIAG = 1 **and** LV\_IGK = 1

**Formula section:**

LV\_BLS\_EDGE = 0

**If** LV\_IM\_BLS = 01 or LV\_IM\_BLS = 10

**Then** LV\_BLS\_EDGE = 1

**Endif**

LV\_BTS\_EDGE = 0

**If** LV\_IM\_BTS = 01 or LV\_IM\_BTS = 10

**Then** LV\_BTS\_EDGE = 1

**Endif**

If(1) LV\_BTS\_EDGE = LV\_BLS\_EDGE

Then(1)

    If(2) LV\_IM\_BLS = LV\_IM\_BTS

    Then(2)

        If(2.1) LV\_BLS\_EDGE = 1 **and** LV\_BTS\_EDGE = 1

        Then(2.1)

            Reset timer T\_BTS\_PLAUS

            LV\_CDN\_DIAG\_IM\_BLS\_PLAUS = 1

            ERR\_SYM\_IM\_BLS\_PLAUS = "NO\_SYM"

            (error flag reset by the error manager)

            LV\_CDN\_DIAG\_IM\_BTS\_PLAUS = 1

            ERR\_SYM\_IM\_BTS\_PLAUS = "NO\_SYM"

            (error flag reset by the error manager)

        Endif(2.1)

    Else(2)

        If(3) CTR\_ABC\_IM\_BLS\_PLAUS > 0

        Then(3)

            Reset timer T\_BTS\_PLAUS

            LV\_CDN\_DIAG\_IM\_BLS\_PLAUS = 1

            ERR\_SYM\_IM\_BLS\_PLAUS = "SYM\_3"

            (error flag set by the error manager)

        Else(3)

            LV\_CDN\_DIAG\_IM\_BLS\_PLAUS = 0

            ERR\_SYM\_IM\_BLS\_PLAUS = "NO\_SYM"

        Endif(3)

        If(4) CTR\_ABC\_IM\_BTS\_PLAUS > 0

        Then(4)

            Reset timer T\_BTS\_PLAUS

            LV\_CDN\_DIAG\_IM\_BTS\_PLAUS = 1

            ERR\_SYM\_IM\_BTS\_PLAUS = "SYM\_3"


            (error flag set by the error manager)

        Else(4)

            LV\_CDN\_DIAG\_IM\_BTS\_PLAUS = 0

            ERR\_SYM\_IM\_BTS\_PLAUS = "NO\_SYM"

            If(5) ERR\_SYM\_IM\_BLS\_PLAUS = "NO\_SYM"

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```

Then(5)
  If(6) T_BTS_PLAUS > C_T_BTS_PLAUS_MAX
  Then(6)
    If(7) LV_IM_BLS = 1
    Then(7)
      Reset timer T_BTS_PLAUS
      LV_CDN_DIAG_IM_BLS_PLAUS = 1
      ERR_SYM_IM_BLS_PLAUS = "SYM_3"
      (error flag set by the error manager)

      LV_CDN_DIAG_IM_BTS_PLAUS = 0
      ERR_SYM_IM_BTS_PLAUS = "NO_SYM"
    Else(7)
      Reset timer T_BTS_PLAUS
      LV_CDN_DIAG_IM_BTS_PLAUS = 1
      ERR_SYM_IM_BTS_PLAUS = "SYM_3"
      (error flag set by the error manager)

      LV_CDN_DIAG_IM_BLS_PLAUS = 0
      ERR_SYM_IM_BLS_PLAUS = "NO_SYM"
    Endif(7)
  Else(6)
    Increment timer T_BTS_PLAUS
  Endif(6)
Endif(5)
Endif(4)
Endif(2)
Else(1)
  If(10) LV_BLS_EDGE = 0
  Then(10)
    LV_CDN_DIAG_IM_BLS_PLAUS = 1
    ERR_SYM_IM_BLS_PLAUS = "SYM_3"
    (error flag set by the error manager)

    LV_CDN_DIAG_IM_BTS_PLAUS = 0
    ERR_SYM_IM_BTS_PLAUS = "NO_SYM"
  Else(10)
    LV_CDN_DIAG_IM_BTS_PLAUS = 1
    ERR_SYM_IM_BTS_PLAUS = "SYM_3"
    (error flag set by the error manager)

    LV_CDN_DIAG_IM_BLS_PLAUS = 0
    ERR_SYM_IM_BLS_PLAUS = "NO_SYM"
  Endif(10)
Endif(1)

```

**Brake switch error detection:**

```


IF          LV_ERR_IM_BLS_PLAUS = 1          or
             LV_ERR_IM_BTS_PLAUS = 1

Then       LV_ERR_BLS_PLAUS = 1

Else      LV_ERR_BLS_PLAUS = 0

Endif

```

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## A.6.1 Brake detection

### Description:

A brake operation is detected if brake light switch or brake test switch is engaged.

### Application conditions

**Initialisation:** 0  
**Recurrence:** 10 ms  
**Activation:** in all operating states

### Formula section:

```

If           LV_IM_BLS = 1           or           LV_IM_BTS = 1
Then        LV_BRAKE_DET = 1
Else        LV_BRAKE_DET = 0
Endif

```

## A.7 Pedal value sensor diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_C_T_VS_BRAKE_MAX	V	0... FFH	0... 2.55	0.01	s
Delay timer for vehicle speed in PVS_BLS_BTS_PLAUS					
CTR_PVS_BLS_NOT_PLAUS_ACT	V	0... FFH	0... 255	1	-
Counter plausibility error PVS /Brake recognized without error entry					
ERR_SYM_PVS_1	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom PVS					
ERR_SYM_PVS_2	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom PVS					
ERR_SYM_PVS_BLS_NOT_PLAUS	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom Plausibility error PVS /Brake					
ERR_SYM_PVS_DOUBLE	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom PVS DOUBLE					
ERR_SYM_PVS_RATIO	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom PVS_RATIO					
ERR_SYM_V_REF_1	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom PVS V_REF					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_V_REF_2	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom PVS V_REF					
LV_CDN_DIAG_PVS_1	O/V	0... 1H	0 ...1	1	-
Diagnosis condition PVS					
LV_CDN_DIAG_PVS_2	O/V	0... 1H	0 ...1	1	-
Diagnosis condition PVS					
LV_CDN_DIAG_PVS_BLS_NOT_PLAUS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition Plausibility error PVS /Brake					
LV_CDN_DIAG_PVS_DOUBLE	O/V	0... 1H	0 ...1	1	-
Diagnosis condition PVS DOUBLE					
LV_CDN_DIAG_PVS_RATIO	O/V	0... 1H	0 ...1	1	-
Diagnosis condition PVS_RATIO					
LV_CDN_DIAG_V_REF_1	O/V	0... 1H	0 ...1	1	-
Diagnosis condition PVS V_REF					
LV_CDN_DIAG_V_REF_2	O/V	0... 1H	0 ...1	1	-
Diagnosis condition PVS V_REF					
LV_CDN_VS_VLD_1	V	0... 1H	0 ...1	1	-
Logical value for VS condition for PVS_BLS_BTS_PLAUS					
LV_CDN_VS_VLD_2	V	0... 1H	0 ...1	1	-
Logical value for brake pressure condition for PVS_BLS_BTS_PLAUS					
LV_DET_ERR_PVS	V	0... 1H	0 ...1	1	-
Logical value (set, if a PVS-error is present)					
LV_DET_NOT_PLAUS_ACT	O/V	0... 1H	0 ...1	1	-
PV_AV /Brake signal current not plausible					
LV_DYN_LIM_1_ACT	O/V	0... 1H	0 ...1	1	-
Limited dynamic 1 is active /passive					
LV_DYN_LIM_2_ACT	O/V	0... 1H	0 ...1	1	-
Limited dynamic 2 is active /passive					
LV_END_DIAG_PVS_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis PVS					
LV_END_DIAG_PVS_2	O/V	0... 1H	0 ...1	1	-
End of diagnosis PVS					
LV_END_DIAG_PVS_BLS_NOT_PLAUS	O/V	0... 1H	0 ...1	1	-
End of diagnosis Plausibility error PVS /Brake					
LV_END_DIAG_PVS_DOUBLE	O/V	0... 1H	0 ...1	1	-
End of diagnosis PVS DOUBLE					
LV_END_DIAG_PVS_RATIO	O/V	0... 1H	0 ...1	1	-
End of diagnosis PVS_RATIO					
LV_END_DIAG_V_REF_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis PVS V_REF					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_V_REF_2	O/V	0... 1H	0 ...1	1	-
End of diagnosis PVS V_REF					
LV_ERR_PVS	O/V	0... 1H	0 ...1	1	-
Global PVS system error					
LV_ERR_PVS_1	O/V	0... 1H	0 ...1	1	-
Global PVS system error					
LV_ERR_PVS_2	O/V	0... 1H	0 ...1	1	-
Global PVS system error					
LV_ERR_PVS_BLS_NOT_PLAUS	O/V	0... 1H	0 ...1	1	-
Plausibility error PVS /Brake recognized with error entry					
LV_ERR_PVS_DOUBLE	O/V	0... 1H	0 ...1	1	-
Present error PVS DOUBLE					
LV_ERR_PVS_RATIO	O/V	0... 1H	0 ...1	1	-
Present error PVS_RATIO					
LV_ERR_V_REF_1	O/V	0... 1H	0 ...1	1	-
Present error PVS V_REF					
LV_ERR_V_REF_2	O/V	0... 1H	0 ...1	1	-
Present error PVS V_REF					
LV_MTC_LIH_ACT	O/V	0... 1H	0 ...1	1	-
Limited dynamic speed limit demand					
LV_N_SP_IS_LIH_ACT	O/V	0... 1H	0 ...1	1	-
Local value for LIH idle speed setpoint					
LV_PV_AV_LIM_ACT	O/V	0... 1H	0 ...1	1	-
Logical value for PV_AV over threshold for PVS_BLS_BTS_PLAUS					
LV_PVS_BLS_NOT_PLAUS_ACT	O/V	0... 1H	0 ...1	1	-
Plausibility error PVS /Brake recognized without error entry					
PV_AV_MAX_BRAKE_DET	O/V	0... FFH	0... 99.60937	0.390625	%
PV_AV_MAX_BRAKE_DET					
STATE_PVS_DIAG	O/V	0H 1H 2H 4H 8H 10H 20H 40H 80H	PVS_NO_ ERROR PVS_LIH_ PRED PVS_LIH_1 PVS_LIH_2 PVS_LIH_MIN PVS_DBL_ ERROR PVS_LIH_BLS PVS_LIH_1_ PRED PVS_LIH_2_ PRED	-	-
Status of PVS-diagnosis					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**Input data:**

BRAKE_PRS {p. 1561}	LV_BRAKE_DET {p. 4209}	LV_ERR_BLS_PLAUS {p. 4209}	LV_IGK {p. 906}
LV_IM_BLS {p. 852}	LV_IM_BTS {p. 852}	N {p. 1525}	PV_AV {p. 1269}
STATE_BRAKE_PRS {p. 1571}	V_PVS_1 {p. 831}	V_PVS_2 {p. 831}	VCC_PVS_1 {p. 831}
VCC_PVS_2 {p. 832}	VS {p. 1176}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_PVS_1	-	0... FFH	0... 255	1	-
Anti-bounce increment value					
C_ABC_INC_PVS_2	-	0... FFH	0... 255	1	-
Anti-bounce increment value					
C_ABC_INC_PVS_BLS_NOT_PLAUS	-	0... FFH	0... 255	1	-
PVS_BLS_BTS_PLAUS counter increment value					
C_ABC_INC_PVS_RATIO	-	0... FFH	0... 255	1	-
Anti-bounce increment value					
C_ABC_INC_V_REF_1	-	0... FFH	0... 255	1	-
Anti-bounce increment value (x=1,2)					
C_ABC_INC_V_REF_2	-	0... FFH	0... 255	1	-
Anti-bounce increment value (x=1,2)					
C_ABC_MAX_PVS_1	-	1... FFH	1... 255	1	-
Anti-bounce maximum value					
C_ABC_MAX_PVS_2	-	1... FFH	1... 255	1	-
Anti-bounce maximum value					
C_ABC_MAX_PVS_BLS_NOT_PLAUS	-	1... FFH	1... 255	1	-
PVS_BLS_BTS_PLAUS counter maximum value					
C_ABC_MAX_PVS_RATIO	-	1... FFH	1... 255	1	-
Anti-bounce maximum value					
C_ABC_MAX_V_REF_1	-	1... FFH	1... 255	1	-
Anti-bounce maximum value (x=1,2)					
C_ABC_MAX_V_REF_2	-	1... FFH	1... 255	1	-
Anti-bounce maximum value (x=1,2)					
C_N_MAX_BRAKE	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for ABC in PVS_BLS_BTS_PLAUS					
C_PV_AV_BRAKE_MAX	-	0... FFH	0... 99.60937	0.390625	%
Maximum PV_AV threshold for PVS_BLS_BTS_PLAUS					
C_PV_AV_BRAKE_MIN	-	0... FFH	0... 99.60937	0.390625	%
Minimum PV_AV threshold for PVS_BLS_BTS_PLAUS					
C_PVS_BLS_BTS_PLAUS_CONF	-	0... 2H	0 ...2	1	-
Enable bit for plausibility check;					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_IS_PVS_ERR	-	0... FFH	0... 2.55	0.01	s
Minimum idle dwell time in error cases					
C_T_THD_VS_BRAKE_MAX	-	0... FFH	0... 2.55	0.01	s
Delay timer threshold for vehicle speed in PVS_BLS_BTS_PLAUS					
C_V_PVS_MAX_DIAG_1	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Upper diagnosis threshold					
C_V_PVS_MAX_DIAG_2	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Upper diagnosis threshold					
C_V_PVS_MIN_DIAG_1	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Lower diagnosis threshold					
C_V_PVS_MIN_DIAG_2	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Lower diagnosis threshold					
C_V_PVS_MIN_DIAG_MIN_1	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Upper diagnosis threshold for switching from faulty channel to error-free					
C_V_PVS_MIN_DIAG_MIN_2	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Upper diagnosis threshold for switching from faulty channel to error-free					
C_VCC_DIF_PVS	-	0... 3FFH	0... 9.9902	9.7656e-3	V
max. permissible variance of the supply voltage of 10V					
C_VS_BRAKE_MAX	-	0... FFH	0... 255	1	km/h
Maximum VS threshold for PVS_BLS_BTS_PLAUS					
C_VS_BRAKE_MIN	-	0... FFH	0... 255	1	km/h
Minimum VS threshold for PVS_BLS_BTS_PLAUS					
C_VS_MAX_BRAKE	-	0... FFH	0... 255	1	km/h
Maximum VS threshold for PVS_BLS_BTS_PLAUS					
IP_PV_AV_MAX_BRAKE_PRS_AT	-	0... FFH	0... 99.60937	0.390625	%
LDPM_BRAKE_PRS_IP_PV_AV_MAX	5	0... FFH	0... 255	1	bar
PV_AV limit for brake pressure for automatic gearbox					
IP_PV_AV_MAX_BRAKE_PRS_MT	-	0... FFH	0... 99.60937	0.390625	%
LDPM_BRAKE_PRS_IP_PV_AV_MAX	5	0... FFH	0... 255	1	bar
PV_AV limit for brake pressure for manual gearbox					
IP_PV_AV_MAX_BRAKE_VS	-	0... FFH	0... 99.60937	0.390625	%
LDP_VS_IP_PV_AV_MAX_BRAKE	5	0... FFH	0... 255	1	km/h
PV_AV limit for VS					
IP_PVS_RATIO_HYS	-	0... 3FFH	0... 4.99511	4.8828e-3	V
LDP_V_PVS_MIN	2	0... 3FFH	0... 4.99511	4.8828e-3	V
permissible variance of the PVS-values					
LC_BRAKE_PRS	-	0... 1H	0...1	1	-
Switch to enable brake pressure monitoring for plausibility check					

## FUNCTION DESCRIPTION:

### General information:

The following diagnosis are performed:

- Diagnosis of sensor-supply voltage VCC\_PVS\_i
- PVS-synchronization control (RATIO-Check)
- Signal range check low and high (SRCL, SRCH)
- PVS double error
- Plausibility between brake /PVS

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## A.7.1 Global PVS system error LV\_ERR\_PVS

### Description:

The global error LV\_ERR\_PVS is set if at least one PVS error is set.

### Application conditions

**Initialisation:**            *0 at LV\_IGK 0->1 or reset*  
**Recurrence:**                *10ms*  
**Activation:**                 *LV\_IGK = 1*

### Formula section:

```

If                    LV_ERR_V_REF_x = 1            // 1 or 2
or                    LV_ERR_PVS_x = 1
or                    LV_ERR_PVS_RATIO = 1
Then                LV_ERR_PVS = 1
Else                LV_ERR_PVS = 0
Endif
    
```

## A.7.2 Diagnosis of sensor-supply voltage VCC\_PVS\_i

### General information:

The PVS sensor supply voltage 5V [ Range 0...9.9902 V ] is compared with the measured actual supply voltage every 10 ms (forming differences).  
 x = 1 and 2

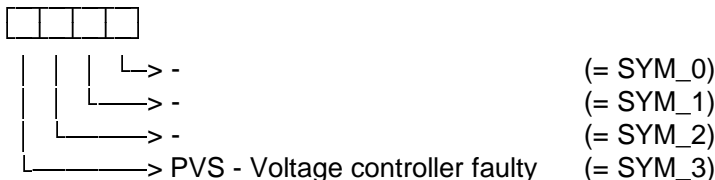
### Description:

If diagnosis condition is reached and error symptom is detected ERR\_SYM\_V\_REF\_i is set. After the debounce LV\_ERR\_V\_REF\_1 (at error channel 1), LV\_ERR\_V\_REF\_2 (at error channel 2) are set. The faulty channel is not evaluated during this driving cycle.

### Remark:

*During the debounce time (ERR\_SYM\_V\_REF\_x = SYM\_3) the PV\_AV value is limited upwards to the last valid PVS-value (see chapter 4 "Determination of accelerator pedal value").*

Error-symptoms are defined to this diagnosis function as following :



### Application conditions

**Initialisation:**            *all 0 at LV\_IGK 0->1 or reset*

**Recurrence:** 10ms

**Activation:**

```

If          LV_IGK = 1                                and
              LV_ERR_V_REF_x = 0
Then         LV_CDN_DIAG_V_REF_x = 1
Else         LV_CDN_DIAG_V_REF_x = 0
Endif

```

### Formula section:

Error detection PVS-Channel:

```

If(1)          | 5V - VCC_PVS_x | > C_VCC_DIF_PVS
Then(1)        ERR_SYM_V_REF_x = SYM_3
Set of LV_ERR_V_REF_1 (or 2) and LV_ERR_PVS:
If(2)          ABC counter reaches max
                // CTR_ABC_V_REF_x >= C_ABC_MAX_V_REF_x
Then(2)        LV_ERR_V_REF_x = 1           // set for this DC
Endif(2)
Else(1)        ERR_SYM_V_REF_x = NO_SYM
Endif(2)

```

Calculation end of diagnosis

LV\_END\_DIAG\_V\_REF\_x is calculated by error management

## A.7.3 PVS-synchronization control (RATIO-Check)

### Description:

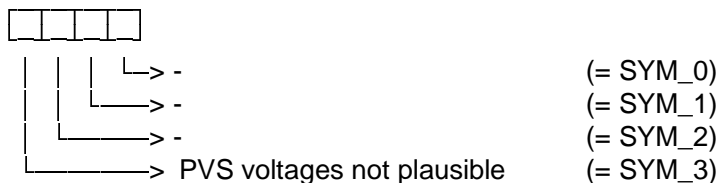
In order to have an error free system the pedal value sensor voltages V\_PVS\_x may not deviate more than IP\_PVS\_RATIO\_HYS (V\_PVS\_2 must be doubled!) from each other. The smaller PVS-voltage serves as a break point for the characteristic curve.

The RATIO-Check is then only carried out if both channels are error - free.

ERR\_SYM\_PVS\_RATIO is set when the error conditions are present; after debounce the error bit LV\_ERR\_PVS\_RATIO is set.

During the debounce time (ERR\_SYM\_PVS\_RATIO = SYM\_3) the PV\_AV value is limited upwards to the last valid PVS-value (see chapter 4 "Determination of accelerator pedal value").

Error-symptoms are defined to this diagnosis function as following :



### Application conditions

**Initialisation:** all 0 at LV\_IGK 0->1 **or** reset

**Recurrence:** 10ms

**Activation:**

```

If          LV_IGK = 1                                and
              LV_ERR_PVS = 0                            and
Then         LV_CDN_DIAG_PVS_RATIO = 1
Else         LV_CDN_DIAG_PVS_RATIO = 0
Endif

```



```

Activation:           If         LV_IGK = 1                               and
                        LV_ERR_PVS_x = 0                               and
                        LV_ERR_V_REF_x = 0
                        Then         LV_CDN_DIAG_PVS_x = 1
                        Else         LV_CDN_DIAG_PVS_x = 0
                        Endif

```

### Formula section:

Short circuit to Vbatt:

```

If(1)           V_PVS_x > C_V_PVS_MAX_DIAG_x           (X = 1,2)

```

```

Then(1)        ERR_SYM_PVS_x = SYM_0

```

Short circuit to GND or open load

```

Else(1)If(2)   V_PVS_x < C_V_PVS_MIN_DIAG_x

```

```

Then(2)        ERR_SYM_PVS_x = SYM_1

```

PVS voltage is in valid range

```

Else(2)        ERR_SYM_PVS_x = NO_SYM

```

```

Endif(2)

```

```

Endif(1)

```

Calculation end of diagnosis and present failure

LV\_ERR\_PVS\_x and LV\_END\_DIAG\_PVS\_x are calculated by error management

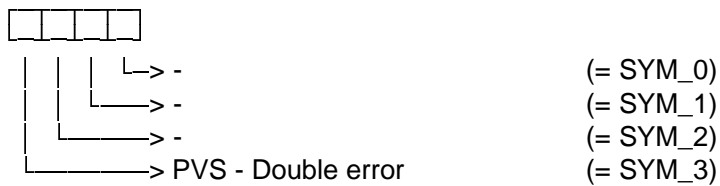
## A.7.5 PVS - Double error

### Description:

In order to illuminate the MIL if both PVS channels are detected as faulty there is a separate error flag LV\_ERR\_PVS\_DOUBLE (all other PVS errors shall be calibrated as non - MIL relevant).

If a channel is already detected as faulty (through sensor supply, SRCH, SRCL) and afterwards another sensor error appears, then the system goes into the PVS limp home for this driving cycle (see limited dynamic 2).

Error-symptoms are defined to this diagnosis function as following :



### Application conditions

```

Initialisation:   all 0 at LV_IGK 0->1 or reset

```

```

Recurrence:      10ms

```

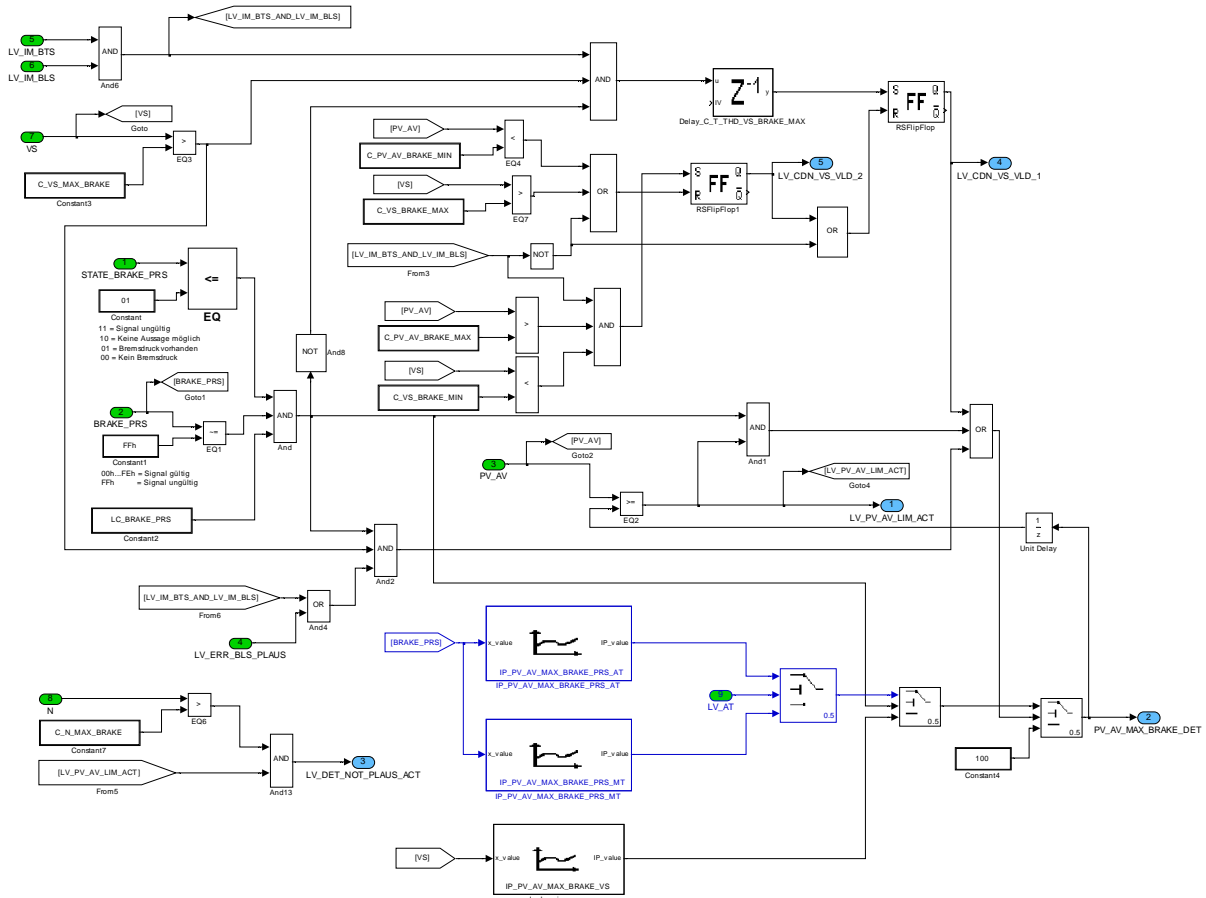
```

Activation:      If         LV_IGK = 1                               and
                        LV_ERR_PVS_DOUBLE = 0
                        Then         LV_CDN_DIAG_PVS_DOUBLE = 1
                        LV_END_DIAG_PVS_DOUBLE = 1
                        Else         LV_CDN_DIAG_PVS_DOUBLE = 0
                        Endif

```



**Formula section:**




**Not Plaus Activation**

**IF(1)** LV\_DET\_NOT\_PLAUS\_ACT = 1  
**IF(2)** C\_PVS\_BLS\_BTS\_PLAUS\_CONF = 2  
**THEN(2)** LV\_CDN\_DIAG\_PVS\_BLS\_NOT\_PLAUS = 1  
 ERR\_SYM\_PVS\_BLS\_NOT\_PLAUS = SYM\_3  
 Debounce of LV\_ERR\_PVS\_BLS\_NOT\_PLAUS  
**ENDIF(2)**

**IF(3)** C\_PVS\_BLS\_BTS\_PLAUS\_CONF = 1  
**THEN(3)** LV\_CDN\_DIAG\_PVS\_BLS\_NOT\_PLAUS = 0  
 CTR\_PVS\_BLS\_NOT\_PLAUS\_ACTn =  
 CTR\_PVS\_BLS\_NOT\_PLAUS\_ACTn-1 +  
 C\_ABC\_INC\_PVS\_BLS\_NOT\_PLAUS  
**IF(4)** CTR\_PVS\_BLS\_NOT\_PLAUS\_ACT >=  
 C\_ABC\_MAX\_PVS\_BLS\_NOT\_PLAUS  
**THEN(4)** LV\_PVS\_BLS\_NOT\_PLAUS\_ACT = 1  
**ENDIF(4)**  
**ENDIF(3)**

**ELSE(1)**  
**IF(5)** [( LV\_ERR\_PVS\_BLS\_NOT\_PLAUS = 0 **and**

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```

        LV_PVS_BLS_NOT_PLAUS_ACT = 0 )
        (( LV_ERR_PVS_BLS_NOT_PLAUS = 1
LV_PVS_BLS_NOT_PLAUS_ACT = 1 ) and
LV_PV_AV_LIM_ACT = 0 ]]
    THEN(5)
IF(6) C_PVS_BLS_BTS_PLAUS_CONF = 2
    THEN(6) LV_CDN_DIAG_PVS_BLS_NOT_PLAUS = 1
        ERR_SYM_PVS_BLS_NOT_PLAUS = NO_SYM
        LV_ERR_PVS_BLS_NOT_PLAUS = 0
            The debounce counters are reset to 0.
    ENDIF(6)
IF(7) C_PVS_BLS_BTS_PLAUS_CONF = 1
    THEN(7) LV_CDN_DIAG_PVS_BLS_NOT_PLAUS = 0
        CTR_PVS_BLS_NOT_PLAUS_ACT = 0
            LV_PVS_BLS_NOT_PLAUS_ACT = 0
    ENDIF(7)
ELSE(5)
IF(8) C_PVS_BLS_BTS_PLAUS_CONF = 2
    THEN(8) LV_CDN_DIAG_PVS_BLS_NOT_PLAUS = 1
        ERR_SYM_PVS_BLS_NOT_PLAUS = NO_SYM
    ENDIF(8)
IF(9) C_PVS_BLS_BTS_PLAUS_CONF = 1
    THEN(9) LV_CDN_DIAG_PVS_BLS_NOT_PLAUS = 0
        IF(10) CTR_PVS_BLS_NOT_PLAUS_ACT = 0
            THEN(10) LV_PVS_BLS_NOT_PLAUS_ACT = 0
        ENDIF(10)
    ENDIF(9)
ENDIF(1)

```

Calculation end of diagnosis

LV\_END\_DIAG\_PVS\_BLS\_NOT\_PLAUS is calculated by error management

## A.7.7 Pedal value sensor limp home

### General information:

Depending if there is a ratio or single or double PVS error, different limp homes are applied.


PVS\_LIH\_PRED: Is active during debounce - time is active. The pedal value is frozen in rising direction.

PVS\_LIH\_x\_PRED: Is active if only one channel is detected as faulty and the remaining channel was not in idle detection range for a calibratable time. Pedal value is 0.

PV\_LIH\_x: Is active if only one channel is detected as faulty and the remaining channel was in idle detection range for a calibratable time. Limited dynamic 1 is applied ( = Lower engine speed limitation and if brake or brake error is active then pedal value is 0).

PVS\_LIH\_MIN: Is active if ratio error is present. Pedal value is selected as a MIN-selection.

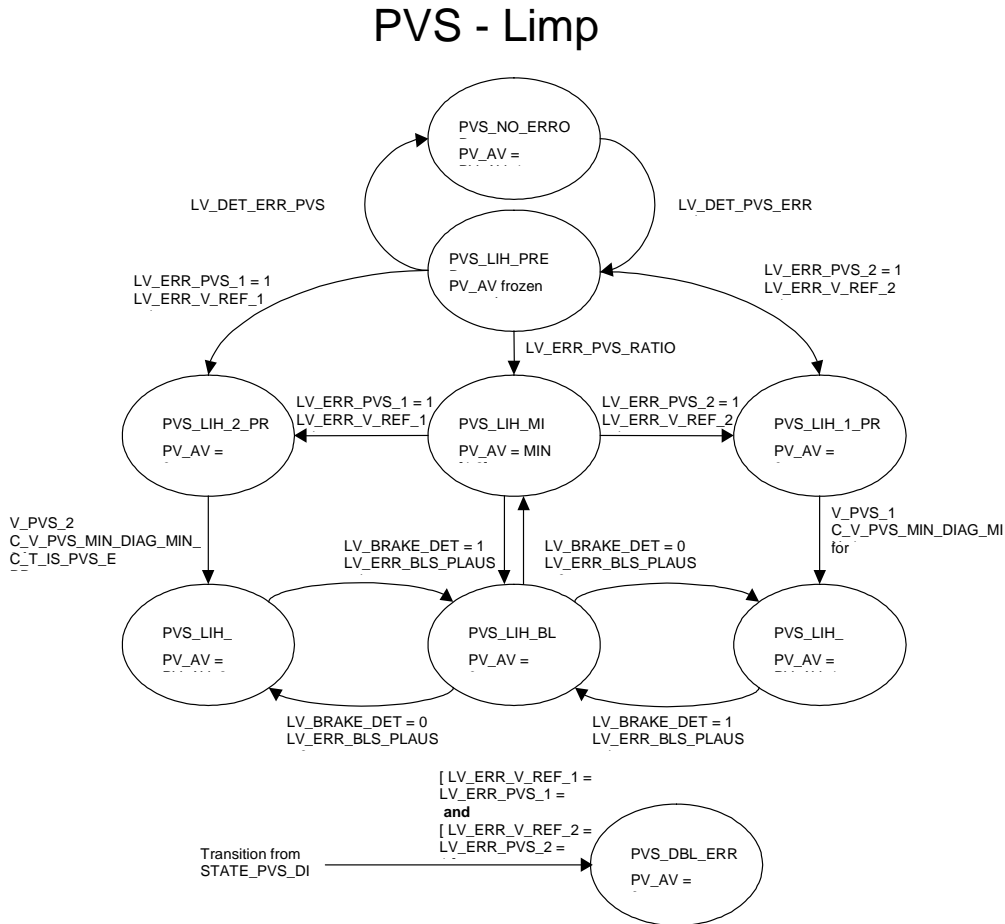
PVS\_DBL\_ERROR: Is active if both channels are detected as faulty or with a present ratio error and a high range error of the observed (=MIN) channel. Limited dynamic 2 is applied ( = pedal value is 0,

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Idle speed with a higher idle speed setpoint. If brake or brake error is active then the normal idle speed setpoint is applied).

**PVS\_LIH\_BLS:** Is active if limited dynamic 1 or 2 is active and brake is detected or brake failure is present. Then pedal value is 0

**Signal flow diagram:**



**A.7.7.1 PVS limp-home limited dynamic 1**

**Description:**

The dynamic of the vehicle is limited in order secure controlled vehicle reactions and adequately longer reaction times for the driver when **one** of the both PVS-channels are detected as faulty. When brake activity or an brake error is detected a lower engine speed limitation is active. If the error memory is cleared the limp home **LV\_DYN\_LIM\_1\_ACT** is set to 0 as well.

**Formula section:**

**If(1)** STATE\_PVS\_DIAG = PVS\_LIH\_1 or PVS\_LIH\_2 or PVS\_LIH\_MIN or

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```

                                PVS_LIH_1_PRED      or
                                PVS_LIH_2_PRED      or
                                PVS_LIH_BLS
Then(1)    LV_DYN_LIM_1_ACT = 1
If (2)      STATE_PVS_DIAG = PVS_LIH_BLS
Then (2)    LV_MTC_LIH_ACT = 1                      //Limp home engine speed limit

Else (2)    LV_MTC_LIH_ACT = 0
Endif (2)
Else(1)     LV_DYN_LIM_1_ACT = 0
Endif (1)

```

### A.7.7.2 PVS limp-home limited dynamic 2

#### Description:

The dynamic of the vehicle is limited in order secure controlled vehicle reactions and adequately longer reaction times for the driver when **both** channels are detected as faulty.

If an error free pedal value sensor signal is no longer present Limited dynamic 2 is set.

With the Limited dynamic 2 the vehicle is more handicaped than with Limited dynamic 1, the vehicle is driven by two idle speed setpoints.

If the error memory is cleared the limp home LV\_DYN\_LIM\_2\_ACT is set to 0 as well.

#### Formula section:

```

If(1)      STATE_PVS_DIAG = PVS_DOUBLE_ERROR
Then(1)    LV_DYN_LIM_2_ACT = 1
            LV_MTC_LIH_ACT = 1          (see Engine speed limit coordination)
If(2)      LV_BRAKE_DET = 1            or
            LV_ERR_BLS_PLAUS = 1
Then(2)    LV_N_SP_IS_LIH_ACT = 0      (PV_AV = 0)
Else(2)    LV_N_SP_IS_LIH_ACT = 1
Endif(2)
Else(1)    LV_DYN_LIM_2_ACT = 1
Endif (1)

```

### A.7.7.3 Determination of STATE\_PVS\_DIAG

#### Description:

The PVS Value selection (See also: Determination of accelerator pedal value, Value selection ) and the PVS-Limp home determination is based on the status value: STATE\_PVS\_DIAG.

#### Formula section:

Status of non-debounced PVS\_error

```

If          ERR_SYM_V_REF_1 (and 2) = NO_SYM      and
            ERR_SYM_PVS_1 (and 2) = NO_SYM      and
            ERR_SYM_PVS_RATIO = NO_SYM
Then        LV_DET_ERR_PVS = 0
Else        LV_DET_ERR_PVS = 1
Endif

```

STATE\_PVS\_DIAG = PVS\_NO\_ERROR

**If** LV\_ERR\_V\_REF\_1/2 = 0 **and** // no detected and present failures

LV\_ERR\_PVS\_1/2 = 0 **and**  
 LV\_ERR\_PVS\_RATIO = 0 **and**  
 LV\_DET\_ERR\_PVS = 0

**Then**

STATE\_PVS\_DIAG = PVS\_NO\_ERROR

**Endif**

STATE\_PVS\_DIAG = PVS\_LIH\_PRED

**If** LV\_ERR\_PVS = 0 **and**

LV\_DET\_ERR\_PVS = 1

**Then**

STATE\_PVS\_DIAG = PVS\_LIH\_PRED

**Endif**

STATE\_PVS\_DIAG = PVS\_LIH\_1\_PRED /PVS\_LIH\_1

**If** LV\_ERR\_V\_REF\_2 = 1 **or**

LV\_ERR\_PVS\_2 = 1

**Then**

STATE\_PVS\_DIAG = PVS\_LIH\_1\_PRED

**If** V\_PVS\_1 < C\_V\_PVS\_MIN\_DIAG\_MIN\_1

**Then** decrement T\_IS\_PVS\_ERR timer

**If** T\_IS\_PVS\_ERR = 0

**Then** STATE\_PVS\_DIAG = PVS\_LIH\_1

**Endif**

**Else** T\_IS\_PVS\_ERR = C\_T\_IS\_PVS\_ERR

**Endif**

**Endif**

STATE\_PVS\_DIAG = PVS\_LIH\_2\_PRED /PVS\_LIH\_2

**If** LV\_ERR\_V\_REF\_1 = 1 **or**

LV\_ERR\_PVS\_1 = 1

**Then**

STATE\_PVS\_DIAG = PVS\_LIH\_2\_PRED

**If** V\_PVS\_2 < C\_V\_PVS\_MIN\_DIAG\_MIN\_2

**Then** decrement T\_IS\_PVS\_ERR timer

**If** T\_IS\_PVS\_ERR = 0

**Then** STATE\_PVS\_DIAG = PVS\_LIH\_2

**Endif**

**Else** T\_IS\_PVS\_ERR = C\_T\_IS\_PVS\_ERR

**Endif**

**Endif**

STATE\_PVS\_DIAG = PVS\_LIH\_MIN


**If** LV\_ERR\_PVS\_RATIO = 1

**Then**

```
STATE_PVS_DIAG = PVS_LIH_MIN
Endif
```

```
STATE_PVS_DIAG = PVS_DBL_ERROR
if LV_ERR_PVS_DOUBLE = 1
Then
  STATE_PVS_DIAG = PVS_DBL_ERROR
Endif
```

```
STATE_PVS_DIAG = PVS_LIH_BLS
if(1) STATE_PVS_DIAG = PVS_LIH_1 or PVS_LIH_2 or PVS_LIH_MIN
Then (1)
  if (2) LV_BRAKE_DET = 1 or
          LV_ERR_BLS_PLAUS = 1
  Then (2) STATE_PVS_DIAG = PVS_LIH_BLS
  Endif (2)
Endif (1)
```

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## A.8 ECU reset service

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LIH_ACT	V	0... FFFFH	0... 65535	1	-
0H = kein E-GAS-Notlauf /AF50H = E-Gas-Notlauf aktiv (gespeichert im resetfesten Bereich)					
LV_N_LIM_REQ_RST_CHK	O/V	0... 1H	0 ...1	1	-
Logical variable to set engine speed limitation after ECU reset					

### Input data:

LV_ERR_TQI_N_MAX_MON {p. 6917}	LV_IGK {p. 906}	LV_MTC_LIH_ACT {p. 4216}	LV_N_LIM_REQ_MON {p. 6877}
LV_TPS_MTC_N_LIM {p. 4982}			

### FUNCTION DESCRIPTION:

#### General information:

If ETC-Limp home is active, performance is limited for the driver. After a reset of the ECU this limitation of performance is lost from one second to another. To prevent this dangerous situation the word LIH\_ACT is saved to reset independant memory every 100 ms. This special part of memory is not deleted in case of warm reset (LV\_WARM\_RST = 1). In case of cold reset (LV\_WARM\_RST = 0) even information in this reset resistant memory is lost.

While initializing the ECU the word LIH\_ACT is been read out of the reset resistant memory. If it is set, LV\_N\_LIM\_REQ\_RST\_CHK is set to 1 for the current driving cycle. At transition LV\_IGK = 1 0 or if the failure memory is been deleted, LV\_N\_LIM\_REQ\_RST\_CHK and LIH\_ACT are reset to 0.

#### Application Conditions:

Recurrence: 100ms

#### Initialisation:

at reset (but not in case of warm-reset LV\_WARM\_RST = 1)

OR

at transition LV\_IGK = 1 0

OR

after clearing failure memory

LV\_N\_LIM\_REQ\_RST\_CHK = 0

LIH\_ACT = 0

The following initialization is only used after warm-reset (LV\_WARM\_RST = 1):

**IF** after warm-reset LIH\_ACT = AF50 hex (44880 dec)  
(read after warm-reset from reset resistant memory)

**THEN** LV\_N\_LIM\_REQ\_RST\_CHK = 1  
(to be written only once while initializing ECU)

**ELSE**           LV\_N\_LIM\_REQ\_RST\_CHK = 0  
                    (to be written only once while initializing ECU)

**ENDIF.**

*Activation:*  
LV\_IGK = 1

*Deactivation:*  
LV\_IGK = 0

**Formula section:**


**IF**                LV\_TPS\_MTC\_N\_LIM = 1                   **OR**            // ETC-LIH request  
                    LV\_MTC\_LIH\_ACT = 1               **OR**            // PVS-LIH request  
                    LV\_N\_LIM\_REQ\_MON = 1               **OR**            // MON-LIH request  
                    LV\_ERR\_TQI\_N\_MAX\_MON = 1           **OR**  
                    LV\_N\_LIM\_REQ\_RST\_CHK = 1

**THEN**            LIH\_ACT = AF50 hex (44880 dec)  
                    (to be written to reset resistant memory every 100ms)

**ELSE**            LIH\_ACT = 0 (to be written to reset resistant memory every 100ms)

**ENDIF.**

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## A.9 ECU selftest

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_ECU_CKS	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected Symptom ECU					
ERR_SYM_ECU_NVMY	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected Symptom ECU					
ERR_SYM_ECU_RAM	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected Symptom ECU RAM					
LV_CDN_DIAG_ECU_CKS	O/V	0... 1H	0 ...1	1	-
ECU Diagnosis active (=1)					
LV_CDN_DIAG_ECU_NVMY	O/V	0... 1H	0 ...1	1	-
ECU Diagnosis active (=1)					
LV_CDN_DIAG_ECU_RAM	O/V	0... 1H	0 ...1	1	-
ECU Diagnosis RAM active (=1)					
LV_END_DIAG_ECU_CKS	O/V	0... 1H	0 ...1	1	-
End of ECU Diagnosis					
LV_END_DIAG_ECU_NVMY	O/V	0... 1H	0 ...1	1	-
End of ECU Diagnosis					
LV_END_DIAG_ECU_RAM	O/V	0... 1H	0 ...1	1	-
End of ECU Diagnosis RAM					
LV_ERR_ECU_CKS	O/V	0... 1H	0 ...1	1	-
Present ECU checksum error					
LV_ERR_ECU_NVMY	O/V	0... 1H	0 ...1	1	-
Present ECU NVMY error					
LV_ERR_ECU_RAM	O/V	0... 1H	0 ...1	1	-
Present ECU RAM error					
PWL_KRAM_SAVE	-	0... FFH	0... 255	1	-
status of PWL					
PWL_KRAM_SAVE_CPL	-	0... FFH	0... 255	1	-
complement of status of PWL					

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```

LV_ERR_ECU_RAM = 1          (error is set for this engine run, no debounce)
LV_END_DIAG_ECU_RAM = 1
Else
after finishing each test once LV_END_DIAG_ECU_RAM = 1
Endif

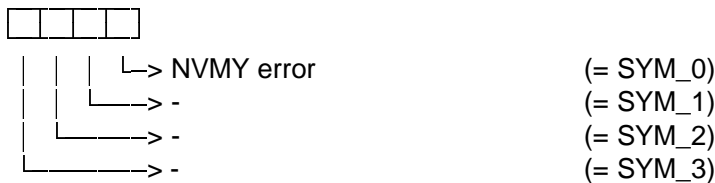
```

### A.9.3 NVMY test

#### Description:

The NVMY blocks are restored after each reset during the initialization phase after start up. If one block is detected as faulty (see "Non volatile data" in chapter Basic SW general operation) only this data is initialized.

Error symptoms are defined for this diagnosis function as:



#### Application conditions

**Initialisation:** all 0 at reset **or** clearing error memory  
**Recurrence:** 40 ms (see formula section)  
**Activation:** at reset

#### Formula section:

##### at reset:

##### Error detection

```

If          V_IGK < C_VB_MIN_OBD1          or
              [ LV_WARM_RST = 1              and
              PWL_KRAM_SAVE == complement of PWL_KRAM_SAVE_CPL and
              PWL_KRAM_SAVE = only BIT NVMY is set ]
Then        no diagnosis
Else        LV_CDN_DIAG_ECU_NVMY = 1
              If      error symptom is detected
              Then    ERR_SYM_ECU_NVMY = SYM_0
                      LV_ERR_ECU_NVMY = 1          /*error is set for this engine run
                                                    no debounce*/
                      LV_END_DIAG_ECU_NVMY = 1
              Else    after finishing the test once LV_END_DIAG_ECU_NVMY = 1
              Endif
              LV_CDN_DIAG_ECU_NVMY = 0          //reset to 0 after call of FMY
Endif


```

**40ms:**

```

If          (ECU_STATE == WAKE_UP      or
              ECU_STATE == PWL)          and
              T_PWL >= C_T_MIN_PWL      and
              PWL_LOCK_CDN Bit NVMY is set
Then       LV_ECU_NVMY_LOCK = 1
Endif
If          LV_ECU_NVMY_LOCK = 1
Then       PWL_KRAM_SAVE = PWL_LOCK_CDN
              PWL_KRAM_SAVE_CPL = complement of PWL_LOCK_CDN
Endif
    
```

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## A.10 ECU temperature diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TECU	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom TECU diagnosis					
LV_CDN_DIAG_TECU	O/V	0... 1H	0 ...1	1	-
Diagnosis condition TECU diagnosis					
LV_END_DIAG_TECU	O/V	0... 1H	0 ...1	1	-
End of diagnosis TECU diagnosis					
LV_ERR_TECU	O/V	0... 1H	0 ...1	1	-
TECU error flag					

### Input data:

LV_IGK {p. 906}	NC_IDX_DIAG_TECU	T_AST_DIAG {p. 1766}	TIA {p. 1226}
VP_TECU {p. 1256}			


### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TECU	-	0... FFH	0... 255	1	-
Anti bounce increment					
C_ABC_MAX_TECU	-	1... FFH	1... 255	1	-
Anti bounce maximum					
C_T_DLY_TECU_DIAG	-	0... FFFFH	0... 32767.5	0.5	s
Delay time for diagnosis activation					
C_TIA_MAX_TECU_DIAG	-	0... FEH	0... 142.5	0.75	°C
TIA threshold TECU diagnosis					
C_VP_TECU_MAX_DIAG	-	0... 7FFFH	0... 4.99984741	15.25879e3	V
TECU_MES threshold for short to VB or line break TECU diagnosis					
C_VP_TECU_MIN_DIAG	-	0... 7FFFH	0... 4.99984741	15.25879e3	V
TECU_MES threshold for short to ground TECU diagnosis					

### Import actions:

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetErrSym</b> (IN<IDX_DIAG>,OUT<ERR_SYM>)
<b>ACTION_ERRM_GetLvCdnDiag</b> (IN<IDX_DIAG>,OUT<LV_CDN_DIAG>)
<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>,OUT<LV_END_DIAG>)
<b>ACTION_ERRM_GetLvErr</b> (IN<IDX_DIAG>,OUT<LV_ERR>)

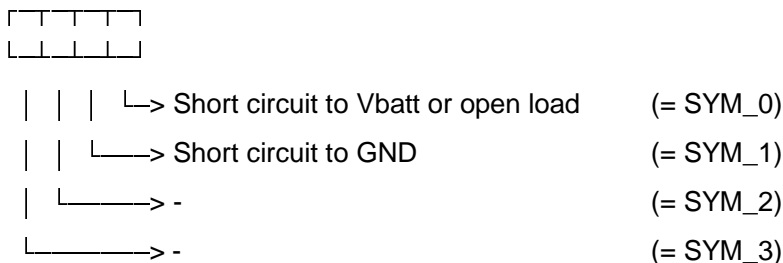
### FUNCTION DESCRIPTION:

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The purpose of the diagnosis shall be to detect electrical faults as defined by OBD I requirements. The input signal is analog from a NTC.

Description:

Error symptoms are defined for this diagnosis function as:



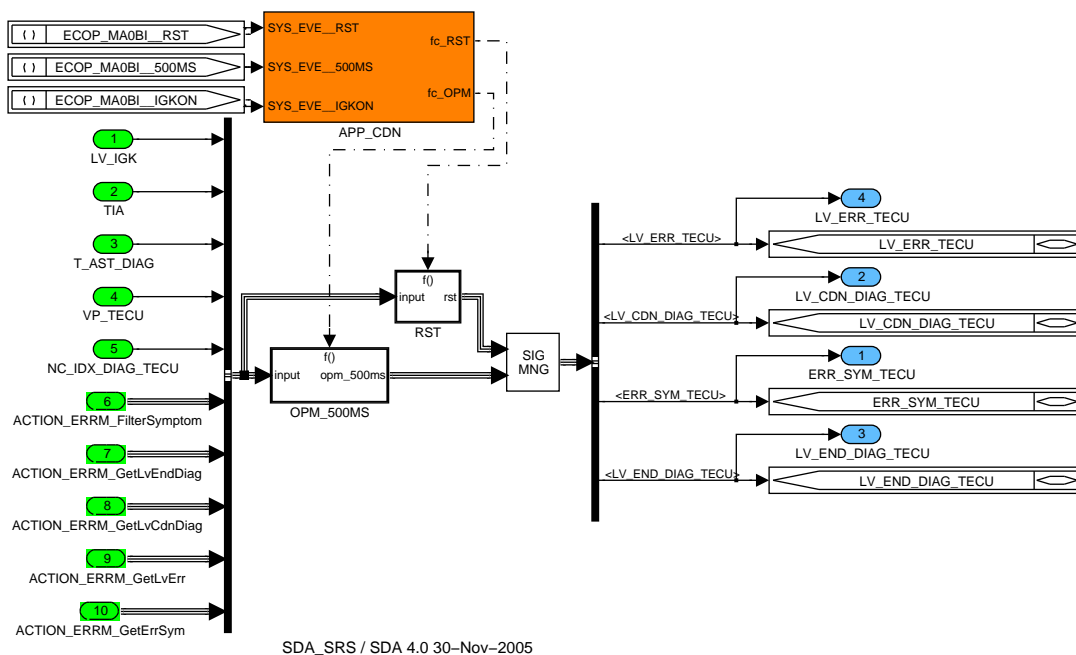


Figure A.10.2: ECOP\_MA0BI


### A.10.1 Initilisation

According ABC configuration **STD\_INI**  
*ABC datas are initialized at transition LV\_IGK 0>1)*

#### Initialisation

Initialisation at system event RESET and IGKON.

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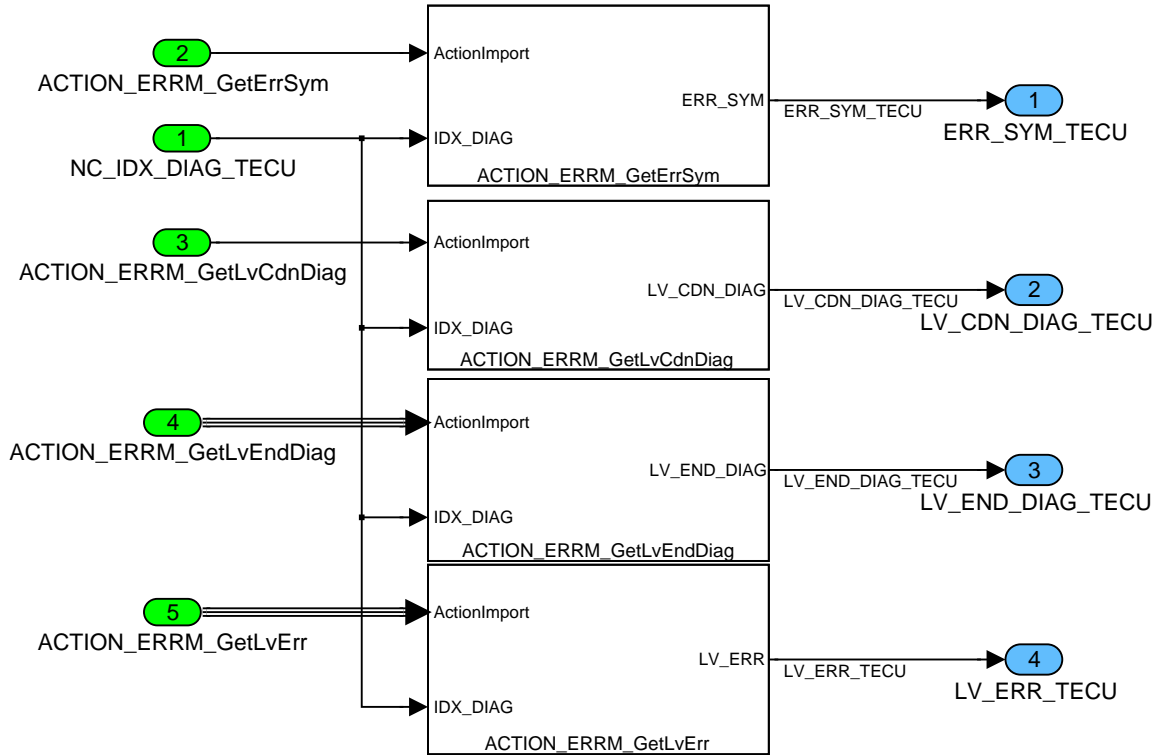


Figure A.10.3: ECOP\_MA0BI/RST/CLC

### A.10.2 Formula Section

#### Activation Condition Check

If LV\_IGK = 1 then the error symptoms are calculated and if false Diagnosis bit is set to 0.

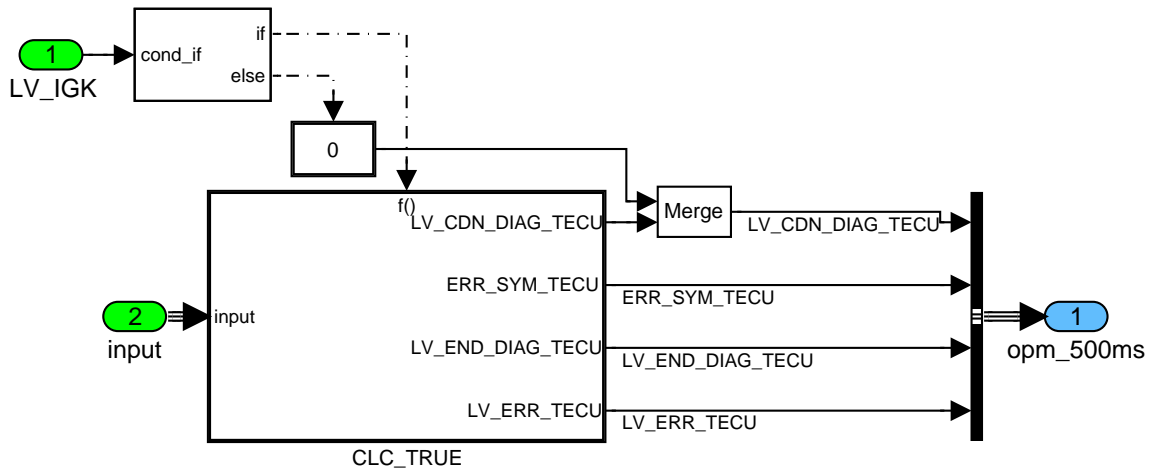


Figure A.10.4: ECOP\_MA0BI/OPM\_500MS/CLC

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### Calculation of Error Management Variables

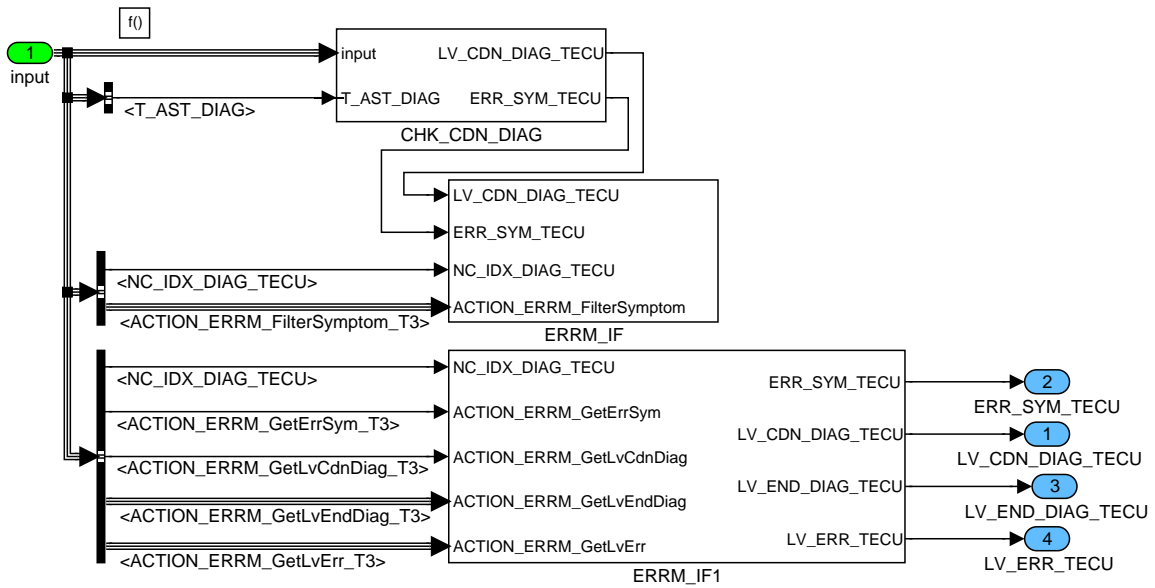


Figure A.10.5: ECOP\_MA0BI/OPM\_500MS/CLC/CLC\_TRUE

### Check Condition

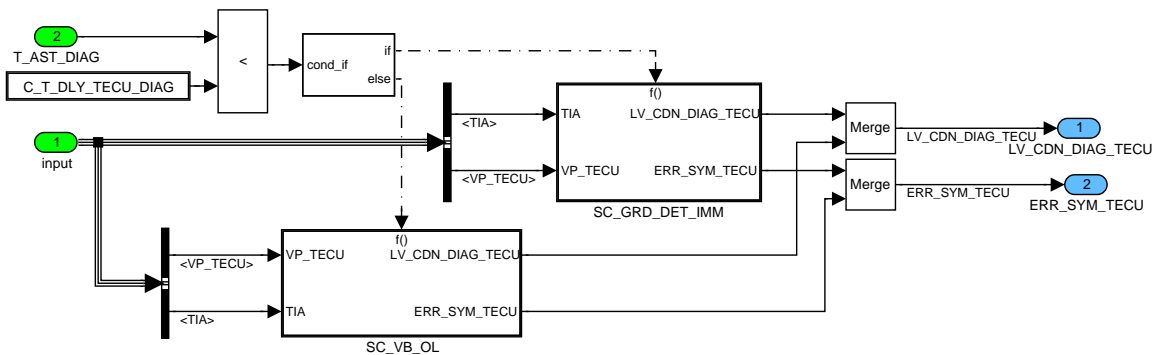


Figure A.10.6: ECOP\_MA0BI/OPM\_500MS/CLC/CLC\_TRUE/CHK\_CDN\_DIAG

### Short circuit to ground can be detected immediately:

ERR\_SYM and LV\_CDN are calculated in this subsystem

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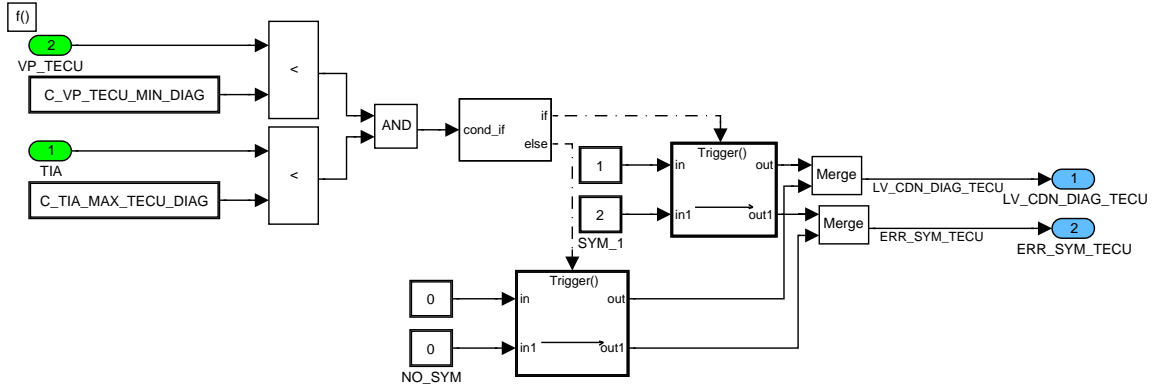


Figure A.10.7: ECOP\_MA0BI/OPM\_500MS/CLC/CLC\_TRUE/CHK\_CDN\_DIAG/SC\_GRD\_DET\_IMM

**Short circuit to VBatt or open load:**

ERR\_SYM and LV\_CDN are calculated in this subsystem

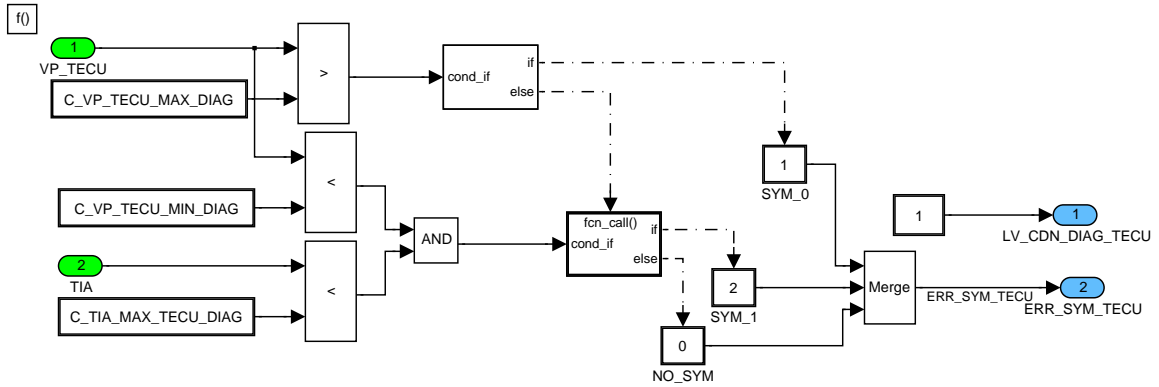


Figure A.10.8: ECOP\_MA0BI/OPM\_500MS/CLC/CLC\_TRUE/CHK\_CDN\_DIAG/SC\_VB\_OL

**Storage of LV\_ERR**

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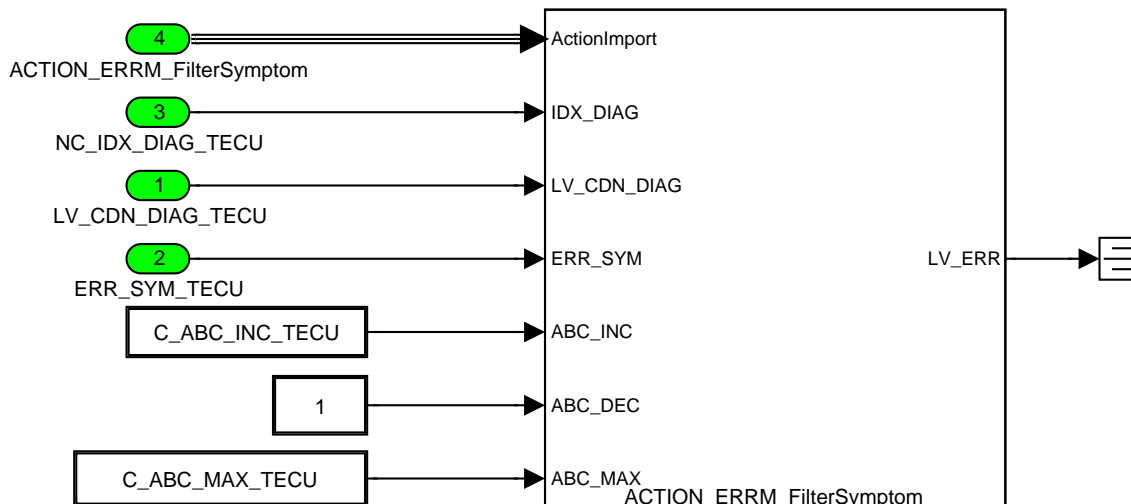


Figure A.10.9: ECOP\_MA0BI/OPM\_500MS/CLC/CLC\_TRUE/ERRM\_IF

**Storage of Error Management Variables**

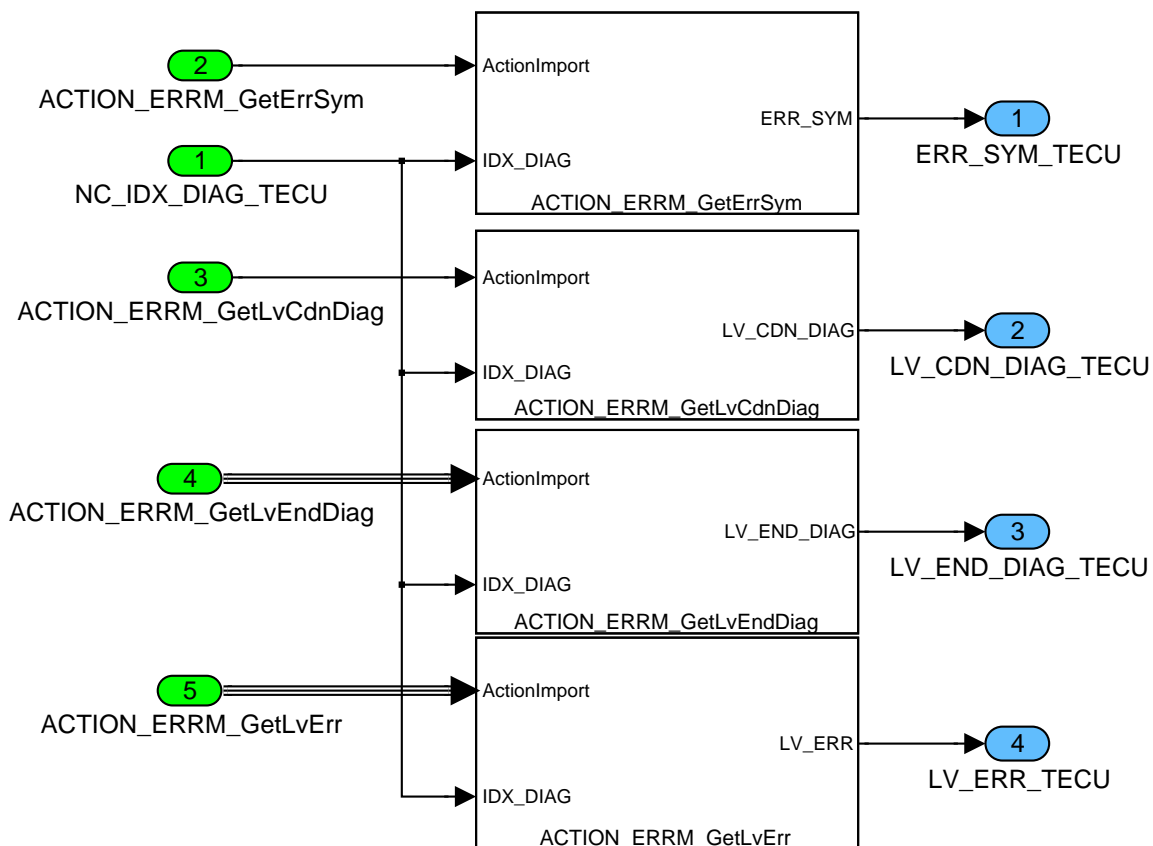


Figure A.10.10: ECOP\_MA0BI/OPM\_500MS/CLC/CLC\_TRUE/ERRM\_IF1


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## A.11 Microcontroller communication diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_SPI_KNK	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		3H	SYM_0, SYM_1		
		4H	SYM_2		
		5H	SYM_0, SYM_2		
		6H	SYM_1, SYM_2		
		7H	SYM_0, SYM_1, SYM_2		
		8H	SYM_3		
		9H	SYM_0, SYM_3		
		AH	SYM_1, SYM_3		
		BH	SYM_0, SYM_1, SYM_3		
		CH	SYM_2, SYM_3		
		DH	SYM_0, SYM_2, SYM_3		
		EH	SYM_1, SYM_2, SYM_3		
		FH	SYM_0, SYM_1, SYM_2, SYM_3		
Detected symptom SPI-busdiagnosis for Knock sensor					
ERR_SYM_SPI_MPS	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		3H	SYM_0, SYM_1		
		4H	SYM_2		
		5H	SYM_0, SYM_2		
		6H	SYM_1, SYM_2		
		7H	SYM_0, SYM_1, SYM_2		
		8H	SYM_3		
		9H	SYM_0, SYM_3		
		AH	SYM_1, SYM_3		
		BH	SYM_0, SYM_1, SYM_3		
		CH	SYM_2, SYM_3		
		DH	SYM_0, SYM_2, SYM_3		
		EH	SYM_1, SYM_2, SYM_3		
		FH	SYM_0, SYM_1, SYM_2, SYM_3		
Detected symptom SPI-busdiagnosis for Multi-powerstage					

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Released by <b>Tettenborn Frank</b>		Date <b>2013-02-13</b>	File <b>17A0AQ01.00A</b>
	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4244 of 8404</b>	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_SPI_KNK	O/V	0... 1H	0 ...1	1	-
Diagnosis condition SPI-bus for Knock sensor					
LV_CDN_DIAG_SPI_MPS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition SPI-bus for Multi-powerstage					
LV_END_DIAG_SPI_KNK	O/V	0... 1H	0 ...1	1	-
End of diagnosis SPI-bus for Knock sensor					
LV_END_DIAG_SPI_MPS	O/V	0... 1H	0 ...1	1	-
End of diagnosis SPI-bus for Multi-powerstage					
LV_ERR_SPI_KNK	O/V	0... 1H	0 ...1	1	-
Present failure SPI-bus diagnosis for Knock sensor					
LV_ERR_SPI_MPS	O/V	0... 1H	0 ...1	1	-
Present failure SPI-bus diagnosis for Multi-powerstage					

**Input data:**

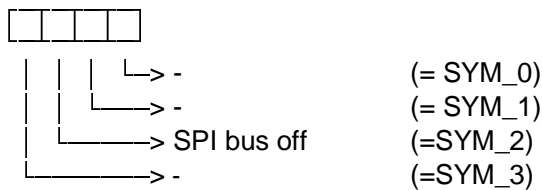
LV_IGK {p. 906}	N_32 {p. 1525}		
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**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_SPI_KNK	-	0... FFH	0... 255	1	-
Anti bounce increment SPI_KNK diagnosis					
C_ABC_INC_SPI_MPS	-	0... FFH	0... 255	1	-
Anti bounce increment SPI_MPS diagnosis					
C_ABC_MAX_SPI_KNK	-	1... FFH	1... 255	1	-
Anti bounce maximum SPI_KNK diagnosis					
C_ABC_MAX_SPI_MPS	-	1... FFH	1... 255	1	-
Anti bounce maximum SPI_MPS diagnosis					

**A.11.1 SPI-Bus diagnosis for Multiple powerstage****Description:**

Error-symptoms are defined to this diagnosis function as following :

**Application conditions**

**Initialization :** all 0 at LV\_IGK 0->1 or reset

**Activation:** at every engine states  
 Recurrency : 10 ms



## A.12 O2 sensor (bin, down) heater circuit diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibit flag for downstream oxygen sensor heater OBDI diagnosis					

### Input data:

LV_CDN_VB_OBD1 {p. 1185}	LV_ERR_SPI_MPS {p. 4245}	LV_LS_DOWN_OBD_1_ MAN_DEAC [NC_CBK_EX_NR] {p. 5449}	LV_ST_END {p. 1720}
NC_CBK_EX_NR {p. 1829}			

### FUNCTION DESCRIPTION:

#### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

#### Description:

The diagnosis is inhibited due to low battery voltage, present error or if sensors are not learnt.

#### Application conditions

**Initialisation:**  $LV\_INH\_DIAG\_LSH\_DOWN[i] = 1$  at reset

**Recurrence:** The function shall be carried out once every 100 ms.

**Activation:**  $LV\_ST\_END = 1$

**Deactivation:**  $LV\_ST\_END = 0$  , set  $LV\_INH\_DIAG\_LSH\_DOWN[i] = 1$

#### Formula section:

**If**  $LV\_CDN\_VB\_OBD1 = 0$  **or**  
 $LV\_ERR\_SPI\_MPS = 1$  **or**  
 $LV\_LS\_DOWN\_OBD\_1\_MAN\_DEAC[i] = 1$   
**Then**  $LV\_INH\_DIAG\_LSH\_DOWN[i] = 1$   
**Else**  $LV\_INH\_DIAG\_LSH\_DOWN[i] = 0$   
**Endif**

## A.13 O2 sensor (bin, down) heater circuit diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_LSH_DOWN [NC_CBK_EX_NR]	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of downstream heater diagnosis OBD I					
ERR_DIAG_LSH_DOWN [NC_CBK_EX_NR]	V	0H 1H 2H 4H	NO_SYM SYM_0 SYM_1 SYM_2	-	-
Raw value of error symptom for downstream heater diagnosis OBD I					
ERR_SYM_LSH_DOWN [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for downstream heater diagnosis OBD I filtered with CDN_DIAG_LSH_DOWN					
LV_CDN_DIAG_LSH_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Diagnosis condition for downstream heater diagnosis OBD I					
LV_END_DIAG_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End of diagnosis for downstream heater diagnosis OBD I					
LV_ERR_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Error flag for downstream heater diagnosis OBD I after debouncing					

### Input data:

LSHPWM_DOWN [NC_CBK_EX_NR] {p. 2421}	LV_IGK {p. 906}	LV_INH_DIAG_LSH_DOWN [NC_CBK_EX_NR] {p. 4247}	LV_VB_CDN_OBD_1 {p. 1046}
NC_CBK_EX_NR {p. 1829}	STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}	TEG_DYN_LS_DOWN [NC_CBK_EX_NR] {p. 1007}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_LSH_DOWN	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_LSH_DOWN	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_LSHPWM_MAX_DIAG_LSH_DOWN	-	0... FFH	0... 99.60937	0.390625	%
Maximum O2-Sensor heater duty cycle to perform the electrical diagnosis					
C_LSHPWM_MIN_DIAG_LSH_DOWN	-	0... FFH	0... 99.60937	0.390625	%
Minimum O2-Sensor heater duty cycle to perform the electrical diagnosis					
C_TEG_DYN_MIN_DIAG_LSH_DOWN	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Minimum exhaust gas temperature threshold to permit SCP to set fault during LSH power rise state					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
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**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_LSH_DOWN	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (typical 2)					

**Import actions:**

<b>ACTION_ERRM_FilterMulticondition</b> (IN<XX>,IN<CDN_DIAG_>,XX>,<IN<>,ERR_DIAG_XX>,<IN>,<C_ABC_INC_XX>,IN<C_ABC_MAX_XX>,OUT<LV_ERR_XX>)
<b>ACTION_INFR_GetEIDiagLshDown</b> (IN<i>,<OUT<cdn_diag>,<OUT<err_diag>)

**Error treatment:**

Diagnostic XX	Symptom description	Symptom	Filter type
Downstream oxygen sensor heater OBDI diagnosis	Short circuit to battery	SYM_0	MPL_STD_INI
	Short circuit to GND	SYM_1	
LSH_DOWN[i]	Open circuit	SYM_2	
	4 <sup>th</sup> symptom description	SYM_3	

**FUNCTION DESCRIPTION:****General information:**

The purpose of the diagnosis is to detect electrical faults as defined by OBD I requirements.

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

All symptoms of the current error code are handled by anti-bouncing.


We assume that only one symptom of an error code can be active at the same time.

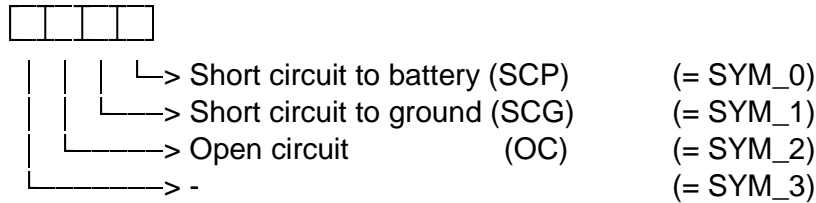
**Description:**

The error detection is effected via the ECU hardware.

The purpose of the diagnosis shall be to detect electrical faults within the oxygen sensor heater circuit as defined by OBD I requirements.

**Error-symptoms and conditions:** are defined to this diagnosis function as following

Released by Tettenborn Frank	Date 2013-02-13	File 30A01N01.00D
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl
	Document key 10171571 SPE 000 AO	Pages Page 4249 of 8404
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The function is intended for use in a hardware configuration where the heater driver shall carry out the electrical fault diagnosis and provide the electrical status via status flags.

1. Short circuit to Vbatt by Over-temperature **or** Overcurrent (SCP)
2. Short circuit to GND (SCG)
3. Open load (OC)

The heater drivers named are capable of detecting an **OC** and **SCP** fault when in the ON state and only capable of detecting a SCG fault in the OFF state. As the heater power is controlled by a PWM signal, the driver will be placed alternately in an ON and then OFF state.

The diagnosis shall be activated should the following conditions be met:

- Engine leaving the engine start state as denoted by LV\_IGK = 1
- Battery voltage falls between pre-set thresholds to protect against false errors at battery voltage extremes as indicated by LV\_VB\_CDN\_OBD\_1.
- CDN depending on duty cycle of LSHPWM\_DOWN[i]
- Inhibit flag not set (LV\_INH\_DIAG\_LSH\_DOWN[i])

In exceptionally rare extreme environmental conditions for certain system configurations, it is possible that the heater driver may be driven into over-temperature during initial oxygen sensor heating. In this case, the driver automatically turns off the output stage in self-protection and sets the **SCP** electrical fault bit. In order to mask an incorrect oxygen sensor heater **SCP** fault, the function shall only allow the **SCP** to set a fault during the initial heater phase, if the exhaust gas temperature has exceeded a pre-determined calibrateable threshold.

The oxygen sensor heater fault detection shall be debounced by use of an anti-bounce counter. This shall be handled by the Dynamic Error Management.

Each of the above listed faults shall be described individually below:

Otherwise the diagnosis has to be suppressed (CDN\_DIAG\_LSH\_DOWN[i] = 0). This is managed within the Diagnosis condition calculation.

### Application conditions

**Initialization:** at reset CDN\_DIAG\_LSHDOWN[i] = 0,  
ERR\_DIAG\_LSH\_DOWN[i] = 0  
All other variables are initialized according filter type

**Activation:** : -

**Deactivation:** -

**Recurrence:** 100 ms

**NOTE: The heater PWM frequency shall be at least 2 times faster than the diagnosis frequency to ensure that an oversampling effect does not occur!**



## A.14 O2 sensor (bin, down) signal circuit diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_FL_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating project specific application conditions for downstream FL diagnosis not met					
LV_INH_DIAG_OC_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating project specific application conditions for downstream open line diagnosis not met					
LV_INH_DIAG_PUC_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating project specific application conditions for downstream PUC diagnosis not met					
LV_INH_DIAG_RBM_OC_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating project specific application conditions for RBM of downstream OC diagnosis not met					
LV_INH_DIAG_RBM_PUC_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating application conditions for RBM of downstream PUC diagnosis not met					
LV_INH_DIAG_RBM_SCG_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating project specific application conditions for RBM of downstream SCG diagnosis not met					
LV_INH_DIAG_SCG_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating project specific application conditions for downstream SCG diagnosis not met					
LV_INH_DIAG_SCP_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating project specific application conditions for downstream short to plus diagnosis not met					
STATE_RBM_OC_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of downstream lambda sensor open-circuit diagnosis with RBM statistics					
STATE_RBM_PUC_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of PUC_LS_DOWN monitor with the Rate-Based Monitoring statistics					
STATE_RBM_SCG_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of downstream lambda sensor short-to-ground diagnosis with RBM statistics					

### Input data:

LC_DIAG_PUE_ACT_LS_DOWN {p. 5191}	LV_DIAG_ACT_REQ_LS_DOWN [NC_CBK_EX_NR] {p. 4266}	LV_END_DIAG_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4266}	LV_END_DIAG_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}
LV_END_DIAG_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}
LV_ERR_CHG_LS_DOWN {p. 5388}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CHK_LS_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_ERR_CRK_PLAUS {p. 4446}

LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_ PER {p. 4432}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_ UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FTL_MIN {p. 4762}
LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}
LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_IVVT {p. 1062}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}
LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_ERR_LSH_LSL_UP [NC_CBK_EX_NR] {p. 5276}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}
LV_ERR_MAF {p. 4815}	LV_ERR_MAP_DIP_ PLAUS {p. 1062}	LV_ERR_MAP_DIP_SENS {p. 4824}	LV_ERR_MAP_DIP_SHIFT {p. 4824}
LV_ERR_MAP_PLAUS {p. 1062}	LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}
LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}	LV_ERR_OBD_LSH_ DOWN [NC_CBK_EX_NR] {p. 5198}	LV_ERR_OBD_VLD_LSH_ UP [NC_CBK_EX_NR] {p. 5438}
LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}
LV_ERR_PUC_VLD_LS_ UP [NC_CBK_EX_NR] {p. 5297}	LV_ERR_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5169}	LV_ERR_REF_CRK_CAM_ EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_ IN [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SHIFT_AFL_ LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_ LSL_UP [NC_CBK_EX_NR] {p. 5334}
LV_ERR_SWT_LS_DOWN [NC_CBK_EX_NR] {p. 5152}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CRK_CAM_ EX [NC_NR_CAM_CBK] {p. 4447}
LV_ERR_SYN_CRK_CAM_ IN [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TPS {p. 4982}

LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VCV {p. 4729}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_FAC_LAM_LIM_MAX [NC_CBK_EX_NR] {p. 2463}
LV_FAC_LAM_LIM_MIN [NC_CBK_EX_NR] {p. 2463}	LV_IGK {p. 906}	LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LS_DOWN_OBD_1_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}
LV_VAR_LSH_DOWN {p. 656}	LV_VB_CDN_OBD_1 {p. 1046}	NC_CBK_EX_NR {p. 1829}	R_IT_LS_DOWN [NC_CBK_EX_NR] {p. 1364}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_FL_LS_DOWN	-	0... FFH	0... 255	1	-
Debounce counter increment for FL plausibility					
C_ABC_INC_OC_LS_DOWN	-	0... FFH	0... 255	1	-
Debounce counter increment for open line electrical check					
C_ABC_INC_PUC_LS_DOWN	-	0... FFH	0... 255	1	-
Debounce counter increment for PUC plausibility					
C_ABC_INC_SCG_LS_DOWN	-	0... FFH	0... 255	1	-
Debounce counter increment for short to ground electrical check					
C_ABC_INC_SCP_LS_DOWN	-	0... FFH	0... 255	1	-
Debounce counter increment for short to plus electrical check					
C_ABC_MAX_FL_LS_DOWN	-	0... FFH	0... 255	1	-
Debounce counter maximum for FL plausibility					
C_ABC_MAX_OC_LS_DOWN	-	0... FFH	0... 255	1	-
Debounce counter maximum for open line electrical check					
C_ABC_MAX_PUC_LS_DOWN	-	0... FFH	0... 255	1	-
Debounce counter maximum for PUC plausibility					
C_ABC_MAX_SCG_LS_DOWN	-	0... FFH	0... 255	1	-
Debounce counter maximum for short to ground electrical check					
C_ABC_MAX_SCP_LS_DOWN	-	0... FFH	0... 255	1	-
Debounce counter maximum for short to plus electrical check					


**Import actions:**

<b>ACTION_ERRM_CheckPendingStatus</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR_PND>)
<b>ACTION_ERRM_CheckPendingStatus</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR_PND>)
<b>ACTION_ERRM_CheckPendingStatus</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR_PND>)

**FUNCTION DESCRIPTION:****General information:**

According the exhaust gas system the variables shall be defined from [i]=1 to NC\_CBK\_EX\_NR.

**Application conditions**

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**Initialisation:** at every transition LV\_IGK = 0 -> 1 or reset all variables shall be reset to 0, except STATE\_RBM\_PUC\_LS\_DOWN[i] //for init of this variable see section below

```

LV_INH_DIAG_FL_LS_DOWN[i] = 0
LV_INH_DIAG_OC_LS_DOWN[i] = 0
LV_INH_DIAG_PUC_LS_DOWN[i] = 0
LV_INH_DIAG_SCG_LS_DOWN[i] = 0
LV_INH_DIAG_SCP_LS_DOWN[i] = 0
LV_INH_DIAG_RBM_PUC_LS_DOWN [i] = 0
LV_INH_DIAG_RBM_OC_LS_DOWN[i] = 0
LV_INH_DIAG_RBM_SCG_LS_DOWN[i] = 0

```

```

at every transition LV_IGK = 1 -> 0
LV_INH_DIAG_FL_LS_DOWN[i] = 1
LV_INH_DIAG_OC_LS_DOWN[i] = 1
LV_INH_DIAG_PUC_LS_DOWN[i] = 1
LV_INH_DIAG_SCG_LS_DOWN[i] = 1
LV_INH_DIAG_SCP_LS_DOWN[i] = 1

```

**Recurrence:** 100 ms

**Activation:** LV\_IGK = 1 **and** LV\_VAR\_LSH\_DOWN = 1

**Deactivation:** LV\_IGK = 0 **or** LV\_VAR\_LSH\_DOWN = 0

### Formula section:

Calculation of LV\_INH\_DIAG\_OC\_LS\_DOWN[i]


```

If      LV_ERR_LSH_DOWN[i] or
          LV_ERR_SCG_LS_DOWN[i] or
          LV_ERR_SCP_LS_DOWN[i] or
          LV_ERR_OBD_LSH_DOWN[i] or
          (i = 1 and
          [ LV_ERR_MIS[0] or
            LV_ERR_MIS[2] or
            LV_ERR_MIS[4]
          ]) or
          (i = 2 and
          [ LV_ERR_MIS[1] or
            LV_ERR_MIS[3] or
            LV_ERR_MIS[5]
          ])
then   LV_INH_DIAG_RBM_OC_LS_DOWN[i] = 1
else   LV_INH_DIAG_RBM_OC_LS_DOWN[i] = 0
endif

If      LV_INH_DIAG_RBM_OC_LS_DOWN[i] = 1 or
          LV_VB_CDN_OBD_1 = 0 or
          LV_LS_DOWN_OBD_1_MAN_DEAC[i]
then   LV_INH_DIAG_OC_LS_DOWN[i] = 1
else   LV_INH_DIAG_OC_LS_DOWN[i] = 0
endif

```

Calculation of LV\_INH\_DIAG\_PUC\_LS\_DOWN[i]

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```

if      LV_ERR_CHG_LS_DOWN                                or
LV_ERR_CHG_LS_UP                                or
LV_ERR_DIAGCPS                                or
LV_ERR_EL_CPS                                  or
LV_ERR_FUP                                    or
LV_ERR_FUP_MFP_PLAUS                           or
LV_ERR_FUP_ORNG                                or
LV_ERR_FUP_ST                                  or
LV_ERR_H_PRS_SYS                               or
LV_ERR_MAF = 1                                 or
LV_ERR_MAP_PLAUS = 1                           or
LV_ERR_MAP_TPS_PLAUS = 1                       or
LV_ERR_VCV                                    or
  LV_ERR_AIR_LSL_UP[i]                          or LV_ERR_CHK_LS_DOWN[i] or
LV_ERR_CTL_LSL_UP[i]                            or
LV_ERR_DELTA_I_LAM[i]                          or
  LV_ERR_DYN_VLD_LS_UP[i]                        or
  LV_ERR_EL_LSL_UP[i]                            or
LV_ERR_FSD [i]                                  or
  LV_ERR_FSD_LAM_LIM[i]                         or
  LV_ERR_LSH_DOWN[i]                            or
LV_ERR_LSH_UP[i]                                or
LV_ERR_LSL_UP_IF[i]                            or
LV_ERR_OBD_LSH_DOWN[i]                         or
LV_ERR_OBD_VLD_LSH_UP[i]                      or
LV_ERR_OC_LS_DOWN[i]                          or
LV_ERR_OC_LSL_UP[i]                            or
LV_ERR_OFS_LSL_UP[i]                          or
LV_ERR_PUC_VLD_LS_UP[i]                       or
  [LV_ERR_PUE_LS_DOWN[i]                        and
LC_DIAG_PUE_ACT_LS_DOWN = 1]                  or
LV_ERR_SCG_LS_DOWN[i]                         or
LV_ERR_SCP_LS_DOWN[i]                         or
  LV_ERR_SHIFT_AFL_LSL_UP[i]                   or
  LV_ERR_SHIFT_AFR_LSL_UP[i]                   or
LV_ERR_SWT_LS_DOWN[i]                         or
LV_ERR_TTIP_MES_LSH_UP[i]                    or
LV_ERR_VLS_DOWN_DIF[i]                       or
  (i = 1                                         and
    [ LV_ERR_IV[0]                               or
      LV_ERR_IV[2]                               or
      LV_ERR_IV[4]
    ])
  (i = 2                                         and
    [ LV_ERR_IV[1]                               or
      LV_ERR_IV[3]                               or
      LV_ERR_IV[5]
    ])
then    LV_INH_DIAG_RBM_PUC_LS_DOWN[i] = 1
else    LV_INH_DIAG_RBM_PUC_LS_DOWN[i] = 0
endif

```



```

if      LV_INH_DIAG_RBM_PUC_LS_DOWN [i]           or
LV_LS_DOWN_OBD_1_MAN_DEAC [i]                   or
LV_VB_CDN_OBD_1 = 0                               or
      R_IT_LS_DOWN[i] > C_R_IT_MAX_DIAG_MPL_LS_DOWN

```

```

Then   LV_INH_DIAG_PUC_LS_DOWN = 1
else   LV_INH_DIAG_PUC_LS_DOWN = 0

```

Calculation of LV\_INH\_DIAG\_FL\_LS\_DOWN[i]

```

IF      LV_LS_DOWN_OBD_1_MAN_DEAC[i]           OR
• LV_ERR_AMP                                     OR
• LV_ERR_AMP_PLAUS                               OR
• LV_ERR_CHG_LS_DOWN                             OR
• LV_ERR_CHG_LS_UP                               OR
• LV_ERR_CRK_PLAUS                               OR
• LV_ERR_CRK_SYN                                  OR
• LV_ERR_CRK_TOOTH                               OR
• LV_ERR_CRK_TOOTH_PER                           OR
• LV_ERR_DIAGCPS                                 OR
• LV_ERR_EL_CPS                                  OR
• LV_ERR_FTL_MIN                                 OR
• LV_ERR_FUP                                      OR
• LV_ERR_FUP_MFP_PLAUS                           OR
• LV_ERR_FUP_ORNG                                OR
• LV_ERR_FUP_ST                                  OR
• LV_ERR_H_PRS_SYS                               OR
• LV_ERR_IVVT                                    OR
• LV_ERR_LOAD_TPS_PLAUS                          OR
• LV_ERR_MAF                                      OR
• LV_ERR_MAP_DIP_PLAUS                           OR
• LV_ERR_MAP_DIP_SENS                            OR
• LV_ERR_MAP_DIP_SHIFT                           OR
• LV_ERR_MAP_TPS_PLAUS                           OR
• LV_ERR_MTC_CTL_2                               OR
• LV_ERR_MTC_CTL_3                               OR
• LV_ERR_MTC_DR                                  OR
• LV_ERR_TPS                                      OR
• LV_ERR_VCV                                      OR
• LV_ERR_FSD[i]                                   OR
• LV_ERR_FSD_LAM_LIM[i]                          OR
• LV_ERR_AIR_LSL_UP[i]                            OR
• LV_ERR_CHK_LS_DOWN[i]                           OR
• LV_ERR_CTL_LSL_UP[i]                            OR
• LV_ERR_DELTA_I_LAM[i]                           OR
• LV_ERR_DYN_VLD_LS_UP[i]                          OR
• LV_ERR_EL_LSL_UP[i]                              OR
• LV_ERR_LSH_DOWN[i]                              OR
• LV_ERR_LSH_LSL_UP[i]                            OR
• LV_ERR_LSH_UP[i]                                OR
• LV_ERR_LSL_UP_IF[i]                             OR

```


```

• LV_ERR_OBD_LSH_DOWN[i] OR
• LV_ERR_OBD_VLD_LSH_UP[i] OR
• LV_ERR_OC_LS_DOWN[i] OR
• LV_ERR_OC_LSL_UP[i] OR
• LV_ERR_OFS_LSL_UP[i] OR
• LV_ERR_PUC_LS_DOWN[i] OR
• LV_ERR_PUC_VLD_LS_UP[i] OR
• [LV_ERR_PUE_LS_DOWN[i]
and LC_DIAG_PUE_ACT_LS_DOWN = 1] OR
• LV_ERR_SCG_LS_DOWN[i] OR
• LV_ERR_SCP_LS_DOWN[i] OR
• LV_ERR_SHIFT_AFL_LSL_UP[i] OR
• LV_ERR_SHIFT_AFR_LSL_UP[i] OR
• LV_ERR_SWT_LS_DOWN[i] OR
• LV_ERR_TTIP_MES_LSH_UP[i] OR
• LV_ERR_VLS_DOWN_DIF[i] OR
• LV_ERR_PER_CAM_EX_1 OR
• LV_ERR_PER_CAM_IN_1 OR
• LV_ERR_PLAUS_CAM_EX_1 OR
• LV_ERR_PLAUS_CAM_IN_1 OR
• LV_ERR_REF_CRK_CAM_EX_1 OR
• LV_ERR_REF_CRK_CAM_IN_1 OR
• LV_ERR_SYN_CAM_EX_1 OR
• LV_ERR_SYN_CAM_IN_1 OR
• LV_ERR_SYN_CRK_CAM_EX_1 OR
• LV_ERR_SYN_CRK_CAM_IN_1 OR
• LV_ERR_TOOTH_OFF_EX_1 OR
• LV_ERR_TOOTH_OFF_IN_1 OR
• (i = 1 AND
[ LV_ERR_IV[0] OR
LV_ERR_IV[2] OR
LV_ERR_IV[4] OR
LV_ERR_MIS[0] OR
LV_ERR_MIS[2] OR
LV_ERR_MIS[4]
]) OR
• (i = 2 AND
[ LV_ERR_IV[1] OR
LV_ERR_IV[3] OR
LV_ERR_IV[5] OR
LV_ERR_MIS[1] OR
LV_ERR_MIS[3] OR
LV_ERR_MIS[5]
]) OR
• LV_VB_CDN_OBD_1 = 0
then LV_INH_DIAG_FL_LS_DOWN[i] = 1
else LV_INH_DIAG_FL_LS_DOWN[i] = 0
endif

```

Calculation of LV\_INH\_DIAG\_SCG\_LS\_DOWN[i]

If LV\_ERR\_CHG\_LS\_DOWN OR

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```

LV_ERR_CHK_LS_DOWN[i] OR
LV_ERR_DELTA_I_LAM[i] OR
LV_ERR_LSH_DOWN[i] OR
LV_ERR_OBD_LSH_DOWN[i] OR
LV_ERR_OC_LS_DOWN[i] OR
LV_ERR_PUC_LS_DOWN[i] OR
[LV_ERR_PUE_LS_DOWN[i] OR
and LC_DIAG_PUE_ACT_LS_DOWN = 1]
LV_ERR_SCP_LS_DOWN[i] OR
LV_ERR_SWT_LS_DOWN[i] OR
LV_ERR_VLS_DOWN_DIF[i] OR
then LV_INH_DIAG_RBM_SCG_LS_DOWN[i] = 1
else LV_INH_DIAG_RBM_SCG_LS_DOWN[i] = 0
endif

if LV_INH_DIAG_RBM_SCG_LS_DOWN[i] = 1 OR
[LV_DIAG_ACT_REQ_LS_DOWN[i] = 0 and
(LV_LAM_LSCL[i] = 0 or
LV_FAC_LAM_LIM_MIN[i] or
LV_FAC_LAM_LIM_MAX[i])] OR
LV_VB_CDN_OBD_1 = 0 OR
LV_LS_DOWN_OBD_1_MAN_DEAC[i]
then LV_INH_DIAG_SCG_LS_DOWN[i] = 1
else LV_INH_DIAG_SCG_LS_DOWN[i] = 0
endif

```

Calculation of LV\_INH\_DIAG\_SCP\_LS\_DOWN[i]

```

if LV_LS_DOWN_OBD_1_MAN_DEAC[i] or
LV_ERR_LSH_DOWN[i] or
LV_ERR_OBD_LSH_DOWN[i] or
LV_ERR_OC_LS_DOWN[i] or
LV_ERR_SCG_LS_DOWN[i] or
LV_VB_CDN_OBD_1 = 0

then LV_INH_DIAG_SCP_LS_DOWN[i] = 1
else LV_INH_DIAG_SCP_LS_DOWN[i] = 0
endif

```

Diagnosis	Symptom	N r	P-Code/ Failure	P-Code/ Symptom	Hardware config	Recurrence	Failure class A/B
Downstream Oxygen Sensor Signal	Short to ground (bank 1/2)	0	see table of failires			100ms	
	SCG_LS_DOWN[i]						
<b>Diagnosis</b>	<b>Symptom</b>	<b>N r</b>	<b>P-Code/ Failure</b>	<b>P-Code/ Symptom</b>	<b>Hardware config</b>	<b>Recurrence</b>	<b>Failure class A/B</b>
Downstream Oxygen Sensor Signal	Short to plus (bank 1/2)	0	see table of failires			100ms	
	SCP_LS_DOWN[i]						
<b>Diagnosis</b>	<b>Symptom</b>	<b>N r</b>	<b>P-Code/ Failure</b>	<b>P-Code/ Symptom</b>	<b>Hardware config</b>	<b>Recurrence</b>	<b>Failure class A/B</b>
Downstream Oxygen Sensor Signal	Open line (bank 1/2)	0	see table of failires			100ms	
	OC_LS_DOWN[i]						
<b>Diagnosis</b>	<b>Symptom</b>	<b>N r</b>	<b>P-Code/ Failure</b>	<b>P-Code/ Symptom</b>	<b>Hardware config</b>	<b>Recurrence</b>	<b>Failure class A/B</b>
Downstream Oxygen Sensor Signal Plausibility	Signal plausibility fault (bank 1/2)	3	see table of failires			100ms	
	PUC_LS_DOWN[i]						
<b>Diagnosis</b>	<b>Symptom</b>	<b>N r</b>	<b>P-Code/ Failure</b>	<b>P-Code/ Symptom</b>	<b>Hardware config</b>	<b>Recurrence</b>	<b>Failure class A/B</b>
Downstream Oxygen Sensor Signal Plausibility	Signal plausibility fault (bank 1/2)	3	see table of failires			100ms	
	FL_LS_DOWN[i]						

## A.14.1 Interface for Rate - Based - Monitoring

### FUNCTION DESCRIPTION:

#### General information:

With this module the interface between the PUC\_LS\_DOWN[i] monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_PUC\_LS\_DOWN[i] data.

Within STATE\_RBM\_PUC\_LS\_DOWN[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)

#### Application conditions

#### Initialisation:


at ECU reset:

bit 0, bit 1 and bit 2 of STATE\_RBM\_PUC\_LS\_DOWN[i] = 0

LV\_DC 0 ->1 transition:

bit 0 and bit 1 of STATE\_RBM\_PUC\_LS\_DOWN [i] = 0

on failure memory reset:

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bit 1 of STATE\_RBM\_PUC\_LS\_DOWN [i] = 0

**Recurrence:** 1 s

**Activation:** LV\_DC = 1

### Formula section:

*At LV\_DC 0 ->1 transition*

bit 2 of STATE\_RBM\_PUC\_LS\_DOWN [i] = 1

The pending status of the following failures has to be checked only once :

Dependence	Error			
	LV_ERR_CHG_LS_DOWN	LV_ERR_CHG_LS_UP	LV_ERR_DIAGCPS	LV_ERR_EL_CPS
	LV_ERR_FUP	LV_ERR_FUP_MFP_PLAUS	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST
	LV_ERR_HPRS_SYS	LV_ERR_MAF_FRQ_EL	LV_ERR_MAF_FRQ_GRD	LV_ERR_MAF_FRQ_RNG
	LV_ERR_MAP_PLAUS	LV_ERR_MAP_TPS_PLAUS	LV_ERR_VCV	
NC_CBK_EX_NR	LV_ERR_FSD[i]	LV_ERR_FSD_LAM_LIM[i]	LV_ERR_AIR_LSL_UP[NC_CBK_EX_NR]	LV_ERR_CHK_LS_DOWN[NC_CBK_EX_NR]
	LV_ERR_CTL_LSL_UP[i]	LV_ERR_DELTA_I_LAM[NC_CBK_EX_NR]	LV_ERR_DYN_VLD_LSL_UP[i]	LV_ERR_EL_LSL_UP[i]
	LV_ERR_LSH_DOWN[NC_CBK_EX_NR]	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]	LV_ERR_OBD_LSH_DOWN[NC_CBK_EX_NR]
	LV_ERR_OBD_VLD_LSH_UP[i]	LV_ERR_OC_LS_DOWN[NC_CBK_EX_NR]	LV_ERR_OC_LSL_UP[i]	LV_ERR_OFS_LSL_UP[i]
	LV_ERR_PUC_VLD_LSL_UP[i]	LV_ERR_SCG_LS_DOWN[NC_CBK_EX_NR]	LV_ERR_SCP_LS_DOWN[NC_CBK_EX_NR]	LV_ERR_SHIFT_AFL_LSL_UP[i]
	LV_ERR_SHIFT_AFR_LSL_UP[i]	LV_ERR_SWT_LS_DOWN[NC_CBK_EX_NR]	LV_ERR_TTIP_MES_LSH_UP[NC_CBK_EX_NR]	LV_ERR_VLS_DOWN_DIF[NC_CBK_EX_NR]
NC_CBK_EX_NR and LC_DIAG_PUE_ACT_LS_DOWN = 1	LV_ERR_PUE_LS_DOWN[NC_CBK_EX_NR]			

Figure A.14.1: For NC\_CBK\_EX\_NR= i = 1

NC_CYL_NR	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	

Figure A.14.2: For NC\_CBK\_EX\_NR= i = 2

NC_CYL_NR	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	

**If(1)** { CPU optimization at LV\_DC 0 ->1 transition }  
 CTR\_ERR\_DYN\_NR <> 0 { the dynamic failure memory isn't empty }

**Then(1)**

**While** bit 1 of STATE\_RBM\_PUC\_LS\_DOWN [i] = 0 do  
 with each XX failure of the above list except LV\_ERR\_PUE\_LS\_DOWN (depending on configuration, see below):  
 ACTION\_ERRM\_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

**If(2)** XX has a pending status

```

    Then(2)          bit 1 of STATE_RBM_PUC_LS_DOWN[i] = 1
    Endif(2)
    For LV_ERR_PUE_LS_DOWN, do the following instead:
    If      LC_DIAG_PUE_ACT_LS_DOWN = 1
    then
        ACTION_ERRM_CheckPendingStatus(IN<XX>,
        OUT<PendingStatus>, SYNCHRONIZATION<CALL>)
        If(3)          XX has a pending status
        Then(3)        bit 1 of STATE_RBM_PUC_LS_DOWN[i] = 1
        Endif(3)
    Endif(2)

    Endwhile

Else(1)          { the dynamic failure memory is empty }      No action
Endif(1)

Every 1 s :
If      bit 0 of STATE_RBM_PUC_LS_DOWN [i] = 0
Then
    If      LV_END_DIAG_PUC_LS_DOWN [i] = 1
    Then    bit 0 of STATE_RBM_PUC_LS_DOWN[i] = 1
    Endif
Endif

If      bit 1 of STATE_RBM_PUC_LS_DOWN [i] = 0
Then
    If      LV_INH_DIAG_RBM_PUC_LS_DOWN [i] = 1
    Then    bit 1 of STATE_RBM_PUC_LS_DOWN [i] = 1
    Endif
Endif

```

## A.14.2 Interface for Rate - Based - Monitoring SCG\_LS\_DOWN[i]

### FUNCTION DESCRIPTION:

#### General information:

With this module the interface between the SCG\_LS\_DOWN[i] monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_SCG\_LS\_DOWN[i] data.

Within STATE\_RBM\_SCG\_LS\_DOWN[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)


- Monitor individual RBM conditions encountered within this DC (bit 2)

#### Application conditions

#### **Initialisation:**

*at ECU reset:*

*bit 0, bit 1 and bit 2 of STATE\_RBM\_SCG\_LS\_DOWN[i] = 0  
LV\_DC 0 ->1 transition:*

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```

    bit 0 and bit 1 of STATE_RBM_SCG_LS_DOWN[i] = 0
    on failure memory reset:
    bit 1 of STATE_RBM_SCG_LS_DOWN[i] = 0

```

**Recurrence:** 1 s

**Activation:** LV\_DC = 1

### Formula section:

At LV\_DC 0 ->1 transition

bit 2 of STATE\_RBM\_SCG\_LS\_DOWN[i] = 1

The pending status of the following failures has to be checked only once:

Dependence	Error			
	LV_ERR_CHG_LS_DOWN			
<b>NC_CBK_EX_N R</b>	LV_ERR_CHK_LS_DOWN N[i]	LV_ERR_DELTA_I_LAM [i]	LV_ERR_LSH_DOWN[i]	LV_ERR_OBD_LSH_D OWN[i]
	LV_ERR_OC_LS_DOWN [i]	LV_ERR_PUC_LS_DOWN N[i]	LV_ERR_SCP_LS_DOWN N[i]	LV_ERR_SWT_LS_DO WN[i]
	LV_ERR_VLS_DOWN_D IF[i]			
<b>NC_CBK_EX_N R and LC_DIAG_PUE_ ACT_LS_DOWN = 1</b>	LV_ERR_PUE_LS_DOW N[i]			

**If(1)** { CPU optimization at LV\_DC 0 ->1 transition }  
CTR\_ERR\_DYN\_NR <> 0 { the dynamic failure memory isn t empty }

**Then(1)**

**While** bit 1 of STATE\_RBM\_SCG\_LS\_DOWN[i] = 0 **do**  
with each XX failure of the above list (depending on configuration, see below)  
except LV\_ERR\_PUE\_LS\_DOWN:  
ACTION\_ERRM\_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

**If(2)** XX has a pending status

**Then(2)** bit 1 of STATE\_RBM\_SCG\_LS\_DOWN[i] = 1

**Endif(2)**

For LV\_ERR\_PUE\_LS\_DOWN[i], do the following instead:

**If** LC\_DIAG\_PUE\_ACT\_LS\_DOWN = 1

**then**

ACTION\_ERRM\_CheckPendingStatus(IN<XX>,  
OUT<PendingStatus>, SYNCHRONIZATION<CALL>)

**If(3)** XX has a pending status

**Then(3)** bit 1 of STATE\_RBM\_SCG\_LS\_DOWN[i] = 1

**Endif(3)**

**Endif(2)**

**Endwhile**

**Else(1)** { the dynamic failure memory is empty } No action

**Endif(1)**

Every 1 s :

**If** bit 0 of STATE\_RBM\_SCG\_LS\_DOWN[i] = 0

**Then**

```

If          LV_END_DIAG_SCG_LS_DOWN[i] = 1
Then          bit 0 of STATE_RBM_SCG_LS_DOWN[i] = 1
Endif

```

**Endif**

```

If          bit 1 of STATE_RBM_SCG_LS_DOWN[i] = 0
Then
If          LV_INH_DIAG_RBM_SCG_LS_DOWN[i] = 1
Then          bit 1 of STATE_RBM_SCG_LS_DOWN[i] = 1
Endif

```

**Endif**

### A.14.3 Interface for Rate - Based - Monitoring OC\_LS\_DOWN[i]

#### FUNCTION DESCRIPTION:

##### General information:

With this module the interface between the OC\_LS\_DOWN[i] monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_OC\_LS\_DOWN[i] data.

Within STATE\_RBM\_OC\_LS\_DOWN[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)

##### Application conditions

**Initialisation:** *at ECU reset:*  
*bit 0, bit 1 and bit 2 of STATE\_RBM\_OC\_LS\_DOWN[i] = 0*  
*LV\_DC 0 ->1 transition:*  
*bit 0 and bit 1 of STATE\_RBM\_OC\_LS\_DOWN[i] = 0*  
*on failure memory reset:*  
*bit 1 of STATE\_RBM\_OC\_LS\_DOWN[i] = 0*

**Recurrence:** 1 s

**Activation:** LV\_DC = 1

##### Formula section:


*At LV\_DC 0 ->1 transition*

bit 2 of STATE\_RBM\_OC\_LS\_DOWN[i] = 1

The pending status of the following failures has to be checked only once:

Dependence	Error			
NC_CBK_EX_N R	LV_ERR_LSH_DOWN[i]	LV_ERR_OBD_LSH_DO WN[i]	LV_ERR_SCG_LS_DOW N[i]	LV_ERR_SCP_LS_DO WN[i]

For i = 1

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NC_CYL_NR	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	
-----------	--------------	--------------	--------------	--

For i = 2

NC_CYL_NR	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	
-----------	--------------	--------------	--------------	--

```

If(1)      { CPU optimization at LV_DC 0 ->1 transition }
             CTR_ERR_DYN_NR <> 0      { the dynamic failure memory isn t empty }
Then(1)
             While      bit 1 of STATE_RBM_OC_LS_DOWN[i] = 0 do
                 with each XX failure of the above list (depending on configuration, see below):
                 ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C
                 If(2)      XX has a pending status
                 Then(2)    bit 1 of STATE_RBM_OC_LS_DOWN[i] = 1
             Endwhile
Else(1)    { the dynamic failure memory is empty }      No action
Endif(1)

```

Every 1 s :

```

If      bit 0 of STATE_RBM_OC_LS_DOWN[i] = 0
Then
             If      LV_END_DIAG_OC_LS_DOWN[i] = 1
                 Then    bit 0 of STATE_RBM_OC_LS_DOWN[i] = 1
                 Endif
             Endif
If      bit 1 of STATE_RBM_OC_LS_DOWN [i] = 0
Then
             If      LV_INH_DIAG_RBM_OC_LS_DOWN[i] = 1
                 Then    bit 1 of STATE_RBM_OC_LS_DOWN[i] = 1
                 Endif
             Endif

```

## A.15 O2 sensor (bin, down) signal circuit diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_R_UPD_DIAG_OC_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Value of handshake counter for last valid resistance value used for diagnosis					
CTR_R_UPD_DIAG_SCG_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Value of handshake counter for last valid resistance value used for short circuit to ground diagnosis					
CTR_SYM_DIAG_SCG_LS_DOWN [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Detection time for SCG					
ERR_SYM_OC_LS_DOWN [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Variable indicating an open circuit fault is currently present on downstream oxygen sensor signal					
ERR_SYM_SCG_LS_DOWN [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Boolean symptom flag, short to ground fault currently present on downstream oxygen sensor signal					
ERR_SYM_SCP_LS_DOWN [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Boolean symptom flag, short to plus fault currently present on downstream oxygen sensor signal					
LV_CDN_DIAG_OC_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Status conditions of downstream oxygen sensor open circuit diagnosis					
LV_CDN_DIAG_SCG_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Status conditions of oxygen sensor short to ground downstream diagnosis					
LV_CDN_DIAG_SCP_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Status conditions of oxygen sensor short to plus downstream diagnosis					
LV_DIAG_ACT_REQ_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request for starting the downstream sensor active plausibility check					
LV_END_DIAG_OC_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Bit to indicate end of downstream oxygen sensor open circuit diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_SCG_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Bit to indicate end of short to ground downstream oxygen sensor signal diagnosis					
LV_END_DIAG_SCP_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Bit to indicate end of short to plus downstream oxygen sensor signal diagnosis					
LV_ERR_EL_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean error flag, electrical fault currently present on downstream oxygen sensor signal					
LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean error flag, open circuit fault currently present on downstream oxygen sensor signal					
LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean error flag, short to ground fault currently present on downstream oxygen sensor signal					
LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean error flag, short to plus fault currently present on downstream oxygen sensor signal					
LV_R_IT_VLD_DIAG_OC_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Valid conditions of resistance of downstream oxygen sensor open circuit diagnosis					
LV_T_CDN_DIAG_OC_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Status conditions of VLS range for the downstream oxygen sensor open circuit diagnosis					
T_ACT_PLS_DIAG_OC_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Delay time for final diagnosis activation					
T_ACT_PLS_DIAG_SCG_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Delay time for final diagnosis activation					
T_CDN_DIAG_OC_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Detection time for status OC before diagnosis					

**Input data:**

CTR_CYCNR_R_IT_LS_DOWN_VLD [NC_CBK_EX_NR] {p. 1364}	LV_CAT_PURGE_ACT [NC_CBK_EX_NR] {p. 2927}	LV_DIAG_CYC_END_LS_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}
LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_IGK {p. 906}
LV_INH_DIAG_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4252}	LV_INH_DIAG_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4252}	LV_INH_DIAG_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4252}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}
MAF_KGH {p. 1195}	NC_CBK_EX_NR {p. 1829}	R_IT_LS_DOWN [NC_CBK_EX_NR] {p. 1364}	STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}
TEG_DYN_LS_DOWN [NC_CBK_EX_NR] {p. 1007}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_MIN_DIAG_SCG_LS_DOWN	-	0... FFH	0... 255	1	-
Minimum duration required for continuous low VLS_DOWN[i] detection					
C_MAF_KGH_MIN_DIAG_SCG_LS_DOWN	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Minimum MAF_KGH flow required for continuous low VLS_DOWN[i] detection					
C_R_IT_MAX_DIAG_SCG_LS_DOWN	-	0... FFFFH	0... 65535	1	ohm
Maximum resistance threshold oxygen sensor internal resistance during short to ground sensor					
C_R_IT_MIN_DIAG_OC_LS_DOWN	-	0... FFFFH	0... 65535	1	ohm
Minimum resistance threshold oxygen sensor internal resistance during open circuit sensor					
C_T_CDN_DIAG_OC_LS_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
Minimum required duration where voltage lies outside of the limits for operable sensor to detect fault					
C_T_DLY_DIAG_OC_LS_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
Minimum required duration where voltage lies outside of the limits for operable sensor to detect fault					
C_T_DLY_DIAG_SCG_LS_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
Minimum duration required for low VLS_DOWN[i] detection					
C_TEG_DYN_MIN_DIAG_OC_LS_DOWN	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Minimum requested exhaust gas temperature for diagnosis					
C_VLS_AFL_THD_DIAG_OC_LS_DOWN	-	0... 3FFH	0... 4.99511	4.88e-3	V
Oxygen sensor voltage-lean mixture threshold for diagnosis					
C_VLS_AFR_THD_DIAG_OC_LS_DOWN	-	0... 3FFH	0... 4.99511	4.88e-3	V
Oxygen sensor voltage-rich mixture threshold for diagnosis					
C_VLS_THD_DIAG_SCG_LS_DOWN	-	0... 3FFH	0... 4.99511	4.88e-3	V
Oxygen sensor voltage threshold under which short to GND may be present					
C_VLS_THD_DIAG_SCP_LS_DOWN	-	0... 3FFH	0... 4.99511	4.88e-3	V
Oxygen sensor voltage threshold over which short to Vbatt present					
LC_DIAG_ACT_CHK_INH	-	0... 1H	0...1	1	-
Inhibition bit for the triggered active diagnosis					


**Error treatment:**

Diagnostic	Symptom description	Symptom	Filter type
<b>XX</b>			
SCG_LS_DOWN[NC_CBK_EX_NR]	short circuit to ground bank i	SYM_1	MEM

Diagnostic	Symptom description	Symptom	Filter type
<b>XX</b>			
SCP_LS_DOWN[NC_CBK_EX_NR]	short circuit to plus bank i	SYM_0	MEM

Diagnostic	Symptom description	Symptom	Filter type
<b>XX</b>			
OC_LS_DOWN[NC_CBK_EX_NR]	Open circuit bank i	SYM_2	MEM

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## FUNCTION DESCRIPTION:

### General information:

According the exhaust gas system shall the variables be defined for [i]=1 to NC\_CBK\_EX\_NR.

The VLS\_DOWN[i] value used for diagnosis purposes shall not be affected should the sensor be "pumped". The value prior to pumping shall be used until the sensor returns to normal operation (no pumping).

Once an electrical fault has been detected and debounced, the plausibility diagnosis shall not be carried out until the electrical fault has been diagnosed as being no longer present. The electrical diagnosis shall remain unaffected by the state of the plausibility diagnosis.

Once an electrical fault has been diagnosed and debounced, the application assistances (Functions that are defined to be affected by the state of the oxygen sensor signal) shall remain active for the remainder of the driving cycle. The restarting of the affected functions during the next driving cycle shall be carried out according to the project philosophy.

The measurement of the oxygen sensor voltage shall not be affected by the detection of a signal fault unless explicitly deactivated.

### Description:

The oxygen sensor signal electrical diagnosis shall detect the following faults:

1. Short circuit of the oxygen sensor signal line to GND
2. Short circuit of the oxygen sensor signal line to Vbatt
3. Open circuit (line break) in the connection to oxygen sensor element

Each fault may set the boolean flag (LV\_ERR\_SCG\_LS\_DOWN[i]; LV\_ERR\_SCP\_LS\_DOWN[i]; LV\_ERR\_OC\_LS\_DOWN[i]) to signal that the particular fault is currently active. Should one of the electrical fault flags (A-C) be set, then a global error flag (LV\_ERR\_EL\_LS\_DOWN[i]) shall be set to indicate that an electrical fault currently exists on the particular oxygen sensor.

Each of the above listed erro shall be described individually in further detail below.

### Application conditions

**Initialisation:** *all variables shall be initialised to 0 with LV\_IGK = 0 -> 1 or reset or at clearing the error memory*

**Recurrence:** *100ms*

**Activation:**

If LV\_IGK = 1

**Deactivation:**


If LV\_IGK = 0

### Formula section:

```

if          LV_ERR_SCG_LS_DOWN[i] = 1
or          LV_ERR_SCP_LS_DOWN[i] = 1
or          LV_ERR_OC_LS_DOWN[i] = 1
then       LV_ERR_EL_LS_DOWN[i] = 1
else       LV_ERR_EL_LS_DOWN[i] = 0
endif

```

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## A.15.1 Short circuit of oxygen sensor signal to GND.

### Description:

According the exhaust gas system shall the variables be defined for [i]=1 to NC\_CBK\_EX\_NR.

In order to determine the electrical fault, short circuit to GND, the oxygen sensor signal voltage is compared to a calibrateable threshold (C\_VLS\_THD\_DIAG\_SCG\_LS\_DOWN) in conjunction with certain activation conditions.

Should a hard short to GND (i.e. approx.  $0 \Omega$ ) exist on the oxygen sensor signal line, the signal voltage will tend to 0 V. This condition may also occur should the air-fuel mixture (AFR) become lean due to a fault in the injection system, due to an air leak, intentional or not, or due to a normal operating conditions. Hence the following additional fault conditions shall be required:

The ignition key shall be determined to be on (LV\_IGK = 1) and the appropriate inhibit flag shall not be set (LV\_INH\_DIAG\_SCG\_LS\_DOWN[i]).

Each time that timer T\_ACT\_PLS\_DIAG\_SCG\_LS\_DOWN[i] exceeded the minimum duration (C\_T\_DLY\_DIAG\_SCG\_LS\_DOWN) for the first time, e.g. first time after engine start or after timer T\_ACT\_PLS\_DIAG\_SCG\_LS\_DOWN[i] has been reset, the CTR\_R\_UPD\_DIAG\_SCG\_LS\_DOWN[i] shall be updated once only with the value CTR\_CYCNR\_R\_IT\_LS\_DOWN\_VLD[i]. This shall ensure that only new internal resistance values be used for diagnosis purposes that have been determined since all the activation conditions have been met.

It shall be determined whether a new internal resistance has been determined by comparing the contents of counter CTR\_R\_UPD\_DIAG\_SCG\_LS\_DOWN[i] with that of CTR\_CYCNR\_R\_IT\_LS\_DOWN\_VLD[i]. Should the counters be unequal, then a new value is available and CTR\_R\_UPD\_DIAG\_SCG\_LS\_DOWN[i] shall be updated with CTR\_CYCNR\_R\_IT\_LS\_DOWN\_VLD[i]. If this conditions and all the above conditions be met, the diagnosis shall be considered to be active.

Should the diagnosis be determined to be active, the oxygen sensor signal voltage shall be compared to the threshold. Should the voltage fall below the threshold and the resistance condition R\_IT\_LS\_DOWN[i] less than threshold be met, a pre - detection counter is incremented. The counter is reset to 0 if the above mentioned conditions are no more fulfilled. If the pre - detection counter counter reached the maximum value then the active check is triggered or if finished the error "Short to GND" is detected. Additionally the triggered active diagnosis can be switched of with LC\_DIAG\_ACT\_CHK\_INH = 1.

### Application conditions


**Initialisation:** *all variables shall be initialised to 0 with LV\_IGK = 0 -> 1 or reset or at clearing the error memory*

**Recurrence:** *T\_SAMPLE = 100ms*

### Activation /Deactivation:

```

If0      LV_IGK = 1
and      LV_INH_DIAG_SCG_LS_DOWN[i] = 0
and      LV_CAT_PURGE_ACT[i] = 0
and      MAF_KGH > C_MAF_KGH_MIN_DIAG_SCG_LS_DOWN
then0 If1  T_ACT_PLS_DIAG_SCG_LS_DOWN[i] C_T_DLY_DIAG_SCG_LS_DOWN
      then1  One-off update CTR_R_UPD_DIAG_SCG_LS_DOWN[i]
            If2  CTR_CYCNR_R_IT_LS_DOWN_VLD[i] ≠
            CTR_R_UPD_DIAG_SCG_LS_DOWN[i]
            Then2 "Diagnosis available"
            LV_CDN_DIAG_SCG_LS_DOWN[i] = 1
            CTR_R_UPD_DIAG_SCG_LS_DOWN[i] =
            CTR_CYCNR_R_IT_LS_DOWN_VLD[i]
            Else2 "Diagnosis NOT available"
            LV_CDN_DIAG_SCG_LS_DOWN[i] = 0
  
```

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```

                Endif2
Else1 LV_CDN_DIAG_SCG_LS_DOWN[i] = 0
      T_ACT_PLS_DIAG_SCG_LS_DOWN[i] =
          T_ACT_PLS_DIAG_SCG_LS_DOWN[i] + T_SAMPLE
    Endif1
Else0 "Diagnosis NOT available"
      T_ACT_PLS_DIAG_SCG_LS_DOWN[i] = 0
      CTR_SYM_DIAG_SCG_LS_DOWN[i] = 0
      LV_CDN_DIAG_SCG_LS_DOWN[i] = 0
      LV_DIAG_ACT_REQ_LS_DOWN[i] = 0

endif0

```

### Formula section:

```

IF0 LV_CDN_DIAG_SCG_LS_DOWN[i] = 1
THEN0 If1 VLS_DOWN[i] < C_VLS_THD_DIAG_SCG_LS_DOWN
      and R_IT_LS_DOWN[i] < C_R_IT_MAX_DIAG_SCG_LS_DOWN
      then1 IF2 CTR_SYM_DIAG_SCG_LS_DOWN[i] > C_CTR_MIN_DIAG_SCG_LS_DOWN
            THEN2 If3 LV_DIAG_CYC_END_LS_DOWN[i] = 1      Active check fin-
              ished
                or LC_DIAG_ACT_CHK_INH = 1
                then3
                  LV_DIAG_ACT_REQ_LS_DOWN[i] = 0
                  ERR_SYM_SCG_LS_DOWN[i] = SYM_1
                  % Error management automatically increment ABC counter
                else3
                  LV_DIAG_ACT_REQ_LS_DOWN[i] = 1      Request active check
                endif3
            ELSE2 CTR_SYM_DIAG_SCG_LS_DOWN[i] =
                  CTR_SYM_DIAG_SCG_LS_DOWN[i] +1
                  ERR_SYM_SCG_LS_DOWN[i] = NO_SYM
                  % Error management automatically decrement ABC counter
            ENDIF2
          else1 LV_DIAG_ACT_REQ_LS_DOWN[i] = 0
                % Error management automatically decrement ABC counter
                ERR_SYM_SCG_LS_DOWN[i] = NO_SYM
                CTR_SYM_DIAG_SCG_LS_DOWN[i] = 0
          endif1
        ENDIF0


```

## A.15.2 Short circuit of oxygen sensor signal to VBATT

### Description:

According the exhaust gas system shall the variables be defined for [i]=1 to NC\_CBK\_EX\_NR.

Should a hard short to Vbatt (i.e. approx. 0 Ω) exist on the oxygen sensor signal line, the signal voltage will tend to Vbatt and the analogue digital converter value will tend to 5 V. This effect does not occur under normal conditions as the sensor delivers typically 1 V for rich AFR at the sensor location and may be used for short to Vbatt detection.

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In order to determine the electrical fault, short circuit to Vbatt, the oxygen sensor signal voltage (VLS\_DOWN[i]) is compared to a calibrateable threshold (C\_VLS\_THD\_DIAG\_SCP\_LS\_DOWN) in conjunction with the herein mentioned activation conditions.

The ignition key shall be determined to be on (LV\_IGK = 1) and the appropriate inhibit flag shall not be set (LV\_INH\_DIAG\_SCP\_LS\_DOWN[i]).

Should the oxygen signal voltage exceed the said threshold, a signal short to Vbatt shall be determined to be present and the debounce counter shall be incremented otherwise the debounce counter shall be decremented.

The error flag LV\_ERR\_SCP\_LS\_DOWN[i] shall be set once the anti-bounce counter has reached its maximum value and reset should the anti-bounce counter reach 0.

### Application conditions

**Initialisation:** *all variables shall be initialised to 0 with LV\_IGK = 0 -> 1 or reset or at clearing the error memory*

**Recurrence:** *100ms*

*Activation /Deactivation:*

```

if          LV_IGK = 1
and        LV_INH_DIAG_SCP_LS_DOWN[i] = 0
then       “Diagnosis available”
             LV_CDN_DIAG_SCP_LS_DOWN[i] = 1
else       “Diagnosis NOT available”
             LV_CDN_DIAG_SCP_LS_DOWN[i] = 0
endif

```

### Formula section:

```

if          LV_CDN_DIAG_SCP_LS_DOWN[i] = 1
then       if          VLS_DOWN[i] > C_VLS_THD_DIAG_SCP_LS_DOWN
             then       “Short to Vbatt fault present”
                       % Error management automatically increment ABC counter
                       ERR_SYM_SCP_LS_DOWN[i] = SYM_0           %SHORT TO PLUS

             else       ERR_SYM_SCP_LS_DOWN[i] = "NO_SYM"
                       % Error management automatically decrement ABC counter
             endif
endif

```

## **A.15.3 Open circuit (line break) in connection to oxygen sensor element.**


### Description:

According the exhaust gas system shall the variables be defined for [i]=1 to NC\_CBK\_EX\_NR.

Should a complete open circuit occur in the oxygen sensor signal or return line, the measured voltage at the input to the microcontroller will tend to the voltage determined by the operative readiness potential divider (approx. 450 mV) and the measured internal resistance will be abnormally high.

In order to determine an open circuit electrical fault, the oxygen sensor internal resistance (R\_IT\_LS\_DOWN[i]) is compared to a calibrateable threshold (C\_R\_IT\_MIN\_DIAG\_OC\_LS\_DOWN) in conjunction with certain activation conditions shown below:

The ignition key shall be determined to be on (LV\_IGK = 1) and the appropriate inhibit flag shall not be set (LV\_INH\_DIAG\_OC\_LS\_DOWN[i]).

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The sensor shall be determined to be in a state of operative readiness (LV\_LS\_DOWN\_READY[i] = 1, possibly thorough forced activation) and the temperature operating conditions of the sensor shall be determined to be sufficient to permit normal operation, i.e. No fault shall be determined to be present in the appropriate downstream oxygen sensor heater (LV\_ERR\_LSH\_DOWN[i] = 0) or if so that the operating temperature be determined to be sufficient for sensor operability (TEG\_DYN\_LS\_DOWN[i] > C\_TEG\_DYN\_MIN\_DIAG\_OC\_LS\_DOWN), and the appropriate heater shall be determined to being controlled normally (STATE\_LSH\_DOWN[i] = LSH\_POW\_CTL).

Should the above initial conditions be met, a timer (T\_ACT\_PLS\_DIAG\_OC\_LS\_DOWN[i]) shall be incremented. Should the conditions no longer be met, both timers shall be reset and flag LV\_T\_CDN\_DIAG\_OC\_LS\_DOWN[i] reset.

The oxygen sensor signal shall be determined to lie in a calibrateable voltage band (C\_VLS\_AFL\_THD\_DIAG\_OC\_LS\_DOWN < VLS\_DOWN[i] < C\_VLS\_AFR\_THD\_DIAG\_OC\_LS\_DOWN).

Should the above listed pre-activation conditions be determined to have been met, a timer T\_CDN\_DIAG\_OC\_LS\_DOWN[i] shall be started. The timer shall be required to equal or exceed a minimum calibrateable duration (C\_T\_CDN\_DIAG\_OC\_LS\_DOWN). When no longer met, T\_CDN\_DIAG\_OC\_LS\_DOWN[i] and LV\_T\_CDN\_DIAG\_OC\_LS\_DOWN[i] shall be reset.

Each time that the T\_CDN\_DIAG\_OC\_LS\_DOWN[i] has exceeded the minimum duration for the first time, e.g. first time after engine start or after the T\_CDN\_DIAG\_OC\_LS\_DOWN[i] has been reset, the CTR\_R\_UPD\_DIAG\_OC\_LS\_DOWN[i] shall be updated once only with the value CTR\_CYCNR\_R\_IT\_LS\_DOWN\_VLD[i]. This shall ensure that only new internal resistance values be used for diagnosis purposes that have been determined since all the activation conditions have been met.

It shall be determined whether a new internal resistance has been determined by comparing the contents of counter CTR\_R\_UPD\_DIAG\_OC\_LS\_DOWN[i] with that of CTR\_CYCNR\_R\_IT\_LS\_DOWN\_VLD[i]. Should the counters be unequal, then a new value is available and CTR\_R\_UPD\_DIAG\_OC\_LS\_DOWN[i] shall be updated with CTR\_CYCNR\_R\_IT\_LS\_DOWN\_VLD[i] and a flag LV\_R\_IT\_VLD\_DIAG\_OC\_LS\_DOWN[i] be set, thus indicating that the voltage lies within the set band and that a new resistance value is available.

If either LV\_T\_CDN\_DIAG\_OC\_LS\_DOWN[i] is set or T\_ACT\_PLS\_DIAG\_OC\_LS\_DOWN[i] equals or exceeds threshold C\_T\_DLY\_DIAG\_OC\_LS\_DOWN, the diagnosis shall be considered to be available.

Should the diagnosis be determined to be available and the condition LV\_R\_IT\_VLD\_DIAG\_OC\_LS\_DOWN[i] has been met, the oxygen sensor internal resistance shall be compared to the said threshold. Should the resistance exceed the threshold, a signal open circuit shall be determined to be present and the debounce counter shall be incremented otherwise the debounce counter shall be decremented.

The error flag LV\_ERR\_OC\_LS\_DOWN[i] shall be set once the anti-bounce counter has reached its maximum and reset should the anti-bounce counter reach 0.

## Application conditions

**Initialisation:** *all variables shall be initialised to 0 with LV\_IGK = 0 -> 1 or reset or at clearing the error memory*

Recurrence: T\_SAMPLE = 100ms


Activation /Deactivation:

**If** LV\_IGK = 1  
**and** LV\_INH\_DIAG\_OC\_LS\_DOWN[i] = 0  
**and** LV\_LS\_DOWN\_READY[i] = 1  
**and** (LV\_ERR\_LSH\_DOWN[i] = 0  
**or** TEG\_DYN\_LS\_DOWN[i] > C\_TEG\_DYN\_MIN\_DIAG\_OC\_LS\_DOWN)  
**and** STATE\_LSH\_DOWN[i] = LSH\_POW\_CTL

**then**

T\_ACT\_PLS\_DIAG\_OC\_LS\_DOWN[i] = T\_ACT\_PLS\_DIAG\_OC\_LS\_DOWN[i] +

T\_SAMPLE

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```

One-off update CTR_R_UPD_DIAG_OC_LS_DOWN[i]
If CTR_CYCNR_R_IT_LS_DOWN_VLD[i] ≠ CTR_R_UPD_DIAG_OC_LS_DOWN[i]
then CTR_R_UPD_DIAG_OC_LS_DOWN[i]
           = CTR_CYCNR_R_IT_LS_DOWN_VLD[i]
           LV_R_IT_VLD_DIAG_OC_LS_DOWN[i] = 1
else LV_R_IT_VLD_DIAG_OC_LS_DOWN[i] = 0
endif
If C_VLS_AFL_THD_DIAG_OC_LS_DOWN < VLS_DOWN[i]
           < C_VLS_AFR_THD_DIAG_OC_LS_DOWN
then
           If T_CDN_DIAG_OC_LS_DOWN[i] C_T_CDN_DIAG_OC_LS_DOWN
           then LV_T_CDN_DIAG_OC_LS_DOWN[i] = 1
           else LV_T_CDN_DIAG_OC_LS_DOWN[i] = 0
           T_CDN_DIAG_OC_LS_DOWN[i] =
           T_CDN_DIAG_OC_LS_DOWN[i] + T_SAMPLE
           endif
           else T_CDN_DIAG_OC_LS_DOWN[i] = 0
           LV_T_CDN_DIAG_OC_LS_DOWN[i] = 0
           endif
else T_CDN_DIAG_OC_LS_DOWN[i] = 0
           T_ACT_PLS_DIAG_OC_LS_DOWN[i] = 0
           LV_R_IT_VLD_DIAG_OC_LS_DOWN[i] = 0
           LV_T_CDN_DIAG_OC_LS_DOWN[i] = 0
endif
If (T_ACT_PLS_DIAG_OC_LS_DOWN[i] C_T_DLY_DIAG_OC_LS_DOWN
or LV_T_CDN_DIAG_OC_LS_DOWN[i] = 1)
and LV_R_IT_VLD_DIAG_OC_LS_DOWN[i] = 1
then "Diagnosis available"
           LV_CDN_DIAG_OC_LS_DOWN[i] = 1
else "Diagnosis NOT available"
           LV_CDN_DIAG_OC_LS_DOWN[i] = 0
endif

```

*NOTE: The variable CTR\_CYCNR\_R\_VLS\_DOWN\_DIAG\_i shall be updated with the current value of the input variable CTR\_CYCNR\_R\_IT\_LS\_DOWN\_VLD[i] on each occasion that the TIMER\_3 exceeds the minimum for the first time. For further function calls where the TIMER\_3 condition is met, the one-off update shall not be carried out. This shall continue until the TIMER\_3 condition is no longer met.*

#### Formula section:

```

If LV_CDN_DIAG_OC_LS_DOWN[i] = 1
then If R_IT_LS_DOWN[i] > C_R_IT_MIN_DIAG_OC_LS_DOWN
           and LV_T_CDN_DIAG_OC_LS_DOWN[i] = 1
           then "Open circuit fault present"
           % Error management automatically increment ABC counter
           ERR_SYM_OC_LS_DOWN[i] = sym_2 %"OPEN LINE"

           else ERR_SYM_OC_LS_DOWN[i] = "NO_SYM"
           % Error management automatically decrement ABC counter
           endif
endif

```

## A.16 O2 sensor (bin, down) signal range diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_FL_LS_DOWN [NC_CBK_EX_NR]	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Boolean error flag, fault currently present on downstream oxygen sensor signal					
ERR_SYM_PUC_LS_DOWN [NC_CBK_EX_NR]	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Boolean error flag, fault currently present on downstream oxygen sensor signal					
LV_CDN_DIAG_FL_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Status conditions of oxygen sensor downstream diagnosis					
LV_CDN_DIAG_PUC_LS_DOWN [NC_CBK_EX_NR]	O/V	0H	PASSIVE	-	-
		1H	ACTIVE		
Status conditions of oxygen sensor downstream diagnosis					
LV_DIAG_CDN_PLAUS_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag, plausibility check on downstream oxygen sensor signal possible					
LV_DIAG_PUC_CHG_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Reminder flag for fuel cut off was active					
LV_END_DIAG_FL_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Bit to indicate end of complete downstream oxygen sensor signal diagnosis					
LV_END_DIAG_PUC_LS_DOWN [NC_CBK_EX_NR]	O/V	0H	PASSIVE	-	-
		1H	ACTIVE		
Bit to indicate end of complete downstream oxygen sensor signal diagnosis					
LV_ERR_FL_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean error flag, FL plausibility fault currently present on downstream oxygen sensor signal					
LV_ERR_PLAUS_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag, error plausibility check on downstream oxygen sensor signal					
LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR]	O/V	0H	PASSIVE	-	-
		1H	ACTIVE		
Boolean error flag, PUC plausibility fault currently present on downstream oxygen sensor signal					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_VLS_DOWN_PUC_AFR_VLD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable indicating that rich voltage threshold has been exceeded before entering PUC phase					
MAF_INT_FL [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1820.42	0.0277778	g
integral of air mass flow while FL active					
MAF_INT_PUC_ACT_OLD	-	0... FFFFH	0... 2912.66666	0.0444444	g
MAF integral during PUC from previous recurrence					
MAF_INT_PUC_NOT_LS_DOWN_DIAG [NC_CBK_EX_NR]	V	0... FFFFH	0... 2912.66666	0.0444444	g
MAF integral out of PUC in case of certain load threshold exceeded					
VLS_DOWN_PUC_ERR [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511	4.8828e-3	V
Last VLS_DOWN value not plausible for PUC conditions					
VLS_DOWN_PUC_OK [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511	4.8828e-3	V
Last VLS_DOWN value satisfying PUC plausibility					
VLS_DOWN_PUC_PLAUS_VLD [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511	4.8828e-3	V
VLS_DOWN[i] value before entering fuel-cut phase					
VLS_DOWN_PUC_SAVE [NC_CBK_EX_NR]	O/V/S	0... 3FFH	0... 4.99511	4.8828e-3	V
Mode 6 value describing last VLS_DOWN PUC plausibility result					

**Input data:**

LV_DIAG_CDN_PLAUS_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_ERR_EL_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_FL_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}
LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_FL {p. 1759}	LV_IGK {p. 906}	LV_INH_DIAG_FL_LS_DOWN [NC_CBK_EX_NR] {p. 4252}
LV_INH_DIAG_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4252}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_PUC {p. 1720}	LV_ST_END {p. 1720}
MAF_CYL {p. 8277}	MAF_INT_FL [NC_CBK_EX_NR] {p. 4276}	MAF_INT_PUC_ACT {p. 2942}	MAF_KGH {p. 1195}
NC_CBK_EX_NR {p. 1829}	STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_UP [NC_CBK_EX_NR] {p. 1341}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_MAF_INT_LS_DOWN_DIAG	-	0... FFH	0... 31.875	0.125	-
Factor for impact of fuel cut off phase to the sensor temperature					
C_MAF_INT_MAX_DIAG_FL_LS_DOWN	-	0... FFFFH	0... 1820.42	0.0277778	g
Maximum threshold for MAF integral to end downstream FL signal plausibility					
C_MAF_INT_MAX_DIAG_PUC_LS_DOWN	-	0... FFFFH	0... 2912.66666	44.4e-3	g
Maximum threshold for MAF integral to end downstream PUC signal plausibility					
C_MAF_INT_MIN_DIAG_FL_LS_DOWN	-	0... FFFFH	0... 1820.42	0.0277778	g
Minimum threshold for MAF integral required to start downstream FL signal plausibility					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_INT_MIN_DIAG_PUC_LS_DOWN	-	0... FFFFH	0... 2912.66666	44.4e-3	g
Minimum threshold for MAF integral required to start downstream PUC signal plausibility					
C_MAF_INT_PUC_NOT_LS_DOWN_DIAG	-	0... FFFFH	0... 2912.66666	44.4e-3	g
Minimum threshold for MAF integral out of PUC required to start downstream PUC signal plausibility					
C_MAF_KGH_MIN_LS_DOWN_DIAG	-	0... FFFFH	0... 2047.96875	31.25e-3	kg/h
Minimum MAF_KGH to start MAF integral					
C_VLS_DOWN_PUC_AFR_VLD	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Rich voltage monitoring threshold between fuel-cut phases					
C_VLS_DOWN_PUC_PLAUS_VLD	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Rich voltage threshold for activation of PUC plausibility diagnosis					
C_VLS_MAX_DIAG_FL_LS_DOWN	-	0... 3FFH	0... 4.99511	4.8828e-3	V
VLS voltage threshold for FL fault detection					
C_VLS_MIN_DIAG_PUC_LS_DOWN	-	0... 3FFH	0... 4.99511	4.88e-3	V
VLS voltage threshold for PUC fault detection					
C_VLS_UP_MAX_MAF_INT_AFR	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Upstream maximum VLS to enable MAF_INT_AFR integration					
C_VLS_UP_MIN_MAF_INT_AFR	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Upstream minimum VLS to enable MAF_INT_AFR integration					
LC_MAF_INT_FL_CDN_AFR	-	0... 1H	0 ...1	1	-
Flag to indicate that upstream rich signal instead of LV_FL should enable the MAF_INT_FL integral					

### Error treatment:

Diagnostic XX	Symptom description	Symptom	Filter type
PUC_LS_DOWN[NCBK_EX_NR]	Signal high during fuel cut off	SYM_3	MEM


Diagnostic XX	Symptom description	Symptom	Filter type
FL_LS_DOWN[NCBK_EX_NR]	Signal low during full load	SYM_3	MEM

### FUNCTION DESCRIPTION:

#### General information:

Due to possible oxygen sensor defects (e.g. reference air poisoning) or faults in the injection system (e.g. leaking fuel injector), the oxygen sensor may not provide the expected lean or rich AFR signal level during overrun fuel cut-off (PUC) or full load (FL) condition. Hence, the oxygen sensor signal shall be checked for plausibility during this engine operating states.

#### Description:

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If the following conditions are met, then the general conditions for plausibility check are determined to be present:

1. Ignition key shall be determined to be on (LV\_IGK = 1)
2. No electrical oxygen sensor fault shall be determined to be present on the sensor being diagnosed (LV\_ERR\_EL\_LS\_DOWN[i] = 0).
3. Sensor shall be in a state of operative readiness (LV\_LS\_DOWN\_READY[i] = 1).
4. The sensor shall be determined to be at operating temperature (STATE\_LSH\_DOWN[i] = LSH\_POW\_CTL & LV\_ERR\_LSH\_DOWN[i] = 0).

The corresponding flag LV\_DIAG\_CDN\_PLAUS\_LS\_DOWN[i] shall then be set.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

### Application conditions

#### **Initialisation:**

At the transition LV\_IGK = 0 -> 1, reset or clearing the error memory, reset of all variables and bits to 0

*Recurrence:*            **T\_sample 10 ms**

#### *Activation /Deactivation:*

```

if                    LV_IGK = 1
and                    LV_ERR_EL_LS_DOWN[i] = 0
and                    LV_LS_DOWN_READY[i] = 1
and                    LV_ERR_LSH_DOWN[i] = 0
and                    STATE_LSH_DOWN[i] = LSH_POW_CTL
then                  Diagnosis available
                         LV_DIAG_CDN_PLAUS_LS_DOWN[i] = 1
else                  Diagnosis NOT available
                         LV_DIAG_CDN_PLAUS_LS_DOWN[i] = 0
endif

```

#### Formula section:

```


if                    LV_ERR_PUC_LS_DOWN[i] = 1
or                    LV_ERR_FL_LS_DOWN[i] = 1
then                  LV_ERR_PLAUS_LS_DOWN[i] = 1
else                  LV_ERR_PLAUS_LS_DOWN[i] = 0
endif

```

## **A.16.1 Overrun fuel cut-off (PUC) oxygen sensor signal plausibility**

### FUNCTION DESCRIPTION:

#### General information:

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**Description:**

Should the oxygen sensor signal voltage (VLS\_DOWN[i]) exceed the calibrateable thresholds (C\_VLS\_MIN\_DIAG\_PUC\_LS\_DOWN) during engine operating state PUC and the following additional conditions are met, then a fault shall be determined to be present:

1. The appropriate inhibit flag shall not be set (LV\_INH\_DIAG\_PUC\_LS\_DOWN[i]).
2. Plausibility check set to be possible (LV\_DIAG\_CDN\_PLAUS\_LS\_DOWN[i] = 1)
3. The PUC state (LV\_PUC = 1) shall be determined to be stable, as determined by comparing the mass air flow integral calculated after activation (MAF\_INT\_PUC\_ACT) with the threshold range (C\_MAF\_INT\_MIN\_VLS\_DOWN\_DIAG; C\_MAF\_INT\_MAX\_VLS\_DOWN\_DIAG).
4. The energy transfer from the exhaust gas to the oxygen sensor shall exceed the calibratable threshold (C\_MAF\_INT\_PUC\_NOT\_LS\_DOWN\_DIAG).
5. The reset of the MAF integral from the last fuel cut off phase must have taken place before activating the diagnosis. Otherwise there is a risk to set the conditions to 1 right at the beginning of the fuel cut off phase. At this time, the lambda sensor voltage downstream is still high and the error symptom would be set for one recurrence.
6. Prior to the PUC phase the VLS\_DOWN[i] must have exceeded the voltage thresholds C\_VLS\_DOWN\_PUC\_PLAUS\_VLD and C\_VLS\_DOWN\_PUC\_AFR\_VLD.

The error flag LV\_ERR\_PUC\_LS\_DOWN[i] shall be set once the anti-bounce counter has reached its maximum value and reset should the anti-bounce counter reach 0.

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then


i = 1, for exhaust cylinder bank 1

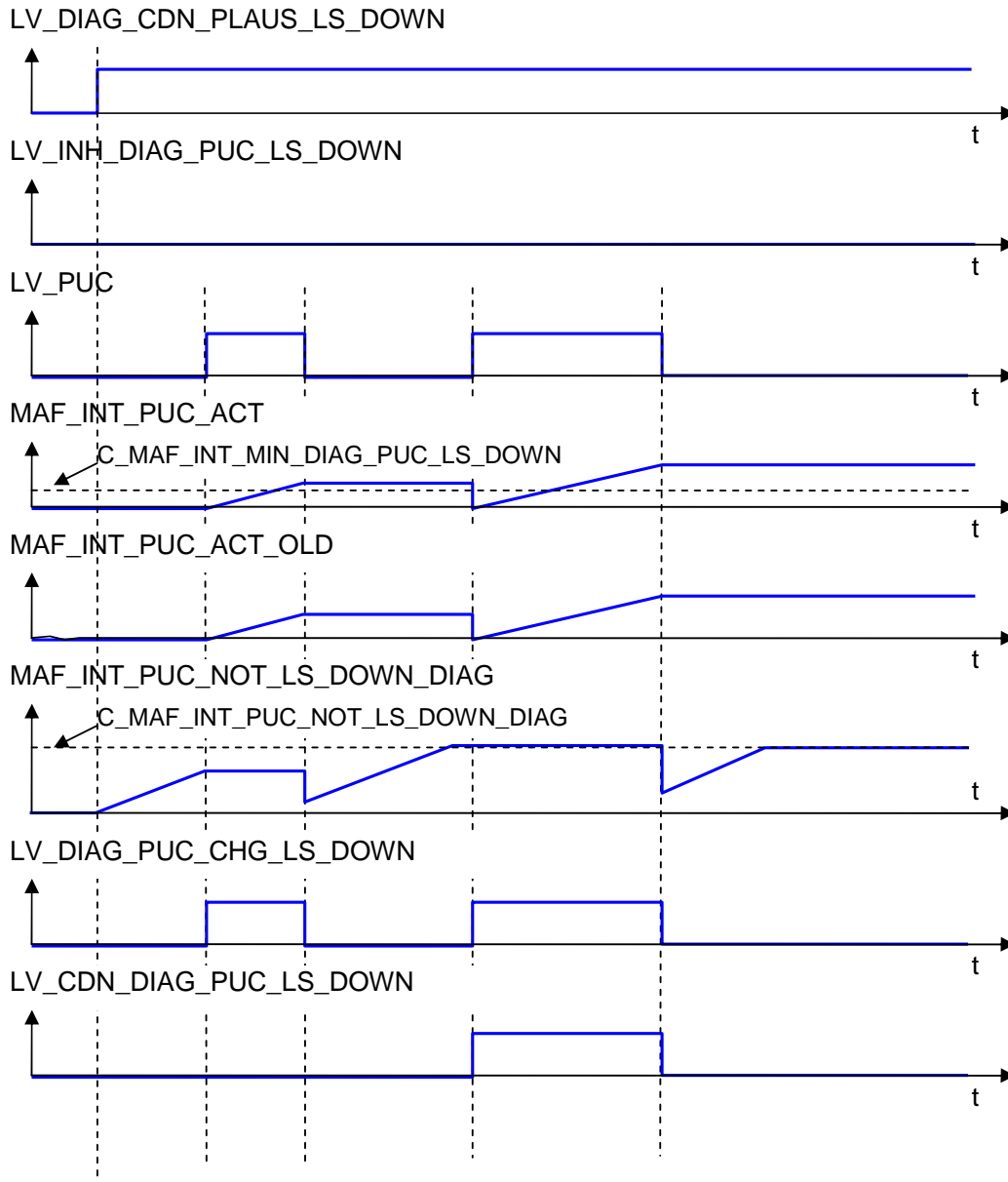
i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

Correlation between MAF integrals MAF\_INT\_PUC\_ACT, MAF\_INT\_PUC\_ACT\_OLD and MAF\_INT\_PUC\_NOT\_LS\_DOWN\_DIAG and diagnosis activation :

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### Application conditions


#### Initialisation:

At the transition  $LV\_IGK = 0 \rightarrow 1$ , reset or clearing the error memory, reset of all variables and bits to 0, except  $VLS\_DOWN\_PUC\_SAVE$ .  $VLS\_UP\_PUC\_SAVE[i]$  shall be initialised to 0 at new ECU and in case of NVMY checksum errors.

Recurrence: **T\_sample 100ms**

Activation /Deactivation: -

#### Formula section:

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Conditions to start the downstream lambda sensor signal observation

```


If (1)          LV_PUC = 0
And(1)         VLS_DOWN[i] > C_VLS_DOWN_PUC_AFR_VLD
Then(1)        LV_VLS_DOWN_PUC_AFR_VLD[i] = 1
Elseif(1)       LV_PUC = 1 --> 0
Then(1)        LV_VLS_DOWN_PUC_AFR_VLD[i] = 0
Endif(1)
If(1)          LV_PUC = 0 --> 1
Then(1)        VLS_DOWN_PUC_PLAUS_VLD[i] = VLS_DOWN[i]
Endif(1)

If(1)          LV_DIAG_CDN_PLAUS_LS_DOWN[i] = 1
And(1)         LV_INH_DIAG_PUC_LS_DOWN[i] = 0
And(1)         LV_PUC = 1
Then(1)        LV_DIAG_PUC_CHG_LS_DOWN[i] = 1
If(2)         C_MAF_INT_MAX_DIAG_PUC_LS_DOWN > MAF_INT_PUC_ACT > C_MAF_INT_MIN_
DIAG_PUC_LS_DOWN
And(2)        MAF_INT_PUC_NOT_LS_DOWN_DIAG[i] >= C_MAF_INT_PUC_NOT_LS_DOWN_DIAG

          % diagnosis active after a certain energy transfer out of fuel cut off
And(2)        MAF_INT_PUC_ACT > MAF_INT_PUC_ACT_OLD
          % MAF integral during PUC from last DC must be reset before starting the diagnosis
And(2)        VLS_DOWN_PUC_PLAUS_VLD[i] > C_VLS_DOWN_PUC_PLAUS_VLD
And(2)        LV_VLS_DOWN_PUC_AFR_VLD[i] = 1

Then(2)        Diagnosis available
          LV_CDN_DIAG_PUC_LS_DOWN[i] = 1
Else(2)        Diagnosis NOT available
          LV_CDN_DIAG_PUC_LS_DOWN[i] = 0
Endif(2)
Else(1)        LV_CDN_DIAG_PUC_LS_DOWN[i] = 0
          VLS_DOWN_PUC_PLAUS_VLD[i] = 0
If(2a)        LV_PUC = 0
And(2a)       LV_DIAG_CDN_PLAUS_LS_DOWN[i] = 1
And(2a)       LV_INH_DIAG_PUC_LS_DOWN[i] = 0
And(2a)       MAF_KGH > C_MAF_KGH_MIN_LS_DOWN_DIAG
Then(2a)
If(3a)        LV_DIAG_PUC_CHG_LS_DOWN[i] = 1 (fuel cut off was active)
Then(3a)       MAF_INT_PUC_NOT_LS_DOWN_DIAG[i]N = MAF_INT_PUC_NOT_LS_
DOWN_DIAG[i]N-1 - C_FAC_MAF_INT_LS_DOWN_DIAG * MAF_INT_PUC_ACT
          LV_DIAG_PUC_CHG_LS_DOWN[i] = 0
Endif(3a)
If(3b)        MAF_INT_PUC_NOT_LS_DOWN_DIAG[i] <= C_MAF_INT_PUC_
NOT_LS_DOWN_DIAG
Then(3b)       MAF_INT_PUC_NOT_LS_DOWN_DIAG[i]N = MAF_INT_PUC_NOT_LS_
DOWN_DIAG[i]N-1 + MAF_KGH * T_SAMPLE[ms] * 1/3600[(g*h)/(kg*ms)]
Else(3b)       MAF_INT_PUC_NOT_LS_DOWN_DIAG[i]N = MAF_INT_PUC_NOT_LS_
DOWN_DIAG[i]N-1
Endif(3b)
Endif(2a)
Endif(1)

```

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MAF\_INT\_PUC\_ACT\_OLD = MAF\_INT\_PUC\_ACT

#### Conditions to start debouncing

```

if                LV_CDN_DIAG_PUC_LS_DOWN[i] = 1
then              if                VLS_DOWN[i] > C_VLS_MIN_DIAG_PUC_LS_DOWN
                    then              PUC signal plausibility fault present
                                        ERR_SYM_PUC_LS_DOWN[i] = sym_3    /"PUC PLAUSIBILITY ERROR"
                                        /Error Manager shall debounce this symptom
                                        VLS_DOWN_PUC_ERR[i] = VLS_DOWN[i]
                    else
                                        ERR_SYM_PUC_LS_DOWN[i] = "NO_SYM"
                                        /Error Manager shall decrement the debounce counter
                                        VLS_DOWN_PUC_OK[i] = VLS_DOWN[i]
                    endif
endif
endif
% At this point, update of the ERRM shall be completed.
% In the following part, current values of LV_END_DIAG_PUC_LS_DOWN[i] and LV_ERR_PUC_LS_
DOWN[i]
% (after updating ERRM with the diagnostic result of this recurrence) shall be used:

if                LV_END_DIAG_PUC_LS_DOWN[i] = 1
then
                    if LV_ERR_PUC_LS_DOWN[i] = 1
                        then
                            VLS_DOWN_PUC_SAVE[i] = VLS_DOWN_PUC_ERR[i]
                        else
                            VLS_DOWN_PUC_SAVE[i] = VLS_DOWN_PUC_OK[i]
                        endif
                    endif
endif
endif

```

## A.16.2 Full load (FL) oxygen sensor signal plausibility

### FUNCTION DESCRIPTION:


#### General information:

#### Description:

Should the oxygen sensor signal voltage (VLS\_DOWN[i]) exceed the calibrateable thresholds (C\_VLS\_MAX\_DIAG\_FL\_LS\_DOWN) during engine operating state FL and the following additional conditions are met, then a fault shall be determined to be present:

1. The appropriate inhibit flag shall not be set (LV\_INH\_DIAG\_FL\_LS\_DOWN[i]).
2. Plausibility check set to be possible (LV\_DIAG\_CDN\_PLAUS\_LS\_DOWN[i] = 1)
3. The FL state (LV\_FL = 1) shall be determined to be stable, as determined by comparing the mass air flow integral calculated after activation (MAF\_INT\_FL[i]) with the threshold range (C\_MAF\_INT\_MIN\_DIAG\_FL\_LS\_DOWN; C\_MAF\_INT\_MAX\_DIAG\_FL\_LS\_DOWN).

The error flag LV\_ERR\_FL\_LS\_DOWN[i] shall be set once the anti-bounce counter has reached its maximum value and reset should the anti-bounce counter reach 0.

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The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

### Application conditions

#### **Initialisation:**

At the transition LV\_IGK = 0 -> 1, reset or clearing the error memory, reset of all variables and bits to 0

*Recurrence:*            **T\_sample 100ms**

#### *Activation /Deactivation:*

```

if                    LV_DIAG_CDN_PLAUS_LS_DOWN[i] = 1
and                    LV_INH_DIAG_FL_LS_DOWN[i] = 0
and                    C_MAF_INT_MAX_DIAG_FL_LS_DOWN > MAF_INT_FL[i]
                         > C_MAF_INT_MIN_DIAG_FL_LS_DOWN
then                  Diagnosis available
                         LV_CDN_DIAG_FL_LS_DOWN[i] = 1
else                  Diagnosis NOT available
                         LV_CDN_DIAG_FL_LS_DOWN[i] = 0
endif

```

#### Formula section:

```

if                    LV_CDN_DIAG_FL_LS_DOWN[i] = 1
then                  if                    VLS_DOWN[i] < C_VLS_MAX_DIAG_FL_LS_DOWN
                         then                  FL signal plausibility fault present
                         ERR_SYM_FL_LS_DOWN[i] = sym_3 /"FL PLAUSIBILITY ERROR"
                         /Error Manager shall debounce this symptom
                         else
                         ERR_SYM_FL_LS_DOWN[i] = "NO_SYM"
                         /Error Manager shall decrement the debounce counter
                         endif
endif

```

## **A.16.3 Calculation of MAF\_INT\_FL**

### FUNCTION DESCRIPTION:

#### General information:

#### Description:

The calculation of MAF\_INT\_FL[i] expires in 20ms raster as long as either the operation status FL is fulfilled or VLS\_UP[i] indicates rich conditions, depending on the setting of LC\_MAF\_INT\_FL\_CDN\_AFR. The integral is calculated even when the application conditions for the plausibility check function

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are not fulfilled. MAF\_INT\_FL[i] is limited to the maximum value if necessary in case of a longer FL (or rich) phase.

The value of MAF\_INT\_FL[i] should reset to 0 if the transition LV\_FL = 1 -> 0 takes place resp. if VLS\_UP[i] no longer indicates rich.

### Remarks:

Although the upstream sensor signal is used here if LC\_MAF\_INT\_FL\_CDN\_AFR = 1, the calculation is still usable for both linear and binary upstream sensors. Only one of the calibrateable VLS\_UP limits should be calibrated for a given type: the upper limit for linear sensors, and the lower limit for binary sensors. The other one is not meaningful and should be set to the physical limit.

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

### Application conditions

#### Initialisation:

At the transition LV\_IGK = 0 -> 1 or reset reset of all variables and bits to 0

Recurrence: **Tsample = 20ms**

Activation /Deactivation:

```

if           LV_ST_END = 1
then        calculation enabled
else        calculation disabled
endif

```

#### Formula section:

```

if          (LC_MAF_INT_FL_CDN_AFR = 0 and LV_FL = 1) or
              (LC_MAF_INT_FL_CDN_AFR = 1 and
              VLS_UP[i] = C_VLS_UP_MIN_MAF_INT_AFR and
              VLS_UP[i] = C_VLS_UP_MAX_MAF_INT_AFR)
then
              MAF_INT_FL[i]n [g] = MAF_INT_FL[i]n-1 [g] + MAF_CYL * T_SAMPLE [ms] * 1/3600 [(g*h) /
              (kg*ms)]
else
              MAF_INT_FL[i] = 0
endif

```

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## A.17 O2 sensor (lin, up) controller SPI diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DELTA_LSL_UP_IF [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Increment of error counter since initialization respectively since last increment of error counter					
CTR_ERR_SAVE_DIAG_LSL_UP_IF [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Number of communication errors during the WRAF sensor controller initialization					
ERR_SYM_LSL_UP_IF [NC_CBK_EX_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom of CJ120 WRAF sensor controller					
LV_CDN_DIAG_LSL_UP_IF [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Conditions to run diagnosis of CJ120 WRAF sensor controller are fulfilled					
LV_END_DIAG_LSL_UP_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Diagnostic of CJ120 WRAF sensor controller available					
LV_ERR_LSL_UP_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Present error in the CJ120 WRAF sensor controller					

### Input data:

CTR_ERR_LSL_IF_SPI_WR [NC_CBK_EX_NR] {p. 955}	LV_IGK {p. 906}	LV_INH_DIAG_LSL_UP_IF [NC_CBK_EX_NR] {p. 4288}	LV_LSL_IF_SPI_RST_END [NC_CBK_EX_NR] {p. 1313}
NC_CBK_EX_NR {p. 1829}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_MAX_SPI_COM_LSL_UP [NC_CBK_EX_NR]	-	0... FFH	0... 255	1	-
Max. allowed number of SPI communication errors					
C_T_END_DIAG_LSL_UP_IF [NC_CBK_EX_NR]	-	0... FFFFH	0... 655.35	0.01	s
Time to diagnostic availability					
C_T_RST_MAX_DIAG_LSL_UP_IF [NC_CBK_EX_NR]	-	0... FFFFH	0... 655.35	0.01	s
Max. waiting time for the initialization of the WRAF sensor controller					

### Error treatment:

Diagnostic XX	Symptom description	Symptom	Filter type
LSL_UP_IF[NC_C BK_EX_NR]	wrong initialisation of WRAF Sensor controller	SYM_0	NO
	SPI communication error	SYM_1	

## FUNCTION DESCRIPTION:

### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

This function shall detect an error during the initialization and/or operation of a WRAF sensor controller which uses a SPI communication, like the CJ120 or ATIC42. For this task informations from the Basic Software (BSW) concerning the initialization and the communication between ASW and the controller are used to judge if the ASIC works properly.

After an ECU reset, the WRAF sensor controller is started and the diagnosis determines the time until the initialization of the ASIC has been performed (LV\_LSL\_IF\_SPI\_RST\_END[i] = 1). If this doesn't happen after a certain time (C\_T\_RST\_MAX\_DIAG\_LSL\_UP\_IF[i]) an error is present and the flag LV\_ERR\_LSL\_UP\_IF[i] shall be set. If the initialization occurs successfully, the difference is checked between the present error counter (CTR\_ERR\_LSL\_IF\_SPI\_WR[i]) and the stored value of this error counter (CTR\_ERR\_SAVE\_DIAG\_LSL\_UP\_IF[i], stored at ECU reset, LV\_IGK switch from 0 -> 1 or at clearing error memory and also after each function call in case that a difference between both counters was found). If there is a difference, another counter is incremented.

If this counter is bigger than a threshold, a SPI communication error is entered.

In any case the flag LV\_ERR\_LSL\_UP\_IF[i] = 1 the operation of the WRAF sensor shall be inhibited.

### Application conditions

#### Initialisation:

At transition LV\_IGK = 0 -> 1, at clearing error memory or at ECU re

```

LV_ERR_LSL_UP_IF[i] = 0
LV_END_DIAG_LSL_UP_IF[i] = 0
ERR_SYM_LSL_UP_IF[i] = 0
CTR_DELTA_LSL_UP_IF[i] = 0
CTR_ERR_SAVE_DIAG_LSL_UP_IF[i] = CTR_ERR_LSL_IF_SPI_WR[i]
Start TIMER_1 and TIMER_2


```

#### Recurrence:

The function shall run every 10 ms

#### Activation:

At LV\_IGK=1 & LV\_INH\_DIAG\_LSL\_UP\_IF[i]=0 the function shall be started and LV\_CDN\_DIAG\_LSL\_UP\_IF[i] = 1

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**Deactivation:**

The deactivation occurs if the activation conditions above are not fulfilled.

**Formula section:**

```

If LV_LSL_IF_SPI_RST_END[i] = 1           /init. of WRAF sensor controller done successfully
Then
    Stop TIMER_1


    If     CTR_ERR_LSL_IF_SPI_WR[i] != CTR_ERR_SAVE_DIAG_LSL_UP_IF[i]
    then   CTR_DELTA_LSL_UP_IF[i]n = CTR_DELTA_LSL_UP_IF[i]n-1 + 1
           CTR_ERR_SAVE_DIAG_LSL_UP_IF[i] = CTR_ERR_LSL_IF_SPI_WR[i]

    If     CTR_DELTA_LSL_UP_IF[i] > C_CTR_MAX_SPI_COM_LSL_UP[i]
    Then
        ERR_SYM_LSL_UP_IF[i] = sym_1
        LV_ERR_LSL_UP_IF[i] = 1
        LV_END_DIAG_LSL_UP_IF[i] = 1
    Endif

Else
    If TIMER_1 > C_T_RST_MAX_DIAG_LSL_UP_IF[i]
    Then
        ERR_SYM_LSL_UP_IF[i] = sym_0           /no init. of WRAF sensor controller
    done
        LV_ERR_LSL_UP_IF[i] = 1
        LV_END_DIAG_LSL_UP_IF[i] = 1
    Else
        Increment TIMER_1
    Endif
Endif

If LV_END_DIAG_LSL_UP_IF[i] = 0
Then
    If TIMER_2 < C_T_END_DIAG_LSL_UP_IF[i]
    Then Increment TIMER_2
    Else
        LV_END_DIAG_LSL_UP_IF[i] = 1           /for the diagnosis readines
        Stop TIMER_2
    Endif
Endif

```

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## A.18 O2 sensor (lin, up) controller SPI diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_LSL_UP_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibit diagnosis					

### Input data:

LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}
LV_LS_UP_OBD_1_MAN_ DEAC [NC_CBK_EX_NR] {p. 5449}	NC_CBK_EX_NR {p. 1829}		

### FUNCTION DESCRIPTION:

#### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

This function shall set the inhibit bit LV\_INH\_DIAG\_LSL\_UP\_IF[i] in case an electrical fault of the WRAF sensor. In this case, i.e., when LV\_ERR\_EL\_LSL\_UP[i] = 1, the communication between sensor and ASIC is stopped, therefore doesn't make sense to run the ASIC diagnosis.

#### Application conditions

##### Initialisation:

At the transition LV\_IGK = 0 -> 1

LV\_INH\_DIAG\_LSL\_UP\_IF[i] = 0

##### Recurrence:

Every 10 ms

##### Activation:


At LV\_IGK = 1

##### Deactivation:

If LV\_ERR\_LSL\_UP\_IF[i] = 1

#### Formula section:

If LV\_ERR\_EL\_LSL\_UP[i] = 1

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```

or      LV_ERR_SPI_MPS = 1
or      LV_LS_UP_OBD_1_MAN_DEAC[i] = 1
Then
  LV_INH_DIAG_LSL_UP_IF[i] = 1
Endif

```

### A.18.1 Configuration Data

Diagnosis	Symptom	N r	P-Code/ Failure	P-Code/ Symptom	Hardware config	Recurrence	Failure class A/B
WRAF Sensor Controller Diagnosis	Sym_0	0	P 0606	--	---		See table of failures
	Sym_1	1		--			
IF_LSL_UP[i]							

## A.19 O2 sensor (lin, up) signal circuit diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_EL_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of "HW-Based Diagnosis"					
LV_IPLSL_DIAG_INH_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of "HW-Based Diagnosis with the CJ120"					

### Input data:

LV_CDN_VB_OBD1 {p. 1185}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_IGK {p. 906}	LV_LS_UP_OBD_1_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}	LV_ST_END {p. 1720}	NC_CBK_EX_NR {p. 1829}
STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 956}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_DIAG_EL_LSL_UP	-	0... FFH	0... 255	1	-
Increment of OBD-I Diagnosis debouncer counter					
C_ABC_MAX_DIAG_EL_LSL_UP	-	1... FFH	1... 255	1	-
Maximum threshold of OBD-I Diagnosis debouncer counter					

### A.19.1 Application Incidences of Electrical Fault Detection

#### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

#### Application conditions:

##### Initialization:


The flag shall be initialized as follow during the transition LV\_IGK = 0 to 1.

LV\_INH\_DIAG\_EL\_LSL\_UP[i] = 0

##### Recurrence:

The function shall be carried out once every 10ms.

##### Activation:

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Transition LV\_IGK = 0 ->1

**Deactivation:**

Transition LV\_IGK = 1 ->0. LV\_INH\_DIAG\_EL\_LSL\_UP[i] shall be set to 1.

**Formula section:**

```

If      LV_CDN_VB_OBD1 = 0                               or
          LV_ERR_LSL_UP_IF[i] = 1                         or
          LV_LS_UP_OBD_1_MAN_DEAC[i] = 1                 or
          LV_ERR_OFS_LSL_UP[i] = 1                       or
          LV_ERR_CTL_LSL_UP[i] = 1                       or
          STATE_LSL_IF_SPI_RD[i] bit LSL_ENA = 0

Then
          LV_INH_DIAG_EL_LSL_UP[i] = 1

Else
          LV_INH_DIAG_EL_LSL_UP[i] = 0

Endif

```

**Application assistances:**

The following list shows the influenced functions if a failure is detected.

Direct error reactions:

The following functions have to be direct deactivated:


- catalyst efficiency diagnosis
- diagnosis of the canister purge system (flow rate diagnosis)
- secondary air diagnosis (flow rate)
- secondary air valve diagnosis (mechanical)
- secondary air pump
- upstream oxygen sensor temperature acquisition
- WRAF Sensor controller diagnosis
- WRAF Sensor Plausibility Diagnosis
- WRAF Sensor dynamic diagnosis
- WRAF Sensor not mounted diagnosis
- WRAF Sensor plausibility diagnosis during PUC
- WRAF Sensor false start diagnosis
- WRAF Sensor heater coupling diagnosis
- WRAF Sensor OBD2 heater diagnosis

The following function has to be activated :

- canister purge function (min. operation)

Diagnostic XX	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readine ss code
EL_LSL_UP[NC_C BK_EX_NR]	Short Circuit to Plus	SYM_0					MIL_ON/	CARB
	Short Circuit to Ground	SYM_1					LAW_M	_LS

## A.19.2 DTC are defined in the table of failures

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## A.19.3 WRAF Sensor Pump Current Controller Diagnosis

### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

### Application conditions:

#### *Initialization:*

The flag shall be initialized as follow during the transition LV\_IGK = 0 to 1.

LV\_IPLSL\_DIAG\_INH\_LSL\_UP[i] = 0

#### *Recurrence:*

The function shall be carried out once every 10ms.

#### *Activation:*

Transition LV\_IGK = 0 -> 1

#### *Deactivation:*

Transition LV\_IGK = 1 -> 0. LV\_IPLSL\_DIAG\_INH\_LSL\_UP[i] shall be set to 1.

### Formula section:

**If** LV\_CDN\_VB\_OBD1 = 0

**Then**

LV\_IPLSL\_DIAG\_INH\_LSL\_UP[i] = 1

**Else**

LV\_IPLSL\_DIAG\_INH\_LSL\_UP[i] = 0


**Endif**

## A.20 O2 sensor (lin, up) signal circuit diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_IPLSL_SYM_DIAG_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Error debounce counter					
ERR_SYM_EL_LSL_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom of electrical failure on the upstream WRAF sensor					
IPLSL_SYM_DIAG_LSL_UP [NC_CBK_EX_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of the WRAF sensor Pump Current Controller Diagnosis					
LV_CDN_DIAG_EL_LSL_UP [NC_CBK_EX_NR]	O/V	0H 1H	PASSIVE ACTIVE	-	-
Conditions to run the electrical diagnosis of the upstream WRAF sensor					
LV_DIAG_ACT_EL_LSL_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical Value for diagnosis active (=1) or not (=0)					
LV_DIAG_IPLSL_CDN_LSL_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Conditions to run the WRAF sensor Pump Current Controller Diagnosis					
LV_DIAG_IPLSL_SYM_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Pump Current Controller in Limitation for too long time					
LV_END_DIAG_EL_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Result of present diagnosis status is valid					
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced diagnosis value caused by an OBD-I error at the WRAF-Sensor					
LV_LSL_UP_SPI_COM_INH [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibit bit for the SPI-communication related to electrical diagnosis on BSW level					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_ERR_EL_LSL_UP [NC_CBK_EX_NR]	O/V	0H	NO_FAULT	-	-
		1H	SCG_LINE_RCD		
		2H	SCG_LINE_VIP		
		3H	SCG_LINE_VG		
		4H	SCG_LINE_VN		
		5H	SCG		
		6H	SCBAT_LINE_RCD		
		7H	SCBAT_LINE_VIP		
		8H	SCBAT_LINE_VG		
		9H	SCBAT_LINE_VN		
AH	SCBAT				
State to distinguish the OBD-I failures					
T_DLY_DIAG_EL_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Delay timer to start the electrical failure diagnosis					

**Input data:**

ERR_SYM_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LC_ICPLSL_ACT {p. 2355}	LV_ES {p. 1720}
LV_ICPLSL_ENA_LSL_IF [NC_CBK_EX_NR] {p. 2351}	LV_IGK {p. 906}	LV_INH_DIAG_EL_LSL_UP [NC_CBK_EX_NR] {p. 4290}	LV_IPLSL_CTL_ENA_LSL_IF [NC_CBK_EX_NR] {p. 2351}
LV_IPLSL_DIAG_INH_LSL_UP [NC_CBK_EX_NR] {p. 4290}	LV_LSL_IF_SPI_RST_END [NC_CBK_EX_NR] {p. 1313}	LV_ST_END {p. 1720}	NC_CBK_EX_NR {p. 1829}
STATE_ERR_IPLSL [NC_CBK_EX_NR] {p. 955}	STATE_ERR_VGLSL [NC_CBK_EX_NR] {p. 955}	STATE_ERR_VIPLSL [NC_CBK_EX_NR] {p. 955}	STATE_ERR_VNLSL [NC_CBK_EX_NR] {p. 955}
STATE_ERR_VRCLSL [NC_CBK_EX_NR] {p. 955}	STATE_LSH_UP [NC_CBK_EX_NR] {p. 2385}	STATE_SYM_OBD_LSL_LSH_UP [NC_CBK_EX_NR] {p. 5439}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_IPLSL_SYM_DIAG_LSL_UP	-	0... FFFFH	0... 65535	1	-
Max. error debounce counter					
C_LAMB_SP_AFL_IPLSL_DIAG_LSL_UP	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Min. lean lambda set point to activate the IP diagnosis					
C_LAMB_SP_AFR_IPLSL_DIAG_LSL_UP	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Max. rich lambda set point to activate the IP diagnosis					
C_T_DLY_DIAG_EL_LSL_UP	-	0... FFFFH	0... 655.35	0.01	s
Time delay to start the electrical failure diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_IPLSL_SYM_DIAG_LSL_UP	-	0... 1H	0 ...1	1	-
Logical variable to force IPLSL symptom flag (only for test purpose)					

### Error treatment:

Diagnostic XX	Symptom description	Symptom	Filter type
EL_LSL_UP[i]	Short to plus	SYM_0	MEM
	Short to ground	SYM_1	

## A.20.1 HW-based Diagnosis with the ATIC42 (WRAF Sensor Controller)

### FUNCTION DESCRIPTION:

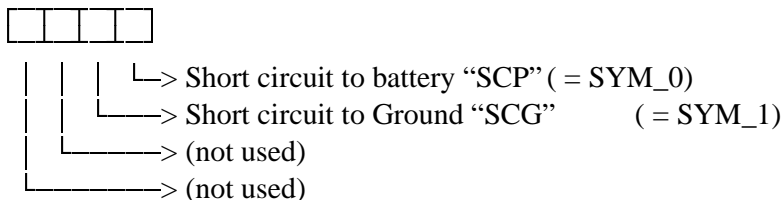
#### General information:

This function shall debounce OBD-I errors at the Wide Range Air/Fuel (WRAF) Sensor detected by the ATIC42 and define a variable containing the diagnosis register of the controller.

If the error is recognised as debounced, the function shall generate an error flag and inhibit the SPI-communication between basic software (BSW) and ATIC42. This is necessary, because in case an electrical failure, the ATIC42 disconnect and reconnect all the PINs of the sensor by itself every recurrence of the BSW, by reading of the Diagnosis-register. This is harmful for the sensor and must be prevented.

According the exhaust gas system the variable shall be defined from [i]=1 to NC\_CBK\_EX\_NR.

Error Symptoms are defined as follows:




### Application conditions

#### Initialisation:

The following variables, related to the diagnosis manager shall be initialized according to the filter type MEM .

(all 0 at LV\_IGK 0->1 or at ECU reset or clearing error memory)

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```

LV_ERR_EL_LSL_UP[i] = 0
LV_CDN_DIAG_EL_LSL_UP[i] = 0
LV_END_DIAG_EL_LSL_UP[i] = 0
ERR_SYM_EL_LSL_UP[i] = NO_SYM

```

The following data shall be set to 0 at LV\_IGK 0->1 or at ECU reset or at clearing error memory

```

STATE_ERR_EL_LSL_UP[i] = No Fault
LV_LSL_UP_SPI_COM_INH[i] = 0
T_DLY_DIAG_EL_LSL_UP[i] = 0

```

#### Recurrence:

The function shall be carried out once every 10ms.

#### Activation /Deactivation:

##### If

```

LV_ST_END = 1           and
LV_ES = 0               and
LV_ERR_EL_LSL_UP[i] = 0 and
LV_LSL_IF_SPI_RST_END[i] = 1 and
LV_INH_DIAG_EL_LSL_UP[i] = 0

```

##### Then

```

LV_DIAG_ACT_EL_LSL_UP[i] = 1
The diagnosis shall be carried out

```

##### Else

```

LV_DIAG_ACT_EL_LSL_UP[i] = 0
The diagnosis shall be deactivated

```

##### Endif

#### Formula section:

The variable STATE\_ERR\_EL\_LSL\_UP[i] is useful during the development phase of the ASIC and shall be built up by the failure-bits STATE\_ERR\_VNLSL[i], STATE\_ERR\_VGLSL[i], STATE\_ERR\_VIPLSL[i], STATE\_ERR\_VRCLSL[i], delivered from the BSW. This variable shall have one of the following values according to the following table:

STATE_ERR_VRCLSL[i]	STATE_ERR_VIPLSL[i]	STATE_ERR_VGLSL[i]	STATE_ERR_VNLSL[i]	Value for STATE_ERR_EL_LSL_UP
0	0	0	0	0H
<b>1</b>	0	0	0	1H
0	<b>1</b>	0	0	2H
0	0	<b>1</b>	0	3H
0	0	0	<b>1</b>	4H
"1" in more then one Variable				5H
<b>2</b>	0	0	0	6H
0	<b>2</b>	0	0	7H
0	0	<b>2</b>	0	8H
0	0	0	<b>2</b>	9H
"2" in more then one Variable				AH

#### Setting the symptoms:

**If (1)** LV\_DIAG\_ACT\_EL\_LSL\_UP[i] = 1



**Then (1)**

**If (2)**  $T\_DLY\_DIAG\_EL\_LSL\_UP[i] > C\_T\_DLY\_DIAG\_EL\_LSL\_UP$

**Then**

$LV\_CDN\_DIAG\_EL\_LSL\_UP[i] = 1$

**If (3)**  $1H \leq STATE\_ERR\_EL\_LSL\_UP[i] \leq 5H$

**Then (3)**

$ERR\_SYM\_EL\_LSL\_UP[i] = sym\_1$  */% Short to ground*

**Else (3)****If (4)**

$6H \leq STATE\_ERR\_EL\_LSL\_UP[i] \leq AH$

**Then (4)**

$ERR\_SYM\_EL\_LSL\_UP[i] = sym\_0$  */% Short to plus*

**Else (4)**

$ERR\_SYM\_EL\_LSL\_UP[i] = NO\_SYM$  */% no symptom*

**Endif (4)****Endif (3)****Else (2)**

*Increment*  $T\_DLY\_DIAG\_EL\_LSL\_UP[i]$

**Endif (2)****Endif (1)**

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

**Apply** filter on current symptoms

**If** filtering result available (after debounce)

**then**

$LV\_ERR\_EL\_LSL\_UP[i] =$  filtering result

$LV\_END\_DIAG\_EL\_LSL\_UP[i] = 1$

**Delivery of the result** to the Error Management

**Endif**

$LV\_LSL\_UP\_SPI\_COM\_INH[i] = LV\_ERR\_EL\_LSL\_UP[i]$

## A.20.2 WRAF Sensor Pump Current Controller Diagnosis


### FUNCTION DESCRIPTION:

#### General information:

This function shall monitor the *pump current controller* inside the WRAF sensor controller ATIC42 in order to protect the oxygen sensor against operation with high pump current ( $I_p$ ) during excessive time which can be harmful to the sensor.

High pump current for long time is allowed only during the warm up phase of the WRAF sensor, when its ceramic temperature not high enough, but the  $I_p$  controller activation is needed to detect the sensor operability as fast as possible. To avoid false error messages this function shall run only after the sensor heater achieves its steady state after the warm up phase, when it starts to work in closed loop.

To avoid any double diagnostic it shall be monitored if no sensor electrical failure exists (short circuit to ground or to battery voltage) or if the heater management works properly. In both cases it is possible due to a failure to flow a high  $I_p$  current through the sensor. Similarly it must be asked if the sensor requires an *reference air pump current* and in positive case, if this is active.

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If a *pump current controller* failure symptom is detected, the use of the sensor is not more possible and the lambda controller shall be deactivated immediately. Should this symptom be completely debounced, the sensor shall not be used for any purpose during the current driving cycle and also the *pump current controller* shall be deactivated in order to avoid any sensor damage.

### Description:

This diagnosis serves to debounce the information concerning the conditions of the *pump current controller* which is delivered by the ATIC42 via its Basic Software.

As long as the  $I_p$  current is at their bounds, which is defined *per* hardware [1], the ATIC42 limits the *pump current controller* output and writes in a warning message in its diagnosis register, indicating that  $I_p$  current is too low or too high. The Basic Software dedicated to the ATIC42 reads out every 10 ms the diagnosis register and save this information in the variable STATE\_ERR\_IPLSL[i]. This shall be evaluated here and in failure case the symptom debounced.

[1] For more informations please see the ATIC42 specification.

### Application conditions

**Initialisation:** At the transition LV\_IGK = 0 -> 1, by ECU-reset or at clearing the error memory shall all variables be reseted.

**Recurrence:** The function shall be carried out once every 100ms.  
*Note: Although the variable STATE\_ERR\_IPLSL[i] is updated every 10 ms, it is not necessary to evaluate it so frequently. The decision to stop the  $I_p$  controller must not be done with a resolution of milliseconds but seconds. It can be taken advantage to that point allowing to filter transient  $I_p$ -controller conditions.*

#### *Activation /Deactivation:*

```

if      (LAMB_SP[i] < C_LAMB_SP_AFR_IPLSL_DIAG_LSL_UP or
          LAMB_SP[i] > C_LAMB_SP_AFL_IPLSL_DIAG_LSL_UP)           and

          LV_IPLSL_CTL_ENA_LSL_IF[i] = 1                          and
          (Ip controller active)

          LV_IPLSL_DIAG_INH_LSL_UP[i] = 0                        and
          (no restriction to run this diagnosis)

          ERR_SYM_EL_LSL_UP[i] = NO SYM                          and
          (no sensor electrical failure)

          STATE_LSH_UP[i] = LSH_POW_CTL                          and
          (sensor is heated properly)

          STATE_SYM_OBD_LSL_LSH_UP[i] = NO SYM                  and
          (no sensor under- or overheating)


          [ LV_ICPLSL_ENA_LSL_IF[i] = 1 or
            (LV_ICPLSL_ENA_LSL_IF[i] = 0 and LC_ICPLSL_ACT = 0) ]
          (ref. Air is properly pumped if it is needed)

then
          LV_DIAG_IPLSL_CDN_LSL_UP[i] = 1
          (activate this function)

else
          LV_DIAG_IPLSL_CDN_LSL_UP[i] = 0
          (deactivate this function)

endif

```

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**Formula section:**

**If** STATE\_ERR\_IPLSL[i] = current high

**Then**

IPLSL\_SYM\_DIAG\_LSL\_UP[i] = sym\_0

**Else**

**If** STATE\_ERR\_IPLSL[i] = current low

**Then**

IPLSL\_SYM\_DIAG\_LSL\_UP[i] = sym\_1

**Else**

IPLSL\_SYM\_DIAG\_LSL\_UP[i] = no sym

**Endif**

**Endif**

% Debouncing error symptom

**If** IPLSL\_SYM\_DIAG\_LSL\_UP[i] ≠ no\_symptom

**Then**

**If** CTR\_IPLSL\_SYM\_DIAG\_LSL\_UP[i] > C\_CTR\_IPLSL\_SYM\_DIAG\_LSL\_UP

**Then**

LV\_DIAG\_IPLSL\_SYM\_LSL\_UP[i] = 1

**Else**

*Increment* CTR\_IPLSL\_SYM\_DIAG\_LSL\_UP[i]


**Endif**

**Else**

LV\_DIAG\_IPLSL\_SYM\_LSL\_UP[i] = LC\_IPLSL\_SYM\_DIAG\_LSL\_UP

CTR\_IPLSL\_SYM\_DIAG\_LSL\_UP[i] = 0

**Endif**

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## A.21 O2 sensor (lin, up) open circuit diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_OC_LSL_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom indicating open circuit failure in one of the lines was detected					
LAMB_SP_DELTA_OC_LSL_UP [NC_CBK_EX_NR]	V	8000... 7FFFH	-32... 31.99902	976.599e-6	-
Lambda setpoint ramp increment for active part of linear sensor open circuit check					
LAMB_SP_DIAG_OC_LSL_UP [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Requested lambda setpoint for active part of linear sensor open circuit check					
LV_CDN_DIAG_OC_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Bit indicating the necessary conditions to run the diagnosis are fulfilled					
LV_DIAG_OC_IF_OSC_DI_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request stop oscillator used to determine sensor internal resistance					
LV_END_DIAG_OC_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Bit indicating the diagnostic is valid					
LV_ERR_OC_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced open circuit failure detected					
LV_VLS_UP_AFS_DIAG_OC_LSL_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Bit indicating LSL stoichiometric voltage					
LV_VLS_UP_MIN_DIAG_OC_LSL_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Bit indicating LSL undervoltage					
STATE_DIAG_OC_LSL_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H	PASSIVE ACTIVE END	-	-
Status of the LSL Open Circuit Diagnosis					
T_DIAG_OC_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer to finish OC diagnosis in case of OBD2 upstream heater error symptom active and conditions for plausibility diagnosis fulfilled					
T_DIAG_OC_RST_LAMB_SP_REQ [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time to finish the active check for OC in VIP /VG					
T_DIAG_OC_RST_OSC_DI [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time to reactivate oscillator for upstream tip temperature measurement					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_VLS_UP_AFS_DIAG_OC_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for lambda signal being in stoichiometric band while it shouldn't					
T_VLS_UP_MIN_DIAG_OC_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for LSL signal under voltage					
T_WAIT_SYM_OBD_2_LSH_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Waiting time to check if OBD2 upstream heater error is present (to distinguish OC on Vip from Vg)					

**Input data:**

LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_DIAG_ACT_END_LSL_UP [NC_CBK_EX_NR] {p. 5237}	LV_DIAG_ACT_SHO_CDN_LSL_UP [NC_CBK_EX_NR] {p. 5237}	LV_DIAG_ACT_SYM_LSL_UP [NC_CBK_EX_NR] {p. 5237}
LV_DIAG_EOL_END_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_DIAG_OBD_CDN_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_DIAG_OBD_END_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_DIAG_OBD_SYM_LSH_UP [NC_CBK_EX_NR] {p. 5438}
LV_DIAG_PUC_END_LSL_UP [NC_CBK_EX_NR] {p. 5297}	LV_DIAG_PUC_SYM_LSL_UP [NC_CBK_EX_NR] {p. 5297}	LV_DIAG_RAW_ACT_END_LSL_UP [NC_CBK_EX_NR] {p. 5237}	LV_DIAG_RAW_ACT_SYM_LSL_UP [NC_CBK_EX_NR] {p. 5237}
LV_ES {p. 1720}	LV_IGK {p. 906}	LV_INH_DIAG_OC_LSL_UP [NC_CBK_EX_NR] {p. 4309}	LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}
LV_R_IT_OSC_ENA_LSL_IF [NC_CBK_EX_NR] {p. 1320}	NC_CBK_EX_NR {p. 1829}	STATE_SYM_DIAG_PUC_LSL_UP [NC_CBK_EX_NR] {p. 5297}	VLS_UP_DIAG [NC_CBK_EX_NR] {p. 2315}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_SP_MAX_DIAG_OC_LSL_UP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Upper end of blind region for lambda setpoint for active test for open circuit in VG /VIP					
C_LAMB_SP_MIN_DIAG_OC_LSL_UP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lower end of blind region for lambda setpoint for active test for open circuit in VG /VIP					
C_LAMB_SP_OC_CHK_LSL_UP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda setpoint target for active test for open circuit in VG /VIP					
C_LAMB_SP_STEP_OC_CHK_LSL_UP	-	1... FFH	1... 255	1	-
Number of recurrences to achieve the desired lambda set point during open-circuit check					
C_T_DIAG_OC_LSL_UP	-	0... FFFFH	0... 6553.5	0.1	s
Timer to finish OC diagnosis in case of OBD2 upstream heater error symptom active and conditions for plausibility diagnosis fulfilled					
C_T_DIAG_OC_RST_OSC_DI	-	0... FFFFH	0... 6553.5	0.1	s
Time to reactivate oscillator for upstream tip temperature measurement					
C_T_VLS_UP_MIN_DIAG_OC_LSL_UP	-	0... FFFFH	0... 6553.5	0.1	s
Max time to debounce open circuit in VN or VG symptom					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_WAIT_SYM_OBD_2_LSH_UP	-	0... FFFFH	0... 6553.5	0.1	s
Waiting time to check if OBD2 upstream heater error is present (to distinguish OC on Vip from Vg)					
C_VLS_UP_DIAG_MIN_OC_LSL_UP	-	8000... 7FFFH	-160... 159.99511	4.8828e-3	V
LSL undervoltage threshold					
C_VLS_UP_MAX_OC_AFS_LSL_UP	-	8000... 7FFFH	-160... 159.99511	4.8828e-3	V
LSL stoichiometric voltage upper threshold					
C_VLS_UP_MIN_OC_AFS_LSL_UP	-	8000... 7FFFH	-160... 159.99511	4.8828e-3	V
LSL stoichiometric voltage lower threshold					
LC_DIAG_PUC_END_MAN_LSL_UP	-	0... 1H	0 ...1	1	-
Boolean switch to bypass activation of LV_DIAG_PUC_END_LSL_UP[i]					

### Error treatment:

Diagnostic XX	Symptom description	Symptom	Filter type
OC_LSL_UP[NC_C BK_EX_NR]	Open Circuit on Nernst Cell (Vn)	SYM_0	NO
	Open Circuit on Virtual Ground (Vg)	SYM_1	
	Open Circuit on Pump Cell (Vip)	SYM_2	
	Open Circuit on comp. resistor (Vrc)	SYM_3	

### FUNCTION DESCRIPTION:

#### General information:

This function shall use some debounced OBD2 lambda sensor faults to evaluate if an open circuit in any of the four electric lines (VN, VG, VIP and VRc) is present. The matrix below shows reaction of sensor/controller to each open line.

Open Circuit on Line	Measured Sensor Temp	Lambda Sensor
VN	V_Ri = 5 V (Ttip = 560 °C)	U_Lambda = 0 V (for NTK sensor only if R <sub>i</sub> oscillator is turned off)
VG	V_Ri = 0 V (Ttip = 880 °C) (only applicable for some sensor types)	U_Lambda = 2.0 V (sensor stuck)
VIP	V_Ri plausible	U_Lambda = 2.0 V (sensor stuck)
VRc	V_Ri plausible	U_Lambda > 4.8 V in air

This function shall run only if at least one of the following diagnoses has set its readiness bit: Activity Check, Plausibility during PUC and Sensor Heater OBD2. The function shall go to the state = "active" if one of the above diagnoses debounced a fault.

The end flag for this diagnosis is set if all the related diagnosis functions have set their end flags or after changing to the STATE "end" with detection of an open circuit error.

OC in the VN line (LSU and ZFAS-Ux sensors) or VG line (ZFAS-Ux only) cause an OBD2 heater symptom. Therefore an OC error is assumed if a heater symptom is accompanied by other indications of these OC errors. For OC in VN, a very low VLS\_UP\_DIAG[i] will occur (for ZFAS-Ux, only if the Ri measurement oscillator is turned off), while for OC in VG this value will be around 2.0V (i.e. stuck at lambda=1). These conditions are tested with an open loop lambda setpoint shift requested here, monitoring of VLS\_UP\_DIAG[i] is coordinated with the detection of shifted lambda setpoint and disabled Ri measurement oscillator. If the lambda shift request is not fulfilled, the diagnosis looks for an activity symptom instead to decide if the VG/VIP line is open, but this probably takes much more time.

If VLS\_UP\_DIAG[i] is stuck at 2.0V, as detected by the PUC plausibility or activity diagnoses, OC in VG or VIP may be present. In ZFAS-Ux sensors, OC in VG would also cause a heater symptom, so further fault isolation is possible using T\_WAIT\_SYM\_OBD\_2\_LSH\_UP[i] to wait for this symptom. If C\_T\_WAIT\_SYM\_OBD\_2\_LSH\_UP is set to 0, all faults causing VLS\_UP\_DIAG[i]= 2.0V are regarded as OC in VIP, even if the test was triggered by an OBD2 heater symptom.

Quite independently, OC in VRC shows up as a VLS\_H\_OC symptom in the PUC plausibility diagnosis and is consumed here. It will be overridden however by any other OC fault.

If any open circuit symptom could be detected the flag LV\_ERR\_OC\_LSL\_UP[i] shall be set to 1.

If two separate catalyst systems are concerned, then

i = 1, for cylinder bank 1

i = 2, for cylinder bank 2,

else

i = 1.

### Description:

### Application conditions

**Initialisation:** At LV\_IGK = 0 to 1, reset **or** at clearing error memory:  
Reset all variables


**Recurrence:** This function shall run every 100 ms.

### *Activation /Deactivation:*

```

if ( LV_DIAG_ACT_END_LSL_UP[i] = 1           or
      LV_DIAG_OBD_END_LSH_UP[i] = 1           or
      LV_DIAG_PUC_END_LSL_UP[i] = 1)
and LV_INH_DIAG_OC_LSL_UP[i] = 0
and LV_IPLSL_VLD[i] = 1
then
    LV_CDN_DIAG_OC_LSL_UP[i] = 1
    % activate function ( = carry out formula section)
else
    LV_CDN_DIAG_OC_LSL_UP[i] = 0
    LAMB_SP_DIAG_OC_LSL_UP[i] = 0
    LV_DIAG_OC_IF_OSC_DI_LSL_UP[i] = 0
    % deactivate function
endif

```

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**Formula section:**

*%Readiness bit setting in case no failure is present*

**If** *% during normal driving cycle*

```
{ LV_DIAG_OBD_SYM_LSH_UP[i] = 0 &
  LV_DIAG_ACT_SYM_LSL_UP[i] = 0 &
  LV_DIAG_PUC_SYM_LSL_UP[i] = 0 &
  LV_DIAG_ACT_END_LSL_UP[i] = 1 &
  LV_DIAG_OBD_END_LSH_UP[i] = 1 &
  (LV_DIAG_PUC_END_LSL_UP[i] = 1 or LC_DIAG_PUC_END_MAN_LSL_UP = 1) &
  LV_END_DIAG_OC_LSL_UP[i] = 0 }
```

**Or** *% during EOL test*

```
{ LV_DIAG_EOL_END_LS_UP_DOWN[i] = 1 & LV_DIAG_PUC_END_LSL_UP[i] = 1 }
```

**Then**

```
ERR_SYM_OC_LSL_UP[i] = NO_SYM
```

```
LV_END_DIAG_OC_LSL_UP[i] = 1
```

**Endif**

## DEFINITION OF THE STATES

**State “PASSIVE”****Action:**

None

**Transition to other states****Condition 1: to state “ACTIVE”**

```
If LV_DIAG_OBD_SYM_LSH_UP[i] = 1 or
  LV_DIAG_ACT_SYM_LSL_UP[i] = 1 or
  LV_DIAG_PUC_SYM_LSL_UP[i] = 1
```

**then**

```
STATE_DIAG_OC_LSL_UP[i] = “ACTIVE”
```

**endif**

**State “ACTIVE”****Action:**

*%Waiting timer for a heater OBD diagnostic*


```
If (( LV_DIAG_ACT_SYM_LSL_UP[i] = 1 or LV_DIAG_PUC_SYM_LSL_UP[i] = 1 )
and LV_DIAG_OBD_CDN_LSH_UP[i] = 1 )
```

**then**

```
increment T_WAIT_SYM_OBD_2_LSH_UP[i]
```

**endif**

*% If a heater OBD2 symptom is present, turn off Ri oscillator and check sensor signal*

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*% with an active lambda shift.*

**If(1)** LV\_DIAG\_OBD\_SYM\_LSH\_UP[i] = 1

**then**

*% Check for additional symptoms of OC faults.*

*% Request to turn off Ri oscillator, if the test has not timed out:*

**If(2a)** T\_DIAG\_OC\_RST\_OSC\_DI[i] < C\_T\_DIAG\_OC\_RST\_OSC\_DI

**then**

LV\_DIAG\_OC\_IF\_OSC\_DI\_LSL\_UP[i] = 1

**Else**

LV\_DIAG\_OC\_IF\_OSC\_DI\_LSL\_UP[i] = 0

**Endif(2a)**

*% If Ri oscillator is off, do test for Vn symptom*

**If(2b)** LV\_R\_IT\_OSC\_ENA\_LSL\_IF[i] = 0

**then**

*increment* T\_DIAG\_OC\_RST\_OSC\_DI[i]

**If(3b)** VLS\_UP\_DIAG[i] < C\_VLS\_UP\_DIAG\_MIN\_OC\_LSL\_UP

**then** *% VLS\_UP\_DIAG symptom for OC@VN*

**If(4b)** T\_VLS\_UP\_MIN\_DIAG\_OC\_LSL\_UP[i] >= C\_T\_VLS\_UP\_MIN\_DIAG\_OC\_LSL\_UP

**then**

LV\_VLS\_UP\_MIN\_DIAG\_OC\_LSL\_UP[i] = 1

**Else**

*increment* T\_VLS\_UP\_MIN\_DIAG\_OC\_LSL\_UP[i]

**Endif (4b)**

**Else (3a)**

*reset* T\_VLS\_UP\_MIN\_DIAG\_OC\_LSL\_UP[i]

**Endif (3b)**

**Endif (2b)**

*%Request lambda setpoint shift, if the test has not timed out:*

**If(2c)** T\_DIAG\_OC\_RST\_LAMB\_SP\_REQ[i] < C\_T\_DIAG\_OC\_RST\_OSC\_DI

**then**

**execute Section "Moving Lambda setpoint"**

**Else**

LAMB\_SP\_DIAG\_OC\_LSL\_UP[i] = 0

**Endif(2c)**

*% If lambda setpoint is shifted far enough, check for open loop test symptom of OC@VG/VIP*

**If(2d)** (C\_LAMB\_SP\_MAX\_DIAG\_OC\_LSL\_UP < LAMB\_SP[i] **or**  
LAMB\_SP[i] < C\_LAMB\_SP\_MIN\_DIAG\_OC\_LSL\_UP)

**then**

*increment* T\_DIAG\_OC\_RST\_LAMB\_SP\_REQ[i]

**If(3d)** C\_VLS\_UP\_MIN\_OC\_AFS\_LSL\_UP < VLS\_UP\_DIAG[i] **and**

VLS\_UP\_DIAG[i] < C\_VLS\_UP\_MAX\_OC\_AFS\_LSL\_UP

**then**

**If(4d)** T\_VLS\_UP\_AFS\_DIAG\_OC\_LSL\_UP[i] >= C\_T\_VLS\_UP\_MIN\_DIAG\_OC\_LSL\_UP

**then**

LV\_VLS\_UP\_AFS\_DIAG\_OC\_LSL\_UP[i] = 1

**Else (4d)**


*increment* T\_VLS\_UP\_AFS\_DIAG\_OC\_LSL\_UP[i]

**Endif (4d)**

**Endif (3d)**

**Endif (2d)**

*% if sensor is active, there cannot be an OC in VG/VIP, even if the lambda setpoint is not shifted*

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```
If(2e)    C_VLS_UP_MIN_OC_AFS_LSL_UP >= VLS_UP_DIAG[i] or
           VLS_UP_DIAG[i] >= C_VLS_UP_MAX_OC_AFS_LSL_UP
```

```
then
```

```
reset T_VLS_UP_AFS_DIAG_OC_LSL_UP[i]
```

```
Endif (2e)
```

```
% abort open loop if lambda setpoint shift did not occur and activity test would have seen the fault
% T_DIAG_OC_LSL_UP approximates the time until the activity diagnosis would come to its final decision.
```

```
If (2f)    LV_DIAG_ACT_SHO_CDN_LSL_UP[i] = 1
```

```
then
```

```
increment T_DIAG_OC_LSL_UP[i]
```

```
Else
```

```
reset T_DIAG_OC_LSL_UP[i]
```

```
Endif (2f)
```

```
Endif (1)
```

### Transition to other states

**Condition 2: to state "END" (Open Circ in line Vn detected)**

```
If    LV_DIAG_OBD_SYM_LSH_UP[i] = 1 and
       LV_VLS_UP_MIN_DIAG_OC_LSL_UP[i] = 1
```

```
then
```

```
STATE_DIAG_OC_LSL_UP[i] = "END"
```

```
ERR_SYM_OC_LSL_UP[i] = "SYM_0" /Open Circ in UN"
```

```
endif
```

**Condition 3: to state "END" (Open Circ in line VIP detected)**

```
If    (T_WAIT_SYM_OBD_2_LSH_UP[i] ≥ C_T_WAIT_SYM_OBD_2_LSH_UP) and
       (LV_DIAG_ACT_SYM_LSL_UP[i] = 1 or
        LV_VLS_UP_AFS_DIAG_OC_LSL_UP[i] = 1 or
        (LV_DIAG_PUC_SYM_LSL_UP[i] = 1 and
         STATE_DIAG_PUC_LSL_UP[i] = "VLS_AFS_OC"))
```

```
then
```

```
% wait if OBD2 upstream heater error symptom is present - to distinguish between OC on Vip and Vg.
```

```
% Only applicable for some sensor types, for others the timer limit should be set zero so that all pump
```

```
% circuit faults are presented as OC in VIP.
```

```
STATE_DIAG_OC_LSL_UP[i] = "END"
```

```
ERR_SYM_OC_LSL_UP[i] = "SYM_2" / Open Circ in VIP"
```

```
Endif
```


**Condition 4: to state "END" (Open Circ in line VG detected)**

```
If    LV_DIAG_OBD_SYM_LSH_UP[i] = 1 and
       (LV_VLS_UP_AFS_DIAG_OC_LSL_UP[i] = 1 or
        LV_DIAG_ACT_SYM_LSL_UP[i] = 1 or
        (LV_DIAG_PUC_SYM_LSL_UP[i] = 1 &
         STATE_SYM_DIAG_PUC_LSL_UP[i] = "VLS_AFS_OC"))
```

```
then
```

```
STATE_DIAG_OC_LSL_UP[i] = "END"
```

```
ERR_SYM_OC_LSL_UP[i] = "SYM_1" /Open Circ in VG"
```

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**endif**

**Condition 5: to state "END" (Open Circ in line VRc detected)**

```

If    LV_DIAG_PUC_SYM_LSL_UP[i] = 1 and
        STATE_SYM_DIAG_PUC_LSL_UP[i] = "VLS_H_OC"
then
STATE_DIAG_OC_LSL_UP[i] = "END"
ERR_SYM_OC_LSL_UP[i] = "SYM_3"    /Open Circ in VRc
endif

```

**Condition 6: to state "end"**

```

% finish diagnosis with "no open circuit error found"
% catch timeouts and secondary symptoms which are proven absent
If    (LV_DIAG_OBD_SYM_LSH_UP[i] = 1 and
        T_DIAG_OC_RST_OSC_DI[i] > C_T_DIAG_OC_RST_OSC_DI and
        (T_DIAG_OC_RST_LAMB_SP_REQ[i] > C_T_DIAG_OC_RST_OSC_DI or
         T_DIAG_OC_LSL_UP[i] > C_T_DIAG_OC_LSL_UP))
        % Heater symptom present, but additional symptoms of OC in VN or VG proven to be absent.
        % This means the heater symptom is caused by a real weak heater.
or
        T_WAIT_SYM_OBD_2_LSH_UP[i] > C_T_WAIT_SYM_OBD_2_LSH_UP
        % Diagnosis triggered by something other than OBD2 LSH and no other condition applied
        % Should happen only if Plaus/PUC triggered the OC test with a symptom of VLS_L
then
STATE_DIAG_OC_LSL_UP[i] = "END"
ERR_SYM_OC_LSL_UP[i] = "NO_SYM"
Endif

```

**Transition action for all change from State active to end (Conditions 2 to 6)**

```

If    ERR_SYM_OC_LSL_UP[i] = "NO_SYM"
then
LV_ERR_OC_LSL_UP[i] = 0
else
LV_ERR_OC_LSL_UP[i] = 1
endif
LV_END_DIAG_OC_LSL_UP[i] = 1

```


**State "end"**

**Action:**

```

% clean up.
T_WAIT_SYM_OBD_2_LSH_UP[i] = 0
T_DIAG_OC_LSL_UP[i] = 0
T_DIAG_OC_RST_OSC_DI[i] = 0
T_DIAG_OC_RST_LAMB_SP_REQ[i] = 0
T_VLS_UP_MIN_DIAG_OC_LSL_UP[i] = 0
T_VLS_UP_AFS_DIAG_OC_LSL_UP[i] = 0
LAMB_SP_DIAG_OC_LSL_UP[i] = 0

```

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```
LV_DIAG_OC_IF_OSC_DI_LSL_UP[i] = 0
```

### Transition to other states

```
% return to passive state.
```

```
if     ERR_SYM_OC_LSL_UP[i] = "NO_SYM"
then
        STATE_DIAG_OC_LSL_UP[i] = "PASSIVE"
endif
```

### Section "Moving Lambda setpoint"

This section shall produce a lambda set point that will be forwarded as a request to the lambda setpoint coordination.

```
% if currently not active, then determine the ramp
```

```
if     LAMB_SP_DIAG_OC_LSL_UP[i] = 0
then
        LAMB_SP_DELTA_OC_LSL_UP[i] = (C_LAMB_SP_OC_CHK_LSL_UP -      LAMB_SP[i])
/C_LAMB_SP_STEP_OC_CHK_LSL_UP
        if     LAMB_SP_DELTA_OC_LSL_UP[i] = 0
        then
                if     C_LAMB_SP_OC_CHK_LSL_UP >= LAMB_SP[i]
                then
                        LAMB_SP_DELTA_OC_LSL_UP[i] = +1H
                Else
                        LAMB_SP_DELTA_OC_LSL_UP[i] = -1H
                endif
        endif
        LAMB_SP_DIAG_OC_LSL_UP[i] = LAMB_SP[i]
```

```
endif
```

```
% move the set point
```

```
increment LAMB_SP_DIAG_OC_LSL_UP[i] with LAMB_SP_DELTA_OC_LSL_UP[i]
```

```
if     (LAMB_SP_DELTA_OC_LSL_UP[i] > 0 and
        LAMB_SP_DIAG_OC_LSL_UP[i] > C_LAMB_SP_OC_CHK_LSL_UP)
or     (LAMB_SP_DELTA_OC_LSL_UP[i] < 0 and
        LAMB_SP_DIAG_OC_LSL_UP[i] < C_LAMB_SP_OC_CHK_LSL_UP)
Then
        LAMB_SP_DIAG_OC_LSL_UP[i] = C_LAMB_SP_OC_CHK_LSL_UP
```

```
endif
```

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## A.22 O2 sensor (lin, up) open circuit diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_OC_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of "Open Circuit Diagnosis"					
LV_INH_DIAG_RBM_OC_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of RBM of "Open Circuit Diagnosis" by malfunction					
STATE_RBM_OC_LSL_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of OC_LSL_UP[NC_CBK_EX_NR] monitor with the Rate-Based Monitoring statistics					

### Input data:

LV_END_DIAG_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}
LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_PLAUS {p. 1062}
LV_ERR_MAP_TPS_PLAUS {p. 1062}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}
LV_ERR_MTC_DR {p. 5002}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}
LV_ERR_TPS {p. 4982}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}
LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}
LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_VCV {p. 4729}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_IGK {p. 906}
LV_LS_UP_OBD_1_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}	LV_VB_CDN_OBD_2 {p. 1046}	NC_CBK_EX_NR {p. 1829}	

**Import actions:**

<b>ACTION_ERRM_CheckPendingStatus (IN&lt;PRM_IDX_DIAG&gt;,OUT&lt;PRM_LV_ERR_PND&gt;)</b>
--

**Error treatment:**

Diagnostic	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
OC_LSL_UP[i]								
Detection of Open Circuit	Open Circuit on Vn	SYM_0					MIL_ON /	CARB_L
	Open Circuit on Vg	SYM_1					LAW_L	S
	Open Circuit on Vip	SYM_2						
	Open Circuit on Vrc	SYM_3						

DTCs are defined in the table of failures.

**A.22.1 General****Application conditions****Initialization:**

At transition LV\_IGK = 0 -> 1 or ECU reset LV\_INH\_DIAG\_OC\_LSL\_UP[i] = 0, LV\_INH\_DIAG\_RBM\_OC\_LSL\_UP[i] = 0.  
at every transition LV\_IGK = 1->0 LV\_INH\_DIAG\_OC\_LSL\_UP[i] = 1

**Recurrence:**

```

if    NC_4D4 = true  (SW Variant = 5 MSD80 4Cyl.)
then  100 ms
else  10 ms
endIf

```

**Activation:**

LV\_IGK = 1

**Deactivation:**

LV\_IGK = 0

**Formula section:**

The following part shall be carried out once every 10ms:

```

if
    LV_ERR_CHG_LS_UP = 1
    LV_ERR_DIAGCPS = 1
    LV_ERR_EL_CPS = 1
    LV_ERR_FUP = 1
    LV_ERR_FUP_MFP_PLAUS = 1
    LV_ERR_FUP_ORNG = 1
    LV_ERR_FUP_ST = 1
    LV_ERR_H_PRS_SYS = 1
    LV_ERR_LOAD_TPS_PLAUS = 1
    LV_ERR_MAF = 1
    LV_ERR_MAP_PLAUS = 1
    LV_ERR_MAP_TPS_PLAUS = 1
    LV_ERR_MTC_CTL_2 = 1
OR
OR
OR
OR
OR
OR
OR
OR
OR
OR
OR
OR
OR
OR
OR

```

```

LV_ERR_MTC_CTL_3 = 1           OR
LV_ERR_MTC_DR = 1             OR
LV_ERR_TPS = 1                OR
LV_ERR_VCV = 1                OR
LV_ERR_AIR_LSL_UP[i] = 1      OR LV_ERR_CTL_
LSL_UP[i] = 1                  OR
LV_ERR_DELTA_I_LAM[i] = 1     OR
LV_ERR_DYN_VLD_LS_UP[i] = 1   OR
LV_ERR_EL_LSL_UP[i] = 1       OR
LV_ERR_LSH_UP[i] = 1          OR
LV_ERR_LSL_UP_IF[i] = 1       OR
LV_ERR_OFS_LSL_UP[i] = 1      OR
LV_ERR_SHIFT_AFL_LSL_UP[i] = 1 OR
LV_ERR_SHIFT_AFR_LSL_UP[i] = 1 OR
LV_ERR_VLS_DOWN_DIF[i] = 1    OR
(i = 1                          AND
    [ LV_ERR_IV[0]              OR
      LV_ERR_IV[2]              OR
      LV_ERR_IV[4]              OR
      LV_ERR_MIS[0]             OR
      LV_ERR_MIS[2]             OR
      LV_ERR_MIS[4]
    ])                            OR
(i = 2                          AND
    [ LV_ERR_IV[1]              OR
      LV_ERR_IV[3]              OR
      LV_ERR_IV[5]              OR
      LV_ERR_MIS[1]             OR
      LV_ERR_MIS[3]             OR
      LV_ERR_MIS[5]
    ])                            OR
Then
LV_INH_DIAG_RBM_OC_LSL_UP[i] = 1
Else
LV_INH_DIAG_RBM_OC_LSL_UP[i] = 0
Endif


If LV_INH_DIAG_RBM_OC_LSL_UP[i] = 1 OR
LV_LS_UP_OBD_1_MAN_DEAC[i] = 1 OR
LV_VB_CDN_OBD_2 = 0

Then
LV_INH_DIAG_OC_LSL_UP[i] = 1
Else
LV_INH_DIAG_OC_LSL_UP[i] = 0
Endif

```

### A.22.1.1 Interface for Rate - Based - Monitoring OC\_LSL\_UP[I]

#### FUNCTION DESCRIPTION:

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## General information:

With this module the interface between the OC\_LSL\_UP[i] monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_OC\_LSL\_UP[i] data.

Within STATE\_RBM\_OC\_LSL\_UP[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)  
(depending on failure status: pending)
- Monitor individual RBM conditions encountered within this DC (bit 2)  
( not valid for catalyst diagnosis )

## Application conditions

### Initialisation:

at ECU reset:

bit 0, bit 1 and bit 2 of STATE\_RBM\_OC\_LSL\_UP[i] = 0  
LV\_DC 0 → 1 transition:

bit 0 and bit 1 of STATE\_RBM\_OC\_LSL\_UP[i] = 0

on failure memory reset:

bit 1 of STATE\_RBM\_OC\_LSL\_UP[i] = 0

### Recurrence:

1 s

### Activation:

LV\_DC = 1

## Formula section:

At LV\_DC 0 → 1 transition

bit 2 of STATE\_RBM\_OC\_LSL\_UP[i] = 1

The pending status of the following failures has to be checked only once :

Dependence	Error			
	LV_ERR_CHG_LS_UP	LV_ERR_DIAGCPS	LV_ERR_EL_CPS	LV_ERR_FUP
	LV_ERR_FUP_MFP_PL AUS	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_SYS
	LV_ERR_LOAD_TPS_PL AUS	LV_ERR_MAP_PLAUS	LV_ERR_MAP_TPS_PLA US	LV_ERR_MTC_CTL_2
	LV_ERR_MTC_CTL_3	LV_ERR_MTC_DR	LV_ERR_TPS_1	LV_ERR_TPS_2
	LV_ERR_TPS_AD	LV_ERR_TPS_AD_BOL	LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2
	LV_ERR_TPS_RATIO	LV_ERR_TPS_ST_CHK 2	LV_ERR_VCV	
<b>NC_CBK_EX_N R</b>	LV_ERR_AIR_LSL_UP[i]	LV_ERR_CTL_LSL_UP[i]	LV_ERR_DELTA_I_LAM[ i]	LV_ERR_DYN_VLD_LS UP[i]
	LV_ERR_EL_LSL_UP[i]	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]	LV_ERR_OFS_LSL_UP[ i]
	LV_ERR_SHIFT_AFR_L SL_UP[i]	LV_ERR_SHIFT_AFL_LS L_UP[i]	LV_ERR_VLS_DOWN_D IF[i]	

Figure A.22.1: For k = 1 to NC\_MAF\_NR (= for any i // or)

NC_MAF_NR	LV_ERR_MAF_FRQ_EL[ k]	LV_ERR_MAF_FRQ_GR D[k]	LV_ERR_MAF_FRQ_RN G[k]	

Figure A.22.2: For NC\_CBK\_EX\_NR = i = 1



<b>NC_CYL_NR</b>	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	LV_ERR_MIS[0]
	LV_ERR_MIS[2]	LV_ERR_MIS[4]		

Figure A.22.3: For NC\_CBK\_EX\_NR = i = 2

<b>NC_CYL_NR</b>	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	LV_ERR_MIS[1]
	LV_ERR_MIS[3]	LV_ERR_MIS[5]		

```

If(1)    { CPU optimization at LV_DC 0 → 1 transition }
           CTR_ERR_DYN_NR <> 0  { the dynamic failure memory isn't empty }

Then(1)

           While bit 1 of STATE_RBM_OC_LSL_UP[i] = 0 do
               with each XX failure of the above list (depending on configuration, see below):
               ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

                   If(2)  XX has a pending status
                       Then(2)    bit 1 of STATE_RBM_OC_LSL_UP[i] = 1
                       Endif(2)

                   Endwhile

           Else(1)  { the dynamic failure memory is empty }    No action
           Endif(1)

```

Every 1 s :

```

If    bit 0 of STATE_RBM_OC_LSL_UP[i] = 0
Then

           If    LV_END_DIAG_OC_LSL_UP[i] = 1
               Then bit 0 of STATE_RBM_OC_LSL_UP[i] = 1
               Endif

           Endif

If    bit 1 of STATE_RBM_OC_LSL_UP[i] = 0
Then

           If    LV_INH_DIAG_RBM_OC_LSL_UP[i] = 1
               Then bit 1 of STATE_RBM_OC_LSL_UP[i] = 1
               Endif

           Endif

```

## A.23 O2 sensor (up) heater circuit diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibit flag for upstream oxygen sensor heater OBDI diagnosis					

### Input data:

LV_CDN_VB_OBD1 {p. 1185}	LV_ERR_SPI_MPS {p. 4245}	LV_LS_UP_OBD_1_MAN_ DEAC [NC_CBK_EX_NR] {p. 5449}	LV_ST_END {p. 1720}
NC_CBK_EX_NR {p. 1829}			

### FUNCTION DESCRIPTION:

#### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

#### Description:

The diagnosis is inhibited due to low battery voltage, present error or if sensors are not learnt.

#### Application conditions

**Initialisation:**  $LV\_INH\_DIAG\_LSH\_UP[i] = 1$  at reset

**Recurrence:** The function shall be carried out once every 100 ms.

**Activation:**  $LV\_ST\_END = 1$

**Deactivation:**  $LV\_ST\_END = 0$  , set  $LV\_INH\_DIAG\_LSH\_UP[i] = 1$

#### Formula section:

```

If      LV_CDN_VB_OBD1 = 0           or
          LV_ERR_SPI_MPS = 1           or
          LV_LS_UP_OBD_1_MAN_DEAC[i] = 1 //sensors not learnt
Then   LV_INH_DIAG_LSH_UP[i] = 1
Else   LV_INH_DIAG_LSH_UP[i] = 0
Endif

```

## A.24 O2 sensor (up) heater circuit diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_LSH_UP [NC_CBK_EX_NR]	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of upstream heater diagnosis OBD I					
ERR_DIAG_LSH_UP [NC_CBK_EX_NR]	V	0H 1H 2H 4H	NO_SYM SYM_0 SYM_1 SYM_2	-	-
Raw value of error symptom for upstream heater diagnosis OBD I					
ERR_SYM_LSH_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for upstream heater diagnosis OBD I filtered with CDN_DIAG_LSH_UP					
LV_CDN_DIAG_LSH_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Diagnosis condition for upstream heater diagnosis OBD 1					
LV_END_DIAG_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End of diagnosis for upstream heater diagnosis OBD I					
LV_ERR_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Error flag for upstream heater diagnosis OBD I after debouncing					
LV_LSH_SCG_ACT_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that debounce for upstream heater OBDI SCG diagnosis active					

### Input data:

LSHPWM_UP [NC_CBK_EX_NR] {p. 2385}	LV_IGK {p. 906}	LV_INH_DIAG_LSH_UP [NC_CBK_EX_NR] {p. 4314}	LV_VB_CDN_OBD_1 {p. 1046}
NC_CBK_EX_NR {p. 1829}	STATE_LSH_UP [NC_CBK_EX_NR] {p. 2385}	TEG_DYN_LS_UP [NC_CBK_EX_NR] {p. 1008}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_LSH_UP	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_LSH_UP	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_LSHPWM_MAX_DIAG_LSH_UP	-	0... FFH	0... 99.60937	0.390625	%
Maximum O2-Sensor heater duty cycle to perform the electrical diagnosis					
C_LSHPWM_MIN_DIAG_LSH_UP	-	0... FFH	0... 99.60937	0.390625	%
Minimum O2-Sensor heater duty cycle to perform the electrical diagnosis					
C_TEG_DYN_MIN_DIAG_LSH_UP	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Minimum exhaust gas temperature threshold to permit SCP to set fault during LSH power rise state					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_LSH_UP	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (typical 2)					

**Import actions:**

<b>ACTION_ERRM_FilterMulticondition</b> (IN<XX>,IN<CDN_DIAG_>,XX>,<IN<>,ERR_DIAG_XX>,<IN>,<C_ABC_INC_XX>,IN<C_ABC_MAX_XX>,OUT<LV_ERR_XX>)
<b>ACTION_INFR_GetEIDiagLshUp</b> (IN<i>,<OUT<cdn_diag>,<OUT<err_diag>)

**Error treatment:**

Diagnostic XX	Symptom description	Symptom	Filter type
Downstream oxygen sensor heater OBDI diagnosis	Short circuit to battery	SYM_0	MPL_STD_INI
	Short circuit to GND	SYM_1	
LSH_UP[i]	Open circuit	SYM_2	
	4 <sup>th</sup> symptom description	SYM_3	

**FUNCTION DESCRIPTION:****General information:**

The purpose of the diagnosis is to detect electrical faults as defined by OBD I requirements.

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

All symptoms of the current error code are handled by anti-bouncing.


We assume that only one symptom of an error code can be active at the same time.

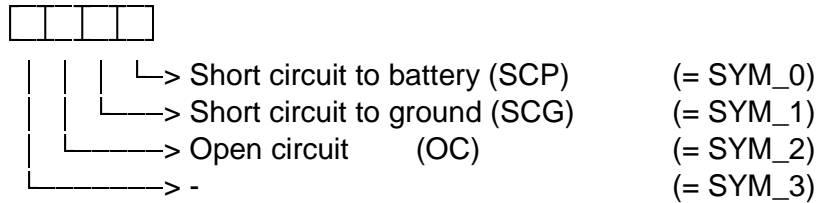
**Description:**

The error detection is effected via the ECU hardware.

The purpose of the diagnosis shall be to detect electrical faults within the oxygen sensor heater circuit as defined by OBD I requirements.

**Error-symptoms and conditions:** are defined to this diagnosis function as following

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The function is intended for use in a hardware configuration where the heater driver shall carry out the electrical fault diagnosis and provide the electrical status via status flags.

1. Short circuit to Vbatt by Over-temperature **or** Overcurrent (SCP)
2. Short circuit to GND (SCG)
3. Open load (OC)

The heater drivers named are capable of detecting an **OC** and **SCP** fault when in the ON state and only capable of detecting a SCG fault in the OFF state. As the heater power is controlled by a PWM signal, the driver will be placed alternately in an ON and then OFF state.

The diagnosis shall be activated should the following conditions be met:

- Engine leaving the engine start state as denoted by LV\_IGK = 1
- Battery voltage falls between pre-set thresholds to protect against false errors at battery voltage extremes as indicated by LV\_VB\_CDN\_OBD\_1.
- CDN depending on duty cycle of LSHPWM\_UP[i]
- Inhibit flag not set (LV\_INH\_DIAG\_LSH\_UP[i])

In exceptionally rare extreme environmental conditions for certain system configurations, it is possible that the heater driver may be driven into over-temperature during initial oxygen sensor heating. In this case, the driver automatically turns off the output stage in self-protection and sets the **SCP** electrical fault bit. In order to mask an incorrect oxygen sensor heater **SCP** fault, the function shall only allow the **SCP** to set a fault during the initial heater phase, if the exhaust gas temperature has exceeded a pre-determined calibrateable threshold.

The oxygen sensor heater fault detection shall be debounced by use of an anti-bounce counter. This shall be handled by the Dynamic Error Management.

Each of the above listed faults shall be described individually below:

Otherwise the diagnosis has to be suppressed (CDN\_DIAG\_LSH\_UP[i] = 0). This is managed within the Diagnosis condition calculation.

### Application conditions

**Initialization:** at reset CDN\_DIAG\_LSH\_UP[i] = 0, ERR\_DIAG\_LSH\_UP[i] = 0  
All other variables are initialized according filter type

**Activation:** : -

**Deactivation:** -

**Recurrence:** 100 ms

**NOTE: The heater PWM frequency shall be at least 2 times faster than the diagnosis frequency to ensure that an oversampling effect does not occur!**

### Formula section:

**If** LV\_IGK = 1  
**and** LV\_VB\_CDN\_OBD\_1 = 1

**and** LV\_INH\_DIAG\_LSH\_UP[i] = 0  
**then**

Usage of the diagnosis information (failure symptoms (raw value) **ERR\_DIAG\_LSH\_UP[i]** and basic diagnosis conditions **CDN\_DIAG\_LSH\_UP[i]**) received from the infrastructure:

**ACTION\_INFR\_GetEIDiagLshUp**(IN <i>, OUT<CDN\_DIAG\_LSH\_UP[i]>, OUT<ERR\_DIAG\_LSH\_UP[i]>)

Basic diagnosis conditions are set according infrastructure information: CDN\_DIAG\_LSH\_UP[i].  
 Failure symptoms (raw value) are set according infrastructure information: ERR\_DIAG\_LSH\_UP[i].

**If** Activation conditions are met for the NC\_PSD\_DLY\_LSH\_UP recurrence

**Then**

**If** LSHPWM\_UP[i] < C\_LSHPWM\_MIN\_DIAG\_LSH\_UP  
**or** [(STATE\_LSH\_UP[i] = LSH\_POW\_RISE  
**or** STATE\_LSH\_UP[i] = LSH\_POW\_RED)  
**and** TEG\_DYN\_LS\_UP[i] < C\_TEG\_DYN\_MIN\_DIAG\_LSH\_UP]  
**then** bit 0 of CDN\_DIAG\_LSH\_UP[i] = 0 (**SCP** can not be detected)

**endif**

**If** LSHPWM\_UP[i] > C\_LSHPWM\_MAX\_DIAG\_LSH\_UP  
**then** bit 1 of CDN\_DIAG\_LSH\_UP[i] = 0 (**SCG** can not be detected)

**endif**

**if** LSHPWM\_UP[i] < C\_LSHPWM\_MIN\_DIAG\_LSH\_UP  
**or** LSHPWM\_UP[i] > C\_LSHPWM\_MAX\_DIAG\_LSH\_UP  
**then** bit 2 of CDN\_DIAG\_LSH\_UP[i] = 0 (**OC** can not be detected)

**endif**

**Else**

CDN\_DIAG\_LSH\_UP[i] = 0

**Endif**

**Else**

CDN\_DIAG\_LSH\_UP[i] = 0

**endif**

### Error Symptom calculation (raw value from I/O SW)

**If** bit 1 of ERR\_DIAG\_LSH\_UP[i] = 1  
**then** LV\_LSH\_SCG\_ACT\_LSH\_UP[i] = 1  
**endif**

**If** abc-counter = 0  
**then** LV\_LSH\_SCG\_ACT\_LSH\_UP[i] = 0  
**endif**


For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN\_DIAG\_LSH\_UP[i] and ERR\_DIAG\_LSH\_UP[i].

**ACTION\_ERRM\_FilterMulticondition**(IN <XX>, IN< CDN\_DIAG\_LSH\_UP[i]>, IN< ERR\_DIAG\_LSH\_UP[i]>, IN <C\_ABC\_INC\_LSH\_UP>, IN <C\_ABC\_MAX\_LSH\_UP>, OUT<LV\_ERR\_LSH\_UP[i]>)


This algorithm determines:

ERR\_SYM\_LSH\_UP[i] (= raw value ERR\_DIAG\_LSH\_UP[i] filtered with CDN\_DIAG\_LSH\_UP[i], detected error symptom for lambda sensor heater upstream [i] diagnosis)

LV\_ERR\_LSH\_UP[i] (Error flag for debounced error of for lambda sensor heater upstream [i])

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LV\_CDN\_DIAG\_LSH\_UP[i]            (Diagnosis condition information)  
 LV\_END\_DIAG\_LSH\_UP[i]        (End of diagnosis information)

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## A.25 Actuator adaptation and diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DIAG_ACR_AD	V	0... FFH	0... 255	1	-
Diagnostic counter used at the continuously BOL adaptation					
CTR_DLY_ACR_AD	V	0... FFH	0... 255	1	-
Delay counter for the activation of the actuator adaptation					
ERR_SYM_ACR_AD	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom for the actuator adaptation					
FAC_ACR_SLOP	O/V/S	0... FFFFH	0... 99.9984741	0.001526	%/V
Signal slop of the actuator measuring system					
LV_CDN_DIAG_ACR_AD	V	0... 1H	0 ...1	1	-
Logical variable is set, if the diagnosis condition for actuator adaptation is fulfilled					
LV_END_DIAG_ACR_AD	V	0... 1H	0 ...1	1	-
Logical variable is set, if end of diagnosis condition for the actuator adaptation is fulfilled					
LV_ERR_ACR_AD	O/V	0... 1H	0 ...1	1	-
Logical variable is set, if an adaptation error occurs					
LV_INH_ACR_CTL_AD	O/V	0... 1H	0 ...1	1	-
Logical variable to inhibit actuator position control					
LV_OPG_SP_AD_ACR	O/V	0... 1H	0 ...1	1	-
Logical variable indicates a setpoint request for the actuator adaptation					
OPG_SP_AD_ACR	O/V	0... FFFFH	0... 99.9755859	0.02441	%
Actuator adaptation setpoint request for actuator position control					
STATE_ACR_AD	O/V	0H	ACR_AD_INIT	-	-
		1H	ACR_AD_BOL		
		2H	ACR_GO_TOL		
		3H	ACR_AD_TOL		
		4H	ACR_GO_BOL		
		5H	ACR_AD_END		
Variable indicate the state of the key on actuator adaptation					
V_ACR_AD_BOL	O/V/S	0... 3FFH	0... 4.99511719	0.00488	V
Adaptation value for the lower mechanical stop of the actuator valve					
V_ACR_AD_BOL_0	V/S	0... 3FFH	0... 4.99511719	0.00488	V
Adaptation value for the lower mechanical stop after first adaptation					
V_ACR_AD_TOL	O/V/S	0... 3FFH	0... 4.99511719	0.00488	V
Adaptation value for the upper mechanical stop					

### Input data:

LV_ACR_AD_ACT {p. 4333}	LV_ACR_AD_REQ {p. 4333}	LV_INH_ACR_AD {p. 4333}	LV_INH_ACR_AD_BOL {p. 4333}
V_ACR {p. 1097}			

### Calibration data:



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_ACR_AD	-	0... FFH	0... 0.99609375	0.003906	-
Correlation constant for the determination of the actuator adaptation value					
C_CTR_ACR_AD	-	0... FFH	0... 255	1	-
Maximum time for the adaptation of the lower mechanical stop					
C_CTR_DIAG_ACR_AD	-	0... FFH	0... 255	1	-
Diagnosis counter threshold for the adaptation of the lower mechanical stop					
C_CTR_DIAG_END_ACR_AD	-	0... FFH	0... 255	1	-
Constant to define the end of diagnosis of the continuously BOL adaptation					
C_CTR_DLY_ACR_AD	-	0... FFH	0... 255	1	-
Delay time before adaptation of the lower and upper mechanical stop will be started					
C_CTR_DLY_ACR_AD_MAX	-	0... FFH	0... 255	1	-
Delay counter for the activation of the actuator adaptation					
C_CTR_DLY_ACR_AD_TOL	-	0... FFH	0... 255	1	-
End of diagnosis counter for the actuator adaptation					
C_FAC_ACR_SLOP	-	0... FFFFH	0... 99.9984741	0.001526	%/V
Signal slop of the actuator measuring system					
C_OPG_SP_AD_LGRD	-	0... FFFH	0... 99.9755859	0.02441	%
Change limitation for the adaptation of the upper mechanical stop					
C_OPG_SP_MAX_AD_ACR	-	0... FFFH	0... 99.9755859	0.02441	%
Start setpoint for the adaptation of the upper mechanical stop					
C_V_ACR_AD_BOL_INI	-	0... 3FFH	0... 4.99511719	0.00488	V
Initialisation value for the adaptation value of the lower mechanical stop					
C_V_ACR_AD_BOL_MAX	-	0... 3FFH	0... 4.99511719	0.00488	V
Upper limit for the plausibility check of the adaptation value for the lower mechanical stop					
C_V_ACR_AD_BOL_MIN	-	0... 3FFH	0... 4.99511719	0.00488	V
Lower limit for the plausibility check of the adaptation value for the lower mechanical stop					
C_V_ACR_AD_CHK_CTL	-	0... 3FFH	0... 4.99511719	0.00488	V
Threshold for the actuator function check during the upper mechanical stop adaptation					
C_V_ACR_AD_TOL_INI	-	0... 3FFH	0... 4.99511719	0.00488	V
Initialisation value of the upper mechanical stop					
C_V_ACR_AD_TOL_MAX	-	0... 3FFH	0... 4.99511719	0.00488	V
Upper limit for the plausibility check of the adaptation value for the upper mechanical stop					
C_V_ACR_AD_TOL_MIN	-	0... 3FFH	0... 4.99511719	0.00488	V
Lower limit for the plausibility check of the adaptation value for the upper mechanical stop					
LC_FAC_ACR_SLOP_AD_ENA	-	0... 1H	0...1	1	-
Logical constant to enable the adaptation of the upper mechanical stop					

### Import actions:

```
ACTION_ERRM_NoFilterSymptom (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_LV_ERR_SET>,IN<PRM_LV_ERR_RST>,IN<PRM_LV_END_DIAG>,OUT<PRM_LV_ERR>)
```

### General information

The actuator valve position is determined by a measuring system. In order to reduce measurement inaccuracy, the sensor signal voltage is referenced to its sensor supply voltage. The electrical value of the lower and upper mechanical stop depends on the actuator characteristic, the actuator temperature and the valve coking therefore the electrical valve characteristic has to be learnt. After the actuator

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adaptation the adaptation values of the lower, the upper mechanical stop and the sensor slope are stored at the end of the driving cycle as "nonvolatile".

**Application Condition**

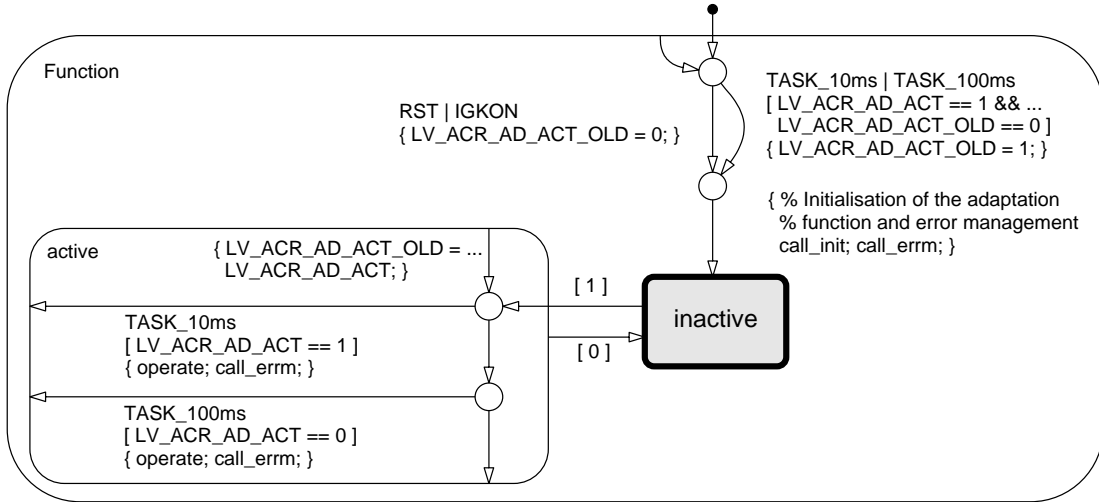
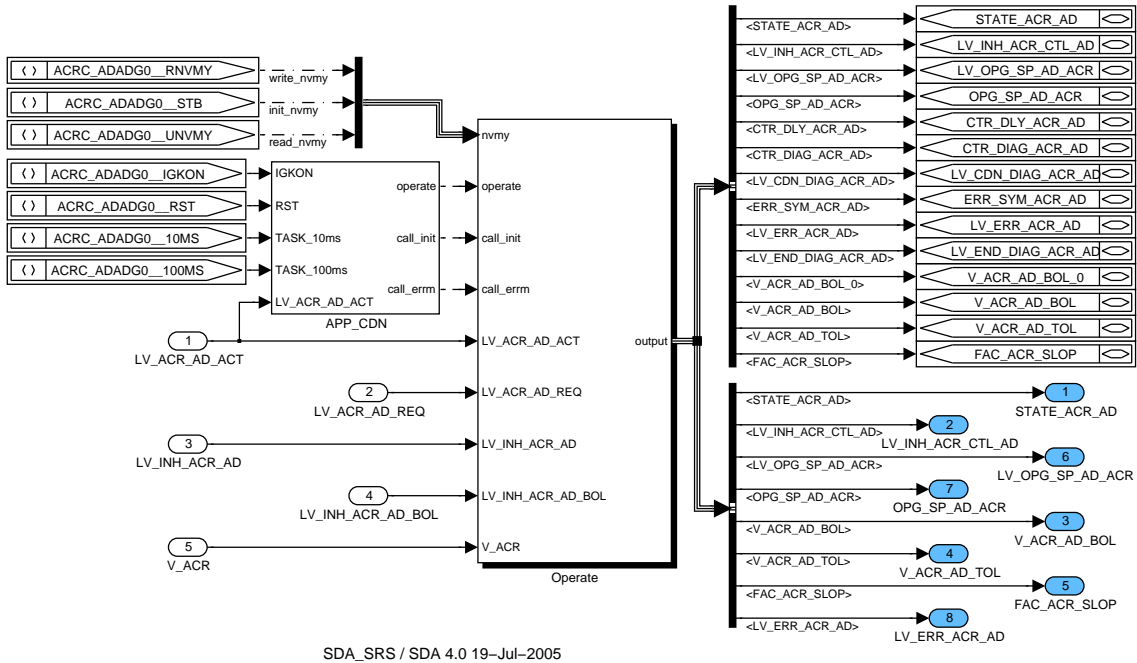


Figure A.25.1: ACRC\_adaptation\_and\_diagnosis/APP\_CDN/APP\_CDN

**Function Description**



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Figure A.25.2: ACRC\_adaptation\_and\_diagnosis

## A.25.1 Adaptation functionalities


The adaptation functionality consists of a complete adaptation of the actuator valve and a continuously adaptation only for the lower mechanical valve stop. The adaptation algorithms are controlled by the variable LV\_ACR\_AD\_ACT and the related inhibition conditions. The variables are provided in corresponding application incidence module.

After the reset of the functionality a complete adaptation of the actuator valve is started if the variable LV\_ACR\_AD\_ACT has been set otherwise the continuously adaptation of the lower mechanical stop will be performed.

The adaptation module contain own diagnostic functions for the check of the adaptation values and the correct function of the actuator valve.

Error symptoms for the actuator adaptation are defined as follows :

- SYM\_0 - Adaptation conditions not fulfilled
- SYM\_1 - Lower adaptation value outside range
- SYM\_2 - Adaptation position not reached
- SYM\_3 - Upper adaptation value outside range

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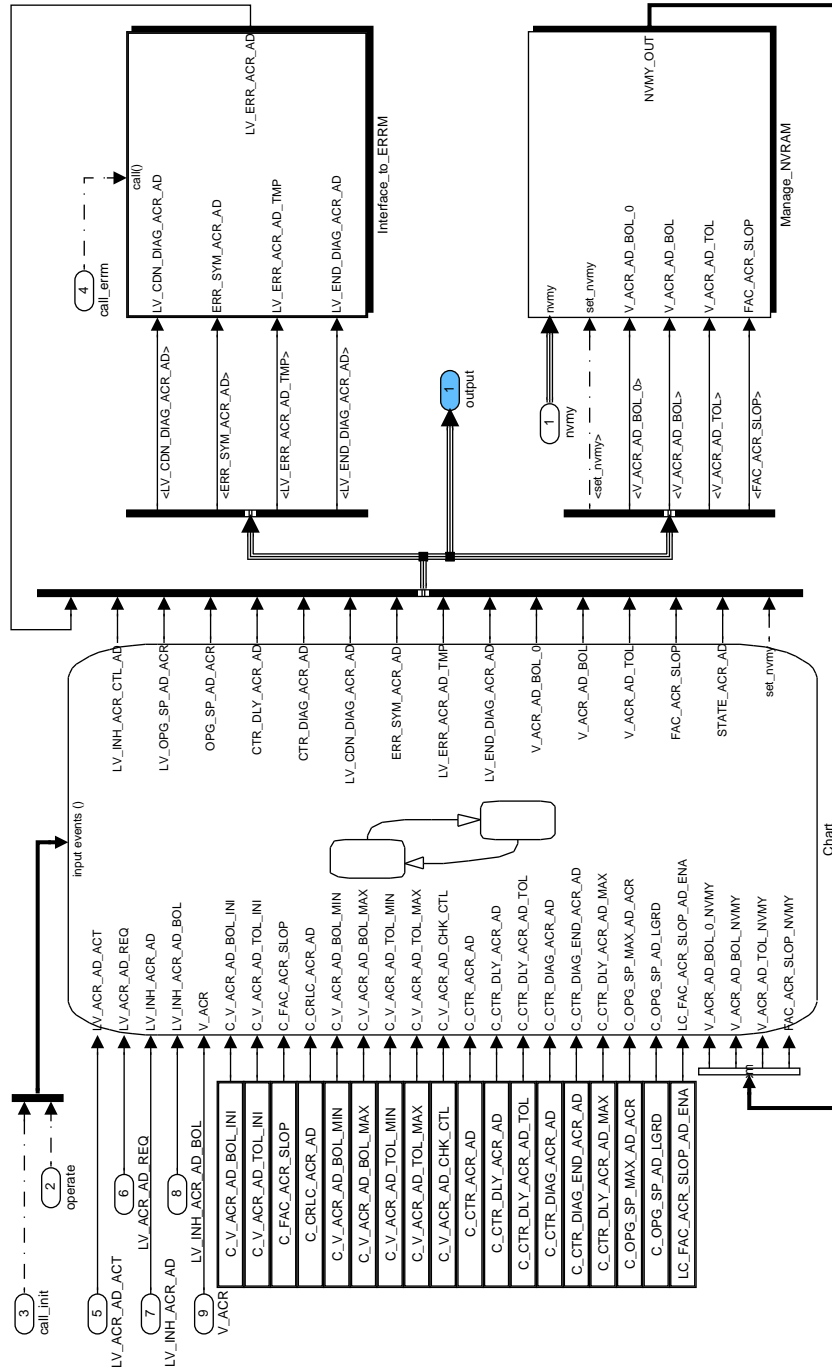



Figure A.25.3: ACRC\_adaptation\_and\_diagnosis/Operate

**State machine of the actuator adaptation**

The state flow diagram of the actuator adaptation functionality contains the complete and the continuously adaptation functionality. The state machine is reset with a new reset event generated by the application conditions that means the functionality will be restarted on the default transition dependent on LV\_ACR\_AD\_ACT.

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The inhibition variable LV\_INH\_ACR\_AD of the adaptation function is only checked after the initialisation state has been finished. If the inhibition variable is set during the check then an error entry will be performed.

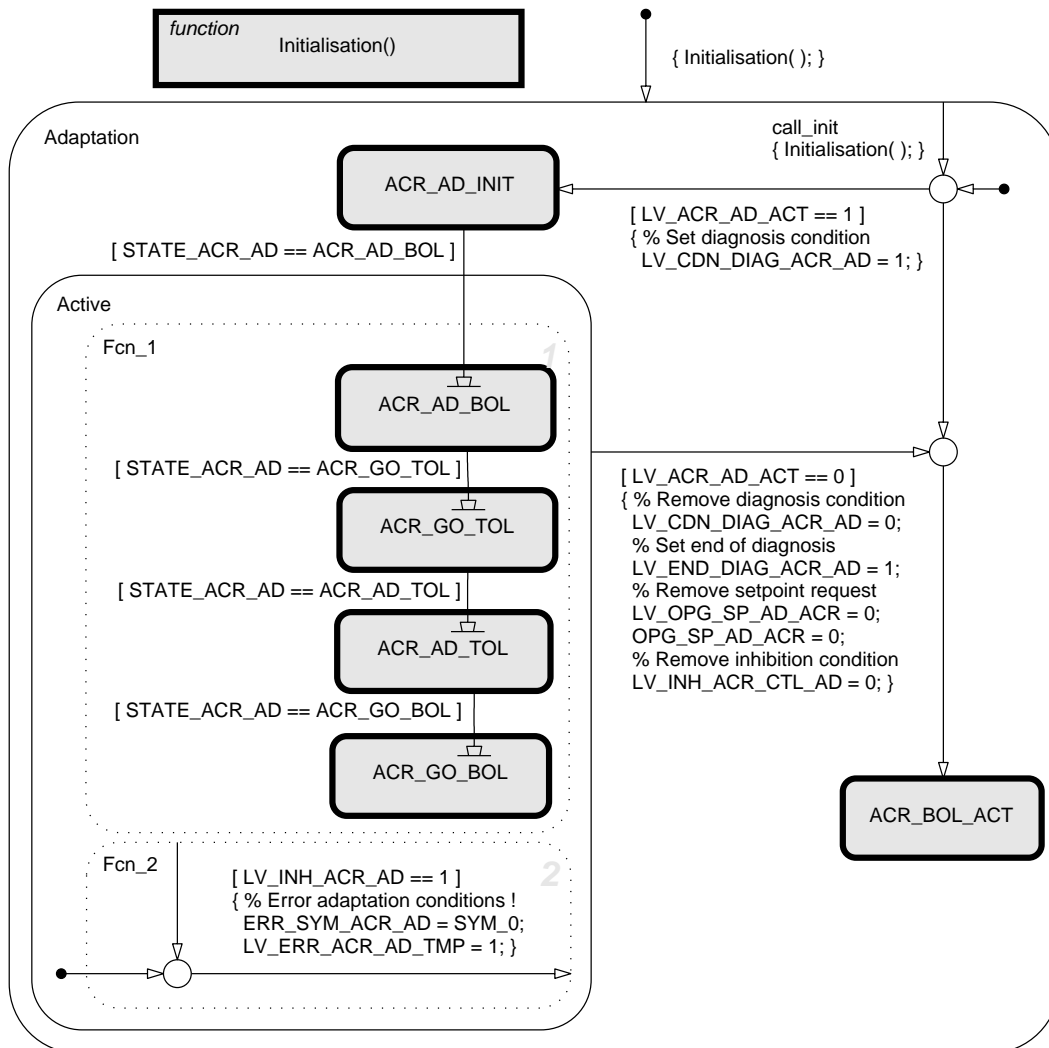


Figure A.25.4: ACRC\_adaptation\_and\_diagnosis/Operate/Chart

### Initialisation function

The following function is used for the initialisation of the actuator adaptation. The function is called from the application condition module and shall initialise the adaptation values, the used error and auxiliary values.

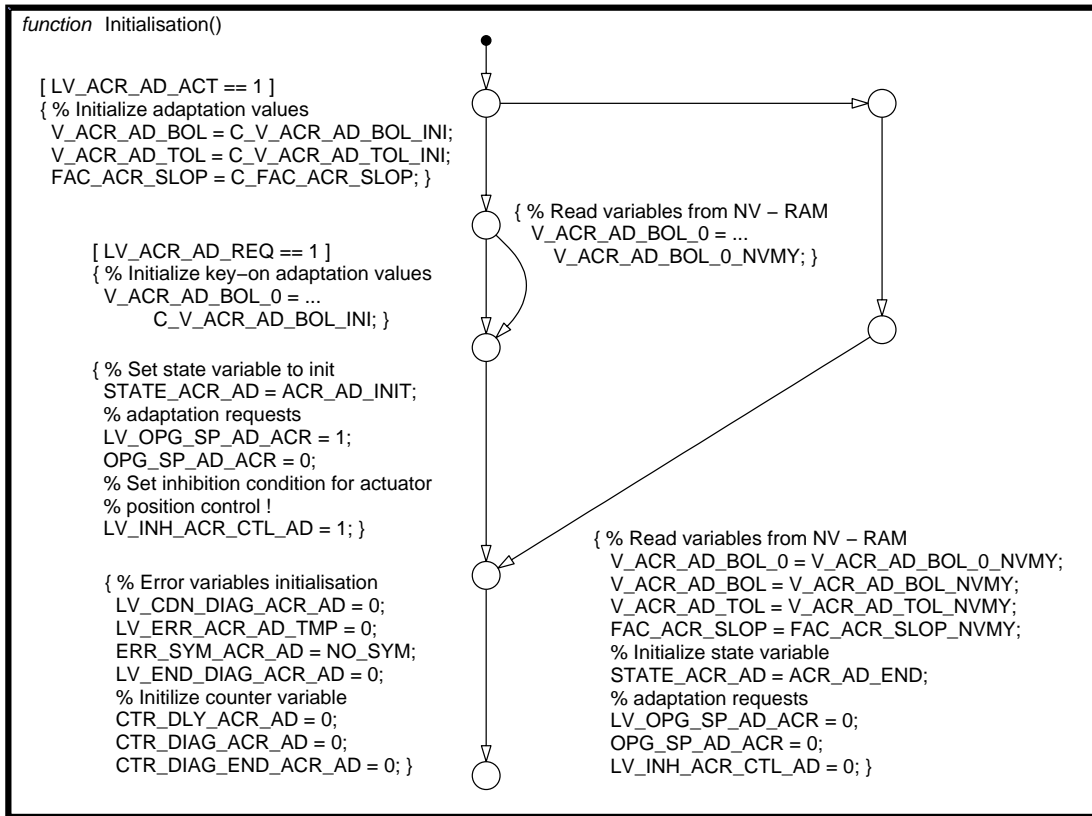


Figure A.25.5: ACRC\_adaptation\_and\_diagnosis/Operate/Chart/Initialisation

**Initialisation state of the actuator adaptation**

At the start of the actuator adaptation the following initialisation function is necessary. During the initialisation state the adaptation waits a defined time for valid adaptation conditions.

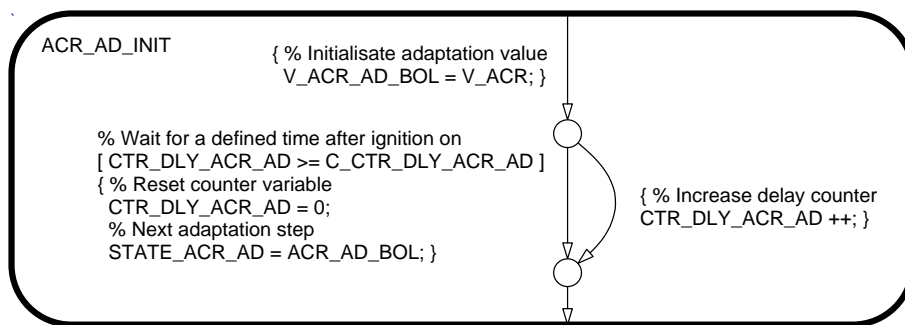


Figure A.25.6: ACRC\_adaptation\_and\_diagnosis/Operate/Chart/Adaptation/ACR\_AD\_INIT

**Adaptation of the lower mechanical stop**

In the following state the lower mechanical stop of the actuator valve is learnt. The adaptation value is determined as moving mean value of the sensor signal voltage. The corresponding correlation constant

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C\_CRLC\_ARC\_AD defines the calculation of the adaptation value. The adaptation is performed only for a defined adaptation time to get a valid adaptation value. At the end of the algorithm the adaptation value is checked for validity. If the adaptation value is outside of the valid range then an error entry will be performed.

Additionally the further adaptation functionality, the adaptation of the upper mechanical stop, can be chosen via configuration data LC\_FAC\_ACR\_SLOP\_AD\_ENA. If the constant is set then the upper mechanical stop and the sensor slope will be learnt, otherwise the adaptation will be finished and the initialisation values will be used !

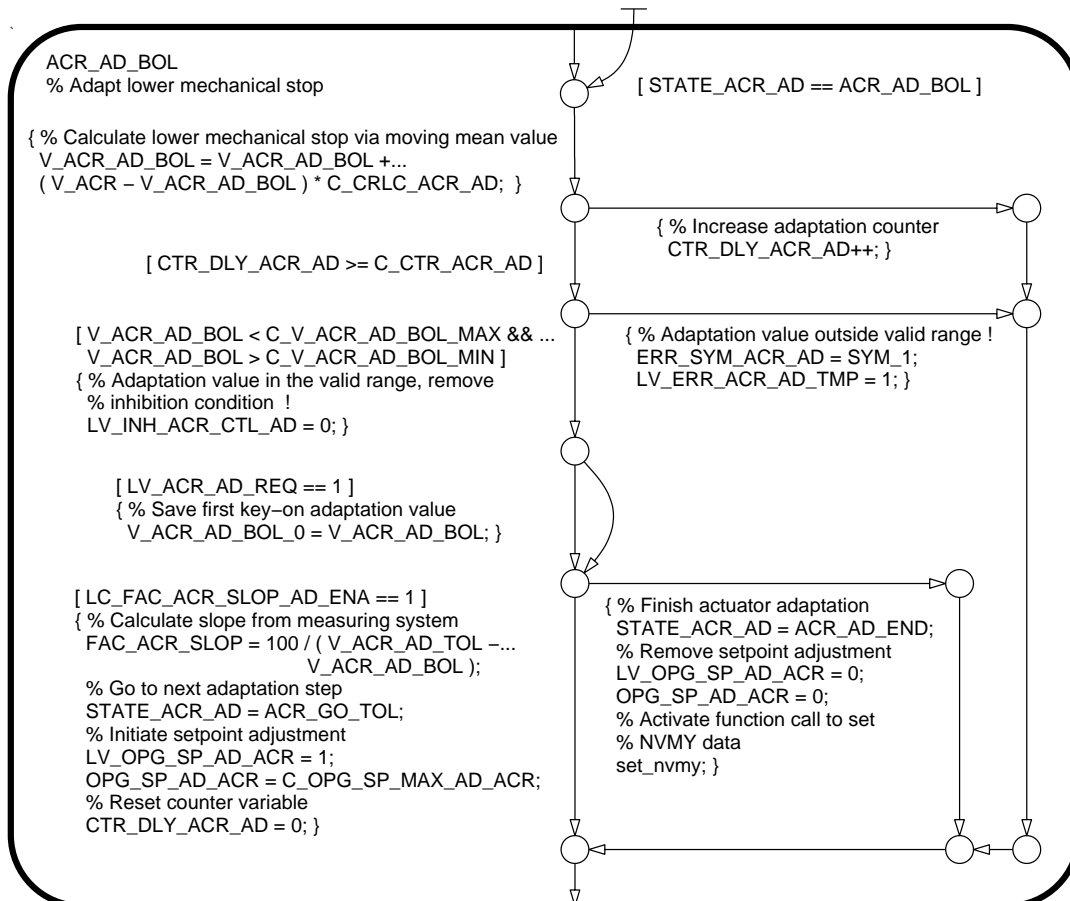


Figure A.25.7: ACRC\_adaptation\_and\_diagnosis/Operate/Chart/Adaptation/Active/ACR\_AD\_BOL

### Drive actuator in the upper mechanical stop

The following state drives the actuator valve in the upper mechanical stop via setpoint adjustment. At first the setpoint for closedloop position control is set to a defined start value and the power stage is switched on. Afterwards the setpoint is increased via change limitation to 100 %.

Additionally the state checks the correct function of the closedloop position control system. If the setpoint is set to 100 % then the actuator valve must exceed a diagnostic threshold otherwise an adaptation error is indicated and the adaptation is stopped.

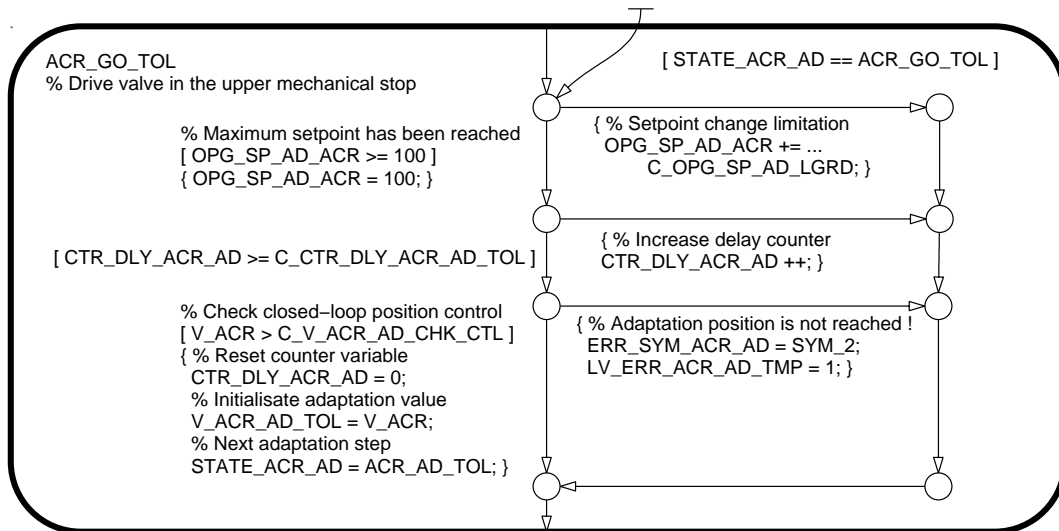


Figure A.25.8: ACRC\_adaptation\_and\_diagnosis/Operate/Chart/Adaptation/Active/ACR\_GO\_TOL

### Adaptation of the upper mechanical stop

In the next adaptation state the upper mechanical stop of the actuator valve is learnt. The adaptation value of the upper mechanical stop is determined as moving mean value of the sensor signal voltage. The corresponding correlation constant  $C\_CRLC\_ARC\_AD$  defines the calculation of the adaptation value. The adaptation is performed only for a defined adaptation time to get a valid adaptation value. At the end of the algorithm the adaptation value of the upper mechanical stop is check of validity. If the adaptation value is outside of the valid range than an error entry will be performed.

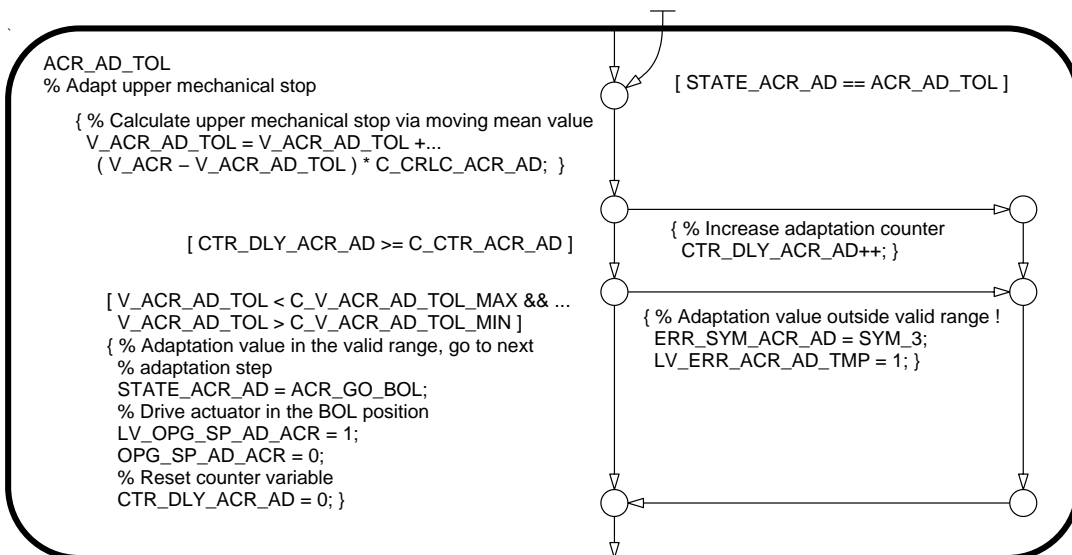


Figure A.25.9: ACRC\_adaptation\_and\_diagnosis/Operate/Chart/Adaptation/Active/ACR\_AD\_TOL

### Finish actuator adaptation



The last state of the adaptation shall drive the actuator valve in the lower mechanical stop and calculate the sensor signal sloop of the measuring system. The adaptation state will be left if a defined waiting time is elapsed.

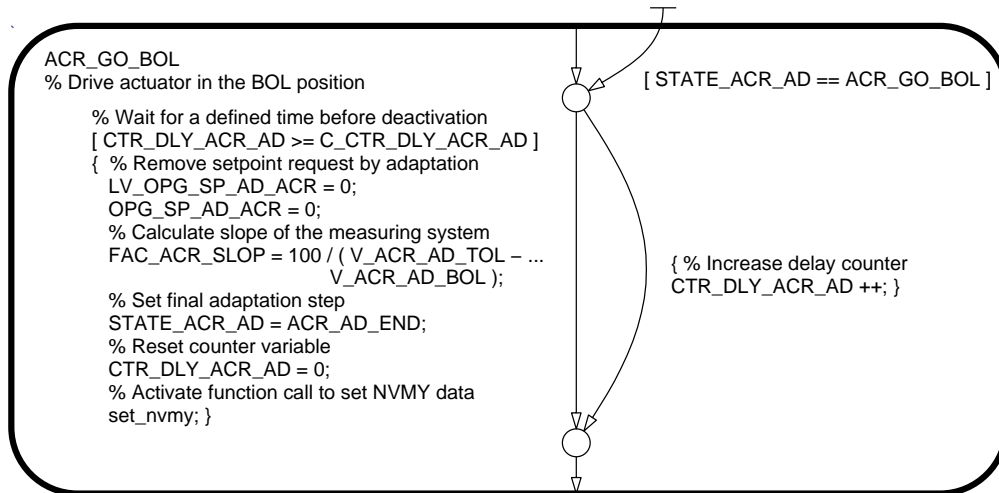


Figure A.25.10: ACRC\_adaptation\_and\_diagnosis/Operate/Chart/Adaptation/Active/ACR\_GO\_BOL

### Continuously adaptation of the lower mechanical stop

If the actuator valve is in closing position, then the adaptation of the lower mechanical stop will be started after a defined delay time. A closed actuator valve is indicated by the state variable STATE\_ACR\_CTL of the position control software. The adaptation value is determined as moving mean value of the sensor signal voltage. The corresponding correlation constant C\_CRLC\_ARC\_AD defines the calculation of the adaptation value.

At the end of the algorithm the adaptation value is check of validity. If the adaptation value is outside of the valid range than an error entry will be performed.

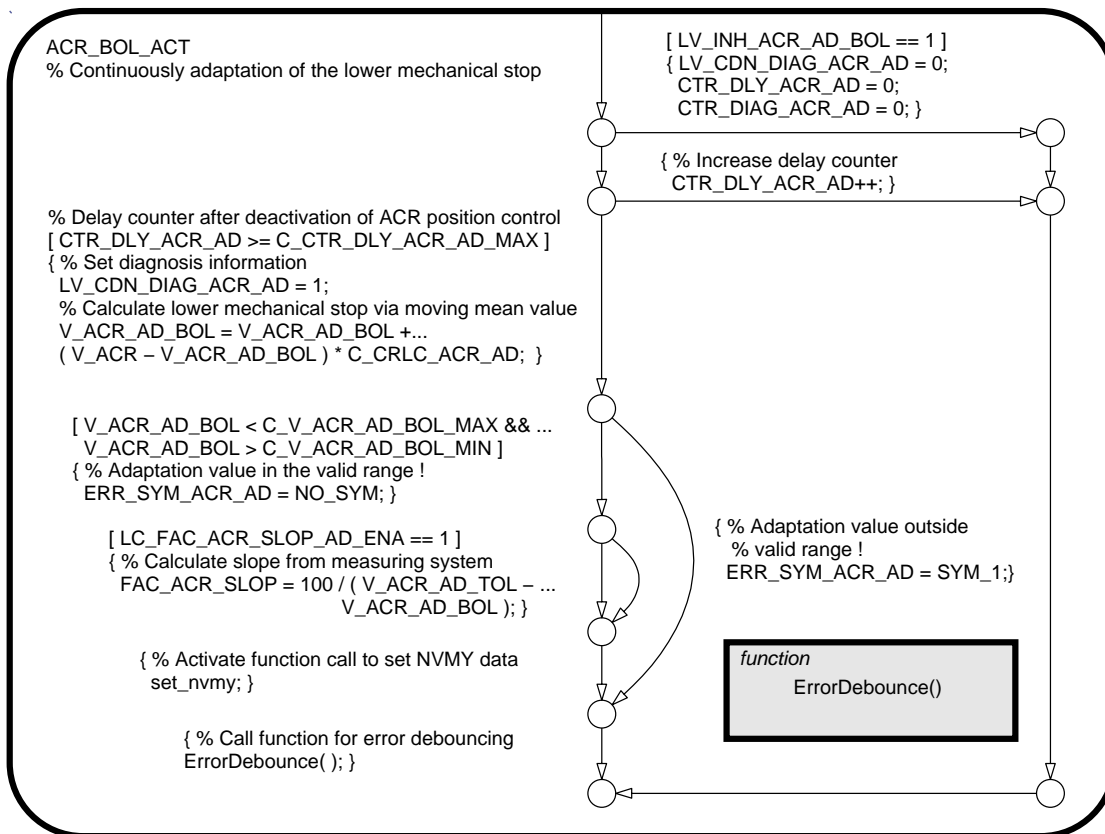


Figure A.25.11: ACRC\_adaptation\_and\_diagnosis/Operate/Chart/Adaptation/ACR\_BOL\_ACT

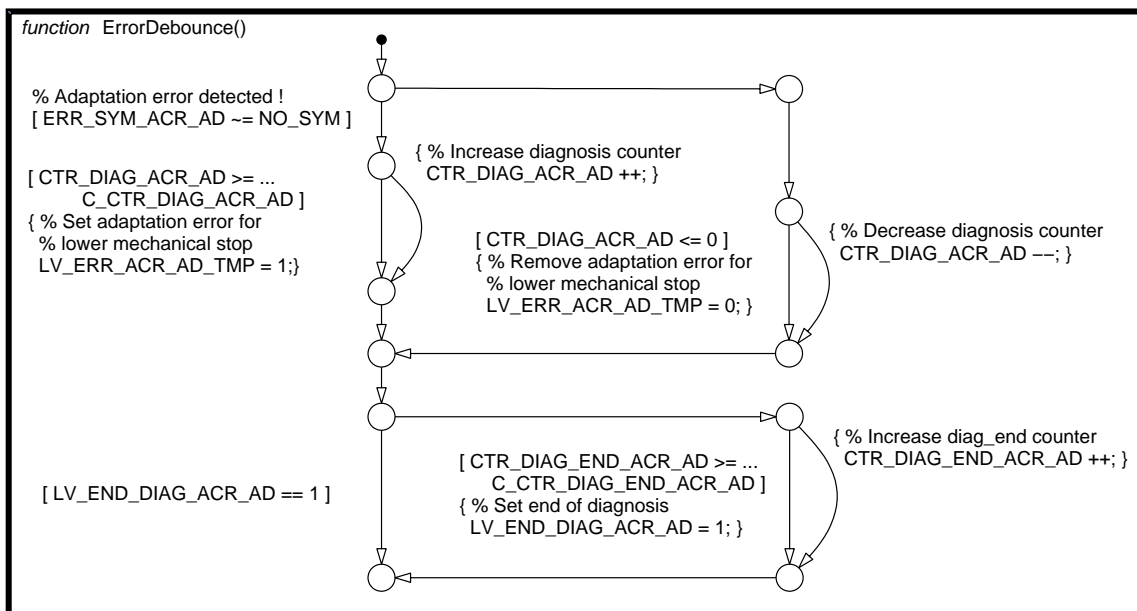


Figure A.25.12: ACRC\_adaptation\_and\_diagnosis/Operate/Chart/Adaptation/ACR\_BOL\_ACT/ErrorDebounce

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## Interface to the error management

The following algorithm set the detected error and the end of diagnosis information according the diagnostic result and delivers the result to Error Management.

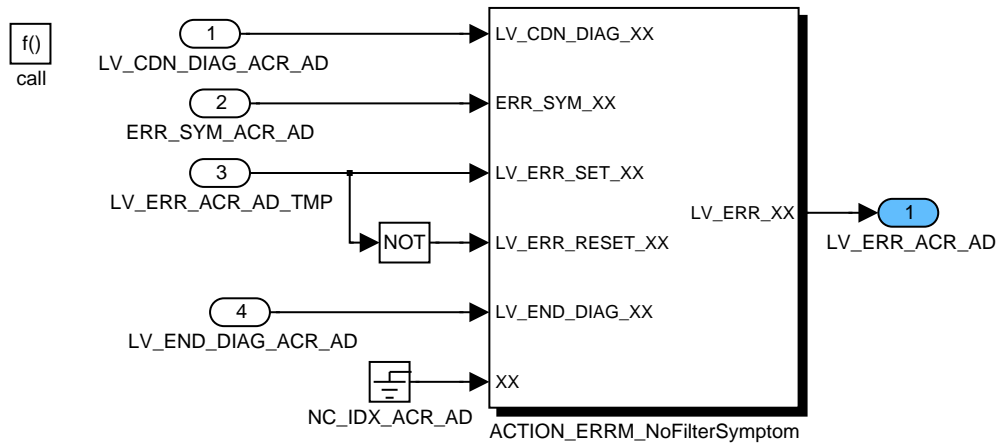


Figure A.25.13: ACRC\_adaptation\_and\_diagnosis/Operate/Interface\_to\_ERRM

## Manage non volatile variables

The last section describes the data handling of variables defined in the non-volatile memory. Three function calls are available for the initialisation, the readout and the update of the non-volatile memory. A special feature has been implemented for the data update. New adaptation values are only stored for an error free system and a successful adaptation end. Otherwise the last valid adaptation values will be used again for the NVRAM update!

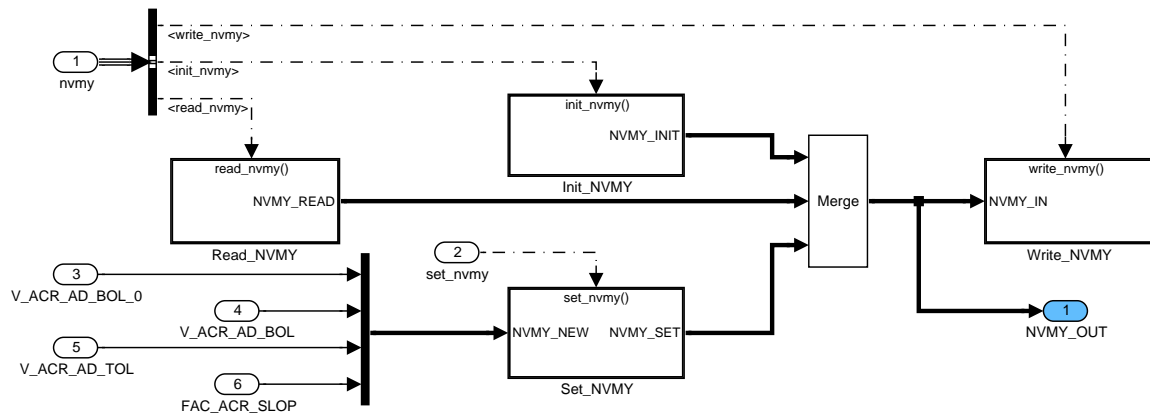


Figure A.25.14: ACRC\_adaptation\_and\_diagnosis/Operate/Manage\_NVRAM

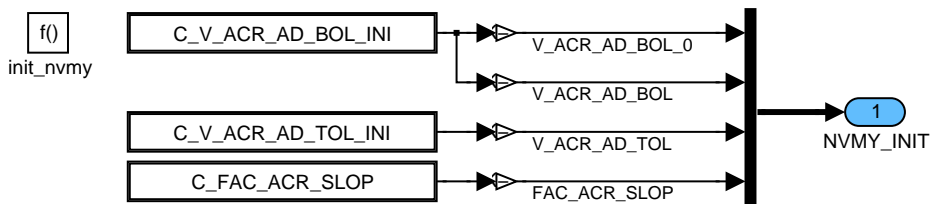


Figure A.25.15: ACRC\_adaptation\_and\_diagnosis/Operate/Manage\_NVRAM/Init\_NVMY

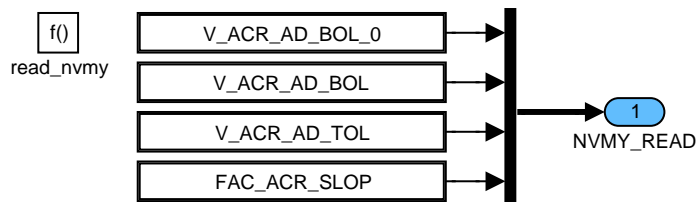


Figure A.25.16: ACRC\_adaptation\_and\_diagnosis/Operate/Manage\_NVRAM/Read\_NVMY

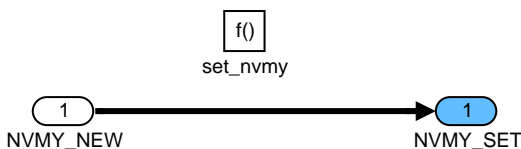


Figure A.25.17: ACRC\_adaptation\_and\_diagnosis/Operate/Manage\_NVRAM/Set\_NVMY

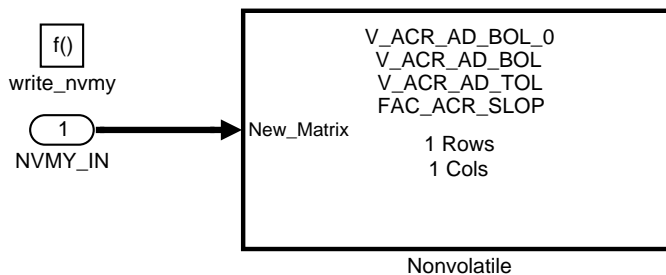


Figure A.25.18: ACRC\_adaptation\_and\_diagnosis/Operate/Manage\_NVRAM/Write\_NVMY

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## A.26 Actuator adaptation and diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ACR_AD_ACT	O/V	0... 1H	0 ...1	1	-
Logical variable to indicate an active actuator adaptation					
LV_ACR_AD_POP_INH	V	0... 1H	0 ...1	1	-
Logical variable to inhibit the actuator adaptation for post operating phase during IGKON					
LV_ACR_AD_REQ	O/V/S	0... 1H	0 ...1	1	-
Logical variable to indicate an actuator adaptation request					
LV_INH_ACR_AD	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the actuator adaptation and diagnosis					
LV_INH_ACR_AD_BOL	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the continuous actuator adaptation and diagnosis					

### Input data:

LV_ERR_ACR_AD {p. 4320}	LV_ES {p. 1720}	LV_IGK {p. 906}	LV_PWM_ACR_OFF_REQ {p. 4345}
STATE_ACR_AD {p. 4320}	STATE_ACR_CTL {p. 3587}	TCO {p. 1100}	VB {p. 1185}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ACR_AD_TCO_MIN	-	0... FEH	0... 142.5	0.75	°C
Temperature threshold for the activation of the actuator adaptation					
C_ACR_AD_VB_MIN	-	0... FFH	0... 25.8984375	0.1015625	V
Battery voltage threshold for the activation of the actuator adaptation					
LC_ACR_AD_POP_ENA	-	0... 1H	0 ...1	1	-
Logical variable to enable the actuator adaptation in the post operating phase					
LC_ACR_AD_REQ	-	0... 1H	0 ...1	1	-
Logical variable to set a new adaptation request					


### Error treatment:

Diagnostic	Symptom description	Symptom	Filter type
ACR_AD			
ACR actuator adaptation and diagnosis	<i>Adaptation conditions not fulfilled</i>	SYM_0	NO
	<i>BOL adaptation value outside range</i>	SYM_1	
	<i>Could not reached TOL position</i>	SYM_2	
	<i>TOL adaptation value outside range</i>	SYM_3	

### General information

This module describes the coordination of the actuator adaptation with corresponding diagnosis functions. The actuator adaptation can be split in a standard adaptation during IGKON and post operation phase and a continuously adaptation only for the adaptation of the lower mechanical stop. Separate inhibition conditions for the described adaptations are available.

### Application Condition

Released by Tettenborn Frank		Date 2013-02-13	File 30A0IL01.00C
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 4333 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

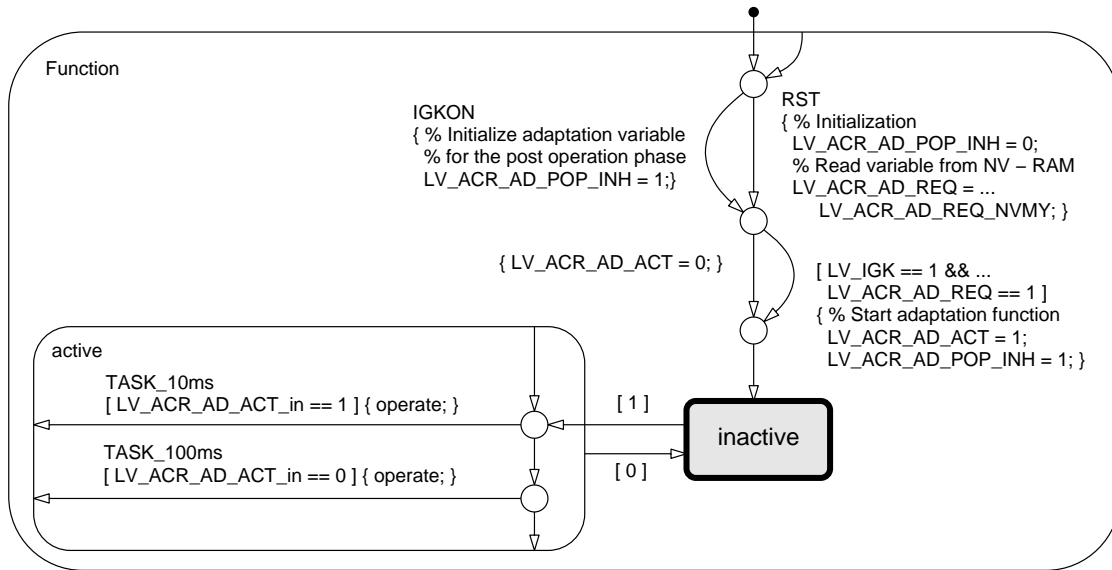


Figure A.26.1: ACRC\_adaptation\_and\_diagnosis\_ai/APP\_CDN/APP\_CDN

**Function Description**

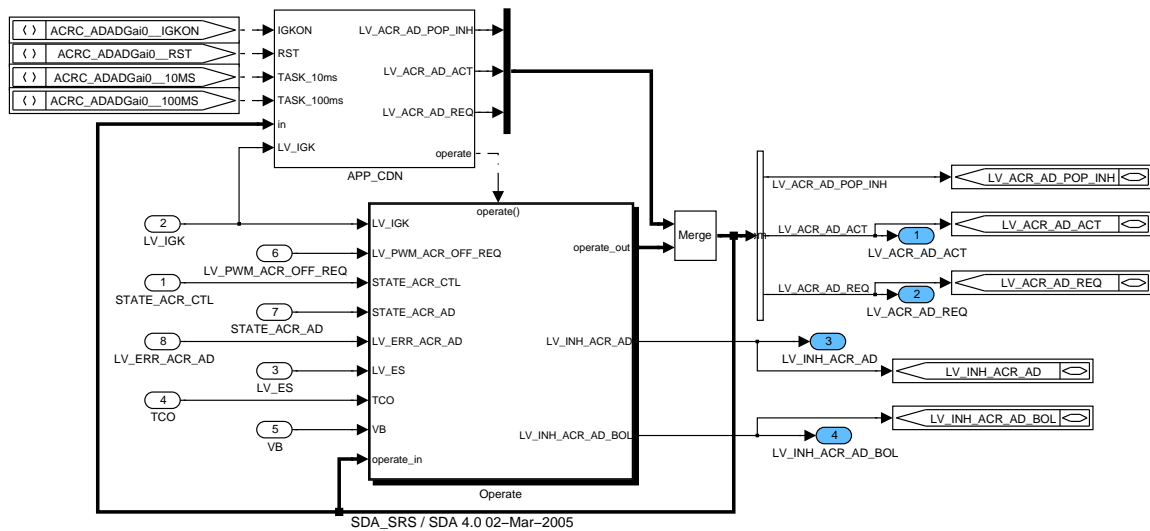


Figure A.26.2: ACRC\_adaptation\_and\_diagnosis\_ai

**A.26.1 Coordination of the adaptation functionality**

The adaptation request LV\_ACR\_AD\_REQ is checked every time the control unit is switched on. If an adaptation is requested then a "first key on" adaptation will be performed with LV\_ACR\_AD\_ACT = 1. The actuator adaptation is necessary in the following cases:

- In initial start ( first engine run or control unit exchange ), that means no adaptation values are stored in the non volatile memory
- Check sum error ( NVMY - error ) is current

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- Adaptation request bit LV\_ACR\_AD\_REQ is set

Each of these points ends with a new adaptation request. After the activation of the "key on" actuator adaptation the corresponding inhibition condition will be checked continuously.

A second part of the adaptation functionality is the actuator adaptation in the post operating phase. After ignition off and engine stop the corresponding inhibition variable is once checked. If all activation conditions are fulfilled then the actuator adaptation will be started, the inhibition variable is **not** checked during the adaptation to avoid possible error entries.

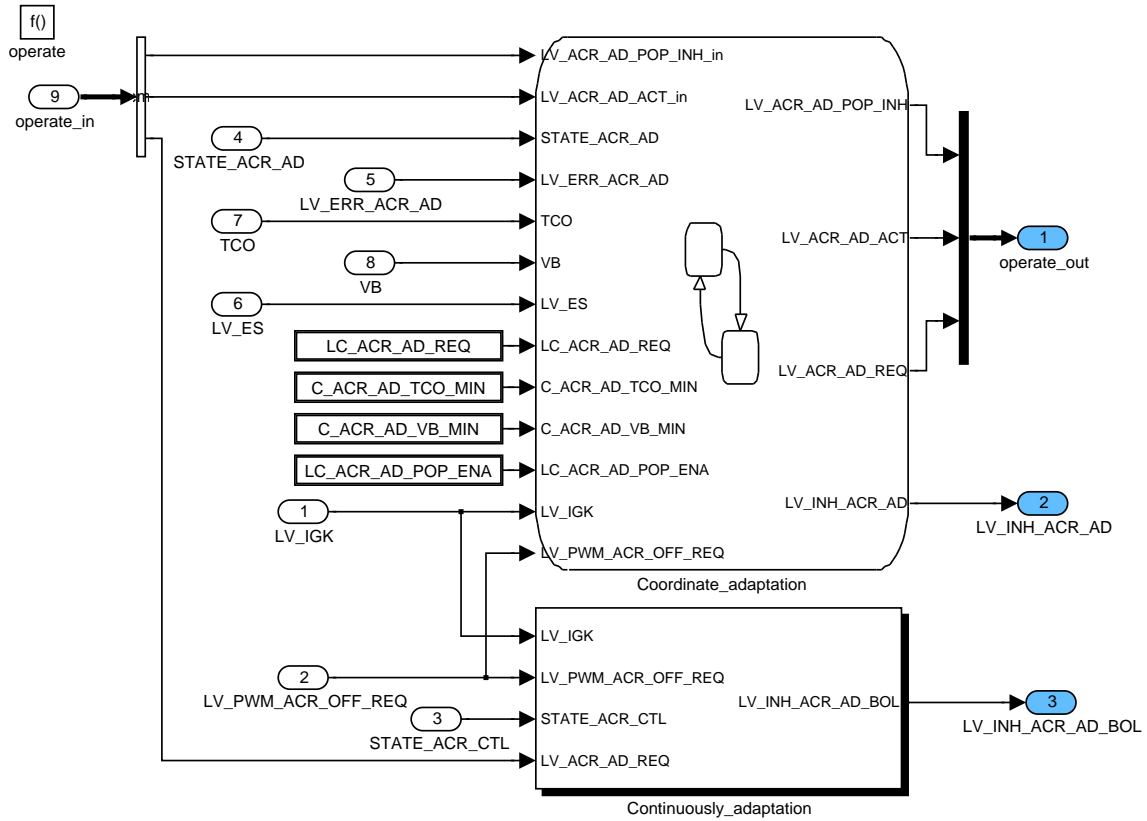


Figure A.26.3: ACRC\_adaptation\_and\_diagnosis\_ai/Operate

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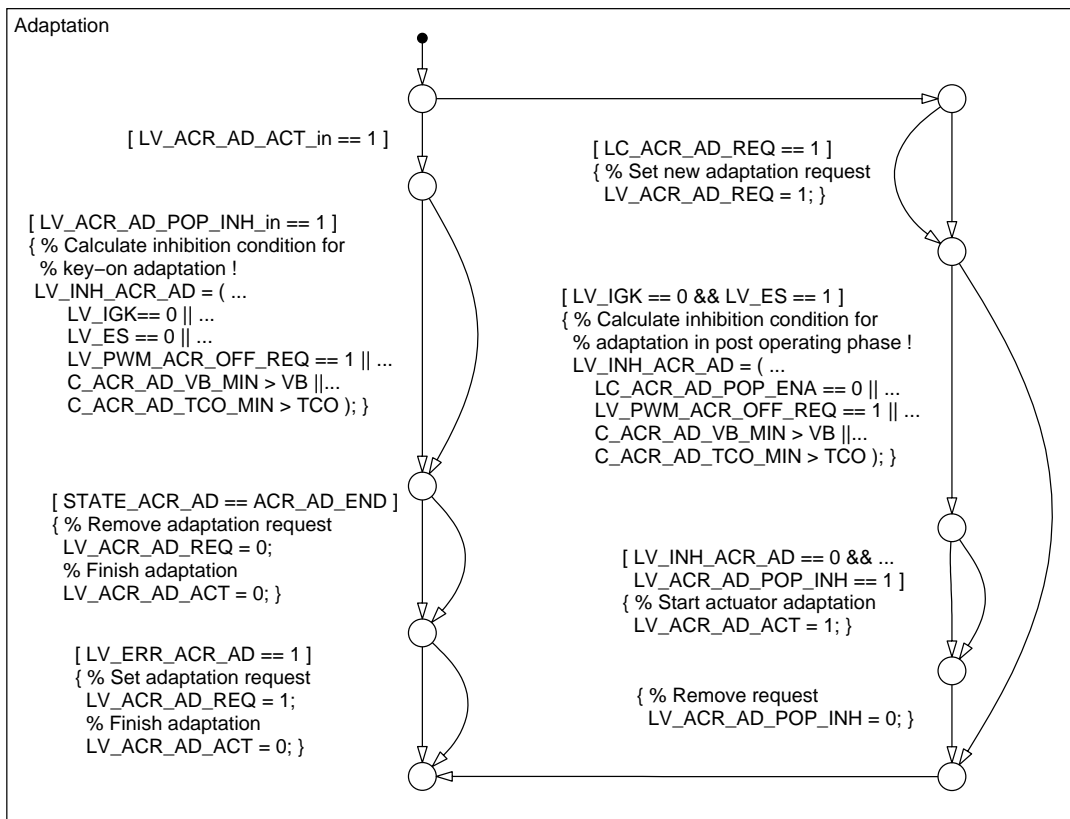


Figure A.26.4: ACRC\_adaptation\_and\_diagnosis\_ai/Operate/Coordinate\_adaptation

**Inhibition condition for the continuous BOL adaptation**

This chapter describes the inhibition condition of the continuously adaptation for the lower mechanical stop.

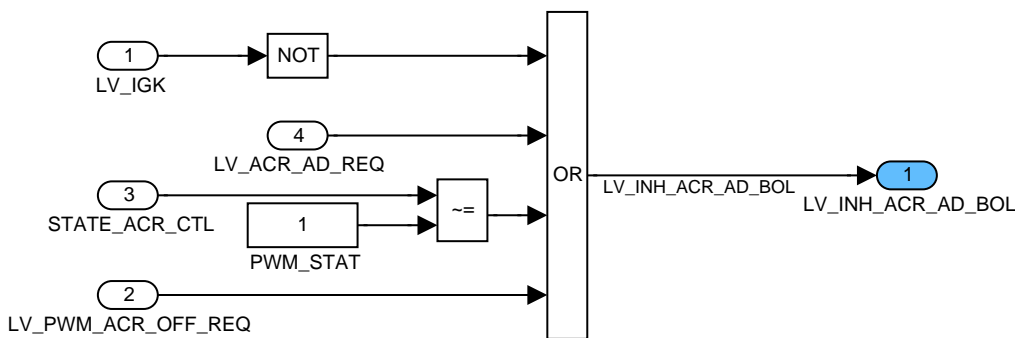


Figure A.26.5: ACRC\_adaptation\_and\_diagnosis\_ai/Operate/Continuously\_adaptation

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## A.27 Actuator diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DIAG_ACR_CTL	O/V	0... FFH	0... 255	1	-
Anti bounce counter for the actuator diagnosis					
ERR_SYM_ACR_CTL	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the actuator diagnosis					
LV_CDN_DIAG_ACR_CTL	V	0... 1H	0 ...1	1	-
Diagnosis condition for the actuator diagnosis					
LV_END_DIAG_ACR_CTL	V	0... 1H	0 ...1	1	-
End of diagnosis information for the actuator diagnosis					
LV_ERR_ACR_CTL	O/V	0... 1H	0 ...1	1	-
Present failure for the actuator diagnosis after the error debounce					
OPG_DIF_ACR_ERR_MAX	V	0... FFFH	0... 99.9755859	0.024414	%
Maximum admissible control deviation of the closed loop position control system					
OPG_SP_ACR_FIL	V	0... FFFH	0... 99.9755859	0.024414	%
Actuator valve position setpoint after filtering by low pass first order					
OPG_SP_ACR_GRD	V	F000... FFFH	0... 99.97559	0.024414	%
Gradient of the actuator valve position setpoint determined by low pass first order					
PWM_ACR_MMV	V	0... 7FFFH	0... 99.9969482	0.003052	%
Moving mean value of the actuator position controller output					

### Input data:

LV_INH_DIAG_ACR_CTL {p. 4343}	OPG_DIF_ACR {p. 3580}	OPG_SP_ACR {p. 3573}	PWM_ACR {p. 3580}
VB_MMV {p. 1185}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_ACR_CTL	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the actuator diagnosis					
C_ABC_INC_ACR_CTL	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the actuator diagnosis					
C_ABC_MAX_ACR_CTL	-	1... FFH	1... 255	1	-
Maximum value for anti bounce counter for the actuator diagnosis					
C_CRLC_OPG_SP_ACR	-	0... FFFFH	0... 0.99998474	152.59e3	-
Correlation constant for filtering of OPG_SP_ACR					
C_CRLC_PWM_ACR	-	0... FFFFH	0... 0.99998474	1.52589 5	-
Correlation constant for filtering of PWM_ACR					
C_PWM_ACR_MAX_DIAG	-	0... 7FFFH	0... 99.9969482	0.003052	%
Maximum permitted PWM output of the ACR position controller					
C_VB_MIN_PWM_ACR_DIAG	-	0... FFH	0... 25.8984375	0.1015625	V
Threshold depend on battery voltage for the activation of the PWM_ACR monitoring					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_OPG_DIF_ACR_ERR_MAX	-	0... FFFH	0... 99.9755859	0.024414	%
LDP_OPG_SP_ACR_GRD_ABSV_IP_OPG	4	0... FFFH	0... 99.9755859	0.024414	%
Maximum admissible control deviation dependent on the actuator valve setpoint gradient					

### Import actions:

```
ACTION_ERRM_NoFilterSymptom (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_LV_ERR_SET>,IN<PRM_LV_ERR_RST>,IN<PRM_LV_END_DIAG>,OUT<PRM_LV_ERR>)
```

### General information

The task of this diagnosis is to detect an actuator valve error or a jammed actuator. The diagnostic observes the control deviation of the closedloop position control system dependent on the gradient of the actuator valve position setpoint.

Additionally the position controller output is monitored by this diagnostic function. If the moving mean value of PWM\_ACR exceeds a defined threshold than an error will be indicated. The calculation of the moving mean value is done by an low pass filter first order.

### Application Condition

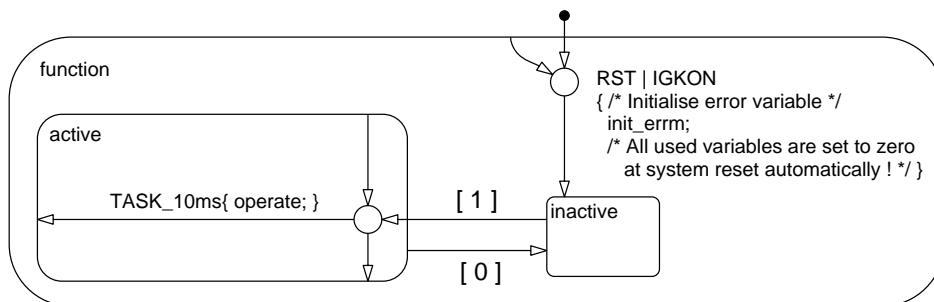


Figure A.27.1: ACRC\_actuator\_diagnosis/APP\_CDN/APP\_CDN

### Function Description

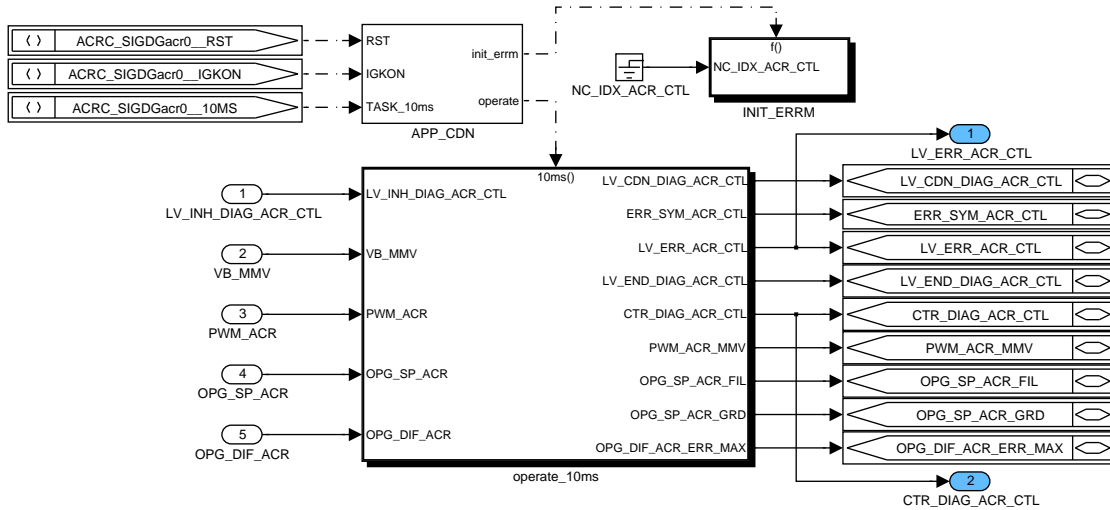


Figure A.27.2: ACRC\_actuator\_diagnosis

### A.27.1 Monitoring of the actuator valve function

The antibounce of the error detection is done at the end of the module without generic debounce algorithm. The increment and decrement value of the implemented algorithm can be calibrated.

The following error symptoms can be distinguished:

- PWM error of the closed loop position control system
- System deviation outside the admissible range

Error symptoms are defined to this diagnosis function as following:

- SYM\_0 - System deviation outside range
- SYM\_1 - PWM\_ACR outside range

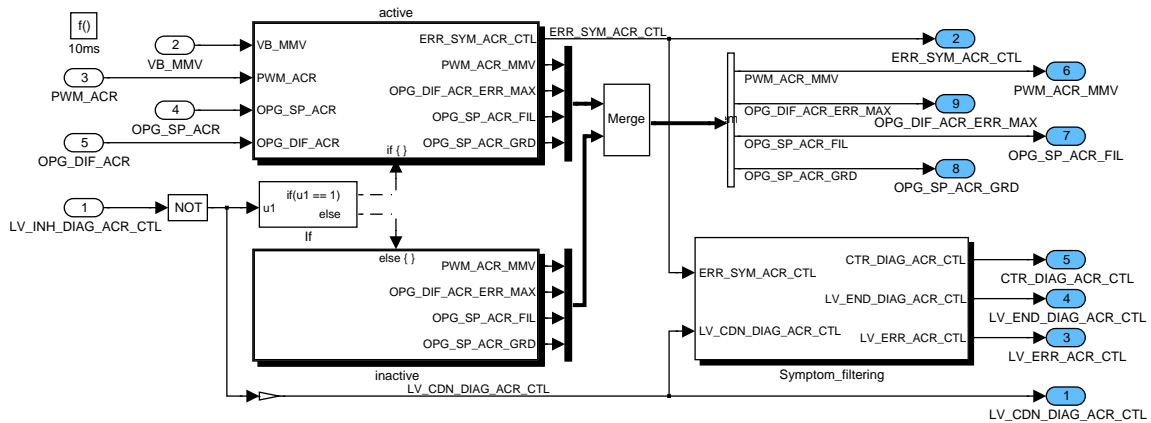


Figure A.27.3: ACRC\_actuator\_diagnosis/operate\_10ms

### Actuator failure detection

This chapter calculates the admissible error of the control deviation and the moving mean value of the position controller output, after than the error symptom determination will be performed !

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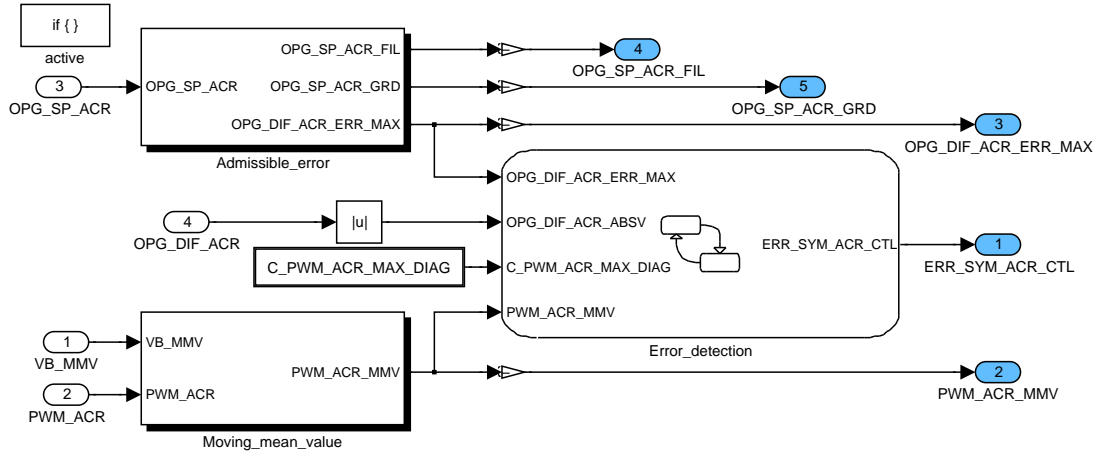


Figure A.27.4: ACRC\_actuator\_diagnosis/operate\_10ms/active

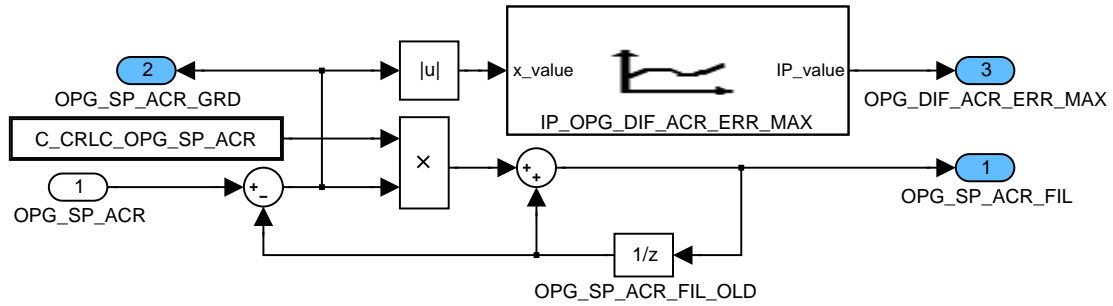


Figure A.27.5: ACRC\_actuator\_diagnosis/operate\_10ms/active/Admissible\_error

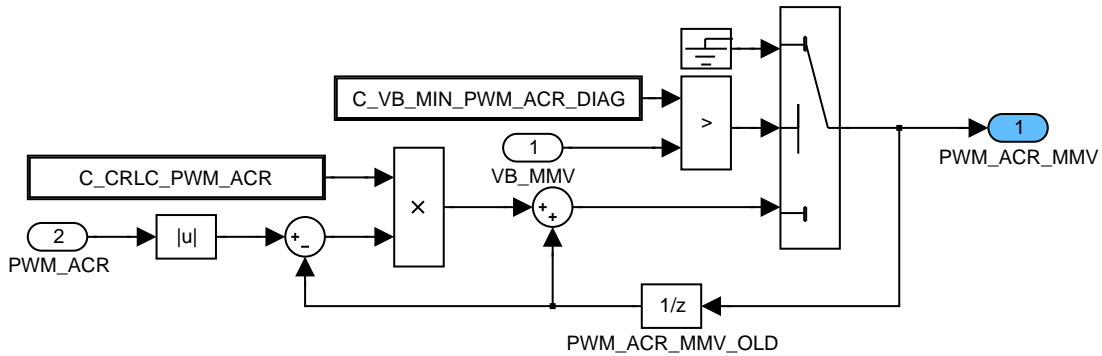


Figure A.27.6: ACRC\_actuator\_diagnosis/operate\_10ms/active/Moving\_mean\_value

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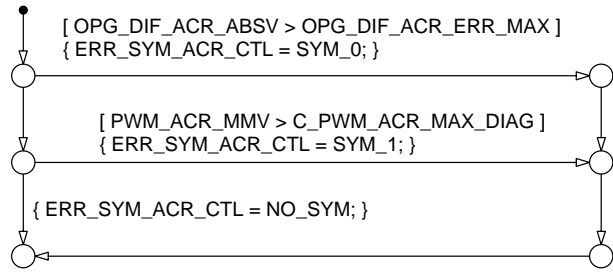
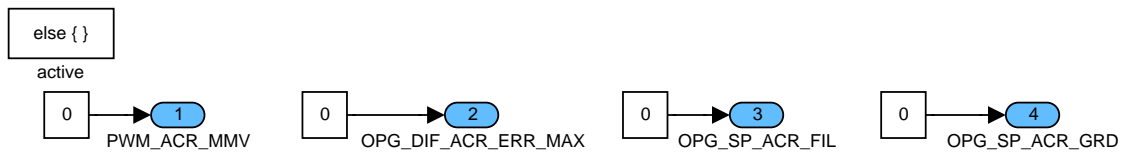


Figure A.27.7: ACRC\_actuator\_diagnosis/operate\_10ms/active/Error\_detection



The state variables PWM\_ACR\_MMV\_OLD and OPG\_SP\_ACR\_FIL\_OLD from the active state are also set to zero

Figure A.27.8: ACRC\_actuator\_diagnosis/operate\_10ms/inactive

**Error symptom filtering**

Finally the antibounce algorithm for the determined error symptoms and the end of diagnosis information are calculated. In case of errors the debounced error variable can be set for the driving cycle with the corresponding inhibition condition.

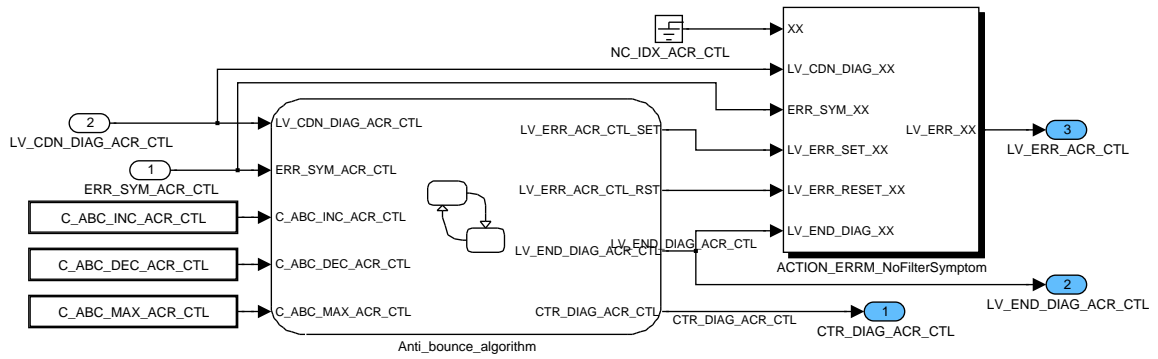


Figure A.27.9: ACRC\_actuator\_diagnosis/operate\_10ms/Symptom\_filtering

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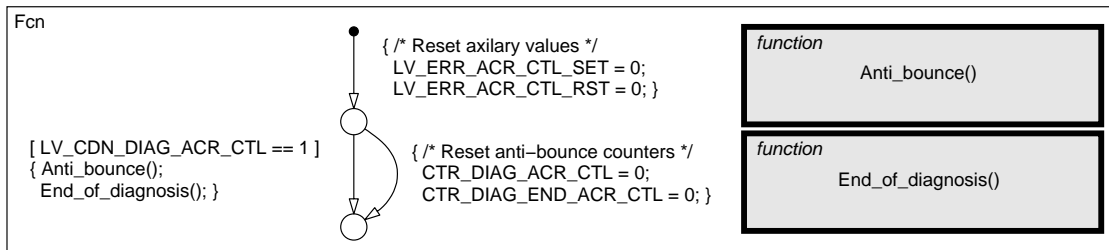


Figure A.27.10: ACRC\_actuator\_diagnosis/operate\_10ms/Symptom\_filtering/Anti\_bounce\_algorithm

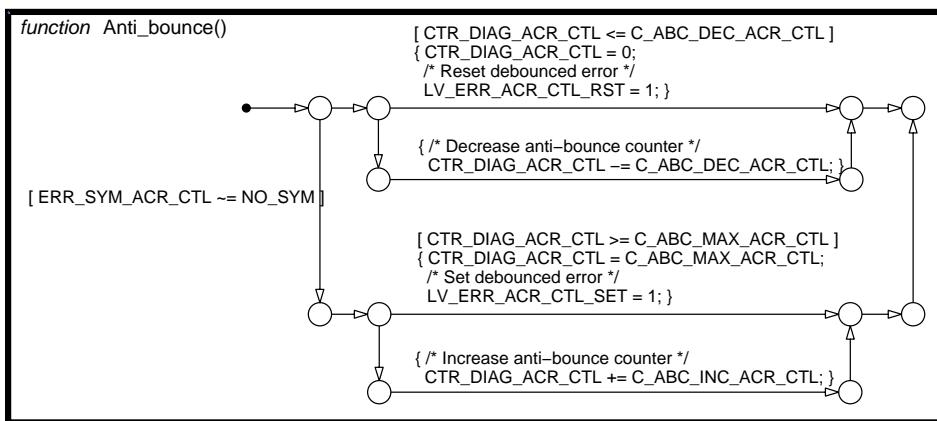


Figure A.27.11: ACRC\_actuator\_diagnosis/operate\_10ms/Symptom\_filtering/Anti\_bounce\_algorithm/Fcn/Anti\_bounce

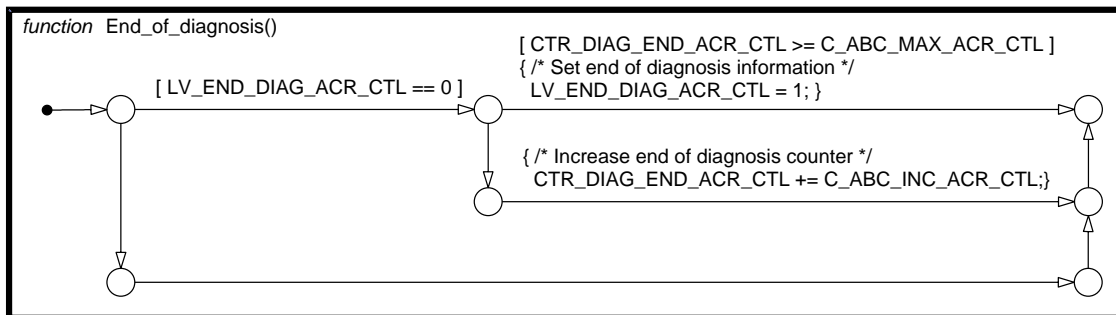


Figure A.27.12: ACRC\_actuator\_diagnosis/operate\_10ms/Symptom\_filtering/Anti\_bounce\_algorithm/Fcn/End\_of\_diagnosis

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## A.28 Actuator diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_ACR_CTL	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the actuator diagnosis					

### Input data:

LV_ACR_AD_ACT {p. 4333}	LV_IGK {p. 906}	STATE_ACR_CTL {p. 3587}	
----------------------------	-----------------	-------------------------	--

### Error treatment:

Diagnostic ACR_CTL	Symptom description	Symptom	Filter type
ACR actuator diagnosis	System deviation outside range	SYM_0	NO
	Output position controller outside range	SYM_1	
	not used	SYM_2	
	not used	SYM_3	

### General information

The flag LV\_INH\_DIAG\_ACR\_CTL permits to deactivate the corresponding diagnostic.

### Application Condition

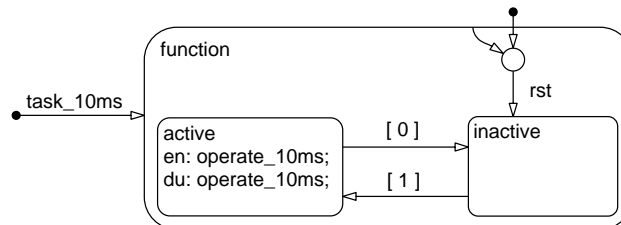


Figure A.28.1: ACRC\_actuator\_diagnosis\_ai/APP\_CDN/APP\_CDN

### Function Description

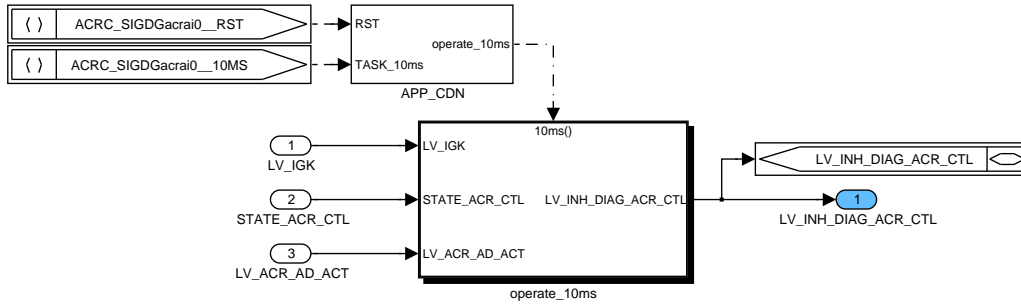


Figure A.28.2: ACRC\_actuator\_diagnosis\_ai

### A.28.1 Setting of the inhibition condition

This chapter describes the inhibition condition for the actuator diagnosis.

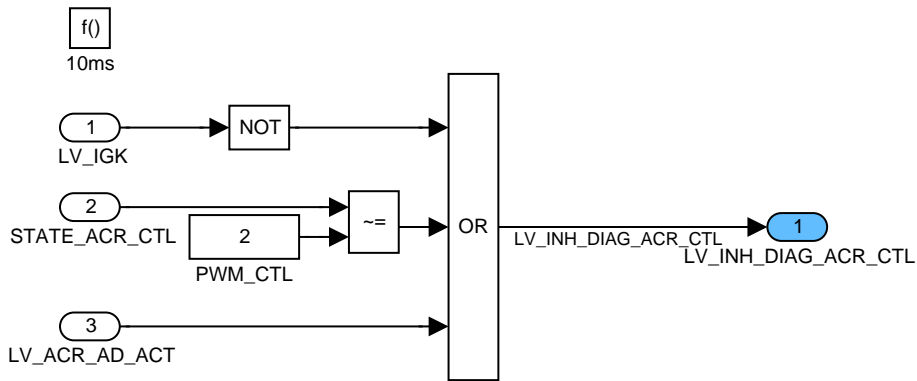


Figure A.28.3: ACRC\_actuator\_diagnosis\_ai/operate\_10ms

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## A.29 Actuator limp home management

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_OPG_ACR_INI_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable requests the replacement value for actuator signal acquisition					
LV_PWM_ACR_OFF_REQ	O/V	0... 1H	0 ...1	1	-
ACR position control deactivation requested from monitoring level 1					

### Input data:

LV_ERR_ACR_AD {p. 4320}	LV_ERR_ACR_CTL {p. 4337}	LV_ERR_ACR_DR {p. 4347}	LV_ERR_SENS_ACR {p. 4352}
LV_ERR_VCC_ACR {p. 4355}			

### General information

The limp home management monitors the diagnostic functions of the closed-loop actuator control system. In case of monitoring level 1 errors the limp home function requests the deactivation of the power stage and actuator position control. The following diagnostic functions for ACRC position control are available:

- ACRC position sensor diagnosis
- ACRC power stage diagnosis
- ACRC actuator diagnosis
- ACRC adaptation diagnosis

### Application Condition

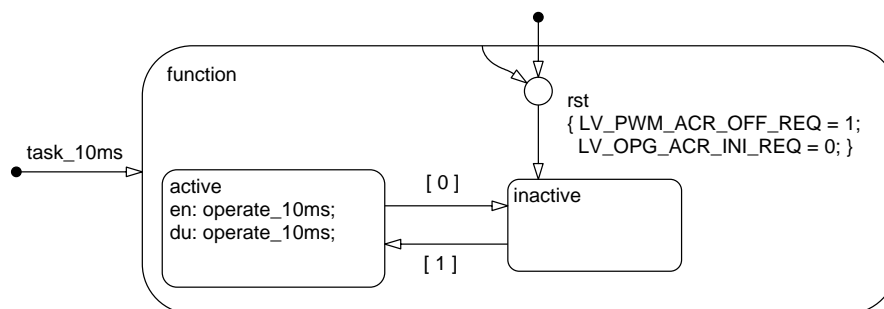


Figure A.29.1: ACRC\_limp\_home\_management/APP\_CDN/APP\_CDN

### Function Description

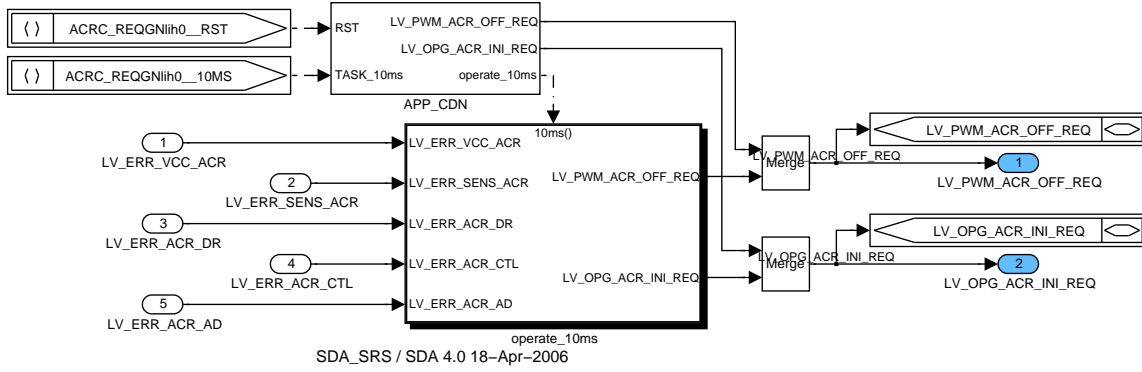


Figure A.29.2: ACRC\_LIMP\_HOME\_MANAGEMENT

**A.29.1 Calculate switch-off request for ACR power stage**

The following section calculates the power stage deactivation request with monitoring level 1 errors. Additionally the request for the replacement value of the sensor signal acquisition is determined.

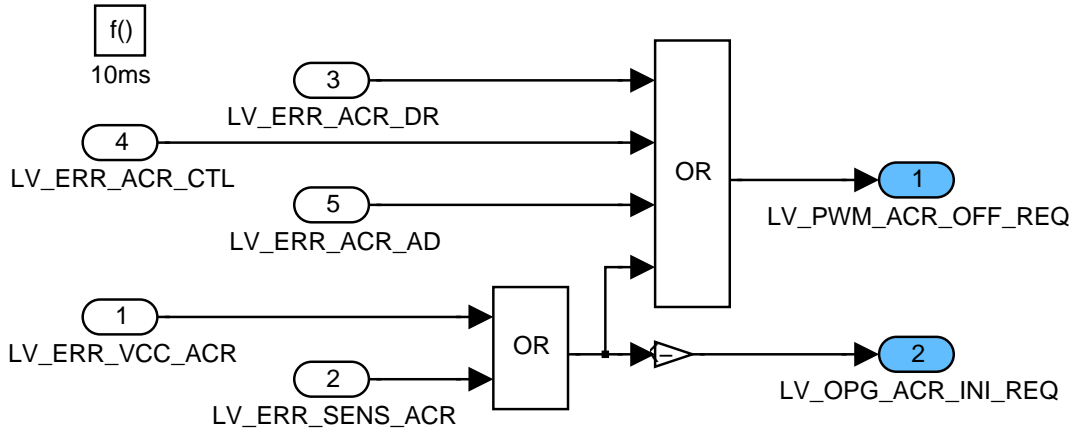


Figure A.29.3: ACRC\_LIMP\_HOME\_MANAGEMENT/OPERATE\_10MS

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## A.30 Actuator power stage diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_ACR_DR	V	0H 1H	NO_SYM SYM_0	-	-
Error symptom for the power stage diagnosis					
LV_CDN_DIAG_ACR_DR	V	0... 1H	0 ...1	1	-
Diagnosis condition for power stage diagnosis					
LV_END_DIAG_ACR_DR	V	0... 1H	0 ...1	1	-
End of diagnosis information for the power stage diagnosis					
LV_ERR_ACR_DR	O/V	0... 1H	0 ...1	1	-
Present failure for power stage diagnosis after error debounce					

### Input data:

LV_INH_DIAG_ACR_DR {p. 4350}			
---------------------------------	--	--	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_ACR_DR	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the power stage diagnosis					
C_ABC_MAX_ACR_DR	-	1... FFH	1... 255	1	-
Maximum value for anti bounce counter for the power stage diagnosis					

### Import actions:

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>, IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX> ,OUT<PRM_LV_ERR>)
<b>ACTION_INFR_GetEIDiagAcrDr</b> (OUT<Lv_state_acr_dr>)

### General information

The used power stage is an intelligent full HBridge, designed for the control of DC and stepper motors in safety critical applications and under extreme environmental conditions. The HBridge is protected against overtemperature, short circuits and has an under voltage lockout for all supply voltages (main DC power supply). All malfunctions cause the output stages to go tristate.

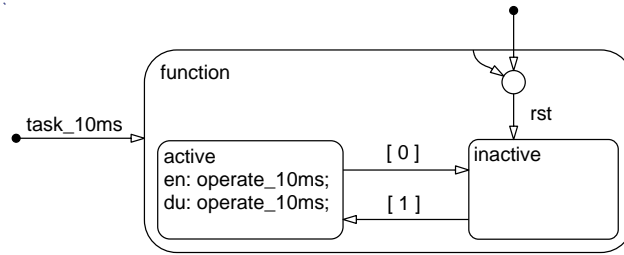
In this application the power stage is implemented in the status flag mode, that means indicated errors can not be distinguished by the software. The following errors can be detected only by the power stage:

Undervoltage /Overcurrent /Overtemperature /hardware disabled manually

Errorsymptoms are defined to this diagnosis function as following:

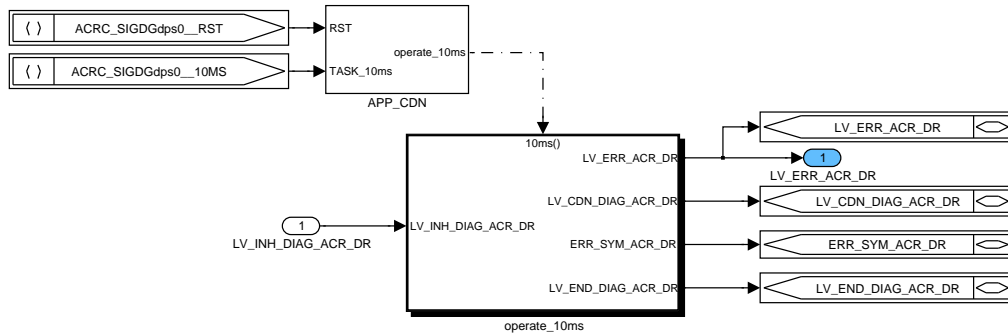
SYM\_0                    ACR power stage error

### Application Condition



ACRC\_power\_stage\_diagnosis/APP\_CDN/APP\_CDN

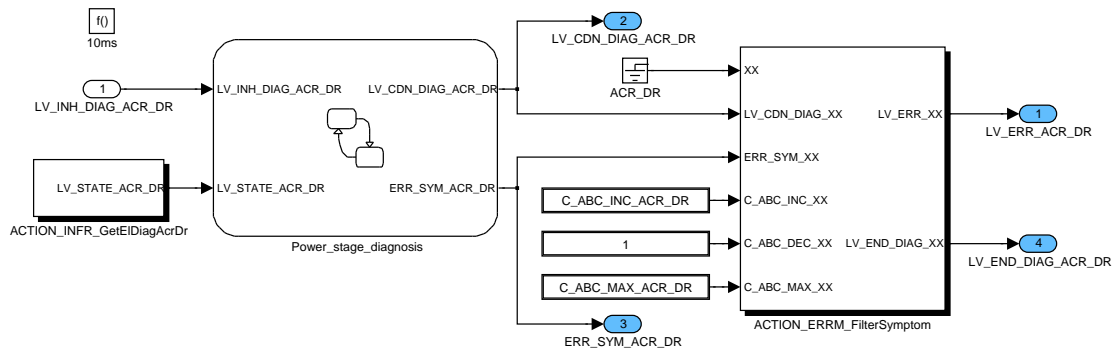
**Function Description**



ACRC\_power\_stage\_diagnosis

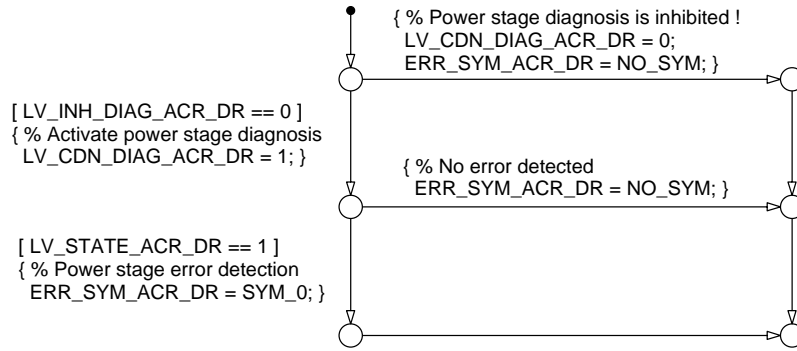
**A.30.1 Power stage diagnosis**

The status flag information from the power stage is read out with an infrastructure action at the beginning of the function and the antibounce filter algorithm from the generic error management is called as action at the end of the module.




ACRC\_power\_stage\_diagnosis/operate\_10ms

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ACRC\_power\_stage\_diagnosis/operate\_10ms/Power\_stage\_diagnosis

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## A.31 Actuator power stage diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_ACR_DR	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the power stage diagnosis					

### Input data:

LV_IGK {p. 906}	STATE_ACR_CTL {p. 3587}	VB {p. 1185}	
-----------------	-------------------------	--------------	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VB_MIN_ACR_DR_DIAG	-	0... FFH	0... 25.8984	0.10156	V
Minimum threshold for the activation/deactivation of the power stage diagnosis					

### Error treatment:

Diagnostic	Symptom description	Symptom	Filter type
<b>ACR_DR</b>			
ACR power stage diagnosis	ACR power stage error	SYM_0	STD_INI
	not used	SYM_1	
	not used	SYM_2	
	not used	SYM_3	

### General information

The flag LV\_INH\_DIAG\_ACR\_DR permits to deactivate the corresponding diagnostic.

### Application Condition

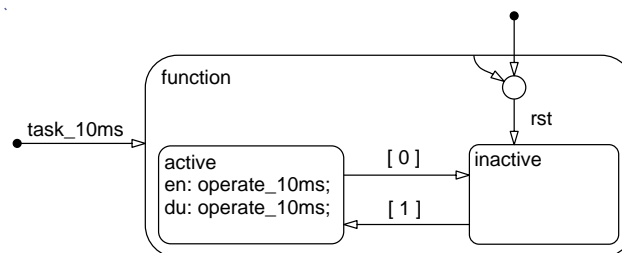


Figure A.31.1: ACRC\_power\_stage\_diag\_SF\_ai/APP\_CDN/APP\_CDN

### Function Description

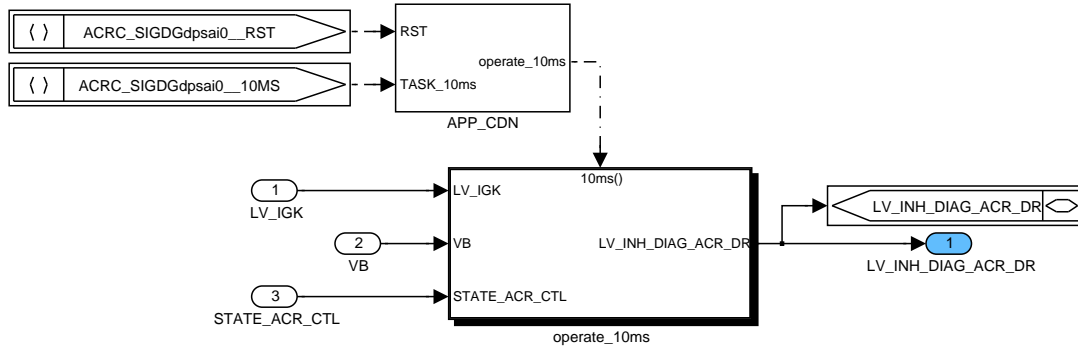


Figure A.31.2: ACRC\_power\_stage\_diag\_SF\_ai

### A.31.1 Setting of the inhibition condition

This chapter describes the inhibition conditions for the power stage diagnosis.

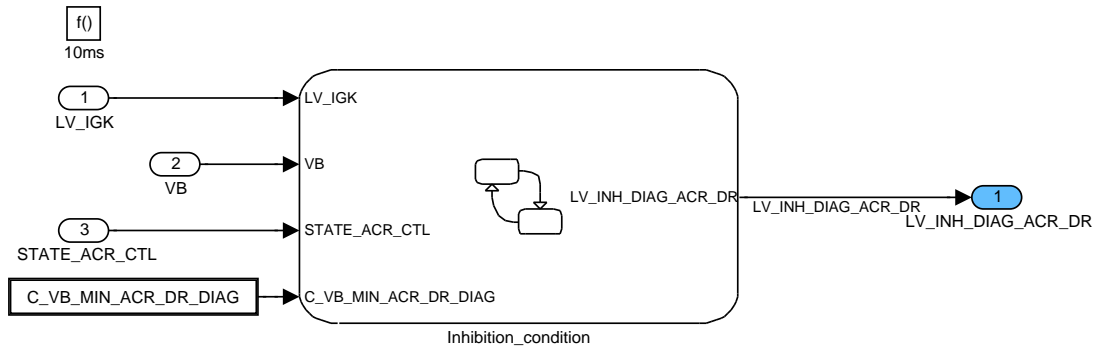


Figure A.31.3: ACRC\_power\_stage\_diag\_SF\_ai/operate\_10ms

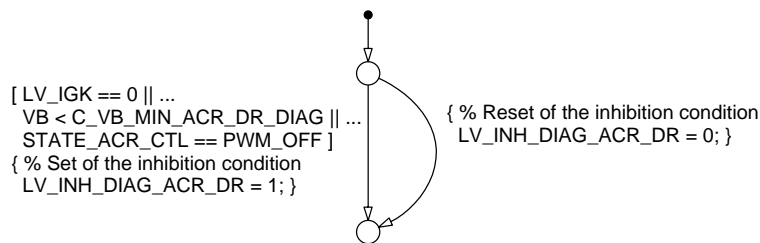


Figure A.31.4: ACRC\_power\_stage\_diag\_SF\_ai/operate\_10ms/Inhibition\_condition

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## A.32 Actuator position sensor diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_SENS_ACR	O/V	0H 1H 2H	NO_SYM SYM_0 SYM_1	-	-
Error symptom for sensor signal range check					
LV_CDN_DIAG_SENS_ACR	V	0... 1H	0 ...1	1	-
Diagnosis condition for sensor signal range check					
LV_END_DIAG_SENS_ACR	V	0... 1H	0 ...1	1	-
End of diagnosis information for sensor signal range check					
LV_ERR_SENS_ACR	O/V	0... 1H	0 ...1	1	-
Present failure for sensor signal range check after error debounce					

### Input data:

LV_INH_DIAG_SENS_ACR {p. 4355}	V_ACR {p. 1097}		
-----------------------------------	-----------------	--	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_SENS_ACR	-	0... FFH	0... 255	1	-
Anti bounce counter increment for signal range check					
C_ABC_MAX_SENS_ACR	-	1... FFH	1... 255	1	-
Maximum value for anti bounce counter for signal range check					
C_V_MAX_SENS_ACR	-	0... 3FFH	0... 4.995117	0.00488	V
Upper diagnostic threshold for the signal range check					
C_V_MIN_SENS_ACR	-	0... 3FFH	0... 4.995117	0.00488	V
Lower diagnostic threshold for the signal range check					

### Import actions:

<b>ACTION_ERRM_FilterSymptom</b>	(IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>, IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,.OUT<PRM_LV_ERR>)
----------------------------------	---


### General information

This diagnosis function is used to monitor the admissible input voltage range of the actuator valve position sensor system. The diagnostic is able to detect short circuit to battery, open circuit and short circuit to ground for the position sensor input according to the pull resistor at the input of the AD - converter.

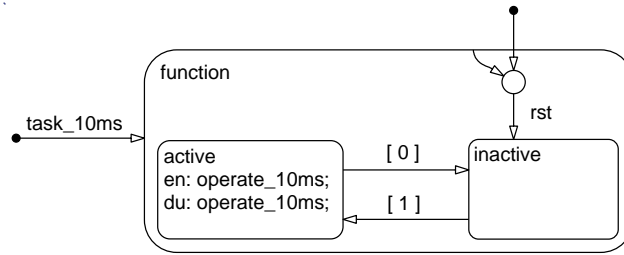
Error symptoms are defined to this function as following:

SYM\_0            Short circuit to battery or open load  
SYM\_1            Short circuit to ground

### Application Condition

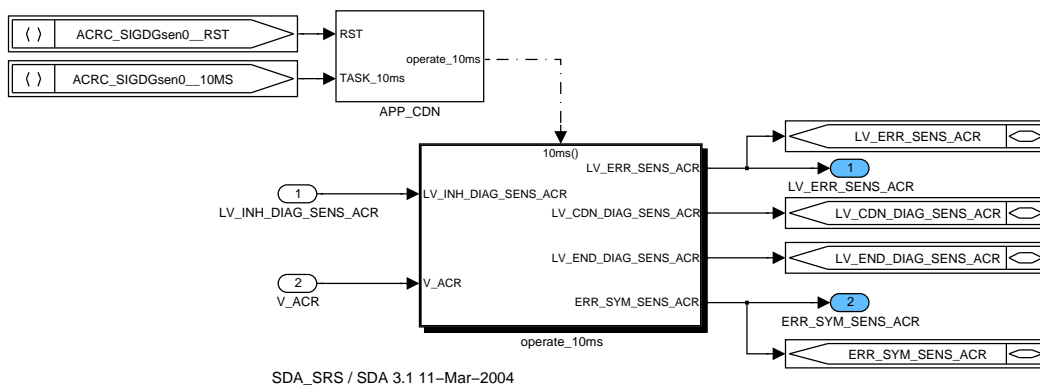
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ACRC\_position\_sensor\_diagnosis/APP\_CDN/APP\_CDN

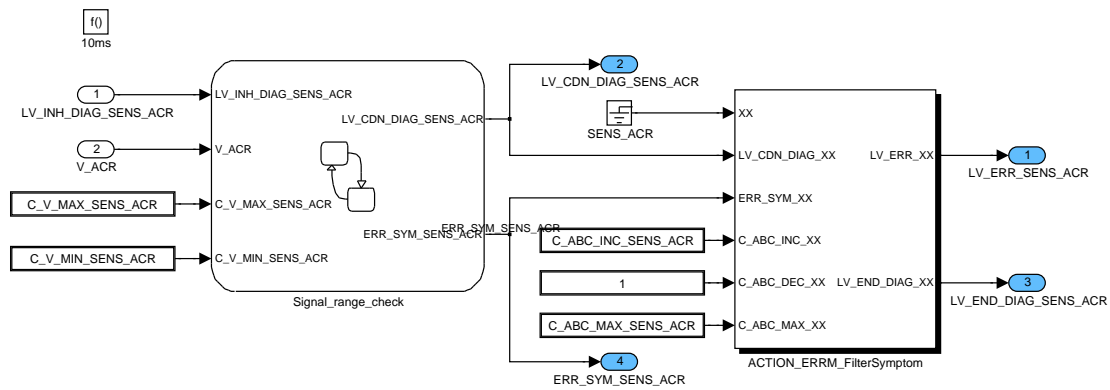
**Function Description**



ACRC\_position\_sensor\_diagnosis

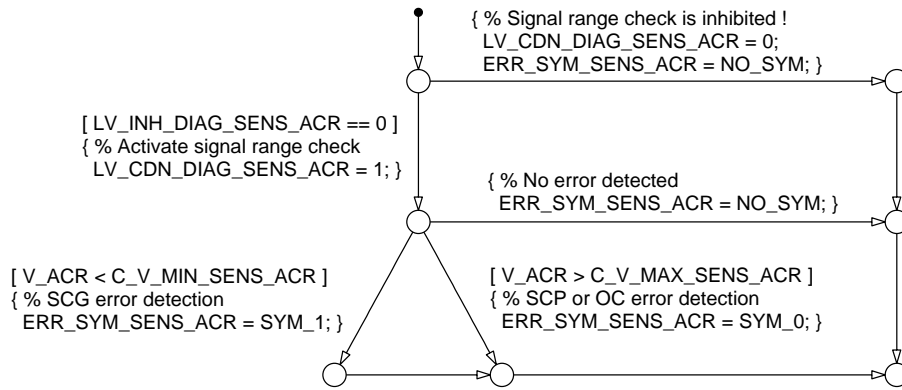
**A.32.1 Sensor signal range check**

The antibounce filter algorithm from the generic error management is called at the end of the module.




ACRC\_position\_sensor\_diagnosis/operate\_10ms

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ACRC\_position\_sensor\_diagnosis/operate\_10ms/Signal\_range\_check

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4354 of 8404</b>	
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## A.33 Actuator position sensor diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_VCC_ACR	O/V	0... 1H	0 ...1	1	-
Actuator sensor supply voltage error, variable is not supported by ERRM					
LV_INH_DIAG_SENS_ACR	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the position sensor range check					

### Input data:

LV_ERR_V_REF_1 {p. 4216}	LV_IGK {p. 906}		
-----------------------------	-----------------	--	--

### Error treatment:

Diagnostic	Symptom description	Symptom	Filter type
<b>SENS_ACR</b>			
ACRC position sensor diagnosis	Short circuit to battery or open load	SYM_0	STD_INI
	Short circuit to ground	SYM_1	
	not used	SYM_2	
	not used	SYM_3	

### General information

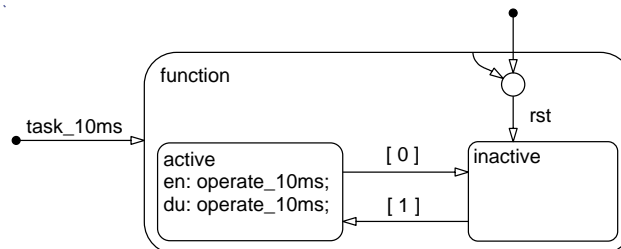
The flag LV\_INH\_DIAG\_SENS\_ACR permit to deactivate the corresponding diagnostic. As projects have different diagnosis information for actuator valve position sensor supply voltage, several error treatments are possible:

If there are no Information available, the error bit is set to 0 generally.

LV\_ERR\_VCC\_ACR = 0


Otherwise the information bit has to be set to LV\_ERR\_VCC\_ACR respectively.

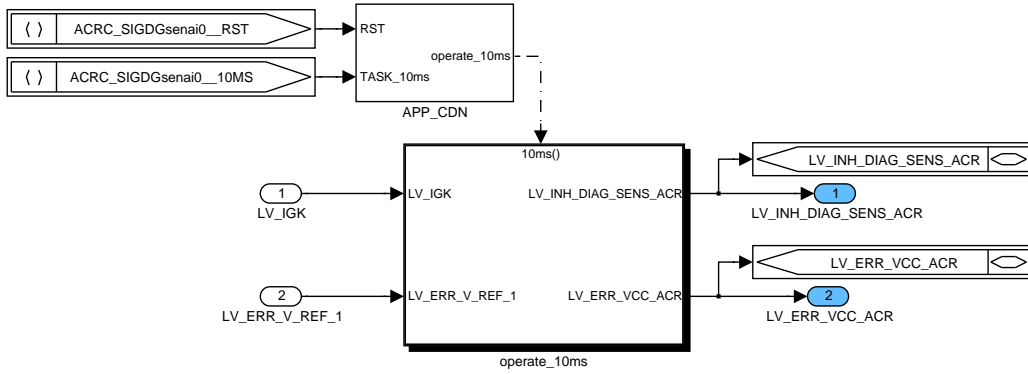
### Application Condition



ACRC\_position\_sensor\_diagnosis\_ai/APP\_CDN/APP\_CDN

### Function Description

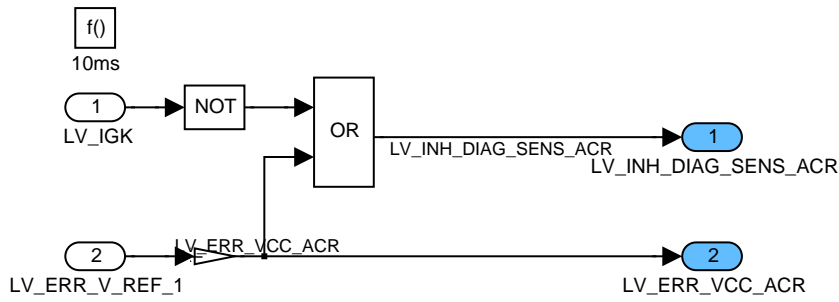
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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl
	Document key 10171571 SPE 000 AO	Pages Page 4355 of 8404
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ACRC\_position\_sensor\_diagnosis\_ai

### A.33.1 Setting of the inhibition condition

This chapter describes the inhibition conditions for the sensor range check .



ACRC\_position\_sensor\_diagnosis\_ai/operate\_10ms

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## A.34 Oil pressure switch diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_POIL_DR	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of POIL_DR bit 0: diagnosis condition for symptom SYM_0 bit 1: diagnosis condition for symptom SYM_1 bit 2: diagnosis condition for symptom SYM_2 bit 3: diagnosis condition for symptom SYM_3					
ERR_DIAG_POIL_DR	-	0... 7H	0 ...7	1	-
Raw value of error symptom for POIL_DR (only parameter) bit 0: Set, if raw value of error symptom SCP (SYM_0) is set bit 1: Set, if raw value of error symptom SCG (SYM_1) is set bit 2: Set, if raw value of error symptom OC (SYM_2) is set (all combinations are possible)					
ERR_SYM_POIL_DR_SCG	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom for engine-oil pressure valve powerstage error SCG					
ERR_SYM_POIL_SWI	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptoms oil pressure switch					
LV_CDN_DIAG_POIL_DR_SCG	V	0... 1H	0 ...1	1	-
Boolean for engine-oil pressure valve powerstage error SCG diagnosis conditions					
LV_CDN_DIAG_POIL_SWI	O/V	0... 1H	0 ...1	1	-
Status of diagnosis oil pressure switch					
LV_END_DIAG_POIL_DR_SCG	V	0... 1H	0 ...1	1	-
Boolean for end of engine-oil pressure valve powerstage error SCG diagnosis					
LV_END_DIAG_POIL_SWI	O/V	0... 1H	0 ...1	1	-
End of diagnosis oil pressure switch					
LV_ERR_POIL_DR	O/V	0... 1H	0 ...1	1	-
Engine-oil pressure valve powerstage error					
LV_ERR_POIL_DR_SCG	O/V	0... 1H	0 ...1	1	-
Engine-oil pressure valve powerstage error SCG					
LV_ERR_POIL_SWI	O/V/S	0... 1H	0 ...1	1	-
Error oil pressure switch					
T_POIL_SWI_PWL	O/V	0... 3EH	0... 6.2	0.1	s
Timer for oil pressure inclination after engine stop					

### Input data:

ECU_STATE {p. 1091}	LC_POIL_CTL_ENA {p. 903}	LV_CDN_VB_OBD1 {p. 1185}	LV_ERR_SPI_MPS {p. 4245}
LV_IGK {p. 906}	LV_POIL_SWI {p. 903}	POIL_PWM {p. 8203}	TOIL {p. 8204}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_POIL_DR	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_INC_POIL_DR_SCG	-	0... FFH	0... 255	1	-
Antibounce counter increment engine-oil pressure valve powerstage error SCG					
C_ABC_INC_POIL_SWI	-	0... FFH	0... 255	1	-
Anti bounce increment value, POIL_SWI					
C_ABC_MAX_POIL_DR	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_ABC_MAX_POIL_DR_SCG	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter engine-oil pressure valve powerstage error SCG					
C_ABC_MAX_POIL_SWI	-	1... FFH	1... 255	1	-
Anti-bounce max. value, POIL_SWI					
C_PWM_POIL_DR_MAX_DIAG_SCG	-	0... FFH	0... 99.609375	0.391	%
Maximum threshold for SCG diagnosis window					
C_PWM_POIL_DR_MIN_DIAG_OC	-	0... FFH	0... 99.609375	0.391	%
Minimum threshold for OC diagnosis window					
C_PWM_POIL_DR_MIN_DIAG_SCP	-	0... FFH	0... 99.609375	0.391	%
Minimum threshold for SCP diagnosis window					
C_T_POIL_SWI_PWL	-	0... 3EH	0... 6.2	0.1	s
Time for oil pressure inclination					
C_TOIL_POIL_SWI_MAX_DIAG	-	0... C8H	-40 ...160	1	°C
Maximum diagnosis threshold TOIL					
C_TOIL_POIL_SWI_MIN_DIAG	-	0... C8H	-40 ...160	1	°C
Minimum diagnosis threshold TOIL					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_POIL_DR	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (= 2)					

**Import actions:**

<b>ACTION_ERRM_FilterMulticondition</b> (IN<XX>,IN<CDN_DIAG_>,XX>,<IN<>,ERR_DIAG_XX>,<IN>,<C_ABC_INC_XX>,IN<C_ABC_MAX_XX>,<OUT<LV_ERR_XX>)
<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,<IN<PRM_C_ABC_MAX>,<OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetLvErr</b> (IN<IDX_DIAG>,<OUT<LV_ERR>)
<b>ACTION_INFR_GetEIDiagPoil_dr</b> (OUT<Cdn_diag_Poil_dr>,<OUT<Err_diag_Poil_dr>)

**Error treatment:**

Diagnostic	Symptom description	Symptom	Filter type
<b>POIL_DR</b>			
Driver diagnosis of oil pressure actuator	SCP	<i>SYM_0</i>	MPL_STD_INI
	SCG	<i>SYM_1</i>	
	OC	<i>SYM_2</i>	

Diagnostic	Symptom description	Symptom	Filter type
<b>POIL_DR_SCG</b>			
Driver diagnosis of oil pressure actuator only for shortcut to plus	-	SYM_0	MEM
	SCG	SYM_1	
	-	SYM_2	
	-	SYM_3	

**Note :**

- The data ERR\_SYM\_POIL\_DR, LV\_END\_DIAG\_POIL\_DR and LV\_CDN\_DIAG\_POIL\_DR are not present in the output data table, because they are not used by other functions. Despite they are provided by the error management and are always visible.

**Note :**

ACTION\_INFR\_GetEIDiagPoil\_dr() is defined in the IRS (Infrastructure requirement specification)

**FUNCTION DESCRIPTION:****General information:**

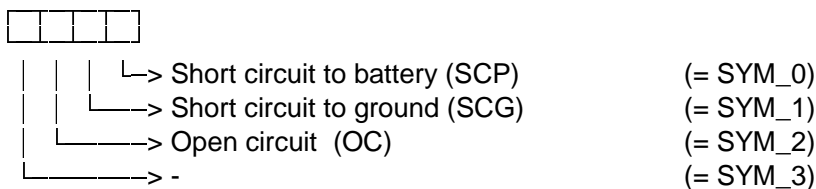
The oil pressure actuator is driven by the ECU via an output driver. The failure detection is done by ECU Hardware.

The purpose of the diagnosis is to detect electrical faults as defined by OBD I requirements.

**Description:**

After activation conditions are met, the diagnosis activation is delayed for NC\_PSD\_DLY\_POIL\_DR executions, to avoid the usage of wrong infrastructure information.

**Error-symptoms and conditions:** are defined to this diagnosis function as following

**Application conditions****Initialisation:**

at transition LV\_IGK 0 - -> 1:  
 LV\_ERR\_POIL\_DR,  
 ERR\_SYM\_POIL\_DR,

```

LV_END_DIAG_POIL_DR
(according filter-type)
Set delay counter for NC_PSD_DLY_POIL_DR
at reset:
CDN_DIAG_POIL_DR = 0,
LV_ERR_POIL_DR = 0 and
ERR_SYM_POIL_DR = 0,
LV_CDN_DIAG_POIL_DR = 0,
LV_END_DIAG_POIL_DR = 0,
(according filter-type)
Set delay counter for NC_PSD_DLY_POIL_DR

```

**Recurrence:** 100 ms

**Activation:** LV\_IGK = 1 and LC\_POIL\_CTL\_ENA = 1 and LV\_ERR\_SPI\_MPS = 0

**Deactivation:** LV\_IGK = 0 or LC\_POIL\_CTL\_ENA = 0 or LV\_ERR\_SPI\_MPS = 1

### Formula section:

**If** LV\_IGK = 1 and LV\_CDN\_VB\_OBD1 = 1

**Then**

Usage of the diagnosis information (failure symptoms (raw value) ERR\_DIAG\_POIL\_DR and basic diagnosis conditions CDN\_DIAG\_POIL\_DR) received from the infrastructure:

ACTION\_INFR\_GetEIDiagPoil\_dr (OUT<Cdn\_diag\_poil\_dr>, OUT<Err\_diag\_poil\_dr>)

Basic diagnosis conditions are set according infrastructure information: CDN\_DIAG\_POIL\_DR

Failure symptoms (raw value) are set according infrastructure information: ERR\_DIAG\_POIL\_DR

**If** Activation conditions are met for the NC\_PSD\_DLY\_POIL\_DR recurrence of the diagnosis

**Then** { *Additional diagnosis conditions* }

**If** C\_PWM\_POIL\_DR\_MIN\_DIAG\_SCP > POIL\_PWM  
**then** bit 0 of CDN\_DIAG\_POIL\_DR = 0 {*Diagnosis of SCP not possible* }

**Endif**

**If** POIL\_PWM > C\_PWM\_POIL\_DR\_MAX\_DIAG\_SCG  
**then** bit 1 of CDN\_DIAG\_POIL\_DR = 0 {*Diagnosis of SCG not possible* }

**Endif**

**If** POIL\_PWM < C\_PWM\_POIL\_DR\_MIN\_DIAG\_OC  
**Or** POIL\_PWM > C\_PWM\_POIL\_DR\_MAX\_DIAG\_SCG  
**then** bit 2 of CDN\_DIAG\_POIL\_DR = 0 {*Diagnosis of OC not possible* }

**Endif**

**Else** CDN\_DIAG\_POIL\_DR = 0

**Endif**


**Else**

CDN\_DIAG\_POIL\_DR = 0

**Endif**

Failure filtering and error management treatment:

For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN\_DIAG\_POIL\_DR and ERR\_DIAG\_POIL\_DR.

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ACTION\_ERRM\_FilterMulticondition (IN<POIL\_DR>, IN<CDN\_DIAG\_POIL\_DR>, IN<ERR\_DIAG\_POIL\_DR>, IN<C\_ABC\_INC\_POIL\_DR>, IN<C\_ABC\_MAX\_POIL\_DR>, OUT<LV\_ERR\_POIL\_DR>)

This algorithm determines:

ERR\_DIAG\_POIL\_DR (detected error symptom for POIL\_DR diagnosis)  
 LV\_ERR\_POIL\_DR (Error flag for debounced error of POIL\_DR)  
 LV\_CDN\_DIAG\_POIL\_DR (Diagnosis condition information)  
 LV\_END\_DIAG\_POIL\_DR (End of diagnosis information)

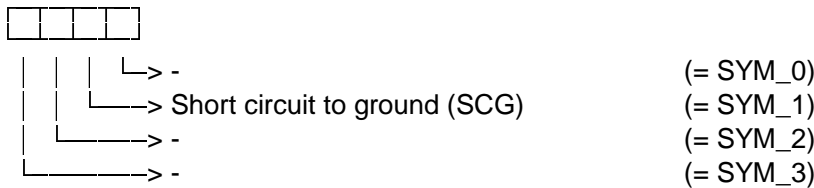
### A.34.1 Electrical diagnosis of oil pressure actuator for shortcut to ground (SCG)

#### FUNCTION DESCRIPTION:

##### General information:

In case of an electrical failure caused by a shortcut to ground (SCG) a special failure - reaction and a different warning - lamp (EML) - handling is necessary (caused by low oil - pressure the engine speed will be limited at 3000 rpm). Due to the need of a separate C\_ERR\_CLAS for this symptom of LV\_ERR\_POIL\_DR it will be copied on LV\_ERR\_POIL\_DR\_SCG.

**Error-symptoms and conditions:** are defined to this diagnosis function as following



#### Application conditions

**Initialisation:** all output data according ABC configuration "MEM"  
 // LV\_IGK 0->1 or reset or at clearing error memory  
 This action initialized the diagnostic result according the filtering  
 ACTION\_ERRM\_GetLvErr( IN<NC\_IDX\_DIAG\_POIL\_DR\_SCG >, OUT<LV\_ERR\_POIL\_DR\_SCG>)

**Recurrence:** 100 ms

**Activation:** LV\_IGK = 1 and LC\_POIL\_CTL\_ENA = 1 and LV\_ERR\_SPI\_MPS = 0

**Deactivation:** LV\_IGK = 0 or LC\_POIL\_CTL\_ENA = 0 or LV\_ERR\_SPI\_MPS = 1

#### Formula section:

LV\_CDN\_DIAG\_POIL\_DR\_SCG = LV\_CDN\_DIAG\_POIL\_DR

If ERR\_SYM\_POIL\_DR = SYM\_1


Then ERR\_SYM\_POIL\_DR\_SCG = SYM\_1

Else ERR\_SYM\_POIL\_DR\_SCG = NO\_SYM

Endif

For failure and error management treatment the anti-bounce mechanism is called with the parameters LV\_CDN\_DIAG\_POIL\_DR\_SCG and ERR\_SYM\_POIL\_DR\_SCG.

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ACTION\_ERRM\_FilterSymptom (IN< POIL\_DR\_SCG >, IN< LV\_CDN\_DIAG\_POIL\_DR\_SCG >, IN< ERR\_SYM\_POIL\_DR\_SCG >, IN< C\_ABC\_INC\_POIL\_DR\_SCG >, IN< C\_ABC\_MAX\_POIL\_DR\_SCG >, IN< 1 >, OUT< LV\_ERR\_POIL\_DR\_SCG >)

This algorithm determines LV\_ERR\_POIL\_DR\_SCG and LV\_END\_DIAG\_POIL\_DR\_SCG and delivers the result to Error Management.

## A.34.2 Oil pressure switch diagnosis

### FUNCTION DESCRIPTION:

#### General information:

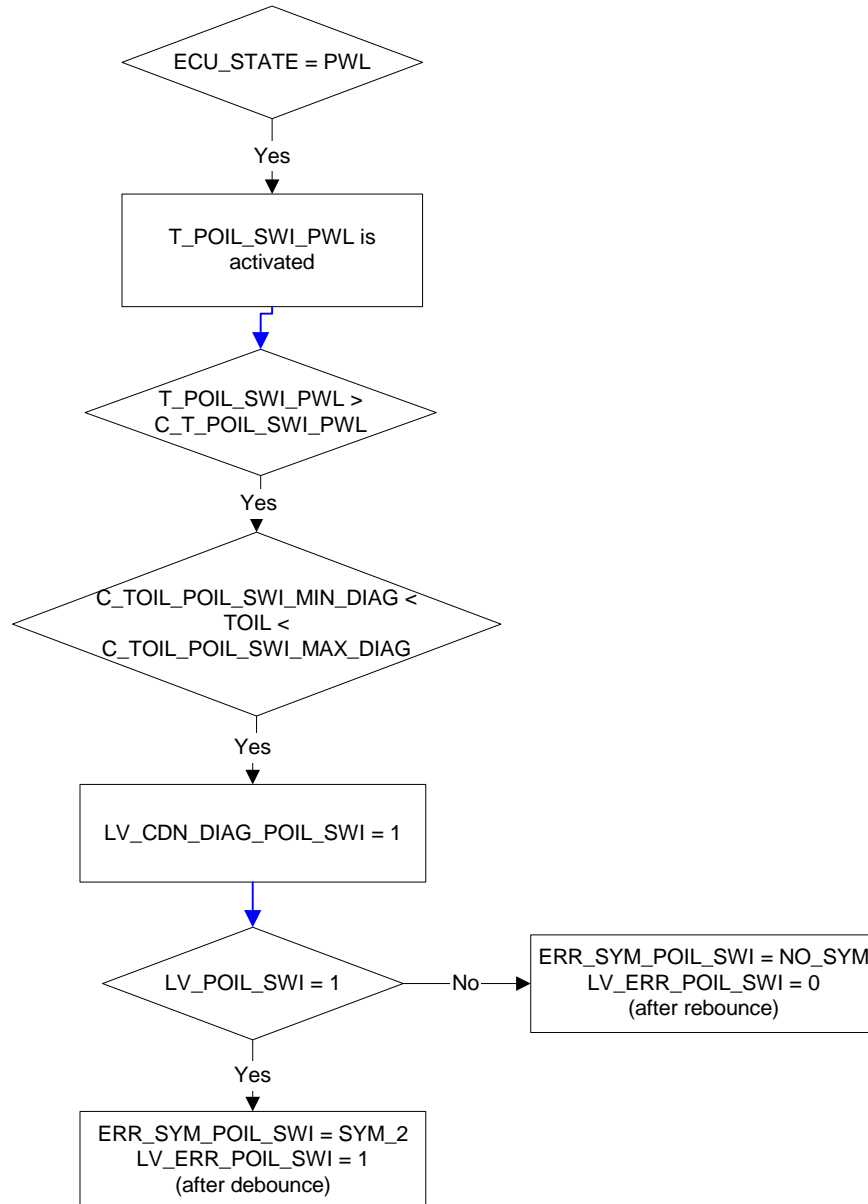
Due to the ECU recognizing the oil pressure as “ok” during “switch open”, a diagnosis of the oil pressure switch is required in order to detect a fallen off plug (open load).

#### Description:

Error symptoms are defined to this diagnosis function as following:



Signal flow diagram:



## Application conditions

### Initialisation:

according ERRM Type "**STD**" (restored out from NVMY)  
at LV\_IGK 0 → 1 **or** at reset: T\_POIL\_SWI\_PWL = 0

### Recurrence:

100 ms

Activation: LV\_END\_DIAG\_POIL\_SWI = 0 **and** ECU\_STATE = PWL  
**and**

LC\_POIL\_CTL\_ENA = 0

Deactivation: LV\_END\_DIAG\_POIL\_SWI = 1 **or**

end of power-latch phase **or** LC\_POIL\_CTL\_ENA = 1

**Formula section:**

*The diagnosis shall be performed during the power-latch-phase until LV\_END\_DIAG\_POIL\_SWI = 1 or the end of power latch phase is reached.*


```

IF (1)      ECU_STATE = PWL
THEN (1)   Timer T_POIL_SWI_PWL starts
      IF (2)      T_POIL_SWI_PWL > C_T_POIL_SWI_PWL
      THEN (2)   IF (3)      C_TOIL_POIL_SWI_MIN_DIAG <
                                TOIL < C_TOIL_POIL_SWI_MAX_DIAG
      THEN (3)   LV_CDN_DIAG_POIL_SWI = 1
      IF (4)      LV_POIL_SWI = 1
      THEN (4)   ERR_SYM_POIL_SWI = SYM_2
                                LV_ERR_POIL_SWI = 1 (after debounce)
      ELSE (4)   ERR_SYM_POIL_SWI = NO_SYM
                                LV_ERR_POIL_SWI = 0 (after rebound)
      ENDIF (4)
      ENDIF (3)
      ENDIF (2)
ENDIF (1)

```

*End of diagnosis calculation LV\_END\_DIAG\_POIL\_SWI:*

- see chapter "Anti-bounce Algorithm: Calculation of the end of diagnosis"

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## A.35 Oil sensor diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_SENS_POIL	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom of oil pressure sensor					
LV_CDN_DIAG_SENS_POIL	O/V	0... 1H	0 ...1	1	-
Diagnosis condition of oil pressure sensor					
LV_END_DIAG_SENS_POIL	O/V	0... 1H	0 ...1	1	-
End of diagnosis of oil pressure sensor					
LV_ERR_SENS_POIL	O/V	0... 1H	0 ...1	1	-
Oil pressure sensor error present					

### Input data:

LC_POIL_CTL_ENA {p. 903}	LV_IGK {p. 906}	V_POIL {p. 831}	
-----------------------------	-----------------	-----------------	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_POIL	-	0... FFH	0... 255	1	-
Anti - bounce counter increment					
C_ABC_MAX_POIL	-	1... FFH	1... 255	1	-
Maximum value of the anti - bounce counter					
C_V_POIL_MAX_DIAG	-	0... 3FFH	0... 4.99511	4.883e-3	V
Maximum diagnostic value for the oil pressure sensor signal					
C_V_POIL_MIN_DIAG	-	0... 3FFH	0... 4.99511	4.883e-3	V
Minimum diagnostic value for the oil pressure sensor signal					

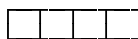
## FUNCTION DESCRIPTION:

### General information:

The purpose of the diagnosis shall be to detect electrical faults as defined by OBD I requirements. The signal of the oil pressure sensor on the A/D-input of the microcontroller is checked.

### Description:

Error-symtoms are defined to this diagnosis function as following :



- > Signal line short to battery voltage or 5 V power supply (= SYM\_0)
- > Signal line short to ground or open load (= SYM\_1)
- > - (= SYM\_2)
- > - (= SYM\_3)

## Application conditions

**Initialization:** all 0 at LV\_IGK 0 - ->1 **or** reset

**Recurrence:** 100ms

**Activation:**           **If**       LV\_IGK = 1       **and**       LC\_POIL\_CTL\_ENA = 1  
                               **Then**   LV\_CDN\_DIAG\_SENS\_POIL = 1  
                               **Else**   LV\_CDN\_DIAG\_SENS\_POIL = 0  
   **Endif**

**Deactivation:**       LV\_IGK = 0 **or**        LC\_POIL\_CTL\_ENA = 0

## Formula section:

Short circuit to VBatt or 5 V power supply:

**If**            V\_POIL > C\_V\_POIL\_MAX\_DIAG  
**Then**       ERR\_SYM\_SENS\_POIL = SYM\_0


Short circuit to ground or open load:

**Else**       **If**        V\_POIL < C\_V\_POIL\_MIN\_DIAG  
                   **Then**   ERR\_SYM\_SENS\_POIL = SYM\_1  
                   **Else**   ERR\_SYM\_SENS\_POIL = NO\_SYM  
                           **Endif**

**Endif**

Calculation of present error and end of diagnosis:

LV\_ERR\_SENS\_POIL and LV\_END\_DIAG\_SENS\_POIL is calculated by the error management.

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## A.36 Engine roughness diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_SEG_AD_ER	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of ER segment time adaptive values					
ERR_SYM_T_SEG_ER	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of segment time adaptive values					
LV_CDN_DIAG_SEG_AD_ER	V	0... 1H	0 ...1	1	-
Diagnosis condition of ER segment time adaptive values					
LV_CDN_DIAG_T_SEG_ER	V	0... 1H	0 ...1	1	-
Diagnosis condition of segment time adaptive values					
LV_END_DIAG_SEG_AD_ER	V	0... 1H	0 ...1	1	-
Diagnosis end of ER segment time adaptive values					
LV_END_DIAG_T_SEG_ER	V	0... 1H	0 ...1	1	-
Diagnosis end of segment time adaptive values					
LV_ERR_SEG_AD_ER	O/V	0... 1H	0 ...1	1	-
Present failure for ER segment time adaptive values					
LV_ERR_T_SEG_ER	O/V	0... 1H	0 ...1	1	-
Present failure for segment time adaptive values					

### Input data:

LV_DC {p. 5746}	LV_INH_DIAG_SEG_AD_ER ER {p. 4371}	LV_INH_DIAG_T_SEG_ER {p. 4371}	LV_INH_MIS_CRK {p. 4432}
LV_SEG_AD_AVL_ER {p. 1473}	LV_SEG_AD_ER {p. 1473}	LV_SEG_AD_LIM_ER {p. 1473}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_SEG_AD_ER	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_INC_T_SEG_ER	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_SEG_AD_ER	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_ABC_MAX_T_SEG_ER	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
LC_CDN_DIAG_SEG_AD_ER	-	0... 1H	0 ...1	1	-
Diagnosis condition mode of ER segment time adaptive values					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

### Error treatment:

Diagnosis T_SEG_ER	Symptom	Nr	ABC type
Engine roughness segment time acquisition	-	0	STD_INI
	Missing/Adding 1 tooth or more on engine roughness segment acquisition	1	
		2	
T_SEG_ER		3	

Diagnosis SEG_AD_ER	Symptom	Nr	ABC type
ER segment adaptation values at the limit	-	0	STD_INI
	ER segment adaptation values at the limit	1	
		2	
SEG_AD_ER		3	

## A.36.1 Engine roughness segment time acquisition error

### FUNCTION DESCRIPTION:

The purpose of this error is to diagnose synchronisation errors on engine roughness segments measurement.

An error symptom *Missing/Adding 1 tooth or more on engine roughness segment acquisition* is detected when a crankshaft synchronisation error caused by 1 or 2 missing/additional tooth occurs on one crankshaft revolution.

### Application conditions

#### **Initialisation:**

at ECU reset or KEY OFF/ KEY ON event  
 LV\_CDN\_DIAG\_T\_SEG\_ER = 0  
 ERR\_SYM\_T\_SEG\_ER = Refer to filtering configuration for the  
 initialisation value  
 LV\_ERR\_T\_SEG\_ER = Refer to filtering configuration for the  
 initialisation value  
 LV\_END\_DIAG\_T\_SEG\_ER = Refer to filtering configuration for  
 the initialisation value

#### **Recurrence:**

each 360°Crk at segment task

#### **Activation/Deactivation: If**

LV\_DC = 1

**And** LV\_INH\_DIAG\_T\_SEG\_ER = 0

**Then** LV\_CDN\_DIAG\_T\_SEG\_ER = 1

diagnosis

is active

**Else** LV\_CDN\_DIAG\_T\_SEG\_ER = 0

diagnosis

is passive

#### **Endlf**

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**Formula section:**Error detection

```

If      LV_INH_MIS_CRK = 1
Then    ERR_SYM_T_SEG_ER = SYM_1
           (symptom "Missing/Adding 1 or 2 teeth on engine roughness segment acquisition" is active,
           ABC counter starts to increment)
           LV_ERR_T_SEG_ER = 1                               (after anti-bounce)
Else    ERR_SYM_T_SEG_ER = NO_SYM
           (no symptom is declared, ABC counter starts to decrement)
           LV_ERR_T_SEG_ER = 0                               (after anti-bounce)
EndIf

```

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

**A.36.2 Engine roughness segment adaptive values out of range error****Description:**

The purpose is to diagnose the ER segment adaptive values.

If during or at the end of the segment adaptive values learning process ( $LV\_SEG\_AD\_ER = 1$  or  $LV\_SEG\_AD\_ER = 1 \rightarrow 0$ ), at least one of the engine roughness segment adaptation values is at the limit ( $LV\_SEG\_AD\_LIM\_ER = 1$ ), the error symptom  $SEG\_AD\_ER$  engine roughness segment adaptation values at the limit is detected.

**Application conditions****Initialisation:**

```

           at ECU reset or KEY OFF/ KEY ON event
LV_CDN_DIAG_SEG_AD_ER = 0
ERR_SYM_SEG_AD_ER = Refer to filtering configuration for the
initialisation value
LV_ERR_SEG_AD_ER = Refer to filtering configuration for
the initialisation value
LV_END_DIAG_SEG_AD_ER = Refer to filtering configuration for
the initialisation value

```

**Recurrence:**

segment task


**Activation/Deactivation:**

```

If      [ ( LV_SEG_AD_ER = 1 -> 0 And LC_CDN_DIAG_SEG_AD_ER = 0 )
           Or ( LV_SEG_AD_ER = 1 And LC_CDN_DIAG_SEG_AD_ER = 1 ) ]
           And LV_SEG_AD_AVL_ER = 1                               // adaptive
           values available
           And LV_INH_DIAG_SEG_AD_ER = 0                         // no application
           fade-out
           Then LV_CDN_DIAG_SEG_AD_ER = 1                         // diagnosis
           is active
           Else LV_CDN_DIAG_SEG_AD_ER = 0                         // diagnosis
           is passive

```

**EndIf**


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**Formula section:**Error detection

```

If          LV_SEG_AD_LIM_ER = 1                // adaptive values at the limit
Then       ERR_SYM_SEG_AD_ER = SYM_1
              (symptom "ER segment time adaptive values at the limit" is active, ABC counter starts to
              increment)
              LV_ERR_SEG_AD_ER = 1                (after anti-bounce)
Else       ERR_SYM_SEG_AD_ER = NO_SYM
              (no symptom is declared, ABC counter starts to decrement)
              LV_ERR_SEG_AD_ER = 0                (after anti-bounce)
EndIf

```

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## A.37 Engine roughness diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_SEG_AD_ER	O/V	0... 1H	0 ...1	1	-
Specific conditions to inhabit Engine roughness segment adaptive values diagnosis					
LV_INH_DIAG_T_SEG_ER	O/V	0... 1H	0 ...1	1	-
Specific conditions to inhibit Engine roughness segment time acquisition diagnosis					

### Input data:

LV_DC {p. 5746}	LV_ERR_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CRK_PLAUS {p. 4446}
LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_PER {p. 4432}	LV_ERR_MAF_FRQ_EL [NC_MAF_NR] {p. 4815}
LV_ERR_MAF_FRQ_GRD [NC_MAF_NR] {p. 4815}	LV_ERR_MAF_FRQ_RNG [NC_MAF_NR] {p. 4815}	LV_ERR_MEC_IVVT_EX {p. 1062}	LV_ERR_MEC_IVVT_IN {p. 1062}
LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}	LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_SLV_IVVT_EX {p. 4627}	LV_ERR_SLV_IVVT_IN {p. 4627}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TPS {p. 4982}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}
LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}
LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_IGK {p. 906}	NC_MAF_NR {p. 834}
NC_NR_CAM_CBK {p. 1507}	NC_NR_CBK_IVVT {p. 604}		

### General information:


In this module the project specific inhibition conditions for the engine roughness diagnosis are defined.

### Application conditions

**Initialization:** *0 at reset or Key Off to On*

**Recurrence:** *Every segment*

**Activation:** *LV\_DC = 1*


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**Formula section:****Inhibition of SEG\_AD\_ER diagnosis:**

```

if          LV_IGK= 0
  Or        LV_ERR_CRK_PLAUS = 1
  Or        LV_ERR_CRK_SYN = 1
  Or        LV_ERR_CRK_TOOTH = 1
  Or        LV_ERR_CRK_TOOTH_PER = 1
  Or        LV_ERR_MEC_IVVT_EX = 1
  Or        LV_ERR_MEC_IVVT_IN = 1
  Or        LV_ERR_MTC_CTL_2 = 1
  Or        LV_ERR_MTC_CTL_3 = 1
  Or        LV_ERR_MTC_DR = 1
  Or        LV_ERR_PER_CAM_EX[0] = 1
  Or        LV_ERR_PER_CAM_IN[0] = 1
  Or        LV_ERR_PLAUS_CAM_EX[0] = 1
  Or        LV_ERR_PLAUS_CAM_IN[0] = 1
  Or        LV_ERR_REF_CRK_CAM_EX[0] = 1
  Or        LV_ERR_REF_CRK_CAM_IN[0] = 1
  Or        LV_ERR_SLV_IVVT_EX = 1
  Or        LV_ERR_SLV_IVVT_IN = 1
  Or        LV_ERR_SYN_CAM_EX[0] = 1
  Or        LV_ERR_SYN_CAM_IN[0] = 1
  Or        LV_ERR_SYN_CRK_CAM_EX[0] = 1
  Or        LV_ERR_SYN_CRK_CAM_IN[0] = 1
  Or        LV_ERR_TOOTH_OFF_EX[0] = 1
  Or        LV_ERR_TOOTH_OFF_IN[0] = 1
  #if      NC_NR_CAM_CBK = 2
    Or      LV_ERR_PER_CAM_EX[1] = 1
      Or      LV_ERR_PER_CAM_IN[1] = 1
      Or      LV_ERR_PLAUS_CAM_EX[1] = 1
      Or      LV_ERR_PLAUS_CAM_IN[1] = 1
      Or      LV_ERR_REF_CRK_CAM_EX[1] = 1
      Or      LV_ERR_REF_CRK_CAM_IN[1] = 1
      Or      LV_ERR_SYN_CAM_EX[1] = 1
      Or      LV_ERR_SYN_CAM_IN[1] = 1
      Or      LV_ERR_SYN_CRK_CAM_EX[1] = 1
      Or      LV_ERR_SYN_CRK_CAM_IN[1] = 1
      Or      LV_ERR_TOOTH_OFF_EX[1] = 1
      Or      LV_ERR_TOOTH_OFF_IN[1] = 1
    #endif
    Or      LV_ERR_TPS = 1
    Or      LV_ERR_TPS_1 = 1
    Or      LV_ERR_TPS_2 = 1
    Or      LV_ERR_TPS_AD = 1
    Or      LV_ERR_TPS_AD_BOL = 1
    Or      LV_ERR_TPS_MAF_1 = 1
    Or      LV_ERR_TPS_MAF_2 = 1
    Or      LV_ERR_TPS_RATIO = 1
    Or      LV_ERR_TPS_ST_CHK_2 = 1
  Or      LV_ERR_CAM_CST_IVVT_IN[0] = 1
  Or      LV_ERR_CAM_CST_IVVT_EX[0] = 1

```

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```

#if    NC_NR_CBK_IVVT = 2
Or    LV_ERR_CAM_CST_IVVT_IN[1] = 1
Or    LV_ERR_CAM_CST_IVVT_EX[1] = 1
#endif

Then   LV_INH_DIAG_SEG_AD_ER = 1
Else   LV_INH_DIAG_SEG_AD_ER = 0
Endif


```

#### Inhibition of T\_SEG\_ER diagnosis:

```

if      LV_IGK= 0
Or      LV_ERR_CRK_PLAUS = 1
Or      LV_ERR_CRK_SYN = 1
Or      LV_ERR_CRK_TOOTH = 1
Or      LV_ERR_CRK_TOOTH_PER = 1
Or      LV_ERR_MAF_FRQ_EL[0] = 1
Or      LV_ERR_MAF_FRQ_GRD[0] = 1
Or      LV_ERR_MAF_FRQ_RNG[0] = 1
#if    NC_MAF_NR = 2
Or      LV_ERR_MAF_FRQ_EL[1] = 1
Or    LV_ERR_MAF_FRQ_GRD[1] = 1
Or    LV_ERR_MAF_FRQ_RNG[1] = 1
#endif
Or    LV_ERR_MEC_IVVT_EX = 1
Or    LV_ERR_MEC_IVVT_IN = 1
Or    LV_ERR_PER_CAM_EX[0] = 1
Or    LV_ERR_PER_CAM_IN[0] = 1
Or    LV_ERR_PLAUS_CAM_EX[0] = 1
Or    LV_ERR_PLAUS_CAM_IN[0] = 1
Or    LV_ERR_REF_CRK_CAM_EX[0] = 1
Or    LV_ERR_REF_CRK_CAM_IN[0] = 1
Or    LV_ERR_SLV_IVVT_EX = 1
Or    LV_ERR_SLV_IVVT_IN = 1
Or    LV_ERR_SYN_CAM_EX[0] = 1
Or    LV_ERR_SYN_CAM_IN[0] = 1
Or    LV_ERR_SYN_CRK_CAM_EX[0] = 1
Or    LV_ERR_SYN_CRK_CAM_IN[0] = 1
Or    LV_ERR_TOOTH_OFF_EX[0] = 1
Or    LV_ERR_TOOTH_OFF_IN[0] = 1
#if    NC_NR_CAM_CBK = 2
Or    LV_ERR_PER_CAM_EX[1] = 1
Or    LV_ERR_PER_CAM_IN[1] = 1
Or    LV_ERR_PLAUS_CAM_EX[1] = 1
Or    LV_ERR_PLAUS_CAM_IN[1] = 1
Or    LV_ERR_REF_CRK_CAM_EX[1] = 1
Or    LV_ERR_REF_CRK_CAM_IN[1] = 1
Or    LV_ERR_SYN_CAM_EX[1] = 1
Or    LV_ERR_SYN_CAM_IN[1] = 1
Or    LV_ERR_SYN_CRK_CAM_EX[1] = 1
Or    LV_ERR_SYN_CRK_CAM_IN[1] = 1
Or    LV_ERR_TOOTH_OFF_EX[1] = 1
Or    LV_ERR_TOOTH_OFF_IN[1] = 1
#endif


```

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```

Or      LV_ERR_TPS_1 = 1
Or      LV_ERR_TPS_2 = 1
Or      LV_ERR_TPS_AD = 1
Or      LV_ERR_TPS_AD_BOL = 1
Or      LV_ERR_TPS_MAF_1 = 1
Or      LV_ERR_TPS_MAF_2 = 1
Or      LV_ERR_TPS_RATIO = 1
Or      LV_ERR_TPS_ST_CHK_2 = 1
Or      LV_ERR_CAM_CST_IVVT_IN[0] = 1
Or      LV_ERR_CAM_CST_IVVT_EX[0] = 1
#if    NC_NR_CBK_IVVT = 2
Or      LV_ERR_CAM_CST_IVVT_IN[1] = 1
Or      LV_ERR_CAM_CST_IVVT_EX[1] = 1
#endif
Then    LV_INH_DIAG_T_SEG_ER = 1
Else    LV_INH_DIAG_T_SEG_ER = 0
Endif

```

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 4374 of 8404	
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## A.38 Idle diagnosis engine roughness

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ER_MMV_IS_DIAG [NC_CYL_NR]	O/V	8000... 7FFFH	-8... 7.99975585938	244.141e-6	-
Filtered engine roughness value cylinder individual, x = 0 ... 5					

### Input data:

ER_CYL [NC_CYL_NR] {p. 1454}	LV_IS {p. 1720}	MAF_HB {p. 805}	N {p. 1525}
NC_CYL_NR {p. 1526}	SEG_NR_ER {p. 1454}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_IS_ER_DIAG	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlation constant for calculating the ER diagnostic values					
IP_THD_IS_ER_DIAG_N_MAF	V	1... 7FFFH	-1... -32767	-1	µs
LDP_N_THD_IS_ER_DIAG	4	0... 1FE0H	0... 8160	1	rpm
LDP_MAF_THD_IS_ER_DIAG	4	0... FFH	0... 1389	5.4470588	mg/stk
ER reference value for ER diagnosis					

### General Information

Conclusions on the combustion quality of a cylinder can be drawn by monitoring the crankshaft acceleration. This can be used in the workshop for diagnostic purposes.

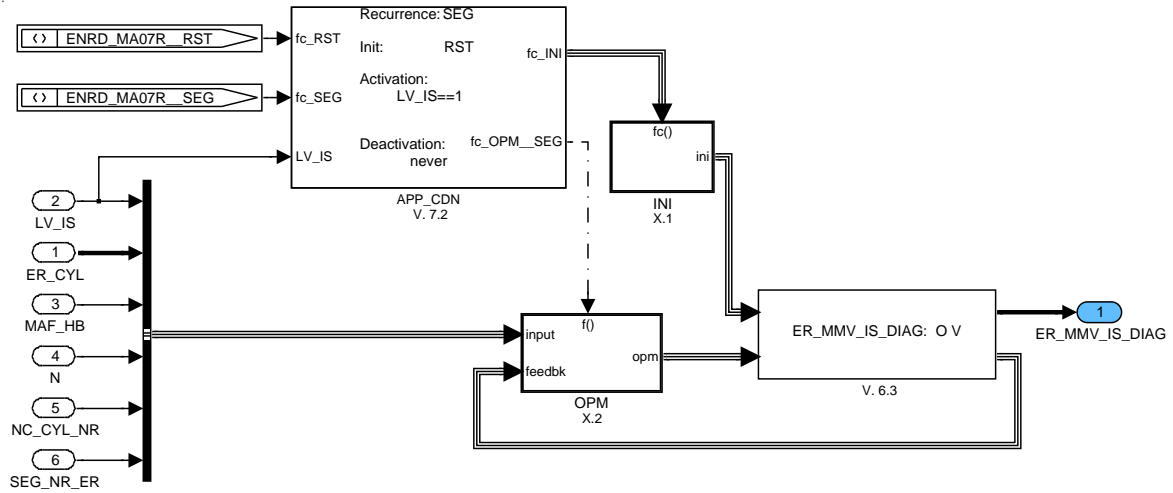
The cylinder individual engine roughness values ER\_CYL[NC\_CYL\_NR], which are determined for mis-fire diagnosis, are taken, related to a TCO- and operating point-dependent threshold and then smoothed by moving mean value calculation.

The 6 diagnostic values are transferred to the workshop tester via K-line. If an ER diagnostic value exceeds a determined threshold, it can be assumed that the corresponding cylinder has a malfunction.

### Application Conditions

Initialization: RST  
 Recurrence: SEG  
 Activation: LV\_IS==1  
 Deactivation: never

### Function description



SDA\_SRS / SDA V 5.3.2 / 13-May-2008

Figure A.38.1: : Path: ENRD\_MA07R

### A.38.1 Initialization

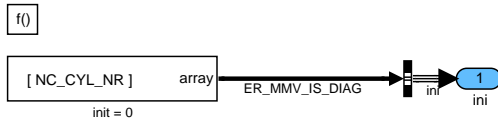


Figure A.38.2: : Path: ENRD\_MA07R/INI

### A.38.2 Formula section

#### A.38.2.1 Calculation of filtered engine roughness value

ER\_MMV\_IS\_DIAG is calculated here.

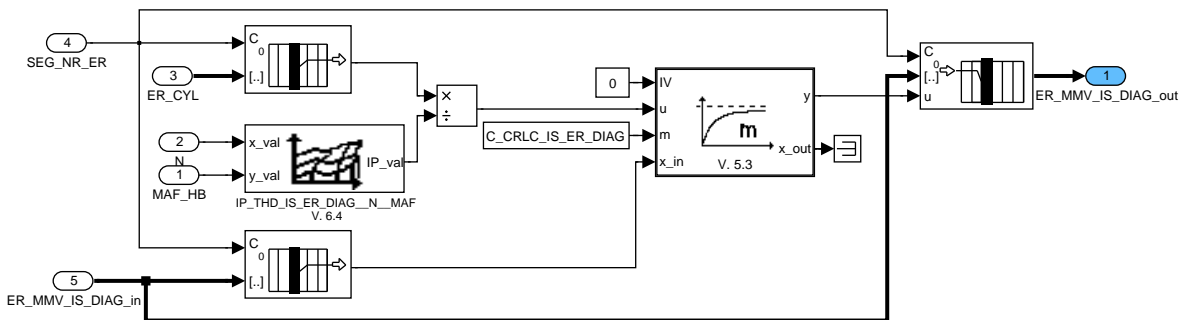


Figure A.38.3: : Path: ENRD\_MA07R/OPM/OPM

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## A.39 Idle speed control diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_ISC	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom idle speed control diagnosis					
ERR_SYM_ISC_CST	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom idle speed control diagnosis at coldstart					
LV_CDN_DIAG_ISC	O/V	0... 1H	0 ...1	1	-
Diagnosis conditions fulfilled					
LV_CDN_DIAG_ISC_CST	O/V	0... 1H	0 ...1	1	-
Diagnosis conditions fulfilled idle speed at coldstart					
LV_CDN_ISC_CST_CLU	V	0... 1H	0 ...1	1	-
Diagnosis conditions for valid TQ_AV for diagnosis					
LV_END_DIAG_ISC	V	0... 1H	0 ...1	1	-
Diagnosis done completely at least one time					
LV_END_DIAG_ISC_CST	V	0... 1H	0 ...1	1	-
Diagnosis at coldstart done completely at least one time					
LV_ERR_ISC	O/V	0... 1H	0 ...1	1	-
Boolean for fault memory Idle Control System: Unplausible Speed					
LV_ERR_ISC_CST	O/V	0... 1H	0 ...1	1	-
Boolean for fault memory Idle Control System: Unplausible speed at coldstart					
N_DIF_MAX_DIAG_ISC_CST	V	0... 1FE0H	0... 8160	1	rpm
Upper engine speed deviation of idle speed control diagnosis at coldstart					
N_DIF_MIN_DIAG_ISC_CST	V	0... 1FE0H	0... 8160	1	rpm
Lower engine speed deviation of idle speed control diagnosis at coldstart					
T_INH_ISC_DIAG_AST	V	0... FFH	0... 25.5	0.1	s
Time delay for diagnosis activation after start					
T_ISC_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
Time delay for diagnosis activation					


### Input data:

FLOW_CPS {p. 3635}	LV_ACCOUT_RLY {p. 3589}	LV_AST_END {p. 2100}	LV_AT {p. 654}
LV_CDN_VB_OBD2 {p. 1185}	LV_CH_N_SP_IS {p. 1775}	LV_DRI {p. 1302}	LV_IGK {p. 906}
LV_INH_DIAG_ISC {p. 4392}	LV_IS {p. 1720}	LV_MTC_CUR_OFF {p. 6565}	LV_REQ_ISC {p. 3501}
LV_ST_END {p. 1720}	LV_VAR_TCT {p. 656}	MAF_HB {p. 805}	N {p. 1525}
N_SP_IS {p. 1122}	NC_IDX_DIAG_ISC	NC_IDX_DIAG_ISC_CST	T_AST {p. 1766}
TCO {p. 1100}	TCO_ST {p. 1100}	TQ_AV {p. 6656}	VS {p. 1176}

**Import actions:**

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>, <b>OUT</b> <PRM_LV_ERR>)
<b>ACTION_ERRM_GetErrSym</b> (IN<IDX_DIAG>, <b>OUT</b> <ERR_SYM>)
<b>ACTION_ERRM_GetLvCdnDiag</b> (IN<IDX_DIAG>, <b>OUT</b> <LV_CDN_DIAG>)
<b>ACTION_ERRM_GetLvErr</b> (IN<IDX_DIAG>, <b>OUT</b> <LV_ERR>)


**0.03125 Calibration data:**

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4378 of 8404</b>	
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Name	Dim	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_ISC	1	0...FFH	0...255	1	-
Anti-bounce counter decrement for idle speed Plausibility check					
C_ABC_DEC_ISC_CST	1	0...FFH	0...255	1	-
Anti-bounce counter decrement for idle speed Plausibility check at coldstart					
C_ABC_INC_ISC	1	0...FFH	0...255	1	-
Anti-bounce counter increment for idle speed Plausibility check					
C_ABC_INC_ISC_CST	1	0...FFH	0...255	1	-
Anti-bounce counter increment for idle speed Plausibility check at coldstart					
C_ABC_MAX_ISC	1	1...FFH	1...255	1	-
Maximum value of the anti-bounce counter for idle speed Plausibility check					
C_ABC_MAX_ISC_CST	1	1...FFH	1...255	1	-
Maximum value of the anti-bounce counter for idle speed Plausibility check at coldstart					
C_FLOW_CPS_MAX_DIAG_ISC	1	0...FFFFH	0...7.99987793	1.2207E-4	kg/h
Maximum canister purge fuel flow from CPS to cylinder to perform idle speed plausibility check					
C_MAF_MAX_DIAG_ISC	1	0...FFH	0...1.389E+3	5.4470588 2	mg/stk
Maximum mass air flow to perform idle speed Plausibility check					
C_N_DIF_MAX_DIAG_ISC	1	0...1FE0H	0...8.16E+3	1	rpm
Maximum deviation above nominal idle speed					
C_N_DIF_MIN_DIAG_ISC	1	0...1FE0H	0...8.16E+3	1	rpm
Maximum deviation below nominal idle speed					
C_TCO_MIN_ISC	1	0...FEH	-48...142.5	0.75	°C
Min TCO threshold for idle speed diagnosis					
C_TCO_MIN_ISC_CST	1	0...FEH	-48...142.5	0.75	°C
Min TCO threshold for idle speed diagnosis at coldstart					
C_TQ_AV_MAX_DIAG_ISC_CST_AT	1	8000...7FFFH	-1.024E+3 ... 1.02397E+3	0.03125	Nm
Actual engine torque max level for ISC_CST diagnosis for automatic transmission					
C_TQ_AV_MAX_DIAG_ISC_CST_MT	1	8000...7FFFH	-1.024E+3 ... 1.02397E+3	0.03125	Nm
Actual engine torque max level for ISC_CST diagnosis for manual transmission					
C_TQ_AV_MAX_DIAG_ISC_CST_TCT	1	8000...7FFFH	-1.024E+3 ... 1.02397E+3	0.03125	Nm
Actual engine torque max level for ISC_CST diagnosis for automatic transmission					
C_T_DLY_ISC_DIAG	1	0...FFFFH	0...6.5535E+3	0.1	s
Time delay for diagnosis activation					
LC_INH_DIAG_ISC_MAN	1	0...1H	0...1	1	-
Flag for manual inhibition of ISC diagnosis					
LC_T_INH_ISC_DIAG_AST	1	0...1H	0...1	1	-
Switch for inhibition of activation timer after start of ISC diagnosis					
IP_FAC_DIF_DIAG_ISC_CST	6	0...FFH	0...1.9921875	0.0078125	-
LDP_T_AST_IP_FAC_DIAG_ISC_CST	6	0...FFFFH	0...6.5535E+3	0.1	[s]
Influence of time after start for limits of idle speed controller diagnosis at coldstart					
IP_T_INH_ISC_DIAG_AST	6	0...FFH	0...25.5	0.1	s
LDP_TCO_ST_IP_T_INH_ISC_DIAG	6	0...FEH	-48...142.5	0.75	[°C]
Initialization for activation timer of idle speed diagnosis after start					
IP_N_DIF_MAX_DIAG_ISC_CST	6x6	0...1FE0H	0...8.16E+3	1	rpm
LDP_TCO_IP_DIAG_ISC_CST	6	0...FEH	-48...142.5	0.75	[°C]
LDP_TCO_ST_IP_DIAG_ISC_CST	6	0...FEH	-48...142.5	0.75	[°C]
Upper engine speed deviation for limits idle speed control diagnosis at coldstart					
IP_N_DIF_MIN_DIAG_ISC_CST	6x6	0...1FE0H	0...8.16E+3	1	rpm
LDP_TCO_IP_DIAG_ISC_CST	6	0...FEH	-48...142.5	0.75	[°C]
LDP_TCO_ST_IP_DIAG_ISC_CST	6	0...FEH	-48...142.5	0.75	[°C]
Lower engine speed deviation for limits idle speed control diagnosis at coldstart					

## Function description

## Application Condition

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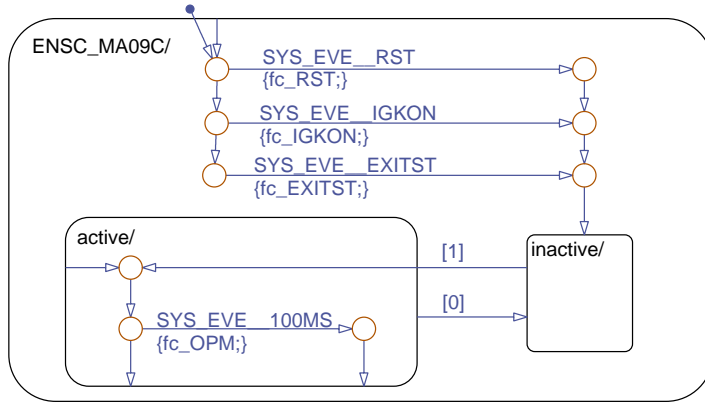



Figure A.39.1: ENSC\_MA09C/APP\_CDN/Chart

**Function Description**

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4380 of 8404</b>	
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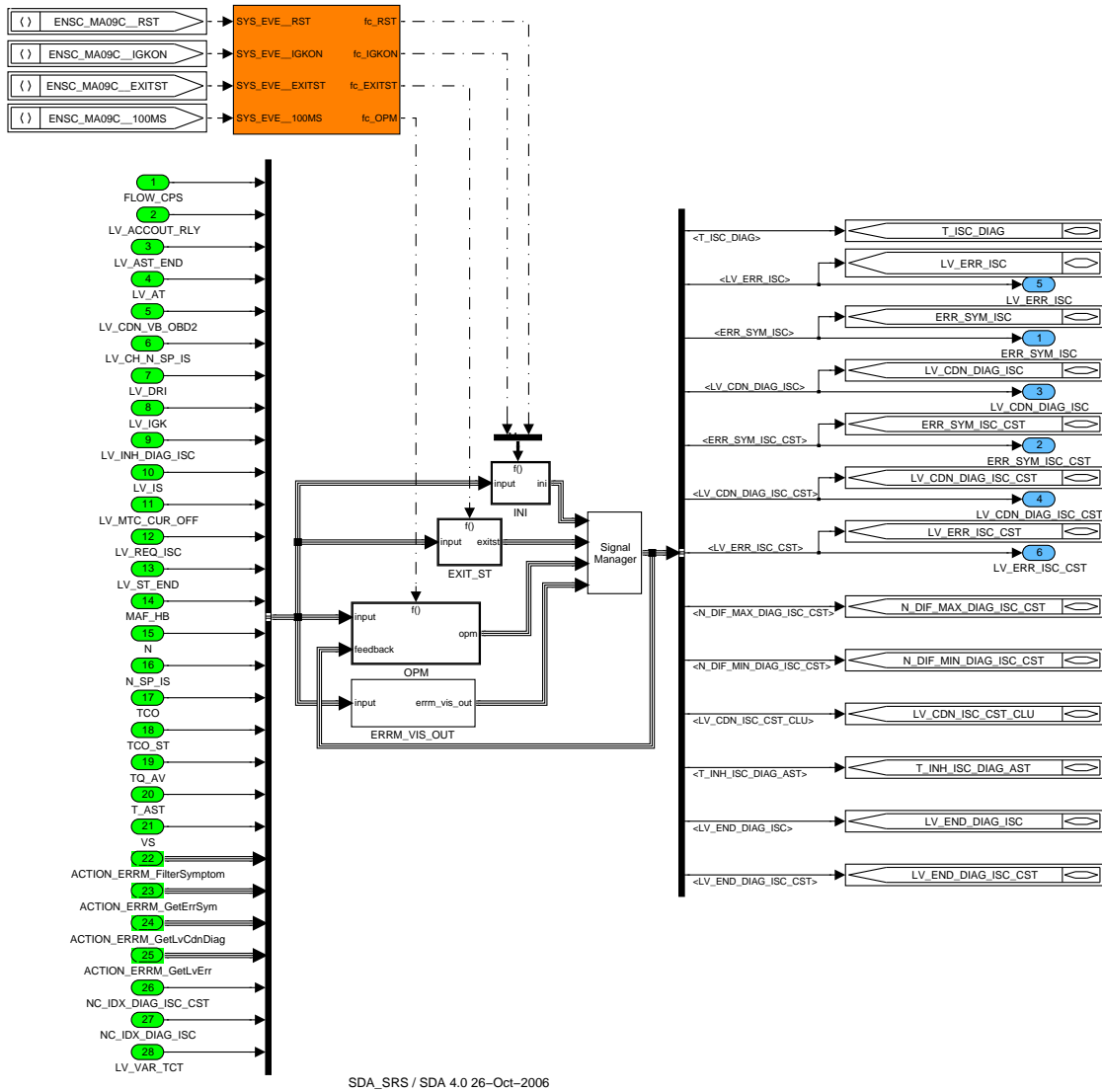


Figure A.39.2: ENSC\_MA09C

### A.39.1 Initialisation at system event reset.

#### Initialisation V/O mode ERRM variable at system reset

according ABC type "STD\_INI" + "DEC\_CAL"

(0 at LV\_IGK 0->1 or reset, calibratable decrement)

All the V/O mode ERRM variable are initialised according to the ERRM template.

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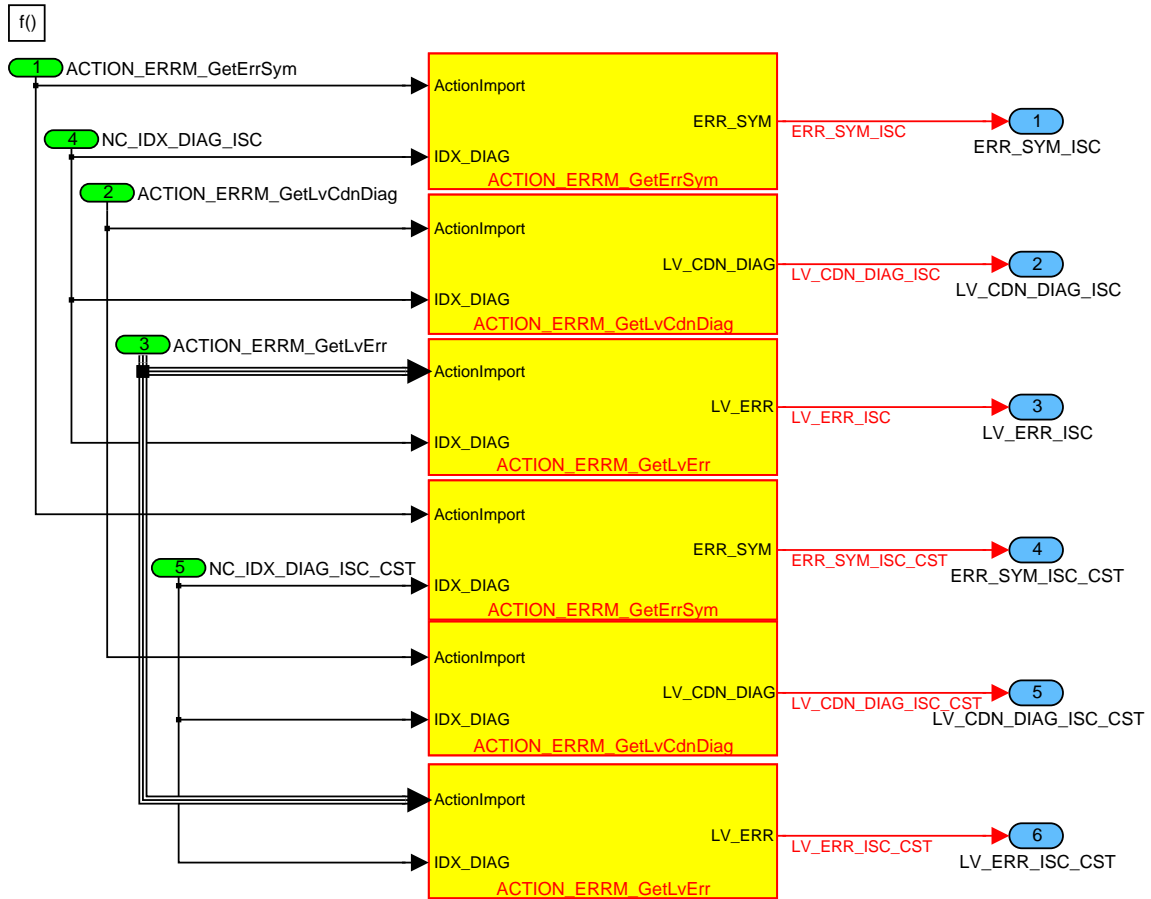


Figure A.39.3: ENSC\_MA09C/INI/INI\_1

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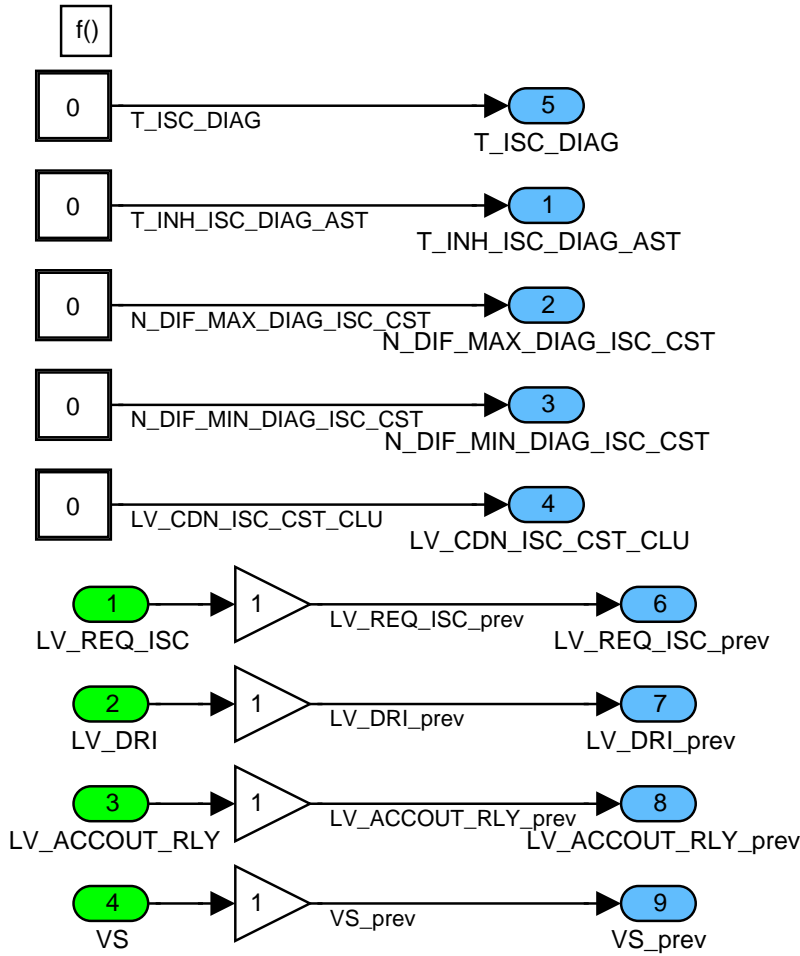


Figure A.39.4: ENSC\_MA09C/INI/INI\_2

### A.39.2 Condition check at EXIT\_ST system event

Condition check when the transition of LV\_ST\_END 0 -> 1 and calculation of variable T\_INH\_ISC\_DIAG\_AST

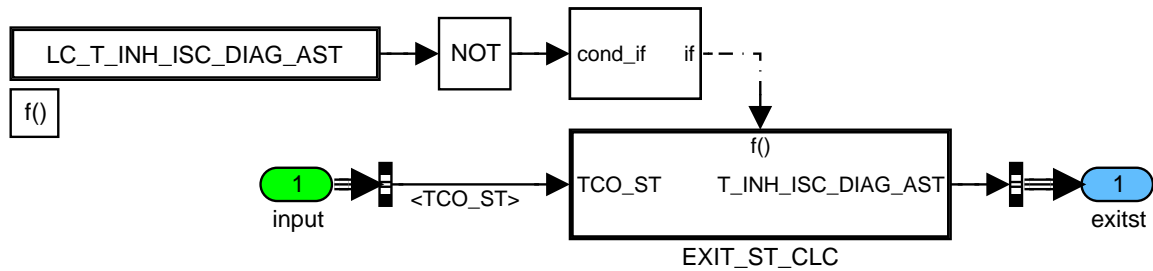



Figure A.39.5: ENSC\_MA09C/EXIT\_ST

### Calculation of T\_INH\_ISC\_DIAG\_AST

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T\_INH\_ISC\_DIAG\_AST is calculated using IP Curve IP\_T\_INH\_ISC\_DIAG\_AST with TCO\_ST as input.

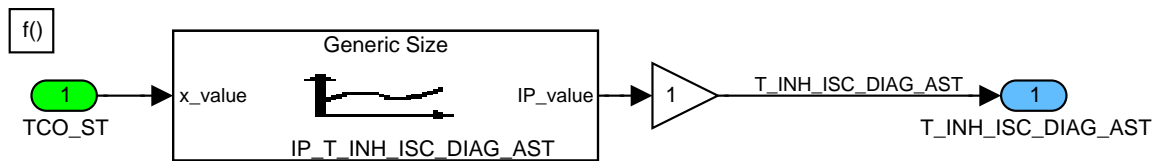


Figure A.39.6: ENSC\_MA09C/EXIT\_ST/EXIT\_ST\_CLC


### A.39.3 Plausibility check

#### FUNCTION DESCRIPTION:

##### General information:

Engine speed deviation from the nominal engine speed is monitored either the vehicle is stopped and the throttle is settled after closing or after engine start. Due to different engine operating characteristics the coldstart-monitoring is performed by using limits depending on the temperature of cooling water and time after start.

If the difference to the nominal idle speed keeps too high or too low in spite of an activated idle speed controller, an idle speed control plausibility error is detected.

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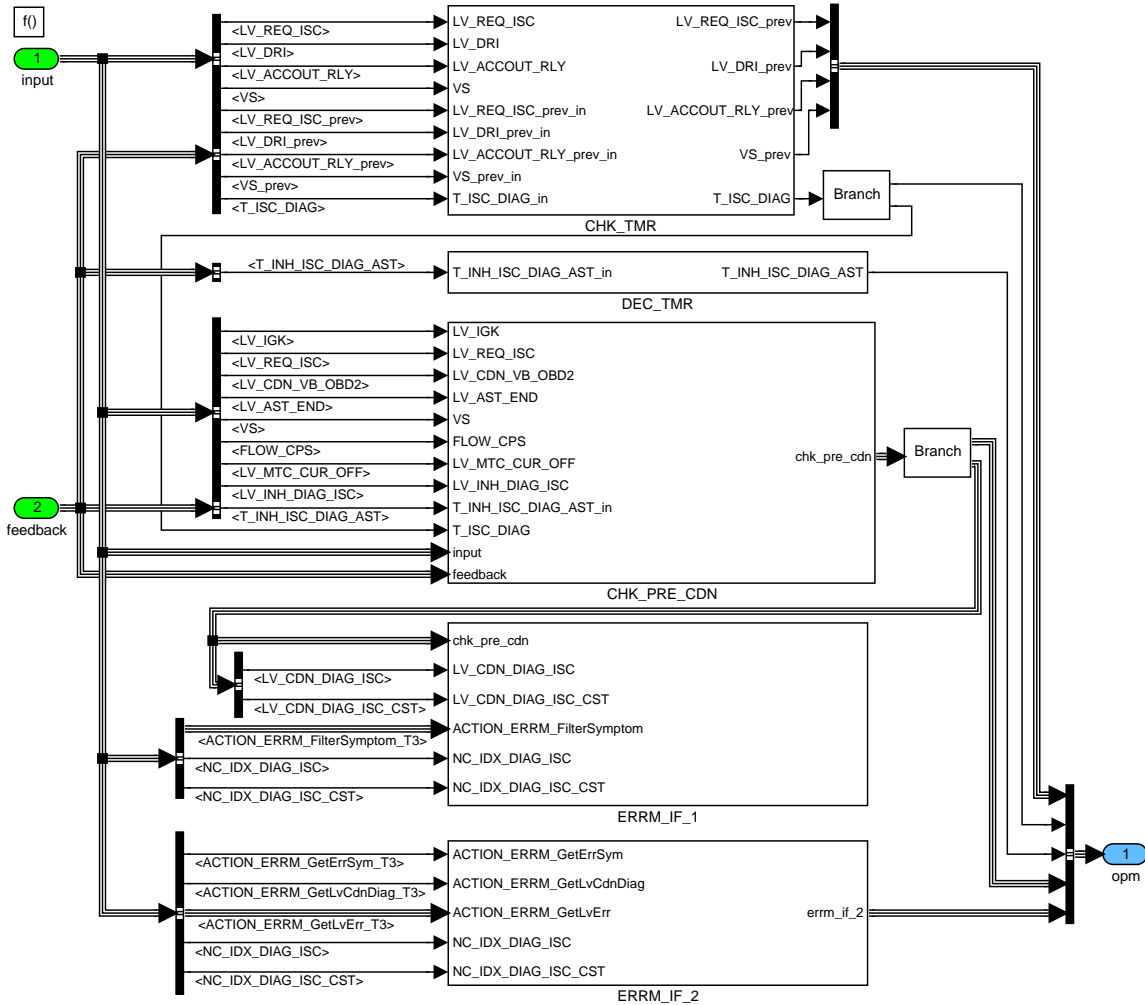


Figure A.39.7: ENSC\_MA09C/OPM

**Calculation of timer T\_ISC\_DIAG**

The following timer is used for delaying the activation of the diagnosis algorithm when the idle speed controller is activated or speed is possibly excited due to strong disturbances such as ACC or drive train engaging (in order to prevent a diagnosis at high, normal speed deviations):

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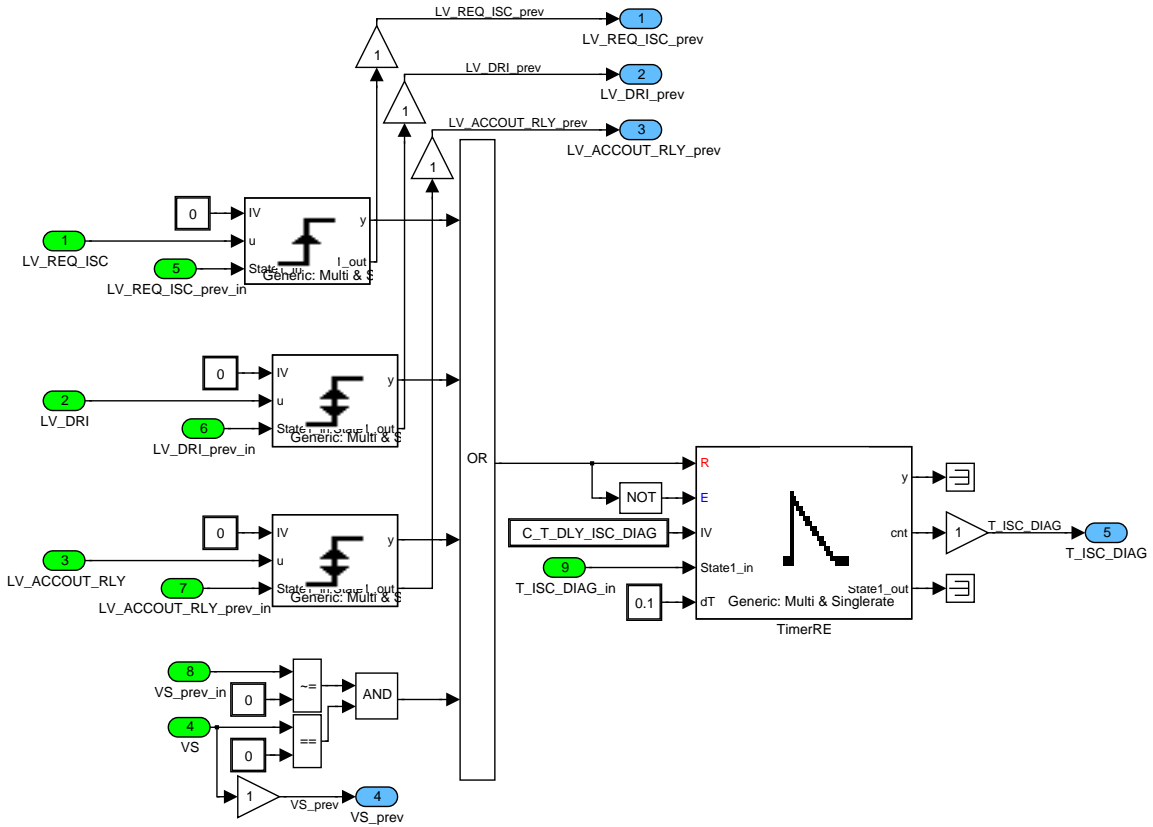


Figure A.39.8: ENSC\_MA09C/OPM/CHK\_TMR

**Calculation of timer T\_INH\_ISC\_DIAG\_AST**

Timer is already initialised at system event EXITST. Here the timer starts decrementing.

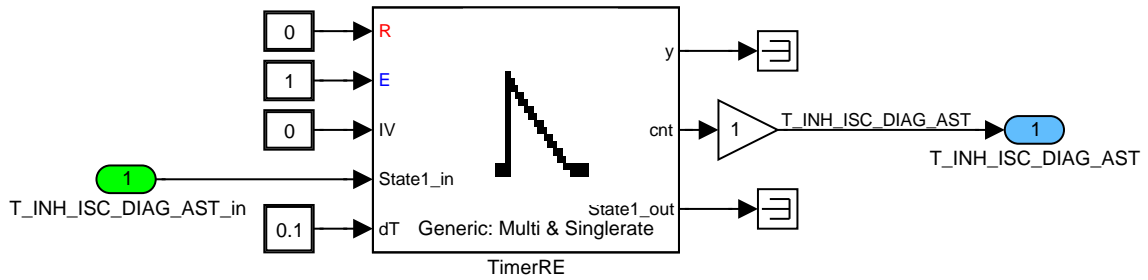


Figure A.39.9: ENSC\_MA09C/OPM/DEC\_TMR

**Checking of pre-condition**

The plausibility diagnosis is performed only if the pre conditions are fulfilled

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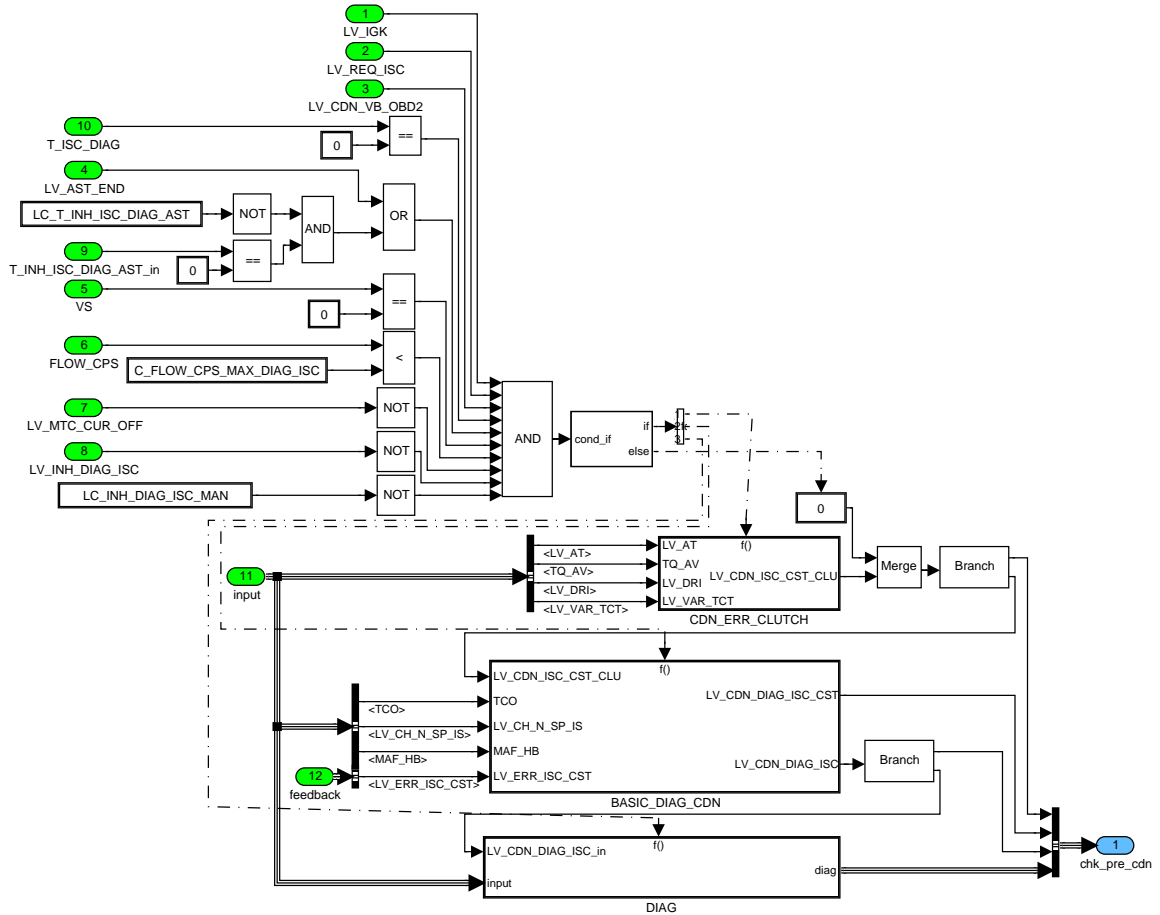


Figure A.39.10: ENSC\_MA09C/OPM/CHK\_PRE\_CDN

**Condition to check clutch error**

Condition to prevent error in case of clutch use

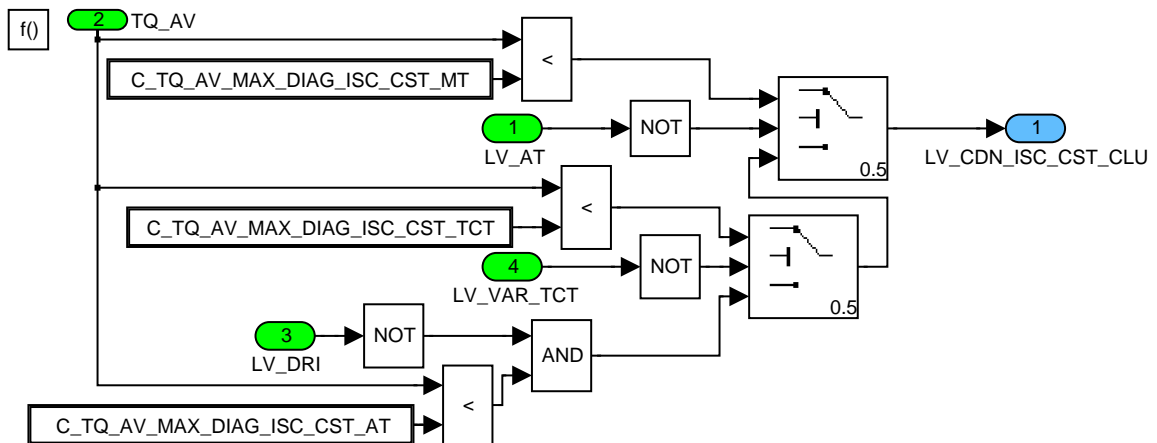


Figure A.39.11: ENSC\_MA09C/OPM/CHK\_PRE\_CDN/CDN\_ERR\_CLUTCH

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### Calculation of ERRM condition check

Calculation LV\_CDN\_DIAG\_ISC and LV\_CDN\_DIAG\_ISC\_CST is done here for diagnosis calculation part. of ERRM.

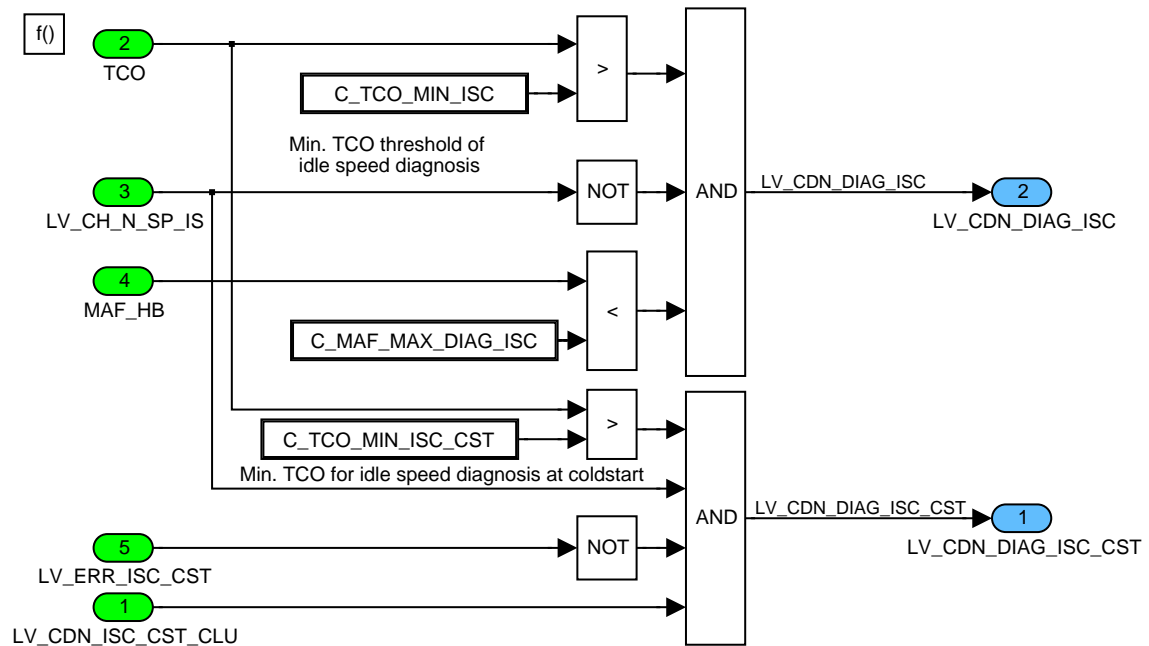


Figure A.39.12: ENSC\_MA09C/OPM/CHK\_PRE\_CDN/BASIC\_DIAG\_CDN

### ERRM diagnosis

#### Diagnosis at warmstart

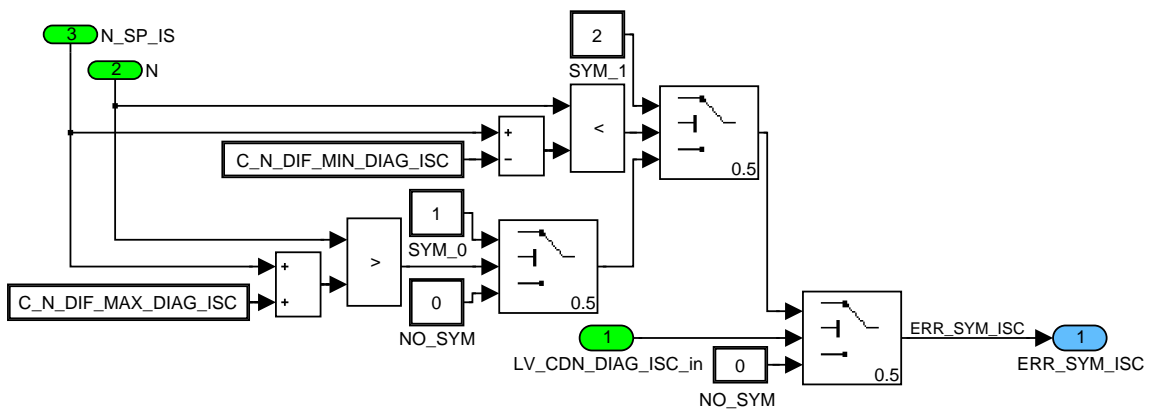


Figure A.39.13: ENSC\_MA09C/OPM/CHK\_PRE\_CDN/DIAG/WARMSTART

#### Diagnosis at coldstart

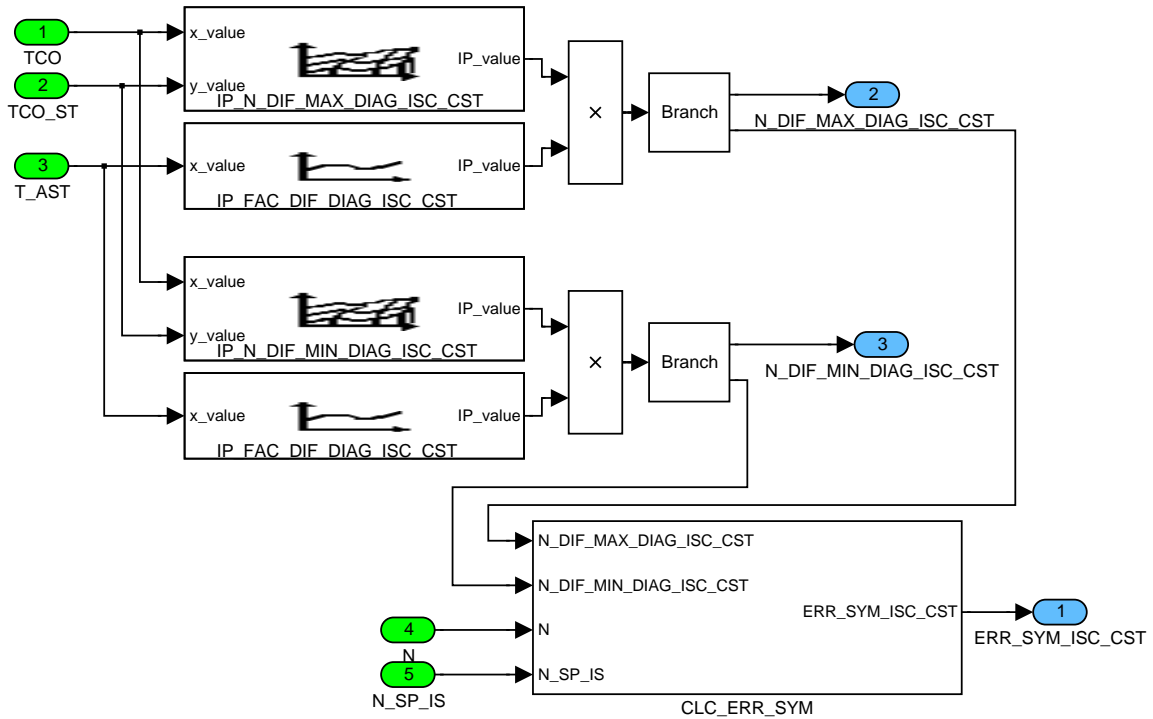


Figure A.39.14: ENSC\_MA09C/OPM/CHK\_PRE\_CDN/DIAG/COLDSTART

**Calculation of ERR\_SYM\_ISC\_CST**

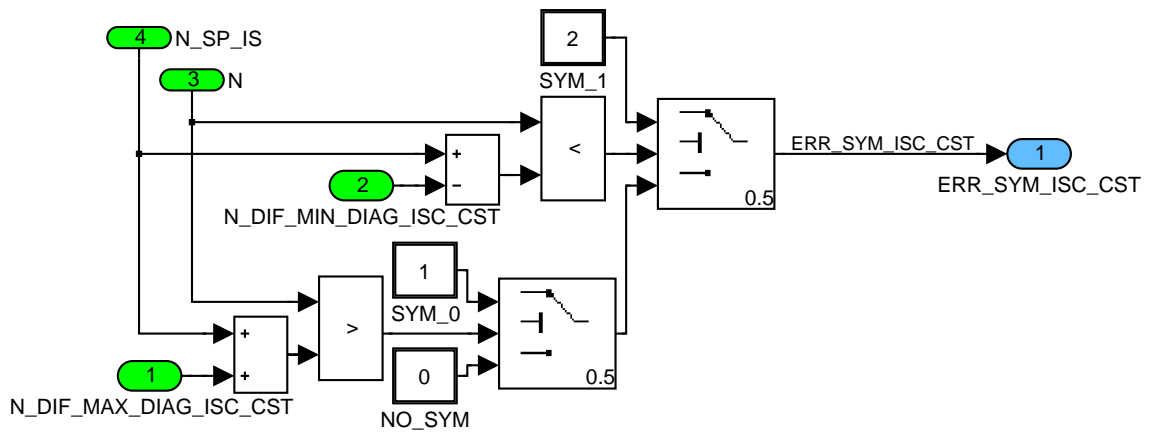


Figure A.39.15: ENSC\_MA09C/OPM/CHK\_PRE\_CDN/DIAG/COLDSTART/CLC\_ERR\_SYM

**ERRM interface 1**

LV\_ERR\_ISC and LV\_ERR\_ISC\_CST are terminated since they are in V/O mode. They will be calculated using the ERRM standard template for V/O mode ERRM variable.

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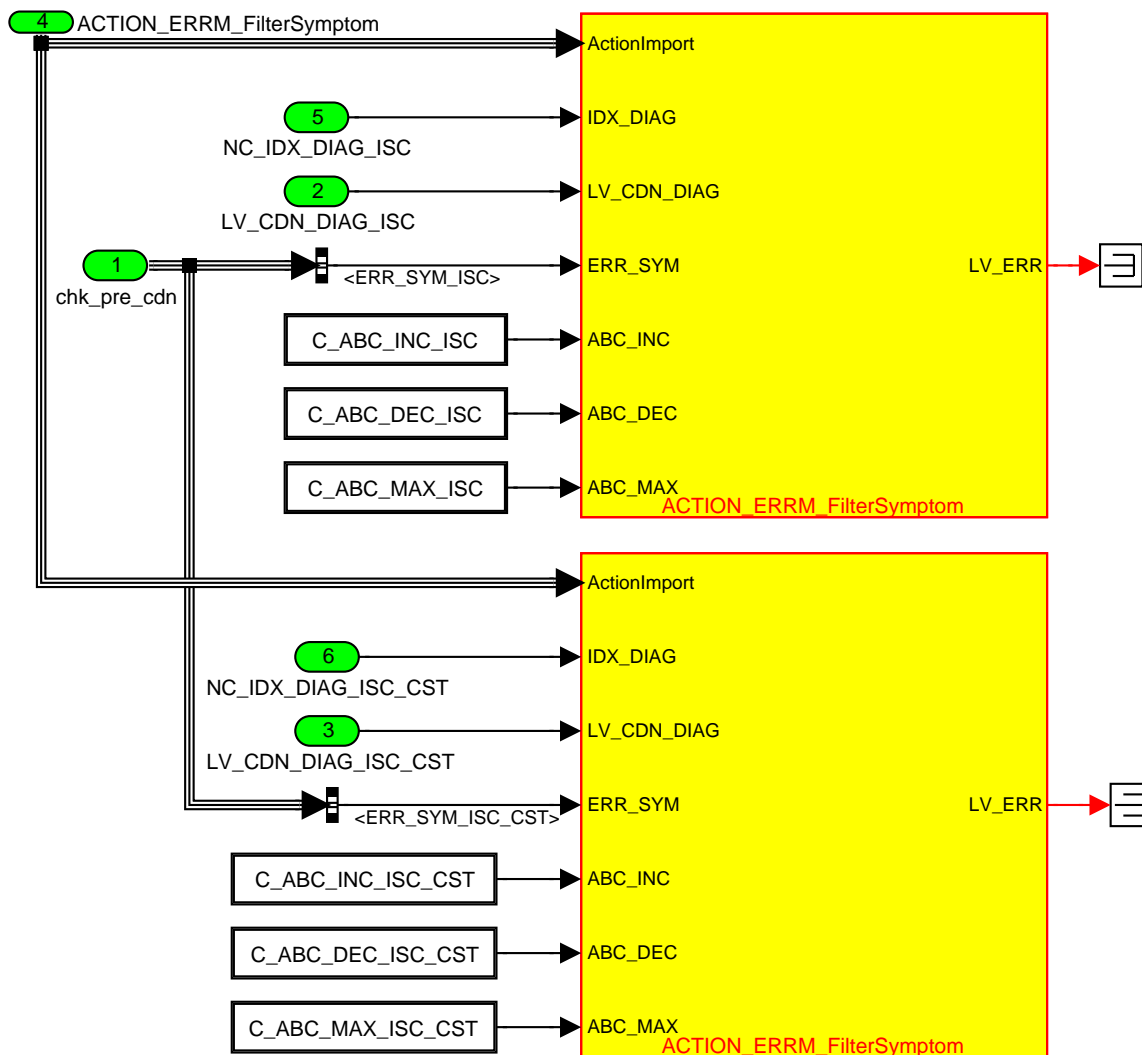


Figure A.39.16: ENSC\_MA09C/OPM/ERRM\_IF\_1

**ERRM interface to calculate V/O mode ERRM variables.**

V/O mode ERRM variables are calculated here.

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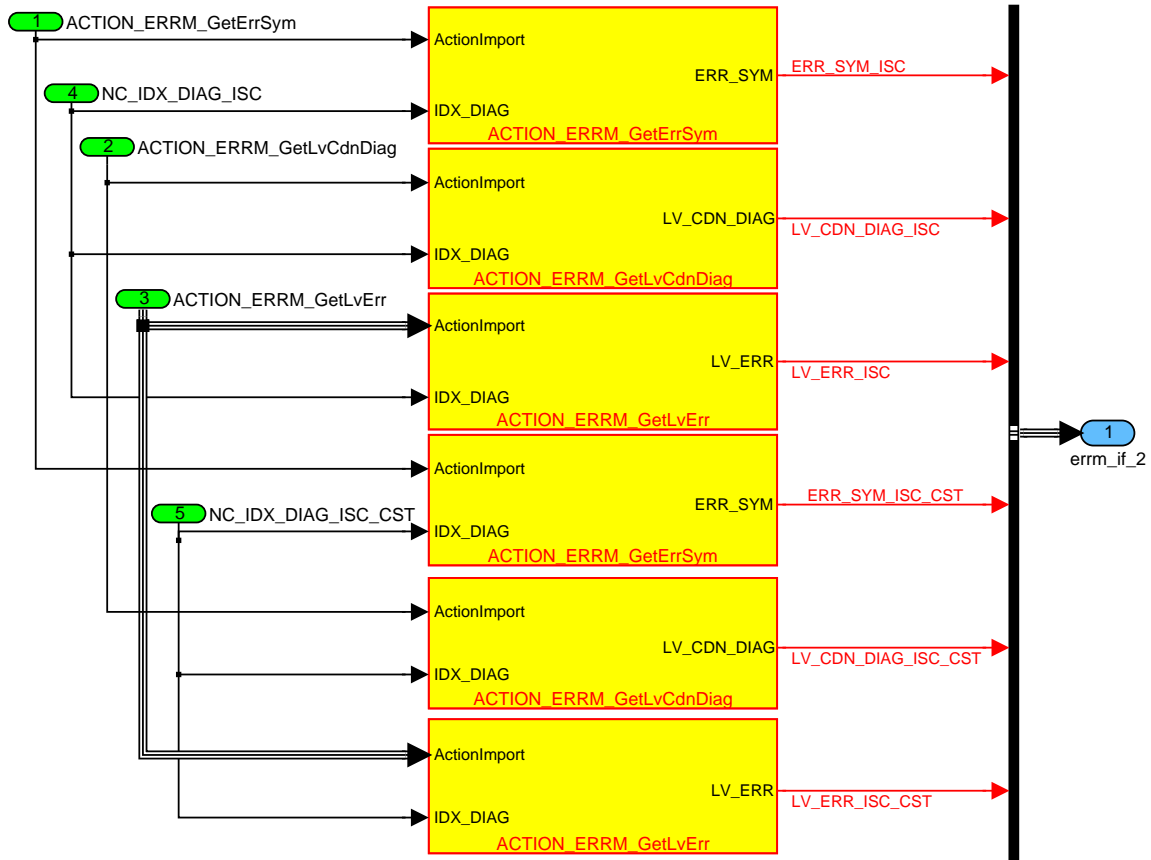


Figure A.39.17: ENSC\_MA09C/OPM/ERRM\_IF\_2

### A.39.4 Visual mode output

Visual mode output is calculated here.

#### Calculation of LV\_END\_DIAG\_ISC and LV\_END\_DIAG\_ISC\_CST using ERRM visual mode template

Calculation of LV\_END\_DIAG\_ISC and LV\_END\_DIAG\_ISC\_CST is done here.

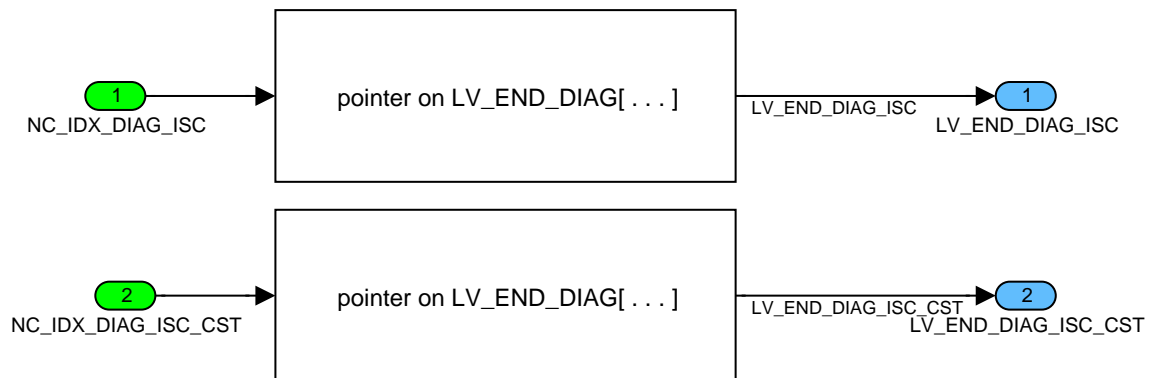


Figure A.39.18: ENSC\_MA09C/ERRM\_VIS\_OUT/CLC\_VIS\_OUT

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## A.40 Idle speed control diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_ISC	O/V	0... 1H	0 ...1	1	-
Flag for inhibition of the Idle Speed Control Diagnosis					
LV_INH_DIAG_RBM_ISC	O/V	0... 1H	0 ...1	1	-
Flag for inhibition of the Idle Speed Control Diagnosis if there is a OBD failure					
LV_MAF_SP_TQI_DYW_DIAG_ISC	O/V	0... 1H	0 ...1	1	-
Indication for limited dynamic condition - functional check ISC					
LV_T_MIN_IS_CH_CST	O/V	0... 1H	0 ...1	1	-
Boolean variable indicating minimum time in idle speed during catalyst heating					
MAF_SP_TQI_MMV_DIAG_ISC	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Moving mean value of MAF_SP_TQI (RAM cell) - functional check ISC					
STATE_RBM_ISC	O/V	0... 7H	0 ...7	1	-
Interface of ISC monitor with the Rate-Based Monitoring statistics Bit 0: conditions for monitoring are met long enough to detect malfunction (bit 0 = 1) Bit 1: inhibition of the monitor because of system failure(s) (bit 1 = 1) Bit 2: individual RBM condition					
STATE_RBM_ISC_CST	O/V	0... 7H	0 ...7	1	-
Interface of ISC_CST monitor with Rate-Based Monitoring statistics Bit 0: conditions for monitoring are met long enough to detect malfunction (bit 0 = 1) Bit 1: inhibition of the monitor because of system failure(s) (bit 1 = 1) Bit 2: individual RBM condition					
T_DLY_MAF_SP_TQI_DIAG_ISC	O/V	0... FFH	0... 25.5	0.1	s
Actual deactivation time after drop of limited dynamic condition					
T_IS_CH_CST	O/V	0... FFH	0... 25.5	0.1	s
Accumulated time in idle speed during CH					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_CH_N_SP_IS {p. 1775}	LV_DC {p. 5746}	LV_END_DIAG_ISC {p. 4377}
LV_END_DIAG_ISC_CST {p. 4377}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT] {p. 1061}
LV_ERR_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAM_CUS {p. 1042}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_DIAGCPS {p. 5926}
LV_ERR_EL_CPS {p. 4708}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}	LV_ERR_MAF {p. 4815}
LV_ERR_MAP_DIP_PLAUS {p. 1062}	LV_ERR_MAP_DIP_SENS {p. 4824}	LV_ERR_MAP_DIP_SHIFT {p. 4824}	LV_ERR_MAP_TPS_PLAUS {p. 1062}
LV_ERR_MEC_IVVT_EX {p. 1062}	LV_ERR_MEC_IVVT_IN {p. 1062}	LV_ERR_PVS_DOUBLE {p. 4216}	LV_ERR_SLV_IVVT_EX {p. 4627}
LV_ERR_SLV_IVVT_IN {p. 4627}	LV_ERR_TPS {p. 4982}	LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_BOL {p. 4951}




LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_TPS_ST_CHK_1 {p. 4951}	LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_VCV {p. 4729}
LV_ERR_VS {p. 5021}	LV_IGK {p. 906}	LV_IS {p. 1720}	LV_ST_END {p. 1720}
LV_TQ_ISC_I_TQ_PST {p. 3440}	MAF_SP_TQI {p. 8390}	NC_IDX_DIAG_AMP	NC_IDX_DIAG_AMP_PLAUS
NC_IDX_DIAG_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	NC_IDX_DIAG_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	NC_IDX_DIAG_CHG_LS_UP	NC_IDX_DIAG_CRK_PLAUS
NC_IDX_DIAG_CRK_SYN	NC_IDX_DIAG_CRK_TOOTH	NC_IDX_DIAG_CRK_TOOTH_PER	NC_IDX_DIAG_DIAGCPS
NC_IDX_DIAG_EL_CPS	NC_IDX_DIAG_FUP	NC_IDX_DIAG_FUP_MFP_PLAUS	NC_IDX_DIAG_FUP_ORNG
NC_IDX_DIAG_FUP_ST	NC_IDX_DIAG_H_PRS_SYS {p. 989}	NC_IDX_DIAG_LOAD_TPS_PLAUS	NC_IDX_DIAG_MAF
NC_IDX_DIAG_MAP_DIP_PLAUS	NC_IDX_DIAG_MAP_DIP_SENS	NC_IDX_DIAG_MAP_DIP_SHIFT	NC_IDX_DIAG_MEC_IVVT_EX [NC_NR_CBK_IVVT]
NC_IDX_DIAG_MEC_IVVT_IN [NC_NR_CBK_IVVT]	NC_IDX_DIAG_MTC_CTL_2	NC_IDX_DIAG_MTC_CTL_3	NC_IDX_DIAG_MTC_DR
NC_IDX_DIAG_PER_CAM_EX_1	NC_IDX_DIAG_PER_CAM_IN_1	NC_IDX_DIAG_PLAUS_CAM_EX_1	NC_IDX_DIAG_PLAUS_CAM_IN_1
NC_IDX_DIAG_PVS_DOUBLE	NC_IDX_DIAG_REF_CRK_CAM_EX_1	NC_IDX_DIAG_REF_CRK_CAM_IN_1	NC_IDX_DIAG_SLV_IVVT_EX [NC_NR_CBK_IVVT]
NC_IDX_DIAG_SLV_IVVT_IN [NC_NR_CBK_IVVT]	NC_IDX_DIAG_SYN_CAM_EX_1	NC_IDX_DIAG_SYN_CAM_IN_1	NC_IDX_DIAG_SYN_CRK_CAM_EX_1
NC_IDX_DIAG_SYN_CRK_CAM_IN_1	NC_IDX_DIAG_TOOTH_OFF_EX_1	NC_IDX_DIAG_TOOTH_OFF_IN_1	NC_IDX_DIAG_TPS_1
NC_IDX_DIAG_TPS_2	NC_IDX_DIAG_TPS_AD	NC_IDX_DIAG_TPS_AD_BOL	NC_IDX_DIAG_TPS_MAF_1
NC_IDX_DIAG_TPS_MAF_2	NC_IDX_DIAG_TPS_RATIO	NC_IDX_DIAG_TPS_ST_CHK_2	NC_IDX_DIAG_VCV
NC_IDX_DIAG_VS {p. 5024}	NC_NR_CBK_IVVT {p. 604}	STATE_CH {p. 1777}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_MAF_SP_TQI_DIAG_ISC	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation constant for calculation of MAF_SP_TQI_MMV_DIAG_ISC					

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 4393 of 8404	
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_MAF_SP_TQI_DIAG_ISC_CST	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation constant of MAF_SP_TQI_MMV_DIAG_ISC during coldstart monitoring					
C_MAF_SP_TQI_DYW_DIAG_ISC	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Dynamic window around MAF_SP_TQI_MMV_DIAG_ISC					
C_MAF_SP_TQI_DYW_DIAG_ISC_CST	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Dynamic window around MAF_SP_TQI_MMV_DIAG_ISC at coldstart					
C_T_DLY_MAF_SP_TQI_DIAG_ISC	-	0... FFH	0... 25.5	0.1	s
Deactivation time after drop of limited dynamic					
C_T_IS_RBM_ISC	-	0... FFH	0... 25.5	0.1	s
RBM Diagnose threshold for the time since state idle active					

### Import actions:

<b>ACTION_ERRM_CheckPendingStatus (IN&lt;PRM_IDX_DIAG&gt;,OUT&lt;PRM_LV_ERR_PND&gt;)</b>
--

### Overview

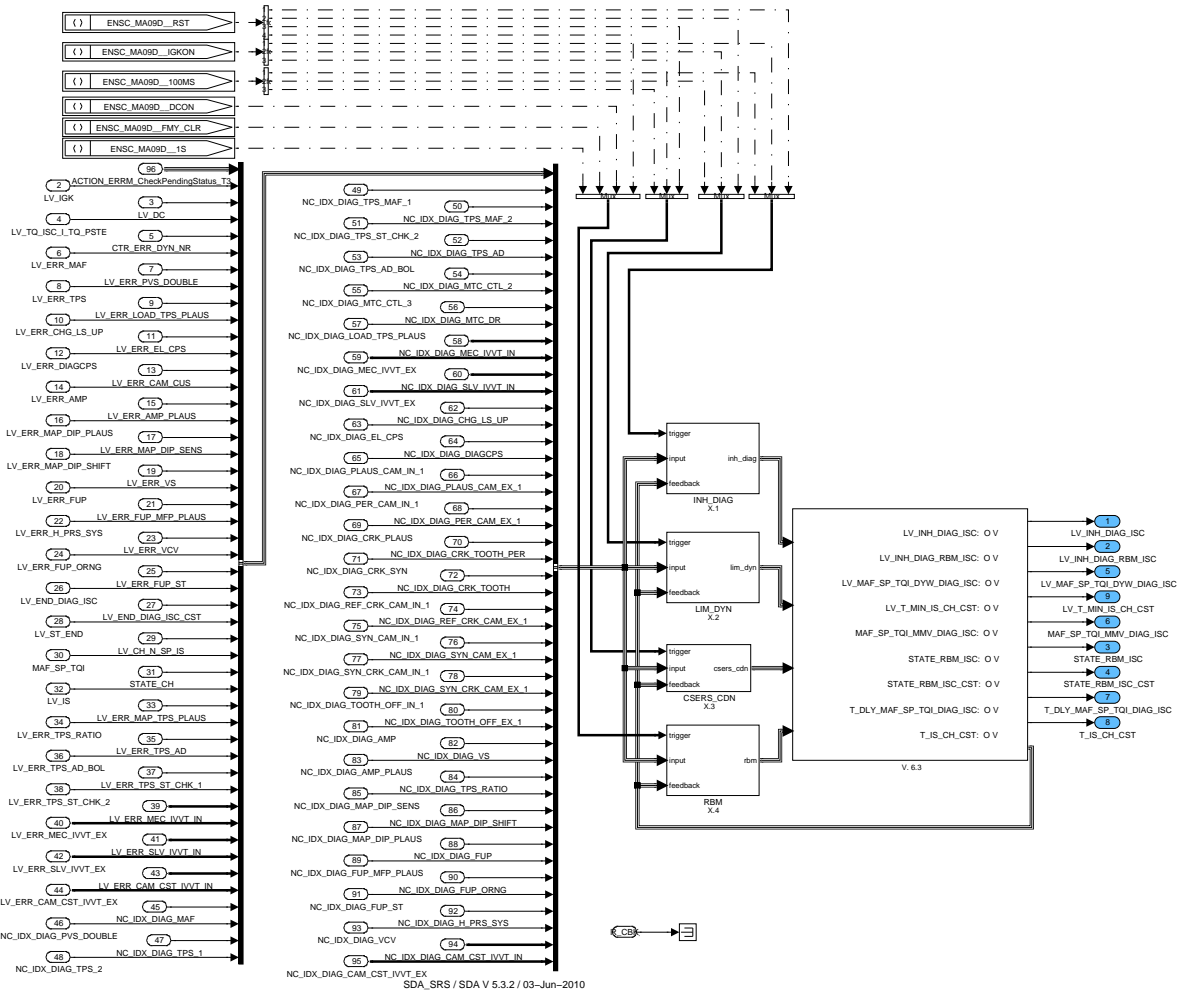


Figure A.40.1: :

**General Information**

**A.40.1 Inhibition of diagnoses**

**Description:**


If one of the following components fail, the ISC diagnoses is stopped by LV\_INH\_DIAG\_ISC = 1. The RBM of ISC diagnoses is stopped by LV\_INH\_DIAG\_RBM\_ISC = 1.

**Application Conditions**

- Initialization: RST, IGKON
- Recurrence: 100MS
- Activation: LV\_IGK==1
- Deactivation: never

**Function description**

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	Document key 10171571 SPE 000 AO	Pages Page 4395 of 8404	
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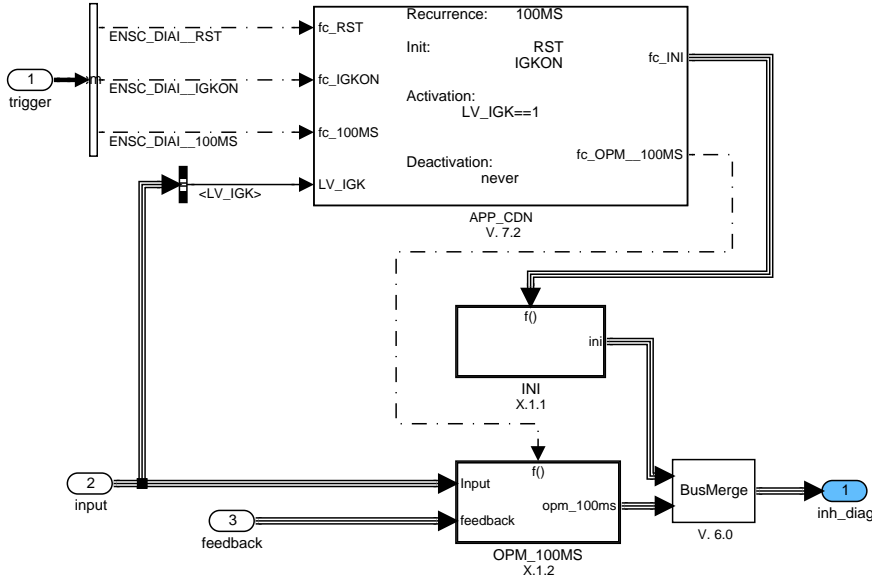


Figure A.40.2: :

**A.40.1.1 Initialization at Reset and Ignition Key off to on**

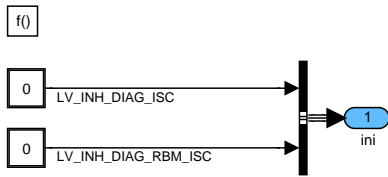


Figure A.40.3: :

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### A.40.1.2 Calculation at 100ms recurrence

#### A.40.1.2.1 Inhibition due to OBD1 error

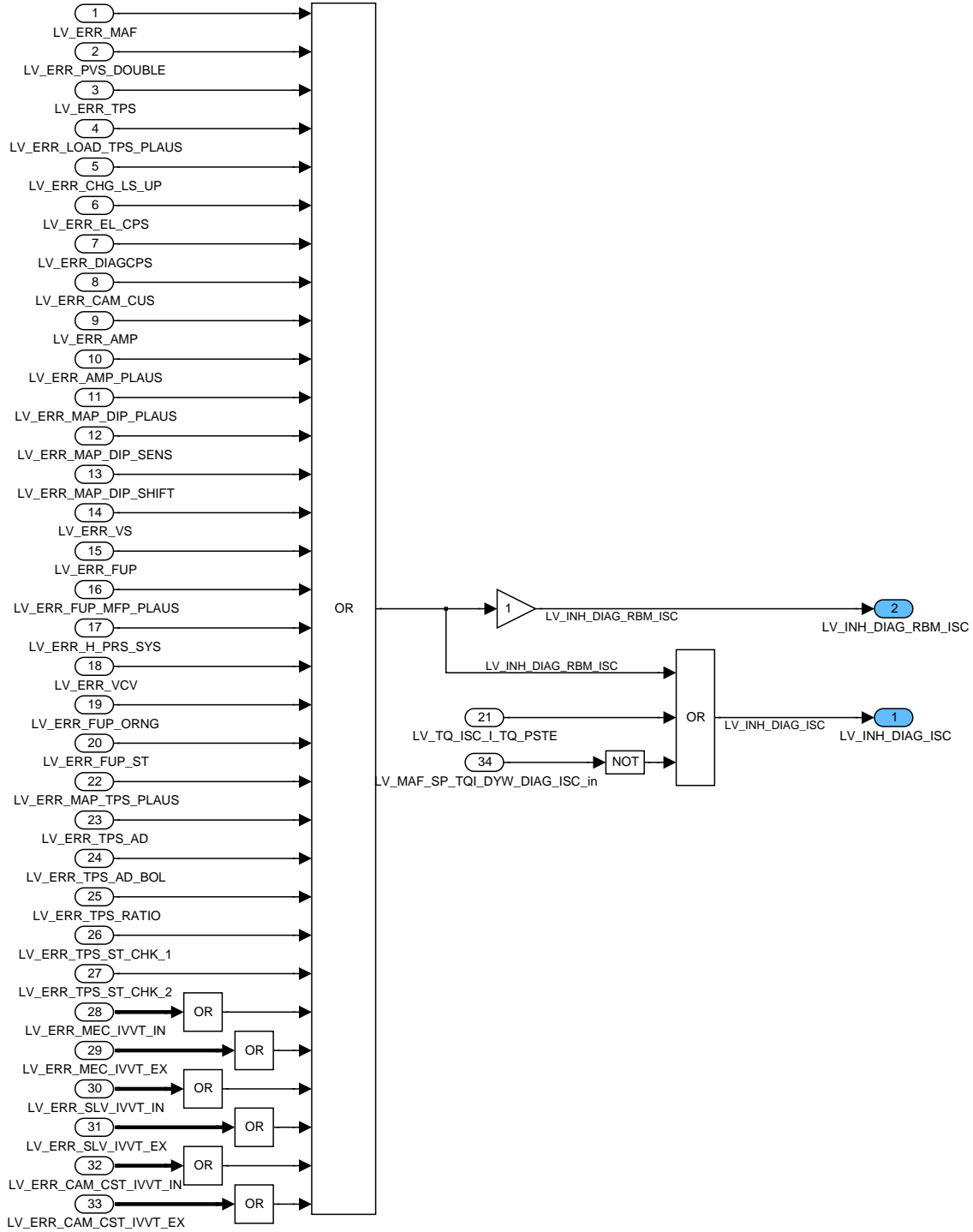


Figure A.40.4: :

### A.40.2 Limited dynamic condition LV\_MAF\_SP\_TQI\_DYW\_DIAG\_ISC

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**Application Conditions**

Initialization: RST, IGKON  
 Recurrence: 100MS  
 Activation: LV\_ST\_END==1  
 Deactivation: LV\_ST\_END==0

**Function description**

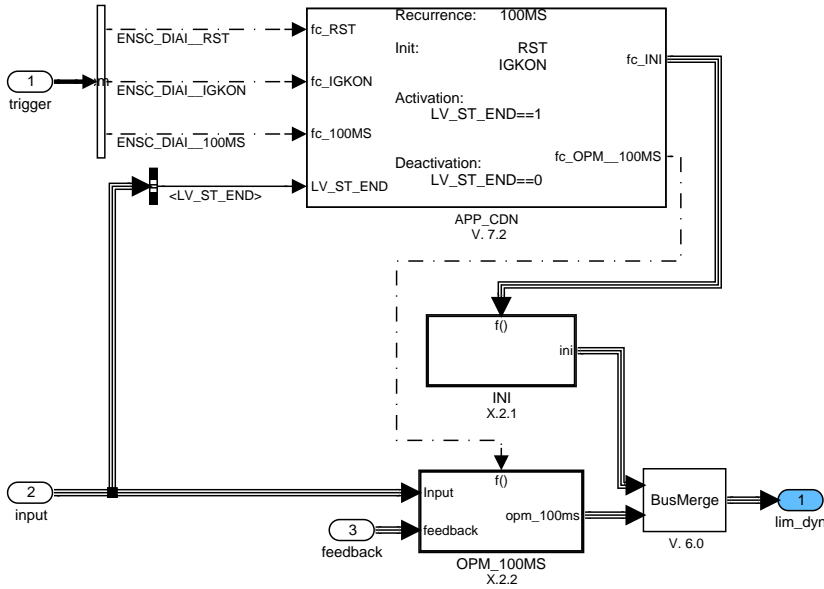


Figure A.40.5: :

**A.40.2.1 Initialization at Reset and Ignition Key off to on**

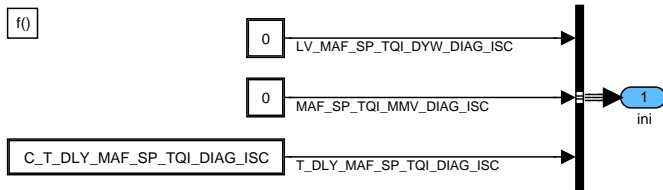


Figure A.40.6: :

**A.40.2.2 Calculation at 100ms recurrence**

Calculation of MAF\_SP\_TQI\_MMV\_DIAG\_ISC:

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**A.40.2.2.1 No title given**

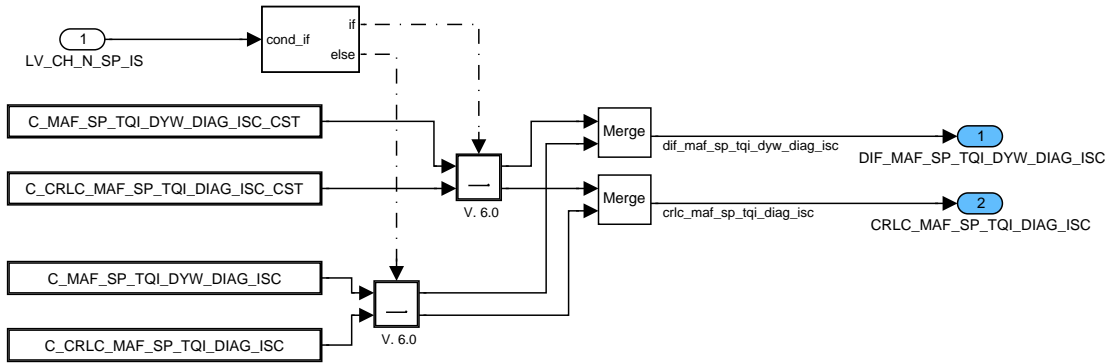


Figure A.40.7: :

**A.40.2.2.2 No title given**

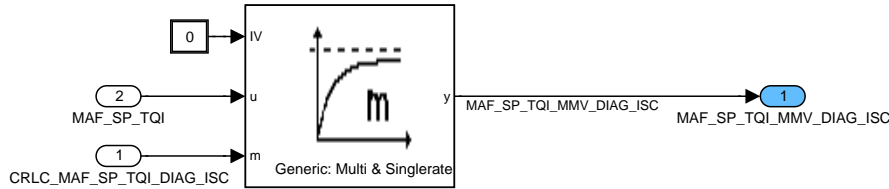


Figure A.40.8: :

**A.40.2.2.3 No title given**

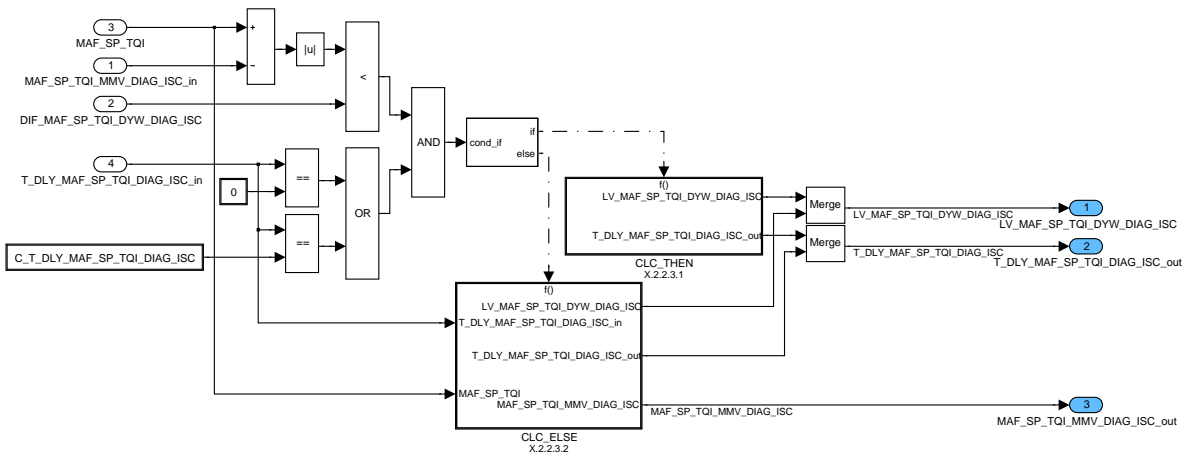


Figure A.40.9: :

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**A.40.2.2.3.1 No title given**

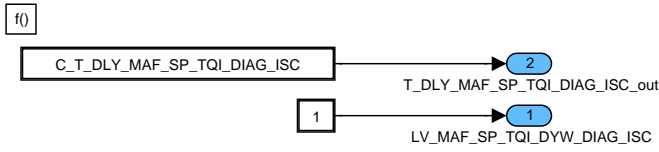


Figure A.40.10: :

**A.40.2.2.3.2 No title given**

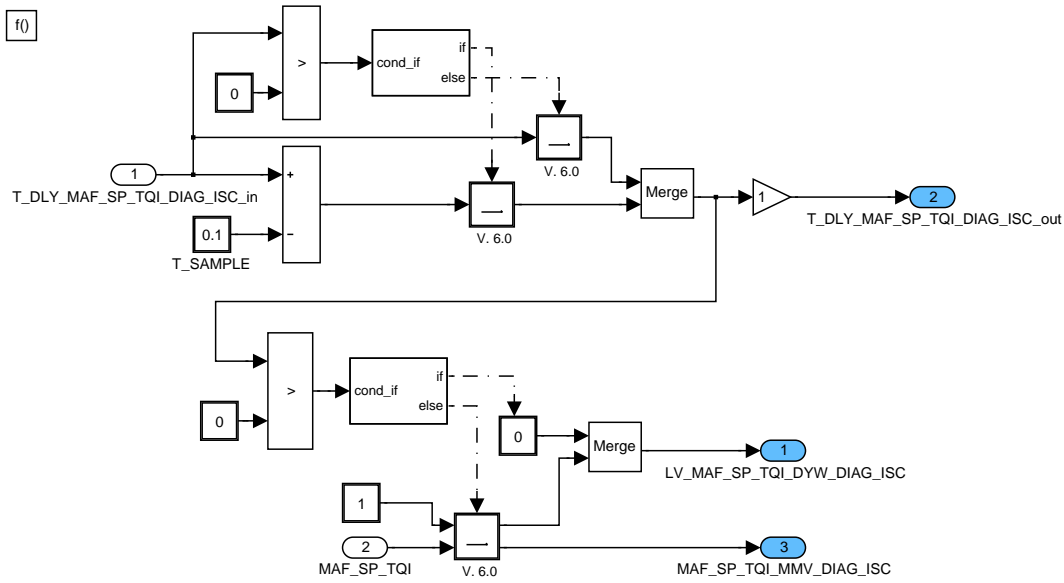


Figure A.40.11: :

**A.40.3 Calculation of STATE\_RBM\_ISC\_CST denominator individual condition.**

**Application Conditions**

Initialization: RST, IGKON


Recurrence: 100MS

Activation: LV\_IGK==1 & LV\_T\_MIN\_IS\_CH\_CST==0

Deactivation: LV\_IGK==0 | LV\_T\_MIN\_IS\_CH\_CST==1

**Function description**

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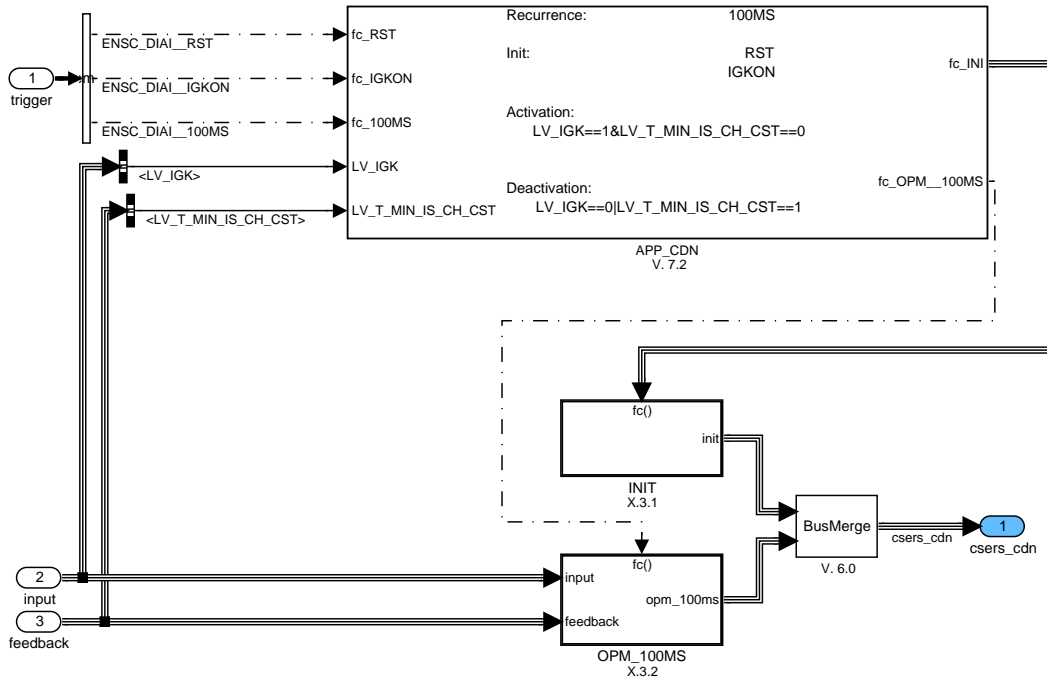


Figure A.40.12: :

### A.40.3.1 Initialization

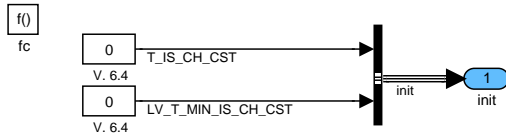


Figure A.40.13: :

### A.40.3.2 Calculation at 100 ms recurrence

#### A.40.3.2.1 Calculation

For the special CSERS denomination of the idle speed control diagnosis under cold start conditions the accumulated time in state "catalyst heating" in keeping with "cold start idle speed setpoint active" is calculated here. The timer is only reset with the start of a new driving cycle.

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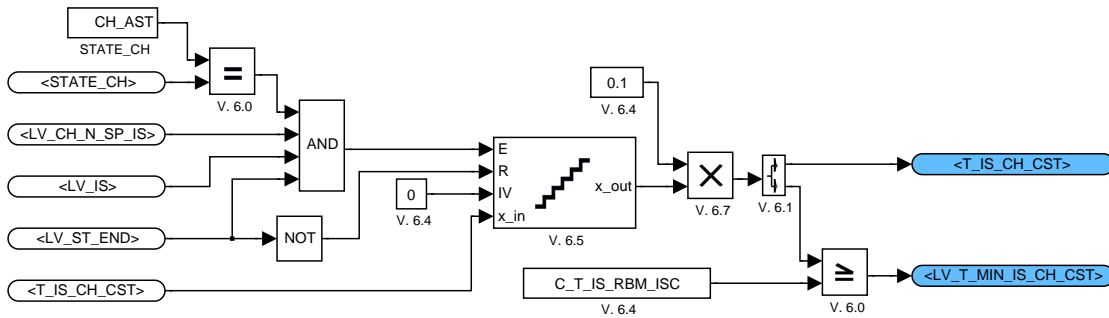


Figure A.40.14: :

## A.40.4 Interface for Rate - Based - Monitoring

### General Information:

With this module the interface between the ISC /ISC\_CST monitor and the rate based monitoring statistics is defined with STATE\_RBM\_ISC /STATE\_RBM\_ISC\_CST data. Within STATE\_RBM\_ISC /ISC\_CST, three different information are defined:

Conditions for monitoring are met long enough to detect manipulation (bit 0) (no intrusive operation, no short trip)

Monitor disabled because of system malfunction (bit 1) (depending on failure status: pending)

Monitor individual RBM conditions encountered within this DC(bit 2) (not valid for ISC daignosis)

### Application Conditions

Initialization: RST, CLRFBMY, DCON

Recurrence: 1S

Activation: LV\_DC==1

Deactivation: LV\_DC==0

### Function description

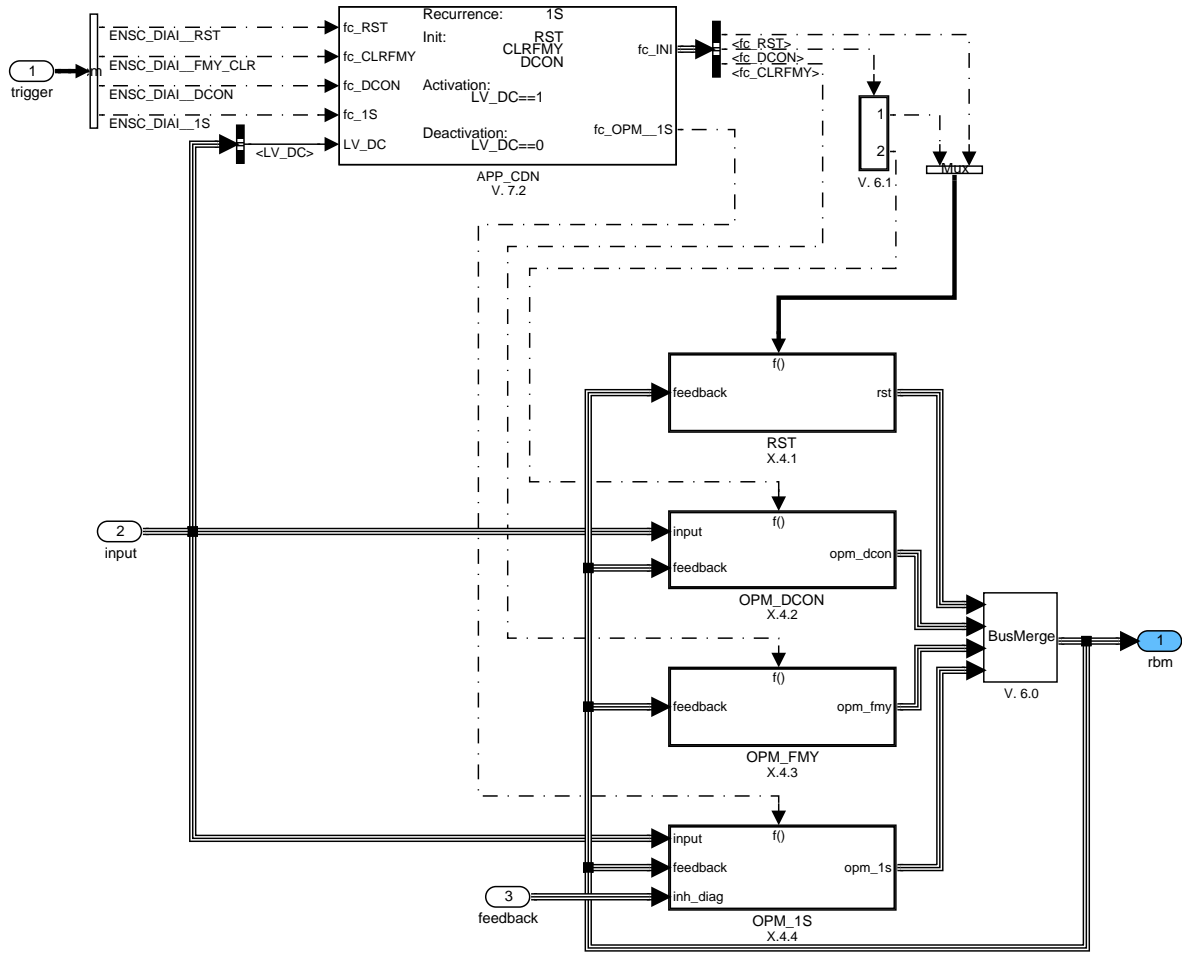


Figure A.40.15: :

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### A.40.4.1 Initialization at Reset

#### A.40.4.1.1 No title given

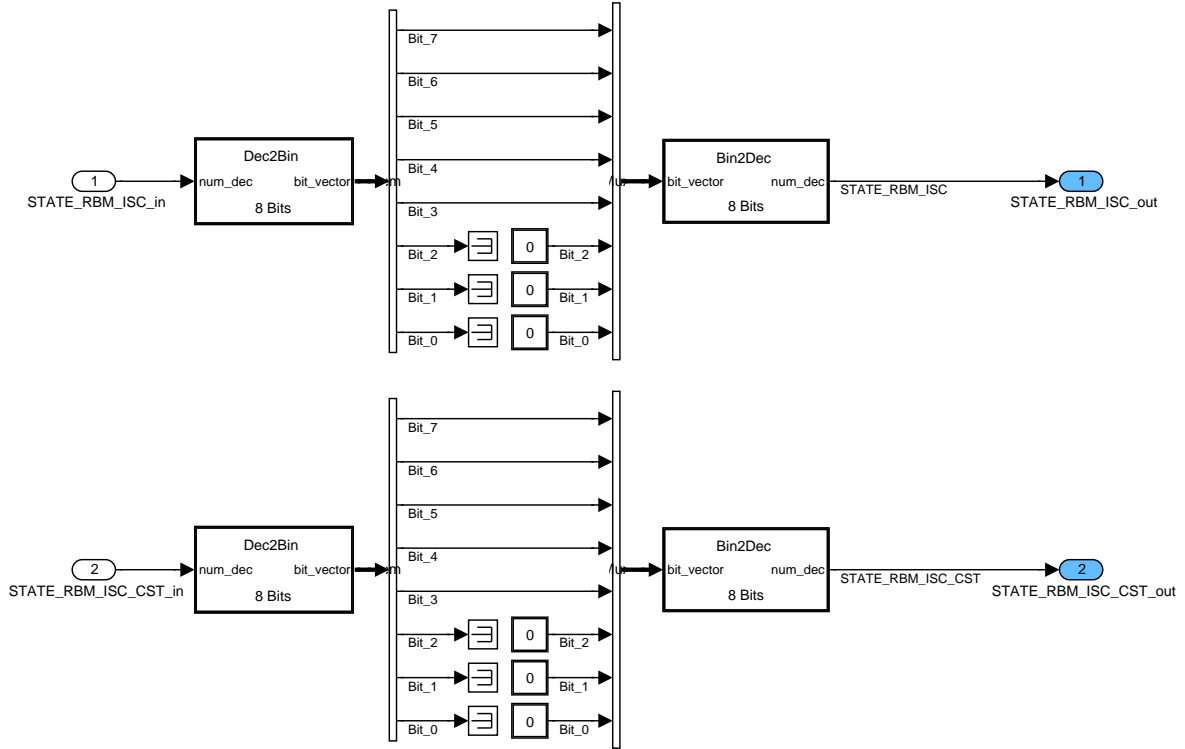


Figure A.40.16: :

### A.40.4.2 At LV\_DC 0 to 1 transition

The pending status of the following failures has to be checked only once :

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LV_ERR_MAF	LV_ERR_PVS_DOUBLE	LV_ERR_TPS_1	LV_ERR_TPS_2
LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2	LV_ERR_TPS_ST_CHK_2	LV_ERR_TPS_AD
LV_ERR_TPS_AD_BOL	LV_ERR_MTC_CTL_2	LV_ERR_MTC_CTL_3	LV_ERR_MTC_DR
LV_ERR_LOAD_TPS_PLAUS	LV_ERR_MEC_IVVT_IN	LV_ERR_MEC_IVVT_EX	LV_ERR_SLV_IVVT_IN
LV_ERR_SLV_IVVT_EX	LV_ERR_CHG_LS_UP	LV_ERR_EL_CPS	LV_ERR_DIAGCPS
LV_ERR_PLAUS_CAM_IN_1	LV_ERR_PLAUS_CAM_EX_1	LV_ERR_PER_CAM_IN_1	LV_ERR_PER_CAM_EX_1
LV_ERR_CRK_PLAUS	LV_ERR_CRK_TOOTH_PERR	LV_ERR_CRK_SYN	LV_ERR_CRK_TOOTH
LV_ERR_REF_CRK_CAM_IN_1	LV_ERR_REF_CRK_CAM_EX_1	LV_ERR_SYN_CAM_IN_1	LV_ERR_SYN_CAM_EX_1
LV_ERR_SYN_CRK_CAM_IN_1	LV_ERR_SYN_CRK_CAM_EX_1	LV_ERR_TOOTH_OFF_IN_1	LV_ERR_TOOTH_OFF_EX_1
LV_ERR_AMP	LV_ERR_VS	LV_ERR_AMP_PLAUS	LV_ERR_TPS_RATIO
LV_ERR_MAP_DIP_SENS	LV_ERR_MAP_DIP_SHIFT	LV_ERR_MAP_DIP_PLAUS	LV_ERR_FUP
LV_ERR_FUP_MFP_PLAUS	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_SYS
LV_ERR_VCV	LV_ERR_MAP_TPS_PLAUS	LV_ERR_CAM_CST_IVVT_IN	LV_ERR_CAM_CST_IVVT_EX

**A.40.4.2.1 No title given**

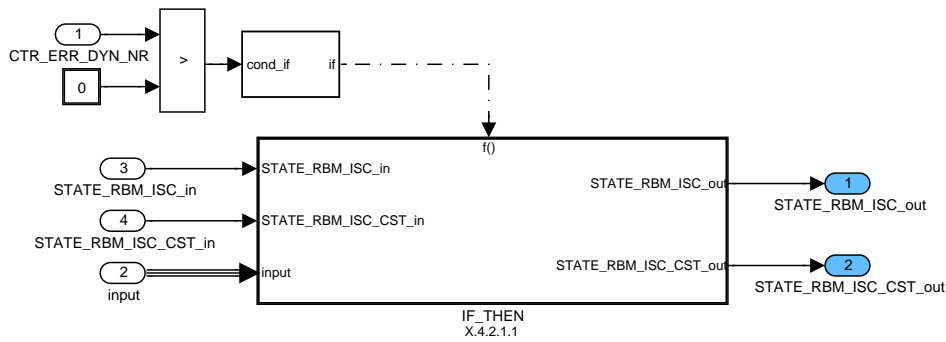


Figure A.40.17: :

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**A.40.4.2.1.1 No title given**

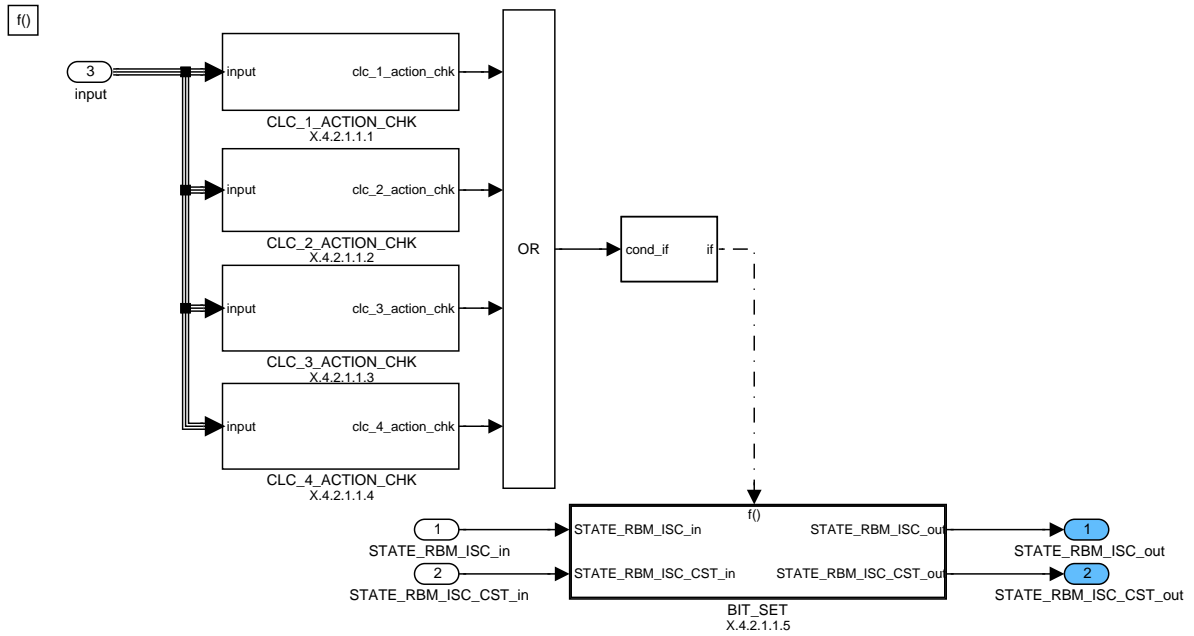


Figure A.40.18: :

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**A.40.4.2.1.1.1 No title given**

**A.40.4.2.1.1.1.1 No title given**

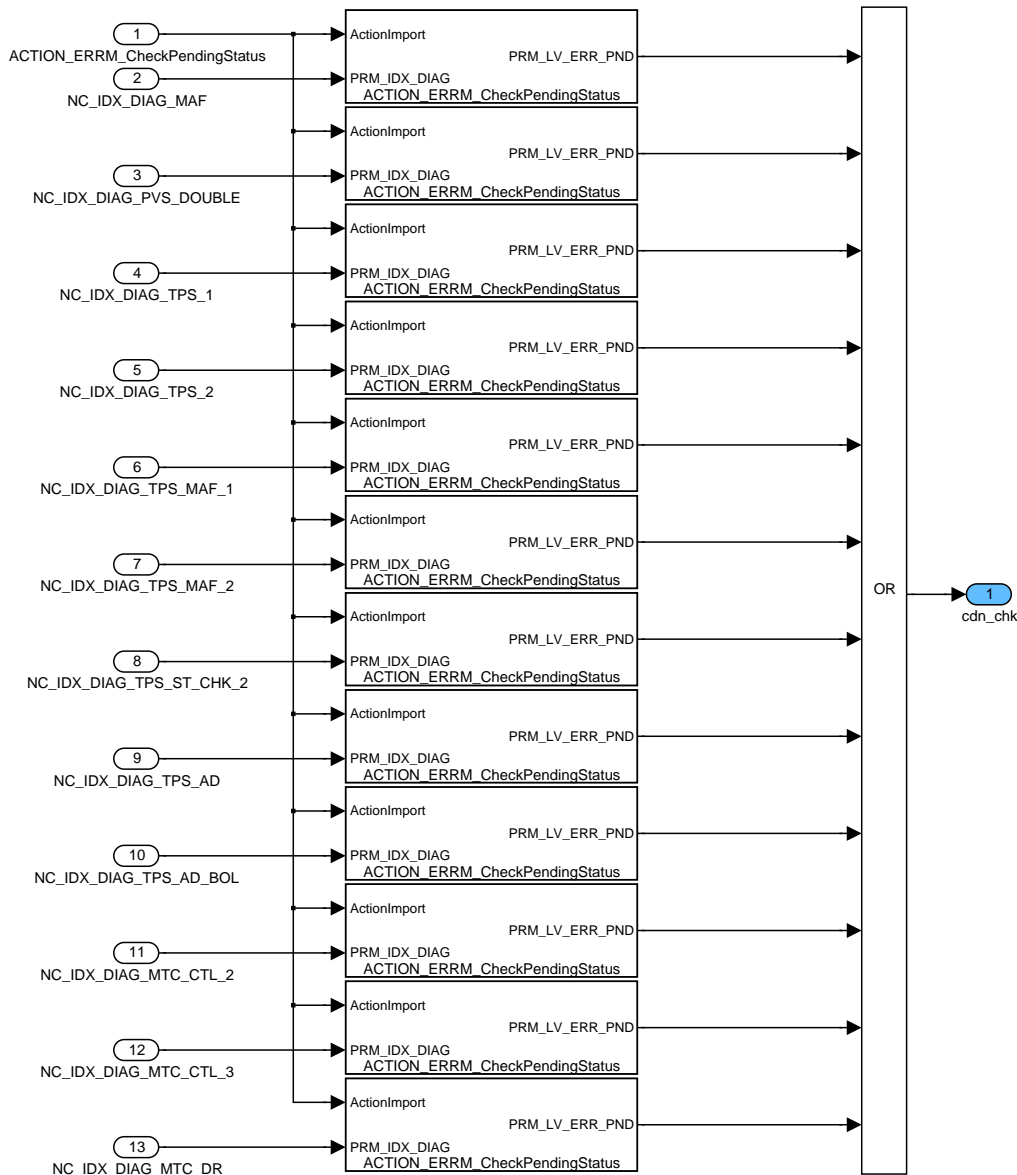


Figure A.40.19: :

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**A.40.4.2.1.1.2 No title given**

**A.40.4.2.1.1.2.1 No title given**

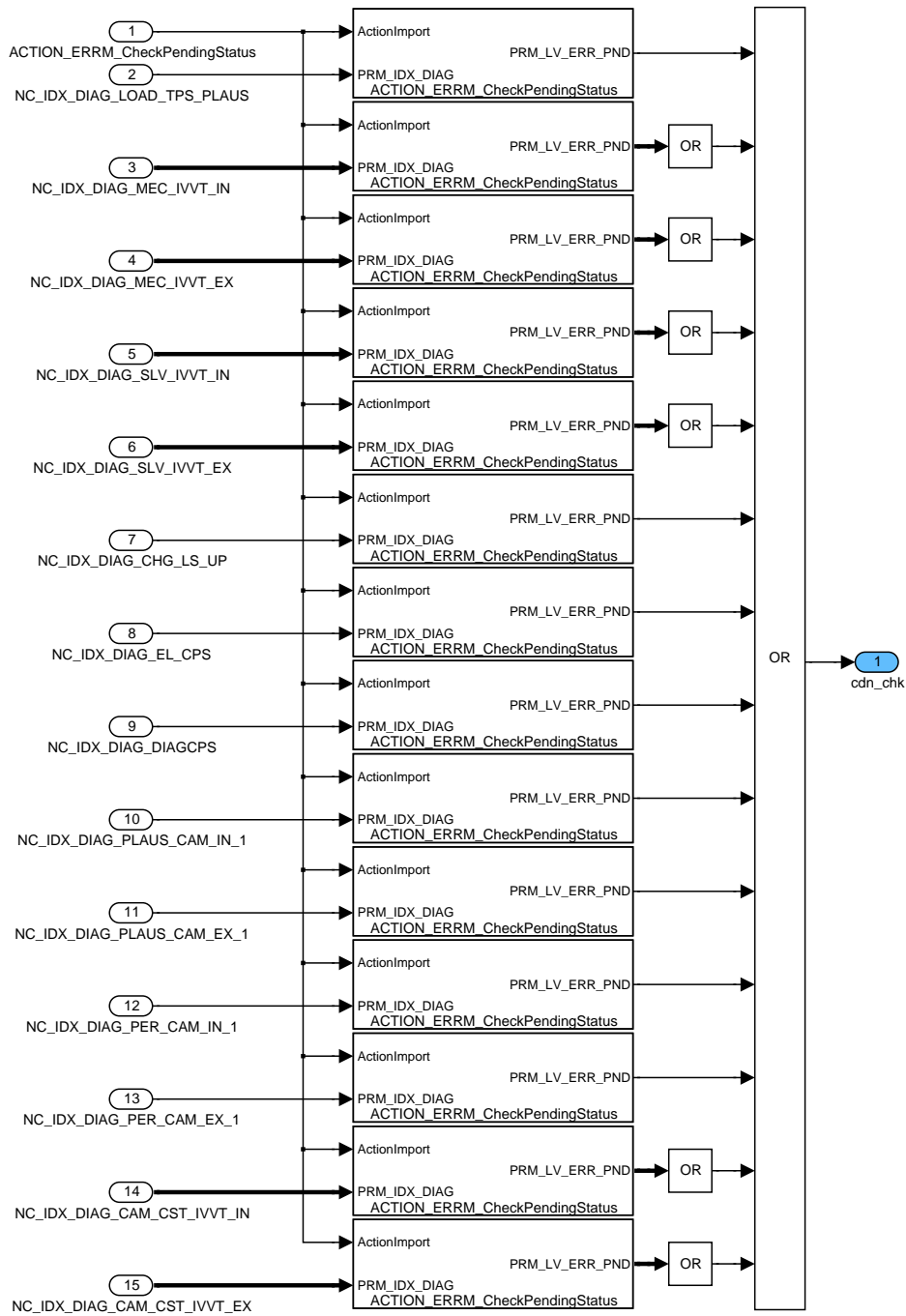


Figure A.40.20: :

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**A.40.4.2.1.1.3 No title given**

**A.40.4.2.1.1.3.1 No title given**

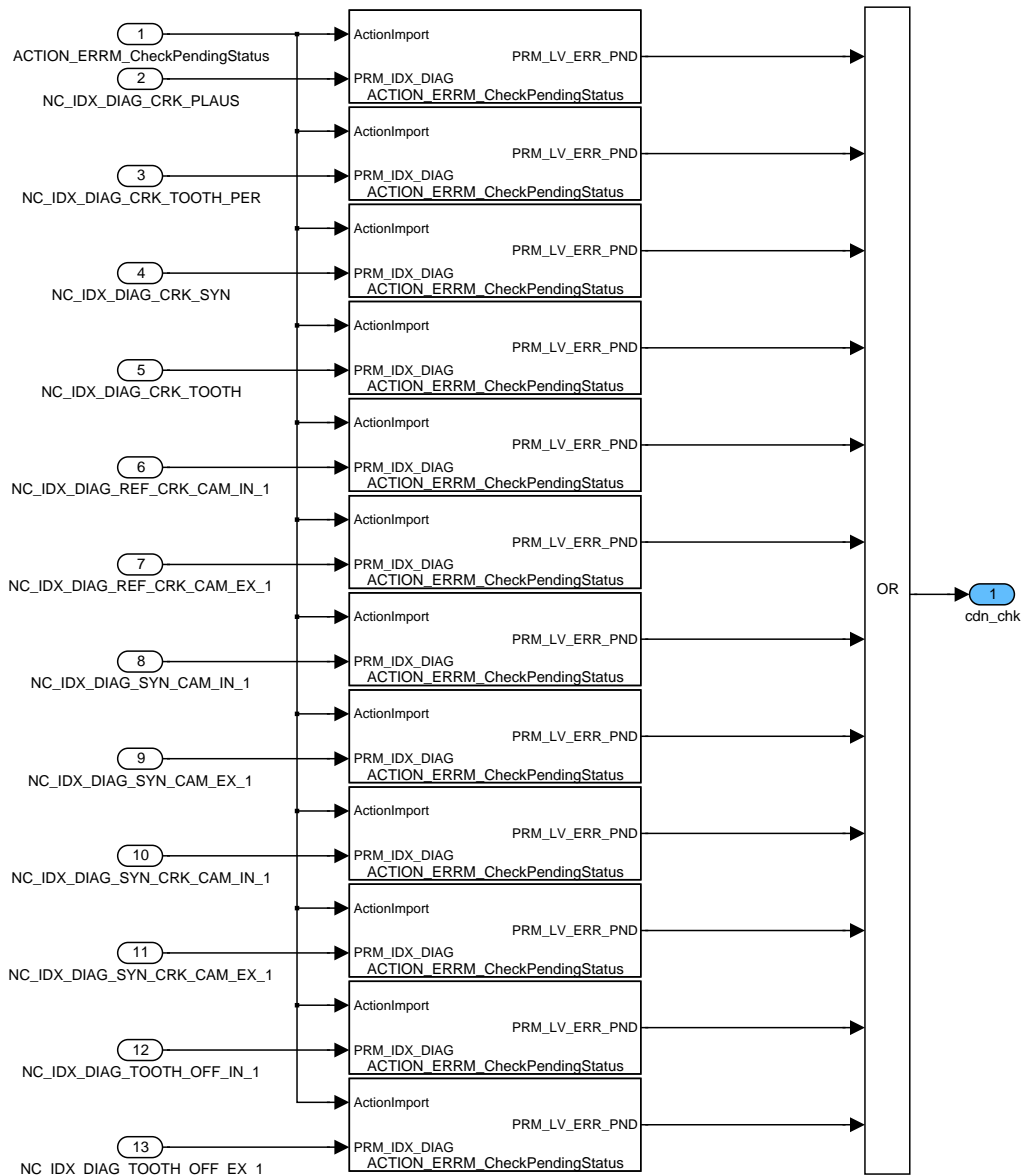


Figure A.40.21: :

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**A.40.4.2.1.1.4 No title given**

**A.40.4.2.1.1.4.1 No title given**

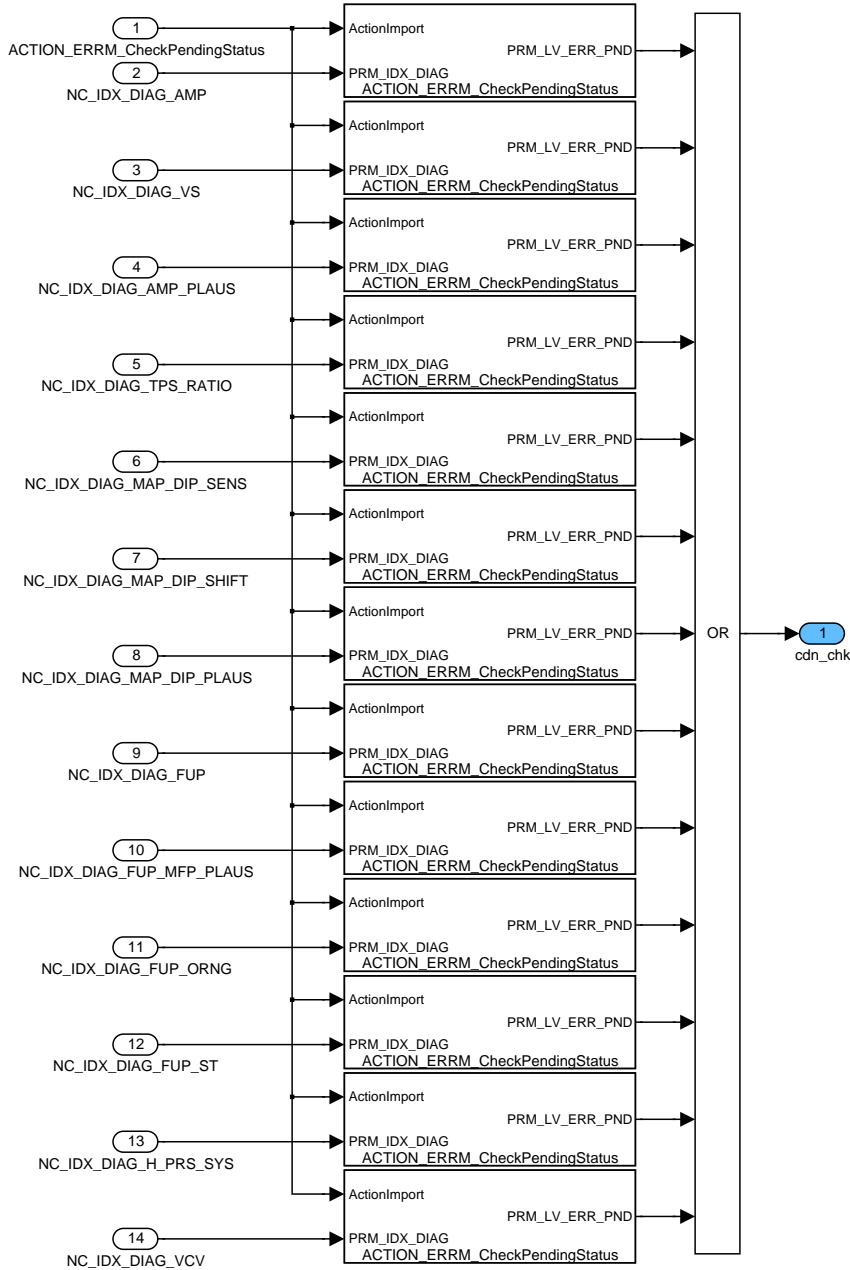


Figure A.40.22: :

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### A.40.4.2.1.1.5 No title given

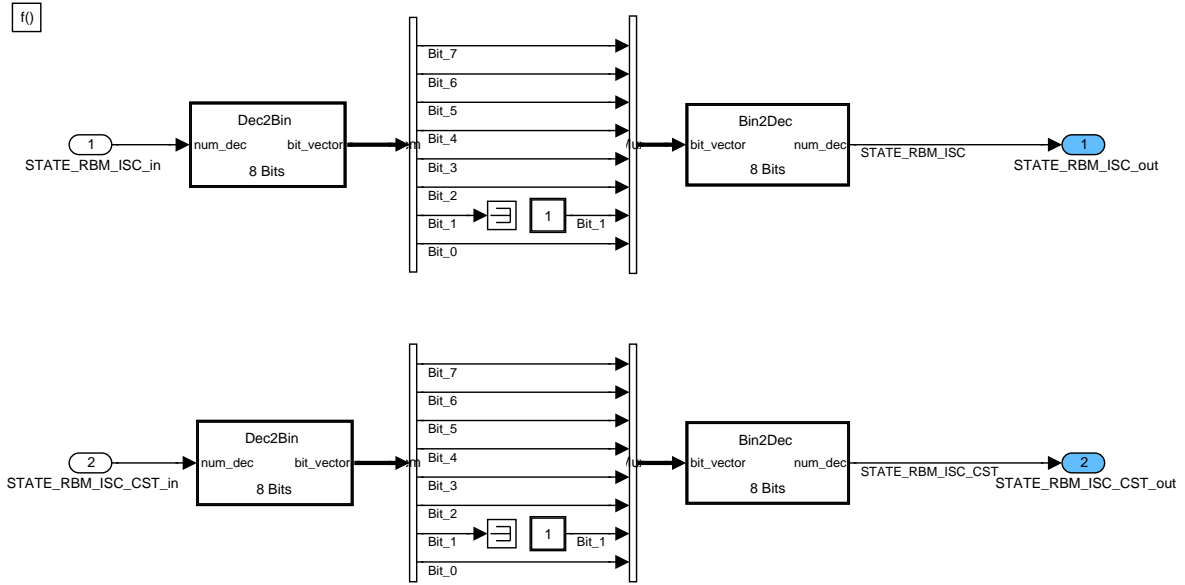


Figure A.40.23: :

### A.40.4.3 Initialization at LV\_DC 0 to 1 transition

#### A.40.4.3.1 No title given

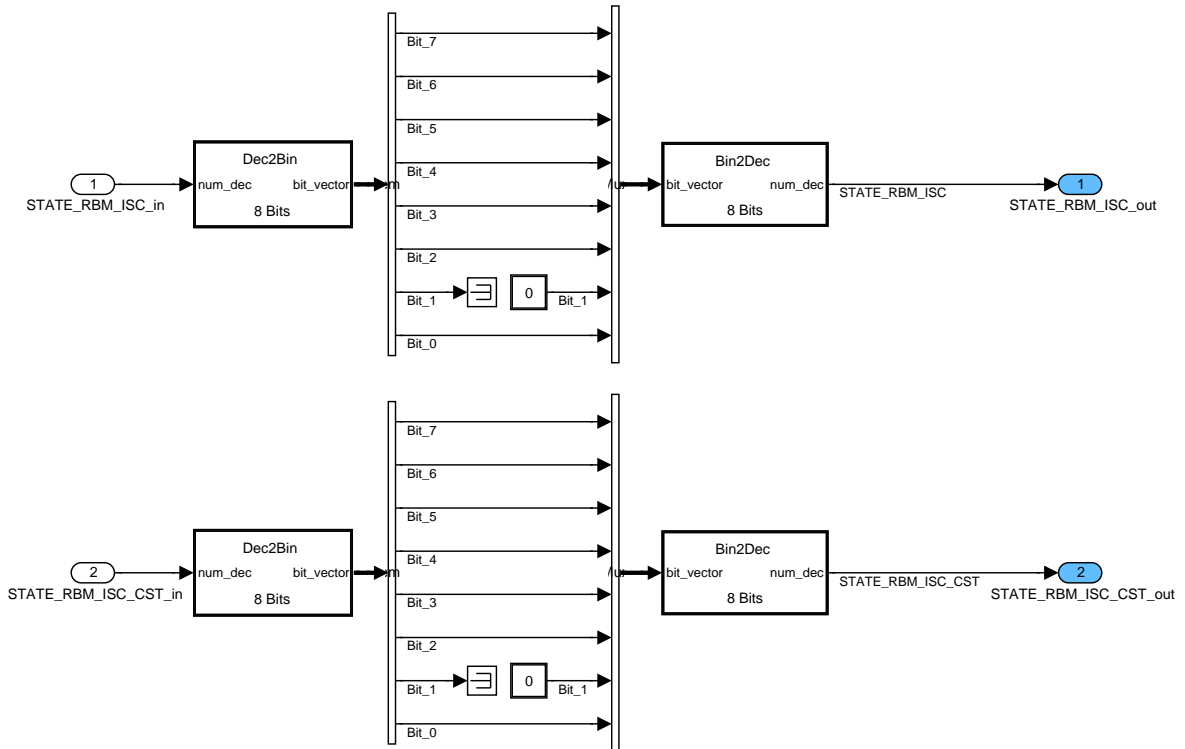


Figure A.40.24: :

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### A.40.4.4 Calculation at 1s recurrence

#### A.40.4.4.1 No title given

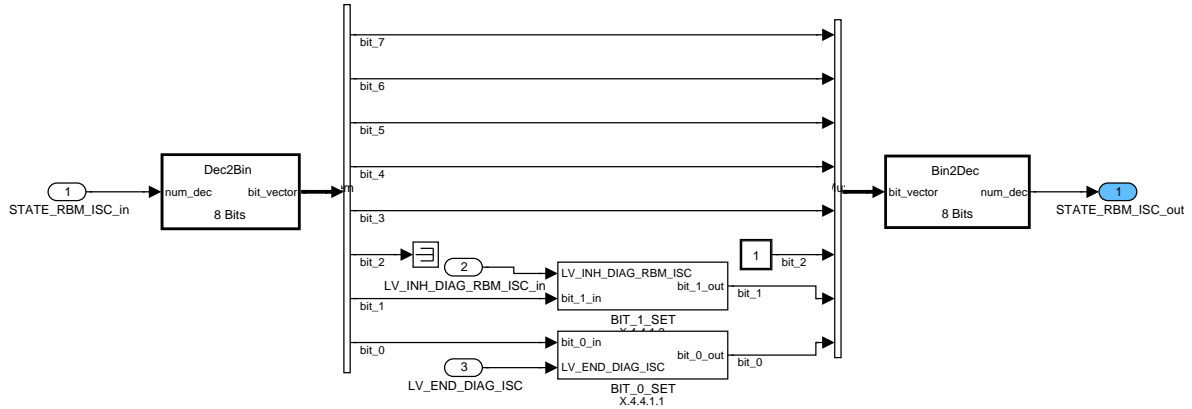


Figure A.40.25: :

#### A.40.4.4.1.1 No title given

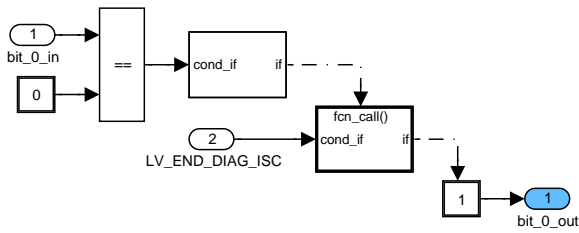


Figure A.40.26: :

#### A.40.4.4.1.2 No title given

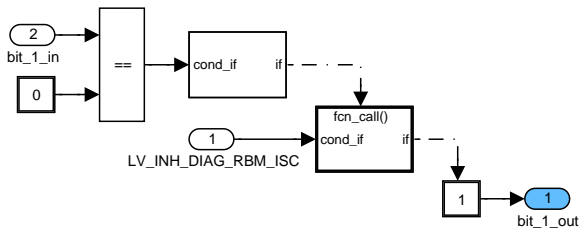


Figure A.40.27: :

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**A.40.4.4.2 No title given**

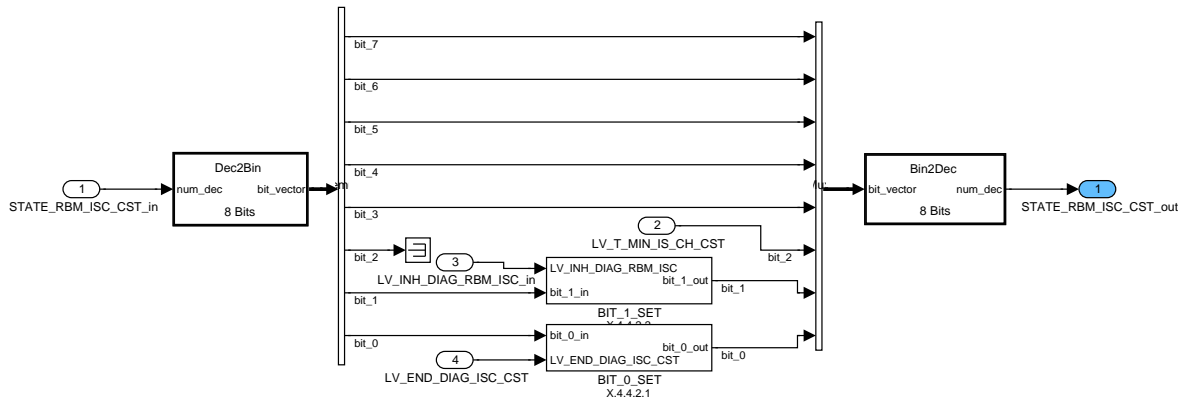


Figure A.40.28: :

**A.40.4.4.2.1 No title given**

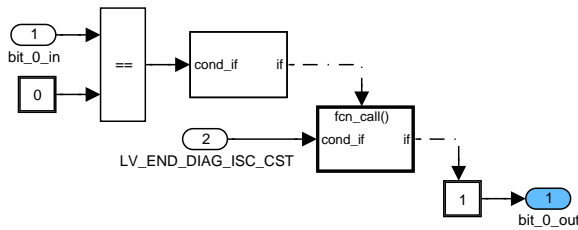


Figure A.40.29: :

**A.40.4.4.2.2 No title given**

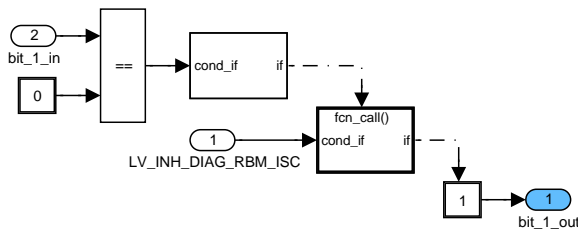


Figure A.40.30: :

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## A.41 Camshaft diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_EXT_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Failure on exhaust camshaft sensor due to external issue					
LV_ERR_EXT_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Failure on intake camshaft sensor due to external issue					
LV_INH_DIAG_EXT_PER_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the camshaft period diagnosis (exhaust)					
LV_INH_DIAG_EXT_PER_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the camshaft period diagnosis (intake)					
LV_INH_DIAG_EXT_PLAUS_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the camshaft sensor plausibility diagnosis (exhaust)					
LV_INH_DIAG_EXT_PLAUS_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the camshaft sensor plausibility diagnosis (intake)					
LV_INH_DIAG_EXT_REF_CRK_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the camshaft position diagnosis (exhaust)					
LV_INH_DIAG_EXT_REF_CRK_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the camshaft position diagnosis (intake)					
LV_INH_DIAG_EXT_SYN_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the camshaft self-synchronization diagnosis (exhaust)					
LV_INH_DIAG_EXT_SYN_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the camshaft self-synchronization diagnosis (intake)					
LV_INH_DIAG_EXT_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the camshaft sensor diagnosis for crankshaft synchronization (exhaust)					
LV_INH_DIAG_EXT_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the camshaft sensor diagnosis for crankshaft synchronization (intake)					
LV_INH_DIAG_EXT_TOOTH_OFF_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the one-tooth-off diagnosis (exhaust i)					
LV_INH_DIAG_EXT_TOOTH_OFF_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the one-tooth-off diagnosis (intake i)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_RBM_TOOTH_OFF_EX [NC_NR_CAM_CBK]	O/V	0... 7H	0 ...7	1	-
Interface of TOOTH_OFF_EX monitor with the Rate-Based Monitoring statistics					
STATE_RBM_TOOTH_OFF_IN [NC_NR_CAM_CBK]	O/V	0... 7H	0 ...7	1	-
Interface of TOOTH_OFF_IN monitor with the Rate-Based Monitoring statistics					

**Input data:**

CTR_ERR_DYN_NR {p. 5767}	LV_DC {p. 5746}	LV_END_DIAG_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_END_DIAG_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}
LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_SYN_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}
LV_INH_DIAG_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4456}	LV_INH_DIAG_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4456}		


**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_DIAG_PER_CAM_EX	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for exhaust camshaft segment period diagnosis					
C_ABC_INC_DIAG_PER_CAM_IN	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for intake camshaft segment period diagnosis					
C_ABC_INC_DIAG_REF_CRK_CAM_EX	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for exhaust camshaft position diagnosis					
C_ABC_INC_DIAG_REF_CRK_CAM_IN	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for intake camshaft position diagnosis					
C_ABC_INC_DIAG_SYN_CAM_EX	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for exhaust camshaft synchronization diagnosis					
C_ABC_INC_DIAG_SYN_CAM_IN	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for intake camshaft synchronization diagnosis					
C_ABC_INC_DIAG_TOOTH_OFF_EX	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for exhaust one-tooth-off diagnosis					
C_ABC_INC_DIAG_TOOTH_OFF_IN	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for intake one-tooth-off diagnosis					
C_ABC_MAX_DIAG_PER_CAM_EX	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for exhaust camshaft segment period diagnosis					
C_ABC_MAX_DIAG_PER_CAM_IN	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for intake camshaft segment period diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_DIAG_REF_CRK_CAM_EX	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for exhaust camshaft position diagnosis					
C_ABC_MAX_DIAG_REF_CRK_CAM_IN	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for intake camshaft position diagnosis					
C_ABC_MAX_DIAG_SYN_CAM_EX	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for exhaust camshaft synchronization diagnosis					
C_ABC_MAX_DIAG_SYN_CAM_IN	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for intake camshaft synchronization diagnosis					
C_ABC_MAX_DIAG_TOOTH_OFF_EX	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for exhaust one-tooth-off diagnosis					
C_ABC_MAX_DIAG_TOOTH_OFF_IN	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for intake one-tooth-off diagnosis					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_DIAG_PER_CAM_EX [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for PER_CAM_EX diagnosis					
NC_IDX_DIAG_PER_CAM_IN [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for PER_CAM_IN diagnosis					
NC_IDX_DIAG_PLAUS_CAM_EX [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for PLAUS_CAM_EX diagnosis					
NC_IDX_DIAG_PLAUS_CAM_IN [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for PLAUS_CAM_IN diagnosis					
NC_IDX_DIAG_REF_CRK_CAM_EX [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for REF_CRK_CAM_EX diagnosis					
NC_IDX_DIAG_REF_CRK_CAM_IN [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for REF_CRK_CAM_IN diagnosis					
NC_IDX_DIAG_SYN_CAM_EX [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for SYN_CAM_EX diagnosis					
NC_IDX_DIAG_SYN_CAM_IN [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for SYN_CAM_IN diagnosis					
NC_IDX_DIAG_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for SYN_CRK_CAM_EX diagnosis					
NC_IDX_DIAG_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for SYN_CRK_CAM_IN diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_DIAG_TOOTH_OFF_EX [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for TOOTH_OFF_EX diagnosis					
NC_IDX_DIAG_TOOTH_OFF_IN [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for TOOTH_OFF_IN diagnosis					

**Import actions:**

<b>ACTION_ERRM_CheckPendingStatus (IN&lt;PRM_IDX_DIAG&gt;,OUT&lt;PRM_LV_ERR_PND&gt;)</b>
--

**Error treatment:**

Diagnostic	Symptom description	Symptom	Filter type
<b>Camshaft sensor</b>  <i>Camshaft segment period diagnosis for intake</i>	PER_CAM_IN	SYM_0	MEM
		SYM_1	
		SYM_2	
		SYM_3	
<i>Camshaft segment period diagnosis for exhaust</i>	PER_CAM_EX	SYM_0	MEM
		SYM_1	
		SYM_2	
		SYM_3	
<i>Camshaft synchronization diagnosis for intake</i>	SYN_CAM_IN	SYM_0	MEM
		SYM_1	
		SYM_2	
		SYM_3	
<i>Camshaft synchronization diagnosis for exhaust</i>	SYN_CAM_EX	SYM_0	MEM
		SYM_1	
		SYM_2	
		SYM_3	
<i>Camshaft position diagnosis for intake</i>	REF_CRK_CAM_IN	SYM_0	MEM
		SYM_1	
		SYM_2	
		SYM_3	
<i>Camshaft position diagnosis for exhaust</i>	REF_CRK_CAM_EX	SYM_0	MEM
		SYM_1	
		SYM_2	
		SYM_3	
<i>One-tooth-off diagnosis for intake</i>	TOOTH_OFF	SYM_0	MEM
		SYM_1	
		SYM_2	
		SYM_3	
<i>One-tooth-off diagnosis for exhaust</i>	TOOTH_OFF	SYM_0	MEM
		SYM_1	
		SYM_2	
		SYM_3	

**Note:**

For filter type definition of PLAUS\_CAM\_IN(EX) and SYN\_CRK\_CAM\_IN(EX) see subchapters "Camshaft sensor plausibility diagnosis" and "Camshaft Sensor Diagnosis for Crankshaft Synchronization"

## A.41.1 External Inhibitions and filter type definitions

### FUNCTION DESCRIPTION:

#### General information:

The flags LV\_INH\_DIAG\_EXT\_... allow to deactivate the corresponding diagnostic.

#### Application conditions

**Initialisation:** At reset : all = 0  
**Recurrence:** once at reset  
**Activation:** -/ -  
**Deactivation:** When the activation condition is not fulfilled

#### Formula section:

LV\_INH\_DIAG\_EXT\_PER\_CAM\_IN(EX)[i] = 0  
 LV\_INH\_DIAG\_EXT\_SYN\_CAM\_IN(EX)[i] = 0  
 LV\_INH\_DIAG\_EXT\_REF\_CRK\_CAM\_IN(EX)[i] = 0  
 LV\_INH\_DIAG\_EXT\_PLAUS\_CAM\_IN(EX)[i] = 0  
 LV\_INH\_DIAG\_EXT\_SYN\_CRK\_CAM\_IN(EX)[i] = 0  
 LV\_INH\_DIAG\_EXT\_TOOTH\_OFF\_IN(EX)[i] = 0  
 LV\_ERR\_EXT\_CAM\_IN(EX)[i] = 0

## A.41.2 Interface of TOOTH\_OFF\_IN/EX error for Rate-based-monitoring

### FUNCTION DESCRIPTION:

#### General information:

With this module the interface between the TOOTH\_OFF\_IN/EX[i] monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_TOOTH\_OFF\_IN/EX[i] data.


Within STATE\_RBM\_TOOTH\_OFF\_IN/EX[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)  
(depending on failure status: pending)
- Monitor individual RBM conditions encountered within this DC (bit 2)  
( not valid for TOOTH\_OFF\_IN/EX[i] diagnosis )

**Remark:** Calculation must be made separate for ...\_EX[i] and ...\_IN[i]

#### Application conditions:

**Initialisation :**  
at LV\_DC 0 → 1 transition :

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bit 0 and bit 1 of STATE\_RBM\_TOOTH\_OFF\_IN/EX[i] = 0  
 bit 2 of STATE\_RBM\_TOOTH\_OFF\_IN/EX[i] = 1

on failure memory reset :

bit 1 of STATE\_RBM\_TOOTH\_OFF\_IN/EX[i] = 0

Recurrence: 1 s

Activation: LV\_DC 0 → 1 transition **and** LV\_DC = 1

### Formula section:

#### At LV\_DC 0 → 1 transition

The pending status of the following failures has to be checked only once :

LV\_ERR\_SYN\_CAM\_IN/EX[i]

LV\_ERR\_PER\_CAM\_IN/EX[i]

LV\_ERR\_PLAUS\_CAM\_IN/EX[i]

LV\_ERR\_SYN\_CRK\_CAM\_IN/EX[i]

LV\_ERR\_REF\_CRK\_CAM\_IN/EX[i]

If(1) { CPU optimization at LV\_DC 0 → 1 transition }  
 CTR\_ERR\_DYN\_NR <> 0 { the dynamic failure memory isn't empty }

#### Then(1)

**While** bit 1 of STATE\_RBM\_TOOTH\_OFF\_IN/EX[i] = 0 **do**

with each XX failure of the above list :

ACTION\_ERRM\_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

**If(2)** XX has a pending status

**Then(2)** bit 1 of STATE\_RBM\_TOOTH\_OFF\_IN/EX[i] = 1

**Endif(2)**

**Endwhile**

**Else(1)** { the dynamic failure memory is empty }

No action

#### Endif(1)

#### Every 1 s :

**If** bit 0 of STATE\_RBM\_TOOTH\_OFF\_IN/EX[i] = 0

**Then** **If** LV\_END\_DIAG\_TOOTH\_OFF\_IN/EX[i] = 1

**Then** bit 0 of STATE\_RBM\_TOOTH\_OFF\_IN/EX[i] = 1

**Endif**

#### Endif

**If** bit 1 of STATE\_RBM\_TOOTH\_OFF\_IN/EX[i] = 0


#### Then

**If** LV\_INH\_DIAG\_TOOTH\_OFF\_IN/EX[i] = 1

**Then** bit 1 of STATE\_RBM\_TOOTH\_OFF\_IN/EX[i] = 1

**Endif**

#### Endif


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## A.42 Camshaft position diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_REF_CRK_CAM_EX [NC_NR_CAM_CBK]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of the exhaust camshaft i position diagnosis					
ERR_SYM_REF_CRK_CAM_IN [NC_NR_CAM_CBK]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of the intake camshaft i position diagnosis					
ERR_SYM_TOOTH_OFF_EX [NC_NR_CAM_CBK]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of the exhaust i one-tooth-off diagnosis					
ERR_SYM_TOOTH_OFF_IN [NC_NR_CAM_CBK]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of the intake i one-tooth-off diagnosis					
LV_CDN_DIAG_REF_CRK_CAM_EX [NC_NR_CAM_CBK]	V	0H	PASSIVE	-	-
		1H	ACTIVE		
Diagnosis condition for exhaust camshaft i					
LV_CDN_DIAG_REF_CRK_CAM_IN [NC_NR_CAM_CBK]	V	0H	PASSIVE	-	-
		1H	ACTIVE		
Diagnosis condition for intake camshaft i					
LV_CDN_DIAG_TOOTH_OFF_EX [NC_NR_CAM_CBK]	V	0H	PASSIVE	-	-
		1H	ACTIVE		
One-tooth-off diagnosis condition for exhaust camshaft i					
LV_CDN_DIAG_TOOTH_OFF_IN [NC_NR_CAM_CBK]	V	0H	PASSIVE	-	-
		1H	ACTIVE		
One-tooth-off diagnosis condition for intake camshaft i					
LV_END_DIAG_REF_CRK_CAM_EX [NC_NR_CAM_CBK]	V	0H	PASSIVE	-	-
		1H	ACTIVE		
Result available of exhaust camshaft i position diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_REF_CRK_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of intake camshaft i position diagnosis					
LV_END_DIAG_TOOTH_OFF_EX [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of exhaust camshaft i one-tooth-off diagnosis					
LV_END_DIAG_TOOTH_OFF_IN [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of intake camshaft i one-tooth-off diagnosis					
LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK]	O/V	0H 1H	PASSIVE ACTIVE	-	-
Present exhaust camshaft i failure reference violation					
LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK]	O/V	0H 1H	PASSIVE ACTIVE	-	-
Present intake camshaft i failure reference violation					
LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK]	O/V	0H 1H	PASSIVE ACTIVE	-	-
Present exhaust camshaft i one-tooth-off failure					
LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK]	O/V	0H 1H	PASSIVE ACTIVE	-	-
Present intake camshaft i one-tooth-off failure					

**Input data:**

CAM_PSN_LST_REF_AD_EX [NC_NR_CAM_CBK] {p. 1533}	CAM_PSN_LST_REF_AD_IN [NC_NR_CAM_CBK] {p. 1533}	LV_INH_DIAG_ENSD {p. 4455}	LV_INH_DIAG_EXT_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4414}
LV_INH_DIAG_EXT_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4414}	LV_INH_DIAG_EXT_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4414}	LV_INH_DIAG_EXT_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4414}	LV_INH_DIAG_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4455}
LV_INH_DIAG_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4455}	LV_INH_DIAG_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4456}	LV_INH_DIAG_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4456}	LV_TOOTH_OFF_DET_ENA_EX [NC_NR_CAM_CBK] {p. 1533}
LV_TOOTH_OFF_DET_ENA_IN [NC_NR_CAM_CBK] {p. 1533}	LV_VLD_PSN_CAM_EX [NC_NR_CAM_CBK] {p. 872}	LV_VLD_PSN_CAM_IN [NC_NR_CAM_CBK] {p. 872}	PSN_EDGE_AD_CAM_EX [NC_NR_EDGE_CAM_EX][NC_NR_CAM_CBK] {p. 1534}
PSN_EDGE_AD_CAM_IN [NC_NR_EDGE_CAM_IN][NC_NR_CAM_CBK] {p. 1534}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TOL_REF_CRK_CAM_EX	-	0... 1FFH	0... 31.9375	0.0625	°CRK
Reference position tolerance range for exhaust camshaft					
C_TOL_REF_CRK_CAM_IN	-	0... 1FFH	0... 31.9375	0.0625	°CRK
Reference position tolerance range for intake camshaft					

**Error treatment:**

See Appl. Inc.

See Appl. Inc.

**A.42.1 Camshaft Position diagnosis****FUNCTION DESCRIPTION:****General information:**

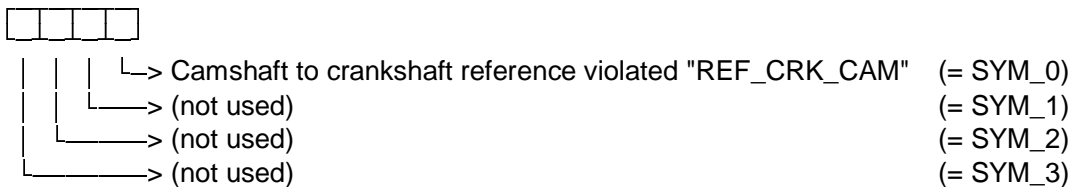
The purpose of the function is to detect when the camshaft reference position is outside of the designed range relative to the engine position from crankshaft. This allows to detect engine misbuilds (wrong assembly of the valve train), camshaft drive defects, or sensor failures that are not detected by the normal signal diagnosis.

i = 1...NC\_NR\_CAM\_CBK

z = 0...NC\_NR\_EDGE\_CAM\_IN/EX

**Description:**

Error-symptoms are defined for this diagnostic function as following:

**Application conditions****Initialisation:**

LV\_CDN\_DIAG\_REF\_CRK\_CAM\_IN(EX)[i] = Refer to filtering configuration for the initialisation value


LV\_END\_DIAG\_REF\_CRK\_CAM\_IN(EX)[i] = Refer to filtering configuration for the initialisation value

LV\_ERR\_REF\_CRK\_CAM\_IN(EX)[i] = Refer to filtering configuration for the initialisation value

ERR\_SYM\_REF\_CRK\_CAM\_IN(EX)[i] = Refer to filtering configuration for the initialisation value

**Recurrence:** every update of the camshaft edge position adaptation values PSN\_EDGE\_AD\_CAM\_IN(EX)[z][i]

**Activation:** LV\_VLD\_PSN\_CAM\_IN(EX)[i] = 1

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And LV\_INH\_DIAG\_REF\_CRK\_CAM\_IN(EX)[i] = 0  
 And LV\_INH\_DIAG\_EXT\_REF\_CRK\_CAM\_IN(EX)[i] = 0  
 And LV\_INH\_DIAG\_ENSD = 0

When the activation conditions are fulfilled then LV\_CDN\_DIAG\_REF\_CRK\_CAM\_IN(EX)[i] = 1.

#### Deactivation:

When the activation conditions are not fulfilled then LV\_CDN\_DIAG\_REF\_CRK\_CAM\_IN(EX)[i] = 0

### Formula Section

#### Symptoms calculation:

```

If      PSN_EDGE_AD_CAM_IN(EX)[z][i] < - C_TOL_REF_CRK_CAM_IN(EX)
           or
           PSN_EDGE_AD_CAM_IN(EX)[z][i] > C_TOL_REF_CRK_CAM_IN(EX)
Then    ERR_SYM_REF_CRK_CAM_IN(EX)[i] = SYM_0 {Detection of symptom REF_CRK_
CAM}
Else    ERR_SYM_REF_CRK_CAM_IN(EX)[i] = NO_SYM
Endif
  
```

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

#### Filtering :

**apply** filter on current symptoms

**If** filtering result available (after debounce)

**then**

LV\_ERR\_REF\_CRK\_CAM\_IN(EX)[i] = filtering result

LV\_END\_DIAG\_REF\_CRK\_CAM\_IN(EX)[i] = 1

**Deliver** the result to Error Management

**Endif**

## A.42.2 One-tooth-off diagnosis

### FUNCTION DESCRIPTION:

#### General information:

The purpose of the function is to detect a sudden drift in the camshaft position.

i = 1...NC\_NR\_CAM\_CBK


z = 0...NC\_NR\_EDGE\_CAM\_IN/EX

#### Description:

Error-symptoms are defined for this diagnostic function as following:



### Application conditions

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**Initialisation:**

LV\_CDN\_DIAG\_TOOTH\_OFF\_IN(EX)[i] = Refer to filtering configuration for the initialisation value

LV\_END\_DIAG\_TOOTH\_OFF\_IN(EX)[i] = Refer to filtering configuration for the initialisation value

LV\_ERR\_TOOTH\_OFF\_IN(EX)[i] = Refer to filtering configuration for the initialisation value

ERR\_SYM\_TOOTH\_OFF\_IN(EX)[i] = Refer to filtering configuration for the initialisation value

*Recurrence:* at LV\_TOOTH\_OFF\_DET\_ENA\_IN(EX)[i] 0 to 1 transition

*Activation:* And LV\_INH\_DIAG\_TOOTH\_OFF\_IN(EX)[i] = 0

And LV\_INH\_DIAG\_EXT\_TOOTH\_OFF\_IN(EX)[i] = 0

And LV\_INH\_DIAG\_ENSD = 0

When the activation conditions are fulfilled then LV\_CDN\_DIAG\_TOOTH\_OFF\_IN(EX)[i] = 1.

*Deactivation:*

When the activation conditions are not fulfilled then LV\_CDN\_DIAG\_TOOTH\_OFF\_IN(EX)[i] = 0

**Formula Section**Symptoms calculation:

**If** CAM\_PSN\_LST\_REF\_AD\_IN(EX)[i] = PSN\_EDGE\_AD\_CAM\_IN(EX)[1][i]

**Then** ERR\_SYM\_TOOTH\_OFF\_IN(EX)[i] = NO\_SYM

**Else** ERR\_SYM\_TOOTH\_OFF\_IN(EX)[i] = SYM\_0 {Detection of symptom ONE\_TOOTH\_OFF}

**Endif**

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

Filtering :

**apply** filter on current symptoms

**If** filtering result available (after debounce)

**then**


LV\_ERR\_TOOTH\_OFF\_IN(EX)[i] = filtering result

LV\_END\_DIAG\_TOOTH\_OFF\_IN(EX)[i] = 1

**Deliver** the result to Error Management

**Endif**

For filter-type-linked calibrations: see Appl. Inc.

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## A.43 Camshaft sensor diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_PER_CAM_EX [NC_NR_CAM_CBK]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of the failure camshaft period too short					
ERR_SYM_PER_CAM_IN [NC_NR_CAM_CBK]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of the failure camshaft period too short					
ERR_SYM_SYN_CAM_EX [NC_NR_CAM_CBK]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of the exhaust camshaft i sensor diagnosis					
ERR_SYM_SYN_CAM_IN [NC_NR_CAM_CBK]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of the intake camshaft i sensor diagnosis					
LV_CDN_DIAG_PER_CAM_EX [NC_NR_CAM_CBK]	V	0H	PASSIVE	-	-
		1H	ACTIVE		
Diagnosis condition					
LV_CDN_DIAG_PER_CAM_IN [NC_NR_CAM_CBK]	V	0H	PASSIVE	-	-
		1H	ACTIVE		
Diagnosis condition					
LV_CDN_DIAG_SYN_CAM_EX [NC_NR_CAM_CBK]	V	0H	PASSIVE	-	-
		1H	ACTIVE		
Diagnosis condition for exhaust camshaft i					
LV_CDN_DIAG_SYN_CAM_IN [NC_NR_CAM_CBK]	V	0H	PASSIVE	-	-
		1H	ACTIVE		
Diagnosis condition for intake camshaft i					
LV_END_DIAG_PER_CAM_EX [NC_NR_CAM_CBK]	V	0H	PASSIVE	-	-
		1H	ACTIVE		
Result available of the failure camshaft period too short					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_PER_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of the failure camshaft period too short					
LV_END_DIAG_SYN_CAM_EX [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of exhaust camshaft i sensor diagnosis					
LV_END_DIAG_SYN_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of intake camshaft i sensor diagnosis					
LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK]	O/V/S	0H 1H	PASSIVE ACTIVE	-	-
Present failure camshaft period too short					
LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK]	O/V/S	0H 1H	PASSIVE ACTIVE	-	-
Present failure camshaft period too short					
LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK]	O/V/S	0H 1H	PASSIVE ACTIVE	-	-
Present exhaust camshaft i failure sensor out of range					
LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK]	O/V/S	0H 1H	PASSIVE ACTIVE	-	-
Present intake camshaft i sensor failure					

**Input data:**


LV_ACT_CAM_EX [NC_NR_CAM_CBK] {p. 1505}	LV_ACT_CAM_IN [NC_NR_CAM_CBK] {p. 1505}	LV_INH_DIAG_ENSD {p. 4455}	LV_INH_DIAG_EXT_PER_ CAM_EX [NC_NR_CAM_CBK] {p. 4414}
LV_INH_DIAG_EXT_PER_ CAM_IN [NC_NR_CAM_CBK] {p. 4414}	LV_INH_DIAG_EXT_SYN_ CAM_EX [NC_NR_CAM_CBK] {p. 4414}	LV_INH_DIAG_EXT_SYN_ CAM_IN [NC_NR_CAM_CBK] {p. 4414}	LV_INH_DIAG_PER_CAM_ EX [NC_NR_CAM_CBK] {p. 4455}
LV_INH_DIAG_PER_CAM_ IN [NC_NR_CAM_CBK] {p. 4455}	LV_INH_DIAG_SYN_CAM_ EX [NC_NR_CAM_CBK] {p. 4456}	LV_INH_DIAG_SYN_CAM_ IN [NC_NR_CAM_CBK] {p. 4456}	LV_ORNG_PER_CAM_EX [NC_NR_CAM_CBK] {p. 871}
LV_ORNG_PER_CAM_IN [NC_NR_CAM_CBK] {p. 871}	LV_ORNG_RATIO_CAM_ EX [NC_NR_CAM_CBK] {p. 871}	LV_ORNG_RATIO_CAM_ IN [NC_NR_CAM_CBK] {p. 871}	

**Error treatment:**

See Appl. Inc.

See Appl. Inc.

**A.43.1 Camshaft Segment Period Diagnosis****FUNCTION DESCRIPTION:**

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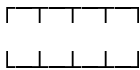
**General information:**

Camshaft signal acquisition validates the segment period by minimum limits derived from the maximum engine speed. The diagnostic state indicates when a segment period was too short, e.g. due to supplementary signal transitions. The camshaft signal acquisition will filter out such signal transitions as far as possible. If there are too many additional pulses however, the camshaft signal acquisition may not be able to synchronize any more, or the accuracy of camshaft position measurement may be degraded.

i = 1...NC\_NR\_CAM\_CBK

**Description:**

Error-symptoms are defined for this diagnostic function as following:



- | | | L → Camshaft segment period too short "CAM\_PER" (= SYM\_0)
- | | L → (not used) (= SYM\_1)
- | L → (not used) (= SYM\_2)
- L → (not used) (= SYM\_3)

**Application conditions**

**Initialisation:**

LV\_CDN\_DIAG\_PER\_CAM\_IN(EX)[i] = Refer to filtering configuration for the initialisation value  
 LV\_END\_DIAG\_PER\_CAM\_IN(EX)[i] = Refer to filtering configuration for the initialisation value  
 LV\_ERR\_PER\_CAM\_IN(EX)[i] = Refer to filtering configuration for the initialisation value  
 ERR\_SYM\_PER\_CAM\_IN(EX)[i] = Refer to filtering configuration for the initialisation value

Recurrence: every camshaft signal edge

Activation: LV\_ACT\_CAM\_IN(EX)[i] = 1  
 And LV\_INH\_DIAG\_PER\_CAM\_IN(EX)[i] = 0  
 And LV\_INH\_DIAG\_EXT\_PER\_CAM\_IN(EX)[i] = 0  
 And LV\_INH\_DIAG\_ENSD = 0

When the activation conditions are fulfilled then LV\_CDN\_DIAG\_PER\_CAM\_IN(EX)[i] = 1

**Deactivation:**

When the activation conditions are not fulfilled then LV\_CDN\_DIAG\_PER\_CAM\_IN(EX)[i] = 0

**Formula section:**

**Symptoms calculation:**

**If** LV\_ORNG\_PER\_CAM\_IN(EX)[i] = 1  
**Then** ERR\_SYM\_PER\_CAM\_IN(EX)[i] = SYM\_0 {detection of symptom CAM\_PER}  
**Else** ERR\_SYM\_PER\_CAM\_IN(EX)[i] = NO\_SYM  
**Endif**

LV\_ORNG\_PER\_CAM\_IN(EX)[i] is reset after reading.

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Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

Filtering:

**Apply** filter on current symptoms

**If** filtering result available (after debounce)

**Then**

LV\_ERR\_PER\_CAM\_IN(EX)[i] = filtering result

LV\_END\_DIAG\_PER\_CAM\_IN(EX)[i] = 1

**Deliver** the result to Error Management

**Endif**

## A.43.2 Camshaft Synchronization Diagnosis

### FUNCTION DESCRIPTION:

#### General information:

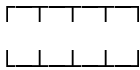
The purpose of the function is to detect camshaft sensor failure. Each time the camshaft signal synchronization algorithm fails, it will set the diagnostic flag LV\_ORNG\_RATIO\_CAM\_IN(EX)[i] for the appropriate camshaft.

The camshaft signal acquisition will filter out supplementary signal transitions as far as possible. If there are too many additional pulses however, the camshaft signal acquisition will not be able to synchronize any more. Synchronization may also be impossible due to missing or inaccurate signal transitions of the sensor.

i = 1...NC\_NR\_CAM\_CBK

#### Description:

Error-symptoms are defined for this diagnostic function as following:



- | | | | ↪ Camshaft synchronization failure "SYNC\_LOSS" (= SYM\_0)
- | | | | ↪ (not used) (= SYM\_1)
- | | | | ↪ (not used) (= SYM\_2)
- | | | | ↪ (not used) (= SYM\_3)

### Application conditions

#### Initialisation:

LV\_CDN\_DIAG\_SYN\_CAM\_IN(EX)[i] = Refer to filtering configuration for the initialisation value

LV\_END\_DIAG\_SYN\_CAM\_IN(EX)[i] = Refer to filtering configuration for the initialisation value

LV\_ERR\_SYN\_CAM\_IN(EX)[i] = Refer to filtering configuration for the initialisation value

ERR\_SYM\_SYN\_CAM\_IN(EX)[i] = Refer to filtering configuration for the initialisation value

*Recurrence:* every camshaft signal edge

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**Activation:**

LV\_ACT\_CAM\_IN(EX)[i] = 1  
 And LV\_INH\_DIAG\_SYN\_CAM\_IN(EX)[i] = 0  
 And LV\_INH\_DIAG\_EXT\_SYN\_CAM\_IN(EX)[i] = 0  
 And LV\_INH\_DIAG\_ENSD = 0

When activation conditions are fulfilled then LV\_CDN\_DIAG\_SYN\_CAM\_IN(EX)[i] = 1.

**Deactivation:**

When activation conditions are not fulfilled then LV\_CDN\_DIAG\_SYN\_CAM\_IN(EX)[i] = 0.

### Formula section:

Symptoms calculation:

**If** LV\_ORNG\_RATIO\_CAM\_IN(EX)[i] = 1  
**Then** ERR\_SYM\_SYN\_CAM\_IN(EX)[i] = SYM\_0 {Detection of symptom SYNC\_LOSS}  
**Else** ERR\_SYM\_SYN\_CAM\_IN(EX)[i] = NO\_SYM  
**Endif**

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

Filtering:

**Apply** filter on current symptoms

**If** filtering result available (after debounce)

**Then**


LV\_ERR\_SYN\_CAM\_IN(EX)[i] = filtering result

LV\_END\_DIAG\_SYN\_CAM\_IN(EX)[i] = 1

**Deliver** the result to Error Management

**Endif**

See Appl. Inc.

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## A.44 Crankshaft sensor circuit diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_CRK_OC	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptom of the crankshaft sensor failure open or short circuit					
LV_CDN_DIAG_CRK_OC	V	0H	PASSIVE	-	-
		1H	ACTIVE		
Diagnosis condition					
LV_END_DIAG_CRK_OC	V	0H	PASSIVE	-	-
		1H	ACTIVE		
Diagnosis result available					
LV_ERR_CRK_OC	O/V	0H	PASSIVE	-	-
		1H	ACTIVE		
Crankshaft sensor failure open or short circuit present					

### Input data:

LV_IGK {p. 906}	LV_INH_DIAG_CRK_OC {p. 4455}	LV_INH_DIAG_EXT_CRK_ OC {p. 4439}	N_32 {p. 1525}
-----------------	---------------------------------	---	----------------

### FUNCTION DESCRIPTION:

#### General information:

This dummy file replaces the MCPS circuit diagnosis for systems with ACPS. A circuit diagnosis for ACPS is not considered necessary, since with any of the three lines open or short-circuited, the signal will be constantly high or low. The failure will then be detected by the functional diagnosis.

#### Application conditions

**Activation:**

$$\begin{aligned} LV\_IGK &= 1 \\ \text{And } LV\_INH\_DIAG\_CRK\_OC &= 0 \\ \text{And } LV\_INH\_DIAG\_EXT\_CRK\_OC &= 0 \end{aligned}$$


When the activation condition is fulfilled then  $LV\_CDN\_DIAG\_CRK\_OC = 1$ .

#### Desactivation:

When the activation condition is not fulfilled then  $LV\_CDN\_DIAG\_CRK\_OC = 0$ .

#### Formula section:

$$\begin{aligned} ERR\_SYM\_CRK\_OC &= 0 \\ LV\_ERR\_CRK\_OC &= 0 \\ LV\_END\_DIAG\_CRK\_OC &= 1 \end{aligned}$$

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## A.45 Crankshaft sensor diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_CRK_SYN	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of the crankshaft failure with loss of synchronization					
ERR_SYM_CRK_TOOTH	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of the crankshaft failure tooth number error					
ERR_SYM_CRK_TOOTH_PER	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of the crankshaft failure implausible tooth period					
LV_CDN_DIAG_CRK_SYN	V	0H	PASSIVE	-	-
		1H	ACTIVE		
Diagnosis condition for crankshaft diagnosis with loss of synchronization					
LV_CDN_DIAG_CRK_TOOTH	V	0H	PASSIVE	-	-
		1H	ACTIVE		
Diagnosis condition					
LV_CDN_DIAG_CRK_TOOTH_PER	V	0H	PASSIVE	-	-
		1H	ACTIVE		
Diagnosis condition for crankshaft diagnosis of implausible tooth period					
LV_END_DIAG_CRK_SYN	V	0H	PASSIVE	-	-
		1H	ACTIVE		
Result available of crankshaft diagnosis with loss of synchronization					
LV_END_DIAG_CRK_TOOTH	V	0H	PASSIVE	-	-
		1H	ACTIVE		
Result available of crankshaft tooth number error					
LV_END_DIAG_CRK_TOOTH_PER	V	0H	PASSIVE	-	-
		1H	ACTIVE		
Result available of crankshaft diagnosis implausible tooth period					
LV_ERR_CRK_SYN	O/V	0H	PASSIVE	-	-
		1H	ACTIVE		
Present crankshaft failure with loss of synchronization					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_CRK_TOOTH	O/V	0H 1H	PASSIVE ACTIVE	-	-
Present crankshaft failure tooth number error					
LV_ERR_CRK_TOOTH_PER	O/V	0H 1H	PASSIVE ACTIVE	-	-
Present crankshaft failure tooth number error					
LV_INH_MIS_CRK	O/V	0... 1H	0 ...1	1	-
Inhibition of misfire detection with crankshaft tooth number error					

**Input data:**

LV_CRK_SYN {p. 853}	LV_INH_DIAG_CRK_SYN {p. 4455}	LV_INH_DIAG_CRK_ TOOTH {p. 4455}	LV_INH_DIAG_CRK_ TOOTH_PER {p. 4455}
LV_INH_DIAG_ENSD {p. 4455}	LV_INH_DIAG_EXT_CRK_ SYN {p. 4439}	LV_INH_DIAG_EXT_CRK_ TOOTH {p. 4439}	LV_INH_DIAG_EXT_CRK_ TOOTH_PER {p. 4439}
LV_LIH_ERR_CRK {p. 1505}	LV_LOST_SYN_CRK {p. 853}	LV_ORNG_NR_TOOTH_ CRK {p. 853}	LV_ORNG_TOOTH_PER_ CRK {p. 853}
LV_RUN_ENG {p. 1505}	LV_STOP_ENG {p. 1505}	N_32 {p. 1525}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_32_MAX_DIAG_CRK_TOOTH	-	0... FFH	0... 8160	32	rpm
Maximum engine speed to enable tooth number diagnosis					

**Error treatment:**

See Appl. Inc.

See Appl. Inc.

See Appl. Inc.

**General information:**

The purpose of the function is to detect failures on the crankshaft signal while the system is synchronized.

The diagnosis is divided in three different parts: tooth number error, implausible tooth period, and loss of synchronization on crankshaft signal.

**A.45.1 Crankshaft Sensor Diagnosis with Tooth Number Error****FUNCTION DESCRIPTION:****General information:**

The number of teeth per crankshaft revolution is monitored by the crankshaft signal acquisition. The algorithm may tolerate a number of missing/additional teeth per revolution without losing synchronization,

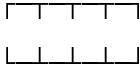


depending on the used target wheel and on configuration data. The bit LV\_ORNG\_NR\_TOOTH\_CRK indicates wrong tooth number during the most recent crankshaft revolution.

If a tooth was missing or added during one revolution, then all variables based on teeth counting will be produced with an error. This concerns for example spark advance, segment time, misfire segments, camshaft position, etc. The purpose of the function is to provide information when the crankshaft signal is inaccurate, in order to take the necessary actions.

### Description:

Error-symptoms are defined for this diagnostic function as following:



L→	Incorrect crankshaft tooth number "TOOTH_NUMBER"	(= SYM_0)
L→	(not used)	(= SYM_1)
L→	(not used)	(= SYM_2)
L→	(not used)	(= SYM_3)

### Application conditions

#### **Initialisation:**

LV\_CDN\_DIAG\_CRK\_TOOTH = Refer to filtering configuration for the initialisation value

LV\_END\_DIAG\_CRK\_TOOTH = Refer to filtering configuration for the initialisation value

LV\_ERR\_CRK\_TOOTH = Refer to filtering configuration for the initialisation value

ERR\_SYM\_CRK\_TOOTH = Refer to filtering configuration for the initialisation value

*Recurrence:* once per crankshaft revolution, after detection of the reference gap, except in the first revolution after synchronization

*Activation:* LV\_CRK\_SYN = 1  
 And LV\_INH\_DIAG\_CRK\_TOOTH = 0  
 And LV\_INH\_DIAG\_EXT\_CRK\_TOOTH = 0  
 And LV\_INH\_DIAG\_ENSD = 0  
 And N\_32 > C\_N\_32\_MAX\_DIAG\_CRK\_TOOTH

When the activation conditions are fulfilled then LV\_CDN\_DIAG\_CRK\_TOOTH = 1.

*Deactivation:*

When the activation conditions are not fulfilled then LV\_CDN\_DIAG\_CRK\_TOOTH = 0.

### Formula Section

Symptoms calculation:

**If** LV\_ORNG\_NR\_TOOTH\_CRK = 0

**Then** ERR\_SYM\_CRK\_TOOTH = NO\_SYM

**Else** ERR\_SYM\_CRK\_TOOTH = "SYM\_0" {Detection of symptom TOOTH\_NUMBER}

**Endif**

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

Filtering:

**Apply** filter on current symptoms**If** filtering result available (after debounce)**Then**

LV\_ERR\_CRK\_TOOTH = filtering result

LV\_END\_DIAG\_CRK\_TOOTH = 1

**Deliver** the result to Error Management**Endif****Calculation of missing/added tooth information for misfire***Initialisation:*

LV\_INH\_MIS\_CRK = 0 at reset and at engine stalling (LV\_STOP\_ENG transition from 0 to 1).

*Recurrence:* once per crankshaft revolution, after detection of the reference gap, except in the first revolution after synchronization*Activation:* LV\_CRK\_SYN = 1*Deactivation:* LV\_CRK\_SYN = 0**Formula Section***Symptoms calculation:***If** LV\_ORNG\_NR\_TOOTH\_CRK = 0**Then** LV\_INH\_MIS\_CRK = 0**Else** LV\_INH\_MIS\_CRK = 1**Endif**

LV\_ORNG\_NR\_TOOTH\_CRK is reset after reading at the reference gap


**A.45.2 Crankshaft Sensor Diagnosis with implausible Tooth Period****FUNCTION DESCRIPTION:****General information:**

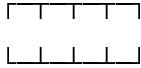
Crankshaft signal acquisition validates the tooth period by limits derived from the current engine speed. Before synchronization, LV\_ORNG\_TOOTH\_PER\_CRK indicates implausible gradient of the tooth period. This flag is also set if a reference gap occurs during valid teeth phase or when the first reference gap cannot be detected.

After synchronization, LV\_ORNG\_TOOTH\_PER\_CRK is set if spikes are detected outside the crankshaft window acceptance window.

**Description:**

Error-symptoms are defined for this diagnostic function as following:

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	↳ Implausible crankshaft tooth period "TOOTH_PERIOD"	(= SYM_0)
	↳ (not used)	(= SYM_1)
	↳ (not used)	(= SYM_2)
	↳ (not used)	(= SYM_3)

## Application conditions

### Initialisation:

LV\_CDN\_DIAG\_CRK\_TOOTH\_PER = Refer to filtering configuration for the initialisation value

LV\_END\_DIAG\_CRK\_TOOTH\_PER = Refer to filtering configuration for the initialisation value

LV\_ERR\_CRK\_TOOTH\_PER = Refer to filtering configuration for the initialisation value

ERR\_SYM\_CRK\_TOOTH\_PER = Refer to filtering configuration for the initialisation value

Recurrence: if LV\_CRK\_SYN = 1: every reference gap  
If LV\_CRK\_SYN = 0: when LV\_ORNG\_TOOTH\_PER\_CRK is set

Activation: LV\_RUN\_ENG = 1  
And LV\_LIH\_ERR\_CRK = 0  
And LV\_INH\_DIAG\_CRK\_TOOTH\_PER = 0  
And LV\_INH\_DIAG\_EXT\_CRK\_TOOTH\_PER = 0  
And LV\_INH\_DIAG\_ENSD = 0

When the activation conditions are fulfilled then LV\_CDN\_DIAG\_CRK\_TOOTH\_PER = 1.

### Deactivation:

When the activation conditions are not fulfilled then LV\_CDN\_DIAG\_CRK\_TOOTH\_PER = 0.

## Formula Section

### Symptoms calculation:

Before crankshaft synchronization (LV\_CRK\_SYN = 0)

**If** LV\_ORNG\_TOOTH\_PER\_CRK = 0  
**Then** ERR\_SYM\_CRK\_TOOTH\_PER = NO\_SYM  
**Else** ERR\_SYM\_CRK\_TOOTH\_PER = SYM\_0" {Detection of symptom TOOTH\_PERIOD}  
**Endif**

After crankshaft synchronization (LV\_CRK\_SYN = 1)

**If** LV\_ORNG\_TOOTH\_PER\_CRK = 1 set at a tooth event or end of tolerance window  
**Then** ERR\_SYM\_CRK\_TOOTH\_PER = SYM\_0" {Detection of symptom TOOTH\_PERIOD}  
**Endif**

LV\_ORNG\_TOOTH\_PER\_CRK is reset after reading

**If** LV\_ORNG\_TOOTH\_PER\_CRK = 0 at the reference gap  
**Then** ERR\_SYM\_CRK\_TOOTH\_PER = NO\_SYM  
**Endif**

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

Filtering:**Apply** filter on current symptoms**If** filtering result available (after debounce)**Then**

LV\_ERR\_CRK\_TOOTH\_PER = filtering result

LV\_END\_DIAG\_CRK\_TOOTH\_PER = 1

**Deliver** the result to Error Management**Endif****A.45.3 Crankshaft Sensor Diagnosis with Loss of Synchronization**FUNCTION DESCRIPTION:General information:


The purpose of the function is to detect crankshaft failure when the system loses synchronization on the crankshaft signal.

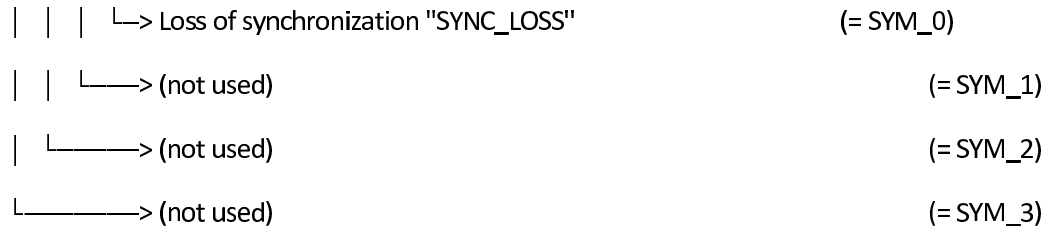
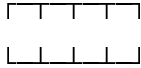
Synchronization will be lost if the reference gap is not detected at the correct position plus/minus a tolerance of missing/additional teeth, depending on the used target wheel and on configuration data.

If the signal fails completely (no more crankshaft signal edges are detected), then no error will be detected by this diagnosis, since the condition is similar to stopped engine. A failure then may be detected by the crankshaft sensor plausibility diagnosis (e.g. test against the camshaft signal).

Description:

Error-symptoms are defined for this diagnostic function as following:

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### Application conditions:

#### *Initialisation:*

LV\_CDN\_DIAG\_CRK\_SYN = Refer to filtering configuration for the initialisation value

LV\_END\_DIAG\_CRK\_SYN = Refer to filtering configuration for the initialisation value

LV\_ERR\_CRK\_SYN = Refer to filtering configuration for the initialisation value

ERR\_SYM\_CRK\_SYN = Refer to filtering configuration for the initialisation value

*Recurrence:* once per crankshaft revolution, after the reference gap, except in the first revolution after synchronization, or when the bit LV\_LOST\_SYN\_CRK is set.

*Activation:* LV\_CRK\_SYN = 1  
 And LV\_INH\_DIAG\_CRK\_SYN = 0  
 And LV\_INH\_DIAG\_EXT\_CRK\_SYN = 0  
 And LV\_INH\_DIAG\_ENSD = 0

When activation conditions are fulfilled then LV\_CDN\_DIAG\_CRK\_SYN = 1.

#### *Deactivation:*

When activation conditions not are fulfilled then LV\_CDN\_DIAG\_CRK\_SYN = 0.

### Formula Section

#### Symptoms calculation:

**If** LV\_LOST\_SYN\_CRK = 0  
**Then** ERR\_SYM\_CRK\_SYN = NO\_SYM  
**Else** ERR\_SYM\_CRK\_SYN = SYM\_0" {Detection of symptom SYNC\_LOSS}  
**Endif**

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

#### Filtering:

**Apply** filter on current symptoms  
**If** filtering result available (after debounce)  
**Then**

LV\_ERR\_CRK\_SYN = filtering result


LV\_END\_DIAG\_CRK\_SYN = 1

**Deliver** the result to Error Management

**Endif**

For filter-type-linked calibrations: see Appl. Inc.

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## A.46 Crankshaft sensor diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_EXT_CRK_OC	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the crankshaft sensor circuit diagnosis					
LV_INH_DIAG_EXT_CRK_PLAUS	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the diagnosis of crankshaft sensor					
LV_INH_DIAG_EXT_CRK_SYN	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the crankshaft sensor diagnosis with loss of synchronization					
LV_INH_DIAG_EXT_CRK_TOOTH	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the crankshaft sensor diagnosis with tooth number error					
LV_INH_DIAG_EXT_CRK_TOOTH_PER	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the crankshaft sensor diagnosis with implausible tooth period					

### Input data:

LV_ERR_CRK_OC {p. 4430}	LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}
LV_ERR_CRK_TOOTH_PER {p. 4432}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_DIAG_CRK_OC	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for crankshaft sensor circuit diagnosis					
C_ABC_INC_DIAG_CRK_SYN	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for crankshaft diagnosis with loss of synchronization					
C_ABC_INC_DIAG_CRK_TOOTH	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for crankshaft tooth number diagnosis					
C_ABC_INC_DIAG_CRK_TOOTH_PER	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for crankshaft tooth period diagnosis					
C_ABC_MAX_DIAG_CRK_OC	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for crankshaft sensor circuit diagnosis					
C_ABC_MAX_DIAG_CRK_SYN	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for crankshaft diagnosis with loss of synchronization					
C_ABC_MAX_DIAG_CRK_TOOTH	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for crankshaft tooth number diagnosis					
C_ABC_MAX_DIAG_CRK_TOOTH_PER	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for crankshaft tooth period diagnosis					

### Error treatment:

Diagnostic	Symptom description	Symptom	Filter type
Crankshaft sensor			
	<i>Crankshaft sensor diagnosis with tooth number error</i>	TOOTH_NUMBER	SYM_0
			SYM_1
			SYM_2
		SYM_3	MEM

Filter types compatibility:

Filter Type	Compatibility	Remark
STD	NO	
STD_INI	YES	
MEM	YES	Prefered solution
MEM_INI	NO	
DEC_CAL	NO	
STC	YES	
NO_FIL	NO	

Figure A.46.1: Diagnosis /Failure Flag

Diagnosis / Failure Flag	Symptom		DTC
Crankshaft sensor tooth number diagnosis  LV_ERR_CRK_TOOTH	Bit 0	Additional or missing teeth per crankshaft revolution	P0370
	Bit 1	unused	
	Bit 2	unused	
	Bit 3	unused	

Diagnostic	Symptom description	Symptom	Filter type
<b>Crankshaft sensor</b>  <i>Crankshaft sensor diagnosis with implausible tooth period error</i>	<i>TOOTH_PERIOD</i>	<i>SYM_0</i>	MEM
		<i>SYM_1</i>	
		<i>SYM_2</i>	
		<i>SYM_3</i>	

Filter types compatibility:

Filter Type	Compatibility	Remark
STD	NO	
STD_INI	YES	
MEM	YES	Prefered solution
MEM_INI	NO	
DEC_CAL	NO	
STC	YES	
NO_FIL	NO	

Figure A.46.2: Diagnosis /Failure Flag

Diagnosis / Failure Flag	Symptom		DTC
Crankshaft sensor tooth period diagnosis  LV_ERR_CRK_TOOTH_PER	Bit 0	Crankshaft tooth period implausible	P0370
	Bit 1	unused	
	Bit 2	unused	
	Bit 3	unused	



Diagnostic	Symptom description	Symptom	Filter type
<b>Crankshaft sensor</b>			
	<i>SYNC_LOSS</i>	<i>SYM_0</i>	<i>MEM</i>
		<i>SYM_1</i>	
		<i>SYM_2</i>	
	<i>SYM_3</i>		
<i>Crankshaft sensor diagnosis with loss of synchronization</i>			

Filter types compatibility:

Filter Type	Compatibility	Remark
STD	NO	
STD_INI	NO	
MEM	YES	Preferred solution
MEM_INI	NO	
DEC_CAL	NO	
STC	NO	
NO_FIL	NO	

Figure A.46.3: Diagnosis /Failure Flag

Diagnosis / Failure Flag	Symptom		DTC
Crankshaft sensor synchronization diagnosis	Bit 0	Loss of crankshaft synchronization	P0370
	Bit 1	unused	
	Bit 2	unused	
LV_ERR_CRK_SYN	Bit 3	unused	

Diagnostic	Symptom description	Symptom	Filter type
<b>Crankshaft sensor circuit</b>			
	<i>OPEN / SHORT CIRCUIT</i>	<i>SYM_0</i>	<i>STD_INI</i>
		<i>SYM_1</i>	
		<i>SYM_2</i>	
	<i>SYM_3</i>		
<i>Magnetic crankshaft position sensor</i>			

Filter types compatibility:

Filter Type	Compatibility	Remark
STD	NO	
STD_INI	YES	Preferred solution
MEM	YES	
MEM_INI	NO	
DEC_CAL	NO	
STC	YES	
NO_FIL	NO	

Figure A.46.4: Diagnosis /Failure Flag

Diagnosis / Failure Flag	Symptom		DTC
Crankshaft sensor	Bit 0	open/short circuit	P0335
Circuit diagnosis	Bit 1	unused	
	Bit 2	unused	
LV_ERR_CRK_OC	Bit 3	unused	

## A.46.1 Crankshaft Sensor Diagnosis with Tooth Number Error

### FUNCTION DESCRIPTION:

#### General information:

The flag LV\_INH\_DIAG\_EXT\_CRK\_TOOTH allows to deactivate the corresponding diagnostic.

#### Application conditions:

##### *Initialisation:*

At reset event : LV\_INH\_DIAG\_EXT\_CRK\_TOOTH= 0

##### *Recurrence:*

Application incidence recurrence = once at reset

##### *Activation:*

-/-

##### *Deactivation:*

When the activation condition is not fulfilled

#### Formula section:

LV\_INH\_DIAG\_EXT\_CRK\_TOOTH = 0

## A.46.2 Crankshaft Sensor Diagnosis with implausible Tooth Period

### FUNCTION DESCRIPTION:

#### General information:

The flag LV\_INH\_DIAG\_EXT\_CRK\_TOOTH\_PER allows to deactivate the corresponding diagnostic.


#### Application conditions:

##### *Initialisation:*

At reset event : LV\_INH\_DIAG\_EXT\_CRK\_TOOTH\_PER= 0

##### *Recurrence:*

Application incidence recurrence = once at reset

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**Activation:**

-/-

**Deactivation:**

When the activation condition is not fulfilled

**Formula section:**

LV\_INH\_DIAG\_EXT\_CRK\_TOOTH\_PER = 0

**A.46.3 Crankshaft Sensor Diagnosis with Loss of Synchronization****FUNCTION DESCRIPTION:****General information:**

The flag LV\_INH\_DIAG\_EXT\_CRK\_SYN allows to deactivate the corresponding diagnostic.

**Application conditions:****Initialisation:**

At reset event : LV\_INH\_DIAG\_EXT\_CRK\_SYN = 0

**Recurrence:**

Application incidence recurrence = once at reset

**Activation:**

-/-

**Deactivation:**

When the activation condition is not fulfilled

**Formula section:**


LV\_INH\_DIAG\_EXT\_CRK\_SYN = 0

**A.46.4 Crankshaft Sensor Circuit Diagnosis (Appl. Inc.)****FUNCTION DESCRIPTION:****General information:**

The flag LV\_INH\_DIAG\_EXT\_CRK\_OC allows to deactivate the corresponding diagnostic.

**Application conditions:****Initialisation:**

At reset event : LV\_INH\_DIAG\_EXT\_CRK\_OC = 0

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**Recurrence:**

Application incidence recurrence = once at reset

**Activation:**

-/-

**Deactivation:**

When the activation condition is not fulfilled

**Formula section:**

LV\_INH\_DIAG\_EXT\_CRK\_OC = 0

**A.46.5 Crankshaft Sensor Plausibility Diagnosis (Appl. Inc.)****A.46.5.1 Diagnosis of crankshaft sensor****FUNCTION DESCRIPTION:****General information:**

The flag LV\_INH\_DIAG\_EXT\_CRK\_PLAUS allows to deactivate the corresponding diagnostic.

**Application conditions:****Initialisation:**

At reset event : LV\_INH\_DIAG\_EXT\_CRK\_PLAUS = 0

**Recurrence:**

Application incidence recurrence = once at reset

**Activation:**

-/-

**Deactivation:**

When the activation condition is not fulfilled

**Formula section:**

LV\_INH\_DIAG\_EXT\_CRK\_PLAUS = 0

Diagnosis / Failure Flag	Symptom		DTC
Crankshaft sensor plausibility diagnosis	Bit 0	Signal Missing	P0374
	Bit 1	Signal Implausible	P0373
	Bit 2	unused	
LV_ERR_CRK_PLAUS	Bit 3	unused	

## A.47 Crankshaft sensor plausibility diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CYC_ENG_PLAUS_CAM_EX [NC_NR_CAM_CBK]	V	0... FFH	0... 255	1	-
Engine cycle counter for camshaft signal plausibility diagnosis					
CTR_CYC_ENG_PLAUS_CAM_IN [NC_NR_CAM_CBK]	V	0... FFH	0... 255	1	-
Engine cycle counter for camshaft signal plausibility diagnosis					
CTR_ORNG_CAM_SYN_CRK	V	0... FFH	0... 255	1	-
Failure counter to detect camshaft error for crankshaft synchronization					
ERR_SYM_CRK_PLAUS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of the crankshaft failure synchronization impossible					
ERR_SYM_PLAUS_CAM_EX [NC_NR_CAM_CBK]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of the camshaft failure synchronization impossible					
ERR_SYM_PLAUS_CAM_IN [NC_NR_CAM_CBK]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of the camshaft failure synchronization impossible					
ERR_SYM_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of the exhaust camshaft diagnosis for crankshaft synchronization					
ERR_SYM_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of the intake camshaft diagnosis for crankshaft synchronization					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_CRK_PLAUS	V	0H 1H	PASSIVE ACTIVE	-	-
Diagnosis condition					
LV_CDN_DIAG_PLAUS_CAM_EX [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Diagnosis condition					
LV_CDN_DIAG_PLAUS_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Diagnosis condition					
LV_CDN_DIAG_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Diagnosis condition					
LV_CDN_DIAG_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Diagnosis condition					
LV_END_DIAG_CRK_PLAUS	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of crankshaft signal diagnosis synchronization impossible					
LV_END_DIAG_PLAUS_CAM_EX [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of camshaft signal diagnosis synchronization impossible					
LV_END_DIAG_PLAUS_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of camshaft signal diagnosis synchronization impossible					
LV_END_DIAG_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of exhaust camshaft diagnosis for crankshaft synchronization					
LV_END_DIAG_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of intake camshaft diagnosis for crankshaft synchronization					
LV_ERR_CRK_PLAUS	O/V	0H 1H	PASSIVE ACTIVE	-	-
Present crankshaft failure synchronization impossible					
LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK]	O/V/S	0H 1H	PASSIVE ACTIVE	-	-
Present camshaft failure synchronization impossible					
LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK]	O/V/S	0H 1H	PASSIVE ACTIVE	-	-
Present camshaft failure synchronization impossible					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]	O/V/S	0H 1H	PASSIVE ACTIVE	-	-
Present exhaust camshaft failure for crankshaft synchronization					
LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]	O/V/S	0H 1H	PASSIVE ACTIVE	-	-
Present intake camshaft failure for crankshaft synchronization					


**Input data:**

CTR_EDGE_CAM_EX [NC_NR_CAM_CBK] {p. 871}	CTR_EDGE_CAM_IN [NC_NR_CAM_CBK] {p. 871}	LV_ACT_CRK {p. 1505}	LV_ACT_SYN_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 1505}
LV_ACT_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 1505}	LV_AD_END_CAM_EX [NC_NR_CAM_CBK] {p. 1533}	LV_AD_END_CAM_IN [NC_NR_CAM_CBK] {p. 1533}	LV_CRK_MISS_RUN_ENG {p. 1505}
LV_CRK_SYN {p. 853}	LV_FIRST_VLD_TOOTH {p. 1505}	LV_IGK {p. 906}	LV_INH_DIAG_CRK_PLAUS {p. 4455}
LV_INH_DIAG_ENSD {p. 4455}	LV_INH_DIAG_EXT_CRK_PLAUS {p. 4439}	LV_INH_DIAG_EXT_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4414}	LV_INH_DIAG_EXT_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4414}
LV_INH_DIAG_EXT_SYN_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4414}	LV_INH_DIAG_EXT_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4414}	LV_INH_DIAG_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4455}	LV_INH_DIAG_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4455}
LV_INH_DIAG_SYN_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4456}	LV_INH_DIAG_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4456}	LV_ORNG_CAM_SYN_CRK {p. 871}	LV_STOP_ENG {p. 1505}
LV_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 872}	LV_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 872}	LV_SYN_VLD {p. 1506}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_ORNG_CAM_SYN_CRK_MAX	-	0... FFH	0... 255	1	-
Failure count to detect camshaft error for crankshaft synchronization					
C_NR_CYC_ENG_PLAUS_CAM_MAX	-	0... 7FH	0... 127	1	-
Number of engine cycles to detect camshaft plausibility error					
C_NR_EDGE_CAM_EX_SYN_CRK_MAX	-	1... FFH	1... 255	1	-
Number of exhaust camshaft signal edges to detect crankshaft plausibility error before synchronization					
C_NR_EDGE_CAM_IN_SYN_CRK_MAX	-	1... FFH	1... 255	1	-
Number of intake camshaft signal edges to detect crankshaft plausibility error before synchronization					
LC_CAM_ERR_ENA_VVT	-	0... 1H	0 ...1	1	-
Switch to enable camshaft error debouncing for VVT reactivation					
LC_CTR_DEC_PLAUS_CAM	-	0... 1H	0 ...1	1	-
Switch to enable camshaft plausibility debouncing					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
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**Error treatment:**

Diagnostic	Symptom description	Symptom	Filter type
<b>Crankshaft sensor</b>			
<i>Crankshaft sensor</i>	<i>SIGNAL MISSING</i>	<i>SYM_0</i>	<i>NO</i>
	<i>SIGNAL IMPLAUSIBLE</i>	<i>SYM_1</i>	
		<i>SYM_2</i>	
		<i>SYM_3</i>	

NB: The filter type for this diagnosis can not be configured, it behaves as a MEM filter.

Diagnostic	Symptom description	Symptom	Filter type
<b>Camshaft sensor plausability</b>			
<i>Camshaft sensor plausability diagnosis for intake</i>	<i>SIGNAL MISSING</i>	<i>SYM_0</i>	<i>NO</i>
		<i>SYM_1</i>	
		<i>SYM_2</i>	
		<i>SYM_3</i>	
<i>Camshaft sensor plausability diagnosis for exhaust</i>	<i>SIGNAL MISSING</i>	<i>SYM_0</i>	<i>NO</i>
		<i>SYM_1</i>	
		<i>SYM_2</i>	
		<i>SYM_3</i>	

NB: The filter type for this diagnosis can not be configured, but it behaves as a MEM if LC\_CTR\_DEC\_PLAUS\_CAM = 0, and as a STD\_INI if LC\_CTR\_DEC\_PLAUS\_CAM = 1



Diagnostic	Symptom description	Symptom	Filter type
Camshaft sensor diagnosis for crankshaft synchronization			
	<i>SIGNAL INVALID</i>	<i>SYM_0</i>	<i>NO</i>
		<i>SYM_1</i>	
		<i>SYM_2</i>	
	<i>SYM_3</i>		
Camshaft sensor diagnosis for crankshaft synchronization on intake			
	<i>SIGNAL INVALID</i>	<i>SYM_0</i>	<i>NO</i>
		<i>SYM_1</i>	
		<i>SYM_2</i>	
	<i>SYM_3</i>		
Camshaft sensor diagnosis for crankshaft synchronization on exhaust			
	<i>SIGNAL INVALID</i>	<i>SYM_0</i>	<i>NO</i>
		<i>SYM_1</i>	
		<i>SYM_2</i>	
	<i>SYM_3</i>		

NB: The filter type for this diagnosis can not be configured, but it behaves as a MEM if LC\_CAM\_ERR\_ENA\_VVT = 0, and as a STD\_INI if LC\_CAM\_ERR\_ENA\_VVT = 1

## A.47.1 Diagnosis of crankshaft sensor

### FUNCTION DESCRIPTION:

#### General information:

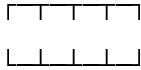
The purpose of the function is to detect a failure if synchronization on crankshaft signal cannot be achieved.

One of the available camshaft signals is selected for crankshaft synchronization by setting one of the flags LV\_ACT\_SYN\_CRK\_CAM\_IN[i] in the engine position control function. The signal edge counter of that camshaft is observed while the crankshaft is not synchronized. If the count reaches a calibrated number, and the system is still not synchronized with the crankshaft signal, then crankshaft sensor plausibility error is set without further debouncing. If valid crankshaft teeth have already been detected, the symptom will be implausible signal, otherwise it will be missing signal.

$i = 1 \dots NC\_NR\_CAM\_CBK$

#### Description:

Error-symptoms are defined to this diagnostic function as following:



| | | | ↪ Signal missing (= SYM\_0)  
 | | | | ↪ Signal implausible (= SYM\_1)  
 | | | | ↪ (not used) (= SYM\_2)  
 | | | | ↪ (not used) (= SYM\_3)

### Application conditions:

#### *Initialisation:*

LV\_CDN\_DIAG\_CRK\_PLAUS = 0 at reset  
 LV\_END\_DIAG\_CRK\_PLAUS = 0 at reset  
 ERR\_SYM\_CRK\_PLAUS = NO\_SYM at reset  
 LV\_ERR\_CRK\_PLAUS = 0 at reset

*Recurrence:* every update of CTR\_EDGE\_CAM\_IN(EX)[i]  
 And  
 0 to 1 transition of LV\_STOP\_ENG

**Activation:** LV\_ACT\_CRK = 1  
 And LV\_INH\_DIAG\_CRK\_PLAUS = 0  
 And LV\_INH\_DIAG\_EXT\_CRK\_PLAUS = 0  
 And LV\_INH\_DIAG\_ENSD = 0

When the activation condition is fulfilled then LV\_CDN\_DIAG\_CRK\_PLAUS = 1.

#### *Deactivation:*

When the activation condition is not fulfilled then LV\_CDN\_DIAG\_CRK\_PLAUS = 0.

### Formula Section

#### Symptoms calculation:

```

If LV_STOP_ENG = 1
  And
  LV_CRK_MISS_RUN_ENG = 1
Then ERR_SYM_CRK_PLAUS = "SYM_0"
  {Crankshaft signal missing but engine is still turning}
else
  If LV_CRK_SYN = 0
  and CTR_EDGE_CAM_IN(EX)[i] > C_NR_EDGE_CAM_IN(EX)_SYN_CRK_MAX
  Then If LV_FIRST_VLD_TOOTH = 1
    Then ERR_SYM_CRK_PLAUS = SYM_1"
    {Detection of symptom SIGNAL IMPLAUSIBLE}
    Else ERR_SYM_CRK_PLAUS = SYM_0"
    {Detection of symptom SIGNAL MISSING}
  Endif
  LV_ERR_CRK_PLAUS = 1
  LV_END_DIAG_CRK_PLAUS = 1
  
```

**Endif**

**Endif**

LV\_ERR\_CRK\_PLAUS and ERR\_SYM\_CRK\_PLAUS are reset to initialization value at 0 to 1 transition of LV\_IGK.

```

If      LV_CRK_SYN = 1
Then    LV_END_DIAG_CRK_PLAUS = 1
          LV_ERR_CRK_PLAUS = 0
          ERR_SYM_CRK_PLAUS = NO_SYM
          Deliver the result to Error Management

```

**Endif**

## A.47.2 Camshaft sensor plausibility diagnosis

### FUNCTION DESCRIPTION:

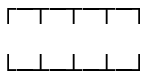
#### General information:

The functional camshaft diagnosis cannot detect a failure when a camshaft sensor delivers no signal at all. Missing signal will be detected if the camshaft edge counter is not incremented at least once per engine cycle.

i = 1...NC\_NR\_CAM\_CBK

#### Description:

Error-symptoms are defined to this diagnostic function as following:



	↳ Signal missing	(= SYM_0)
	↳ (not used)	(= SYM_1)
	↳ (not used)	(= SYM_2)
	↳ (not used)	(= SYM_3)

#### Application conditions:

##### *Initialisation:*

LV\_CDN\_DIAG\_PLAUS\_CAM\_IN(EX)[i] = 0 at reset

LV\_END\_DIAG\_PLAUS\_CAM\_IN(EX)[i] = 0 at reset

ERR\_SYM\_PLAUS\_CAM\_IN(EX)[i] = NO\_SYM at reset

LV\_ERR\_PLAUS\_CAM\_IN(EX)[i] = 0 at reset

CTR\_CYC\_ENG\_PLAUS\_CAM\_IN(EX)[i] = C\_NR\_CYC\_ENG\_PLAUS\_CAM\_MAX at reset

*Recurrence:* once per engine cycle (two crankshaft revolutions), at any phasing i.e. on crankshaft revolution which was on-going at engine synchronization

Activation:

```

LV_CRK_SYN = 1
And LV_INH_DIAG_PLAUS_CAM_IN(EX)[i] = 0
And LV_INH_DIAG_EXT_PLAUS_CAM_IN(EX)[i] = 0
And LV_INH_DIAG_ENSD = 0
And C_NR_CYC_ENG_PLAUS_CAM_MAX ? 0

```

When the activation condition is fulfilled then LV\_CDN\_DIAG\_PLAUS\_CAM\_IN(EX)[i] = 1.

*Deactivation:*

When the activation condition is not fulfilled then LV\_CDN\_DIAG\_PLAUS\_CAM\_IN(EX)[i] = 0.

### Formula Section

Symptoms calculation:

```

If CTR_EDGE_CAM_IN(EX)[i]n = CTR_EDGE_CAM_IN(EX)[i]n-1
Then ERR_SYM_PLAUS_CAM_IN(EX)[i] = SYM_0" {SIGNAL MISSING}
      increment CTR_CYC_ENG_PLAUS_CAM_IN(EX)[i]
Else ERR_SYM_PLAUS_CAM_IN(EX)[i] = NO_SYM
      decrement CTR_CYC_ENG_PLAUS_CAM_IN(EX)[i]
Endif
CTR_EDGE_CAM_IN(EX)[i]n-1 will be initialized to zero at engine stop detection.

If CTR_CYC_ENG_PLAUS_CAM_IN(EX)[i] = 2*C_NR_CYC_ENG_PLAUS_CAM_MAX
Then LV_ERR_PLAUS_CAM_IN(EX)[i] = 1
      LV_END_DIAG_PLAUS_CAM_IN(EX)[i] = 1
      reset CTR_CYC_ENG_PLAUS_CAM_IN(EX)[i] (to C_NR_CYC_ENG_PLAUS_CAM_MAX)

      Deliver the result to Error Management
Else If CTR_CYC_ENG_PLAUS_CAM_IN(EX)[i] = 0
      Then If LC_CTR_DEC_PLAUS_CAM = 1
      Then LV_ERR_PLAUS_CAM_IN(EX)[i] = 0
      Endif
      LV_END_DIAG_PLAUS_CAM_IN(EX)[i] = 1
      reset CTR_CYC_ENG_PLAUS_CAM_IN(EX)[i] (to C_NR_CYC_ENG_PLAUS_CAM_MAX)
      Deliver the result to Error Management
Endif
Endif

```

LV\_ERR\_PLAUS\_CAM\_IN(EX)[i] , ERR\_SYM\_PLAUS\_CAM\_IN(EX)[i] and CTR\_CYC\_ENG\_PLAUS\_CAM\_IN(EX)[i] are reset to initialization value at 0 to 1 transition of LV\_IGK.

```

If LV_SYN_CAM_IN(EX)[i] = 1
Then If LC_CTR_DEC_PLAUS_CAM = 1
      Then LV_ERR_PLAUS_CAM_IN(EX)[i] = 0
      Endif
      LV_END_DIAG_PLAUS_CAM_IN(EX)[i] = 1
      ERR_SYM_PLAUS_CAM_IN(EX)[i] = NO_SYM
      reset CTR_CYC_ENG_PLAUS_CAM_IN(EX)[i] (to C_NR_CYC_ENG_PLAUS_CAM_MAX)

      Deliver the result to Error Management
Endif

```

## A.47.3 Camshaft Sensor Diagnosis for Crankshaft Synchronization

### FUNCTION DESCRIPTION:

#### General information:

The purpose of the function is to detect a failure of the camshaft information for crankshaft synchronization.

Up to four camshaft signals may be available in the system (intake and/or exhaust on one or two cylinder banks). The Engine Position Control selects one camshaft for synchronization by activating the corresponding operating mode. The camshaft signal acquisition will indicate camshaft signal out of range for crankshaft synchronization by setting LV\_ORNG\_CAM\_SYN\_CRK, which has to be reset by the diagnosis after treatment. A counter is incremented at every recurrence if LV\_ORNG\_CAM\_SYN\_CRK is set. The error is detected when the counter reaches a calibrated maximum.

$i = 1 \dots NC\_NR\_CAM\_CBK$

#### Description:

Error-symptoms are defined to this diagnostic function as following:



	↳ Camshaft signal not valid for crankshaft synchronization	(= SYM_0)
	↳ (not used)	(= SYM_1)
	↳ (not used)	(= SYM_2)
	↳ (not used)	(= SYM_3)

#### Application conditions:

##### *Initialisation:*

LV\_CDN\_DIAG\_SYN\_CRK\_CAM\_IN(EX)[i] = 0 at reset

LV\_END\_DIAG\_SYN\_CRK\_CAM\_IN(EX)[i] = 0 at reset

ERR\_SYM\_SYN\_CRK\_CAM\_IN(EX)[i] = NO\_SYM at reset

LV\_ERR\_SYN\_CRK\_CAM\_IN(EX)[i] = 0 at reset

*Recurrence:* every crankshaft reference gap and every camshaft edge

*Activation:* LV\_ACT\_CRK = 1

And LV\_INH\_DIAG\_SYN\_CRK\_CAM\_IN(EX)[i] = 0

And LV\_INH\_DIAG\_EXT\_SYN\_CRK\_CAM\_IN(EX)[i] = 0


And LV\_INH\_DIAG\_ENSD = 0

When the activation condition is fulfilled then LV\_CDN\_DIAG\_SYN\_CRK\_CAM\_IN(EX)[i] = 1

##### *Deactivation:*

When the activation condition is not fulfilled then LV\_CDN\_DIAG\_SYN\_CRK\_CAM\_IN(EX)[i] = 0.

### Formula Section

Released by Tettenborn Frank		Date 2013-02-13	File 30A0B901.00L
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 4453 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

**Symptoms calculation:**

For LV\_ACT\_SYN\_CRK\_CAM\_IN(EX)[i] = 1 (camshaft sensor currently selected for synchronization):

```

if      LV_ORNG_CAM_SYN_CRK = 0
then    ERR_SYM_SYN_CRK_CAM_IN(EX)[i] = NO_SYM
else    ERR_SYM_SYN_CRK_CAM_IN(EX)[i] = SYM_0" {SIGNAL INVALID}
          increment CTR_ORNG_CAM_SYN_CRK
endif

if      CTR_ORNG_CAM_SYN_CRK > C_CTR_ORNG_CAM_SYN_CRK_MAX
then    LV_ERR_SYN_CRK_CAM_IN(EX)[i] = 1
          LV_END_DIAG_SYN_CRK_CAM_IN(EX)[i] = 1
          Deliver the result to Error Management
          reset CTR_ORNG_CAM_SYN_CRK
endif

if      LV_SYN_VLD = 1
then    LV_END_DIAG_SYN_CRK_CAM_IN(EX)[i] = 1
          ERR_SYM_SYN_CRK_CAM_IN(EX)[i] = NO_SYM
          LV_ERR_SYN_CRK_CAM_IN(EX)[i] = 0
          Deliver the result to Error Management
          reset CTR_ORNG_CAM_SYN_CRK
endif

```

For LV\_ACT\_SYN\_CRK\_CAM\_IN(EX)[i] = 0 (camshaft sensor currently **not** selected for cam/crk synchronization):

```

if      LV_SYN_CAM_IN(EX)[i] = 1
          And
          LV_AD_END_CAM_IN(EX)[i] = 1
then    ERR_SYM_SYN_CRK_CAM_IN(EX)[i] = NO_SYM
          If      LC_CAM_ERR_ENA_VVT = 1
          Then    LV_ERR_SYN_CRK_CAM_IN(EX)[i] = 0
          LV_END_DIAG_SYN_CRK_CAM_IN(EX)[i] = 1
          Deliver the result to Error Management
          Endif
endif

```

LV\_ERR\_SYN\_CRK\_CAM\_IN(EX)[i], ERR\_SYM\_SYN\_CRK\_CAM\_IN(EX)[i] and CTR\_ORNG\_CAM\_SYN\_CRK are reset to initialization value at 0 to 1 transition of LV\_IGK.

## A.48 Engine position and speed diagnosis manager

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Failure of exhaust camshaft sensor i					
LV_ERR_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Failure of intake camshaft sensor i					
LV_ERR_CAM_TOT	O/V	0... 1H	0 ...1	1	-
Failure of at least one camshaft sensor on a camshaft with IVVT actuator					
LV_ERR_CRK	O/V	0... 1H	0 ...1	1	-
Crankshaft sensor failure					
LV_IGN_INJ_LOCK_REQ	O/V	0... 1H	0 ...1	1	-
Request to lock ignition and/or injection due to backwards rotation detection					
LV_INH_DIAG_CRK_OC	O/V	0... 1H	0 ...1	1	-
Inhibition of Crankshaft sensor circuit diagnosis					
LV_INH_DIAG_CRK_PLAUS	O/V	0... 1H	0 ...1	1	-
Inhibition of Crankshaft sensor plausibility diagnosis					
LV_INH_DIAG_CRK_SYN	O/V	0... 1H	0 ...1	1	-
Inhibition of Crankshaft sensor synchronization diagnosis					
LV_INH_DIAG_CRK_TOOTH	O/V	0... 1H	0 ...1	1	-
Inhibition of Crankshaft sensor tooth number diagnosis					
LV_INH_DIAG_CRK_TOOTH_PER	O/V	0... 1H	0 ...1	1	-
Inhibition of Crankshaft sensor tooth period diagnosis					
LV_INH_DIAG_ENSD	O/V	0... 1H	0 ...1	1	-
Inhibition of cam/crk diagnosis during fail safe delay					
LV_INH_DIAG_PER_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of exhaust camshaft i period diagnosis					
LV_INH_DIAG_PER_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of intake camshaft i period diagnosis					
LV_INH_DIAG_PLAUS_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of exhaust camshaft i plausibility diagnosis					
LV_INH_DIAG_PLAUS_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of intake camshaft i plausibility diagnosis					
LV_INH_DIAG_REF_CRK_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of exhaust camshaft i position diagnosis					
LV_INH_DIAG_REF_CRK_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of intake camshaft i position diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_SYN_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of exhaust camshaft i synchronization diagnosis					
LV_INH_DIAG_SYN_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of intake camshaft i synchronization diagnosis					
LV_INH_DIAG_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of exhaust camshaft sensor diagnosis for crankshaft synchronization					
LV_INH_DIAG_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of intake camshaft sensor diagnosis for crankshaft synchronization					
LV_INH_DIAG_TOOTH_OFF_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of exhaust camshaft i one-tooth-off diagnosis					
LV_INH_DIAG_TOOTH_OFF_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of exhaust camshaft i one-tooth-off diagnosis					

**Input data:**

LC_NOT_ADJ_CAM_IVVT_EX [NC_NR_CBK_IVVT] {p. 8400}	LC_NOT_ADJ_CAM_IVVT_IN [NC_NR_CBK_IVVT] {p. 8400}	LV_ENG_BACK_CFM {p. 1505}	LV_ENG_BACK_DET {p. 1505}
LV_ERR_CRK_OC {p. 4430}	LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}
LV_ERR_CRK_TOOTH_PER {p. 4432}	LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}
LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_IGK {p. 906}	LV_ORNG_CAM_SYN_CRK {p. 871}	LV_ORNG_TOOTH_PER_CRK {p. 853}
LV_STOP_ENG {p. 1505}	LV_SYN_ENG {p. 1506}	LV_SYN_VLD {p. 1506}	N_TOOTH {p. 1525}
NC_NR_CAM_CBK {p. 1507}	NLC_IVVT_EX {p. 8400}	NLC_IVVT_IN {p. 8401}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_NOT_REST	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for cam/crk diagnosis deactivation					
C_T_DLY_REST_IGK	-	0... FFH	0... 2550	10	ms
Delay time for diagnosis reactivation after key-off at low engine speed					
C_T_DLY_REST_STALL	-	0... FFFFH	0... 655350	10	ms
Delay time for diagnosis reactivation after engine stalling					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MAX_INH_DIAG_ENSD	-	0... FFFFH	0... 655350	10	ms
Maximum delay before reactivating diagnosis after engine backwards rotation confirmation					
C_T_MIN_INH_DIAG_ENSD	-	0... FFFFH	0... 655350	10	ms
Minimum delay before reactivating diagnosis in case of key off to on after engine backwards rotation confirmation					
LC_ENG_BACK_INH	-	0... 1H	0 ...1	1	-
Inhibition of engine backwards rotation detection					

## A.48.1 Calculation of Fail Safe Delay

### General information:

Calculation of the time delay to inhibit cam/crk diagnosis when there is a risk of reverse engine rotation.

### Application conditions

**Initialisation:** no initialization value.  
**Recurrence:** 10ms **and** 1 to 0 transition of LV\_IGK  
**Activation:** no condition  
**Deactivation:** no condition

### Formula section:

```

If          LV_IGK = 0      And      LV_INH_DIAG_ENSD = 0
Then       check N_TOOTH every 10ms
              If          0 < N_TOOTH < C_N_NOT_REST
              Then       Inhibition of all diagnosis functions except sensor circuit diagnosis
                          LV_INH_DIAG_ENSD = 1
                          Wait for a time C_T_DLY_REST_IGK
                          LV_INH_DIAG_ENSD = 0
              Endif
Endif

If          LV_STOP_ENG = 1      And LV_ENG_BACK_DET = 0
/* to be checked before LV_ENG_BACK_DET reset on LV_STOP_ENG transition */
And
/* don't activate fail safe delay if cam/crk synchronization is out of range */
LV_ORNG_CAM_SYN_CRK = 0
And
/* don't activate fail safe delay if tooth period is out of range */
LV_ORNG_TOOTH_PER_CRK = 0
And
LV_INH_DIAG_ENSD = 0
Then       If          0 < N_TOOTH < C_N_NOT_REST
                          (N_TOOTH: most recently calculated engine speed)
              Then       Inhibition of all diagnosis functions except sensor circuit diagnosis
                          LV_INH_DIAG_ENSD = 1
                          Wait for a time C_T_DLY_REST_STALL

```

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 4457 of 8404	
Regensburg (RGB)		Copyright ( C ) Continental AG,2007	A4: 2007-11

Stop timer C\_T\_DLY\_REST\_STALL at 0 to 1 transition of LV\_IGK  
 LV\_INH\_DIAG\_ENSD = 0

Endif

Endif

## A.48.2 Diagnosis general inhibition in case of engine backwards rotation detection

### General information:

Inhibits cam/crk diagnosis when a reverse engine rotation has been detected until confirmation/nullification.

### Application conditions

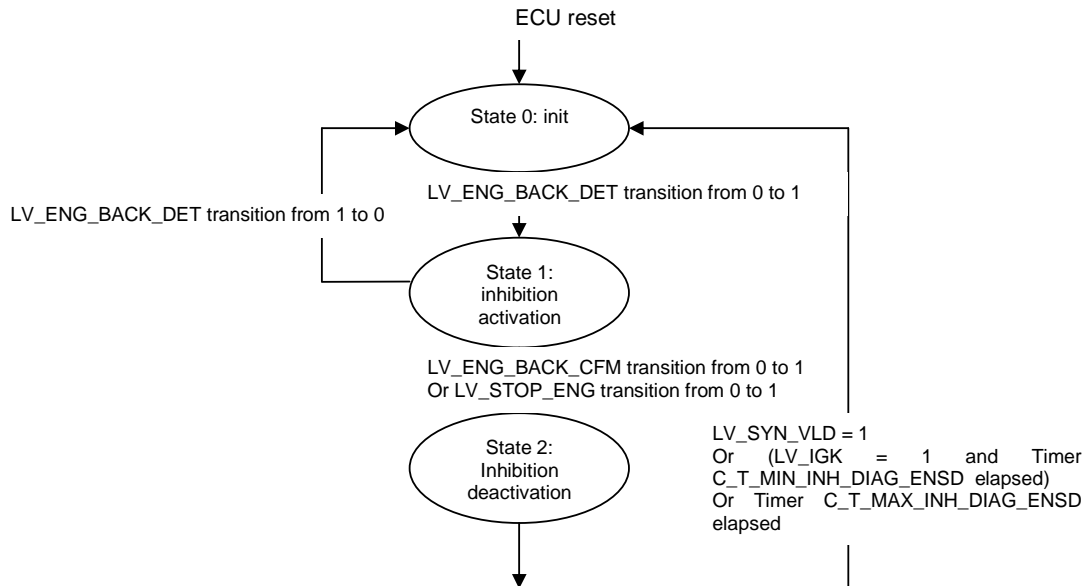
**Initialisation:** no initialization value.

**Recurrence:** 10ms **and** transition from 1 to 0 of LV\_IGK **and** every update of LV\_ENG\_BACK\_DET or LV\_ENG\_BACK\_CFM **and** transition from 0 to 1 of LV\_SYN\_VLD **and** transition from 0 to 1 of LV\_STOP\_ENG

**Activation:** LC\_ENG\_BACK\_INH = 0

**Deactivation:** when application conditions are not fulfilled

### Formula section:



### State 0: Initialisation

#### Input conditions:

External event : ECU reset  
 From state 1: LV\_ENG\_BACK\_DET transition from 1 to 0  
 From state 2: LV\_SYN\_VLD = 1  
 Or (LV\_IGK = 1 and timer C\_T\_MIN\_INH\_DIAG\_ENSD elapsed)

Or timer C\_T\_MAX\_INH\_DIAG\_ENSD elapsed

*Output conditions:*

To state 1: LV\_ENG\_BACK\_DET transition from 0 to 1  
**And** Timer C\_T\_DLY\_REST\_IGK stopped

*Action in the state:*

Set timer to C\_T\_MIN\_INH\_DIAG\_ENSD  
 Set timer to C\_T\_MAX\_INH\_DIAG\_ENSD

*Transition action:*

None

State 1: Inhibition activation

*Input conditions:*

From state 0: LV\_ENG\_BACK\_DET transition from 0 to 1

*Output conditions:*

To state 0: ECU reset  
 Or LV\_ENG\_BACK\_DET transition from 1 to 0  
 To state 2: LV\_ENG\_BACK\_CFM transition from 0 to 1  
 Or LV\_STOP\_ENG transition from 0 to 1

*Action in the state:*

LV\_INH\_DIAG\_ENSD = 1  
 LV\_IGN\_INJ\_LOCK\_REQ = 1  
 Stop timer C\_T\_MIN\_INH\_DIAG\_ENSD if on-going  
 Stop timer C\_T\_MAX\_INH\_DIAG\_ENSD if on-going

*Transition action:*

To state 0: LV\_INH\_DIAG\_ENSD = 0  
 LV\_IGN\_INJ\_LOCK\_REQ = 0  
 To State 2: Start timer C\_T\_MAX\_INH\_DIAG\_ENSD  
 Start timer C\_T\_MIN\_INH\_DIAG\_ENSD if LV\_IGK = 0

State 2: Inhibition deactivation

*Input conditions:*

From state 1: LV\_ENG\_BACK\_CFM transition from 0 to 1  
 Or LV\_STOP\_ENG transition from 0 to 1

*Output conditions:*

To state 0: ECU reset  
 Or LV\_SYN\_VLD = 1  
 Or (LV\_IGK = 1 and timer C\_T\_MIN\_INH\_DIAG\_ENSD elapsed)  
 Or timer C\_T\_MAX\_INH\_DIAG\_ENSD elapsed

*Action in the state:*

Start timer C\_T\_MIN\_INH\_DIAG\_ENSD on transition of LV\_IGK from 1 to 0


*Transition action:*

To state 0: LV\_INH\_DIAG\_ENSD = 0  
 LV\_IGN\_INJ\_LOCK\_REQ = 0

Remark: if C\_T\_MIN\_INH\_DIAG\_ENSD = 0, then timer is started at transition of LV\_IGK from 1 to 0 and considered as elapsed immediately.

## A.48.3 Diagnosis Manager

General information:

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One purpose of the diagnosis manager is to provide a summary of diagnostic information, in order to facilitate taking the necessary actions in case of a failure, e.g. switch to limp-home mode. The corresponding outputs are crankshaft limp-home request a general camshaft error flag for IVVT, and a general camshaft error for synchronization.

The other purpose is to avoid getting multiple error codes and freeze frames for the same failure. The corresponding outputs are the inhibit flags for the various diagnosis functions.

$i = 1 \dots NC\_NR\_CAM\_CBK$

### Application conditions

**Initialisation:** no initialization value.

**Recurrence:** every change in the error flags of one of the diagnostic functions  
Or  
when error memory is cleared  
Or  
At key 0 to 1 transition

**Activation:**

**Deactivation:**

### Formula section:

#### LV\_ERR\_CRK

$LV\_ERR\_CRK = 1$  if  $LV\_ERR\_CRK\_SYN = 1$  or  $LV\_ERR\_CRK\_TOOTH\_PER = 1$  or  $LV\_ERR\_CRK\_TOOTH = 1$  or  $LV\_ERR\_CRK\_PLAUS = 1$  or  $LV\_ERR\_CRK\_OC = 1$

$LV\_ERR\_CRK = 0$  if  $LV\_ERR\_CRK\_SYN = 0$  and  $LV\_ERR\_CRK\_TOOTH\_PER = 0$  and  $LV\_ERR\_CRK\_TOOTH = 0$  and  $LV\_ERR\_CRK\_PLAUS = 0$  and  $LV\_ERR\_CRK\_OC = 0$ .

If  $LV\_ERR\_CRK = 1$ , all other diagnoses on the crankshaft signal will be inhibited via the interfaces  $LV\_INH\_DIAG\_CRK\_SYN$ ,  $LV\_INH\_DIAG\_CRK\_TOOTH$ ,  $LV\_INH\_DIAG\_CRK\_TOOTH\_PER$ ,  $LV\_INH\_DIAG\_CRK\_PLAUS$  and  $LV\_INH\_DIAG\_CRK\_OC$ , except the one that detected the failure.

#### LV\_ERR\_CAM\_IN(EX)[i]

$LV\_ERR\_CAM\_IN(EX)[i] = 1$  if  $LV\_ERR\_SYN\_CAM\_IN(EX)[i] = 1$  or  $LV\_ERR\_PER\_CAM\_IN(EX)[i] = 1$  or  $LV\_ERR\_PLAUS\_CAM\_IN(EX)[i] = 1$  or  $LV\_ERR\_REF\_CRK\_CAM\_IN(EX)[i] = 1$  or  $LV\_ERR\_SYN\_CRK\_CAM\_IN(EX)[i] = 1$  or  $LV\_ERR\_TOOTH\_OFF\_IN(EX)[i] = 1$ .

$LV\_ERR\_CAM\_IN(EX)[i] = 0$  if  $LV\_ERR\_SYN\_CAM\_IN(EX)[i] = 0$  and  $LV\_ERR\_PER\_CAM\_IN(EX)[i] = 0$  and  $LV\_ERR\_PLAUS\_CAM\_IN(EX)[i] = 0$  and  $LV\_ERR\_REF\_CRK\_CAM\_IN(EX)[i] = 0$  and  $LV\_ERR\_SYN\_CRK\_CAM\_IN(EX)[i] = 0$  and  $LV\_ERR\_TOOTH\_OFF\_IN(EX)[i] = 0$ .

If  $LV\_ERR\_CAM\_IN(EX)[i] = 1$ , other diagnoses on the same camshaft signal will be inhibited via the interfaces  $LV\_INH\_DIAG\_SYN\_CAM\_IN(EX)[i]$ ,  $LV\_INH\_DIAG\_PER\_CAM\_IN(EX)[i]$ ,  $LV\_INH\_DIAG\_PLAUS\_CAM\_IN(EX)[i]$ ,  $LV\_INH\_DIAG\_REF\_CRK\_CAM\_IN(EX)[i]$  and  $LV\_INH\_DIAG\_TOOTH\_OFF\_IN(EX)[i]$ , except the one that detected the failure.


#### LV\_ERR\_CAM\_TOT

VVT actuators existing in the system are given by a logical combination of the configuration data  $NLC\_IVVT\_IN(EX)$  and the calibration data  $LC\_NOT\_ADJ\_CAM\_IVVT\_IN(EX)[i]$ .

$LV\_ERR\_CAM\_TOT = 1$  if  $LV\_ERR\_CAM\_IN(EX)[i] = 1$  for one of the sensors on camshafts with IVVT actuator.

$LV\_ERR\_CAM\_TOT = 0$  if  $LV\_ERR\_CAM\_IN(EX)[i] = 0$  for all sensors on camshafts with IVVT actuator.

## A.48.4 Inhibition of camshaft sensor diagnosis for crankshaft synchronization

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**General information:**

Calculation of the inhibition flag of camshaft sensor diagnosis for crankshaft synchronization in case of possible reverse rotation.

I = 1...NC\_NR\_CAM\_CBK

**Application conditions**

**Initialisation:** LV\_INH\_DIAG\_SYN\_CRK\_CAM\_IN(EX) [i] = 0 at ECU reset **and** 0 to 1 transition of LV\_IGK

**Recurrence:** 10ms **and** transition from 0 to 1 of LV\_STOP\_ENG **and** transition from 0 to 1 of LV\_SYN\_VLD

**Activation:** -

**Deactivation:** -

**Formula section:**

```


If   LV_SYN_ENG = 0
      And   LC_ENG_BACK_INH = 0
          And   LV_INH_DIAG_ENSD = 0
          And   0 < N_TOOTH < C_N_NOT_REST
              And   LV_ORNG_TOOTH_PER_CRK = 1
Then  LV_INH_DIAG_SYN_CRK_CAM_IN(EX)[i] = 1
Endif

```

```

If   LV_SYN_VLD = 1
Then  LV_INH_DIAG_SYN_CRK_CAM_IN(EX)[i] = 0
Endif

```

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## A.49 Engine overspeed detection diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_KM_N_MAX	O/V/S	0... FFFFH	0... 655350	10	km
km counter at highest event					
CTR_N_MAX	O/V/S	0... FFH	0... 255	1	-
event frequency counter					
GEAR_EF_N_MAX	O/V/S	0... FFH	0... 255	1	-
Gear ratio at highest event					
LV_CS_N_MAX	O/V/S	0... 1H	0 ...1	1	-
Clutch switch detection at highest event					
N_GRD_N_MAX	O/V/S	80... 7FH	-4096 ...4064	32	rpm/s
Engine speed gradient at highest event					
N_MAX	O/V/S	0... 1FE0H	0... 8160	1	rpm
highest engine speed reached					
NR_PAT_SCC_N_MAX	O/V/S	0... FFH	0... 255	1	-
Selected index of fuel cut off pattern at highest event					
PV_AV_N_MAX	O/V/S	0... FFH	0... 99.609375	0.390625	%
Pedal value at highest event					
T_N_MAX	O/V/S	0... FFFFH	0... 6553.5	0.1	s
Time sum at highest event					
T_SUM_N_MAX	O/V/S	0... FFFFH	0... 6553.5	0.1	s
Time sum of all events maximum engine speed reached					
TRT_N_MAX	O/V/S	0... FFFFFFFFH	0... 119.304647083e3	27.7777e-6	h
total running time in case of maximum engine speed reached					
VS_N_MAX	O/V/S	0... FFH	0... 255	1	km/h
Vehicle speed at highest event					

### Input data:

CTR_KM_CAN {p. 1563}	GEAR_EF {p. 1302}	LV_CS {p. 8394}	LV_N_MAX {p. 3779}
LV_VS_MAX {p. 1148}	N {p. 1525}	N_GRD {p. 1525}	NR_PAT_SCC {p. 6665}
PV_AV {p. 1269}	TRT {p. 1504}	VS {p. 1176}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_LIM_MIN	V	0... 1FE0H	0... 8160	1	rpm
engine speed threshold for overreving event					

### General information

This function is for detection of an overreving event and with non-volatile storage of environmental datas if triggered.

### Description:

An overreving event starts at exceeding the engine speed C\_N\_LIM\_MIN and active engine speed limitation (LV\_N\_MAX = 1).

At each overrevving event, the event frequency counter CTR\_N\_MAX is incremented by 1. The timer T\_SUM\_N\_MAX is always incremented at every active event and remains at the maximum value if reached. The timer T\_N\_TMP recorded the duration of each event and is used for the T\_N\_MAX calculation (= the duration with the highest event)

The remaining environmental data are stored at the first event but will be only overwritten if the new event has a higher engine speed then the old one. At the end of a driving cycle the data are stored in NVMY.

### Application conditions:

**Initialisation:** all data restored out of NVMY  
**Activation:** at [ LV\_N\_MAX = 1 and LV\_VS\_MAX = 0 ]  
**Deactivation:** at LV\_N\_MAX = 0  
**Recurrence:** segment synchronous

### Function description:

#### Formula section:

##### determination of event-frequency-counter :

```
if      N > C_N_LIM_MIN
then    CTR_N_MAX = CTR_N_MAX + 1    ( only once per trigger )
else    CTR_N_MAX = CTR_N_MAX
endif
```

##### determination of total time :


```
if      N > C_N_LIM_MIN
then    starts timer T_SUM_N_MAX    (always incremented, remains at
                                     FFFFH if reached)
else    stop timer T_SUM_N_MAX
endif
```

##### determination of individual time per event :

```
if      N > C_N_LIM_MIN
then    T_N_TMP ++
        N_MAX_TMP = MAX [ N ]
elseif  N_MAX_TMP > N_MAX           //stored in NVMY or stored at last event
then    T_N_MAX = T_N_TMP           //update
else    T_N_MAX = T_N_MAX           //unchanged
endif
T_N_TMP = 0                         //reset
N_MAX_TMP = 0                       //reset
endif
```

##### determination of environmental data at first event :

```
if      N > C_N_LIM_MIN
then    N_MAX           = N
        TRT_N_MAX      = TRT
        CTR_KM_N_MAX    = CTR_KM_CAN
```

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```

N_GRD_N_MAX          = N_GRD
VS_N_MAX             = VS
PV_AV_N_MAX         = PV_AV
GEAR_EF_N_MAX       = GEAR_EF
LV_CS_N_MAX         = LV_CS
NR_PAT_SCC_N_MAX     = NR_PAT_SCC

```

**endif**

determination of environmental data at the next events:

```

if      N > C_N_LIM_MIN      and
          N > N_MAX           (stored in NVMY or stored at last event)
then    update of all environmental data:
          N_MAX               = N
          TRT_N_MAX           = TRT
          CTR_KM_N_MAX        = CTR_KM_CAN
          N_GRD_N_MAX         = N_GRD
          VS_N_MAX            = VS
          PV_AV_N_MAX         = PV_AV
          GEAR_EF_N_MAX       = GEAR_EF
          LV_CS_N_MAX         = LV_CS
          NR_PAT_SCC_N_MAX     = NR_PAT_SCC
else    old values remains unchanged:
          N_MAX               = N_MAX
          TRT_N_MAX           = TRT_N_MAX
          CTR_KM_N_MAX        = CTR_KM_N_MAX
          N_GRD_N_MAX         = N_GRD_N_MAX
          VS_N_MAX            = VS_N_MAX
          PV_AV_N_MAX         = PV_AV_N_MAX
          GEAR_EF_N_MAX       = GEAR_EF_N_MAX
          LV_CS_N_MAX         = LV_CS_N_MAX
          NR_PAT_SCC_N_MAX     = NR_PAT_SCC_N_MAX

```

**endif**



## A.50 Engine stop function diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_T_ES	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom of engine off duration error					
ERR_SYM_T_ES_DIAG_1	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom of engine off duration error for diagnosis 1					
ERR_SYM_T_ES_DIAG_2	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom of engine off duration error for diagnosis 2					
ERR_SYM_T_ES_DIAG_3	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom of engine off duration error diagnosis 3					
ERR_SYM_T_ES_TCO_FAST	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom of engine off duration error for diagnosis "TCO_FAST"					
ERR_SYM_T_ES_TCO_SLOW	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom of engine off duration error for diagnosis "TCO SLOW"					
LV_CDN_DIAG_T_ES	O/V	0... 1H	0 ...1	1	-
Diagnosis condition of engine off duration error					
LV_CDN_DIAG_T_ES_DIAG_1	V	0... 1H	0 ...1	1	-
Conditions for engine off plausibility diagnosis 1 fulfilled					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_T_ES_DIAG_1_CUS	V	0... 1H	0 ...1	1	-
Customer condition for diagnosis 1 fulfilled (diagnosis 1 unlocked)					
LV_CDN_DIAG_T_ES_DIAG_2	V	0... 1H	0 ...1	1	-
Conditions for engine off plausibility diagnosis 2 fulfilled					
LV_CDN_DIAG_T_ES_DIAG_3	V	0... 1H	0 ...1	1	-
Conditions for engine off plausibility diagnosis 3 fulfilled					
LV_CDN_DIAG_T_ES_TCO_FAST	V	0... 1H	0 ...1	1	-
Conditions for engine off plausibility diagnosis "TCO FAST" fulfilled					
LV_CDN_DIAG_T_ES_TCO_SLOW	V	0... 1H	0 ...1	1	-
Conditions for engine off plausibility diagnosis "TCO SLOW" fulfilled					
LV_END_DIAG_T_ES	O/V	0... 1H	0 ...1	1	-
End of diagnosis of engine off duration error					
LV_END_DIAG_T_ES_DIAG_1	O/V	0... 1H	0 ...1	1	-
End of plausibility diagnosis 1 of engine off duration error					
LV_END_DIAG_T_ES_DIAG_2	O/V	0... 1H	0 ...1	1	-
End of plausibility diagnosis 2 of engine off duration error					
LV_END_DIAG_T_ES_DIAG_3	O/V	0... 1H	0 ...1	1	-
End of plausibility diagnosis 3 of engine off duration error					
LV_END_DIAG_T_ES_TCO_FAST	O/V	0... 1H	0 ...1	1	-
End of plausibility diagnosis "TCO FAST" of engine off duration error					
LV_END_DIAG_T_ES_TCO_SLOW	O/V	0... 1H	0 ...1	1	-
End of plausibility diagnosis "TCO SLOW" of engine off duration error					
LV_ERR_T_ES	O/V	0... 1H	0 ...1	1	-
Engine off duration error					
LV_ERR_T_ES_DIAG_1	V	0... 1H	0 ...1	1	-
Engine off duration error diagnosis 1					
LV_ERR_T_ES_DIAG_2	V	0... 1H	0 ...1	1	-
Engine off duration error diagnosis 2					
LV_ERR_T_ES_DIAG_3	V	0... 1H	0 ...1	1	-
Engine off duration error diagnosis 3					
LV_ERR_T_ES_TCO_FAST	O/V	0... 1H	0 ...1	1	-
Engine off duration error diagnosis "TCO_FAST"					
LV_ERR_T_ES_TCO_SLOW	O/V	0... 1H	0 ...1	1	-
Engine off duration error "TCO SLOW"					
LV_IGK_DLY	V	0... 1H	0 ...1	1	-
End of first delay time after ignition on reached					
LV_IGK_DLY_2	V	0... 1H	0 ...1	1	-
End of second delay time after ignition on reached					
LV_IGK_DLY_3	V	0... 1H	0 ...1	1	-
End of third delay time after ignition on reached					
LV_PWL_ACT_MEM	V	0... 1H	0 ...1	1	-
Bit indicating that PWL was active before					
LV_T_ES_CUS_DIAG_2	V	0... 1H	0 ...1	1	-
Comparison timer of diagnosis 2 initialized					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_T_ES_NOT_PLAUS	O/V	0... 1H	0 ...1	1	-
T_ES not plausible - interface to T_ES consuming functions					
T_CDN_T_ES_DIAG_2	V	0... FFFFFFFFH	0... 4294967295	1	s
Time counter - condition for diagnosis 2 fulfilled					
T_ES_CUS_DIAG_1	V	0... FFFFFFFFH	0... 4294967295	1	s
Comparison timer for engine off plausibility diagnosis 1					
T_ES_CUS_DIAG_2	V	0... FFFFFFFFH	0... 4294967295	1	s
Comparison timer for engine off plausibility diagnosis 2					
T_ES_CUS_DIAG_3	V	0... FFFFFFFFH	0... 4294967295	1	s
Comparison timer for engine off plausibility diagnosis 3					
T_ES_CUS_ST_DIAG	V	0... FFFFH	0... 65535	1	min
Engine off duration time at start of driving cycle					
T_ES_CUS_TCO_FAST_DIAG_MAX	V	0... FFFFH	0... 65535	1	min
Calculated maximum engine off time for TCO_FAST diagnosis.					
T_ES_CUS_TCO_SLOW_DIAG_MIN	V	0... FFFFH	0... 65535	1	min
Calculated minimum engine off time for TCO_SLOW diagnosis.					
T_IGK_DLY	V	0... 9F6H	0... 255	0.1	s
First delay time after ignition on					
T_IGK_DLY_2	V	0... 9F6H	0... 255	0.1	s
Second delay time after ignition on					
T_IGK_DLY_3	V	0... 9F6H	0... 255	0.1	s
Third delay time after ignition on					
TCO_ST_DIAG_TMP	V	0... FEH	-48... 142.5	0.75	°C
TCO at start of driving cycle					
TCO_STOP_DIAG_TMP	V	0... FEH	-48... 142.5	0.75	°C
TCO at end of last driving cycle					
TCO_STOP_ST	V	0... FEH	0... 190.5	0.75	°C
TCO_STOP - TCO_ST					
TCO_STOP_TAM	V	0... FEH	0... 190.5	0.75	°C
TCO_STOP -TAM					

**Input data:**

LV_CDN_VB_OBD2 {p. 1185}	LV_END_DIAG_TCO_ STUCK {p. 5691}	LV_ENG_EXT_HEAT {p. 800}	LV_IGK {p. 906}
LV_INH_DIAG_T_ES {p. 4477}	LV_INH_DIAG_T_ES_ TCO_FAST {p. 4477}	LV_INH_DIAG_T_ES_ TCO_SLOW {p. 4477}	LV_PWL_ACT {p. 3776}
LV_T_REL_CAN_REG {p. 1567}	T_ES_CUS {p. 1444}	T_REL_CAN_2 {p. 1579}	T_REL_CAN_ES {p. 1444}
T_REL_CAN_ES_2 {p. 1444}	TAM_ST {p. 1214}	TCO {p. 1100}	TCO_ST {p. 1100}
TCO_STOP {p. 1100}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_T_ES	-	0... FFH	0... 255	1	-
Debounce counter increment - T_ES diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_T_ES_DIAG_1	-	0... FFH	0... 255	1	-
Debounce counter increment - T_ES diagnosis 1					
C_ABC_INC_T_ES_DIAG_2	-	0... FFH	0... 255	1	-
Debounce counter increment - T_ES diagnosis 2					
C_ABC_INC_T_ES_DIAG_3	-	0... FFH	0... 255	1	-
Debounce counter increment - T_ES diagnosis 3					
C_ABC_INC_T_ES_TCO_FAST	-	0... FFH	0... 255	1	-
Debounce counter increment - T_ES diagnosis "TCO FAST"					
C_ABC_INC_T_ES_TCO_SLOW	-	0... FFH	0... 255	1	-
Debounce counter increment - T_ES diagnosis "TCO SLOW"					
C_ABC_MAX_T_ES	-	1... FFH	1... 255	1	-
Debounce counter maximum value -T_ES diagnosis					
C_ABC_MAX_T_ES_DIAG_1	-	1... FFH	1... 255	1	-
Debounce counter maximum value -T_ES diagnosis 1					
C_ABC_MAX_T_ES_DIAG_2	-	1... FFH	1... 255	1	-
Debounce counter maximum value -T_ES diagnosis 2					
C_ABC_MAX_T_ES_DIAG_3	-	1... FFH	1... 255	1	-
Debounce counter maximum value -T_ES diagnosis 3					
C_ABC_MAX_T_ES_TCO_FAST	-	1... FFH	1... 255	1	-
Debounce counter maximum value -T_ES diagnosis "TCO FAST"					
C_ABC_MAX_T_ES_TCO_SLOW	-	1... FFH	1... 255	1	-
Debounce counter maximum value -T_ES diagnosis "TCO SLOW"					
C_T_CDN_T_ES_DIAG_2	-	0... FFFFFFFFH	0... 4294967295	1	s
reshold for time condition diagnosis 2 is set					
C_T_ES_DIAG_FAST_MAX	-	0... FFFFH	0... 65535	1	min
Maximum T_ES threshold for T_ES diagnosis "TCO_FAST"					
C_T_ES_DIAG_FAST_MIN	-	0... FFFFH	0... 65535	1	min
Minimum T_ES threshold for T_ES diagnosis "TCO_FAST"					
C_T_ES_DIAG_MIN	-	0... FFFFH	0... 65535	1	min
Minimum T_ES for T_ES diagnosis "TCO SLOW/FAST"					
C_T_ES_DIAG_SLOW_MAX	-	0... FFFFH	0... 65535	1	min
Maximum T_ES threshold for T_ES diagnosis "TCO_SLOW"					
C_T_ES_DIF_MAX_IGN_ON	-	0... FFFFH	-32768 ...32767	1	s
Maximal deviation between saved engine off time and engine time when ignition on					
C_T_IGK_DLY	-	0... 9F6H	0... 255	0.1	s
Threshold to finish the first delay time after ignition on					
C_T_IGK_DLY_2	-	0... 9F6H	0... 255	0.1	s
Threshold to finish the second delay time after ignition on					
C_T_IGK_DLY_3	-	0... 9F6H	0... 255	0.1	s
Threshold to finish the third delay time after ignition on					
C_T_REL_DIF_MAX_ENG_ON	-	0... FFFFH	-32768 ...32767	1	s
Maximal difference (absolute value) between instrument cluster timer and ECU timer during engine running					
C_T_REL_DIF_MAX_PWL	-	0... FFFFH	-32768 ...32767	1	s
Maximal difference (absolute value) between instrument cluster timer and ECU timer at out from PWL					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_ST_T_ES_DIAG_MIN	-	0... FEH	-48... 142.5	0.75	°C
Minimum TCO_ST value for T_ES diagnosis "TCO SLOW/FAST"					
C_TCO_STOP_T_ES_DIAG_MIN	-	0... FEH	-48... 142.5	0.75	°C
Minimum TCO_STOP value for T_ES diagnosis "TCO SLOW/FAST"					
C_TCO_T_ES_DIAG_FAST_MAX	-	0... FEH	0... 190.5	0.75	°C
Maximum TCO_STOP_ST threshold for T_ES diagnosis "TCO_FAST"					
C_TCO_T_ES_DIAG_SLOW_MIN	-	0... FEH	0... 190.5	0.75	°C
Minimum TCO_STOP_ST threshold for T_ES diagnosis "TCO_SLOW"					
IP_T_ES_TCO_FAST_DIAG	V	0... FFFFH	0... 65535	1	min
LDP_TCO_STOP_START_FAST	6	0... FEH	0... 190.5	0.75	°C
LDP_TCO_STOP_TAM_FAST	6	0... FEH	0... 190.5	0.75	°C
threshold for maximum T_ES for "TCO check FAST" diagnosis					
IP_T_ES_TCO_SLOW_DIAG	V	0... FFFFH	0... 65535	1	min
LDP_TCO_STOP_START_SLOW	6	0... FEH	0... 190.5	0.75	°C
LDP_TCO_STOP_TAM_SLOW	6	0... FEH	0... 190.5	0.75	°C
threshold for minimum T_ES for "TCO check SLOW" diagnosis					
LC_T_ES_DIAG_1_SWI	-	0... 1H	0 ...1	1	-
Switch for additional lock condition for diagnosis 1					
LC_T_ES_DIAG_1_SWI_2	-	0... 1H	0 ...1	1	-
Switch for ERRM call - T_ES diagnosis					

### Error treatment:

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Engine Off duration diagnosis	T_ES	-	0	STD_INI	CC
		-	1		
		CAN signal unplausible	2		
		-	3		
Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Engine Off duration diagnosis	T_ES_DIAG_1	-	0	STD_INI	CC
		-	1		
		-	2		
		CAN signal unplausible	3		
Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Engine Off duration diagnosis	T_ES_DIAG_2	-	0	STD_INI	CC
		-	1		
		-	2		
		CAN signal unplausible	3		
Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Engine Off duration diagnosis	T_ES_DIAG_3	-	0	STD_INI	CC
		-	1		
		-	2		
		CAN signal unplausible	3		
Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Engine Off duration diagnosis	T_ES_TCO_SLOW	-	0	STD_INI	CC
		-	1		
		-	2		
		T_ES unplausible (too fast)	3		
Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Engine Off duration diagnosis	T_ES_TCO_FAST	-	0	STD_INI	CC
		-	1		
		-	2		
		T_ES unplausible (too slow)	3		

Fields information (For more information refers to Error Management file Table of Failure) :


- ABC Type : STD\_INI, STD, MEM, MEM\_INI, DEC\_CAL, STC, NO, MPL\_STD\_INI
- CARB Class : MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO.

## A.50.1 Diagnosis algorithm

### FUNCTION DESCRIPTION:

#### General information:

The engine off duration should be monitored concerning legislation requirements. Three different diagnosis are carried out concerning the time signal from CAN (LV\_ERR\_T\_ES is set in error case). Two

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different diagnosis ensure The plausibility of T\_ES to TCO and TAM. (LV\_ERR\_T\_ES\_TCO\_SLOW or LV\_ERR\_T\_ES\_TCO\_FAST are set in error case)

### Application conditions

#### Initialization:

according ERRM initialization type "**STD\_INI**"  
 At reset: LV\_IGK\_DLY = 0  
           LV\_IGK\_DLY\_2 = 0  
 LV\_IGK\_DLY\_3 = 0  
           T\_IGK\_DLY = 0  
           T\_IGK\_DLY\_2 = 0  
           T\_IGK\_DLY\_3 = 0  
           T\_CDN\_T\_ES\_DIAG\_2 = 0  
           LV\_T\_ES\_CUS\_DIAG\_2 = 0  
                   T\_ES\_CUS\_DIAG\_1 = 0  
           T\_ES\_CUS\_DIAG\_2 = 0  
           T\_ES\_CUS\_DIAG\_3 = 0  
           LV\_CDN\_DIAG\_T\_ES = 0  
           LV\_CDN\_DIAG\_T\_ES\_DIAG\_1 = 0  
           LV\_CDN\_DIAG\_T\_ES\_DIAG\_2 = 0  
           LV\_CDN\_DIAG\_T\_ES\_DIAG\_3 = 0  
           LV\_CDN\_DIAG\_T\_ES\_TCO\_SLOW = 0  
           LV\_CDN\_DIAG\_T\_ES\_TCO\_FAST = 0  
           LV\_CDN\_DIAG\_T\_ES\_DIAG\_1\_CUS = 1  
           LV\_T\_ES\_NOT\_PLAUS = 0  
           T\_ES\_CUS\_TCO\_SLOW\_DIAG\_MIN = 0  
           T\_ES\_CUS\_TCO\_FAST\_DIAG\_MAX = 0  
**At system-event DCON:**  
           TCO\_STOP\_DIAG\_TMP = TCO\_STOP  
           TCO\_ST\_DIAG\_TMP = TCO\_ST  
           TCO\_STOP\_ST = TCO\_STOP - TCO\_ST  
           TCO\_STOP\_TAM = TCO\_STOP - TAM\_ST  
           T\_ES\_CUS\_ST\_DIAG = T\_ES\_CUS

**Recurrence:** 100 ms

**Activation:** always

### Formula section:

#### Set of LV\_T\_ES\_NOT\_PLAUS

LV\_T\_ES\_NOT\_PLAUS is set as soon as LV\_ERR\_T\_ES or LV\_ERR\_T\_ES\_XXX is set.

Please note: the switch LC\_T\_ES\_DIAG\_1\_SWI\_2 is used to either link the error bits LV\_ERR\_T\_ES\_1 and \_2 with an 'and' or an 'or' when it is set to 0 or 1 respectively.

```

If(1)          LV_ERR_T_ES = 1                               or
                  LV_ERR_T_ES_TCO_SLOW = 1                   or
                  LV_ERR_T_ES_TCO_FAST = 1                    =1   or
                  LV_ERR_T_ES_DIAG_3 = 1                       or
                  (LC_T_ES_DIAG_1_SWI_2 = 1                     and
                  (LV_ERR_T_ES_DIAG_1 = 1                       or
                  LV_ERR_T_ES_DIAG_2 = 1))                     or
                  (LC_T_ES_DIAG_1_SWI_2 = 0                     and
                  LV_ERR_T_ES_DIAG_1 = 1                       and
                  LV_ERR_T_ES_DIAG_2 = 1)
Then(1)        LV_T_ES_NOT_PLAUS = 1
Else(1)        LV_T_ES_NOT_PLAUS = 0
Endif(1)

```

### Calculation of T\_IGK\_DLY (Delaytime after Ignition on)

Three different delay times after ignition on for plausibility diagnosis 1 /diagnosis TCO SLOW/FAST , plausibility diagnosis 2 and plausibility diagnosis 3 can be calibrated

```

If(1)          LV_IGK = 1          and          LV_IGK_DLY = 0
Then(1)       T_IGK_DLY = T_IGK_DLY + 100ms
          If(2)          T_IGK_DLY > C_T_IGK_DLY
          Then(2)       LV_IGK_DLY = 1
          Else(2)       LV_IGK_DLY = 0
          Endif(2)
Endif(1)

If(3)          LV_IGK = 1          and          LV_IGK_DLY_2 = 0
Then(3)       T_IGK_DLY_2 = T_IGK_DLY_2 + 100ms
          If(4)          T_IGK_DLY_2 > C_T_IGK_DLY_2
          Then(4)       LV_IGK_DLY_2 = 1
          Else(4)       LV_IGK_DLY_2 = 0
          Endif(4)
Endif(3)

If(5)          exit PWL
Then(5)       LV_PWL_ACT_MEM = 1 // indicating that PWL was active before
Endif(5)

If(6)          LV_PWL_ACT_MEM = 1          and          LV_IGK_DLY_3 = 0
Then(6)       T_IGK_DLY_3 = T_IGK_DLY_3 + 100ms
          If(7)          T_IGK_DLY_3 > C_T_IGK_DLY_3
          Then(7)       LV_IGK_DLY_3 = 1          and
          LV_PWL_ACT_MEM = 0
          Else(7)       LV_IGK_DLY_3 = 0
          Endif(7)
Endif(6)

```

### **Reset of Delay Times for Diagnosis 2 and Diagnosis 3**

If Ignition Key is switched off the delay-timer for diagnosis 2 and diagnosis 3 are reset to 0.

Also The Comparison timer of diagnosis 2 is initialized again after switching IGK to 1 by setting LV\_T\_ES\_CUS\_DIAG\_2 = 0 in Case of IGK 1- ->0.

```

If(1)          LV_IGK= 1- ->0
Then(1)       LV_IGK_DLY_2 = 0
          T_IGK_DLY_2 = 0
          LV_T_ES_CUS_DIAG_2 = 0
          T_CDN_T_ES_DIAG_2 = 0
          LV_IGK_DLY_3 = 0
          T_IGK_DLY_3 = 0
          LV_PWL_ACT_MEM = 0
Endif(1)

```



**Initialization of timers after Delay time**

```

If(2)      LV_IGK_DLY = 0 -> 1
Then(2)    T_ES_CUS_DIAG_1 = T_REL_CAN_2
Endif(2)

```

**Additional diagnosis - TCO:**

Diagnosis of T\_ES Plausibility with TCO and TAM.

This additional diagnosis has no influence on LV\_ERR\_T\_ES. In an error case LV\_ERR\_T\_ES\_TCO\_SLOW or LV\_ERR\_T\_ES\_TCO\_FAST are set.

```

If(1)      LV_ST_END = 1                                and
LV_IGK_DLY = 1                                and
LV_CDN_VB_OBD2 = 1                            and
LV_T_REL_CAN_REG = 1                          and
T_ES_CUS_ST_DIAG > C_T_ES_DIAG_MIN           and
TCO_ST_DIAG_TMP > C_TCO_ST_T_ES_DIAG_MIN     and
TCO_STOP_DIAG_TMP > C_TCO_STOP_T_ES_DIAG_MIN and
LV_ENG_EXT_HEAT = 0
// diagnosis is carried out once

Then(1)

If(2)      T_ES_CUS_ST_DIAG < C_T_ES_DIAG_SLOW_MAX     and
TCO_STOP_ST > C_TCO_T_ES_DIAG_SLOW_MIN           and
LV_END_DIAG_TCO_STUCK = 1                       and
LV_END_DIAG_T_ES_TCO_SLOW = 0                   and
LV_INH_DIAG_T_ES_TCO_SLOW = 0

Then(2)    LV_CDN_DIAG_T_ES_TCO_SLOW = 1
T_ES_CUS_TCO_SLOW_DIAG_MIN =
IP_T_ES_TCO_SLOW_DIAG(TCO_STOP_ST,
TCO_STOP_TAM)

If(3)      T_ES_CUS_ST_DIAG < T_ES_CUS_TCO_SLOW_DIAG_
MIN

Then(3)    ERR_SYM_T_ES_TCO_SLOW = SYM_3
Else(3)    ERR_SYM_T_ES_TCO_SLOW = NO_SYM
Endif(3)

Else(2)    LV_CDN_DIAG_T_ES_TCO_SLOW = 0
Endif(2)

If(2)      T_ES_CUS_ST_DIAG > C_T_ES_DIAG_FAST_MIN     and
T_ES_CUS_ST_DIAG < C_T_ES_DIAG_FAST_MAX         and
TCO_STOP_ST < C_TCO_T_ES_DIAG_FAST_MAX         and
LV_END_DIAG_T_ES_TCO_FAST = 0                   and
LV_INH_DIAG_T_ES_TCO_FAST = 0

Then(2)    LV_CDN_DIAG_T_ES_TCO_FAST = 1
T_ES_CUS_TCO_FAST_DIAG_MAX =
IP_T_ES_TCO_FAST_DIAG (TCO_STOP_ST, TCO_STOP_TAM)

If(3)      T_ES_CUS_ST_DIAG > T_ES_CUS_TCO_FAST_DIAG_MAX

Then(3)    ERR_SYM_T_ES_TCO_FAST = SYM_3
Else(3)    ERR_SYM_T_ES_TCO_FAST = NO_SYM
Endif(3)

```

```

Else(2)      LV_CDN_DIAG_T_ES_TCO_FAST = 0
Endif(2)

```

```

Else(1)      LV_CDN_DIAG_T_ES_TCO_FAST = 0
              LV_CDN_DIAG_T_ES_TCO_SLOW = 0
Endif(1)

```

### Plausibility diagnosis 1: at start after keep alive Mode

```

IF(1)        LC_T_ES_DIAG_1_SWI = 1                // switch for advanced Condition
Then(1)      LV_CDN_DIAG_T_ES_DIAG_1_CUS = 0      // diagnosis 1 is locked
Endif(1)

```

```

If(1)        LV_IGK_DLY = 0- ->1                and          // diagnosis is carried out
once

```

```

              LV_CDN_VB_OBD2 = 1                and
              LV_T_REL_CAN_REG = 1              and
              LV_INH_DIAG_T_ES = 0              and
LV_CDN_DIAG_T_ES_DIAG_1_CUS = 1

```

```

Then(1)      LV_CDN_DIAG_T_ES_DIAG_1 = 1

```

```

If(2)        (T_ES_CUS_DIAG_1 - T_REL_CAN_ES_2) <
              C_T_ES_DIF_MAX_IGN_ON

```

```

Then(2)      ERR_SYM_T_ES_DIAG_1 = SYM_3
Else(2)      ERR_SYM_T_ES_DIAG_1 = NO_SYM

```

```

Else(1)      LV_CDN_DIAG_T_ES_DIAG_1 = 0
Endif(1)

```

### Plausibility diagnosis 2: during engine running

```

If(1)        LV_IGK_DLY_2 = 1                and
              LV_CDN_VB_OBD2 = 1                and
              LV_T_REL_CAN_REG = 1                and
LV_INH_DIAG_T_ES = 0                and
T_CDN_T_ES_DIAG_2 < C_T_CDN_T_ES_DIAG_2

```

```

Then(1)

```

```

If(2)        LV_T_ES_CUS_DIAG_2 = 0          //Flag for saving of T_ES_CUS_
DIAG_2

```

```

Then(2)      T_ES_CUS_DIAG_2 = T_REL_CAN_2    and
              LV_T_ES_CUS_DIAG_2 = 1

```

```

Else(2)      T_ES_CUS_DIAG_2 = T_ES_CUS_DIAG_2 + 0,1 s
              T_CDN_T_ES_DIAG_2 = T_CDN_T_ES_DIAG_2 + 0,1s
              LV_CDN_DIAG_T_ES_DIAG_2 = 1

```

```

If(3) |T_ES_CUS_DIAG_2 - T_REL_CAN_2| >= C_T_REL_DIF_MAX_ENG_ON

```

```

Then(3)      ERR_SYM_T_ES_DIAG_2 = SYM_3
Else(3)      ERR_SYM_T_ES_DIAG_2 = NO_SYM
Endif (3)

```

```

Endif(2)
Else(1)    LV_T_ES_CUS_DIAG_2 = 0
             LV_CDN_DIAG_T_ES_DIAG_2 = 0
Endif(1)

```

### Plausibility diagnosis 3: at restart during keep alive mode

// diagnosis will run once at transition from power latch to ignition on.

```

If(1)          LV_PWL_ACT: 0 -->1
Then(1)       T_ES_CUS_DIAG_3 = T_REL_CAN_2
Endif(1)

If(2)       LV_IGK=0 and LV_PWL_ACT=1
Then(2)     T_ES_CUS_DIAG_3 = T_ES_CUS_DIAG_3 + 0,1 s
Endif(2)

If(3)          LV_IGK_DLY_3 = 0 -->1          and
LV_IGK = 1          and
LV_PWL_ACT = 0          and
LV_T_REL_CAN_REG = 1          and
LV_CDN_VB_OBD2 = 1          and
LV_INH_DIAG_T_ES = 0

Then(3)       LV_CDN_DIAG_T_ES_DIAG_3 = 1
If(4)       | T_ES_CUS_DIAG_3 - T_REL_CAN_2 + T_IGK_DLY_3 | >= C_T_REL_DIF_MAX_PWL

Then(4)       ERR_SYM_T_ES_DIAG_3 = SYM_3
Else(4)       ERR_SYM_T_ES_DIAG_3 = NO_SYM
Endif(4)
Else(3)       LV_CDN_DIAG_T_ES_DIAG_3 = 0
Endif(3)

```

### Error management call

```

IF(1)       LV_CDN_DIAG_T_ES_DIAG_1 = 1          or
LV_CDN_DIAG_T_ES_DIAG_2 = 1          or
LV_CDN_DIAG_T_ES_DIAG_3 = 1

Then(1)     LV_CDN_DIAG_T_ES = 1
Else(1)     LV_CDN_DIAG_T_ES = 0
Endif(1)

IF(1) LC_T_ES_DIAG_1_SWI_2 = 1
Then(1)
If(2)       LV_ERR_T_ES_DIAG_1 = 1          or
LV_ERR_T_ES_DIAG_2 = 1          or
LV_ERR_T_ES_DIAG_3 = 1

Then(2)     ERR_SYM_T_ES = SYM_2
Else(2)     If(3)       ERR_SYM_T_ES = SYM_2
Then(3)     ERR_SYM_T_ES = NO_SYM
Endif(2)

```

**Else(1)**

**If(4)** (LV\_ERR\_T\_ES\_DIAG\_1 = 1 and LV\_ERR\_T\_ES\_DIAG\_2 = 1) or  
LV\_ERR\_T\_ES\_DIAG\_3 = 1

**Then(4)** ERR\_SYM\_T\_ES = SYM\_2

**Else(4)** **If(3)** ERR\_SYM\_T\_ES = SYM\_2

**Then(3)** ERR\_SYM\_T\_ES = NO\_SYM

**Endif(3)**

**Endif(4)**

**Endif(1)**

The following algorithm determines LV\_ERR\_T\_ES and delivers the result to Error Management.

If a symptom was detected, the antibounce counter is increased by C\_ABC\_INC\_T\_ES. If the counter reaches C\_ABC\_MAX\_T\_ES, the error flag LV\_ERR\_T\_ES is set. If no symptom detected, the antibounce counter is decreased and the error flag is resetted.

ACTION\_ERRM\_FilterSymptom (IN < NC\_IDX\_DIAG\_T\_ES >, IN< LV\_CDN\_DIAG\_T\_ES >, IN< ERR\_SYM\_T\_ES >, IN< C\_ABC\_INC\_T\_ES >, IN< C\_ABC\_MAX\_T\_ES >, IN< 1 >, OUT<LV\_ERR\_T\_ES >

The following algorithm determines LV\_ERR\_T\_ES\_XXX and delivers the result to Error Management.

If a symptom was detected, the antibounce counter is increased by C\_ABC\_INC\_T\_ES. If the counter reaches C\_ABC\_MAX\_T\_ES\_XXX, the error flag LV\_ERR\_T\_ES\_XXX is set. If no symptom detected, the antibounce counter is decreased and the error flag is resetted.


ACTION\_ERRM\_FilterSymptom (IN < NC\_IDX\_DIAG\_T\_ES\_DIAG\_1 >, IN< LV\_CDN\_DIAG\_T\_ES\_DIAG\_1 >, IN< ERR\_SYM\_T\_ES\_DIAG\_1 >, IN< C\_ABC\_INC\_T\_ES\_DIAG\_1 >, IN< C\_ABC\_MAX\_T\_ES\_DIAG\_1 >, IN< 1 >, OUT<LV\_ERR\_T\_ES\_DIAG\_1 >)

ACTION\_ERRM\_FilterSymptom (IN < NC\_IDX\_DIAG\_T\_ES\_DIAG\_2 >, IN< LV\_CDN\_DIAG\_T\_ES\_DIAG\_2 >, IN< ERR\_SYM\_T\_ES\_DIAG\_2 >, IN< C\_ABC\_INC\_T\_ES\_DIAG\_2 >, IN< C\_ABC\_MAX\_T\_ES\_DIAG\_2 >, IN< 1 >, OUT<LV\_ERR\_T\_ES\_DIAG\_2 >)

ACTION\_ERRM\_FilterSymptom (IN < NC\_IDX\_DIAG\_T\_ES\_DIAG\_3 >, IN< LV\_CDN\_DIAG\_T\_ES\_DIAG\_3 >, IN< ERR\_SYM\_T\_ES\_DIAG\_3 >, IN< C\_ABC\_INC\_T\_ES\_DIAG\_3 >, IN< C\_ABC\_MAX\_T\_ES\_DIAG\_3 >, IN< 1 >, OUT<LV\_ERR\_T\_ES\_DIAG\_3 >)

ACTION\_ERRM\_FilterSymptom (IN < NC\_IDX\_DIAG\_T\_ES\_TCO\_SLOW >, IN< LV\_CDN\_DIAG\_T\_ES\_TCO\_SLOW >, IN< ERR\_SYM\_T\_ES\_TCO\_SLOW >, IN< C\_ABC\_INC\_T\_ES\_TCO\_SLOW >, IN< C\_ABC\_MAX\_T\_ES\_TCO\_SLOW >, IN< 1 >, OUT<LV\_ERR\_T\_ES\_TCO\_SLOW >)

ACTION\_ERRM\_FilterSymptom (IN < NC\_IDX\_DIAG\_T\_ES\_TCO\_FAST >, IN< LV\_CDN\_DIAG\_T\_ES\_TCO\_FAST >, IN< ERR\_SYM\_T\_ES\_TCO\_FAST >, IN< C\_ABC\_INC\_T\_ES\_TCO\_FAST >, IN< C\_ABC\_MAX\_T\_ES\_TCO\_FAST >, IN< 1 >, OUT<LV\_ERR\_T\_ES\_TCO\_FAST >)

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## A.51 Engine stop function diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_T_ES	O/V	0... 1H	0 ...1	1	-
Flag for inhibition off engine of duration diagnosis.					
LV_INH_DIAG_T_ES_TCO_FAST	O/V	0... 1H	0 ...1	1	-
Flag for inhibition of engine off duration diagnosis TCO_FAST.					
LV_INH_DIAG_T_ES_TCO_SLOW	O/V	0... 1H	0 ...1	1	-
Flag for inhibition of engine off duration diagnosis TCO_SLOW.					
STATE_RBM_T_ES	O/V	0... 7H	0 ...7	1	-
Interface of T_ES monitor with the Rate-Based Monitoring statistics					
STATE_RBM_T_ES_TCO_FAST	O/V	0... 7H	0 ...7	1	-
Interface of T_ES_TCO_FAST monitor with the Rate-Based Monitoring statistics					
STATE_RBM_T_ES_TCO_SLOW	O/V	0... 7H	0 ...7	1	-
Interface of T_ES_TCO_SLOW monitor with the Rate-Based Monitoring statistics					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_DC {p. 5746}	LV_END_DIAG_T_ES {p. 4466}	LV_END_DIAG_T_ES_ DIAG_1 {p. 4466}
LV_END_DIAG_T_ES_ DIAG_2 {p. 4466}	LV_END_DIAG_T_ES_ DIAG_3 {p. 4466}	LV_END_DIAG_T_ES_ TCO_FAST {p. 4466}	LV_END_DIAG_T_ES_ TCO_SLOW {p. 4466}
LV_ERR_BN_T_ICL {p. 4870}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_COM_2_BOFF {p. 801}	LV_ERR_COM_2_T_ICL {p. 801}
LV_ERR_COM_2_TAM_ ICL	LV_ERR_ECU_NVMY {p. 4232}	LV_ERR_T_ES {p. 4466}	LV_ERR_T_ES_TCO_ FAST {p. 4466}
LV_ERR_T_ES_TCO_ SLOW {p. 4466}	LV_ERR_TAM_CAN {p. 5076}	LV_ERR_TAM_PLAUS {p. 5076}	LV_ERR_TCO_EL {p. 4496}
LV_ERR_TCO_GRD {p. 4496}	LV_ERR_TCO_PLAUS {p. 5682}	LV_ERR_TCO_STUCK {p. 5691}	LV_ERR_TCO_STUCK_ RNG {p. 5675}
NC_IDX_DIAG_BN_T_ICL	NC_IDX_DIAG_CAN_ BOFF	NC_IDX_DIAG_COM_2_ BOFF	NC_IDX_DIAG_COM_2_T_ ICL
NC_IDX_DIAG_COM_2_ TAM_ICL	NC_IDX_DIAG_ECU_ NVMY	NC_IDX_DIAG_T_ES	NC_IDX_DIAG_T_ES_ TCO_FAST
NC_IDX_DIAG_T_ES_ TCO_SLOW	NC_IDX_DIAG_TAM_CAN	NC_IDX_DIAG_TAM_ PLAUS	NC_IDX_DIAG_TCO_EL
NC_IDX_DIAG_TCO_GRD	NC_IDX_DIAG_TCO_ PLAUS	NC_IDX_DIAG_TCO_ STUCK	NC_IDX_DIAG_TCO_ STUCK_RNG

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_T_ES_DIAG_1_RBM_SWI	-	0... 1H	0 ...1	1	-
Switch to change the calculation logic for bit0 of STATE_RBM_T_ES.					

**Import actions:**

<b>ACTION_ERRM_CheckPendingStatus</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR_PND>)
--

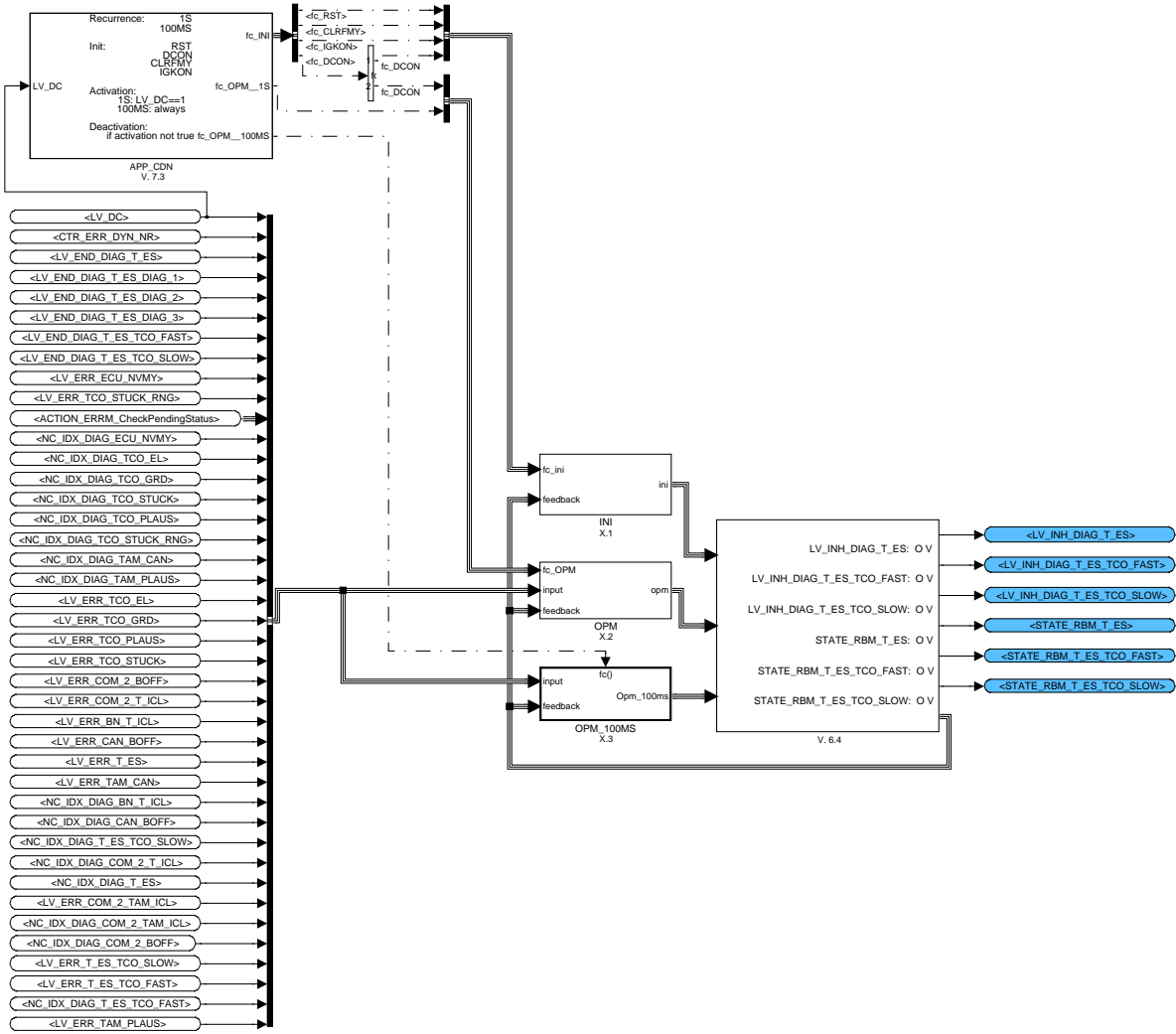
**General information:**

The calculation STATE\_RBM\_T\_ES is based on the status of the 3 plausibility checks with the internal ECU-timer. In addition, two further RBM-ratios are calculated, namely STATE\_RBM\_T\_ES\_TCO\_SLOW and STATE\_RBM\_T\_ES\_TCO\_FAST.

**Application conditions:**

*Initialisation:* RST, DCON, CLRFRMY, IGKON  
*Recurrence:* 1S, 100MS  
*Activation:* 1S: LV\_DC==1 100MS: always  
*Deactivation:* if activation not true

**Function description:****Formula section:**



SDA\_SRS / SDA V 6.0.3 / 06-Aug-2009

Figure A.51.1: :

## A.51.1 Initialization

### A.51.1.1 Initialization at RST

All variables are reset to zero.

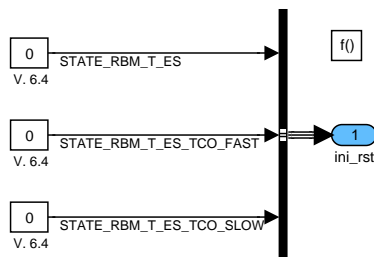


Figure A.51.2: :

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### A.51.1.2 Initialization at DCON

at LV\_DC 0 --> 1 transition:

bit 0, bit 1 and bit 2 of STATE\_RBM\_T\_ES = 0

bit 0, bit 1 and bit 2 of STATE\_RBM\_T\_ES\_TCO\_FAST = 0

bit 0, bit 1 and bit 2 of STATE\_RBM\_T\_ES\_TCO\_SLOW = 0

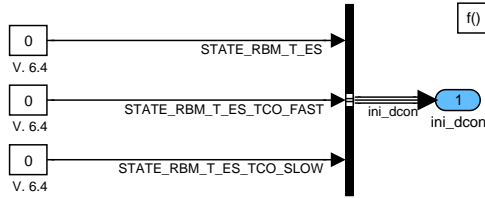


Figure A.51.3: :

### A.51.1.3 Initialization at CLRFRMY

on failure memory reset :

bit 1 of STATE\_RBM\_T\_ES = 0

bit 1 of STATE\_RBM\_T\_ES\_TCO\_FAST = 0

bit 1 of STATE\_RBM\_T\_ES\_TCO\_SLOW = 0

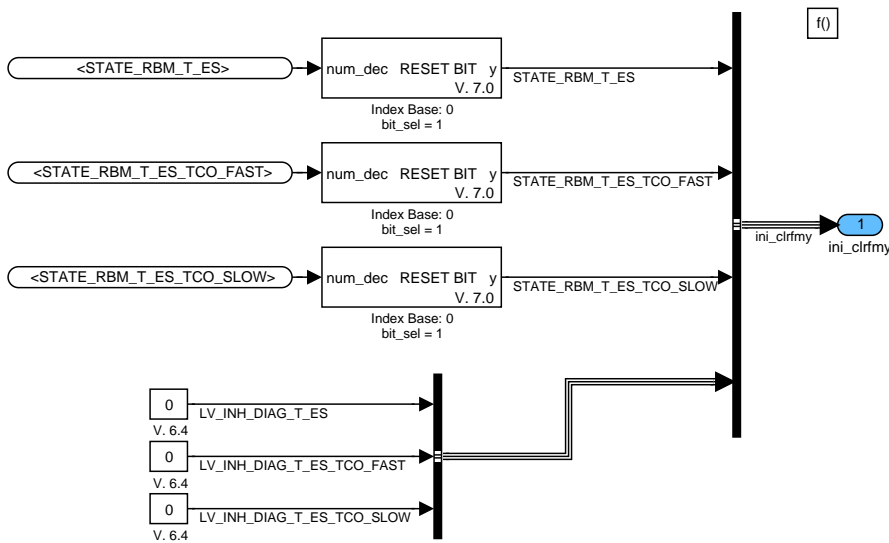


Figure A.51.4: :

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### A.51.1.4 Initialization at RST or LV\_IGK 0->1

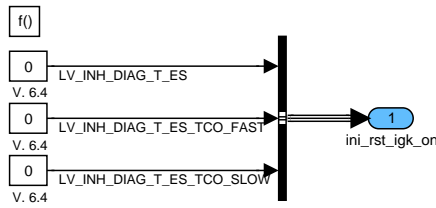


Figure A.51.5: :

## A.51.2 Formula section

### A.51.2.1 Calculation of STATE\_RBM\_T\_ES

With this module the interface between the T\_ES monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_T\_ES data. With the switch LC\_T\_ES\_DIAG\_1\_RBM\_SWI, the calculation logic of bit0 of STATE\_RBM\_T\_ES based on the END-flags of T\_ES\_DIAG\_1, T\_ES\_DIAG\_2 and T\_ES\_DIAG\_3 can be changed.

Within STATE\_RBM\_T\_ES, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0) (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1) (depending on failure status: pending)
- Monitor indiv. RBM conditions encountered within this DC (bit 2 not valid for T\_ES)

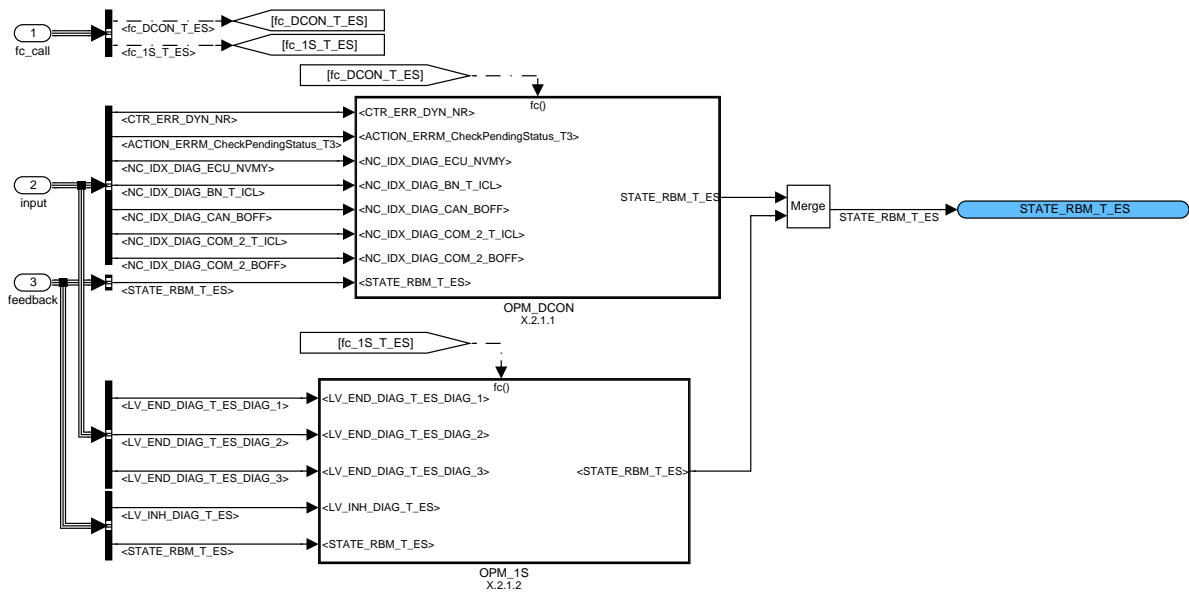



Figure A.51.6: :

#### A.51.2.1.1 Operation at DCON

At LV\_DC 0 - -> 1 transition

The pending status of the following failures has to be checked only once :

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LV_ERR_ECU_NVMY	LV_ERR_BN_T_ICL	LV_ERR_CAN_BOFF	LV_ERR_COM_2_BOFF
LV_ERR_COM_2_T_ICL			

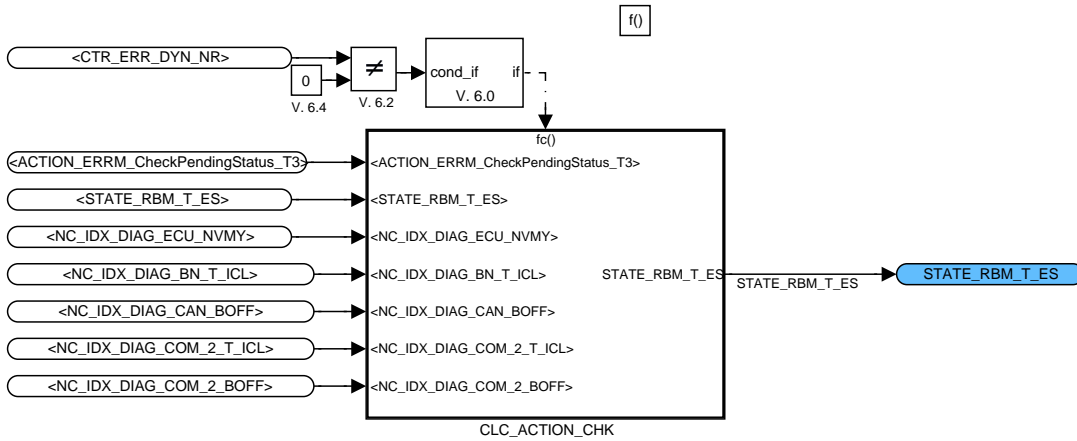


Figure A.51.7: :

### A.51.2.1.1.1 Assignment of STATE\_RBM\_T\_ES

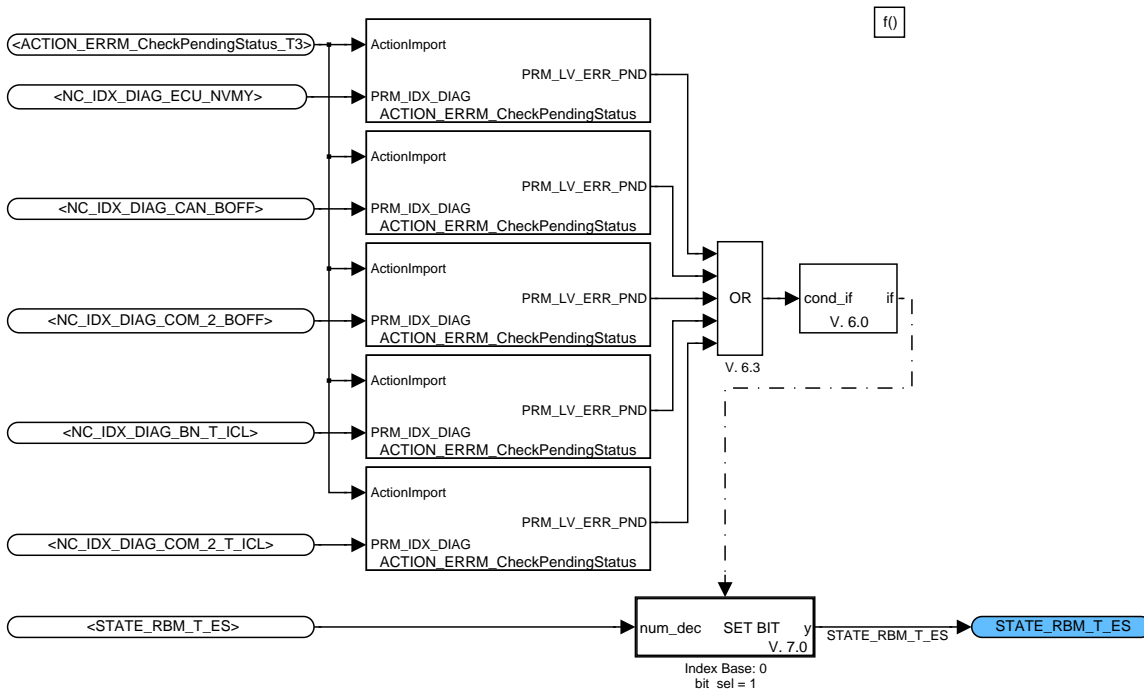


Figure A.51.8: :

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**A.51.2.1.2 Operation at 1S recurrence**

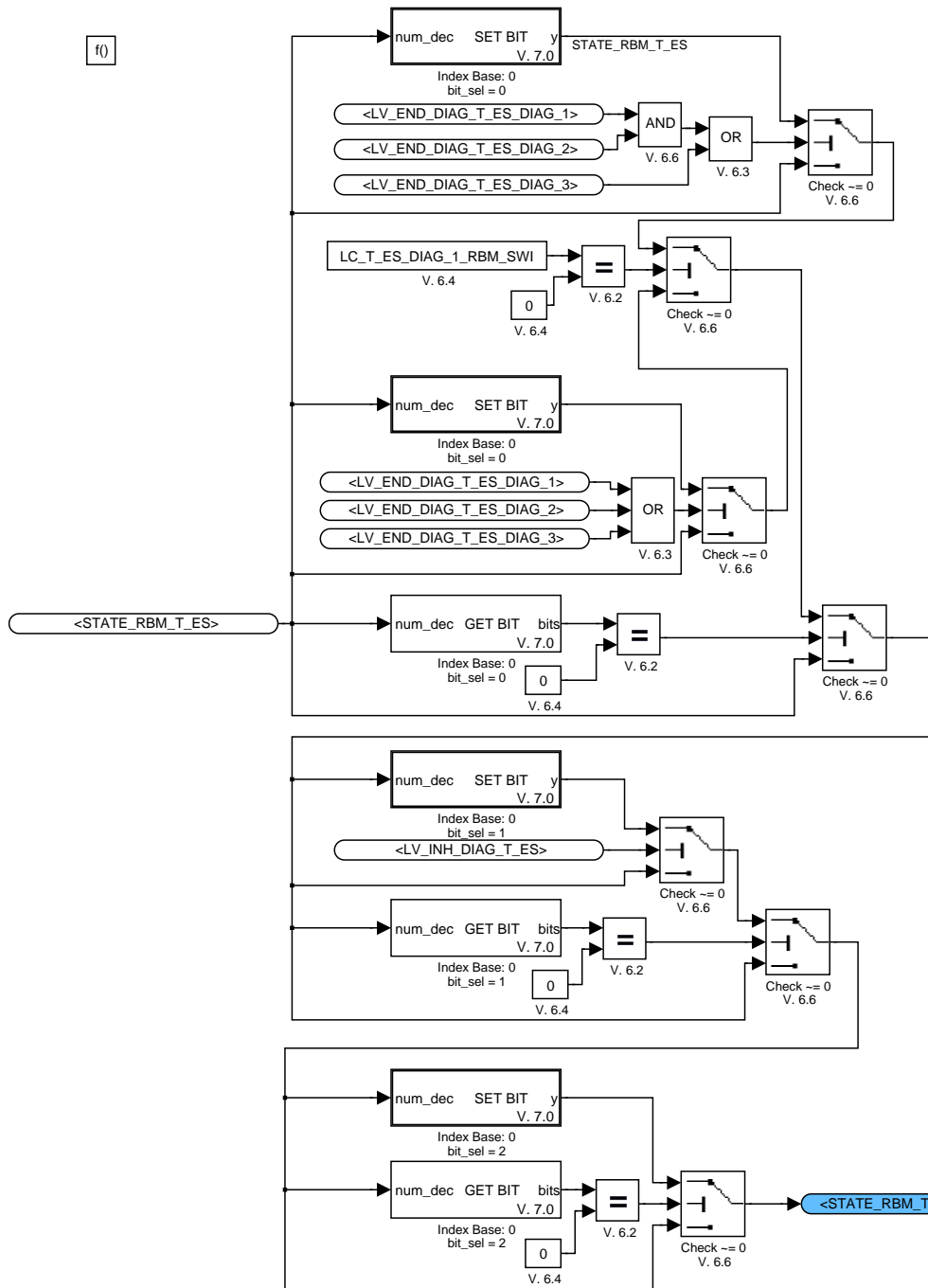


Figure A.51.9: :

**A.51.2.2 Calculation of STATE\_RBM\_T\_ES\_TCO\_FAST**

With this module the interface between the T\_ES\_TCO\_FAST monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_T\_ES\_TCO\_FAST data.

Within STATE\_RBM\_T\_ES, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)

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(no intrusive operation, no short trip)

- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor indiv. RBM conditions encountered within this DC (bit 2 not valid for T\_ES\_TCO\_FAST)

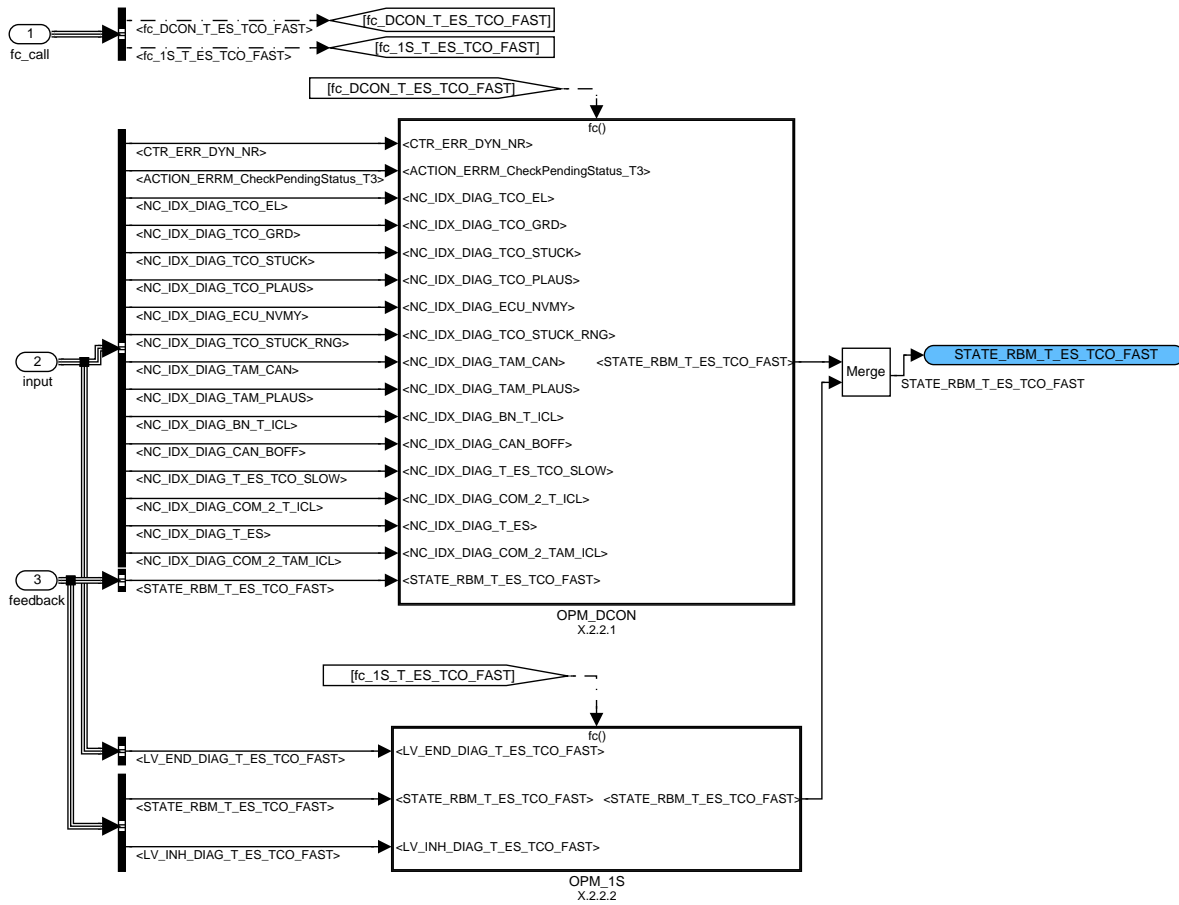


Figure A.51.10: :

### A.51.2.2.1 Operation at DCON

At LV\_DC 0 --> 1 transition

The pending status of the following failures has to be checked only once :

LV_ERR_ECU_NVMY	LV_ERR_TCO_EL	LV_ERR_TCO_GRD	LV_ERR_TCO_PLAUS
LV_ERR_TCO_STUCK_RNG	LV_ERR_TCO_STUCK	LV_ERR_TAM_CAN	LV_ERR_TAM_PLAUS
LV_ERR_T_ES	LV_ERR_CAN_BOFF	LV_ERR_BN_T_ICL	LV_ERR_COM_2_T_ICL
LV_ERR_T_ES_TCO_SLOW	LV_ERR_COM_2_TAM_ICL		

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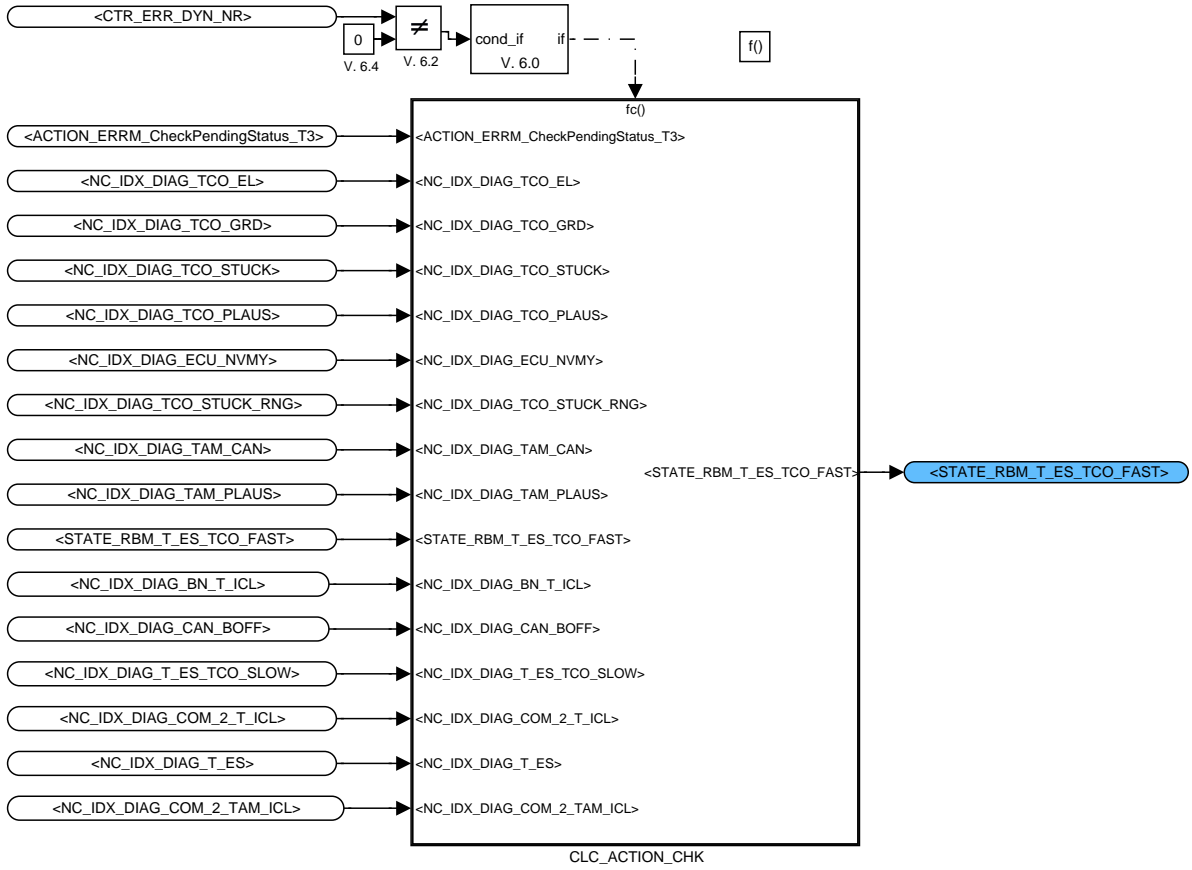


Figure A.51.11: :

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### A.51.2.2.1.1 Assignment of STATE\_RBM\_T\_ES\_TCO\_FAST

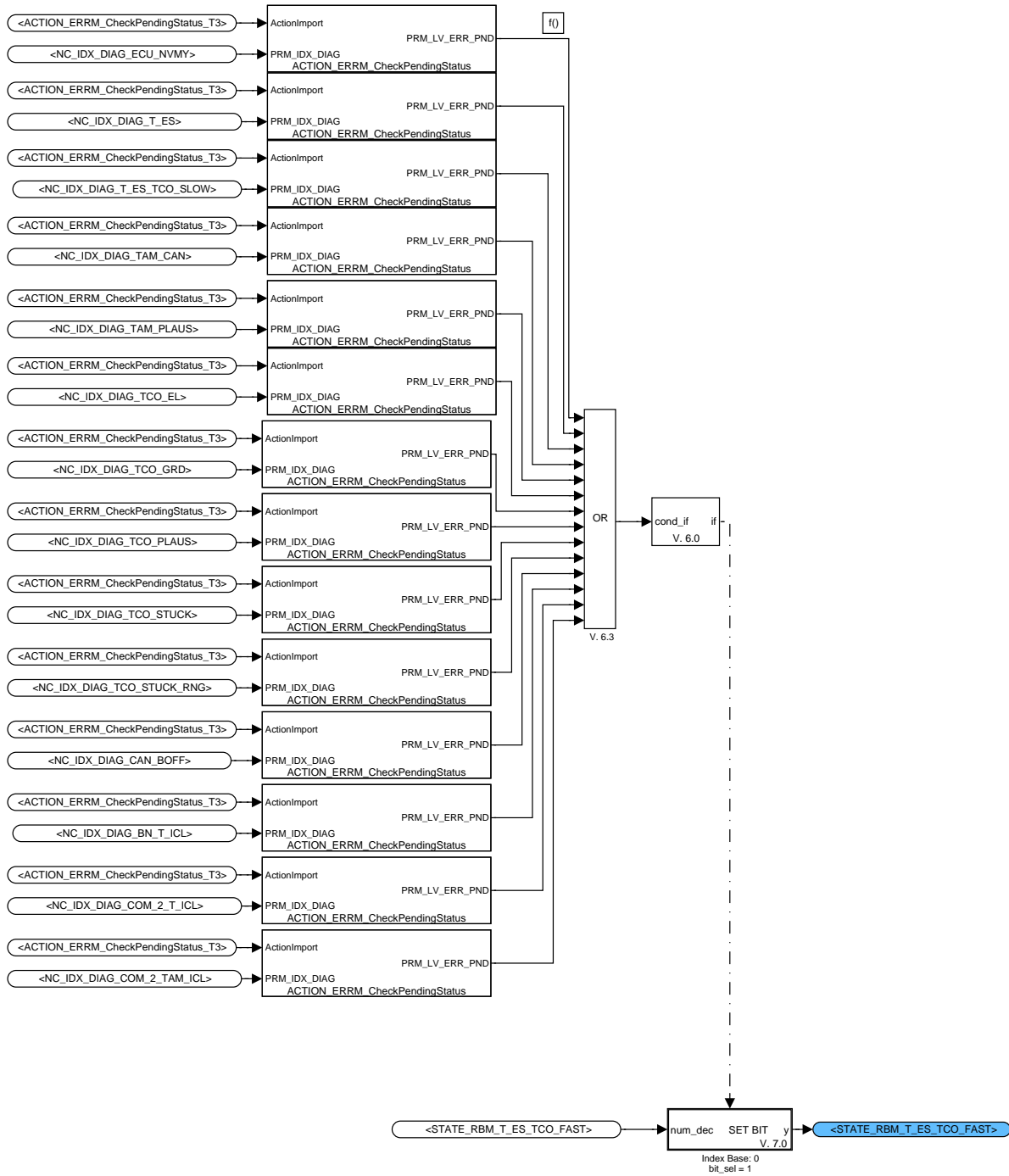


Figure A.51.12: :

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### A.51.2.2.2 Operation at 1S recurrence

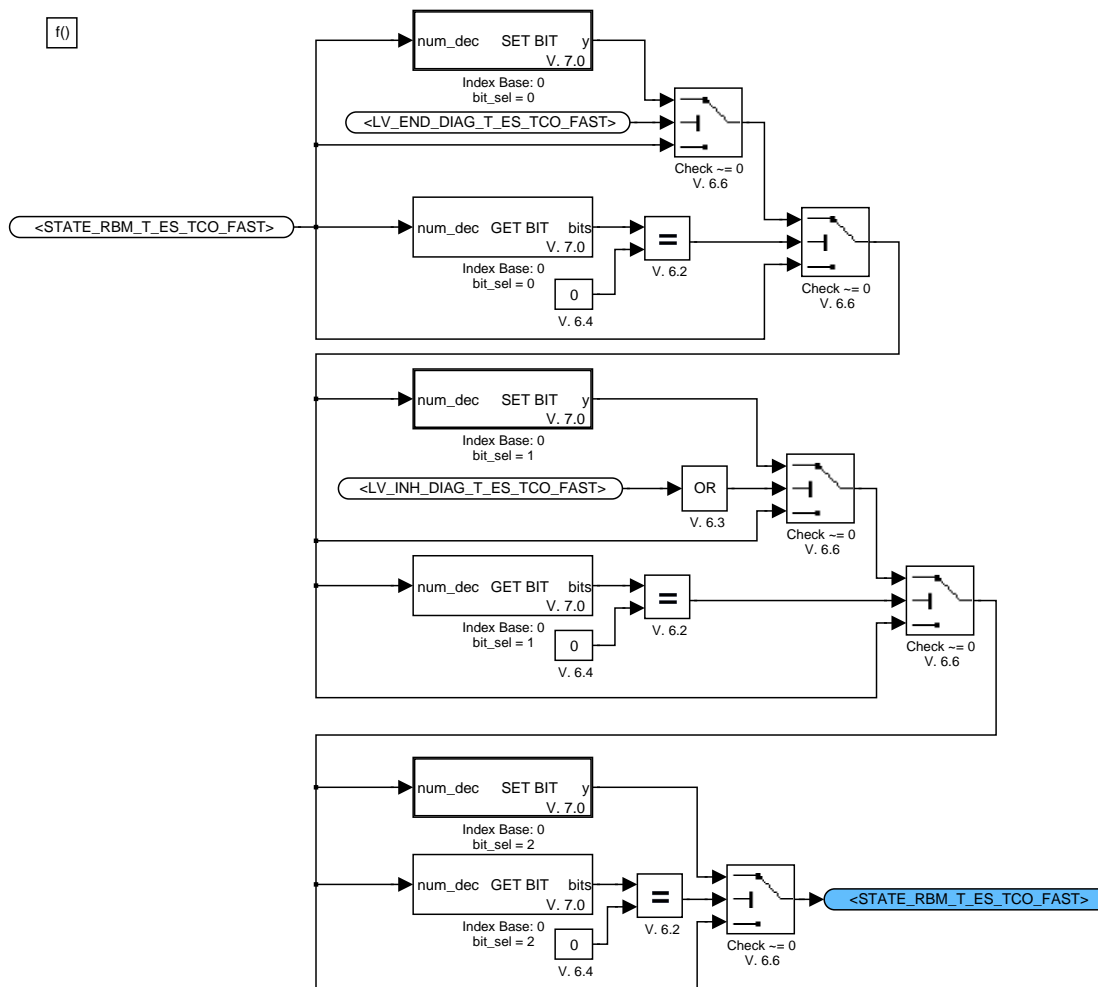


Figure A.51.13: :

### A.51.2.3 Calculation of STATE\_RBM\_T\_ES\_TCO\_SLOW

With this module the interface between the T\_ES\_TCO\_SLOW monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_T\_ES\_TCO\_SLOW data.

Within STATE\_RBM\_T\_ES, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0) (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1) (depending on failure status: pending)
- Monitor indiv. RBM conditions encountered within this DC (bit 2 not valid for T\_ES)

#### A.51.2.3.1 Operation at DCON

At LV\_DC 0 ->1 transition

The pending status of the following failures has to be checked only once :

LV_ERR_ECU_NVMY	LV_ERR_TCO_EL	LV_ERR_TCO_GRD	LV_ERR_TCO_PLAUS
LV_ERR_TCO_STUCK_RNG	LV_ERR_TCO_STUCK	LV_ERR_TAM_CAN	LV_ERR_TAM_PLAUS
LV_ERR_T_ES	LV_ERR_CAN_BOFF	LV_ERR_BN_T_ICL	LV_ERR_COM_2_T_ICL
LV_ERR_T_ES_TCO_FAST	LV_ERR_COM_2_TAM_ICL		

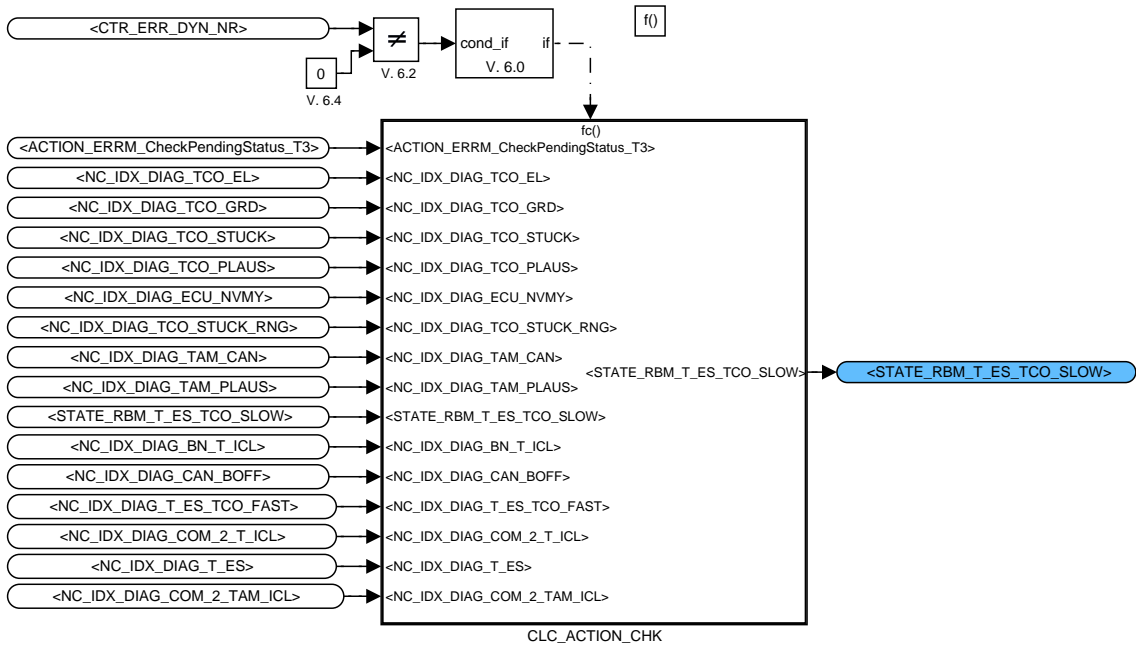


Figure A.51.14: :

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### A.51.2.3.1.1 Assignment of STATE\_RBM\_T\_ES\_TCO\_SLOW

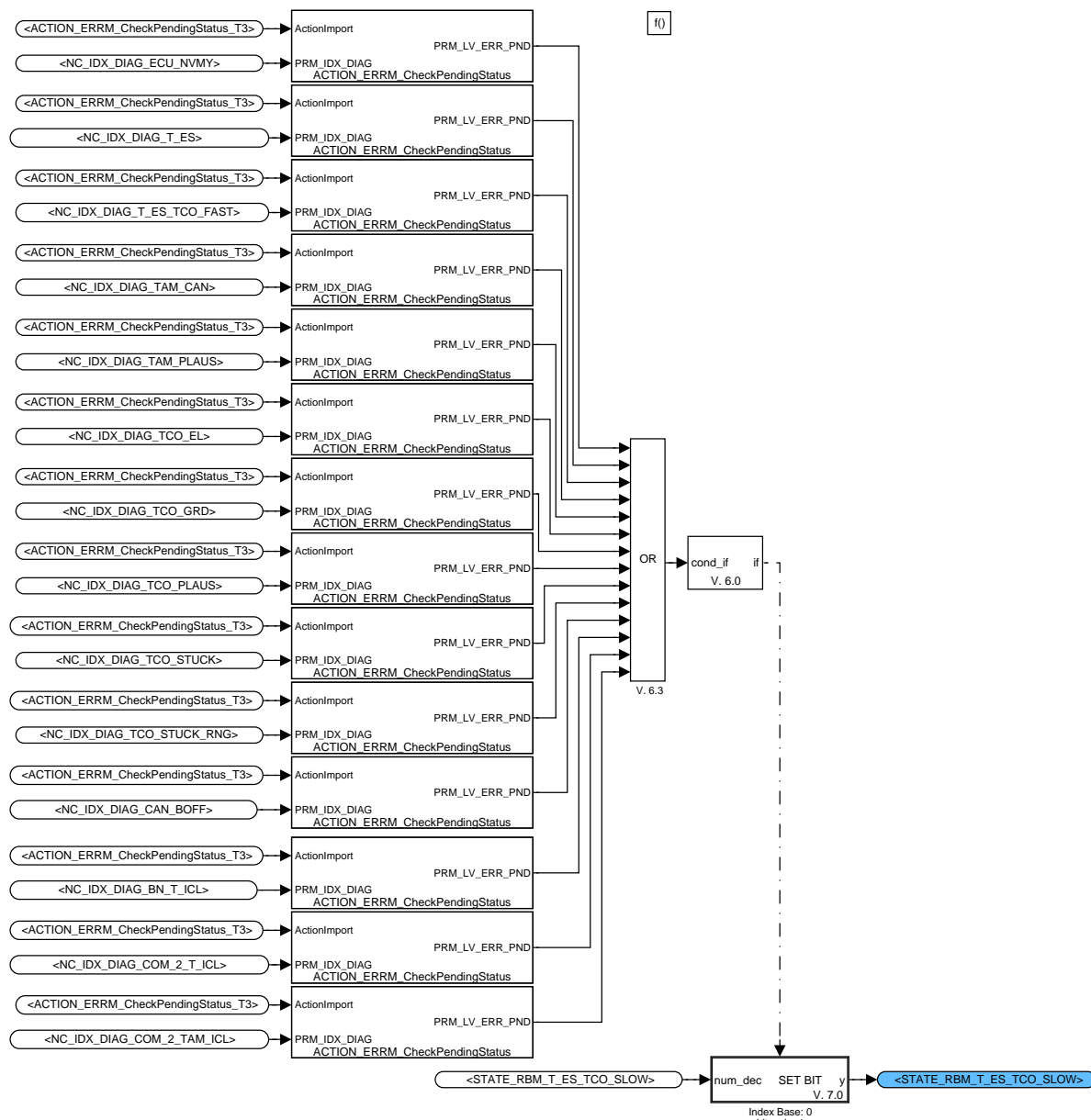


Figure A.51.15: :

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### A.51.2.3.2 Operation at 1S recurrence

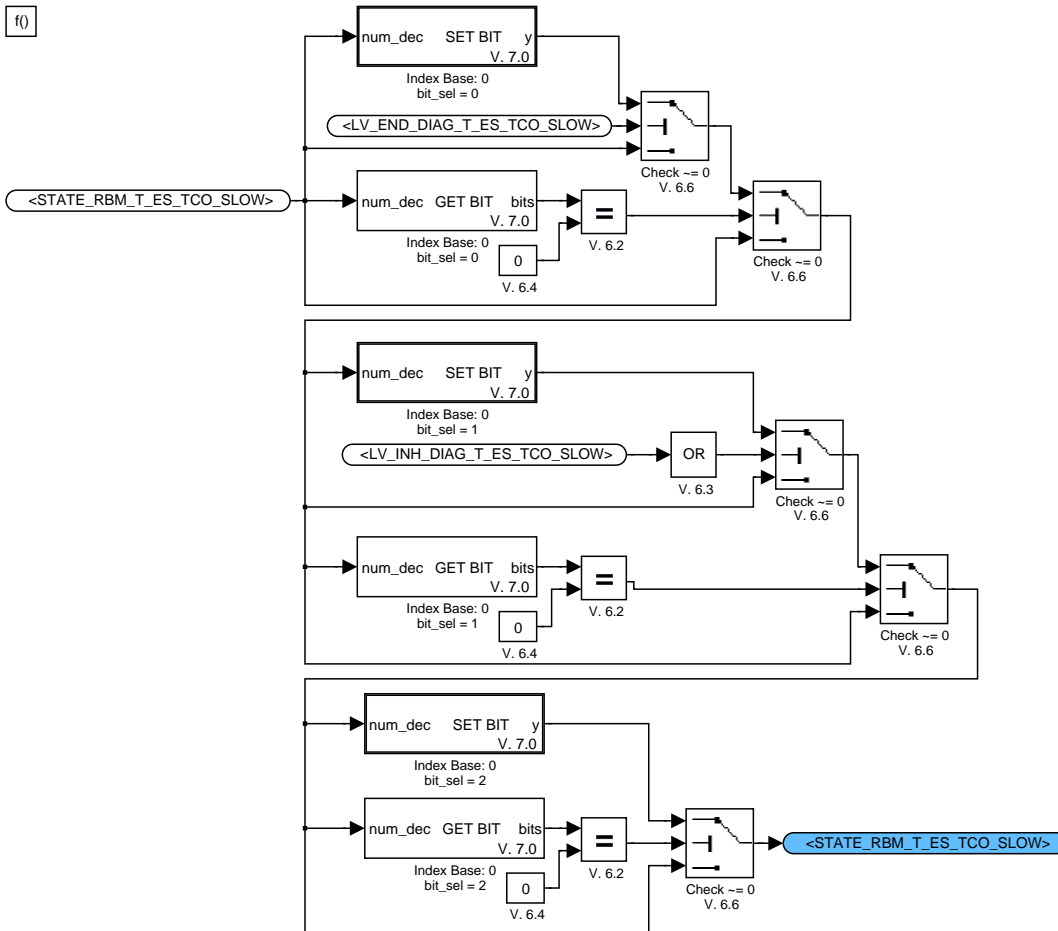


Figure A.51.16: :

### A.51.3 Inhibition of diagnosis

Depending on the project specific requirements, the engine off duration diagnosis and the engine off duration plausibilisation with TCO can be inhibited by setting the flags LV\_INH\_DIAG\_T\_ES and LV\_INH\_DIAG\_T\_ES\_TCO\_SLOW/FAST respectively.

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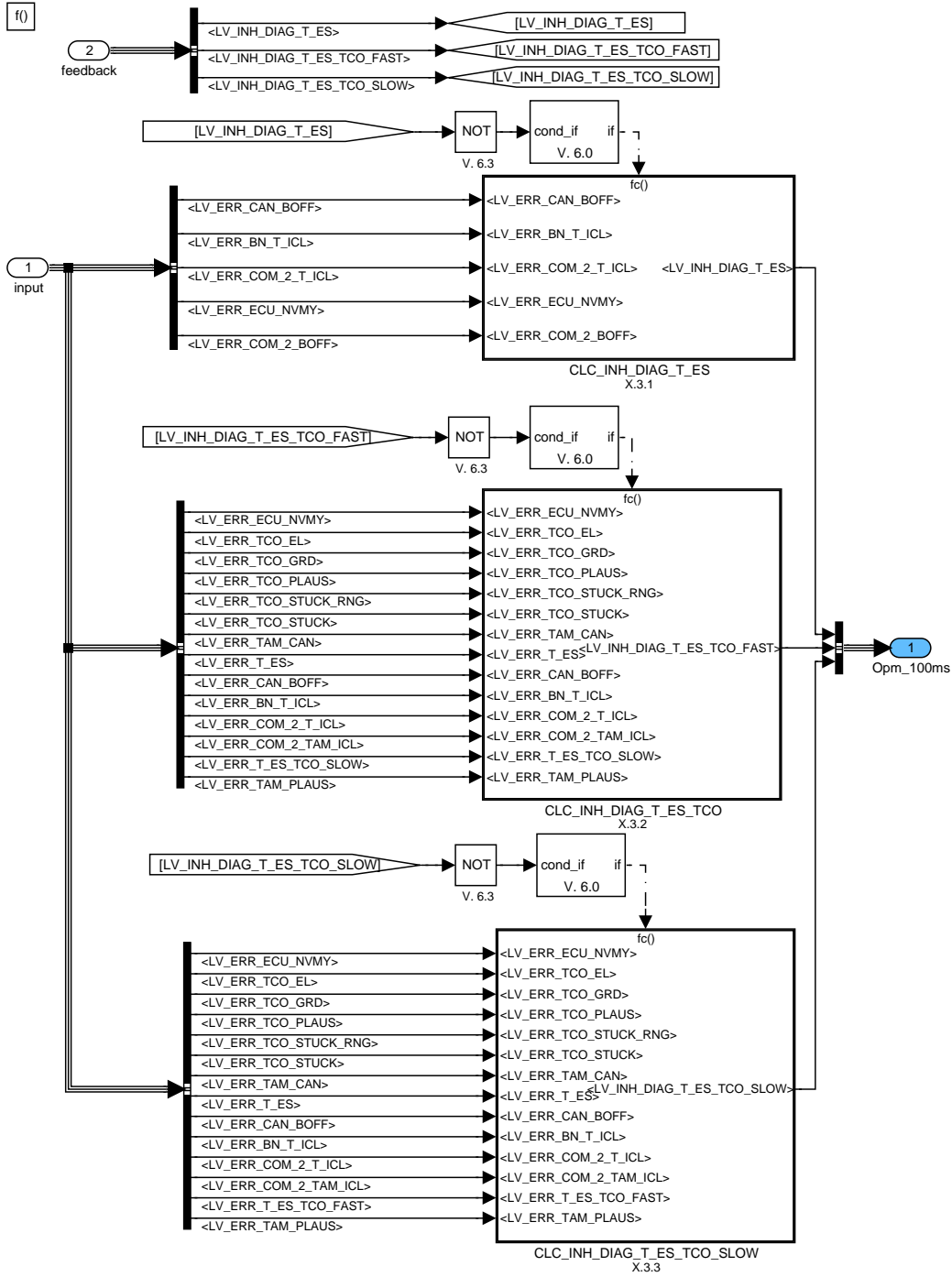


Figure A.51.17: :

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### A.51.3.1 Inhibition of T\_ES diagnosis via LV\_INH\_DIAG\_T\_ES

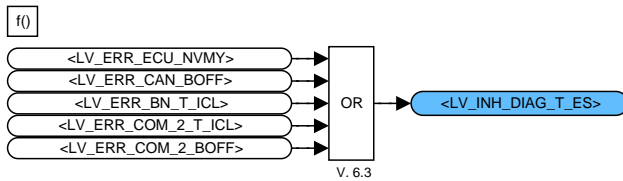


Figure A.51.18: :

### A.51.3.2 Inhibition of T\_ES\_TCO\_FAST diagnosis via LV\_INH\_DIAG\_T\_ES\_TCO\_FAST

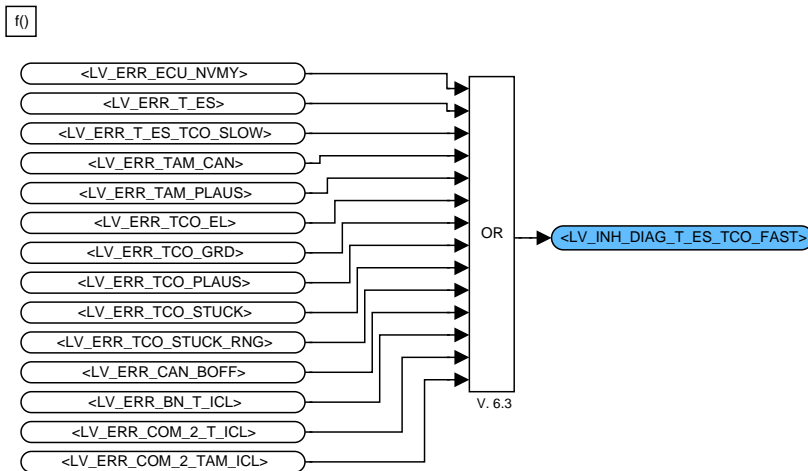


Figure A.51.19: :

### A.51.3.3 Inhibition of T\_ES\_TCO\_SLOW diagnosis via LV\_INH\_DIAG\_T\_ES\_TCO\_SLOW

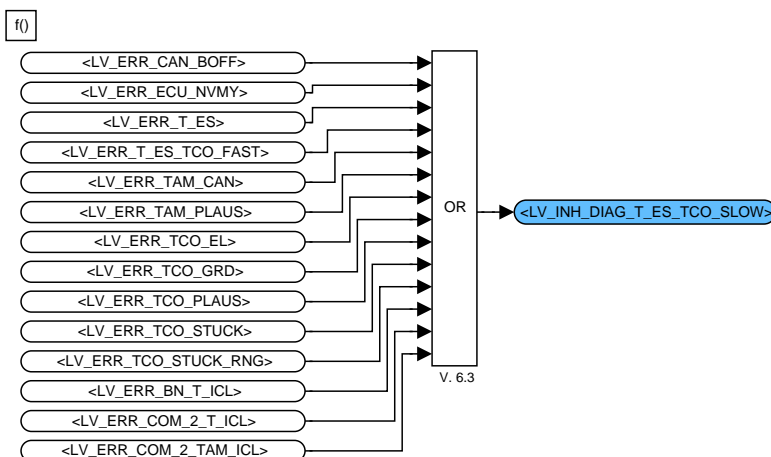


Figure A.51.20: :

## A.52 Coolant temperature diagnosis interface

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_ENA_RATIO_T_AST	V	0... 1H	0 ...1	1	-
Boolean for ratio time after engine start enable condition					
RATIO_T_IS_AST	O/V	0... FFH	0... 99.609	0.3906	%
Idle speed activation time in percent since engine start					
RATIO_T_LOAD_MIN_AST	O/V	0... FFH	0... 99.609	0.3906	%
"Minimum load" time in percent since engine start					
RATIO_T_PUC_AST	O/V	0... FFH	0... 99.609	0.3906	%
"Trailing throttle fuel cut-off" activation time in percent since engine start					
RATIO_T_VS_MAX_AST	O/V	0... FFH	0... 99.609	0.3906	%
"Maximum vehicle speed " time in percent since engine start					
RATIO_T_VS_MIN_AST	O/V	0... FFH	0... 99.609	0.3906	%
"Minimum vehicle speed " time in percent since engine start					
T_DIAG_AST	O/V	0... FFFFH	0... 65535	1	s
Time after engine start for diagnosis functions					
T_IS_AST	V	0... FFFFH	0... 65535	1	s
Idle speed activation time since engine start					
T_LOAD_MIN_AST	V	0... FFFFH	0... 65535	1	s
"Minimum load" time since engine start					
T_PUC_AST	V	0... FFFFH	0... 65535	1	s
"Trailing throttle fuel cut-off" activation time since engine start					
T_VS_MAX_AST	V	0... FFFFH	0... 65535	1	s
"Maximum vehicle speed " time since engine start					
T_VS_MIN_AST	V	0... FFFFH	0... 65535	1	s
"Minimum vehicle speed " time since engine start					

### Input data:

LV_IS {p. 1720}	LV_PUC {p. 1720}	MAF_KGH {p. 1195}	TAM {p. 1579}
VS {p. 1176}			


### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VS_THD_VS_MAX_AST	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed threshold for high vehicle speed period calculation after start					
C_VS_THD_VS_MIN_AST	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed threshold for low vehicle speed period calculation after start					
IP_MAF_KGH_LOAD_MIN_AST	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_TAM_IP_MAF_KGH_LOAD_MIN_AST	4	0... FEH	-48... 142.5	0.75	°C
Ambient temperature dependent minimum engine load threshold for low load period calculation after start					

## FUNCTION DESCRIPTION:

### General information:

The coolant temperature increase after engine start is most dependent on the ambient- and the engine operating conditions. To avoid monitoring failures within the diagnosis functions related to the coolant

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temperature behaviour, the influence of critical engine driving conditions must be taken into consideration. To allow a comparison to the time elapsed since engine start, the activation time of the critical driving conditions are calculated in percent of the elapsed time. The percentage values are used in several diagnosis functions to cancel monitoring in order to avoid failures.

### Application conditions

**Initialisation at Exit start (EXIT\_ST):** LV\_CDN\_ENA\_RATIO\_T\_AST = 1  
all other output data are set to 0 [phys]

**Initialisation at Engine run to Engine stop (ERU\_to\_ES):** LV\_CDN\_ENA\_RATIO\_T\_AST = 0  
T\_DIAG\_AST = 0 s

**Recurrence:** 1000 ms

**Activation:** LV\_CDN\_ENA\_RATIO\_T\_AST = 1

**Deactivation:** LV\_CDN\_ENA\_RATIO\_T\_AST = 0

### Formula section:

#### Calculation of the after start time for diagnosis functions:

```

if          T_DIAG_AST < 65535 s
then       T_DIAG_AST(n) = T_DIAG_AST(n-1) + 1 s
else       T_DIAG_AST(n) = T_DIAG_AST(n-1)
endif

```

#### Calculation of the "idle speed" period after start:

```

if          LV_IS = 1
then       T_IS_AST(n) = T_IS_AST(n-1) + 1 s
else       T_IS_AST(n) = T_IS_AST(n-1)
endif

```

RATIO\_T\_IS\_AST = (T\_IS\_AST / T\_DIAG\_AST) \* 100 %

#### Calculation of the " trailing throttle fuel cut-off " period after start:

```

if          LV_PUC = 1
then       T_PUC_AST(n) = T_PUC_AST(n-1) + 1 s
else       T_PUC_AST(n) = T_PUC_AST(n-1)
endif

```

RATIO\_T\_PUC\_AST = (T\_PUC\_AST / T\_DIAG\_AST) \* 100 %

#### Calculation of the "low load" period after start:

```

if          MAF_KGH <= IP_MAF_KGH_LOAD_MIN_AST
then       T_LOAD_MIN_AST(n) = T_LOAD_MIN_AST(n-1) + 1 s
else       T_LOAD_MIN_AST(n) = T_LOAD_MIN_AST(n-1)
endif

```

RATIO\_T\_LOAD\_MIN\_AST = (T\_LOAD\_MIN\_AST / T\_DIAG\_AST) \* 100 %


#### Calculation of the "low vehicle speed" period after start:

```

if          VS <= C_VS_THD_VS_MIN_AST
then       T_VS_MIN_AST(n) = T_VS_MIN_AST(n-1) + 1 s
else       T_VS_MIN_AST(n) = T_VS_MIN_AST(n-1)
endif

```

RATIO\_T\_VS\_MIN\_AST = (T\_VS\_MIN\_AST / T\_DIAG\_AST) \* 100 %


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**Calculation of the "high vehicle speed" period after start:**

```

if                VS > C_VS_THD_VS_MAX_AST
then             T_VS_MAX_AST(n) = T_VS_MAX_AST(n-1) + 1 s
else             T_VS_MAX_AST(n) = T_VS_MAX_AST(n-1)
endif
RATIO_T_VS_MAX_AST = (T_VS_MAX_AST / T_DIAG_AST) * 100 %

```

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## A.53 Coolant temperature sensor diagnosis


### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TCO_EL	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptom for coolant temperature signal range error					
ERR_SYM_TCO_GRD	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptom for coolant temperature signal gradient error					
LV_CDN_DIAG_TCO_EL	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature signal range diagnosis conditions					
LV_CDN_DIAG_TCO_GRD	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature signal gradient diagnosis conditions					
LV_CDN_ENA_TCO_PREL	V	0... 1H	0 ...1	1	-
Boolean for preliminary coolant temperature error enable conditions					
LV_END_DIAG_TCO_EL	O/V	0... 1H	0 ...1	1	-
Boolean for end of coolant temperature signal range diagnosis					
LV_END_DIAG_TCO_GRD	O/V	0... 1H	0 ...1	1	-
Boolean for end of coolant temperature signal gradient diagnosis					
LV_ERR_TCO	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on coolant temperature acquisition					
LV_ERR_TCO_EL	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature signal range error					
LV_ERR_TCO_GRD	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature signal gradient error					
LV_ERR_TCO_PREL	O/V	0... 1H	0 ...1	1	-
Boolean for preliminary error currently present on coolant temperature acquisition					
LV_ERR_TCO_PREL_DET	V/S	0... 1H	0 ...1	1	-
Boolean for preliminary error present on coolant temperature acquisition during driving cycle					

### Input data:

CTR_ABC_TCO_EL	CTR_ABC_TCO_GRD	LV_CDN_VB_MIN_DIAG {p. 1185}	LV_ERR_TCO_PLAUS {p. 5682}
LV_ERR_TCO_STUCK {p. 5691}	LV_ERR_TCO_STUCK_ RNG {p. 5675}	LV_IGK {p. 906}	LV_INH_DIAG_TCO_EL {p. 4502}
LV_INH_DIAG_TCO_GRD {p. 4502}	NC_NR_TCO_SENS {p. 576}	T_DIAG_AST {p. 4493}	TCO_MES {p. 1100}
TIA_THR {p. 984}	VP_TCO [NC_NR_TCO_SENS] {p. 1100}		

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**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_ABC_THD_TCO_PREL	-	0... FFH	0... 255	1	-
Threshold for anti-bounce counter value for preliminary coolant temperature error detection					
C_T_AST_MIN_DIAG_TCO_EL	-	0... FFFFH	0... 65535	1	s
Minimum time delay after start for the coolant temperature electrical diagnosis					
C_TCO_MES_GRD_MAX_DIAG_TCO_GRD	-	0... FEH	0... 190.5	0.75	°C
Maximum coolant temperature gradient for the coolant temperature gradient diagnosis					
C_TIA_THR_MIN_DIAG_TCO_EL	-	0... FEH	-48... 142.5	0.75	°C
Minimum intake air temperature value for the coolant temperature electrical diagnosis					
C_VP_TCO_MAX_DIAG_TCO_EL	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Maximum raw sensor signal voltage for the coolant temperature electrical diagnosis					
C_VP_TCO_MIN_DIAG_TCO_EL	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Minimum raw sensor signal voltage for the coolant temperature electrical diagnosis					

**FUNCTION DESCRIPTION:****General information:**

The purpose of the diagnosis function is to detect electrical failures as defined by OBD I and OBD II requirements. The coolant temperature raw sensor voltage (VP\_TCO[0]) is measured with use of an 10bit A/D converter by the ECU hardware. The modified sensor signal is converted then into a measured temperature value (TCO\_MES). Each by the ECU hardware measured raw sensor value is checked as well as the converted temperature signal.

**Application conditions:**

See separate chapters:


**A.53.1 Global coolant temperature failure****FUNCTION DESCRIPTION:****General information:**

A global coolant temperature error is set without debounce as soon as an electrical-, or signal gradient-, or stuck signal-, or plausibility- error is detected. All separate diagnosis functions are performed all the time if the diagnosis conditions are fulfilled. The deactivation of diagnosis functions with use of configuration switches is not possible.

In addition a preliminary coolant temperature error is set as soon as debouncing of an electrical-, or signal gradient- symptom occurs. The preliminary coolant temperature error will be stored in the non-volatile memory during the ECU's self-holding phase to be available at the beginning of the next driving cycle.

**Application conditions:**

*Initialisation at Reset:*

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```

LV_ERR_TCO = 0
LV_CDN_ENA_TCO_PREL = 1
LV_ERR_TCO_PREL = LV_ERR_TCO_PREL_DET (NVMY)
LV_ERR_TCO_PREL_DET = LV_ERR_TCO_PREL_DET (NVMY)
(NVMY: stored in the non-volatile memory)

```

*Initialisation at Engine stop to Engine run (ES\_to\_ERU):*

```

LV_ERR_TCO_PREL_DET = 0
LV_CDN_ENA_TCO_PREL = 0

```

*Initialisation at Engine stop*

```

LV_CDN_ENA_TCO_PREL = 1

```

*Initialisation at FMY clear:*

```

LV_ERR_TCO = 0
LV_ERR_TCO_PREL = 0
LV_ERR_TCO_PREL_DET = 0

```

*Recurrence:* 100 ms

*Activation:* at every engine operating state

#### Formula section:

```

if          LV_ERR_TCO_EL = 1          or
              LV_ERR_TCO_GRD = 1       or
              LV_ERR_TCO_STUCK = 1     or
              LV_ERR_TCO_STUCK_RNG = 1 or
              LV_ERR_TCO_PLAUS = 1     or
then        LV_ERR_TCO = 1          (without debounce)
else        LV_ERR_TCO = 0
endif

```

### A.53.1.1 Preliminary coolant temperature failure at engine stop

#### Application conditions

**Recurrence:** 100 ms

**Activation:** LV\_CDN\_ENA\_TCO\_PREL = 1

**Deactivation:** LV\_CDN\_ENA\_TCO\_PREL = 0

#### Formula section:

```


if          CTR_ABC_TCO_EL > 0       or
              CTR_ABC_TCO_GRD > 0     or
              LV_ERR_TCO_PREL_DET = 1
then        LV_ERR_TCO_PREL = 1     (without debounce)
else        LV_ERR_TCO_PREL = 0
endif

```

### A.53.1.2 Preliminary coolant temperature failure at engine run

#### Application conditions

**Recurrence:** 100 ms

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**Activation:**  $LV\_CDN\_ENA\_TCO\_PREL = 0$

**Deactivation:**  $LV\_CDN\_ENA\_TCO\_PREL = 1$

### Formula section:

```

if          CTR_ABC_TCO_EL      > C_CTR_ABC_THD_TCO_PREL or
             CTR_ABC_TCO_GRD     > C_CTR_ABC_THD_TCO_PREL
then       LV_ERR_TCO_PREL_DET = 1    (irrevocable for current driving cycle)
endif

```

```

if          CTR_ABC_TCO_EL      > 0      or
             CTR_ABC_TCO_GRD     > 0      or
then       LV_ERR_TCO_PREL      = 1      (without debounce)
else       LV_ERR_TCO_PREL      = 0
endif

```

## A.53.2 Coolant temperature signal range diagnosis (TCO\_EL)

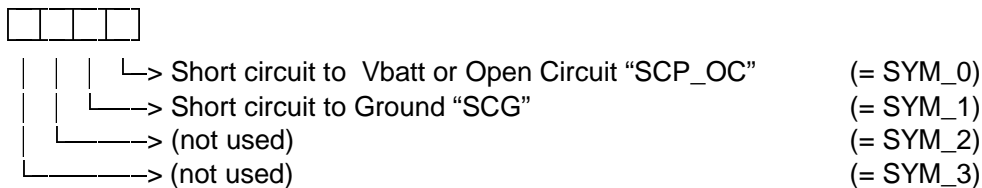
### FUNCTION DESCRIPTION:

#### General information:

The purpose of the signal range- or electrical diagnosis is to detect electrical errors in the input circuit of the coolant temperature sensor. The analog sensor input signal is converted into a digital value with use of an A/D converter. All symptoms of the error code are handled by anti-bouncing. Only one symptom can be active at a time.

#### Description:

Error-symptoms are defined to this diagnosis function as following:



#### Application conditions:

##### *Initialisation:*

LV\_ERR\_TCO\_EL = Refer to filtering configuration for the initialisation  
 LV\_END\_DIAG\_TCO\_EL = Refer to filtering configuration for the initialisation  
 LV\_CDN\_DIAG\_TCO\_EL = Refer to filtering configuration for the initialisation  
 ERR\_SYM\_TCO\_EL = Refer to filtering configuration for the initialisation

**Recurrence:** 100 ms

**Activation:** LV\_IGK = 1 **and**  
 LV\_CDN\_VB\_MIN\_DIAG = 1 **and**  
 LV\_INH\_DIAG\_TCO\_EL = 0

**Deactivation:** Activation condition not true  
At Deactivation: LV\_CDN\_DIAG\_TCO\_EL = 0

### Formula section:

#### Error detection:

```

if (1)          VP_TCO[0] < C_VP_TCO_MIN_DIAG_TCO_EL
                // coolant temperature sensor voltage signal (VP_TCO[0])
then (1)       (error detection "Short circuit to GND")
                LV_CDN_DIAG_TCO_EL = 1
                ERR_SYM_TCO_EL = "SYM_1"
                LV_ERR_TCO_EL = 1                                (after debounce)
else (1)
  if (2)       VP_TCO[0] > C_VP_TCO_MAX_DIAG_TCO_EL
                // coolant temperature sensor voltage signal (VP_TCO[0])
                (error detection "Short circuit to Vbatt or open load" possible)
    then (2)
      if (3)   TIA_THR >= C_TIA_THR_MIN_DIAG_TCO_EL
                or
                TIA_THR < C_TIA_THR_MIN_DIAG_TCO_EL           and
                T_DIAG_AST > C_T_AST_MIN_DIAG_TCO_EL
    then (3)   LV_CDN_DIAG_TCO_EL = 1
                ERR_SYM_TCO_EL = "SYM_0"
                LV_ERR_TCO_EL = 1                                (after debounce)
    else (3)   LV_CDN_DIAG_TCO_EL = 0
    endif (3)
  else (2)   LV_CDN_DIAG_TCO_EL = 1
                ERR_SYM_TCO_EL = "NO_SYM"
                LV_ERR_TCO_EL = 0                                (after rebound)
  endif (2)
endif (1)

```

#### End of diagnosis:

For the calculation of LV\_END\_DIAG\_TCO\_EL see "Anti-bounce Algorithm, calculation of the end of diagnosis".

## **A.53.3 Coolant temperature signal gradient diagnosis (TCO\_GRD)**


### FUNCTION DESCRIPTION:

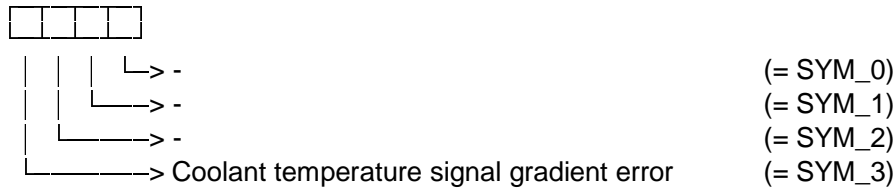
#### General information:

The purpose of the signal gradient diagnosis is to detect a not plausible gradient on the measured coolant temperature sensor signal. The monitoring is based on a comparison between the actual measured and the last measure coolant temperature value. The symptom of the error code is handled by anti-bouncing.

#### Description:

Error-symptoms are defined to this diagnosis function as following:

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### Application conditions

**Initialisation:**

LV\_ERR\_TCO\_GRD = Refer to filtering configuration for the initialisation

LV\_END\_DIAG\_TCO\_GRD = Refer to filtering configuration for the initialisation

LV\_CDN\_DIAG\_TCO\_GRD = Refer to filtering configuration for the initialisation

ERR\_SYM\_TCO\_GRD = Refer to filtering configuration for the initialisation

**Recurrence:** 100 ms

**Activation:**

```

if LV_IGK = 1 and
    LV_CDN_VB_MIN_DIAG = 1 and
    LV_INH_DIAG_TCO_GRD = 0
then LV_CDN_DIAG_TCO_GRD = 1
else LV_CDN_DIAG_TCO_GRD = 0
  
```

**endif**

### Formula section:

Error detection:

```

if |TCO_MES(n-1) - TCO_MES(n)| > C_TCO_MES_GRD_MAX_DIAG_TCO_GRD
then ERR_SYM_TCO_GRD = "SYM_3"
    LV_ERR_TCO_GRD = 1 (after debounce)
else ERR_SYM_TCO_GRD = "NO_SYM"
    LV_ERR_TCO_GRD = 0 (after rebound)
  
```

**endif**

End of diagnosis:

For the calculation of LV\_END\_DIAG\_TCO\_GRD see "Anti-bounce Algorithm, calculation of the end of diagnosis".

## A.54 Coolant temperature sensor diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_RBM_TCO_STUCK	V	0... 1H	0 ...1	1	-
Boolean for temperature stuck signal diagnosis inhibit due to OBD error					
LV_INH_DIAG_TCO_EL	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature signal range diagnosis inhibit					
LV_INH_DIAG_TCO_GRD	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature signal gradient diagnosis inhibit					
LV_INH_DIAG_TCO_STUCK	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature stuck signal diagnosis inhibit					
STATE_RBM_TCO_STUCK	O/V	0... 7H	0 ...7	1	-
Interface of TCO_STUCK monitor with the Rate-Based Monitoring statistics					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_CDN_CST_RBM {p. 5870}	LV_DC {p. 5746}	LV_END_DIAG_TCO_ STUCK {p. 5691}
LV_ERR_TCO_EL {p. 4496}	LV_ERR_TCO_GRD {p. 4496}	LV_ERR_TCO_PLAUS {p. 5682}	LV_ERR_TCO_STUCK_ RNG {p. 5675}
LV_ERR_TIA {p. 4200}	LV_IGK {p. 906}	LV_ST_END {p. 1720}	

### Import actions:

<b>ACTION_ERRM_CheckPendingStatus</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR_PND>)
--

### Error treatment:

#### Error debounce:

Debounce counter increment: C\_ABC\_INC\_TCO\_EL  
Debounce counter maximum value: C\_ABC\_MAX\_TCO\_EL

#### Diagnosis Configuration

ERRM configuration for LV\_ERR\_TCO\_EL is "**STD\_INI**" //all 0 at LV\_IGK 0->1 or reset

#### Error debounce:

Debounce counter increment: C\_ABC\_INC\_TCO\_GRD  
Debounce counter maximum value: C\_ABC\_MAX\_TCO\_GRD

#### Diagnosis Configuration


ERRM configuration for LV\_ERR\_TCO\_GRD is "**MEM**" //error is set irreversible

#### Error debounce:

no debounce

#### Diagnosis Configuration

Initialization LV\_ERR\_TCO\_STUCK is managed by function, thus configuration is "**NO**"

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**FUNCTION DESCRIPTION:****General information:**

Task of the coolant temperature sensor diagnosis (Appl. Inc.) is to allow the projects to adapt their specific requirements to generic coolant temperature sensor diagnosis. The setting of the interface output variables have to be provided by the projects.

**Application conditions**

**Initialisation:** *see separate chapter*  
**Recurrence:** *see separate chapter*  
**Activation:** *at every engine operating state*  
**Deactivation:** -

**A.54.1 Coolant temperature signal range diagnosis - interface parameter****FUNCTION DESCRIPTION:****General information:**

Depending on project specific requirements, the electrical diagnosis of the main coolant temperature sensor can be inhibited by setting of LV\_INH\_DIAG\_TCO\_EL.

**Application conditions**

**Initialisation:** **If** Reset **or** Transition: LV\_IGK  
= 0 -> LV\_IGK = 1  
**then** LV\_INH\_DIAG\_TCO\_EL = 0  
**endif**

**Recurrence:** 100 ms

**Activation:** LV\_IGK = 1

**Deactivation:** LV\_IGK = 0

**Formula section:**

```
IF          LV_ERR_TIA = 1
THEN      LV_INH_DIAG_TCO_EL = 1
ELSE      LV_INH_DIAG_TCO_EL = 0
ENDIF
```

**A.54.2 Coolant temperature signal gradient diagnosis - interface parameter****FUNCTION DESCRIPTION:**

**General information:**

Depending on project specific requirements, the signal gradient diagnosis of the main coolant temperature sensor can be inhibited by setting of LV\_INH\_DIAG\_TCO\_GRD.

**Application conditions**

```

Initialisation:      If          Reset          or Transition:      LV_IGK
                       = 0 -> LV_IGK = 1
                       then          LV_INH_DIAG_TCO_GRD = 0
                       endif
Recurrence:        100 ms
Activation:        LV_IGK = 1
Deactivation:     LV_IGK = 0
  
```

**Formula section:**

```

If          LV_ERR_TCO_EL = 1          or
              LV_ERR_TCO_STUCK = 1      or
              LV_ERR_TCO_PLAUS = 1      or
              LV_ERR_TCO_STUCK_RNG = 1
then        LV_INH_DIAG_TCO_GRD = 1
else        LV_INH_DIAG_TCO_GRD = 0
endif
  
```


**A.54.3 Coolant temperature signal stuck diagnosis - interface parameter****FUNCTION DESCRIPTION:****General information:**

Depending on project specific requirements, the signal stuck diagnosis of the main coolant temperature sensor can be inhibited by setting of LV\_INH\_DIAG\_TCO\_STUCK.

**Application conditions**

```

Initialisation:    at RESET or LV_IGK = 0 -> 1 or FMY clear:
                       LV_INH_DIAG_TCO_STUCK = 0
                       LV_INH_DIAG_RBM_TCO_STUCK = 0
Recurrence:      1000 ms
Activation:      LV_ST_END = 1
                       (Calculation of the TCO stuck diagnosis interface parameter
                       enabled)
Deactivation:    LV_ST_END = 0
                       (Calculation of the TCO stuck diagnosis interface parameter
                       disabled)
  
```

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**Formula section:**

```

if          LV_ERR_TCO_EL = 1                or
              LV_ERR_TCO_GRD = 1              or
              LV_ERR_TCO_STUCK_RNG = 1        or
              LV_ERR_TCO_PLAUS = 1
then       LV_INH_DIAG_RBM_TCO_STUCK = 1
endif

if          LV_INH_DIAG_RBM_TCO_STUCK = 1    or
              LV_IGK = 0                      or
              LV_DC = 0
then       LV_INH_DIAG_TCO_STUCK = 1
endif
    
```

**A.54.4 Interface for Rate - Based - Monitoring**

**FUNCTION DESCRIPTION:**

**General information:**

With this module the interface between the TCO\_STUCK monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_TCO\_STUCK data.

Within STATE\_RBM\_TCO\_STUCK, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)  
(depending on failure status: pending)
- Monitor individual RBM conditions encountered within this DC (bit 2)

**Application conditions:**

*Initialisation :*

at ECU reset :

*bit 0, bit 1 and bit 2 of STATE\_RBM\_TCO\_STUCK = 0*

at LV\_DC 0 1 transition :

*bit 0, bit 1 and bit 2 of STATE\_RBM\_TCO\_STUCK = 0*

on failure memory reset :

*bit 1 of STATE\_RBM\_TCO\_STUCK = 0*

*Recurrence:* 1 s

*Activation:* LV\_DC = 1

**Formula section:**

*At LV\_DC 0 1 transition*

The pending status of the following failures has to be checked only once :

LV_ERR_TCO_EL	LV_ERR_TCO_PLAUS	LV_ERR_TCO_GRD	LV_ERR_TCO_STUCK_RNG
---------------	------------------	----------------	----------------------

**If(1)** { CPU optimization at LV\_DC 0 1 transition }

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```

CTR_ERR_DYN_NR <> 0      { the dynamic failure memory isn t empty }

Then(1)
  While      bit 1 of STATE_RBM_TCO_STUCK = 0 do
    with each XX failure of the above list :
      ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

        If(2)      XX has a pending status
          Then(2)   bit 1 of STATE_RBM_TCO_STUCK = 1
          Endif(2)
        Endwhile
      Else(1)
        { the dynamic failure memory is empty }
        No action
      Endif(1)
    Every 1 s :
    If      bit 0 of STATE_RBM_TCO_STUCK = 0
    Then
      If      LV_END_DIAG_TCO_STUCK = 1
      Then    bit 0 of STATE_RBM_TCO_STUCK = 1
      Endif
    Endif
    If      bit 1 of STATE_RBM_TCO_STUCK = 0
    Then
      If      LV_INH_DIAG_RBM_TCO_STUCK = 1
      Then    bit 1 of STATE_RBM_TCO_STUCK = 1
      Endif
    Endif
    If      bit 2 of STATE_RBM_TCO_STUCK = 0
    Then
      If      LV_CDN_CST_RBM = 1
      Then    bit 2 of STATE_RBM_TCO_STUCK = 1
      Endif
    Endif
  Endif

```

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## A.55 Cooling fan diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_ECFPWM_FB [NC_ECF_NR]	V	0... FFH	0... 255	1	-
Antibounce counter for ECF failure feedback diagnosis.					
CDN_DIAG_ECF_EL	V	0... FFH	0... 255	1	-
Diagnosis condition for each symptom					
CDN_DIAG_ECFPWM_BAS [NC_ECF_NR]	O/V	0... 7H	0 ...7	1	-
Primary diagnosis condition read from the infrastructure for each symptom of ECFPWMbit 0: diagnosis condition for symptom SYM_0 (SCP)bit 1: diagnosis condition for symptom SYM_1 (SCG)bit 2: diagnosis condition for symptom SYM_2 (OC)					
ERR_DIAG_ECFPWM [NC_ECF_NR]	O/V	0... 7H	0 ...7	1	-
Raw value of error symptom for ECFPWM detected on interface ECU and ECF control unitbit 0: diagnosis condition for symptom SYM_0 (SCP)bit 1: diagnosis condition for symptom SYM_1 (SCG)bit 2: diagnosis condition for symptom SYM_2 (OC)					
ERR_ECFPWM_FB [NC_ECF_NR]	O/V	0... FFH	0... 255	1	-
The failure status of the failure feedback coming from the ECF control unit00H: no failure feedback01H: failure 1 detected by ECF control unitFFH: init value /feedback possibleThe values 01H are only valid, if LV_ECFPWM_FB_VLD[x] = 1, else the f					
ERR_SYM_ECF_EL [NC_ECF_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom for electronic controlled cooling fan signal range error					
ERR_SYM_ECFPWM_FB [NC_ECF_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom ECF failure feedback diagnosis.					
LV_CDN_DIAG_ECF_EL [NC_ECF_NR]	V	0... 1H	0 ...1	1	-
Boolean for electronic controlled cooling fan signal range diagnosis conditions					
LV_CDN_DIAG_ECFPWM_FB [NC_ECF_NR]	V	0... 1H	0 ...1	1	-
Diagnosis condition ECF failure feedback diagnosis.					
LV_ECFPWM_FB_VLD [NC_ECF_NR]	O/V	0... 1H	0 ...1	1	-
If LV_ECFPWM_FB_VLD[x] = 1 the failure number ERR_ECFPWM_FB[x] (01H) is valid					
LV_END_DIAG_ECF_EL [NC_ECF_NR]	V	0... 1H	0 ...1	1	-
Boolean for end of electronic controlled cooling fan signal range diagnosis					
LV_END_DIAG_ECFPWM_FB [NC_ECF_NR]	V	0... 1H	0 ...1	1	-
End of diagnosis ECF failure feedback diagnosis.					
LV_ERR_ECF_EL [NC_ECF_NR]	O/V	0... 1H	0 ...1	1	-
Boolean for electronic controlled cooling fan signal range error					
LV_ERR_ECFPWM_FB [NC_ECF_NR]	O/V	0... 1H	0 ...1	1	-
Error currently present, indicated by failure feedback from ECF control unit.					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_ACT_ECFPWM_FB [NC_ECF_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time with ECFPWM[NC_ECF_NR] > C_EFPWM_MIN_FB[NC_ECF_NR] necessary to have failure feedback from ECF control unit					
T_ECFPWM_FB [NC_ECF_NR]	V	0... FFH	0... 25.5	0.1	s
Timer counting flow for failure feedback recognition					

**Input data:**

CDN_DIAG_ECFPWM_BAS [NC_ECF_NR] {p. 4507}	ECFPWM [NC_ECF_NR] {p. 3596}	ERR_DIAG_ECFPWM [NC_ECF_NR] {p. 4507}	ERR_ECFPWM_FB [NC_ECF_NR] {p. 4507}
LV_CDN_VB_MIN_DIAG {p. 1185}	LV_ECFPWM_FB_VLD [NC_ECF_NR] {p. 4507}	LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}
NC_ECF_NR {p. 576}	TAM {p. 1579}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_ECFPWM_FB [NC_ECF_NR]	-	1... FFH	1... 255	1	-
If C_ABC_ECFPWM_FB[x] times sequentially a failure feedback for the same failure is detected, the failure LV_ERR_ECFPWM_FB[x] is set.					
C_ABC_INC_ECF_EL	-	0... FFH	0... 255	1	-
Debounce counter increment ECF diagnosis					
C_ABC_MAX_ECF_EL	-	1... FFH	1... 255	1	-
Debounce counter maximum value - ECF diagnosis					
C_ECFPWM_DIAG_MAX [NC_ECF_NR]	-	0... FFH	0... 99.60937	0.390625	%
Maximum duty cycle threshold of ECF_EL for electrical ECF diagnosis					
C_ECFPWM_DIAG_MIN [NC_ECF_NR]	-	0... FFH	0... 99.60937	0.390625	%
Minimum duty cycle threshold of ECF_EL for electrical ECF diagnosis					
C_ECFPWM_MIN_FB [NC_ECF_NR]	-	0... FFH	0... 99.60937	0.390625	%
Minimum duty cycle of ECFPWM to have a failure feedback from ECF control unit					
C_T_ACT_ECFPWM_FB [NC_ECF_NR]	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time necessary to have failure feedback from ECF control unit					
C_T_ECFPWM_FB_MAX [NC_ECF_NR]	-	0... FFH	0... 25.5	0.1	s
Time range necessary for identification of failure feedback maximal value					
C_T_ECFPWM_FB_MIN [NC_ECF_NR]	-	0... FFH	0... 25.5	0.1	s
Time range necessary for identification of failure feedback minimal value					
C_TAM_MIN_ECFPWM_FB_DIAG_TH	-	0... FEH	-48... 142.5	0.75	°C
Minimum TAM for enabling ECFPWM_FB-diagnosis					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_ECF_EL	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (typical 2)					

**Import actions:**

Continued on next page

**ACTION\_ERRM\_FilterMulticondition** (IN<XX>,IN<CDN\_DIAG\_>.XX>,<IN<>,ERR\_DIAG\_XX>,<IN>,<C\_ABC\_INC\_XX>,IN<C\_ABC\_MAX\_XX>,<OUT<LV\_ERR\_XX>)

### Error treatment:

Diagnostic ECF_EL[NC_ECF_NR]	Symptom description	Symptom	Filter type
ECF _EL[NC_ECF_NR] Diagnostic	SCP	SYM_0	MPL_STD_INI
	SCG	SYM_1	
	OC	SYM_2	

Diagnostic ECFPWM_ERR_FB[NC_ECF_NR]	Symptom description	Symptom	Filter type
failure feedback diagnosis of ECF control unit	see description	SYM_0	NO
		SYM_1	
		SYM_2	
		SYM_3	

## A.55.1 Diagnostic information from infrastructure

### FUNCTION DESCRIPTION:

#### Description:

The ECF control unit is controlled by a PWM signal line driven by the ATIC 39. The driver can distinguish between three symptoms: Short circuit to Vbatt , Short circuit to GND and Open Load . This function reads the failure information (ERR\_DIAG\_ECFPWM[x]) from the infrastructure. The [x] is the placeholder for [NC\_ECF\_NR].

#### Application conditions


**Initialisation:** reset or transition LV\_IGK off - -> on or reset of failure memory  
 $CDN\_DIAG\_ECFPWM\_BAS[x] = 0$   
 $ERR\_DIAG\_ECFPWM[x] = 0$

**Recurrence:** 100ms

**Activation:** every ECU state

#### Formula section:

Usage of the diagnosis information (failure symptoms (raw value) ERR\_DIAG\_ECFPWM[x] and diagnosis conditions CDN\_DIAG\_ECFPWM\_BAS[x]) received from the infrastructure:

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Diagnosis conditions are set according infrastructure info.: CDN\_DIAG\_ECFPWM\_BAS[x]  
Failure symptoms are set according infrastructure info.: ERR\_DIAG\_ECFPWM[x]

## A.55.2 ECF control unit: Failure feedback recognition

### FUNCTION DESCRIPTION:

If a failure is detected from the ECF control unit, a failure feedback is send to the ECU by pulling the signal line (interface ECU to the ECF control unit) to ground in a definted pattern. The time  $t_{low}$  is a identification for the failure.

### Description:

If a failure is detected from the ECF control unit, a failure feedback is send to the ECU by pulling the signal line (interface ECU to the ECF control unit) to ground in a definted pattern. The time  $t_{low}$  is a identification for the failure.

For the recognition of the failure feedback the information, if a failure short circuit to ground is detected on the signal line between ECU and ECF control unit is used.

### Application conditions

**Initialisation:** reset or transition LV\_IGK off - -> on or reset of failure memory  
 ERR\_ECFPWM\_FB[x] = FFH  
 T\_ECFPWM\_FB[x] = 0  
 LV\_ECFPWM\_FB\_VLD[x] = 0

**Recurrence:** 100ms

**Activation:** LV\_CDN\_VB\_MIN\_DIAG = 1 and  
 LV\_ERR\_SPI\_MPS= 0


**Deactivation:** at deactivation function is initialized one time

### Formula section:

```

LV_ECFPWM_FB_VLD[x] = 0
If bit 1 of ERR_DIAG_ECFPWM[x] = 1 (SCG detected by HW)
Then T_ECFPWM_FB[x] = T_ECFPWM_FB[x] + 100ms
    ERR_ECFPWM_FB[x] = FFH (failure feedback possible)
If C_T_ECFPWM_FB_MAX[x] T_ECFPWM_FB[x]
    (T_ECFPWM_FB[x] out of range for FB)
Then ERR_ECFPWM_FB[x]= 00H
Endif
Else If C_T_ECFPWM_FB_MIN[x] T_ECFPWM_FB[x] C_T_ECFPWM_FB_MAX[x]
Then failure feedback detected
    ERR_ECFPWM_FB[x] = 01H
    LV_ECFPWM_FB_VLD[x] = 1
Else no failure feedback possible
    ERR_ECFPWM_FB[x] = 00H
Endif
T_ECFPWM_FB[x] = 0
Endif
    
```

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### A.55.3 Electrical diagnosis of ECF

#### FUNCTION DESCRIPTION:

##### General information:

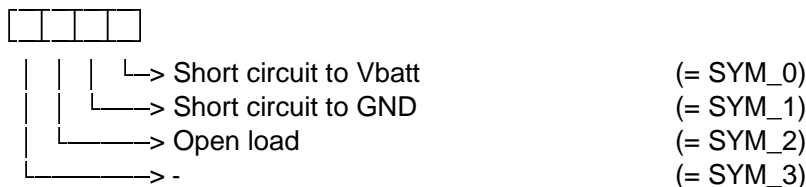
The purpose is to diagnose the signal from the driver, which controls the electrical cooling fan.  
The input signal is a modulated control pulse (PWM).

##### Description:

The driver can distinguish between three symptoms: Short circuit to Vbatt , Short circuit to GND and Open Load . The diagnosis of all these symptoms is possible at the same time in the duty cycle range C\_ECFPWM\_DIAG\_MIN[[x] ... C\_ECFPWM\_DIAG\_MAX[x].

The error detection algorithm in this function for short circuit to GND is respecting the status of the failure feedback recognition (ERR\_ECFPWM\_FB[x]). The failure, detected by the HW, is delivered from the infrastructure ERR\_DIAG\_ECFPWM[x].

**Error-symptoms:** are defined to this diagnosis function as following



#### Application conditions

**Initialization:** according filter-type: MPL\_STD\_INI

**Recurrence:** 100ms

**Activation:** activation in all engine states

#### Formula section:


```

If          LV_CDN_VB_MIN_DIAG = 1
              and LV_ERR_SPI_MPS= 0
Then       If          Activation conditions are met for the NC_PSD_DLY_ECF_EL recurrence
              and       C_ECFPWM_DIAG_MIN[x] ECFPWM[NC_ECF_NR] C_ECFPWM_DIAG_MAX[x]

              and       ERR_ECFPWM_FB[x] = 00H (no failure feedback possible)
              Then       CDN_DIAG_ECF_EL[x] = CDN_DIAG_ECFPWM_BAS[x]
                          ERR_DIAG_ECFPWM[x] is used for debounce mechanism
              Else       CDN_DIAG_ECF_EL[x] = 0 (diagnosis not possible)
              Endif
Else       CDN_DIAG_ECF_EL[x] = 0
Endif
    
```

Failure filtering and error management treatment:

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For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN\_DIAG\_ECF\_EL[x] and ERR\_DIAG\_ECFPWM[x].

ACTION\_ERRM\_FilterMulticondition (IN<ECF\_EL[x]>, IN<CDN\_DIAG\_ECF\_EL[x]>, IN<ERR\_DIAG\_ECFPWM[x]>, IN<C\_ABC\_INC\_ECF\_EL[x]>, IN<C\_ABC\_INC\_ECF\_EL[x]>, OUT<LV\_ERR\_ECF\_EL[X]>, SYNCRONIZATION<CALL>)

This algorithm determines:

ERR\_SYM\_ECF\_EL[x] (detected error symptom for ECF diagnosis)  
 LV\_ERR\_ECF\_EL[x] (Error flag for debounced error of ECF)  
 LV\_CDN\_DIAG\_ECF\_EL[x] (Diagnosis condition information)  
 LV\_END\_DIAG\_ECF\_EL[x] (End of diagnosis information)

### A.55.4 ECF control unit: Failure feedback diagnosis

#### FUNCTION DESCRIPTION:

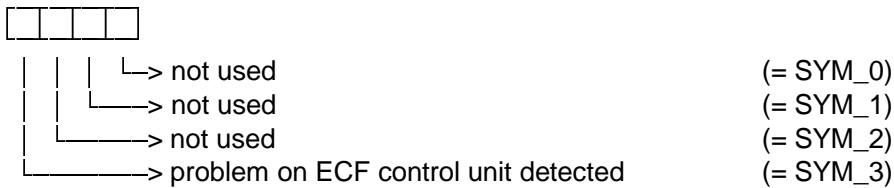
##### General information:

If a failure is detected by the ECF control unit, a failure feedback is send to the ECU.

##### Description:

According the possible failure feedback from the ECF control unit (defined by ERR\_ECFPWM\_FB[x] and LV\_ECFPWM\_FB\_VLD[x]), the diagnosis is managing the following failure: LV\_ERR\_ECFPWM\_FB[x].

##### Error-symptoms of failure LV\_ERR\_ECFPWM\_FB[x]:



#### Application conditions

**Initialization:** reset or transition LV\_IGK off - -> on or reset of failure memory  
 all output = 0

**Recurrence:** 100ms

**Activation:** activation in all engine states

#### Formula section:

If LV\_CDN\_VB\_MIN\_DIAG =1 and

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```

LV_ERR_SPI_MPS= 0
Then
  LV_CDN_DIAG_ECFPWM_FB[x] = 1
  If      ECFPWM[x] > C_ECFPWM_MIN_FB[x]
  Then    T_ACT_ECFPWM_FB[x] = T_ACT_ECFPWM_FB[x] +100ms
          T_ACT_ECFPWM_FB[x] is limited to 6553.5s
  Endif
  If      LV_ERR_ECFPWM_FB[x] = 0
  Then
    If      LV_ECFPWM_FB_VLD[x] = 1
            (valid failure feedback information available)      and
            TAM > C_TAM_MIN_ECFPWM_FB_DIAG_TH
    Then    ERR_SYM_ECFPWM_FB[x] = SYM_3
            ABC_ECFPWM_FB[x] = ABC_ECFPWM_FB[x] + 1
            If      ABC_ECFPWM_FB[x] > C_ABC_ECFPWM_FB[x]
            Then    LV_ERR_ECFPWM_FB[x] = 1
                    LV_END_DIAG_ECFPWM_FB[x] = 1
            Endif
    Endif
    Else    If      ERR_ECFPWM_FB[x] = 0      (no failure feedback de-
            tected)
            Then    ERR_SYM_ECFPWM_FB[x] = 0
                    //please note: the LV_CDN_DIAG_ECFPWM_FB [x] should not be re-
                    set
                    If      T_ACT_ECFPWM_FB[x]
                            C_T_ACT_ECFPWM_FB[x]
                    Then    LV_END_DIAG_ECFPWM_FB[x] = 1
                    Endif
            Endif
    Endif
  Else    LV_CDN_DIAG_ECFPWM_FB[x] = 0
  Endif
Else
  LV_CDN_DIAG_ECFPWM_FB[x] = 0
Endif

```

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## A.56 Electronically controlled radiator shutter diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_ECRAS_EL	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of ECRAS_ELbit 0: diagnosis condition for symptom SYM_0 (SCP)bit 1: diagnosis condition for symptom SYM_1 (SCG)bit 2: diagnosis condition for symptom SYM_2 (OC)					
CDN_DIAG_ECRASPWM_BAS	O	0... 7H	0 ...7	1	-
Primary diagnosis condition read from the infrastructure for each symptom of ECRASPWMbit 0: diagnosis condition for symptom SYM_0 (SCP)bit 1: diagnosis condition for symptom SYM_1 (SCG)bit 2: diagnosis condition for symptom SYM_2 (OC)					
CTR_ECRAS_DOWN_DET	V	0... FFH	0... 255	1	-
Counter for detecting ECRAS_DOWN					
ERR_DIAG_ECRASPWM	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for ECRASPWM detected on interface ECU and ECRAS control unitbit 0: diagnosis condition for symptom SYM_0 (SCP)bit 1: diagnosis condition for symptom SYM_1 (SCG)bit 2: diagnosis condition for symptom SYM_2 (OC)					
ERR_ECRASPWM_FB	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
The failure status of the failure feedback coming from the ECRAS control unit 00H: no failure feedback01H: failure 1 detected by ECRAS control unit FFH: init value /feedback p					
ERR_SYM_ECRAS_DOWN_FB	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom ECRAS_DOWN failure feedback diagnosis.					
ERR_SYM_ECRAS_EL	V	0... 4H	0 ...4	1	-
Error symptom ECRAS diagnosis					
ERR_SYM_ECRAS_UP_FB	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom ECRAS_UP failure feedback diagnosis.					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_ECRAS_DOWN_FB	V	0... 1H	0 ...1	1	-
Diagnosis condition ECRAS_DOWN failure feedback diagnosis.					
LV_CDN_DIAG_ECRAS_EL	V	0... 1H	0 ...1	1	-
Diagnosis condition ECRAS diagnosis					
LV_CDN_DIAG_ECRAS_UP_FB	V	0... 1H	0 ...1	1	-
Diagnosis condition ECRAS_UP failure feedback diagnosis.					
LV_DIAG_ECRAS	O/V	0... 1H	0 ...1	1	-
Diagnosis mode of ECRAS control unit activated (10% PWM)					
LV_DIAG_ECRAS_END	O/V	0... 1H	0 ...1	1	-
Diagnosis mode feedback of ECRAS control unit received (diagnosis ability of ECRAS detected)					
LV_DIAG_ECRAS_ERR_END	O/V	0... 1H	0 ...1	1	-
Diagnosis mode feedback of ECRAS control unit not received (diagnosis ability of ECRAS not detected)					
LV_ECRAS_DOWN_DET_ACT	O/V	0... 1H	0 ...1	1	-
Bit indicating learning of ECRAS_DOWN					
LV_ECRAS_DOWN_DET_RST	V	0... 1H	0 ...1	1	-
Reset learning of ECRAS_DOWN					
LV_ECRAS_DOWN_DET_SET	O/V/S	0... 1H	0 ...1	1	-
Diagnosis /learning of ECRAS_DOWN run through one-time					
LV_ECRAS_FB_DET	V	0... 1H	0 ...1	1	-
Change from short circuit to ground to normal PWM signal detected (bit 1 ERR_DIAG_ECRASPWM 1->0)					
LV_ECRAS_FB_DIAG	V	0... 1H	0 ...1	1	-
Feedback of ECRAS control unit or timeout detected					
LV_EDGE_ECRAS_DOWN	V	0... 1H	0 ...1	1	-
Detected change in LV_ECRAS_DOWN_1					
LV_EDGE_ECRAS_UP	V	0... 1H	0 ...1	1	-
Detected change in LV_ECRAS_UP_1					
LV_END_DIAG_ECRAS_DOWN_FB	O/V	0... 1H	0 ...1	1	-
End of diagnosis ECRAS_DOWN failure feedback diagnosis.					
LV_END_DIAG_ECRAS_EL	O/V	0... 1H	0 ...1	1	-
End of diagnosis ECRAS diagnosis					
LV_END_DIAG_ECRAS_UP_FB	O/V	0... 1H	0 ...1	1	-
End of diagnosis ECRAS_UP failure feedback diagnosis.					
LV_ERR_ECRAS	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on ECRAS command signal.					
LV_ERR_ECRAS_DOWN_FB	O/V	0... 1H	0 ...1	1	-
ECRAS_DOWN error currently present, indicated by failure feedback from ECRAS control unit.					
LV_ERR_ECRAS_EL	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on ECRAS command signal					
LV_ERR_ECRAS_UP_FB	O/V	0... 1H	0 ...1	1	-
ECRAS_UP error currently present, indicated by failure feedback from ECRAS control unit.					
LV_INTR_DIAG_ECRAS_EL	O/V	0... 1H	0 ...1	1	-
Boolean for irreversible interrupt of ECRAS_EL diagnosis					
LV_VAR_ECRAS_DOWN	O/V/S	0... 1H	0 ...1	1	-
ECRAS_DOWN flap of ECRAS system detected (2 flap system)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_ECRAS_FB	V	0H 1H 2H 3H 4H 5H 6H undef:1H undef:2H undef3588d42970- 2668123d31H	NO_FB DIAG_ABILITY EL_ERR_UP MEC_ERR_UP EL_ERR_ DOWN EL_ERR_UP_ AND_DOWN MEC_ERR_ UP_ AND_EL_ERR_ DOWN undef	-	-
State of the received feedback from ECRAS control unit					
T_DIAG_ECRAS	V	0... FFH	0... 25.5	0.1	s
Timer for waiting of answer of ECRAS control unit					
T_ECRAS_DOWN_DET	V	0... FFH	0... 25.5	0.1	s
Timer for learning of ECRAS_DOWN					
T_ECRAS_DOWN_DET_NEG	V	0... FFH	0... 25.5	0.1	s
Timer indicating time since start of short circuit to ground phase of ECRASPWM					
T_ECRAS_DOWN_DET_POS	V	0... FFH	0... 25.5	0.1	s
Timer indicating time since start of normal ECRASPWM signal (no SCG)					
T_ECRASPWM_FB	V	0... FFH	0... 25.5	0.1	s
Timer counting tlow for failure feedback recognition					

**Input data:**

ECRASPWM {p. 3863}	LV_ACT_ECRAS_EOL_ EXT_ADJ {p. 7763}	LV_CDN_VB_MIN_DIAG {p. 1185}	LV_ECRAS_DOWN_1 {p. 3863}
LV_ECRAS_UP_1 {p. 3863}	LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}	LV_ST_END {p. 1720}
LV_VAR_ECRAS_UP {p. 655}	VS {p. 1176}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_ECRAS_DOWN_FB	-	0... FFH	0... 255	1	-
anti bounce counter increment for ECRAS_DOWN diagnosis					
C_ABC_INC_ECRAS_EL	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_INC_ECRAS_UP_FB	-	0... FFH	0... 255	1	-
anti bounce counter increment for ECRAS_UP diagnosis					
C_ABC_MAX_ECRAS_DOWN_FB	-	1... FFH	1... 255	1	-
maximal value of anti bounce counter for ECRAS_DOWN diagnosis					
C_ABC_MAX_ECRAS_EL	-	1... FFH	1... 255	1	-
C_ABC_MAX_ECRAS_EL					
C_ABC_MAX_ECRAS_UP_FB	-	1... FFH	1... 255	1	-
maximal value of anti bounce counter for ECRAS_UP diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_ECRAS_DOWN_DET	-	0... FFH	0... 255	1	-
Counter threshold for detection of ECRAS_DOWN					
C_ECRASPWM_DIAG_MAX_SCG	-	0... FFH	0... 99.60937	0.390625	%
C_ECRASPWM_DIAG_MAX_SCG					
C_ECRASPWM_DIAG_MIN_OC	-	0... FFH	0... 99.60937	0.390625	%
C_ECRASPWM_DIAG_MIN_OC					
C_ECRASPWM_DIAG_MIN_SCP	-	0... FFH	0... 99.60937	0.390625	%
C_ECRASPWM_DIAG_MIN_SCP					
C_T_DIAG_ECRAS	-	0... FFH	0... 25.5	0.1	s
Maximum waiting time for answer of ECRAS control unit					
C_T_ECRAS_DOWN_DET	-	0... FFH	0... 25.5	0.1	s
Time window for diagnosis /learning of ECRAS_DOWN					
C_T_ECRASPWM_FB_MAX	-	0... FFH	0... 25.5	0.1	s
C_T_ECRASPWM_FB_MAX					
C_T_ECRASPWM_FB_MAX_1	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'diagnosis ability', max value					
C_T_ECRASPWM_FB_MAX_2	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'elctrical failure ECRAS_UP', max value					
C_T_ECRASPWM_FB_MAX_3	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'mechanical failure ECRAS_UP', max value					
C_T_ECRASPWM_FB_MAX_4	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'electrical failure ECRAS_DOWN', max value					
C_T_ECRASPWM_FB_MAX_5	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'electrical failure ECRAS_UP/_DOWN', max value					
C_T_ECRASPWM_FB_MAX_6	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'mech. failure ECRAS_UP, el. ECRAS_DOWN', max value					
C_T_ECRASPWM_FB_MIN_1	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'diagnosis ability', min value					
C_T_ECRASPWM_FB_MIN_2	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'elctrical failure ECRAS_UP', min value					
C_T_ECRASPWM_FB_MIN_3	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'mechanical failure ECRAS_UP', min value					
C_T_ECRASPWM_FB_MIN_4	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'electrical failure ECRAS_DOWN', min value					
C_T_ECRASPWM_FB_MIN_5	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'electrical failure ECRAS_UP/_DOWN', min value					
C_T_ECRASPWM_FB_MIN_6	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'mech. failure ECRAS_UP, el. ECRAS_DOWN', min value					
C_T_MAX_ECRAS_DOWN_DET	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback SCG or normal PWM, max value					
C_T_MIN_ECRAS_DOWN_DET	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback SCG or normal PWM, min value					
C_VS_MAX_ECRAS_DIAG	-	0... FFH	0... 255	1	km/h
Maximum VS threshold for deactivation for electrical ECRAS diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_ECRAS_EL	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (typical 2)					

**Import actions:**

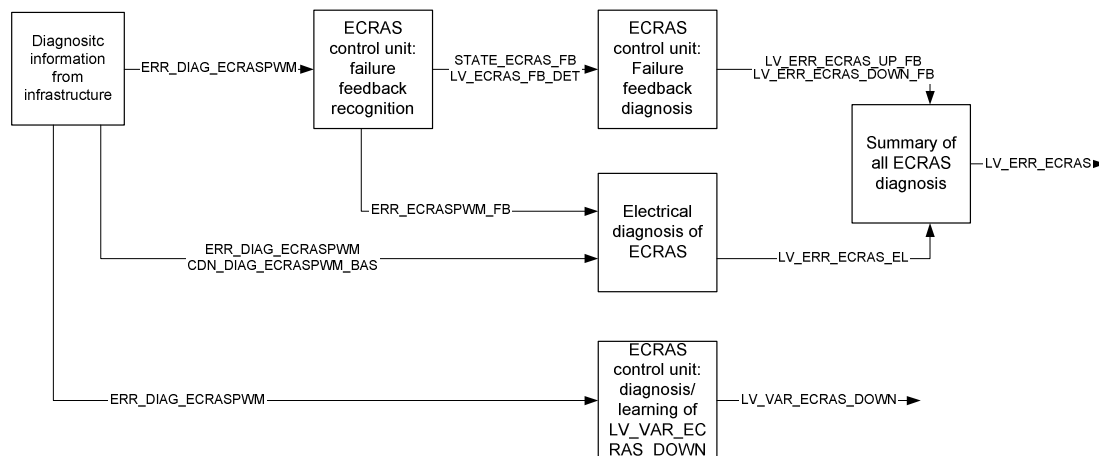
<b>ACTION_ERRM_FilterMulticondition</b>	(IN<XX>,IN<CDN_DIAG_>,XX>,<IN<>,ERR_DIAG_XX>,<IN>,<C_ABC_INC_XX>,IN<C_ABC_MAX_XX>,OUT<LV_ERR_XX>)
---	---

**Error treatment:**


Diagnostic	Symptom description	Symptom	Filter type
<b>ECRAS_EL</b>			
<i>ECRAS_EL Diagnostic</i>	SCP	SYM_0	MPL_STD_INI
	SCG	SYM_1	
	OC	SYM_2	

**General information:**

This modul consists of 6 parts. The parts and their correlation is described in the figure below. The diagnostic information from the infrastructure is used for detection of feedback from the ECRAS control unit and for the electrical diagnosis. The information from the infrastructure is also used for the diagnosis /learning of the ECRAS variant with the second flap (LV\_VAR\_ECRAS\_DOWN). The recognised feedbacks from the ECRAS control unit are processed by the failure feedback diagnosis.



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**Formula section:**

Usage of the diagnosis information (failure symptoms (raw value) ERR\_DIAG\_ECRASPWM and diagnosis conditions CDN\_DIAG\_ECRASPWM\_BAS ) received from the infrastructure:

Diagnosis conditions are set according infrastructure info.: CDN\_DIAG\_ECRASPWM\_BAS

Failure symptoms are set according infrastructure info.: ERR\_DIAG\_ECRASPWM

**A.56.3 ECRAS control unit: Failure feedback recognition****FUNCTION DESCRIPTION:****Description:**

If a failure is detected from the ECRAS control unit, a failure feedback is send to the ECU by pulling the signal line (interface ECU to the ECRAS control unit) to ground in a defined pattern. The time  $t_{low}$  is a identification for the failure. Depending on  $t_{low}$  a specific failure is identified and set in STATE\_ECRAS\_FB.

For the recognition of the failure feedback the information, if a failure short circuit to ground is detected on the signal line between ECU and ECRAS control unit is used.

**Application conditions**

**Initialisation:** reset or reset of failure memory or LV\_IGK = 0 -> 1  
ERR\_ECRASPWM\_FB = FFH, all others = 0

**Recurrence:** 100ms

**Activation:** LV\_CDN\_VB\_MIN\_DIAG = 1 and  
LV\_ERR\_SPI\_MPS= 0 and  
LV\_VAR\_ECRAS\_UP = 1 and  
LV\_IGK = 1

**Deactivation:** at deactivation function is initialized one time

**Formula section:**

STATE\_ECRAS\_FB = 0H  
LV\_ECRAS\_FB\_DET = 0

```

If bit 1 of ERR_DIAG_ECRASPWM = 1 (SCG detected by HW)
Then T_ECRASPWM_FB = T_ECRASPWM_FB + 100ms
      ERR_ECRASPWM_FB = FFH (ECRAS ECU failure possible)
If T_ECRASPWM_FB > C_T_ECRASPWM_FB_MAX
      (T_ECRASPWM_FB out of range for FB, C_T_ECRASPWM_FB_MAX should be
      > than C_T_ECRASPWM_FB_MAX_6, DIAG_EL will be enabled)
Then ERR_ECRASPWM_FB = 00H
Endif
Else If T_ECRASPWM_FB > 0 //change from SCG to normal detected
      then LV_ECRAS_FB_DET = 1
      endif
If C_T_ECRASPWM_FB_MIN_1 T_ECRASPWM_FB
      C_T_ECRASPWM_FB_MAX_1
Then ECRAS feedback detected: diagnosis ability of ECRAS
  
```



```

ERR_ECRASPWM_FB = 01H
STATE_ECRAS_FB = 01H
Elseif      C_T_ECRASPWM_FB_MIN_2    T_ECRASPWM_FB
           C_T_ECRASPWM_FB_MAX_2
Then      ECRAS feedback detected: elctrical failure ECRAS_UP
ERR_ECRASPWM_FB = 01H
STATE_ECRAS_FB = 02H
Elseif      C_T_ECRASPWM_FB_MIN_3    T_ECRASPWM_FB
           C_T_ECRASPWM_FB_MAX_3
Then      ECRAS feedback detected: mechanical failure ECRAS_UP
ERR_ECRASPWM_FB = 01H
STATE_ECRAS_FB = 03H
Elseif      C_T_ECRASPWM_FB_MIN_4    T_ECRASPWM_FB
           C_T_ECRASPWM_FB_MAX_4
Then      ECRAS feedback detected: electrical failure ECRAS_DOWN
ERR_ECRASPWM_FB = 01H
STATE_ECRAS_FB = 04H
Elseif      C_T_ECRASPWM_FB_MIN_5    T_ECRASPWM_FB
           C_T_ECRASPWM_FB_MAX_5
Then      ECRAS feedback detected: elctrical failure ECRAS_UP/_DOWN
ERR_ECRASPWM_FB = 01H
STATE_ECRAS_FB = 05H
Elseif      C_T_ECRASPWM_FB_MIN_6    T_ECRASPWM_FB
           C_T_ECRASPWM_FB_MAX_6
Then      ECRAS feedb. detected: mech. failure ECRAS_UP, elctr. ECRAS_DOWN
ERR_ECRASPWM_FB = 01H
STATE_ECRAS_FB = 06H
Else      no ECRAS ECU failure possible
ERR_ECRASPWM_FB = 00H
Endif
T_ECRASPWM_FB = 0
Endif

```

## A.56.4 Electrical diagnosis of ECRAS

### FUNCTION DESCRIPTION:

#### General information:

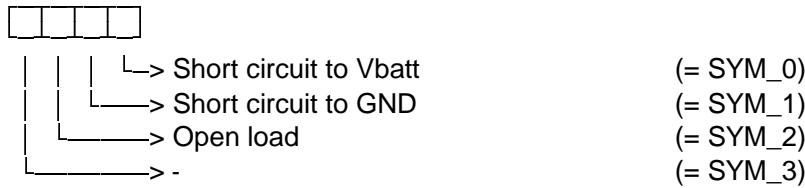
The purpose is to diagnose the signal from the driver, which controls the electrical cooling fan. The input signal is a modulated control pulse (PWM).

#### Description:

The driver can distinguish between three symptoms: Short circuit to Vbatt , Short circuit to GND and Open Load .

The error detection algorithm in this function for short circuit to GND is respecting the status of the failure feedback recognition (ERR\_ECRASPWM\_FB). The failure, detected by the HW, is delivered from the infrastructure ERR\_DIAG\_ECRASPWM .

**Error-symptoms:** are defined to this diagnosis function as following



### Application conditions

**Initialization:** according filter-type: **MPL\_STD\_INI**  
 LV\_INTR\_DIAG\_ECRAS\_EL = 0 at LV\_IGK 0->1 **or** reset **or**  
 clear FMY

**Recurrence:** 100ms

**Activation:** LV\_VAR\_ECRAS\_UP = 1

**Deactivation:** if LV\_INTR\_DIAG\_ECRAS\_EL = 1, set CDN\_DIAG\_ECRAS\_EL = 0  
 if LV\_VAR\_ECRAS\_UP = 0, set LV\_END\_DIAG\_ECRAS\_EL = 1

### Formula section:

**If** VS >= C\_VS\_MAX\_ECRAS\_DIAG  
**Then** LV\_INTR\_DIAG\_ECRAS\_EL = 1 //remains active until next initialization  
**Endif**

**If** LV\_CDN\_VB\_MIN\_DIAG = 1  
**and** LV\_ERR\_SPI\_MPS= 0  
**and** LV\_IGK = 1  
**Then**

Note: The failure symptoms ERR\_SYM\_ECRAS\_EL and the diagnosis conditions CDN\_DIAG\_ECRAS\_EL (raw values) shall be set according infrastructure information ERR\_DIAG\_ECRASPWM and CDN\_DIAG\_ECRASPWM\_BAS.

**If** Activation conditions are met for the NC\_PSD\_DLY\_ECRAS\_EL recurrence  
**And** ERR\_ECRASPWM\_FB = 00h  
**Then**

{ Additional diagnosis conditions }

**If** ECRASPWM < C\_ECRASPWM\_DIAG\_MIN\_SCP  
 { condition that disables the SYM\_0 detection }

**Then** bit 0 of CDN\_DIAG\_ECRAS\_EL = 0 { Diagnosis of SCP is not possible }

**Endif**

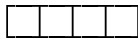
**If** ECRASPWM > C\_ECRASPWM\_DIAG\_MAX\_SCG  
 { condition that disables the SYM\_1 detection }

**Then** bit 1 of CDN\_DIAG\_ECRAS\_EL = 0 { Diagnosis of SCG is not possible }

**Endif**

**If** ECRASPWM < C\_ECRASPWM\_DIAG\_MIN\_OC  
**or** ECRASPWM > C\_ECRASPWM\_DIAG\_MAX\_SCG  
 { conditions that disable the SYM\_2 detection }



**Error-symptoms of failure LV\_ERR\_ECRAS\_DOWN\_FB :****Application conditions**

**Initialization:** according filter type **STD\_INI**, all others = 0 at reset **or** reset of failure  
memory **or** LV\_IGK = 0 -> 1

**Recurrence:** 100ms

**Activation:** LV\_VAR\_ECRAS\_UP = 1 **and**  
(ERR\_SYM\_ECRAS\_UP\_FB != SYM\_3 **or** LV\_ERR\_ECRAS\_UP\_FB = 0)

**Deactivation:** if LV\_VAR\_ECRAS\_UP=0, set LV\_END\_DIAG\_ECRAS\_UP\_FB = 1 and  
LV\_END\_DIAG\_ECRAS\_DOWN\_FB = 1  
if (LV\_ERR\_ECRAS\_UP\_FB = 1 and ERR\_SYM\_ECRAS\_UP\_FB = Sym\_3),  
set LV\_CDN\_DIAG\_ECRAS\_UP\_FB = 0 and LV\_CDN\_DIAG\_ECRAS\_DOWN\_FB = 0

**Formula section:**

**IF** LV\_CDN\_VB\_MIN\_DIAG = 1 **and**  
LV\_ERR\_SPI\_MPS= 0 **and**  
LV\_ERR\_ECRAS\_EL = 0 **and**  
LV\_IGK = 1

**THEN**

**if** LV\_ECRAS\_UP\_1 0-> 1 **or** 1-> 0  
**then** LV\_EDGE\_ECRAS\_UP = 1  
**endif**

**if** LV\_ECRAS\_DOWN\_1 0-> 1 **or** 1-> 0  
**then** LV\_EDGE\_ECRAS\_DOWN = 1  
**endif**

*// activated diagnosis-mode of ECRAS\_UP (PWM = 10%)*

**if** (LV\_ACT\_ECRAS\_EOL\_EXT\_ADJ = 1 **or** LV\_ST\_END = 1)  
**and** LV\_DIAG\_ECRAS\_END = 0 **and** LV\_DIAG\_ECRAS\_ERR\_END = 0  
**and** LV\_EDGE\_ECRAS\_UP = 0 **and** LV\_EDGE\_ECRAS\_DOWN = 0  
**then** LV\_DIAG\_ECRAS = 1  
**endif**

*// calculating timer*

**if** LV\_DIAG\_ECRAS = 1 **or** LV\_EDGE\_ECRAS\_UP = 1 **or**  
LV\_EDGE\_ECRAS\_DOWN = 1

```

then    T_DIAG_ECRAS = T_DIAG_ECRAS + 100ms
endif

// setting feedback diagnosis enabled -> required to set LV_CDN_DIAG_XXX
if    LV_ECRAS_FB_DET = 1 or T_DIAG_ECRAS >= C_T_DIAG_ECRAS
then    LV_ECRAS_FB_DIAG = 1
else    LV_ECRAS_FB_DIAG = 0
endif

// setting of the diagnosis conditions
if    LV_ECRAS_FB_DIAG = 1 and
(LV_EDGE_ECRAS_UP = 1 or LV_DIAG_ECRAS = 1)
then    LV_CDN_DIAG_ECRAS_UP_FB = 1
else    LV_CDN_DIAG_ECRAS_UP_FB = 0
endif
if    LV_ECRAS_FB_DIAG = 1 and
LV_EDGE_ECRAS_DOWN = 1 and
LV_ERR_ECRAS_UP_FB = 0
then    LV_CDN_DIAG_ECRAS_DOWN_FB = 1
else    LV_CDN_DIAG_ECRAS_DOWN_FB = 0
endif


//setting LV_DIAG_ECRAS_END if diagnosis mode of ECRAS_UP successful and setting of LV_
DIAG_ECRAS_ERR_END if diagnosis mode was not successful
if    LV_DIAG_ECRAS = 1 and LV_ECRAS_FB_DIAG = 1
then    if    STATE_ECRAS_FB = 01H
then    LV_DIAG_ECRAS_END = 1
else    LV_DIAG_ECRAS_ERR_END = 1
endif
endif

// diagnosis LV_ERR_ECRAS_UP_FB
if    LV_CDN_DIAG_ECRAS_UP_FB = 1
then    if    LV_DIAG_ECRAS = 0 and (STATE_ECRAS_FB = 02H or
STATE_ECRAS_FB = 05H)
then    ERR_SYM_ECRAS_UP_FB = SYM_0 (debouncing by ERRM)
elseif    LV_DIAG_ECRAS = 0 and (STATE_ECRAS_FB = 03H or
STATE_ECRAS_FB = 06H)
then    ERR_SYM_ECRAS_UP_FB = SYM_1 (debouncing by ERRM)
elseif    LV_DIAG_ECRAS = 1 and T_DIAG_ECRAS >= C_T_DIAG_ECRAS
then    if    C_ABC_INC_ECRAS_UP_FB > 0
then    ERR_SYM_ECRAS_UP_FB = SYM_3 CTR_ABC_ECRAS_UP_FB =
C_ABC_MAX_ECRAS_UP_FB
(-> thus LV_ERR_ECRAS_UP_FB will be set by ERRM)
else    ERR_SYM_ECRAS_UP_FB = SYM_3 (debouncing by ERRM)
endif
else    ERR_SYM_ECRAS_UP_FB = NO_SYM (debouncing by ERRM)
endif
endif

// LV_ERR_ECRAS_UP_FB and LV_END_DIAG_ECRAS_UP_FB set by ERRM

// diagnosis LV_ERR_ECRAS_DOWN_FB

```

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```

if      LV_CDN_DIAG_ECRAS_DOWN_FB = 1
then   if  STATE_ECRAS_FB = 04H   or
        STATE_ECRAS_FB = 05H   or
        STATE_ECRAS_FB = 06H
      then   if      LV_VAR_ECRAS_DOWN = 1
            then     ERR_SYM_ECRAS_DOWN_FB = SYM_0 (debouncing by ERRM)
            else     ERR_SYM_ECRAS_DOWN_FB = NO_SYM (debounc. by ERRM)
            endif
            LV_ECRAS_DOWN_DET_RST = 0
      else     ERR_SYM_ECRAS_DOWN_FB = NO_SYM (debouncing by ERRM)
            if      LV_VAR_ECRAS_DOWN = 0
          then     LV_ECRAS_DOWN_DET_RST = 1
          else     LV_ECRAS_DOWN_DET_RST = 0
          endif
            endif
      else     LV_ECRAS_DOWN_DET_RST = 0
    endif
// LV_ERR_ECRAS_DOWN_FB and LV_END_DIAG_ECRAS_DOWN_FB set by ERRM

// resetting of values in case of feedback diagnosis -> calculated at last in this modul !
if      LV_ECRAS_FB_DIAG = 1
then   LV_EDGE_ECRAS_UP      = 0
        LV_EDGE_ECRAS_DOWN  = 0
        LV_DIAG_ECRAS       = 0
        T_DIAG_ECRAS        = 0

endif
ENDIF

```

## A.56.6 ECRAS control unit: diagnosis/detecting of LV\_VAR\_ECRAS\_DOWN

### FUNCTION DESCRIPTION:

#### Description:


If an ECRAS control unit is detected (LV\_VAR\_ECRAS\_UP) a learn algorithm /diagnosis for the variant LV\_VAR\_ECRAS\_DOWN will be start once. LV\_VAR\_ECRAS\_DOWN will be recognised by a pattern of short circuit to ground and normal phases of the ECRASPWM signal set by the ECRAS control unit. For this mode the ECRAS control unit has to be driven by an ECRASPWM of 90% (learnig mode - see Calculation of ECRASPWM).

#### Application conditions

**Initialisation:** *all = 0 at reset or LV\_IGK 0->1, except LV\_ECRAS\_DOWN\_DET\_SET and LV\_VAR\_ECRAS\_DOWN from NVMY  
LV\_ECRAS\_DOWN\_DET\_SET = 0 and LV\_VAR\_ECRAS\_DOWN = 0 at LC\_AD\_CLR\_VAR 01*

**Recurrence:** *100 ms*

**Activation:** *LV\_CDN\_VB\_MIN\_DIAG = 1 and  
LV\_IGK = 1*

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**Formula section:**

```

IF      LV_VAR_ECRAS_UP = 1
//setting and resetting of LV_ECRAS_DOWN_DET_SET
if      T_ECRAS_DOWN_DET >= C_T_ECRAS_DOWN_DET
then    LV_ECRAS_DOWN_DET_SET = 1
elseif  LV_ECRAS_DOWN_DET_RST = 1
then    LV_ECRAS_DOWN_DET_SET = 0
endif

// enabling of learning of LV_VAR_ECRAS_DOWN
if      LV_ECRAS_DOWN_DET_SET = 0    and
          LV_VAR_ECRAS_DOWN = 0
then    LV_ECRAS_DOWN_DET_ACT = 1
          T_ECRAS_DOWN_DET = T_ECRAS_DOWN_DET + 100 ms
else    LV_ECRAS_DOWN_DET_ACT = 0
          T_ECRAS_DOWN_DET = 0
          CTR_ECRAS_DOWN_DET = 0
endif

if      LV_ECRAS_DOWN_DET_ACT = 1
then    // detect change SCG <- -> normal PWM and set counter if correct pattern
          if      (bit 1 of ERR_DIAG_ECRASPWM 0 -> 1    and
                  C_T_MIN_ECRAS_DOWN_DET < T_ECRAS_DOWN_DET_POS
                  < C_T_MAX_ECRAS_DOWN_DET)
          or
          (bit 1 of ERR_DIAG_ECRASPWM 1 -> 0    and
          C_T_MIN_ECRAS_DOWN_DET < T_ECRAS_DOWN_DET_NEG
          < C_T_MAX_ECRAS_DOWN_DET)
          then    CTR_ECRAS_DOWN_DET = CTR_ECRAS_DOWN_DET + 1
          else    CTR_ECRAS_DOWN_DET unchanged
          endif

// Variant LV_VAR_ECRAS_DOWN recognised
if      CTR_ECRAS_DOWN_DET >= C_CTR_ECRAS_DOWN_DET
then    LV_VAR_ECRAS_DOWN = 1
else    LV_VAR_ECRAS_DOWN unchanged
endif

// calculate time since start of SCG phase (T_ECRAS_DOWN_DET_NEG)
if      bit 1 of ERR_DIAG_ECRASPWM = 1    and
          [(T_ECRAS_DOWN_DET_NEG = 0    and //cdn for first entry
            CTR_ECRAS_DOWN_DET = 0)    or
            T_ECRAS_DOWN_DET_NEG > 0    or
            C_T_MIN_ECRAS_DOWN_DET < T_ECRAS_DOWN_DET_POS
            < C_T_MAX_ECRAS_DOWN_DET]
then    T_ECRAS_DOWN_DET_NEG = T_ECRAS_DOWN_DET_NEG +
          100 ms
          T_ECRAS_DOWN_DET_POS = 0 s
endif

// calculate time since start of normal PWM (T_ECRAS_DOWN_DET_POS)
if      bit 1 of ERR_DIAG_ECRASPWM = 0    and


```

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```

(T_ECRAS_DOWN_DET_POS > 0    or
C_T_MIN_ECRAS_DOWN_DET < T_ECRAS_DOWN_DET_NEG
                                < C_T_MAX_ECRAS_DOWN_DET)
then      T_ECRAS_DOWN_DET_POS = T_ECRAS_DOWN_DET_POS +
          100 ms
          T_ECRAS_DOWN_DET_NEG = 0 s
endif
endif
ELSE
LV_VAR_ECRAS_DOWN = 0
LV_ECRAS_DOWN_DET_SET = 0
T_ECRAS_DOWN_DET_NEG = 0 s
T_ECRAS_DOWN_DET_POS = 0 s
CTR_ECRAS_DOWN_DET = 0
T_ECRAS_DOWN_DET = 0
ENDIF

```

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## A.57 Electronically controlled thermostat diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_ECT_EL	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of ECT bit 0: diagnosis condition for symptom SYM_0 bit 1: diagnosis condition for symptom SYM_1 bit 2: diagnosis condition for symptom SYM_2					
ERR_DIAG_ECT_EL	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for ECT (only parameter)					
ERR_SYM_ECT_EL	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for ECT (only parameter) - SCG					
ERR_SYM_ECT_EL_OC	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom for electrical thermostat open circuit error.					
ERR_SYM_ECT_EL_SCP	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom for electrical thermostat short circuit to battery error.					
LV_CDN_DIAG_ECT_EL	V	0... 1H	0 ...1	1	-
Boolean for electrical thermostat short circuit to ground diagnosis conditions.					
LV_CDN_DIAG_ECT_EL_OC	V	0... 1H	0 ...1	1	-
Boolean for electrical thermostat open circuit diagnosis conditions.					
LV_CDN_DIAG_ECT_EL_SCP	V	0... 1H	0 ...1	1	-
Boolean for electrical thermostat short circuit to battery diagnosis conditions.					
LV_END_DIAG_ECT_EL	V	0... 1H	0 ...1	1	-
Boolean for end of electrical thermostat diagnosis - SCG					
LV_END_DIAG_ECT_EL_OC	V	0... 1H	0 ...1	1	-
Boolean for end electrical thermostat open circuit diagnosis.					
LV_END_DIAG_ECT_EL_SCP	V	0... 1H	0 ...1	1	-
Boolean for end of electrical thermostat short circuit to battery diagnosis.					
LV_ERR_ECT	O/V	0... 1H	0 ...1	1	-
Boolean for electronic controlled thermostat error					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_ECT_EL	O/V	0... 1H	0 ...1	1	-
ECT Electrical error detected - SCG					
LV_ERR_ECT_EL_OC	O/V	0... 1H	0 ...1	1	-
Boolean electrical thermostat open circuit error.					
LV_ERR_ECT_EL_SCP	O/V	0... 1H	0 ...1	1	-
Boolean electrical thermostat short circuit to battery error.					

**Input data:**

ECTPWM {p. 3858}	LV_CDN_VB_OBD1 {p. 1185}	LV_ERR_ECT_MEC {p. 1045}	LV_IGK {p. 906}
LV_INH_DIAG_ECT_EL {p. 4535}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_ECT_EL	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_INC_ECT_EL_OC	-	0... FFH	0... 255	1	-
Antibounce counter increment, electrical controlled thermostat diagnosis					
C_ABC_INC_ECT_EL_SCP	-	0... FFH	0... 255	1	-
Antibounce counter increment, electrical controlled thermostat diagnosis					
C_ABC_MAX_ECT_EL	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_ABC_MAX_ECT_EL_OC	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter, electrical controlled thermostat diagnosis					
C_ABC_MAX_ECT_EL_SCP	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter, electrical controlled thermostat diagnosis					
C_ECT_EL_PWM_DIAG_MAX_SCG	-	0... FFH	0... 99.60937	0.390625	%
Maximum threshold for SCG diagnosis window					
C_ECT_EL_PWM_DIAG_MIN_OC	-	0... FFH	0... 99.60937	0.390625	%
Minimum threshold for OC diagnosis window					
C_ECT_EL_PWM_DIAG_MIN_SCP	-	0... FFH	0... 99.60937	0.390625	%
Minimum threshold for SCP diagnosis window					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_ECT_EL	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (typical 2)					

**Import actions:**

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>, IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,OUT<PRM_LV_ERR>)
---

**Error treatment:**

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Short to plus of electrical controlled thermostat	ECT_EL_SCP	SCP	0	STD_INI	CC
		-	1		
		-	2		
		-	3		
Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Short to ground of electrical controlled thermostat	ECT_EL	-	0	STD_INI	CC
		SCG	1		
		-	2		
		-	3		
Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Open circuit of electrical controlled thermostat	ECT_EL_OC	-	0	STD_INI	CC
		-	1		
		OC	2		
		-	3		

Fields information (For more information refers to Error Management file "Table of Failure") :

- ABC Type : STD\_INI, STD, MEM, MEM\_INI, DEC\_CAL, STC, NO, MPL\_STD\_INI
- CARB Class : MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO.

## FUNCTION DESCRIPTION:

### General information:

A global electronically controlled thermostat error (LV\_ERR\_ECT) is set without debounce as soon as SCG (LV\_ERR\_ECT\_EL) or a mechanical (LV\_ERR\_ECT\_MEC) thermostat failure is detected. The activation of the mechanical thermostat diagnosis (ECT rationality check) is not configurable with a configuration switch. Both, the electrical- and mechanical thermostat diagnosis function are performed if the vehicle is equipped with an electrically controlled thermostat.

### Application conditions

**Initialisation at Reset:**  $LV\_ERR\_ECT = 0$

**Recurrence:**  $500\ ms$

**Activation:**  $at\ every\ engine\ operating\ state$

**Deactivation:**  $-$

### Formula section:

```

if          LV_ERR_ECT_EL = 1          or
              LV_ERR_ECT_MEC = 1
then       LV_ERR_ECT = 1              (without debounce)
else       LV_ERR_ECT = 0
endif

```

## A.57.1 ECT diagnosis (Electrical diagnostic with PWM output - - Multicondition filter)

### FUNCTION DESCRIPTION:

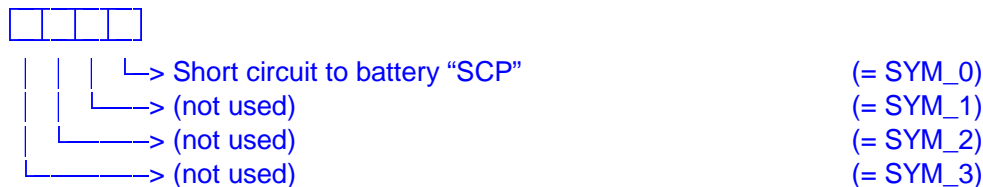
#### General information:

The ECT is driven by the ECU via an output driver. The failure detection is done by ECU Hardware. The purpose of the diagnosis is to detect electrical faults as defined by OBD I requirements.

#### Description:

The purpose is to perform the electrical diagnosis of the ECT actuator. 3 symptoms are distinguished, each having its own error location:

Error-symptoms and conditions: are defined to this diagnosis function as following



### Application conditions

**Initialisation:** all ERRM data are initialized according to Filter-type.  
At Reset: `CDN_DIAG_ECT_EL = 0`


**Recurrence:** 500 ms

**Activation:** every engine operating state

**Deactivation:** -

### Formula section:

Usage of the diagnosis information (failure symptoms (raw value) ERR\_DIAG\_ECT\_EL and diagnosis conditions CDN\_DIAG\_ECT\_EL) received from the infrastructure:

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Diagnosis conditions are set according infrastructure information: CDN\_DIAG\_ECT\_EL

Failure symptoms (raw value) are set according infrastructure information: ERR\_DIAG\_ECT\_EL

```

If   LV_IGK = 1                               (Activation conditions)
and  LV_CDN_VB_OBD1 = 1
and  LV_INH_DIAG_ECT_EL = 0
Then

    If   Activation conditions are met for the NC_PSD_DLY_ECT_EL recurrence
    Then Additional diagnosis conditions:
        If   bit 0 of CDN_DIAG_ECT_EL = 1      (info from infrastructure)
        and   C_ECT_EL_PWM_DIAG_MIN_SCP <= ECTPWM
        then
            bit 0 of CDN_DIAG_ECT_EL = 1      (Diagnosis of SCP possible)
        Endif
        If   bit 1 of CDN_DIAG_ECT_EL = 1      (info from infrastructure)
        and   ECTPWM <= C_ECT_EL_PWM_DIAG_MAX_SCG
        then
            bit 1 of CDN_DIAG_ECT_EL = 1      (Diagnosis of SCG possible)
        Endif
        If   bit 2 of CDN_DIAG_ECT_EL = 1      (info from infrastructure)
        and   C_ECT_EL_PWM_DIAG_MIN_OC <= ECTPWM <= C_ECT_EL_PWM_DIAG_MAX_SCG
        then
            bit 2 of CDN_DIAG_ECT_EL = 1      (Diagnosis of OC possible)
        Endif
    Else
        CDN_DIAG_ECT_EL = 0
    Endif
Else
    CDN_DIAG_ECT_EL = 0
Endif

If   bit 0 of CDN_DIAG_ECT_EL = 1           //SCP
Then LV_CDN_DIAG_ECT_EL_SCP = 1
Else LV_CDN_DIAG_ECT_EL_SCP = 0
Endif
If   bit 1 of CDN_DIAG_ECT_EL = 1           //SCG
Then LV_CDN_DIAG_ECT_EL = 1
Else LV_CDN_DIAG_ECT_EL = 0
Endif
If   bit 2 of CDN_DIAG_ECT_EL = 1           //OC
Then LV_CDN_DIAG_ECT_EL_OC = 1
Else LV_CDN_DIAG_ECT_EL_OC = 0
Endif
If   bit 0 of ERR_DIAG_ECT_EL = 1           //SCP
Then ERR_SYM_ECT_EL_SCP = SYM_0
Else ERR_SYM_ECT_EL_SCP = NO_SYM
Endif
If   bit 1 of ERR_DIAG_ECT_EL = 1           //SCG
Then ERR_SYM_ECT_EL = SYM_1

```

```

Else      ERR_SYM_ECT_EL = NO_SYM
Endif
If        bit 2 of ERR_DIAG_ECT_EL = 1    //OC
Then     ERR_SYM_ECT_EL_OC = SYM_2
Else     ERR_SYM_ECT_EL_OC = NO_SYM
Endif

```

LV\_ERR\_ECT\_EL(\_XX) and LV\_END\_DIAG\_ECT\_EL(\_XX) are calculated by error management.

#### Failure filtering and error management treatment:

For failure and error management treatment the anti-bounce mechanisms are called with the parameters ERR\_SYM\_ECT\_EL(\_XX) and LV\_CDN\_DIAG\_ECT\_EL(\_XX).

```

ACTION_ERRM_FilterSymptom (IN<ECT_EL_XX>, IN<LV_CDN_DIAG_ECT_EL_XX>,
    IN<LV_ERR_ECT_EL_XX>, IN<C_ABC_INC_ECT_EL_XX>, IN<C_ABC_MAX_ECT_EL_XX>,
    OUT<LV_ERR_ECT_EL_XX>, SYNCRONIZATION<CALL>)

```

This algorithm determines:

```

ERR_SYM_ECT_EL(_XX)      (detected error symptom for ECT diagnosis)
LV_ERR_ECT_EL(_XX)      (Error flag for debounced error of ECT)
LV_CDN_DIAG_ECT_EL_XX) (Diagnosis condition information)
LV_END_DIAG_ECT_EL_XX) (End of diagnosis information)

```

## A.58 Electronically controlled thermostat diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_ECT_EL	O/V	0... 1H	0 ...1	1	-
Boolean for electronically controlled thermostat signal range diagnosis inhibit					

### Input data:

LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}		
-----------------------------	-----------------	--	--

### FUNCTION DESCRIPTION:

#### General information:

Depending on project specific requirements, the electrical diagnosis of the electronically controlled thermostat can be inhibited by setting of LV\_INH\_DIAG\_ECT\_EL.

#### Application conditions

**Initialisation:** *0 at LV\_IGK 0->1 or Reset*

**Recurrence:** *500 ms*

**Activation:** *at every engine operating state*

**Deactivation:** *-*

#### Formula section:

```

IF                LV_ERR_SPI_MPS = 0
THEN             LV_INH_DIAG_ECT_EL = 0
ELSE             LV_INH_DIAG_ECT_EL = 1
ENDIF

```

## A.59 Electronically controlled water pump diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_CWP_COM_PLAUS	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error-symptoms electrical waterpump communication					
ERR_SYM_CWP_INT_OFF	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptom CWP shut down error triggered by internal CWP errors					
ERR_SYM_CWP_PLAUS	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error-symptoms electrical waterpump					
ERR_SYM_CWP_PWR	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error-sym. electrical waterpump power					
LV_CDN_DIAG_CWP_COM_PLAUS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition electrical waterpump communication					
LV_CDN_DIAG_CWP_INT_OFF	O/V	0... 1H	0 ...1	1	-
Condition diagnosis CWP internal error					
LV_CDN_DIAG_CWP_PLAUS	O/V	0... 1H	0 ...1	1	-
Condition diagnosis waterpump plausibility error					
LV_CDN_DIAG_CWP_PWR	O/V	0... 1H	0 ...1	1	-
Condition diagnosis electrical waterpump internal error					
LV_CWP_NOT_PLAUS	O/V	0... 1H	0 ...1	1	-
Waterpump speed stages out of range					
LV_CWP_OFF	O/V	0... 1H	0 ...1	1	-
Shut down of the CWP triggered by internal CWP errors, set after delay time					
LV_CWP_TMP_OFF	O/V	0... 1H	0 ...1	1	-
Temporary shut down of the CWP triggered by internal CWP errors					
LV_END_DIAG_CWP_COM_PLAUS	O/V	0... 1H	0 ...1	1	-
End diag flag of Plausibility error electrical waterpump communication					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_CWP_INT_OFF	O/V	0... 1H	0 ...1	1	-
End diag flag for diagnosis CWP internal error					
LV_END_DIAG_CWP_PLAUS	O/V	0... 1H	0 ...1	1	-
End diag flag of Plausibility error electrical waterpump					
LV_END_DIAG_CWP_PWR	O/V	0... 1H	0 ...1	1	-
End of CWP PWR diagnosis					
LV_ERR_CWP_COM_PLAUS	O/V	0... 1H	0 ...1	1	-
Plausibility error electrical waterpump communication					
LV_ERR_CWP_INT_OFF	O/V	0... 1H	0 ...1	1	-
CWP shut down error triggered by internal CWP errors					
LV_ERR_CWP_PLAUS	O/V	0... 1H	0 ...1	1	-
Plausibility error electrical waterpump					
LV_ERR_CWP_PWR	O/V	0... 1H	0 ...1	1	-
Logical value for CWP PWR error					
N_REL_CWP_DIF	O/V	0... FFH	0... 255	1	-
Difference of actual waterpump speed range to setpoint					
REL_CWP_PWR	O/V	0... FFH	0... 99.609375	0.390625	%
relative CWP power (reduced power)					
STATE_CWP_INT	O/V	0... AH	0... 10	1	-
internal operating states of the CWP					
STATE_CWP_INT_MODE	V	0... 5H	0 ...5	1	-
Transition of internal operating states of the CWP					
T_CWP_4	V	0... FFH	0... 25.5	0.1	s
Time delay before the transition to power reduced operation is performed due to voltage supply too low					
T_CWP_5	V	0... FFH	0... 25.5	0.1	s
Time delay before the transition to power reduced operation is performed due to electronics temp. too high					
T_CWP_CDN_DIAG_INT_OFF	V	0... FFH	0... 25.5	0.1	s
Time delay after the CDN Diag Flag can be set if no error is present -> End Diag Flag set by error Manag.					
T_CWP_CDN_DIAG_PWR	V	0... FFH	0... 25.5	0.1	s
Time delay after the CDN Diag Flag can be set if no error is present -> End Diag Flag set by error Manag.					
T_CWP_DIF	V	0... FFH	0... 25.5	0.1	s
Timer for CWP speed monitoring					
T_CWP_DIF_END_DIAG	V	0... FFH	0... 25.5	0.1	s
Timer for CWP speed monitoring End Diag detection					
T_CWP_LOCK	V	0... FFH	0... 25.5	0.1	s
Time delay before the error management is triggered by the internal error "Current consumption too high"					
T_CWP_TEMP_HIGH	V	0... FFH	0... 25.5	0.1	s
Time delay before the error management is triggered by the internal error "Electronic temp. too high"					
T_CWP_VCC_PLAUS	V	0... FFH	0... 25.5	0.1	s
Time delay before the error management is triggered by the internal error "Supply voltage too high"					

**Input data:**


LV_ALTER_ERR_EL {p. 4094}	LV_ALTER_ERR_MEC {p. 4094}	LV_ALTER_ERR_TEMP {p. 4094}	LV_CDN_VB_MIN_DIAG {p. 1185}
LV_CWP_BLOCK_DEAC {p. 4094}	LV_CWP_HW_LIH_IN_CHK {p. 4094}	LV_CWP_LOCK {p. 4094}	LV_CWP_PRE_LOCK {p. 4094}

LV_CWP_TEMP_HIGH {p. 4094}	LV_CWP_VCC_PLAUS {p. 4094}	LV_ERR_BSD {p. 4834}	LV_ERR_CWP_COM {p. 4834}
LV_ES {p. 1720}	LV_IGK {p. 906}	LV_N_MON_CWP_DEAC {p. 4095}	LV_ST {p. 1720}
N_REL_CWP {p. 4095}	N_REL_CWP_SP {p. 8225}	NC_IDX_DIAG_CWP_ COM_PLAUS	NC_IDX_DIAG_CWP_INT_ OFF
NC_IDX_DIAG_CWP_ PLAUS	NC_IDX_DIAG_CWP_PWR	TCO {p. 1100}	TEMP_EL_CWP {p. 4096}
V_CWP {p. 4096}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_CWP_CHK_INP	-	0... FFH	0... 255	1	-
Anti-bounce increment for LV_ERR_CWP_COM_PLAUS					
C_ABC_INC_CWP_INT_OFF	-	0... FFH	0... 255	1	-
CWP internal Diagnosis increment					
C_ABC_INC_CWP_PWR	-	0... FFH	0... 255	1	-
CWP internal Diagnosis increment					
C_ABC_MAX_CWP_CHK_INP	-	1... FFH	1... 255	1	-
number of timeouts for antibounce of LV_ERR_CWP_COM_PLAUS					
C_ABC_MAX_CWP_INT_OFF	-	1... FFH	1... 255	1	-
Debounce threshold for internal shut off errors CWP					
C_ABC_MAX_CWP_PWR	-	1... FFH	1... 255	1	-
Diagnosis increment					
C_N_REL_CWP_DIF_MAX	-	0... FFH	0... 255	1	-
Max- control deviation threshold for ratio speed stages diagnosis					
C_N_REL_CWP_HYS	-	0... FFH	0... 255	1	-
Ratio speed stages hysteresis					
C_N_REL_CWP_SP_THD_MIN	-	0... FFH	0... 255	1	-
Minimum CWP speed above the voltage monitoring is activated					
C_T_CWP_DIF_MAX	-	0... FFH	0... 25.5	0.1	s
Timer Threshold CWP speed monitoring (Timer: T_CWP)					
C_T_CWP_LOCK_MAX	-	0... FFH	0... 25.5	0.1	s
Timer threshold for internal CWP error "current consumption too high"					
C_T_CWP_TEMP_HIGH_MAX	-	0... FFH	0... 25.5	0.1	s
Timer threshold for internal CWP error "Electronic temperature too high"					
C_T_CWP_VCC_PLAUS_MAX	-	0... FFH	0... 25.5	0.1	s
Timer threshold for internal CWP error "Supply voltage too high"					
C_T_TEMP_EL_CWP_THD_1	-	0... FFH	0... 25.5	0.1	s
timer threshold (for first transition condition "E")					
C_T_TEMP_EL_CWP_THD_2	-	0... FFH	0... 25.5	0.1	s
timer threshold (for second transition condition "E")					
C_T_V_CWP_MAX_DIAG	-	0... FFH	0... 25.5	0.1	s
timer threshold (for transition condition "G")					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_CWP_REL_MIN_DIAG	-	0... FEH	-48... 142.5	0.75	°C
TCO min threshold to enable CWP speed monitoring					
C_TEMP_EL_CWP_HYS	-	0... FFH	-50 ...205	1	°C
Electronics CWP temperature hysteresis					
C_TEMP_EL_CWP_MAX_THD_1	-	0... FFH	-50 ...205	1	°C
first power reduction threshold temperature CWP electronics					
C_TEMP_EL_CWP_MAX_THD_2	-	0... FFH	-50 ...205	1	°C
second power reduction threshold temperature CWP electronics					
C_V_CWP_HYS	-	0... FFH	0... 25.5	0.1	V
voltage hysteresis					
C_V_CWP_MIN_DIAG_IT	-	0... FFH	0... 25.5	0.1	V
Min threshold voltage CWP to enable CWP internal state					
C_V_CWP_MIN_DIAG_MON	-	0... FFH	0... 25.5	0.1	V
Min threshold voltage CWP to enable CWP speed monitoring					
ID_REL_CWP_PWR	-	0... FFH	0... 99.609375	0.390625	%
LDP_STATE_CWP_INT	11	0... AH	0... 10	1	-
power reduction of the CWP					
LC_SWI_CWP_INP	-	0... 1H	0 ...1	1	-
switch between LV_IGK and LV_CDN_VB_MIN_DIAG					

### Import actions:

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>, <b>OUT</b> <PRM_LV_ERR>)
<b>ACTION_ERRM_GetErrSym</b> (IN<IDX_DIAG>, <b>OUT</b> <ERR_SYM>)
<b>ACTION_ERRM_GetLvCdnDiag</b> (IN<IDX_DIAG>, <b>OUT</b> <LV_CDN_DIAG>)
<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>, <b>OUT</b> <LV_END_DIAG>)
<b>ACTION_ERRM_NoFilterReset</b> (IN<PRM_IDX_DIAG>, <b>OUT</b> <PRM_LV_ERR>)
<b>ACTION_ERRM_NoFilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_LV_ERR_SET>, <b>IN</b> <PRM_LV_ERR_RST>, <b>IN</b> <PRM_LV_END_DIAG>, <b>OUT</b> <PRM_LV_ERR>)

### General information:

### Application conditions:

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	Document key 10171571 SPE 000 AO	Pages Page 4539 of 8404
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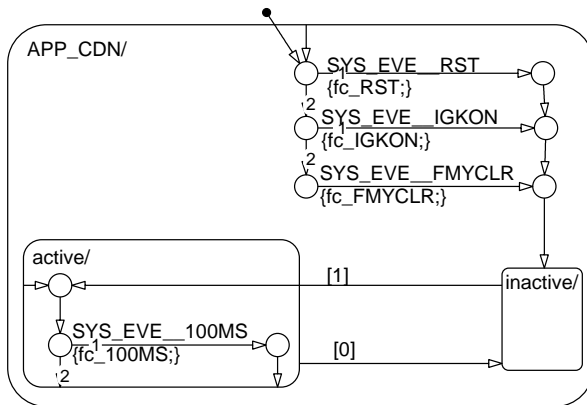


Figure A.59.1: :

**Function description:**

**Formula section:**

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4540 of 8404</b>	
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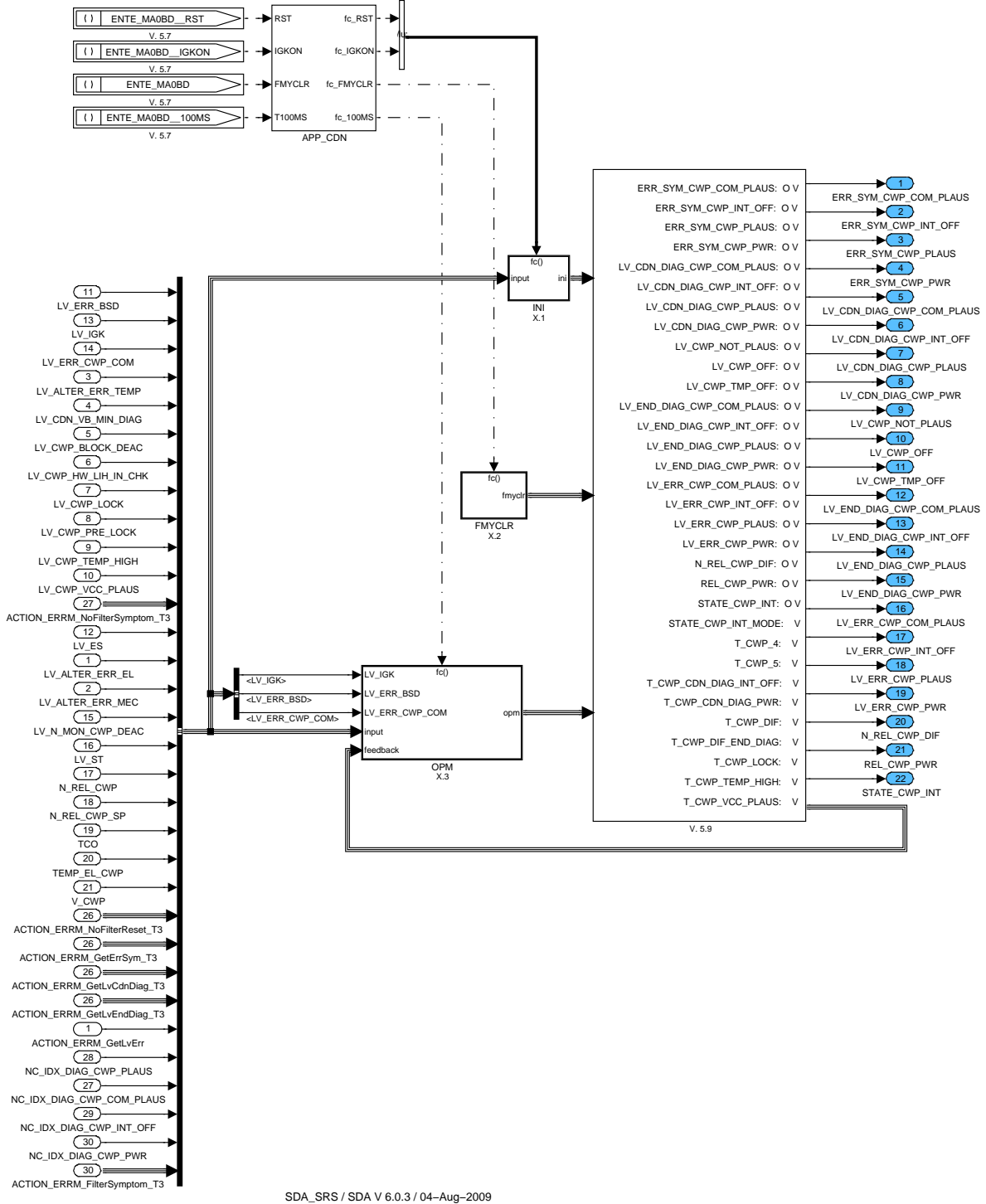


Figure A.59.2: :

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## A.59.1 Initialization during event Reset or LV\_IGK 0-> 1

### A.59.1.1 Initialization during Electrical controlled water pump speed monitoring (filter type NO\_FIL)

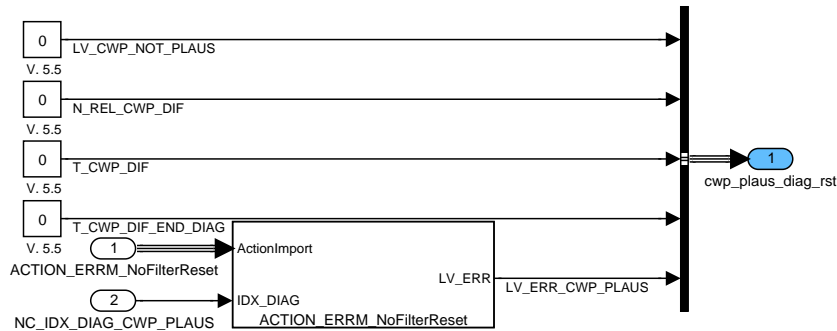


Figure A.59.3: :

### A.59.1.2 Initialization during Water pump internal shut off errors

According ABC filter Type STD\_INI; all other output data are set to 0 at LV\_IGK 0->1 or reset

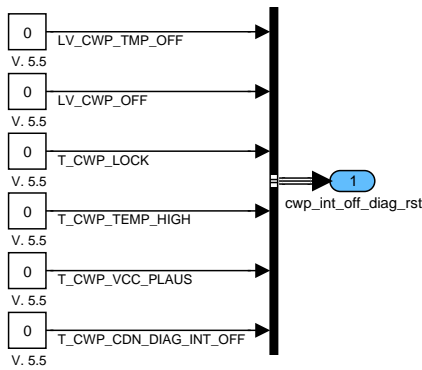


Figure A.59.4: :

### A.59.1.3 Initialization during Electrical controlled water pump Power Reduction Monitoring and water pump internal state

According ABC filter Type STD\_INI; all other output data are set to 0 at LV\_IGK 0->1 or reset

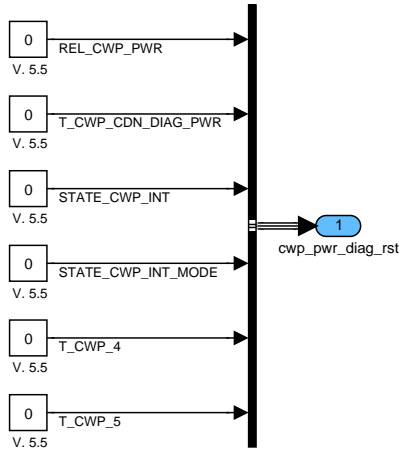


Figure A.59.5: :

### A.59.2 Initialization at clearing error memory

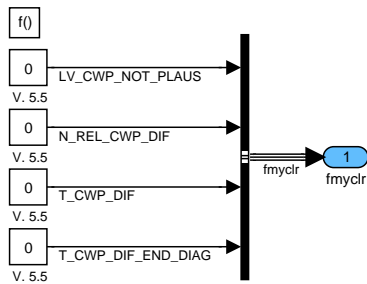


Figure A.59.6: :

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### A.59.3 Formula section

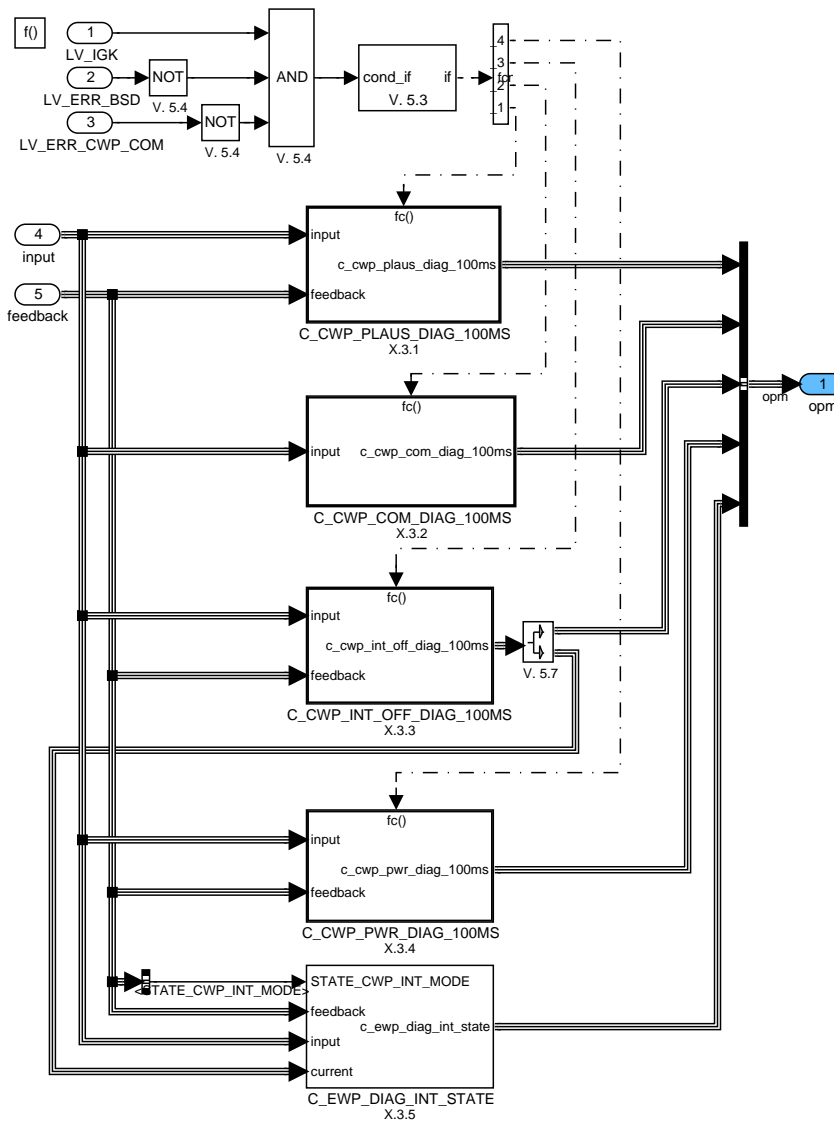


Figure A.59.7: :

#### A.59.3.1 Electrical controlled water pump speed monitoring

Description:

This diagnosis function is the interface between BSD driver and waterpump controller.

Error-symptoms are defined to this diagnosis function as following :

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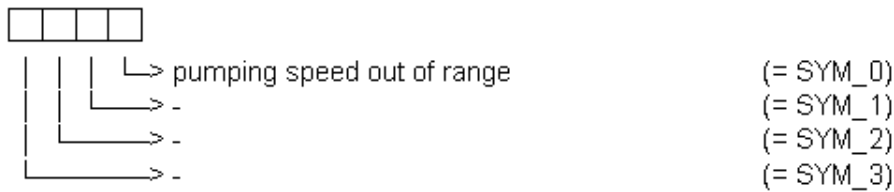


Figure A.59.8: :

**A.59.3.1.1 Evaluation of diagnostic condition**

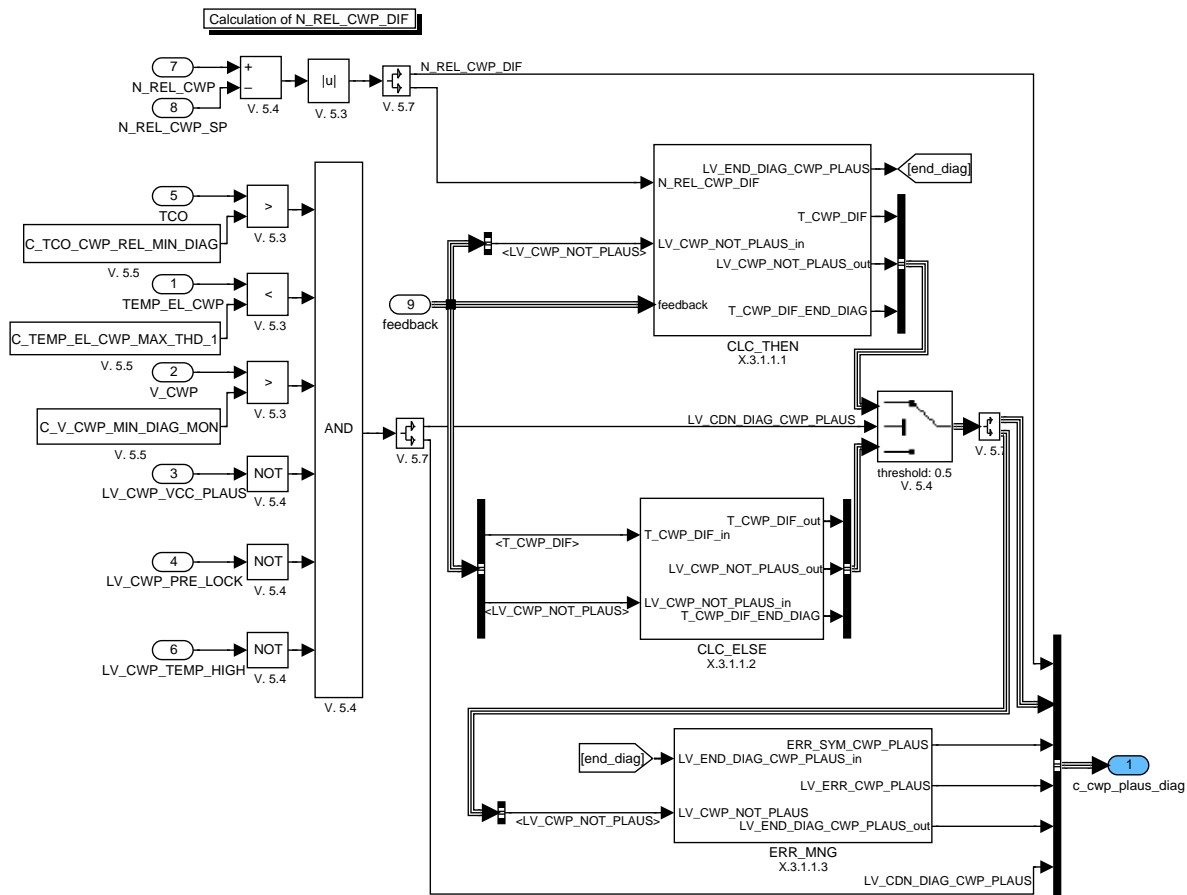


Figure A.59.9: :

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**A.59.3.1.1.1 Ratio detection**

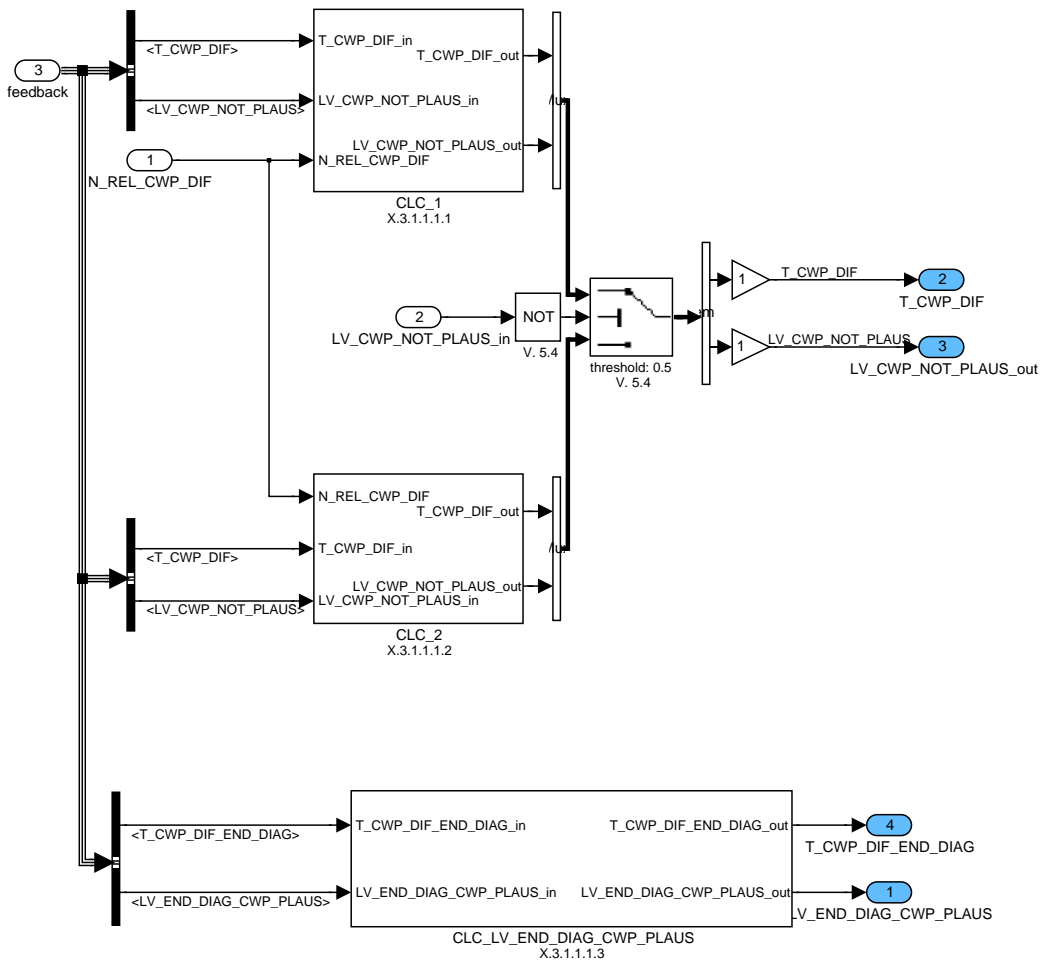



Figure A.59.10: :

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**A.59.3.1.1.1.1 Timer for CWP speed monitoring when Water pump speed stages within the range.**

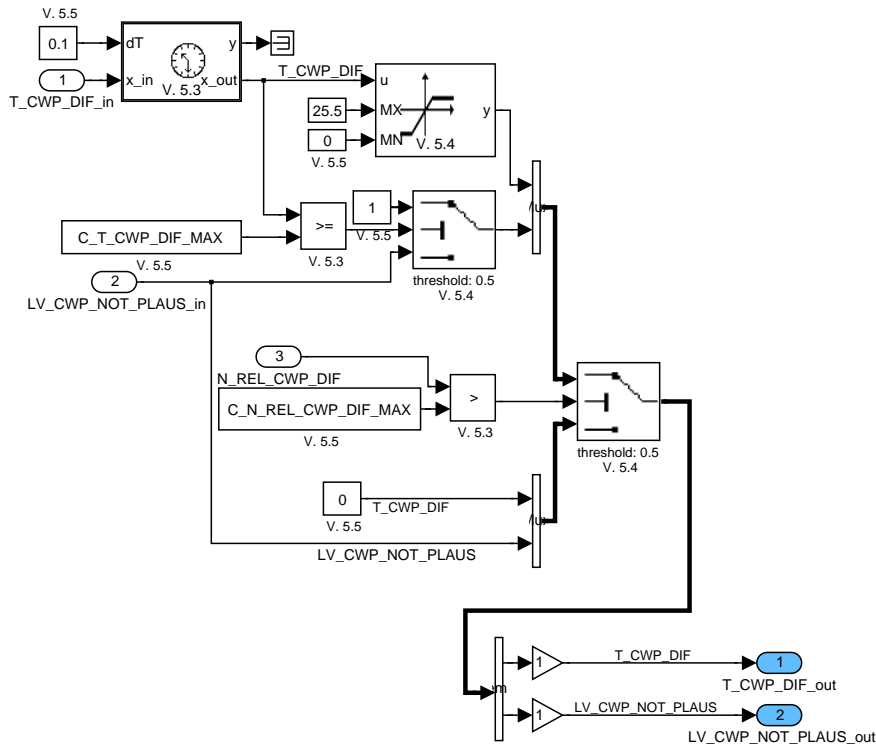


Figure A.59.11: :

**A.59.3.1.1.1.2 Timer for CWP speed monitoring when Water pump speed stages out of range**

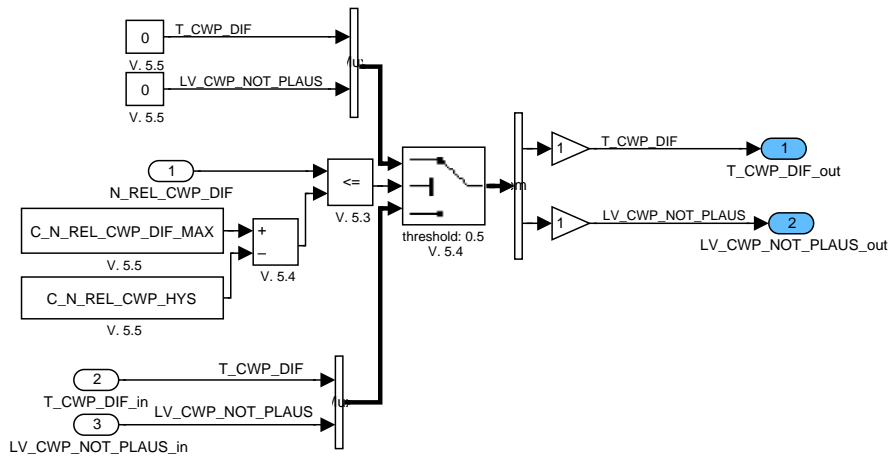


Figure A.59.12: :

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### A.59.3.1.1.3 Calculate LV\_END\_DIAG\_CWP\_PLAUS

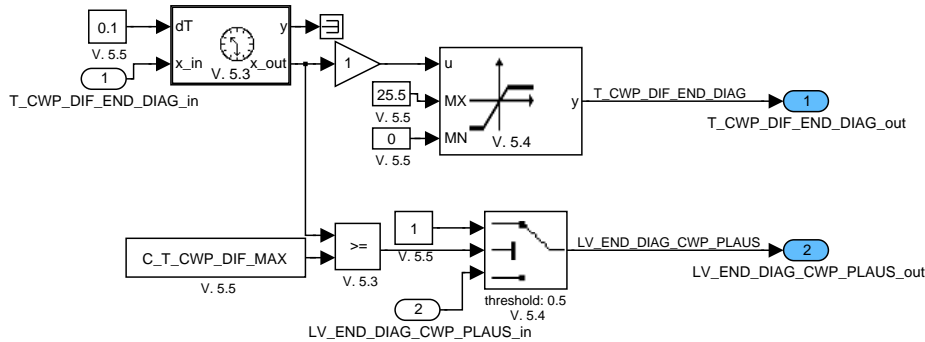


Figure A.59.13: :

### A.59.3.1.1.2 Reset Timer for CWP speed monitoring End diag detection when LV\_END\_DIAG\_CWP\_PLAUS is zero

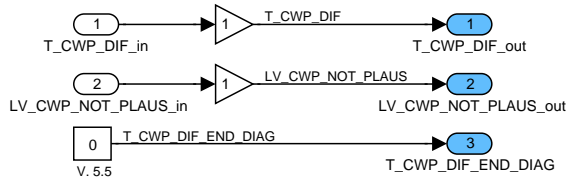


Figure A.59.14: :

### A.59.3.1.1.3 Error Management

Plausibility error electrical water pump

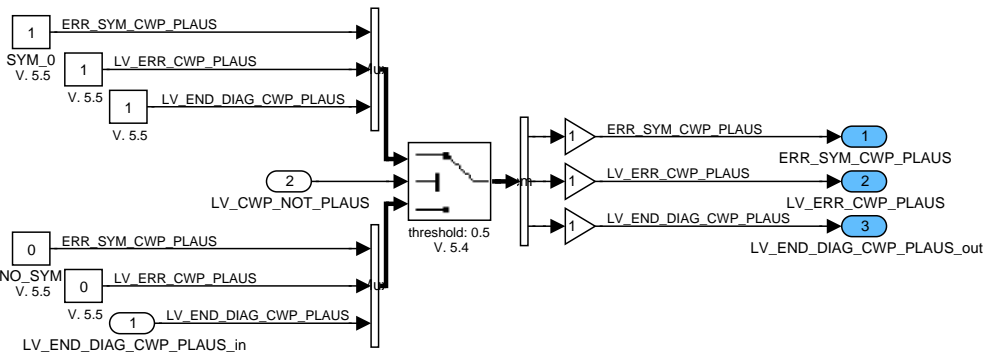


Figure A.59.15: :

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### A.59.3.1.2 Interface to ERRM

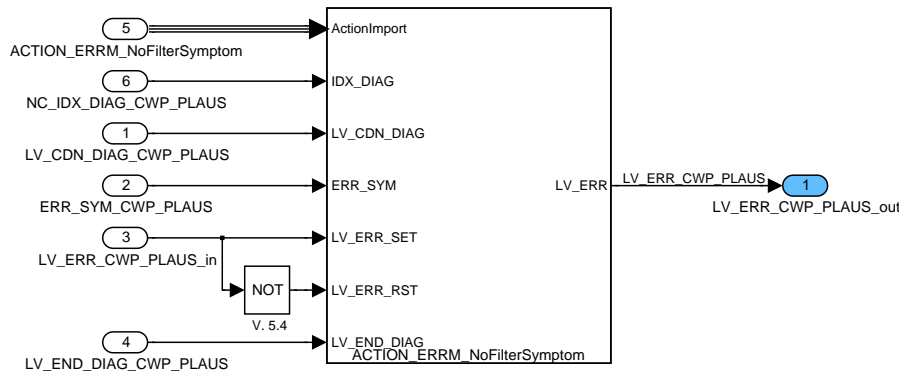


Figure A.59.16: :

### A.59.3.2 Diagnosis of hardware input line for Limp Home Operation of CWP

General information:

This function detects an error in the hardware line for Limp Home Operation of the CWP.

A hardware signal is connected to the CWP to activate the limp home mode of the CWP in case of a BSD communication error. To detect the correct functionality of the hardware signal line, the CWP state is submitted to the ECU (EWM\_ERR\_3). The ECU compares the state of the LV\_IGK or LV\_CDN\_VB\_MIN\_DIAG (dependend on a switch LC\_SWI\_CWP\_INP) with the state of EWM\_ERR3 register (LV\_CWP\_HW\_LIH\_IN\_CHK). For no compliance a plausibility failure is set.

Description:

Error-symptoms are defined to this diagnosis function as following :

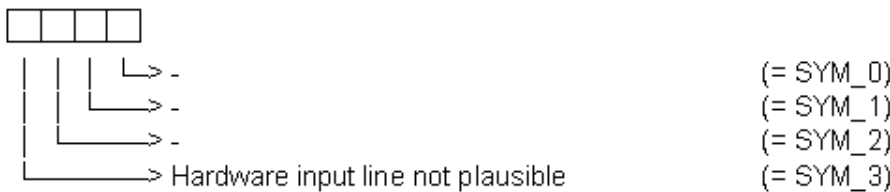


Figure A.59.17: :

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**A.59.3.2.1 Symptom determination and evaluation of diagnostic condition**

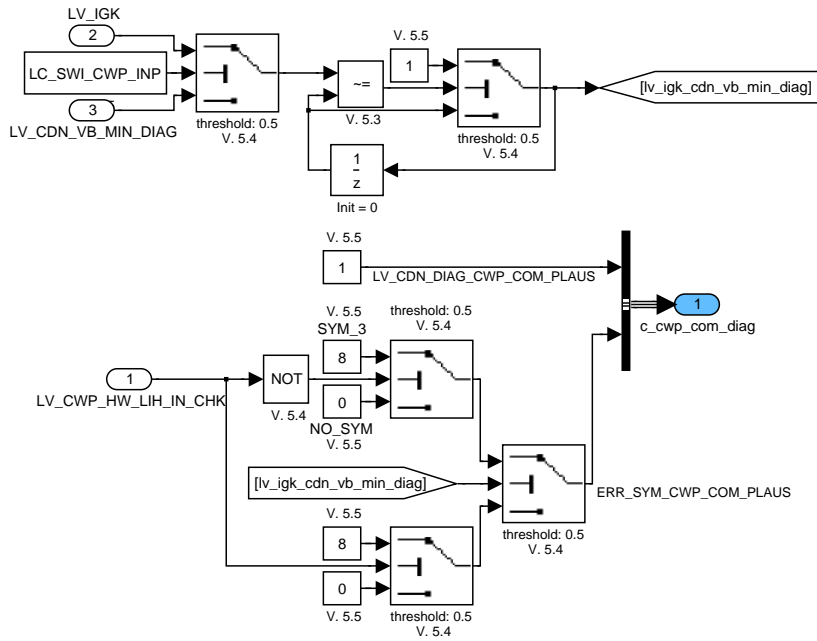


Figure A.59.18: :

**A.59.3.2.2 Interface to ERRM**

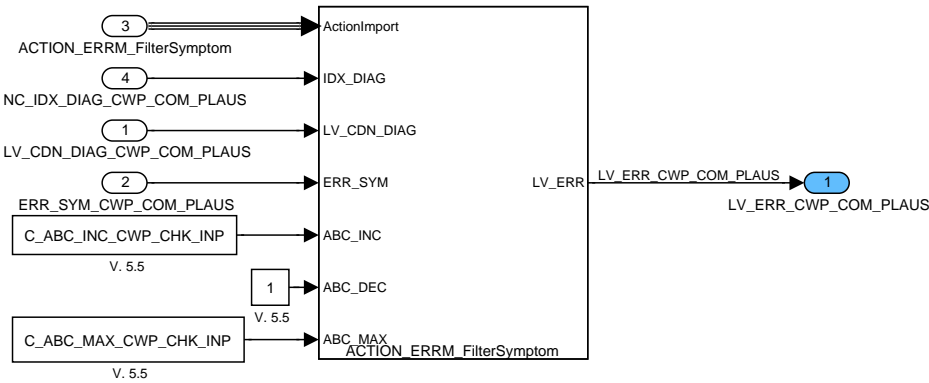


Figure A.59.19: :

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### A.59.3.2.3 ERRM call and update for LV\_END\_DIAG and ERR\_SYM by calling ERRM Actions

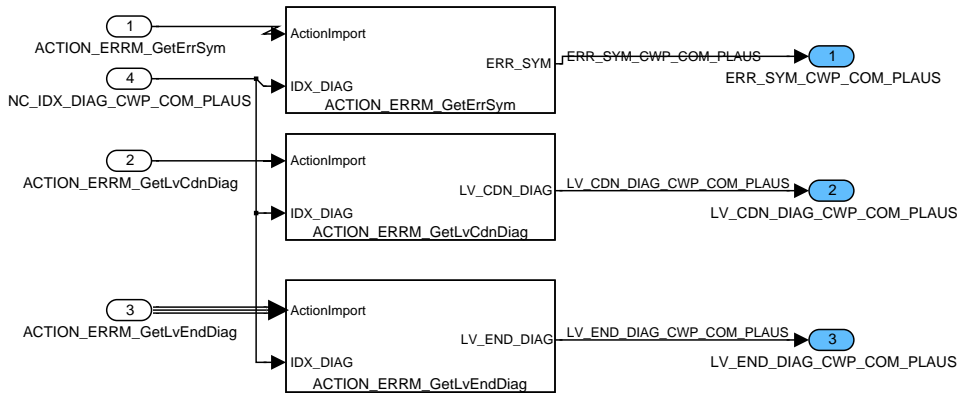


Figure A.59.20: :

### A.59.3.3 Waterpump internal shut off errors

#### FUNCTION DESCRIPTION:

Description:

Error-symptoms are defined to this diagnosis function as following :

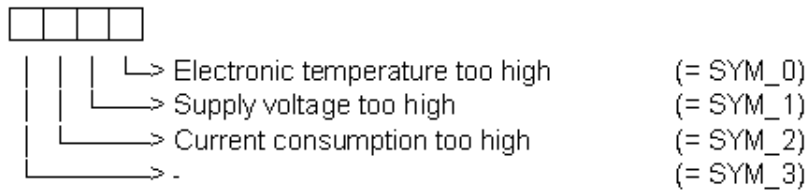


Figure A.59.21: :

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### A.59.3.3.1 Evaluation of diagnostic condition

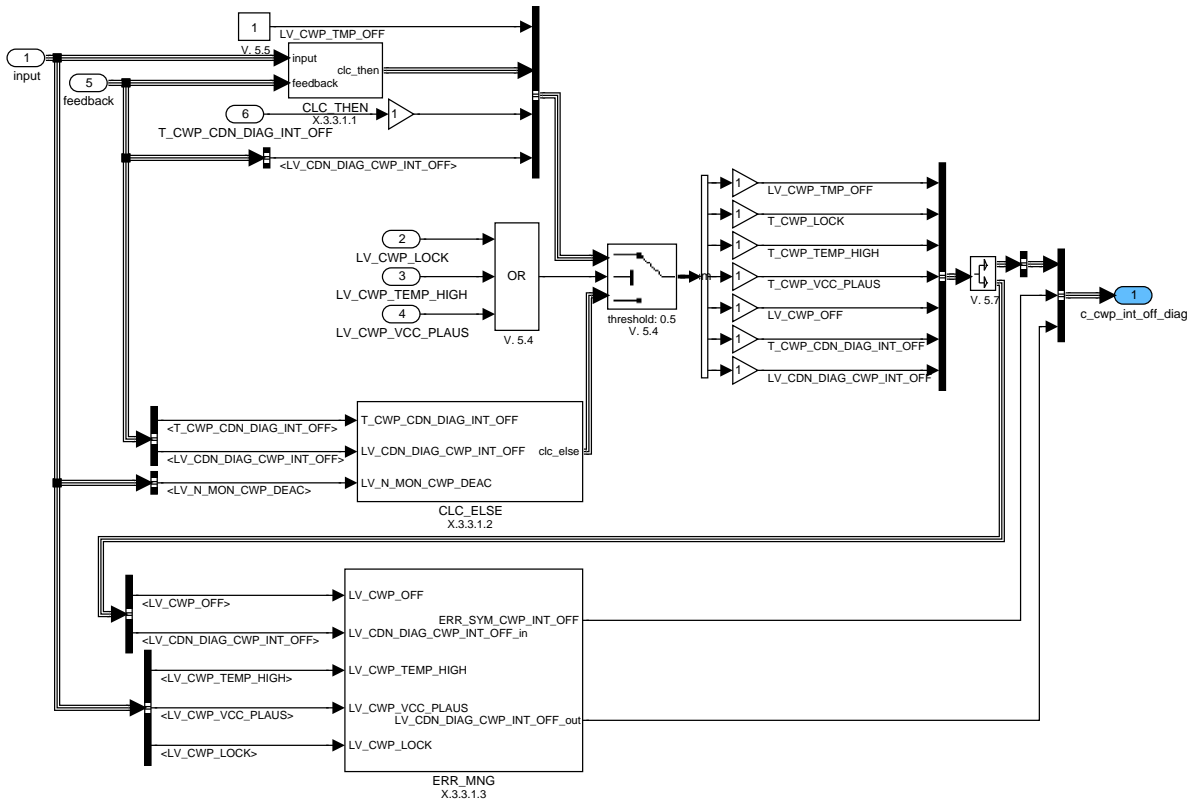


Figure A.59.22: :

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**A.59.3.3.1.1 The following calculation is based on the diagnostic condition**

**A.59.3.3.1.1.1 Current consumption too high, CWP blocked**

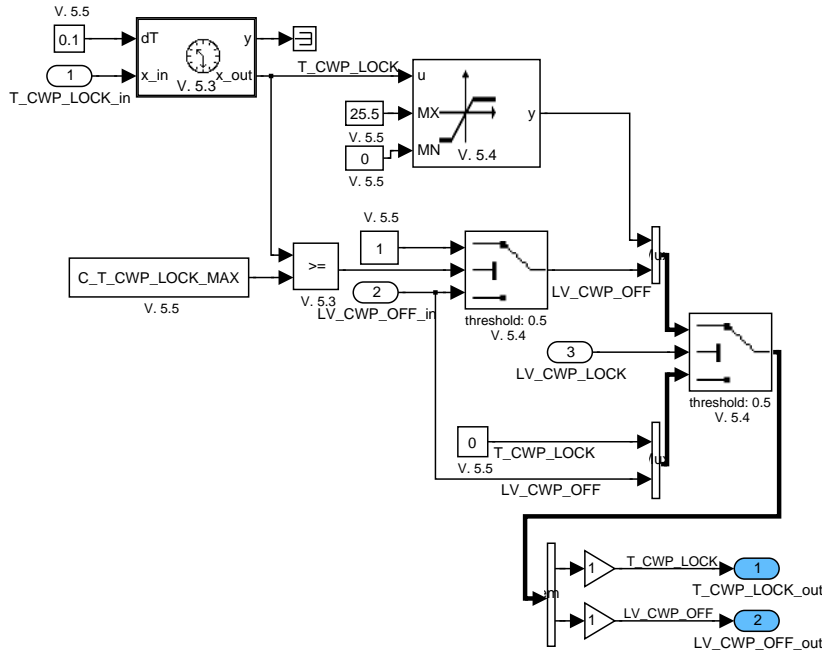


Figure A.59.23: :

**A.59.3.3.1.1.2 Electronics CWP temperature too high**

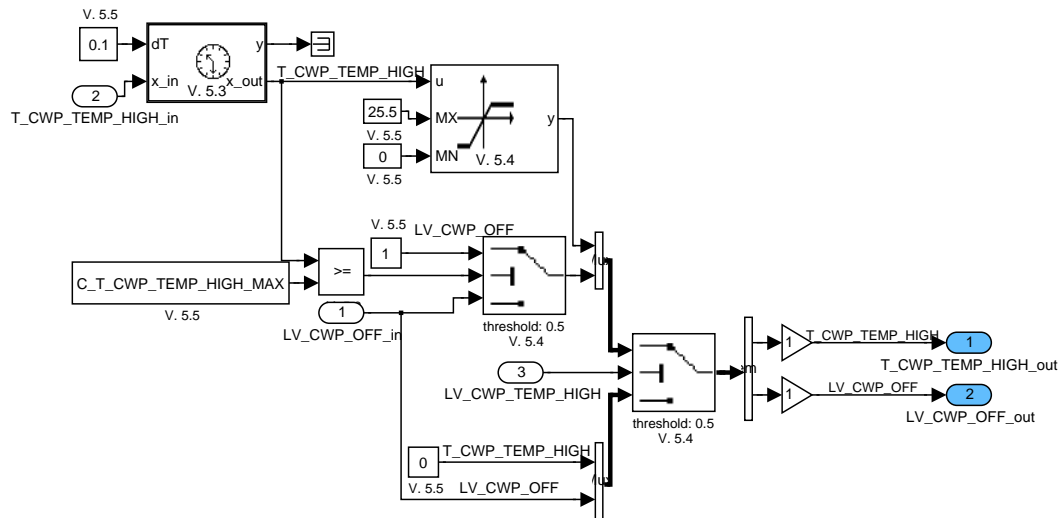


Figure A.59.24: :

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### A.59.3.3.1.3 Supply voltage CWP too high

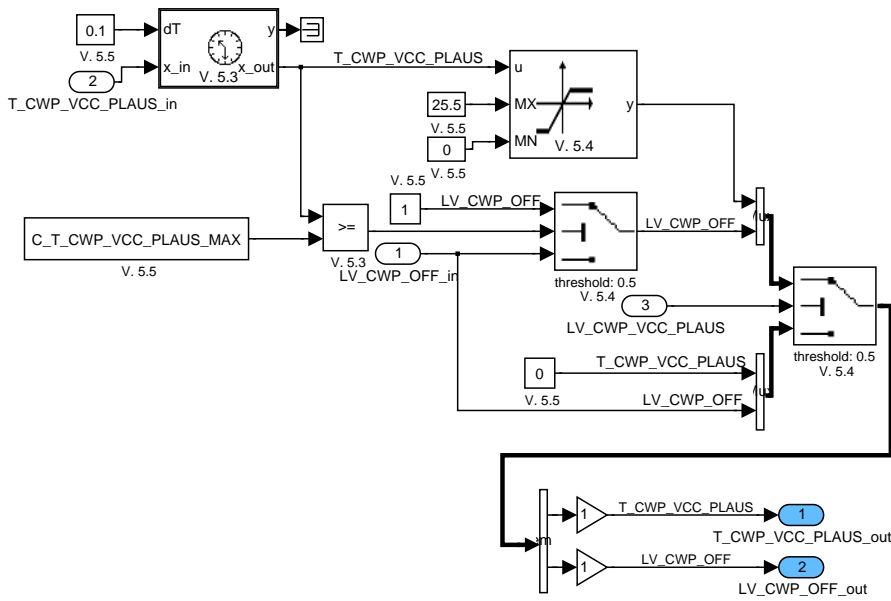


Figure A.59.25: :

### A.59.3.3.1.2 The following variables are reset when the diagnosis condition is zero

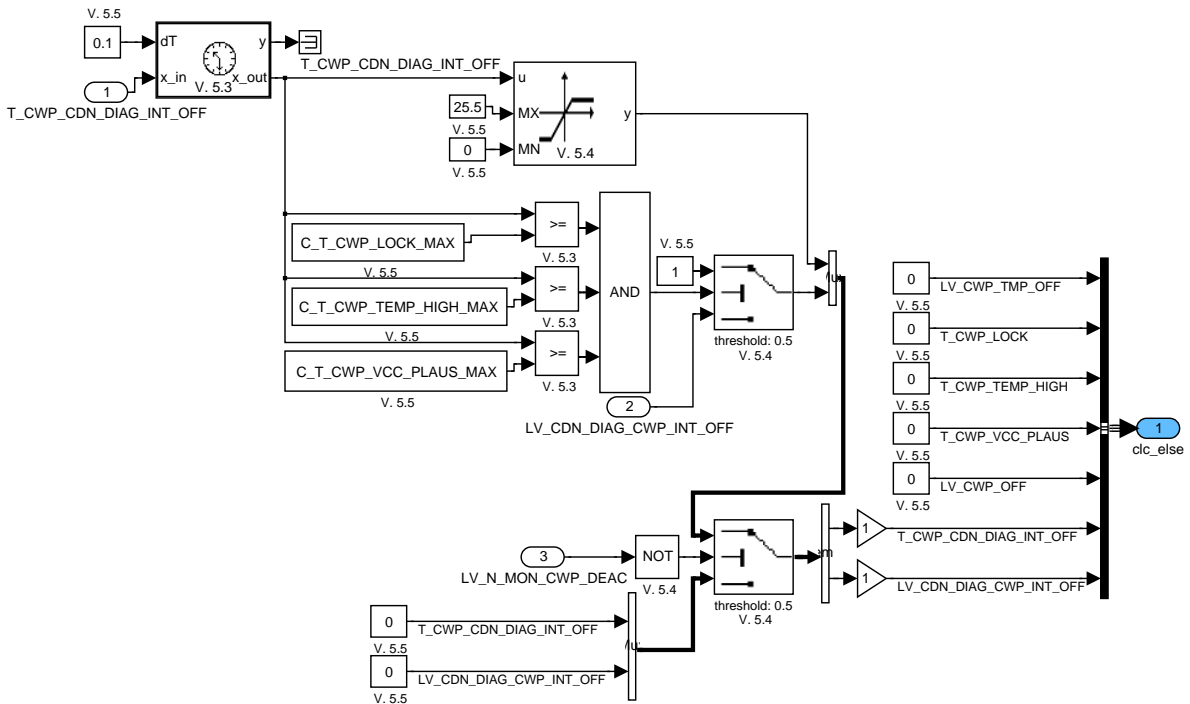


Figure A.59.26: :

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### A.59.3.3.1.3 Error management

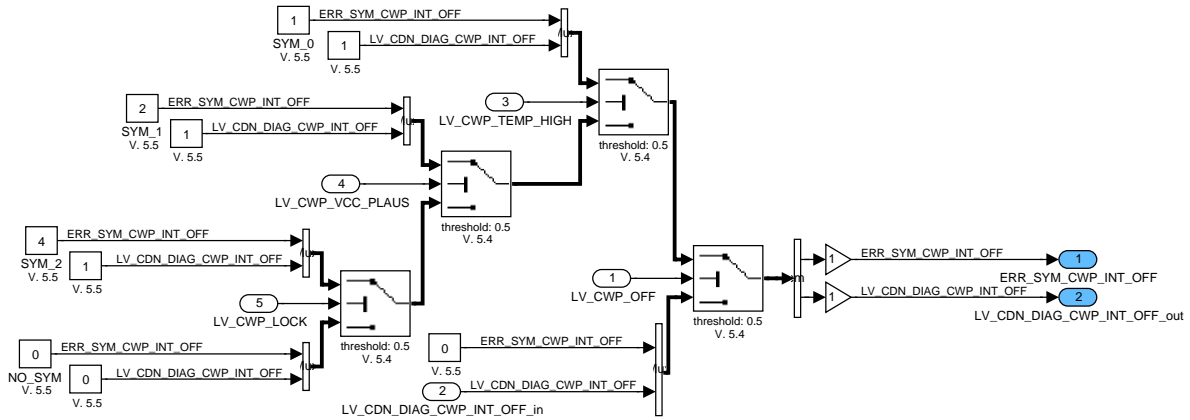


Figure A.59.27: :

### A.59.3.3.2 Interface to ERRM

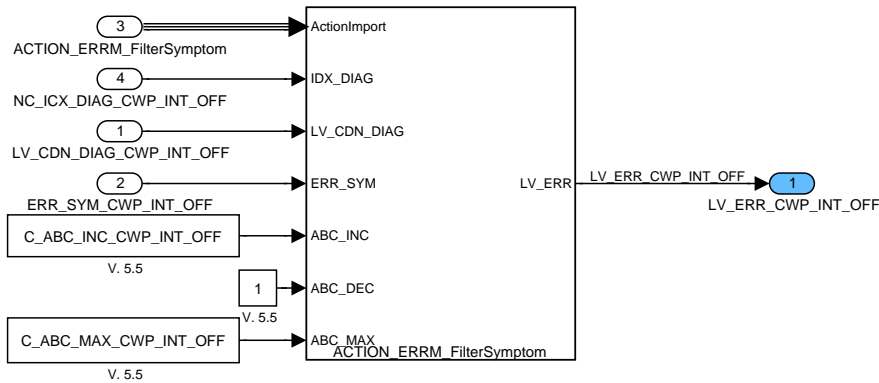


Figure A.59.28: :

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### A.59.3.3.3 ERRM call and update for LV\_END\_DIAG and ERR\_SYM by calling ERRM Actions

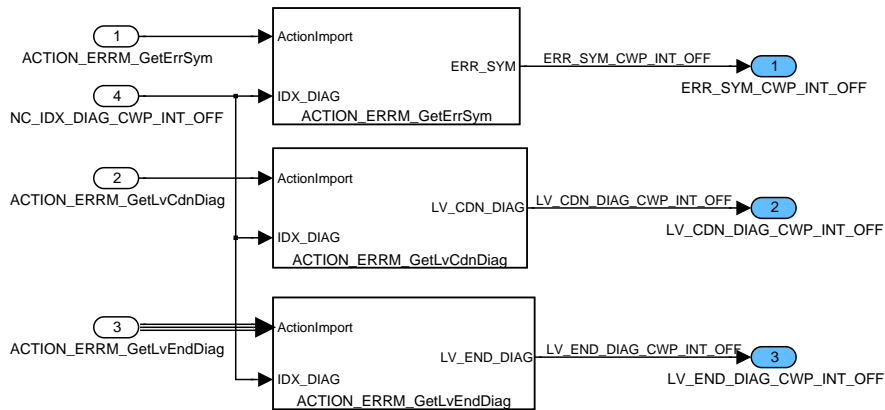


Figure A.59.29: :

### A.59.3.4 Electrical controlled water pump Power Reduction Monitoring

#### FUNCTION DESCRIPTION:

This function monitors the power reduction modes of the coolant water pump.

#### General information:

If the operating conditions of the electrical coolant water pump deviates from the normal conditions the output power of the pump will be reduced by the power management. Depending on the actual state a calibratable power setpoint is given. The state is determined separately by a state machine.

#### Description:

This diagnosis function is the interface between BSD driver and waterpump controller.

Error-symptoms are defined to this diagnosis function as following :

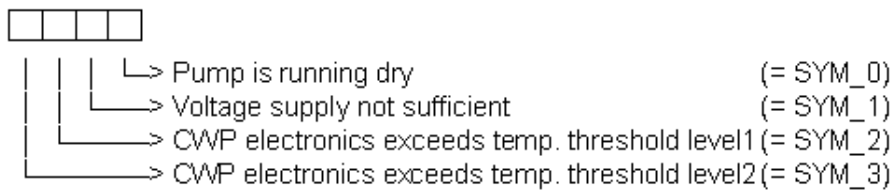


Figure A.59.30: :

### A.59.3.4.1 Symptom determination

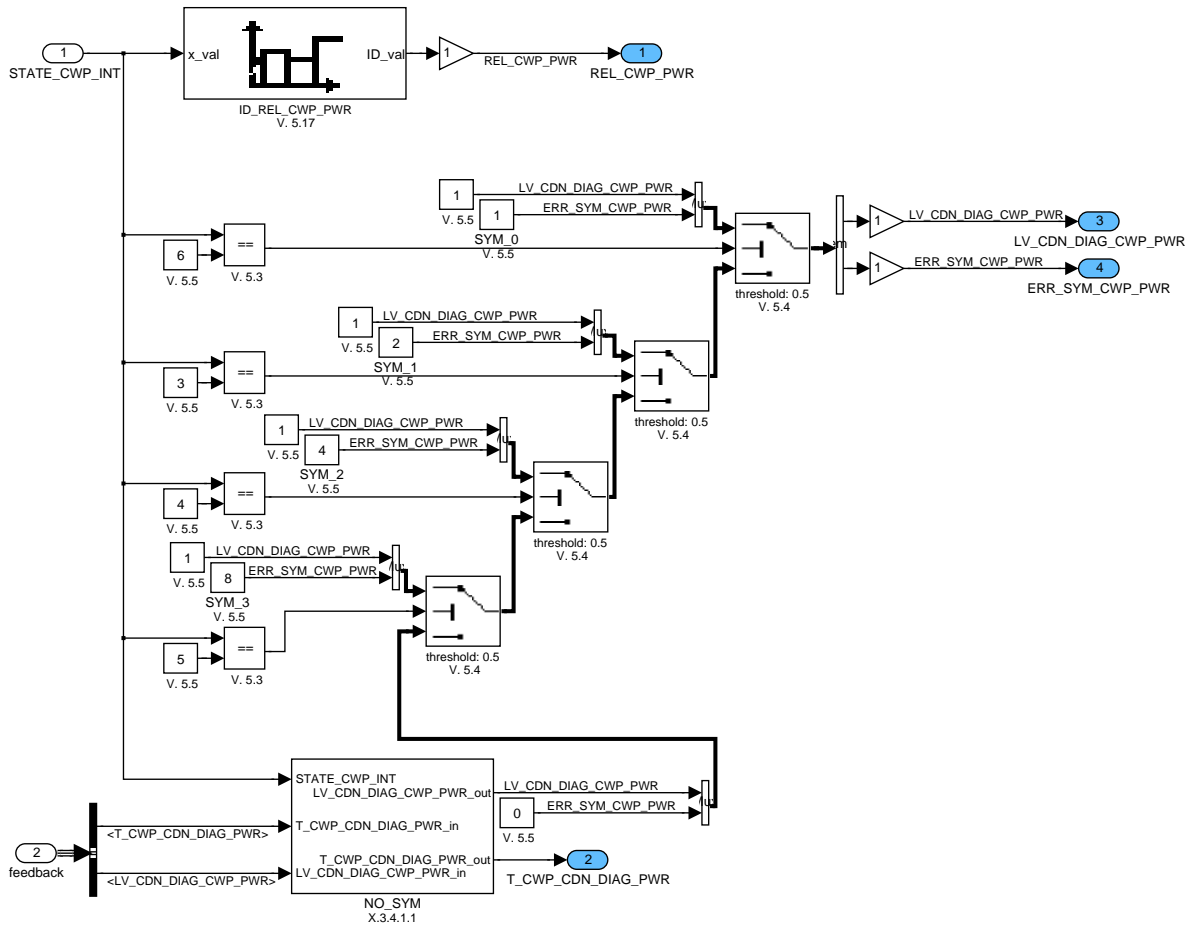


Figure A.59.31: :

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**A.59.3.4.1.1 Set of LV\_CDN\_DIAG\_CWP\_PWR in case of no error**

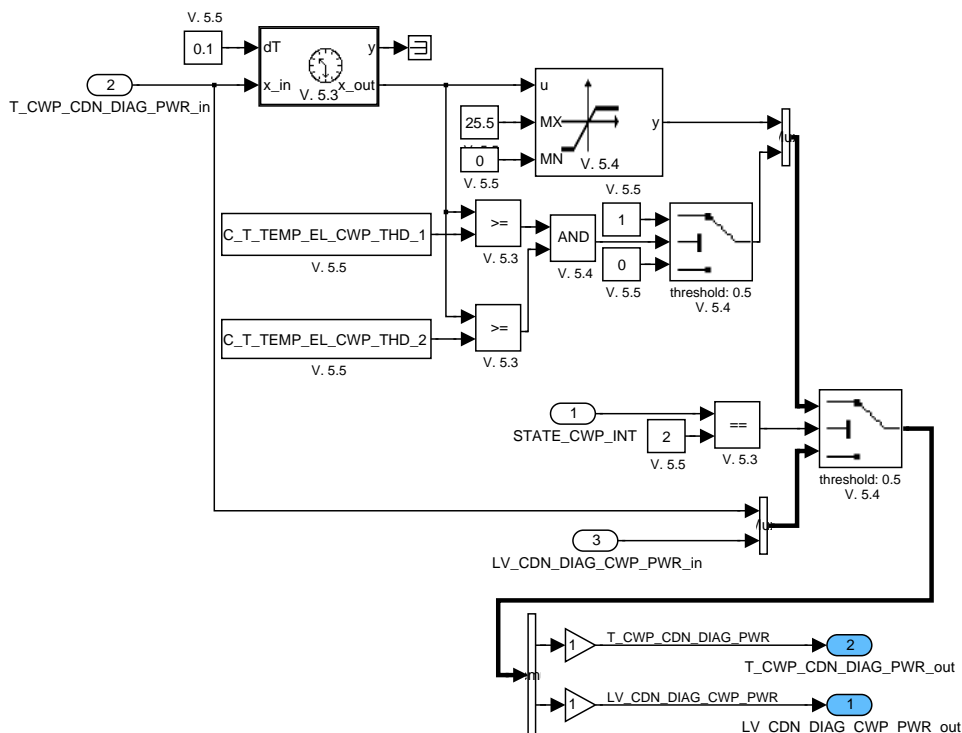


Figure A.59.32: :

**A.59.3.4.2 Interface to ERRM**

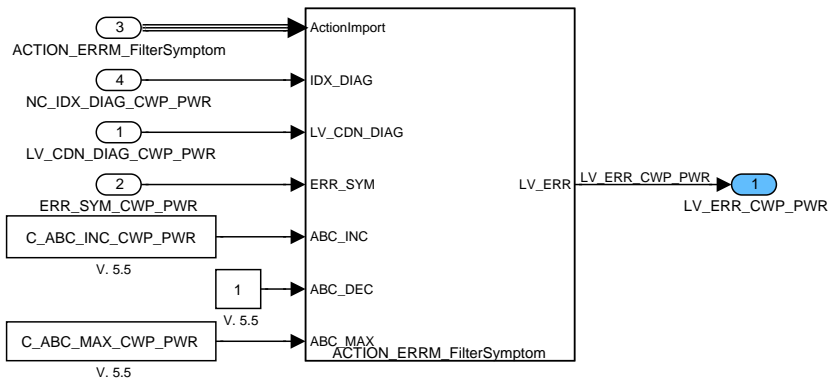


Figure A.59.33: :

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### A.59.3.4.3 ERRM call and update for LV\_END\_DIAG and ERR\_SYM by calling ERRM Actions

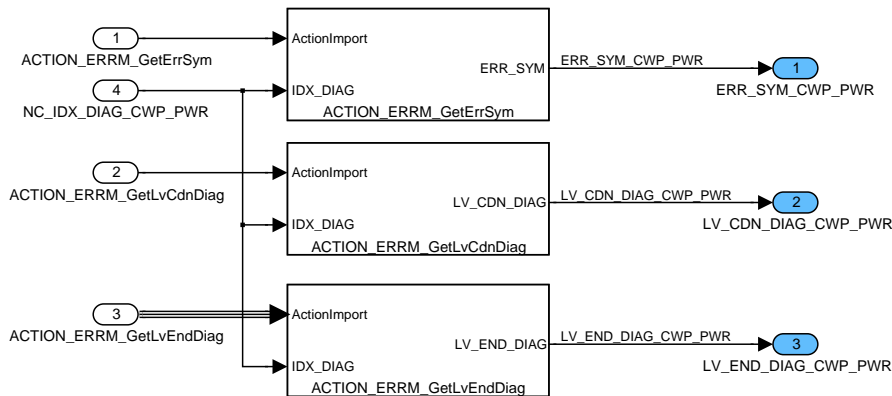


Figure A.59.34: :

### A.59.3.5 Waterpump internal state

#### FUNCTION DESCRIPTION:

This state machine determines the operation mode of the coolant water pump. By distinguishing several operation modes a specific diagnosis of the CWP at different states is possible.

#### General information:

After initialization some transition conditions must be fulfilled to change from one state to the other.

Operating State of the CWP STATE\_CWP\_INT (controlled internally in the CWP electronics):

STATE_CWP_INT	Operating state of the CWP	Addition explanations concerning the operating State
0	initialization	Pump is initialized, not ready to operate
1	normal operation mode open loop control	No speed monitoring active (speed <u>setpoint</u> = actual speed) LV_N_MON_CWP_DEAC = 1
2	normal operation mode closed loop control	Speed Monitoring active, closed loop controlled operation LV_N_MON_CWP_DEAC = 0
3	power reduced mode	Power reduced operation due to low voltage supply Voltage <u>supply</u> <u>potentially</u> not sufficient to achieve the required <u>speed setpoint</u>
4	power reduced mode	Power reduced operation due to high CWP electronics temperature (level 1) Pump is not able the achieve the required <u>speed setpoint</u>
5	power reduced mode	Power reduced operation due to high CWP electronics temperature (level 2) Pump is not able the achieve the required <u>speed setpoint</u>
6	pump running dry	Pump is running dry and <u>limits</u> <u>therefore</u> the max speed
7	temporary shut-off	High current consumption detected; automatic de-blocking disabled; max. 3 restarts are executed before permanent shut off
8	temporary shut-off	High current consumption detected; automatic de-blocking enabled; pump tries to de-block itself
9	permanent shut-off	Pump deactivates itself, possible reasons: <ul style="list-style-type: none"> <li>- Voltage supply too high</li> <li>- Current consumption too high</li> <li>- CWP electronics temperature too high</li> </ul>
10	<u>unplausible</u> operation	Actual pump speed deviates to desired pump speed; diagnosis active above opening temp. of the thermostat and voltage supply sufficient only

Figure A.59.35: :

Signal flow diagram:



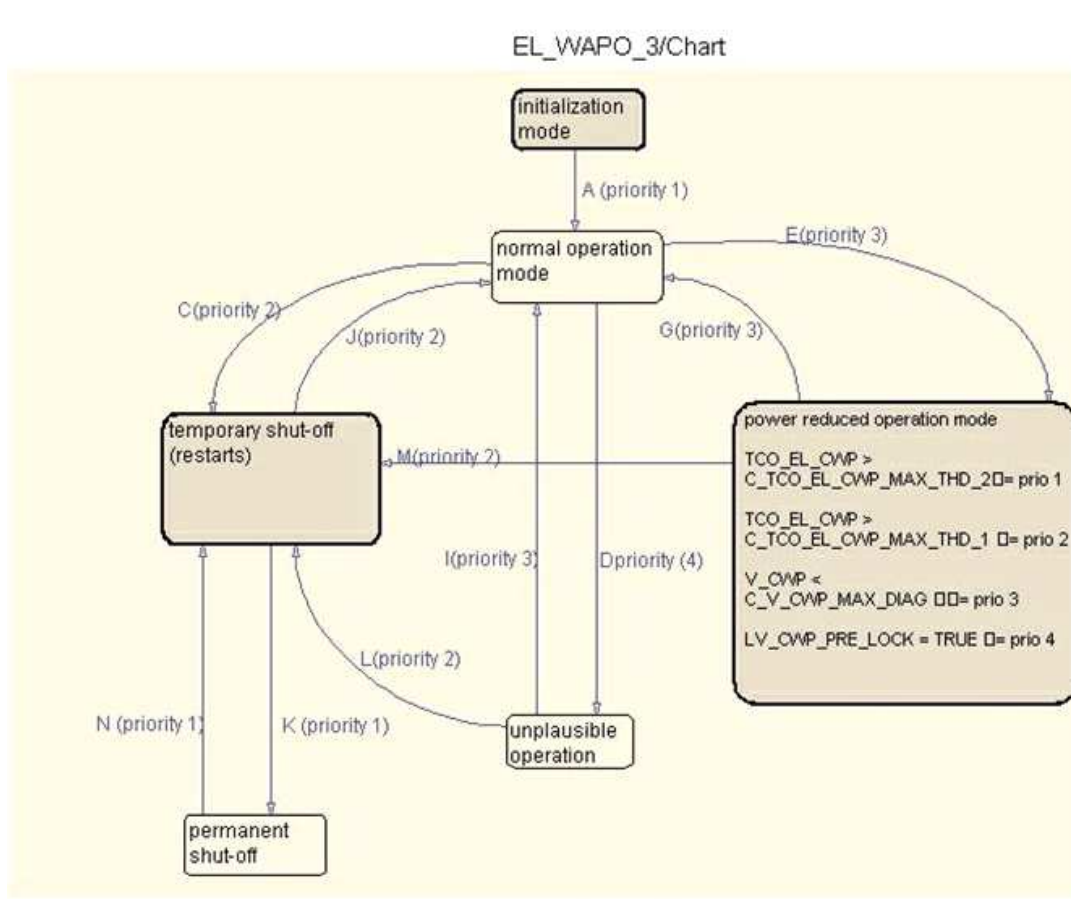



Figure A.59.36: :

Additional conditions to determine the correct state:

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4561 of 8404</b>	
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State	additional condition	STATE_CWP_INT
initialization	non	0
normal operation mode	LV_N_MON_CWP_DEAC = true	1
	LV_N_MON_CWP_DEAC = false	2
power reduced mode	TEMP_EL_CWP > C_TEMP_EL_CWP_MAX_THD_2	5 = prio 1
	TEMP_EL_CWP > C_TEMP_EL_CWP_MAX_THD_1	4 = prio 2
	V_CWP < C_V_CWP_MIN_DIAG_IT	3 = prio 3
	LV_CWP_PRE_LOCK = true	6 = prio 4
	<b>Internal 'Change Modus' conditions:</b> <b>If</b> TEMP_EL_CWP > C_TEMP_EL_CWP_MAX_THD_2 <b>Then</b> STATE_CWP_INT = 5 <b>Else if</b> TEMP_EL_CWP > C_TEMP_EL_CWP_MAX_THD_1 <b>Then</b> STATE_CWP_INT = 4 <b>Else if</b> V_CWP < C_V_CWP_MIN_DIAG_IT <b>Then</b> STATE_CWP_INT = 3 <b>Else if</b> LV_CWP_PRE_LOCK = 1 <b>Then</b> STATE_CWP_INT = 6 <b>Else if</b> T_CWP_5 < C_T_V_CWP_MAX_DIAG <b>Then</b> keep actual state STATE_CWP_INT <b>Endif</b> <b>Endif</b> <b>Endif</b> <b>Endif</b> <b>Endif</b>	
unplausible operation	Non Reset timer T_CWP_4 and T_CWP_5	10
temporary shut-off	Reset timer T_CWP_4 and T_CWP_5 (LV_CWP_TMP_OFF = true <b>and</b> LV_CWP_BLOCK_DEAC = false)	7
	(LV_CWP_TMP_OFF = true <b>and</b> LV_CWP_BLOCK_DEAC = true)	8
permanent shut-off	non	9

Figure A.59.37: :

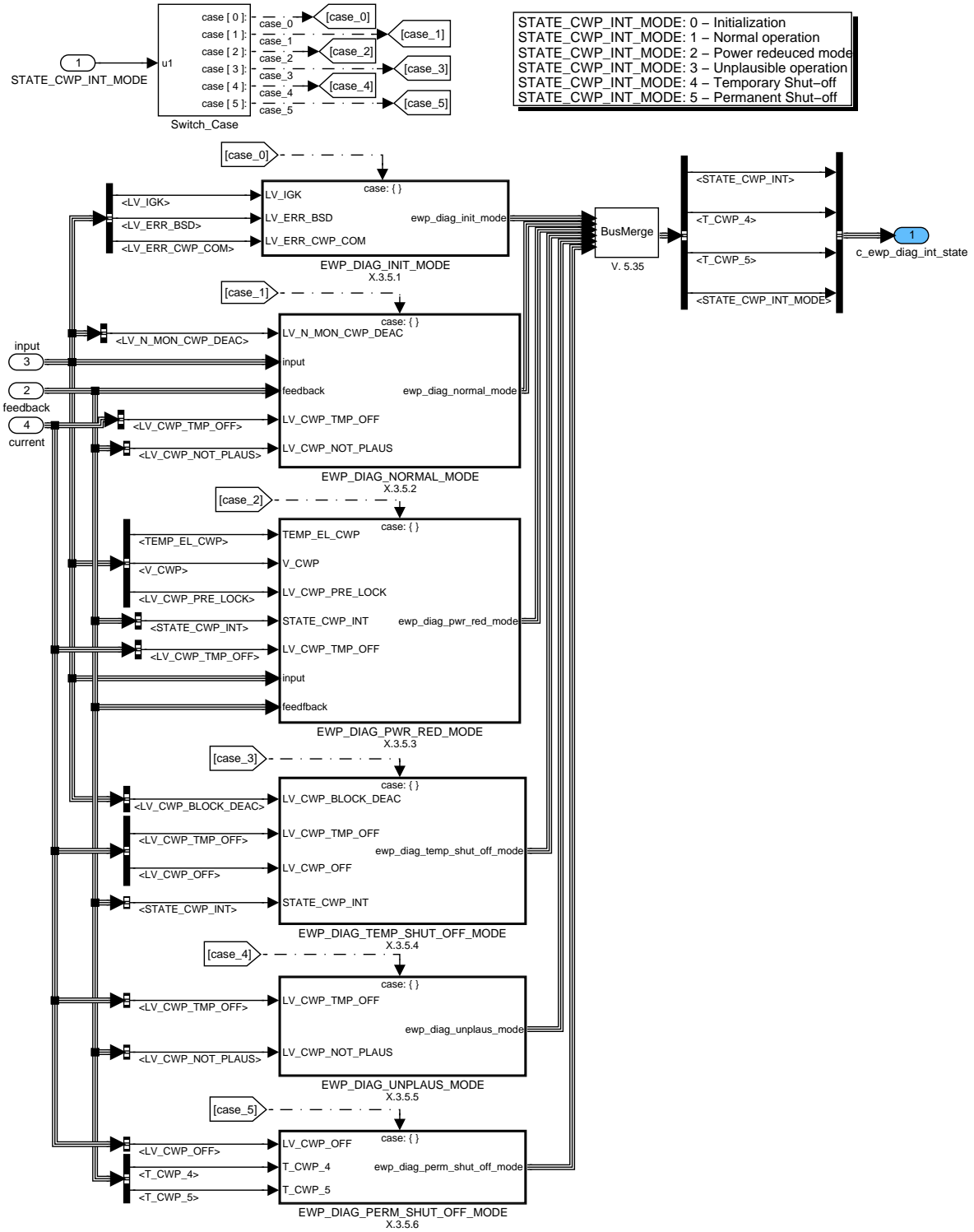


Figure A.59.38: :

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**A.59.3.5.1 Pump is initialized, not ready to operate**

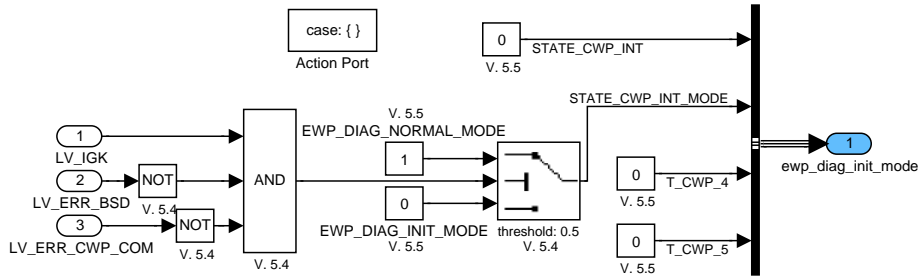


Figure A.59.39: :

**A.59.3.5.2 Normal operation mode**

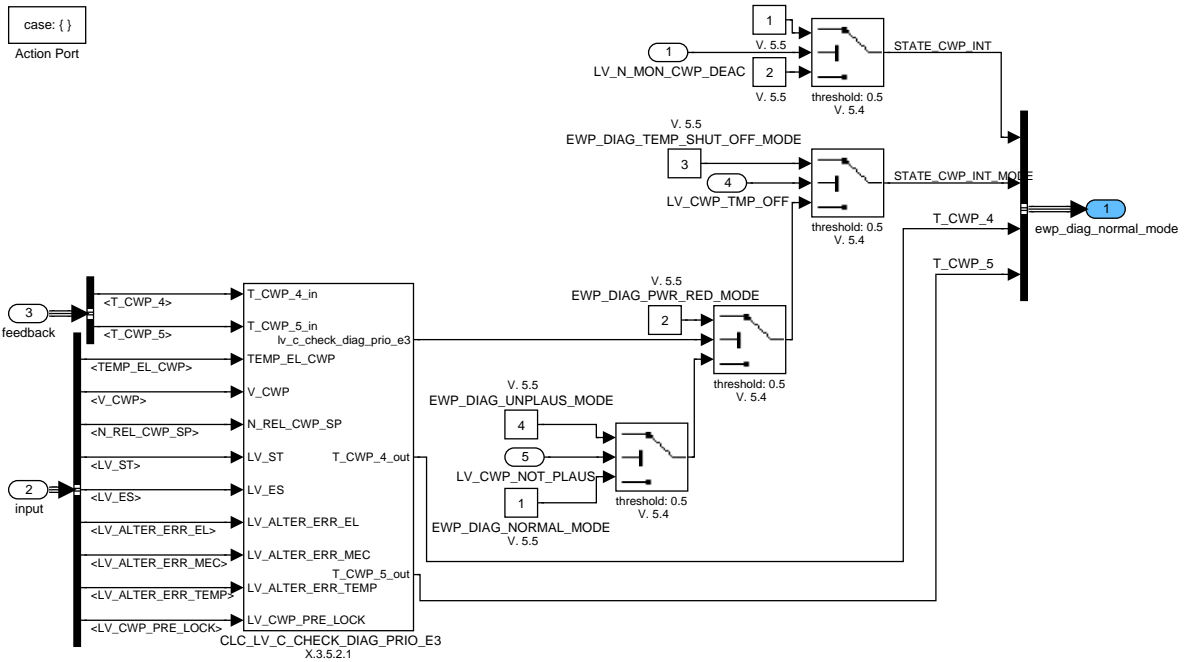


Figure A.59.40: :

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**A.59.3.5.2.1 Check for Transition condition**

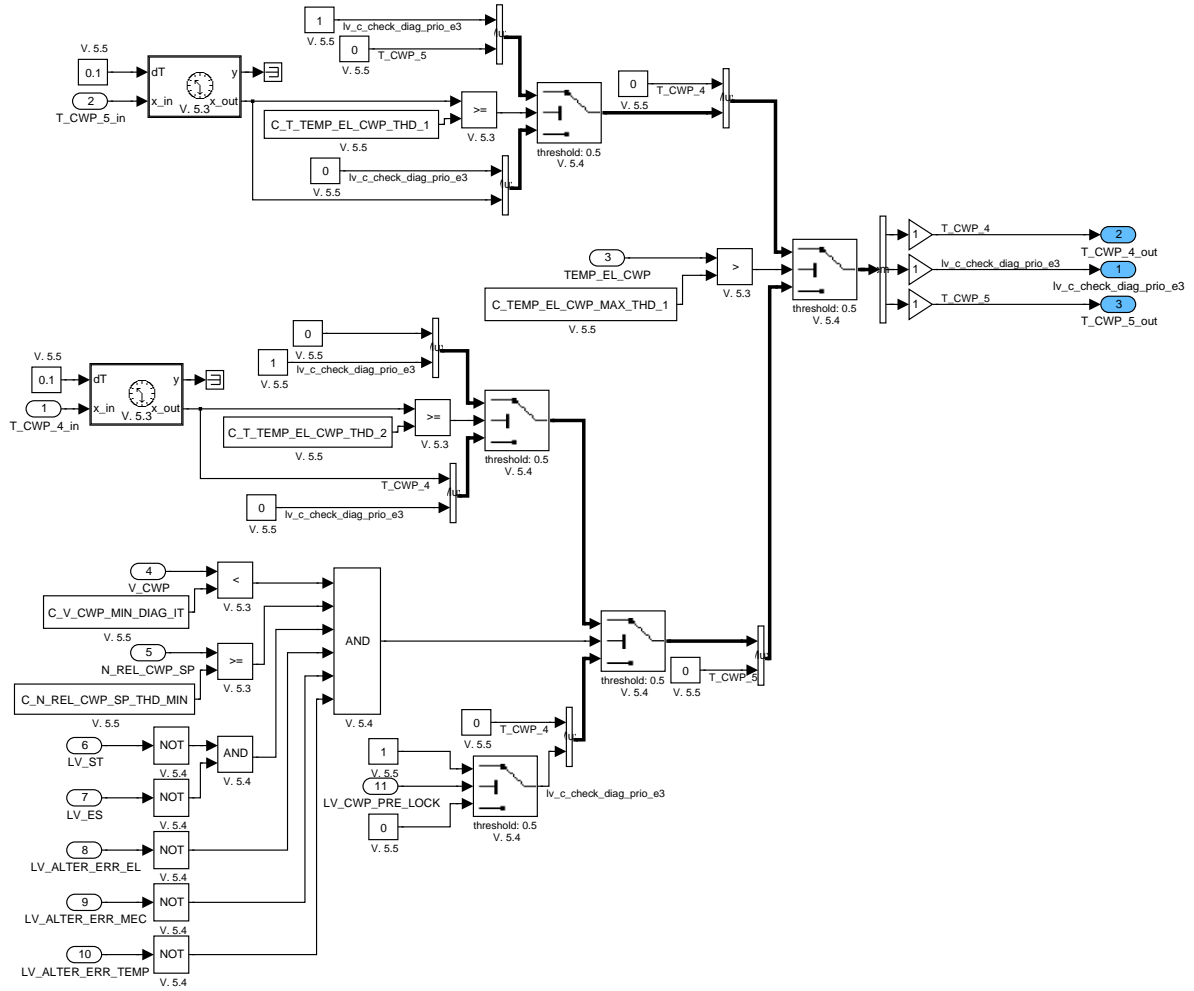



Figure A.59.41: :

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### A.59.3.5.3 Power reduced mode

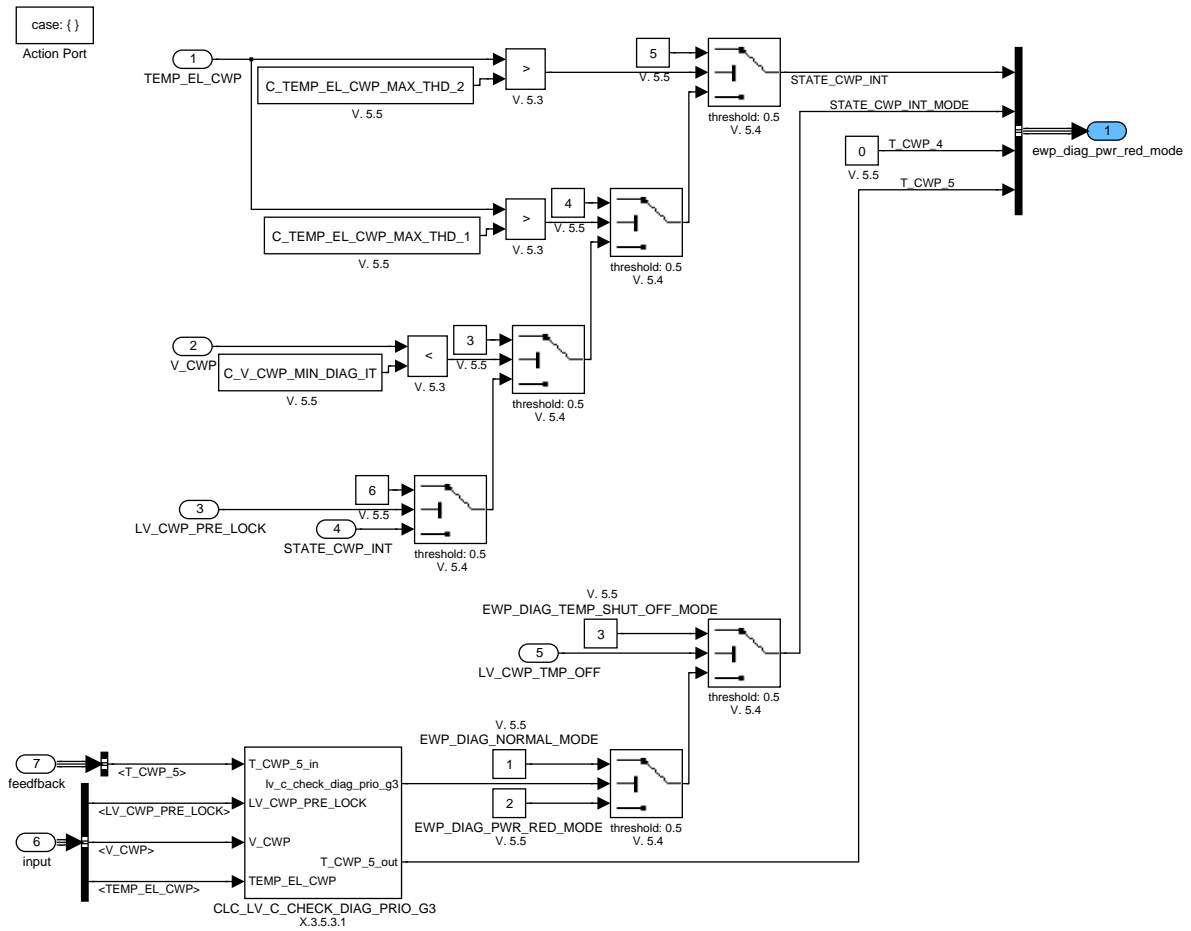


Figure A.59.42: :

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**A.59.3.5.3.1 Transition condition**

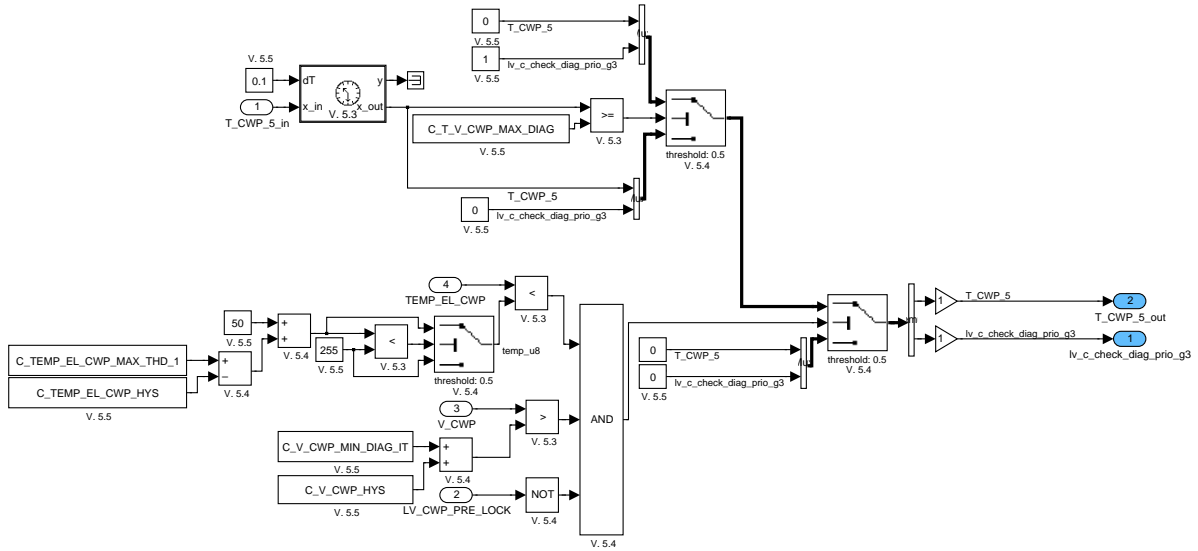


Figure A.59.43: :

**A.59.3.5.4 Temporary shut-off mode**

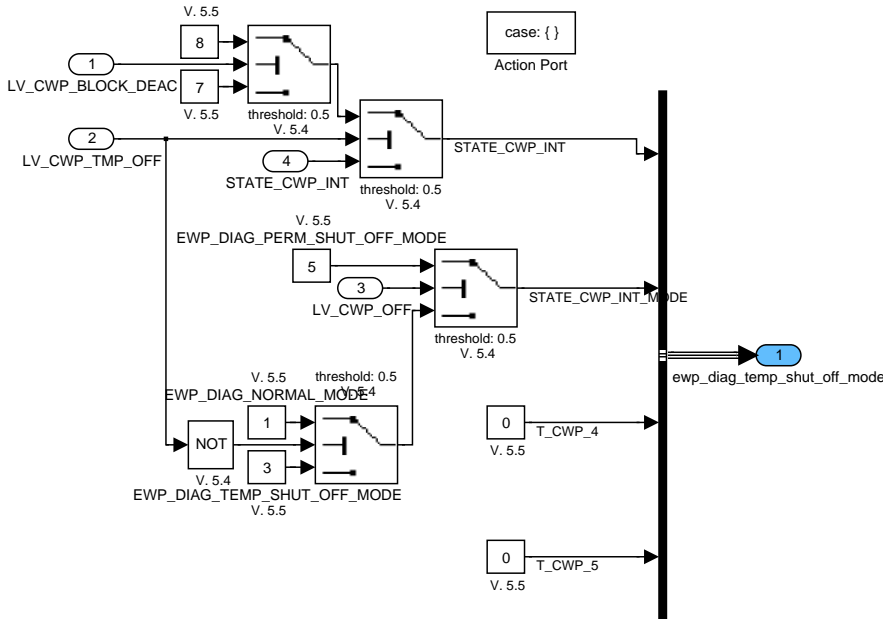


Figure A.59.44: :

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### A.59.3.5.5 Unplausible operation

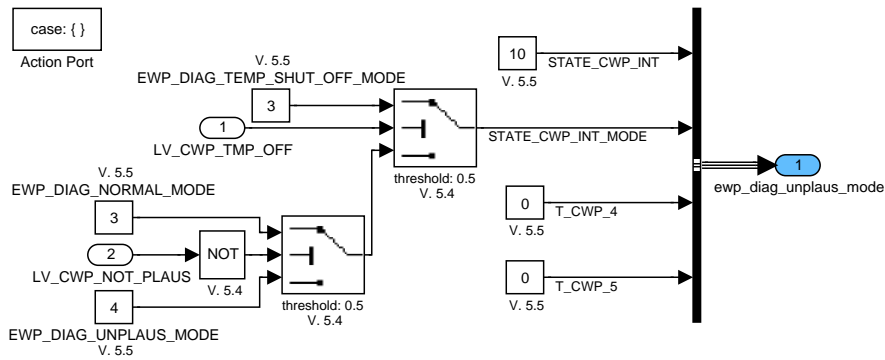


Figure A.59.45: -:

### A.59.3.5.6 Permanent shut-off mode

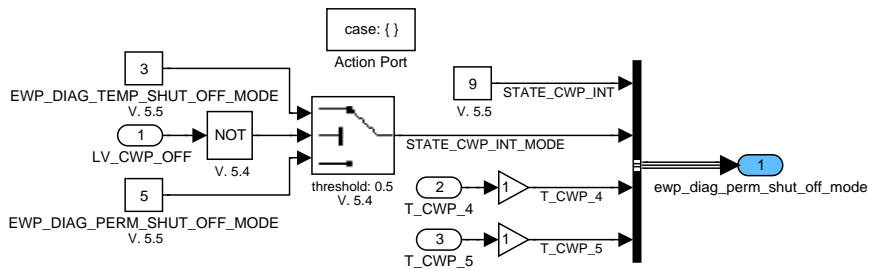


Figure A.59.46: :

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## A.60 Radiator shutter diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_RAS	O/V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom					
ERR_DIAG_RAS	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for RAS (only parameter)					
ERR_SYM_RAS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom Radiator Shutter (= Sound Flap) diagnosis					
LV_CDN_DIAG_RAS	V	0... 1H	0 ...1	1	-
Diagnosis condition RAS power stage diagnosis					
LV_END_DIAG_RAS	V	0... 1H	0 ...1	1	-
End of Radiator Shutter (= Sound Flap) diagnosis					
LV_ERR_RAS	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on Radiator Shutter (= Sound Flap) command signal					

### Input data:

LC_RAS_ACT {p. 3594}	LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}	LV_RAS_OUT {p. 3594}
LV_VB_CDN_OBD_1 {p. 1046}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_RAS	-	0... FFH	0... 255	1	-
Debounce counter increment Radiator Shutter power stage diagnosis					
C_ABC_MAX_RAS	-	1... FFH	1... 255	1	-
Debounce counter maximum value Radiator Shutter power stage diagnosis					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_RAS	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (= 2)					

### Import actions:

<b>ACTION_ERRM_FilterMulticondition</b> (IN<XX>,IN<CDN_DIAG_>,XX>,<IN<>,ERR_DIAG_XX>,<IN>,<C_ABC_INC_XX>,IN<C_ABC_MAX_XX>,OUT<LV_ERR_XX>)
Continued on next page

**ACTION\_INFR\_GetEIDiagRas (OUT<Cdn\_diag\_ras\_out\_el>,OUT<Err\_diag\_ras\_out\_el>)**

### Error treatment:

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Radiator shutter	RAS	Short circuit to Vbatt SCP	0	MPL_ST	CC
		Short circuit to Ground SCG	1		
		Open Circuit OC	2		
		-	3		

Possible configuration for ABC type and CARB class (see also "Table of Failure")

ABC Type: STD\_INI, STD, MEM, MEM\_INI, DEC\_CAL, STC, NO, MPL\_STD\_INI

CARB Class: MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO

### FUNCTION DESCRIPTION:

#### General information:

The RAS is driven by the ECU via an output driver. The failure detection is done by ECU Hardware. The purpose of the diagnosis is to detect electrical faults as defined by OBD I requirements. The RAS can be switched on or off (no PWM-signal).

#### Description:

The purpose is to perform the electrical diagnosis of the RAS actuator. 3 symptoms are distinguished:

#### Application conditions

**Initialisation:** ERRM variables are initialized according Filter-type.  
At Reset: All 0  
Set delay counter for NC\_PSD\_DLY\_RAS

**Recurrence:** 100ms

**Activation:** LV\_IGK = 1 **and** LC\_RAS\_ACT= 1

**Deactivation:** LV\_IGK = 0 **or** LC\_RAS\_ACT= 0

#### Formula section:

**If** LV\_ERR\_SPI\_MPS = 0  
**and** LV\_VB\_CDN\_OBD\_1 = 1


#### **Then**

Usage of the diagnosis information (failure symptoms (raw value) ERR\_DIAG\_RAS and diagnosis conditions CDN\_DIAG\_RAS) received from the infrastructure:

ACTION\_INFR\_GetEIDiagRas (OUT<CDN\_DIAG\_RAS>, OUT<ERR\_DIAG\_RAS>)

Basic diagnosis conditions are set according to infrastructure information: CDN\_DIAG\_RAS

Failure symptoms (raw value) are set according to infrastructure information: ERR\_DIAG\_RAS

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```

If      Activation conditions are met for the NC_PSD_DLY_RAS recurrence
Then
          { No additional diagnosis conditions are necessary }
Else
          CDN_DIAG_RAS = 0
Endif
Else
          CDN_DIAG_RAS = 0
Endif

```

Failure filtering and error management treatment:

For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN\_DIAG\_RAS and ERR\_DIAG\_RAS.

```

ACTION_ERRM_FilterMulticondition (IN<RAS_OUT>, IN<CDN_DIAG_RAS>,
  IN<ERR_DIAG_RAS>, IN<C_ABC_INC_RAS>, IN<C_ABC_MAX_RAS>,
  OUT< LV_ERR_RAS>)


```

This algorithm determines:

```

ERR_SYM_RAS           (detected error symptom for RAS diagnosis)
LV_ERR_RAS           (Error flag for debounced error of RAS)
LV_CDN_DIAG_RAS      (Diagnosis condition information)
LV_END_DIAG_RAS      (End of diagnosis information)

```

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## A.61 Coolant temperature sensor (radiator outlet) diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TCO_2_EL	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptom for coolant temperature (radiator outlet) signal range error					
ERR_SYM_TCO_2_GRD	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptom for coolant temperature (radiator outlet) signal gradient error					
LV_CDN_DIAG_TCO_2_EL	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) signal range diagnosis conditions					
LV_CDN_DIAG_TCO_2_GRD	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) signal gradient diagnosis conditions					
LV_CDN_ENA_TCO_2_PREL	V	0... 1H	0 ...1	1	-
Boolean for preliminary coolant temperature (radiator outlet) error enable conditions					
LV_END_DIAG_TCO_2_EL	V	0... 1H	0 ...1	1	-
Boolean for end of coolant temperature (radiator outlet) signal range diagnosis					
LV_END_DIAG_TCO_2_GRD	V	0... 1H	0 ...1	1	-
Boolean for end of coolant temperature (radiator outlet) signal gradient diagnosis					
LV_ERR_TCO_2	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on coolant temperature (radiator outlet) acquisition					
LV_ERR_TCO_2_EL	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) signal range error					
LV_ERR_TCO_2_GRD	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) signal gradient error					
LV_ERR_TCO_2_PREL	O/V	0... 1H	0 ...1	1	-
Boolean for preliminary error currently present on coolant temperature (radiator outlet) acquisition					
LV_ERR_TCO_2_PREL_DET	V/S	0... 1H	0 ...1	1	-
Boolean for preliminary error present on coolant temperature (radiator outlet) acquisition during driving cycle					

### Input data:

CTR_ABC_TCO_2_EL	CTR_ABC_TCO_2_GRD	LV_CDN_VB_MIN_DIAG {p. 1185}	LV_ERR_TCO_2_PLAUS {p. 5666}
LV_IGK {p. 906}	LV_INH_DIAG_TCO_2_EL {p. 4578}	LV_INH_DIAG_TCO_2_ GRD {p. 4578}	NC_NR_TCO_SENS {p. 576}
T_DIAG_AST {p. 4493}	TCO_2_MES {p. 1218}	TIA_THR {p. 984}	VP_TCO [NC_NR_TCO_SENS] {p. 1100}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_ABC_THD_TCO_2_PREL	-	0... FFH	0... 255	1	-
Threshold for anti-bounce counter value for preliminary coolant temperature (radiator outlet) error detection					
C_T_AST_MIN_DIAG_TCO_2_EL	-	0... FFFFH	0... 65535	1	s
Minimum time delay after start for the coolant temperature (radiator outlet) electrical diagnosis					
C_TCO_2_MES_GRD_MAX_DIAG_TCO_2	-	0... FEH	0... 190.5	0.75	°C
Maximum coolant temperature gradient for the coolant temperature (radiator outlet) gradient diagnosis					
C_TIA_THR_MIN_DIAG_TCO_2_EL	-	0... FEH	-48... 142.5	0.75	°C
Minimum intake air temperature value for the coolant temperature (radiator outlet) electrical diagnosis					
C_VP_TCO_2_MAX_DIAG_TCO_2_EL	-	0... 7FFFH	0... 4.999847412	153e-6	V
Maximum raw sensor signal voltage for the coolant temperature (radiator outlet) electrical diagnosis					
C_VP_TCO_2_MIN_DIAG_TCO_2_EL	-	0... 7FFFH	0... 4.999847412	153e-6	V
Minimum raw sensor signal voltage for the coolant temperature (radiator outlet) electrical diagnosis					

**FUNCTION DESCRIPTION:****General information:**

The purpose of the diagnosis function is to detect electrical failures as defined by OBD I requirements. The coolant temperature (radiator outlet) raw sensor voltage (VP\_TCO [1]) is measured with use of an 10bit A/D converter by the ECU hardware. The modified sensor signal is converted then into a measured temperature value at radiator outlet. Each by the ECU hardware measured raw sensor value is checked as well as the converted temperature signal.

A global coolant temperature (radiator outlet) error is set without debounce as soon as an electrical- or signal gradient- or coolant temperature (radiator outlet) plausibility error is detected. All separate diagnosis functions are performed all the time if the diagnosis conditions are fulfilled. The deactivation of diagnosis functions with use of configuration switches is not possible.

In addition a preliminary coolant temperature (radiator outlet) error is set as soon as debouncing of an electrical-, or signal gradient- symptom occurs. The preliminary coolant temperature (radiator outlet) error will be stored in the non-volatile memory during the ECU s self-holding phase to be available at the beginning of the next driving cycle.

**Application conditions:***Initialisation at Reset:*

```

LV_ERR_TCO_2 = 0
LV_CDN_ENA_TCO_2_PREL = 1
LV_ERR_TCO_2_PREL = LV_ERR_TCO_2_PREL_DET (NVMY)
LV_ERR_TCO_2_PREL_DET = LV_ERR_TCO_2_PREL_DET (NVMY)
(NVMY: stored in the non-volatile memory)

```

*Initialisation at Engine stop to Engine run (ES\_to\_ERU):*

```

LV_ERR_TCO_2_PREL_DET = 0
LV_CDN_ENA_TCO_2_PREL = 0


```

*Initialisation at FMY clear:*

```

LV_ERR_TCO_2 = 0
LV_ERR_TCO_2_PREL = 0

```

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LV\_ERR\_TCO\_2\_PREL\_DET = 0

**Recurrence:** 100 ms

**Activation:** at every engine operating state

**Deactivation:** -

**Formula section:**

```

If          LV_ERR_TCO_2_EL = 1          or
              LV_ERR_TCO_2_GRD = 1          or
              LV_ERR_TCO_2_PLAUS = 1
then       LV_ERR_TCO_2 = 1          (without debounce)
else       LV_ERR_TCO_2 = 0
endif

```

### A.61.1 Preliminary coolant temperature (radiator outlet) failure (at ES after RE-SET)

**Application conditions**

**Recurrence:** 100 ms

**Activation:** LV\_CDN\_ENA\_TCO\_2\_PREL = 1

**Deactivation:** LV\_CDN\_ENA\_TCO\_2\_PREL = 0

**Formula section:**

```

If          CTR_ABC_TCO_2_EL > 0          or
              CTR_ABC_TCO_2_GRD > 0          or
              LV_ERR_TCO_2_PREL_DET = 1
then       LV_ERR_TCO_2_PREL = 1          (without debounce)
else       LV_ERR_TCO_2_PREL = 0
endif

```

### A.61.2 Preliminary coolant temperature failure (at ERU /at ES after ERU\_to\_ES)

**Application conditions**

**Recurrence:** 100 ms

**Activation:** LV\_CDN\_ENA\_TCO\_2\_PREL = 0

**Deactivation:** LV\_CDN\_ENA\_TCO\_2\_PREL = 1

**Formula section:**

```

If          CTR_ABC_TCO_2_EL > C_CTR_ABC_THD_TCO_2_PREL          or
              CTR_ABC_TCO_2_GRD > C_CTR_ABC_THD_TCO_2_PREL          or
              LV_ERR_TCO_2_PLAUS = 1
then       LV_ERR_TCO_2_PREL_DET = 1          (irrevocable for current driving cycle)

```



**Formula section:**Error detection:

```

if (1)      VP_TCO[1] < C_VP_TCO_2_MIN_DIAG_TCO_2_EL
              // coolant temperature sensor (radiator outlet) voltage signal (VP_TCO[1])
              (error detection Short circuit to GND )
then (1)
LV_CDN_DIAG_TCO_2_EL = 1
ERR_SYM_TCO_2_EL = SYM_1
LV_ERR_TCO_2_EL = 1                                (after debounce)

else (1)
  if (2)      VP_TCO[1] > C_VP_TCO_2_MAX_DIAG_TCO_2_EL
                // coolant temperature sensor (radiator outlet) voltage signal (VP_TCO[1])
                (error detection Short circuit to Vbatt or open load possible)
  then (2)
    if (3)      TIA_THR >= C_TIA_THR_MIN_DIAG_TCO_2_EL
                  or
                  TIA_THR < C_TIA_THR_MIN_DIAG_TCO_2_EL    and
                  T_DIAG_AST > C_T_AST_MIN_DIAG_TCO_2_EL
    then (3)
LV_CDN_DIAG_TCO_2_EL = 1
ERR_SYM_TCO_2_EL = SYM_0
LV_ERR_TCO_2_EL = 1                                (after debounce)
    else (3)
LV_CDN_DIAG_TCO_2_EL = 0
    endif (3)
  else (2)
LV_CDN_DIAG_TCO_2_EL = 1
ERR_SYM_TCO_2_EL = NO_SYM
LV_ERR_TCO2_EL = 0                                (after rebound)
  endif (2)
endif (1)

```

End of diagnosis:


For the calculation of LV\_END\_DIAG\_TCO\_2\_EL see Anti-bounce Algorithm, calculation of the end of diagnosis .

**A.61.4 Coolant temperature (radiator outlet) signal gradient diagnosis****FUNCTION DESCRIPTION:****General information:**

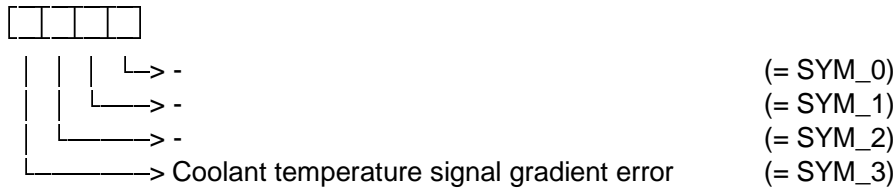
The purpose of the signal gradient diagnosis is to detect a not plausible gradient on the measured coolant temperature (radiator outlet) sensor signal. The monitoring is based on a comparison between the actual measured and the last measured coolant temperature value at radiator outlet. The symptom of the error code is handled by anti-bouncing.

**Description:**

Error-symptoms are defined to this diagnosis function as following:

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### Application conditions

#### Initialisation:

**LV\_ERR\_TCO\_2\_GRD** = Refer to filtering configuration for the initialisation

**LV\_END\_DIAG\_TCO\_2\_GRD** = Refer to filtering configuration for the initialisation

**LV\_CDN\_DIAG\_TCO\_2\_GRD** = Refer to filtering configuration for the initialisation

**ERR\_SYM\_TCO\_2\_GRD** = Refer to filtering configuration for the initialisation

**Recurrence:** 100 ms

**Activation:** **if** LV\_IGK = 1 **and**  
 LV\_CDN\_VB\_MIN\_DIAG = 1 **and**  
 LV\_INH\_DIAG\_TCO\_2\_GRD = 0  
**then** LV\_CDN\_DIAG\_TCO\_2\_GRD = 1  
**else** LV\_CDN\_DIAG\_TCO\_2\_GRD = 0

**endif**

**Deactivation:** Activation condition not true

### Formula section:

#### Error detection:

**if**  $|TCO\_2\_MES(n-1) - TCO\_2\_MES(n)| >$   
 $C\_TCO\_2\_MES\_GRD\_MAX\_DIAG\_TCO\_2$   
**then** ERR\_SYM\_TCO\_2\_GRD = SYM\_3  
 LV\_ERR\_TCO\_2\_GRD = 1 (after debounce)  
**else** ERR\_SYM\_TCO\_2\_GRD = NO\_SYM  
 LV\_ERR\_TCO\_2\_GRD = 0 (after rebound)  
**endif**

#### End of diagnosis:

For the calculation of LV\_END\_DIAG\_TCO\_2\_GRD see Anti-bounce Algorithm, calculation of the end of diagnosis .

## A.62 Coolant temperature sensor (radiator outlet) diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_TCO_2_EL	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) signal range diagnosis inhibit					
LV_INH_DIAG_TCO_2_GRD	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) signal gradient diagnosis inhibit					

### Input data:

LV_ERR_TCO_2_EL {p. 4572}	LV_IGK {p. 906}		
------------------------------	-----------------	--	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TCO_2_EL	-	0... FFH	0... 255	1	-
Debounce counter increment value for the coolant temperature (radiator outlet) sensor electrical diagnosis					
C_ABC_INC_TCO_2_GRD	-	0... FFH	0... 255	1	-
Debounce counter increment value for the coolant temperature (radiator outlet) sensor gradient diagnosis					
C_ABC_MAX_TCO_2_EL	-	1... FFH	1... 255	1	-
Debounce counter maximum value for the coolant temperature (radiator outlet) sensor electrical diagnosis					
C_ABC_MAX_TCO_2_GRD	-	1... FFH	1... 255	1	-
Debounce counter maximum value for the coolant temperature (radiator outlet) sensor gradient diagnosis					

### Error treatment:

#### Error debounce:

Debounce counter increment: C\_ABC\_INC\_TCO\_2\_EL  
Debounce counter maximum value: C\_ABC\_MAX\_TCO\_2\_EL

#### Diagnosis Configuration

ERRM configuration for LV\_ERR\_TCO\_2\_EL is "STD\_INI" //all 0 at LV\_IGK 0->1 or reset

#### Error debounce:

Debounce counter increment: C\_ABC\_INC\_TCO\_2\_GRD  
Debounce counter maximum value: C\_ABC\_MAX\_TCO\_2\_GRD

#### Diagnosis Configuration:


ERRM configuration for LV\_ERR\_TCO\_2\_GRD is "MEM" //error is set irreversible

### FUNCTION DESCRIPTION:

#### General information:

Task of the coolant temperature (radiator outlet) sensor diagnosis (Appl. Inc.) is to allow the projects to adapt their specific requirements to generic coolant temperature (radiator outlet) sensor diagnosis. The setting of the interface output variables have to be provided by the projects.


### Application conditions

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**endif***Recurrence:* 1000 ms*Activation:* at every engine operating state*Deactivation:* -**Formula section:**

**If** LV\_ERR\_TCO\_2\_EL = 1  
**Then** LV\_INH\_DIAG\_TCO\_2\_GRD = 1  
**Else** LV\_INH\_DIAG\_TCO\_2\_GRD = 0  
**Endif**

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## A.63 Debounce algorithm

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ABC_END_DIAG_XX	V	0... FFH	0... 255	1	-
Counter for end of diagnosis XX generation					
CTR_ABC_XX	O/V/S	0... FFH	0... 255	1	-
anti bounce counter of diagnosis XX					
ERR_SYM_PREV_XX	-	0... FH	0... 15	1	-
Previous value of ERR_SYM_XX when the diagnosis conditions are fulfilled					
ERR_SYM_XX	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
For each symptom : status of failure (set to 1 when failure symptom detected)					
LV_CDN_DIAG_XX	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled)					
LV_END_DIAG_XX	V	0... 1H	0 ...1	1	-
Diagnostic done completely at least one time					

### Input data:

LV_ABC_INH {p. 4610}	LV_DC {p. 5746}	LV_IGK {p. 906}	
----------------------	-----------------	-----------------	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_XX	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement for XX diagnosis					
C_ABC_INC_XX	-	0... FFH	0... 255	1	-
XX diagnosis anti-bounce counter increment (for anti-bounce filtering) or frequency counter maximum value (for statistical filtering)					
C_ABC_MAX_XX	-	1... FFH	1... 255	1	-
XX diagnosis anti-bounce counter maximum value (for anti-bounce filtering) or threshold of period counter for failure detection (for statistical filtering)					
LC_ABC_BENCH	-	0... 1H	0 ...1	1	-
Logical constant to manage the anti-bounce bench mode					
LC_ERR_DET_UPD	-	0... 1H	0 ...1	1	-
Logical constant to manage some functionality as the visualisation of the sporadic error					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ABC_CONF_FCT_DIAG_XX	-	0... FFH	0... 255	1	-
Anti-bounce algorithm configuration of each XX diagnosis					
NLC_ABC_INI_DC_END_DIAG	-	0... 1H	0 ...1	1	-
Initialisation of LV_END_DIAG_XX at LV_DC transition or not					
NLC_BENCH_MODE	-	0... 1H	0 ...1	1	-
Bench mode configuration (0: the bench mode is removed, max CPU optimisation is reached)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**Remark :** The present failure and the anti-bounce counter may be saved or not (see 'Calculation of the Anti-bounce')

### A.63.1 Import Actions

<b>#IF NC_ERR_DET_UPD = 1</b>
ACTION_ERRM_UpdErrDet (IN<XX>)
This action indicates each occurrence of the detected error
<b>#ENDIF</b>

### A.63.2 Export Actions

Name
ACTION_ERRM_FilterSymptom( IN< XX >, IN< lv_cdn_diag_XX >, IN< err_sym_XX >, IN< C_ABC_INC_XX >, IN< C_ABC_DEC_XX >, IN< C_ABC_MAX_XX >, OUT< LV_ERR_XX > )
This action computes the elementary anti-bounce filter for one failure treatment and returns filter result
ACTION_ERRM_NoFilterSymptom( IN< XX >, IN< lv_cdn_diag_XX >, IN< err_sym_XX >, IN< lv_err_set_XX >, IN< lv_err_reset_XX >, IN< lv_end_diag_XX >, OUT< LV_ERR_XX > )
This action computes the elementary treatment case no filtering is used
ACTION_ERRM_AbcFilterSymptomEnd( IN< XX >, IN< C_ABC_MAX_XX >, OUT< LV_ERR_XX > )
This action erases diagnostic failure and sets the end of diagnostic in case of antibounce filter type
ACTION_ERRM_NoFilterSymptomEnd( IN< XX >, OUT< LV_ERR_XX > )
This action erases diagnostic failure and sets the end of diagnostic in case of no filter
ACTION_ERRM_AbcFilterReset( IN< XX >, OUT< LV_ERR_XX > )
This action resets data filter in case of antibounce filter type
ACTION_ERRM_NoFilterReset( IN< XX >, OUT< LV_ERR_XX > )
This action resets data filter in case of no filter
ACTION_ERRM_GetLvErr( IN< XX >, OUT< LV_ERR_XX > )
This action is used to get LV_ERR_XX value
ACTION_ERRM_GetLvEndDiag( IN< XX >, OUT< LV_END_DIAG_XX > )
This action is used to get LV_END_DIAG_XX value
ACTION_ERRM_GetLvCdnDiag( IN< XX >, OUT< LV_CDN_DIAG_XX > )
This action is used to get LV_CDN_DIAG_XX value
ACTION_ERRM_GetErrSym( IN< XX >, OUT< ERR_SYM_XX > )
This action is used to get ERR_SYM_XX value

ERR\_SYM\_XX is defined like output data for each diagnosis as following :

Name	Mode	Hex. Limits	Phys. Limits	Resol.	Unit
ERR_SYM_XX	O/V	0..0FH 0H 1H 2H 4H 8H FH	All combination NO_SYM SYM_0 SYM_1 SYM_2 SYM_3 BENCH_MODE	1	-
Symptom : failure without filtering of diagnosis XX					

It is possible to combine several symptoms.

### FUNCTION DESCRIPTION:

General information:

The filtering algorithm (anti-bounce or statistic) is used usually for the simple diagnosis (e.g. : usually OBD1 diagnosis). If there is another need, diagnosis manages itself the filtering and the end of diagnosis (e.g. : usually OBD2 diagnosis).

The filtering is used to filter the detected failure. The failure becomes present after filtering.

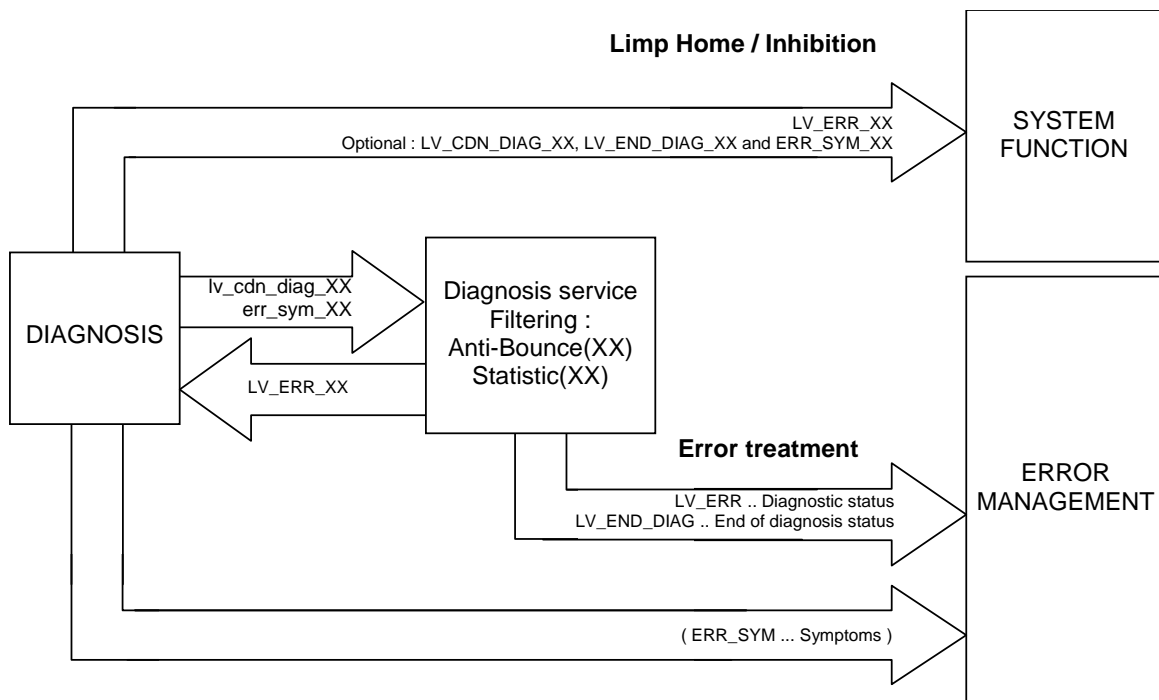
The end of diagnosis definition is realised after a time defined as the minimum time to detect a present failure.

The filtering algorithm (anti-bounce or statistic) uses one counter to check failure detection threshold and one counter to manage the end of diagnosis (Diagnostic result available).

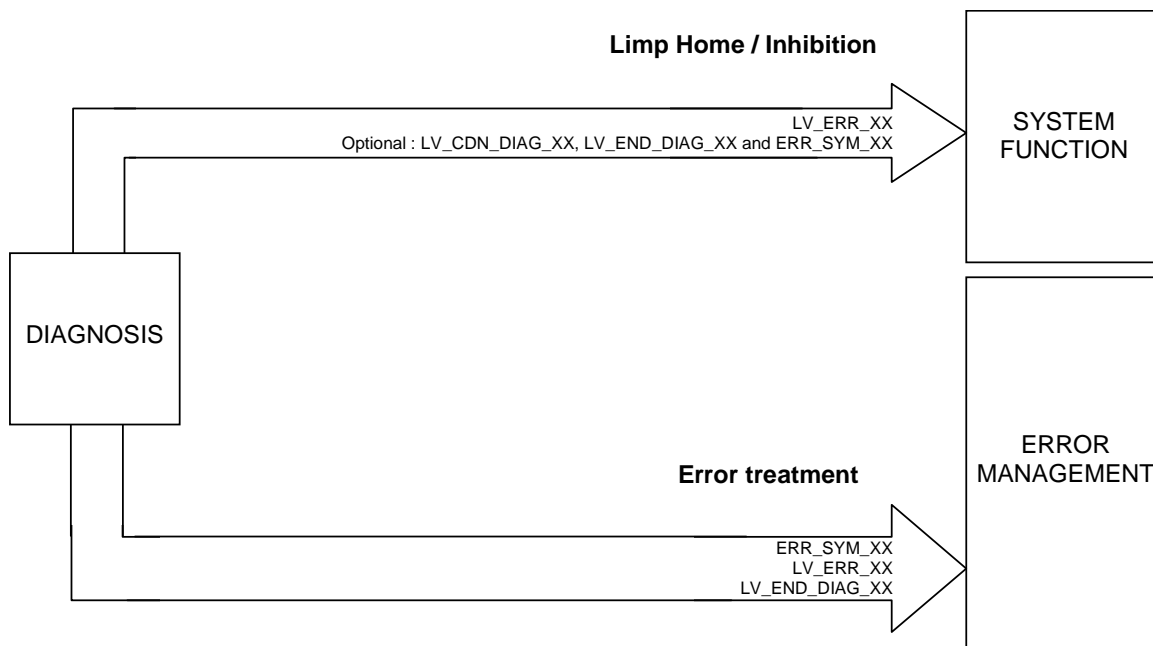
Filter choice selection : according to the diagnostic filtering configuration the filtering algorithm used is the anti-bounce filtering (NLC\_ABC\_STC\_XX = 0) or the standard statistical filtering (NLC\_ABC\_STC\_XX=1)

Signal flow diagram :

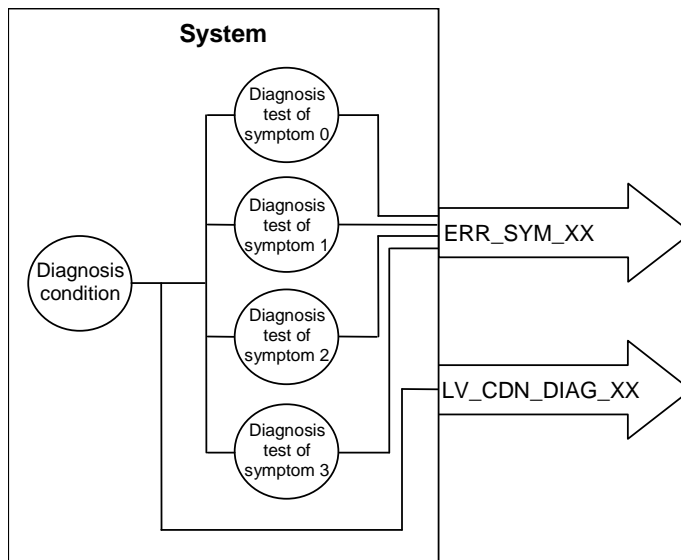
Diagnosis with an anti-bounce algorithm :



Diagnosis without anti-bounce algorithm :



The symptoms are evaluated when diagnosis conditions are fulfilled :



### A.63.3 Initialisation of anti-bounce, statistical and multi-conditions filters

This paragraph is dedicated to the initialisation of main data, at the following events:

- ECU reset
- LV\_IGK 0 → 1 transition before the end of the power-latch phase
- LV\_DC 1 → 0 transition


#### A.63.3.1 At ECU reset

##### Management of NVMY

**If** NVMY not corrupted **and** not first ECU power-up

**Then**

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CTR\_ABC\_XX is restored from NVMY  
 LV\_ERR\_XX is restored from NVMY  
 ERR\_SYM\_XX is restored from NVMY

**Else**

CTR\_ABC\_XX = 0  
 LV\_ERR\_XX = 0  
 ERR\_SYM\_XX = 0

**Endif**

LV\_CDN\_DIAG\_XX = 0  
 CTR\_ABC\_END\_DIAG\_XX = 0  
 LV\_END\_DIAG\_XX = 0

**If** NLC\_ABC\_NOT\_SAVE\_XX = 1  
**Then**

*{ case of STD\_INI, MEM and STC configurations }*  
 CTR\_ABC\_XX = 0  
 LV\_ERR\_XX = 0  
 ERR\_SYM\_XX = 0

**Endif**

#### Configuration evaluation

**If** NLC\_ABC\_INI\_VALUE\_XX = 1  
**Then**

*{ case of MEM\_INI configuration }*  
**if** LV\_ERR\_XX = 1

**Then**

CTR\_ABC\_XX = C\_ABC\_MAX\_XX - C\_ABC\_INC\_XX

**Else**

CTR\_ABC\_XX = 0

**Endif**

LV\_ERR\_XX = 0  
 ERR\_SYM\_XX = 0

**Endif**

#### **A.63.3.2 At LV\_IGK 0 ? 1 transition, without ECU reset**

**If** NLC\_ABC\_NOT\_SAVE\_XX = 1 and NLC\_ABC\_INI\_IGK\_XX = 1  
**Then**

CTR\_ABC\_XX = 0  
 LV\_ERR\_XX = 0  
 ERR\_SYM\_XX = 0


**Endif**

LV\_CDN\_DIAG\_XX = 0

**If** NLC\_ABC\_NOT\_SAVE\_XX = 0  
**and** NLC\_ABC\_INI\_VALUE\_XX = 1  
**and** NLC\_ABC\_INI\_IGK\_XX = 1

**Then**

*{ case of MEM\_INI configuration }*  
**if** LV\_ERR\_XX = 1  
**Then**

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```

CTR_ABC_XX = C_ABC_MAX_XX - C_ABC_INC_XX
Else
    CTR_ABC_XX = 0
Endif
LV_ERR_XX = 0
ERR_SYM_XX = 0
Endif

If
    NLC_ABC_INI_DC_END_DIAG = 0
Then
    CTR_ABC_END_DIAG_XX = 0
    LV_END_DIAG_XX = 0
Endif

```

### A.63.3.3 At LV\_DC 1 ? 0 transition

```

If
    NLC_ABC_INI_DC_END_DIAG = 1
Then
    CTR_ABC_END_DIAG_XX = 0
    LV_END_DIAG_XX = 0
Endif

If
    LV_ERR_XX = 0 and NLC_ABC_INI_VALUE_XX = 0
Then
    { all cases excepted MEM_INI configuration }
    CTR_ABC_XX = 0
    ERR_SYM_XX = 0
Endif

```

### A.63.4 Recurrence

The recurrence is always managed by the diagnosis recurrence.

### A.63.5 Filtering algorithm description

#### A.63.5.1 Description:

**Syntax :** ACTION\_ERRM\_FilterSymptom( IN<XX>, IN<lv\_cdn\_diag\_XX>, IN< err\_sym\_xx>, IN<C\_ABC\_INC\_XX>, IN<C\_ABC\_DEC\_XX>,IN<C\_ABC\_MAX\_XX>, OUT<LV\_ERR\_XX> )

**Parameter(in) :**

XX	Type: index to identify the Diagnostic
lv_cdn_diag_XX	Type: Diagnostic condition
err_sym_XX	Status of failure
C_ABC_INC_XX	Anti-bounce counter increment
C_ABC_DEC_XX	Anti-bounce counter decrement
C_ABC_MAX_XX	Maximum value of anti-bounce counter

**Parameter(out) :** LV\_ERR\_XX Type: Boolean (=1 when failure)


**Short Description :** This action returns the filter result on symptoms detected at each diagnostic recurrence

#### A.63.5.2 Antibounce algorithm filtering type

##### A.63.5.2.1 Calculation of the anti-bounce counter

#### Description:

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**Anti-bounce operation:**

If the system failure is detected and the diagnosis conditions are fulfilled (LV\_CDN\_DIAG\_XX = 1) then the failure is detected (ERR\_SYM\_XX = 0) and the anti-bounce counter is incremented. In this case an action is called to manage some functionality (eg : to visualise the sporadic error of all diagnosis using this anti-bounce algorithm).

If the system failure isn't detected and the diagnosis conditions are fulfilled (LV\_CDN\_DIAG\_XX = 1) then the failure isn't detected (ERR\_SYM\_XX = 0) and the anti-bounce counter is decremented.

If the diagnosis conditions aren't fulfilled (LV\_CDN\_DIAG\_XX = 0) then the detected failure is unchanged (ERR\_SYM\_XX(N) = ERR\_SYM\_XX(N-1)) and the anti-bounce counter is unchanged.

The present failure is set when the anti-bounce counter has reached its MAX (unequal to zero).

The configuration allows:

- to save or not the present failure and the anti-bounce counter
- to initialise or not the present failure and the anti-bounce counter at transition LV\_IGK 0 → 1
- to manage the decrement of the anti-bounce counter or not (the anti-bounce counter remains at the maximum value)
- to calibrate or not the decrement of the anti-bounce counter.

**Anti-bounce bench mode:**

To make easier the development phase, it may be interesting to force the LV\_ERR\_XX flag (present failure) and the associated symptoms in order to free the diagnosis and to test only the error management and/or the application incidence (limp home or inhibition) associated to the present failure. This mode is active only if the LC\_ABC\_BENCH and NLC\_BENCH\_MODE flags are set.

To set LV\_ERR\_XX to one and ERR\_SYM\_XX = FH (all detected error symptoms) :

Set the C\_ABC\_INC\_XX calibration to the maximum value (FFH).

To set LV\_ERR\_XX to zero and ERR\_SYM\_XX = 0 (no detected error symptom) :

Set the C\_ABC\_INC\_XX calibration to zero.

Note:


In this mode, the diagnosis condition (LV\_CDN\_DIAG\_XX) and the end of diagnosis (LV\_END\_DIAG\_XX) are set to 1 (LV\_CDN\_DIAG\_XX = 1 means the ERR\_SYM\_XX is valid and LV\_END\_DIAG\_XX = 1 means the LV\_ERR\_XX flag is valid).

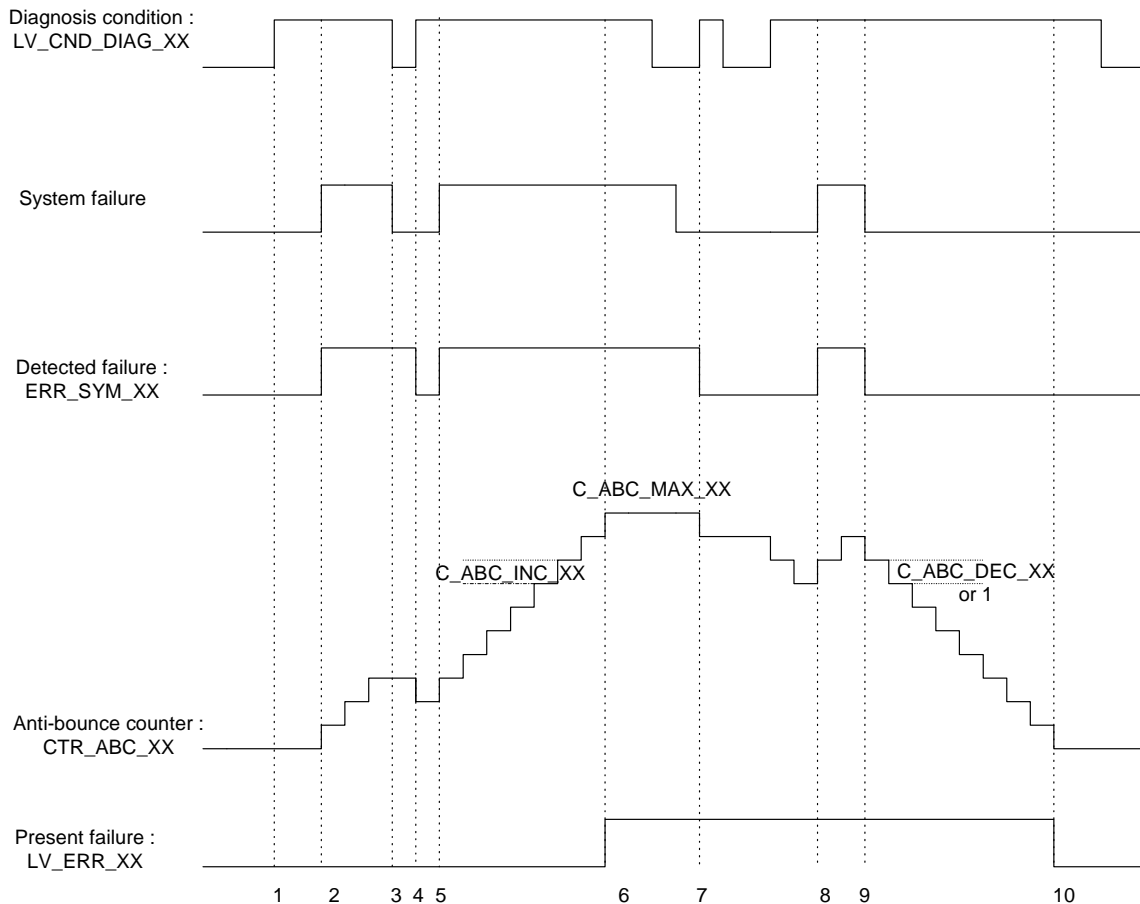
**Anti-bounce inhibition:**

For specific needs, the anti-bounce filtering calculation (anti-bounce operation and anti-bounce bench mode) may be inhibited, with LV\_ABC\_INH inhibition flag.

**Signal flow diagram:**

1 -The anti-bounce counter may be decremented (NLC\_ABC\_NOT\_DEC\_XX = 0):

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- 1: The diagnosis conditions are fulfilled  
but the failure isn't detected  
LV\_CDN\_DIAG\_XX = 1,  
ERR\_SYM\_XX = 0. CTR\_ABC\_XX remains at the value 0.  
LV\_ERR\_XX = 0.
- 2: The diagnosis conditions are fulfilled  
and the failure is detected.  
LV\_CDN\_DIAG\_XX = 1,  
ERR\_SYM\_XX <> 0. CTR\_ABC\_XX = 0 + C\_ABC\_INC\_XX  
LV\_ERR\_XX = 0.
- 3: The diagnosis conditions aren't fulfilled  
and the failure remains detected.  
LV\_CDN\_DIAG\_XX = 0,  
ERR\_SYM\_XX <> 0. CTR\_ABC\_XX is frozen  
LV\_ERR\_XX = 0.
- 4: The diagnosis conditions are fulfilled again  
and the failure is no more detected. CTR\_ABC\_XX =  
CTR\_ABC\_XX - decrement  
LV\_CDN\_DIAG\_XX = 1, LV\_ERR\_XX = 0.  
ERR\_SYM\_XX = 0.
- 5: The diagnosis conditions are still fulfilled  
and the failure is detected again CTR\_ABC\_XX =

LV\_CDN\_DIAG\_XX = 1, CTR\_ABC\_XX + C\_ABC\_INC\_XX  
ERR\_SYM\_XX <> 0. LV\_ERR\_XX = 0.

- 6:** The diagnosis conditions are still fulfilled,  
the failure is still detected  
and the failure becomes present. CTR\_ABC\_XX = C\_ABC\_MAX\_XX  
LV\_CDN\_DIAG\_XX = 1, LV\_ERR\_XX = 1.  
ERR\_SYM\_XX <> 0.

- 7:** The diagnosis conditions are fulfilled,  
the failure isn't detected  
and the failure remains present. CTR\_ABC\_XX =  
LV\_CDN\_DIAG\_XX = 1, CTR\_ABC\_XX - decrement  
ERR\_SYM\_XX = 0. LV\_ERR\_XX = 1.

- 8:** The diagnosis conditions are still fulfilled,  
the failure is detected again  
and the failure remains present. CTR\_ABC\_XX =  
LV\_CDN\_DIAG\_XX = 1, CTR\_ABC\_XX + C\_ABC\_INC\_XX  
ERR\_SYM\_XX <> 0. LV\_ERR\_XX = 1.

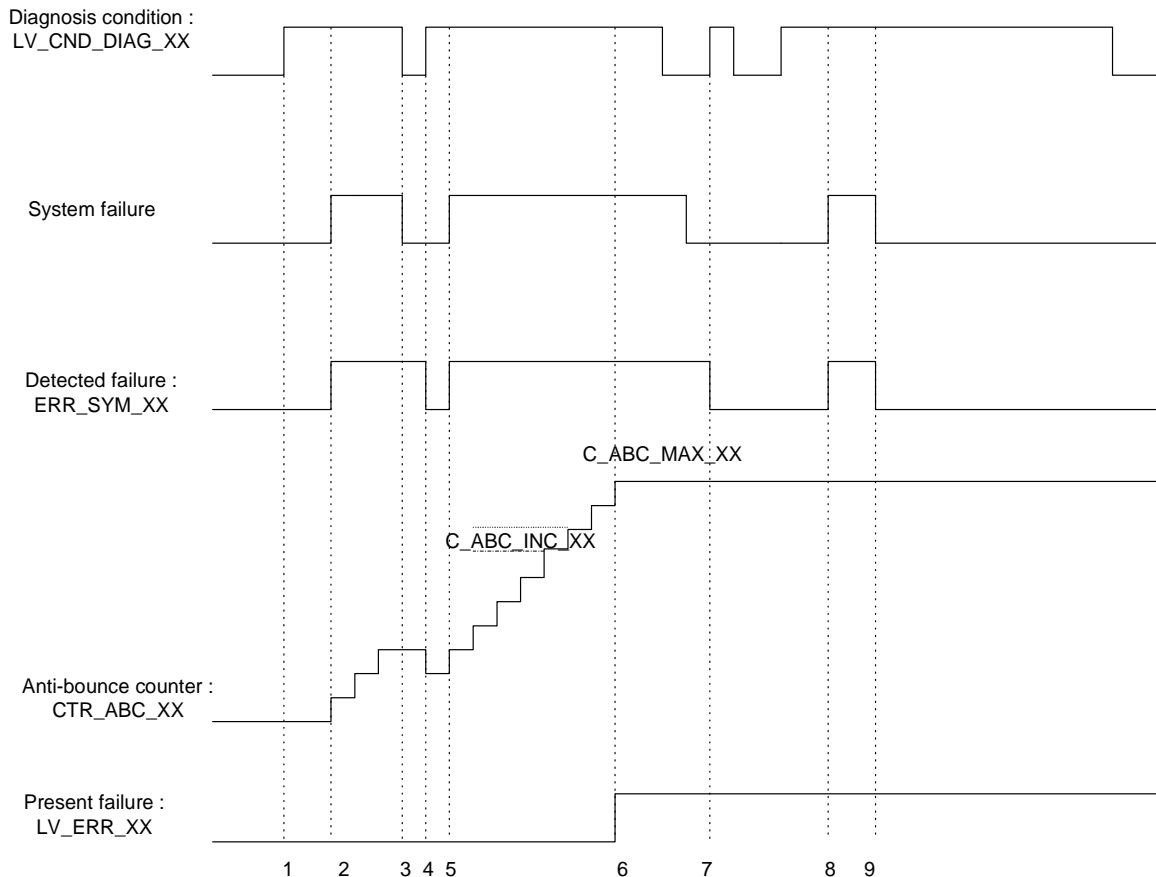
- 9:** The diagnosis conditions are still fulfilled,  
the failure isn't detected  
and the failure remains present. CTR\_ABC\_XX =  
LV\_CDN\_DIAG\_XX = 1, CTR\_ABC\_XX - decrement  
ERR\_SYM\_XX = 0. LV\_ERR\_XX = 1.

- 10:** The diagnosis conditions are still fulfilled,  
the failure isn't detected  
and the failure is no more present. CTR\_ABC\_XX = 0  
LV\_CDN\_DIAG\_XX = 1, LV\_ERR\_XX = 0.  
ERR\_SYM\_XX = 0.

### Remark

- Decrement value = 1 if NLC\_ABC\_CAL\_DEC\_XX bit = 0
- Decrement value = C\_ABC\_DEC\_XX if NLC\_ABC\_CAL\_DEC\_XX bit = 1.

2-The anti-bounce counter isn't decremented (NLC\_ABC\_NOT\_DEC\_XX = 1):



- 1: The diagnosis conditions are fulfilled but the failure isn't detected  
 $LV\_CDN\_DIAG\_XX = 1,$   
 $ERR\_SYM\_XX = 0.$   
 $CTR\_ABC\_XX$  remains at the value 0.  
 $LV\_ERR\_XX = 0.$
- 2: The diagnosis conditions are fulfilled and the failure is detected.  
 $LV\_CDN\_DIAG\_XX = 1,$   
 $ERR\_SYM\_XX <> 0.$   
 $CTR\_ABC\_XX = 0 + C\_ABC\_INC\_XX$   
 $LV\_ERR\_XX = 0.$
- 3: The diagnosis conditions aren't fulfilled and the failure remains detected.  
 $LV\_CDN\_DIAG\_XX = 0,$   
 $ERR\_SYM\_XX <> 0.$   
 $CTR\_ABC\_XX$  is frozen  
 $LV\_ERR\_XX = 0.$
- 4: The diagnosis conditions are fulfilled again and the failure is no more detected.  
 $LV\_CDN\_DIAG\_XX = 1,$   
 $ERR\_SYM\_XX = 0.$   
 $CTR\_ABC\_XX =$   
 $CTR\_ABC\_XX - \text{decrement}$   
 $LV\_ERR\_XX = 0.$
- 5: The diagnosis conditions are still fulfilled and the failure is detected again  
 $LV\_CDN\_DIAG\_XX = 1,$   
 $CTR\_ABC\_XX =$   
 $CTR\_ABC\_XX + C\_ABC\_INC\_XX$

ERR\_SYM\_XX <> 0.

LV\_ERR\_XX = 0.

- 6:** The diagnosis conditions are still fulfilled,  
the failure is still detected  
and the failure becomes present.  
LV\_CDN\_DIAG\_XX = 1,  
ERR\_SYM\_XX <> 0.

CTR\_ABC\_XX = C\_ABC\_MAX\_XX  
LV\_ERR\_XX = 1.

- 7:** The diagnosis conditions are fulfilled,  
the failure isn't detected  
and the failure remains present.  
LV\_CDN\_DIAG\_XX = 1,  
ERR\_SYM\_XX = 0.

CTR\_ABC\_XX = C\_ABC\_MAX\_XX  
(counter not decrement)  
LV\_ERR\_XX = 1.

- 8:** The diagnosis conditions are still fulfilled,  
the failure is detected again  
and the failure remains present.  
LV\_CDN\_DIAG\_XX = 1,  
ERR\_SYM\_XX <> 0.

CTR\_ABC\_XX = C\_ABC\_MAX\_XX  
LV\_ERR\_XX = 1.

- 9:** The diagnosis conditions are still fulfilled,  
the failure isn't detected  
and the failure remains present.  
LV\_CDN\_DIAG\_XX = 1,  
ERR\_SYM\_XX = 0.

CTR\_ABC\_XX = C\_ABC\_MAX\_XX  
(counter not decrement)  
LV\_ERR\_XX = 1.

#### Remark

- Decrement value = 1 if NLC\_ABC\_CAL\_DEC\_XX bit = 0
- Decrement value = C\_ABC\_DEC\_XX if NLC\_ABC\_CAL\_DEC\_XX bit = 1.

### Application conditions

**Initialization:** See "Initialisation of anti-bounce, statistical and multi-conditions filters" paragraph

**Recurrence:** The recurrence is managed by the diagnosis.

**Activation:** The activation is managed by the diagnosis for the anti-bounce operation or the anti-bounce bench mode.

**Deactivation:** LV\_ABC\_INH = 1

### Formula section:

Anti-bounce bench mode :

**If(1)** (LC\_ABC\_BENCH = 1 and NLC\_BENCH\_MODE=1) and ((C\_ABC\_INC\_XX = 0) or (C\_ABC\_INC\_XX = FFH))

**Then(1)**

**If(2)** C\_ABC\_INC\_XX = 0

**Then(2)**


ERR\_SYM\_XX = 0  
LV\_ERR\_XX = 0

```

                CTR_ABC_XX = 0
Else(2)      If(3)          C_ABC_INC_XX = FFH
                Then(3)
                    ERR_SYM_XX = 0FH
                    LV_ERR_XX = 1
                    CTR_ABC_XX = C_ABC_MAX_XX
                Endif(3)
            Endif(2)
Endif(1)

Anti-bounce operation (not in bench mode) :
If(1a)      (LV_CDN_DIAG_XX = 1) and not(      (LC_ABC_BENCH = 1 and NLC_BENCH_
MODE=1) and ((C_ABC_INC_XX = 0) or (C_ABC_INC_XX = FFH)))
Then(1a)
    If(1b)      C_ABC_INC_XX = 0      { component XX not available }
    Then(1b)
        { the diagnosis result is forced to 'no error' }
        ERR_SYM_XX = 0
        LV_ERR_XX = 0
        CTR_ABC_XX = 0
    Else(1b)
        If(2)          ERR_SYM_XX <> 0
        Then(2)
            { at each detected error, a treatment shall be done }
            If(3a)      NC_ERR_DET_UPD = 1
                        and LC_ERR_DET_UPD=1
            Then(3a)
                ACTION_ERRM_UpdErrDet( IN<XX>,
                SYNCHRONIZATION<CALL> )
            Endif(3a)
            If(3b)      CTR_ABC_XX <> C_ABC_MAX_XX
            Then(3b)
                CTR_ABC_XX = CTR_ABC_XX + C_ABC_INC_XX
            If(4)          CTR_ABC_XX >= C_ABC_MAX_XX
            Then(4)
                LV_ERR_XX = 1
                CTR_ABC_XX = C_ABC_MAX_XX
            Endif(4)
            Endif(3b)
        Else(2)
            If(3)          (NLC_ABC_NOT_DEC_XX = 0 OR LV_ERR_XX
= 0)
            Then(3)
                If(4)          CTR_ABC_XX <> 0
                Then(4)      If(5)          NLC_ABC_CAL_
DEC_XX = 0
                                Then(5)
                                    (without calibratable decrement)
                                    CTR_ABC_XX = CTR_ABC_XX -
1
                                If(6)          CTR_ABC_XX
= 0
                                Then(6)

```

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```

LV_ERR_XX = 0
Endif(6)
Else(5)
  (with calibratable decrement)
  CTR_ABC_XX = ( CTR_ABC_
XX - C_ABC_DEC_XX )
  If(6) CTR_ABC_XX
  Then(6)
    LV_ERR_XX = 0
    CTR_ABC_XX = 0
  Endif(6)
Endif(5)
Endif(4)
Endif(3)
Endif(2)
Endif(1b)
Endif(1a)

```

### A.63.5.2.2 Calculation of the end of diagnosis

#### Description:

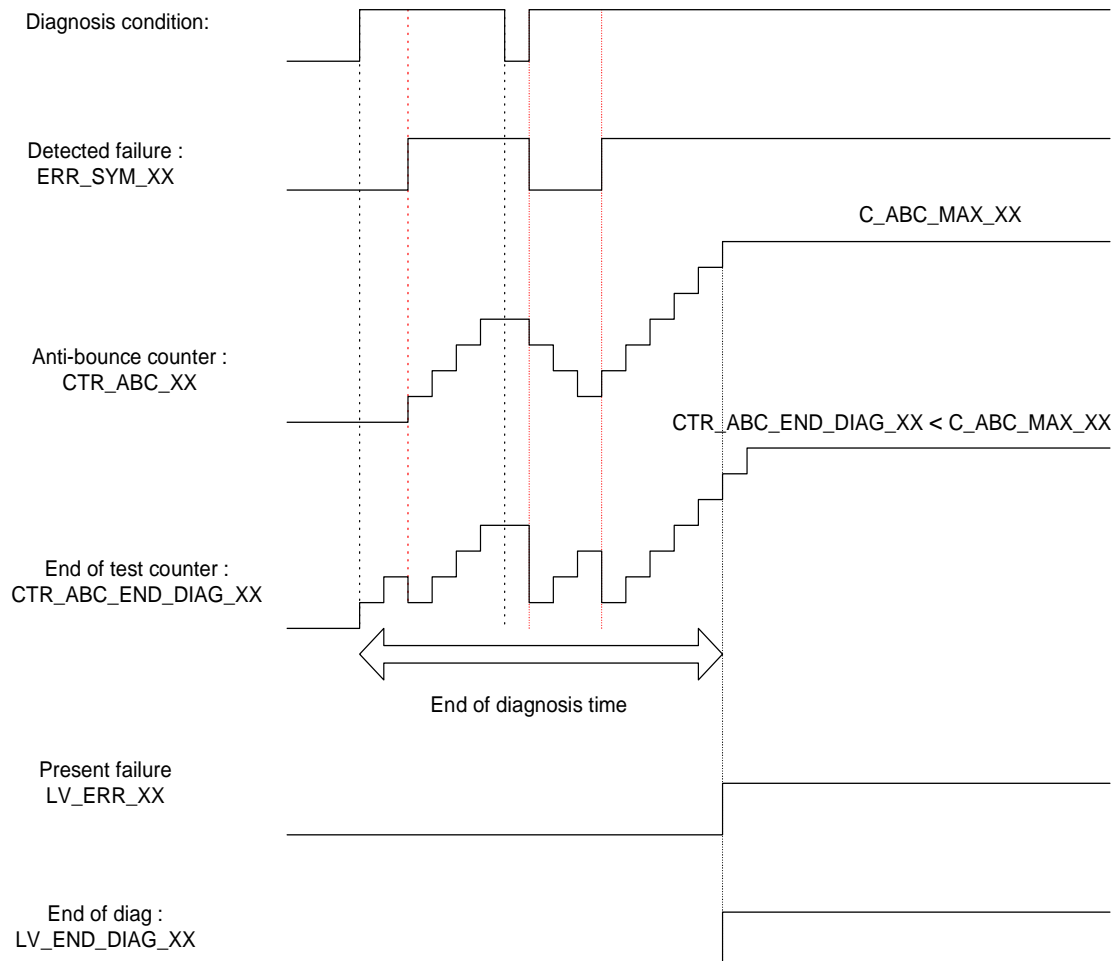
The end of diagnosis definition is set after a time defined like being the time necessary to evaluate the failure (present or not).

#### Signal flow diagram:

#### End of diagnosis algorithm illustration in standard case :

The end of diagnosis counter is reset at each transition of the detected failure.

When the failure becomes present : the end of diagnosis is set.

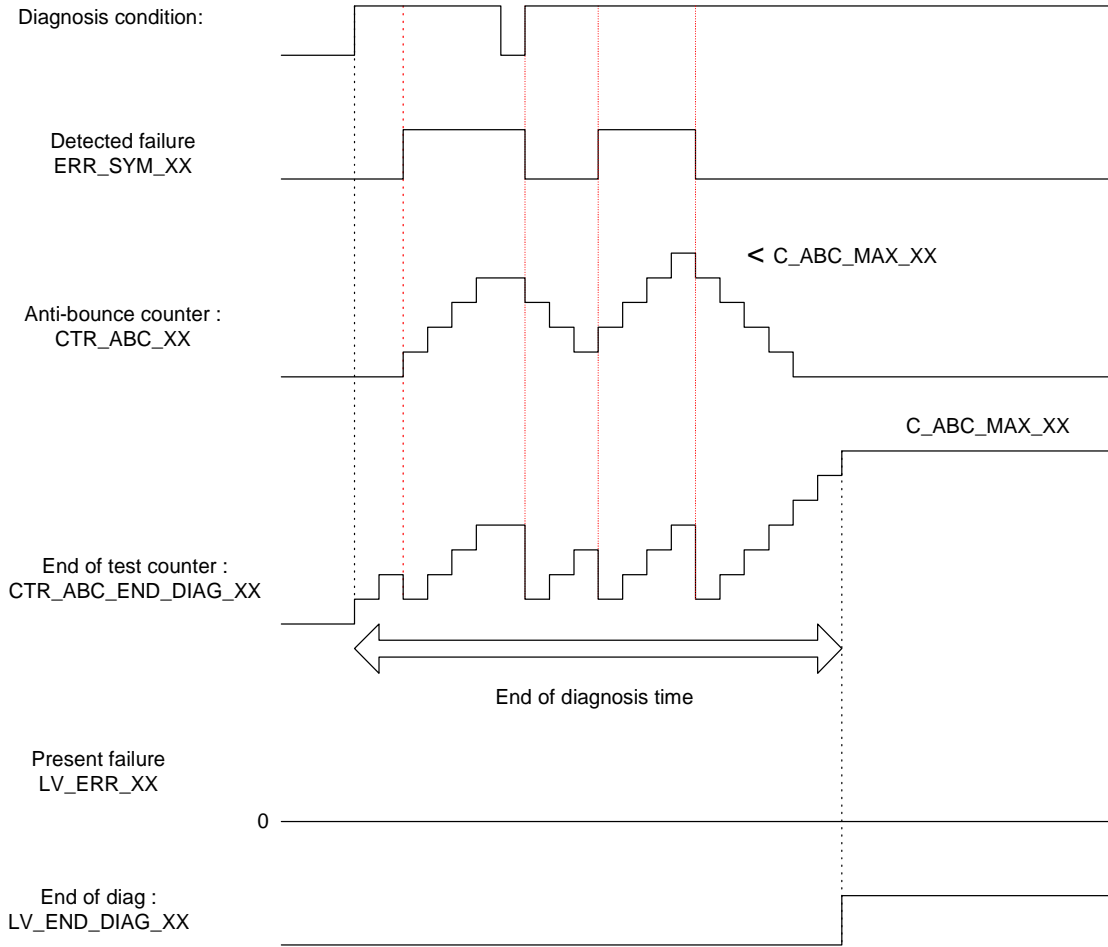


The detected failure will disappear and the anti-bounce counter won't reach the maximum value then the failure won't become present.

The end of diagnosis counter is reset at each transition of the detected failure.

When the detected failure is stable : the end of diagnosis counter is incremented until the maximum value while the diagnosis conditions are fulfilled.

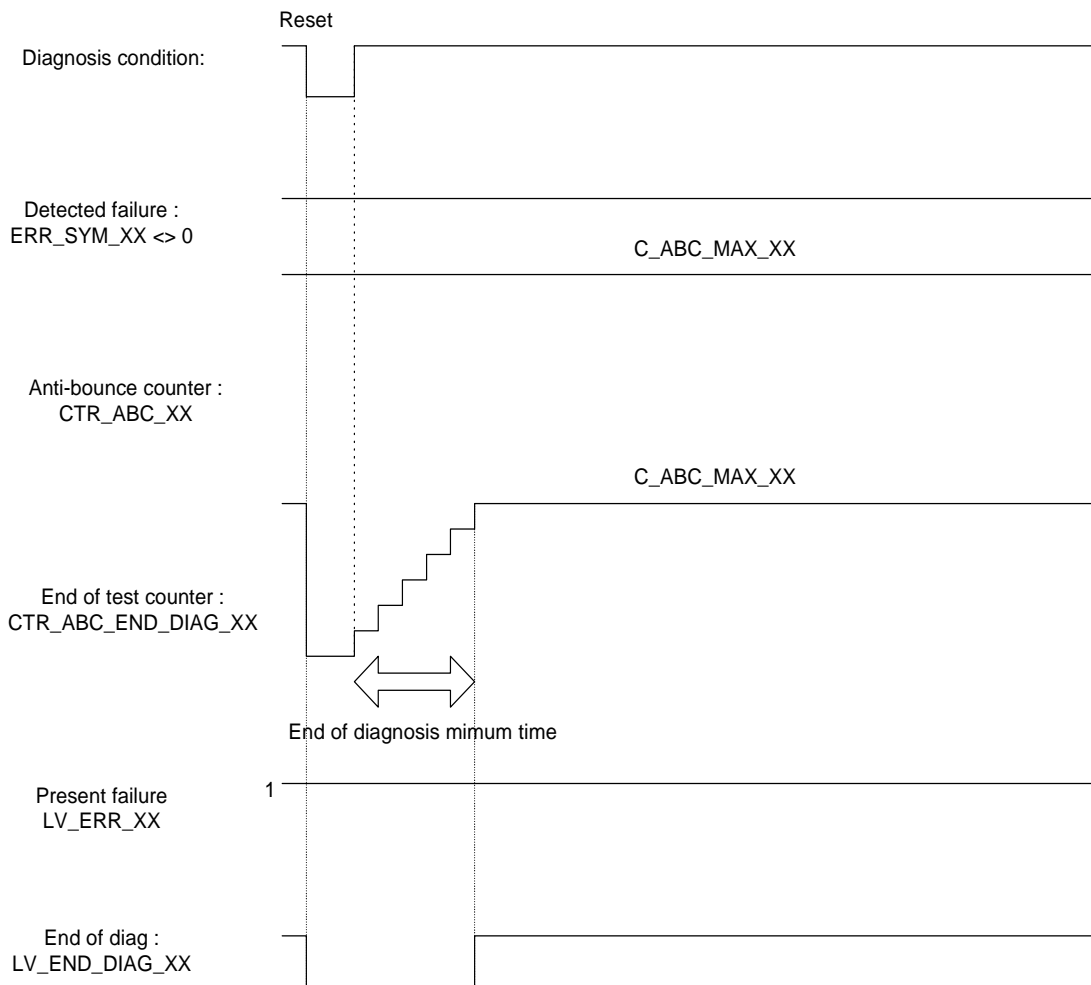
When the end of diagnosis counter has reached the maximum value : the end of diagnosis is set.



End of diagnosis algorithm illustration in case of reset event :

After the reset event, the detected failure remains present (stable) : the end of diagnosis counter is incremented until the maximum value while the diagnosis conditions are fulfilled.  
 When the end of diagnosis counter has reached the maximum value : the end of diagnosis is set.  
 The failure has been present and remains present after reset.

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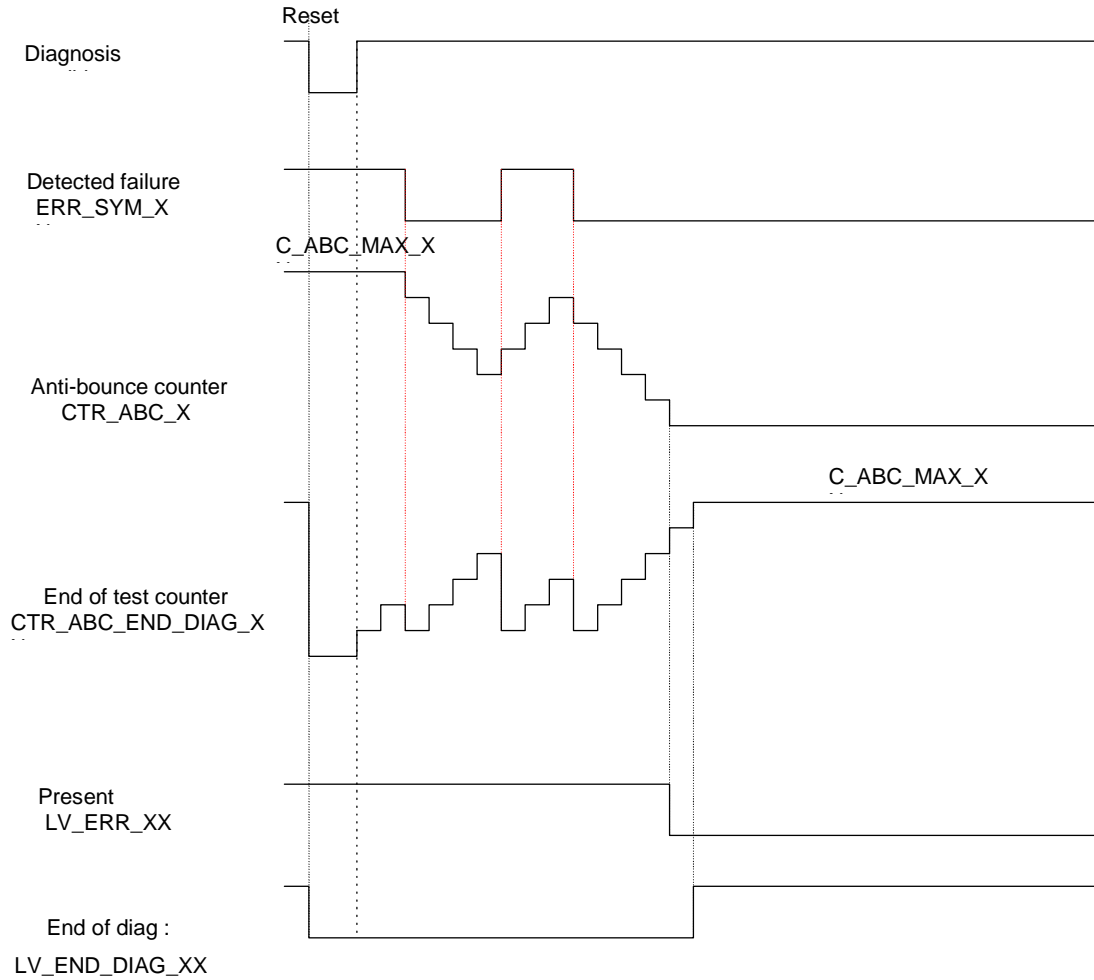
Before the reset, the failure was detected until the failure became present.

After the reset, the detected failure appears during a glitch so the end of diagnosis counter is reset at each transition of the detected failure,

When the detected failure disappears after all (stable) then

- the present failure disappears
- the end of diagnosis counter is incremented until the maximum value while the diagnosis conditions are fulfilled.

When the end of diagnosis counter has reached the maximum value : the end of diagnosis is set.

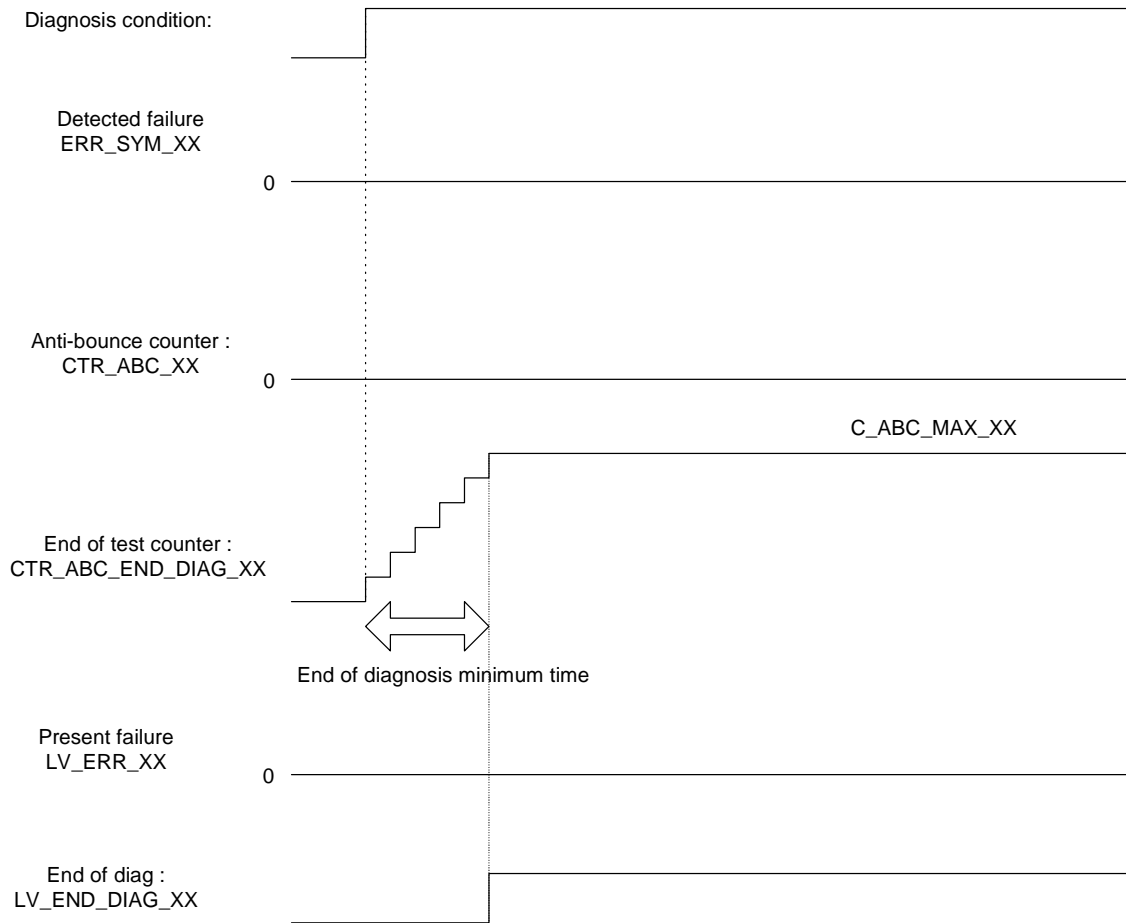


### End of diagnosis algorithm illustration when the time to reach the end of diagnosis is minimum

The failure isn't detected (stable) : the end of diagnosis counter is incremented until the maximum value while the diagnosis conditions are fulfilled.

When the end of diagnosis counter has reached the maximum value : the end of diagnosis is set.

The end of diagnosis appears after the minimum time (the detected failure doesn't appear).

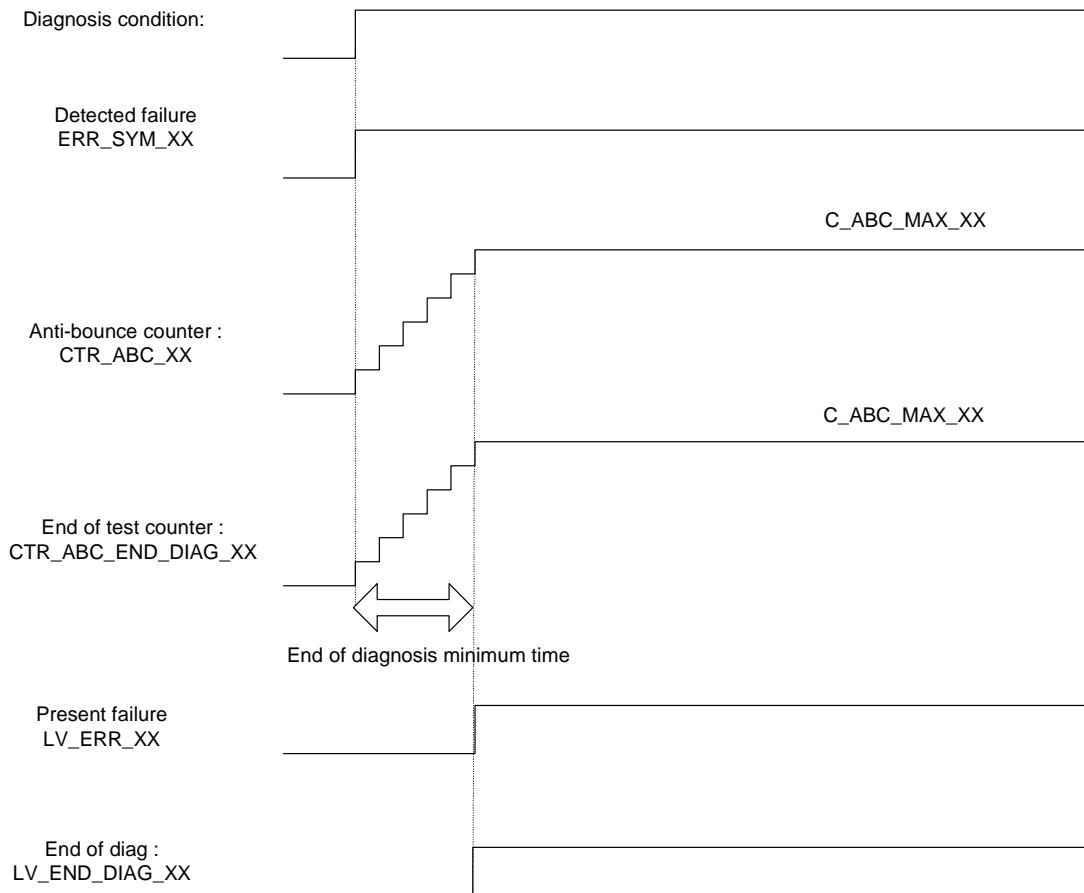


The failure is detected unchangingly (stable) : the end of diagnosis counter is incremented until the maximum value while the diagnosis conditions are fulfilled.

When the failure becomes present : the end of diagnosis is set.

The end of diagnosis and the failure appears after the minimum time (the detected failure is permanent).

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## Application conditions

**Initialization:** See "Initialisation of anti-bounce, statistical and multi-conditions filters" paragraph

**Recurrence:** The recurrence is managed by the diagnosis.

**Activation:** The activation is managed by the diagnosis for the anti-bounce operation or the anti-bounce bench mode.

**Deactivation:** -

## Formula section:

**If(0)**  $LV\_ABC\_INH = 0$  {No inhibition of anti-bounce filtering}

**Then(0)**

End of diagnosis in the bench mode:

**If(1)** ( $LC\_ABC\_BENCH = 1$  and  $NLC\_BENCH\_MODE=1$ ) and ( $(C\_ABC\_INC\_XX = 0)$  or ( $C\_ABC\_INC\_XX = FFH$ ))

**Then(1)**

$LV\_CDN\_DIAG\_XX = 1$

$LV\_END\_DIAG\_XX = 1$

CTR\_ABC\_END\_DIAG\_XX = C\_ABC\_MAX\_XX

End of diagnosis in the normal mode:

```

Else(1)
  If(2)      C_ABC_INC_XX = 0  { component XX not available }
    Then(2)
      LV_END_DIAG_XX = 0
      CTR_ABC_END_DIAG_XX = 0
    Else(2)
      If(3a)      (LV_CDN_DIAG_XX = 1) and (LV_END_DIAG_XX = 0)
        Then(3a) If(4a)      ((ERR_SYM_PREV_XX = 0) and (ERR_SYM_XX = 0))
          or ((ERR_SYM__PREV_XX = 0) and (ERR_SYM_
XX  0))
            Then(4a)
              CTR_ABC_END_DIAG_XX = 0
            Endif(4a)
            If(4b)      (ERR_SYM_XX = 0)
              Then(4b)
                CTR_ABC_END_DIAG_XX = (CTR_ABC_END_
DIAG_XX+ C_ABC_INC_XX)
                Else(4b)
                  If(5)
                    Then(5)
                      CTR_ABC_END_DIAG_XX = (CTR_ABC_END_DIAG_XX
+ 1)
                    Else(5)
                      CTR_ABC_END_DIAG_XX = (CTR_ABC_END_DIAG_XX
+ C_ABC_DEC_XX)
                  En-
dif(5)
                    Endif(4b)
                    If(4c)      CTR_ABC_END_DIAG_XX >= C_ABC_MAX_
XX
                      Then(4c) LV_END_DIAG_XX = 1
                        CTR_ABC_END_DIAG_XX = C_ABC_MAX_XX
                      Endif(4c)
                      ERR_SYM_PREV_XX = ERR_SYM_XX
                    Endif(3a)
                    If(3b)      LV_ERR_XX 0 → 1
                      Then(3b) LV_END_DIAG_XX = 1
                    Endif(3b)
                    Endif(2)
                  Endif(1)
                Else(0)
                  {Inhibition of anti-bounce filtering}
                  If(1)      (LV_CDN_DIAG_XX = 1
or
((LC_ABC_BENCH = 1 and NLC_BENCH_MODE=1)
and (C_ABC_INC_XX = 0) or (C_ABC_INC_XX = FFH))
                  Then(1)

```



*{ERR\_SYM\_PREV\_XX is updated at each diagnosis recurrence even during the inhibition, so that when the inhibition is removed ERR\_SYM\_PREV\_XX is updated with the value calculated at the last diagnosis recurrence of the inhibition phase.}*

ERR\_SYM\_PREV\_XX = ERR\_SYM\_XX

Endif(1)

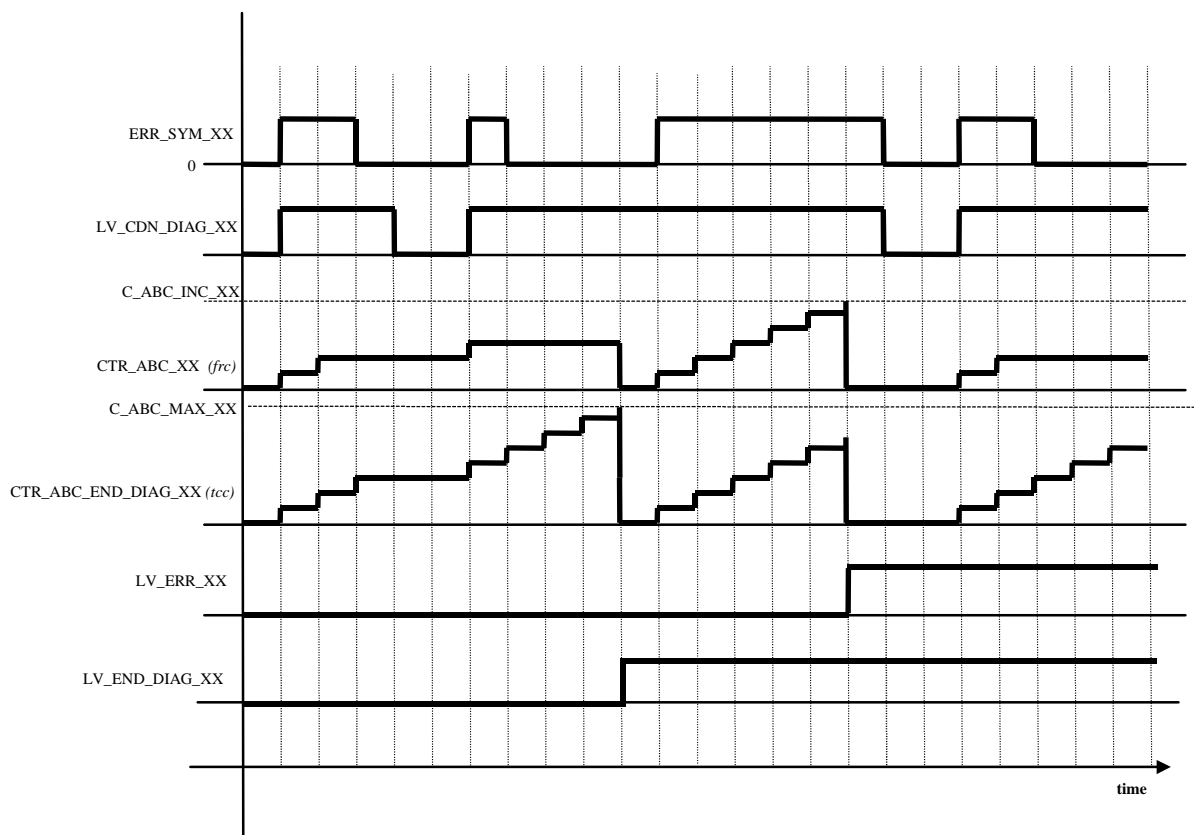
Endif(0)

### A.63.5.3 Standard statistical filtering type

#### General information:

The purpose is to make an error detection by statistical evaluation.

An error is only detected, if a symptom is active for C\_ABC\_INC\_XX times within the test period C\_ABC\_MAX\_XX, with test symptom condition fulfilled (LV\_CDN\_DIAG\_XX = 1).



In this chapter,


- the data CTR\_ABC\_XX represents the frequency counter
- the calibration C\_ABC\_INC\_XX represents the maximum for frequency counter of the processed symptom
- the data CTR\_ABC\_END\_DIAG\_XX represents the period counter increment
- the calibration C\_ABC\_MAX\_XX represents the maximum for test counter of the processed symptom

The calibration C\_ABC\_MAX\_XX must be greater than C\_ABC\_INC\_XX.

#### Formula section:

Anti-bounce in the bench mode :

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```

If          (LC_ABC_BENCH = 1 and NLC_BENCH_MODE=1)
and
((C_ABC_INC_XX = 0) or (C_ABC_INC_XX = FFH))

Then

If          C_ABC_INC_XX = 0
Then
  ERR_SYM_XX = 0
  LV_ERR_XX = 0
  CTR_ABC_XX = 0
Else
If          C_ABC_INC_XX = FFH
Then
  ERR_SYM_XX = 0FH
  LV_ERR_XX = 1
  CTR_ABC_XX = C_ABC_INC_XX
Endif
Endif

Endif
Frequency counter increment:
If          LV_CDN_DIAG_XX = 1
and ERR_SYM_XX = 0
and C_ABC_INC_XX = 0

Then

If          NC_ERR_DET_UPD = 1
and LC_ERR_DET_UPD = 1

Then
  ACTION_ERRM_UpdErrDet( IN<XX>, SYNCHRONIZATION<CALL> )
Endif
  CTR_ABC_XX = CTR_ABC_XX + 1

Endif

Period counter increment:
If          LV_CDN_DIAG_XX = 1

Then
  CTR_ABC_END_DIAG_XX = CTR_ABC_END_DIAG_XX + 1

Endif

Detection of the error state for the current symptom:
If          CTR_ABC_XX >= C_ABC_INC_XX

Then
  LV_ERR_XX = 1
  { The current symptom is entered to failure memory }

Endif

Detection of the error free symptom:
If          CTR_ABC_END_DIAG_XX = C_ABC_MAX_XX
and CTR_ABC_XX < C_ABC_INC_XX

Then
  LV_ERR_XX = 0

Endif

```

End of the diagnostic period for statistic symptom:

```

If          CTR_ABC_END_DIAG_XX = C_ABC_MAX_XX
             or CTR_ABC_XX = C_ABC_INC_XX

```

**Then**

```

    CTR_ABC_XX = 0
    CTR_ABC_END_DIAG_XX = 0
    { End of diagnostic period for statistic symptom is reached }
    LV_END_DIAG_XX=1

```

**Endif**

### A.63.6 Description for ACTION\_ERRM\_NoFilterSymptom :

Syntax : ACTION\_ERRM\_NoFilterSymptom(IN<XX>, IN<lv\_cdn\_diag\_XX>, IN<err\_sym\_XX>, IN<lv\_err\_set\_XX>, IN<lv\_err\_reset\_XX>, IN<lv\_end\_diag\_XX>, OUT<LV\_ERR\_XX>)

Parameter(in) :           XX                                   Type: index to identify the Diagnostic  
                   lv\_cdn\_diag\_XX                   Type: Diagnostic condition  
                   err\_sym\_XX                        Status of failure  
                   lv\_err\_set\_XX                    Type: Boolean to set the failure  
                   lv\_err\_reset\_XX                 Type: Boolean to reset the failure  
                   lv\_end\_diag\_XX                 Type: Boolean (=1 when result available)

Parameter(out) :           LV\_ERR\_XX                                   Type: Boolean (=1 when failure)

Short Description :           This action returns the result on symptoms detected at each diagnostic recurrence, when no filter is used.

### A.63.7 System Description:

This action is used in case of diagnostics which don't need any filtering will use the "NO type" filter. LV\_ERR\_XX is managed as a **STD** anti-bounce filtering type (saved in NVMY at end of power latch, ...).

LV\_END\_DIAG\_XX is managed by error management (reset at DC transition, ...).

**ERR\_SYM\_XX is updated at each diagnostic recurrence, to fulfil the diagnostic result.**

#### Formula section :

**If** LV\_ABC\_INH = 0                    {No inhibition of anti-bounce filtering}

**Then**

**If** lv\_end\_diag\_XX = 1

**Then**

            LV\_END\_DIAG\_XX = 1

**Endif**

**If** lv\_err\_set\_XX = 1

**Then**

            LV\_ERR\_XX = 1

**Endif**

**If** lv\_err\_reset\_XX = 1

**Then**

            LV\_ERR\_XX = 0

**Endif**

**If** lv\_cdn\_diag\_XX =1

```

Then
    LV_CDN_DIAG_XX = 1
    ERR_SYM_XX = err_sym_xx
Else
    LV_CDN_DIAG_XX = 0
    { ERR_SYM_XX is unchanged }
Endif
Endif
    
```

### A.63.8 Description for ACTION\_ERRM\_AbcFilterSymptomEnd:

**Syntax:** ACTION\_ERRM\_AbcFilterSymptomEnd( IN<XX>, IN< C\_ABC\_MAX\_XX>, OUT< LV\_ERR\_XX >)

**Parameter(in):** XX Type: index to identify the Diagnostic  
C\_ABC\_MAX\_XX Maximum value of anti-bounce counter

**Parameter(out):** LV\_ERR\_XX Type: Boolean

**Short Description:** This action erases diagnostic failure and sets immediately the end of diagnostic information in case of anti-bounce filter (STD, STD\_INI, STC, MEM and MEM\_INI)

#### Formula section :

**If** LV\_ABC\_INH = 0 {No inhibition of anti-bounce filtering}

```

Then
    LV_CDN_DIAG_XX = 1
    ERR_SYM_XX = NO_SYM
    LV_ERR_XX = 0
    CTR_ABC_XX = 0
    LV_END_DIAG_XX = 1
    CTR_ABC_END_DIAG_XX = C_ABC_MAX_XX
Endif
    
```

### A.63.9 Description for ACTION\_ERRM\_NoFilterSymptomEnd:

**Syntax:** ACTION\_ERRM\_NoFilterSymptomEnd(IN<XX>, OUT<LV\_ERR\_XX>)

**Parameter(in):** XX Type: index to identify the Diagnostic

**Parameter(out):** LV\_ERR\_XX Type: Boolean

**Short Description:** This action erases diagnostic failure and sets immediately the end of diagnostic information in case of no filter (NO)

#### Formula section :

**If** LV\_ABC\_INH = 0 {No inhibition of anti-bounce filtering}

```

Then
    LV_CDN_DIAG_XX = 1
    ERR_SYM_XX = NO_SYM
    LV_ERR_XX = 0
    LV_END_DIAG_XX = 1
Endif
    
```

### A.63.10 Description for ACTION\_ERRM\_AbcFilterReset:

**Syntax:** ACTION\_ERRM\_AbcFilterReset(IN<XX>, OUT<LV\_ERR\_XX>)

**Parameter(in):** XX Type: index to identify the Diagnostic

Parameter(out): LV\_ERR\_XX Type: Boolean  
Short Description: This action resets data filter in case of ABC filter type

**Formula section :**

If LV\_ABC\_INH = 0 {No inhibition of anti-bounce filtering}

**Then**

LV\_CDN\_DIAG\_XX = 0  
ERR\_SYM\_XX = NO\_SYM  
LV\_ERR\_XX = 0  
CTR\_ABC\_XX = 0  
LV\_END\_DIAG\_XX is unchanged  
CTR\_ABC\_END\_DIAG\_XX is unchanged

**Endif**

**A.63.11 Description for ACTION\_ERRM\_NoFilterReset:**

Syntax: ACTION\_ERRM\_NoFilterReset(IN<XX>, OUT<LV\_ERR\_XX>)  
Parameter(in): XX Type: index to identify the Diagnostic  
Parameter(out): LV\_ERR\_XX Type: Boolean  
Short Description: This action resets data filter in case of no filter usage

**Formula section :**

If LV\_ABC\_INH = 0 {No inhibition of anti-bounce filtering}

**Then**

LV\_CDN\_DIAG\_XX = 0  
ERR\_SYM\_XX = NO\_SYM  
LV\_ERR\_XX = 0  
LV\_END\_DIAG\_XX is unchanged

**Endif**

**A.63.12 Description for ACTION\_ERRM\_GetLvErr:**

Syntax: ACTION\_ERRM\_GetLvErr(IN<XX>, OUT<LV\_ERR\_XX>)  
Parameter(in): XX Type: index to identify the Diagnostic  
Parameter(out): LV\_ERR\_XX Type: Boolean  
Short Description: This action returns the failure status for the diagnostic XX.

**Formula section :**

LV\_ERR\_XX = failure status for the diagnostic XX


**A.63.13 Description for ACTION\_ERRM\_GetLvEndDiag:**

Syntax: ACTION\_ERRM\_GetLvEndDiag(IN<XX>, OUT<LV\_END\_DIAG\_XX>)  
Parameter(in): XX Type: index to identify the Diagnostic  
Parameter(out): LV\_END\_DIAG\_XX Type: Boolean  
Short Description: This action returns the end of diagnostic flag for the diagnostic XX.

**Formula section :**

LV\_END\_DIAG\_XX = end of diagnostic flag for the diagnostic XX

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### A.63.14 Description for ACTION\_ERRM\_GetLvCdnDiag:

Syntax: ACTION\_ERRM\_GetLvCdnDiag(IN<XX>, OUT<LV\_CDN\_DIAG\_XX>)  
Parameter(in): XX Type: index to identify the Diagnostic  
Parameter(out): LV\_CDN\_DIAG\_XX Type: Boolean  
Short Description: This action returns the condition status for the diagnostic XX.

**Formula section :**

LV\_CDN\_DIAG\_XX = condition status for the diagnostic XX

### A.63.15 Description for ACTION\_ERRM\_GetErrSym:

Syntax: ACTION\_ERRM\_GetErrSym(IN<XX>, OUT<ERR\_SYM\_XX>)  
Parameter(in): XX Type: index to identify the Diagnostic  
Parameter(out): ERR\_SYM\_XX Status of failure  
Short Description: This action returns the symptoms for the diagnostic XX.

**Formula section :**

ERR\_SYM\_XX = symptoms for the diagnostic XX

### A.63.16 CPU load optimisation mechanisms

**General information:**

This section describes the mechanism of optimisation. The principle is to suspend the filter algorithm execution when it is not necessary.

**Formula section:**

```

If          NLC_BENCH_MODE = 0
Then
    { the bench mode isn't available whatever LC_ABC_BENCH value }
    the CPU load is reduced
Else
    { the bench mode is available if LC_ABC_BENCH = 1 }
    less CPU load reduction than with NLC_BENCH_MODE = 0
Endif
Case 1 : the diagnostic uses an anti-bounce filtering algorithm
If          LV_ERR_XX = 0
    and LV_END_DIAG_XX = 1
    and ERR_SYM_XX = 0
    and CTR_ABC_XX = 0
Then
    { it is not necessary to call the Error Management (including the filtering) }
    LV_END_DIAG_XX = 1    { unchanged }
    LV_ERR_XX = 0        { unchanged }
Endif

```


Case 2 : the diagnostic doesn't use an anti-bounce filtering algorithm

```

If          ( LV_ERR_XX = 0 and LV_END_DIAG_XX = 1 and ERR_SYM_XX = 0 )
Then

```

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```

{ it is not necessary to call the Error Management }
LV_END_DIAG_XX = 1      { unchanged }
LV_ERR_XX = 0          { unchanged }

```

Endif

### A.63.17 Synchronisation between Anti-bounce algorithm and Error Management

#### General information:

This section describes the mechanism of synchronisation of the failure filtering with the Error Management core. The principle is to call the Error Management upon events.

LV\_END\_DIAG\_XX 0 → 1 transition

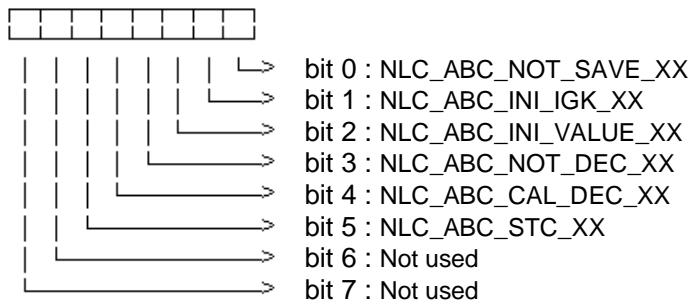
LV\_ERR\_XX 0 → 1 transition

LV\_ERR\_XX 1 → 0 transition

This mechanism is followed whatever the filter (type STD, STD\_INI, DEC\_CAL, MEM, MEM\_INI, STC) but also for diagnoses which don't use any filter (type NO).

### A.63.18 Configuration and calibration data

NC\_ABC\_CONF\_FCT\_DIAG\_XX :



#### Bits definition

- **NLC\_ABC\_NOT\_SAVE\_XX** : if this bit is set to 0 the anti-bounce context (CTR\_ABC\_XX and LV\_ERR\_XX) is saved at the end of power latch, only when the failure is in dynamic memory, and restored at the event Reset.

**Limitation** : the saved configuration is only available if the NVMY manager take into account the filter environment data (LV\_ERR\_XX, CTR\_ABC\_XX).

- **NLC\_ABC\_INI\_IGK\_XX** : LV\_ERR\_XX and CTR\_ABC\_XX are reset at the transition LV\_IGK 0 -> 1 and at the event reset.

- **NLC\_ABC\_INI\_VALUE\_XX** : if this bit is set to 1 then the anti-bounce counter is initialised with C\_ABC\_MAX\_XX - C\_ABC\_INC\_XX if there was a failure between the last and this initialisation (NLC\_ABC\_NOT\_SAVE\_XX = 0 to test the failure before this initialisation) else the anti-bounce counter is initialised with 0 value.

- **NLC\_ABC\_NOT\_DEC\_XX** : if this bit is set to 0 then the anti-bounce counter can be decremented if the condition for decrement are fulfilled. If this bit is set to 1 then the anti-bounce counter can be decremented if the condition for decrement are fulfilled until the anti-bounce counter hasn't reached the maximum value; when the anti-bounce counter has reached the maximum value then the anti-bounce counter and the failure remains (the anti-bounce counter can be decremented anymore) until a transition LV\_IGK 0 → 1 or reset following the NLC\_ABC\_INI\_IGK\_XX bit configuration (If the NLC\_ABC\_NOT\_DEC\_XX bit is set to 1 then NLC\_ABC\_NOT\_SAVE\_XX must be set to 1).

- NLC\_ABC\_CAL\_DEC\_XX : if this bit is set then the anti-bounce decrement is calibratable, the calibration is named C\_ABC\_DEC\_XX else the anti-bounce decrement is equal to 1 and there isn't calibration.
- NLC\_ABC\_STC\_XX : if this bit is set then the filter used is the statistical filter else the filter used is the anti-bounce filter (Standard configuration).

**Predefined filter type :**

	NLC_ABC_STC_XX	NLC_ABC_CAL_DEC_XX	NLC_ABC_NOT_DEC_XX	NLC_ABC_INI_VALUE_XX	NLC_ABC_INI_IGK_XX	NLC_ABC_NOT_SAVE_XX
<b>STD_INI</b>	0	0	0	0	1	1
<b>STD</b>	0	0	0	0	0	0
<b>MEM</b>	0	0	1	0	1	1
<b>MEM_INI</b>	0	0	1	1	1	0
<b>DEC_CAL</b>	0	1	0	0	0	0
<b>STC</b>	1	0	0	0	1	1
<b>NO</b>	0	0	0	0	0	0

The **standard configuration with initialisation (STD\_INI)** is NC\_ABC\_CONF\_FCT\_DIAG\_XX = 3H (default configuration)

The data CTR\_ABC\_XX and LV\_ERR\_XX are reset at the transition LV\_IGK 0 → 1 and reset (NLC\_ABC\_NOT\_SAVE\_XX = 1, NLC\_ABC\_INI\_IGK\_XX = 1) and the anti-bounce counter is initialised to 0 value (NLC\_ABC\_INI\_VALUE\_XX = 0).

The anti-bounce counter may be decremented (NLC\_ABC\_NOT\_DEC\_XX = 0).

The decrement value is equal to 1 (NLC\_ABC\_CAL\_DEC\_XX = 0).

The filter used is the Anti-bounce (NLC\_ABC\_STC\_XX = 0).

The **statistical configuration (STC)** is NC\_ABC\_CONF\_FCT\_DIAG\_XX = 23H

The data CTR\_ABC\_XX and LV\_ERR\_XX are reset at the transition LV\_IGK 0 → 1 and reset (NLC\_ABC\_NOT\_SAVE\_XX = 1, NLC\_ABC\_INI\_IGK\_XX = 1) and the frequency counter (CTR\_ABC\_XX) is initialised to 0 value (NLC\_ABC\_INI\_VALUE\_XX = 0).

The filter used is the statistical (NLC\_ABC\_STC\_XX = 1).

The **standard configuration (STD)** is NC\_ABC\_CONF\_FCT\_DIAG\_XX = 0H

The data CTR\_ABC\_XX and LV\_ERR\_XX are saved (NLC\_ABC\_NOT\_SAVE\_XX = 0, NLC\_ABC\_INI\_IGK\_XX = 0, NLC\_ABC\_INI\_VALUE\_XX = 0).

The anti-bounce counter may be decrement (NLC\_ABC\_NOT\_DEC\_XX = 0).

The decrement value is equal to 1 (NLC\_ABC\_CAL\_DEC\_XX = 0).

The **memory configuration (MEM)** is NC\_ABC\_CONF\_FCT\_DIAG\_XX = BH

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The data CTR\_ABC\_XX and LV\_ERR\_XX are reset at the transition LV\_IGK 0 → 1 and reset (NLC\_ABC\_NOT\_SAVE\_XX = 1, NLC\_ABC\_INI\_IGK\_XX = 1) and the anti-bounce counter is initialised to 0 value (NLC\_ABC\_INI\_VALUE\_XX = 0).

The anti-bounce counter can be decremented if the condition for decrement are fulfilled until the anti-bounce counter hasn't reached the maximum value; when the anti-bounce counter has reached the maximum value then the anti-bounce counter and the failure remains until a transition LV\_IGK 0 → 1 or reset (NLC\_ABC\_NOT\_DEC\_XX = 1).

The decrement value is equal to 1 (NLC\_ABC\_CAL\_DEC\_XX = 0).

The **memory configuration (MEM\_INI)** is NC\_ABC\_CONF\_FCT\_DIAG\_XX = EH

The data CTR\_ABC\_XX and LV\_ERR\_XX are initialised at the transition LV\_IGK 0 → 1 and reset (NLC\_ABC\_INI\_IGK\_XX = 1). The anti-bounce counter is initialised to the C\_ABC\_MAX\_XX - C\_ABC\_INC\_XX value (NLC\_ABC\_INI\_VALUE\_XX = 1) only if there was a failure between the last and this initialisation (NLC\_ABC\_NOT\_SAVE\_XX = 0 to test the failure before this initialisation) else the anti-bounce counter is initialised with 0 value. The data LV\_ERR\_XX is initialised with 0 value.

The anti-bounce counter can be decremented if the condition for decrement are fulfilled until the anti-bounce counter hasn't reached the maximum value; when the anti-bounce counter has reached the maximum value then the anti-bounce counter and the failure remains until a transition LV\_IGK 0 → 1 or reset (NLC\_ABC\_NOT\_DEC\_XX = 1).

The decrement value is equal to 1 (NLC\_ABC\_CAL\_DEC\_XX = 0).

The **decrement calibratable configuration (DEC\_CAL)** is set with NC\_ABC\_CONF\_FCT\_DIAG\_XX = 10H

The data CTR\_ABC\_XX and LV\_ERR\_XX are saved (NLC\_ABC\_NOT\_SAVE\_XX = 0, NLC\_ABC\_INI\_IGK\_XX = 0, NLC\_ABC\_INI\_VALUE\_XX = 0).

The anti-bounce counter may be decrement (NLC\_ABC\_NOT\_DEC\_XX = 0).

The decrement value is calibratable (NLC\_ABC\_CAL\_DEC\_XX = 1).

The standard configuration is NLC\_ABC\_INI\_DC\_END\_DIAG = 0 and NC\_ERR\_DET\_UPD = 0 (default configuration).

Some functionalities (e.g. : to visualise the sporadic error of all diagnosis using this anti-bounce algorithm) aren't used when the failure is detected.

**Remark :**

The standard calibration is LC\_ABC\_BENCH = 0 **and** NLC\_BENCH\_MODE=0 (default calibration) then the bench mode isn't managed.

If the diagnosis doesn't manage calibratable decrement then the C\_ABC\_DEC\_XX calibration isn't defined in calibration data (NLC\_ABC\_CAL\_DEC\_XX = 0).

**Configuration detailed description:**

NLC\_ABC\_INI\_DC\_END\_DIAG

1 : Initialisation of LV\_END\_DIAG\_XX at LV\_DC 1→0 transition

0 : Initialisation of LV\_END\_DIAG\_XX at LV\_IGK 0→1 transition or ECU

reset

## A.64 Debounce algorithm (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ERR_INTM_NR	V	0... FFH	0... 255	1	-
Number of failures stored in intermittent failure array					
ERR_INTM_CTR_FRC [NC_NR_ERR_INTM]	V/S	0... FFH	0... 255	1	-
Frequency of reappearance of failure stored in ERR_INTM_DIAG_INST					
ERR_INTM_DIAG_INST [NC_NR_ERR_INTM]	V/S	0... FFFFH	0... 65535	1	-
Array of diagnosis instances with intermittent failure					
LV_ABC_INH	O/V	0... 1H	0 ...1	1	-
Anti-bounce filterings inhibition					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_ERR_INTM	-	1... FFH	1... 255	1	-
Maximum number of diagnosis instances to be listed in ERR_INTM_DIAG_INST					

### Action definition

ACTION_ERRM_InhibitFiltering (IN<InhibitFilter>)	Mode: O
This action shall be used to inhibit anti-bounce filtering calculations	

### FUNCTION DESCRIPTION:

#### General information:

Intermittent failures are neither visualized nor stored with the following configuration :  
NLC\_ERR\_DET\_UPD = 00h

#### Application conditions

**Initialisation:** ERR\_INTM\_DIAG\_INST[0...NC\_NR\_ERR\_INTM -1] = 0  
ERR\_INTM\_CTR\_FRC[0...NC\_NR\_ERR\_INTM -1] = 0  
CTR\_ERR\_INTM\_NR = 0

**Recurrence:** -

**Activation:** at ECU reset

#### Formula section:

No action to be performed with this configuration.

### A.64.1 Anti-bounce filtering inhibition

**Description:**

In addition, LV\_ABC\_INH flag must be securised to avoid any undesired inhibition.  
 To avoid failure recording during specific ECU phases (e.g. reprogramming,...), diagnoses are inhibited.  
 To realize this inhibition, anti-bounce filtering calculations are frozen.  
 This inhibition is generally used during reprogramming phase.

**Syntax:** ACTION\_ERRM\_InhibitFiltering ( IN <InhibitFilter> )

**Parameter(in):** InhibitFilter filter inhibition

**Parameter(out):** No parameter

**Short Description:** This API permits to activate or deactivate the anti-bounce calculation.

**Application conditions**

**Initialisation:** at ECU reset  
                           LV\_ABC\_INH = 0  
                           (default value : Anti-bounce calculation is not inhibited)

**Recurrence:** -


**Activation:** at action request

**Formula section:**

LV\_ABC\_INH = 0


## A.65 Diagnostic filter algorithms

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## A.66 Diagnostic filter algorithms (Appl. Inc.)

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## A.67 Electrical diagnosis of power stage outputs

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_XX	-	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom for XX					
ERR_DIAG_XX	-	0... 7H	0 ...7	1	-
Diagnosis symptom (raw value) for each symptom for XX					

### Input data:

CDN_DIAG_XX {p. 4614}	ERR_DIAG_XX {p. 4614}	LV_IGK {p. 906}	LV_INH_DIAG_XX
XXPWM			

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY	-	0... FFH	0... 255	1	-
The diagnosis is reactivated after (LV_INH_DIAG_XX 1->0 or CDN_DIAG_XX >0 (depending on case)) and LV_IGK 0->1 and reset and FMY reset after NC_PSD_DLY recurrences.					

### Import actions:

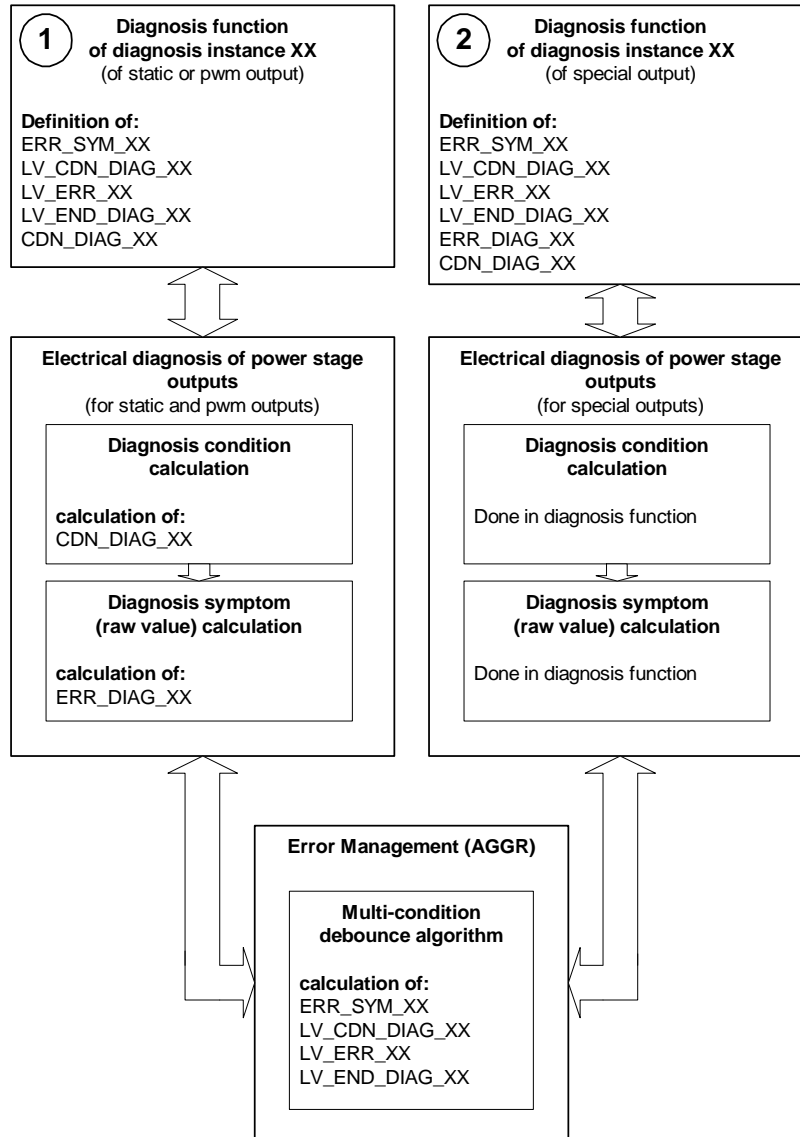
<b>ACTION_ERRM_FilterMulticondition</b>	(IN<XX>,IN<CDN_DIAG_>,XX>,<IN<>,ERR_DIAG_XX>,<IN>,<C_ABC_INC_XX>,IN<C_ABC_MAX_XX>,<OUT<LV_ERR_XX>)
<b>ACTION_ERRM_FilterMulticondition</b>	(IN<XX>,IN<CDN_DIAG_>,XX>,<IN<>,ERR_DIAG_XX>,<IN>,<C_ABC_INC_XX>,IN<C_ABC_MAX_XX>,<OUT<LV_ERR_XX>)
<b>ACTION_ERRM_FilterMulticondition</b>	(IN<XX>,IN<CDN_DIAG_>,XX>,<IN<>,ERR_DIAG_XX>,<IN>,<C_ABC_INC_XX>,IN<C_ABC_MAX_XX>,<OUT<LV_ERR_XX>)

## FUNCTION DESCRIPTION:

### General information:

In this function description the electrical diagnosis of power stage outputs is specified. Because of the possibility of different hardware configurations, the specification is split into three parts plus one common part for the symptom debounce and error management treatment.

- Diagnosis of static outputs (e.g. relays)
- Diagnosis of pwm outputs (e.g. VVT actuator)
- Diagnosis of special outputs (other hardware configurations)



According to these three different kinds of driver outputs, the management of the electrical diagnosis is different between static/pwm outputs and special outputs (see previous picture case 1 and 2).

For all types of these diagnoses, three main calculations must be done:

- Diagnosis condition calculation
- Diagnosis symptom (raw value) calculation
- anti-bounce mechanism with error management treatments

In the following chapter, these treatments are described.

## A.67.1 Diagnosis of static outputs

### General information:

The purpose is to diagnose electrical errors detected by the hardware for static outputs. The signal is controlled by the ATIC 39.

The driver can distinguish between three symptoms: 'Short to battery' SCB, 'Short to ground' SCG and 'Open circuit' OC.

**Description:**

By the diagnosis condition calculation the information given by the BSW ('Diagnosis of symptom ... is valid') that shows, that a diagnosis of a symptom was possible, since the last recurrence of the diagnosis function, is displayed for each symptom within the value CDN\_DIAG\_XX.

The information of the failure symptom is also delivered by the BSW ('Failure symptom ... detected by HW'). According this information the diagnosis symptom (raw value) calculation is performed to set ERR\_DIAG\_XX.

The calculation of LV\_ERR\_XX, LV\_CDN\_DIAG\_XX, ERR\_SYM\_XX and LV\_END\_DIAG\_XX is done in the Multi-condition debounce algorithm (part of Error Management AGGR).

**Application conditions****Initialization:**

-

**Recurrence:**

-

**Activation:**

every ECU state  
 reactivation in the NC\_PSD\_DLY recurrence after LV\_INH\_DIAG\_XX 1->0 and LV\_IGK 0->1 and reset and FMY reset

**Deactivation:**

LV\_INH\_DIAG\_XX = 1  
 at deactivation: CDN\_DIAG\_XX = 0

**Formula section:**

Diagnosis condition calculation:

CDN\_DIAG\_XX = 0

Diagnosis condition calculation for symptom 'Short to battery' SCB:

**If** 'Diagnosis of symptom SCB is valid' (BSW information)  
**Then** bit 0 of CDN\_DIAG\_XX = 1  
**Endif**

Diagnosis condition calculation for symptom 'Short to ground' SCG:

**If** 'Diagnosis of symptom SCG is valid' (BSW information)  
**Then** bit 1 of CDN\_DIAG\_XX = 1  
**Endif**

Diagnosis condition calculation for symptom 'Open circuit' OC:

**If** 'Diagnosis of symptom OC is valid' (BSW information)  
**Then** bit 2 of CDN\_DIAG\_XX = 1  
**Endif**


Diagnosis symptom (raw value) calculation:

Symptom calculation for 'Short to battery' SCB:

**If** 'Failure symptom SCB detected by HW' (BSW information)  
**Then** bit 0 of ERR\_DIAG\_XX = 1  
**Else** bit 0 of ERR\_DIAG\_XX = 0  
**Endif**

Symptom calculation for 'Short to ground' SCG:

**If** 'Failure symptom SCG detected by HW' (BSW information)  
**Then** bit 1 of ERR\_DIAG\_XX = 1  
**Else** bit 1 of ERR\_DIAG\_XX = 0

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**Endif**Symptom calculation for 'Open circuit' OC:**If** 'Failure symptom OC detected by HW' (BSW information)**Then** bit 2 of ERR\_DIAG\_XX = 1**Else** bit 2 of ERR\_DIAG\_XX = 0**Endif**

ACTION\_ERRM\_FilterMulticondition (XX, CDN\_DIAG\_XX, ERR\_DIAG\_XX, LV\_END\_DIAG\_XX, LV\_ERR\_XX, LV\_CDN\_DIAG\_XX, ERR\_SYM\_XX)

Remark: For failure debouncing and error management treatment the algorithm Multi-condition debounce algorithm (part of Error Management AGGR) is used with the parameters CDN\_DIAG\_XX and ERR\_DIAG\_XX.

**A.67.2 Diagnosis of PWM outputs****FUNCTION DESCRIPTION:****General information:**

The purpose is to diagnose electrical errors detected by the hardware for PWM outputs. The signal is controlled by ATIC39.

The driver can distinguish between three symptoms: 'Short to battery' SCB, 'Short to ground' SCG and 'Open circuit' OC.

Because of the different filter times for SCB, SCG and OC detection, the diagnosis window, where a symptom can be detected, is defined for each symptom. A diagnosis window is defined by a minimum and a maximum duty cycle of the PWM signal controlled by the output of the driver.

SCB diagnosis window:

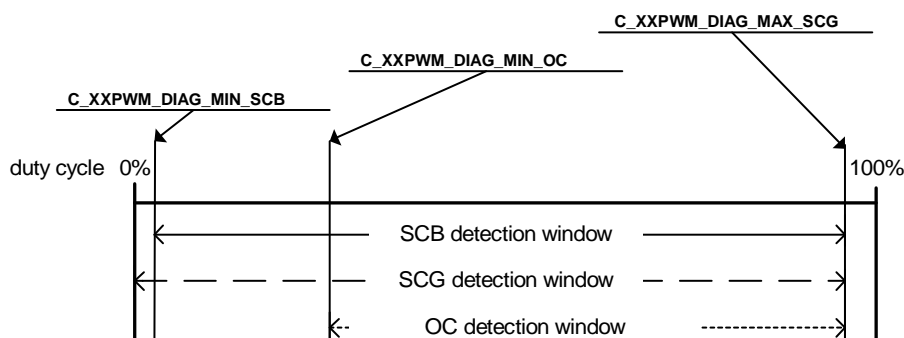
C\_XXPWM\_DIAG\_MIN\_SCB &lt;- - - -&gt; C\_XXPWM\_DIAG\_MAX\_SCG

SCG diagnosis window:

0 &lt;- - - -&gt; C\_XXPWM\_DIAG\_MAX\_SCG

OC diagnosis window:

C\_XXPWM\_DIAG\_MIN\_OC &lt;- - - -&gt; C\_XXPWM\_DIAG\_MAX\_SCG



For some diagnosis it's not necessary to define different diagnosis windows for each symptom. This is possible for all diagnosis, where a limitation of the duty cycle range is made within the function which controls the corresponding output. The limitation must be made in this way, that a diagnosis of all three

symptoms can always (if LV\_INH\_DIAG\_XX= 0) be made (CDN\_DIAG\_XX = 7H, LV\_CDN\_DIAG\_XX = 1).

These two possibilities of a diagnosis condition calculation are described in the following chapter. It's distinguished between a "open range" (different diagnosis windows for each symptom necessary) and a "limited" duty cycle calculation.

## A.67.2.1 Diagnosis condition calculation

### A.67.2.1.1 Open range duty cycle

#### Description:

For an output with an "open range" duty cycle range, a diagnosis result of a symptom can be considered as valid, if the duty cycle of the PWM output was in the right window at least one time between two calculations of the diagnosis function and not only if diagnosis function is called. To have a better reflection of this behavior, the diagnosis condition is calculated independently of the diagnosis function.

If the recurrence of the 'diagnosis condition' calculation is the same like the 'symptom' calculation, the 'diagnosis condition' calculation must be treated after the 'symptom' calculation to have a new diagnosis condition CDN\_DIAG\_XX information of the following diagnosis window for the next symptom calculation.

#### Application conditions

**Initialization:** -

**Recurrence:** -

**Activation:** every ECU state  
reactivation in the NC\_PSD\_DLY recurrence after LV\_INH\_DIAG\_XX 1->0 and LV\_IGK 0->1 and reset and FMY reset

**Deactivation:** LV\_INH\_DIAG\_XX = 1  
at deactivation CDN\_DIAG\_XX = 0

#### Formula section:

Diagnosis window calculation:

**If**  $0 \leq \text{XXPWM} < \text{C\_XXPWM\_DIAG\_MIN\_SCB}$

**Then** bit 1 of CDN\_DIAG\_XX = 1

*Diagnosis of SCG is valid*

**Else If**  $\text{XXPWM} < \text{C\_XXPWM\_DIAG\_MIN\_OC}$

**Then** bit 0 and bit 1 of CDN\_DIAG\_XX = 1

*Diagnosis of SCB, SCG is valid*

**Else If**  $\text{XXPWM} \leq \text{C\_XXPWM\_DIAG\_MAX\_SCG}$

**Then** bit 0, bit 1 and bit 2 of CDN\_DIAG\_XX = 1

*Diagnosis of SCB, SCG and OC is valid*

**Endif**

**Endif**

**Endif**

### A.67.2.1.2 Limited duty cycle

**Description:**

For an output with a “limited” duty cycle range, the diagnosis result of a symptom can always be considered as valid, because of the current duty cycle. It only can be invalid because special conditions managed by the BSW.

**Application conditions****Initialization:** –**Recurrence:** –

**Activation:** every ECU state  
reactivation in the NC\_PSD\_DLY recurrence after LV\_INH\_DIAG\_XX 1->0 and LV\_IGK 0->1 and reset and FMY reset

**Deactivation:** LV\_INH\_DIAG\_XX = 1  
at deactivation: CDN\_DIAG\_XX = 0

**Formula section:**

bit 0, bit 1 and bit 2 of CDN\_DIAG\_XX = 1

*Diagnosis of SCB, SCG and OC is valid*

**A.67.2.2 Diagnosis symptom (raw value) calculation****FUNCTION DESCRIPTION:****Application conditions****Initialization:** –**Recurrence:** –

**Activation:** every ECU state  
reactivation in the NC\_PSD\_DLY recurrence after LV\_INH\_DIAG\_XX 1->0 and LV\_IGK 0->1 and reset and FMY reset

**Deactivation:** LV\_INH\_DIAG\_XX = 1

**Formula section:**


*Symptom calculation for ‘Short to battery’ SCB:*

**If** ‘Failure symptom SCB detected by HW’ (BSW information)  
**Then** bit 0 of ERR\_DIAG\_XX = 1  
**Else** bit 0 of ERR\_DIAG\_XX = 0  
**Endif**

*Symptom calculation for ‘Short to ground’ SCG:*

**If** ‘Failure symptom SCG detected by HW’ (BSW information)  
**Then** bit 1 of ERR\_DIAG\_XX = 1  
**Else** bit 1 of ERR\_DIAG\_XX = 0  
**Endif**

*Symptom calculation for ‘Open circuit’ OC:*

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```

If          'Failure symptom OC detected by HW'          (BSW information)
Then       bit 2 of ERR_DIAG_XX = 1
Else       bit 2 of ERR_DIAG_XX = 0
Endif

```

Diagnosis condition from BSW verification:

Diagnosis condition calculation for symptom 'Short to battery' SCB:

```

If          'Diagnosis of symptom SCB is not valid'      (BSW information)
Then       bit 0 of CDN_DIAG_XX = 0
Endif

```

Diagnosis condition calculation for symptom 'Short to ground' SCG:

```

If          'Diagnosis of symptom SCG is not valid'      (BSW information)
Then       bit 0 of CDN_DIAG_XX = 0
Endif

```

Diagnosis condition calculation for symptom 'Open circuit' OC:

```

If          'Diagnosis of symptom OC is not valid'       (BSW information)
Then       bit 0 of CDN_DIAG_XX = 0
Endif

```

ACTION\_ERRM\_FilterMulticondition (XX, CDN\_DIAG\_XX, ERR\_DIAG\_XX, LV\_END\_DIAG\_XX, LV\_ERR\_XX, LV\_CDN\_DIAG\_XX, ERR\_SYM\_XX)

Remark: For failure debouncing and error management treatment the algorithm Multi-condition debounce algorithm (part of Error Management AGGR) is used with the parameters CDN\_DIAG\_XX and ERR\_DIAG\_XX.

CDN\_DIAG\_XX = 0 (after failure debouncing and error management treatment)

### A.67.3 Diagnosis of special outputs

#### General information:

The purpose is to diagnose electrical errors detected by the hardware for special outputs. Special outputs are outputs, which cannot be treated like "normal" static or pwm outputs, like described in the previous chapters.

#### Description:

The diagnosis condition calculation for the driver output is done in the diagnosis function of the diagnosis instance XX. It's displayed for each symptom within the value CDN\_DIAG\_XX. Also the diagnosis symptom (raw value) calculation (ERR\_DIAG\_XX) is performed in the diagnosis function for special outputs.

The calculation of LV\_ERR\_XX, LV\_CDN\_DIAG\_XX, ERR\_SYM\_XX and LV\_END\_DIAG\_XX is done in the Multi-condition debounce algorithm (part of Error Management AGGR).

#### Application conditions

**Initialization:** -

**Recurrence:** -

**Activation:** every ECU state  
reactivation in the NC\_PSD\_DLY recurrence after CDN\_DIAG\_XX > 0 and LV\_IGK 0->1 and reset and FMY reset

**Deactivation:** -


**Formula section:**

Diagnosis condition /Diagnosis symptom (raw value) calculation:

CDN\_DIAG\_XX and ERR\_DIAG\_XX are calculated in the diagnosis function.

ACTION\_ERRM\_FilterMulticondition (XX, CDN\_DIAG\_XX, ERR\_DIAG\_XX, LV\_END\_DIAG\_XX, LV\_ERR\_XX, LV\_CDN\_DIAG\_XX, ERR\_SYM\_XX)

Remark: For failure debouncing and error management treatment the algorithm Multi-condition debounce algorithm (part of Error Management AGGR) is used with the parameters CDN\_DIAG\_XX and ERR\_DIAG\_XX.

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## A.68 Electrical diagnosis of power stage outputs (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_DMTLH	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of DMTLH bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
CDN_DIAG_EBOX_CFA	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of EBOX_CFA bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
CDN_DIAG_EF	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of EF bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
CDN_DIAG_RLY_ACCOUT	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of RLY_ACCOUT bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
CDN_DIAG_RLY_CRCV_HEAT	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of RLY_CRCV_HEAT bit 0: diagnosis condition for symptom SCP (SYM_0)bit 1: diagnosis condition for symptom SCG (SYM_1)bit 2: diagnosis condition for symptom OC (SYM_2)					
CDN_DIAG_RLY_DMTL_PUMP	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of DMTL_PUMP bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
CDN_DIAG_RLY_DMTLS	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of DMTLS bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
CDN_DIAG_RLY_ST	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of RLY_ST bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
CDN_DIAG_SLV_IVVT_EX	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of SLV_IVVT_EX bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_SLV_IVVT_IN	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of SLV_IVVT_IN bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
ERR_DIAG_DMTLH	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for DMTLH (only parameter)					
ERR_DIAG_EBOX_CFA	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for EBOX_CFA (only parameter)					
ERR_DIAG_EF	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for EF (only parameter)					
ERR_DIAG_RLY_ACCOUT	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for RLY_ACCOUT (only parameter)					
ERR_DIAG_RLY_CRCV_HEAT	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for RLY_CRCV_HEAT (only parameter)					
ERR_DIAG_RLY_DMTL_PUMP	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for DMTL_PUMP (only parameter)					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_DIAG_RLY_DMTLS	-	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Raw value of error symptom for DMTLS (only parameter)					
ERR_DIAG_RLY_ST	-	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Raw value of error symptom for RLY_ST (only parameter)					
ERR_DIAG_SLV_IVVT_EX	-	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Raw value of error symptom for SLV_IVVT_EX (only parameter)					
ERR_DIAG_SLV_IVVT_IN	-	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Raw value of error symptom for SLV_IVVT_IN (only parameter)					
ERR_SYM_DMTL_PUMP	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom DMTL_PUMP diagnosis					
ERR_SYM_DMTLH	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom DMTLH diagnosis					
ERR_SYM_DMTLS	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom DMTLS diagnosis					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_EBOX_CFA	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom EBOX_CFA diagnosis					
ERR_SYM_EF	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom EFdiagnosis					
ERR_SYM_RLY_ACCOUT	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom RLY_ACCOUT diagnosis					
ERR_SYM_RLY_CRCV_HEAT	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom CRCV_HEAT					
ERR_SYM_RLY_ST	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom RLY_ST diagnosis					
ERR_SYM_SLV_IVVT_EX	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom SLV_IVVT_EX_i					
ERR_SYM_SLV_IVVT_IN	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom SLV_IVVT_IN_i					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_DMTL_PUMP	O/V	0... 1H	0 ...1	1	-
Diagnosis condition DMTL_PUMP diagnosis					
LV_CDN_DIAG_DMTLH	O/V	0... 1H	0 ...1	1	-
Diagnosis condition DMTLH diagnosis					
LV_CDN_DIAG_DMTLS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition DMTLS diagnosis					
LV_CDN_DIAG_EBOX_CFA	O/V	0... 1H	0 ...1	1	-
Diagnosis condition EBOX_CFA diagnosis					
LV_CDN_DIAG_EF	O/V	0... 1H	0 ...1	1	-
Diagnosis condition EF diagnosis					
LV_CDN_DIAG_RLY_ACCOUT	O/V	0... 1H	0 ...1	1	-
Diagnosis condition RLY_ACCOUT diagnosis					
LV_CDN_DIAG_RLY_CRCV_HEAT	O/V	0... 1H	0 ...1	1	-
Diagnosis condition CRCV_HEAT					
LV_CDN_DIAG_RLY_ST	O/V	0... 1H	0 ...1	1	-
Diagnosis condition RLY_ST diagnosis					
LV_CDN_DIAG_SLV_IVVT_EX	O/V	0... 1H	0 ...1	1	-
Diagnosis condition SLV_IVVT_EX_i					
LV_CDN_DIAG_SLV_IVVT_IN	O/V	0... 1H	0 ...1	1	-
Diagnosis condition SLV_IVVT_IN_i					
LV_END_DIAG_DMTL_PUMP	O/V	0... 1H	0 ...1	1	-
End of diagnosis DMTL_PUMP diagnosis					
LV_END_DIAG_DMTLH	O/V	0... 1H	0 ...1	1	-
End of diagnosis DMTLH diagnosis					
LV_END_DIAG_DMTLS	O/V	0... 1H	0 ...1	1	-
End of diagnosis DMTLS diagnosis					
LV_END_DIAG_EBOX_CFA	O/V	0... 1H	0 ...1	1	-
End of diagnosis EBOX_CFA diagnosis					
LV_END_DIAG_EF	O/V	0... 1H	0 ...1	1	-
End of diagnosis EF diagnosis					
LV_END_DIAG_RLY_ACCOUT	O/V	0... 1H	0 ...1	1	-
End of diagnosis RLY_ACCOUT diagnosis					
LV_END_DIAG_RLY_CRCV_HEAT	O/V	0... 1H	0 ...1	1	-
End of CRCV_HEAT diagnosis					
LV_END_DIAG_RLY_ST	O/V	0... 1H	0 ...1	1	-
End of diagnosis RLY_ST diagnosis					
LV_END_DIAG_SLV_IVVT_EX	O/V	0... 1H	0 ...1	1	-
End of SLV_IVVT_EX_i diagnosis					
LV_END_DIAG_SLV_IVVT_IN	O/V	0... 1H	0 ...1	1	-
End of SLV_IVVT_IN_i diagnosis					
LV_ERR_DMTL_PUMP	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on DMTL_PUMP command signal.					
LV_ERR_DMTLH	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on DMTLH command signal.					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_DMTLS	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on DMTLS command signal.					
LV_ERR_EBOX_CFA	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on EBOX_CFA command signal.					
LV_ERR_EF	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on EF command signal.					
LV_ERR_RLY_ACCOUT	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on RLY_ACCOUT command signal.					
LV_ERR_RLY_CRCV_HEAT	O/V	0... 1H	0 ...1	1	-
Logical value for CRCV_HEAT error					
LV_ERR_RLY_ST	O/V	0... 1H	0 ...1	1	-
Status of starter output diagnosis.					
LV_ERR_SLV_IVVT_EX	O/V	0... 1H	0 ...1	1	-
Error flag solenoid valve of exhaust camshaft i					
LV_ERR_SLV_IVVT_IN	O/V	0... 1H	0 ...1	1	-
Error flag solenoid valve of inlet camshaft i					
LV_INH_DIAG_DMTL_PUMP	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition DMTLH_PUMP diagnosis					
LV_INH_DIAG_DMTLH	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition DMTLH diagnosis					
LV_INH_DIAG_DMTLS	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition DMTLS diagnosis					
LV_INH_DIAG_EBOX_CFA	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition EBOX_CFA diagnosis					
LV_INH_DIAG_EF	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition EF diagnosis					
LV_INH_DIAG_RLY_ACCOUT	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition RLY_ACCOUT diagnosis					
LV_INH_DIAG_RLY_CRCV_HEAT	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition RLY_CRCV_HEAT diagnosis					
LV_INH_DIAG_RLY_ST	O/V	0... 1H	0 ...1	1	-
Inhibition of diagnosis RLY_ST diagnosis					
LV_INH_DIAG_SLV_IVVT_EX	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition IVVT_EX					
LV_INH_DIAG_SLV_IVVT_IN	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition IVVT_IN					
T_V_DMTL_MAX_DIAG	V	0... FFH	0... 2.55	0.01	s
SCB detection timer					


**Input data:**

ECU_STATE {p. 1091}	IVVTPWM_0 {p. 915}	IVVTPWM_1 {p. 915}	LV_CDN_VB_MIN_DIAG {p. 1185}
LV_CDN_VB_OBD1 {p. 1185}	LV_CONF_DMTL {p. 654}	LV_DMTL_PUMP {p. 5963}	LV_ERR_SPI_MPS {p. 4245}
LV_IGK {p. 906}	LV_ST_END {p. 1720}	LV_VAR_ACIN {p. 655}	LV_VAR_EBOX_CFA {p. 655}
LV_VAR_EF {p. 655}	LV_VAR_RLY_ACCOUT {p. 656}	LV_VAR_RLY_ST {p. 656}	V_DMTL

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_DMTL_PUMP	-	0... FFH	0... 255	1	-
Debounce counter increment DMTL_PUMP diagnosis					
C_ABC_INC_DMTLH	-	0... FFH	0... 255	1	-
Debounce counter increment DMTLH diagnosis					
C_ABC_INC_DMTLS	-	0... FFH	0... 255	1	-
Debounce counter increment DMTLS diagnosis					
C_ABC_INC_EBOX_CFA	-	0... FFH	0... 255	1	-
Debounce counter increment EBOX_CFA diagnosis					
C_ABC_INC_EF	-	0... FFH	0... 255	1	-
Debounce counter increment - EF diagnosis					
C_ABC_INC_RLY_ACCOUT	-	0... FFH	0... 255	1	-
Debounce counter increment RLY_ACCOUT diagnosis					
C_ABC_INC_RLY_CRCV_HEAT	-	0... FFH	0... 255	1	-
Debounce counter increment CRCV_HEAT					
C_ABC_INC_RLY_ST	-	0... FFH	0... 255	1	-
Anti-bounce increment value					
C_ABC_INC_SLV_IVVT	-	0... FFH	0... 255	1	-
Debounce counter increment - VANOS diagnosis magnetic valve					
C_ABC_MAX_DMTL_PUMP	-	1... FFH	1... 255	1	-
Debounce counter maximum value - DMTL_PUMP diagnosis					
C_ABC_MAX_DMTLH	-	1... FFH	1... 255	1	-
Debounce counter maximum value - DMTLH diagnosis					
C_ABC_MAX_DMTLS	-	1... FFH	1... 255	1	-
Debounce counter maximum value - DMTLS diagnosis					
C_ABC_MAX_EBOX_CFA	-	1... FFH	1... 255	1	-
Debounce counter maximum value - EBOX_CFA diagnosis					
C_ABC_MAX_EF	-	1... FFH	1... 255	1	-
Debounce counter maximum value - EF diagnosis					
C_ABC_MAX_RLY_ACCOUT	-	1... FFH	1... 255	1	-
Debounce counter maximum value - RLY_ACCOUT diagnosis					
C_ABC_MAX_RLY_CRCV_HEAT	-	1... FFH	1... 255	1	-
Debounce counter maximum value CRCV_HEAT					
C_ABC_MAX_RLY_ST	-	1... FFH	1... 255	1	-
Anti-bounce maximum value					
C_ABC_MAX_SLV_IVVT	-	1... FFH	1... 255	1	-
Debounce counter maximum value - VANOS diagnosis magnetic valves					
C_SLV_IVVT_PWM_DIAG_MAX_SCG	-	0... FFFFH	0... 99.99847	1.53e-3	%
Maximum threshold for SCG diagnosis window					
C_SLV_IVVT_PWM_DIAG_MIN_OC	-	0... FFFFH	0... 99.99847	1.53e-3	%
Minimum threshold for OC diagnosis window					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_SLV_IVVT_PWM_DIAG_MIN_SCB	-	0... FFFFH	0... 99.99847	1.53e-3	%
Minimum threshold for SCB diagnosis window					
C_T_V_DMTL_MAX_DIAG	-	0... FFH	0... 2.55	0.01	s
Time threshold for SCB detection					
C_V_DMTL_MAX_DIAG	-	0... 3FFH	0... 4.99511	4.88e-3	V
Threshold for SCB detection					

### General information:

This specification defines all output-data and calibration data for all ATIC39 powerstage diagnosis as well as specific functions like limp home which are not covered by the generic ATIC39 basic algorithm for static and PWM outputs

#### Remark:

For all static outputs a minimum switch-on time of 50ms for error symptom detection is necessary.

## A.68.1 Diagnosis of static outputs

### A.68.1.1 Crankcase ventilation heater relay diagnosis (LV\_ERR\_RLY\_CRCV\_HEAT)

#### FUNCTION DESCRIPTION:

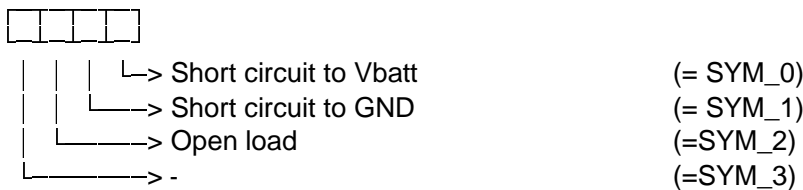
#### General information:

The purpose is to diagnose the signal from the driver which controls the crankcase ventilation heater relay.

#### Description:

For error detection algorithm see "Electrical diagnosis of powerstage outputs ATIC39".

Error-symptoms are defined to this diagnosis function as following :



#### Application conditions

<b>Initialisation:</b>	according Filter-type <b>MPL_STD_INI</b> (reset of variables at LV_IGK 0 -> 1 or ECU reset)
<b>Recurrence:</b>	1000ms
<b>Activation:</b>	LV_IGK = 1
<b>Deactivation:</b>	LV_IGK = 0

**Formula section:**

If diagnosis is not inhibited (LV\_INH\_DIAG\_RLY\_CRCV\_HEAT = 0 ) the diagnosis conditions are set according infrastructure information: CDN\_DIAG\_RLY\_CRCV\_HEAT.

Failure symptoms (raw value) are set according infrastructure information: ERR\_DIAG\_RLY\_CRCV\_HEAT.

**Failure debouncing and error management treatment:**

For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN\_DIAG\_RLY\_CRCV\_HEAT and ERR\_DIAG\_RLY\_CRCV\_HEAT.

This algorithm determines:

ERR_SYM_RLY_CRCV_HEAT	(Detected error symptom)
LV_ERR_RLY_CRCV_HEAT	(Error flag for debounced error)
LV_CDN_DIAG_RLY_CRCV_HEAT	(Diagnosis condition information)
LV_END_DIAG_RLY_CRCV_HEAT	(End of diagnosis information)

**Diagnosis inhibition:**

```

if          LV_IGK = 1                and
             LV_CDN_VB_MIN_DIAG = 1 and
             LV_ERR_SPI_MPS = 0

```

```

Then       LV_INH_DIAG_RLY_CRCV_HEAT = 0

```

```

Else       LV_INH_DIAG_RLY_CRCV_HEAT = 1

```

```

Endif

```

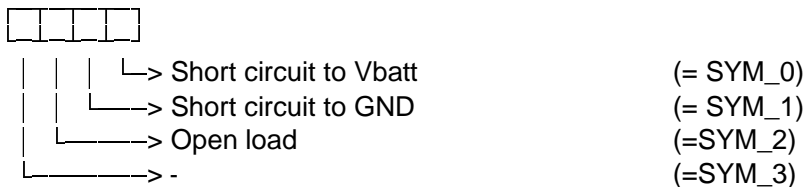
**A.68.1.2 Air condition compressor relay diagnosis ( LV\_ERR\_RLY\_ACCOUT )****FUNCTION DESCRIPTION:****General information:**

The purpose is to diagnose the signal from the driver which controls the air condition relay signal. The diagnosis is only active if "Vehicle with ACC" is learnt.


**Description:**

For error detection algorithm see "Electrical diagnosis of powerstage outputs ATIC39".

Error-symptoms are defined to this diagnosis function as following :

**Application conditions**

**Initialisation:** according Filter-type **MPL\_STD\_INI**

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(reset of variables at LV\_IGK 0 -> 1 or ECU reset)

**Recurrence:** 1s

**Activation:** LV\_VAR\_RLY\_ACCOUT = 1 **AND**  
LV\_VAR\_ACIN = 1

### Formula section:

If diagnosis is not inhibited ( LV\_INH\_DIAG\_RLY\_ACCOUT = 0 ) the diagnosis conditions are set according infrastructure information: CDN\_DIAG\_RLY\_ACCOUT .

Failure symptoms (raw value) are set according infrastructure information: ERR\_DIAG\_RLY\_ACCOUT.

### Failure debouncing and error management treatment:

For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN\_DIAG\_RLY\_ACCOUT and ERR\_DIAG\_RLY\_ACCOUT.

This algorithm determines:

ERR_SYM_RLY_ACCOUT	(Detected error symptom)
LV_ERR_RLY_ACCOUT	(Error flag for debounced error)
LV_CDN_DIAG_RLY_ACCOUT	(Diagnosis condition information)
LV_END_DIAG_RLY_ACCOUT	(End of diagnosis information)

### Diagnosis inhibition:

```

IF      LV_IGK = 1          AND
        LV_CDN_VB_MIN_DIAG = 1 AND
        LV_ERR_SPI_MPS = 0
THEN    LV_INH_DIAG_RLY_ACCOUT = 0
ELSE    LV_INH_DIAG_RLY_ACCOUT = 1
ENDIF

```

## A.68.1.3 DMTL change over valve diagnosis ( LV\_ERR\_DMTLS )

### FUNCTION DESCRIPTION:

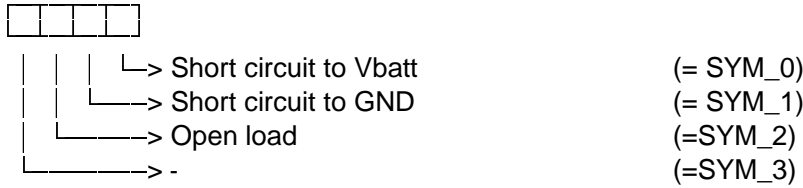
#### General information:

The purpose is to diagnose the signal from the driver which controls the DMTL valve.  
The diagnosis is only activated if DMTL is configured.

#### Description:

For error detection algorithm see "Electrical diagnosis of powerstage outputs ATIC39".

Error-symptoms are defined to this diagnosis function as following :



### Application conditions

**Initialisation:** according Filter-type **MPL\_STD\_INI**  
(reset of variables at LV\_IGK 0 -> 1 or ECU reset)

**Recurrence:** 100ms

**Activation:** LV\_CONF\_DMTL = 1

### Formula section:

If diagnosis is not inhibited ( LV\_INH\_DIAG\_DMTLS = 0 ) the diagnosis conditions are set according infrastructure information: CDN\_DIAG\_DMTLS.

Failure symptoms (raw value) are set according infrastructure information: ERR\_DIAG\_DMTLS.

### Failure debouncing and error management treatment:

For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN\_DIAG\_DMTLS and ERR\_DIAG\_DMTLS.

This algorithm determines:

ERR\_SYM\_DMTLS (detected error symptom)  
 LV\_ERR\_DMTLS (Error flag for debounced error)  
 LV\_CDN\_DIAG\_DMTLS (Diagnosis condition information)  
 LV\_END\_DIAG\_DMTLS (End of diagnosis information)

### Diagnosis inhibition:

```

IF      LV_CDN_VB_OBD1 = 1      AND
          LV_ERR_SPI_MPS = 0      AND
          ECU_STATE != WAKE_UP
THEN    LV_INH_DIAG_DMTLS = 0
ELSE    LV_INH_DIAG_DMTLS = 1
ENDIF

```

### A.68.1.4 DMTL pump diagnosis ( LV\_ERR\_DMTL\_PUMP )

### FUNCTION DESCRIPTION:

### General information:

The purpose is to diagnose the signal from the driver which controls the DMTL pump.  
 The diagnosis is only activated if DMTL is configured.



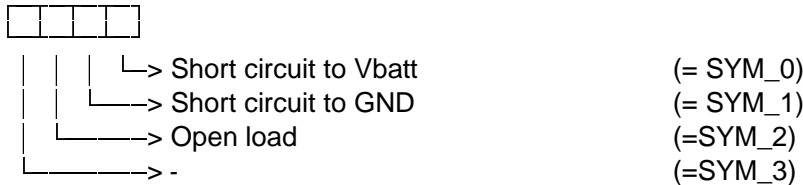
**Description:**

For error detection algorithm see "Electrical diagnosis of powerstage outputs ATIC39".

**Remark:**

Due to hardware conditions and overtemperature protection for shunt resistor (max. time for SCB is 50ms) the SCB detection is only possible with monitoring the voltage V\_DMTL.

Error-symptoms are defined to this diagnosis function as following :

**Application conditions**

**Initialisation:** according Filter-type **MPL\_STD\_INI**  
(reset of variables at LV\_IGK 0 -> 1 or ECU reset)

**Recurrence:** 100ms for SCG/ OL detection  
10ms for SCB detection

**Activation:** LV\_CONF\_DMTL = 1

**Formula section:**

If diagnosis is not inhibited ( LV\_INH\_DIAG\_DMTL\_PUMP = 0 ) the diagnosis conditions are set according infrastructure information: CDN\_DIAG\_DMTL\_PUMP.

Failure symptoms (raw value) are set according infrastructure information: ERR\_DIAG\_DMTL\_PUMP.

**Failure debouncing and error management treatment:**

For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN\_DIAG\_DMTL\_PUMP and ERR\_DIAG\_DMTL\_PUMP.

This algorithm determines:

ERR\_SYM\_DMTL\_PUMP (Detected error symptom)  
LV\_ERR\_DMTL\_PUMP (Error flag for debounced error)  
LV\_CDN\_DIAG\_DMTL\_PUMP (Diagnosis condition information)  
LV\_END\_DIAG\_DMTL\_PUMP (End of diagnosis information)

**Diagnosis inhibition:**

**IF** LV\_CDN\_VB\_OBD1 = 0 **OR**  
LV\_ERR\_SPI\_MPS = 1 **OR**  
ECU\_STATE = WAKE\_UP **OR**  
ERR\_SYM\_DMTL\_PUMP = SYM\_0

**THEN** LV\_INH\_DIAG\_DMTL\_PUMP = 1

**ELSE** LV\_INH\_DIAG\_DMTL\_PUMP = 0

**ENDIF**

**Detection of SCB:**

**IF(1)** LV\_DMTL\_PUMP = 1 //Pump is switched on

**THEN(1)IF(2)** V\_DMTL > C\_V\_DMTL\_MAX\_DIAG







**Activation:** LV\_VAR\_EF = 1

### Formula section:

If diagnosis is not inhibited ( LV\_INH\_DIAG\_EF = 0 ) the diagnosis conditions are set according infrastructure information: CDN\_DIAG\_EF.

Failure symptoms (raw value) are set according infrastructure information: ERR\_DIAG\_EF.

### Failure debouncing and error management treatment:

For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN\_DIAG\_EF and ERR\_DIAG\_EF.

This algorithm determines:

ERR\_SYM\_EF (Detected error symptom)  
 LV\_ERR\_EF (Error flag for debounced error)  
 LV\_CDN\_DIAG\_EF (Diagnosis condition information)  
 LV\_END\_DIAG\_EF (End of diagnosis information)

### Diagnosis inhibition:

```

IF      LV_IGK = 1                AND
        LV_CDN_VB_MIN_DIAG = 1   AND
        LV_ERR_SPI_MPS = 0
THEN    LV_INH_DIAG_EF = 0
ELSE    LV_INH_DIAG_EF = 1
ENDIF
  
```

## A.68.1.8 Starter relay output diagnosis ( LV\_ERR\_RLY\_ST )

### FUNCTION DESCRIPTION:

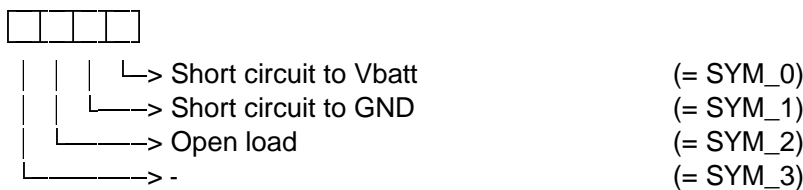
#### General information:

The purpose is to diagnose the starter signal from the driver which switches the output signal for the CAS - ECU. This diagnosis detects electrical faults as defined by OBD I requirements. The diagnosis is only performed if the variant "BN2000" is enabled.

#### Description:

For error detection algorithm see "Electrical diagnosis of powerstage outputs ATIC39"

Error-symptoms are defined to this diagnosis function as following :



## Application conditions

**Initialisation:** according Filter-type **MPL\_STD\_INI**  
(reset of variables at LV\_IGK 0 -> 1 or ECU reset)

**Recurrence:** 50ms in case of LV\_ST\_END = 0  
1000ms in case of LV\_ST\_END = 1

**Activation:** LV\_VAR\_RLY\_ST = 1

## Formula section:

If diagnosis is not inhibited ( LV\_INH\_DIAG\_RLY\_ST = 0 ) the diagnosis conditions are set according infrastructure information: CDN\_DIAG\_RLY\_ST.

Failure symptoms (raw value) are set according infrastructure information: ERR\_DIAG\_RLY\_ST.

### Failure debouncing and error management treatment:

For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN\_DIAG\_RLY\_ST and ERR\_DIAG\_RLY\_ST.

This algorithm determines:

ERR\_SYM\_RLY\_ST (detected error symptom)  
LV\_ERR\_RLY\_ST (Error flag for debounced error)  
LV\_CDN\_DIAG\_RLY\_ST (Diagnosis condition information)  
LV\_END\_DIAG\_RLY\_ST (End of diagnosis information)

### Diagnosis inhibition:

```

IF      LV_IGK = 1          AND
        LV_CDN_VB_OBD1 = 1  AND
        LV_ERR_SPI_MPS = 0
THEN   LV_INH_DIAG_RLY_ST = 0
ELSE   LV_INH_DIAG_RLY_ST = 1
ENDIF

```

## A.68.2 Diagnosis of PWM outputs

### A.68.2.1 IVVT solenoid valve diagnosis ( LV\_ERR\_SLV\_IVVT\_IN /EX )

#### FUNCTION DESCRIPTION:

##### General information:


The purpose of the diagnosis is to detect electrical faults in the IVVT unit.  
The input signal is a modulated control pulse (PWM).

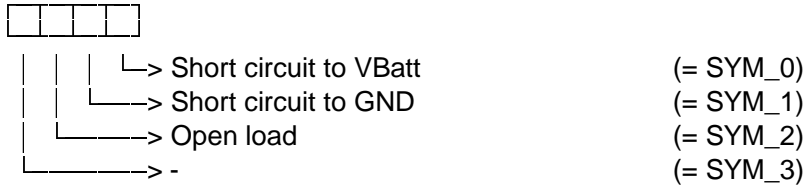
##### Description:

For error detection algorithm see "Electrical diagnosis of powerstage outputs ATIC39".

The diagnosis condition calculation is done according "Open range" duty cycle, thus a definition of the PWM diagnosis windows is necessary (see calibration data).

Error-symptoms are defined to this diagnosis function as following :

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### Application conditions

**Initialisation:** according Filter-type **MPL\_STD\_INI**  
(reset of variables at LV\_IGK 0 -> 1 or ECU reset)

**Recurrence:** 100ms

**Activation:** at every engine operating state

### Formula section:

If diagnosis is not inhibited ( LV\_INH\_DIAG\_SLV\_IVVT\_IN/EX = 0 ) the diagnosis conditions are set according infrastructure information: CDN\_DIAG\_SLV\_IVVT\_IN/EX.

Failure symptoms (raw value) are set according infrastructure information: ERR\_DIAG\_SLV\_IVVT\_IN/EX .

### Failure debouncing and error management treatment:

For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN\_DIAG\_SLV\_IVVT\_IN/EX and ERR\_DIAG\_SLV\_IVVT\_IN/EX.

This algorithm determines:

ERR\_SYM\_SLV\_IVVT\_IN/EX (detected error symptom)  
 LV\_ERR\_SLV\_IVVT\_IN/EX (Error flag for debounced error)  
 LV\_CDN\_DIAG\_SLV\_IVVT\_IN/EX (Diagnosis condition information)  
 LV\_END\_DIAG\_SLV\_IVVT\_IN/EX (End of diagnosis information)

### Diagnosis inhibition:

```

IF          LV_IGK = 1          AND
              LV_CDN_VB_OBD1 = 1 AND
              LV_ERR_SPI_MPS = 0
THEN       LV_INH_DIAG_SLV_IVVT_IN/EX = 0
ELSE       LV_INH_DIAG_SLV_IVVT_IN/EX = 1
ENDIF
  
```

## A.69 Multi condition debounce algorithm

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_PREV_XX	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Diagnostic condition of last failure symptom					
CTR_ABC_END_DIAG_XX	O/V	0... FFH	0... 255	1	-
Counter for end of diagnosis XX generation					
CTR_ABC_XX	O/V/S	0... FFH	0... 255	1	-
anti bounce counter of diagnosis XX					

### Input data:

LC_ABC_BENCH {p. 4581}	LC_ERR_DET_UPD {p. 4581}	LV_ABC_INH {p. 4610}	LV_IGK {p. 906}
NC_ABC_CONF_FCT_ DIAG_XX {p. 4581}	NC_ERR_DET_UPD {p. 645}	NLC_ABC_INI_DC_END_ DIAG {p. 4581}	NLC_BENCH_MODE {p. 4581}

### Configuration data:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_SYM_XX	-	1... FH	1... 15	1	-
Available symptom for diagnostic XXSymptom 0 and 1 available : 03HSymptom 0 ,1 and 2 available : 07H (typical value)Symptom 0,1,2 and 3 available : 0FH					

### Action definition

<b>ACTION_ERRM_FilterMulticonditio</b> (IN<PRM_IDX_DIAG>,IN<PRM_CDN_DIAG>,IN<PRM_ERR_DIAG>,IN<PRM_ABC_INC>,IN<PRM_ABC_MAX>,OUT<PRM_LV_ERR>)	Mode: O
This action compute the elementary antibounce filter for one failure treatment and return filter result.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_IDX_DIAG	in	0... FFFFH	0... 65535	1	-
Diagnostic symptom instance.					
PRM_CDN_DIAG	in	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of SAP; bit 0: Set, if diagnosis condition for symptom SCP is fulfilled; bit 1: Set, if diagnosis condition for symptom SCG is fulfilled; bit 2: Set, if diagnosis condition for symptom OC is fulfilled					
PRM_ERR_DIAG	in	0... 7H	0 ...7	1	-
Raw value of error symptom for SAP; bit 0: Set, if raw value of error symptom SCP is set; bit 1: Set, if raw value of error symptom SCG is set; bit 2: Set, if raw value of error symptom OC is set					
PRM_ABC_INC	in	0... FFH	0... 255	1	-
Anti bounce increment					
PRM_ABC_MAX	in	0... FFH	0... 255	1	-
Anti-bounce maximum					
PRM_LV_ERR	out	0... 1H	0 ...1	1	-
Error flag for diagnostic instance					

<b>ACTION_ERRM_MultiFilterReset</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR>)	Mode: O
--	---------

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This action resets data filter in case of antibounce filter type					
Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_IDX_DIAG	in	0... FFFFH	0... 65535	1	-
Diagnostic symptom instance.					
PRM_LV_ERR	out	0... 1H	0 ...1	1	-
Error flag for diagnostic instance					

ACTION_ERRM_MultiFilterSymEnd (IN<PRM_IDX_DIAG>,IN<PRM_ABC_MAX>,OUT<PRM_LV_ERR>)					Mode: O
This action returns the filter result on symptoms detected at each diagnostic recurrence					
Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_IDX_DIAG	in	0... FFFFH	0... 65535	1	-
Diagnostic symptom instance.					
PRM_ABC_MAX	in	0... FFH	0... 255	1	-
Anti-bounce maximum					
PRM_LV_ERR	out	0... 1H	0 ...1	1	-
Error flag for diagnostic instance					

## General information

### Import actions:

#IF NC_ERR_DET_UPD = 1 and NLC_ENA_MULTI_CDN = 1
ACTION_ERRM_UpdErrDet (IN<XX>)
This action indicates each occurrence of the detected error
#ENDIF

According the diagnosis condition information CDN\_DIAG\_XX and the diagnosis symptom (raw value) information the symptom calculation ERR\_SYM\_XX is performed. Then the failure symptom is debounced to set the present failure LV\_ERR\_XX.

A special readiness calculation is done to set the end of diagnosis information. LV\_END\_DIAG\_XX is set only if there was enough time to make a diagnosis of all symptoms or a failure gets present.

### Note:


To set the LV\_END\_DIAG\_XX is necessary to have the conditions for all symptoms at the same time for a given time.

### Restrictions:

In case of multiple symptoms at the same time, only one symptom will be taken into account according the following priority rule: SYM\_0 ==> SYM\_3 ; Priority max ==> Priority Min

Only the last symptom present will be taken into account in this algorithm, so in case of symptom change, only the last symptom will be used to increment and decrement the counters.

### Application conditions:

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**Initialisation:**

At ECU reset and LV\_IGK 0 → 1 transition  
 CDN\_DIAG\_PREV\_XX = 0

Other data initialization

ERR\_SYM\_XX = Refer to "Antibounce algorithms" chapter

for initialization

CTR\_ABC\_XX = Refer to "Antibounce algorithms" chapter

for initialization

LV\_ERR\_XX = Refer to "Antibounce algorithms" chapter

for initialization

CTR\_ABC\_END\_DIAG\_XX = Refer to "Antibounce algorithms"

chapter for initialization

**Activation:**

-

**Deactivation:**

-

**Recurrence:**

-

**Function description:****Formula section:****A.69.1 Multi-condition anti-bounce filter algorithm description****Description for ACTION\_ERRM\_FilterMulticondition:****Syntax :**

ACTION\_ERRM\_FilterMulticondition (IN<XX>, IN<CDN\_DIAG\_XX>,  
 IN<ERR\_DIAG\_XX>, IN<C\_ABC\_INC\_XX>, IN<C\_ABC\_MAX\_XX>,  
 OUT<LV\_ERR\_XX>)

**Parameter(in):**

XX

Type: index to identify the Diagnostic

CDN\_DIAG\_XX

Type: Byte carrier (Each symptom condition)

ERR\_DIAG\_XX

Type: Byte carrier (Raw value symptom)

C\_ABC\_INC\_XX

Type: Calibration byte for the increment value

C\_ABC\_MAX\_XX

Type: Calibration byte for the maximum value

**Parameter(out):**

LV\_ERR\_XX

Type: Boolean (=1 when failure)

**Short Description:**

This action returns information necessary for the diagnostic and the error management.

**Formula section:**

Anti-bounce bench mode :

**If (0)** LV\_ABC\_INH = 0


**Then**

**If (1)** (LC\_ABC\_BENCH = 1 **and** NLC\_BENCH\_MODE=1) **and** ((C\_ABC\_INC\_XX = 0) **or** (C\_ABC\_INC\_XX = FFH))

**Then (1)**

**If (2)** C\_ABC\_INC\_XX = 0

**Then (2)**

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```

    {Case force no failure}
    LV_ERR_XX = 0
    ERR_SYM_XX = 0
    CTR_ABC_XX = 0
    LV_END_DIAG_XX = 1
    CTR_ABC_END_DIAG_XX = C_ABC_MAX_XX
Else (2)
    If (3) C_ABC_INC_XX = FFH
    Then (3)
        {Forced failure}
        LV_ERR_XX = 1
        ERR_SYM_XX = 0Fh
        CTR_ABC_XX = C_ABC_MAX_XX
        LV_END_DIAG_XX = 1
        CTR_ABC_END_DIAG_XX = C_ABC_MAX_XX
    Endif (3)
Endif (2)
Endif (1)
Symptom calculation:

{Erase not available bit}
CDN_DIAG_XX = CDN_DIAG_XX and NC_NR_SYM_XX
ERR_DIAG_XX = ERR_DIAG_XX and NC_NR_SYM_XX

If (1) CDN_DIAG_XX ≠ 0 {Diagnosis of at least one symptom is valid}
Symptom SYM_0 calculation:
Then (1)
    If (2) bit 0 of CDN_DIAG_XX = 1
        and
        bit 0 of ERR_DIAG_XX = 1
    Then (2)
        ERR_SYM_XX = 1H
        {Memorization of last failure symptom number}
        CDN_DIAG_PREV_XX = 1H
Symptom SYM_1 calculation:
Else (2)
    If (3) bit 1 of CDN_DIAG_XX = 1
        and
        bit 1 of ERR_DIAG_XX = 1
    Then (3)
        ERR_SYM_XX = 2H
        {Memorization of last failure symptom number}
        CDN_DIAG_PREV_XX = 2H
Symptom SYM_2 calculation:
Else (3)
    If (4) bit 2 of CDN_DIAG_XX = 1
        and
        bit 2 of ERR_DIAG_XX = 1
    Then (4)
        ERR_SYM_XX = 4H
        {Memorization of last failure symptom number}
        CDN_DIAG_PREV_XX = 4H
Symptom SYM_3 calculation:
Else (4)
    If (5) bit 3 of CDN_DIAG_XX = 1
        and
        bit 3 of ERR_DIAG_XX = 1
    Then (5)
        ERR_SYM_XX = 8H
        {Memorization of last failure symptom number}
        CDN_DIAG_PREV_XX = 8H

```

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Symptom calculation for 'No symptom detected':

```

Else (5)
  If bit 0 of CDN_DIAG_XX = 1
  Then
    bit 0 of ERR_SYM_XX = 0
  Endif
  If bit 1 of CDN_DIAG_XX = 1
  Then
    bit 1 of ERR_SYM_XX = 0
  Endif
  If bit 2 of CDN_DIAG_XX = 1
  Then
    bit 2 of ERR_SYM_XX = 0
  Endif
  If bit 3 of CDN_DIAG_XX = 1
  Then
    bit 3 of ERR_SYM_XX = 0
  Endif
Endif (5)
Endif (4)
Endif (3)
Endif (2)
Endif (1)
If (1) (CDN_DIAG_PREV_XX = 0 and CDN_DIAG_XX ≠ 0)
  or (bit 0 of CDN_DIAG_PREV_XX = 1 and bit 0 of CDN_DIAG_XX = 1)
  or (bit 1 of CDN_DIAG_PREV_XX = 1 and bit 1 of CDN_DIAG_XX = 1)
  or (bit 2 of CDN_DIAG_PREV_XX = 1 and bit 2 of CDN_DIAG_XX = 1)
  or (bit 3 of CDN_DIAG_PREV_XX = 1 and bit 3 of CDN_DIAG_XX = 1)
Then (1)
  LV_CDN_DIAG_XX = 1
Else (1)
  {Anti-bounce value is frozen}
  LV_CDN_DIAG_XX = 0
Endif (1)

```

Anti-bounce of diagnosis instance XX:

```

If (1) LV_CDN_DIAG_XX = 1


```

Incrementation of antibounce:

```

Then (1)
  If (2a) ERR_SYM_XX ≠ 0
  Then (2a) If C_ABC_INC_XX ≠ 0
    Then { at each detected error, a treatment may be done }
      If NC_ERR_DET_UPD = 1 and LC_ERR_DET_UPD = 1
      Then
        ACTION_ERRM_UpdErrDet (IN<XX>,
        SYNCHRONIZATION<CALL>)
      Endif
      If CTR_ABC_XX ≠ C_ABC_MAX_XX
      Then
        CTR_ABC_XX = CTR_ABC_XX + C_ABC_INC_XX
        If CTR_ABC_XX ≥ C_ABC_MAX_XX
        Then
          LV_ERR_XX = 1
          CTR_ABC_XX = C_ABC_MAX_XX
        Endif
      Endif
    Endif
  Endif
Else (2a)

```

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```

If    CTR_ABC_XX  $\neq$  0
Then
    {Decrementation of antibounce}
    CTR_ABC_XX = CTR_ABC_XX - 1
    If    CTR_ABC_XX = 0    { minimum value }
    Then
        LV_ERR_XX = 0
        {Reset of last failure symptom memorized}
        CDN_DIAG_PREV_XX = 0H
    Endif
Endif
Endif (2a)

Readiness calculation for diagnosis instance XX:
If (2b)  CTR_ABC_END_DIAG_XX < C_ABC_MAX_XX

End of diagnosis is set, if failure gets present:
Then (2b) If    LV_ERR_XX = 1    { failure XX is present }
Then    LV_END_DIAG_XX = 1
          CTR_ABC_END_DIAG_XX = C_ABC_MAX_XX

End of diagnosis is set, if all symptoms can be detected after a specified time:
Else
    {Check if all symptoms can be detected if all
    significant bit 0, bit 1, bit 2 and bit 3 of
    CDN_DIAG_XX = 1 }
    If    CDN_DIAG_XX = NC_NR_SYM_XX
          and
          ERR_SYM_XX = 0
    Then
        CTR_ABC_END_DIAG_XX = CTR_ABC_END_DIAG_XX
                              + C_ABC_INC_XX
    If    CTR_ABC_END_DIAG_XX  $\geq$  C_ABC_MAX_XX
    Then
        CTR_ABC_END_DIAG_XX = C_ABC_MAX_XX
        LV_END_DIAG_XX = 1
    Endif
Else
    {Check if a failure is detected}
    If    ERR_SYM_XX  $\neq$  0
    Then
        CTR_ABC_END_DIAG_XX = 0
    Endif
Endif
Endif (2b)
Endif (1)
Endif (0)

```

### A.69.2 Description for ACTION\_ERRM\_MultiFilterSymEnd :

**Syntax:** ACTION\_ERRM\_MultiFilterSymEnd( IN<XX>, IN<C\_ABC\_MAX\_XX>, OUT<LV\_ERR\_XX>)

**Parameter(in):** XX Type: index to identify the Diagnostic  
C\_ABC\_MAX\_XX Type: Calibration byte for the maximum value

**Parameter(out):** LV\_ERR\_XX Type: Boolean

**Short Description:** This action erases diagnostic failure and sets immediately the end of diagnostic information in case of multi-conditions filter (MPL\_STD\_INI)

#### Formula section :

```
LV_CDN_DIAG_XX = 1
ERR_SYM_XX = NO_SYM
LV_ERR_XX = 0
CTR_ABC_XX = 0
LV_END_DIAG_XX = 1
CTR_ABC_END_DIAG_XX = C_ABC_MAX_XX
```

### A.69.3 Description for ACTION\_ERRM\_MultiFilterReset:

**Syntax:** ACTION\_ERRM\_MultiFilterReset(IN<XX>, OUT<LV\_ERR\_XX>)

**Parameter(in):** XX Type: index to identify the Diagnostic

**Parameter(out):** LV\_ERR\_XX Type: Boolean

**Short Description:** This action resets data filter in case of Multiconditions filter type

#### Formula section :

```
LV_CDN_DIAG_XX = 0
ERR_SYM_XX = NO_SYM
LV_ERR_XX = 0
CTR_ABC_XX = 0
LV_END_DIAG_XX is unchanged
CTR_ABC_END_DIAG_XX is unchanged
```

### A.69.4 Synchronization between multi-condition algorithm & Error Management

This section describes the mechanism of synchronisation of the failure filtering with the Error Management core. The principle is to call the Error Management upon events.

LV\_END\_DIAG\_XX 0 → 1 transition

LV\_ERR\_XX 0 → 1 transition


LV\_ERR\_XX 1 → 0 transition

### A.69.5 Mechanism for CPU load optimisation

This section describes the mechanism of optimisation. The principle is to suspend the filter algorithm execution when is not necessary. When the bench mode is used for a diagnostic XX the mechanism of CPU load optimisation is disabled for this instance.

#### Formula section:

**If** LV\_ERR\_XX = 0  
**and** LV\_END\_DIAG\_XX = 1

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```

and ERR_SYM_XX = 0
and CTR_ABC_XX = 0

```

**Then**

It is not necessary to call error management (including filtering)

```

LV_END_DIAG_XX = 1      {unchanged}
LV_ERR_XX = 0          {unchanged}

```

**Endif****A.69.6 Configuration data****Configuration data detailed description:**

Symptoms 0 and 1 available: 03H  
 Symptoms 0, 1 and 2 available: 07H (typical value)  
 Symptoms 0, 1, 2 and 3 available: 0FH

Predefined filter type:

	NLC_ ABC_ STC_XX	NLC_ ABC_ CAL_ DEC_ XX	NLC_ ABC_ NOT_ DEC_ XX	NLC_ ABC_ INI_ VALUE_ XX	NLC_ ABC_ INI_ IGK_XX	NLC_ ABC_ NOT_ SAVE_ XX
<b>MPL_STD_INI</b>	0	0	0	0	1	1

The **standard configuration with initialisation (MPL\_STD\_INI)** is NC\_ABC\_CONF\_FCT\_DIAG\_XX = 3H (default configuration)

The data CTR\_ABC\_XX and LV\_ERR\_XX are Reset at the transition LV\_IGK 0 → 1 and Reset (NLC\_ABC\_NOT\_SAVE\_XX = 1, NLC\_ABC\_INI\_IGK\_XX = 1) and the anti-bounce counter is initialised to 0 value (NLC\_ABC\_INI\_VALUE\_XX = 0).

The anti-bounce counter may be decremented (NLC\_ABC\_NOT\_DEC\_XX = 0).

The decrement value is equal to 1 (NLC\_ABC\_CAL\_DEC\_XX = 0).

The filter used is the Anti-bounce (NLC\_ABC\_STC\_XX = 0).

## A.70 Table of failures

### FUNCTION DESCRIPTION:

#### General information:

This specification is automatic generated out from SW and Dataset.


Listing of all implemented diagnosis instances (LV\_ERR\_xx) including all calibration data (proposal) like error class (C\_ERR\_CLAS\_xx), Environmental data (ID\_ERR\_ENVD\_xx), Trouble codes (ID\_ERR\_DTC\_xx).

#### Remark:

All diagnosis instances marked with grey colour do have a missing calibration !

### A.70.1 Calibration part ( sorted by alphabetic order )


Made from dataset file 3KBIJHZA auf XKC0S gemischt [E93\_N54\_DKG\_LEV\_240KW] mit Vorbedatung\_BMW\_30Mar11\_1+LEV2\_1

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
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Diagnostic Instance	Diagnostic Trouble Code			Failure class	ENV D	
	DTC	Info	Nr.		Nr.	Nr.
ACK_IGK_OFF			"SYM0"	0x11	0x11	0
			"SYM1"		0x0C	1
			"SYM2"		0x6A	2
			"SYM3"		0x23	3
			"GLOBAL"			
	0x2BA2		"DTC"			
ACR_AD	0x3045		"SYM0"	0x00	0xFC	0
	0x3046		"SYM1"		0xF7	1
	0x3048		"SYM2"		0x3C	2
	0x3047		"SYM3"		0xFD	3
			"GLOBAL"			
	0x2A0F		"DTC"			
ACR_CTL	0x3043		"SYM0"	0x00	0xFC	0
	0x3044		"SYM1"		0xF7	1
			"SYM2"		0x3C	2
			"SYM3"		0xFD	3
			"GLOBAL"			
	0x2A0E		"DTC"			
ACR_DR	0x0487		"SYM0"	0x00	0xFC	0
			"SYM1"		0xF7	1
			"SYM2"		0x3C	2
			"SYM3"		0xFD	3
			"GLOBAL"			
	0x2A0D		"DTC"			
AEB_0	0x0A16		"SYM0"	0x11	0x8B	0
	0x0A15		"SYM1"		0x0C	1
	0x0A14		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2FAB		"DTC"			
AEB_1	0x0AB8		"SYM0"	0x00	0x8B	0
	0x0AB7		"SYM1"		0x0C	1
	0x0AB6		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2FAC		"DTC"			
AIR_LSL_UP_1	0x2414		"SYM0"	0x56	0x8B	0
			"SYM1"		0x49	1
			"SYM2"		0x45	2
			"SYM3"		0x8C	3
			"GLOBAL"			
	0x2C3B		"DTC"			
AIR_LSL_UP_2	0x2415		"SYM0"	0x56	0x8B	0

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
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		"SYM1"		0x4B	1
		"SYM2"		0x48	2
		"SYM3"		0x8F	3
		"GLOBAL"			
	0x2C3C	"DTC"			
ALTER_BN	0x160C	"SYM0"	0x11	0x11	0
	0x160D	"SYM1"		0x6A	1
	0x160E	"SYM2"		0x98	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2DEB	"DTC"			
ALTER_BN_BAT		"SYM0"	0x11	0x68	0
	0x160A	"SYM1"		0x69	1
		"SYM2"		0x6A	2
	0x160B	"SYM3"		0xA8	3
		"GLOBAL"			
	0x2DEC	"DTC"			
ALTER_BN_RGN		"SYM0"	0x11	0x6B	0
		"SYM1"		0x6C	1
		"SYM2"		0x6E	2
	0x160F	"SYM3"		0x3C	3
		"GLOBAL"			
	0x2DED	"DTC"			
ALTER_COM		"SYM0"	0x11	0x8B	0
		"SYM1"		0x35	1
	0xD132	"SYM2"		0x42	2
		"SYM3"		0x15	3
		"GLOBAL"			
	0x2E98	"DTC"			
AMP	0x2229	"SYM0"	0x56	0x21	0
	0x2228	"SYM1"		0x34	1
		"SYM2"		0x70	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2F76	"DTC"			
AMP_PLAUS	0x11CB	"SYM0"	0x56	0x34	0
	0x0129	"SYM1"		0x70	1
		"SYM2"		0x33	2
		"SYM3"		0x24	3
		"GLOBAL"			
	0x2F77	"DTC"			
AMP_PLAUS_CUS		"SYM0"	0x56	0x34	0
		"SYM1"		0x0B	1
		"SYM2"		0xDD	2
	0x129C	"SYM3"		0xDE	3
		"GLOBAL"			

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	0x2F79		"DTC"			
BAT_SENS	0x150A		"SYM0"	0x11	0x7C	0
			"SYM1"		0x24	1
	0x150B		"SYM2"		0x6A	2
	0x150C		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2E8B		"DTC"			
BAT_SENS_IT	0x150D		"SYM0"	0x11	0x7C	0
			"SYM1"		0x24	1
	0x150E		"SYM2"		0x6A	2
	0x150F		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2E8C		"DTC"			
BAT_SENS_IT_EL	0x151A		"SYM0"	0x11	0x7C	0
			"SYM1"		0x24	1
	0x151C		"SYM2"		0x6A	2
	0x151B		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2E8D		"DTC"			
BN_ACC			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
	0xD12C		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDA9		"DTC"			
BN_ANG_PSTE			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
	0xD120		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDA1		"DTC"			
BN_ARS			"SYM0"	0x11	0x11	0
	0xD123		"SYM1"		0x21	1
	0xD124		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDA4		"DTC"			
BN_CAS			"SYM0"	0x11	0x11	0
	0xD11D		"SYM1"		0x21	1
	0xD11E		"SYM2"		0x3C	2
	0xD11F		"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDA0		"DTC"			
BN_CDN_DOOR			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
	0xD13A		"SYM2"		0x3C	2

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		"SYM3"		0x7C	3
		"GLOBAL"			
	0xCDB1	"DTC"			
BN_DHL_CTL		"SYM0"	0x11	0x11	0
		"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0xCDBE	"DTC"			
BN_EFP		"SYM0"	0x11	0x11	0
		"SYM1"		0x21	1
	0xD128	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0xCDA6	"DTC"			
BN_EFP_CRASH		"SYM0"	0x11	0x0D	0
		"SYM1"		0x3C	1
	0xD12D	"SYM2"		0x11	2
		"SYM3"		0x32	3
		"GLOBAL"			
	0xCDA A	"DTC"			
BN_ETCU		"SYM0"	0x56	0x11	0
		"SYM1"		0x21	1
	0xD11A	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0xCD9D	"DTC"			
BN_ETCU_2		"SYM0"	0x11	0x0D	0
		"SYM1"		0x3C	1
	0xD11B	"SYM2"		0x11	2
		"SYM3"		0x32	3
		"GLOBAL"			
	0xCD9E	"DTC"			
BN_ETCU_3		"SYM0"	0x11	0x11	0
	0xD161	"SYM1"		0x21	1
	0xD160	"SYM2"		0x3C	2
	0xD162	"SYM3"		0x7C	3
		"GLOBAL"			
	0xCDB4	"DTC"			
BN_ETCU_DISP		"SYM0"	0x11	0x0D	0
		"SYM1"		0x3C	1
	0xD13E	"SYM2"		0x11	2
		"SYM3"		0x32	3
		"GLOBAL"			
	0xCDB0	"DTC"			
BN_GEAR_REV		"SYM0"	0x11	0x11	0

		"SYM1"		0x21	1
	0xD129	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0xCDA7	"DTC"			
BN_ICL		"SYM0"	0x56	0x11	0
	0xD12A	"SYM1"		0x21	1
	0xD12B	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0xCDA8	"DTC"			
BN_KM_ICL		"SYM0"	0x11	0x11	0
		"SYM1"		0x21	1
	0xD11C	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0xCD9F	"DTC"			
BN_LDM		"SYM0"	0x11	0x11	0
		"SYM1"		0x21	1
	0xD13D	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0xCDAD	"DTC"			
BN_LTG_HDLP_L		"SYM0"	0x11	0x11	0
		"SYM1"		0x21	1
	0xD134	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0xCDAB	"DTC"			
BN_MSW		"SYM0"	0x11	0x11	0
	0xD102	"SYM1"		0x21	1
	0xD103	"SYM2"		0x3C	2
	0xD104	"SYM3"		0x7C	3
		"GLOBAL"			
	0xCD95	"DTC"			
BN_PBR		"SYM0"	0x11	0x11	0
		"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0xCDB9	"DTC"			
BN_POW_GEN		"SYM0"	0x11	0x11	0
		"SYM1"		0x21	1
	0xD122	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
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	0xCDA3	"DTC"			
BN_POW_VB		"SYM0"	0x11	0x11	0
		"SYM1"		0x21	1
	0xD121	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0xCDA2	"DTC"			
BN_REQ_PBR		"SYM0"	0x11	0x11	0
		"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0xCDBA	"DTC"			
BN_SPT_SWI		"SYM0"	0x00	0x11	0
		"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0xCDBD	"DTC"			
BN_STAT_TCT		"SYM0"	0x11	0x11	0
		"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0xCDC3	"DTC"			
BN_T_CLK		"SYM0"	0x11	0x11	0
		"SYM1"		0x21	1
	0xD13C	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0xCDAE	"DTC"			
BN_T_ICL		"SYM0"	0x56	0x11	0
		"SYM1"		0x21	1
	0xD101	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0xCD94	"DTC"			
BN_TCS		"SYM0"	0x11	0x11	0
		"SYM1"		0x21	1
	0xD126	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0xCDA5	"DTC"			
BN_TQ_AMT		"SYM0"	0x00	0x11	0
	0xD111	"SYM1"		0x21	1
	0xD112	"SYM2"		0x3C	2

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	0xD113	"SYM3"		0x7C	3
		"GLOBAL"			
	0xCD9A	"DTC"			
BN_TQ_DCC		"SYM0"	0x11	0x11	0
	0xD105	"SYM1"		0x21	1
	0xD106	"SYM2"		0x3C	2
	0xD107	"SYM3"		0x7C	3
		"GLOBAL"			
	0xCD96	"DTC"			
BN_TQ_ETCU		"SYM0"	0x56	0x11	0
	0xD10E	"SYM1"		0x21	1
	0xD10F	"SYM2"		0x3C	2
	0xD110	"SYM3"		0x7C	3
		"GLOBAL"			
	0xCD99	"DTC"			
BN_TQ_PBR		"SYM0"	0x11	0x11	0
		"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0xCDC2	"DTC"			
BN_TQ_PSTE_2		"SYM0"	0x11	0x11	0
	0xD108	"SYM1"		0x21	1
	0xD109	"SYM2"		0x3C	2
	0xD10A	"SYM3"		0x7C	3
		"GLOBAL"			
	0xCD97	"DTC"			
BN_TQ_PSTE_3		"SYM0"	0x11	0x11	0
	0xD108	"SYM1"		0x21	1
	0xD109	"SYM2"		0x3C	2
	0xD10A	"SYM3"		0x7C	3
		"GLOBAL"			
	0xCDB3	"DTC"			
BN_TQ_TCS		"SYM0"	0x11	0x11	0
	0xD10B	"SYM1"		0x21	1
	0xD10C	"SYM2"		0x3C	2
	0xD10D	"SYM3"		0x7C	3
		"GLOBAL"			
	0xCD98	"DTC"			
BN_TQ_TCT		"SYM0"	0x00	0x11	0
	0xD10E	"SYM1"		0x21	1
	0xD10F	"SYM2"		0x3C	2
	0xD110	"SYM3"		0x7C	3
		"GLOBAL"			
	0xCDB8	"DTC"			
BN_TRL		"SYM0"	0x11	0x11	0

		"SYM1"		0x21	1
	0xC137	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0xCDAF	"DTC"			
BN_VEH_MOD		"SYM0"	0x11	0x11	0
	0xD114	"SYM1"		0x21	1
	0xD115	"SYM2"		0x3C	2
	0xD116	"SYM3"		0x7C	3
		"GLOBAL"			
	0xCD9B	"DTC"			
BN_VS_TCS		"SYM0"	0x11	0x11	0
		"SYM1"		0x21	1
	0xD118	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0xCD9C	"DTC"			
BN_WHEEL_CAN		"SYM0"	0x56	0x0C	0
		"SYM1"		0x0D	1
	0xD16D	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x3179	"DTC"			
BSD		"SYM0"	0x11	0x11	0
		"SYM1"		0x3C	1
	0xD19D	"SYM2"		0x67	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2E7C	"DTC"			
CAM_CST_IVVT_EX_1		"SYM0"	0x56	0x11	0
		"SYM1"		0x1F	1
		"SYM2"		0x7C	2
	0x054B	"SYM3"		0x3C	3
		"GLOBAL"			
	0x2A7A	"DTC"			
CAM_CST_IVVT_IN_1		"SYM0"	0x56	0x11	0
		"SYM1"		0x1F	1
		"SYM2"		0x7C	2
	0x052B	"SYM3"		0x3C	3
		"GLOBAL"			
	0x2A7C	"DTC"			
CAN_BOFF		"SYM0"	0x56	0x11	0
		"SYM1"		0x32	1
	0x3202	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			

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	0xCD87		"DTC"			
CAT_DIAG_1	0x0420		"SYM0"	0x56	0x11	0
	0x0420		"SYM1"		0x18	1
			"SYM2"		0x1F	2
			"SYM3"		0x1E	3
			"GLOBAL"			
	0x29F4		"DTC"			
CAT_DIAG_2	0x0430		"SYM0"	0x56	0x11	0
	0x0430		"SYM1"		0x18	1
			"SYM2"		0x1F	2
			"SYM3"		0x1E	3
			"GLOBAL"			
	0x29F5		"DTC"			
CAT_DIAG_AFL_1	0x140F		"SYM0"	0x00	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2A26		"DTC"			
CAT_DIAG_AFL_2	0x141F		"SYM0"	0x00	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2A27		"DTC"			
CAT_DIAG_SUM_1			"SYM0"	0x00	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x29F6		"DTC"			
CAT_DIAG_SUM_2			"SYM0"	0x00	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x29F7		"DTC"			
CHG_LS_DOWN			"SYM0"	0x56	0x1F	0
			"SYM1"		0x8B	1
			"SYM2"		0x49	2
	0x0041		"SYM3"		0x4B	3
			"GLOBAL"			
	0x2C6A		"DTC"			
CHG_LS_UP			"SYM0"	0x56	0x05	0
			"SYM1"		0x8B	1
			"SYM2"		0x45	2

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	0x0040	"SYM3"		0x48	3
		"GLOBAL"			
	0x2C24	"DTC"			
CHK_FUC	0x0455	"SYM0"	0x00	0x3B	0
		"SYM1"		0x59	1
		"SYM2"		0x5B	2
		"SYM3"		0x8D	3
		"GLOBAL"			
	0x2A1B	"DTC"			
CHK_LS_DOWN_1	0x2271	"SYM0"	0x56	0x45	0
	0x2270	"SYM1"		0x5C	1
		"SYM2"		0x11	2
		"SYM3"		0x49	3
		"GLOBAL"			
	0x2C6B	"DTC"			
CHK_LS_DOWN_2	0x2273	"SYM0"	0x56	0x48	0
	0x2272	"SYM1"		0x5D	1
		"SYM2"		0x11	2
		"SYM3"		0x4B	3
		"GLOBAL"			
	0x2C6C	"DTC"			
COM_GB		"SYM0"	0x11	0x11	0
		"SYM1"		0x14	1
		"SYM2"		0x32	2
		"SYM3"		0x0D	3
		"GLOBAL"			
	0x2E7F	"DTC"			
CONV_MON_1		"SYM0"	0x58	0xB8	0
		"SYM1"		0x47	1
		"SYM2"		0x54	2
	0x16CE	"SYM3"		0x3C	3
		"GLOBAL"			
	0x2D5C	"DTC"			
CRK_PLAUS	0x0335	"SYM0"	0x58	0x11	0
	0x0336	"SYM1"		0x32	1
		"SYM2"		0x7C	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2A94	"DTC"			
CRK_SYN	0x138F	"SYM0"	0x58	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0x7C	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2A95	"DTC"			
CRK_TOOTH	0x0370	"SYM0"	0x58	0x11	0

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		"SYM1"		0x32	1
		"SYM2"		0x7C	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2A96	"DTC"			
CRK_TOOTH_PER	0x0370	"SYM0"	0x58	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0x7C	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2A97	"DTC"			
CRU_INH_MON_1	0x16A6	"SYM0"	0x11	0xC4	0
	0x16B4	"SYM1"		0x0D	1
	0x166A	"SYM2"		0xB7	2
		"SYM3"		0x81	3
		"GLOBAL"			
	0x2D50	"DTC"			
CS	0x0832	"SYM0"	0x11	0x11	0
	0x0831	"SYM1"		0x0D	1
		"SYM2"		0x32	2
		"SYM3"		0x18	3
		"GLOBAL"			
	0x2F67	"DTC"			
CSERS_INJ	0x1210	"SYM0"	0x56	0x04	0
		"SYM1"		0x05	1
		"SYM2"		0x0C	2
		"SYM3"		0xEF	3
		"GLOBAL"			
	0x2E62	"DTC"			
CTL_LSL_UP_1	0x2627	"SYM0"	0x00	0x45	0
	0x2628	"SYM1"		0x71	1
	0x2246	"SYM2"		0x8C	2
		"SYM3"		0x01	3
		"GLOBAL"			
	0x2C45	"DTC"			
CTL_LSL_UP_2	0x2630	"SYM0"	0x00	0x48	0
	0x2631	"SYM1"		0x73	1
	0x2250	"SYM2"		0x8F	2
		"SYM3"		0x01	3
		"GLOBAL"			
	0x2C46	"DTC"			
CWP_COM		"SYM0"	0x11	0x11	0
		"SYM1"		0x05	1
		"SYM2"		0x7C	2
		"SYM3"		0x3C	3
		"GLOBAL"			

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	0x2E84		"DTC"			
CWP_COM_PLAUS			"SYM0"	0x11	0x11	0
			"SYM1"		0x05	1
			"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2E85		"DTC"			
CWP_INT_OFF	0x15D1		"SYM0"	0x11	0x05	0
	0x15D2		"SYM1"		0xE9	1
			"SYM2"		0xEC	2
			"SYM3"		0xED	3
			"GLOBAL"			
	0x2E82		"DTC"			
CWP_PLAUS	0x15D0		"SYM0"	0x11	0x05	0
			"SYM1"		0xE9	1
			"SYM2"		0xEA	2
			"SYM3"		0xEB	3
			"GLOBAL"			
	0x2E81		"DTC"			
CWP_PWR			"SYM0"	0x11	0x05	0
	0x15D5		"SYM1"		0xE9	1
	0x15D6		"SYM2"		0xEC	2
	0x15D7		"SYM3"		0xEE	3
			"GLOBAL"			
	0x2E83		"DTC"			
CYL_BAL_ER_0			"SYM0"	0x00	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x3070		"DTC"			
CYL_BAL_ER_1			"SYM0"	0x00	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x3074		"DTC"			
CYL_BAL_ER_2			"SYM0"	0x00	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x3072		"DTC"			
CYL_BAL_ER_3			"SYM0"	0x00	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x3C	2

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		"SYM3"		0x7C	3
		"GLOBAL"			
	0x3075	"DTC"			
CYL_BAL_ER_4		"SYM0"	0x00	0x0D	0
		"SYM1"		0x11	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
		0x3071	"DTC"		
CYL_BAL_ER_5		"SYM0"	0x00	0x0D	0
		"SYM1"		0x11	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
		0x3073	"DTC"		
CYL_BAL_LAM_0		"SYM0"	0x00	0x0D	0
		"SYM1"		0x11	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
		0x307C	"DTC"		
CYL_BAL_LAM_1		"SYM0"	0x00	0x0D	0
		"SYM1"		0x11	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
		0x3080	"DTC"		
CYL_BAL_LAM_2		"SYM0"	0x00	0x0D	0
		"SYM1"		0x11	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
		0x307E	"DTC"		
CYL_BAL_LAM_3		"SYM0"	0x00	0x0D	0
		"SYM1"		0x11	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
		0x3081	"DTC"		
CYL_BAL_LAM_4		"SYM0"	0x00	0x0D	0
		"SYM1"		0x11	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
		0x307D	"DTC"		
CYL_BAL_LAM_5		"SYM0"	0x00	0x0D	0

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		"SYM1"		0x11	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x307F	"DTC"			
DCC		"SYM0"	0x11	0x0D	0
		"SYM1"		0x11	1
		"SYM2"		0x32	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2DBE	"DTC"			
DELTA_I_LAM_1	0x2097	"SYM0"	0x76	0x49	0
	0x2096	"SYM1"		0x45	1
		"SYM2"		0x78	2
		"SYM3"		0xF5	3
		"GLOBAL"			
	0x2C31	"DTC"			
DELTA_I_LAM_2	0x2099	"SYM0"	0x76	0x4B	0
	0x2098	"SYM1"		0x48	1
		"SYM2"		0x79	2
		"SYM3"		0xF6	3
		"GLOBAL"			
	0x2C32	"DTC"			
DIAGCPS		"SYM0"	0x56	0x1F	0
		"SYM1"		0x18	1
	0x110E	"SYM2"		0x11	2
	0x0440	"SYM3"		0x4D	3
		"GLOBAL"			
	0x2A1A	"DTC"			
DMTL_MAX	0x1449	"SYM0"	0x56	0x11	0
		"SYM1"		0x3B	1
		"SYM2"		0x59	2
		"SYM3"		0x5A	3
		"GLOBAL"			
	0x2B3A	"DTC"			
DMTL_MIN		"SYM0"	0x56	0x11	0
	0x1448	"SYM1"		0x3B	1
		"SYM2"		0x59	2
		"SYM3"		0x5A	3
		"GLOBAL"			
	0x2B3B	"DTC"			
DMTL_PLAUS		"SYM0"	0x56	0x11	0
		"SYM1"		0x3B	1
		"SYM2"		0x59	2
	0x1447	"SYM3"		0x5A	3
		"GLOBAL"			

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	0x2B3D		"DTC"			
DMTL_PUMP	0x2402		"SYM0"	0x56	0x34	0
	0x2401		"SYM1"		0x74	1
	0x2400		"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A13		"DTC"			
DMTL_SIG			"SYM0"	0x56	0x11	0
			"SYM1"		0x3B	1
	0x1434		"SYM2"		0x59	2
			"SYM3"		0x5A	3
			"GLOBAL"			
	0x2B3C		"DTC"			
DMTLH	0x240C		"SYM0"	0x56	0x34	0
	0x240B		"SYM1"		0x74	1
	0x240A		"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A18		"DTC"			
DMTLS	0x2420		"SYM0"	0x56	0x34	0
	0x2419		"SYM1"		0x74	1
	0x2418		"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A12		"DTC"			
DUR_IGC_MPL			"SYM0"	0x11	0x05	0
			"SYM1"		0x3C	1
			"SYM2"		0x11	2
	0x1383		"SYM3"		0x32	3
			"GLOBAL"			
	0x2E77		"DTC"			
DYN_VLD_LS_UP_1			"SYM0"	0x56	0x71	0
	0x0133		"SYM1"		0x45	1
			"SYM2"		0x30	2
			"SYM3"		0x8C	3
			"GLOBAL"			
	0x2C39		"DTC"			
DYN_VLD_LS_UP_2			"SYM0"	0x56	0x73	0
	0x0153		"SYM1"		0x48	1
			"SYM2"		0x31	2
			"SYM3"		0x8F	3
			"GLOBAL"			
	0x2C3A		"DTC"			
EBOX_CFA	0x3226		"SYM0"	0x11	0x11	0
	0x3227		"SYM1"		0x1E	1
	0x3228		"SYM2"		0x21	2


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		"SYM3"		0x0D	3
		"GLOBAL"			
	0x2F71	"DTC"			
ECF_EL_1	0x0692	"SYM0"	0x11	0x20	0
	0x0691	"SYM1"		0x7F	1
	0x0480	"SYM2"		0x32	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2EFE	"DTC"			
ECFPWM_FB_1		"SYM0"	0x11	0x24	0
		"SYM1"		0x7F	1
		"SYM2"		0x3C	2
	0x14C0	"SYM3"		0x20	3
		"GLOBAL"			
	0x2EFF	"DTC"			
ECRAS_DOWN_FB	0x14C6	"SYM0"	0x11	0x3C	0
		"SYM1"		0x24	1
		"SYM2"		0xD2	2
		"SYM3"		0xD3	3
		"GLOBAL"			
	0x2F10	"DTC"			
ECRAS_EL	0x300A	"SYM0"	0x11	0x11	0
	0x300B	"SYM1"		0x0D	1
	0x300C	"SYM2"		0x3C	2
		"SYM3"		0x80	3
		"GLOBAL"			
	0x2F0D	"DTC"			
ECRAS_UP_FB	0x14C5	"SYM0"	0x11	0x3C	0
	0x14C4	"SYM1"		0x24	1
		"SYM2"		0xD2	2
	0xD130	"SYM3"		0xD3	3
		"GLOBAL"			
	0x2F11	"DTC"			
ECT_EL		"SYM0"	0x56	0x1F	0
	0x0598	"SYM1"		0x20	1
		"SYM2"		0x32	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2EF5	"DTC"			
ECT_EL_OC		"SYM0"	0x56	0x1F	0
		"SYM1"		0x20	1
	0x0597	"SYM2"		0x32	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2EF7	"DTC"			
ECT_EL_SCP	0x0599	"SYM0"	0x56	0x1F	0




		"SYM1"		0x20	1
		"SYM2"		0x32	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2EF8	"DTC"			
ECU_CKS	0x16A0	"SYM0"	0x99	0x11	0
	0x16A1	"SYM1"		0x21	1
	0x16A2	"SYM2"		0x7C	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2AB3	"DTC"			
ECU_NVMMY	0x16A3	"SYM0"	0x56	0x11	0
		"SYM1"		0x21	1
		"SYM2"		0x7C	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2AB4	"DTC"			
ECU_RAM	0x0604	"SYM0"	0x56	0x11	0
	0x0604	"SYM1"		0x21	1
		"SYM2"		0x7C	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2AB2	"DTC"			
EF	0x0478	"SYM0"	0x11	0x0D	0
	0x0477	"SYM1"		0x8B	1
	0x0475	"SYM2"		0xAD	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2F6C	"DTC"			
EFF_IGA_CST_IS	0x050B	"SYM0"	0x56	0x11	0
		"SYM1"		0x0E	1
		"SYM2"		0x1F	2
		"SYM3"		0x04	3
		"GLOBAL"			
	0x2E7A	"DTC"			
EFF_IGA_CST_PL	0x13EA	"SYM0"	0x33	0x11	0
		"SYM1"		0x0E	1
		"SYM2"		0x1F	2
		"SYM3"		0x04	3
		"GLOBAL"			
	0x2E7B	"DTC"			
EFP	0x1214	"SYM0"	0x00	0x32	0
	0x1215	"SYM1"		0x3C	1
	0x1216	"SYM2"		0x7C	2
	0x1217	"SYM3"		0xAF	3
		"GLOBAL"			

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	Document key 10171571 SPE 000 AO	Pages Page 4665 of 8404	
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	0x2AAE		"DTC"			
EFP_CRASH			"SYM0"	0x11	0x32	0
			"SYM1"		0x3C	1
	0x213F		"SYM2"		0x7C	2
			"SYM3"		0xAF	3
			"GLOBAL"			
	0x2AAD		"DTC"			
EFPWM_PLAUS	0x10C4		"SYM0"	0x11	0xF3	0
	0x10C5		"SYM1"		0x11	1
	0x10C6		"SYM2"		0x3C	2
			"SYM3"		0xBA	3
			"GLOBAL"			
	0x2AAF		"DTC"			
EGRV_PSN_PLAUS			"SYM0"	0x00	0x0C	0
			"SYM1"		0xF7	1
			"SYM2"		0x0B	2
			"SYM3"		0xE2	3
			"GLOBAL"			
	0x2A0C		"DTC"			
EGY_MIN			"SYM0"	0x11	0x0D	0
			"SYM1"		0x3C	1
			"SYM2"		0x11	2
			"SYM3"		0x32	3
			"GLOBAL"			
	0x2FC6		"DTC"			
EGY_MIN_2			"SYM0"	0x11	0x11	0
	0x15A9		"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2FC7		"DTC"			
EL_CPS	0x0459		"SYM0"	0x56	0x11	0
	0x0458		"SYM1"		0x32	1
	0x0444		"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A19		"DTC"			
EL_LSL_UP_1	0x0132		"SYM0"	0x56	0x37	0
	0x0131		"SYM1"		0x15	1
			"SYM2"		0x45	2
			"SYM3"		0x27	3
			"GLOBAL"			
	0x2C3F		"DTC"			
EL_LSL_UP_2	0x0152		"SYM0"	0x56	0x38	0
	0x0151		"SYM1"		0x15	1
			"SYM2"		0x48	2

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 4666 of 8404	
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		"SYM3"		0x28	3
		"GLOBAL"			
	0x2C40	"DTC"			
ER_STRAT		"SYM0"	0x00	0x1F	0
		"SYM1"		0x11	1
		"SYM2"		0xD1	2
		"SYM3"		0x0D	3
		"GLOBAL"			
		0x3104	"DTC"		
ER_STRAT_WUP		"SYM0"	0x00	0x1F	0
		"SYM1"		0x11	1
		"SYM2"		0xD1	2
		"SYM3"		0x0D	3
		"GLOBAL"			
		0x3105	"DTC"		
FL_LS_DOWN_1		"SYM0"	0x00	0x96	0
		"SYM1"		0x49	1
		"SYM2"		0x16	2
	0x1204	"SYM3"		0x45	3
		"GLOBAL"			
		0x2C6F	"DTC"		
FL_LS_DOWN_2		"SYM0"	0x00	0x97	0
		"SYM1"		0x4B	1
		"SYM2"		0x16	2
	0x1205	"SYM3"		0x48	3
		"GLOBAL"			
		0x2C70	"DTC"		
FSD_1		"SYM0"	0x76	0x0C	0
		"SYM1"		0x0B	1
	0x0171	"SYM2"		0x13	2
	0x0172	"SYM3"		0xE0	3
		"GLOBAL"			
		0x29E0	"DTC"		
FSD_2		"SYM0"	0x76	0x0C	0
		"SYM1"		0x0B	1
	0x0174	"SYM2"		0x13	2
	0x0175	"SYM3"		0xE0	3
		"GLOBAL"			
		0x29E1	"DTC"		
FSD_H_RNG_1	0x2192	"SYM0"	0x01	0x0C	0
	0x2191	"SYM1"		0x0B	1
		"SYM2"		0x13	2
		"SYM3"		0xE0	3
		"GLOBAL"			
		0x29E5	"DTC"		
FSD_H_RNG_2	0x2194	"SYM0"	0x01	0x0C	0

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	0x2193	"SYM1"		0x0B	1
		"SYM2"		0x13	2
		"SYM3"		0xE0	3
		"GLOBAL"			
	0x29E6	"DTC"			
FSD_LAM_LIM_1	0x0171	"SYM0"	0x76	0x0C	0
	0x0172	"SYM1"		0x0B	1
		"SYM2"		0x13	2
		"SYM3"		0xE0	3
		"GLOBAL"			
	0x2A2B	"DTC"			
FSD_LAM_LIM_2	0x0174	"SYM0"	0x76	0x0C	0
	0x0175	"SYM1"		0x0B	1
		"SYM2"		0x13	2
		"SYM3"		0xE0	3
		"GLOBAL"			
	0x2A2C	"DTC"			
FTL_LE_CAN	0x0463	"SYM0"	0x33	0x0E	0
	0x0462	"SYM1"		0x16	1
		"SYM2"		0x39	2
	0x1407	"SYM3"		0x61	3
		"GLOBAL"			
	0x2DE4	"DTC"			
FTL_MIN	0x142E	"SYM0"	0x58	0x1F	0
	0x142F	"SYM1"		0x18	1
		"SYM2"		0x11	2
	0x140E	"SYM3"		0x3B	3
		"GLOBAL"			
	0x29DC	"DTC"			
FTL_OBD		"SYM0"	0x33	0x0E	0
		"SYM1"		0x16	1
		"SYM2"		0x39	2
	0x144B	"SYM3"		0x61	3
		"GLOBAL"			
	0x2A22	"DTC"			
FTL_RI_CAN	0x2068	"SYM0"	0x33	0x0E	0
	0x2067	"SYM1"		0x16	1
		"SYM2"		0x39	2
	0x1408	"SYM3"		0x61	3
		"GLOBAL"			
	0x2DE5	"DTC"			
FUP	0x0193	"SYM0"	0x58	0x11	0
	0x0192	"SYM1"		0xF0	1
		"SYM2"		0xF4	2
		"SYM3"		0xEF	3
		"GLOBAL"			


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	0x29E2		"DTC"			
FUP_CH	0x15DE		"SYM0"	0x56	0x11	0
	0x15DF		"SYM1"		0x1F	1
			"SYM2"		0xEF	2
			"SYM3"		0xF3	3
	0x2B2C		"GLOBAL" "DTC"			
FUP_EFP	0x2542		"SYM0"	0x11	0x11	0
	0x2541		"SYM1"		0xF4	1
			"SYM2"		0xF3	2
			"SYM3"		0x3B	3
	0x29F3		"GLOBAL" "DTC"			
FUP_EFP_NOT_PLAUS	0x2540		"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
	0x2A29		"GLOBAL" "DTC"			
FUP_MFP_PLAUS	0x10ED		"SYM0"	0x58	0xF0	0
	0x10EE		"SYM1"		0xF2	1
			"SYM2"		0x55	2
			"SYM3"		0x56	3
	0x29F1		"GLOBAL" "DTC"			
FUP_ORNG	0x303A		"SYM0"	0x00	0xF0	0
	0x303A		"SYM1"		0x11	1
	0x303C		"SYM2"		0xF2	2
			"SYM3"		0xBA	3
	0x2FC0		"GLOBAL" "DTC"			
FUP_ST_DLY			"SYM0"	0x01	0x11	0
			"SYM1"		0xF0	1
			"SYM2"		0x25	2
			"SYM3"		0x33	3
	0x2FDA		"GLOBAL" "DTC"			
FUP_ST_H_PRS			"SYM0"	0x01	0x76	0
			"SYM1"		0x77	1
			"SYM2"		0xF3	2
			"SYM3"		0x82	3
	0x2FCA		"GLOBAL" "DTC"			
FUP_ST_NO_RISE			"SYM0"	0x01	0xF0	0
			"SYM1"		0x11	1
			"SYM2"		0x82	2

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		"SYM3"		0x25	3
		"GLOBAL"			
	0x2FDB	"DTC"			
FUP_STOP		"SYM0"	0x11	0xF0	0
		"SYM1"		0xF2	1
		"SYM2"		0x11	2
		"SYM3"		0x32	3
		"GLOBAL"			
		0x2FBE	"DTC"		
GEN	0x0A3B	"SYM0"	0x11	0x44	0
	0x324A	"SYM1"		0x87	1
	0x0620	"SYM2"		0x98	2
	0x3223	"SYM3"		0x15	3
		"GLOBAL"			
		0x2E97	"DTC"		
GEN_CLC_V_NOT_PLAUS	0x325A	"SYM0"	0x11	0x57	0
		"SYM1"		0x87	1
		"SYM2"		0x98	2
		"SYM3"		0x15	3
		"GLOBAL"			
		0x2ECE	"DTC"		
GEN_CTL_NOT_PLAUS	0x324E	"SYM0"	0x11	0x72	0
		"SYM1"		0x35	1
		"SYM2"		0x42	2
		"SYM3"		0x15	3
		"GLOBAL"			
		0x2ED2	"DTC"		
GEN_DIAG	0x3255	"SYM0"	0x11	0x8B	0
		"SYM1"		0x32	1
		"SYM2"		0x7C	2
		"SYM3"		0x3C	3
		"GLOBAL"			
		0x2E96	"DTC"		
GEN_EL	0x0620	"SYM0"	0x11	0x57	0
		"SYM1"		0x87	1
		"SYM2"		0x98	2
		"SYM3"		0x15	3
		"GLOBAL"			
		0x2ECD	"DTC"		
GEN_H_TEMP	0x0A3B	"SYM0"	0x11	0x44	0
		"SYM1"		0x87	1
		"SYM2"		0x57	2
		"SYM3"		0x13	3
		"GLOBAL"			
		0x2ECF	"DTC"		

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 4670 of 8404	
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GEN_H_TEMP_CLC	0x324C	"SYM0"	0x11	0x44	0
		"SYM1"		0x87	1
		"SYM2"		0x57	2
		"SYM3"		0x13	3
		"GLOBAL"			
	0x2ED0	"DTC"			
GEN_MEC	0x3223	"SYM0"	0x11	0x8B	0
		"SYM1"		0x87	1
		"SYM2"		0x98	2
		"SYM3"		0x15	3
		"GLOBAL"			
	0x2ED1	"DTC"			
GEN_MSG_LOST	0xD132	"SYM0"	0x11	0x8B	0
		"SYM1"		0x35	1
		"SYM2"		0x42	2
		"SYM3"		0x15	3
		"GLOBAL"			
	0x2ECC	"DTC"			
GEN_TYP_NOT_PLAUS	0x324A	"SYM0"	0x11	0x8B	0
		"SYM1"		0x35	1
		"SYM2"		0x42	2
		"SYM3"		0x15	3
		"GLOBAL"			
	0x2ED3	"DTC"			
GS		"SYM0"	0x01	0x32	0
		"SYM1"		0x81	1
		"SYM2"		0x7C	2
	0x0700	"SYM3"		0x3C	3
		"GLOBAL"			
	0x2AD0	"DTC"			
H_PRS_SYS_PRE		"SYM0"	0x00	0x00	0
		"SYM1"		0x00	1
		"SYM2"		0x00	2
		"SYM3"		0x00	3
		"GLOBAL"			
		"DTC"			
IGC_SCG_0		"SYM0"	0x11	0x05	0
	0x1301	"SYM1"		0x3C	1
		"SYM2"		0x11	2
		"SYM3"		0xB1	3
		"GLOBAL"			
	0x2E18	"DTC"			
IGC_SCG_1		"SYM0"	0x11	0x05	0
	0x1305	"SYM1"		0x3C	1
		"SYM2"		0x11	2
		"SYM3"		0xB2	3

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		"GLOBAL"			
	0x2E1C	"DTC"			
IGC_SCG_2		"SYM0"	0x11	0x05	0
	0x1303	"SYM1"		0x3C	1
		"SYM2"		0x11	2
		"SYM3"		0xB3	3
		"GLOBAL"			
	0x2E1A	"DTC"			
IGC_SCG_3		"SYM0"	0x11	0x05	0
	0x1306	"SYM1"		0x3C	1
		"SYM2"		0x11	2
		"SYM3"		0xB4	3
		"GLOBAL"			
	0x2E1D	"DTC"			
IGC_SCG_4		"SYM0"	0x11	0x05	0
	0x1302	"SYM1"		0x3C	1
		"SYM2"		0x11	2
		"SYM3"		0xB5	3
		"GLOBAL"			
	0x2E19	"DTC"			
IGC_SCG_5		"SYM0"	0x11	0x05	0
	0x1304	"SYM1"		0x3C	1
		"SYM2"		0x11	2
		"SYM3"		0xB6	3
		"GLOBAL"			
	0x2E1B	"DTC"			
IGC_SCP_0	0x2301	"SYM0"	0x11	0x05	0
		"SYM1"		0x3C	1
		"SYM2"		0x11	2
		"SYM3"		0xB1	3
		"GLOBAL"			
	0x30A0	"DTC"			
IGC_SCP_1	0x2313	"SYM0"	0x11	0x05	0
		"SYM1"		0x3C	1
		"SYM2"		0x11	2
		"SYM3"		0xB2	3
		"GLOBAL"			
	0x30A4	"DTC"			
IGC_SCP_2	0x2307	"SYM0"	0x11	0x05	0
		"SYM1"		0x3C	1
		"SYM2"		0x11	2
		"SYM3"		0xB3	3
		"GLOBAL"			
	0x30A2	"DTC"			
IGC_SCP_3	0x2316	"SYM0"	0x11	0x05	0
		"SYM1"		0x3C	1

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4672 of 8404</b>	
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		"SYM2"		0x11	2
		"SYM3"		0xB4	3
		"GLOBAL"			
	0x30A5	"DTC"			
IGC_SCP_4	0x2304	"SYM0"	0x11	0x05	0
		"SYM1"		0x3C	1
		"SYM2"		0x11	2
		"SYM3"		0xB5	3
		"GLOBAL"			
	0x30A1	"DTC"			
IGC_SCP_5	0x2310	"SYM0"	0x11	0x05	0
		"SYM1"		0x3C	1
		"SYM2"		0x11	2
		"SYM3"		0xB6	3
		"GLOBAL"			
	0x30A3	"DTC"			
IM_BLS_PLAUS		"SYM0"	0x11	0xCE	0
		"SYM1"		0xB7	1
		"SYM2"		0x7C	2
	0x0571	"SYM3"		0x4A	3
		"GLOBAL"			
	0x2F63	"DTC"			
IM_BTS_PLAUS		"SYM0"	0x11	0xCE	0
		"SYM1"		0xB7	1
		"SYM2"		0x7C	2
	0x0703	"SYM3"		0x4A	3
		"GLOBAL"			
	0x2F64	"DTC"			
IMOB_0		"SYM0"	0x11	0x11	0
	0x1667	"SYM1"		0x3C	1
		"SYM2"		0x7C	2
	0x16CF	"SYM3"		0x21	3
		"GLOBAL"			
	0x2F49	"DTC"			
IMOB_1	0x165A	"SYM0"	0x11	0x11	0
	0x1660	"SYM1"		0x3C	1
	0x1661	"SYM2"		0x7C	2
	0x165B	"SYM3"		0x21	3
		"GLOBAL"			
	0x2F4A	"DTC"			
IMOB_2	0x165C	"SYM0"	0x11	0x11	0
	0x165D	"SYM1"		0x3C	1
	0x1668	"SYM2"		0x7C	2
	0x165E	"SYM3"		0x21	3
		"GLOBAL"			
	0x2F4B	"DTC"			

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IMOB_3		"SYM0"	0x11	0x11	0
	0xD166	"SYM1"		0x3C	1
	0xC167	"SYM2"		0x7C	2
		"SYM3"		0x21	3
		"GLOBAL"			
	0x2F4C	"DTC"			
ISC	0x0507	"SYM0"	0x56	0x11	0
	0x0506	"SYM1"		0x12	1
		"SYM2"		0x13	2
		"SYM3"		0x14	3
		"GLOBAL"			
	0x2ADF	"DTC"			
ISC_CST	0x1562	"SYM0"	0x56	0x11	0
	0x1561	"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2AE0	"DTC"			
IV_0	0x0201	"SYM0"	0x58	0x11	0
	0x310B	"SYM1"		0x1F	1
	0x310B	"SYM2"		0x32	2
	0x0201	"SYM3"		0x3C	3
		"GLOBAL"			
	0x2E30	"DTC"			
IV_1	0x0205	"SYM0"	0x58	0x11	0
	0x312B	"SYM1"		0x1F	1
	0x312B	"SYM2"		0x32	2
	0x0205	"SYM3"		0x3C	3
		"GLOBAL"			
	0x2E34	"DTC"			
IV_2	0x0203	"SYM0"	0x58	0x11	0
	0x311B	"SYM1"		0x1F	1
	0x311B	"SYM2"		0x32	2
	0x0203	"SYM3"		0x3C	3
		"GLOBAL"			
	0x2E32	"DTC"			
IV_3	0x0206	"SYM0"	0x58	0x11	0
	0x312E	"SYM1"		0x1F	1
	0x312E	"SYM2"		0x32	2
	0x0206	"SYM3"		0x3C	3
		"GLOBAL"			
	0x2E35	"DTC"			
IV_4	0x0202	"SYM0"	0x58	0x11	0
	0x310E	"SYM1"		0x1F	1
	0x310E	"SYM2"		0x32	2
	0x0202	"SYM3"		0x3C	3

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4674 of 8404</b>	
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		"GLOBAL"			
	0x2E31	"DTC"			
IV_5	0x0204	"SYM0"	0x58	0x11	0
	0x311E	"SYM1"		0x1F	1
	0x311E	"SYM2"		0x32	2
	0x0204	"SYM3"		0x3C	3
		"GLOBAL"			
	0x2E33	"DTC"			
IV_SC_0	0x3149	"SYM0"	0x11	0x11	0
	0x3102	"SYM1"		0x1F	1
	0x3150	"SYM2"		0x32	2
	0x3101	"SYM3"		0x3C	3
		"GLOBAL"			
	0x30AC	"DTC"			
IV_SC_1	0x3161	"SYM0"	0x11	0x11	0
	0x3118	"SYM1"		0x1F	1
	0x3162	"SYM2"		0x32	2
	0x3117	"SYM3"		0x3C	3
		"GLOBAL"			
	0x30B0	"DTC"			
IV_SC_2	0x3155	"SYM0"	0x11	0x11	0
	0x3110	"SYM1"		0x1F	1
	0x3156	"SYM2"		0x32	2
	0x3109	"SYM3"		0x3C	3
		"GLOBAL"			
	0x30AE	"DTC"			
IV_SC_3	0x3164	"SYM0"	0x11	0x11	0
	0x3122	"SYM1"		0x1F	1
	0x3165	"SYM2"		0x32	2
	0x3121	"SYM3"		0x3C	3
		"GLOBAL"			
	0x30B1	"DTC"			
IV_SC_4	0x3152	"SYM0"	0x11	0x11	0
	0x3106	"SYM1"		0x1F	1
	0x3153	"SYM2"		0x32	2
	0x3105	"SYM3"		0x3C	3
		"GLOBAL"			
	0x30AD	"DTC"			
IV_SC_5	0x3158	"SYM0"	0x11	0x11	0
	0x3114	"SYM1"		0x1F	1
	0x3159	"SYM2"		0x32	2
	0x3113	"SYM3"		0x3C	3
		"GLOBAL"			
	0x30AF	"DTC"			
KNK_PRE_0		"SYM0"	0x01	0x11	0
		"SYM1"		0x13	1

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		"SYM2"		0x1E	2
	0x13A0	"SYM3"		0x1F	3
		"GLOBAL"			
	0x30ED	"DTC"			
KNK_PRE_1		"SYM0"	0x01	0x11	0
		"SYM1"		0x13	1
		"SYM2"		0x1E	2
	0x13A4	"SYM3"		0x1F	3
		"GLOBAL"			
	0x30F1	"DTC"			
KNK_PRE_2		"SYM0"	0x01	0x11	0
		"SYM1"		0x13	1
		"SYM2"		0x1E	2
	0x13A2	"SYM3"		0x1F	3
		"GLOBAL"			
	0x30EF	"DTC"			
KNK_PRE_3		"SYM0"	0x01	0x11	0
		"SYM1"		0x13	1
		"SYM2"		0x1E	2
	0x13A5	"SYM3"		0x1F	3
		"GLOBAL"			
	0x30F2	"DTC"			
KNK_PRE_4		"SYM0"	0x01	0x11	0
		"SYM1"		0x13	1
		"SYM2"		0x1E	2
	0x13A1	"SYM3"		0x1F	3
		"GLOBAL"			
	0x30EE	"DTC"			
KNK_PRE_5		"SYM0"	0x01	0x11	0
		"SYM1"		0x13	1
		"SYM2"		0x1E	2
	0x13A3	"SYM3"		0x1F	3
		"GLOBAL"			
	0x30F0	"DTC"			
KNKS_1	0x0328	"SYM0"	0x58	0x11	0
	0x0327	"SYM1"		0x12	1
		"SYM2"		0x83	2
	0x0326	"SYM3"		0x85	3
		"GLOBAL"			
	0x2E68	"DTC"			
KNKS_2	0x1328	"SYM0"	0x58	0x11	0
	0x1327	"SYM1"		0x12	1
		"SYM2"		0x86	2
	0x135B	"SYM3"		0x88	3
		"GLOBAL"			
	0x2E69	"DTC"			

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L_PRS_SYS	0x008B	"SYM0"	0x11	0xF3	0
	0x3095	"SYM1"		0x11	1
	0x008A	"SYM2"		0x3C	2
		"SYM3"		0xBA	3
		"GLOBAL"			
	0x2A2D	"DTC"			
LAM_AD_CUS_1		"SYM0"	0x56	0x11	0
	0x119D	"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2E74	"DTC"			
LAM_AD_CUS_2		"SYM0"	0x56	0x11	0
	0x119E	"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2E75	"DTC"			
LDM	0x166B	"SYM0"	0x11	0x11	0
		"SYM1"		0x13	1
		"SYM2"		0x32	2
	0x166C	"SYM3"		0x91	3
		"GLOBAL"			
	0x2DC0	"DTC"			
LOAD_TPS_PLAUS	0x00BD	"SYM0"	0x00	0x0C	0
	0x00BC	"SYM1"		0x12	1
		"SYM2"		0x58	2
		"SYM3"		0x89	3
		"GLOBAL"			
	0x2D06	"DTC"			
LOCAN_BOFF		"SYM0"	0x11	0x11	0
		"SYM1"		0x21	1
	0x3205	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0xCD8B	"DTC"			
LSH_DOWN_1	0x0038	"SYM0"	0x56	0x96	0
	0x0037	"SYM1"		0x5C	1
	0x0036	"SYM2"		0x49	2
		"SYM3"		0x29	3
		"GLOBAL"			
	0x2C9E	"DTC"			
LSH_DOWN_2	0x0058	"SYM0"	0x56	0x97	0
	0x0057	"SYM1"		0x5D	1
	0x0056	"SYM2"		0x4B	2
		"SYM3"		0x2A	3


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		"GLOBAL"			
	0x2C9F	"DTC"			
LSH_LSL_UP_1	0x2231	"SYM0"	0x00	0x15	0
		"SYM1"		0x45	1
		"SYM2"		0x3B	2
		"SYM3"		0x8C	3
		"GLOBAL"			
	0x2C37	"DTC"			
LSH_LSL_UP_2	0x2234	"SYM0"	0x00	0x15	0
		"SYM1"		0x48	1
		"SYM2"		0x3B	2
		"SYM3"		0x8F	3
		"GLOBAL"			
	0x2C38	"DTC"			
LSH_UP_1	0x0032	"SYM0"	0x56	0x8C	0
	0x0031	"SYM1"		0x8B	1
	0x0030	"SYM2"		0x15	2
		"SYM3"		0x27	3
		"GLOBAL"			
	0x2C9C	"DTC"			
LSH_UP_2	0x0052	"SYM0"	0x56	0x8F	0
	0x0051	"SYM1"		0x8B	1
	0x0050	"SYM2"		0x15	2
		"SYM3"		0x28	3
		"GLOBAL"			
	0x2C9D	"DTC"			
LSL_UP_IF_1	0x3024	"SYM0"	0x56	0x9B	0
	0x3022	"SYM1"		0x2C	1
		"SYM2"		0x45	2
		"SYM3"		0x15	3
		"GLOBAL"			
	0x2C41	"DTC"			
LSL_UP_IF_2	0x3025	"SYM0"	0x56	0x9C	0
	0x3023	"SYM1"		0x2D	1
		"SYM2"		0x48	2
		"SYM3"		0x15	3
		"GLOBAL"			
	0x2C42	"DTC"			
MAF		"SYM0"	0x00	0xAE	0
		"SYM1"		0x11	1
		"SYM2"		0x58	2
		"SYM3"		0x1E	3
		"GLOBAL"			
	0x2D0F	"DTC"			
MAF_FRQ_EL_0	0x0100	"SYM0"	0x00	0x12	0
	0x00BD	"SYM1"		0x18	1

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		"SYM2"		0x0C	2
		"SYM3"		0x0F	3
		"GLOBAL"			
	0x2D27	"DTC"			
MAF_FRQ_GRD_0		"SYM0"	0x00	0x12	0
		"SYM1"		0x18	1
		"SYM2"		0x0C	2
		"SYM3"		0x0F	3
		"GLOBAL"			
		0x2D17	"DTC"		
MAF_FRQ_RNG_0	0x00BC	"SYM0"	0x00	0x12	0
		"SYM1"		0x18	1
		"SYM2"		0x0C	2
		"SYM3"		0x0F	3
		"GLOBAL"			
		0x2D15	"DTC"		
MAF_LAMB_MAX		"SYM0"	0x01	0x11	0
		"SYM1"		0xDD	1
		"SYM2"		0x06	2
		"SYM3"		0x07	3
		"GLOBAL"			
		0x2D18	"DTC"		
MAP_DIP_PLAUS		"SYM0"	0x00	0x11	0
		"SYM1"		0x26	1
		"SYM2"		0x0B	2
		"SYM3"		0x13	3
		"GLOBAL"			
		0x2D34	"DTC"		
MAP_DIP_SENS	0x0108	"SYM0"	0x56	0x0B	0
	0x0107	"SYM1"		0x11	1
		"SYM2"		0x1F	2
		"SYM3"		0x7C	3
		"GLOBAL"			
		0x2D33	"DTC"		
MAP_DIP_SHIFT		"SYM0"	0x00	0x1E	0
		"SYM1"		0x1F	1
		"SYM2"		0x0B	2
	0x119C	"SYM3"		0x3C	3
		"GLOBAL"			
		0x2D35	"DTC"		
MAP_PLAUS		"SYM0"	0x56	0x34	0
		"SYM1"		0x0B	1
		"SYM2"		0xDD	2
	0x129B	"SYM3"		0xDE	3
		"GLOBAL"			
		0x2D2B	"DTC"		

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4679 of 8404</b>	
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MAP_TPS_PLAUS	0x112F	"SYM0"	0x56	0x11	0
	0x112E	"SYM1"		0x26	1
		"SYM2"		0x0B	2
		"SYM3"		0x13	3
		"GLOBAL"			
	0x2D2E	"DTC"			
MEC_IVVT_EX		"SYM0"	0x58	0x11	0
		"SYM1"		0x1C	1
		"SYM2"		0x1D	2
	0x0015	"SYM3"		0x1F	3
		"GLOBAL"			
	0x2A87	"DTC"			
MEC_IVVT_IN		"SYM0"	0x58	0x11	0
		"SYM1"		0x1A	1
		"SYM2"		0x1B	2
	0x0012	"SYM3"		0x1F	3
		"GLOBAL"			
	0x2A82	"DTC"			
MFF_MON_1		"SYM0"	0x58	0xC2	0
		"SYM1"		0x18	1
		"SYM2"		0x0A	2
	0x323F	"SYM3"		0xA7	3
		"GLOBAL"			
	0x2D60	"DTC"			
MIS_0	0x0301	"SYM0"	0x76	0x1F	0
	0x0301	"SYM1"		0xE5	1
	0x0301	"SYM2"		0x11	2
		"SYM3"		0x06	3
		"GLOBAL"			
	0x29CD	"DTC"			
MIS_1	0x0305	"SYM0"	0x76	0x1F	0
	0x0305	"SYM1"		0xE5	1
	0x0305	"SYM2"		0x11	2
		"SYM3"		0x08	3
		"GLOBAL"			
	0x29D1	"DTC"			
MIS_2	0x0303	"SYM0"	0x76	0x1F	0
	0x0303	"SYM1"		0xE5	1
	0x0303	"SYM2"		0x11	2
		"SYM3"		0x06	3
		"GLOBAL"			
	0x29CF	"DTC"			
MIS_3	0x0306	"SYM0"	0x76	0x1F	0
	0x0306	"SYM1"		0xE5	1
	0x0306	"SYM2"		0x11	2
		"SYM3"		0x08	3

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		"GLOBAL"			
	0x29D2	"DTC"			
MIS_4	0x0302	"SYM0"	0x76	0x1F	0
	0x0302	"SYM1"		0xE5	1
	0x0302	"SYM2"		0x11	2
		"SYM3"		0x06	3
		"GLOBAL"			
	0x29CE	"DTC"			
MIS_5	0x0304	"SYM0"	0x76	0x1F	0
	0x0304	"SYM1"		0xE5	1
	0x0304	"SYM2"		0x11	2
		"SYM3"		0x08	3
		"GLOBAL"			
	0x29D0	"DTC"			
MIS_FTL_L		"SYM0"	0x11	0xF0	0
	0x0313	"SYM1"		0x6D	1
		"SYM2"		0x34	2
		"SYM3"		0x3B	3
		"GLOBAL"			
	0x29D9	"DTC"			
MIS_MPL	0x0300	"SYM0"	0x56	0x24	0
	0x0300	"SYM1"		0xF0	1
	0x0300	"SYM2"		0x3C	2
	0x0300	"SYM3"		0x6D	3
		"GLOBAL"			
	0x29CC	"DTC"			
MON_3	0x0605	"SYM0"	0x11	0xD9	0
	0x0604	"SYM1"		0xDA	1
	0x0606	"SYM2"		0xAA	2
	0x060C	"SYM3"		0xA9	3
		"GLOBAL"			
	0x2D67	"DTC"			
MSW_2		"SYM0"	0x11	0x0D	0
		"SYM1"		0x7A	1
		"SYM2"		0x32	2
	0x1576	"SYM3"		0x7C	3
		"GLOBAL"			
	0x2DB5	"DTC"			
MSW_3		"SYM0"	0x11	0x0D	0
		"SYM1"		0x7A	1
		"SYM2"		0x32	2
	0x1563	"SYM3"		0x7C	3
		"GLOBAL"			
	0x2DB6	"DTC"			
MSW_TOG		"SYM0"	0x11	0x0D	0
		"SYM1"		0x7A	1

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		"SYM2"		0x32	2
	0x155A	"SYM3"		0x7C	3
		"GLOBAL"			
	0x2DB7	"DTC"			
MTC_CTL_1	0x1638	"SYM0"	0x58	0x58	0
		"SYM1"		0x3F	1
		"SYM2"		0x43	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2CEC	"DTC"			
MTC_CTL_2	0x1639	"SYM0"	0x58	0x58	0
		"SYM1"		0x3F	1
		"SYM2"		0x43	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2CED	"DTC"			
MTC_CTL_3	0x11AA	"SYM0"	0x58	0x58	0
		"SYM1"		0x3F	1
		"SYM2"		0x43	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2CEE	"DTC"			
MTC_DR		"SYM0"	0x58	0x58	0
		"SYM1"		0x3F	1
	0x061F	"SYM2"		0x7C	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2CEF	"DTC"			
N_32_MON_1		"SYM0"	0x58	0x11	0
		"SYM1"		0xB8	1
		"SYM2"		0xC0	2
	0x16A9	"SYM3"		0x32	3
		"GLOBAL"			
	0x2D52	"DTC"			
N_MAX_DRIV_REQ		"SYM0"	0x11	0x11	0
		"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2F91	"DTC"			
N_MAX_HOMS		"SYM0"	0x00	0x8B	0
		"SYM1"		0x0C	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2B00	"DTC"			

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4682 of 8404</b>	
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N_WHEEL_FN_LE		"SYM0"	0x56	0x0D	0
		"SYM1"		0x11	1
		"SYM2"		0x15	2
	0x15B8	"SYM3"		0x81	3
		"GLOBAL"			
	0x2FE5	"DTC"			
N_WHEEL_FN_RI		"SYM0"	0x56	0x0D	0
		"SYM1"		0x11	1
		"SYM2"		0x15	2
	0x15B9	"SYM3"		0x81	3
		"GLOBAL"			
	0x2FE7	"DTC"			
N_WHEEL_RE_LE		"SYM0"	0x56	0x0D	0
		"SYM1"		0x11	1
		"SYM2"		0x15	2
	0x15C8	"SYM3"		0x81	3
		"GLOBAL"			
	0x2FE4	"DTC"			
N_WHEEL_RE_RI		"SYM0"	0x56	0x0D	0
		"SYM1"		0x11	1
		"SYM2"		0x15	2
	0x15C9	"SYM3"		0x81	3
		"GLOBAL"			
	0x2FE6	"DTC"			
NEUT_PSN_GB_LRN		"SYM0"	0x00	0x11	0
		"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2FD0	"DTC"			
NEUT_PSN_GB_PLAUS		"SYM0"	0x00	0x11	0
		"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2FCF	"DTC"			
NOX_SENS_1		"SYM0"	0x00	0x11	0
		"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2EB0	"DTC"			
NOX_SENS_2		"SYM0"	0x00	0x11	0
		"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"SYM3"		0x7C	3

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4683 of 8404</b>	
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		"GLOBAL"			
	0x2EB1	"DTC"			
NS_ACT_1	0x2201	"SYM0"	0x01	0xA2	0
		"SYM1"		0xA1	1
		"SYM2"		0xA3	2
		"SYM3"		0x10	3
		"GLOBAL"			
	0x30D6	"DTC"			
NS_AFR_1	0x123C	"SYM0"	0x01	0xA3	0
	0x123D	"SYM1"		0xA1	1
	0x123E	"SYM2"		0x89	2
		"SYM3"		0xA2	3
		"GLOBAL"			
	0x30D8	"DTC"			
NS_AVL_1	0x124C	"SYM0"	0x01	0xA4	0
	0x124D	"SYM1"		0x36	1
		"SYM2"		0xA2	2
		"SYM3"		0x10	3
		"GLOBAL"			
	0x30DA	"DTC"			
NS_GAIN_1		"SYM0"	0x01	0xA4	0
		"SYM1"		0xA1	1
		"SYM2"		0xA6	2
		"SYM3"		0xA5	3
		"GLOBAL"			
	0x2AFE	"DTC"			
NS_HTP_1	0x125A	"SYM0"	0x01	0xA4	0
	0x125B	"SYM1"		0x8B	1
	0x125C	"SYM2"		0x0F	2
		"SYM3"		0x6A	3
		"GLOBAL"			
	0x30DC	"DTC"			
NS_LSL_UP_DOWN_1	0x126A	"SYM0"	0x01	0xA2	0
		"SYM1"		0x89	1
		"SYM2"		0x8A	2
		"SYM3"		0xA3	3
		"GLOBAL"			
	0x30DE	"DTC"			
NS_OBD_1_HTP_1		"SYM0"	0x01	0x10	0
		"SYM1"		0x32	1
	0x2205	"SYM2"		0x53	2
	0x121C	"SYM3"		0xA4	3
		"GLOBAL"			
	0x2B05	"DTC"			
NS_OBD_1_LAMB_1		"SYM0"	0x01	0x10	0
		"SYM1"		0x32	1

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	0x121E	"SYM2"		0x53	2
	0x121F	"SYM3"		0xA4	3
		"GLOBAL"			
	0x2B06	"DTC"			
NS_OBD_1_NOX_1		"SYM0"	0x01	0x10	0
		"SYM1"		0x32	1
	0x2200	"SYM2"		0x53	2
	0x122C	"SYM3"		0xA4	3
		"GLOBAL"			
	0x2B07	"DTC"			
NS_OBD_1_VLS_1		"SYM0"	0x01	0x10	0
		"SYM1"		0x32	1
	0x122E	"SYM2"		0x53	2
	0x122F	"SYM3"		0xA4	3
		"GLOBAL"			
	0x2AFB	"DTC"			
NS_OFS_1	0x126C	"SYM0"	0x01	0x10	0
		"SYM1"		0xA6	1
		"SYM2"		0x9E	2
		"SYM3"		0xA5	3
		"GLOBAL"			
	0x30E0	"DTC"			
NS_PUC_1	0x126E	"SYM0"	0x01	0x49	0
	0x126F	"SYM1"		0xA1	1
	0x127B	"SYM2"		0xA6	2
	0x127A	"SYM3"		0xA3	3
		"GLOBAL"			
	0x30E2	"DTC"			
NS_SHIFT_1		"SYM0"	0x11	0xE3	0
		"SYM1"		0xD1	1
		"SYM2"		0x49	2
		"SYM3"		0x4B	3
		"GLOBAL"			
	0x2AEC	"DTC"			
NS_STOP_1	0x128A	"SYM0"	0x01	0x49	0
	0x128B	"SYM1"		0xA3	1
		"SYM2"		0x4B	2
		"SYM3"		0x10	3
		"GLOBAL"			
	0x30E4	"DTC"			
NS_VERS_1		"SYM0"	0x11	0x4A	0
		"SYM1"		0x32	1
		"SYM2"		0x1F	2
		"SYM3"		0x8B	3
		"GLOBAL"			
	0x2AED	"DTC"			

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4685 of 8404</b>	
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NS_VLS_DYN_1	0x128E	"SYM0"	0x01	0xA2	0
		"SYM1"		0x4B	1
		"SYM2"		0xA1	2
		"SYM3"		0x10	3
		"GLOBAL"			
	0x30E6	"DTC"			
NT_AGI	0x2000	"SYM0"	0x01	0x11	0
		"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x30E9	"DTC"			
NT_SO2P		"SYM0"	0x00	0xA5	0
		"SYM1"		0xA6	1
		"SYM2"		0x9E	2
		"SYM3"		0xA0	3
		"GLOBAL"			
	0x30EA	"DTC"			
OBD_LSH_DOWN_1	0x0141	"SYM0"	0x56	0x96	0
		"SYM1"		0x5C	1
		"SYM2"		0x29	2
		"SYM3"		0x49	3
		"GLOBAL"			
	0x2CA8	"DTC"			
OBD_LSH_DOWN_2	0x0161	"SYM0"	0x56	0x97	0
		"SYM1"		0x5D	1
		"SYM2"		0x2A	2
		"SYM3"		0x4B	3
		"GLOBAL"			
	0x2CA9	"DTC"			
OBD_VLD_LSH_UP_1	0x3026	"SYM0"	0x56	0x94	0
		"SYM1"		0x15	1
	0x165F	"SYM2"		0x27	2
		"SYM3"		0x8C	3
		"GLOBAL"			
	0x2CA6	"DTC"			
OBD_VLD_LSH_UP_2	0x3027	"SYM0"	0x56	0x95	0
		"SYM1"		0x15	1
	0x166F	"SYM2"		0x28	2
		"SYM3"		0x8F	3
		"GLOBAL"			
	0x2CA7	"DTC"			
OC_LS_DOWN_1		"SYM0"	0x56	0x96	0
		"SYM1"		0x5C	1
	0x0136	"SYM2"		0x49	2
		"SYM3"		0x8B	3

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 4686 of 8404	
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		"GLOBAL"			
	0x2C77	"DTC"			
OC_LS_DOWN_2		"SYM0"	0x56	0x97	0
		"SYM1"		0x5D	1
	0x0156	"SYM2"		0x4B	2
		"SYM3"		0x8B	3
		"GLOBAL"			
	0x2C78	"DTC"			
OC_LSL_UP_1	0x2243	"SYM0"	0x56	0x71	0
	0x112C	"SYM1"		0x9B	1
	0x112C	"SYM2"		0x45	2
	0x2626	"SYM3"		0x8C	3
		"GLOBAL"			
	0x2C3D	"DTC"			
OC_LSL_UP_2	0x2247	"SYM0"	0x56	0x73	0
	0x112D	"SYM1"		0x9C	1
	0x112D	"SYM2"		0x48	2
	0x2629	"SYM3"		0x8F	3
		"GLOBAL"			
	0x2C3E	"DTC"			
OFS_LSL_UP_1		"SYM0"	0x00	0x9B	0
		"SYM1"		0x8B	1
		"SYM2"		0x21	2
		"SYM3"		0x15	3
		"GLOBAL"			
	0x2C43	"DTC"			
OFS_LSL_UP_2		"SYM0"	0x00	0x9C	0
		"SYM1"		0x8B	1
		"SYM2"		0x21	2
		"SYM3"		0x15	3
		"GLOBAL"			
	0x2C44	"DTC"			
PBK_IV_1	0x10A5	"SYM0"	0x58	0x11	0
	0x10A6	"SYM1"		0x1F	1
	0x10A7	"SYM2"		0x32	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x30BA	"DTC"			
PBK_IV_2	0x10A8	"SYM0"	0x58	0x11	0
	0x10A9	"SYM1"		0x1F	1
	0x10AA	"SYM2"		0x32	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x30BB	"DTC"			
PER_CAM_EX_1	0x130A	"SYM0"	0x58	0x11	0
		"SYM1"		0x32	1

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		"SYM2"		0x22	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2AA3	"DTC"			
PER_CAM_IN_1	0x1300	"SYM0"	0x58	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0x22	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2AA2	"DTC"			
PLAUS_CAM_EX_1	0x0365	"SYM0"	0x58	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0x22	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2AA1	"DTC"			
PLAUS_CAM_IN_1	0x0340	"SYM0"	0x58	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0x22	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2AA0	"DTC"			
PLAUS_IGK_3	0x15B0	"SYM0"	0x11	0x11	0
	0x15B1	"SYM1"		0x32	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2ACA	"DTC"			
PLAUS_IGK_BN	0x15B0	"SYM0"	0x11	0x11	0
	0x15B1	"SYM1"		0x32	1
	0x15B2	"SYM2"		0x3C	2
	0x15B3	"SYM3"		0x7C	3
		"GLOBAL"			
	0x2DC3	"DTC"			
PLAUS_IV_CAL		"SYM0"	0x11	0x11	0
		"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x30BE	"DTC"			
POIL_CTL_DYN	0x159E	"SYM0"	0x00	0x11	0
		"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x30C0	"DTC"			

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POIL_CTL_MEC	0x15A1	"SYM0"	0x00	0x11	0
	0x15A2	"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x30C4	"DTC"			
POIL_CTL_STAT	0x159F	"SYM0"	0x00	0x11	0
	0x15A0	"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x30C1	"DTC"			
POIL_DR	0x15EC	"SYM0"	0x00	0x11	0
	0x15EB	"SYM1"		0x22	1
	0x15EA	"SYM2"		0x6F	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x30C2	"DTC"			
POIL_DR_SCG		"SYM0"	0x00	0x11	0
		"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x30C9	"DTC"			
POIL_PUMP	0x15A3	"SYM0"	0x00	0x11	0
	0x0524	"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x30C5	"DTC"			
POIL_SENS_PLAUS	0x15A6	"SYM0"	0x00	0x11	0
	0x15A7	"SYM1"		0x21	1
		"SYM2"		0x3C	2
	0x0521	"SYM3"		0x7C	3
		"GLOBAL"			
	0x30C6	"DTC"			
POIL_SWI		"SYM0"	0x11	0x11	0
		"SYM1"		0x22	1
	0x0520	"SYM2"		0x1F	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2F7B	"DTC"			
POIL_SYS	0x15A5	"SYM0"	0x00	0x11	0
		"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3

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		"GLOBAL"			
	0x30C7	"DTC"			
PUC_LS_DOWN_1		"SYM0"	0x56	0x96	0
		"SYM1"		0x5C	1
		"SYM2"		0x49	2
	0x013E	"SYM3"		0x45	3
		"GLOBAL"			
	0x2C7B	"DTC"			
PUC_LS_DOWN_2		"SYM0"	0x56	0x97	0
		"SYM1"		0x5D	1
		"SYM2"		0x4B	2
	0x014A	"SYM3"		0x48	3
		"GLOBAL"			
	0x2C7C	"DTC"			
PUC_VLD_LS_UP_1	0x2297	"SYM0"	0x56	0x0B	0
		"SYM1"		0x45	1
		"SYM2"		0x7D	2
		"SYM3"		0x8C	3
		"GLOBAL"			
	0x2C2D	"DTC"			
PUC_VLD_LS_UP_2	0x2298	"SYM0"	0x56	0x0B	0
		"SYM1"		0x48	1
		"SYM2"		0x7E	2
		"SYM3"		0x8F	3
		"GLOBAL"			
	0x2C2E	"DTC"			
PUE_LS_DOWN_1		"SYM0"	0x56	0x96	0
		"SYM1"		0x5C	1
		"SYM2"		0x06	2
	0x013B	"SYM3"		0x49	3
		"GLOBAL"			
	0x2C79	"DTC"			
PUE_LS_DOWN_2		"SYM0"	0x56	0x97	0
		"SYM1"		0x5D	1
		"SYM2"		0x08	2
	0x013D	"SYM3"		0x4B	3
		"GLOBAL"			
	0x2C7A	"DTC"			
PUT_EL	0x0238	"SYM0"	0x58	0x11	0
	0x0237	"SYM1"		0xDD	1
		"SYM2"		0x58	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2ABC	"DTC"			
PUT_PLAUS		"SYM0"	0x58	0x34	0
		"SYM1"		0x0B	1

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4690 of 8404</b>	
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		"SYM2"		0xDD	2
	0x129A	"SYM3"		0xDE	3
		"GLOBAL"			
	0x2ABD	"DTC"			
PVS_1	0x2123	"SYM0"	0x22	0x46	0
	0x2122	"SYM1"		0x47	1
		"SYM2"		0x43	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2D1B	"DTC"			
PVS_2	0x2128	"SYM0"	0x22	0x46	0
	0x2127	"SYM1"		0x47	1
		"SYM2"		0x54	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2D1C	"DTC"			
PVS_BLS_NOT_PLAUS		"SYM0"	0x11	0xB7	0
		"SYM1"		0x0D	1
		"SYM2"		0x14	2
	0x2299	"SYM3"		0xCE	3
		"GLOBAL"			
	0x2F8F	"DTC"			
PVS_DOUBLE		"SYM0"	0x58	0x43	0
		"SYM1"		0x54	1
		"SYM2"		0x46	2
	0x1224	"SYM3"		0x47	3
		"GLOBAL"			
	0x2D1F	"DTC"			
PVS_MON_1		"SYM0"	0x58	0xC4	0
		"SYM1"		0xB9	1
		"SYM2"		0xE7	2
	0x16B0	"SYM3"		0xE8	3
		"GLOBAL"			
	0x2D55	"DTC"			
PVS_RATIO		"SYM0"	0x22	0x46	0
		"SYM1"		0x47	1
		"SYM2"		0x43	2
	0x2138	"SYM3"		0x14	3
		"GLOBAL"			
	0x2D20	"DTC"			
QOIL_COM		"SYM0"	0x11	0x11	0
		"SYM1"		0x0D	1
	0x252A	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2EA1	"DTC"			

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4691 of 8404</b>	
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QOIL_SENS	0x1586	"SYM0"	0x11	0x11	0
	0x1587	"SYM1"		0x32	1
	0x1521	"SYM2"		0x7C	2
	0x15B4	"SYM3"		0x3C	3
		"GLOBAL"			
	0x2E9F	"DTC"			
RAS		"SYM0"	0x11	0x11	0
		"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2F5E	"DTC"			
REF_CRK_CAM_EX_1	0x13B6	"SYM0"	0x58	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0x22	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2A99	"DTC"			
REF_CRK_CAM_IN_1	0x13B4	"SYM0"	0x58	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0x22	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2A98	"DTC"			
RFP_DR	0x0035	"SYM0"	0x00	0x11	0
	0x0034	"SYM1"		0x1F	1
	0x0033	"SYM2"		0x7C	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x30CA	"DTC"			
RLY_ACCOUT	0x0647	"SYM0"	0x11	0x11	0
	0x0646	"SYM1"		0x0D	1
	0x0645	"SYM2"		0x1F	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2F12	"DTC"			
RLY_CRCV_HEAT	0x053C	"SYM0"	0x11	0x24	0
	0x053B	"SYM1"		0x3A	1
	0x053A	"SYM2"		0x8B	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2AE4	"DTC"			
RLY_MAIN	0x0687	"SYM0"	0x11	0x8B	0
	0x0686	"SYM1"		0x4A	1
		"SYM2"		0x7C	2
		"SYM3"		0x3C	3

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		"GLOBAL"			
	0x2ACB	"DTC"			
RLY_MAIN_DLY	0x16C5	"SYM0"	0x11	0x43	0
		"SYM1"		0x4A	1
		"SYM2"		0x7C	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2ACC	"DTC"			
RLY_MTC_HEAT	0x167B	"SYM0"	0x11	0x8B	0
	0x167C	"SYM1"		0x0C	1
	0x167D	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2D0B	"DTC"			
RLY_ST	0x0512	"SYM0"	0x11	0x8B	0
	0x0512	"SYM1"		0x4A	1
	0x0512	"SYM2"		0x53	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2F58	"DTC"			
ROUGH_LEAK	0x0442	"SYM0"	0x56	0x3B	0
		"SYM1"		0x59	1
		"SYM2"		0x5A	2
		"SYM3"		0x8D	3
		"GLOBAL"			
	0x2A15	"DTC"			
SCG_LS_DOWN_1		"SYM0"	0x56	0x96	0
	0x0137	"SYM1"		0x5C	1
		"SYM2"		0x49	2
		"SYM3"		0x8B	3
		"GLOBAL"			
	0x2C75	"DTC"			
SCG_LS_DOWN_2		"SYM0"	0x56	0x97	0
	0x0157	"SYM1"		0x5D	1
		"SYM2"		0x4B	2
		"SYM3"		0x8B	3
		"GLOBAL"			
	0x2C76	"DTC"			
SCP_LS_DOWN_1	0x0138	"SYM0"	0x56	0x96	0
		"SYM1"		0x5C	1
		"SYM2"		0x49	2
		"SYM3"		0x8B	3
		"GLOBAL"			
	0x2C73	"DTC"			
SCP_LS_DOWN_2	0x0158	"SYM0"	0x56	0x97	0
		"SYM1"		0x5D	1


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		"SYM2"		0x4B	2
		"SYM3"		0x8B	3
		"GLOBAL"			
	0x2C74	"DTC"			
SEG_AD_ER		"SYM0"	0x56	0x11	0
	0x1396	"SYM1"		0x3C	1
		"SYM2"		0xF8	2
		"SYM3"		0xF9	3
		"GLOBAL"			
	0x29DA	"DTC"			
SENS_ACR	0x040A	"SYM0"	0x00	0xFC	0
	0x040C	"SYM1"		0xF7	1
		"SYM2"		0xE4	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2A10	"DTC"			
SENS_BAT_SMT_COM		"SYM0"	0x11	0x7C	0
		"SYM1"		0x24	1
	0x150B	"SYM2"		0x6A	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2E8E	"DTC"			
SENS_POIL	0x0523	"SYM0"	0x00	0x0D	0
	0x0522	"SYM1"		0x11	1
		"SYM2"		0x22	2
		"SYM3"		0x6F	3
		"GLOBAL"			
	0x30C3	"DTC"			
SHIFT_AFL_LSL_UP_1	0x2195	"SYM0"	0x56	0x8C	0
		"SYM1"		0x49	1
		"SYM2"		0x71	2
		"SYM3"		0x45	3
		"GLOBAL"			
	0x2C27	"DTC"			
SHIFT_AFL_LSL_UP_2	0x2197	"SYM0"	0x56	0x8F	0
		"SYM1"		0x4B	1
		"SYM2"		0x73	2
		"SYM3"		0x48	3
		"GLOBAL"			
	0x2C28	"DTC"			
SHIFT_AFR_LSL_UP_1	0x2196	"SYM0"	0x56	0x8C	0
		"SYM1"		0x49	1
		"SYM2"		0x71	2
		"SYM3"		0x45	3
		"GLOBAL"			
	0x2C2B	"DTC"			

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SHIFT_AFR_LSL_UP_2	0x2198	"SYM0"	0x56	0x8F	0
		"SYM1"		0x4B	1
		"SYM2"		0x73	2
		"SYM3"		0x48	3
		"GLOBAL"			
	0x2C2C	"DTC"			
SLV_IVVT_EX	0x2091	"SYM0"	0x58	0x11	0
	0x2090	"SYM1"		0x32	1
	0x0013	"SYM2"		0x7C	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2A85	"DTC"			
SLV_IVVT_IN	0x2089	"SYM0"	0x58	0x11	0
	0x2088	"SYM1"		0x32	1
	0x0010	"SYM2"		0x7C	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2A80	"DTC"			
SMALL_LEAK		"SYM0"	0x56	0x3B	0
	0x0456	"SYM1"		0x11	1
		"SYM2"		0x5B	2
		"SYM3"		0x8D	3
		"GLOBAL"			
	0x2B28	"DTC"			
SOF	0x15AC	"SYM0"	0x00	0x11	0
	0x15AD	"SYM1"		0x0D	1
	0x15AE	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2AC1	"DTC"			
SOF_REQ	0x1540	"SYM0"	0x11	0x11	0
	0x1541	"SYM1"		0x0D	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2AC6	"DTC"			
SPI_KNK		"SYM0"	0x58	0x11	0
		"SYM1"		0x21	1
	0x16A4	"SYM2"		0x7C	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2AB5	"DTC"			
SPI_MPS		"SYM0"	0x56	0x11	0
		"SYM1"		0x21	1
	0x16A5	"SYM2"		0x7C	2
		"SYM3"		0x3C	3

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Released by Tetenborn Frank		Date 2013-02-13	File 43A01503.00F
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 4695 of 8404	
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		"GLOBAL"			
	0x2AB6	"DTC"			
SWI_AFS_MON		"SYM0"	0x11	0xFE	0
		"SYM1"		0x2E	1
		"SYM2"		0x2F	2
		"SYM3"		0x9D	3
		"GLOBAL"			
	0x2D64	"DTC"			
SWT_LS_DOWN_1		"SYM0"	0x56	0x96	0
		"SYM1"		0x5C	1
		"SYM2"		0x10	2
	0x013A	"SYM3"		0x49	3
		"GLOBAL"			
	0x2C6D	"DTC"			
SWT_LS_DOWN_2		"SYM0"	0x56	0x97	0
		"SYM1"		0x5D	1
		"SYM2"		0x10	2
	0x013C	"SYM3"		0x4B	3
		"GLOBAL"			
	0x2C6E	"DTC"			
SYN_CAM_EX_1	0x13B2	"SYM0"	0x58	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0x22	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2A9F	"DTC"			
SYN_CAM_IN_1	0x13B0	"SYM0"	0x58	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0x22	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2A9E	"DTC"			
SYN_CRK_CAM_EX_1	0x0017	"SYM0"	0x22	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0x22	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2A9B	"DTC"			
SYN_CRK_CAM_IN_1	0x0016	"SYM0"	0x58	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0x22	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2A9A	"DTC"			
T_ES		"SYM0"	0x56	0x11	0
		"SYM1"		0x32	1

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	0x2610	"SYM2"		0x82	2
		"SYM3"		0x23	3
		"GLOBAL"			
	0x2F81	"DTC"			
T_ES_DIAG_1		"SYM0"	0x00	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0x82	2
		"SYM3"		0x23	3
		"GLOBAL"			
	0x2F82	"DTC"			
T_ES_DIAG_2		"SYM0"	0x11	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0x82	2
		"SYM3"		0x23	3
		"GLOBAL"			
	0x2F83	"DTC"			
T_ES_DIAG_3		"SYM0"	0x11	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0x82	2
		"SYM3"		0x23	3
		"GLOBAL"			
	0x2F84	"DTC"			
T_ES_ICO_FAST		"SYM0"	0x56	0x11	0
		"SYM1"		0x33	1
		"SYM2"		0x82	2
	0x15E9	"SYM3"		0x23	3
		"GLOBAL"			
	0x2F7F	"DTC"			
T_ES_ICO_SLOW		"SYM0"	0x56	0x11	0
		"SYM1"		0x33	1
		"SYM2"		0x82	2
	0x15E8	"SYM3"		0x23	3
		"GLOBAL"			
	0x2F7E	"DTC"			
T_SEG_ER		"SYM0"	0x11	0x11	0
	0x0370	"SYM1"		0x1F	1
		"SYM2"		0x18	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x29DB	"DTC"			
TAM_CAN	0x0073	"SYM0"	0x56	0x24	0
	0x0072	"SYM1"		0x33	1
	0x110F	"SYM2"		0x1E	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2F9A	"DTC"			

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Released by <b>Tettenborn Frank</b>		Date <b>2013-02-13</b>	File <b>43A01503.00F</b>
	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4697 of 8404</b>	
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TAM_PLAUS		"SYM0"	0x56	0x24	0
		"SYM1"		0x33	1
		"SYM2"		0x82	2
	0x10EC	"SYM3"		0x20	3
		"GLOBAL"			
	0x2F99	"DTC"			
TCHA_LEAK		"SYM0"	0x00	0x34	0
		"SYM1"		0x24	1
		"SYM2"		0xDD	2
	0x15AA	"SYM3"		0x0C	3
		"GLOBAL"			
	0x30FC	"DTC"			
TCHA_PRS_CTL		"SYM0"	0x22	0x34	0
		"SYM1"		0x24	1
		"SYM2"		0xDD	2
	0x1260	"SYM3"		0x0C	3
		"GLOBAL"			
	0x3100	"DTC"			
TCHA_PRS_DIF		"SYM0"	0x00	0x34	0
		"SYM1"		0x24	1
		"SYM2"		0xDD	2
		"SYM3"		0x0C	3
		"GLOBAL"			
	0x30FD	"DTC"			
TCHA_PRS_HIGH		"SYM0"	0x22	0x34	0
		"SYM1"		0x24	1
		"SYM2"		0xDD	2
	0x0234	"SYM3"		0x0C	3
		"GLOBAL"			
	0x30FE	"DTC"			
TCHA_PRS_LOW		"SYM0"	0x22	0x34	0
		"SYM1"		0x24	1
		"SYM2"		0xDD	2
	0x0299	"SYM3"		0x0C	3
		"GLOBAL"			
	0x30FF	"DTC"			
TCHA_SYS_1		"SYM0"	0x00	0x11	0
		"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x3101	"DTC"			
TCO_2_EL	0x00B4	"SYM0"	0x00	0x52	0
	0x00B3	"SYM1"		0x20	1
		"SYM2"		0x24	2
		"SYM3"		0x1E	3

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		"GLOBAL"			
	0x2EEA	"DTC"			
TCO_2_GRD		"SYM0"	0x00	0x20	0
		"SYM1"		0x1F	1
		"SYM2"		0x24	2
	0x00B2	"SYM3"		0xEA	3
		"GLOBAL"			
	0x2EEB	"DTC"			
TCO_2_PLAUS	0x3196	"SYM0"	0x00	0x20	0
		"SYM1"		0x82	1
		"SYM2"		0x1F	2
	0x3195	"SYM3"		0x32	3
		"GLOBAL"			
	0x2EEC	"DTC"			
TCO_EL	0x0118	"SYM0"	0x56	0x50	0
	0x0117	"SYM1"		0x1F	1
		"SYM2"		0x24	2
		"SYM3"		0x1E	3
		"GLOBAL"			
	0x2EE0	"DTC"			
TCO_GRD		"SYM0"	0x56	0x1F	0
		"SYM1"		0x20	1
		"SYM2"		0x24	2
	0x0116	"SYM3"		0x7F	3
		"GLOBAL"			
	0x2EE3	"DTC"			
TCO_PLAUS		"SYM0"	0x00	0x1F	0
		"SYM1"		0x20	1
		"SYM2"		0x3C	2
	0x0125	"SYM3"		0xEC	3
		"GLOBAL"			
	0x2EE1	"DTC"			
TCO_STUCK		"SYM0"	0x56	0x1F	0
		"SYM1"		0x20	1
		"SYM2"		0x24	2
	0x316B	"SYM3"		0x82	3
		"GLOBAL"			
	0x2EE2	"DTC"			
TCO_STUCK_RNG		"SYM0"	0x56	0x23	0
		"SYM1"		0x82	1
		"SYM2"		0x3A	2
	0x316A	"SYM3"		0x33	3
		"GLOBAL"			
	0x2EE6	"DTC"			
TECU	0x0669	"SYM0"	0x11	0x41	0
	0x0668	"SYM1"		0x21	1

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		"SYM2"		0x24	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2F85	"DTC"			
TEG_PCAT_DOWN	0x0546	"SYM0"	0x01	0x11	0
	0x0545	"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
		0x2C87	"DTC"		
TH		"SYM0"	0x56	0x24	0
		"SYM1"		0x82	1
		"SYM2"		0x20	2
	0x0128	"SYM3"		0x11	3
		"GLOBAL"			
		0x2EF4	"DTC"		
TIA_EL	0x007D	"SYM0"	0x58	0x51	0
	0x007C	"SYM1"		0x1E	1
		"SYM2"		0x24	2
		"SYM3"		0x3C	3
		"GLOBAL"			
		0x2F13	"DTC"		
TIA_GRD		"SYM0"	0x58	0x1E	0
		"SYM1"		0x13	1
	0x10D0	"SYM2"		0x24	2
	0x007B	"SYM3"		0x1F	3
		"GLOBAL"			
		0x2F30	"DTC"		
TIA_PLAUS	0x10B0	"SYM0"	0x58	0x1E	0
	0x10B1	"SYM1"		0x3A	1
		"SYM2"		0x24	2
	0x10B8	"SYM3"		0x1F	3
		"GLOBAL"			
		0x2F15	"DTC"		
TIA_TCHA_UP	0x104E	"SYM0"	0x00	0x51	0
	0x104F	"SYM1"		0x1E	1
		"SYM2"		0x24	2
		"SYM3"		0xD5	3
		"GLOBAL"			
		0x2F0A	"DTC"		
TOIL_LEVEL		"SYM0"	0x11	0x11	0
	0x250F	"SYM1"		0x21	1
	0x250A	"SYM2"		0x3C	2
	0x250B	"SYM3"		0x7C	3
		"GLOBAL"			
		0x2F9E	"DTC"		

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TOOTH_OFF_EX_1	0x13BC	"SYM0"	0x58	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0x22	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2AA5	"DTC"			
TOOTH_OFF_IN_1	0x13BA	"SYM0"	0x58	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0x22	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2AA4	"DTC"			
TOUT_NOX_SENS_1		"SYM0"	0x00	0x11	0
		"SYM1"		0x21	1
	0xC29D	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2EAE	"DTC"			
TOUT_NOX_SENS_2		"SYM0"	0x00	0x11	0
		"SYM1"		0x21	1
	0xC29E	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2EAF	"DTC"			
TPS		"SYM0"	0x58	0x11	0
		"SYM1"		0x1E	1
	0x110D	"SYM2"		0x1F	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2D09	"DTC"			
TPS_1	0x0123	"SYM0"	0x58	0x4E	0
	0x0122	"SYM1"		0x4C	1
		"SYM2"		0x43	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2CF9	"DTC"			
TPS_2	0x0223	"SYM0"	0x58	0x4E	0
	0x0222	"SYM1"		0x4C	1
		"SYM2"		0x43	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2CFA	"DTC"			
TPS_AD	0x1632	"SYM0"	0x58	0x4E	0
	0x1633	"SYM1"		0x4C	1
	0x1694	"SYM2"		0xB0	2
	0x16BC	"SYM3"		0x3C	3


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		"GLOBAL"			
	0x2CFB	"DTC"			
TPS_AD_BOL	0x1635	"SYM0"	0x58	0x4E	0
		"SYM1"		0x4C	1
		"SYM2"		0x43	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2CFE	"DTC"			
TPS_JAM_DET	0x164E	"SYM0"	0x00	0x8B	0
	0x164F	"SYM1"		0x0C	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2D0C	"DTC"			
TPS_MAF_1		"SYM0"	0x58	0xAB	0
		"SYM1"		0xE4	1
		"SYM2"		0x4C	2
	0x1141	"SYM3"		0x4E	3
		"GLOBAL"			
	0x2CF6	"DTC"			
TPS_MAF_2		"SYM0"	0x58	0xAC	0
		"SYM1"		0xE4	1
		"SYM2"		0x4C	2
	0x1162	"SYM3"		0x4E	3
		"GLOBAL"			
	0x2CF7	"DTC"			
TPS_MON_1		"SYM0"	0x58	0x58	0
		"SYM1"		0xB8	1
		"SYM2"		0x4E	2
	0x060E	"SYM3"		0x4C	3
		"GLOBAL"			
	0x2D61	"DTC"			
TPS_RATIO		"SYM0"	0x58	0x4E	0
		"SYM1"		0x4C	1
		"SYM2"		0x43	2
	0x115F	"SYM3"		0x3C	3
		"GLOBAL"			
	0x2D07	"DTC"			
TPS_ST_CHK_1	0x1675	"SYM0"	0x11	0x4E	0
		"SYM1"		0x4C	1
		"SYM2"		0x43	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2CFD	"DTC"			
TPS_ST_CHK_2	0x16BA	"SYM0"	0x58	0x4E	0
	0x169A	"SYM1"		0x4C	1

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		"SYM2"		0x43	2
		"SYM3"		0x3C	3
		"GLOBAL"			
	0x2CFC	"DTC"			
TQ_CST	0x1559	"SYM0"	0x00	0x11	0
		"SYM1"		0x21	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2AE1	"DTC"			
TQ_DIF_ISC_MON_1		"SYM0"	0x58	0xC3	0
		"SYM1"		0xC7	1
	0x16B1	"SYM2"		0xC8	2
	0x16B2	"SYM3"		0xCA	3
		"GLOBAL"			
	0x2D56	"DTC"			
TQ_EXT_MON_1	0x16B3	"SYM0"	0x11	0x81	0
		"SYM1"		0xBF	1
	0x16B5	"SYM2"		0x93	2
	0x16B6	"SYM3"		0x3C	3
		"GLOBAL"			
	0x2D57	"DTC"			
TQ_REQ_CAN		"SYM0"	0x01	0x11	0
		"SYM1"		0x2B	1
		"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2DC5	"DTC"			
TQ_REQ_MON_1	0x16B7	"SYM0"	0x58	0xD4	0
	0x16B8	"SYM1"		0xD6	1
	0x16B9	"SYM2"		0xCD	2
		"SYM3"		0x32	3
		"GLOBAL"			
	0x2D58	"DTC"			
TQI_AV_MON_1		"SYM0"	0x58	0xB8	0
		"SYM1"		0xCF	1
		"SYM2"		0xD0	2
	0x16C1	"SYM3"		0x75	3
		"GLOBAL"			
	0x2D59	"DTC"			
TQI_LIM		"SYM0"	0x11	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0xCF	2
		"SYM3"		0xD1	3
		"GLOBAL"			
	0x2D5A	"DTC"			

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TQI_N_MAX_MON_1		"SYM0"	0x58	0xC5	0
		"SYM1"		0xC6	1
		"SYM2"		0xDB	2
	0x16C2	"SYM3"		0xDC	3
		"GLOBAL"			
	0x2D53	"DTC"			
TTIP_MES_LSH_UP_1	0x3026	"SYM0"	0x56	0x94	0
		"SYM1"		0x15	1
	0x165F	"SYM2"		0x27	2
		"SYM3"		0x45	3
		"GLOBAL"			
	0x2CAA	"DTC"			
TTIP_MES_LSH_UP_2	0x3027	"SYM0"	0x56	0x95	0
		"SYM1"		0x15	1
	0x166F	"SYM2"		0x28	2
		"SYM3"		0x48	3
		"GLOBAL"			
	0x2CAB	"DTC"			
V_REF_1		"SYM0"	0x58	0x43	0
		"SYM1"		0x54	1
		"SYM2"		0x46	2
	0x164C	"SYM3"		0x3C	3
		"GLOBAL"			
	0x2D1D	"DTC"			
V_REF_2		"SYM0"	0x58	0x43	0
		"SYM1"		0x54	1
		"SYM2"		0x47	2
	0x1625	"SYM3"		0x3C	3
		"GLOBAL"			
	0x2D1E	"DTC"			
VAR_COD		"SYM0"	0x11	0x11	0
		"SYM1"		0x3C	1
	0x3287	"SYM2"		0x7C	2
	0x3239	"SYM3"		0x8B	3
		"GLOBAL"			
	0x2FA3	"DTC"			
VCV	0x0004	"SYM0"	0x58	0xF2	0
	0x0003	"SYM1"		0xF0	1
	0x0001	"SYM2"		0xE4	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2FBC	"DTC"			
VCV_PLAUS		"SYM0"	0x00	0xF0	0
		"SYM1"		0x11	1
		"SYM2"		0xF2	2
		"SYM3"		0xBA	3

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		"GLOBAL"			
	0x2FC3	"DTC"			
VEH_POW_VAR		"SYM0"	0x11	0x11	0
		"SYM1"		0x3C	1
		"SYM2"		0x7C	2
		"SYM3"		0x8B	3
		"GLOBAL"			
	0x2FA4	"DTC"			
VIM_1_EL	0x0662	"SYM0"	0x11	0x11	0
	0x0661	"SYM1"		0x0D	1
	0x1511	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2AA8	"DTC"			
VIM_2_EL	0x0662	"SYM0"	0x11	0x11	0
	0x0661	"SYM1"		0x0D	1
	0x1511	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2AA9	"DTC"			
VIM_PLAUS		"SYM0"	0x11	0x11	0
		"SYM1"		0x1F	1
		"SYM2"		0x32	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x2AAA	"DTC"			
VIMPWM_1_FB		"SYM0"	0x11	0x3C	0
		"SYM1"		0x0C	1
		"SYM2"		0x18	2
	0x14C2	"SYM3"		0x24	3
		"GLOBAL"			
	0x2AAB	"DTC"			
VIMPWM_2_FB		"SYM0"	0x11	0x3C	0
		"SYM1"		0x0C	1
		"SYM2"		0x18	2
	0x14C3	"SYM3"		0x24	3
		"GLOBAL"			
	0x2AAC	"DTC"			
VLS_DOWN_DIF_1	0x114A	"SYM0"	0x56	0x49	0
	0x114B	"SYM1"		0x45	1
		"SYM2"		0x78	2
		"SYM3"		0xF5	3
		"GLOBAL"			
	0x2C7E	"DTC"			
VLS_DOWN_DIF_2	0x114C	"SYM0"	0x56	0x4B	0
	0x114D	"SYM1"		0x48	1


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		"SYM2"		0x79	2
		"SYM3"		0xF6	3
		"GLOBAL"			
	0x2C7F	"DTC"			
VS		"SYM0"	0x56	0x11	0
		"SYM1"		0x32	1
	0x1505	"SYM2"		0xD1	2
		"SYM3"		0x81	3
		"GLOBAL"			
	0x2F5F	"DTC"			
VS_BOL		"SYM0"	0x11	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0xD1	2
		"SYM3"		0x81	3
		"GLOBAL"			
	0x2F56	"DTC"			
VS_GRD		"SYM0"	0x11	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0xD1	2
		"SYM3"		0x81	3
		"GLOBAL"			
	0x2F57	"DTC"			
VS_PLAUS_POW		"SYM0"	0x11	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0xD1	2
		"SYM3"		0x81	3
		"GLOBAL"			
	0x2F5D	"DTC"			
VS_PLAUS_STUCK		"SYM0"	0x11	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0xD1	2
		"SYM3"		0x81	3
		"GLOBAL"			
	0x2F5B	"DTC"			
VS_TOL		"SYM0"	0x11	0x11	0
		"SYM1"		0x32	1
		"SYM2"		0xD1	2
		"SYM3"		0x81	3
		"GLOBAL"			
	0x2F5C	"DTC"			
WARM_RST	0x0602	"SYM0"	0x01	0x67	0
		"SYM1"		0x3D	1
	0x1640	"SYM2"		0x3E	2
	0x1615	"SYM3"		0x40	3
		"GLOBAL"			
	0x2D5F	"DTC"			

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WG_1_DR	0x0246	"SYM0"	0x22	0x11	0
	0x0245	"SYM1"		0x1F	1
	0x0243	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x30CF	"DTC"			
WG_2_DR	0x0250	"SYM0"	0x22	0x11	0
	0x0249	"SYM1"		0x1F	1
	0x0247	"SYM2"		0x3C	2
		"SYM3"		0x7C	3
		"GLOBAL"			
	0x30D0	"DTC"			
WHEEL_GRD_FR_LE	0x15DA	"SYM0"	0x56	0x0D	0
		"SYM1"		0x11	1
		"SYM2"		0x15	2
		"SYM3"		0xE5	3
		"GLOBAL"			
	0x2F52	"DTC"			
WHEEL_GRD_FR_RI	0x15DB	"SYM0"	0x56	0x0D	0
		"SYM1"		0x11	1
		"SYM2"		0x15	2
		"SYM3"		0xE5	3
		"GLOBAL"			
	0x2F53	"DTC"			
WHEEL_GRD_RE_LE	0x15DC	"SYM0"	0x56	0x0D	0
		"SYM1"		0x11	1
		"SYM2"		0x15	2
		"SYM3"		0xE5	3
		"GLOBAL"			
	0x2F54	"DTC"			
WHEEL_GRD_RE_RI	0x15DD	"SYM0"	0x56	0x0D	0
		"SYM1"		0x11	1
		"SYM2"		0x15	2
		"SYM3"		0xE5	3
		"GLOBAL"			
	0x2F55	"DTC"			

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## A.71 Canister purge valve diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_EL_CPS	V	0... 7H	0...7	1	-
Diagnosis condition for each symptom of CPS; bit 0: diagnosis condition for symptom SYM_0; bit 1: diagnosis condition for symptom SYM_1; bit 2: diagnosis condition for symptom SYM_2					
CPPWM_LIH	O/V	0... FFH	0... 99.60937	0.390625	%
PWM signal for CPS opening limp home value					
ERR_DIAG_EL_CPS	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for CPS (only parameter)					
ERR_SYM_EL_CPS	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of the failure					
LV_ERR_EL_CPS	O/V/S	0... 1H	0...1	1	-
Logical value for present electrical canister purge valve failure					

### Input data:

CPPWM_CPS {p. 3749}	LV_IGK {p. 906}	LV_INH_DIAG_EL_CPS {p. 4712}	LV_ST {p. 1720}
---------------------	-----------------	---------------------------------	-----------------

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_EL_CPS_DIAG	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_EL_CPS_DIAG	-	0... FFH	0... 255	1	-
Maximum value for antibounce counter					
C_CPPWM_DIAG_MAX_SCG	-	0... FFH	0... 99.60937	0.390625	%
Maximum threshold for SCG diagnosis window					
C_CPPWM_DIAG_MIN_OC	-	0... FFH	0... 99.60937	0.390625	%
Minimum threshold for OC diagnosis window					
C_CPPWM_DIAG_MIN_SCP	-	0... FFH	0... 99.60937	0.390625	%
Minimum threshold for SCP diagnosis window					
C_CPPWM_SUB_DIAG_1	-	0... FFH	0... 99.60937	0.390625	%
cppwm substitute when SCG failure					
C_CPPWM_SUB_DIAG_2	-	0... FFH	0... 99.60937	0.390625	%
cppwm substitute when SCB or OL failure					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_CPS	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (typical 2)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**Import actions:**

<b>ACTION_ERRM_FilterMulticondition</b> (IN<XX>,IN<CDN_DIAG_>,XX>,<IN<>,ERR_DIAG_XX>,<IN>,<C_ABC_INC_XX>,IN<C_ABC_MAX_XX>,<OUT<LV_ERR_XX>)
<b>ACTION_INFR_GetEIDiagCPS</b> (OUT<CDN_DIAG_EL_CPS>,<OUT<ERR_DIAG_EL_CPS>)

**Error treatment:**

Diagnostic	Symptom description	Symptom	Filter type
<b>CPS</b>			
CPS Diagnostic	SCP	SYM_0	MPL_STD_INI
	SCG	SYM_1	
	OC	SYM_2	

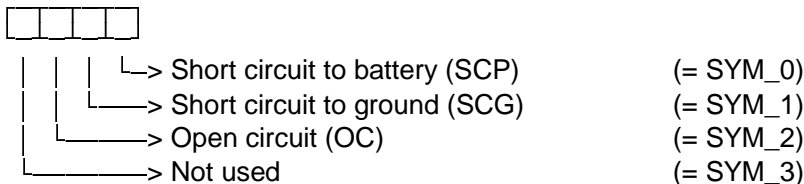
**General information:**

The CPS is driven by the ECU via an output driver. The failure detection is done by ECU Hardware.

The purpose of the diagnosis is

The purpose is to perform the electrical diagnosis of the CPS actuator to detect electrical faults as defined by OBD I requirements. Three symptoms are distinguished:

**Error-symptoms and conditions:** are defined to this diagnosis function as following

**Application conditions**

**Initialisation:** LV\_ERR\_EL\_CPS is initialized according filter-type.  
at reset: CDN\_DIAG\_EL\_CPS = 0


**Recurrence:** 100ms

**Activation:** -

**Deactivation:** -

**Formula section:**

// Usage of the diagnosis information (failure symptoms (raw value) ERR\_DIAG\_EL\_CPS and diagnosis conditions CDN\_DIAG\_EL\_CPS) received from the infrastructure:

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**ACTION\_INFR\_GetEIDiagCPS** (OUT<CDN\_DIAG\_EL\_CPS>, OUT<ERR\_DIAG\_EL\_CPS>, SYNCRONIZATION<CALL>)

// Diagnosis conditions are set according infrastructure information: CDN\_DIAG\_EL\_CPS. Failure symptoms (raw value) are set according infrastructure information: ERR\_DIAG\_EL\_CPS

```

if      LV_IGK                = 1
and     LV_ST                  = 0

and     LV_INH_DIAG_EL_CPS    = 0
then    if      activation conditions are met for NC_PSD_DLY_CPS recurrences
then    // additional diagnosis conditions
          // conditions that disable SCP detection
          if      CPPWM_CPS < C_CPPWM_DIAG_MIN_SCP
          then    bit 0 of CDN_DIAG_EL_CPS = 0      // diagnosis of SCP is not possible
          endif

          // conditions that disable SCG detection
          if      CPPWM_CPS > C_CPPWM_DIAG_MAX_SCG
          then    bit 1 of CDN_DIAG_EL_CPS = 0      // diagnosis of SCG is not possible
          endif

          // conditions that disable OC detection
          if      CPPWM_CPS < C_CPPWM_DIAG_MIN_OC
          or      CPPWM_CPS > C_CPPWM_DIAG_MAX_SCG
          then    bit 2 of CDN_DIAG_EL_CPS = 0      // diagnosis of OC is not possible
          endif
else    CDN_DIAG_EL_CPS = 0
else    CDN_DIAG_EL_CPS = 0
endif

```

// Failure filtering and error management treatment

For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN\_DIAG\_EL\_CPS and ERR\_DIAG\_EL\_CPS; this algorithm determines:

- ERR\_SYM\_EL\_CPS (detected error symptom for CPS diagnosis)
- LV\_ERR\_EL\_CPS (Error flag for debounced error of CPS)
- LV\_CDN\_DIAG\_EL\_CPS (Diagnosis condition information)
- LV\_END\_DIAG\_EL\_CPS (End of diagnosis information)


**ACTION\_ERRM\_FilterMulticondition** (IN<CPS>, IN<CDN\_DIAG\_EL\_CPS>, IN<ERR\_DIAG\_EL\_CPS>, IN<C\_ABC\_INC\_EL\_CPS\_DIAG>, IN<C\_ABC\_MAX\_EL\_CPS\_DIAG>, OUT< LV\_ERR\_CPS>, SYNCRONIZATION<CALL>)

// Limp-home value

```


if      LV_ERR_EL_CPS = 1
then    case selection on ERR_SYM_EL_CPS
          SCG:          CPPWM_LIH = C_CPPWM_SUB_DIAG_1
          SCP, OC:     CPPWM_LIH = C_CPPWM_SUB_DIAG_2
          NO_SYM:     CPPWM_LIH = CPPWM_LIHn-1
          end case selection
else    CPPWM_LIH = 0
endif

```

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**end**

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## A.72 Canister purge valve diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_EL_CPS	O/V	0... 1H	0 ...1	1	-
Inhibits canister purge valve diagnosis					

### Input data:

LV_CDN_VB_OBD1 {p. 1185}	LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}	
-----------------------------	-----------------------------	-----------------	--

### General information:

This chapter describes the canister purge valve diagnosis inhibition.

### Application conditions

**Initialisation:** LV\_INH\_DIAG\_EL\_CPS = 0 at LV\_IGK = 0->1 or reset

**Recurrence:** 100 ms & every transition of an error flag.

**Activation:** at every engine operating state

**Deactivation:** - -

### Formula section:

```

If          LV_IGK = 1           and
              LV_CDN_VB_OBD1 = 1   and
              LV_ERR_SPI_MPS = 0
Then       LV_INH_DIAG_EL_CPS = 0
Else       LV_INH_DIAG_EL_CPS = 1
Endif

```



## A.73 Exhaust gas temperature sensor diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_SAMPLE_ACT_TEG_SENS_DIAG	V	0... FFFFH	0... 65535	1	-
Sample counter for continuous temperature sensor diagnosis					
CTR_TEG_SENS_DIAG_SUM	V	0... FFFFH	0... 65535	1	-
Sum counter for wehgtig factors for continuous TEG diagnosis					
CTR_TQ_MIN_TEG_SENS_DIAG	V	0... FFFFH	0... 65535	1	-
Counter to control the temperature sensor diagnosis activation and deactivation					
CTR_TQ_MIN_TEG_SENS_DIAG_1	V	0... FFFFH	0... 65535	1	-
Counter to control the temperature sensor continuous diagnosis activation and deactivation					
ERR_SYM_TEG_PCAT_DOWN	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of the diagnostic instance TEG_PCAT_DOWN					
LV_CDN_DIAG_TEG_PCAT_DOWN	O/V	0... 1H	0 ...1	1	-
Condition for diagnostic of temperature sensor downstream catalyst					
LV_END_DIAG_TEG_PCAT_DOWN	O/V	0... 1H	0 ...1	1	-
End of diagnostics of the temperature sensor downstream catalyst					
LV_ERR_PREL_TEG_PCAT_DOWN	O/V	0... 1H	0 ...1	1	-
Temp. after precatlyst antibouce flag					
LV_ERR_TEG_PCAT_DOWN	O/V	0... 1H	0 ...1	1	-
Temp. after precatlyst error flag					
LV_TEG_SENS_DIAG_RLS	V	0... 1H	0 ...1	1	-
Release temperatur sensor diagnosis flag					
RATE_SAMPLE_STC_TEG_SENS_DIAG [32]	V	0... FFFFH	0... 65535	1	-
Number of samples per calibrated time interval for continuous TEG diagnosis					

### Input data:

LV_IGK {p. 906}	LV_VAR_TCHA {p. 656}	N {p. 1525}	STATE_ENG {p. 1720}
T_AST_DIAG {p. 1766}	TAM {p. 1579}	TEG_CAT_DOWN_MDL {p. 8236}	TQ_AV {p. 6656}
VP_TEG_PCAT_DOWN {p. 1253}	VS {p. 1176}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TEG_PCAT_DOWN	-	0... FFH	0... 255	1	-
Debounce counter increment TEG Diagnosis					
C_ABC_MAX_TEG_PCAT_DOWN	-	1... FFH	1... 255	1	-
Debounce counter maximum TEG Diagnosis					
C_CTR_CYC_TEG_SENS_DIAG_1	-	0... 20H	0... 32	1	-
Number of cycles for sum calculating for continuous TEG diagnosis					
C_CTR_MIN_TQ_MIN_TEG_SENS_DIAG	-	0... FFFFH	0... 65535	1	-
Minimum counter value for temperature sensor diagnosis dependent on TQ					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TEG_SENS_DIAG [32]	-	0... 80H	0 ...1	0.0078125	-
Array for weighting factor for continuous TEG diagnosis					
C_N_MIN_TEG_SENS_DIAG_1	-	0... 1FE0H	0... 8160	1	rpm
Minimum requested engine speed for counter activation for continuous TEG diagnosis					
C_RATE_SAMPLE_MIN_TEG_SENS_DIAG	-	0... FFFFH	0... 65535	1	-
Min number of samples per calibrated time interval for continuous TEG sensor diagnosis					
C_RATE_SAMPLE_TEG_SENS_DIAG_1	-	0... 400H	0... 10240	10	-
Number of samples for save cycle for continuous TEG diagnosis					
C_T_AST_MIN_TEG_SENS_DIAG	-	0... FFFFH	0... 32767.5	0.5	s
Minimum time delay after start for exhaust gas temperature sensor diagnosis					
C_TEMP_THD_TEG_SENS_DIAG_1	-	0... 400H	0... 1024	1	°C
Exhaust gas temperature threshold for activation of TEG sensor diagnosis					
C_TQ_MIN_TEG_SENS_DIAG	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
calibratable threshold as minimum requested torque for activating diagnosis of exhaust gas temperature sensors					
C_TQ_MIN_TEG_SENS_DIAG_1	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Min. requested torque for counter activating for continuous TEG diagnosis					
C_VP_TEG_MES_GRD_MAX	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Maximum voltage gradient threshold for error detection					
C_VP_TEG_PCAT_DOWN_DIAG_MAX	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Maximum voltage threshold for error detection					
C_VP_TEG_PCAT_DOWN_DIAG_MIN	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Minimum voltage threshold for error detection					
C_VP_TEG_SENS_ACT_DIAG	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Exhaust gas temperature sensor signal voltage threshold for activation of diagnosis of TEG sensors					
C_VS_MIN_TEG_SENS_DIAG	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for activating diagnosis of exhaust gas temperature sensors					
IP_CTR_TQ_MIN_TEG_SENS_DIAG	-	0... FFFFH	0... 65535	1	-
LDP_TAM_IP_CTR_TQ_MIN_TEG_SENS	8	0... FEH	-48... 142.5	0.75	°C
Max value from sum. counter for TQ_AV check for continuous TEG diagnosis					

## FUNCTION DESCRIPTION:

### General information:

The purpose of the diagnosis shall be to detect electrical faults as defined by OBD I requirements. VP\_TEG\_PCAT\_DOWN is monitored for invalid gradients and values (see also exhaust gas temperature in chapter system variables ).


The diagnosis for "short circuit to Vbatt or open load" is only performed:

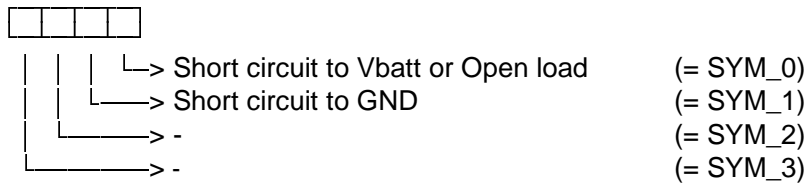
- either by reaching a certain voltage on the pin or after a calibrateable time after start or counter for activation of diagnosis reached calibrateable value
- and at the moment of diagnosis additional conditions are fulfilled

This functionality shall prevent a wrong failure detection due to too low sensor temperatures, i.e. at cold start.

### Description:

Error-symptoms are defined to this diagnosis function as following:

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 4714 of 8404	
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### Application conditions

**Initialization:** according configuration MEM  
(0 at LV\_IGK 0->1 or reset)

**Recurrence:** 100ms

**Activation:** see formula section

### Formula section:

```

If(1)      LV_IGK = 1
Then(1)    CTR_SAMPLE_ACT_TEG_SENS_DIAG++
If(2)      TQ_AV > C_TQ_MIN_TEG_SENS_DIAG_1
             and N > C_N_MIN_TEG_SENS_DIAG_1
Then(2)    CTR_TQ_MIN_TEG_SENS_DIAG_1++
Endif(2)
If(3)      CTR_SAMPLE_ACT_TEG_SENS_DIAG >= C_RATE_SAMPLE_TEG_SENS_DIAG_1
Then(3)
             For(3) (x = 31; x = 1; x --)
                 {RATE_SAMPLE_STC_TEG_SENS_DIAG[x] =
                   RATE_SAMPLE_STC_TEG_SENS_DIAG[x-1] }

```

RATE\_SAMPLE\_STC\_TEG\_SENS\_DIAG[0] = CTR\_TQ\_MIN\_TEG\_SENS\_DIAG\_1

CTR\_TQ\_MIN\_TEG\_SENS\_DIAG\_1 = 0

CTR\_SAMPLE\_ACT\_TEG\_SENS\_DIAG = 0

**Endif(3)**

### Short circuit to GND:

```

If(4a)    VP_TEG_PCAT_DOWN < C_VP_TEG_PCAT_DOWN_DIAG_MIN
             and LV_VAR_TCHA = 0
Then(4a)  LV_CDN_DIAG_TEG_PCAT_DOWN = 1
             LV_ERR_PREL_TEG_PCAT_DOWN = 1
             ERR_SYM_TEG_PCAT_DOWN = SYM_1

```

**Else(4a)** LV\_CDN\_DIAG\_TEG\_PCAT\_DOWN = 0

**Endif(4a)**

### Short circuit to Vbatt or Open load:

```

If(4b)    LV_TEG_SENS_DIAG_RLS = 0
             and CTR_TQ_MIN_TEG_SENS_DIAG <          | calculation of
             C_CTR_MIN_TQ_MIN_TEG_SENS_DIAG          | counter for
             and TQ_AV >= C_TQ_MIN_TEG_SENS_DIAG     | activation of
             and VS >= C_VS_MIN_TEG_SENS_DIAG       | diagnosis

```

```

    and LV_VAR_TCHA = 0
Then(4b)    CTR_TQ_MIN_TEG_SENS_DIAG++
Else(4b)    freeze CTR_TQ_MIN_TEG_SENS_DIAG
Endif(4b)
If(4c)    LV_TEG_SENS_DIAG_RLS = 0
Then(4c)
If(4d)    CTR_TQ_MIN_TEG_SENS_DIAG >=

C_CTR_MIN_TQ_MIN_TEG_SENS_DIAG
    or
        (VP_TEG_PCAT_DOWN < C_VP_TEG_SENS_ACT_DIAG and
         T_AST_DIAG >= C_T_AST_MIN_TEG_SENS_DIAG)
Then(4d)    LV_TEG_SENS_DIAG_RLS = 1
Endif(4d)
Endif(4c)
If(4e)    LV_TEG_SENS_DIAG_RLS = 1
Then4(e)    LV_CDN_DIAG_TEG_PCAT_DOWN = 1
                CTR_TQ_MIN_TEG_SENS_DIAG = 0
                CTR_TEG_SENS_DIAG_SUM = 0
For(4e)    (x = 1; x <= C_CTR_CYC_TEG_SENS_DIAG_1; x++)
    { CTR_TEG_SENS_DIAG_SUM = CTR_TEG_SENS_DIAG_SUM + C_FAC_TEG_SENS_
      DIAG[x-1] * RATE_SAMPLE_STC_TEG_SENS_DIAG[x-1] }
If(5)    VP_TEG_PCAT_DOWN > C_VP_TEG_PCAT_DOWN_DIAG_MAX
Then(5)
If(6)    (CTR_TEG_SENS_DIAG_SUM > IP_CTR_TQ_MIN_TEG_SENS_DIAG
and        STATE_ENG != PUC
and        RATE_SAMPLE_STC_TEG_SENS_DIAG[0] >
           C_RATE_SAMPLE_MIN_TEG_SENS_DIAG)
    or
        TEG_CAT_DOWN_MDL[1] > C_TEMP_THD_TEG_SENS_DIAG_1

Then(6) LV_ERR_PREL_TEG_PCAT_DOWN = 1
                ERR_SYM_TEG_PCAT_DOWN = SYM_0
                LV_ERR_TEG_PCAT_DOWN = 1
Endif(6)
Else(5)    ERR_SYM_TEG_PCAT_DOWN = NO_SYM
                LV_ERR_PREL_TEG_PCAT_DOWN = 0

Endif(5)
Else(4e)    LV_CDN_DIAG_TEG_PCAT_DOWN = 0
Endif(4e)

Calculation of the gradient control
If (4f)    | VP_TEG_PCAT_DOWN(n) - VP_TEG_PCAT_DOWN(n-1) | > C_VP_TEG_MES_
GRD_MAX
Then (4f)    LV_ERR_PREL_TEG_PCAT_DOWN = 1
Endif (4f)

Endif(1)

```

## A.74 Fuel pressure sensor diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_FUP	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom FUP sensor					
LV_CDN_DIAG_FUP	V	0... 1H	0 ...1	1	-
Status od diagnosis for FUP sensor					
LV_END_DIAG_FUP	V	0... 1H	0 ...1	1	-
End of diagnosis for FUP sensor diagnosis					
LV_ERR_FUP	O/V	0... 1H	0 ...1	1	-
FUP sensor error detected					

### Input data:

LV_IGK {p. 906}	LV_INH_DIAG_FUP {p. 4720}	N_32 {p. 1525}	V_FUP_MV {p. 1283}
-----------------	------------------------------	----------------	--------------------

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_FUP	-	0... FFH	0... 255	1	-
Increment debounce counter					
C_ABC_MAX_FUP	-	1... FFH	1... 255	1	-
Maximum value debounce counter					
C_N_32_FUP_DIAG_MAX	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for FUP diagnosis					
C_V_FUP_MV_MAX_DIAG	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Threshold value V_FUP_MV to detect Short circuit in signal wire to VB					
C_V_FUP_MV_MIN_DIAG	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Threshold value V_FUP_MV to detect Short circuit in signal wire to ground or wire break					

### Import actions:

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>, IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,,OUT<PRM_LV_ERR>)
--

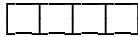
### FUNCTION DESCRIPTION:

#### General Information:

Analog input signal in the A/D-Input from the Microprocessor.

#### Description

Error-symtoms are defined to this diagnosis function as following :



**Remark:** Calculation of LV\_END\_DIAG\_FUP see generic calculation “End of diagnosis” in anti bounce algorithm.

## Application conditions

### Initialization:

LV\_CDN\_DIAG\_FUP = Refer to filtering configuration for the initialisation value

LV\_END\_DIAG\_FUP = Refer to filtering configuration for the initialisation value

LV\_ERR\_FUP = Refer to filtering configuration for the initialisation value

ERR\_SYM\_FUP = Refer to filtering configuration for the initialisation value

Recurrence: 40 ms

```

Activation:
    if      LV_IGK = 1 AND LV_INH_DIAG_FUP = 0
           AND N_32 <= C_N_32_FUP_DIAG_MAX
    Then    LV_CDN_DIAG_FUP = 1
           (diagnosis is active)
    else    LV_CDN_DIAG_FUP = 0
           (diagnosis is inactive)
    endif
  
```

### Deactivation:

When the activation condition is not fulfilled then LV\_CDN\_DIAG\_FUP = 0.

### Formula section:

```


{ SYM_0 : Short circuit in signal wire to VB or wire break }
if      V_FUP_MV > C_V_FUP_MV_MAX_DIAG
then
  ERR_SYM_FUP = SYM_0           { Symptom SCP or OC is active }
else
  { SYM_1 : Short circuit in signal wire to ground }
  if      V_FUP_MV < C_V_FUP_MV_MIN_DIAG
  then
    ERR_SYM_FUP = SYM_1       { Symptom SCG is active }
  else
    ERR_SYM_FUP = NO_SYM     { No failure has been detected }
  endif
endif
endif
  
```

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

For failure and error management treatment the anti-bounce mechanism is called with the parameters LV\_CDN\_DIAG\_FUP and ERR\_SYM\_FUP.

ACTION\_ERRM\_FilterSymptom (IN< FUP >, IN< LV\_CDN\_DIAG\_FUP >, IN< ERR\_SYM\_FUP >, IN< C\_ABC\_INC\_FUP >, IN< 1 >, IN< C\_ABC\_MAX\_FUP >, OUT< LV\_ERR\_FUP >)

This algorithm determines LV\_ERR\_FUP and LV\_END\_DIAG\_FUP and delivers the result to Error Management.

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4719 of 8404</b>	
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## A.75 Fuel pressure sensor diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_FUP	O/V	0... 1H	0 ...1	1	-
Inhibition bit for the fuel pressure sensor diagnosis					

### Input data:

LV_IGK {p. 906}			
-----------------	--	--	--

### Error treatment:

Diagnostic	Symptom description	Symptom	Filter type
<b>FUP</b>			
<i>Fuel pressure sensor diagnosis with short circuit signal wire to VB or to ground or wire break</i>	SCP_OC	SYM_0	STD
	SCG	SYM_1	

### FUNCTION DESCRIPTION:

#### General Information:

Depending on certain conditions the fuel pressure sensor diagnosis must be inhibited.

#### Application conditions

**Initialization (at reset and LV\_IGK = 0- -> 1):** LV\_INH\_DIAG\_FUP = 0

**Recurrence:** 40 ms

#### Activation:

LV\_IGK = 1

#### Deactivation:

When the activation condition is not fulfilled

#### Formula section:

LV\_INH\_DIAG\_FUP = 0



## A.76 Fuel pump low pressure diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_EFP	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom EFP diagnosis					
ERR_SYM_EFP_CRASH	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom CRASH_EFP diagnosis					
LV_CDN_DIAG_EFP	O/V	0... 1H	0 ...1	1	-
Diagnosis condition EFP diagnosis					
LV_CDN_DIAG_EFP_CRASH	O/V	0... 1H	0 ...1	1	-
Diagnosis condition CRASH_EFP diagnosis					
LV_END_DIAG_EFP	O/V	0... 1H	0 ...1	1	-
End of Diagnosis EFP diagnosis					
LV_END_DIAG_EFP_CRASH	O/V	0... 1H	0 ...1	1	-
End of Diagnosis CRASH_EFP diagnosis					
LV_ERR_EFP	O/V	0... 1H	0 ...1	1	-
Logical variable error in case of EFP-error (selfdiagnosis EFP via CAN)					
LV_ERR_EFP_CRASH	O/V	0... 1H	0 ...1	1	-
logical variable error in case of crash switch off EFP					

### Input data:

CONF_SWI_EFP_OUT {p. 654}	LV_CDN_VB_CAN_DIAG {p. 1185}	LV_ECU_SLA {p. 800}	LV_ERR_BN_EFP {p. 4869}
LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_COM_3_BOFF {p. 801}	LV_ERR_COM_3_EFP {p. 801}	LV_ERR_LOCAN_BOFF {p. 4846}
LV_IGK {p. 906}	LV_VAR_BN {p. 655}	LV_VAR_BN_EFP {p. 655}	NC_IDX_DIAG_EFP
NC_IDX_DIAG_EFP_ CRASH	STATE_DIAG_EFP {p. 1573}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_EFP	-	0... FFH	0... 255	1	-
Increment of EFP-error					
C_ABC_INC_EFP_CRASH	-	0... FFH	0... 255	1	-
Increment of EFP-error					
C_ABC_MAX_EFP	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter of diagnostic instance EFP					
C_ABC_MAX_EFP_CRASH	-	1... FFH	1... 255	1	-
MAX-threshold EFP-error					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

### Import actions:

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetErrSym</b> (IN<IDX_DIAG>,OUT<ERR_SYM>)
<b>ACTION_ERRM_GetLvCdnDiag</b> (IN<IDX_DIAG>,OUT<LV_CDN_DIAG>)
<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>,OUT<LV_END_DIAG>)
<b>ACTION_ERRM_GetLvErr</b> (IN<IDX_DIAG>,OUT<LV_ERR>)

### General Information

The EKP sends diagnosis-information to the DME via CAN-bus, the following diagnoses are defined:

EFP Selfdiagnosis

EFP switch off in case of vehicle crash

Description:

Error symptoms are defined for this diagnosis function as:

Diagnostic EFP	Symptom description	Symptom	Filter type
EFP Selfdiagnosis	<i>Symptom rpm to high (N_high)</i>	<i>SYM_0</i>	<i>STD_INI</i>
	<i>Symptom rpm to low (N_low)</i>	<i>SYM_1</i>	
	<i>Symptom limp home mode (LIH)</i>	<i>SYM_2</i>	
	<i>Symptom high temperature (Temp)</i>	<i>SYM_3</i>	

### Application Conditions


Initialization: RST, IGKON, CLRFRMY

Recurrence: 1S

Activation: LV\_ECU\_SLA==0

Deactivation: if activation not true

### Function description

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl
	Document key 10171571 SPE 000 AO	Pages Page 4722 of 8404
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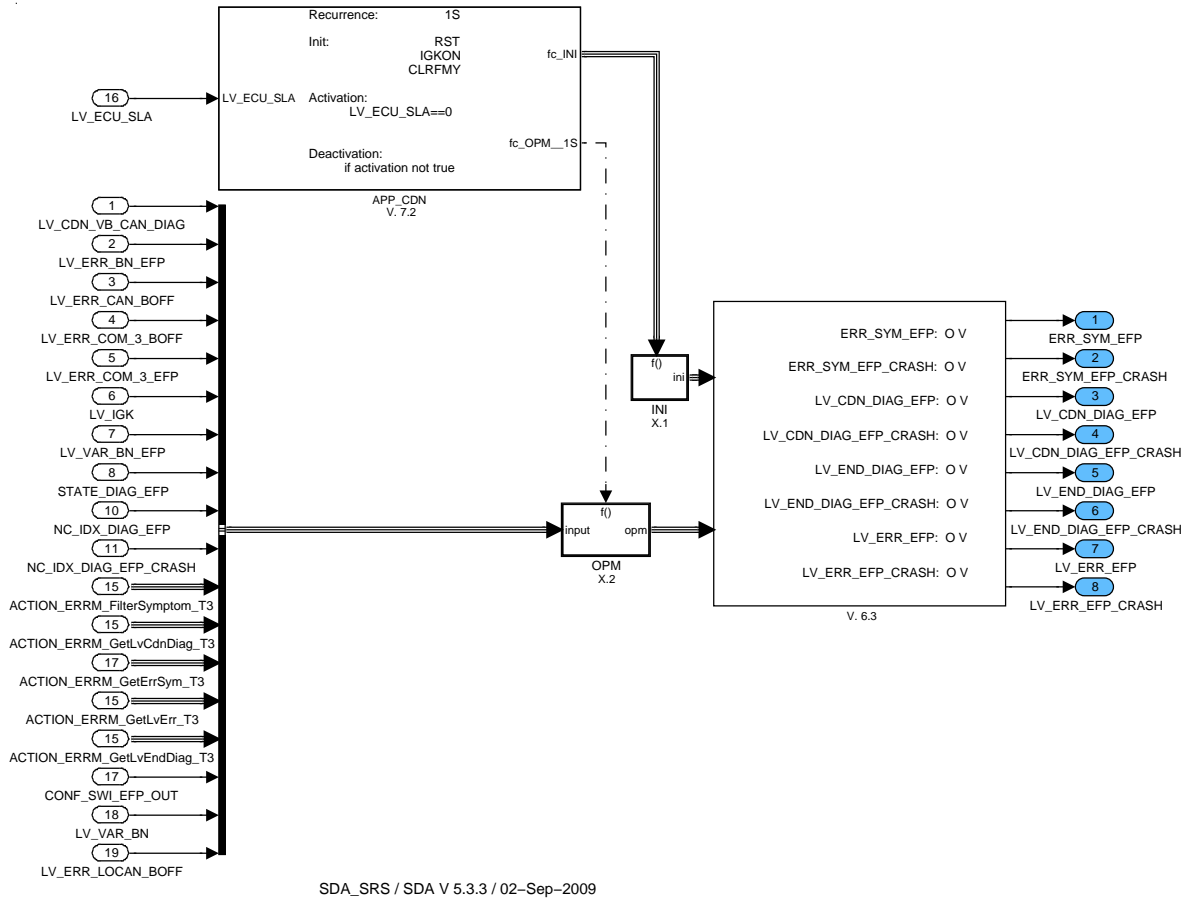


Figure A.76.1: : Path: FUSL\_MA01C

**A.76.1 All 0 at transition LV\_IGK 0->1 or reset or at clearing error memory**

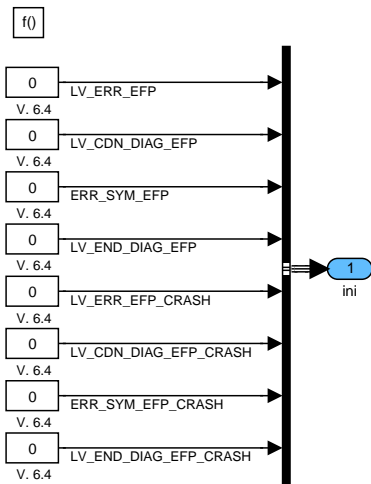


Figure A.76.2: : Path: FUSL\_MA01C/INI

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### A.76.2 Formula section

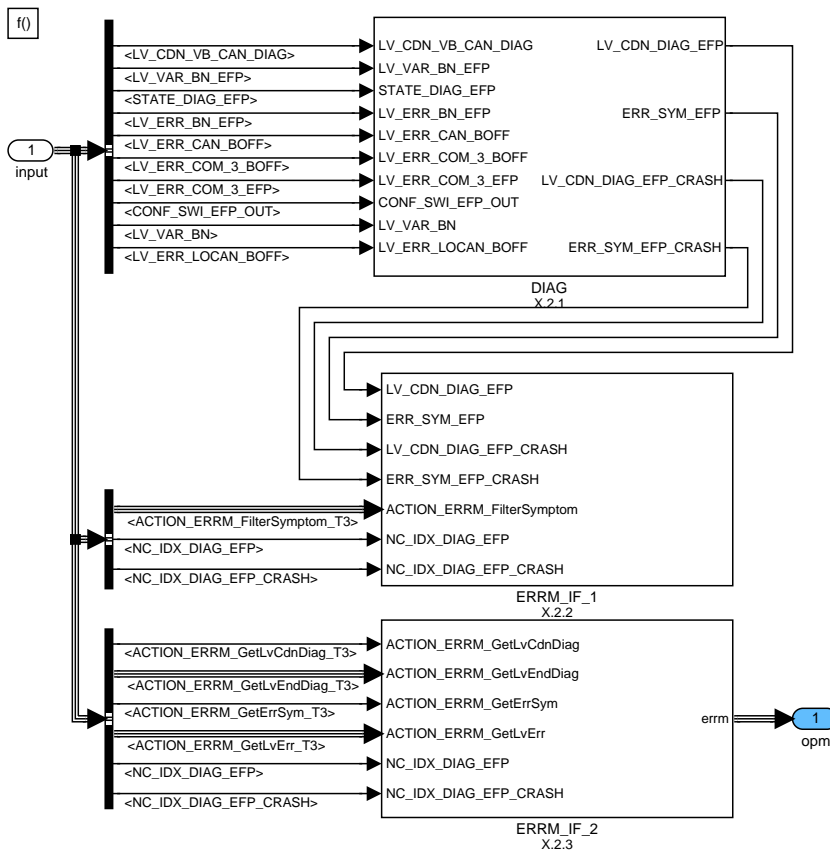


Figure A.76.3: : Path: FUSL\_MA01C/OPM

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### A.76.2.1 Diagnosis calculation

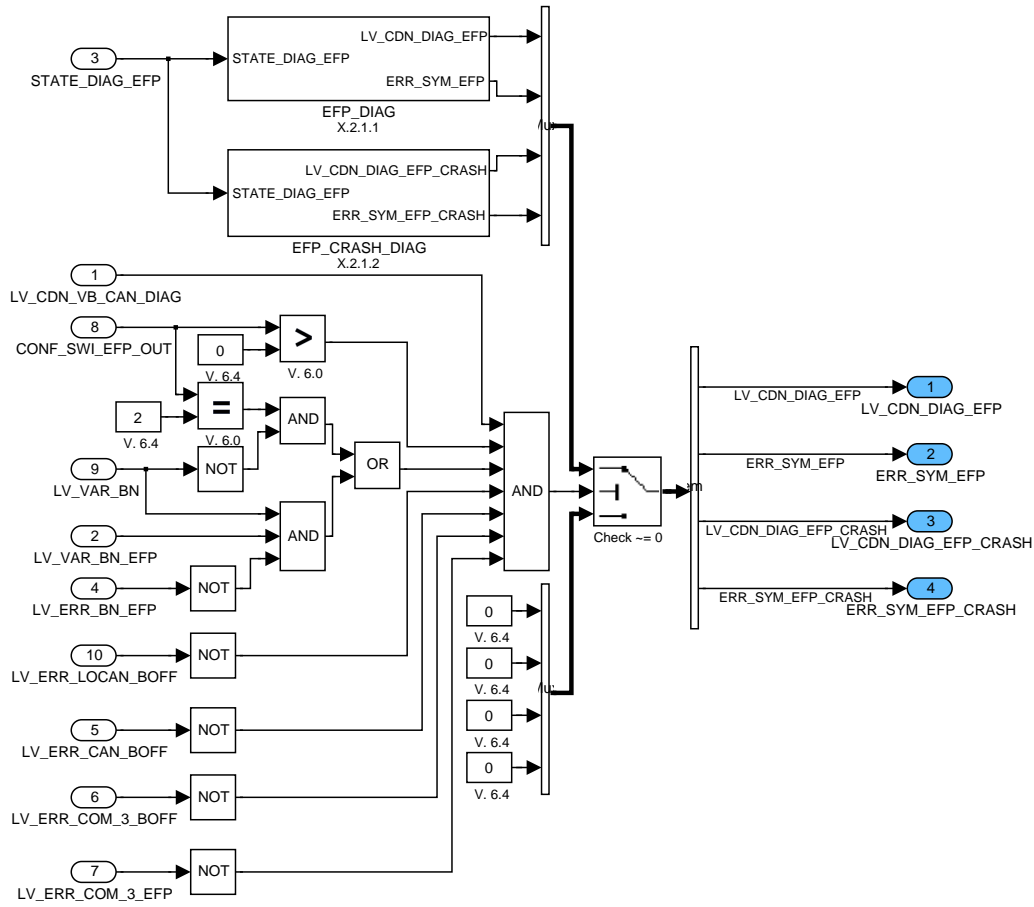


Figure A.76.4: : Path: FUSL\_MA01C/OPM/DIAG

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### A.76.2.1.1 EFP selfdiagnosis

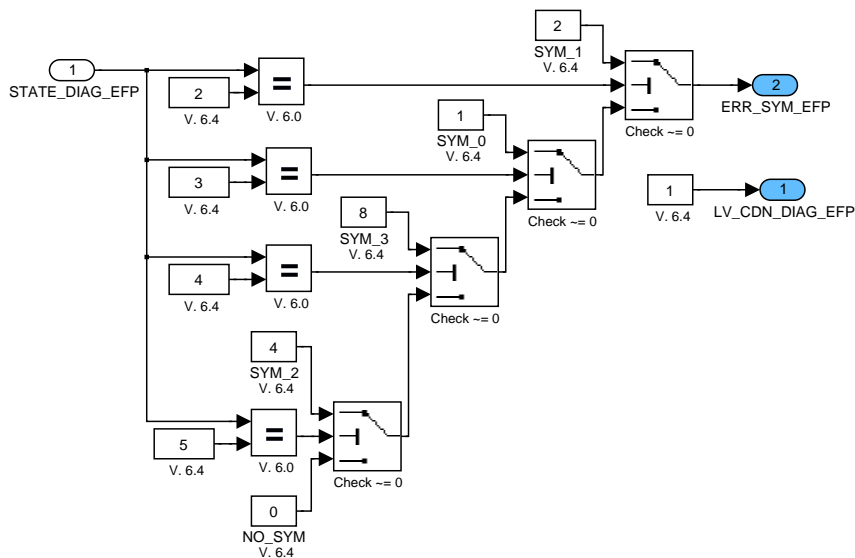


Figure A.76.5: : Path: FUSL\_MA01C/OPM/DIAG/EFP\_DIAG

### A.76.2.1.2 EFP switch off in case off vehicle crash

Description:

Error symptoms are defined for this diagnosis function as:

Diagnostic EFP_CRASH	Symptom description	Symptom	Filter type
EFP switch off in case of vehicle crash	Symptom switch off due to vehicle crash	SYM_2	STD_INI

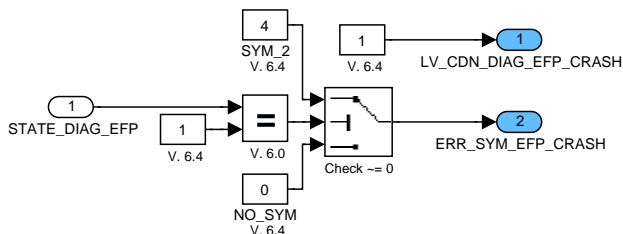


Figure A.76.6: : Path: FUSL\_MA01C/OPM/DIAG/EFP\_CRASH\_DIAG

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### A.76.2.2 Error management

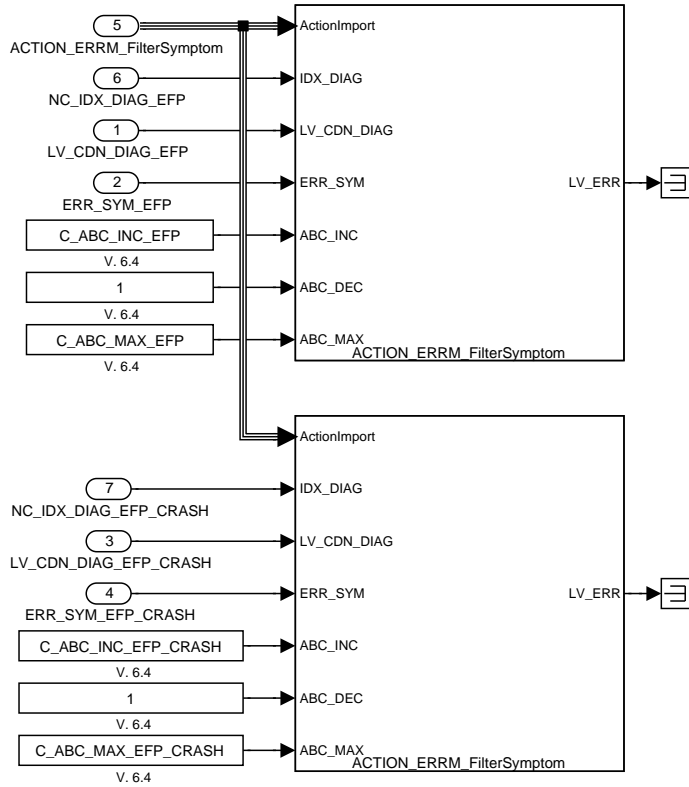


Figure A.76.7: : Path: FUSL\_MA01C/OPM/ERRM\_IF\_1

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### A.76.2.3 ERRM output

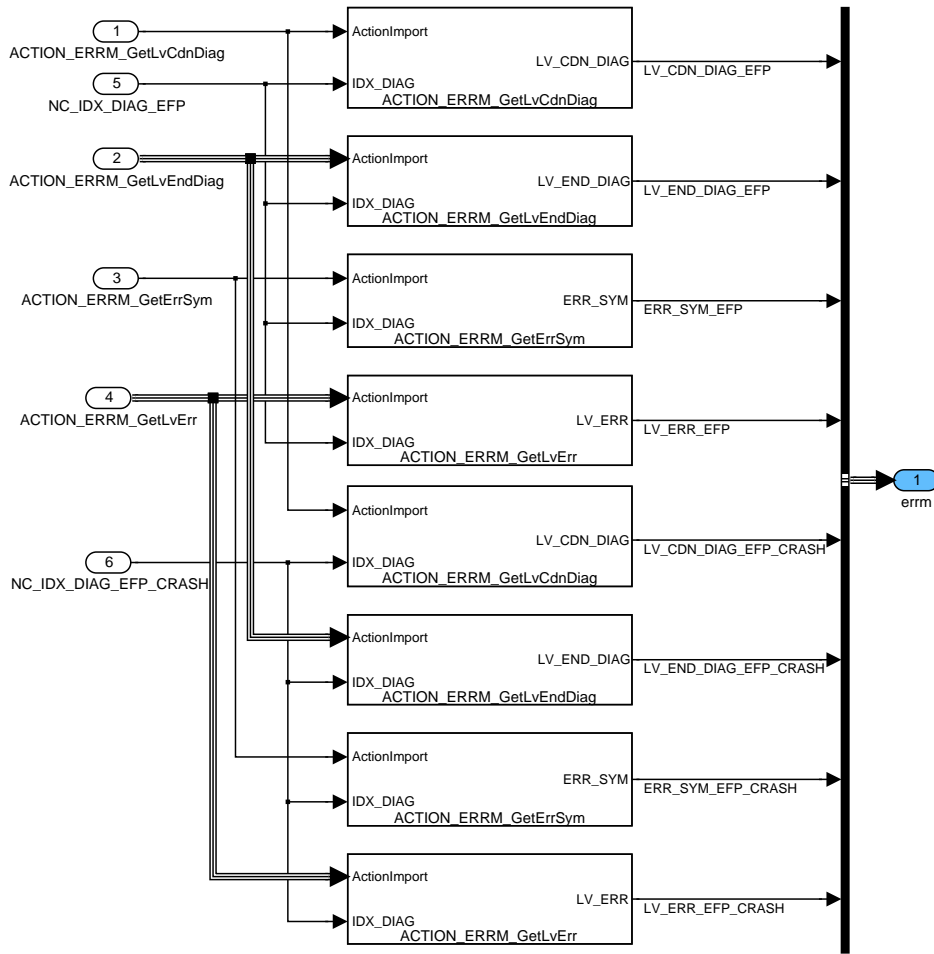


Figure A.76.8: : Path: FUSL\_MA01C/OPM/ERRM\_IF\_2

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## A.77 Fuel pressure power stage diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_VCV	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of VCV bit 0: diagnosis condition for symptom SYM_0 bit 1: diagnosis condition for symptom SYM_1 bit 2: diagnosis condition for symptom SYM_2 bit 3: diagnosis condition for symptom SYM_3					
ERR_DIAG_VCV	-	0... 7H	0 ...7	1	-
Raw value of error symptom for VCV (only parameter) bit 0: Set, if raw value of error symptom SCP (SYM_0) is set bit 1: Set, if raw value of error symptom SCG (SYM_1) is set bit 2: Set, if raw value of error symptom OC (SYM_2) is set (all combinations are possible)					
LV_ERR_VCV	O/V	0... 1H	0 ...1	1	-
Present failure: failure after filtering of diagnosis VCV					

### Input data:

LV_CDN_VB_OBD1 {p. 1185}	LV_IGK {p. 906}	LV_INH_DIAG_VCV {p. 4732}	PWM_VCV {p. 3955}
-----------------------------	-----------------	------------------------------	-------------------

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_VCV	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_VCV	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_PWM_VCV_MAX_DIAG_SCG	-	0... FFH	0... 99.609375	0.391	%
Maximum threshold for SCG diagnosis window					
C_PWM_VCV_MIN_DIAG_OC	-	0... FFH	0... 99.609375	0.391	%
Minimum threshold for OC diagnosis window					
C_PWM_VCV_MIN_DIAG_SCP	-	0... FFH	0... 99.609375	0.391	%
Minimum threshold for SCP diagnosis window					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_VCV	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (= 2)					

### Import actions:

<b>ACTION_ERRM_FilterMulticondition</b> (IN<XX>,IN<CDN_DIAG_>,XX>,<IN<>,ERR_DIAG_XX>,<IN>,<C_ABC_INC_XX>,IN<C_ABC_MAX_XX>,<OUT<LV_ERR_XX>)
<b>ACTION_INFR_GetEIDiagVcv</b> (OUT<Cdn_diag_vcv>,<OUT<Err_diag_vcv>)

### Error treatment:

Diagnostic VCV	Symptom description	Symptom	Filter type
Diagnostic description	SCP	SYM_0	MPL_STD_INI
	SCG	SYM_1	
	OC	SYM_2	

**Note :**

- The data ERR\_SYM\_VCV, LV\_END\_DIAG\_VCV and LV\_CDN\_DIAG\_VCV are not present in output data, because they are not used by other functions. Despite the data are not present in output these data are provided in error management and always visible.

**Note :**

ACTION\_INFR\_GetEIDiagVcv() is defined in the IRS (Infrastructure requirement specification)

**FUNCTION DESCRIPTION:****General information:**

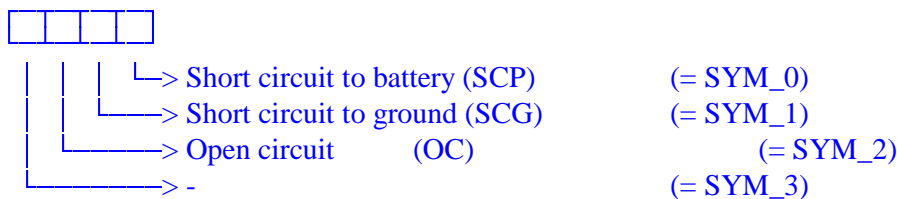
The Volume controlled valve (VCV) is driven by the ECU via an output driver. The failure detection is done by ECU Hardware.

The purpose of the diagnosis is to detect electrical faults as defined by OBD I requirements.

**Description:**

After activation conditions are met, the diagnosis activation is delayed for NC\_PSD\_DLY\_VCV executions, to avoid the usage of wrong infrastructure information.

**Error-symptoms and conditions:** are defined to this diagnosis function as following

**Application conditions****Initialisation:**

```

at transition lv_igk 0->1:
  LV_ERR_VCV = 0 and
  ERR_SYM_VCV,
  LV_END_DIAG_VCV
  (according Filter-type)
  Set delay counter for NC_PSD_DLY_VCV
at reset:
  CDN_DIAG_VCV = 0,
  LV_ERR_VCV = 0 and
  ERR_SYM_VCV = 0,
  LV_CDN_DIAG_VCV = 0,
  
```

```

LV_END_DIAG_VCV = 0,
    (according Filter-type)
Set delay counter for NC_PSD_DLY_VCV

```

**Recurrence:** 100 ms

**Activation:** -

**Deactivation:** When the activation condition is not fulfilled

#### Formula section:

```

If      LV_IGK = 1
        and LV_CDN_VB_OBD1 = 1
        and LV_INH_DIAG_VCV = 0

```

#### Then

Usage of the diagnosis information (failure symptoms (raw value) ERR\_DIAG\_VCV and basic diagnosis conditions CDN\_DIAG\_VCV) received from the infrastructure:

```

ACTION_INFR_GetEIDiagVcv (OUT<Cdn_diag_vcv>, OUT<Err_diag_vcv>)

```

Basic diagnosis conditions are set according infrastructure information: CDN\_DIAG\_VCV

Failure symptoms (raw value) are set according infrastructure information: ERR\_DIAG\_VCV

```

If      Activation conditions are met for the NC_PSD_DLY_VCV recurrence of
        the diagnosis
Then    { Additional diagnosis conditions }
If      C_PWM_VCV_MIN_DIAG_SCP > PWM_VCV
then    bit 0 of CDN_DIAG_VCV = 0 {Diagnosis of SCP not possible }
Endif
If      PWM_VCV > C_PWM_VCV_MAX_DIAG_SCG
then    bit 1 of CDN_DIAG_VCV = 0      { Diagnosis of SCG not possible }
Endif
If      PWM_VCV < C_PWM_VCV_MIN_DIAG_OC
Or      PWM_VCV > C_PWM_VCV_MAX_DIAG_SCG
then    bit 2 of CDN_DIAG_VCV = 0      { Diagnosis of OC not possible }
Endif
Else    CDN_DIAG_VCV = 0
Endif

```

#### Else

```

CDN_DIAG_VCV = 0

```

#### Endif

#### Failure filtering and error management treatment:

For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN\_DIAG\_VCV and ERR\_DIAG\_VCV.

```

ACTION_ERRM_FilterMulticondition (IN<VCV>, IN<CDN_DIAG_VCV>, IN<ERR_DIAG_VCV>, IN<C_
ABC_INC_VCV>, IN<C_ABC_MAX_VCV>, OUT<LV_ERR_VCV>)

```

This algorithm determines:

```

ERR_SYM_VCV      (detected error symptom for VCV diagnosis)
LV_ERR_VCV       (Error flag for debounced error of VCV)
LV_CDN_DIAG_VCV (Diagnosis condition information)
LV_END_DIAG_VCV (End of diagnosis information)

```

## A.78 Fuel pressure power stage diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_VCV	O/V	0... 1H	0 ...1	1	-
Inhibition bit for the fuel pressure actuator diagnosis					

### FUNCTION DESCRIPTION:

#### General information:

Depending on certain conditions the fuel pressure actuator diagnosis must be inhibited.

#### Application conditions

Initialisation (at reset and ignition key off to on): LV\_INH\_DIAG\_VCV = 0

Recurrence: 100 ms

#### Formua section:

LV\_INH\_DIAG\_VCV = 0

## A.79 Fuel pressure sensor diagnosis for low pressure

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_FUP_EFP	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom FUP sensor					
LV_CDN_DIAG_FUP_EFP	V	0... 1H	0 ...1	1	-
Status od diagnosis for FUP sensor					
LV_EFP_MIN_PLAUS_DIAG	V	0... 1H	0 ...1	1	-
Flag indicating that the timer threshold for T_EFPPWM_MIN_PLAUS_DIAG has been reached					
LV_END_DIAG_FUP_EFP	O/V	0... 1H	0 ...1	1	-
End of diagnosis for FUP sensor diagnosis					
LV_ERR_FUP_EFP	O/V	0... 1H	0 ...1	1	-
FUP sensor error detected					
T_EFP_EFPPWM_MAX_PLAUS_DIAG	V	0... FFFFH	0... 655.35	0.01	s
Timer for activation of SYM_3 detection					
T_EFP_EFPPWM_MIN_PLAUS_DIAG	V	0... FFFFH	0... 655.35	0.01	s
Timer for activation of SYM_3 detection					
T_FUP_EFP_OFS_NOT_PLAUS	V	0... FFFFH	0... 655.35	0.01	s
Remaining time of allowed fuel pressure deviation for plausibility check (high resolution counter for 10ms calculation)					
V_FUP_EFP_DIF_PLAUS_DIAG	V	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Difference of minimum and maximum value of V_EFP_FUP_MV during plausibility diagnosis					
V_FUP_EFP_MAX_PLAUS_DIAG	V	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Maximum value of V_FUP_EFP_MV during EFP plausibility diagnosis					
V_FUP_EFP_MIN_PLAUS_DIAG	V	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Minimum value of V_FUP_EFP_MV during EFP plausibility diagnosis					

### Input data:

EFPPWM {p. 3796}	FUP_EFP_MES {p. 1290}	FUP_EFP_SP {p. 3792}	LV_ECU_SLA {p. 800}
LV_END_DIAG_FUP_EFP_COPL {p. 4743}	LV_ERR_FUP_EFP_COPL {p. 4743}	LV_IGK {p. 906}	LV_INH_DIAG_FUP_EFP {p. 4743}
LV_PUC {p. 1720}	LV_ST_END {p. 1720}	NC_STATE_ECU_MST_SLA {p. 806}	V_FUP_EFP_MV {p. 1290}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_FUP_EFP	-	0... FFH	0... 255	1	-
Increment debounce counter					
C_ABC_MAX_FUP_EFP	-	1... FFH	1... 255	1	-
Maximum value debounce counter					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EFPPWM_MAX_NOT_PLAUS	-	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Maximum electric fuel pump speed for FUP_EFP_OFS_NOT_PLAUS diagnosis					
C_EFPPWM_MAX_PLAUS_DIAG	-	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Maximum electric fuel pump speed threshold to to start EPF plausibility diagnosis using V_FUP_EFP_MV					
C_EFPPWM_MIN_PLAUS_DIAG	-	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Minimum electric fuel pump speed threshold to to start EPF plausibility diagnosis using V_FUP_EFP_MV					
C_FUP_EFP_MAX_NOT_PLAUS	-	0... FFFFH	0... 173888	2.6533608	hPa
Upper limit of fuel pressure range for plausibility check					
C_FUP_EFP_MIN_NOT_PLAUS	-	0... FFFFH	0... 173888	2.6533608	hPa
Lower limit of fuel pressure range for plausibility check					
C_T_EFP_EFPPWM_MAX_PLAUS_DIAG	-	0... FFFFH	0... 655.35	0.01	s
Timer threshold for SYS_3 detection					
C_T_EFP_EFPPWM_MIN_PLAUS_DIAG	-	0... FFFFH	0... 655.35	0.01	s
Timer threshold for SYS_3 detection					
C_T_FUP_EFP_OFS_NOT_PLAUS	-	0... FFFFH	0... 655.35	0.01	s
Maximum time of allowed fuel pressure deviation for plausibility check (high range counter for 10ms calculation)					
C_V_FUP_EFP_DIF_PLAUS_DIAG	-	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Absolute threshold of MIN/MAX difference of V_FUP_EFP_MV during EFP plausibility diagnosis					
C_V_FUP_EFP_MV_MAX_DIAG	-	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Threshold value V_FUP_EFP_MV to detect Short circuit in signal wire to VB					
C_V_FUP_EFP_MV_MIN_DIAG	-	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Threshold value V_FUP_EFP_MV to detect Short circuit in signal wire to ground or wire break					
LC_USE_FUP_EFP_SP_PLAUS_DIAG	-	0... 1H	0 ...1	1	-
Calibratable activation flag of calculation of EFP plausibility diagnosis using FUP_EFP_SP					
LC_USE_V_FUP_EFP_DIF_PLAUS_DIAG	-	0... 1H	0 ...1	1	-
Calibratable activation flag of calculation of EFP plausibility diagnosis using V_FUP_EFP_MV					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_DIAG_FUP_EFP	-	1... FFH	1... 255	1	-
Diagnosis index for FUP_EFP					

**Import actions:**

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetErrSym</b> (IN<IDX_DIAG>,OUT<ERR_SYM>)
<b>ACTION_ERRM_GetLvCdnDiag</b> (IN<IDX_DIAG>,OUT<LV_CDN_DIAG>)
<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>,OUT<LV_END_DIAG>)
<b>ACTION_ERRM_GetLvErr</b> (IN<IDX_DIAG>,OUT<LV_ERR>)
Continued on next page

<b>ACTION_ERRM_NoFilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_LV_ERR_SET>,IN<PRM_LV_ERR_RST>,IN<PRM_LV_END_DIAG>,<b>OUT<PRM_LV_ERR>)
--

### General information:

Analog input signal to the A/D-Input of the Microprocessor.

Possible configuration for ABC type and CARB class (see also Table of Failure )

ABC Type: STD\_INI, STD, MEM, MEM\_INI, DEC\_CAL, STC, NO, MPL\_STD\_INI

CARB Class: MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO

Remark: Calculation of LV\_END\_DIAG\_FUP\_EFP see generic calculation End of diagnosis in anti bounce algorithm.

In case of slave ECU (LV\_ECU\_SLA = 1) the error management interface information (LV\_END\_DIAG\_FUP\_EFP, LV\_ERR\_FUP\_EFP) is imported from master ECU and used for the calculation of the error information on the slave ECU.


The slave ECU will set or reset the error without antibounce filtering (different Error Management call in comparison to master ECU)

### Application conditions:

*Initialisation:* RST, IGKON, CLRFBY  
*Recurrence:* 10MS  
*Activation:* always  
*Deactivation:* never

### Function description:

### Formula section:

Released by Tettenborn Frank		Date 2013-02-13	File 6ZA0FK02.00D
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 4735 of 8404	
Regensburg (RGB)		Copyright ( C ) Continental AG,2007	A4: 2007-11

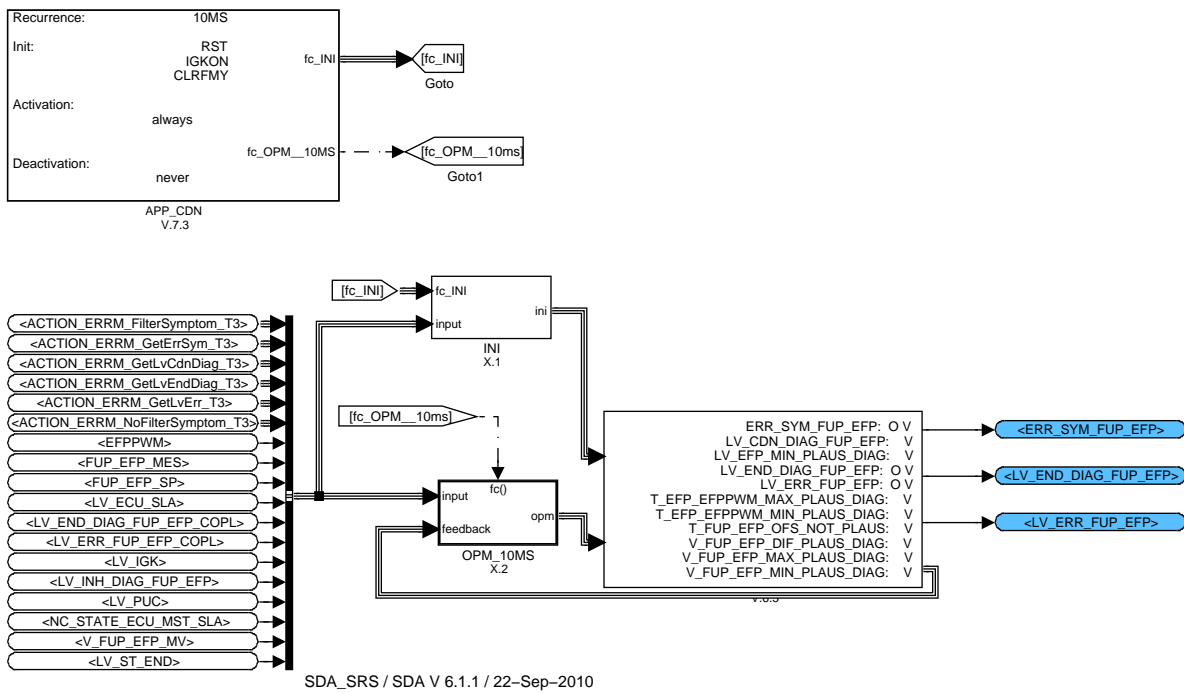


Figure A.79.1: :

## A.79.1 Initialization

### A.79.1.1 Initialisation of diagnostic data

In this subsystem all data that has to be reset at failure clearance is initialised.

### A.79.1.2 Initialization of the error management interfaces according to antibounce mechanism "STD\_INI"

The timer T\_FUP\_EFF\_OFS\_NOT\_PLAUS is initialised with it's calibration value at ECU-reset.

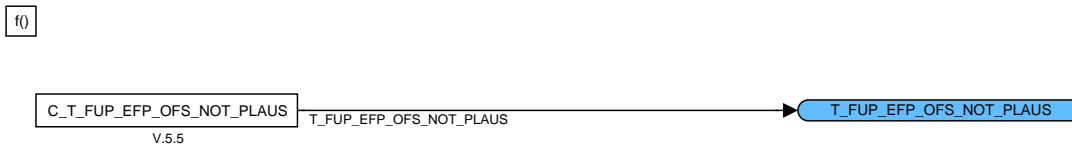


Figure A.79.2: :

## A.79.2 Formula section

In case of master-/slave-ECU-configuration the failure evaluation (subsystem CLC) is not done at the slave-ECU. Here, the failure is received from the master-ECU as LV\_ERR\_FUP\_EFF\_COPL for further treatment at error management.

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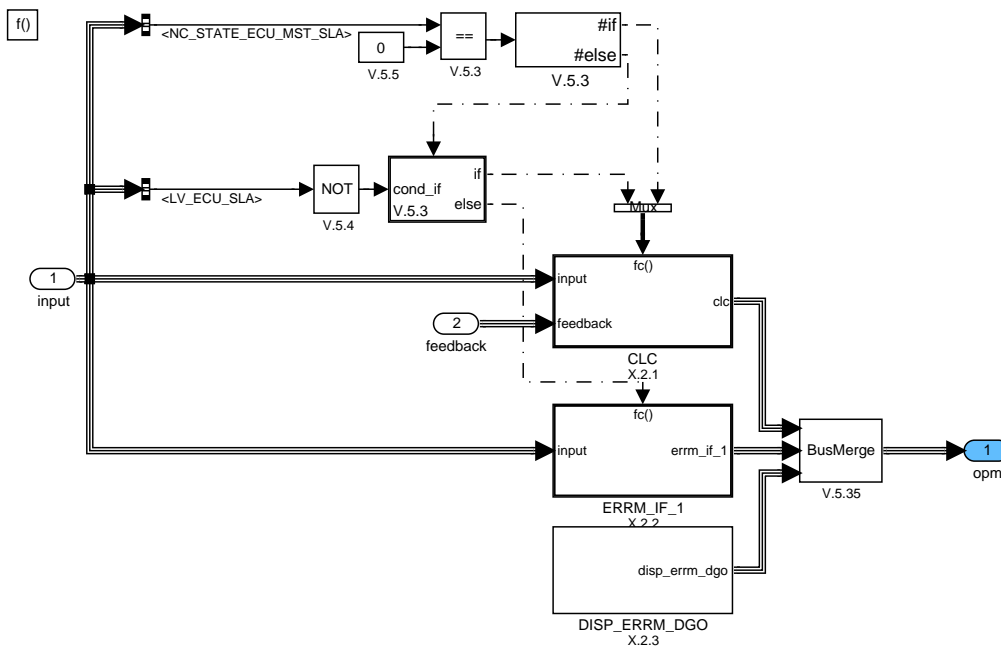


Figure A.79.3: :

## A.79.2.1 Calculation on master ECU

### A.79.2.1.1 Evaluation of diagnostic condition on master ECU

In case no symptom concerning a signal wire problem is detected, the LV\_CDN\_DIAG is delayed for the time C\_T\_FUP\_EFP\_OFS\_NOT\_PLAUS. This is the same time the symptom 'open line in ground wire' needs for being detected.

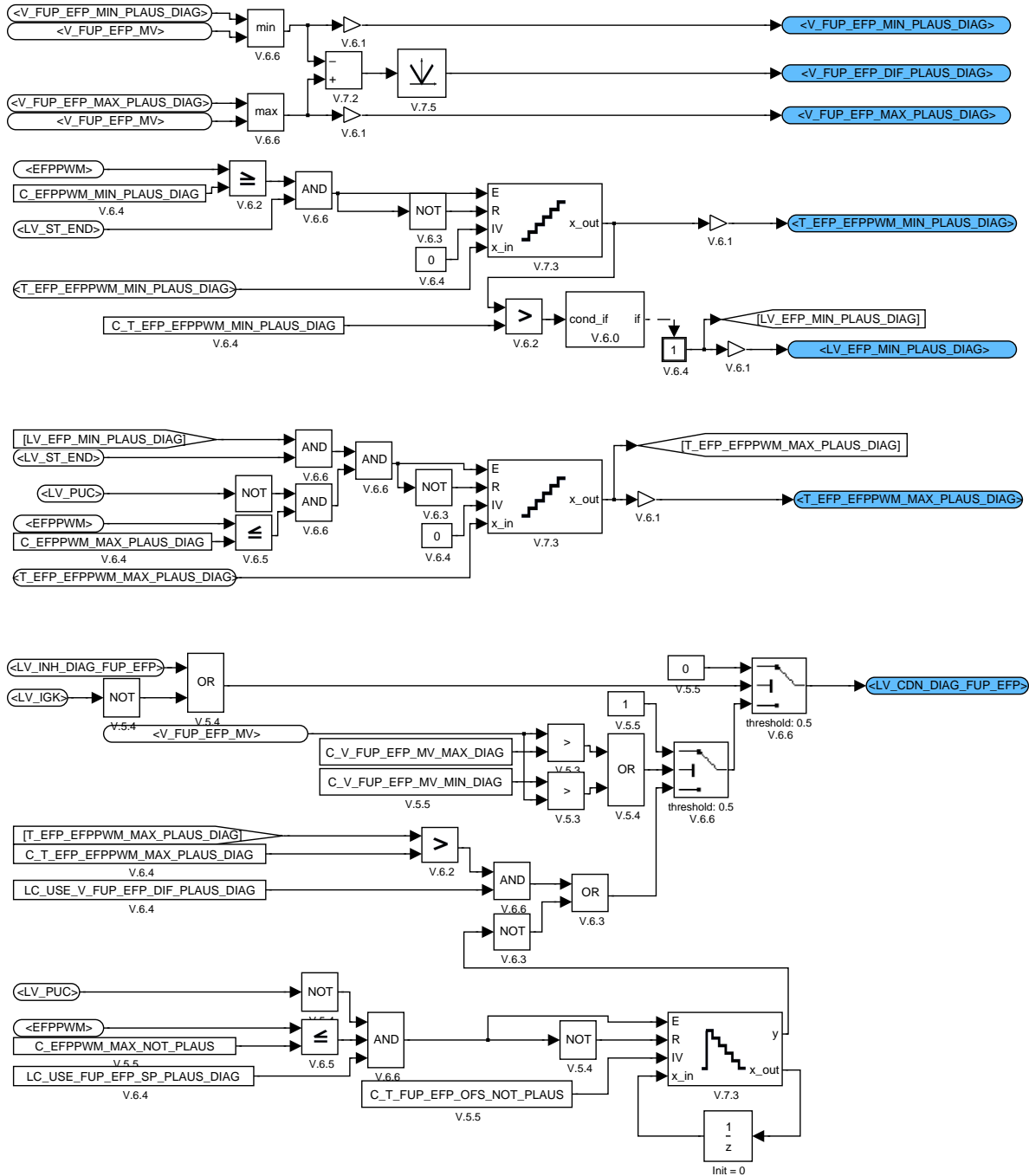



Figure A.79.4: :

### A.79.2.1.2 Symptom determination on master ECU

Short circuit or open line in signal wire lead to very low or very high signal voltage. This is detected by comparison of the signal voltage with according thresholds.

In case the ground wire of the sensor is broken, the signal voltage is approx. 3.6 V, which is -alone- a plausible value. But as this value is no more connected to the real fuel pressure, the pressure controller will not be able to adjust the measured FUP\_EFP to it's setpoint. So if this failure occurs, the FUP\_EFP\_MES will take a defined value corresponding 3.6 V and a deviation to the FUP\_EFP\_SP cannot be eliminated by the FUP\_EFP controller. This is ensured by the error symptom SYM\_3.

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 4738 of 8404	
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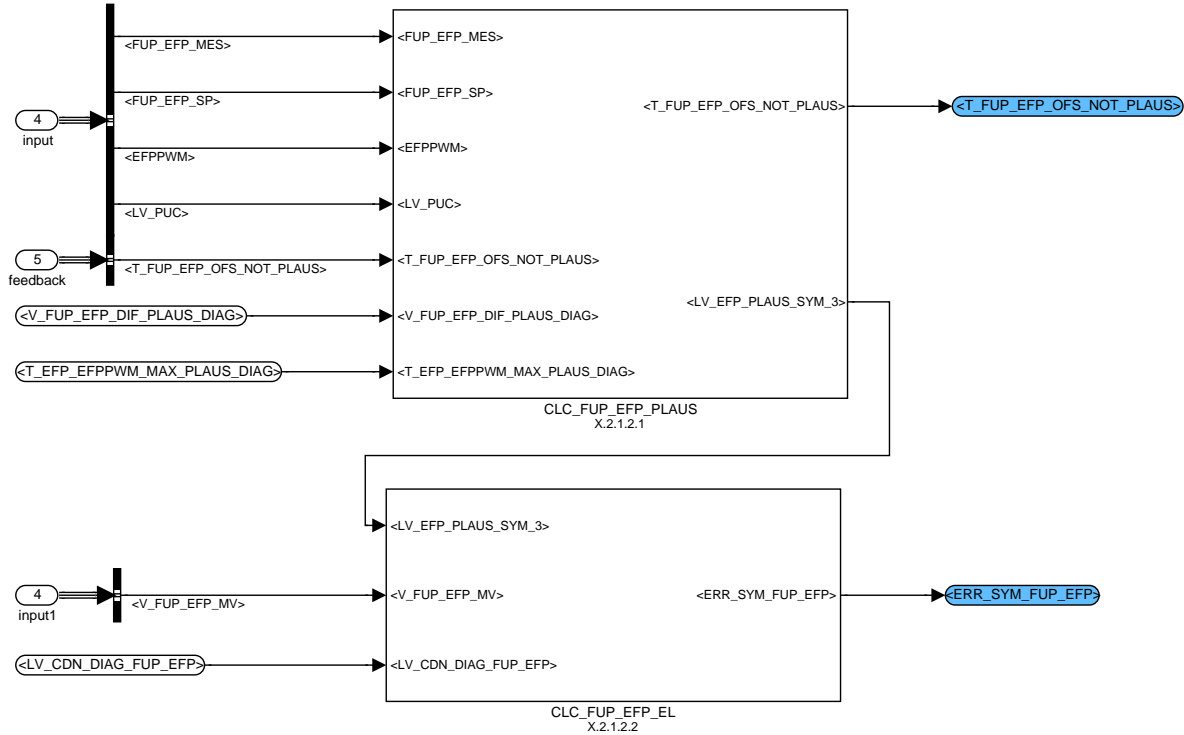


Figure A.79.5: :

**A.79.2.1.2.1 Evaluation of plausibility diagnosis**

In case the ground wire of the sensor is broken, the signal voltage is approx. 3.6 V, which is -alone- a plausible value. But as this value is no more connected to the real fuel pressure, the pressure controller will not be able to adjust the measured FUP\_EFP to it's setpoint. So if this failure occurs, the FUP\_EFP\_MES will take a defined value corresponding 3.6 V and a deviation to the FUP\_EFP\_SP cannot be eliminated by the FUP\_EFP controller. This is enquired by the error symptom SYM\_3.

Additionally the plausibility of the sensor signal can be determined by checking the sensor dynamics after start. If the difference between minimum and maximum of the sensor mean value over a certain time does not exceed a calibratable threshold it is assumed that the sensor is hanging.

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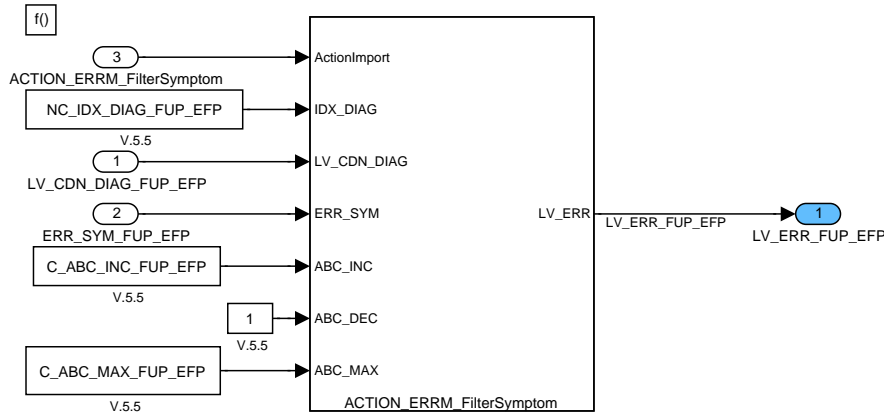


Figure A.79.8: :

**A.79.2.1.3.2 Calculation of ERRM variables on master ECU**

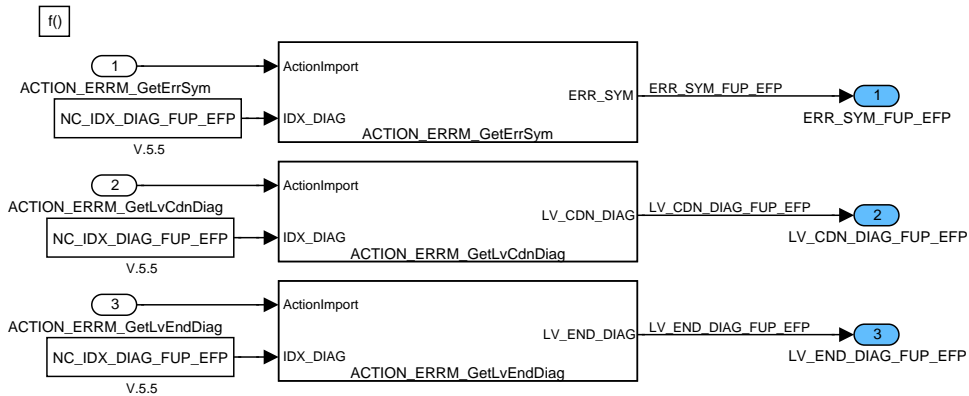


Figure A.79.9: :

**A.79.2.2 Interface to ERRM on slave ECU**

**A.79.2.2.1 Interface to ERRM on slave ECU**

Calculation of present error and end of diagnosis:

LV\_ERR\_FUP\_EFP and LV\_END DIAG\_FUP\_EFP is calculated by error management.

No Antibouncing of the error symptom, because the slave ECU inherits error symptom from master ECU.

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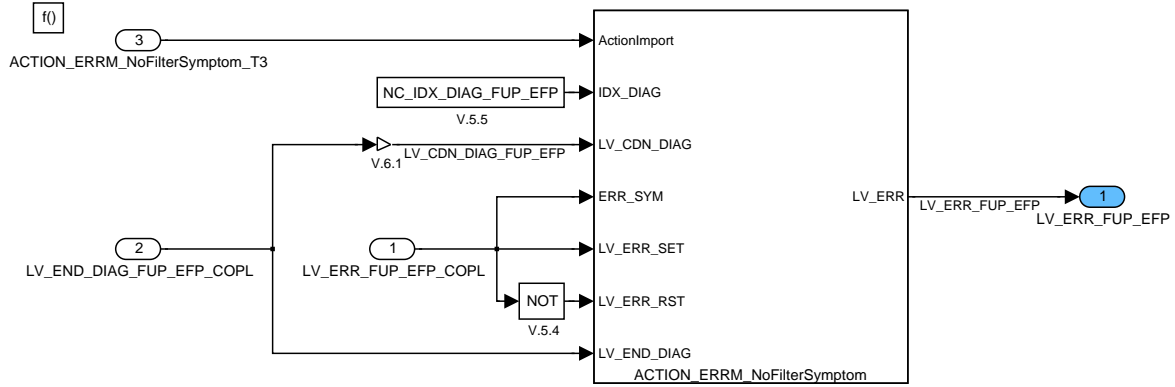


Figure A.79.10: :

**A.79.2.2.2 Calculation of ERRM variables on slave ECU**

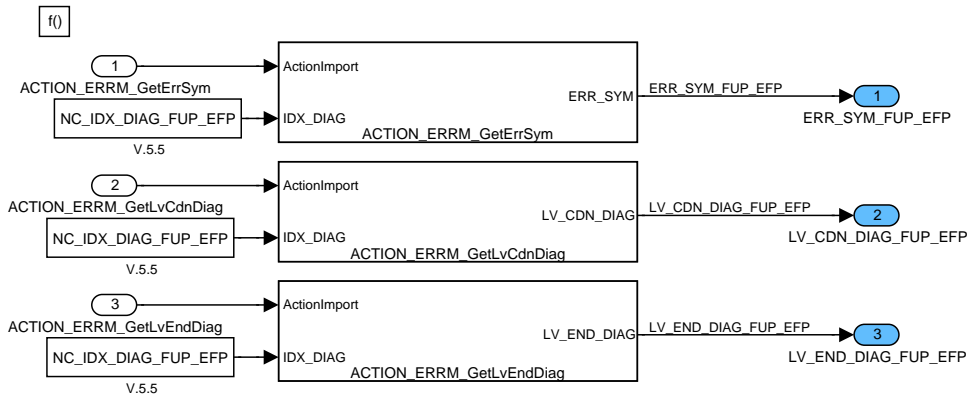


Figure A.79.11: :

**A.79.2.3 DISP\_ERRM\_DGO**

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## A.80 Fuel pressure sensor diagnosis for low pressure (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_FUP_EFP_COPL	O/V	0... 1H	0 ...1	1	-
End of diagnosis for FUP sensor diagnosis get from ECU coupling					
LV_ERR_FUP_EFP_COPL	O/V	0... 1H	0 ...1	1	-
FUP sensor error detected get from ECU coupling					
LV_INH_DIAG_FUP_EFP	O/V	0... 1H	0 ...1	1	-
Inhibition bit for the fuel pressure sensor diagnosis (low pressure circuit)					

### Input data:

LV_FUP_LIH_HOM_VCV_OPEN_REQ {p. 4001}	LV_IGK {p. 906}		
--	-----------------	--	--

### Error treatment:

Diagnostic instance		Symptoms		ABC Type	CARB class
Description	Name(XX)	Description	Nr		
<i>Electrical and plausibility diagnosis</i>	FUP_EFP	Short circuit in signal wire to VB	0	STD_INI	CC
		Short circuit signal wire to ground or signal wire break	1		
		-	2		
		Open line in ground wire	3		

### Fields information (For more information refer to Error Management file "Table of Failure")

- ABC Type : STD\_INI, STD\_MEM, MEM\_INI, DEC\_CAL, STC, NO, MPL\_STD\_INI
- CARB Class : MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO

\* For ERRM 4.7 the CARB class is configured/calibrated inside the failure class module.

### General information:

#### General Information:

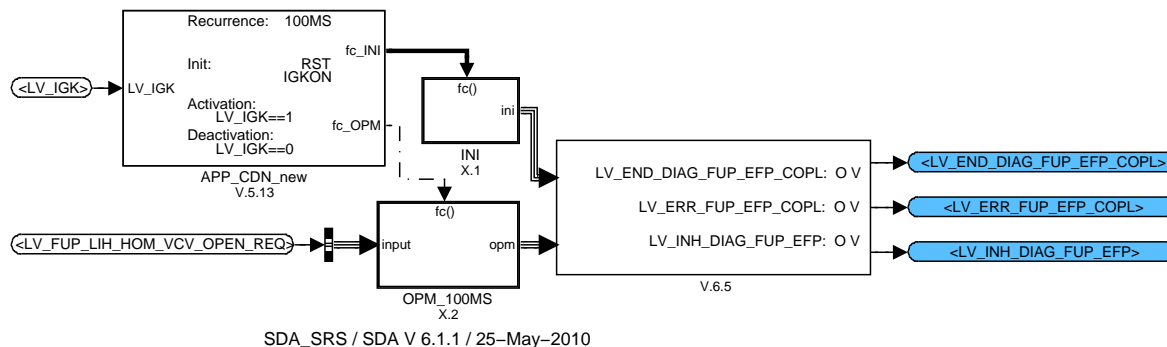
Depending on certain conditions the fuel pressure sensor diagnosis for the low pressure system must be inhibited.

### Application conditions:

*Initialisation:* RST, IGKON  
*Recurrence:* 100MS  
*Activation:* LV\_IGK==1  
*Deactivation:* LV\_IGK==0

**Function description:**

**Formula section:**



SDA\_SRS / SDA V 6.1.1 / 25-May-2010

Figure A.80.1: :

**A.80.1 Initialization at Reset and IGKON**

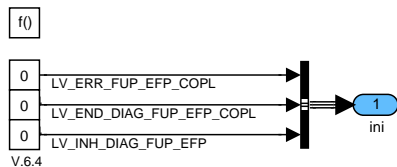


Figure A.80.2: :

**A.80.2 Formula section**

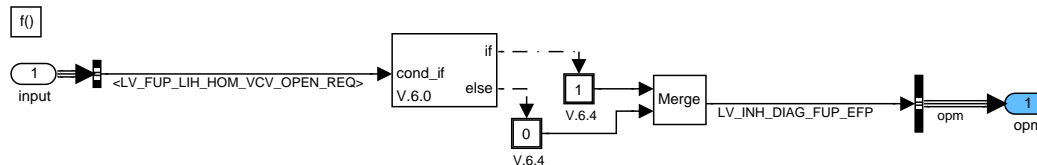


Figure A.80.3: :

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## A.81 Fuel tank level input signal diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_FTL_LE_CAN	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error					
ERR_SYM_FTL_OBD	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error					
ERR_SYM_FTL_RI_CAN	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error					
LV_CDN_DIAG_FTL_LE_CAN	O/V	0... 1H	0 ...1	1	-
Diagnosis condition					
LV_CDN_DIAG_FTL_OBD	O/V	0... 1H	0 ...1	1	-
Diagnosis condition					
LV_CDN_DIAG_FTL_RI_CAN	O/V	0... 1H	0 ...1	1	-
Diagnosis condition					
LV_END_DIAG_FTL_LE_CAN	O/V	0... 1H	0 ...1	1	-
End of Diagnosis					
LV_END_DIAG_FTL_OBD	O/V	0... 1H	0 ...1	1	-
End of Diagnosis					
LV_END_DIAG_FTL_RI_CAN	O/V	0... 1H	0 ...1	1	-
End of Diagnosis					
LV_ERR_FTL_LE_CAN	O/V	0... 1H	0 ...1	1	-
error flag for left (second) fuel tank level					
LV_ERR_FTL_OBD	O/V	0... 1H	0 ...1	1	-
error flag fuel tank level					
LV_ERR_FTL_RI_CAN	O/V	0... 1H	0 ...1	1	-
error flag for right (first) fuel tank level					

### Input data:

C_CONF_DMTL {p. 658}	LV_ECU_SLA {p. 800}	LV_ERR_FTL_OBD_COPL	LV_ERR_FTL_PLAUS {p. 5965}
LV_ERR_TOUT_ICL_7 {p. 802}	LV_ES {p. 1720}	LV_FTL_DIAG {p. 5966}	LV_FTL_LE_CAN_ERR {p. 1565}
LV_FTL_RI_CAN_ERR {p. 1565}	LV_FTL_TOT_CAN_ERR {p. 1565}	LV_IGK {p. 906}	LV_ST {p. 1720}

LV_STATE_ERR_CAN_ TOUT {p. 1567}	NC_IDX_DIAG_FTL_LE_ CAN	NC_IDX_DIAG_FTL_RI_ CAN	NC_STATE_ECU_MST_ SLA {p. 806}
STATE_ERR_SYM_FTL_ LE_CAN {p. 1573}	STATE_ERR_SYM_FTL_ RI_CAN {p. 1573}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_FTL_LE_CAN	-	0... FFH	0... 255	1	-
Increment for debouncing diagnosis					
C_ABC_INC_FTL_RI_CAN	-	0... FFH	0... 255	1	-
Increment for debouncing diagnosis					
C_ABC_MAX_FTL_LE_CAN	-	1... FFH	1... 255	1	-
Max threshold for diagnosis					
C_ABC_MAX_FTL_RI_CAN	-	1... FFH	1... 255	1	-
Max threshold for diagnosis					


**Import actions:**

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>, IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX> ,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>,OUT<LV_END_DIAG>)

**General information:****Application conditions:**

*Initialisation:* IGKON, RST, CLRFRMY  
*Recurrence:* 1S  
*Activation:* always  
*Deactivation:* never

**Function description:****Formula section:**

Released by Tettenborn Frank	Date 2013-02-13	File 17A08601.001
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl
	Document key 10171571 SPE 000 AO	Pages Page 4746 of 8404
Regensburg (RGB)	Copyright ( C ) Continental AG,2007	A4: 2007-11

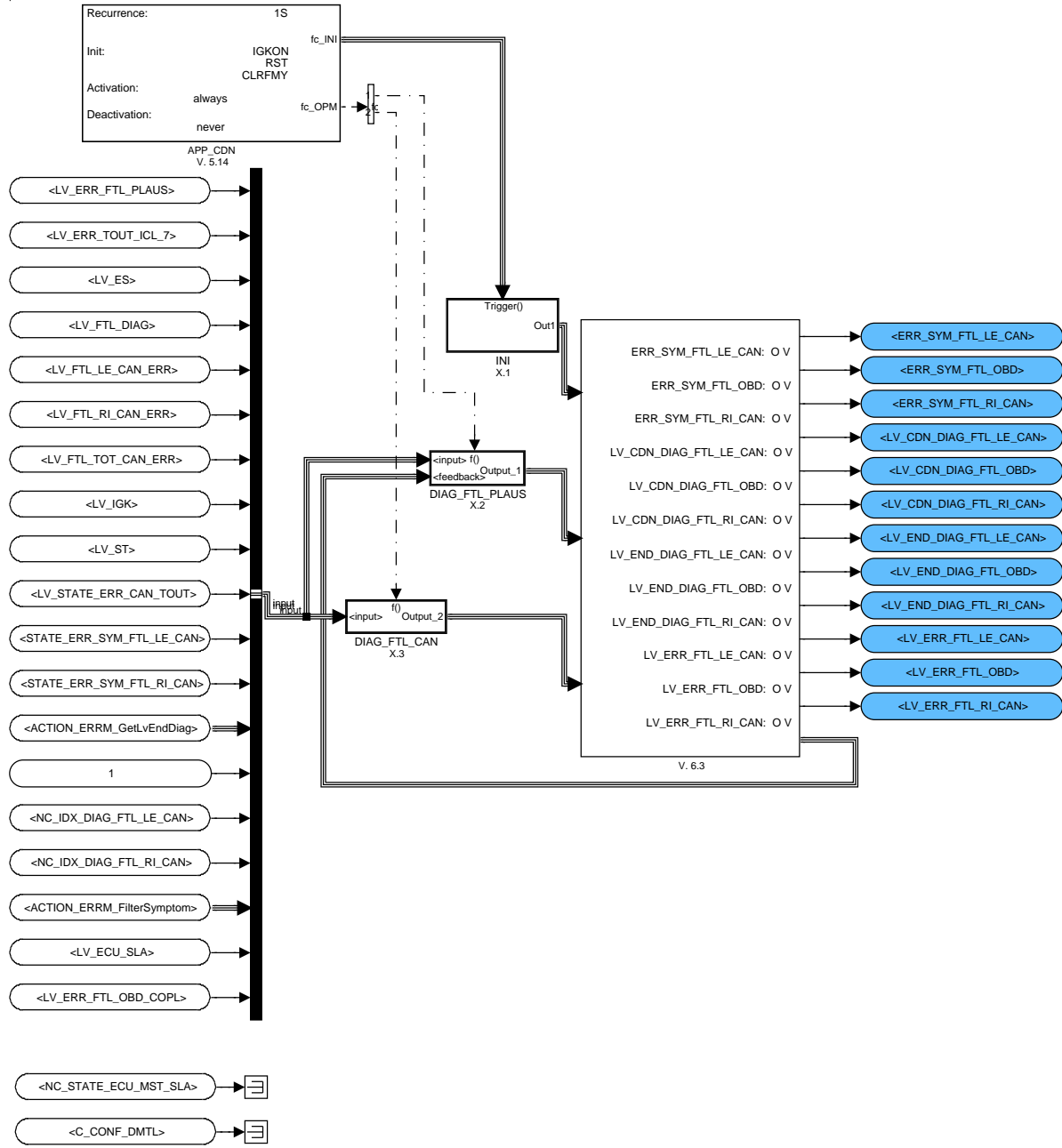


Figure A.81.1: :

### A.81.1 Initialisation

CAN related errors are initialised as per std\_ini.

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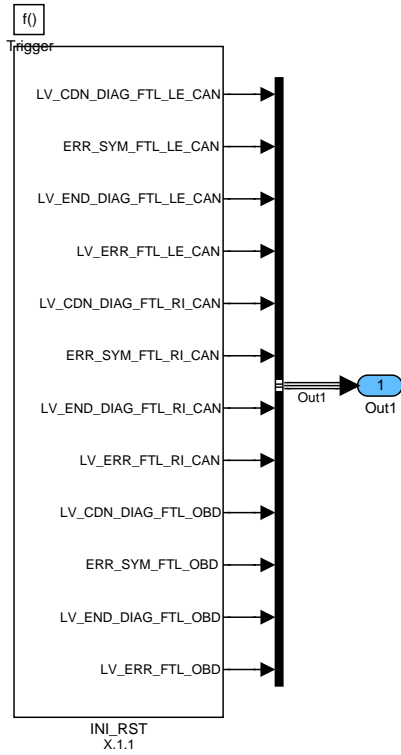


Figure A.81.2: :

**A.81.1.1 Initialisation at Reset, LV\_IGK = 0( 1 or at Clear FMY**

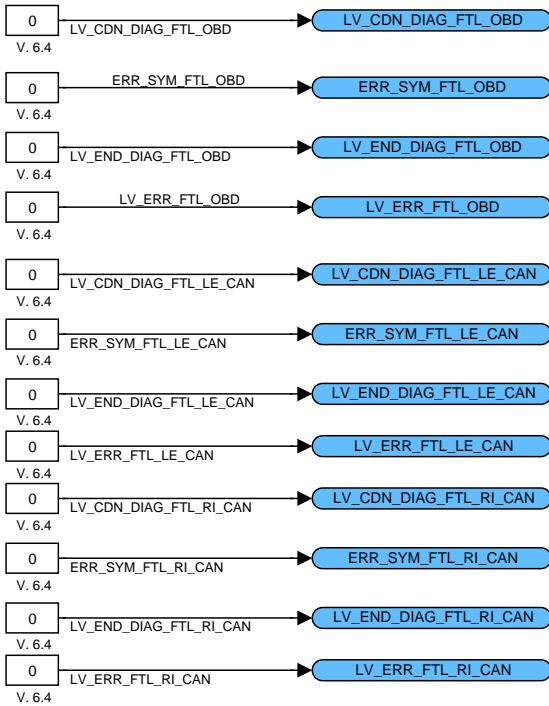



Figure A.81.3: :

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Released by <b>Tettenborn Frank</b>		Date <b>2013-02-13</b>	File <b>17A08601.001</b>
	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4748 of 8404</b>	
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### A.81.2 Fuel tank level (Plausibility error)

General information:

This diagnosis is for collecting the failure bit of the fuel tank level plausibility function.

In case of Slave ECU (LV\_ECU\_SLA = 1) the error management interface information (LV\_ERR\_FTL\_OBD) is imported from the Master ECU and used for the calculation of the error information on the Slave ECU.

The Slave will set or reset the error without antibounce filtering (different Error Management call compared to Master).

Description:

Error-symptoms are defined to this diagnosis function as following :

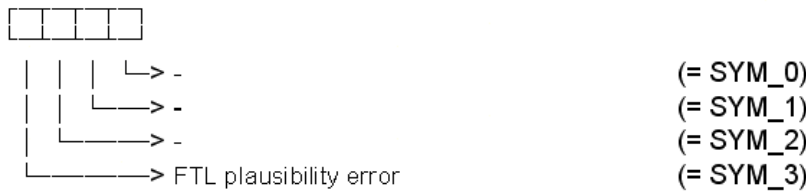


Figure A.81.4. :

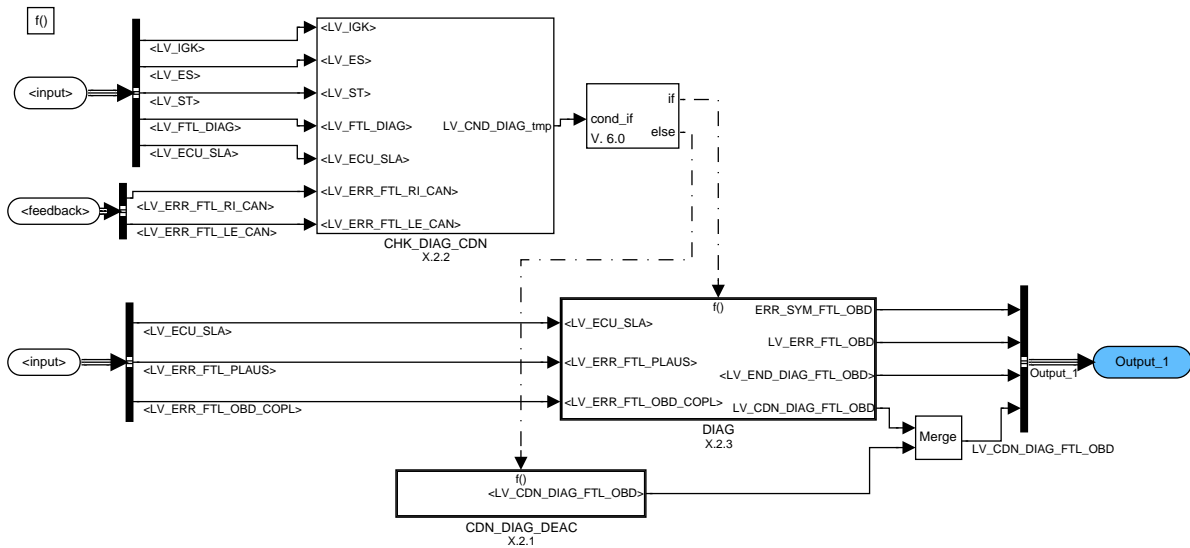


Figure A.81.5. :

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### A.81.2.1 Diagnosis Deactivation



Figure A.81.6: :

### A.81.2.2 Calculation of Activation Condition

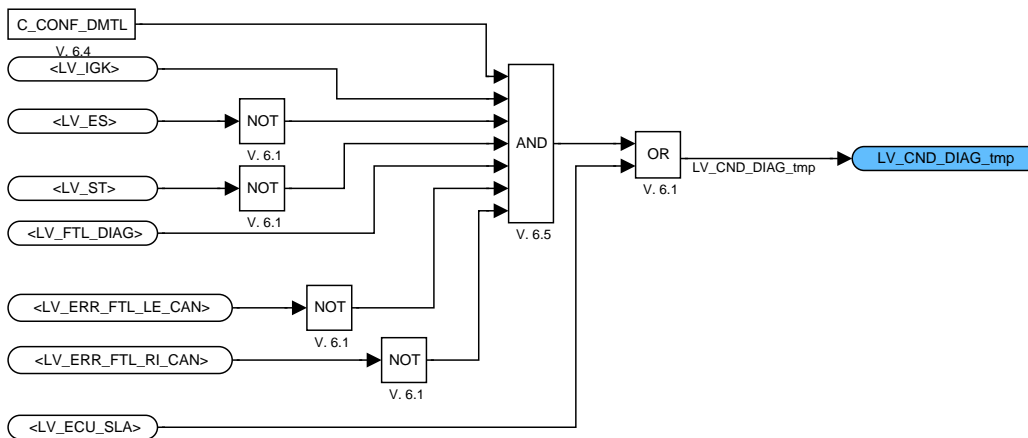


Figure A.81.7: :

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### A.81.2.3 Diagnosis during Activation

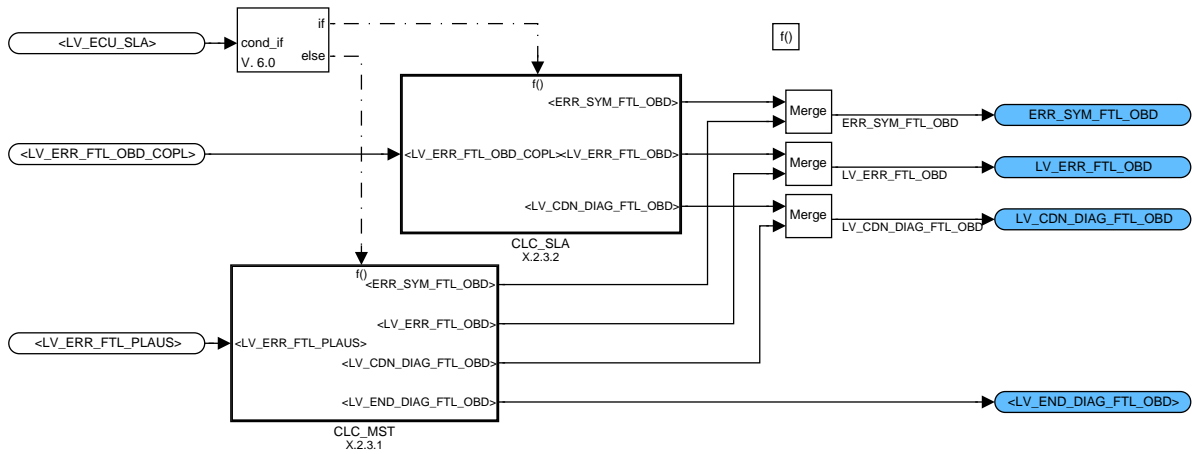


Figure A.81.8: :

#### A.81.2.3.1 Calculations on non-Master/Slave systems or on Master ECU

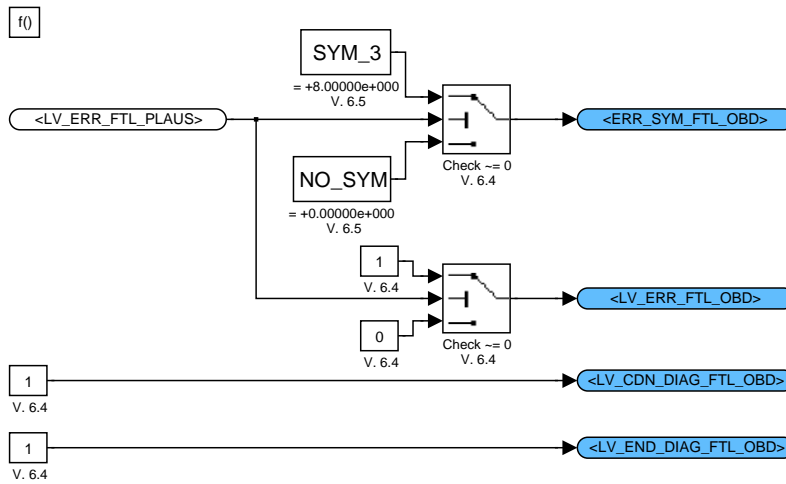


Figure A.81.9: :

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### A.81.2.3.2 FUTL diagnosis only for Master/Slave Systems

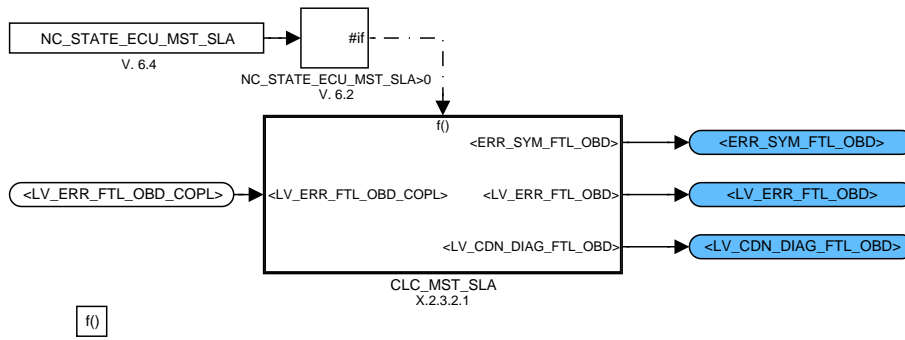


Figure A.81.10: :

#### A.81.2.3.2.1 Calculations on slave ECU

ERR\_SYM\_FTL\_OBD is always set to Symptom 0 at Slave regardless of symptom at Master.  
 LV\_ERR\_FTL\_OBD is set immediately without anti-bounce filtering.

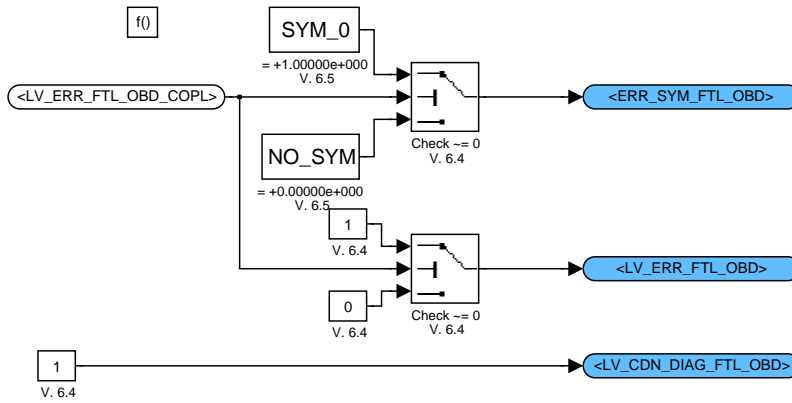


Figure A.81.11: :

### A.81.3 Fuel tank level (CAN error)

General information:

This diagnosis is for collecting the failure bits for LV\_ERR\_FTL\_LE\_CAN and LV\_ERR\_FTL\_RI\_CAN from CAN (Kombi).

Description:

Error-symptoms are defined for LV\_ERR\_FTL\_LE\_CAN and LV\_ERR\_FTL\_RI\_CAN diagnosis function as following :



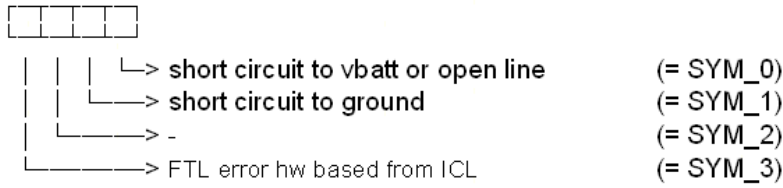


Figure A.81.12: :

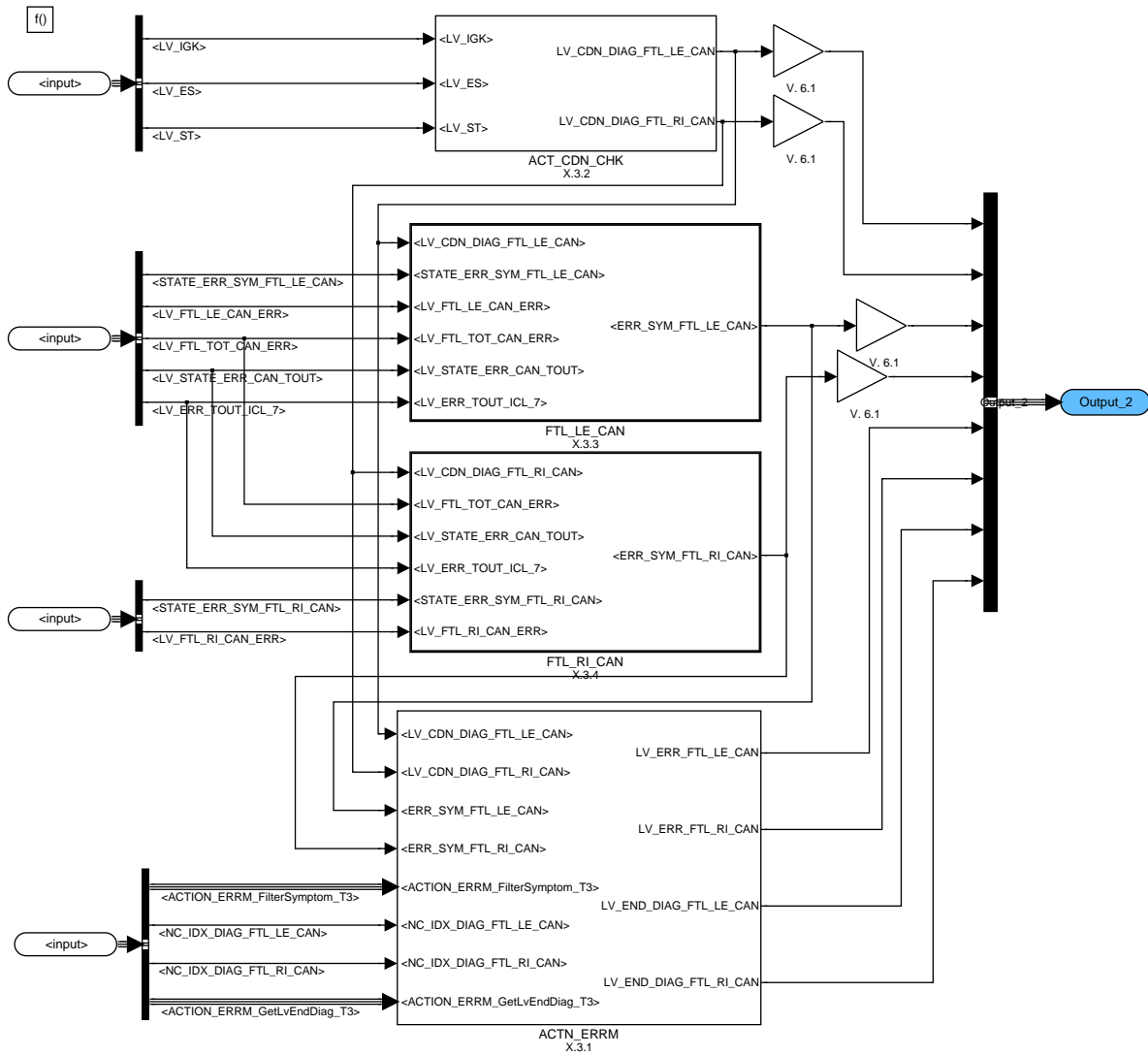


Figure A.81.13: :

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### A.81.3.1 Calculation of LV\_ERR\_FTL\_LE\_CAN, LV\_ERR\_FTL\_RI\_CAN, LV\_END\_DIAG\_FTL\_LE\_CAN and LV\_END\_DIAG\_FTL\_RI\_CAN

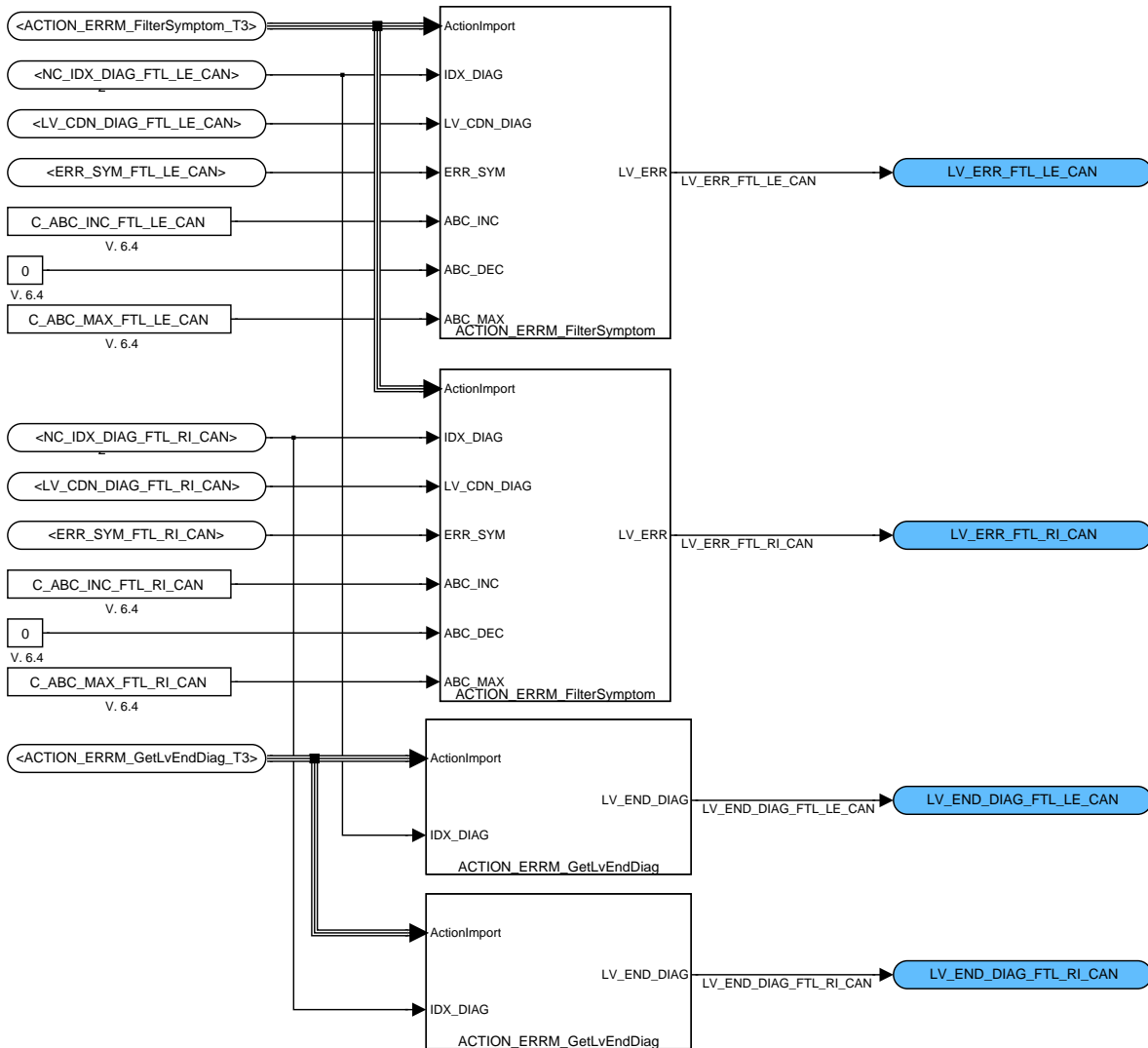


Figure A.81.14: :

### A.81.3.2 Activation condition

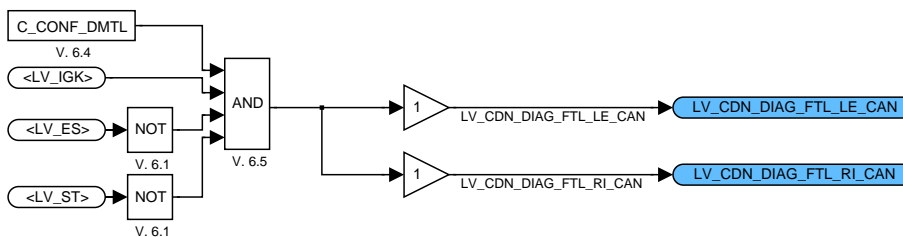


Figure A.81.15: :

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### A.81.3.3 Condition for calculation of ERR\_SYM\_FTL\_LE\_CAN

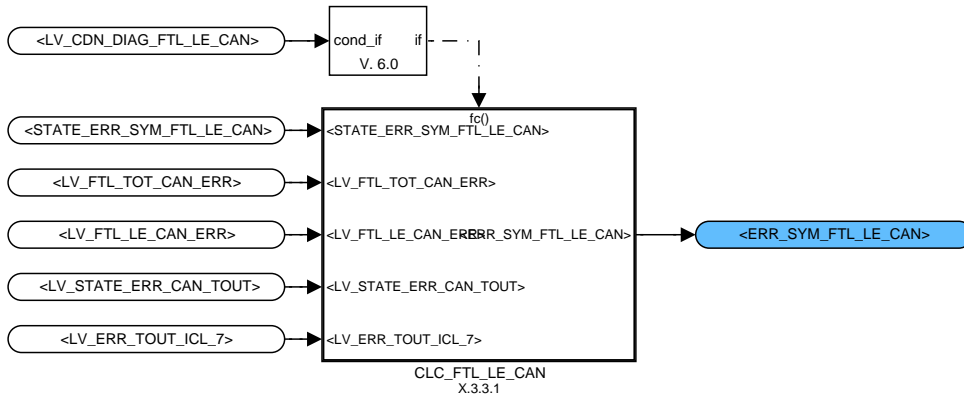


Figure A.81.16: :

#### A.81.3.3.1 Calculation of ERR\_SYM\_FTL\_LE\_CAN

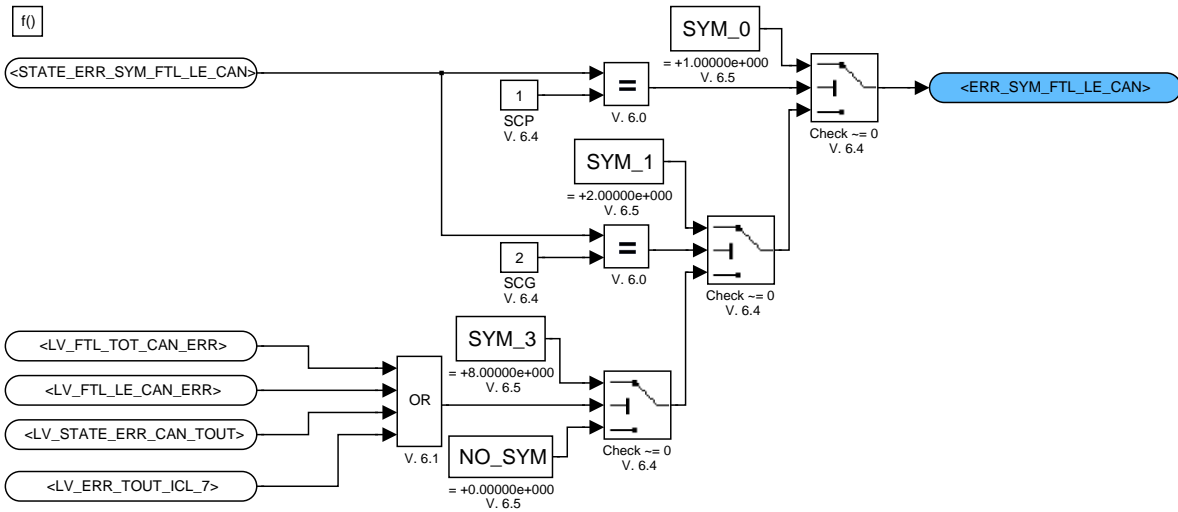


Figure A.81.17: :

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### A.81.3.4 Condition for calculation of ERR\_SYM\_FTL\_RI\_CAN

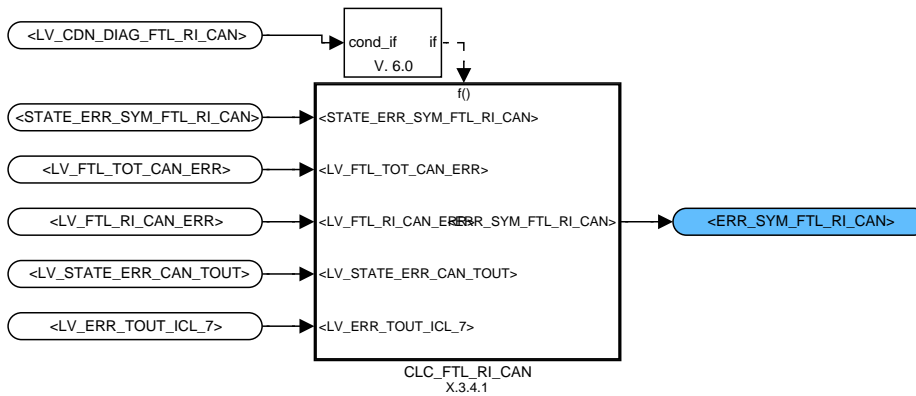


Figure A.81.18: :

#### A.81.3.4.1 Calculation of ERR\_SYM\_FTL\_RI\_CAN

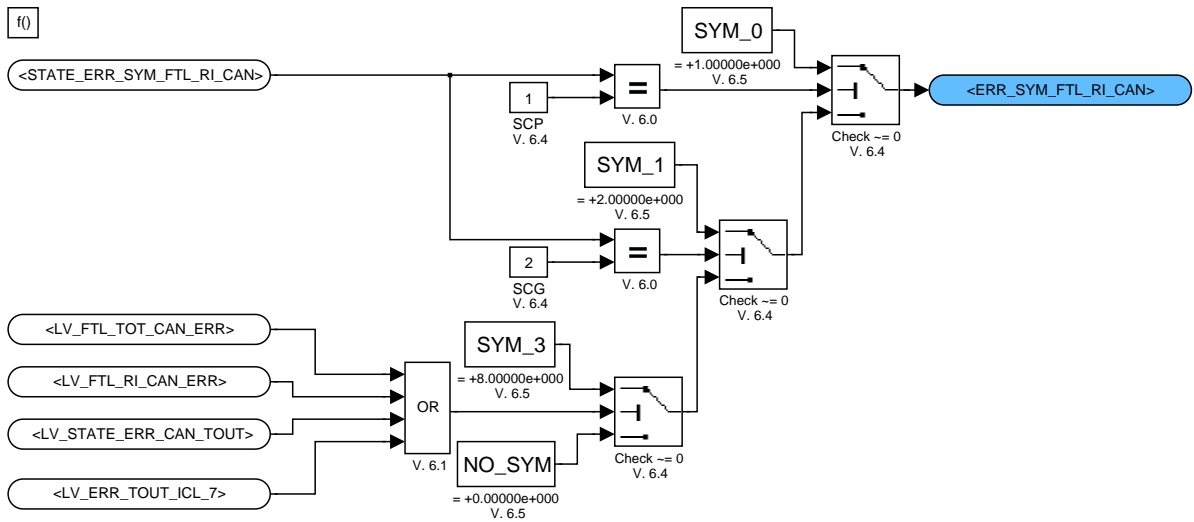


Figure A.81.19: :

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## A.82 Fuel tank level input signal diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_FTL_OBD	O/V	0... 1H	0 ...1	1	-
Inhibition of FTL_OBD diagnosis					
LV_INH_DIAG_RBM_FTL_OBD	V	0... 1H	0 ...1	1	-
Inhibition of RBM for FTL diagnosis					
STATE_RBM_FTL_OBD	O/V	0... 7H	0 ...7	1	-
Interface of FTL_OBD monitor with the Rate-Based Monitoring statistics					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_DC {p. 5746}	LV_ECU_SLA {p. 800}	LV_END_DIAG_FTL_OBD {p. 4745}
LV_ERR_FTL_LE_CAN {p. 4745}	LV_ERR_FTL_RI_CAN {p. 4745}	NC_IDX_DIAG_FTL_LE_ CAN	NC_IDX_DIAG_FTL_RI_ CAN

### General information:

#### General information:

With this module the interface between the FTL\_OBD monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_FTL\_OBD data. The inhibition of FTL\_OBD diagnosis is also calculated in this module.

Within STATE\_RBM\_FTL\_OBD, three different information are defined:

Conditions for monitoring are met long enough to detect malfunction (bit 0)

(no intrusive operation, no short trip)

Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

Monitor individual RBM conditions encountered within this DC (bit 2)

( not valid for FTL\_OBD diagnosis )

### Application conditions:

*Initialisation:* CLRFRMY, DCON, RST

*Recurrence:* 1S

*Activation:* always

*Deactivation:* never

### Function description:

### Formula section:

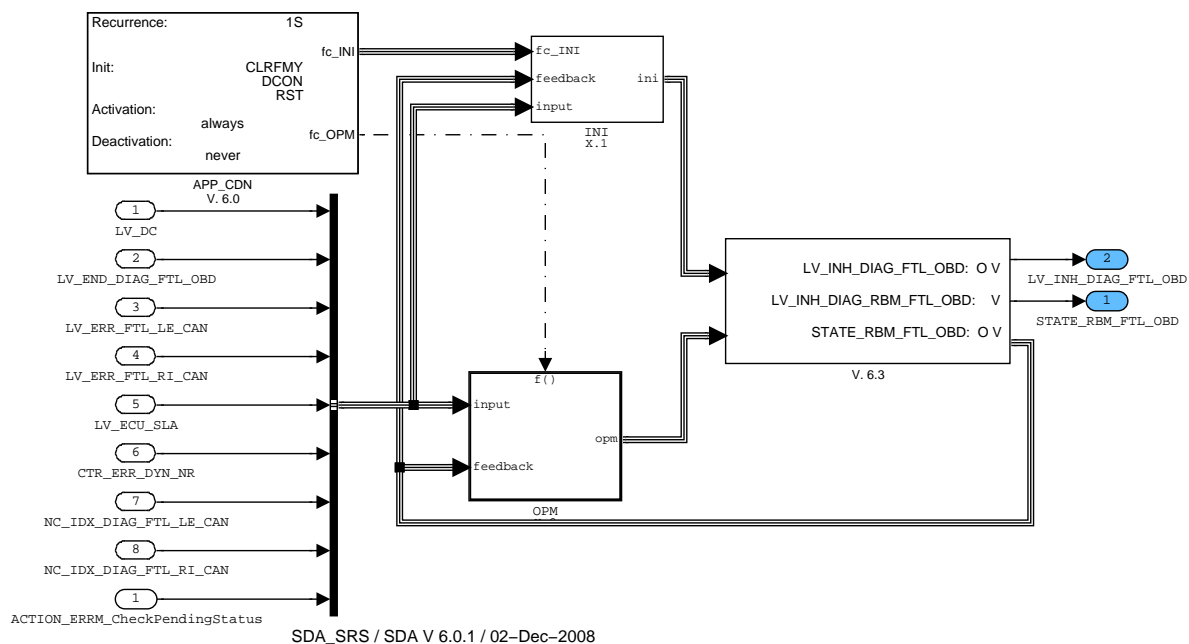


Figure A.82.1: :

### A.82.1 Initialization

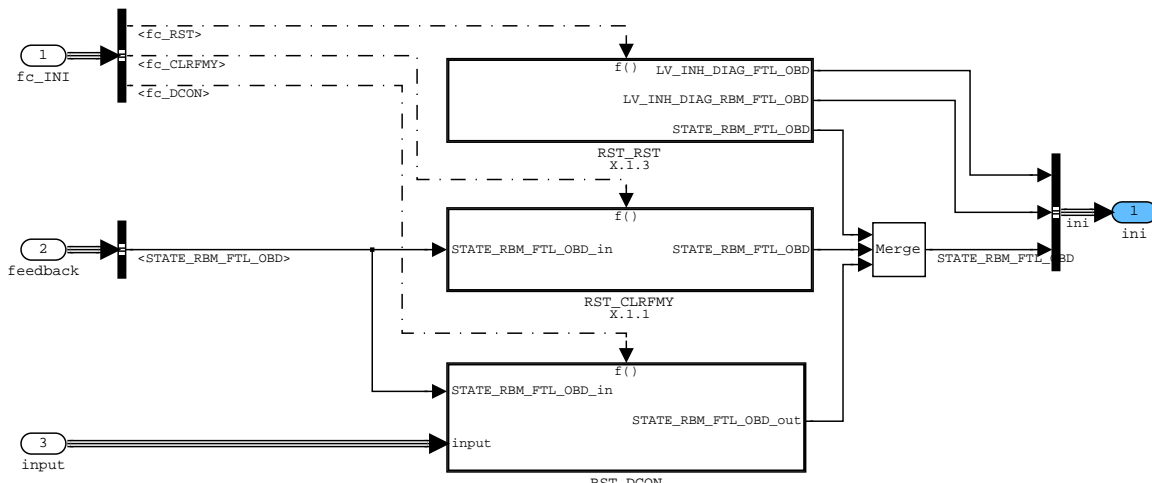


Figure A.82.2: :

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### A.82.1.1 Initialization at Failure Memory Clear

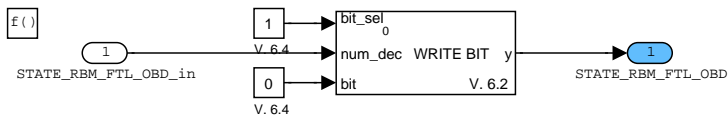


Figure A.82.3: :

### A.82.1.2 Initialization at Driving Cycle OFF to ON

If some failures are pending, the inhibition bit of STATE\_RBM\_FTL\_OBD is set.

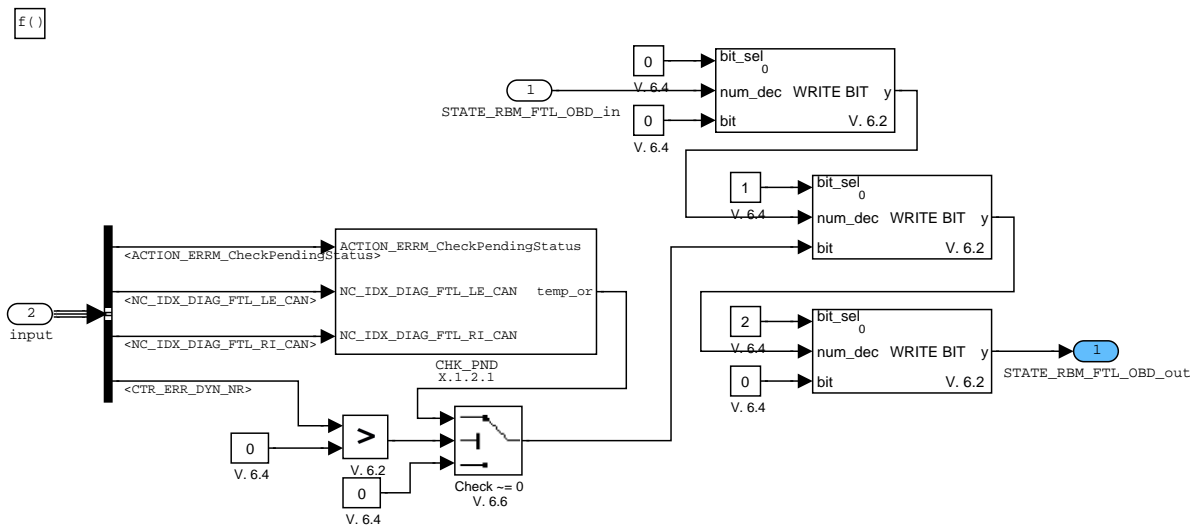


Figure A.82.4: :

#### A.82.1.2.1 Calculation of failures pending status

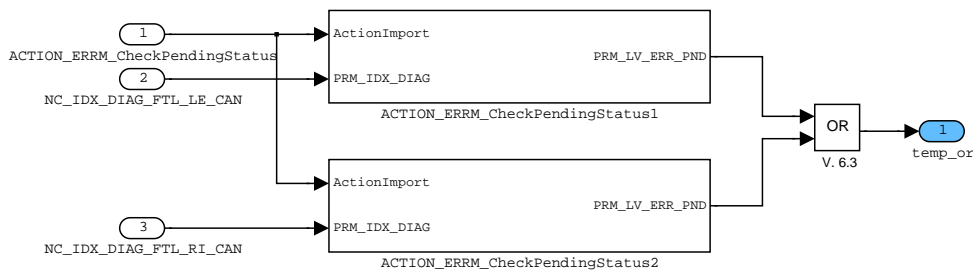


Figure A.82.5: :

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### A.82.1.3 Initialization at Reset

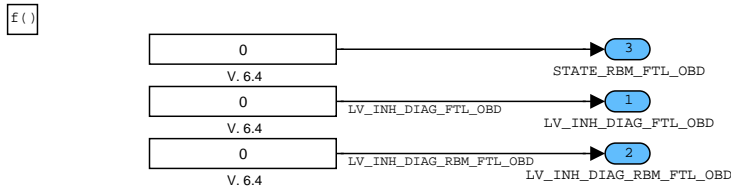


Figure A.82.6: :

### A.82.2 Formula Section

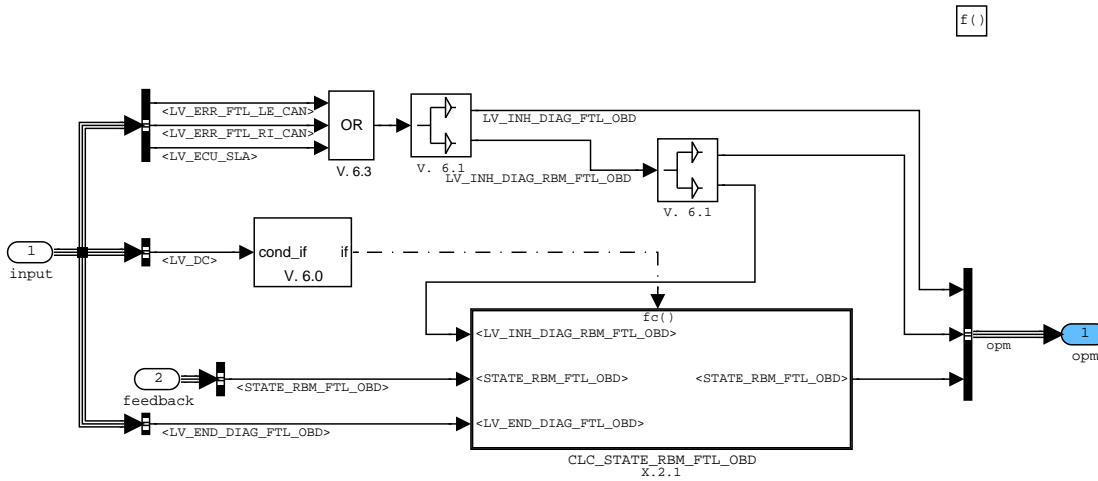


Figure A.82.7: :

#### A.82.2.1 Calculation of STATE\_RBM\_FTL\_OBD

Interface of FTL\_OBD monitor with the Rate-Based Monitoring statistics

Bit 0: conditions for monitoring are met long enough to detect malfunction (bit 0 = 1)

Bit 1: inhibition of the monitor because of system failure(s) (bit 1 = 1)

Bit 2: individual RBM conditions of the monitor were encountered within this DC (bit 2 = 1)

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E()

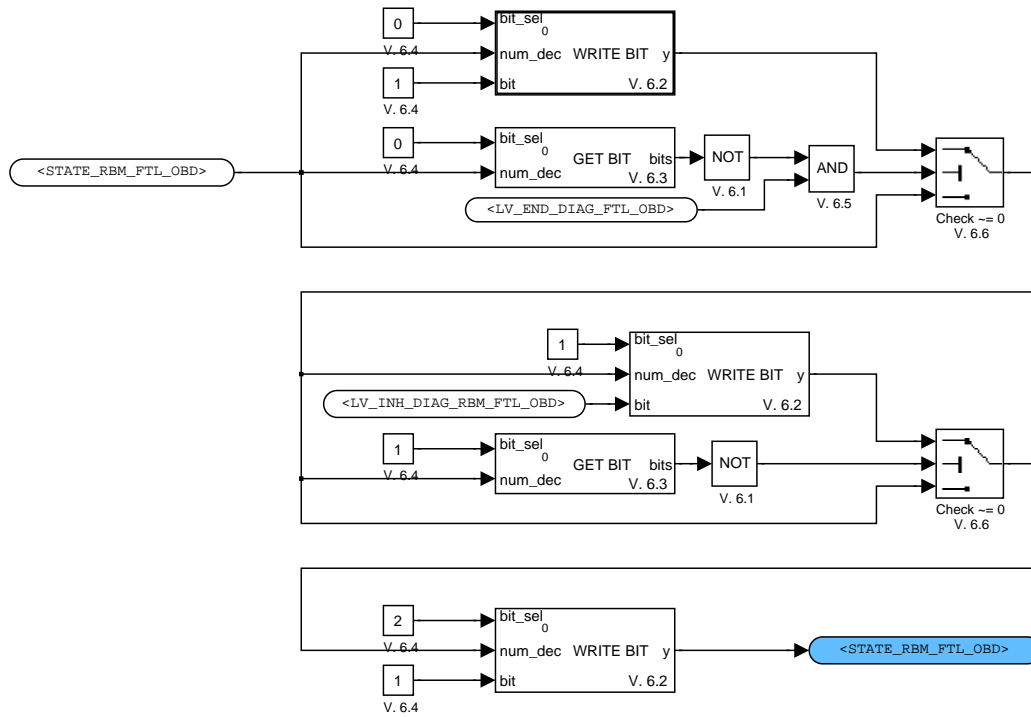


Figure A.82.8: :

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## A.83 Fuel reserve signal diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ABC_FTL_MIN	V	0... FFH	0... 255	1	-
Dbounce counter					
CTR_FTL_MIN_ACT	V	0... FFFFH	0... 65535	1	-
Pre counter FTL events					
ER_FTL_MIN	V	8000... 7FFFH	-32768 ...32767	1	µs
Engine roughness for FTL_MIN diagnosis					
ERR_SYM_FTL_MIN	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptome					
FTL_LE_MMV	V	0... 7FH	0... 127	1	l
Moving mean value of FTL_LE					
FTL_LE_MMV_H_RES	V	0... 7F00H	0... 127	3.9062e-3	l
Moving mean value of FTL_LE with high resolution					
FTL_RI_MMV	V	0... 7FH	0... 127	1	l
Moving mean value of FTL_RI					
FTL_RI_MMV_H_RES	V	0... 7F00H	0... 127	3.9062e-3	l
Moving mean value of FTL_RI with high resolution					
INH_IV_FTL_MIN	O/V	0... FFH	0... 255	1	-
Bit coded inhibit condition cylinder selective for fuel tank low level					
LV_CDN_DIAG_FTL_MIN	V	0... 1H	0 ...1	1	-
Condition diag					
LV_END_DIAG_FTL_MIN	V	0... 1H	0 ...1	1	-
End of diagnosis					
LV_ERR_FTL_MIN	O/V	0... 1H	0 ...1	1	-
Fuel tank level low Injection intervention					
LV_ERR_FUP_DIAG_ACT_HPRS	V	0... 1H	0 ...1	1	-
Logical variable indicating the use of error flags for diagnosis condition in High Pressure System					
LV_ERR_FUP_DIAG_ACT_LPRS	V	0... 1H	0 ...1	1	-
Logical variable indicating the use of error flags for diagnosis condition in Low Pressure System					
LV_FTL_LE_RE_ACT	V	0... 1H	0 ...1	1	-
Flag indicating left and right side of tank below theshold					
LV_FTL_MIN_ACT	V	0... 1H	0 ...1	1	-
Activation conditions for Diagnosis passed					
LV_FUP_AVL_DIAG_TMP	V	0... 1H	0 ...1	1	-
Logical variable indicating fuel pressure falls below a threshold of the FTL diagnosis					
LV_LAMB_PLAUS_FTL_MIN_DIAG_TMP	V	0... 1H	0 ...1	1	-
Logical variable indicating an unplausible lambda signal for FTL diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
RATIO_FTL	V	0... FFFFH	0... 0.99998	15.3e-6	-
Ratio of counter					
RATIO_FTL_INI	V	0... FFFFH	0... 0.99998	15.3e-6	-
Ratio of initialisation counter					
STATE_ERR_FTL	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
State Defining the Source of the Error symptom					
T_DIAG_FTL_MIN	V	0... FFH	0... 25.5	0.1	s
Timer to stop ERR_SYM_FTL_MIN = SYM_0 diagnosis and reset inhibit flag					

**Input data:**

ER {p. 1454}	FAC_LAM_LIM [NC_CBK_EX_NR] {p. 2461}	FTL_LE {p. 1564}	FTL_RI {p. 1564}
FUP {p. 1283}	FUP_EFP {p. 1290}	FUP_SP {p. 3868}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}
LAMB_SP_FIL_HOM [NC_CBK_EX_NR] {p. 2462}	LAMB_SP_MV	LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_CHG_LS_UP {p. 5416}
LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DYN_VLD_LS_ UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}
LV_ERR_FUP {p. 4717}	LV_ERR_FUP_EFP {p. 4733}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}
LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_TPS_ PLAUS {p. 1062}
LV_ERR_OBD_VLD_LSH_ UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_PUC_VLD_LS_ UP [NC_CBK_EX_NR] {p. 5297}
LV_ERR_SHIFT_AFL_ LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_ LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_TTIP_MES_LSH_ UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}
LV_ES {p. 1720}	LV_FUP_LIH_HOM_REQ {p. 4001}	LV_FUP_LIH_HOM_VCV_ OPEN_REQ {p. 4001}	LV_FUP_LIH_L_PRS_ CTL_REQ {p. 4001}
LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}	LV_LAMB_LS_UP_VLD [NC_CBK_EX_NR] {p. 2352}	LV_PUC {p. 1720}
OPM_AV {p. 8137}	T_AST {p. 1766}	TEG_DYN {p. 8236}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_FTL_MIN	-	0... FFH	0... 255	1	-
Decrement					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_FTL_MIN	-	0... FFH	0... 255	1	-
Increment					
C_ABC_MAX_FTL_MIN	-	1... FFH	1... 255	1	-
Maximum					
C_CRLC_FTL_MMV	-	0... FFH	0... 0.99609	3.9063e-3	-
Correlation constant for calculation of moving mean value of FTL_LE/RI_MMV					
C_CTR_FTL_MAX	-	0... FFFFH	0... 65535	1	-
Maximum of increments					
C_FAC_LAM_FTL_MIN	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Threshold of limited value of lambda controller output for FTL diagnosis					
C_FAC_RATIO_FTL_INI_MAX	-	0... FFFFH	0... 655.35	0.01	-
Correction factor					
C_FAC_RATIO_FTL_INI_MIN	-	0... FFFFH	0... 655.35	0.01	-
Correction factor					
C_FTL_MIN_DIAG_HYS	-	0... 7FH	0... 127	1	l
Hysteresis					
C_FTL_MIN_DIAG_LE	-	0... 7FH	0... 127	1	l
Threshold fuel level left					
C_FTL_MIN_DIAG_RI	-	0... 7FH	0... 127	1	l
Threshold fuel level right					
C_FTL_RATIO_MAX	-	8000... 7FFFH	-32768 ...32767	1	µs
Maximum of increments					
C_FUP_DIF_FTL_MAX	-	0... FFFFH	0... 347776	5.3067216	hPa
Fuel Pressure Difference Maximum for FTL diagnosis					
C_FUP_EFP_DIAG_FTL_MIN	-	0... FFFFH	0... 173888	2.6533608	hPa
Fuel pressure of low pressure threshold for FTL diagnosis					
C_INH_IV_FTL_MIN	-	0... FFH	0... 255	1	-
Bitmask of inhibit cylinders					
C_LAMB_DIF_FIL_MAX	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Threshold of lambda difference for FTL diagnosis					
C_T_FTL_PUC_MAX	-	0... FFH	0... 25.5	0.1	s
Maximum for Timer to stop ERR_SYM_FTL_MIN = SYM_0 diagnosis					
C_T_INH_IV_FTL_MAX	-	0... FFH	0... 25.5	0.1	s
Maximum for Timer to reset cylinder inhibition due to cross reaction with other inhibit flags					
C_TEG_DYN_FTL_HYS	-	0... 7FF0H	0... 2047	0.0625	°C
Temperature hysteresis					
C_TEG_DYN_FTL_MIN	-	0... 7FF0H	0... 2047	0.0625	°C
Temperature threshold					
IP_FUP_DIAG_FTL_MIN	-	0... FFFFH	0... 347776	5.3067216	hPa
LDP_N_32_FUP_DIAG_FTL_MIN	4	0... FFH	0... 8160	32	rpm
Fuel pressure threshold for FTL diagnosis					
IP_T_AST_FTL_ACT	-	0... FFFFH	0... 6553.5	0.1	s
LDP_TEMP_CAT_T_AST_FTL_ACT	4	0... FFFFH	-33... 990.98437	0.015625	°C
Wait time after start to activate diag_ftl_min					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_ER_FTL_MIN_ACT	-	0... 1H	0 ...1	1	-
Logical constant indicating the use of engine roughness flags for diagnosis condition					
LC_ERR_FUP_DIAG_ACT_HPRS	-	0... 1H	0 ...1	1	-
Logical constant indicating the use of error flags for diagnosis condition at High Pressure					
LC_ERR_FUP_DIAG_ACT_LPRS	-	0... 1H	0 ...1	1	-
Logical constant indicating the use of error flags for diagnosis condition at Low Pressure					
LC_FTL_MIN_ES_INI_INH	-	0... 1H	0 ...1	1	-
Inhibition of FTL_MIN diagnosis initialization at engine restart event					
LC_LAMB_PLAUS_FTL_MIN_DIAG	-	0... 1H	0 ...1	1	-
Logical constant indicating the non plausible lambda signal for FTL diagnosis					
LC_STATE_FTL_MIN_ENA	-	0... 1H	0 ...1	1	-
Function enable condition					

## A.83.1 Activation of Diagnosis

### Description:

### Application conditions


<b>Initialisation:</b>	at reset <b>or</b> (LV_IGK = 0->1 <b>and</b> LV_ES = 0): LV_FTL_MIN_ACT = 0
<b>Recurrence:</b>	100 ms
<b>Activation:</b>	always
<b>Deactivation:</b>	otherwise

### Formula section:

```

IF LV_IGK == 1           and
LV_ES == 0              and
LV_ERR_MAF == 0        and
LV_ERR_LOAD_TPS_PLAUS == 0 and
LV_ERR_CHG_LS_UP == 0  and
LV_ERR_OFS_LSL_UP[0] == 0 and
LV_ERR_OFS_LSL_UP[1] == 0 and
LV_ERR_CTL_LSL_UP[0] == 0 and
LV_ERR_CTL_LSL_UP[1] == 0 and
LV_ERR_MAP_TPS_PLAUS == 0 and
LV_ERR_AIR_LSL_UP[0] == 0 and
LV_ERR_AIR_LSL_UP[1] == 0 and
LV_ERR_DELTA_I_LAM[0] == 0 and
LV_ERR_DELTA_I_LAM[1] == 0 and
LV_ERR_DYN_VLD_LS_UP[0] == 0 and
LV_ERR_DYN_VLD_LS_UP[1] == 0 and
LV_ERR_EL_LSL_UP[0] == 0 and
LV_ERR_EL_LSL_UP[1] == 0 and
LV_ERR_LSH_UP[0] == 0  and
LV_ERR_LSH_UP[1] == 0  and

```

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```

LV_ERR_LSL_UP_IF[0] == 0          and
LV_ERR_LSL_UP_IF[1] == 0          and
LV_ERR_OBD_VLD_LSH_UP[0] == 0     and
LV_ERR_OBD_VLD_LSH_UP[1] == 0     and
LV_ERR_OC_LSL_UP[0] == 0           and
LV_ERR_OC_LSL_UP[1] == 0           and
LV_ERR_PUC_VLD_LS_UP[0] == 0       and
LV_ERR_PUC_VLD_LS_UP[1] == 0       and
LV_ERR_SHIFT_AFL_LSL_UP[0] == 0    and
LV_ERR_SHIFT_AFL_LSL_UP[1] == 0    and
LV_ERR_SHIFT_AFR_LSL_UP[0] == 0    and
LV_ERR_SHIFT_AFR_LSL_UP[1] == 0    and
LV_ERR_TTIP_MES_LSH_UP[0] == 0     and
LV_ERR_TTIP_MES_LSH_UP[1] == 0     and
LV_ERR_VLS_DOWN_DIF[0] == 0        and
LV_ERR_VLS_DOWN_DIF[1] == 0        and
T_AST > IP_T_AST_FTL_ACT

THEN    LV_FTL_MIN_ACT = 1

ELSE    LV_FTL_MIN_ACT = 0
ENDIF

```

## A.83.2 Diagnosis Function

### General information:

The intention of this diagnosis is to detect a fuel level getting empty. An analysis is done based on the two chambers fuel level of the fuel tank.

### Application conditions

**Initialisation:** at reset or LV\_IGK 0 to 1 or (LV\_ES 1 to 0 and LC\_FTL\_MIN\_ES\_INI\_INH=0)  
*LV\_ERR\_FTL\_MIN, RATIO\_FTL, RATIO\_FTL\_INI, LV\_CDN\_DIAG\_FTL\_MIN, CTR\_FTL\_MIN\_ACT, ER\_FTL\_MIN, ERR\_SYM\_FTL\_MIN, LV\_LAMB\_PLAUS\_FTL\_MIN\_DIAG\_TMP, LV\_FUP\_AVL\_DIAG\_TMP, LV\_FTL\_LE\_RE\_ACT*  
all with 0 physical  
*FTL\_RI\_MMV* = *FTL\_RI*  
*FTL\_RI\_MMV\_H\_RES* = *FTL\_RI*  
*FTL\_LE\_MMV* = *FTL\_LE*  
*FTL\_LE\_MMV\_H\_RES* = *FTL\_LE*


**Recurrence:** 100ms

**Activation:** LV\_FTL\_MIN\_ACT =1 and LV\_ERR\_FTL\_MIN = 0

**Deactivation:** LV\_FTL\_MIN\_ACT = 0 or LV\_ERR\_FTL\_MIN = 1

### Description:

Error-symptoms are defined to this diagnosis function as following :

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→ low pressure intervention in high pressure system (= SYM\_0)  
 → low pressure intervention in low pressure system (= SYM\_1)  
 → - (= SYM\_2)  
 → low fuel level intervention (= SYM\_3)

### Formula section:

Reset of variables on FMY\_clear:

**IF(1)** failure memory is cleared

**THEN(1)** LV\_LAMB\_PLAUS\_FTL\_MIN\_DIAG\_TMP = 0  
 LV\_FUP\_AVL\_DIAG\_TMP = 0  
 STATE\_ERR\_FTL = 0

**ENDIF(1)**

Timer Setting to stop SYM\_0 detection:

**IF(1)** LV\_PUC = 1->0 (Flank from 1 to 0)

**THEN(1)** T\_DIAG\_FTL\_MIN = C\_T\_FTL\_PUC\_MAX

**ENDIF(1)**

Lambda plausibility condition:

**IF(1)** LC\_LAMB\_PLAUS\_FTL\_MIN\_DIAG = 1 **and** OPM\_AV = 2H ('AFS' = HOM)  
**and** LV\_PUC = 0

**THEN(1)** **IF(2)** {[(LV\_LAMB\_LS\_UP\_VLD[0] = 1 **and**  
 LAMB\_LS\_UP[0] - LAMB\_SP\_FIL\_HOM[0] >  
 C\_LAMB\_DIF\_FIL\_MAX ) **or**  
 (LV\_LAMB\_LS\_UP\_VLD[1] = 1 **and**  
 LAMB\_LS\_UP[1] - LAMB\_SP\_FIL\_HOM[1] >  
 C\_LAMB\_DIF\_FIL\_MAX ) ]}

**or**

[(LV\_LAM\_LSCL[0] = 1 **and**  
 LV\_LAM\_STOP[0] = 0 **and**  
 FAC\_LAM\_LIM[1] > C\_FAC\_LAM\_FTL\_MIN ) **or**  
 (LV\_LAM\_LSCL[1] = 1 **and**  
 LV\_LAM\_STOP[1] = 0 **and**  
 FAC\_LAM\_LIM[2] > C\_FAC\_LAM\_FTL\_MIN ) ]} **and**

T\_DIAG\_FTL\_MIN = 0

**THEN(2)** LV\_LAMB\_PLAUS\_FTL\_MIN\_DIAG\_TMP = 1

**ELSE(2)** LV\_LAMB\_PLAUS\_FTL\_MIN\_DIAG\_TMP = 0

**ENDIF(2)**

**ELSE(1)** LV\_LAMB\_PLAUS\_FTL\_MIN\_DIAG\_TMP = 0

**ENDIF(1)**

High Pressure Condition:

**IF(1)** LC\_ERR\_FUP\_DIAG\_ACT\_HPRS = 1

**THEN(1)** **IF(2)** LV\_ERR\_FUP\_MFP\_PLAUS = 0 **and**  
 LV\_ERR\_FUP = 0

```

    THEN(2)    LV_ERR_FUP_DIAG_ACT_HPRS = 1
    ELSE(2)    LV_ERR_FUP_DIAG_ACT_HPRS = 0
    ENDIF(2)
ELSE(1)    LV_ERR_FUP_DIAG_ACT_HPRS = 0
ENDIF(1)

```

Low Pressure Condition:

```

IF(1)    LC_ERR_FUP_DIAG_ACT_LPRS = 1
THEN(1)  IF(2)    LV_ERR_FUP_EFP = 0
          THEN(2)    LV_ERR_FUP_DIAG_ACT_LPRS = 1
          ELSE(2)    LV_ERR_FUP_DIAG_ACT_LPRS = 0
          ENDIF(2)
ELSE(1)  LV_ERR_FUP_DIAG_ACT_LPRS = 0
ENDIF(1)

```

Individual Tank Levels Condition:

Right:

```

IF(1)    FTL_RI - FTL_RI_MMV > 0
THEN(1)  FTL_RI_MMV_H_RES = FTL_RI
          FTL_RI_MMV = FTL_RI_MMV_H_RES
ELSE(1)  FTL_RI_MMV_H_RES = FTL_RI_MMV_H_RES + (FTL_RI - FTL_RI_MMV_H_
RES) * C_CRLC_FTL_MMV
          FTL_RI_MMV = FTL_RI_MMV_H_RES
ENDIF(1)

```

Left:

```

IF(1)    FTL_LE - FTL_LE_MMV > 0
THEN(1)  FTL_LE_MMV_H_RES = FTL_LE
          FTL_LE_MMV = FTL_LE_MMV_H_RES
ELSE(1)  FTL_LE_MMV_H_RES = FTL_LE_MMV_H_RES + (FTL_LE - FTL_LE_MMV_H_
RES) * C_CRLC_FTL_MMV
          FTL_LE_MMV = FTL_LE_MMV_H_RES
ENDIF(1)

```

Empty Tank Decision based on tank level condition:

```

IF(1a)    LC_STATE_FTL_MIN_ENA == 1                and
          FTL_LE_MMV <= C_FTL_MIN_DIAG_LE         and
          FTL_RI_MMV <= C_FTL_MIN_DIAG_RI         and
          TEG_DYN => C_TEG_DYN_FTL_MIN
THEN(1a)  LV_FTL_LE_RE_ACT = 1

ELSEIF(1b)    FTL_LE_MMV > C_FTL_MIN_DIAG_LE + C_FTL_MIN_DIAG_HYS or
              FTL_RI_MMV > C_FTL_MIN_DIAG_RI + C_FTL_MIN_DIAG_HYS or
              TEG_DYN < C_TEG_DYN_FTL_MIN - C_TEG_DYN_FTL_HYS
THEN(1b)    LV_FTL_LE_RE_ACT = 0

ELSE(1)    LV_FTL_LE_RE_ACT(n) = LV_FTL_LE_RE_ACT(n-1)

ENDIF(1)

```

Error Decision:



```

IF(1)    OPM_AV = 2H ('AFS' = HOM)
THEN(1)
    IF(2)    LV_FTL_LE_RE_ACT = 1                and
              (STATE_ERR_FTL = SYM_0            or
               STATE_ERR_FTL = SYM_1)          and
              LV_FUP_AVL_DIAG_TMP = 1         and
              LV_LAMB_PLAUS_FTL_MIN_DIAG_TMP = 1
    THEN(2)  LV_FUP_AVL_DIAG_TMP = 1
              STATE_ERR_FTL = SYM_3
    ELSE(2)
    IF(3)    FUP_SP - FUP > C_FUP_DIF_FTL_MAX    and
              FUP < IP_FUP_DIAG_FTL_MIN        and
              LV_ERR_FUP_DIAG_ACT_HPRS = 1     and
              LV_LAMB_PLAUS_FTL_MIN_DIAG_TMP = 1
    THEN(3)  LV_FUP_AVL_DIAG_TMP = 1
              STATE_ERR_FTL = SYM_0
    ELSE(3)
    IF(4)    FUP_EFP < C_FUP_EFP_DIAG_FTL_MIN    and
              LV_ERR_FUP_DIAG_ACT_HPRS = 0     and
              LV_ERR_FUP_DIAG_ACT_LPRS = 1     and
              LV_LAMB_PLAUS_FTL_MIN_DIAG_TMP = 1
    THEN(4)  LV_FUP_AVL_DIAG_TMP = 1
              STATE_ERR_FTL = SYM_1
    ELSE(4)  LV_FUP_AVL_DIAG_TMP = 0
              STATE_ERR_FTL = NO_SYM
    ENDIF(4)
  ENDIF(3)
ENDIF(2)
ELSE(1)  LV_FUP_AVL_DIAG_TMP(n) = LV_FUP_AVL_DIAG_TMP(n-1)
ENDIF(1)


```

Error Setting:

```

IF(0)  LC_ER_FTL_MIN_ACT = 1
THEN(0)
IF(1)  LV_FUP_AVL_DIAG_TMP = 1
THEN(1) LV_CDN_DIAG_FTL_MIN = 0
    IF (2)  RATIO_FTL_INI == 0
    Then(2)  IF (3)  CTR_FTL_MIN_ACT < C_CTR_FTL_MAX
    Then(3)  CTR_FTL_MIN_ACT = CTR_FTL_MIN_ACT + 1
              ER_FTL_MIN = ER_FTL_MIN + abs(ER)
    ELSE(3)  RATIO_FTL_INI = ER_FTL_MIN / C_FTL_RATIO_MAX
              CTR_FTL_MIN_ACT = 0
              ER_FTL_MIN = 0
    Endif(3)
  ELSE(2)
    IF(3)  CTR_FTL_MIN_ACT < C_CTR_FTL_MAX
    Then(3)  CTR_FTL_MIN_ACT = CTR_FTL_MIN_ACT + 1
              ER_FTL_MIN = ER_FTL_MIN + abs(ER)
    ELSE(3)  RATIO_FTL = ER_FTL_MIN / C_FTL_RATIO_MAX
    IF(4)  RATIO_FTL > RATIO_FTL_INI * C_FAC_RATIO_FTL_INI_MAX or
              RATIO_FTL < RATIO_FTL_INI * C_FAC_RATIO_FTL_INI_MIN
    Then(4)  LV_CDN_DIAG_FTL_MIN = 1

```

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```

        IF(5)  STATE_ERR_FTL = SYM_0
        THEN(5)  ERR_SYM_FTL_MIN = SYM_0

        ELSEIF(5)  STATE_ERR_FTL = SYM_1
        THEN(5)  ERR_SYM_FTL_MIN = SYM_1

        ELSEIF(5)  STATE_ERR_FTL = SYM_3
        THEN(5)  ERR_SYM_FTL_MIN = SYM_3


        ELSE(5)  ERR_SYM_FTL_MIN = NO_SYM
        ENDIF(5)
    CTR_FTL_MIN_ACT = 0
    ER_FTL_MIN = 0
    debounce LV_ERR_FTL_MIN
    C_ABC_INC_FTL_MIN; C_ABC_MAX_FTL_MIN
Else(4)  reset  ER_FTL_MIN = 0
    CTR_FTL_MIN_ACT = 0
Endif(4)
Endif(3)
Endif(2)
ELSE(1)  LV_CDN_DIAG_FTL_MIN = 1
    ERR_SYM_FTL_MIN = NO_SYM
    Rebounce with C_ABC_DEC_FTL_MIN
    RATIO_FTL_INI = RATIO_FTL = 0;
    ER_FTL_MIN = 0
    CTR_FTL_MIN_ACT = 0
Endif(1)
ELSE(0)
    IF(1)  LV_FUP_AVL_DIAG_TMP = 1
    THEN(1)
        IF(2)  STATE_ERR_FTL = SYM_0
        THEN(2)  ERR_SYM_FTL_MIN = SYM_0
            LV_CDN_DIAG_FTL_MIN = 1
            debounce LV_ERR_FTL_MIN
            C_ABC_INC_FTL_MIN; C_ABC_MAX_FTL_MIN

        ELSEIF(2)  STATE_ERR_FTL = SYM_1
        THEN(2)  ERR_SYM_FTL_MIN = SYM_1
            LV_CDN_DIAG_FTL_MIN = 1
            debounce LV_ERR_FTL_MIN
            C_ABC_INC_FTL_MIN; C_ABC_MAX_FTL_MIN

        ELSEIF(2)  STATE_ERR_FTL = SYM_3
        THEN(2)  ERR_SYM_FTL_MIN = SYM_3
            LV_CDN_DIAG_FTL_MIN = 1
            debounce LV_ERR_FTL_MIN
            C_ABC_INC_FTL_MIN; C_ABC_MAX_FTL_MIN

        ENDIF(2)
    ELSE(1)  ERR_SYM_FTL_MIN = NO_SYM
        LV_CDN_DIAG_FTL_MIN = 1
        Rebounce with C_ABC_DEC_FTL_MIN

```

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**ENDIF(1)**  
**ENDIF(0)**

### A.83.3 Inhibition Flag

#### Application conditions

**Initialisation:** INH\_IV\_FTL\_MIN = 0 ; T\_DIAG\_FTL\_MIN = 0  
**Recurrence:** 100ms  
**Activation:** LV\_IGK ==1  
**Deactivation:** LV\_IGK ==0

#### Formula section:

Timer Setting to stop SYM\_0 detection:

**Decrement** T\_DIAG\_FTL\_MIN

```

IF (1a)          LV_ERR_FTL_MIN = 1                                and
                  STATE_ERR_FTL = SYM_0                            and
                  (
                    LV_FUP_LIH_L_PRS_CTL_REQ = 1                    or
                    LV_FUP_LIH_HOM_VCV_OPEN_REQ = 1                or
                    LV_FUP_LIH_HOM_REQ = 1
                  )                                                and
                  T_DIAG_FTL_MIN = 0
THEN(1a)        INH_IV_FTL_MIN = 00H
ELSEIF (1b)     LV_ERR_FTL_MIN = 1
THEN(1b)        INH_IV_FTL_MIN = C_INH_IV_FTL_MIN
                  IF(2a)          STATE_ERR_FTL = SYM_0                                and
                  LV_FUP_LIH_L_PRS_CTL_REQ = 0                    and
                  LV_FUP_LIH_HOM_VCV_OPEN_REQ = 0                and
                  LV_FUP_LIH_HOM_REQ = 0
                  THEN(2a)        T_DIAG_FTL_MIN = C_T_INH_IV_FTL_MAX
                  ENDIF(2a)
ELSE(1b)        INH_IV_FTL_MIN = 00H
                  "BIT mask for selection of cylinder to inhibit"
ENDIF(1b)

```

## A.84 Ignition diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_DUR_IGC_MPL	V	0H 8H	NO_SYM SYM_3	-	-
Symptom of the ignition coil failure : open load on all cylinders					
ERR_SYM_IGC_SCG [NC_CYL_NR]	V	0H 2H	NO_SYM SYM_1	-	-
Symptom of the ignition coil failure primary short circuit ground					
ERR_SYM_IGC_SCP [NC_CYL_NR]	V	0H 1H	NO_SYM SYM_0	-	-
Symptom of the ignition coil failure primary short circuit plus					
IGC_DIAG_MIS	O/V	0... FFH	0... 255	1	-
Non filtered error information for misfire detection					
LV_CDN_DIAG_DUR_IGC_MPL	V	0H 1H	Passive Active	-	-
Diagnosis condition bit for open load on all cylinders					
LV_CDN_DIAG_IGC_SCG [NC_CYL_NR]	V	0H 1H	Passive Active	-	-
Ignition diagnosis condition for short circuit to ground					
LV_CDN_DIAG_IGC_SCP [NC_CYL_NR]	O/V	0H 1H	Passive Active	-	-
Ignition diagnosis condition for short circuit plus					
LV_END_DIAG_DUR_IGC_MPL	V	0H 1H	Passive Active	-	-
Result of ignition diagnosis : open load on all cylinders					
LV_END_DIAG_IGC_SCG [NC_CYL_NR]	V	0H 1H	Passive Active	-	-
Result of ignition diagnosis for SCG					
LV_END_DIAG_IGC_SCP [NC_CYL_NR]	V	0H 1H	Passive Active	-	-
Result of ignition diagnosis for SCP					
LV_ERR_DUR_IGC_MPL	O/V	0H 1H	Passive Active	-	-
Ignition coil failure : open load on all cylinders					
LV_ERR_IGC	O/V	0... 1H	0 ...1	1	-
OR of every failure every 100 ms					
LV_ERR_IGC_SCG [NC_CYL_NR]	O/V	0H 1H	Passive Active	-	-
ignition coil failure primary short circuit ground					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_IGC_SCP [NC_CYL_NR]	O/V	0H 1H	Passive Active	-	-
Ignition coil failure short circuit plus					
LV_INH_IGC [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Inhibition for ignition system of cylinder x					
LV_INH_INJ_DIAG_IGC	O/V	0... 1H	0 ...1	1	-
Flag to inhibit injection on all cylinders due to lost ignition coil supply					

**Input data:**

IGC_x_EXT_ADJ {p. 798}	LV_CDN_VB_OBD1 {p. 1185}	LV_ERR_CAM {p. 1505}	LV_ES {p. 1720}
LV_IGC_x_EXT_ADJ {p. 803}	LV_IGK {p. 906}	LV_INH_DIAG_DUR_IGC_ MPL {p. 4780}	LV_INH_DIAG_IGC_SCG {p. 4780}
LV_INH_DIAG_IGC_SCP {p. 4780}	LV_SCG_IGC [NC_CYL_NR] {p. 920}	LV_SCP_IGC [NC_CYL_NR] {p. 920}	LV_ST {p. 1720}
N_32 {p. 1525}	NC_CYL_NR {p. 1526}	TCO {p. 1100}	TD_AD [NC_CYL_NR] {p. 932}
TD_IGC [NC_CYL_NR] {p. 1876}	V_DUR_IGC [NC_CYL_NR] {p. 920}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_IGC_SCP	-	0... FFH	0... 255	1	-
Value of anti-bounce counter after regeneration cycle Typical value for debug = 128					
C_ESB_IGN_CUT_DIAG	-	0... 01H	0 ...1	1	-
C_ESB_IGN_CUT_DIAG = 1 will inhibit the function Typical value for debug = 0					
C_IGA_OFF_CYCNR_HLD	-	0... FFH	0... 255	1	-
Duration for regeneration cycle Recurrence number; coil has been switched off Typical value for debug = 16					
C_N_32_MIN_OL_SCG_IGC_DIAG	-	0... FFH	0... 8160	32	Rpm
Min engine speed for condition diagnosis OL/SCG Typical value for debug = 500 rpm					
C_N_32_MIN_SCP_IGC_DIAG	-	0... FFH	0... 8160	32	Rpm
Min engine speed for condition diagnosis SCP Typical value for debug = 500 rpm					
C_SUM_IGC_SCP	-	0... FFH	0... 255	1	-
Number of cycles before switching off the coil until reset Typical value for debug = 255					
C_TCO_MIN_IGC_DIAG	-	0... FEH	-48... 142.5	0.75	°C
Min Temperature for condition diagnosis OL & SCG Typical value for debug = 20 ° (emission cycle starting)					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IGC_DLY	-	0... FFH	0... 255	1	-
Number of recurrence after engine start, which had to pass by to activate the diagnosis value = 16					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IGN_DIAG_TYP	-	0... FFH	0... 255	1	-
ATM46 = 01H ATIC29 = 02H SHUNT (not supported today) Typical value for debug = ATIC29					

**FUNCTION DESCRIPTION:**

**General information:**

The purpose of this diagnosis function is to detect all major failures, which can happen between ECU output and ignition coils.

This function is adaptable on every engine but the type of spark plugs and ignition coils must be taken into account.

The diagnosis is performed separate for each ignition coil. The feedback signal from the specific ignition coil (following the firing order) is evaluated by the microcontroller.

**A.84.1 Short circuit to plus: SCP**

**Description:**

In some hardware driver the ignition power stage is not protected against short circuit to ground and they are not able to withstand an overload current for a long time so it is necessary to switch off the power stage by software.

For ignition coil actuator tests purpose, the SCP diagnostic function has to be enabled, activated and monitored upon the tests requests

The same case and comments (see before) apply here also.

The Ignition output diagnosis function detects short circuit to battery and sets LV\_IGC\_SCP[x]. It cuts off the ignition driver after a delay time which is defined in the IGBT Protection function. In the ignition diagnosis function the error is debounced.

**Application conditions**

**Normal Engine Running mode**

**Initialization:** *all ERRM output data according Filter type (see Applic. Inc.), all other output data 0 at reset*

**Recurrence:** **If** NC\_IGN\_DIAG\_TYP =ATM46 every segment  
**If** NC\_IGN\_DIAG\_TYP =ATIC29 every 100 ms

**Activation:** **If** LV\_INH\_IGC[x] = 0  
**And** LV\_ERR\_CAM = 0  
**And** N\_32 > C\_N\_32\_MIN\_SCP\_IGC\_DIAG  
**And** LV\_INH\_DIAG\_IGC\_SCP = 0  
**And** **if** NC\_IGN\_DIAG\_TYP =ATIC29  
 Failure information for current cylinder from ATIC29 is valid

**Endif**  
**Then** LV\_CDN\_DIAG\_IGC\_SCP[x] = 1  
**Else** LV\_CDN\_DIAG\_IGC\_SCP[x] = 0  
**Endif**

**Ignition Actuator Tests mode**

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**Initialisation:** all output variables of the function have to be set to 0 at reset ECU  
*(except saved error flag)*

**Recurrence:** **if** NC\_IGN\_DIAG\_TYP =ATM46  
On transition of IGC\_x\_EXT\_ADJ from 1 to 0  
for reading the SCP failure status

**Activation:** **For** x = 0 to NC\_CYL\_NR - 1  
**If** LV\_INH\_IGC[x] = 0  
**And** LV\_ERR\_CAM = 0  
    **[And** LV\_ES = 1 // Actuator tests activation  
    **And** LV\_IGK = 1  
    **And** LV\_IGC\_x\_EXT\_ADJ = 1]  
**Then** LV\_CDN\_DIAG\_IGC\_SCP[x] = 1  
**Else** LV\_CDN\_DIAG\_IGC\_SCP[x] = 0  
**Endif**  
**EndFor**

**Formula section:**

**If** LV\_CDN\_DIAG\_IGC\_SCP =1  
**Then** **if** LV\_SCP\_IGC[x] = 1  
    **Then** ERR\_SYM\_IGC\_SCP[x] = SYM\_0  
    **Else** ERR\_SYM\_IGC\_SCP[x] = NO\_SYM  
**Else** No action on the antibounce counter  
**Endif**

**Debounce:**

Anti - bounce counter increment: according ABC type  
Maximum value of anti - bounce counter: according ABC type  
**If** LV\_CDN\_DIAG\_IGC\_SCP[x] =1  
**Then** **if** ERR\_SYM\_IGC\_SCP[x] = SYM\_0  
    **Then** the antibounce counter is started according ABC type  
    **Else** The antibounce counter is decremented according ABC type  
**Endif**  
**Endif**

**Ignition cut off conditions:**

**If** C\_ABC\_MAX\_IGC\_SCP delay is reached  
**Then** LV\_INH\_IGC[x] = 1  
**Endif**


**Ignition restart after cut off:**

To regenerate the power stage the diagnosis will be switched off (LV\_INH\_IGC[x] = 1) for C\_IGA\_OFF\_CYCNR\_HLD recurrence number (see graphic, failure reaction in case of error).

After the refreshing cycle the debounce counter is set to C\_ABC\_IGC\_SCP (see graphic below) and the ignition will be switched on to test the operating stage again. In case of error it will be debounced again.

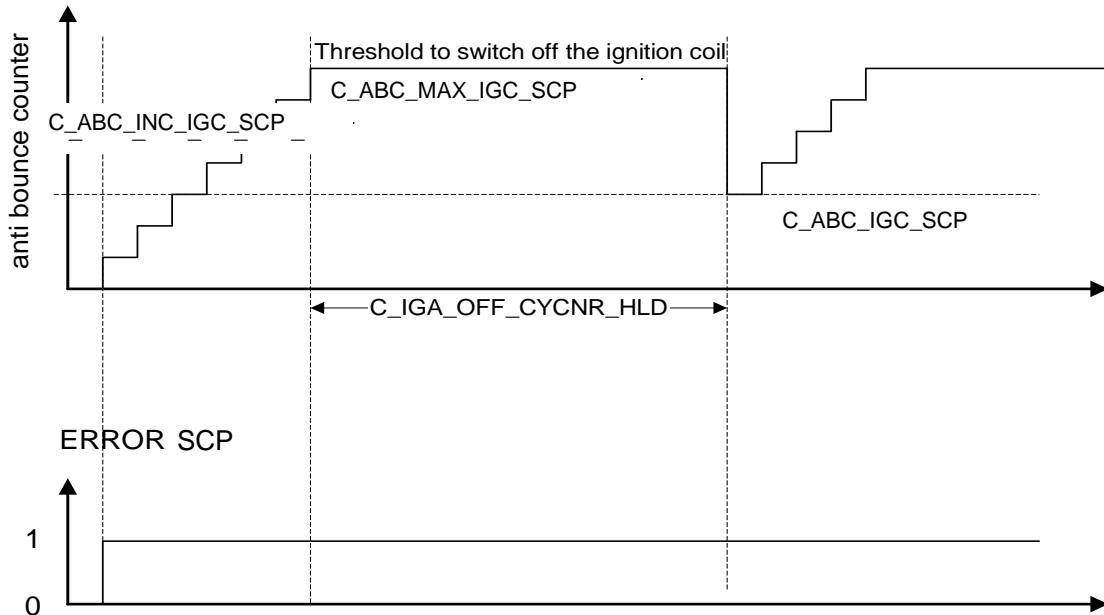
This procedure is executed C\_SUM\_IGC\_SCP times before the coil is absolutely switched off, until reset for ATM46 not for ATIC29

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In next engine cycle the error is kept present. To take sure that the vehicle is able to restart the ignition will be switched on, till the diagnosis conditions are fulfilled and the diagnosis restarts.

*Failure reaction in case of error*



Application hint:

Some driver as ATM46 does not cut itself in case of SCP failure. For better Driver protection The counter threshold C\_ABC\_IGC\_SCP mustn't exceed 4 cycles For the same reason the counter C\_ABC\_MAX\_IGC\_SCP must be set below 12 cycles.

The function can be disabled by the 'enable byte' C\_ESB\_IGN\_CUT\_DIAG.

## A.84.2 SCG diagnosis

### Description

The diagnosis is based on SCG information from the ignition output diagnosis function. Please note that this diagnosis is valid also for Open Load detection.

### Application conditions

**Initialisation:** all ERRM output data according Filter type (see Applic. Inc.), all other output data 0 at reset


**Recurrence:** if NC\_IGN\_DIAG\_TYP =ATM46 every segment  
if NC\_IGN\_DIAG\_TYP =ATIC29 every 100 ms

**Activation:**

```

If      LV_ES = 0
And    LV_ST = 0
And    N_32 > C_N_32_MIN_OL_SCG_IGC_DIAG
And    TCO > C_TCO_MIN_IGC_DIAG
And    LV_INH_IGC[x] = 0
And    LV_ERR_CAM = 0
And    No low voltage battery (LV_CDN_VB_OBD1 = 1)
And    Counter Number of recurrence > NC_IGC_DLY
And    LV_INH_DIAG_IGC_SCG = 0
And    if      NC_IGN_DIAG_TYP =ATIC29
    
```

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```

Failure information for current cylinder
from ATIC29 is valid
    endif
    Then LV_CDN_DIAG_IGC_SCG[x] =1
    Else LV_CDN_DIAG_IGC_SCG[x] = 0
    Endif
    
```

**Formula section:**

```

If LV_CDN_DIAG_IGC_SCG[x] =1
Then If LV_SCG_IGC[x] = 1
      Then ERR_SYM_IGC_SCG[x] = SYM_1
      Else ERR_SYM_IGC_SCG[x] = NO_SYM
      Endif
Else No action on the antibounce counter
Endif
    
```

**Debounce:**

Anti - bounce counter increment: C\_ABC\_INC\_IGC\_SCG

Maximum value of anti - bounce counter: C\_ABC\_MAX\_IGC\_SCG

```

If LV_CDN_DIAG_IGC_SCG[x] =1
Then If ERR_SYM_IGC_SCG[x] = SYM_1
      Then the antibounce SCG counter is started according ABC type
      Else The antibounce SCG counter is decremented according ABC type
      Endif
Endif
    
```

### A.84.3 Loss of power supply for all ignition coils

**Description:**

If all flags V\_DUR\_IGC[x] are equal to 0 at the same time it is assumed that the power supply for all ignition coils is lost or damaged. in this case LV\_ERR\_DUR\_IGC\_MPL is set.

**Application conditions**

**Initialisation:** according ABC type  
LV\_INH\_INJ\_DIAG\_IGC = 0 at LV\_IGK 0 - ->1 or reset or clearing  
FMY


**Recurrence:** every segment

**Activation:**

```

If LV_ES = 0
And LV_ST = 0
And LV_IGK = 1
And LV_INH_DIAG_DUR_IGC_MPL = 0
Then LV_CDN_DIAG_DUR_IGC_MPL = 1
Else LV_CDN_DIAG_DUR_IGC_MPL = 0
Endif
    
```

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**Formula section:**

```

If          LV_CDN_DIAG_DUR_IGC_MPL =1
Then       If          all V_DUR_IGC[x] = 0 ms           // for all cylinders

                Then  ERR_SYM_DUR_IGC_MPL = SYM_3
                    If          LV_ERR_DUR_IGC_MPL = 1
                        Then  LV_INH_INJ_DIAG_IGC = 1
                    Endif
                Else  ERR_SYM_DUR_IGC_MPL = NO_SYM
                    LV_INH_INJ_DIAG_IGC = 0
                Endif
Else       No action on the antibounce counter
Endif
    
```

LV\_ERR\_DUR\_IGC\_MPL and LV\_END\_DIAG\_DUR\_IGC\_MPL are calculated by error management.

**A.84.4 Or of ignition failure**

*Initialisation:* output variable has to be set to "0" at reset  
*Recurrence:* **If** NC\_IGN\_DIAG\_TYP =ATM46 every segment  
                   **If** NC\_IGN\_DIAG\_TYP =ATIC29 every 100 ms

*Activation:*

**Formula section:**

LV\_ERR\_IGC = LV\_ERR\_IGC\_SCP[x] **OR** LV\_ERR\_IGC\_SCG[x]

**A.84.5 Unfiltered ignition error information for misfire detection**

**Application conditions**

**Initialisation:** IGC\_DIAG\_MIS = 0 at reset ECU  
**Recurrence:** **If** NC\_IGN\_DIAG\_TYP =ATM46 every segment  
                   **If** NC\_IGN\_DIAG\_TYP =ATIC29 every 100 ms

**Formula section:**


```

If          LV_SCP_IGC[x]          = 1
Or          LV_SCG_IGC[x]          = 1
Then       set the bit for the actual cylinder in IGC_DIAG_MIS = 1
Else       reset the bit for the actual cylinder in IGC_DIAG_MIS = 0
Endif
    
```

**Description:**

The error information of the ignition system should not be filtered. The different error detections are linked by a wired "OR". As soon as an ignition error is detected the information should be available as output cylinder individually in the byte IGC\_DIAG\_MIS.  
 IGC\_DIAG\_MIS

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Bit Low to high	4 cylinder	5 cylinder	6 cylinder	8 cylinder
0	Cyl 0	Cyl 0	Cyl 0	Cyl 0
1	Cyl 1	Cyl 1	Cyl 1	Cyl 1
2	Cyl 2	Cyl 2	Cyl 2	Cyl 2
3	Cyl 3	Cyl 3	Cyl 3	Cyl 3
4		Cyl 4	Cyl 4	Cyl 4
5			Cyl 5	Cyl 5
6				Cyl 6
7				Cyl 7

Note: typical value for debug is proposed for default value of the Calibration

## A.85 Ignition diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INH_IV_IGC	O/V	0... FFH	0... 255	1	-
Injection cut off					
LV_INH_DIAG_DUR_IGC_MPL	O/V	0... 1H	0 ...1	1	-
Inhibition condition for diagnosis of open load on all cylinders					
LV_INH_DIAG_IGC_OL	O/V	0... 1H	0 ...1	1	-
Inhibition condition for open load for ignition diagnosis					
LV_INH_DIAG_IGC_SCG	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the short circuit to ground for ignition diagnosis					
LV_INH_DIAG_IGC_SCP	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the short circuit plus for ignition diagnosis					

### Input data:

LV_CDN_VB_OBD2 {p. 1185}	LV_ERR_CRK {p. 4455}	LV_ERR_TCO {p. 4496}	LV_IGK {p. 906}
LV_INH_IGC [NC_CYL_NR] {p. 4773}	LV_INH_INJ_DIAG_IGC {p. 4773}		


### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_DUR_IGC_MPL	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the ignition system diagnosis multiple open load Typical value for debug = 5					
C_ABC_INC_DUR_IGC_MPL	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the ignition system diagnosis multiple open load Typical value for debug = 5					
C_ABC_INC_IGC_OL	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the ignition system diagnosis OL Typical value for debug = 5					
C_ABC_INC_IGC_SCG	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the ignition system diagnosis SCG Typical value for debug = 5					
C_ABC_INC_IGC_SCP	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the ignition system diagnosis SCPTypical value for debug = 5					
C_ABC_MAX_DUR_IGC_MPL	-	1... FFH	1... 255	1	-
Maximum value of the anti - bounce counter for the ignition system diagnosis multiple open load Typical value for debug = 255					
C_ABC_MAX_IGC_OL	-	1... FFH	1... 255	1	-
Maximum value of the anti - bounce counter for the ignition system diagnosis OLTypical value for debug = 255					
C_ABC_MAX_IGC_SCG	-	1... FFH	1... 255	1	-
Maximum value of the anti - bounce counter for the ignition system diagnosis SCGTypical value for debug = 255					
C_ABC_MAX_IGC_SCP	-	1... FFH	1... 255	1	-
Maximum value of the anti - bounce counter for the ignition system diagnosis to switch off the coil Typical value for debug = 255					

### Error treatment:

Diagnosis	Symptom	SYM	ABC type
Ignition diagnosis for SCP	SCP	SYM_0	STD_INI
LV_ERR_IGC_SCP			

Figure A.85.1: Diagnosis

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Diagnosis	Symptom	SYM	ABC type
Ignition diagnosis for OL and SCG	OL	SYM_2	STD_INI
	SCG	SYM_1	
LV_ERR_IGC_OL LV_ERR_IGC_SCG			

Figure A.85.2: Diagnosis

Diagnosis	Symptom	SYM	ABC type
Ignition diagnosis for OL on all cylinders	MPL_OL	SYM_3	STD_INI + DEC_CAL
LV_ERR_DUR_IGC_MPL			

## A.85.1 IGBT protection

### Description:

To protect the catalyst in case of ignition driver cut off it is necessary to shut off the injection of the concerning cylinder as well.

*Recurrence: Segment Synchronous*

### Formula section:

Shut off injection sequence of IGBT protection:

```

if          LV_INH_INJ_DIAG_IGC = 1
then       set all bits in INH_IV_IGC
else       reset all bits in INH_IV_IGC
              for x = 0 to NC_CYL_NR-1
                if LV_INH_IGC[x] = 1
                  then set bit x in INH_IV_IGC
                  else reset bit x in INH_IV_IGC
                endif
              endfor
endif


```

## A.85.2 Inhibition flags for ignition diagnosis

### Description:

### Application conditions

**Initialisation:** At reset event :  
LV\_INH\_DIAG\_IGC\_SCP = 0

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```

LV_INH_DIAG_IGC_SCG = 0
LV_INH_DIAG_IGC_OL = 0
LV_INH_DIAG_DUR_IGC_MPL = 0

```

**Recurrence:** *10 ms*

**Activation:**

**Deactivation:**

**Formula section:**

```


if          LV_IGK = 1          and
              LV_ERR_TCO = 0      and
              LV_ERR_CRK = 0

then       LV_INH_DIAG_IGC_SCP = 0
else       LV_INH_DIAG_IGC_SCP = 1
endif

if          LV_CDN_VB_OBD2 = 1    and
              LV_ERR_TCO = 0        and
              LV_ERR_CRK = 0

then       LV_INH_DIAG_IGC_OL = 0
else       LV_INH_DIAG_IGC_OL = 1
endif
LV_INH_DIAG_IGC_SCG = LV_INH_DIAG_IGC_OL

```

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## A.86 Immobilizer diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_IMOB_1	O/V	0... FFH	0... 255	1	-
Condition bit coded for each sym					
CDN_DIAG_IMOB_3	O/V	0... FFH	0... 255	1	-
Condition bit coded for each sym					
ERR_SYM_IMOB_0	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
For each symptom : status of failure (set to 1 when failure symptom detected)					
ERR_SYM_IMOB_1	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
For each symptom : status of failure (set to 1 when failure symptom detected)					
ERR_SYM_IMOB_2	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
For each symptom : status of failure (set to 1 when failure symptom detected)					
ERR_SYM_IMOB_3	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
For each symptom : status of failure (set to 1 when failure symptom detected)					
LV_CDN_DIAG_IMOB_0	O/V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled)					
LV_CDN_DIAG_IMOB_1	O/V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled)					
LV_CDN_DIAG_IMOB_2	O/V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled)					
LV_CDN_DIAG_IMOB_3	O/V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled)					
LV_END_DIAG_IMOB_0	O/V	0... 1H	0 ...1	1	-
Diagnostic performed at least one time					
LV_END_DIAG_IMOB_1	O/V	0... 1H	0 ...1	1	-
Diagnostic performed at least one time					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_IMOB_2	O/V	0... 1H	0 ...1	1	-
Diagnostic performed at least one time					
LV_END_DIAG_IMOB_3	O/V	0... 1H	0 ...1	1	-
Diagnostic performed at least one time					
LV_ERR_IMOB_0	O/V	0... 1H	0 ...1	1	-
Present failure in IMOB manipulation after filtering					
LV_ERR_IMOB_1	O/V	0... 1H	0 ...1	1	-
Present failure in IMOB CAS BUS after filtering					
LV_ERR_IMOB_2	O/V	0... 1H	0 ...1	1	-
Present failure in IMOB data storage after filtering					
LV_ERR_IMOB_3	O/V	0... 1H	0 ...1	1	-
Present failure in IMOB CAN BUS after filtering					

**Input data:**

LV_IGK {p. 906}	LV_VAR_BN {p. 655}	PWL_LOCK_CDN {p. 3776}	STATE_CAN_DNM_D
STATE_IMOB_0_ERR	STATE_IMOB_2_ERR		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_IMOB_0	-	0... FFH	0... 255	1	-
Antibounce counter decrement					
C_ABC_DEC_IMOB_1	-	0... FFH	0... 255	1	-
Antibounce counter decrement					
C_ABC_DEC_IMOB_3	-	0... FFH	0... 255	1	-
Antibounce counter decrement					
C_ABC_INC_IMOB_0	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_INC_IMOB_1	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_INC_IMOB_2	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_INC_IMOB_3	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_IMOB_0	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_ABC_MAX_IMOB_1	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_ABC_MAX_IMOB_2	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_ABC_MAX_IMOB_3	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					

**Action definition**

<b>ACTION_IMOB_DIAG_ERR_1 (CDN_IMOB,&lt;SYM_IMOB&gt;)</b>	Mode: O
---	---------

<b>ACTION_IMOB_DIAG_ERR_3 (CDN_IMOB,&lt;SYM_IMOB&gt;)</b>	Mode: O
---	---------



**Error treatment:**

Diagnostic	Symptom description	Symptom	Filter type
<b>IMOB_0</b>			
manipulation	not used	SYM_0	STD_INI
	no secrete key	SYM_1	
	not used	SYM_2	
	response does not match	SYM_3	

Diagnostic	Symptom description	Symptom	Filter type
<b>IMOB_2</b>			
Data storage	No storage for secrete key avl.	SYM_0	STD_INI
	read/write FSC (nvm error)	SYM_1	
	Read error secrete key (2of3)	SYM_2	
	Spare for checksum error (later)	SYM_3	

Diagnostic	Symptom description	Symptom	Filter type
<b>IMOB_1</b>			
Kbus	Open line	SYM_0	STD
	Frame error (type_ews/st_ews)	SYM_1	
	Time out data	SYM_2	
	CRC error	SYM_3	

Diagnostic	Symptom description	Symptom	Filter type
<b>IMOB_3</b>			
CAN	Not used	SYM_0	STD
	Frame error (type_ews/st_ews)	SYM_1	
	Time out data	SYM_2	
	Not used	SYM_3	

**General information:**

IMOB diagnosis is performed to provide error-symptom-information by setting of LV\_ERR\_IMOB\_i and entry in error memory in case of ECU-blocking/error detection.

**Defined in non-public specification:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LOCK_IMOB	I/O	0...1H	0...1	1	[-]
LV indicates locking of IGN and INJ by IMOB					
INH_IV_IMOB	I/O	0...FFH	0...255	1	[-]
Locking request for INJ by IMOB					

**FUNCTION DESCRIPTION:**

This diagnosis calculates the error LV\_ERR\_IMOB\_0

Imob: Manipulation

### Application conditions

**Initialisation:**

```

LV_CDN_DIAG_IMOB_0 = STD_INI
LV_END_DIAG_IMOB_0 = STD_INI
LV_ERR_IMOB_0      = STD_INI
ERR_SYM_IMOB_0     = STD_INI
  
```

when LV\_IGK changes from 01 or at reset:

Recurrence: 100ms

*Activation/Deactivation:*

```

IF          LV_IGK = 1 then
THEN       LV_CDN_DIAG_IMOB_0 = 1
ELSE       LV_CDN_DIAG_IMOB_0 = 0
ENDIF
  
```

### Formula section:

Symptoms calculation:

Error state of STATE\_IMOB\_0\_ERR equal to ERR\_SYM  
 Error set after debounce.  
 End of diag calculation see ERRM

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

### FUNCTION DESCRIPTION:

This diagnosis calculates the error LV\_ERR\_IMOB\_2  
 Imob: Data storage

### Application conditions

**Initialization:**

```

LV_CDN_DIAG_IMOB_2 = STD_INI
LV_END_DIAG_IMOB_2 = STD_INI
LV_ERR_IMOB_2      = STD_INI
ERR_SYM_IMOB_2     = STD_INI
  
```

when LV\_IGK changes from 01 or at reset:

Recurrence: 100ms

*Activation/Deactivation:*

```

IF          LV_IGK = 1 then
THEN       LV_CDN_DIAG_IMOB_2 = 1
ELSE       LV_CDN_DIAG_IMOB_2 = 0
ENDIF
  
```

**Formula section:**

Symptoms calculation:

Error state of STATE\_IMOB\_2\_ERR equal to ERR\_SYM  
 Error set after debounce.  
 End of diag calculation see ERRM

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

**Exported Interface: ACTION\_IMOB\_DIAG\_ERR\_1(CDN\_IMOB, SYM\_IMOB)**

**FUNCTION DESCRIPTION:**

This diagnosis calculates the error LV\_ERR\_IMOB\_1  
 Imob: KBUS Diagnosis  
 Note: Diagnosis is **not** initialized at KL15 0->1 because diagnosis is already active at ecu\_state = wakeup

**Application conditions**

**Initialization:**

all at 0 only at reset:  
 LV\_CDN\_DIAG\_IMOB\_1 = STD = 0  
 LV\_END\_DIAG\_IMOB\_1 = STD = 0  
 LV\_ERR\_IMOB\_1 = STD = 0  
 ERR\_SYM\_IMOB\_1 = STD = 0

*Activation/Deactivation:*

LV\_VAR\_BN = 0 **or** (STATE\_CAN\_DNM\_D > 0 and PWL\_LOCK\_CDN[BN2000] = 1)

Recurrence: at call ACTION\_IMOB\_DIAG\_ERR\_1(CDN\_IMOB, SYM\_IMOB)


Symptoms calculation:

Error state of ERRM: ERR\_SYM equal to SYM\_IMOB

```

If SYM_IMOB = END_DIAG
Then LV_END_DIAG_IMOB_1 = 1 (set immediatly)
Else
    If SYM_IMOB > 0
    Then LV_CDN_DIAG_IMOB_1 = 1
        ERR_SYM_IMOB_1 = SYM_IMOB
        LV_ERR_IMOB_1 = 1 (after debounce)
    Else If (CDN_IMOB & ERR_SYM_IMOB_1) = true or
        ERR_SYM_IMOB_1 = NO_SYM
        Then LV_CDN_DIAG_IMOB_1 = 1
            healing only of cdn fits to err_sym once
            ERR_SYM_IMOB_1 = NO_SYM
            LV_ERR_IMOB_1 = 0 (after debounce)
        Else LV_CDN_DIAG_IMOB_1 = 0 (freeze healing)
    Endif
Endif
    
```

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**Endif**

Error state of ERRM: ERR\_SYM = SYM\_IMOB  
 CDN\_DIAG\_IMOB\_1 = CDN\_IMOB  
 Error set after debounce.

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

**Exported Interface: ACTION\_IMOB\_DIAG\_ERR\_3(CDN\_IMOB, SYM\_IMOB)**

**FUNCTION DESCRIPTION:**

This diagnosis calculates the error LV\_ERR\_IMOB\_3  
 Imob: CAN Diagnosis  
 Note: Diagnosis is **not** initialized at KL15 0->1 because diagnosis is already active at ecu\_state = wakeup

**Application conditions**

**Initialisation:**

all at 0 only at reset:  
 LV\_CDN\_DIAG\_IMOB\_3 = STD = 0  
 LV\_END\_DIAG\_IMOB\_3 = STD = 0  
 LV\_ERR\_IMOB\_3 = STD = 0  
 ERR\_SYM\_IMOB\_3 = STD = 0

**Activation/Deactivation:**

LV\_VAR\_BN = 0 **or** (STATE\_CAN\_DNM\_D > 0 and PWL\_LOCK\_CDN[BN2000] = 1)

Recurrence: at call ACTION\_IMOB\_DIAG\_ERR\_3(CDN\_IMOB, SYM\_IMOB)

**Formula section:**


Symptoms calculation:

Error state of ERRM: ERR\_SYM equal to SYM\_IMOB

```

If SYM_IMOB = END_DIAG
Then LV_END_DIAG_IMOB_3 = 1 (set immediatly)
Else
    If SYM_IMOB > 0
    Then LV_CDN_DIAG_IMOB_3 = 1
        ERR_SYM_IMOB_3 = SYM_IMOB
        LV_ERR_IMOB_3 = 1 (after debounce)
    Else If (CDN_IMOB & ERR_SYM_IMOB_3) = true or
        ERR_SYM_IMOB_3 = NO_SYM
        Then LV_CDN_DIAG_IMOB_3 = 1
            healing only of cdn fits to err_sym once
            ERR_SYM_IMOB_3 = NO_SYM
            LV_ERR_IMOB_3 = 0 (after debounce)
        Else LV_CDN_DIAG_IMOB_3 = 0 (freeze healing)
    Endif
Endif
Endif
    
```

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Error state of ERRM: ERR\_SYM = SYM\_IMOB

CDN\_DIAG\_IMOB\_3 = CDN\_IMOB

Error set after debounce.

End of diag calculation:

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

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## A.87 Injector classification programming diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_PLAUS_IV_CAL	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom PLAUS_IV_CAL					
LF_ERR_PLAUS_IV_EGY_CAL	O/V	0... FFFFH	0... 65535	1	-
cylinder individuell bit coded not plausible injector valve coding values "Energie" ( 1 - not plausible, 0 - plausible )					
LF_ERR_PLAUS_IV_MFF_CAL	O/V	0... FFFFH	0... 65535	1	-
cylinder individuell bit coded not plausible injector valve coding values "Kleinmenge" ( 1 - not plausible, 0 - plausible )					
LV_CDN_DIAG_PLAUS_IV_CAL	V	0... 1H	0 ...1	1	-
Diagnosis condition PLAUS_IV_CAL					
LV_END_DIAG_PLAUS_IV_CAL	V	0... 1H	0 ...1	1	-
End of Diagnosis PLAUS_IV_CAL					
LV_ERR_PLAUS_IV_CAL	O/V	0... 1H	0 ...1	1	-
Flag that indicates at least one injector coding is not plausible					

### Input data:

EGY_SP_IV_EXT_ADJ [NC_CYL_NR] {p. 7679}	LV_IGK {p. 906}	LV_ST_END {p. 1720}	MFF_ABSV_IV_EXT_ADJ [NC_CYL_NR] {p. 7681}
N {p. 1525}	NC_CYL_NR {p. 1526}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_PLAUS_IV_CAL	-	0... FFH	0... 255	1	-
Debounce counter increment injection valve programming plausibility diagnosis (default: 1)					
C_ABC_MAX_PLAUS_IV_CAL	-	1... FFH	1... 255	1	-
Debounce counter maximum value injection valve programming plausibility diagnosis (default: 1)					
C_EGY_SP_IV_CAL_MAX	-	0... FFFFH	0... 255	3.8911e-3	mJ
maximal value for plausible injectoe programming value "Energie"					
C_EGY_SP_IV_CAL_MIN	-	0... FFFFH	0... 255	3.8911e-3	mJ
minimal value for plausible injector programming value "Energie"					
C_MFF_ABS_IV_CAL_MAX	-	0... FFFFH	0... 1389	0.0211948	mg/stk
maximal value for plausible injector programming value "Kleinmenge"					
C_MFF_ABS_IV_CAL_MIN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
minimal value for plausible injector programming value "Kleinmenge"					
C_N_MIN_PLAUS_IV_VAL	-	0... 1FE0H	0... 8160	1	rpm
minimum of engine speed for injection valve programming plausibility diagnosis					

### Import actions:

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>, IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,OUT<PRM_LV_ERR>)
Continued on next page

<b>ACTION_ERRM_GetLvErr (IN&lt;IDX_DIAG&gt;,OUT&lt;LV_ERR&gt;)</b>
--

**Error treatment:**

Diagnostic GS	Symptom description	Symptom	Filter type
Injector programming plausibility diagnosis	-	SYM_0	STD_INI
	-	SYM_1	
	"Energie"-programming value for at least ore cylinder is not plausible	SYM_2	
	"Kleinmengen"-programming value for at least ore cylinder is not plausible	SYM_3	

**A.87.1 Checking plausibility of injector programming value "Kleinmenge"****FUNCTION DESCRIPTION:****General information:**

Goal of this chapter is to check the plausibility of injector programming value "Kleinmenge".

**Application conditions**

**Initialisation at reset:** *first calculation*  
**Recurrence:** *1 s*  
**Activation:** *at every engine operating state*  
**Deactivation:** *-*

**Formula section:**

```

For i = 0 to (NC_CYL_NR -1)
do
  if MFF_ABSV_IV_EXT_ADJ[i] < C_MFF_ABS_IV_CAL_MIN
  or
  MFF_ABSV_IV_EXT_ADJ[i] > C_MFF_ABS_IV_CAL_MAX
  then
    set bit i of LF_ERR_PLAUS_IV_MFF_CAL to "1"
  else
    reset bit i of LF_ERR_PLAUS_IV_MFF_CAL to "0"
  endif
endfor

```

## A.87.2 Checking plausibility of injector programming value "Energie"

### FUNCTION DESCRIPTION:

#### General information:

Goal of this chapter is to check the plausibility of injector programming value "Energie".

#### Application conditions

**Initialisation at reset:** *first calculation*

**Recurrence:** *1 s*

**Activation:** *at every engine operating state*

**Deactivation:** *-*

#### Formula section:

```

For i = 0 to (NC_CYL_NR -1)
do
    if EGY_SP_IV_EXT_ADJ[i] < C_EGY_SP_IV_CAL_MIN
    or
    EGY_SP_IV_EXT_ADJ[i] > C_EGY_SP_IV_CAL_MAX
    then
        set bit i of LF_ERR_PLAUS_IV_EGY_CAL to "1"
    else
        reset bit i of LF_ERR_PLAUS_IV_EGY_CAL to "0"
    endif
endfor

```

## A.87.3 Error detection for injector programming plausibility

### FUNCTION DESCRIPTION:

#### General information:

The flag LV\_ERR\_PLAUS\_IV\_CAL indicates an at least one not plausible injector programming values. That occurs if injector programming was not done by testerservice or at least one written value by testerservice is out of allowed range.

#### Description:

Error-symptoms are defined to this diagnosis function as following :





**Application conditions:**

Initialisation: all output data according ABC configuration "**STD\_INI**"

//LV\_IGK 0->1 **or** reset **or** at clearing error memory

This action initialized the diagnostic result according the filtering configuration :

ACTION\_ERRM\_GetLvErr( IN<NC\_IDX\_DIAG\_GS>, OUT<LV\_ERR\_GS>)

Activation:           **if**       LV\_IGK = 1 and LV\_ST\_END = 0  
                           **then**   LV\_CDN\_DIAG\_PLAUS\_IV\_CAL = 1  
                           **endif**

Deactivation:       **if**       LV\_IGK = 0 or LV\_ST\_END = 1  
                           **then**   LV\_CDN\_DIAG\_PLAUS\_IV\_CAL = 0  
                           **endif**

Recurrence:         10ms

**Formula section:**

```

if(1)       LF_ERR_PLAUS_IV_EGY_CAL = 0
  and       LF_ERR_PLAUS_IV_MFF_CAL = 0
then(1)    ERR_SYM_PLAUS_IV_CAL = NO_SYM
else(1)
  if(2)     N >= C_N_MIN_PLAUS_IV_VAL
    if(3)     LF_ERR_PLAUS_IV_EGY_CAL <> 0
      then(3)   ERR_SYM_PLAUS_IV_CAL = SYM_2
    elseif(3)  LF_ERR_PLAUS_IV_MFF_CAL <> 0
      then(3)   ERR_SYM_PLAUS_IV_CAL = SYM_3
    endif(3)
  endif(2)
endif(1)

```

For failure and error management treatment the anti-bounce mechanism is called with the parameters LV\_CDN\_DIAG\_PLAUS\_IV\_CAL and ERR\_SYM\_PLAUS\_IV\_CAL.

ACTION\_ERRM\_FilterSymptom

```

( IN< GS >,
  IN< LV_CDN_DIAG_GS >,
  IN< ERR_SYM_GS >,
  IN< C_ABC_INC_GS >,
  IN< 1 >,
  IN< C_ABC_MAX_GS >,
  OUT< LV_ERR_GS >
)

```

This algorithm determines LV\_ERR\_PLAUS\_IV\_CAL and LV\_END\_DIAG\_PLAUS\_IV\_CAL and delivers the result to Error Management.

## A.88 Injection valve power stage diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INH_PBK_IV_DIAG_ERR	O/V	0... FFH	0... 255	1	-
Cylinder shut off request from injection valve power stage diagnosis (cylinder allocated)					
INJ_DR_PBK_IV_REF [NC_PBK_IV_NR]	O/V	0... FFH	0... 255	1	-
Assignment between logical cylinders and injection power banks (power bank individual)					
LV_ERR_PBK_IV_LST_CYC	O/V/S	0... 1H	0 ...1	1	-
Flag that indicates if a debounced injection valve power stage error is present at the end of the driving cycle					
LV_INH_DIAG_PBK_IV	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the injection valve power stage diagnosis					

### Input data:

ERR_SYM_PBK_IV [NC_PBK_IV_NR] {p. 4797}	LV_ERR_TMP_MU_MC {p. 7072}	LV_IGK {p. 906}	LV_INJ_OFF_TMR_INJ_ ENA {p. 7158}
LV_MC_SOPC_INH_DI {p. 7186}	NC_CYL_NR {p. 1526}	NC_IDX_CYL_PBK_IV_ REF [NC_CYL_NR] {p. 626}	NC_PBK_IV_NR {p. 628}
NC_STATE_PBK_IV_ST_ TRIM_ERR {p. 4798}	STATE_ERR_PBK_IV {p. 4797}	STATE_ERR_SYM_PBK_ IV_ST [NC_PBK_IV_NR] {p. 4797}	STATE_PBK_IV_INI {p. 2040}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_DIAG_INH_PBK_IV_ERR_ENA	-	0... 1H	0 ...1	1	-
Flag to enable inhibition of cylinders due to injection power bank errors					
LC_DIAG_INH_PBK_IV_ERR_ST_ENA	-	0... 1H	0 ...1	1	-
Flag to enable inhibition of cylinders due to injection power bank start up errors					

## FUNCTION DESCRIPTION:

### General information:

The flag LV\_INH\_DIAG\_PBK\_IV deactivates (freezes) the power stage online diagnostic of all injection valve drivers.


If a de-bounced injector error is present at the end of the driving cycle (LV\_ERR\_PBK\_IV = 1), the flag LV\_ERR\_PBK\_IV\_LST\_CYC is set and is stored in the non-volatile memory.

The variable INJ\_DR\_PBK\_IV\_REF[NC\_PBK\_IV\_NR] represents an inhibit pattern, which inhibits all cylinders assigned to the injection power bank reversed to by the array index.

### A.88.1 Calculation of INJ\_DR\_PBK\_IV\_REF[NC\_PBK\_IV\_NR]

### Application conditions

**Activation:** *every engine state*

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```

AND (LC_DIAG_INH_PBK_IV_ERR_ST_ENA = 1)
(2)THEN
    INH_PBK_IV_DIAG_ERR = INH_PBK_IV_DIAG_ERR BitwiseOR
                          INJ_DR_PBK_IV_REF[p]
(2)ENDIF
(3)IF (Bit p of STATE_ERR_PBK_IV = 1)
    AND (ERR_SYM_PBK_IV[p] ≠ SYM_0)
    AND (LC_DIAG_INH_PBK_IV_ERR_ENA = 1)
(3)THEN
    INH_PBK_IV_DIAG_ERR = INH_PBK_IV_DIAG_ERR BitwiseOR
                          INJ_DR_PBK_IV_REF[p]
(3)ENDIF
(1)ENDFOR
(1)ELSE
    INH_PBK_IV_DIAG_ERR = 0
(1)ENDIF

```

### A.88.3 Calculation of LV\_ERR\_PBK\_IV\_LST\_CYC

#### Application conditions

**Activation:**  $LV\_IGK = 1 \rightarrow 0$

**Deactivation:** -

**Initialisation:** -

**Recurrence:** only once at  $LV\_IGK = 1 \rightarrow 0$


#### Formula section:

```

(1) IF
STATE_ERR_PBK_IV ≠ 0
(1) THEN
LV_ERR_PBK_IV_LST_CYC = 1
(1) ELSE
LV_ERR_PBK_IV_LST_CYC = 0
(1) ENDIF

```

**Note:** In case of “checksum error” after power latch or reset the flag LV\_ERR\_PBK\_IV\_LST\_CYC has to be set to zero.

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## A.89 Injection valve power stage diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_PBK_IV [NC_PBK_IV_NR]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Diagnosis condition for each error symptom of injection valve power stage bank					
ERR_DIAG_PBK_IV [NC_PBK_IV_NR]	-	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Raw value of error symptom for injection valve power stage bank					
ERR_SYM_PBK_IV [NC_PBK_IV_NR]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom for injection valve power stage bank filtered with CDN_DIAG_PBK_IV					
LV_CDN_DIAG_PBK_IV [NC_PBK_IV_NR]	V	0... 1H	0 ...1	1	-
Diagnosis condition for injection valve power stage bank					
LV_END_DIAG_PBK_IV [NC_PBK_IV_NR]	V	0... 1H	0 ...1	1	-
End of diagnosis for injection valve power stage bank					
LV_ERR_PBK_IV [NC_PBK_IV_NR]	V	0... 1H	0 ...1	1	-
Error flag for injection valve power stage bank errors derived from STATE_ERR_PBK_IV (only for display)					
STATE_DIAG_PBK_IV	O/V	0... FFH	0... 255	1	-
Error pattern without debouncing for all injection valve power stages					
STATE_ERR_PBK_IV	O/V	0... FFH	0... 255	1	-
Error pattern after debouncing for all injection valve power stages					
STATE_ERR_SYM_PBK_IV [NC_PBK_IV_NR]	O/V	0... FFH	0... 255	1	-
Detailed error symptom information of injection valve power stages, ATIC bank individual					
STATE_ERR_SYM_PBK_IV_ST [NC_PBK_IV_NR]	O/V	0... FFH	0... 255	1	-
Detailed error symptom information of injection valve power stages during startup phase, ATIC bank individual					

### Input data:

CDN_DIAG_PBK_IV_RAW [NC_PBK_IV_NR] {p. 2035}	LV_ES {p. 1720}	LV_IGK {p. 906}	LV_INH_DIAG_PBK_IV {p. 4794}
NC_PBK_IV_NR {p. 628}	SEG_NR {p. 1525}	STATE_ERR_PBK_IV_RAW [NC_PBK_IV_NR] {p. 2039}	STATE_ERR_PBK_IV_ST_RAW [NC_PBK_IV_NR] {p. 2040}
STATE_PBK_IV_INI {p. 2040}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_PBK_IV	-	0... FFH	0... 255	1	-
Anti-bounce increment value for injection valve power stage diagnosis					
C_ABC_MAX_PBK_IV	-	1... FFH	1... 255	1	-
Anti-bounce maximum value for injection valve power stage diagnosis					
C_STATE_ERR_SYM_PBK_IV_INH	-	0... FFH	0... 255	1	-
Manual inhibition pattern for injection valve power stage online diagnosis symptom (bit x = 1, diagnosis symptom will be inhibited)					
C_STATE_ERR_SYM_PBK_IV_ST_INH	-	0... FFH	0... 255	1	-
Manual inhibition pattern for injection valve power stage startup diagnosis symptom (bit x = 1, diagnosis symptom will be inhibited)					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_STATE_PBK_IV_ST_TRIM_ERR	-	0... FFH	0... 255	1	-
Start up error byte when only a trim pulse error occurred during injection power stage start up.					

**Import actions:**

**ACTION\_ERRM\_FilterMulticondition** (IN<XX>,IN<CDN\_DIAG\_>,XX>,<IN<>,ERR\_DIAG\_XX>,<IN>,<C\_ABC\_INC\_XX>,IN<C\_ABC\_MAX\_XX>,OUT<LV\_ERR\_XX>)

**Error treatment:**

Diagnosis	Symptom	Nr	ABC type
Injection valves power stage diagnosis	Power stage startup error	0	MPL_STD_INI
	Power stage online error	1	
	Power stage internal clock error	2	
PBK_IV[p]			

**Overview**

The purpose of the injection valve power stage diagnosis is to detect electrical faults of used ATIC drivers. STATE\_ERR\_PBK\_IV is the general error state after de-bouncing for limp-home reactions.

All symptoms of the current error code are handled by anti-bouncing.


We assume that only one symptom of an error code can be active at the same time.

The error detection is effected via the ECU hardware.

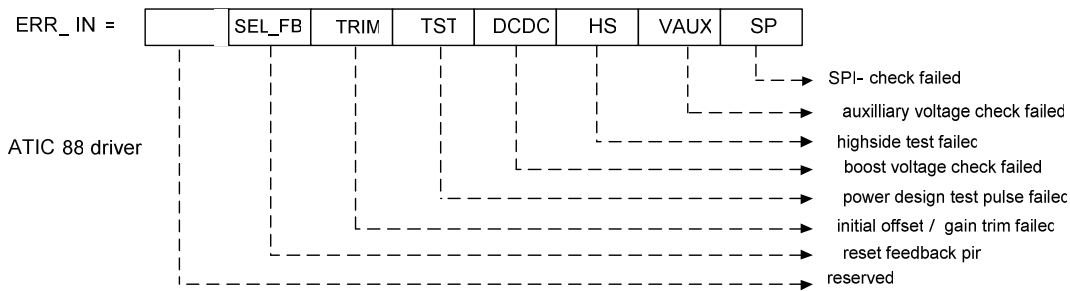
**Please Note:**

A valid diagnosis of all failures can only be detected when the injector was operated at least one time since the last changes and the filter times are observed.

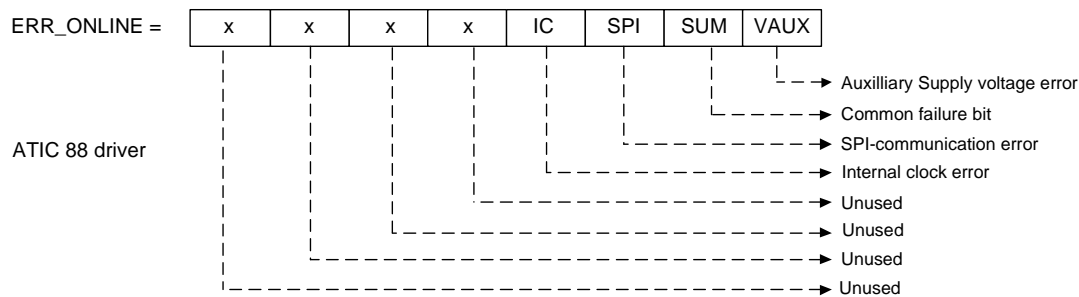
**FUNCTION DESCRIPTION:**

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## Structure of the initialization error byte (STATE\_ERR\_SYM\_PBK\_IV\_ST):



## Structure of the online error byte (STATE\_ERR\_SYM\_PBK\_IV):

**Application conditions**

**Activation** : (LV\_IGK = 1) **AND** (STATE\_PBK\_IV\_INI = "INIT\_FINISHED")

**Deactivation:** at transition of LV\_IGK 1 -> 0 DO:  
 LV\_CDN\_DIAG\_PBK\_IV[NC\_PBK\_IV\_NR] = 0  
 CDN\_DIAG\_PBK\_IV[NC\_PBK\_IV\_NR] = NO\_SYM

**Initialization:** at reset , at transition of LV\_IGK 0 -> 1 and at global clearing of failure memory DO:  
 STATE\_DIAG\_PBK\_IV = 0  
 STATE\_ERR\_PBK\_IV = 0  
 STATE\_ERR\_SYM\_PBK\_IV[NC\_PBK\_IV\_NR] = 0  
 STATE\_ERR\_SYM\_PBK\_IV\_ST[NC\_PBK\_IV\_NR] = 0  
 all other output data according filter type by ERRM

**Recurrence:** LV\_ES = 0: segment synchronous  
 LV\_ES = 1: 10 ms

**Formula section:****A.89.1 Common injection valve power stage diagnosis operations**

(1) FOR p = 0 TO (NC\_PBK\_IV\_NR -1) DO:

**Error Condition calculation:**

(1) IF (LV\_INH\_DIAG\_PBK\_IV = 0)

```

AND
(LV_ES = 0)
AND
(SEG_NR = 0)
(1) THEN
  CDN_DIAG_PBK_IV[p] = NO_SYM
  (2) IF (CDN_DIAG_PBK_IV_RAW[p] AND 0x08) = 0x08 ...bitwise
  (2) THEN
    CDN_DIAG_PBK_IV[p] = SYM_2
  (2) ENDIF
  (3) IF (CDN_DIAG_PBK_IV_RAW[p] AND 0x05) ≠ 0 ...bitwise
  (3) THEN
    CDN_DIAG_PBK_IV[p] = CDN_DIAG_PBK_IV[p] OR SYM_1 ...bitwise
  (3) ENDIF
  STATE_ERR_SYM_PBK_IV[p] = STATE_ERR_PBK_IV_RAW[p]
    AND CDN_DIAG_PBK_IV_RAW[p] ...bitwise
    AND NOT(C_STATE_ERR_SYM_PBK_IV_INH) ...bitwise
(1) ELSE
  CDN_DIAG_PBK_IV[p] = NO_SYM
(1) ENDIF
CDN_DIAG_PBK_IV[p] = CDN_DIAG_PBK_IV[p] OR SYM_0 ...bitwise
STATE_ERR_SYM_PBK_IV_ST[p] = STATE_ERR_PBK_IV_ST_RAW[p]
  AND NOT(C_STATE_ERR_SYM_PBK_IV_ST_INH) ...bitwise

```

#### Error Symptom calculation:

```

ERR_DIAG_PBK_IV[p] = NO_SYM
(4) IF STATE_ERR_SYM_PBK_IV_ST[p] ≠ 0
(4) THEN
  ERR_DIAG_PBK_IV[x] = SYM_0
  'Power stage startup error' detected
(4) ENDIF
(5) IF (STATE_ERR_SYM_PBK_IV[p] AND 0x08) = 0x08 ...bitwise
(5) THEN
  ERR_DIAG_PBK_IV[x] = ERR_DIAG_PBK_IV[x] OR SYM_2 ...bitwise
  'Power stage internal clock error' detected
(5) ENDIF
(6) IF (STATE_ERR_SYM_PBK_IV[p] AND 0x05) ≠ 0 ...bitwise
(6) THEN
  ERR_DIAG_PBK_IV[x] = ERR_DIAG_PBK_IV[x] OR SYM_1 ...bitwise
  'Power stage online error' detected
(6) ENDIF

```


#### Error Symptom debouncing:

ACTION\_ERRM\_FilterMulticondition (PBK\_IV[p], CDN\_DIAG\_PBK\_IV[p], ERR\_DIAG\_PBK\_IV[p], LV\_END\_DIAG\_PBK\_IV[p], LV\_ERR\_PBK\_IV[p], LV\_CDN\_DIAG\_PBK\_IV[p], ERR\_SYM\_PBK\_IV[p])

*Note: For failure debouncing and error management treatment the multicondition debounce algorithm (part of Error Management AGGR) is used with the parameters CDN\_DIAG\_PBK\_IV[p] and ERR\_DIAG\_PBK\_IV[p].*

*This algorithm determines:*

*ERR\_SYM\_PBK\_IV[p] (= raw value ERR\_DIAG\_PBK\_IV[p] filtered with CDN\_DIAG\_PBK\_IV[x])  
and*

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$LV\_ERR\_PBK\_IV[p]$       (*Error flag for debounced error of injection valve power stage [p]*)  
 and  
 $LV\_CDN\_DIAG\_PBK\_IV[p]$   
 and  
 $LV\_END\_DIAG\_PBK\_IV[p]$

Calculation of STATE\_DIAG\_PBK\_IV:

```

(7) IF      ERR_SYM_PBK_IV[p] <> 0
(7) THEN    Bit p of STATE_DIAG_PBK_IV = 1
(7) ELSE    Bit p of STATE_DIAG_PBK_IV = 0
(7) ENDIF
  
```

Calculation of STATE\_ERR\_PBK\_IV:

Bit p of STATE\_ERR\_PBK\_IV = LV\_ERR\_PBK\_IV[p]


(1) ENDFOR

## A.89.2 Definition of NCs

For ATIC88 projects, following definition is valid:

NC\_STATE\_PBK\_IV\_ST\_TRIM\_ERR = 0x20 (hex value)

**Note:** This bit mask refers to the "TRIM" error bit within the "ERR\_INI" error byte!

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## A.90 Injection valve diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_IV [NC_CYL_NR]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Diagnosis condition for each symptom of injector [x]					
ERR_DIAG_IV [NC_CYL_NR]	-	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Raw value of error symptom for injector [x]					
ERR_SYM_IV [NC_CYL_NR]	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom for injector [x] filtered with CDN_DIAG_IV [NC_CYL_NR]					
ERR_SYM_IV_SC [NC_CYL_NR]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Short circuit detailed error symptom for injector [x]					
ERR_SYM_IV_SC_TMP [NC_CYL_NR]	-	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Short circuit detailed error symptom for temporary calculations					
LV_CDN_DIAG_IV [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Diagnosis condition for injector [x]					
LV_CDN_DIAG_IV_SC [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Short circuit detailed error diagnosis condition for injector [x]					
LV_END_DIAG_IV [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
End of diagnosis for injector [x]					
LV_END_DIAG_IV_SC [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
End of short circuit detailed error diagnosis for injector [x]					
LV_ERR_IV [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Error flag for IVx derived from STATE_ERR_IV (only for display)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_IV_SC [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Error flag for indication of a detailed short circuit error information (only for display)					
NR_CYL_DIAG_IV	V	0... 7H	0 ...7	1	-
Number of the logical cylinder, which has done its injection valve diagnosis cycle					
NR_CYL_INJ_BAS_DIAG_IV_TMP	-	0... 7H	0 ...7	1	-
Temporary number of the current cylinder, which has reached its CRK_INJ_BAS[x]-Event					
NR_CYL_INJ_BAS_PREV_DIAG_IV_TMP	-	0... 7H	0 ...7	1	-
Temporary number of the previous cylinder, which had reached its CRK_INJ_BAS[x]-Event					
STATE_DIAG_IV	O/V	0... FFH	0... 255	1	-
Error pattern without debouncing for all injectors					
STATE_ERR_IV	O/V	0... FFH	0... 255	1	-
Error pattern after debouncing for all injectors					
STATE_ERR_IV_CYL [NC_CYL_NR]	V	0... FFH	0... 255	1	-
Detailed error information of injection valve, cylinder individual					
STATE_ERR_IV_CYL_TMP [NC_CYL_NR]	-	0... FFH	0... 255	1	-
Temporary detailed error information of injection valve, cylinder individual					

**Input data:**

CDN_DIAG_IV_RAW [NC_CYL_NR] {p. 2035}	CTR_ABC_IV [NC_CYL_NR]	LV_CDN_VB_OBD1 {p. 1185}	LV_ES {p. 1720}
LV_IGK {p. 906}	LV_INH_DIAG_IV {p. 4810}	N_32 {p. 1525}	NC_CYL_NR {p. 1526}
NR_CYL_INJ_BAS {p. 2039}	NR_CYL_INJ_BAS_PREV {p. 2039}	STATE_ERR_IV_CYL_ RAW [NC_CYL_NR] {p. 2039}	TI_1_MES [NC_CYL_NR] {p. 2040}


**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_IV	-	0... FFH	0... 255	1	-
Anti-bounce increment value					
C_ABC_MAX_IV	-	1... FFH	1... 255	1	-
Anti-bounce maximum value					
C_INH_DIAG_IV_SWI_MAN	-	0... FFH	0... 255	1	-
Manual switch pattern for cylinder individual inhibition of injection valve diagnosis (bit x = 1, diagnosis of cylinder x will be inhibited)					
C_N_CDN_DIAG_IV_FL_THD	-	0... FFH	0... 8160	32	rpm
Threshold disable diagnosis at full load					
C_TI_THD_INH_DIAG_IV	-	0... FFFFH	0... 65.535	0.001	ms
Injection time threshold below the IV diagnosis will be inhibited					
LC_DIAG_INH_IV_SC	-	0... 1H	0 ...1	1	-
Switch to disable the detailed injection valve short circuit diagnosis.					

**Import actions:**

<b>ACTION_ERRM_FilterMulticondition</b>	(IN<XX>,IN<CDN_DIAG_>,XX>,<IN<>,ERR_DIAG_XX>,<IN>,<C_ABC_INC_XX>,IN<C_ABC_MAX_XX>,<OUT<LV_ERR_XX>)
<b>ACTION_ERRM_NoFilterSymptom</b>	(IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_LV_ERR_SET>,<IN<PRM_LV_ERR_RST>,<IN<PRM_LV_END_DIAG>,<OUT<PRM_LV_ERR>)

**Error treatment:**

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Diagnosis	Symptom	Nr	ABC type
Injection valve diagnosis	Open circuit (OC)	0	MPL_STD_INI
	Short circuit (SC)	1	
	High side to low side short circuit (HL)	2	
	Open circuit at charged injector (OCC)	3	
IV[x]			

Figure A.90.1: Diagnosis

Diagnosis	Symptom	Nr	ABC type
Injection valve diagnosis short circuit detailed	High side to ground short circuit (HG)	0	NO_FIL
	Low side to battery short circuit (LB)	1	
	High side to battery short circuit (HB)	2	
	Low side to ground short circuit (LG)	3	
IV_SC[x]			

## Overview

The purpose of the diagnosis is to detect electrical faults.

STATE\_ERR\_IV is the general error state after de-bouncing for limp-home reactions.

All symptoms of the current error code are handled by anti-bouncing.

We assume that only one symptom of an error code can be active at the same time.

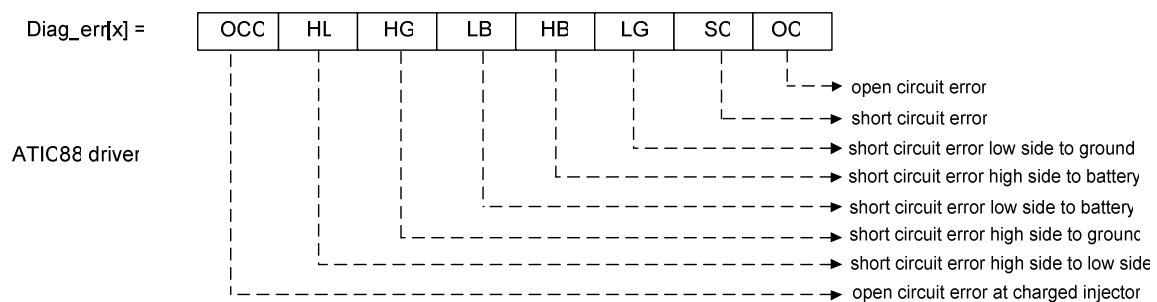
The error detection is effected via the ECU hardware.

## Please Note:

A valid diagnosis of all failures can only be detected when the injector was operated at least one time since the last changes and the filter times are observed.

## FUNCTION DESCRIPTION:

Structure of the injection valve error byte (STATE\_ERR\_IV\_CYL):



## Application conditions

Activation : LV\_IGK = 1

**Deactivation:** at transition of LV\_IGK 1 -> 0 DO:  
 LV\_CDN\_DIAG\_IV[NC\_CYL\_NR] = 0  
 LV\_CDN\_DIAG\_IV\_SC[NC\_CYL\_NR] = 0  
 CDN\_DIAG\_IV[x] = 0

**Initialization:** at reset , at transition of LV\_IGK 0 -> 1 and at global clearing of failure memory DO:  
 STATE\_DIAG\_IV = 0  
 STATE\_ERR\_IV = 0  
 STATE\_ERR\_IV\_CYL[NC\_CYL\_NR] = 0  
 LV\_ERR\_IV\_SC[NC\_CYL\_NR] = 0  
 ERR\_SYM\_IV\_SC[NC\_CYL\_NR] = NO\_SYM  
 LV\_CDN\_DIAG\_IV\_SC[NC\_CYL\_NR] = 0  
 LV\_END\_DIAG\_IV\_SC[NC\_CYL\_NR] = 0  
 all other output data according filter type by ERRM

**Recurrence:** segment synchronous

### Formula section:

## A.90.1 Electrical Injection Valve Diagnosis - selection of the current cylinder number

Determine the previous cylinder:

NR\_CYL\_INJ\_BAS\_PREV\_DIAG\_IV\_TMP = NR\_CYL\_INJ\_BAS\_PREV

Determine the current cylinder:

NR\_CYL\_INJ\_BAS\_DIAG\_IV\_TMP = NR\_CYL\_INJ\_BAS

Check cylinder numbers under consideration of re-entrance capability:

**(1) IF** NR\_CYL\_INJ\_BAS\_PREV\_DIAG\_IV\_TMP  $\neq$  NR\_CYL\_INJ\_BAS\_PREV

**(1) THEN**

NR\_CYL\_INJ\_BAS\_PREV\_DIAG\_IV\_TMP = NR\_CYL\_INJ\_BAS\_PREV

NR\_CYL\_INJ\_BAS\_DIAG\_IV\_TMP = NR\_CYL\_INJ\_BAS

**(1) ENDIF**

## A.90.2 Electrical Injection Valve Diagnosis - diagnosis routine call

**(1) IF** NR\_CYL\_DIAG\_IV = NR\_CYL\_INJ\_BAS\_DIAG\_IV\_TMP

**(1) THEN**

Nothing to do! The last diagnosis cycle is equal to the current.

**(1) ELSE**

Diagnosis Cycle has to be done:

**(1) IF** NR\_CYL\_DIAG\_IV  $\neq$  NR\_CYL\_INJ\_BAS\_PREV\_DIAG\_IV\_TMP

**(1) THEN**

Diagnosis Cycle has to be done for the previous cylinder, because its missing:

**EXECUTE** "1.3 Common Diagnosis Operations" for cylinder x = NR\_CYL\_INJ\_BAS\_PREV\_DIAG\_IV\_TMP

**(1) ENDIF**


Diagnosis Cycle has to be done for the current cylinder:

**EXECUTE** "1.3 Common Diagnosis Operations" for cylinder x = NR\_CYL\_INJ\_BAS\_DIAG\_IV\_TMP

Update cylinder number of the done diagnosis cycle:

NR\_CYL\_DIAG\_IV = NR\_CYL\_INJ\_BAS\_DIAG\_IV\_TMP

**(1) ENDIF**

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### A.90.3 Common Diagnosis Operations

This section works like a subroutine call in C-code programs

Note! x represents the current assigned active cylinder number from calling section.

```

(1) IF (LV_INH_DIAG_IV = 0)
    AND
    (LV_CDN_VB_OBD1 = 1)
    AND
    (LV_ES = 0)
    AND
    (TI_1_MES[x] >= C_TI_THD_INH_DIAG_IV)
    AND
    (N_32 < C_N_CDN_DIAG_IV_FL_THD)
    AND
    (Bit x of C_INH_DIAG_IV_SWI_MAN = 0)

(1) THEN
    Valid diagnosis conditions:
    CDN_DIAG_IV[x] = CDN_DIAG_IV_RAW[x]
    STATE_ERR_IV_CYL_TMP[x] = STATE_ERR_IV_CYL_RAW[x] AND CDN_DIAG_IV[x]
    ... bitwise

    STATE_ERR_IV_CYL[x] = (STATE_ERR_IV_CYL[x]
    OR STATE_ERR_IV_CYL_TMP[x]) ... bitwise
    AND 0xFF ... bitwise

    CDN_DIAG_IV[x] = (CDN_DIAG_IV[x] AND 0x03) ... bitwise
    (5) IF (CDN_DIAG_IV[x] = SYM_1) (SC-Error detectable)
    OR
    (CDN_DIAG_IV[x] = (SYM_1 OR SYM_0)) ... bit-
    wise
    (5) THEN
    CDN_DIAG_IV[x] = CDN_DIAG_IV[x] OR SYM_2 ... bitwise
    (5) ENDIF
    (6) IF (CDN_DIAG_IV[x] = SYM_0) (OC-Error detectable)
    OR
    (CDN_DIAG_IV[x] = (SYM_1 OR SYM_0)) ... bit-
    wise
    (6) THEN
    CDN_DIAG_IV[x] = CDN_DIAG_IV[x] OR SYM_3 ... bitwise
    (6) ENDIF

(1) ELSE
    CDN_DIAG_IV[x] = 0
    STATE_ERR_IV_CYL_TMP[x] = 0

(1) ENDIF
    
```

#### Error Symptom calculation (raw value from I/O SW)

```

ERR_DIAG_IV[x] = 0
(7) IF (STATE_ERR_IV_CYL_TMP[x] AND 0xFF) ≠ 0
(7) THEN
    (8) IF (STATE_ERR_IV_CYL[x] AND 0x7E) ≠ 0
    (8) THEN
        (9) IF (STATE_ERR_IV_CYL[x] AND 0x40) ≠ 0
        (9) THEN
            ERR_DIAG_IV[x] = SYM_2    HL-Error detected
        
```

```

(9) ELSE
    ERR_DIAG_IV[x] = SYM_1      SC-Error detected
(9) ENDIF
(8) ELSE
(10) IF (STATE_ERR_IV_CYL[x] AND 0x80) ≠ 0
(10) THEN
    ERR_DIAG_IV[x] = SYM_3      OCC-Error detected
(10) ELSE
    ERR_DIAG_IV[x] = SYM_0      OC-Error detected
(10) ENDIF
(8) ENDIF
(7) ENDIF
ACTION_ERRM_FilterMulticondition (IV[x], CDN_DIAG_IV[x], ERR_DIAG_IV[x], LV_END_DIAG_IV[x],
LV_ERR_IV[x], LV_CDN_DIAG_IV[x], ERR_SYM_IV[x])
Note: For failure debouncing and error management treatment the multicondition debounce algorithm
(part of Error Management AGGR) is used with the parameters CDN_DIAG_IV[x] and ERR_DIAG_IV[x].
This algorithm determines:
ERR_SYM_IV [x] (= raw value ERR_DIAG_IV [x] filtered with CDN_DIAG_IV [x])
and
LV_ERR_IV [x]    (Error flag for debounced error of Injector [x])
and
LV_CDN_DIAG_IV [x]
and
LV_END_DIAG_IV [x]

```

Calculation of STATE\_DIAG\_IV:

```

(11) IF      ERR_SYM_IV [x] <> 0
(11) THEN    Bit x of STATE_DIAG_IV = 1
(11) ELSE    Bit x of STATE_DIAG_IV = 0
(11) ENDIF

```

Calculation of STATE\_ERR\_IV:

Bit x of STATE\_ERR\_IV = LV\_ERR\_IV [x]

Calculation of detailed SC error information:

```

(12) IF LV_ERR_IV[x] 0 → 1 AND LC_DIAG_INH_IV_SC = 0
(12) THEN
(13) IF Bit HG of STATE_ERR_IV_CYL[x] is set
(13) THEN
    ERR_SYM_IV_SC_TMP = SYM_0 (HG-Error detected)
(13) ELSE
(14) IF Bit LB of STATE_ERR_IV_CYL[x] is set
(14) THEN
    ERR_SYM_IV_SC_TMP = SYM_1 (LB-Error detected)
(14) ELSE
(15) IF Bit HB of STATE_ERR_IV_CYL[x] is set
(15) THEN
    ERR_SYM_IV_SC_TMP = SYM_2 (HB-Error detected)
(15) ELSE
(16) IF Bit LG of STATE_ERR_IV_CYL[x] is set

```

```

(16) THEN
    ERR_SYM_IV_SC_TMP = SYM_3 (LG-Error detected)
(16) ELSE
    ERR_SYM_IV_SC_TMP = NO_SYM (Not a detailed SC-Error was detected
                                or HL-Error was detected)
(16) ENDIF
(15) ENDIF
(14) ENDIF
(13) ENDIF
ERR_SYM_IV_SC[x] = ERR_SYM_IV_SC_TMP
(17) IF ERR_SYM_IV_SC_TMP = NO_SYM
(17) THEN
    ACTION_ERRM_NoFilterSymptom( IN< IV_SC >,
    IN< LV_CDN_DIAG_IV[x] >, IN <ERR_SYM_IV_SC[x] >,
    IN< lv_err_set_IV_SC = 0>, IN< lv_err_reset_IV_SC = 1>,
    IN< LV_END_DIAG_IV[x] >, OUT< LV_ERR_IV_SC> )
(17) ELSE
    ACTION_ERRM_NoFilterSymptom( IN< IV_SC >,
    IN< LV_CDN_DIAG_IV[x] >, IN <ERR_SYM_IV_SC[x] >,
    IN< lv_err_set_IV_SC = 1>, IN< lv_err_reset_IV_SC = 0>,
    IN< LV_END_DIAG_IV[x] >, OUT< LV_ERR_IV_SC> )
(17) ENDIF
(12) ENDIF


(18) IF LV_ERR_IV[x] 1 → 0
(18) THEN
    ERR_SYM_IV_SC[x] = NO_SYM
    ACTION_ERRM_NoFilterSymptom( IN< IV_SC >,
    IN< LV_CDN_DIAG_IV[x] >, IN <ERR_SYM_IV_SC[x] >,
    IN< lv_err_set_IV_SC = 0>, IN< lv_err_reset_IV_SC = 1>,
    IN< LV_END_DIAG_IV[x] >, OUT< LV_ERR_IV_SC> )
(18) ENDIF

(19) IF LV_ERR_IV[x] stays unchanged
(19) THEN
    ACTION_ERRM_NoFilterSymptom( IN< IV_SC >,
    IN< LV_CDN_DIAG_IV[x] >, IN <ERR_SYM_IV_SC[x] >,
    IN< lv_err_set_IV_SC = 0>, IN< lv_err_reset_IV_SC = 0>,
    IN< LV_END_DIAG_IV[x] >, OUT< LV_ERR_IV_SC> )
(19) ENDIF

(18) IF CTR_ABC_IV[x] = 0
(18) THEN
    STATE_ERR_IV_CYL[x] = 0
(18) ENDIF

```


**Note:** CTR\_ABC\_IV is realized with an ERRM action!

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*Please Note! Synchronization of LV\_CDN\_DIAG\_IV\_SC[x] with LV\_CDN\_DIAG\_IV[x] and LV\_END\_DIAG\_IV\_SC[x] with LV\_END\_DIAG\_IV[x] by parameter passing to ACTION\_ERRM\_NoFilter-Symptom.*

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## A.91 Injection valve diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INH_IV_DIAG_ERR	O/V	0... FFH	0... 255	1	-
Cylinder shut off request from injection valve diagnosis (cylinder allocated)					
INJ_DR_CYL_REF [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
Assignment between logical cylinders and injector drivers					
LV_ERR_IV_LST_CYC	O/V/S	0... 1H	0 ...1	1	-
Flag that indicates if a debounced injector error is present at the end of the driving cycle					
LV_INH_DIAG_IV	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the IV diagnostic					

### Input data:

ERR_SYM_IV [NC_CYL_NR] {p. 4802}	LV_ERR_MU_MC {p. 7072}	LV_ERR_SPI_MPS {p. 4245}	LV_ERR_TMP_MU_MC {p. 7072}
LV_IGK {p. 906}	LV_INJ_OFF_TMR_INJ_ ENA {p. 7158}	LV_MC_SOPC_INH_DI {p. 7186}	NC_CYL_NR {p. 1526}
NC_IDX_CYL_PBK_IV_ REF [NC_CYL_NR] {p. 626}	STATE_ERR_IV {p. 4803}	TCO {p. 1100}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_THD_INH_DIAG_IV	-	0... FEH	-48... 142.5	0.75	°C
TCO threshold below which the injector diagnosis is inhibited					
LC_INH_IV_DIAG_ERR_ENA	-	0... 1H	0 ...1	1	-
Manual switch for activation of INH_IV_DIAG_ERR					

### FUNCTION DESCRIPTION:

#### General information:

The flag LV\_INH\_DIAG\_IV deactivates (freezes) the power stage diagnostic of all injection valves.

The injector diagnosis has to be deactivated in case of:

- TCO is below the threshold C\_TCO\_THD\_INH\_DIAG\_IV


If a de-bounced injector error is present at the end of the driving cycle (LV\_ERR\_IV = 1), the flag LV\_ERR\_IV\_LST\_CYC is set and is stored in the permanent RAM.

#### A.91.1 Calculation of INJ\_DR\_CYL\_REF[NC\_CYL\_NR]

#### Application conditions

**Activation:** *every engine state*

**Deactivation:** -

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**Initialisation:** -

**Recurrence:** only once at reset

### Formula section:

The variable INJ\_DR\_CYL\_REF[x] represents an inhibit pattern where all cylinders on the same bank as cylinder x are inhibited (corresponding bits are set to 1) due to injection valve errors.

Calculation of INJ\_DR\_CYL\_REF[NC\_CYL\_NR]:

Note: m reverts to the injection power stage bank within this loop

```

FOR x = 0 TO NC_CYL_NR - 1 DO
  INJ_DR_CYL_REF[x] = 0
  m = NC_IDX_CYL_PBK_IV_REF[x]
  FOR y = 0 TO NC_CYL_NR - 1 DO
    IF NC_IDX_CYL_PBK_IV_REF[y] = m // cylinder y is on bank m
    THEN
      Bit y of INJ_DR_CYL_REF[x] = 1
    ENDIF
  ENDFOR
ENDFOR

```

## A.91.2 Calculation of LV\_INH\_DIAG\_IV

### Application conditions

**Activation:** every engine state

**Deactivation:** -

**Initialisation:** at reset: LV\_INH\_DIAG\_IV = 1

**Recurrence:** segment synchronous and 'at first valid tooth'

### Formula section:

```


(1)IF TCO < C_TCO_THD_INH_DIAG_IV
  OR LV_MC_SOPC_INH_DI = 1
  OR LV_ERR_TMP_MU_MC = 1
  OR LV_ERR_MU_MC = 1
  OR LV_ERR_SPI_MPS = 1
  OR LV_INJ_OFF_TMR_INJ_ENA = 0
(1)THEN
  LV_INH_DIAG_IV = 1
(1)ELSE
  LV_INH_DIAG_IV = 0
(1)ENDIF

```

## A.91.3 Calculation of LV\_ERR\_IV\_LST\_CYC

### Application conditions

**Activation:** LV\_IGK = 1 → 0

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**Deactivation:** -  
**Initialisation:** -  
**Recurrence:** only once at LV\_IGK = 1 → 0

#### Formula section:

```
(1) IF
STATE_ERR_IV ≠ 0
(1) THEN
LV_ERR_IV_LST_CYC = 1
(1) ELSE
LV_ERR_IV_LST_CYC = 0
(1) ENDIF
```

**Note:** In case of “checksum error” after power latch or reset the flag LV\_ERR\_IV\_LST\_CYC has to be set to zero.

### A.91.4 Shut off request from injection valve diagnosis

#### General information:


In this chapter the diagnosis information for ATIC 63 PIEZO driver will be analysed. In the case of a short circuit error (SC) except the case of a high side to low side short circuit error (HL) all the injectors, which are connected to the same injection driver have to be switched off to prevent wrong fuel mass on not affected injection valves. In the case of an OC or HL error only the injector with a diagnosed error has to be switched off.

#### Application conditions

**Activation:** LV\_IGK = 1  
**Deactivation:** -  
**Initialisation:** at reset, at transition of LV\_IGK 0 -> 1 and at global clearing of failure memory DO:  
 INH\_IV\_DIAG\_ERR = 0  
**Recurrence:** segment synchronous  
**Note:** The chapter 1.4 Shut off request from injection valve diagnosis has to be calculated after the module “Injection valve diagnosis”.

#### Formula section:

```
(1) IF (STATE_ERR_IV ≠ 0) AND (LC_INH_IV_DIAG_ERR_ENA = 1)
(1) THEN
  INH_IV_DIAG_ERR = STATE_ERR_IV
  (Switch off all injectors with an error symptom)
(1) FOR x = 0 TO (NC_CYL_NR - 1) DO:
  (2) IF (Bit x of STATE_ERR_IV = 1) AND (ERR_SYM_IV[x] = 'SC-Error')
    (Check if a short circuit error (without HL-error) was detected)
  (2) THEN
    (Switch off all the injectors which are connected to the same driver additionally)
```


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```

    INH_IV_DIAG_ERR =      INH_IV_DIAG_ERR
                           OR
    wise                    INJ_DR_CYL_REF[x]

    (2) END IF
    (1) END FOR
(1) ELSE
    INH_IV_DIAG_ERR = 0
(1) ENDIF

```

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## A.92 Air mass flow sensor diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_TCC_T_PER_MAF_FRQ_EL [NC_MAF_NR]	O/V	0... FFH	0... 255	1	-
TCC counter for diagnostic instance MAF_FRQ_EL[NC_MAF_NR]					
ERR_SYM_MAF	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom MAF					
ERR_SYM_MAF_FRQ_EL [NC_MAF_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
error symptoms of diagnostic instance MAF_FRQ_EL[NC_MAF_NR]					
ERR_SYM_MAF_FRQ_GRD [NC_MAF_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
error symptoms of diagnostic instance MAF_FRQ_GRD[NC_MAF_NR]					
ERR_SYM_MAF_FRQ_RNG [NC_MAF_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
error symptoms of diagnostic instance MAF_FRQ_RNG[NC_MAF_NR]					
LV_CDN_DIAG_MAF	O/V	0... 1H	0 ...1	1	-
Diagnosis condition MAF diagnosis					
LV_CDN_DIAG_MAF_FRQ_EL [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
Condition flag for diagnostic instance MAF_FRQ_EL[NC_MAF_NR]					
LV_CDN_DIAG_MAF_FRQ_GRD [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
Condition flag for diagnostic instance MAF_FRQ_GRD[NC_MAF_NR]					
LV_CDN_DIAG_MAF_FRQ_RNG [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
Condition flag for diagnostic instance MAF_FRQ_RNG[NC_MAF_NR]					
LV_END_DIAG_MAF	O/V	0... 1H	0 ...1	1	-
End of Diagnosis MAF					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_MAF_FRQ_EL [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
end flag for diagnostic instance MAF_FRQ_EL[NC_MAF_NR]					
LV_END_DIAG_MAF_FRQ_GRD [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
end flag for diagnostic instance MAF_FRQ_GRD_j					
LV_END_DIAG_MAF_FRQ_RNG [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
end flag for diagnostic instance MAF_FRQ_RNG[NC_MAF_NR]					
LV_ERR_MAF	O/V	0... 1H	0 ...1	1	-
MAF sensor error detected					
LV_ERR_MAF_FRQ_EL [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
error flag for MAF electrical diagnosis					
LV_ERR_MAF_FRQ_GRD [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
error flag for gradient check of T_PER_MAF_FRQ_BAS[NC_MAF_NR]					
LV_ERR_MAF_FRQ_RNG [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
error flag for range check of T_PER_MAF_FRQ_BAS[NC_MAF_NR]					

**Input data:**

CTR_MAF_FRQ_KGH_SUM [NC_MAF_NR] {p. 833}	CTR_T_PER_MAF_FRQ_GRD [NC_MAF_NR] {p. 833}	CTR_T_PER_MAF_FRQ_RNG [NC_MAF_NR] {p. 833}	FAC_MAF_REL {p. 8277}
LV_CDN_VB_OBD1 {p. 1185}	LV_CTR_T_PER_MAF_FRQ_EL [NC_MAF_NR] {p. 833}	LV_CTR_T_PER_MAF_FRQ_SENS [NC_MAF_NR] {p. 833}	LV_IGK {p. 906}
LV_ST_END {p. 1720}	LV_VAR_MAF {p. 656}	N {p. 1525}	NC_MAF_NR {p. 834}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_MAF	-	0... FFH	0... 255	1	-
Anti-bounce increment value					
C_ABC_INC_MAF_FRQ_EL [NC_MAF_NR]	-	0... FFH	0... 255	1	-
anti bounce counter increment for diagnosis instance MAF_FRQ_EL[NC_MAF_NR]					
C_ABC_INC_MAF_FRQ_GRD [NC_MAF_NR]	-	0... FFH	0... 255	1	-
anti bounce counter increment for diagnosis instance MAF_FRQ_GRD_j					
C_ABC_INC_MAF_FRQ_RNG [NC_MAF_NR]	-	0... FFH	0... 255	1	-
anti bounce counter increment for diagnosis instance MAF_FRQ_RNG[NC_MAF_NR]					
C_ABC_MAX_MAF	-	1... FFH	1... 255	1	-
Anti-bounce maximum value					
C_ABC_MAX_MAF_FRQ_EL [NC_MAF_NR]	-	1... FFH	1... 255	1	-
anti bounce counter maximum value for diagnosis instance MAF_FRQ_EL[NC_MAF_NR]					
C_ABC_MAX_MAF_FRQ_GRD [NC_MAF_NR]	-	1... FFH	1... 255	1	-
anti bounce counter maximum value for diagnosis instance MAF_FRQ_GRD_j					
C_ABC_MAX_MAF_FRQ_RNG [NC_MAF_NR]	-	1... FFH	1... 255	1	-
anti bounce counter maximum value for diagnosis instance MAF_FRQ_RNG[NC_MAF_NR]					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_TCC_T_PER_MAF_FRQ_EL	-	0... FFH	0... 255	1	-
threshold for TCC counter for diagnostic instance MAF_FRQ_EL[NC_MAF_NR]					
C_FAC_MAF_REL_THD_MAF_RNG_MIN	-	0... BB8H	0... 300	0.1	%
min. relative cylinder filling for enable the MAF_FRQ_RNG diagnosis					
C_N_THD_MAF_FRQ_RNG_MIN	-	0... 1FE0H	0... 8160	1	rpm
min. N threshold for enable the MAF_FRQ_RNG diagnosis					
C_RATIO_T_PER_MAF_FRQ_GRD_DIAG	-	0... 7FFFH	0... 99.99694	3.0518e-3	%
maximum acceptable percentage of exceeding gradients for T_PER_MAF_FRQ_SUM_j per ms					
C_RATIO_T_PER_MAF_FRQ_RNG_DIAG	-	0... 7FFFH	0... 99.99694	3.0518e-3	%
maximum acceptable percentage of out of range T_PER_MAF_FRQ_SUM[NC_MAF_NR] per ms					

## FUNCTION DESCRIPTION:

The whole electrical diagnostic feature for frequential MAF sensor consists of four parts:

The error detection itself is done within the signal acquisition. Every 1 ms the mean period time per ms of mass air flow sensor (T\_PER\_MAF\_FRQ\_BAS[NC\_MAF\_NR]) is evaluated. Whenever an error is detected (per ms) the corresponding counter (CTR\_T\_PER\_MAF\_FRQ\_RNG[NC\_MAF\_NR] or CTR\_T\_PER\_MAF\_FRQ\_GRD[NC\_MAF\_NR]) gets incremented and this value itself is neglected.

Here in the diagnostic function these summed up error counters as well as the summed up counter for valid values per segment (CTR\_MAF\_FRQ\_KGH\_SUM[NC\_MAF\_NR]) are evaluated at the end of each segment.

### A.92.1 Frequential MAF Sensor: Period Range Check per ms

#### General information:

The diagnosis described in this section is performed for each MAF sensor separately [NC\_MAF\_NR].

The purpose is to check the range of the mean period time per ms of mass air flow sensor (T\_PER\_MAF\_FRQ\_BAS[NC\_MAF\_NR]). The diagnostic instance consists of the following symptom:

- SYM\_0: MAF-sensor-[NC\_MAF\_NR]: mean period time per ms exceeding limit  
MAF\_FRQ\_RNG[NC\_MAF\_NR]

#### Description:


```

Activation      If      LV_VAR_MAF = 1
                then if  LV_IGK = 1                and
                                LV_CDN_VB_OBD1 = 1                and
                                LV_ST_END = 1                and
                                N > C_N_THD_MAF_FRQ_RNG_MIN        and
                                FAC_MAF_REL > C_FAC_MAF_REL_THD_MAF_RNG_MIN
                Then      LV_CDN_DIAG_MAF_FRQ_RNG[NC_MAF_NR] = 1
                Else      LV_CDN_DIAG_MAF_FRQ_RNG[NC_MAF_NR] = 0
                endif
                else      LV_END_DIAG_MAF_FRQ_RNG[NC_MAF_NR] = 1
                                LV_CDN_DIAG_MAF_FRQ_RNG[NC_MAF_NR] = 0
                Endif

```

Initialization: STD\_INI

Recurrence: every segment

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**Formula section:**

```

If      LV_CDN_DIAG_MAF_FRQ_RNG[NC_MAF_NR] = 1
then if
    [CTR_T_PER_MAF_FRQ_RNG[NC_MAF_NR] /
    (CTR_MAF_FRQ_KGH_SUM[NC_MAF_NR] + CTR_T_PER_MAF_FRQ_RNG[NC_MAF_
    NR] + CTR_T_PER_MAF_FRQ_GRD[NC_MAF_NR])]
    > C_RATIO_T_PER_MAF_FRQ_RNG_DIAG      AND
    LV_CTR_T_PER_MAF_FRQ_SENS[NC_MAF_NR] = 0      AND
    LV_CTR_T_PER_MAF_FRQ_EL[NC_MAF_NR] = 0
then ERR_SYM_MAF_FRQ_RNG[NC_MAF_NR] = SYM_0
else ERR_SYM_MAF_FRQ_RNG[NC_MAF_NR] = NO_SYM
endif
endif

```

Calculation end of diagnosis

LV\_END\_DIAG\_MAF\_FRQ\_RNG[NC\_MAF\_NR] is calculated by error management if diagnosis is active.

**A.92.2 Frequential MAF Sensor: Gradient Check per ms****General information:**

The diagnosis described in this section is performed for each MAF sensor separately (j = 0 ... NC\_MAF\_NR - 1).

Purpose is to check the gradient of consecutively measured mean period times per ms (absolute value) of mass air flow sensor (T\_PER\_MAF\_FRQ\_BAS[NC\_MAF\_NR]). This allows to detect a completely unplausible increase or decrease of it caused by a loose contact. The diagnostic instance consists of the following error symptom:

- SYM\_0: MAF-sensor-[NC\_MAF\_NR]: unplausible gradient of mean period time per ms  
**MAF\_FRQ\_GRD[NC\_MAF\_NR]**

**Description:**

```

Activation      If          LV_VAR_MAF = 1
                   then      if          LV_IGK = 1      and
                               LV_CDN_VB_OBD1 = 1      and
                               LV_ST_END = 1
                   Then      LV_CDN_DIAG_MAF_FRQ_GRD[NC_MAF_NR] = 1
                   Else      LV_CDN_DIAG_MAF_FRQ_GRD[NC_MAF_NR] = 0
                               endif
                   else      LV_END_DIAG_MAF_FRQ_GRD[NC_MAF_NR] = 1
                               LV_CDN_DIAG_MAF_FRQ_GRD[NC_MAF_NR] = 0
                   Endif

```

*Initialization:* STD\_INI


*Recurrence:* every segment

**Formula section:**

```

If      LV_CDN_DIAG_MAF_FRQ_GRD[NC_MAF_NR] = 1

```

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```

then      if
    [CTR_T_PER_MAF_FRQ_GRD[NC_MAF_NR] /
    (CTR_MAF_FRQ_KGH_SUM[NC_MAF_NR] + CTR_T_PER_MAF_FRQ_RNG[NC_MAF_NR] +
    CTR_T_PER_MAF_FRQ_GRD[NC_MAF_NR])]
    > C_RATIO_T_PER_MAF_FRQ_GRD_DIAG      AND
    LV_CTR_T_PER_MAF_FRQ_SENS[NC_MAF_NR] = 0      AND
    LV_CTR_T_PER_MAF_FRQ_EL[NC_MAF_NR] = 0
    then    ERR_SYM_MAF_FRQ_GRD[NC_MAF_NR] = SYM_0
    else    ERR_SYM_MAF_FRQ_GRD[NC_MAF_NR] = NO_SYM
    endif

```

**endif**

Calculation end of diagnosis

LV\_END\_DIAG\_MAF\_FRQ\_GRD[NC\_MAF\_NR] is calculated by error management if diagnosis is active.

## A.92.3 MAF electrical diagnosis

### General information:

The diagnosis described in this section is performed for each MAF sensor separately (j = 0 ... NC\_MAF\_NR - 1).

Purpose is to recognize a problem due to an electrical error (SCG, SCB of open line) of the mass air flow sensor (within the sensor on the wiring harness) or a self diagnosis problem is recognized. The diagnostic instance consists of the following error symptom:

- SYM\_0: MAF-sensor-[NC\_MAF\_NR]: electrical fault
- SYM\_1: 'MAF-sensor-[NC\_MAF\_NR]: sensor error recognized

```

Activation      if
                then      if
                    LV_VAR_MAF = 1
                    LV_IGK = 1      and
                    LV_CDN_VB_OBD1 = 1      and
                    LV_ST_END = 1
                    Then    LV_CDN_DIAG_MAF_FRQ_EL[NC_MAF_NR] = 1
                    Else    LV_CDN_DIAG_MAF_FRQ_EL[NC_MAF_NR] = 0
                    endif
                else      LV_END_DIAG_MAF_FRQ_EL[NC_MAF_NR] = 1
                    LV_CDN_DIAG_MAF_FRQ_EL[NC_MAF_NR] = 0
                Endif

```

*Initialization:* STD\_INI

*Recurrence:* every segment

### Formula section:

```

if      LV_CDN_DIAG_MAF_FRQ_EL[NC_MAF_NR] = 1
then    if      LV_CTR_T_PER_MAF_FRQ_EL[NC_MAF_NR] = 1
            then    CTR_TCC_T_PER_MAF_FRQ_EL[NC_MAF_NR] ++
            Else    CTR_TCC_T_PER_MAF_FRQ_EL[NC_MAF_NR] = 0
            Endif
        if      CTR_TCC_T_PER_MAF_FRQ_EL[NC_MAF_NR] >
            C_CTR_TCC_T_PER_MAF_FRQ_EL
        then    ERR_SYM_MAF_FRQ_EL[NC_MAF_NR] = SYM_0
        else if LV_CTR_T_PER_MAF_FRQ_SENS[NC_MAF_NR] = 1

```

```

then   ERR_SYM_MAF_FRQ_EL[NC_MAF_NR] = SYM_1
else   ERR_SYM_MAF_FRQ_EL[NC_MAF_NR] = NO_SYM
      endif
endif

```

**endif**

Calculation end of diagnosis

LV\_END\_DIAG\_MAF\_FRQ\_EL[NC\_MAF\_NR] is calculated by error management if diagnosis is active.

#### A.92.4 Global error instance

```

Activation
      if       LV_VAR_MAF = 1
      then     if       LV_ST_END = 1
      then     LV_IGK = 1
      and     LV_CDN_VB_OBD1 = 1
      and     then     LV_CDN_DIAG_MAF = 1
      else     LV_CDN_DIAG_MAF = 0
      endif
      else     LV_END_DIAG_MAF = 1
      LV_CDN_DIAG_MAF = 0
      endif

```

*Initialization:* STD\_INI

*Recurrence:* every segment

#### Formula section:

```

if       LV_CDN_DIAG_MAF = 1 // only frequency MAF //
Then    if       LV_ERR_MAF_FRQ_RNG[NC_MAF_NR] = 1
Then    ERR_SYM_MAF = SYM_0
          LV_ERR_MAF = 1
Else    if       LV_ERR_MAF_FRQ_GRD[NC_MAF_NR] = 1
Then    ERR_SYM_MAF = SYM_1
          LV_ERR_MAF = 1
Else    if       LV_ERR_MAF_FRQ_EL[NC_MAF_NR] = 1
Then    ERR_SYM_MAF = SYM_2
          LV_ERR_MAF = 1
Else    ERR_SYM_MAF = NO_SYM
          LV_ERR_MAF = 0
Endif // no longer failure symptom of analog MAF treated //
Endif

```

**Endif**

Calculation end of diagnosis

LV\_END\_DIAG\_MAF is calculated by error management if diagnosis is active.

## A.93 Air mass flow sensor diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_MAF	O/V	0... 1H	0 ...1	1	-
Inhibition of MAF diagnosis					
LV_MAF_BLS_DIAG	O/V	0... 1H	0 ...1	1	-
MAF error and brake is active					
STATE_RBM_MAF	O/V	0... 7H	0 ...7	1	-
Interface of MAF monitor with the Rate-Based Monitoring statistics Bit 0: conditions for monitoring are met long enough to detect malfunction (bit 0 = 1) Bit 1: inhibition of the monitor because of system failure(s) (bit 1 = 1) Bit 2: individual RBM conditions of the monitor were encountered within this DC (bit 2 = 1)					

### Input data:

LV_BRAKE_DET {p. 4209}	LV_DC {p. 5746}	LV_END_DIAG_MAF {p. 4814}	LV_ERR_BLS_PLAUS {p. 4209}
LV_ERR_MAF {p. 4815}	LV_VAR_MAF {p. 656}		

### General information:

LV\_MAF\_BLS\_DIAG is used by engine speed limit coordination and torque request at clutch.

### Application conditions

<b>Initialisation:</b>	<i>0 at reset</i>
<b>Recurrence:</b>	<i>10ms</i>
<b>Activation:</b>	<i>LV_VAR_MAF = 1</i>
<b>Deactivation:</b>	<i>LV_VAR_MAF = 0</i>

### Formula section:

LV\_INH\_DIAG\_MAF = 0

```

If          LV_ERR_MAF = 1          and
              [ LV_BRAKE_DET = 1      or
                LV_ERR_BLS_PLAUS = 1]
Then       LV_MAF_BLS_DIAG = 1
Else       LV_MAF_BLS_DIAG = 0
Endif


```

### A.93.1 Interface for Rate - Based - Monitoring

#### FUNCTION DESCRIPTION:

### General information:

With this module the interface between the MAF monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_MAF data.

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Within STATE\_RBM\_MAF, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)  
( not valid for MAF diagnosis )

### Application conditions:

*Initialisation :*

at LV\_DC 0 1 transition :

bit 0, bit 1 and bit 2 of STATE\_RBM\_MAF = 0

on failure memory reset :

bit 1 of STATE\_RBM\_MAF = 0

*Recurrence:* 1 s

*Activation:* LV\_DC 0 1 transition **and** LV\_DC = 1

### Formula section:

Bit 0:

**If** bit 0 of STATE\_RBM\_MAF = 0

**then**

**if** LV\_END\_DIAG\_MAF = 1

**then** bit 0 of STATE\_RBM\_MAF = 1

**endif**

**endif**

Bit 1:

bit 1 of STATE\_RBM\_MAF = 0

Bit 2:

bit 2 of STATE\_RBM\_MAF = 1

## A.94 Ambient pressure sensor diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_AMP	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom AMP					
LV_CDN_DIAG_AMP	O/V	0... 1H	0 ...1	1	-
Diagnosis condition AMP					
LV_END_DIAG_AMP	O/V	0... 1H	0 ...1	1	-
End of Diagnosis AMP					
LV_ERR_AMP	O/V	0... 1H	0 ...1	1	-
AMP error present					

### Input data:

LV_ES {p. 1720}	LV_IGK {p. 906}	LV_ST {p. 1720}	V_AMP {p. 831}
-----------------	-----------------	-----------------	----------------

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_AMP	-	0... FFH	0... 255	1	-
Anti - bounce counter increment					
C_ABC_MAX_AMP	-	1... FFH	1... 255	1	-
Maximum value of the anti - bounce counter					
C_V_AMP_MAX_DIAG	-	0... 3FFH	0... 4.99511	4.88e-3	V
Maximum diagnostic value for the ambient pressure value					
C_V_AMP_MIN_DIAG	-	0... 3FFH	0... 4.99511	4.88e-3	V
Minimum diagnostic value for the ambient pressure value					

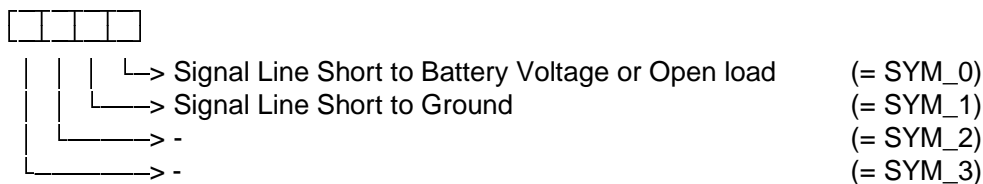
### FUNCTION DESCRIPTION:

#### General information:

The purpose of the diagnosis shall be to detect electrical faults as defined by OBD I requirements. The signal of the altitude pressure sensor on the A/D-input of the microcontroller is checked.

#### Description:

Error-symtoms are defined to this diagnosis function as following :



## Application conditions

**Initialization:** all 0 at LV\_IGK 0->1 **or** reset

**Recurrence:** 100ms

```

Activation      If          LV_IGK = 1           and
                   LV_ES = 0           and
                   LV_ST = 0
                   Then          LV_CDN_DIAG_AMP = 1
                   Else          LV_CDN_DIAG_AMP = 0
                   Endif

```

## Formula section:

Short circuit to VBatt or open load

```
If          V_AMP > C_V_AMP_MAX_DIAG
```

```
Then      ERR_SYM_AMP = SYM_0
```

Short circuit to ground

```
Elseif    V_AMP < C_V_AMP_MIN_DIAG
```

```
Then      ERR_SYM_AMP = SYM_1
```

```
Else      ERR_SYM_AMP = NO_SYM
```

```
Endif
```

Calculation of present error and end of diagnosis:

LV\_ERR\_AMP and LV\_END\_DIAG\_AMP is calculated by error management

## A.95 Manifold air pressure sensor diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_MAP_DIP_SENS	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom MAP_DIP sensor					
ERR_SYM_MAP_DIP_SHIFT	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom MAP_DIP sensor					
LV_CDN_DIAG_MAP_DIP_SENS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition MAP_DIP sensor					
LV_CDN_DIAG_MAP_DIP_SHIFT	O	0... 1H	0 ...1	1	-
Diagnosis condition MAP_DIP sensor					
LV_END_DIAG_MAP_DIP_SENS	O/V	0... 1H	0 ...1	1	-
End of Diagnosis MAP_DIP sensor					
LV_END_DIAG_MAP_DIP_SHIFT	O	0... 1H	0 ...1	1	-
End of Diagnosis MAP_DIP sensor					
LV_ERR_MAP_DIP_SENS	O/V	0... 1H	0 ...1	1	-
MAP_DIP sensor error present					
LV_ERR_MAP_DIP_SHIFT	O	0... 1H	0 ...1	1	-
MAP_DIP sensor error present					

### Input data:

C_TPS_V_MAP_AD_MIN {p. 1199}	ECU_STATE {p. 1091}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}	LV_ERR_MAP_TPS_ PLAUS {p. 1062}
LV_ERR_TPS {p. 4982}	LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_ST_CHK_2 {p. 4951}
LV_ES {p. 1720}	LV_IGK {p. 906}	LV_ST {p. 1720}	TPS_AV {p. 1169}
V_MAP {p. 1198}	V_MAP_DIF {p. 1198}	V_MAP_DIF_VLD {p. 1198}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_MAP_DIP_SENS	-	0... FFH	0... 255	1	-
Anti - bounce counter increment					
C_ABC_INC_MAP_DIP_SHIFT	-	0... FFH	0... 255	1	-
Anti - bounce counter increment					
C_ABC_MAX_MAP_DIP_SENS	-	1... FFH	1... 255	1	-
Maximum value of the anti - bounce counter					
C_ABC_MAX_MAP_DIP_SHIFT	-	1... FFH	1... 255	1	-
Maximum value of the anti - bounce counter					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_V_MAP_BAS_MAX_DIAG	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Maximum diagnostic value for the manifold differential pressure value					
C_V_MAP_BAS_MIN_DIAG	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Minimum diagnostic value for the manifold differential pressure value					

## A.95.1 Electrical diagnosis

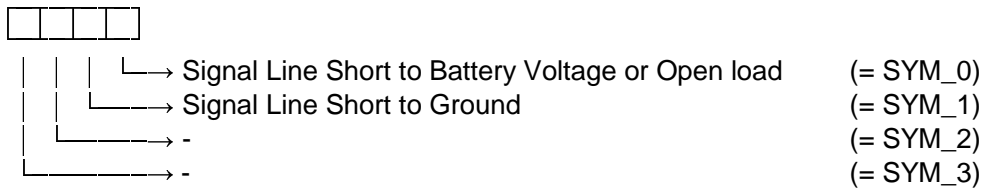
### FUNCTION DESCRIPTION:

#### General information:

The purpose of the diagnosis shall be to detect electrical faults as defined by OBD I requirements. The signal of the manifold differential pressure sensor on the A/D-input of the microcontroller is checked.

#### Description:

Error-symtoms are defined to this diagnosis function as following :



#### Application conditions

**Initialization:** according ABC type **STD\_INI** (all 0 at LV\_IGK 0→1 or at reset)

**Recurrence:** 100ms

**Activation**

```

If      LV_IGK = 1      and
          LV_ES = 0      and
          LV_ST = 0
Then    LV_CDN_DIAG_MAP_DIP_SENS = 1
Else    LV_CDN_DIAG_MAP_DIP_SENS = 0
Endif

```

#### Formula section:

Short circuit to VBatt or open load

```

If      V_MAP > C_V_MAP_BAS_MAX_DIAG
Then    ERR_SYM_MAP_DIP_SENS = SYM_0

```

Short circuit to ground

```

Elseif  V_MAP < C_V_MAP_BAS_MIN_DIAG
Then    ERR_SYM_MAP_DIP_SENS = SYM_1
Else    ERR_SYM_MAP_DIP_SENS = NO_SYM
Endif

```

Calculation of present error and end of diagnosis:

LV\_ERR\_MAP\_DIP\_SENS and LV\_END\_DIAG\_MAP\_DIP\_SENS is calculated by error management.

## A.95.2 Plausibility diagnosis

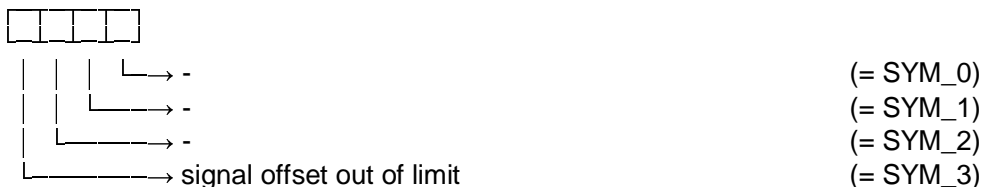
### FUNCTION DESCRIPTION:

#### General information:

The purpose of the diagnosis shall be to detect an unplausible shift of the sensor characteristic. The deviation and the maximum allowed deviation from the nominal curve are determined by the module "Pressure Variables (MAP-Sensor) /Adaptation of sensor characteristic".

#### Description:

Error-symtoms are defined to this diagnosis function as following :



### Application conditions

**Initialization:** according ABC type **STD** (init. from nonvolatile error memory)

**Recurrence:** 100ms

**Activation**

```

If      ECU_STATE = PWL and
          TPS_AV C_TPS_V_MAP_AD_MIN and
          LV_ERR_TPS = 0 and
          LV_ERR_MAP_DIP_SENS = 0 and
          LV_ERR_TPS_AD = 0 and

          LV_ERR_TPS_AD_BOL = 0 and
          LV_ERR_TPS_ST_CHK_2 = 0 and
          LV_ERR_LOAD_TPS_PLAUS = 0 and
          LV_ERR_MAP_TPS_PLAUS = 0
Then   LV_CDN_DIAG_MAP_DIP_SHIFT = 1
Else   LV_CDN_DIAG_MAP_DIP_SHIFT = 0
Endif
  
```

**Formula section:**


```

if   |V_MAP_DIF| > V_MAP_DIF_VLD
then   ERR_SYM_MAP_DIP_SHIFT = SYM_3
else   ERR_SYM_MAP_DIP_SHIFT = NO_SYM
endif

```

Calculation of present error and end of diagnosis:

LV\_ERR\_MAP\_DIP\_SHIFT and LV\_END\_DIAG\_MAP\_DIP\_SHIFT is calculated by error management.

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4827 of 8404</b>	
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## A.96 Pressure up throttle sensor diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_PUT_EL	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom electrical PUT sensor					
LV_CDN_DIAG_PUT_EL	O/V	0... 1H	0 ...1	1	-
Status of diagnosis for electrical PUT sensor					
LV_END_DIAG_PUT_EL	O/V	0... 1H	0 ...1	1	-
End of pressure up throttle sensor diagnosis					
LV_ERR_PUT_EL	O/V	0... 1H	0 ...1	1	-
electrical PUT sensor error detected					

### Input data:

LV_VAR_TCHA {p. 656}	LV_VB_CDN_OBD_1 {p. 1046}	V_PUT {p. 1198}	V_PUT_MV_MAX_DIAG {p. 4830}
V_PUT_MV_MIN_DIAG {p. 4830}			

### FUNCTION DESCRIPTION:

#### General Information:

Analog input signal in the A/D-Input from the Microprocessor.

#### Description

Error-symtoms are defined to this diagnosis function as following :



**Remark:** Calculation of LV\_END\_DIAG\_PUT see generic calculation "End of diagnosis" in anti bounce algorithm.

### Application conditions

**Activation:** LV\_VAR\_TCHA = 1

**Deactivation:** **If** LV\_VAR\_TCHA = 0  
**Then** LV\_END\_DIAG\_PUT\_EL = 1  
**Endif**

**Initialization:** -

**Calcualtion recurrence:** 10ms

**Formula section:**

```

if          LV_VB_CDN_OBD_1      = 1
then       LV_CDN_DIAG_PUT_EL = 1  (diagnosis is active)
else       LV_CDN_DIAG_PUT_EL = 0  (diagnosis inactive)
---
If        V_PUT > V_PUT_MV_MAX_DIAG
Then      Symptom "Circuit high input" is active, anti-bounce counter increment
            ERR_SYM_PUT_EL = 1H
            LV_ERR_PUT_EL = 1      (after debounce)
            //Short circuit to battery or open circuit//

Else

            If          V_PUT      <      V_PUT_MV_MIN_DIAG
Then          Symptom "Circuit low input" is active, anti-bounce counter
increment     ERR_SYM_PUT_EL = 2H
            LV_ERR_PUT_EL = 1      (after debounce)
            //Short circuit to ground//

Else          Symptom "Circuit high input" and "Circuit low input" are
inactive, anti-bounce counter decrement
            ERR_SYM_PUT_EL = 0H
            LV_ERR_PUT_EL = 0      (after debounce)

Endif

Endif

```

## A.97 Pressure up throttle sensor diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_PUT_DIAG_ENG_RUN	-	0... 1H	0 ...1	1	-
thresholds for running engine were once written function must no longer be calculated					
V_PUT_MV_MAX_DIAG	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Threshold value of V_PUT_MV to detect Short circuit in signal wire to VB					
V_PUT_MV_MIN_DIAG	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Threshold value of V_PUT_MV to detect Short circuit in signal wire to earth or wire break					

### Input data:

LV_ES {p. 1720}	LV_VAR_TCHA {p. 656}		
-----------------	----------------------	--	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_PUT_EL	-	0... FFH	0... 255	1	-
Increment debounce counter					
C_ABC_MAX_PUT_EL	-	1... FFH	1... 255	1	-
Maximum value debounce counter					
C_V_PUT_MV_MAX_DIAG	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Threshold value V_PUT_MV to detect Short circuit in signal wire to VB					
C_V_PUT_MV_MAX_DIAG_ES	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Threshold value V_PUT_MV to detect Short circuit in signal wire to VB for engine Stop					
C_V_PUT_MV_MIN_DIAG	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Threshold value V_PUT_MV to detect Short circuit in signal wire to earth or wire break					
C_V_PUT_MV_MIN_DIAG_ES	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Threshold value V_PUT_MV to detect Short circuit in signal wire to earth or wire break for engine Stop					

### Error treatment:

#### Error debounce:

- Debounce counter increment: C\_ABC\_INC\_PUT\_EL
- Debounce counter decrement: 1
- Debounce counter maximum value: C\_ABC\_MAX\_PUT\_EL

### FUNCTION DESCRIPTION:

#### General Information:


Defined the thresholds to detect either Short circuit in signal wire to battery or Short circuit in signal wire to earth or wire break. PUT = Pressure upstream throttle

#### Application conditions

**Activation :** LV\_VAR\_TCHA = 1 **and** LV\_PUT\_DIAG\_ENG\_RUN = 0

**Deactivation:** LV\_PUT\_DIAG\_ENG\_RUN = 1

**Initialization:** LV\_PUT\_DIAG\_ENG\_RUN = 0 at reset

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**Calculation recurrence:** 10ms

**Formula section:**

**If** LV\_PUT\_DIAG\_ENG\_RUN = 0 and LV\_ES = 0  
**Then** LV\_PUT\_DIAG\_ENG\_RUN = 1  
*Short circuit in signal wire to VB:*  
 V\_PUT\_MV\_MAX\_DIAG = C\_V\_PUT\_MV\_MAX\_DIAG  
*Short circuit in signal wire to earth or wire break:*  
 V\_PUT\_MV\_MIN\_DIAG = C\_V\_PUT\_MV\_MIN\_DIAG  
**else** *thresholds for not running engine*  
 V\_PUT\_MV\_MAX\_DIAG = C\_V\_PUT\_MV\_MAX\_DIAG\_ES  
 V\_PUT\_MV\_MIN\_DIAG = C\_V\_PUT\_MV\_MIN\_DIAG\_ES

**Endif**

**Configuration of diagnostic syptoms :**

Diagnosis	Symptom	Nr	ABC type
<i>Pressure upstream throttle sensor diagnosis with short circuit signal wire to VB</i>	Short circuit in signal wire to VB	0	MEM
<i>Pressure upstream throttle sensor diagnosis short circuit in signal wire to earth or wire break</i>	short circuit in signal wire to earth or wire break	1	MEM

## A.98 Bit serial data line communication


### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ABC_ALTER_COM	V	0... FFH	0... 255	1	-
Anti-bounce counter for alternator BSD communication error					
CTR_ABC_CWP_COM	V	0... FFH	0... 255	1	-
Anti-bounce counter for electrical coolant water pump BSD communication error					
CTR_ABC_QOIL_COM	V	0... FFH	0... 255	1	-
Anti-bounce counter for oil quality sensor (QLT) BSD communication error					
CTR_ABC_SENS_BAT_SMT_COM	O/V	0... FFH	0... 255	1	-
Anti-bounce counter for intelligent battery sensor (IBS) BSD communication error					
CTR_END_DIAG_ALTER_COM	V	0... FFH	0... 255	1	-
Counter for End of diagnosis condition detection for alternator BSD communication error					
CTR_END_DIAG_CWP_COM	V	0... FFH	0... 255	1	-
Counter for End of diagnosis condition detection for electrical coolant water pump BSD communication error					
CTR_END_DIAG_QOIL_COM	V	0... FFH	0... 255	1	-
Counter for End of diagnosis condition detection for oil quality sensor (QLT) BSD communication error					
CTR_END_DIAG_SENS_BAT_SMT_COM	V	0... FFH	0... 255	1	-
Counter for End of diagnosis condition detection for intelligent battery sensor (IBS) BSD communication error					
CTR_MSG_ALTER_COM_DIAG	V	0... FFH	0... 255	1	-
Counter of faulty alternator transmitting slots					
CTR_MSG_ALTER_COM_STOP	O/V	0... FFFFH	0... 65535	1	-
Interrupt counter to stop the communication to the alternator					
CTR_MSG_CWP_COM_DIAG	V	0... FFH	0... 255	1	-
Counter of faulty electrical coolant water pump transmitting slots					
CTR_MSG_CWP_COM_STOP	O/V	0... FFFFH	0... 65535	1	-
Interrupt counter to stop the communication to the electrical coolant water pump					
CTR_MSG_QOIL_COM_DIAG	V	0... FFH	0... 255	1	-
Counter of faulty oil quality sensor (QLT) transmitting slots					
CTR_MSG_QOIL_COM_STOP	O/V	0... FFFFH	0... 65535	1	-
Interrupt counter to stop the communication to the oil quality sensor (QLT)					
CTR_MSG_SENS_BAT_SMT_COM_DIAG	O/V	0... FFH	0... 255	1	-
Counter of faulty intelligent battery sensor (IBS) transmitting slots					
CTR_MSG_SENS_BAT_SMT_COM_STOP	O/V	0... FFFFH	0... 65535	1	-
Interrupt counter to stop the communication to the intelligent battery sensor (IBS)					
ERR_SYM_ALTER_COM	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom for alternator BSD communication error					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_BSD	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BSD					
ERR_SYM_CWP_COM	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom for electrical coolant water pump BSD communication error					
ERR_SYM_QOIL_COM	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom for oil quality sensor (QLT) BSD communication error					
ERR_SYM_SENS_BAT_SMT_COM	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom for intelligent battery sensor (IBS) BSD communication error					
LV_CDN_DIAG_ALTER_COM	O/V	0... 1H	0 ...1	1	-
Diagnosis condition for alternator BSD communication error					
LV_CDN_DIAG_BSD	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BSD diagnosis					
LV_CDN_DIAG_CWP_COM	O/V	0... 1H	0 ...1	1	-
Diagnosis condition for electrical coolant water pump BSD communication error					
LV_CDN_DIAG_QOIL_COM	O/V	0... 1H	0 ...1	1	-
Diagnosis condition for oil quality sensor (QLT) BSD communication error					
LV_CDN_DIAG_SENS_BAT_SMT_COM	O/V	0... 1H	0 ...1	1	-
Diagnosis condition for intelligent battery sensor (IBS) BSD communication error					
LV_END_DIAG_ALTER_COM	O/V	0... 1H	0 ...1	1	-
End of diagnosis condition for alternator BSD communication error					
LV_END_DIAG_BSD	O/V	0... 1H	0 ...1	1	-
End of BSD - Diagnosis					
LV_END_DIAG_CWP_COM	O/V	0... 1H	0 ...1	1	-
End of diagnosis condition for electrical coolant water pump BSD communication error					
LV_END_DIAG_QOIL_COM	O/V	0... 1H	0 ...1	1	-
End of diagnosis condition for oil quality sensor (QLT) BSD communication error					
LV_END_DIAG_SENS_BAT_SMT_COM	O/V	0... 1H	0 ...1	1	-
End of diagnosis condition for intelligent battery sensor (IBS) BSD communication error					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_ALTER_COM	O/V	0... 1H	0 ...1	1	-
Logical variable for alternator BSD communication error					
LV_ERR_BSD	O/V	0... 1H	0 ...1	1	-
logical variable for BSD error					
LV_ERR_CWP_COM	O/V	0... 1H	0 ...1	1	-
Logical variable for electrical coolant water pump BSD communication error					
LV_ERR_QOIL_COM	O/V	0... 1H	0 ...1	1	-
Logical variable for oil quality sensor (QLT) BSD communication error					
LV_ERR_SENS_BAT_SMT_COM	O/V	0... 1H	0 ...1	1	-
Logical variable for intelligent battery sensor (IBS) BSD communication error					
LV_INH_CWP_DIAG	O/V	0... 1H	0 ...1	1	-
Flag to freeze the CWP diagnosis in case a non-acknowledge of the BSD component CWP occurred					
LV_MSG_ALTER_COM_STOP	V	0... 1H	0 ...1	1	-
Flag indication that the communication stop counter of the device alternator <>0					
LV_MSG_CWP_COM_STOP	V	0... 1H	0 ...1	1	-
Flag indication that the communication stop counter of the device el. Coolant water pump <>0					
LV_MSG_QOIL_COM_STOP	V	0... 1H	0 ...1	1	-
Flag indication that the communication stop counter of the device oil quality sensor <>0					
LV_MSG_SENS_BAT_SMT_COM_STOP	V	0... 1H	0 ...1	1	-
Flag indication that the communication stop counter of the device intelligent battery sensor <>0					
STATE_BSD_MSG_COM_STOP	O/V	0... FFH	0... 255	1	-
Status of the communication STOP counter to the BSD devices					

**Input data:**

LV_CDN_VB_MIN_DIAG {p. 1185}	LV_IGK {p. 906}		
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**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_ALTER_COM	-	0... FFH	0... 255	1	-
Anti-bounce counter increment - diagnosis BSD communication to alternater					
C_ABC_INC_BSD	-	0... FFH	0... 255	1	-
anti bounce counter increment - diagnosis BSD					
C_ABC_INC_CWP_COM	-	0... FFH	0... 255	1	-
Anti-bounce counter increment - diagnosis BSD communication to electrical coolant water pump					
C_ABC_INC_QOIL_COM	-	0... FFH	0... 255	1	-
Anti-bounce counter increment - diagnosis BSD communication to oil quality sensor					
C_ABC_INC_SENS_BAT_SMT_COM	-	0... FFH	0... 255	1	-
Anti-bounce counter increment - diagnosis BSD communication to intelligent battery sensor					
C_ABC_MAX_ALTER_COM	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum value - diagnosis BSD communication to alternater					
C_ABC_MAX_BSD	-	1... FFH	1... 255	1	-
anti bounce counter maximum value - diagnosis BSD					
C_ABC_MAX_CWP_COM	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum value - diagnosis BSD communication to electrical coolant water pump					
C_ABC_MAX_QOIL_COM	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum value - diagnosis BSD communication to oil quality sensor					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_SENS_BAT_SMT_COM	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum value - diagnosis BSD communication to intelligent battery sensor					
C_CTR_MAX_ALTER_COM_STOP	-	0... FFFFH	0... 65535	1	-
Time out threshold for counter of alternator transmitting slots					
C_CTR_MAX_CWP_COM_STOP	-	0... FFFFH	0... 65535	1	-
Number of time out transmitting slots for electrical coolant water pump					
C_CTR_MAX_MSG_ALTER_COM	-	0... FFH	0... 255	1	-
Threshold for counter of faulty alternator transmitting slots					
C_CTR_MAX_MSG_CWP_COM	-	0... FFH	0... 255	1	-
Threshold for counter of faulty electrical coolant water pump transmitting slots					
C_CTR_MAX_MSG_QOIL_COM	-	0... FFH	0... 255	1	-
Threshold for counter of faulty oil quality sensor transmitting slots					
C_CTR_MAX_MSG_SENS_BAT_SMT_COM	-	0... FFH	0... 255	1	-
Threshold for counter of faulty intelligent battery sensor transmitting slots					
C_CTR_MAX_QOIL_COM_STOP	-	0... FFFFH	0... 65535	1	-
Number of time out transmitting slots for oil quality sensor					
C_CTR_MAX_SENS_BAT_SMT_COM_STOP	-	0... FFFFH	0... 65535	1	-
Number of time out transmitting slots for intelligent battery sensor					
C_CTR_THD_MSG_CWP_COM_DIAG	-	0... FFH	0... 255	1	-
Threshold to disable the functional CWP diagnosis in case a problem with the interface BSD is present					

### Action definition

<b>ACTION_AGGR_SetBsdGlobalCom</b> (IN<CTR_BSD_CPT_COM_OK>)	Mode: O
Action which delivers at the end of the BSD scheduling timing table the status of the communication of all BSD components of the list (counter = 0 ; no communication occurred at all)	

<b>ACTION_AGGR_SetBsdSingleCom</b> (IN<STATE_BSD_CPT>,IN<STATE_BSD_COM>)	Mode: O
Action which delivers at the end of the BSD timing slot the status of the communication of the actual BSD device of the scheduling list	


## A.98.1 Global BSD Error - No communication to any of the BSD components

### Description for actions:

<b>ACTION_COMS_SetBsdGlobalCom_COM</b> (<CTR_BSD_CPT_COM_OK>)					
Action which delivers at the end of the BSD timing table the status of the communication of all BSD devices of the list; number of successful communications for one scheduling timing list cycle					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
CTR_BSD_CPT_COM_OK	IN	0...FFH	0...255	1	-
Number of the 'ok' communications per total scheduling timing list cycle of the BSD devices					

### FUNCTION DESCRIPTION:

### General information:

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This diagnosis is to detect a malfunction in the BSD-line (**Bit-Serial-Data transfer**). There could be several components be connected to the BSD bus (alternator, intelligent battery sensor, oil quality sensor, electrical coolant water pump).

The diagnosis works with the help of basic software information. To detect an error symptom it is necessary to have a data transfer before, thus the information is stored until the next recurrency of the diagnosis. The error symptoms are set exclusive per data transfer.

There is a certain scheduling defined to serve the several components via BSD bus. In total for one complete cycle (defined in the BSD scheduling timing table) several time slots have to be passed after a decision can be made whether the communication to at least one BSD component has successfully been passed. Is there no positive acknowledgement from none of the BSD components, the counter CTR\_BSD\_CPT\_COM\_OK = 0 is indicating a global communication.

Each component is linked to certain time slots.

In general each component can be either configured by a calibration switch (must component; e.g. alternator, electrical coolant water pump, oil quality sensor) or can be learnt (intelligent battery sensor).

### Description:

As soon as the communication via BSD has been started the ECU expects in all time slots correct messages (positive acknowledgement). In case none of the messages have been received the global BSD error is set after debounce followed by inhibiting of the individual BSD communication errors.

After the error has been detected, the BSD timing coordinator is still serving the BSD components in the hope that the problem which disturbed the global communication disappears.

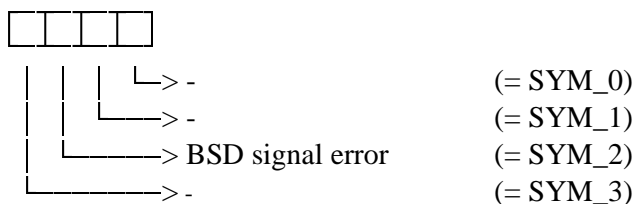
The error symptom detection is made out of basic software information BIOS\_BSD\_xx:

If one of the following error symptoms are detected:

- To less Bits were received (*BIOS\_BSD\_TOO\_FEW\_BITS\_ERR* is set)
- To many Bits were received (*BIOS\_BSD\_TOO\_MANY\_BITS\_ERR* is set)
- At least one data-bit was not inside the puls (*BIOS\_BSD\_BIT\_LVL\_ERR* is set)
- Receiver send NAK (*BIOS\_BSD\_ACK\_ERR* is set)
- Receiver does not respond (*BIOS\_BSD\_SLAVE\_TO\_ERR* is set)
- One of the parity-bits in the data frame is wrong (*BIOS\_BSD\_PARITY\_ERR* is set)
- Period of last measured bit was not o.k. (*BIOS\_BSD\_PER\_ERR* is set)

then the error symptom BSD signal error is set to active.

For error symptom calculation (*ERR\_SYM\_BSD*) the symptom position is:



### Application conditions

**Initialisation:** all 0 at LV\_IGK 0->1 **or** at reset

**Recurrence:** *Function called after each communication block (see BSD timing table)*

**Activation:** **If** LV\_CDN\_VB\_MIN\_DIAG = 1 and  
Communication on BSD started

```

Then          LV_CDN_DIAG_BSD = 1
Else          LV_CDN_DIAG_BSD = 0
Endif

```

#### Error management:

```

If          LV_CDN_DIAG_BSD = 1
Then If      CTR_BSD_CPT_COM_OK = 0           //no BSD com occured at all conf. CPT
Then        ERR_SYM_BSD = SYM_2             //Error symptom detected, ABC increments
Else        ERR_SYM_BSD = NO_SYM           //No error symptom detected, ABC decrements
Endif
Endif

```

**Remark:** LV\_ERR\_BSD and LV\_END\_DIAG\_BSD are calculated by error management if diagnosis is active.

## A.98.2 Single BSD component errors (ALTER, QOIL, CWP, SENS\_BAT\_SMT)

### Description for actions:

<b>ACTION_COMS_SetBsdSingleCom (&lt;STATE_BSD_CPT&gt;,&lt;STATE_BSD_COM&gt;)</b>					
Action which delivers at the end of the BSD timing slot the status of the communication of the actual BSD device of the scheduling list					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
STATE_BSD_CPT	IN	0...FFH	0...255	1	-
BSD device, which communicates actually with the ECU via BSD					
STATE_BSD_COM	IN	0...FFH	0...255	1	-
Status of the communication to the BSD devices (faulty /o.k.)					

### FUNCTION DESCRIPTION:

#### General information:

In addition to the global diagnosis of the BSD communication a selective diagnosis for each individual BSD component (alternator, intelligent battery sensor, oil quality sensor, electrical coolant water pump) is performed. There are several counters introduced to control the diagnosis. A counter (CTR\_MSG\_xxx\_COM\_DIAG) which monitors the transmitting slot of each individual component is incremented as soon as a faulty transmitting slot has been detected by the BSW (symptoms of the error please see Global BSD Error - No communication to any of the BSD components). In case of a faulty transmitting slot (no positive acknowledge) has been detected the next corresponding transmitting slot is served by a 22 synchronisation pulse phase and an incrementation of the counter CTR\_MSG\_xxx\_COM\_DIAG by 1+1 (1 for the missing acknowledge and 1 for the 22 synchronisation pulses).

The 22 synchronisation pulse phase is followed by new communication trial in the transmitting slot of the corresponding component determined by the timing coordinator. In case of a positive acknowledge the counter CTR\_MSG\_xxx\_COM\_DIAG is decremented by 2, otherwise it is proceeded as described above.

As soon as the counter CTR\_MSG\_xxx\_COM\_DIAG exceeds the threshold C\_CTR\_MAX\_MSG\_xxx\_COM, a break for certain transmitting time slots can be applied by starting the counter CTR\_MSG\_xxx\_COM\_STOP (displayed in the flags LV\_MSG\_xxx\_COM\_STOP) in combination with the call of the anti-bounce algorithm of the error management and resetting the counter CTR\_MSG\_xxx\_COM\_DIAG after

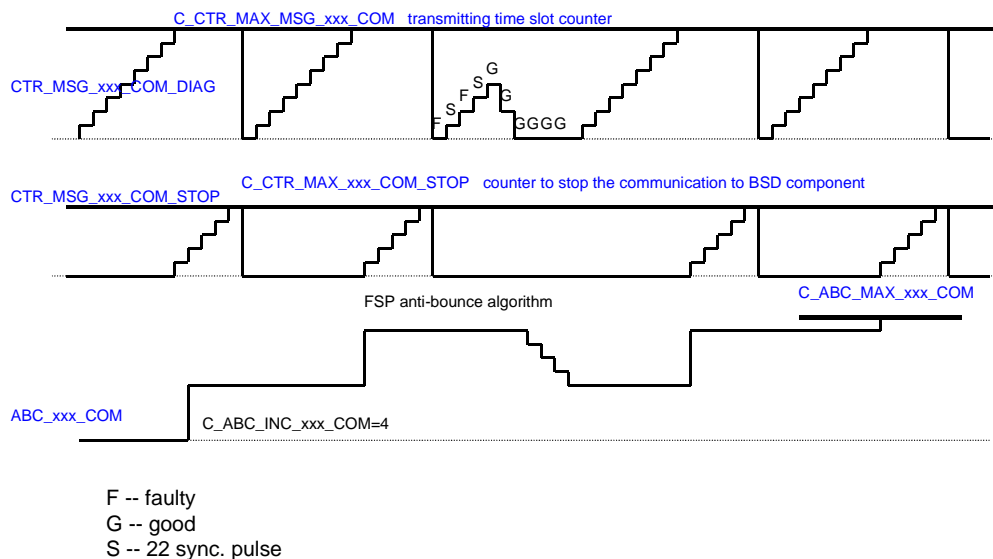
the counter CTR\_MSG\_xxx\_COM\_STOP has reached the threshold C\_CTR\_MAX\_xxx\_COM\_STOP. The counter CTR\_MSG\_xxx\_COM\_STOP is incremented in each corresponding transmitting time slot until the threshold C\_CTR\_MAX\_xxx\_COM\_STOP has been reached. During this period the timing coordinator does not serve the corresponding component. After the break in the communication to the corresponding component has elapsed (C\_CTR\_MAX\_xxx\_COM\_STOP reached) the next test cycle is started as described above. This occurs until the error has been debounced by the anti-bounce algorithm. After the debounce of the error the component is no longer served in this driving cycle by the timing coordinator.

If the counter threshold C\_CTR\_MAX\_xxx\_COM\_STOP to stop the communication to the corresponding BSD component is calibrated to = 0, no break of the communication occurs.

Special treatment if the counter threshold is calibrated to C\_CTR\_MAX\_xxx\_COM\_STOP = FFFFH. In that case no break of the communication occurs and the component is served although the error has been detected.

With xxx:            ALTER                            - alternator  
                   CWP                                - electrical coolant water pump  
                   QOIL                                - oil quality sensor (QLT)  
                   SENS\_BAT\_SMT                        - intelligent battery sensor (IBS)

### Description:



### Application conditions

**Initialisation:** all 0 at LV\_IGK 0->1 **or** at reset

**Recurrence:** Function called after each communication time slot (see BSD timing table)

**Activation:**

```

If         LV_CDN_VB_MIN_DIAG = 1           and
             Communication on BSD started      and
             LV_ERR_BSD = 0
Then      LV_CDN_DIAG_xxx_COM = 1
Else      LV_CDN_DIAG_xxx_COM = 0
Endif

```


**Formula section:**

```

If STATE_BSD_CPT = 0H // time slot for SENS_BAT_SMT was active//
CTR_END_DIAG_SENS_BAT_SMT_COM++ // END_DIAG in case no error//

Then
If C_CTR_MAX_SENS_BAT_SMT_COM_STOP<> FFFFH
Then
If CTR_END_DIAG_SENS_BAT_SMT_COM =
((C_CTR_MAX_MSG_SENS_BAT_SMT_COM +
C_CTR_MAX_SENS_BAT_SMT_COM_STOP)
(C_ABC_MAX_SENS_BAT_SMT_COM /
C_ABC_INC_SENS_BAT_SMT_COM ))
Then LV_END_DIAG_SENS_BAT_SMT_COM = 1
Endif
Else
If CTR_END_DIAG_SENS_BAT_SMT_COM =
C_CTR_MAX_MSG_SENS_BAT_SMT_COM
(C_ABC_MAX_SENS_BAT_SMT_COM /
C_ABC_INC_SENS_BAT_SMT_COM )
Then LV_END_DIAG_SENS_BAT_SMT_COM = 1
Endif
Endif
If STATE_BSD_COM = FFH // time out for SENS_BAT_SMT is active//
Then CTR_MSG_SENS_BAT_SMT_COM_DIAG =
CTR_MSG_SENS_BAT_SMT_COM_DIAG
CTR_MSG_SENS_BAT_SMT_COM_STOP++
//Communication passive during time slot to SENS_BAT_COM //
LV_MSG_SENS_BAT_SMT_COM_STOP == 1
If CTR_MSG_SENS_BAT_SMT_COM_STOP =
C_CTR_MAX_SENS_BAT_SMT_COM_STOP
Then reset CTR_MSG_SENS_BAT_SMT_COM_DIAG == 0
reset CTR_MSG_SENS_BAT_SMT_COM_STOP == 0
reset LV_MSG_SENS_BAT_SMT_COM_STOP == 0
Endif
Else
If STATE_BSD_COM = 1H // no acknowledge from SENS_BAT_SMT//
Then CTR_MSG_SENS_BAT_SMT_COM_DIAG++
If CTR_MSG_SENS_BAT_SMT_COM_DIAG =
C_CTR_MAX_MSG_SENS_BAT_SMT_COM
//Error symptom detected, ABC increments//
Then ERR_SYM_SENS_BAT_SMT_COM = SYM_2
CTR_ABC_SENS_BAT_SMT_COM=
CTR_ABC_SENS_BAT_SMT_COM +
C_ABC_INC_SENS_BAT_SMT_COM
Limitation to C_ABC_MAX_SENS_BAT_SMT_COM
If CTR_ABC_SENS_BAT_SMT_COM =
C_ABC_MAX_SENS_BAT_SMT_COM
Then LV_ERR_SENS_BAT_SMT_COM == 1
LV_END_DIAG_SENS_BAT_SMT_COM == 1
Endif
If C_CTR_MAX_SENS_BAT_SMT_COM_STOP<> (FFFFH or 0H)
Then CTR_MSG_SENS_BAT_SMT_COM_STOP++

```


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```

//Communication passive during time slot to SENS_BAT_COM //
LV_MSG_SENS_BAT_SMT_COM_STOP == 1
  If      CTR_MSG_SENS_BAT_SMT_COM_STOP =
          C_CTR_MAX_SENS_BAT_SMT_COM_STOP
  Then    reset CTR_MSG_SENS_BAT_SMT_COM_DIAG == 0
          reset CTR_MSG_SENS_BAT_SMT_COM_STOP == 0
          reset LV_MSG_SENS_BAT_SMT_COM_STOP == 0
  Endif
  Else    If      CTR_ABC_SENS_BAT_SMT_COM <
              C_ABC_MAX_SENS_BAT_SMT_COM
          Then    reset CTR_MSG_SENS_BAT_SMT_COM_DIAG == 0
          Else
          Endif
  Endif
  Endif
Else     CTR_MSG_SENS_BAT_SMT_COM_DIAG =
        CTR_MSG_SENS_BAT_SMT_COM_DIAG - 2
  If      CTR_MSG_SENS_BAT_SMT_COM_DIAG = 0
  //Error symptom detected, ABC decrements//
  Then    ERR_SYM_SENS_BAT_SMT_COM = NO_SYM
          CTR_ABC_SENS_BAT_SMT_COM =
          CTR_ABC_SENS_BAT_SMT_COM - 1
  If      CTR_ABC_SENS_BAT_SMT_COM = 0
  Then LV_ERR_SENS_BAT_SMT_COM == 0
  Endif
  Endif
  Endif
  Endif
  Endif
Else     If      STATE_BSD_CPT = 3H      // time slot for CWP was active//
          CTR_END_DIAG_CWP_COM++      // END_DIAG in case
no error//
  Then
  If      C_CTR_MAX_CWP_COM_STOP <> FFFFH
  Then
  If      CTR_END_DIAG_CWP_COM =
          ((C_CTR_MAX_MSG_CWP_COM +
            C_CTR_MAX_CWP_COM_STOP)
          (C_ABC_MAX_CWP_COM /
            C_ABC_INC_CWP_COM ))
  Then    LV_END_DIAG_CWP_COM = 1
  Endif
  Else
  If      CTR_END_DIAG_CWP_COM =
          C_CTR_MAX_MSG_CWP_COM
          (C_ABC_MAX_CWP_COM /
            C_ABC_INC_CWP_COM )
  Then    LV_END_DIAG_CWP_COM = 1
  Endif
  Endif
  Endif
  If      STATE_BSD_COM = FFH      // time out for CWP is active//
  Then    CTR_MSG_CWP_COM_DIAG =
          CTR_MSG_CWP_COM_DIAG

```


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```

                LV_INH_CWP_DIAG = 1                                // time out CWP is active; no func.
Diag.//
    CTR_MSG_CWP_COM_STOP++
    //Communication passive during time slot to CWP //
    LV_MSG_CWP_COM_STOP == 1
    If          CTR_MSG_CWP_COM_STOP =
                C_CTR_MAX_CWP_COM_STOP
    Then        reset CTR_MSG_CWP_COM_DIAG == 0
                reset CTR_MSG_CWP_COM_STOP == 0
                reset LV_MSG_CWP_COM_STOP == 0
    Endif
    Else
    If          STATE_BSD_COM = 8H          // no acknowledge from CWP//
    Then        CTR_MSG_CWP_COM_DIAG++
    If          CTR_MSG_CWP_COM_DIAG
                C_CTR_THD_MSG_CWP_COM_DIAG
    Then        LV_INH_CWP_DIAG = 1          //CWP com. BSD disturbed; no func.
Diag.//
    Endif
    If          CTR_MSG_CWP_COM_DIAG =
                C_CTR_MAX_MSG_CWP_COM
    //Error symptom detected, ABC increments//
    Then        ERR_SYM_CWP_COM = SYM_2
                CTR_ABC_CWP_COM=
                CTR_ABC_CWP_COM +
                C_ABC_INC_CWP_COM
                Limitation to C_ABC_MAX_CWP_COM
    If          CTR_ABC_CWP_COM =
                C_ABC_MAX_CWP_COM
    Then        LV_ERR_CWP_COM == 1
    LV_END_DIAG_CWP_COM == 1
    Endif
    If          C_CTR_MAX_CWP_COM_STOP<> (FFFFH or 0H)
    Then        CTR_MSG_CWP_COM_STOP++
                //Communication passive during time slot to CWP//
                LV_MSG_CWP_COM_STOP == 1
    If          CTR_MSG_CWP_COM_STOP =
                C_CTR_MAX_CWP_COM_STOP
    Then        reset CTR_MSG_CWP_COM_DIAG == 0
                reset CTR_MSG_CWP_COM_STOP == 0
                reset LV_MSG_CWP_COM_STOP == 0
                reset LV_INH_CWP_DIAG == 0                                //reset com. disturbance
    bit.//
    Endif
    Else        If          CTR_ABC_CWP_COM <
                C_ABC_MAX_CWP_COM
    Then        reset CTR_MSG_CWP_COM_DIAG == 0
    Else
    Endif
    Endif
    Endif
    Else        CTR_MSG_CWP_COM_DIAG =


```

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```

        CTR_MSG_CWP_COM_DIAG - 2
    If      CTR_MSG_CWP_COM_DIAG <
        C_CTR_THD_MSG_CWP_COM_DIAG
    Then    LV_INH_CWP_DIAG = 0           //reset com. disturbance bit.//
    Endif
    If      CTR_MSG_CWP_COM_DIAG = 0
    //Error symptom detected, ABC decrements//
    Then    ERR_SYM_CWP_COM = NO_SYM
           CTR_ABC_CWP_COM=
           CTR_ABC_CWP_COM - 1
           If      CTR_ABC_CWP_COM = 0
           Then    LV_ERR_CWP_COM == 0
    Endif
    Endif
    Endif
    Endif
Else      If      STATE_BSD_CPT = 4H           // time slot for QOIL was
active//
           CTR_END_DIAG_QOIL_COM++           // END_DIAG in case
no error//
    Then
    If      C_CTR_MAX_QOIL_COM_STOP <> FFFFH
    Then
    If      CTR_END_DIAG_QOIL_COM =
           ((C_CTR_MAX_MSG_QOIL_COM +
           C_CTR_MAX_QOIL_COM_STOP)
           (C_ABC_MAX_QOIL_COM /
           C_ABC_INC_QOIL_COM ))
    Then    LV_END_DIAG_QOIL_COM = 1
    Endif
    Else
    If      CTR_END_DIAG_QOIL_COM =
           C_CTR_MAX_MSG_QOIL_COM
           (C_ABC_MAX_QOIL_COM /
           C_ABC_INC_QOIL_COM )
    Then    LV_END_DIAG_QOIL_COM = 1
    Endif
    Endif
    If      STATE_BSD_COM = FFH           // time out for QOIL is active//
    Then    CTR_MSG_QOIL_COM_DIAG =
           CTR_MSG_QOIL_COM_DIAG
           CTR_MSG_QOIL_COM_STOP++
           //Communication passive during time slot to QOIL //
           LV_MSG_QOIL_COM_STOP == 1
    If      CTR_MSG_QOIL_COM_STOP =
           C_CTR_MAX_QOIL_COM_STOP
    Then    reset CTR_MSG_QOIL_COM_DIAG == 0
           reset CTR_MSG_QOIL_COM_STOP == 0
           reset LV_MSG_QOIL_COM_STOP == 0
    Endif
    Else
    If      STATE_BSD_COM = 10H           // no acknowledge from QOIL//


```

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```

Then      CTR_MSG_QOIL_COM_DIAG++
If        CTR_MSG_QOIL_COM_DIAG =
          C_CTR_MAX_MSG_QOIL_COM
//Error symptom detected, ABC increments//
Then      ERR_SYM_QOIL_COM = SYM_2
          CTR_ABC_QOIL_COM=
          CTR_ABC_QOIL_COM +
          C_ABC_INC_QOIL_COM
          Limitation to C_ABC_MAX_QOIL_COM
If        CTR_ABC_QOIL_COM =
          C_ABC_MAX_QOIL_COM
Then      LV_ERR_QOIL_COM == 1
LV_END_DIAG_QOIL_COM == 1
Endif
If        C_CTR_MAX_QOIL_COM_STOP<> (FFFFH or 0H)
Then      CTR_MSG_QOIL_STOP++
          //Communication passive during time slot to QOIL//
          LV_MSG_QOIL_COM_STOP == 1
If        CTR_MSG_QOIL_STOP =
          C_CTR_MAX_QOIL_COM_STOP
Then      reset CTR_MSG_QOIL_COM_DIAG == 0
          reset CTR_MSG_QOIL_COM_STOP == 0
          reset LV_MSG_QOIL_COM_STOP == 0
Endif
Else      If      CTR_ABC_QOIL_COM <
          C_ABC_MAX_QOIL_COM
          Then      reset CTR_MSG_QOIL_COM_DIAG == 0
          Else
          Endif
Endif
Endif
Else      CTR_MSG_QOIL_COM_DIAG =
          CTR_MSG_QOIL_COM_DIAG - 2
If        CTR_MSG_QOIL_COM_DIAG = 0
//Error symptom detected, ABC decrements//
Then      ERR_SYM_QOIL_COM = NO_SYM
          CTR_ABC_QOIL_COM=
          CTR_ABC_QOIL_COM - 1
If        CTR_ABC_QOIL_COM = 0
Then      LV_ERR_QOIL_COM == 0
Endif
Endif
Endif
Endif
Else      If      STATE_BSD_CPT = 6H                // time slot for ALTER was
active//
          CTR_END_DIAG_ALTER_COM++                // END_DIAG in case
no error//
Then
If        C_CTR_MAX_ALTER_COM_STOP<> FFFFH
Then
If        CTR_END_DIAG_ALTER_COM =


```

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```

        ((C_CTR_MAX_MSG_ALTER_COM +
         C_CTR_MAX_ALTER_COM_STOP)
        (C_ABC_MAX_ALTER_COM /
         C_ABC_INC_ALTER_COM ))
    Then
        LV_END_DIAG_ALTER_COM = 1
    Endif
Else
    If
        CTR_END_DIAG_ALTER_COM =
        C_CTR_MAX_MSG_ALTER_COM
        (C_ABC_MAX_ALTER_COM /
         C_ABC_INC_ALTER_COM )
    Then
        LV_END_DIAG_ALTER_COM = 1
    Endif
Endif
If
    STATE_BSD_COM = FFH
    // time out for ALTER is active//
Then
    CTR_MSG_ALTER_COM_DIAG =
    CTR_MSG_ALTER_COM_DIAG
    CTR_MSG_ALTER_COM_STOP++
    //Communication passive during time slot to ALTER //
    LV_MSG_ALTER_COM_STOP == 1
    If
        CTR_MSG_ALTER_COM_STOP =
        C_CTR_MAX_ALTER_COM_STOP
    Then
        reset CTR_MSG_ALTER_COM_DIAG == 0
        reset CTR_MSG_ALTER_COM_STOP == 0
        reset LV_MSG_ALTER_COM_STOP == 0
    Endif
Else
    If
        STATE_BSD_COM = 40H
        // no acknowledge from ALTER//
    Then
        CTR_MSG_ALTER_COM_DIAG++
        If
            CTR_MSG_ALTER_COM_DIAG =
            C_CTR_MAX_MSG_ALTER_COM
        //Error symptom detected, ABC increments//
        Then
            ERR_SYM_ALTER_COM = SYM_2
            CTR_ABC_ALTER_COM=
            CTR_ABC_ALTER_COM +
            C_ABC_INC_ALTER_COM
            Limitation to C_ABC_MAX_ALTER_COM
        If
            CTR_ABC_ALTER_COM =
            C_ABC_MAX_ALTER_COM
        Then
            LV_ERR_ALTER_COM == 1
        LV_END_DIAG_ALTER_COM == 1
        Endif
        If
            C_CTR_MAX_ALTER_COM_STOP<> (FFFFH or 0H)
        Then
            CTR_MSG_ALTER_STOP++
            //Communication passive during time slot to ALTER//
            LV_MSG_ALTER_COM_STOP == 1
        If
            CTR_MSG_ALTER_STOP =
            C_CTR_MAX_ALTER_COM_STOP
        Then
            reset CTR_MSG_ALTER_COM_DIAG == 0
            reset CTR_MSG_ALTER_COM_STOP == 0
            reset LV_MSG_ALTER_COM_STOP == 0
        Endif
    Endif

```

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```

Else      If      CTR_ABC_ALTER_COM <
                C_ABC_MAX_ALTER_COM
    Then          reset CTR_MSG_ALTER_COM_DIAG == 0
    Else
    Endif
Endif
Endif
Else      CTR_MSG_ALTER_COM_DIAG =
          CTR_MSG_ALTER_COM_DIAG - 2
    If      CTR_MSG_ALTER_COM_DIAG = 0
    //Error symptom detected, ABC decrements//
    Then    ERR_SYM_ALTER_COM = NO_SYM
            CTR_ABC_QOIL_COM=
            CTR_ABC_QOIL_COM - 1
    If      CTR_ABC_QOIL_COM = 0
    Then    LV_ERR_QOIL_COM == 0
    Endif
    Endif
    Endif
    Endif
    Endif
    Endif
Endif

```

With:

STATE\_BSD\_MSG\_COM\_STOP = LV\_MSG\_XXX\_COM\_STOP

STATE_BSD_CPT	STATE_BSD_MSG_COM_STOP
0H --SENS_BAT_SMT-intelligent battery sensor	1H = LV_MSG_SENS_BAT_SMT_COM_STOP=1
3H -- CWP- electrical coolant water pump	2H = LV_MSG_CWP_COM_STOP = 1
4H - QOIL - oil quality sensor (QLT)	4H = LV_MSG_QOIL_COM_STOP = 1
6H -- ALTER - alternator	8H = LV_MSG_ALTER_COM_STOP = 1

## A.99 CAN bus off diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_CAN_BOFF	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom CAN_BOFF					
ERR_SYM_LOCAN_BOFF	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom Boff diagnosis LOCAN					
LV_CDN_DIAG_CAN_BOFF	O/V	0... 1H	0 ...1	1	-
Diagnosis condition CAN_BOFF					
LV_CDN_DIAG_LOCAN_BOFF	O/V	0... 1H	0 ...1	1	-
Diagnosis condition LOCAN Boff diagnosis					
LV_END_DIAG_CAN_BOFF	O/V	0... 1H	0 ...1	1	-
End of Diagnosis CAN_BOFF					
LV_END_DIAG_LOCAN_BOFF	O/V	0... 1H	0 ...1	1	-
End of Diagnosis Boff diagnosis LOCAN					
LV_ERR_CAN_BOFF	O/V	0... 1H	0 ...1	1	-
Present error CAN bus off					
LV_ERR_LOCAN_BOFF	O/V	0... 1H	0 ...1	1	-
Present error LOCAN bus off					

### Input data:

LV_CDN_VB_CAN_DIAG {p. 1185}			
---------------------------------	--	--	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_CAN_BOFF	-	0... FFH	0... 255	1	-
Anti-Bounce counter increment for CAN diagnosis "Can Bus off detected by CAN"					
C_ABC_INC_LOCAN_BOFF	-	0... FFH	0... 255	1	-
Anti bounce counter increment - diagnosis of LOCAN bus on /off					
C_ABC_MAX_CAN_BOFF	-	1... FFH	1... 255	1	-
Anti-Bounce counter maximum for CAN diagnosis "CAN Bus off detected by CAN"					
C_ABC_MAX_LOCAN_BOFF	-	1... FFH	1... 255	1	-
Anti bounce counter maximum value - diagnosis of LOCAN bus on /off					

## A.99.1 PT-CAN bus off diagnosis

### FUNCTION DESCRIPTION

**General information:**

This diagnosis is working for BN2000 and CAN11H.

**Description:**

From CPU- CAN- controller a message is sent if CAN bus is on or off (internal). This diagnosis takes place every 10 ms at all engine operating states with ignition key on.

If CAN bus off is active the anti bounce counter is incremented by C\_ABC\_INC\_CAN\_BOFF. If the anti bounce counter reaches the calibratable threshold C\_ABC\_MAX\_CAN\_BOFF then the error bit LV\_ERR\_CAN\_BOFF is set to 1.

Error symptoms are defined for this diagnosis function as:



**Application conditions**

**Initialisation:** *STD\_INI*

**Recurrence:** *10 ms*

**Activation:**

```

If    LV_CDN_VB_CAN_DIAG = 1
      Then  LV_CDN_DIAG_CAN_BOFF = 1
      Else   LV_CDN_DIAG_CAN_BOFF = 0
      Endif
    
```

**Formula section:**

Detection of error symptom

```

If           CAN bus off = active
Then         ERR_SYM_CAN_BOFF = SYM_2
               LV_ERR_CAN_BOFF = 1   (after debounce)
Else         ERR_SYM_CAN_BOFF = NO_SYM
               LV_ERR_CAN_BOFF = 0   (after rebound)
Endif
    
```


Calculation end of diagnosis

LV\_END\_DIAG\_CAN\_BOFF is calculated by error management

**A.99.2 LOCAN bus off diagnosis**

**FUNCTION DESCRIPTION**

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	Document key 10171571 SPE 000 AO	Pages Page 4847 of 8404	
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**General information:**

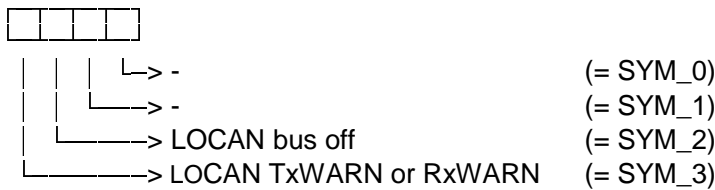
This diagnosis is working for LOCAN applications like EFP - control or NOX - sensors.

**Description:**

From CPU hardware a message is sent if CAN bus is on or off (internal). This diagnosis takes place every 10 ms at all engine operating states with ignition key on.

If CAN bus off is active the anti bounce counter is incremented by C\_ABC\_INC\_LOCAN\_BOFF. If the anti bounce counter reaches the calibratable threshold C\_ABC\_MAX\_LOCAN\_BOFF then the error bit LV\_ERR\_LOCAN\_BOFF is set to 1.

Error symptoms are defined for this diagnosis function as:



**Application conditions**

**Initialisation:** *STD\_INI*

**Recurrence:** *10 ms*

**Activation:**  
**If** LV\_CDN\_VB\_CAN\_DIAG = 1  
**Then** LV\_CDN\_DIAG\_LOCAN\_BOFF = 1  
**Else** LV\_CDN\_DIAG\_LOCAN\_BOFF = 0  
**Endif**

**Formula section:**

Detection of error symptom

**If** LOCAN bus off = active  
**Then** ERR\_SYM\_LOCAN\_BOFF = SYM\_2  
 LV\_ERR\_LOCAN\_BOFF = 1 *(after debounce)*  
**Else** ERR\_SYM\_LOCAN\_BOFF = NO\_SYM  
 LV\_ERR\_LOCAN\_BOFF = 0 *(after rebound)*  
**Endif**

Calculation end of diagnosis

LV\_END\_DIAG\_LOCAN\_BOFF is calculated by error management

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## A.100 CAN functional diagnosis electronic transmission control unit

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_COM_GB	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptom for diagnosis					
LV_CDN_DIAG_COM_GB	V	0... 1H	0 ...1	1	-
condition bit for diagnosis					
LV_END_DIAG_COM_GB	V	0... 1H	0 ...1	1	-
end bit for diagnosis					
LV_ERR_COM_GB	O/V	0... 1H	0 ...1	1	-
Error indicating problem in communication from gearbox to engine management					

### Input data:

LV_ERR_BN_ETCU {p. 4870}	LV_ERR_BN_ETCU_2 {p. 4870}	LV_ERR_BN_ETCU_3 {p. 4870}	LV_ERR_BN_STAT_TCT {p. 4870}
LV_ERR_BN_TQ_ETCU {p. 4871}	LV_ERR_BN_TQ_TCT {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_TOUT_ETCU_1 {p. 802}
LV_ERR_TOUT_ETCU_2 {p. 802}	LV_IGK {p. 906}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_COM_GB	-	0... FFH	0... 255	1	-
diagnosis decrement					
C_ABC_INC_COM_GB	-	0... FFH	0... 255	1	-
diagnosis increment					
C_ABC_MAX_COM_GB	-	1... FFH	1... 255	1	-
diagnosis error threshold					

### Error treatment:

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Error indicating problem in communication from gearbox to engine management	COM_GB	-	0	STD_INI	CC
		-	1		
		communication error	2		
		-	3		

Possible configuration for ABC type and CARB class (see also "Table of Failure")

ABC Type: STD\_INI, STD, MEM, MEM\_INI, DEC\_CAL, STC, NO, MPL\_STD\_INI

CARB Class: MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO

**FUNCTION DESCRIPTION:**

This diagnosis checks if the communication path from gearbox control unit to engine control unit is disturbed. If this is detected an ERRM entry is done.

**Application conditions**

**Initialisation:** *STD\_INI*

**Recurrence:** *1 s*

**Activation:** *LV\_IGK = 1, at deactivation set LV\_CDN\_DIAG\_COM\_GB = 0*

**Formula section:**

LV\_CDN\_DIAG\_COM\_GB = 1

```

if      LV_ERR_BN_ETCU      = 1           or
          LV_ERR_BN_ETCU_2    = 1           or
          LV_ERR_BN_ETCU_3    = 1           or
          LV_ERR_BN_TQ_ETCU   = 1           or
          LV_ERR_BN_TQ_TCT    = 1           or
          LV_ERR_BN_STAT_TCT  = 1           or
          LV_ERR_CAN_BOFF     = 1           or
          LV_ERR_TOUT_ETCU_1  = 1           or
          LV_ERR_TOUT_ETCU_2  = 1

```

**then** ERR\_SYM\_COM\_GB = SYM\_2

**else** ERR\_SYM\_COM\_GB = NO\_SYM

**endif**

Calculation of the end of diagnosis and LV\_ERR\_ xxx:

LV\_END\_DIAG\_COM\_GB and LV\_ERR\_COM\_GB calculated by ERRM

## A.101 Internal CAN diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ABC_TQ_REQ_CAN	O/V	0... FFH	0... 255	1	-
anti-bounce counter of TQ-request via CAN					
ERR_SYM_TQ_REQ_CAN	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
detected symptom of TQ-request via CAN					
LV_CDN_DIAG_TQ_REQ_CAN	O/V	0... 1H	0 ...1	1	-
condition of TQ-request via CAN					
LV_END_DIAG_TQ_REQ_CAN	O/V	0... 1H	0 ...1	1	-
end of diagnosis of TQ-request via CAN					
LV_ERR_TQ_REQ_CAN	O/V	0... 1H	0 ...1	1	-
Torque request via CAN not plausible					
STATE_TQ_CAN_PLAUS	O/V	0... FFH	0... 255	1	-
State indicating which ECU is rejected due to TQ-plausibility-error via CAN					

### Input data:

ECU_STATE {p. 1091}	LV_CDN_VB_BN_DIAG {p. 1185}	LV_ERR_SYM_TQ_DCC_ CS {p. 1710}	STATE_TQ_AMT_PLAUS {p. 809}
STATE_TQ_ARS_PLAUS {p. 6650}	STATE_TQ_DCC_PLAUS {p. 6731}	STATE_TQ_ETCU_PLAUS {p. 6718}	STATE_TQ_PSTE_2_ PLAUS {p. 6621}
STATE_TQ_PSTE_3_ PLAUS {p. 6621}	STATE_TQ_TCS_PLAUS {p. 6741}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TQ_REQ_CAN	-	0... FFH	0... 255	1	-
Anti bounce increment value, TQ-plausibility via CAN					
C_ABC_MAX_TQ_REQ_CAN	-	1... FFH	1... 255	1	-
Anti-bounce max. value, TQ-plausibility via CAN					
C_STATE_TQ_CAN_PLAUS_ENA	-	0... FFH	0... 255	1	-
Mask for selective enabling of diagnoses					
LC_TQ_CAN_PLAUS_INFO	-	0... 1H	0 ...1	1	-
LC for selective information of diagnosis					

### FUNCTION DESCRIPTION:

#### General information:

The torque functionality detects if the torque requests via CAN are not plausible.

As a consequence of that further torque requests of the respective control unit are rejected. The purpose of this diagnosis is to provide the information when a ECU is rejected by error-entry in the FMY. Through environmental data (STATE\_TQ\_CAN\_PLAUS) the information is given which ECU has been rejected.

Additional there is the possibility to calibrate via LC\_TQ\_CAN\_PLAUS which failure of the respective ECU lead to the error entry.

If a torque-plausibility-error is detected by the torque calculation (STATE\_TQ\_XXX\_PLAUS = ) the error symptom is set and the anti bounce counter is incremented by C\_ABC\_INC\_TQ\_REQ\_CAN. If the plausibility error is not present any longer, the anti bounce counter is decremented.

### Application conditions

**Initialisation:** according ERRM initialization type "STD\_INI"  
//reset at LV\_IGK 0->1 or reset

**Recurrence:** 10 ms

**Activation:** **If** LV\_CDN\_VB\_BN\_DIAG = 1 **and**  
LV\_ES = 0  
**Then** LV\_CDN\_DIAG\_TQ\_REQ\_CAN = 1

**Deactivation:** **If** LV\_CDN\_VB\_BN\_DIAG = 0 **or**  
LV\_ES = 1 **or**  
ECU\_STATE = PWL  
**Then** LV\_CDN\_DIAG\_TQ\_REQ\_CAN = 0  
**Endif**

### Formula section:

**IF** Bit x of STATE\_TQ\_XXX\_PLAUS is set **and**  
Bit x of C\_STATE\_TQ\_CAN\_PLAUS is set **and**  
Depending on LC\_TQ\_CAN\_PLAUS\_INFO  
// --> see below

STATE_TQ_XXX_PLAUS	Bits [0...15]	Condition	C_STATE_TQ_CAN_PLAUS_ENA Bits [0...7]	Condition	LC_TQ_CAN_PLAUS_INFO	Action	STATE_TQ_CAN_PLAUS Bits [0...7]
STATE_TQ_TCS_PLAUS	2	&&	0	&&	x	=	Bit 0 (= dez 1)
STATE_TQ_AMT_PLAUS	3	&&	1	&&	x	=	Bit 1 (= dez 2)
STATE_TQ_ETCU_PLAUS	2,3	&&	2	&&	0	=	Bit 2 (= dez 4)
	2	&&		&&	1	=	Bits 2+0 (= dez 5)
STATE_TQ_DCC_PLAUS	3	&&	3	&&	1	=	Bits 2+1 (= dez 6)
	5	&&		&&	x	=	Bit 3 (= dez 8)
STATE_TQ_ARS_PLAUS	2,3	&&	4	&&	0	=	Bit 4 (= dez 16)
	2	&&		&&	1	=	Bits 4+0 (= dez 17)
STATE_TQ_PSTE_2_PLAUS	3	&&	5	&&	1	=	Bits 4+1 (= dez 18)
	0,1,2	&&		&&	0	=	Bit 5 (= dez 32)
LV_ERR_SYM_TQ_DCC_CS	0	&&	6	&&	1	=	Bits 5+0 (= dez 33)
	1	&&		&&	1	=	Bits 5+1 (= dez 34)
	2	&&		&&	1	=	Bits 5+1+0 (= dez 35)
STATE_TQ_PSTE_3_PLAUS	-	&&	7	&&	x	=	Bit 6 (= dez 64)
	0,1	&&		&&	0	=	Bit 7 (= dez 128)
STATE_TQ_PSTE_3_PLAUS	0	&&	7	&&	1	=	Bits 7 + 0 (= dez 129)
	1	&&		&&	1	=	Bits 7 + 1 (= dez 130)

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<b>Steuergerät</b>								
	DSC	SMG	EGS	ACC	ARS	AFS	ACC-HS	EHB3

```

THEN    Bit x of STATE_TQ_CAN_PLAUS is set
           ERR_SYM_TQ_REQ_CAN = SYM_3
           LV_ERR_TQ_REQ_CAN = 1           after debounce
ELSE    ERR_SYM_TQ_REQ_CAN = NO_SYM
           LV_ERR_TQ_REQ_CAN = 0           after rebound
ENDIF

```

End of diagnosis calculation LV\_END\_DIAG\_TQ\_REQ\_CAN:

- see chapter “Anti-bounce Algorithm: Calculation of the end of diagnosis”

## A.102 Local CAN diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CYC_CTR_NOX_SENS_i_DIAG	V	0... FFH	0... 255	1	-
counter of not received NOX_SENS_i messages					
LV_ERR_TOUT_NOX_SENS [i]	O/V	0... 1H	0 ...1	1	-
logical variable timeout error CAN message NOX_SENS_i (NOX_SENS - sensor bank i)					
Masked Variable [i]	O/V	0... 1H	0 ...1	1	-
Diagnosis condition NOX_SENS_i					
Masked Variable [i]	O/V	0H 4H	NO_SYM SYM_3	-	-
Detected Symptom NOX_SENS_i					
Masked Variable [i]	O/V	0... 1H	0 ...1	1	-
End of diagnosis NOX_SENS_i					

### Input data:

LV_CDN_VB_CAN_DIAG {p. 1185}	LV_ERR_LOCAN_BOFF {p. 4846}	LV_IGK {p. 906}	
---------------------------------	--------------------------------	-----------------	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TOUT_NOX_SENS	-	0... FFH	0... 255	1	-
anti bounce counter increment - diagnosis of timeout CAN message NOX_SENS					
C_ABC_MAX_TOUT_NOX_SENS	-	1... FFH	1... 255	1	-
anti bounce counter maximum value - diagnosis of timeout CAN message NOX_SENS					
C_NOX_SENS_CYCNR_MAX	-	1... FFH	1... 255	1	-
maximum number of missing NOX_SENS messages for error debounce counter increment					

## FUNCTION DESCRIPTION

### General information:

The following CAN diagnosis are defined:


- Timeout CAN messages NOX

### A.102.1 Timeout CAN messages NOX

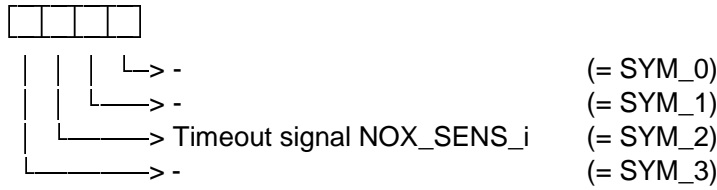
#### Description:

The counter CYC\_CTR\_NOX\_SENS\_i\_DIAG are always incremented if the CAN messages NOX\_SENS\_i have not been received. The counter are set to 0 if a CAN message NOX\_SENS\_i has been received or if the counter has reached his maximum value C\_NOX\_SENS\_CYCNR\_MAX.

If these counters have reached the calibratable threshold C\_NOX\_SENS\_CYCNR\_MAX and there is no CAN message NOX\_SENS\_i then the error symptom is set and the anti bounce counter is incremented by C\_ABC\_INC\_TOUT\_NOX\_SENS. If a CAN message NOX\_SENS\_i is received, the anti bounce counter is decremented. If the anti bounce counter has reached his maximum value C\_ABC\_MAX\_TOUT\_NOX\_SENS the timeout error CAN message NOX\_SENS (LV\_ERR\_TOUT\_NOX\_SENS\_i) is set.

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	Document key 10171571 SPE 000 AO	Pages Page 4855 of 8404	
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Error symptoms are defined for this diagnosis function as:



**Application conditions**

**Initialisation:** all 0 at Transition LV\_IGK 0->1 or reset or at clearing error memory

**Recurrence:** 10 ms

**Activation:** **If** LV\_CDN\_VB\_CAN\_DIAG = 1 **and**  
NOX-message has been received via LoCAN at least for once  
**and**  
LV\_ERR\_LOCAN\_BOFF = 0  
**Then** LV\_CDN\_DIAG\_TOUT\_NOX\_SENS\_i = 1  
**Else** LV\_CDN\_DIAG\_TOUT\_NOX\_SENS\_i = 0  
**Endif**

**Formula section:**

Calculation of time-out counter

**If** no CAN message NOX\_SENS\_i received  
**Then** CYC\_CTR\_NOX\_SENS\_i\_DIAG <sub>N</sub> = CYC\_CTR\_NOX\_SENS\_i\_DIAG  
<sub>N-1</sub>  
+1  
**Else** CYC\_CTR\_NOX\_SENS\_i\_DIAG = 0 (reset)  
**Endif**

Detection of error symptom

**If(1)** CYC\_CTR\_NOX\_SENS\_i\_DIAG = C\_NOX\_SENS\_CYCNR\_MAX  
**Then(1)** CYC\_CTR\_NOX\_SENS\_i\_DIAG = 0 (reset)  
**If(2)** no CAN message NOX\_SENS\_i is received  
**Then(2)** ERR\_SYM\_TOUT\_NOX\_SENS\_i = SYM\_2 *Timeout is detected*  
ABC counter starts to increment  
LV\_ERR\_TOUT\_NOX\_SENS\_i = 1 (after debounce)  
**Else(2)** ERR\_SYM\_TOUT\_NOX\_SENS\_i = NO\_SYM  
ABC counter starts to decrement  
LV\_ERR\_TOUT\_NOX\_SENS\_i = 0 (after rebound)  
**Endif(2)**  
**Endif(1)**

Calculation end of diagnosis

LV\_END\_DIAG\_TOUT\_NOX\_SENS\_i is calculated by error management

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## A.103 PT-CAN diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DIAG_CKS_CAS	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_ETCU	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_ETCU_3	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_LDM	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_MSW	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_PBR	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_REQ_PBR	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_TQ_AMT	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_TQ_DCC	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_TQ_ETCU	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_TQ_PBR	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_TQ_PSTE_2	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_TQ_PSTE_3	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_TQ_TCS	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_TQ_TCT	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_VEH_MOD	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_TCC_CAN_ARS	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_CAS	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_ETCU	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_ETCU_3	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DIAG_TCC_CAN_ICL	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_LDM	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_MSW	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_PBR	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_REQ_PBR	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_SPT_SWI	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_T_CLK	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_TQ_AMT	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_TQ_DCC	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_TQ_ETCU	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_TQ_PBR	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_TQ_PSTE_2	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_TQ_PSTE_3	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_TQ_TCS	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_TQ_TCT	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_VEH_MOD	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TOUT_ACC	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_ANG_PSTE	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_ARS	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_CAS	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_CDN_DOOR	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_DHL_CTL	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DIAG_TOUT_EFP	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_EFP_CRASH	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_ETCU	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_ETCU_2	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_ETCU_3	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_ETCU_DISP	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_GEAR_REV	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_ICL	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_KM_ICL	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_LDM	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_LTG_HDLP_L	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_MSW	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_PBR	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_POW_GEN	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_POW_VB	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_REQ_PBR	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_SPT_SWI	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TOUT_STAT_TCT	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_T_CLK	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_T_ICL	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_TCS	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_TQ_AMT	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DIAG_TOUT_TQ_DCC	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_TQ_ETCU	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_TQ_PBR	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_TQ_PSTE_2	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_TQ_PSTE_3	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_TQ_TCS	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_TQ_TCT	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_TRL	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_VEH_MOD	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_VS_TCS	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_WHEEL_CAN	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
ERR_SYM_BN_ACC	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_ANG_PSTE	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_ARS	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_BN_CAS	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_CDN_DOOR	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_DHL_CTL	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_EFP	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_EFP_CRASH	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_ETCU	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_ETCU_2	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_BN_ETCU_3	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_ETCU_DISP	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_GEAR_REV	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_ICL	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_KM_ICL	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_LDM	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_LTG_HDLP_L	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					


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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4862 of 8404</b>	
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_BN_MSW	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_PBR	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_POW_GEN	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_POW_VB	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_REQ_PBR	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_SPT_SWI	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom Communication on CAN diagnosis(Mdrive message)					
ERR_SYM_BN_STAT_TCT	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_BN_T_CLK	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_T_ICL	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_TCS	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_TQ_AMT	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_TQ_DCC	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_TQ_ETCU	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_TQ_PBR	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 4864 of 8404</b>	
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_BN_TQ_PSTE_2	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_TQ_PSTE_3	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_TQ_TCS	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_TQ_TCT	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_TRL	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_VEH_MOD	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_VS_TCS	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_BN_WHEEL_CAN	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom BN2000 diagnosis					
LV_CDN_DIAG_BN_ACC	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_ANG_PSTE	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_ARS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_CAS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_CDN_DOOR	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_DHL_CTL	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_EFP	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_EFP_CRASH	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_ETCU	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_ETCU_2	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_ETCU_3	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_ETCU_DISP	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_GEAR_REV	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_ICL	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_KM_ICL	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_LDM	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_LTG_HDLP_L	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_MSW	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_PBR	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 4866 of 8404	
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_BN_POW_GEN	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_POW_VB	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_REQ_PBR	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_SPT_SWI	O/V	0... 1H	0 ...1	1	-
Diagnosis condition Communication on CAN diagnosis(Mdrive message)					
LV_CDN_DIAG_BN_STAT_TCT	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_T_CLK	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_T_ICL	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_TCS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_TQ_AMT	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_TQ_DCC	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_TQ_ETCU	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_TQ_PBR	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_TQ_PSTE_2	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_TQ_PSTE_3	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_TQ_TCS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_TQ_TCT	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_TRL	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_VEH_MOD	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_VS_TCS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_WHEEL_CAN	V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_END_DIAG_BN_ACC	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_ANG_PSTE	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 4867 of 8404	
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_BN_ARS	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_CAS	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_CDN_DOOR	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_DHL_CTL	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_EFP	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_EFP_CRASH	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_ETCU	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_ETCU_2	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_ETCU_3	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_ETCU_DISP	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_GEAR_REV	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_ICL	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_KM_ICL	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_LDM	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_LTG_HDLP_L	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_MSW	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_PBR	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_POW_GEN	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_POW_VB	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_REQ_PBR	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_SPT_SWI	O/V	0... 1H	0 ...1	1	-
End of diagnosis Communication on CAN diagnosis(Mdrive message)					
LV_END_DIAG_BN_STAT_TCT	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_BN_T_CLK	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_T_ICL	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_TCS	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_TQ_AMT	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_TQ_DCC	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_TQ_ETCU	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_TQ_PBR	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_TQ_PSTE_2	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_TQ_PSTE_3	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_TQ_TCS	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_TQ_TCT	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_TRL	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_VEH_MOD	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_VS_TCS	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_WHEEL_CAN	V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_ERR_BN_ACC	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_ANG_PSTE	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_ARS	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_CAS	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_CDN_DOOR	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_DHL_CTL	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_EFP	O/V	0... 1H	0 ...1	1	-
Present error BN2000					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_BN_EFP_CRASH	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_ETCU	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_ETCU_2	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_ETCU_3	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_ETCU_DISP	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_GEAR_REV	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_ICL	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_KM_ICL	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_LDM	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_LTG_HDLP_L	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_MSW	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_PBR	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_POW_GEN	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_POW_VB	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_REQ_PBR	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_SPT_SWI	O/V	0... 1H	0 ...1	1	-
Present error communication on PT-CAN					
LV_ERR_BN_STAT_TCT	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_T_CLK	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_T_ICL	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_TCS	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_TQ_AMT	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_TQ_DCC	O/V	0... 1H	0 ...1	1	-
Present error BN2000					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_BN_TQ_ETCU	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_TQ_PBR	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_TQ_PSTE_2	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_TQ_PSTE_3	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_TQ_TCS	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_TQ_TCT	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_TRL	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_VEH_MOD	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_VS_TCS	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_WHEEL_CAN	O/V	0... 1H	0 ...1	1	-
Present error BN2000					

**Input data:**

C_T_DET_VAR_CAN {p. 658}	CKS_CAN_ETCU_3 {p. 1561}	CKS_CAN_PBR {p. 1561}	CKS_CAN_REQ_PBR {p. 1561}
CKS_CAN_TQ_PBR {p. 1561}	CKS_CLC_ETCU_3 {p. 1562}	CKS_CLC_PBR {p. 1562}	CKS_CLC_REQ_PBR {p. 1562}
CKS_CLC_TQ_PBR {p. 1562}	LV_AT {p. 654}	LV_VAR_4WD {p. 655}	LV_VAR_ACIN {p. 655}
LV_VAR_AMT {p. 655}	LV_VAR_ARS {p. 655}	LV_VAR_BN_EFP {p. 655}	LV_VAR_BN_GEAR_REV {p. 655}
LV_VAR_BN_LDM {p. 655}	LV_VAR_BN_LTG_HDLP_L {p. 655}	LV_VAR_BN_MSW {p. 655}	LV_VAR_BN_TRL {p. 655}
LV_VAR_DCC {p. 655}	LV_VAR_EFP_CRASH {p. 655}	LV_VAR_ETCU {p. 655}	LV_VAR_ETCU_3 {p. 655}
LV_VAR_ICL {p. 656}	LV_VAR_PBR {p. 656}	LV_VAR_PSTE {p. 656}	LV_VAR_PSTE_2 {p. 656}
LV_VAR_PSTE_3 {p. 656}	LV_VAR_SPT_SWI {p. 656}	LV_VAR_TCT {p. 656}	LV_VAR_TQ_PBR {p. 656}
LV_VAR_VEH {p. 656}	LV_VAR_VEH_MOD {p. 1568}	TCC_CAN_BN_SPT_SWI	TCC_CAN_ETCU_3 {p. 1580}
TCC_CAN_PBR {p. 1580}	TCC_CAN_REQ_PBR {p. 1580}	TCC_CAN_TQ_PBR {p. 1580}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_BN_ACC	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_ANG_PSTE	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_ARS	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_BN_CAS	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_CDN_DOOR	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_DHL_CTL	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_EFP	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_EFP_CRASH	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_ETCU	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_ETCU_2	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_ETCU_3	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_ETCU_DISP	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_GEAR_REV	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_ICL	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_KM_ICL	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_LDM	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_LTG_HDLP_L	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_MSW	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_PBR	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_POW_GEN	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_POW_VB	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_REQ_PBR	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_SPT_SWI	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement Communication on PT-CAN diagnosis (Mdrive message)					
C_ABC_DEC_BN_STAT_TCT	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_T_CLK	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_BN_T_ICL	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_TCS	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_TQ_AMT	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_TQ_DCC	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_TQ_ETCU	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_TQ_PBR	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_TQ_PSTE_2	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_TQ_PSTE_3	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_TQ_TCS	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_TQ_TCT	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_TRL	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_VEH_MOD	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_VS_TCS	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_WHEEL_CAN	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_INC_BN_ACC	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_ANG_PSTE	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_ARS	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_CAS	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_CDN_DOOR	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_DHL_CTL	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_EFP	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_EFP_CRASH	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_BN_ETCU	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_ETCU_2	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_ETCU_3	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_ETCU_DISP	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_GEAR_REV	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_ICL	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_KM_ICL	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_LDM	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_LTG_HDLP_L	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_MSW	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_PBR	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_POW_GEN	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_POW_VB	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_REQ_PBR	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_SPT_SWI	-	0... FFH	0... 255	1	-
Anti-bounce counter increment Communication PT-CAN diagnosis (Mdrive message)					
C_ABC_INC_BN_STAT_TCT	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_T_CLK	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_T_ICL	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_TCS	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_TQ_AMT	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_TQ_DCC	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_TQ_ETCU	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_BN_TQ_PBR	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_TQ_PSTE_2	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_TQ_PSTE_3	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_TQ_TCS	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_TQ_TCT	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_TRL	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_VEH_MOD	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_VS_TCS	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_WHEEL_CAN	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_MAX_BN_ACC	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_ANG_PSTE	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_ARS	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_CAS	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_CDN_DOOR	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_DHL_CTL	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_EFP	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_EFP_CRASH	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_ETCU	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_ETCU_2	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_ETCU_3	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_ETCU_DISP	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_GEAR_REV	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_BN_ICL	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_KM_ICL	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_LDM	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_LTG_HDLP_L	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_MSW	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_PBR	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_POW_GEN	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_POW_VB	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_REQ_PBR	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_SPT_SWI	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum Communication PT-CAN diagnosis (Mdrive message)					
C_ABC_MAX_BN_STAT_TCT	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_T_CLK	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_T_ICL	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_TCS	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_TQ_AMT	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_TQ_DCC	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_TQ_ETCU	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_TQ_PBR	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_TQ_PSTE_2	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_TQ_PSTE_3	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_TQ_TCS	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_TQ_TCT	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_BN_TRL	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_VEH_MOD	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_VS_TCS	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_WHEEL_CAN	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_CTR_DIAG_CKS_MAX_CAS	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message CAS					
C_CTR_DIAG_CKS_MAX_ETCU	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message ETCU					
C_CTR_DIAG_CKS_MAX_ETCU_3	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message ETCU_3					
C_CTR_DIAG_CKS_MAX_LDM	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message LDM					
C_CTR_DIAG_CKS_MAX_MSW	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message MSW					
C_CTR_DIAG_CKS_MAX_PBR	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message PBR					
C_CTR_DIAG_CKS_MAX_REQ_PBR	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message REQ_PBR					
C_CTR_DIAG_CKS_MAX_TQ_AMT	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message TQ_AMT					
C_CTR_DIAG_CKS_MAX_TQ_DCC	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message TQ_DCC					
C_CTR_DIAG_CKS_MAX_TQ_ETCU	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message TQ_ETCU					
C_CTR_DIAG_CKS_MAX_TQ_PBR	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message ETCU_3					
C_CTR_DIAG_CKS_MAX_TQ_PSTE_2	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message TQ_PSTE_2					
C_CTR_DIAG_CKS_MAX_TQ_PSTE_3	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message TQ_PSTE_3					
C_CTR_DIAG_CKS_MAX_TQ_TCS	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message TQ_TCS					
C_CTR_DIAG_CKS_MAX_TQ_TCT	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message TQ_TCT					
C_CTR_DIAG_CKS_MAX_VEH_MOD	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message VEH_MOD					
C_CTR_DIAG_TCC_CAN_MAX_ARS	-	0... FFH	0... 255	1	-
Maximum number of wrong ATCC_CANe count events before error detection of message ARS					
C_CTR_DIAG_TCC_CAN_MAX_CAS	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN count events before error detection of message CAS					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_DIAG_TCC_CAN_MAX_ETCU	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN count events before error detection of message ETCU_3					
C_CTR_DIAG_TCC_CAN_MAX_ETCU_3	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN count events before error detection of message ETCU_3					
C_CTR_DIAG_TCC_CAN_MAX_ICL	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN count events before error detection of message ICL					
C_CTR_DIAG_TCC_CAN_MAX_LDM	-	0... FFH	0... 255	1	-
Maximum number of wrong LDM_CAN count events before error detection of message LDM					
C_CTR_DIAG_TCC_CAN_MAX_MSW	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN count events before error detection of message MSW					
C_CTR_DIAG_TCC_CAN_MAX_PBR	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN counter events before error detection of message PBR					
C_CTR_DIAG_TCC_CAN_MAX_REQ_PBR	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN counter events before error detection of message REQ_PBR					
C_CTR_DIAG_TCC_CAN_MAX_SPT_SWI	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC count events before error detection of message BN_SPT_SWI					
C_CTR_DIAG_TCC_CAN_MAX_T_CLK	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN count events before error detection of message T_CLK					
C_CTR_DIAG_TCC_CAN_MAX_TQ_AMT	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN count events before error detection of message TQ_AMT					
C_CTR_DIAG_TCC_CAN_MAX_TQ_DCC	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN count events before error detection of message TQ_DCC					
C_CTR_DIAG_TCC_CAN_MAX_TQ_ETCU	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN count events before error detection of message TQ_ETCU					
C_CTR_DIAG_TCC_CAN_MAX_TQ_PBR	-	0... FFH	0... 255	1	-
Maximum number of wrong alive counter events for error debounce counter increment					
C_CTR_DIAG_TCC_CAN_MAX_TQ_PSTE_2	-	0... FFH	0... 255	1	-
Maximum number of wrong ATCC_CANe count events before error detection of message TQ_PSTE_2					
C_CTR_DIAG_TCC_CAN_MAX_TQ_PSTE_3	-	0... FFH	0... 255	1	-
Maximum number of wrong ATCC_CANe count events before error detection of message TQ_PSTE_3					
C_CTR_DIAG_TCC_CAN_MAX_TQ_TCS	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN count events before error detection of message TQ_TCS					
C_CTR_DIAG_TCC_CAN_MAX_TQ_TCT	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN count events before error detection of message TQ_TCT					
C_CTR_DIAG_TCC_CAN_MAX_VEH_MOD	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN count events before error detection of message VEH_MOD					
C_CTR_DIAG_TOUT_MAX_ACC	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message ACC					
C_CTR_DIAG_TOUT_MAX_ANG_PSTE	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message ANG_PSTE					
C_CTR_DIAG_TOUT_MAX_ARS	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message ARS					
C_CTR_DIAG_TOUT_MAX_CAS	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message CAS					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_DIAG_TOUT_MAX_CDN_DOOR	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message CDN_DOOR					
C_CTR_DIAG_TOUT_MAX_DHL_CTL	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message DHL_CTL					
C_CTR_DIAG_TOUT_MAX_EFP	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message EFP					
C_CTR_DIAG_TOUT_MAX_EFP_CRASH	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message EFP_CRASH					
C_CTR_DIAG_TOUT_MAX_ETCU	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message ETCU					
C_CTR_DIAG_TOUT_MAX_ETCU_2	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message ETCU_2					
C_CTR_DIAG_TOUT_MAX_ETCU_3	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message ETCU_3					
C_CTR_DIAG_TOUT_MAX_ETCU_DISP	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message ETCU_DISP					
C_CTR_DIAG_TOUT_MAX_GEAR_REV	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message GEAR_REV					
C_CTR_DIAG_TOUT_MAX_ICL	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message ICL					
C_CTR_DIAG_TOUT_MAX_KM_ICL	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message KM_ICL					
C_CTR_DIAG_TOUT_MAX_LDM	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message LDM					
C_CTR_DIAG_TOUT_MAX_LTG_HDLP_L	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message LTG_HDLP_L					
C_CTR_DIAG_TOUT_MAX_MSW	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message MSW					
C_CTR_DIAG_TOUT_MAX_PBR	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message PBR					
C_CTR_DIAG_TOUT_MAX_POW_GEN	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message POW_GEN					
C_CTR_DIAG_TOUT_MAX_POW_VB	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message POW_VB					
C_CTR_DIAG_TOUT_MAX_REQ_PBR	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message REQ_PBR					
C_CTR_DIAG_TOUT_MAX_SPT_SWI	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message BN_SPT_SWI					
C_CTR_DIAG_TOUT_MAX_STAT_TCT	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message ACC					
C_CTR_DIAG_TOUT_MAX_T_CLK	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message T_CLK					
C_CTR_DIAG_TOUT_MAX_T_ICL	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message ICL					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_DIAG_TOUT_MAX_TCS	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message TCS					
C_CTR_DIAG_TOUT_MAX_TQ_AMT	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message TQ_AMT					
C_CTR_DIAG_TOUT_MAX_TQ_DCC	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message TQ_DCC					
C_CTR_DIAG_TOUT_MAX_TQ_ETCU	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message TQ_ETCU					
C_CTR_DIAG_TOUT_MAX_TQ_PBR	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message ACC					
C_CTR_DIAG_TOUT_MAX_TQ_PSTE_2	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message TQ_PSTE_2					
C_CTR_DIAG_TOUT_MAX_TQ_PSTE_3	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message TQ_PSTE_3					
C_CTR_DIAG_TOUT_MAX_TQ_TCS	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message TQ_TCS					
C_CTR_DIAG_TOUT_MAX_TQ_TCT	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message TQ_TCT					
C_CTR_DIAG_TOUT_MAX_TRL	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message TRL					
C_CTR_DIAG_TOUT_MAX_VEH_MOD	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message VEH_MOD					
C_CTR_DIAG_TOUT_MAX_VS_TCS	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message VS_TCS					
C_CTR_DIAG_TOUT_MAX_WHEEL_CAN	-	0... FFH	0... 255	1	-
Maximum number of missing messages events before error detection of message WHEEL_CAN					

## A.103.1 Table of BN2000 diagnosis

### FUNCTION DESCRIPTION:

#### General information:

This chapter is for the definition of all ERRM relevant output - data using the general BN2000 diagnosis algorithm.

The CAN diagnosis for BN input messages are only enabled if the variant has been recognized. In case of a modul (e.g. Kombi) which is not a variant but implemented in every vehicle the diagnosis is always enabled.


#### A.103.1.1 Diagnosis ACC module (Distance cruise control)

##### A.103.1.1.1 DREHMOMENT\_ANF\_ACC ( LV\_ERR\_BN\_TQ\_DCC )

#### General information:

See general BN2000 diagnosis algorithm

#### Application conditions

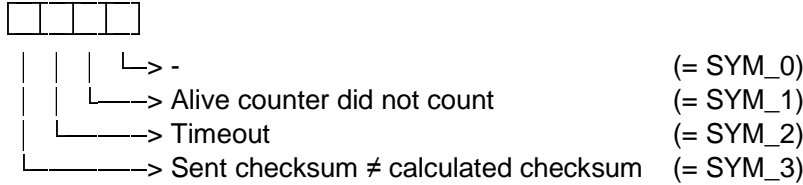
Released by Tettenborn Frank		Date 2013-02-13	File 17A0JT03.00B
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 4880 of 8404	
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**Activation:**  $LV\_VAR\_DCC = 1$

**Description:**

Error symptoms are defined for this diagnosis function as:



**A.103.1.2 Diagnosis ARS module**

**A.103.1.2.1 STAT\_ARS ( LV\_ERR\_BN\_ARS )**

**General information:**

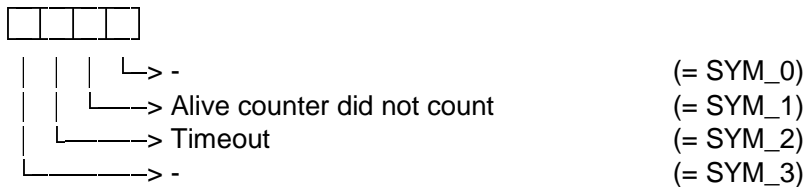
See general BN2000 diagnosis algorithm

**Application conditions**

**Activation:**  $LV\_VAR\_ARS = 1$

**Description:**

Error symptoms are defined for this diagnosis function as:



**A.103.1.3 Diagnosis AFS module ( Active front steering )**

**A.103.1.3.1 DREHMOMENT\_ANF\_AFS ( LV\_ERR\_BN\_TQ\_PSTE\_2 )**

**General information:**

See general BN2000 diagnosis algorithm


**Application conditions**

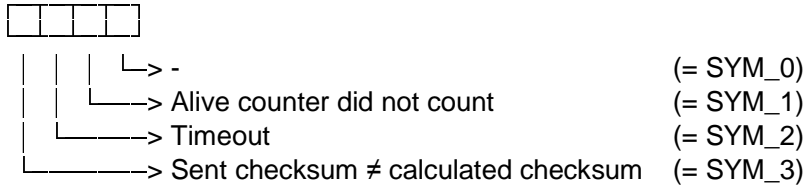
**Activation:**  $LV\_VAR\_PSTE\_2 = 1$

**Description:**

Error symptoms are defined for this diagnosis function as:

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	Document key 10171571 SPE 000 AO	Pages Page 4881 of 8404	
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### A.103.1.4 Diagnosis EHB module ( Electro-hydraulic brake )

#### A.103.1.4.1 DREHMOMENT\_ANF\_STE ( LV\_ERR\_BN\_TQ\_PSTE\_3 )

#### General information:

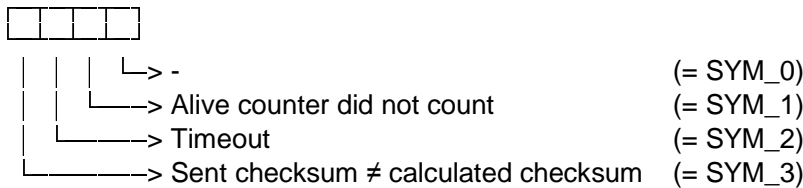
See general BN2000 diagnosis algorithm

#### Application conditions

**Activation:** `LV_VAR_PSTE_3 = 1`

#### Description:

Error symptoms are defined for this diagnosis function as:



### A.103.1.5 Diagnosis EMF module ( Electro-mechanical parke brake )

#### A.103.1.5.1 STELLANF\_EMF ( LV\_ERR\_BN\_REQ\_PBR )

#### General information:

See general BN2000 diagnosis algorithm


#### Application conditions

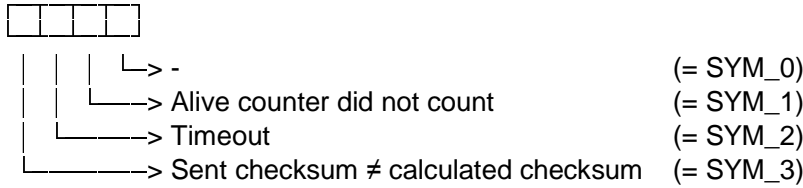
**Activation:** `LV_VAR_PBR = 1`  
`//set LV_END in case of not learnt variant:`  
**if** `LV_VAR_PBR = 0`  
**then** `LV_END_DIAG_BN_REQ_PBR = 1`  
**endif**

#### Description:

Error symptoms are defined for this diagnosis function as:

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 4882 of 8404	
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### A.103.1.5.2 STATUS\_EMF ( LV\_ERR\_BN\_PBR )

#### General information:

See general BN2000 diagnosis algorithm

#### Application conditions

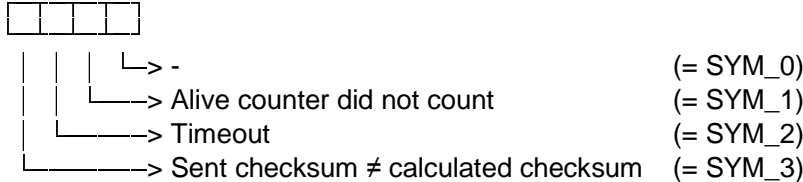
**Activation:**

```

LV_VAR_PBR = 1
//set LV_END in case of not learnt variant:
if                LV_VAR_PBR = 0
then             LV_END_DIAG_BN_PBR = 1
endif
    
```

#### Description:

Error symptoms are defined for this diagnosis function as:



### A.103.1.5.3 ST\_RQ\_EMF ( LV\_ERR\_BN\_TQ\_PBR )

#### General information:

See general BN2000 diagnosis algorithm

#### Application conditions

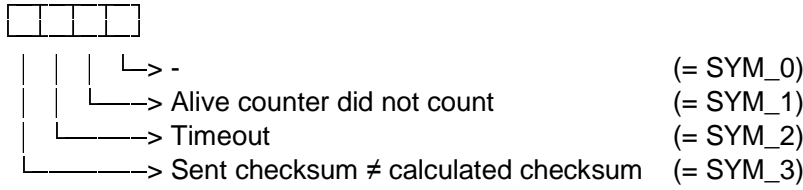
**Activation:**

```

LV_VAR_TQ_PBR = 1
//set LV_END in case of not learnt variant:
if                LV_VAR_TQ_PBR = 0
then             LV_END_DIAG_BN_TQ_PBR = 1
endif
    
```

#### Description:

Error symptoms are defined for this diagnosis function as:



### A.103.1.6 Diagnosis CAS ( Car-access-system )

#### A.103.1.6.1 Klemmenstatus ( LV\_ERR\_BN\_CAS )

##### General information:

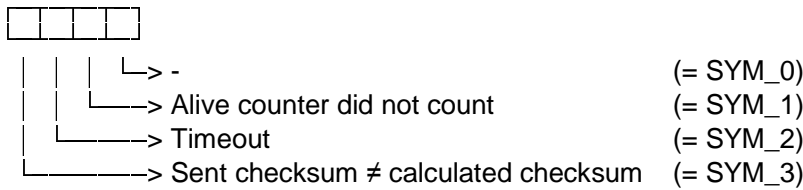
See general BN2000 diagnosis algorithm

##### Application conditions

**Activation:** *in every engine operating state*

##### Description:

Error symptoms are defined for this diagnosis function as:



#### A.103.1.6.2 Fahrzeugmodus ( LV\_ERR\_BN\_VEH\_MOD )

##### General information:

See general BN2000 diagnosis algorithm

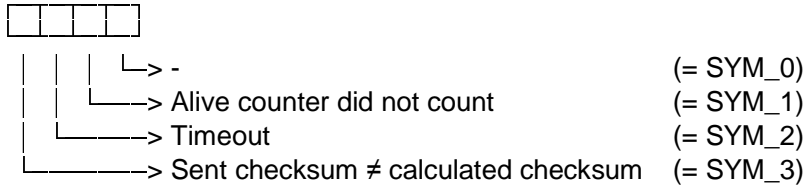
##### Application conditions

**Activation:** *LV\_VAR\_VEH\_MOD = 1*

##### Description:

Error symptoms are defined for this diagnosis function as:

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**A.103.1.6.3 STAT\_ZV\_KLAPPEN ( LV\_ERR\_BN\_CDN\_DOOR )**

**General information:**

See general BN2000 diagnosis algorithm

**Application conditions**

**Activation:** *in every engine operating state*

**Description:**

Error symptoms are defined for this diagnosis function as:



**A.103.1.7 Diagnosis DSC - modul ( Traction control system )**

**A.103.1.7.1 DREHMOMENT\_ANF\_DSC ( LV\_ERR\_BN\_TQ\_TCS )**

**General information:**

See general BN2000 diagnosis algorithm


**Application conditions**

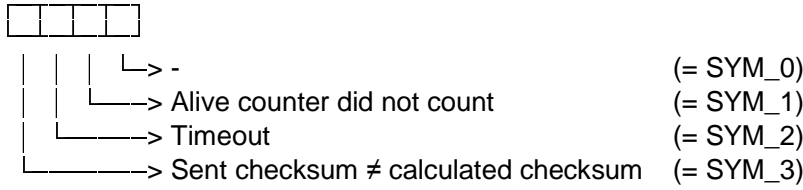
**Activation:** *in every engine operating state*

**Description:**

Error symptoms are defined for this diagnosis function as:

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	Document key 10171571 SPE 000 AO	Pages Page 4885 of 8404	
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### A.103.1.7.2 GESCHWINDIGKEIT ( LV\_ERR\_BN\_VS\_TCS )

**General information:**

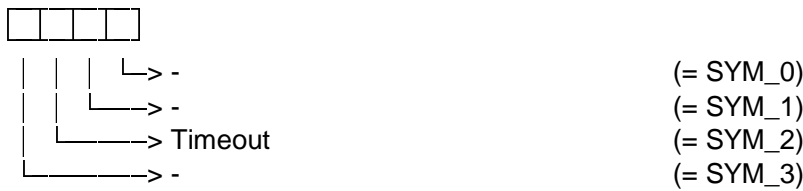
See general BN2000 diagnosis algorithm

**Application conditions**

**Activation:** *in every engine operating state*

**Description:**

Error symptoms are defined for this diagnosis function as:



### A.103.1.7.3 GESCHWINDIGKEIT\_RAD ( LV\_ERR\_BN\_WHEEL\_CAN )

**General information:**

See general BN2000 diagnosis algorithm

**Application conditions**


**Activation:** *in every engine operating state*

**Description:**

Error symptoms are defined for this diagnosis function as:



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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 4886 of 8404	
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### A.103.1.7.4 STAT\_DSC ( LV\_ERR\_BN\_TCS )

#### General information:

See general BN2000 diagnosis algorithm

#### Application conditions

**Activation:** in every engine operating state

#### Description:

Error symptoms are defined for this diagnosis function as:



### A.103.1.8 Diagnosis EGS ( Electronic transmission control unit )

#### A.103.1.8.1 DREHMOMENT\_ANF\_EGS ( LV\_ERR\_BN\_TQ\_ETCU )

#### General information:

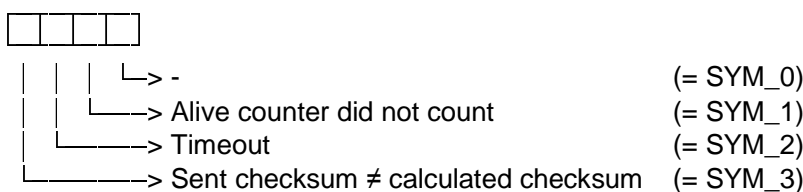
See general BN2000 diagnosis algorithm

#### Application conditions

**Activation:** LV\_AT = 1  
**If** LV\_AT = 0  
(AT not learnt if C\_T\_DET\_VAR\_CAN elapsed after LV\_IGK 0 1)  
**Then** LV\_END\_DIAG\_BN\_TQ\_ETCU = 1 (set for readiness)  
**Endif**

#### Description:

Error symptoms are defined for this diagnosis function as:



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### A.103.1.9 Diagnosis SSG module ( Automated manual transmission )

#### A.103.1.9.1 DREHMOMENT\_ANF\_SSG ( LV\_ERR\_BN\_TQ\_AMT )

##### General information:

See general BN2000 diagnosis algorithm

##### Application conditions

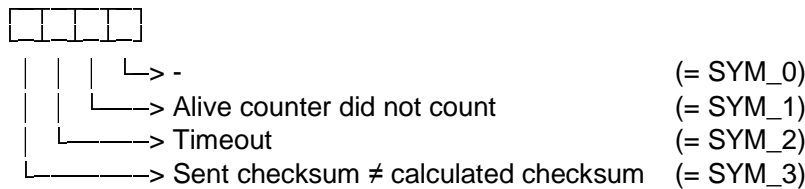
##### **Activation:**

```

LV_VAR_AMT = 1
If    LV_VAR_AMT = 0
(AMT not learnt if C_T_DET_VAR_CAN elapsed after LV_IGK 0 1)
Then    LV_END_DIAG_BN_TQ_AMT = 1    (set for readiness)
Endif
    
```

##### Description:

Error symptoms are defined for this diagnosis function as:



### A.103.1.10 Diagnosis DKG module ( Twin clutch transmission )

#### A.103.1.10.1 DREHMOMENT\_ANF\_DKG ( LV\_ERR\_BN\_TQ\_TCT )

##### General information:

See general BN2000 diagnosis algorithm

##### Application conditions

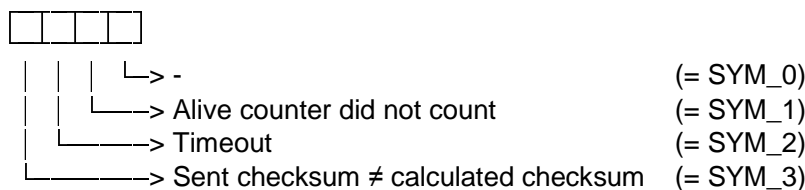
##### **Activation:**

```


LV_VAR_TCT = 1
If    LV_VAR_TCT = 0
(TCT not learnt if C_T_DET_VAR_CAN elapsed after LV_IGK 0 1)
Then    LV_END_DIAG_BN_TQ_TCT = 1    (set for readiness)
Endif
    
```

##### Description:

Error symptoms are defined for this diagnosis function as:



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### A.103.1.10.2 ST\_DKG ( LV\_ERR\_BN\_STAT\_TCT )

#### General information:

See general BN2000 diagnosis algorithm

#### Application conditions

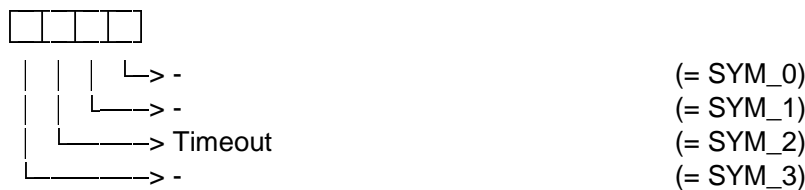
**Activation:**

```

LV_VAR_TCT = 1
If    LV_VAR_TCT = 0
(TCT not learnt if C_T_DET_VAR_CAN elapsed after LV_IGK 0 1)
Then    LV_END_DIAG_BN_STAT_TCT = 1 (set for readiness)
Endif
    
```

#### Description:

Error symptoms are defined for this diagnosis function as:



### A.103.1.11 Transmission data ( from transmission units )

#### A.103.1.11.1 GETRIEBEDATEN ( LV\_ERR\_BN\_ETCU )

#### General information:

See general BN2000 diagnosis algorithm

#### Application conditions

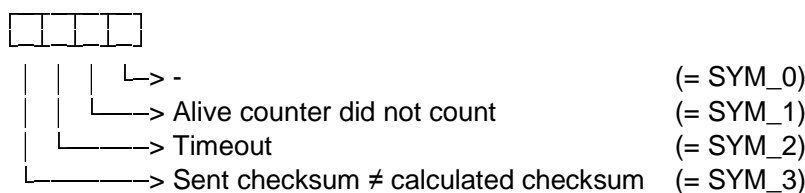
**Activation:**

```

LV_VAR_ETCU = 1
If    LV_VAR_ETCU = 0
Then    LV_END_DIAG_BN_ETCU = 1 (set for readiness)
Endif
    
```

#### Description:

Error symptoms are defined for this diagnosis function as:



### A.103.1.11.2 GETRIEBEDATEN\_2 (LV\_ERR\_BN\_ETCU\_2)

#### General information:

See general BN2000 diagnosis algorithm

#### Application conditions

**Activation:**

```

LV_AT = 1  or  LV_VAR_TCT = 1
If      LV_AT = 0  and  LV_VAR_TCT = 0
Then    LV_END_DIAG_BN_ETCU_2 = 1    (set for readiness)
Endif
    
```

#### Description:

Error symptoms are defined for this diagnosis function as:



### A.103.1.11.3 GETRIEBEDATEN\_3 ( LV\_ERR\_BN\_ETCU\_3 )

#### General information:

See general BN2000 diagnosis algorithm

#### Application conditions

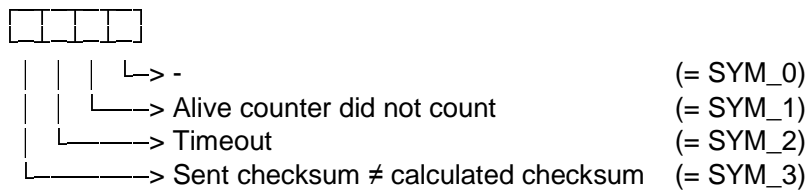
**Activation:**

```

LV_VAR_ETCU_3 = 1
//set LV_END in case of not learnt variant:
if          LV_VAR_ETCU_3 = 0
then       LV_END_DIAG_BN_ETCU_3 = 1
endif
    
```

#### Description:

Error symptoms are defined for this diagnosis function as:



### A.103.1.11.4 ANZEIGE\_GETRIEBEDATEN (LV\_ERR\_BN\_ETCU\_DISP)

#### General information:

See general BN2000 diagnosis algorithm

#### Application conditions

**Activation:**

```

LV_AT = 1 or LV_VAR_TCT = 1
If      LV_AT = 0 and LV_VAR_TCT = 0
Then    LV_END_DIAG_BN_ETCU_DISP = 1      (set for readiness)
Endif
    
```

#### Description:

Error symptoms are defined for this diagnosis function as:



### A.103.1.12 Diagnosis IHKA

#### A.103.1.12.1 WÄRMASTROM\_KLIMA ( LV\_ERR\_BN\_ACC )

#### General information:

See general BN2000 diagnosis algorithm

#### Application conditions

**Activation:**  $LV\_VAR\_ACIN = 1$

#### Description:


Error symptoms are defined for this diagnosis function as:



### A.103.1.13 Diagnosis KOMBI

#### A.103.1.13.1 A\_TEMP\_RELATIVZEIT ( LV\_ERR\_BN\_T\_ICL )

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**General information:**

See general BN2000 diagnosis algorithm

**Application conditions**

**Activation:**  $LV\_VAR\_ICL = 1$

**Description:**

Error symptoms are defined for this diagnosis function as:



**A.103.1.13.2 KILOMETERSTAND ( LV\_ERR\_BN\_KM\_ICL )**

**General information:**

See general BN2000 diagnosis algorithm

**Application conditions**

**Activation:**  $LV\_VAR\_ICL = 1$

**Description:**

Error symptoms are defined for this diagnosis function as:



**A.103.1.13.3 STAT\_KOMBI ( LV\_ERR\_BN\_ICL )**


**General information:**

See general BN2000 diagnosis algorithm

**Application conditions**

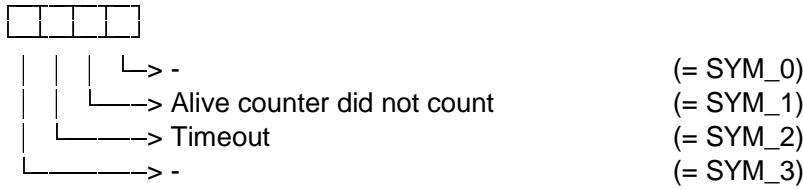
**Activation:**  $LV\_VAR\_ICL = 1$

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**Description:**

Error symptoms are defined for this diagnosis function as:



**A.103.1.13.4 UHRZEIT\_DATUM ( LV\_ERR\_BN\_T\_CLK )**

**General information:**

See general BN2000 diagnosis algorithm

**Application conditions**

**Activation:**  $LV\_VAR\_ICL = 1$

**Description:**

Error symptoms are defined for this diagnosis function as:



**A.103.1.14 Diagnosis Power modul**

**A.103.1.14.1 POWERMGMT\_BATTERIESPANNUNG ( LV\_ERR\_BN\_POW\_VB )**

**General information:**

See general BN2000 diagnosis algorithm


**Application conditions**

**Activation:**  $LV\_VAR\_VEH = 1$

**Description:**

Error symptoms are defined for this diagnosis function as:

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### A.103.1.14.2 POWERMGMT\_LADESPANNUNG ( LV\_ERR\_BN\_POW\_GEN )

**General information:**

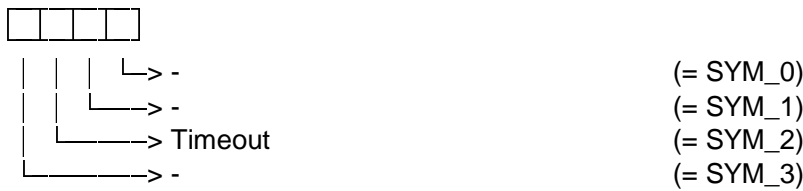
See general BN2000 diagnosis algorithm

**Application conditions**

**Activation:**  $LV\_VAR\_VEH = 1$

**Description:**

Error symptoms are defined for this diagnosis function as:



### A.103.1.15 Diagnosis SZ Lenksäule

#### A.103.1.15.1 BEDIENUNG\_TEMPOMAT ( LV\_ERR\_BN\_MSW )

**General information:**

See general BN2000 diagnosis algorithm


**Application conditions**

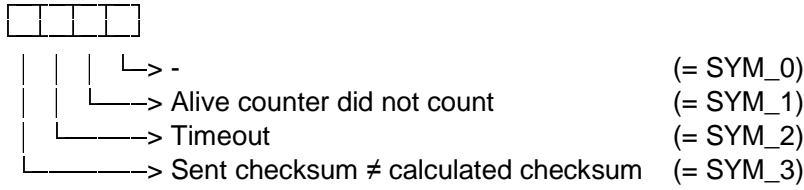
**Activation:**  $LV\_VAR\_BN\_MSW = 1$

**Description:**

Error symptoms are defined for this diagnosis function as:

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### A.103.1.15.2 LENKRADWINKEL ( LV\_ERR\_BN\_ANG\_PSTE )

#### General information:

See general BN2000 diagnosis algorithm

#### Application conditions

**Activation:**  $LV\_VAR\_PSTE = 1$

#### Description:

Error symptoms are defined for this diagnosis function as:



### A.103.1.16 Diagnosis EKP

#### A.103.1.16.1 STAT\_EKP( LV\_ERR\_BN\_EFP )

#### General information:

See general BN2000 diagnosis algorithm


#### Application conditions

**Activation:**  $LV\_VAR\_BN\_EFP = 1$

#### Description:

Error symptoms are defined for this diagnosis function as:

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**A.103.1.17 Diagnosis K\_CAN: LM**

**A.103.1.17.1 STAT\_GANG\_RUECKWAERTS ( LV\_ERR\_BN\_GEAR\_REV )**

**General information:**

See general BN2000 diagnosis algorithm

**Application conditions**

**Activation:**  $LV\_VAR\_BN\_GEAR\_REV = 1$

**Description:**

Error symptoms are defined for this diagnosis function as:



**A.103.1.17.2 LAMPENZUSTAND ( LV\_ERR\_BN\_LTG\_HDLP\_L )**

**General information:**

See general BN2000 diagnosis algorithm


**Application conditions**

**Activation:**  $LV\_VAR\_BN\_LTG\_HDLP\_L = 1$

**Description:**

Error symptoms are defined for this diagnosis function as:

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### A.103.1.17.3 STAT\_ANHAENGER ( LV\_ERR\_BN\_TRL )

**General information:**

See general BN2000 diagnosis algorithm

**Application conditions**

**Activation:**  $LV\_VAR\_BN\_TRL = 1$

**Description:**

Error symptoms are defined for this diagnosis function as:



### A.103.1.18 Diagnosis LDM

#### A.103.1.18.1 ANFORDERUNG\_RADM\_ANTRIEBSTRANG ( LV\_ERR\_BN\_LDM )

**General information:**

See general BN2000 diagnosis algorithm

**Application conditions**

**Activation:**  $LV\_VAR\_BN\_LDM = 1$

**Description:**

Error symptoms are defined for this diagnosis function as:

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### A.103.1.19 Diagnosis EKP-Crashabschaltung

#### A.103.1.19.1 Steuerung EKP-Crashabschaltung ( LV\_ERR\_BN\_EFP\_CRASH )

##### General information:

See general BN2000 diagnosis algorithm

##### Application conditions

**Activation:**  $LV\_VAR\_EFP\_CRASH = 1$

##### Description:

Error symptoms are defined for this diagnosis function as:



### A.103.1.20 Diagnosis DXC

#### A.103.1.20.1 SOLL\_MOM\_ANF ( LV\_ERR\_BN\_DHL\_CTL )

##### General information:

See general BN2000 diagnosis algorithm


##### Application conditions

**Activation:**  $LV\_VAR\_4WD = 1$   
**If**  $LV\_VAR\_4WD = 0$   
**Then**  $LV\_END\_DIAG\_BN\_DHL\_CTL = 1$  (set for readiness)  
**Endif**

##### Description:

Error symptoms are defined for this diagnosis function as:

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### A.103.1.21 Diagnosis M-DRIVE

#### A.103.1.21.1 BEDIENUNG\_MDRV (LV\_ERR\_BN\_SPT\_SWI)

# IF ( NC\_SPORT\_SZL != 0 ) // Compiler switch for deactivation of functionality

#### Application conditions

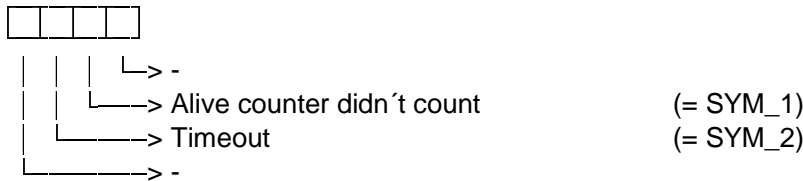
**Initialisation:** *STD\_INI, all others = 0*

**Recurrence:** *1s*

**Activation:** *LV\_VAR\_SPT\_SWI = 1*

#### Description:

Error symptoms are defined for this diagnosis function as:



#ENDIF

### A.103.2 BN2000 diagnosis algorithm

#### FUNCTION DESCRIPTION:

#### General information:

All diagnosis are only activated if the variant BN2000 is valid (LV\_VAR\_BN = 1).  
For the diagnosis each message is monitored.

XXX is the variable for each different input message (see "CAN messages BN2000, Enable condition for BN2000 diagnosis).

#### Description:

The following symptoms can be detected:

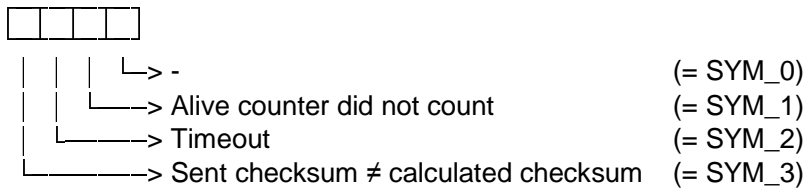
- Alive counter did not count
- Timeout of the message
- Sent checksum is not equal to the calculated checksum of the message

For detailed information of Alive-counter, checksum calculation and timeout see (see "CAN messages BN2000).

If symptom "Timeout" is detected (counter CTR\_DIAG\_TOUT\_XXX ≠ 0), the remaining symptom detection is inhibited.

If C\_CTR\_DIAG\_TOUT/CKS/TCC\_CAN\_MAX\_XXX are calibrated to 0 then the diagnosis of the symptom TOUT/CKS/TCC\_CAN is inhibited.

Error symptoms are defined for this diagnosis function as:



**Application conditions**

**Initialisation:** all 0 at LV\_IGK 0->1 or reset or at clearing error memory

**Recurrence:** each message is diagnosed

**Activation:** If Diagnosis is enabled (learnt/ calibrated etc..., see "CAN messages BN2000, enable condition for BN2000 diagnosis).

```

Then If LV_WAKE_UP = 1 and
LV_CDN_VB_BN_DIAG = 1 and
LV_ERR_CAN_BOFF = 0 and
LV_VAR_BN = 1 and
Then LV_CDN_DIAG_BN_XXX = 1
Else LV_CDN_DIAG_BN_XXX = 0
Endif
Else LV_CDN_DIAG_BN_XXX = 0
    
```

**Endif**

**Deactivation:**

```

If XXX = TQ_DCC (Diagnosis of TQ_DCC message)
Then If LV_ERR_BN_XXX = 1 and
ERR_SYM_BN_XXX = SYM_1/SYM_3
Then LV_CDN_DIAG_BN_XXX = 0 (for this DC!)
Endif
Endif
    
```

**Endif**

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**Formula section:**

Error detection alive counter:

```

If(1)          CTR_DIAG_TOUT_XXX = 0          and
                CTR_DIAG_CKS_XXX = 0          and
                C_CTR_DIAG_TCC_CAN_MAX_XXX ≠ 0
Then If(2)    TCC_CAN_XXX n = TCC_CAN_XXX n-1    or
                TCC_CAN_XXX = FH
Then(2)      CTR_DIAG_TCC_CAN_XXX n = CTR_DIAG_TCC_CAN_XXX n-1 + 1
If(3)        CTR_DIAG_TCC_CAN_XXX ≥ C_CTR_DIAG_TCC_CAN_MAX_XXX
Then(3)      Error symptom "Alive-counter" is active
                ERR_SYM_BN_XXX = SYM_1
                anti-bounce increment per C_ABC_INC_BN_XXX
                LV_ERR_BN_XXX = 1          after debounce
Endif(3)
Else(2)      CTR_DIAG_TCC_CAN_XXX = 0
                Error symptom "Alive-counter" is passive
                ERR_SYM_BN_XXX = NO_SYM
                anti-bounce decrement per C_ABC_DEC_BN_XXX
                LV_ERR_BN_XXX = 0          after rebound
Endif(2)
Else(1)      No error detection
Endif(1)

```

Error detection "Checksum is wrong":

```

If(1)          CTR_DIAG_TOUT_XXX = 0          and
                C_CTR_DIAG_CKS_MAX_XXX ≠ 0
Then If(2)    CKS_CAN_XXX ≠ CKS_CLC_XXX    (sent ≠ calculated)
Then(2)      CTR_DIAG_CKS_XXX n = CTR_DIAG_CKS_XXX n-1 + 1
If(3)        CTR_DIAG_CKS_XXX ≥ C_CTR_DIAG_CKS_MAX_XXX
Then(3)      Error symptom "Calculated checksum ≠ sent checksum" is active
                ERR_SYM_BN_XXX = SYM_3
                anti-bounce increment per C_ABC_INC_BN_XXX
                LV_ERR_BN_XXX = 1          after debounce
Endif(3)
Else(2)      CTR_DIAG_CKS_XXX = 0
                Error symptom "Calculated checksum ≠ sent checksum" is passive,
                ERR_SYM_BN_XXX = NO_SYM
                anti-bounce decrement per C_ABC_DEC_BN_XXX
                LV_ERR_BN_XXX = 0          after rebound
Endif(2)
Else(1)      No error detection
Endif(1)

```


Error detection "Timeout":

```

If(1)          C_CTR_DIAG_TOUT_MAX_XXX ≠ 0
ThenIf(2)     no BN2000 message XXX is received
Then(2)      CTR_DIAG_TOUT_XXX n = CTR_DIAG_TOUT_XXX n-1 + 1
If(3)        CTR_DIAG_TOUT_XXX ≥ C_CTR_DIAG_TOUT_MAX_XXX
Then(3)      Error symptom "Timeout" is active
                ERR_SYM_BN_XXX = SYM_2
                anti-bounce increment per C_ABC_INC_BN_XXX
                LV_ERR_BN_XXX = 1          after debounce
Else(3)

```

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```

Endif(3)
Else(2)    CTR_DIAG_TOUT_XXX = 0
              Error symptom "Timeout" is passive,
              ERR_SYM_BN_XXX = NO_SYM
              anti-bounce decrement per C_ABC_DEC_BN_XXX
              LV_ERR_BN_XXX = 0      after rebound
Endif(2)
Else(1)    No error detection
Endif(1)


```

Calculation of the end of diagnosis:

For calculation of LV\_END\_DIAG\_BN\_XXX see "Anti-bounce algorithm, calculation of the end of diagnosis"

Configuration of Anti-bounce

NC\_ABC\_CONF\_FCT\_DIAG\_XX = 19H (Not saved, INI at LV\_IGK, CTR\_ABC\_.. = 0 at INI, Calibratable decrement)

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## A.104 Knock sensor diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CYCNR_DYW_KNKS_DIAG [NC_NR_SENS_KNK]	V	0... FFH	0... 255	1	seg
Cycle counter for Master -algorithm (knock sensor diagnosis)					
CYCNR_INT_KNKS_DIAG [NC_NR_SENS_KNK]	V	0... FFH	0... 255	1	seg
Cycle counter Slave - algorithm (knock sensor diagnosis)					
DYW_KNKS_DIAG [NC_NR_SENS_KNK]	V	0... 3FFH	0... 4.99511	4.8828e-3	V
Bandwidth knock signal to noise level					
ERR_SYM_KNKS [NC_NR_SENS_KNK]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom KNKS					
LV_CDN_DIAG_KNKS [NC_NR_SENS_KNK]	O/V	0... 1H	0 ...1	1	-
Boolean for knock sensor 2 error currently active					
LV_END_DIAG_KNKS [NC_NR_SENS_KNK]	O/V	0... 1H	0 ...1	1	-
End of diagnosis KNKS					
LV_ERR_KNKS [NC_NR_SENS_KNK]	O/V	0... 1H	0 ...1	1	-
Boolean for knock sensor 1 error currently active					
V_INT_KNKS_DIAG [NC_NR_SENS_KNK]	V	0... FFFFH	0... 319.99511	4.8828e-3	V
Integrator value of bandwidth output voltage of the knock sensor					

### Input data:

KNKS [NC_CYL_NR] {p. 849}	KNKS_1_DIAG {p. 1961}	KNKS_2_DIAG {p. 1961}	LV_DC {p. 5746}
LV_INH_DIAG_KNKS {p. 4908}	LV_KNK_CTL_ENA {p. 1961}	LV_PU {p. 1720}	LV_PUC {p. 1720}
MAF {p. 8277}	MFF_SP_MV {p. 2151}	N_32 {p. 1525}	NC_KNKS_CONF {p. 1967}
NC_NR_SENS_KNK	NL [NC_CYL_NR] {p. 1962}	USE_SW_VER {p. 605}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_KNKS	-	0... FFH	0... 255	1	-
Anti-bounce increment value					
C_ABC_MAX_KNKS	-	1... FFH	1... 255	1	-
Anti-bounce maximum value					
C_CYCNR_KNKS_DIAG	-	0... FFH	0... 255	1	seg
Number of cycles (f(KNKS_DIAG[NC_CBK_EX_NR])) for the Master-Slave knock sensor diagnosis					
C_MAF_MIN_KNKS_DIAG	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Lower engine load threshold for knock sensor diagnosis					
C_MFF_MIN_KNKS_DIAG	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Lower engine load threshold for knock sensor diagnosis based on MFF					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_MIN_KNKS_DIAG	-	0... FFH	0... 8160	32	rpm
Lower engine speed treshold for knock sensor diagnosis					
C_NL_MAX_DIAG	-	0... FFH	0... 4.98046	0.0195312	V
Maximum noise level threshold					
C_NL_MIN_DIAG	-	0... FFH	0... 4.98046	0.0195312	V
Minimum noise level threshold					
IP_DYW_MIN_KNKS_DIAG	-	0... 3FFH	0... 4.99511	4.8828e-3	V
LDPM_N_32_KNKS_DIAG	6	0... FFH	0... 8160	32	rpm
Bandwidth threshold to detect the error via the 'Master Algorithm'					
IP_V_INT_KNKS_DIAG	-	0... FFFFH	0... 319.99511	4.8828e-3	V
LDPM_N_32_KNKS_DIAG	6	0... FFH	0... 8160	32	rpm
Integrator voltage threshold to detect the error via the 'Slave Algorithm'					

## FUNCTION DESCRIPTION:

The array NC\_CBK\_EX\_NR refers to sensor number (0 is KNKS\_1; 1 is KNKS\_2).

### General information:

The task of the function "knock sensor diagnosis" lies in the input signal monitoring of the respective knock sensor.

The sensor signal is checked continuously regarding plausibility. This is done by observation of the signal noise value NL[NC\_CYL\_NR] ('Range Check') and with two algorithms ( Master - and Slave - Algorithm). The bandwidth (DYW\_KNKS\_DIAG) of the signal will be observed with these two algorithms. Both algorithms have to indicate the same system condition before the debounce counter is started.

The debounce counter will be called up every 720 °KW. The three test algorithms will be called up segment synchronously which will be done under consideration of the configuration values NC\_KNKS\_CONF (which knock sensor "hears" which cylinder), KNKS\_1\_DIAG and KNKS\_2\_DIAG (which cylinder will be taken for which knock sensor regarding diagnosis).

### Range Check

In the range check a test will be done to find out if the output signal of the knock-IC is in the allowed working range between the calibratable minimum fault detection threshold and maximum fault detection threshold. A fault case is given if the minimum threshold is fallen-below or the maximum limit is exceeded. The ERR\_SYM\_KNKS is set when one (or more) of the monitored signals infringe a fault threshold.

### Master -Algorithm


In the master-algorithm the bandwidth of the signal (DYW\_KNKS\_DIAG = NL[NC\_CYL\_NR] - KNKS[NC\_CYL\_NR]) will be calculated for the concerned cylinder which is allocated to the concerned knock sensor regarding diagnosis purposes. The calculated bandwidth will be compared to the calibrated threshold value IP\_DYW\_MIN\_KNKS\_DIAG.

At short circuit against ground or VB as well as a broken signal line the bandwidth of the signal does not exceed the threshold value. In this case the counter CYCNR\_DYW\_KNKS\_DIAG will be incremented in each monitored segment.

As soon as the bandwidth of the sensor signal exceeds the value IP\_DYW\_MIN\_KNKS\_DIAG again and LV\_ERR\_KNKS is not set the value will be reset again. In the case of LV\_ERR\_KNKS already set the value CYCNR\_DYW\_KNKS\_DIAG will be decremented by 5 units.

If the counter reaches the value C\_CYCNR\_KNKS\_DIAG a failure of the knock sensor will be set if the 'slave'-algorithm confirms this failure. When a failure has already debounced the SYM\_3 is set as long as the counter of the master-algorithm is above 5. This is to delay the failure recovery.

The counter will be reset at transition LV\_CDN\_DIAG\_KNKS = 0=>1.

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### Slave -Algorithm

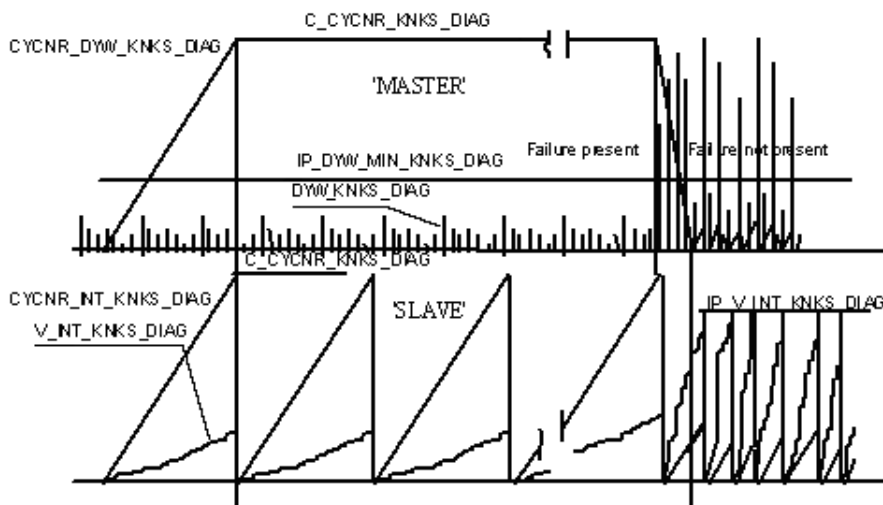
In the slave-algorithm the bandwidth of the sensor signal will also be used as an input signal. It will be recorded in its chronological process and will be integrated by means of an appropriate integration method. The calculated integral value  $V\_INT\_KNKS\_DIAG$  will be compared to the threshold value  $IP\_V\_INT\_KNKS\_DIAG$ .

As soon as the threshold value is reached or exceeded the counter  $CYCNR\_INT\_KNKS\_DIAG$  will be reset. Otherwise it will be incremented by '1' in each monitored segment. When the counter reaches the value  $C\_CYCNR\_KNKS\_DIAG$  the sensor failure will be confirmed through the slave-algorithm and value  $CYCNR\_INT\_KNKS\_DIAG$  and value  $V\_INT\_KNKS\_DIAG$  reset to 0.

The counter will be reset at transition  $LV\_CDN\_DIAG\_KNKS = 0 \Rightarrow 1$ .

If a sensor failure is recognized by both algorithms the debounce will get started.

### Description:



### Application conditions

#### Initialisation:

at reset **or**  $LV\_IGK = 0 \rightarrow 1$  **or** clearing FMY:  
all = 0, except:

$LV\_ERR\_KNKS[NC\_NR\_SENS\_KNK]$  **and**  
 $CTR\_ABC\_KNKS[NC\_NR\_SENS\_KNK]$  are initialised from FMY  
(according STD filter type)

#### Recurrence:

Signal range check and Master- Slave- Algorithm: segment  
Error management: each 720 °KW


#### Activation:

**If**  $LV\_KNK\_CTL\_ENA = 1$  **and**  
 $LV\_PU = 0$  **and**  
 $LV\_PUC = 0$  **and**

[ ( $USE\_SW\_VER = NC\_MSV70$  **or**  
 $USE\_SW\_VER = NC\_MSS70$  **or**  
 $USE\_SW\_VER = NC\_MSV80$ )  
**and**  $MAF > C\_MAF\_MIN\_KNKS\_DIAG$ )

**or**

( ( $USE\_SW\_VER = NC\_MSD70$  **or**  
 $USE\_SW\_VER = NC\_MSD81$  **or**  
 $USE\_SW\_VER = NC\_MSD87$  **or**

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```

USE_SW_VER = NC_MSD70 or
USE_SW_VER = NC_MSD85 )
and MFF_SP_MV > C_MFF_MIN_KNKS_DIAG ]
and
N_32 > C_N_MIN_KNKS_DIAG and
LV_INH_DIAG_KNKS = 0
Then LV_CDN_DIAG_KNKS = 1
Transition LV_CDN_DIAG_KNKS = 0 -> 1
CYCNR_INT_KNKS_DIAG[NC_CBK_EX_NR] = 0;
CYCNR_DYW_KNKS_DIAG[NC_CBK_EX_NR] = 0;
V_INT_KNKS_DIAG[NC_CBK_EX_NR] = 0;
Else LV_CDN_DIAG_KNKS = 0

```

### Formula section:

#### Master-Algorithm

DYW\_KNKS\_DIAG[i] = NLx - KNKS[x]

```

If DYW_KNKS_DIAG[i] > IP_DYW_MIN_KNKS_DIAG or
DYW_KNKS_DIAG[i]n-1 > IP_DYW_MIN_KNKS_DIAG
Then If LV_ERR_KNKS[i] = 1 and
CYCNR_DYW_KNKS_DIAG[i] > 5
Then CYCNR_DYW_KNKS_DIAG[i]n = CYCNR_DYW_KNKS_DIAG[i]n-1 -5
Else CYCNR_DYW_KNKS_DIAG[i] = 0
Endif
Else If CYCNR_DYW_KNKS_DIAG[i] < C_CYCNR_KNKS_DIAG
Then CYCNR_DYW_KNKS_DIAG[i]n = CYCNR_DYW_KNKS_DIAG[i]n-1 + 1
Endif
Endif

```

#### Slave-Algorithm

V\_INT\_KNKS\_DIAG[i] = V\_INT\_KNKS\_DIAG[i]<sub>n-1</sub> + DYW\_KNKS\_DIAG[i]  
CYCNR\_INT\_KNKS\_DIAG[i]<sub>n</sub> = CYCNR\_INT\_KNKS\_DIAG[i]<sub>n-1</sub> + 1

```

If CYCNR_INT_KNKS_DIAG[i]n < C_CYCNR_KNKS_DIAG
Then CYCNR_INT_KNKS_DIAG[i]n = 0
V_INT_KNKS_DIAG[i]n = 0
Else If V_INT_KNKS_DIAG[i]n-1 > IP_V_INT_KNKS_DIAG
Then CYCNR_INT_KNKS_DIAG[i]n = 0
V_INT_KNKS_DIAG[i]n = 0
Endif
Endif


```

#### Signal range check and anti bounce

```

If NL[x] > C_NL_MAX_DIAG /*at least one signal is above threshold*/
Then ERR_SYM_KNKS[i] = SYM_0 /*signal too high*/
Else If NL[x] < C_NL_MIN_DIAG /*at least one signal is below thresh-
old*/
Then ERR_SYM_KNKS[i] = SYM_1 /*signal too low*/
Else If ( CYCNR_DYW_KNKS_DIAG[i] < C_CYCNR_KNKS_DIAG and
CYCNR_INT_KNKS_DIAG[i] < C_CYCNR_KNKS_DIAG ) or
( CYCNR_DYW_KNKS_DIAG[i] > 5 and
LV_ERR_KNKS[i] = 1 )
Then ERR_SYM_KNKS[i] = SYM_3 /*signal implau-
sible*/

```

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```

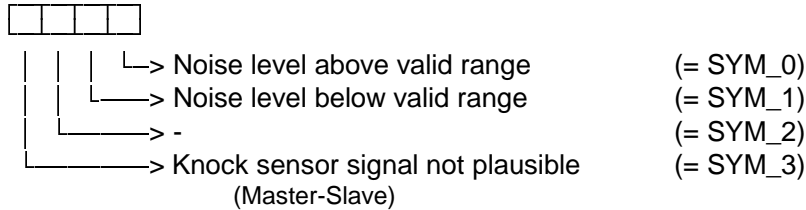
                Else          ERR_SYM_KNKS[i] = NO_SYM          /*signal ok*/
                Endif
    Endif
Endif

```

The bit **LV\_ERR\_KNKS** will be set after debounce through the error management.

The bit **LV\_END\_DIAG\_KNKS** will be set through the error management when after the last start of the diagnosis (normally it will be done only at the beginning of a Driving Cycle) the error debounce or the failure recovery would have been taken place.

Error-symptoms are defined to this diagnosis function as following :



## A.105 Knock sensor diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_KNKS	O/V	0... 1H	0 ...1	1	-
Flag to inhibit the knock sensor diagnosis					

### Input data:

LV_ERR_SPI_KNK {p. 4245}			
-----------------------------	--	--	--

### FUNCTION DESCRIPTION:

#### General information:

This application incidences give the possibility to define customer specific conditions for inhibiting the diagnosis of knock sensors.

#### Application conditions

**Initialisation:** *LV\_INH\_DIAG\_KNKS = 1 at Reset*

**Recurrence:** *like diagnosis*

**Activation:** *LV\_IGK = 1*

#### Formula section:

```

If           LV_ERR_SPI_KNK = 1
Then        LV_INH_DIAG_KNKS = 1
Else        LV_INH_DIAG_KNKS = 0
Endif

```

## A.106 Pre ignition diagnosis via knock control

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ABC_KNK_PRE_DIAG [NC_CYL_NR]	V	0... FFH	0... 255	1	-
Customer specific antibounce counter for knock control pre-ignition detection diagnosis					
ERR_SYM_KNK_PRE [NC_CYL_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom knock control pre-ignition cylinder shut off					
LV_CDN_DIAG_KNK_PRE [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Diagnosis condition knock control pre-ignition cylinder shut off					
LV_END_DIAG_KNK_PRE [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Diagnosis knock control pre-ignition cylinder shut off done at least one time					
LV_ERR_KNK_PRE [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Error caused by knock control pre-ignition cylinder shut off					

### Input data:

CYL_ID_KNK {p. 1960}	LV_KNK_CTL_PRE_ENA {p. 1961}	LV_KNK_PRE_DET {p. 1962}	N_32 {p. 1525}
----------------------	---------------------------------	-----------------------------	----------------

### Calibration data:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_KNK_PRE	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_KNK_PRE	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_ABC_MAX_KNK_PRE_DIAG	-	1... FFH	1... 255	1	-
Maximum value for customer specific antibounce counter					
IP_ABC_INC_KNK_PRE_DIAG	-	0... FFH	0... 255	1	-
LDP_N_32_ABC_INC_KNK_PRE_DIAG	4	0... FFH	0... 8160	32	rpm
Customer specific antibounce counter increment					

### Error treatment:

For each cylinder a separate fault location is used symptoms for cylinder[NC\_CYL\_NR]

Diagnostic	Symptom description	Symptom	Filter type
<b>KNK_PRE</b>			
<i>knock control pre-ignition cylinder shut off</i>		-	STD_INI
		-	
		-	
<i>cylinder[NC_CYL_NR]</i>	knock control pre-ignition cylinder shut off	SYM_3	

### FUNCTION DESCRIPTION:

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**General information:**

Workshops must be able to get information about cylinder shut off caused by pre-ignition detection e.g. in case of engine damages.

**Description:**

For error management failures on single cylinders should be set after a certain number of detected Pre-Ignitions by knock control.

The fault is detected by the error management.

**Application conditions****Initialisation:**

```

according filter type 'STD_INI'
    (ERR_SYM_KNK_PRE[0 to NC_CYL_NR-1] = NO_SYM,
    LV_ERR_KNK_PRE[0 to NC_CYL_NR-1] = 0, ...)
    (clear general failure memory variables)
according filter type 'STD_INI'
    CTR_ABC_KNK_PRE_DIAG[0 to NC_CYL_NR-1] = 0
    tmp_err_sym_knk_pre[0 to NC_CYL_NR-1] = NO_SYM
    (clear individual detection delay counter and temporary
    failure symptom also, e.g. at failure memory reset)

```

**Recurrence:**

```

segment synchronous (analogous knock control)
    every 720° CRK for the individual cylinder - update for cylinder
    x
    only in the corresponding segment, where injection shut off
    bit could change

```

**Activation:**

```

If          LV_KNK_CTL_PRE_ENA = 1
Then       LV_CDN_DIAG_KNK_PRE[CYL_ID_KNK] = 1

```

**Deactivation:**

```

If          LV_KNK_CTL_PRE_ENA = 0
Then       LV_CDN_DIAG_KNK_PRE[CYL_ID_KNK] = 0

```

**Formula section:**

```

If          LV_KNK_PRE_DET = 1
Then       CTR_ABC_KNK_PRE_DIAG[CYL_ID_KNK] =
    CTR_ABC_KNK_PRE_DIAG[CYL_ID_KNK] + IP_ABC_INC_KNK_PRE_DIAG(N_32)
If          CTR_ABC_KNK_PRE_DIAG[CYL_ID_KNK] >=
    C_ABC_MAX_KNK_PRE_DIAG
Then       ERR_SYM_KNK_PRE[CYL_ID_KNK] = SYM_3
Endif

```

**Endif**

The debounce algorithm is realized by a customized functionality.


Because of that C\_ABC\_INC\_KNK\_PRE must be set >= C\_ABC\_MAX\_KNK\_PRE.

The bits LV\_ERR\_xx and LV\_END\_DIAG\_xx are set by the error management after debounce.

**N.B.: CYL\_ID\_KNK represents, where the corresponding cylinder is evaluated by the module 'Knock Control'**

**Failure reaction:**

handled by LV\_KNK\_PRE\_DET

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## A.107 Sound flap diagnosis

### Data definition:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_SOF	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of SOF bit 0 : diagnosis condition for symptom SCP (SYM_0) bit 1 : diagnosis condition for symptom SCG (SYM_1) bit 1 : diagnosis condition for symptom OC (SYM_2)					
ERR_DIAG_SOF	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for SOF (only parameter)					
ERR_SYM_SOF	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error					
ERR_SYM_SOF_REQ	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error					
LV_CDN_DIAG_SOF	O/V	0... 1H	0 ...1	1	-
Diagnosis condition					
LV_CDN_DIAG_SOF_REQ	O/V	0... 1H	0 ...1	1	-
Diagnosis condition					
LV_END_DIAG_SOF	O/V	0... 1H	0 ...1	1	-
End of Diagnosis					
LV_END_DIAG_SOF_REQ	O/V	0... 1H	0 ...1	1	-
End of Diagnosis					
LV_ERR_SOF	O/V	0... 1H	0 ...1	1	-
Error flag sound-flap					
LV_ERR_SOF_REQ	O/V	0... 1H	0 ...1	1	-
Error flag sport-mode switch request					
LV_INH_DIAG_SOF	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition SOF diagnosis					

### Input data:

CONF_SOF_SWI {p. 654}	LV_CDN_VB_MIN_DIAG {p. 1185}	LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}
LV_VAR_BN {p. 655}	LV_VAR_SOF {p. 656}	V_SOF_SWI {p. 831}	

### Calibration data:

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_SOF	-	0... FFH	0... 255	1	-
Debounce counter increment - SOF diagnosis					
C_ABC_INC_SOF_REQ	-	0... FFH	0... 255	1	-
-					
C_ABC_MAX_SOF	-	1... FFH	1... 255	1	-
Debounce counter maximum value - SOF diagnosis					
C_ABC_MAX_SOF_REQ	-	1... FFH	1... 255	1	-
-					
C_V_SOF_SWI_MAX	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Input voltage treshold max					
C_V_SOF_SWI_MIN	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Input voltage treshold min					

### A.107.1 Input signal (sport switch) range check

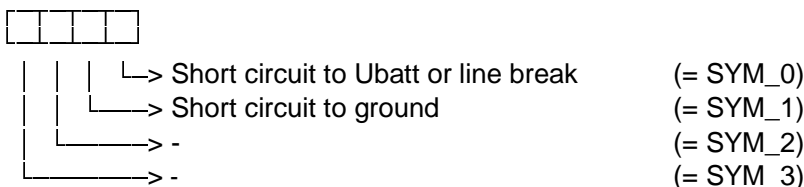
#### FUNCTION DESCRIPTION:

##### General information:

This diagnosis is for checking the range of input signal voltage from the sport-mode-switch.

##### Description:

Error-symptoms are defined to this diagnosis function as following :



#### Application conditions

**Initialisation:** *at reset or LV\_IGK = 0 1 all 0*

**Recurrence:** *10 ms*

**Activation:**

```

If          LV_VAR_BN = 0          and
LV_IGK = 1          and
CONF_SOF_SWI > 0    and
LV_ERR_SOF_REQ = 0
Then        LV_CDN_DIAG_SOF_REQ = 1
Else        LV_CDN_DIAG_SOF_REQ = 0
Endif
    
```

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**Formula section:**

Short circuit to ground:

```

if          V_SOF_SWI < C_V_SOF_SWI_MIN      AND
             CONF_SOF_SWI = 1
Then      ERR_SYM_SOF_REQ = SYM_1
             LV_ERR_SOF_REQ = 1      (after debounce)
Endif
    
```

Short circuit to Ubatt or open line:

```

if          V_SOF_SWI > C_V_SOF_SWI_MAX
Then      ERR_SYM_SOF_REQ = SYM_0
             LV_ERR_SOF_REQ = 1      (after debounce)
Endif
    
```

Calculation of end of diagnosis:

For calculation of LV\_END\_DIAG\_SOF\_REQ see Anti-bounce - algorithmus, calculation of the end of diagnosis .

**A.107.2 Sound flap diagnosis (LV\_ERR\_SOF)**

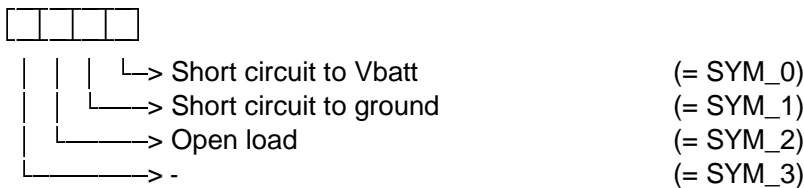
**FUNCTION DESCRIPTION:**

**General information:**

The purpose is to diagnose the sound flap signal from the driver which controls the sound flap. Diagnosis is only done if variant sound flap is choosen.

**Description:**


For error detection algorithm see "Electrical diagnosis of powerstage outputs ATIC39".  
(Static control of PIN)



**Application conditions**

- Initialisation:** according Filter-type **MPL\_STD\_INI**  
(reset of variables at LV\_IGK = 0 1 or ECU reset)
- Recurrence:** 100ms
- Activation:** LV\_VAR\_SOF = 1

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**Formula section:**

If diagnosis is not inhibited (LV\_INH\_DIAG\_SOF = 1) the diagnosis conditions are set according infrastructure information: CDN\_DIAG\_SOF.

Failure symptoms (raw value) are set according infrastructure information: ERR\_DIAG\_SOF.

Failure debouncing and error management treatment:

For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN\_DIAG\_SOF and ERR\_DIAG\_SOF


This algorithm determines:

ERR\_SYM\_SOF (Detected error symptom)  
LV\_ERR\_SOF (Error flag for debounced error)  
LV\_CDN\_DIAG\_SOF (Diagnosis condition information)  
LV\_END\_DIAG\_SOF (End of diagnosis information)

Diagnosis inhibition:

```
IF          LV_IGK = 1          AND
           LV_CDN_VB_MIN_DIAG = 1  AND
           LV_ERR_SPI_MPS = 0
THEN       LV_INH_DIAG_SOF = 0
ELSE       LV_INH_DIAG_SOF = 1
ENDIF
```

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## A.108 NOx sensor OBDI diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_NS_OBD_1_HTP [NC_NOX_SENS_CONF]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of NOx sensor OBD I - heater diagnosis					
ERR_SYM_NS_OBD_1_LAMB [NC_NOX_SENS_CONF]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of NOx sensor OBD I - linear Lambda circuit diagnosis					
ERR_SYM_NS_OBD_1_NOX [NC_NOX_SENS_CONF]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of NOx sensor OBD I - NOx circuit diagnosis					
ERR_SYM_NS_OBD_1_VLS [NC_NOX_SENS_CONF]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of NOx sensor OBD I - binary Lambda circuit diagnosis					
LV_CDN_DIAG_NS_OBD_1 [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection at NOx sensor OBD I diagnosis					
LV_END_DIAG_NS_OBD_1_HTP [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor OBD I - heater diagnosis is completed at least one time					
LV_END_DIAG_NS_OBD_1_LAMB [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor OBD I - linear Lambda circuit diagnosis is completed at least one time					
LV_END_DIAG_NS_OBD_1_NOX [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor OBD I - NOx circuit diagnosis is completed at least one time					
LV_END_DIAG_NS_OBD_1_VLS [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor OBD I - binary Lambda circuit diagnosis is completed at least one time					
LV_ERR_NS_OBD_1 [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor OBD I failure is present after filtering					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_NS_OBD_1_HTP [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor OBD I - heater failure is present after filtering					
LV_ERR_NS_OBD_1_LAMB [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor OBD I - linear Lambda circuit failure is present after filtering					
LV_ERR_NS_OBD_1_NOX [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor OBD I - NOx circuit failure is present after filtering					
LV_ERR_NS_OBD_1_VLS [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor OBD I - binary Lambda circuit failure is present after filtering					

**Input data:**

ERR_NS [NC_NOX_SENS_CONF] {p. 1380}	LV_ERR_NS_CAN_BOFF {p. 991}	LV_ERR_NS_CAN_MSG_ LOST [NC_NOX_SENS_CONF] {p. 991}	LV_INH_DIAG_NS_OBD_1 [NC_NOX_SENS_CONF] {p. 4921}
LV_ST_END {p. 1720}	NC_NOX_SENS_CONF {p. 643}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_NS_OBD_1_HTP	-	0... FFH	0... 255	1	-
Anti-bounce counter increment of NOx sensor OBD I - heater diagnosis					
C_ABC_INC_NS_OBD_1_LAMB	-	0... FFH	0... 255	1	-
Anti-bounce counter increment of NOx sensor OBD I - linear Lambda circuit diagnosis					
C_ABC_INC_NS_OBD_1_NOX	-	0... FFH	0... 255	1	-
Anti-bounce counter increment of NOx sensor OBD I - NOx circuit diagnosis					
C_ABC_INC_NS_OBD_1_VLS	-	0... FFH	0... 255	1	-
Anti-bounce counter increment of NOx sensor OBD I - binary Lambda circuit diagnosis					
C_ABC_MAX_NS_OBD_1_HTP	-	0... FFH	0... 255	1	-
Maximum value of anti-bounce counter for NOx sensor OBD I - heater diagnosis					
C_ABC_MAX_NS_OBD_1_LAMB	-	0... FFH	0... 255	1	-
Maximum value of anti-bounce counter for NOx sensor OBD I - linear Lambda circuit diagnosis					
C_ABC_MAX_NS_OBD_1_NOX	-	0... FFH	0... 255	1	-
Maximum value of anti-bounce counter for NOx sensor OBD I - NOx circuit diagnosis					
C_ABC_MAX_NS_OBD_1_VLS	-	0... FFH	0... 255	1	-
Maximum value of anti-bounce counter for NOx sensor OBD I - binary Lambda circuit diagnosis					

**Import actions:**

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>, IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>, <b>OUT</b> <PRM_LV_ERR>)
--

**FUNCTION DESCRIPTION:**

### General information:

The NOx sensor has an own Electronic Control Unit (ECU), which monitors the cable connection between sensor element and sensor ECU on electrical faults like open circuits or short circuits. The actual monitoring result/the actual diagnosis result is cyclic transmitted to the EMS by the CAN messages, which include the sensor measurement signals.

The purpose of this diagnosis is to evaluate the cyclic received sensor ECU diagnosis result. If the sensor ECU reports an electrical fault (OBDI error between sensor element and sensor ECU) then this error is debounced and stored within error memory by use of standard error memory algorithm.

At ERR\_SYM\_NS\_OBD\_1\_HTP, ERR\_SYM\_NS\_OBD\_1\_NOX, ERR\_SYM\_NS\_OBD\_1\_LAMB and ERR\_SYM\_NS\_OBD\_1\_VLS combinations of error symptoms are possible (0...0x0F).

The following table describes the meaning of NOx sensor status byte:

**Remark: The meaning of NOx sensor error byte was copied from NOx sensor specification of sensor manufacturer. If the sensor manufacturer makes a change at sensor error byte meaning, then this specification will not be updated!**

NOx sensor error byte: ERR_NS[j]								Function
B7	B6	B5	B4	B3	B2	B1	B0	
0	0	0	0	0	0	0	0	no failure detected
							1	open wire at heater circuit
						1		open wire at NOx circuit
					1			open wire at linear Lambda circuit
				1				open wire at binary Lambda circuit
			1					short circuit at heater circuit
		1						short circuit at NOx circuit
	1							short circuit at linear Lambda circuit
1								short circuit at binary Lambda circuit

Specific diagnostic information to the project are defined in chapters Diagnostic general information or application incidence (EOL, DTC, error code number, symptom number...).

### Description:

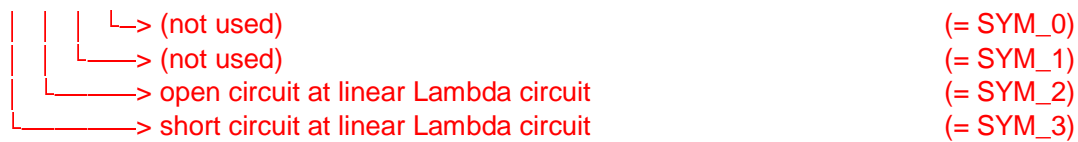
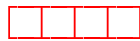
Error-symptoms of heater diagnosis are defined as following:



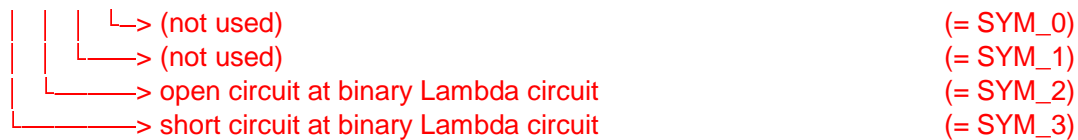
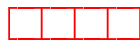
Error-symptoms of NOx circuit diagnosis are defined as following:



Error-symptoms of linear Lambda circuit diagnosis are defined as following:



Error-symptoms of binary Lambda circuit diagnosis are defined as following:



## Application conditions

### Initialisation:

at reset:

LV\_CDN\_DIAG\_NS\_OBD\_1[i] = 0

LV\_ERR\_NS\_OBD\_1[i] = 0

ERR\_SYM\_NS\_OBD\_1\_HTP[i] = Refer to filtering configuration for the initialisation value

LV\_ERR\_NS\_OBD\_1\_HTP[i] = Refer to filtering configuration for the initialisation value

LV\_END\_DIAG\_NS\_OBD\_1\_HTP[i] = Refer to filtering configuration for the initialisation value

ERR\_SYM\_NS\_OBD\_1\_NOX[i] = Refer to filtering configuration for the initialisation value

LV\_ERR\_NS\_OBD\_1\_NOX[i] = Refer to filtering configuration for the initialisation value

LV\_END\_DIAG\_NS\_OBD\_1\_NOX[i] = Refer to filtering configuration for the initialisation value

ERR\_SYM\_NS\_OBD\_1\_LAMB[i] = Refer to filtering configuration for the initialisation value

LV\_ERR\_NS\_OBD\_1\_LAMB[i] = Refer to filtering configuration for the initialisation value

LV\_END\_DIAG\_NS\_OBD\_1\_LAMB[i] = Refer to filtering configuration for the initialisation value  
 ERR\_SYM\_NS\_OBD\_1\_VLS[i] = Refer to filtering configuration for the initialisation value  
 LV\_ERR\_NS\_OBD\_1\_VLS[i] = Refer to filtering configuration for the initialisation value  
 LV\_END\_DIAG\_NS\_OBD\_1\_VLS[i] = Refer to filtering configuration for the initialisation value  
 at activation:  
 LV\_CDN\_DIAG\_NS\_OBD\_1[i] = 1  
 at deactivation:  
 LV\_CDN\_DIAG\_NS\_OBD\_1[i] = 0

**Recurrence:** 10ms

**Activation:** LV\_ST\_END = 1                   **AND**  
 LV\_ERR\_NS\_CAN\_BOFF = 0                   **AND**  
 LV\_ERR\_NS\_CAN\_MSG\_LOST[i] = 0                   **AND**  
 LV\_INH\_DIAG\_NS\_OBD\_1[i] = 0

**Deactivation:** if any activation condition is not fulfilled

### Formula section:

#### Heater circuit failures:

```

if Bit B0 of ERR_NS[i] = 1
then ERR_SYM_NS_OBD_1_HTP[i] = set bit SYM_2 of ERR_SYM_NS_OBD_1_HTP[i]
else ERR_SYM_NS_OBD_1_HTP[i] = reset bit SYM_2 of ERR_SYM_NS_OBD_1_HTP[i]
endif

if Bit B4 of ERR_NS[i] = 1
then ERR_SYM_NS_OBD_1_HTP[i] = set bit SYM_3 of ERR_SYM_NS_OBD_1_HTP[i]
else ERR_SYM_NS_OBD_1_HTP[i] = reset bit SYM_3 of ERR_SYM_NS_OBD_1_HTP[i]
endif
  
```

For failure and error management treatment the anti-bounce mechanism is called:

ACTION\_ERRM\_FilterSymptom( IN<NS\_OBD\_1\_HTP[i]>, IN<LV\_CDN\_DIAG\_NS\_OBD\_1[i]>, IN<ERR\_SYM\_NS\_OBD\_1\_HTP[i]>, IN<C\_ABC\_INC\_NS\_OBD\_1\_HTP>, IN<1>, IN<C\_ABC\_MAX\_NS\_OBD\_1\_HTP>, OUT<LV\_ERR\_NS\_OBD\_1\_HTP[i]>)

#### NOx circuit failures:

```

if Bit B1 of ERR_NS[i] = 1
then ERR_SYM_NS_OBD_1_NOX[i] = set bit SYM_2 of ERR_SYM_NS_OBD_1_NOX[i]
else ERR_SYM_NS_OBD_1_NOX[i] = reset bit SYM_2 of ERR_SYM_NS_OBD_1_NOX[i]
endif

if Bit B5 of ERR_NS[i] = 1
then ERR_SYM_NS_OBD_1_NOX[i] = set bit SYM_3 of ERR_SYM_NS_OBD_1_NOX[i]
else ERR_SYM_NS_OBD_1_NOX[i] = reset bit SYM_3 of ERR_SYM_NS_OBD_1_NOX[i]
endif
  
```


For failure and error management treatment the anti-bounce mechanism is called:

ACTION\_ERRM\_FilterSymptom( IN<NS\_OBD\_1\_NOX[i]>, IN<LV\_CDN\_DIAG\_NS\_OBD\_1[i]>, IN<ERR\_SYM\_NS\_OBD\_1\_NOX[i]>, IN<C\_ABC\_INC\_NS\_OBD\_1\_NOX>, IN<1>, IN<C\_ABC\_MAX\_NS\_OBD\_1\_NOX>, OUT<LV\_ERR\_NS\_OBD\_1\_NOX[i]>)

#### Linear Lambda circuit failures:

```

if Bit B2 of ERR_NS[i] = 1
then ERR_SYM_NS_OBD_1_LAMB[i] = set bit SYM_2 of ERR_SYM_NS_OBD_1_LAMB[i]
else ERR_SYM_NS_OBD_1_LAMB[i] = reset bit SYM_2 of ERR_SYM_NS_OBD_1_LAMB[i]
endif
  
```

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```

endif
if                                Bit B6 of ERR_NS[i] = 1
then                             ERR_SYM_NS_OBD_1_LAMB[i] = set bit SYM_3 of ERR_SYM_NS_OBD_1_LAMB[i]
else                             ERR_SYM_NS_OBD_1_LAMB[i] = reset bit SYM_3 of ERR_SYM_NS_OBD_1_LAMB[i]
endif

```

For failure and error management treatment the anti-bounce mechanism is called:

```

ACTION_ERRM_FilterSymptom( IN<NS_OBD_1_LAMB[i]>, IN<LV_CDN_DIAG_NS_OBD_1[i]>,
IN<ERR_SYM_NS_OBD_1_LAMB[i]>, IN<C_ABC_INC_NS_OBD_1_LAMB>, IN<1>, IN<C_ABC_
MAX_NS_OBD_1_LAMB>, OUT<LV_ERR_NS_OBD_1_LAMB[i]>)

```

Binary Lambda circuit failures:

```

if                                Bit B3 of ERR_NS[i] = 1
then                             ERR_SYM_NS_OBD_1_VLS[i] = set bit SYM_2 of ERR_SYM_NS_OBD_1_VLS[i]
else                             ERR_SYM_NS_OBD_1_VLS[i] = reset bit SYM_2 of ERR_SYM_NS_OBD_1_VLS[i]
endif

```

```

if                                Bit B7 of ERR_NS[i] = 1
then                             ERR_SYM_NS_OBD_1_VLS[i] = set bit SYM_3 of ERR_SYM_NS_OBD_1_VLS[i]
else                             ERR_SYM_NS_OBD_1_VLS[i] = reset bit SYM_3 of ERR_SYM_NS_OBD_1_VLS[i]
endif

```

For failure and error management treatment the anti-bounce mechanism is called:

```

ACTION_ERRM_FilterSymptom( IN<NS_OBD_1_VLS[i]>, IN<LV_CDN_DIAG_NS_OBD_1[i]>, IN<ERR_
SYM_NS_OBD_1_VLS[i]>, IN<C_ABC_INC_NS_OBD_1_VLS>, IN<1>, IN<C_ABC_MAX_NS_
OBD_1_VLS>, OUT<LV_ERR_NS_OBD_1_VLS[i]>)

```

Summarise of failures:

```

if                                LV_ERR_NS_OBD_1_HTP[i] = 1                OR
    LV_ERR_NS_OBD_1_NOX[i] = 1                OR
    LV_ERR_NS_OBD_1_LAMB[i] = 1                OR
    LV_ERR_NS_OBD_1_VLS[i] = 1
then                             LV_ERR_NS_OBD_1[i] = 1
else                             LV_ERR_NS_OBD_1[i] = 0
endif

```



## A.109 NOx sensor OBDI diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_NS_OBD_1 [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx sensor OBD I diagnosis					

### Input data:

LV_CDN_VB_CAN_DIAG {p. 1185}	LV_ST_END {p. 1720}	LV_VAR_NOX {p. 656}	NC_NOX_SENS_CONF {p. 643}
---------------------------------	---------------------	---------------------	------------------------------

### Error treatment:

Diagnostic	Symptom description	Symptom	Filter type
NS_OBD_1_ HTP[i]			
NOx sensor OBDI - heater diagnosis	(not used)	SYM_0	STD_INI
	(not used)	SYM_1	
	open circuit at heater	SYM_2	
	short circuit at heater	SYM_3	

Figure A.109.1: Diagnostic

Diagnostic	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NS_OBD_1_ HTP[i]								
NOx sensor OBDI - heater diagnosis	(not used)	SYM_0						
	(not used)	SYM_1						
	open circuit at heater	SYM_2						
	short circuit at heater	SYM_3						

Figure A.109.2: Diagnostic

Diagnostic	Symptom description	Symptom	Filter type
NS_OBD_1_ NOX[i]			
NOx sensor OBDI - NOx circuit diagnosis	(not used)	SYM_0	STD_INI
	(not used)	SYM_1	
	open circuit at NOx circuit	SYM_2	
	short circuit at NOx circuit	SYM_3	

Figure A.109.3: Diagnostic

Diagnostic	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NS_OBD_1_NOX[i]								
NOx sensor OBDI - NOx circuit diagnosis	(not used)	SYM_0						
	(not used)	SYM_1						
	open circuit at NOx circuit	SYM_2						
	short circuit at NOx circuit	SYM_3						

Figure A.109.4: Diagnostic

Diagnostic	Symptom description	Symptom	Filter type
NS_OBD_1_LAMB[i]			
NOx sensor OBDI - linear Lambda circuit diagnosis	(not used)	SYM_0	STD_INI
	(not used)	SYM_1	
	open circuit at linear Lambda circuit	SYM_2	
	short circuit at linear Lambda circuit	SYM_3	

Figure A.109.5: Diagnostic

Diagnostic	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NS_OBD_1_LAMB[i]								
NOx sensor OBDI - linear Lambda circuit diagnosis	(not used)	SYM_0						
	(not used)	SYM_1						
	open circuit at linear Lambda circuit	SYM_2						
	short circuit at linear Lambda circuit	SYM_3						

Figure A.109.6: Diagnostic

Diagnostic	Symptom description	Symptom	Filter type
NS_OBD_1_VLS[i]			
NOx sensor OBDI - binary Lambda circuit diagnosis	(not used)	SYM_0	STD_INI
	(not used)	SYM_1	
	open circuit at binary Lambda circuit	SYM_2	
	short circuit at binary Lambda circuit	SYM_3	

Figure A.109.7: Diagnostic

Diagnostic	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NS_OBD_1_VLS[i]								
NOx sensor OBDI - binary Lambda circuit diagnosis	(not used)	SYM_0						
	(not used)	SYM_1						
	open circuit at binary Lambda circuit	SYM_2						
	short circuit at binary Lambda circuit	SYM_3						

## A.109.1 Inhibition of NOx sensor error byte evaluation

### FUNCTION DESCRIPTION:

#### General information:

The flag LV\_INH\_DIAG\_NS\_OBD\_1[i] allows to inhibit the NOx sensor OBDI diagnosis, which evaluates the NOx sensor error byte.

#### Application conditions

**Initialisation:** at reset, at deactivation:  
LV\_INH\_DIAG\_NS\_OBD\_1[i] = 1

**Recurrence:** 100ms


**Activation:** LV\_ST\_END = 1

**Deactivation:** LV\_ST\_END = 0

#### Formula section:

```

if                                     (NOx message has not been received via LOCAN at
least for once - LV_VAR_NOX)
    LV_VAR_NOX = 0                      OR
    LV_CDN_VB_CAN_DIAG = 0
then    LV_INH_DIAG_NS_OBD_1[i] = 1
else    LV_INH_DIAG_NS_OBD_1[i] = 0
endif
  
```

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## A.110 Alternator power management diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DIAG_GEN_DIAG	V	0... 200H	0... 512	1	-
Diagnosis counter for fulfilled diagnosis values					
CTR_REF_GEN_DIAG	V	0... 200H	0... 512	1	-
Reference counter for diagnosis result					
ERR_SYM_GEN_DIAG	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
Detected symptoms generator diagnosis					
LV_CDN_DIAG_GEN_DIAG	O/V	0... 1H	0 ...1	1	-
Status of diagnosis generator diagnosis					
LV_END_DIAG_GEN_DIAG	O/V	0... 1H	0 ...1	1	-
End of diagnosis generator diagnosis					
LV_ERR_GEN_DIAG	O/V	0... 1H	0 ...1	1	-
Error generator diagnosis					

### Input data:

LV_ALTER_SWI_OFF {p. 8368}	LV_ERR_BSD {p. 4834}	LV_IGK {p. 906}	LV_ST_END {p. 1720}
LV_VB_JUMP {p. 1185}	POW_REL_ALTER_CLC {p. 8368}	T_AST {p. 1766}	VB_MES {p. 845}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_GEN_DIAG	-	0... FFH	0... 255	1	-
Anti-bounce increment value					
C_ABC_MAX_GEN_DIAG	-	1... FFH	1... 255	1	-
Anti-bounce maximum value					
C_DFFGEN_THD_MAX	-	0... FFH	0... 99.60937	0.390625	%
Max. DF-diagnosis threshold for generator diagnosis					
C_DFFGEN_THD_MIN	-	0... FFH	0... 99.60937	0.390625	%
Min. DF-diagnosis threshold for generator diagnosis					
C_PERC_GEN_DIAG_VB_MAX	-	0... FFFFH	0... 99.99847	1.53e-3	%
Percentage of battery voltage values within diagnosis range					
C_T_AST_GEN_DIAG_OFF	-	0... FFFFH	0... 6553.5	0.1	s
End of generator diagnosis T_AST					
C_T_AST_GEN_DIAG_ON	-	0... FFFFH	0... 6553.5	0.1	s
Begin of generator diagnosis T_AST					
C_VB_MES_GEN_DIAG_THD	-	0... 3FFH	0... 28.7055	28.1e-3	V
Battery voltage diagnosis threshold					
C_VB_MES_GEN_DIAG_THD_MAX	-	0... 3FFH	0... 28.7055	28.1e-3	V
Max. battery voltage threshold for diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

### General information:

The diagnosis is implemented to check, that the alternator has surely made an under excitation for several seconds after start end.

### Application conditions

**Initialisation:** *all 0 at LV\_IGK 0->1 or reset or at clearing error memory*

**Recurrence:** *100 ms*

**Activation:** For alternator 1: LV\_IGK = 1 and LV\_ST\_END = 1 and  
LV\_ALTER\_SWI\_OFF = 1 and LV\_ERR\_BSD = 0

**Deactivation:** LV\_END\_DIAG\_GEN\_DIAG = 1

### Formula section:

```

If      C_T_AST_GEN_DIAG_ON < T_AST  C_T_AST_GEN_DIAG_OFF      AND
LV_VB_JUMP = 0                                          AND
! (VB_MES > C_VB_MES_GEN_DIAG_THD_MAX      AND
C_DFFGEN_THD_MIN < POW_REL_ALTER_CLC < C_DFFGEN_THD_MAX)
Then    CTR_REF_GEN_DIAG ++
if      VB_MES < C_VB_MES_GEN_DIAG_THD
Then    CTR_DIAG_GEN_DIAG ++
Endif
Endif

If      T_AST  C_T_AST_GEN_DIAG_OFF
Then    LV_CDN_DIAG_GEN_DIAG = 1
if      (VB_MES > C_VB_MES_GEN_DIAG_THD_MAX      AND
(C_DFFGEN_THD_MAX POW_REL_ALTER_CLC      OR
POW_REL_ALTER_CLC C_DFFGEN_THD_MIN))      AND
CTR_REF_GEN_DIAG = !0      AND
(CTR_DIAG_GEN_DIAG /CTR_REF_GEN_DIAG) * 100 % <
C_PERC_GEN_DIAG_VB_MAX
Then    ERR_SYM_GEN_DIAG = SYM_0
LV_ERR_GEN_DIAG = 1      (after debounce)
Else    ERR_SYM_GEN_DIAG = NO_SYM
LV_ERR_GEN_DIAG = 0      (after rebound)
Endif
Endif

```

*End of diagnosis calculation LV\_END\_DIAG\_GEN\_DIAG = 1:  
see chapter Anti - bounce Algorithm: Calculation of the end of diagnosis*

## A.111 Energy spare mode diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_EGY_MIN	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom EGY_MIN					
ERR_SYM_EGY_MIN_2	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom EGY_MIN for transportation mode					
LV_CDN_DIAG_EGY_MIN	V	0... 1H	0 ...1	1	-
Diagnosis condition EGY_MIN					
LV_CDN_DIAG_EGY_MIN_2	V	0... 1H	0 ...1	1	-
Diagnosis condition EGY_MIN for transportation mode					
LV_END_DIAG_EGY_MIN	V	0... 1H	0 ...1	1	-
End of Diagnosis EGY_MIN					
LV_END_DIAG_EGY_MIN_2	V	0... 1H	0 ...1	1	-
End of Diagnosis EGY_MIN for transportation mode					
LV_ERR_EGY_MIN	O/V	0... 1H	0 ...1	1	-
Energy spare mode (EGY_MIN - Energiesparmodus) error flag					
LV_ERR_EGY_MIN_2	O/V	0... 1H	0 ...1	1	-
Energy spare mode (EGY_MIN - Energiesparmodus) error flag for transportation mode					

### Input data:

LV_IGK {p. 906}	STATE_EGY_MIN_KWP {p. 7483}		
-----------------	--------------------------------	--	--


### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_EGY_MIN_DIAG	-	0... 1H	0 ...1	1	-
Activation of energy spare mode diagnosis					
LC_EGY_MIN_DIAG_2	-	0... 1H	0 ...1	1	-
Activation of energy spare mode diagnosis for transportation mode					

### Error treatment:

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Energy spare mode for production and garage mode (EGY_MIN - Energiesparmodus) error flag	EGY_MIN	Fertigungsmodus	0	NO	CC
			1		
		Werkstattmodus	2		
			3		

Possible configuration for ABC type and CARB class (see also "Table of Failure")

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ABC Type: STD\_INI, STD, MEM, MEM\_INI, DEC\_CAL, STC, NO, MPL\_STD\_INI  
 CARB Class: MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Energy spare mode for transportation mode (EGY_MIN_2 - Energiesparmodus) error flag	EGY_MIN_2		0	NO	CC
		Transportmodus	1		
			2		
			3		

Possible configuration for ABC type and CARB class (see also "Table of Failure")

ABC Type: STD\_INI, STD, MEM, MEM\_INI, DEC\_CAL, STC, NO, MPL\_STD\_INI  
 CARB Class: MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO

### A.111.1 LV\_ERR\_EGY\_MIN for production and garage mode

#### FUNCTION DESCRIPTION:

##### General information:

The purpose of the diagnosis shall be to detect an activated energy spare mode. There are different energy spare modes. In this chapter the production and the garage mode are treated.

##### Application conditions

**Initialisation:** all 0 at LV\_IGK 0 -> 1 **or** reset  
 LV\_END\_DIAG\_EGY\_MIN is initialized by ERRM

**Recurrence:** 1s

**Activation:** **If** LV\_IGK = 1 **and** LC\_EGY\_MIN\_DIAG = 1  
**Then** LV\_CDN\_DIAG\_EGY\_MIN = 1  
**Endif**

**Deactivation:** **If** LV\_IGK = 0 **or** LC\_EGY\_MIN\_DIAG = 0  
**Then** LV\_CDN\_DIAG\_EGY\_MIN = 0  
**Endif**

##### Formula section:

**If** STATE\_EGY\_MIN\_KWP = 0 **or** STATE\_EGY\_MIN\_KWP = 2  
**Then** LV\_ERR\_EGY\_MIN = 0  
 ERR\_SYM\_EGY\_MIN = NO\_SYM

**Else** LV\_ERR\_EGY\_MIN = 1  
**If** STATE\_EGY\_MIN\_KWP = 1  
**Then** ERR\_SYM\_EGY\_MIN = SYM\_0  
**Elseif** STATE\_EGY\_MIN\_KWP = 3  
**Then** ERR\_SYM\_EGY\_MIN = SYM\_2  
**Endif**

**Endif**  
 LV\_END\_DIAG\_EGY\_MIN = 1

## A.111.2 LV\_ERR\_EGY\_MIN\_2 for transportation mode

### FUNCTION DESCRIPTION:

#### General information:

The purpose of the diagnosis shall be to detect an activated energy spare mode. There are different energy spare modes. In this chapter the transportation mode is treated.

#### Application conditions

**Initialisation:** all 0 at LV\_IGK 0 -> 1 **or** reset  
LV\_END\_DIAG\_EGY\_MIN\_2 is initialized by ERRM

**Recurrence:** 1s

**Activation:** **If** LV\_IGK = 1 **and** LC\_EGY\_MIN\_DIAG\_2 = 1  
**Then** LV\_CDN\_DIAG\_EGY\_MIN\_2 = 1  
**Endif**

**Deactivation:** **If** LV\_IGK = 0 **or** LC\_EGY\_MIN\_DIAG\_2 = 0  
**Then** LV\_CDN\_DIAG\_EGY\_MIN\_2 = 0  
**Endif**

#### Formula section:

**If** STATE\_EGY\_MIN\_KWP = 2  
**Then** LV\_ERR\_EGY\_MIN\_2 = 1  
ERR\_SYM\_EGY\_MIN\_2 = SYM\_1  
**Else** LV\_ERR\_EGY\_MIN\_2 = 0  
ERR\_SYM\_EGY\_MIN\_2 = NO\_SYM  
**Endif**

LV\_END\_DIAG\_EGY\_MIN\_2 = 1



## A.112 Key position diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_PLAUS_IGK_3	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
detected error symptom on KL15-3					
ERR_SYM_PLAUS_IGK_BN	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
detected error symptom					
LV_CDN_DIAG_PLAUS_IGK_3	V	0... 1H	0 ...1	1	-
diagnosis condition					
LV_CDN_DIAG_PLAUS_IGK_BN	V	0... 1H	0 ...1	1	-
diagnosis condition					
LV_END_DIAG_PLAUS_IGK_3	O/V	0... 1H	0 ...1	1	-
end of diagnosis of KL15-3					
LV_END_DIAG_PLAUS_IGK_BN	O/V	0... 1H	0 ...1	1	-
end of diagnosis					
LV_ERR_PLAUS_IGK_3	O/V	0... 1H	0 ...1	1	-
plausibility error of IGK-signal 15-3 to signal IGK-WUP					
LV_ERR_PLAUS_IGK_BN	O/V	0... 1H	0 ...1	1	-
plausibility error of IGK-signal from CAN/HW					

### Input data:


LV_MU_IGN_KEY {p. 7135}	LV_VAR_BN {p. 655}	LV_VAR_L6 {p. 805}	STATE_PLAUS_IGK_BN {p. 906}
VB {p. 1185}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_PLAUS_IGK_3	-	0... FFH	0... 255	1	-
Debounce counter increment - igk-signal 15-3 plausibility diagnosis					
C_ABC_INC_PLAUS_IGK_BN	-	0... FFH	0... 255	1	-
Debounce counter increment - igk-signal plausibility diagnosis					
C_ABC_MAX_PLAUS_IGK_3	-	1... FFH	1... 255	1	-
Debounce counter max. value - igk-signal 15-3 plausibility diagnosis					
C_ABC_MAX_PLAUS_IGK_BN	-	1... FFH	1... 255	1	-
Debounce counter max. value - igk-signal plausibility diagnosis					
C_VB_MIN_IGK_DIAG	-	0... FFH	0... 25.89843	0.1015625	V
VB threshold for de-/activation of IGK-diagnosis					

### Import actions:

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<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,,OUT<PRM_LV_ERR>)

**Error treatment:**

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
plausibility error of IGK-signal from CAN/HW	PLAUS_IGK_BN	SCB	0	STD_INI	CC
		SCG	1		
		CAS error	2		
		CAS-plausibility error	3		

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
plausibility error of IGK-signal KL15-3	PLAUS_IGK_3	SCB	0	STD_INI	CC
		SCG, OL	1		
		-	2		
		-	3		

**A.112.1 Plausibility check between signal from CAN and HW-signal****FUNCTION DESCRIPTION:****Description:**

For BN2000-vehicles there are two possibilities of getting the LV\_IGK-signal:

1. via CAN (from the control unit CAS)
2. via HW-signal ("Weckleitung")

In order to detect a CAS error or a HW-error (e.g. shortcut to ground) a plausibility check has to be done between CAN-signal and HW-signal. SYM\_0, SYM\_1 and SYM\_3 are debounced with the recurrence of Klemmenstatus or Klemmen message. SYM\_2 is debounced with the recurrence of 10 ms (no message with Klemmen information available).


**Application conditions**

**Initialisation:** *all 0 at reset*

**Recurrence:** *10ms*

```

Activation:
    if LV_VAR_BN = 1
    then if (VB > = C_VB_MIN_IGK_DIAG)
    then LV_CDN_DIAG_PLAUS_IGK_BN = 1
    endif
    else LV_CDN_DIAG_PLAUS_IGK_BN = 0
    endif
  
```

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```

Deactivation:      if                (VB < C_VB_MIN_IGK_DIAG)      or
                    at                State bus sleep
                    then              LV_CDN_DIAG_PLAUS_IGK_BN = 0
                    endif

```

### Formula section:

```

IF                STATE_PLAUS_IGK_BN = 0H      and
                    Klemmen or Klemmenstatus message from CAS received
THEN              ERR_SYM_PLAUS_IGK_BN = NO_SYM
                    LV_ERR_PLAUS_IGK_BN = 0      after rebound
ELSEIF            STATE_PLAUS_IGK_BN = 1H
THEN              ERR_SYM_PLAUS_IGK_BN = SYM_0      //SCB, Master CAN
                    LV_ERR_PLAUS_IGK_BN = 1      after debounce
ELSEIF            STATE_PLAUS_IGK_BN = 2H
THEN              ERR_SYM_PLAUS_IGK_BN = SYM_1      //SCG, Master CAN
                    LV_ERR_PLAUS_IGK_BN = 1      after debounce
ELSEIF            STATE_PLAUS_IGK_BN = 4H
THEN              ERR_SYM_PLAUS_IGK_BN = SYM_2      //CAS error, Master HW
                    LV_ERR_PLAUS_IGK_BN = 1      after debounce
ELSEIF            STATE_PLAUS_IGK_BN = 8H
THEN              ERR_SYM_PLAUS_IGK_BN = SYM_3      // CAN-signal not plausible
ENDIF

```

For calculation of condition-diagnosis-bit and end of diagnosis-bit LV\_END\_DIAG\_PLAUS\_IGK\_BN see "Anti-bounce - algorithmus, calculation of the end of diagnosis"

For failure and error management treatment the anti-bounce mechanism is called :

```

ACTION_ERRM_FilterSymptom( IN<NC_IDX_DIAG_PLAUS_IGK_BN>, IN<LV_CDN_DIAG_PLAUS_IGK_BN>,
IN<ERR_SYM_PLAUS_IGK_BN>, IN<ABC_INC_PLAUS_IGK_BN>, IN<1>, IN<ABC_MAX_PLAUS_IGK_BN>,
OUT<LV_ERR_PLAUS_IGK_BN>)

```

## **A.112.2 Diagnosis of KL15-3 with plausibility check to the signals from CAN and HW-signal KL15-WUP**

### FUNCTION DESCRIPTION:

#### Description:

The HW-signal KL15-3 is redundant to the KI15WUP, but the engine won't start if KL15-3 is not available. To make the reason of a non starting engine in the case of a missing KL15-3-line visible, a diagnosis for the signal is necessary.


To detect a error at the input KL15-3, a plausibility check to the KI15WUP and the CAN-signal has to be done.

SYM\_0, SYM\_1 are debounced with the recurrence of Klemmenstatus or Klemmen message).

#### Application conditions

**Initialisation:**            *all 0 at reset*

**Recurrence:**                *10ms*

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```

Activation:          If                LV_VAR_BN = 1          or
                        LV_VAR_L6 = 1
Then          if                (VB > = C_VB_MIN_IGK_DIAG) and
                        STATE_PLAUS_IGK_BN = 0
then          LV_CDN_DIAG_PLAUS_IGK_3 = 1
endif
Else          LV_CDN_DIAG_PLAUS_IGK_3 = 0
Endif

Deactivation:      If                (VB < C_VB_MIN_IGK_DIAG)          or
                        at State bus sleep          or
                        STATE_PLAUS_IGK_BN != 0
then          LV_CDN_DIAG_PLAUS_IGK_3 = 0
endif

```

**Formula section:**

```

If                STATE_PLAUS_IGK_BN = 0
Then
  If                LV_IGK = 1
  Then
    If                LV_MU_IGN_KEY = 1          // Pin KL15_3 is high
    Then ERR_SYM_PLAUS_IGK_3 = NO_SYM
          // LV_ERR_PLAUS_IGK_3 = 0          after debounce
    Else ERR_SYM_PLAUS_IGK_3 = SYM_1          // SCG or OL
          // LV_ERR_PLAUS_IGK_3 = 1          after debounce
    Endif
  Else
    If                LV_MU_IGN_KEY = 0          // Pin KL15_3 is low
    Then ERR_SYM_PLAUS_IGK_3 = NO_SYM
          // LV_ERR_PLAUS_IGK_3 = 0          after debounce
    Else ERR_SYM_PLAUS_IGK_3 = SYM_0          // SCB
          // LV_ERR_PLAUS_IGK_3 = 1          after debounce
    Endif
  Endif
Else                LV_CDN_DIAG_PLAUS_IGK_3 = 0
Endif

```

For failure and error management treatment the anti-bounce mechanism is called :

```

ACTION_ERRM_FilterSymptom( IN<NC_IDX_DIAG_PLAUS_IGK_3>, IN<LV_CDN_DIAG_PLAUS_IGK_3>,
IN<ERR_SYM_PLAUS_IGK_3>, IN<ABC_INC_PLAUS_IGK_3>, IN<1>, IN<ABC_MAX_PLAUS_IGK_3>,
OUT<LV_ERR_PLAUS_IGK_3>)

```

## A.113 Main relay diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_RLY_MAIN	-	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of RLY_MAIN bit 0: diagnosis condition for symptom SCP (SYM_0) bit1: diagnosis condition for symptom SCPG(SYM_1) bit2 diagnosis condition for symptom OC (SYM_2)					
CTR_DIAG_RLY_MAIN_DLY	V	0... FFH	0... 255	1	-
Debounce counter - main relay diagnosis for "switch on" diagnosis					
CTR_END_DIAG_RLY_MAIN_DLY	V	0... FFH	0... 255	1	-
counter for END_DIAG - main relay diagnosis for "switch on" diagnosis					
ERR_RLY_MAIN	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for RLY_MAIN (only Parameter)					
ERR_SYM_RLY_MAIN	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom RLY_MAIN					
ERR_SYM_RLY_MAIN_DLY	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom RLY_MAIN_DLY					
LV_CDN_DIAG_RLY_MAIN	O/V	0... 1H	0 ...1	1	-
Diagnosis condition RLY_MAIN					
LV_CDN_DIAG_RLY_MAIN_DLY	O/V	0... 1H	0 ...1	1	-
Diagnosis condition RLY_MAIN_DLY					
LV_DIAG_END_RLY_MAIN_DLY	O/V	0... 1H	0 ...1	1	-
End of Diagnosis RLY_MAIN_DLY (flag not for error management)					
LV_END_DIAG_RLY_MAIN	O/V	0... 1H	0 ...1	1	-
End of Diagnosis RLY_MAIN					
LV_END_DIAG_RLY_MAIN_DLY	O/V	0... 1H	0 ...1	1	-
End of Diagnosis RLY_MAIN_DLY					
LV_ERR_RLY_MAIN	O/V	0... 1H	0 ...1	1	-
Boolean for error detected at the main relay.					
LV_ERR_RLY_MAIN_DLY	O/V	0... 1H	0 ...1	1	-
Error detected switch on relay					
LV_RLY_MAIN_DLY_ERR	O/V	0... 1H	0 ...1	1	-
Error detected switch on relay (flag not for error management)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_DLY_RLY_MAIN_DIAG	O/V	0... FFH	0... 2550	10	ms
delay Timer for the diagnosis to allow switching of the relay					
T_RLY_MAIN_DIAG	V	0... FFH	0... 2550	10	ms
Time window to perform the main relay diagnosis.					

**Input data:**

LV_IGK {p. 906}	LV_RLY_MAIN {p. 3772}	LV_VAR_L6 {p. 805}	PWL_LOCK_CDN {p. 3776}
V_IGK {p. 1185}	VB {p. 1185}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_RLY_MAIN	-	0... FFH	0... 255	1	-
Debounce counter increment - RLY_MAIN diagnosis					
C_ABC_MAX_RLY_MAIN	-	1... FFH	1... 255	1	-
Debounce counter maximum value - RLY_MAIN diagnosis					
C_CTR_INC_DIAG_RLY_MAIN_DLY	V	0... FFH	0... 255	1	-
Debounce counter increment - main relay "too slow" diagnosis					
C_CTR_INC_END_DIAG_RLY_MAIN_DLY	V	0... FFH	0... 255	1	-
counter increment for END_DIAG - main relay "too slow" diagnosis					
C_CTR_MAX_DIAG_RLY_MAIN_DLY	V	1... FFH	1... 255	1	-
Debounce counter maximum value - main relay "too slow" diagnosis					
C_CTR_MAX_END_DIAG_RLY_MAIN_DLY	V	1... FFH	1... 255	1	-
counter maximum value for END_DIAG - main relay "too slow" diagnosis					
C_T_DLY_RLY_MAIN_DIAG	-	0... FFH	0... 2550	10	ms
Delay Time for the diagnosis to allow switching of the relay.					
C_T_RLY_MAIN_DIAG	-	0... FFH	0... 2550	10	ms
Time window to perform the main relay diagnosis					
C_V_IGK_RLY_MAIN_DIAG	-	0... FFH	0... 25.8984375	0.1015625	V
voltage threshold for detection of main relay on.					
C_VB_RLY_MAIN_DIAG	-	0... FFH	0... 25.8984375	0.1015625	V
voltage threshold for detection of battery voltage present.					
C_VB_RLY_MAIN_DLY_DIAG	V	0... FFH	0... 25.8984375	0.1015625	V
Voltage threshold for main relay "too slow" diagnosis					


**Import actions:**

**ACTION\_INFR\_GetEIDiagRlyMain** (OUT<PRM\_CDN\_DIAG\_RLY\_MAIN>,OUT<PRM\_ERR\_RLY\_MAIN>)

**Error treatment**

Diagnostic Identifier	Symptom Description	Nr	OBD DTC	Sym	OBD Global DTC	Filter Type	CARB class
RLY_MAIN	Main relay has not switched off	0				STD_INI	CC
Main relay "switch on"	Main relay has not switched on	1					

*"switched off" diagnosis*

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Diagnostic Identifier	Symptom Description	Nr	OBD DTC	Sym	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>							
		2					
		3					

Diagnostic Identifier	Symptom Description	Nr	OBD DTC	Sym	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>							
RLY_MAIN_DLY	Main relay hasn't switched before predrive check	0				NO	CC
<i>Main relay "switched on too slow" diagnosis for pre-drive check</i>		1					
		2					
		3					

## General information

The Main Relay Diagnosis is performed to detect if the Main Relay has switched and remains on after Key-On and if it has switched off after the Power Latch Phase

### A.113.1 Main relay "switch on" / "switched off" diagnosis

#### General information:

#### Description:

The diagnosis is delayed for C\_T\_DLY\_RLY\_MAIN\_DIAG to allow the relay to switch on/off. After this the actual VB is compared with a diagnostic threshold. If the error conditions are fulfilled the error is debounced.

If an error is detected after the Power Latch Phase the ECU is switched off after T\_RLY\_MAIN\_DIAG has elapsed.

Error-symptoms are defined to this diagnosis function as following :

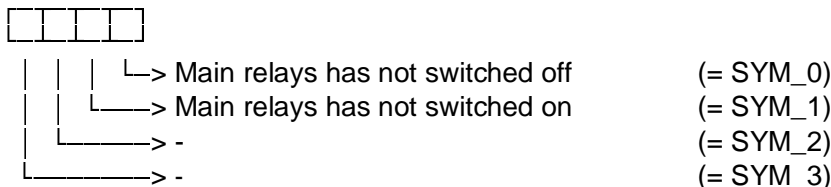



Figure A.113.1:

#### Application conditions:

**Initialisation:** all 0 at LV\_IGK 0->1 or reset or at clearing error memory

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but T\_RLY\_MAIN\_DIAG is calculated as described below

**Activation:** see Formula section

**Deactivation:** -

**Recurrence:** The application recurrence for the Diagnosis is 10 ms;  
The "Main Relay Off"-Detection is performed only once after  
power latch.

### Function description:

### Formula section:

#### Detection if Main Relay is on during Key-On

Call I/O Power-Stage-Diagnosis (Short to Ubatt) and ignore return value in order to restart the Power-Stage after shut off due to short circuit to battery

*//this is done to try to wake up the power stage after instable battery voltage*

ACTION\_INFR\_GetElDiagRlyMain (OUT<cdn\_diag\_rly\_main>, OUT<err\_rly\_main>)

```

If (1)  LV_RLY_MAIN = 1          and
         LV_END_DIAG_RLY_MAIN = 0 and
         V_IGK > C_V_IGK_RLY_MAIN_DIAG
         //direct connection to the battery,
         //to ensure a battery voltage that would be able to switch the relay

Then (1)  wait time: C_T_DLY_RLY_MAIN_DIAG
         //time to allow the relay to switch, set only once. For continuous
         //diagnosis set to 0

         If (2)    C_T_DLY_RLY_MAIN_DIAG has run out //if started, see above
         Then (2)  LV_CDN_DIAG_RLY_MAIN = 1
         If (3)    VB < C_VB_RLY_MAIN_DIAG
         //connection to battery via main relay

         Then (3)  ERR_SYM_RLY_MAIN = SYM_1
         LV_ERR_RLY_MAIN = 1 //after debounce

         Else (3)  ERR_SYM_RLY_MAIN = NO_SYM
         LV_ERR_RLY_MAIN = 0 //after rebound
         //error can only be reset with LV_IGK 0->1 because
         //diagnosis doesn't run after an error has been detected !


         Endif (3)
         Else (2)  C_T_DLY_RLY_MAIN_DIAG //is still running
         Endif (2)
         Else (1)  LV_CDN_DIAG_RLY_MAIN = 0 //no Diagnosis
         Endif (1)

If LV_VAR_L6 = 0
Then set lock condition once to extend power latch phase (PWL_LOCK_CDN)
Endif
// because the OFF-diagnosis is used only in L4 projects, the PWL_LOCK_CDN should
// be set only in L4 projects.

```

#### Calculation end of diagnosis

LV\_END\_DIAG\_RLY\_MAIN is calculated by error management after diagnosis is active

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**Detection if Main Relay is off after Power Latch Phase:**

```

If (1)    LV_RLY_MAIN = 0 and LV_VAR_L6 = 0 // no Relay-OFF-diagnosis at L6
Then (1)  LV_END_DIAG_RLY_MAIN = 0
            LV_ERR_RLY_MAIN = 0 //reset of error to be able to set it with
                                new symptom
            start time:    C_T_DLY_RLY_MAIN_DIAG
            //time to allow the relay to switch
If (2)    PWL_LOCK_CDN is set and
            C_T_DLY_RLY_MAIN_DIAG has run out
Then (2)  start T_RLY_MAIN_DIAG for C_T_RLY_MAIN_DIAG
            (start the time window during the diagnosis is performed)
If (3)    T_RLY_MAIN_DIAG is still running
Then (3)  LV_CDN_DIAG_RLY_MAIN = 1
If (4)    VB > C_VB_RLY_MAIN_DIAG
            //connection to battery via main relay
Then (4)  ERR_SYM_RLY_MAIN = SYM_0
            LV_ERR_RLY_MAIN = 1 //after debounce
Else (4)  ERR_SYM_RLY_MAIN = NO_SYM
            LV_ERR_RLY_MAIN = 0 //after rebound
Endif (4)
Else (3)  LV_CDN_DIAG_RLY_MAIN = 0
            erase lock condition for power latch phase (PWL_LOCK_CDN)
Else (2)  T_RLY_MAIN_DIAG = 0 //reset
            LV_CDN_DIAG_RLY_MAIN = 0 //no switched off Diagnosis
Endif (2)
Else (1)  LV_CDN_DIAG_RLY_MAIN = 0 //no Diagnosis
Endif (1)

```

**A.113.2 Main relay “switched on too slow” diagnosis for pre-drive check****General information:****Description:**

The main relay diagnosis is performed at reset to detect if the main relay has been switched on within the correct timing. This diagnostic is comparable to main relay switch on, but is separated for having faster reaction time.

Once no failure has been found, diagnosis is then disabled.

The diagnosis starts after LV\_IGK 0->1. After this the actual VB is compared with a diagnostic threshold. If the error conditions are fulfilled the error is debounced.

Error-symptoms are defined to this diagnosis function as following :

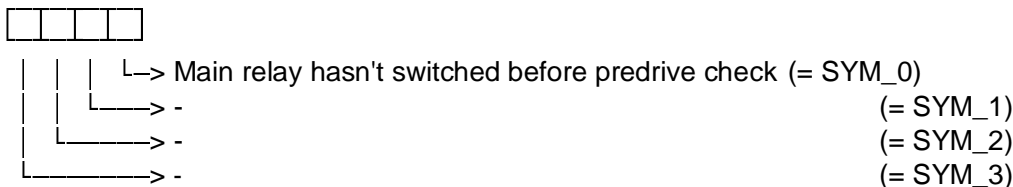


Figure A.113.2:

**Application conditions:****Initialisation:**

ERRM data according filter type: **NO**  
 At reset :           LV\_CDN\_DIAG\_RLY\_MAIN\_DLY = 0  
                   LV\_ERR\_RLY\_MAIN\_DLY = 0  
                   ERR\_SYM\_RLY\_MAIN\_DLY = NO\_SYM  
                   CTR\_END\_DIAG\_RLY\_MAIN\_DLY = 0  
                   CTR\_DIAG\_RLY\_MAIN\_DLY = 0  
                   LV\_DIAG\_END\_RLY\_MAIN\_DLY = 0  
                   LV\_RLY\_MAIN\_DLY\_ERR = 0  
 At clearing FMY: reset of FMY variables according ERRM

**Activation:**

LV\_IGK = 1

**Deactivation:**

LV\_DIAG\_END\_RLY\_MAIN\_DLY = 1 **and** LV\_RLY\_MAIN\_DLY\_ERR = 0  
 set LV\_CDN\_DIAG\_RLY\_MAIN\_DLY = 0

**Recurrence:**

10 ms

**Function description:****Formula section:**

**If (1)** LV\_RLY\_MAIN = 1

**Then (1)**

LV\_CDN\_DIAG\_RLY\_MAIN\_DLY = 1

**If (2)**

VB >= C\_VB\_RLY\_MAIN\_DLY\_DIAG  
 (connection to battery via main relay)

**Then (2)**

ERR\_SYM\_RLY\_MAIN\_DLY = NO\_SYM  
 CTR\_END\_DIAG\_RLY\_MAIN\_DLY = CTR\_END\_DIAG\_RLY\_MAIN\_DLY +  
                                   C\_CTR\_INC\_END\_DIAG\_RLY\_MAIN\_DLY

**If (3a)**

CTR\_END\_DIAG\_RLY\_MAIN\_DLY >= C\_CTR\_MAX\_END\_DIAG\_RLY\_MAIN\_DLY

**Then (3a)**

LV\_END\_DIAG\_RLY\_MAIN\_DLY = 1  
 LV\_DIAG\_END\_RLY\_MAIN\_DLY = 1  
 LV\_ERR\_RLY\_MAIN\_DLY = 0  
 LV\_RLY\_MAIN\_DLY\_ERR = 0

**Endif (3a)**

**Else (2)**

**If (3b)** V\_IGK > C\_V\_IGK\_RLY\_MAIN\_DIAG

**Then (3b)** ERR\_SYM\_RLY\_MAIN\_DLY = SYM\_0

CTR\_DIAG\_RLY\_MAIN\_DLY = CTR\_DIAG\_RLY\_MAIN\_DLY +  
                                   C\_CTR\_INC\_DIAG\_RLY\_MAIN\_DLY

**If (4)**

CTR\_DIAG\_RLY\_MAIN\_DLY >= C\_CTR\_MAX\_DIAG\_RLY\_MAIN\_DLY

**Then (4)**

LV\_END\_DIAG\_RLY\_MAIN\_DLY = 1  
 LV\_DIAG\_END\_RLY\_MAIN\_DLY = 1  
 LV\_ERR\_RLY\_MAIN\_DLY = 1  
 LV\_RLY\_MAIN\_DLY\_ERR = 1  
 CTR\_END\_DIAG\_RLY\_MAIN\_DLY = 0

**Endif (4)**


**Endif (3b)**

**Endif (2)**

**Else (1)**

LV\_CDN\_DIAG\_RLY\_MAIN\_DLY = 0

**Endif (1)**

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## A.114 Main relay diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_ACK_IGK_OFF	V	0... 7H	0 ...7	1	-
Diagnosis condition ACK_IGK_OFF for each symptom					
ERR_DIAG_ACK_IGK_OFF	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for ACK_IGK_OFF (only parameter)					
ERR_SYM_ACK_IGK_OFF	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom ACK_IGK_OFF power stage diagnosis					
LV_CDN_DIAG_ACK_IGK_OFF	V	0... 1H	0 ...1	1	-
Diagnosis condition ACK_IGK_OFF power stage diagnosis					
LV_END_DIAG_ACK_IGK_OFF	V	0... 1H	0 ...1	1	-
End of diagnosis ACK_IGK_OFF power stage diagnosis					
LV_ERR_ACK_IGK_OFF	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on ACK_IGK_OFF power stage					

### Input data:

LC_IGK_OFF_ACK {p. 3772}	LV_CDN_VB_OBD1 {p. 1185}	LV_IGK {p. 906}	LV_IGK_OFF_ACK {p. 3772}
LV_IGK_OFF_ACK_ENA {p. 7680}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_ACK_IGK_OFF	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_ACK_IGK_OFF	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_ACK_IGK_OFF	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (= 2)					

### Import actions:

<b>ACTION_ERRM_FilterMulticondition</b> (IN<XX>,IN<CDN_DIAG_>,XX>,<IN<>,ERR_DIAG_XX>,<IN>,<C_ABC_INC_XX>,IN<C_ABC_MAX_XX>,OUT<LV_ERR_XX>)
Continued on next page

<b>ACTION_INFR_GetEIDiagIGK_OFF (OUT&lt;Cdn_diag_ack_igk_off&gt;,OUT&lt;Err_diag_ack_igk_off&gt;)</b>
---

**Note :**

ACTION\_INFR\_GetEIDiagIGK\_OFF(), ACTION\_INFR\_SetEIDiagIGK\_OFF() are defined in the IRS (Infrastructure requirement specification)

**FUNCTION DESCRIPTION:****General information:**

The HW line acknowledge IGK off /starter relay for start stop automatic (STST) is driven by the ECU via an output driver. The failure detection is done by ECU Hardware.

The purpose of the diagnosis is to detect electrical faults as defined by OBD I requirements.

**Description:**

After activation conditions are met, the diagnosis activation is delayed for NC\_PSD\_DLY\_ACK\_IGK\_OFF executions, to avoid the usage of wrong infrastructure information.

**Error-symptoms and conditions:** are defined to this diagnosis function as following

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name	Description	Nr		
HW line acknowledge IGK_OFF / starter relay for start stop automatic (STST)	ACK_IGK_OFF	Sym 0 Short circuit to battery (SCP)	0	MPL_STD _INI	CC
		Sym 1 Short circuit to ground (SCG)	1		
		Sym 2 Open circuit (OC)	2		
		Sym 3 -	3		

**Application conditions****Initialisation:**

```

at transition LV_IGK 0 - -> 1:
  Set delay counter for NC_PSD_DLY_ACK_IGK_OFF
  at reset:
  Set delay counter for NC_PSD_DLY_ACK_IGK_OFF

```

**Recurrence:**

```

if      LV_IGK_OFF_ACK = 0
then    100 ms
else    20ms
endif

```

**Activation:**

```

LC_IGK_OFF_ACK = 1 and LV_IGK_OFF_ACK_ENA = 1

```

**Deactivation:**

```

LC_IGK_OFF_ACK = 0 or LV_IGK_OFF_ACK_ENA = 0

```

**Formula section:**


```

if      LV_IGK = 1 and
          LV_CDN_VB_OBD1 = 1

```

**Then**

Usage of the diagnosis information (failure symptoms (raw value) ERR\_DIAG\_ACK\_IGK\_OFF and basic diagnosis conditions CDN\_DIAG\_ACK\_IGK\_OFF) received from the infrastructure:

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ACTION\_INFR\_GetEIDiagIGK\_OFF (OUT<Cdn\_diag\_ack\_igk\_off>, OUT<Err\_diag\_ack\_igk\_off>)

Basic diagnosis conditions are set according infrastructure information: CDN\_DIAG\_ACK\_IGK\_OFF  
Failure symptoms (raw value) are set according infrastructure information: ERR\_DIAG\_ACK\_IGK\_OFF

**If** Activation conditions are met for the NC\_PSD\_DLY\_ACK\_IGK\_OFF recurrence of the diagnosis

**Then** [CDN\_DIAG\_ACK\_IGK\_OFF valid from Infrastructure]

**Else** CDN\_DIAG\_ACK\_IGK\_OFF = 0

**Endif**

**Else**

CDN\_DIAG\_ACK\_IGK\_OFF = 0

**Endif**

Failure filtering and error management treatment:

For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN\_DIAG\_ACK\_IGK\_OFF and ERR\_DIAG\_ACK\_IGK\_OFF.

ACTION\_ERRM\_FilterMulticondition (IN<ACK\_IGK\_OFF>, IN<CDN\_DIAG\_ACK\_IGK\_OFF>, IN<ERR\_DIAG\_ACK\_IGK\_OFF>, IN<C\_ABC\_INC\_ACK\_IGK\_OFF>, IN<C\_ABC\_MAX\_ACK\_IGK\_OFF>, OUT<LV\_ERR\_ACK\_IGK\_OFF>)

This algorithm determines:

ERR\_DIAG\_ACK\_IGK\_OFF (detected error symptom for ACK\_IGK\_OFF diagnosis)

LV\_ERR\_ACK\_IGK\_OFF (Error flag for debounced error of ACK\_IGK\_OFF)

LV\_CDN\_DIAG\_ACK\_IGK\_OFF (Diagnosis condition information)

LV\_END\_DIAG\_ACK\_IGK\_OFF (End of diagnosis information)

## A.115 Active engine brackets diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_AEB [NC_AEB_NR]	V	0... 7H	0 ...7	1	-
Diagnosis condition AEB for each symptom					
ERR_DIAG_AEB [NC_AEB_NR]	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for AEB (only parameter)					
ERR_SYM_AEB [NC_AEB_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom AEB power stage diagnosis					
LV_CDN_DIAG_AEB [NC_AEB_NR]	O/V	0... 1H	0 ...1	1	-
Diagnosis condition AEB power stage diagnosis					
LV_END_DIAG_AEB [NC_AEB_NR]	O/V	0... 1H	0 ...1	1	-
End of diagnosis AEB power stage diagnosis					
LV_ERR_AEB [NC_AEB_NR]	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on AEB[i] power stage					

### Input data:

LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}	LV_VAR_AEB {p. 655}	LV_VB_CDN_OBD_1 {p. 1046}
-----------------------------	-----------------	---------------------	------------------------------

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_AEB	-	0... FFH	0... 255	1	-
Debounce counter increment AEB[i] power stage diagnosis					
C_ABC_MAX_AEB	-	1... FFH	1... 255	1	-
Debounce counter maximum value AEB[i] power stage diagnosis					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_AEB_NR	-	0... 2H	0 ...2	1	-
Number of active engine brackets					
NC_PSD_DLY_AEB	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (= 2)					

### Import actions:

<b>ACTION_ERRM_FilterMulticondition</b> (IN<XX>,IN<CDN_DIAG_>,XX>,<IN<>,ERR_DIAG_XX>,<IN>,<C_ABC_INC_XX>,IN<C_ABC_MAX_XX>,OUT<LV_ERR_XX>)
Continued on next page

<b>ACTION_INFR_GetEIDiagAEB (OUT&lt;CDN_DIAG_XX&gt;,OUT&lt;ERR_DIAG_XX&gt;)</b>
---

### Error treatment:

Diagnostic	Symptom description	Symptom	Filter type
<b>AEB</b>			
Active engine bracket Diagnostic	SCP	SYM_0	MPL_STD_INI
	SCG	SYM_1	
	OC	SYM_2	

### FUNCTION DESCRIPTION:

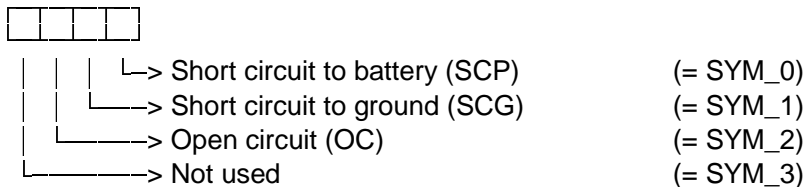
#### General information:

The AEB is driven by the ECU via an output driver. The failure detection is done by ECU Hardware. The purpose of the diagnosis is to detect electrical faults as defined by OBD I requirements. The AEB can be switched on or off (no PWM-signal).

#### Description:

The purpose is to perform the electrical diagnosis of the AEB actuator. 3 symptoms are distinguished:

**Error-symptoms and conditions:** are defined to this diagnosis function as following



### Application conditions

**Initialisation:** ERRM variables are initialized according Filter-type.  
At Reset: CDN\_DIAG\_AEB = 0

**Recurrence:** 100ms

**Activation:** LV\_IGK = 1 **and** LV\_VAR\_AEB = 1

**Deactivation:** LV\_IGK = 0 **or** LV\_VAR\_AEB = 0

### Formula section:

**If** LV\_ERR\_SPI\_MPS = 0  
**and** LV\_CDN\_VB\_OBD\_1 = 1

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**and** LV\_IGK = 1

**Then**

Usage of the diagnosis information (failure symptoms (raw value) ERR\_DIAG\_AEB and diagnosis conditions CDN\_DIAG\_AEB) received from the infrastructure:  
ACTION\_INFR\_GetEIDiagAEB (OUT<CDN\_DIAG\_AEB>, OUT<ERR\_DIAG\_AEB>)

Basic diagnosis conditions are set according infrastructure information: CDN\_DIAG\_AEB  
Failure symptoms (raw value) are set according infrastructure information: ERR\_DIAG\_AEB

**If** Activation conditions are met for the NC\_PSD\_DLY\_AEB recurrence

**Then**  
{ No additional diagnosis conditions are necessary }

**Else**  
CDN\_DIAG\_AEB = 0

**Endif**

**Else**  
CDN\_DIAG\_AEB = 0

**Endif**

Failure filtering and error management treatment:

For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN\_DIAG\_AEB and ERR\_DIAG\_AEB.

ACTION\_ERRM\_FilterMulticondition (IN<AEB>, IN<CDN\_DIAG\_AEB>,  
IN<ERR\_DIAG\_AEB>, IN<C\_ABC\_INC\_AEB>, IN<C\_ABC\_MAX\_AEB>,  
OUT< LV\_ERR\_AEB>)

This algorithm determines:

ERR\_SYM\_AEB (detected error symptom for AEB diagnosis)  
LV\_ERR\_AEB (Error flag for debounced error of AEB)  
LV\_CDN\_DIAG\_AEB (Diagnosis condition information)  
LV\_END\_DIAG\_AEB (End of diagnosis information)



## A.116 Variant coding diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ABC_VEH_POW_VAR	V	0... FFH	0... 255	1	-
antibounce counter error of wrong or unknown power variant					
ERR_SYM_VAR_COD	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
symptoms of variant coding error					
ERR_SYM_VEH_POW_VAR	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom wrong or unknown power variant					
LV_CDN_DIAG_VAR_COD	O/V	0... 1H	0 ...1	1	-
condition for diagnosis of variant coding					
LV_CDN_DIAG_VEH_POW_VAR	O/V	0... 1H	0 ...1	1	-
Diagnosis condition wrong or unknown power variant					
LV_END_DIAG_VAR_COD	O/V	0... 1H	0 ...1	1	-
diagnosis of variant coding ended					
LV_END_DIAG_VEH_POW_VAR	O/V	0... 1H	0 ...1	1	-
End of diagnosis wrong or unknown power variant					
LV_ERR_VAR_COD	O/V/S	0... 1H	0 ...1	1	-
Configuration variant coding error					
LV_ERR_VEH_POW_VAR	O/V	0... 1H	0 ...1	1	-
Present error of wrong or unknown power variant					
LV_POW_CLAS_VEH_CAN_REQ	O/V	0... 1H	0 ...1	1	-
LV to request CAN signal "vehicle type"					
T_POW_CLAS_VEH_CAN_REQ	V	0... FFH	0... 25.5	0.1	s
time since request of CAN signal "vehicle type"					
T_VEH_POW_VAR_ACT	V	0... FFH	0... 25.5	0.1	s
time since function "check of power variant" activation					

### Input data:

LV_ERR_CAN_BOFF {p. 4846}	LV_IGK {p. 906}	LV_POW_CLAS_VEH_ CAN_RCV {p. 1567}	LV_SWT_CHK_PMAX_ FINISHED
LV_SWT_PMAX_ENA	LV_VAR_BN {p. 655}	POW_CONF_IDX_EXT_ REQ {p. 7682}	STATE_POW_CLAS_VEH {p. 1575}
VIN_SHO [7] {p. 7541}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_POW_CLAS_VEH_ERR	-	1... FFH	1... 255	1	-
number of timeouts for antibounce of LV_ERR_VEH_POW_VAR					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_IDX_COD_CONV	-	0... FFH	0... 255	1	-
BMW coding index to disable check of successful BMW coding of variants via KWP					
C_STATE_POW_CLAS_VEH	-	0... 3H	0 ...3	1	-
calibrated status vehicle power class					
C_T_MAX_POW_CLAS_VEH_CAN_RCV	-	0... FFH	0... 25.5	0.1	s
timeout for receiving LV_POW_CLAS_VEH_CAN_RCV					
C_T_MIN_POW_CLAS_VEH_CAN_REQ	-	0... FFH	0... 25.5	0.1	s
delay time before check of power variant coding					
LC_VEH_POW_VAR_ERR_DIS	-	0... 1H	0 ...1	1	-
Logical constant to disable check of power variant coding					
LC_VEH_POW_VAR_TUN_ERR_DIS	-	0... 1H	0 ...1	1	-
Logical constant to disable check of tuning variant via SWT					

## A.116.1 Diagnosis of successful BMW coding of variants via KWP

### FUNCTION DESCRIPTION:

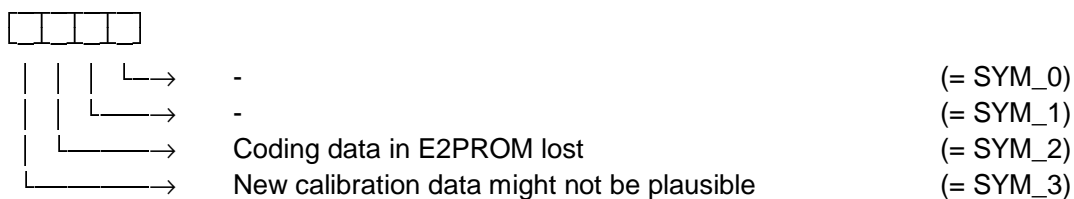
#### General information:

If not disabled by C\_IDX\_COD\_CONV, this function checks the successful BMW coding of variants via KWP. Therefore the CAL-ID (identifier of the calibration- dataset) which is actual programmed in Flash memory is compared with the CAL-ID in the E2PROM. The CAL-ID is written to E2PROM memory only by receiving the tester command \$3B\_90 - Kurze Fahrgestellnummer schreiben. The receiving of this command is interpreted as successful coding.

If the two Call-IDs are not equal, a error is written into error memory. This error can only be erased by clearing the error memory.

#### Description:

Error symptoms are defined for this diagnosis function as:



#### Application conditions

- Initialisation:** all output data are set to 0  
at clearing error memory
- Recurrence:** 1000 ms
- Activation:** LV\_IGK = 1 **and** LV\_ERR\_VAR\_COD = 0
- Deactivation:** not activation

**Formula section:**

```

If(1)      C_IDX_COD_CONV > 0
then(1)    LV_CDN_DIAG_VAR_COD = 1
            LV_END_DIAG_VAR_COD = 1
            if(2)      (all elements of VIN_SHO[7] (in RAM) = 0 or FFh) OR
                       CRC failure E2PROM
            then(2)    LV_ERR_VAR_COD = 1
                       ERR_SYM_VAR_COD = SYM_2
            else(2)    if(3)      CAL-ID in Flash memory  CAL-ID in E2PROM
                       then(3)    LV_ERR_VAR_COD = 1
                       ERR_SYM_VAR_COD = SYM_3
            endif(3)
            endif(2)
endif(1)
    
```

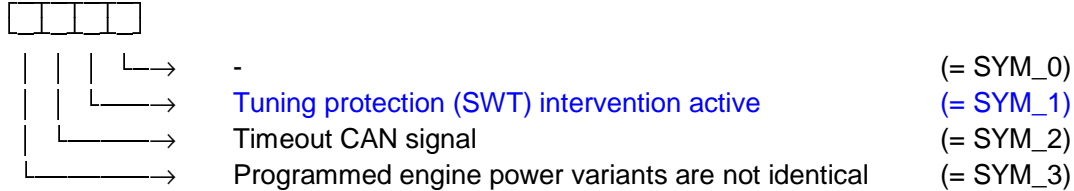
**A.116.2 Diagnosis of incorrect engine power variant**

**General information:**

If not disabled by LC\_VEH\_POW\_VAR\_(TUN\_)ERR\_DIS = 1, this function checks the plausibility of the programmed (tuning) engine power variant.

**Description:**

Error symptoms are defined for this diagnosis function as:



**Application conditions**

**Initialisation:** according ABC filter Type **MEM**; all other output data are set to 0 at LV\_IGK 01 **or** reset **or** at clearing error memory

**Recurrence:** 100 ms  
**Activation:** LV\_IGK = 1  
**Deactivation:** not activation

**Formula section:**

```

// General engine power variant check
If(0)      LV_ERR_CAN_BOFF = 0
then(0)
If(1)      LC_VEH_POW_VAR_ERR_DIS = 0
then(1)    T_VEH_POW_VAR_ACT = T_VEH_POW_VAR_ACTn-1 + 100 ms ,
    
```

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```

                                limited to 25.5 s
                                LV_CDN_DIAG_VEH_POW_VAR = 1
if(2)  T_VEH_POW_VAR_ACT    C_T_MIN_POW_CLAS_VEH_CAN_REQ
then(2)
if(2a) LV_VAR_BN = 0
      then(2a)
        if(2b) C_STATE_POW_CLAS_VEH POW_CONF_IDX_EXT_REQ
          then(2b)  ERR_SYM_VEH_POW_VAR = SYM_3
                    LV_ERR_VEH_POW_VAR = 1
                    LV_END_DIAG_VEH_POW_VAR = 1
          else(2b)
            ERR_SYM_VEH_POW_VAR = NO_SYM
            LV_END_DIAG_VEH_POW_VAR = 1
          endif(2b)
        else(2a)
if(3)  LV_POW_CLAS_VEH_CAN_RCV = 1
then(3)
if(4a) STATE_POW_CLAS_VEH POW_CONF_IDX_EXT_REQ
then(4a)  ERR_SYM_VEH_POW_VAR = SYM_3
          LV_ERR_VEH_POW_VAR = 1
          LV_END_DIAG_VEH_POW_VAR = 1
        else(4a)
if(5)  STATE_POW_CLAS_VEH C_STATE_POW_CLAS_VEH
then(5)  ERR_SYM_VEH_POW_VAR = SYM_3
          LV_ERR_VEH_POW_VAR = 1
          LV_END_DIAG_VEH_POW_VAR = 1
        else(5)
          ERR_SYM_VEH_POW_VAR = NO_SYM
          LV_END_DIAG_VEH_POW_VAR = 1
        endif(5)
      endif(4a)
    else(3)
if(4b) T_POW_CLAS_VEH_CAN_REQ = C_T_MAX_POW_CLAS_VEH_CAN_RCV
then(4b)  ERR_SYM_VEH_POW_VAR = SYM_2
          CTR_ABC_VEH_POW_VAR = CTR_ABC_VEH_POW_VARn-1 + 1
          T_POW_CLAS_VEH_CAN_REQ = 0
          LV_POW_CLAS_VEH_CAN_REQ = 0
if(6) CTR_ABC_VEH_POW_VAR = C_ABC_MAX_POW_CLAS_VEH_ERR
then(6)  LV_ERR_VEH_POW_VAR = 1
          LV_END_DIAG_VEH_POW_VAR = 1
        endif(6)
      else(4b)  LV_POW_CLAS_VEH_CAN_REQ = 1
               T_POW_CLAS_VEH_CAN_REQ = T_POW_CLAS_VEH_CAN_REQn-1
               + 100 ms
            endif(4b)
          endif(3)
        endif(2a)
      endif(2)
    endif(1)
  endif(0)

```

// Tuning engine power variant check

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```


if(0)          LC_VEH_POW_VAR_TUN_ERR_DIS = 0
then(0)       LV_CDN_DIAG_VEH_POW_VAR = 1
                if(1)          LV_SWT_CHK_PMAX_FINISHED = 1
                then(1)       LV_END_DIAG_VEH_POW_VAR = 1 // Calculation of flag is done by
                error mangement
                    if(2)          LV_SWT_PMAX_ENA = 0
                    then(2)       ERR_SYM_VEH_POW_VAR = SYM_1
                                LV_ERR_VEH_POW_VAR = 1

                                endif(2)
                endif(1)

endif(0)

```

// No call of error management after calculation of general engine power variant check, but after calculation of tuning engine power variant check

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## A.117 Electronic throttle control actuator adaptation diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ST_CHK_CHK_LIH_1_ERR	O/V/S	0... FFFFH	0... 65535	1	-
Start check check limp home 1 not passed					
CTR_ST_CHK_CHK_LIH_1_READY	O/V/S	0... FFFFH	0... 65535	1	-
Start check check limp home 1 passed					
ERR_SYM_TPS_AD	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom TPS_AD					
ERR_SYM_TPS_AD_BOL	V	0H 1H	NO_SYM SYM_0	-	-
Detected error symptom TPS_AD_BOL					
ERR_SYM_TPS_ST_CHK_1	V	0H 1H	NO_SYM SYM_0	-	-
Detected error symptom TPS_ST_CHK_1					
ERR_SYM_TPS_ST_CHK_2	V	0H 1H 2H	NO_SYM SYM_0 SYM_1	-	-
Detected error symptom TPS_ST_CHK_2					
INH_IV_TPS_AD	O	0... FFH	0... 255	1	-
Logical variable to inhibit injection and ignition during TPS adaptation					
LV_CDN_DIAG_TPS_AD	V	0... 1H	0 ...1	1	-
Logic variable data if diagnosis conditions TPS_AD are fulfilled					
LV_CDN_DIAG_TPS_AD_BOL	V	0... 1H	0 ...1	1	-
Logic variable data if diagnosis conditions TPS_AD_BOL are fulfilled					
LV_CDN_DIAG_TPS_ST_CHK_1	V	0... 1H	0 ...1	1	-
Logic variable data if diagnosis conditions TPS_ST_CHK_1 are fulfilled					
LV_CDN_DIAG_TPS_ST_CHK_2	V	0... 1H	0 ...1	1	-
Logic variable data if diagnosis conditions TPS_ST_CHK_2 are fulfilled					
LV_END_DIAG_TPS_AD	V	0... 1H	0 ...1	1	-
Logic variable data if end of diagnosis TPS_AD is reached					
LV_END_DIAG_TPS_AD_BOL	V	0... 1H	0 ...1	1	-
Logic variable data if end of diagnosis TPS_AD_BOL is reached					
LV_END_DIAG_TPS_ST_CHK_1	V	0... 1H	0 ...1	1	-
Logic variable data if end of diagnosis TPS_ST_CHK_1 is reached					
LV_END_DIAG_TPS_ST_CHK_2	V	0... 1H	0 ...1	1	-
Logic variable data if end of diagnosis TPS_ST_CHK_2 is reached					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_TPS_AD	O/V	0... 1H	0 ...1	1	-
TPS-error-bit (Adaptation)					
LV_ERR_TPS_AD_BOL	O/V	0... 1H	0 ...1	1	-
Error bit (set if the continuous adaptation of MEC_BOL not passed)					
LV_ERR_TPS_ST_CHK_1	O/V	0... 1H	0 ...1	1	-
TPS error bit (Return spring test)					
LV_ERR_TPS_ST_CHK_2	O/V	0... 1H	0 ...1	1	-
TPS error bit (Return spring test)					
LV_N_LIM_TPS_AD	O/V	0... 1H	0 ...1	1	-
Demand ETC-LIMP-HOME-2 (EMB)					
LV_TPS_AD_ACT	O/V	0... 1H	0 ...1	1	-
TPS Adaptation activ/passiv					
LV_TPS_AD_CUR_OFF	O/V	0... 1H	0 ...1	1	-
Logical variable to switch of the ETC controller during TPS adaptation					
LV_TPS_AD_DIAG_CUR_OFF	O/V	0... 1H	0 ...1	1	-
Demand ETC-LIMP-HOME-1					
LV_TPS_AD_REQ	O/V/S	0... 1H	0 ...1	1	-
Demand TPS-adaptation					
LV_TPS_ST_BOL_END	V	0... 1H	0 ...1	1	-
MEC_BOL check in ST_BOL routine finished					
TPS_AD_SLOP_GAIN_1	O/V/S	0... FFFFH	0... 7.99987	122e-6	-
Adaptation value of the amplification factor of amplified poti 1					
TPS_AD_STEP	O/V	0H	ST_LIH_1	-	-
		1H	ST_UP_POS		
		2H	ST_LIH_2		
		3H	ST_BOL		
		4H	ST_END		
		5H	AD_LIH_1		
		6H	AD_UP_POS		
		7H	AD_LIH_2		
		8H	AD_LOW_ STOP		
		9H	AD_GO_LIH		
AH	AD_LIH_3				
BH	AD_END				
Steps of throttle adaptation					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TPS_LIH_1	O/V/S	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Limp home position of the throttle valve of TPS-Poti 1					
TPS_LIH_2	O/V/S	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Limp home position of the throttle valve of TPS-Poti 2					
TPS_LIH_INI	O/V	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Limp home position of the throttle valve - initialization value					
TPS_SP_AD	O/V	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Throttle position setpoint during adaptation					
V_TPS_AD_BOL_GAIN_1	V	0... 3FFH	0... 4.99511	4.88e-3	V
Adaptation value for the lower mechanical stop of the amplification poti 1					
V_TPS_AD_EL_BOL_1	O/V/S	0... 3FFH	0... 4.99511	4.88e-3	V
Adaptation value for the lower stop, TPS-channel 1					
V_TPS_AD_EL_BOL_2	O/V/S	0... 3FFH	0... 4.99511	4.88e-3	V
Adaptation value for the lower stop, TPS-channel 2					
V_TPS_AD_LIH_1	O/V/S	0... 3FFH	0... 4.99511	4.88e-3	V
Adaptation value for the limp home position, TPS-channel 1					
V_TPS_AD_LIH_2	O/V/S	0... 3FFH	0... 4.99511	4.88e-3	V
Adaptation value for the limp home position, TPS-channel 2					
V_TPS_AD_OFS_GAIN_1	O/V/S	FE00... 200H	-2.5 ...2.5	4.88e-3	V
Adaptation value of the amplification offset of of amplified poti 1					
V_TPS_AD_TOL_1	V	0... 3FFH	0... 4.99511	4.88e-3	V
Non-amplified upper adaptation value for the adaptation of amplified of TPS-channel 1					
V_TPS_AD_TOL_GAIN_1	V	0... 3FFH	0... 4.99511	4.88e-3	V
Amplified upper adaptation value for the adaptation of amplified of TPS-channel 1					

**Input data:**

LV_ERR_MTC_CTL_1 {p. 4977}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}
LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_V_REF_1 {p. 4216}
LV_IGK {p. 906}	LV_MTC_CUR_OFF {p. 6565}	LV_ST {p. 1720}	N {p. 1525}
STATE_ETC_LIH {p. 4982}	TCO {p. 1100}	TIA {p. 1226}	TPS_AV {p. 1169}
TPS_LIH {p. 1169}	V_TPS_1 {p. 831}	V_TPS_2 {p. 831}	V_TPS_GAIN_1 {p. 986}
VB {p. 1185}	VS {p. 1176}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_MAX_TPS_AD	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for adaptation					
C_T_DYW_TPS_LIH_CHK	-	0... FFH	0... 1.275	0.005	s
Time period for Dynamic window around Limp Home					
C_T_MAX_ST_BOL	-	0... FFH	0... 1.275	0.005	s
Maximum time for adaptation of BOL position during Start Check					
C_T_MAX_TPS_AD	-	0... FFH	0... 1.275	0.005	s
Maximum time for adaptation of the LIH and BOL position					
C_T_MAX_TPS_LIH_CHK	-	0... FFH	0... 1.275	0.005	s
Maximum time for Limp Home recognition					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MAX_TPS_SP_RST_CHK	-	0... FFH	0... 1.275	0.005	s
Maximum time to reach the position C_TPS_SP_RST_CHK					
C_T_TPS_AD_HYS	-	0... FFH	0... 1.275	0.005	s
Time period for hysteresis band to adaptation					
C_T_TPS_AV_RST_CHK	-	0... FFH	0... 1.275	0.005	s
Time condition for deactivating the position controller					
C_T_TPS_ST_BOL_HYS	-	0... FFH	0... 1.275	0.005	s
Time period for hysteresis band to adaptation of BOL position during Start Check					
C_TCO_MAX_TPS_AD	-	0... FEH	-48... 142.5	0.75	°C
Max. TCO threshold for TPS adaptation					
C_TCO_MIN_TPS_AD	-	0... FEH	-48... 142.5	0.75	°C
Min. TCO threshold for TPS adaptation					
C_TIA_MIN_TPS_AD	-	0... FEH	-48... 142.5	0.75	°C
TIA threshold for TPS adaptation					
C_TPS_AD_SLOP_GAIN_INI_1	-	0... FFFFH	0... 7.99987	122e-6	-
Nominal value of the amplification slope of amplified poti 1					
C_TPS_AV_RST_CHK	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Threshold for activating the position controller					
C_TPS_SP_BOL_LGRD	-	1... FFH undef:1H	7.29414E-03 ...1.86000	-	°TPS/5ms
Change limitation for stopping the lower position					
C_TPS_SP_RST_CHK	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
TPS_SP for testing the retracting spring					
C_TPS_SP_RST_CHK_BAS	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
TPS_SP for testing the retracting spring					
C_TPS_SP_RST_CHK_HYS	-	1... FFH undef:1H	7.29414E-03 ...1.86000	-	°TPS
Hysteresis of C_TPS_SP_RST_CHK					
C_TPS_SP_RST_CHK_LGRD	-	1... FFH undef:1H	7.29414E-03 ...1.86000	-	°TPS/5ms
Change limitation for stopping the position C_TPS_SP_RST_CHK					
C_TPS_SP_SPR_CHK_UP	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
TPS_SP for GO_LIH position					
C_V_TPS_AD_BOL_INI_1	-	0... FFH	0... 4.998	19.5e-3	V
Start value for the adaptation value lower start (Poti 1)					
C_V_TPS_AD_BOL_INI_2	-	0... FFH	0... 4.998	19.5e-3	V
Start value for the adaptation value lower start (Poti 2)					
C_V_TPS_AD_HYS	-	0... FFH	0... 1.2	4.88e-3	V
Hysteresis band for adaptation value determination					
C_V_TPS_AD_OFS_GAIN_INI_1	-	FE00... 200H	-2.5 ...2.5	4.88e-3	V
Nominal value of the amplification offset of amplified poti 1					
C_V_TPS_AD_WIN_2_BOL	-	0... FFH	0... 2.49023	9.77e-3	V
Adaptation window size (+/-) for continuously mec BOL adaptation of lower stop					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_V_TPS_AD_WIN_BOL	-	0... FFH	0... 2.49023	9.77e-3	V
Adaptation window size (+/-) for adaptation of lower stop					
C_V_TPS_AD_WIN_LIH	-	0... FFH	0... 2.49023	9.77e-3	V
Adaptation window size (+/-) for adaptation of the Limp Home position					
C_V_TPS_LIH_CHK_HYS	-	0... FFH	0... 1.2	4.88e-3	V
Admissible tolerance on checking the limp home position					
C_V_TPS_SP_BOL_1	-	0... FFH	0... 4.998	19.5e-3	V
lower limit for plausibility check of the adaptation value lower stop TPS_1					
C_V_TPS_SP_BOL_2	-	0... FFH	0... 4.998	19.5e-3	V
upper limit for plausibility check of the adaptation value lower stop TPS_1					
C_V_TPS_SP_LIH_1	-	0... FFH	0... 4.998	19.5e-3	V
Set point of the limp home position voltage value channel 1					
C_V_TPS_SP_LIH_2	-	0... FFH	0... 4.998	19.5e-3	V
Set point of the limp home position voltage value channel 2					
C_VB_MIN_TPS_AD	-	0... FFH	0... 25.89843	0.1015625	V
VB threshold for ETC adaptation					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_VS_MAX_TPS_AD	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed threshold for adaptation					

**FUNCTION DESCRIPTION:****General information:**

The throttle position is determined by a two-channeled sensor system (contact potentiometer). Both channels deliver inverse dispersing voltage signals. In order to reduce the measurement inaccuracy, the two signal voltages will be referenced to their supply voltage. After the initial engine start and component change the characteristic Potentiometer value is learnt within an adaptation routine. The value for the lower stop is stored at the end of the driving cycle in the non-volatile memory.

A plausibilization unit monitors both sensor signals, as well as the belonging supply voltage and from them establishes the system state of the THR-position acquisition (undisturbed, disturbed, THR-position not recognizable). From the voltages of both TPS-channels, the THR-position for each channel is determined, taking into consideration the adaptation values for the lower stop. Based on the determined state of the system, the resulting THR-position is determined by the individual values. In case of a disturbance of the position acquisition (LV\_ERR\_TPS\_x 0, see chapter TPS diagnosis), the selection of the position is conducted from one of the two TPS-channels - respectively, in case of a complete collapse, the THR-control is switched off (limp home).

**Application conditions****Initialisation:**


```
all error memory outputs are initialized with 0
(LV_ERR_..., LV_CDN_DIAG_..., ERR_SYM_..., LV_END_DIAG_...
)
LV_TPS_ST_BOL_END = 0 at transition LV_IGK 0 → 1
remaining outputs see chapters
```

**Recurrence:**

5ms

**Activation:**

see Chapters

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**Signal flow diagram:**

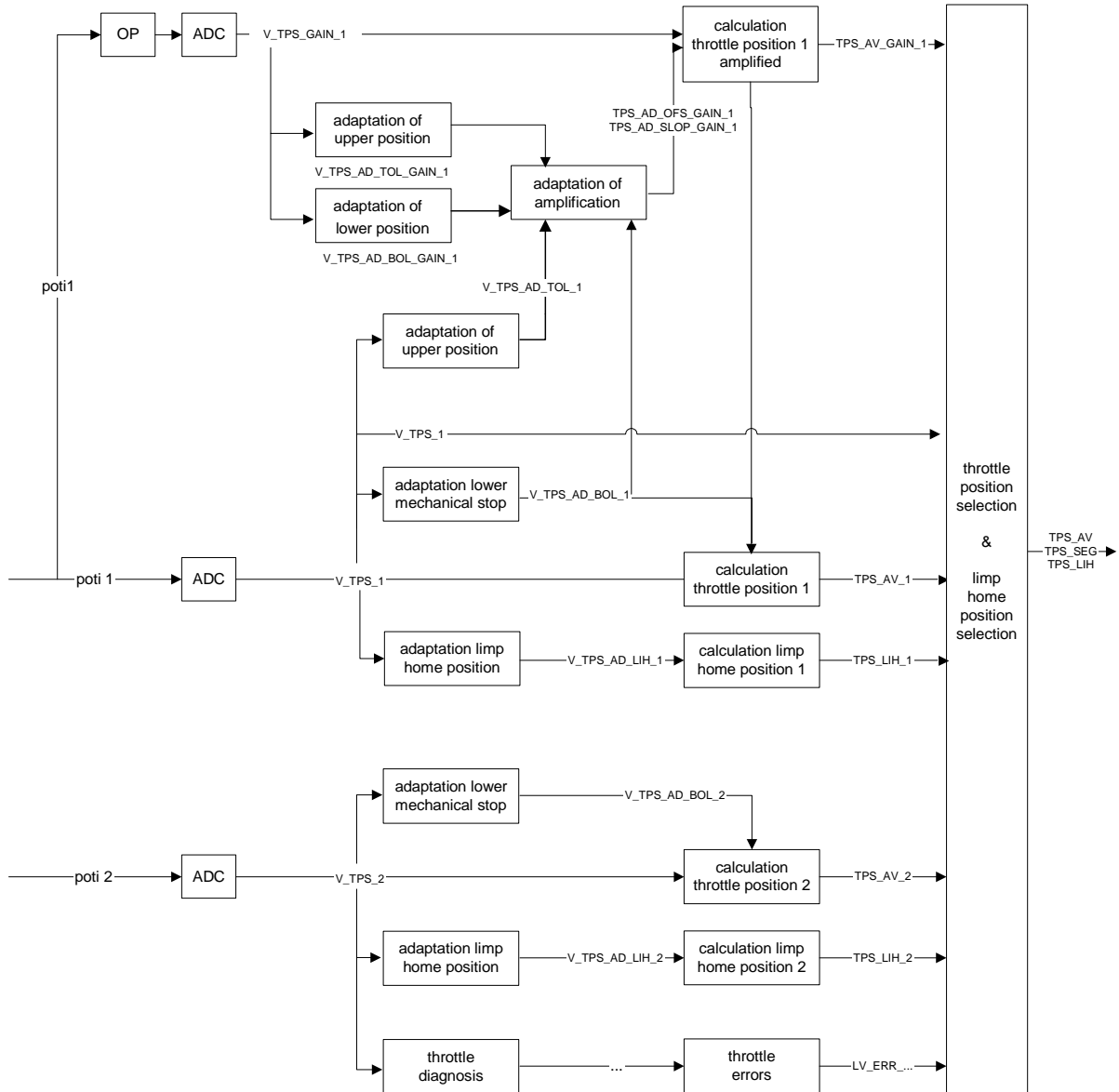


Figure A.117.1: : Overview of the functions of the TPS-position acquisition

**A.117.1 Algorithm of adaptation and start-check**

**Description:**

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The acquisition of the throttle position includes two sections: the start-check routine and adaptation routine. The start-check routine is a kind of slightly reduced adaptation routine with own thresholds and the possibility to be aborted after a first LIH-check by engine start. It is carried out at every switch on the engine control unit. In the case engine is started before start routine is finished, old adaption values for the lower mechanical stop are used. The adaptation routine starts only if the adaptation is requested.

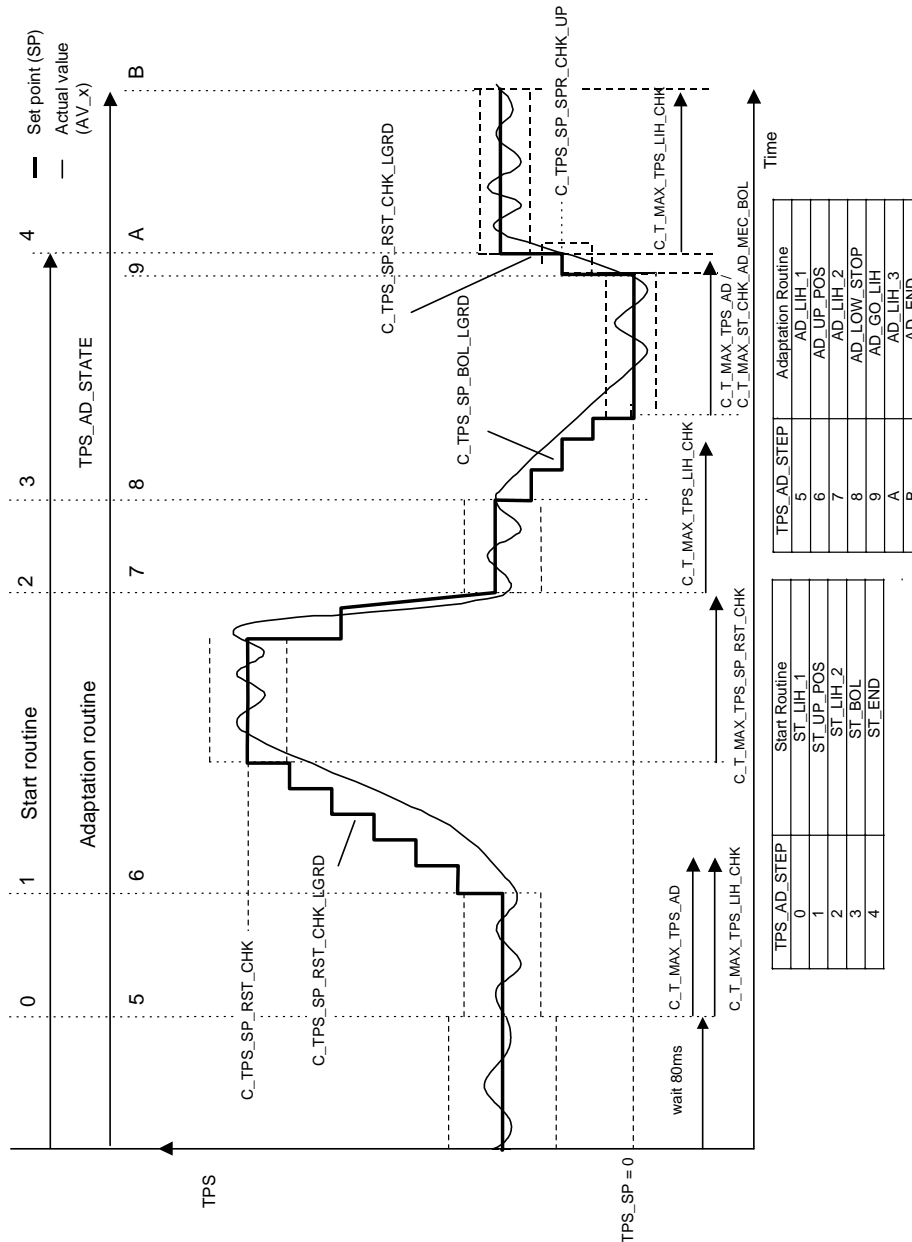
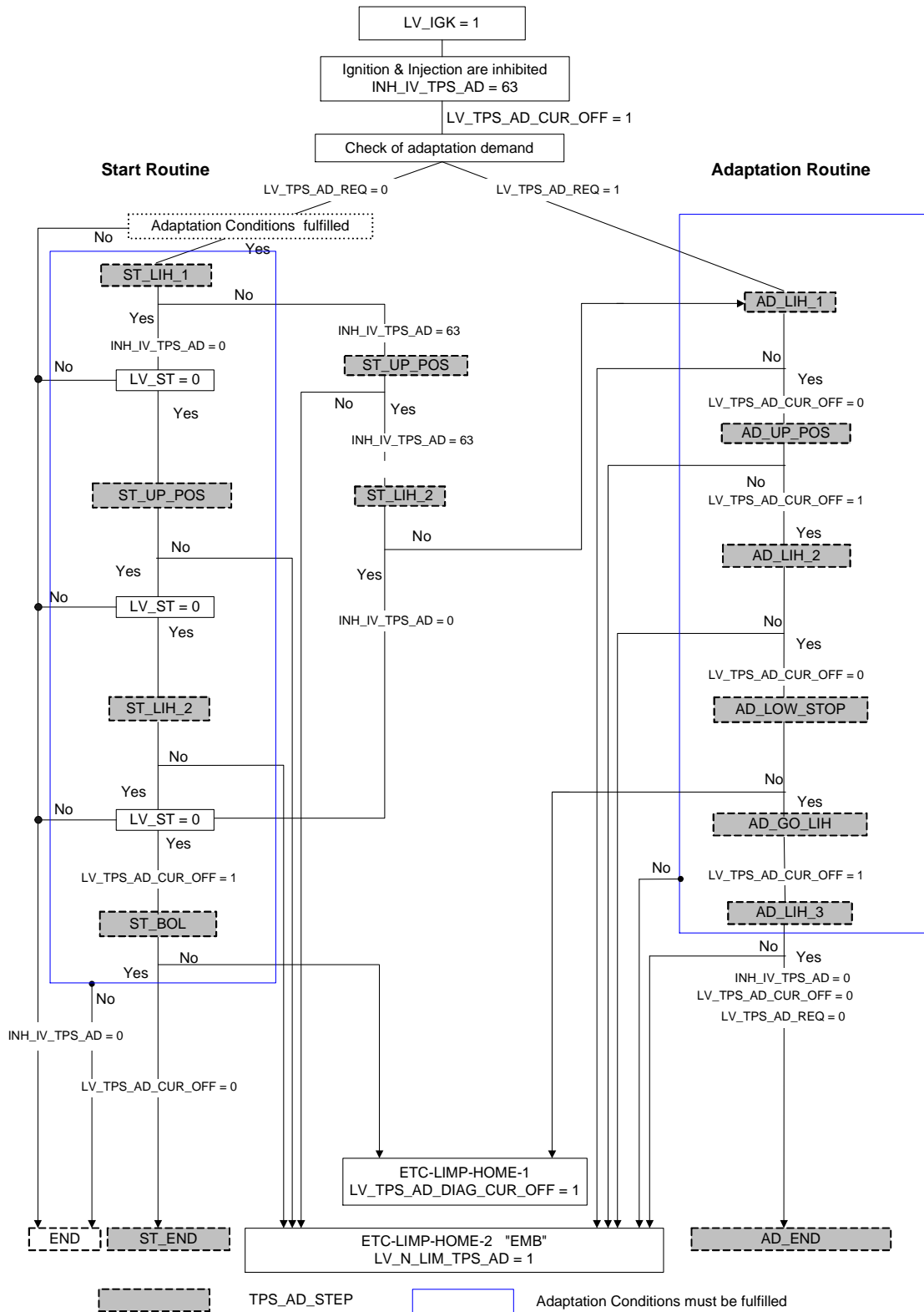


Fig. 2 Time conditions of start-check / adaption routine


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**Fig. 3 Algorithm of Adaptation and Start-check**

The Algorithm shows the reactions in passed and not passed conditions of both routines.

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## A.117.2 Initialization

### General information:

The delivered voltage from the TPS-poti is a measurement for the throttle position. Because of the electrical and the mechanical tolerances, the characteristic potentiometer values must be adapted. The adaptation and diagnosis of the Poti-voltages for the lower mechanical stops and Limp Home (LIH) occurs within a set routine. By learning and checking of the Limp Home position it delivers information whether there has been an exchange in the throttle actuator. The adapted lower mechanical stop and the upper check position are used as a reference point for the calculation of the throttle valve position. The upper mechanical stop is not learned. During the adaptation phase no limitations of the THR-setpoint are active. The learned value for the lower stop and the upper position is stored at the end of the driving cycle as non-volatile .

### Formula section:

At the beginning of the adaptation (either 1<sup>st</sup> adaptation at end of line or adaptation requested by failed start check) the values are described with the following EEPROM- and Default-values:

Default (only if adaptation requested LV\_TPS\_AD\_REQ = 1):

V_TPS_AD_LIH_1	= C_V_TPS_SP_LIH_1
V_TPS_AD_LIH_2	= C_V_TPS_SP_LIH_2
V_TPS_AD_EL_BOL_1	= C_V_TPS_AD_BOL_INI_1
V_TPS_AD_EL_BOL_2	= C_V_TPS_AD_BOL_INI_2
TPS_AD_SLOP_GAIN_1	= C_TPS_AD_SLOP_GAIN_INI_1
V_TPS_AD_OFS_GAIN_1	= C_V_TPS_AD_OFS_GAIN_INI_1
TPS_LIH_1 = TPS_LIH_2 = TPS_SP_AD = TPS_LIH_INI	

Always:

TPS_LIH_INI	= C_TPS_SLOP / 2 * (C_V_TPS_SP_LIH_1 - C_V_TPS_AD_BOL_INI_1 - C_V_TPS_SP_LIH_2 + C_V_TPS_AD_BOL_INI_2)
TPS_SP_AD = TPS_LIH_1	

## A.117.3 Calculation of ERRM output variables

### A.117.3.1 Diagnosis condition definition

#### Description:

The diagnosis condition for LV\_ERR\_TPS\_AD is true as long as the adaptation routine is active.

The diagnosis condition for LV\_ERR\_TPS\_ST\_CHK\_1 is true if TPS\_AD\_STEP = ST\_LIH\_2.

The diagnosis condition for LV\_ERR\_TPS\_ST\_CHK\_2 is true if TPS\_AD\_STEP = ST\_UP\_POS or ST\_LIH\_2.


The diagnosis condition for LV\_ERR\_TPS\_AD\_BOL is true if TPS\_AD\_STEP = ST\_BOL.

#### Formula section:

```

If           TPS_AD_STEP = 5H or 6H or 7H or 8H or 9H or AH
Then        LV_CDN_DIAG_TPS_AD = 1
Else        LV_CDN_DIAG_TPS_AD = 0
Endif

If           TPS_AD_STEP = 1H or 2H
Then        LV_CDN_DIAG_TPS_ST_CHK_2 = 1
Else        LV_CDN_DIAG_TPS_ST_CHK_2 = 0
  
```

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**Endif**

```

If           TPS_AD_STEP = 2H
Then        LV_CDN_DIAG_TPS_ST_CHK_1 = 1
Else        LV_CDN_DIAG_TPS_ST_CHK_1 = 0

```

**Endif**

```

If           TPS_AD_STEP = 3H
Then        LV_CDN_DIAG_TPS_AD_BOL = 1
Else        LV_CDN_DIAG_TPS_AD_BOL = 0


```

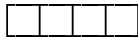
**Endif****A.117.3.2 Error symptom definition****Description:**

Error symptoms are defined for this diagnosis as:

**Adaptation routine**

TPS\_AD

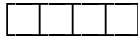
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- > Adaptation conditions exceeded (= SYM\_0)
- > Voltage value at LIH-adaptation outside range (= SYM\_1)
- > Spring-test and CHK\_LIH not passed (= SYM\_2)
- > Adaptation values - lower mechanical stop - outside range (= SYM\_3)

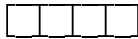
Start routine

## TPS\_ST\_CHK\_1



- > New TPS adaptation necessary (= SYM\_0)
- > - (= SYM\_1)
- > - (= SYM\_2)
- > - (= SYM\_3)

## TPS\_ST\_CHK\_2



- > Spring-test not passed (= SYM\_0)
- > ST\_LIH\_2 not passed (= SYM\_1)
- > - (= SYM\_2)
- > - (= SYM\_3)

## TPS\_AD\_BOL



- > MEC\_BOL adaptation not passed (= SYM\_0)
- > - (= SYM\_1)
- > - (= SYM\_2)
- > - (= SYM\_3)

**A.117.3.3 Calculation end of diagnosis**Description:

The end of diagnosis in errorfree case is set on the end of Start-check/Adaptation or latest if a error is set.

Formula section:

Calculation end of diagnosis in error case

**If**  $LV\_ERR\_TPS\_XY = 1$  (XY = AD or ST\_CHK\_1 or ST\_CHK\_2 or AD\_BOL)

**Then**  $LV\_END\_DIAG\_TPS\_XY = 1$

Calculation end of diagnosis in errorfree case

**Else** **If**  $TPS\_AD\_STEP = ST\_END$

**Then**  $LV\_END\_DIAG\_TPS\_ST\_CHK\_1 = 1$

$LV\_END\_DIAG\_TPS\_ST\_CHK\_2 = 1$



```

                LV_END_DIAG_TPS_AD_BOL = 1
    Endif
    If          TPS_AD_STEP = AD_END                or
                LV_TPS_AD_REQ = 0
    Then       LV_END_DIAG_TPS_AD = 1
    Endif

```

Endif

### A.117.4 Requests to activate the adaptation-routine or start-check

#### Description

After the control unit is switched on the activation bit for start-check or adaptation is set (LV\_TPS\_AD\_ACT=1).

If the adaptation request LV\_TPS\_AD\_REQ is set then the adaptation-routine will start otherwise the start-routine is activated.

#### Conditions for setting LV\_TPS\_AD\_REQ:

- In initial start ( first engine run or control unit exchange ), that means no adaptation values are stored in the non volatile memory
- After a component exchange , if the poti values are lie outside the tolerance window
- Check sum error is current
- Initiated by the tester
- Adaptation demand requested by diagnosis e.g. if adaptation or start-check was failed

#### Formula section:

```

If          Adaptation request is active
Then       LV_TPS_AD_REQ = 1
Endif

If          LV_IGK 0->1
Then       LV_TPS_AD_ACT = 1                //activation bit for adaptation or start-check
                LV_TPS_AD_CUR_OFF = 1      //request to switch off ETC
                INH_IV_TPS_AD = 63        //inhibition of injection
    If          LV_TPS_AD_REQ = 0
    Then     Start routine
                TPS_AD_STEP = ST_LIH_1
    Else     Start of adaptation routine
                TPS_AD_STEP = AD_LIH_1
    Endif
Endif

```

#### A.117.4.1 Monitoring of adaptation or start-check conditions

#### Description:

To get a plausible battery voltage the check of conditions for adaptation or start-check is delayed 80 ms after control unit is switched on.

If the conditions are exceeded the routine (adaptation or start-check) is stopped, injection will be released.

If the conditions are exceeded during the adaptation routine then:

- Error Adaptations conditions exceeded is set
- ETC limp home 2 EMB is activated
- New adaptation in the next driving cycle is requested

If the conditions are exceeded during the start check routine, it will be ignored without error entry.

### Formula section:

```

If(1)          LV_TPS_AD_ACT = 1          and          //Adaptation or Start-check is
active
                time delay of 80ms after LV_IGK = 1 is elapsed

Then(1)
If(2)          LV_IGK = 0                      or
                VB < C_VB_MIN_TPS_AD              or
                N > C_N_MAX_TPS_AD                 or
                VS > 2km/h (NC_VS_MAX_TPS_AD)     or
                TIA ≤ C_TIA_MIN_TPS_AD            or
                TCO ≤ C_TCO_MIN_TPS_AD            or
                TCO ≥ C_TCO_MAX_TPS_AD            or
                LV_ERR_V_REF_1 = 1                 or
                LV_ERR_TPS_1 = 1                   or
                LV_ERR_TPS_2 = 1                   or
                LV_ERR_TPS_RATIO = 1               or
                LV_ERR_MTC_CTL_1 = 1               or
                LV_ERR_MTC_CTL_2 = 1               or
                LV_ERR_MTC_CTL_3 = 1               or
                LV_ERR_MTC_DR = 1

Then(2)          If(3)          INH_IV_TPS_AD = 63
                                and
                                TPS_AD_STEP = 1H or 2H
                                Then(3)          LV_TPS_AD_ACT = 1
                                //Value remains; start routine continues; adaptation conditions for
                                //failed ST_LIH_1 ignored
                                Else(3)          LV_TPS_AD_ACT = 0
                                //Stopping the TPS adaptation /start-check
                                If(4)          TPS_AD_STEP = 5H or 6H or 7H or 8H or 9H or AH
                                //Adaptation routine is active
                                Then(4)          ERR_SYM_TPS_AD = SYM_0
                                //Adaptation conditions exceeded
                                LV_ERR_TPS_AD = 1
                                LV_TPS_AD_REQ = 1
                                //New TPS adaptation necessary
                                LV_N_LIM_TPS_AD = 1
                                //ETC-LIMP-HOME-2 is requested
                                Endif(4)
                                INH_IV_TPS_AD = 0          //Activate injection
                                Endif(3)
                                continue adaptation or start-check
Else(2)
Endif(2)
Endif(1)

```



**and** within the interval: C\_T\_DYW\_TPS\_LIH\_CHK

**Then(3)** "Check Limp home ok"  
 CTR\_ST\_CHK\_CHK\_LIH\_1\_READY is incremented once  
 TPS\_AD\_STEP = ST\_UP\_POS  
 LV\_TPS\_AD\_CUR\_OFF = 0  
 INH\_IV\_TPS\_AD = 0

**Else(3)** start "Then (2)" again

**Else(2)** CTR\_ST\_CHK\_CHK\_LIH\_1\_ERR is incremented once  
 TPS\_AD\_STEP = ST\_UP\_POS  
 Ignition and injection remains deactivated  
 LV\_TPS\_AD\_CUR\_OFF = 0

**Else(1)** INH\_IV\_TPS\_AD = 0

**Endif**

#### Limp Home position:

Calculation of limp home positions right after CHK\_LIH\_1. A synchronized TPS\_LIH is necessary for the Throttle catch function:

$$\text{TPS\_LIH\_1} = (\text{V\_TPS\_AD\_LIH\_1} - \text{V\_TPS\_AD\_EL\_BOL\_1}) * \text{C\_TPS\_SLOP}$$

$$\text{TPS\_LIH\_2} = (\text{V\_TPS\_AD\_EL\_BOL\_2} - \text{V\_TPS\_AD\_LIH\_2}) * \text{C\_TPS\_SLOP}$$

$$0^\circ \leq \text{TPS\_LIH\_x} \leq \text{C\_TPS\_MAX}$$

#### Continuously LIH AD:

The Continuously limp home adaptation is calculated parallel to the first Limp home check. If the first Limp home Check is passed then the engine start is not locked any more and the start routine is going on with or without successfully adaptation.

**IF(1)** LV\_TPS\_AD\_ACT = 1 **and**  
 LV\_MTC\_CUR\_OFF = 1 **and**  
 LV\_TPS\_AD\_REQ = 0 **and**  
 "LIH CHECK 1 active":  
 INH\_IV\_TPS\_AD = 63 **and**  
 TPS\_AD\_STEP = ST\_LIH\_1

**Then(1)** Start Time: C\_T\_TPS\_AD\_HYS

**IF(2)** Within the interval: C\_T\_TPS\_AD\_HYS **and**  
 $\text{V\_TPS\_x}_{1+n} - \text{V\_TPS\_x}_1 \leq \text{C\_V\_TPS\_AD\_HYS}$  (n=1,2;3;...)

**Then(2) IF(3)**  $\left| \frac{\text{V\_TPS\_x}_1 + \text{V\_TPS\_x}_{\text{END}}}{2} - \text{C\_V\_TPS\_SP\_LIH\_x} \right|$

C\_V\_TPS\_AD\_WIN\_LIH

**Then(3)**  $\text{V\_TPS\_AD\_LIH\_x} = \frac{\text{V\_TPS\_x}_1 + \text{V\_TPS\_x}_{\text{END}}}{2}$

**Else (3) IF(4)**  $\frac{\text{V\_TPS\_x}_1 + \text{V\_TPS\_x}_{\text{END}}}{2} > \text{C\_V\_TPS\_AD\_WIN\_LIH} +$

C\_V\_TPS\_SP\_LIH\_x

```

Then (4) V_TPS_AD_LIH_x = C_V_TPS_AD_WIN_LIH +
                               C_V_TPS_SP_LIH_x
Else (4) V_TPS_AD_LIH_x    = C_V_TPS_SP_LIH_x -
                               C_V_TPS_AD_WIN_LIH

```

Else(2) start "Then (1)" again

Else(1) continue with the old adaptation values

Endif

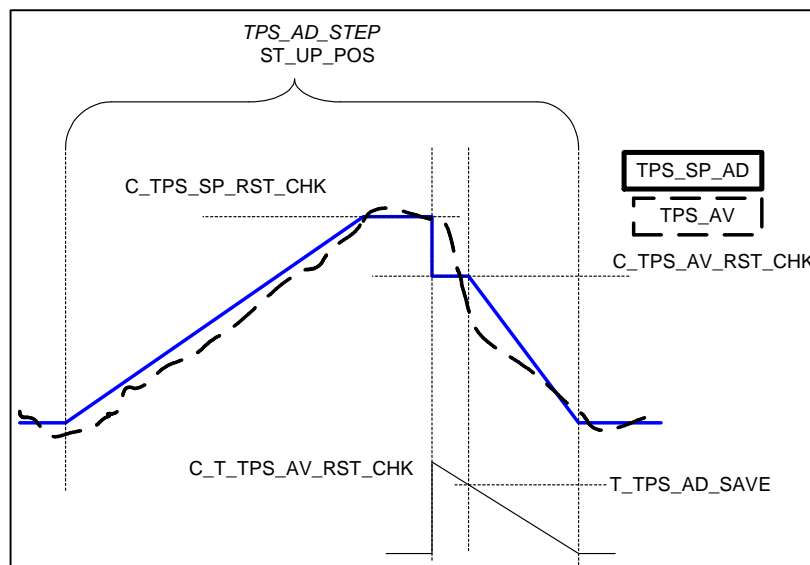
### A.117.5.2 Spring Test at the Start routine (ST\_UP\_POS)

#### Description:

Out of the Limp home position the throttle position setpoint is increased using the changing limitation until the setpoint for testing the retracting spring is reached. Now a timer is started. The actual value of the throttle position has to reach the setpoint within the hysteresis within a limit maximum of time.

Regarding certain cases with closed throttle at the limp home position it is necessary to switch on the position controller near the lower mechanical stop to prevent that the throttle is going into the lower mechanical stop with high acceleration.

#### Signal flow diagram:



#### Formula section:

TPS\_AD\_STEP = ST\_UP\_POS

```

IF(1)    LV_TPS_AD_ACT = 1      and
         LV_TPS_AD_REQ = 0      and
         ( LV_ST = 0           or
           INH_IV_TPS_AD = 63 ) // ST_LIH_1 not passed

```

Then(1)

```

If(2)    LV_TPS_AD_CUR_OFF = 0  and
         LV_MTC_CUR_OFF = 1     // request to switch on ETC is not fulfilled

```

Then(2) // no further action

**Else(2)**

```

begin          TPS_SP_AD + C_TPS_SP_RST_CHK_LGRD
until         TPS_SP_AD C_TPS_SP_RST_CHK_BAS
Start time: C_T_MAX_TPS_SP_RST_CHK
If(3)        T < C_T_MAX_TPS_SP_RST_CHK          and
            TPS_AV - C_TPS_SP_RST_CHK_BAS
            C_TPS_SP_RST_CHK_HYS
Then(3)      LV_TPS_AD_CUR_OFF = 1
            TPS_SP_AD = C_TPS_AV_RST_CHK
Start Timer T_TPS_AD(dec) = C_T_TPS_AV_RST_CHK
-----
If(4)        T_TPS_AD(dec) > 0
Then(4)      If(5)          TPS_AV <= C_TPS_AV_RST_CHK; #1
            Then(5)       LV_TPS_AD_CUR_OFF = 0
            TPS_SP_AD = TPS_SP_AD -
            ((C_TPS_AV_RST_CHK - TPS_LIH) * 5ms /
            T_TPS_AD_SAVE)
            Else(5)       go to If(4)
            Endif(5)
            #1: At transition from TPS_AV > C_TPS_AV_RST_CHK to TPS_AV <=
            C_TPS_AV_RST_CHK a snap shot is done of T_TPS_AD into T_TPS_
            AD_SAVE.
Else(4)      LV_TPS_AD_CUR_OFF = 1
Endif(4)
-----
TPS_AD_STEP = ST_LIH_2

Else(3)      LV_N_LIM_TPS_AD = 1          //ETC-LIMP-HOME-2
            ERR_SYM_TPS_ST_CHK_2 = SYM_0          // Spring-test not passed
            LV_ERR_TPS_ST_CHK_2 = 1
Endif(2)
Else(1)      LV_TPS_AD_CUR_OFF = 0
Endif(1)

```

**A.117.5.3 Second Check of Limp Home position at Start routine (ST\_LIH\_2)****Description:**


After the return spring test follows a check of limp home position again. Depending on the result of the test the start routine is finished, starts the adaptation routine or goes to security fuel cut off.

**Formula section:**

```

TPS_AD_STEP = ST_LIH_2
IF(1)        LV_TPS_AD_ACT = 1          and
            LV_MTC_CUR_OFF = 1          and
            LV_TPS_AD_REQ = 0          and
            ( LV_ST = 0                or
            INH_IV_TPS_AD = 63 )      // ST_LIH_1 not passed
Then(1)      Start Time: C_T_MAX_TPS_LIH_CHK

```

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```

If(2)      T < C_T_MAX_TPS_LIH_CHK
Then (2) Start Time: C_T_DYW_TPS_LIH_CHK
IF(3)V_TPS_X - V_TPS_AD_LIH_x  C_V_TPS_LIH_CHK_HYS ( X = Poti 1, 2 ) and
      within the interval: C_T_DYW_TPS_LIH_CHK
Then(3)   INH_IV_TPS_AD = 0
            LV_TPS_AD_CUR_OFF = 0
            TPS_AD_STEP = ST_BOL
Else(3)   goto IF (2)
Else (2) If(4)   INH_IV_TPS_AD = 0
Then(4)   ERR_SYM_TPS_ST_CHK_2 = SYM_1    CHK_LIH not passed
            LV_ERR_TPS_ST_CHK_2 = 1
            LV_N_LIM_TPS_AD =1   (ETC-LIMP-HOME-2)
Else (4)   ERR_SYM_TPS_ST_CHK_1 = SYM_0
            New TPS adaptation necessary
            LV_ERR_TPS_ST_CHK_1 = 1
            LV_TPS_AD_REQ = 1
            TPS_AD_STEP = AD_LIH_1
Else(1)   LV_TPS_AD_CUR_OFF = 0
Endif(1)

```

#### A.117.5.4 Adaption of lower mechanical stop and limp home spring test opening at Start routine (ST\_BOL)

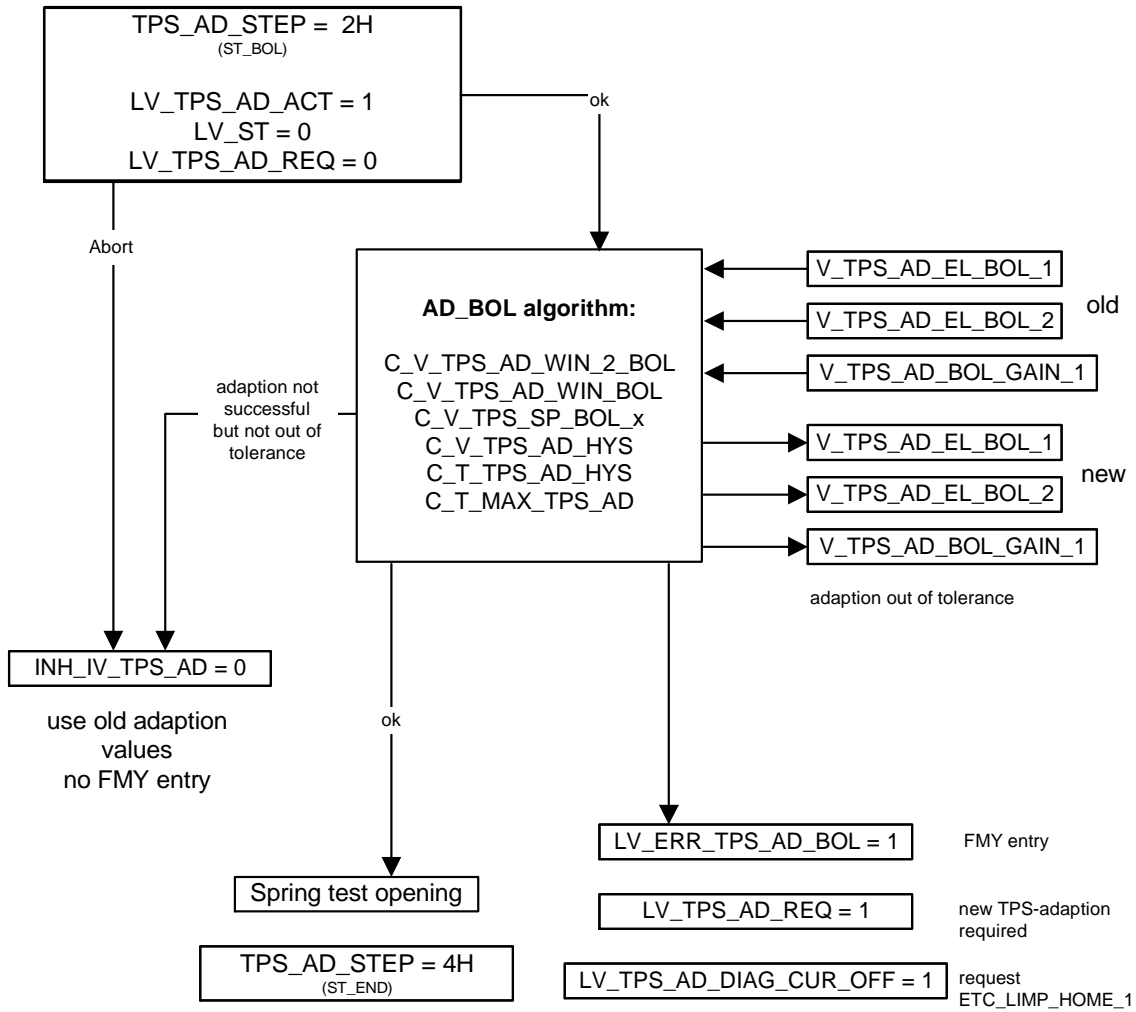
##### Description:

During a complete start check (not aborted by a quick start), the lower mechanical stop is learnt. After successful adaptation, the adaptation values V\_TPS\_AD\_EL\_BOL\_1/2 are saved in the non-volatile memory. If the adaptation is not completed successfully (e.g. abnormal termination due to violation of the activation conditions), the adaptation value learnt last remains valid.

During adaptation, all voltage values must be within the adaptation window V\_TPS\_AD\_EL\_BOL\_X C\_V\_TPS\_AD\_WIN\_2\_BOL; otherwise LV\_ERR\_TPS\_AD\_BOL is set.

A hysteresis band C\_V\_TPS\_AD\_HYS is placed around the first detected value (pots 1 and 2). If all values are within this hysteresis band during the adjustable time C\_T\_TPS\_AD\_HYS, the adaptation values are determined from the first and last value each (Fig. 6). If the value of a pot is outside of the hysteresis band, the operation is re-started for the two pots. The learning algorithm is limited by the maximum time C\_T\_MAX\_ST\_CHK\_AD\_MEC\_BOL.

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**Signal flow diagram:**

**Formula section:**

TPS\_AD\_STEP = ST\_BOL

**IF(1)**      LV\_TPS\_AD\_ACT = 1  
                  LV\_ST = 0  
                  LV\_TPS\_AD\_REQ = 0

**and  
and**

**Then(1)**

**If(2)**                      LV\_TPS\_ST\_BOL\_END = 0


**Then(2)**

**If(3)**                      TPS\_SP\_AD > 0  
**Then(3)**                  TPS\_SP\_AD = TPS\_SP\_AD<sub>(n-1)</sub> - C\_TPS\_SP\_BOL\_LGRD

**Else(3)**

Start time: C\_T\_MAX\_ST\_BOL

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```

If(4)          V_TPS_x - C_V_TPS_SP_BOL_x > C_V_TPS_AD_WIN_
BOL

                or
                V_TPS_x - V_TPS_AD_EL_BOL_x > C_V_TPS_AD_WIN_2_
                BOL

Then(4)

If(5)          T ≥ C_T_MAX_ST_BOL
Then(5)        ERR_SYM_TPS_AD_BOL = SYM_0
                //MEC_BOL adaptation not passed
                LV_ERR_TPS_AD_BOL = 1
                LV_TPS_AD_REQ = 1
                //New TPS adaptation necessary
                LV_TPS_AD_DIAG_CUR_OFF = 1
                //ETC-LIMP-HOME-1 demand
                LV_TPS_AD_ACT = 0

Else(5)        reset timer C_T_TPS_ST_BOL_HYS
Endif(5)

Else(4)        continue MEC BOL Adaptation
Endif(4)

If(6)          T < C_T_MAX_ST_BOL
Then(6)

If(7)          Within the interval: C_T_TPS_ST_BOL_HYS
and

                V_TPS_x1+n - V_TPS_x1 < C_V_TPS_AD_HYS
                (n=1,2;3;...)

Then(7)

                V_TPS_AD_EL_BOL_x =

                
$$\frac{V\_TPS\_x_1 + V\_TPS\_x\_END}{2}$$


                V_TPS_AD_BOL_GAIN_1 =

                
$$\frac{V\_TP1\_GAIN\_1_1 + V\_TPS\_GAIN\_1\_END}{2}$$


                LV_TPS_ST_BOL_END = 1

Else(7)        go to If(6)
Else (6)        adaptation remains the last valid values
                LV_TPS_ST_BOL_END = 1
Endif (6)

Endif(3)

Else(2)

If(8)          TPS_SP_AD < C_TPS_SP_SPR_CHK_UP

Then(8)        TPS_SP_AD =          TPS_SP_AD(n-1) +
                C_TPS_SP_RST_CHK_LGRD

```

**Else(8)**

```

LV_TPS_AD_CUR_OFF = 1
TPS_SP_AD = TPS_LIH_INI
TPS_AD_STEP = ST_END
// Second Limp Home Check in case of not successfull adaptation

```

of lower stop

**Else (1)**

```

INH_IV_TPS_AD = 0
LV_TPS_AD_CUR_OFF = 0

```

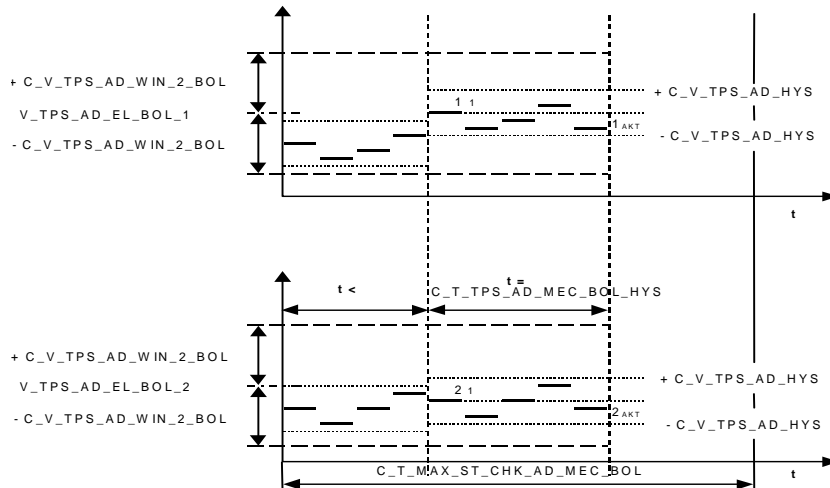
**Endif (1)**

Figure A.117.3: Determination of the adaptation values in case of MEC\_BOL adaptation during start routine

## A.117.6 Adaptation routine

### General information:

The Adaption routine includes:

- Limp home check and Adaptation of Limp Home Position
- Limp home spring test closing and adaptation of upper position
- Limp home check
- Limp home spring test opening and Adaptation of lower mechanical stop
- Limp home check

### A.117.6.1 Adaption of Limp Home position at Adaption routine (AD\_LIH\_1)

#### Description:

The first step is the adaptation of the Limp Home position. The actuator is without current and is forced by the spring power in the limp home position.

The learning of the adaptation value depict the algorithm in Fig. 6. During the adaptation all the voltage values must be in the adaptation windows. A hysteresis band is set up around each of the first recorded values (poti 1 and 2). If all the values lie in this hysteresis band during an adjustable time then the

adaptation values are determined from each first and last value. If the Poti-value lies outside the hysteresis band then the process is newly started for both Poti's. The learning algorithm is limited by the maximum time. This procedure is the same for the Limp home position and the lower mechanical stop. Just the calibration values are different.

An error memory entry occurs only at the adaptation after ECU-first initialisation not at the continuous LIH-adaptation. An error is detected if the adaptation could not be carried out during the max. time C\_T\_MAX\_TPS\_AD.

### Formula section:

TPS\_AD\_STEP = AD\_LIH\_1

Start time: C\_T\_MAX\_TPS\_AD

**If (1)**  $V\_TPS\_x - C\_V\_TPS\_SP\_LIH\_x) < C\_V\_TPS\_AD\_WIN\_LIH)$

**Then(1) If(2)**  $T < C\_T\_MAX\_TPS\_AD$

**Then(2)** Start Time: C\_T\_TPS\_AD\_HYS

**If(3)** Within the interval: C\_T\_TPS\_AD\_HYS **and**

$V\_TPS\_x_{1+n} - V\_TPS\_x_1 < C\_V\_TPS\_AD\_HYS) (n=1,2,3;...)$

**Then(3)**

$$V\_TPS\_AD\_LIH\_x = \frac{V\_TPS\_x_1 + V\_TPS\_x_{END}}{2}$$

LV\_TPS\_AD\_CUR\_OFF = 0

TPS\_AD\_STEP = AD\_UP\_POS

**Else(3)** goto If (2)

**Else(2)** goto Else (1)

**Else(1)** ERR\_SYM\_TPS\_AD = SYM\_1 Voltage value at LIH-adaptation outside range

LV\_ERR\_TPS\_AD = 1

LV\_TPS\_AD\_ACT = 0 (Stopping the TPS adaptation)

LV\_N\_LIM\_TPS\_AD = 1 (ETC-LIMP-HOME-2)

LV\_TPS\_AD\_REQ = 1 (New TPS adaptation nesecarry)

INH\_IV\_TPS\_AD = 0 (Activate ignition and injection)

**Endif**

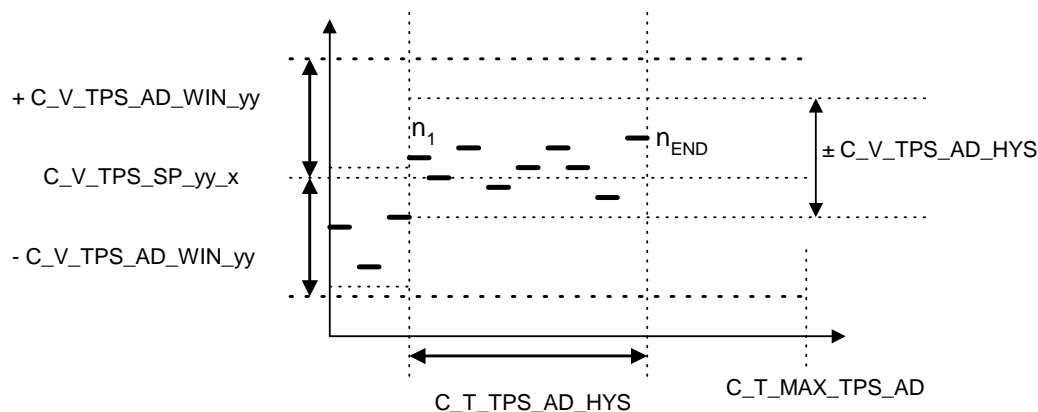


Figure A.117.4: Determining the adaptation value (AD\_yy)yy correspond to LIH or BOL  
x correspond to poti 1 or 2

### A.117.6.2 Spring test at the adaptation routine (AD\_UP\_POS)

#### Description:

After passing the check of limp home position the adaptation routine goes on with the spring test. Out of the Limp home position the throttle position set point is increased using the changing limitation until the set point for testing the retracting spring is reached. Now a timer is started. The actual value of the throttle position has to reach the set point within the hysteresis and a limit of time. Then the upper position will be adapted and the throttle is returning currentless.

#### Formula section:

TPS\_AD\_STEP = AD\_UP\_POS

**begin** TPS\_SP\_AD + C\_TPS\_SP\_RST\_CHK\_LGRD

**until** TPS\_SP\_AD C\_TPS\_SP\_RST\_CHK

Start Time : C\_T\_MAX\_TPS\_SP\_RST\_CHK

**If(1)** TPS\_AV - C\_TPS\_SP\_RST\_CHK C\_TPS\_SP\_RST\_CHK\_HYS) **and**  
T < C\_T\_MAX\_TPS\_SP\_RST\_CHK

**Then(1)** Start time C\_T\_MAX\_TPS\_AD

**IF(2)** T < C\_T\_MAX\_TPS\_AD

**Then(2)**

**If(3)** Within the interval: C\_T\_TPS\_AD\_HYS **and**  
V\_TPS\_1<sub>1+n</sub> - V\_TPS\_1 C\_V\_TPS\_AD\_HYS (n=1,2;3;...)

**Then(3)**

New calculation of upper value of amplified poti 1

$$V\_TPS\_AD\_TOL\_1 = \frac{V\_TPS\_1 + V\_TPS\_1_{END}}{2}$$

$$V\_TPS\_AD\_TOL\_GAIN\_1 = \frac{V\_TPS\_GAIN\_1 + V\_TPS\_GAIN\_1_{END}}{2}$$

LV\_TPS\_AD\_CUR\_OFF = 1

TPS\_SP\_AD = C\_TPS\_AV\_RST\_CHK

-----

Start Timer T\_TPS\_AD<sub>(dec)</sub> = C\_T\_TPS\_AV\_RST\_CHK

**If** T\_TPS\_AD<sub>(dec)</sub> > 0

**If** TPS\_AV <= C\_TPS\_AV\_RST\_CHK; #1

**Then** LV\_TPS\_AD\_CUR\_OFF = 0

TPS\_SP\_AD = TPS\_SP\_AD -

((C\_TPS\_AV\_RST\_CHK - TPS\_LIH) \* 5ms /  
T\_TPS\_AD\_SAVE)

**endif**

**Else** LV\_TPS\_AD\_CUR\_OFF = 1

**Endif**

#1: At transition from TPS\_AV > C\_TPS\_AV\_RST\_CHK to TPS\_AV <= C\_TPS\_AV\_RST\_CHK a snap shot is done of T\_TPS\_AD into T\_TPS\_AD\_SAVE.

-----

TPS\_AD\_STEP = AD\_LIH\_2

**Else(3)** goto If (2)

**Else(2)** goto Else (1)

```

Else(1)      ERR_SYM_TPS_AD = SYM_2           Spring test and CHK_LIH not passed
             LV_ERR_TPS_AD = 1
             LV_TPS_AD_ACT = 0                (Stopping the TPS adaptation)
             LV_N_LIM_TPS_AD = 1             (ETC-LIMP-HOME-2, )
             LV_TPS_AD_REQ = 1               (New TPS adaptation nesecarry)
             INH_IV_TPS_AD = 0              (Activate ignition and injection)

Endi

```

### A.117.6.3 Second Check of Limp Home position at Adaptation routine (AD\_LIH\_2)

#### Description:

After the return spring test the adaptation routine repeats the ckeck of limp home position.

#### Formula section:

```

TPS_AD_STEP = AD_LIH_2
Start time: C_T_MAX_TPS_LIH_CHK
If(1)        T < C_T_MAX_TPS_LIH_CHK
Then(1)
  If(2)      within the interval: C_T_DYW_TPS_LIH_CHK           and
             V_TPS_x - V_TPS_AD_LIH_x   C_V_TPS_LIH_CHK_HYS ( X = Poti 1, 2 )
  Then(2)    LV_TPS_AD_CUT_OFF = 0
             TPS_AD_STEP = AD_LOW_STOP
Else(2)      goto If (1)
Else(1)      ERR_SYM_TPS_AD = SYM_2           Spring test and CHK_LIH not passed
             LV_ERR_TPS_AD = 1
             LV_TPS_AD_ACT = 0                (Stopping the TPS adaptation)
             LV_N_LIM_TPS_AD = 1             (ETC-LIMP-HOME-2, )
             LV_TPS_AD_REQ = 1               (New TPS adaptation nesecarry)
             INH_IV_TPS_AD = 0              (Activate ignition and injection)

Endif

```

### A.117.6.4 Adaptation of lower mechanical stop during adaption routine (AD\_LOW\_STOP)

#### Description:

As soon as the mechanical stop is reached, the described adaptation algorithm in Fig. 7, is triggered. The scanned data is used for both, calculation of the lower mechanical /electrical stop and for the amplification characteristic. After the adaptation of the lower stop and calculated amplification the throttle at the electrical stop opens a small angle in relation to the mechanical stop. This is necessary to prevent a chock.

#### Formula section:

```

TPS_AD_STEP = AD_LOW_STOP
Begin        TPS_SP_AD - C_TPS_SP_BOL_LGRD
Until        TPS_SP_AD = 0
Start Time: C_T_MAX_TPS_AD
If(1)        V_TPS_x - C_V_TPS_SP_BOL_x   C_V_TPS_AD_WIN_BOL)
Then(1)

```

**If(2)**       $T < C\_T\_MAX\_TPS\_AD$

**Then(2)**

**IF(3)** Within the interval:  $C\_T\_TPS\_AD\_HYS$       **and**  
 $V\_TPS\_x_{1+n} - V\_TPS\_x_1$        $C\_V\_TPS\_AD\_HYS$       (n=1,2;3;...)

**Then(3)**

$$V\_TPS\_AD\_EL\_BOL\_x = \frac{V\_TPS\_x_1 + V\_TPS\_x\_END}{2}$$

$$V\_TPS\_AD\_BOL\_GAIN\_1 = \frac{V\_TP1\_GAIN\_1 + V\_TPS\_GAIN\_1\_END}{2}$$

slope of amplification of amplified poti 1:

$$TPS\_AD\_SLOP\_GAIN\_1 = \frac{V\_TPS\_AD\_TOL\_GAIN\_1 - V\_TPS\_AD\_BOL\_GAIN\_1}{V\_TPS\_AD\_TOL\_1 - V\_TPS\_AD\_EL\_BOL\_1}$$

offset of amplification of amplified poti 1:

$$V\_TPS\_AD\_OFS\_GAIN\_1 = V\_TPS\_AD\_BOL\_GAIN\_1 - V\_TPS\_AD\_EL\_BOL\_1 * TPS\_AD\_SLOP\_GAIN\_1$$

$TPS\_AD\_STEP = AD\_GO\_LIH$

**Else(3)** go to If(2)

**Else(2)** go to else(1)

**Else (1)**       $ERR\_SYM\_TPS\_AD = SYM\_3$

Adaptation value - lower mechanical stop - outside range

$LV\_ERR\_TPS\_AD = 1$

$LV\_TPS\_AD\_ACT = 0$

(Stopping the TPS adaptation)

$LV\_TPS\_AD\_DIAG\_CUR\_OFF = 1$

(ETC-LIMP-HOME-1 demand)

$LV\_TPS\_AD\_REQ = 1$

(New TPS adaptation necessary)

$INH\_IV\_TPS\_AD = 0$

(Activate ignition and injection)

**Endif**

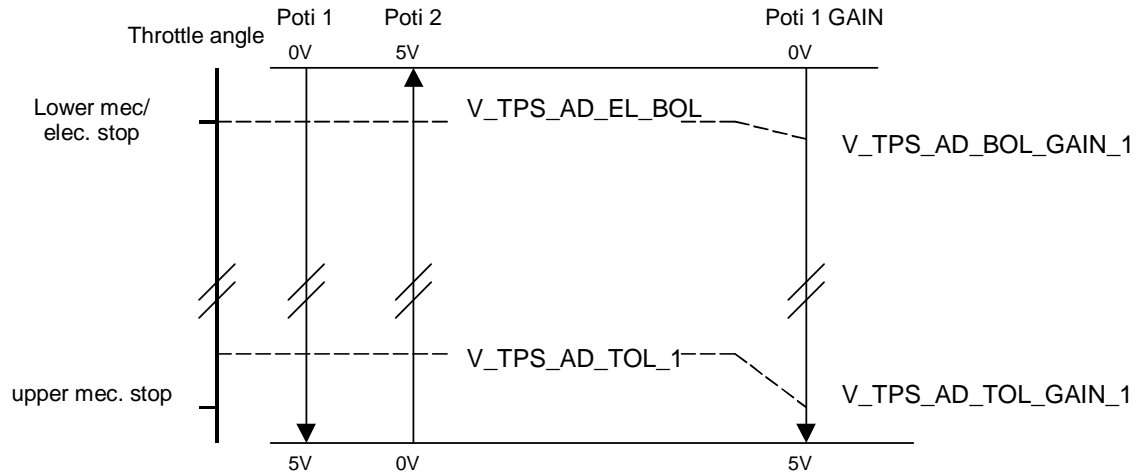


Figure A.117.5: Fig 7. Definition of the adaptation positions

### A.117.6.5 Limp home spring Test opening (AD\_GO\_LIH)

#### Description:

After finish the lower adaptation the MTC opens the throttle using the change limitation until the nominal values for current cut off is reached. As from that position the spring returns the throttle currentless to the Limp Home position and carries through the Limp Home Check again, because it is possible that the throttle itself clamps at the mechanical stop.

#### Formula section:

TPS\_AD\_STEP = AD\_GO\_LIH

**begin**

TPS\_SP\_AD + C\_TPS\_SP\_RST\_CHK\_LGRD

**until** TPS\_SP\_AD C\_TPS\_SP\_SPR\_CHK\_UP

LV\_TPS\_AD\_CUR\_OFF = 1

TPS\_SP\_AD = TPS\_LIH\_INI

TPS\_AD\_STEP = AD\_LIH\_3

Third Limp Home Check

### A.117.6.6 Third Check of Limp Home position at Adaptation routine (AD\_LIH\_3)

#### Description:

After the spring test at the lower stop follows the check of limp home position again. Now the adaptation routine is finished. Depending on the passed test the adaptation request is cancelled.

#### Formula section:

TPS\_AD\_STEP = AD\_LIH\_3

Start time: C\_T\_MAX\_TPS\_LIH\_CHK

**if(1)** T < C\_T\_MAX\_TPS\_LIH\_CHK

```

Then(1)      Start Time: C_T_DYW_TPS_LIH_CHK
If(2)       within the interval: C_T_DYW_TPS_LIH_CHK           and
                V_TPS_X -V_TPS_AD_LIH_x   C_V_TPS_LIH_CHK_HYS   ( X = Poti 1, 2 )
Then(2)     LV_TPS_AD_CUR_OFF = 0
                INH_IV_TPS_AD =0
                TPS_AD_STEP = AD_END
Else (2)    go to If (1)
Else (1)     ERR_SYM_TPS_AD = SYM_2           Spring test and CHK_LIH not passed
                LV_ERR_TPS_AD = 1
                LV_TPS_AD_ACT = 0           (Stopping the TPS adaptation)
                LV_TPS_AD_REQ = 1           (New TPS adaptation necessary)
                LV_N_LIM_TPS_AD = 1        (ETC-LIMP-HOME-2)
                INH_IV_TPS_AD = 0          (Activate ignition and injection)

```

**Endif**

Limp Home position:

$TPS\_LIH\_1 = (V\_TPS\_AD\_LIH\_1 - V\_TPS\_AD\_EL\_BOL\_1) * C\_TPS\_SLOP$

$TPS\_LIH\_2 = (V\_TPS\_AD\_EL\_BOL\_2 - V\_TPS\_AD\_LIH\_2) * C\_TPS\_SLOP$

$0^\circ \leq TPS\_LIH\_x \leq C\_TPS\_MAX$



## A.118 Electronic throttle control actuator diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_MTC_CTL_1	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom MTC_CTL_1					
ERR_SYM_MTC_CTL_2	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom MTC_CTL_2					
ERR_SYM_MTC_CTL_3	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom MTC_CTL_3					
LV_CDN_DIAG_MTC_CTL_1	O/V	0... 1H	0 ...1	1	-
Diagnosis condition MTC_CTL_1					
LV_CDN_DIAG_MTC_CTL_2	O/V	0... 1H	0 ...1	1	-
Diagnosis condition MTC_CTL_2					
LV_CDN_DIAG_MTC_CTL_3	O/V	0... 1H	0 ...1	1	-
Diagnosis condition MTC_CTL_3					
LV_END_DIAG_MTC_CTL_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis MTC_CTL_1					
LV_END_DIAG_MTC_CTL_2	O/V	0... 1H	0 ...1	1	-
End of diagnosis MTC_CTL_2					
LV_END_DIAG_MTC_CTL_3	O/V	0... 1H	0 ...1	1	-
End of diagnosis MTC_CTL_3					
LV_ERR_MTC_CTL_1	O/V	0... 1H	0 ...1	1	-
Logical variable (set. if a MTCPWM error is present)					
LV_ERR_MTC_CTL_2	O/V	0... 1H	0 ...1	1	-
Logical variable (set. if a MTCPWM error is present)					
LV_ERR_MTC_CTL_3	O/V	0... 1H	0 ...1	1	-
Logical variable (set. if a control difference error is present)					
T_MTCPWM_PI_DIAG	O/V	0... FFH	0... 2.55	0.01	s
Debounce timer for MTCPWM error					

### Input data:

LV_ES {p. 1720}	LV_IGK {p. 906}	LV_MTC_CUR_OFF {p. 6565}	LV_ST {p. 1720}
LV_TPS_AD_ACT {p. 4951}	LV_TPS_SP_EXT_ADJ {p. 7435}	LV_TPS_SP_JAM {p. 6531}	MTCPWM {p. 6546}

STATE_ETC_LIH {p. 4982}	TPS_DIF {p. 6546}		
-------------------------	-------------------	--	--

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MTCPWM_PI_MAX_DIAG	-	0... 7FFFH	0... 99.99694	3.05e-3	%
Diagnosis threshold for MTCPWM					
C_T_MTCPWM_PI_DIAG	-	0... FFH	0... 2.55	0.01	s
Tolerance time MTCPWM-error					
C_T_MTCPWM_PI_DIAG_CUR_OFF	-	0... FFH	0... 2.55	0.01	s
Time threshold for end break-away					
C_T_TPS_DIF_DIAG	-	0... FFH	0... 2.55	0.01	s
Tolerance time control variance					
C_TPS_DIF_MAX_DIAG	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Maximum permissible control variance					

**FUNCTION DESCRIPTION:****General information:**

This diagnosis is to detect a throttle valve error or a jammed actuator.

The following diagnosis are performed:

- Pulse width modulation check
- Control difference check

**Description:****Pulse width modulation check:**

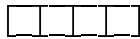
If the given pulse width modulation signal MTCPWM exceeds the position controller permissible maximum value C\_MTCPWM\_PI\_MAX\_DIAG for longer than C\_T\_MTCPWM\_PI\_DIAG then the error is detected and a reversible limp home is applied.

If the pulse width modulation signal lies below the threshold C\_MTCPWM\_PI\_MAX\_DIAG as long as  $T < C_T\_MTCPWM\_PI\_DIAG\_CUR\_OFF$  then the jammed throttle valve could break free (LV\_ERR\_MTC\_CTL\_1 is reset to 0) and the reversible limp home is passive.

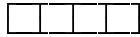
If the pulse width modulation signal lies below the threshold C\_MTCPWM\_PI\_MAX\_DIAG for longer than C\_T\_MTCPWM\_PI\_DIAG\_CUR\_OFF then a irreversible limp home is applied (Throttle is switched off).

Error symptoms are defined to this diagnosis as:

MTC\_CTL\_1



### MTC\_CTL\_2

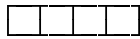


### Checking the control difference

If the throttle valve control difference `TPS_DIF` exceeds the permissible maximum value `C_TPS_DIF_MAX_DIAG` for longer than `C_T_TPS_DIF_DIAG` then a error is detected and a irreversible limp home is applied (Throttle is switched off).

Error symptoms are defined to this diagnosis as:

### MTC\_CTL\_3



### Application conditions

**Initialisation:** all 0 at LV\_IGK 0->1 **or** reset

**Recurrence:** 10ms

**Activation:**

```

If                LV_IGK = 1
and                LV_ST = 0
and                (LV_ES = 0 or LV_TPS_SP_EXT_ADJ = 1)
and                LV_TPS_AD_ACT = 0
and                LV_MTC_CUR_OFF = 0
and                STATE_ETC_LIH <> 10H
and                LV_TPS_SP_JAM = 0
Then              LV_CDN_DIAG_MTC_CTL_n = 1      (n = 1,2,3)
Else              Deactivation:
                    LV_CDN_DIAG_MTC_CTL_n = 0
Endif

```

**Formula section:**

Pulse width modulation check:

```

If(1)          LV_CDN_DIAG_MTC_CTL_1/2 = 1          //both
Then(1)If(2)   | MTCPWM | C_MTCPWM_PI_MAX_DIAG
  Then(2)       T_MTCPWM_PI_DIAG++
    If(3)       T_MTCPWM_PI_DIAG > C_T_MTCPWM_PI_DIAG
      Then(3)If(4)   T_MTCPWM_PI_DIAG < ...
                            C_T_MTCPWM_PI_DIAG_CUR_OFF
        Then(4)     ERR_SYM_MTC_CTL_1 = SYM_0
                            LV_ERR_MTC_CTL_1 = 1 //set direct
      Else(4)      ERR_SYM_MTC_CTL_2 = SYM_0
                            LV_ERR_MTC_CTL_2 = 1 //set direct for this DC
                            ERR_SYM_MTC_CTL_1 = NO_SYM
                            LV_ERR_MTC_CTL_1 = 0 /reset
      Endif(4)
    Else(3)       Timer is still running
  Endif(3)
Else(2)       T_MTCPWM_PI_DIAG = 0
                            ERR_SYM_MTC_CTL_1 = NO_SYM
                            LV_ERR_MTC_CTL_1 = 0
Endif(2)
Else(1)       T_MTCPWM_PI_DIAG = 0
Endif(1)

```

End of diagnosis pulse width modulation check:

```

If          LV_CDN_DIAG_MTC_CTL_1/2 = 1          //both
Then       Start Timer
  If         Timer > C_T_MTCPWM_PI_DIAG
    Then      LV_END_DIAG_MTC_CTL_1 = 1
      If      Timer >= C_T_MTCPWM_PI_DIAG_CUR_OFF
        Then  LV_END_DIAG_MTC_CTL_2 = 1
      Endif
    Else     Reset timer to 0
  Endif

```

Checking the control difference

```

If(1)          LV_CDN_DIAG_MTC_CTL_3 = 1
Then(1)If(2)   TPS_DIF > C_TPS_DIF_MAX_DIAG
  Then(2)       Start Timer
    If(3)       Timer > C_T_TPS_DIF_DIAG
      Then(3)   ERR_SYM_MTC_CTL_3 = SYM_0
                            LV_ERR_MTC_CTL_3 = 1 //set direct for this DC
    Endif(3)
  Else(2)     Reset Timer to 0
Endif(2)
Else(1)     Reset Timer to 0
Endif(1)

```

End of diagnosis pulse width modulation check:

```

If          LV_CDN_DIAG_MTC_CTL_3 = 1
Then       Start Timer
  If         Timer > C_T_TPS_DIF_DIAG
    Then     LV_END_DIAG_MTC_CTL_3 = 1
  Endif


```

```

Else      Reset Timer to 0
Endif

```

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
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## A.119 Electronic throttle control limp home management

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TPS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom					
LV_CDN_DIAG_TPS	V	0... 1H	0 ...1	1	-
Diagnosis condition					
LV_END_DIAG_TPS	V	0... 1H	0 ...1	1	-
End of Diagnosis					
LV_ERR_TPS	O/V	0... 1H	0 ...1	1	-
Logical variable, set if one TPS channel is identified as faulty or a ETC-Limp-Home is active					
LV_MTC_CUR_OFF_REQ	O/V	0... 1H	0 ...1	1	-
ETC without power request					
LV_MTC_LIH_CUR_OFF	O/V	0... 1H	0 ...1	1	-
ETC-LIMP-HOME-1					
LV_N_LIM_ETC_LIH	O/V	0... 1H	0 ...1	1	-
ETC-LIMP-HOME-2 (SAS)					
LV_N_LIM_ETC_LIH_REV	O/V	0... 1H	0 ...1	1	-
ETC-LIMP-HOME-3 (Reversible)					
LV_TPS_MTC_N_LIM	O/V	0... 1H	0 ...1	1	-
Logical variable, set if LIH engine speed limitation is required					
STATE_ETC_LIH	O/V	0H	ETC_NO_LIH	-	-
		1H	ETC_LIH_1		
		2H	ETC_LIH_2_		
		4H	ETC_LIH_2		
		8H	ETC_LIH_3		
Status ETC Limp-Home					
STATE_TPS_DIAG	O/V	0H	TPS_NO_	-	-
		1H	ERROR		
		2H	TPS_LIH_1		
		4H	TPS_LIH_2		
		8H	TPS_LIH_MAX		
Status TPS Diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**Input data:**

C_T_DYW_TPS_LIH_CHK {p. 4952}	C_T_MAX_TPS_LIH_CHK {p. 4952}	C_V_TPS_LIH_CHK_HYS {p. 4954}	LV_CT {p. 1442}
LV_DET_ERR_TPS_RATIO {p. 4990}	LV_ERR_MTC_CTL_1 {p. 4977}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}
LV_ERR_MTC_DR {p. 5002}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_MAF_1 {p. 4990}
LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_V_REF_1 {p. 4216}	LV_IGK {p. 906}	LV_N_LIM_TPS_AD {p. 4951}
LV_TPS_AD_DIAG_CUR_ OFF {p. 4951}	V_TPS_1 {p. 831}	V_TPS_2 {p. 831}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TPS	-	0... FFH	0... 255	1	-
Anti-bounce increment					
C_ABC_MAX_TPS	-	1... FFH	1... 255	1	-
Anti-bounce maximum					

**FUNCTION DESCRIPTION:****General information:**

The following TPS/ETC-Limp Home system reactions are defined:

- **TPS-EMERGENCY-MAX** (STATE\_TPS\_DIAG = TPS\_LIH\_MAX)
- **TPS-EMERGENCY-X** (STATE\_TPS\_DIAG = TPS\_LIH\_X)
- **ETC-LIMP-HOME-1** (STATE\_ETC\_LIH = ETC\_LIH\_1)
- **ETC-LIMP-HOME-2-REV** (STATE\_ETC\_LIH = ETC\_LIH\_2\_REV)
- **ETC-LIMP-HOME-2 (SAS)** (STATE\_ETC\_LIH = ETC\_LIH\_2)
- **ETC-LIMP-HOME-3** (STATE\_ETC\_LIH = ETC\_LIH\_3)

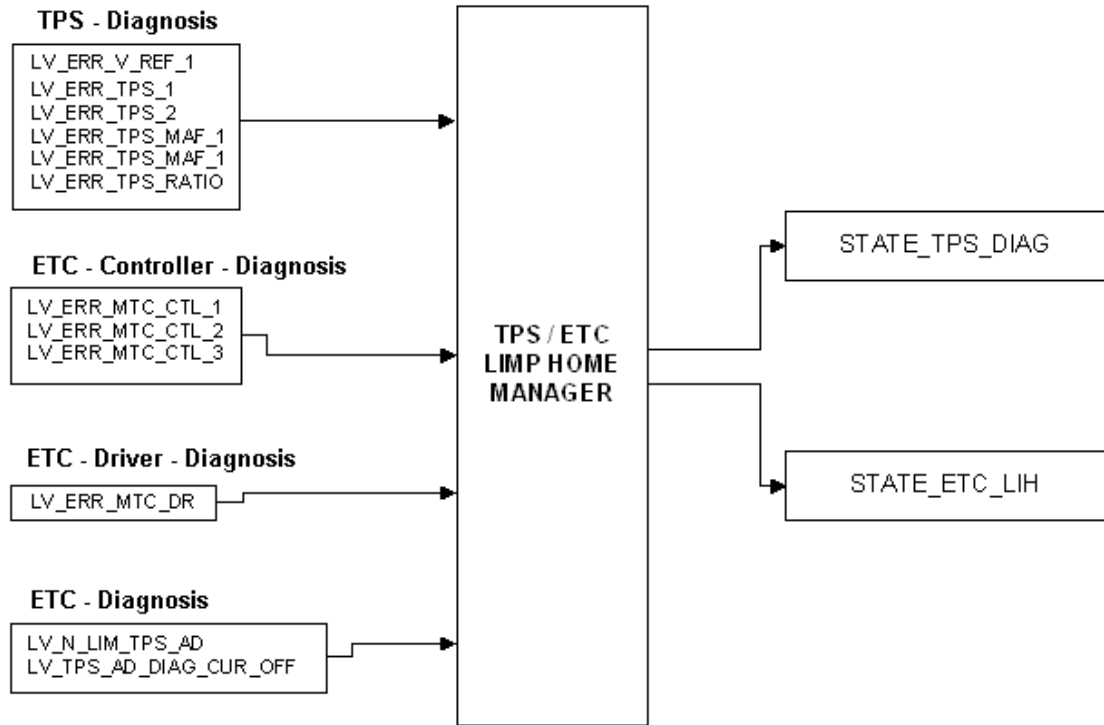
All **ETC-LIMP-HOME-..** have a higher priority then all **TPS-EMERGENCY-..**

**Application conditions**

<b>Initialization:</b>	all outputs = 0 at LV_IGK 0->1 or reset or at clearing error memory LV_ERR_TPS according ABC type <b>STD_INI</b>
<b>Recurrence:</b>	5ms
<b>Activation:</b>	LV_IGK = 1
<b>Deactivation:</b>	LV_IGK = 0 (set LV_CDN_DIAG_TPS = 0)

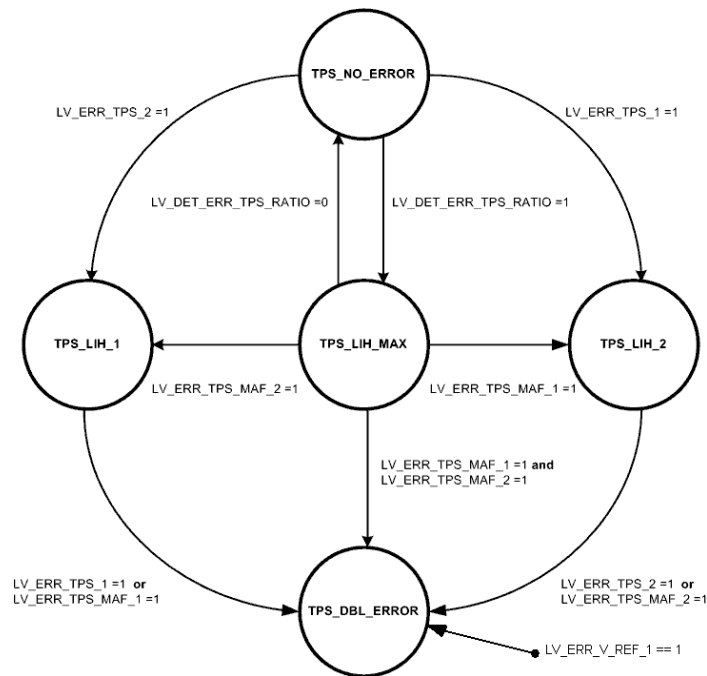
**Signal flow diagram:****TPS /ETC Limp Home Manager**

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**Signal flow diagram:**

**STATE\_TPS\_DIAG**



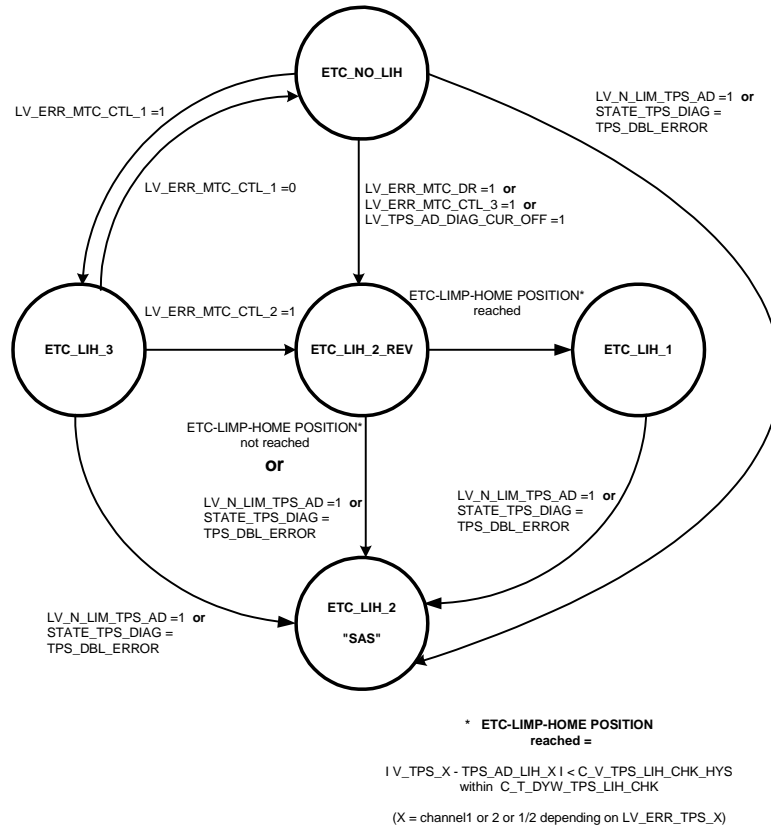
**Signal flow diagram:**

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**STATE\_ETC\_LIH**



**A.119.1 TPS-EMERGENCY-MAX**

(STATE\_TPS\_DIAG = TPS\_LIH\_MAX)

**Description:**

If TPS-Emergency MAX is activ, there is a maximum selection between the two channels (see Determination of the Throttle Position ).

**Formula section:**

**If** LV\_DET\_ERR\_TPS\_RATIO = 1  
**Then** STATE\_TPS\_DIAG = TPS\_LIH\_MAX  
**Endif**


**A.119.2 TPS-EMERGENCY-X**

(STATE\_TPS\_DIAG = TPS\_LIH\_X)

**Description:**

If one TPS channel (=Y) is detected as faulty then TPS-EMERGENCY-X is active.  
 If TPS-EMERGENCY-X is active, the throttle position acquisition is done with a leading Poti-X (see Acquisition of the throttle position ).

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**Formula section:**

**If** LV\_ERR\_TPS\_Y = 1 **or**  
LV\_ERR\_TPS\_MAF\_Y = 1

**Then** STATE\_TPS\_DIAG = TPS\_LIH\_X

**Endif**

Idle speed demand:

**If** STATE\_TPS\_DIAG = TPS\_LIH\_X **and**  
LV\_CT = 1

**Then** LV\_TPS\_MTC\_N\_LIM = 1 (see Engine speed limit coordination)

**Endif**

**A.119.3 ETC-LIMP-HOME-1 /ETC-LIMP-HOME-2-REV**

(STATE\_ETC\_LIH = ETC\_LIH\_1)/(STATE\_ETC\_LIH = ETC\_LIH\_2\_REV)

**Description:**

ETC-LIMP-HOME-1 is demanded by the ETC diagnosis (see Engine throttle diagnosis and adaptation ) and the ETC driver diagnosis.

During ETC-LIMP-HOME-1 the following limp home measures are defined:

- Throttle valve without power (hold by spring power in the Limp-Home position)
- Engine speed limitation in limp home mode (with considering the drivers request)

ETC-LIMP-HOME-2-REV is initiated reversible until the ETC-Limp Home throttle position (for calibration data and additional information see: Check of the Limp-Home position in chapter Engine throttle diagnosis and adaptation ) has been safely reached.

If the Limp-Home Position is reached ETC-LIMP-HOME-1 is set, if not ETC-LIMP-HOME-2 is set.

During ETC-LIMP-HOME-2\_REV the following limp home measures are defined:

- Throttle valve without power (hold by spring power in the Limp-Home position)
- Engine speed limitation in limp home mode (without considering the drivers request)

**Formula section:**

Activation condition of ETC-LIMP-HOME-1:

**If(1)** [ STATE\_ETC\_LIH = ETC\_NO\_LIH **and**  
LV\_ERR\_MTC\_DR = 1 **or**  
LV\_ERR\_MTC\_CTL\_3 = 1 **or**  
LV\_TPS\_AD\_DIAG\_CUR\_OFF = 1]

**Or**

[ STATE\_ETC\_LIH = ETC\_LIH\_3 **and**  
LV\_ERR\_MTC\_CTL\_2 = 1


**Then(1)**

Activation of ETC-LIMP-HOME-2-REV:

STATE\_ETC\_LIH = ETC\_LIH\_2\_REV  
LV\_MTC\_CUR\_OFF\_REQ = 1 (ETC without power request)  
LV\_N\_LIM\_ETC\_LIH = 1  
LV\_TPS\_MTC\_N\_LIM = 1 (see Engine speed limit coordination)

Check of Limp Home position:

Start Time: C\_T\_MAX\_TPS\_LIH\_CHK  
**IF(2)** T < C\_T\_MAX\_TPS\_LIH\_CHK **and**  
IV\_TPS\_X - V\_TPS\_AD\_LIH\_XI < C\_V\_TPS\_LIH\_CHK\_HYS

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Within the interval: C\_T\_DYW\_TPS\_LIH\_CHK  
 Activation of ETC-LIMP-HOME-1/Deactivation of ETC-LIMP-HOME-2-REV:

**Then(2)** Check limp home ok  
 STATE\_ETC\_LIH = ETC\_LIH\_1  
 LV\_MTC\_LIH\_CUR\_OFF = 1  
 LV\_N\_LIM\_ETC\_LIH = 0  
 LV\_TPS\_MTC\_N\_LIM = 0

Activation of ETC-LIMP-HOME-2:

**Else(2)** STATE\_ETC\_LIH = ETC\_LIH\_2  
**Endif(2)**

**Else(1)** STATE\_ETC\_LIH = ETC\_NO\_LIH

**Endif(1)**

## A.119.4 ETC-LIMP-HOME-2 (SAS)

(STATE\_ETC\_LIH = ETC\_LIH\_2)

### Description:

ETC-LIMP-HOME-2 (German abbreviation: SAS = Sicherheitsschubabschalten) is demanded by the ETC diagnosis (see Engine throttle diagnosis and adaptation ) and/or the TPS diagnosis (if both TPS channels are faulty). ETC-LIMP-HOME-2 is set unreversible for the engine run.

During ETC-LIMP-HOME-2 the following limp home measures are defined:

- Throttle valve without power (hold by spring power in the Limp-Home position)
- Engine speed limitation in limp home mode (without considering the drivers request)

### Formula section:


Activation of ETC-LIMP-HOME-2:

**If** STATE\_ETC\_LIH = ETC\_NO\_LIH **or**  
 STATE\_ETC\_LIH = ETC\_LIH\_1 **or**  
 STATE\_ETC\_LIH = ETC\_LIH\_2\_REV **or**  
 STATE\_ETC\_LIH = ETC\_LIH\_3  
**and**  
 LV\_N\_LIM\_TPS\_AD **or**  
 LV\_ERR\_V\_REF\_1 = 1 **or**  
 [LV\_ERR\_TPS\_1 = 1 **and**  
 LV\_ERR\_TPS\_2 = 1] **or**  
 [LV\_ERR\_TPS\_MAF\_1 = 1 **and**  
 LV\_ERR\_TPS\_MAF\_2 = 1] **or**  
 [LV\_ERR\_TPS\_X = 1 **and**  
 LV\_ERR\_TPS\_MAF\_Y = 1]  
**Then** STATE\_ETC\_LIH = ETC\_LIH\_2  
 LV\_N\_LIM\_ETC\_LIH = 1  
 LV\_MTC\_CUR\_OFF\_REQ = 1 (ETC without power request)  
 LV\_TPS\_MTC\_N\_LIM = 1 (see Engine speed limit coordination)  
**Endif**

## A.119.5 ETC-LIMP-HOME-3

(STATE\_ETC\_LIH = ETC\_LIH\_3)

### Description:

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ETC-LIMP-HOME-3 is demanded by the ETC position controller diagnosis (see Engine throttle diagnosis and adaptation). ETC-LIMP-HOME-3 is set reversible for the engine run.

During ETC-LIMP-HOME-3 the following limp home measures are defined:

- Engine speed limitation in limp home mode (without considering the drivers request)

### Formula section:

Activation of ETC-LIMP-HOME-3:

```

If           STATE_ETC_LIH = ETC_NO_LIH           and
               LV_ERR_MTC_CTL_1 = 1
Then        STATE_ETC_LIH = ETC_LIH_3
               LV_N_LIM_ETC_LIH_REV = 1
               LV_TPS_MTC_N_LIM = 1           (see Engine speed limit coordination)
Else       STATE_ETC_LIH = ETC_NO_LIH
Endif

```

### A.119.6 Calculation of LV\_ERR\_TPS

#### Description:

LV\_ERR\_TPS is used for MIL activation and inhibition of functions. The error is set depending the present status of ETC limp-home (combination of operation-mode and present TPS errors).

#### Formula section:

```

LV_CDN_DIAG_TPS = 1
If           STATE_ETC_LIH = ETC_LIH_1           or
               STATE_ETC_LIH = ETC_LIH_2_REV      or
               STATE_ETC_LIH = ETC_LIH_2
Then        ERR_SYM_TPS = SYM_2
Else       ERR_SYM_TPS = NO_SYM
Endif

```


LV\_ERR\_TPS, LV\_END\_DIAG\_TPS is calculated by error management.

## A.120 Electronic throttle control position sensor diagnosis

### Data definition:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TPS_1	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom TPS1 diagnosis					
ERR_SYM_TPS_2	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom TPS2 diagnosis					
ERR_SYM_TPS_MAF_1	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom TPS_MAF 1					
ERR_SYM_TPS_MAF_2	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom TPS_MAF 1					
ERR_SYM_TPS_RATIO	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom TPS_RATIO diagnosis					
LV_CDN_DIAG_TPS_1	V	0... 1H	0 ...1	1	-
Electrical TPS 1 diagnosis condition					
LV_CDN_DIAG_TPS_2	V	0... 1H	0 ...1	1	-
Electrical TPS 2 diagnosis condition					
LV_CDN_DIAG_TPS_MAF_1	V	0... 1H	0 ...1	1	-
Diagnosis condition TPS_MAF 1					
LV_CDN_DIAG_TPS_MAF_2	V	0... 1H	0 ...1	1	-
Diagnosis condition TPS_MAF 2					
LV_CDN_DIAG_TPS_RATIO	V	0... 1H	0 ...1	1	-
Diagnosis condition TPS_RATIO diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DET_ERR_TPS_RATIO	O/V	0... 1H	0 ...1	1	-
Logic variable set if TPS_RATIO error is detected					
LV_END_DIAG_TPS_1	V	0... 1H	0 ...1	1	-
End of diagnosis TPS1 diagnosis					
LV_END_DIAG_TPS_2	V	0... 1H	0 ...1	1	-
End of diagnosis TPS2 diagnosis					
LV_END_DIAG_TPS_MAF_1	V	0... 1H	0 ...1	1	-
End of diagnosis TPS_MAF 1					
LV_END_DIAG_TPS_MAF_2	V	0... 1H	0 ...1	1	-
End of diagnosis TPS_MAF 2					
LV_END_DIAG_TPS_RATIO	O/V	0... 1H	0 ...1	1	-
End of diagnosis TPS_RATIO diagnosis					
LV_ERR_TPS_1	O/V	0... 1H	0 ...1	1	-
Electrical TPS error, channel 1					
LV_ERR_TPS_2	O/V	0... 1H	0 ...1	1	-
Electrical error TPS channel 2					
LV_ERR_TPS_MAF_1	O/V	0... 1H	0 ...1	1	-
TPS channel 1 is not plausible to MAF					
LV_ERR_TPS_MAF_2	O/V	0... 1H	0 ...1	1	-
TPS channel 2 is not plausible to MAF					
LV_ERR_TPS_RATIO	O/V	0... 1H	0 ...1	1	-
Logic variable set if TPS_RATIO error is present					
T_DLY_TPS_DIAG_REQ_HOM_ACT	V	0... FFH	0... 1.275	0.005	s
Delay timer to check the HOM mode after active TPS error					
T_MAX_TPS_DIF_DIAG	V	0... FFH	0... 1.275	0.005	s
Integration timer for plausibility check in case of single channel error					
T_TPS_DIF_INT	-	0... FFH	0... 1.275	0.005	s
Integration timer for deviation between measured and calculated DK value					
TPS_DIF_DIAG_1	V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Difference between measured TPS_AV_1 and modelled TPS_SUB_DIAG					
TPS_DIF_DIAG_2	V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Difference between measured TPS_AV_2 and modelled TPS_SUB_DIAG					
TPS_DIF_DIAG_COR_1	O/V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Corrected value of TPS_DIF_DIAG_1					
TPS_DIF_DIAG_COR_2	O/V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Corrected value of TPS_DIF_DIAG_2					
TPS_DIF_DIAG_COR_MMV_1	V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Filtered corrected value of TPS_DIF_DIAG_COR_1					
TPS_DIF_DIAG_COR_MMV_2	V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Filtered corrected value of TPS_DIF_DIAG_COR_2					
TPS_SUM_DIF_DIAG_COR_1	O/V	0... FFFFH	0... 32767.5	0.5	°TPS
Integrated value of TPS_DIF_DIAG_COR_1					
TPS_SUM_DIF_DIAG_COR_1_OLD	-	0... FFFFH	0... 32767.5	0.5	°TPS
Old value of TPS_SUM_DIF_DIAG_COR_1					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TPS_SUM_DIF_DIAG_COR_2	O/V	0... FFFFH	0... 32767.5	0.5	°TPS
Integrated value of TPS_DIF_DIAG_COR_2					
TPS_SUM_DIF_DIAG_COR_2_OLD	-	0... FFFFH	0... 32767.5	0.5	°TPS
Old value of TPS_SUM_DIF_DIAG_COR_2					

**Input data:**

LV_ERR_V_REF_1 {p. 4216}	LV_HOM_ACT {p. 8136}	LV_IGK {p. 906}	LV_ST_END {p. 1720}
LV_TPS_SUB_DIAG_ERR {p. 5000}	LV_TPS_SUB_DIAG_NOT_ VLD {p. 8277}	STATE_TPS_DIAG {p. 4982}	TPS_AV_1 {p. 1169}
TPS_AV_2 {p. 1169}	TPS_SUB_DIAG {p. 8377}	V_TPS_1 {p. 831}	V_TPS_2 {p. 831}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TPS_1	-	0... FFH	0... 255	1	-
Anti-bounce increment value TPS diagnosis					
C_ABC_INC_TPS_2	-	0... FFH	0... 255	1	-
Anti-bounce increment value TPS diagnosis					
C_ABC_INC_TPS_RATIO	-	0... FFH	0... 255	1	-
Anti-bounce increment value TPS ratio diagnosis					
C_ABC_MAX_TPS_1	-	1... FFH	1... 255	1	-
Anti-bounce maximum value TPS diagnosis					
C_ABC_MAX_TPS_2	-	1... FFH	1... 255	1	-
Anti-bounce maximum value TPS diagnosis					
C_ABC_MAX_TPS_RATIO	-	1... FFH	1... 255	1	-
Anti-bounce maximum value TPS ratio diagnosis					
C_T_DLY_TPS_DIAG_REQ_HOM_ACT	-	0... FFH	0... 1.275	0.005	s
Delay timer to check the HOM mode after active TPS error					
C_T_MAX_TPS_DIF_DIAG	-	0... FFH	0... 1.275	0.005	s
Integration time for plausibility check in case of single channel error					
C_T_TPS_DIF_INT	-	0... FFH	0... 1.275	0.005	s
Integration time for deviation between measured and calculated DK value					
C_TPS_DIF_DIAG_COR_MMV_MAX	-	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Threshold of max. deviation of filtered TPS difference value					
C_TPS_SUB_CRLC_DIF	-	0... FFFFH	0 ...1	15.3e-6	-
Correlation constant for filtering of error (second error)					
C_TPS_SUM_DIF_DIAG_COR_MAX	-	0... FFFFH	0... 32767.5	0.5	°TPS
Threshold of integrated corrected max. difference of measured and modelled TPS value					
C_V_TPS_MAX_DIAG_1	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Upper diagnostic voltage TPS 1					
C_V_TPS_MAX_DIAG_2	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Upper diagnostic voltage TPS 2					
C_V_TPS_MIN_DIAG_1	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Lower diagnostic voltage TPS 1					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_V_TPS_MIN_DIAG_2	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Lower diagnostic voltage TPS 2					
C_V_TPS_RATIO_HYS	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Admissible deviation of DK angle					
IP_FAC_TPS_DIF_1	V	0... FFH	0... 1.99218	0.0078125	-
LDP_N_IP_FAC_TPS_DIF_1	8	0... 1FE0H	0... 8160	1	rpm
LDP_MAF_SP_TQI_IP_FAC_TPS_DIF_1	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Factor 1 for TPS_DIF_DIAG calculation					
IP_FAC_TPS_DIF_2	-	0... FFH	0... 1.99218	0.0078125	-
LDP_PQ_SP_IP_FAC_TPS_DIF_2	6	0... FFFFH	0... 0.99998	15.3e-6	-
Factor 2 for TPS_DIF_DIAG calculation					
LC_USE_TPS_MAF_DIAG	-	0... 1H	0 ...1	1	-
Local value to switch off TPS_MAF diagnosis ( MSV70 = 0, MSD70 = 1)					

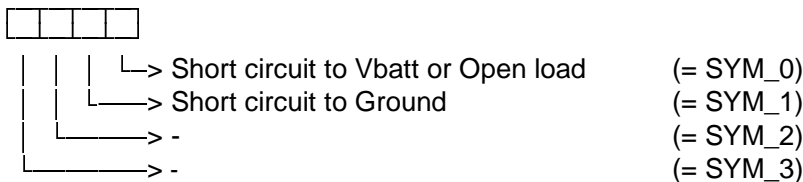
## A.120.1 Diagnosis of the admissible voltage ranges V\_TPS\_1 /V\_TPS\_2

### FUNCTION DESCRIPTION:

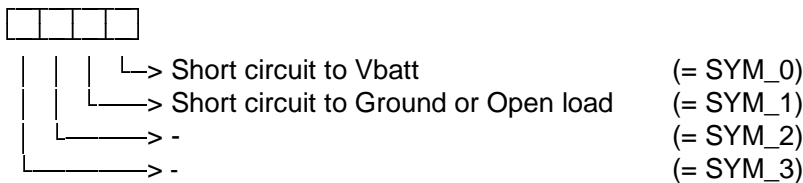
#### Description:

In the case of an error-free system, the potentiometer voltages must be within admissible limits. The following errors symptoms can be distinguished:

#### ERR\_SYM\_TPS\_1:



#### ERR\_SYM\_TPS\_2:



### Application conditions

**Initialisation:** according filtertype **STD\_INI** (all 0 at LV\_IGK  
0->1 or reset)

**Recurrence:** 5ms

**Activation:** **If** LV\_IGK = 1 **and**  
LV\_ERR\_V\_REF\_1 = 0 **and**  
LV\_ERR\_TPS\_1/ 2 = 0 **and**



```

Then                LV_CDN_DIAG_TPS_1/ 2 = 1
Else                LV_CDN_DIAG_TPS_1/ 2 = 0
Endif

```

### Formula section:

#### Calculation End of Diagnosis:

For calculation of LV\_END\_DIAG\_TPS\_1/2 see Anti-bounce algorithm, calculation of the end of diagnosis .

#### Error detection TPS\_1 short circuit to ground:

```

If                V_TPS_1 < C_V_TPS_MIN_DIAG_1
Then              ERR_SYM_TPS_1 = SYM_1
                    LV_ERR_TPS_1 = 1                //after debounce, remains active until next initialization

```

#### Error detection TPS\_1 short circuit to Vbatt or open load:

```

Elseif           V_TPS_1 > C_V_TPS_MAX_DIAG_1
Then              ERR_SYM_TPS_1 = SYM_0
                    LV_ERR_TPS_1 = 1                //after debounce, remains active until next initialization

```

```

Else              ERR_SYM_TPS_1 = NO_SYM

```

```

Endif

```

#### Error detection TPS\_2 short circuit to ground or open load:

```

If                V_TPS_2 < C_V_TPS_MIN_DIAG_2
Then              ERR_SYM_TPS_2 = SYM_1
                    LV_ERR_TPS_2 = 1                //after debounce, remains active until next initialization

```

#### Error detection TPS\_2 short circuit to VBatt:

```

Elseif           V_TPS_2 > C_V_TPS_MAX_DIAG_2
Then              ERR_SYM_TPS_2 = SYM_0
                    LV_ERR_TPS_2 = 1                //after debounce, remains active until next initialization

```

```

Else              ERR_SYM_TPS_2 = NO_SYM

```

```

Endif

```

## A.120.2 Ratio - check between TPS values V\_TPS\_1 /V\_TPS\_2


### FUNCTION DESCRIPTION:

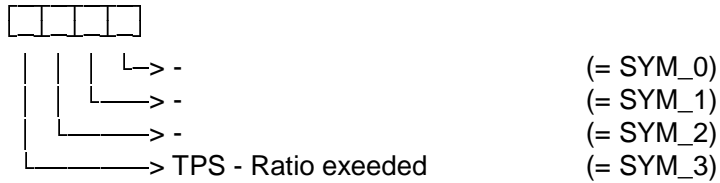
#### General information:

In the case of an error-free system, the Poti-voltages V\_TPS\_1 and V\_TPS\_2 must not differ by more than C\_V\_TPS\_RATIO\_HYS. The voltage V\_TPS\_2 is inverted in order to carry out the channel comparison.

#### Description:

If the threshold C\_V\_TPS\_RATIO\_HYS is exceeded, the TPS\_RATIO error will be debounced. Error symptoms are defined for this diagnosis function as:

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### Application conditions

**Initialisation:** according filter type *STD\_INI*

**Recurrence:** 5ms

**Activation:**

```

If                LV_IGK = 1
and              LV_ST_END = 1
and              LV_ERR_V_REF_1 = 0
and              LV_ERR_TPS_1/ 2 = 0    both channels must be errorfree
and              LV_ERR_TPS_MAF_1/ 2 = 0
Then             LV_CDN_DIAG_TPS_RATIO = 1
Else             LV_CDN_DIAG_TPS_RATIO = 0
                   LV_DET_ERR_TPS_RATIO = 0
Endif

```

### Formula section:

```

If                | V_TPS_1 - (5[V] - V_TPS_2) | > C_V_TPS_RATIO_HYS
Then              ERR_SYM_TPS_RATIO = SYM_3                //anti bounce increment
                   LV_DET_ERR_TPS_RATIO = 1
Else              ERR_SYM_TPS_RATIO = NO_SYM              //anti bounce decrement
                   LV_DET_ERR_TPS_RATIO = 0

```

**Endif**

LV\_ERR\_TPS\_RATIO , LV\_END\_DIAG\_TPS\_RATIO is calculated by error management

## A.120.3 TPS /TPS\_SUB\_DIAG plausibility check after RATIO-error is detected

### FUNCTION DESCRIPTION:

#### General information:

This function is only performed if calibrated LC\_USE\_MAF\_TPS\_DIAG = 1.

If RATIO error is detected the algorithm is used to decide if channel one or two or both are not plausible. It is based on the modelled TPS value TPS\_SUB\_DIAG.

X = channel 1 and 2

## Description:

### Detection of TPS first error:

The integration is done for C\_T\_TPS\_DIF\_INT if diagnosis conditions are active.

TPS\_DIF\_DIAG\_X is the difference between the measured value TPS\_AV\_X and the modelled TPS value TPS\_SUB\_DIAG.

TPS\_DIF\_DIAG\_COR\_X is the corrected value based on N, MAF\_SP\_TQI, PQ.

TPS\_SUM\_DIF\_DIAG\_COR\_X is the integrated value of TPS\_DIF\_DIAG\_COR\_X.

Depending on TPS\_SUM\_DIF\_DIAG\_COR\_X channel one or two or both are set as not plausible and the diagnosis is switched off.

The plausibility check cannot be performed if TPS\_SUB\_DIAG cannot be calculated in the right way because an active lambda-sensor fault or a load-sensor fault.

In this case, the two channels are declared as faulty when LV\_DET\_ERR\_TPS\_RATIO is set for C\_T\_TPS\_DIF\_INT.

### Continuous TPS /TPS\_SUB\_DIAG monitoring for single channel

In the case of one channel is diagnosed as faulty, a plausibility check for the remaining channel to the other one is no longer possible. In this case, the substitute value TPS\_DIF\_DIAG\_COR\_X is used for the plausibility check while the engine is running. The difference between the measured TPS\_AV value and the substitute value TPS is normalized and the mean value is established with a correlation constant.

The plausibility check cannot be performed when a mass air flow signal is missing; in this case, the channel is declared as faulty.

Error symptom definition see TPS-FIRST-ERROR diagnosis.

### Check of the combustion mode with active TPS error

In order to perform the first /second error diagnosis the combustion-mode must be homogeneous, thus there's a delay timer which runs after a present Ratio /Single TPS error.

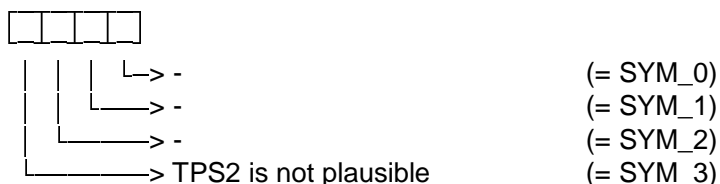
If the timer is elapsed without active HOM mode, a TPS double fault is set and the throttle is switched off.

Error symptoms are defined for this diagnosis function as:

#### ERR\_SYM\_TPS\_MAF\_1:



#### ERR\_SYM\_TPS\_MAF\_2:



## Application conditions




```

ERR_SYM_TPS_MAF_2 = SYM_3
LV_ERR_TPS_MAF_2 = 1
LV_END_DIAG_TPS_MAF_2 = 1
Endif(5)
Else(4)
T_MAX_TPS_DIF_DIAG --
Endif(4)
Elseif(3)
(LV_ERR_TPS_2 = 1 or LV_ERR_TPS_MAF_2 = 1) //TPS_2 faulty
Then(3)
LV_CDN_DIAG_TPS_MAF_1 = 1
Call "calculation TPS_DIF_DIAG_COR_MMV_1"
If(4b)
LV_TPS_SUB_DIAG_ERR = 1
Then(4b)
ERR_SYM_TPS_MAF_1 = SYM_3
LV_ERR_TPS_MAF_1 = 1
LV_END_DIAG_TPS_MAF_1 = 1
Elseif(4b)
(LV_TPS_SUB_DIAG_ERR = 0 and
TPS_DIF_DIAG_COR_MMV_1 > C_TPS_DIF_DIAG_COR_MMV_MAX)
Then(4b)
If(5b)
T_MAX_TPS_DIF_DIAG < C_T_MAX_TPS_DIF_DIAG
Then(5b)
T_MAX_TPS_DIF_DIAG ++ //count debounce time

Else(5b)
ERR_SYM_TPS_MAF_1 = SYM_3
LV_ERR_TPS_MAF_1 = 1
LV_END_DIAG_TPS_MAF_1 = 1
Endif(5b)
Else(4)
T_MAX_TPS_DIF_DIAG --
Endif(4b)
Else(3)
Call " First error detection"
Endif(3)
Else(2) Double TPS error, no diagnosis
Endif(2)
Else(1)//reset
T_TPS_DIF_INT = 0
TPS_SUM_DIF_DIAG_COR_1 = 0
TPS_SUM_DIF_DIAG_COR_2 = 0
TPS_SUM_DIF_DIAG_COR_1_OLD = 0
TPS_SUM_DIF_DIAG_COR_2_OLD = 0
TPS_DIF_DIAG_COR_1 = 0
TPS_DIF_DIAG_COR_2 = 0
TPS_DIF_DIAG_1 = 0
TPS_DIF_DIAG_2 = 0
T_MAX_TPS_DIF_DIAG = 0

```

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**Endif(1)****A.120.3.1 Calculation of TPS\_DIF\_DIAG\_COR\_MMV\_x = Filtered value**

$$\text{TPS\_DIF\_DIAG\_COR\_MMV\_x}(n) = \text{TPS\_DIF\_DIAG\_COR\_MMV\_x}(n-1) +$$

$$[\text{TPS\_DIF\_DIAG\_COR\_x} - \text{TPS\_DIF\_DIAG\_COR\_MMV\_x}(n-1)] *$$

$$\text{C\_TPS\_SUB\_CLRC\_DIF}$$
**A.120.3.2 First error detection****If(1)**

LV\_DET\_ERR\_TPS\_RATIO = 1

**Then(1)**

LV\_CDN\_DIAG\_TPS\_MAF\_1 = 1

LV\_CDN\_DIAG\_TPS\_MAF\_2 = 1

**If(2)**

T\_TPS\_DIF\_INT &lt; C\_T\_TPS\_DIF\_INT //INT timer not elapsed

**Then(2)**

Integration timer T\_TPS\_DIF\_INT ++ //count INT timer

1 TPS\_SUM\_DIF\_DIAG\_COR\_1=TPS\_SUM\_DIF\_DIAG\_COR\_1\_OLD + TPS\_DIF\_DIAG\_COR\_1

2 TPS\_SUM\_DIF\_DIAG\_COR\_2=TPS\_SUM\_DIF\_DIAG\_COR\_2\_OLD + TPS\_DIF\_DIAG\_COR\_2

**If(3)**

LV\_TPS\_SUB\_DIAG\_ERR = 1

**Then(3)**

ERR\_SYM\_TPS\_MAF\_1 = SYM\_3

LV\_ERR\_TPS\_MAF\_1 = 1

LV\_END\_DIAG\_TPS\_MAF\_1 = 1

ERR\_SYM\_TPS\_MAF\_2 = SYM\_3

LV\_ERR\_TPS\_MAF\_2 = 1

LV\_END\_DIAG\_TPS\_MAF\_2 = 1

**Else(3)****If(4) //integrated value reached threshold**

TPS\_SUM\_DIF\_DIAG\_COR\_1 &gt; C\_TPS\_SUM\_DIF\_DIAG\_COR\_MAX

**Then(4)**

ERR\_SYM\_TPS\_MAF\_1 = SYM\_3

LV\_ERR\_TPS\_MAF\_1 = 1

LV\_END\_DIAG\_TPS\_MAF\_1 = 1

**If(5) //integrated value reached threshold**

TPS\_SUM\_DIF\_DIAG\_COR\_2 &gt; C\_TPS\_SUM\_DIF\_DIAG\_COR\_MAX

**Then(5)**

ERR\_SYM\_TPS\_MAF\_2 = SYM\_3

LV\_ERR\_TPS\_MAF\_2 = 1

LV\_END\_DIAG\_TPS\_MAF\_2 = 1

**Else(2) //Timer elapsed****If(6)**

LV\_TPS\_SUB\_DIAG\_ERR = 1

**Then(6)**

ERR\_SYM\_TPS\_MAF\_1 = SYM\_3

LV\_ERR\_TPS\_MAF\_1 = 1

LV\_END\_DIAG\_TPS\_MAF\_1 = 1

ERR\_SYM\_TPS\_MAF\_2 = SYM\_3

LV\_ERR\_TPS\_MAF\_2 = 1

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```
LV_END_DIAG_TPS_MAF_2 = 1
```

```
If(7)
```

```
TPS_SUM_DIF_DIAG_COR_1 ≥ TPS_SUM_DIF_DIAG_COR_2
```

```
Then(7)
```

```
ERR_SYM_TPS_MAF_1 = SYM_3
```

```
LV_ERR_TPS_MAF_1 = 1
```

```
LV_END_DIAG_TPS_MAF_1 = 1
```

```
Else(7)
```

```
ERR_SYM_TPS_MAF_2 = SYM_3
```

```
LV_ERR_TPS_MAF_2 = 1
```

```
LV_END_DIAG_TPS_MAF_2 = 1
```

```
Endif
```

```
Else(3a)
```

```
Else(1) // set end of diagnosis
```

```
If(8) LV_END_DIAG_TPS_MAF_X = 0 //both
```

```
Then(8) LV_CDN_DIAG_TPS_MAF_X = 1 //both
```

```
LV_END_DIAG_TPS_MAF_X = 1 //both
```

```
Else(8) // Ratio symptom no more detected, reset variables
```

```
LV_CDN_DIAG_TPS_MAF_X = 0 //both
```

```
T_TPS_DIF_INT = 0
```

```
TPS_SUM_DIF_DIAG_COR_1_OLD = 0
```

```
TPS_SUM_DIF_DIAG_COR_2_OLD = 0
```

```
Endif(8)
```

```
Endif(1)
```

### A.120.3.3 Check of the combustion mode with active TPS error

```
If LV_DET_ERR_TPS_RATIO = 1 or
```

```
LV_ERR_TPS_1 = 1 or
```

```
LV_ERR_TPS_2 = 1 or
```

```
LV_ERR_TPS_MAF_1 = 1 or
```

```
LV_ERR_TPS_MAF_2 = 1
```

```
Then T_DLY_TPS_DIAG_REQ_HOM_ACT ++
```

```
If T_DLY_TPS_DIAG_REQ_HOM_ACT ≥ C_T_DLY_TPS_DIAG_REQ_HOM_ACT
```

```
and
```

```
LV_HOM_ACT = 0
```

```
Then LV_CDN_DIAG_TPS_MAF_1/2 = 1 //both
```

```
ERR_SYM_TPS_MAF_1/2 = SYM_3
```

```
LV_ERR_TPS_MAF_1/2 = 1
```

```
LV_END_DIAG_TPS_MAF_1/2 = 1
```

```
Endif
```

```
Else T_DLY_TPS_DIAG_REQ_HOM_ACT = 0
```

```
Endif
```

## A.121 Electronic throttle control position sensor diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_TPS_SUB_DIAG_ERR	O/V	0... 1H	0 ...1	1	-
TPS_SUB_DIAG is not valid due to present component error					

### Input data:

LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_DIP_SENS {p. 4824}
LV_ERR_MAP_DIP_SHIFT {p. 4824}	LV_IGK {p. 906}	LV_ST_END {p. 1720}	LV_VAR_MAF {p. 656}
NC_CBK_EX_NR {p. 1829}			

### A.121.1 Calculation of LV\_TPS\_SUB\_DIAG\_ERR

#### Description:

TPS\_SUB\_DIAG is the modelled TPS value calculated out of the measured lambda and the intake manifold model. With a present component error this calculation is no more possible, thus both TPS channels are set as faulty.

#### Application conditions

**Initialisation:** *0 atreset*

**Recurrence:** *5ms*


**Activation:** *LV\_ST\_END = 1*

#### Formula section:

```

LV_TPS_SUB_DIAG_ERR = 0
If //OBD1 error, valid for all variants
    LV_ERR_AMP = 1 or
    LV_ERR_AMP_PLAUS = 1 or
    LV_ERR_MAP_DIP_SENS = 1 or
    LV_ERR_MAP_DIP_SHIFT = 1
Then
    LV_TPS_SUB_DIAG_ERR = 1
Elseif //HFM error, valid if equipped
    LV_VAR_MAF = 1
Then
    If LV_ERR_MAF = 1
        Then LV_TPS_SUB_DIAG_ERR = 1
    Endif
Else
    If LV_ERR_DIAGCPS = 1 or
    LV_ERR_EL_CPS = 1

```


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```

    Then      LV_TPS_SUB_DIAG_ERR = 1
Else      If      [ NC_CBK_EX_NR = 2
                ( LV_ERR_FSD[1] = 1
                  LV_ERR_LS_UP[2] = 1 )
                ( LV_ERR_FSD[2] = 1
                  LV_ERR_LS_UP[1] = 1 )
                LV_ERR_FSD[NC_CBK_EX_NR] = 1
                LV_ERR_LS_UP[NC_CBK_EX_NR] = 1 ]
    Then      LV_TPS_SUB_DIAG_ERR = 1
Else      If      NC_CBK_EX_NR = 1
                LV_ERR_FSD[1] = 1
                LV_ERR_LS_UP[1] = 1
    Then      LV_TPS_SUB_DIAG_ERR = 1
    Endif
Endif
Endif
Endif

```

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## A.122 Electronic throttle control power stage diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_MTC_DR	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom MTC_DR					
LV_CDN_DIAG_MTC_DR	O/V	0... 1H	0 ...1	1	-
Diagnosis condition MTC_DR					
LV_END_DIAG_MTC_DR	O/V	0... 1H	0 ...1	1	-
End of Diagnosis MTC_DR					
LV_ERR_MTC_DR	O/V	0... 1H	0 ...1	1	-
MTC_DR error present					

### Input data:

BIOS_HBR_FAULT_STATUS_MTC	LV_ES {p. 1720}	LV_IGK {p. 906}	LV_MTC_CUR_OFF {p. 6565}
LV_ST {p. 1720}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_MTC_DR	-	0... FFH	0... 255	1	-
Debounce counter increment, MTC driver diagnosis					
C_ABC_MAX_MTC_DR	-	1... FFH	1... 255	1	-
Debounce counter maximum value, MTC driver diagnosis					

## FUNCTION DESCRIPTION:

### General information:

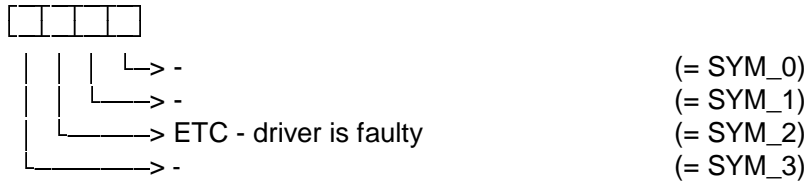
Error detection is effected via the ECU hardware (MTC H-Bridge IC).

### Description:

The following errors symptoms ( Error state BIOS\_HBR\_FAULT\_STATUS\_MTC is delivered from the basic software ) can be distinguished:

- Undervoltage
- Overcurrent
- Overtemperature

Error-symptoms are defined to this diagnosis function as following:



### Application conditions

**Initialisation:** all 0 at LV\_IGK 0->1 **or** reset

**Recurrence:** 5ms

**Activation:**

```

If      LV_IGK = 1          and
          LV_ES = 0          and
          LV_ST = 0          and
                    LV_MTC_CUR_OFF = 0          //Position controller has power
Then    LV_CDN_DIAG_MTC_DR = 1
Else    LV_CDN_DIAG_MTC_DR = 0
Endif

```

### Formula section:

```

If      BIOS_HBR_FAULT_STATUS_MTC = 1
Then    ERR_SYM_MTC_DR = SYM_2
          LV_ERR_MTC_DR = 1          //after debounce
Else    ERR_SYM_MTC_DR = NO_SYM
          LV_ERR_MTC_DR = 0          //after rebound
Endif

```

Calculation end of diagnosis:

LV\_END\_DIAG\_MTC\_DR is calculated by error management

## A.123 Mass air flow throttle control diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_RLY_MTC_HEAT	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of RLY_MTC_HEAT bit 0: diagnosis condition for symptom SCP (SYM_0)bit 1: diagnosis condition for symptom SCG (SYM_1)bit 2: diagnosis condition for symptom OC (SYM_2)					
ERR_DIAG_RLY_MTC_HEAT	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for RLY_MTC_HEAT (only parameter)					
ERR_SYM_RLY_MTC_HEAT	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom MTC_HEAT of power stage					
LV_CDN_DIAG_RLY_MTC_HEAT	O/V	0... 1H	0 ...1	1	-
Diagnosis condition MTC_HEAT of power stage					
LV_END_DIAG_RLY_MTC_HEAT	O/V	0... 1H	0 ...1	1	-
End of MTC_HEAT power stage diagnosis					
LV_ERR_RLY_MTC_HEAT	O/V	0... 1H	0 ...1	1	-
Logical value for MTC_HEAT error of power stage					
LV_INH_DIAG_RLY_MTC_HEAT	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition RLY_MTC_HEAT diagnosis					

### Input data:

LV_CDN_VB_MIN_DIAG {p. 1185}	LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}	
---------------------------------	-----------------------------	-----------------	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_RLY_MTC_HEAT	-	0... FFH	0... 255	1	-
Debounce counter increment MTC_HEAT					
C_ABC_MAX_RLY_MTC_HEAT	-	1... FFH	1... 255	1	-
Debounce counter maximum value MTC_HEAT					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_RLY_MTC_HEAT	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (= 2)					

### Import actions:

Continued on next page
------------------------

<b>ACTION_ERRM_FilterMulticondition</b> (IN<XX>,IN<CDN_DIAG_>,XX>,<IN<>,ERR_DIAG_XX>,<IN>,<C_ABC_INC_XX>,IN<C_ABC_MAX_XX>,OUT<LV_ERR_XX>)
<b>ACTION_INFR_GetEIDiagMTCHEAT</b> (OUT<Cdn_diag_rly_mtc_heat>,<OUT<Err_diag_rly_mtc_heat>)

### Error treatment:

Diagnostic	Symptom description	Symptom	Filter type
<b>RLY_MTC_HEAT</b>			
Diagnostic description	SCP	SYM_0	MPL_STD_INI
	SCG	SYM_1	
	OC	SYM_2	

**Note :** ACTION\_INFR\_GetEIDiagMTCHEAT() is defined in the IRS (Infrastructure requirement specification AGGR THRO)

### FUNCTION DESCRIPTION:

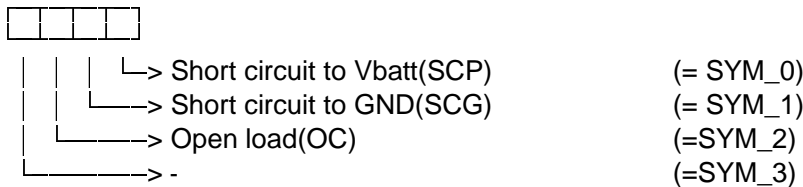
#### General information:

The signal from the driver which controls the throttle housing heater relay is diagnosed. The relay is driven by the ECU via an output driver. The failure detection is done by ECU Hardware and given to ASW. The purpose of the diagnosis is based on the detection of electrical faults as defined by OBD I requirements.

#### Description:

After activation conditions are met, the diagnosis activation is delayed for NC\_PSD\_DLY\_RLY\_MTC\_HEAT executions, to avoid the usage of wrong infrastructure information. The error detection algorithm operates the electrical diagnosis of powerstage outputs of ATIC39.

Error-symptoms are defined to this diagnosis function as following :



#### Application conditions

**Initialisation:** according Filter-type **MPL\_STD\_INI**  
 (reset of variables at LV\_IGK 0 -> 1 or ECU reset)  
 Set delay counter for NC\_PSD\_DLY\_RLY\_MTC\_HEAT

**Recurrence:** 100 ms

**Activation:** LV\_IGK = 1

**Deactivation:** LV\_IGK = 0

### Formula section:

If diagnosis is not inhibited (LV\_INH\_DIAG\_RLY\_MTC\_HEAT = 0 ) the diagnosis conditions are set according infrastructure information: CDN\_DIAG\_RLY\_MTC\_HEAT.

Failure symptoms (raw value) are set according infrastructure information: ERR\_DIAG\_RLY\_MTC\_HEAT.

### Failure debouncing and error management treatment:

For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN\_DIAG\_RLY\_MTC\_HEAT and ERR\_DIAG\_RLY\_MTC\_HEAT.

ACTION\_ERRM\_FilterMulticondition (IN<RLY\_MTC\_HEAT>, IN<CDN\_DIAG\_RLY\_MTC\_HEAT>, IN<ERR\_DIAG\_RLY\_MTC\_HEAT>, IN<C\_ABC\_INC\_RLY\_MTC\_HEAT>, IN<C\_ABC\_MAX\_RLY\_MTC\_HEAT>, OUT<LV\_ERR\_RLY\_MTC\_HEAT>)

This algorithm determines:

ERR\_SYM\_RLY\_MTC\_HEAT (Detected error symptom)  
 LV\_ERR\_RLY\_MTC\_HEAT (Error flag for debounced error)  
 LV\_CDN\_DIAG\_RLY\_MTC\_HEAT (Diagnosis condition information)  
 LV\_END\_DIAG\_RLY\_MTC\_HEAT (End of diagnosis information)

### Diagnosis inhibition:

```

If          LV_IGK = 1                and
              LV_CDN_VB_MIN_DIAG = 1 and
              LV_ERR_SPI_MPS = 0
Then       LV_INH_DIAG_RLY_MTC_HEAT = 0
Else       LV_INH_DIAG_RLY_MTC_HEAT = 1
Endif
  
```

```

If          LV_INH_DIAG_RLY_MTC_HEAT = 0
  
```

### **Then**

Usage of the diagnosis information (failure symptoms (raw value) ERR\_DIAG\_RLY\_MTC\_HEAT and basic diagnosis conditions CDN\_DIAG\_RLY\_MTC\_HEAT) received from the infrastructure:

ACTION\_INFR\_GetEIDiagMTCHEAT (OUT<Cdn\_diag\_rly\_mtc\_heat>, OUT<Err\_diag\_rly\_mtc\_heat>)

Basic diagnosis conditions are set according infrastructure information: CDN\_DIAG\_RLY\_MTC\_HEAT  
 Failure symptoms (raw value) are set according infrastructure information: ERR\_DIAG\_RLY\_MTC\_HEAT

**If** Activation conditions are met for the NC\_PSD\_DLY\_RLY\_MTC\_HEAT recurrence of the diagnosis

**Then** [CDN\_DIAG\_RLY\_MTC\_HEAT valid from Infrastructure]

**Else** CDN\_DIAG\_RLY\_MTC\_HEAT = 0

**Endif**

**Else**

CDN\_DIAG\_RLY\_MTC\_HEAT = 0

**Endif**

## A.124 Mass air flow throttle control diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_RBM_TPS	O/V	0... 7H	0 ...7	1	-
Interface of TPS monitor with the Rate-Based Monitoring statistics					

### Input data:

LV_END_DIAG_MTC_CTL_3 {p. 4977}	LV_END_DIAG_TPS_AD {p. 4950}	LV_END_DIAG_TPS_AD_BOL {p. 4950}	
------------------------------------	---------------------------------	-------------------------------------	--

### FUNCTION DESCRIPTION:

#### General information:

With this module the interface between the TPS monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_TPS data.

Within STATE\_RBM\_TPS, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
- Monitor disabled because of system malfunction (bit 1, not valid for TPS)
- Monitor indiv. RBM conditions encountered within this DC (bit 2 not valid for TPS)

#### Application conditions:

##### Initialisation :

at LV\_DC 0 1 transition :  
bit 0, bit 1 and bit 2 of STATE\_RBM\_TPS = 0

on failure memory reset :  
bit 1 of STATE\_RBM\_TPS = 0

Recurrence: 1 s

Activation: LV\_DC 0 1 transition **and** LV\_DC = 1

#### Formula section:

```

If          bit 0 of STATE_RBM_TPS = 0
Then       If          LV_END_DIAG_MTC_CTL_3 = 1          and
              LV_END_DIAG_TPS_AD_BOL = 1                    and
              LV_END_DIAG_TPS_AD = 1
              Then       bit 0 of STATE_RBM_TPS = 1
              Endif

```

**Endif**  
bit 2 of STATE\_RBM\_TPS = 1 (no individual RBM conditions)

## A.125 Torque request for safety diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ABC_TQI_REQ_LIM	O/V	0... FFFF H	0... 65535	1	-
counter for torque request for safety is active					
LV_ERR_TQI_LIM	O/V	0... 1H	0 ...1	1	-
Error flag torque request for safety is active					

### Input data:

LV_ES {p. 1720}	LV_IGK {p. 906}	LV_MTC_CUR_OFF {p. 6565}	LV_TQ_LIM_INTV {p. 6692}
-----------------	-----------------	-----------------------------	--------------------------

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TQI_LIM	-	0... FF H	0... 255	1	-
increment counter for torque request for safety					
C_ABC_MAX_TQI_LIM	-	0... FFFF H	0... 65535	1	-
maximum counter for torque request for safety					

## FUNCTION DESCRIPTION:

### General information:

The objective of this function is to determine the number of intervention actions concerning the torque request for safety and to set the failure table entry depending on LV\_ERR\_TQI\_LIM if the counter exceeds a calibratable threshold.

The monitoring level generates a desired indicated torque TQI\_SP\_MON. If the actual torque TQI\_REF\_IGA\_LAMB exceeds this value for more than a calibratable threshold a torque demand for the slow and the fast path is generated. The flag LV\_TQ\_LIM\_INTV shows whether this torque intervention is active or not (see chapter D - "Torque request for safety").

LV\_ERR\_TQI\_LIM.

### Description:

The counter is initialized with zero for ECU reset, ignition key off, engine starts and engine stops. Otherwise it is incremented, if LV\_TQ\_LIM\_INTV is active.

### Application conditions

**Activation:** LV\_IGK = 1 **and** LV\_ES = 0 **and** LV\_MTC\_CUR\_OFF = 0

**Deactivation:** LV\_MTC\_CUR\_OFF == 1

**Initialization:** 0  
by: ECU reset  
**OR** LV\_IGK == 0  
**OR** LV\_ES == 1

**Recurrence:** 100 ms



**Formula section:**

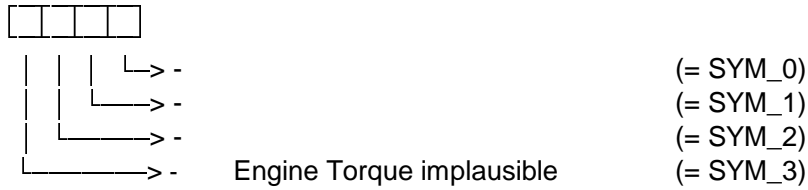
```

IF           LV_TQ_LIM_INTV == 1
THEN        LV_ERR_TQI_LIM = 1 after debounce
ELSE        the debounce counter (CTR_ABC_TQI_LIM) is set to 0.
ENDIF

```

**Description:**

Error-symptoms are defined to this diagnosis function as following:



## A.126 Automatic gear shift signal diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_GS	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom GS					
LV_CDN_DIAG_GS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition GS					
LV_END_DIAG_GS	O/V	0... 1H	0 ...1	1	-
End of diagnosis cycle GS diagnosis					
LV_ERR_GS	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on GS					
STATE_DIAG_GS	O/V	0... FFH	0... 255	1	-
Status of GS diagnosis for feedback to gearbox					

### Input data:

LV_AT {p. 654}	LV_CDN_VB_OBD1 {p. 1185}	LV_DC {p. 5746}	LV_DC_RBM {p. 5858}
LV_ERR_CFM [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_MEM_XX {p. 5767}	LV_IGK {p. 906}	LV_MIL_REQ_ETCU {p. 1566}
LV_VAR_BN {p. 655}	LV_VAR_TCT {p. 656}	LV_WUP_CYC {p. 5746}	STATE_ETCU_OBD {p. 1574}
WAL_CONF_XX {p. 5811}			


### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_GS	-	0... FFH	0... 255	1	-
Anti bounce decrement for GS diagnosis					
C_ABC_INC_GS	-	0... FFH	0... 255	1	-
Anti bounce increment for GS diagnosis					
C_ABC_MAX_GS	-	1... FFH	1... 255	1	-
Anti bounce maximum for GS diagnosis					
LC_ETCU_FRF	-	0... 1H	0 ...1	1	-
Logical constant for storing freeze frame for ETCU ( 1 = FRF stored for ETCU)					
LC_VAR_GS_EOBD	-	0... 1H	0 ...1	1	-
Logical constant for variant EOBD (=1) or US (=0)					

### Import actions:

<b>ACTION_ERRM_ReadFrFByDtc</b>	(IN<PRM_TYPEOFFF>,<IN<PRM_FFIDENTIFIER>,<IN<PRM_DTCIDENTIFIER>,<IN<PRM_LEVELOFDTC>,<INOUT<PRM_FRF>,<OUT<PRM_RESULTFRF>)
---------------------------------	---

### FUNCTION DESCRIPTION:

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**General information:**

The diagnosis is performed for AT or TCT vehicles in order to manage the OBD requirement which is defined by law (MIL activation and Freeze - frame storage).

Depending of CAN 12H /11H and TCT/AT and LC\_ETCU\_FRF the diagnosis is performed in a different way.

**Description:**

- Request of Gearbox to ECU: STATE\_ETCU\_OBD
- Response from ECU to Gearbox: STATE\_DIAG\_GS

Calculation of STATE\_DIAG\_GS (only first 3 bits, only valid for LC\_ETCU\_FRF = 1):

	Case 1	Case 2	Case 3	Case 4
<b>Init</b>	No FRF <b>000</b>	FRF not from GS <b>001</b>	FRF from GS <b>010</b>	FRF from GS <b>010</b>
<b>Event</b>	GS error	GS error	OBD error	OBD error with higher prior (FSD / MSF)
<b>Result</b>	FRF from GS <b>010</b>	FRF not from GS <b>001</b>	FRF from GS <b>010</b>	FRF from OBD error <b>001</b> (next DC)

**Application conditions**

**Initialisation:** according ABC configuration "**STD\_INI**" + NLC\_ABC\_CAL\_DEC\_GS = 1  
STATE\_DIAG\_GS = 0 at LV\_IGK 0->1 **or** reset **or** at clearing error memory

**Recurrence:** 10ms

**Activation:** **If** (LV\_AT = 1 **or** LV\_VAR\_TCT = 1) **and**  
LV\_CDN\_VB\_OBD1 = 1  
**Then** LV\_CDN\_DIAG\_GS = 1  
**Else** LV\_CDN\_DIAG\_GS = 0  
**Endif**

*Deactivation:* **If** LV\_AT = 0 **and** LV\_VAR\_TCT = 0  
**Then** LV\_END\_DIAG\_GS = 1 //always set for readiness CARB\_CC  
**Endif**

LV\_CDN\_DIAG\_GS = 0  
**Endif**

**Formula section:**

Calculation of STATE\_DIAG\_GS

**If(1)** LC\_ETCU\_FRF = 1

**Then(1)**

**If** LV\_ERR\_MEM\_GS = 0 **and**  
LV\_ERR\_GS = 0

**Thenif** at least one LV\_ERR\_CFM[NC\_NR\_ERR\_DYN]= 1 **and**  
Bit 4 of WAL\_CONF\_XX of this error is calibrated

**Then If** LV\_VAR\_BN = 0

**Then** STATE\_DIAG\_GS = set bit ( 001 - - - ) //FRF stored for OBD error, 11H

**Else** STATE\_DIAG\_GS = set bit ( 001 - - ) //FRF stored for OBD error, 12H

**Endif**

**Else If** LV\_VAR\_BN = 0

```


    Then STATE_DIAG_GS = set bit ( 000 - - - ) //no FRF stored, 11H
    Else STATE_DIAG_GS = set bit ( 000 - - ) //no FRF stored, 12H
    Endif
Elseif LV_ERR_GS 0->1 and //request from EGS to store GS error
    LV_ERR_MEM_GS (n-1) = 0 //not stored yet
Then If at least one LV_ERR_CFM[NC_NR_ERR_DYN] (n-1) = 1 and
    Bit 4 of WAL_CONF_XX of this error is calibrated
    Then If LV_VAR_BN = 0
        Then STATE_DIAG_GS = set bit ( 001 - - - ) //FRF stored for OBD error, 11H
        Else STATE_DIAG_GS = set bit ( 001 - - ) //FRF stored for OBD error, 12H
        Endif
    Else If LV_VAR_BN = 0
        Then STATE_DIAG_GS = set bit ( 010 - - - ) //FRF stored for GS, 11H
        Call of error memory to store LV_ERR_GS
        Else STATE_DIAG_GS = set bit ( 010 - - ) //FRF stored for GS, 12H
        Call of error memory to store LV_ERR_GS
        Endif
    Endif
Elseif LV_IGK 0->1 or reset
    Then ACTION_ERRM_ReadFrByDtc
        If Resp XX = GS //FRF still stored for LV_ERR_GS
        Then If LV_VAR_BN = 0
            Then STATE_DIAG_GS = set bits ( 010 - - - ) //FRF stored for GS, 11H
            Else STATE_DIAG_GS = set bits ( 010 - - ) //FRF stored for GS, 12H
            Endif
        Else If LV_VAR_BN = 0
            Then STATE_DIAG_GS = set bit ( 001 - - - ) //FRF stored for OBD error, 11H
            Else STATE_DIAG_GS = set bit ( 001 - - ) //FRF stored for OBD error, 12H
            Endif
        Else no change of bits x in STATE_DIAG_GS (xxx - - )
        Endif
    Else(1) If LV_VAR_BN = 0
        Then STATE_DIAG_GS = set bit ( 000 - - - ) //no FRF at all
        Else STATE_DIAG_GS = set bit ( 000 - - ) //no FRF at all
        Endif
    Endif(1)

If LV_DC = 1
Thenif LV_VAR_BN = 0
    Then STATE_DIAG_GS = set bit ( - - - 1 - - ) //Driving cycle active, 11H
    Else STATE_DIAG_GS = set bit ( - - - 1 - ) //Driving cycle active, 12H
    Endif
Endif

If LV_WUP_CYC = 1
Thenif LV_VAR_BN = 0
    Then STATE_DIAG_GS = set bit ( - - - - 1 ) //Warm-up cycle active, 11H
    Else STATE_DIAG_GS = set bit ( - - - - 1 ) //Warm-up cycle active, 12H
    Endif
Endif

If LV_DC_RBM = 1

```

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```

Thenif    LV_VAR_BN = 0
    Then    STATE_DIAG_GS = set bit (- - - - 1-) //RBM cycle active, 11H
    Endif
Endif

```

*// Remark: in case of LV\_VAR\_BN = 1 the information of LV\_DC\_RBM is transmitted via CAN in a separate signal, not within STATE\_DIAG\_GS; for detailed information see CAN-messages BN2000*

#### Calculation of STATE\_ETCU\_OBD

```
If(0)          LV_VAR_TCT = 0
```

```
Then(0)
```

```
If(1a) LC_ETCU_FRF = 1
```

```
Then(1a)
```

```
If(1b) LC_VAR_GS_EOBD = 0
```

```
Then(1b) If(2) LV_AT = 1
```

Calculation is done for - EGS - Configuration US-market

```
Then(2)If    STATE_ETCU_OBD = 0110 or 0100
```

```
    Then    ERR_SYM_GS = SYM_3
```

Anti-bounce counter increments, set LV\_ERR\_GS after debounce

```
    Elseif STATE_ETCU_OBD = 0000 or 0010
```

```
    Then    ERR_SYM_GS = NO_SYM
```

Anti-bounce counter decrements with calibratable decrement,  
reset LV\_ERR\_GS after debounce

```
    Else    no change
```

```
    Endif
```

```
Endif(2)
```

```
Else(1b) If(2a) LV_AT = 1
```

Calculation is done for - EGS - Configuration EOBD

```
Then(2a)If    STATE_ETCU_OBD = 0010
```

```
    Then    ERR_SYM_GS = SYM_3
```

Anti-bounce counter increments, set LV\_ERR\_GS after debounce

```
    Elseif STATE_ETCU_OBD = 0000
```

```
    Then    ERR_SYM_GS = NO_SYM
```

Anti-bounce counter decrements with calibratable decrement,  
reset LV\_ERR\_GS after debounce

```
    Else    no change
```

```
    Endif
```

```
Endif(2a)
```

```
Endif(1b)
```

```
Else(1a)
```

```
If          LV_AT = 1
```

Calculation is done for - EGS

```
Then If      STATE_ETCU_OBD = 0100
```

```
    Then    ERR_SYM_GS = SYM_3
```

Anti-bounce counter increments, set LV\_ERR\_GS after debounce

```
    Elseif STATE_ETCU_OBD = 0000
```

```
    Then    ERR_SYM_GS = NO_SYM
```

Anti-bounce counter decrements with calibratable decrement,  
reset LV\_ERR\_GS after debounce

```
    Else    no change
```

```
    Endif
```

**Endif**

**Endif(1a)**

**Else(0)**

**If** LV\_MIL\_REQ\_ETCU = 1

**Then** ERR\_SYM\_GS = SYM\_3

Anti-bounce counter increments,  
set LV\_ERR\_GS after debounce


**Else** ERR\_SYM\_GS = NO\_SYM

Anti-bounce counter decrements with calibratable decrement,  
reset LV\_ERR\_GS after debounce

**Endif**

**Endif(0)**

For the calculation of the LV\_END\_DIAG\_GS, see "Anti-bounce-Algorithm, calculation of the end of diagnosis"

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## A.127 Clutch switch diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_CS	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected CS Symptom					
LV_CDN_DIAG_CS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition CS					
LV_CS_DIAG	V	0... 1H	0 ...1	1	-
Flag set when vehicle was stopped = pre-condition for diagnosis cycle					
LV_CS_SWI	V	0... 1H	0 ...1	1	-
Flag set when CS change its state					
LV_END_DIAG_CS	O/V	0... 1H	0 ...1	1	-
End of CS diagnosis					
LV_ERR_CS	O/V	0... 1H	0 ...1	1	-
Active CS error					
T_MIN_MAF_CS_DIAG	V	0... FFH	0... 255	1	s
Minimum diagnosis time for MAF condition					

### Input data:

C_VS_MIN_RUN {p. 1177}	LV_AT {p. 654}	LV_ERR_VS {p. 5021}	LV_ES {p. 1720}
LV_IGK {p. 906}	LV_IM_CS_PN {p. 852}	LV_ST {p. 1720}	LV_VAR_TCT {p. 656}
MAF {p. 8277}	N_32 {p. 1525}	VS {p. 1176}	


### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_CS	-	0... FFH	0... 255	1	-
Anti bounce increment CS diagnosis					
C_ABC_MAX_CS	-	1... FFH	1... 255	1	-
Anti bounce maximum CS diagnosis					
C_MAF_CS_DIAG	-	0... FFFFH	0... 1389	21.2e-3	mg/stk
MAF threshold for error detection					
C_N_32_CS_DIAG	-	0... FFH	0... 8160	32	rpm
N32 threshold for error detection					
C_T_MIN_MAF_CS_DIAG	-	0... FFH	0... 255	1	s
Minimum diagnosis time for MAF condition					
C_VS_CS_DIAG	-	0... FFH	0... 255	1	km/h
Speed threshold for activation of diagnosis cycle					

### FUNCTION DESCRIPTION:

### General information:

This module performs the diagnosis of the clutch switch. This is valid only in case of manual transmission.

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The diagnosis is based on the verification of the presence of the expected clutch action to shift the gears necessary to bring the vehicle to a certain speed. It is highly improbable that the vehicle is accelerated several consecutive times to a certain speed with the clutch always depressed or never depressed.

### Description:

If there is a change in LV\_IM\_CS\_PN, the CS is diagnosed as error-free and the diagnosis is switched off if end of diagnosis is reached.

If there is no change in LV\_IM\_CS\_PN then each time the vehicle is stopped, the diagnosis is enabled. Until the vehicle gets to a certain speed, LV\_IM\_CS\_PN is monitored for value change (clutch pedal actuation). If, for several times (Anti bounce is incrementing by one increment per diagnosis cycle) the vehicle gets to speed and the clutch switch state has never changed (always 0 or 1) then a failure is recognized.

Depending of status LV\_IM\_CS\_PN 0/1 at beginning of monitoring period there is the symptom OL/SCB or SCG.

### Application conditions

**Initialisation:** according filter type: "STD-INI", all other outputs 0 at LV\_IGK 0->1 **or** reset **or** at clearing error memory

**Recurrence:** 1s (10 ms for LV\_IM\_CS\_PN detection)

**Activation:**

```

If          LV_IGK = 0                or
              LV_ES = 1                or
              LV_ST = 1                or
              LV_AT = 1                or
              LV_VAR_TCT      = 1      or
              LV_END_DIAG_CS = 1      or
              LV_ERR_VS = 1            // VS error

Then      Function passive   LV_CDN_DIAG_CS is reset to 0
Else      Function active
Endif

```

### Formula section:

LV\_CDN\_DIAG\_CS = 0

Errorfree case: CS activation detected:

```

If          LV_IM_CS_PN   switched once from 1 to 0 or 0 to 1 (managed each 10 ms)
Then      LV_CDN_DIAG_CS = 1
              ERR_SYM_CS = NO_SYM
              LV_CS_SWI = 1
              LV_END_DIAG_CS = 1                Calculated by error management
Else

```

Error case: High vehicle speed without CS activation

```

If          VS ≤ C_VS_MIN_RUN                Init when vehicle is stopped
Then      LV_CS_DIAG = 1
Else      If          VS > C_VS_CS_DIAG      and
              MAF > C_MAF_CS_DIAG      and      above zero no load line
              N_32 > C_N_32_CS_DIAG      out of idle speed
Then      increment T_MIN_MAF_CS_DIAG
              If      T_MIN_MAF_CS_DIAG ≥ C_T_MIN_MAF_CS_DIAG      and
              LV_CS_SWI = 0      and      the clutch did not switched
              LV_CS_DIAG = 1      vehicle was stopped

```



```


Then      LV_CDN_DIAG_CS = 1
      If      LV_IM_CS_PN = 1
Then      ERR_SYM_CS = SYM_0
      If      LV_IM_CS_PN = 0
Then      ERR_SYM_CS = SYM_1
      Endif
LV_CS_DIAG = 0
// vehicle must stop again before next diagnosis CTR_ABC_CSn = CTR_
ABC_CSn-1 + C_ABC_INC_CS      only once
      Else      no Action
      Endif
Else      T_MIN_MAF_CS_DIAG = 0      reset
      Endif
End if
Endif

```

Calculation of LV\_END\_DIAG\_CS and LV\_ERR\_CS

LV\_ERR\_CS                      Calculated by error management : CTR\_ABC\_CS reach maximum

LV\_END\_DIAG\_CS                Calculated by error management

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## A.128 Clutch switch diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_RBM_CS	O/V	0... 7H	0 ...7	1	-
Interface of CS monitor with the Rate-Based Monitoring statistics Bit 0: conditions for monitoring are met long enough to detect malfunction (bit 0 = 1) Bit 1: inhibition of the monitor because of system failure(s) (bit 1 = 1) Bit 2: individual RBM condition					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_AT {p. 654}	LV_DC {p. 5746}	LV_END_DIAG_CS {p. 5015}
LV_ERR_VS {p. 5021}	LV_VAR_TCT {p. 656}		

### Import actions:

<b>ACTION_ERRM_CheckPendingStatus</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR_PND>)
--

## FUNCTION DESCRIPTION:

### General information:

With this module the interface between the CS monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_CS data.

Within STATE\_RBM\_CS, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)  
( not valid for CS diagnosis )

### Application conditions:

#### Initialisation :

- at LV\_DC 0 1 transition :  
bit 0, bit 1 and bit 2 of STATE\_RBM\_CS = 0
- on failure memory reset :  
bit 1 of STATE\_RBM\_CS = 0


Recurrence: 1 s

Activation: LV\_DC 0 1 transition and LV\_DC = 1

### Formula section:

#### At LV\_DC 0 1 transition

The pending status of the following failures has to be checked only once :

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LV_ERR_VS			
-----------	--	--	--

```

If(1)      { CPU optimization at LV_DC 0 1 transition }
             CTR_ERR_DYN_NR <> 0      { the dynamic failure memory isn t empty }

Then(1)

             While      bit 1 of STATE_RBM_CS = 0 do
                 with each XX failure of the above list :
                 ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

                 If(2)      XX has a pending status
                 Then(2)
                     bit 1 of STATE_RBM_CS = 1

                 Endif(2)

             Endwhile

Else(1)
             { the dynamic failure memory is empty }
             No action

Endif(1)
Every 1 s :
If      bit 0 of STATE_RBM_CS = 0
Then
             If      LV_END_DIAG_CS = 1      or
                 LV_AT = 1      or
                 LV_VAR_TCT = 1
             Then      bit 0 of STATE_RBM_CS = 1
             Endif

Endif
If      bit 1 of STATE_RBM_CS = 0
Then
             If      LV_ERR_VS = 1
             Then      bit 1 of STATE_RBM_CS = 1
             Endif

Endif
             bit 2 of STATE_RBM_CS = 1

```

## A.129 Vehicle speed signal diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_VS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected Symptom VS					
ERR_SYM_VS_BOL	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
For each symptom: status of failure (set to 1 when failure symptom detected) for VS_BOL					
ERR_SYM_VS_GRD	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
For each symptom: status of failure (set to 1 when failure symptom detected) for VS_GRD					
ERR_SYM_VS_PLAUS_POW	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected Symptom VS_PLAUS_POW					
ERR_SYM_VS_PLAUS_STUCK	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
For each symptom: status of failure (set to 1 when failure symptom detected) for VS_PLAUS_STUCK					
ERR_SYM_VS_TOL	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
For each symptom: status of failure (set to 1 when failure symptom detected) for VS_TOL					
LV_CDN_DIAG_VS	V	0... 1H	0 ...1	1	-
VS Diagnosis active (=1)					
LV_CDN_DIAG_VS_BOL	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled) for VS_BOL					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_VS_GRD	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled) for VS_GRD					
LV_CDN_DIAG_VS_PLAUS_POW	V	0... 1H	0 ...1	1	-
VS_PLAUS_POW Diagnosis active (=1)					
LV_CDN_DIAG_VS_PLAUS_STUCK	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled) for VS_PLAUS_STUCK					
LV_CDN_DIAG_VS_TOL	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled) for VS_TOL					
LV_END_DIAG_VS	O/V	0... 1H	0 ...1	1	-
End of VS Diagnosis					
LV_END_DIAG_VS_BOL	V	0... 1H	0 ...1	1	-
Diagnostic done completely at least one time for VS_BOL					
LV_END_DIAG_VS_GRD	V	0... 1H	0 ...1	1	-
Diagnostic done completely at least one time for VS_GRD					
LV_END_DIAG_VS_PLAUS_POW	O/V	0... 1H	0 ...1	1	-
End of VS_PLAUS_POW Diagnosis					
LV_END_DIAG_VS_PLAUS_STUCK	V	0... 1H	0 ...1	1	-
Diagnostic done completely at least one time for VS_PLAUS_STUCK					
LV_END_DIAG_VS_TOL	V	0... 1H	0 ...1	1	-
Diagnostic done completely at least one time for VS_TOL					
LV_ERR_SET_VS_PLAUS_POW	V	0... 1H	0 ...1	1	-
Boolean to set the symptom for no filter					
LV_ERR_VS	O/V	0... 1H	0 ...1	1	-
VS sensor error bit					
LV_ERR_VS_BOL	V	0... 1H	0 ...1	1	-
Present failure after filtering of diagnostic VS_BOL					
LV_ERR_VS_GRD	V	0... 1H	0 ...1	1	-
Present failure after filtering of diagnostic VS_GRD					
LV_ERR_VS_PLAUS	O/V	0... 1H	0 ...1	1	-
VS plaus sensor error bit					
LV_ERR_VS_PLAUS_POW	V	0... 1H	0 ...1	1	-
VS_PLAUS_POW sensor error bit					
LV_ERR_VS_PLAUS_STUCK	V	0... 1H	0 ...1	1	-
Present failure after filtering of diagnostic VS_PLAUS_STUCK					
LV_ERR_VS_TOL	V	0... 1H	0 ...1	1	-
Present failure after filtering of diagnostic VS_TOL					
LV_VS_BOL	V	0... 1H	0 ...1	1	-
VS_BOL Diagnosis active (=1)					
LV_VS_STUCK	V	0... 1H	0 ...1	1	-
VS_STUCK diagnosis active(=1)					
T_VS_BOL	V	0... FFH	0... 25.5	0.1	s
Debounce counter for diagnosis of VS_BOL					
T_VS_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
Time counter for error detection					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_VS_END_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
Time counter for end of diagnosis					
T_VS_STUCK	V	0... FFH	0... 25.5	0.1	s
Debounce counter for start of diagnosis for VS_PLAUS_STUCK					

**Input data:**

LV_AT {p. 654}	LV_ERR_COM_1_BOFF {p. 800}	LV_ERR_COM_1_ST_UP {p. 800}	LV_ERR_COM_1_VS {p. 800}
LV_ES {p. 1720}	LV_IGK {p. 906}	LV_LDM_ACT {p. 6615}	LV_ST_END {p. 1720}
N {p. 1525}	N_WHEEL_RE_LE {p. 806}	N_WHEEL_RE_RI {p. 806}	PV_AV {p. 1269}
STATE_CC {p. 1571}	STATE_CC_ETCU	STATE_ENG {p. 1720}	STATE_VEH_ROLL_CDN {p. 809}
T_AST {p. 1766}	TQ_AV {p. 6656}	VS {p. 1176}	VS_HIGH_RES {p. 811}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_VS	V	0... FFH	0... 255	1	-
ABC Increment value for VS diagnosis					
C_ABC_INC_VS_BOL	V	0... FFH	0... 255	1	-
Anti bounce counter increment of diagnostic instance VS_BOL					
C_ABC_INC_VS_GRD	V	0... FFH	0... 255	1	-
Anti bounce counter increment of diagnostic instance VS_GRD					
C_ABC_INC_VS_PLAUS_STUCK	V	0... FFH	0... 255	1	-
Anti bounce counter increment of diagnostic instance VS_PLAUS_STUCK					
C_ABC_INC_VS_TOL	V	0... FFH	0... 255	1	-
Anti bounce counter increment of diagnostic instance VS_TOL					
C_ABC_MAX_VS	V	1... FFH	1... 255	1	-
ABC Maximum value for VS diagnosis					
C_ABC_MAX_VS_BOL	V	1... FFH	1... 255	1	-
Maximum value for anti bounce counter of diagnostic instance VS_BOL					
C_ABC_MAX_VS_GRD	V	1... FFH	1... 255	1	-
Maximum value for anti bounce counter of diagnostic instance VS_GRD					
C_ABC_MAX_VS_PLAUS_STUCK	V	1... FFH	1... 255	1	-
Maximum value for anti bounce counter of diagnostic instance VS_PLAUS_STUCK					
C_ABC_MAX_VS_TOL	V	1... FFH	1... 255	1	-
Maximum value for anti bounce counter of diagnostic instance VS_TOL					
C_N_VS_MIN_DIAG_AT	V	0... 1FE0H	0... 8160	1	rpm
Engine speed condition - vehicle speed diagnosis, AT vehicle					
C_N_VS_MIN_DIAG_MT	V	0... 1FE0H	0... 8160	1	rpm
Engine speed condition - vehicle speed diagnosis, MT vehicle					
C_N_WHEEL_MAX_DIF	V	8000... 7FFFH	-512... 511.984375	0.015625	rad/s
maximum difference between rear wheels on the roller test bench					
C_PV_AV_MAX_VS_GRD	V	0... FFH	0... 99.609375	0.390625	%
Maximum Pedal Value for Vehicle speed gradient diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_PV_AV_MIN_VS_GRD	V	0... FFH	0... 99.609375	0.390625	%
Minimum Pedal Value for Vehicle speed gradient diagnosis					
C_SEL_ENG_STATE_AT	V	1... 5H	1...5	1	-
Engine state selection for VS_BOL diagnosis for AT					
C_SEL_ENG_STATE_MT	V	1... 5H	1...5	1	-
Engine state selection for VS_BOL diagnosis for MT					
C_T_MAX_VS_BOL_AT	V	0... FFH	0... 25.5	0.1	s
Max. counter of VS_BOL diagnosis for AT					
C_T_MAX_VS_BOL_MT	V	0... FFH	0... 25.5	0.1	s
Max. counter of VS_BOL diagnosis for MT					
C_T_MAX_VS_STUCK_AT	V	0... FFH	0... 25.5	0.1	s
Max. counter for diagnosis of VS stuck signal with AT					
C_T_MAX_VS_STUCK_MT	V	0... FFH	0... 25.5	0.1	s
Max. counter for diagnosis of VS stuck signal with MT					
C_T_VS_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
Time counter for error detection					
C_T_VS_MIN_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
Time condition - vehicle speed diagnosis					
C_THD_N_VS_PLAUS_AT	V	0... 1FE0H	0... 8160	1	rpm
Threshold for the engine speed change for VS diagnosis with AT					
C_THD_N_VS_PLAUS_MT	V	0... 1FE0H	0... 8160	1	rpm
Threshold for the engine speed change for VS diagnosis with MT					
C_THD_TQ_AV_VS_PLAUS_AT	V	0... FFH	0... 510	2	Nm
Threshold for change in the actual torque at clutch for VS diagnosis with AT					
C_THD_TQ_AV_VS_PLAUS_MT	V	0... FFH	0... 510	2	Nm
Threshold for change in the actual torque at clutch for VS diagnosis with MT					
C_TQ_AV_MAX_VS_GRD	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum Actual Torque required for Vehicle speed gradient diagnosis					
C_TQ_AV_MIN_VS_GRD	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Minimum Actual Torque required for Vehicle speed gradient diagnosis					
C_TQ_AV_VS_MIN_DIAG_AT	V	0... FFH	0... 510	2	Nm
TQ_AV condition - vehicle speed diagnosis, AT vehicle					
C_TQ_AV_VS_MIN_DIAG_MT	V	0... FFH	0... 510	2	Nm
TQ_AV condition - vehicle speed diagnosis, MT vehicle					
C_VS_BOL_MIN_DIAG	V	0... FFH	0... 255	1	km/h
Minimum vehicle speed to start VS_BOL diagnosis					
C_VS_MAX_ERR_PUC_AT	V	0... FFH	0... 255	1	km/h
VS-Schwelle, bei der beim Unterschreiten in PU/PUC ein Fehler eingetragen wird for AT					
C_VS_MAX_ERR_PUC_MT	V	0... FFH	0... 255	1	km/h
VS-Schwelle, bei der beim Unterschreiten in PU/PUC ein Fehler eingetragen wird for MT					
C_VS_MAX_GRD	V	0... 7FFFH	0... 327.67	0.01	km/h
Maximum gradient threshold for vehicle speed variation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VS_MAX_WIN	V	0... 7FFFH	0... 327.67	0.01	km/h
Maximum threshold window for vehicle speed variation					
C_VS_MIN_DIAG_GRD	V	0... FFH	0... 255	1	km/h
Speed threshold to enable the diagnosis					
C_VS_MIN_GRD	V	0... 7FFFH	0... 327.67	0.01	km/h
Minimum gradient threshold for vehicle speed variation					
C_VS_MIN_WIN	V	0... 7FFFH	0... 327.67	0.01	km/h
Minimum threshold window for vehicle speed variation					
C_VS_TOL_DIAG	V	0... 7FFFH	0... 327.67	0.01	km/h
Plausible maximum speed threshold for top limit speed error detection					
CLF_VS_PLAUS_ENA	V	0... FFH	0... 255	1	-
Bit-wise enabling of Vehicle speed plausibility diagnosis (0:Plausibility check, 1:Top limit check, 2:Bottom limit check,3.:Gradient check, 4:Stuck signal check enabled)					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_DIAG_VS	-	0... FFFFH	0... 65535	1	-
ERRM diagnosis identifier of vehicle speed diagnosis					
NC_IDX_DIAG_VS_BOL	-	0... FFFFH	0... 65535	1	-
Failure index for diagnostic instance VS_BOL					
NC_IDX_DIAG_VS_GRD	-	0... FFFFH	0... 65535	1	-
Failure index for diagnostic instance VS_GRD					
NC_IDX_DIAG_VS_PLAUS_POW	-	0... FFFFH	0... 65535	1	-
Failure index for diagnostics instance VS_PLAUS_POW					
NC_IDX_DIAG_VS_PLAUS_STUCK	-	0... FFFFH	0... 65535	1	-
Failure index for diagnostic instance VS_PLAUS_STUCK					
NC_IDX_DIAG_VS_TOL	-	0... FFFFH	0... 65535	1	-
Failure index for diagnostic instance VS_TOL					

**Error treatment**

Diagnostic Identifier	Symptom Description	Nr	OBD DTC	Sym	OBD Global DTC	Filter Type	CARB class
NC_IDX_DIAG_VS_PLAUS_POW	-	0				NO_FIL	CC
<i>Failure index for diagnostics instance VS_PLAUS_POW</i>	-	1					
	-	2					
	Vehicle speed not plausible	3					




Diagnostic Identifier	Symptom Description	Nr	OBD DTC	Sym	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>							
NC_IDX_DIAG_VS_TOL	Vehicle speed top limit implausible	0				MEM	CC
<i>Failure index for diagnostic instance VS_TOL</i>		1					
		2					
		3					

Diagnostic Identifier	Symptom Description	Nr	OBD DTC	Sym	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>							
NC_IDX_DIAG_VS_BOL	Vehicle speed bottom limit implausible	0				MEM	CC
<i>Failure index for diagnostic instance VS_BOL</i>		1					
		2					
		3					

Diagnostic Identifier	Symptom Description	Nr	OBD DTC	Sym	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>							
NC_IDX_DIAG_VS_GRD	Vehicle speed gradient implausible	0				MEM	CC
<i>Failure index for diagnostic instance VS_GRD</i>		1					
		2					
		3					

Diagnostic Identifier	Symptom Description	Nr	OBD DTC	Sym	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>							
NC_IDX_DIAG_VS_PLAUS_STUCK	Vehicle speed frozen	0				MEM	CC
<i>Failure index for diagnostic instance VS_PLAUS_STUCK</i>		1					
		2					
		3					

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Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>						
NC_IDX_DIAG_VS	-	0			STD_INI	CC
ERRM diagnosis identifier of vehicle speed diagnosis	-	1				
	no vehicle speed signal	2				
	-	3				

## General information

### A.129.1 Plausibility check of VS signal

#### General information:

An vehicle speed signal error is detected if at calibratable engine speed-, mass air flow- and time thresholds the vehicle speed signal VS = 0. Depending if the vehicle is MT /AT different calibration data a applied ( If LV\_AT = 1 then \_AT are used, else \_MT are used).

**If** (vehicle speed VS = 0 **or** testbenchdetection with different rotation at the rearwheels) **and** engine speed N >= C\_N\_VS\_MIN\_DIAG\_AT /\_MT **and** (converterclutch is closed **or** manual-gearbox) **and** actual torque TQ\_AV >= C\_TQ\_AV\_VS\_MIN\_DIAG\_AT /\_MT the time counter T\_VS\_DIAG is started. The vehicle speed signal error bit LV\_ERR\_VS\_PLAUS is set to 1 **if** T\_VS\_DIAG >= C\_T\_VS\_MIN\_DIAG.

#### Application conditions:

##### Initialisation:

The configuration is **NO\_FIL**  
 (=> all 0 at LV\_IGK 0->1 **or** reset **or** clearing error memory)  
 LV\_CDN\_DIAG\_VS\_PLAUS\_POW = 0  
 LV\_ERR\_SET\_VS\_PLAUS\_POW = 0  
 ERR\_SYM\_VS\_PLAUS\_POW = 0  
 LV\_END\_DIAG\_VS\_PLAUS\_POW = 0  
 T\_VS\_DIAG = 0  
 T\_VS\_END\_DIAG = 0

At reset:

This action erases filter data :  
 ACTION\_ERRM\_NoFilterReset( IN<NC\_IDX\_DIAG\_VS\_PLAUS\_POW >,  
 OUT< LV\_ERR\_VS\_PLAUS\_POW >)

##### Activation:

LV\_IGK = 1 **and**  
 LV\_ERR\_VS\_PLAUS = 0 **and**  
 CLF\_VS\_PLAUS\_ENA bit 0 = 1

**Deactivation:** When activation not met  
 Following should be updated during de-activation  
 LV\_CDN\_DIAG\_VS\_PLAUS\_POW = 0  
 ERR\_SYM\_VS\_PLAUS\_POW = NO\_SYM

**Recurrence:** 100 ms

### Function description:

#### Formula section:

Timer start:

```

If N >= C_N_VS_MIN_DIAG_AT / _MT and
      (STATE_CC = 2 or LV_AT = 0) and
      TQ_AV >= C_TQ_AV_VS_MIN_DIAG_AT / _MT and
      LV_INH_DIAG_VS_PLAUS = 0
Then
  If (2) VS = 0 or
      (STATE_VEH_ROLL_CDN = 4 and
      |N_WHEEL_RE_LE - N_WHEEL_RE_RI | > C_N_WHEEL_MAX_DIF)
  Then (2)
    T_VS_END_DIAG = 0
    If T_VS_DIAG < C_T_VS_DIAG
    Then
      LV_CDN_DIAG_VS_PLAUS_POW = 0
      T_VS_DIAG++
    Else
      LV_CDN_DIAG_VS_PLAUS_POW = 1
      ERR_SYM_VS_PLAUS_POW = SYM_3
      LV_END_DIAG_VS_PLAUS_POW = 1
      LV_ERR_SET_VS_PLAUS_POW = 1
  //Once the LV_ERR_VS_PLAUS_POW is set, should be reset only LV_IGK 0- ->1
  Endif
  Else (2)
    T_VS_DIAG = 0
    ERR_SYM_VS_PLAUS_POW = NO_SYM
    If T_VS_END_DIAG < C_T_VS_DIAG
    Then
      LV_CDN_DIAG_VS_PLAUS_POW = 0
      T_VS_END_DIAG++
    Else
      LV_CDN_DIAG_VS_PLAUS_POW = 1
      LV_ERR_SET_VS_PLAUS_POW = 0
      LV_END_DIAG_VS_PLAUS_POW = 1
    Endif
  Endif (2)
Else
  LV_CDN_DIAG_VS_PLAUS_POW = 0
  ERR_SYM_VS_PLAUS_POW = NO_SYM
  T_VS_DIAG = 0
  T_VS_END_DIAG = 0
Endif
  
```

For error management treatment the following action is called:  
 ACTION\_ERRM\_NoFilterSymptom(IN< NC\_IDX\_DIAG\_VS\_PLAUS\_POW >,  
 IN<LV\_CDN\_DIAG\_VS\_PLAUS\_POW >, IN<ERR\_SYM\_VS\_PLAUS\_POW >,  
 IN< LV\_ERR\_SET\_VS\_PLAUS\_POW >, IN< 0 >, IN<LV\_END\_DIAG\_VS\_PLAUS\_POW>, OUT<  
 LV\_ERR\_VS\_PLAUS\_POW > )

## A.129.2 Top limit check of the vehicle speed signal, 'VS\_TOL'

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**General information:**

A range check is carried out to determine if the vehicle speed exceeds the plausible maximum threshold. As such the diagnosis instance VS\_TOL contains one error symptom:

- Signal out of range **VS\_TOL**

The general error treatment is described in the chapters "ABC algorithm" and "Dynamic Error Management": environmental data, DTC, error classes (priority assignment, lamp management), communication interface, etc..

**Application conditions:**

**Initialisation:** The configuration is MEM  
(=> all 0 at LV\_IGK 0->1 or reset or clearing error memory)

**Activation:** LV\_IGK = 1 **and**  
LV\_ERR\_VS\_PLAUS = 0 **and**  
CLF\_VS\_PLAUS\_ENA bit 1 = 1

**Deactivation:** When activation condition does not met

Following should be updated during de-activation  
LV\_CDN\_DIAG\_VS\_TOL = 0  
ERR\_SYM\_VS\_TOL = NO\_SYM

**Recurrence:** 100 ms

**Function description:****Formula section:**

```

If VS > 0
Then
    LV_CDN_DIAG_VS_TOL = 1
    If VS_HIGH_RES > C_VS_TOL_DIAG
    Then
        ERR_SYM_VS_TOL = SYM_0
    Else
        ERR_SYM_VS_TOL = NO_SYM
    Endif
Else
    LV_CDN_DIAG_VS_TOL = 0
Endif

```


For failure and error management treatment the anti-bounce mechanism is called :

```

ACTION_ERRM_FilterSymptom(IN< NC_IDX_DIAG_VS_TOL >,
IN< LV_CDN_DIAG_VS_TOL>, IN< ERR_SYM_VS_TOL >, IN< C_ABC_INC_VS_TOL >, IN<
1 >, IN< C_ABC_MAX_VS_TOL >, OUT< LV_ERR_VS_TOL > )

```

**A.129.3 Bottom Limit check of the vehicle speed signal, 'VS\_BOL'**

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**General information:**

A plausibility check is carried out to determine if the observed vehicle speed is plausible for the given engine conditions (PU or PUC mode). In the engine states PU or PUC the vehicle speed may not be below calibratable threshold. As such the diagnosis instance VS\_BOL contains one error symptom:

- BOL check in PU/PUC mode fails **VS\_BOL**

The general error treatment is described in the chapters "ABC algorithm" and "Dynamic Error Management": environmental data, DTC, error classes (priority assignment, lamp management), communication interface, etc..

**Application conditions:**

**Initialisation:** The configuration is **MEM**  
 (=> all 0 at LV\_IGK 0->1 or reset or clearing error memory)  
 Except: LV\_VS\_BOL = 1

**Activation:** LV\_IGK = 1 **and**  
 LV\_ERR\_VS\_PLAUS = 0 **and**  
 VS > C\_VS\_BOL\_MIN\_DIAG **and**  
 CLF\_VS\_PLAUS\_ENA bit 2 = 1

**Deactivation:** When activation condition does not met

Following should be updated during de-activation  
 LV\_CDN\_DIAG\_VS\_BOL = 0  
 ERR\_SYM\_VS\_BOL = NO\_SYM

**Recurrence:** 100 ms

**Function description:****Formula section:**

**If Case 1: C\_SEL\_ENG\_STATE\_MT/ \_AT = 1**  
 STATE\_ENG = "PU"

**Case 2: C\_SEL\_ENG\_STATE\_MT/ \_AT = 2**  
 STATE\_ENG = "PUC"

**Case 3: C\_SEL\_ENG\_STATE\_MT/ \_AT = 3**  
 STATE\_ENG = "PU" **OR**  
 STATE\_ENG = "PUC"

**Then**

**If** T\_VS\_BOL < C\_T\_MAX\_VS\_BOL\_AT/ \_MT //Separate cal for AT/ MT

**Then**

LV\_CDN\_DIAG\_VS\_BOL = 0

T\_VS\_BOL++

**If** VS > C\_VS\_MAX\_ERR\_PUC\_AT/ \_MT //Separate cal for AT/ MT


**Then**

LV\_VS\_BOL = 0

**Endif****Else**

LV\_CDN\_DIAG\_VS\_BOL = 1

**If** LV\_VS\_BOL = 1

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```

    Then
        ERR_SYM_VS_BOL      = SYM_0
    Else
        ERR_SYM_VS_BOL      = NO_SYM
    Endif
    T_VS_BOL = 0
    LV_VS_BOL = 1
Endif
Else
    LV_CDN_DIAG_VS_BOL = 0
    ERR_SYM_VS_BOL = NO_SYM
    T_VS_BOL = 0
    LV_VS_BOL = 1
Endif

```

For failure and error management treatment the anti-bounce mechanism is called :

```

ACTION_ERRM_FilterSymptom( IN< NC_IDX_DIAG_VS_BOL >,
IN< LV_CDN_DIAG_VS_BOL >, IN< ERR_SYM_VS_BOL >, IN< C_ABC_INC_VS_BOL >,
IN< 1 >, IN< C_ABC_MAX_VS_BOL >, OUT< LV_ERR_VS_BOL > )

```

## A.129.4 Gradient check for vehicle speed signal 'VS\_GRD'

### General information:

A speed gradient check is carried out, if speed changes for more than C\_VS\_MAX\_GRD within 100ms. It will be calibrated to a value which is physically not possible to reach with the acceleration of the vehicle. So if the value is ever reached, it means we have a problem with the speed signal.

- Unrealistic gradient signal **VS\_GRD**

The general error treatment is described in the chapters "ABC algorithm" and "Dynamic Error Management": environmental data, DTC, error classes (priority assignment, lamp management), communication interface, etc..

### Application conditions:

**Initialisation:** The configuration is **MEM**  
(=> all 0 at LV\_IGK 0->1 or reset or clearing error memory)


```
VS_HIGH_RES_TMP      = 0
```

**Activation:** LV\_IGK = 1 **and**  
LV\_ERR\_VS\_PLAUS = 0 **and**  
CLF\_VS\_PLAUS\_ENA bit 3 = 1

**Deactivation:** When activation condition does not met

Following should be updated during de-activation  
LV\_CDN\_DIAG\_VS\_GRD = 0  
ERR\_SYM\_VS\_GRD = NO\_SYM

**Recurrence:** 100 ms

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**Function description:****Formula section:**

```

If VS > C_VS_MIN_DIAG_GRD      and
      TQ_AV > C_TQ_AV_MIN_VS_GRD  and
      TQ_AV < C_TQ_AV_MAX_VS_GRD  and
      PV_AV > C_PV_AV_MIN_VS_GRD  and
      PV_AV < C_PV_AV_MAX_VS_GRD

```

**Then**

```
LV_CDN_DIAG_VS_GRD = 1
```

**Else**

```
LV_CDN_DIAG_VS_GRD = 0
```

**Endif**

```
If LV_CDN_DIAG_VS_GRD = 1
```

**Then**

```

If VS_HIGH_RES > VS_HIGH_RES_TMP + C_VS_MAX_GRD or
      VS_HIGH_RES < VS_HIGH_RES_TMP - C_VS_MIN_GRD

```

**Then**

```
ERR_SYM_VS_GRD = SYM_0
```

**Else**

```
ERR_SYM_VS_GRD = NO_SYM
```

**Endif****Endif**

```
VS_HIGH_RES_TMP = VS_HIGH_RES (memorize vehicle speed in temporary variable)
```

For failure and error management treatment the anti-bounce mechanism is called :

```

ACTION_ERRM_FilterSymptom( IN< NC_IDX_DIAG_VS_GRD >, IN< LV_CDN_DIAG_VS_GRD
>, IN< ERR_SYM_VS_GRD >, IN< C_ABC_INC_VS_GRD >, IN< 1 >,
IN< C_ABC_MAX_VS_GRD >, OUT< LV_ERR_VS_GRD > )

```


**A.129.5 Plausibility check for stuck vehicle speed signal 'VS\_PLAUS\_STUCK'****General information:**

A plausibility check for vehicle speed stuck signal is carried out with reference to engine load change. When there is a significant change of engine load, but vehicle speed signal lies within a small calibratable window for calibratable duration and once the counter elapses without speed change vehicle speed signal will be declared as stuck.

- Vehicle speed stuck signal

**VS\_PLAUS\_STUCK**

The general error treatment is described in the chapters "ABC algorithm" and "Dynamic Error Management": environmental data, DTC, error classes (priority assignment, lamp management), communication interface, etc..

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**Application conditions:**

**Initialisation:** The configuration is **MEM**  
 (=> all 0 at LV\_IGK 0->1 or reset or clearing error memory)

```

N0          = 0
TQ_AV0     = 0
VS_HIGH_RES0 = 0
T_VS_STUCK = 0
LV_VS_STUCK = 1

```

**Activation:**

```

LV_IGK          = 1 and
LV_ERR_VS_PLAUS = 0 and
LV_ST_END      = 1 and
T_AST >= C_T_VS_MIN_DIAG and
CLF_VS_PLAUS_ENA bit 4 = 1

```

**Deactivation:** When activation condition does not met

Following should be updated during de-activation

```

LV_CDN_DIAG_VS_PLAUS_STUCK = 0
ERR_SYM_VS_PLAUS_STUCK    = NO_SYM

```

**Recurrence:** 100 ms

**Function description:****Formula section:**

```

If LV_ES          = 0 and
LV_INH_DIAG_VS_PLAUS = 0 and
LV_LDM_ACT          = 0 and
VS_HIGH_RES         > 0 and
(STATE_CC = 2H(CLOSED) or LV_AT = 0)

```

**Then**

```

If |N -N0| >= C_THD_N_VS_PLAUS_AT/ _MT and //Separate cal for AT/ MT
TQ_AV-TQ_AV0| >= C_THD_TQ_AV_VS_PLAUS_AT/ _MT

```

**Then**

```

If T_VS_STUCK < C_T_MAX_VS_STUCK_AT/ _MT

```

**Then**

```

LV_CDN_DIAG_VS_PLAUS_STUCK = 0

```

```

T_VS_STUCK ++

```

```

If VS_HIGH_RES > VS_HIGH_RES0 + C_VS_MAX_WIN or

```

```

VS_HIGH_RES < VS_HIGH_RES0 - C_VS_MIN_WIN

```

```

//speed change detected

```

```

Then LV_VS_STUCK = 0

```

**Endif**

**Else**

```

LV_CDN_DIAG_VS_PLAUS_STUCK = 1

```

```

If LV_VS_STUCK = 1

```

**Then**

```

ERR_SYM_VS_PLAUS_STUCK = SYM_0

```

**Else**

```

ERR_SYM_VS_PLAUS_STUCK = NO_SYM


```

**Endif**

```

T_VS_STUCK = 0 (restart diagnosis)

```

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```

Endif
Else
    LV_CDN_DIAG_VS_PLAUS_STUCK = 0
    ERR_SYM_VS_PLAUS_STUCK     = NO_SYM
    T_VS_STUCK                  = 0 (restart diagnosis)
Endif
Else
    LV_CDN_DIAG_VS_PLAUS_STUCK = 0
    ERR_SYM_VS_PLAUS_STUCK     = NO_SYM
    T_VS_STUCK                  = 0
Endif

ACTION_ERRM_FilterSymptom( IN< NC_IDX_DIAG_VS_PLAUS_STUCK >,
IN<LV_CDN_DIAG_VS_PLAUS_STUCK>,IN< ERR_SYM_VS_PLAUS_STUCK >,
IN<C_ABC_INC_VS_PLAUS_STUCK>, IN< 1>,
IN<C_ABC_MAX_VS_PLAUS_STUCK>, OUT<LV_ERR_VS_PLAUS_STUCK > )

If T_VS_STUCK = 0 (restart diagnosis)
Then N0 = N
    TQ_AV0 = TQ_AV
    VS_HIGH_RES0 = VS_HIGH_RES
    LV_VS_STUCK = 1
Endif

```

## A.129.6 Emission relevant VS error or missing Flexray signal

### General information:

LV\_ERR\_VS is set if no VS signal is available from ECU-PIN (L4-Projects) or flexray (L6-Projects)

### Application conditions:

**Initialisation:** The configuration is **STD\_INI**  
(=> all 0 at LV\_IGK 0->1 **or** reset **or** clearing error memory)


**Activation:** LV\_IGK = 1

**Deactivation:** When activation condition does not met

Following should be updated during de-activation  
LV\_CDN\_DIAG\_VS = 0  
ERR\_SYM\_VS = NO\_SYM

**Recurrence:** 100 ms

### Function description:

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**Formula section:**

```

If ((LV_END_DIAG_VS_PLAUS_POW = 1 or CLF_VS_PLAUS_ENA bit 0 = 0) and
(LV_END_DIAG_VS_TOL = 1 or CLF_VS_PLAUS_ENA bit 1 = 0) and
(LV_END_DIAG_VS_BOL = 1 or CLF_VS_PLAUS_ENA bit 2 = 0) and
(LV_END_DIAG_VS_GRD = 1 or CLF_VS_PLAUS_ENA bit 3 = 0) and
(LV_END_DIAG_VS_PLAUS_STUCK = 1 or CLF_VS_PLAUS_ENA bit 4 = 0)) or
LV_ERR_VS_PLAUS_POW = 1 or
LV_ERR_VS_TOL = 1 or
LV_ERR_VS_BOL = 1 or
LV_ERR_VS_GRD = 1 or
LV_ERR_VS_PLAUS_STUCK = 1 or
LV_ERR_COM_1_VS = 1 or
LV_ERR_COM_1_BOFF = 1 or
LV_ERR_COM_1_ST_UP = 1

```

**Then**

```
LV_CDN_DIAG_VS = 1
```

**Else**

```
LV_CDN_DIAG_VS = 0
```

**Endif**

```

If LV_CDN_DIAG_VS = 1 AND
(LV_ERR_VS_PLAUS_POW = 1 or
LV_ERR_VS_TOL = 1 or
LV_ERR_VS_BOL = 1 or
LV_ERR_VS_GRD = 1 or
LV_ERR_VS_PLAUS_STUCK = 1 or
LV_ERR_COM_1_VS = 1 or
LV_ERR_COM_1_BOFF = 1 or
LV_ERR_COM_1_ST_UP = 1 )

```

**Then**

```
LV_ERR_VS_PLAUS = 1
ERR_SYM_VS = SYM_2
```

**Else**

```
LV_ERR_VS_PLAUS = 0
ERR_SYM_VS = NO_SYM
```

**Endif**

For failure and error management treatment the anti-bounce mechanism is called :

```

ACTION_ERRM_FilterSymptom( IN< NC_IDX_DIAG_VS >, IN< LV_CDN_DIAG_VS >,
IN< ERR_SYM_VS >, IN< C_ABC_INC_VS >, IN< 1 >, IN< C_ABC_MAX_VS >,
OUT< LV_ERR_VS > )

```

## A.130 Vehicle speed signal diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_VS_PLAUS	O/V	0... 1H	0 ...1	1	-
Activation condition for VS_PLAUS diagnosis					
STATE_RBM_VS_PLAUS	O/V	0... 7H	0 ...7	1	-
RBM interface for VS_PLAUS diagnosis					

### Input data:

LV_DC {p. 5746}	LV_END_DIAG_VS {p. 5021}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}
LV_ERR_AMP_PLAUS_ CUS {p. 1061}	LV_ERR_CAM_CST_IVVT_ EX_1	LV_ERR_CAM_CST_IVVT_ EX_2	LV_ERR_CAM_CST_IVVT_ IN_1
LV_ERR_CAM_CST_IVVT_ IN_2	LV_ERR_CAM_EX_1	LV_ERR_CAM_EX_2	LV_ERR_CAM_IN_2
LV_ERR_CONV_MON_1 {p. 6858}	LV_ERR_CRK {p. 4455}	LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}
LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_ PER {p. 4432}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_ETC_CTL_1	LV_ERR_ETC_CTL_2	LV_ERR_ETC_DR_1	LV_ERR_ETC_DR_2
LV_ERR_ETC_PWM_1	LV_ERR_ETC_PWM_2	LV_ERR_HFM_SELF_ DIAG_0	LV_ERR_HFM_SELF_ DIAG_1
LV_ERR_IVVT {p. 1062}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}	LV_ERR_LOAD_TPS_ PLAUS_1	LV_ERR_LOAD_TPS_ PLAUS_2
LV_ERR_MAF {p. 4815}	LV_ERR_MAF_FRQ_EL_0	LV_ERR_MAF_FRQ_EL_1	LV_ERR_MAF_FRQ_GRD_ 0
LV_ERR_MAF_FRQ_RNG_ 0	LV_ERR_MAF_FRQ_RNG_ 1	LV_ERR_MAP {p. 982}	LV_ERR_MAP_DIP_ PLAUS {p. 1062}
LV_ERR_MAP_SENS_1	LV_ERR_MAP_SENS_2	LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_MAP_TPS_ PLAUS_1
LV_ERR_MAP_TPS_ PLAUS_2	LV_ERR_MEC_IVVT_EX_0	LV_ERR_MEC_IVVT_EX_1	LV_ERR_MEC_IVVT_EX_2
LV_ERR_MEC_IVVT_IN_0	LV_ERR_MEC_IVVT_IN_1	LV_ERR_MEC_IVVT_IN_2	LV_ERR_MFF_MON_1 {p. 6859}
LV_ERR_N_32_MON_1 {p. 6859}	LV_ERR_PER_CAM_EX_1	LV_ERR_PER_CAM_EX_2	LV_ERR_PER_CAM_IN_1

LV_ERR_PER_CAM_IN_2	LV_ERR_PLAUS_CAM_EX_1	LV_ERR_PLAUS_CAM_EX_2	LV_ERR_PLAUS_CAM_IN_1
LV_ERR_PLAUS_CAM_IN_2	LV_ERR_PUT_EL {p. 4828}	LV_ERR_PUT_EL_1	LV_ERR_REF_CRK_CAM_EX_1
LV_ERR_REF_CRK_CAM_EX_2	LV_ERR_REF_CRK_CAM_IN_1	LV_ERR_REF_CRK_CAM_IN_2	LV_ERR_SLV_IVVT_EX_0
LV_ERR_SLV_IVVT_EX_1	LV_ERR_SLV_IVVT_EX_2	LV_ERR_SLV_IVVT_IN_0	LV_ERR_SLV_IVVT_IN_1
LV_ERR_SLV_IVVT_IN_2	LV_ERR_SYN_CAM_EX_1	LV_ERR_SYN_CAM_EX_2	LV_ERR_SYN_CAM_IN_1
LV_ERR_SYN_CAM_IN_2	LV_ERR_SYN_CRK_CAM_EX_1	LV_ERR_SYN_CRK_CAM_EX_2	LV_ERR_SYN_CRK_CAM_IN_1
LV_ERR_SYN_CRK_CAM_IN_2	LV_ERR_TCO {p. 4496}	LV_ERR_TCO_2 {p. 4572}	LV_ERR_TIA {p. 4200}
LV_ERR_TIA_IM_EL_2	LV_ERR_TIA_MES_PLAUS_1	LV_ERR_TIA_MES_PLAUS_2	LV_ERR_TIA_PWM_EL_1
LV_ERR_TIA_PWM_EL_2	LV_ERR_TIA_THR_MES_PLAUS_1	LV_ERR_TIA_THR_MES_PLAUS_2	LV_ERR_TOOTH_OFF_EX_1
LV_ERR_TOOTH_OFF_EX_2	LV_ERR_TOOTH_OFF_IN_1	LV_ERR_TOOTH_OFF_IN_2	LV_ERR_TPS {p. 4982}
LV_ERR_TPS_1_1	LV_ERR_TPS_1_2	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_2_1
LV_ERR_TPS_2_2	LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_1	LV_ERR_TPS_AD_2
LV_ERR_TPS_AD_SPR_1	LV_ERR_TPS_AD_SPR_2	LV_ERR_TPS_MAF_1_1	LV_ERR_TPS_MAF_1_2
LV_ERR_TPS_MAF_2_1	LV_ERR_TPS_MAF_2_2	LV_ERR_TPS_RATIO_1	LV_ERR_TPS_RATIO_2
LV_ERR_TPS_ST_CHK_1 {p. 4951}	LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_TQ_EXT_MON_1 {p. 6859}	LV_ERR_TQ_REQ_MON_1 {p. 6859}
LV_ERR_TQI_AV_MON_1 {p. 6859}	LV_ERR_TQI_N_MAX_MON_1 {p. 6859}	LV_ERR_VS_BOL {p. 5021}	LV_ERR_VS_GRD {p. 5021}
LV_ERR_VS_PLAUS_STUCK {p. 5021}	LV_ERR_VS_TOL {p. 5021}	NC_NR_VS_DIAG	

## General information

The below table describes the value to which NC\_NR\_VS\_DIAG needs to be configured for the various projects inside non implemented specification(anonimpl.h) for the respective project.

Project	Value of NC_NR_VS_DIAG
4DB	1
4DS	2
4D8	3
Continued on next page	

4D9	4
4V6	5
4DC	6
4V5	7
4D6	8
4D2	9

## A.130.1 Interface for Rate - Based - Monitoring

### General information:

With this module the interface between the VS\_PLAUS monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_VS\_PLAUS data.

Within STATE\_RBM\_VS\_PLAUS, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)  
(depending on failure status: pending)
- Monitor individual RBM conditions encountered within this DC (bit 2)  
( not valid for VS\_PLAUS diagnosis )

### Application conditions:

**Initialisation:** at LV\_DC 0 -> 1 transition :  
bit 0, bit 1 and bit 2 of STATE\_RBM\_VS\_PLAUS = 0  
on failure memory reset :  
bit 1 of STATE\_RBM\_VS\_PLAUS = 0

**Activation:** LV\_DC 0 -> 1 transition and LV\_DC = 1

**Deactivation:** -

**Recurrence:** 1 s

### Function description:

#### Formula section:

```

If (NC_NR_VS_DIAG == 1   or      // NC for 4DB
      NC_NR_VS_DIAG == 2   or      // NC for 4DS
      NC_NR_VS_DIAG == 3   or      // NC for 4D8
      NC_NR_VS_DIAG == 4   or      // NC for 4D9
      NC_NR_VS_DIAG == 5   or      // NC for 4V6
      NC_NR_VS_DIAG == 6   or      // NC for 4DC
      NC_NR_VS_DIAG == 7   or      // NC for 4V5
      NC_NR_VS_DIAG == 8   or      // NC for 4D6
      NC_NR_VS_DIAG == 9) // NC for 4D2


```

#### Then

```

Bit 0:
If bit 0 of STATE_RBM_VS_PLAUS = 0

```

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```

Then
  If LV_END_DIAG_VS = 1
    Then
      bit 0 of STATE_RBM_VS_PLAUS = 1
    Endif
  Endif
  Bit 1:
  At LV_DC 0 @ 1 transition
  The pending status of the respective failures for each project has
  to be checked only once :
  // The failures have been defined in the VS_PLAUS diagnosis
  If { CPU optimization at LV_DC 0 -> 1 transition }
  CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn't empty }
  Then
    While bit 1 of STATE_RBM_VS_PLAUS = 0
      do with each XX failure of the corresponding project :
      ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>,
      SYNCHRONIZATION<CALL>)
        If XX has a pending status
          Then bit 1 of STATE_RBM_VS_PLAUS = 1
        Endif
      Endwhile
    Else { the dynamic failure memory is empty }
      No action
    Endif
  // The below calculation for bit 1 will happen at each activation
  If bit 1 of STATE_RBM_VS_PLAUS = 0
  Then
    If LV_INH_DIAG_VS_PLAUS =1
      Then bit 1 of STATE_RBM_VS_PLAUS =1
    Endif
  Endif
  Bit 2:
  bit 2 of STATE_RBM_VS_PLAUS = 1
Endif

```

## A.130.2 VS\_PLAUS - Diagnosis

### General information:

VS\_PLAUS-diagnosis is used to detect whether the VS-signal is plausible:

An vehicle speed signal error is detected if at calibratable engine speed-, mass air flow- and time thresholds the vehicle speed signal VS = 0. Depending if the vehicle is MT /AT different calibration data a applied ( If LV\_AT = 1 then \_AT are used, else \_MT are used).

### Application conditions:

**Initialisation:** At LV\_IGK 0->1 **or** reset **or** clearing error memory:  
LV\_INH\_DIAG\_VS\_PLAUS = 0

**Activation:** LV\_IGK = 1

**Deactivation:** -

**Recurrence:** 100 ms (to be called before VS\_PLAUS-diagnosis)

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**Function description:****Formula section:**

**If** (NC\_NR\_VS\_DIAG == 1 **or** // NC for 4DB  
 NC\_NR\_VS\_DIAG == 2 **or** // NC for 4DS  
 NC\_NR\_VS\_DIAG == 3 **or** // NC for 4D8  
 NC\_NR\_VS\_DIAG == 4 **or** // NC for 4D9  
 NC\_NR\_VS\_DIAG == 5 **or** // NC for 4V6  
 NC\_NR\_VS\_DIAG == 6 **or** // NC for 4DC  
 NC\_NR\_VS\_DIAG == 7 **or** // NC for 4V5  
 NC\_NR\_VS\_DIAG == 8 **or** // NC for 4D6  
 NC\_NR\_VS\_DIAG == 9) // NC for 4D2

LV\_ERR\_CAM\_CST\_IVVT\_EX\_1 = 1 **or**  
 LV\_ERR\_CAM\_CST\_IVVT\_IN\_1 = 1 **or**  
 LV\_ERR\_CONV\_MON\_1 = 1 **or**  
 LV\_ERR\_CRK\_PLAUS = 1 **or**  
 LV\_ERR\_CRK\_SYN = 1 **or**  
 LV\_ERR\_CRK\_TOOTH = 1 **or**  
 LV\_ERR\_CRK\_TOOTH\_PER = 1 **or**  
 LV\_ERR\_MAF\_FRQ\_EL\_0 = 1 **or**  
 LV\_ERR\_MAF\_FRQ\_RNG\_0 = 1 **or**  
 LV\_ERR\_N\_32\_MON\_1 = 1 **or**  
 LV\_ERR\_REF\_CRK\_CAM\_EX\_1 = 1 **or**  
 LV\_ERR\_REF\_CRK\_CAM\_IN\_1 = 1 **or**  
 LV\_ERR\_SYN\_CRK\_CAM\_EX\_1 = 1 **or**  
 LV\_ERR\_SYN\_CRK\_CAM\_IN\_1 = 1 **or**  
 LV\_ERR\_TQ\_EXT\_MON\_1 = 1 **or**  
 LV\_ERR\_TQ\_REQ\_MON\_1 = 1 **or**  
 LV\_ERR\_TQI\_AV\_MON\_1 = 1 **or**  
 LV\_ERR\_TQI\_N\_MAX\_MON\_1 = 1 **or**  
 LV\_ERR\_VS\_BOL = 1 **or**  
 LV\_ERR\_VS\_GRD = 1 **or**  
 LV\_ERR\_VS\_PLAUS\_STUCK = 1 **or**  
 LV\_ERR\_VS\_TOL = 1 **or**

**If** (NC\_NR\_VS\_DIAG == 1 **or** // NC for 4DB  
 NC\_NR\_VS\_DIAG == 2 **or** // NC for 4DS  
 NC\_NR\_VS\_DIAG == 3 **or** // NC for 4D8  
 NC\_NR\_VS\_DIAG == 4) // NC for 4D9

LV\_ERR\_CAM\_CST\_IVVT\_EX\_2 = 1 **or**  
 LV\_ERR\_CAM\_CST\_IVVT\_IN\_2 = 1 **or**  
 LV\_ERR\_ETC\_CTL\_1 = 1 **or**  
 LV\_ERR\_ETC\_CTL\_2 = 1 **or**  
 LV\_ERR\_ETC\_DR\_1 = 1 **or**  
 LV\_ERR\_ETC\_DR\_2 = 1 **or**  
 LV\_ERR\_ETC\_PWM\_1 = 1 **or**  
 LV\_ERR\_ETC\_PWM\_2 = 1 **or**  
 LV\_ERR\_HFM\_SELF\_DIAG\_0 = 1 **or**

```

LV_ERR_HFM_SELF_DIAG_1 = 1    or
LV_ERR_LOAD_TPS_PLAUS_1 = 1  or
LV_ERR_LOAD_TPS_PLAUS_2 = 1  or
LV_ERR_MAF_FRQ_EL_1 = 1      or
LV_ERR_MAF_FRQ_RNG_1 = 1     or
LV_ERR_MAP_DIP_PLAUS = 1     or
LV_ERR_MAP_SENS_1 = 1        or
LV_ERR_MAP_SENS_2 = 1        or
LV_ERR_MAP_TPS_PLAUS_1 = 1   or
LV_ERR_MAP_TPS_PLAUS_2 = 1   or
LV_ERR_MEC_IVVT_EX_1 = 1     or
LV_ERR_MEC_IVVT_EX_2 = 1     or
LV_ERR_MEC_IVVT_IN_1 = 1     or
LV_ERR_MEC_IVVT_IN_2 = 1     or
LV_ERR_MFF_MON_1 = 1         or
LV_ERR_REF_CRK_CAM_EX_2 = 1  or
LV_ERR_REF_CRK_CAM_IN_2 = 1  or
LV_ERR_SLV_IVVT_EX_1 = 1     or
LV_ERR_SLV_IVVT_EX_2 = 1     or
LV_ERR_SLV_IVVT_IN_1 = 1     or
LV_ERR_SLV_IVVT_IN_2 = 1     or
LV_ERR_SYN_CRK_CAM_EX_2 = 1  or
LV_ERR_SYN_CRK_CAM_IN_2 = 1  or
LV_ERR_TPS_1_1 = 1           or
LV_ERR_TPS_1_2 = 1           or
LV_ERR_TPS_2_1 = 1           or
LV_ERR_TPS_2_2 = 1           or
LV_ERR_TPS_AD_1 = 1          or
LV_ERR_TPS_AD_2 = 1          or
LV_ERR_TPS_AD_SPR_1 = 1     or
LV_ERR_TPS_AD_SPR_2 = 1     or
LV_ERR_TPS_MAF_1_1 = 1      or
LV_ERR_TPS_MAF_1_2 = 1      or
LV_ERR_TPS_MAF_2_1 = 1      or
LV_ERR_TPS_MAF_2_2 = 1      or
LV_ERR_TPS_RATIO_1 = 1      or
LV_ERR_TPS_RATIO_2 = 1      or
LV_ERR_TPS_ST_CHK_1 = 1     or
LV_ERR_TPS_ST_CHK_2 = 1

```

**Endif**

```


If (NC_NR_VS_DIAG == 5 or // NC for 4V6
NC_NR_VS_DIAG == 6 or // NC for 4DC
NC_NR_VS_DIAG == 7 or // NC for 4V5
NC_NR_VS_DIAG == 8) // NC for 4D6

```

```

LV_ERR_LOAD_TPS_PLAUS = 1    or
LV_ERR_MAF_FRQ_GRD_0 = 1    or
LV_ERR_MAP_DIP_PLAUS = 1    or
LV_ERR_MEC_IVVT_EX = 1      or
LV_ERR_MEC_IVVT_IN = 1      or
LV_ERR_MTC_CTL_2 = 1        or

```

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```

LV_ERR_MTC_CTL_3 = 1      or
LV_ERR_MTC_DR = 1        or
LV_ERR_SLV_IVVT_EX = 1   or
LV_ERR_SLV_IVVT_IN = 1   or
LV_ERR_TPS = 1           or
LV_ERR_TPS_1 = 1         or
LV_ERR_TPS_2 = 1         or
LV_ERR_TPS_AD = 1        or
LV_ERR_TPS_AD_BOL = 1    or
LV_ERR_TPS_MAF_1 = 1     or
LV_ERR_TPS_MAF_2 = 1     or
LV_ERR_TPS_RATIO = 1     or
LV_ERR_TPS_ST_CHK_1 = 1  or
LV_ERR_TPS_ST_CHK_2 = 1

```

**Endif**

```

If (NC_NR_VS_DIAG == 5)      //NC for 4V6
                             //Functional content of 17A00603

```

```

LV_ERR_MAF = 1 or
LV_ERR_MAP_TPS_PLAUS = 1 or

```

**Endif**

```

If (NC_NR_VS_DIAG == 1 or // NC for 4DB
    NC_NR_VS_DIAG == 4 or // NC for 4D9
    NC_NR_VS_DIAG == 5 or // NC for 4V6
    NC_NR_VS_DIAG == 8 or // NC for 4D6
    NC_NR_VS_DIAG == 9)   // NC for 4D2

```

```

LV_ERR_COM_1_BOFF = 1  or
LV_ERR_COM_1_ST_UP = 1  or
LV_ERR_COM_1_VS = 1

```

**Endif**

```

If (NC_NR_VS_DIAG == 6 or // NC for 4DC
    NC_NR_VS_DIAG == 8)   // NC for 4D6

```

```

LV_ERR_MAP_TPS_PLAUS = 1  or
LV_ERR_MFF_MON_1 = 1

```

**Endif**

```

If (NC_NR_VS_DIAG == 9)      // NC for 4D2

```

```

LV_ERR_ETC_CTL = 1      or
LV_ERR_ETC_DR = 1       or
LV_ERR_ETC_PWM = 1      or
LV_ERR_HFM_SELF_DIAG_0 = 1 or
LV_ERR_LOAD_TPS_PLAUS = 1 or
LV_ERR_MAP_SENS_1 = 1   or
LV_ERR_MAP_TPS_PLAUS = 1 or
LV_ERR_MEC_IVVT_EX_1 = 1 or
LV_ERR_MEC_IVVT_IN_1 = 1 or
LV_ERR_MFF_MON_1 = 1    or
LV_ERR_SLV_IVVT_EX_1 = 1 or


```

```

LV_ERR_SLV_IVVT_IN_1 = 1   or
LV_ERR_TPS = 1             or
LV_ERR_TPS_1 = 1          or
LV_ERR_TPS_2 = 1          or
LV_ERR_TPS_AD = 1         or
LV_ERR_TPS_AD_SPR = 1     or
LV_ERR_TPS_MAF_1 = 1      or
LV_ERR_TPS_MAF_2 = 1      or
LV_ERR_TPS_RATIO = 1      or
LV_ERR_TPS_ST_CHK = 1

Endif
  Then LV_INH_DIAG_VS_PLAUS = 1
Else LV_INH_DIAG_VS_PLAUS = 0
Endif

```

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## A.131 Wheel speed sensor diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_N_WHEEL_FN_LE	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom of signal diagnosis for front left wheel speed sensor					
ERR_SYM_N_WHEEL_FN_RI	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom of signal diagnosis for front right wheel speed sensor					
ERR_SYM_N_WHEEL_RE_LE	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom of signal diagnosis for rear left wheel speed sensor					
ERR_SYM_N_WHEEL_RE_RI	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom of signal diagnosis for rear right wheel speed sensor					
LV_CDN_DIAG_N_WHEEL_FN_LE	V	0... 1H	0 ...1	1	-
Condition for front left wheel speed sensor diagnosis					
LV_CDN_DIAG_N_WHEEL_FN_RI	V	0... 1H	0 ...1	1	-
Condition for front right wheel speed sensor diagnosis					
LV_CDN_DIAG_N_WHEEL_RE_LE	V	0... 1H	0 ...1	1	-
Condition for rear left wheel speed sensor diagnosis					
LV_CDN_DIAG_N_WHEEL_RE_RI	V	0... 1H	0 ...1	1	-
Condition for rear right wheel speed sensor diagnosis					
LV_END_DIAG_N_WHEEL_FN_LE	V	0... 1H	0 ...1	1	-
End of diagnosis for front left wheel speed sensor					
LV_END_DIAG_N_WHEEL_FN_RI	V	0... 1H	0 ...1	1	-
End of diagnosis for front right wheel speed sensor					
LV_END_DIAG_N_WHEEL_RE_LE	V	0... 1H	0 ...1	1	-
End of diagnosis for rear left wheel speed sensor					
LV_END_DIAG_N_WHEEL_RE_RI	V	0... 1H	0 ...1	1	-
End of diagnosis for rear right wheel speed sensor					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_N_WHEEL_FN_LE	O/V	0... 1H	0 ...1	1	-
Error flag for invalid wheel speed signal					
LV_ERR_N_WHEEL_FN_RI	O/V	0... 1H	0 ...1	1	-
Error flag for invalid wheel speed signal					
LV_ERR_N_WHEEL_RE_LE	O/V	0... 1H	0 ...1	1	-
Error flag for invalid wheel speed signal					
LV_ERR_N_WHEEL_RE_RI	O/V	0... 1H	0 ...1	1	-
Error flag for invalid wheel speed signal					
T_AST_ENA_N_WHEEL_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
Delay timer after engine start phase end for wheel speed sensor diagnosis					

**Input data:**

LV_CDN_VB_BN_DIAG {p. 1185}	LV_ERR_BN_TCS {p. 4870}	LV_ERR_BN_WHEEL_ CAN {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}
LV_ERR_COM_1_BOFF {p. 800}	LV_ERR_COM_1_ST_UP {p. 800}	LV_ERR_COM_1_WHEEL_ TCS	LV_IGK {p. 906}
LV_ST_END {p. 1720}	LV_WHEEL_CAN_FN_LE_ ERR {p. 1568}	LV_WHEEL_CAN_FN_RI_ ERR {p. 1568}	LV_WHEEL_CAN_RE_LE_ ERR {p. 1568}
LV_WHEEL_CAN_RE_RI_ ERR {p. 1568}	STATE_N_WHEEL_FN_LE	STATE_N_WHEEL_FN_RI	STATE_N_WHEEL_RE_LE
STATE_N_WHEEL_RE_RI	STATE_TCS_CAN {p. 1577}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_N_WHEEL_FN_LE	V	0... FFH	0... 255	1	-
Anti bounce counter decrement for front left wheel speed sensor diagnostics					
C_ABC_DEC_N_WHEEL_FN_RI	V	0... FFH	0... 255	1	-
Anti bounce counter decrement for front right wheel speed sensor diagnostics					
C_ABC_DEC_N_WHEEL_RE_LE	V	0... FFH	0... 255	1	-
Anti bounce counter decrement for rear left wheel speed sensor diagnostics					
C_ABC_DEC_N_WHEEL_RE_RI	V	0... FFH	0... 255	1	-
Anti bounce counter decrement for rear right wheel speed sensor diagnostics					
C_ABC_INC_N_WHEEL_FN_LE	V	0... FFH	0... 255	1	-
Anti bounce counter increment for front left wheel speed sensor diagnostics					
C_ABC_INC_N_WHEEL_FN_RI	V	0... FFH	0... 255	1	-
Anti bounce counter increment for front right wheel speed sensor diagnostics					
C_ABC_INC_N_WHEEL_RE_LE	V	0... FFH	0... 255	1	-
Anti bounce counter increment for rear left wheel speed sensor diagnostics					
C_ABC_INC_N_WHEEL_RE_RI	V	0... FFH	0... 255	1	-
Anti bounce counter increment for rear right wheel speed sensor diagnostics					
C_ABC_MAX_N_WHEEL_FN_LE	V	1... FFH	1... 255	1	-
Anti bounce counter threshold value for front left wheel speed sensor diagnostics					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_N_WHEEL_FN_RI	V	1... FFH	1... 255	1	-
Anti bounce counter threshold value for front right wheel speed sensor diagnostics					
C_ABC_MAX_N_WHEEL_RE_LE	V	1... FFH	1... 255	1	-
Anti bounce counter threshold value for rear left wheel speed sensor diagnostics					
C_ABC_MAX_N_WHEEL_RE_RI	V	1... FFH	1... 255	1	-
Anti bounce counter threshold value for rear right wheel speed sensor diagnostics					
C_T_AST_ENA_N_WHEEL_DIAG_MAX	V	0... FFFFH	0... 6553.5	0.1	s
Calibrating data for wait time between start and diagnosis enable for wheel speed sensor					
CLF_N_WHEEL_DIAG_EL	V	0... FH	0... 15	1	-
Calibration data to map wheel speed sensor electrical fault to error symptom					
CLF_N_WHEEL_DIAG_NO_ERR	V	0... FH	0... 15	1	-
Calibration data to map wheel speed sensor error healing symptom					
CLF_N_WHEEL_DIAG_OC	V	0... FH	0... 15	1	-
Calibration data to map wheel speed sensor open circuit diagnosis error to error symptom					
CLF_N_WHEEL_DIAG_SCG	V	0... FH	0... 15	1	-
Calibration data to map wheel speed senso short circuit to ground diagnosis error to error symptom					
CLF_N_WHEEL_DIAG_SCP	V	0... FH	0... 15	1	-
Calibration data to map wheel speed senso short circuit to positive diagnosis error to error symptom					
LC_N_WHEEL_EL	V	0... 1H	0 ...1	1	-
Activate electrical fault symptom calculation for wheel speed sensor					
LC_N_WHEEL_OC	V	0... 1H	0 ...1	1	-
Activate open circuit symptom calculation for wheel speed sensor					
LC_N_WHEEL_SCG	V	0... 1H	0 ...1	1	-
Activate short circuit to ground symptom calculation for wheel speed sensor					
LC_N_WHEEL_SCP	V	0... 1H	0 ...1	1	-
Activate short circuit to positive symptom calculation for wheel speed sensor					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_DIAG_N_WHEEL_FN_LE	-	0... FFFFH	0... 65535	1	-
Failure index for diagnostic instance N_WHEEL_FN_LE					
NC_IDX_DIAG_N_WHEEL_FN_RI	-	0... FFFFH	0... 65535	1	-
Failure index for diagnostic instance N_WHEEL_FN_RI					
NC_IDX_DIAG_N_WHEEL_RE_LE	-	0... FFFFH	0... 65535	1	-
Failure index for diagnostic instance N_WHEEL_RE_LE					
NC_IDX_DIAG_N_WHEEL_RE_RI	-	0... FFFFH	0... 65535	1	-
Failure index for diagnostic instance N_WHEEL_RE_RI					

**Import actions:**

**ACTION\_ERRM\_FilterSymptom** (IN<PRM\_IDX\_DIAG>,IN<PRM\_LV\_CDN\_DIAG>,IN<PRM\_ERR\_SYM>,IN<PRM\_C\_ABC\_INC>,IN<PRM\_C\_ABC\_DEC>,IN<PRM\_C\_ABC\_MAX>,OUT<PRM\_LV\_ERR>)


**Error treatment**

Diagnostic Identifier	Symptom Description	Nr	OBD DTC	Sym	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>							
NC_IDX_DIAG_N_WHEEL_FN_LE	Front-left wheel speed sensor short circuit to battery	0				STD_INI	CC
<i>Failure index for diagnostic instance N_WHEEL_FN_LE</i>	Front-left wheel speed sensor short circuit to ground	1					
	Front-left wheel speed sensor open circuit	2					
	Front-left wheel speed sensor electrical fault	3					

Diagnostic Identifier	Symptom Description	Nr	OBD DTC	Sym	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>							
NC_IDX_DIAG_N_WHEEL_FN_RI	Front-right wheel speed sensor short circuit to battery	0				STD_INI	CC
<i>Failure index for diagnostic instance N_WHEEL_FN_RI</i>	Front-right wheel speed sensor short circuit to ground	1					
	Front-right wheel speed sensor open circuit	2					
	Front-right wheel speed sensor electrical fault	3					

Diagnostic Identifier	Symptom Description	Nr	OBD DTC	Sym	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>							
NC_IDX_DIAG_N_WHEEL_RE_LE	Rear-left wheel speed sensor short circuit to battery	0				STD_INI	CC
<i>Failure index for diagnostic instance N_WHEEL_RE_LE</i>	Rear-left wheel speed sensor short circuit to ground	1					
	Rear-left wheel speed sensor open circuit	2					
	Rear-left wheel speed sensor electrical fault	3					

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Diagnostic Identifier	Symptom Description	Nr	OBD DTC	Sym	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>							
NC_IDX_DIAG_N_WHEEL_RE_RI	Rear-right wheel speed sensor short circuit to battery	0				STD_INI	CC
<i>Failure index for diagnostic instance N_WHEEL_RE_RI</i>	Rear-right wheel speed sensor short circuit to ground	1					
	Rear-right wheel speed sensor open circuit	2					
	Rear-right wheel speed sensor electrical fault	3					

Diagnostic Identifier	Symptom Description	Nr	OBD DTC	Sym	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>							
NC_IDX_DIAG_N_WHEEL_FN_LE	not used	0				STD_INI	CC
<i>Failure index for diagnostic instance N_WHEEL_FN_LE</i>	not used	1					
	not used	2					
	Front-left wheel speed sensor fault	3					

Diagnostic Identifier	Symptom Description	Nr	OBD DTC	Sym	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>							
NC_IDX_DIAG_N_WHEEL_FN_RI	not used	0				STD_INI	CC
<i>Failure index for diagnostic instance N_WHEEL_FN_RI</i>	not used	1					
	not used	2					
	Front-right wheel speed sensor fault	3					

Diagnostic Identifier	Symptom Description	Nr	OBD DTC	Sym	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>							
NC_IDX_DIAG_N_WHEEL_RE_LE	not used	0				STD_INI	CC

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Diagnostic Identifier	Symptom Description	Nr	OBD DTC	Sym	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>							
<i>Failure index for diagnostic instance N_WHEEL_RE_LE</i>	not used	1					
	not used	2					
	Rear-left wheel speed sensor fault	3					

Diagnostic Identifier	Symptom Description	Nr	OBD DTC	Sym	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>							
NC_IDX_DIAG_N_WHEEL_RE_RI	not used	0				STD_INI	CC
<i>Failure index for diagnostic instance N_WHEEL_RE_RI</i>	not used	1					
	not used	2					
	Rear-right wheel speed sensor fault	3					

## General information

**Note:** In the above Error treatment table the first 4 diagnostic instances (NC\_IDX's) are for BN2020 (L6 variant) and the last 4 diagnostic instances (NC\_IDX's) are for BN2000 (L4 variant).

### For BN2020(L6):

The electrical diagnosis is performed using the STATE\_N\_WHEEL\_XX\_YY, which contain, amongst other information, the error status of each individual wheel speed sensor obtained via flexray. For each wheel speed sensor, the 4-bit information contained in STATE\_N\_WHEEL\_XX\_YY can be allocated freely to 1 of the 4 error symptoms using the calibratable bitfield CLF\_N\_WHEEL\_DIAG\_XXX (e.g:xxx = SCP or SCG, or OC or EL) . Each error symptom can be activated or deactivated using the switches LC\_N\_WHEEL\_XXX. For error healing, one additional, 4-bit value of STATE\_N\_WHEEL\_XX\_YY can be calibrated using CLF\_N\_WHEEL\_DIAG\_NO\_ERR.

### For BN2000(L4):

The electrical diagnosis is performed using the error flags LV\_WHEEL\_CAN\_XX\_YY\_ERR, which contain the error information of each individual wheel speed sensor obtained via CAN. An error is detected when LV\_WHEEL\_CAN\_XX\_YY\_ERR = 1 and at the same time the DSC-status STATE\_TCS\_CAN = 2, meaning DSC has detected an electrical defect

/\*\*For code optimization use FOR loop with common activation conditions for all the four wheel diagnosis and capture different wheel specific information via common variable\*\*/



**Note:** The electrical diagnosis strategy for all four individual wheel speed sensors is same and there will be a single algorithm for all the four wheel speed sensors as below with respective wheel information designated by XX\_YY.

**XX\_YY has following diagnostic instances with XX = FN or RE and YY = LE or RI**

- **FN\_LE (Front left wheel speed sensor)**
- **FN\_RI (Front right wheel speed sensor)**
- **RE\_LE (Rear left wheel speed sensor)**
- **RE\_RI (Rear right wheel speed sensor)**

### Application conditions:

**Initialisation:** The configuration is STD\_INI  
(=> all 0 at LV\_IGK 0->1 or reset or clearing error memory)

At LV\_IGK 0->1 or reset:

T\_AST\_ENA\_N\_WHEEL\_DIAG = C\_T\_AST\_ENA\_N\_WHEEL\_DIAG\_MAX

**Activation:** LV\_IGK = 1

**Deactivation:** When activation condition does not met

Following should be updated during de-activation

LV\_CDN\_DIAG\_N\_WHEEL\_XX\_YY = 0

**Recurrence:** 100 ms

### Function description:

#### Formula section:

```

If LV_ST_END = 1
Then T_AST_ENA_N_WHEEL_DIAG- -
      //timer T_AST_ENA_N_WHEEL_DIAG decrement to zero
Else Do nothing
End

```

```

#IF (USE_L6 == ACTIVE)// Compiler switch for BN2020(Signal from Flexray)
#THEN

```

#### **Condition calculation:**

```

If LV_CDN_VB_BN_DIAG      = 1 AND
      LV_ERR_COM_1_BOFF     = 0 AND
      LV_ERR_COM_1_ST_UP    = 0 AND
      LV_ERR_COM_1_WHEEL_TCS = 0 AND
      T_AST_ENA_N_WHEEL_DIAG = 0 AND
      (( STATE_N_WHEEL_XX_YY = CLF_N_WHEEL_DIAG_SCP) AND LC_N_WHEEL_SCP) OR
      (( STATE_N_WHEEL_XX_YY = CLF_N_WHEEL_DIAG_SCG) AND LC_N_WHEEL_SCG) OR
      (( STATE_N_WHEEL_XX_YY = CLF_N_WHEEL_DIAG_OC) AND LC_N_WHEEL_OC) OR
      ( STATE_N_WHEEL_XX_YY = CLF_N_WHEEL_DIAG_NO_ERR) OR
      (( STATE_N_WHEEL_XX_YY = CLF_N_WHEEL_DIAG_EL) AND LC_N_WHEEL_EL) )

```

```


Then
      LV_CDN_DIAG_N_WHEEL_XX_YY = 1

```

```

Else
      LV_CDN_DIAG_N_WHEEL_XX_YY = 0

```

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**Endif**

**Symptom calculation:**

```

If LV_CDN_DIAG_N_WHEEL_XX_YY = 1
Then
  If STATE_N_WHEEL_XX_YY = CLF_N_WHEEL_DIAG_SCP //SCP
  Then
    ERR_SYM_N_WHEEL_XX_YY = SYM_0
  Else
    If STATE_N_WHEEL_XX_YY = CLF_N_WHEEL_DIAG_SCG //SCG
    Then
      ERR_SYM_N_WHEEL_XX_YY = SYM_1
    Else
      If STATE_N_WHEEL_XX_YY = CLF_N_WHEEL_DIAG_OC //OC
      Then
        ERR_SYM_N_WHEEL_XX_YY = SYM_2
      Else
        If STATE_N_WHEEL_XX_YY = CLF_N_WHEEL_DIAG_EL //EL
        Then
          ERR_SYM_N_WHEEL_XX_YY = SYM_3
        Else
          ERR_SYM_N_WHEEL_XX_YY = NO_SYM
        Endif
      Endif
    Endif
  Endif
Endif

```

**#ELSE // Compiler switch for BN2000 (Signal from CAN)**

**Condition calculation:**

```

If LV_CDN_VB_BN_DIAG      = 1   AND
    LV_ERR_CAN_BOFF        = 0   AND
    LV_ERR_BN_WHEEL_CAN   = 0   AND
    LV_ERR_BN_TCS         = 0   AND
    T_AST_ENA_N_WHEEL_DIAG = 0
Then
  LV_CDN_DIAG_N_WHEEL_XX_YY = 1
Else
  LV_CDN_DIAG_N_WHEEL_XX_YY = 0
Endif

```

**Symptom calculation:**

```

If LV_CDN_DIAG_N_WHEEL_XX_YY = 1
Then
  If LV_WHEEL_CAN_XX_YY_ERR = 1 AND
    STATE_TCS_CAN           = 2
  Then
    ERR_SYM_N_WHEEL_XX_YY = SYM_3
  Else
    ERR_SYM_N_WHEEL_XX_YY = NO_SYM
  Endif
Endif
#ENDIF


```

For failure and error management treatment the anti-bounce mechanism is called  
:

```

ACTION_ERRM_FilterSymptom( IN< NC_IDX_DIAG_N_WHEEL_XX_YY >,
IN< LV_CDN_DIAG_N_WHEEL_XX_YY >, IN< ERR_SYM_N_WHEEL_XX_YY >,
IN< C_ABC_INC_N_WHEEL_XX_YY >, IN< C_ABC_DEC_N_WHEEL_XX_YY >,
IN< C_ABC_MAX_N_WHEEL_XX_YY >, OUT< LV_ERR_N_WHEEL_XX_YY > )

```

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## A.132 Cruise control device diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_DCC	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptoms DCC error reversible/irreversible					
LV_CDN_DIAG_DCC	O/V	0... 1H	0 ...1	1	-
Status of diagnosis DCC error reversible/irreversible					
LV_DCC_OFF_ECU	O/V	0... 1H	0 ...1	1	-
Irreversible DCC error					
LV_END_DIAG_DCC	O/V	0... 1H	0 ...1	1	-
End of diagnosis DCC error reversible/irreversible					
LV_ERR_DCC	O/V	0... 1H	0 ...1	1	-
DCC error reversible/irreversible					
T_DCC_BRAKE_DET	V	0... FFH	0... 2.55	0.01	s
Brake delay timer					

### Input data:

ERR_SYM_BN_TQ_DCC {p. 4864}	LV_BRAKE_DET {p. 4209}	LV_DCC_OFF_ACK {p. 1565}	LV_DI_TQ_REQ_CAN_ MPI_GDI {p. 800}
LV_ERR_BLS_PLAUS {p. 4209}	LV_ERR_BN_TQ_DCC {p. 4870}	LV_ERR_CRK {p. 4455}	LV_ERR_CS {p. 5015}
LV_ERR_PVS {p. 4216}	LV_IGK {p. 906}	LV_TQI_REQ_CAN_INH {p. 6687}	LV_VAR_DCC {p. 655}
STATE_DCC_INTV {p. 1572}			


### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_DCC	-	0... FFH	0... 255	1	-
Increment counter					
C_ABC_MAX_DCC	-	1... FFH	1... 255	1	-
Maximum counter					
C_T_MAX_BRAKE_DET_DCC	-	0... FFH	0... 2.55	0.01	s
Maximum Brake delay timer					

### FUNCTION DESCRIPTION:

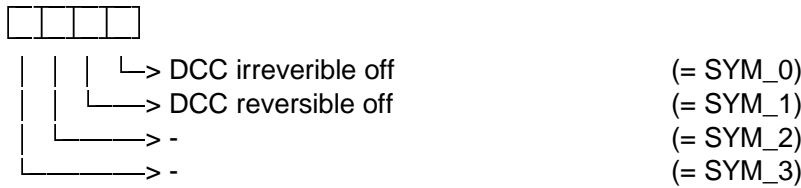
#### General information:

At implausible DCC messages, e.g. timeout errors, or ECU internal errors a reversible or irreversible error is detected and reflect to the DCC Unit. This should be confirmed by the DCC switch-off flag LV\_DCC\_OFF\_ACK. Only if the switch-off is confirmed by DCC the reversible DCC error is reset. This is necessary for a safety communication between ECU and DCC.

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**Description:**

The following symptoms can be detected:



**Application conditions**

**Initialisation:** all 0 at LV\_IGK 0->1 **or** reset **or** at clearing error memory

**Recurrence:** 10 ms

**Activation:** **If** LV\_VAR\_DCC = 1 **and**  
LV\_IGK = 1  
**Then** LV\_CDN\_DIAG\_DCC = 1

**Deactivation:** **If** LV\_VAR\_DCC = 0 **or**  
LV\_IGK = 0 **or**  
[ LV\_ERR\_DCC = 1 **and**  
ERR\_SYM\_DCC = SYM\_0 ]  
**Then** LV\_CDN\_DIAG\_DCC = 0  
**Endif**

**Formula section:**

Calculation of error condition brake detection for setting irreversible error

**If** LV\_BRAKE\_DET = 1  
**Then** T\_DCC\_BRAKE\_DET<sub>n</sub> = T\_DCC\_BRAKE\_DET<sub>n-1</sub> + 10 ms  
**Else** T\_DCC\_BRAKE\_DET<sub>n</sub> = 0 ms  
**Endif**

Calculation of irreversible error

**If** [ LV\_ERR\_BN\_TQ\_DCC = 1 **and** //ONLY ALIVE AND CHECKSUM  
**ERROR**  
ERR\_SYM\_BN\_TQ\_DCC = SYM\_1 **or** SYM\_3 ] **or**  
LV\_TQI\_REQ\_CAN\_INH = 1 **or**  
LV\_ERR\_PVS = 1 **or**  
[ (T\_DCC\_BRAKE\_DET > C\_T\_MAX\_BRAKE\_DET\_DCC) **and**  
STATE\_DCC\_INTV == 01H ]  
**Then** ERR\_SYM\_DCC = SYM\_0 //symptom irreversible DCC error  
// LV\_ERR\_DCC = 1 set after debounce by error management, set for this DC

Calculation of reversible error

**Elseif** ( LV\_ERR\_BN\_TQ\_DCC = 1 **and** ERR\_SYM\_BN\_TQ\_DCC = SYM\_2 ) **or**  
//only timeout  
LV\_ERR\_BLS\_PLAUS = 1 **or**  
LV\_ERR\_CRK = 1 **or**  
LV\_ERR\_CS = 1 **or**  
LV\_DI\_TQ\_REQ\_CAN\_MPI\_GDI = 1

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```

Then      ERR_SYM_DCC = SYM_1                //symptom reversible DCC error
// LV_ERR_DCC = 1 set after debounce by error management
Else      If      LV_ERR_DCC = 0                //not debounced yet
                Then      ERR_SYM_DCC = NO_SYM
                debounce counter reset to 0        //reset CTR_ABC_DCC to 0
                                                    //no rebounding!
                Else      If      LV_DCC_OFF_ACK = 1
                Then      ERR_SYM_DCC = NO_SYM
                LV_ERR_DCC = 0                //reset error and CTR_ABC_DCC to
                0
                debounce counter reset to 0        //no rebounding!
                Else      ERR_SYM_DCC = old value (SYM_0 or SYM_1)
                Endif
            Endif
Endif
Endif
Calculation of LV_DCC_OFF_ECU
If      LV_ERR_DCC = 1
Then      LV_DCC_OFF_ECU = 1
Elseif   LV_DCC_OFF_ACK = 1
            Then      LV_DCC_OFF_ECU = 0
            Else      unchanged
Endif

```

## A.133 IPM diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_LDM	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptoms LDM error reversible/irreversible					
LV_CDN_DIAG_LDM	O/V	0... 1H	0 ...1	1	-
Status of diagnosis LDM error reversible/irreversible					
LV_END_DIAG_LDM	O/V	0... 1H	0 ...1	1	-
End of diagnosis LDM error reversible/irreversible					
LV_ERR_LDM	O/V	0... 1H	0 ...1	1	-
LDM error reversible/irreversible					
LV_LDM_BRAKE_PLAUS_ERR	O/V	0... 1H	0 ...1	1	-
Conditions for enabling LDM not plausible					
LV_LDM_ENA_PLAUS_ERR	O/V	0... 1H	0 ...1	1	-
Conditions for enabling LDM not plausible					
LV_LDM_OFF_ECU	O/V	0... 1H	0 ...1	1	-
Irreversible LDM error					
LV_LDM_OFF_ECU_1	V	0... 1H	0 ...1	1	-
LDM Irreversible off					
LV_LDM_OFF_ECU_2	V	0... 1H	0 ...1	1	-
LDM reversible off					
T_LDM_BRAKE_DET	V	0... FFH	0... 2.55	0.01	s
Brake delay timer					

### Input data:

LV_BRAKE_DET {p. 4209}	LV_DI_TQ_REQ_CAN_MPI_GDI {p. 800}	LV_ERR_BLS_PLAUS {p. 4209}	LV_ERR_BN_LDM {p. 4870}
LV_ERR_CRK {p. 4455}	LV_ERR_CS {p. 5015}	LV_ERR_PVS {p. 4216}	LV_ETCU_DISABLE_CAN {p. 6718}
LV_IGK {p. 906}	LV_LDM_CAN_INI {p. 1566}	LV_TQ_WHEEL_LDM_REQ {p. 1568}	LV_TQI_REQ_CAN_INH {p. 6687}
LV_VAR_BN_LDM {p. 655}	STATE_LDM {p. 1575}	STATE_LDM_INTV {p. 1575}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_LDM	-	0... FFH	0... 255	1	-
Increment counter					
C_ABC_MAX_LDM	-	1... FFH	1... 255	1	-
Maximum counter					
C_T_MAX_BRAKE_DET_LDM	-	0... FFH	0... 2.55	0.01	s
Maximum Brake delay timer					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_LDM_ENA_PLAUS_ERR	-	0... 1H	0 ...1	1	-
LC for enabling diagnosis due to plausibility error					

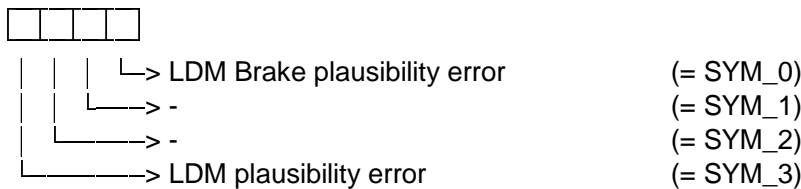
**FUNCTION DESCRIPTION:**

**General information:**

At implausible LDM messages, e.g. timeout errors, or ECU internal errors a reversible or irreversible error is detected and reflect to the LDM Unit.

**Description:**

The following symptoms can be detected:



**Application conditions**

**Initialisation:** all 0 at LV\_IGK 0->1 **or** reset **or** at clearing error memory

**Recurrence:** 10 ms

**Activation:** **If** LV\_VAR\_BN\_LDM = 1 **and**  
 LV\_IGK= 1 **and**  
 LV\_LDM\_OFF\_ECU\_1 = 0 **and**  
 LV\_LDM\_CAN\_INI = 0  
**Then** LV\_CDN\_DIAG\_LDM = 1

**Deactivation:** **If** LV\_VAR\_BN\_LDM = 0 **or**  
 LV\_IGK = 0 **or**  
 LV\_LDM\_OFF\_ECU\_1 = 1 **or**  
 LV\_LDM\_CAN\_INI = 1  
**Then** LV\_CDN\_DIAG\_LDM = 0  
**Endif**

**Formula section:**

Calculation of error condition "brake detection" for setting irreversible error

**If** LV\_BRAKE\_DET = 1  
**Then** T\_LDM\_BRAKE\_DET<sub>n</sub> = T\_LDM\_BRAKE\_DET<sub>n-1</sub> + 10 ms  
**Else** T\_LDM\_BRAKE\_DET<sub>n</sub> = 0 ms  
**Endif**

Calculation of error condition "brake detection ldm not plausible" for setting irreversible error

**If** [(T\_LDM\_BRAKE\_DET > C\_T\_MAX\_BRAKE\_DET\_LDM) and

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```

STATE_LDM_INTV == 01H ]
Then LV_LDM_BRAKE_PLAUS_ERR = 1
Else LV_LDM_BRAKE_PLAUS_ERR = 0
Endif

```

Calculation of error condition "enable conditions not plausible" for setting irreversible error

```

If (STATE_LDM != 1 or 2 or 3 or 4 and
LV_TQ_WHEEL_LDM_REQ = 1)
Then LV_LDM_ENA_PLAUS_ERR = 1
Else LV_LDM_ENA_PLAUS_ERR = 0
Endif

```

Calculation of error

```

If LV_LDM_BRAKE_PLAUS_ERR = 1
Then ERR_SYM_LDM = SYM_0
LV_ERR_LDM = 1
// LV_ERR_LDM = 1 set after debounce by error management, set for this DC
Elseif LV_LDM_ENA_PLAUS_ERR = 1 and
LC_LDM_ENA_PLAUS_ERR = 1
Then ERR_SYM_LDM = SYM_3
LV_ERR_LDM = 1
// LV_ERR_LDM = 1 set after debounce by error management
Else If LV_ERR_LDM = 0 //not debounced yet
Then ERR_SYM_LDM = NO_SYM //debounce counter reset to 0
Else ERR_SYM_LDM = NO_SYM
LV_ERR_LDM = 0 //after rebound
Endif
Endif

```

Calculation of LDM irreversible off

```

If [ LV_ERR_BN_LDM = 1 and //ONLY ALIVE AND CHECKSUM ER-
ROR
ERR_SYM_BN_LDM = SYM_1 or SYM_3 ] or
LV_TQI_REQ_CAN_INH = 1 or
LV_ERR_PVS = 1 or
LV_ERR_LDM = 1
Then LV_LDM_OFF_ECU_1 = 1 //LDM irreversible off

```

Calculation of reversible off

```

Elseif ( LV_ERR_BN_LDM = 1 and ERR_SYM_BN_LDM = SYM_2 ) or
//only timeout
LV_ETCU_DISABLE_CAN = 1 or
LV_ERR_BLS_PLAUS = 1 or
LV_ERR_CS = 1 or
LV_ERR_CRK = 1 or
LV_DI_TQ_REQ_CAN_MPI_GDI = 1
Then LV_LDM_OFF_ECU_2 = 1 //LDM reversible LDM off
Else LV_LDM_OFF_ECU_2 = 0
Endif


```

Calculation of LV\_LDM\_OFF\_ECU



```
If          LV_LDM_OFF_ECU_1 = 1  or  
            LV_LDM_OFF_ECU_2 = 1  
Then       LV_LDM_OFF_ECU = 1  
Else       LV_LDM_OFF_ECU = 0  
Endif
```

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## A.134 Multi function steering wheel diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_MSW_2	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error					
ERR_SYM_MSW_3	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error					
ERR_SYM_MSW_TOG	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error					
LV_CDN_DIAG_MSW_2	O/V	0... 1H	0 ...1	1	-
Diagnosis condition MSW_2					
LV_CDN_DIAG_MSW_3	O/V	0... 1H	0 ...1	1	-
Diagnosis condition MSW_3					
LV_CDN_DIAG_MSW_TOG	O/V	0... 1H	0 ...1	1	-
Diagnosis condition TOG					
LV_END_DIAG_MSW_2	O/V	0... 1H	0 ...1	1	-
End of Diagnosis MSW_2					
LV_END_DIAG_MSW_3	O/V	0... 1H	0 ...1	1	-
End of Diagnosis MSW_3					
LV_END_DIAG_MSW_TOG	O/V	0... 1H	0 ...1	1	-
End of Diagnosis TOG					
LV_ERR_MSW_2	O/V	0... 1H	0 ...1	1	-
Redundant coding of the signal-error MSW_2					
LV_ERR_MSW_3	O/V	0... 1H	0 ...1	1	-
Toggle switch test-error MSW_3					
LV_ERR_MSW_TOG	O/V	0... 1H	0 ...1	1	-
Toggle bit monitoring-error TOG					
LV_MSW_MSG_VLD	O	0... 1H	0 ...1	1	-
Flag for MSW message is valid					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_MSW_DATA	0	1H 3H 25H 49H 91H	NONE TIP_DOWN OFF TIP_UP RESUME	-	-
State MSW data					

**Input data:**

BIOS_CRU_DATA {p. 942}	BIOS_CRU_TOG {p. 942}	BIOS_LV_CRU_ERR	C_T_READY_CRU {p. 7221}
LV_IGK {p. 906}	LV_VAR_BN_MSW {p. 655}	LV_VAR_MSW {p. 656}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_MSW_2	-	0... FFH	0... 255	1	-
Debounce counter increment - MSW diagnosis					
C_ABC_INC_MSW_3	-	0... FFH	0... 255	1	-
Debounce counter increment - MSW diagnosis					
C_ABC_INC_MSW_TOG	-	0... FFH	0... 255	1	-
Debounce counter increment - Toggle bit monitoring					
C_ABC_MAX_MSW_2	-	1... FFH	1... 255	1	-
Debounce counter maximum value - MSW diagnosis					
C_ABC_MAX_MSW_3	-	1... FFH	1... 255	1	-
Debounce counter maximum value - MSW diagnosis					
C_ABC_MAX_MSW_TOG	-	1... FFH	1... 255	1	-
Debounce counter maximum value - Toggle bit monitoring					
C_T_MAX_MSW_BIT_DIAG	-	0... FFH	0... 2550	10	ms
Max. diagnostic threshold - Toggle bit monitoring					
C_T_MIN_MSW_BIT_DIAG	-	0... FFH	0... 2550	10	ms
Min. diagnostic threshold - Toggle bit monitoring					
C_VB_MIN_MSW_DIAG	-	0... FFH	0... 25.89843	0.1015625	V
Min. battery voltage for MSW diagnosis					

**FUNCTION DESCRIPTION:****General information:**


In this function the diagnosis of the relevant signals from the MSW for the cruise control is made. The following error can be distinguished:

- Redundant coding of the signal
- Toggle switch test
- Toggle bit monitoring

**Application conditions**

**Initialisation:** *all 0 at LV\_IGK 0->1 or reset*

**Recurrence:** *see diagnosis*

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**Activation:**

```

If          V_IGK > C_VB_MIN_MSW_DIAG
and        Time since V_IGK > C_VB_MIN_MSW_DIAG greater
than C_T_READY_CRU
and        LV_VAR_MSW = 1
and        LV_VAR_BN_MSW = 0

```

### A.134.1 Determination of STATE\_MSW\_DATA /LV\_MSW\_MSG\_VLD

#### Description:

The datas are used for function cruise control.

#### Formula section:

Calculation of LV\_MSW\_MSG\_VLD:

```

If          a single message is valid (no ERR_SYM_... is active, BIOS_LV_CRU_ERR = 0)
Then        LV_MSW_MSG_VLD = 1
Else        LV_MSW_MSG_VLD = 0
Endif

```

Calculation of STATE\_MSW\_DATA:

STATE\_MSW\_DATA = (range converted) BIOS\_CRU\_DATA

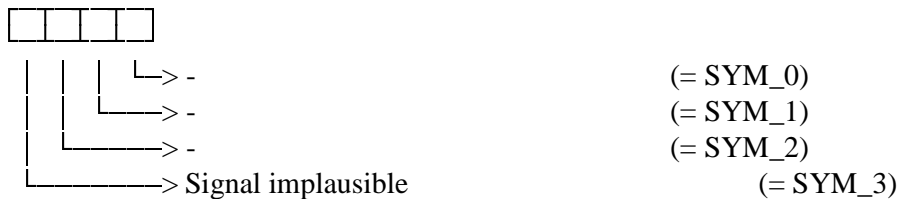
### A.134.2 Redundant coding check of the signal ( LV\_ERR\_MSW\_2 )

#### Application conditions

**Recurrence:** 80ms  
 = every four equal messages plus delay time due to different  
 recurrency  
 [ 4 x (15ms + Delay) ]

#### Description:

Error-symptoms are defined to this diagnosis function as following :



#### Formula section:

Calculation of diagnosis condition:

```

If          at least one of the bits for WA, S/B or OFF is active in BIOS_CRU_DATA
Then        LV_CDN_DIAG_MSW_2 = 1


```

Error detection and plausibility:

```

If          Redundant coding is infringed (see "Supplementary functions" chapter, CRU )
Then        ERR_SYM_MSW_2 = SYM_3
                // LV_ERR_MSW_2 = 1          after debounce by error management

```

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```

Else      ERR_SYM_MSW_2 = NO_SYM
          //LV_ERR_MSW_2 = 0      after rebound by error management

Endif
Else      LV_CDN_DIAG_MSW_2 = 0
Endif

```

Calculation end of diagnosis:

LV\_END\_DIAG\_MSW\_2 is calculated by error management if diagnosis condition is true.

### A.134.3 Toggle switch test ( LV\_ERR\_MSW\_3 )

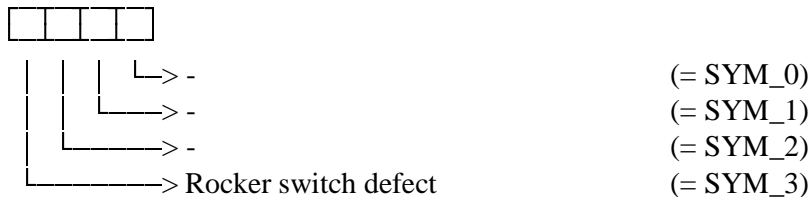
#### Application conditions

**Recurrence:** 80ms  
 = every four equal messages plus delay time due to different recurrency  
 [ 4 x (15ms + Delay) ]

#### Description:

The toggle switch condition is checked for each new message (BIOS\_CRU\_DATA) in which S/B or VE are active. If this is infringed, the preceding message remains valid.

Error-symptoms are defined to this diagnosis function as following :



#### Formula section:

Calculation of diagnosis condition:

```

If      S/B or VE is active in BIOS_CRU_DATA
Then    LV_CDN_DIAG_MSW_3 = 1

```

Error detection and plausibility:

```

If      S/B and VE are simultaneously active
Then    ERR_SYM_MSW_3 = SYM_3
          //LV_ERR_MSW_3 = 1      after debounce by error management

Else    ERR_SYM_MSW_3 = NO_SYM
          //LV_ERR_MSW_3 = 0      after rebound by error management

Endif
Else    LV_CDN_DIAG_MSW_3 = 0
Endif

```

Calculation end of diagnosis:

LV\_END\_DIAG\_MSW\_3 is calculated by error management if diagnosis condition is true.

### A.134.4 Toggle bit monitoring ( LV\_ERR\_MSW\_TOG )

## Application conditions

**Recurrence:** each change of toggle bit (error free: about 0.5s)

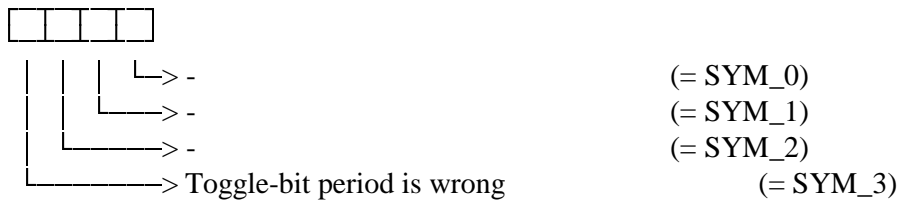
## Description:

The diagnosis condition is set latest if C\_T\_MAX\_MSW\_BIT\_DIAG is reached, after this the diagnosis condition is on and T\_TOG (time between two state changes of the toggle bit BIOS\_CRU\_TOG) is checked for MIN and MAX time at each new message.

If C\_T\_MAX\_MSW\_BIT\_DIAG is reached without toggle bit change the error LV\_ERR\_MSW\_TOG is set directly without debounce.

If toggle bit change is faster C\_T\_MIN\_MSW\_BIT\_DIAG then the error symptom ERR\_SYM\_MSW\_TOG is set and the anti-bounce is incrementing.

Error-symptoms are defined to this diagnosis function as following :



## Formula section:

### Error detection and plausibility:

T\_TOG is incrementing (10ms steps) and reseted at every toggle bit change

```

If                a full toggle bit cycle is received
Then             LV_CDN_DIAG_MSW_TOG = 1
  If               T_TOG < C_T_MIN_MSW_BIT_DIAG
    Then            ERR_SYM_MSW_TOG = SYM_3
                    // LV_ERR_MSW_TOG = 1 after debounce by error management
  Else            ERR_SYM_MSW_TOG = NO_SYM
                    // LV_ERR_MSW_TOG = 0 after rebound by error management
  Endif
Elseif           T_TOG > C_T_MAX_MSW_BIT_DIAG
  Then            LV_CDN_DIAG_MSW_TOG = 1
                    ERR_SYM_MSW_TOG = SYM_3
                    LV_ERR_MSW_TOG = 1
                    //set directly without debounce, Anti-bounce counter is set to max value
  Else            no change
Endif
Endif

```

### Calculation end of diagnosis:

LV\_END\_DIAG\_MSW\_TOG is calculated by error management if diagnosis condition is true.

## A.135 Variable intake manifold diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_VIMPWM_1_FB	-	0... FFH	0... 255	1	-
Antibounce counter for DISA failure feedback diagnosis.					
ABC_VIMPWM_2_FB	-	0... FFH	0... 255	1	-
Antibounce counter for DISA failure feedback diagnosis.					
CDN_DIAG_VIM_1_BAS	O	0... 7H	0 ...7	1	-
Primary diagnosis condition read from the infrastructure for each symptom of VIM bit 0: diagnosis condition for symptom SYM_0 (SCP) bit 1: diagnosis condition for symptom SYM_1 (SCG) bit 2: diagnosis condition for symptom SYM_2 (OC)					
CDN_DIAG_VIM_1_EL	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of VIM_1bit 0: diagnosis condition for symptom SCP (SYM_0)bit 1: diagnosis condition for symptom SCG (SYM_1)bit 2: diagnosis condition for symptom OC (SYM_2)					
CDN_DIAG_VIM_2_BAS	O	0... 7H	0 ...7	1	-
Primary diagnosis condition read from the infrastructure for each symptom of VIM bit 0: diagnosis condition for symptom SYM_0 (SCP) bit 1: diagnosis condition for symptom SYM_1 (SCG) bit 2: diagnosis condition for symptom SYM_2 (OC)					
CDN_DIAG_VIM_2_EL	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of VIM_2bit 0: diagnosis condition for symptom SCP (SYM_0)bit 1: diagnosis condition for symptom SCG (SYM_1)bit 2: diagnosis condition for symptom OC (SYM_2)					
CTR_VIMPWM_1_EDGE	O/V/S	0... FFFFFFFH	0... 16777215	1	-
counter detection switch flap 1					
CTR_VIMPWM_2_EDGE	O/V/S	0... FFFFFFFH	0... 16777215	1	-
counter detection switch flap 2					
ERR_DIAG_VIM_1	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for VIM_1 (only parameter)					
ERR_DIAG_VIM_2	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for VIM_2 (only parameter)					
ERR_SYM_VIM_1_EL	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom VIM_1 diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_VIM_2_EL	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom VIM_2 diagnosis					
ERR_SYM_VIMPWM_1_FB	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom DISA failure feedback diagnosis.					
ERR_SYM_VIMPWM_2_FB	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom DISA failure feedback diagnosis.					
ERR_VIMPWM_1_FB	O/V	0... FFH	0... 255	1	-
00H: no failure feedback 01H: failure 1 detected by control unit FFH: init value /feedback possible The values 01H are only valid, if LV_VIMPWM_1_FB_VLD = 1, else the failure is only supposed.					
ERR_VIMPWM_2_FB	O/V	0... FFH	0... 255	1	-
00H: no failure feedback 01H: failure 1 detected by control unit FFH: init value /feedback possible The values 01H are only valid, if LV_VIMPWM_2_FB_VLD = 1, else the failure is only supposed.					
LV_CDN_DIAG_VIM_1_EL	O/V	0... 1H	0 ...1	1	-
Diagnosis condition VIM_1 diagnosis					
LV_CDN_DIAG_VIM_2_EL	O/V	0... 1H	0 ...1	1	-
Diagnosis condition VIM_2 diagnosis					
LV_CDN_DIAG_VIMPWM_1_FB	V	0... 1H	0 ...1	1	-
Diagnosis condition DISA failure feedback diagnosis.					
LV_CDN_DIAG_VIMPWM_2_FB	V	0... 1H	0 ...1	1	-
Diagnosis condition DISA failure feedback diagnosis.					
LV_EDGE_DIAG_VIM_1	V	0... 1H	0 ...1	1	-
DISA switch ready (Flap 1)					
LV_EDGE_DIAG_VIM_2	V	0... 1H	0 ...1	1	-
DISA switch ready (Flap 2)					
LV_EDGE_VIM_1	V	0... 1H	0 ...1	1	-
DISA switch (Flap 1)					
LV_EDGE_VIM_2	V	0... 1H	0 ...1	1	-
DISA switch (Flap 2)					
LV_END_DIAG_VIM_1_EL	O/V	0... 1H	0 ...1	1	-
End of diagnosis VIM_1 diagnosis					
LV_END_DIAG_VIM_2_EL	O/V	0... 1H	0 ...1	1	-
End of diagnosis VIM_2 diagnosis					




Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_VIMPWM_1_FB	V	0... 1H	0 ...1	1	-
End of diagnosis DISA failure feedback diagnosis.					
LV_END_DIAG_VIMPWM_2_FB	V	0... 1H	0 ...1	1	-
End of diagnosis DISA failure feedback diagnosis.					
LV_ERR_VIM_1	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on VIM_1 (VIM_H) signal.					
LV_ERR_VIM_1_EL	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on VIM_1 (VIM_H) signal.					
LV_ERR_VIM_2	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on VIM_2 (VIM_L) signal.					
LV_ERR_VIM_2_EL	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on VIM_2 (VIM_L) signal.					
LV_ERR_VIMPWM_1_FB	O/V	0... 1H	0 ...1	1	-
Error currently present, indicated by failure feedback from DISA control unit.					
LV_ERR_VIMPWM_2_FB	O/V	0... 1H	0 ...1	1	-
Error currently present, indicated by failure feedback from DISA control unit.					
LV_INH_DIAG_VIM_1_EL	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition VIM_1 diagnosis					
LV_INH_DIAG_VIM_2_EL	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition VIM_2 diagnosis					
LV_VIMPWM_1_FB_VLD	O/V	0... 1H	0 ...1	1	-
If LV_VIMPWM_1_FB_VLD = 1 the failure number ERR_VIMPWM_1_FB (01H) is valid					
LV_VIMPWM_2_FB_VLD	O/V	0... 1H	0 ...1	1	-
If LV_VIMPWM_2_FB_VLD = 1 the failure number ERR_VIMPWM_2_FB (01H) is valid					
T_ACT_VIMPWM_1_FB	-	0... FFFFH	0... 6553.5	0.1	s
Time with VIMPWM_1 > C_VIMPWM_MIN_FB necessary to have failure feedback from DISA control unit					
T_ACT_VIMPWM_2_FB	-	0... FFFFH	0... 6553.5	0.1	s
Time with VIMPWM_2 > C_VIMPWM_MIN_FB necessary to have failure feedback from DISA control unit					
T_DIAG_VIMPWM_1_FB	V	0... FFFFH	0... 6553.5	0.1	s
feedback timer to allow decrement after switch (Flap 1)					
T_DIAG_VIMPWM_2_FB	V	0... FFFFH	0... 6553.5	0.1	s
feedback timer to allow decrement after switch (Flap 2)					
T_VIMPWM_1_FB	V	0... FFH	0... 25.5	0.1	s
Timer counting tlow for failure feedback recognition					
T_VIMPWM_2_FB	-	0... FFH	0... 25.5	0.1	s
Timer counting tlow for failure feedback recognition					

**Input data:**

LV_CDN_VB_MIN_DIAG {p. 1185}	LV_CDN_VB_OBD1 {p. 1185}	LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}
LV_VIM_1 {p. 3622}	LV_VIM_2 {p. 3622}	N_32 {p. 1525}	VIMPWM_1 {p. 3622}
VIMPWM_2 {p. 3622}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_VIMPWM_1_FB	-	0... FFH	0... 255	1	-
ABC Decrement for VIMPWM_1_FB Diagnosis					
C_ABC_DEC_VIMPWM_2_FB	-	0... FFH	0... 255	1	-
ABC Decrement for VIMPWM_2_FB Diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_VIM_1_EL	-	0... FFH	0... 255	1	-
Debounce counter increment VIM_1 diagnosis					
C_ABC_INC_VIM_2_EL	-	0... FFH	0... 255	1	-
Debounce counter increment VIM_2 diagnosis					
C_ABC_INC_VIMPWM_1_FB	-	0... FFH	0... 255	1	-
ABC Increment for VIMPWM_1_FB Diagnosis					
C_ABC_INC_VIMPWM_2_FB	-	0... FFH	0... 255	1	-
ABC Increment for VIMPWM_2_FB Diagnosis					
C_ABC_MAX_VIM_1_EL	-	1... FFH	1... 255	1	-
Debounce counter maximum value VIM_1 diagnosis					
C_ABC_MAX_VIM_2_EL	-	1... FFH	1... 255	1	-
Debounce counter maximum value VIM_2 diagnosis					
C_ABC_MAX_VIMPWM_1_FB	-	1... FFH	1... 255	1	-
ABC Maximum for VIMPWM_1_FB Diagnosis					
C_ABC_MAX_VIMPWM_2_FB	-	1... FFH	1... 255	1	-
ABC Maximum for VIMPWM_2_FB Diagnosis					
C_N_MAX_ERR_VIM_FB	-	0... FFH	0... 8160	32	rpm
Engine speed threshold, no VIM feedback error above					
C_T_ACT_VIMPWM_1_FB	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time necessary to have failure feedback from DISA control unit					
C_T_ACT_VIMPWM_2_FB	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time necessary to have failure feedback from DISA control unit					
C_T_DIAG_VIMPWM_1_FB	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time necessary after switch to allow decrement (Flap 1)					
C_T_DIAG_VIMPWM_2_FB	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time necessary after switch to allow decrement (Flap 2)					
C_T_VIMPWM_1_FB_MAX	-	0... FFH	0... 25.5	0.1	s
Time range necessary for identification of failure feedback maximal value					
C_T_VIMPWM_1_FB_MIN	-	0... FFH	0... 25.5	0.1	s
Time range necessary for identification of failure feedback minimal value					
C_T_VIMPWM_2_FB_MAX	-	0... FFH	0... 25.5	0.1	s
Time range necessary for identification of failure feedback maximal value					
C_T_VIMPWM_2_FB_MIN	-	0... FFH	0... 25.5	0.1	s
Time range necessary for identification of failure feedback minimal value					
C_VIM_PWM_DIAG_MAX_SCG	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
Maximum threshold for SCG diagnosis window					
C_VIM_PWM_DIAG_MIN_OC	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
Minimum threshold for OC diagnosis window					
C_VIM_PWM_DIAG_MIN_SCP	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
Minimum threshold for SCB diagnosis window					
C_VIMPWM_1_MIN_FB	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
Minimum duty cycle of VIMPWM_1 to have a failure feedback from DISA control unit					
C_VIMPWM_2_MIN_FB	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
Minimum duty cycle of VIMPWM_2 to have a failure feedback from DISA control unit					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_VIM_EL	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (typical 2)					

**Import actions:**

<b>ACTION_ERRM_FilterMulticondition</b>	(IN<XX>,IN<CDN_DIAG_>,XX>,<IN<>,ERR_DIAG_XX>,<IN>,<C_ABC_INC_XX>,IN<C_ABC_MAX_XX>,OUT<LV_ERR_XX>)
---	---

**A.135.1 Summary of all VIM diagnosis****FUNCTION DESCRIPTION:**

This function shall summarize all VIM failures in one flag only for each VIM.

**Description:****Application conditions**

**Initialisation:** reset **or** FMY reset **or** LV\_IGK = 0 -> 1  
 LV\_ERR\_VIM\_1 = 0  
 LV\_ERR\_VIM\_2 = 0

**Recurrence:** 100ms

**Activation:** every ECU state

**Formula section:**

**If** LV\_ERR\_VIM\_1\_EL = 1 or LV\_ERR\_VIMPWM\_1\_FB = 1

**Then** LV\_ERR\_VIM\_1 = 1

**Else** LV\_ERR\_VIM\_1 = 0

**Endif**


**If** LV\_ERR\_VIM\_2\_EL = 1 or LV\_ERR\_VIMPWM\_2\_FB = 1

**Then** LV\_ERR\_VIM\_2 = 1

**Else** LV\_ERR\_VIM\_2 = 0

**Endif**

**A.135.2 Diagnostic information from infrastructure****FUNCTION DESCRIPTION:**

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**Description:**

The DISA control unit is controlled by a PWM signal line driven by the ATIC 39. The driver can distinguish between three symptoms: 'Short circuit to Vbatt', 'Short circuit to GND' and 'Open Load'. This function reads the failure information (ERR\_DIAG\_VIM\_1/2) from the infrastructure.

**Application conditions**

**Initialisation:** reset **or** reset of failure memory **or** LV\_IGK = 0 -> 1  
 CDN\_DIAG\_VIM\_1\_BAS = 0  
 CDN\_DIAG\_VIM\_2\_BAS = 0  
 ERR\_DIAG\_VIM\_1 = 0  
 ERR\_DIAG\_VIM\_2 = 0

**Recurrence:** 100ms

**Activation:** every ECU state

**Formula section:**

Usage of the diagnosis information (failure symptoms (raw value) ERR\_DIAG\_VIM\_1/2 and diagnosis conditions CDN\_DIAG\_VIM\_1\_BAS/2\_BAS received from the infrastructure:

Diagnosis conditions are set according infrastructure info.: CDN\_DIAG\_VIM\_1\_BAS/2\_BAS

Failure symptoms are set according infrastructure info.: ERR\_DIAG\_VIM\_1/2

**A.135.3 Failure feedback recognition of VIM****FUNCTION DESCRIPTION:**

If a failure is detected from the DISA control unit, a failure feedback is send to the ECU by pulling the signal line (interface ECU to the DISA control unit) to ground in a defined pattern. The time  $t_{low}$  is an identification for the failure.

**Description:**

For the recognition of the failure feedback the information, if a failure "short circuit to ground" is detected on the signal line between ECU and DISA control unit is used.


**Application conditions**

**Initialisation:** at reset **or** FMY reset **or** LV\_IGK = 0 -> 1  
 ERR\_VIMPWM\_1\_FB = FFH  
 ERR\_VIMPWM\_2\_FB = FFH  
 T\_VIMPWM\_1\_FB = 0  
 T\_VIMPWM\_2\_FB = 0  
 LV\_VIMPWM\_1\_FB\_VLD = 0  
 LV\_VIMPWM\_2\_FB\_VLD = 0

**Recurrence:** 100ms

*FB-Diagnosis has to be calculated **after** VIM-Powerstage-Diagnosis*

**Activation:** LV\_IGK = 1 **and**  
 LV\_CDN\_VB\_MIN\_DIAG = 1 **and**  
 N\_32 ≤ C\_N\_MAX\_ERR\_VIM\_FB **and**  
 LV\_ERR\_SPI\_MPS = 0

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**Deactivation:** not activation  
 at deactivation function is initialized  
 one time

### Formula section:

LV\_VIMPWM\_1\_FB\_VLD = 0

```

If ERR_DIAG_VIM_1 = 2 (SCG detected by Powerstage-diagnosis)
Then T_VIMPWM_1_FB = T_VIMPWM_1_FB + 100ms
      ERR_VIMPWM_1_FB = FFH (failure feedback possible)
If T_VIMPWM_1_FB > C_T_VIMPWM_1_FB_MAX
      (T_VIMPWM_1_FB out of range for FB)
      Then ERR_VIMPWM_1_FB = 00H
      Endif
Else
      If C_T_VIMPWM_1_FB_MIN ≤ T_VIMPWM_1_FB ≤ C_T_VIMPWM_1_FB_MAX
      Then failure feedback detected
            ERR_VIMPWM_1_FB = 01H
            LV_VIMPWM_1_FB_VLD = 1
      Else no failure feedback possible
            ERR_VIMPWM_1_FB = 00H
      Endif
      T_VIMPWM_1_FB = 0
Endif

```

The same calculation is done for all ...VIMPWM\_2...-outputs.

## A.135.4 Electrical diagnosis of VIM ( LV\_ERR\_VIM\_1 /2\_EL )

### FUNCTION DESCRIPTION:

#### General information:


The purpose is to diagnose the electrical signal from the two drivers which controls the VIM.

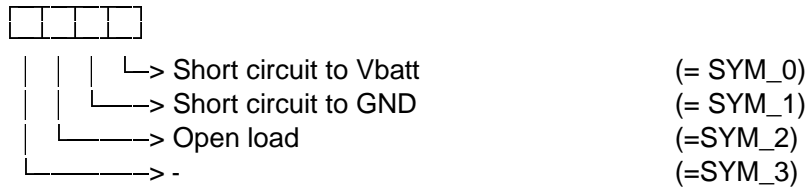
#### Description:

The driver can distinguish between three symptoms: 'Short circuit to Vbatt', 'Short circuit to GND' and 'Open Load'.

The error detection algorithm in this function for "short circuit to GND" is respecting the status of the failure feedback recognition (ERR\_VIMPWM\_1\_FB and ERR\_VIMPWM\_2\_FB). The failure, detected by the HW, is delivered from the infrastructure ERR\_DIAG\_VIM\_1 and ERR\_DIAG\_VIM\_2.

**Error-symptoms:** are defined to this diagnosis function as following :

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### Application conditions

**Initialisation:** according Filter-type **MPL\_STD\_INI**  
*(reset of variables at LV\_IGK 0 -> 1 or ECU reset)*  
 LV\_ERR\_VIM\_1\_EL = 0  
 LV\_ERR\_VIM\_2\_EL = 0  
 CDN\_DIAG\_VIM\_1\_EL = 0  
 CDN\_DIAG\_VIM\_2\_EL = 0  
 ERR\_SYM\_VIM\_1\_EL = 0  
 ERR\_SYM\_VIM\_2\_EL = 0  
 LV\_INH\_DIAG\_VIM\_1\_EL = 0  
 LV\_INH\_DIAG\_VIM\_2\_EL = 0

**Recurrence:** 100ms

**Activation:** at every engine operating state

### Formula section:

#### Diagnosis inhibition:

```

If          LV_IGK = 1          and
              LV_CDN_VB_OBD1 = 1  and
              LV_ERR_SPI_MPS = 0
Then       LV_INH_DIAG_VIM_1_EL = 0
Else       LV_INH_DIAG_VIM_1_EL = 1
Endif
  
```

```

If          LV_INH_DIAG_VIM_1_EL = 0
Then
  
```

Note: The failure symptoms ERR\_SYM\_VIM\_1\_EL and the diagnosis conditions CDN\_DIAG\_VIM\_1\_EL (raw values) shall be set according infrastructure information ERR\_DIAG\_VIM\_1 and CDN\_DIAG\_VIM\_1\_BAS.

```

If          Activation conditions are met for the NC_PSD_DLY_VIM_EL recurrence
And       ERR_VIMPWM_1_FB = 00h
Then
  
```

*{ Additional diagnosis conditions }*

```

If VIMPWM_1 < C_VIM_PWM_DIAG_MIN_SCP
      { condition that disables the SYM_0 detection }
Then
  
```

bit 0 of CDN\_DIAG\_VIM\_1\_EL = 0 *{ Diagnosis of SCP is not possible }*

**Endif**

```

If VIMPWM_1 > C_VIM_PWM_DIAG_MAX_SCG
      { condition that disables the SYM_1 detection }
Then
  
```

bit 1 of CDN\_DIAG\_VIM\_1\_EL = 0 *{ Diagnosis of SCG is not possible }*

```

Endif
If VIMPWM_1 < C_VIM_PWM_DIAG_MIN_OC
    or VIMPWM_1 > C_VIM_PWM_DIAG_MAX_SCG
        { conditions that disable the SYM_2 detection }
    Then
        bit 2 of CDN_DIAG_VIM_1_EL = 0    { Diagnosis of OC is not possible }
    Endif
Else
    CDN_DIAG_VIM_1_EL = 0
Endif
Else
    CDN_DIAG_VIM_1_EL = 0
Endif

```

**The same calculation is done for all ...VIMPWM\_2...-outputs.**

Failure debouncing and error management treatment:

For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN\_DIAG\_VIM\_1/2\_EL and ERR\_DIAG\_VIM\_1/2.

```

ACTION_ERRM_FilterMulticondition    (IN<VIMPWM_1/2_EL>,
                                     IN<CDN_DIAG_VIM_1/2_EL>,
                                     IN<ERR_DIAG_VIM_1/2>,
                                     IN<C_ABC_INC_VIM_1/2_EL>, IN<C_ABC_MAX_VIM_
                                     1/2_EL>,
                                     OUT<LV_ERR_VIM_1/2_EL>,
                                     SYNCHRONIZATION<CALL>)

```

This algorithm determines:

```

ERR_SYM_VIM_1/2_EL                (detected error symptom)
LV_ERR_VIM_1/2_EL                 (Error flag for debounced error)
LV_CDN_DIAG_VIM_1/2_EL           (Diagnosis condition information)
LV_END_DIAG_VIM_1/2_EL           (End of diagnosis information)

```

## A.135.5 Feedback diagnosis of VIM

### FUNCTION DESCRIPTION:


#### General information:

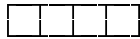
If a failure is detected by the DISA control unit, a failure feedback is send to the ECU.

#### Description:

According the possible failure feedback from the DISA control unit (defined by ERR\_VIMPWM\_1/2\_FB and LV\_VIMPWM\_1/2\_FB\_VLD), the diagnosis is managing the following failure: LV\_ERR\_VIMPWM\_1/2\_FB.

#### Error-symptoms of failure LV\_ERR\_VIMPWM\_1/2\_FB:

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→ not used (= SYM\_0)  
 → not used (= SYM\_1)  
 → not used (= SYM\_2)  
 → problem on DISA control unit detected (= SYM\_3)

### Application conditions

**Initialization:** at reset **or** FMY reset **or** LV\_IGK = 0 -> 1  
 at NVRAM error CTR\_VIMPWM\_1\_EDGE and CTR\_VIMPWM\_2\_EDGE are set to 0

### Remark:

CTR\_VIMPWM\_1\_EDGE and CTR\_VIMPWM\_2\_EDGE are lifetime counter, they are not initialized at SW version change!

according filter-type NO\_FIL  
 T\_ACT\_VIMPWM\_1\_FB = 0  
 T\_ACT\_VIMPWM\_2\_FB = 0  
 T\_DIAG\_VIMPWM\_1\_FB = 0  
 T\_DIAG\_VIMPWM\_2\_FB = 0  
 ABC\_VIMPWM\_1\_FB = 0  
 ABC\_VIMPWM\_2\_FB = 0  
 LV\_EDGE\_VIM\_1 = 0  
 LV\_EDGE\_VIM\_2 = 0  
 LV\_EDGE\_DIAG\_VIM\_1 = 0  
 LV\_EDGE\_DIAG\_VIM\_2 = 0  
 LV\_ERR\_VIMPWM\_1\_FB = 0  
 LV\_ERR\_VIMPWM\_2\_FB = 0  
 LV\_CDN\_DIAG\_VIMPWM\_1\_FB = 0  
 LV\_CDN\_DIAG\_VIMPWM\_2\_FB = 0  
 ERR\_SYM\_VIMPWM\_1\_FB = 0  
 ERR\_SYM\_VIMPWM\_2\_FB = 0

**Recurrence:** 100ms

**Activation:** LV\_CDN\_VB\_MIN\_DIAG = 1 **and** LV\_ERR\_SPI\_MPS = 0

**Deactivation:** LV\_CDN\_VB\_MIN\_DIAG = 0 **or** LV\_ERR\_SPI\_MPS = 1  
 at deactivation: LV\_CDN\_DIAG\_VIMPWM\_1/2\_FB = 0

### Formula section:

LV\_CDN\_DIAG\_VIMPWM\_1\_FB = 1

**If** VIMPWM\_1 > C\_VIMPWM\_1\_MIN\_FB  
**Then** T\_ACT\_VIMPWM\_1\_FB = T\_ACT\_VIMPWM\_1\_FB + 100ms  
 T\_ACT\_VIMPWM\_1\_FB is limited to 6553.5s

**Endif**



```

If(1) LV_VIM_1  01 or 10                                // Disa switches
Then(1)  LV_EDGE_VIM_1 = 1                               // Switch detection
          T_DIAG_VIMPWM_1_FB = 0                         // Timer feedback re-set
          If(2) C_ABC_INC_VIMPWM_1_FB > 0              // diagnosis activ /Disa available
          Then(2) CTR_VIMPWM_1_EDGE + 1                // counter increments irreversible
          Endif(2)                                       //(reso/range FFFFFFFh, 16777215 dec.)
Else(1)  If(3) LV_EDGE_VIM_1 = 1 and ERR_VIMPWM_1_FB = 0
          // switch without failure feedback
          Then(3) T_DIAG_VIMPWM_1_FB = T_DIAG_VIMPWM_1_FB +100ms
          // start feedback timer
          Else(3) T_DIAG_VIMPWM_1_FB = 0                // reset feedbacktimer
          Endif(3)
Endif(1)

If(4) T_DIAG_VIMPWM_1_FB >= C_T_DIAG_VIMPWM_1_FB // Timer limit (ca. 6 sek)
Then(4)  LV_EDGE_DIAG_VIM_1 = 1                       // Switch ready
          LV_EDGE_VIM_1 = 0                             // re-set switch-detection
Else(4)  LV_EDGE_DIAG_VIM_1 = 0
Endif(4)

If  LV_ERR_VIMPWM_1_FB = 0
Then  If LV_VIMPWM_1_FB_VLD = 1 (valid failure feedback information available)
          Then ERR_SYM_VIMPWM_1_FB = SYM_3
          LV_EDGE_VIM_1 = 0
          ABC_VIMPWM_1_FB = ABC_VIMPWM_1_FB
                               + C_ABC_INC_VIMPWM_1_FB
          If  ABC_VIMPWM_1_FB C_ABC_MAX_VIMPWM_1_FB
          Then LV_ERR_VIMPWM_1_FB = 1
          LV_END_DIAG_VIMPWM_1_FB = 1
          Endif
          Else If ERR_VIMPWM_1_FB = 0 (no failure feedback detected)
          Then ERR_SYM_VIMPWM_1_FB = 0
          If LV_EDGE_DIAG_VIM_1 = 1
          Then ABC_VIMPWM_1_FB = ABC_VIMPWM_1_FB
                               - C_ABC_DEC_VIMPWM_1_FB
          Endif
          If  T_ACT_VIMPWM_1_FB C_T_ACT_VIMPWM_1_FB
          Then LV_END_DIAG_VIMPWM_1_FB = 1
          Endif
          Endif
          Endif
Endif

```


The same calculations are done for all ...VIMPWM\_2...-outputs.

### Diagnostic symptoms:

Diagnostic	Symptom description	Symptom	Filter type
VIMPWM_1/2_ERR_FB			
failure feedback diagnosis of DISA control unit	see description	SYM_0	NO
		SYM_1	
		SYM_2	
		SYM_3	

# B - OBD II functions

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## B.1 Ambient air temperature plausibility diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TAM_CAN	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom TAM_CAN diagnosis					
ERR_SYM_TAM_PLAUS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom TAM_PLAUS					
LV_CDN_DIAG_TAM_CAN	V	0... 1H	0 ...1	1	-
Diagnosis condition TAM_CAN					
LV_CDN_DIAG_TAM_PLAUS	V	0... 1H	0 ...1	1	-
Diagnosis condition TAM_PLAUS					
LV_CDN_RBM_TAM_PLAUS	V	0... 1H	0 ...1	1	-
Diagnosis condition for RBM statistics TAM_PLAUS					
LV_CNL_DIAG_TAM_PLAUS	V	0... 1H	0 ...1	1	-
Irreversible stop of diagnosis TAM_PLAUS					
LV_DET_ERR_TAM_PLAUS	V	0... 1H	0 ...1	1	-
TAM-plaus error is detected but not validated					
LV_END_DIAG_TAM_CAN	V	0... 1H	0 ...1	1	-
End of Diagnosis cycle TAM_CAN					
LV_END_DIAG_TAM_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis cycle TAM_PLAUS					
LV_END_RBM_TAM_PLAUS	O/V	0... 1H	0 ...1	1	-
End of diagnosis cycle TAM_PLAUS for RBM statistics					
LV_ERR_TAM	O/V	0... 1H	0 ...1	1	-
Present failure on TIA sensor(s) which might affect temperature TAM					
LV_ERR_TAM_CAN	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on TAM sensor					
LV_ERR_TAM_PLAUS	O/V	0... 1H	0 ...1	1	-
TAM sensor signal is not plausible					
LV_VS_CDN_TAM_ERR	V	0... 1H	0 ...1	1	-
Bit information of status vehicle was driven with speed to validate the diagnosis result					
T_TAM_DIF_DIAG	V	0... FFH	0... 25.5	0.1	s
Timer for anti-bounce the temperature difference					
T_VS_MIN_VLD_TAM_ERR	V	0... FFFFH	0... 6553.5	0.1	s
Timer of vehicle speed period					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TAM_DIF_DIAG	V	0... FEH	0... 190.5	0.75	°C
TAM difference to detect a TAM error					
TAM_DIF_MAX_DIAG	V	0... FEH	-48... 142.5	0.75	°C
Maximum reached TAM in diagnosis cycle					
TAM_DIF_MIN_DIAG	V	0... FEH	-48... 142.5	0.75	°C
Minimum reached TAM in diagnosis cycle					
TAM_DIF_PLAUS	V	0... FEH	0... 190.5	0.75	°C
TAM difference to detect a moving signal					

**Input data:**

LV_DIAG_CDN_TAM_PLAUS {p. 5083}	LV_ERR_BN_T_ICL {p. 4870}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_COM_2_BOFF {p. 801}
LV_ERR_COM_2_TAM_ICL	LV_ERR_TOUT_ICL_3 {p. 802}	LV_ERR_TOUT_ICL_7 {p. 802}	LV_IGK {p. 906}
LV_INH_DIAG_TAM_PLAUS {p. 5083}	LV_ST_END {p. 1720}	LV_STATE_ERR_CAN_TOUT {p. 1567}	LV_TAM_CAN_ERR {p. 1567}
LV_VAR_TCO_2 {p. 656}	STATE_ERR_SYM_TAM_CAN {p. 1573}	T_AST {p. 1766}	T_ES_CUS {p. 1444}
TAM {p. 1579}	TAM_ST {p. 1214}	TAM_STOP {p. 1214}	TCO {p. 1100}
TCO_2 {p. 1218}	TCO_2_ST {p. 1218}	TCO_ST {p. 1100}	TIA {p. 1226}
VS {p. 1176}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TAM_CAN	-	0... FFH	0... 255	1	-
Anti-bounce increment TAM_CAN diagnosis					
C_ABC_MAX_TAM_CAN	-	1... FFH	1... 255	1	-
Anti-bounce maximum TAM_CAN diagnosis					
C_T_AST_MAX_TAM_DIAG	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time after start to deactivate the diagnosis condition					
C_T_ES_MIN_TAM_DIAG	-	0... FFFFH	0... 65535	1	min
Minimum engine stop time to activate the diagnosis condition					
C_T_TAM_DIF_MAX_ERR	-	0... FFH	0... 25.5	0.1	s
Anti bounce time to detect a TAM error					
C_T_VS_MIN_VLD_TAM_ERR	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time period of vehicle with speed					
C_TAM_DIF_MAX_ERR	-	0... FEH	0... 190.5	0.75	°C
Temperature difference to detect a TAM error					
C_TAM_DIF_PLAUS_MIN	-	0... FEH	0... 190.5	0.75	°C
Minimum TAM difference to detect a moving signal during engine run					
C_TAM_DIF_ST_END	-	0... FEH	0... 190.5	0.75	°C
Minimum TAM difference to detect a moving signal after start					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TAM_MAX_TAM_DIAG	-	0... FEH	-48... 142.5	0.75	°C
Maximum ambient temperature to activate the diagnosis condition					
C_TAM_MIN_TAM_DIAG	-	0... FEH	-48... 142.5	0.75	°C
Minimum ambient temperature to activate the diagnosis condition					
C_TCO_2_ST_MIN_TAM_DIAG	-	0... FEH	-48... 142.5	0.75	°C
Minimum exhaust engine cooling temperature to activate the diagnosis condition					
C_TCO_2_TIA_DIF_MAX	-	0... FEH	0... 190.5	0.75	°C
Maximum deviation between TCO_2 and TIA to start TAM_PLAUS diagnosis					
C_TCO_ST_MIN_TAM_DIAG	-	0... FEH	-48... 142.5	0.75	°C
Minimum engine cooling temperature to activate the diagnosis condition					
C_TCO_TIA_DIF_MAX	-	0... FEH	0... 190.5	0.75	°C
Maximum deviation between TCO and TIA to start TAM_PLAUS diagnosis					
C_VS_MIN_VLD_TAM_ERR	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed to count time period for error validation					

### B.1.1 Global TAM system error ( LV\_ERR\_TAM )

#### General information:

The global error flag LV\_ERR\_TAM can be used for inhibition. It is set if a CAN or a plausibility TIA error occurs.

#### Application conditions

**Initialisation:** *0 at reset*

**Recurrence:** *100ms*

**Activation:** *LV\_IGK = 1*

#### Formula section:

**If** LV\_ERR\_TAM\_CAN = 1 or LV\_ERR\_TAM\_PLAUS = 1

**Then** LV\_ERR\_TAM = 1

**Else** LV\_ERR\_TAM = 0

**Endif**

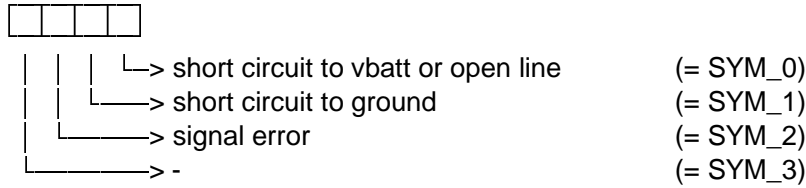
### B.1.2 CAN based TAM - signal diagnosis ( LV\_ERR\_TAM\_CAN )

#### General information:

The purpose of the diagnosis shall be to detect electrical faults as defined by OBD I requirements. The input signals are from CAN.

#### Description:

Error symptoms are defined for this diagnosis function as:



### Application conditions

**Initialization:** according ABC configuration **STD\_INI**  
*(ABC datas are initialized at transition LV\_IGK 0->1)*

**Recurrence:** 100 ms

**Activation:** LV\_IGK = 1

### Formula section:

```

LV_CDN_DIAG_TAM_CAN = 1
ERR_SYM_TAM_CAN = NO_SYM
If          LV_ERR_CAN_BOFF          = 0      and
              LV_ERR_COM_2_BOFF       = 0      and
              LV_ERR_TOUT_ICL_7       = 0      and
              LV_STATE_ERR_CAN_TOUT = 0      and
              STATE_ERR_SYM_TAM_CAN = SCP      // error symptom get from CAN
Then      ERR_SYM_TAM_CAN = SYM_0
Elseif   LV_ERR_CAN_BOFF          = 0      and
              LV_ERR_COM_2_BOFF       = 0      and
              LV_ERR_TOUT_ICL_7       = 0      and
              LV_STATE_ERR_CAN_TOUT = 0      and
              STATE_ERR_SYM_TAM_CAN = SCG      // error symptom get from CAN
Then      ERR_SYM_TAM_CAN = SYM_1
Elseif   LV_TAM_CAN_ERR           = 1      and
              LV_ERR_TOUT_ICL_3       = 0      and
              LV_ERR_BN_T_ICL         = 0      and
              LV_ERR_CAN_BOFF         = 0      and
              LV_ERR_COM_2_TAM_ICL    = 0      and
              LV_ERR_COM_2_BOFF       = 0
Then      ERR_SYM_TAM_CAN = SYM_2
Endif

```

Calculation of present error and end of diagnosis:

LV\_ERR\_TAM\_CAN and LV\_END\_DIAG\_TAM\_CAN are calculated by error management

### B.1.3 Ambient temperature sensor plausibility check ( LV\_ERR\_TAM\_PLAUS)

#### FUNCTION DESCRIPTION:

**General information:**

This diagnosis is performed in order to detect a sticking or not plausible TAM signal which cannot be detected by electrical range diagnosis.

**Description:****Diagnosis condition:**

The diagnosis should only be activated:

- after a long engine stop time, e.g. > 10h in order to get similar temperatures of TAM /TIA /TCO\_2 or TCO (depending on variant coding LV\_VAR\_TCO\_2)
- if TAM is in a "critical" range e.g. fade out temperature of other OBD2 diagnosis
- just after start to avoid warming-up effects, e.g. within 5 s
- not in cold environment, because it's not requested by law

If these conditions are not fulfilled the diagnosis is switched off if C\_T\_AST\_MAX\_TAM\_DIAG is elapsed after start.

**Error detection**

The TAM\_PLAUS error is detected if the temperature-difference TAM\_DIF\_DIAG is over the threshold C\_TAM\_DIF\_MAX\_ERR for the anti-bounce time C\_T\_TAM\_DIF\_MAX\_ERR.

**End of diagnosis cycle with positive result**

The positive diagnosis result is based on the monitoring of the alteration of TAM at and can be reached even if a error is detected or the validation phase is running.

- Just after start, comparing the start and stop temperature
- During warm up phase

If a alteration is detected the diagnosis is finished.

**Error validation**

The validation is only performed if all el. diagnosis for TIA /TCO\_2 or TCO and finished (LV\_DIAG\_CDN\_TAM\_PLAUS = 1) and the vehicle was driven with a certain vehicle speed ( C\_VS\_MIN\_VLD\_TAM\_ERR for C\_T\_VS\_MIN\_VLD\_TAM\_ERR ).

If both conditions are true and a error was detected then the error LV\_ERR\_TAM\_PLAUS is set for this driving cycle and the diagnosis is switched off.


**Application conditions**

**Initialisation:** 0 at LV\_IGK 0->1 **or** reset **or** at clearing error memory  
TAM\_DIF\_MAX / MIN\_DIAG = TAM\_ST  
at LV\_ST\_END = 1 **or** reset **or** at clearing error memory

**Recurrence:** 100ms

**Activation:** LV\_ST\_END = 1

**Deactivation:** LV\_END\_DIAG\_TAM\_PLAUS = 1 **or**  
LV\_INH\_DIAG\_TAM\_PLAUS = 1 **or**  
LV\_CNL\_DIAG\_TAM\_PLAUS = 1  
( set LV\_CDN\_DIAG\_TAM\_PLAUS = 0 at deactivation )

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**Formula section:**

Calculation of TAM\_DIF\_PLAUS to end the diagnosis

TAM\_DIF\_MAX\_DIAG = MAX [ TAM, TAM\_DIF\_MAX\_DIAG(n-1) ]

TAM\_DIF\_MIN\_DIAG = MIN [ TAM, TAM\_DIF\_MIN\_DIAG(n-1) ]

TAM\_DIF\_PLAUS = ABS (TAM\_DIF\_MAX\_DIAG - TAM\_DIF\_MIN\_DIAG)

If TAM\_DIF\_PLAUS > C\_TAM\_DIF\_PLAUS\_MIN or //e.g. 3°C  
ABS (TAM\_STOP - TAM\_ST) > C\_TAM\_DIF\_ST\_END //e.g. 5°C

Then LV\_CDN\_DIAG\_TAM\_PLAUS = 1  
LV\_END\_DIAG\_TAM\_PLAUS = 1

Endif

Calculation of diagnosis condition /error detection

If(1) T\_AST < C\_T\_AST\_MAX\_TAM\_DIAG and //e.g. 5s

LV\_DET\_ERR\_TAM\_PLAUS = 0

Then(1)

If(2) T\_ES\_CUS > C\_T\_ES\_MIN\_TAM\_DIAG and //e.g. >10h  
[ TAM > C\_TAM\_MAX\_TAM\_DIAG or //e.g. >35°C or <-10°C  
TAM < C\_TAM\_MIN\_TAM\_DIAG ]

Then(2) // conditions to calculate TAM\_DIF\_DIAG fulfilled

If(3) LV\_VAR\_TCO\_2 = 1

Then(3)

If(4)

TCO\_2\_ST > C\_TCO\_2\_ST\_MIN\_TAM\_DIAG and //e.g. > -7°C  
ABS[ TCO\_2 - TIA ] < C\_TCO\_2\_TIA\_DIF\_MAX and //e.g. < 10°C

Then(4)

LV\_CDN\_RBM\_TAM\_PLAUS = 1  
TAM\_DIF\_DIAG = ABS [ (TIA + TCO\_2) \* 0.5 - TAM ]

Else(4)

TAM\_DIF\_DIAG = TAM\_DIF\_DIAG //freeze

Endif(4)

Else(3)

If(4a)

TCO\_ST > C\_TCO\_ST\_MIN\_TAM\_DIAG and //e.g. > -7°C  
ABS[ TCO - TIA ] < C\_TCO\_TIA\_DIF\_MAX and //e.g. < 10°C

Then(4a)

LV\_CDN\_RBM\_TAM\_PLAUS = 1  
TAM\_DIF\_DIAG = ABS [ (TIA + TCO) \* 0.5 - TAM ]

Else(4a)

TAM\_DIF\_DIAG = TAM\_DIF\_DIAG //freeze

Endif(4a)

Endif(3)

Endif(2)

Else(1) If LV\_DET\_ERR\_TAM\_PLAUS = 0 and  
LV\_CDN\_RBM\_TAM\_PLAUS = 0

Then LV\_CNL\_DIAG\_TAM\_PLAUS = 1 //deactivation of diag-

nosis

Else stop diagnosis condition calculation, waiting for LV\_END\_DIAG\_TAM\_

PLAUS


Endif

Endif(1)

Calculation of debounce-timer for error detection

If TAM\_DIF\_DIAG > C\_TAM\_DIF\_MAX\_ERR

Then T\_TAM\_DIF\_DIAG ++

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```


If      T_TAM_DIF_DIAG > C_T_TAM_DIF_MAX_ERR      //e.g. 1s
Then    LV_DET_ERR_TAM_PLAUS = 1
Endif

Else    T_TAM_DIF_DIAG --
Endif

Calculation of minimum time period of vehicle with speed
If      VS > C_VS_MIN_VLD_TAM_ERR                  //e.g. 50km/h
Then    T_VS_MIN_VLD_TAM_ERR ++
          If      T_VS_MIN_VLD_TAM_ERR > C_T_VS_MIN_VLD_TAM_ERR
          Then    LV_VS_CDN_TAM_ERR = 1
          Endif
Else    T_VS_MIN_VLD_TAM_ERR = T_VS_MIN_VLD_TAM_ERR      //freeze
Endif

End of diagnosis cycle
If      LV_DIAG_CDN_TAM_PLAUS = 1      and      //TIA /TCO_2 or TCO signal
is valid
          LV_VS_CDN_TAM_ERR = 1          //Vehicle was driven
Then    LV_CDN_DIAG_TAM_PLAUS = 1
          ERR_SYM_TAM_PLAUS = NO_SYM
          LV_END_DIAG_TAM_PLAUS = 1
          LV_END_RBM_TAM_PLAUS = 1
          If      LV_DET_ERR_TAM_PLAUS = 1
          Then    ERR_SYM_TAM_PLAUS = SYM_3
                  LV_ERR_TAM_PLAUS = 1
          Endif
Endif

```

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## B.2 Ambient air temperature plausibility diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_CDN_TAM_PLAUS	O/V	0... 1H	0 ...1	1	-
Flag for status all TCO /TCO_2 diagnosis cycle are finished					
LV_INH_DIAG_TAM_PLAUS	O/V	0... 1H	0 ...1	1	-
Inhibition of TAM plaus diagnosis due to present error					
STATE_RBM_TAM_PLAUS	O/V	0... 7H	0 ...7	1	-
Interface of TAM_PLAUS monitor with the Rate-Based Monitoring statisticsBit 0: conditions for monitoring are met long enough to detect malfunction (bit 0 = 1)Bit 1: inhibition of the monitor because of system failure(s) (bit 1 = 1)Bit 2: individual RBM co					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_CDN_CST_RBM {p. 5870}	LV_DC {p. 5746}	LV_END_DIAG_TCO_2_EL {p. 4572}
LV_END_DIAG_TCO_2_GRD {p. 4572}	LV_END_DIAG_TCO_EL {p. 4496}	LV_END_DIAG_TCO_GRD {p. 4496}	LV_END_DIAG_TIA_EL {p. 4194}
LV_END_RBM_TAM_PLAUS {p. 5076}	LV_ERR_BN_T_ICL {p. 4870}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_COM_2_BOFF {p. 801}
LV_ERR_COM_2_T_ICL {p. 801}	LV_ERR_COM_2_TAM_ICL	LV_ERR_T_ES {p. 4466}	LV_ERR_TAM_CAN {p. 5076}
LV_ERR_TCO {p. 4496}	LV_ERR_TIA {p. 4200}	LV_ERR_VS {p. 5021}	LV_IGK {p. 906}
LV_ST_END {p. 1720}	LV_VAR_TCO_2 {p. 656}	NC_IDX_DIAG_BN_T_ICL	NC_IDX_DIAG_CAN_BOFF
NC_IDX_DIAG_COM_2_BOFF	NC_IDX_DIAG_COM_2_T_ICL	NC_IDX_DIAG_COM_2_TAM_ICL	NC_IDX_DIAG_T_ES
NC_IDX_DIAG_TAM_CAN	NC_IDX_DIAG_TCO_EL	NC_IDX_DIAG_TCO_GRD	NC_IDX_DIAG_TCO_PLAUS
NC_IDX_DIAG_TCO_STUCK	NC_IDX_DIAG_TCO_STUCK_RNG	NC_IDX_DIAG_TIA_EL	NC_IDX_DIAG_TIA_GRD
NC_IDX_DIAG_TIA_PLAUS	NC_IDX_DIAG_VS {p. 5024}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_INH_DIAG_TAM_PLAUS	-	0... 1H	0 ...1	1	-
Switch to shut off the TAM plaus diagnosis (=1)					

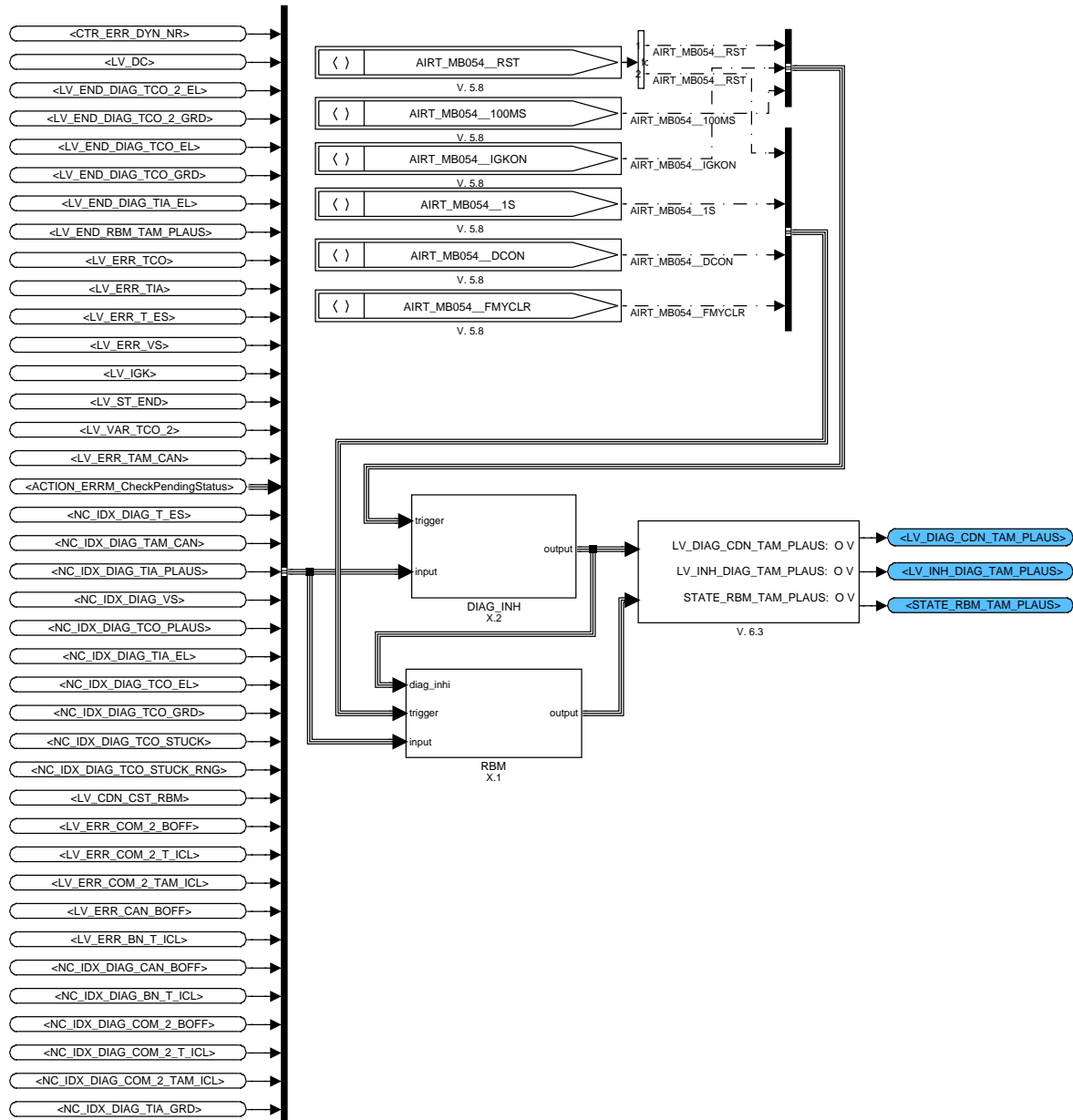
### Import actions:

Continued on next page
------------------------

**ACTION\_ERRM\_CheckPendingStatus (IN<PRM\_IDX\_DIAG>,OUT<PRM\_LV\_ERR\_PND>)**

**General information:**


**Signal flow diagram:**



SDA\_SRS / SDA V 6.0.3 / 15-Feb-2010

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Figure B.2.1: :

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## B.2.1 Interface for Rate - Based - Monitoring

### General information:

General information:

With this module the interface between the TAM\_PLAUS monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_TAM\_PLAUS data.

Within STATE\_RBM\_TAM\_PLAUS, three different information are defined:

Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)

Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

### Application conditions:

<i>Initialisation:</i>	RST
<i>Recurrence:</i>	DCON, FMYCLR, 1S
<i>Activation:</i>	always
<i>Deactivation:</i>	never

### Function description:

### Formula section:

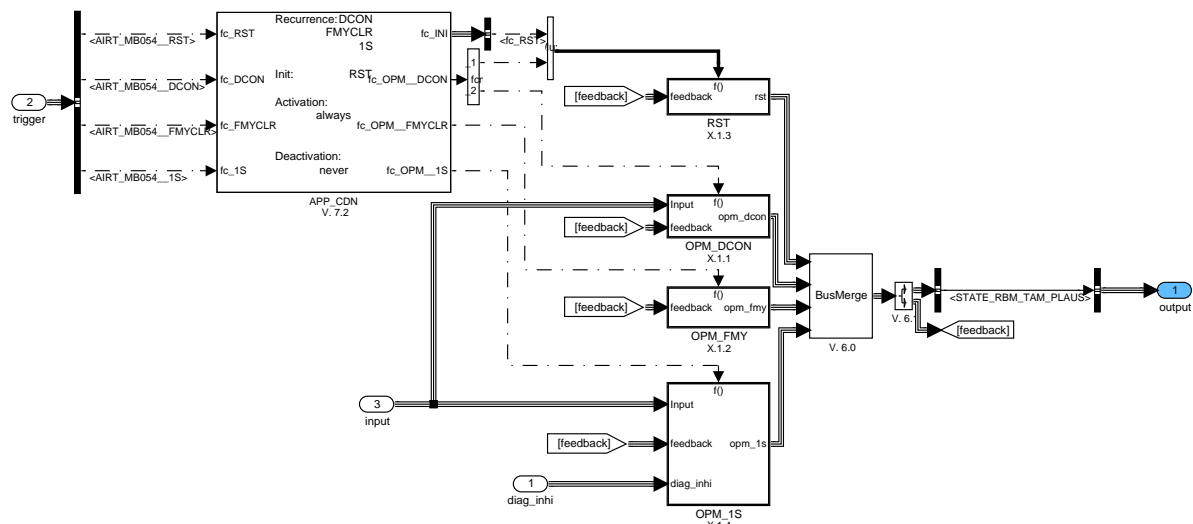


Figure B.2.2: :

### B.2.1.1 Formula Section for SYSTEM EVENT DCON

#### B.2.1.1.1 If\_Then

All the calculation within formula section will be done when this block is triggered. The pending status check function will be called if CTR\_ERR\_DYN\_NR is greater than zero.

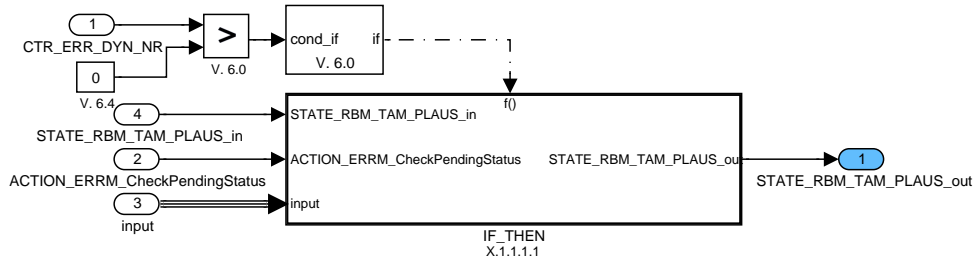


Figure B.2.3: :

**B.2.1.1.1.1 IF\_THEN/IF\_THEN**

**B.2.1.1.1.1.1 Bit 1\_Reset**

If the failure is present bit 1 of STATE\_RBM\_TAM\_PLAUS is reset to zero.

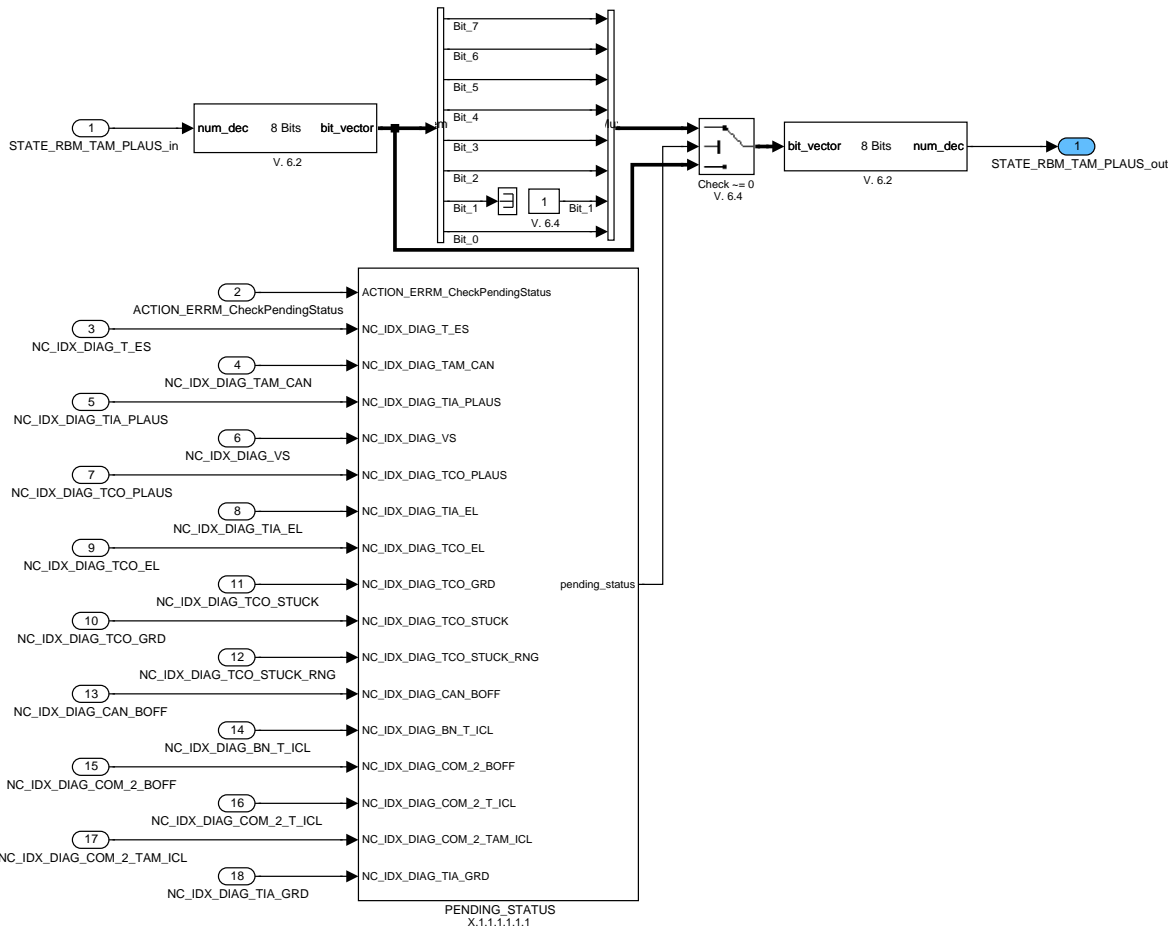


Figure B.2.4: :

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### B.2.1.1.1.1.1 Pending\_Status Check

This API shall be used to verify if a failure stored in the dynamic memory has the pending status or not. When it is impossible to determine if the fault is pending or not (failure not store because the dynamic memory is full), this failure should be considered as pending anyway.

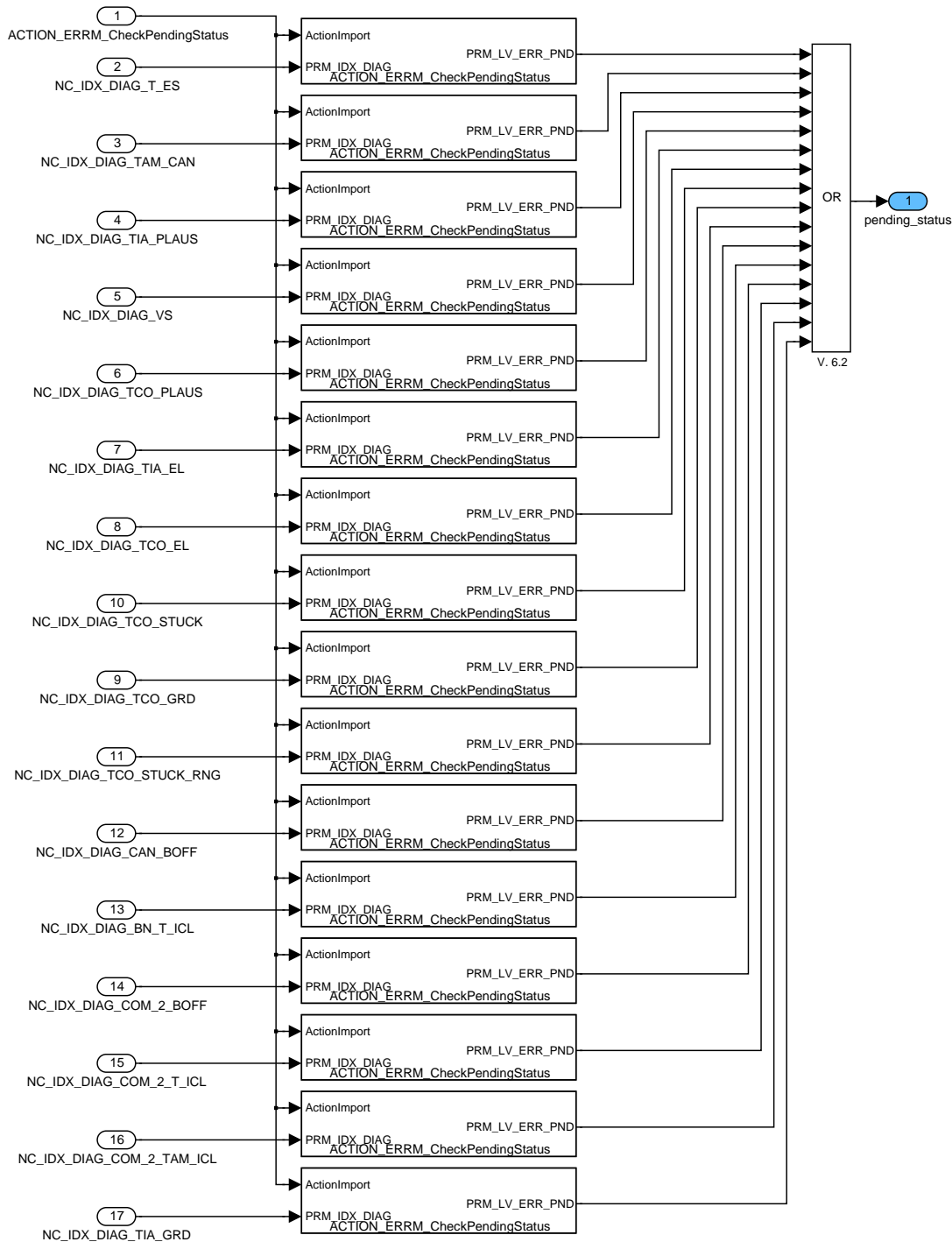


Figure B.2.5: :

### B.2.1.2 Reset at FMY\_CLR EVENT

On failure memory reset the bit 1 of STATE\_RBM\_TAM\_PLAUS.

f()

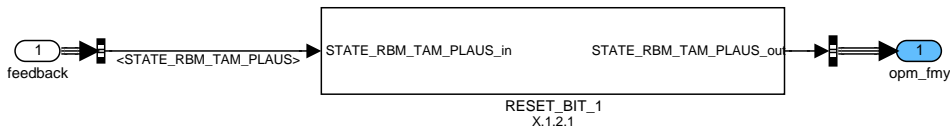


Figure B.2.6: :

**B.2.1.2.1 Reset of Bit-1**

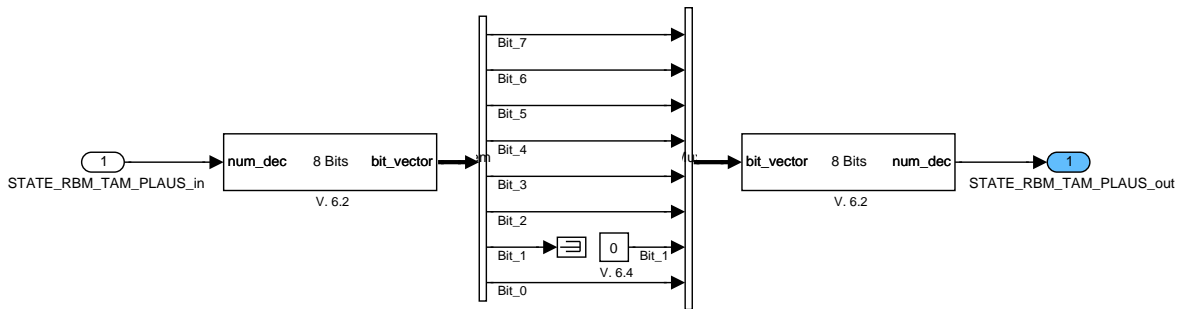


Figure B.2.7: :

**B.2.1.3 Initialization at DCON**

At 0->1 transition of LV\_DC, the bit 0, bit 1 and bit 2 of STATE\_RBM\_TAM\_PLAUS are reset to zero.

f()

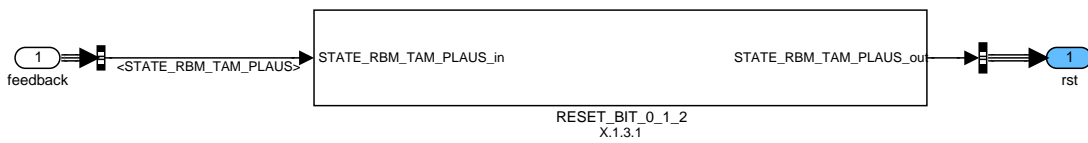


Figure B.2.8: :

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### B.2.1.3.1 Reset of Bit-0,1,2

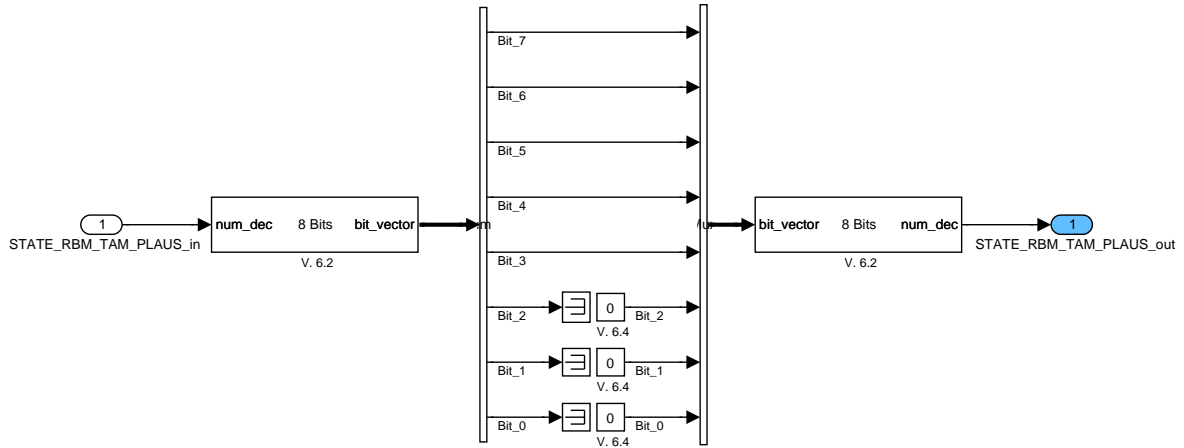


Figure B.2.9: :

### B.2.1.4 Formula Section for SYSTEM EVENT 1S

#### B.2.1.4.1 Calculation at DC on

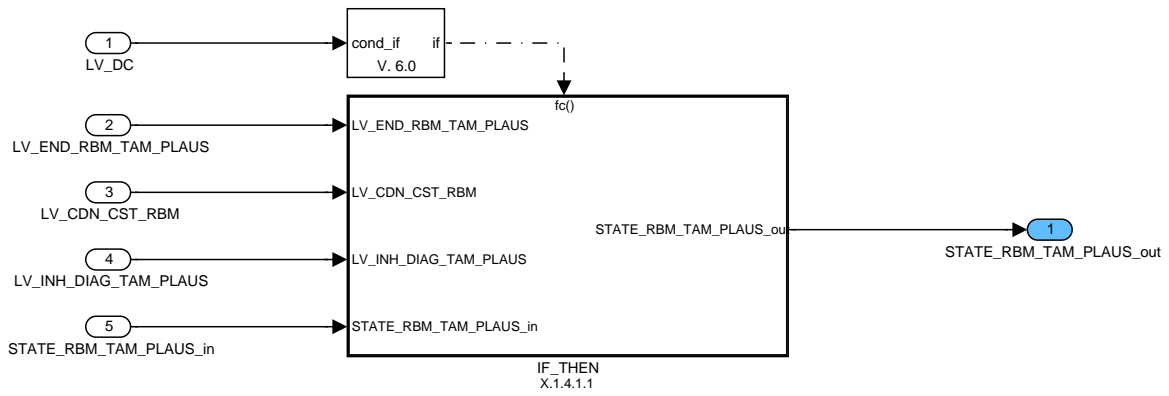


Figure B.2.10: :

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**B.2.1.4.1.1 Calculation of Bit-0,1,2**

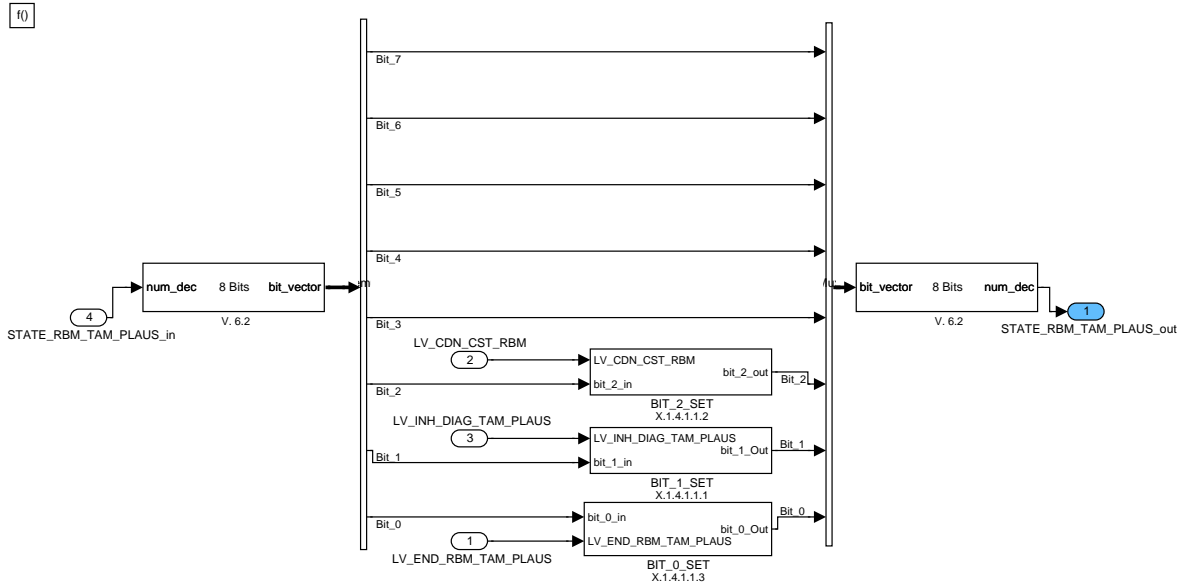


Figure B.2.11: :

**B.2.1.4.1.1.1 Bit-1 set**

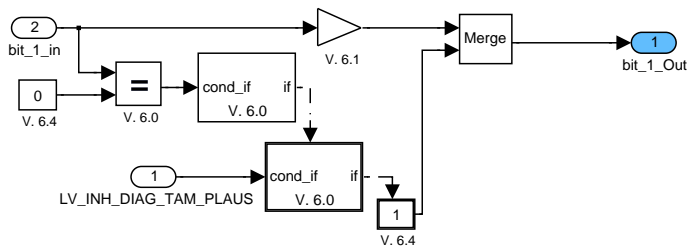


Figure B.2.12: :

**B.2.1.4.1.1.2 Bit-2 set**

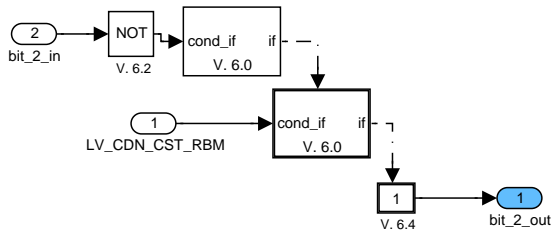


Figure B.2.13: :

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### B.2.1.4.1.1.3 Bit-0 set

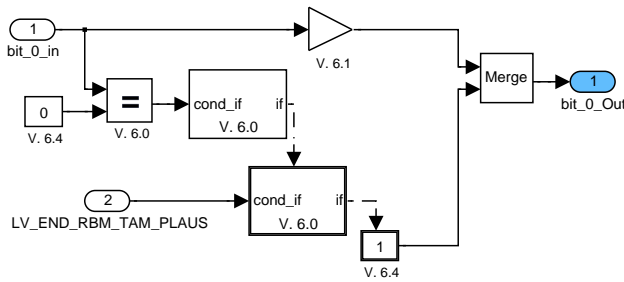


Figure B.2.14: :

## B.2.2 Inhibition of diagnosis

### General information:

### Application conditions:

*Initialisation:* RST, IGKON  
*Recurrence:* 100MS  
*Activation:* LV\_ST\_END && !LV\_INH\_DIAG\_TAM\_PLAUS  
*Deactivation:* never

### Function description:

### Formula section:

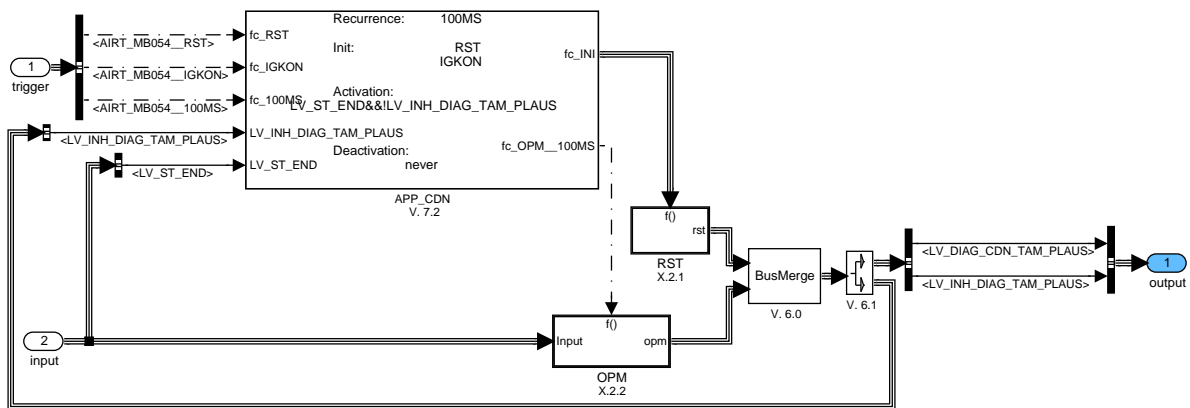



Figure B.2.15: :

### B.2.2.1 Initialization

The output variables are reset to zero.

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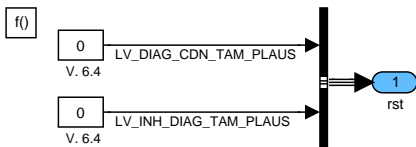


Figure B.2.16: :

### B.2.2.2 Formula Section

#### B.2.2.2.1 Calculation

All the calculation within formula section will be done when this block is triggered. The output variables will be set to one if the respective conditions are true.

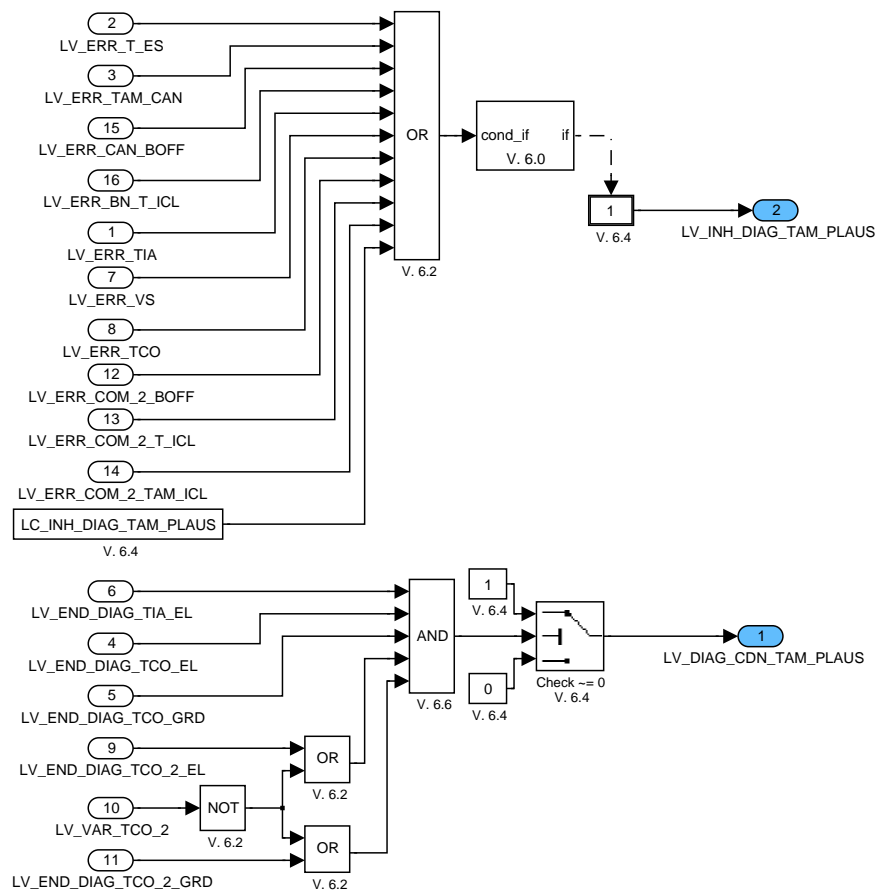


Figure B.2.17: :

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## B.3 Intake air temperature plausibility diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_IS_CDN_TIA_PLAUS	V	0... FFH	0... 255	1	-
Cycle counter for T_IS condition					
ERR_SYM_TIA_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom TIA_PLAUS					
LV_CDN_DIAG_TIA_PLAUS	V	0... 1H	0 ...1	1	-
Diagnosis condition TIA_PLAUS					
LV_DIF_CDN_TIA_PLAUS_DIAG	V	0... 1H	0 ...1	1	-
Flag indicating that TIA signal was moving					
LV_END_DIAG_TIA_PLAUS	O/V	0... 1H	0 ...1	1	-
End of diagnosis cycle TIA_PLAUS					
LV_ERR_TIA_PLAUS	O/V	0... 1H	0 ...1	1	-
temperature air sensor plausibility error					
LV_IS_CDN_TIA_PLAUS_DIAG	V	0... 1H	0 ...1	1	-
Flag indicating that vehicle idle condition is reached					
LV_LOAD_IS_CDN_TIA_PLAUS	V	0... 1H	0 ...1	1	-
Flag indicating that vehicle was driven with high load to enter in idle condition					
LV_VS_CDN_TIA_PLAUS_DIAG	V	0... 1H	0 ...1	1	-
Flag indicating that vehicle speed condition is reached					
T_IS_TIA_PLAUS_DIAG	V	0... FFFFH	0... 32767.5	0.5	s
Time period - vehicle is driven in Idle					
T_LOAD_IS_CDN_TIA_PLAUS	V	0... FFFFH	0... 32767.5	0.5	s
Time period - vehicle is driven with high load					
T_VS_TIA_PLAUS_DIAG	V	0... FFFFH	0... 32767.5	0.5	s
Time period - vehicle is driven with certain speed					
TIA_DIF_DIAG	V	0... FEH	0... 190.5	0.75	°C
Difference between TIA and TIA_ST					
TIA_DIF_MAX_DIAG	V	0... FEH	-48... 142.5	0.75	°C
Maximum reached TIA					
TIA_DIF_MIN_DIAG	V	0... FEH	-48... 142.5	0.75	°C
Minimum reached TIA					
TIA_PLAUS_MAX_DIAG	V	0... FEH	-48... 142.5	0.75	°C
Maximum expected TIA					
TIA_PLAUS_MIN_DIAG	V	0... FEH	-48... 142.5	0.75	°C
Minimum expected TIA					

### Input data:

LV_END_DIAG_TIA_EL {p. 4194}	LV_IGK {p. 906}	LV_INH_DIAG_TIA_PLAUS {p. 5103}	LV_IS {p. 1720}
MAF {p. 8277}	NC_IDX_DIAG_TIA_PLAUS	T_AST_DIAG {p. 1766}	TAM {p. 1579}

TAM_ST {p. 1214}	TCO {p. 1100}	TIA_MES {p. 1226}	VS {p. 1176}
------------------	---------------	-------------------	--------------

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TIA_PLAUS	-	0... FFH	0... 255	1	-
Anti bounce increment TIA_PLAUS diagnosis					
C_ABC_MAX_TIA_PLAUS	-	1... FFH	1... 255	1	-
Anti bounce maximum TIA_PLAUS diagnosis					
C_CTR_IS_CDN_TIA_PLAUS	-	0... FFH	0... 255	1	-
Number of valid IS conditions cycles					
C_MAF_MIN_INT_CDN_TIA_PLAUS	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Threshold MAF to enable MAF_CYL integral					
C_T_LOAD_IS_CDN_TIA_PLAUS	-	0... FFFFH	0... 32767.5	0.5	s
Threshold for load timer to enter IS condition					
C_T_VS_MIN_TIA_PLAUS_DIAG	-	0... FFFFH	0... 32767.5	0.5	s
Minimum time period with a certain vehicle speed to expect a moving TIA signal					
C_TAM_MAX_TIA_PLAUS_DIAG	-	0... FEH	-48... 142.5	0.75	°C
Maximum ambient temperture to activate the diagnosis condition					
C_TAM_MIN_TIA_PLAUS_DIAG	-	0... FEH	-48... 142.5	0.75	°C
Minimum ambient temperture to activate the diagnosis condition					
C_TCO_MIN_IS_CDN_TIA_PLAUS	-	0... FEH	-48... 142.5	0.75	°C
TIA offset to MAX/MIN range to detect a error					
C_TIA_DIF_DIAG	-	0... FEH	0... 190.5	0.75	°C
Minimum temperature difference to detect a non-stucking TIA signal					
C_TIA_PLAUS_DIF_ERR	-	0... FEH	0... 190.5	0.75	°C
TIA offset to MAX/MIN range to detect a error					
C_VS_MAX_IS_CDN_TIA_PLAUS	-	0... FFH	0... 255	1	km/h
Maximum VS for valid IS condition					
C_VS_MIN_TIA_PLAUS_DIAG	-	0... FFH	0... 255	1	km/h
Minimum VS for valid VS conditon cycle					
ID_T_IS_MIN_TIA_PLAUS_DIAG	-	0... FFFFH	0... 32767.5	0.5	s
LDP_TAM_TIA_PLAUS_DIAG	4	0... FEH	-48... 142.5	0.75	°C
Minimum time period in IDLE to expect a moving TIA signal					

**Import actions:**

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>,OUT<LV_END_DIAG>)

**General information:**

## General information:

This diagnosis is performed in order to detect a sticking or not plausible TIA\_MESsignal which cannot be detected by electrical range diagnosis.

## Description:

The diagnosis can be inhibited in cold conditions ( If TAM\_ST <= C\_TAM\_MIN\_TIA\_PLAUS\_DIAG ).

The error detection is based on two different diagnosis:

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**Plausible range detection:**

The plausible TIA\_MES must be between TCO and TAM. If TIA\_MES is outside of the range plus offset the error symptom MAX/MIN is set and the error is debounced.

**Sticking signal:**

If the vehicle was driven with a certain vehicle speed for a calibratable time (cool down of hot TIA\_MES) or vehicle was in IDLE for a calibratable time and cycles (hot up of cold TIA\_MES) and the TIA\_MES signal was not moving then a sticking TIA\_MES signal is detected and the error is debounced.

Error symptoms are defined for this diagnosis function as:

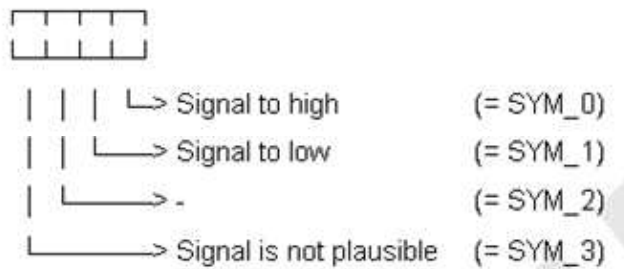


Figure B.3.1: :

**Application conditions:**

*Initialisation:* RST, IGKON, DCON, CLRFRMY, Deactivation  
*Recurrence:* 500MS  
*Activation:* LV\_DIAG\_ACT\_tmp  
*Deactivation:* if activation not true

**Function description:****Formula section:**

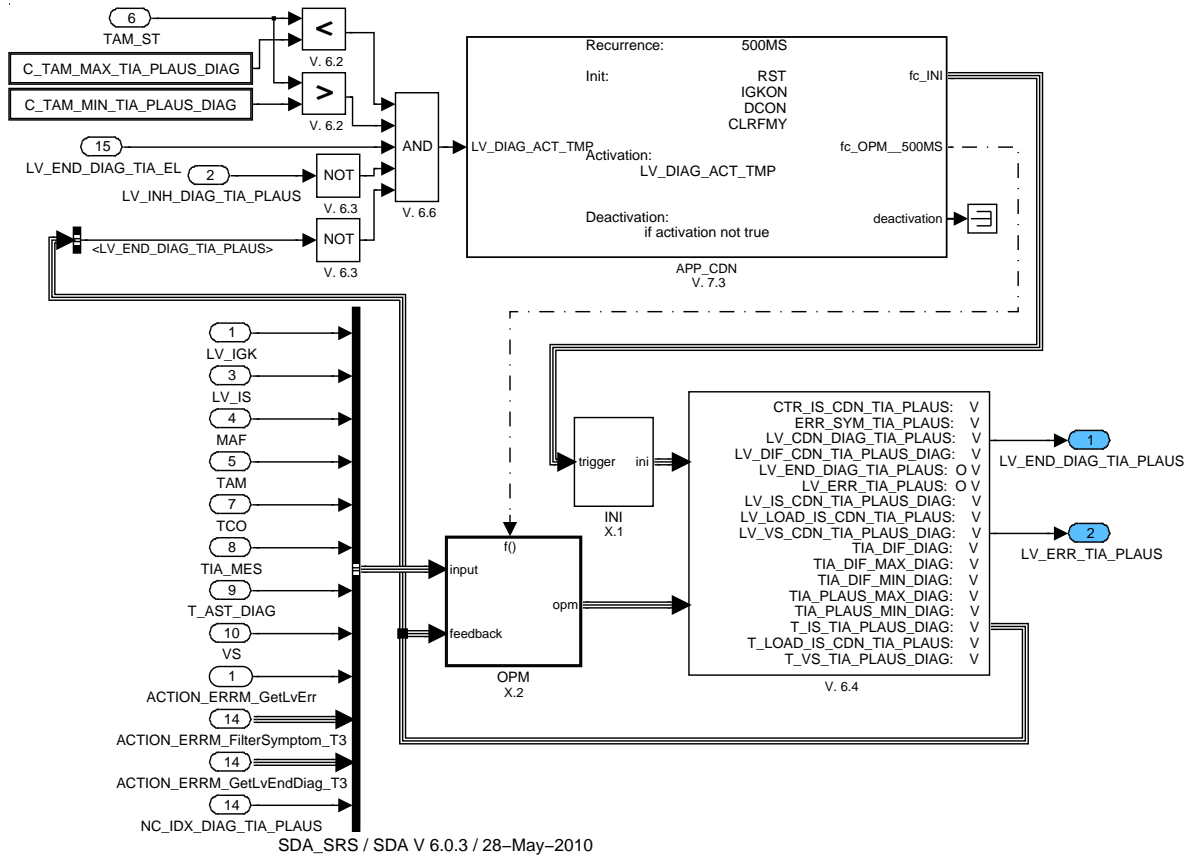


Figure B.3.2: :

### B.3.1 Initialisations

#### B.3.1.1 Initialisation at DCON or Reset or Clearing-Error-Memory

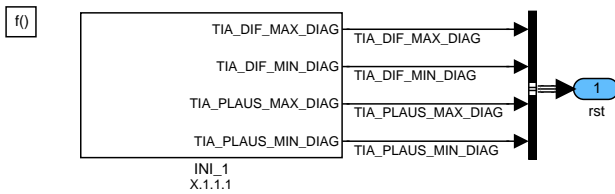


Figure B.3.3: :

#### B.3.1.1.1 Initialisation

Initialisation of TIA\_DIF\_MAX/MIN\_DIAG and TIA\_PLAUS\_MAX/MIN\_DIAG.

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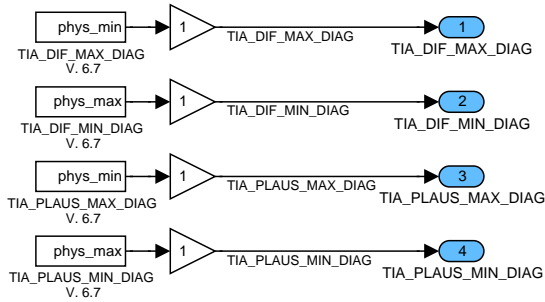


Figure B.3.4: :

### B.3.1.2 Initialisation at IGKON or Reset or Clearing-Error-Memory

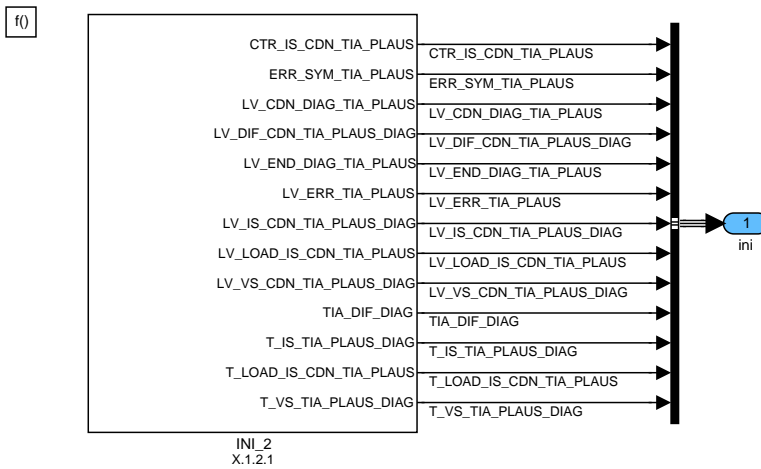


Figure B.3.5: :

#### B.3.1.2.1 Initialisation

All variables except TIA\_DIF\_MAX/MIN\_DIAG and TIA\_PLAUS\_MAX/MIN\_DIAG are initialised

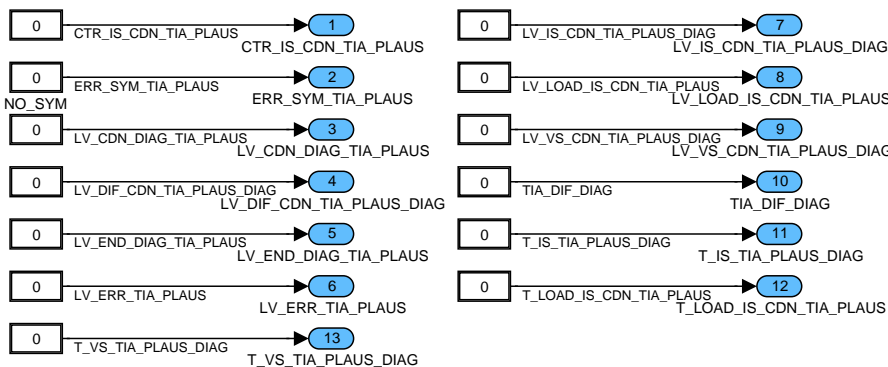


Figure B.3.6: :

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### B.3.1.3 Resetting the value of LV\_CDN\_DIAG\_TIA\_PLAUS at deactivation

LV\_CDN\_DIAG\_TIA\_PLAUS value is set to 0 when Inhibition bit or LV\_END\_DIAG\_TIA\_PLAUS bit goes low.

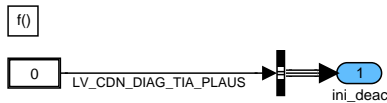


Figure B.3.7: :

## B.3.2 Formula section

### B.3.2.1 Calculation of TIA\_PLAUS\_MAX/MIN\_DIAG and TIA\_DIF\_MAX/MIN\_DIAG

#### B.3.2.1.1 Calculation

Calculation of TIA\_PLAUS\_MAX/MIN\_DIAG and TIA\_DIF\_MAX/MIN\_DIAG from the inputs TIA, TAM and TCO and past value of TIA\_PLAUS\_MAX/MIN\_DIAG and TIA\_DIF\_MAX/MIN\_DIAG.

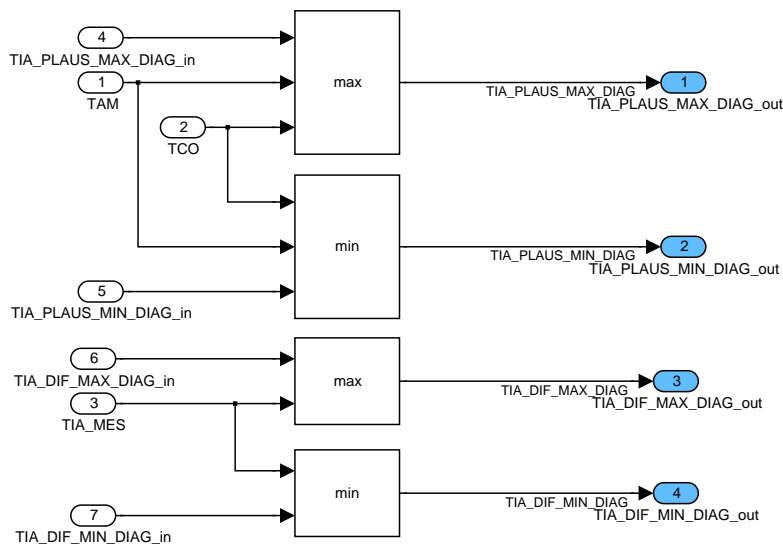


Figure B.3.8: :

### B.3.2.2 Calculation of TIA\_DIF\_DIAG

#### B.3.2.2.1 Calculation of the TIA\_DIF\_DIAG for sticking detection

Calculation of the TIA\_DIF\_DIAG for sticking detection. If TIA\_DIF\_DIAG is greater than C\_TIA\_DIF\_DIAG (e.g. 3°C) LV\_DIF\_CDN\_TIA\_PLAUS\_DIAG is set to 1 (set irreversible)

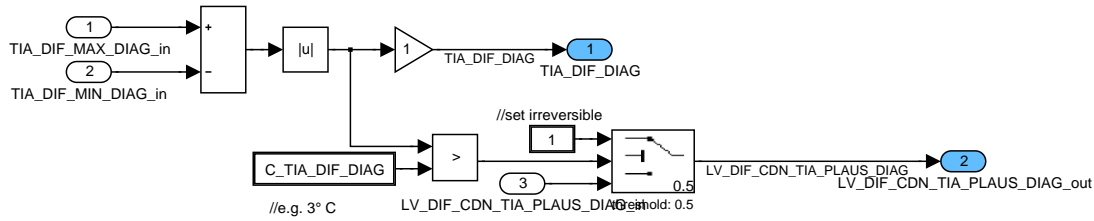


Figure B.3.9: :

### B.3.2.3 Calculation at vehicle speed (VS)

#### B.3.2.3.1 Calculation of time period when vehicle is moving (Vehicle with speed)

When VS is greater than C\_VS\_MIN\_TIA\_PLAUS\_DIAG (e.g. 40km/h) then timer (T\_VS\_TIA\_PLAUS\_DIAG) starts incrementing and if T\_VS\_CDN\_TIA\_PLAUS\_DIAG is greater than threshold for load timer ,C\_T\_VS\_MIN\_TIA\_PLAUS\_DIAG (e.g. 180 s) then LV\_VS\_CDN\_TIA\_PLAUS\_DIAG is set to 1(set irreversible). If VS is less than minimum VS then timer is reset.

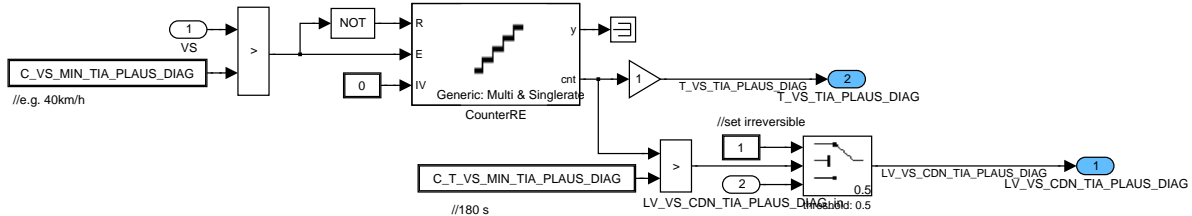


Figure B.3.10: :

### B.3.2.4 Calculation at idle speed condition

#### B.3.2.4.1 Calculation of load timer to enter in idle speed condition

If MAF is greater than C\_MAF\_MIN\_INT\_CDN\_TIA\_PLAUS (e.g. 200 mg/stk), time period of the vehicle driven with high load (T\_LOAD\_IS\_CDN\_TIA\_PLAUS) and flag indication that vehicle was driven with high load to enter in idle condition (LV\_LOAD\_IS\_CDN\_TIA\_PLAUS) is calculated.

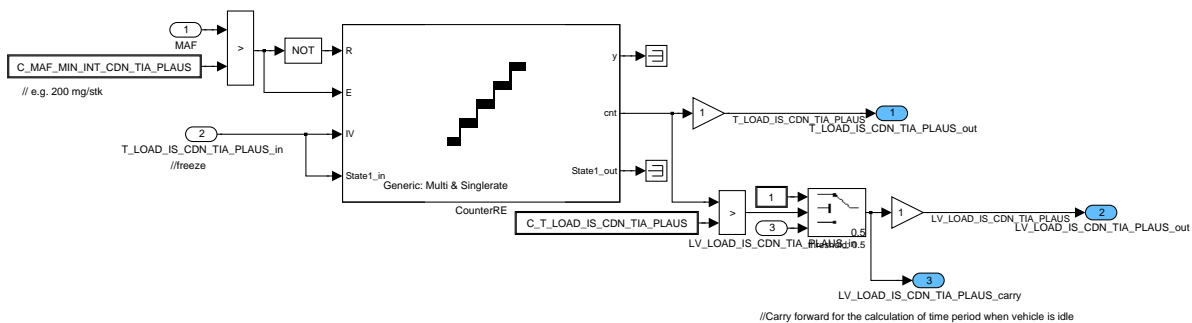



Figure B.3.11: :

### B.3.2.5 Calculation at vehicle idle

#### B.3.2.5.1 Condition check for LV\_VS\_CDN\_TIA\_PLAUS\_DIAG

Calculation starts when LV\_VS\_CDN\_TIA\_PLAUS\_DIAG is 1.

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	Document key 10171571 SPE 000 AO	Pages Page 5099 of 8404	
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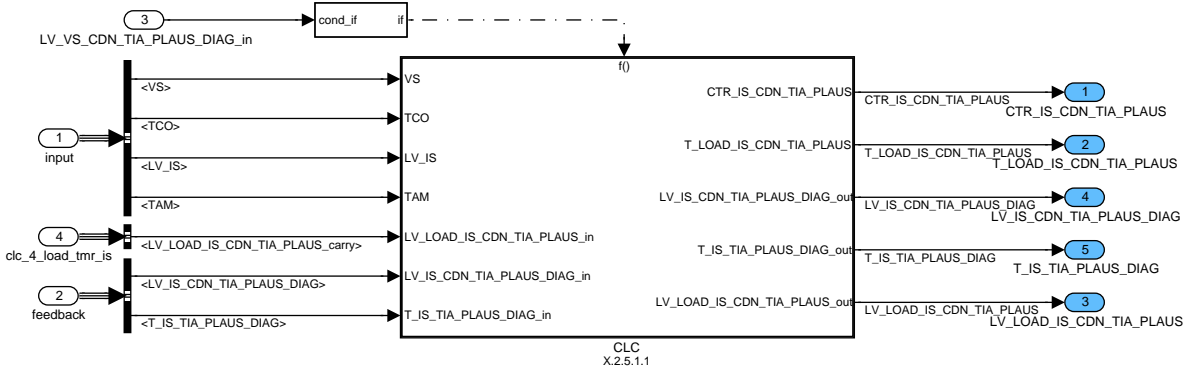


Figure B.3.12: :

**B.3.2.5.1.1 Condition check and Calculation of T\_IS\_TIA\_PLAUS\_DIAG**

If LV\_IS is true and VS is greater than maximum VS, C\_VS\_MAX\_IS\_CDN\_TIA\_PLAUS (e.g. 3km/h) and coolant temperature is greater than TIA offset to detect error, C\_TCO\_MIN\_IS\_CDN\_TIA\_PLAUS (e.g. 85 C) and LV\_LOAD\_IS\_CDN\_TIA\_PLAUS is true, then timer, T\_IS\_TIA\_PLAUS\_DIAG increment else resets. If the timer value exceeds the threshold value evaluated from ID map (e.g. 20s), then also the timer resets.

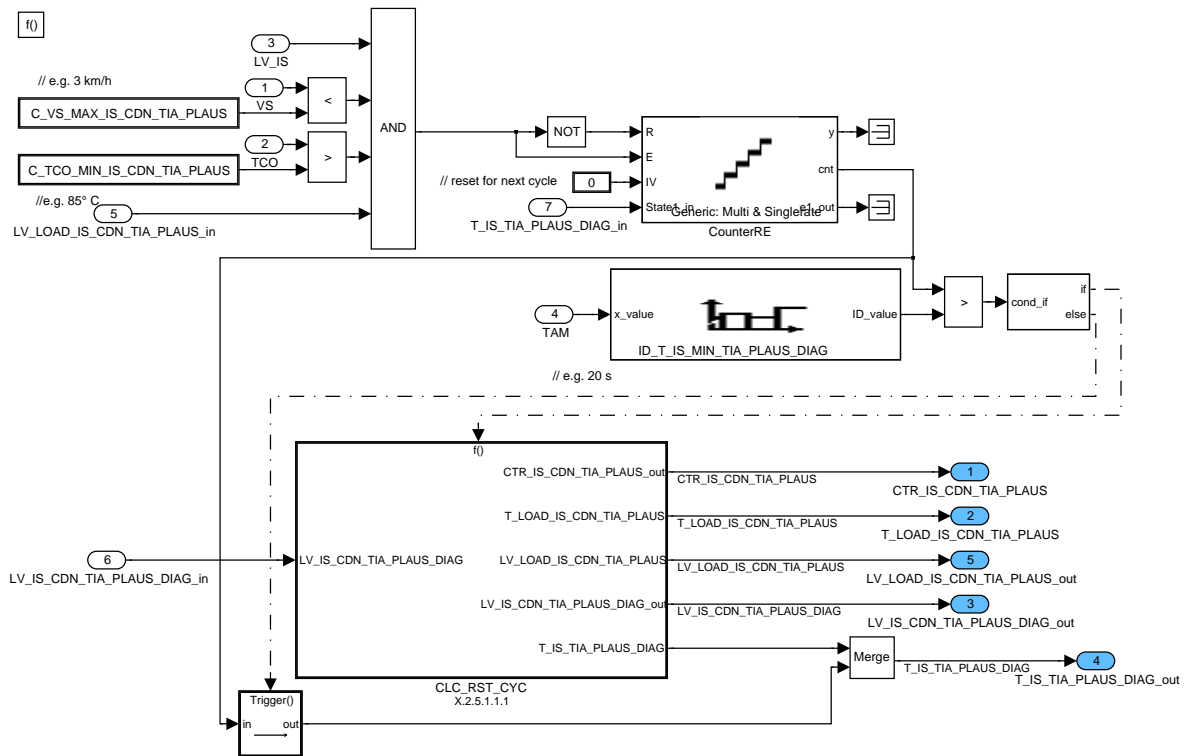


Figure B.3.13: :

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### B.3.2.5.1.1.1 Calculation of reset for next cycle

T\_IS\_TIA\_PLAUS\_DIAG, T\_LOAD\_IS\_CDN\_TIA\_PLAUS, LV\_LOAD\_IS\_CDN\_TIA\_PLAUS are reset to 0. If the incremented value of cycle counter for T\_IS condition (CTR\_IS\_CDN\_TIA\_PLAUS) is greater than number of valid IS condition cycles (C\_CTR\_IS\_CDN\_TIA\_PLAUS) then LV\_IS\_CDN\_TIA\_PLAUS\_DIAG is set to 1(set irreversible).

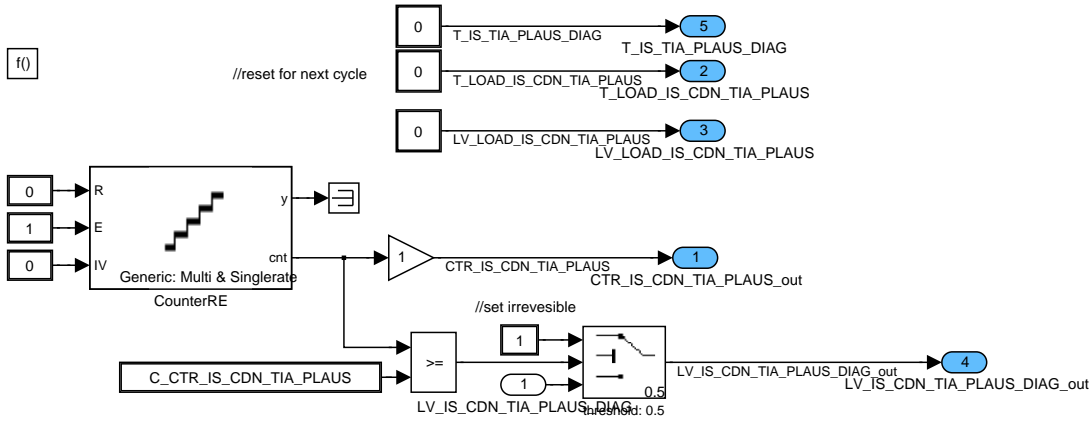


Figure B.3.14: :

### B.3.2.6 ERRM diagnosis and interface

#### B.3.2.6.1 ERRM diagnosis

Signal to high, signal to low and signal is not plausible error symptoms are calculated here.

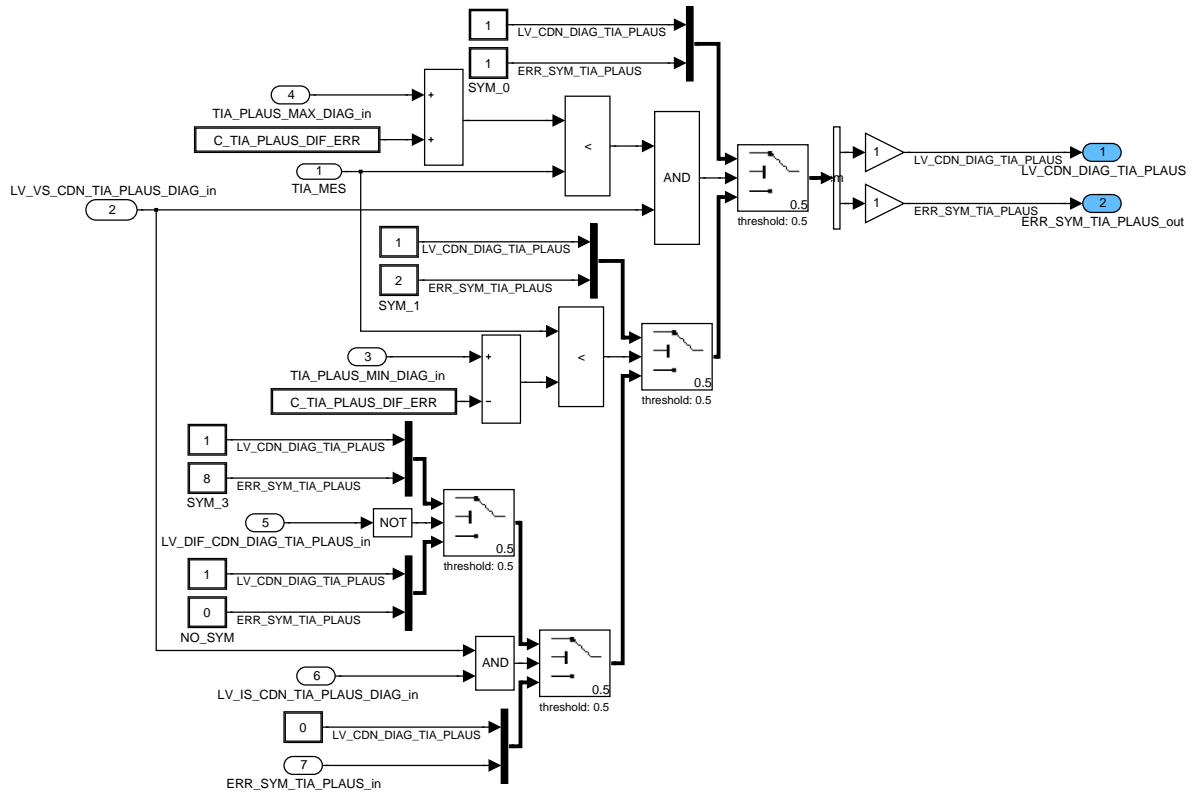


Figure B.3.15: :

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### B.3.2.6.2 ERRM interface

LV\_ERR\_TIA\_PLAUS and LV\_END\_DIAG\_TIA\_PLAUS are calculated.

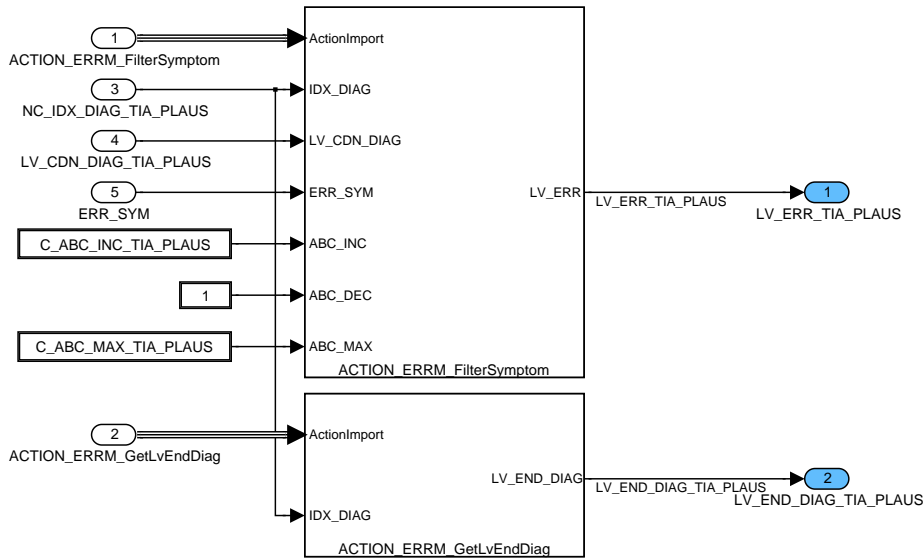


Figure B.3.16: :

### B.3.2.7 Visual mode outputs

LV\_CDN\_DIAG\_TIA\_PLAUS and ERR\_SYM\_TIA\_PLAUS are calculated.

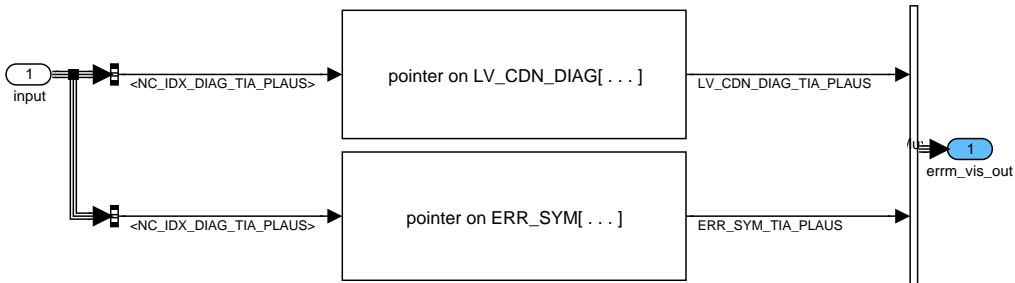


Figure B.3.17: :

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## B.4 Intake air temperature plausibility diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_TIA_PLAUS	O/V	0... 1H	0 ...1	1	-
Inhibition of TIA PLAUS diagnosis					
STATE_RBM_TIA_PLAUS	O/V	0... 7H	0 ...7	1	-
Interface of TIA_PLAUS monitor with the Rate-Based Monitoring statistics Bit 0: conditions for monitoring are met long enough to detect malfunction (bit 0 = 1) Bit 1: inhibition of the monitor because of system failure(s) (bit 1 = 1) Bit 2: individual RBM co					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_CDN_CST_RBM {p. 5870}	LV_DC {p. 5746}	LV_END_DIAG_TIA_PLAUS {p. 5093}
LV_ERR_BN_T_ICL {p. 4870}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_COM_2_BOFF {p. 801}	LV_ERR_COM_2_TAM_ICL
LV_ERR_TAM_CAN {p. 5076}	LV_ERR_TAM_PLAUS {p. 5076}	LV_ERR_TCO_EL {p. 4496}	LV_ERR_TCO_GRD {p. 4496}
LV_ERR_TCO_PLAUS {p. 5682}	LV_ERR_TCO_STUCK {p. 5691}	LV_ERR_TCO_STUCK_RNG {p. 5675}	LV_ERR_TIA {p. 4200}
LV_ERR_VS {p. 5021}	LV_IGK {p. 906}	LV_ST_END {p. 1720}	NC_IDX_DIAG_BN_T_ICL
NC_IDX_DIAG_CAN_BOFF	NC_IDX_DIAG_COM_2_BOFF	NC_IDX_DIAG_COM_2_TAM_ICL	NC_IDX_DIAG_TAM_CAN
NC_IDX_DIAG_TAM_PLAUS	NC_IDX_DIAG_TCO_EL	NC_IDX_DIAG_TCO_GRD	NC_IDX_DIAG_TCO_PLAUS
NC_IDX_DIAG_TCO_STUCK	NC_IDX_DIAG_TCO_STUCK_RNG	NC_IDX_DIAG_TIA_EL	NC_IDX_DIAG_TIA_GRD
NC_IDX_DIAG_VS {p. 5024}			

### Import actions:

<b>ACTION_ERRM_CheckPendingStatus (IN&lt;PRM_IDX_DIAG&gt;,OUT&lt;PRM_LV_ERR_PND&gt;)</b>
--

### Overview

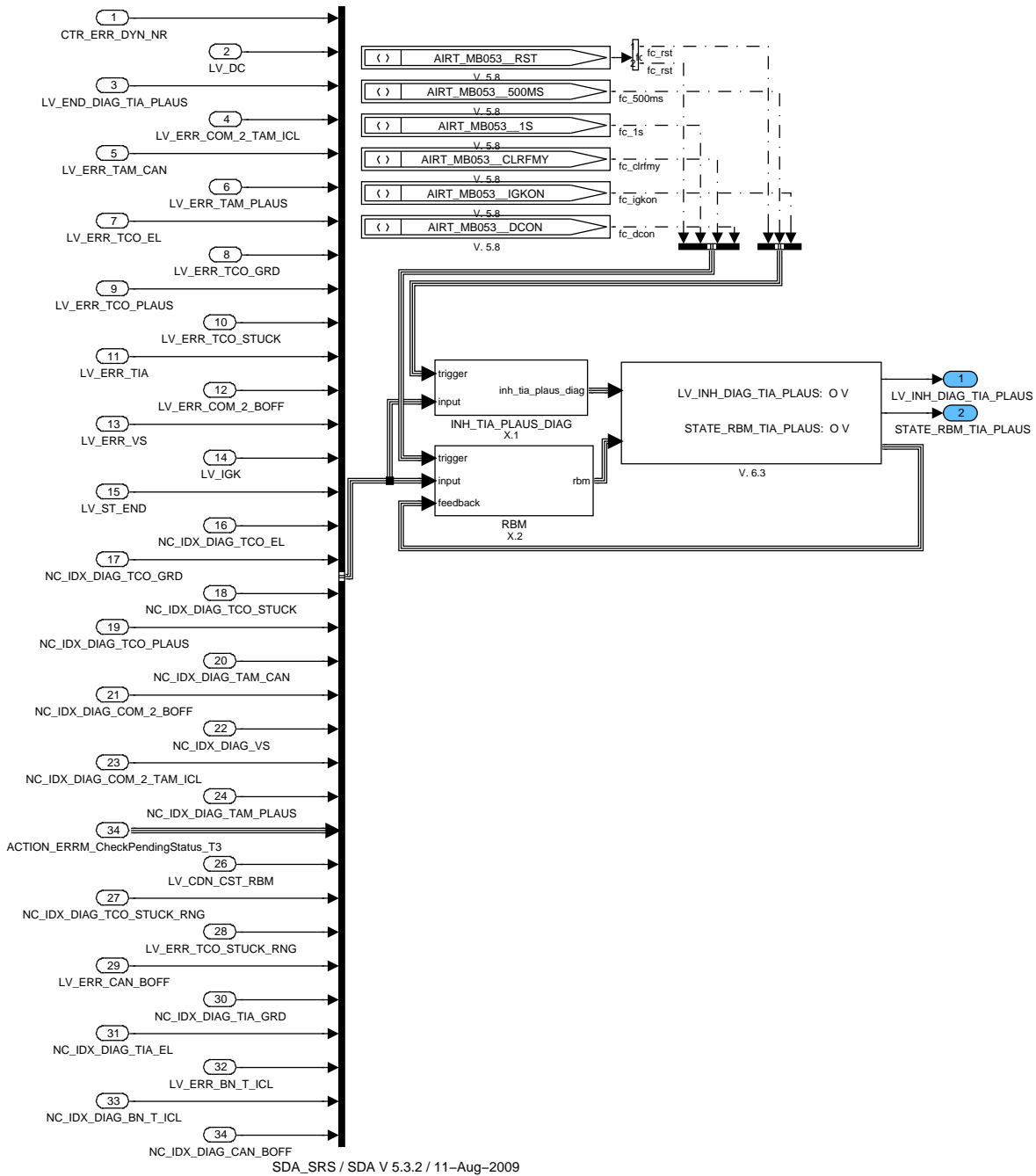


Figure B.4.1: :


**General Information**

**B.4.1 Inhibition of TIA\_PLAUS diagnosis due to present error**

General information:

Inhibiton flag to inhibit the TIA\_PLAUS diagnosis because of present error.

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	Document key 10171571 SPE 000 AO	Pages Page 5104 of 8404	
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## Application Conditions

Initialization: RST, IGKON

Recurrence: 500MS

Activation: LV\_ST\_END==1 & LV\_END\_DIAG\_TIA\_PLAUS==0

Deactivation: LV\_END\_DIAG\_TIA\_PLAUS==1

## Function description

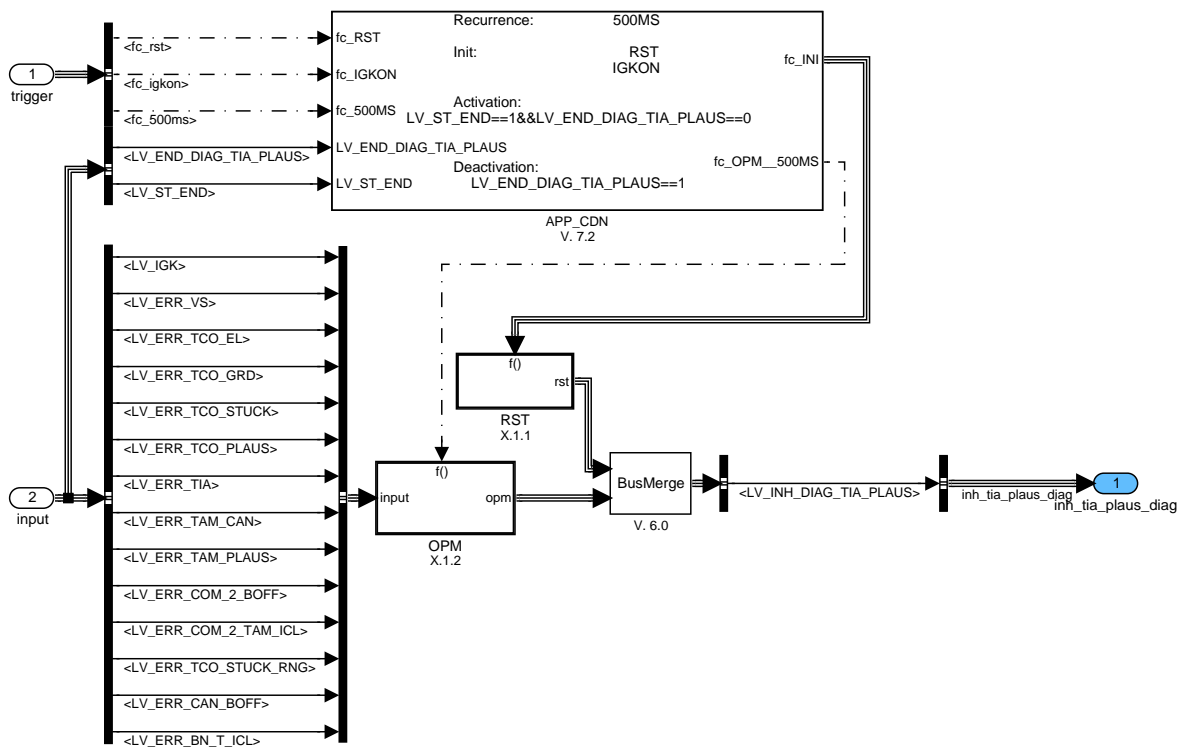


Figure B.4.2: :

### B.4.1.1 Initialisation

Initialisation of LV\_INH\_DIAG\_TIA\_PLAUS

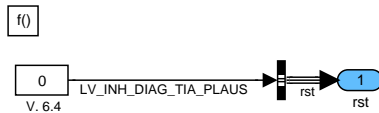


Figure B.4.3: :

### B.4.1.2 Formula Section

#### B.4.1.2.1 Calculation of LV\_INH\_DIAG\_TIA\_PLAUS

Irreversible inhibition of diagnosis. LV\_INH\_DIAG\_TIA\_PLAUS bit is set to 1, if any one of the inputs is 1.

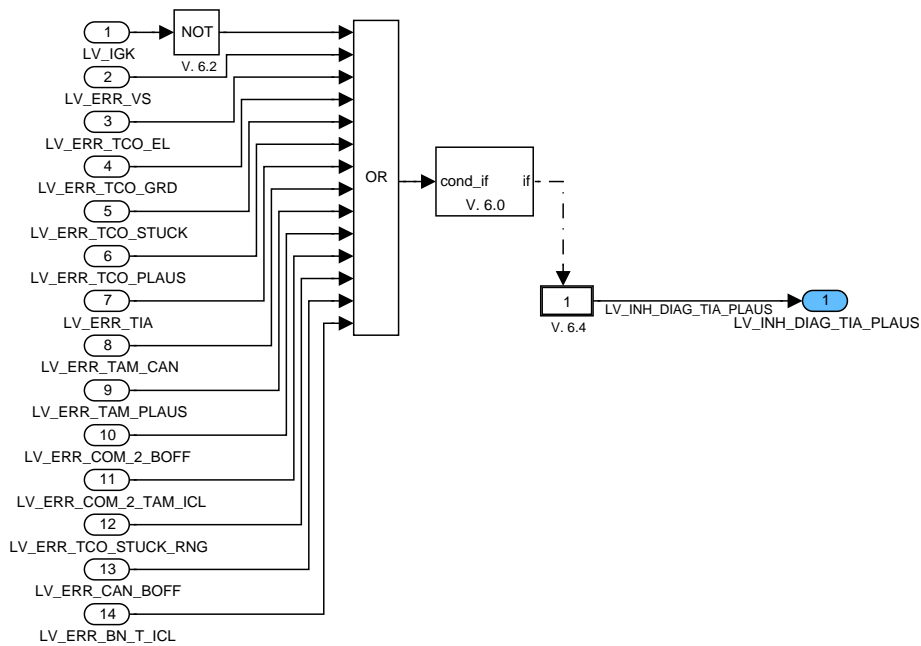


Figure B.4.4: :

## B.4.2 Interface for Rate - Based - Monitoring

General information:

With this module the interface between the TIA\_PLAUS monitor and the RateBased Monitoring statistics is defined with STATE\_RBM\_TIA\_PLAUS data.

Within STATE\_RBM\_TIA\_PLAUS, three different information are defined:

Conditions for monitoring are met long enough to detect malfunction (bit 0)

(no intrusive operation, no short trip)

Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

Monitor individual RBM conditions encountered within this DC (bit 2)

( not valid for TIA\_PLAUS diagnosis )

### Application Conditions

Initialization: RST, CLRFRMY, DCON

Recurrence: 1S

Activation: always

Deactivation: never

### Function description

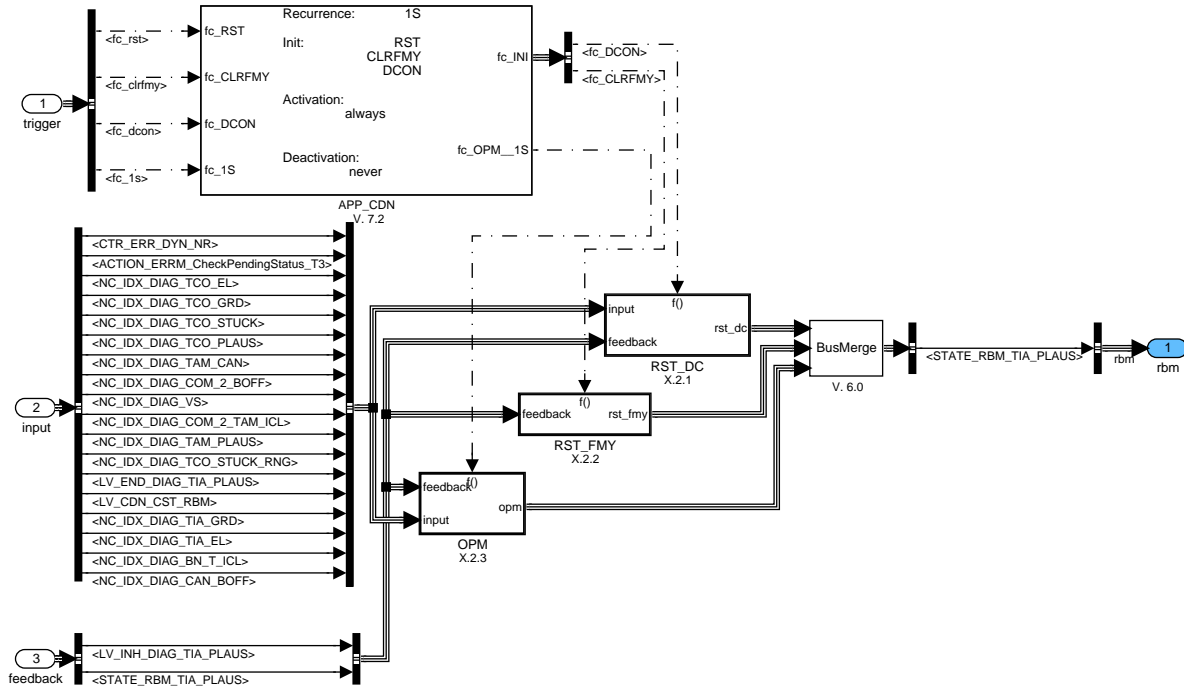


Figure B.4.5: :

### B.4.2.1 Formula Section at reset on driving cycle on

#### B.4.2.1.1 Initialisation at DCON

Bits 0, 1 and 2 of STATE\_RBM\_TIA\_PLAUS are reset to 0, whenever there is transition of LV\_DC from 0 to 1.

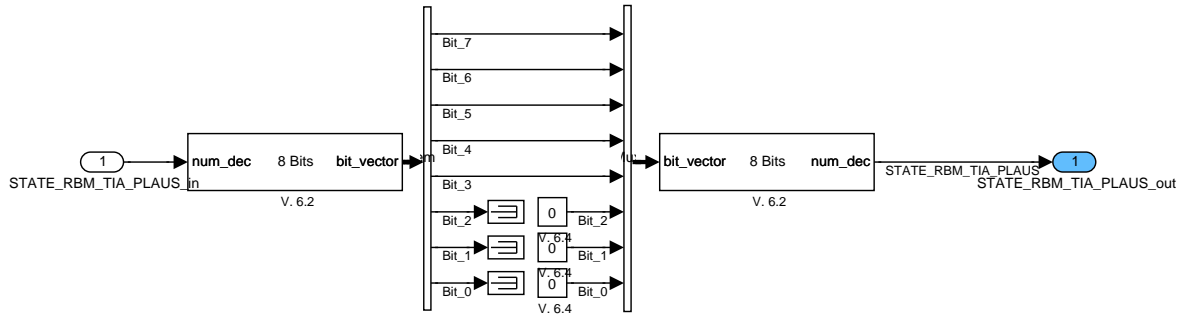


Figure B.4.6: :

#### B.4.2.1.2 Condition check for CTR\_ERR\_DYN\_NR

Activation condition at LV\_DC transition from 0 to 1 and the dynamic failure memory is not empty(CTR\_ERR\_DYN\_NR is not equal to 0)

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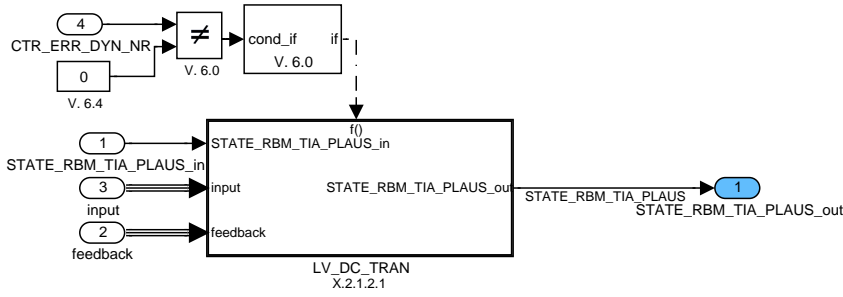


Figure B.4.7: :

### B.4.2.1.2.1 Condition check for bit 1 of STATE\_RBM\_TIA\_PLAUS

While bit 1 of STATE\_RBM\_TIA\_PLAUS is 0 the pending status for each of the failure will be checked.

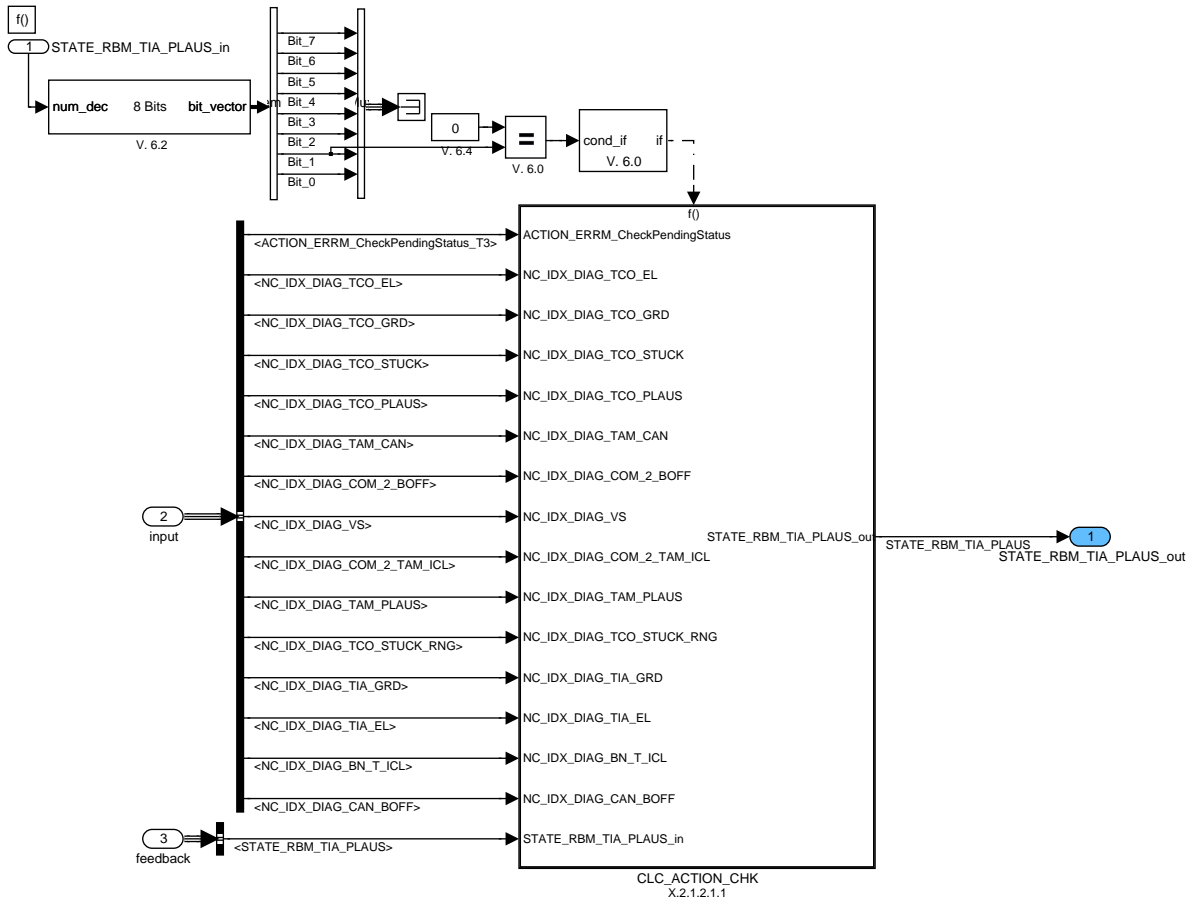


Figure B.4.8: :

#### B.4.2.1.2.1.1 Pending status check

Pending status for each of the failure is checked using Check Pending Status Action call from ERRM.

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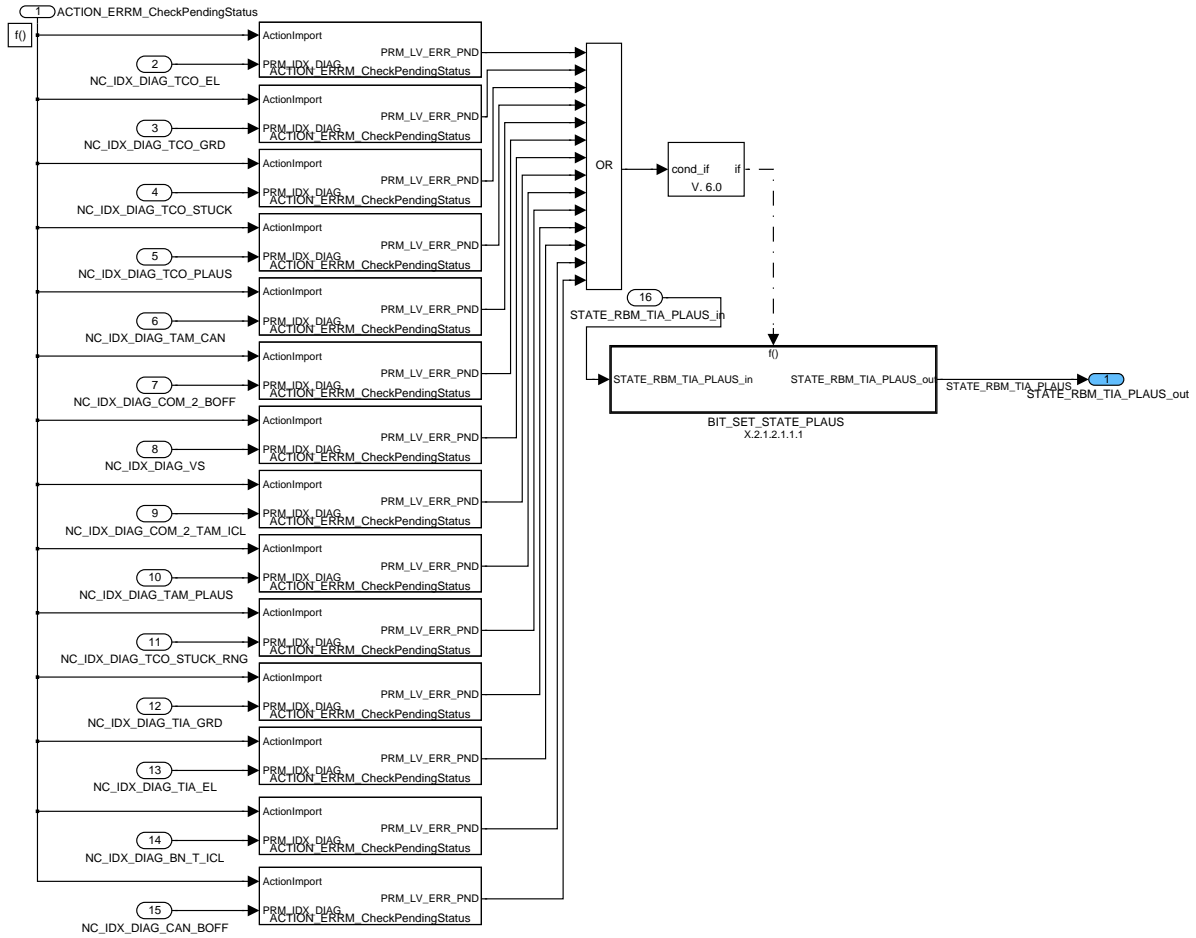


Figure B.4.9: :

### B.4.2.1.2.1.1.1 Bit 1 setting for STATE\_RBM\_TIA\_PLAUS

If any of the failures has pending status the bit 1 of STATE\_RBM\_TIA\_PLAUS will be set to 1

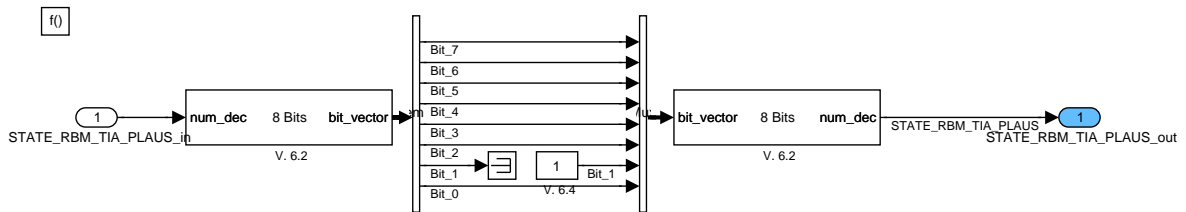


Figure B.4.10: :

## B.4.2.2 Initialisation at Failure Memory Reset

### B.4.2.2.1 Initialisation at Failure Memory Reset

Bit 1 of STATE\_RBM\_TIA\_PLAUS is reset to 0 whenever there is Failure Memory reset event.

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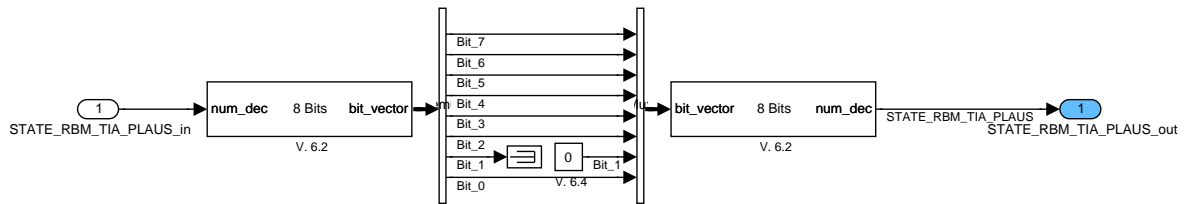


Figure B.4.11: :

## B.4.2.3 Formula section for 1 second recurrence

### B.4.2.3.1 Bit set operation

Calculation of status of bits 0, 1 and 2 of STATE\_RBM\_TIA\_PLAUS at 1 second recurrence.

If bit 0 of STATE\_RBM\_TIA\_PLAUS is 0 and LV\_END\_DIAG\_TIA\_PLAUS is 1 then bit 0 of STATE\_RBM\_TIA\_PLAUS is set to 1.

If bit 1 of STATE\_RBM\_TIA\_PLAUS is 0 and LV\_INH\_DIAG\_TIA\_PLAUS is 1 then bit 1 of STATE\_RBM\_TIA\_PLAUS is set to 1

If bit 2 of STATE\_RBM\_TIA\_PLAUS is 0 and LV\_CDN\_CST\_RBM is 1 then bit 2 of STATE\_RBM\_TIA\_PLAUS is set to 1

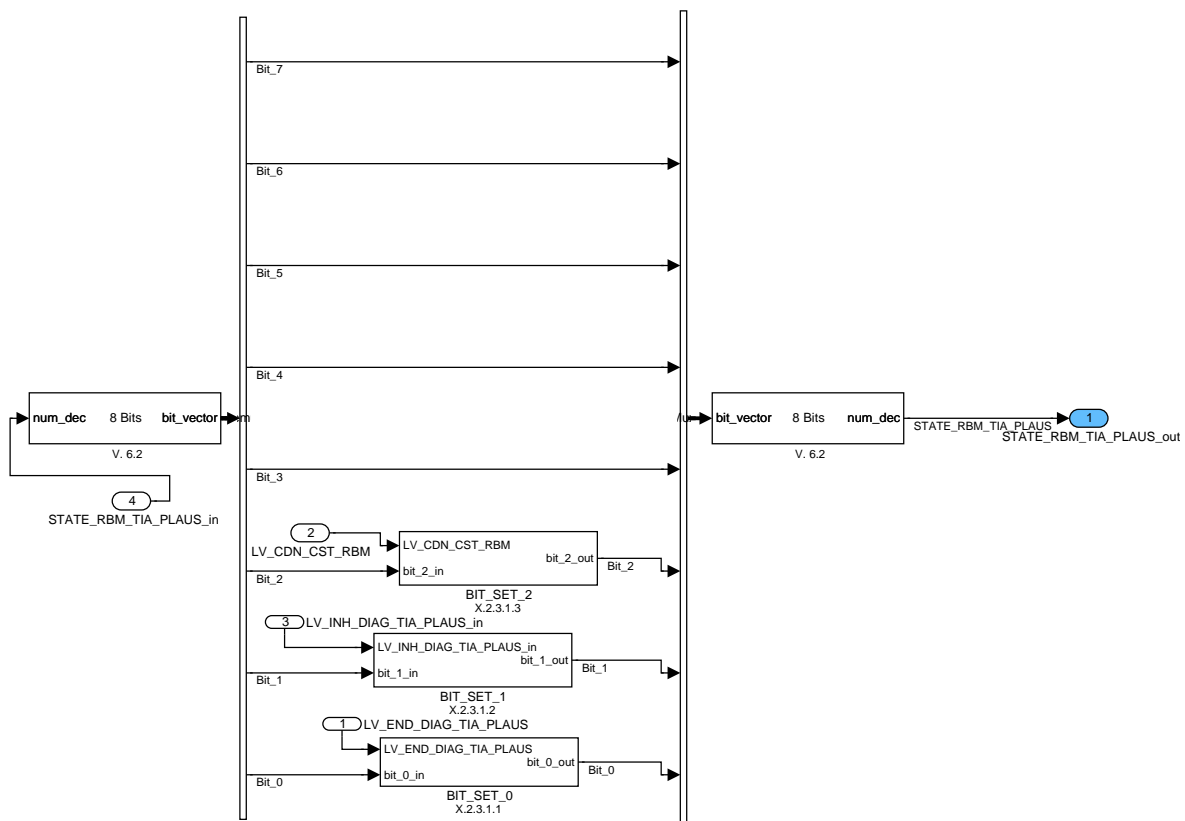


Figure B.4.12: :

### B.4.2.3.1.1 BIT\_SET\_0

Bit 0 of STATE\_RBM\_TIA\_PLAUS is set to 1, if bit 0 of STATE\_RBM\_TIA\_PLAUS is 0 and LV\_END\_DIAG\_TIA\_PLAUS is 1

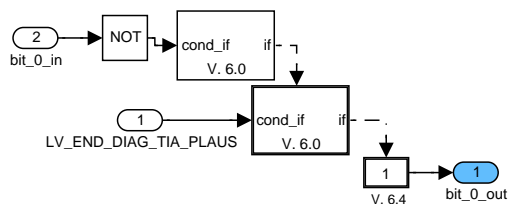


Figure B.4.13: :

### B.4.2.3.1.2 BIT\_SET\_1

Bit 1 of STATE\_RBM\_TIA\_PLAUS is set to 1, if bit 0 of STATE\_RBM\_TIA\_PLAUS is 0 and LV\_INH\_DIAG\_TIA\_PLAUS is 1

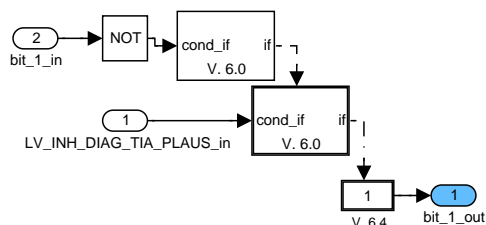


Figure B.4.14: :

### B.4.2.3.1.3 BIT\_SET\_2

If bit 2 of STATE\_RBM\_TIA\_PLAUS is 0 and LV\_CDN\_CST\_RBM is 1 then bit 2 of STATE\_RBM\_TIA\_PLAUS is set to 1.

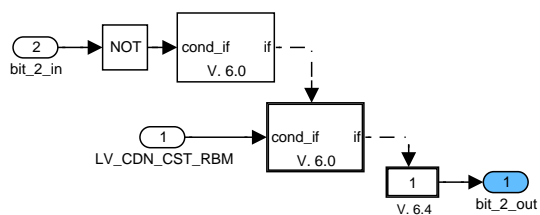


Figure B.4.15: :

## B.5 Cylinder balancing OBDII diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ERR_OBD_DIAG_CYL_BAL_ER	O/V/S	0... FFH	0... 255	1	-
Anti-bounce-counter for detected error up to current driving cycle (output of CYBL_ER concerned)					
CTR_ERR_OBD_DIAG_CYL_BAL_LAM [NC_CBK_EX_NR]	O/V/S	0... FFH	0... 255	1	-
Anti-bounce-counter for detected error up to current driving cycle (output of CILC concerned)					
ERR_SYM_CYL_BAL_ER [NC_CYL_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected failure symptom - output of CYBL_ER concerned					
ERR_SYM_CYL_BAL_LAM [NC_CYL_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected failure symptom - output of CILC concerned					
LV_CDN_DIAG_CYL_BAL_ER [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Diagnosis conditions - output of CYBL_ER concerned					
LV_CDN_DIAG_CYL_BAL_LAM [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Diagnosis condition - output of CILC concerned					
LV_END_DIAG_CYL_BAL_ER [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
End of first diagnosis cycle - output of CYBL_ER concerned					
LV_END_DIAG_CYL_BAL_LAM [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
End of first diagnosis cycle - output of CILC concerned					
LV_END_DIAG_WIN_CYL_BAL_ER [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
End of diagnosis cycle for similar conditions window - output of CYBL_ER concerned					
LV_END_DIAG_WIN_CYL_BAL_LAM [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
End of diagnosis cycle for similar conditions window - output of CILC concerned					
LV_ERR_CYL_BAL_ER [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Cylinder balancing error detected - output of CYBL_ER concerned					
LV_ERR_CYL_BAL_LAM [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Cylinder balancing error detected - output of CILC concerned					
LV_ERR_REF_CYL_BAL_ER	V	0... 1H	0 ...1	1	-
Reference flag indicating the CYBL_ER - error was occurred at least once for the current driving cycle					
LV_ERR_REF_CYL_BAL_LAM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Reference flag indicating the CILC - error was occurred at least once for the current driving cycle					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_OBD_DIAG_CYL_BAL_ER	O/V	0... 1H	0 ...1	1	-
Inhibit flag for CYBL_ER - cylinder balancing error detected over several driving cycles					
LV_INH_OBD_DIAG_CYL_BAL_LAM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibit flag for CILC - cylinder balancing error detected over several driving cycles					
T_SUM_CYL_BAL_ER_LIM_MAX [NC_CYL_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for detected diagnosis limit - upper limit of CYBL_ER concerned					
T_SUM_CYL_BAL_ER_LIM_MIN [NC_CYL_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for detected diagnosis limit - lower limit of CYBL_ER concerned					
T_SUM_CYL_BAL_LAM_LIM_MAX [NC_CYL_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for detected diagnosis limit - upper limit of CILC concerned					
T_SUM_CYL_BAL_LAM_LIM_MIN [NC_CYL_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for detected diagnosis limit - lower limit of CILC concerned					
T_SUM_END_DIAG_WIN_CYL_BAL_ER [NC_CYL_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for the diagnosis window - output of CYBL_ER concerned					
T_SUM_END_DIAG_WIN_CYL_LAM [NC_CYL_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for the diagnosis window - output of CILC concerned					
T_SUM_RST_CYL_BAL_ER [NC_CYL_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer to update the diagnosis window - output of CYBL_ER concerned					
T_SUM_RST_CYL_BAL_LAM [NC_CYL_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer to update the diagnosis window - output of CILC concerned					

**Input data:**

FAC_LAM_CYL_SEL_ ADJ_H_RNG [NC_CYL_NR] {p. 2731}	FAC_LAM_CYL_SEL_ ADJ_L_RNG [NC_CYL_NR] {p. 2731}	LF_LS_CBK_EX_LAM_ CYL_SEL_CONF {p. 2864}	LV_CTR_CYL_BAL_RST_ EXT {p. 7482}
LV_DC {p. 5746}	LV_IGK {p. 906}	LV_MFF_ADD_ER_BAL_ OBD_MAX_NEG [NC_CYL_NR] {p. 3269}	LV_MFF_ADD_ER_BAL_ OBD_MAX_POS [NC_CYL_NR] {p. 3269}
LV_MFF_FAC_ER_BAL_ OBD_MAX_NEG [NC_CYL_NR] {p. 3298}	LV_MFF_FAC_ER_BAL_ OBD_MAX_POS [NC_CYL_NR] {p. 3298}	LV_ST_END {p. 1720}	NC_CBK_EX_NR {p. 1829}
NC_CYL_NR {p. 1526}	STATE_CTL_TI_ER_BAL {p. 4006}	STATE_DELTA_CRK_CYL_ LAM [NC_CBK_EX_NR] {p. 2839}	STATE_LAM_CYL_SEL_ ADJ [NC_CBK_EX_NR] {p. 2733}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_DEC_ERR_OBD_DIAG_CYL_BAL	-	0... FFH	0... 255	1	-
Decrement constant of anti-bounce-counter					
C_CTR_INC_ERR_OBD_DIAG_CYL_BAL	-	0... FFH	0... 255	1	-
Increment constant of anti-bounce-counter					
C_CTR_MAX_CYL_BAL_ER_ERR	-	1... FFH	1... 255	1	-
Threshold of anti-bounce-counter to set the inhibit flag for CYBL_ER					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_MAX_CYL_BAL_LAM_ERR	-	1... FFH	1... 255	1	-
Threshold of anti-bounce-counter to set the inhibit flag for cylinder individual lambda control					
C_FAC_LAM_CYL_SEL_ADJ_DIAG_MAX	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Upper diagnosis limit of the cylinder individual nominal-adaptation correction factor					
C_FAC_LAM_CYL_SEL_ADJ_DIAG_MIN	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Lower diagnosis limit of the cylinder individual nominal-adaptation correction factor					
C_T_SUM_MIN_CYL_BAL_LIM	-	1... FFFFH	0.1... 6553.5	0.1	s
Minimum run-off time for error detection					
C_T_SUM_RST_MAX_CYL_BAL	-	1... FFFFH	0.1... 6553.5	0.1	s
Diagnosis time interval					
C_T_SUM_THD_CYL_BAL_LIM	-	1... FFFFH	0.1... 6553.5	0.1	s
Time threshold to set the error flag					
LC_CTR_ERR_OBD_DIAG_CYL_BAL	-	0... 1H	0 ...1	1	-
Anti-bounce-counter reset					

### Error treatment:

Diagnostic	Symptom description	Symptom	Filter type
<b>CYL_BAL_LAM[x]</b>			
Detected failure symptom - output of CILC concerned	<i>minimum diagnosis limit of cylinder individual lambda control reached</i>	SYM_0	NO
	<i>maximum diagnosis limit of cylinder individual lambda control reached</i>	SYM_1	
	<i>not used</i>	SYM_2	
	<i>not used</i>	SYM_3	


Figure B.5.1: Diagnostic

Diagnostic	Symptom description	Symptom	Filter type
<b>CYL_BAL_ER[x]</b>			
Detected failure symptom - output of CYBL_ER concerned	<i>minimum diagnosis limit of CYBL_ER reached</i>	SYM_0	NO
	<i>maximum diagnosis limit of CYBL_ER reached</i>	SYM_1	
	<i>not used</i>	SYM_2	
	<i>not used</i>	SYM_3	

### FUNCTION DESCRIPTION:

#### General information:

The objective function of cylinder balancing diagnosis is monitoring the output of cylinder individual lambda control in homogenous engine operation and output of cylinder balancing via engine roughness in stratified or homogenous-stratified engine operation mode. Breaking the diagnosis limits for a long

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time, which may have been caused by injector- failures, shall be diagnosed by cylinder balancing diagnosis. The failure allocation is cylinder selective. In case of failure detection for one of the cylinders the failure symptom of remaining cylinders shall be checked. Should the run-off time of any cylinder be over the minimum threshold, the concerned cylinder has to be detected as defect. Should the output of cylinder individual lambda control be concerned, the diagnosis shall be executed for all of the exhaust-bank-related cylinders (1.2, 1.4.1,1.5, 1.6.1,1.7.1.1).

The diagnosis shall be executed for all of the cylinders if the output of cylinder balancing via engine roughness is concerned (1.2, 1.4.2, 1.5, 1.6.2, 1.7.2).


### **Description of index "[i]" and "[x]":**

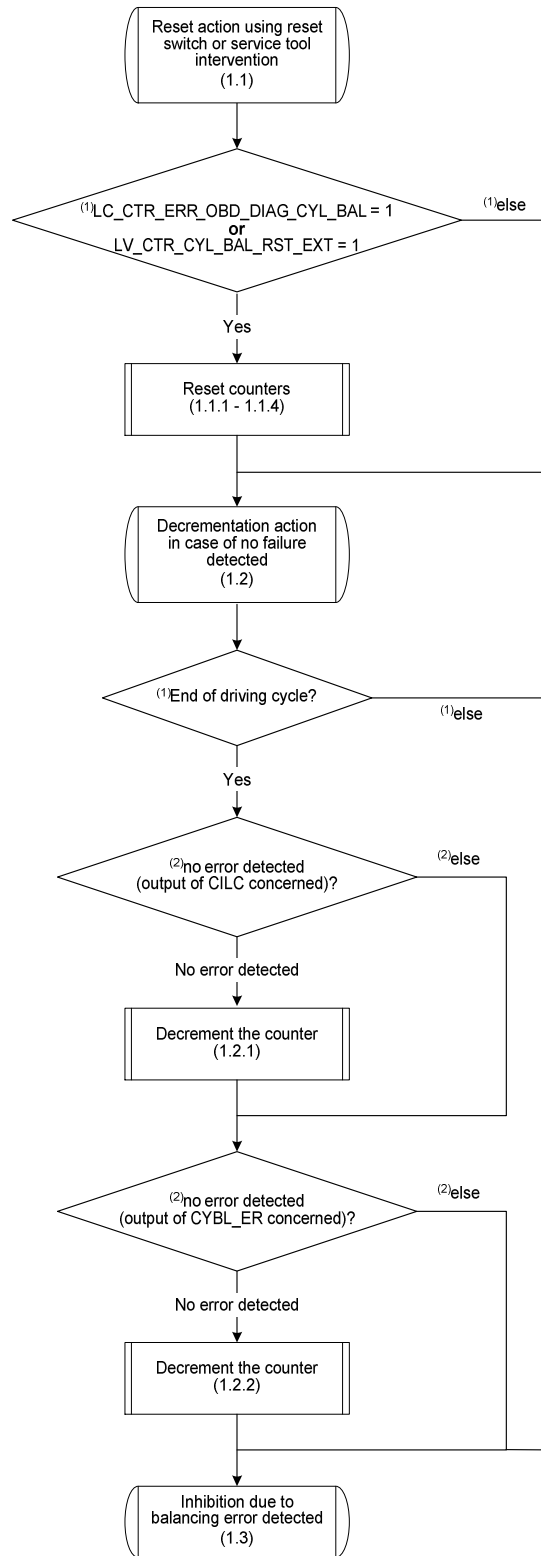
*x: logical cylinder*

*use **NC\_CYL\_NR**: number of engine cylinders - index "[x]"*

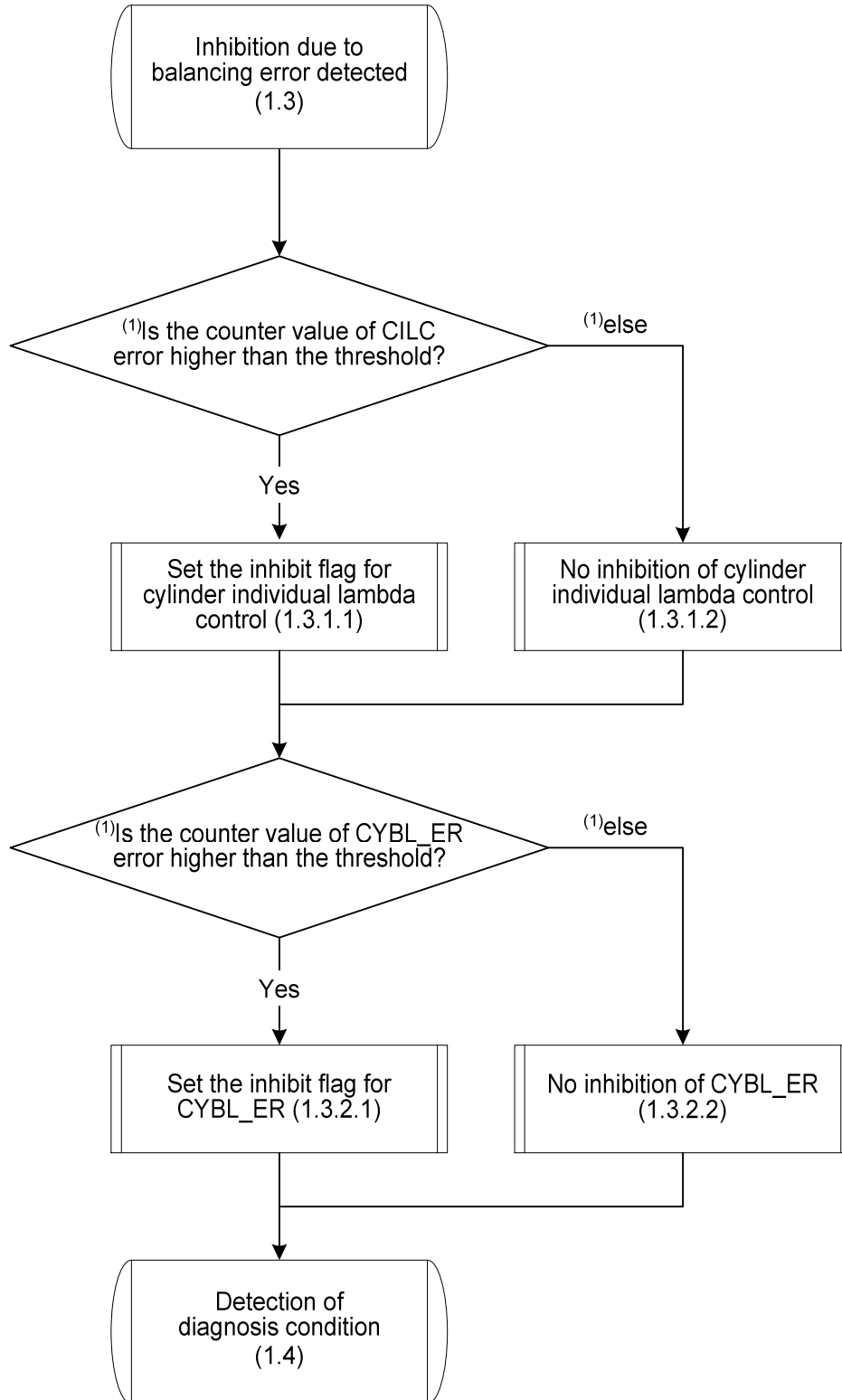
*use **LF\_LS\_CBK\_EX\_LAM\_CYL\_SEL\_CONF**: pattern for allocation of physical cylinders to exhaust bank - index "[i]"*

### **Signal flow diagram:**

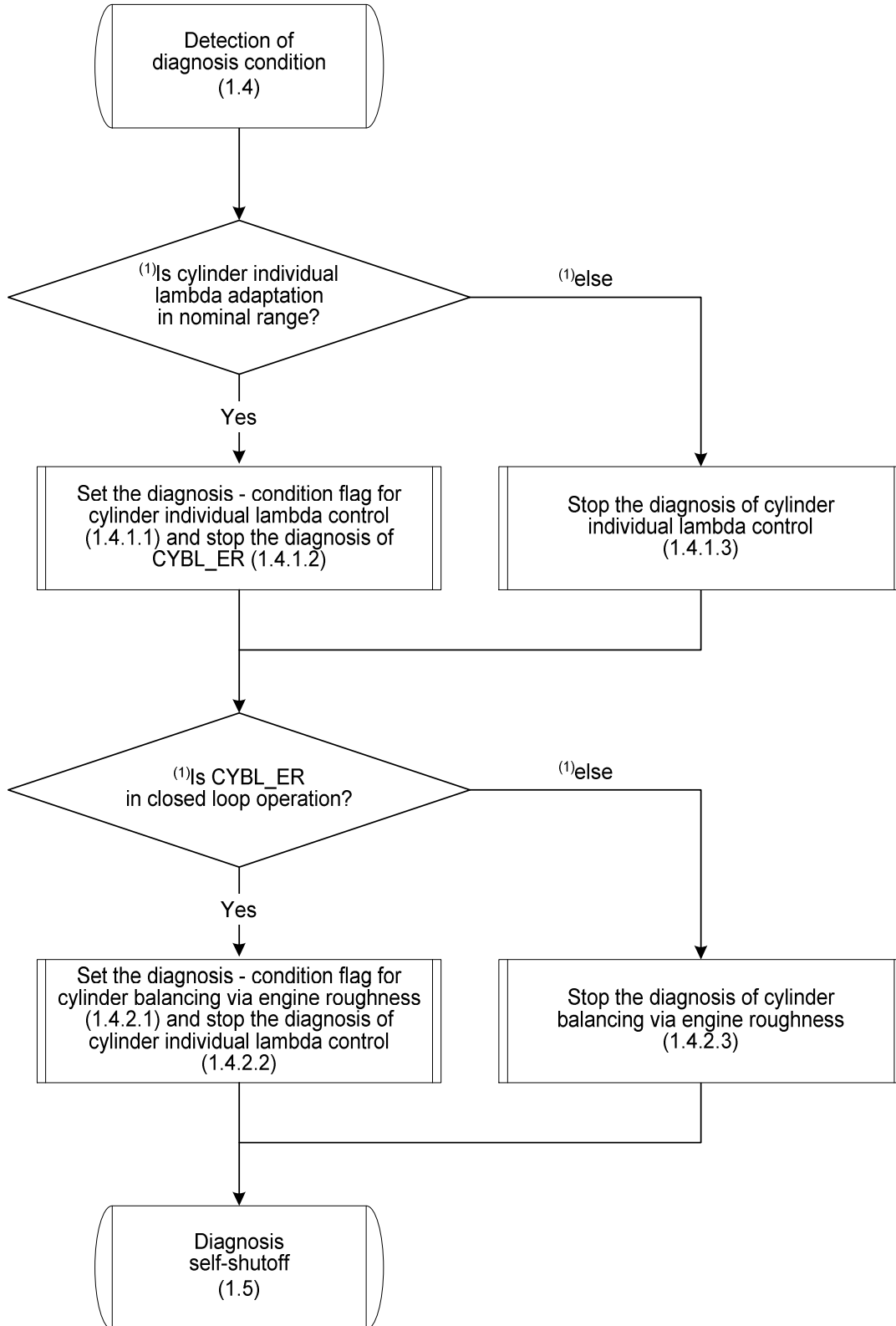
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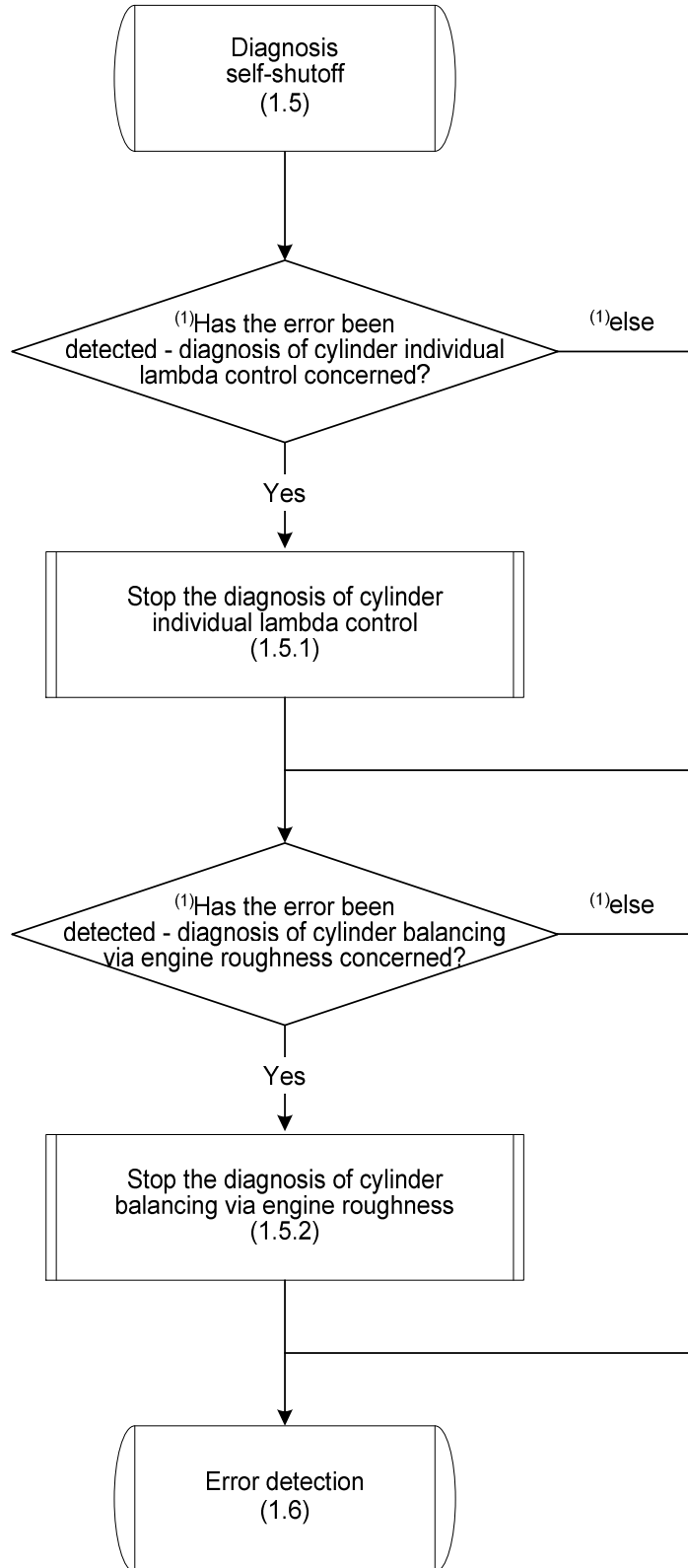
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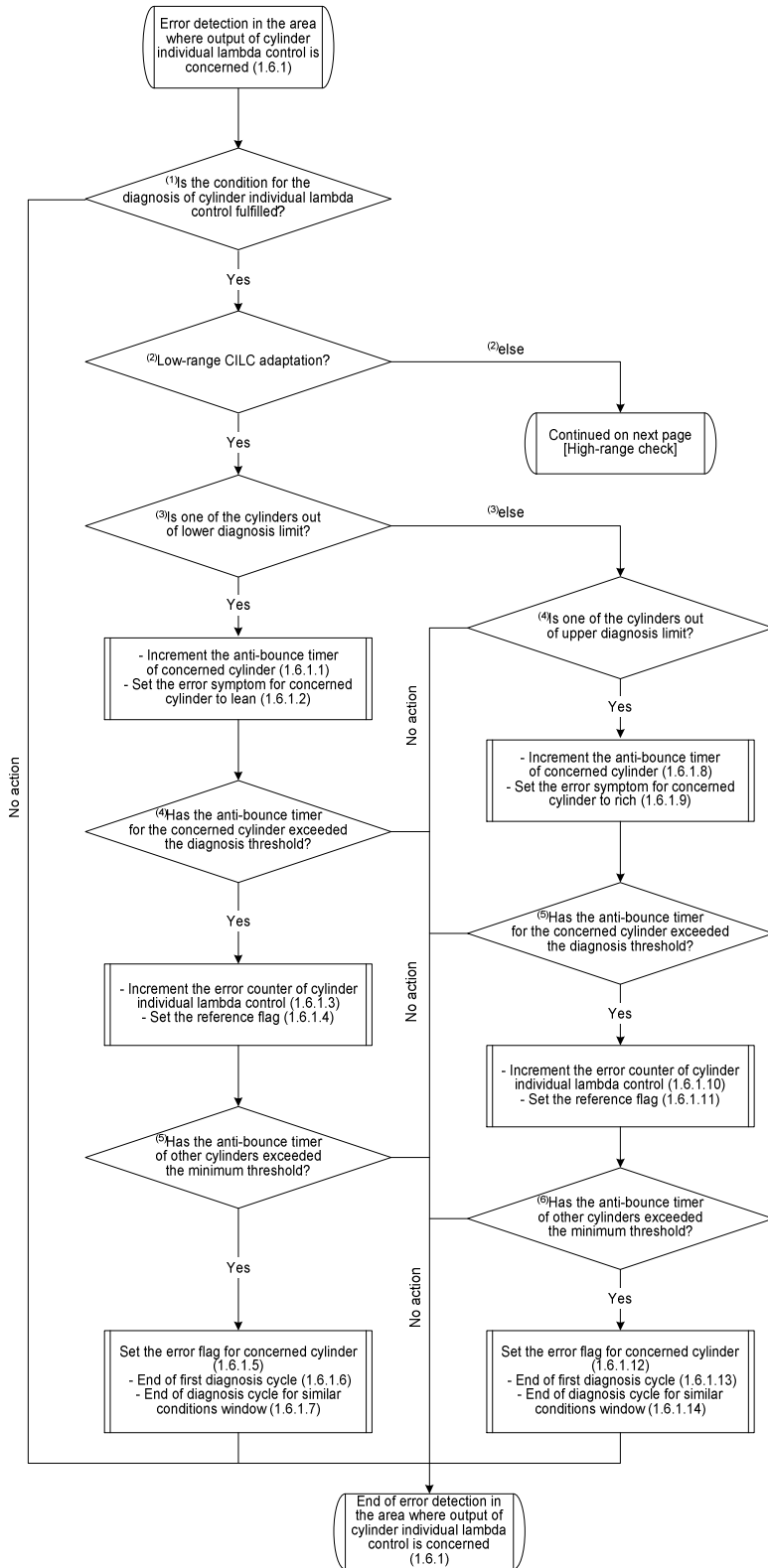
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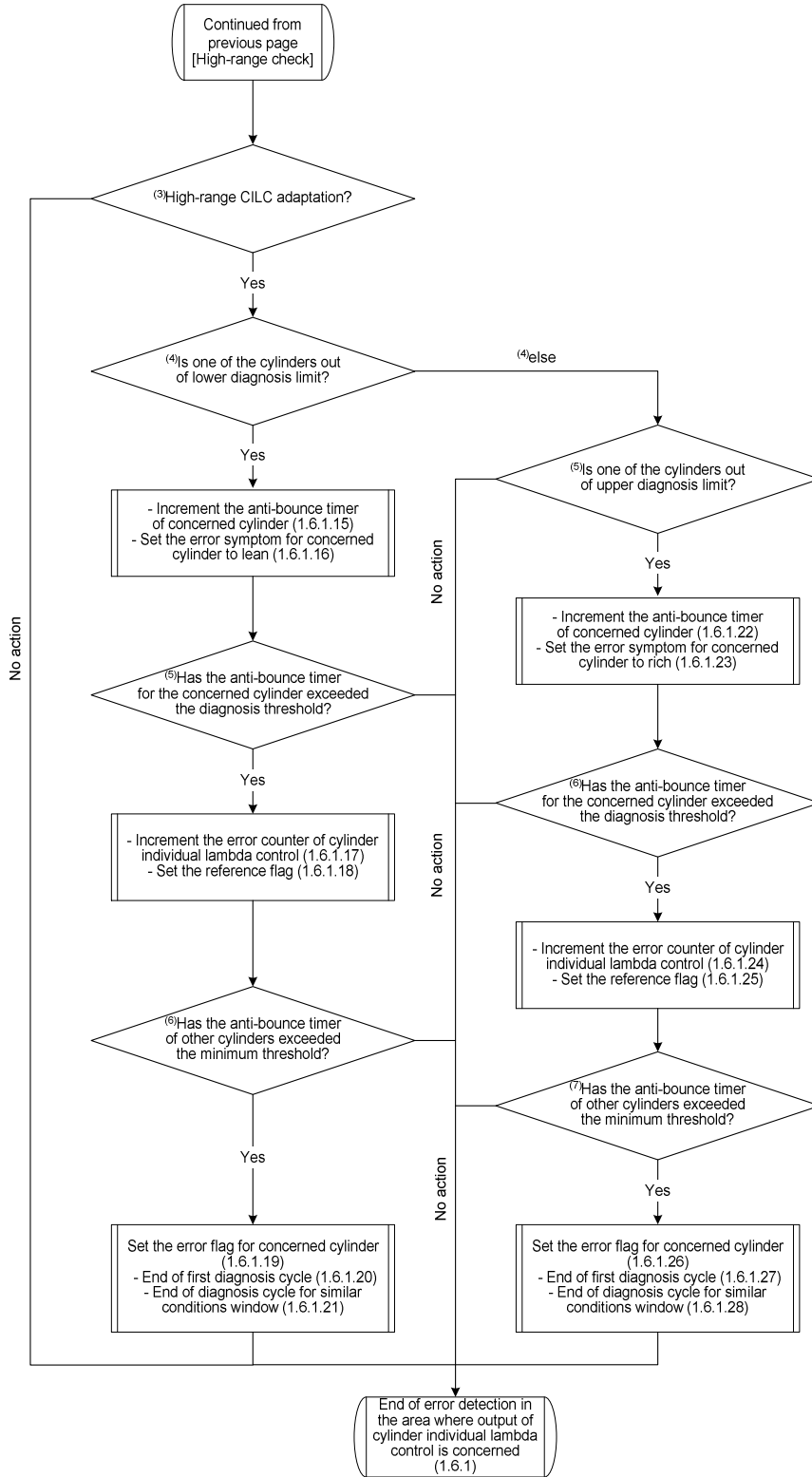


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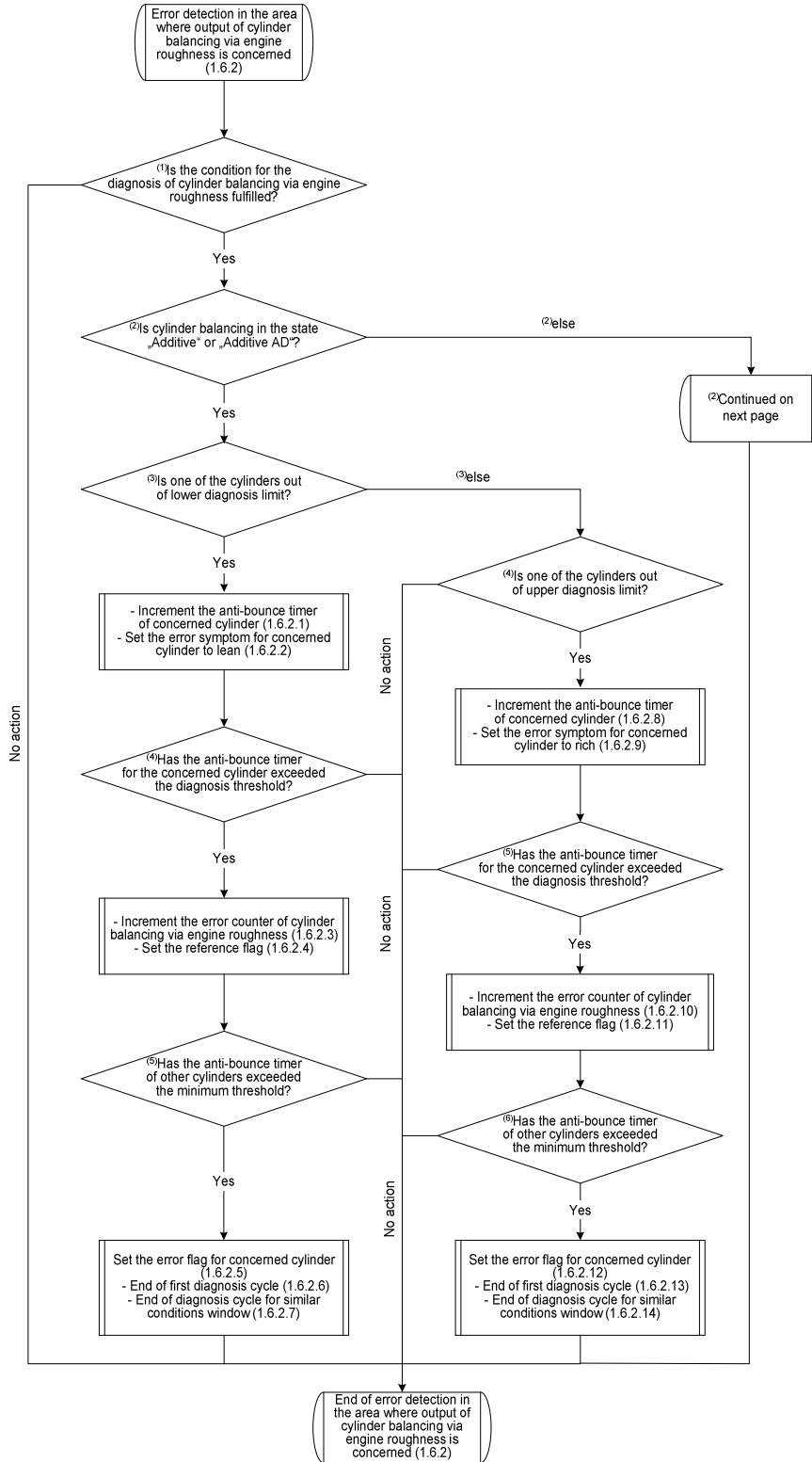


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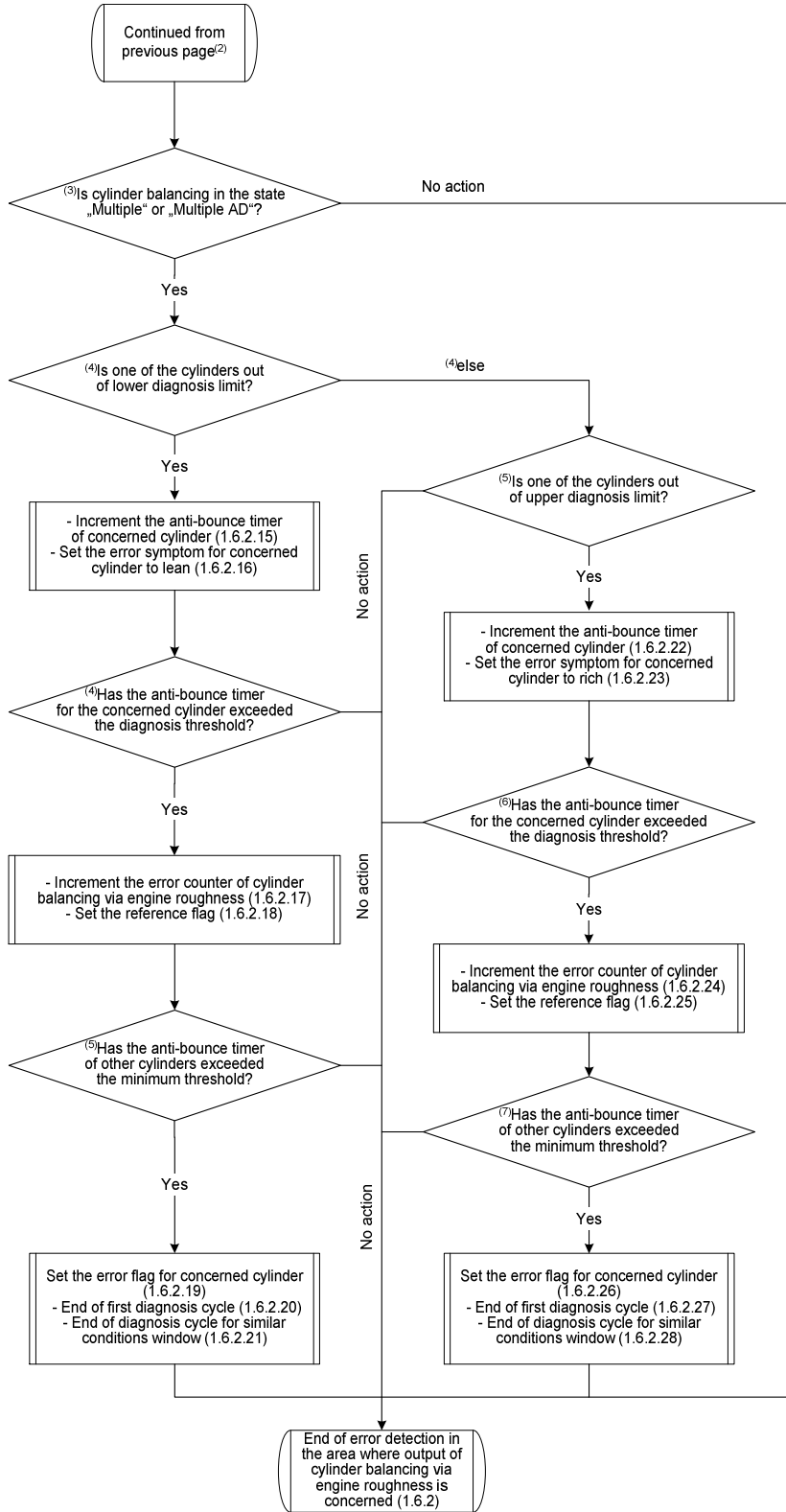




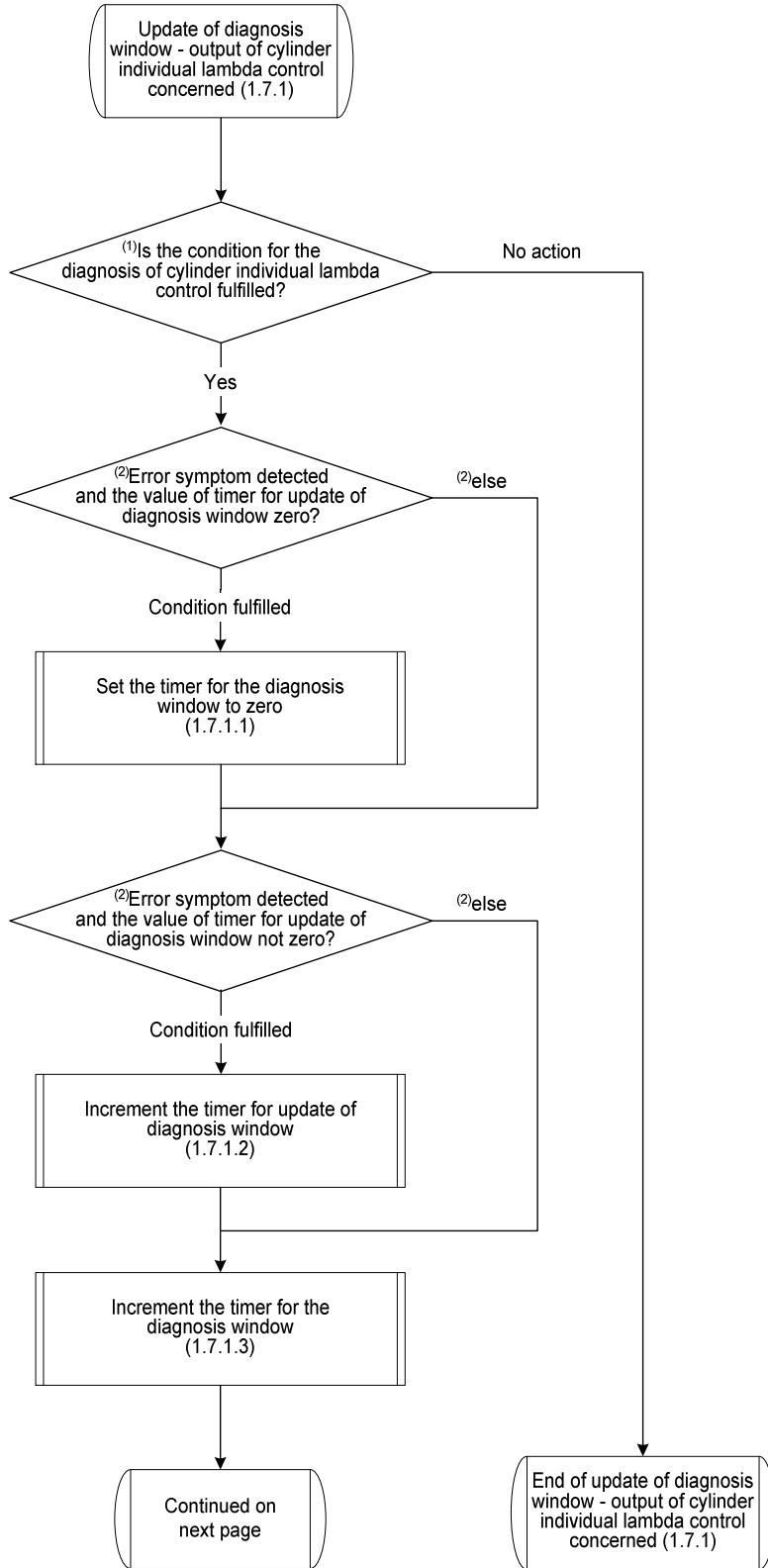
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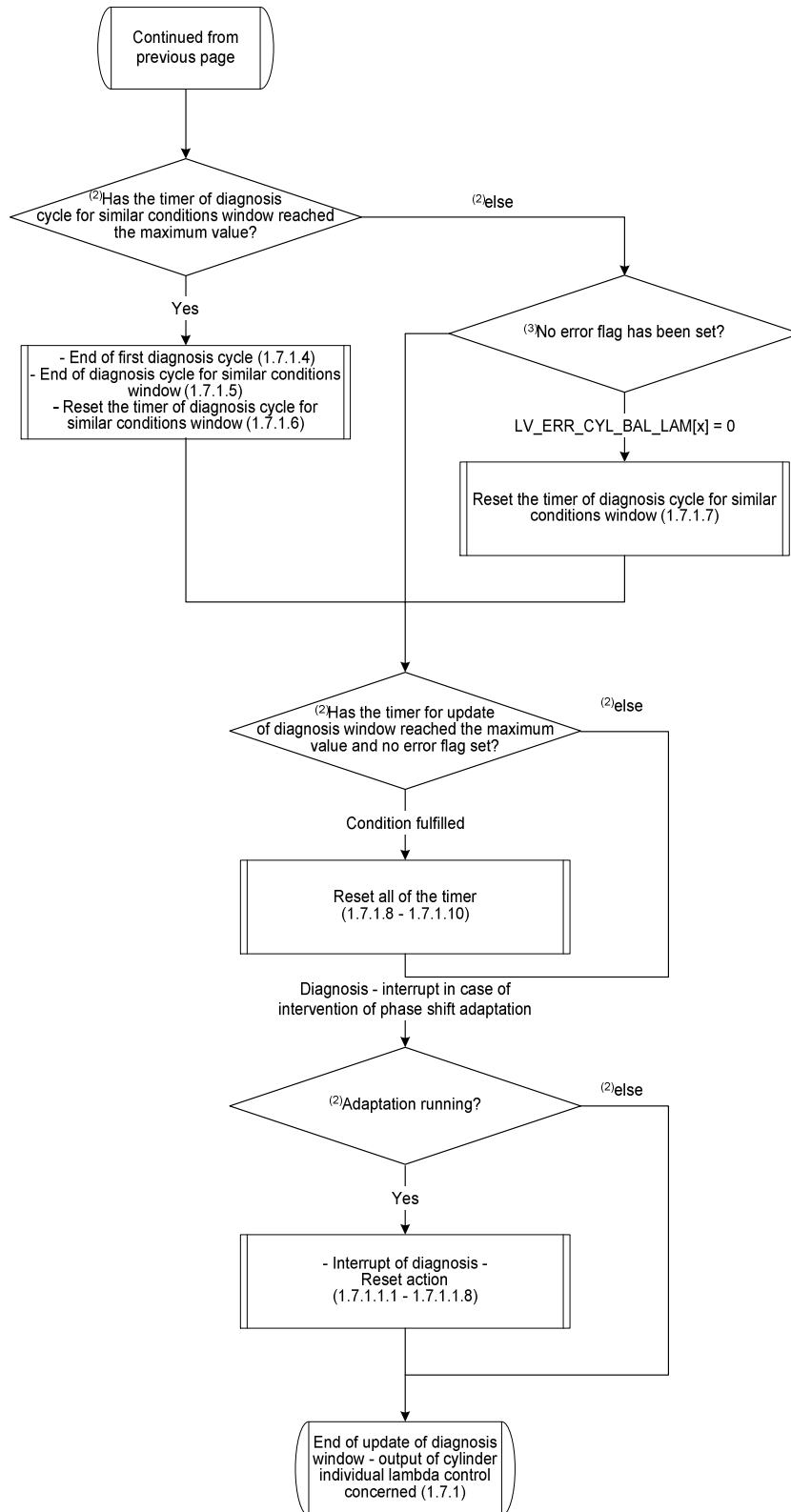
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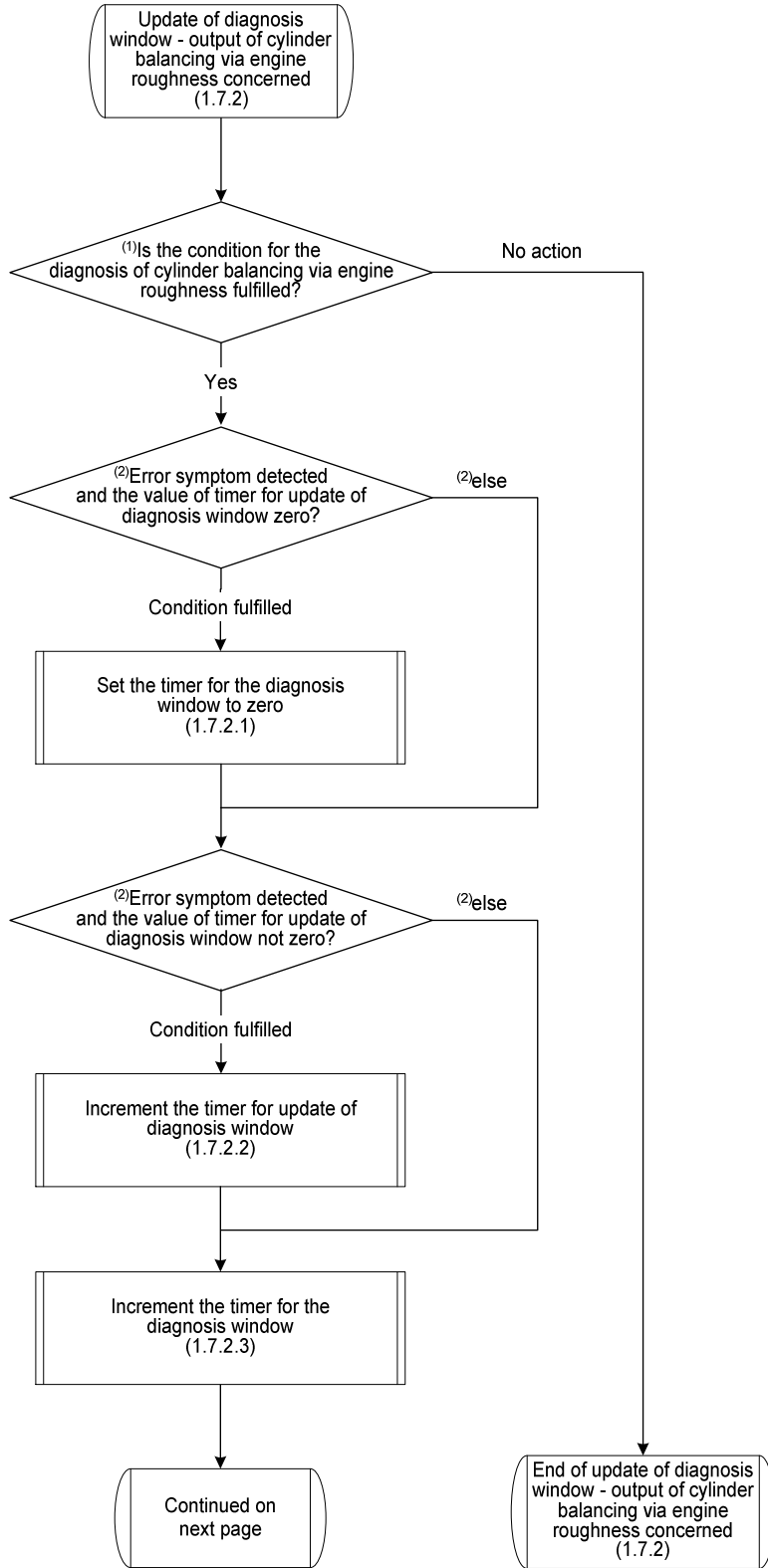
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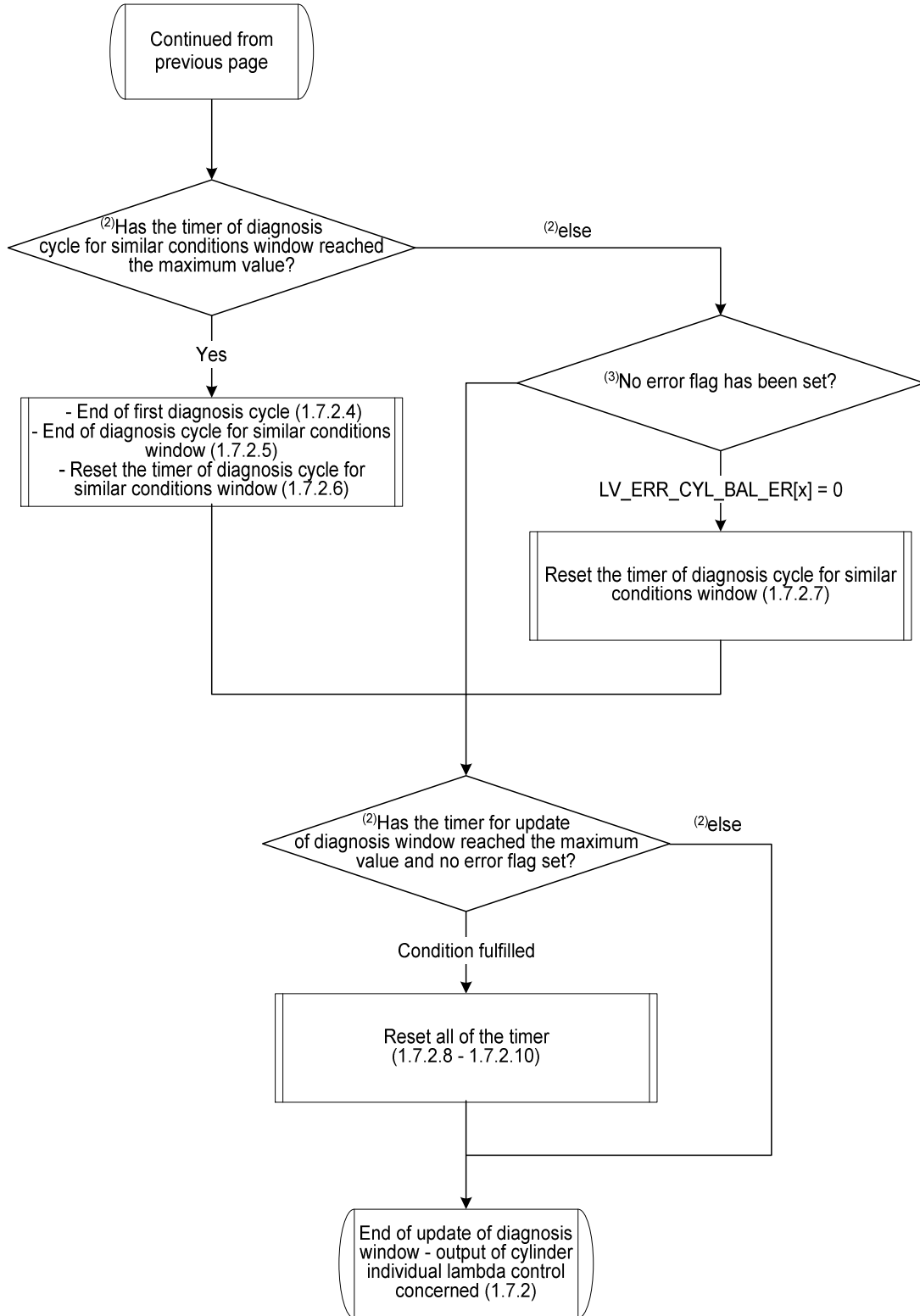
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**Application conditions**

**Initialization:**

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**at reset, LV\_IGK = 0 1 and clear error memory:**

```

LV_CDN_DIAG_CYL_BAL_LAM[x] = 0
LV_CDN_DIAG_CYL_BAL_ER[x] = 0
ERR_SYM_CYL_BAL_LAM[x] = 0
ERR_SYM_CYL_BAL_ER[x] = 0
LV_ERR_CYL_BAL_LAM[x] = 0
LV_ERR_CYL_BAL_ER[x] = 0
T_SUM_CYL_BAL_LAM_LIM_MIN[x] = 0
T_SUM_CYL_BAL_LAM_LIM_MAX[x] = 0
T_SUM_CYL_BAL_ER_LIM_MIN[x] = 0
T_SUM_CYL_BAL_ER_LIM_MAX[x] = 0
T_SUM_RST_CYL_BAL_LAM[x] = 0
T_SUM_RST_CYL_BAL_ER[x] = 0
T_SUM_END_DIAG_WIN_CYL_LAM[x] = 0
T_SUM_END_DIAG_WIN_CYL_BAL_ER[x] = 0
LV_INH_OBD_DIAG_CYL_BAL_LAM[i] = 0
LV_INH_OBD_DIAG_CYL_BAL_ER = 0
LV_ERR_REF_CYL_BAL_LAM[i] = 0
LV_ERR_REF_CYL_BAL_ER = 0

```

**At E\*\*2PROM - failure:**

```

CTR_ERR_OBD_DIAG_CYL_BAL_LAM[i] = 0
CTR_ERR_OBD_DIAG_CYL_BAL_ER = 0

```

*Recurrence:*

100 ms

*Activation:*

LV\_ST\_END = 1

*Deactivation:*

-

**Formula section:****B.5.1 Reset action using reset switch or service tool intervention**

```

if(1) (LC_CTR_ERR_OBD_DIAG_CYL_BAL = 1 or LV_CTR_CYL_BAL_RST_EXT = 1)

```

**then**

```

    CTR_ERR_OBD_DIAG_CYL_BAL_LAM[i] = 0

```

(1.1.1)

```

    CTR_ERR_OBD_DIAG_CYL_BAL_ER = 0

```

(1.1.2)

```

    LV_ERR_REF_CYL_BAL_LAM[i] = 0

```

(1.1.3)

```

    LV_ERR_REF_CYL_BAL_ER = 0

```

(1.1.4)

**endif<sup>(1)</sup>****B.5.2 Decrement action in case of no failure detected**

```

if(1) LV_DC 1 0

```



```

then
    if(2)      (LV_ERR_CYL_BAL_LAM[x] = 0 and
LAM[i] > 0)
    error flag shall be assigned to the corresponding
    exhaust bank (index x -> index
    i)]
        then
            CTR_ERR_OBD_DIAG_CYL_BAL_LAM[i] =
LAM[i] -
CYL_BAL
mented only once per recurrence] (1.2.1)
        endif(2)

        if(2)      (LV_ERR_CYL_BAL_ER[x] = 0 and
ER > 0)
        then
            CTR_ERR_OBD_DIAG_CYL_BAL_ER =
ER -
CYL_BAL
mented only once per recurrence] (1.2.2)
        endif(2)
endif(1)

```

### B.5.3 Inhibition due to balancing error detected

#### B.5.3.1 Inhibition of cylinder individual lambda control

```

if(1)      CTR_ERR_OBD_DIAG_CYL_BAL_LAM[i] C_CTR_MAX_CYL_BAL_LAM_ERR
then
    LV_INH_OBD_DIAG_CYL_BAL_LAM[i] = 1
                                                    (1.3.1.1)
else(1)
    LV_INH_OBD_DIAG_CYL_BAL_LAM[i] = 0
                                                    (1.3.1.2)
endif(1)

```

#### B.5.3.2 Inhibition of CYBL\_ER

```

if(1)      CTR_ERR_OBD_DIAG_CYL_BAL_ER C_CTR_MAX_CYL_BAL_ER_ERR
then
    LV_INH_OBD_DIAG_CYL_BAL_ER = 1
                                                    (1.3.2.1)
else(1)
    LV_INH_OBD_DIAG_CYL_BAL_ER = 0
                                                    (1.3.2.2)
endif(1)

```

## B.5.4 Diagnosis condition

### B.5.4.1 Diagnosis condition - output of cylinder individual lambda control concerned

**if**<sup>(1)</sup> (STATE\_LAM\_CYL\_SEL\_ADJ[i] = 4 ' ADJ\_NOM\_L\_RNG' or  
5 ' ADJ\_NOM\_H\_RNG')

*calculation shall be executed for all of the  
index i -> index x) - (1.4.1.1) and (1.4.1.3)]*

**then**

LV\_CDN\_DIAG\_CYL\_BAL\_LAM[x] = 1

*executed for all of the exhaust-bank-related cylinders*

LV\_CDN\_DIAG\_CYL\_BAL\_ER[x] = 0

*executed for all of the cylinders (index x)] (1.4.1.2)*

**else**<sup>(1)</sup>

LV\_CDN\_DIAG\_CYL\_BAL\_LAM[x] = 0

*executed for all of the exhaust-bank-related  
cylinders (index i -> index x)] (1.4.1.3)*

**endif**<sup>(1)</sup>

### B.5.4.2 Diagnosis condition - output of CYBL\_ER concerned

**if**<sup>(1)</sup> STATE\_CTL\_TI\_ER\_BAL 0

**then**

LV\_CDN\_DIAG\_CYL\_BAL\_ER[x] = 1

*executed for all of the cylinders (index x)] (1.4.2.1)*

LV\_CDN\_DIAG\_CYL\_BAL\_LAM[x] = 0

*executed for all of the cylinders (index x)] (1.4.2.2)*

**else**<sup>(1)</sup>

LV\_CDN\_DIAG\_CYL\_BAL\_ER[x] = 0

*executed for all of the cylinders (index x)] (1.4.2.3)*

**endif**<sup>(1)</sup>

## B.5.5 Diagnosis self-shutoff

**if**<sup>(1)</sup> LV\_ERR\_CYL\_BAL\_LAM[x] = 1

**then**

LV\_CDN\_DIAG\_CYL\_BAL\_LAM[x] = 0

*executed for all of the exhaust-bank-related  
cylinders (index i -> index x)] (1.5.1)*

**endif**<sup>(1)</sup>

**if**<sup>(1)</sup> LV\_ERR\_CYL\_BAL\_ER[x] = 1

**then**

LV\_CDN\_DIAG\_CYL\_BAL\_ER[x] = 0

[Remark: the calculation shall be

executed for all of the cylinders (index x)] (1.5.2)

**endif**<sup>(1)</sup>

## B.5.6 Error detection

### B.5.6.1 Error detection in the area where the cylinder individual lambda adaptation is concerned

**if**<sup>(1)</sup> LV\_CDN\_DIAG\_CYL\_BAL\_LAM[x] = 1

**then**

**if**<sup>(2)</sup> STATE\_LAM\_CYL\_SEL\_ADJ[i] = 4 ' ADJ\_NOM\_L\_RNG'

[Remark: the exhaust bank based

calculation shall be executed for all of the

exhaust-bank-related cylinders (in-

dex i -> index x) - (1.6.1.1) - (1.6.1.14)]

**then**

**if**<sup>(3)</sup> FAC\_LAM\_CYL\_SEL\_ADJ\_L\_RNG[x] <

C\_FAC\_LAM\_CYL\_SEL\_ADJ\_DIAG\_

MIN

**then**

**increment** (T\_SUM\_CYL\_BAL\_LAM\_LIM\_MIN[x])  
(1.6.1.1)

ERR\_SYM\_CYL\_BAL\_LAM[x] = 1 'SYM\_0'  
(1.6.1.2)

**if**<sup>(4)</sup> T\_SUM\_CYL\_BAL\_LAM\_LIM\_MIN[x] >  
C\_T\_SUM\_THD\_CYL\_BAL\_LIM

**then**

**if**<sup>(5)</sup> LV\_ERR\_REF\_CYL\_BAL\_LAM[i] = 0

**then**

CTR\_ERR\_OBD\_DIAG\_CYL\_BAL\_LAM[i] =  
CTR\_ERR\_OBD\_DIAG\_CYL\_BAL\_

LAM[i] +

C\_CTR\_INC\_ERR\_OBD\_DIAG\_CYL\_

BAL

(1.6.1.3)

LV\_ERR\_REF\_CYL\_BAL\_LAM[i] = 1  
(1.6.1.4)

**endif**<sup>(5)</sup>

**for**<sup>(5)</sup> j(x) = 1 : Number of cylinders per exhaust bank

**if**<sup>(6)</sup> [(T\_SUM\_CYL\_BAL\_LAM\_LIM\_MIN[x] >  
C\_T\_SUM\_MIN\_CYL\_BAL\_LIM) or  
(T\_SUM\_CYL\_BAL\_LAM\_LIM\_MAX[x]

>

C\_T\_SUM\_MIN\_CYL\_BAL\_LIM)]

**then**

LV\_ERR\_CYL\_BAL\_LAM[x] = 1  
(1.6.1.5)

LV\_END\_DIAG\_CYL\_BAL\_LAM[x] = 1  
(1.6.1.6)

LV\_END\_DIAG\_WIN\_CYL\_BAL\_LAM[x] = 1  
(1.6.1.7)

```

                                endif(6)
                            endfor(5)
                        endif(4)
                    else(3)
                        if(4)          FAC_LAM_CYL_SEL_ADJ_L_RNG[x] >
                                C_FAC_LAM_CYL_SEL_ADJ_DIAG_
MAX
                                then
                                    increment (T_SUM_CYL_BAL_LAM_LIM_MAX[x])
                                        (1.6.1.8)
                                    ERR_SYM_CYL_BAL_LAM[x] = 2 'SYM_1'
                                        (1.6.1.9)
                                    if(5)          T_SUM_CYL_BAL_LAM_LIM_MAX[x] >
                                                C_T_SUM_THD_CYL_BAL_LIM
                                then
                                    if(6)          LV_ERR_REF_CYL_BAL_LAM[i] = 0
                                        then
                                            CTR_ERR_OBD_DIAG_CYL_BAL_LAM[i] =
LAM[i] +
                                                CTR_ERR_OBD_DIAG_CYL_BAL_
BAL
                                                C_CTR_INC_ERR_OBD_DIAG_CYL_
                                        (1.6.1.10)
                                        LV_ERR_REF_CYL_BAL_LAM[i] = 1
                                        (1.6.1.11)
                                    endif(6)
                                    for(6)          j(x) = 1 : Number of cylinders per exhaust bank
                                        if(7)          [(T_SUM_CYL_BAL_LAM_LIM_MIN[x] >
                                                C_T_SUM_MIN_CYL_BAL_LIM) or
                                                (T_SUM_CYL_BAL_LAM_LIM_MAX[x]
>
                                                C_T_SUM_MIN_CYL_BAL_LIM)]
                                then
                                    LV_ERR_CYL_BAL_LAM[x] = 1
                                        (1.6.1.12)
                                    LV_END_DIAG_CYL_BAL_LAM[x] = 1
                                        (1.6.1.13)
                                    LV_END_DIAG_WIN_CYL_BAL_LAM[x] = 1
                                        (1.6.1.14)
                                endif(7)
                            endfor(6)
                        endif(4)
                    endif(3)
                else(2)
                    if(3)          STATE_LAM_CYL_SEL_ADJ[i] = 5 ' ADJ_NOM_H_RNG'
                                [Remark: the exhaust bank based
                                calculation shall be executed for all of the
                                exhaust-bank-related cylinders (in-
                                dex i -> index x) - (1.6.1.15) - (1.6.1.28)]
                                then
                                    if(4)          FAC_LAM_CYL_SEL_ADJ_H_RNG[x] <

```

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```

MIN
C_FAC_LAM_CYL_SEL_ADJ_DIAG_
then
  increment (T_SUM_CYL_BAL_LAM_LIM_MIN[x])
  (1.6.1.15)
  ERR_SYM_CYL_BAL_LAM[x] = 1 'SYM_0'
  (1.6.1.16)
  if(5) T_SUM_CYL_BAL_LAM_LIM_MIN[x] >
    C_T_SUM_THD_CYL_BAL_LIM
  then
    if(6) LV_ERR_REF_CYL_BAL_LAM[i] = 0
    then
      CTR_ERR_OBD_DIAG_CYL_BAL_LAM[i] =
      CTR_ERR_OBD_DIAG_CYL_BAL_
      C_CTR_INC_ERR_OBD_DIAG_CYL_
      (1.6.1.17)
      LV_ERR_REF_CYL_BAL_LAM[i] = 1
      (1.6.1.18)
    endif(6)
    for(6) j(x) = 1 : Number of cylinders per exhaust bank
    if(7) [(T_SUM_CYL_BAL_LAM_LIM_MIN[x] >
      C_T_SUM_MIN_CYL_BAL_LIM) or
      (T_SUM_CYL_BAL_LAM_LIM_MAX[x] >
      C_T_SUM_MIN_CYL_BAL_LIM)]
    then
      LV_ERR_CYL_BAL_LAM[x] = 1
      (1.6.1.19)
      LV_END_DIAG_CYL_BAL_LAM[x] = 1
      (1.6.1.20)
      LV_END_DIAG_WIN_CYL_BAL_LAM[x] = 1
      (1.6.1.21)
    endif(7)
    endfor(6)
  endif(5)
else(4)
  if(5) FAC_LAM_CYL_SEL_ADJ_H_RNG[x] >
    C_FAC_LAM_CYL_SEL_ADJ_DIAG_
  then
    increment (T_SUM_CYL_BAL_LAM_LIM_MAX[x])
    (1.6.1.22)
    ERR_SYM_CYL_BAL_LAM[x] = 2 'SYM_1'
    (1.6.1.23)
    if(6) T_SUM_CYL_BAL_LAM_LIM_MAX[x] >
      C_T_SUM_THD_CYL_BAL_LIM
    then
      if(7) LV_ERR_REF_CYL_BAL_LAM[i] = 0
      then
        CTR_ERR_OBD_DIAG_CYL_BAL_LAM[i] =

```

```

LAM[i] +
BAL
CTR_ERR_OBD_DIAG_CYL_BAL_
C_CTR_INC_ERR_OBD_DIAG_CYL_
(1.6.1.24)
LV_ERR_REF_CYL_BAL_LAM[i] = 1
(1.6.1.25)
endif(7)
for(7) j(x) = 1 : Number of cylinders per exhaust
bank
if(8) [(T_SUM_CYL_BAL_LAM_LIM_MIN[x] >
C_T_SUM_MIN_CYL_BAL_LIM) or
(T_SUM_CYL_BAL_LAM_LIM_MAX[x]
>
C_T_SUM_MIN_CYL_BAL_LIM)]
then
LV_ERR_CYL_BAL_LAM[x] = 1
(1.6.1.26)
LV_END_DIAG_CYL_BAL_LAM[x]
= 1
(1.6.1.27)
LV_END_DIAG_WIN_CYL_BAL_
LAM[x] = 1
(1.6.1.28)
endif(8)
endfor(7)
endif(6)
endif(5)
endif(4)
endif(3)
endif(2)
endif(1)

```

### B.5.6.2 Error detection in the area where output of CYBL\_ER is concerned

```

if(1) LV_CDN_DIAG_CYL_BAL_ER[x] = 1
[Remark: the calculation shall be
executed for all of the cylinders (index x) -
(1.6.2.1) - (1.6.2.28)]
then
if(2) (STATE_CTL_TI_ER_BAL = 1 or STATE_CTL_TI_ER_BAL = 2)
then
if(3) LV_MFF_ADD_ER_BAL_OBD_MAX_NEG[x] = 1
then
increment (T_SUM_CYL_BAL_ER_LIM_MIN[x])
(1.6.2.1)
ERR_SYM_CYL_BAL_ER[x] = 1 'SYM_0'
(1.6.2.2)
if(4) T_SUM_CYL_BAL_ER_LIM_MIN[x] >
C_T_SUM_THD_CYL_BAL_LIM
then
if(5) LV_ERR_REF_CYL_BAL_ER = 0
then

```

```

CTR_ERR_OBD_DIAG_CYL_BAL_ER =
ER +
CTR_ERR_OBD_DIAG_CYL_BAL_
BAL
C_CTR_INC_ERR_OBD_DIAG_CYL_
(1.6.2.3)
LV_ERR_REF_CYL_BAL_ER = 1
(1.6.2.4)
endif(5)
for(5) j(x) = 1 : Number of cylinders
if(6) [(T_SUM_CYL_BAL_ER_LIM_MIN[x] >
C_T_SUM_MIN_CYL_BAL_LIM) or
(T_SUM_CYL_BAL_ER_LIM_MAX[x]
>
C_T_SUM_MIN_CYL_BAL_LIM)]
then
LV_ERR_CYL_BAL_ER[x] = 1
(1.6.2.5)
LV_END_DIAG_CYL_BAL_ER[x] = 1
(1.6.2.6)
LV_END_DIAG_WIN_CYL_BAL_ER[x] = 1
(1.6.2.7)
endif(6)
endifor(5)
endif(4)
else(3)
if(4) LV_MFF_ADD_ER_BAL_OBD_MAX_POS[x] = 1
then
increment (T_SUM_CYL_BAL_ER_LIM_MAX[x])
(1.6.2.8)
ERR_SYM_CYL_BAL_ER[x] = 2 'SYM_1'
(1.6.2.9)
if(5) T_SUM_CYL_BAL_ER_LIM_MAX[x] >
C_T_SUM_THD_CYL_BAL_LIM
then
if(6) LV_ERR_REF_CYL_BAL_ER = 0
then
CTR_ERR_OBD_DIAG_CYL_BAL_ER =
ER +
CTR_ERR_OBD_DIAG_CYL_BAL_
BAL
C_CTR_INC_ERR_OBD_DIAG_CYL_
(1.6.2.10)
LV_ERR_REF_CYL_BAL_ER = 1
(1.6.2.11)
endif(6)
for(6) j(x) = 1 : Number of cylinders
if(7) [(T_SUM_CYL_BAL_ER_LIM_MIN[x] >
C_T_SUM_MIN_CYL_BAL_LIM) or
(T_SUM_CYL_BAL_ER_LIM_MAX[x]
>
C_T_SUM_MIN_CYL_BAL_LIM)]
then


```

```

LV_ERR_CYL_BAL_ER[x] = 1
(1.6.2.12)
LV_END_DIAG_CYL_BAL_ER[x] = 1
(1.6.2.13)
LV_END_DIAG_WIN_CYL_BAL_ER[x] = 1
(1.6.2.14)
endif(7)
endfor(6)
endif(5)
endif(4)
endif(3)
else(2)
if(3) (STATE_CTL_TI_ER_BAL = 3 or STATE_CTL_TI_ER_BAL = 4)
then
if(4) LV_MFF_FAC_ER_BAL_OBD_MAX_NEG[x] = 1
then
increment (T_SUM_CYL_BAL_ER_LIM_MIN[x])
(1.6.2.15)
ERR_SYM_CYL_BAL_ER[x] = 1 'SYM_0'
(1.6.2.16)
if(5) T_SUM_CYL_BAL_ER_LIM_MIN[x] >
C_T_SUM_THD_CYL_BAL_LIM
then
if(6) LV_ERR_REF_CYL_BAL_ER = 0
then
CTR_ERR_OBD_DIAG_CYL_BAL_ER =
CTR_ERR_OBD_DIAG_CYL_BAL_
ER +
C_CTR_INC_ERR_OBD_DIAG_CYL_
BAL
(1.6.2.17)
LV_ERR_REF_CYL_BAL_ER = 1
(1.6.2.18)
endif(6)
for(6) j(x) = 1 : Number of cylinders
if(7) [(T_SUM_CYL_BAL_ER_LIM_MIN[x] >
C_T_SUM_MIN_CYL_BAL_LIM) or
(T_SUM_CYL_BAL_ER_LIM_MAX[x]
C_T_SUM_MIN_CYL_BAL_LIM)]
then
LV_ERR_CYL_BAL_ER[x] = 1
(1.6.2.19)
LV_END_DIAG_CYL_BAL_ER[x] = 1
(1.6.2.20)
LV_END_DIAG_WIN_CYL_BAL_ER[x] = 1
(1.6.2.21)
endif(7)
endfor(6)
endif(5)
else(4)
if(5) LV_MFF_FAC_ER_BAL_OBD_MAX_POS[x] = 1

```

&gt;

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```

then
    increment (T_SUM_CYL_BAL_ER_LIM_MAX[x])
                (1.6.2.22)
    ERR_SYM_CYL_BAL_ER[x] = 2 'SYM_1'
                (1.6.2.23)
    if(6)      T_SUM_CYL_BAL_ER_LIM_MAX[x] >
                C_T_SUM_THD_CYL_BAL_LIM
    then
        if(7)    LV_ERR_REF_CYL_BAL_ER = 0
        then
            CTR_ERR_OBD_DIAG_CYL_BAL_ER =
                CTR_ERR_OBD_DIAG_CYL_BAL_
ER +
                C_CTR_INC_ERR_OBD_DIAG_CYL_
BAL
                (1.6.2.24)
            LV_ERR_REF_CYL_BAL_ER = 1
                (1.6.2.25)
        endif(7)
        for(7)    j(x) = 1 : Number of cylinders
            if(8) [(T_SUM_CYL_BAL_ER_LIM_MIN[x] >
                C_T_SUM_MIN_CYL_BAL_LIM) or
                (T_SUM_CYL_BAL_ER_LIM_MAX[x]
>
                C_T_SUM_MIN_CYL_BAL_LIM)]
            then
                LV_ERR_CYL_BAL_ER[x] = 1
                    (1.6.2.26)
                LV_END_DIAG_CYL_BAL_ER[x] = 1
                    (1.6.2.27)
                LV_END_DIAG_WIN_CYL_BAL_
ER[x] = 1
                    (1.6.2.28)
            endif(8)
        endfor(7)
    endif(6)
endif(5)
endif(4)
endif(3)
endif(2)
endif(1)

```

## B.5.7 Update of diagnosis window

### B.5.7.1 Update of diagnosis window - output of cylinder individual lambda control concerned

```
if(1)      LV_CDN_DIAG_CYL_BAL_LAM[x] = 1
```

*[Remark: the calculation shall be*


*executed for all of the cylinders (index x) -*  
- (1.7.1.10)]

(1.7.1.1)

```
then
```

```
    if(2)      (ERR_SYM_CYL_BAL_LAM[x] > 0 and T_SUM_RST_CYL_BAL_LAM[x] = 0)
```

```
    then
```

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T\_SUM\_END\_DIAG\_WIN\_CYL\_LAM[x] = 0

(1.7.1.1)

endif<sup>(2)</sup>

if<sup>(2)</sup> (ERR\_SYM\_CYL\_BAL\_LAM[x] > 0 or T\_SUM\_RST\_CYL\_BAL\_LAM[x] > 0)

then

increment (T\_SUM\_RST\_CYL\_BAL\_LAM[x])

(1.7.1.2)

endif<sup>(2)</sup>

increment (T\_SUM\_END\_DIAG\_WIN\_CYL\_LAM[x])

(1.7.1.3)

if<sup>(2)</sup> T\_SUM\_END\_DIAG\_WIN\_CYL\_LAM[x] = C\_T\_SUM\_RST\_MAX\_CYL\_BAL

then

LV\_END\_DIAG\_CYL\_BAL\_LAM[x] = 1

(1.7.1.4)

LV\_END\_DIAG\_WIN\_CYL\_BAL\_LAM[x] = 1

(1.7.1.5)

T\_SUM\_END\_DIAG\_WIN\_CYL\_LAM[x] = 0

(1.7.1.6)

else<sup>(2)</sup>

if<sup>(3)</sup> LV\_ERR\_CYL\_BAL\_LAM[x] = 0

then

LV\_END\_DIAG\_WIN\_CYL\_BAL\_LAM[x] = 0

(1.7.1.7)

endif<sup>(3)</sup>

endif<sup>(2)</sup>

if<sup>(2)</sup> (T\_SUM\_RST\_CYL\_BAL\_LAM[x] = C\_T\_SUM\_RST\_MAX\_CYL\_BAL and LV\_ERR\_CYL\_BAL\_LAM[x] = 0)

then

T\_SUM\_CYL\_BAL\_LAM\_LIM\_MIN[x] = 0

(1.7.1.8)

T\_SUM\_CYL\_BAL\_LAM\_LIM\_MAX[x] = 0

(1.7.1.9)

T\_SUM\_RST\_CYL\_BAL\_LAM[x] = 0

(1.7.1.10)

endif<sup>(2)</sup>

### B.5.7.1.1 Diagnosis- interrupt in case of intervention of phase shift adaptation

if<sup>(2)</sup> (STATE\_DELTA\_CRK\_CYL\_LAM[i] = 3 'AD\_INI' or  
= 4 'AD\_DEC' or  
= 5 'AD\_INC')

calculation shall be executed for all of the

dex  $i \rightarrow$  index  $x$ ) - (1.7.1.1.1) - (1.7.1.1.8)]

then

T\_SUM\_CYL\_BAL\_LAM\_LIM\_MIN[x] = 0

(1.7.1.1.1)

T\_SUM\_CYL\_BAL\_LAM\_LIM\_MAX[x] = 0

(1.7.1.1.2)

T\_SUM\_RST\_CYL\_BAL\_LAM[x] = 0

```

T_SUM_END_DIAG_WIN_CYL_LAM[x] = 0 (1.7.1.1.3)
LV_END_DIAG_CYL_BAL_LAM[x] = 0 (1.7.1.1.4)
LV_END_DIAG_WIN_CYL_BAL_LAM[x] = 0 (1.7.1.1.5)
LV_ERR_CYL_BAL_LAM[x] = 0 (1.7.1.1.6)
ERR_SYM_CYL_BAL_LAM[x] = 0 'NO_SYM' (1.7.1.1.7)
ERR_SYM_CYL_BAL_LAM[x] = 0 'NO_SYM' (1.7.1.1.8)
endif(2)
endif(1)

```

### B.5.7.2 Update of diagnosis window - output of CYBL\_ER concerned

```
if(1) LV_CDN_DIAG_CYL_BAL_ER[x] = 1
```

[Remark: the calculation shall be

executed for all of the cylinders (index x) -

(1.7.2.1)

- (1.7.2.10)]

then

```
if(2) (ERR_SYM_CYL_BAL_ER[x] > 0 and T_SUM_RST_CYL_BAL_ER[x] = 0)
```

then

```
T_SUM_END_DIAG_WIN_CYL_BAL_ER[x] = 0
```

(1.7.2.1)

endif(2)

```
if(2) (ERR_SYM_CYL_BAL_ER[x] > 0 or T_SUM_RST_CYL_BAL_ER[x] > 0)
```

then

```
increment (T_SUM_RST_CYL_BAL_ER[x])
```

(1.7.2.2)

endif(2)

```
increment (T_SUM_END_DIAG_WIN_CYL_BAL_ER[x])
```

(1.7.2.3)

```
if(2) T_SUM_END_DIAG_WIN_CYL_BAL_ER[x] = C_T_SUM_RST_MAX_CYL_BAL
```

then

```
LV_END_DIAG_CYL_BAL_ER[x] = 1
```

(1.7.2.4)

```
LV_END_DIAG_WIN_CYL_BAL_ER[x] = 1
```

(1.7.2.5)

```
T_SUM_END_DIAG_WIN_CYL_BAL_ER[x] = 0
```

(1.7.2.6)

else(2)

```
if(3) LV_ERR_CYL_BAL_ER[x] = 0
```

then

```
LV_END_DIAG_WIN_CYL_BAL_ER[x] = 0
```

(1.7.2.7)

endif(3)

endif(2)

```
if(2) (T_SUM_RST_CYL_BAL_ER[x] = C_T_SUM_RST_MAX_CYL_BAL and
LV_ERR_CYL_BAL_ER[x] = 0)
```

then

```
T_SUM_CYL_BAL_ER_LIM_MIN[x] = 0
```

(1.7.2.8)


$$T\_SUM\_CYL\_BAL\_ER\_LIM\_MAX[x] = 0$$

(1.7.2.9)

$$T\_SUM\_RST\_CYL\_BAL\_ER[x] = 0$$

(1.7.2.10)

**endif**<sup>(2)</sup>  
**endif**<sup>(1)</sup>

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## B.6 Cylinder individual lambda control monitoring

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_LAM_CYL_SEL [ _i]	O/V	0... 1H	0 ...1	1	-
CILC error detected over several driving cycles					

### Input data:

LV_ES {p. 1720}	LV_INH_OBD_DIAG_CYL_ BAL_LAM [NC_CBK_EX_NR] {p. 5113}	LV_ST_END {p. 1720}	NC_CBK_EX_NR {p. 1829}
-----------------	--	---------------------	------------------------

### FUNCTION DESCRIPTION:

#### General information:

Variable assignment

#### Description of index " \_i":

use **NC\_LAMB\_REF**: pattern for allocation of physical cylinders to exhaust bank - index " \_j or [i]"

#### Remark:

index " \_i" is equivalent to "[i]"

#### Application conditions

#### Initialization:

at reset, LV\_IGK = 0 1 and clear error memory:

LV\_ERR\_LAM\_CYL\_SEL\_i = 0

#### Recurrence:

T\_SAMPLE = 100 ms

#### Activation:

- LV\_ST\_END = 1

#### Deactivation:

- LV\_ES = 1

#### Formula section:

LV\_ERR\_LAM\_CYL\_SEL\_i = LV\_INH\_OBD\_DIAG\_CYL\_BAL\_LAM[i]

## B.7 O2 sensor (bin, down) dynamic diagnosis after NOx CAT regeneration

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_END_DIAG_RGN_NT_LS_DOWN [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for end bit calculation					
CTR_SYM_DIAG_RGN_NT_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Counter for internal anti-bounce of error symptom					
LV_DIAG_ACT_RGN_NT_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0...1	1	-
Logical variable indicating that diagnosis conditions are fulfilled					
LV_DIAG_RGN_NT_LS_DOWN_END [NC_CBK_EX_NR]	O/V	0... 1H	0...1	1	-
End bit for monitoring lean to rich switching times after Nox cat regeneration					
LV_DIAG_RGN_NT_LS_DOWN_ERR [NC_CBK_EX_NR]	O/V	0... 1H	0...1	1	-
Debounced diagnosis result for monitoring lean to rich switching times after Nox cat regeneration					
MAF_INT_RGN_NT_END [NC_CBK_EX_NR]	V	0... FFFFH	0... 2912.66666	0.0444444	g
Mass air flow which has passed since last regeneration cycle					
MAF_INT_RGN_NT_S_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0... 2912.66666	0.0444444	g
Mass air flow which has passed since activation of stratified mode					
T_RGN_NT_END [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Time which has passed after leaving last regeneration cycle					
VLS_DOWN_RGN_NT_DIF [NC_CBK_EX_NR]	V	FC00... 3FFH	-5... 4.99511	4.8828e-3	V
Measured Voltage difference used for error detection					
VLS_DOWN_RGN_NT_END [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511	4.8828e-3	V
Maximum monitor sensor voltage during last regeneration phase of NOx trap, Bank i (i=1,2)					
VLS_DOWN_RGN_NT_MAX_TMP [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511	4.8828e-3	V
Temporary maximum monitor sensor voltage during MAF integral calculation in stratified mode					
VLS_DOWN_RGN_NT_MES_SAE [NC_CBK_EX_NR]	O/V/S	0... FFFFH	0... 7.99987	122.1e-6	V
Test value for diagnosis result evaluation for mode 6 communication					
VLS_DOWN_RGN_NT_MIN_END [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511	4.8828e-3	V
Minimum monitor sensor voltage during MAF integral calculation in stratified mode					
VLS_DOWN_RGN_NT_MIN_SAE [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 7.99987	122.1e-6	V
Minimum voltage threshold for diagnosis result evaluation for mode 6 communication					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VLS_DOWN_RGN_NT_MIN_TMP [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511	4.8828e-3	V
Temporary minimum monitor sensor voltage during MAF integral calculation in stratified mode					


**Input data:**

LV_IGK {p. 906}	LV_INH_DIAG_RGN_NT_LS_DOWN [NC_CBK_EX_NR] {p. 5148}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_NT_RGN_REQ {p. 996}
LV_NT_RGN_REQ_AD {p. 996}	LV_S_ACT {p. 8137}	MAF_KGH {p. 1195}	NC_CBK_EX_NR {p. 1829}
STATE_RGN [NC_CBK_EX_NR] {p. 2885}	TCO {p. 1100}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_END_DIAG_RGN_NT_LS_DOWN	-	0... FFH	0... 255	1	-
Counter threshold for setting of diagnosis end bit					
C_CTR_INC_DIAG_RGN_NT_LS_DOWN	-	0... FFH	0... 255	1	-
Counter increment for present error symptom					
C_CTR_SYM_MAX_RGN_NT_LS_DOWN	-	0... FFFFH	0... 65535	1	-
Threshold for detection of downstream sensor dynamic error after NOx cat regeneration					
C_MAF_INT_RGN_NT_END	-	0... FFFFH	0... 2912.66666	0.0444444	g
Mass air flow which has passed since last regeneration cycle					
C_MAF_INT_RGN_NT_S_ACT	-	0... FFFFH	0... 2912.66666	0.0444444	g
Mass air flow which has passed since activation of stratified mode					
C_MAF_MAX_DIAG_RGN_NT_LS_DOWN	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Maximum mass air flow for activation of RGN_NT_LS_DOWN[i] diagnosis					
C_MAF_MIN_DIAG_RGN_NT_LS_DOWN	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Minimum mass air flow for activation of RGN_NT_LS_DOWN[i] diagnosis					
C_T_RGN_NT_END	-	0... FFFFH	0... 1310.7	0.02	s
Threshold for time which has passed after leaving last regeneration cycle					
C_TCO_MIN_DIAG_RGN_NT_LS_DOWN	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature for activation of RGN_NT_LS_DOWN[i] diagnosis					
C_TEMP_MIN_DIAG_RGN_NT_LS_DOWN	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Catalyst temperature threshold for activation of RGN_NT_LS_DOWN[i] diagnosis					
C_VLS_DOWN_RGN_NT_DIF_THD	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Measured Voltage difference used for error detection					
C_VLS_MIN_DIAG_RGN_LS_DOWN	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Minimum voltage during regeneration phase to enable diagnosis					
LC_STATE_RGN_L_AMPL_DEAC	-	0... 1H	0 ...1	1	-
Logical calibration data to skip check of STATE_RGN[i] depending on regeneration strategy					

**FUNCTION DESCRIPTION:****General information:**

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The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

With level monitoring of the monitor sensor after leaving regeneration phase of NOx trap unplausible voltage values can be detected and a plausibility check of the sensor can be made.

### Description:

If the general conditions for activating the diagnostic function are fulfilled and if during a regeneration phase either the state STATE\_RGN[i] is set to L\_AMPL or LC\_STATE\_RGN\_L\_AMPL\_DEAC = 1 (withdrawal of monitoring STATE\_RGN[i] depending on regeneration strategy) the lambda probe voltage and its previous value shall be stored.

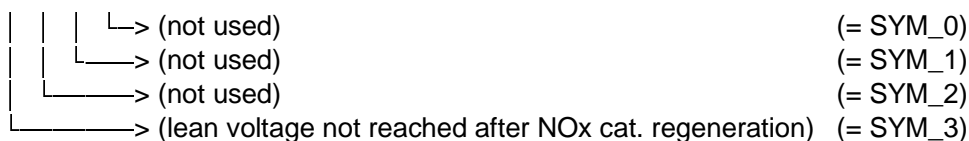
Upon leaving the regeneration phase the previously measured voltage shall be compared to the threshold which, when exceeded, allows to activate the diagnosis as indicated by LV\_DIAG\_ACT\_RGN\_NT\_LS\_DOWN[i] = 1. Additionally the timer T\_RGN\_NT\_END[i] and the mass air flow integral MAF\_INT\_RGN\_NT\_END[i] are calculated until the next stratified combustion mode is activated.


Provided that the stratified mode is activated before the timer T\_RGN\_NT\_END[i] or the MAF integral MAF\_INT\_RGN\_NT\_END[i] exceed their respective threshold values monitoring the lambda probe voltage after leaving the regeneration phase shall be started and the MAF integral MAF\_INT\_RGN\_NT\_S\_ACT[i] shall be calculated. After exceeding the MAF integral threshold C\_MAF\_INT\_RGN\_NT\_S\_ACT, i.e. if the stratified mode has been active long enough, the voltage difference between leaving the regeneration phase and exceeding the MAF integral threshold shall be calculated as expressed by VLS\_DOWN\_RGN\_NT\_DIF[i].

Comparison of the voltage difference to a threshold value allows to recognize a sensor malfunction. Each time the voltage comparison is made the counter for end of diagnosis recognition shall be increased. Provided that the measured voltage difference does not exceed its respective threshold C\_VLS\_DOWN\_RGN\_NT\_DIF\_THD the symptom counter CTR\_SYM\_DIAG\_RGN\_NT\_LS\_DOWN[i] shall be incremented by the calibratable increment C\_CTR\_INC\_DIAG\_RGN\_NT\_LS\_DOWN and decremented otherwise with a decrement of 1.

The final diagnosis result is drawn after the end cycle counter has reached the calibratable minimum number of necessary diagnostic cycles C\_CTR\_END\_DIAG\_RGN\_NT\_LS\_DOWN. In this case the end indication flag shall be set and the error indication flag shall be set following an n-out-of-m statistical evaluation for the case that the symptom counter has exceeded the corresponding threshold C\_CTR\_SYM\_MAX\_RGN\_NT\_LS\_DOWN. The result shall not be transmitted to the ERRM directly, since another diagnosis is expected to include it in its error and end state considerations.

### Error-symptoms and conditions:



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**Application conditions:***Initialisation:*

At reset or the transition of LV\_IGK = 0 -> 1 or at clearing the error memory all variables shall be reset to 0, except VLS\_DOWN\_RGN\_NT\_MES\_SAE[i] and VLS\_DOWN\_RGN\_NT\_MIN\_SAE[i].

*Initialisation in case of new ECU and NVMY checksum errors:*

VLS\_DOWN\_RGN\_NT\_MES\_SAE[i] = 0V

*Initialisation in case of reset:*

VLS\_DOWN\_RGN\_NT\_MIN\_SAE[i] = C\_VLS\_DOWN\_RGN\_NT\_DIF\_THD

Recurrence: 20 ms

Activation: At any engine operating state

**Formula section:***Check diagnosis availability*

```

if                LV_INH_DIAG_RGN_NT_LS_DOWN[i] = 0
and                LV_DIAG_RGN_NT_LS_DOWN_END[i] = 0
and                TCO > C_TCO_MIN_DIAG_RGN_NT_LS_DOWN
and                LV_LS_DOWN_READY[i] = 1
and                C_MAF_MIN_DIAG_RGN_NT_LS_DOWN <= MAF_KGH
                    <= C_MAF_MAX_DIAG_RGN_NT_LS_DOWN
and                TEMP_CAT_DYN_MDL[i] > C_TEMP_MIN_DIAG_RGN_NT_LS_DOWN
then              % diagnosis available
                    if                LV_NT_RGN_REQ = 0 -> 1
                    then              VLS_DOWN_RGN_NT_END[i] = 0           % reinitialize for a new cycle
                    endif
                    if                LV_NT_RGN_REQ = 1
                    and                (STATE_RGN[i] = L_AMPL
                    or                LC_STATE_RGN_L_AMPL_DEAC = 1)
                    and                LV_NT_RGN_REQ_AD = 0
                    then              VLS_DOWN_RGN_NT_END[i] =
                    MAX (VLS_DOWN[i](n-1), VLS_DOWN_RGN_NT_END[i])
                    endif
                    if                LV_NT_RGN_REQ = 1 -> 0
                    and                VLS_DOWN_RGN_NT_END[i] > C_VLS_MIN_DIAG_RGN_LS_DOWN
                    then              VLS_DOWN_RGN_NT_MIN_END[i] = physical maximum limit
                    LV_DIAG_ACT_RGN_NT_LS_DOWN[i] = 1
                    diagnosis available
                    endif
else              % diagnosis not available
                    LV_DIAG_ACT_RGN_NT_LS_DOWN[i] = 0
                    VLS_DOWN_RGN_NT_END[i] = 0
                    VLS_DOWN_RGN_NT_DIF[i] = 0
                    MAF_INT_RGN_NT_END[i] = 0
                    MAF_INT_RGN_NT_S_ACT[i] = 0
                    T_RGN_NT_END[i] = 0
endif


```

*Conditions for activation of diagnosis fulfilled*

```

if                LV_DIAG_ACT_RGN_NT_LS_DOWN[i] = 1
then              if                LV_S_ACT = 0
                    then              Check if stratified mode activated in time

```

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```

MAF_INT_RGN_NT_S_ACT[i] = 0
if      (MAF_INT_RGN_NT_END[i] C_MAF_INT_RGN_NT_END
or      T_RGN_NT_END[i] C_T_RGN_NT_END )
then    LV_DIAG_ACT_RGN_NT_LS_DOWN[i] = 0
          MAF_INT_RGN_NT_END[i] = 0
          T_RGN_NT_END[i] = 0
          VLS_DOWN_RGN_NT_END[i] = 0
else    MAF_INT_RGN_NT_END[i] =
          MAF_INT_RGN_NT_END[i] + MAF_KGH * 0.02/3.6
          T_RGN_NT_END[i] = T_RGN_NT_END[i] + T_SAMPLE
endif
else    Monitoring of lambda probe voltage after NOx catalyst regeneration
          MAF_INT_RGN_NT_END[i] = 0
          T_RGN_NT_END[i] = 0
if      MAF_INT_RGN_NT_S_ACT[i] > C_MAF_INT_RGN_NT_S_ACT
then    VLS_DOWN_RGN_NT_DIF[i] = VLS_DOWN_RGN_NT_END[i] -
          VLS_DOWN_RGN_NT_MIN_END[i]
          LV_DIAG_ACT_RGN_NT_LS_DOWN[i] = 0
          CTR_END_DIAG_RGN_NT_LS_DOWN[i] =
          CTR_END_DIAG_RGN_NT_LS_DOWN[i] + 1
          VLS_DOWN_RGN_NT_END[i] = 0
          MAF_INT_RGN_NT_S_ACT[i] = 0
if      VLS_DOWN_RGN_NT_DIF[i] <
          C_VLS_DOWN_RGN_NT_DIF_THD
then    CTR_SYM_DIAG_RGN_NT_LS_DOWN[i] =
          CTR_SYM_DIAG_RGN_NT_LS_DOWN[i] +
          C_CTR_INC_DIAG_RGN_NT_LS_DOWN
          VLS_DOWN_RGN_NT_MIN_TMP[i] =
          VLS_DOWN_RGN_NT_DIF[i]
else    CTR_SYM_DIAG_RGN_NT_LS_DOWN[i] =
          CTR_SYM_DIAG_RGN_NT_LS_DOWN[i] - 1
          VLS_DOWN_RGN_NT_MAX_TMP[i] =
          VLS_DOWN_RGN_NT_DIF[i]
endif
else    MAF_INT_RGN_NT_S_ACT[i] =
          MAF_INT_RGN_NT_S_ACT[i] + MAF_KGH * 0.02/3.6
          VLS_DOWN_RGN_NT_MIN_END[i] =
          MIN(VLS_DOWN[i], VLS_DOWN_RGN_NT_MIN_END[i]n-1)
endif
endif

```


**endif**

#### Evaluation of final diagnosis result

```

if      CTR_END_DIAG_RGN_NT_LS_DOWN[i]
          C_CTR_END_DIAG_RGN_NT_LS_DOWN
then    LV_DIAG_RGN_NT_LS_DOWN_END[i] = 1
if      CTR_SYM_DIAG_RGN_NT_LS_DOWN[i]
          C_CTR_SYM_MAX_RGN_NT_LS_DOWN
then    LV_DIAG_RGN_NT_LS_DOWN_ERR[i] = 1
          VLS_DOWN_RGN_NT_MES_SAE[i] = VLS_DOWN_RGN_NT_MIN_TMP[i]
else    LV_DIAG_RGN_NT_LS_DOWN_ERR[i] = 0


```

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```

VLS_DOWN_RGN_NT_MES_SAE[i] = VLS_DOWN_RGN_NT_MAX_TMP[i]
endif
endif
endif

```

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## B.8 O2 sensor (bin, down) dynamic diagnosis after NOx CAT reg. (Appl.Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_RGN_NT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable indicating inhibition of downstream oxygen sensor diagnosis after NOx cat regeneration					

### Input data:

LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAM_CUS {p. 1042}	LV_ERR_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}
LV_ERR_CHG_LS_DOWN {p. 5388}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CRK {p. 4455}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_EL_CPS {p. 4708}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}
LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_IVVT {p. 1062}
LV_ERR_MAF {p. 4815}	LV_ERR_MAP_DIP_ PLAUS {p. 1062}	LV_ERR_MAP_DIP_SENS {p. 4824}	LV_ERR_MAP_DIP_SHIFT {p. 4824}
LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_MEC_OPEN_ CPS {p. 1001}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_SLV_IVVT_IN {p. 4627}
LV_ERR_TCO {p. 4496}	LV_ERR_TPS {p. 4982}	LV_ERR_TTIP_MES_LSH_ UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VCV {p. 4729}
LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_LS_DOWN_OBD_2_ MAN_DEAC [NC_CBK_EX_NR] {p. 5449}	LV_MIS_STATE_A {p. 6238}	LV_MIS_STATE_B {p. 6238}
NC_CBK_EX_NR {p. 1829}			


### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_INH_DIAG_RGN_NT_LS_DOWN [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Manual deactivation of the RGN_NT_LS_DOWN diagnosis (when = 1)					

### 1.1. Calculation of inhibition for diagnosis

### FUNCTION DESCRIPTION:

### General information:

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The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

### Application conditions

**Initialization:** *at reset all variables shall be initialized with 1*

At the transition LV\_IGK = 0 -> 1 or ECU-Reset:

LV\_INH\_DIAG\_RGN\_NT\_LS\_DOWN[i] = 0

At the transition LV\_IGK = 1 -> 0

LV\_INH\_DIAG\_RGN\_NT\_LS\_DOWN[i] = 1

**Recurrence:** 20 ms

**Activation:** LV\_IGK = 1

**Deactivation:** LV\_IGK = 0

### Formula section:


IF	LV_ERR_LS_DOWN[i] = 1	OR
	LV_ERR_FSD[i] = 1	OR
	LV_ERR_MAF = 1	OR
	LV_ERR_MAP_DIP_SENS = 1	OR
	LV_ERR_MAP_DIP_PLAUS = 1	OR
	LV_ERR_MAP_DIP_SHIFT = 1	OR
	LV_ERR_CHG_LS_UP = 1	OR
	LV_ERR_DIAGCPS = 1	OR
	LV_MIS_STATE_A = 1	OR
	LV_MIS_STATE_B = 1	OR
	LV_ERR_CRK = 1	OR
	LV_ERR_CAM_CUS = 1	OR
	LV_ERR_AMP = 1	OR
	LV_ERR_AMP_PLAUS = 1	OR
	LV_ERR_DELTA_I_LAM[i] = 1	OR
	LV_ERR_VLS_DOWN_DIF[i] = 1	OR
	LV_ERR_FSD_LAM_LIM[i] = 1	OR
	LV_ERR_FUP = 1	OR
	LV_ERR_FUP_MFP_PLAUS = 1	OR
	LV_ERR_H_PRS_SYS = 1	OR
	LV_ERR_VCV = 1	OR
	LV_ERR_CHG_LS_DOWN = 1	OR
	LV_ERR_FUP_ORNG = 1	OR
	LV_ERR_FUP_ST = 1	OR
	LV_ERR_TTIP_MES_LSH_UP[i] = 1	OR
	LV_ERR_IV[x] = 1 (x = 0,2,4 for Bank1; x=1,3,5 for Bank2)	OR
	LV_ERR_IVVT = 1	OR
	LV_ERR_CAT_DIAG[i] = 1	OR
	LV_ERR_EL_CPS = 1	OR
	LV_ERR_MEC_OPEN_CPS = 1	OR
	LV_ERR_TCO = 1	OR

```

LV_ERR_TPS = 1
LV_LS_DOWN_OBD_2_MAN_DEAC[i] = 1
LC_INH_DIAG_RGN_NT_LS_DOWN[i] = 1
LV_ERR_SLV_IVVT_IN = 1
LV_ERR_OFS_LSL_UP[i] = 1
LV_ERR_CTL_LSL_UP[i] = 1
LV_ERR_MAP_TPS_PLAUS = 1
OR
OR
OR
OR
OR
OR
OR
THEN
LV_INH_DIAG_RGN_NT_LS_DOWN[i] = 1
ELSE
LV_INH_DIAG_RGN_NT_LS_DOWN[i] = 0
ENDIF

```

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## B.9 O2 sensor (bin, down) dynamic diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CYCNR_SWT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 1.99218	0.0078125	-
Average of weighted CTR_SWT_ACT_LS_DOWN[NC_CBK_EX_NR], Bank i					
CTR_QUO_SUM_SWT_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 511.99219	0.0078125	-
Sum of weighted CTR_SWT_ACT_LS_DOWN[NC_CBK_EX_NR], Bank i					
CTR_QUO_SWT_LS_DOWN [NC_CBK_EX_NR]	V	0... FFH	0... 1.99218	0.0078125	-
weighted value of CTR_SWT_ACT_LS_DOWN[NC_CBK_EX_NR]					
CTR_QUO_SWT_LS_DOWN_MAX [NC_CBK_EX_NR]	V	0... FFH	0... 1.99218	0.0078125	-
Maximum measured weighted value of CTR_SWT_ACT_LS_DOWN[NC_CBK_EX_NR]					
CTR_QUO_SWT_LS_DOWN_MIN [NC_CBK_EX_NR]	V	0... FFH	0... 1.99218	0.0078125	-
Minimum measured weighted value of CTR_SWT_ACT_LS_DOWN[NC_CBK_EX_NR]					
CTR_QUO_SWT_RBM_LS_DOWN [NC_CBK_EX_NR]	V	0... FFH	0... 1.99218	0.0078125	-
weighted value of CTR_SWT_ACT_RBM_LS_DOWN[NC_CBK_EX_NR] for RBM purpose					
CTR_SAVE_SWT_LS_DOWN [NC_CBK_EX_NR]	O/V/S	0... FFH	0... 1.99218	0.0078125	-
Mean value of the ratio between the monitor sensor switching time and the threshold value for scantool					
CTR_SWT_ACT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 5100	20	ms
Cycle counter for switching time determination, Bank i					
CTR_SWT_ACT_RBM_LS_DOWN [NC_CBK_EX_NR]	V	0... FFH	0... 5100	20	ms
Cycle counter for RBM switching time determination, Bank i					
CTR_SWT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Number of valid switching times from rich to lean					
ERR_SYM_SWT_LS_DOWN [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Determined error of the switching time diagnosis					
LV_CDN_DIAG_SWT_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Status of permission for diagnosis of switching time check					
LV_DIAG_MPL_CDN_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Status of general activation conditions for diagnosis					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_SWT_LS_DOWN_S_ENA [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Conditions for SWT diagnosis after rich-lean combustion mode transition fulfilled					
LV_END_DIAG_SWT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
bit to indicate end of switching time diagnosis					
LV_ERR_SWT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Error bit of the switching time diagnosis					
LV_SWT_DIAG_VLD_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Validity bit of the current switching time check					
MAF_INT_LAMB_AFR_SWT_S_ENA [NC_CBK_EX_NR]	V	0... FFFFH	0... 2912.66666	0.0444444	g
Air mass with definite rich conditions for stratified SWT diagnosis (upstream lambda criterion)					
MAF_INT_S_MAX_SWT_S [NC_CBK_EX_NR]	V	0... FFFFH	0... 2912.66666	0.0444444	g
Air mass after entering lean combustion mode for stratified SWT diagnosis					
MAF_INT_VLS_AFR_SWT_S_ENA [NC_CBK_EX_NR]	V	0... FFFFH	0... 2912.66666	0.0444444	g
Air mass with definite rich conditions for stratified SWT diagnosis (downstream lambda criterion)					
MAF_KGH_MIN_PUC	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Minimum value of MAF_KGH while switching time calculation					
T_LAMB_NOT_AFR_SWT_S_ENA [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Time after leaving definite rich conditions for stratified SWT diagnosis (upstream lambda criterion)					
T_VLS_NOT_AFR_SWT_S_ENA [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Time after leaving definite rich conditions for stratified SWT diagnosis (downstream lambda criterion)					
VLS_DOWN_TRAN_PUC [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Monitor sensor voltage on activating the trailing throttle fuel cut-off, Bank i					

**Input data:**

LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LAMB_SP_FIL_S [NC_CBK_EX_NR] {p. 2462}	LV_DIAG_RGN_NT_LS_ DOWN_END [NC_CBK_EX_NR] {p. 5142}	LV_DIAG_RGN_NT_LS_ DOWN_ERR [NC_CBK_EX_NR] {p. 5142}
LV_END_DIAG_PUE_LS_ DOWN [NC_CBK_EX_NR] {p. 5169}	LV_IGK {p. 906}	LV_INH_DIAG_SWT_LS_ DOWN [NC_CBK_EX_NR] {p. 5160}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}
LV_PUC {p. 1720}	LV_S_ACT {p. 8137}	MAF_INT_PUC_ACT {p. 2942}	MAF_INT_PUC_NOT_ACT {p. 2942}
MAF_KGH {p. 1195}	NC_CBK_EX_NR {p. 1829}	TCO {p. 1100}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}
VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VS {p. 1176}		

**Calibration data:**

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_SWT_DIAG_LS_DOWN	-	0... FFH	0... 255	1	-
Condition for the start of the lambda sensor switching time check					
C_CTR_SWT_LS_DOWN	-	0... FFH	0... 1.99218	0.0078125	-
Diagnostic threshold for CTR_CYCNR_SWT_LS_DOWN[NC_CBK_EX_NR]					
C_FAC_VLS_MAX_DIAG_SWT_LS_DOWN	-	0... FFH	0... 0.99609	3.9063e-3	-
Reduction factor for start of switching time determination					
C_FAC_VLS_MIN_DIAG_SWT_LS_DOWN	-	0... FFH	0... 0.99609	3.9063e-3	-
Reduction factor for end of switching time determination					
C_LAMB_SP_AFR_MAX_SWT_S	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Maximum lambda to determine rich conditions for stratified SWT diagnosis (upstream lambda criterion)					
C_LAMB_SP_MIN_AFL_SWT_S	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Minimum upstream lambda at the moment of signal transition to validate a switching time measurement					
C_MAF_INT_MIN_LAMB_AFR_SWT_S	-	0... FFFFH	0... 2912.66666	0.0444444	g
Minimum air mass to determine rich conditions for stratified SWT diagnosis (upstream lambda criterion)					
C_MAF_INT_MIN_VLS_AFR_SWT_S	-	0... FFFFH	0... 2912.66666	0.0444444	g
Minimum air mass to determine rich conditions for stratified SWT diagnosis (downstream lambda criterion)					
C_MAF_INT_S_MAX_SWT_S	-	0... FFFFH	0... 2912.66666	0.0444444	g
Air mass limit after which diagnosis cycle is aborted if no signal transition occurred					
C_MAF_PUC_MAX_DIAG_SWT_LS_DOWN	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Mass air flow threshold for diagnosis of the switching times					
C_MAF_PUC_MIN_DIAG_SWT_LS_DOWN	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Mass air flow threshold for diagnosis of the switching times					
C_T_MAX_LAMB_NOT_AFR_SWT_S [NC_CBK_EX_NR]	-	0... FFFFH	0... 1310.7	0.02	s
Maximum time after leaving rich conditions for stratified SWT diagnosis (upstream lambda criterion)					
C_T_MAX_VLS_NOT_AFR_SWT_S	-	0... FFFFH	0... 1310.7	0.02	s
Maximum time after leaving rich conditions for stratified SWT diagnosis (downstream lambda criterion)					
C_TCO_MIN_DIAG_MPL_LS_DOWN	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature for diagnosis of the monitor sensors					
C_TEMP_CAT_MIN_DIAG_MPL_LS_DOWN	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Catalyst temperature threshold for diagnosis of the monitor sensors					
C_VLS_DOWN_AFR_MIN_SWT_S	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Minimum signal to determine rich conditions for stratified SWT diagnosis (downstream lambda criterion)					
C_VLS_HYS_DIAG_SWT_LS_DOWN	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Monitor sensor voltage hysteresis					
C_VLS_PUC_MIN_DIAG_SWT_LS_DOWN	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Voltage threshold for monitor sensor diagnosis					
C_VS_MAX_DIAG_MPL_LS_DOWN	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed for diagnosis of the monitor sensors					
C_VS_MIN_DIAG_MPL_LS_DOWN	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed for diagnosis of the monitor sensors					
IP_FAC_CYCNR_MAX_LS_DOWN_ACT	-	0... FFH	0... 5100	20	ms
LDP_MAF_KGH_IP_FAC_LS_DOWN	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
Weighting factor for CTR_SWT_ACT_LS_DOWN[NC_CBK_EX_NR]					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_DIAG_SWT_LS_DOWN_S_ENA	-	0... 1H	0 ...1	1	-
Logical calibration data for activating downstream SWT diagnosis on rich-lean combustion mode transistions					
LC_SWT_LS_DOWN_MV	-	0... 1H	0 ...1	1	-
Logical calibration data for activation of mean value evaluation of switching time diagnosis					

## FUNCTION DESCRIPTION:

### General information:

The monitor sensor diagnosis consists of three separate tests. These tests are carried out at the beginning or at the end of the pull fuel cut-off (PUC) or after switching from stoichiometric to lean combustion. In detail there are the tests monitoring of the rich-lean switching time, monitoring of the signal voltage transition during PUC or after switching to lean combustion and monitoring of the signal voltage motion after PUC, the last one being complemented by an alternative function providing the error flags LV\_DIAG\_RGN\_NT\_LS\_DOWN\_ERR[i] and the completion flags LV\_DIAG\_RGN\_NT\_LS\_DOWN\_END[i]. The purpose of these tests is the recognition of emission relevant sensor errors caused by changes in the sensor behaviour or by electrical errors like open circuits.

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

### Application conditions:

*Initialisation:*

```

if                At LV_IGK 0->1 or reset orat clearing error memory
then             reset of all variables and bits to 0
endif

```

*Recurrence:* 20 ms

*Activation /Deactivation:*

```

if                TCO > C_TCO_MIN_DIAG_MPL_LS_DOWN
and               LV_LS_DOWN_READY[i] = 1
                   (Operating readiness of the monitor sensor must be detected)
and               C_VS_MIN_DIAG_MPL_LS_DOWN ≤ VS
                   ≤ C_VS_MAX_DIAG_MPL_LS_DOWN
                   (Vehicle speed in range)
and               TEMP_CAT_DYN_MDL[i] > C_TEMP_CAT_MIN_DIAG_MPL_LS_DOWN
                   (Catalytic converter at operating temperature)
then              LV_DIAG_MPL_CDN_LS_DOWN[i] = 1
Else              LV_DIAG_MPL_CDN_LS_DOWN[i] = 0
endif

```

```

if                LV_DIAG_MPL_CDN_LS_DOWN[i] = 1
and              (LV_END_DIAG_PUE_LS_DOWN[i] = 0
or              LV_END_DIAG_SWT_LS_DOWN[i] = 0)
then
    LV_DIAG_MPL_CDN_LS_DOWN[i] = 1
else
    LV_DIAG_MPL_CDN_LS_DOWN[i] = 0
endif

```

## B.9.1 Monitoring the rich-lean switching times in the trailing throttle fuel cut-off

### FUNCTION DESCRIPTION:

#### General information:

Changes in the dynamic behaviour of the monitor sensor can be detected by the recognition of the rich-lean switching time after fuel cut-off or after changing the combustion mode from homogenous mode to stratified mode.

#### Description:

After detection of the PUC engine operating state, the rich-lean switching time of the lambda sensor is determined and weighted depending upon the mass air flow in the intake system. The functioning of the sensor is diagnosed by comparison of the mean value of the weighted switching time with a limit. The functioning is guaranteed in this test if the switching time is below the limit.

The switching time diagnosis shall be finished for the current driving cycle, if C\_CTR\_SWT\_DIAG\_LS\_DOWN valid switching times are calculated or if the alternative function indicates its completion via LV\_DIAG\_RGN\_NT\_LS\_DOWN\_END[i] = 1. Whenever one of the two functions completes, its diagnostic result is used for the current driving cycle and the result of the other function is ignored.


The rich-lean switching time of the sensor is determined in defined ranges of the mass air flow. A prerequisite for performing the diagnosis is that the voltage of the monitor sensor at the time of activating the trailing throttle fuel cut-off VLS\_DOWN\_TRAN\_PUC[i] is above the threshold C\_VLS\_PUC\_MIN\_DIAG\_SWT\_LS\_DOWN. The voltage value of the sensor at the time of trailing throttle fuel cut-off VLS\_DOWN\_TRAN\_PUC[i] is required for the calculation of the dynamic limits for switching point determination and must be stored for the diagnostic period.

If the sensor voltage drops below the value C\_FAC\_VLS\_MAX\_DIAG\_SWT\_LS\_DOWN \* VLS\_DOWN\_TRAN\_PUC[i], the switching time determination starts and the cycle counter CTR\_SWT\_ACT\_LS\_DOWN[i] has to be started. The counting process is ended if the limit C\_FAC\_VLS\_MIN\_DIAG\_SWT\_LS\_DOWN \* VLS\_DOWN\_TRAN\_PUC[i] is exceeded downwards. The value of the cycle counter CTR\_SWT\_ACT\_LS\_DOWN[i] is a measure of the rich-lean switching time of the monitor sensor.

If a rich peak which exceeds C\_VLS\_HYS\_DIAG\_SWT\_LS\_DOWN occurs during determination of the switching time, its determination is interrupted and the relevant switching time is no longer further processed. The determination of the sensor switching times must also be interrupted if PUC is left.

Simultaneously to incrementation of CTR\_SWT\_ACT\_LS\_DOWN[i] the counter CTR\_SWT\_ACT\_RBM\_LS\_DOWN[i] shall be incremented until the corresponding ratio CTR\_QUO\_SWT\_RBM\_LS\_DOWN[i] exceeds the threshold for a defective lambda probe C\_CTR\_SWT\_LS\_DOWN. After this condition has been fulfilled the valid cycle counter CTR\_SWT\_LS\_DOWN[i] shall be incremented. This procedure ensures that within each diagnostic cycle and after completion of the required total number of diagnostic cycles a probe malfunction can be detected as is demanded by ARB.

A valid value of the switching times for the monitor sensor must be weighted depending upon the minimum value for the mass flow during the determination of the switching time of the lambda sensor

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MAF\_KGH\_MIN\_PUC. The weighting factor is determined via the map IP\_FAC\_CYCNR\_MAX\_LS\_DOWN\_ACT.

If for the determined switching time of the monitor sensor doesn't exceed the limit the sensor is diagnosed as functioning, otherwise as malfunctioning. Depending on LC\_SWT\_LS\_DOWN\_MV the average value of the switching time determination or the respective minimum value shall be evaluated. The minimum or maximum measured diagnosis values are saved for the scantool SAE 1979 accordingly.

### Application conditions:

*Initialisation:*

```

if                At LV_IGK 0->1 or reset orat clearing error memory
then             reset of all variables and bits to 0, except:
                    MAF_KGH_MIN_PUC = "max phys. limit"
                    CTR_SAVE_SWT_LS_DOWN[i] which shall be initialized with its saved
                    Value. Reset only at clearing error memory.
                    CTR_QUO_SWT_LS_DOWN_MIN[i] which shall be initialized with its maximum value
endif

```

*Recurrence:* 20 ms

*Activation /Deactivation:*

```

if                ((LV_DIAG_MPL_CDN_LS_DOWN[i] = 1
and                LV_INH_DIAG_SWT_LS_DOWN[i] = 0)
or                LV_DIAG_RGN_NT_LS_DOWN_END[i] = 1)
and                LV_END_DIAG_SWT_LS_DOWN[i] = 0
then              LV_CDN_DIAG_SWT_LS_DOWN[i] = 1
else              LV_CDN_DIAG_SWT_LS_DOWN[i] = 0
                    (switching time check disabled)
                    VLS_DOWN_TRAN_PUC[i] = 0
                    LV_SWT_DIAG_VLD_LS_DOWN[i] = 0
                    CTR_SWT_ACT_LS_DOWN[i] = 0
                    CTR_SWT_ACT_RBM_LS_DOWN[i] = 0
                    MAF_KGH_MIN_PUC = "max phys. limit"
                    LV_DIAG_SWT_LS_DOWN_S_ENA[i] = 0
endif

```

### Formula section:

*% Ensure that either upstream or downstream sensor indicates rich conditions for a minimum contiguous air*

*% mass integral. After such conditions, leaner conditions are allowed for a limited time. The upstream criterion*

*% is preferred, because a slow downstream sensor could make it hard to detect short rich phases, thus*


*% inhibiting its own detection. Fuel cut is a blocking criterion on its own, because lambda setpoint is*

*% not a reliable indicator in this condition.*

```

if                LV_PUC = 0
then              if LAMB_SP[i]n < C_LAMB_SP_AFR_MAX_SWT_S
                    then          if LAMB_SP[i]n-1 >= C_LAMB_SP_AFR_MAX_SWT_S
                                    then          reset MAF_INT_LAMB_AFR_SWT_S_ENA[i]
                                    endif
                    MAF_INT_LAMB_AFR_SWT_S_ENA[i] + MAF_KGH * 0.02/3.6
                    reset T_LAMB_NOT_AFR_SWT_S_ENA[i]
                    else          increment T_LAMB_NOT_AFR_SWT_S_ENA[i]


```

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```

        if      T_LAMB_NOT_AFR_SWT_S_ENA[i] >=
              C_T_MAX_LAMB_NOT_AFR_SWT_S[NC_CBK_EX_NR]
        then
            reset MAF_INT_LAMB_AFR_SWT_S_ENA[i]
        endif
    endif
If      VLS_DOWN[i]n > C_VLS_DOWN_AFR_MIN_SWT_S
then    if      VLS_DOWN[i]n-1 <= C_VLS_DOWN_AFR_MIN_SWT_S
then    reset MAF_INT_VLS_AFR_SWT_S_ENA[i]
endif
then    MAF_INT_VLS_AFR_SWT_S_ENA[i] + MAF_KGH * 0.02/3.6
            reset T_VLS_NOT_AFR_SWT_S_ENA[i]
else    increment T_VLS_NOT_AFR_SWT_S_ENA[i]
if      T_VLS_NOT_AFR_SWT_S_ENA[i] >=
              C_T_MAX_VLS_NOT_AFR_SWT_S
then    reset MAF_INT_VLS_AFR_SWT_S_ENA[i]
endif
    endif
else    reset MAF_INT_VLS_AFR_SWT_S_ENA[i]
            reset MAF_INT_LAMB_AFR_SWT_S_ENA[i]
endif
If      MAF_INT_VLS_AFR_SWT_S_ENA[i] > C_MAF_INT_MIN_VLS_AFR_SWT_S
or      MAF_INT_LAMB_AFR_SWT_S_ENA[i] > C_MAF_INT_MIN_LAMB_AFR_SWT_S
then    LV_DIAG_SWT_LS_DOWN_S_ENA[i] = 1
endif
If      (LV_PUC = 0 -> 1      and      LV_S_ACT = 0)
then    VLS_DOWN_TRAN_PUC[i] = VLS_DOWN[i]
endif
% Check whether stable rich conditions have been reached before transition to lean combustion mode
and
% calculate a lean air mass integral for the last lean combustion period.
If      LV_S_ACT = 0->1
then    if      LC_DIAG_SWT_LS_DOWN_S_ENA = 1
and      LV_DIAG_SWT_LS_DOWN_S_ENA[i] = 1
then    VLS_DOWN_TRAN_PUC[i] = VLS_DOWN[i]
else    VLS_DOWN_TRAN_PUC[i] = 0
endif
            reset MAF_INT_S_MAX_SWT_S[i]
            LV_DIAG_SWT_LS_DOWN_S_ENA[i] = 0
endif
If      LV_S_ACT = 1
then    MAF_INT_S_MAX_SWT_S[i] + MAF_KGH * 0.02/3.6
endif
% Lean combustion is an alternate way to start the diagnosis, if appropriate conditions are met (see
above)
% In lean mode, stop the diagnosis if the sensor does not show the lean transition after a certain air
% mass consumption.
% Additionally, require a lean enough upstream lambda when the downstream transition occurs to en-
% sure
% that the signal does not float around at stoichiometric. If upstream is too rich, abort the current
cycle.
If      (LV_PUC = 1
or      (LV_S_ACT = 1 and LC_DIAG_SWT_LS_DOWN_S_ENA = 1 and
            MAF_INT_S_MAX_SWT_S[i] < C_MAF_INT_S_MAX_SWT_S))

```

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```

and          VLS_DOWN_TRAN_PUC[i] C_VLS_PUC_MIN_DIAG_SWT_LS_DOWN
and          C_MAF_PUC_MIN_DIAG_SWT_LS_DOWN < MAF_KGH
                                     < C_MAF_PUC_MAX_DIAG_SWT_LS_DOWN
and          (VLS_DOWN[i]n < VLS_DOWN[i]n-1 + C_VLS_HYS_DIAG_SWT_LS_DOWN
or          (LV_S_ACT = 1          and          VLS_DOWN[i] >=
C_FAC_VLS_MAX_DIAG_SWT_LS_DOWN * VLS_DOWN_TRAN_PUC[i]))
% allow rising signal for stratified case, if it occurs before start of SWT measurement
then if     VLS_DOWN[i] < C_FAC_VLS_MAX_DIAG_SWT_LS_DOWN *
VLS_DOWN_TRAN_PUC[i]
then        increment CTR_SWT_ACT_RBM_LS_DOWN[i]
if         C_FAC_VLS_MIN_DIAG_SWT_LS_DOWN *
VLS_DOWN_TRAN_PUC[i] < VLS_DOWN[i]
then        increment CTR_SWT_ACT_LS_DOWN[i]
MAF_KGH_MIN_PUC = MIN(MAF_KGH; MAF_KGH_MIN_PUC)
else        freeze CTR_SWT_ACT_LS_DOWN[i]
MAF_KGH_MIN_PUCN = MAF_KGH_MIN_PUCN-1
CTR_QUO_SWT_RBM_LS_DOWN[i] =
CTR_SWT_ACT_RBM_LS_DOWN[i] /
IP_FAC_CYCNR_MAX_LS_DOWN_ACT
if         (CTR_QUO_SWT_RBM_LS_DOWN[i] >=
C_CTR_SWT_LS_DOWN)
and        LV_SWT_DIAG_VLD_LS_DOWN[i] = 0
then        LV_SWT_DIAG_VLD_LS_DOWN[i] = 1
increment CTR_SWT_LS_DOWN[i]
CTR_QUO_SWT_LS_DOWN[i] =
CTR_SWT_ACT_LS_DOWN[i] /
IP_FAC_CYCNR_MAX_LS_DOWN_ACT
CTR_QUO_SWT_LS_DOWN_MIN[i] =
MIN(CTR_QUO_SWT_LS_DOWN_MIN[i],
CTR_QUO_SWT_LS_DOWN[i])
CTR_QUO_SWT_LS_DOWN_MAX[i] =
MAX(CTR_QUO_SWT_LS_DOWN_MAX[i],
CTR_QUO_SWT_LS_DOWN[i])
CTR_QUO_SUM_SWT_LS_DOWN[i] =
CTR_QUO_SUM_SWT_LS_DOWN[i] +
CTR_QUO_SWT_LS_DOWN[i]
CTR_CYCNR_SWT_LS_DOWN[i] =
CTR_QUO_SUM_SWT_LS_DOWN[i] /
CTR_SWT_LS_DOWN[i]
endif
endif
if         (LV_PUC = 0
and        LAMB_SP_FIL_S < C_LAMB_SP_MIN_AFL_SWT_S)
then        VLS_DOWN_TRAN_PUC[i] = 0
endif
endif
else       VLS_DOWN_TRAN_PUC[i] = 0
LV_SWT_DIAG_VLD_LS_DOWN[i] = 0
CTR_SWT_ACT_LS_DOWN[i] = 0
CTR_SWT_ACT_RBM_LS_DOWN[i] = 0
MAF_KGH_MIN_PUC = "max phys. limit"
endif

```

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```

if          CTR_SWT_LS_DOWN[i] ≥ C_CTR_SWT_DIAG_LS_DOWN
then
  if          (CTR_CYCNR_SWT_LS_DOWN[i] < C_CTR_SWT_LS_DOWN
    and        LC_SWT_LS_DOWN_MV = 1)
  or          (CTR_QUO_SWT_LS_DOWN_MIN[i] < C_CTR_SWT_LS_DOWN
    and        LC_SWT_LS_DOWN_MV = 0)
  then        LV_ERR_SWT_LS_DOWN[i] = 0
    ERR_SYM_SWT_LS_DOWN[i] = "NO_SYM"
    CTR_SAVE_SWT_LS_DOWN[i] = CTR_QUO_SWT_LS_DOWN_MIN[i]
  else        LV_ERR_SWT_LS_DOWN[i] = 1
    ERR_SYM_SWT_LS_DOWN[i] = "SYM_3"
    CTR_SAVE_SWT_LS_DOWN[i] = CTR_QUO_SWT_LS_DOWN_MAX[i]
  endif
LV_END_DIAG_SWT_LS_DOWN[i] = 1

else
  if          LV_DIAG_RGN_NT_LS_DOWN_END[i] = 1
  then
    if          LV_DIAG_RGN_NT_LS_DOWN_ERR[i] = 0
    then        LV_ERR_SWT_LS_DOWN[i] = 0
      ERR_SYM_SWT_LS_DOWN[i] = "NO_SYM"
    else        LV_ERR_SWT_LS_DOWN[i] = 1
      ERR_SYM_SWT_LS_DOWN[i] = "SYM_2"
    Endif
    LV_END_DIAG_SWT_LS_DOWN[i] = 1
  else        % Switching time diagnosis going on
  endif

```

**endif**


Filtering :

**Apply** filter on current symptoms

**If** filtering result available (after internal debounce; see Appl. Inc. ABC type: No)

**Delivery** the result to Error Management

**Endif**

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## B.10 O2 sensor (bin, down) dynamic diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_RBM_SWT_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating inhibition of RBM for lambda sensor switching time diagnosis downstream					
LV_INH_DIAG_SWT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating inhibition of lambda sensor switching time diagnosis downstream					
STATE_RBM_SWT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 7H	0 ...7	1	-
Interface of SWT_LS_DOWN monitor with the Rate-Based Monitoring statistics					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_DC {p. 5746}	LV_END_DIAG_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5169}	LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}
LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT] {p. 1061}
LV_ERR_CHG_LS_DOWN {p. 5388}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CHK_LS_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_ERR_CRK_PLAUS {p. 4446}
LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_PER {p. 4432}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FUP {p. 4717}
LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}
LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_IVVT {p. 1062}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}
LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_PLAUS {p. 1062}
LV_ERR_MAP_TPS_PLAUS {p. 1062}	LV_ERR_MEC_IVVT_EX {p. 1062}	LV_ERR_MEC_IVVT_IN {p. 1062}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}
LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}	LV_ERR_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5198}



LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}
LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_ERR_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5297}	LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}
LV_ERR_SLV_IVVT_EX {p. 4627}	LV_ERR_SLV_IVVT_IN {p. 4627}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TPS {p. 4982}
LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_BOL {p. 4951}
LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_TPS_ST_CHK_2 {p. 4951}
LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VCV {p. 4729}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_IGK {p. 906}
LV_LS_UP_OBD_2_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}	LV_MTC_CUR_OFF {p. 6565}	LV_VB_CDN_OBD_2 {p. 1046}	NC_CBK_EX_NR {p. 1829}
NC_CYL_NR {p. 1526}	NC_NR_CAM_CBK {p. 1507}	NC_NR_CBK_IVVT {p. 604}	R_IT_LS_DOWN [NC_CBK_EX_NR] {p. 1364}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_R_IT_MAX_DIAG_MPL_LS_DOWN	V	0... FFFFH	0... 65535	1	Ohm
Maximum allowed internal resistance of the downstream sensor for downstream dynamic diagnosis					
LC_INH_DIAG_SWT_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Manual deactivation of the SWT diagnosis (when = 1)					
LC_INH_LS_DOWN_MAN_DEAC	V	0... 1H	0 ...1	1	-
Manual deactivation of inhibit conditions (when = 1)					

**Import actions:**

**ACTION\_ERRM\_CheckPendingStatus (IN<PRM\_IDX\_DIAG>,OUT<PRM\_LV\_ERR\_PND>)**

**Error treatment**

Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>						
SWT_LS_DOWN		0			NO	
Oxygen sensor downstream rich lean switch time check		1				
		2				
	SYM_3	3				

## General information

### B.10.1 Inhibition of diagnosis of the monitor sensors

#### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

It must be considered that there is one pump and also one exhaust line pro cylinder bank. Therefore NC\_CBK\_EX\_NR and NC\_CBK\_HPP\_NR can be considered in the code as equivalent.

If one of the below mentioned conditions is not fulfilled, the inhibit bit interrupts the downstream oxygen sensor diagnosis.

#### Application conditions:

**Initialisation:** at every transition LV\_IGK = 0 -> lor reset all variables shall be reset to 0, except STATE\_RBM\_SWT\_LS\_DOWN[i] //for init of this variable see section below

at every transition LV\_IGK = 1 -> 0  
LV\_INH\_DIAG\_SWT\_LS\_DOWN[NC\_CBK\_EX\_NR] = 1

**Activation:** LV\_IGK = 1

**Deactivation:** LV\_IGK = 0

**Recurrence:** 100 ms


#### Function description:

**Formula section:**

```

If   LV_ERR_AMP = 1                               or
        LV_ERR_AMP_PLAUS = 1                       or
        LV_ERR_CHG_LS_DOWN = 1                    or
        LV_ERR_CHG_LS_UP = 1                      or
        LV_ERR_CRK_PLAUS = 1                      or
        LV_ERR_CRK_SYN = 1                        or
        LV_ERR_CRK_TOOTH = 1                     or
        LV_ERR_CRK_TOOTH_PER = 1                 or
        LV_ERR_DIAGCPS = 1                      or
        LV_ERR_EL_CPS = 1                       or
        LV_ERR_FUP = 1                          or
        LV_ERR_FUP_MFP_PLAUS = 1                 or
        LV_ERR_FUP_ORNG = 1                     or
        LV_ERR_FUP_ST = 1                       or
        LV_ERR_H_PRS_SYS = 1                    or
        LV_ERR_IVVT = 1                         or
        LV_ERR_LOAD_TPS_PLAUS = 1               or
        LV_ERR_MAF = 1                          or
        LV_ERR_MAP_PLAUS = 1                    or
        LV_ERR_MAP_TPS_PLAUS = 1                or
        LV_ERR_MTC_CTL_2 = 1                    or
        LV_ERR_MTC_CTL_3 = 1                    or
        LV_ERR_MTC_DR = 1                      or
        LV_ERR_TPS = 1                          or
        LV_ERR_VCV = 1                          or
        LV_ERR_AIR_LSL_UP[i] = 1                or
        LV_ERR_CHK_LS_DOWN[i] = 1               or
        LV_ERR_CTL_LSL_UP_[i] = 1                or
        LV_ERR_DELTA_I_LAM[i] = 1                or
        LV_ERR_DYN_VLD_LS_UP[i] = 1             or
        LV_ERR_EL_LSL_UP[i] = 1                 or
        LV_ERR_FSD[i] = 1                       or
        LV_ERR_FSD_LAM_LIM[i] = 1               or
        LV_ERR_LSH_DOWN[i] = 1                  or
        LV_ERR_LSH_UP[i] = 1                    or
        LV_ERR_LSL_UP_IF[i] = 1                 or
        LV_ERR_OBD_LSH_DOWN[i] = 1              or
        LV_ERR_OBD_VLD_LSH_UP[i] = 1            or
        LV_ERR_OC_LS_DOWN[i] = 1                or
        LV_ERR_OC_LSL_UP[i] = 1                 or
        LV_ERR_OFS_LSL_UP[i] = 1                or
        LV_ERR_PUC_LS_DOWN[i] = 1               or
        LV_ERR_PUC_VLD_LS_UP[i] = 1             or
        LV_ERR_SCG_LS_DOWN[i] = 1               or
        LV_ERR_SCP_LS_DOWN[i] = 1               or
        LV_ERR_SHIFT_AFL_LSL_UP[i] = 1          or
        LV_ERR_SHIFT_AFR_LSL_UP[i] = 1          or
        LV_ERR_TTIP_MES_LSH_UP[i] = 1           or
        LV_ERR_VLS_DOWN_DIF[i] = 1              or
        (i = 1                                   AND
         [LV_ERR_IV[0]                           or
          LV_ERR_IV[2]                           or
          LV_ERR_IV[4]                           or
          LV_ERR_MIS[0]                          or
          LV_ERR_MIS[2]                          or
          LV_ERR_MIS[4] ] )                     or
        (i = 2                                   AND
         [ LV_ERR_IV[1]                           or
          LV_ERR_IV[3] ] )                     or

```

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```

LV_ERR_IV[5]                                or
LV_ERR_MIS[1]                               or
LV_ERR_MIS[3]                               or
LV_ERR_MIS[5] ]                            or
LV_ERR_PER_CAM_EX[y] = 1                    y = 1 for i= 1,2    or
LV_ERR_PER_CAM_IN[y] = 1                    y = 1 for i= 1,2    or
LV_ERR_PLAUS_CAM_EX[y] = 1                  y = 1 for i= 1,2    or
LV_ERR_PLAUS_CAM_IN[y] = 1                  y = 1 for i= 1,2    or
LV_ERR_REF_CRK_CAM_EX[y] = 1                y = 1 for i= 1,2    or
LV_ERR_REF_CRK_CAM_IN[y] = 1                y = 1 for i= 1,2    or
LV_ERR_SYN_CAM_EX[y] = 1                    y = 1 for i= 1,2    or
LV_ERR_SYN_CAM_IN[y] = 1                    y = 1 for i= 1,2    or
LV_ERR_SYN_CRK_CAM_IN[y] = 1                y = 1 for i= 1,2    or
LV_ERR_TOOTH_OFF_EX[y] = 1                  y = 1 for i= 1,2    or
LV_ERR_TOOTH_OFF_IN[y] = 1                  y = 1 for i= 1,2
then
else
endif

LV_INH_DIAG_RBM_SWT_LS_DOWN[NC_CBK_EX_NR] = 1
LV_INH_DIAG_RBM_SWT_LS_DOWN[NC_CBK_EX_NR] = 0

If
((LV_INH_DIAG_RBM_SWT_LS_DOWN [i] = 1      or
R_IT_LS_DOWN[i] > C_R_IT_MAX_DIAG_MPL_LS_DOWN
LV_VB_CDN_OBD_2 = 0                          or
LV_LS_UP_OBD_2_MAN_DEAC[i] = 1)             and
LC_INH_LS_DOWN_MAN_DEAC = 0)               or
LC_INH_DIAG_SWT_LS_DOWN[i] = 1
then
else
endif
LV_INH_DIAG_SWT_LS_DOWN[i] = 1
LV_INH_DIAG_SWT_LS_DOWN[i] = 0

```

## B.10.2 RBM – Interface for monitor sensor diagnosis

### General information:

With this module the interface between the SWT\_LS\_DOWN[i] monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_SWT\_LS\_DOWN[i] data.

Within STATE\_RBM\_SWT\_LS\_DOWN[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)  
(depending on failure status: pending)
- Monitor individual RBM conditions encountered within this DC (bit 2)  
(not valid for SWT\_LS\_DOWN[i] diagnosis)


### Application conditions:

**Initialisation:** at ECU reset all bits of STATE\_RBM\_SWT\_LS\_DOWN[i] shall be initialized with 0  
at LV\_DC 0 ->1 transition :  
bit 0 and bit 1 of STATE\_RBM\_SWT\_LS\_DOWN[i] = 0  
bit 2 of STATE\_RBM\_SWT\_LS\_DOWN[i] = 1  
on failure memory reset :  
bit 1 of STATE\_RBM\_SWT\_LS\_DOWN[i] = 0

**Activation:** LV\_DC 0 -> 1 transition **and** LV\_DC = 1

**Deactivation:** -

**Recurrence:** 1 s

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**Function description:****Formula section:**At LV\_DC 0 -> 1 transition

The pending status of the following failures has to be checked only once :

Dependence	Error			
	LV_ERR_AMP	LV_ERR_AMP_PLAUS	LV_ERR_CHG_LS_DOWN	LV_ERR_CHG_LS_UP
	LV_ERR_CRK_PLAUS	LV_ERR_CRK_SYN	LV_ERR_CRK_TOOTH	LV_ERR_CRK_TOOTH_ PER
	LV_ERR_DIAGCPS	LV_ERR_EL_CPS	LV_ERR_FUP	LV_ERR_FUP_MFP_ PLAUS
	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_SYS	LV_ERR_LOAD_TPS_ PLAUS
	LV_ERR_MAF_FRQ_EL	LV_ERR_MAF_FRQ_GRD	LV_ERR_MAF_FRQ_RNG	LV_ERR_MAP_PLAUS
	LV_ERR_MAP_TPS_ PLAUS	LV_ERR_MTC_CTL_2	LV_ERR_MTC_CTL_3	LV_ERR_MTC_DR
	LV_ERR_TPS_1	LV_ERR_TPS_2	LV_ERR_TPS_AD	LV_ERR_TPS_AD_BOL
	LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2	LV_ERR_TPS_RATIO	LV_ERR_TPS_ST_CHK_ 2
	LV_ERR_VCV			
NC_CBK_EX_NR	LV_ERR_AIR_LSL_UP [i]	LV_ERR_CHK_LS_DOWN [i]	LV_ERR_CTL_LSL_UP [i]	LV_ERR_DELTA_I_LAM [i]
	LV_ERR_DYN_VLD_LS_ UP [i]	LV_ERR_EL_LSL_UP[i]	LV_ERR_FSD [i]	LV_ERR_FSD_LAM_LIM [i]
	LV_ERR_LSH_DOWN [i]	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]	LV_ERR_OBD_VLD_ LSH_UP [i]
	LV_ERR_OBD_LSH_ DOWN [i]	LV_ERR_OC_LS_DOWN [i]	LV_ERR_OC_LSL_UP [i]	LV_ERR_OFS_LSL_UP [i]
	LV_ERR_PUC_LS_DOWN [i]	LV_ERR_PUC_VLD_LS_ UP [i]	LV_ERR_SCG_LS_DOWN [i]	LV_ERR_SCP_LS_ DOWN [i]
	LV_ERR_SHIFT_AFL_ LSL_UP [i]	LV_ERR_SHIFT_AFR_ LSL_UP [i]	LV_ERR_TTIP_MES_ LSH_UP [i]	LV_ERR_VLS_DOWN_ DIF [i]

for any i

NC_NR_CAM_ CBK	LV_ERR_PER_CAM_EX[1]	LV_ERR_PER_CAM_IN[1]	LV_ERR_PLAUS_CAM_ EX[1]	LV_ERR_PLAUS_CAM_ IN[1]
	LV_ERR_REF_CRK_ CAM_EX[1]	LV_ERR_REF_CRK_CAM_IN[1]	LV_ERR_SYN_CAM_EX[1]	LV_ERR_SYN_CAM_ IN[1]
	LV_ERR_SYN_CRK_ CAM_IN[1]	LV_ERR_TOOTH_OFF_IN[1]	LV_ERR_TOOTH_OFF_ EX[1]	

Continued on next page

--	--	--	--	--	--

For x = 1 to NC\_NR\_CBK\_IVVT (= for any i // or)

NC_NR_CBK_IVVT	LV_ERR_CAM_CST_IVVT_EX[x]	LV_ERR_CAM_CST_IVVT_IN[x]	LV_ERR_MEC_IVVT_EX[x]	LV_ERR_MEC_IVVT_IN[x]
	LV_ERR_SLV_IVVT_EX[x]	LV_ERR_SLV_IVVT_IN[x]		

For NC\_CBK\_EX\_NR = i = 1

NC_CYL_NR	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	LV_ERR_MIS[0]
	LV_ERR_MIS[2]	LV_ERR_MIS[4]		

For NC\_CBK\_EX\_NR = i = 2

NC_CYL_NR	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	LV_ERR_MIS[1]
	LV_ERR_MIS[3]	LV_ERR_MIS[5]		

**If (1)**

{ CPU optimization at LV\_DC 0 -> 1 transition }

CTR\_ERR\_DYN\_NR <> 0

{ the dynamic failure memory isn't empty }

**Then (1)**

**While** bit 1 of STATE\_RBM\_SWT\_LS\_DOWN[i] = 0 **do**  
 with each XX failure of the above list (depending on configuration, see below):  
 ACTION\_ERRM\_CheckPendingStatus (IN<XX>,  
 OUT<PendingStatus>, SYNCHRONIZATION<CALL>)

**If (2)**

XX has a pending status

**Then (2)** bit 1 of STATE\_RBM\_SWT\_LS\_DOWN[i] = 1

**Endif (2)**

**Endwhile**

**Else (1)**

{ the dynamic failure memory is empty } No action

**Endif (1)**

Every 1 s :

**If** bit 0 of STATE\_RBM\_SWT\_LS\_DOWN[i] = 0

**Then**

**If** LV\_END\_DIAG\_SWT\_LS\_DOWN[i] = 1

**Then** bit 0 of STATE\_RBM\_SWT\_LS\_DOWN[i] = 1


**Endif**

**Endif**

```

If      bit 1 of STATE_RBM_SWT_LS_DOWN[i] = 0
Then
      If      LV_INH_DIAG_RBM_SWT_LS_DOWN[i]= 1
      Then    bit 1 of STATE_RBM_SWT_LS_DOWN[i] = 1
      Endif
Endif

```

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## B.11 O2 sensor (bin, down) gradient monitoring

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_NR_DIAG_PUE_LS_DOWN [NC_CBK_EX_NR]	O/V/S	0... 3FFH	0... 1023	1	-
Counter for completed gradient monitoring diagnosis					
CTR_NR_DIAG_PUE_LS_DOWN_OLD [NC_CBK_EX_NR]	V	0... 3FFH	0... 1023	1	-
Counter for completed gradient monitoring diagnosis - old value					
CTR_PUC_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for number of valid fuel cut-off phases					
CTR_PUC_PUE_LS_DOWN_OLD [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for number of valid fuel cut-off phases - old value					
ERR_SYM_PUE_LS_DOWN [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom of pull end plausibility					
FAC_COR_PUE_LS_DOWN	V	0... FFH	0... 3.984375	0.015625	-
Correction factor for the gradient					
LAMB_MMV_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Moving mean value of lambda signal value of the WRAF sensor					
LAMB_SP_ADD_PUE_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFFH	0... 0.249939	61.0352e-6	-
Additional value of lambda setpoint for catalyst enrichment function					
LV_CAT_PURGE_ACT_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable to indicate an active catalyst purge after fuel cut-off phase					
LV_CDN_DIAG_TMP_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Temporary status condition for gradient monitoring of oxygen sensor downstream					
LV_CTR_CHK_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Status condition indicating that fuel cut-off phase has been present					
LV_DIAG_ACT_PUE_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable to indicate the activation of the diagnosis					
LV_DIAG_CDN_RST_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable to reset the condition flags					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_CLC_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Status flag for gradient calculation					
LV_DIAG_RST_WIN_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable to reset the window condition flag					
LV_DIAG_VLD_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable indicating that fuel cut-off phase and time after fuel cut-off were long enough					
LV_DIAG_WIN_CDN_1_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable to indicate the status of the window condition					
LV_DIAG_WIN_CDN_2_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable to indicate the status of the window condition					
LV_DIAG_WIN_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable to indicate the status of the window condition					
LV_END_DIAG_PUE_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Bit to indicate end of pull end plausibility diagnosis					
LV_ERR_PUE_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced diagnosis result of pull end plausibility					
LV_VLS_DOWN_PUE_CAT_PURGE [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable to indicate that a catalyst purge phase has been present					
MAF_INT_PUC_NOT_ACT_OLD [NC_CBK_EX_NR]	V	0... FFFFH	0... 2912.66666667	0.0444444	g
Air mass flow integral out of pull cut off phase - old value					
MAF_KGH_MMV_PUE_LS_DOWN	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Moving mean value of mass air flow, measured per segment					
N_MMV_PUE_LS_DOWN	V	0... 1FE0H	0... 8160	1	rpm
Moving mean value of the engine speed					
T_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 639CH	0... 255	0.01	s
Timer to limit the length of the change from lean to rich					
T_R_IT_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Timer to ensure a valid measurement of the internal resistant of the oxygen sensor downstream					
VLS_DOWN_PUE_BOL_SAE [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	-65536 ...65534	2	mV/s
Service 06h - min test limit: EGCP system diagnosis - - lean to rich					
VLS_DOWN_PUE_DRV1_MMV [NC_CBK_EX_NR]	V	8000... 7FFFH	-65536 ...65534	2	mV/s
Gradient calculated with the correction factor					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VLS_DOWN_PUE_DYN_VLD [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-65536 ...65534	2	mV/s
Output of the relevant gradient for the Cat-Diagnosis					
VLS_DOWN_PUE_MMV [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	-65536 ...65534	2	mV/s
Moving mean value of gradient monitoring					
VLS_DOWN_PUE_OLD [NC_CBK_EX_NR]	V	0... 3FFFH	0... 4.9951171875	4.88281e-3	V
Downstream sensor voltage measured - old value					
VLS_DOWN_PUE_PUC_GRD [NC_CBK_EX_NR]	V	8000... 7FFFH	-65536 ...65534	2	mV/s
Valid gradient after fuel cut-off phases of downstream oxygen sensor voltage from lean to rich					
VLS_DOWN_PUE_PUC_MAX [NC_CBK_EX_NR]	V	8000... 7FFFH	-65536 ...65534	2	mV/s
Maximum gradient after fuel cut-off phases of downstream oxygen sensor voltage from lean to rich					
VLS_DOWN_PUE_PUC_MAX_OLD [NC_CBK_EX_NR]	V	8000... 7FFFH	-65536 ...65534	2	mV/s
Maximum gradient after fuel cut-off phases of downstream oxygen sensor voltage from lean to rich - old value					
VLS_DOWN_PUE_PUC_MIN [NC_CBK_EX_NR]	V	8000... 7FFFH	-65536 ...65534	2	mV/s
Minimum gradient after fuel cut-off phases of downstream oxygen sensor voltage from lean to rich					
VLS_DOWN_PUE_PUC_MIN_OLD [NC_CBK_EX_NR]	V	8000... 7FFFH	-65536 ...65534	2	mV/s
Minimum gradient after fuel cut-off phases of downstream oxygen sensor voltage from lean to rich - old value					
VLS_DOWN_PUE_SAE [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	-65536 ...65534	2	mV/s
Service 06h - test value: EGCP system diagnosis - - lean to rich					
VLS_DOWN_PUE_SAVE_MAX [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	-65536 ...65534	2	mV/s
Saved maximum gradient of oxygen sensor downstream of all driving cycles					
VLS_DOWN_PUE_SAVE_MIN [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	-65536 ...65534	2	mV/s
Saved minimum gradient of oxygen sensor downstream of all driving cycles					
VLS_DOWN_PUE_STD [NC_CBK_EX_NR]	O/V/S	0... FFFFFFFFH	0 ...	128e-6	(V/s)**2
Squared standard deviation of gradient monitoring					
VLS_DOWN_PUE_TOL_SAE [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	-65536 ...65534	2	mV/s
Service 06h - max test limit: EGCP system diagnosis - - lean to rich					

**Input data:**

LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_CAT_PURGE_ACT [NC_CBK_EX_NR] {p. 2927}	LV_INH_DIAG_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5190}
LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_PUC {p. 1720}	MAF_INT_PUC_ACT {p. 2942}	MAF_INT_PUC_NOT_ACT {p. 2942}
MAF_KGH {p. 1195}	N {p. 1525}	NC_CBK_EX_NR {p. 1829}	R_IT_LS_DOWN [NC_CBK_EX_NR] {p. 1364}


T_SAMPLE_R_IT_LS_DOWN [NC_CBK_EX_NR] {p. 1364}	TEG_DYN_LS_DOWN [NC_CBK_EX_NR] {p. 1007}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}
VLS_DOWN_DRV1_MMV [NC_CBK_EX_NR] {p. 2409}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_LAMB_PUE_LS_DOWN	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation constant for lambda signal value of the WRAF sensor					
C_CRLC_MAF_PUE_LS_DOWN	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation constant for mass air flow					
C_CRLC_N_PUE_LS_DOWN	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation constant for engine speed					
C_CTR_PUE_LS_DOWN_MIN	-	0... FFH	1... 256	1	-
Minimum fuel cut-off phases to get a gradient of the oxygen sensor downstream voltage					
C_LAMB_MMV_PUE_MAX	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Maximum threshold for lambda signal value of the WRAF sensor					
C_LAMB_MMV_PUE_MIN	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Minimum threshold for lambda signal value of the WRAF sensor					
C_LAMB_SP_ADD_PUE_LS_DOWN	-	0... FFFH	0... 0.249939	61.0352e-6	-
Additional value of lambda setpoint for catalyst enrichment function					
C_LAMB_SP_PUE_MAX	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Maximum value of lambda setpoint for a valid gradient calculation					
C_MAF_INT_PUC_ACT_PUE_MIN	-	0... FFFFH	0... 2912.66666667	0.0444444	g
Threshold for air mass flow integral during fuel cut off phase					
C_MAF_INT_PUC_NOT_ACT_MAX	-	0... FFFFH	0... 2912.66666667	0.0444444	g
Maximum threshold for air mass flow integral out of pull cut off phase					
C_MAF_INT_PUC_NOT_ACT_MIN	-	0... FFFFH	0... 2912.66666667	0.0444444	g
Minimum threshold for air mass flow integral out of pull cut off phase					
C_MAF_KGH_PUE_LS_DOWN_MIN	-	0... FFFFH	0... 1023.984375	0.015625	kg/h
Threshold of total air mass flow for activation conditions					
C_R_IT_PUE_LS_DOWN_MAX	-	0... FFFFH	0... 65535	1	Ohm
Threshold of Internal resistance of downstream oxygen sensor for activation conditions					
C_T_PUE_LS_DOWN_MIN	-	0... 639CH	0... 255	0.01	s
Threshold for the timer to limit the length of the change from lean to rich					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_R_IT_PUE_LS_DOWN_MAX	-	0... FFFFH	0... 655.35	0.01	s
Threshold for time measured between internal resistance samples					
C_T_R_PUE_LS_DOWN_MAX	-	0... FFFFH	0... 655.35	0.01	s
Threshold for the timer of internal resistant calculation (oxygen sensor downstream)					
C_TEG_DYN_PUE_LS_DOWN_MAX	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Maximum threshold for exhaust gas temperatures at the lambda sensor downstream catalyst					
C_TEG_DYN_PUE_LS_DOWN_MIN	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Minimum threshold for exhaust gas temperatures at the lambda sensor downstream catalyst					
C_TEMP_CAT_DYN_PUE_LS_DOWN_MAX	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Maximum threshold for modelled catalyst temperature under dynamic conditions					
C_TEMP_CAT_DYN_PUE_LS_DOWN_MIN	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Minimum threshold for modelled catalyst temperature under dynamic conditions					
C_VLS_DOWN_PUE_CAT_PURGE	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Threshold for oxygen sensor downstream voltage after cat purge					
C_VLS_DOWN_PUE_HYS	-	0... FFFFH	-5... 4.99984741211	152.588e-6	V
Calibrateable hysteresis for the analysis of continuous rising downstream voltage					
C_VLS_DOWN_PUE_MAX_MIN	-	8000... 7FFFH	-65536 ...65534	2	mV/s
Minimum threshold of maximum gradient for oxygen sensor fault detection					
C_VLS_DOWN_PUE_MAX_TOL	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Threshold for oxygen sensor downstream voltage					
C_VLS_DOWN_PUE_MIN_MIN	-	8000... 7FFFH	-65536 ...65534	2	mV/s
Minimum threshold of minimum gradient for oxygen sensor fault detection					
C_VLS_DOWN_PUE_PUC_BOL	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Minimum oxygen sensor downstream voltage for windows monitoring					
C_VLS_DOWN_PUE_PUC_TOL	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Maximum oxygen sensor downstream voltage for windows monitoring					
C_VLS_DOWN_PUE_WIN	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Window voltage of oxygen sensor downstream for gradient monitoring					
IP_VLS_DOWN_PUE	V	0... FFH	0... 12.75	0.05	-
LDP_MAF_KGH_PUE_LS_DOWN	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_LAMB_LS_UP	8	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Correction factor for gradient calculation of oxygen sensor downstream voltage					

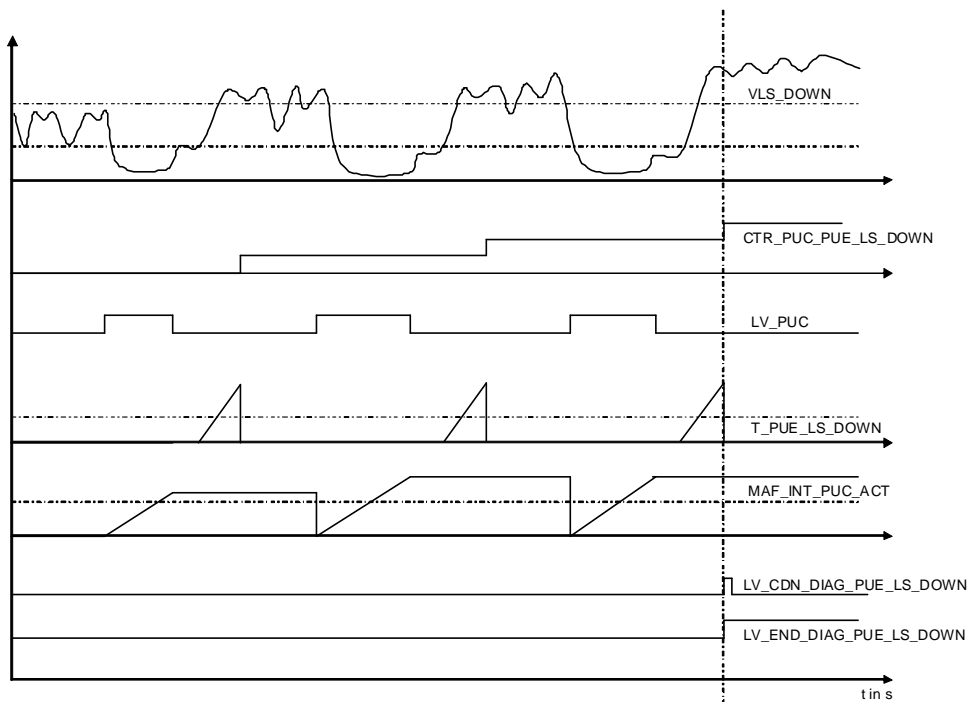
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_VLS_DOWN_PUE_N	-	0... FFH	0... 12.75	0.05	-
LDP_N_PUE_LS_DOWN	8	0... 1FE0H	0... 8160	1	rpm
Correction factor for gradient calculation of oxygen sensor downstream voltage					
LC_DIAG_PUE_LS_DOWN	-	0... 1H	0 ...1	1	-
Switch to lock the diagnosis in combination with the end flag					
LC_VLS_DOWN_MMV	-	0... 1H	0 ...1	1	-
Switch to activate the calculation of the gradient s mean value					
LC_VLS_DOWN_PUE_CON	-	0... 1H	0 ...1	1	-
Switch to analyse only gradients of continuous rising downstream voltage					
LC_VLS_DOWN_PUE_PUC_MIN	-	0... 1H	0 ...1	1	-
Switch to analyse minimum gradients of fuel cut-off phases of oxygen sensor downstream voltage					
LC_VLS_DOWN_PUE_STC_CLR	-	0... 1H	0 ...1	1	-
Switch to clear the labels of the statistical analysis					

## General Information

The downstream oxygen sensor is used for several tasks where signal dynamics is critical, e.g. trim control, catalyst purge, or monitoring of the catalyst performance. If the sensor response to a lean to rich transition is slow, these functions may not operate properly and diagnoses may produce wrong results. Therefore the sensor signal is monitored for sufficient dynamics.




## FUNCTION DESCRIPTION:

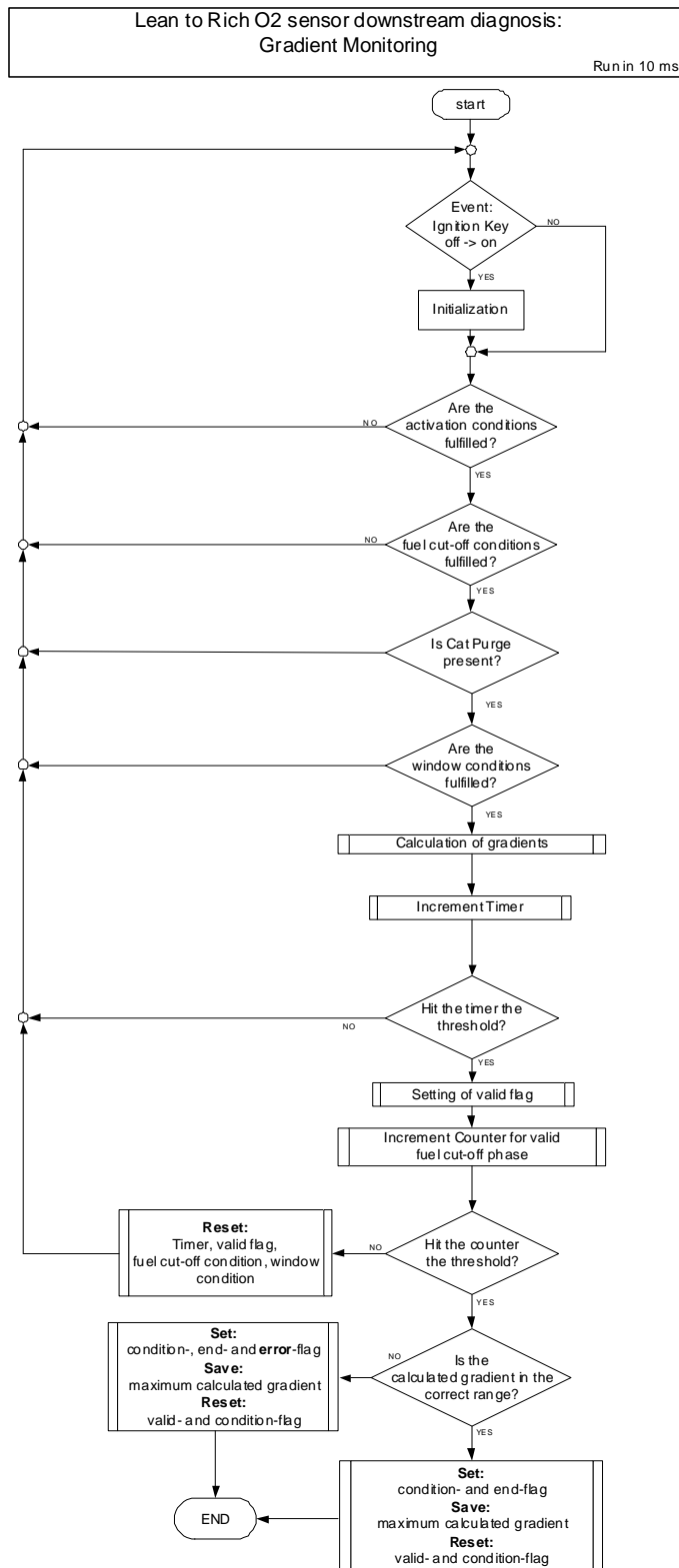
The diagnosis runs once per driving cycle (adjustable by LC) and monitors the gradient of the downstream oxygen sensor voltage (VLS\_DOWN). For the diagnosis to run, the sensor must be ready, no inhibitions must be indicated and the sensor voltage must be in a plausible range.

The function tests if the sensor signal changes fast enough by evaluating the gradient after removal of high-frequency noise. To ensure that a result is produced only if enough signal dynamics can be expected, a certain number of suitable fuel cut phases must occur before the diagnosis finishes. A "suitable fuel cut phase" is long enough to ensure a lean catalyst, and enough gas has passed afterwards to purge the catalyst. Both criteria can be calibrated in terms of air mass integrals and a timer.

The overall maximum and/or minimum of the signal gradient is calculated until the condition of the diagnosis has been determined. At that moment, the value is compared against a threshold, and if it is high enough, the sensor passes diagnosis, otherwise it fails. At the same time the relevant gradient and the thresholds are stored for mode06 output.

The following Flowchart is a short overview of the characteristic of the diagnosis.

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## Application Conditions

Initialization: CLRFBY, IGKON, RST

Recurrence: 10MS

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Activation: always

Deactivation: never

## Function description

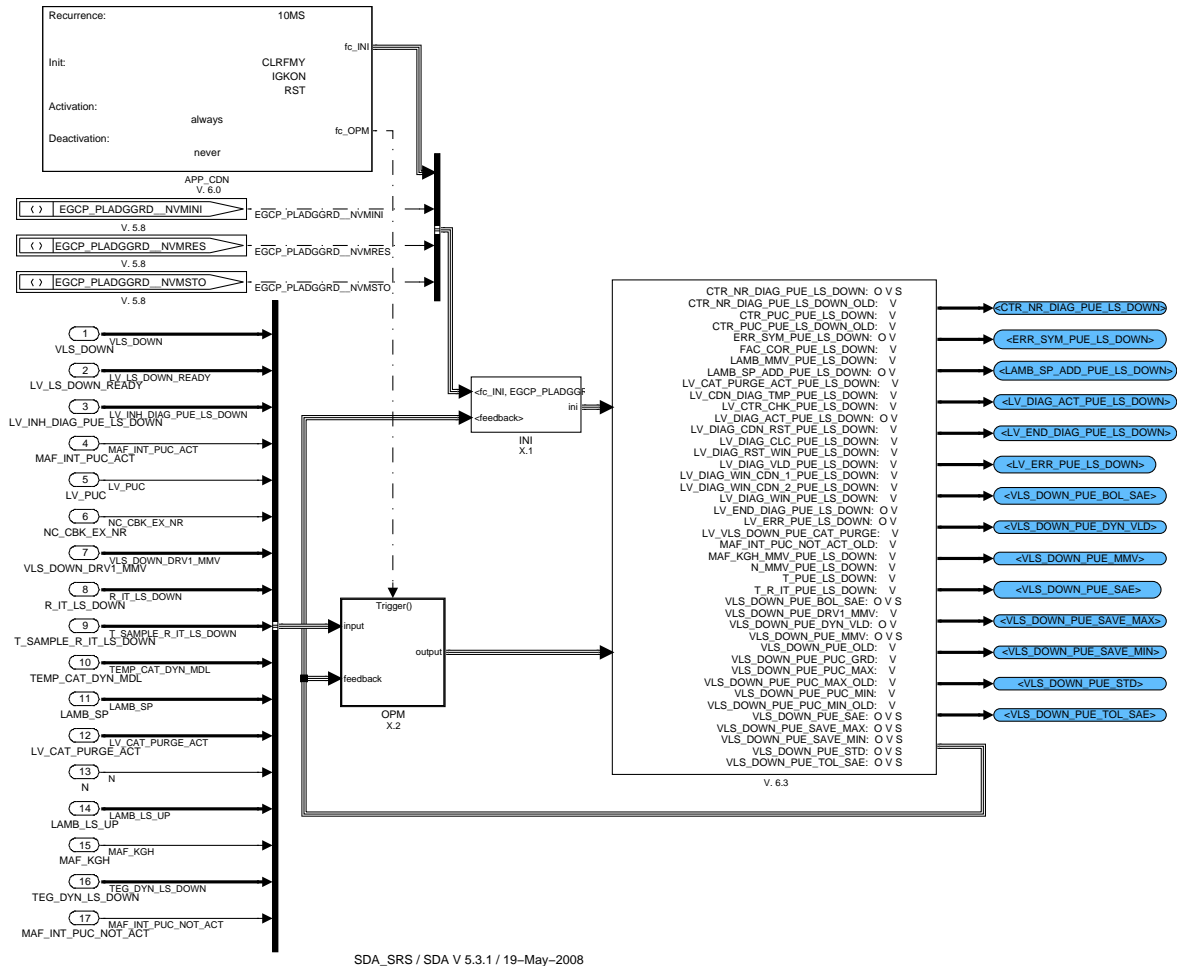


Figure B.11.1: :

## B.11.1 Initialization

Initialization of (normal) variables, non-volatile memory variables and variables that are directly linked to error manager is described.

Initialization of variables takes place at ignition key on and reset.

The variables saved in the non-volatile memory are reset in case the error memory is cleared and by initializing the NVMY.

Variables that are directly linked with the error manager are initialized according to related error manager routines (ACTION\_ERRM).

### B.11.1.1 Synchronization with ERRM at clear failure memory and reset of Mode06 Label

Synchronisation between LV\_ERR\_PUE\_LS\_DOWN, LV\_END\_DIAG\_PUE\_LS\_DOWN and ERR\_SYM\_PUE\_LS\_DOWN and its result from ERRM is done using action ACTION\_ERRM\_GetLvErr(), ACTION\_ERRM\_GetLvEnd() and ACTION\_ERRM\_GetErrSym() at clear failure memory.



<b>ACTION_ERRM_GetLvErr(IN &lt;IDX_DIAG&gt;, OUT &lt;LV_ERR&gt;)</b>
Action that returns the status of the debounced failure
<b>ACTION_ERRM_GetErrSym(IN &lt;IDX_DIAG&gt;, OUT &lt;ERR_SYM&gt;)</b>
Action that returns the symptom of the failure
<b>ACTION_ERRM_GetLvEndDiag(IN &lt;IDX_DIAG&gt;, OUT &lt;LV_END_DIAG&gt;)</b>
Action that returns the status of the failure availability

### B.11.1.2 Initialization at reset, ignition key on and clear failure memory

<b>ACTION_ERRM_NoFilterReset(IN &lt;IDX_DIAG&gt;, OUT &lt;LV_ERR&gt;)</b>
This action resets data filter in case of no filter usage
<b>ACTION_ERRM_GetErrSym(IN &lt;IDX_DIAG&gt;, OUT &lt;ERR_SYM&gt;)</b>
Action that returns the symptom of the failure
<b>ACTION_ERRM_GetLvEndDiag(IN &lt;IDX_DIAG&gt;, OUT &lt;LV_END_DIAG&gt;)</b>
Action that returns the status of the failure availability

### B.11.1.3 Initialization of non volatile memory

### B.11.1.4 Restore of non volatile memory

## B.11.2 Formula Section (Recurrence 10ms)

### B.11.2.1 Calculation of Moving Mean Values

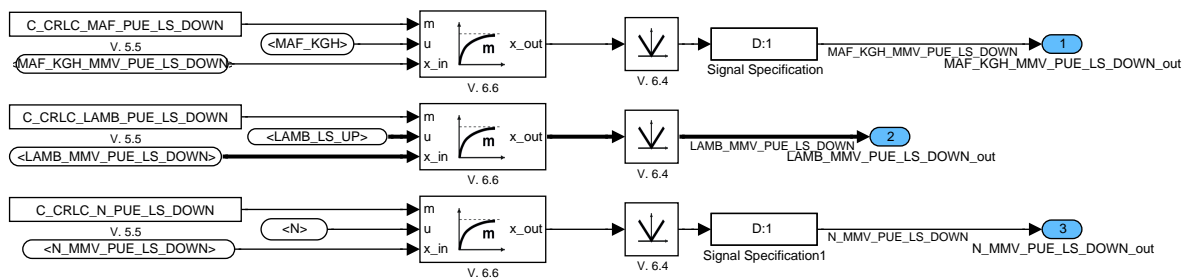


Figure B.11.2: :

### B.11.2.2 Calculation of Signals for all Cylinder Banks

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR=2) then  
 i=1, for exhaust cylinder bank 1  
 i=2, for exhaust cylinder bank 2  
 otherwise (NC\_CBK\_EX\_NR=1)

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i=1, for single exhaust cylinder bank.

i = 1 to NC\_CBK\_EX\_NR

**B.11.2.2.1 Calculation for Activation or Deactivation of Diagnosis**

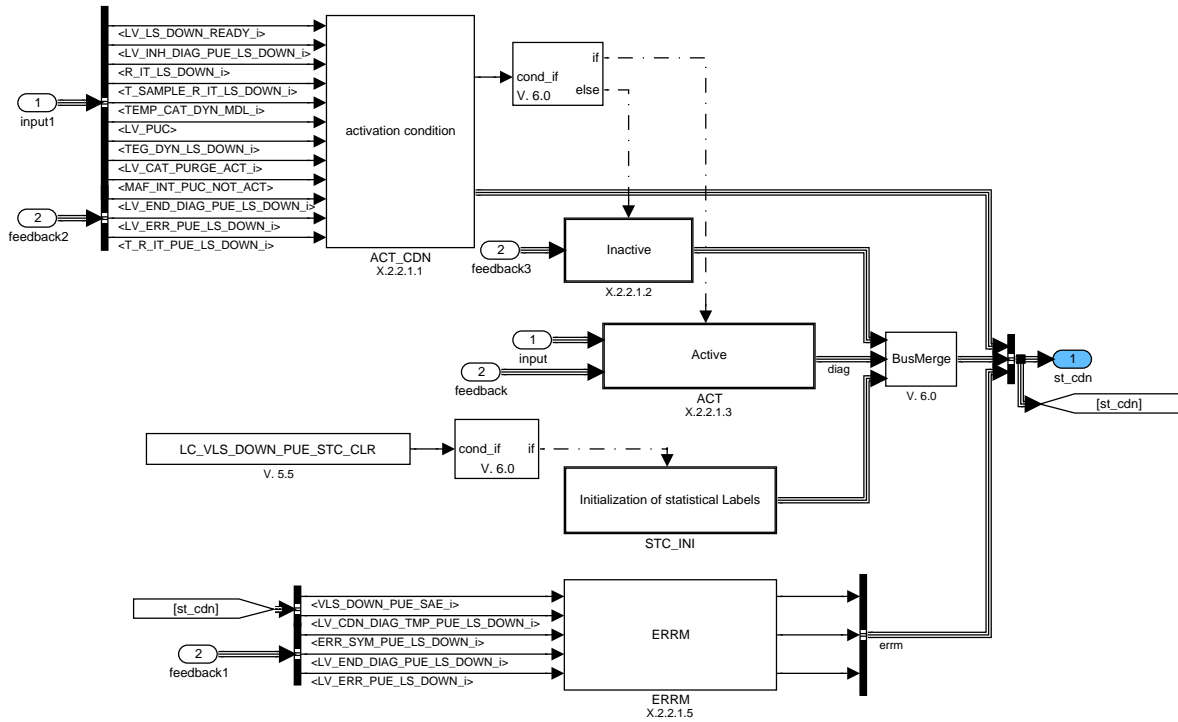


Figure B.11.3: :

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### B.11.2.2.1.3.1 Calculation of Gradients and of Condition flags for the Analysis of the Gradients

#### B.11.2.2.1.3.1.1 PUC\_CDN: Calculation of Fuel Cut-Off Condition

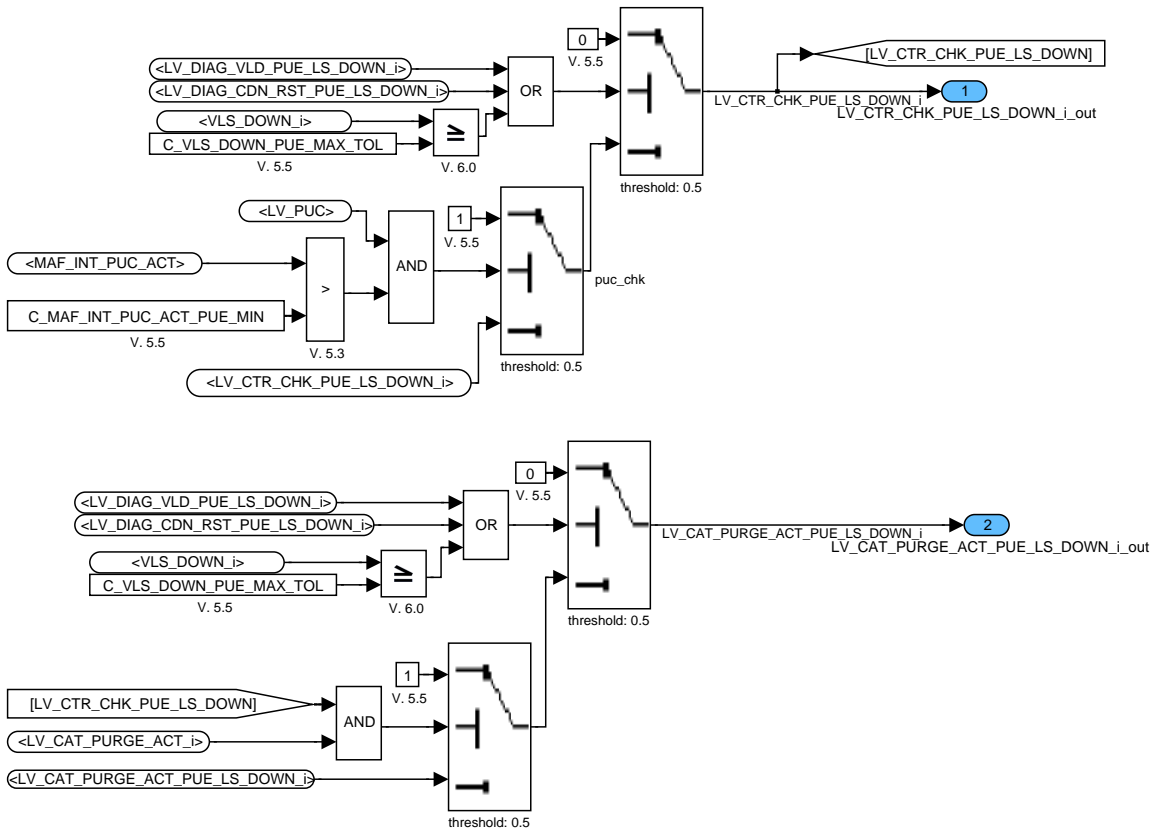



Figure B.11.5: :

#### B.11.2.2.1.3.1.2 Calculation of Reset flag

Monitoring of constant rising oxygen sensor downstream voltage, lambda setpoint and lambda signal upstream.

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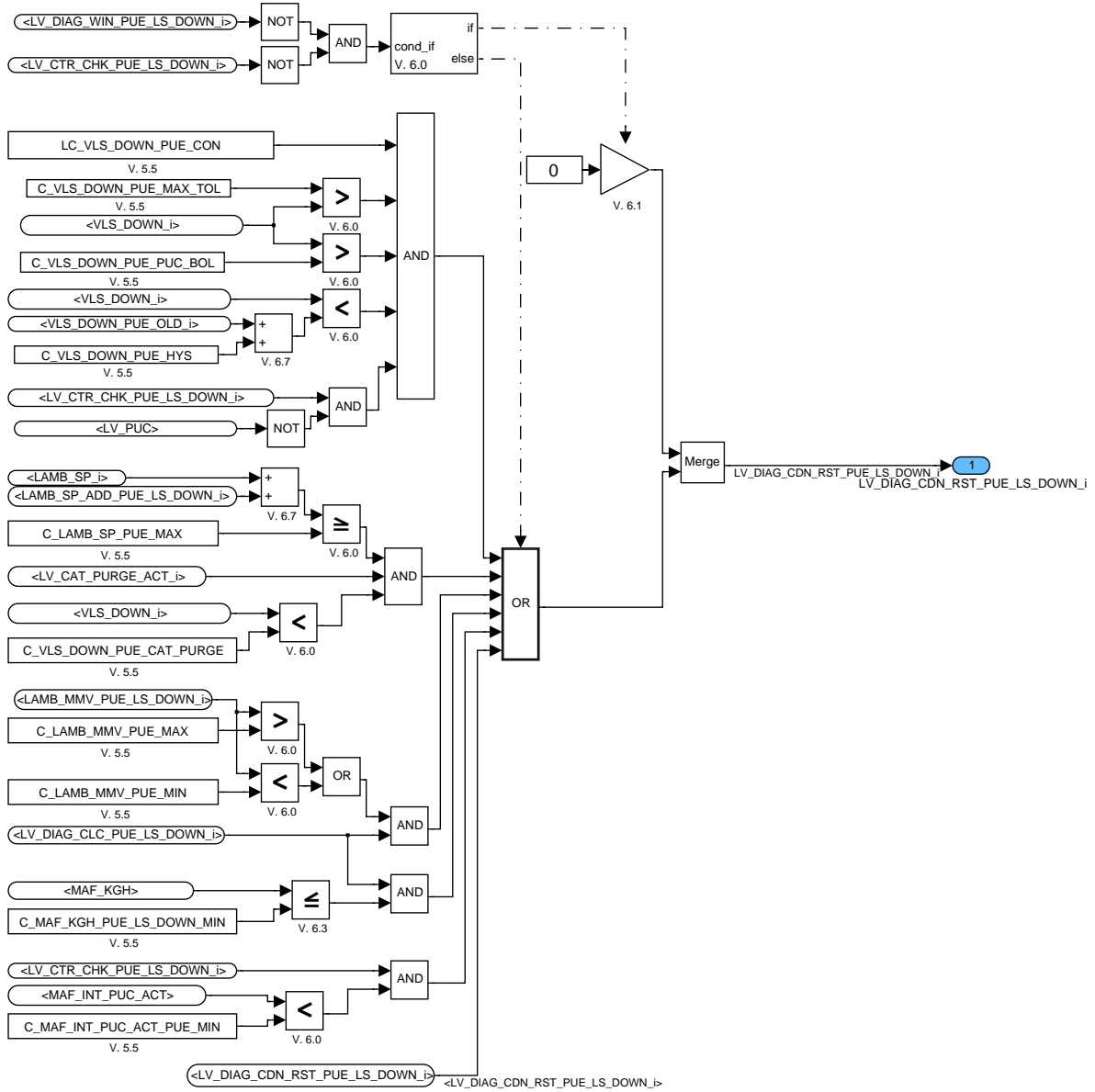



Figure B.11.6: :

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### B.11.2.2.1.3.1.3 WIN\_CDN: Calculation of Window Condition

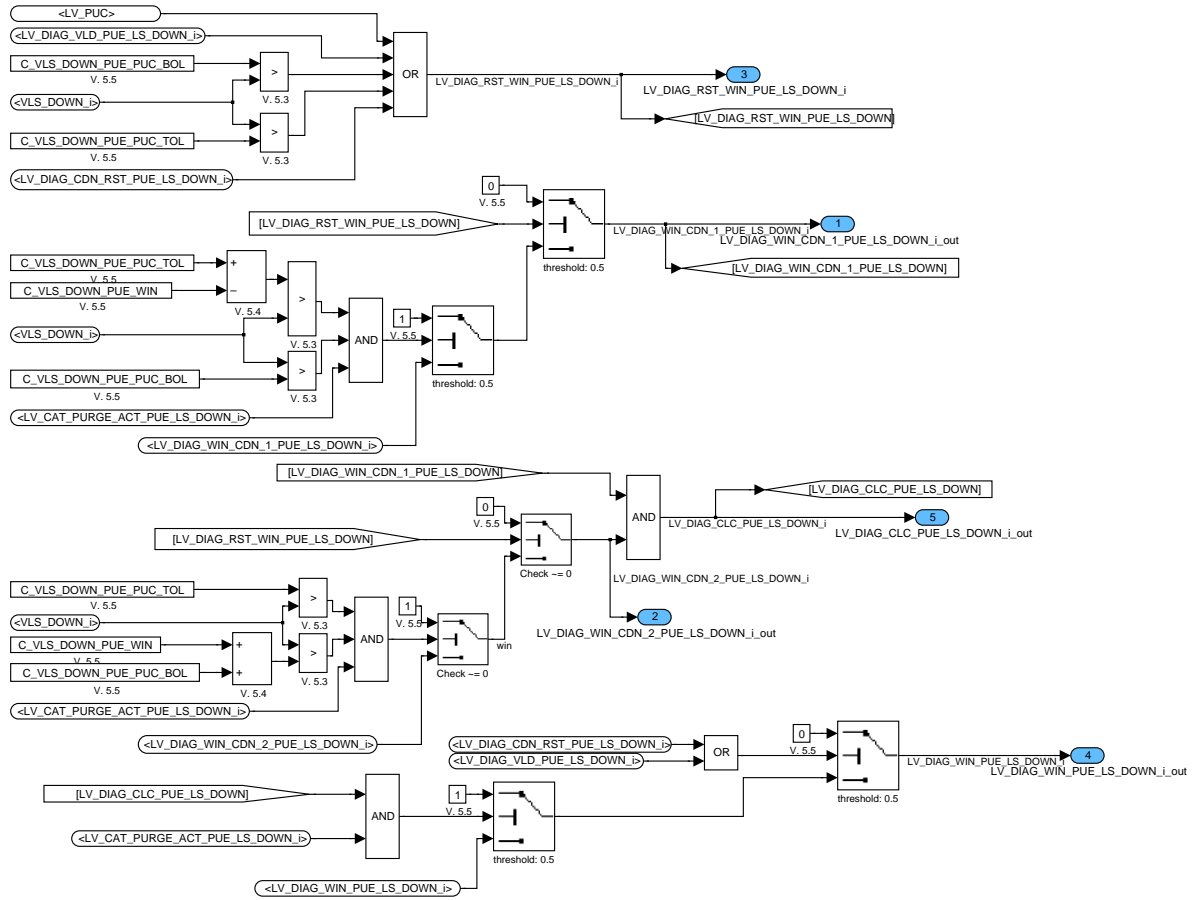


Figure B.11.7: :

### B.11.2.2.1.3.1.4 Calculation of gradients

#### B.11.2.2.1.3.1.4.1 CLC\_DRV1\_MMV: Calculation of Correction Factor for the Gradient

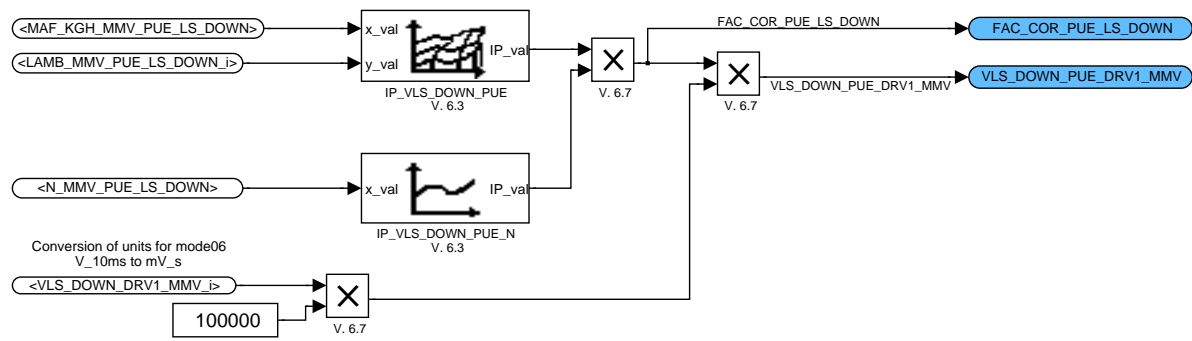


Figure B.11.8: :

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**B.11.2.2.1.3.1.4.2 MAX\_PUE: Calculation of the Maximum Gradient**

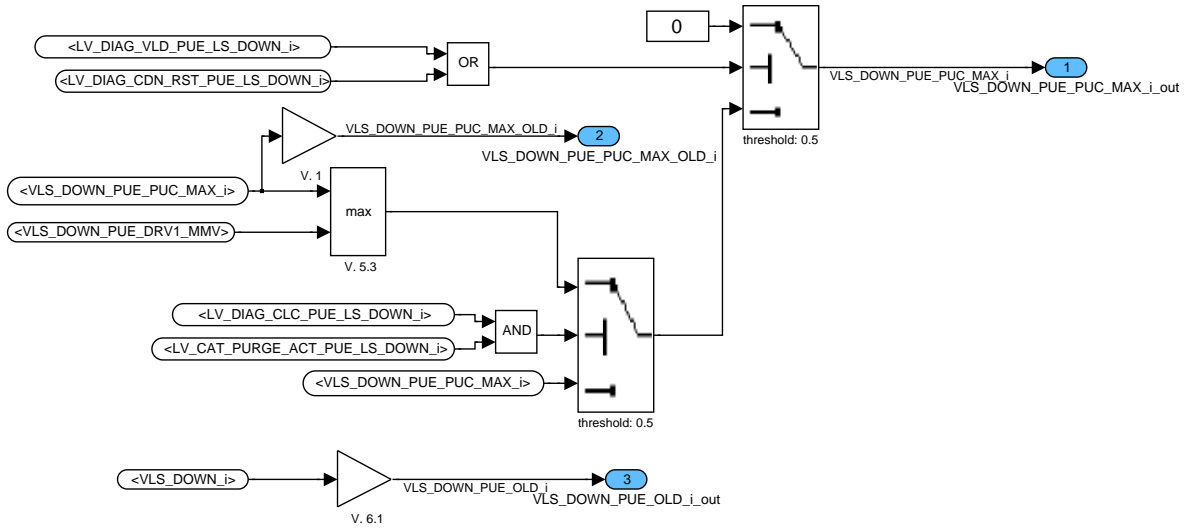


Figure B.11.9: :

**B.11.2.2.1.3.1.4.3 MIN\_PUE: Calculation of the Minimum Gradient**

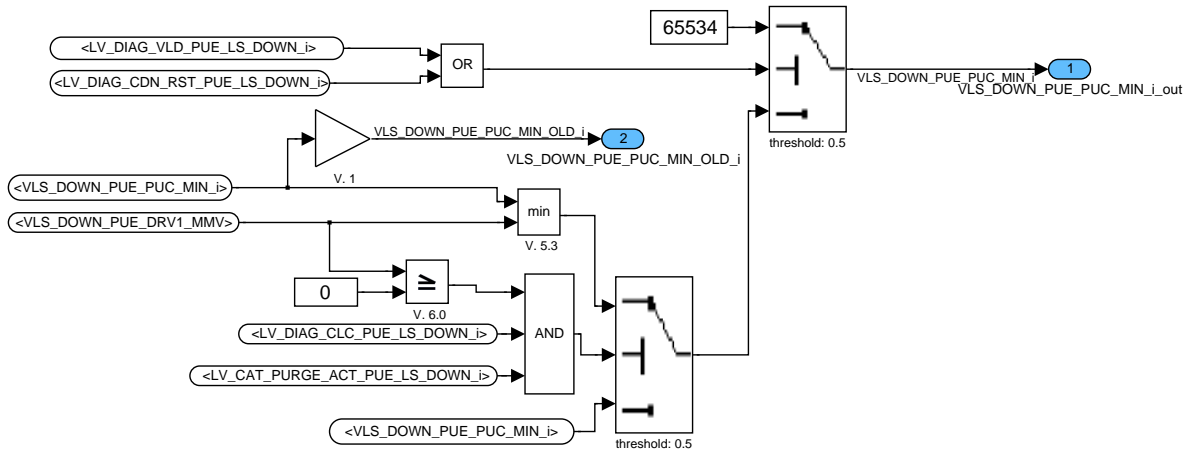



Figure B.11.10: :

**B.11.2.2.1.3.1.5 STORE\_PREV\_FRF: Prestored Freeze Frame**

Every calculated gradient will be checked against a threshold and at a fault the Prestore Freeze Frame will be triggered.

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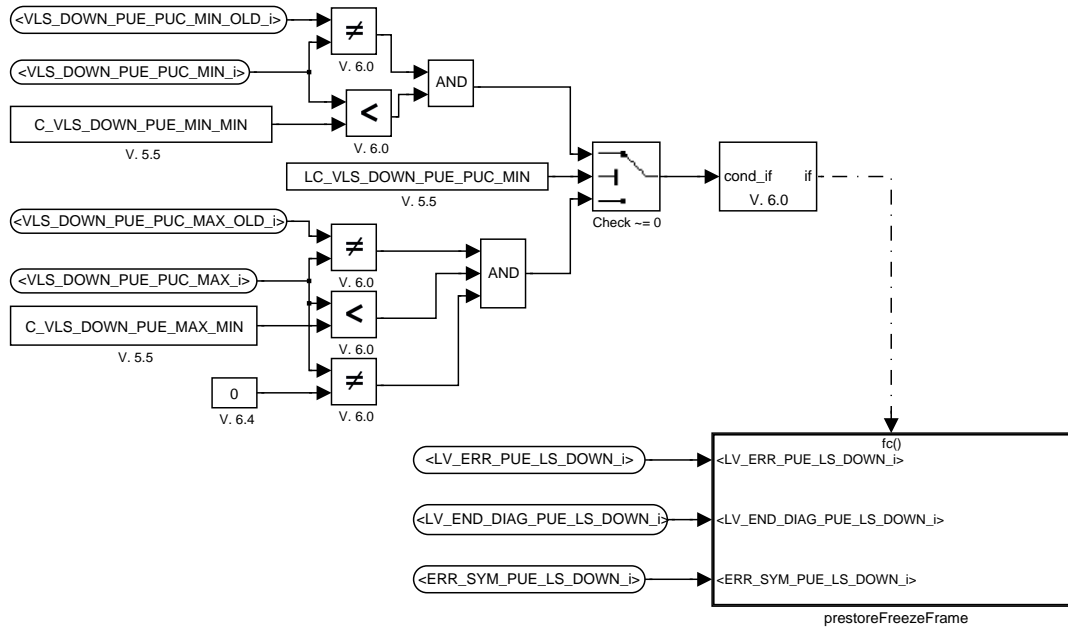


Figure B.11.11: :

**B.11.2.2.1.3.2 Check of Condition**

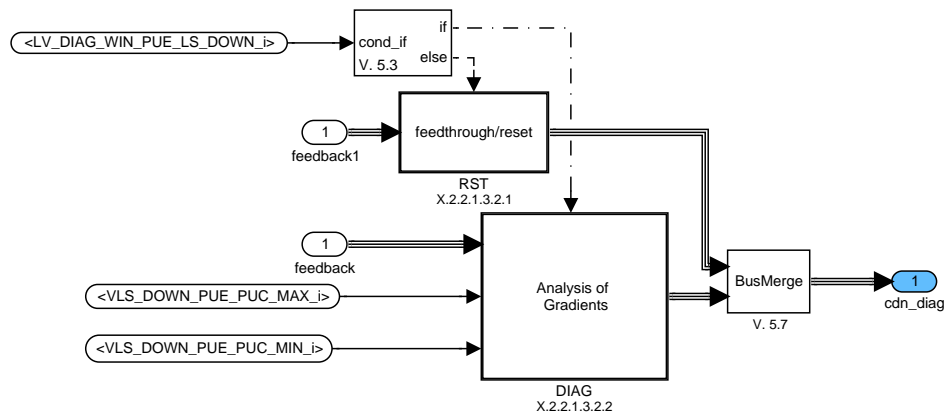


Figure B.11.12: :


**B.11.2.2.1.3.2.1 Reset**

**B.11.2.2.1.3.2.2 DIAG: Calculation of Diagnosis Mode06 and Output for Cat-Diagnosis**

**B.11.2.2.1.3.2.2.1 Calculation of Variables**

The timer limits the period of the change from lean to rich after a valid fuel cut-off phase. By crossing the threshold the valid flag would be set and the counter increments. After adjustable fuel cut-off phases a result should be available.

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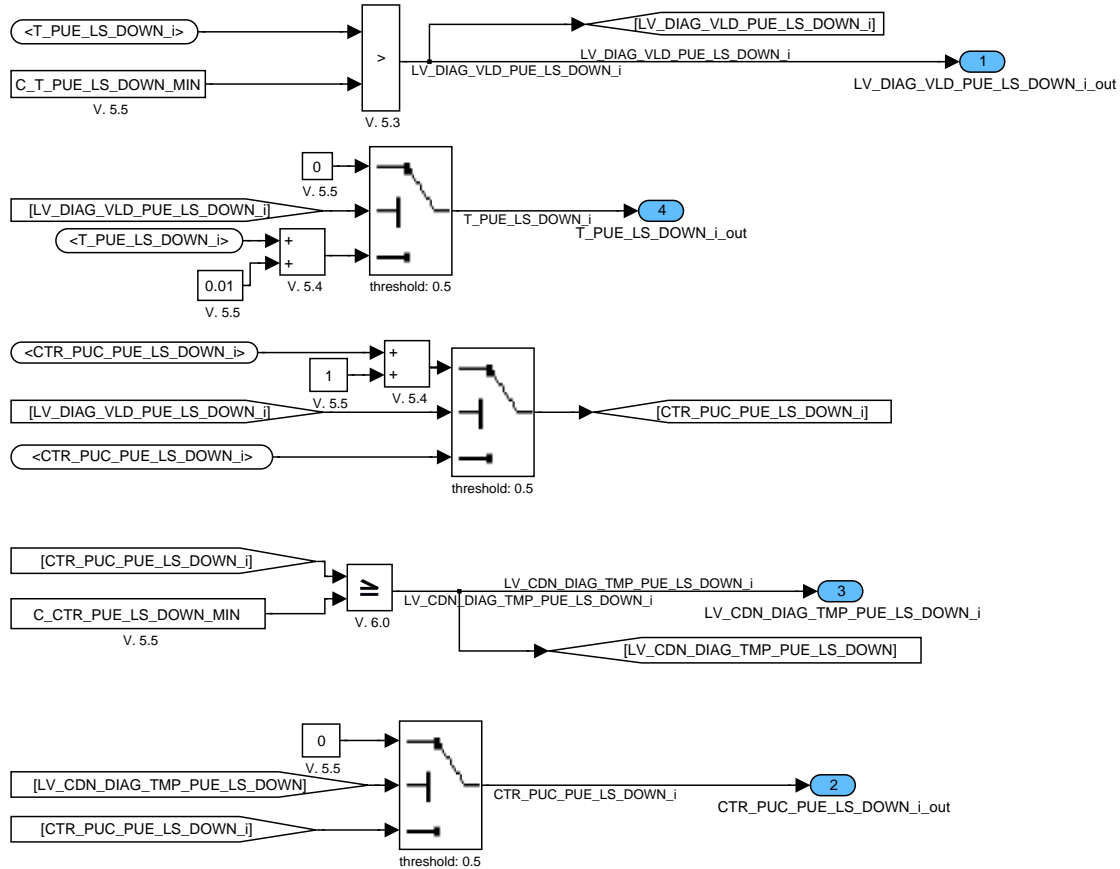


Figure B.11.13: :

**B.11.2.2.1.3.2.2.2 Mean Value of the Gradient**

The switch LC\_VLS\_DOWN\_MMV allows to choose the mean value or the minimum/maximum of the gradient.

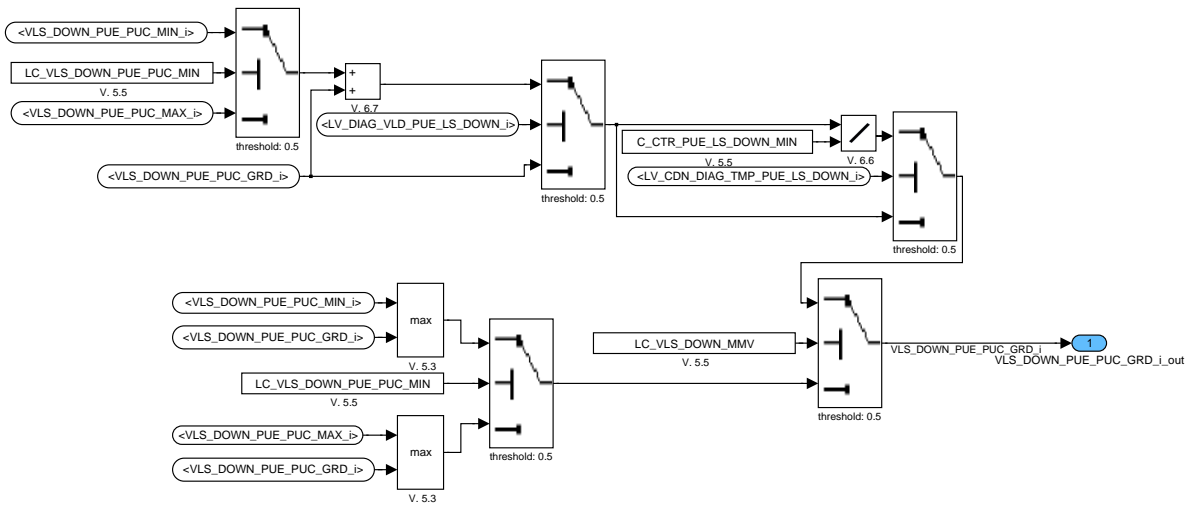


Figure B.11.14: :

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### B.11.2.2.1.3.2.2.3 Mode06

The calculated gradient (test value) and limits will be saved (independently of 'good case' or 'bad case').

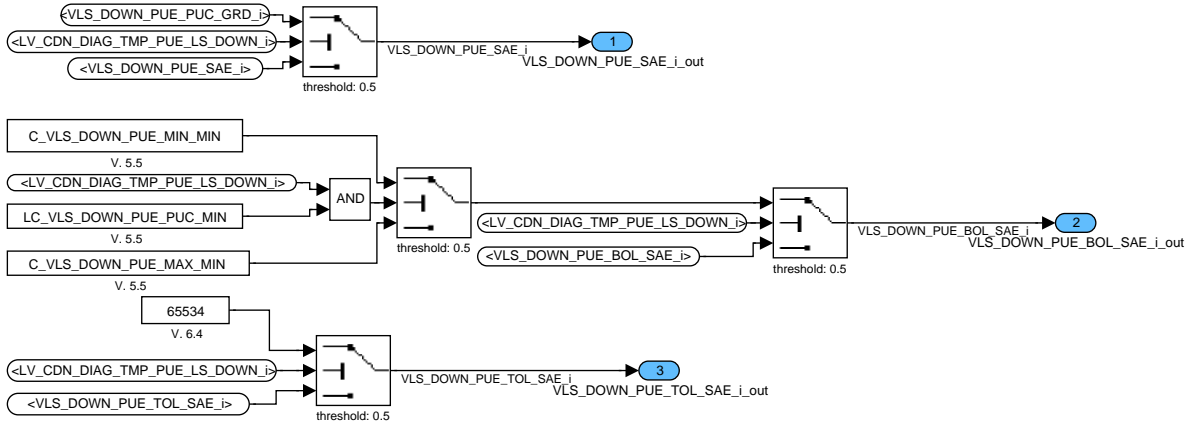


Figure B.11.15: :

### B.11.2.2.1.3.2.2.4 Calculation of the Output for Cat-Diagnosis

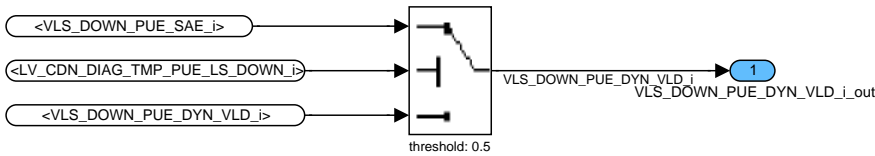


Figure B.11.16: :

### B.11.2.2.1.3.2.2.5 Reset of Gradient Mean Value

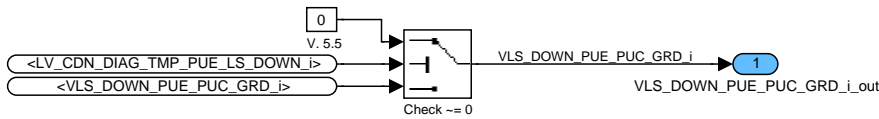


Figure B.11.17: :

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### B.11.2.2.1.3.3 Statistical Calculation of Diagnosis Cycle

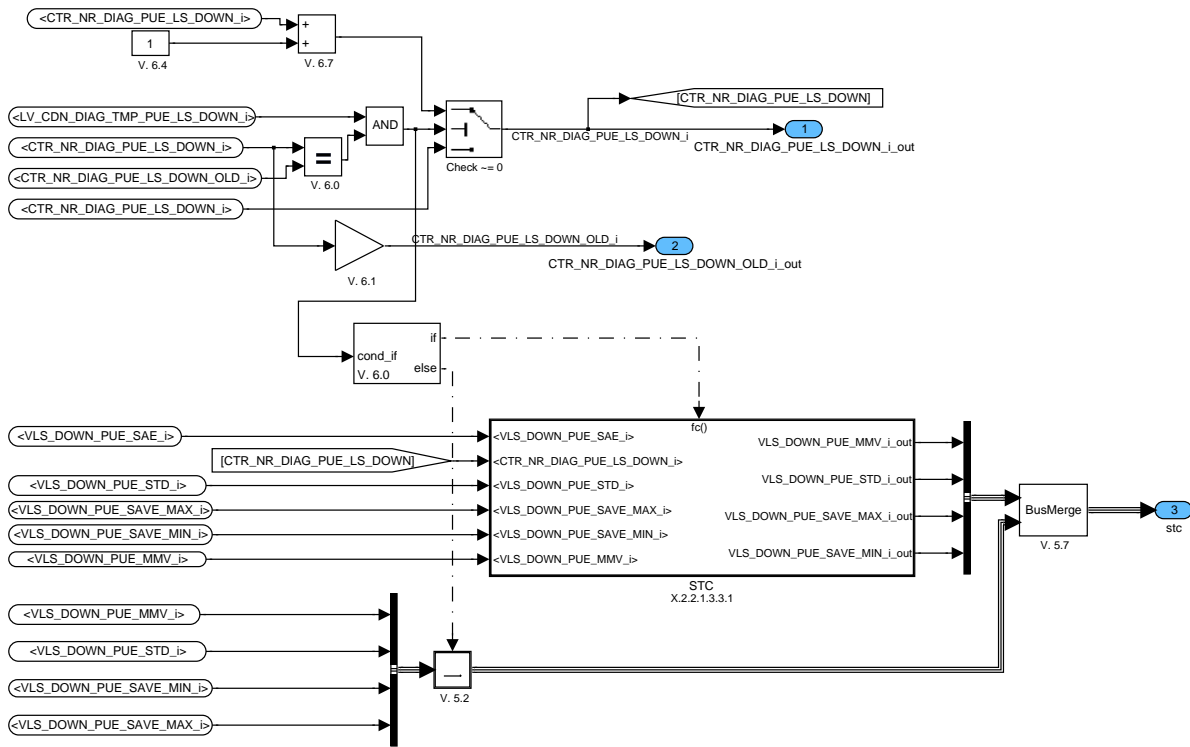


Figure B.11.18: :

#### B.11.2.2.1.3.3.1 Statistical Calculation

Calculation of mean value and standard deviation.

Evaluation of maximum and minimum calculated gradients of all driving cycles and diagnosis runs.

A reset could be done by the switch LC\_VLS\_DOWN\_PUE\_STC\_CLR.

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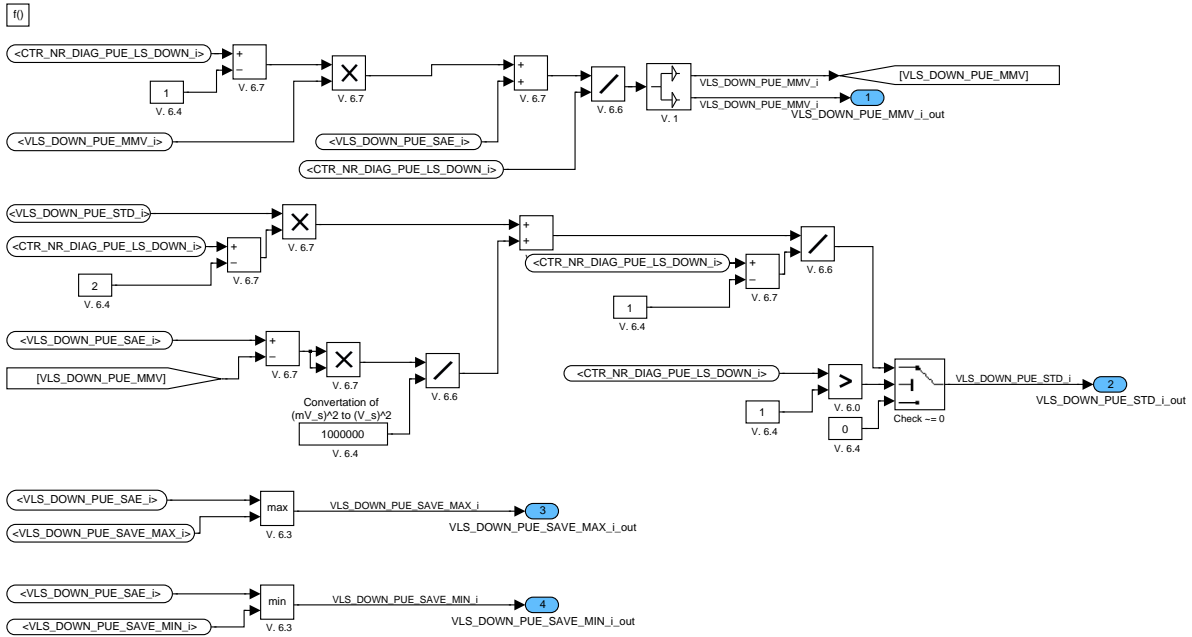


Figure B.11.19: :

**B.11.2.2.1.3.4 Calculation of value for catalyst enrichment function**

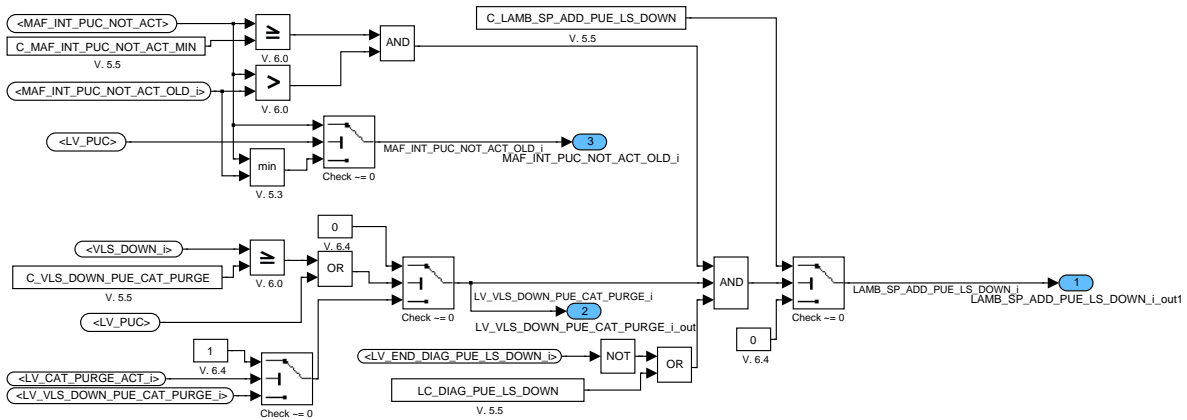


Figure B.11.20: :

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**B.11.2.2.1.4 Calculation of ERRM relevant Labels and ERRM Interface**

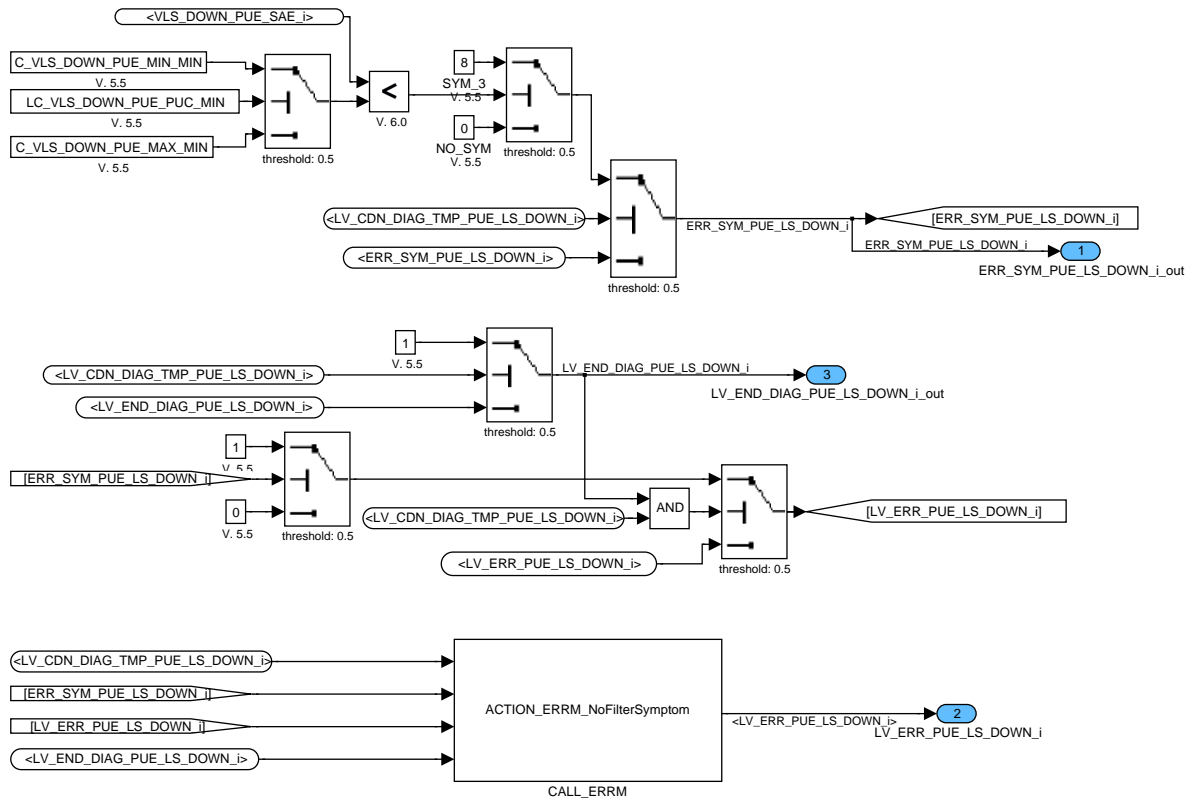


Figure B.11.21: :

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## B.12 O2 sensor (bin, down) gradient monitoring (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_PUE_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating inhibition of lambda sensor PUC-end diagnosis downstream					
LV_INH_DIAG_RBM_PUE_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating inhibition of RBM for lambda sensor PUC-end diagnosis downstream					
STATE_RBM_PUE_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of PUE_LS_DOWN monitor with the Rate-Based Monitoring statistics					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_DC {p. 5746}	LV_END_DIAG_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5169}	LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}
LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT] {p. 1061}
LV_ERR_CHG_LS_DOWN {p. 5388}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CHK_LS_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_ERR_CRK_PLAUS {p. 4446}
LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_PER {p. 4432}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FUP {p. 4717}
LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}
LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_IVVT {p. 1062}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}
LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_PLAUS {p. 1062}
LV_ERR_MAP_TPS_PLAUS {p. 1062}	LV_ERR_MEC_IVVT_EX {p. 1062}	LV_ERR_MEC_IVVT_IN {p. 1062}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}
LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}	LV_ERR_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5198}

LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}
LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_ERR_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5297}	LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}
LV_ERR_SLV_IVVT_EX {p. 4627}	LV_ERR_SLV_IVVT_IN {p. 4627}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TPS {p. 4982}
LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_BOL {p. 4951}
LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_TPS_ST_CHK_2 {p. 4951}
LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VCV {p. 4729}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_IGK {p. 906}
LV_LS_UP_OBD_2_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}	LV_ST_END {p. 1720}	LV_VB_CDN_OBD_2 {p. 1046}	NC_CBK_EX_NR {p. 1829}
NC_CYL_NR {p. 1526}	NC_NR_CBK_IVVT {p. 604}	R_IT_LS_DOWN [NC_CBK_EX_NR] {p. 1364}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_DIAG_PUE_ACT_LS_DOWN	O	0... 1H	0 ...1	1	-
Switch to set the PUE Diagnosis active or inactive					

**Import actions:**

**ACTION\_ERRM\_CheckPendingStatus** (IN<PRM\_IDX\_DIAG>,OUT<PRM\_LV\_ERR\_PND>)

**Error treatment**

Diagnostic Identifier	Symptom Description	Nr	OBD DTC	Sym	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>							
PUE_LS_DOWN[1]		0					LS

Diagnostic Identifier	Symptom Description	Nr	OBD DTC	Sym	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>							
O2 sensor gradient monitoring, bank 1, sensor 1		1					
		2					
	O2 sensor dynamic malfunction, bank 1, sensor 1	3					

Diagnostic Identifier	Symptom Description	Nr	OBD DTC	Sym	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>							
PUE_LS_DOWN [2]		0					CC
O2 sensor gradient monitoring, bank 2, sensor 1		1					
		2					
	O2 sensor dynamic malfunction, bank 2, sensor 1	3					

## General information

### B.12.1 Inhibition of oxygen sensor downstream gradient monitoring

#### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.


This function shall evaluate the application conditions applicable to the oxygen sensor gradient monitoring lean to rich and provide the result in a single boolean flag. This flag shall represent the interface to the main diagnosis function. Additionally the inhibition bit for Rate Based Monitoring is evaluated.

#### Description:

The oxygen sensor gradient monitoring lean to rich shall be inhibited if one of the following listed errors was recognized:

- LV\_ERR\_LS\_DOWN (LV\_ERR\_SCG\_LS\_DOWN, LV\_ERR\_SCP\_LS\_DOWN, LV\_ERR\_OC\_LS\_DOWN, LV\_ERR\_CHK\_LS\_DOWN, LV\_ERR\_PUC\_LS\_DOWN, LV\_ERR\_LSH\_DOWN, LV\_ERR\_OBD\_LSH\_DOWN, LV\_ERR\_CHG\_LS\_DOWN) is a system error flag and has influence on the oxygen sensor downstream readiness.

- LV\_ERR\_LS\_UP is a system error flag of the oxygen sensor upstream. The upstream sensor produce the LAMB\_LS\_UP which shall be in the correct range to activate the gradient monitoring diagnosis.

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**Application conditions:**

**Initialisation:** The following variables shall be initialised at reset and at the ignition key transition on (i.e. LV\_IGK = 0 → 1):  
 LV\_INH\_DIAG\_PUE\_LS\_DOWN[i] = 0  
 LV\_INH\_DIAG\_RBM\_PUE\_LS\_DOWN[i] = 0


**Activation:** LV\_IGK = 1

**Deactivation:** LV\_IGK = 0

**Recurrence:** The function shall be carried out once every 10 ms

**Function description:****Formula section:**

<b>If</b>	LV_ERR_AMP = 1	<b>or</b>
	LV_ERR_AMP_PLAUS = 1	<b>or</b>
	LV_ERR_CHG_LS_DOWN = 1	<b>or</b>
	LV_ERR_CHG_LS_UP = 1	<b>or</b>
	LV_ERR_CRK_PLAUS = 1	<b>or</b>
	LV_ERR_CRK_SYN = 1	<b>or</b>
	LV_ERR_CRK_TOOTH = 1	<b>or</b>
	LV_ERR_CRK_TOOTH_PER = 1	<b>or</b>
	LV_ERR_DIAGCPS = 1	<b>or</b>
	LV_ERR_EL_CPS = 1	<b>or</b>
	LV_ERR_FUP = 1	<b>or</b>
	LV_ERR_FUP_MFP_PLAUS = 1	<b>or</b>
	LV_ERR_FUP_ORNG = 1	<b>or</b>
	LV_ERR_FUP_ST = 1	<b>or</b>
	LV_ERR_H_PRS_SYS = 1	<b>or</b>
	LV_ERR_IVVT = 1	<b>or</b>
	LV_ERR_LOAD_TPS_PLAUS = 1	<b>or</b>
	LV_ERR_MAF = 1	<b>or</b>
	LV_ERR_MAP_PLAUS = 1	<b>or</b>
	LV_ERR_MAP_TPS_PLAUS = 1	<b>or</b>
	LV_ERR_MTC_CTL_2 = 1	<b>or</b>
	LV_ERR_MTC_CTL_3 = 1	<b>or</b>
	LV_ERR_MTC_DR = 1	<b>or</b>
	LV_ERR_TPS = 1	<b>or</b>
	LV_ERR_VCV = 1	<b>or</b>
	LV_ERR_AIR_LSL_UP [i] = 1	<b>or</b>
	LV_ERR_CHK_LS_DOWN[i] = 1	<b>or</b>
	LV_ERR_CTL_LSL_UP[i] = 1	<b>or</b>
	LV_ERR_DELTA_I_LAM[i] = 1	<b>or</b>
	LV_ERR_DYN_VLD_LS_UP[i] = 1	<b>or</b>
	LV_ERR_EL_LSL_UP[i] = 1	<b>or</b>
	LV_ERR_FSD[i] = 1	<b>or</b>
	LV_ERR_FSD_LAM_LIM[i] = 1	<b>or</b>
	LV_ERR_LSH_DOWN[i] = 1	<b>or</b>
	LV_ERR_LSH_UP[i] = 1	<b>or</b>
	LV_ERR_LSL_UP_IF[i] = 1	<b>or</b>
	LV_ERR_OBD_LSH_DOWN[i] = 1	<b>or</b>
	LV_ERR_OBD_VLD_LSH_UP[i] = 1	<b>or</b>
	LV_ERR_OC_LS_DOWN[i] = 1	<b>or</b>
	LV_ERR_OC_LSL_UP[i] = 1	<b>or</b>

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```

LV_ERR_OFS_LSL_UP[i] = 1
LV_ERR_PUC_LS_DOWN[i] = 1
LV_ERR_PUC_VLD_LS_UP[i] = 1
LV_ERR_SCG_LS_DOWN[i] = 1
LV_ERR_SCP_LS_DOWN[i] = 1
LV_ERR_SHIFT_AFL_LSL_UP[i] = 1
LV_ERR_SHIFT_AFR_LSL_UP[i] = 1
LV_ERR_TTIP_MES_LSH_UP[i] = 1
LV_ERR_VLS_DOWN_DIF[i] = 1
(i = 1
[ LV_ERR_IV[0]
LV_ERR_IV[2]
LV_ERR_IV[4]
LV_ERR_MIS[0]
LV_ERR_MIS[2]
LV_ERR_MIS[4] ])
(i = 2
[ LV_ERR_IV[1]
LV_ERR_IV[3]
LV_ERR_IV[5]
LV_ERR_MIS[1]
LV_ERR_MIS[3]
LV_ERR_MIS[5] ] )
LV_ERR_PER_CAM_EX[y] = 1      y = 1 for i= 1,2
LV_ERR_PER_CAM_IN[y] = 1     y = 1 for i= 1,2
LV_ERR_PLAUS_CAM_EX[y] = 1   y = 1 for i= 1,2
LV_ERR_PLAUS_CAM_IN[y] = 1   y = 1 for i= 1,2
LV_ERR_REF_CRK_CAM_EX[y] = 1 y = 1 for i= 1,2
LV_ERR_REF_CRK_CAM_IN[y] = 1 y = 1 for i= 1,2
LV_ERR_SYN_CAM_EX[y] = 1     y = 1 for i= 1,2
LV_ERR_SYN_CAM_IN[y] = 1     y = 1 for i= 1,2
LV_ERR_SYN_CRK_CAM_IN[y] = 1 y = 1 for i= 1,2
LV_ERR_TOOTH_OFF_EX[y] = 1   y = 1 for i= 1,2
LV_ERR_TOOTH_OFF_IN[y] = 1   y = 1 for i= 1,2

then LV_INH_DIAG_RBM_PUE_LS_DOWN[i] = 1
else LV_INH_DIAG_RBM_PUE_LS_DOWN[i] = 0
endif

```

```

If LV_INH_DIAG_RBM_PUE_LS_DOWN [i] = 1 or
LV_ST_END = 0 or
LV_VB_CDN_OBD_2 = 0 or
LV_LS_UP_OBD_2_MAN_DEAC[i] = 1

then
LV_INH_DIAG_PUE_LS_DOWN [i] = 1
else
LV_INH_DIAG_PUE_LS_DOWN [i] = 0
endif

```

## B.12.2 Interface for Rate Based Monitoring

**General information:**

With this module the interface between the PUE\_LS\_DOWN[i] monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_PUE\_LS\_DOWN[i] data.

Within STATE\_RBM\_PUE\_LS\_DOWN[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)  
(depending on failure status: pending)
- Monitor individual RBM conditions encountered within this DC (bit 2)

**Application conditions:****Initialisation:**

at ECU reset :  
     bit 0, bit 1 and bit 2 of STATE\_RBM\_PUE\_LS\_DOWN[i]  
 = 0  
 at LV\_DC 0 → 1 transition :  
     bit 0 and bit 1 of STATE\_RBM\_PUE\_LS\_DOWN[i] = 0  
 on failure memory reset :  
     bit 1 of STATE\_RBM\_PUE\_LS\_DOWN[i] = 0

**Activation:**

LV\_DC = 1

**Deactivation:**

-

**Recurrence:**

1 s

**Function description:****Formula section:****At LV\_DC 0 → 1 transition**

bit 2 of STATE\_RBM\_PUE\_LS\_DOWN[i] = 1

The pending status of the following failures has to be checked only once:

Dependence	Error			
	LV_ERR_AMP	LV_ERR_AMP_PLAUS	LV_ERR_CHG_LS_DOWN	LV_ERR_CHG_LS_UP
	LV_ERR_CRK_PLAUS	LV_ERR_CRK_SYN	LV_ERR_CRK_TOOTH	LV_ERR_CRK_TOOTH_ PER
	LV_ERR_DIAGCPS	LV_ERR_EL_CPS	LV_ERR_FUP	LV_ERR_FUP_MFP_ PLAUS
	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_SYS	LV_ERR_LOAD_TPS_ PLAUS
Continued on next page				

	LV_ERR_MAF_FRQ_EL	LV_ERR_MAF_FRQ_GRD	LV_ERR_MAF_FRQ_RNG	LV_ERR_MAP_PLAUS
	LV_ERR_MAP_TPS_PLAUS	LV_ERR_MTC_CTL_2	LV_ERR_MTC_CTL_3	LV_ERR_MTC_DR
	LV_ERR_TPS_1	LV_ERR_TPS_2	LV_ERR_TPS_AD	LV_ERR_TPS_AD_BOL
	LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2	LV_ERR_TPS_RATIO	LV_ERR_TPS_ST_CHK_2
	LV_ERR_VCV			
<b>NC_CBK_EX_NR</b>	LV_ERR_AIR_LSL_UP [i]	LV_ERR_CHK_LS_DOWN [i]	LV_ERR_CTL_LSL_UP[i]	LV_ERR_DELTA_I_LAM [i]
	LV_ERR_DYN_VLD_LS_UP [i]	LV_ERR_EL_LSL_UP[i]	LV_ERR_FSD[i]	LV_ERR_FSD_LAM_LIM[i]
	LV_ERR_LSH_DOWN [i]	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]	LV_ERR_OBD_LSH_DOWN [i]
	LV_ERR_OBD_VLD_LSH_UP [i]	LV_ERR_OC_LS_DOWN [i]	LV_ERR_OC_LSL_UP [i]	LV_ERR_OFS_LSL_UP [i]
	LV_ERR_PUC_LS_DOWN [i]	LV_ERR_PUC_VLD_LS_UP [i]	LV_ERR_SCG_LS_DOWN [i]	LV_ERR_SCP_LS_DOWN [i]
	LV_ERR_SHIFT_AFL_LSL_UP [i]	LV_ERR_SHIFT_AFR_LSL_UP [i]	LV_ERR_TTIP_MES_LSH_UP [i]	LV_ERR_VLS_DOWN_DIF [i]

for any i

<b>NC_NR_CAM_CBK</b>	LV_ERR_PER_CAM_EX[1]	LV_ERR_PER_CAM_IN[1]	LV_ERR_PLAUS_CAM_EX[1]	LV_ERR_PLAUS_CAM_IN[1]
	LV_ERR_REF_CRK_CAM_EX[1]	LV_ERR_REF_CRK_CAM_IN[1]	LV_ERR_SYN_CAM_EX[1]	LV_ERR_SYN_CAM_IN[1]
	LV_ERR_SYN_CRK_CAM_IN[1]	LV_ERR_TOOTH_OFF_IN[1]	LV_ERR_TOOTH_OFF_EX[1]	


x = 1 to NC\_NR\_CBK\_IVVT (= for any i // or)

<b>NC_NR_CBK_IVVT</b>	LV_ERR_CAM_CST_IVVT_EX[x]	LV_ERR_CAM_CST_IVVT_IN[x]	LV_ERR_MEC_IVVT_EX[x]	LV_ERR_MEC_IVVT_IN[x]
	LV_ERR_SLV_IVVT_EX[x]	LV_ERR_SLV_IVVT_IN[x]		

For NC\_CBK\_EX\_NR = i = 1

<b>NC_CYL_NR</b>	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	LV_ERR_MIS[0]
	LV_ERR_MIS[4]	LV_ERR_MIS[4]		

For NC\_CBK\_EX\_NR = i = 2

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NC_CYL_NR	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	LV_ERR_MIS[1]
	LV_ERR_MIS[3]	LV_ERR_MIS[5]		

**If (1)**

{ CPU optimization at LV\_DC 0 → 1 transition }

CTR\_ERR\_DYN\_NR <> 0

{ the dynamic failure memory isn't empty }

**Then (1)**

**While** bit 1 of STATE\_RBM\_PUE\_LS\_DOWN[i] = 0 **do**

with each XX failure of the above list :

ACTION\_ERRM\_CheckPendingStatus(IN<XX>, OUT<PendingStatus>,  
SYNCHRONIZATION<CALL>)

**If (2)** XX has a pending status

**Then (2)** bit 1 of STATE\_RBM\_PUE\_LS\_DOWN[i] = 1

**Endif (2)**

**Endwhile**

**Else (1)**

{ the dynamic failure memory is empty } No action

**Endif (1)**

Every 1 s :

**If** bit 0 of STATE\_RBM\_PUE\_LS\_DOWN[i] = 0

**Then**

**If** LV\_END\_DIAG\_PUE\_LS\_DOWN[i] = 1

**Then** bit 0 of STATE\_RBM\_PUE\_LS\_DOWN[i] = 1

**Endif**

**Endif**

**If** bit 1 of STATE\_RBM\_PUE\_LS\_DOWN[i] = 0

**Then**


**If** LV\_INH\_DIAG\_RBM\_PUE\_LS\_DOWN[i] = 1 **OR**  
LC\_DIAG\_PUE\_ACT\_LS\_DOWN = 0

**Then**

bit 1 of STATE\_RBM\_PUE\_LS\_DOWN[i] = 1

**Endif**

**Endif**

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## B.13 O2 sensor (bin, down) heater diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CYCNR_R_IT_OBD_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Value of handshake counter for last valid resistance value used for diagnosis					
ERR_SYM_OBD_LSH_DOWN [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Variable indicating status of each symptom, updated each recurrence & at diagnosis completion					
LV_CDN_DIAG_OBD_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0...1	1	-
Boolean flag indicating that conditions for diagnosis met					
LV_END_DIAG_OBD_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0...1	1	-
Boolean flag indicating that diagnosis has been completed					
LV_ERR_OBD_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0...1	1	-
Boolean flag indicating that fault is present and has been debounced					
POW_INT_MIN_OBD_LSH_DOWN_TMP	-	0... FFFFH	0... 65535	1	J
Minimum required cooling energy required at downstream sensor prior to checking Ri threshold					
POW_INT_OBD_LSH_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	J
Integral indicates measure of cooling energy of exhaust gas at sensor location					
R_IT_H_MES_OBD_LSH_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	Ohm
Latest measured downstream oxygen sensor internal resistance value for error case, mode 6 information					
R_IT_H_REF_OBD_LSH_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	Ohm
Latest reference value for measured internal resistance downstream in error case, mode 6 information					
R_IT_L_MES_OBD_LSH_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	Ohm
Latest measured downstream oxygen sensor internal resistance value for no error case, mode 6 information					
R_IT_L_REF_OBD_LSH_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	Ohm
Latest reference value for measured internal resistance downstream in error case, mode 6 information					
R_IT_OBD_LSH_DOWN [NC_CBK_EX_NR]	O/V/S	0... FFFFH	0... 65535	1	Ohm
Most current downstream oxygen sensor internal resistance used for diagnosis cycle, Mode 6 information					
R_IT_THD_OBD_LSH_DOWN [NC_CBK_EX_NR]	O/V/S	0... FFFFH	0... 65535	1	Ohm
Threshold for most current downstream oxygen sensor internal resistance used for diagnosis cycle, Mode 6 information					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_OBD_LSH_DOWN [NC_CBK_EX_NR]	V	0H	DIAG_OFF	-	-
		1H	DIAG_INIT		
		2H	LS_READY		
		3H	OBD1_DLY		
		4H	OBD1_CHK		
		5H	TEG_THD		
		6H	POW_INT		
		7H	DIAG_ACT		
		8H	DIAG_END		
Indicates current phase of oxygen sensor heater OBDII diagnosis					
T_DLY_OBD_LSH_DOWN_TMP	-	0... FFH	0... 255	1	s
Minimum delay time prior to checking status of OBDI heater /signal faults					
TCC_ERR_OBD_LSH_DOWN [NC_CBK_EX_NR]	V	0... 3FFH	0... 1023	1	-
Number of faults detected during valid diagnosis cycles					
TCC_THD_ERR_OBD_LSH_DOWN_TMP	-	0... 3FFH	0... 1023	1	-
Fault detection threshold for determination of defective heater					
TCC_THD_OBD_LSH_DOWN_TMP	-	0... 3FFH	0... 1023	1	-
Number of valid downstream LSH OBDII diagnosis cycles after which statistic evaluation is carried out					
TCC_VLD_OBD_LSH_DOWN [NC_CBK_EX_NR]	V	0... 3FFH	0... 1023	1	-
Number of completed valid diagnosis cycles					
TEMP_DIF_OBD_LSH_DOWN [NC_CBK_EX_NR]	V	0... 7FFH	0... 2047	1	K
Indicates difference in temperature between set operating temperature & exhaust gas at sensor location					

**Input data:**

CTR_CYCNR_R_IT_LS_DOWN_VLD [NC_CBK_EX_NR] {p. 1364}	LSHPWM_DOWN [NC_CBK_EX_NR] {p. 2421}	LV_DIAG_EOL_END_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_DIAG_EOL_REQ_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5210}
LV_ERR_EL_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_LS_DOWN [NC_CBK_EX_NR] {p. 5449}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_IGK {p. 906}
LV_INH_DIAG_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5210}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_ST_END {p. 1720}	LV_VB_CDN_OBD_2 {p. 1046}
MAF_KGH {p. 1195}	NC_CBK_EX_NR {p. 1829}	NC_STATE_LSL_UP_IF {p. 651}	R_IT_LS_DOWN [NC_CBK_EX_NR] {p. 1364}
R_IT_MDL_LS_DOWN_NEW [NC_CBK_EX_NR] {p. 1364}	STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}	TEG_DYN_LS_DOWN [NC_CBK_EX_NR] {p. 1007}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LSHPWM_MAX_LSH_DOWN	-	0... FFH	0... 99.60937	0.390625	%
Maximum permitted heater effective voltage PWM for downstream LSH OBDII diagnosis					
C_LSHPWM_MIN_LSH_DOWN	-	0... FFH	0... 99.60937	0.390625	%
Minimum permitted heater effective voltage PWM for downstream LSH OBDII diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_POW_INT_MIN_OBD_LSH_DOWN	-	0... FFFFH	0... 65535	1	J
Measure of minimum required cooling energy required at downstream sensor prior to checking Ri threshold					
C_POW_INT_MIN_OBD_LSH_DOWN_EOL	-	0... FFFFH	0... 65535	1	J
Measure of minimum required cooling energy required at downstream sensor prior to checking Ri threshold when EOL test required					
C_T_DLY_OBD_LSH_DOWN	-	0... FFH	0... 255	1	s
Minimum delay prior to checking status of OBDI heater /signal faults					
C_T_DLY_OBD_LSH_DOWN_EOL	-	0... FFH	0... 255	1	s
Minimum delay prior to checking status of OBDI heater /signal faults when EOL test required					
C_TCC_THD_ERR_OBD_LSH_DOWN	-	0... 3FFH	0... 1023	1	-
Fault detection threshold, when exceeded, heater is determined to be defective during driving cycle					
C_TCC_THD_ERR_OBD_LSH_DOWN_EOL	-	0... 3FFH	0... 1023	1	-
Fault detection threshold, when exceeded, heater is determined to be defective during driving cycle when EOL test required					
C_TCC_THD_OBD_LSH_DOWN	-	0... 3FFH	0... 1023	1	-
Number of valid downstream LSH OBDII diagnosis cycles over which statistic evaluation to be carried out					
C_TCC_THD_OBD_LSH_DOWN_EOL	-	0... 3FFH	0... 1023	1	-
Number of valid downstream LSH OBDII diagnosis cycles over which statistic evaluation to be carried out when EOL test required					
C_TEG_DYN_MAX_OBD_LSH_DOWN	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Temperature threshold under which downstream LSH OBDII diagnosis activated					
C_TEMP_SP_OBD_LSH_DOWN	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Set temperature for downstream LSH operation used to generate power integral					
IP_FAC_MAF_OBD_LSH_DOWN	-	0... FFH	0... 15.9375	0.0625	J/K
LDPM_MAF_KGH_3_EGCP	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Factor reflecting forced convection influence of cooling area, gas velocity and heat transfer coefficient					
IP_R_IT_THD_OBD_LSH_DOWN	-	0... FFFFH	0... 65535	1	Ohm
LDP_R_IT_LS_DOWN_NEW_LSH_DOWN	4	0... FFFFH	0... 65535	1	Ohm
Internal resistance threshold, when exceeded, heater is determined to be defective for current diagnosis cycle; including reference to modelled value for new sensor					
LC_DIAG_EOL_END_LSH_DOWN [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Locigal calibration data to enforce end of diagnosis when EOL test has passed					


### Error treatment:

Diagnostic	Symptom description	Symptom	Filter type
XX			
OBD_LSH_DOWN/NC CBK_EX_NR]	Heater fault	SYM_0	NO

### FUNCTION DESCRIPTION:

### General information:

The calculation shall be done for all exhaust cylinder banks.

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For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1


i = 2, for exhaust cylinder bank 2

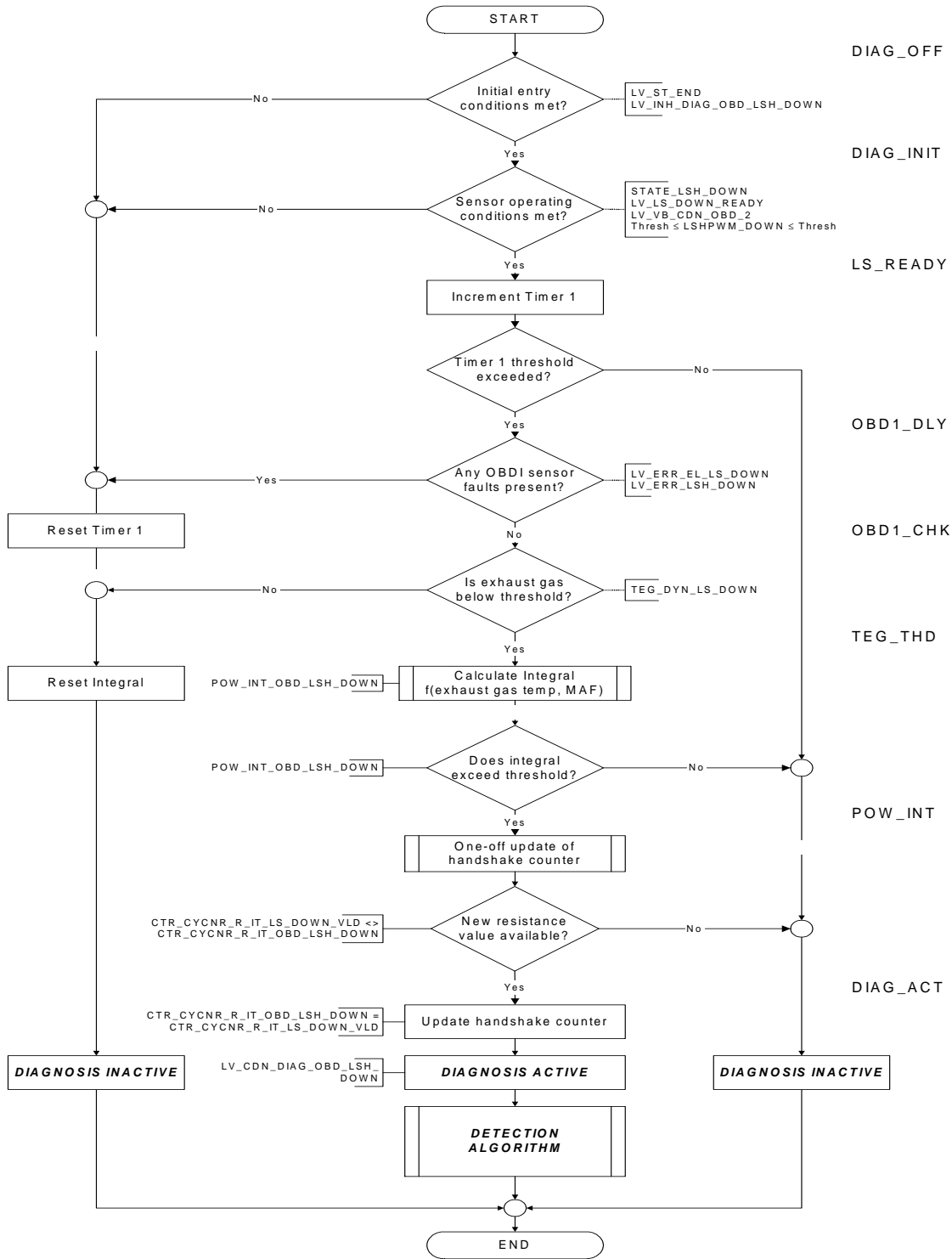
otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

### Signal flow diagram:

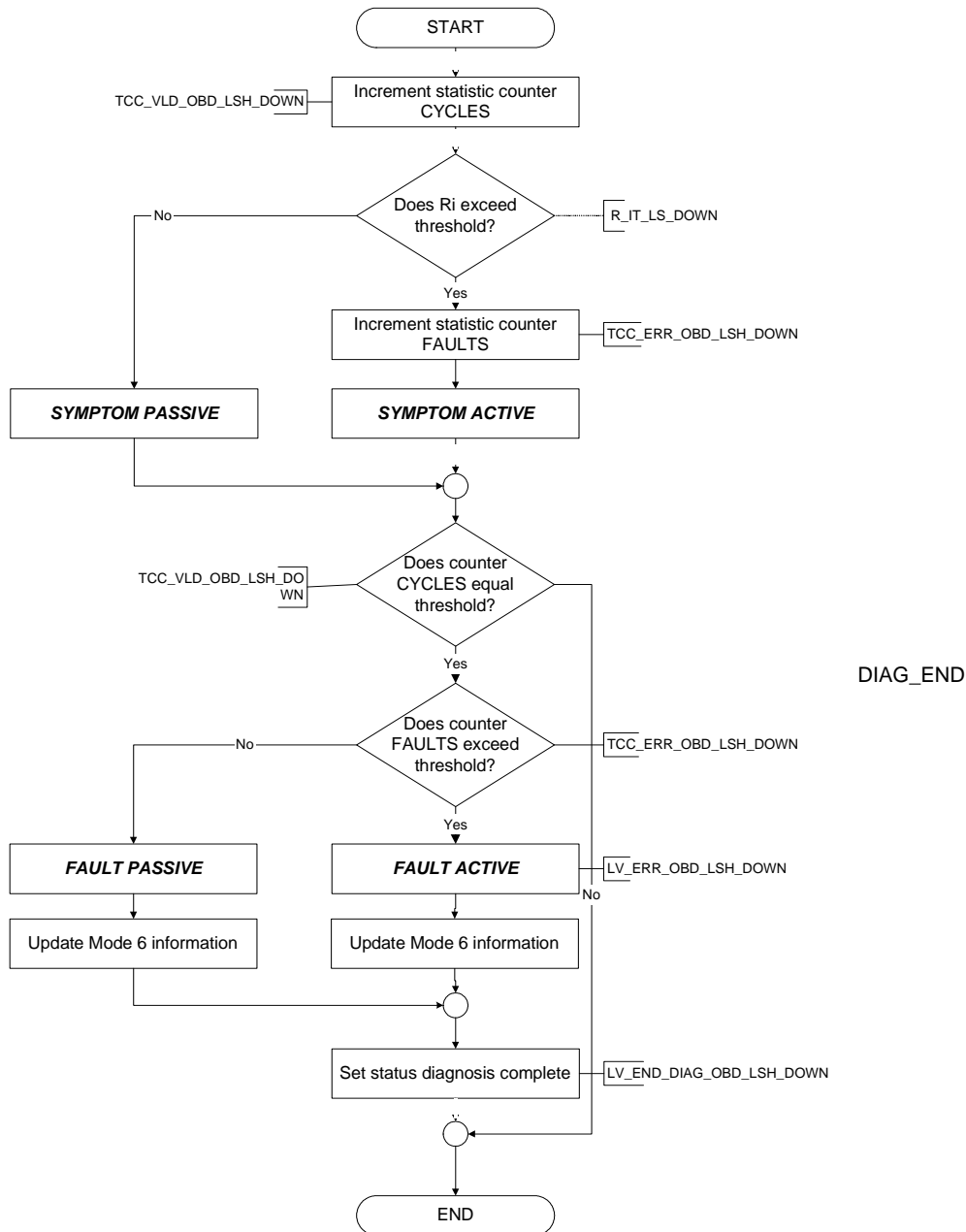
*Activation conditions:*

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Detection Algorithm:

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### Description:

The downstream oxygen sensor heater circuit shall detect any loss in heater power that would cause a drop in the sensor operating temperature, thereby possibly causing exhaust gas emissions to rise above the applicable standards or prevent the sensor signal from being used as a diagnostic system monitoring device.

Losses in heater power may occur due to, for example, ageing of the heater element, defective wiring, increased heater cct. connector contact resistance, defective heater driver etc.

The hereafter mentioned diagnosis strategy is based on the comparison of the oxygen sensor internal resistance to an absolute threshold during operating conditions where the exhaust gas temperature has been determined to be sufficiently low as to cause the sensor ceramic temperature to fall outside normal operating levels, in cases where a power is insufficient.

The functionality of the diagnosis may be described in further detail below:

The initial diagnosis application condition; LV\_ST\_END shall ensure that the engine is running and has left the start phase but not yet entered the engine stop phase, LV\_INH\_DIAG\_OBD\_LSH\_DOWN[i] shall ensure that the project specific application conditions (Application Incidences) have been met and LV\_END\_DIAG\_OBD\_LSH\_DOWN[i] shall ensure that the diagnosis only be carried out once per driving cycle.

In order to ensure that the sensor has reached its normal operating temperature, the heater management state STATE\_LSH\_DOWN[i] shall be determined to be in the open loop control state LSH\_POW\_CTL, the sensor shall be determined to be in a state of operative readiness via LV\_LS\_DOWN\_READY[i], the battery voltage VB shall be in a range determined to be fit for carrying out OBD2 diagnosis shown by LV\_VB\_CDN\_OBD\_2 and the heater duty-cycle LSHPWM\_DOWN[i] shall be determined to be within calibrateable range C\_LSHPWM\_MIN\_LSH\_DOWN & C\_LSHPWM\_MAX\_LSH\_DOWN.

Should the above initial and operative conditions have been determined to be met, a timer, denoted herein as *TIMER\_1*, shall be started. The timer shall run until the threshold T\_DLY\_OBD\_LSH\_DOWN\_TMP is equalled or exceeded. Once this delay has passed, the status of the OBDI error bits LV\_ERR\_EL\_LS\_DOWN[i] & LV\_ERR\_LSH\_DOWN[i] shall be read to ensure that no signal electrical or plausibility faults and no heater electrical faults are present in the sensor cct. under test. The delay shall ensure that sufficient time passes to permit completion of the OBDI monitoring prior to the start of OBDII monitoring.


Should no OBDI faults be present, the modelled exhaust gas temperature TEG\_DYN\_LS\_DOWN[i] shall be compared to a calibrateable threshold C\_TEG\_DYN\_MAX\_OBD\_LSH\_DOWN. Due tolerances in the determination of the sensor internal resistance and in the case of a functional heater, the maximum resistance value may be given by a minimum tolerance sensor at a much lower temperature than for a maximum tolerance sensor at a higher temperature. Therefore, in the case of diagnosis based on an absolute internal resistance threshold, a certain temperature tolerance exists. The above mentioned temperature threshold shall lie below the minimum temperature determined from analysis of the internal resistance tolerances and be sufficient to cool the sensor ceramic element to below normal operating conditions, in the case of a heater fault.

Should the exhaust gas temperature be determined to equal or fall below the threshold, the monitoring strategy shall ensure that the sensor be cooled sufficiently long by the exhaust gas to enable differentiation between a functional and non-functional heater cct. (The time required is dependent on the thermal capacity of the system at the sensor location and the forced convection cooling of the sensor location). This shall be achieved by integrating the heat flux of the forced convection thermal transfer between sensor and exhaust gas, this being a measure for the cooling energy of the exhaust gas. The heat flux shall be calculated by determining the difference between the typical set sensor operating temperature C\_TEMP\_SP\_OBD\_LSH\_DOWN and the modelled exhaust gas temperature TEG\_DYN\_LS\_DOWN[i] and multiplying the result by the factor IP\_FAC\_MAF\_OBD\_LSH\_DOWN representing the heat transfer coefficient and surface area concerned in the thermal transfer. As the heat transfer coefficient is a function of the velocity of the exhaust gas, the factor shall be mapped and dependent on the current mass airflow MAF\_KGH.

The resultant integral POW\_INT\_OBD\_LSH\_DOWN[i] shall be compared to the threshold POW\_INT\_MIN\_OBD\_LSH\_DOWN\_TMP. Each time that the threshold be exceeded for the first time, e.g. first time after engine start or after the power integral has been reset, the CTR\_CYCNR\_R\_IT\_OBD\_LS\_DOWN[i] shall be updated once only with the value CTR\_CYCNR\_R\_IT\_LS\_DOWN\_VLD[i]. This shall ensure that only new internal resistance values be used for diagnosis purposes that have been determined since all the activation conditions have been met.

It shall be determined whether a new internal resistance has been determined by comparing the contents of counter CTR\_CYCNR\_R\_IT\_OBD\_LS\_DOWN[i] with that of CTR\_CYCNR\_R\_IT\_LS\_DOWN\_VLD[i]. Should the counters be unequal, then a new value is available and CTR\_CYCNR\_R\_IT\_OBD\_LS\_DOWN[i] shall be updated with CTR\_CYCNR\_R\_IT\_LS\_DOWN\_VLD[i]. If this conditions and all the above conditions be met, LV\_CDN\_DIAG\_OBD\_LSH\_DOWN[i] shall be set and the diagnosis shall be considered to be active and the current monitoring cycle valid.

Once the current monitoring cycle has been determined to be valid, a counter TCC\_VLD\_OBD\_LSH\_DOWN[i] shall be incremented, denoting the number of valid monitoring cycles carried out to date. The internal resistance R\_IT\_LS\_DOWN[i] shall be compared to a calibrateable threshold IP\_R\_IT\_THD\_OBD\_LSH\_DOWN according to modelled tip temperature of a new sensor (including safety margin).

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Should the resistance equal or exceed the threshold, a heater fault shall be determined to be present in the current cycle and a counter `TCC_ERR_OBD_LSH_DOWN[i]` shall be incremented, denoting the number of heater faults within the valid monitoring cycles carried out to date.

In order to comply with OBDII requirements, the current `R_IT_LS_DOWN[i]` value used shall be made available to an external tester. This information is Mode 6 information. Hence once the comparison to the threshold has been carried out, the latest measured internal resistance and threshold values (`R_IT_L_MES_OBD_LSH_DOWN[i]` and `R_IT_L_REF_OBD_LSH_DOWN[i]`) shall be copied to the respective Mode 6 interface variables `R_IT_OBD_LS_DOWN[i]` and `R_IT_THD_OBD_LSH_DOWN[i]` for the no error case. In the error case the variables `R_IT_H_MES_OBD_LSH_DOWN[i]` and `R_IT_H_REF_OBD_LSH_DOWN[i]` shall be handed out.

Once the number of valid monitoring cycles `TCC_THD_OBD_LSH_DOWN_TMP` has been determined to have been carried out, the diagnosis shall carry out a n-out-of-m statistical evaluation of the results. Should the number of determined heater faults exceed the threshold `TCC_THD_ERR_OBD_LSH_DOWN_TMP`, the oxygen sensor heater under test shall be considered to be faulty for the current driving cycle and flag `LV_ERR_OBD_LSH_DOWN[i]` shall be set.

If the number of faults does not exceed the threshold, `LV_ERR_OBD_LSH_DOWN[i]` shall be reset.

Once the statistical evaluation has been carried out, no further monitoring cycles shall be executed in the remaining driving cycle. This is achieved by setting `LV_END_DIAG_OBD_LSH_DOWN[i]`.

Should, according to project philosophy, the diagnosis be activated for an end of line (EOL) test, specific threshold conditions for the diagnosis delay timer, the power integral, the required number of test and error indicating cycles may be chosen to shorten the time until recognition of diagnosis end.


#### NOTES:

1. The integral `POW_INT_OBD_LSH_DOWN[i]` shall be reset to 0 should the exhaust gas temperature exceed the applicable threshold. This would cause the sensor to be re-heated from the exhaust gas once again and a certain delay would be required prior to the sensor being cooled long enough to permit valid diagnosis to occur.
2. The timer `TIMER_1` and integral `POW_INT_OBD_LSH_DOWN[i]` shall be reset should any of the initial entry or operative readiness conditions no longer be met or an OBDI fault be detected in the sensor under test. This may cause the sensor to leave its normal operating conditions and the OBDII diagnosis shall be required to start from the beginning as the sensor operating conditions would require time to stabilise should the conditions be met again.
3. The statistic counters `TCC_VLD_OBD_LSH_DOWN[i]` and `TCC_ERR_OBD_LSH_DOWN[i]` shall not be reset by changing conditions and therefore shall only increment or remain frozen during any given monitoring cycle. The counters shall only be reset at the beginning of a new driving cycle.
4. Projects that provide for an internal statistical error management shall use their internal error management and apply this wherever reference to `TCC_VLD_OBD_LSH_DOWN[i]`, `TCC_ERR_OBD_LSH_DOWN[i]`, `TCC_THD_OBD_LSH_DOWN_TMP` & `TCC_THD_ERR_OBD_LSH_DOWN_TMP` is made.
5. The variable `STATE_OBD_LSH_DOWN[i]` shall indicate, at the end of the each monitoring cycle, the status of the diagnosis within that cycle. The following correlation of variable content to description shall apply:

0:	<code>DIAG_OFF</code>	Initialisation state; no conditions met
1:	<code>DIAG_INIT</code>	Initial conditions & application incidences met only
2:	<code>LS_READY</code>	Sensor operatively ready conditions met + 1,
3:	<code>OBD1_DLY</code>	OBDI monitoring completion delay exceeded + 1 & 2
4:	<code>OBD1_CHK</code>	No OBDI faults present +1, 2 & 3
5:	<code>TEG_THD</code>	Exhaust gas below threshold + 1, 2, 3 & 4
6:	<code>POW_INT</code>	Power integral exceeded + 1,2,3,4 & 5
7:	<code>DIAG_ACT</code>	<b>Diagnosis detection active</b>
8:	<code>DIAG_END</code>	<b>Diagnosis detection complete</b>

### Application conditions

#### Initialisation:

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The following variables shall be initialised at reset, at the transition ignition key on (i.e. LV\_IGK = 0 -> 1) and at clearing the error memory:

```

LV_CDN_DIAG_OBD_LSH_DOWN[i] = 0
ERR_SYM_OBD_LSH_DOWN[i] = 0
LV_ERR_OBD_LSH_DOWN[i] = 0
LV_END_DIAG_OBD_LSH_DOWN[i] = 0
STATE_OBD_LSH_DOWN[i] = 0
TEMP_DIF_OBD_LSH_DOWN[i] = 0
POW_INT_OBD_LSH_DOWN[i] = 0
TCC_VLD_OBD_LSH_DOWN[i] = 0
TCC_ERR_OBD_LSH_DOWN[i] = 0
CTR_CYCNR_R_IT_OBD_LS_DOWN[i] = 0
R_IT_L_MES_OBD_LSH_DOWN[i]      = 0
R_IT_L_REF_OBD_LSH_DOWN[i]      = 0
R_IT_H_MES_OBD_LSH_DOWN[i]      = 0
R_IT_H_REF_OBD_LSH_DOWN[i]      = 0

```

### Reset *TIMER\_1*

R\_IT\_OBD\_LSH\_DOWN[i] and R\_IT\_THD\_OBD\_LSH\_DOWN[i] shall be initialised with the last value from the previous driving cycle stored in non-volatile memory after RESET.

**NOTE: *TIMER\_1* refers to a program specific timer and is not intended to represent a variable name!**

#### Recurrence:

The OBDII oxygen sensor heater diagnosis shall be carried out once per driving cycle. The diagnosis shall require a number of monitoring cycles to be carried out to permit statistical evaluation of the results. These monitoring cycles shall occur every 1 s, until a calibrateable number of valid diagnosis cycles has been exceeded.

Once this threshold has been completed, the OBDII oxygen sensor heater diagnosis shall no longer be carried out until a new driving cycle is initiated.


Should an OBDII heater fault be detected, the application assistances (Functions that are defined to be affected by the state of the oxygen sensor signal) shall remain active for the remainder of the driving cycle. The restarting of the affected functions during the next driving cycle shall be carried out according to the project philosophy.

#### Activation:

```

if (LV_ST_END = 1) &
    (LV_INH_DIAG_OBD_LSH_DOWN[i] = 0)
then if LV_DIAG_EOL_REQ_OBD_LSH_DOWN[i] = 0
    then T_DLY_OBD_LSH_DOWN_TMP = C_T_DLY_OBD_LSH_DOWN
        POW_INT_MIN_OBD_LSH_DOWN_TMP =
            C_POW_INT_MIN_OBD_LSH_DOWN
        TCC_THD_OBD_LSH_DOWN_TMP = C_TCC_THD_OBD_LSH_DOWN
        TCC_THD_ERR_OBD_LSH_DOWN_TMP =
            C_TCC_THD_ERR_OBD_LSH_DOWN
    else T_DLY_OBD_LSH_DOWN_TMP = C_T_DLY_OBD_LSH_DOWN_EOL
        POW_INT_MIN_OBD_LSH_DOWN_TMP =
            C_POW_INT_MIN_OBD_LSH_DOWN_EOL
        TCC_THD_OBD_LSH_DOWN_TMP = C_TCC_THD_OBD_LSH_DOWN_EOL
        TCC_THD_ERR_OBD_LSH_DOWN_TMP =
            C_TCC_THD_ERR_OBD_LSH_DOWN_EOL
    endif
if (LV_LS_DOWN_READY[i] = 1) &
    (STATE_LSH_DOWN[i] = LSH_POW_CTL) &
    (LV_VB_CDN_OBD_2 = 1) &

```

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```

(C_LSHPWM_MIN_LSH_DOWN LSHPWM_DOWN[i]) &
(LSHPWM_DOWN[i] C_LSHPWM_MAX_LSH_DOWN)
then   Increment TIMER_1
If   (TIMER_1 T_DLY_OBD_LSH_DOWN_TMP)
then   If   (LV_ERR_EL_LS_DOWN[i] = 0) &
        (LV_ERR_LSH_DOWN[i] = 0)
        then   If   (TEG_DYN_LS_DOWN[i]
                    C_TEG_DYN_MAX_OBD_LSH_DOWN)
        then   Calculate POW_INT_OBD_LSH_DOWN[i]
        If   (POW_INT_OBD_LSH_DOWN[i]
            POW_INT_MIN_OBD_LSH_DOWN_TMP)
        then   One-off update CTR_CYCNR_R_IT_OBD_LS_DOWN[i]
            % see note below
        If   (CTR_CYCNR_R_IT_LS_DOWN_VLD[i] <>
            CTR_CYCNR_R_IT_OBD_LS_DOWN[i])
        then   LV_CDN_DIAG_OBD_LSH_DOWN[i] = 1
            CTR_CYCNR_R_IT_OBD_LS_DOWN[i] =
            CTR_CYCNR_R_IT_LS_DOWN_VLD[i]
            Diagnosis detection active
        else   STATE_OBD_LSH_DOWN[i] = POW_INT
            LV_CDN_DIAG_OBD_LSH_DOWN[i] = 0
        endif
        else   STATE_OBD_LSH_DOWN[i] = TEG_THD
            LV_CDN_DIAG_OBD_LSH_DOWN[i] = 0
        endif
        else   STATE_OBD_LSH_DOWN[i] = OBD1_CHK
            Reset POW_INT_OBD_LSH_DOWN[i]
            LV_CDN_DIAG_OBD_LSH_DOWN[i] = 0
        endif
        else   STATE_OBD_LSH_DOWN[i] = OBD1_DLY
            Reset TIMER_1
            Reset POW_INT_OBD_LSH_DOWN[i]
            LV_CDN_DIAG_OBD_LSH_DOWN[i] = 0
        endif
        else   STATE_OBD_LSH_DOWN[i] = LS_READY
            LV_CDN_DIAG_OBD_LSH_DOWN[i] = 0
        endif
        else   STATE_OBD_LSH_DOWN[i] = DIAG_INIT
            Reset TIMER_1
            Reset POW_INT_OBD_LSH_DOWN[i]
            LV_CDN_DIAG_OBD_LSH_DOWN[i] = 0
        endif
else   STATE_OBD_LSH_DOWN[i] = DIAG_OFF
        Reset TIMER_1
        Reset POW_INT_OBD_LSH_DOWN[i]
        LV_CDN_DIAG_OBD_LSH_DOWN[i] = 0
endif.


```

*Deactivation:*

```

If   (LV_END_DIAG_OBD_LSH_DOWN[i] = 1)
then   Diagnosis detection complete
endif.

```

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**NOTES:** The state variable STATE\_OBD\_LSH\_DOWN[i] shall only be validated at the completion of the current monitoring cycle, i.e. the state should not vary within the current 1 s monitoring cycle, but indicate at the end of the current cycle, the last state reached, dependant upon the branches.

The variable CTR\_CYCNR\_R\_IT\_OBD\_LS\_DOWN[i] shall be updated with the current value of the input variable CTR\_CYCNR\_R\_IT\_LS\_DOWN\_VLD[i] on each occasion that the integral POW\_INT\_OBD\_LSH\_DOWN[i] exceeds the threshold for the first time. For further function calls where the integral condition is met, the one-off update shall not be carried out. This shall continue until the integral condition is no longer met.

### **Formula section:**

#### Calculation of cooling energy integral:

Determine difference between typical sensor operating temperature and exhaust gas temperature:

TEMP\_DIF\_OBD\_LSH\_DOWN[i] = (C\_TEMP\_SP\_OBD\_LSH\_DOWN - TEG\_DYN\_LS\_DOWN[i])  
(NOTE: Resolution of temperature difference is reduced from 0.0625 °C, resolution of the individual temperature variables, to 1 °C; The difference shall be limited to provide only positive values, i.e. 0)

The integral of heat flux (in Watts) provides a measure for the total cooling energy of the exhaust gas (in Joules):

POW\_INT\_OBD\_LSH\_DOWN[i]<sub>(n)</sub> = (POW\_INT\_OBD\_LSH\_DOWN[i]<sub>(n-1)</sub> +  
TEMP\_DIF\_OBD\_LSH\_DOWN[i] \* IP\_FAC\_MAF\_OBD\_LSH\_DOWN)

(NOTE: Integral shall be limited to its maximum hex limit, i.e. FFFFH or 65535 digits, to prevent overflow.)

Detection: (Assumes Diagnosis detection active)

**also NOTE D above!**

**Increment** TCC\_VLD\_OBD\_LSH\_DOWN[i]

**If** (R\_IT\_LS\_DOWN[i] IP\_R\_IT\_THD\_OBD\_LSH\_DOWN)

**then** **Symptom Oxygen sensor heater fault, bank i active**

ERR\_SYM\_OBD\_LSH\_DOWN[i] = "SYM\_0"

R\_IT\_H\_MES\_OBD\_LSH\_DOWN[i] = R\_IT\_LS\_DOWN[i]

R\_IT\_H\_REF\_OBD\_LSH\_DOWN[i] = IP\_R\_IT\_THD\_OBD\_LSH\_DOWN

**Increment** TCC\_ERR\_OBD\_LSH\_DOWN[i]

**else** **Symptom Oxygen sensor heater fault, bank i passive**

ERR\_SYM\_OBD\_LSH\_DOWN[i] = "NO\_SYM"

R\_IT\_L\_MES\_OBD\_LSH\_DOWN[i] = R\_IT\_LS\_DOWN[i]

R\_IT\_L\_REF\_OBD\_LSH\_DOWN[i] = IP\_R\_IT\_THD\_OBD\_LSH\_DOWN

**endif.**

**If** (TCC\_VLD\_OBD\_LSH\_DOWN[i] TCC\_THD\_OBD\_LSH\_DOWN\_TMP)

**then** STATE\_OBD\_LSH\_DOWN[i] = DIAG\_END

**If** (TCC\_ERR\_OBD\_LSH\_DOWN[i] TCC\_THD\_ERR\_OBD\_LSH\_DOWN\_TMP)

**then** **Symptom Oxygen sensor heater fault, bank i active**

LV\_ERR\_OBD\_LSH\_DOWN[i] = 1

ERR\_SYM\_OBD\_LSH\_DOWN[i] = "SYM\_0"

R\_IT\_OBD\_LSH\_DOWN[i] = R\_IT\_H\_MES\_OBD\_LSH\_DOWN[i]


R\_IT\_THD\_OBD\_LSH\_DOWN[i] = R\_IT\_H\_REF\_OBD\_LSH\_DOWN[i]

**else** **Symptom Oxygen sensor heater fault, bank i passive**

LV\_ERR\_OBD\_LSH\_DOWN[i] = 0

ERR\_SYM\_OBD\_LSH\_DOWN[i] = "NO\_SYM"

R\_IT\_OBD\_LSH\_DOWN[i] = R\_IT\_L\_MES\_OBD\_LSH\_DOWN[i]

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```

        R_IT_THD_OBD_LSH_DOWN[i] = R_IT_L_REF_OBD_LSH_DOWN[i]
    endif
else    STATE_OBD_LSH_DOWN[i] = DIAG_ACT
endif.

```


*The diagnosis end bit shall be calculated each recurrence independently on STATE\_OBD\_LSH\_DOWN[i] until diagnosis deactivation:*

```

if          STATE_OBD_LSH_DOWN[i] = DIAG_END
or ...      #if          NC_STATE_LSL_UP_IF > 0
                #then    ...    (LV_DIAG_EOL_END_LS_UP_DOWN[i] = 1
                and      LC_DIAG_EOL_END_LSH_DOWN[i] = 1
                and      LV_ERR_LS_DOWN[i] = 0)
                #endif
then        LV_END_DIAG_OBD_LSH_DOWN[i] = 1
endif

```

**See also NOTE D above!**

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## B.14 O2 sensor (bin, down) heater diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_EOL_REQ_OBD_LSH_DOWN [NC_CBK_EX_NR]	O	0... 1H	0 ...1	1	-
Logical variable indicating requested EOL test for downstream heater diagnosis					
LV_INH_DIAG_OBD_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean inhibit flag for O2 sensor heater OBDII monitoring					
LV_INH_DIAG_RBM_OBD_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag to inhibit rate based monitoring for oxygen sensor heater OBDII diagnosis					
STATE_RBM_OBD_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of OBD_LSH_DOWN monitor with the Rate-Based Monitoring statistics					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_CDN_VB_OBD2 {p. 1185}	LV_DC {p. 5746}	LV_END_DIAG_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5198}
LV_ERR_CHK_LS_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}
LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_IGK {p. 906}	LV_ST_END {p. 1720}	LV_VAR_LSH_DOWN {p. 656}
NC_CBK_EX_NR {p. 1829}	TCO {p. 1100}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_MIN_OBD2_LSH_DOWN	-	0... FEH	-48... 142.5	0.75	°C
TCO threshold for OBD2 heater diagnosis downstream					

### Import actions:


**ACTION\_ERRM\_CheckPendingStatus** (IN<PRM\_IDX\_DIAG>,OUT<PRM\_LV\_ERR\_PND>)

### B.14.1 1.1. Inhibition of diagnosis

#### FUNCTION DESCRIPTION:

#### General information:

LV\_INH\_DIAG\_OBD\_LSH\_DOWN[NC\_CBK\_EX\_NR] represents the influence by errors/conditions deactivating the O2 heater diagnosis. Additionally the interfaces for Rate Based Monitoring RBM are provided.

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The calculation shall be done for all exhaust cylinder banks. For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1 for exhaust cylinder bank 1

i = 2 for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1 for single exhaust cylinder bank.

### Application conditions

**Initialisation:** 0 at LV\_IGK = 0→1 or at reset

**Recurrence:** 1 s

**Activation:** LV\_ST\_END = 1

**Deactivation:** LV\_ST\_END = 0

### Formula section:

```

if      LV_ERR_LSH_DOWN[i] = 1
or      LV_ERR_SCP_LS_DOWN[i] = 1
or      LV_ERR_SCG_LS_DOWN[i] = 1
or      LV_ERR_OC_LS_DOWN[i] = 1
or      LV_ERR_CHK_LS_DOWN[i] = 1

then    LV_INH_DIAG_RBM_OBD_LSH_DOWN[i] = 1
else    LV_INH_DIAG_RBM_OBD_LSH_DOWN[i] = 0
endif

```

```

if      LV_VAR_LSH_DOWN = 0
or      LV_CDN_VB_OBD2 = 0
or      TCO < C_TCO_MIN_OBD2_LSH_DOWN
or      LV_INH_DIAG_RBM_OBD_LSH_DOWN[i] = 1
or      LV_LS_DOWN_OBD_2_MAN_DEAC[i] = 1
then    LV_INH_DIAG_OBD_LSH_DOWN[i] = 1
else    LV_INH_DIAG_OBD_LSH_DOWN[i] = 0
endif

```

LV\_DIAG\_EOL\_REQ\_OBD\_LSH\_DOWN[i] = 0

## **B.14.2 1.2. Interface for Rate Based Monitoring**


### FUNCTION DESCRIPTION:

#### General information:

With this module the interface between the OBD\_LSH\_DOWN[i] monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_OBD\_LSH\_DOWN[i] data.

Within STATE\_RBM\_OBD\_LSH\_DOWN[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)  
(depending on failure status: pending)

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- Monitor individual RBM conditions encountered within this DC (bit 2)

### Application conditions:

#### *Initialisation :*

at ECU reset : bit 0, bit 1 and bit 2 of STATE\_RBM\_OBD\_LSH\_DOWN[i] = 0  
 at LV\_DC 0 → 1 transition : bit 0 and bit 1 of STATE\_RBM\_OBD\_LSH\_DOWN[i] = 0  
 on failure memory reset : bit 1 of STATE\_RBM\_OBD\_LSH\_DOWN[i] = 0

*Recurrence:* 1 s  
*Activation:* LV\_DC = 1

### Formula section:

#### At LV\_DC 0 → 1 transition

bit 2 of STATE\_RBM\_OBD\_LSH\_DOWN[i] = 1

The pending status of the following failures has to be checked only once:

LV_ERR_LSH_DOWN[NC_CBK_EX_NR]
LV_ERR_SCP_LS_DOWN[NC_CBK_EX_NR]
LV_ERR_SCG_LS_DOWN[NC_CBK_EX_NR]
LV_ERR_OC_LS_DOWN[NC_CBK_EX_NR]
LV_ERR_CHK_LS_DOWN[NC_CBK_EX_NR]

**If(1)** { CPU optimization at LV\_DC 0 → 1 transition }  
 CTR\_ERR\_DYN\_NR <> 0 { the dynamic failure memory isn't empty }

#### **Then(1)**

**While** bit 1 of STATE\_RBM\_OBD\_LSH\_DOWN[i] = 0 **do**  
 with all XX failures of the above list

ACTION\_ERRM\_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

**If(2)** XX has a pending status

#### **Then(2)**

bit 1 of STATE\_RBM\_OBD\_LSH\_DOWN[i] = 1

#### **Endif(2)**

#### **Endwhile**

#### **Else(1)**

{ the dynamic failure memory is empty }  
 No action

#### **Endif(1)**

#### Every 1 s :

**If** (bit 0 of STATE\_RBM\_OBD\_LSH\_DOWN[i] = 0 **and**  
 LV\_END\_DIAG\_OBD\_LSH\_DOWN[i] = 1)

**Then** bit 0 of STATE\_RBM\_OBD\_LSH\_DOWN[i] = 1


#### **Endif**

**If** (bit 1 of STATE\_RBM\_OBD\_LSH\_DOWN[i] = 0 **and**  
 LV\_INH\_DIAG\_RBM\_OBD\_LSH\_DOWN[i] = 1)

```

Then      bit 1 of STATE_RBM_OBD_LSH_DOWN[i] = 1
Endif

```

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## B.15 O2 sensor (bin, down) oscillation diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_SP_OSC_CHK [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
lambda setpoint requested by oscillation check for downstream lambda sensor					
LV_END_DIAG_OSC_CHK [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End of oscillation diagnosis for downstream sensor					
LV_ERR_OSC_CHK [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced failure of oscillation diagnosis for downstream sensor					

### FUNCTION DESCRIPTION:

#### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

#### Description:

This is a stub module to provide signals consumed in other EGCP modules.

#### Application conditions

##### Initialisation:

*The output shall be set to the following values, which are never changed:*

*LV\_ERR\_OSC\_CHK[i] = 0*

*LV\_END\_DIAG\_OSC\_CHK[i] = 1*

*LAMB\_SP\_OSC\_CHK[i] = 0*

##### Recurrence:

*not applicable*

##### Activation:

*not applicable*

#### Formula section:

- This function does not execute any actions or calculations. -

## B.16 O2 sensor fuel trim diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_DELTA_I_LAM [NC_CBK_EX_NR]	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptom of trim controller limit error					
ERR_SYM_LAM_ADJ [NC_CBK_EX_NR]	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptoms of the lambda trim control errors					
ERR_SYM_VLS_DOWN_DIF [NC_CBK_EX_NR]	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptom of trim controller deviation error					
LAM_MMV_VLS_DIF_DLY_LDC [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
floating mean value for limited lambda deviation					
LAMB_DELTA_I_SAVE_DIAG [NC_CBK_EX_NR]	O/V/S	F800... 800H	-0.125 ...0.125	61e-6	-
I-share from trim controller - to be transmitted to the Scan Tool mode06					
LV_CDN_DIAG_DELTA_I_LAM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean Flag to indicate the activation of trim controller limit diagnosis					
LV_CDN_DIAG_VLS_DOWN_DIF [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean Flag to indicate the activation of trim controller deviation diagnosis					
LV_DET_SYM_EVE_DELTA_I_LAM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Bit for second time counter DELTA_I_LAM (T_SUM_END_READY_DELTA_I_LAM[i])					
LV_END_DIAG_DELTA_I_LAM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
First cycle of trim controller limit diagnosis finished					
LV_END_DIAG_LAM_ADJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Diagnostic cycle for lambda trim control complete					
LV_END_DIAG_VLS_DOWN_DIF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Trim controller deviation diagnosis available					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_WIN_DELTA_I_LAM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End of diagnosis cycle for similar conditions window					
LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Trim controller limit error					
LV_ERR_LAM_ADJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Status diagnostic result of lambda trim control					
LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Trim controller deviation error					
LV_VLS_DIF_DLY_LDC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Status limited dynamic for the function "Monitoring Trim Controller Deviation"					
LV_VLS_DIF_DLY_LDC_LAM_MV [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Status limited dynamic FAC_LAM_MV					
LV_VLS_DIF_DLY_LDC_MAF	V	0... 1H	0 ...1	1	-
Status limited dynamic MAF					
LV_VLS_DIF_DLY_LDC_N	V	0... 1H	0 ...1	1	-
Status limited dynamic N					
MAF_INT_OPM_STAT	V	0... FFFFH	0... 1820.41666	0.0277778	g
Integral to start trim controller deviation diagnosis after changing in homogeneous combustion mode					
MAF_INT_RST_VLS_DOWN_DIF_DIAG [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.41666	0.0277778	g
Integral to start a new diagnostic cycle and to set the end flag					
MAF_INT_VLS_DIF_DLY_LDC [NC_CBK_EX_NR]	V	0... FFFFH	0... 1389	0.0211948	g
integral of mass air flow since limited dynamic conditions fulfilled					
MAF_INT_VLS_DIF_DLY_MAX [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral for upper VLS_DIF_DLY deviation					
MAF_INT_VLS_DIF_DLY_MIN [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral for lower VLS_DIF_DLY deviation					
MAF_MMV_VLS_DIF_DLY_LDC	V	0... FFFFH	0... 1389	0.0211948	mg/stk
floating mean value for limited MAF					
N_MMV_VLS_DIF_DLY_LDC	V	0... 1FE0H	0... 8160	1	rpm
floating mean value for limited engine speed					
T_SUM_END_DIAG_WIN_DELTA_I_LAM [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time counter to set LV_END_DIAG_WIN_DELTA_I_LAM[i] for similar conditions window					
T_SUM_END_READY_DELTA_I_LAM [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Second time counter to set LV_END_DIAG_DELTA_I_LAM[i]					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_SUM_MAX_DELTA_I_LAM [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Total duration over C_LAMB_DELTA_I_MAX_DIAG					
T_SUM_MIN_DELTA_I_LAM [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Total duration over C_LAMB_DELTA_I_MIN_DIAG					
T_SUM_RST_DELTA_I_LAM [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time counter to reset T_SUM_MAX_DELTA_I_LAM[i] and T_SUM_MIN_DELTA_I_LAM[i].					

**Input data:**

EFF_CAT_DIAG [NC_CBK_EX_NR] {p. 5535}	FAC_LAM_MV {p. 1014}	LAMB_DELTA_AD_LAM_ ADJ [NC_CBK_EX_NR] {p. 2622}	LAMB_DELTA_I_LAM_ADJ [NC_CBK_EX_NR] {p. 2589}
LV_CP_RAMP_OPEN_ACT {p. 3636}	LV_DIAG_EOL_END_LS_ UP_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_ES {p. 1720}	LV_IGK {p. 906}
LV_INH_DIAG_DLY_LAM [NC_CBK_EX_NR] {p. 5229}	LV_LAM_ADJ_I_ACT [NC_CBK_EX_NR] {p. 2589}	LV_LAM_ADJ_P_ACT [NC_CBK_EX_NR] {p. 2589}	LV_ST_END {p. 1720}
MAF {p. 8277}	MAF_CYL {p. 8277}	MAF_KGH {p. 1195}	N {p. 1525}
NC_CBK_EX_NR {p. 1829}	OPM_AV {p. 8137}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CAT_DIAG_MAX_DELTA_I_LAM [NC_CBK_EX_NR]	-	0... FFH	0... 1.99218	0.0078125	-
Maximum threshold for catalyst diagnosis result to perform the diagnosis					
C_DEAC_DIAG_LAM_ADJ	-	0... FFH	0... 255	1	-
Bit vector for override of individual end flags in summary end flag LV_END_DIAG_LAM_ADJ					
C_LAM_MV_CRLC_LDC_VLS_DIF_DLY	-	0... FFFFH	0... 0.99998	15.3e-6	-
correlation constant floating mean value calculation lambda					
C_LAM_MV_LDC_VLS_DIF_DLY	-	0... FFFFH	0... 99.99847	1.5259e-3	%
threshold limited dynamic lambda					
C_LAMB_DELTA_I_MAX_DIAG	-	F800... 800H	-0.125 ...0.125	61e-6	-
Maximum limit of LAMB_DELTA_I_LAM_ADJ[i] + LAMB_DELTA_AD_LAM_ADJ[i]					
C_LAMB_DELTA_I_MIN_DIAG	-	F800... 800H	-0.125 ...0.125	61e-6	-
Minimum limit of LAMB_DELTA_I_LAM_ADJ[i] + LAMB_DELTA_AD_LAM_ADJ[i]					
C_MAF_CRLC_LDC_VLS_DIF_DLY	-	0... FFFFH	0... 0.99998	15.3e-6	-
correlation constant floating mean value calculation MAF					
C_MAF_INT_MIN_VLS_DIF_DLY_LDC [NC_CBK_EX_NR]	-	0... FFFFH	0... 1389	0.0211948	g
Maximum value of the mass air flow integral after limited dynamic conditions were fulfilled					
C_MAF_INT_OPM_STAT	-	0... FFFFH	0... 1820.41666	0.0277778	g
Minimum value of mass air flow after changing in homogeneous combustion mode to allow diagnosis (VLS_DOWN_DIF)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_INT_RST_VLS_DOWN_DIF_DIAG [NC_CBK_EX_NR]	-	0... FFFFH	0... 1820.41666	0.0277778	g
Threshold for integral to start a new diagnostic cycle and to set the end flag					
C_MAF_INT_VLS_DIF_DLY_MAX [NC_CBK_EX_NR]	-	0... FFFFH	0... 1820.41666	0.0277778	g
Maximum MAF integral of VLS_DIF_DLY deviation (lean side)					
C_MAF_INT_VLS_DIF_DLY_MIN [NC_CBK_EX_NR]	-	0... FFFFH	0... 1820.41666	0.0277778	g
Maximum MAF integral of VLS_DIF_DLY deviation (rich side)					
C_MAF_LDC_VLS_DIF_DLY	-	0... FFFFH	0... 1389	0.0211948	mg/stk
threshold limited dynamic engine MAF					
C_N_CRLC_LDC_VLS_DIF_DLY	-	0... FFFFH	0... 0.99998	15.3e-6	-
correlation constant floating mean value calculation engine speed					
C_N_LDC_VLS_DIF_DLY	-	0... 1FE0H	0... 8160	1	rpm
threshold limited dynamic engine speed					
C_T_SUM_MAX_ERR_DELTA_I_LAM [NC_CBK_EX_NR]	-	0... FFFFH	0... 6553.5	0.1	s
Time counter for maximum time of trim control over limit to set LV_END_DIAG_DELTA_I_LAM[i]					
C_T_SUM_MAX_MAX_DELTA_I_LAM [NC_CBK_EX_NR]	-	0... FFFFH	0... 6553.5	0.1	s
Duration of T_SUM_MAX_DELTA_I_LAM[i] to detect an error					
C_T_SUM_MIN_MAX_DELTA_I_LAM [NC_CBK_EX_NR]	-	0... FFFFH	0... 6553.5	0.1	s
Duration of T_SUM_MIN_DELTA_I_LAM[i] to detect an error					
C_T_SUM_READY_DELTA_I_LAM [NC_CBK_EX_NR]	-	0... FFFFH	0... 6553.5	0.1	s
Time counter for end of diagnosis					
C_T_SUM_RST_MAX_DELTA_I_LAM [NC_CBK_EX_NR]	-	0... FFFFH	0... 6553.5	0.1	s
Time counter to reset T_SUM_MIN/MAX_DELTA_I_LAM[i]					
C_VLS_DOWN_MAX_DIAG_LAM_ADJ [NC_CBK_EX_NR]	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Rich limit for VLS_DOWN for trim control diagnosis					
C_VLS_DOWN_MIN_DIAG_LAM_ADJ [NC_CBK_EX_NR]	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Lean limit for VLS_DOWN for trim control diagnosis					

### Import actions:

<b>ACTION_ERRM_NoFilterReset</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_NoFilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_LV_ERR_SET>, IN<PRM_LV_ERR_RST>, IN<PRM_LV_END_DIAG>, OUT<PRM_LV_ERR>)

### Error treatment:

Diagnosis	Symptom	Nr	ABC type
Dynamic fuel trim I-share	AF too RICH	0	NO
	AF too LEAN	1	
DELTA_I_LAM[i]			

Figure B.16.1: Diagnosis

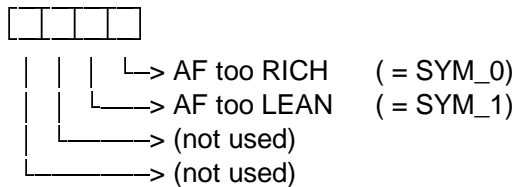
Diagnosis	Symptom	Nr	ABC type
Trim controller deviation	AF too RICH	0	NO
	AF too LEAN	1	
VLS_DOWN_DIF[i]			

## FUNCTION DESCRIPTION:

### General information:

This function shall summarize the results of both dynamic fuel trim diagnosis specified in this module. Although this function has variable names which are according to the error management naming convention, it does not include an interface to the error manager.

Error Symptoms are defined as follows:



### Application conditions

#### Initialisation:

At transition  $LV\_IGK = 0$  to  $1$ , ECU reset or at clearing error memory reset all variables to zero, except for the following:

$T\_SUM\_RST\_DELTA\_I\_LAM[i] = C\_T\_SUM\_RST\_MAX\_DELTA\_I\_LAM[i]$

$T\_SUM\_END\_DIAG\_WIN\_DELTA\_I\_LAM[i] = C\_T\_SUM\_RST\_MAX\_DELTA\_I\_LAM[i]$

$T\_SUM\_END\_READY\_DELTA\_I\_LAM[i] = C\_T\_SUM\_READY\_DELTA\_I\_LAM[i]$

LAMB\_DELTA\_I\_SAVE\_DIAG[i] shall not be initialized

#### Recurrence:

100 ms

#### Activation:

–

**Formula section:**

**If** LV\_ERR\_DELTA\_I\_LAM[i]= 1 or LV\_ERR\_VLS\_DOWN\_DIF[i]= 1

**Then**

**If**(ERR\_SYM\_DELTA\_I\_LAM[i] = SYM\_0 &  
ERR\_SYM\_VLS\_DOWN\_DIF[i] <> SYM\_1 )

**Or**(ERR\_SYM\_DELTA\_I\_LAM[i] <> SYM\_1 &  
ERR\_SYM\_VLS\_DOWN\_DIF[i] = SYM\_0 )

**Then**

LV\_ERR\_LAM\_ADJ[i] = 1  
ERR\_SYM\_LAM\_ADJ[i] = SYM\_0

**Else**

**If**(ERR\_SYM\_DELTA\_I\_LAM[i] = SYM\_1 &  
ERR\_SYM\_VLS\_DOWN\_DIF[i] <> SYM\_0 )  
**Or**(ERR\_SYM\_DELTA\_I\_LAM[i] <> SYM\_0 &  
ERR\_SYM\_VLS\_DOWN\_DIF[i] = SYM\_1 )

**Then**

LV\_ERR\_LAM\_ADJ[i] = 1  
ERR\_SYM\_LAM\_ADJ[i] = SYM\_1

**Else**

ERR\_SYM\_LAM\_ADJ[i] = NO\_SYM

**Endif**

**Endif**

**Endif**

**If** ((LV\_END\_DIAG\_DELTA\_I\_LAM[i] = 1 or C\_DEAC\_DIAG\_LAM\_ADJ.bit0 = 1)  
**and** (LV\_END\_DIAG\_VLS\_DOWN\_DIF[i] = 1 or C\_DEAC\_DIAG\_LAM\_ADJ.bit1 = 1))

**OR** LV\_ERR\_DELTA\_I\_LAM[i] = 1

**OR** LV\_ERR\_VLS\_DOWN\_DIF[i] = 1

**OR** LV\_DIAG\_EOL\_END\_LS\_UP\_DOWN[i] = 1

**Then**

LV\_END\_DIAG\_LAM\_ADJ[i] = 1

**Endif**

**B.16.1 Monitoring trim controller I-Share**


**FUNCTION DESCRIPTION:**

**General information:**

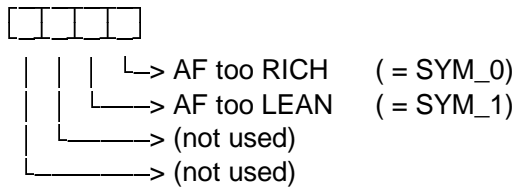
To fulfil the legal requirements of the OBDII lambda sensor diagnosis, the trim of the lambda control by the lambda sensor signal downstream of the catalytic converter must be monitored in addition to the diagnosis of the lambda sensor upstream of the catalytic converter. In the case of a trim control error, a plausibility check is performed to assign the faulty behavior to the control sensor or the monitoring sensor.

Faulty behavior of the lambda sensors upstream or downstream from the catalytic converter exists if one of the emission components exceeds the standard emissions in the emission test cycle by a certain factor.

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Error Symptoms are defined as follows:



**Application conditions:**

Initialisation: - - (see first chapter) - -

`ACTION_ERRM_NoFilterReset( IN<NC_IDX_DIAG_DELTA_I_LAM[i]>, OUT<LV_ERR_DELTA_I_LAM[i]>)`

Recurrence: 100ms

Activation /Deactivation:

```
if      LV_INH_DIAG_DLY_LAM[i] = 0
and    LV_CP_RAMP_OPEN_ACT = 0
and    LV_LAM_ADJ_I_ACT[i] = 1
and    LV_ERR_DELTA_I_LAM[i] = 0
and    C_LAMB_DELTA_I_MAX_DIAG > C_LAMB_DELTA_I_MIN_DIAG
then   LV_CDN_DIAG_DELTA_I_LAM[i] = 1
       diagnosis enabled
else   LV_CDN_DIAG_DELTA_I_LAM[i] = 0
       diagnosis disabled
endif
```

**Description:**

**B.16.2 Reset of time counters and set of end of diagnosis flags**

After a calibrateable time during which the diagnosis has been activated and no error has been set, the timers for detection of too rich or lean system are reset or respectively reinitialised for the next diagnosis check. This must be done e.g. to avoid to sum up intermitten failures over a too long period.

Beside the items mentioned above the end of diagnosis flag can be set by two different time counters also. (T\_SUM\_END\_DIAG\_WIN\_DELTA\_I\_LAM[i] and T\_SUM\_END\_READY\_DELTA\_I\_LAM[i])


After a calibrateable time during which the diagnosis has been activated the end of diagnosis flag is set. The flag of temporary end of diagnosis is a trigger for the similar conditions check and therefore always set after every completed DELTA\_I\_LAM cycle check (reset next recurrence).

At engine stop all time counters are reset respectively reinitialised.

**Formula section:**

```
if      LV_CDN_DIAG_DELTA_I_LAM[i] = 1
then   % Reset of time counters and set of end of diagnosis flags
       if      ERR_SYM_DELTA_I_LAM[i] = SYM_0 or SYM_1
       and    T_SUM_RST_DELTA_I_LAM[i] = C_T_SUM_RST_MAX_DELTA_I_LAM[i]
```

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```

then T_SUM_END_DIAG_WIN_DELTA_I_LAM[i] =
        C_T_SUM_RST_MAX_DELTA_I_LAM[i]
        T_SUM_END_READY_DELTA_I_LAM[i] =
        C_T_SUM_READY_DELTA_I_LAM[i]

endif
If ERR_SYM_DELTA_I_LAM[i] = SYM_0 or SYM_1
or T_SUM_RST_DELTA_I_LAM[i] C_T_SUM_RST_MAX_DELTA_I_LAM[i]
then decrement T_SUM_RST_DELTA_I_LAM[i]
endif
decrement T_SUM_END_DIAG_WIN_DELTA_I_LAM[i]
If T_SUM_END_DIAG_WIN_DELTA_I_LAM[i] = 0
then LV_END_DIAG_WIN_DELTA_I_LAM[i] = 1
        LV_END_DIAG_DELTA_I_LAM[i] = 1
        T_SUM_END_DIAG_WIN_DELTA_I_LAM[i] =
        C_T_SUM_RST_MAX_DELTA_I_LAM[i]
else LV_END_DIAG_WIN_DELTA_I_LAM[i] = 0
endif
If T_SUM_MAX_DELTA_I_LAM[i] > C_T_SUM_MAX_ERR_DELTA_I_LAM[i] or
T_SUM_MIN_DELTA_I_LAM[i] > C_T_SUM_MAX_ERR_DELTA_I_LAM[i]
then LV_DET_SYM_EVE_DELTA_I_LAM[i] = 1
else LV_DET_SYM_EVE_DELTA_I_LAM[i] = 0
endif
decrement T_SUM_END_READY_DELTA_I_LAM[i]
If T_SUM_END_READY_DELTA_I_LAM[i] = 0
and LV_DET_SYM_EVE_DELTA_I_LAM[i] = 0
and LV_END_DIAG_DELTA_I_LAM[i] = 0
then LV_END_DIAG_DELTA_I_LAM[i] = 1
        LV_END_DIAG_WIN_DELTA_I_LAM[i] = 1
        T_SUM_END_DIAG_WIN_DELTA_I_LAM[i] =
T_SUM_RST_MAX_DELTA_I_LAM[i]
endif
If T_SUM_RST_DELTA_I_LAM[i] = 0
and LV_ERR_DELTA_I_LAM[i] = 0
then T_SUM_MAX_DELTA_I_LAM[i] = 0
        T_SUM_MIN_DELTA_I_LAM[i] = 0
        T_SUM_RST_DELTA_I_LAM[i] = C_T_SUM_RST_MAX_DELTA_I_LAM[i]
endif
else freezeT_SUM_RST_DELTA_I_LAM[i]
freeze T_SUM_END_DIAG_WIN_DELTA_I_LAM[i]
freeze T_SUM_END_READY_DELTA_I_LAM[i]
LV_END_DIAG_WIN_DELTA_I_LAM[i] = 0
If LV_ES = 1
then T_SUM_MAX_DELTA_I_LAM[i] = 0
        T_SUM_MIN_DELTA_I_LAM[i] = 0
        T_SUM_RST_DELTA_I_LAM[i] = C_T_SUM_RST_MAX_DELTA_I_LAM[i]
        T_SUM_END_DIAG_WIN_DELTA_I_LAM[i] =
        C_T_SUM_RST_MAX_DELTA_I_LAM[i]
        T_SUM_END_READY_DELTA_I_LAM[i] =
        C_T_SUM_READY_DELTA_I_LAM[i]

endif
endif

```

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### B.16.3 Error detection for rich/lean A/F ratio deviation

If the total amount of I-share of the trim controller (  $LAMB\_DELTA\_I\_LAM\_ADJ[i] + LAMB\_DELTA\_AD\_LAM\_ADJ[i]$  ) exceeds the diagnostic threshold  $C\_LAMB\_DELTA\_I\_MAX/MIN\_DIAG[i]$ ,  $T\_SUM\_MAX/MIN\_DELTA\_I\_LAM[i]$  is incremented as long as the diagnostic threshold is exceeded. If (  $LAMB\_DELTA\_I\_LAM\_ADJ[i] + LAMB\_DELTA\_AD\_LAM\_ADJ[i]$  ) falls below the diagnostic threshold, then  $T\_SUM\_MAX/MIN\_DELTA\_I\_LAM[i]$  is stopped. A failure is detected as soon as  $T\_SUM\_MAX/MIN\_DELTA\_I\_LAM[i]$  is above the threshold  $C\_T\_SUM\_MAX/MIN\_MAX\_DELTA\_I\_LAM[i]$ . Incrementation restarts, if the I-share of the trim controller exceeds the limit again.

If the engine is stopped the time counters shall be reset.

```

If      LV_CDN_DIAG_DELTA_I_LAM[i] = 1
then    % Error detection for rich/lean A/F ratio deviation
          If      ( LAMB_DELTA_I_LAM_ADJ[i] + LAMB_DELTA_AD_LAM_ADJ[i] ) >
                                C_LAMB_DELTA_I_MAX_DIAG
          then    increment T_SUM_MAX_DELTA_I_LAM[i]
                                ERR_SYM_DELTA_I_LAM[i] = SYM_1      /AF too LEAN
          else    freeze T_SUM_MAX_DELTA_I_LAM[i]
          If      ( LAMB_DELTA_I_LAM_ADJ[i] +
                                LAMB_DELTA_AD_LAM_ADJ[i] ) < C_LAMB_DELTA_I_MIN_DIAG
          then    increment T_SUM_MIN_DELTA_I_LAM[i]
                                ERR_SYM_DELTA_I_LAM[i] = SYM_0      /AF too RICH
          else    freeze T_SUM_MIN_DELTA_I_LAM[i]
                                ERR_SYM_DELTA_I_LAM[i] = NO_SYM    /no Symptom
          endif
          endif
          If      T_SUM_MAX_DELTA_I_LAM[i] >
                                C_T_SUM_MAX_MAX_DELTA_I_LAM[i]
          or      T_SUM_MIN_DELTA_I_LAM[i] >
                                C_T_SUM_MIN_MAX_DELTA_I_LAM[i]
          then    LV_ERR_DELTA_I_LAM[i] = 1
                                LV_END_DIAG_DELTA_I_LAM[i] = 1
                                LV_END_DIAG_WIN_DELTA_I_LAM[i] = 1
                                LAMB_DELTA_I_SAVE_DIAG[i] = ( LAMB_DELTA_I_LAM_ADJ[i] +
                                                                LAMB_DELTA_AD_LAM_ADJ[i] )
          endif
else
          freeze ERR_SYM_DELTA_I_LAM[i]
          freeze T_SUM_MAX_DELTA_I_LAM[i]
          freeze T_SUM_MIN_DELTA_I_LAM[i]
endif

If      LV_END_DIAG_DELTA_I_LAM[i] = 0 -> 1
then    LAMB_DELTA_I_SAVE_DIAG[i] = ( LAMB_DELTA_I_LAM_ADJ[i] + LAMB_DELTA_AD_LAM_ADJ[i] )
endif

```


For failure and error management treatment the anti-bounce mechanism is called :

% if LV\_ERR\_XX=1 then LV\_ERR\_SET=1 or if LV\_ERR\_XX=0 then LV\_ERR\_RST=1

ACTION\_ERRM\_NoFilterSymptom( IN<NC\_IDX\_DIAG\_DELTA\_I\_LAM[i]>, IN<LV\_CDN\_DIAG\_DELTA\_I\_LAM[i]>, IN<ERR\_SYM\_DELTA\_I\_LAM[i]>, IN<LV\_ERR\_SET\_DELTA\_I\_LAM[i]>, IN<LV\_ERR\_RST\_DELTA\_I\_LAM[i]>, IN<LV\_END\_DIAG\_DELTA\_I\_LAM[i]>, OUT<LV\_ERR\_DELTA\_I\_LAM[i]> )

**Application hint:** the data for each individual bank should fulfill the following conditions

1.  $C\_T\_SUM\_RST\_MAX\_DELTA\_I\_LAM \gg C\_T\_SUM\_READY\_DELTA\_I\_LAM$

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2. C\_T\_SUM\_MIN\_MAX\_DELTA\_I\_LAM and C\_T\_SUM\_MAX\_MAX\_DELTA\_I\_LAM >> C\_T\_SUM\_MAX\_ERR\_DELTA\_I\_LAM

## B.16.4 Monitoring of trim controller deviation

### FUNCTION DESCRIPTION:

#### General information:

In order to get a fast decision of error location in case of oxygen sensor failure, trim controller input signal is monitored. Insufficient trim control over long period can be obtained out of this function. In conjunction with activity check of the up- and downstream sensors it is decided which sensor is damaged (up- or downstream).

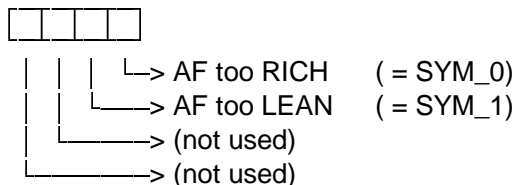
#### Description:

The downstream sensor signal deviation to setpoint (VLS\_DIF\_LAM\_ADJ[i]) is observed during trim controller diagnosis phase. This implements the activation of trim control.

If VLS\_DIF\_LAM\_ADJ[i] exceeds either maximum or minimum voltage thresholds corresponding MAF integrals are started. As long as the diagnostic threshold is exceeded the MAF integral is incremented, else it is stopped. A failure is detected as soon as the MAF integral exceeds the threshold (MAF\_INT\_VLS\_DIF\_DLY\_MAX/MIN). Then symptom flag LV\_ERR\_VLS\_DOWN\_DIF[i] and the corresponding symptom (MIN or MAX) are set.

MAF\_INT\_RST\_VLS\_DOWN\_DIF\_DIAG[i] is incremented if no end flag is set so far, or if a symptom was detected at least once in the current diagnostic cycle, it serves two purposes: It causes a "good" diagnostic result if no symptom is detected after sufficient time has elapsed, and it aborts and restarts the diagnosis if a symptom was present, but occurs only rarely (e.g. due to dynamic driving conditions).

Error Symptoms are defined as follows:



### Application conditions

**Initialisation:** -- (see first chapter) --  
 ACTION\_ERRM\_NoFilterReset ( IN< NC\_IDX\_DIAG\_VLS\_DOWN\_DIF[i]>,  
 OUT<LV\_ERR\_VLS\_DOWN\_DIF[i]>)

**Recurrence:** 100ms

#### Activation:

```

if OPM_AVn <> OPM_AVn-1
then MAF_INT_OPM_STAT = C_MAF_INT_OPM_STAT
else MAF_INT_OPM_STATn =
      MAF_INT_OPM_STATn-1
      - MAF_KGH* T_SAMPLE [ms] * 1/3600 [(g*h)/(kg*ms)]
  
```

**endif**



```

if      LV_INH_DIAG_DLY_LAM[i] = 0
and    LV_CP_RAMP_OPEN_ACT = 0
and    LV_LAM_ADJ_P_ACT[i] = 1
and    LV_VLS_DIF_DLY_LDC[i] = 1
and    EFF_CAT_DIAG[i] <= C_CAT_DIAG_MAX_DELTA_I_LAM[i]
and    MAF_INT_OPM_STAT = 0
then
    LV_CDN_DIAG_VLS_DOWN_DIF[i] = 1
    diagnosis enabled
else
    LV_CDN_DIAG_VLS_DOWN_DIF[i] = 0
    diagnosis disabled
    freeze all variables
endif


```

### Formula section:

```

if (1) MAF_INT_RST_VLS_DOWN_DIF_DIAG[i] <
    C_MAF_INT_RST_VLS_DOWN_DIF_DIAG[i]
then (1) % current diag cycle not too long without result
    if (2a) VLS_DOWN[i] ≤ C_VLS_DOWN_MIN_DIAG_LAM_ADJ[i]
    then (2a) % too lean after catalyst
        ERR_SYM_VLS_DOWN_DIF[i] = SYM_1 /AF too LEAN
        if (3a) MAF_INT_VLS_DIF_DLY_MAX[i] > C_MAF_INT_VLS_DIF_DLY_MAX[i]
        then (3a) % symptom present long enough - store the error
            LV_ERR_VLS_DOWN_DIF[i] = 1
            LV_END_DIAG_VLS_DOWN_DIF[i] = 1
        else (3b) % symptom present - set the symptom and count up, but don't store an error
            MAF_INT_VLS_DIF_DLY_MAX[i]n =
                MAF_INT_VLS_DIF_DLY_MAX[i]n-1 +
                MAF_CYL * T_SAMPLE [ms] * 1/3600 [(g*h)/(kg*ms)]
        endif (3a/b)
    else (2b) % not too lean after catalyst - do not touch the lean case, but check if it's too rich
        freeze MAF_INT_VLS_DIF_DLY_MAX[i]
        if (3b) VLS_DOWN[i] ≥ C_VLS_DOWN_MAX_DIAG_LAM_ADJ[i]
        then (3b) % too rich after catalyst
            ERR_SYM_VLS_DOWN_DIF[i] = SYM_0 /AF too RICH
            if (4a) MAF_INT_VLS_DIF_DLY_MIN[i] > C_MAF_INT_VLS_DIF_DLY_MIN[i]
            then (4a) % symptom present long enough - store the error
                LV_ERR_VLS_DOWN_DIF[i] = 1
                LV_END_DIAG_VLS_DOWN_DIF[i] = 1
            else (4b) % symptom present - set the symptom and count up, but don't store an error
                MAF_INT_VLS_DIF_DLY_MIN[i]n = MAF_INT_VLS_DIF_DLY_MIN[i]n-1 +
                    MAF_CYL * T_SAMPLE [ms] * 1/3600 [(g*h)/(kg*ms)]
            endif (4a/b)
        else (3b) % not too lean and not too rich - set the symptom (counting is done below)
            freeze MAF_INT_VLS_DIF_DLY_MIN[i]
            if (4c) LV_ERR_VLS_DOWN_DIF[i] = 0
            Then (4c)

```

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```

ERR_SYM_VLS_DOWN_DIF[i] = NO_SYM
endif (4c)
endif (3a/b)
endif (2a/b)
% count a MAF integral to generate an end flag for the good case.
If (2c) LV_END_DIAG_VLS_DOWN_DIF[i] = 0
or MAF_INT_RST_VLS_DOWN_DIF_DIAG[i] > 0
or ERR_SYM_VLS_DOWN_DIF[i] <> NO_SYM
then (2c)
    MAF_INT_RST_VLS_DOWN_DIF_DIAG[i]n =
        MAF_INT_RST_VLS_DOWN_DIF_DIAG[i]n-1 +
        CYL * T_SAMPLE [ms] * 1/3600 [(g*h)/(kg*ms)]
else (2d)
    freeze MAF_INT_RST_VLS_DOWN_DIF_DIAG[i]
endif (2c/d)
else (1)
% running too long without coming to an end. Cancel a running diagnosis cycle by resetting the MAF
integrals (assuming a symptom is either not present at all or intermittent but rare). Also indicate a
"good" diag result, if no end was reached so far.
    MAF_INT_RST_VLS_DOWN_DIF_DIAG[i] = 0
    MAF_INT_VLS_DIF_DLY_MIN[i] = 0
    MAF_INT_VLS_DIF_DLY_MAX[i] = 0
    If (2e) LV_END_DIAG_VLS_DOWN_DIF[i] = 0
    then (2e)
        LV_END_DIAG_VLS_DOWN_DIF[i] = 1
        LV_ERR_VLS_DOWN_DIF[i] = 0
        ERR_SYM_VLS_DOWN_DIF[i] = NO_SYM
    endif (2e)
endif (1)

```

For failure and error management treatment the anti-bounce mechanism is called :

```

% if LV_ERR_XX=1 then LV_ERR_SET=1 or if LV_ERR_XX=0 then LV_ERR_RST=1
ACTION_ERRM_NoFilterSymptom( IN<NC_IDX_DIAG_VLS_DOWN_DIF[i]>, IN<LV_CDN_DIAG_VLS_
DOWN_DIF[i]>, IN< ERR_SYM_VLS_DOWN_DIF[i] >, IN< LV_ERR_SET_VLS_DOWN_DIF[i] >,
IN<LV_ERR_RST_VLS_DOWN_DIF[i]>, IN<LV_END_DIAG_VLS_DOWN_DIF[i]>, OUT<LV_ERR_VLS_
DOWN_DIF[i]> )

```


## B.16.5 Limited dynamic for the function Monitoring the Trim Controller Deviation

### FUNCTION DESCRIPTION:

#### General information:

As it is specified in the function Monitoring Trim Controller Deviation contained in this module, this shall be carried out every time the Trim Controller P-share is being calculated. This is active most of the time to maintain the the air fuel ratio inside the catalyst window also if any deviation happens. Under such unstable condition its not proper to carry out the trim controller diagnosis and this shall be inhibit until the system achieves the steady state. This shall be facilitated by the present function which shall summarize informations concerning the dynamic of engine speed, mass air flow and air fuel ratio.

#### Description:

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The floating mean value  $N\_MMV\_VLS\_DIF\_DLY\_LDC$  is computed using the averaging constant  $C\_N\_CRLC\_LDC\_VLS\_DIF\_DLY$ . The limited dynamics condition only exist while the engine speed  $N$  lies within the dynamics window around  $N\_MMV\_VLS\_DIF\_DLY\_LDC$ .

If the above limited dynamics condition is violated, the floating mean value  $N\_MMV\_VLS\_DIF\_DLY\_LDC$  is set to the current engine speed in order to reach the limited dynamics condition faster:

The floating mean value  $MAF\_MMV\_VLS\_DIF\_DLY\_LDC$  is computed using the averaging constant  $C\_MAF\_CRLC\_LDC\_VLS\_DIF\_DLY$ . The limited dynamics condition only exist while the air mass  $MAF$  stays within the dynamics window around  $MAF\_MMV\_VLS\_DIF\_DLY\_LDC$ . If the above limited dynamics condition is violated, the floating mean value  $MAF\_MMV\_VLS\_DIF\_DLY\_LDC$  is set to the current air-mass value in order to reach the limited dynamics condition faster:

The floating mean value  $LAM\_MMV\_VLS\_DIF\_DLY\_LDC[i]$  is computed using the averaging constant  $C\_LAM\_MV\_CRLC\_LDC\_VLS\_DIF\_DLY$ . The limited dynamics condition continues to exist while the mean oxygen value  $FAC\_LAM\_MV[i]$  stays within the dynamics window around  $LAM\_MMV\_VLS\_DIF\_DLY\_LDC[i]$ . If the above limited dynamics condition is violated, the floating mean value  $LAM\_MMV\_VLS\_DIF\_DLY\_LDC[i]$  is set to the current mean oxygen value in order to reach the limited dynamics condition faster.

### Application conditions

**Initialisation:** - - (see first chapter) -

**Recurrence:**  $T\_SAMPLE = 100ms$

**Activation:** If  $(LV\_IGK = 1 \text{ and } LV\_ST\_END = 1)$

**Deactivation:** *the above conditions are not fulfilled*  
 Initialization at deactivation:  
 $N\_MMV\_VLS\_DIF\_DLY\_LDC = N$   
 $MAF\_MMV\_VLS\_DIF\_DLY\_LDC = MAF$   
 $LAM\_MMV\_VLS\_DIF\_DLY\_LDC[i] = FAC\_LAM\_MV[i]$

### Formula section:

#### **Limited engine speed (N) dynamics:**

$$N\_MMV\_VLS\_DIF\_DLY\_LDC = N\_MMV\_VLS\_DIF\_DLY\_LDC * (1 - C\_N\_CRLC\_LDC\_VLS\_DIF\_DLY) + C\_N\_CRLC\_LDC\_VLS\_DIF\_DLY * N$$

**IF**  $|N - N\_MMV\_VLS\_DIF\_DLY\_LDC| < C\_N\_LDC\_VLS\_DIF\_DLY$

**THEN**  $LV\_VLS\_DIF\_DLY\_LDC\_N = 1$

**ELSE**  $LV\_VLS\_DIF\_DLY\_LDC\_N = 0$

$N\_MMV\_VLS\_DIF\_DLY\_LDC = N$


**ENDIF**

#### **Limited mass air flow (MAF) dynamics:**

$$MAF\_MMV\_VLS\_DIF\_DLY\_LDC = MAF\_MMV\_VLS\_DIF\_DLY\_LDC * (1 - C\_MAF\_CRLC\_LDC\_VLS\_DIF\_DLY) + C\_MAF\_CRLC\_LDC\_VLS\_DIF\_DLY * MAF$$

**IF**  $|MAF - MAF\_MMV\_VLS\_DIF\_DLY\_LDC| < C\_MAF\_LDC\_VLS\_DIF\_DLY$

**THEN**  $LV\_VLS\_DIF\_DLY\_LDC\_MAF = 1$

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```

ELSE      LV_VLS_DIF_DLY_LDC_MAF = 0
          MAF_MMV_VLS_DIF_DLY_LDC = MAF
ENDIF

```

**Limited mean oxygen value (FAC\_LAM\_MV[i]) dynamics:**

```

LAM_MMV_VLS_DIF_DLY_LDC[i] =
    LAM_MMV_VLS_DIF_DLY_LDC[i] * (1 - C_LAM_MV_CRLC_LDC_VLS_DIF_DLY)
    + C_LAM_MV_CRLC_LDC_VLS_DIF_DLY * FAC_LAM_MV[i]

```

```

IF | FAC_LAM_MV[i] - LAM_MMV_VLS_DIF_DLY_LDC[i] | <
                                                    C_LAM_MV_LDC_VLS_DIF_DLY

```

```

THEN      LV_VLS_DIF_DLY_LDC_LAM_MV[i] = 1
ELSE      LV_VLS_DIF_DLY_LDC_LAM_MV[i] = 0
          LAM_MMV_VLS_DIF_DLY_LDC[i] = FAC_LAM_MV[i]
ENDIF

```


**Summarizing limited dynamic conditions:**

```

IF LV_VLS_DIF_DLY_LDC_N = 1  AND  LV_VLS_DIF_DLY_LDC_MAF = 1  AND
  LV_VLS_DIF_DLY_LDC_LAM_MV[i] = 1
THEN
  IF      MAF_INT_VLS_DIF_DLY_LDC[i] ≤ C_MAF_INT_MIN_VLS_DIF_DLY_LDC[i]
  THEN
    MAF_INT_VLS_DIF_DLY_LDC[i]n =
      MAF_INT_VLS_DIF_DLY_LDC[i]n-1
      + MAF_KGH * T_SAMPLE [ms] * 1/3600 [(g*h)/(kg*ms)]

  ELSE
    freeze MAF_INT_VLS_DIF_DLY_LDC[i]
    LV_VLS_DIF_DLY_LDC[i] = 1
  ENDIF
ELSE
  LV_VLS_DIF_DLY_LDC[i]      = 0
  MAF_INT_VLS_DIF_DLY_LDC[i] = 0
ENDIF

```

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## B.17 O2 sensor fuel trim diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_DLY_LAM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the dynamic fuel trim diagnosis					
LV_INH_DIAG_RBM_DLY_LAM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Inhibition of the dynamic fuel trim diagnosis due to failures					
MAF_INT_SCAV_NOT_ACT	V	0... FFFFH	0... 1820.41666	0.0277778	g
Integral to start fuel trim diagnosis after scavenging (Turbo)					
STATE_RBM_VLS_DOWN_DIF [NC_CBK_EX_NR]	O/V	0... 7H	0 ...7	1	-
RBM - Interface of VLS_DOWN_DIF monitor					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	LC_DIAG_PUE_ACT_LS_DOWN {p. 5191}	LV_DC {p. 5746}	LV_DIAG_EOL_REQ_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5407}
LV_END_DIAG_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5215}	LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}
LV_ERR_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}	LV_ERR_CHG_LS_UP {p. 5416}
LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_PER {p. 4432}
LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FTL_MIN {p. 4762}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_PLAUS {p. 6062}
LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}
LV_ERR_IVVT {p. 1062}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}
LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_PLAUS {p. 1062}	LV_ERR_MAP_TPS_PLAUS {p. 1062}
LV_ERR_MEC_IVVT_EX {p. 1062}	LV_ERR_MEC_IVVT_IN {p. 1062}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}


LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}	LV_ERR_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5198}	LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}
LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}
LV_ERR_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5297}	LV_ERR_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5169}	LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SLV_IVVT_EX {p. 4627}	LV_ERR_SLV_IVVT_IN {p. 4627}
LV_ERR_SWT_LS_DOWN [NC_CBK_EX_NR] {p. 5152}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4447}
LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TPS {p. 4982}	LV_ERR_TPS_1 {p. 4990}
LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_MAF_1 {p. 4990}
LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}
LV_ERR_VCV {p. 4729}	LV_IGK {p. 906}	LV_LS_UP_OBD_2_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}	LV_NT_RGN_REQ {p. 996}
LV_VAR_LSH_DOWN {p. 656}	LV_VB_CDN_OBD_2 {p. 1046}	MAF_KGH {p. 1195}	MAF_SCAV_EXT {p. 8278}
N {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_NR_CAM_CBK {p. 1507}
NC_NR_CBK_IVVT {p. 604}	STATE_DIAG_ACT_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5389}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_INT_SCAV_NOT_ACT	-	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral threshold to allow fuel trim diagnosis after scavenging					
C_MAF_SCAV_MAX_INH_DLY_LAM	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Maximum allowed MAF during scavenging to inhibit fuel trim diagnosis					
C_N_MIN_DIAG_DLY_LAM	-	0... 1FE0H	0... 8160	1	rpm
Minimum engine speed to allow fuel trim diagnosis					
LC_INH_DIAG_DLY_LAM [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Manual inhibition of the dynamic fuel trim diagnosis (bank individual)					

**Import actions:**

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<b>ACTION_ERRM_CheckPendingStatus (IN&lt;PRM_IDX_DIAG&gt;,OUT&lt;PRM_LV_ERR_PND&gt;)</b>
--

## B.17.1 Inhibition of Dynamic fuel trim diagnosis

### FUNCTION DESCRIPTION:

#### General information:

The calculation shall be done for all exhaust cylinder banks. For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2), then:

i = 1 for exhaust cylinder bank 1

i = 2 for exhaust cylinder bank 2,

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1 for single exhaust cylinder bank.

#### Application conditions

##### Initialisation:

at reset all variables shall be set to zero;

at LV\_IGK = 0 -> 1 all variables except *STATE\_RBM\_VLS\_DOWN\_DIF[i]* shall be set to zero;

at every LV\_IGK = 1 -> 0 *LV\_INH\_DIAG\_DLY\_LAM[i]* = 1

##### Recurrence:

1 s

##### Activation:

LV\_IGK = 1

Deactivation: LV\_IGK = 0

#### Formula section:

```

If          MAF_SCAV_EXT > C_MAF_SCAV_MAX_INH_DLY_LAM
then       MAF_INT_SCAV_NOT_ACT = C_MAF_INT_SCAV_NOT_ACT
else       MAF_INT_SCAV_NOT_ACTn =
              MAF_INT_SCAV_NOT_ACTn-1
              - MAF_KGH* T_SAMPLE [ms] * 1/3600 [(g*h)/(kg*ms)]
  
```

**endif**

*% Inhibition of the diagnosis during scavenging (especially for turbocharged engines)*

```

If         LV_ERR_AMP          or
LV_ERR_AMP_PLAUS          or
LV_ERR_CHG_LS_UP          or
LV_ERR_CRK_PLAUS          or
LV_ERR_CRK_SYN            or
LV_ERR_CRK_TOOTH          or
LV_ERR_CRK_TOOTH_PER     or
LV_ERR_DIAGCPS            or
LV_ERR_EL_CPS             or
LV_ERR_FTL_MIN            or
LV_ERR_FUP                or
  
```

```

LV_ERR_FUP_MFP_PLAUS          or
LV_ERR_FUP_ORNG              or
LV_ERR_FUP_ST                or
LV_ERR_H_PRS_SYS            or
    LV_ERR_IVVT              or
LV_ERR_LOAD_TPS_PLAUS        or
LV_ERR_MAF                   or
    LV_ERR_MAP_PLAUS        or
    LV_ERR_MAP_TPS_PLAUS    or
LV_ERR_MTC_CTL_2            or
LV_ERR_MTC_CTL_3            or
LV_ERR_MTC_DR               or
LV_ERR_TPS = 1              or
LV_ERR_VCV                  or
    LV_ERR_AIR_LSL_UP[i]    or          LV_ERR_CAT_DIAG[i]
or
    LV_ERR_CTL_LSL_UP[i]    or
LV_ERR_DYN_VLD_LS_UP[i]      or
    LV_ERR_EL_LSL_UP[i]     or
LV_ERR_LSH_DOWN[i]          or
LV_ERR_LSH_UP[i]            or
LV_ERR_LSL_UP_IF[i]         or
LV_ERR_OBD_LSH_DOWN[i]      or
LV_ERR_OBD_VLD_LSH_UP[i]    or
LV_ERR_OC_LS_DOWN[i]        or
LV_ERR_OC_LSL_UP[i]         or
LV_ERR_OFS_LSL_UP[i]        or
LV_ERR_PUC_LS_DOWN[i]       or
LV_ERR_PUC_VLD_LS_UP[i]     or
[LV_ERR_PUE_LS_DOWN[i]      or
and LC_DIAG_PUE_ACT_LS_DOWN = 1]
LV_ERR_SCG_LS_DOWN[i]       or
LV_ERR_SCP_LS_DOWN[i]       or
LV_ERR_SWT_LS_DOWN[i]       or
LV_ERR_TTIP_MES_LSH_UP[i]   or

(i = 1                        and
    [      LV_ERR_IV[0]      or
    LV_ERR_IV[2]            or
    LV_ERR_IV[4]            or
    LV_ERR_MIS[0]           or
    LV_ERR_MIS[2]           or
    LV_ERR_MIS[4]
    ])
(i = 2                        and
    [      LV_ERR_IV[1]      or
    LV_ERR_IV[3]            or
    LV_ERR_IV[5]            or
    LV_ERR_MIS[1]           or
    LV_ERR_MIS[3]           or
    LV_ERR_MIS[5]
    ])
]

```



LV_ERR_PER_CAM_EX[m]		<i>m=1 for i=1,2</i>	<b>or</b>
LV_ERR_PER_CAM_IN[m]		<i>m=1 for i=1,2</i>	<b>or</b>
LV_ERR_PLAUS_CAM_EX[m]		<i>m=1 for i=1,2</i>	<b>or</b>
LV_ERR_PLAUS_CAM_IN[m]		<i>m=1 for i=1,2</i>	<b>or</b>
LV_ERR_REF_CRK_CAM_EX[m]	1	<i>m=1 for i=1,2</i>	<b>or</b>
LV_ERR_REF_CRK_CAM_IN[m]		<i>m=1 for i=1,2</i>	<b>or</b>
LV_ERR_SYN_CAM_EX[m]		<i>m=1 for i=1,2</i>	<b>or</b>
LV_ERR_SYN_CAM_IN[m]		<i>m=1 for i=1,2</i>	<b>or</b>
LV_ERR_SYN_CRK_CAM_IN[m]		<i>m=1 for i=1,2</i>	<b>or</b>
LV_ERR_TOOTH_OFF_EX[m]		<i>m=1 for i=1,2</i>	<b>or</b>
LV_ERR_TOOTH_OFF_IN[m]		<i>m=1 for i=1,2</i>	

```

then      LV_INH_DIAG_RBM_DLY_LAM[i] = 1
else      LV_INH_DIAG_RBM_DLY_LAM[i] = 0
endif

```

```

If          LV_VAR_LSH_DOWN = 1
and        LC_INH_DIAG_DLY_LAM[i] = 0
and        LV_NT_RGN_REQ = 0
and        LV_VB_CDN_OBD_2 = 1
and        LV_LS_UP_OBD_2_MAN_DEAC[i] = 0
and        LV_INH_DIAG_RBM_DLY_LAM[i] = 0
and        STATE_DIAG_ACT_LS_UP_DOWN[i] = PASSIVE or CHECK_FINISHED for all i
and        LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 0 for all i
and        MAF_INT_SCAV_NOT_ACT = 0
and        N >= C_N_MIN_DIAG_DLY_LAM

then      LV_INH_DIAG_DLY_LAM[i] = 0
else      LV_INH_DIAG_DLY_LAM[i] = 1
endif

```

## B.17.2 Interface for Rate - Based - Monitoring

### FUNCTION DESCRIPTION:

#### General information:

With this module the interface between the VLS\_DOWN\_DIF[i] monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_VLS\_DOWN\_DIF[i] data.

Within STATE\_RBM\_VLS\_DOWN\_DIF[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)


(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)  
( not valid for trim diagnosis )

#### Application conditions

#### Initialisation:

at LV\_DC 0 -> 1 transition:

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bit 0 , bit 1 of STATE\_RBM\_VLS\_DOWN\_DIF[i] = 0  
 bit 2 shall be set to 1.  
 at ECU reset:  
 all bits of STATE\_RBM\_VLS\_DOWN\_DIF[i] = 0

**Recurrence:** 1 s

**Activation:** LV\_DC = 1

### Formula section:

At LV\_DC 0 -> 1 transition

The pending status of the following failures has to be checked only once :

Dependence	Error			
	LV_ERR_AMP	LV_ERR_AMP_PLAUS	LV_ERR_CHG_LS_UP	LV_ERR_CRK_PLAUS
	LV_ERR_CRK_SY N	LV_ERR_CRK_TOOTH	LV_ERR_CRK_TOOTH_PER	LV_ERR_DIAG CPS
	LV_ERR_EL_CP S	LV_ERR_FTL_MIN	LV_ERR_FUP	LV_ERR_FUP_MFP_PLAUS
	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PR S_SYS	LV_ERR_LOAD_TPS_PLAUS
	LV_ERR_MAF_FRQ_EL	LV_ERR_MAF_FRQ_GRD	LV_ERR_MAF_FRQ_RNG	LV_ERR_MAP_PLAUS
	LV_ERR_MAP_TPS_PLAUS	LV_ERR_MTC_CTL_2	LV_ERR_MTC_CTL_3	LV_ERR_MTC_DR
	LV_ERR_TPS_1	LV_ERR_TPS_2	LV_ERR_TPS_AD	LV_ERR_TPS_AD_BOL
	LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2	LV_ERR_TPS_RATIO	LV_ERR_TPS_ST_CHK_2
	LV_ERR_VCV			
<b>NC_CBK_EX_N R</b>	LV_ERR_AIR_LSL_UP[i]	LV_ERR_CAT_DIAG[i]	LV_ERR_CTL_LSL_UP[i]	LV_ERR_DYN_VLD_LS_UP[i]
	LV_ERR_EL_LSL_UP[i]	LV_ERR_LSH_DOWN[i]	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]
	LV_ERR_OBD_LSH_DOW N[i]	LV_ERR_OBD_VLD_LS_H_UP[i]	LV_ERR_OC_LS_DOWN [i]	LV_ERR_OC_LSL_UP[i]
	LV_ERR_OFS_LSL_UP[i]	LV_ERR_PUC_LS_DOW N[i]	LV_ERR_PUC_VLD_LS_UP[i]	LV_ERR_PUE_LS_DOW N[i]
	LV_ERR_SCG_LS_DOW N[i]	LV_ERR_SCP_LS_DOW N[i]	LV_ERR_SWT_LS_DOW N[i]	LV_ERR_TTIP_MES_L SH_UP[i]

Figure B.17.1: For z = 1 to NC\_NR\_CBK\_IVVT (= for any i // or)

<b>NC_NR_CBK_I VVT</b>	LV_ERR_CAM_CST_IVV T_EX[z]	LV_ERR_CAM_CST_IVV T_IN[z]	LV_ERR_MEC_IVVT_EX [z]	LV_ERR_MEC_IVVT_IN [z]
	LV_ERR_SLV_IVVT_IN[z]	LV_ERR_SLV_IVVT_EX [z]		

Figure B.17.2: For i = 1, 2

<b>NC_NR_CAM_CBK</b>	LV_ERR_PER_CAM_IN[1]	LV_ERR_PER_CAM_EX[1]	LV_ERR_PLAUS_CAM_EX[1]	LV_ERR_PLAUS_CAM_IN[1]
	LV_ERR_REF_CRK_CAM_EX[1]	LV_ERR_REF_CRK_CAM_IN[1]	LV_ERR_SYN_CAM_EX[1]	LV_ERR_SYN_CAM_IN[1]
	LV_ERR_SYN_CRK_CAM_IN[1]	LV_ERR_TOOTH_OFF_EX[1]	LV_ERR_TOOTH_OFF_IN[1]	

Figure B.17.3: For NC\_CBK\_EX\_NR = i = 1

<b>NC_CYL_NR</b>	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	LV_ERR_MIS[0]
	LV_ERR_MIS[2]	LV_ERR_MIS[4]		

Figure B.17.4: For NC\_CBK\_EX\_NR = i = 2

<b>NC_CYL_NR</b>	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	LV_ERR_MIS[1]
	LV_ERR_MIS[3]	LV_ERR_MIS[5]		

```

If(1)      { CPU optimization at LV_DC 0 -> 1 transition }
            CTR_ERR_DYN_NR <> 0      { the dynamic failure memory isn't empty }

Then(1)

    While      bit 1 of STATE_RBM_VLS_DOWN_DIF[i] = 0 do
        with each XX failure of the above list except LV_ERR_PUE_LS_DOWN (depending
        on configuration, see below):
        ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<CALL>)

        If(2)      XX has a pending status
        Then(2)      bit 1 of STATE_RBM_VLS_DOWN_DIF[i] = 1
        Endif(2)
        For LV_ERR_PUE_LS_DOWN, do the following instead:
        If          LC_DIAG_PUE_ACT_LS_DOWN = 1
        then
            ACTION_ERRM_CheckPendingStatus(IN<XX>,
            OUT<PendingStatus>, SYNCHRONIZATION<CALL>)
            If(3)      XX has a pending status
            Then(3)      bit 1 of STATE_RBM_VLS_DOWN_DIF[i] = 1
            Endif(3)
        Endif(2)
    Endwhile

    Else(1)      { the dynamic failure memory is empty }      No action
Endif(1)

Every 1 s :
If          bit 0 of STATE_RBM_VLS_DOWN_DIF[i] = 0
Then
    If          LV_END_DIAG_VLS_DOWN_DIF[i] = 1
    Then      bit 0 of STATE_RBM_VLS_DOWN_DIF[i] = 1
    Endif
Endif


If          bit 1 of STATE_RBM_VLS_DOWN_DIF[i] = 0
Then
    If          LV_INH_DIAG_RBM_DLY_LAM[i] = 1
  
```

```

Then          bit 1 of STATE_RBM_VLS_DOWN_DIF[i] = 1
Endif

Endif

```

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## B.18 O2 sensor (lin, up) activity diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_END_ACT_LSL_UP [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter to have valid diagnostic result from the no-activity check (second part)					
CTR_LAMB_DE_INT_ACT_LSL_UP [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter of forced stimulation periods					
CTR_RAW_ACT_END_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Counter to have valid diagnostic result from the no-activity check (first part)					
CTR_RAW_ACT_SYM_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Counter to set the raw symptom of sensor no-activity check (first part)					
CTR_SYM_ACT_LSL_UP [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Debounce counter of the sensor non-activity symptom					
LAMB_DE_INT_ACT_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 63.99902	976.599e-6	-
Cumulating value of the lambda deviation					
LAMB_DE_LSL [NC_CBK_EX_NR]	V	0... FFFFH	0... 63.99902	976.599e-6	-
Deviation of the instantaneous lambda value from the mean moving value					
LAMB_DE_TOT_ACT_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 63.99902	976.599e-6	-
Total cumulated lambda deviation					
LAMB_MMV_ACT_LSL_UP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda moving mean value during the time the forced stimulation is active					
LV_DIAG_ACT_CDN_LSL_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating the conditions to activate the second test for sensor non-activity are fulfilled					
LV_DIAG_ACT_END_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating end of detailed test of no-activity check (from second test)					
LV_DIAG_ACT_SHO_CDN_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the short term conditions to activate the second test for sensor non-activity are fulfilled					
LV_DIAG_ACT_SYM_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating a detected poor upstream sensor activity (from second test)					
LV_DIAG_RAW_ACT_END_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating end of raw symptom test of no-activity check (from first test)					
LV_DIAG_RAW_ACT_SYM_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating a detected raw symptom of sensor non-activity (from first test)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**Input data:**

FAC_DIAG_DYN_LSL_UP [NC_CBK_EX_NR] {p. 5345}	FAC_MV_DIAG_DYN_LSL_UP [NC_CBK_EX_NR] {p. 5346}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_SP_DE_PLS {p. 2958}
LV_AFL [NC_CBK_EX_NR] {p. 2439}	LV_DIAG_ACT_INH_LSL_UP [NC_CBK_EX_NR] {p. 5245}	LV_IGK {p. 906}	LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}
LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_VLS_UP_VLD [NC_CBK_EX_NR] {p. 1341}	MAF_KGH {p. 1195}
N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	T_SUM_AFL_AFR_CYC [NC_CBK_EX_NR] {p. 2439}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}
VLS_UP_DIAG [NC_CBK_EX_NR] {p. 2315}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_ACT_LSL_UP	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation factor for the moving mean value					
C_CTR_LAMB_DE_INT_ACT_LSL_UP	-	0... FFH	0... 255	1	-
Number of forced stimulation periods to calculate the total cumulated lambda deviation					
C_CTR_RAW_ACT_END_LSL_UP	-	0... FFFFH	0... 65535	1	-
Counter threshold to have valid diagnostic result from the no-activity check (first part)					
C_CTR_RAW_ACT_RST_LSL_UP	-	0... FFFFH	0... 65535	1	-
Counter threshold to reset symptom counter if raw symptom has disappeared					
C_CTR_RAW_ACT_SYM_LSL_UP	-	0... FFFFH	0... 65535	1	-
Counter threshold to set the raw symptom flag of the no-activity check (first part)					
C_CTR_SYM_DEC_ACT_LSL_UP	-	0... FFH	0... 255	1	-
Counter decrement to set the sensor non-activity symptom flag					
C_CTR_SYM_INC_ACT_LSL_UP	-	0... FFH	0... 255	1	-
Counter increment to set the sensor non-activity symptom flag					
C_CTR_SYM_MAX_ACT_LSL_UP	-	0... FFH	0... 255	1	-
Counter threshold to set the sensor non-activity symptom flag					
C_FAC_DYN_INT_ACT_LSL_UP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Relative sensor signal damping admitted to monitor the sensor activity(see WRAF Sensor Dynamic Diagnosis)					
C_LAMB_DE_TOT_ACT_LSL_UP	-	0... FFFFH	0... 63.99902	976.599e-6	-
Threshold of the total cumulated lambda deviation to debounce the sensor non-activity symptom					
C_LAMB_SP_DE_PLS_ACT_LSL_UP	-	0... 7FFH	0... 0.12493	61e-6	-
Lower forced stimulation amplitude admitted to monitor the sensor activity					
C_MAF_KGH_MIN_ACT_LSL_UP	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Lower mass airflow in Kg/h admitted to monitor the sensor activity					
C_N_MIN_ACT_LSL_UP	-	0... FFH	0... 8160	32	rpm
Lower engine speed admitted to monitor the sensor activity					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_SUM_AFL_AFR_ACT_LSL_UP	-	0... FFFFH	0... 655.35	0.01	s
Lower forced stimulation period admitted to monitor the sensor activity					
C_VLS_UP_AFS_MAX_PLAUS_LSL_UP	-	8000... 7FFFH	-160... 159.99511	4.8828e-3	V
Upper limit of upstream sensor signal window to detect the sensor non-activity					
C_VLS_UP_AFS_MIN_PLAUS_LSL_UP	-	8000... 7FFFH	-160... 159.99511	4.8828e-3	V
Lower limit of upstream sensor signal window to detect the sensor non-activity					
ID_CTR_INC_RAW_ACT_LSL_UP	-	0... FFH	0... 255	1	-
LDP_MAF_KGH_ID_CTR_ACT_LSL_UP	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
Counter increment to detect raw symptom of upstream sensor non-activity					
ID_LAMB_GAIN_LS_UP_DYN	-	0... FFH	0... 31.875	0.125	-
LDP_FAC_DIAG_DYN_LSL_UP_ID_LAMB	8	0... 400H	0 ...1	976.599e-6	-
Gain factor to consider an aged linear lambda sensor					
ID_LAMB_GAIN_VLS_DOWN	-	0... FFH	0... 1.99218	0.0078125	-
LDP_VLS_DOWN_ID_LAMB_GAIN	8	0... 3FFFH	0... 4.99511	4.8828e-3	V
Gain/Damping factor to calculate LAMB_DE_INT_ACT_LSL_UP to double-check with VLS_DOWN					

## FUNCTION DESCRIPTION:

### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.


This function shall facilitate the upstream sensor non-activity detection, which can be caused by a extremely cold sensors or an open circuit some ATIC42 or CJ125 lines.

### Description:

In the first part of this test the sensor is assumed to have no activity if VLS\_UP\_DIAG remains stuck in a tight band around stoichiometric values. If this is true for C\_CTR\_RAW\_ACT\_SYM\_LSL\_UP recurrences, then the raw symptom flag LV\_DIAG\_RAW\_ACT\_SYM\_LSL\_UP is set.

Rate Based Monitoring (RBM) requires similar time spans for the diagnosis to come to an end with or without a failure present. Therefore, if VLS\_UP\_DIAG is not within the mentioned band (thus a failure is unlikely) the counter CTR\_RAW\_ACT\_END\_LSL\_UP is incremented until the threshold C\_CTR\_RAW\_ACT\_END\_LSL\_UP is reached. At this point the end flag LV\_DIAG\_RAW\_ACT\_END\_LSL\_UP is set. VLS\_UP\_DIAG of a faultless sensor might pass through or come to lie within the critical band. In these cases the end counter is frozen and the incrementation is resumed, once the critical band is left again.

In the failure case CTR\_RAW\_ACT\_SYM\_LSL\_UP is incremented until the threshold C\_CTR\_RAW\_ACT\_SYM\_LSL\_UP is reached, where the end flag and the raw symptom flag are set at the same instance. In case of intermittent faults, excursion from the critical band should not lead to an immediate reset of the raw symptom flag. Therefore, the raw symptom flag is taken back only if the raw symptom counter drops below C\_CTR\_RAW\_ACT\_RST\_LSL\_UP.

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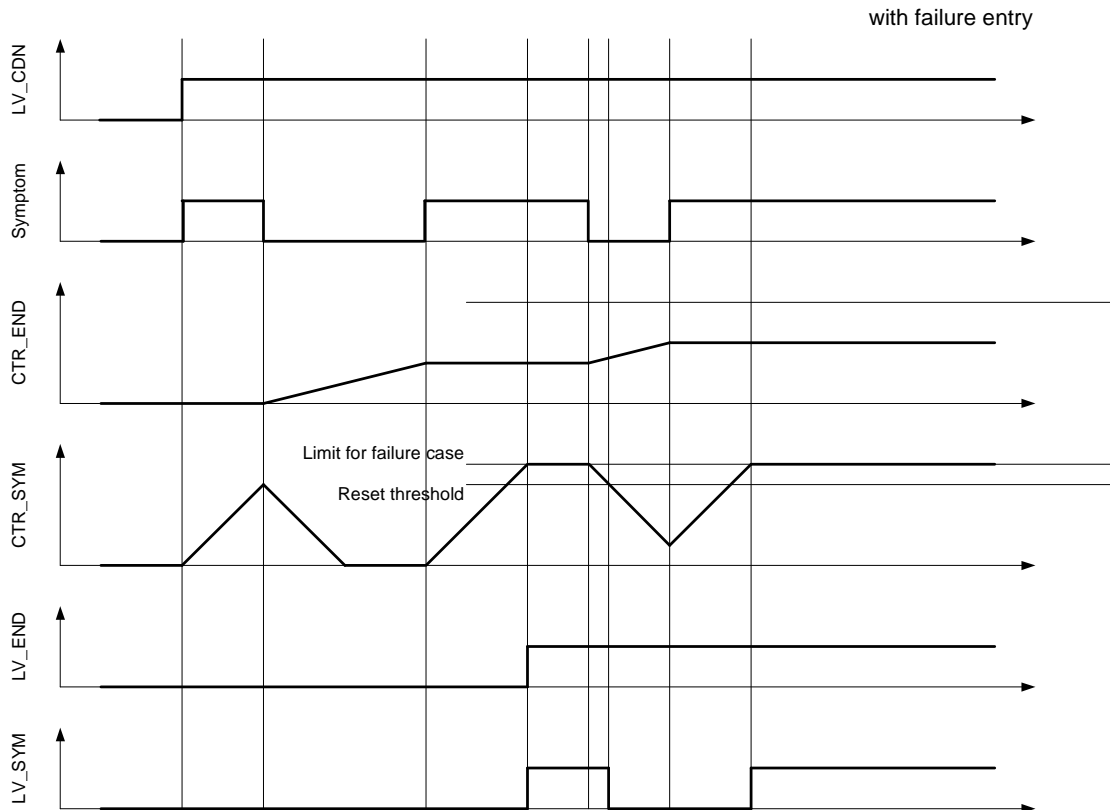


Figure B.18.1: : Basic principle of debounce algorithm for first part of activity check (LV\_DIAG\_RAW\_ACT\_END/SYM\_LSL\_UP)

The second part is started once the first part has come to an end and the following conditions are met: The forced stimulation is active and additionally engine speed, engine load, amplitude and period of the forced stimulation are sufficient to provoke the fluctuation of the sensor output. If these conditions are fulfilled then the following procedure is carried out. The difference between  $LAMB\_LS\_UP[i]$  and the moving mean value  $LAMB\_MMV\_ACT\_LSL\_UP[i]$  is calculated and integrated. After  $C\_CTR\_LAMB\_DE\_INT\_ACT\_LSL\_UP$  forced stimulation periods the result is saved in the variable  $LAMB\_DE\_TOT\_ACT\_LSL\_UP[i]$ .

While integrating the difference between  $LAMB\_LS\_UP[i]$  and the moving mean value two different gain factors are taken into account. First,  $ID\_LAMB\_GAIN\_LS\_UP\_DYN$  considers an aged sensor. Second, with  $ID\_LAMB\_GAIN\_VLS\_DOWN$  the speed of integration is reduced, if  $VLS\_DOWN[i]$  shows either very rich or very lean conditions. The background here is that the combination of an upstream signal near stoichiometry and a very rich or very lean downstream signal strongly points to a not active upstream signal.

If the value of the deviation integral after  $C\_CTR\_LAMB\_DE\_INT\_ACT\_LSL\_UP$  forced stimulation cycles is lower than the threshold  $C\_LAMB\_DE\_TOT\_ACT\_LSL\_UP$ , then the symptom counter shall be incremented, otherwise it shall be decremented. If the symptom counter has achieved the maximum  $C\_CTR\_SYM\_MAX\_ACT\_LSL\_UP$  cycles, then the symptom flag  $LV\_DIAG\_ACT\_SYM\_LSL\_UP[i]$  is set, indicating that the sensor activity is very poor. This flag shall trigger the Open Circuit Diagnosis to narrow down the source of the failure. To have a valid end flag in case of a faultless sensor the counter  $C\_CTR\_END\_ACT\_LSL\_UP$  is incremented once the end flag of the first part is set and no raw symptom was detected. The end flag of the Activity Check is set when the end counter reaches the sum of both loops needed for the fault detection.

### Application conditions



**Initialisation:**

At the transition LV\_IGK = 0 to 1, reset or at clearing error memory reset all variables.  
 At the transition LV\_DIAG\_ACT\_CDN\_LSL\_UP[i] = 0 -> 1 initialize as follow:

```

CTR_SYM_ACT_LSL_UP[i] = 0
CTR_END_ACT_LSL_UP[i] = 0
CTR_RAW_ACT_SYM_LSL_UP[i] = 0
CTR_RAW_ACT_END_LSL_UP[i] = 0
CTR_LAMB_DE_INT_ACT_LSL_UP[i] = 0
LAMB_DE_INT_ACT_LSL_UP[i] = 0
LAMB_DE_TOT_ACT_LSL_UP[i] = 0
LAMB_MMV_ACT_LSL_UP[i] = 1

```

**Recurrence:**

20 ms

**Activation:**

LV\_ST\_END = 1

**Deactivation:**

LV\_ST\_END = 0

**Formula section:**

```

IF [LV_IPLSL_VLD[i] = 1 OR (LV_IPLSL_VLD[i] = 0 AND LV_VLS_UP_VLD[i] = 0)]
AND LV_DIAG_ACT_INH_LSL_UP[i] = 0
AND FAC_MV_DIAG_DYN_LSL_UP[i] < C_FAC_DYN_INT_ACT_LSL_UP
THEN
  LV_DIAG_ACT_CDN_LSL_UP[i] = 1
ELSE
  LV_DIAG_ACT_CDN_LSL_UP[i] = 0
ENDIF

```

*% First Part: Fast detection of no sensor activity  
 % counter management*

```

IF(1b) LV_DIAG_ACT_CDN_LSL_UP[i] = 1
  IF(2a) VLS_UP_DIAG[i] < C_VLS_UP_AFS_MIN_PLAUS_LSL_UP
  OR(2a) VLS_UP_DIAG[i] > C_VLS_UP_AFS_MAX_PLAUS_LSL_UP
  THEN(2a) % no raw symptom is present
    IF(3a) CTR_RAW_ACT_END_LSL_UP[i] < C_CTR_RAW_ACT_END_LSL_UP
    THEN(3a)
      increment CTR_RAW_ACT_END_LSL_UP[i] with ID_CTR_INC_RAW_ACT_LSL_UP
    ENDIF(3a)
    decrement CTR_RAW_ACT_SYM_LSL_UP[i] with ID_CTR_INC_RAW_ACT_LSL_UP
  ELSE(2a) % raw symptom is present
    IF(3b) CTR_RAW_ACT_SYM_LSL_UP[i] < C_CTR_RAW_ACT_SYM_LSL_UP
    THEN(3b)
      increment CTR_RAW_ACT_SYM_LSL_UP[i] with ID_CTR_INC_RAW_ACT_LSL_UP
    ENDIF(3b)
  ENDIF(2a)

  % end flag and symptom flag management
  % diagnosis has come to an end without any raw symptom present
  IF(2b) CTR_RAW_ACT_END_LSL_UP[i] >= C_CTR_RAW_ACT_END_LSL_UP
  THEN(2b)

```

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```

LV_DIAG_RAW_ACT_END_LSL_UP[i] = 1
END(2b)
% raw symptom is detected and sensor non-activity detailed check is triggered
IF(2c) CTR_RAW_ACT_SYM_LSL_UP[i] >= C_CTR_RAW_ACT_SYM_LSL_UP
THEN(2c)
    LV_DIAG_RAW_ACT_SYM_LSL_UP[i] = 1
    LV_DIAG_RAW_ACT_END_LSL_UP[i] = 1
ELSEIF(2c)
    % short excursion from critical window should not lead to an immediate reset of the raw symptom flag
    CTR_RAW_ACT_SYM_LSL_UP[i] < C_CTR_RAW_ACT_RST_LSL_UP
THEN(2c)
    LV_DIAG_RAW_ACT_SYM_LSL_UP[i] = 0
END(2c)
END(1a)

% Second Part: Monitoring upstream sensor integral deviation
% Checking the long term conditions enabling the integral deviation monitor
IF(1b) LV_DIAG_ACT_CDN_LSL_UP[i] = 1 AND LV_DIAG_RAW_ACT_END_LSL_UP[i] = 1
THEN(1b)
    % Checking the short term conditions enabling the integral deviation monitor
IF(2d) LV_LAMB_PLS_ACT[i] = 1
AND(2d) T_SUM_AFL_AFR_CYC[i] > C_T_SUM_AFL_AFR_ACT_LSL_UP
AND(2d) LAMB_SP_DE_PLS > C_LAMB_SP_DE_PLS_ACT_LSL_UP
AND(2d) MAF_KGH > C_MAF_KGH_MIN_ACT_LSL_UP
AND(2d) N_32 > C_N_MIN_ACT_LSL_UP
AND(2d) LV_LS_DOWN_READY[i] = 1
THEN(2d)
    LV_DIAG_ACT_SHO_CDN_LSL_UP[i] = 1
ELSE(2d)
    LV_DIAG_ACT_SHO_CDN_LSL_UP[i] = 0
ENDIF(2d)

% reset counter
IF(2e) LV_DIAG_RAW_ACT_SYM_LSL_UP[i] 0 -> 1
OR(2e) LV_DIAG_RAW_ACT_SYM_LSL_UP[i] 1 -> 0
THEN(2e)
    reset CTR_LAMB_DE_INT_ACT_LSL_UP[i]
    reset CTR_SYM_ACT_LSL_UP[i]
    reset LV_DIAG_ACT_SYM_LSL_UP[i]
    reset LAMB_DE_INT_ACT_LSL_UP[i]
ENDIF(2e)

% activation of the integral deviation monitor
LAMB_MMV_ACT_LSL_UP[i] (new) =
    LAMB_MMV_ACT_LSL_UP[i] (old) * (1-C_CRCLC_ACT_LSL_UP) +
    C_CRCLC_ACT_LSL_UP * LAMB_LS_UP[i]

IF (2f) LV_DIAG_ACT_SHO_CDN_LSL_UP[i] = 1
THEN (2f)
    IF(3f) LV_AFL[i] = 0 -> 1
    THEN(3f)

```

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```

IF(4f) LV_DIAG_RAW_ACT_SYM_LSL_UP[i] = 0
THEN(4f)    % no raw symptom present => no failure case
            IF(5f) CTR_END_ACT_LSL_UP[i] <
                (C_CTR_LAMB_DE_INT_ACT_LSL_UP + 1) *
                C_CTR_SYM_MAX_ACT_LSL_UP/C_CTR_SYM_INC_ACT_LSL_
UP
                % to mirror the time span needed to detect a sensor with no activity,
                the time delay of the first part has to be considered here, too (RBM require
                ment).
            THEN(5f)
                increment CTR_END_ACT_LSL_UP[i]
            ELSE(5f)
                LV_DIAG_ACT_END_LSL_UP = 1
            ENDIF(5f)
ELSE(4f) % raw symptom present => failure case
            % freeze CTR_END_ACT_LSL_UP[i]
            IF(5g) CTR_LAMB_DE_INT_ACT_LSL_UP[i] <
                C_CTR_LAMB_DE_INT_ACT_LSL_UP
            THEN(5g)
                increment CTR_LAMB_DE_INT_ACT_LSL_UP[i]
            ELSE(5g)
                % analysis of the deviation integral is only performed after the raw symptom
                is constantly present for C_CTR_LAMB_DE_INT_ACT_LSL + 1 times.
                LAMB_DE_TOT_ACT_LSL_UP[i] = LAMB_DE_INT_ACT_LSL_
UP[i]
                LAMB_DE_INT_ACT_LSL_UP[i] = 0
                CTR_LAMB_DE_INT_ACT_LSL_UP[i] = 0
            IF(6f) LAMB_DE_TOT_ACT_LSL_UP[i] ≤
                C_LAMB_DE_TOT_ACT_LSL_UP
            THEN(6f) % deviation integral is low => possible failure
                IF(7f) CTR_SYM_ACT_LSL_UP[i] <
                    C_CTR_SYM_MAX_ACT_LSL_UP
                THEN(7f)
                    increment CTR_SYM_ACT_LSL_UP[i] with
                    C_CTR_SYM_INC_ACT_LSL_UP
                ENDIF(7f)
            ELSE(6f) %deviation integral is sufficiently high => failure unlikely
                IF(7g) CTR_SYM_ACT_LSL_UP[i] >
                    C_CTR_SYM_DEC_ACT_LSL_UP
                THEN(7g)
                    decrement CTR_SYM_ACT_LSL_UP[i] with
                    C_CTR_SYM_DEC_ACT_LSL_UP
                ENDIF(7g)
            ENDIF(6f)
            IF(6g) CTR_SYM_ACT_LSL_UP[i] <=
                CTR_SYM_DEC_ACT_LSL_UP
            THEN(6g)
                LV_DIAG_ACT_SYM_LSL_UP[i] = 0
            ELSEIF(6g) CTR_SYM_ACT_LSL_UP[i] >=
                CTR_SYM_MAX_ACT_LSL_UP
                LV_DIAG_ACT_SYM_LSL_UP[i] = 1
                LV_DIAG_ACT_END_LSL_UP[i] = 1
            ENDIF(6g)


```

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```

                ENDIF(5g)
            ENDIF(4f)
        ELSE(3f)
            LAMB_DE_LSL[i] = | LAMB_LS_UP[i] - LAMB_MMV_ACT_LSL_UP[i] |
            LAMB_DE_INT_ACT_LSL_UP[i] (new) = LAMB_DE_INT_ACT_LSL_UP[i](old) +
                LAMB_DE_LSL[i] * ID_LAMB_GAIN_VLS_DOWN * ID_LAMB_GAIN_LS_UP_DYN
        ENDIF(3f)
    ELSE(2f) %short term conditions for activation of the integral deviation monitor not fulfilled
        Freeze CTR_LAMB_DE_INT_ACT_LSL_UP[i]
        Freeze LAMB_DE_INT_ACT_LSL_UP[i]
    ENDIF(2f)
ENDIF(1b)

```

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## B.19 O2 sensor (lin, up) activity diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_ACT_INH_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of "Activity Diagnosis"					

### Input data:

LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}
LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_ UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_CPS {p. 4708}	LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}
LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PL AUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}
LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_LOAD_TPS_ PL AUS {p. 1062}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}
LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_PL AUS {p. 1062}	LV_ERR_MAP_TPS_ PL AUS {p. 1062}
LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}
LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_SHIFT_AFL_ LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_ LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_TPS {p. 4982}
LV_ERR_VCV {p. 4729}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_IGK {p. 906}	LV_LS_UP_OBD_2_MAN_ DEAC [NC_CBK_EX_NR] {p. 5449}
LV_N_LIM_ETC_LIH {p. 4982}	NC_CBK_EX_NR {p. 1829}		

### FUNCTION DESCRIPTION:

#### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2


otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

#### Application conditions

#### Initialisation:

at every transition LV\_IGK = 0 -> lor reset all variables shall be reset to 0.

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at every transition LV\_IGK = 1 -> 0 LV\_DIAG\_ACT\_INH\_LSL\_UP[i] = 1

**Recurrence:** The functions shall be carried out once every 1s.

**Activation:**

LV\_IGK = 1

**Deactivation:**

LV\_IGK = 0


### Formula Section:

This function has to be deactivated, if at least one of the following errors /special modes is active.

```

IF      LV_LS_UP_OBD_2_MAN_DEAC[i] = 1      OR
          LV_N_LIM_ETC_LIH = 1                OR
          LV_ERR_CHG_LS_UP = 1                OR
          LV_ERR_DIAGCPS = 1                  OR
          LV_ERR_EL_CPS = 1                   OR
          LV_ERR_FUP = 1                       OR
          LV_ERR_FUP_MFP_PLAUS = 1            OR
          LV_ERR_FUP_ORNG = 1                 OR
          LV_ERR_FUP_ST = 1                   OR
          LV_ERR_H_PRS_SYS = 1                OR
          LV_ERR_LOAD_TPS_PLAUS = 1           OR
          LV_ERR_MAF = 1                      OR
          LV_ERR_MAP_PLAUS = 1                OR
          LV_ERR_MAP_TPS_PLAUS = 1            OR
          LV_ERR_MTC_CTL_2 = 1                 OR
          LV_ERR_MTC_CTL_3 = 1                 OR
          LV_ERR_MTC_DR = 1                   OR
          LV_ERR_TPS = 1                      OR
          LV_ERR_VCV = 1                      OR
          LV_ERR_AIR_LSL_UP[i] = 1            OR
          LV_ERR_CTL_LSL_UP[i] = 1            OR
          LV_ERR_DELTA_I_LAM[i] = 1           OR
          LV_ERR_DYN_VLD_LS_UP[i] = 1         OR
          LV_ERR_EL_LSL_UP[i] = 1             OR
          LV_ERR_LSH_UP[i] = 1                OR
          LV_ERR_LSL_UP_IF[i] = 1             OR
          LV_ERR_OFS_LSL_UP[i] = 1            OR
          LV_ERR_SHIFT_AFL_LSL_UP[i] = 1      OR
          LV_ERR_SHIFT_AFR_LSL_UP[i] = 1      OR
          LV_ERR_VLS_DOWN_DIF[i] = 1          OR
          (i = 1      AND
            [ LV_ERR_IV[0]      OR
              LV_ERR_IV[2]      OR
              LV_ERR_IV[4]      OR
              LV_ERR_MIS[0]      OR
              LV_ERR_MIS[2]      OR
              LV_ERR_MIS[4]
            ]
          ) OR
          (i = 2      AND
            [ LV_ERR_IV[1]      OR
              LV_ERR_IV[3]
            ]
          )

```

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```

                LV_ERR_IV[5]           OR
                LV_ERR_MIS[1]          OR
                LV_ERR_MIS[3]          OR
                LV_ERR_MIS[5]
    )

```


**THEN**

```
LV_DIAG_ACT_INH_LSL_UP[i] = 1
```

**ELSE**

```
    LV_DIAG_ACT_INH_LSL_UP[i]= 0
```

**ENDIF**

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## B.20 O2 sensor (lin, up) controller offset diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_CTL_LSL_UP [NC_CBK_EX_NR]	V	0... FH	0... 15	1	-
Conditions to run the pump current controller diagnosis for the WRAF sensor controller					
CTR_OFS_ADJ_CMPL [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
number of completed offset adjustments					
ERR_DIAG_CTL_LSL_UP [NC_CBK_EX_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom of pump current controller fault on the upstream WRAF sensor controller					
ERR_SYM_OFS_LSL_UP [NC_CBK_EX_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom of offset correction error on the upstream WRAF sensor					
LV_CDN_DIAG_OFS_LSL_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Conditions to run the offset diagnosis of the upstream WRAF sensor controller					
LV_END_DIAG_CTL_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End flag of the pump current controller diagnosis for WRAF sensor controller					
LV_END_DIAG_OFS_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Result of present diagnosis status is valid					
LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced result of pump current controller diagnosis					
LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced diagnosis value caused by an offset correction error of the WRAF Sensor controller					
LV_LSL_OFS_ADJ_DIAG_OFS_OLD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Value of LV_LS_OFS_ADJ_ACT from last recurrence of the WRAF controller offset diagnosis					
T_DIAG_ACT_OFS [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
time offset adjustment is active					

### Input data:

CDN_DIAG_CTL_LSL_DI [NC_CBK_EX_NR] {p. 5255}	CDN_DIAG_CTL_LSL_INH [NC_CBK_EX_NR] {p. 5255}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_ICPLSL_ENA_LSL_IF [NC_CBK_EX_NR] {p. 2351}
LV_IGK {p. 906}	LV_INH_DIAG_OFS_LSL [NC_CBK_EX_NR] {p. 5255}	LV_IPLSL_CTL_ENA_LSL_IF [NC_CBK_EX_NR] {p. 2351}	LV_IPLSL_CTL_ENA_PLS_ACT [NC_CBK_EX_NR] {p. 2351}
LV_LSL_OFS_ADJ_ACT [NC_CBK_EX_NR] {p. 2313}	LV_TTIP_MES_VLD_LS_UP [NC_CBK_EX_NR] {p. 1320}	LV_VLS_OFS_ADJ_CMPL [NC_CBK_EX_NR] {p. 2314}	LV_VLS_OFS_LIM_LSL [NC_CBK_EX_NR] {p. 2314}



LV_VLS_OFS_LIM_LSL_L_ GAIN [NC_CBK_EX_NR] {p. 2314}	LV_VNLSL_LIM [NC_CBK_EX_NR] {p. 955}	LV_VPLSL_LIM [NC_CBK_EX_NR] {p. 955}	NC_CBK_EX_NR {p. 1829}
STATE_ERR_IPLSL [NC_CBK_EX_NR] {p. 955}	TTIP_MES_LS_UP [NC_CBK_EX_NR] {p. 1321}	VLS_UP_DIAG [NC_CBK_EX_NR] {p. 2315}	


**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_DIAG_CTL_LSL_UP [NC_CBK_EX_NR]	-	0... FFH	0... 255	1	-
Antibounce counter increment of pump current controller diagnosis					
C_ABC_INC_DIAG_OFS_LSL_UP [NC_CBK_EX_NR]	-	0... FFH	0... 255	1	-
Antibounce counter increment of offset adjustment diagnosis					
C_ABC_MAX_DIAG_CTL_LSL_UP [NC_CBK_EX_NR]	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter of pump current controller diagnosis					
C_ABC_MAX_DIAG_OFS_LSL_UP [NC_CBK_EX_NR]	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter of offset adjustment diagnosis					
C_LAMB_SP_MAX_DIAG_CTL_LSL_UP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Maximum lambda setpoint to execute pump current controller diagnosis					
C_LAMB_SP_MIN_DIAG_CTL_LSL_UP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Minimum lambda setpoint to execute pump current controller diagnosis					
C_T_DIAG_ACT_OFS_MAX	-	0... FFFFH	0... 655.35	0.01	s
Maximum allowed duration of offset adjustment					
C_TTIP_MAX_DIAG_CTL_LSL_UP	-	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Maximum sensor tip temperature to allow pump current controller diagnosis					
C_TTIP_MIN_DIAG_CTL_LSL_UP	-	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Minimum sensor tip temperature to allow pump current controller diagnosis					
C_VLS_UP_MAX_DIAG_CTL_LSL_UP	-	8000... 7FFFH	-160... 159.99511	4.8828e-3	V
Upper end of blind spot for pump current controller diagnosis					
C_VLS_UP_MIN_DIAG_CTL_LSL_UP	-	8000... 7FFFH	-160... 159.99511	4.8828e-3	V
Lower end of blind spot for pump current controller diagnosis					

**Import actions:**

<b>ACTION_ERRM_FilterMulticonditio</b> (IN<PRM_IDX_DIAG>,IN<PRM_CDN_DIAG>,IN<PRM_ERR_DIAG>,IN<PRM_ABC_INC>,IN<PRM_ABC_MAX>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>,OUT<LV_END_DIAG>)
<b>ACTION_ERRM_GetLvErr</b> (IN<IDX_DIAG>,OUT<LV_ERR>)

**Error treatment:**

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Diagnostic	Symptom description	Symptom	Filter type
OFS_LSL_UP[i]			
Diagnostic description	limitation of offset correction in low gain	SYM_0	STD_INI
	limitation of offset in high gain	SYM_1	
	maximum duration of offset correction exceeded	SYM_2	

Figure B.20.1: Diagnostic

Diagnostic	Symptom description	Symptom	Filter type
CTL_LSL_UP[i]			
Diagnostic description	Pump current limitation	SYM_0	MPL_STD_INI
	Pump voltage limitation	SYM_1	
	Reference pump current cutoff because of VN overvoltage	SYM_2	

**FUNCTION DESCRIPTION:****Application conditions****Initialisation:**

**At reset and LV\_IGK 0 → 1 transition,** do the following synchronization with ERRM:

```

ACTION_ERRM_GetLvErr ( in   OFS_LSL_UP_i,
                      out   LV_ERR_OFS_LSL_UP[i])
ACTION_ERRM_GetLvEndDiag ( in OFS_LSL_UP_i,
                          out   LV_END_DIAG_OFS_LSL_
UP[i])
ACTION_ERRM_GetLvErr ( in   CTL_LSL_UP_i,
                      out   LV_ERR_CTL_LSL_UP[i])
ACTION_ERRM_GetLvEndDiag ( in CTL_LSL_UP_i,
                          out   LV_END_DIAG_CTL_LSL_
UP[i])

```

**When clearing the error memory,** all ERRM related data shall be reset to 0.

Additionally, the following initialization shall be done on all these occasions:

```

CDN_DIAG_CTL_LSL_UP[i] = 0
ERR_DIAG_CTL_LSL_UP[i] = 0
CTR_OFS_ADJ_CMPL[i] = 0
T_DIAG_ACT_OFS[i] = 0
LV_LSL_OFS_ADJ_DIAG_OFS_OLD[i] = 0

```

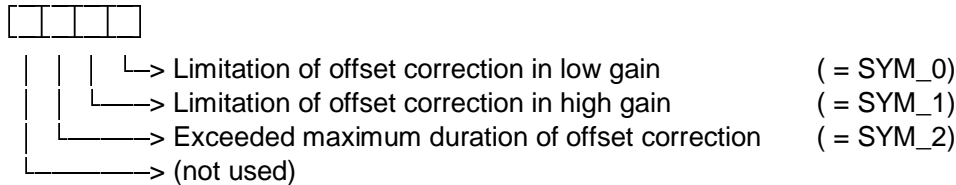
For activation conditions and recurrences see the individual function blocks.

**B.20.1 WRAF Controller Offset Diagnosis**

**General information:**

This part of the function shall check the performance of the offset adjustment carried out by the WRAF controller. The measured offset should fall within a calibrateable band, and the time taken by an offset adjustment should be shorter than a calibrateable upper limit.

Error Symptoms are defined as follows:

**Recurrence:**

The function shall be carried out once every 10ms.

**Activation:** LV\_INH\_DIAG\_OFS\_LSL[i] = 0 and  
(LV\_LSL\_OFS\_ADJ\_DIAG\_OFS\_OLD[i] = 1 or  
LV\_LSL\_OFS\_ADJ\_ACT[i] = 1)

**Formula section:**

```

if(1)      LV_LSL_OFS_ADJ_ACT[i] = 1
then(1)    Increment T_DIAG_ACT_OFS[i]
else(1)    Reset T_DIAG_ACT_OFS[i]
endif(1)
LV_LSL_OFS_ADJ_DIAG_OFS_OLD[i] = LV_LSL_OFS_ADJ_ACT[i]

```

**Setting the symptoms:**

```

if (1)      LV_VLS_OFS_ADJ_CMPL[i] 0 -> 1
then (1)    LV_CDN_DIAG_OFS_LSL_UP[i] = 1
              Reset T_DIAG_ACT_OFS[i]
              Increment CTR_OFS_ADJ_CMPL[i]
if (2) LV_VLS_OFS_LIM_LSL_L_GAIN[i] = 1
then (2) ERR_SYM_OFS_LSL_UP[i] = SYM_0    % "offset correction limitation low gain"
elseif (2) LV_VLS_OFS_LIM_LSL_L_GAIN[i] = 1
then (2) ERR_SYM_OFS_LSL_UP[i] = SYM_1    % "offset correction limitation high gain"
else (2) ERR_SYM_OFS_LSL_UP[i] = NO_SYM    % "offset correction works normal"
endif (2)
elseif (1) T_DIAG_ACT_OFS[i] >= C_T_DIAG_ACT_OFS_MAX
then (1)    LV_CDN_DIAG_OFS_LSL_UP[i] = 1
              ERR_SYM_OFS_LSL_UP[i] = SYM_2    % "offset correction maximum duration exceeded"
else (1)    LV_CDN_DIAG_OFS_LSL_UP[i] = 0
endif (1)

```

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

Calling the generic error management for anti-bounce filtering and update of the outputs:

```

ACTION_ERRM_FilterSymptom (      in      OFS_LSL_UP_i,
                                in      LV_CDN_DIAG_OFS_LSL_UP[i],
                                in      ERR_SYM_OFS_LSL_UP[i],
                                in      C_ABC_INC_DIAG_OFS_LSL_UP[i],
                                in      1,
                                in      C_ABC_MAX_DIAG_OFS_LSL_UP[i],
                                out     LV_ERR_OFS_LSL_UP[i])
ACTION_ERRM_GetLvEndDiag (      in      OFS_LSL_UP_i,
                                out     LV_END_DIAG_OFS_LSL_UP[i])

```

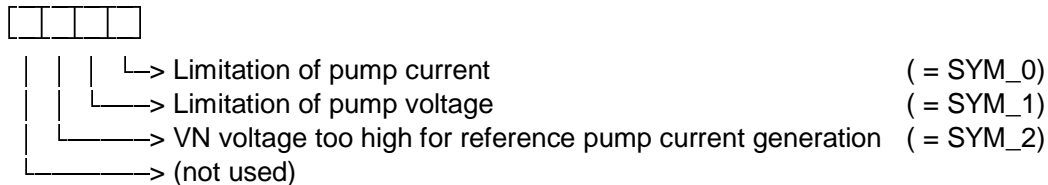
## B.20.2 WRAF Controller Limitation Diagnosis

### General information:

This part of the function shall check the performance of the pump current controller and (if used) the reference pump current generator in the WRAF sensor controller. For this, the pump current, pump voltage and nernst overvoltage diagnostic flags read out from the controller by the BSW are checked. Since the flags are also set if there is an open circuit in one or more of the sensor lines, the diagnosis must only operate under conditions that exclude an open circuit. Hence the checks for tip temperature and VLS\_UP\_DIAG limits.

To disable monitoring for the individual flags based on driving conditions, the corresponding bit in CDN\_DIAG\_CTL\_LSL\_INH[i] should be set. To turn off a monitor permanently, the bit in CDN\_DIAG\_CTL\_LSL\_DI[i] must be set instead, otherwise the diagnosis end bit will never be set.

Error Symptoms are defined as follows:



### Recurrence:

The function shall be carried out once every 10ms.

**Activation:** LV\_IPLSL\_CTL\_ENA\_LSL\_IF[i] = 1 and  
 (CDN\_DIAG\_CTL\_LSL\_INH[i].bit\_x = 0 and  
 CDN\_DIAG\_CTL\_LSL\_DI[i].bit\_x = 0) for any x = 0...2

### Formula section:

**If** LV\_IPLSL\_CTL\_ENA\_PLS\_ACT[i] = 0  
**and** C\_LAMB\_SP\_MIN\_DIAG\_CTL\_LSL\_UP <= LAMB\_SP[i]  
**and** LAMB\_SP[i] <= C\_LAMB\_SP\_MAX\_DIAG\_CTL\_LSL\_UP  
**and** LV\_TTIP\_MES\_VLD\_LS\_UP[i]  
**and** TTIP\_MES\_LS\_UP[i] > C\_TTIP\_MIN\_DIAG\_CTL\_LSL\_UP  
**and** C\_TTIP\_MAX\_DIAG\_CTL\_LSL\_UP > TTIP\_MES\_LS\_UP[i]  
**and** (VLS\_UP\_DIAG[i] < C\_VLS\_UP\_MIN\_DIAG\_CTL\_LSL\_UP  
**or** C\_VLS\_UP\_MAX\_DIAG\_CTL\_LSL\_UP < VLS\_UP\_DIAG[i])

**then (1)**

*% Exclude conditions that may indicate open circuit faults to avoid false CTL\_LSL\_UP entries.*

```

if   CDN_DIAG_CTL_LSL_DI[i].bit_0 = 0
and   STATE_ERR_IPLSL [i] != NO_SYM
then (2a)
    Set "SYM_0" in ERR_DIAG_CTL_LSL_UP[i]
    %pump current above limits allowed by hardware

```

```

Else (2a)
    Clear "SYM_0" in ERR_DIAG_CTL_LSL_UP[i]
    %pump current OK

```

**Endif (2a)**

```

if   CDN_DIAG_CTL_LSL_DI[i].bit_1 = 0
and   LV_VPLSL_LIM[i] = 1
then (2b)
    Set "SYM_1" in ERR_DIAG_CTL_LSL_UP[i]
    %pump voltage above limits allowed by hardware

```

```

Else (2b)
    Clear "SYM_1" in ERR_DIAG_CTL_LSL_UP[i]
    %pump voltage OK

```

**Endif (2b)**

```

if   CDN_DIAG_CTL_LSL_DI[i].bit_2 = 0
and   LV_VNLSL_LIM[i] = 1
and   LV_ICPLSL_ENA_LSL_IF[i] = 1
then (2c)
    Set "SYM_2" in ERR_DIAG_CTL_LSL_UP[i]
    %voltage at VN too high for correct generation of reference pump current

```

```

Else (2c)
    Clear "SYM_2" in ERR_DIAG_CTL_LSL_UP[i]
    %voltage at VN OK

```

**Endif (2c)**

*% now generate the conditions for the ERRM multi-condition filter call. Bits 0, 1 and 2 in  
 % CDN\_DIAG\_CTL\_LSL\_DI/INH[i] correspond to the condition for SYM\_0, SYM\_1  
 % and SYM\_2 respectively, as denoted by the suffix \_x below.*

```

if   CDN_DIAG_CTL_LSL_DI[i].bit_x = 1
or   CDN_DIAG_CTL_LSL_INH[i].bit_x = 0
then (2d)

```

*Diagnostic conditions for SYM\_x are fulfilled*

**Else (2d)**

*Diagnostic conditions for SYM\_x are not fulfilled*

**Endif (2d)****Else (1)**

*%no diagnostic result is available*

*Diagnostic conditions for SYM\_0, SYM\_1 and SYM\_2 not fulfilled*

**Endif (1)**

Calling the generic error management for anti-bounce filtering and update of the outputs:

```


ACTION_ERRM_FilterMulticonditio (          in      CTL_LSL_UP_i,
                                           in      CDN_DIAG_CTL_LSL_UP[i],
                                           in      ERR_DIAG_CTL_LSL_UP[i],
                                           in      C_ABC_INC_DIAG_CTL_LSL_UP[i],
                                           in      C_ABC_MAX_DIAG_CTL_LSL_UP[i],
                                           out     LV_ERR_CTL_LSL_UP[i])

```

```

ACTION_ERRM_GetLvEndDiag (      in    CTL_LSL_UP_i,
                                out    LV_END_DIAG_CTL_LSL_UP[i])

```

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## B.21 O2 sensor (lin, up) controller offset diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_CTL_LSL_DI [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Permanently disabled monitors for the pump current controller diagnosis					
CDN_DIAG_CTL_LSL_INH [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Temporarily inhibited monitors for the pump current controller diagnosis					
LV_INH_DIAG_CTL_LSL_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Inhibition condition for the pump current controller diagnosis					
LV_INH_DIAG_OFS_LSL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the Offset adjustment diagnosis					

### Input data:

LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FTL_MIN {p. 4762}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}
LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_LS_UP_OBD_2_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}
LV_VB_CDN_OBD_2 {p. 1046}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CDN_DIAG_CTL_LSL_DI	-	0... FFH	0... 255	1	-
Constant for permanently disabled monitors for the pump current controller diagnosis					

### Error treatment:


Diagnostic XX	Symptoms	Ref.	DTC Symptom SAE	DTC Symptom Customer	DTC Global SAE	DTC Global Customer	Failure class A/B	Readiness code
Diagnostic description	1 <sup>st</sup> symptom description	SYM_0			P2A00			CARB_L S
	2 <sup>nd</sup> symptom description	SYM_1			P2A01			
	3 <sup>rd</sup> symptom description	SYM_2						

Figure B.21.1: Diagnostic

Diagnostic XX	Symptoms	Ref.	DTC Symptom SAE	DTC Symptom Customer	DTC Global SAE	DTC Global Customer	Failure class A/B	Readiness code
Diagnostic description	1 <sup>st</sup> symptom description	SYM_0			P21xx			CARB_L S
	2 <sup>nd</sup> symptom description	SYM_1			P21xx			
	3 <sup>rd</sup> symptom description	SYM_2						

Fields information (For more information refer to Error Management file Table of Failure) :

- DTC Symptom : give for each symptom the corresponding DTC. According to the configuration one or two fields are possible (In our table one is for CARB the other for customer)

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- DTC Global : recommended DTC value, it may be the code defined by the law. According to the configuration two fields are possible (In our table one is for CARB the other for customer)
- Failure class parameter for calibrating the behaviour of the Error management for this failure. The failure class values are described in Error management aggregate.
- Readiness code : put the corresponding readiness group code.

## FUNCTION DESCRIPTION:

### General information:

The flag LV\_INH\_DIAG\_OFS\_LSL allows to deactivate the corresponding diagnostic.

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

### Description:

### Application conditions:

#### *Initialisation:*

The following data shall be set to 0 at LV\_IGK 0->1 or at ECU reset or at clearing error memory:

LV\_INH\_DIAG\_OFS\_LSL[i] = 0

LV\_INH\_DIAG\_CTL\_LSL\_UP[i] = 0

CDN\_DIAG\_CTL\_LSL\_DI[i] = C\_CDN\_DIAG\_CTL\_LSL\_DI

CDN\_DIAG\_CTL\_LSL\_INH[i] = 0

The following data shall be set to 1 at LV\_IGK 1->0:

LV\_INH\_DIAG\_OFS\_LSL[i] = 1

LV\_INH\_DIAG\_CTL\_LSL\_UP[i] = 1

*Recurrence:* 10ms

*Activation:* LV\_IGK = 1


*Deactivation:* LV\_IGK = 0

### Formula section:

```

IF          LV_LS_UP_OBD_2_MAN_DEAC[i] = 1          OR
            LV_VB_CDN_OBD_2 = 0                    OR
            LV_ERR_LSL_UP_IF[i] = 1                OR
            LV_ERR_EL_LSL_UP[i] = 1
THEN       LV_INH_DIAG_OFS_LSL[i] = 1
ELSE       LV_INH_DIAG_OFS_LSL[i] = 0
ENDIF

```

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```

if      LV_LS_UP_OBD_2_MAN_DEAC[i] = 1      OR
LV_VB_CDN_OBD_2 = 0      OR
LV_ERR_FTL_MIN = 1      OR
LV_ERR_EL_LSL_UP[i] = 1      OR
LV_ERR_LSL_UP_IF[i] = 1      OR
LV_ERR_OFS_LSL_UP[i] = 1      OR
LV_ERR_OBD_VLD_LSH_UP[i] = 1      OR
LV_ERR_OC_LSL_UP[i] = 1      OR
LV_ERR_LSH_UP[i] = 1

```

**then**

```
LV_INH_DIAG_CTL_LSL_UP[i] = 1
```

**Else**

```
LV_INH_DIAG_CTL_LSL_UP[i] = 0
```

**Edif**

```
if      LV_INH_DIAG_CTL_LSL_UP[i] = 1
```

**then**

*% inhibition may be changed dynamically here.*

*% Disable flags should never be changed, since this would fake a premature end of the diagnosis!*

```
CDN_DIAG_CTL_LSL_INH[i] = 00000111bin
```

**ELSE**

```
CDN_DIAG_CTL_LSL_INH[i] = 0
```

**Endif**

## B.22 O2 sensor (lin,up) delay diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_AFL_AFR_CYC_DLY [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Counter of single AFL/AFR cycles					
CTR_AFL_AFR_CYC_DLY_MMV [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter of AFL/AFR cycle series					
CTR_DLY_DIAG_ACT_CDN_DYN	V	0... FFH	0... 255	1	-
Counter for delay of activation due to dynamic conditions					
FAC_DLY_DIAG_LSL [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	-
Single O2L factor					
FAC_DLY_DIAG_LSL_AMPL_MV [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	-
Average amplitude of the diagnosis factor					
FAC_DLY_DIAG_LSL_MAX [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	-
Maximal delay factor over complete diagnosis					
FAC_DLY_DIAG_LSL_MAX_MV [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	-
Average maximal diagnosis factor over more AFL/AFR series					
FAC_DLY_DIAG_LSL_MIN_MV [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	-
Average minimal diagnosis factor over more AFL/AFR series					
FAC_DLY_DIAG_LSL_OUT [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Linear sensor signal delay diagnosis final value					
FAC_DLY_DIAG_TMP_MAX [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	-
Maximal diagnosis factor over defined number AFL/AFR cycles (serie)					
FAC_DLY_DIAG_TMP_MAX_SUM [NC_CBK_EX_NR]	V	8000... 7FFFH	-400... 399.987792969	0.012207	-
Sum of maximal diagnosis factor over defined number AFL/AFR cycles (series)					
FAC_DLY_DIAG_TMP_MIN [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	-
Minimal diagnosis factor over defined number AFL/AFR cycles (series)					
FAC_DLY_DIAG_TMP_MIN_SUM [NC_CBK_EX_NR]	V	8000... 7FFFH	-400... 399.987792969	0.012207	-
Sum of minimal diagnosis factor over defined number AFL/AFR cycles (series)					
FAC_LAM_TMP_MMV_DIAG [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Filtered selected controller output for the diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DLY_DIAG_ACT_CDN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation condition for the linear sensor signal delay diagnosis					
LV_DLY_DIAG_ACT_CDN_DYN	V	0... 1H	0 ...1	1	-
Dynamic activation condition for the linear sensor signal delay diagnosis					
LV_DLY_DIAG_ACT_CDN_STAT	V	0... 1H	0 ...1	1	-
Static activation condition for the linear sensor signal delay diagnosis					
LV_DLY_DIAG_REQ_LAM_GAIN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request for switch of lambda controller parameters for linear lambda sensor delay diagnosis					
LV_DLY_END_LSL_DIAG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Indicator of finished linear sensor signal delay diagnosis					
LV_FAC_DLY_DIAG_MIN_MAX_RST [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for reset of the single MIN/MAX values at calculation of the amplitude					
MAF_KGH_INT_LAM_GAIN_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0... 2912.6666667	0.0444444	g
MAF_KGH integral for delay of the diagnosis after switch to according controller parameters					
MAF_KGH_LIM_DYN_DLY_ABS	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Absolute value of the MAF limited dynamic					
MAF_KGH_LIM_DYN_DLY_MMV	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Filtered MAF_KGH signal					
N_32_LIM_DYN_DLY_ABS	V	0... FFH	0... 8160	32	rpm
Absolute value of the engine speed limited dynamic					
N_LIM_DYN_DLY_MMV	V	0... 1FE0H	0... 8160	1	rpm
Filtered engine speed for limited dynamic					
O2L_OUT_INT_DLY_DIAG_LSL [NC_CBK_EX_NR]	V	0... FFFFH	0... 20.93479	319.444e-6	g
O2 loading actual value					
T_DLY_ACT_DIAG_LAM_GAIN_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Delay timer of activation of the diagnosis after switch to required lambda controller parameters					
TQI_AV_LIM_DYN_DLY_ABS	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Absolute value of the TQI_AV limited dynamic					
TQI_AV_LIM_DYN_DLY_MMV	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Filtered TQI_AV signal					

**Input data:**

FAC_LAM_OUT [NC_CBK_EX_NR] {p. 2462}	FAC_LAM_P_LIM [NC_CBK_EX_NR] {p. 2462}	LV_DIAG_EOL_DYN_LS_UP [NC_CBK_EX_NR] {p. 5377}	LV_DLY_DIAG_ACT_LAM_GAIN {p. 5348}
LV_INH_SENS_DLY_DIAG [NC_CBK_EX_NR] {p. 5377}	MAF_FG_CYL {p. 1212}	MAF_KGH {p. 1195}	N {p. 1525}
NC_CBK_EX_NR {p. 1829}	STATE_LAMB_PLS_DET_VALUE {p. 2958}	TQI_AV {p. 981}	VS {p. 1176}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FAC_LAM_MMV_DIAG	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation factor for controller output filtering for diagnosis					
C_CRLC_MAF_LIM_DYN_DLY	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation factor for MAF filtering					
C_CRLC_N_32_LIM_DYN_DLY	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation factor for engine speed filtering					
C_CRLC_TQI_LIM_DYN_DLY	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation factor for torque value filtering					
C_CTR_AFL_AFR_CYC_DLY	-	0... FFFFH	0... 65535	1	-
Number of single AFL/AFR cycles for single diagnosis value calculation					
C_CTR_AFL_AFR_CYC_DLY_MV	-	0... FFH	0... 255	1	-
Number of AFL/AFR cycle series for average diagnosis value calculation					
C_CTR_LDC_SENS_DIAG_ACT	-	0... FFH	0... 255	1	-
Delay for setting of the limited dynamic conditions once the conditions are true					
C_MAF_KGH_INT_LAM_GAIN_ACT	-	0... FFFFH	0... 2912.66666667	0.0444444	g
Maximum MAF_KGH integral for delay of the diagnosis after switch to according controller parameters					
C_MAF_KGH_INT_LAM_GAIN_ACT_EOL	-	0... FFFFH	0... 2912.66666667	0.0444444	g
Maximum MAF_KGH integral for delay of the diagnosis after switch to according controller parameters at EOL					
C_MAF_KGH_NOM_O2L_INT	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Normalization of the O2L integral regarding MAF_KGH					
C_MAF_THD_LDC_DLY	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
MAF threshold for limited dynamic check					
C_MAF_THD_MAX_DLY	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Upper MAF threshold for activation of the diagnosis					
C_MAF_THD_MIN_DLY	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Lower MAF threshold for activation of the diagnosis					
C_N_32_THD_LDC_DLY	-	0... FFH	0... 8160	32	rpm
N_32 threshold for limited dynamic check					
C_N_32_THD_MAX_DLY	-	0... FFH	0... 8160	32	rpm
Upper N_32 threshold for activation of the diagnosis					
C_N_32_THD_MIN_DLY	-	0... FFH	0... 8160	32	rpm
Lower N_32 threshold for activation of the diagnosis					
C_O2L_OUT_INT_DLY_DIAG_LSL_MAX	-	0... FFFFH	0... 20.93479	319.444e-6	g
Maximum O2 integral to stop the diagnosis earlier and set an error					
C_STATE_DIAG_DET_SEL_DYN	-	0... FFH	0... 255	1	-
Selection of the diagnosis method to set the error flag					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_FAC_LAM_SEL_DYN	-	0... FFH	0... 255	1	-
Selection of the diagnosed signal					
C_STATE_PLS_DET_SEL_DYN	-	0... FFH	0... 255	1	-
Selection of the activation window for the diagnosis regarding forced stimulation					
C_T_DLY_ACT_LAM_GAIN_ACT	-	0... FFFFH	0... 655.35	0.01	s
Maximum delay of activation of the diagnosis after switch to required lambda controller parameters					
C_T_DLY_ACT_LAM_GAIN_ACT_EOL	-	0... FFFFH	0... 655.35	0.01	s
Maximum delay of activation of the diagnosis after switch to required lambda controller parameters at EOL					
C_TQI_THD_LDC_DLY	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque threshold for limited dynamic check					
C_VS_THD_MIN_DLY	-	0... FFH	0... 255	1	km/h
Lower VS threshold for activation of the diagnosis					
IP_FAC_OPP_FAC_DLY_DIAG	V	0... FFFFH	0... 3.99993896484	61.0352e-6	-
LDP_MAF_KGH_IP_FAC_OPP_DLY_DIAG	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_N_IP_FAC_OPP_DLY_DIAG	6	0... 1FE0H	0... 8160	1	rpm
Correction factor depending on operating point					
LC_SWI_SIG_CLC_DIAG	-	0... 1H	0 ...1	1	-
Switch to the controller output signal for calculation of MIN/MAX and amplitude					

### General information:

This diagnosis is necessary to recognize delays (especially pure phase shift) of the linear lambda sensor accordingly to OBD requirements.

For the diagnosis the lambda controller output is used. The bigger the oscillations of the signal, bigger will be the diagnosis value.

The diagnosis is covering two concepts:

Evaluation of the integral of the controller output deviation, the integral is representing quasi oxygen loading of the catalyst, which is representing directly the emissions increasing

Evaluation of the absolute amplitude of the controller output

Choice between both these concepts can be done using the LC\_SWI\_SIG\_CLC\_DIAG.

Calculation of the O2L integral principle, evaluation of the diagnosed signal when the activation conditions are fulfilled:

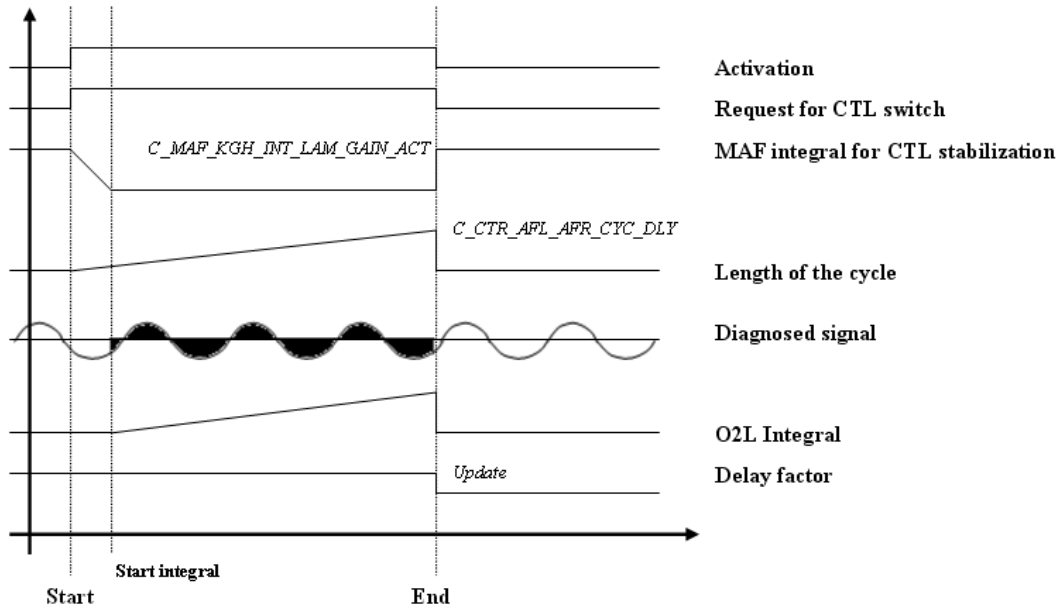


Figure B.22.1: :

Behavior of the single and mean value counters (the Y-axis is different for both counters):

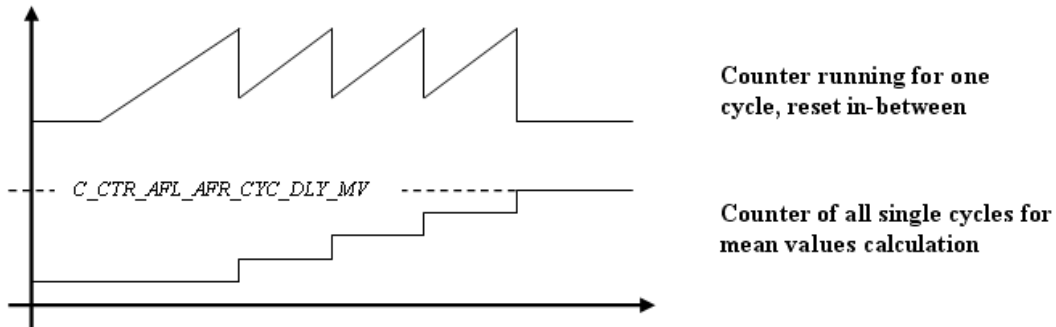


Figure B.22.2: :

Update of the values for calculation of the factor:

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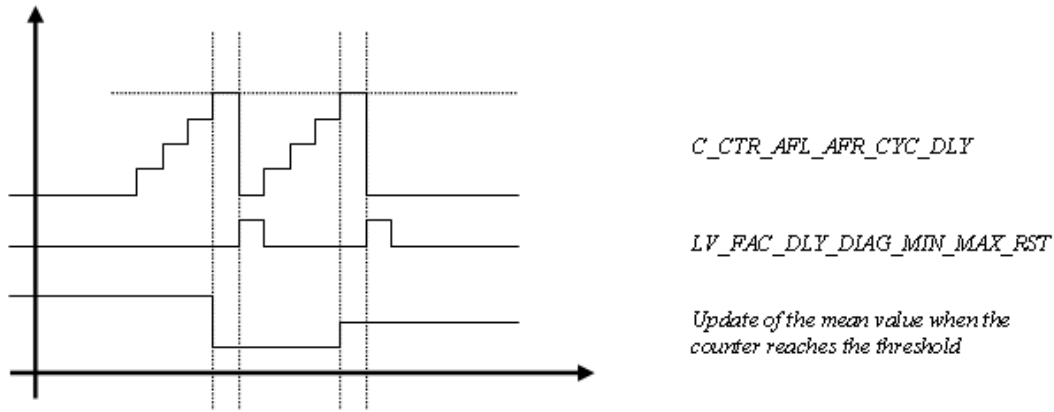


Figure B.22.3: :

Initialization of the MIN/MAX temporary values for both concepts:

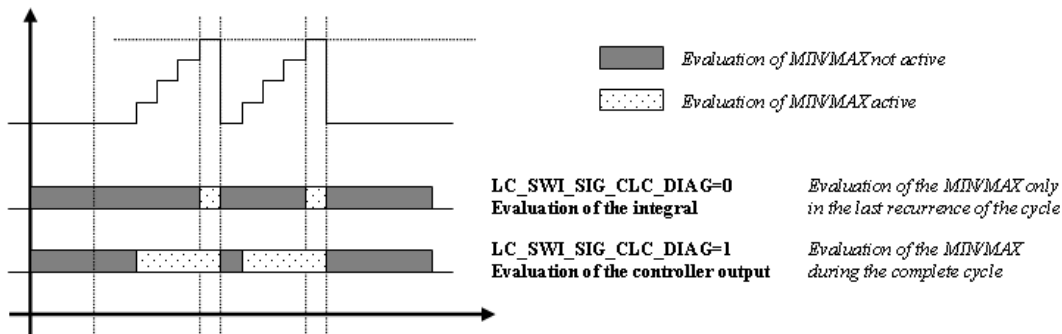


Figure B.22.4: :

**Application conditions:**

*Initialisation:* RST, CLRFRMY, IGKON  
*Recurrence:* 20MS  
*Activation:* always  
*Deactivation:* if activation not true

**Function description:**

**Formula section:**

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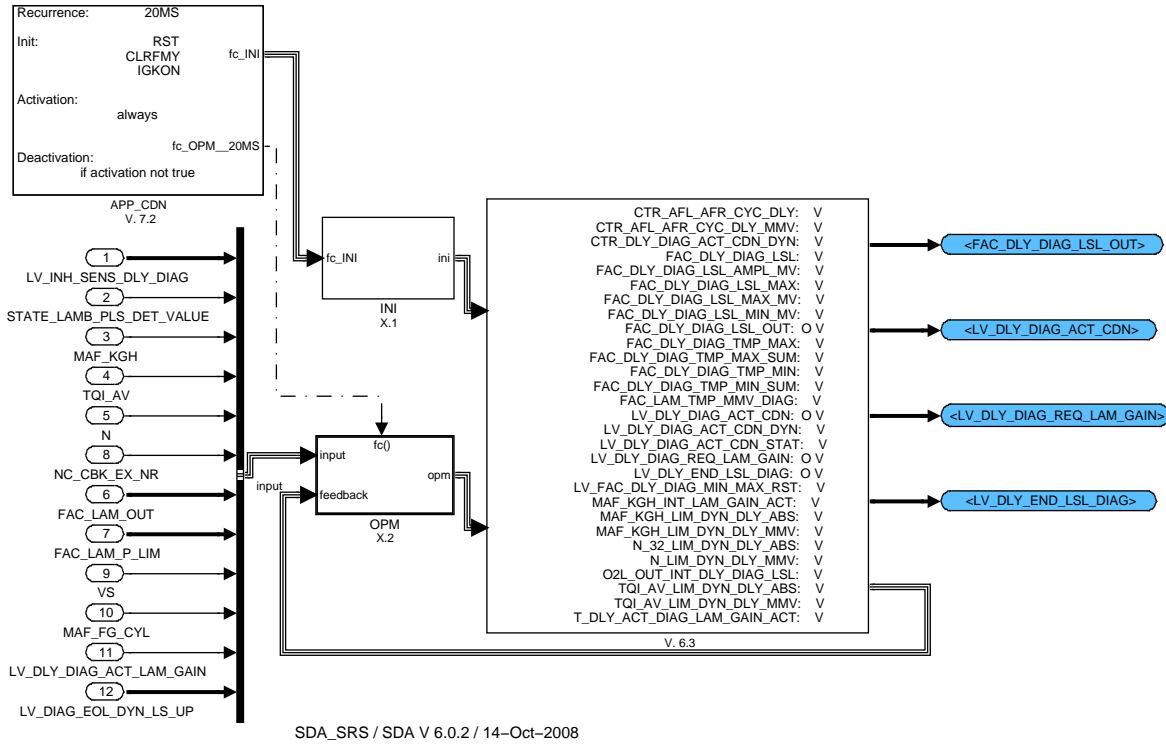


Figure B.22.5: :

### B.22.1 INITIALIZATION at RESET, IGKON and CLRFRMY

All variables are initialized by "0"

#### FUNCTION DESCRIPTION

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## B.22.2 Calculation of the activation conditions

### B.22.2.1 Calculation of the static conditions

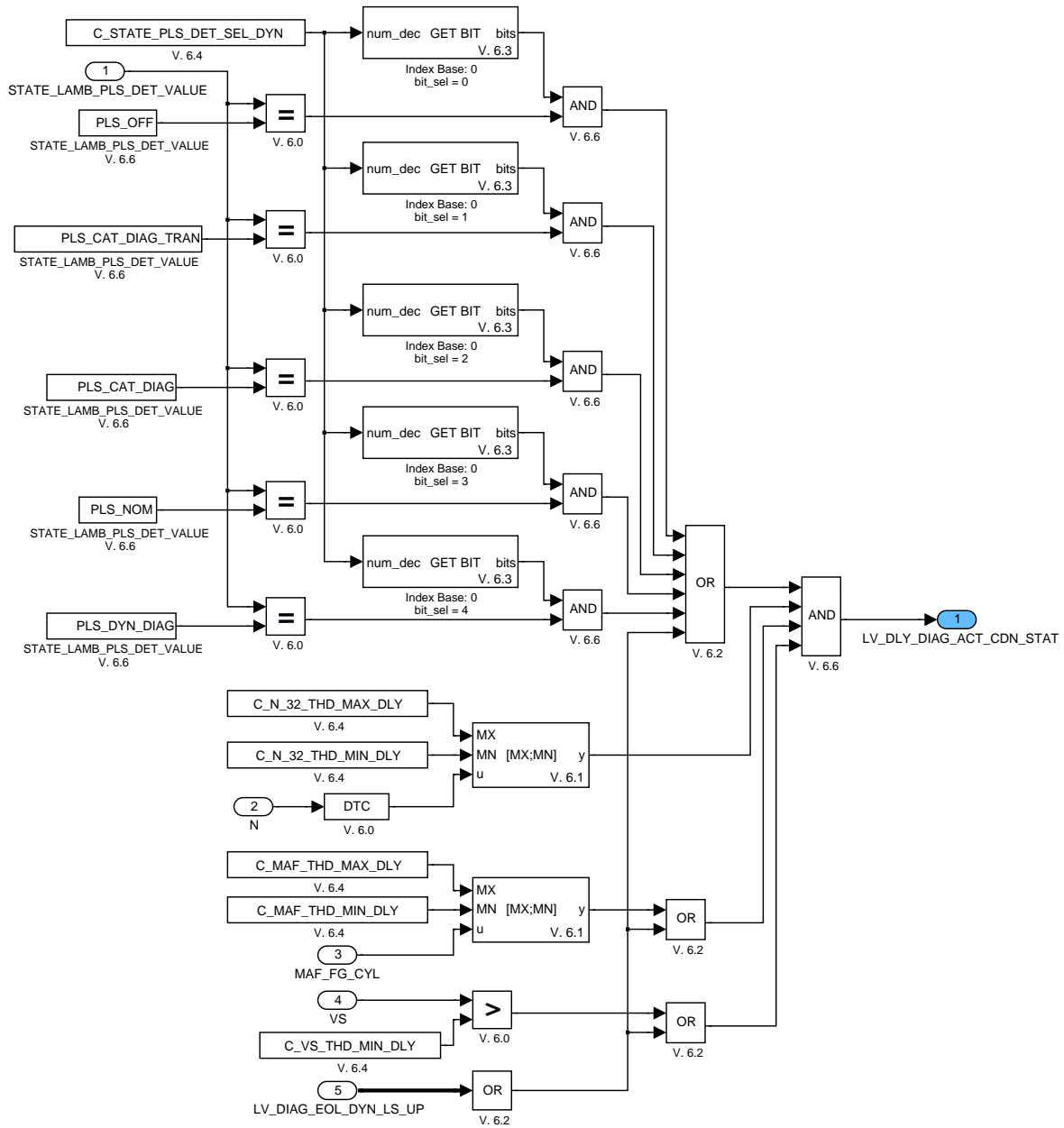


Figure B.22.6: :

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### B.22.2.2 Calculation of the dynamic conditions

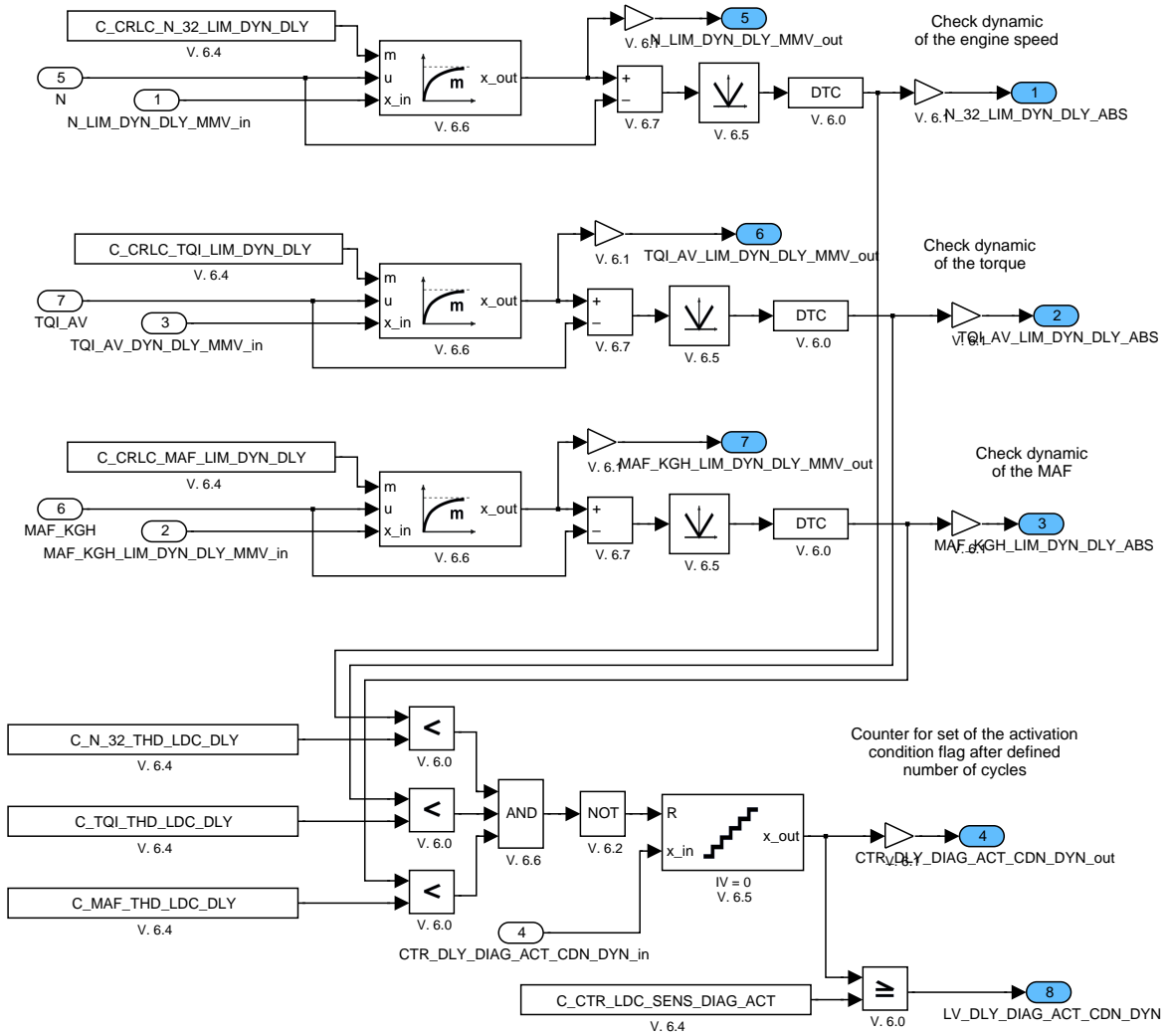


Figure B.22.7: :

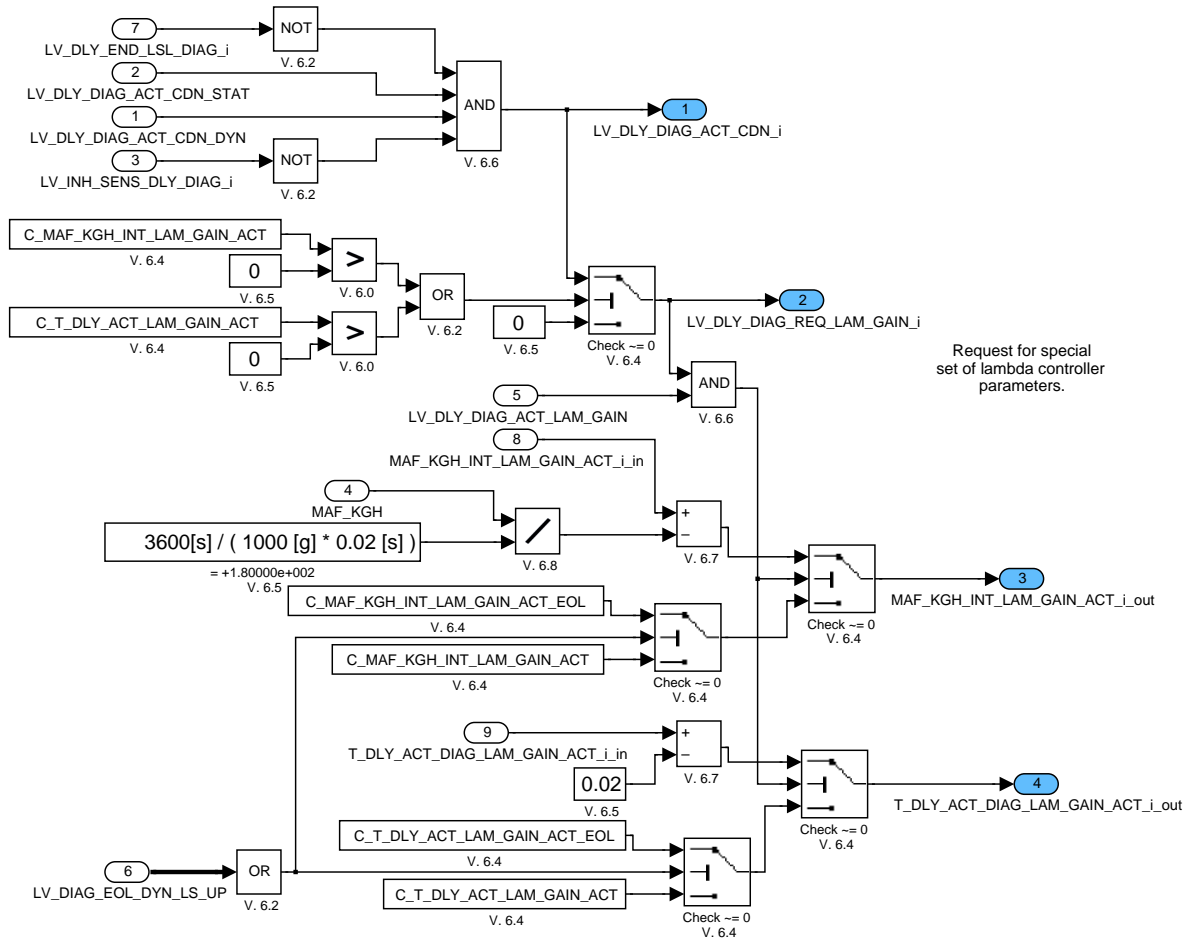
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### B.22.3 Introduction multiple bank system

#### B.22.3.1 Calculation of the diagnosis value

##### B.22.3.1.1 Calculation of the static and dynamic activation conditions

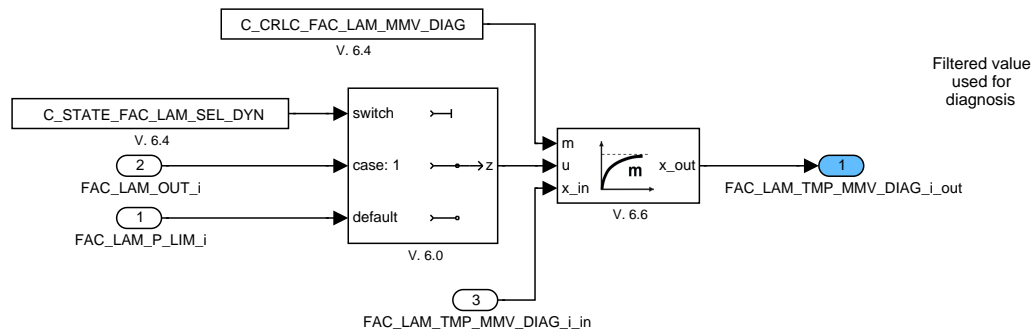
###### B.22.3.1.1.1 Check of the static and dynamic activation conditions



Request for special set of lambda controller parameters.

Figure B.22.8: :

##### B.22.3.1.2 Selection of the signal for the diagnosis



Filtered value used for diagnosis

Figure B.22.9: :

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### B.22.3.1.3 Check conditions for calculation of the diagnosis value

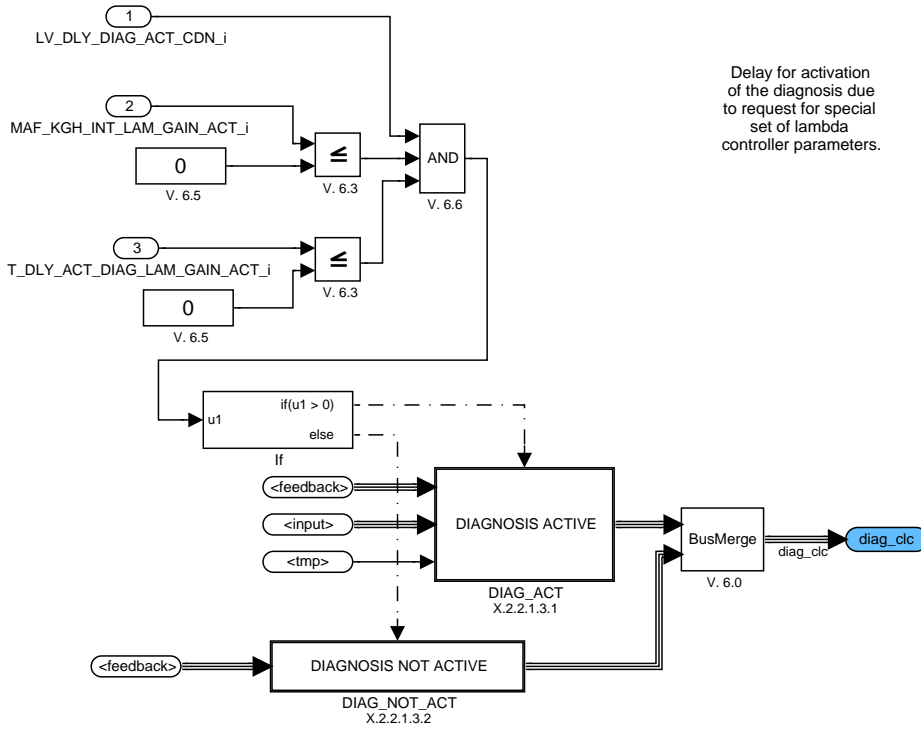


Figure B.22.10: :

#### B.22.3.1.3.1 DIAGNOSIS ACTIVE

##### B.22.3.1.3.1.1 Calculation of a counter of the single AFL/AFR cycles

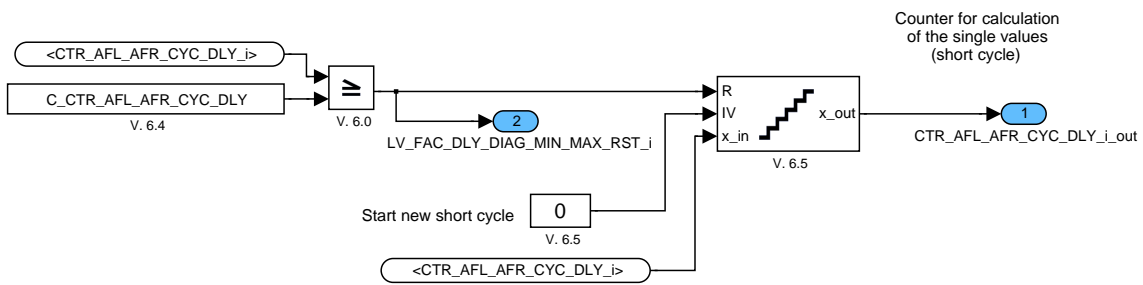


Figure B.22.11: :

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### B.22.3.1.3.1.2 Calculation of the O2 integrals and ratio

#### B.22.3.1.3.1.2.1 Calculation of the pre-controlled and real O2 integral

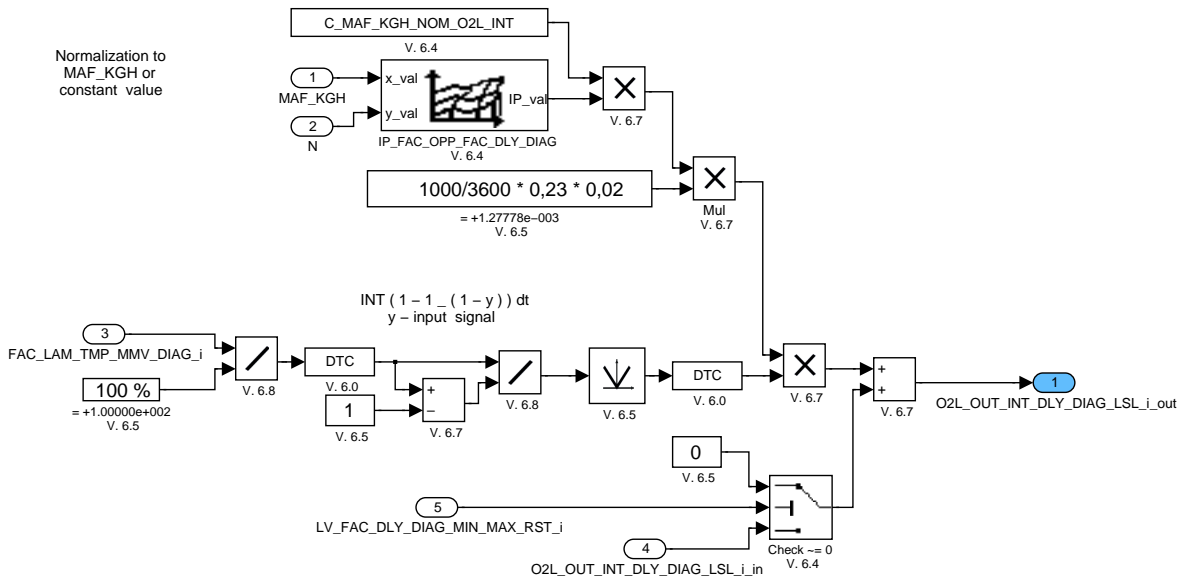


Figure B.22.12: :

#### B.22.3.1.3.1.2.2 Calculation of the ratio between pre-controlled and real O2 integrals

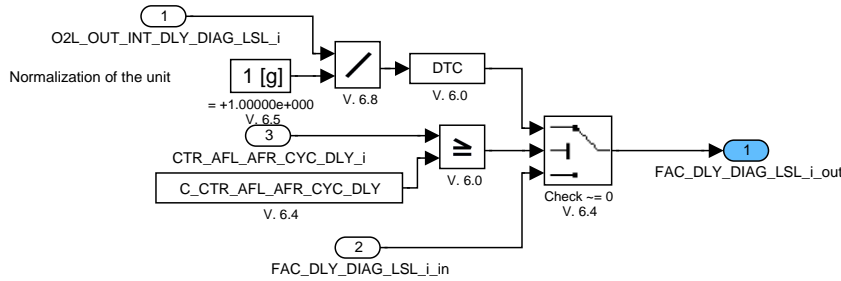


Figure B.22.13: :

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### B.22.3.1.3.1.3 Calculation of the minimum, maximum and amplitude of the diagnosed signal

#### B.22.3.1.3.1.3.1 Single minimum and maximum of defined number of cycles

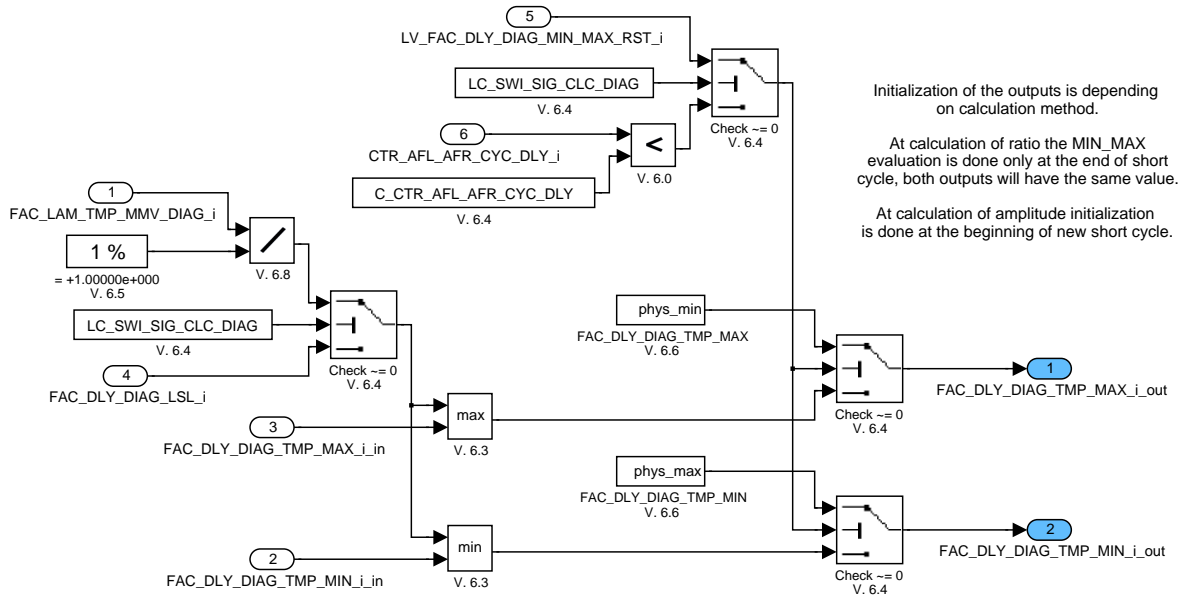


Figure B.22.14: :

#### B.22.3.1.3.1.3.2 Check counter for calculation of the mean values

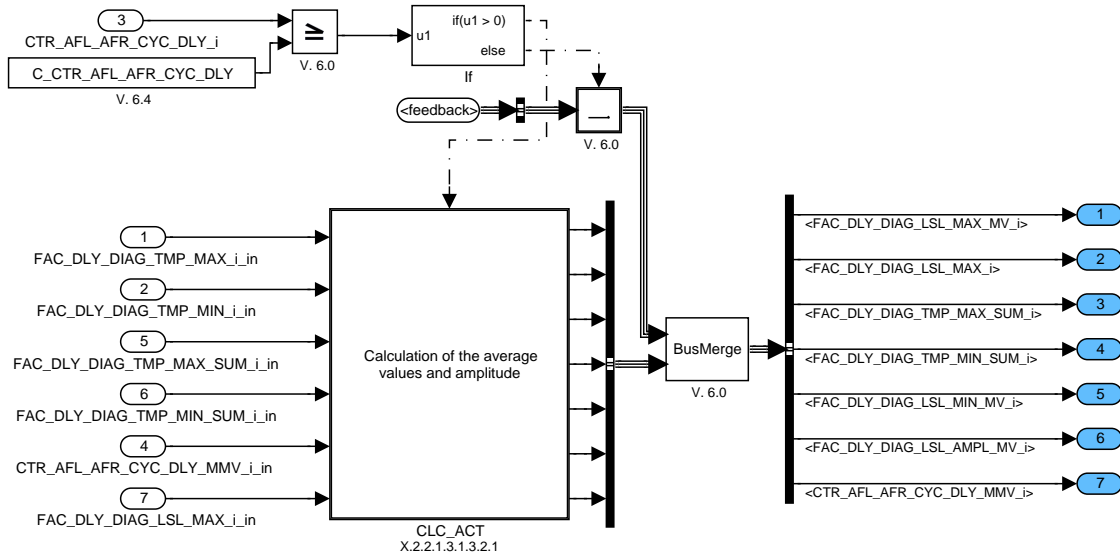


Figure B.22.15: :

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### B.22.3.1.3.1.3.2.1 Calculation of the mean values of minimum and maximum and calculation of the amplitude

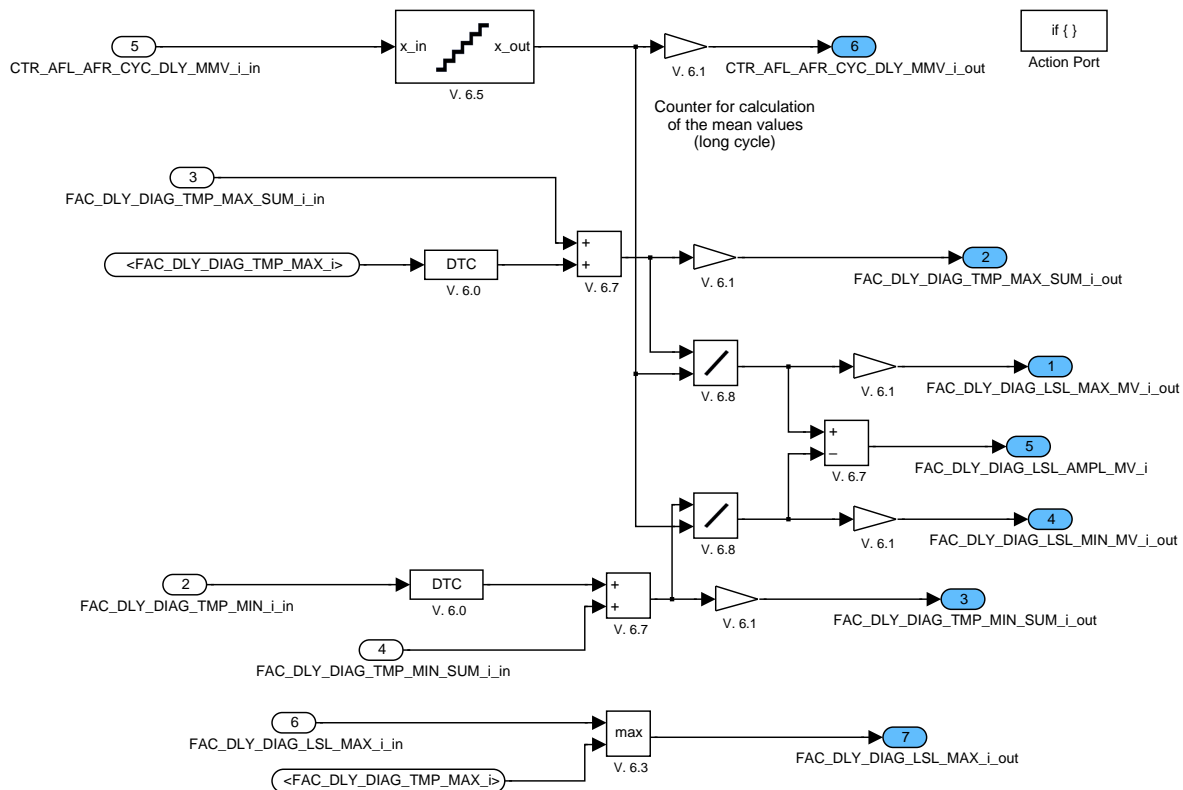


Figure B.22.16: :

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### B.22.3.1.3.1.4 Determination of the diagnosis value

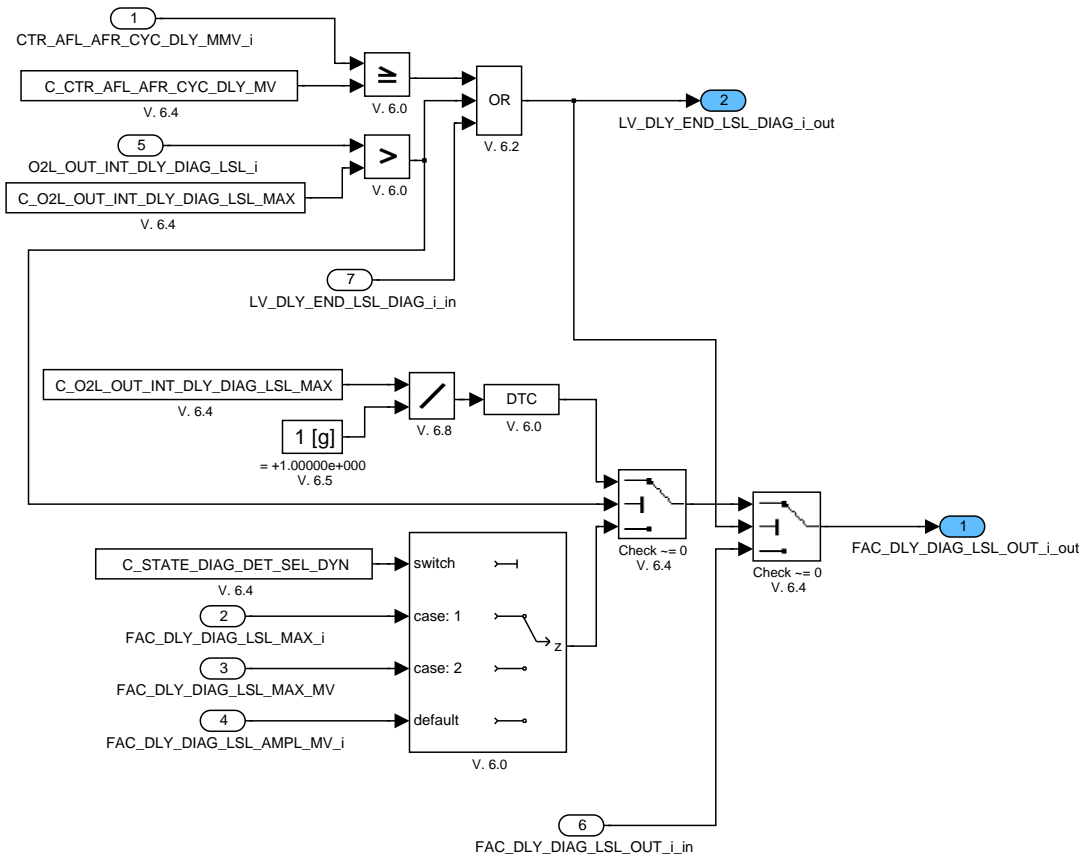


Figure B.22.17: :

### B.22.3.1.3.2 DIAGNOSIS NOT ACTIVE

#### B.22.3.1.3.2.1 Initialization and deactivation of the diagnosis

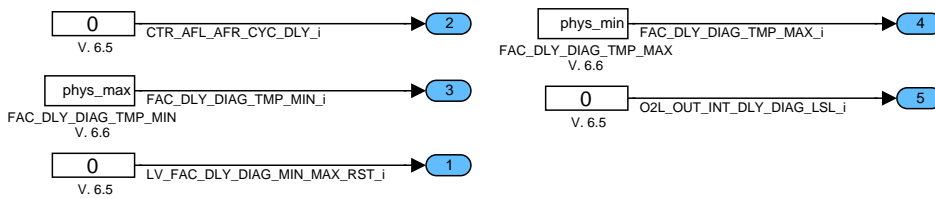


Figure B.22.18: :

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## B.23 O2 sensor (lin, up) heater coupling diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_LSH_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of "Diagnosis of the Heater Coupling in the Sensor Signal"					
LV_LSL_DIAG_LSH_LSL_UP_DEAC	O/V	0... 1H	0 ...1	1	-
Manual deactivation of "Diagnosis of the Heater Coupling in the Sensor Signal"					

### Input data:

LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}
LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}
LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}
LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5297}	LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}
LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VB_FB_0 {p. 802}	LV_ERR_VB_FB_1 {p. 802}	LV_ERR_VB_FB_2 {p. 802}
LV_ERR_VB_FB_3 {p. 802}	LV_ERR_VB_FB_INJ	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_VAR_VVL {p. 805}
NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_LSL_DIAG_LSH_LSL_UP_DEAC	-	0... 1H	0 ...1	1	-
Logical calibration data for manual deactivation of heater coupling diagnosis					

### Application conditions

**Recurrence:** 100 ms.

**Initialisation:** 0, at LV\_IGK = 0 to 1 or ECU-Reset:

**Activation:** LV\_ST\_END = 1

**Deactivation:** LV\_ST\_END = 0

### Description:

The function Diagnosis of the Heater Coupling in the Sensor Signal has to be deactivated, if at least one of the following errors /special modes

**Formula section:**

```

IF      LV_ERR_CHG_LS_UP = 1                OR
        LV_ERR_AIR_LSL_UP[i] = 1          OR
        LV_ERR_CTL_LSL_UP[i] = 1          OR
        LV_ERR_DELTA_I_LAM[i] = 1        OR
        LV_ERR_DYN_VLD_LS_UP[i] = 1      OR
        LV_ERR_EL_LSL_UP[i] = 1          OR
        LV_ERR_LSH_UP[i] = 1             OR
        LV_ERR_LSL_UP_IF[i] = 1         OR
        LV_ERR_OBD_VLD_LSH_UP[i] = 1    OR
        LV_ERR_OC_LSL_UP[i] = 1         OR
        LV_ERR_OFS_LSL_UP[i] = 1        OR
        LV_ERR_PUC_VLD_LS_UP[i] = 1     OR
        LV_ERR_SHIFT_AFL_LSL_UP[i] = 1  OR
        LV_ERR_SHIFT_AFR_LSL_UP[i] = 1  OR
        LV_ERR_VLS_DOWN_DIF[i] = 1     OR
(i = 1  AND
    [   LV_ERR_IV[0] = 1                OR
        LV_ERR_IV[2] = 1                OR
        LV_ERR_IV[4] = 1                OR
        LV_ERR_MIS[0] = 1               OR
        LV_ERR_MIS[2] = 1               OR
        LV_ERR_MIS[4] = 1
    ]) OR
(i = 2  AND
    [   LV_ERR_IV[1] = 1                OR
        LV_ERR_IV[3] = 1                OR
        LV_ERR_IV[5] = 1                OR
        LV_ERR_MIS[1] = 1               OR
        LV_ERR_MIS[3] = 1               OR
        LV_ERR_MIS[5] = 1
    ]) OR
(LV_VAR_VVL = 0 AND
LV_ERR_TTIP_MES_LSH_UP[i] = 1) OR //for MSD87_6

(LV_VAR_VVL = 1 AND
[LV_ERR_VB_FB_0 = 1
LV_ERR_VB_FB_1 = 1
LV_ERR_VB_FB_2 = 1
LV_ERR_VB_FB_3 = 1
LV_ERR_VB_FB_INJ = 1]) OR //for MSV90

```

**THEN**


LV\_INH\_DIAG\_LSH\_LSL\_UP[i] = 1

**ELSE**


LV\_INH\_DIAG\_LSH\_LSL\_UP[i] = 0

**ENDIF**

LV\_LSL\_DIAG\_LSH\_LSL\_UP\_DEAC = LC\_LSL\_DIAG\_LSH\_LSL\_UP\_DEAC

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Diagnosis	Symptom	Nr	P-Code/ Failure	P-Code/ Symptom	Hardware config	Recurrence	Failure class A/B
Diagnosis of the heater coupling in the sensor signal	<i>Symptom detected</i>	0	P0130 / P0150	P2231 / P2234	--		LAMP CARB_M
LSH_LSL_UP[i]							

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## B.24 O2 sensor (lin, up) heater coupling diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_SYM_DIAG_LSH_LSL_UP [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter of forced stimulation periods with a present symptom					
CYCNR_DIAG_LSH_LSL_UP [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter of forced stimulation periods investigated					
ERR_SYM_LSH_LSL_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom of the heater coupling diagnosis					
LAMB_DELTA_FALL [NC_CBK_EX_NR]	V	8000... 7FFFH	-2... 1.99993	61e-6	-
Variation of lambda value before and after lshpwm signal falling edge					
LAMB_DELTA_FALL_LPF [NC_CBK_EX_NR]	V	8000... 7FFFH	-2... 1.99993	61e-6	-
Mean value for heater coupling (falling edge)					
LAMB_DELTA_RISE [NC_CBK_EX_NR]	V	8000... 7FFFH	-2... 1.99993	61e-6	-
Variation of lambda value before and after lshpwm signal rising edge					
LAMB_DELTA_RISE_LPF [NC_CBK_EX_NR]	V	8000... 7FFFH	-2... 1.99993	61e-6	-
Mean value for heater coupling (rising edge)					
LAMB_SYN_LSHPWM_FALL [NC_CBK_EX_NR]	V	0... 7FFFH	0... 1.99993	61e-6	-
Lambda value acquired after lshpwm signal falling edge					
LAMB_SYN_LSHPWM_RISE [NC_CBK_EX_NR]	V	0... 7FFFH	0... 1.99993	61e-6	-
Lambda value acquired after lshpwm signal rising edge					
LV_CDN_DIAG_LSH_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Heater coupling diagnosis condition					
LV_END_DIAG_LSH_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating a valid diagnostic is available					
LV_ERR_LSH_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced heater coupling failure					
MAF_INT_DIAG_LSH_LSL_UP	V	0... FFFFH	0... 1820.41666	0.0277778	g
Integral of the air flow, for the activation of the heater coupling diagnosis					
T_DLY_TRIG_LSH_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 0.255	0.001	s
Time delay for acquisition of oxygen sensor signal and lambda model					

### Input data:

IP_LAMB_LS_UP {p. 2317}	LAMB_SP_DE_PLS {p. 2958}	LAMB_SP_FIL_DELTA_ FALL [NC_CBK_EX_NR] {p. 970}	LAMB_SP_FIL_DELTA_ RISE [NC_CBK_EX_NR] {p. 970}
LSHPWM_UP [NC_CBK_EX_NR] {p. 2385}	LV_IGK {p. 906}	LV_INH_DIAG_LSH_LSL_ UP [NC_CBK_EX_NR] {p. 5273}	LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}

LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}	LV_LDC_LAM_ADJ [NC_CBK_EX_NR] {p. 2613}	LV_LS_UP_READY [NC_CBK_EX_NR] {p. 2335}	LV_LSL_DIAG_LSH_LSL_ UP_DEAC {p. 5273}
LV_PUC {p. 1720}	MAF_KGH {p. 1195}	NC_CBK_EX_NR {p. 1829}	T_SUM_AFL_AFR_CYC [NC_CBK_EX_NR] {p. 2439}
TEG_DYN_LS_UP [NC_CBK_EX_NR] {p. 1008}	VLS_UP_DELTA_FALL [NC_CBK_EX_NR] {p. 970}	VLS_UP_DELTA_RISE [NC_CBK_EX_NR] {p. 970}	


**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_LPF_FALL_DIAG_LSH_LSL_UP	-	0... FFH	0... 0.99609	3.91e-3	-
Filter constant for Fall					
C_CRLC_LPF_RISE_DIAG_LSH_LSL_UP	-	0... FFH	0... 0.99609	3.91e-3	-
Filter constant for Rise					
C_CTR_SYM_DIAG_LSH_LSL_UP	-	0... FFH	0... 255	1	-
Limit value of the diagnosis results to diagnose the heater coupling					
C_CYCNR_MAX_DIAG_LSH_LSL_UP	-	0... FFH	0... 255	1	-
Quantity of valid diagnosis values in one function cycle					
C_LAMB_DELTA_LPF_THD	-	0... 7FFFH	0... 1.99993	61e-6	-
Threshold for the maximum transition of the sensor signal					
C_LAMB_SP_DE_DIAG_LSH_LSL_UP	-	0... 7FH	0... 0.12402	976.999e-6	-
Maximum value of the forced excitation amplitude to activate the diagnosis					
C_LSHPWM_MAX_DIAG_LSH_LSL_UP	-	0... FFH	0... 99.60937	0.390625	%
maximum heater PWM value allowed to carry out the heater coupling diagnosis					
C_LSHPWM_MIN_DIAG_LSH_LSL_UP	-	0... FFH	0... 99.60937	0.390625	%
minimum heater PWM value allowed to carry out the heater coupling diagnosis					
C_MAF_INT_DIAG_LSH_LSL_UP	-	0... FFFFH	0... 1820.41666	0.0277778	g
Threshold for the activation of the MAF-Integral					
C_T_AFL_AFR_DIAG_LSH_LSL_UP	-	0... FFFFH	0... 655.35	0.01	s
Threshold of the MAF-Integral to activate the heater-coupling diagnosis					
C_TEG_MIN_DIAG_LSH_LSL_UP	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Minimum value of the exhaust temperature to activate the function					
IP_T_DLY_TRIG_LSH_UP	-	0... FFH	0... 0.255	0.001	s
LDP_LSHPWM_UP_IP_T_DLY_ACQ_VLS	4	0... FFH	0... 99.60937	0.390625	%
Time delay to trigger oxygen sensor signal and lambda model					

**Error treatment:**

Diagnosis	Symptom	Nr	ABC type
Diagnosis of the heater coupling in the sensor signal LSH_LSL_UP[NC_CBK_EX_NR]	Heater Coupling Failure Symptom	0	NO

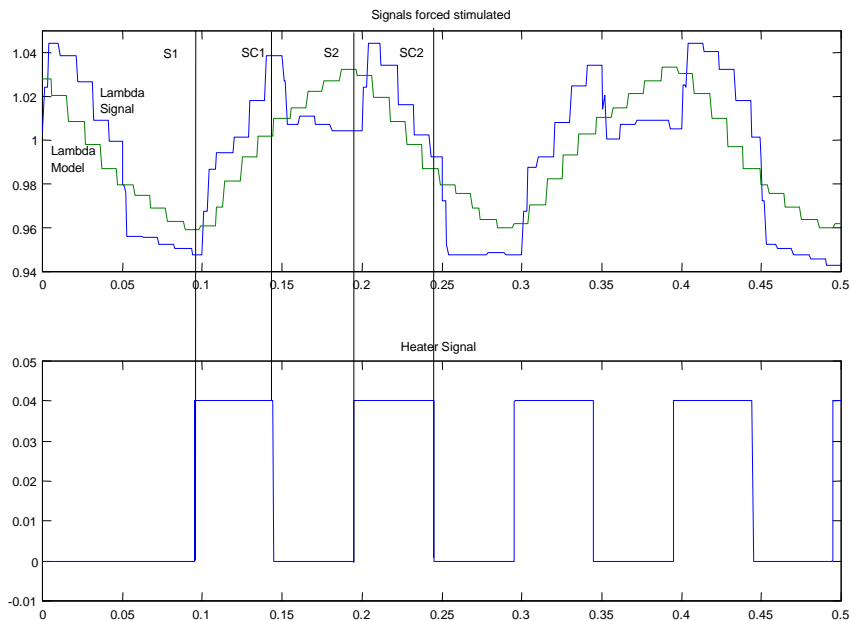
**FUNCTION DESCRIPTION:**

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## General information:

The diagnosis of heater coupling on the sensor signal shall detect an increase in the leakage current from heater to sensor circuit, which can be originated by the reduction of insulation resistance, and causes a crosstalk from the heater signal to the sensor circuit. Due to the heater coupling the measured signal of the wide range A/F sensor is perturbed and the lambda regulation influenced. The diagnosis criterion is the difference in the slope between measured sensor signal and model synchronised with the rising and falling edges of the heater PWM-signal. This is showed in the following picture, where a heater frequency of 10 Hz is admitted.

Sx ... sampling of the Lambda value  
SCx ... sampling of the Lambda value and handover from Basic software




The values  $LAMB\_SP\_FIL\_DELTA\_FALL[i]$ ,  $LAMB\_SP\_FIL\_DELTA\_RISE[i]$ ,  $VLS\_UP\_DELTA\_RISE[i]$  and  $VLS\_UP\_DELTA\_FALL[i]$  are delivered from the BASIC-Software and represent the lambda model and the oxygen sensor voltage values acquired synchronised with the rising and falling edges of the heater PWM-signal.

## Description:

At the beginning of every diagnosis period, the counter  $CTR\_SYM\_DIAG\_LSH\_LSL\_UP[i]$  and the cycle counter  $CYCNR\_DIAG\_LSH\_LSL\_UP[i]$  shall be initialised by 0.

After the hand over of  $VLS\_UP\_DELTA\_RISE[i]$ ,  $VLS\_UP\_DELTA\_FALL[i]$ ,  $LAMB\_SP\_FIL\_DELTA\_RISE[i]$  and  $LAMB\_SP\_FIL\_DELTA\_FALL[i]$  from the Basic-software (at the time SCx) this function has to start with the calculation of  $LAMB\_DELTA\_RISE/FALL[i]$ .

For a better separation of the forced stimulation and the heater coupling (the forced stimulation has the same symptom as the heater coupling), it is necessary to include the sensor signal model in the diagnosis calculation. This will be realised by a subtraction from the relative deviation of the sensor signal model ( $(?_{SC1} - ?_{S1})_{model}$ ) and the relative deviation of sensor signal ( $(?_{SC1} - ?_{S1})_{meas}$ ). This results gets absolute value. Then it will be filtered by a first order lag element (for mean value). This values will be named to  $LAMB\_DELTA\_RISE\_LPF[i]$  (calculated at time point S1 and SC1) and  $LAMB\_DELTA\_FALL\_LPF[i]$  ( $(?_{SC1} - ?_{S2})_{model} - (?_{SC1} - ?_{S2})_{meas}$ ).

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This values will be compared with the threshold C\_LAMB\_DELTA\_LPF\_THD. Is the calculated value higher than the threshold, the error-counter (CTR\_SYM\_DIAG\_LSH\_LSL\_UP[i]) will be incremented by 1.

After a resumption of the diagnosis it must be guaranteed that LAMB\_DELTA\_FALL\_LPF[i] contains a current value. If LAMB\_DELTA\_FALL\_LPF[i] and LAMB\_DELTA\_RISE\_LPF[i] are measured, then the cycle counter CYCNR\_DIAG\_LSH\_LSL\_UP[i] shall be incremented. If the necessary quantity of diagnosis for one cycle has been carried out, i.e. if  $CYCNR\_DIAG\_LSH\_LSL\_UP[i] > C\_CYCNR\_MAX\_DIAG\_LSH\_LSL\_UP$  is valid, the diagnosis result must be determined.

By the comparison of the diagnosis results to the limit value, the heater coupling is diagnosed, i.e. if  $CTR\_SYM\_DIAG\_LSH\_LSL\_UP[i] > C\_CTR\_SYM\_DIAG\_LSH\_LSL\_UP$  is true, a heater coupling (ERR\_SYM\_LSH\_LSL\_UP[i] = 1) is recognised. If no error is diagnosed, than ERR\_SYM\_LSH\_LSL\_UP[i] = 0 is valid. After the reaching of the required number of diagnosis steps C\_CYCNR\_MAX\_DIAG\_LSH\_LSL\_UP, a new diagnosis cycle is started.

If an error could be detected, then the error flag LV\_ERR\_LSH\_LSL\_UP[i] = 1 is set, otherwise LV\_ERR\_LSH\_LSL\_UP[i] is set to 0.

*Remark:* The range of lambda sensor heater duty cycle must be limited, through the sampling of the wide range A/F sensor signal with an period of 10 ms. A heater coupling recognition is possible only in a range of 15% up to 85% of the duty cycle.

At the function reactivation after LV\_PUC=1 the MAF-integral shall be calculated. If the MAF-integral exceeds a defined threshold the heater coupling diagnosis starts.

### **Application conditions:**

#### *Initialisation:*

At LV\_IGK = 0 to 1, reset or at clearing error memory:

```

CYCNR_DIAG_LSH_LSL_UP[i] = 0
CTR_SYM_DIAG_LSH_LSL_UP[i] = 0
MAF_INT_DIAG_LSH_LSL_UP = C_MAF_INT_DIAG_LSH_LSL_UP
LV_ERR_LSH_LSL_UP[i] = 0
LV_CDN_DIAG_LSH_LSL_UP[i] = 0
LV_END_DIAG_LSH_LSL_UP[i] = 0
ERR_SYM_LSH_LSL_UP[i] = NO SYMPTOM
LV_ERR_LSH_LSL_UP[i] = 0
LAMB_DELTA_RISE[i] = 0
LAMB_DELTA_FALL[i] = 0
LAMB_DELTA_RISE_LPF[i] = 0
LAMB_DELTA_FALL_LPF[i] = 0
LAMB_SYN_LSHPWM_RISE[i] = 0
LAMB_SYN_LSHPWM_FALL[i] = 0
T_DLY_TRIG_LSH_UP[i] = 0

```

*Recurrence:* 20 ms.

#### *Activation:*

**IF** LV\_PUC = 0


**AND** LV\_LSL\_DIAG\_LSH\_LSL\_UP\_DEAC = 0

**THEN**

**IF** MAF\_INT\_DIAG\_LSH\_LSL\_UP < C\_MAF\_INT\_DIAG\_LSH\_LSL\_UP **THEN**

calculate MAF-integral

**ELSE**

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```

IF LV_LAM_STOP[i]= 0           AND
    LV_LDC_LAM_ADJ[i] = 1           AND
    LV_LS_UP_READY[i] = 1           AND
    TEG_DYN_LS_UP[i] > C_TEG_MIN_DIAG_LSH_LSL_UP AND
    LV_INH_DIAG_LSH_LSL_UP[i] = 0   AND

    { (LAMB_SP_DE_PLS < C_LAMB_SP_DE_DIAG_LSH_LSL_UP &
      T_SUM_AFL_AFR_CYC[i] < C_T_AFL_AFR_DIAG_LSH_LSL_UP)
      OR
      LV_LAMB_PLS_ACT[i] = 0 }      AND

    C_LSHPWM_MIN_DIAG_LSH_LSL_UP LSHPWM_UP[i]
    C_LSHPWM_MAX_DIAG_LSH_LSL_UP
    THEN
    LV_CDN_DIAG_LSH_LSL_UP[i] = 1
    /activate function
ELSE
    LV_CDN_DIAG_LSH_LSL_UP[i] = 0
    /deactivate function
    LAMB_DELTA_RISE_LPF[i] = 0
    LAMB_DELTA_FALL_LPF[i] = 0
ENDIF
ENDIF
ELSE
    MAF_INT_DIAG_LSH_LSL_UP = 0
    LAMB_DELTA_RISE_LPF[i] = 0
    LAMB_DELTA_FALL_LPF[i] = 0
ENDIF

```

### Formula section:

#### 1. Calculation of the MAF-integral:

**Recurrence:** The MAF-Integral calculation shall be incremented every  $T\_SAMPLE = 100$  ms.

$$MAF\_INT\_DIAG\_LSH\_LSL\_UP_N = MAF\_INT\_DIAG\_LSH\_LSL\_UP_{N-1} + MAF\_KGH * T\_SAMPLE [ms] * 1/3600 [(g*h)/(kg*ms)]$$

#### 1. Monitoring the electrical coupling between heater PWM and sensor signal

**Recurrence:** Every time the BSW hands over new values, i.e. if one of the conditions below is true:

```

IF(1) LAMB_SP_FIL_DELTA_FALL[i]N ? LAMB_SP_FIL_DELTA_FALL[i]N-1
OR(1) VLS_UP_DELTA_FALL[i]N ? VLS_UP_DELTA_FALL[i]N-1
THEN(1)
increment CYCNR_DIAG_LSH_LSL_UP[i]

```


% Determination of the lambda value synchronized with the heater PWM

$$LAMB\_SYN\_LSHPWM\_RISE[i] = IP\_LAMB\_LS\_UP(VLS\_UP\_DELTA\_RISE[i])$$

$$LAMB\_SYN\_LSHPWM\_FALL[i] = IP\_LAMB\_LS\_UP(VLS\_UP\_DELTA\_FALL[i])$$

**Note:**

1) Before the determination of  $LAMB\_SYN\_LSHPWM\_RISE[i]$ , please adapt the resolution of  $VLS\_UP\_DELTA\_RISE[i]$  to the axis of  $IP\_LAMB\_LS\_UP$ . The analogous shall be done to  $LAMB\_SYN\_LSHPWM\_FALL[i]$ .

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2) The Map  $IP\_LAMB\_LS\_UP$  is used in other functions, i.e. any changes in this map will influence other functions.

3) At the first function call the values of  $LAMB\_DELTA\_RISE/FALL$  should not be calculated because at this time no old values (N-1) are available.

$$LAMB\_DELTA\_RISE[i]_N = (LAMB\_SP\_FIL\_DELTA\_FALL[i]_N - LAMB\_SP\_FIL\_DELTA\_RISE[i]_N) - (LAMB\_SYN\_LSHPWM\_FALL[i]_N - LAMB\_SYN\_LSHPWM\_RISE[i]_N)$$

$$LAMB\_DELTA\_FALL[i]_N = (LAMB\_SP\_FIL\_DELTA\_FALL[i]_{N-1} - LAMB\_SP\_FIL\_DELTA\_RISE[i]_N) - (LAMB\_SYN\_LSHPWM\_FALL[i]_{N-1} - LAMB\_SYN\_LSHPWM\_RISE[i]_N)$$

$$LAMB\_DELTA\_RISE\_LPF[i]_N = LAMB\_DELTA\_RISE\_LPF[i]_{N-1} + (LAMB\_DELTA\_RISE[i]_{N-1} - LAMB\_DELTA\_RISE\_LPF[i]_{N-1}) * C\_CRLC\_LPF\_RISE\_DIAG\_LSH\_LSL\_UP$$

$$LAMB\_DELTA\_FALL\_LPF[i]_N = LAMB\_DELTA\_FALL\_LPF[i]_{N-1} + (LAMB\_DELTA\_FALL[i]_N - LAMB\_DELTA\_FALL\_LPF[i]_{N-1}) * C\_CRLC\_LPF\_FALL\_DIAG\_LSH\_LSL\_UP$$

**IF**  $abs(LAMB\_DELTA\_RISE\_LPF[i])$  **OR**  $abs(LAMB\_DELTA\_FALL\_LPF[i]) > C\_LAMB\_DELTA\_LPF\_THD$

**THEN**

increment  $CTR\_SYM\_DIAG\_LSH\_LSL\_UP[i]$

**ENDIF**

**IF**  $CYCNR\_DIAG\_LSH\_LSL\_UP[i] > C\_CYCNR\_MAX\_DIAG\_LSH\_LSL\_UP$

**THEN**

**IF**  $CTR\_SYM\_DIAG\_LSH\_LSL\_UP[i] > C\_CTR\_SYM\_DIAG\_LSH\_LSL\_UP$

**THEN**

$ERR\_SYM\_LSH\_LSL\_UP[i] = Sym\_0$

$LV\_ERR\_LSH\_LSL\_UP[i] = 1$

$LV\_END\_DIAG\_LSH\_LSL\_UP[i] = 1$

**ELSE**

$ERR\_SYM\_LSH\_LSL\_UP[i] = NO\ SYMPTOM$

$LV\_END\_DIAG\_LSH\_LSL\_UP[i] = 1$

**ENDIF**

$CYCNR\_DIAG\_LSH\_LSL\_UP[i] = 0$

$CTR\_SYM\_DIAG\_LSH\_LSL\_UP[i] = 0$

**ENDIF**

% Adjusting the acquisition delay of sensor signal  $VLS\_UP[i]$  and the modeled sensor signal  
%  $LAMB\_SP\_FIL\_HOM[i]$

$T\_DLY\_TRIG\_LSH\_UP[i] = IP\_T\_DLY\_TRIG\_LSH\_UP(LSHPWM\_UP[i])$

**ENDIF(1)**

## B.25 O2 sensor (lin, up) not mounted diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_AIR_LSL_UP [NC_CBK_EX_NR]	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
diagnosis symptom of upstream sensor signal monitoring					
LV_CDN_DIAG_AIR_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0...1	1	-
Diagnosis condition					
LV_END_DIAG_AIR_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0...1	1	-
Result of diagnosis exist					
LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0...1	1	-
Debounced diagnosis result of upstream sensor signal monitoring					
T_END_DIAG_AIR_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer to have a diagnostic available					
T_SYM_DIAG_AIR_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer to debounce an error					

### Input data:

LV_DIAG_EOL_END_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_FL {p. 1759}	LV_IGK {p. 906}	LV_INH_DIAG_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5285}
LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}	LV_PL {p. 1720}	NC_CBK_EX_NR {p. 1829}	VLS_UP_DIAG [NC_CBK_EX_NR] {p. 2315}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_END_DIAG_AIR_LSL_UP	-	0... FFFFH	0... 6553.5	0.1	s
Time to have a diagnostic available					
C_T_SYM_DIAG_AIR_LSL_UP	-	0... FFFFH	0... 6553.5	0.1	s
Time filter to detect a symptom					
C_VLS_UP_DIAG_MAX_AIR_LSL_UP	-	8000... 7FFFH	-160... 159.99511	4.8828e-3	V
Upstream sensor signal max. threshold during engine operation (PUC excepted)					

### Error treatment:

Diagnostic XX	Symptom description	Symptom	Filter type
AIR_LSL_UP[NC_ CBK_EX_NR]	Sensor on air	SYM_0	NO

## FUNCTION DESCRIPTION:

### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

### Description:

This function shall detect a mechanically not attached sensor to the exhaust gas pipe. To do this the WRAF sensor output signal must be monitored during the engine operation, when power is generated. This shall be done by comparing the sensor signal VLS\_UP\_DIAG[i] with a threshold.

The function shall be activated during Partial Load or Full Load, if the sensor was recognised as operable, i.e. LV\_IPLSL\_VLD[i] = 1. A symptom shall be detected if the engine runs, i.e. it generates power, and at the same time the sensor signal is very high, indicating a very lean combustion mixture.

### Initialisation:

At LV\_IGK = 0 to 1, reset orat clearing error memory reset all variables.

### Recurrence:

The function shall be carried out every 100 ms.

### Activation:

```

IF
  LV_IPLSL_VLD[i] = 1
  (LV_PL = 1 OR LV_FL = 1)
  LV_INH_DIAG_AIR_LSL_UP[i] = 0
AND
AND
THEN
  LV_CDN_DIAG_AIR_LSL_UP[i] = 1
  /activate function
ELSE
  LV_CDN_DIAG_AIR_LSL_UP[i] = 0
  /deactivate function
ENDIF

```

### Formula section:

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```

IF VLS_UP_DIAG[i] > C_VLS_UP_DIAG_MAX_AIR_LSL_UP
THEN
    ERR_SYM_AIR_LSL_UP[i] = SYM_0
    IF T_SYM_DIAG_AIR_LSL_UP[i] > C_T_SYM_DIAG_AIR_LSL_UP
        THEN
            LV_ERR_AIR_LSL_UP[i] = 1
            LV_END_DIAG_AIR_LSL_UP[i] = 1
        ELSE
            Increment T_SYM_DIAG_AIR_LSL_UP[i]
        ENDIF
    ELSE
        ERR_SYM_AIR_LSL_UP[i] = NO_SYM
        T_SYM_DIAG_AIR_LSL_UP[i] = 0
    ENDIF


```

Minimum time to have a valid diagnostic available

```

IF(a) LV_END_DIAG_AIR_LSL_UP[i] = 0
THEN(a)
    IF(b) T_END_DIAG_AIR_LSL_UP[i] > C_T_END_DIAG_AIR_LSL_UP
        OR(b) LV_DIAG_EOL_END_LS_UP_DOWN[i] = 1
    THEN(b)
        LV_END_DIAG_AIR_LSL_UP[i] = 1
    ELSE(b)
        Increment T_END_DIAG_AIR_LSL_UP[i]
    ENDIF(b)
ENDIF(a)

```

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## B.26 O2 sensor (lin, up) not mounted diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_EOL_AIR_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation of short trip for upstream sensor signal monitoring					
LV_DIAG_EOL_AIR_LSL_UP_DC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical Value as reminder for End of Line test within this driving cycle					
LV_INH_DIAG_AIR_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of "Monitoring Upstream Sensor Signal "					
LV_INH_DIAG_RBM_AIR_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of Rate Based Monitoring of Monitoring Upstream Sensor Signal by malfunction					
STATE_RBM_AIR_LSL_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of AIR_LSL_UP [NC_CBK_EX_NR] monitor with the Rate-Based Monitoring statistics					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_CDN_VB_OBD2 {p. 1185}	LV_DC {p. 5746}	LV_END_DIAG_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}
LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAM_CST_IVVT_ EX [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAM_CST_IVVT_ IN [NC_NR_CBK_IVVT] {p. 1061}
LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_ UP [NC_CBK_EX_NR] {p. 5348}
LV_ERR_EL_CPS {p. 4708}	LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}
LV_ERR_FTL_MIN {p. 4762}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IVVT {p. 1062}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}
LV_ERR_LSH_LSL_UP [NC_CBK_EX_NR] {p. 5276}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}
LV_ERR_MAP_PLAUS {p. 1062}	LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_MEC_IVVT_EX {p. 1062}	LV_ERR_MEC_IVVT_IN {p. 1062}
LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}

LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_PUC_VLD_LSL_UP [NC_CBK_EX_NR] {p. 5297}
LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SLV_IVVT_EX {p. 4627}	LV_ERR_SLV_IVVT_IN {p. 4627}
LV_ERR_TPS {p. 4982}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}
LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}
LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VCV {p. 4729}	LV_HOM_ACT {p. 8136}
LV_IGK {p. 906}	LV_LS_UP_OBD_2_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}	LV_SCC [NC_CBK_EX_NR] {p. 2295}	NC_CBK_EX_NR {p. 1829}
NC_CYL_NR {p. 1526}	NC_NR_CBK_IVVT {p. 604}	STATE_ERR_IV {p. 4803}	

**Import actions:**

<b>ACTION_ERRM_CheckPendingStatus</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR_PND>)
--

**General information:**

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

**Application conditions**

**Initialisation:** at every transition LV\_IGK = 0->1or reset all variables shall be reset to 0.

at every transition LV\_IGK = 1->0

LV\_INH\_DIAG\_AIR\_LSL\_UP [NC\_CBK\_EX\_NR] = 1

**Recurrence:** *the functions shall be carried out once every 1s.*

**Activation:** LV\_IGK = 1

**Deactivation:** LV\_IGK = 0

**Formula section:**

This function has to be deactivated, if at least one of the following errors /special modes is active.


**IF**

- LV\_ERR\_AMP = 1
- LV\_ERR\_AMP\_PLAUS = 1
- LV\_ERR\_CHG\_LS\_UP = 1

**OR**

**OR**


**OR**

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```

• LV_ERR_DIAGCPS = 1          OR
• LV_ERR_EL_CPS = 1          OR
• LV_ERR_FTL_MIN = 1         OR
• LV_ERR_FUP = 1             OR
• LV_ERR_FUP_MFP_PLAUS = 1   OR
• LV_ERR_FUP_ORNG = 1        OR
• LV_ERR_FUP_ST = 1          OR
• LV_ERR_H_PRS_SYS = 1       OR
• LV_ERR_IVVT = 1            OR
• LV_ERR_LOAD_TPS_PLAUS = 1  OR
• LV_ERR_MAF = 1             OR
• LV_ERR_MAP_PLAUS = 1       OR
• LV_ERR_MAP_TPS_PLAUS = 1   OR
• LV_ERR_MTC_CTL_2 = 1       OR
• LV_ERR_MTC_CTL_3 = 1       OR
• LV_ERR_MTC_DR = 1          OR
• LV_ERR_TPS = 1             OR
• LV_ERR_VCV = 1             OR
• LV_ERR_CTL_LSL_UP[i] = 1   OR
• LV_ERR_DYN_VLD_LS_UP[i]= 1 OR
• LV_ERR_EL_LSL_UP[i]= 1     OR
• LV_ERR_FSD[i] = 1          OR
• LV_ERR_FSD_LAM_LIM[i] = 1  OR
• LV_ERR_LSH_LSL_UP[i] = 1   OR
• LV_ERR_LSH_UP[i]= 1        OR
• LV_ERR_LSL_UP_IF[i]= 1     OR
• LV_ERR_OBD_VLD_LSH_UP[i] = 1 OR
• LV_ERR_OC_LSL_UP[i]= 1     OR
• LV_ERR_OFS_LSL_UP[i] = 1   OR
• LV_ERR_PUC_VLD_LS_UP[i]= 1 OR
• LV_ERR_SHIFT_AFL_LSL_UP[i]= 1 OR
• LV_ERR_SHIFT_AFR_LSL_UP[i]= 1 OR
• LV_ERR_TTIP_MES_LSH_UP[i] = 1 OR
• (i = 1                      AND
    [ LV_ERR_IV[0]            OR
      LV_ERR_IV[2]            OR
      LV_ERR_IV[4]            OR
      LV_ERR_MIS[0]           OR
      LV_ERR_MIS[2]           OR
      LV_ERR_MIS[4]
    ]
  )
• (i = 2                      AND
    [ LV_ERR_IV[1]            OR
      LV_ERR_IV[3]            OR
      LV_ERR_IV[5]            OR
      LV_ERR_MIS[1]           OR
      LV_ERR_MIS[3]           OR
      LV_ERR_MIS[5]
    ]
  )
THEN LV_INH_DIAG_RBM_AIR_LSL_UP[i]= 1
ELSE LV_INH_DIAG_RBM_AIR_LSL_UP [i]= 0

```

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**ENDIF**

```

IF      LV_LS_UP_OBD_2_MAN_DEAC[i] = 1      OR
- LV_INH_DIAG_RBM_AIR_LSL_UP[i]= 1      OR
- LV_CDN_VB_OBD2 = 0      OR
- LV_SCC[NC_CBK_EX_NR] = 1      OR
- LV_HOM_ACT = 0
THEN    LV_INH_DIAG_AIR_LSL_UP[i]= 1
ELSE    LV_INH_DIAG_AIR_LSL_UP[i]= 0
ENDIF

```

**Data :**

Diagnosis	Symptom	Nr	P-Code/ Failure	P-Code/ Symptom	Hardware config	Recurrence	Failure class A/B
Monitoring upstream sensor	Sym_0	0	see table of failires	see table of failires	--		NO_LAMP CARB_M
AIR_LSL_UP[i]							

**B.26.1 Interface for Rate - Based - Monitoring AIR\_LSL\_UP[i]****FUNCTION DESCRIPTION:****General information:**

With this module the interface between the AIR\_LSL\_UP[i] monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_AIR\_LSL\_UP[i] data.

Within STATE\_RBM\_AIR\_LSL\_UP[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)

- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)  
( not valid for catalyst diagnosis )

**Application conditions****Initialisation:**

at ECU reset:

```

bit 0, bit 1 and bit 2 of STATE_RBM_AIR_LSL_UP[i] = 0
LV_DIAG_EOL_AIR_LSL_UP_DC[i] = 0

```

LV\_DC 0 1 transition:

```

bit 0 and bit 1 of STATE_RBM_AIR_LSL_UP[i] = 0
LV_DIAG_EOL_AIR_LSL_UP_DC[i] = 0

```

on failure memory reset:

```

bit 1 of STATE_RBM_STATE_RBM_AIR_LSL_UP[i] = 0
LV_DIAG_EOL_AIR_LSL_UP_DC[i] = 0


```

**Recurrence:**

1 s

**Activation:**

LV\_DC = 1

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**Formula section:**

*At LV\_DC 0 -> 1 transition*

bit 2 of STATE\_RBM\_AIR\_LSL\_UP[i] = 1

The pending status of the following failures has to be checked only once :

Dependence	Error			
	LV_ERR_AMP	LV_ERR_AMP_PLAUS	LV_ERR_CHG_L S_UP	LV_ERR_DIAGCPS
	LV_ERR_EL_CPS	LV_ERR_FTL_MIN	LV_ERR_FUP	LV_ERR_FUP_MFP _PLAUS
	LV_ERR_FUP_ ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_ SYS	LV_ERR_LOAD_TP S_PLAUS
	LV_ERR_MAF_F RQ_EL	LV_ERR_MAF_FRQ_GR D	LV_ERR_MAF_F RQ_RNG	LV_ERR_MAP_ PLAUS
	LV_ERR_MAP_TPS_ PLAUS	LV_ERR_MTC_CTL_ 2	LV_ERR_MTC_ CTL_3	LV_ERR_MTC_DR
	LV_ERR_TPS_1	LV_ERR_TPS_2	LV_ERR_TPS_AD	LV_ERR_TPS_AD_ BOL
	LV_ERR_TPS_ MAF_1	LV_ERR_TPS_MAF_2	LV_ERR_TPS_RATI O	LV_ERR_TPS_ST_C HK_2
	LV_ERR_VCV			
<b>NC_CBK_EX_N R</b>	LV_ERR_FSD[i]	LV_ERR_FSD_LAM_LIM [i]	LV_ERR_CTL_LSL_UP[i]	LV_ERR_DYN_VLD_LS _UP[i]
	LV_ERR_EL_LSL_UP[i]	LV_ERR_LSH_LSL_UP[i]	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]
	LV_ERR_OBD_VLD_LSH _UP[i]	LV_ERR_OC_LSL_UP[i]	LV_ERR_OFS_LSL_UP [i]	LV_ERR_PUC_VLD_LS _UP[i]
	LV_ERR_SHIFT_AFL_LS L_UP[i]	LV_ERR_SHIFT_AFR_L SL_UP[i]	LV_ERR_TTIP_MES_LS H_UP[i]	

Figure B.26.1: For x = 1 to NC\_NR\_CBK\_IVVT (= for any i // or)

<b>NC_NR_CBK_I VVT</b>	LV_ERR_CAM_CST_IVV T_EX[x]	LV_ERR_CAM_CST_IV VT_IN[x]	LV_ERR_MEC_IVVT_EX [x]	LV_ERR_MEC_IVVT_IN [x]
	LV_ERR_SLV_IVVT_EX[x]	LV_ERR_SLV_IVVT_IN[ x]		

Figure B.26.2: For i = 1

<b>NC_CYL_NR</b>	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	LV_ERR_MIS[0]
	LV_ERR_MIS[2]	LV_ERR_MIS[4]		

Figure B.26.3: For i = 2

<b>NC_CYL_NR</b>	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	LV_ERR_MIS[1]
	LV_ERR_MIS[3]	LV_ERR_MIS[5]		

**If(1)** { CPU optimization at LV\_DC 0 -> 1 transition }  
 CTR\_ERR\_DYN\_NR <> 0 { the dynamic failure memory isn't empty }

**Then(1)**

**While** bit 1 of STATE\_RBM\_AIR\_LSL\_UP[i] = 0 **do**

with each XX failure of the above list (depending on configuration, see below):

ACTION\_ERRM\_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

```

                If(2)          XX has a pending status
                Then(2)         bit 1 of STATE_RBM_AIR_LSL_UP[i] = 1
                Endif(2)
            Endwhile
Else(1)         { the dynamic failure memory is empty }      No action
Endif(1)

```

Every 1 s :

```

If          LV_DIAG_EOL_AIR_LSL_UP[i] = 1
Then       LV_DIAG_EOL_AIR_LSL_UP_DC[i] = 1
Endif

```

```

If          bit 0 of STATE_RBM_AIR_LSL_UP[i] = 0
Then
    If          LV_END_DIAG_AIR_LSL_UP[i] = 1                and
    LV_DIAG_EOL_AIR_LSL_UP_DC[i] = 0
    Then       bit 0 of STATE_RBM_AIR_LSL_UP[i] = 1
    Endif
Endif

```

```

If          bit 1 of STATE_RBM_AIR_LSL_UP[i] = 0
Then
    If          LV_INH_DIAG_RBM_AIR_LSL_UP[i] = 1
    Then       bit 1 of STATE_RBM_AIR_LSL_UP[i] = 1
    Endif
Endif

```

## B.26.2 Activation of short trip Monitoring AIR\_LSL\_UP[i]

### FUNCTION DESCRIPTION:

#### General information:

Not yet defined

#### Application conditions

**Initialisation:** LV\_DIAG\_EOL\_AIR\_LSL\_UP[i] = 0 (never changed)

## B.27 O2 sensor (lin, up) PUC plausibility diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_EOL_PUC_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation of short trip for Monitoring Upstream Sensor during PUC					
LV_INH_DIAG_PUC_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of "Monitoring Upstream Sensor Signal during PUC"					
LV_INH_DIAG_RBM_PUC_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of Monitoring Upstream Sensor Signal during PUC by other failures					
STATE_RBM_PUC_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of PUC_VLD_LS_UP[NC_CBK_EX_NR] monitor with the Rate-Based Monitoring statistics					

### Input data:

LV_END_DIAG_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5297}	LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}
LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_PLAUS {p. 1062}
LV_ERR_MAP_TPS_PLAUS {p. 1062}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}
LV_ERR_MTC_DR {p. 5002}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}
LV_ERR_TPS {p. 4982}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}
LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}
LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_VCV {p. 4729}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_IGK {p. 906}

LV_LS_UP_OBD_1_MAN_ DEAC [NC_CBK_EX_NR] {p. 5449}	LV_VB_CDN_OBD_2 {p. 1046}	NC_CBK_EX_NR {p. 1829}	
---	------------------------------	------------------------	--

**Import actions:**

<b>ACTION_ERRM_CheckPendingStatus</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR_PND>)
--

**General information:**

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

**Application conditions**

**Initialisation:** at every transition LV\_IGK = 0->1 or reset all variables shall be reset to 0.

at every transition LV\_IGK = 1->0

LV\_INH\_DIAG\_PUC\_LSL\_UP [NC\_CBK\_EX\_NR] = 1

**Recurrence:** the functions shall be carried out once every 100ms.

**Activation:** LV\_IGK = 1


**Deactivation:** LV\_IGK = 0

**Formula section:**

This function has to be deactivated, if at least one of the following errors /special modes is active.

**IF**

LV_ERR_CHG_LS_UP = 1	OR
LV_ERR_DIAGCPS = 1	OR
LV_ERR_EL_CPS = 1	OR
LV_ERR_FUP = 1	OR
LV_ERR_FUP_MFP_PLAUS = 1	OR
LV_ERR_FUP_ORNG = 1	OR
LV_ERR_FUP_ST = 1	OR
LV_ERR_H_PRS_SYS = 1	OR
LV_ERR_LOAD_TPS_PLAUS = 1	OR
LV_ERR_MAF = 1	OR
LV_ERR_MAP_PLAUS = 1	OR
LV_ERR_MAP_TPS_PLAUS = 1	OR
LV_ERR_MTC_CTL_2 = 1	OR
LV_ERR_MTC_CTL_3 = 1	OR
LV_ERR_MTC_DR = 1	OR
LV_ERR_TPS = 1	OR
LV_ERR_VCV = 1	OR

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```

LV_ERR_AIR_LSL_UP[i] = 1
LSL_UP[i] = 1
LV_ERR_DELTA_I_LAM[i] = 1
LV_ERR_DYN_VLD_LS_UP[i] = 1
LV_ERR_EL_LSL_UP[i] = 1
LV_ERR_LSH_UP[i] = 1
LV_ERR_LSL_UP_IF[i] = 1
LV_ERR_OFS_LSL_UP[i] = 1
LV_ERR_SHIFT_AFL_LSL_UP[i] = 1
LV_ERR_SHIFT_AFR_LSL_UP[i] = 1
LV_ERR_VLS_DOWN_DIF[i] = 1
(i = 1
    [ LV_ERR_IV[0]
    LV_ERR_IV[2]
    LV_ERR_IV[4]
    LV_ERR_MIS[0]
    LV_ERR_MIS[2]
    LV_ERR_MIS[4]
    ]
    )
(i = 2
    [ LV_ERR_IV[1]
    LV_ERR_IV[3]
    LV_ERR_IV[5]
    LV_ERR_MIS[1]
    LV_ERR_MIS[3]
    LV_ERR_MIS[5]
    ]
    )
THEN LV_INH_DIAG_RBM_PUC_LSL_UP[i] = 1
ELSE LV_INH_DIAG_RBM_PUC_LSL_UP[i] = 0
ENDIF

IF LV_LS_UP_OBD_2_MAN_DEAC[i] = 1
LV_CDN_VB_OBD2 = 0
LV_INH_DIAG_RBM_PUC_LSL_UP[i] = 1
OR
OR
OR

THEN LV_INH_DIAG_PUC_LSL_UP[i] = 1
ELSE LV_INH_DIAG_PUC_LSL_UP[i] = 0
ENDIF

```

## B.27.1 Activation of short trip for Monitoring Upstream Sensor during PUC


### FUNCTION DESCRIPTION:

#### General information:

Not yet defined

#### Application conditions

**Initialisation:** LV\_DIAG\_EOL\_PUC\_LSL\_UP[i] = 0 (*never changed*)

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Diagnosis	Symptom	Nr	P-Code/ Failure	P-Code/ Symptom	Hardware config	Recurrence	Failure class A/B
WRAF Sensor diagnosis during PUC	Sym_0	0	see table of failures	see table of failures	--		See Table of failure
PUC_VLD_LS_UP[i]							

### B.27.1.1 Interface for Rate - Based - Monitoring PUC\_VLD\_LS\_UP[i]

#### FUNCTION DESCRIPTION:

##### General information:

With this module the interface between the PUC\_VLD\_LS\_UP[i] monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_PUC\_VLD\_LS\_UP[i] data.

Within STATE\_RBM\_PUC\_VLD\_LS\_UP[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)  
( not valid for PUC\_VLD\_LS\_UP[i] diagnosis )

##### Application conditions

##### Initialisation:

at ECU reset:  
bit 0, bit 1 and bit 2 of STATE\_RBM\_PUC\_VLD\_LS\_UP[i] = 0  
LV\_DC 0 → 1 transition:  
bit 0 and bit 1 of STATE\_RBM\_PUC\_VLD\_LS\_UP[i] = 0  
on failure memory reset:  
bit 1 of STATE\_RBM\_PUC\_VLD\_LS\_UP[i] = 0

##### Recurrence:

1 s

##### Activation:

LV\_DC = 1

##### Formula section:

##### At LV\_DC 0 → 1 transition

bit 2 of STATE\_RBM\_PUC\_VLD\_LS\_UP[i] = 1

The pending status of the following failures has to be checked only once :

Dependence	Error			
	LV_ERR_CHG_LS_UP	LV_ERR_DIAGCPS	LV_ERR_EL_CPS	LV_ERR_FUP
	LV_ERR_FUP_MFP_PL AUS	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_SYS
	LV_ERR_LOAD_TPS_PL AUS	LV_ERR_MAP_PLAUS	LV_ERR_MAP_TPS_PLA US	LV_ERR_MTC_CTL_2
	LV_ERR_MTC_CTL_3	LV_ERR_MTC_DR	LV_ERR_TPS_1	LV_ERR_TPS_2
	LV_ERR_TPS_AD	LV_ERR_TPS_AD_BOL	LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2
	LV_ERR_TPS_RATIO	LV_ERR_TPS_ST_CHK_2	LV_ERR_VCV	
NC_CBK_EX_NR	LV_ERR_AIR_LSL_UP[i]	LV_ERR_CTL_LSL_UP[i]	LV_ERR_DELTA_I_LAM[i]	LV_ERR_DYN_VLD_LS UP[i]
	LV_ERR_EL_LSL_UP[i]	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]	LV_ERR_OFS_LSL_UP[i]
	LV_ERR_SHIFT_AFR_L SL_UP[i]	LV_ERR_SHIFT_AFL_LS L_UP[i]	LV_ERR_VLS_DOWN_D IF[i]	

Figure B.27.1: For k = 1 to NC\_MAF\_NR (= for any i // or)

NC_MAF_NR	LV_ERR_MAF_FRQ_EL[k]	LV_ERR_MAF_FRQ_GR D[k]	LV_ERR_MAF_FRQ_RN G[k]	
-----------	----------------------	---------------------------	---------------------------	--

Figure B.27.2: For NC\_CBK\_EX\_NR = i = 1

NC_CYL_NR	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	LV_ERR_MIS[0]
	LV_ERR_MIS[2]	LV_ERR_MIS[4]		

Figure B.27.3: For NC\_CBK\_EX\_NR = i = 2

NC_CYL_NR	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	LV_ERR_MIS[1]
	LV_ERR_MIS[3]	LV_ERR_MIS[5]		

**If(1)** { CPU optimization at LV\_DC 0 → 1 transition }  
 CTR\_ERR\_DYN\_NR <> 0 { the dynamic failure memory isn't empty }

**Then(1)**

**While** bit 1 of STATE\_RBM\_PUC\_VLD\_LS\_UP[i] = 0 **do**

with each XX failure of the above list (depending on configuration, see below):

ACTION\_ERRM\_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

**If(2)** XX has a pending status

**Then(2)** bit 1 of STATE\_RBM\_PUC\_VLD\_LS\_UP[i] = 1

**Endif(2)**

**Endwhile**

**Else(1)** { the dynamic failure memory is empty } No action

**Endif(1)**

**Every 1 s :**

**If** bit 0 of STATE\_RBM\_PUC\_VLD\_LS\_UP[i] = 0

**Then**

**If** LV\_END\_DIAG\_PUC\_VLD\_LS\_UP[i] = 1

**Then** bit 0 of STATE\_RBM\_PUC\_VLD\_LS\_UP[i] = 1

**Endif**

**Endif**

**If** bit 1 of STATE\_RBM\_PUC\_VLD\_LS\_UP[i] = 0


**Then**

**If** LV\_INH\_DIAG\_RBM\_PUC\_LSL\_UP[i] = 1

**Then** bit 1 of STATE\_RBM\_PUC\_VLD\_LS\_UP[i] = 1

**Endif**

**Endif**

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## B.28 O2 sensor (lin, up) PUC plausibility diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_PUC_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
symptom of signal plausibility from the upstream sensor during PUC					
LV_CDN_DIAG_PUC_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Diagnosis condition for error symptom of signal plausibility of upstream sensor during PUC					
LV_DIAG_CDN_PUC_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Diagnosis condition					
LV_DIAG_PUC_END_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Result of diagnosis exist					
LV_DIAG_PUC_SYM_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced failure symptom of the signal plausibility from the upstream sensor during PUC					
LV_END_DIAG_PUC_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End of diagnosis of signal plausibility from the upstream sensor during PUC					
LV_ERR_PUC_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced failure of the signal plausibility from the upstream sensor during PUC					
MAF_INT_PUC_ACT_OLD_DIAG_PUC	V	0... FFFFH	0... 2912.66666667	0.0444444	g
MAF integral during PUC from previous recurrence					
STATE_SYM_DIAG_PUC_LSL_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H	VLS_OK VLS_L VLS_H_OC VLS_AFS_OC	-	-
Symptom of the signal plausibility from the upstream sensor during PUC					
T_DIAG_END_PUC_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer to have a diagnostic available					
T_DIAG_SYM_PUC_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Symptom debouncer timer					
T_DLY_DIAG_PUC_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Delay Time to activate the diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_MAX_DIAG_END_PUC_LSL_UP	V	0... FFFFH	0... 6553.5	0.1	s
Time to set the end bit					
T_MAX_DIAG_SYM_PUC_LSL_UP	V	0... FFFFH	0... 6553.5	0.1	s
Symptom debouncer time					
T_MAX_DLY_DIAG_PUC_LSL_UP	V	0... FFFFH	0... 6553.5	0.1	s
Maximum delay time to activate the diagnosis					
VLS_UP_DIAG_SAVE_PUC_LSL_UP [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	-160... 159.995117188	4.88281e-3	V
Upstream sensor voltage - value used during the diagnosis and transmitted to the Scan Tool in mode06					

**Input data:**

LV_DIAG_EOL_PUC_LSL_UP [NC_CBK_EX_NR] {p. 5291}	LV_IGK {p. 906}	LV_INH_DIAG_PUC_LSL_UP [NC_CBK_EX_NR] {p. 5291}	LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}
LV_PUC {p. 1720}	MAF_INT_PUC_ACT {p. 2942}	NC_CBK_EX_NR {p. 1829}	NC_IDX_DIAG_PUC_VLD_ LS_UP [NC_CBK_EX_NR]
STATE_LSH_UP [NC_CBK_EX_NR] {p. 2385}	TEG_DYN_LS_UP [NC_CBK_EX_NR] {p. 1008}	VLS_UP_DIAG [NC_CBK_EX_NR] {p. 2315}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DIAG_END_EOL_PUC_LSL_UP	-	0... FFFFH	0... 6553.5	0.1	s
Time to have a diagnostic available (EOL test)					
C_T_DIAG_END_PUC_LSL_UP	-	0... FFFFH	0... 6553.5	0.1	s
Time to have a diagnostic available					
C_T_DIAG_SYM_EOL_PUC_LSL_UP	-	0... FFFFH	0... 6553.5	0.1	s
Time filter to detect a symptom (EOL test)					
C_T_DIAG_SYM_PUC_LSL_UP	-	0... FFFFH	0... 6553.5	0.1	s
Time filter to detect a symptom					
C_T_DLY_DIAG_EOL_PUC_LSL_UP	-	0... FFFFH	0... 6553.5	0.1	s
Waiting time after beginning of PUC to test sensor signal (EOL test)					
C_T_DLY_DIAG_PUC_LSL_UP	-	0... FFFFH	0... 6553.5	0.1	s
Waiting time after beginning of PUC to test sensor signal					
C_TEG_MIN_DIAG_PUC_LSL_UP	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Minimum admissible exhaust gas temperature in PUC					
C_VLS_UP_DIAG_AFS_PUC_LSL_UP	-	8000... 7FFFH	-160... 159.995117188	4.88281e-3	V
Upstream sensor output voltage in PUC corresponding to Open Circuit on WRAF Sensor					
C_VLS_UP_DIAG_MAX_PUC_LSL_UP	-	8000... 7FFFH	-160... 159.995117188	4.88281e-3	V
Upstream sensor output voltage in PUC corresponding to Open Circuit on WRAF Sensor					
C_VLS_UP_DIAG_MIN_PUC_LSL_UP	-	8000... 7FFFH	-160... 159.995117188	4.88281e-3	V
Minimum admissible upstream sensor output voltage in PUC					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

### Import actions:

<b>ACTION_ERRM_NoFilterReset</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_NoFilterSymptom</b> (IN<PRM_IDX_DIAG>, IN<PRM_LV_CDN_DIAG>, IN<PRM_ERR_SYM>, IN<PRM_LV_ERR_SET>, IN<PRM_LV_ERR_RST>, IN<PRM_LV_END_DIAG>, OUT<PRM_LV_ERR>)

### General information:

#### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

#### Description:


This function shall test the plausibility of the upstream sensor signal during the Pull Fuel Cut-off phase (PUC).

Three symptoms are distinguished:

VLS\_H\_OC indicates too high sensor voltage due to open circuit on sensor pin VRC (compensative resistance)

VLS\_AFS\_OC indicates very low sensor voltage near offset value of measurement circuit. The reason for a voltage drop down to offset value is either a open circuit on sensor pin VIP or VG.

VLS\_L indicates that voltage is too low, but still above offset value. The reason for such a voltage drop may be poisoning or ageing of the lambda sensor.

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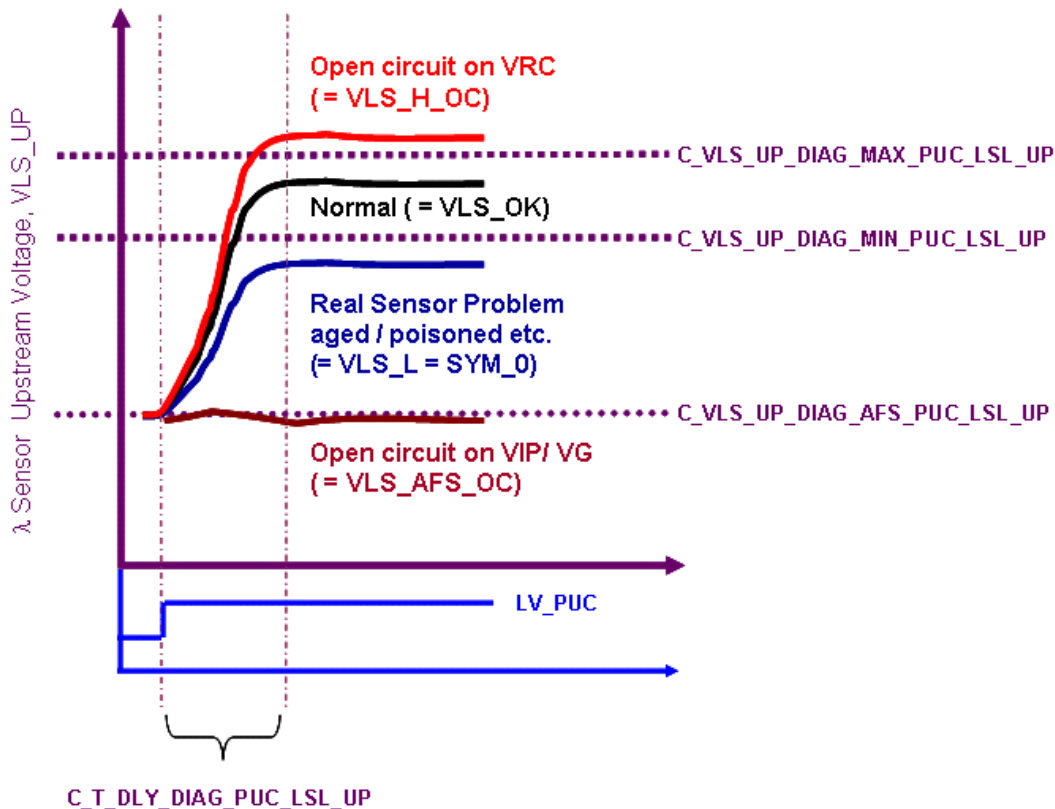


Figure B.28.1: :

If an open circuit of one of the sensor pins is detected (VLS\_H\_OC or VLS\_AFS\_OC), this information is not sent directly to the error management. Instead of this, the information is sent to the function "O2 sensor (lin) open circuit diagnosis" (A0J0). In this function the results of several diagnoses are collected and a clear identification of the open pin is done (pin-pointing). The communication to error management is done by the function "O2 sensor (lin) open circuit diagnosis in this case.

In case of detected failure VLS\_L the information is transferred directly to the error management.

The variable VLS\_UP\_DIAG\_SAVE\_PUC\_LSL\_UP[i] contains the sensor voltage at the moment a failure is detected. It retains its value until an updated one is present. It is reset only in case the Error Management memory is deleted.

### Application conditions:

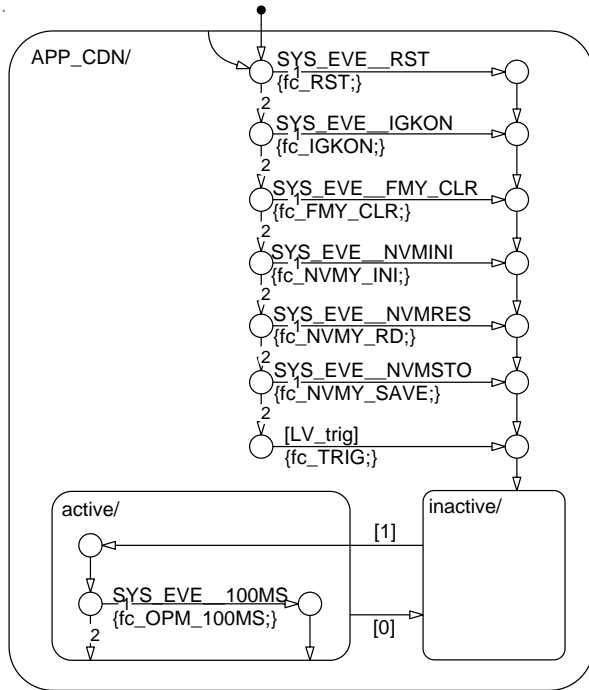



Figure B.28.2: :

**Function description:**

**Formula section:**

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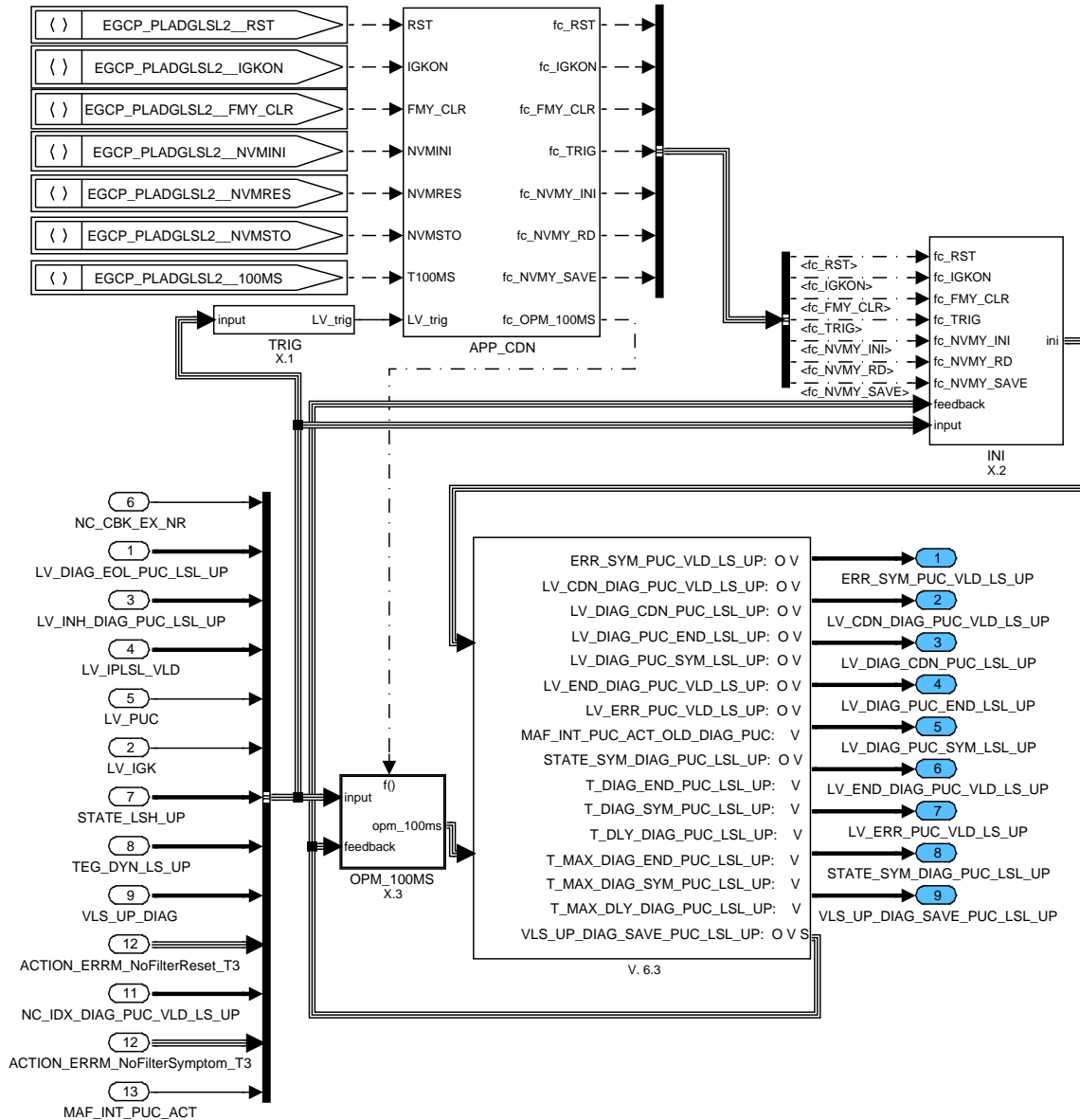


Figure B.28.3: :

## B.28.1 Subsystem TRIG: Calculation of special initialization condition

In the subsystem TRIG a trigger (LV\_trig) for variable initialisation is calculated, which is not supported by standard function calls.

### B.28.1.1 Calculation of special initialisation condition:

New Initialization of variables shall take place in case of LV\_DIAG\_EOL\_PUC\_LSL\_UP 0->1.

The toggling of this variable indicates the beginning of an End-of-line (EOL) test.

The output variable LV\_trig is an additional input for the Application conditions (APP\_CDN) next to the standard function calls which are provided by the SW-system environment.

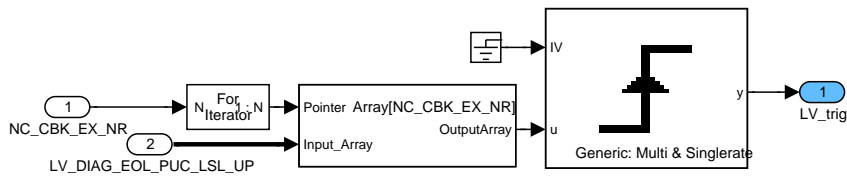


Figure B.28.4: :

## B.28.2 INITIALIZATION: Initialization of normal and non-volatile memory variables

Initialization of (normal) variables, non-volatile memory variables and variables that are directly linked to error manager is described.

Initialization of variables takes place at LV\_IGK = 0 to 1, reset, LV\_DIAG\_EOL\_PUC\_LSL = 0 to 1 (LV\_trig) and at clearing error memory.

The variables saved in the non-volatile memory are reset only in case the error memory is cleared.

Variables that are directly linked with the Error manager are initialized according to related error manager routines (ACTION\_ERRM).

### B.28.2.1 Initialization at RESET

All "normal" variables are initialized with "0"

The ERRM variables are initialized accordingly to filter type

### B.28.2.2 Handling NVMY data

#### B.28.2.2.1 Initialization of NVMY data

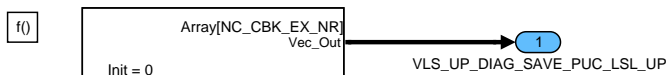


Figure B.28.5: :

## B.28.3 Formula section of PUC plausibility diagnosis

### B.28.3.1 Introduction multiple bank system

#### B.28.3.1.1 Check of activation conditions and main calculations

##### B.28.3.1.1.1 Calculation of activation (condition) flag for the diagnosis

The diagnosis is activated, if fuel cut off is indicated, sensor is active, exhaust gas temperature is below threshold, tip temperature of lambda sensor is controlled and no project specific inhibitions are active.

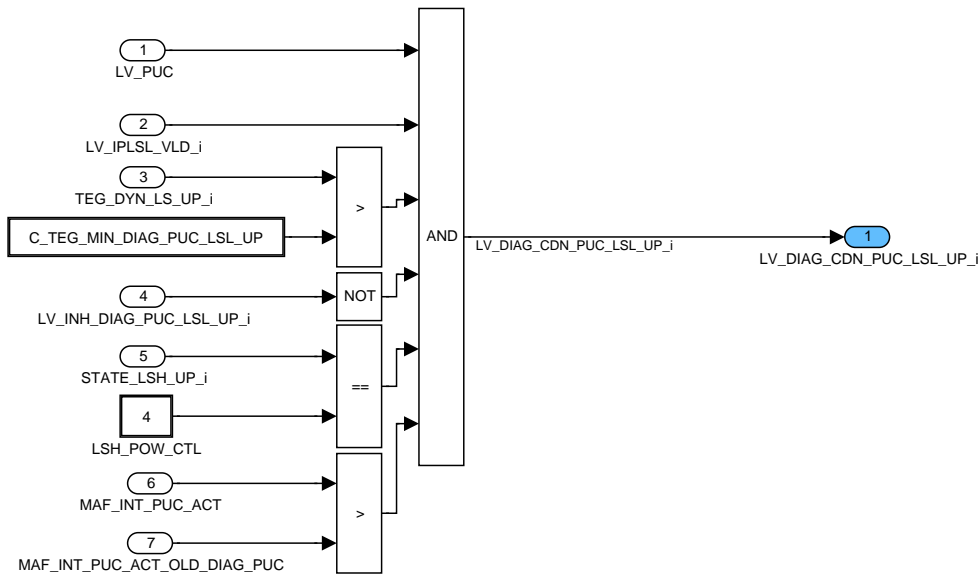


Figure B.28.6: :

### B.28.3.1.1.2 Check of the activation conditions for diagnosis

ACT: the LV\_DIAG\_CDN\_PUC\_LSL\_UP is true

DEAC: the LV\_DIAG\_CDN\_PUC\_LSL\_UP is false

The calculation at ACT and DEAC are specified in next figures

#### B.28.3.1.1.2.1 ACT: activation condition for diagnosis true

Content:

Initialization of delay timers

##### B.28.3.1.1.2.1.1 Calculation of maximal thresholds for delay timers

The bit LV\_DIAG\_EOL\_PUC\_LSL\_UP indicates, that End-of-line test (EOL) is active. The function gives the possibility to use different calibration data for standard case and EOL. This may become necessary, if only very short PUC-phases are available during EOL.



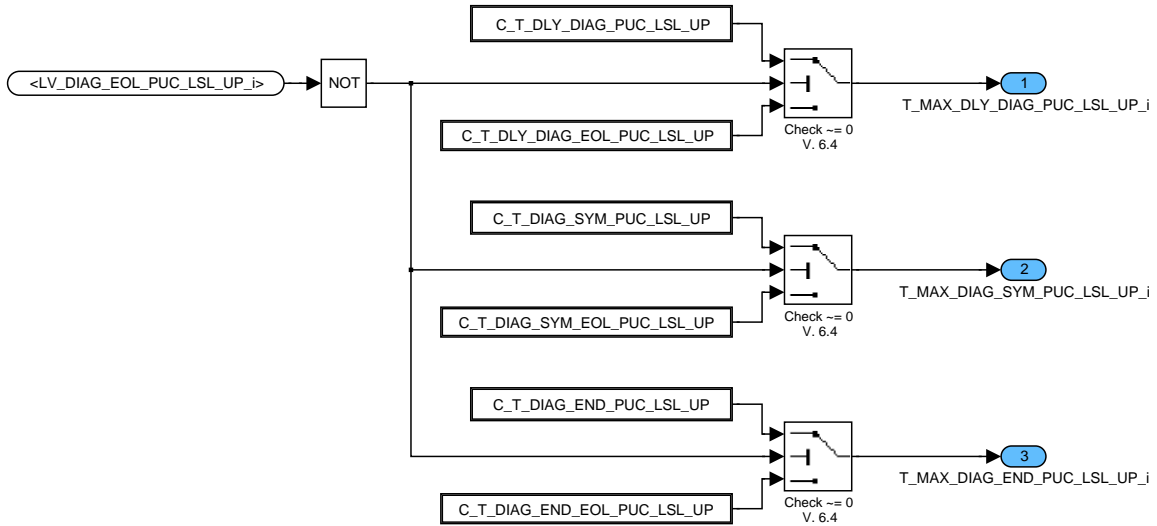


Figure B.28.7: :

**B.28.3.1.1.2.1.2 Start and check of delay timer, initialization of diagnosis (DIAG)**

As soon as activation conditions for diagnosis are fulfilled, the delay-timer `T_DLY_DIAG_PUC_LSL_UP` is started.

If the delay timer has exceeded, the calculations for the diagnosis are triggered.

DIAG: calculation of diagnosis result

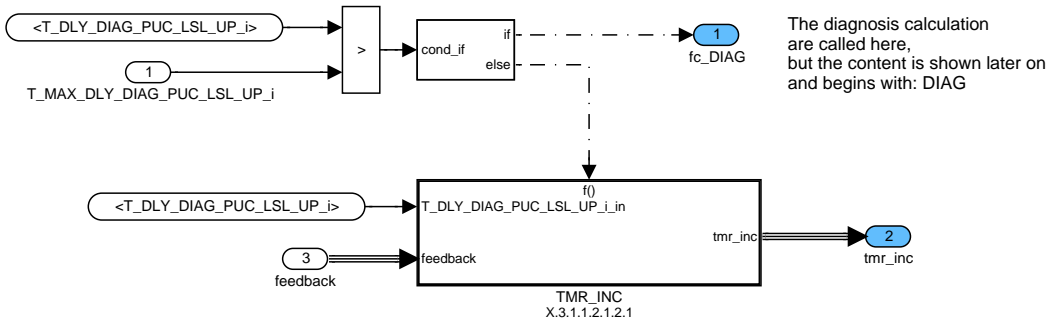


Figure B.28.8: :

**B.28.3.1.1.2.1.2.1 Condition false**

**B.28.3.1.1.2.1.2.1.1 Increment of delay timer**

As long as delay timer is below calibrated threshold, increment of timer takes place. The bit `LV_CDN_DIAG_PUC_VLD_LSL_UP` is set to 0 and inhibits the start of diagnosis.

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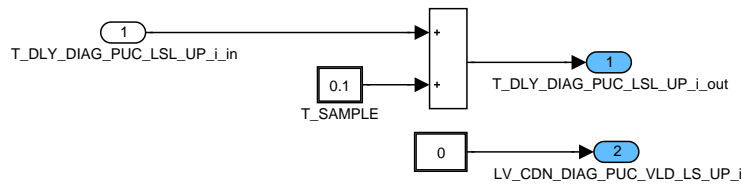


Figure B.28.9: :

### B.28.3.1.1.2.2 DEAC: activation condition for diagnosis false

#### B.28.3.1.1.2.2.1 Deactivate diagnosis

If the activation conditions for the diagnosis are not fulfilled, both condition-bits are reset.

If an symptom has been already detected and de-bounced, STATE\_SYM\_DIAG\_PUC\_LSL\_UP is frozen to actual value.

Otherwise STATE\_SYM\_DIAG\_PUC\_LSL\_UP is set to "VLS\_OK"

(for the cases : 1) Symptom has never been indicated. 2) symptom is indicated, but de-bounce has not yet been completed, because interrupt by revoke of activation conditions took place)

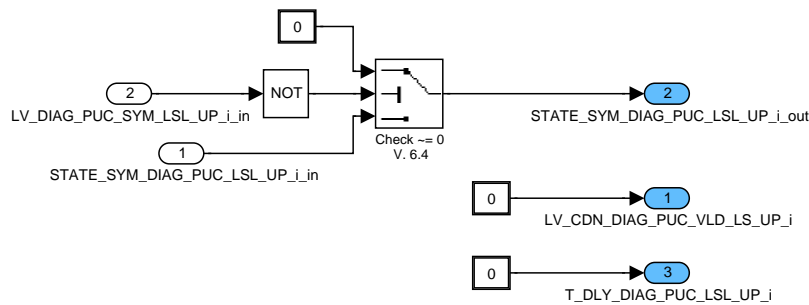


Figure B.28.10: :

### B.28.3.1.1.3 DIAG: calculation of diagnosis result

If activation conditions are fulfilled, and the delay timer has passed, the calculations for the PUC plausibility diagnosis take place.

The principal of diagnosis is shown in the signal flow diagram below.

Please note that the diagram gives only an overview about the signal flow. Not all calculations are included in the diagram !

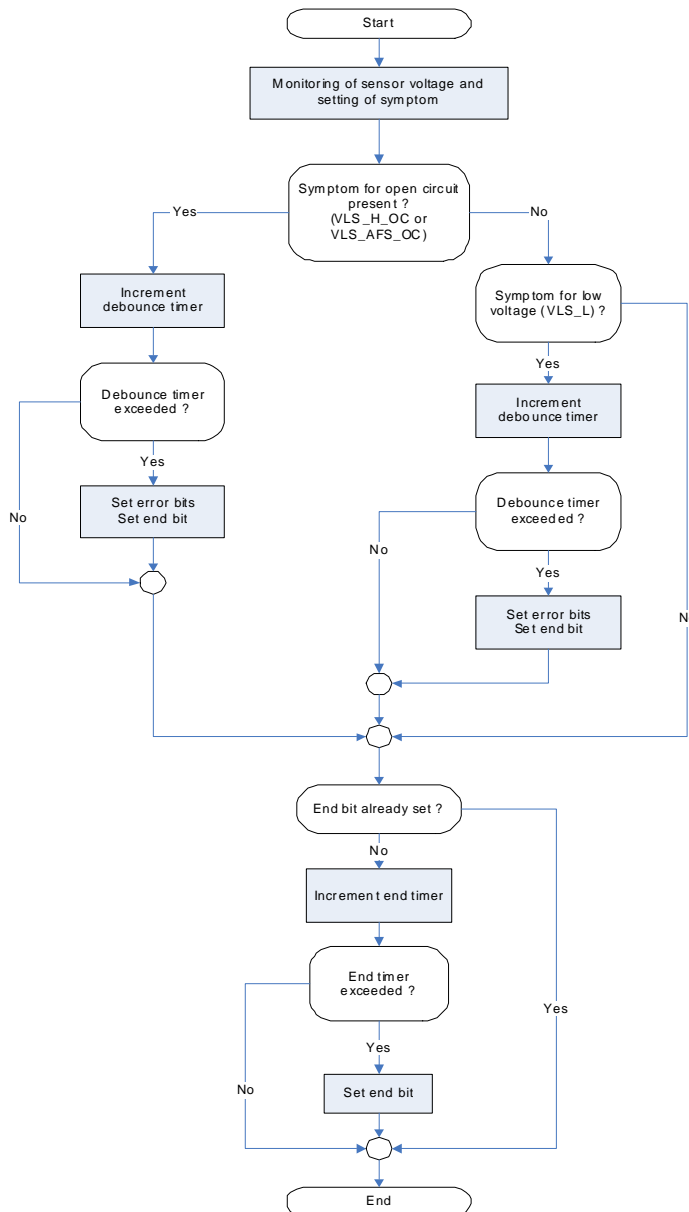


Figure B.28.11: :

### B.28.3.1.1.3.1 DIAG: Monitoring of sensor voltage (setting of symptoms)

If activation conditions are fulfilled and the delay timer has passed, the monitoring of the sensor voltage signal starts. STATE\_SYM\_DIAG\_PUC\_LSL\_UP is set according to measured voltage.

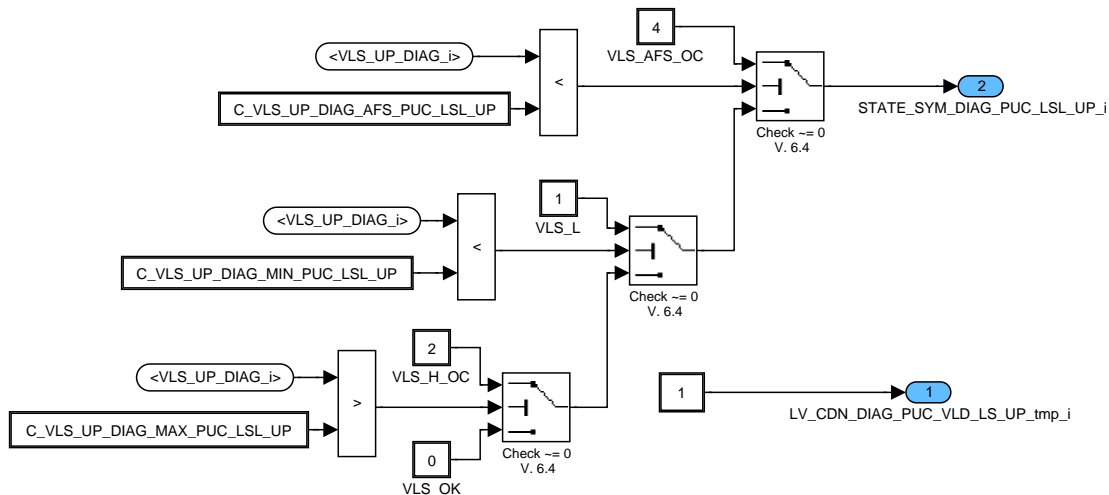


Figure B.28.12: :

### B.28.3.1.1.3.2 DIAG: Distinguish symptoms according linkage to Error manager

The symptoms VLS\_L and VLS\_OK are directly linked to Error Management. The symptoms VLS\_AFS\_OC and VLS\_H\_OC are not directly linked to Error Management. Instead of this, they are linked to the function "O2 sensor (lin) open circuit diagnosis" (A0J0).

Because of this difference, different subsystems are called depending on the value of STATE\_SYM\_DIAG\_PUC\_LSL\_UP.

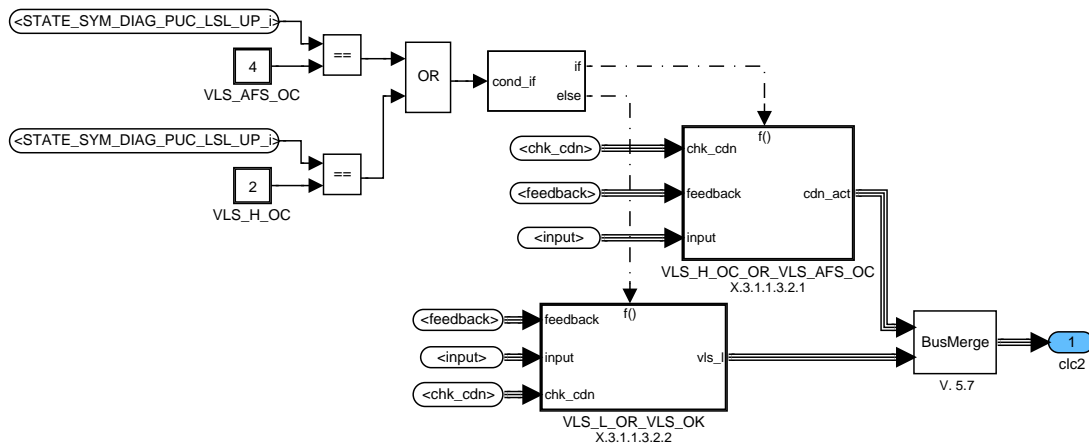


Figure B.28.13: :

### B.28.3.1.1.3.2.1 Distinguish symptoms linked to Error manager: condition true

#### B.28.3.1.1.3.2.1.1 Calculation for Symptoms VLS\_AFS\_OC and VLS\_H\_OC

As long as the symptom VLS\_AFS\_OC or VLS\_H\_OC is fulfilled, the debounce timer is incremented. If the de-bounce timer exceeds the calibrated thresholds, the symptom bit and the end bits are set (this information is send to the function "O2 sensor (lin) open circuit diagnosis" (A0J0)). The actual output voltage of the sensor is stored in the non-volatile memory.

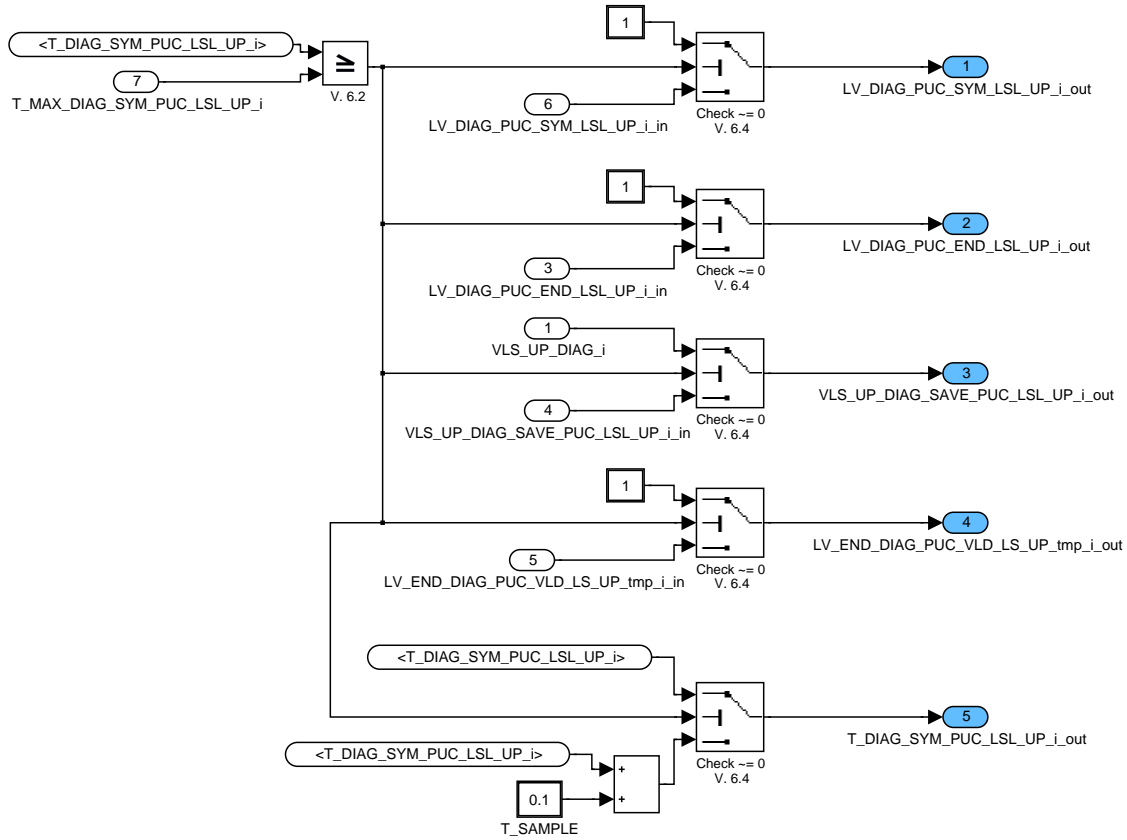


Figure B.28.14: :

**B.28.3.1.1.3.2.2 Distinguish symptoms linked to Error manager: condition false**

**B.28.3.1.1.3.2.2.1 Check of symptoms linked to ERRM**

This calculation is only done, if neither symptom VLS\_H\_OC nor VLS\_AFS\_OCS is active. The remaining possible states are VLS\_L and VLS\_OK. The variable STATE\_SYM\_DIAG\_PUC\_LSL\_UP is checked and different calculations are triggered.

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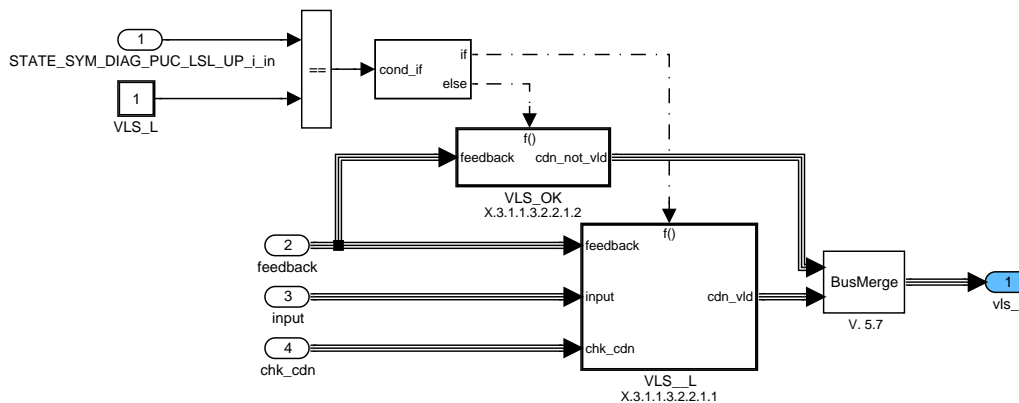


Figure B.28.15: :

### B.28.3.1.1.3.2.2.1.1 Check of symptoms linked to ERRM: condition true

#### B.28.3.1.1.3.2.2.1.1.1 De-bouncing and setting of failure for symptom VLS\_L

The de-bounce counter T\_DIAG\_SYM\_PUC\_LSL\_UP is increased until the calibrated threshold is reached. The actual sensor voltage is stored in the non-volatile memory and the failure is transferred to Error management by setting of the corresponding variables.

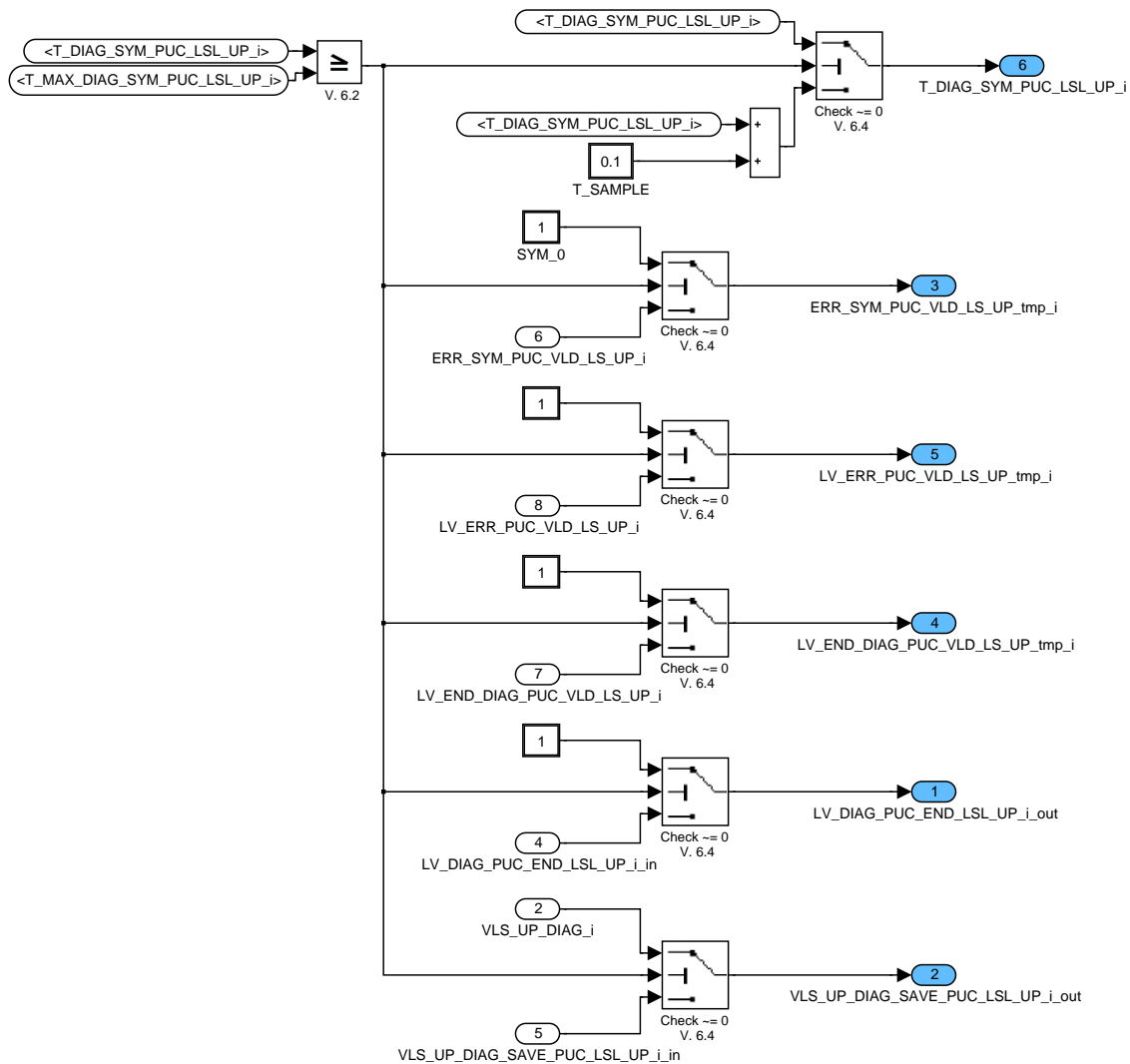


Figure B.28.16: :

### B.28.3.1.1.3.2.2.1.2 Check of symptoms linked to ERRM: condition false

#### B.28.3.1.1.3.2.2.1.2.1 Calculation in case of symptom VLS\_OK

As soon as symptom is VLS\_OK (sensor voltage within allowed band) the debounce timer is set to zero.

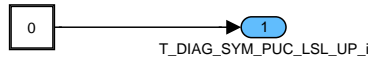


Figure B.28.17: :

### B.28.3.1.1.3.3 DIAG: Timer for setting the End-bit: Conditions for timer increment

If the End-bit(s) of the diagnosis is set already, no further calculations are done in this subsystem.

If the End-bit(s) are not set, the End-timer of the diagnosis is increased and checked against a calibrated threshold (in subsystem CDN\_VLD).

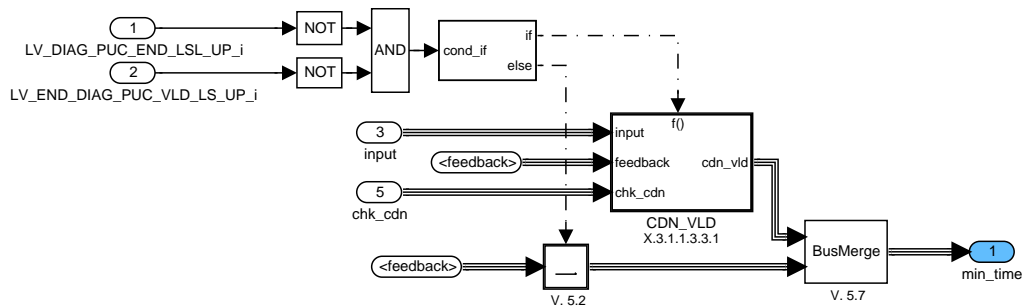


Figure B.28.18: :

### B.28.3.1.1.3.3.1 Conditions for timer increment valid

#### B.28.3.1.1.3.3.1.1 Timer increment and setting of End-bit

The End-timer is increased and compared with a calibrated threshold. If the threshold is reached, the end-bit(s) of the diagnosis are set. (The error-bit remains unchanged, this means = 0 )

This is the usual way for setting the end-bit ( VLS\_OK ).

In the failure case (VLS\_H\_OC, VLS\_AFS\_OC, VLS\_L) end bit is set by on different path together with error-bit.

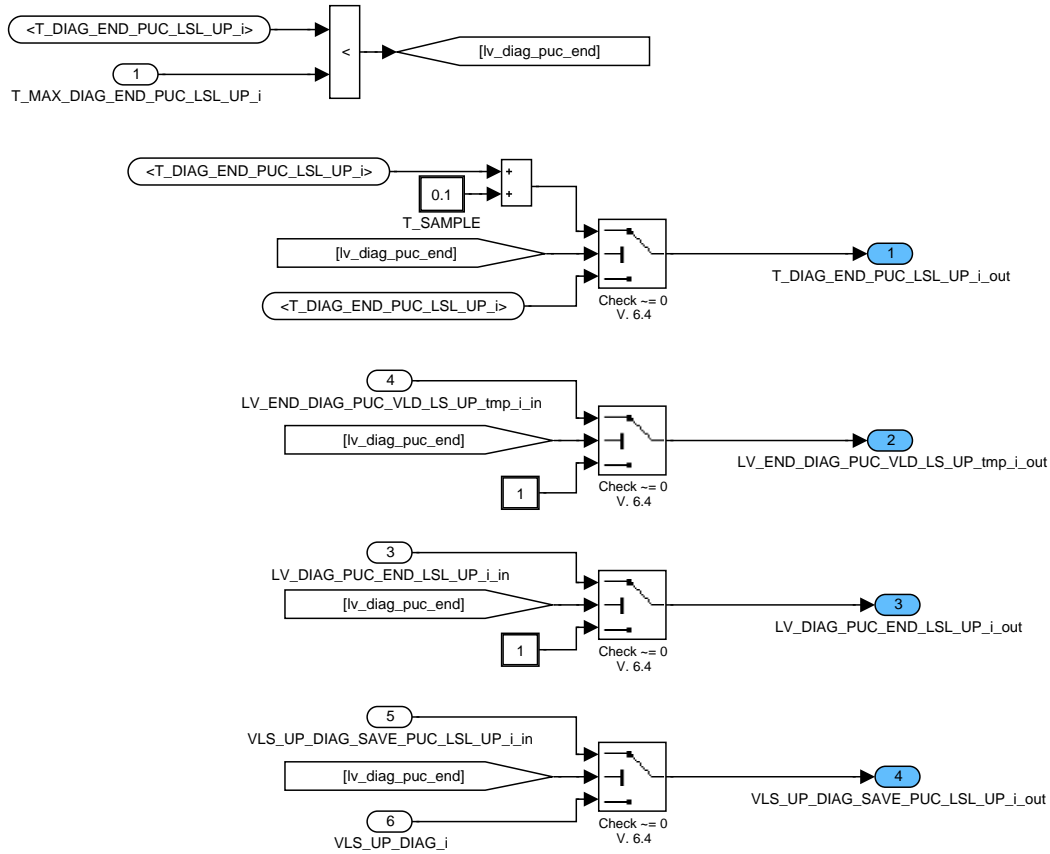


Figure B.28.19: :

**B.28.3.1.1.4 Connection to Error manager for setting of failure**

Synchronisation with error management is done every recurrence.

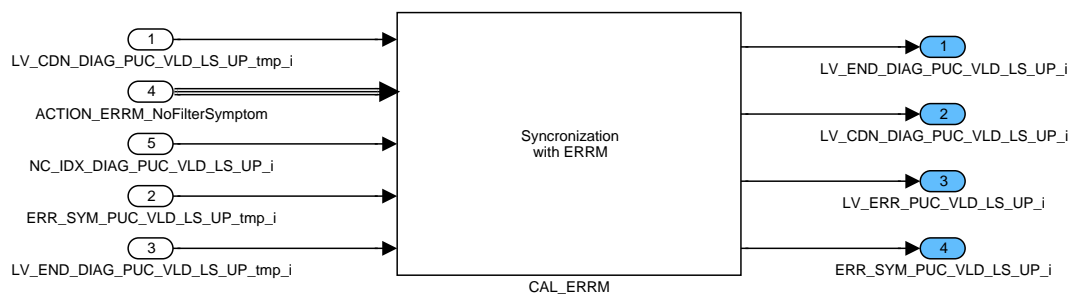


Figure B.28.20: :

**B.28.3.2 Calculation of Mass Air Flow Integral to detect a short interruption of a Fuel Cut-Off Phase**

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## B.29 O2 sensor (lin, up) dynamic diagnosis after NOx CAT regeneration

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CONC_O2_CLC_DIAG_DYN_S [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 1.99993896	610.352e3	-
O2 concentration derived from lambda value of sensor model					
CONC_O2_CLC_DIAG_DYN_S_ST [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 1.99993896	610.352e3	-
O2 concentration from sensor model at the last transition out of homogenous combustion mode					
CONC_O2_CLC_INT_DIAG_DYN_S [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 1.99993896	610.352e3	-
integral of modelled O2 concentration in stratified dynamics diagnosis					
CONC_O2_DIF_INT_DIAG_DYN_S [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 1.99993896	610.352e3	-
integral of the difference between modelled and measured O2 concentration in stratified dynamics diagnosis					
CONC_O2_MES_DIAG_DYN_S [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 1.99993896	610.352e3	-
O2 concentration derived from measured lambda value from sensor					
CONC_O2_MES_DIAG_DYN_S_ST [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 1.99993896	610.352e3	-
measured O2 concentration at time of last transition out of homogenous combustion mode					
CONC_O2_MES_MAX_DIAG_DYN_S [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 1.99993896	610.352e3	-
measured O2 concentration at time of last transition out of homogenous combustion mode					
CTR_DIAG_DYN_S_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
number of valid diagnostic samples in the current driving cycle					
FAC_MV_DIAG_DYN_S_LSL_UP [NC_CBK_EX_NR]	O/V	8000... 7FFFH	0... 127.996094	0.00390625	-
final diagnostic value of stratified dynamics diagnosis					
FAC_SUM_DIAG_DYN_S_LSL_UP [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	0... 8388610	0.00390625	-
sum of all diagnostic values for stratified dynamics diagnosis sampled in the current driving cycle					
FAC_VALUE_DIAG_DYN_S_LSL_UP [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 127.996094	0.00390625	-
last sample of stratified dynamics diagnosis value					
LV_DIAG_DYN_S_LSL_UP_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End flag from stratified combustion lambda sensor dynamics diagnosis					
LV_DIAG_DYN_S_LSL_UP_ERR [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
error signalization from stratified dynamics diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_DYN_S_LSL_UP_SAMPLE [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
signals that a new diagnostic sample should be calculated and included into the average					
LV_DIAG_DYN_S_LSL_UP_STOP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
signals that the diagnosis shall sleep until reactivated by another homogenous combustion phase					
MAF_INT_DIAG_DYN_S_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0... 2912.67	0.04444444	g
MAF integral since transition out of homogenous combustion mode					
STATE_SYM_DIAG_DYN_S_LSL_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
error symptom from stratified dynamics diagnosis					

**Input data:**

LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_SP_FIL_S [NC_CBK_EX_NR] {p. 2462}	LV_DIAG_DYN_S_SWI_ CMB {p. 5332}	LV_HOM_ACT {p. 8136}
LV_INH_DYN_DIAG_S_ LSL_UP [NC_CBK_EX_NR] {p. 5332}	MAF_CYL {p. 8277}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}
TQI_SP_S {p. 8391}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CONC_O2_CLC_HOM_MAX_DYN_S	-	8000... 7FFFH	0... 1.99993896	610.352e3	-
maximum allowable modelled O2 concentration for stratified dynamics diagnosis					
C_CONC_O2_DIF_MAX_DIAG_DYN_S	-	8000... 7FFFH	0... 1.99993896	610.352e3	-
maximum allowable difference between measured and modelled O2 concentration for stratified dynamics diagnosis					
C_CONC_O2_DIF_ST_MAX_DIAG_DYN_S	-	8000... 7FFFH	0... 1.99993896	610.352e3	-
maximum difference between measured and modelled O2 concentration to allow stratified dynamics diagnosis					
C_CONC_O2_MES_DEC_MAX_DYN_S	-	8000... 7FFFH	0... 1.99993896	610.352e3	-
maximum allowable difference between measured and modelled O2 concentration for stratified dynamics diagnosis					
C_CTR_DIAG_DYN_S_LSL_UP	-	0... FFH	0... 255	1	-
Number of valid regeneration cycles needed for averaging in stratified dynamics diagnosis					
C_FAC_CONC_O2_COR_DIAG_DYN_S	-	0... FFH	0... 1.9921875	0.0078125	-
scaling factor in stratified dynamics diagnosis for correction of measured O2 concentration					
C_FAC_DIAG_DYN_S_LSL_UP_MAX	-	8000... 7FFFH	0... 127.996094	0.00390625	-
maximum dynamics characterization value from stratified diagnosis allowable for a "good" lambda sensor					
C_MAF_INT_END_DIAG_DYN_S	-	0... FFFFH	0... 2912.67	0.04444444	g
air mass integral after end of regeneration phase after which to one diagnosis cycle ends					
C_MAF_INT_ST_DIAG_DYN_S	-	0... FFFFH	0... 2912.67	0.04444444	g
air mass integral to wait for before starting integration of differences in stratified dynamics diagnosis					
C_N_MAX_STOP_DIAG_DYN_S	-	0... FFH	0... 8160	32	rpm
maximum engine speed to conduct stratified dynamics diagnosis					
C_N_MIN_STOP_DIAG_DYN_S	-	0... FFH	0... 8160	32	rpm
minimum engine speed to conduct stratified dynamics diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TQI_MAX_DIAG_DYN_S	-	8000... 7FFFH	0... 1023.97	0.03125	Nm
maximum torque request allowable for stratified dynamics diagnosis					
C_TQI_MIN_DIAG_DYN_S	-	8000... 7FFFH	0... 1023.97	0.03125	Nm
minimum torque request allowable for stratified dynamics diagnosis					
IP_FAC_COR_CONC_O2_DIF_DYN_HOMS	-	0... FFH	0... 0.06225586	24.41409e3	-
LDPM_N_32_LS_UP_DYN	8	0... FFH	0... 8160	32	rpm
LDP_TQI_SP_S_IP_CONC_O2_DYN_S	8	0... FFFFH	0... 1023.97	0.03125	Nm
weighting factor for dynamics diagnosis result					
IP_FAC_COR_CONC_O2_DIF_DYN_S	-	0... FFH	0... 0.06225586	24.41409e3	-
LDPM_N_32_LS_UP_DYN	8	0... FFH	0... 8160	32	rpm
LDP_TQI_SP_S_IP_CONC_O2_DYN_S	8	0... FFFFH	0... 1023.97	0.03125	Nm
weighting factor for dynamics diagnosis result					
LC_DIAG_DYN_S_LSL_UP_MOD	-	0... 1H	0 ...1	1	-
switch between integral and difference as basis for dynamics diagnosis					

## B.29.1 EGCP\_PLADGLSL6

This is an alternative diagnosis for the sensor dynamics of WRAF sensors in stratified combustion engines. It expects NOx trap regeneration or other short phases of homogenous combustion in a normally stratified or other lean engine operation. The function interprets the transition from homogenous to stratified mode as a steplike input to the sensor and monitors the sensor's signal response as it rises from around  $\lambda=1$  to higher values (typically above  $\lambda=2$ ).

The difference between this response and the modelled behaviour of a good sensor is integrated, start and end of the integral can be calibrated in terms of a MAF integral to focus on the parts of the signal trace that show large and reproducible differences between new and aged sensors. To get more even weighting of differences in the high and low  $\lambda$  ranges, the modelled and measured  $\lambda$  values are transformed into O<sub>2</sub> concentrations and the integrals are calculated with these concentrations. A map is used to correct for influences of mass air flow and engine speed on the sensor response.

### Application Condition

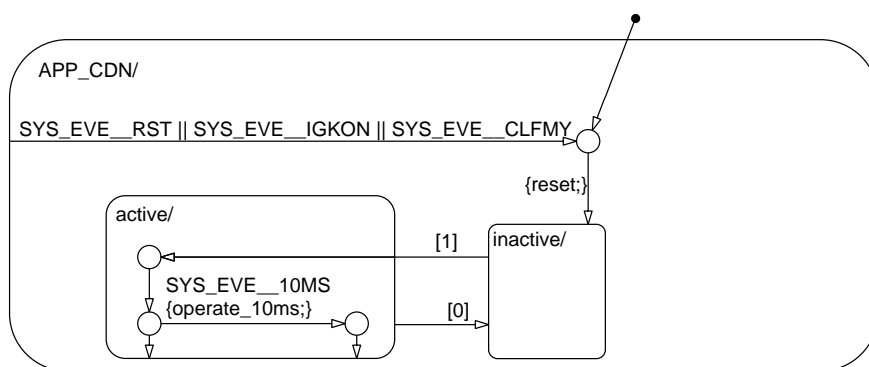
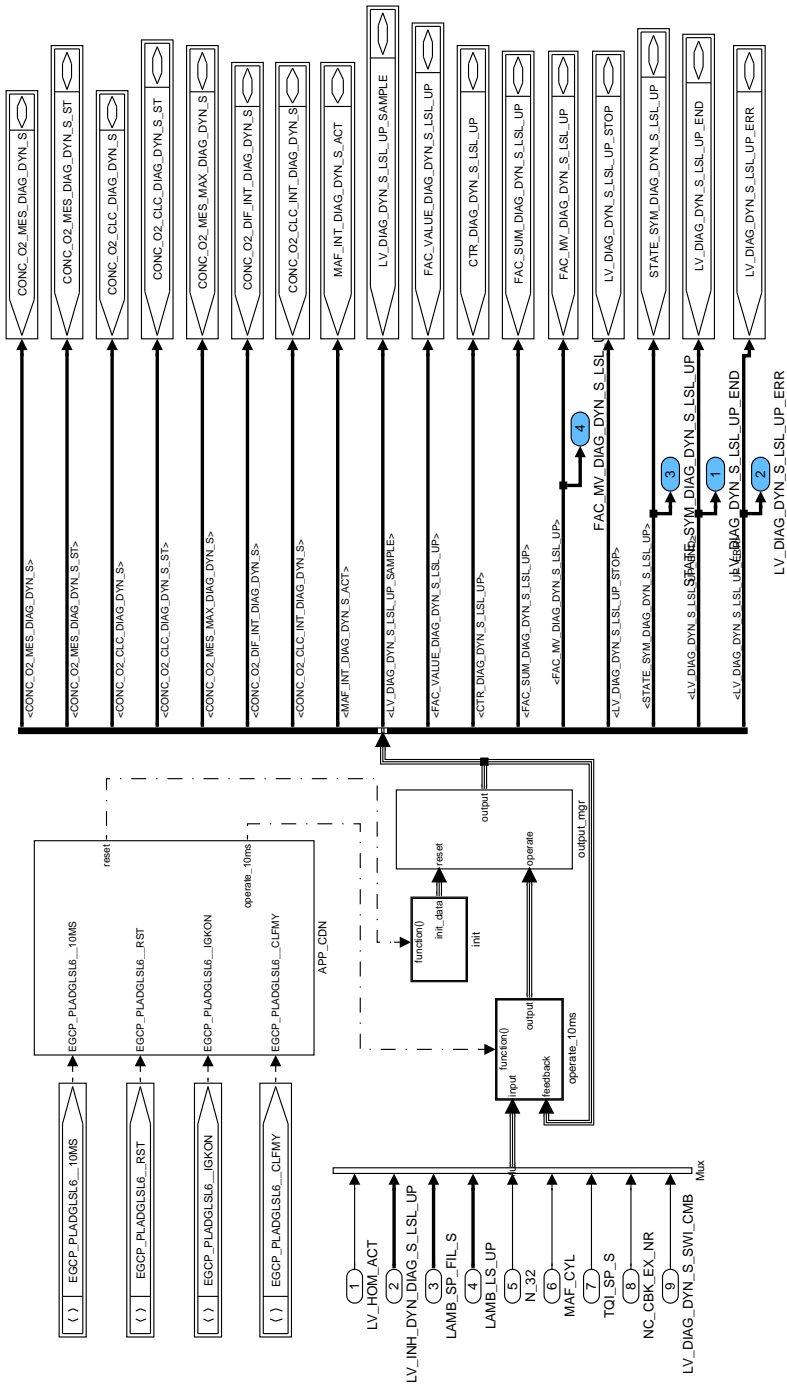


Figure B.29.1: EGCP\_PLADGLSL6/APP\_CDN/Chart

### Function Description



SDA\_SRS / SDA 4.0 31-May-2006

Figure B.29.2: EGCP\_PLADGLSL6

#### B.29.1.1 EGCP\_PLADGLSL6/INIT

Initialization of the online data takes place at reset, when clearing the error memory and at the beginning of a driving cycle.

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 5316 of 8404	
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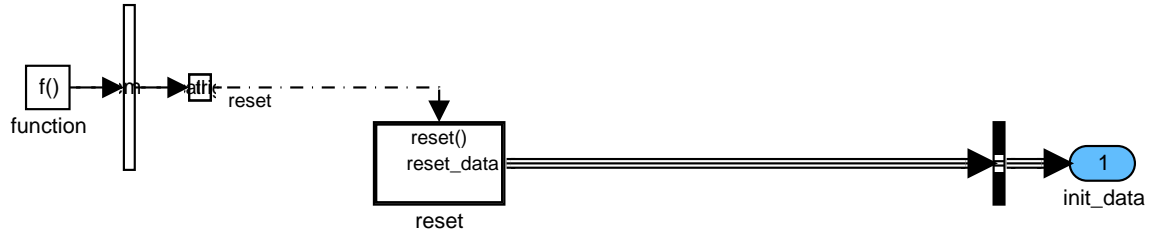


Figure B.29.3: EGCP\_PLADGLSL6/init

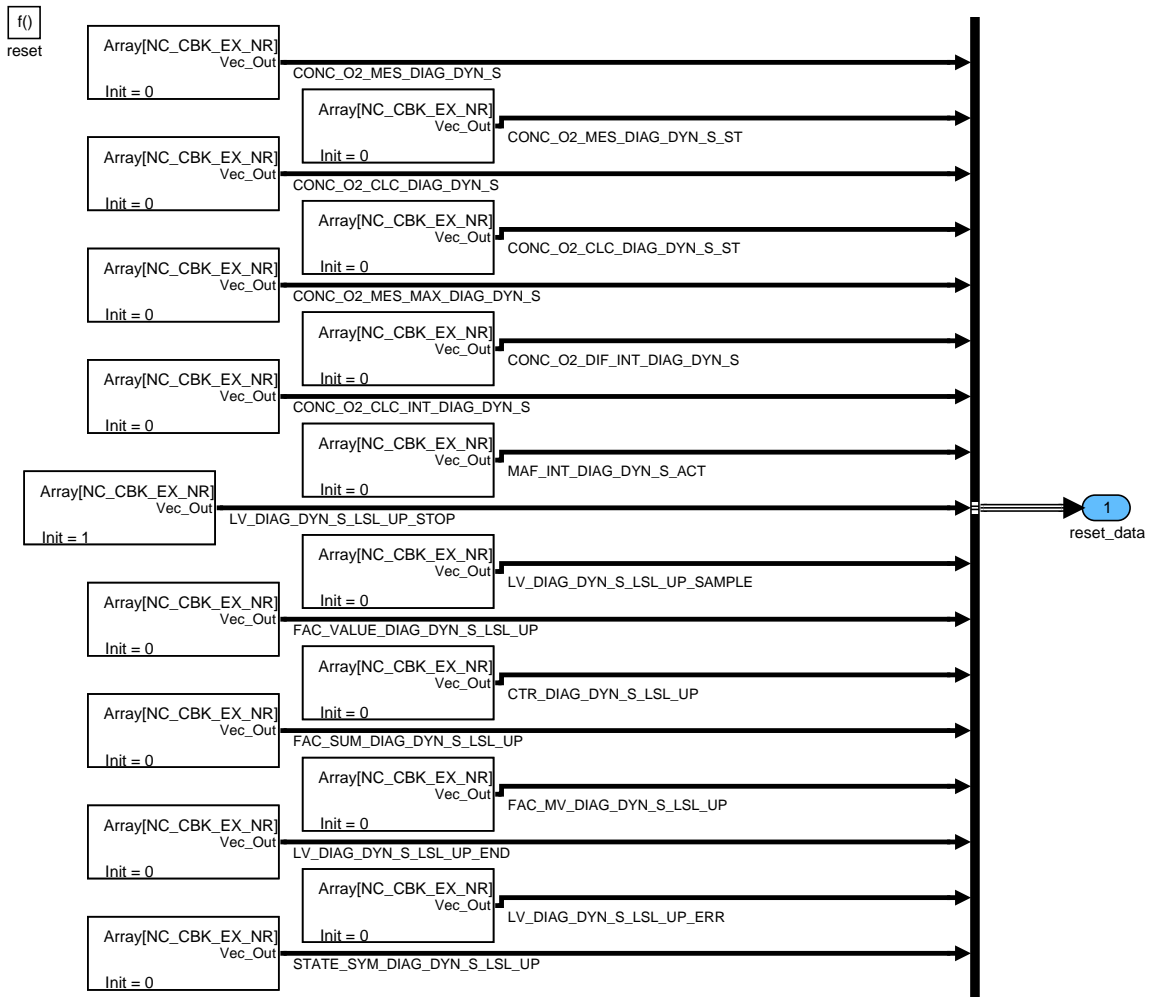


Figure B.29.4: EGCP\_PLADGLSL6/init/reset

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### B.29.1.2 SUBFUNCTION: operate\_10ms

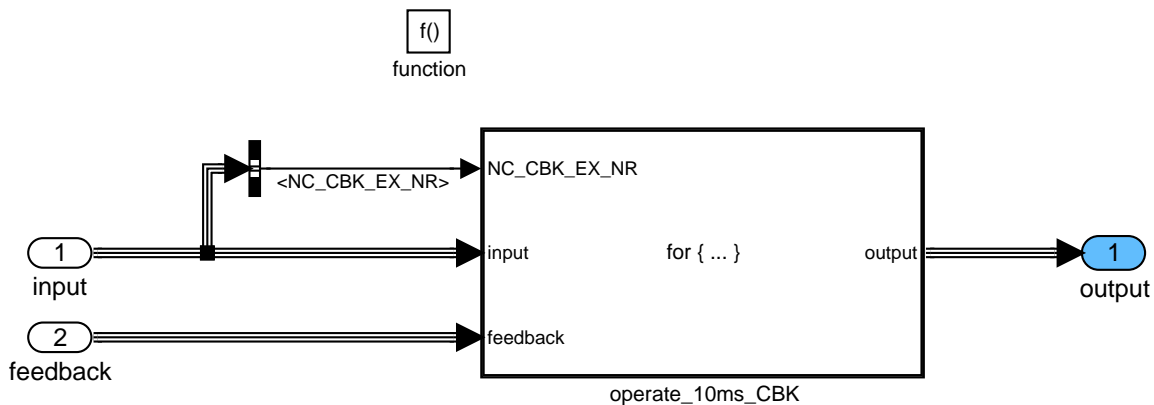


Figure B.29.5: EGCP\_PLADGLSL6/operate\_10ms

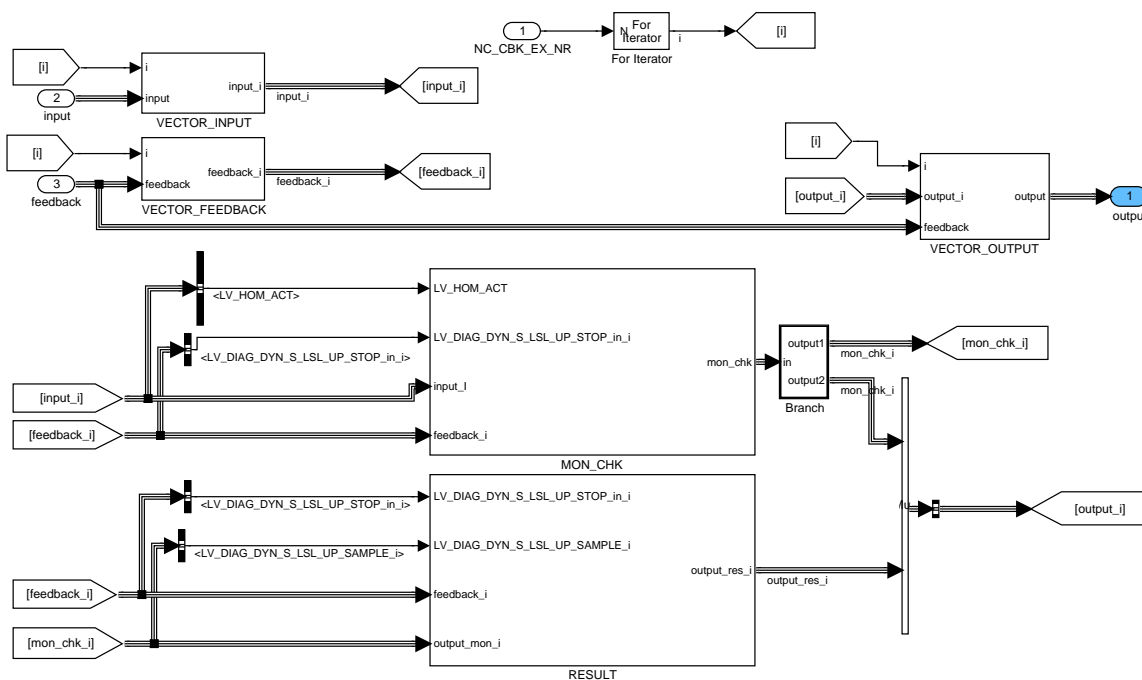


Figure B.29.6: EGCP\_PLADGLSL6/operate\_10ms/operate\_10ms\_CBK

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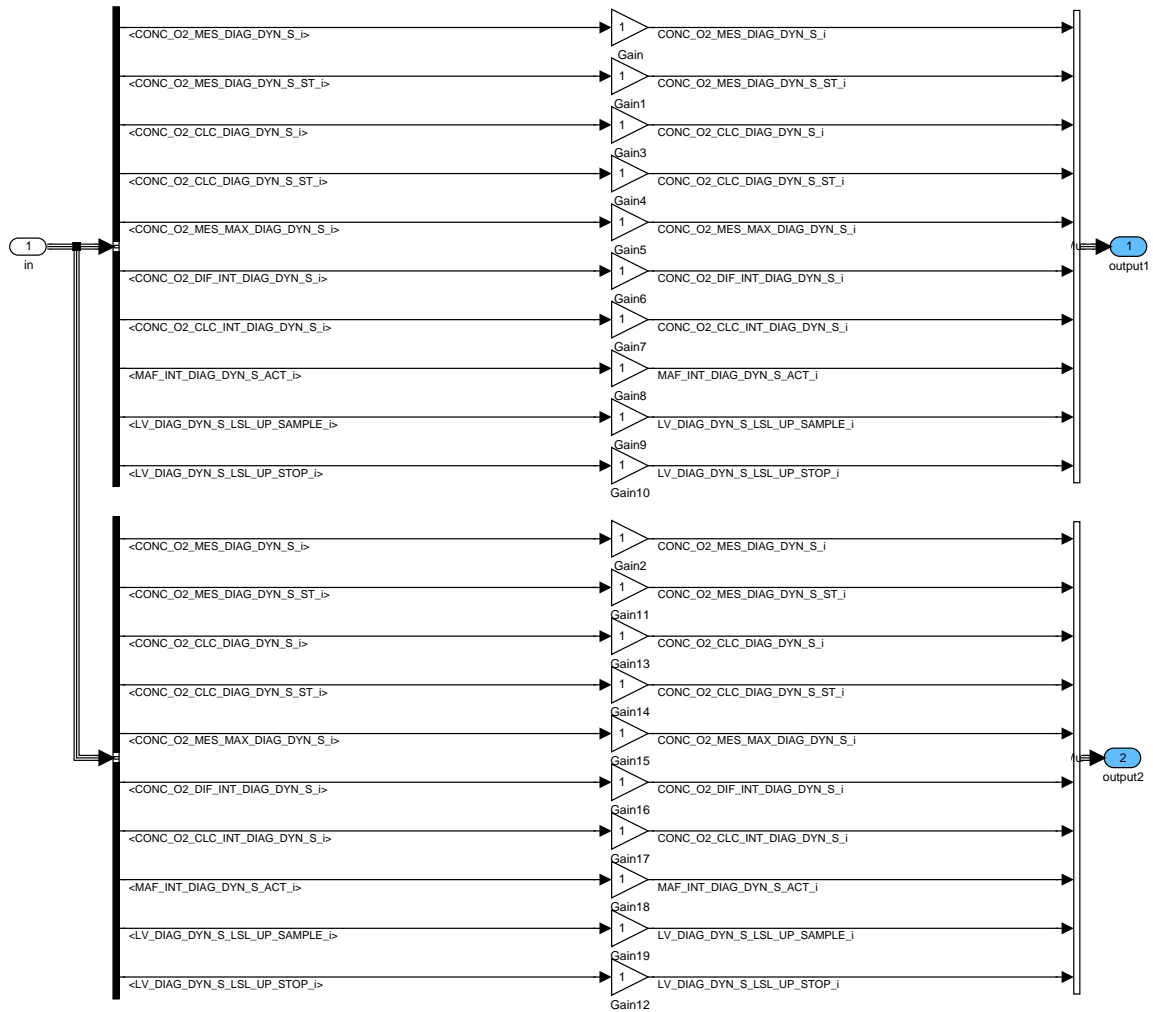


Figure B.29.7: EGCP\_PLADGLSL6/operate\_10ms/operate\_10ms\_CBK/Branch

### EGCP\_PLADGLSL6/OPERATE\_10MS/OPERATE\_10MS\_CBK/MON\_CHK

This is the first part of the diagnosis, which continuously monitors the WRAF sensor signal and calculates several integrals (see below for further explanation). It starts if the engine is running in homogenous combustion mode and continues into the start of the following phase of stratified combustion until aborted or finished.

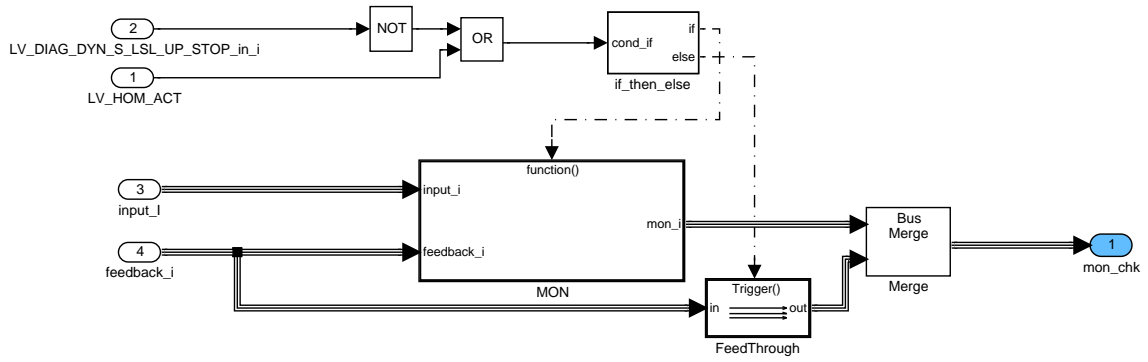



Figure B.29.8: EGCP\_PLADGLSL6/operate\_10ms/operate\_10ms\_CBK/MON\_CHK

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 5320 of 8404</b>	
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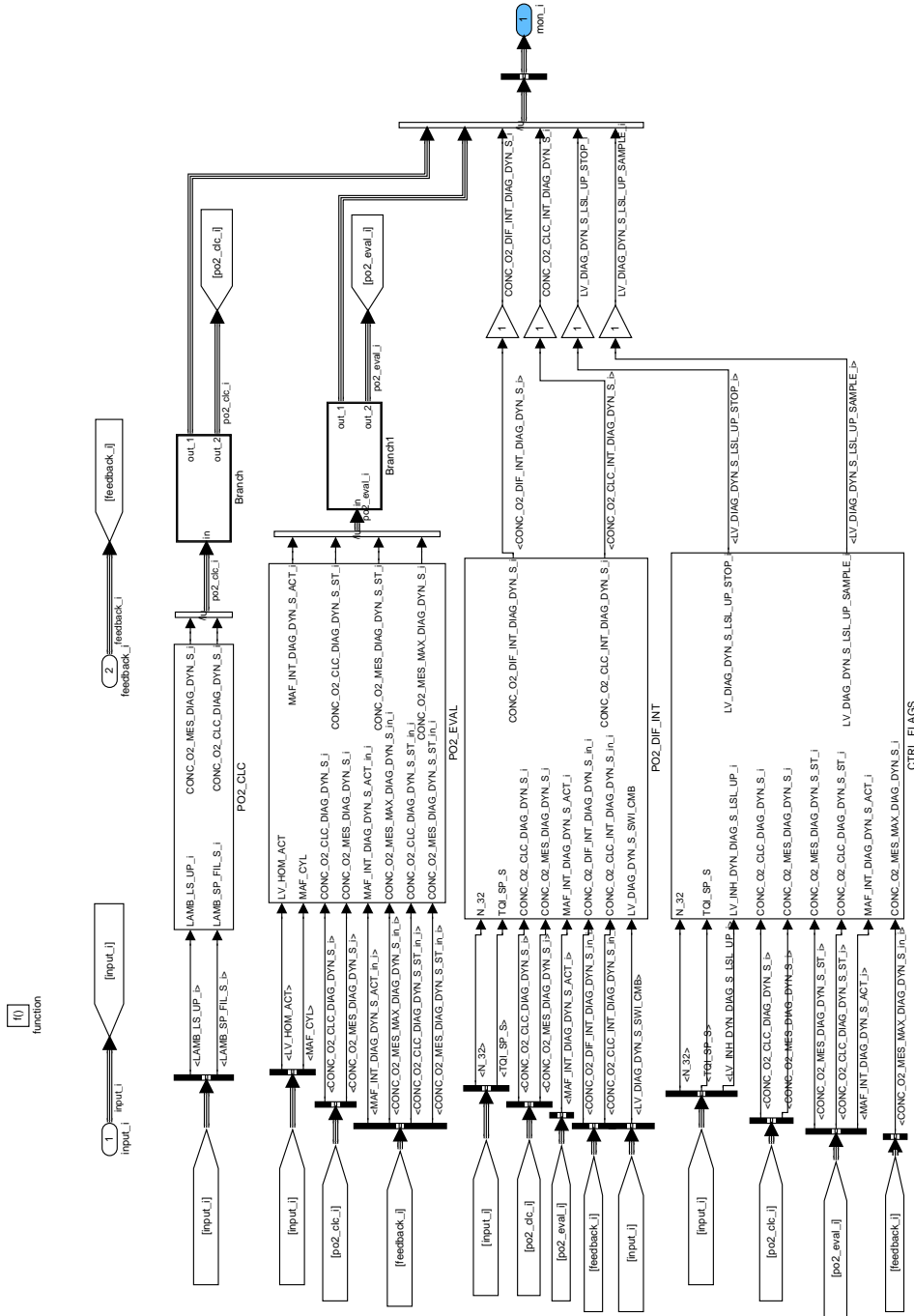


Figure B.29.9: EGCP\_PLADGLSL6/operate\_10ms/operate\_10ms\_CBK/MON\_CHK/MON

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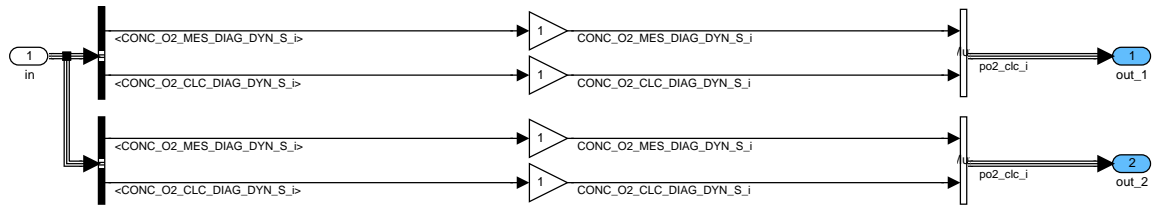


Figure B.29.10: EGCP\_PLADGLSL6/operate\_10ms/operate\_10ms\_CBK/MON\_CHK/MON/Branch

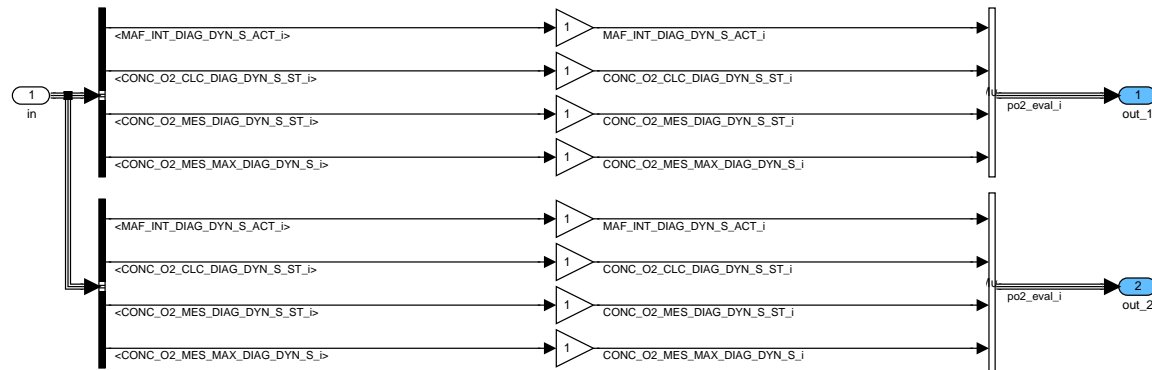


Figure B.29.11: EGCP\_PLADGLSL6/operate\_10ms/operate\_10ms\_CBK/MON\_CHK/MON/Branch1

### EGCP\_PLADGLSL6/OPERATE\_10MS/OPERATE\_10MS\_CBK/MON\_CHK/MON/CTRL\_FLAGS

This section shall generate two flags. `LV_DIAG_DYN_S_LSL_UP_SAMPLE[i]` triggers the calculation of a result at the end of the current diagnostic cycle. It will be set to 1 in the last recurrence before the function deactivates itself, and reset to 0 at the start of the next cycle.

`LV_DIAG_DYN_S_LSL_UP_STOP[i]` is expected to be set to 0 during a homogenous combustion phase to indicate that a diagnostic cycle can be started at the next transition to stratified combustion. It will be set to 1 if the cycle should be stopped, either because a result is available or because required conditions are not fulfilled anymore.

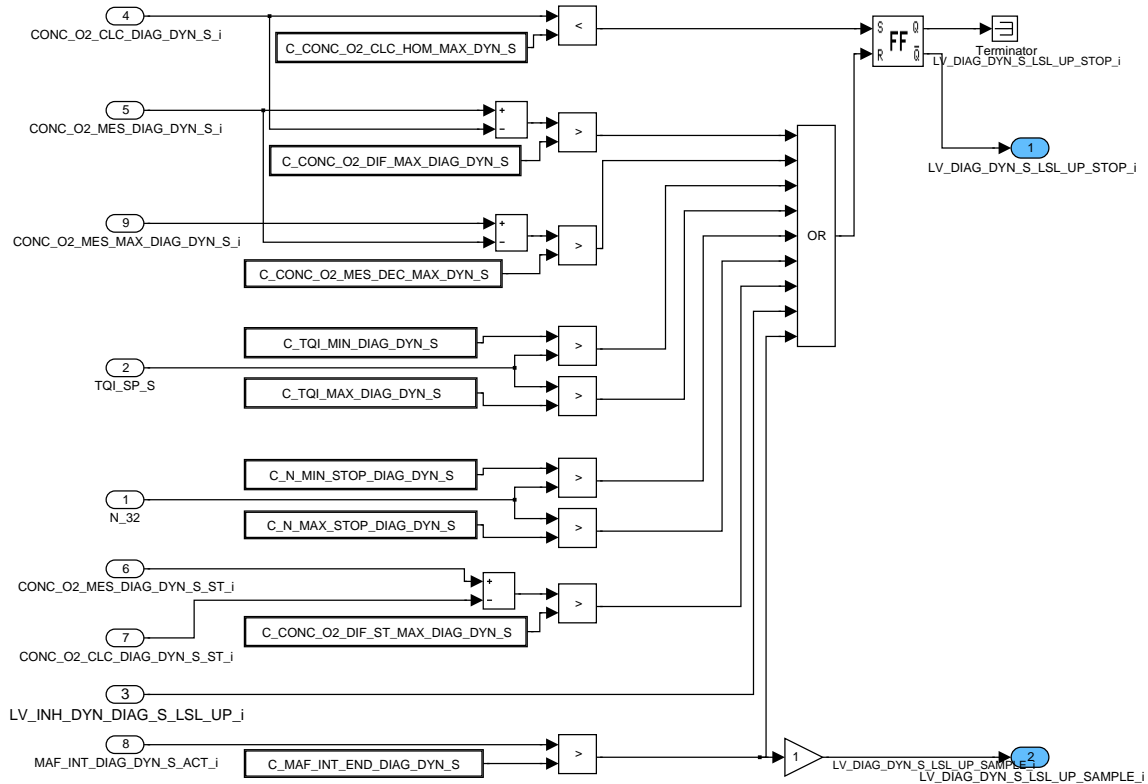


Figure B.29.12: EGCP\_PLADGLSL6/operate\_10ms/operate\_10ms\_CBK/MON\_CHK/MON/CTRL\_FLAGS

**EGCP\_PLADGLSL6/OPERATE\_10MS/OPERATE\_10MS\_CBK/MON\_CHK/MON/PO2\_CLC**

This block calculates the O2 concentrations CONC\_O2\_MES\_DIAG\_DYN\_S[i] from LAMB\_LS\_UP[i] and CONC\_O2\_CLC\_DIAG\_DYN\_S[i] from LAMB\_SP\_FIL\_S[i]. CONC\_O2\_MES\_DIAG\_DYN\_S[i] can be scaled with a constant factor to improve diagnostic results for good sensors. The CONC\_O2 values are used throughout the diagnosis because accuracy and dynamics are more similar across the different lambda ranges than for lambda itself.

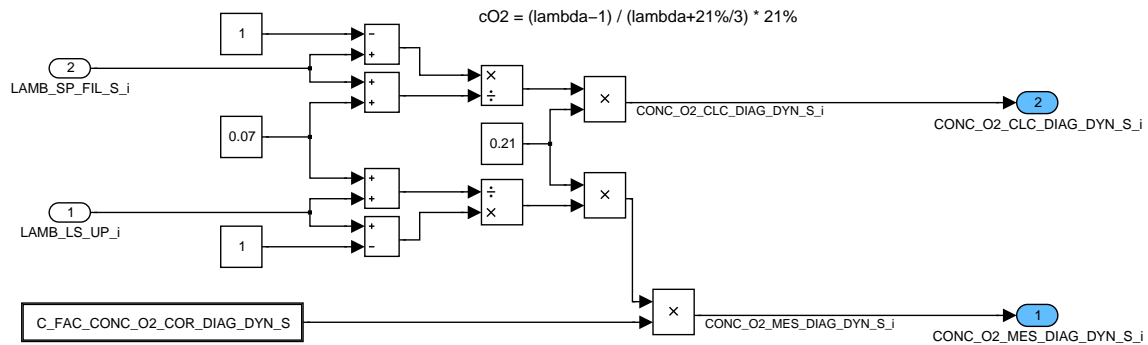


Figure B.29.13: EGCP\_PLADGLSL6/operate\_10ms/operate\_10ms\_CBK/MON\_CHK/MON/PO2\_CLC

**EGCP\_PLADGLSL6/OPERATE\_10MS/OPERATE\_10MS\_CBK/MON\_CHK/MON/PO2\_DIF\_INT**

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Here, two integrals are produced which are used to calculate the diagnostic value. In `CONC_O2_DIF_INT_DIAG_DYN_S[i]` integrates the differences between modelled and measured O2 concentration, while `CONC_O2_CLC_INT_DIAG_DYN_S[i]` integrates the modelled oxygen concentration itself. Both integrals start only after a calibrateable air mass has passed since the homogenous combustion mode was left. This can be used to avoid signal features shortly after the transition and to focus the diagnostic value on parts of the signal trace that show large and clear deviations between a modelled (fast) and a slow sensor. The integrals are stopped implicitly by calculating a result from them once after a certain air mass was consumed by the engine. After this, the function deactivates itself until the engine enters homogenous combustion mode again.

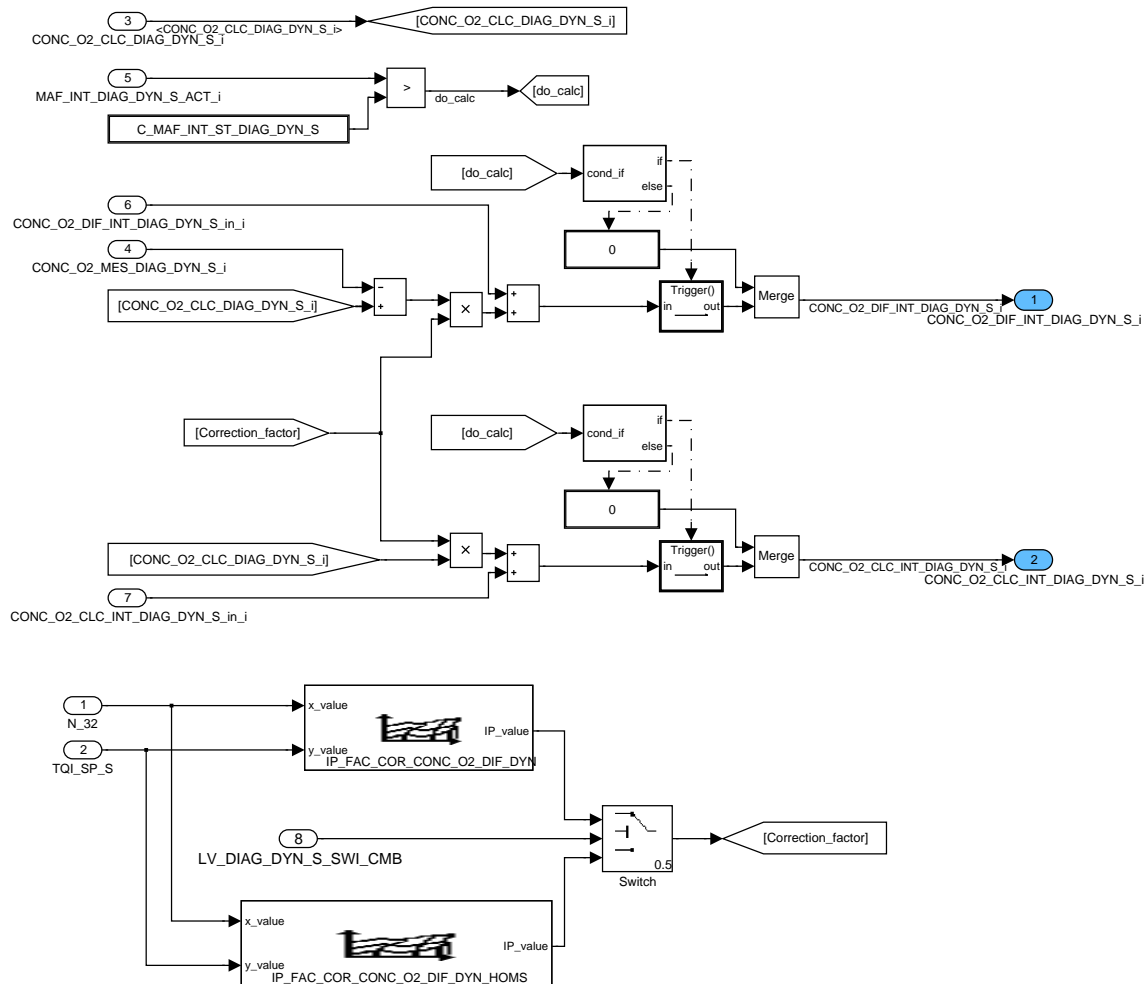


Figure B.29.14:  
EGCP\_PLADGLSL6/operate\_10ms/operate\_10ms\_CBK/MON\_CHK/MON/PO2\_DIF\_INT

### EGCP\_PLADGLSL6/OPERATE\_10MS/OPERATE\_10MS\_CBK/MON\_CHK/MON/PO2\_EVAL

Here, a mass flow integral is calculated, which starts at the transition out of homogenous combustion and governs start and end points for the calculation of the diagnostic value. `CONC_O2_MES_DIAG_DYN_S_ST[i]` and `CONC_O2_CLC_DIAG_DYN_S_ST[i]` receive the values of `CONC_O2_MES_DIAG_DYN_S[i]` and `CONC_O2_CLC_DIAG_DYN_S[i]` at the time of the transition, they are used to calculate and validate the diagnostic result of the current transition. `CONC_O2_MES_MAX_DIAG_DYN_S[i]` is the highest O2 concentration found in the current diagnostic cycle, it is used in validation of the result.

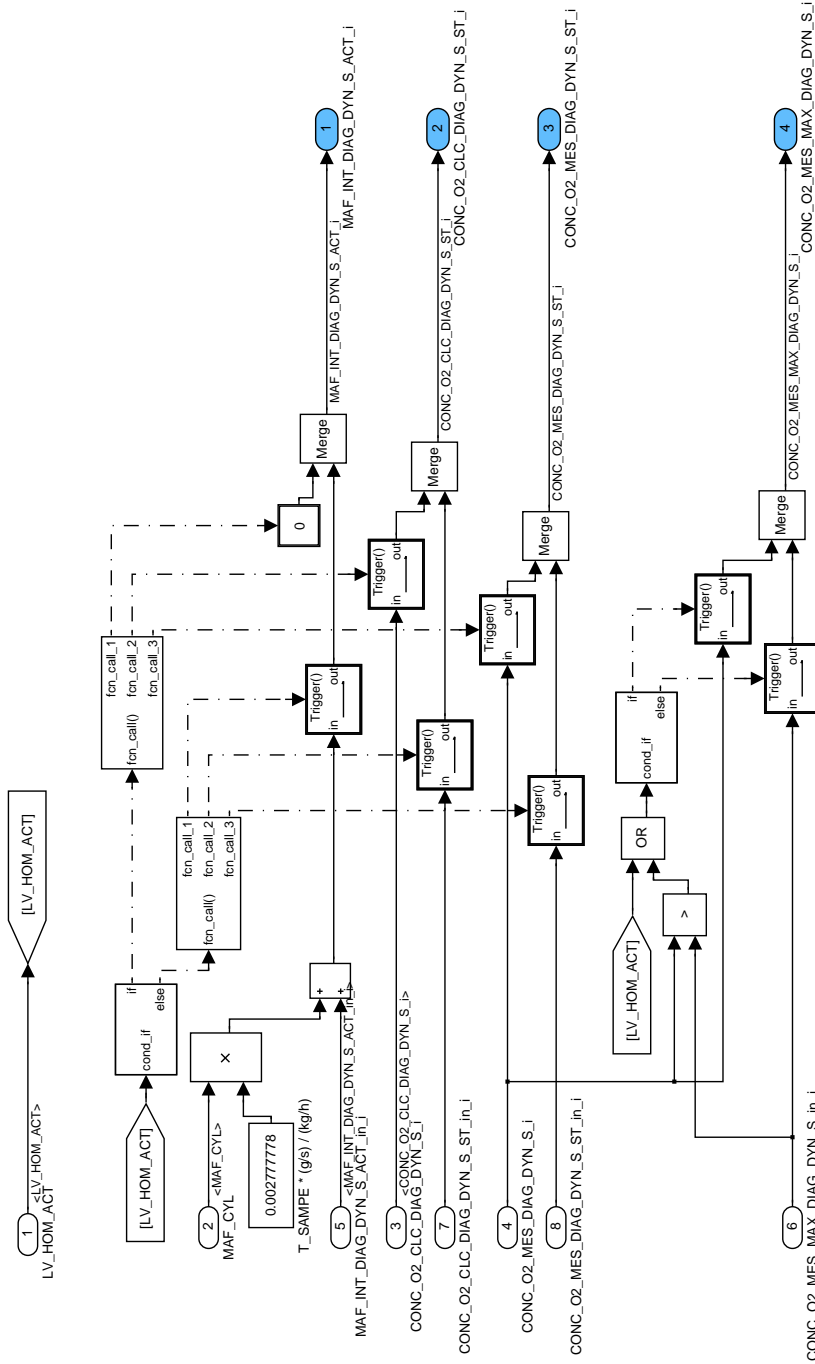



Figure B.29.15: EGCP\_PLADGLSL6/operate\_10ms/operate\_10ms\_CBK/MON\_CHK/MON/PO2\_EVAL

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	Document key 10171571 SPE 000 AO	Pages Page 5325 of 8404	
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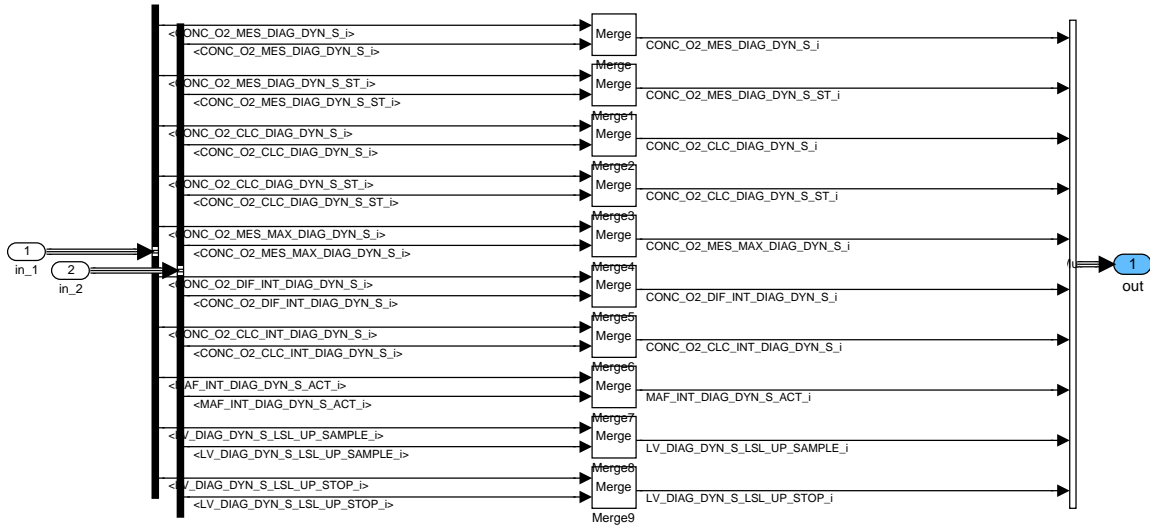


Figure B.29.16: EGCP\_PLADGLSL6/operate\_10ms/operate\_10ms\_CBK/MON\_CHK/Merge

**EGCP\_PLADGLSL6/OPERATE\_10MS/OPERATE\_10MS\_CBK/RESULT**

The logic shown here triggers the calculation of a result once after a diagnostic cycle has completed successfully.

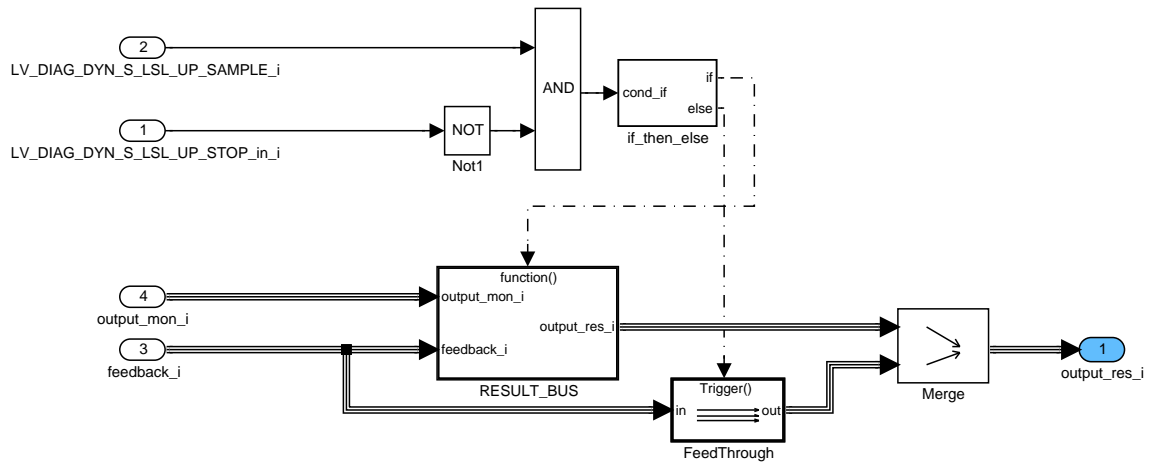


Figure B.29.17: EGCP\_PLADGLSL6/operate\_10ms/operate\_10ms\_CBK/RESULT

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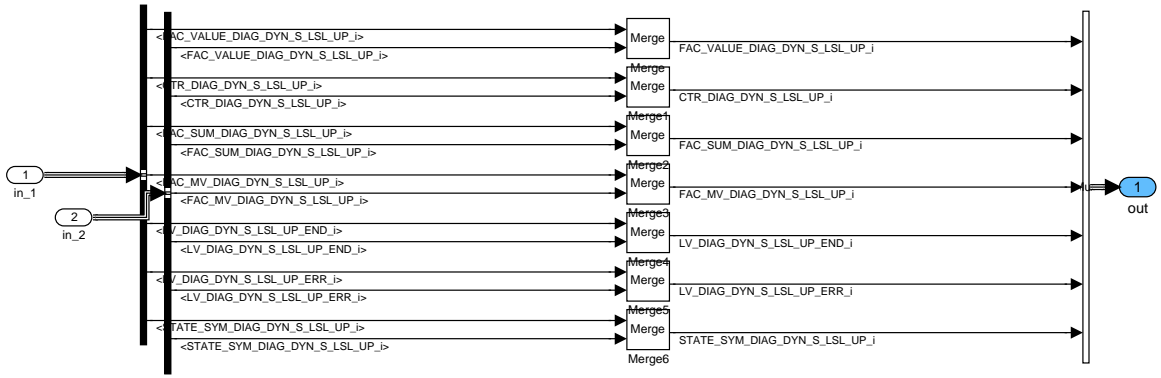


Figure B.29.18: EGCP\_PLADGLSL6/operate\_10ms/operate\_10ms\_CBK/RESULT/Merge

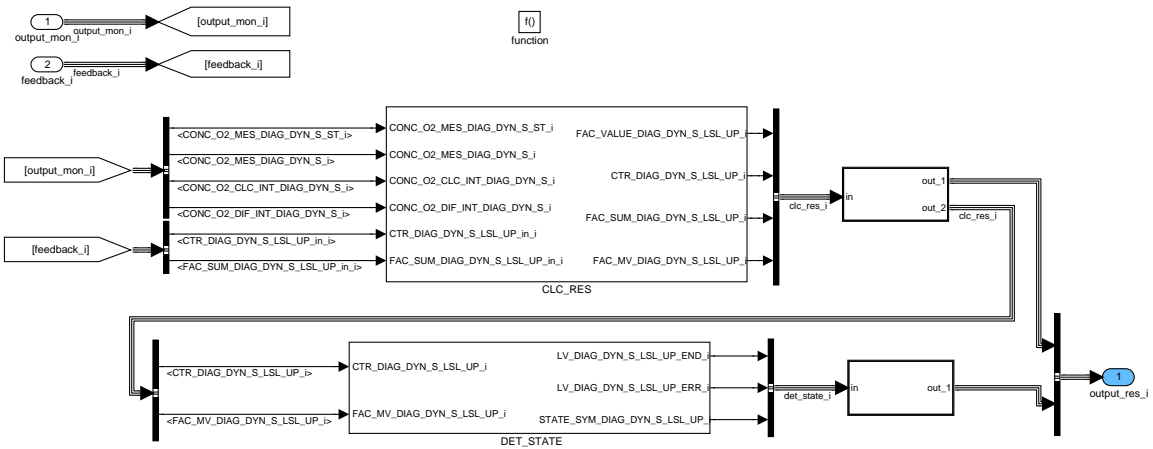


Figure B.29.19: EGCP\_PLADGLSL6/operate\_10ms/operate\_10ms\_CBK/RESULT/RESULT\_BUS

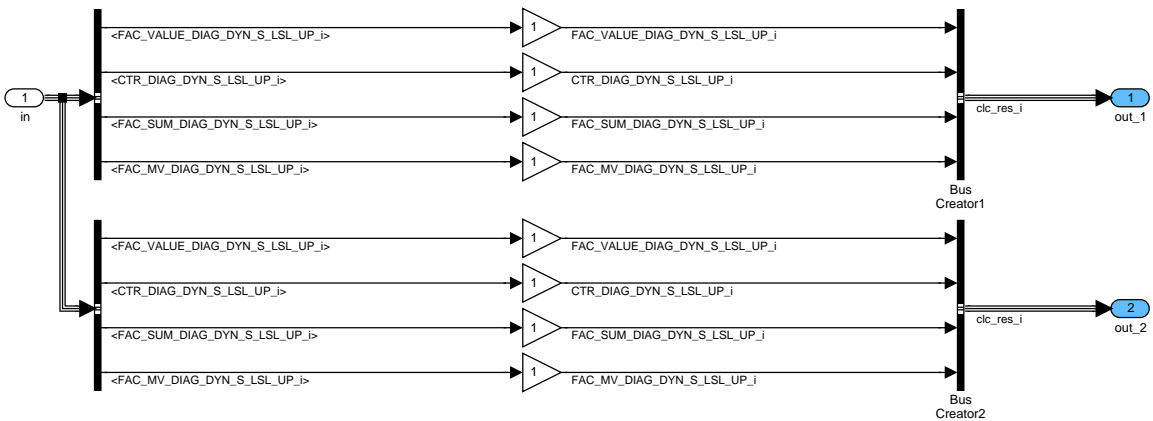


Figure B.29.20: EGCP\_PLADGLSL6/operate\_10ms/operate\_10ms\_CBK/RESULT/RESULT\_BUS/Branch

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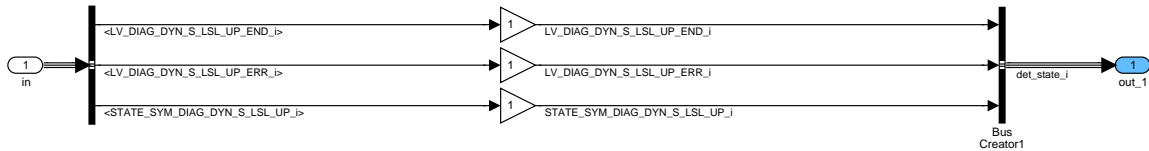


Figure B.29.21:

EGCP\_PLADGLSL6/operate\_10ms/operate\_10ms\_CBK/RESULT/RESULT\_BUS/Branch1

### EGCP\_PLADGLSL6/OPERATE\_10MS/OPERATE\_10MS\_CBK/RESULT/RESULT\_BUS/CLC\_RES

The result of one single diagnostic cycle is calculated in one of two ways and stored in  $FAC\_VALUE\_DIAG\_DYN\_S\_LSL\_UP[i]$ . It resembles the difference between modelled (i.e. "good") and actual sensor response to the lambda change in the transition from homogenous to lean combustion. If  $LC\_DIAG\_DYN\_S\_LSL\_UP\_MOD = 1$ , the difference is normalized to the signal change of the sensor and resembles the time constant of the sensor response. Otherwise it is normalized to the integrated signal change in the model, which makes the result more stable for slow sensors.

$FAC\_MV\_DIAG\_DYN\_S\_LSL\_UP[i]$  is a cumulated average for the current driving cycle, which is the basis for the decision whether the sensor is good or not.

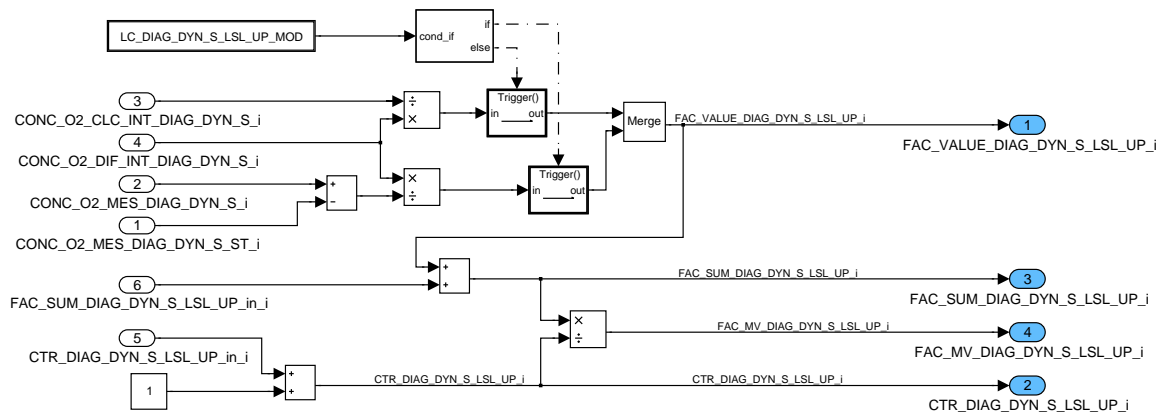


Figure B.29.22:

EGCP\_PLADGLSL6/operate\_10ms/operate\_10ms\_CBK/RESULT/RESULT\_BUS/CLC\_RES

### EGCP\_PLADGLSL6/OPERATE\_10MS/OPERATE\_10MS\_CBK/RESULT/RESULT\_BUS/DET\_STATE



The block determines the diagnostic decision. With every cycle, the good/bad status in LV\_DIAG\_DYN\_S\_LSL\_UP\_ERR[i] and STATE\_SYM\_DIAG\_DYN\_S\_LSL\_UP[i] is updated, and if enough cycles have been completed, the end of diagnosis is indicated via LV\_DIAG\_DYN\_S\_LSL\_UP\_END[i]. This information is not transmitted to the error memory directly.

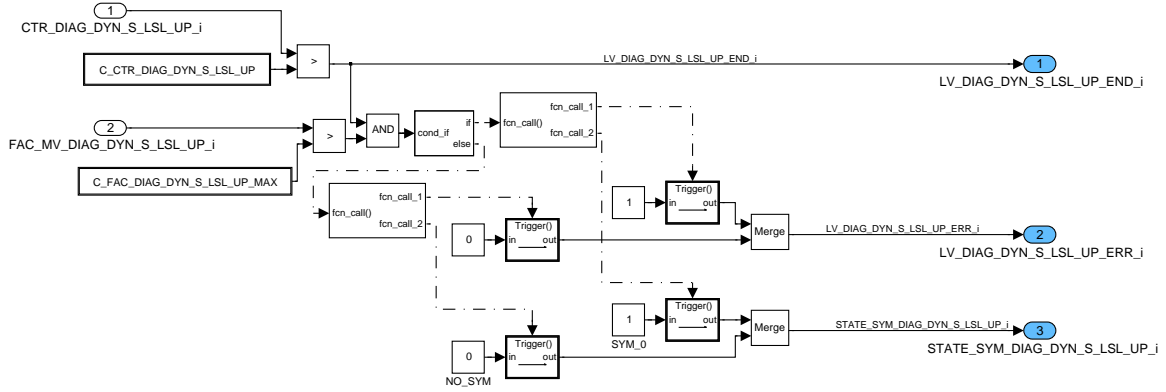


Figure B.29.23:  
EGCP\_PLADGLSL6/operate\_10ms/operate\_10ms\_CBK/RESULT/RESULT\_BUS/DET\_STATE

**EGCP\_PLADGLSL6/OPERATE\_10MS/OPERATE\_10MS\_CBK/VECTOR\_FEEDBACK**

This block selects required values from the last recurrence into a vector used in the functions for the current cylinder bank.

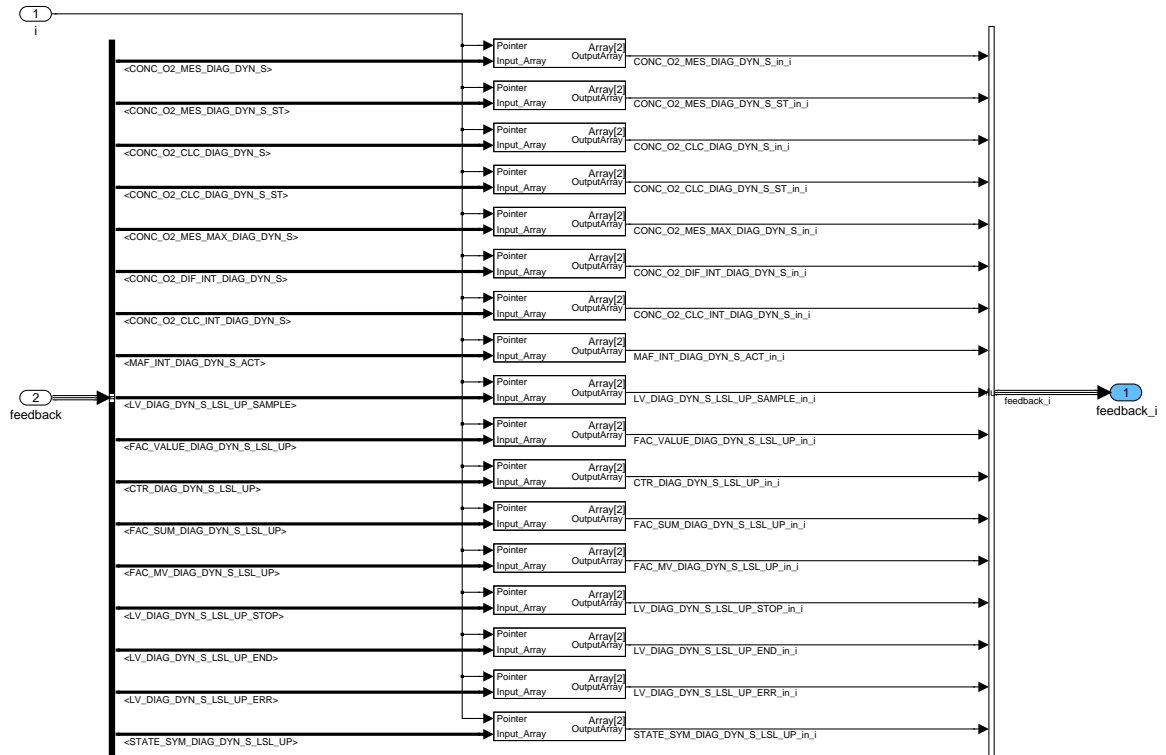


Figure B.29.24: EGCP\_PLADGLSL6/operate\_10ms/operate\_10ms\_CBK/VECTOR\_FEEDBACK

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### EGCP\_PLADGLSL6/OPERATE\_10MS/OPERATE\_10MS\_CBK/VECTOR\_INPUT

The result of this block is a vector with the current input needed for the cylinder bank to be calculated.

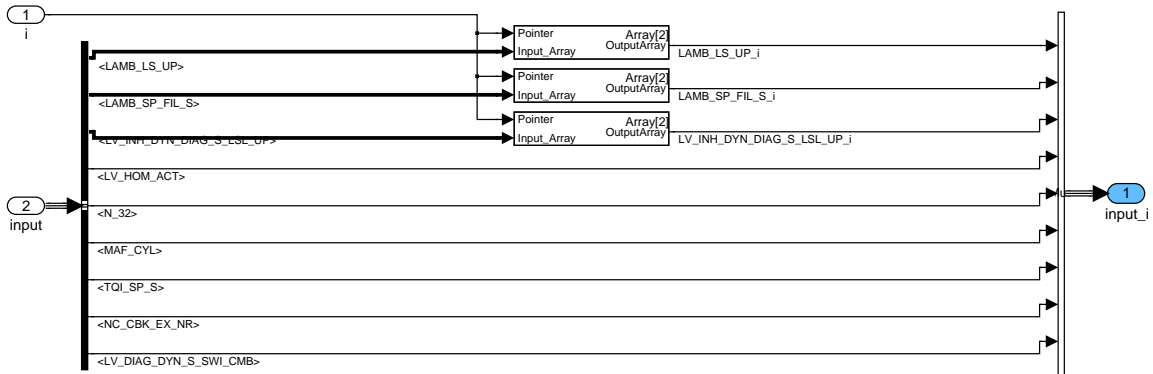


Figure B.29.25: EGCP\_PLADGLSL6/operate\_10ms/operate\_10ms\_CBK/VECTOR\_INPUT

### EGCP\_PLADGLSL6/OPERATE\_10MS/OPERATE\_10MS\_CBK/VECTOR\_OUTPUT

The output block assembles the model output vector from the results for the individual cylinder banks.

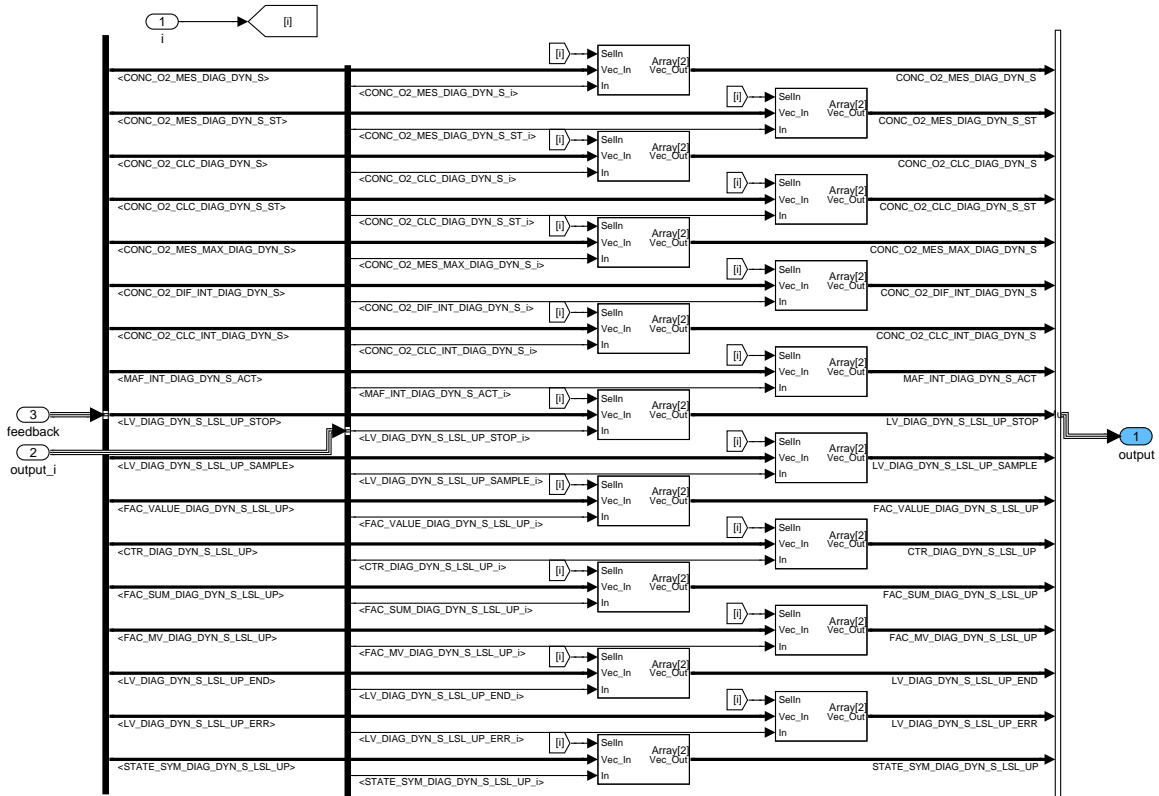


Figure B.29.26: EGCP\_PLADGLSL6/operate\_10ms/operate\_10ms\_CBK/VECTOR\_OUTPUT

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### B.29.1.3 EGCP\_PLADGLSL6/OUTPUT\_MGR

The output manager merges the results of init and operate blocks into the functions' output vector.

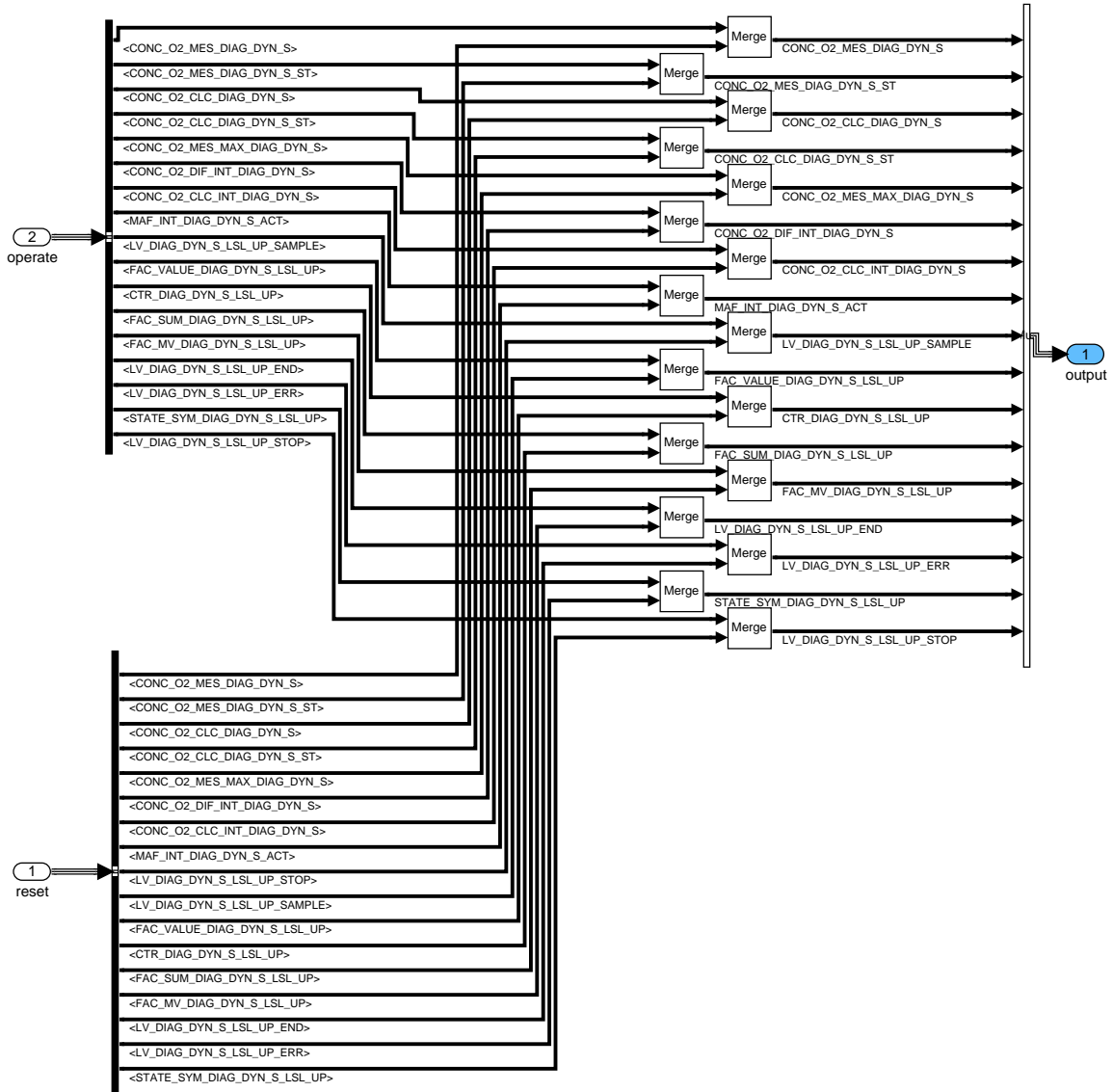


Figure B.29.27: EGCP\_PLADGLSL6/output\_mgr

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## B.30 O2 sensor (lin, up) dynamic diagnosis after NOx CAT reg. (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_DYN_S_SWI_CMB	O/V	0... 1H	0 ...1	1	-
Logical variable to switch weighting factor depending on combustion mode					
LV_INH_DYN_DIAG_S_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibition of linear lambda sensor dynamic diagnosis for stratified combustion					

### Input data:

LV_DIAG_DYN_INH_LSL_UP [NC_CBK_EX_NR] {p. 5377}	LV_END_DIAG_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_MAP_TPS_PLAUS {p. 1062}
LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_SLV_IVVT_IN {p. 4627}	LV_IGK {p. 906}	LV_ST_END {p. 1720}
OPM_AV {p. 8137}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DIAG_DYN_INH_CMB_TRAN	-	0... 3H	0 ...3	1	-
Inhibition of DYN_DIAG due to switching combustion mode					
LC_INH_DYN_DIAG_S_LSL_UP [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Manual inhibition of WRAF sensor dynamic diagnosis in stratified operation					

### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

With C\_DIAG\_DYN\_INH\_CMB\_TRAN the diagnosis can be interrupted due to switching of the combustion mode.

Interruption in case of:

Switching CBM from AFL to S and C\_DIAG\_DYN\_INH\_CMB\_TRAN = 1

Switching CBM from S to AFL and C\_DIAG\_DYN\_INH\_CMB\_TRAN = 2

Switching CBM from S to AFL and AFL to S and C\_DIAG\_DYN\_INH\_CMB\_TRAN = 3

### Application conditions

#### Initialisation:

At transition LV\_IGK = 0 -> 1 or reset LV\_INH\_DYN\_DIAG\_S\_LSL\_UP[i] shall be set to 1.

**Recurrence:** 20ms .

**Activation:** -

**Formula section:**

```

If   LV_ST_END = 0                or
        LV_IGK = 0                  or
        LV_ERR_SLV_IVVT_IN = 1      or
        LV_ERR_OFS_LSL_UP[i] = 1    or
        LV_ERR_CTL_LSL_UP[i] = 1    or
        LV_ERR_MAP_TPS_PLAUS = 1    or
        LV_DIAG_DYN_INH_LSL_UP[i] = 1 or
        LV_END_DIAG_DYN_VLD_LS_UP[i] = 1 or
        LC_INH_DYN_DIAG_S_LSL_UP[i] = 1 or
        (OPM_AV = 3h --> 1h and
         C_DIAG_DYN_INH_CMB_TRAN = 1) or
        (OPM_AV = 1h --> 3h and
         C_DIAG_DYN_INH_CMB_TRAN = 2) or
        ((OPM_AV = 3h --> 1h or
         OPM_AV = 1h --> 3h) and
         C_DIAG_DYN_INH_CMB_TRAN = 3))

```

*% Inhibitions are the same as for homogenous dynamics diagnosis, plus inhibition of stratified mode*

*% and manual deactivation.*

**Then**

LV\_INH\_DYN\_DIAG\_S\_LSL\_UP[i] = 1

**Else**

LV\_INH\_DYN\_DIAG\_S\_LSL\_UP[i] = 0

**Endif**

**If** OPM\_AV = 3h

*% Engine runs in mode AFL*

**Then**

LV\_DIAG\_DYN\_S\_SWI\_CMB = 0

**Else**

LV\_DIAG\_DYN\_S\_SWI\_CMB = 1

**Endif**

## B.31 O2 sensor (lin, up) characteristic line diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
WRAF Sensor characteristic line shift to lean SYMPTOM detected					
ERR_SYM_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
WRAF Sensor characteristic line shift to rich SYMPTOM detected					
LV_CDN_DIAG_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Condition to run the Diagnosis WRAF Sensor characteristic line shift to lean					
LV_CDN_DIAG_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Condition to run the Diagnosis WRAF Sensor characteristic line shift to rich					
LV_END_DIAG_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Diagnostic available for the WRAF Sensor characteristic line shift to lean					
LV_END_DIAG_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Diagnostic available for the WRAF Sensor characteristic line shift to rich					
LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
WRAF Sensor characteristic line shift to lean ERROR detected					
LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
WRAF Sensor characteristic line shift to rich ERROR detected					
LV_T_DLY_DIAG_SHIFT_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End flag of the shift down diagnosis in the no failure case (RBM purpose)					
T_DLY_DIAG_SHIFT_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Delay timer for the end flag of the shift down diagnosis in the no failure case (RBM purpose)					

### Input data:

LV_DIAG_AFL_CHK_SYM_LSL_UP [NC_CBK_EX_NR] {p. 5388}	LV_DIAG_AFR_CHK_SYM_LSL_UP [NC_CBK_EX_NR] {p. 5388}	LV_DIAG_EOL_END_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_DIAG_PLAUS_END_LSL_UP [NC_CBK_EX_NR] {p. 5422}
LV_DIAG_PLAUS_SYM_LSL_UP [NC_CBK_EX_NR] {p. 5422}	LV_END_DIAG_LAM_ADJ [NC_CBK_EX_NR] {p. 5215}	LV_ERR_LAM_ADJ [NC_CBK_EX_NR] {p. 5216}	LV_FAC_LAM_LIM_MAX [NC_CBK_EX_NR] {p. 2463}

LV_FAC_LAM_LIM_MIN [NC_CBK_EX_NR] {p. 2463}	LV_IGK {p. 906}	LV_ST_END {p. 1720}	NC_CBK_EX_NR {p. 1829}
NC_IDX_DIAG_SHIFT_ AFL_LSL_UP [NC_CBK_EX_NR]	NC_IDX_DIAG_SHIFT_ AFR_LSL_UP	STATE_DIAG_ACT_LS_ UP_DOWN [NC_CBK_EX_NR] {p. 5389}	STATE_SYM_DIAG_ PLAUS_LSL_UP [NC_CBK_EX_NR] {p. 5422}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DLY_DIAG_SHIFT_DOWN [NC_CBK_EX_NR]	-	0... FFFFH	0... 6553.5	0.1	s
Threshold for the "end flag" delay timer in the no failure case					

**Import actions:**

<b>ACTION_ERRM_NoFilterReset</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_NoFilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_LV_ERR_SET>,IN<PRM_LV_ERR_RST>,IN<PRM_LV_END_DIAG>,OUT<PRM_LV_ERR>)

**Error treatment:**


Diagnostic XX	Symptom description	Symptom	Filter type
SHIFT_AFL_LSL_U P[i]	Characteristic Line Shift to Lean	SYM_0	NO
SHIFT_AFR_LSL_U P[i]	Characteristic Line Shift to Rich	SYM_0	NO

**B.31.1 Delay time calculation after finishing fuel trim diagnosis without failure****FUNCTION DESCRIPTION:****General information:**

This function shall deliver information in the no failure case, indicating that the sensor characteristic shift down diagnosis could have finished in the failure case.

**Application conditions****Initialisation:**

At LV\_IGK = 0 to 1, reset **orat** clearing error memory:

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```
T_DLY_DIAG_SHIFT_DOWN[i] = 0
LV_T_DLY_DIAG_SHIFT_DOWN[i] = 0
```

**Recurrence:**

The function should be carried out once every 100 ms.

**Activation /Deactivation:**

The function will be carried out in case of

```
LV_ST_END = 1
```

**Formula section:**

```

if   T_DLY_DIAG_SHIFT_DOWN[i] >= C_T_DLY_DIAG_SHIFT_DOWN[i]
then LV_T_DLY_DIAG_SHIFT_DOWN[i] = 1
else   if   LV_END_DIAG_LAM_ADJ[i] = 1
          and   LV_ERR_LAM_ADJ[i] = 0
          then   increment T_DLY_DIAG_SHIFT_DOWN[i]
          endif
endif

```

**B.31.2 Sensor Characteristic Line Shift to Lean (CSD)****FUNCTION DESCRIPTION:****General information:**

This function shall deliver information indicating that the sensor characteristic line has a shift to lean (**CSD**), which shall be done by summarizing all similar failure symptoms of this kind.

It is assumed such deviation from the nominal behavior can be occur due to the poisoning of sensor reference air channel with fuel, but also due to a leak current inside the sensor, a very low reference air pump current (used in some types of wide range oxygen sensors) or a relatively high impedance short circuit to the battery voltage or ground in one of the four sensor lines.


In dependence of the shift strength that are three different paths followed by this function:

1. Strong shift to lean: lambda controller go to its limit and the plausibility check recognises this error.
2. Middle strong shift to lean: the trim controller goes to its limit but the lambda controller not, the trim controller deviation diagnosis recognises that the system has a problem and the active test detects that the problem is in the upstream sensor, this showing a characteristic line shift to lean.
3. Mild shift to lean: the trim controller goes to its limit but the lambda controller not. The trim controller I-share runs to its limit, whereas the trim ctr. deviation diagnosis are not able to recognise that the system has a problem. The trim ctr I-share diagnosis triggers the active test which detects that the problem is in the upstream sensor, this showing a characteristic line shift to lean.

**Application conditions****Initialisation:**

At LV\_IGK = 0 to 1, reset **orat** clearing error memory:

```
ACTION_ERRM_NoFilterReset( IN<NC_IDX_DIAG_SHIFT_AFL_LSL_UP[i]>,
```

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OUT<LV\_ERR\_SHIFT\_AFL\_LSL\_UP[i]>)

**Recurrence:**

The function should be carried out once every 100 ms.

**Activation /Deactivation:**

The diagnosis will be carried out

**If** LV\_ST\_END = 1 and LV\_ERR\_SHIFT\_AFL\_LSL\_UP[i] = 0

**Then**

LV\_CDN\_DIAG\_SHIFT\_AFL\_LSL\_UP[i] = 1 */activation*

**Else**

LV\_CDN\_DIAG\_SHIFT\_AFL\_LSL\_UP[i] = 0 */deactivation*

**Endif**

**Formula section:**

**IF** LV\_DIAG\_AFR\_CHK\_SYM\_LSL\_UP[i] = 1

% failure detected during active test

**OR**

LV\_DIAG\_PLAUS\_SYM\_LSL\_UP[i] = 1 &

STATE\_SYM\_DIAG\_PLAUS\_LSL\_UP[i] = SYM\_1 &

LV\_FAC\_LAM\_LIM\_MAX[i] = 1

% failure detected through plausibility test and lambda ctr. in limitation

**THEN**

LV\_ERR\_SHIFT\_AFL\_LSL\_UP[i] = 1

ERR\_SYM\_SHIFT\_AFL\_LSL\_UP[i] = SYM\_0

LV\_END\_DIAG\_SHIFT\_AFL\_LSL\_UP[i] = 1

**ELSE**

**% normal driving cycle, no error detected**

**IF** ( LV\_T\_DLY\_DIAG\_SHIFT\_DOWN[i] = 1

**OR** STATE\_DIAG\_ACT\_LS\_UP\_DOWN[i] = "check finished" )

**AND** LV\_DIAG\_PLAUS\_END\_LSL\_UP[i] = 1

**THEN** LV\_END\_DIAG\_SHIFT\_AFL\_LSL\_UP[i] = 1

**ELSE**

**% EOL Test, no error detected**

**IF** LV\_DIAG\_EOL\_END\_LS\_UP\_DOWN[i] = 1

**THEN**

LV\_END\_DIAG\_SHIFT\_AFL\_LSL\_UP[i] = 1

**ENDIF**

**ENDIF**

**ENDIF**


For failure and error management treatment the anti-bounce mechanism is called :

% if LV\_ERR\_XX=1 then LV\_ERR\_SET=1 or if LV\_ERR\_XX=0 then LV\_ERR\_RST=1

ACTION\_ERRM\_NoFilterSymptom( IN<NC\_IDX\_DIAG\_SHIFT\_AFL\_LSL\_UP[i]>, IN<LV\_CDN\_DIAG\_SHIFT\_AFL\_LSL\_UP[i]>, IN<ERR\_SYM\_SHIFT\_AFL\_LSL\_UP[i]>, IN<LV\_ERR\_SET\_SHIFT\_AFL\_LSL\_UP[i]>, IN<LV\_ERR\_RST\_SHIFT\_AFL\_LSL\_UP[i]>, IN<LV\_END\_DIAG\_SHIFT\_AFL\_LSL\_UP[i]>, OUT<LV\_ERR\_SHIFT\_AFL\_LSL\_UP[i]> )

### B.31.3 Sensor Characteristic Line Shift to Rich

**FUNCTION DESCRIPTION:**

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
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**General information:**

This function shall deliver information indicating that the sensor characteristic line has a shift to rich, which shall be done by summarizing all similar failure symptoms of this kind.

It is assumed such deviation from the nominal behavior can occur due to a leak current inside the sensor, as well as a relatively high impedance short circuit to the battery voltage or ground in one of the four sensor lines.

In dependence of the shift strength there are three different paths followed by this function:

1. Strong shift to rich: lambda controller go to its limit and the plausibility check recognises this error.
2. Middle strong shift to rich: the trim controller goes to its limit but the lambda controller not: The trim controller deviation diagnosis recognises that the system has a problem and the active test detects that the problem is in the upstream sensor showing a characteristic line shift to rich.
3. Mild shift to rich: the trim controller goes to its limit but the lambda controller not. The trim controller I-share runs to its limit, whereas the trim ctr. deviation diagnosis are not able to recognise that the system has a problem. The trim ctr I-share diagnosis triggers the active test which detects that the problem is in the upstream sensor, this showing a characteristic line shift to rich.

**Application conditions****Initialisation:**

At LV\_IGK = 0 to 1, reset **or**at clearing error memory:

```
ACTION_ERRM_NoFilterReset( IN< NC_IDX_DIAG_SHIFT_AFR_LSL_UP[i]>,
OUT<LV_ERR_SHIFT_AFR_LSL_UP[i]>)
```

**Recurrence:**

The function should be carried out once every 100 ms.

**Activation /Deactivation:**

The diagnosis will be carried out

**If** LV\_ST\_END = 1 and LV\_ERR\_SHIFT\_AFR\_LSL\_UP[i] = 0

**Then**

```
LV_CDN_DIAG_SHIFT_AFR_LSL_UP[i] = 1 /activation
```

**Else**

```
LV_CDN_DIAG_SHIFT_AFR_LSL_UP[i] = 0 /deactivation
```

**Endif****Formula section:**

**IF** LV\_DIAG\_AFL\_CHK\_SYM\_LSL\_UP[i] = 1

% failure detected during active test

**OR**

```
LV_DIAG_PLAUS_SYM_LSL_UP[i] = 1 &
```

```
STATE_SYM_DIAG_PLAUS_LSL_UP[i] = "SYM_0 &
```

```
LV_FAC_LAM_LIM_MIN[i] = 1
```


% failure detected through plausibility test. No open circuit failure detected.

**THEN**

```
LV_ERR_SHIFT_AFR_LSL_UP[i] = 1
```

```
ERR_SYM_SHIFT_AFR_LSL_UP[i] = SYM_0
```

```
LV_END_DIAG_SHIFT_AFR_LSL_UP[i] = 1
```

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**ELSE**

**% normal driving cycle, no error detected**

```

IF (LV_T_DLY_DIAG_SHIFT_DOWN[i] = 1
OR   STATE_DIAG_ACT_LS_UP_DOWN[i] = "check finished" )
AND   LV_DIAG_PLAUS_END_LSL_UP[i] = 1
THEN   LV_END_DIAG_SHIFT_AFR_LSL_UP[i] = 1

```

**ELSE**

**% EOL Test, no error detected**

```

IF LV_DIAG_EOL_END_LS_UP_DOWN[i] = 1
THEN
    LV_END_DIAG_SHIFT_AFR_LSL_UP[i] = 1
ENDIF

```

**ENDIF****ENDIF**

For failure and error management treatment the anti-bounce mechanism is called :

*% if LV\_ERR\_XX=1 then LV\_ERR\_SET=1 or if LV\_ERR\_XX=0 then LV\_ERR\_RST=1*

```

ACTION_ERRM_NoFilterSymptom( IN<NC_IDX_DIAG_SHIFT_AFR_LSL_UP[i]>, IN<LV_CDN_DIAG_
SHIFT_AFR_LSL_UP[i]>, IN< ERR_SYM_SHIFT_AFR_LSL_UP[i] >, IN< LV_ERR_SET_SHIFT_AFR_
LSL_UP[i] >, IN<LV_ERR_RST_SHIFT_AFR_LSL_UP[i]>, IN<LV_END_DIAG_SHIFT_AFR_LSL_UP[i]>,
OUT<LV_ERR_SHIFT_AFR_LSL_UP[i]> )

```

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## B.32 O2 sensor (lin, up) characteristic line diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_RBM_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of SHIFT_AFL_LSL_UP[NC_CBK_EX_NR] monitor with the Rate-Based Monitoring statistics Bit 0: conditions for monitoring are met long enough to detect malfunction (bit 0 = 1) Bit 1: inhibition of the monitor because of system failure(s) (bit 1 = 1) Bit					
STATE_RBM_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of SHIFT_AFR_LSL_UP[NC_CBK_EX_NR] monitor with the Rate-Based Monitoring statistics Bit 0: conditions for monitoring are met long enough to detect malfunction (bit 0 = 1) Bit 1: inhibition of the monitor because of system failure(s) (bit 1 = 1) Bit					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	LC_DIAG_PUE_ACT_LS_ DOWN {p. 5191}	LV_END_DIAG_SHIFT_ AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_END_DIAG_SHIFT_ AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}
LV_IGK {p. 906}	LV_INH_DIAG_RBM_ PLAUS_LSL_UP [NC_CBK_EX_NR] {p. 5429}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}

### Import actions:

**ACTION\_ERRM\_CheckPendingStatus** (IN<PRM\_IDX\_DIAG>,OUT<PRM\_LV\_ERR\_PND>)

### B.32.1 Upstream sensor lean/rich - shift diagnosis: Interface for rate - based - monitoring

#### FUNCTION DESCRIPTION:

#### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1


i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

With this module the interface between the SHIFT\_AFL\_LSL\_UP[i] and SHIFT\_AFR\_LSL\_UP[i] monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_SHIFT\_AFL\_LSL\_UP[i] and STATE\_RBM\_SHIFT\_AFR\_LSL\_UP[i] data.

Within STATE\_RBM\_SHIFT\_AFL/AFR[i], three different informations are defined:

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- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)  
( not valid for lean/rich shift diagnosis )

### Application conditions

#### Initialisation:

```

at ECU reset:
    bit 0, bit 1 and bit 2 of STATE_RBM_SHIFT_AFL_LSL_UP[i]
= 0
    bit 0, bit 1 and bit 2 of STATE_RBM_SHIFT_AFR_LSL_UP[i]
= 0
LV_DC = 0 - -> 1 transition:
    bit 0 and bit 1 of STATE_RBM_SHIFT_AFL_LSL_UP[i] = 0
    bit 0 and bit 1 of STATE_RBM_SHIFT_AFR_LSL_UP[i] = 0
    bit 2 of STATE_RBM_SHIFT_AFL_LSL_UP[i] = 1
    bit 2 of STATE_RBM_SHIFT_AFR_LSL_UP[i] = 1
on failure memory reset:
    bit 1 of STATE_RBM_SHIFT_AFL_LSL_UP[i] = 0
    bit 1 of STATE_RBM_SHIFT_AFR_LSL_UP[i] = 0

```

#### Recurrence:

1 s

#### Activation:

LV\_DC = 1


#### Deactivation:

LV\_DC = 0

### Formula section:

#### At LV\_DC 0 - -> 1 transition

The pending status of the following failures has to be checked only once :

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Dependence	Error			
	LV_ERR_AMP	LV_ERR_AMP_PLAUS	LV_ERR_CHG_LS_UP	LV_ERR_CRK_PLAUS
	LV_ERR_CRK_SYN	LV_ERR_CRK_TOOTH	LV_ERR_CRK_TOOTH_PER	LV_ERR_DIAG_CPS
	LV_ERR_EL_CPS	LV_ERR_FTL_MIN	LV_ERR_FUP	LV_ERR_FUP_MFP_PLAUS
	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PR_S_SYS	LV_ERR_LOAD_TPS_PLAUS
	LV_ERR_MAF_FRQ_EL	LV_ERR_MAF_FRQ_GRD	LV_ERR_MAF_FRQ_RNG	LV_ERR_MAP_PLAUS
	LV_ERR_MAP_TPS_PLAUS	LV_ERR_MTC_CTL_2	LV_ERR_MTC_CTL_3	LV_ERR_MTC_DR
	LV_ERR_TPS_1	LV_ERR_TPS_2	LV_ERR_TPS_AD	LV_ERR_TPS_AD_BOL
	LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2	LV_ERR_TPS_RATIO	LV_ERR_TPS_ST_CHK_2
LV_ERR_VCV				
NC_CBK_EX_NR	LV_ERR_AIR_LSL_UP[i]	LV_ERR_CAT_DIAG[i]	LV_ERR_CTL_LSL_UP[i]	LV_ERR_DYN_VLD_LS_UP[i]
	LV_ERR_EL_LSL_UP[i]	LV_ERR_LSH_DOWN[i]	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]
	LV_ERR_OBD_LSH_DOWN[i]	LV_ERR_OBD_VLD_LSH_UP[i]	LV_ERR_OC_LS_DOWN[i]	LV_ERR_OC_LSL_UP[i]
	LV_ERR_OFS_LSL_UP[i]	LV_ERR_PUC_LS_DOWN[i]	LV_ERR_PUC_VLD_LS_UP[i]	LV_ERR_PUE_LS_DOWN[i]
	LV_ERR_SCG_LS_DOWN[i]	LV_ERR_SCP_LS_DOWN[i]	LV_ERR_SWT_LS_DOWN[i]	LV_ERR_TTIP_MES_LSH_UP[i]

Figure B.32.1: n = 1 for any i

NC_NR_CBK_IVVT	LV_ERR_CAM_CST_IVT_EX[n]	LV_ERR_CAM_CST_IVT_IN[n]	LV_ERR_MEC_IVVT_EX[n]	LV_ERR_MEC_IVVT_IN[n]
	LV_ERR_SLV_IVVT_EX[n]	LV_ERR_SLV_IVVT_IN[n]		

Figure B.32.2: m = 1 for any i

NC_NR_CAM_CBK	LV_ERR_PER_CAM_EX[m]	LV_ERR_PER_CAM_IN[m]	LV_ERR_PLAUS_CAM_EX[m]	LV_ERR_PLAUS_CAM_IN[m]
	LV_ERR_REF_CRK_CAM_EX[m]	LV_ERR_REF_CRK_CAM_IN[m]	LV_ERR_SYN_CAM_EX[m]	LV_ERR_SYN_CAM_IN[m]
	LV_ERR_SYN_CRK_CAM_IN[m]	LV_ERR_TOOTH_OFF_EX[m]	LV_ERR_TOOTH_OFF_IN[m]	

Figure B.32.3: For NC\_CBK\_EX\_NR = i = 1

NC_CYL_NR	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	LV_ERR_MIS[0]
	LV_ERR_MIS[2]	LV_ERR_MIS[4]		

Figure B.32.4: For NC\_CBK\_EX\_NR = i = 2

<b>NC_CYL_NR</b>	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	LV_ERR_MIS[1]
	LV_ERR_MIS[3]	LV_ERR_MIS[5]		

**If(1)** { CPU optimization at LV\_IGK 0 -> 1 transition }  
CTR\_ERR\_DYN\_NR <> 0 { the dynamic failure memory isn't empty }

**Then(1)**

**While** bit 1 of STATE\_RBM\_SHIFT\_AFL\_LSL\_UP[i] = 0 **do**  
with each XX failure of the above list except LV\_ERR\_PUE\_LS\_DOWN (depending on configuration, see below):  
ACTION\_ERRM\_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<CALL>)

**If(2)** XX has a pending status  
**Then(2)** bit 1 of STATE\_RBM\_SHIFT\_AFL\_LSL\_UP[i] = 1  
**Endif(2)**

For LV\_ERR\_PUE\_LS\_DOWN, do the following instead:

**If** LC\_DIAG\_PUE\_ACT\_LS\_DOWN = 1  
**then**  
ACTION\_ERRM\_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<CALL>)  
**If(3)** XX has a pending status  
**Then(3)** bit 1 of STATE\_RBM\_SHIFT\_AFL\_LSL\_UP[i] = 1  
**Endif(3)**  
**Endif(2)**

**Endwhile**

bit 1 of STATE\_RBM\_SHIFT\_AFR\_LSL\_UP[i] =  
bit 1 of STATE\_RBM\_SHIFT\_AFL\_LSL\_UP[i]

**Else(1)** { the dynamic failure memory is empty } No action  
**Endif(1)**

Every 1 s :

**If** bit 0 of STATE\_RBM\_SHIFT\_AFL\_LSL\_UP[i] = 0

**Then**

**If** LV\_END\_DIAG\_SHIFT\_AFL\_LSL\_UP[i] = 1  
**Then** bit 0 of STATE\_RBM\_SHIFT\_AFL\_LSL\_UP[i] = 1  
**Endif**

**Endif**

**If** bit 0 of STATE\_RBM\_SHIFT\_AFR\_LSL\_UP[i] = 0

**Then**

**If** LV\_END\_DIAG\_SHIFT\_AFR\_LSL\_UP[i] = 1  
**Then** bit 0 of STATE\_RBM\_SHIFT\_AFR\_LSL\_UP[i] = 1  
**Endif**

**Endif**

**If** bit 1 of STATE\_RBM\_SHIFT\_AFL\_LSL\_UP[i] = 0

**Then**

**If** LV\_INH\_DIAG\_RBM\_PLAUS\_LSL\_UP[i] = 1  
**Then** bit 1 of STATE\_RBM\_SHIFT\_AFL\_LSL\_UP[i] = 1  
bit 1 of STATE\_RBM\_SHIFT\_AFR\_LSL\_UP[i] = 1  
**Endif**

**Endif**

Diagnosis	Symptom	Nr	P-Code/ Failure	P-Code/ Symptom	Hardware config	Recurrence	Failure class A/B
O2 Sensor characteristic line shift to rich	See Table of failure	0	See Table of failure	See Table of failure			See Table of failure
SHIFT_AFR_LSL_UP[i]							

Figure B.32.5: Diagnosis

Diagnosis	Symptom	Nr	P-Code/ Failure	P-Code/ Symptom	Hardware config	Recurrence	Failure class A/B
O2 Sensor characteristic line shift to lean	See Table of failure	0	See Table of failure	See Table of failure			See Table of failure
SHIFT_AFL_LSL_UP[j]							



## B.33 O2 sensor (lin, up) dynamic diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_WAIT_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Number of forced stimulation periods before carrying out amplitude measurements					
CYCNR_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
number of cycles necessary to finish the diagnosis					
CYCNR_DIAG_DYN_LSL_UP_ERR [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Number of diag cycles over threshold during linear lambda dynamic diagnosis					
ERR_SYM_DYN_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom to be transmitted to the error management					
FAC_COMP_MV_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Mean value of normalised asymmetric single factor					
FAC_COMP_MV_DIAG_DYN_SENS_MDL [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Dynamic diagnosis asymmetric factor used in lambda controller plant model					
FAC_COMP_SUM_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-6553.6 ...6553.6	3.05175e-6	-
Summation over all normalised asymmetric single factor					
FAC_COMP_VALUE_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Normalised asymmetric single factor					
FAC_COMP_VALUE_DYN_LSL_UP_TMP [NC_CBK_EX_NR]	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Temporary normalised asymmetric single factor					
FAC_COMP_VALUE_MAX_DYN_LSL_UP [NC_CBK_EX_NR]	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Maximum of normalised asymmetric single factor					
FAC_COMP_VALUE_MIN_DYN_LSL_UP [NC_CBK_EX_NR]	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Minimum normalised asymmetric single factor					
FAC_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	O/V/S	0... 400H	0 ...1	976.562e-6	-
Adaption factor to the modeled sensor time constant					
FAC_DIAG_DYN_LSL_UP_ERR [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Normalised single sensor signal amplitude (bad sample for later service 06h output)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_DIAG_DYN_LSL_UP_OK [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Normalised single sensor signal amplitude (good sample for later service 06h output)					
FAC_DLY_DIAG_LSL_TMP [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Scaled result of delay diagnosis (for evaluation and mode\$06)					
FAC_DLY_LSL_UP_DIAG_SAE [NC_CBK_EX_NR]	O/V/S	0... FFFFH	0... 65.535	0.001	-
Service 06h test value of upstream lambda sensor dynamics (effect) diagnosis					
FAC_DLY_LSL_UP_DIAG_TOL_SAE [NC_CBK_EX_NR]	O/V/S	0... FFFFH	0... 65.535	0.001	-
Service 06h top limit of upstream lambda sensor dynamics (effect) diagnosis					
FAC_DYN_LSL_UP_DIAG_SAE [NC_CBK_EX_NR]	O/V/S	0... FFFFH	0... 65.535	0.001	-
Service 06h test value of upstream lambda sensor dynamics diagnosis					
FAC_DYN_LSL_UP_DIAG_TOL_SAE [NC_CBK_EX_NR]	O/V/S	0... FFFFH	0... 65.535	0.001	-
Service 06h top limit of upstream lambda sensor dynamics diagnosis					
FAC_MV_COR_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Temporary mean value of normalised asymmetric single factor (coorrected - MAF, N)					
FAC_MV_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Mean value of normalised single sensor signal amplitude					
FAC_MV_SUM_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Temporary mean value of normalised asymmetric single factor					
FAC_SUM_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFFFFFH	0... 4.19430399902e6	976.562e-6	-
Summation over all normalised single sensor signal amplitude					
FAC_VALUE_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Normalised single sensor signal amplitude					
FAC_VALUE_MAX_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Maximum of normalised single sensor signal amplitude					
FAC_VALUE_MIN_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Minimum of normalised single sensor signal amplitude					
LAMB_AMPL_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FH	0... 0.1240234375	976.562e-6	-
carried out single sensor signal amplitude measurement					
LAMB_AMPL_MAX_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FH	0... 0.1240234375	976.562e-6	-
Maximum acceptable carried out single sensor signal amplitude measurement					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_AMPL_MIN_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FH	0... 0.1240234375	976.562e-6	-
Minimum acceptable carried out single sensor signal amplitude measurement					
LAMB_COR_DIAG_DYN_LS_UP [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Upstream lambda, corrected by slow trim control shares					
LAMB_DIF_MAX_DYN_LSL_UP_COMP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Difference between the maximum lambda value of the diagnosis and the real maximum					
LAMB_DIF_MIN_DYN_LSL_UP_COMP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Difference between the minimum lambda value of the diagnosis and the real minimum					
LAMB_LPF_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Lambda value filtered with a Low Pass Filter					
LAMB_LPF_GRD_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	8000... 7FFFH	-3.2... 3.19990234375	97.6562e-6	-
Gradient of the filtered lambda signal					
LAMB_MAX_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Maximum value of the lambda sensor signal (per sample period)					
LAMB_MAX_DIAG_DYN_LSL_UP_COMP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Real maximum value of the lambda sensor signal (per sample period)					
LAMB_MAX_DIAG_DYN_LSL_UP_TMP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Highest signal level seen so far during current lean monitoring period					
LAMB_MAX_DYN_LSL_UP_COMP_TMP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Temporary real maximum value of the lambda sensor signal (per sample period)					
LAMB_MIN_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Minimum value of the lambda sensor signal (per sample period)					
LAMB_MIN_DIAG_DYN_LSL_UP_COMP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Real minimum value of the lambda sensor signal (per sample period)					
LV_CDN_DIAG_DYN_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating condition of correspondent diagnosis					
LV_CYCNR_DYN_LSL_UP_VLD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Number of carried out single valid amplitude calculation					
LV_DIAG_DYN_CDN_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Diagnosis condition					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_DYN_END_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Result of diagnosis exist					
LV_DIAG_DYN_LSL_UP_CYC_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Indicator for completed minimum amplitude measurement period, trigger for cycle evaluation					
LV_DIAG_DYN_LSL_UP_ENA	V	0... 1H	0 ...1	1	-
Indication that forced stimulation and lambda control are set for amplitude diagnosis					
LV_DIAG_DYN_LSL_UP_LDC_MAF	V	0... 1H	0 ...1	1	-
Indication of low enough MAF dynamics in linear lambda dynamics diagnosis					
LV_DIAG_DYN_LSL_UP_LDC_N	V	0... 1H	0 ...1	1	-
Indication of low enough N dynamics in linear lambda dynamics diagnosis					
LV_DIAG_DYN_LSL_UP_LDC_TQ	V	0... 1H	0 ...1	1	-
Indication of low enough FAC_TQ_REQ dynamics in linear lambda dynamics diagnosis					
LV_DIAG_DYN_SYM_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounce diagnosis value of the sensor dynamics					
LV_DLY_DIAG_ACT_LAM_GAIN	O/V	0... 1H	0 ...1	1	-
Switch of lambda controller parameters for linear lambda sensor delay diagnosis activated					
LV_DLY_ERR_LSL_DIAG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Error indicator of linear sensor signal delay diagnosis					
LV_END_DIAG_DYN_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating end of correspondent diagnosis					
LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the validation of correspondent symptom (transmitted to the error management)					
LV_FAC_COMP_DIAG_DYN_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable to indicate an asymmetric failure					
LV_LAM_ADJ_REQ_DYN_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request dynamic trim controller parameters specific for the WRAF sensor dynamic					
LV_LAMB_PLS_REQ_DYN_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request forced stimulation parameters specific for the WRAF sensor dynamic					
LV_LS_DIAG_MNG_PRIO_CAT_ACT	-	0... 1H	0 ...1	1	-
Intermediate flag indicating cat diag request for forced stimulation					
LV_LS_DIAG_MNG_PRIO_CAT_END	-	0... 1H	0 ...1	1	-
Intermediate flag indicating cat diag completion					
LV_LS_DIAG_MNG_PRIO_DLY_ACT	-	0... 1H	0 ...1	1	-
Intermediate flag indicating dynamic diag (effect diag) request for forced stimulation and lambda control					
LV_LS_DIAG_MNG_PRIO_DLY_END	-	0... 1H	0 ...1	1	-
Intermediate flag indicating dynamic diag (effect diag) completion					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LS_DIAG_MNG_PRIO_DLY_REQ	V	0... 1H	0 ...1	1	-
Request from dynamic (effect) diagnosis for forced stimulation after prioritization					
LV_LS_DIAG_MNG_PRIO_DYN_ACT	-	0... 1H	0 ...1	1	-
Intermediate flag indicating dynamic diag (amplitude diag) request for forced stimulation and lambda control					
LV_LS_DIAG_MNG_PRIO_DYN_END	-	0... 1H	0 ...1	1	-
Intermediate flag indicating dynamic diag (amplitude diag) completion					
LV_LS_DIAG_MNG_PRIO_DYN_REQ	V	0... 1H	0 ...1	1	-
Request from dynamic (amplitude) diagnosis for forced stimulation after prioritization					
LV_LS_DIAG_REQ_INH_CAT_DIAG	O/V	0... 1H	0 ...1	1	-
Request from diagnosis priority manager to deactivate catalyst diagnosis					
MAF_KGH_MMV_DYN_LSL_UP_LDC	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Moving mean value for LDC					
N_MMV_DYN_LSL_UP_LDC	V	0... 1FE0H	0... 8160	1	rpm
Moving mean value for LDC					
STATE_DYN_DIAG [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H	PASSIVE WAIT ACQUISITION END	-	-
State shows the condition of the forced stimulation					
STATE_LAM_GAIN_REQ_LS_DIAG	O/V	0H 1H 2H	NONE DYN_DIAG DLY_DIAG	-	-
Request for specific lambda controller parameters for lambda sensor diagnoses					
STATE_LAMB_PLS_REQ_LS_DIAG	O/V	0H 1H 2H	NONE DYN_DIAG DLY_DIAG	-	-
Request for forced lambda stimulation for lambda sensor diagnoses					
T_CON_LAMB_AFL_DYN_LS_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer to detect a local maximum to avoid false diagnosis					
T_CON_LAMB_AFR_DYN_LS_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer to detect a local minimum to avoid false diagnosis					
T_DIAG_DYN_LSL_UP_LDC_MAF	V	0... FFH	0... 5.1	0.02	s
Delay timer after MAF dynamics in linear lambda dynamics diagnosis					
T_DYN_DIAG_AFL [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer for maximum amplitude measurement duration after LV_AFL 0 -> 1					
T_DYN_DIAG_AFL_COMP [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer for real lambda maximum detection (asymmetric failure detection)					
T_DYN_DIAG_AFL_THD [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Start delay limit for maximum amplitude measurement period after LV_AFL 0 -> 1					
T_DYN_DIAG_AFR [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer for maximum amplitude measurement duration after LV_AFL 1 -> 0					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_DYN_DIAG_AFR_COMP [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer for real lambda maximum detection (asymmetric failure detection)					
T_DYN_DIAG_AFR_THD [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Start delay limit for minimum amplitude measurement period after LV_AFL 1 -> 0					
TQ_MMV_DIAG_DYN_LSL_UP	V	0... FFFFH	0... 1.9999694824218	30.5175e-6	-
Moving mean of FAC_TQ_REQ for limited dynamics in linear lambda dynamics diagnosis					

**Input data:**

C_FAC_DIAG_DYN_S_LSL_UP_MAX {p. 5314}	FAC_DLY_DIAG_LSL_OUT [NC_CBK_EX_NR] {p. 5258}	FAC_MV_DIAG_DYN_S_LSL_UP [NC_CBK_EX_NR] {p. 5313}	FAC_TQ_REQ {p. 6706}
LAMB_DELTA_AD_LAM_ADJ [NC_CBK_EX_NR] {p. 2622}	LAMB_DELTA_I_LAM_ADJ [NC_CBK_EX_NR] {p. 2589}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LV_AFL [NC_CBK_EX_NR] {p. 2439}
LV_CAT_DIAG_ACT_EXT {p. 5377}	LV_CAT_DIAG_END_EXT {p. 5377}	LV_CAT_PURGE_ACT [NC_CBK_EX_NR] {p. 2927}	LV_DIAG_DYN_INH_LSL_UP [NC_CBK_EX_NR] {p. 5377}
LV_DIAG_DYN_S_LSL_UP_END [NC_CBK_EX_NR] {p. 5313}	LV_DIAG_DYN_S_LSL_UP_ERR [NC_CBK_EX_NR] {p. 5313}	LV_DIAG_EOL_DYN_LS_UP [NC_CBK_EX_NR] {p. 5377}	LV_DLY_DIAG_ACT_EXT {p. 5377}
LV_DLY_DIAG_END_EXT {p. 5377}	LV_DLY_DIAG_REQ_LAM_GAIN [NC_CBK_EX_NR] {p. 5259}	LV_DLY_END_LSL_DIAG [NC_CBK_EX_NR] {p. 5259}	LV_DYN_DIAG_ACT_EXT {p. 5377}
LV_DYN_DIAG_END_EXT {p. 5377}	LV_FAC_LAM_LIM_MAX [NC_CBK_EX_NR] {p. 2463}	LV_FAC_LAM_LIM_MIN [NC_CBK_EX_NR] {p. 2463}	LV_IGK {p. 906}
LV_INH_DIAG_DYN_VLD_LS_UP_ERR [NC_CBK_EX_NR] {p. 5377}	LV_INTR_DIAG_LS_DYN [NC_CBK_EX_NR] {p. 803}	LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}	LV_LAM_GAIN_LS_DIAG {p. 2463}
LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}	LV_LAMB_PLS_LS_DIAG {p. 2579}	LV_LS_DIAG_MNG_PRIO_EXT {p. 5377}	LV_LS_DIAG_REQ_INH_CAT_DIAG_EXT {p. 5377}
LV_VLS_DIF_DLY_LDC [NC_CBK_EX_NR] {p. 5216}	MAF {p. 8277}	MAF_HB {p. 805}	MAF_KGH {p. 1195}
N {p. 1525}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_IDX_DIAG_DYN_VLD_LS_UP
STATE_CAT_DIAG [NC_CBK_EX_NR] {p. 5474}	STATE_LAMB_PLS_REQ_LS_DIAG_EXT {p. 5377}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_LPF_FAC_AD_DYN_LSL_UP	O/V	0... FFH	0... 0.99609375	0.00390625	-
Correlation factor for low pass filtered (sensor time constant) adaptation factor					
C_CRLC_LPF_LAMB_DIAG_DYN_LSL_UP	O/V	0... FFFFH	0... 0.9999847412109	15.2587e-6	-
Correlation factor for low pass filtered lambda value					
C_CTR_WAIT_DIAG_DYN_LSL_UP	O/V	0... FFH	0... 255	1	-
Number of forced stimulation periods during the diagnosis status transition "wait" to "acquisition"					
C_CYCNR_END_DIAG_DYN_LSL_UP	O/V	0... FFH	0... 255	1	-
Number of long term mean values to deliver the sensor dynamic diagnostic					
C_CYCNR_EOL_DIAG_DYN_LSL_UP	O/V	0... FFH	0... 255	1	-
Number of long term mean values to deliver the sensor dynamic diagnostic (EOL test)					
C_CYCNR_MIN_DIAG_DYN_LSL_UP	O/V	0... FFH	0... 255	1	-
Minimum number of short term mean values to calculate the long term mean value					
C_FAC_AD_RST_DIAG_DYN_LSL_UP	O/V	0... FFFFH	0... 65.535	0.001	-
Diagnosis value threshold to reset adaptation of sensor time constant model					
C_FAC_AD_THD_DIAG_DYN_LSL_UP	O/V	0... FFFFH	0... 65.535	0.001	-
Diagnosis value threshold for begin adaptation of sensor time constant model					
C_FAC_COMP_L2R_DIAG_DYN_LSL_UP	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Constant for asymmetric failure detection from L2R					
C_FAC_COMP_L2R_MIN_DYN_LSL_UP	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Minimum threshold to remove the maximum outlier (L2R failure case)					
C_FAC_COMP_NOM_DYN_LSL_UP	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Nominal threshold to remove the minimum or maximum outlier (L2R or R2L good case)					
C_FAC_COMP_NOM_L2R_DYN_LSL_UP	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Nominal minimum threshold to remove the minimum outlier (L2R good case)					
C_FAC_COMP_NOM_R2L_DYN_LSL_UP	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Maximum threshold to remove the maximum outlier (R2L good case)					
C_FAC_COMP_R2L_DIAG_DYN_LSL_UP	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Constant for asymmetric failure detection from L2R					
C_FAC_COMP_R2L_MAX_DYN_LSL_UP	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Maximum threshold to remove the minimum outlier (R2L failure case)					
C_FAC_COMP_SENS_MDL_L2R_ACT	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Calibration constant to activate the slow L2R plant model					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_COMP_SENS_MDL_L2R_DEAC	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Calibration constant to deactivate the slow L2R plant model					
C_FAC_COMP_SENS_MDL_R2L_ACT	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Calibration constant to activate the slow R2L plant model					
C_FAC_COMP_SENS_MDL_R2L_DEAC	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Calibration constant to deactivate the slow R2L plant model					
C_FAC_DLY_DIAG_LSL_THD	O/V	8000... 7FFFH	-50... 49.998474121093	0.00152587	-
Threshold to set the linear sensor signal delay error					
C_FAC_MAF_DYW_NEG_DYN_LSL_UP	V	8000... 7FFFH	-8... 7.999755859375	244.14e-6	-
Calibratable factor for the dynamic engine load deviation					
C_FAC_MIN_LAMB_AMPL_DIAG_DYN	O/V	0... FFH	0... 1.275	0.005	-
Lambda dynamic diagnosis amplitude threshold (fraction of IP_LAMB_AMPL_MIN_DIAG_DYN_LSL_UP) for increased weight of bad diagnostic values					
C_FAC_MV_MAX_DIAG_DYN_LSL_UP	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Average of Lambda dynamic diagnosis diagnostic value, max value					
C_FAC_MV_MIN_DIAG_DYN_LSL_UP	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Average of Lambda dynamic diagnosis diagnostic value, min value					
C_FAC_MV_THD_DIAG_DYN_LSL_UP	O/V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Limited diagnosis value for the error diagnosis					
C_FAC_VALUE_NOT_PLAUS_DIAG_DYN	O/V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Lambda dynamic diagnosis diagnostic value increase for signal amplitudes of exactly 0					
C_LAMB_AMPL_MAX_DYN_LSL_UP	O/V	0... 7FH	0... 0.1240234375	976.562e-6	-
Calibration data for adjust the expected amplitude: low range					
C_LAMB_AMPL_MIN_DYN_LSL_UP	O/V	0... 7FH	0... 0.1240234375	976.562e-6	-
Calibration data for adjust the expected amplitude: low range					
C_LAMB_LPF_GRD_MIN_DIAG_DYN	O/V	8000... 7FFFH	-3.2... 3.19990234375	97.6562e-6	-
Minimum lambda signal gradient for search of min/max values in sensor dynamic diagnosis					
C_LAMB_LPF_HYS_DYN_LSL_UP	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Constant to set the allowed difference between Lambda and MAX/MIN Lambda					
C_LAMB_MAX_DIAG_DYN_LSL_UP	O/V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Highest allowed sensor signal max value					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_MIN_DIAG_DYN_LSL_UP	O/V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Lowest allowed sensor signal min value					
C_MAF_CRLC_DYN_LSL_UP	V	0... FFFFH	0... 0.999985	15.3186e-6	-
Correlation factor for low pass filtered mass air flow					
C_MAF_KGH_MIN_DIAG_DYN	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Minimum air mass flow to activate the lambda sensor dynamic diagnosis					
C_MAF_MAX_DIAG_DYN_LSL_UP	O/V	0... FFFFH	0... 1389	0.02119478	mg/stk
Maximum mass airflow rate to activate the diagnosis function					
C_MAF_MIN_DIAG_DYN_LSL_UP	O/V	0... FFFFH	0... 1389	0.02119478	mg/stk
Minimum mass airflow rate to activate the diagnosis function					
C_N_CRLC_LDC_DYN_LSL_UP	V	0... FFFFH	0... 0.999985	15.3186e-6	-
Correlation factor for low pass filtered engine speed					
C_N_DYW_DIAG_DYN_LSL_UP	O/V	0... 1FE0H	0... 8160	1	rpm
Maximum dynamic engine speed deviation for limited dynamics (linear sensor dynamic diagnosis)					
C_N_MAX_DIAG_DYN_LSL_UP	O/V	0... FFH	0... 8160	32	rpm
Maximum engine speed to activate the diagnosis					
C_N_MIN_DIAG_DYN_LSL_UP	O/V	0... FFH	0... 8160	32	rpm
Minimum engine speed to activate the diagnosis					
C_RATIO_DIAG_DYN_LSL_UP_STC	O/V	0... FFH	0... 0.99609375	0.00390625	-
Maximum ratio of failed diagnostic cycles for statistical evaluation in linear lambda dynamics diagnosis					
C_STATE_PRIO_INH_DIAG_CAT	O/V	0... FFH	0... 255	1	-
Bit vector for prioritization of other diagnoses over catalyst diagnosis					
C_STATE_PRIO_INH_DIAG_DLY	O/V	0... FFH	0... 255	1	-
Bit vector for prioritization of other diagnoses over lambda sensor dynamic (effect) diagnosis					
C_STATE_PRIO_INH_DIAG_DYN	O/V	0... FFH	0... 255	1	-
Bit vector for prioritization of other diagnoses over lambda sensor dynamic (amplitude) diagnosis					
C_T_CON_LAMB_DYN_LS_UP	V	0... FFFFH	0... 1310.7	0.02	s
Constant to set the monitoring time for a local maximum and minimum					
C_TQ_CRLC_DIAG_DYN_LSL_UP	O/V	0... FFFFH	0... 0.9999847412109	15.2587e-6	-
Correlation factor for TQ request limited dynamics in linear lambda dynamics diagnosis					
C_TQ_DYW_DIAG_DYN_LSL_UP	O/V	0... FFFFH	0... 1.9999694824218	30.5175e-6	-
Maximum deviation from MMV for TQ dynamics in linear lambda dynamics diagnosis					
IP_FAC_COMP_DYN_LSL_UP	V	0... FFH	0... 31.875	0.125	-
LDP_FAC_COMP_MV_DYN_LSL_UP	8	0... FFFFH	-32... 31.9990234375	976.562e-6	-
Calculation of the weighting factor for the asymmetric failure detection					
IP_FAC_COMP_VALUE_DYN_LSL_UP	V	0... FFH	0... 12.75	0.05	-
LDPM_N_32_LS_UP_DYN	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_LS_UP_DYN	8	0... FFH	0... 1389	5.44705882	mg/stk
Correction factor for the calculation of asymmetric failure detection					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_SCA_FAC_MV_DIAG_DYN	O/V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
LDP_FAC_MV_DIAG_DYN_S_LSL_UP	4	0... 7FFFH	0... 127.99609	0.00390624	-
Scaling of result from dynamic diagnosis after NoX-cat-regeneration to fit result from dynamic diagnosis (homogen)					
IP_FAC_VALUE_DYN_LSL_UP_COMP	V	0... FFFFH	-32... 31.9990234375	976.562e-6	-
LDP_LAMB_DIF_MAX_DYN_LSL_UP	8	0... 7FFFH	0... 31.99902344	976.562e-6	-
LDP_LAMB_DIF_MIN_DYN_LSL_UP	8	0... 7FFFH	0... 31.99902344	976.562e-6	-
Map to set the dif-ratio factor for the asymmetric failure detection					
IP_LAMB_AMPL_MAX_DYN_LSL_UP	O/V	0... 7FH	0... 0.1240234375	976.562e-6	-
LDPM_N_32_LS_UP_DYN	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_LS_UP_DYN	8	0... FFH	0... 1389	5.44705882	mg/stk
Nominal sensor expected amplitude during the Dynamic Diagnosis Rem.: The same points in LDPM_N_32_2_EGTR and LDPM_MAF_HB_2_EGTR shall be used					
IP_LAMB_AMPL_MIN_DYN_LSL_UP	O/V	0... 7FH	0... 0.1240234375	976.562e-6	-
LDPM_N_32_LS_UP_DYN	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_LS_UP_DYN	8	0... FFH	0... 1389	5.44705882	mg/stk
Limit sensor expected amplitude during the Dynamic Diagnosis Rem.: The same points in LDPM_N_32_2_EGTR and LDPM_MAF_HB_2_EGTR shall be used					
IP_MAF_KGH_DYW_DYN_LSL_UP	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_MAF_KGH_DYW_DYN_LSL_UP	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
Maximum dynamic engine load deviation for limited dynamics					
IP_T_DIAG_DYN_LSL_UP_LDC_MAF	V	0... FFH	0... 5.1	0.02	s
LDP_MAF_IP_T_DIAG_DYN_LSL_UP	2	0... FFFFH	0... 1389	0.02119478	mg/stk
LDP_VS_IP_T_DIAG_DYN_LSL_UP	2	0... FFH	0... 255	1	km/h
Delay timer after MAF dynamics in linear lambda dynamics diagnosis					
IP_T_DYN_DIAG	O/V	0... FFFFH	0... 1310.7	0.02	s
LDPM_N_32_LS_UP_DYN	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_LS_UP_DYN	8	0... FFH	0... 1389	5.44705882	mg/stk
Amplitude measurement time: same points than in LDPM_N_32_2_EGTR and LDPM_MAF_HB_2_EGTR shall be used					
IP_T_DYN_DIAG_COMP	V	0... FFFFH	0... 1310.7	0.02	s
LDPM_N_32_LS_UP_DYN	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_LS_UP_DYN	8	0... FFH	0... 1389	5.44705882	mg/stk
Real maximum and minimum lambda measurement time					
IP_T_DYN_DIAG_THD [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1310.7	0.02	s
LDPM_N_32_LS_UP_DYN	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_LS_UP_DYN	8	0... FFH	0... 1389	5.44705882	mg/stk
Amplitude measurement start delay of linear lambda dynamics diagnosis					
LC_DIAG_DYN_AFR_DLY_ENA	O/V	0... 1H	0 ...1	1	-
Enable extension of rich minimum search into next lean half period					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_DIAG_DYN_LSL_UP_CAT_SYN	O/V	0... 1H	0 ...1	1	-
Boolean switch to synchronise the dynamic diagnosis with the catalyst efficiency diagnosis					
LC_DIAG_DYN_LSL_UP_DLY_ACT	O/V	0... 1H	0 ...1	1	-
Enable evaluation of delay diagnosis result					
LC_DIAG_DYN_LSL_UP_LAM_OFF	O/V	0... 1H	0 ...1	1	-
Disable check for lambda controller limitation in linear lambda dynamics diagnosis					
LC_DIAG_DYN_LSL_UP_LDC_TQ	O/V	0... 1H	0 ...1	1	-
Enable alternate LDC in linear lambda dynamics diagnosis					
LC_DIAG_DYN_LSL_UP_STC	O/V	0... 1H	0 ...1	1	-
Enable statistical evaluation in linear lambda dynamics diagnosis					
LC_FAC_MV_DIAG_DYN_LSL_UP_UPD	V	0... 1H	0 ...1	1	-
Switch to actualise the mean value of normalised single sensor signal amplitude (= 1)					
LC_LAMB_COR_DIAG_DELTA_LAM_ADJ	V	0... 1H	0 ...1	1	-
Switch for Upstream lambda correction with deltas					
LC_T_CON_DYN_LSL_UP	V	0... 1H	0 ...1	1	-
Switch to freeze or to set the Timer T_CON_DYN_LSL_UP to 0					
LC_T1_AD_DIAG_DYN_LSL_UP	O/V	0... 1H	0 ...1	1	-
Boolean switch to allow the adaptation of the sensor time constant model T1_LSL_UP[i]					

### Import actions:

<b>ACTION_ERRM_NoFilterReset</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_NoFilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_LV_ERR_SET>,IN<PRM_LV_ERR_RST>,IN<PRM_LV_END_DIAG>,OUT<PRM_LV_ERR>)

### General information

#### Configuration for diagnostic symptoms:

Diagnostic	Symptom description	Symptom	Filter type
XX			
DYN_VLD_LS_UP[NC_CBK_EX_NR]	Signal dynamic fault (slow response, delay or phase shift)	SYM_1	NO

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then


i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

This function shall evaluate the Linear Oxygen Sensor dynamic behaviour once per driving cycle by measuring the sensor output signal damping during the time when the forced stimulation is active with

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the special set of parameters for the Dynamic Diagnosis or for the Catalyst Efficiency Diagnosis. During this time the air-fuel ratio is stimulated with a defined amplitude and period.

The amplitude of the air-fuel oscillation is measured by looking for minimum and maximum signal values in restricted time windows after start of the rich and lean cycles. This amplitude is normalized using the expected amplitudes for new and aged sensors and averaged over a number of measurements. The time window for determination of minimum (or maximum) values starts at the time defined in IP\_T\_DYN\_DIAG\_THD after the start of the rich (or lean) cycle, as indicated by LV\_AFL edges, and lasts for the time IP\_T\_DYN\_DIAG\_COMP. The nominal maximum and minimum lambda value while the Timer T\_DYN\_DIAG\_AFL/AFR is lower than THD and higher 0. The real minimum and maximum (COMP – comparison) is calculated while T\_DYN\_DIAG\_AFL/AFR\_COMP > 0 and T\_DYN\_DIAG\_AFL/AFR < THD. The window may extend into the following lean (or rich) cycle, but it is truncated at the end of that cycle. Restriction of the time window makes the diagnosis sensitive to delays in the occurrence of the amplitude maximum and allows focusing on a portion of the signal where the difference between new and aged sensors is high, thus improving over the assessment of only the signal oscillation amplitude. The calculation of a FAC\_COMP\_VALUE\_DIAG\_DYN\_LSL\_UP, done in a map like

$$dif\_ratio = \frac{lamb\_max\_comp - lamb\_max}{lamb\_min - lamb\_min\_comp}$$

Figure B.33.1:


, shall detect an asymmetric failure earlier by weighting the FAC\_MV\_DIAG\_DYN\_LSL\_UP[i]. The FAC\_COMP\_MV\_DIAG\_DYN\_SENS\_MDL is an output for the lambda sensor plant model (LACO). The rich to lean or lean to rich transition could be adapted in case of an asymmetric failure to improve the emissions.

Once the diagnosis is active, after every forced stimulation period, the lambda sensor signal amplitude is calculated. This amplitude is normalised versus engine speed and load. After a calibrateable number of normalised amplitude values are available, a mean value is determined. The lambda amplitude mean value is transformed into the relative damping factor FAC\_MV\_DIAG\_DYN\_LSL\_UP[i] by comparing with the amplitude of a new sensor with the value for the limit aged sensor. Once the relative damping factor FAC\_MV\_DIAG\_DYN\_LSL\_UP[i] is determined for the current driving cycle, it is compared with a calibrateable threshold to establish a good/bad result.

To make the final decision, results from another diagnosis may be necessary. The results of both diagnoses evaluate different properties of the sensor but share the same symptom. A good result can only be established if both diagnoses have confirmed a good result, but a bad result of any of the diagnoses makes the combined result bad as soon as this result is determined. The other diagnosis is expected to produce the end flag LV\_DLY\_END\_LSL\_DIAG[i] and the diagnostic value FAC\_DLY\_DIAG\_LSL\_OUT[i], not providing a good/bad result by itself. For historical reasons (to avoid changes in service 06h output), this value is scaled such that the limit to be applied becomes the same as the limit applied to FAC\_MV\_DIAG\_DYN\_LSL\_UP, and this scaled value is compared to determine the result status of the other diagnosis.

For systems using stratified or other lean combustion modes an alternate diagnosis may be used to evaluate the same sensor dynamic properties as the diagnosis described here. Therefore a good (or bad) result may be established as soon as one of the diagnoses has a result. The alternate diagnosis is expected to supply the error and end flags LV\_DIAG\_DYN\_S\_LSL\_UP\_ERR[i] and LV\_DIAG\_DYN\_S\_LSL\_UP\_END[i] and the diagnostic result FAC\_MV\_DIAG\_DYN\_S\_LSL\_UP[i]. From this result an equivalent FAC\_MV\_DIAG\_DYN\_LSL\_UP[i] is obtained using IP\_FAC\_SCA\_FAC\_MV\_DIAG\_DYN.

The factor FAC\_MV\_DIAG\_DYN\_LSL\_UP[i] can also be used to adapt the sensor time constant model T1\_LSL\_UP[i] for symmetric failure cases by setting the Boolean switch LC\_T1\_AD\_DIAG\_DYN\_LSL\_UP = 1. For asymmetric failure cases the FAC\_COMP\_MV\_DIAG\_DYN\_SENS\_MDL[i] can be used to adapt the plant model for rich to lean or lean to rich transitions with additional time. In that case a simple linear interpolation is done between the time constant for a new sensor and that for the aged

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limit sensor, which are saved in the correspondent maps IP\_T1\_LSL\_UP\_AGI\_LIM[i] and IP\_T1\_LSL\_UP[i]. For more information please refer to the function specification *Lambda control (Fuel mass)*.

To help the calibration of this function a tuning guide is available.

### Application conditions:


#### **Initialisation:**

At the transition LV\_IGK = 0 ->1, by ECU reset, by clearing the Error Memory or by triggering the EOL test (transition LV\_DIAG\_EOL\_DYN\_LS\_UP[i] = 0 -> 1) initialise the variables as indicated below:

```
FAC_COMP_VALUE_MIN_DYN_LSL_UP[i] = 32
FAC_VALUE_MAX_DIAG_DYN_LSL_UP[i] = 0
FAC_VALUE_MIN_DIAG_DYN_LSL_UP[i] = 32
LAMB_MIN_DIAG_DYN_LSL_UP[i] = 32
LAMB_MIN_DIAG_DYN_LSL_UP_COMP[i] = 32
LV_LS_DIAG_REQ_INH_CAT_DIAG = 1
STATE_DYN_DIAG[i] = "passive"
STATE_LAM_GAIN_REQ_LS_DIAG = NONE
STATE_LAMB_PLS_REQ_LS_DIAG = NONE
T_DYN_DIAG_AFL[i] = 1310.7
T_DYN_DIAG_AFR[i] = 1310.7
TQ_MMV_DIAG_DYN_LSL_UP = FAC_TQ_REQ
```

set the following variables to zero:

```
CTR_WAIT_DIAG_DYN_LSL_UP[i]
CYCNR_DIAG_DYN_LSL_UP[i]
CYCNR_DIAG_DYN_LSL_UP_ERR[i]
FAC_COMP_SUM_DIAG_DYN_LSL_UP[i]
FAC_COMP_VALUE_DIAG_DYN_LSL_UP[i]
FAC_COMP_VALUE_DYN_LSL_UP_TMP[i]
FAC_COMP_VALUE_MAX_DYN_LSL_UP[i]
FAC_DIAG_DYN_LSL_UP_ERR[i]
FAC_DIAG_DYN_LSL_UP_OK[i]
FAC_DLY_DIAG_LSL_TMP[i]
FAC_MV_COR_DIAG_DYN_LSL_UP[i]
FAC_MV_DIAG_DYN_LSL_UP[i]
FAC_MV_SUM_DIAG_DYN_LSL_UP[i]
FAC_SUM_DIAG_DYN_LSL_UP[i]
FAC_VALUE_DIAG_DYN_LSL_UP[i]
LAMB_AMPL_DIAG_DYN_LSL_UP[i]
LAMB_AMPL_MAX_DIAG_DYN_LSL_UP[i]
LAMB_AMPL_MIN_DIAG_DYN_LSL_UP[i]
LAMB_COR_DIAG_DYN_LS_UP[i]
LAMB_DIF_MAX_DYN_LSL_UP_COMP[i]
LAMB_DIF_MIN_DYN_LSL_UP_COMP[i]
LAMB_LPF_DIAG_DYN_LSL_UP[i]
LAMB_LPF_GRD_DIAG_DYN_LSL_UP[i]
LAMB_MAX_DIAG_DYN_LSL_UP[i]
LAMB_MAX_DIAG_DYN_LSL_UP_COMP[i]
LAMB_MAX_DIAG_DYN_LSL_UP_TMP[i]
LAMB_MAX_DYN_LSL_UP_COMP_TMP[i]
LV_CYCNR_DYN_LSL_UP_VLD[i]
LV_DIAG_DYN_CDN_LSL_UP[i]
LV_DIAG_DYN_END_LSL_UP[i]
```

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```

LV_DIAG_DYN_LSL_UP_CYC_END[i]
LV_DIAG_DYN_LSL_UP_ENA
LV_DIAG_DYN_LSL_UP_LDC_MAF
LV_DIAG_DYN_LSL_UP_LDC_N
LV_DIAG_DYN_LSL_UP_LDC_TQ
LV_DIAG_DYN_SYM_LSL_UP[i]
LV_DLY_DIAG_ACT_LAM_GAIN
LV_DLY_ERR_LSL_DIAG[i]
LV_FAC_COMP_DIAG_DYN_UP[i]
LV_LAM_ADJ_REQ_DYN_LSL_UP[i]
LV_LAMB_PLS_REQ_DYN_LSL_UP[i]
LV_LS_DIAG_MNG_PRIO_DLY_REQ
LV_LS_DIAG_MNG_PRIO_DYN_REQ
MAF_KGH_MMV_DYN_LSL_UP_LDC
N_MMV_DYN_LSL_UP_LDC
T_CON_LAMB_AFL_DYN_LS_UP[i]
T_CON_LAMB_AFR_DYN_LS_UP[i]
T_DIAG_DYN_LSL_UP_LDC_MAF
T_DYN_DIAG_AFL_COMP[i]
T_DYN_DIAG_AFL_THD[i]
T_DYN_DIAG_AFR_COMP[i]
T_DYN_DIAG_AFR_THD[i]

```

```

call ACTION_ERRM_NoFilterReset
( IN<NC_IDX_DIAG_DYN_VLD_LS_UP[i]>,OUT<LV_ERR_DYN_VLD_LS_
UP[i]>)

```

At the initialisation of new ECU or at a EEPROM checksum error, initialize FAC\_DIAG\_DYN\_LSL\_UP[i] with 0

At the initialisation of new ECU, at a EEPROM checksum error or when clearing the Error Memory, initialize the following variables with 0:

```

FAC_COMP_MV_DIAG_DYN_LSL_UP[i]
FAC_COMP_MV_DIAG_DYN_SENS_MDL[i]
FAC_DYN_LSL_UP_DIAG_SAE[i]
FAC_DYN_LSL_UP_DIAG_TOL_SAE[i]
FAC_DLY_LSL_UP_DIAG_SAE[i]
FAC_DLY_LSL_UP_DIAG_TOL_SAE[i]

```

### Activation:

The activation shall cover chapters 1 and 2 (precalculation and state machine). The dynamic diagnosis manager in chapter 3 and the priority manager in chapter 4 shall not depend on it.

```

TQ_MMV_DIAG_DYN_LSL_UP =
TQ_MMV_DIAG_DYN_LSL_UP * (1-C_TQ_CRCLC_DIAG_DYN_LSL_UP) +
FAC_TQ_REQ * C_TQ_CRCLC_DIAG_DYN_LSL_UP

```

```

If |TQ_MMV_DIAG_DYN_LSL_UP - FAC_TQ_REQ| <
C_TQ_DYW_DIAG_DYN_LSL_UP
then LV_DIAG_DYN_LSL_UP_LDC_TQ = 1
else LV_DIAG_DYN_LSL_UP_LDC_TQ = 0
endif


```

*%Limited engine speed (N) dynamics:*

```

N_MMV_DYN_LSL_UP_LDC =
N_MMV_DYN_LSL_UP_LDC * (1 - C_N_CRCLC_LDC_DYN_LSL_UP) +

```

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```

C_N_CRLC_LDC_DYN_LSL_UP * N

If      |N_MMV_DYN_LSL_UP_LDC - N| <
          C_N_DYW_DIAG_DYN_LSL_UP
then    LV_DIAG_DYN_LSL_UP_LDC_N = 1
else    LV_DIAG_DYN_LSL_UP_LDC_N = 0
endif

%Limited mass air flow (MAF) dynamics:
MAF_KGH_MMV_DYN_LSL_UP_LDC =
MAF_KGH_MMV_DYN_LSL_UP_LDC *
(1 - C_MAF_CRLC_DYN_LSL_UP) +
C_MAF_CRLC_DYN_LSL_UP * MAF_KGH

If      IP_MAF_KGH_DYW_DYN_LSL_UP (MAF_KGH) *
          C_FAC_MAF_DYW_NEG_DYN_LSL_UP <
          MAF_KGH - MAF_KGH_MMV_DYN_LSL_UP_LDC <
          IP_MAF_KGH_DYW_DYN_LSL_UP (MAF_KGH)

% In dependency to mass air flow the thresholds should be
% calculated and could be selected different for positive and
% negative deviation!
then    T_DIAG_DYN_LSL_UP_LDC_MAF - -

% timer is decremented and limited to 0
if      T_DIAG_DYN_LSL_UP_LDC_MAF = 0
then    LV_DIAG_DYN_LSL_UP_LDC_MAF = 1
else    LV_DIAG_DYN_LSL_UP_LDC_MAF = 0
endif
else    LV_DIAG_DYN_LSL_UP_LDC_MAF = 0
          T_DIAG_DYN_LSL_UP_LDC_MAF =
          IP_T_DIAG_DYN_LSL_UP_LDC_MAF
endif

LV_DIAG_DYN_CDN_LSL_UP[i] = 0
LV_LAMB_PLS_REQ_DYN_LSL_UP[i] = 0


If (0)   LV_DIAG_EOL_DYN_LS_UP[i] = 1
then
% activation by a short test
IF      LV_IPLSL_VLD[i] = 1 &
          LV_LAMB_PLS_ACT[i] = 1 &
          LV_DIAG_DYN_INH_LSL_UP[i] = 0 &
          LV_FAC_LAM_LIM_MAX[i] = 0 &
          LV_FAC_LAM_LIM_MIN[i] = 0

THEN
If      LC_DIAG_DYN_LSL_UP_CAT_SYN = 1
then    LV_DIAG_DYN_CDN_LSL_UP[i] = 1
else    LV_LAMB_PLS_REQ_DYN_LSL_UP[i] = 1
          If      LV_DIAG_DYN_LSL_UP_ENA = 1
          then    LV_DIAG_DYN_CDN_LSL_UP[i] = 1
          endif
endif
ENDIF
ELSE (0)

% normal diagnosis activation
If (1)   LV_END_DIAG_DYN_VLD_LS_UP[i] = 0 &
          LV_DIAG_DYN_INH_LSL_UP[i] = 0

Then (1)

```

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```

If (2)    LC_DIAG_DYN_LSL_UP_CAT_SYN = 1

% diagnosis carried out together with the catalyst efficiency
diagnosis
    Then (2)
If (3)    STATE_CAT_DIAG[i] = "passive"

OR

    (STATE_CAT_DIAG[i] = "END" &
    CYCNR_DIAG_DYN_LSL_UP[i] <
    C_CYCNR_MIN_DIAG_DYN_LSL_UP)

    Then (3)
% keep passive

    Else (3) LV_DIAG_DYN_CDN_LSL_UP[i] = 1
    Endif (3)

    Else (2)
% diagnosis carried out after or before the catalyst efficiency
diagnosis
    If (3)    LV_IPLSL_VLD[i] = 1 &
    LV_LAMB_PLS_ACT[i] = 1 &
    [(LV_FAC_LAM_LIM_MAX[i] = 0 &
    LV_FAC_LAM_LIM_MIN[i] = 0) or
    LC_DIAG_DYN_LSL_UP_LAM_OFF = 1] &

    C_N_MIN_DIAG_DYN_LSL_UP < N_32

    <

    C_N_MAX_DIAG_DYN_LSL_UP &
    C_MAF_MIN_DIAG_DYN_LSL_UP < MAF

    <

    C_MAF_MAX_DIAG_DYN_LSL_UP &
    C_MAF_KGH_MIN_DIAG_DYN < MAF_KGH

    &

    [(LV_VLS_DIF_DLY_LDC[i] = 1 &
    LC_DIAG_DYN_LSL_UP_LDC_TQ = 0) or

    (LV_DIAG_DYN_LSL_UP_LDC_N = 1 &

    LV_DIAG_DYN_LSL_UP_LDC_MAF = 1

    &

    LV_DIAG_DYN_LSL_UP_LDC_TQ=1 &
    LC_DIAG_DYN_LSL_UP_LDC_TQ=1)] &

    LV_CAT_PURGE_ACT[i] = 0

% catalyst purge function not active
    Then (3) LV_LAMB_PLS_REQ_DYN_LSL_UP[i] =

    1

    If    LV_DIAG_DYN_LSL_UP_ENA =

    1

    then LV_DIAG_DYN_CDN_LSL_UP[i]

    endif

    Endif (3)

    Endif (2)

    Endif (1)

Endif (0)


```

Deactivation:

-

Recurrence:

20 ms

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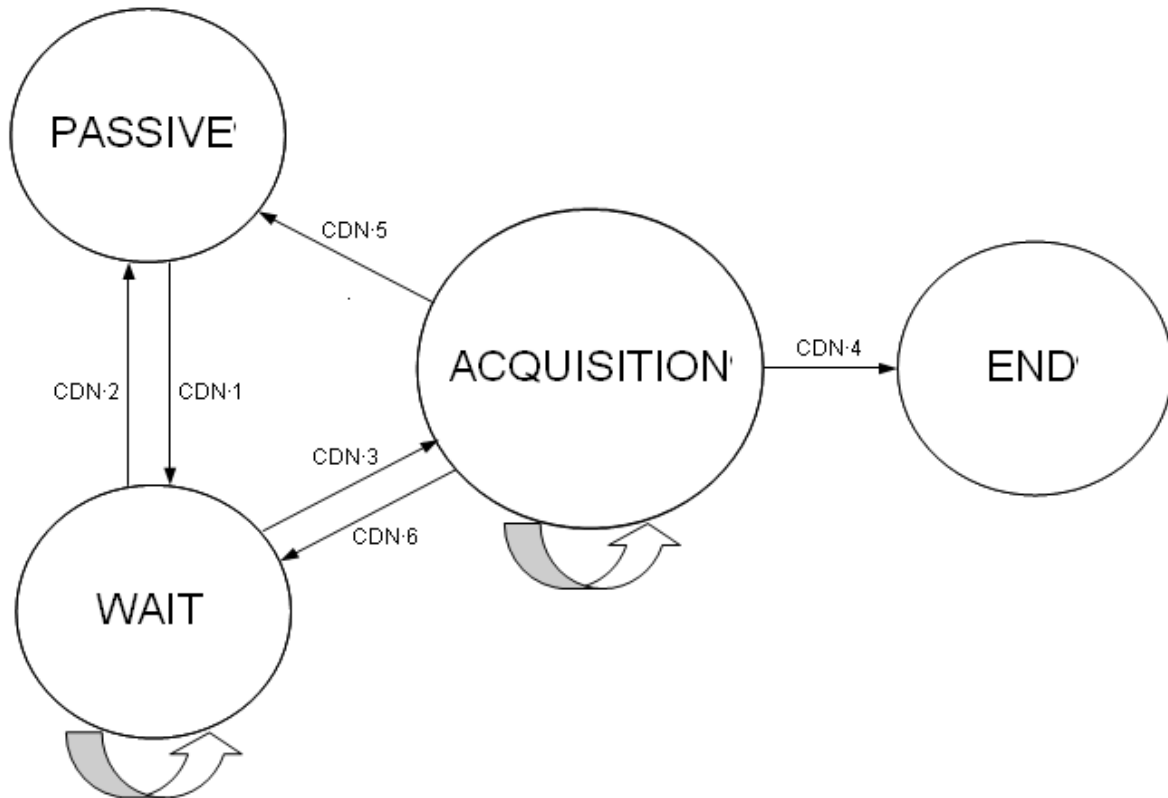
**Function description:****Signal flow diagram:**

Figure B.33.2:

**Formula section:****B.33.1 PRE-CALCULATIONS****B.33.1.1 FILTERING HIGH FREQUENCY PERTUBATIONS**

```

If    LC_LAMB_COR_DIAG_DELTA_LAM_ADJ = 1
then  LAMB_COR_DIAG_DYN_LS_UP[i] = LAMB_LS_UP[i] +
        LAMB_DELTA_I_LAM_ADJ[i] + LAMB_DELTA_AD_LAM_ADJ[i]
else   LAMB_COR_DIAG_DYN_LS_UP[i] = LAMB_LS_UP[i]
endif

LAMB_LPF_DIAG_DYN_LSL_UP[i] (new) =
LAMB_LPF_DIAG_DYN_LSL_UP[i] (old) * (1 - C_CRLC_LPF_LAMB_DIAG_DYN_LSL_UP) +
C_CRLC_LPF_LAMB_DIAG_DYN_LSL_UP * LAMB_COR_DIAG_DYN_LS_UP[i]
  
```


**B.33.1.2 CALCULATION OF SENSOR SIGNAL MIN and MAX VALUES**

```

LAMB_LPF_GRD_DIAG_DYN_LSL_UP[i] =
(LAMB_LPF_DIAG_DYN_LSL_UP[i] (new) - LAMB_LPF_DIAG_DYN_LSL_UP[i] (old))
  
```

```

If(1) LV_AFL[i] = 0 -> 1
  
```

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```

then
  if(2) T_DYN_DIAG_AFL_COMP[i] > 0
  then
    LAMB_MAX_DIAG_DYN_LSL_UP[i] = LAMB_MAX_DIAG_DYN_LSL_UP_TMP[i]
    LAMB_MAX_DIAG_DYN_LSL_UP_TMP[i] = 0
    LAMB_MAX_DIAG_DYN_LSL_UP_COMP[i] =
    LAMB_MAX_DYN_LSL_UP_COMP_TMP[i]
    LAMB_MAX_DYN_LSL_UP_COMP_TMP[i] = 0
  endif(2)

```

### Timer decrements after switching to lean

```
T_DYN_DIAG_AFL[i] = IP_T_DYN_DIAG + IP_T_DYN_DIAG_THD[i]
```

### Threshold time doesn't decrement

```
T_DYN_DIAG_AFL_THD[i] = IP_T_DYN_DIAG
```

### Timer decrements after reaching the threshold T\_DYN\_DIAG\_AFL\_THD

```
T_DYN_DIAG_AFL_COMP[i] = IP_T_DYN_DIAG_COMP(N_32, MAF_HB)
```

### Timer to detect a local maximum to avoid false diagnosis

```
T_CON_LAMB_AFL_DYN_LSL_UP[i] = C_T_CON_LAMB_DYN_LSL_UP
```

```

else(1)
  if(2) T_DYN_DIAG_AFL_COMP[i] = 0.02s (1 step)
  then
    LAMB_MAX_DIAG_DYN_LSL_UP[i] =
    LAMB_MAX_DIAG_DYN_LSL_UP_TMP[i]
    LAMB_MAX_DIAG_DYN_LSL_UP_TMP[i] = 0
    LAMB_MAX_DIAG_DYN_LSL_UP_COMP[i] =
    LAMB_MAX_DYN_LSL_UP_COMP_TMP[i]
    LAMB_MAX_DYN_LSL_UP_COMP_TMP[i] = 0
    T_DYN_DIAG_AFL_COMP[i] = 0
  endif(2)
  decrement T_DYN_DIAG_AFL[i]

```

```
endif(1)
```

### Calculation of temporary diagnosis maximum lambda value

```

If(1) T_DYN_DIAG_AFL[i] > 0 and
  T_DYN_DIAG_AFL[i] <= T_DYN_DIAG_AFL_THD[i] and
  LAMB_LPF_GRD_DIAG_DYN_LSL_UP[i] > C_LAMB_LPF_GRD_MIN_DIAG_DYN and
  LAMB_MAX_DIAG_DYN_LSL_UP_TMP[i] < LAMB_LPF_DIAG_DYN_LSL_UP[i]
Then
  LAMB_MAX_DIAG_DYN_LSL_UP_TMP[i] = LAMB_LPF_DIAG_DYN_LSL_UP[i]

```

### /set maximum Lambda value

```

else(1) freeze LAMB_MAX_DIAG_DYN_LSL_UP_TMP[i]
endif(1)

```

### Calculation of the temporary real maximum lambda value

```

If(1) T_DYN_DIAG_AFL_COMP[i] > 0 and
  T_DYN_DIAG_AFL[i] <= T_DYN_DIAG_AFL_THD[i]
Then decrement T_DYN_DIAG_AFL_COMP[i]
  If(2) LAMB_LPF_GRD_DIAG_DYN_LSL_UP[i] > C_LAMB_LPF_GRD_MIN_DIAG_DYN and
    LAMB_MAX_DYN_LSL_UP_COMP_TMP[i] < LAMB_LPF_DIAG_DYN_LSL_UP[i] and
    T_CON_LAMB_AFL_DYN_LSL_UP[i] > 0
  Then
    LAMB_MAX_DYN_LSL_UP_COMP_TMP[i] = LAMB_LPF_DIAG_DYN_LSL_UP[i]

```

### /set Maximum Lambda value

```

else(2) freeze LAMB_MAX_DYN_LSL_UP_COMP_TMP[i]
endif(2)

```

```
endif(1)
```

### Timer to detect a local maximum to avoid false diagnosis

```

If(1) T_DYN_DIAG_AFL_COMP[i] > 0 and
  T_DYN_DIAG_AFL[i] <= T_DYN_DIAG_AFL_THD[i] and
  T_CON_LAMB_AFL_DYN_LSL_UP[i] > 0


```

```
then
```

```

If(1)
  LAMB_MAX_DYN_LSL_UP_COMP_TMP[i] (new) =
  LAMB_MAX_DYN_LSL_UP_COMP_TMP[i] (old) and

```

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```

        LAMB_MAX_DYN_LSL_UP_COMP_TMP[i] >=
        LAMB_LPF_DIAG_DYN_LSL_UP[i] + C_LAMB_LPF_HYS_DYN_LSL_UP
    then decrement T_CON_LAMB_AFL_DYN_LS_UP[i]
    elseif(3) LC_T_CON_DYN_LSL_UP = 0
    then T_CON_LAMB_AFL_DYN_LS_UP[i] = C_T_CON_LAMB_DYN_LS_UP
    else(3) freeze T_CON_LAMB_AFL_DYN_LS_UP[i]
    endif(3)
endif(2)
endif(1)
LV_DIAG_DYN_LSL_UP_CYC_END[i] = 0
If(1) LV_AFL[i] = 1 -> 0
then
    If(2) T_DYN_DIAG_AFR_COMP[i] > 0 and
        LC_DIAG_DYN_AFR_DLY_ENA = 1)
    then LV_DIAG_DYN_LSL_UP_CYC_END[i] = 1
    Endif(2)

```

*Timer decrements after switching to rich*

```
T_DYN_DIAG_AFR[i] = IP_T_DYN_DIAG + IP_T_DYN_DIAG_THD[i]
```

*Threshold time doesn't decrement*

```
T_DYN_DIAG_AFR_THD[i] = IP_T_DYN_DIAG
```

*additional timer to get the real maximum and minimum and to detect asymmetry*

```
T_DYN_DIAG_AFR_COMP[i] = IP_T_DYN_DIAG_COMP(N_32, MAF_HB)
```

*Timer to detect a local minimum to avoid false diagnosis*

```
T_CON_LAMB_AFR_DYN_LS_UP[i] = C_T_CON_LAMB_DYN_LS_UP
```

```

else(1)
    If(2) T_DYN_DIAG_AFR_COMP[i] = 0.02s (1 step) and
        LC_DIAG_DYN_AFR_DLY_ENA = 1) or
        (LV_AFL[i] = 0 -> 1 and
        LC_DIAG_DYN_AFR_DLY_ENA = 0)
    then LV_DIAG_DYN_LSL_UP_CYC_END[i] = 1
        T_DYN_DIAG_AFR[i] = 0
        T_DYN_DIAG_AFR_COMP[i] = 0
    Endif(2)

```

```
decrement T_DYN_DIAG_AFR[i]
```

```
endif(1)
```

*Calculation of the diagnosis minimum lambda value*

```

If(1) T_DYN_DIAG_AFR[i] > 0 and
    T_DYN_DIAG_AFR[i] <= T_DYN_DIAG_AFR_THD[i] and
    LAMB_LPF_GRD_DIAG_DYN_LSL_UP[i] < -
    C_LAMB_LPF_GRD_MIN_DIAG_DYN and
    LAMB_MIN_DIAG_DYN_LSL_UP[i] > LAMB_LPF_DIAG_DYN_LSL_UP[i]
then
    LAMB_MIN_DIAG_DYN_LSL_UP[i] = LAMB_LPF_DIAG_DYN_LSL_UP[i]

```

*/set minimum Lambda value*

```

else(1) freeze LAMB_MIN_DIAG_DYN_LSL_UP[i]
endif(1)

```

*Calculation of the real minimum lambda value*


```

If(1) T_DYN_DIAG_AFR_COMP[i] > 0 and
    T_DYN_DIAG_AFR[i] <= T_DYN_DIAG_AFR_THD[i]
Then decrement T_DYN_DIAG_AFR_COMP[i]
    If(2) LAMB_LPF_GRD_DIAG_DYN_LSL_UP[i] < -
        C_LAMB_LPF_GRD_MIN_DIAG_DYN and
        LAMB_MIN_DIAG_DYN_LSL_UP_COMP[i] >
        LAMB_LPF_DIAG_DYN_LSL_UP[i] and
        T_CON_LAMB_AFR_DYN_LS_UP[i] > 0
    Then LAMB_MIN_DIAG_DYN_LSL_UP_COMP[i] = LAMB_LPF_DIAG_DYN_LSL_UP[i]

```

*set minimum Lambda value*

```
Else(2) freeze LAMB_MIN_DIAG_DYN_LSL_UP_COMP[i]
```

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```

    endif(2)
endif(1)
Timer to detect a local maximum to avoid false diagnosis
if(1)    T_DYN_DIAG_AFR_COMP[i] > 0 and
        T_DYN_DIAG_AFR[i] <= T_DYN_DIAG_AFR_THD[i] and
        T_CON_LAMB_AFR_DYN_LS_UP[i] > 0

Then
    if(2)    LAMB_MIN_DIAG_DYN_LSL_UP_COMP[i] (new) =
            LAMB_MIN_DIAG_DYN_LSL_UP_COMP[i] (old) and
            LAMB_MIN_DIAG_DYN_LSL_UP_COMP[i] <=
            LAMB_LPF_DIAG_DYN_LSL_UP[i] - C_LAMB_LPF_HYS_DYN_LSL_UP
    then
        decrement T_CON_LAMB_AFR_DYN_LS_UP[i]
        elseif(3)    LC_T_CON_DYN_LSL_UP = 0
        Then
            T_CON_LAMB_AFR_DYN_LS_UP[i] = C_T_CON_LAMB_DYN_LS_UP
        else(3)
            freeze T_CON_LAMB_AFR_DYN_LS_UP[i]
        endif(3)
    endif(2)
endif(1)

```

## B.33.2 STATE MACHINE

In the state machine, the transitions shall be handled first and the current state be changed if required. Then the state actions of the new current state shall be executed.

### B.33.2.1 STATE\_DYN\_DIAG[i] = "passive"

Actions: None

Condition 1:

from STATE\_DYN\_DIAG[i] = "passive" to "wait"  
LV\_DIAG\_DYN\_CDN\_LSL\_UP[i] = 1

Transition actions:

STATE\_DYN\_DIAG[i] = "wait"

### B.33.2.2 STATE\_DYN\_DIAG[i] = "wait"

Actions:

If<sup>(1)</sup> LV\_AFL[i] = 0 -> 1 & LC\_DIAG\_DYN\_LSL\_UP\_CAT\_SYN = 0

Then

If<sup>(2)</sup> LV\_LAM\_ADJ\_REQ\_DYN\_LSL\_UP[i] = 0

Then LV\_LAM\_ADJ\_REQ\_DYN\_LSL\_UP[i] = 1

the current value of the trim controller I-share shall be saved. Moreover its parameters shall be temporarily changed to the one originally defined for the Catalyst Eff. Diag. After the end of the current diagnosis the trim ctr. I-share shall be re-initialised with its old value.

Else<sup>(2)</sup> Increment CTR\_WAIT\_DIAG\_DYN\_LSL\_UP[i]

Endif<sup>(2)</sup>

forced stimulation and trim ctr. I-share parameters set by the Catalyst Eff. Diag

Endif<sup>(1)</sup>

LV\_CYCNR\_DYN\_LSL\_UP\_VLD[i] = 0

If<sup>(1)</sup> LV\_DIAG\_DYN\_LSL\_UP\_CYC\_END[i] = 1

Then LAMB\_MAX\_DIAG\_DYN\_LSL\_UP\_COMP[i] = 0

LAMB\_MIN\_DIAG\_DYN\_LSL\_UP\_COMP[i] = 32

LAMB\_MAX\_DYN\_LSL\_UP\_COMP\_TMP[i] = 0

LAMB\_MAX\_DIAG\_DYN\_LSL\_UP[i] = 0

LAMB\_MIN\_DIAG\_DYN\_LSL\_UP[i] = 32


Endif<sup>(1)</sup>

Condition 2:

from STATE\_DYN\_DIAG[i] = "wait" to "passive"

LV\_DIAG\_DYN\_CDN\_LSL\_UP[i] = 0

Transition actions:

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```
STATE_DYN_DIAG[i] = "passive"
LV_LAM_ADJ_REQ_DYN_LSL_UP[i] = 0
CTR_WAIT_DIAG_DYN_LSL_UP[i] = 0
```

**Condition 3:**

from STATE\_DYN\_DIAG[i] = "wait" to "acquisition"

```
[LC_DIAG_DYN_LSL_UP_CAT_SYN = 1 &
STATE_CAT_DIAG = "cyc_lean" or "cyc_rich" ] Or
[LC_DIAG_DYN_LSL_UP_CAT_SYN = 0 &
CTR_WAIT_DIAG_DYN_LSL_UP[i] > C_CTR_WAIT_DIAG_DYN_LSL_UP]
```

**Transition actions:**

```
STATE_DYN_DIAG[i] = "acquisition"
```

**B.33.2.3 STATE\_DYN\_DIAG[i] = "acquisition"****Actions:**

**If (1)** LV\_DIAG\_DYN\_LSL\_UP\_CYC\_END[i] = 1  
% both lean and rich monitoring cycles have completed

**Then (1)**

```
If (2) LV_CYCNR_DYN_LSL_UP_VLD[i] = 1 &
LV_INTR_DIAG_LS_DYN[i] = 0 &
LAMB_MAX_DIAG_DYN_LSL_UP[i] ≤ C_LAMB_MAX_DIAG_DYN_LSL_UP &
LAMB_MIN_DIAG_DYN_LSL_UP[i] ≥ C_LAMB_MIN_DIAG_DYN_LSL_UP
```

Purpose of this test is to avoid any shift in the lambda set point. Narrow calibration of those constants can reduce strongly the number of valid measured amplitudes. Moreover, the current lean/rich cycle must be marked as valid via LV\_CYCNR\_DYN\_LSL\_UP\_VLD[i].

**Then (2)****Calculation of the Lambda-Amplitude**

$$\text{LAMB\_AMPL\_DIAG\_DYN\_LSL\_UP}[i] = \text{LAMB\_MAX\_DIAG\_DYN\_LSL\_UP}[i] - \text{LAMB\_MIN\_DIAG\_DYN\_LSL\_UP}[i]$$

$$\text{LAMB\_AMPL\_MIN\_DIAG\_DYN\_LSL\_UP}[i] = \text{IP\_LAMB\_AMPL\_MIN\_DYN\_LSL\_UP} - \text{C\_LAMB\_AMPL\_MIN\_DYN\_LSL\_UP}$$

$$\text{LAMB\_AMPL\_MAX\_DIAG\_DYN\_LSL\_UP}[i] = \text{IP\_LAMB\_AMPL\_MAX\_DYN\_LSL\_UP} + \text{C\_LAMB\_AMPL\_MAX\_DYN\_LSL\_UP}$$

Purpose of this test is, if wanted, to avoid flat line signals or excessive sensor gain. C\_LAMB\_AMPL\_MAX/MIN can be viewed as are amplitude tolerances necessary due to frequent amplitude dispersion. Calculation of the Lambda-Difference to detect an asymmetric failure

$$\text{LAMB\_DIF\_MAX\_DYN\_LSL\_UP\_COMP}[i] = \text{LAMB\_MAX\_DIAG\_DYN\_LSL\_UP\_COMP}[i] - \text{LAMB\_MAX\_DIAG\_DYN\_LSL\_UP}[i]$$


$$\text{LAMB\_DIF\_MIN\_DYN\_LSL\_UP\_COMP}[i] = \text{LAMB\_MIN\_DIAG\_DYN\_LSL\_UP\_COMP}[i] - \text{LAMB\_MIN\_DIAG\_DYN\_LSL\_UP}[i]$$

```
If (3) LAMB_AMPL_MIN_DIAG_DYN_LSL_UP[i] ≤
LAMB_AMPL_DIAG_DYN_LSL_UP[i] ≤
LAMB_AMPL_MAX_DIAG_DYN_LSL_UP[i]
```

**Then (3)**

```
FAC_VALUE_DIAG_DYN_LSL_UP[i] =
(IP_LAMB_AMPL_MAX_DYN_LSL_UP -
LAMB_AMPL_DIAG_DYN_LSL_UP[i]) /
(IP_LAMB_AMPL_MAX_DYN_LSL_UP -
IP_LAMB_AMPL_MIN_DYN_LSL_UP)
FAC_COMP_VALUE_DIAG_DYN_LSL_UP[i] =
IP_FAC_VALUE_DYN_LSL_UP_COMP
(LAMB_DIF_MAX_DYN_LSL_UP_COMP[i],
LAMB_DIF_MIN_DYN_LSL_UP_COMP[i])
```

*The temporary variable is necessary for the application to know the influence of the different maps!*

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```
FAC_COMP_VALUE_DYN_LSL_UP_TMP [ i ] =
FAC_COMP_VALUE_DIAG_DYN_LSL_UP [ i ]
```

*Correction of the asymmetric factor with mass air flow and engine speed.*

```
FAC_COMP_VALUE_DIAG_DYN_LSL_UP [ i ] =
FAC_COMP_VALUE_DIAG_DYN_LSL_UP [ i ] *
IP_FAC_COMP_VALUE_DYN_LSL_UP ( N, MAF )
If(4) ( LAMB_AMPL_DIAG_DYN_LSL_UP [ i ] /
IP_LAMB_AMPL_MIN_DYN_LSL_UP ) <
C_FAC_MIN_LAMB_AMPL_DIAG_DYN
```

**then**

*emphasize the impact of very low amplitudes to improve error detection with short periods of forced stimulation*

```
increment FAC_VALUE_DIAG_DYN_LSL_UP [ i ] with
C_FAC_VALUE_NOT_PLAUS_DIAG_DYN *
( 1 - LAMB_AMPL_DIAG_DYN_LSL_UP [ i ] /
( IP_LAMB_AMPL_MIN_DYN_LSL_UP *
C_FAC_MIN_LAMB_AMPL_DIAG_DYN ) )
```

**endif**<sup>(4)</sup>

```
FAC_SUM_DIAG_DYN_LSL_UP [ i ] =
FAC_SUM_DIAG_DYN_LSL_UP [ i ] +
FAC_VALUE_DIAG_DYN_LSL_UP [ i ]
FAC_COMP_SUM_DIAG_DYN_LSL_UP [ i ] =
FAC_COMP_SUM_DIAG_DYN_LSL_UP [ i ] +
FAC_COMP_VALUE_DIAG_DYN_LSL_UP [ i ]
```

**Number cycles (short-term measurements)**

*increment* CYCNR\_DIAG\_DYN\_LSL\_UP [ i ]

**Number of failed cycles for statistical evaluation**

```
If(4) ( FAC_VALUE_DIAG_DYN_LSL_UP [ i ] >
C_FAC_MV_THD_DIAG_DYN_LSL_UP )
then increment CYCNR_DIAG_DYN_LSL_UP_ERR [ i ]
FAC_DIAG_DYN_LSL_UP_ERR [ i ] =
FAC_VALUE_DIAG_DYN_LSL_UP [ i ]
else(4) FAC_DIAG_DYN_LSL_UP_OK [ i ] =
FAC_VALUE_DIAG_DYN_LSL_UP [ i ]
endif(4)
```

**Endif (3)**

**Endif (2)**

```
If FAC_VALUE_DIAG_DYN_LSL_UP [ i ] < FAC_VALUE_MIN_DIAG_DYN_LSL_UP [ i ]
Then FAC_VALUE_MIN_DIAG_DYN_LSL_UP [ i ] = FAC_VALUE_DIAG_DYN_LSL_UP [ i ]
Else FAC_VALUE_MIN_DIAG_DYN_LSL_UP [ i ](n) =
FAC_VALUE_MIN_DIAG_DYN_LSL_UP [ i ](n-1)
Endif
```

```
If FAC_VALUE_DIAG_DYN_LSL_UP [ i ] > FAC_VALUE_MAX_DIAG_DYN_LSL_UP [ i ]
Then FAC_VALUE_MAX_DIAG_DYN_LSL_UP [ i ] = FAC_VALUE_DIAG_DYN_LSL_UP [ i ]
Else FAC_VALUE_MAX_DIAG_DYN_LSL_UP [ i ](n) =
FAC_VALUE_MAX_DIAG_DYN_LSL_UP [ i ](n-1)
Endif
```

**Endif**

*Trailing pointer for the minimum comparison/asymmetric factor*


```
If FAC_COMP_VALUE_DIAG_DYN_LSL_UP [ i ] < FAC_COMP_VALUE_MIN_DYN_LSL_UP [ i ]
Then FAC_COMP_VALUE_MIN_DYN_LSL_UP [ i ] = FAC_COMP_VALUE_DIAG_DYN_LSL_UP [ i ]
Else FAC_COMP_VALUE_MIN_DYN_LSL_UP [ i ](n) =
FAC_COMP_VALUE_MIN_DYN_LSL_UP [ i ](n-1)
Endif
```

**Endif**

*Trailing pointer for the maximum comparison/asymmetric factor*

```
If FAC_COMP_VALUE_DIAG_DYN_LSL_UP [ i ] > FAC_COMP_VALUE_MAX_DYN_LSL_UP [ i ]
Then FAC_COMP_VALUE_MAX_DYN_LSL_UP [ i ] = FAC_COMP_VALUE_DIAG_DYN_LSL_UP [ i ]
Else FAC_COMP_VALUE_MAX_DYN_LSL_UP [ i ](n) =
FAC_COMP_VALUE_MAX_DYN_LSL_UP [ i ](n-1)
Endif
```

**Endif**

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```

LV_CYCNR_DYN_LSL_UP_VLD[i] = 1
LAMB_MAX_DIAG_DYN_LSL_UP[i] = 0
LAMB_MIN_DIAG_DYN_LSL_UP[i] = 32
LAMB_MAX_DIAG_DYN_LSL_UP_COMP = 0
LAMB_MIN_DIAG_DYN_LSL_UP_COMP = 32

```

**Endif (1)**

**Condition 4:**

from STATE\_DYN\_DIAG[i] = "acquisition" to "end"

```

LV_DIAG_EOL_DYN_LS_UP[i] = 0 &
LC_DIAG_DYN_LSL_UP_CAT_SYN = 1 &
( CYCNR_DIAG_DYN_LSL_UP[i] ≥ C_CYCNR_END_DIAG_DYN_LSL_UP or
  (STATE_CAT_DIAG = "end" &
  CYCNR_DIAG_DYN_LSL_UP[i] ≥ C_CYCNR_MIN_DIAG_DYN_LSL_UP) ) Or
LV_DIAG_EOL_DYN_LS_UP[i] = 1 &
LC_DIAG_DYN_LSL_UP_CAT_SYN = 1 &
( CYCNR_DIAG_DYN_LSL_UP[i] ≥ C_CYCNR_EOL_DIAG_DYN_LSL_UP or
  (STATE_CAT_DIAG = "end" &
  CYCNR_DIAG_DYN_LSL_UP[i] ≥ C_CYCNR_MIN_DIAG_DYN_LSL_UP) ) Or
LV_DIAG_EOL_DYN_LS_UP[i] = 0 &
LC_DIAG_DYN_LSL_UP_CAT_SYN = 0 &
CYCNR_DIAG_DYN_LSL_UP[i] ≥ C_CYCNR_END_DIAG_DYN_LSL_UP Or
LV_DIAG_EOL_DYN_LS_UP[i] = 1 &
CYCNR_DIAG_DYN_LSL_UP[i] ≥ C_CYCNR_EOL_DIAG_DYN_LSL_UP

```

**Transition actions:**

Diagnosis of sensor dynamic:

FAC\_MV\_DIAG\_DYN\_LSL\_UP[i] = FAC\_SUM\_DIAG\_DYN\_LSL\_UP[i] / CYCNR\_DIAG\_DYN\_LSL\_UP[i]

*Temporary mean before correction!*

FAC\_MV\_SUM\_DIAG\_DYN\_LSL\_UP[i] = FAC\_MV\_DIAG\_DYN\_LSL\_UP[i]  
 FAC\_COMP\_MV\_DIAG\_DYN\_LSL\_UP[i] = FAC\_COMP\_SUM\_DIAG\_DYN\_LSL\_UP[i] / CYCNR\_DIAG\_DYN\_LSL\_UP[i]

**If** LC\_FAC\_MV\_DIAG\_DYN\_LSL\_UP\_UPD= 1 **AND**  
 CYCNR\_DIAG\_DYN\_LSL\_UP[i] > 1

**Then**

**If** FAC\_MV\_DIAG\_DYN\_LSL\_UP[i] > C\_FAC\_MV\_MAX\_DIAG\_DYN\_LSL\_UP **AND**  
 FAC\_MV\_DIAG\_DYN\_LSL\_UP[i] < C\_FAC\_MV\_MIN\_DIAG\_DYN\_LSL\_UP **AND**  
 CYCNR\_DIAG\_DYN\_LSL\_UP[i] > 2

*to erase the min and max outlier the constants above have to be set to phys max and phys min*

*C\_FAC\_MV\_MAX\_DIAG\_DYN\_LSL\_UP = phys-min*

*C\_FAC\_MV\_MIN\_DIAG\_DYN\_LSL\_UP = phys-max*

**Then** FAC\_MV\_DIAG\_DYN\_LSL\_UP[i] = (FAC\_SUM\_DIAG\_DYN\_LSL\_UP[i] -  
 FAC\_VALUE\_MIN\_DIAG\_DYN\_LSL\_UP[i] -  
 FAC\_VALUE\_MAX\_DIAG\_DYN\_LSL\_UP[i]) /  
 (CYCNR\_DIAG\_DYN\_LSL\_UP[i] - 2)

**Else**

bad case, eliminate the min value (outlier)


**If** FAC\_MV\_DIAG\_DYN\_LSL\_UP[i] >  
 C\_FAC\_MV\_MAX\_DIAG\_DYN\_LSL\_UP

**Then** FAC\_MV\_DIAG\_DYN\_LSL\_UP[i] = (FAC\_SUM\_DIAG\_DYN\_LSL\_UP[i] -  
 VALUE\_MIN\_DIAG\_DYN\_LSL\_UP[i]) /  
 (CYCNR\_DIAG\_DYN\_LSL\_UP[i] - 1)

**Else**

good case, eliminate the max value (outlier)

**If** FAC\_MV\_DIAG\_DYN\_LSL\_UP[i] <  
 C\_FAC\_MV\_MIN\_DIAG\_DYN\_LSL\_UP

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```

    Then FAC_MV_DIAG_DYN_LSL_UP[i] =
        (FAC_SUM_DIAG_DYN_LSL_UP[i] -
         FAC_VALUE_MAX_DIAG_DYN_LSL_UP[i]) /
        (CYCNR_DIAG_DYN_LSL_UP[i] - 1)
    Endif
  Endif
Endif
Endif

```

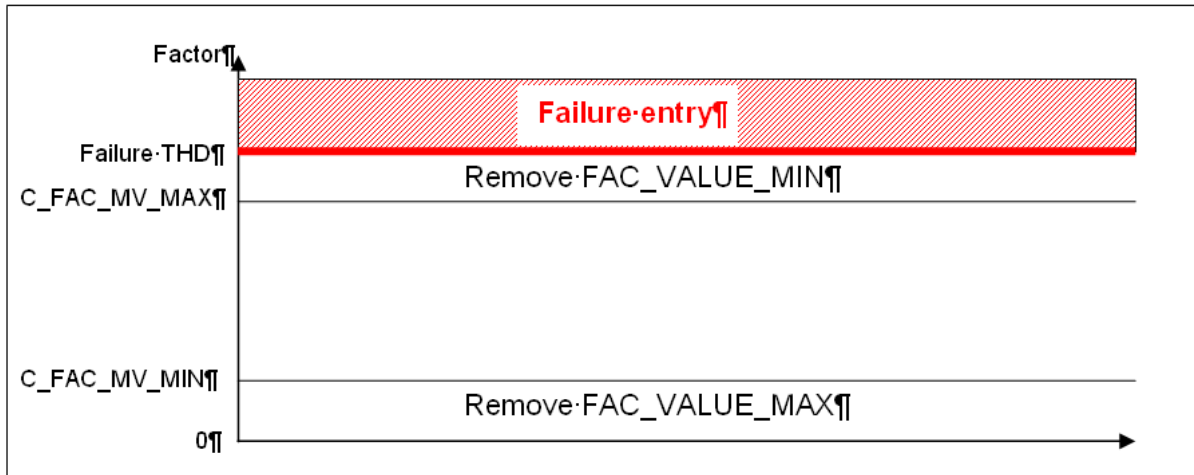


Figure B.33.3:

asymmetric bad case R2L, eliminate the min value (outlier)

```

If FAC_COMP_MV_DIAG_DYN_LSL_UP[i] > C_FAC_COMP_R2L_MAX_DYN_LSL_UP
Then FAC_COMP_MV_DIAG_DYN_LSL_UP[i] = (FAC_COMP_SUM_DIAG_DYN_LSL_UP[i] -
COMP_VALUE_MIN_DYN_LSL_UP) / (CYCNR_DIAG_DYN_LSL_UP[i] - 1)
Else

```

asymmetric bad case L2R, eliminate the max value (outlier)

```

If FAC_COMP_MV_DIAG_DYN_LSL_UP[i] < C_FAC_COMP_L2R_MIN_DYN_LSL_UP
Then FAC_COMP_MV_DIAG_DYN_LSL_UP[i] =
(FAC_COMP_SUM_DIAG_DYN_LSL_UP[i] -
FAC_COMP_VALUE_MAX_DYN_LSL_UP) / (CYCNR_DIAG_DYN_LSL_UP[i] - 1)
Endif

```

Endif

asymmetric good case R2L, eliminate the max value (outlier)

```

If C_FAC_COMP_NOM_DYN_LSL_UP < FAC_COMP_MV_DIAG_DYN_LSL_UP[i] <
C_FAC_COMP_NOM_R2L_DYN_LSL_UP
Then FAC_COMP_MV_DIAG_DYN_LSL_UP[i] = (FAC_COMP_SUM_DIAG_DYN_LSL_UP[i] -
FAC_COMP_VALUE_MAX_DYN_LSL_UP) / (CYCNR_DIAG_DYN_LSL_UP[i] - 1)

```

Else

asymmetric good case L2R, eliminate the min value (outlier)

```

If C_FAC_COMP_NOM_DYN_LSL_UP > FAC_COMP_MV_DIAG_DYN_LSL_UP[i] >
C_FAC_COMP_NOM_L2R_DYN_LSL_UP
Then FAC_COMP_MV_DIAG_DYN_LSL_UP[i] =
(FAC_COMP_SUM_DIAG_DYN_LSL_UP[i] -
FAC_COMP_VALUE_MIN_DYN_LSL_UP) / (CYCNR_DIAG_DYN_LSL_UP[i] - 1)

```

Endif

Endif



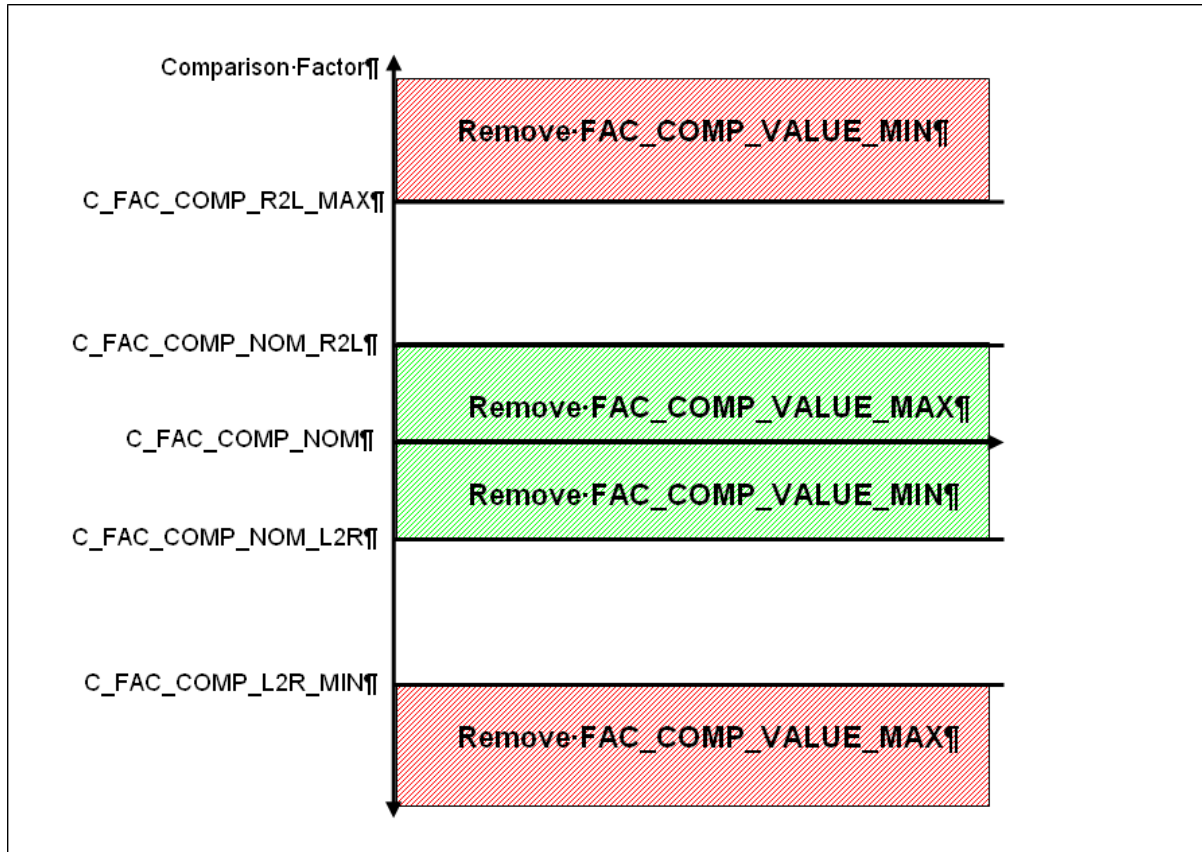


Figure B.33.4:

*Temporary mean value after deleting the outlier!*

```
FAC_MV_COR_DIAG_DYN_LSL_UP[i] = FAC_MV_DIAG_DYN_LSL_UP[i]
```

*Detection of asymmetry*

```
If   FAC_COMP_MV_DIAG_DYN_LSL_UP[i] >
      C_FAC_COMP_R2L_DIAG_DYN_LSL_UP OR
      FAC_COMP_MV_DIAG_DYN_LSL_UP[i] <
      C_FAC_COMP_L2R_DIAG_DYN_LSL_UP
```

**Then**

*Correction of factor to detect an asymmetric failure*

```
FAC_MV_DIAG_DYN_LSL_UP[i] = FAC_MV_DIAG_DYN_LSL_UP[i] *
IP_FAC_COMP_DYN_LSL_UP(FAC_COMP_MV_DIAG_DYN_LSL_UP[i])
LV_FAC_COMP_DIAG_DYN_UP[i] = 1
```

**Endif**

*Calculation of asymmetric factor to activate and deactivate the slow plant model*

```
If   FAC_COMP_MV_DIAG_DYN_LSL_UP[i] > C_FAC_COMP_SENS_MDL_R2L_ACT or
      FAC_COMP_MV_DIAG_DYN_LSL_UP[i] < C_FAC_COMP_SENS_MDL_L2R_ACT
```

```
Then FAC_COMP_MV_DIAG_DYN_SENS_MDL[i] = FAC_COMP_MV_DIAG_DYN_LSL_UP[i]
```

**Else**

```
If   FAC_COMP_MV_DIAG_DYN_LSL_UP[i] <
      C_FAC_COMP_SENS_MDL_R2L_DEAC and
      FAC_COMP_MV_DIAG_DYN_LSL_UP[i] >
      C_FAC_COMP_SENS_MDL_L2R_DEAC
```

```
Then FAC_COMP_MV_DIAG_DYN_SENS_MDL[i] = 0
```

```
Else Freeze FAC_COMP_MV_DIAG_DYN_SENS_MDL[i]
```

**Endif**

**Endif**

% Check the average and, if enabled, the ratio.

```
If FAC_MV_DIAG_DYN_LSL_UP[i] ≥ C_FAC_MV_THD_DIAG_DYN_LSL_UP or
```

```
(LC_DIAG_DYN_LSL_UP_STC = 1 and
CYCNR_DIAG_DYN_LSL_UP_ERR[i] /CYCNR_DIAG_DYN_LSL_UP[i] >
C_RATIO_DIAG_DYN_LSL_UP_STC)
```

**Then**

% symptom is present

```
LV_DIAG_DYN_SYM_LSL_UP[i] = 1
```

**Endif**

% return trim ctr and forced stimulation to their original parameters

```
LV_LAM_ADJ_REQ_DYN_LSL_UP[i] = 0
```

```
CTR_WAIT_DIAG_DYN_LSL_UP[i] = 0
```

```
STATE_DYN_DIAG[i] = "end"
```

```
LV_DIAG_DYN_END_LSL_UP[i] = 1
```

**Condition 5:**

```
from STATE_DYN_DIAG[i] = "acquisition" to "passive"
```

```
LV_DIAG_DYN_CDN_LSL_UP[i] = 0
```

**Transition actions:**

```
STATE_DYN_DIAG[i] = "passive"
```

```
LV_LAM_ADJ_REQ_DYN_LSL_UP[i] = 0
```

```
CTR_WAIT_DIAG_DYN_LSL_UP[i] = 0
```

**Condition 6:**

```
from STATE_DYN_DIAG[i] = "acquisition" to "wait"
```

```
LC_DIAG_DYN_LSL_UP_CAT_SYN = 1 & STATE_CAT_DIAG = "wait"
```

**Transition actions:**

```
STATE_DYN_DIAG[i] = "wait"
```

**B.33.2.4 STATE\_DYN\_DIAG[i] = "end"**Actions:

none

**B.33.3 DYNAMIC DIAGNOSIS MANAGER**

This section looks at the state of concurrent diagnoses, it shall not depend on the activation condition of the dynamic diagnosis. There may be two additional monitors that link into the same fault symptom:

	Delay "bad"	Delay "good"	Delay "ongoing"
Dyn "bad"	"bad"	"bad"	"bad"
Dyn "good"	"bad"	"good"	wait for delay
Dyn "ongoing"	"bad"	wait for hom/strat	wait for delay + hom/strat

A delay diagnosis, which looks at some other sensor signal property. If this diagnosis is active, a fault may be determined as soon as either of the diagnoses detect a fault, but a good result is confirmed only by good results of both diagnoses.

	Stratified "bad"	Stratified "good"	Strat. "ongoing"
Continued on next page			

Hom. "bad"	"bad"	"bad"	"bad"
Hom. "good"	"bad"	"good"	"good"
Hom. "ongoing"	"bad"	"good"	wait for at least one of hom/ strat

An alternate dynamic diagnosis for stratified combustion, which evaluates the same properties as the diagnosis described here. If this diagnosis is active, it is just another way to detect good/bad sensor dynamics, so both good and bad sensor dynamics can be confirmed by either of these functions. On top of this a delay result, as described above, may still be necessary to confirm a good sensor

*% Result priority for both fault flag and mode\$06 output:*

*% 1) If dynamic (homogenous or stratified) is bad, set dynamic result, with preference*

*% for homogenous if both have found a fault at the same time.*

*% 2) If delay is bad, set delay result.*

*% 3) If both of delay and at least one of homogenous or stratified dynamic are good,*

*% set dynamic result. Preference for homogenous, if both dynamic diagnoses*

*% have finished at this point.*

```
LV_CDN_DIAG_DYN_VLD_LS_UP[i] = 0
```

```
If(0) LV_IGK = 1
```

```
then
```

```
    If(1) LV_DLY_END_LSL_DIAG[i] 0 - -> 1
```

```
    then
```

*Scale the provided mode\$06 test value such that the limit equals C\_FAC\_MV\_THD\_..., then compare against that threshold to determine fault status. This is done to ensure consistency with mode\$06 and to avoid rounding errors and needs for a new triplet.*

```
FAC_DLY_DIAG_LSL_TMP[i] = FAC_DLY_DIAG_LSL_OUT[i] *
```

```
C_FAC_MV_THD_DIAG_DYN_LSL_UP / C_FAC_DLY_DIAG_LSL_THD
```

```
If(2) FAC_DLY_DIAG_LSL_TMP[i] > C_FAC_MV_THD_DIAG_DYN_LSL_UP
```

```
then LV_DLY_ERR_LSL_DIAG[i] = 1
```

```
else(2) LV_DLY_ERR_LSL_DIAG[i] = 0
```

```
endif(2)
```

```
Endif(1)
```

```
If(1) (LV_DIAG_DYN_SYM_LSL_UP[i] = 1 or  
LV_DIAG_DYN_S_LSL_UP_ERR[i] = 1 ) and  
LV_ERR_DYN_VLD_LS_UP[i] = 0
```

```
then
```

*% No fault yet and dynamic/stratified pair of diagnosis has a fault*

```
LV_CDN_DIAG_DYN_VLD_LS_UP[i] = 1
```

```
LV_END_DIAG_DYN_VLD_LS_UP[i] = 1
```

```
LV_ERR_DYN_VLD_LS_UP[i] = 1
```

```
ERR_SYM_DYN_VLD_LS_UP[i] = "SYM_1"
```

```
Else(1)
```

```
    If(2) LV_DLY_ERR_LSL_DIAG[i] = 1 and  
    LV_ERR_DYN_VLD_LS_UP[i] = 0 and  
    LC_DIAG_DYN_LSL_UP_DLY_ACT = 1
```

```
    then
```

*No fault yet and delay diagnosis has a fault and is to be included in the result*

```
LV_CDN_DIAG_DYN_VLD_LS_UP[i] = 1
```

```
LV_END_DIAG_DYN_VLD_LS_UP[i] = 1
```

```
LV_ERR_DYN_VLD_LS_UP[i] = 1
```

```
ERR_SYM_DYN_VLD_LS_UP[i] = "SYM_1"
```

```
Else(2)
```

```

If(3) (LV_DIAG_DYN_END_LSL_UP[i] = 1 or
LV_DIAG_DYN_S_LSL_UP_END[i] = 1) and
(LV_DLY_END_LSL_DIAG[i] = 1 or
LC_DIAG_DYN_LSL_UP_DLY_ACT = 0) and
LV_END_DIAG_DYN_VLD_LS_UP[i] = 0

```

```

then

```

*No result yet and both diagnoses have a result (only good cases left)*

```

LV_CDN_DIAG_DYN_VLD_LS_UP[i] = 1
LV_END_DIAG_DYN_VLD_LS_UP[i] = 1
LV_ERR_DYN_VLD_LS_UP[i] = 0
ERR_SYM_DYN_VLD_LS_UP[i] = "NO_SYM"

```

```

Endif(3)

```

```

Endif(2)

```

```

Endif(1)

```

```

If(1) (LV_END_DIAG_DYN_VLD_LS_UP[i](n-1) = 0 and
LV_END_DIAG_DYN_VLD_LS_UP[i](n) = 1) or
(LV_ERR_DYN_VLD_LS_UP[i](n-1) = 0 and
LV_ERR_DYN_VLD_LS_UP[i](n) = 1)

```

```

then

```

*diagnosis just finished or just found an error – set or update mode\$06*

```

If LV_DLY_END_LSL_DIAG[i] = 1 and
LC_DIAG_DYN_LSL_UP_DLY_ACT = 1

```

```

then

```

*Delay diagnosis is active and has something – forward into mode\$06*

```

FAC_DLY_LSL_UP_DIAG_SAE[i] = FAC_DLY_DIAG_LSL_TMP[i]
FAC_DLY_LSL_UP_DIAG_TOL_SAE[i] =
C_FAC_MV_THD_DIAG_DYN_LSL_UP

```

```

else

```

*Delay diagnosis not complete or not active – remove mode\$06 data*

```

FAC_DLY_LSL_UP_DIAG_SAE[i] = 0
FAC_DLY_LSL_UP_DIAG_TOL_SAE[i] = 0

```

```

endif

```

```

If(2) LV_DIAG_DYN_END_LSL_UP[i] = 1 and
(LV_DIAG_DYN_S_LSL_UP_ERR[i] = 0 or
LV_DIAG_DYN_SYM_LSL_UP[i] = 1)

```

```

then

```

*homogenous dynamic diagnosis has something not conflicting with stratified  
get appropriate mode\$06 from hom. dynamic diagnosis*

```

FAC_DYN_LSL_UP_DIAG_TOL_SAE[i] = C_FAC_MV_THD_DIAG_DYN_LSL_UP

```

```

If(3a) LV_DIAG_DYN_SYM_LSL_UP[i] = 1

```

```

then

```

```

If(4a) FAC_MV_DIAG_DYN_LSL_UP[i] >
C_FAC_MV_THD_DIAG_DYN_LSL_UP

```

```

then FAC_DYN_LSL_UP_DIAG_SAE[i] =
FAC_MV_DIAG_DYN_LSL_UP[i]

```

```

else(4a) FAC_DYN_LSL_UP_DIAG_SAE[i] =
FAC_DIAG_DYN_LSL_UP_ERR[i]

```

```

endif(4a)

```

```

else(3a)

```

```

If(4b) FAC_MV_DIAG_DYN_LSL_UP[i] <=
C_FAC_MV_THD_DIAG_DYN_LSL_UP

```

```

then FAC_DYN_LSL_UP_DIAG_SAE[i] =
FAC_MV_DIAG_DYN_LSL_UP[i]

```

```

else(4b) FAC_DYN_LSL_UP_DIAG_SAE[i] =
FAC_DIAG_DYN_LSL_UP_OK[i]

```

```

endif(4b)

```

```


endif(3a)

```

```

else(2)

```

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can't use hom. diagnosis result (because it doesn't exist or is overridden by stratified fault)

```
If(3b) LV_DIAG_DYN_S_LSL_UP_END[i] = 1
then
```

stratified result present – forward it to mode\$06 output

```
FAC_MV_DIAG_DYN_LSL_UP[i] =
IP_FAC_SCA_FAC_MV_DIAG_DYN (FAC_MV_DIAG_DYN_S_LSL_UP)
FAC_DYN_LSL_UP_DIAG_SAE[i] = FAC_MV_DIAG_DYN_LSL_UP[i]
FAC_DYN_LSL_UP_DIAG_TOL_SAE[i] =
IP_FAC_SCA_FAC_MV_DIAG_DYN
(C_FAC_DIAG_DYN_S_LSL_UP_MAX)
```

```
else(3b)
```

no stratified or homogenous dynamic result – remove mode\$06 data

```
FAC_DYN_LSL_UP_DIAG_SAE[i] = 0
FAC_DYN_LSL_UP_DIAG_TOL_SAE[i] = 0
```

```
endif(3b)
```

```
endif(2)
```

```
endif(1)
```

Adaptation of sensor time constant:

```
If (1) LC_T1_AD_DIAG_DYN_LSL_UP = 1 &
LV_DIAG_EOL_DYN_LS_UP[i] = 0 &
FAC_DYN_LSL_UP_DIAG_SAE[i] ≥ C_FAC_AD_THD_DIAG_DYN_LSL_UP &
LV_CDN_DIAG_DYN_VLD_LS_UP[i] = 1
(current value as set above) &
LV_DLY_ERR_LSL_DIAG[i] = 0
```

```
Then (1)
```

update FAC\_DIAG\_DYN\_LSL\_UP[i] once if adaptation is enabled, a result is available (as indicated by

the LV\_CDN\_DIAG flag, which is set once upon completion) and delay is OK.

To be consistent with the physical meaning of this variable, its maximum value shall be less than 1

see Output Table.

```
FAC_DIAG_DYN_LSL_UP[i] (new) =
FAC_DIAG_DYN_LSL_UP[i] (old) + C_CRLC_LPF_FAC_AD_DYN_LSL_UP
* (FAC_MV_DIAG_DYN_LSL_UP[i] - FAC_DIAG_DYN_LSL_UP[i] (old))
```

```
Else (1)
```

```
If (2) FAC_DYN_LSL_UP_DIAG_SAE[i] <
C_FAC_AD_RST_DIAG_DYN_LSL_UP
```

```
Then (2) FAC_DIAG_DYN_LSL_UP[i] (new) = 0
```

```
Else (2) FAC_DIAG_DYN_LSL_UP[i]
```

shall retain its value saved in the memory

```
FAC_DIAG_DYN_LSL_UP[i] (new) =
FAC_DIAG_DYN_LSL_UP[i] (old)
```

```
Endif (2)
```


```
Endif (1)
```

```
Endif(0)
```

For failure and error management treatment the anti-bounce mechanism is called :

if LV\_ERR\_XX=1 then LV\_ERR\_SET=1 or if LV\_ERR\_XX=0 then LV\_ERR\_RST=1

```
ACTION_ERRM_NoFilterSymptom( IN<NC_IDX_DIAG_DYN_VLD_LS_UP[i]>, IN<LV_CDN_DIAG_
DYN_VLD_LS_UP[i]>, IN< ERR_SYM_DYN_VLD_LS_UP[i] >, IN< LV_ERR_SET_DYN_VLD_
LS_UP[i] >, IN<LV_ERR_RST_DYN_VLD_LS_UP[i]>, IN<LV_END_DIAG_DYN_VLD_LS_UP[i]>,
OUT<LV_ERR_DYN_VLD_LS_UP[i]> )
```

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### B.33.4 DIAGNOSIS request coordination

This section shall not fall under the activation conditions but be always active. It coordinates the requests for forced stimulation and lambda control parameters that originate in the delay diagnosis, the dynamic diagnosis and the catalyst diagnosis. Each of these diagnoses may need specific parameters to run, but only one set of parameters may be active at the same time.

This section uses calibrateable bit vectors to determine which diagnosis has priority over another one. Delay and dynamic diagnoses are controlled via enable flags that are set when the diagnosis has requested its parameters and the request coordination has found that these parameters are in effect. Catalyst diagnosis is controlled by an inhibition request.

For every involved diagnosis there is one byte of lock flags, and in this byte there is a pair of bits for each diagnosis. If in `C_STATE_PRIO_INH_DIAG_<diag1>` the bit `<diag2>_ACT` (denoted as `C_STATE_PRIO_INH_DIAG_<diag1>.<diag2>_ACT`) is set, then an FLS request of diagnosis `<diag2>` locks `<diag1>`, and if bit `<diag2>_END` is set, then `<diag1>` cannot run until `<diag2>` has completed the parts where a specific FLS is needed. The following structure shall be used for the lock bytes:

Lock flag	Bit value	Meaning
CAT_ACT	2 <sup>0</sup> = 1	Inhibit if catalyst diagnosis wants to run
CAT_END	2 <sup>1</sup> = 2	Inhibit if catalyst diagnosis is not complete
DYN_ACT	2 <sup>2</sup> = 4	Inhibit if dynamic (amplitude) diagnosis wants to run
DYN_END	2 <sup>3</sup> = 8	Inhibit if dynamic (amplitude) diagnosis is not complete
DLY_ACT	2 <sup>4</sup> = 16	Inhibit if dynamic (effect) diagnosis wants to run
DLY_END	2 <sup>5</sup> = 32	Inhibit if dynamic (effect) diagnosis is not complete

The structure shall be the same for all lock bytes even though it doesn't make sense to lock a diagnosis against itself. Bits for the diagnosis itself are ignored. The locking is disabled for EOL mode to give EOL a chance to reorder the diagnosis sequence via inhibit flags from the appl. inc.

```
if1a LV_LS_DIAG_MNG_PRIO_EXT = 0
```

```
then
```

*Part 1: helper flags to make the structure of the priority manager more clear and symmetric*

*For each involved diagnosis there is an indication of the FLS request and of its completion.*

*All banks existing in the ECU as well as an external request (e.g. from another ECU in a master/slave system) are consulted.*

```

if STATE_CAT_DIAG[i] = "RAMPUP" or "CYC_LEAN" or "CYC_RICH" for any i
or LV_CAT_DIAG_ACT_EXT = 1
then LV_LS_DIAG_MNG_PRIO_CAT_ACT = 1
else LV_LS_DIAG_MNG_PRIO_CAT_ACT = 0
endif

if STATE_CAT_DIAG[i] = "END" for all i
and LV_CAT_DIAG_END_EXT = 1
then LV_LS_DIAG_MNG_PRIO_CAT_END = 1
else LV_LS_DIAG_MNG_PRIO_CAT_END = 0
endif

if LV_LAMB_PLS_REQ_DYN_LSL_UP[i] = 1 for any i
or LV_DYN_DIAG_ACT_EXT = 1
then LV_LS_DIAG_MNG_PRIO_DYN_ACT = 1
else LV_LS_DIAG_MNG_PRIO_DYN_ACT = 0
endif

if (STATE_DYN_DIAG[i] = "END"
or LV_END_DIAG_DYN_VLD_LS_UP[i] = 1

```

```

or      LV_INH_DIAG_DYN_VLD_LS_UP_ERR[i] = 1) for all i
and    LV_DYN_DIAG_END_EXT = 1
then   LV_LS_DIAG_MNG_PRIO_DYN_END = 1
else   LV_LS_DIAG_MNG_PRIO_DYN_END = 0
endif
If    LV_DLY_DIAG_REQ_LAM_GAIN[i] = 1 for any i
or    LV_DLY_DIAG_ACT_EXT = 1
then  LV_LS_DIAG_MNG_PRIO_DLY_ACT = 1
else  LV_LS_DIAG_MNG_PRIO_DLY_ACT = 0
endif
If    (LV_DLY_END_LSL_DIAG[i] = 1
or    LV_END_DIAG_DYN_VLD_LS_UP[i] = 1
or    LV_INH_DIAG_DYN_VLD_LS_UP_ERR[i] = 1) for all i
and  LV_DLY_DIAG_END_EXT = 1
then  LV_LS_DIAG_MNG_PRIO_DLY_END = 1
else  LV_LS_DIAG_MNG_PRIO_DLY_END = 0
endif


```

*Part 2: calculate the inhibition out of calibrateable priority rules and (for the EGCP internal diagnoses) the current FLS state.*

```

If    ((LV_LS_DIAG_MNG_PRIO_CAT_ACT = 0 or
C_STATE_PRIO_INH_DIAG_DLY.CAT_ACT = 0) and
(LV_LS_DIAG_MNG_PRIO_DYN_ACT = 0 or
C_STATE_PRIO_INH_DIAG_DLY.DYN_ACT = 0) and
(LV_LS_DIAG_MNG_PRIO_CAT_END = 1 or
C_STATE_PRIO_INH_DIAG_DLY.CAT_END = 0) and
(LV_LS_DIAG_MNG_PRIO_DYN_END = 1 or
C_STATE_PRIO_INH_DIAG_DLY.DYN_END = 0))
then  LV_LS_DIAG_MNG_PRIO_DLY_REQ = LV_LS_DIAG_MNG_PRIO_DLY_ACT
else  LV_LS_DIAG_MNG_PRIO_DLY_REQ = 0
endif
If    ((LV_LS_DIAG_MNG_PRIO_CAT_ACT = 0 or
C_STATE_PRIO_INH_DIAG_DYN.CAT_ACT = 0) and
(LV_LS_DIAG_MNG_PRIO_DLY_ACT = 0 or
C_STATE_PRIO_INH_DIAG_DYN.DLY_ACT = 0) and
(LV_LS_DIAG_MNG_PRIO_CAT_END = 1 or
C_STATE_PRIO_INH_DIAG_DYN.CAT_END = 0) and
(LV_LS_DIAG_MNG_PRIO_DLY_END = 1 or
C_STATE_PRIO_INH_DIAG_DYN.DLY_END = 0))
then  LV_LS_DIAG_MNG_PRIO_DYN_REQ = LV_LS_DIAG_MNG_PRIO_DYN_ACT
else  LV_LS_DIAG_MNG_PRIO_DYN_REQ = 0
endif
If    ((LV_LS_DIAG_MNG_PRIO_DYN_ACT = 0 or
C_STATE_PRIO_INH_DIAG_CAT.DYN_ACT = 0) and
(LV_LS_DIAG_MNG_PRIO_DLY_ACT = 0 or
C_STATE_PRIO_INH_DIAG_CAT.DLY_ACT = 0) and
(LV_LS_DIAG_MNG_PRIO_DYN_END = 1 or
C_STATE_PRIO_INH_DIAG_CAT.DYN_END = 0) and
(LV_LS_DIAG_MNG_PRIO_DLY_END = 1 or
C_STATE_PRIO_INH_DIAG_CAT.DLY_END = 0))
then  LV_LS_DIAG_REQ_INH_CAT_DIAG = 0
else  LV_LS_DIAG_REQ_INH_CAT_DIAG = 1
endif

```

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Part 3: Calculate the FLS and lambda control requests. Since FLS may be changed or disabled for a variety of reasons, FLS is requested first, and if this request is met, lambda control parameters are requested too.

```

if2a LV_LS_DIAG_MNG_PRIO_DYN_REQ = 1
then STATE_LAMB_PLS_REQ_LS_DIAG = DYN_DIAG
else2a
    if LV_LS_DIAG_MNG_PRIO_DLY_REQ = 1
    then STATE_LAMB_PLS_REQ_LS_DIAG = DLY_DIAG
    else STATE_LAMB_PLS_REQ_LS_DIAG = NONE
    endif
endif2a
else1a
    If external priority control is active, just copy the requests
    STATE_LAMB_PLS_REQ_LS_DIAG = STATE_LAMB_PLS_REQ_LS_DIAG_EXT
    LV_LS_DIAG_REQ_INH_CAT_DIAG = LV_LS_DIAG_REQ_INH_CAT_DIAG_EXT
endif1a

if LV_LAMB_PLS_LS_DIAG = 1
then STATE_LAM_GAIN_REQ_LS_DIAG = STATE_LAMB_PLS_REQ_LS_DIAG
else STATE_LAM_GAIN_REQ_LS_DIAG = NONE
endif
if LV_LAMB_PLS_LS_DIAG = 1
and STATE_LAMB_PLS_REQ_LS_DIAG = DLY_DIAG
and LV_LAM_GAIN_LS_DIAG = 1
and STATE_LAM_GAIN_REQ_LS_DIAG = DLY_DIAG
then LV_DLY_DIAG_ACT_LAM_GAIN = 1
else LV_DLY_DIAG_ACT_LAM_GAIN = 0
endif
if LV_LAMB_PLS_LS_DIAG = 1
and STATE_LAMB_PLS_REQ_LS_DIAG = DYN_DIAG
and LV_LAM_GAIN_LS_DIAG = 1
and STATE_LAM_GAIN_REQ_LS_DIAG = DYN_DIAG
then LV_DIAG_DYN_LSL_UP_ENA = 1
else LV_DIAG_DYN_LSL_UP_ENA = 0
endif

```

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## B.34 O2 sensor (lin, up) dynamic diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CAT_DIAG_ACT_EXT	O	0... 1H	0 ...1	1	-
Summarized catalyst diag activation flag					
LV_CAT_DIAG_END_EXT	O	0... 1H	0 ...1	1	-
Summarized catalyst diag end flag					
LV_DIAG_DYN_INH_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of "Diagnosis of the WRAF Sensor Dynamic"					
LV_DIAG_EOL_DYN_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Status variable to activate the short test trip at the end of line					
LV_DIAG_EOL_DYN_LS_UP_DC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical Value as reminder for End of Line test within this driving cycle					
LV_DLY_DIAG_ACT_EXT	O	0... 1H	0 ...1	1	-
Summarized dynamic (effect) diag activation flag					
LV_DLY_DIAG_END_EXT	O	0... 1H	0 ...1	1	-
Summarized dynamic (effect) diag end flag					
LV_DYN_DIAG_ACT_EXT	O	0... 1H	0 ...1	1	-
Summarized dynamic (amplitude) diag activation flag					
LV_DYN_DIAG_END_EXT	O	0... 1H	0 ...1	1	-
Summarized dynamic (amplitude) diag end flag					
LV_INH_DIAG_DYN_VLD_LS_UP_ERR [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of "Diagnosis of WRAF Sensor Dynamic" by malfunction					
LV_INH_DIAG_LS_UP_DYN_CP	O/V	0... 1H	0 ...1	1	-
Canister Purge Load too high					
LV_INH_DIAG_RBM_DYN_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of Rate Based Monitoring of "Diagnosis of WRAF Sensor Dynamic" by malfunction					
LV_INH_SENS_DLY_DIAG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibition flag for sensor delay diagnosis					
LV_LS_DIAG_MNG_PRIO_EXT	O	0... 1H	0 ...1	1	-
Activation of external diagnosis priority manager override					
LV_LS_DIAG_REQ_INH_CAT_DIAG_EXT	O	0... 1H	0 ...1	1	-
External request from diagnosis priority manager to deactivate catalyst diagnosis					
STATE_LAMB_PLS_REQ_LS_DIAG_EXT	O	0H 1H 2H	NONE DYN_DIAG DLY_DIAG	-	-
External request for forced lambda stimulation for lambda sensor diagnoses					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_RBM_DYN_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0... 7H	0 ...7	1	-
Interface of DYN_VLD_LS_UP					

**Input data:**

CL_MMV {p. 3698}	CTR_ERR_DYN_NR {p. 5767}	LC_DIAG_PUE_ACT_LS_ DOWN {p. 5191}	LV_CDN_VB_OBD2 {p. 1185}
LV_CL_CLC_AVL {p. 3635}	LV_DC {p. 5746}	LV_DIAG_DYN_END_LSL_ UP [NC_CBK_EX_NR] {p. 5348}	LV_END_DIAG_DYN_ VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}
LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAM_CST_IVVT_ EX [NC_NR_CBK_IVVT] {p. 1061}
LV_ERR_CAM_CST_IVVT_ IN [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CHG_LS_DOWN {p. 5388}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CHK_LS_DOWN [NC_CBK_EX_NR] {p. 5388}
LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_ PER {p. 4432}
LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FTL_MIN {p. 4762}
LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}
LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_IVVT {p. 1062}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}
LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}
LV_ERR_MAP_PLAUS {p. 1062}	LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_MEC_IVVT_EX {p. 1062}	LV_ERR_MEC_IVVT_IN {p. 1062}
LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}
LV_ERR_OBD_LSH_ DOWN [NC_CBK_EX_NR] {p. 5198}	LV_ERR_OBD_VLD_LSH_ UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}

LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}
LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_ERR_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5297}	LV_ERR_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5169}
LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}
LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SLV_IVVT_EX {p. 4627}	LV_ERR_SLV_IVVT_IN {p. 4627}
LV_ERR_SWT_LS_DOWN [NC_CBK_EX_NR] {p. 5152}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4447}
LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TPS {p. 4982}	LV_ERR_TPS_1 {p. 4990}
LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_MAF_1 {p. 4990}
LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}
LV_ERR_VCV {p. 4729}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_ERR_VS {p. 5021}	LV_ERR_VS_PLAUS {p. 5021}
LV_IGK {p. 906}	LV_INH_DLY_DIAG_PRI_MNG [NC_CBK_EX_NR] {p. 803}	LV_INH_DYN_DIAG_PRI_MNG [NC_CBK_EX_NR] {p. 803}	LV_LS_UP_OBD_2_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}
NC_CBK_EX_NR {p. 1829}	NC_NR_CBK_IVVT {p. 604}	STATE_CP {p. 3637}	TCO {p. 1100}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_MMV_LS_UP_DIAG_MAX	V	0... FFFFH	0... 1.9999694824218	30.5175e-6	-
Maximum degree of saturation of the evaporative canister to activate the function					
C_TCO_MIN_DIAG_DYN_LSL_UP	V	0... FEH	-48... 142.5	0.75	°C
Min TCO threshold to enable upstream O2 sensor Dynamic Diag if performed unsync. to cat diag					
LC_DIAG_DYN_CP_ENA	V	0... 1H	0...1	1	-
Enable dynamic diagnosis even if canister pruge could be critical					

**Import actions:**


<b>ACTION_ERRM_CheckPendingStatus (IN&lt;PRM_IDX_DIAG&gt;,OUT&lt;PRM_LV_ERR_PND&gt;)</b>
--

**General information**

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

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i = 2, for exhaust cylinder bank 2  
 otherwise (NC\_CBK\_EX\_NR = 1)  
 i = 1, for single exhaust cylinder bank.  
 i = 1, for single exhaust cylinder bank.

### B.34.1 No title given

#### General information:

#### Application conditions:

**Initialisation:** at every transition LV\_IGK = 0->1 or reset all variables shall be reset to 0.  
 at every transition LV\_IGK = 1->0 LV\_DIAG\_DYN\_INH\_LSL\_UP[i] = 1  
 Following outputs shall be equal to the given values at all times:  
 LV\_CAT\_DIAG\_ACT\_EXT = 0  
 LV\_CAT\_DIAG\_END\_EXT = 1  
 LV\_DYN\_DIAG\_ACT\_EXT = 0  
 LV\_DYN\_DIAG\_END\_EXT = 1  
 LV\_DLY\_DIAG\_ACT\_EXT = 0  
 LV\_DLY\_DIAG\_END\_EXT = 1  
 LV\_LS\_DIAG\_MNG\_Prio\_EXT = 0  
 STATE\_LAMB\_PLS\_REQ\_LS\_DIAG\_EXT = NONE  
 LV\_LS\_DIAG\_REQ\_INH\_CAT\_DIAG\_EXT = 0

**Activation:** LV\_IGK = 1

**Deactivation:** LV\_IGK = 0

**Recurrence:** the functions shall be carried out once every 1s.

#### Function description:

#### Formula section:


The function "Diagnosis of the WRAF Sensor Dynamic" has to be deactivated, if at least one of the following errors is active.

<b>IF</b>	LV_ERR_AMP = 1	<b>OR</b>
	LV_ERR_AMP_PLAUS = 1	<b>OR</b>
	LV_ERR_CHG_LS_DOWN = 1	<b>OR</b>
	LV_ERR_CHG_LS_UP = 1	<b>OR</b>
	LV_ERR_CRK_PLAUS = 1	<b>OR</b>
	LV_ERR_CRK_SYN = 1	<b>OR</b>
	LV_ERR_CRK_TOOTH = 1	<b>OR</b>
	LV_ERR_CRK_TOOTH_PER = 1	<b>OR</b>
	LV_ERR_DIAGCPS = 1	<b>OR</b>
	LV_ERR_EL_CPS = 1	<b>OR</b>
	LV_ERR_FTL_MIN = 1	<b>OR</b>
	LV_ERR_FUP = 1	<b>OR</b>

```

LV_ERR_FUP_MFP_PLAUS = 1 OR
LV_ERR_FUP_ORNG = 1 OR
LV_ERR_FUP_ST = 1 OR
LV_ERR_H_PRS_SYS = 1 OR
LV_ERR_IVVT = 1 OR
LV_ERR_LOAD_TPS_PLAUS = 1 OR
LV_ERR_MAF = 1 OR
LV_ERR_MAP_PLAUS = 1 OR
LV_ERR_MAP_TPS_PLAUS = 1 OR
LV_ERR_MTC_CTL_2 = 1 OR
LV_ERR_MTC_CTL_3 = 1 OR
LV_ERR_MTC_DR = 1 OR
LV_ERR_TPS = 1 OR
LV_ERR_VCV = 1 OR
LV_ERR_VS= 1 OR
LV_ERR_VS_PLAUS= 1 OR
LV_ERR_AIR_LSL_UP[i] = 1 OR
LV_ERR_CHK_LS_DOWN[i] = 1 OR
LV_ERR_CTL_LSL_UP[i] = 1 OR
LV_ERR_DELTA_I_LAM = 1 OR
LV_ERR_EL_LSL_UP[i] = 1 OR
LV_ERR_FSD[i] = 1 OR
LV_ERR_FSD_LAM_LIM[i] = 1 OR
LV_ERR_LSH_DOWN[i] = 1 OR
LV_ERR_LSH_UP[i] = 1 OR
LV_ERR_LSL_UP_IF[i] = 1 OR
LV_ERR_OBD_LSH_DOWN[i] = 1 OR
LV_ERR_OBD_VLD_LSH_UP[i] = 1 OR
LV_ERR_OC_LS_DOWN[i] = 1 OR
LV_ERR_OC_LSL_UP[i] = 1 OR
LV_ERR_OFS_LSL_UP[i] = 1 OR
LV_ERR_PUC_LS_DOWN[i] = 1 OR
LV_ERR_PUC_VLD_LS_UP[i] = 1 OR
[LV_ERR_PUE_LS_DOWN[i] = 1 AND
LC_DIAG_PUE_ACT_LS_DOWN = 1 ] OR
LV_ERR_SCG_LS_DOWN[i] = 1 OR
LV_ERR_SCP_LS_DOWN[i] = 1 OR
LV_ERR_SHIFT_AFL_LSL_UP[i] = 1 OR
LV_ERR_SHIFT_AFR_LSL_UP[i] = 1 OR
LV_ERR_SWT_LS_DOWN[i] = 1 OR
LV_ERR_TTIP_MES_LSH_UP[i] = 1 OR
LV_ERR_VLS_DOWN_DIF[i] = 1 OR
(i = 1 AND
[LV_ERR_IV[0] OR
LV_ERR_IV[2] OR
LV_ERR_IV[4] OR
LV_ERR_MIS[0] OR
LV_ERR_MIS[2] OR
LV_ERR_MIS[4] ] ) OR
(i = 2 AND
[LV_ERR_IV[1] OR
LV_ERR_IV[3] OR
LV_ERR_IV[5] OR
LV_ERR_MIS[1] OR
LV_ERR_MIS[3] OR
LV_ERR_MIS[5] ] ) OR
LV_ERR_PER_CAM_EX[k] = 1 any k for i=1, 2 OR
LV_ERR_PER_CAM_IN[k] = 1 any k for i=1, 2 OR
LV_ERR_PLAUS_CAM_EX[k] = 1 any k for i=1, 2 OR
LV_ERR_PLAUS_CAM_IN[k] = 1 any k for i=1, 2 OR
LV_ERR_REF_CRK_CAM_EX[k] = 1 any k for i=1, 2 OR

```

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```

LV_ERR_REF_CRK_CAM_IN[k] = 1          any k for i=1, 2      OR
LV_ERR_SYN_CAM_EX[k] = 1             any k for i=1, 2      OR
LV_ERR_SYN_CAM_IN[k] = 1             any k for i=1, 2      OR
LV_ERR_SYN_CRK_CAM_IN[k] = 1         any k for i=1, 2      OR
LV_ERR_TOOTH_OFF_IN[k] =1            any k for i=1, 2      OR
LV_ERR_TOOTH_OFF_EX[k] =1            any k for i=1, 2

THEN          LV_INH_DIAG_RBM_DYN_VLD_LS_UP[i] = 1
                LV_INH_DIAG_DYN_VLD_LS_UP_ERR[i] = 1
ELSE          LV_INH_DIAG_RBM_DYN_VLD_LS_UP[i] = 0
                LV_INH_DIAG_DYN_VLD_LS_UP_ERR[i] = 0
ENDIF

```

### % Monitoring Canister Purge

```

IF          LV_DIAG_EOL_DYN_LS_UP[i] = 0
THEN

    % short test not required
    IF        LC_DIAG_DYN_CP_ENA = 1          OR
                STATE_CP = NO_PURGE          OR
                STATE_CP = CP_NOT_ACT        OR
                STATE_CP = WAIT_RAMP_OPEN    OR
                (STATE_CP = MIN_PURGE & LV_CL_CLC_AVL = 1) OR
                (STATE_CP = MAX_PURGE & CL_MMV ≤ C_CL_MMV_LS_UP_DIAG_MAX)
    THEN      LV_INH_DIAG_LS_UP_DYN_CP = 0
    ELSE      LV_INH_DIAG_LS_UP_DYN_CP = 1
    ENDIF

ELSE

    % short test required
    IF        (STATE_CP = MAX_PURGE) & (CL_MMV ≤ C_CL_MMV_LS_UP_DIAG_MAX) OR
                STATE_CP = NO_PURGE
    THEN      LV_INH_DIAG_LS_UP_DYN_CP = 0
    ELSE      LV_INH_DIAG_LS_UP_DYN_CP = 1
    ENDIF

ENDIF

```

The functions "Diagnosis of the WRAF Sensor Dynamic" and "Delay Diag "have to be deactivated, if at least one of the special modes is active.

```

IF          LV_LS_UP_OBD_2_MAN_DEAC[i] = 1          OR
                LV_CDN_VB_OBD2 = 0                OR
                LV_INH_DIAG_RBM_DYN_VLD_LS_UP[i] = 1 OR
                LV_INH_DIAG_LS_UP_DYN_CP = 1
THEN

    // do not active diags
    LV_DIAG_DYN_INH_LSL_UP[i] = 1
    LV_INH_SENS_DLY_DIAG[i] = 1

ELSE

    IF        (TCO < C_TCO_MIN_DIAG_DYN_LSL_UP) OR
                LV_DIAG_DYN_END_LSL_UP[i] = 1 OR
                LV_INH_DYN_DIAG_PRI_MNG[i] = 1
    THEN      LV_DIAG_DYN_INH_LSL_UP[i] = 1
    ELSE      LV_DIAG_DYN_INH_LSL_UP[i] = 0
    ENDIF

    IF        LV_END_DIAG_DYN_VLD_LS_UP[i] = 1 OR
                LV_INH_DLY_DIAG_PRI_MNG[i] = 1
    THEN      LV_INH_SENS_DLY_DIAG[i] = 1
    ELSE      LV_INH_SENS_DLY_DIAG[i] = 0
    ENDIF

ENDIF

```

## B.34.2 Interface for Rate – Based - Monitoring

**General information:**

With this module the interface between the DYN\_VLD\_LS\_UP[i] monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_DYN\_VLD\_LS\_UP[i] data.

Within STATE\_RBM\_DYN\_VLD\_LS\_UP[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)  
(depending on failure status: pending)
- Monitor individual RBM conditions encountered within this DC (bit 2)  
(not valid for catalyst diagnosis)

**Application conditions:****Initialisation:**

```

at ECU reset:
    bit 0, bit 1 and bit 2 of STATE_RBM_DYN_VLD_LS_UP[i]
= 0
    LV_DIAG_EOL_DYN_LS_UP_DC[i] = 0
LV_DC 0 ->1 transition:
    bit 0 and bit 1 of STATE_RBM_DYN_VLD_LS_UP[i] = 0
    LV_DIAG_EOL_DYN_LS_UP_DC[i] = 0
on failure memory reset:
    bit 1 of STATE_RBM_STATE_RBM_DYN_VLD_LS_UP[i] = 0
    LV_DIAG_EOL_DYN_LS_UP_DC[i] = 0

```

**Activation:** LV\_DC = 1

**Deactivation:** -

**Recurrence:** 1 s

**Function description:****Formula section:****At LV\_DC 0 ->1 transition**

bit 2 of STATE\_RBM\_DYN\_VLD\_LS\_UP[i] = 1

The pending status of the following failures has to be checked only once :

Dependence	Error			
	LV_ERR_AMP	LV_ERR_AMP_PLAUS	LV_ERR_CHG_LS_DOWN	LV_ERR_CHG_LS_UP
	LV_ERR_CRK_PLAUS	LV_ERR_CRK_SYN	LV_ERR_CRK_TOOTH	LV_ERR_CRK_TOOTH_ PER
	LV_ERR_DIAGCPS	LV_ERR_EL_CPS	LV_ERR_FTL_MIN	LV_ERR_FUP
Continued on next page				

	LV_ERR_FUP_MFP_PLAUS	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_SYS
	LV_ERR_LOAD_TPS_PLAUS	LV_ERR_MAF_FRQ_EL	LV_ERR_MAF_FRQ_GRD	LV_ERR_MAF_FRQ_RNG
	LV_ERR_MAP_PLAUS	LV_ERR_MAP_TPS_PLAUS	LV_ERR_MTC_CTL_2	LV_ERR_MTC_CTL_3
	LV_ERR_MTC_DR	LV_ERR_TPS_1	LV_ERR_TPS_2	LV_ERR_TPS_AD
	LV_ERR_TPS_AD_BOL	LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2	LV_ERR_TPS_RATIO
	LV_ERR_TPS_ST_CHK_2	LV_ERR_VCV	LV_ERR_VS	LV_ERR_VS_PLAUS
<b>NC_CBK_EX_NR</b>	LV_ERR_AIR_LSL_UP[i]	LV_ERR_CHK_LS_DOWN[i]	LV_ERR_CTL_LSL_UP[i]	LV_ERR_DELTA_I_LAM[i]
	LV_ERR_EL_LSL_UP[i]	LV_ERR_FSD[i]	LV_ERR_FSD_LAM_LIM[i]	LV_ERR_LSH_DOWN[i]
	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]	LV_ERR_OBD_LSH_DOWN[i]	LV_ERR_OBD_VLD_LSH_UP[i]
	LV_ERR_OC_LS_DOWN[i]	LV_ERR_OC_LSL_UP[i]	LV_ERR_OFS_LSL_UP[i]	LV_ERR_PUC_LS_DOWN[i]
	LV_ERR_PUC_VLD_LS_UP[i]	LV_ERR_PUE_LS_DOWN[i]	LV_ERR_SCG_LS_DOWN[i]	LV_ERR_SCP_LS_DOWN[i]
	LV_ERR_SHIFT_AFL_LSL_UP[i]	LV_ERR_SHIFT_AFR_LSL_UP[i]	LV_ERR_SWT_LS_DOWN[i]	LV_ERR_TTIP_MES_LSH_UP[i]
	LV_ERR_VLS_DOWN_DIF[i]			

For k = 1 to NC\_NR\_CAM\_CBK (= for any i // or)

<b>NC_NR_CAM_CBK</b>	LV_ERR_PER_CAM_EX[k]	LV_ERR_PER_CAM_IN[k]	LV_ERR_PLAUS_CAM_EX[k]	LV_ERR_PLAUS_CAM_IN[k]
	LV_ERR_REF_CRK_CAM_EX[k]	LV_ERR_REF_CRK_CAM_IN[k]	LV_ERR_SYN_CAM_EX[k]	LV_ERR_SYN_CAM_IN[k]
	LV_ERR_SYN_CRK_CAM_IN[k]	LV_ERR_TOOTH_OFF_IN[k]	LV_ERR_TOOTH_OFF_EX[k]	


For x = 1 to NC\_NR\_CBK\_IVVT (= for any i // or)

<b>NC_NR_CBK_IVVT</b>	LV_ERR_CAM_CST_IVVT_EX[x]	LV_ERR_CAM_CST_IVVT_IN[x]	LV_ERR_MEC_IVVT_EX[x]	LV_ERR_MEC_IVVT_IN[x]
	LV_ERR_SLV_IVVT_EX[x]	LV_ERR_SLV_IVVT_IN[x]		

For NC\_CBK\_EX\_NR = i = 1

<b>NC_CYL_NR</b>	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	LV_ERR_MIS[0]
	LV_ERR_MIS[2]	LV_ERR_MIS[4]		

For NC\_CBK\_EX\_NR = i = 2

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NC_CYL_NR	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	LV_ERR_MIS[1]
	LV_ERR_MIS[3]	LV_ERR_MIS[5]		

**If (1)**

```
{ CPU optimization at LV_DC 0 ->1 transition }
CTR_ERR_DYN_NR <> 0
      { the dynamic failure memory isn't empty }
```

**Then (1)**

```
While bit 1 of STATE_RBM_DYN_VLD_LS_UP[i] = 0 do
with each XX failure of the above list (depending on configuration, see below) ex-
cept
LV_ERR_PUE_LS_DOWN:
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>,
SYNCHRONIZATION<CALL>)
```

**If (2)**

XX has a pending status

```
Then (2) bit 1 of STATE_RBM_DYN_VLD_LS_UP[i] = 1
Endif (2)
```

For LV\_ERR\_PUE\_LS\_DOWN[i], do the following instead:

```
If LC_DIAG_PUE_ACT_LS_DOWN = 1
then
ACTION_ERRM_CheckPendingStatus(IN<XX>,
OUT<PendingStatus>, SYNCHRONIZATION<CALL>)
```

**If (3)**

XX has a pending status

```
Then (3) bit 1 of STATE_RBM_DYN_VLD_LS_UP[i] = 1
Endif (3)
```

**Endif**

**Endwhile**

**Else (1)**

{ the dynamic failure memory is empty } No action

**Endif (1)**

Every 1 s :

```
If LV_DIAG_EOL_DYN_LS_UP[i] = 1
Then LV_DIAG_EOL_DYN_LS_UP_DC[i] = 1
Endif
```

```
If bit 0 of STATE_RBM_DYN_VLD_LS_UP[i] = 0
```

**Then**

```
If LV_END_DIAG_DYN_VLD_LS_UP[i] = 1 And
LV_DIAG_EOL_DYN_LS_UP_DC[i] = 0
Then bit 0 of STATE_RBM_DYN_VLD_LS_UP[i] = 1
Endif
```

**Endif**

```
If bit 1 of STATE_RBM_DYN_VLD_LS_UP[i] = 0
```

**Then**

```
If LV_INH_DIAG_RBM_DYN_VLD_LS_UP[i] = 1
Then bit 1 of STATE_RBM_DYN_VLD_LS_UP[i] = 1
Endif
```

**Endif**

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### B.34.3 Activation of short trip for WRAF sensor dynamic diagnosis

#### General information:

Not yet defined

#### Application conditions:

**Initialisation:** LV\_DIAG\_EOL\_DYN\_LS\_UP [NC\_CBK\_EX\_NR] = 0 (never changed)


**Activation:** —

**Deactivation:** —

**Recurrence:** —

#### Function description:

#### Formula section:

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## B.35 O2 sensor open loop diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_AFL_CHK_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Debounce counter for the lean test					
CTR_AFR_CHK_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Debounce counter for the rich test					
CTR_SUM_RST_AFL_CHK_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Reset counter for the rich active test					
CTR_SUM_RST_AFR_CHK_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Reset counter for the rich active test					
ERR_SYM_CHG_LS_DOWN	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom for downstream lambda sensors interchanged					
ERR_SYM_CHK_LS_DOWN [NC_CBK_EX_NR]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom in the downstream sensor					
LAMB_SP_BEG_DIAG_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Initial value of lambda set point					
LAMB_SP_DELTA_LS_UP_DOWN [NC_CBK_EX_NR]	V	8000... 7FFFH	-32... 31.99902	976.599e-6	-
Increment of of lambda set point					
LAMB_SP_DIAG_OPL_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
lambda setpoint requested by open-loop test for upstream and downstream lambda sensors					
LV_CDN_DIAG_CHG_LS_DOWN	V	0... 1H	0 ...1	1	-
Condition to run the diagnosis are fulfilled					
LV_CDN_DIAG_CHK_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Conditions to run active test of downstream sensor fulfilled					
LV_DIAG_ACT_CDN_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Conditions to perform rich/lean check of open loop diag are fulfilled - not relevant for soft check					
LV_DIAG_ACT_CHK_CDN_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Conditions to run active test of upstream sensor fulfilled					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_ACT_CHK_END_LSL_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
End active test of upstream sensor					
LV_DIAG_ACT_END_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag, end of active check of the oxygen sensors					
LV_DIAG_AFL_CDN_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the condition to execute LEAN active check are met					
LV_DIAG_AFL_CHK_SYM_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced failure in the upstream sensor during the LEAN active check					
LV_DIAG_AFL_END_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the end of LEAN active check					
LV_DIAG_AFR_CDN_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the condition to execute RICH active check are met					
LV_DIAG_AFR_CHK_SYM_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced failure in the upstream sensor during the RICH active check					
LV_DIAG_AFR_END_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the end of RICH active check					
LV_DIAG_CYC_END_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End of cycle of active test of downstream sensor					
LV_DIAG_EOL_DC_LS_UP_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating eol test was active in this driving cycle.					
LV_DIAG_EOL_END_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag, end of active check of the oxygen sensors (EOL test)					
LV_END_DIAG_CHG_LS_DOWN	V	0... 1H	0 ...1	1	-
End of downstream oxygen sensors interchanged test					
LV_END_DIAG_CHK_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End active test of downstream sensor					
LV_ERR_CHG_LS_DOWN	O/V	0... 1H	0 ...1	1	-
Debounced failure of downstream lambda sensors interchanged					
LV_ERR_CHK_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced failure in the downstream sensor					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAM_DI_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request disable close loop operation of the lambda controller					
LV_LAMB_SP_AFL_REQ_DIAG_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Trigger function to change lambda set point for AFL active plausibility test					
LV_LAMB_SP_AFR_REQ_DIAG_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Trigger function to change lambda set point for AFR active plausibility test					
LV_SYM_AFL_CHK_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Symptom of oxygen sensor downstream too lean in case of 2 bank system during end of line test or sensor interchanged test					
LV_SYM_AFR_CHK_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Symptom of oxygen sensor downstream too rich in case of 2 bank system during end of line test or sensor interchanged test					
MAF_INT_DIAG_LS_UP_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.41666	0.0277778	g
integral of air mass flow while check is active					
STATE_DIAG_ACT_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H undef:1H	PASSIVE RICH_CHECK LEAN_CHECK CHECK_ FINISHED	-	-
State of check of downstream oxygen sensor signal for lambda sensor error manager					
T_AFL_CHK_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Debounce counter for the lean test					
T_AFR_CHK_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Debounce counter for the rich test					
T_DIAG_ACT_AFL_LS_UP_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for plausibility test under lean AF conditions					
T_DIAG_ACT_AFR_LS_UP_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for plausibility test under rich AF conditions					
T_END_DIAG_ACT_LS_DOWN	V	0... FFFFH	0... 6553.5	0.1	s
Timer for the end of the downstream sensor active test in the no failure case					

**Input data:**

LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_DIAG_ACT_INH_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5407}	LV_DIAG_AFR_AFL_INH_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5407}
LV_DIAG_EOL_REQ_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5407}	LV_DIAG_OPL_REQ_CBK [NC_CBK_EX_NR] {p. 5407}	LV_END_DIAG_LAM_ADJ [NC_CBK_EX_NR] {p. 5215}	LV_IGK {p. 906}
LV_INH_DIAG_CHG_LS_DOWN {p. 5407}	LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_ST_END {p. 1720}	MAF_CYL {p. 8277}

NC_CBK_EX_NR {p. 1829}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}		
------------------------	-------------------------------------	--	--

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_CHK_LSL_UP	-	0... FFH	0... 255	1	-
Increment for debounce algorithmus					
C_ABC_MAX_CHK_LSL_UP	-	0... FFFFH	0... 65535	1	-
Maximum value for debounce algorithmus					
C_CTR_SUM_RST_AFL_CHK_LSL_UP	-	0... FFFFH	0... 65535	1	-
Reset debounce counter for Lean test					
C_CTR_SUM_RST_AFR_CHK_LSL_UP	-	0... FFFFH	0... 65535	1	-
Reset debounce counter for Richt test					
C_LAMB_AFL_MAX_DIAG_LS_UP_DOWN	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Max. lambda set point for lean fault detection					
C_LAMB_AFL_MIN_DIAG_LS_UP_DOWN	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Min. lambda set point for lean fault detection					
C_LAMB_AFL_THD_DIAG_ACT_LSL_UP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda value threshold for lean fault detection (upstream sensor)					
C_LAMB_AFR_MAX_DIAG_LS_UP_DOWN	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Max. lambda set point for rich fault detection					
C_LAMB_AFR_MIN_DIAG_LS_UP_DOWN	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Min. lambda set point for rich fault detection					
C_LAMB_AFR_THD_DIAG_ACT_LSL_UP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda value threshold for rich fault detection (upstream sensor)					
C_LAMB_SP_AFL_DIAG_LS_UP_DOWN	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda set point for lean fault detection					
C_LAMB_SP_AFR_DIAG_LS_UP_DOWN	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda set point for rich fault detection					
C_LAMB_SP_STEP_DIAG_LS_UP_DOWN	-	1... FFH	1... 255	1	-
Number of recurrences to achieve the desired lambda set point					
C_MAF_INT_DIAG_LS_UP_DOWN [NC_CBK_EX_NR]	-	0... FFFFH	0... 1820.41666	0.0277778	g
Minimum threshold for MAF integral required to start active test					
C_MAF_INT_EOL_DIAG_LS_UP_DOWN [NC_CBK_EX_NR]	-	0... FFFFH	0... 1820.41666	0.0277778	g
Initialization of MAF integral to reduce required minimum MAF value to start active test					
C_T_DIAG_EOL_LS_UP_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
Initialization of timer in case EOL to reduce the required minimum activity test time					
C_T_END_DIAG_ACT_LS_DOWN [NC_CBK_EX_NR]	-	0... FFFFH	0... 6553.5	0.1	s
Timer threshold for the end of the downstream sensor active test in the no failure case					
C_T_MAX_CHK_LS_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
Time to debounce the error					
C_T_MAX_DIAG_AFL_LS_UP_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
Timer threshold for plausibility test under lean AF conditions					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MAX_DIAG_AFR_LS_UP_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
Timer threshold for plausibility test under rich AF conditions					
C_VLS_AFL_THD_DIAG_ACT_LS_DOWN [NC_CBK_EX_NR]	-	0... 3FFH	0... 4.99511	4.8828e-3	V
VLS voltage threshold for lean fault detection (downstream sensor)					
C_VLS_AFR_THD_DIAG_ACT_LS_DOWN [NC_CBK_EX_NR]	-	0... 3FFH	0... 4.99511	4.8828e-3	V
VLS voltage threshold for rich fault detection (downstream sensor)					
LC_DIAG_AUTH_CHK_LS_UP_DOWN	-	0... 1H	0 ...1	1	-
Boolean switch allowing the active test					

## B.35.1 State machine

### FUNCTION DESCRIPTION:

#### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

Due to possible oxygen sensor defects (e.g. reference air poisoning) or faults in the injection system (e.g. leaking fuel injector), the oxygen sensors may not provide the expected lean or rich AF signal level during definite conditions (lean or rich). Hence, the oxygen sensor signals shall be checked for plausibility during this engine operating states. The handling is requested and results are utilized by a separate manager for oxygen sensors error.

#### Description:

If the following conditions are met, then the conditions for plausibility check at lean conditions are determined to be present:

1. The Fuel Trim Diagnosis has detected an error (transmitted by LV\_DIAG\_OPL\_REQ\_CBK[1]).
- B. No general inhibition observed (LV\_DIAG\_ACT\_INH\_LS\_UP\_DOWN[i]) and no specific inhibition exists (LV\_DIAG\_AFR\_AFL\_INH\_LS\_UP\_DOWN[i] = 0).
- C. The lean state shall be determined to be stable, as determined by comparing the mass air flow integral calculated after activation (MAF\_INT\_DIAG\_LS\_UP\_DOWN[i]) with the threshold range (C\_MAF\_INT\_DIAG\_LS\_UP\_DOWN[i]).
- D. The lean condition will be maintained until a timer is elapsed or an error was found on the upstream sensor or in case of a 1 bank system also on the downstream sensor.

The rich check follows always the lean test. The procedure is analogous to the lean check.

In case of a two bank system and finished open loop test on bank 1 and if there was no upstream linear lambda sensor fault detected, the bank 2 will be checked (triggered by LV\_DIAG\_OPL\_REQ\_CBK[2] which is set in application incidences).

In case an EOL test the timers shall be initialized with a non-zero calibrateable value to reduce the minimum required time. The same is valid for the initialization of the MAF integral.

### **Application conditions**

#### **Initialisation:**

At LV\_IGK = 0 to 1, by reset, by clearing error memory or by triggering the EOL test (LV\_DIAG\_EOL\_REQ\_LS\_UP\_DOWN[i] = 0 -> 1; while LV\_DIAG\_ACT\_END\_LS\_UP\_DOWN[i] = 0) initialise the variables as follows:

```
STATE_DIAG_ACT_LS_UP_DOWN[i] = 0
MAF_INT_DIAG_LS_UP_DOWN[i] = 0
LV_DIAG_ACT_END_LS_UP_DOWN[i] = 0
LV_DIAG_EOL_END_LS_UP_DOWN[i] = 0
LV_DIAG_AFR_CDN_LS_UP_DOWN[i] = 0
LV_DIAG_AFR_END_LS_UP_DOWN[i] = 0
LV_DIAG_AFL_CDN_LS_UP_DOWN[i] = 0
LV_DIAG_AFL_END_LS_UP_DOWN[i] = 0
LAMB_SP_BEG_DIAG_LS_UP_DOWN[i] = 1
LV_LAMB_SP_AFR_REQ_DIAG_ACT[i] = 0
LV_LAMB_SP_AFL_REQ_DIAG_ACT[i] = 0
T_DIAG_ACT_AFR_LS_UP_DOWN[i] = 0
T_DIAG_ACT_AFL_LS_UP_DOWN[i] = 0
LV_LAM_DI_REQ[i] = 0
```

Recurrence:  $T\_SAMPLE = 100\text{ms}$

#### Note:

The functions contained in this module shall be carried out according the following sequence:

1. active test upstream sensor
2. active test downstream sensor
3. state machine


#### Activation:

LV\_ST\_END = 1

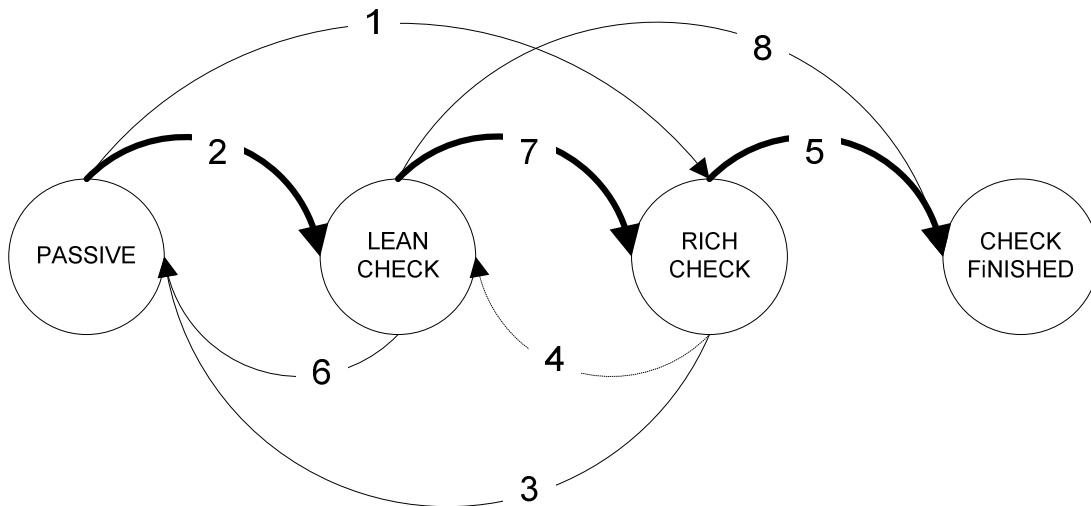
### **B.35.1.1 Sequence for check of signal plausibility monitoring (state machine)**

The state machine shall remain in its current state and carry out the actions specified to occur within that state once per recurrence unless otherwise specified. The state machine shall only move to another state when one of the conditions has been determined to be met.

The priority of the conditions to change between states shall be defined by the order in which these conditions are listed within the appropriate state as described below.

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### STATE machine diagram:

```

if      LV_DIAG_ACT_INH_LS_UP_DOWN[i] = 0
and     LV_DIAG_ACT_END_LS_UP_DOWN[i] = 0
and [ ( LV_DIAG_OPL_REQ_CBK[i] = 1 & LC_DIAG_AUTH_CHK_LS_UP_DOWN = 1 ) or
        LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1 ]
then
    LV_DIAG_ACT_CDN_LS_UP_DOWN[i] = 1
else
    LV_DIAG_ACT_CDN_LS_UP_DOWN[i] = 0
endif
  
```

#### B.35.1.2 State "PASSIVE"

##### Actions:

**none**

##### Condition 1: Transition to state "RICH CHECK"

```

if      LV_DIAG_AFR_AFL_INH_LS_UP_DOWN[i] = 0
and     LV_DIAG_AFR_END_LS_UP_DOWN[i] = 0
and     LV_DIAG_AFL_END_LS_UP_DOWN[i] = 1
and     LV_DIAG_ACT_CDN_LS_UP_DOWN[i] = 1
then
    STATE_DIAG_ACT_LS_UP_DOWN[i] = "RICH CHECK"
    LAMB_SP_BEG_DIAG_LS_UP_DOWN[i] = LAMB_SP[i]
    LV_LAMB_SP_AFR_REQ_DIAG_ACT[i] = 1
    LV_LAM_DI_REQ[i] = 1
    if LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1
    Then
        MAF_INT_DIAG_LS_UP_DOWN[i] = C_MAF_INT_EOL_DIAG_LS_UP_DOWN[i]
        T_DIAG_ACT_AFL_LS_UP_DOWN[i] = C_T_DIAG_EOL_LS_UP_DOWN
    Else
        T_DIAG_ACT_AFL_LS_UP_DOWN[i] = 0
        MAF_INT_DIAG_LS_UP_DOWN[i] = 0
  
```

**endif**  
**endif**

Condition 2: Transition to state "LEAN CHECK"

```

If          LV_DIAG_AFR_AFL_INH_LS_UP_DOWN[i] = 0
and        LV_DIAG_AFL_END_LS_UP_DOWN[i] = 0
and        ( LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1      or
              LV_DIAG_OPL_REQ_CBK[i] = 1 )
and        LV_DIAG_ACT_CDN_LS_UP_DOWN[i] = 1
then
  STATE_DIAG_ACT_LS_UP_DOWN[i] = "LEAN CHECK"
  LAMB_SP_BEG_DIAG_LS_UP_DOWN[i] = LAMB_SP[i]
  LV_LAMB_SP_AFL_REQ_DIAG_ACT[i] = 1
  LV_LAM_DI_REQ[i] = 1    % disable lambda ctr. close loop operation
  If LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1
    Then
      MAF_INT_DIAG_LS_UP_DOWN[i] = C_MAF_INT_EOL_DIAG_LS_UP_DOWN[i]
      T_DIAG_ACT_AFL_LS_UP_DOWN[i] = C_T_DIAG_EOL_LS_UP_DOWN
    Else
      T_DIAG_ACT_AFL_LS_UP_DOWN[i] = 0
      MAF_INT_DIAG_LS_UP_DOWN[i] = 0
    endif
  endif
endif

```

### B.35.1.3 State "RICH CHECK"

#### Description:

The MAF integral runs. After exceeding the calibrateable threshold for MAF the signal voltage is observed and the check is complete. The corresponding diagnosis flag is set in case of not sufficient voltage value.


The calculation of MAF\_INT\_DIAG\_LS\_UP\_DOWN[i] expires in 100ms raster as long as the operation state is fulfilled. MAF\_INT\_DIAG\_LS\_UP\_DOWN[i] is limited to the maximum value if necessary in case of a longer rich phase.

#### Actions:

```

If      LV_LAM_LSCL[i] = 0
and     LAMB_SP[i] > C_LAMB_AFR_MIN_DIAG_LS_UP_DOWN
and     LAMB_SP[i] < C_LAMB_AFR_MAX_DIAG_LS_UP_DOWN
then
  MAF_INT_DIAG_LS_UP_DOWN[i] n = MAF_INT_DIAG_LS_UP_DOWN[i] n-1 + MAF_CYL* T_
  SAMPLE [ms] * 1/3600 [(g*h)/(kg*ms)]
else
  If LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1
    Then
      MAF_INT_DIAG_LS_UP_DOWN[i] = C_MAF_INT_EOL_DIAG_LS_UP_DOWN[i]
    else
      MAF_INT_DIAG_LS_UP_DOWN[i] = 0
    endif
  endif
endif

```

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```

if      MAF_INT_DIAG_LS_UP_DOWN[i] > C_MAF_INT_DIAG_LS_UP_DOWN[i]
then    keep MAF_INT_DIAG_LS_UP_DOWN[i]
if      T_DIAG_ACT_AFR_LS_UP_DOWN[i] < C_T_MAX_DIAG_AFR_LS_UP_DOWN
then    active test runs
          LV_DIAG_AFR_CDN_LS_UP_DOWN[i] = 1
          if LV_ERR_CHK_LS_DOWN[i] = 1
          or LV_DIAG_AFR_CHK_SYM_LSL_UP[i] = 1
          then
            LV_DIAG_AFR_CDN_LS_UP_DOWN[i] = 0
            go to transition to check finished
          else
            Increment T_DIAG_ACT_AFR_LS_UP_DOWN[i]
          endif
        else active test timed out
          LV_DIAG_AFR_CDN_LS_UP_DOWN[i] = 0
          LV_DIAG_AFR_END_LS_UP_DOWN[i] = 1
          keep T_DIAG_ACT_AFR_LS_UP_DOWN[i]

          if LV_DIAG_AFL_END_LS_UP_DOWN[i] = 1
          then go to transition to check finished
        else go to transition to lean check
        endif
      endif
    else
      LV_DIAG_AFR_CDN_LS_UP_DOWN[i] = 0
      if T_DIAG_ACT_AFR_LS_UP_DOWN[i] < C_T_MAX_DIAG_AFR_LS_UP_DOWN
      Then
        if LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1
        Then
          T_DIAG_ACT_AFR_LS_UP_DOWN[i] = C_T_DIAG_EOL_LS_UP_DOWN
        else
          T_DIAG_ACT_AFR_LS_UP_DOWN[i] = 0
        endif
      else
        Keep T_DIAG_ACT_AFR_LS_UP_DOWN[i]
      endif
    endif
  endif

```

#### Condition 3: Transition to state "PASSIVE"

```

if LV_DIAG_AFR_AFL_INH_LS_UP_DOWN[i] = 1
or  LV_DIAG_ACT_CDN_LS_UP_DOWN[i] = 0
then
  LV_LAM_DI_REQ[i] = 0           % re-enable lambda ctr. close loop operation
  LV_LAMB_SP_AFR_REQ_DIAG_ACT[i] = 0
  LV_DIAG_AFR_CDN_LS_UP_DOWN[i] = 0
  STATE_DIAG_ACT_LS_UP_DOWN[i] = "PASSIVE"
endif


```

#### Condition 4: Transition to state "LEAN CHECK"

```

if transition to lean test
then
  MAF_INT_DIAG_LS_UP_DOWN[i] = 0

```

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```

LV_LAMB_SP_AFR_REQ_DIAG_ACT[i] = 0
LV_LAMB_SP_AFL_REQ_DIAG_ACT[i] = 1
LAMB_SP_BEG_DIAG_LS_UP_DOWN[i] = LAMB_SP[i]
STATE_DIAG_ACT_LS_UP_DOWN[i] = "LEAN CHECK "

```

**endif**

Condition 5: Transition to state "CHECK FINISHED"

*If transition to check finished*

**Then**

```

LV_LAM_DI_REQ[i] = 0           % re-enable lambda ctr. close loop operation
LV_LAMB_SP_AFR_REQ_DIAG_ACT[i] = 0
LV_DIAG_ACT_END_LS_UP_DOWN[i] = 1
STATE_DIAG_ACT_LS_UP_DOWN[i] = " CHECK FINISHED "
If LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1
then
    LV_DIAG_EOL_END_LS_UP_DOWN[i] = 1

```

**endif**

**endif**

### B.35.1.4 State "LEAN CHECK"

#### Description:

The MAF integral runs. After exceeding the calibrateable threshold for MAF the signal voltage is observed and the check is complete. The corresponding diagnosis flag is set in case of not sufficient voltage value.

The calculation of MAF\_INT\_DIAG\_LS\_UP\_DOWN[i] expires in 100ms raster as long as the operation state is fulfilled. MAF\_INT\_DIAG\_LS\_UP\_DOWN[i] is limited to the maximum value if necessary in case of a longer rich phase.

#### Actions

```

If LV_LAM_LSCL[i] = 0
and LAMB_SP[i] > C_LAMB_AFL_MIN_DIAG_LS_UP_DOWN
and LAMB_SP[i] < C_LAMB_AFL_MAX_DIAG_LS_UP_DOWN
then
MAF_INT_DIAG_LS_UP_DOWN[i]n = MAF_INT_DIAG_LS_UP_DOWN[i]n-1 + MAF_CYL * T_SAMPLE [ms] * 1/3600 [(g*h)/(kg*ms)]
else
If LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1
Then
    MAF_INT_DIAG_LS_UP_DOWN[i] = C_MAF_INT_EOL_DIAG_LS_UP_DOWN[i]
else
    MAF_INT_DIAG_LS_UP_DOWN[i] = 0
endif
endif

If MAF_INT_DIAG_LS_UP_DOWN[i] > C_MAF_INT_DIAG_LS_UP_DOWN[i]
then    keep MAF_INT_DIAG_LS_UP_DOWN[i]
If T_DIAG_ACT_AFL_LS_UP_DOWN[i] < C_T_MAX_DIAG_AFL_LS_UP_DOWN
then    active test runs
    LV_DIAG_AFL_CDN_LS_UP_DOWN[i] = 1

```

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```

if LV_ERR_CHK_LS_DOWN[i] = 1
or LV_DIAG_AFL_CHK_SYM_LSL_UP[i] = 1
  then
    LV_DIAG_AFL_CDN_LS_UP_DOWN[i] = 0
    go to transition to check finished
  else
    Increment T_DIAG_ACT_AFL_LS_UP_DOWN[i]
  endif
else active test timed out
  LV_DIAG_AFL_CDN_LS_UP_DOWN[i] = 0
  LV_DIAG_AFL_END_LS_UP_DOWN[i] = 1
  keep T_DIAG_ACT_AFL_LS_UP_DOWN[i]

  if LV_DIAG_AFR_END_LS_UP_DOWN[i] = 1
    then go to transition to check finished
  else go to transition to rich check
  endif
endif
else
  LV_DIAG_AFL_CDN_LS_UP_DOWN[i] = 0
  if T_DIAG_ACT_AFL_LS_UP_DOWN[i] < C_T_MAX_DIAG_AFL_LS_UP_DOWN
  then
    if LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1
    Then
      T_DIAG_ACT_AFL_LS_UP_DOWN[i] = C_T_DIAG_EOL_LS_UP_DOWN
    else
      T_DIAG_ACT_AFL_LS_UP_DOWN[i] = 0
    endif
  else
    Keep T_DIAG_ACT_AFL_LS_UP_DOWN[i]
  endif
endif

```

#### Condition 6: Transition to state "PASSIVE"

```

if LV_DIAG_AFR_AFL_INH_LS_UP_DOWN[i] = 1
or LV_DIAG_ACT_CDN_LS_UP_DOWN[i] = 0
then
  LV_LAM_DI_REQ[i] = 0           % re-enable lambda ctr. close loop operation
  LV_LAMB_SP_AFL_REQ_DIAG_ACT[i] = 0
  LV_DIAG_AFL_CDN_LS_UP_DOWN[i] = 0
  STATE_DIAG_ACT_LS_UP_DOWN[i] = "PASSIVE"
endif


```

#### Condition 7: Transition to state "RICH CHECK"

```

if transition to rich test
then
  MAF_INT_DIAG_LS_UP_DOWN[i] = 0
  LV_LAMB_SP_AFL_REQ_DIAG_ACT[i] = 0
  LV_LAMB_SP_AFR_REQ_DIAG_ACT[i] = 1
  LAMB_SP_BEG_DIAG_LS_UP_DOWN[i] = LAMB_SP[i]
  STATE_DIAG_ACT_LS_UP_DOWN[i] = " RICH CHECK "
endif

```

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**Condition 8: Transition to state "CHECK FINISHED"****If** *transition to check finished***Then**

LV\_LAM\_DI\_REQ[i] = 0           % re-enable lambda ctr. close loop operation

LV\_LAMB\_SP\_AFL\_REQ\_DIAG\_ACT[i] = 0

LV\_DIAG\_ACT\_END\_LS\_UP\_DOWN[i] = 1

STATE\_DIAG\_ACT\_LS\_UP\_DOWN[i] = "CHECK FINISHED"

**If** LV\_DIAG\_EOL\_REQ\_LS\_UP\_DOWN[i] = 1**Then**

LV\_DIAG\_EOL\_END\_LS\_UP\_DOWN[i] = 1

**endif****endif****B.35.1.5 State "CHECK FINISHED"**Action:

none

**B.35.2 O2 Sensor (up) open loop diag****FUNCTION DESCRIPTION:**

This function shall do a plausibility test of the upstream oxygen sensor after the lambda set point was shifted to rich and/or lean. The failure entry will be done by the O2 Sensor diagnosis management (characteristic shift down diagnosis). Consequently the flags LV\_ERR\_.... and LV\_END\_DIAG\_... are defined there.

**Description:****Application conditions**

**Initialisation:**           At LV\_IGK change 0 -> 1, reset or at clearing error memory initialize the variables as follows:

LV\_DIAG\_AFR\_CHK\_SYM\_LSL\_UP[i] = 0

LV\_DIAG\_AFL\_CHK\_SYM\_LSL\_UP[i] = 0

LV\_DIAG\_ACT\_CHK\_CDN\_LSL\_UP[i] = 0

LV\_DIAG\_ACT\_CHK\_END\_LSL\_UP[i] = 0

CTR\_SUM\_RST\_AFR\_CHK\_LSL\_UP[i] = 0

CTR\_SUM\_RST\_AFL\_CHK\_LSL\_UP[i] = 0

CTR\_AFR\_CHK\_LSL\_UP[i] = 0

CTR\_AFL\_CHK\_LSL\_UP[i] = 0


**Recurrence:**

This function shall be carried out every 100 ms.

**Activation:****If** LV\_DIAG\_AFR\_CDN\_LS\_UP\_DOWN[i] = 1 **or** LV\_DIAG\_AFL\_CDN\_LS\_UP\_DOWN[i] = 1**then**

LV\_DIAG\_ACT\_CHK\_CDN\_LSL\_UP[i] = 1

*Activate function*

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Else

LV\_DIAG\_ACT\_CHK\_CDN\_LSL\_UP[i] = 0

*Deactivate function*

endif

**Formula section:**

If LV\_DIAG\_AFR\_CDN\_LS\_UP\_DOWN[i] = 1

And CTR\_SUM\_RST\_AFR\_CHK\_LSL\_UP[i] < C\_CTR\_SUM\_RST\_AFR\_CHK\_LSL\_UP  
then

If LAMB\_LS\_UP[i] > C\_LAMB\_AFR\_THD\_DIAG\_ACT\_LSL\_UP

Then

If CTR\_AFR\_CHK\_LSL\_UP[i] < C\_ABC\_MAX\_CHK\_LSL\_UP

Then

Increment CTR\_AFR\_CHK\_LSL\_UP[i] with C\_ABC\_INC\_CHK\_LSL\_UP

Else

LV\_DIAG\_AFR\_CHK\_SYM\_LSL\_UP[i]= 1

% sensor shows a shift to lean

LV\_DIAG\_ACT\_CHK\_END\_LSL\_UP[i]= 1

Endif

Else

stop CTR\_AFR\_CHK\_LSL\_UP[i]

Endif

If CTR\_AFR\_CHK\_LSL\_UP[i] > 0

Then

Increment CTR\_SUM\_RST\_AFR\_CHK\_LSL\_UP\_i

Endif

Else

CTR\_SUM\_RST\_AFR\_CHK\_LSL\_UP[i]= 0

CTR\_AFR\_CHK\_LSL\_UP[i] = 0

Endif

If LV\_DIAG\_AFL\_CDN\_LS\_UP\_DOWN[i] = 1

And CTR\_SUM\_RST\_AFL\_CHK\_LSL\_UP[i] < C\_CTR\_SUM\_RST\_AFL\_CHK\_LSL\_UP

then

If LAMB\_LS\_UP[i] < C\_LAMB\_AFL\_THD\_DIAG\_ACT\_LSL\_UP

Then

If CTR\_AFL\_CHK\_LSL\_UP[i] < C\_ABC\_MAX\_CHK\_LSL\_UP

Then

Increment CTR\_AFL\_CHK\_LSL\_UP[i] with C\_ABC\_INC\_CHK\_LSL\_UP

Else

LV\_DIAG\_AFL\_CHK\_SYM\_LSL\_UP[i]= 1

% sensor shows a shift to lean

LV\_DIAG\_ACT\_CHK\_END\_LSL\_UP[i]= 1

Endif


Else

stop CTR\_AFL\_CHK\_LSL\_UP[i]

Endif

If CTR\_AFL\_CHK\_LSL\_UP[i] > 0

Then

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```

Increment CTR_SUM_RST_AFL_CHK_LSL_UP[i]
Endif
Else
CTR_SUM_RST_AFL_CHK_LSL_UP[i]= 0
CTR_AFL_CHK_LSL_UP[i] = 0
Endif

```

### B.35.3 O2 sensor (down) open loop diag

#### FUNCTION DESCRIPTION:

##### General information:

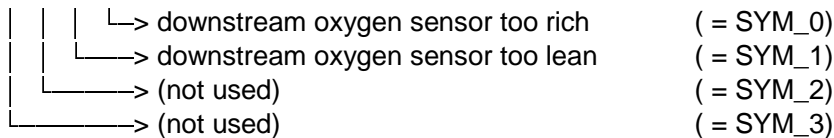
This function shall do a plausibility test of the downstream oxygen sensor after the lambda set point was shifted to rich and/or lean. Once the test is complete on all cylinder banks, the symptoms are combined to produce appropriate error entries. The evaluation is different for 1 bank and 2 bank systems, more than 2 banks are not supported.

Here the dynamic error manager is used to set the flags LV\_ERR\_.... and LV\_END\_DIAG\_.... LV\_DIAG\_CYC\_END\_LS\_DOWN[i] is defined as dummy for global interface reasons.

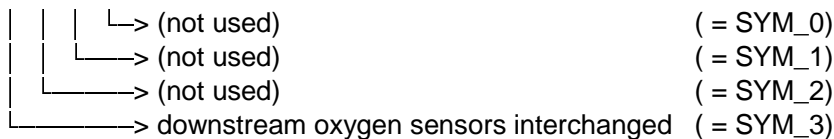
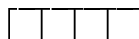
##### Description:

Error Symptoms are defined as follows:

##### ERR\_SYM\_CHK\_LS\_DOWN



##### ERR\_SYM\_CHG\_LS\_DOWN



#### Application conditions

**Initialisation:** At LV\_IGK change 0 -> 1, reset or at clearing error memory initialize the variables as follows:

```

LV_ERR_CHK_LS_DOWN[i] = 0
ERR_SYM_CHK_LS_DOWN[i] = 0
LV_CDN_DIAG_CHK_LS_DOWN[i] = 0
LV_DIAG_CYC_END_LS_DOWN[i] = 1
LV_END_DIAG_CHK_LS_DOWN[i] = 0
LV_ERR_CHG_LS_DOWN = 0

```



```

ERR_SYM_CHG_LS_DOWN = 0
LV_CDN_DIAG_CHG_LS_DOWN = 0
LV_END_DIAG_CHG_LS_DOWN = 0
T_END_DIAG_ACT_LS_DOWN = 0
LV_SYM_AFL_CHK_LS_DOWN[i] = 0
LV_SYM_AFR_CHK_LS_DOWN[i] = 0
T_AFR_CHK_LS_DOWN[i] = 0
T_AFL_CHK_LS_DOWN[i] = 0
LV_DIAG_EOL_DC_LS_UP_DOWN[i] = 0

```

**Recurrence:**

This function shall be carried out every 100 ms.

**Activation:**

```

If      LV_END_DIAG_LAM_ADJ[i] = 1
or      LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1
or      LV_DIAG_EOL_DC_LS_UP_DOWN[i] = 1
or      LV_DIAG_OPL_REQ_CBK[i] = 1 for any i
then
  LV_CDN_DIAG_CHK_LS_DOWN[i] = 1

```

*Activate the function*

```

If      LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1
then    LV_DIAG_EOL_DC_LS_UP_DOWN[i] =
DIAG_EOL_REQ_LS_UP_DOWN[i]
endif

```

**Else**

```

LV_CDN_DIAG_CHK_LS_DOWN[i] = 0

```

*Deactivate the function***Endif****Formula section:**

```

If(1a) LV_INH_DIAG_CHG_LS_DOWN = 0

```

**then(1a)**

```

If(2a) LV_DIAG_ACT_END_LS_UP_DOWN[i] = 0 for any i
% at least one bank still not complete: Symptom acquisition

```

**then(2a)**

```

If(3a) LV_DIAG_AFR_CDN_LS_UP_DOWN[i] = 1

```

**then(3a)**

```

If(4a) VLS_DOWN[i] < C_VLS_AFR_THD_DIAG_ACT_LS_DOWN[i]

```

**then(4a)**

```

If(5a) T_AFR_CHK_LS_DOWN[i] < C_T_MAX_CHK_LS_DOWN

```

**then(5a)**

```

Increment T_AFR_CHK_LS_DOWN[i]

```


**else(5b)**

```

LV_SYM_AFL_CHK_LS_DOWN[i] = 1

```

**endif(5a/b)****endif(4a)**


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```

elseif(3b)      LV_DIAG_AFL_CDN_LS_UP_DOWN[i] = 1
then(3b)
  if(4b)        VLS_DOWN[i] > C_VLS_AFL_THD_DIAG_ACT_LS_DOWN[i]
  then(4b)
    if(5c)      T_AFL_CHK_LS_DOWN[i] < C_T_MAX_CHK_LS_DOWN[i]

    then(5c)
      Increment T_AFL_CHK_LS_DOWN[i]
    else(5d)
      LV_SYM_AFR_CHK_LS_DOWN[i] = 1
    endif(5c/d)
  endif(4b)
endif(3b)
else(2b)
  % check on all banks complete: Symptom evaluation and error flag generation
  # If(3c) (NC_CBK_EX_NR == 2)
  # then(3c) % 2 banks configuration: check for rich/lean shifts and interchanged symptom
  LV_CDN_DIAG_CHG_LS_DOWN = 1
  if(4c) ( LV_SYM_AFL_CHK_LS_DOWN[1] = 1
  and     LV_SYM_AFR_CHK_LS_DOWN[2] = 0
  and     LV_SYM_AFL_CHK_LS_DOWN[2] = 0 )
  then(4c)
    ERR_SYM_CHK_LS_DOWN[1] = SYM_1           %signal too low bank
    1
    LV_ERR_CHK_LS_DOWN[1] = 1
  elseif(4d) ( LV_SYM_AFL_CHK_LS_DOWN[2] = 1
  and     LV_SYM_AFR_CHK_LS_DOWN[1] = 0
  and     LV_SYM_AFL_CHK_LS_DOWN[1] = 0 )
  then(4d)
    ERR_SYM_CHK_LS_DOWN[2] = SYM_1           %signal too low bank
    2
    LV_ERR_CHK_LS_DOWN[2] = 1
  elseif(4e) ( LV_SYM_AFR_CHK_LS_DOWN[1] = 1
  and     LV_SYM_AFR_CHK_LS_DOWN[2] = 0
  and     LV_SYM_AFL_CHK_LS_DOWN[2] = 0 )
  then(4e)
    ERR_SYM_CHK_LS_DOWN[1] = SYM_0           %signal too high
    bank 1
    LV_ERR_CHK_LS_DOWN[1] = 1
  elseif(4f) ( LV_SYM_AFR_CHK_LS_DOWN[2] = 1
  and     LV_SYM_AFR_CHK_LS_DOWN[1] = 0
  and     LV_SYM_AFL_CHK_LS_DOWN[1] = 0 )
  then(4f)
    ERR_SYM_CHK_LS_DOWN[2] = SYM_0           %signal too high
    bank 2
    LV_ERR_CHK_LS_DOWN[2] = 1
  elseif(4g)   (( LV_SYM_AFR_CHK_LS_DOWN[2] = 1
  or     LV_SYM_AFL_CHK_LS_DOWN[2] = 1 )
  and     ( LV_SYM_AFR_CHK_LS_DOWN[1] = 1
  or     LV_SYM_AFL_CHK_LS_DOWN[1] = 1 ))
  then(4g)
    ERR_SYM_CHG_LS_DOWN = SYM_3
                                           %downstream oxygen sensors
    interchanged

```

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```

        LV_ERR_CHG_LS_DOWN = 1
    else(4h)
        ERR_SYM_CHK_LS_DOWN[i] = NO_SYM for [1] and [2]
        ERR_SYM_CHG_LS_DOWN = "NO_SYM"
    endif(4c-h)
# elseif(3d) (NC_CBK_EX_NR == 1)
# then(3d) % 1 bank configuration: check for rich/lean shifts only
    If(4i) (LV_SYM_AFL_CHK_LS_DOWN[1] = 1)
    then(4i)
        ERR_SYM_CHK_LS_DOWN[1] = SYM_1 %signal too low
        LV_ERR_CHK_LS_DOWN[1] = 1
    elseif(4j) (LV_SYM_AFR_CHK_LS_DOWN[1] = 1)
    then(4j)
        ERR_SYM_CHK_LS_DOWN[1] = SYM_0 %signal too high
        LV_ERR_CHK_LS_DOWN[1] = 1
    endif(4i/j)
# endif(3c/d)
endif(2a/b)
else(1b) % LV_INH_DIAG_CHG_LS_DOWN = 1 - downstream interchanged sensors not possible
    If(2c) LV_DIAG_AFR_CDN_LS_UP_DOWN[i] = 1
    then(2c)
        If(3e) VLS_DOWN[i] < C_VLS_AFR_THD_DIAG_ACT_LS_DOWN[i]
        then(3e)
            If(4k) T_AFR_CHK_LS_DOWN[i] < C_T_MAX_CHK_LS_DOWN
            then(4k)
                Increment T_AFR_CHK_LS_DOWN[i]
            else(4l)
                LV_SYM_AFL_CHK_LS_DOWN[i] = 1
                ERR_SYM_CHK_LS_DOWN[i] = SYM_1 %signal too low
                LV_ERR_CHK_LS_DOWN[i] = 1
            endif(4k/l)
        endif(3e)
    elseif(2d) LV_DIAG_AFL_CDN_LS_UP_DOWN[i] = 1
    then(2d)
        If(3f) VLS_DOWN[i] > C_VLS_AFL_THD_DIAG_ACT_LS_DOWN[i]
        then(3f)
            If(4m) T_AFL_CHK_LS_DOWN[i] < C_T_MAX_CHK_LS_DOWN
            then(4m)
                Increment T_AFL_CHK_LS_DOWN[i]
            else(4n)
                LV_SYM_AFR_CHK_LS_DOWN[i] = 1
                ERR_SYM_CHK_LS_DOWN[i] = SYM_0 %signal too high
                LV_ERR_CHK_LS_DOWN[i] = 1
            endif(4m/n)
        endif(3f)
    endif(2d)
end(1a/b)


```

### End flag generation

```

If T_END_DIAG_ACT_LS_DOWN[i] >= C_T_END_DIAG_ACT_LS_DOWN[i] for all i
or LV_DIAG_ACT_END_LS_UP_DOWN[i] = 1 for all i
or LV_ERR_CHK_LS_DOWN[i] = 1 for any i

```

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```

or          LV_ERR_CHG_LS_DOWN = 1
then       LV_END_DIAG_CHG_LS_DOWN = 1
else       %active test was not triggered - no failure case
  If       LV_DIAG_OPL_REQ_CBK[i] = 0 for all i
  and      LV_END_DIAG_LAM_ADJ[i] = 1
  and      LV_DIAG_ACT_INH_LS_UP_DOWN[i] = 0
  and      LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 0

          then      increment T_END_DIAG_ACT_LS_DOWN[i]
          else      freeze T_END_DIAG_ACT_LS_DOWN[i]
        endif

endif

if         LV_END_DIAG_CHG_LS_DOWN = 1
or         (T_END_DIAG_ACT_LS_DOWN[i] >= C_T_END_DIAG_ACT_LS_DOWN[i]
          and LV_INH_DIAG_CHG_LS_DOWN = 1)
then      LV_END_DIAG_CHK_LS_DOWN[i] = 1
endif

```

Hint: The constant  $C\_T\_END\_DIAG\_ACT\_LS\_DOWN[i]$  must be bigger equal  $2 * (C\_T\_MAX\_DIAG\_AFL\_LS\_UP\_DOWN + C\_T\_MAX\_DIAG\_AFR\_LS\_UP\_DOWN + \text{maximum time for the MAF integral } C\_MAF\_INT\_DIAG\_LS\_UP\_DOWN[i] \text{ times } 2)$ .

The reason is to be in line with Rate Based Monitoring requirements (duration of diagnosis in the no failure case not shorter than in the failure case).

## B.35.4 Moving Lambda Set Point

### FUNCTION DESCRIPTION:

This functions shall move the lambda set point to a calibratable value, in order to do a plausibility test with the upstream and the downstream oxygen sensors separately. To avoid a jump in the lambda value and consequently any problem concernig driving confort, the shift in the lambda set point should be done through a ramp function with calibratable slope. The slope is defined as the diference between desired lambda set point and its value before the active test divided by the number of recurrences to achieve the final set point value, which is calibratable.

While the function is moving the lambda set point the flag  $LV\_LAMB\_SP\_REQ\_DIAG\_ACT[i]$  is active (set in module 708A) to import this new value with high priority to the lambda coordination. To avoid any unbounded value of  $LAMB\_SP[i]$ , it s monitored while the movemnt occurs. As bounds for the lambda set point, it is used the desired AFR and AFL calibration data.

### Description:

### Application conditions

### Initialisation:


At  $LV\_IGK = 0$  to 1, reset or at clearing error memory initialize all variables as follows:

$LAMB\_SP\_DELTA\_LS\_UP\_DOWN[i] = 0$

$LAMB\_SP\_DIAG\_OPL\_LS\_UP\_DOWN[i] = 0$

### Recurrence:

This function shall be carried out every 100 ms.

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**Activation:**

This function shall be activated when

LV\_LAMB\_SP\_AFR\_REQ\_DIAG\_ACT[i] = 1 **or**  
 LV\_LAMB\_SP\_AFL\_REQ\_DIAG\_ACT[i] = 1

Otherwise this function shall be deactivated and LAMB\_SP\_DIAG\_OPL\_LS\_UP\_DOWN[i] shall be set to zero.

**Formula section:**Shift lambda set point to rich

/One-off update by the activation of the rich test

**If** LV\_LAMB\_SP\_AFR\_REQ\_DIAG\_ACT<sub>n-1</sub>[i] = 0

**And** LV\_LAMB\_SP\_AFR\_REQ\_DIAG\_ACT<sub>n</sub>[i] = 1

**Then** //Calc. only for the first time

LAMB\_SP\_DELTA\_LS\_UP\_DOWN[i] =  
 (C\_LAMB\_SP\_AFR\_DIAG\_LS\_UP\_DOWN - LAMB\_SP\_BEG\_DIAG\_LS\_UP\_DOWN[i]) /  
 C\_LAMB\_SP\_STEP\_DIAG\_LS\_UP\_DOWN

**If** LAMB\_SP\_DELTA\_LS\_UP\_DOWN[i] = 0

**then**

LAMB\_SP\_DELTA\_LS\_UP\_DOWN[i] = - 1H

**endif**

Update LAMB\_SP\_DIAG\_OPL\_LS\_UP\_DOWN[i] = LAMB\_SP\_BEG\_DIAG\_LS\_UP\_DOWN[i]

**Endif**

/moving lambda set point

**If** LV\_LAMB\_SP\_AFR\_REQ\_DIAG\_ACT[i] = 1

**then**

**If** LAMB\_SP\_DIAG\_OPL\_LS\_UP\_DOWN[i] > C\_LAMB\_SP\_AFR\_  
 DIAG\_LS\_UP\_DOWN

**then**

increment LAMB\_SP\_DIAG\_OPL\_LS\_UP\_DOWN[i] with LAMB\_SP\_DELTA\_  
 LS\_UP\_DOWN [i]

**else**

LAMB\_SP\_DIAG\_OPL\_LS\_UP\_DOWN[i] = C\_LAMB\_SP\_AFR\_DIAG\_LS\_UP\_DOWN

**endif**

**endif**

Shift lambda set point to lean

/One-off update by the activation of the lean test

**If** LV\_LAMB\_SP\_AFL\_REQ\_DIAG\_ACT<sub>n-1</sub>[i] = 0

**And** LV\_LAMB\_SP\_AFL\_REQ\_DIAG\_ACT<sub>n</sub>[i] = 1

**Then** //Calc. only for the first time


LAMB\_SP\_DELTA\_LS\_UP\_DOWN[i] =  
 (C\_LAMB\_SP\_AFL\_DIAG\_LS\_UP\_DOWN - LAMB\_SP\_BEG\_DIAG\_LS\_UP\_DOWN[i]) /  
 C\_LAMB\_SP\_STEP\_DIAG\_LS\_UP\_DOWN

**If** LAMB\_SP\_DELTA\_LS\_UP\_DOWN[i] = 0

**then**

LAMB\_SP\_DELTA\_LS\_UP\_DOWN[i] = +1H

**endif**

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```

Update LAMB_SP_DIAG_OPL_LS_UP_DOWN[i] = LAMB_SP_BEG_DIAG_LS_UP_DOWN[i]

endif
/moving lambda set point
If LV_LAMB_SP_AFL_REQ_DIAG_ACT[i] = 1
then
If LAMB_SP_DIAG_OPL_LS_UP_DOWN[i] < C_LAMB_SP_AFL_
DIAG_LS_UP_DOWN
then
increment LAMB_SP_DIAG_OPL_LS_UP_DOWN[i] with LAMB_SP_DELTA_
LS_UP_DOWN[i]
else
LAMB_SP_DIAG_OPL_LS_UP_DOWN[i] = C_LAMB_SP_AFL_DIAG_LS_UP_DOWN

endif
endif

```

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## B.36 O2 sensor open loop diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_ACT_INH_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
General inhibition Oxygen Sensor Active Plausibility Check					
LV_DIAG_ACT_INH_RBM_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibit- flag for RBM for Oxygen Sensor Active Plausibility Check					
LV_DIAG_AFR_AFL_INH_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibition of open loop diag while interfering functions are deactivated in failure case					
LV_DIAG_EOL_REQ_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Start EOL active test					
LV_DIAG_OPL_REQ_CBK [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request open loop diagnosis					
LV_INH_DIAG_CHG_LS_DOWN	O/V	0... 1H	0 ...1	1	-
Inhibit diagnosis interchanged downstream sensors					
STATE_RBM_CHK_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 7H	0 ...7	1	-
RBM - Interface of CHK_LS_DOWN monitor					

### Input data:

CPPWM {p. 3749}	CTR_ERR_DYN_NR {p. 5767}	LC_DIAG_PUE_ACT_LS_ DOWN {p. 5191}	LV_DC {p. 5746}
LV_DIAG_ACT_END_LS_ UP_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_END_DIAG_CHK_LS_ DOWN [NC_CBK_EX_NR] {p. 5388}	LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_AMP {p. 4822}
LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAM_CST_IVVT_ EX [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAM_CST_IVVT_ IN [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}
LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}
LV_ERR_CRK_TOOTH_ PER {p. 4432}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}
LV_ERR_DYN_VLD_LS_ UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_CPS {p. 4708}	LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FTL_MIN {p. 4762}
LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}

LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_IVVT {p. 1062}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}
LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}
LV_ERR_MAP_PLAUS {p. 1062}	LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_MEC_IVVT_EX {p. 1062}	LV_ERR_MEC_IVVT_IN {p. 1062}
LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}
LV_ERR_OBD_LSH_ DOWN [NC_CBK_EX_NR] {p. 5198}	LV_ERR_OBD_VLD_LSH_ UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}
LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}
LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_ERR_PUC_VLD_LS_ UP [NC_CBK_EX_NR] {p. 5297}	LV_ERR_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5169}
LV_ERR_REF_CRK_CAM_ EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_ IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}
LV_ERR_SHIFT_AFL_ LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_ LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SLV_IVVT_EX {p. 4627}	LV_ERR_SLV_IVVT_IN {p. 4627}
LV_ERR_SWT_LS_DOWN [NC_CBK_EX_NR] {p. 5152}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CRK_CAM_ IN [NC_NR_CAM_CBK] {p. 4447}
LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TPS {p. 4982}	LV_ERR_TPS_1 {p. 4990}
LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_MAF_1 {p. 4990}
LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_TTIP_MES_LSH_ UP [NC_CBK_EX_NR] {p. 5438}
LV_ERR_VCV {p. 4729}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_FL {p. 1759}	LV_IGK {p. 906}
LV_IND_FCUT {p. 803}	LV_LAMB_COP [NC_CBK_EX_NR] {p. 8233}	LV_LS_UP_OBD_2_MAN_ DEAC [NC_CBK_EX_NR] {p. 5449}	LV_PUC {p. 1720}
LV_SAP {p. 804}	LV_SAV {p. 804}	LV_SAWUP {p. 804}	LV_VB_CDN_OBD_2 {p. 1046}



NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_NR_CAM_CBK {p. 1507}	NC_NR_CBK_IVVT {p. 604}
NR_CBK_EX {p. 944}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_DIAG_CHG_LS_DOWN_INH	-	0... 1H	0 ...1	1	-
Manual inhibition of symptom evaluation for downstream sensor interchanged error					

**Import actions:**

<b>ACTION_ERRM_CheckPendingStatus</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR_PND>)
--

**FUNCTION DESCRIPTION:****General information:**

In this Appl. Incidence the execution order of the AF lean and rich active tests are defined. Also some criteria are defined, which must inhibit each test.

$i = 1 \dots NC\_CBK\_EX\_NR$

**Application conditions****Initialisation:**

```

If LV_IGK = 01 or reset or clearing the error memory then
  LV_DIAG_ACT_INH_LS_UP_DOWN[i] = 0
  LV_DIAG_AFR_AFL_INH_LS_UP_DOWN[i] = 0
  LV_DIAG_OPL_REQ_CBK[i] = 0
  LV_INH_DIAG_CHG_LS_DOWN = 0
  LV_DIAG_ACT_INH_RBM_LS_UP_DOWN[i] = 0
  LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 0
  If LV_IGK = 10
  LV_INH_DIAG_CHG_LS_DOWN = 1
  LV_DIAG_ACT_INH_LS_UP_DOWN[i] = 1

```

**Recurrence:**

100 ms

**Activation:**

LV\_IGK = 1

**Deactivation:** LV\_DIAG\_ACT\_END\_LS\_UP\_DOWN[i] = 1 or LV\_IGK = 0

**Formula section:**

If the following conditions are true, the active test shall wait until the interfering functions are deactivated in the failure case.


**If** CPPWM <> 0% *canister purge valve is open*

**then** LV\_DIAG\_AFR\_AFL\_INH\_LS\_UP\_DOWN[i] = 1

**else** LV\_DIAG\_AFR\_AFL\_INH\_LS\_UP\_DOWN[i] = 0

**endif**

If the following errors/special mode are true the whole function shall be inhibited.

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If

```

LV_ERR_AMP = 1 OR
LV_ERR_AMP_PLAUS = 1 OR
LV_ERR_CHG_LS_UP = 1 OR
LV_ERR_CRK_PLAUS = 1 OR
LV_ERR_CRK_SYN = 1 OR LV_ERR_CRK_TOOTH = 1 OR

LV_ERR_CRK_TOOTH_PER = 1 OR
LV_ERR_DIAGCPS = 1 OR
LV_ERR_EL_CPS = 1 OR
LV_ERR_FTL_MIN = 1 OR
LV_ERR_FUP = 1 OR
LV_ERR_FUP_MFP_PLAUS = 1 OR
LV_ERR_FUP_ORNG = 1 OR
LV_ERR_FUP_ST = 1 OR
LV_ERR_H_PRS_SYS = 1 OR
LV_ERR_IVVT = 1 OR
LV_ERR_LOAD_TPS_PLAUS = 1 OR
LV_ERR_MAF = 1 OR
LV_ERR_MAP_PLAUS = 1 OR
LV_ERR_MAP_TPS_PLAUS = 1 OR
LV_ERR_MTC_CTL_2 = 1 OR
LV_ERR_MTC_CTL_3 = 1 OR
LV_ERR_MTC_DR = 1 OR
LV_ERR_TPS = 1 OR
LV_ERR_VCV = 1 OR
LV_ERR_AIR_LSL_UP[i] = 1 OR LV_
ERR_CAT_DIAG[i] = 1 OR
LV_ERR_CTL_LSL_UP[i] = 1 OR
LV_ERR_DYN_VLD_LS_UP[i] = 1 OR
LV_ERR_EL_LSL_UP[i] = 1 OR
LV_ERR_LSH_DOWN[i] = 1 OR
LV_ERR_LSH_UP[i] = 1 OR
LV_ERR_LSL_UP_IF[i] = 1 OR
LV_ERR_OBD_LSH_DOWN[i] = 1 OR
LV_ERR_OBD_VLD_LSH_UP[i] = 1 OR
LV_ERR_OC_LS_DOWN[i] = 1 OR
LV_ERR_OC_LSL_UP[i] = 1 OR
LV_ERR_OFS_LSL_UP[i] = 1 OR
LV_ERR_PUC_LS_DOWN[i] = 1 OR
LV_ERR_PUC_VLD_LS_UP[i] = 1 OR
[LV_ERR_PUE_LS_DOWN[i] = 1 OR
and LC_DIAG_PUE_ACT_LS_DOWN = 1]
LV_ERR_SCG_LS_DOWN[i] = 1 OR
LV_ERR_SCP_LS_DOWN[i] = 1 OR
LV_ERR_SWT_LS_DOWN[i] = 1 OR
LV_ERR_TTIP_MES_LSH_UP[i] = 1 OR
(i = 1 AND
[ LV_ERR_IV[0] OR
LV_ERR_IV[2] OR
LV_ERR_IV[4] OR

```

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```

        LV_ERR_MIS[0]          OR
        LV_ERR_MIS[2]          OR
        LV_ERR_MIS[4]
    ])          OR
    (i = 2      AND
        [ LV_ERR_IV[1]        OR
        LV_ERR_IV[3]          OR
        LV_ERR_IV[5]          OR
        LV_ERR_MIS[1]         OR
        LV_ERR_MIS[3]         OR
        LV_ERR_MIS[5]
    ])          OR
    LV_ERR_PER_CAM_EX[m] = 1    m=1 for i=1,2    OR
    LV_ERR_PER_CAM_IN[m] = 1    m=1 for i=1,2    OR
    LV_ERR_PLAUS_CAM_EX[m] = 1  m=1 for i=1,2    OR
    LV_ERR_PLAUS_CAM_IN[m] = 1  m=1 for i=1,2    OR
    LV_ERR_REF_CRK_CAM_EX[m] = 1 m=1 for i=1,2    OR
    LV_ERR_REF_CRK_CAM_IN[m] = 1 m=1 for i=1,2    OR
    LV_ERR_SYN_CAM_EX[m] = 1     m=1 for i=1,2    OR
    LV_ERR_SYN_CAM_IN[m] = 1     m=1 for i=1,2    OR
    LV_ERR_SYN_CRK_CAM_IN[m] = 1 m=1 for i=1,2    OR
    LV_ERR_TOOTH_OFF_EX[m] = 1   m=1 for i=1,2    OR
    LV_ERR_TOOTH_OFF_IN[m] = 1   m=1 for i=1,2

    then      LV_DIAG_ACT_INH_RBM_LS_UP_DOWN[i] = 1
    else      LV_DIAG_ACT_INH_RBM_LS_UP_DOWN[i] = 0
    endif


    if      LV_DIAG_ACT_INH_RBM_LS_UP_DOWN[i] = 1          OR
    LV_LS_UP_OBD_2_MAN_DEAC[i] = 1          OR
    LV_VB_CDN_OBD_2 = 0 battery voltage is too low      OR
    LV_PUC = 1          pull fuel cut off          OR
    LV_FL = 1          full load          OR
    LV_SAV = 1          secondary air valve active      OR
    LV_SAP = 1          secondary air pump active      OR
    LV_SAWUP = 1       secondary air is active          OR
    LV_IND_FCUT = 1    cylinder cut off is active          OR
    LV_LAMB_COP_j = 1  catalyst overheating protection active

    then      LV_DIAG_ACT_INH_LS_UP_DOWN[i] = 1
    else      LV_DIAG_ACT_INH_LS_UP_DOWN[i] = 0
    endif

```

*% Inhibition of symptom evaluation for downstream sensor interchanged error*

**IF** LC\_DIAG\_CHG\_LS\_DOWN\_INH = 1 **OR**

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```

LV_LS_UP_OBD_2_MAN_DEAC[2] = 1
THEN LV_INH_DIAG_CHG_LS_DOWN = 1
ELSE LV_INH_DIAG_CHG_LS_DOWN = 0
ENDIF

```

*% Start and control of open loop test*

```

If LV_ERR_DELTA_I_LAM[i] = 1 OR
LV_ERR_VLS_DOWN_DIF[i] = 1 for any i
Then LV_DIAG_OPL_REQ_CBK[1] = 1
Endif

```

```

# If NC_CBK_EX_NR = 2
# Then
If LV_DIAG_OPL_REQ_CBK[1] = 1 and
(LV_DIAG_ACT_END_LS_UP_DOWN[1] = 1 or NR_CBK_EX = 1)
Then LV_DIAG_OPL_REQ_CBK[2] = 1
Endif
# Endif

```

```

If LV_DIAG_ACT_END_LS_UP_DOWN[i] = 1 for all i
Then LV_DIAG_OPL_REQ_CBK[i] = 0 for all i
Endif

```

*//reset of LV\_DIAG\_OPL\_REQ\_CBK[i] after open loop test to re- enable e.g. stratified combustion*

#### Data :

Diagnosis	Symptom	Nr	P-Code/ Failure	P-Code/ Symptom	Hardware config	Recurrence	Failure class A/B
Downstream sensors Bank1 and 2 interchanged	See Table of failure		see table of failires	see table of ailires	--		See Table of failure
CHG_LS_DOWN		3					

## B.36.1 Interface for Rate - Based - Monitoring

### FUNCTION DESCRIPTION:

#### General information:


With this module the interface between the CHK\_LS\_DOWN[i] monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_CHK\_LS\_DOWN[i] data.

Within STATE\_RBM\_CHK\_LS\_DOWN[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)

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( not valid for active- check )

### Application conditions

#### Initialisation:

at LV\_DC 0 1 transition:  
 bit 0 , bit 1 of STATE\_RBM\_CHK\_LS\_DOWN[i] = 0  
 bit 2 of STATE\_RBM\_CHK\_LS\_DOWN[i] = 1  
 on failure memory reset:  
 bit 1 of STATE\_RBM\_CHK\_LS\_DOWN[i] = 0  
 at ECU reset all bits of STATE\_RBM\_CHK\_LS\_DOWN[i] shall be set to zero.

#### Recurrence:

1 s

#### Activation:

LV\_DC = 1

### Formula section:

#### At LV\_DC 0 1 transition

The pending status of the following failures has to be checked only once :

Dependence	Error			
	LV_ERR_AMP	LV_ERR_AMP_PLAUS	LV_ERR_CHG_LS_UP	LV_ERR_CRK_PLAUS
	LV_ERR_CRK_SYN	LV_ERR_CRK_TOOTH	LV_ERR_CRK_TOOTH_PER	LV_ERR_DIAGCPS
	LV_ERR_EL_CPS	LV_ERR_FTL_MIN	LV_ERR_FUP	LV_ERR_FUP_MFP_PLAUS
	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_SYS	LV_ERR_LOAD_TPS_PLAUS
	LV_ERR_MAF_FRQ_EL	LV_ERR_MAF_FRQ_GRD	LV_ERR_MAF_FRQ_RNG	LV_ERR_MAP_PLAUS
	LV_ERR_MAP_TPS_PLAUS	LV_ERR_MTC_CTL_2	LV_ERR_MTC_CTL_3	LV_ERR_MTC_DR
	LV_ERR_TPS_1	LV_ERR_TPS_2	LV_ERR_TPS_AD	LV_ERR_TPS_AD_BOL
	LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2	LV_ERR_TPS_RATIO	LV_ERR_TPS_ST_CHK_2
	LV_ERR_VCV			
<b>NC_CBK_EX_N R</b>	LV_ERR_AIR_LSL_UP[i]	LV_ERR_CAT_DIAG[i]	LV_ERR_CTL_LSL_UP[i]	LV_ERR_DYN_VLD_LS_UP[i]
	LV_ERR_EL_LSL_UP[i]	LV_ERR_LSH_DOWN[i]	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]
	LV_ERR_OBD_LSH_DOWN[i]	LV_ERR_OBD_VLD_LSH_UP[i]	LV_ERR_OC_LS_DOWN[i]	LV_ERR_OC_LSL_UP[i]
	LV_ERR_OFS_LSL_UP[i]	LV_ERR_PUC_LS_DOWN[i]	LV_ERR_PUC_VLD_LS_UP[i]	LV_ERR_PUE_LS_DOWN[i]
	LV_ERR_SCG_LS_DOWN[i]	LV_ERR_SCP_LS_DOWN[i]	LV_ERR_SWT_LS_DOWN[i]	LV_ERR_TTIP_MES_LSH_UP[i]

Figure B.36.1: For x = 1 to NC\_NR\_CBK\_IVVT (= for any i)

<b>NC_NR_CBK_IVVT</b>	LV_ERR_CAM_CST_IVT_EX[x]	LV_ERR_CAM_CST_IVT_IN[x]	LV_ERR_MEC_IVVT_EX[x]	LV_ERR_MEC_IVVT_IN[x]
	LV_ERR_SLV_IVVT_EX[x]	LV_ERR_SLV_IVVT_IN[x]		

Figure B.36.2: m = 1 for all i

<b>NC_NR_CAM_CBK</b>	LV_ERR_PER_CAM_EX[m]	LV_ERR_PER_CAM_IN[m]	LV_ERR_PLAUS_CAM_EX[m]	ERR_PLAUS_CAM_IN[m]
	LV_ERR_REF_CRK_CAM_EX[m]	LV_ERR_REF_CRK_CAM_IN[m]	LV_ERR_SYN_CAM_EX[m]	LV_ERR_SYN_CAM_IN[m]
	LV_ERR_SYN_CRK_CAM_IN[m]	LV_ERR_TOOTH_OFF_EX[m]	LV_ERR_TOOTH_OFF_IN[m]	

Figure B.36.3: For NC\_CBK\_EX\_NR = i = 1

<b>NC_CYL_NR</b>	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	LV_ERR_MIS[0]
	LV_ERR_MIS[2]	LV_ERR_MIS[4]		

Figure B.36.4: For NC\_CBK\_EX\_NR = i = 2

<b>NC_CYL_NR</b>	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	LV_ERR_MIS[1]
	LV_ERR_MIS[3]	LV_ERR_MIS[5]		

```

If(1)      { CPU optimization at LV_DC 0  1 transition }
            CTR_ERR_DYN_NR <> 0      { the dynamic failure memory isn t empty }

Then(1)

            While      bit 1 of STATE_RBM_CHK_LS_DOWN[i] = 0 do
                with each XX failure of the above list except LV_ERR_PUE_LS_DOWN      (de-
                pending on configuration, see below):
                ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<CALL>)

                If(2)      XX has a pending status
                Then(2)      bit 1 of STATE_RBM_CHK_LS_DOWN[i] = 1
                Endif(2)

                For LV_ERR_PUE_LS_DOWN, do the following instead:
                If      LC_DIAG_PUE_ACT_LS_DOWN = 1
                then
                    ACTION_ERRM_CheckPendingStatus(IN<XX>,
                    OUT<PendingStatus>, SYNCHRONIZATION<CALL>)
                    If(3)      XX has a pending status
                    Then(3)      bit 1 of STATE_RBM_CHK_LS_DOWN[i] = 1
                    Endif(3)
                Endif(2)

            Endwhile

Else(1)      { the dynamic failure memory is empty }      No action
Endif(1)

```

Every 1 s :

```

If      bit 0 of STATE_RBM_CHK_LS_DOWN[i] = 0
Then
            If      LV_END_DIAG_CHK_LS_DOWN[i] = 1

```


```

                Then      bit 0 of STATE_RBM_CHK_LS_DOWN[i] = 1
                Endif

Endif

If      bit 1 of STATE_RBM_CHK_LS_DOWN[i] = 0
Then
                If      LV_DIAG_ACT_INH_RBM_LS_UP_DOWN[i] = 1
                Then      bit 1 of STATE_RBM_CHK_LS_DOWN[i] = 1
                Endif
Endif

```

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## B.37 O2 sensor (up, down) interchanged diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_CHG_LS_UP	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom					
LV_CDN_DIAG_CHG_LS_UP	V	0... 1H	0...1	1	-
Condition to run the diagnosis are fulfilled					
LV_END_DIAG_CHG_LS_UP	O/V	0... 1H	0...1	1	-
Diagnostic available					
LV_ERR_CHG_LS_UP	O/V	0... 1H	0...1	1	-
Debounced error: upstream sensor of banks 1 and 2 interchanged					
MAF_INT_END_DIAG_CHG_LS_UP	V	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral for end of upstream interchanged sensors detection in no failure case					
MAF_INT_SYM_DIAG_CHG_LS_UP	V	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral for detection of interchanged upstream sensors					

### Input data:

FAC_LAM_LIM [NC_CBK_EX_NR] {p. 2461}	LV_IGK {p. 906}	LV_INH_DIAG_CHG_LS_UP {p. 5420}	LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}
LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}	LV_LAM_STOP_SHO_ PER_CDN [NC_CBK_EX_NR] {p. 5420}	MAF_CYL {p. 8277}	NC_CBK_EX_NR {p. 1829}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_LAM_LIM_MAX_CHG_LS_UP	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Max. Threshold to detect a interchanged sensor					
C_FAC_LAM_LIM_MIN_CHG_LS_UP	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Min. Threshold to detect a interchanged sensor					
C_FAC_NEG_CHG_LS_UP	-	0... FFH	0... 1.99218	0.0078125	-
Gain factor when MAF integral decreased					
C_FAC_POS_CHG_LS_UP	-	0... FFH	0... 1.99218	0.0078125	-
Gain factor when MAF integral is increased					
C_MAF_INT_DIAG_CHG_LS_UP	-	0... FFFFH	0... 1820.41666	0.0277778	g
Max. MAF integral value when ERR_SYM_... ("NO_SYM")					
C_MAF_INT_END_DIAG_CHG_LS_UP	-	0... FFFFH	0... 1820.41666	0.0277778	g
Max. MAF integral value to have a valid diagnostic result					

### Error treatment:



Diagnostic XX	Symptom description	Symptom	Filter type
CHG_LS_UP	1 <sup>st</sup> symptom description	SYM_3	NO

## B.37.1 Upstream Sensor Banks 1 and 2

### FUNCTION DESCRIPTION:

#### General information:

This function was written for exhaust gas systems having two banks, where a sensor interchange cannot be avoided by hardware measures. In case the upstream sensors were interchanged it is expected that both lambda signals will drift from the set point in different directions and the lambda controllers achieve their maximum.

A symptom can be detected if the lambda controller correction of one bank crosses the min threshold whereas the other one crosses the max threshold.

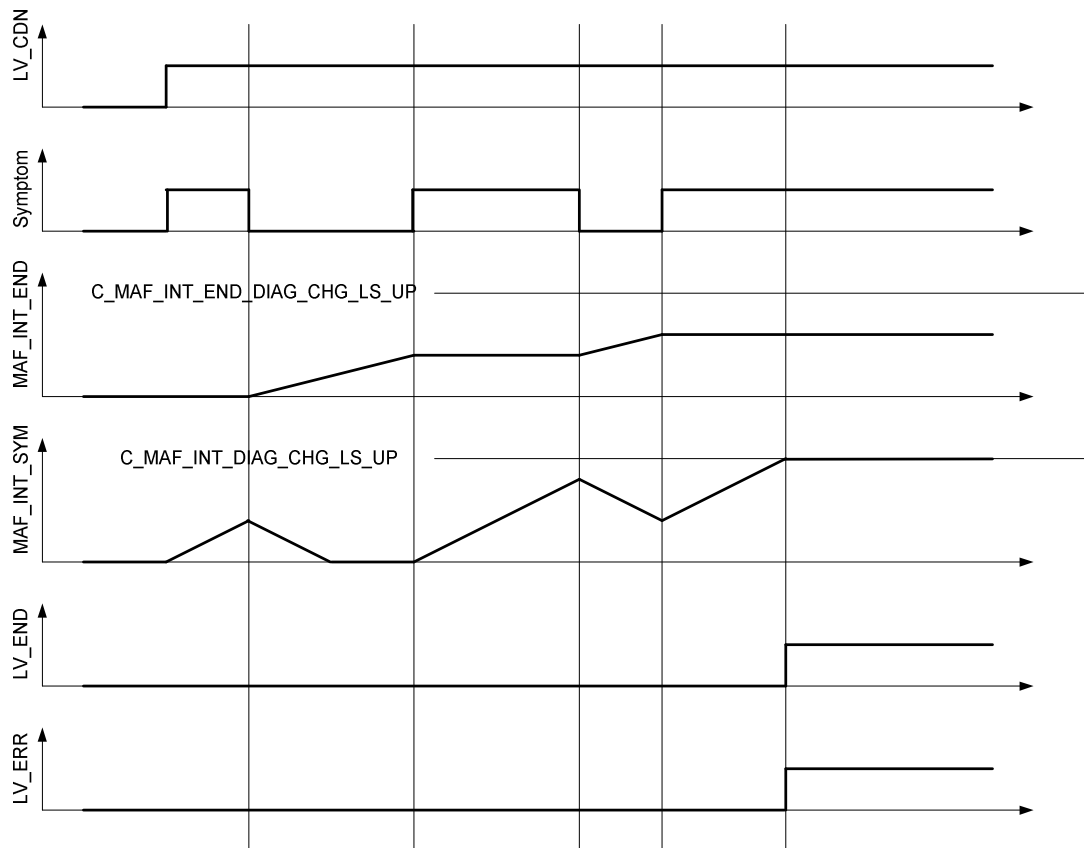


Figure B.37.1: : Basic principle of applied debounce algorithm.

### Application conditions

**Initialisation:** At the transition  $LV\_IGK = 0 \rightarrow 1$ , reset or clearing error memory reset all variables.

**Recurrence:** This function shall run every  $T\_SAMPLE = 100$  ms.

#### Activation/Deactivation:

```

IF      LV_LAM_LSCL[i] = 1      for all [i]
AND      (LV_LAM_STOP[1] = 0      OR LV_LAM_STOP_SHO_PER_CDN[1] = 1)
AND      (LV_LAM_STOP[2] = 0 OR LV_LAM_STOP_SHO_PER_CDN[2] = 1)
AND      LV_INH_DIAG_CHG_LS_UP = 0
AND      LV_END_DIAG_CHG_LS_UP = 0
THEN
    LV_CDN_DIAG_CHG_LS_UP = 1
ELSE
    LV_CDN_DIAG_CHG_LS_UP = 0
ENDIF

```

#### Formula section:

```

IF(1a)      LV_CDN_DIAG_CHG_LS_UP = 1
THEN(1a)

```

**IF(2a)**

LV\_END\_DIAG\_CHG\_LS\_UP = 0 &

MAF\_INT\_END\_DIAG\_CHG\_LS\_UP < C\_MAF\_INT\_END\_DIAG\_CHG\_LS\_UP

**THEN(2a)**

**IF(3a)** ERR\_SYM\_CHG\_LS\_UP = "NO\_SYM"

**THEN(3a)**

MAF\_INT\_END\_DIAG\_CHG\_LS\_UP<sub>n</sub> =  
LS\_UP<sub>n-1</sub> + MAF\_CYL \* T\_SAMPLE [ms]

MAF\_INT\_END\_DIAG\_CHG\_  
\* 1/3600 [(g\*h)/(kg\*ms)]

**ELSE(3a)**

MAF\_INT\_END\_DIAG\_CHG\_LS\_UP<sub>n</sub> =  
LS\_UP<sub>n-1</sub>

MAF\_INT\_END\_DIAG\_CHG\_

**ENDIF(3a)**

**ELSE(2a)**

LV\_END\_DIAG\_CHG\_LS\_UP = 1

**ENDIF(2a)**

**IF(2b)**

(FAC\_LAM\_LIM[1] > C\_FAC\_LAM\_LIM\_MAX\_CHG\_LS\_UP &  
FAC\_LAM\_LIM[2] < C\_FAC\_LAM\_LIM\_MIN\_CHG\_LS\_UP)

**OR(2b)**

(FAC\_LAM\_LIM[1] < C\_FAC\_LAM\_LIM\_MIN\_CHG\_LS\_UP &  
FAC\_LAM\_LIM[2] > C\_FAC\_LAM\_LIM\_MAX\_CHG\_LS\_UP)

**THEN(2b)**

ERR\_SYM\_CHG\_LS\_UP = SYM\_3

**IF(3b)** MAF\_INT\_SYM\_DIAG\_CHG\_LS\_UP < C\_MAF\_INT\_DIAG\_CHG\_LS\_UP

**THEN(3b)**

MAF\_INT\_SYM\_DIAG\_CHG\_LS\_UP<sub>n</sub> =  
INT\_SYM\_DIAG\_CHG\_LS\_UP<sub>n-1</sub> +

MAF\_CYL \* C\_FAC\_POS\_CHG\_LS\_UP \*  
T\_SAMPLE [ms] \* 1/3600 [(g\*h)/(kg\*ms)]

MAF\_

**ELSE(3b)**

LV\_ERR\_CHG\_LS\_UP = 1

LV\_END\_DIAG\_CHG\_LS\_UP = 1

**ENDIF(3b)**

**ELSE(2b)**

ERR\_SYM\_CHG\_LS\_UP = NO\_SYM

MAF\_INT\_SYM\_DIAG\_CHG\_LS\_UP<sub>n</sub> =

SYM\_DIAG\_CHG\_LS\_UP<sub>n-1</sub>

- MAF\_CYL \* C\_FAC\_NEG\_CHG\_LS\_UP \* T\_SAMPLE [ms]  
\* 1/3600 [(g\*h)/(kg\*ms)]

MAF\_INT\_

**ENDIF(2b)**

**ELSE(1a)**

MAF\_INT\_SYM\_DIAG\_CHG\_LS\_UP = 0

MAF\_INT\_END\_DIAG\_CHG\_LS\_UP = 0

**ENDIF(1a)**

## B.38 O2 sensor (up, down) interchanged diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_CHG_LS_UP	O/V	0... 1H	0 ...1	1	-
Inhibit diagnosis interchanged upstream sensors					
LV_LAM_STOP_SHO_PER_CDN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
substitute to LV_LAM_STOP_SHO_PER in interchanged signal diagnosis					

### Input data:

LV_CDN_VB_OBD2 {p. 1185}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_EL_CPS {p. 4708}	LV_ERR_FTL_MIN {p. 4762}
LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}
LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_PLAUS {p. 1062}
LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_IGK {p. 906}	LV_LAM_STOP_SHO_PER [NC_CBK_EX_NR] {p. 2448}	LV_LS_UP_OBD_2_MAN_ DEAC [NC_CBK_EX_NR] {p. 5449}
LV_ST_END {p. 1720}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_INJ_CONF {p. 626}

### B.38.1 Upstream sensor banks 1 and 2

#### General Information:

The calculation shall be done for all exhaust cylinder banks.

#### Application conditions

##### Initialisation:

At the transition LV\_IGK = 0 -> 1 or ECU-Reset:  
 LV\_INH\_DIAG\_CHG\_LS\_UP = 0  
 LV\_LAM\_STOP\_SHO\_PER\_CDN[i] = 0  
 At the transition LV\_IGK = 1 -> 0  
 LV\_INH\_DIAG\_CHG\_LS\_UP = 1  
 LV\_LAM\_STOP\_SHO\_PER\_CDN[i] = 1

##### Recurrence:

100 ms

##### Activation:

LV\_IGK = 1

##### Deactivation

LV\_IGK = 0

**Formula section:**

LV\_LAM\_STOP\_SHO\_PER\_CDN[i] = LV\_LAM\_STOP\_SHO\_PER[i]

% prevent frequent deactivation of diagnosis caused by active sensor offset adjustment

```

IF      LV_CDN_VB_OBD2 = 0
LV_LS_UP_OBD_2_MAN_DEAC[i]      for any i
LV_ERR_IV[k]                    for any k
LV_ERR_DIAGCPS
LV_ERR_EL_CPS
LV_ERR_FTL_MIN
LV_ERR_FUP
LV_ERR_FUP_MFP_PLAUS
LV_ERR_FUP_ORNG
LV_ERR_FUP_ST
LV_ERR_H_PRS_SYS
LV_ERR_MAF
LV_ERR_MAP_PLAUS
LV_ERR_MAP_TPS_PLAUS
OR
OR
OR
OR
OR
OR
OR
OR
OR
OR
OR
OR

```

**THEN**

LV\_INH\_DIAG\_CHG\_LS\_UP = 1

**ELSE**

LV\_INH\_DIAG\_CHG\_LS\_UP = 0

**ENDIF**

Diagnosis	Symptom	Nr	P-Code/ Failure	P-Code/ Symptom	Hardware config	Recurrence	Failure class A/B
Plausibility check of sensor signal	Symptom detected	0	P040	---	---		NO_LAMP CARB_M
CHG_LS_UP							

## B.39 O2 sensor (up, down) plausibility diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_AFL_SYM_PLAUS_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Oxygen Sensor Plausibility Check - not debounced symptom -SENS_AFL-					
LV_DIAG_AFR_SYM_PLAUS_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Oxygen Sensor Plausibility Check - not debounced symptom "SENS_AFR"					
LV_DIAG_CDN_PLAUS_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Oxygen Sensor Plausibility Check condition					
LV_DIAG_PLAUS_END_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Oxygen Sensor Plausibility Check result available					
LV_DIAG_PLAUS_SYM_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced diagnosis result of the signal plausibility for the wide range A/F sensor					
MAF_END_PLAUS_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral for valid diagnostic result					
MAF_SYM_PLAUS_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral for detection of mutual not plausible sensor signals					
MAF_SYM_RAW_PLAUS_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral for the plausibility symptom (compensation of the catalyst delay)					
STATE_SYM_DIAG_PLAUS_LSL_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Oxygen Sensor Plausibility Check Symptom					

### Input data:

LAMB_DELTA_LAM_ADJ [NC_CBK_EX_NR] {p. 2589}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LV_CAT_PURGE_ACT [NC_CBK_EX_NR] {p. 2927}	LV_DIAG_PLAUS_INH_LSL_UP [NC_CBK_EX_NR] {p. 5429}
LV_IGK {p. 906}	LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}	LV_LAMB_SP_AFL_REQ_DIAG_ACT [NC_CBK_EX_NR] {p. 5389}	LV_LAMB_SP_AFR_REQ_DIAG_ACT [NC_CBK_EX_NR] {p. 5389}
LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_VLS_DIF_DLY_LDC [NC_CBK_EX_NR] {p. 5216}	MAF_CYL {p. 8277}	MAF_KGH {p. 1195}
N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	TCO {p. 1100}	TEG_DYN_LS_DOWN [NC_CBK_EX_NR] {p. 1007}

VLS_DOWN [NC_CBK_EX_NR] {p. 967}			
-------------------------------------	--	--	--

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_AFL_PLAUS_LSL_UP [NC_CBK_EX_NR]	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lean-mixture threshold of the upstream sensor voltage					
C_LAMB_AFR_PLAUS_LSL_UP [NC_CBK_EX_NR]	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Rich-mixture threshold of the upstream sensor voltage					
C_MAF_KGH_MAX_DIAG_PLAUS_LSL_UP	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Maximum mass air flow to carry out the plausibility					
C_MAF_KGH_MIN_DIAG_PLAUS_LSL_UP	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Minimum mass air flow to carry out the plausibility					
C_MAF_SYM_PLAUS_LSL_UP [NC_CBK_EX_NR]	-	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral threshold for detection of mutual not plausible sensor signals					
C_MAF_SYM_RAW_PLAUS_LSL_UP [NC_CBK_EX_NR]	-	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral threshold for compensation of the catalyst delay					
C_MAF_SYM_RAW_RST_PLAUS_LSL_UP [NC_CBK_EX_NR]	-	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral threshold for reset of raw symptom					
C_N_MIN_DIAG_PLAUS_LSL_UP	-	0... FFH	0... 8160	32	rpm
Lower engine speed admitted to carry out the plausibility					
C_TCO_MIN_DIAG_PLAUS_LSL_UP	-	0... FEH	-48... 142.5	0.75	°C
Minimum threshold of the cooling-water temperature to activate the function					
C_TEG_MAX_PLAUS_LSL_UP [NC_CBK_EX_NR]	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Maximum temperature of the catalyst to carry out the plausibility					
C_TEG_MIN_PLAUS_LSL_UP [NC_CBK_EX_NR]	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Minimum temperature of the catalyst to carry out the plausibility					
C_VLS_DOWN_AFL_PLAUS_LSL_UP [NC_CBK_EX_NR]	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Lean-mixture threshold of the downstream sensor voltage					
C_VLS_DOWN_AFR_PLAUS_LSL_UP [NC_CBK_EX_NR]	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Rich-mixture threshold of the downstream sensor voltage					

**FUNCTION DESCRIPTION:****General information:**

The calculation shall be done for all exhaust cylinder banks.


For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

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## Description:

The plausibility check between the upstream oxygen sensor (WRAF sensor) and the downstream oxygen sensor (binary) signal is done once the expected driving conditions are fulfilled. A non-plausibility symptom detected by this diagnosis indicates that a failure is present in one of both sensors.


Two different symptoms can be detected:

- STATE\_SYM\_DIAG\_PLAUS\_LSL\_UP[i] = SYM\_0, if the upstream sensor indicates a rich lambda value, while the downstream sensor signal lean.
- STATE\_SYM\_DIAG\_PLAUS\_LSL\_UP[i] = SYM\_1, if the upstream sensor indicates a lean lambda value, while the downstream sensor signal rich.

Once the down- and upstream sensor signals are not mutual plausible first the mass flow integral MAF\_SYM\_RAW\_PLAUS\_LSL\_UP[i] is calculated to take into account the delay time caused by the oxygen storage capability of the catalyst. If this integral reaches the threshold C\_MAF\_SYM\_RAW\_PLAUS\_LSL\_UP[i] the status in STATE\_SYM\_DIAG\_PLAUS\_LSL\_UP[i] is set to the respective symptom. If either LV\_DIAG\_AFR\_SYM\_PLAUS\_LSL\_UP[i] or LV\_DIAG\_AFS\_SYM\_PLAUS\_LSL\_UP[i] disappears the MAF integral is decremented. When the integral reaches C\_MAF\_SYM\_RAW\_RST\_PLAUS\_LSL\_UP[i] the status flag is taken back.

Second, after STATE\_SYM\_DIAG\_PLAUS\_LSL\_UP[i] is set to the respective symptom the debounce algorithm is started. If both LV\_DIAG\_AFR/AFS\_SYM\_PLAUS\_LSL\_UP[i] and STATE\_SYM\_DIAG\_PLAUS\_LSL\_UP[i] are active MAF\_SYM\_PLAUS\_LSL\_UP is integrated. In contrast if both symptom indicators are inactive (thus no failure is expected) the integral MAF\_END\_PLAUS\_LSL\_UP[i] is integrated. Should the status of flag differ from each other, then both integrals are frozen. MAF\_SYM\_PLAUS\_LSL\_UP is reset when the status of STATE\_SYM\_DIAG\_PLAUS\_LSL\_UP[i] changes. There is not reset condition for the end integral in order to have a valid end flag also in case of a jittering signal.

LV\_DIAG\_PLAUS\_SYM\_LSL\_UP[i] is set to one once the symptom integral exceeds C\_MAF\_SYM\_PLAUS\_LSL\_UP[i] is exceeded. LV\_DIAG\_PLAUS\_END\_LSL\_UP[i] is set when the end integral exceeds sum of C\_MAF\_SYM\_PLAUS\_LSL\_UP[i] and C\_MAF\_SYM\_RAW\_PLAUS\_LSL\_UP[i] or when the LV\_DIAG\_PLAUS\_SYM\_LSL\_UP[i] is set.

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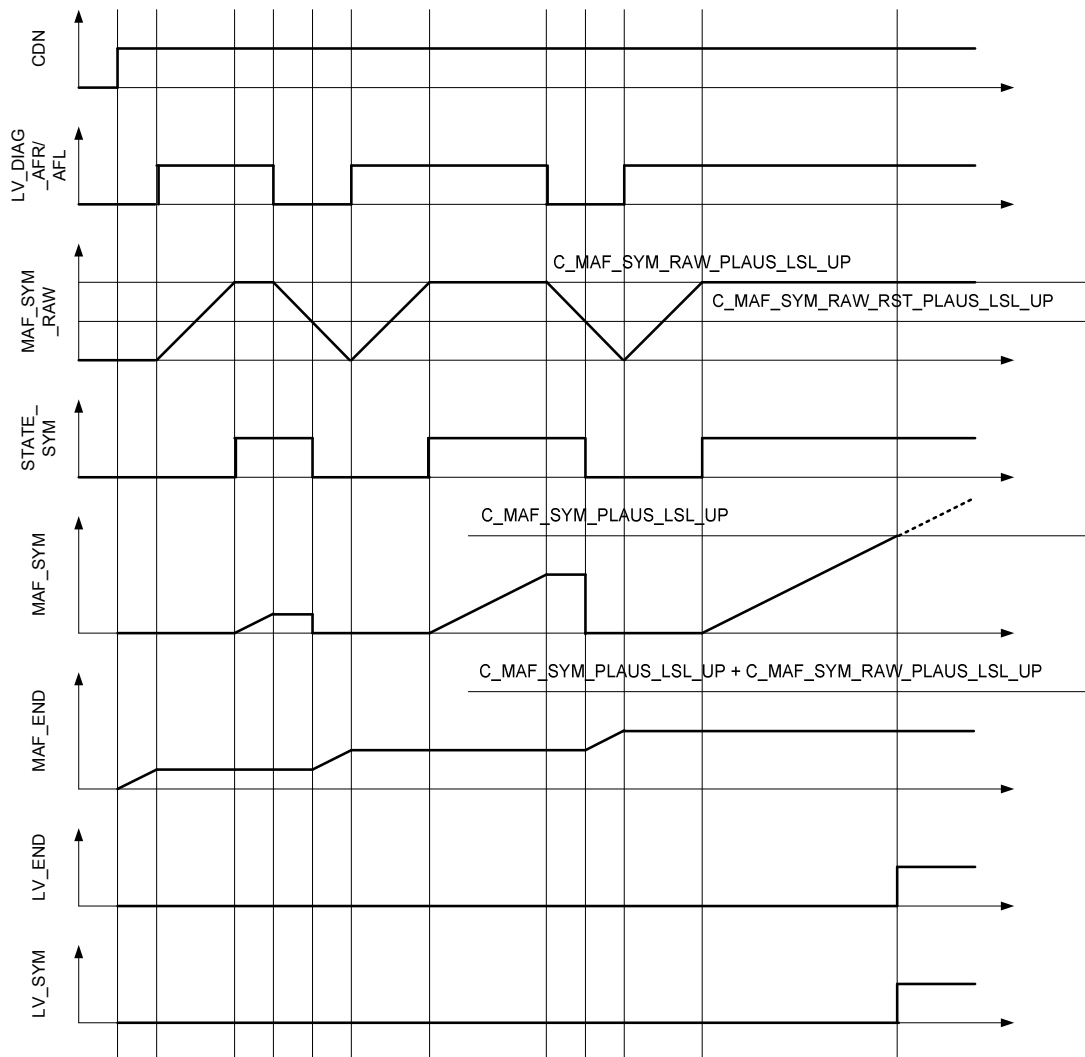


Figure B.39.1: : Basic principle of applied debounce algorithm.

The symptom flag `LV_DIAG_PLAUS_SYM_LSL_UP` is exported to *Sensor Characteristic Line Shift to Lean* and *Shift to Rich* functions to facilitate the detection of the faulty sensor and failure cause. The calibration of this function is described in its Tuning Guide.

### Application conditions:

#### Initialisation:

At transition `LV_IGK = 0 to 1`, reset or at clearing error memory resettall variables.

Recurrence: 100 ms

#### Activation:

<b>IF</b>	<code>LV_DIAG_PLAUS_SYM_LSL_UP[i] = 0</code>	<b>AND</b>
	<code>LV_IPLSL_VLD[i] = 1</code>	<b>AND</b>
	<code>LV_LS_DOWN_READY[i] = 1</code>	<b>AND</b>
	<code>LV_LAMB_SP_AFR_REQ_DIAG_ACT[i] = 0</code>	<b>AND</b>
	<code>LV_LAMB_SP_AFL_REQ_DIAG_ACT[i] = 0</code>	<b>AND</b>

```

N_32 > C_N_MIN_DIAG_PLAUS_LSL_UP                AND
C_MAF_KGH_MIN_DIAG_PLAUS_LSL_UP < MAF_KGH <
      C_MAF_KGH_MAX_DIAG_PLAUS_LSL_UP          AND
TCO C_TCO_MIN_DIAG_PLAUS_LSL_UP                AND
C_TEG_MIN_PLAUS_LSL_UP[i] < TEG_DYN_LS_DOWN[i] <
C_TEG_MAX_PLAUS_LSL_UP[i]                      AND
LV_DIAG_PLAUS_INH_LSL_UP[i] = 0                AND
LV_CAT_PURGE_ACT[i] = 0                        AND
LV_VLS_DIF_DLY_LDC[i] = 1
THEN % activate function
LV_DIAG_CDN_PLAUS_LSL_UP[i] = 1
ELSE % deactivate function
LV_DIAG_CDN_PLAUS_LSL_UP[i] = 0
% freeze STATE_SYM_DIAG_PLAUS_LSL_UP[i]
% freeze MAF_SYM_PLAUS_LSL_UP[i]
ENDIF

```

### Formula section:

% Testing signal shift to rich:

**IF(1a)** VLS\_DOWN[i] <= C\_VLS\_DOWN\_AFL\_PLAUS\_LSL\_UP[i]

% downstream sensor signal lean

**AND(1a)** LAMB\_LS\_UP[i] + LAMB\_DELTA\_LAM\_ADJ[i] <

LAMB\_AFR\_PLAUS\_LSL\_UP[i]

% upstream sensor output rich

**THEN(1a)** LV\_DIAG\_AFR\_SYM\_PLAUS\_LSL\_UP[i] = 1

% upstream sensor probably too rich

**ELSE(1a)**

% Testing signal shift to lean:

LV\_DIAG\_AFR\_SYM\_PLAUS\_LSL\_UP[i] = 0

**IF(2a)** VLS\_DOWN[i] >= C\_VLS\_DOWN\_AFR\_PLAUS\_LSL\_UP[i]

% downstream sensor signal rich

**AND(2a)** LAMB\_LS\_UP[i] + LAMB\_DELTA\_LAM\_ADJ[i] >

PLAUS\_LSL\_UP[i]

% upstream sensor output lean

**THEN(2a)** LV\_DIAG\_AFL\_SYM\_PLAUS\_LSL\_UP[i] = 1

% upstream sensor probably too lean

**ELSE(2a)** LV\_DIAG\_AFL\_SYM\_PLAUS\_LSL\_UP[i] = 0

**ENDIF(2a)**

**ENDIF(1a)**

% First anti-bouncing filter (to eliminate the catalyst oxygen buffer effect):

**IF(1b)** LV\_DIAG\_AFR\_SYM\_PLAUS\_LSL\_UP[i] = 1 **OR**

DIAG\_AFL\_SYM\_PLAUS\_LSL\_UP[i] = 1

**THEN(1b)**

**IF(2b)** MAF\_SYM\_RAW\_PLAUS\_LSL\_UP[i] < C\_MAF\_SYM\_RAW\_PLAUS\_LSL\_UP[i]


**THEN(2b)**

MAF\_SYM\_RAW\_PLAUS\_LSL\_UP[i]<sub>n</sub> = MAF\_SYM\_RAW\_PLAUS\_LSL\_UP[i]<sub>n-1</sub> + MAF\_  
CYL \* T\_SAMPLE[ms] \* 1/3600 [g\*h/(kg\*ms)]

**ELSE(2b)**

**IF(3b)** LV\_DIAG\_AFR\_SYM\_PLAUS\_LSL\_UP[i] = 1

**THEN(3b)**

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```

        STATE_SYM_DIAG_PLAUS_LSL_UP[i] = SYM_0
    ELSE(3b)
        STATE_SYM_DIAG_PLAUS_LSL_UP[i] = SYM_1
    ENDIF(3b)
ENDIF(2b)
ELSE(1b)
    MAF_SYM_RAW_PLAUS_LSL_UP[i]n = MAF_SYM_RAW_PLAUS_LSL_UP[i]n-1 - MAF_CYL *
    T_SAMPLE[ms] * 1/3600 [g*h/(kg*ms)]
ENDIF(1b)

IF(1c) MAF_SYM_RAW_PLAUS_LSL_UP[i] <=
MAF_SYM_RAW_RST_PLAUS_LSL_UP[i]
THEN(1c)
    STATE_SYM_DIAG_PLAUS_LSL_UP[i] = NO_SYM
ENDIF(1c)

```

C\_

% Anti-bounce Counter and minimum time to have a valid diagnostic:


```

IF(1a) LV_DIAG_AFR_SYM_PLAUS_LSL_UP[i] = 0
AND(1a) LV_DIAG_AFL_SYM_PLAUS_LSL_UP[i] = 0
THEN(1a) % "raw symptom" not present => no failure case
    IF(2a) STATE_SYM_DIAG_PLAUS_LSL_UP[i] = NO_SYM
    THEN(2a)
        MAF_END_PLAUS_LSL_UP[i]n = MAF_END_PLAUS_LSL_UP[i]n-1 + MAF_CYL * T_
        SAMPLE[ms] * 1/3600 [g*h/(kg*ms)]
    ELSE(2a)
        MAF_END_PLAUS_LSL_UP[i]n = MAF_END_PLAUS_LSL_UP[i]n-1
        MAF_SYM_PLAUS_LSL_UP[i]n = MAF_SYM_PLAUS_LSL_UP[i]n-1
    ENDIF(2a)
ELSEIF(1a) LV_DIAG_AFR_SYM_PLAUS_LSL_UP[i] = 1
OR(1a) LV_DIAG_AFL_SYM_PLAUS_LSL_UP[i] = 1
THEN(1a) % "raw symptom" is present => failure case
    IF(2b) STATE_SYM_DIAG_PLAUS_LSL_UP[i] = NO_SYM
    THEN(2b) % symptom flag is not yet set
        MAF_END_PLAUS_LSL_UP[i]n = MAF_END_PLAUS_LSL_UP[i]n-1
        MAF_SYM_PLAUS_LSL_UP[i]n = MAF_SYM_PLAUS_LSL_UP[i]n-1
    ELSE(2b) % symptom flag has been set
        MAF_SYM_PLAUS_LSL_UP[i]n = MAF_SYM_PLAUS_LSL_UP[i]n-1 +
        MAF_CYL * T_SAMPLE[ms] * 1/3600 [g*h/(kg*ms)]
    ENDIF(2b)
ENDIF(1a)

% Reset of MAF_SYM_PLAUS_LSL_UP
IF(1b)
    STATE_SYM_DIAG_PLAUS_LSL_UP[i]n <> STATE_SYM_DIAG_PLAUS_LSL_UP[i]n-1
THEN(1b)
    MAF_SYM_PLAUS_LSL_UP[i] = 0
ENDIF(1b)
STATE_SYM_DIAG_PLAUS_LSL_UP[i]n-1 = STATE_SYM_DIAG_PLAUS_LSL_UP[i]n

```

% Failure determination and setting of end flag

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```

IF(1c) MAF_END_PLAUS_LSL_UP[i] > C_MAF_SYM_PLAUS_LSL_UP[i] + C_
MAF_SYM_RAW_PLAUS_LSL_UP[i]

```

% To assure time symmetry between good (no failure) case and failure case, for the good case the MAF integral has to reach the sum of the thresholds of the anti-bounce filters.

```

THEN(1c) % End-Bit is set in case no symptom present

```

```

    LV_DIAG_PLAUS_END_LSL_UP[i] = 1

```

```

ENDIF(1c)

```

```

IF(1d) MAF_SYM_PLAUS_LSL_UP[i] > C_MAF_SYM_PLAUS_LSL_UP[i]

```

```

THEN(1d) % End-bit is set in case symptom present

```

```

    LV_DIAG_PLAUS_SYM_LSL_UP[i] = 1

```

```


    LV_DIAG_PLAUS_END_LSL_UP[i] = 1

```

```

ENDIF(1d)

```

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## B.40 O2 sensor (up, down) plausibility diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_PLAUS_INH_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of "Plausibility check of the sensor signal"					
LV_INH_DIAG_RBM_PLAUS_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of Rate Base Monitoring of "Plausibility check of the sensor signal"					

### Input data:

LC_DIAG_PUE_ACT_LS_DOWN {p. 5191}	LV_CAT_PURGE_ACT [NC_CBK_EX_NR] {p. 2927}	LV_CDN_VB_OBD2 {p. 1185}	LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}
LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}	LV_ERR_CHG_LS_UP {p. 5416}
LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_PER {p. 4432}
LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FTL_MIN {p. 4762}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_PLAUS {p. 6062}
LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}
LV_ERR_IVVT {p. 1062}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}
LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_PLAUS {p. 1062}	LV_ERR_MAP_TPS_PLAUS {p. 1062}
LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}
LV_ERR_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5198}	LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}
LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}
LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_ERR_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5297}	LV_ERR_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5169}

LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}
LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SWT_LS_DOWN [NC_CBK_EX_NR] {p. 5152}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_TPS {p. 4982}	LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VCV {p. 4729}	LV_IGK {p. 906}
LV_LS_UP_OBD_2_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_NR_CAM_CBK {p. 1507}

### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

### Application conditions

**Initialisation:** at every transition LV\_IGK = 0->1 or reset all variables shall be reset to 0.

at every transition LV\_IGK = 1->0

LV\_DIAG\_PLAUS\_INH\_LSL\_UP [NC\_CBK\_EX\_NR] = 1

**Recurrence:** the functions shall be carried out once every 1s.

**Activation:** LV\_IGK = 1

**Deactivation:** LV\_IGK = 0

### Formula section:

This function has to be deactivated, if at least one of the following errors /special modes is active.


IF

LV_ERR_AMP = 1	OR	
LV_ERR_AMP_PLAUS = 1		OR
LV_ERR_CHG_LS_UP = 1		OR
LV_ERR_CRK_PLAUS = 1	OR	
LV_ERR_CRK_SYN = 1	OR	LV_ERR_CRK_TOOTH = 1
		OR
LV_ERR_CRK_TOOTH_PER = 1	OR	
LV_ERR_DIAGCPS = 1	OR	
LV_ERR_EL_CPS = 1		OR
LV_ERR_FTL_MIN = 1		OR
LV_ERR_FUP = 1		OR
LV_ERR_FUP_MFP_PLAUS = 1	OR	

```

LV_ERR_FUP_ORNG = 1 OR
LV_ERR_FUP_ST = 1 OR
LV_ERR_H_PRS_SYS = 1 OR
LV_ERR_IVVT = 1 OR
LV_ERR_LOAD_TPS_PLAUS = 1 OR
LV_ERR_MAF = 1 OR
LV_ERR_MAP_PLAUS = 1 OR
LV_ERR_MAP_TPS_PLAUS = 1 OR
LV_ERR_MTC_CTL_2 = 1 OR
LV_ERR_MTC_CTL_3 = 1 OR
LV_ERR_MTC_DR = 1 OR
LV_ERR_TPS = 1 OR
LV_ERR_VCV = 1 OR
LV_ERR_AIR_LSL_UP[i] = 1 OR LV_
ERR_CAT_DIAG [i] = 1 OR
LV_ERR_CTL_LSL_UP[i] = 1 OR
LV_ERR_DYN_VLD_LS_UP[i] = 1 OR
LV_ERR_EL_LSL_UP[i] = 1 OR
LV_ERR_LSH_DOWN[i] = 1 OR
LV_ERR_LSH_UP[i] = 1 OR
LV_ERR_LSL_UP_IF[i] = 1 OR
LV_ERR_OBD_LSH_DOWN[i] = 1 OR
LV_ERR_OBD_VLD_LSH_UP[i] = 1 OR
LV_ERR_OC_LS_DOWN[i] = 1 OR
LV_ERR_OC_LSL_UP[i] = 1 OR
LV_ERR_OFS_LSL_UP[i] = 1 OR
LV_ERR_PUC_LS_DOWN[i] = 1 OR
LV_ERR_PUC_VLD_LS_UP[i] = 1 OR
[LV_ERR_PUE_LS_DOWN[i] = 1 and
LC_DIAG_PUE_ACT_LS_DOWN = 1] OR
LV_ERR_SCG_LS_DOWN[i] = 1 OR
LV_ERR_SCP_LS_DOWN[i] = 1 OR
LV_ERR_SWT_LS_DOWN[i] = 1 OR
LV_ERR_TTIP_MES_LSH_UP[i] = 1 OR
(i = 1 AND
[ LV_ERR_IV[0] OR
LV_ERR_IV[2] OR
LV_ERR_IV[4] OR
LV_ERR_MIS[0] OR
LV_ERR_MIS[2] OR
LV_ERR_MIS[4]
]) OR
(i = 2 AND
[ LV_ERR_IV[1] OR
LV_ERR_IV[3] OR
LV_ERR_IV[5] OR
LV_ERR_MIS[1] OR
LV_ERR_MIS[3] OR
LV_ERR_MIS[5]
]) OR
LV_ERR_PER_CAM_EX[m] = 1 m=1 for i=1,2 OR
LV_ERR_PER_CAM_IN[m] = 1 m=1 for i=1,2 OR

```

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```

LV_ERR_PLAUS_CAM_EX[m] = 1           m=1 for i=1,2      OR
LV_ERR_PLAUS_CAM_IN[m] = 1          m=1 for i=1,2      OR
LV_ERR_REF_CRK_CAM_EX[m] = 1        m=1 for i=1,2      OR
LV_ERR_REF_CRK_CAM_IN[m] = 1        m=1 for i=1,2      OR
LV_ERR_SYN_CAM_EX[m] = 1            m=1 for i=1,2      OR
LV_ERR_SYN_CAM_IN[m] = 1            m=1 for i=1,2      OR
LV_ERR_SYN_CRK_CAM_IN[m] = 1        m=1 for i=1,2      OR
LV_ERR_TOOTH_OFF_EX[m] = 1          m=1 for i=1,2      OR
LV_ERR_TOOTH_OFF_IN[m] = 1          m=1 for i=1,2

```

```

THEN      LV_INH_DIAG_RBM_PLAUS_LSL_UP[NC_CBK_EX_NR] = 1
ELSE      LV_INH_DIAG_RBM_PLAUS_LSL_UP[NC_CBK_EX_NR] = 0
ENDIF

```

```

IF      LV_INH_DIAG_RBM_PLAUS_LSL_UP[NC_CBK_EX_NR] = 1      OR
LV_CAT_PURGE_ACT[NC_CBK_EX_NR] = 1      OR
LV_CDN_VB_OBD2 = 0      OR
LV_LS_UP_OBD_2_MAN_DEAC[NC_CBK_EX_NR] = 1      OR
LV_ERR_SHIFT_AFL_LSL_UP[NC_CBK_EX_NR] = 1      OR
LV_ERR_SHIFT_AFR_LSL_UP[NC_CBK_EX_NR] = 1      OR

```

```

THEN      LV_DIAG_PLAUS_INH_LSL_UP[NC_CBK_EX_NR] = 1
ELSE      LV_DIAG_PLAUS_INH_LSL_UP[NC_CBK_EX_NR] = 0
ENDIF

```



## B.41 O2 sensor (up) heater plausibility diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_OBD_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean inhibit flag for O2 sensor heater OBDII monitoring					
LV_INH_DIAG_RBM_OBD_LSH_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean inhibit flag for Rate Based Monitoring of O2 sensor heater OBDII diagnosis					
STATE_RBM_OBD_VLD_LSH_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of OBD_VLD_LSH_UP[NC_CBK_EX_NR] monitor with the Rate-Based Monitoring statistics Bit 0: conditions for monitoring are met long enough to detect malfunction (bit 0 = 1) Bit 1: inhibition of the monitor because of system failure(s) (bit 1 = 1) Bit 2					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}
LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_PLAUS {p. 1062}
LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}
LV_ERR_MTC_DR {p. 5002}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_SHIFT_AFL_ LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_ LSL_UP [NC_CBK_EX_NR] {p. 5334}
LV_ERR_TPS {p. 4982}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}
LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}
LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_VCV {p. 4729}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_IGK {p. 906}
LV_LS_UP_OBD_2_MAN_ DEAC [NC_CBK_EX_NR] {p. 5449}	LV_ST_END {p. 1720}	LV_VAR_LSH_UP {p. 656}	LV_VB_CDN_OBD_2 {p. 1046}

NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}		
------------------------	---------------------	--	--

**Import actions:**

<b>ACTION_ERRM_CheckPendingStatus (IN&lt;PRM_IDX_DIAG&gt;,OUT&lt;PRM_LV_ERR_PND&gt;)</b>
--

**B.41.1 Upstream sensor heater OBD2 diagnosis: Inhibition of diagnosis****Description:**

This function shall evaluate the application conditions applicable to the oxygen sensor ceramic temperature OBDII monitoring and provide the result in a single boolean flag. This flag shall represent the interface to the main diagnosis function.

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2), then

i = 1, for cylinder bank 1

i = 2, for cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank 1.

**Application conditions****Initialisation:**

at every transition LV\_IGK = 0 -> 1 or reset all variables shall be reset to 0, except STATE\_RBM\_OBD\_VLD\_LSH\_UP[i] //for init of this variable see section below  
at every transition LV\_IGK = 1 -> 0  
LV\_INH\_DIAG\_OBD\_LSH\_UP[NC\_CBK\_EX\_NR] = 1

**Recurrence:**


1 s

**Activation:**

LV\_IGK = 1

**Formula section:**

<b>If</b>	LV_ERR_CHG_LS_UP = 1	<b>OR</b>
	LV_ERR_DIAGCPS = 1	<b>OR</b>
	LV_ERR_EL_CPS = 1	<b>OR</b>
	LV_ERR_FUP = 1	<b>OR</b>
	LV_ERR_FUP_MFP_PLAUS = 1	<b>OR</b>
	LV_ERR_FUP_ORNG = 1	<b>OR</b>
	LV_ERR_FUP_ST = 1	<b>OR</b>
	LV_ERR_H_PRS_SYS = 1	<b>OR</b>
	LV_ERR_LOAD_TPS_PLAUS = 1	<b>OR</b>
	LV_ERR_MAF = 1	<b>OR</b>
	LV_ERR_MAP_PLAUS = 1	<b>OR</b>
	LV_ERR_MAP_TPS_PLAUS = 1	<b>OR</b>
	LV_ERR_MTC_CTL_2 = 1	<b>OR</b>
	LV_ERR_MTC_CTL_3 = 1	<b>OR</b>
	LV_ERR_MTC_DR = 1	<b>OR</b>
	LV_ERR_TPS = 1	<b>OR</b>

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```

LV_ERR_VCV = 1                OR
  LV_ERR_AIR_LSL_UP[i] = 1    OR
LV_ERR_CTL_LSL_UP[i] = 1      OR
LV_ERR_DELTA_I_LAM[i] = 1     OR
LV_ERR_DYN_VLD_LS_UP[i] = 1   OR
LV_ERR_EL_LSL_UP[i] = 1       OR
LV_ERR_LSH_UP[i] = 1          OR
LV_ERR_LSL_UP_IF[i] = 1       OR
LV_ERR_OFS_LSL_UP[i] = 1      OR
LV_ERR_SHIFT_AFL_LSL_UP[i] = 1 OR
LV_ERR_SHIFT_AFR_LSL_UP[i] = 1 OR
LV_ERR_VLS_DOWN_DIF[i] = 1    OR
(i = 1
  AND
  [ LV_ERR_IV[0]                OR
    LV_ERR_IV[2]                OR
    LV_ERR_IV[4]                OR
    LV_ERR_MIS[0]               OR
    LV_ERR_MIS[2]               OR
    LV_ERR_MIS[4]
  ])
(i = 2
  AND
  [ LV_ERR_IV[1]                OR
    LV_ERR_IV[3]                OR
    LV_ERR_IV[5]                OR
    LV_ERR_MIS[1]               OR
    LV_ERR_MIS[3]               OR
    LV_ERR_MIS[5]
  ])

then LV_INH_DIAG_RBM_OBD_LSH_UP[i] = 1
else LV_INH_DIAG_RBM_OBD_LSH_UP[i] = 0
endif

If LV_LS_UP_OBD_2_MAN_DEAC[i] = 1 OR
LV_INH_DIAG_RBM_OBD_LSH_UP[i] = 1 OR
LV_VB_CDN_OBD_2 = 0 OR
LV_VAR_LSH_UP = 0

then LV_INH_DIAG_OBD_LSH_UP[i] = 1
else LV_INH_DIAG_OBD_LSH_UP[i] = 0
endif

```


## B.41.2 Upstream sensor heater OBD2 diagnosis: Interface for rate - based - monitoring

### Description:

With this module the interface between the OBD\_VLD\_LSH\_UP[i] monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_OBD\_VLD\_LSH\_UP[i] data.

Within STATE\_RBM\_OBD\_VLD\_LSH\_UP[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)

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(no intrusive operation, no short trip)

- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)

( not valid for heater diagnosis )

### Application conditions

#### Initialisation:

at ECU reset:  
 bit 0, bit 1 and bit 2 of STATE\_RBM\_OBD\_VLD\_LSH\_UP[i]  
 = 0  
 LV\_DC 0 -> 1 transition:  
 bit 0 and bit 1 of STATE\_RBM\_OBD\_VLD\_LSH\_UP[i] = 0  
 bit 2 of STATE\_RBM\_OBD\_VLD\_LSH\_UP[i] = 1  
 on failure memory reset:  
 bit 1 of STATE\_RBM\_OBD\_VLD\_LSH\_UP[i] = 0

#### Recurrence:

1 s

#### Activation:

LV\_DC = 1

### Formula section:

#### At LV\_DC 0 -> 1 transition


The pending status of the following failures has to be checked only once :

Dependence	Error			
	LV_ERR_CHG_LS_UP	LV_ERR_DIAGCP S	LV_ERR_EL_CPS	LV_ERR_FUP
	LV_ERR_FUP_MF_P_PLAUS	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_SYS
	LV_ERR_LOAD_TPS_PLAUS	LV_ERR_MAF_FRQ_EL	LV_ERR_MAF_FRQ_GRD	LV_ERR_MAF_FRQ_RNG
	LV_ERR_MAP_PLAUS	LV_ERR_MAP_TPS_PLAUS	LV_ERR_MTC_CTL_2	LV_ERR_MTC_CTL_3
	LV_ERR_MTC_DR	LV_ERR_TPS_1	LV_ERR_TPS_2	LV_ERR_TPS_AD
	LV_ERR_TPS_AD_BOL	LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2	LV_ERR_TPS_RATIO
	LV_ERR_TPS_ST_CHK_2	LV_ERR_VCV		
NC_CBK_EX_NR	LV_ERR_AIR_LSL_UP[i]	LV_ERR_CTL_LSL_UP[i]	LV_ERR_DELTA_I_LAM[i]	LV_ERR_DYN_VLD_LSL_UP[i]
	LV_ERR_EL_LSL_UP[i]	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]	LV_ERR_OFS_LSL_UP[i]
	LV_ERR_SHIFT_AFR_LSL_UP[i]	LV_ERR_SHIFT_AFL_LSL_UP[i]	LV_ERR_VLS_DOWN_DLIF[i]	

Figure B.41.1: For NC\_CBK\_EX\_NR = i = 1

NC_CYL_NR	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	LV_ERR_MIS[0]
	LV_ERR_MIS[2]	LV_ERR_MIS[4]		

Figure B.41.2: For NC\_CBK\_EX\_NR = i = 2

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<b>NC_CYL_NR</b>	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	LV_ERR_MIS[1]
	LV_ERR_MIS[3]	LV_ERR_MIS[5]		

```

If(1)      { CPU optimization at LV_DC 0 - -> 1 transition }
            CTR_ERR_DYN_NR <> 0      { the dynamic failure memory isn t empty }

Then(1)

            While      bit 1 of STATE_RBM_OBD_VLD_LSH_UP[i] = 0 do
                    with each XX failure of the above list (depending on configuration, see below):
                    ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

                            If(2)      XX has a pending status
                            Then(2)      bit 1 of STATE_RBM_OBD_VLD_LSH_UP[i] = 1
                            Endif(2)

            Endwhile

Else(1)      { the dynamic failure memory is empty }      No action
Endif(1)
Every 1 s :

If      bit 0 of STATE_RBM_OBD_VLD_LSH_UP[i] = 0
Then

            If      LV_END_DIAG_OBD_VLD_LSH_UP[i] = 1
                    Then      bit 0 of STATE_RBM_OBD_VLD_LSH_UP[i] = 1
                    Endif

Endif

If      bit 1 of STATE_RBM_OBD_VLD_LSH_UP[i] = 0
Then

            If      LV_INH_DIAG_RBM_OBD_LSH_UP[i] = 1
                    Then      bit 1 of STATE_RBM_OBD_VLD_LSH_UP[i] = 1
                    Endif

Endif

```

## B.42 O2 sensor (up) heater plausibility diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_OBD_VLD_LSH_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom to be transmitted to the error management					
ERR_SYM_TTIP_MES_LSH_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for general tip temperature plausibility					
LV_CDN_DIAG_OBD_VLD_LSH_UP [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Boolean flag indicating condition of correspondent diagnosis					
LV_CDN_DIAG_TTIP_MES_LSH_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating availability of general tip temperature plausibility diagnosis					
LV_DIAG_OBD_CDN_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that conditions for diagnosis met					
LV_DIAG_OBD_END_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that diagnosis has been completed					
LV_DIAG_OBD_SYM_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that fault is present and has been debounced					
LV_END_DIAG_OBD_VLD_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating end of correspondent diagnosis					
LV_END_DIAG_TTIP_MES_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating end of general tip temperature plausibility diagnosis					
LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the validation of correspondent symptom (transmitted to the error management)					
LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the validation of general tip temperature plausibility symptom					
LV_LAMB_PLS_REQ_DIAG_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag requesting exaggerated forced stimulation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_SYM_OBD_LSL_LSH_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H	NO_SYM TTIP_ERR READY_ERR TTIP_MES_ ERR	-	-
Variable indicating status of each symptom, updated each recurrence & at diagnosis completion					
TCC_END_DIAG_OBD_LSH_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Counter for end flag determination of TTIP_MES diagnosis					
TCC_ERR_OBD_LSH_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Number of diagnosis cycles in which temperature deviation exceeding limits present					
TTIP_LSH_UP_MES_TMP [NC_CBK_EX_NR]	O/V	0... FFFFH	-40... 6513.5	0.1	°C
Temporary storage of sensor temperature for Service06h output.					
TTIP_MES_OBD_LSH_UP_IT [NC_CBK_EX_NR]	O/V/S	0... FFFFH	-40... 6513.5	0.1	°C
internal copy of TTIP_MES_LS_UP to assure same datatype for diagnosis and service 06h output					
TTIP_OBD_LSH_UP_MES_BOL_SAE [NC_CBK_EX_NR]	O/V/S	0... FFFFH	-40... 6513.5	0.1	°C
Service 06h - min value : diagnosis of lambda sensor temperature upstream					
TTIP_OBD_LSH_UP_MES_SAE [NC_CBK_EX_NR]	O/V/S	0... FFFFH	-40... 6513.5	0.1	°C
Service 06h - test value : diagnosis of lambda sensor temperature upstream					
TTIP_OBD_LSH_UP_MES_TOL_SAE [NC_CBK_EX_NR]	O/V/S	0... FFFFH	-40... 6513.5	0.1	°C
Service 06h - max value : diagnosis of lambda sensor temperature upstream					

**Input data:**

C_TTIP_MIN_LS_UP_READY {p. 2336}	C_TTIP_THD_IPLSL_ACT_LS_UP {p. 2354}	LSHPWM_UP [NC_CBK_EX_NR] {p. 2385}	LV_END_DIAG_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}
LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_IGK {p. 906}	LV_INH_DIAG_OBD_LSH_UP [NC_CBK_EX_NR] {p. 5433}	LV_LS_UP_READY [NC_CBK_EX_NR] {p. 2335}
LV_ST_END {p. 1720}	LV_TEMP_DEW_LS_UP [NC_CBK_EX_NR] {p. 1007}	LV_TTIP_MES_VLD_LS_UP [NC_CBK_EX_NR] {p. 1320}	LV_V_REF_VLD_R_IT_LS_UP [NC_CBK_EX_NR] {p. 1320}
LV_VB_CDN_OBD_2 {p. 1046}	NC_CBK_EX_NR {p. 1829}	NC_IDX_DIAG_OBD_VLD_LS_UP [NC_CBK_EX_NR]	NC_IDX_DIAG_TTIP_MES_LS_UP [NC_CBK_EX_NR]
STATE_DIAG_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	STATE_LSH_UP [NC_CBK_EX_NR] {p. 2385}	T_POW_RISE_LS_UP [NC_CBK_EX_NR] {p. 2386}	TEG_DYN_LS_UP [NC_CBK_EX_NR] {p. 1008}
TTIP_MES_LS_UP [NC_CBK_EX_NR] {p. 1321}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LSHPWM_MIN_LSH_UP	-	0... FFH	0... 99.60937	0.390625	%
Minimum permitted heater effective voltage PWM for upstream LSH OBD2 diagnosis					
C_T_DLY_LS_UP_READY_OBD_LSH_UP	-	0... FFFFH	0... 6553.5	0.1	s
Time threshold after heater management start where fault detected, if no full operative readiness observed					
C_T_DLY_POW_CTL_OBD_LSH_UP	-	0... FFFFH	0... 6553.5	0.1	s
Minimum delay prior to checking status of OBD1 heater /signal faults					
C_T_DLY_TTIP_MES_OBD_LSH_UP	-	0... FFFFH	0... 6553.5	0.1	s
Time delay after TTIP_ERR_MES symptom valid to set error flag					
C_T_DLY_TTIP_RES_OBD_LSH_UP	-	0... FFFFH	0... 6553.5	0.1	s
Time delay to reset TTIP_ERR_MES timer					
C_TCC_ERR_INC_OBD_LSH_UP	-	0... FFH	0... 255	1	-
Increment of heater fault counter in case that Ttip is below diagnostic threshold					
C_TCC_ERR_INC_OBD_LSH_UP_FAST	-	0... FFH	0... 255	1	-
Fast increment of heater fault counter in case that Ttip is below IP control activation limit					
C_TCC_THD_ERR_OBD_LSH_UP	-	0... FFFFH	0... 65535	1	-
Fault detection threshold, when exceeded, heater is determined to be defective during driving cycle					
C_TEG_DYN_MIN_OBD_LSH_UP	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Minimum exhaust temperature to activate oxygen sensor ceramic temperature diagnosis					
C_TTIP_MAX_OBD_LSH_UP	-	0... FFFFH	-40... 6513.5	0.1	°C
Upper diagnosis threshold for oxygen sensor ceramic temperature					
C_TTIP_MIN_OBD_LSH_UP	-	0... FFFFH	-40... 6513.5	0.1	°C
Lower diagnosis threshold for oxygen sensor ceramic temperature					
LC_OBD_LSH_UP	-	0... 1H	0 ...1	1	-
Logical constant permitting diagnosis to be carried out					
LC_OBD_REP_LSH_UP	-	0... 1H	0 ...1	1	-
Logical constant permitting diagnosis to be repeated within one driving cycle					


**Import actions:**

<b>ACTION_ERRM_NoFilterReset</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_NoFilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_LV_ERR_SET>,>,IN<PRM_LV_ERR_RST>,>,IN<PRM_LV_END_DIAG>,>,OUT<PRM_LV_ERR>)

**Error treatment:**

Diagnostic XX	Symptom description	Symptom	Filter type
OBD_VLD_LSH_UP[ NC_CBK_EX_NR]	"sensor temperature out of range"	SYM_0	NO
	"sensor readiness delayed"	SYM_1	
	"invalid sensor temperature"	SYM_2	

Figure B.42.1: Diagnostic

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Diagnostic XX	Symptom description	Symptom	Filter type
TTIP_MES_LSH_UP [NC_CBK_EX_NR]	"sensor temperature out of range"	SYM_0	NO
	"sensor readiness delayed"	SYM_1	
	"invalid sensor temperature"	SYM_2	

## FUNCTION DESCRIPTION:

### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

This function shall facilitate the detection of oxygen sensor heater failures that would lead to an increase in emissions beyond the thresholds stated in the appropriate regulations. The diagnosis shall be carried out by determining whether the operative readiness of the sensor exceeds a time threshold or whether the measured oxygen sensor ceramic temperature exceeds or falls below set bounds over a number of measurement cycles, defined to be the actions carried out once per recurrence. The latter evaluation over the diagnosis cycle, defined to be after the completion of the set number of monitoring cycles, shall be carried out statistically.

### Description:

Deviations in the oxygen sensor ceramic temperature or the oxygen sensor not being operatively ready in a timely manner can lead to an increase in emissions above the applicable standards or prevent the sensor signal from being used as a diagnostic system monitoring device.

The deviations may occur due to, for example, ageing of the heater element, defective wiring, increased heater circuit connector contact resistance, defective heater driver etc.


The hereafter mentioned diagnosis strategy is based on the detection via one of two methods, both cases being emissions relevant. Firstly the time to operative readiness shall be checked and secondly a statistical evaluation of the oxygen sensor ceramic temperature over a pre-defined number of monitoring cycles shall be carried out, whereby if the temperature should fall out of pre-set bounds a calibrateable number of times during the complete diagnosis cycle, a fault shall be detected as being present.

The oxygen sensor ceramic temperature shall be obtained indirectly via the measured internal resistance of the sensor.

The functionality of the diagnosis may be described in further detail below:

The diagnosis shall be carried out at least once per driving cycle or may be permitted to repeat, dependent on the status of flag LC\_OBD\_REP\_LSH\_UP. It shall be clear that only the temperature deviation detection method can repeat as the sensor warm-up phase is usually only carried out once per driving cycle. Due to the requirement, that "good" SAE values are only allowed to be written once per driving cycle (after decision only further bad case allowed), repeating the diag is restricted possible with bad case only. The diagnosis shall require a number of monitoring cycles to be carried out to permit statistical evaluation of the results. The function may set

The function shall be activated and deactivated dependent on the engine start state, denoted by flag LV\_ST\_END. Should the function be deactivated, the diagnosis conditions flags LV\_DIAG\_OBD\_CDN\_

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LSH\_UP[i], LV\_CDN\_DIAG\_OBD\_VLD\_LSH\_UP[i] and LV\_CDN\_DIAG\_TTIP\_MES\_LSH\_UP[i] and the SW internal timer *TIMER\_1* shall be reset and the diagnosis shall be considered to be Not Available

Additional application conditions shall be met prior to permitting monitoring cycles to take place:

- LC\_OBD\_LSH\_UP shall permit the diagnosis to be enabled or disabled from within the calibration system.
- LV\_INH\_DIAG\_OBD\_LSH\_UP[i] shall facilitate the interfacing of project specific application conditions.
- STATE\_LSH\_UP[i] shall neither be in LSH\_OFF nor LSH\_VB\_PROT. See following description for explanation.
- VB shall remain within bounds as indicated by LV\_VB\_CDN\_OBD\_2. This shall provide the facility to ensure that the battery voltage is sufficient to carry out OBD II diagnosis.
- LSHPWM\_UP[i] shall remain above or equal to C\_LSHPWM\_MIN\_LSH\_UP. This shall provide the facility to limit the performing of the diagnosis in a region where the sensor temperature can be controlled. No upper limit is given as should the heater become defective then the closed loop heater voltage controller will tend to drive the LSHPWM\_UP[i] to its maximum limit.
- The condition (LV\_DIAG\_OBD\_END\_LSH\_UP[i] = 0 or LC\_OBD\_REP\_LSH\_UP = 1) shall permit the diagnosis to be carried out once only per driving cycle (LC\_OBD\_REP\_LSH\_UP = 0) or continuously over the whole driving cycle (LC\_OBD\_REP\_LSH\_UP = 1). Note: Once a good case have been detected, continuous algorithm is only checking symptoms. (No further "good SAE values")
- The dew point shall have passed as denoted by LV\_TEMP\_DEW\_LS\_UP[i] = 1.


The function shall determine whether the full operative readiness LV\_LS\_UP\_READY[i] has been detected. If not, then the time to operative readiness detection method shall be carried out. Internal *TIMER\_1* shall be reset, the diagnosis conditions flag LV\_DIAG\_OBD\_CDN\_LSH\_UP[i] shall be set and the diagnosis shall be declared as being Available. Timer *T\_POW\_RISE\_LSH\_UP[i]* shall be checked against threshold *C\_T\_DLY\_LS\_UP\_READY\_OBD\_LSH\_UP*. Should it equal or exceed the threshold then the operative readiness has not been detected in a timely manner and the symptoms shall be set to *READY\_ERR*, fault flag LV\_DIAG\_OBD\_SYM\_LSH\_UP[i] and the error flags shall be set and the end of diagnosis flags shall be set. Because of writing the SAE values are only allowed once per driving cycle, setting of SAE values, LV\_DIAG\_OBD\_SYM\_LSH\_UP[i] and LV\_DIAG\_OBD\_END\_LSH\_UP is only done in case of no Symptom is already present.

In order to meet Mode 6 diagnosis requirements, the current oxygen sensor ceramic temperature shall be stored in *TTIP\_OBD\_LSH\_UP\_MES\_SAE[i]*. (This is used for the detection of the full operative readiness and hence may be used to meet the requirements). The Temperature limits come out of the Readiness check module. Therefore the SAE BOL and TOL are set accordingly.

Once the full operative readiness has been detected, further conditions shall be met prior to determining whether the oxygen sensor temperature falls within bounds, i.e. detection method two.

The function shall determine whether a time to operative readiness fault has been detected by observing LV\_DIAG\_OBD\_SYM\_LSH\_UP. Provided no error symptom is active, the function shall then wait for STATE\_LSH\_UP[i] to reach LSH\_POW\_CTL. Additionally the exhaust gas temperature shall exceed the limit *C\_TEG\_DYN\_MIN\_OBD\_LSH\_UP* to ensure that in long PUC phases sensor cooling does not lead to false error detection. After this condition has been met, the function shall await the delay *C\_T\_DLY\_POW\_CTL\_OBD\_LSH\_UP*. The delay provides the heater controller sufficient time to regulate the ceramic temperature to the set-point. Furthermore, this condition excludes states LSH\_VB\_PROT & LSH\_TEMP\_PROT. In both of these states, the heater power is reduced to prevent damage to the sensor. Under such conditions, it cannot be expected that the sensor temperature remain stable and hence OBDII heater diagnosis shall not be carried out in these instances. The SW internal timer used to await the delay shall be reset whenever STATE\_LSH\_UP[i] is no longer in LSH\_POW\_CTL or when the other above listed conditions are no longer met.

Additionally LV\_TTIP\_MES\_VLD\_LS\_UP[i] shall be set, indicating that the ceramic temperature computation is active. This is the case when either the normal operative readiness has been detected via the raw operative readiness and validated via the ceramic temperature or the conditional operative readiness has been detected (forced operative readiness). These conditions permit the use of the measured ceramic temperature (*TTIP\_MES\_LS\_UP[i]*) and not its initialised value (0 °C), i.e. the system tries to measure the ceramic temperature even if the heater fails sufficiently such that the normal operative

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readiness cannot be detected, where the oscillator used to measure the internal resistance and hence the ceramic temperature is only switched on when the sensor shows raw operative readiness. Note that during ceramic temperature reference measurements, the flag LV\_TTIP\_MES\_VLD\_LS\_UP[i] will be re-voled until the reference measurement cycle has been completed. The latter shall not cause TIMER\_1 to be reset.

Once the application conditions have been met, this shall be indicated by setting the flag LV\_DIAG\_OBD\_CDN\_LSH\_UP[i] and the function shall consider the diagnosis to be Available . Should the conditions not be met, then LV\_DIAG\_OBD\_CDN\_LSH\_UP[i] shall be reset and the diagnosis shall be considered to be Not Available .

The function shall implement a statistical approach to detect a weak sensor heater: If the temperature is outside calibrateable limits, an error accumulator shall be incremented either with normal steps or with large steps, depending on the temperature being above or below a limit where the sensor is not functional. If the temperature is in range, the accumulator shall be decremented slowly. If the accumulator has reached a limit, the diagnosis shall indicate that an error is present. A second increment-only accumulator shall run in parallel to indicate that the diagnosis is done in the "good" case, i.e. that a fault would have been detected if it was permanently present. The diagnosis shall stop once an error has been detected. For Mode \$06 SAE values the temperatures values must be stored. In "good" case (no error) the "TCC\_END\_DIAG\_OBD\_LSH\_UP" counter reaches the "C\_TCC\_THD\_ERR\_OBD\_LSH\_UP - limit" with the "TCC\_ERR\_OBD\_LSH\_UP"-counter still counting; even if the current temperature value is "out of good range". Therefore the last stored good temperature "TTIP\_MES\_OBD\_LSH\_UP\_IT" must be stored as SAE value. In "bad" case (error/symptom) the "TCC\_ERR\_OBD\_LSH\_UP" counter reaches the limit and SAE values as well as Symptom and end flags must be set.

TCC_END_DIAG_OBD_LSH_UP	TCC_ERR_OBD_LSH_UP	Requirement for SAE values	
Counting	Counting	Do not write	1
Reach calibrated Limit	Counting	Write last valid good TTIP	2
Counting	Reach calibrated Limit	Write TTIP (calibrated limit can only be reached if TTIP is out of Temp-Range)	3
Reach calibrated Limit	Reach calibrated Limit	Dto.	4

If the repeat flag LC\_OBD\_REP\_LSH\_UP\_i is not set, the diagnosis shall stop as soon as the increment-only accumulator has reached or exceeded the required value and the end flag is set. If not, the diagnosis keeps running, but the result shall not change anymore once an error has been indicated.

If the repeat flag LC\_OBD\_REP\_LSH\_UP is set, the diagnosis will:

- stop nevertheless in case of Symptom detected
- run only for Symptom detection in case of finished with good case.

### Application conditions:

#### Initialisation:

The following variables shall be initialised after reset, at the transition of ignition key on (i.e. LV\_IGK = 0 -> 1) and upon clearing of the error memory:

STATE\_SYM\_OBD\_LSL\_LSH\_UP[i] = 0

LV\_DIAG\_OBD\_SYM\_LSH\_UP[i] = 0

LV\_DIAG\_OBD\_CDN\_LSH\_UP[i] = 0

LV\_DIAG\_OBD\_END\_LSH\_UP[i] = 0

LV\_LAMB\_PLS\_REQ\_DIAG\_LSH\_UP[i] = 0

TCC\_ERR\_OBD\_LSH\_UP[i] = 0

TCC\_END\_DIAG\_OBD\_LSH\_UP[i] = 0

ACTION\_ERRM\_NoFilterReset( IN<NC\_IDX\_DIAG\_OBD\_VLD\_LSH\_UP[i]> ,

OUT<LV\_ERR\_OBD\_VLD\_LSH\_UP[i]> )

ACTION\_ERRM\_NoFilterReset( IN<NC\_IDX\_DIAG\_TTIP\_MES\_LSH\_UP[i]> ,

OUT<LV\_ERR\_ TTIP\_MES\_LSH\_UP[i]>)

### Reset all timers

**NOTE: timers refer to internal SW timer and not to output data variable.**

Initialisation at clearing error memory (FMY\_CLR:) or in case of EEPROM checksum error or in case of new ECU connection

The following variable shall be reset to physical "0" :

- TTIP\_OBD\_LSH\_UP\_MES\_BOL\_SAE[i]
- TTIP\_OBD\_LSH\_UP\_MES\_SAE[i]
- TTIP\_OBD\_LSH\_UP\_MES\_TOL\_SAE[i]
- TTIP\_MES\_OBD\_LSH\_UP\_IT[i]

### Recurrence:

The monitoring cycles shall occur every 100 ms providing the conditions are met.

Activation: "in all engine states"

### Formula section:

*Different datatype definitions can cause inconsistency between diagnosis and Service 06h output. Therefore internal copy is taken, to make sure that diagnosis uses same datatype as Service 06h*

TTIP\_LSH\_UP\_MES\_TMP[i] = TTIP\_MES\_LS\_UP[i]

```

If(1)      LV_ST_END = 1
and       LC_OBD_LSH_UP = 1
and       LV_INH_DIAG_OBD_LSH_UP[i] = 0
and       STATE_LSH_UP[i] <> LSH_OFF
and       STATE_LSH_UP[i] <> LSH_VB_PROT
and       STATE_LSH_UP[i] <> LSH_TEMP_PROT
and       LV_VB_CDN_OBD_2 = 1
and       C_LSHPWM_MIN_LSH_UP  LSHPWM_UP[i]
and       (LV_DIAG_OBD_END_LSH_UP[i] = 0
or        LC_OBD_REP_LSH_UP = 1)
and       LV_TEMP_DEW_LS_UP[i] = 1
then(1)

```

*% recognize both errors for delayed readiness*

LV\_CDN\_DIAG\_TTIP\_MES\_LSH\_UP[i] = 1

LV\_CDN\_DIAG\_OBD\_VLD\_LSH\_UP[i] = 1

**If(2)** LV\_LS\_UP\_READY[i] = 0

**then(2)Reset TIMER\_1**

LV\_DIAG\_OBD\_CDN\_LSH\_UP[i] = 1

**Diagnosis Available**

**If(3)** T\_POW\_RISE\_LSH\_UP[i]

C\_T\_DLY\_LS\_UP\_READY\_OBD\_LSH\_UP

**then(3)STATE\_SYM\_OBD\_LSL\_LSH\_UP[i] = READY\_ERR**

Symptom Oxygen sensor heater fault **READY\_ERR active**

**If(4)** (LV\_DIAG\_OBD\_SYM\_LSH\_UP = 0)//set SAE only in case no


Symptom up to now

**Then(4)**

// the SAE value is decremented for 1hex because of comparison for setting LV\_LS\_

READY is done

// with "=" and not with ">="

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```

TTIP_OBD_LSH_UP_MES_SAE[i] = TTIP_LSH_UP_MES_TMP[i] - 1hex
// limit at hex0
// note different datatype definitions in following assignment !
TTIP_OBD_LSH_UP_MES_BOL_SAE[i] = C_TTIP_MIN_LS_UP_READY //type conversion!
TTIP_OBD_LSH_UP_MES_TOL_SAE[i] = 6513.5; // set to physical max. limit !
LV_DIAG_OBD_SYM_LSH_UP[i] = 1
LV_DIAG_OBD_END_LSH_UP[i] = 1
endif(4)
endif(3)
else(2)
  if(3) LV_DIAG_OBD_SYM_LSH_UP[i] = 0
  and STATE_LSH_UP[i] = LSH_POW_CTL
  and TEG_DYN_LS_UP[i] > C_TEG_DYN_MIN_OBD_LSH_UP
  then(3)increment TIMER_1
    if(4) TIMER_1 C_T_DLY_POW_CTL_OBD_LSH_UP
    then(4)LV_DIAG_OBD_CDN_LSH_UP[i] = 1
      Diagnosis Available
      if(5) LV_TTIP_MES_VLD_LS_UP[i] = 1
      and LV_V_REF_VLD_R_IT_LS_UP[i] = 1
      then(5)
        if TCC_END_DIAG_OBD_LSH_UP[i]
          < C_TCC_THD_ERR_OBD_LSH_UP
          Then(6a) % don't exceed the threshold
          increment TCC_END_DIAG_OBD_LSH_UP[i]
          with C_TCC_ERR_INC_OBD_LSH_UP
          Endif(6a)
        if (C_TTIP_MAX_OBD_LSH_UP < TTIP_LSH_UP_MES_
TMP[i]
LSH_UP)
          or TTIP_LSH_UP_MES_TMP[i] < C_TTIP_MIN_OBD_
          then(6b) % symptom found. set state, , push error ctr.
          // badcase needs not to be stored. ...TMP value can be
taken below
          STATE_SYM_OBD_LSL_LSH_UP[i] = TTIP_ERR
          Symptom Oxygen sensor heater fault TTIP_ERR active
          if TTIP_MES_LS_UP[i] < C_TTIP_THD_IPLSL_
ACT_LS_UP
          then(7a) % pump current will be off, accelerated error recog-
          inition
          increment TCC_ERR_OBD_LSH_UP[i]
          with C_TCC_ERR_INC_OBD_LSH_UP_FAST
          % freeze at upper limit, don't wrap
          Else(7a) % normal error recognition
          increment TCC_ERR_OBD_LSH_UP[i]
          with C_TCC_ERR_INC_OBD_LSH_UP
          % freeze at upper limit, don't wrap
          Endif(7a)
          Else(6b) % no symptom. clear state, store "good" TTIP, roll back
          error ctr.
          TTIP_MES_OBD_LSH_UP_IT[i] =TTIP_LSH_UP_MES_
TMP[i];
          reset STATE_SYM_OBD_LSL_LSH_UP[i]

```

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```


Symptom Oxygen sensor heater fault TTIP_ERR pas-
sive

decrement TCC_ERR_OBD_LSH_UP[i]
% freeze at zero limit, don't wrap
Endif(6b)
If (TCC_END_DIAG_OBD_LSH_UP[i] >= C_TCC_THD_ERR_
OBD_LSH_UP)

Then(6c) % we have a result available
If ( (TCC_ERR_OBD_LSH_UP[i] < C_TCC_THD_ERR_
OBD_LSH_UP) and
(LV_DIAG_OBD_END_LSH_UP == 0) )
Then(7) // good result -> store corresponding SAE values
LV_DIAG_OBD_END_LSH_UP[i] = 1
TTIP_OBD_LSH_UP_MES_SAE[i] = TTIP_MES_
OBD_LSH_UP_IT[i];
TTIP_OBD_LSH_UP_MES_BOL_SAE[i] = C_TTIP_
MIN_OBD_LSH_UP;
TTIP_OBD_LSH_UP_MES_TOL_SAE[i] = C_TTIP_MAX_OBD_LSH_
UP
Endif(7)
Endif(6c)
If TCC_ERR_OBD_LSH_UP[i] >= C_TCC_THD_ERR_
OBD_LSH_UP

Then(6c) % an error was debounced
LV_DIAG_OBD_END_LSH_UP[i] = 1
LV_DIAG_OBD_SYM_LSH_UP[i] = 1
// update SAE values in case of error debounced
// Due to LV_DIAG_OBD_SYM_LSH_UP is an entry condi-
tion "if(3)" SAEs are set only once.
TTIP_OBD_LSH_UP_MES_SAE[i] = TTIP_LSH_UP_MES_
TMP[i]
TTIP_OBD_LSH_UP_MES_BOL_SAE[i] = C_TTIP_MIN_OBD_LSH_UP
TTIP_OBD_LSH_UP_MES_TOL_SAE[i] = C_TTIP_MAX_OBD_LSH_UP
Endif(6c)
else(5) Symptom Oxygen sensor heater fault TTIP_MES_ERR
active
STATE_SYM_OBD_LSL_LSH_UP[i] = TTIP_MES_ERR
Increment TIMER_2
If(6) TIMER_2 C_T_DLY_TTIP_MES_OBD_LSH_UP
then(6) LV_DIAG_OBD_SYM_LSH_UP[i] = 1
LV_DIAG_OBD_END_LSH_UP[i] = 1
// due to the fact that this error is caused by another error
// SAE value shall be at physical 0; cyclic writing of SAE
TTIP_OBD_LSH_UP_MES_SAE[i] = 0 // physical 0
TTIP_OBD_LSH_UP_MES_BOL_SAE[i] = C_TTIP_MIN_
OBD_LSH_UP
TTIP_OBD_LSH_UP_MES_TOL_SAE[i] = C_TTIP_MAX_OBD_LSH_UP
endif(6)
endif(5)
If(5) (LV_TTIP_MES_VLD_LS_UP[i] = 1->0
and Timer_3 = 0)

```

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```

        or          Timer_3 <> 0
        then(5)Increment TIMER_3
            If(6)          TIMER_3 C_T_DLY_TTIP_RES_OBD_LSH_UP
            then(7)Reset TIMER_2
                Reset TIMER_3
            endif(7)
        endif(5)
    else(4)Diagnosis Not Available
        LV_DIAG_OBD_CDN_LSH_UP[i] = 0
    endif(4)
else(3)          Reset TIMER_1
    LV_DIAG_OBD_CDN_LSH_UP[i] = 0
    Diagnosis Not Available
endif(3)
endif(2)
else(1)
    Reset TIMER_1
    LV_DIAG_OBD_CDN_LSH_UP[i] = 0
    % recognize both errors for delayed readiness
    LV_CDN_DIAG_TTIP_MES_LSH_UP[i] = 0
    LV_CDN_DIAG_OBD_VLD_LSH_UP[i] = 0
    Diagnosis Not Available
endif(1)

```

### Symptom Validation

```

% decide about general error. never reset in one driving cycle
ERR_SYM_TTIP_MES_LSH_UP[i] = STATE_SYM_OBD_LSL_LSH_UP[i]
If          LV_DIAG_OBD_END_LSH_UP[i] = 1
then(1b) % general tip temperature plausibility diagnosis is finished
    LV_END_DIAG_TTIP_MES_LSH_UP[i] = 1
    If          LV_DIAG_OBD_SYM_LSH_UP[i] = 1
    then(2b) % a failure is present
        LV_ERR_TTIP_MES_LSH_UP[i] = 1
    endif(2b)
endif(1b)

```

For failure and error management treatment the anti-bounce mechanism is called :

```

% if LV_ERR_XX=1 then LV_ERR_SET=1 or if LV_ERR_XX=0 then LV_ERR_RST=1
ACTION_ERRM_NoFilterSymptom( IN<NC_IDX_DIAG_OBD_VLD_LSH_UP [i]>, IN<LV_CDN_DIAG_
OBD_VLD_LSH_UP [i]>, IN<ERR_SYM_OBD_VLD_LSH_UP [i]>, IN<LV_ERR_SET_OBD_VLD_
LSH_UP [i]>, IN<LV_ERR_RST_OBD_VLD_LSH_UP [i]>, IN<LV_END_DIAG_OBD_VLD_LSH_UP
[i]>, OUT<LV_ERR_OBD_VLD_LSH_UP [i]> )

```

% now, if the OC diagnosis also has a result, decide about real heater error entry.

```

If          LV_END_DIAG_OC_LSL_UP[i] = 1
and        STATE_DIAG_OC_LSL_UP[i] <> "active"
then(1c) %hold back if open circuit debounce is going on
    LV_END_DIAG_OBD_VLD_LSH_UP[i] = 1
    If          LV_ERR_TTIP_MES_LSH_UP[i] = 0
    or          LV_ERR_OC_LSL_UP[i] = 1
    then(2c) % no failure present or failure is due to an open circuit
        LV_ERR_OBD_VLD_LSH_UP[i] = 0
        ERR_SYM_OBD_VLD_LSH_UP[i] = No symptom
    endif(2c)
endif(1c)

```

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```

else(2c) % a real heater failure is present
    LV_ERR_OBD_VLD_LSH_UP[i] = 1
    ERR_SYM_OBD_VLD_LSH_UP[i] = STATE_SYM_OBD_LSL_LSH_UP[i]
endif(2c)

```

**endif(1c)**

For failure and error management treatment the anti-bounce mechanism is called :


*% if LV\_ERR\_XX=1 then LV\_ERR\_SET=1 or if LV\_ERR\_XX=0 then LV\_ERR\_RST=1*

```

ACTION_ERRM_NoFilterSymptom( IN<NC_IDX_DIAG_TTIP_MES_LSH_UP[i]>, IN<LV_CDN_DIAG_
TTIP_MES_LSH_UP[i]>, IN<ERR_SYM_TTIP_MES_LSH_UP[i]>, IN<LV_ERR_SET_TTIP_MES_
LSH_UP[i]>, IN<LV_ERR_RST_TTIP_MES_LSH_UP[i]>, IN<LV_END_DIAG_TTIP_MES_LSH_UP[i]>,
OUT<LV_ERR_TTIP_MES_LSH_UP[i]> )

```

The calibration of the anti-bounce is defined in the chapter Diagnosis information .

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## B.43 O2 sensor (up, down) diagnosis management

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Final diagnostic of the downstream oxygen sensor					
LV_ERR_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Final diagnostic of the upstream oxygen sensor					
LV_LS_DOWN_DIAG_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Collecting end flag for the diagnosis functions of the downstream oxygen sensor					
LV_LS_DOWN_OBD_1_MAN_DEAC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable indicating manual deactivation of all OBD1 diagnosis for downstream oxygen sensor					
LV_LS_DOWN_OBD_2_MAN_DEAC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable indicating manual deactivation of all OBD2 diagnosis for downstream oxygen sensor					
LV_LS_UP_DIAG_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Sum end bit of upstream oxygen sensor diagnosis functions					
LV_LS_UP_OBD_1_MAN_DEAC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable indicating manual deactivation of all OBD1 diagnosis for upstream oxygen sensor					
LV_LS_UP_OBD_2_MAN_DEAC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable indicating manual deactivation of all OBD2 diagnosis for upstream oxygen sensor					

### Input data:

LC_DIAG_PUE_ACT_LS_ DOWN {p. 5191}	LV_END_DIAG_AIR_LSL_ UP [NC_CBK_EX_NR] {p. 5282}	LV_END_DIAG_CHG_LS_ DOWN {p. 5388}	LV_END_DIAG_CHG_LS_ UP {p. 5416}
LV_END_DIAG_CHK_LS_ DOWN [NC_CBK_EX_NR] {p. 5388}	LV_END_DIAG_DYN_ VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_END_DIAG_EL_LSL_ UP [NC_CBK_EX_NR] {p. 4293}	LV_END_DIAG_FL_LS_ DOWN [NC_CBK_EX_NR] {p. 4275}
LV_END_DIAG_LSH_ DOWN [NC_CBK_EX_NR] {p. 4248}	LV_END_DIAG_LSH_LSL_ UP [NC_CBK_EX_NR] {p. 5276}	LV_END_DIAG_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_END_DIAG_LSL_UP_ IF [NC_CBK_EX_NR] {p. 4285}
LV_END_DIAG_OBD_ LSH_DOWN [NC_CBK_EX_NR] {p. 5198}	LV_END_DIAG_OBD_ VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_END_DIAG_OC_LS_ DOWN [NC_CBK_EX_NR] {p. 4266}	LV_END_DIAG_OC_LSL_ UP [NC_CBK_EX_NR] {p. 4300}
LV_END_DIAG_PUC_LS_ DOWN [NC_CBK_EX_NR] {p. 4275}	LV_END_DIAG_PUC_ VLD_LS_UP [NC_CBK_EX_NR] {p. 5297}	LV_END_DIAG_PUE_LS_ DOWN [NC_CBK_EX_NR] {p. 5169}	LV_END_DIAG_SCG_LS_ DOWN [NC_CBK_EX_NR] {p. 4267}
LV_END_DIAG_SCP_LS_ DOWN [NC_CBK_EX_NR] {p. 4267}	LV_END_DIAG_SHIFT_ AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_END_DIAG_SHIFT_ AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_END_DIAG_SWT_LS_ DOWN [NC_CBK_EX_NR] {p. 5152}

LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_CHG_LS_DOWN {p. 5388}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CHK_LS_DOWN [NC_CBK_EX_NR] {p. 5388}
LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}
LV_ERR_LSH_LSL_UP [NC_CBK_EX_NR] {p. 5276}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5198}
LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_PLAUS_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_ERR_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5297}
LV_ERR_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5169}	LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SWT_LS_DOWN [NC_CBK_EX_NR] {p. 5152}
LV_IGK {p. 906}	LV_LS_DOWN_OBD_MAN_DEAC_EXT {p. 5457}	LV_LS_UP_OBD_MAN_DEAC_EXT {p. 5457}	LV_ST_END {p. 1720}
NC_CBK_EX_NR {p. 1829}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NR_END_DIAG_LS_DOWN [NC_CBK_EX_NR]	-	0... FFFFH	0... 65535	1	-
Bit mask to select the consideration of a certain end flag for the final end flag					
C_NR_END_DIAG_LSL_UP [NC_CBK_EX_NR]	-	0... FFFFH	0... 65535	1	-
Bit mask to select the consideration of a certain end flag for the final end flag					
LC_ERR_CHG_LS_DOWN	-	0... 1H	0 ...1	1	-
Allow Sensor Interchanged Fault to be considered as Sensor Failure (in case of 1)					
LC_ERR_CHG_LS_UP	-	0... 1H	0 ...1	1	-
Allow Sensor Interchanged Fault to be considered as Sensor Failure (stops closed loop AF control)					
LC_ERR_DYN_VLD_LS_UP	-	0... 1H	0 ...1	1	-
Allow Sensor Dynamic Fault to be considered as Sensor Failure (stops closed loop AF control)					
LC_LS_DOWN_DIAG_ACT [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Activation bit for downstream oxygen sensor final diagnosis					
LC_LS_DOWN_ERR [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Opportunity for manual setting of LV_ERR_LS_DOWN[i] = 1					
LC_LS_DOWN_OBD_1_MAN_DEAC [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Logical calibration data for manual deactivation of all OBD1 diagnosis for downstream oxygen sensor					
LC_LS_DOWN_OBD_2_MAN_DEAC [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Logical calibration data for manual deactivation of all OBD2 diagnosis for downstream oxygen sensor					
LC_LS_UP_DIAG_ACT [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Activation bit for upstream oxygen sensor final diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_LS_UP_ERR [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Opportunity for manual setting of LV_ERR_LS_UP[i] = 1					
LC_LS_UP_OBD_1_MAN_DEAC [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Logical calibration data for manual deactivation of all OBD1 diagnosis for upstream oxygen sensor					
LC_LS_UP_OBD_2_MAN_DEAC [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Logical calibration data for manual deactivation of all OBD2 diagnosis for upstream oxygen sensor					

## B.43.1 Upstream O2 sensor final diagnosis

### FUNCTION DESCRIPTION:

#### General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank.

This function shall summarize the diagnostic status of the upstream oxygen sensor delivered from the OBD I & II functions (heater and sensor) through the flag LV\_ERR\_LS\_UP[i].

The ultimate error flag LV\_ERR\_LS\_UP[i] is a component error and no DTC shall be sent to the Error Management.

To reduce the number of variables to be checked by other diagnosis functions, the collecting flag LV\_LS\_UP\_DIAG\_END is introduced. It provides the possibility to combine the end flags from almost all the upstream linear lambda sensor diagnosis functions. By a bit mask variable it is calibratable which end flag contributes to the collecting end flag.

#### Note:

1. If two separate Banks are concerned, then  $i=1$  for cylinder bank 1 and  $i=2$  for cylinder bank 2.

### Application conditions

#### Initialisation:

At LV\_IGK = 0 to 1, reset orat clearing error memory:

LV\_ERR\_LS\_UP[i] = 0


LV\_LS\_UP\_OBD\_1\_MAN\_DEAC[i] = 0

LV\_LS\_UP\_OBD\_2\_MAN\_DEAC[i] = 0

LV\_LS\_UP\_DIAG\_END[i] = 0

#### Recurrence:

The function should be carried out once every 100 ms.

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**Activation/Deactivation:**

The diagnosis will be carried out if LV\_ST\_END = 1

**Formula section:**

```

If                LV_LS_UP_OBD_MAN_DEAC_EXT = 1
Then             LV_LS_UP_OBD_1_MAN_DEAC[i] = 1
                   LV_LS_UP_OBD_2_MAN_DEAC[i] = 1
Else
                   LV_LS_UP_OBD_1_MAN_DEAC[i] = LC_LS_UP_OBD_1_MAN_DEAC[i];
                   LV_LS_UP_OBD_2_MAN_DEAC[i] = LC_LS_UP_OBD_2_MAN_DEAC[i];
Endif

```

**The linear lambda sensor error flag shall be set under the following conditions:**

```

IF
  LC_LS_UP_DIAG_ACT[i] = 1    % activation of final diagnosis           AND
( LV_ERR_EL_LSL_UP[i] = 1    % electrical failure                     OR
  LV_ERR_OC_LSL_UP[i] = 1    % open circuit failure                   OR
  LV_ERR_LSL_UP_IF[i] = 1    % linear sensor controller failure       OR

  LV_ERR_LSH_UP[i] = 1        % heater electrical failure             OR
  LV_ERR_OBD_VLD_LSH_UP[i] = 1 % heater controller failure           OR
  LV_ERR_LSH_LSL_UP[i] = 1    % heater to sensor signal coupling failure OR

  LV_ERR_AIR_LSL_UP[i] = 1    % sensor not mounted in exhaust pipe    OR
  LV_ERR_PUC_VLD_LS_UP[i]= 1  % sensor charact. line slope failure    OR
  LV_ERR_SHIFT_AFL_LSL_UP[i]= 1 % sensor charact. line shift to lean failure OR
  LV_ERR_SHIFT_AFR_LSL_UP[i]= 1 % sensor charact. line shift to rich failure OR

  LV_ERR_DYN_VLD_LS_UP[i]=1 & LC_ERR_DYN_VLD_LS_UP = 1           OR
    % sensor dynamic failure (allowed by the project to stop closed loop control)
  LV_ERR_CHG_LS_UP =1 & LC_ERR_CHG_LS_UP = 1                       OR
    % sensor interchanged failure (allowed by the project to stop closed loop control)

  LC_LS_UP_ERR[i] = 1      )    % manual activation of lambda sensor error
THEN
  LV_ERR_LS_UP[i] = 1
ELSE
  LV_ERR_LS_UP[i] = 0
ENDIF

```

**The general end flag is created according to the following logic:**

If the corresponding bit is one, the LV\_END\_DIAG\_XX flag shall be considered for the final end flag.

Bit position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Bit mask variable (example) C_NR_END_DIAG_LSL_UP[i]	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
	Not used	Not used	Not used	Not used	LV_END_DIAG_CHG_LS_UP	LV_END_DIAG_AIR_LSL_UP[i]	LV_END_DIAG_LSH_LSL_UP[i]	LV_END_DIAG_PUC_VLD_LS_UP[i]	LV_END_DIAG_SHIFT_AFR_LSL_UP[i]	LV_END_DIAG_SHIFT_AFL_LSL_UP[i]	LV_END_DIAG_DYN_VLD_LS_UP[i]	LV_END_DIAG_OBD_VLD_LSH_UP[i]	LV_END_DIAG_LSL_UP_IF[i]	LV_END_DIAG_OC_LSL_UP[i]	LV_END_DIAG_EL_LSL_UP[i]	LV_END_DIAG_LSH_UP[i]

For this proposal, the number would be 0000011111111111 binary = 2047 decimal. All end flags except the one from the interchanged diagnosis must be set to 1 to also set the final end flag to 1.

The bitmask shall be combined with the single end flags as follows:

**if** [(C\_NR\_END\_DIAG\_LSL\_UP[i].bit 0 = 0 **or** LV\_END\_DIAG\_LSH\_UP[i] = 1)  
**and**  
(C\_NR\_END\_DIAG\_LSL\_UP[i].bit 1 = 0 **or** LV\_END\_DIAG\_EL\_LSL\_UP[i] = 1)  
**and**  
(C\_NR\_END\_DIAG\_LSL\_UP[i].bit 2 = 0 **or** LV\_END\_DIAG\_OC\_LSL\_UP[i] = 1)  
**and**  
(C\_NR\_END\_DIAG\_LSL\_UP[i].bit 3 = 0 **or** LV\_END\_DIAG\_LSL\_UP\_IF[i] = 1)  
**and**  
(C\_NR\_END\_DIAG\_LSL\_UP[i].bit 4 = 0 **or** LV\_END\_DIAG\_OBD\_VLD\_LSH\_UP[i] = 1)  
**and**  
(C\_NR\_END\_DIAG\_LSL\_UP[i].bit 5 = 0 **or** LV\_END\_DIAG\_DYN\_VLD\_LS\_UP[i] = 1)  
**and**  
(C\_NR\_END\_DIAG\_LSL\_UP[i].bit 6 = 0 **or** LV\_END\_DIAG\_SHIFT\_AFL\_LSL\_UP[i]=1)  
**and**  
(C\_NR\_END\_DIAG\_LSL\_UP[i].bit 7 = 0 **or** LV\_END\_DIAG\_SHIFT\_AFR\_LSL\_UP[i]=1)  
**and**  
(C\_NR\_END\_DIAG\_LSL\_UP[i].bit 8 = 0 **or** LV\_END\_DIAG\_PUC\_VLD\_LS\_UP[i] = 1)  
**and**  
(C\_NR\_END\_DIAG\_LSL\_UP[i].bit 9 = 0 **or** LV\_END\_DIAG\_LSH\_LSL\_UP[i] = 1)  
**and**  
(C\_NR\_END\_DIAG\_LSL\_UP[i].bit 10 = 0 **or** LV\_END\_DIAG\_AIR\_LSL\_UP[i] = 1)  
**and**  
(C\_NR\_END\_DIAG\_LSL\_UP[i].bit 11 = 0 **or** LV\_END\_DIAG\_CHG\_LS\_UP = 1)

**then**  
LV\_LS\_UP\_DIAG\_END[i] = 1

**else**  
LV\_LS\_UP\_DIAG\_END[i] = 0

**endif**

## B.43.2 Downstream O2 sensor final diagnosis

### FUNCTION DESCRIPTION:

#### General information:

This function shall summarize the diagnostic status of the downstream oxygen sensor delivered from the OBD I & II (heater and sensor) functions through the flag LV\_ERR\_LS\_DOWN[i].

The ultimate error flag LV\_ERR\_LS\_DOWN[i] is a System Error Flag. It should neither be saved in the Error Management nor a DTC code should be given.

To reduce the number of variables to be checked by other diagnosis functions, the collecting flag LV\_LS\_DOWN\_DIAG\_END is introduced. It provides the possibility to combine the end flags from almost all the downstream lambda sensor diagnosis functions. By a bit mask variable it is calibratable which end flag contributes to the collecting end flag.

#### **Note:**

1. If two separate Banks are concerned, then  $i=1$  for cylinder bank 1 and  $i=2$  for cylinder bank 2.
2. The diagnosis for interchanged lambda sensors is not included in the final error and end flag as this is mainly related to the End of Line test or to a final check after a repair in the garage.

### Application conditions

#### **Initialisation:**

At LV\_IGK = 0 to 1, reset **or**at clearing error memory:

```
LV_ERR_LS_DOWN[i] = 0
LV_LS_DOWN_OBD_1_MAN_DEAC[i] = 0
LV_LS_DOWN_OBD_2_MAN_DEAC[i] = 0
LV_LS_DOWN_DIAG_END[i] = 0
```

#### *Recurrence:*

The function should be carried out once every 100 ms.

#### *Activation /Deactivation:*

The diagnosis will be carried out only if LV\_ST\_END = 1

### Formula section:


```
If                LV_LS_DOWN_OBD_MAN_DEAC_EXT = 1
Then             LV_LS_DOWN_OBD_1_MAN_DEAC[i] = 1
                   LV_LS_DOWN_OBD_2_MAN_DEAC[i] = 1
```

#### **Else**

```
LV_LS_DOWN_OBD_1_MAN_DEAC[i] = LC_LS_DOWN_OBD_1_MAN_DEAC[i]
LV_LS_DOWN_OBD_2_MAN_DEAC[i] = LC_LS_DOWN_OBD_2_MAN_DEAC[i]
```

**Endif**

### Calculation of sum error bit for downstream oxygen sensor diagnosis

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**IF**

LC\_LS\_DOWN\_DIAG\_ACT[i] = 1

% final diagnosis active

( LV\_ERR\_EL\_LS\_DOWN[i] = 1

% electrical failure

LV\_ERR\_SWT\_LS\_DOWN[i] = 1

% switching time rich-to-lean

failure

**OR**

( LV\_ERR\_PUE\_LS\_DOWN[i] = 1

% sensor signal after PUC

phase failure

**AND**

LC\_DIAG\_PUE\_ACT\_LS\_DOWN)

LV\_ERR\_CHK\_LS\_DOWN[i] = 1

% error detected by the active

test

**OR**LV\_ERR\_PLAUS\_LS\_DOWN[i] = 1 % error detected by the passive test **OR**LV\_ERR\_LSH\_DOWN[i] = 1 % heater electrical failure **OR**LV\_ERR\_OBD\_LSH\_DOWN[i] = 1 % heater obd2 failure **OR**

( LV\_ERR\_CHG\_LS\_DOWN = 1 &amp; LC\_ERR\_CHG\_LS\_DOWN = 1 )

**OR**

% sensor interchanged failure

LC\_LS\_DOWN\_ERR[i] = 1 ) % manual activation of sensor error

**THEN**

LV\_ERR\_LS\_DOWN[i] = 1

**ELSE**

LV\_ERR\_LS\_DOWN[i] = 0

**ENDIF****The general end flag is created according to the following logic:**


If the corresponding bit is one, the LV\_END\_DIAG\_XX flag shall be considered for the final end flag.

Bit position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Bit mask variable (example) C_NR_END_DIAG_LS_DOW N[i]	0	0	0	0	0	0	0	1	1	1	0	1	1	1	1	1
	Not used	Not used	Not used	Not used	Not used	LV_END_DIAG_CHG_LS_DOW	LV_END_DIAG_PUE_LS_DOWN[i]	LV_END_DIAG_SWT_LS_DOWN[i]	LV_END_DIAG_CHK_LS_DOWN[i]	LV_END_DIAG_PUC_LS_DOWN[i]	LV_END_DIAG_FL_LS_DOWN[i]	LV_END_DIAG_OC_LS_DOWN[i]	LV_END_DIAG_SCG_LS_DOWN[i]	LV_END_DIAG_SCP_LS_DOWN[i]	LV_END_DIAG_OBD_LSH_DOWN[i]	LV_END_DIAG_LSH_DOWN[i]

For this proposal, the number would be 000000111011111 binary = 479 decimal.

The bitmask shall be combined with the single end flags as follows:


**If** [(C\_NR\_END\_DIAG\_LS\_DOWN[i].bit 0 = 0 or LV\_END\_DIAG\_LSH\_DOWN[i] = 1)

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```

and
(C_NR_END_DIAG_LS_DOWN[i].bit 1 = 0 or LV_END_DIAG_OBD_LSH_DOWN[i] = 1)
and
(C_NR_END_DIAG_LS_DOWN[i].bit 2 = 0 or LV_END_DIAG_SCP_LS_DOWN[i] = 1)
and
(C_NR_END_DIAG_LS_DOWN[i].bit 3 = 0 or LV_END_DIAG_SCG_LS_DOWN[i] = 1)
and
(C_NR_END_DIAG_LS_DOWN[i].bit 4 = 0 or LV_END_DIAG_OC_LS_DOWN[i] = 1)
and
(C_NR_END_DIAG_LS_DOWN[i].bit 5 = 0 or LV_END_DIAG_FL_LS_DOWN[i] = 1)
and
(C_NR_END_DIAG_LS_DOWN[i].bit 6 = 0 or LV_END_DIAG_PUC_LS_DOWN[i] = 1)
and
(C_NR_END_DIAG_LS_DOWN[i].bit 7 = 0 or LV_END_DIAG_CHK_LS_DOWN[i] = 1)
and
(C_NR_END_DIAG_LS_DOWN[i].bit 8 = 0 or LV_END_DIAG_SWT_LS_DOWN[i] = 1)
and
(C_NR_END_DIAG_LS_DOWN[i].bit 9 = 0 or LV_END_DIAG_PUE_LS_DOWN[i] = 1)
and
(C_NR_END_DIAG_LS_DOWN[i].bit 10 = 0 or LV_END_DIAG_CHG_LS_DOWN = 1)
then
LV_LS_DOWN_DIAG_END[i] = 1
else
LV_LS_DOWN_DIAG_END[i] = 0
endif

```

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## B.44 O2 sensor (up, down) diagnosis management (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LS_DOWN_OBD_MAN_DEAC_EXT	O/V	0... 1H	0 ...1	1	-
Downstream Oxygen Sensor Diagnosis deactivation for all banks					
LV_LS_UP_OBD_MAN_DEAC_EXT	O/V	0... 1H	0 ...1	1	-
Upstream WRAF Sensor Diagnosis deactivation for all banks					

### Input data:

LV_VAR_LSH_DOWN {p. 656}	LV_VAR_LSH_UP {p. 656}		
-----------------------------	------------------------	--	--

### B.44.1 General inhibition of all upstream oxygen sensor diagnosis for systems without lambda-sensors

#### FUNCTION DESCRIPTION:

#### General information:

This function serves to be able to deactivate all WRAF Sensor Diagnosis functions with one flag. If the variant "Lambda-sensors" is not learnt then all upstream-diagnosis are inhibited.

#### Application conditions

**Initialisation after reset:** LV\_LS\_UP\_OBD\_MAN\_DEAC\_EXT =! LV\_VAR\_LSH\_UP

**Recurrence:** The function should be carried out once every 1000 ms.

**Activation:** LV\_IGK = 1

**Deactivation:** LV\_IGK = 0

#### Formula section:

LV\_LS\_UP\_OBD\_MAN\_DEAC\_EXT =! LV\_VAR\_LSH\_UP

### B.44.2 General inhibition of all downstream oxygen sensor diagnosis for systems without lambda-sensors

#### FUNCTION DESCRIPTION:

#### General information:

This function serves to be able to deactivate all Downstream Oxygen Sensor Diagnosis functions with one flag. If the variant "Lambda-sensors" is not learnt then all downstream-diagnosis are inhibited.

**Application conditions**

**Initialisation after reset:** LV\_LS\_DOWN\_OBD\_MAN\_DEAC\_EXT **≠!** LV\_VAR\_LSH\_DOWN


**Recurrence:** The function should be carried out once every 1000 ms.

**Activation:** LV\_IGK = 1

**Deactivation:** LV\_IGK = 0

**Formula section:**

LV\_LS\_DOWN\_OBD\_MAN\_DEAC\_EXT **≠!** LV\_VAR\_LSH\_DOWN

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## B.45 Activation conditions for catalyst efficiency diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CAT_DIAG_CDN_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation conditions for O2 sensor and catalyst efficiency diagnosis (OSC method)					
MAF_INT_DLY_CAT_DIAG [NC_CBK_EX_NR]	V	0... FFFFH	0 ...1	0.02222222	g
Air mass flow integral after conditions are fulfilled for catalyst diagnosis activation					

### Input data:

AMP_AD {p. 982}	CL_MMV {p. 3698}	LV_CAT_DIAG_REQ_EOL {p. 799}	LV_CAT_LDC [NC_CBK_EX_NR] {p. 5542}
LV_CAT_PURGE_ACT [NC_CBK_EX_NR] {p. 2927}	LV_CL_CLC_AVL {p. 3635}	LV_DC {p. 5746}	LV_LAM_ADJ_RNG_VLD_ CAT_DIAG [NC_CBK_EX_NR] {p. 1037}
LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}	LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}
LV_SAWUP {p. 804}	MAF {p. 8277}	MAF_CYL {p. 8277}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	STATE_CP {p. 3637}	STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}	TCO {p. 1100}
TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	VS {p. 1176}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_MIN_CAT	-	0... FFFFH	0... 5434	0.08291752	hPa
Min. ambient pressure threshold					
C_CL_MAX_CAT	-	0... FFFFH	0... 1.99996948	305.176e3	-
Maximum canister load to allow catalyst and O2 sensor diagnosis					
C_MAF_HYS_CAT	-	0... FFFFH	0... 1389	0.02119478	mg/stk
hysteresis after exceeding MAF_LAM_CAT threshold					
C_MAF_INT_DLY_CAT_DIAG	-	0... FFFFH	0 ...1	0.02222222	g
Air mass flow threshold for cat diag activation after PUC, CL max purge, forced stimulation on, downstream sensor ready					
C_MAF_INT_SW_CAT_DIAG	-	0... FFFFH	0 ...1	0.02222222	g
Air mass flow initial for cat diag activation after MAX to NO_PURGE and back					
C_TCO_MIN_CAT	-	0... FEH	0... 142.5	0.75	°C
Min TCO threshold					
C_TEMP_HYS_CAT	-	0... FFH	0... 1766.85	8	°C
hysteresis after exceeding catalyst temperature threshold for catalyst diagnosis activation					
C_TEMP_MAX_CAT	-	0... FFH	0... 1766.85	8	°C
max. catalyst temperature threshold for catalyst diagnosis activation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TEMP_MIN_CAT	-	0... FFH	0... 1766.85	8	°C
min. catalyst temperature threshold for catalyst diagnosis activation					
C_TEMP_MIN_CAT_EOL	-	0... FFH	0... 1766.85	8	°C
min. catalyst temperature threshold for catalyst diagnosis activation in case of EOL test					
C_VS_MAX_CAT	-	0... FFH	0... 255	1	km/h
max. VS threshold					
C_VS_MIN_CAT	-	0... FFH	0... 255	1	km/h
min. VS threshold					
IP_MAF_MAX_CAT	-	0... FFFFH	0... 1389	0.02119478	mg/stk
LDPM_N_32_3_EGTR	6	0... FFH	0... 8160	32	rpm
max. MAF threshold for catalyst diagnosis activation					
IP_MAF_MIN_CAT	-	0... FFFFH	0... 1389	0.02119478	mg/stk
LDPM_N_32_3_EGTR	6	0... FFH	0... 8160	32	rpm
min. MAF threshold for catalyst diagnosis activation					
LC_CAT_DIAG_CDN_ACT_MAN	-	0... 1H	0 ...1	1	-
flag to set catalyst diagnosis condition manually					

### B.45.1 EGTR\_FCTDGCEFAC0

This function determines the activation flag LV\_CAT\_DIAG\_CDN\_ACT[i] for catalyst efficiency diagnosis (OSC method). This flag can be also be set manually by LC\_CAT\_DIAG\_CDN\_ACT\_MAN.

The recurrence time is defined by T\_SAMPLE in [ms].

NC\_CBK\_EX\_NR defines the number of exhaust banks.

For vector elements, the variable extension `_i` is used in the model instead of `[i]` as found in the textual description.

For the calculation of the air mass flow integral the unit conversion:

$$[g] = [kg/h] * [ms] * [(g*h)/(kg*ms)] / 3600$$

has to be considered.

#### Application Condition

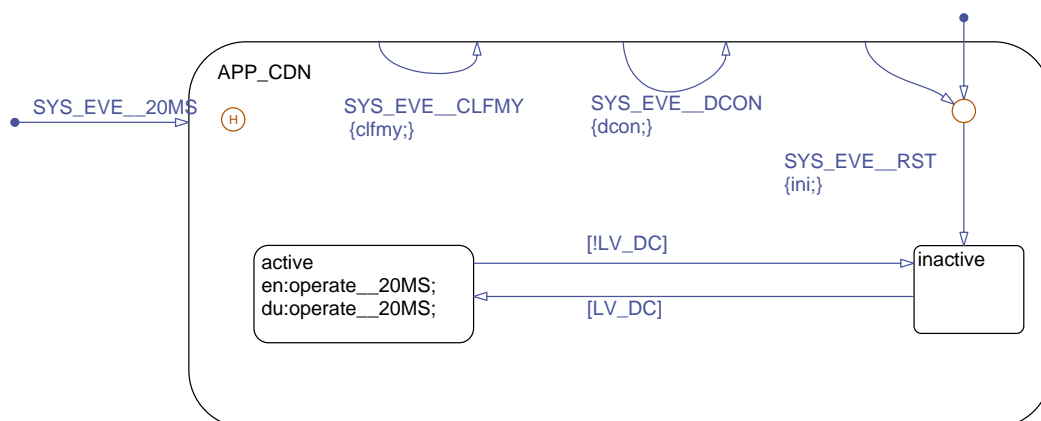



Figure B.45.1: EGTR\_FCTDGCEFAC0/APP\_CDN/APP\_CDN

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**Function Description**

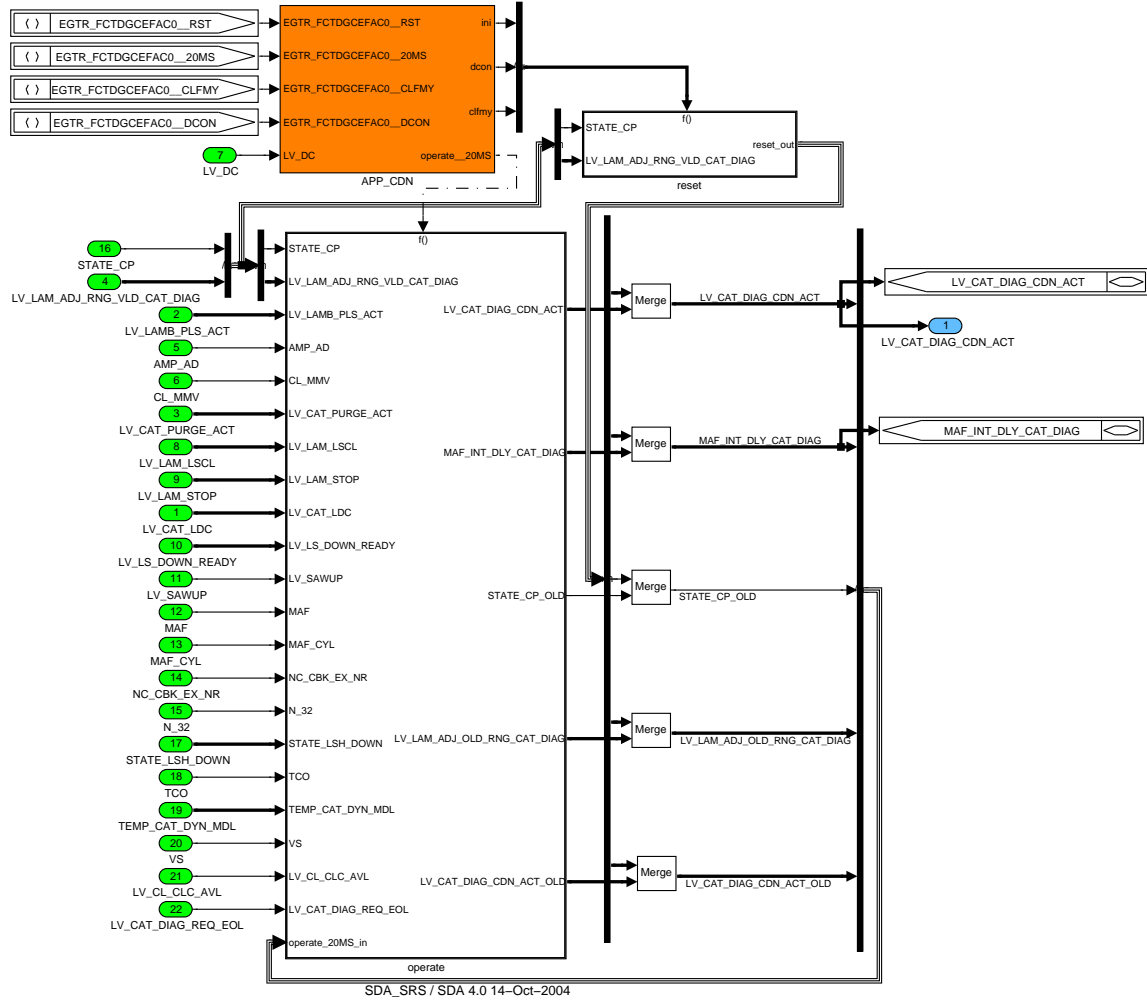


Figure B.45.2: EGTR\_FCTDGCEFAC0

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### B.45.1.1 SUBFUNCTION: operate

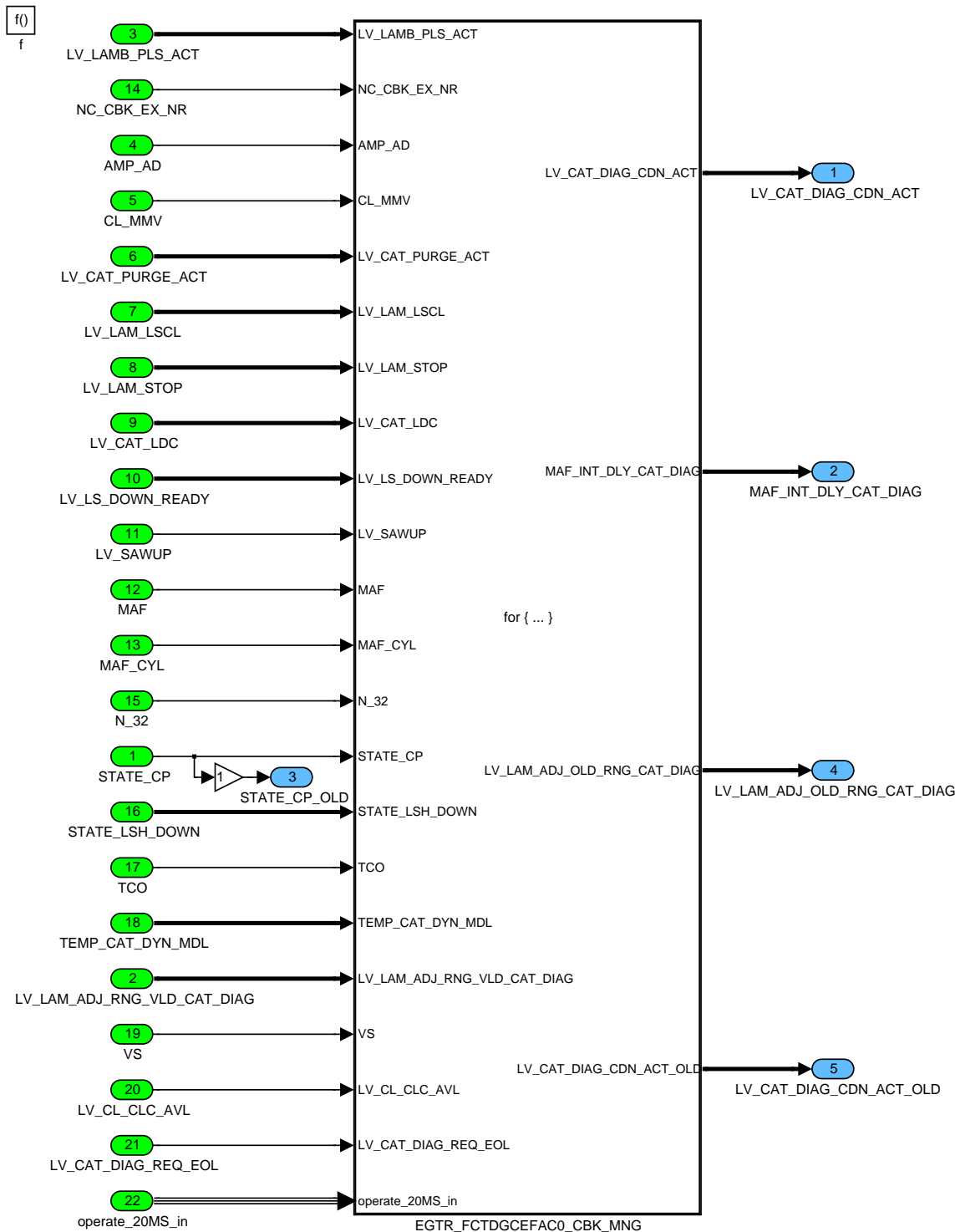


Figure B.45.3: EGTR\_FCTDGCEFAC0/operate

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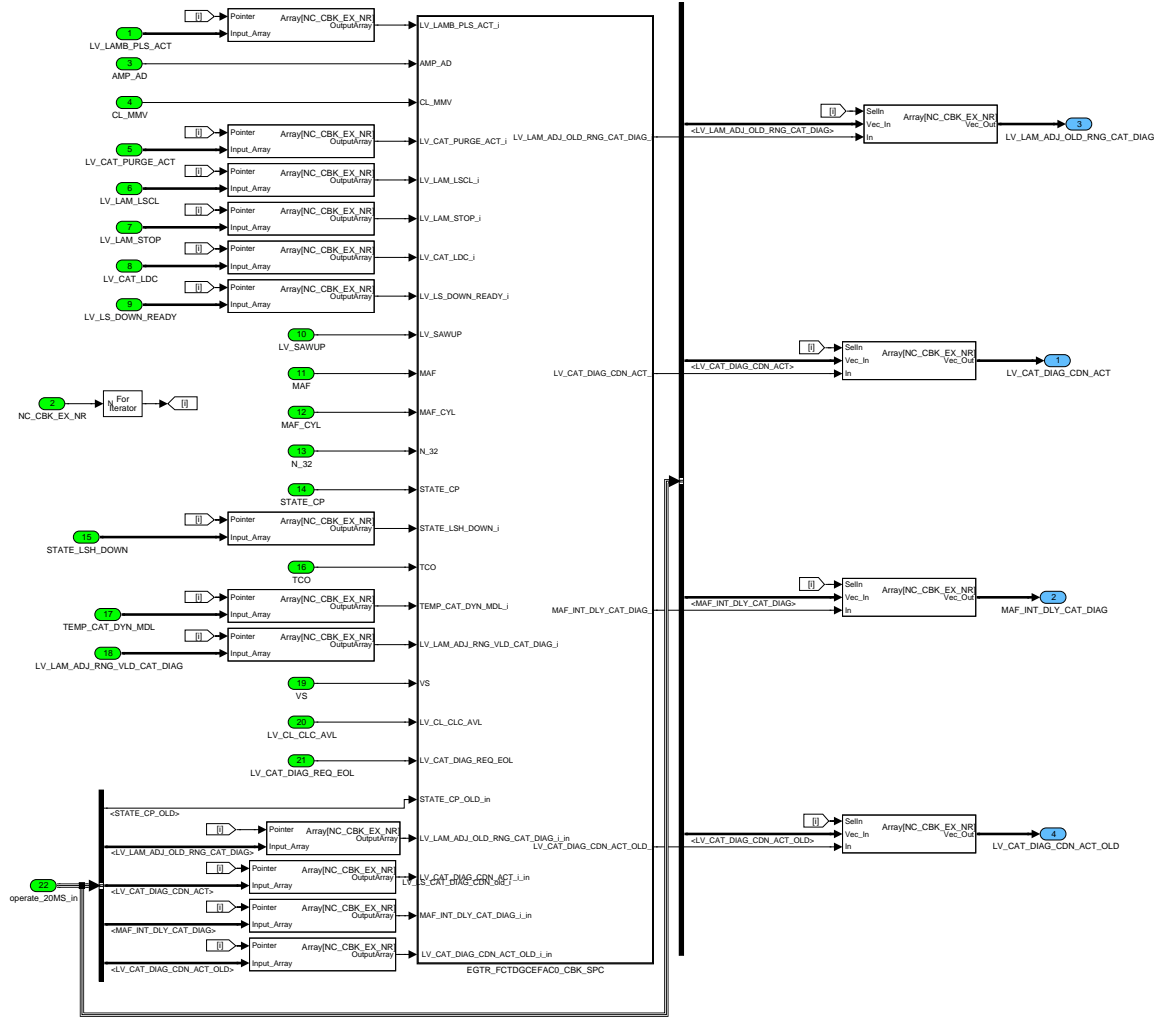


Figure B.45.4: EGTR\_FCTDGCEFAC0/operate/EGTR\_FCTDGCEFAC0\_CBK\_MNG

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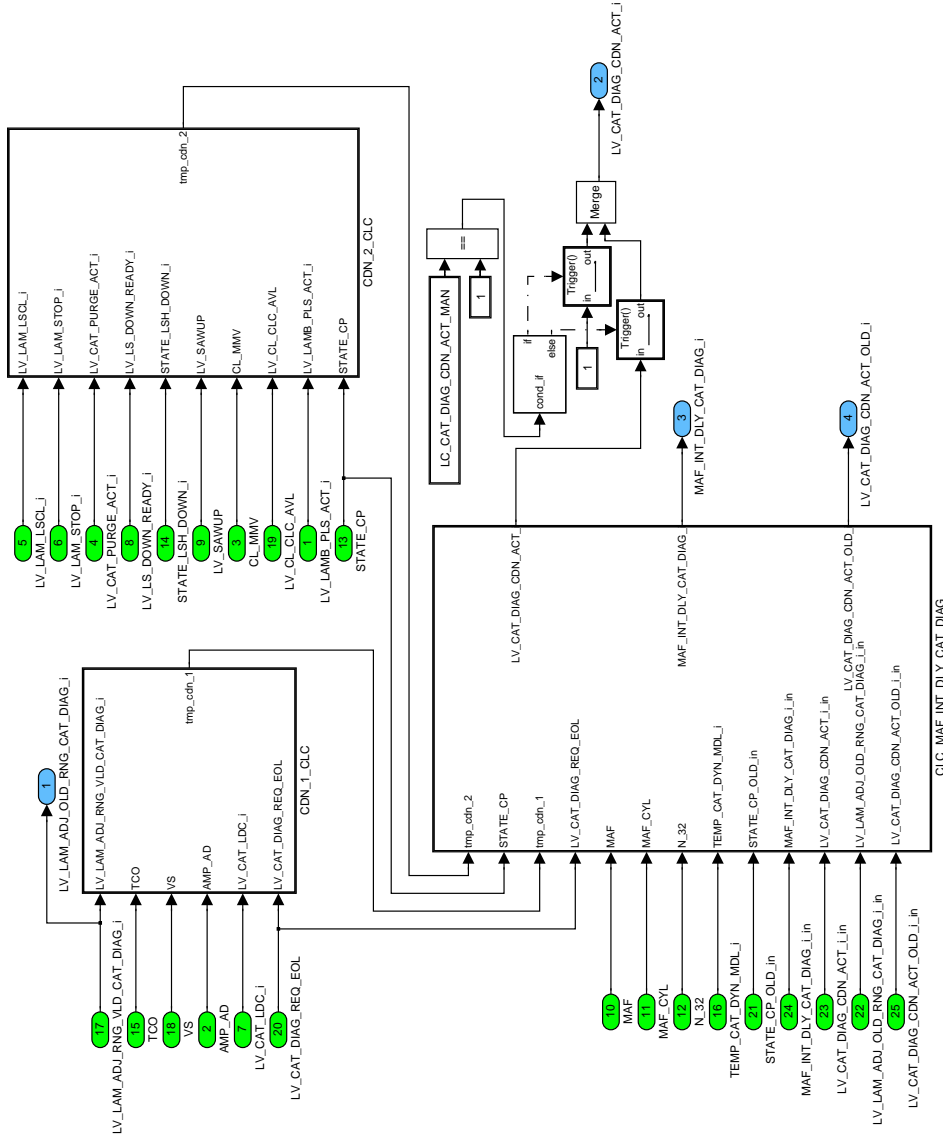


Figure B.45.5: EGTR\_FCTDGCEFAC0/operate/EGTR\_FCTDGCEFAC0\_CBK\_MNG/  
EGTR\_FCTDGCEFAC0\_CBK\_SPC

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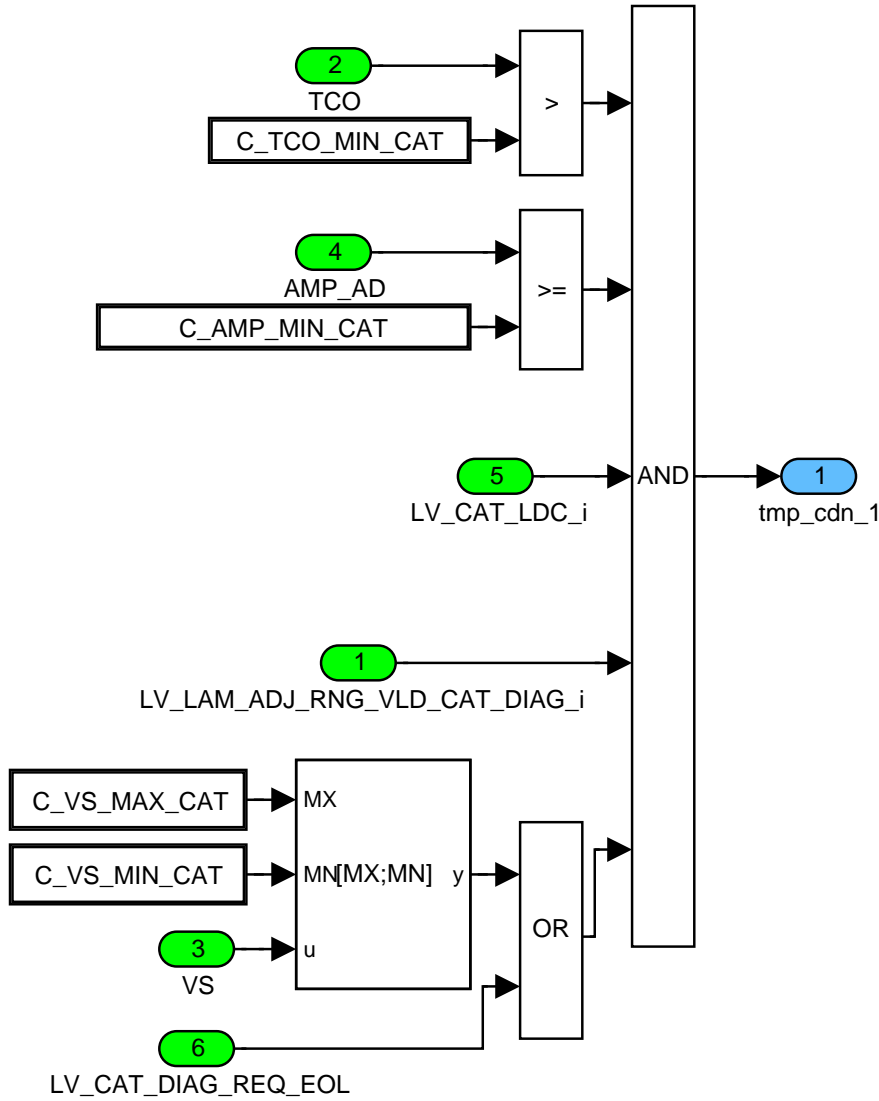


Figure B.45.6: EGTR\_FCTDGCEFAC0/operate/EGTR\_FCTDGCEFAC0\_CBK\_MNG/  
EGTR\_FCTDGCEFAC0\_CBK\_SPC/CDN\_1\_CLC

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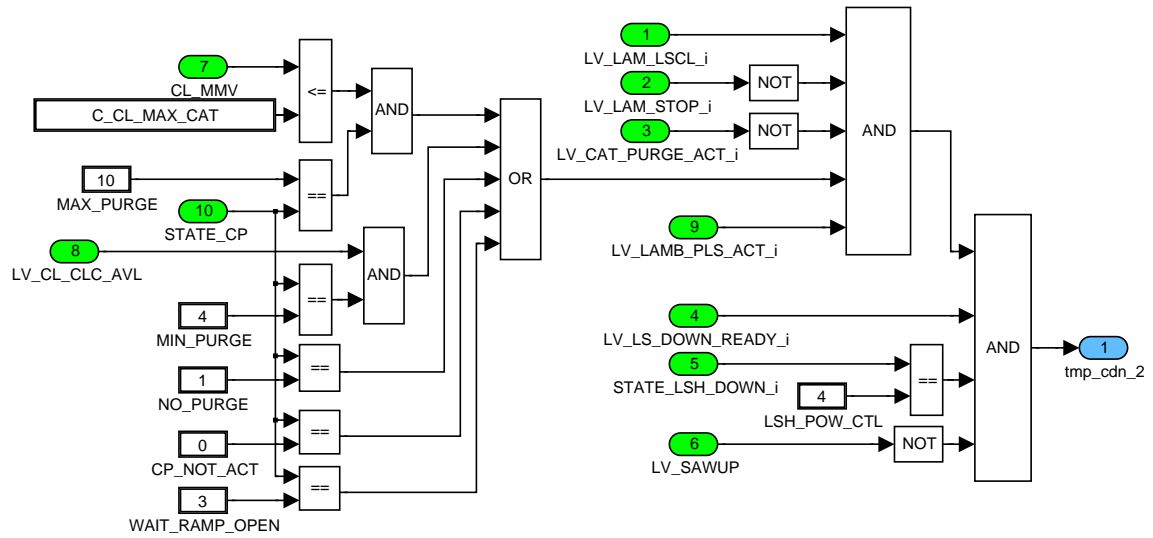
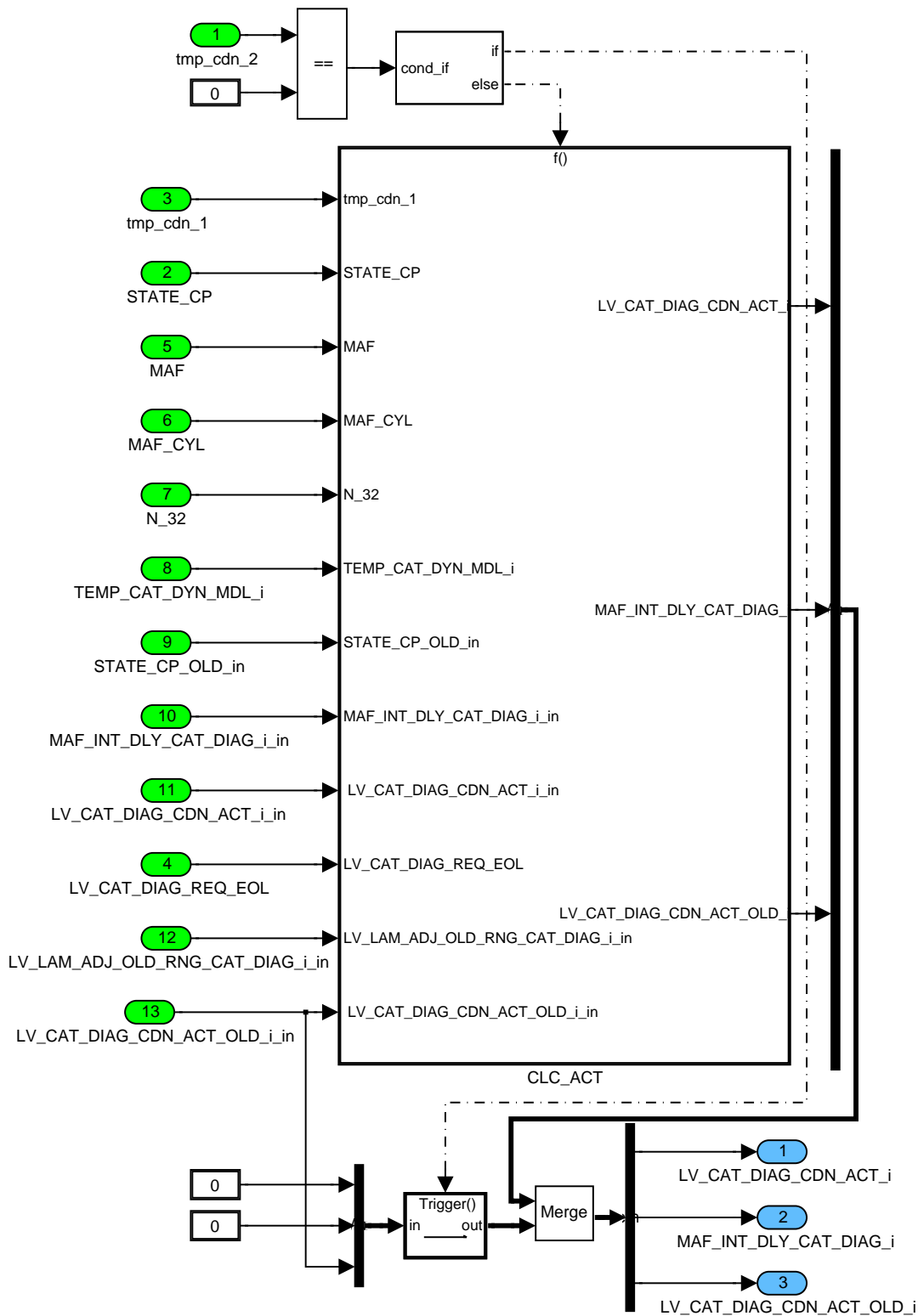


Figure B.45.7: EGTR\_FCTDGCEFAC0/operate/EGTR\_FCTDGCEFAC0\_CBK\_MNG/EGTR\_FCTDGCEFAC0\_CBK\_SPC/CDN\_2\_CLC

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Figure B.45.8: EGTR\_FCTDGCEFAC0/operate/EGTR\_FCTDGCEFAC0\_CBK\_MNG/EGTR\_FCTDGCEFAC0\_CBK\_SPC/CLC\_MAF\_INT\_DLY\_CAT\_DIAG

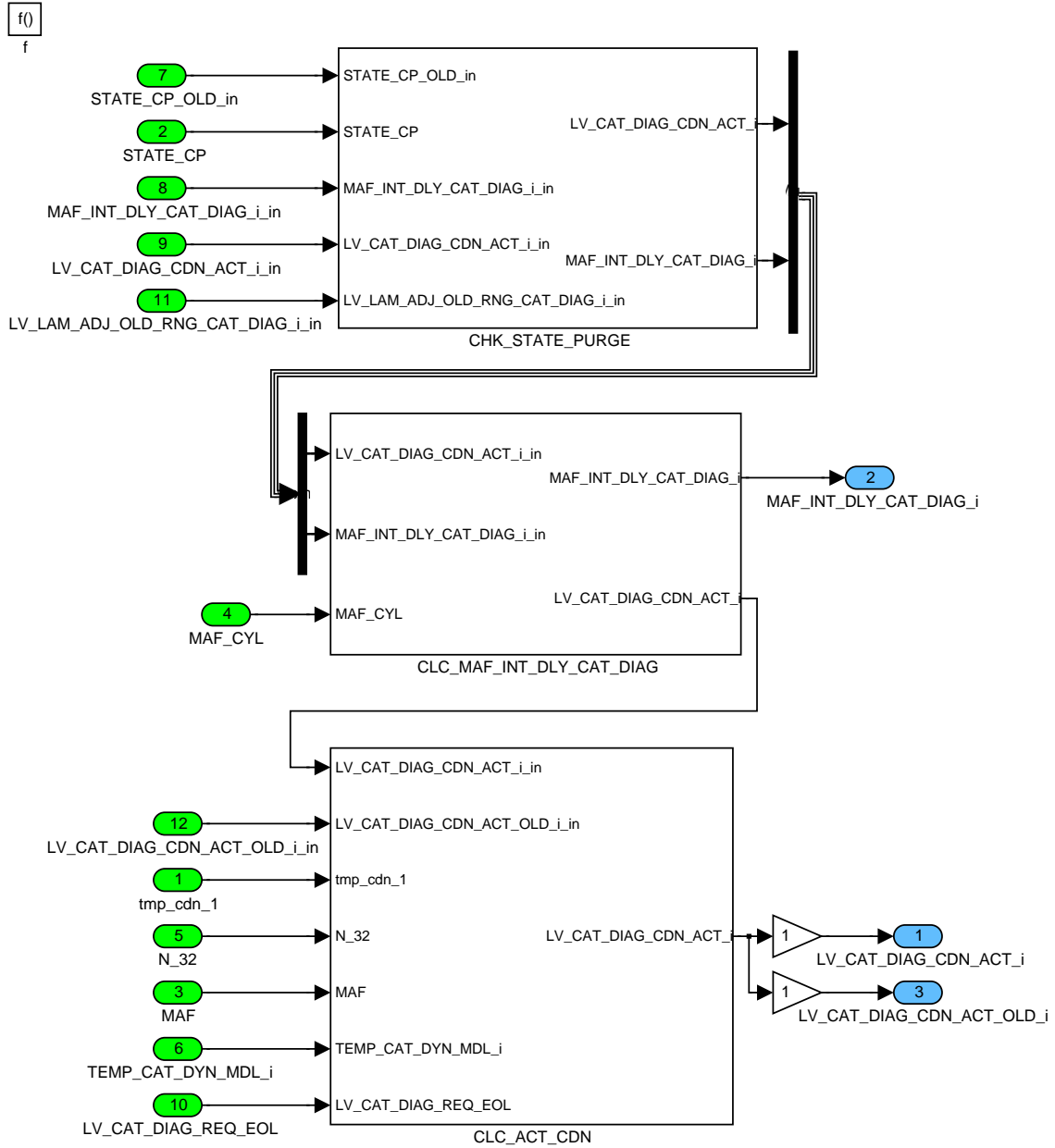


Figure B.45.9: EGTR\_FCTDGCEFAC0/operate/EGTR\_FCTDGCEFAC0\_CBK\_MNG/  
EGTR\_FCTDGCEFAC0\_CBK\_SPC/CLC\_MAF\_INT\_DLY\_CAT\_DIAG/CLC\_ACT

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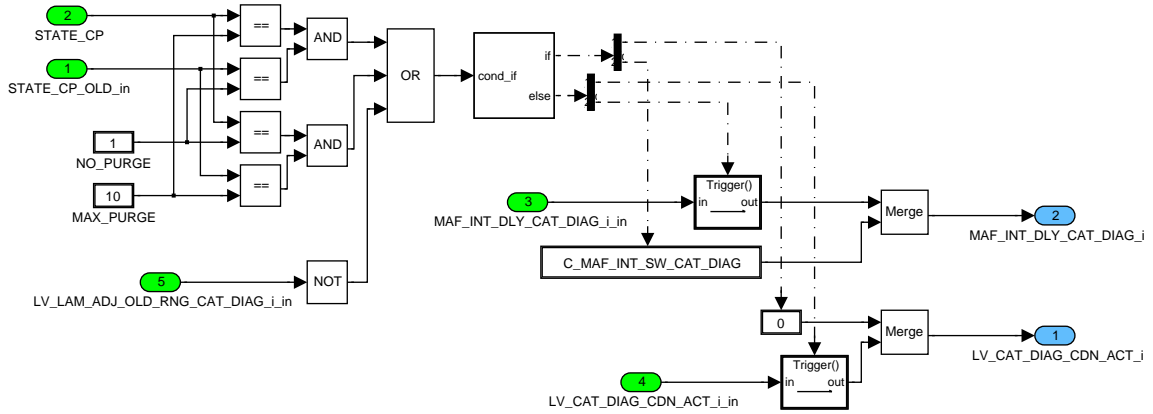


Figure B.45.10: EGTR\_FCTDGCEFAC0/operate/EGTR\_FCTDGCEFAC0\_CBK\_MNG/EGTR\_FCTDGCEFAC0\_CBK\_SPC/CLC\_MAF\_INT\_DLY\_CAT\_DIAG/CLC\_ACT/CHK\_STATE\_PURGE

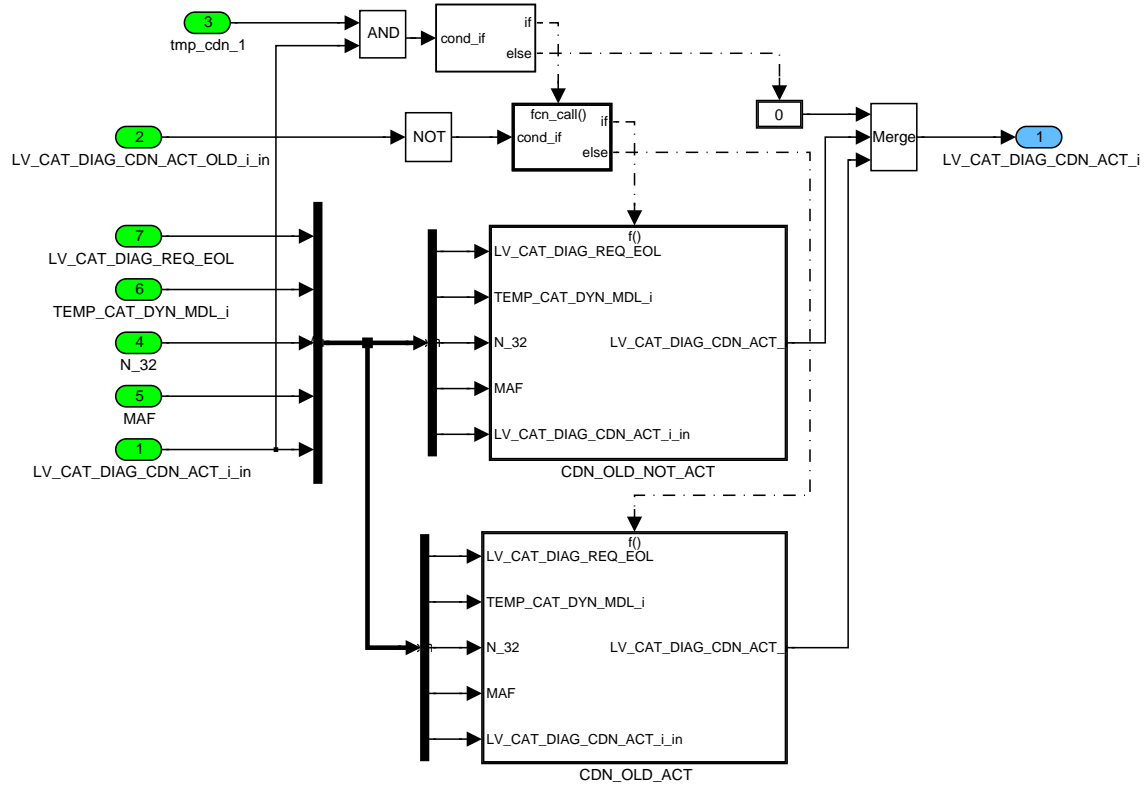


Figure B.45.11: EGTR\_FCTDGCEFAC0/operate/EGTR\_FCTDGCEFAC0\_CBK\_MNG/EGTR\_FCTDGCEFAC0\_CBK\_SPC/CLC\_MAF\_INT\_DLY\_CAT\_DIAG/CLC\_ACT/CLC\_ACT\_CDN

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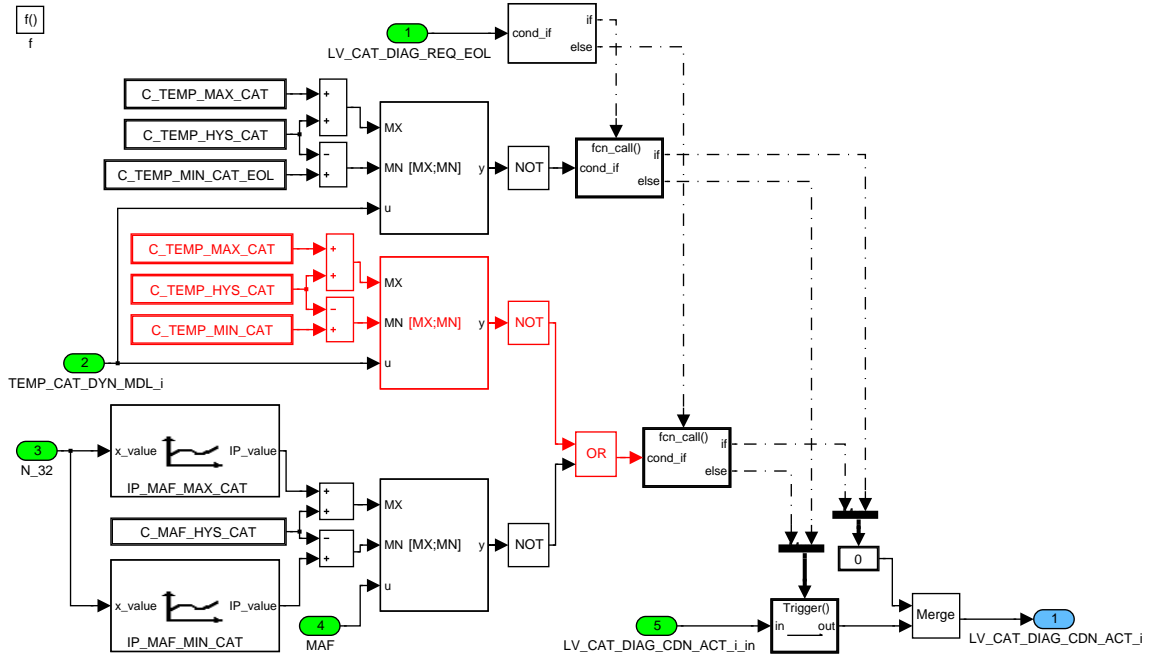


Figure B.45.12: EGTR\_FCTDGCEFAC0/operate/EGTR\_FCTDGCEFAC0\_CBK\_MNG/EGTR\_FCTDGCEFAC0\_CBK\_SPC/CLC\_MAF\_INT\_DLY\_CAT\_DIAG/CLC\_ACT/CLC\_ACT\_CDN/CDN\_OLD\_ACT

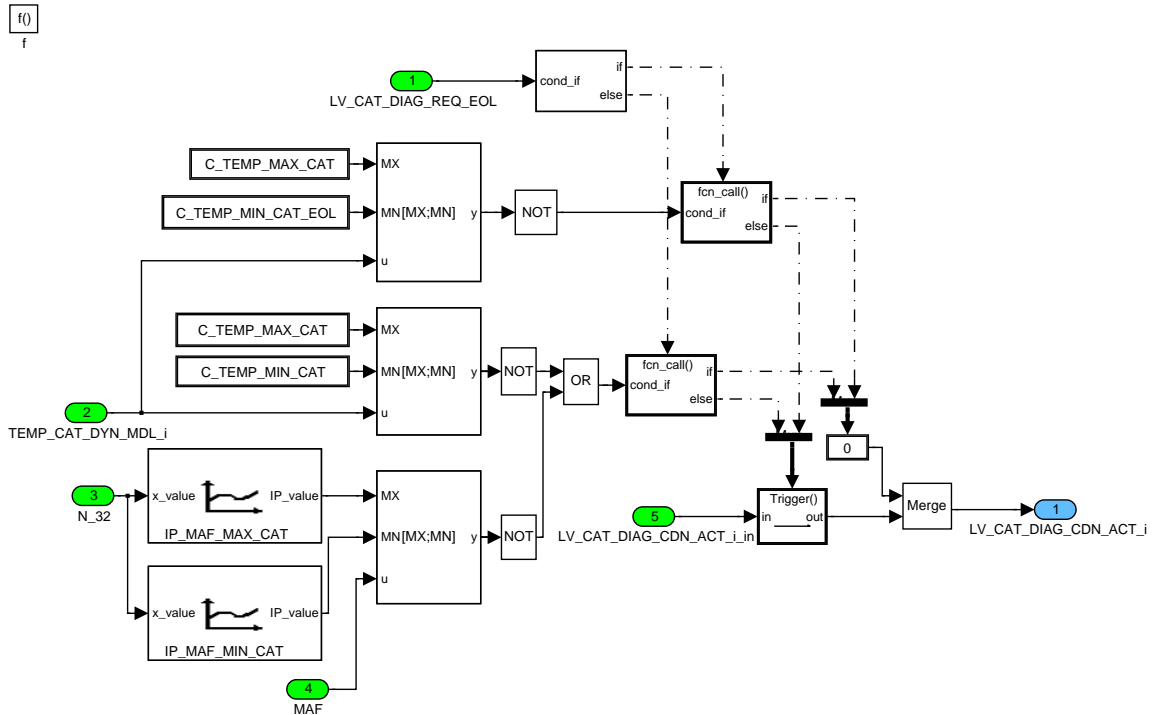


Figure B.45.13: EGTR\_FCTDGCEFAC0/operate/EGTR\_FCTDGCEFAC0\_CBK\_MNG/EGTR\_FCTDGCEFAC0\_CBK\_SPC/CLC\_MAF\_INT\_DLY\_CAT\_DIAG/CLC\_ACT/CLC\_ACT\_CDN/CDN\_OLD\_NOT\_ACT

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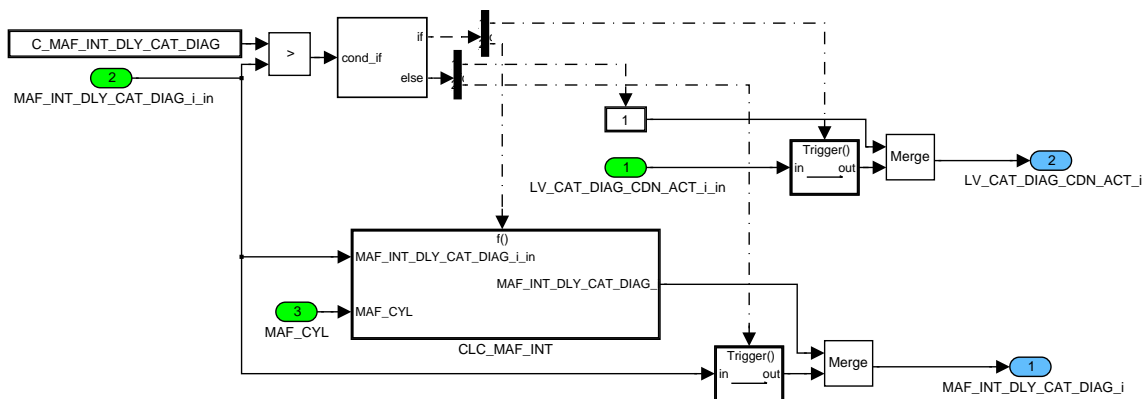


Figure B.45.14: EGTR\_FCTDGCEFAC0/operate/EGTR\_FCTDGCEFAC0\_CBK\_MNG/EGTR\_FCTDGCEFAC0\_CBK\_SPC/CLC\_MAF\_INT\_DLY\_CAT\_DIAG/CLC\_ACT/CLC\_MAF\_INT\_DLY\_CAT\_DIAG

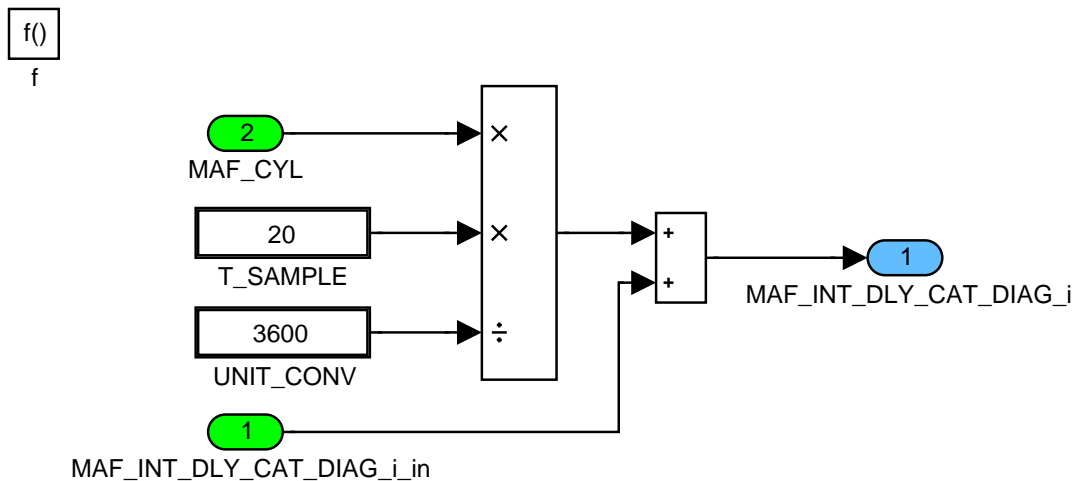


Figure B.45.15: EGTR\_FCTDGCEFAC0/operate/EGTR\_FCTDGCEFAC0\_CBK\_MNG/EGTR\_FCTDGCEFAC0\_CBK\_SPC/CLC\_MAF\_INT\_DLY\_CAT\_DIAG/CLC\_ACT/CLC\_MAF\_INT\_DLY\_CAT\_DIAG/CLC\_MAF\_INT

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**B.45.1.2 SUBFUNCTION: reset**

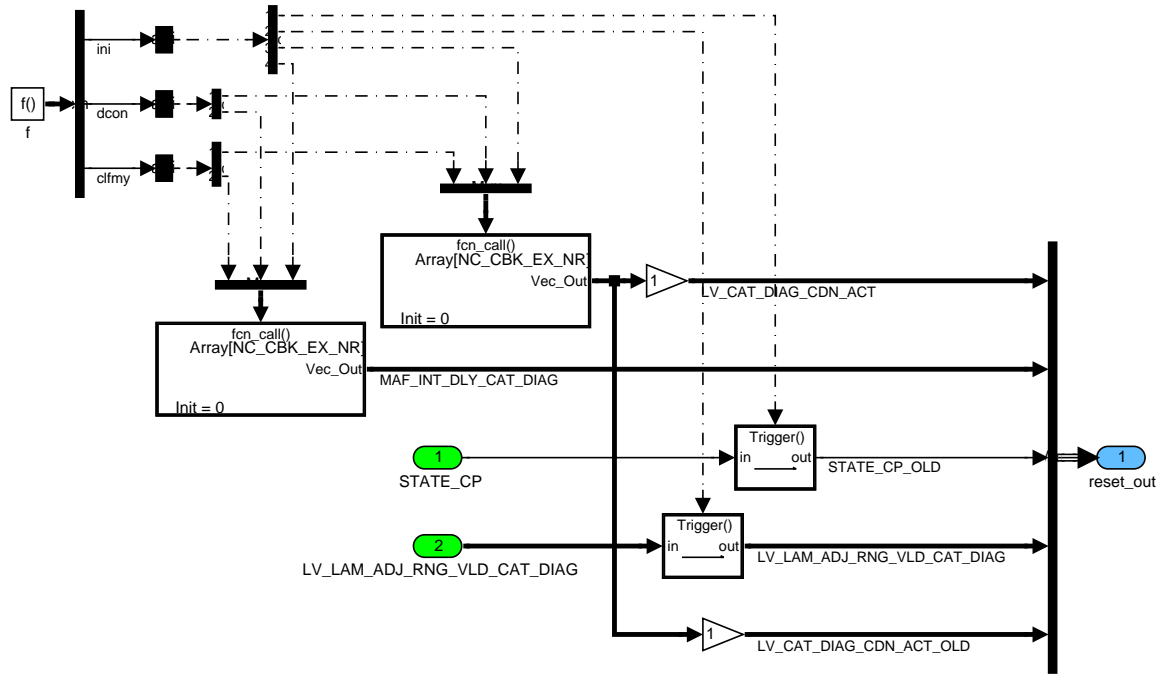


Figure B.45.16: EGTR\_FCTDGCEFAC0/reset


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## B.46 Catalyst efficiency diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CAT_DIAG [NC_CBK_EX_NR]	V	0... 1FFH	0... 511	1	-
monitoring cycle counter					
CTR_LAMB_CAT_DOWN_SUM [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Counter for the summation of LAMB_CAT_DOWN_SUM for each period					
CTR_LAMB_OUT_CAT_DIAG [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter of non valid cycle due to LAMB_CAT_DOWN_MV[i] is not in right range, for switch off Cat Diag					
CTR_TOT_CAT_DIAG [NC_CBK_EX_NR]	V/S	0... FFH	0... 255	1	-
Total sum of all completed diagnosis cycles since ECU programming					
EFF_CAT_DIAG_HOM [NC_CBK_EX_NR]	O/V/S	0... FFH	0... 1.9921875	7.8125e-3	-
Catalyst diagnosis value in OSC range (from lambda=1 cat diag)					
FLOW_O2_CAT_DIF [NC_CBK_EX_NR]	V	0... FFFFH	0... 0.00204441	31.1957e-9	g/ms
downstream O2 flow difference to mean value					
LAMB_CAT_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Lambda downstream of catalyst; linearization of downstream LS signal					
LAMB_CAT_DOWN_MAX [NC_CBK_EX_NR]	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Maximum of LAMB_CAT_DOWN[NC_CBK_EX_NR] over diagnosis period					
LAMB_CAT_DOWN_MIN [NC_CBK_EX_NR]	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Minimum of LAMB_CAT_DOWN[NC_CBK_EX_NR] over diagnosis period					
LAMB_CAT_DOWN_MV [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996948242	30.5176e-6	-
downstream lambda mean value for complete diagnosis period					
LAMB_CAT_DOWN_ST_CYC [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996948242	30.5176e-6	-
LAMB_CAT_DOWN[i] value at start of monitoring cycle					
LAMB_CAT_DOWN_SUM [NC_CBK_EX_NR]	V	0... FFFFFFFFH	0... 131071.999969	30.5176e-6	-
integral of downstream Lambda through 1diagnosis period for calculation of mean value					
LV_AFL_OLD [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Auxiliary flag for edge detection of LV_AFL[i]					
LV_CAT_CYC_WAIT_TMP [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
temporary flag for catalyst diagnosis wait state					
LV_LAM_ADJ_CAT_DIAG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag to switch trim control parameters for OSC/NOX Cat. Diagnosis (only in case of NC_USE_EGTR = 0)					
LV_LAMB_PLS_REQ_CAT_DIAG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag to switch forced stimulation parameters for OSC/NOX Cat. Diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MASS_O2_CAT_DIF_CYC [NC_CBK_EX_NR]	V	0... FFFFH	0... 0.0817765299	1.24783e-6	g
Mass O2 downstream catalyst to mean value through 1 diagnosis period					
RATIO_MASS_O2_CAT_DIF [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Weighted MASS_O2_CAT_DIF_CYC[i] value related to O2-load upstream catalyst from lambda controller					
RATIO_MASS_O2_CAT_DIF_SUM [NC_CBK_EX_NR]	V	0... FFFFFFFFH	0... 131071.999969	30.5176e-6	-
Summation of MASS_O2_CAT_DIF_RATIO[i] over all valid monitoring cycles					
STATE_CAT_DIAG [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H 4H 5H	PASSIVE WAIT CYC_LEAN CYC_RICH END RAMP_UP	-	-
State of diagnosis					
STATE_CAT_DIAG_CYC_VLD [NC_CBK_EX_NR]	V	0... 3FH	0... 63	1	-
Summary validity bits, current monitoring cycle valid and involved in calculation of diagnosis value; 1H = 1CROSS; 2H = MVDEL; 4H = 2CROSS; 8H = DIFMV; 10H = RANGE; 20H = TEMP					
TEMP_CAT_DIF_DYN_STAT [NC_CBK_EX_NR]	V	0... FFH	-256 ...254	2	°C
Temperature difference between dynamic and stationary catalyst temperature (from cat. temperature model)					

**Input data:**

C_NR_STEP_PLS_NOM_CAT_DIAG {p. 2959}	CTR_STEP_PLS_NOM_CAT_DIAG {p. 2958}	LV_AFL [NC_CBK_EX_NR] {p. 2439}	LV_AT {p. 654}
LV_CAT_DIAG_CDN_ACT [NC_CBK_EX_NR] {p. 5459}	LV_CAT_DIAG_REQ_EOL {p. 799}	LV_DC {p. 5746}	LV_INH_DIAG_CAT_DIAG [NC_CBK_EX_NR] {p. 5506}
MAF_CYL {p. 8277}	MAF_HB {p. 805}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}
STATE_LAMB_PLS_DET_VALUE {p. 2958}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	TEMP_CAT_STAT_MDL [NC_CBK_EX_NR] {p. 8237}	VLS_DELTA_LAM_ADJ_CAT_DIAG [NC_CBK_EX_NR] {p. 2613}
VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_SP_LAM_ADJ [NC_CBK_EX_NR] {p. 2590}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_LAMB_OUT_CAT_DIAG	-	0... FFH	0... 255	1	-
Threshold to switch off Cat Diag due to LAMB_CAT_DOWN_MV is not in the right range					
C_CTR_MIN_CAT_DIAG	-	0... 1FFH	0... 511	1	-
min. number of required monitoring cycles for catalyst diagnosis					
C_CTR_MIN_CAT_DIAG_EOL	-	0... 1FFH	0... 511	1	-
min. threshold of required monitoring cycles for catalyst diagnosis at EOL test					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_CAT_DELTA_MAX [NC_CBK_EX_NR]	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
max. deviation between LAMB_CAT_MV and setpoint for a valid monitoring cycle					
C_LAMB_CAT_DELTA_MAX_EOL [NC_CBK_EX_NR]	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
max. deviation between LAMB_CAT_MV and setpoint for a valid monitoring cycle at end-of-line test					
C_LAMB_CAT_MV_DELTA_MAX [NC_CBK_EX_NR]	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
max. allowed fluctuation between LAMB_CAT_DOWN[i] and LAMB_CAT_DOWN_MV[i] fin the same monitoring cycle					
C_LAMB_CAT_MV_DIF_MAX [NC_CBK_EX_NR]	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
max. allowed LAMB_CAT_DOWN_MV[i] fluctuation between 2 subsequent monitoring cycles					
C_N_32_CAT_DIAG_DEAC	-	0... FFH	0... 8160	32	rpm
Engine speed threshold to deactivate catalyst diagnosis to save ECU performance					
C_O2L_CAT_AFL	-	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Adjust parameter for RATIO_MASS_O2L_CAT_DIF calculation					
C_TEMP_CAT_DIF_DYN_MAX [NC_CBK_EX_NR]	-	0... 7FH	0... 254	2	°C
Max. Temperature difference for catalyst diagnosis cycle validity					
C_TEMP_CAT_DIF_DYN_ST [NC_CBK_EX_NR]	-	0... 7FH	0... 254	2	°C
Max. Temperature difference for catalyst diagnosis begin					
IP_FAC_MASS_O2_CAT_DIAG_AT	V	0... FFFFH	0... 1.99996948242	30.5176e-6	-
LDPM_N_32_1_EGTR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_1_EGTR	8	0... FFH	0... 1389	5.4470588	mg/stk
weight factor of downstream sensor signal integral for automatic transmission					
IP_FAC_MASS_O2_CAT_DIAG_MT	V	0... FFFFH	0... 1.99996948242	30.5176e-6	-
LDPM_N_32_1_EGTR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_1_EGTR	8	0... FFH	0... 1389	5.4470588	mg/stk
weight factor of downstream sensor signal integral for manual transmission					
IP_FAC_TEMP_CAT_DIF_STAT	V	0... 3FFH	0... 4.9951171875	4.88281e-3	V
LDP_TEMP_CAT_DYN_MDL_IP_FAC_CAT	8	0... FFH	-273.15 ...1766.85	8	°C
LDP_TEMP_CAT_DIF_DYN_STAT	8	0... FFH	-256 ...254	2	°C
Factor to correct cat.diag. value at catalyst temperature different to stationary temperature in this working point					
IP_LAMB_CAT	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
LDP_VLS_TEMP_IP_LAMB_CAT	12	0... 3FFH	0... 4.9951171875	4.88281e-3	V
lambda linearization from downstream LS signal					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
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### General Information

That catalyst diagnosis function is suitable for single branch (only one exhaust bank) and twin branch exhaust lines (two exhaust banks).

For a twin branch exhaust line the function has the same structure for both exhaust lines. The conversion properties of the two catalysts are monitored separately.

NC\_CBK\_EX\_NR labels the number of exhaust banks.

For vector elements, the variable extension `_i` is used in the model instead of `[i]` as found in the textual description.

The signals from the control sensor upstream and the associated monitoring sensor downstream from the catalyst are used for catalyst diagnosis.

If a catalyst has good conversion properties, the oscillating lambda signal upstream from the catalyst generated by the lambda controller (which shall ensure defined O2-load of catalyst) downstream is smoothed by the Oxygen Storage Capacity of the catalyst.

If the conversion provided by the catalyst is low due to aging, poisoning by leaded fuel or misfire, then the oscillating lambda signal upstream of the catalyst also exists downstream of the catalyst. The lambda oscillation downstream of the catalyst is detected by an oxygen sensor (monitoring sensor).

Every monitored catalyst or combination of catalysts shall be indicated when the HC emission exceeds the applicable emission test threshold.

#### Description:

The diagnosis algorithm is realized with a state machine in order to improve specification understanding and coherence between specification and SW.

Monitoring cycle:(STATE\_CAT\_DIAG[i]: CYC\_LEAN and CYC\_RICH)

The first monitoring cycle is started following the rich-lean change (LV\_AVL 0->1). A monitoring cycle lasts one complete lambda controller period (2 subsequent lambda richness changes). Several monitoring cycles are needed to finish the diagnosis.


At activation of Catalyst diagnosis the Forced stimulation is switched to higher Cat diag forced stimulation (soft switch in NC\_NOM\_CAT\_DIAG\_STEP cycles) and Trim control is switched to Cat diag parameters (P-share and I-share with own calibration, additionally shift of VLS setpoint depends from EFF\_CAT\_DIAG\_HOM value). VLS\_DOWN signal from monitoring Lambda sensor is converted with inverse sensor characteristic LAMB\_CAT\_DOWN\_i.

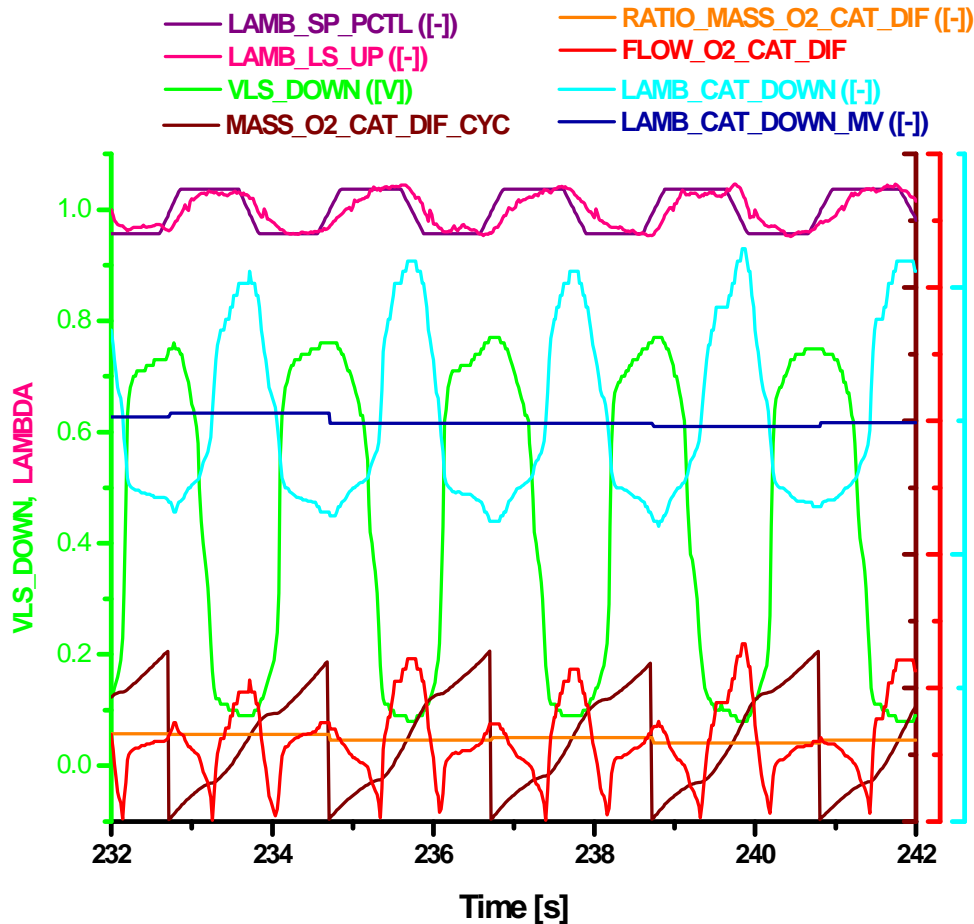
In the wait state before the first cycle after every reactivation (rich-lean change LV\_AFL) only LAMB\_CAT\_DOWN\_MV\_i is calculated. LAMB\_CAT\_DOWN\_SUM\_i is obtained by the summation of the LAMB\_CAT\_DOWN\_i over a complete monitoring cycle. If LAMB\_CAT\_DOWN\_MV\_i agree with VLS\_DOWN setpoint, catalyst diagnosis could start. WAIT state turns to RAMP\_UP state and the O2load (realized by forced stimulation) ramps up from nominal value to catalyst diagnosis value. After ramp up of O2load finished, forced stimulation informs the catalyst diagnosis by forced stimulation state, really evaluated catalyst diagnosis cycles could start (CYC\_LEAN/RICH).

LAMB\_CAT\_DOWN\_MV\_i is the mean value of the LAMB\_CAT\_DOWN\_i - O2\_load downstream the Catalyst calculated as inverse characteristic of binary lambda sensor from VLS\_DOWN\_i signal for one monitoring cycle. The calculation of MASS\_O2\_CAT\_DIF\_CYC\_i is based on LAMB\_CAT\_DOWN\_MV\_i of the previous monitoring cycle. MASS\_O2\_CAT\_DIF\_CYC\_i is the integrated difference between actual LAMB\_CAT\_DOWN\_i signal and LAMB\_CAT\_DOWN\_MV\_i of the previous monitoring cycle.

#### Illustration monitoring cycle

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Validity check: (STATE\_CAT\_DIAG\_i: Transition CYC\_RICH -> CYC\_LEAN)

The obtained MASS\_O2\_CAT\_DIF\_CYC[i] of a monitoring cycle is only used for the calculation of the diagnosis value if the validity check was passed (STATE\_VLD\_CAT\_DIAG\_i reach the minimum value for validity)

To pass the validity check it is necessary that:

LAMB\_CAT\_DOWN[i] must cross at least once LAMB\_CAT\_DOWN\_MV[i] of the previous monitoring: 0.bit of STATE\_VLD\_CAT\_DIAG\_i is set (bit '1CROSS').

OR

The deviation between LAMB\_CAT\_DOWN[i] and LAMB\_CAT\_DOWN\_MV[i] of the last monitoring cycle is smaller than C\_LAMB\_CAT\_MV\_DELTA\_MAX: 1.bit of STATE\_VLD\_CAT\_DIAG\_i is set (bit 'MVDEL').

OR

LAMB\_CAT\_DOWN[i] cross two times LAMB\_CAT\_DOWN\_MV[i] of the previous monitoring (periodically braking down of VLS\_DOWN occurs): 2.bit of STATE\_VLD\_CAT\_DIAG\_i is set (bit '2CROSS').

AND

Difference between actual and the LAMB\_CAT\_DOWN\_MV[i] of the last monitoring cycle is not too high (if LAMB\_CAT\_DOWN[i] cross two times LAMB\_CAT\_DOWN\_MV[i], higher difference allowed): 3.bit of STATE\_VLD\_CAT\_DIAG\_i is set (bit 'DIVMV').

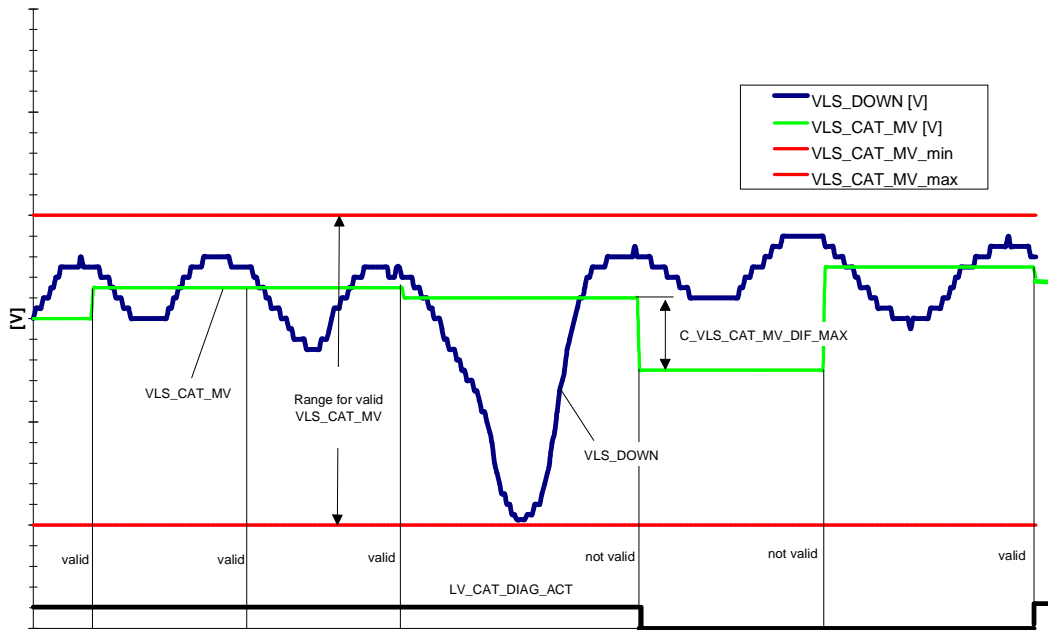
AND

LAMB\_CAT\_DOWN\_MV[i] is in the right range 4.bit of STATE\_VLD\_CAT\_DIAG\_i is set (bit 'RANGE').

AND

Catalyst temperature dynamic is limited: 5.bit of STATE\_VLD\_CAT\_DIAG\_i is set (bit 'TEMP').

Illustration validity check



Calculation of diagnosis value: (STATE\_CAT\_DIAG[i]: Transition CYC\_RICH -> CYC\_LEAN)

Monitoring cycle counter CTR\_CAT\_DIAG[i] is incremented for each valid monitoring cycle.

MASS\_O2\_CAT\_DIF\_CYC[i] is weighted by engine speed and load (IP\_FAC\_MASS\_O2\_CAT\_DIAG\_XX). From that calculation MASS\_O2\_CAT\_DIF\_RATIO[i] results. MASS\_O2\_CAT\_DIF\_RATIO[i] is summed up for all monitoring cycles. That summation give MASS\_O2\_CAT\_DIF\_RATIO\_SUM[i]. Finally, the average of MASS\_O2\_CAT\_DIF\_RATIO\_SUM[i] over all valid monitoring cycles give the diagnosis value EFF\_CAT\_DIAG\_HOM[i]

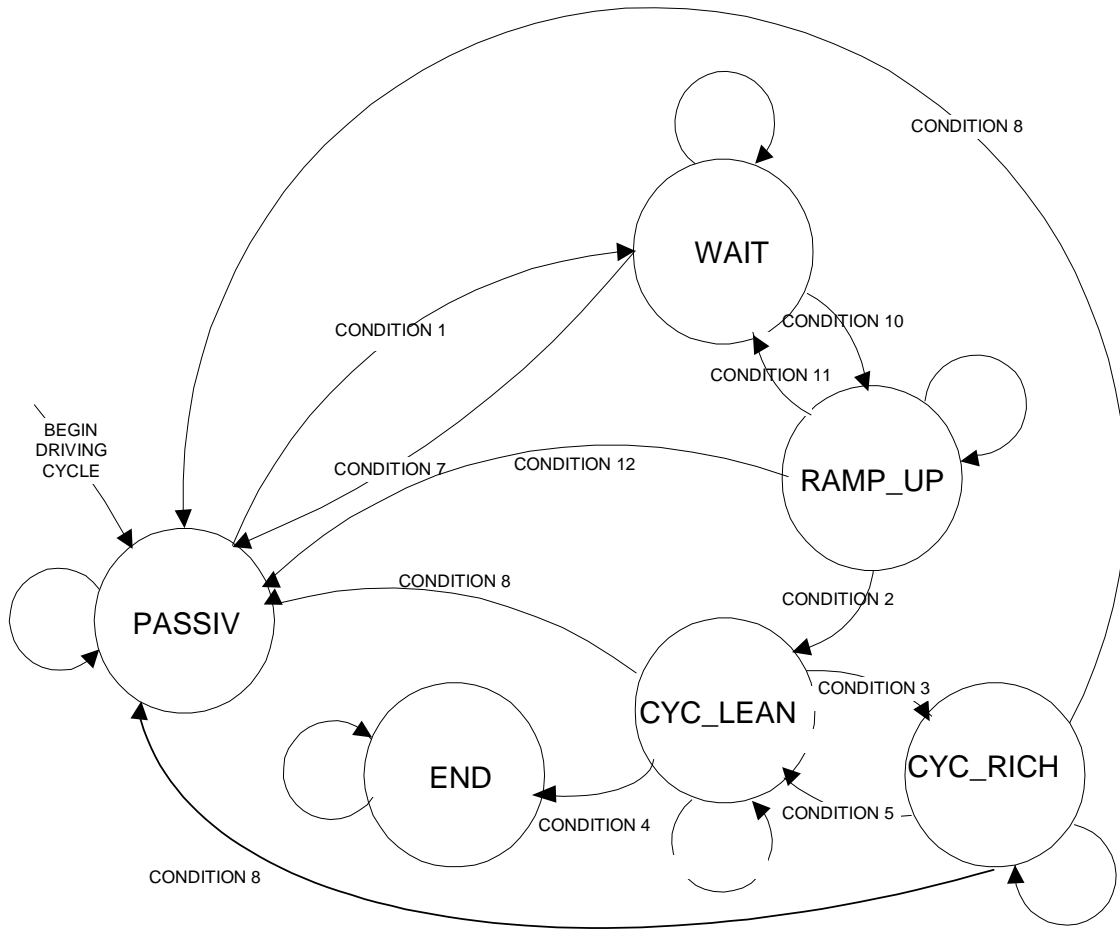
End of diagnosis: (STATE\_CAT\_DIAG[i]: Transition CYC\_LEAN -> END)

If the necessary number of valid monitoring cycles CTR\_CAT\_DIAG[i] reaches C\_CTR\_MIN\_CAT\_DIAG the diagnosis is ended for that driving cycle and the catalyst diagnosis value EFF\_CAT\_DIAG\_HOM[i] is calculated and stored in the EEPROM.

The monitoring counter CTR\_CAT\_DIAG[i] is used to set the readiness code. For this reason C\_CTR\_MIN\_CAT\_DIAG must be reached in the emission test cycle.

State diagram: STATE\_CAT\_DIAG[i]

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Note: The priorities of the conditions to change between states are defined by order described in the STATEFLOW diagram below. The condition 8 as transition to PASSIVE is twice available and contain the same conditions each.

The recurrence time is defined by T\_SAMPLE in [ms].

#### Application Assistance

For OBD II O2 sensor diagnosis: C\_CTR\_MIN\_CAT\_DIAG has to be applied higher then the thresholds C\_SUM\_CYC\_MIN\_DIAG and C\_SUM\_CYCNR\_MIN\_DIAG (LV\_LS\_FRQ\_DIAG\_READY -> 1 and LV\_LS\_SWT\_DIAG\_READY -> 1). They have to be reached before STATE\_CAT\_DIAG[i] is set to END.

#### Hint:

An active catalyst diagnosis can disable the module Downstream Fuel Trim Regulation also a additional lambda offset can be imposed on the basic lambda setpoint in the module Basic Lambda setpoint . When the catalyst diagnosis is completed the above functions return to their normal operation.


#### Overview: Chronological order of diagnosis algorithm:

Triggering of catalyst diagnosis calculation by LV\_AFL[i] 0->1...

%setpoint of the O2-load with CAT DIAG for the lambda controller (output, not used here)

1) LAMB\_CAT\_DOWNN[i] = IP\_LAMB\_CAT(VLS\_DOWNN[i]) %every recurrence

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2)  $LAMB\_CAT\_DOWN\_SUM[i]_{n+1} = LAMB\_CAT\_DOWN\_SUM[i]_n + LAMB\_CAT\_DOWN[i]$  %every recurrence

3)  $LAMB\_CAT\_DOWN\_MV[i] = LAMB\_CAT\_DOWN\_SUM[i] / LAMB\_CAT\_DOWN\_SUM[i]$  CTR\_

(after end of current diagnosis period)

4)  $FLOW\_O2\_CAT\_DIF[i] = 0.23 * (1/3600)[g/ms] * I1/LAMB\_CAT\_DOWN\_MV[i] - 1/LAMB\_CAT\_DOWN[i] * MAF\_CYL[kg/h]$

5)  $MASS\_O2\_CAT\_DIF\_CYC[i]_{n+1} = MASS\_O2\_CAT\_DIF\_CYC[i]_n + FLOW\_O2\_CAT\_DIF[i] * T\_SAMPLE[ms]$  %every recurrence

6)  $RATIO\_MASS\_O2\_CAT\_DIF [i] = MASS\_O2\_CAT\_DIF\_CYC[i] * IP\_FAC\_TEMP\_CAT\_DIF\_STAT / (C\_O2L\_CAT\_AFL * IP\_FAC\_MASS\_O2\_CAT\_DIAG\_XX)$  ( with XX for AT or MT (after end of current diagnosis period)

7)  $RATIO\_MASS\_O2\_CAT\_DIF\_SUM[i]_{n+1} = RATIO\_MASS\_O2\_CAT\_DIF\_SUM[i]_n + MASS\_O2\_CAT\_DIF\_RATIO[i]$

(after end of current diagnosis period and passed validity check)

8)  $EFF\_CAT\_DIAG\_HOM[i] = MASS\_O2\_CAT\_DIF\_RATIO\_SUM[i] / CTR\_CAT\_DIAG[i]$

(Catalyst diagnosis value after diagnosis finished)

Scheduling of formulas:

1+2: states WAIT, RAMP\_UP, CYC\_LEAN, CYC\_RICH

3: state WAIT, transitions RAMP\_UP or CYC\_RICH to CYC\_LEAN

4+5: states CYC\_LEAN, CYC\_RICH

6+7: transition CYC\_RICH to CYC\_LEAN

8: transition CYC\_LEAN to END

Several system events will trigger a function response:

EGTR\_FCTDGCEF0\_\_RST (reset): reset

EGTR\_FCTDGCEF0\_\_20MS (regular trigger every 20 msec): operate

EGTR\_FCTDGCEF0\_\_CLFMY (clear failure memory): reset

EGTR\_FCTDGCEF0\_\_STB (standby; ECU programming or fault): reset, init\_nvmy

EGTR\_FCTDGCEF0\_\_UNVMY (update non volatile memory): save\_nvmy

EGTR\_FCTDGCEF0\_\_RNVMY (read non volatile memory): read\_nvmy

## Application Conditions



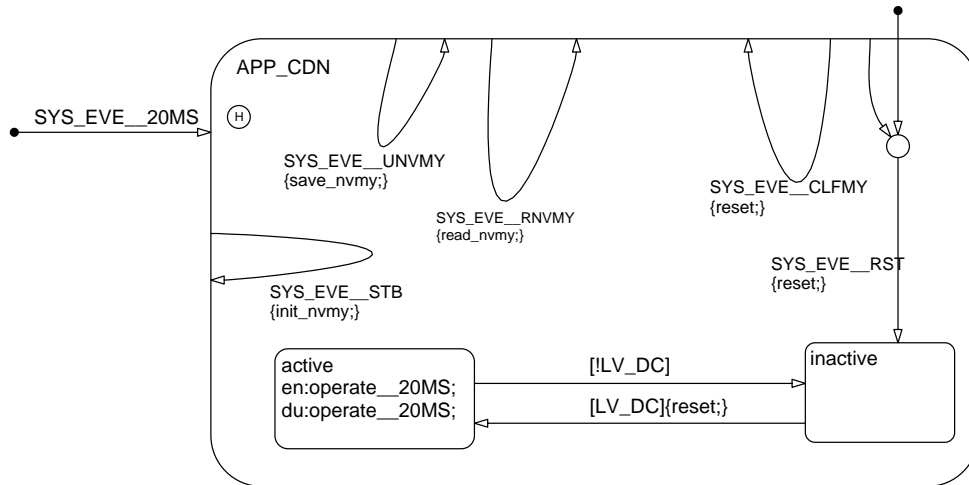



Figure B.46.1: :

**Function description**

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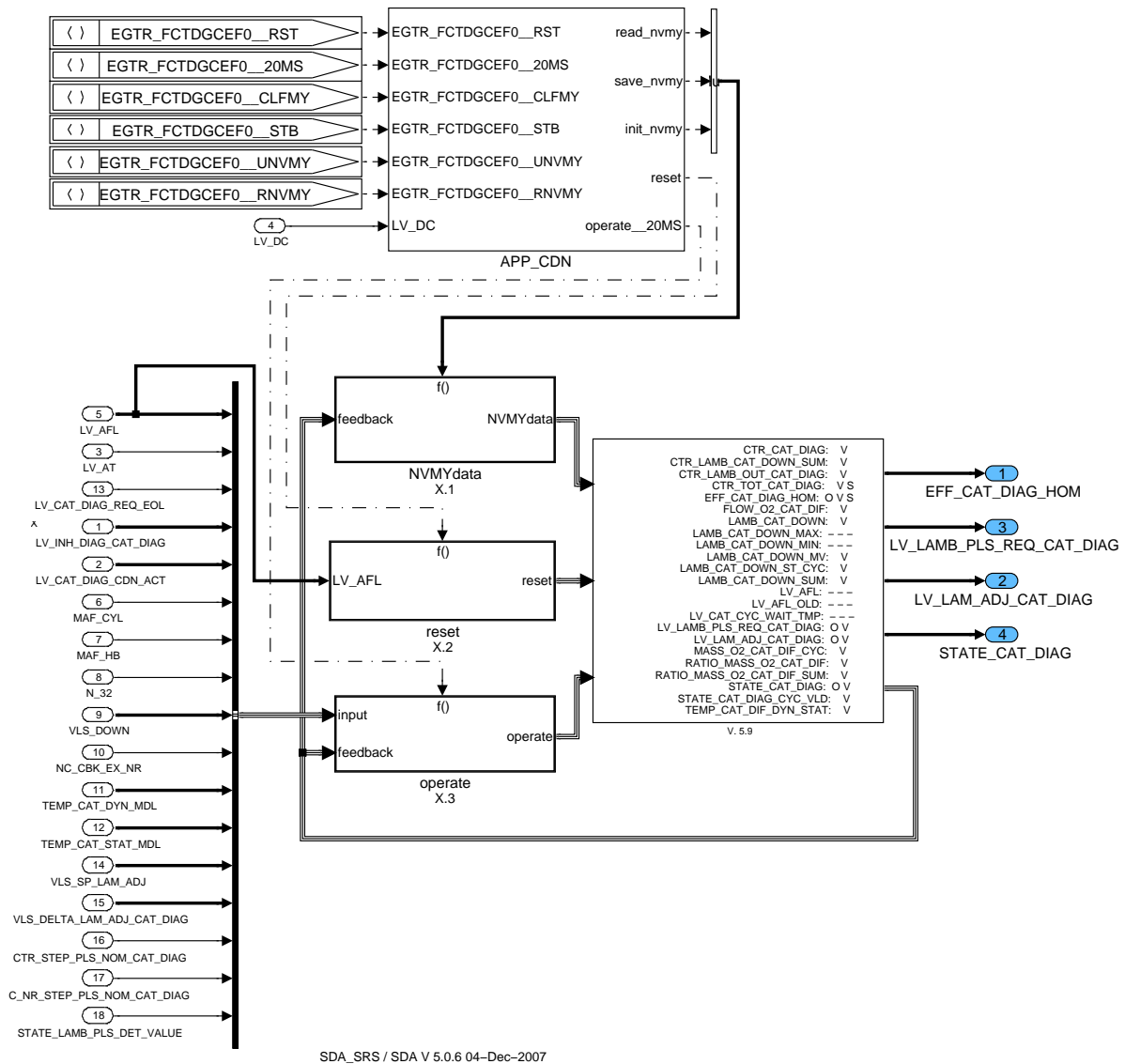


Figure B.46.2: :

### B.46.1 Handling data at non volatile memory:

Triggering of one of the following actions:

**RNVMY** (read non volatile memory): Reading the diagnosis value of last completed diagnosis cycle and the number of totally completed diagnosis cycles since ECU programming from non volatile memory.

**UNVMY** (update non volatile memory): Saving the diagnosis value of last completed diagnosis cycle and the number of totally completed diagnosis cycles since ECU programming to non volatile memory.

**STB** (standby): Initializing the diagnosis value and the number of totally completed diagnosis cycles since ECU programming to zero and saving to non volatile memory.

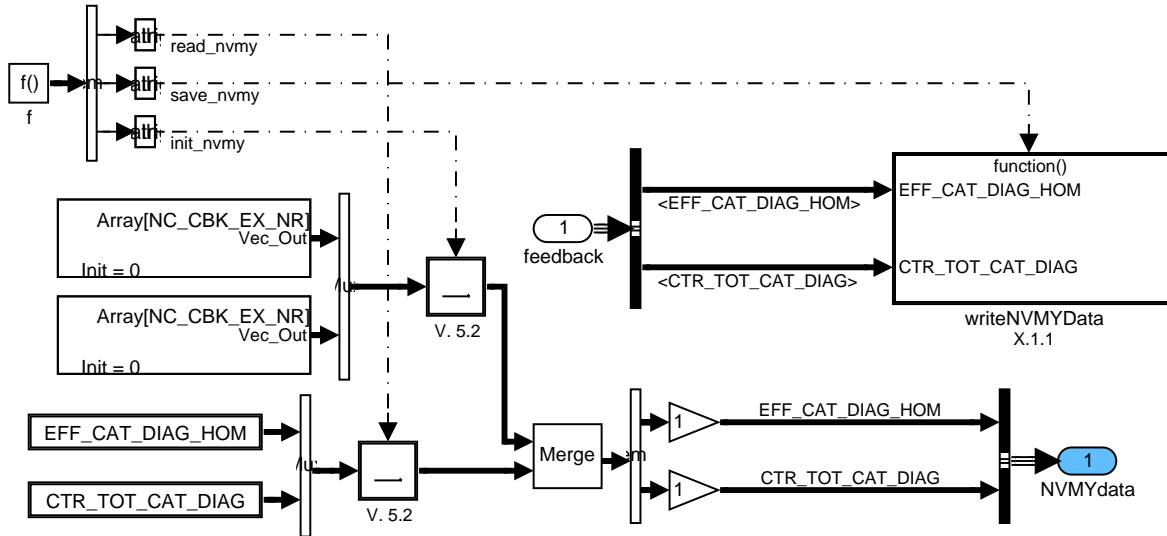


Figure B.46.3: :

### B.46.1.1 Writing to non volatile memory (UNVMY):

Storing the final diagnosis value to non volatile memory and incrementing there the total number of completed diagnosis cycles since ECU programming by one.

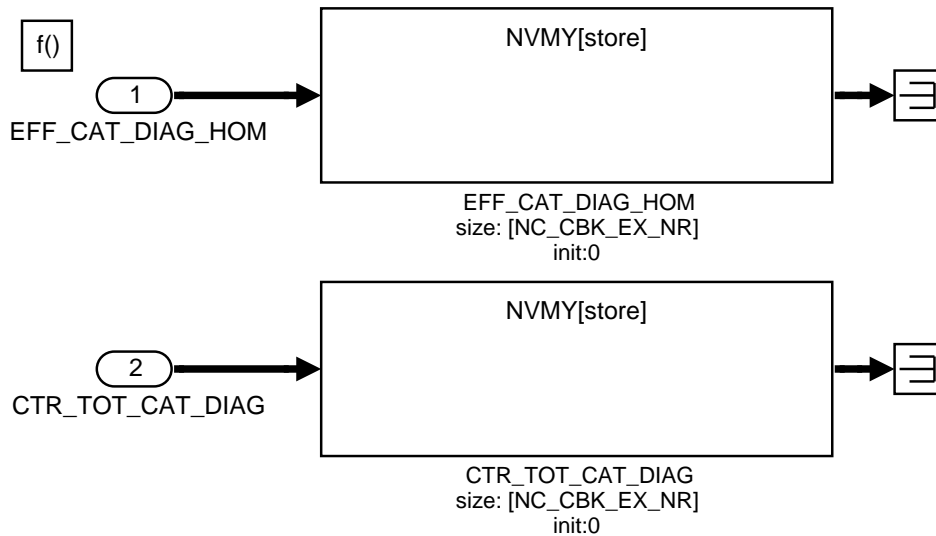


Figure B.46.4: :

### B.46.2 RESET:

Initializing all listed variables to zero.

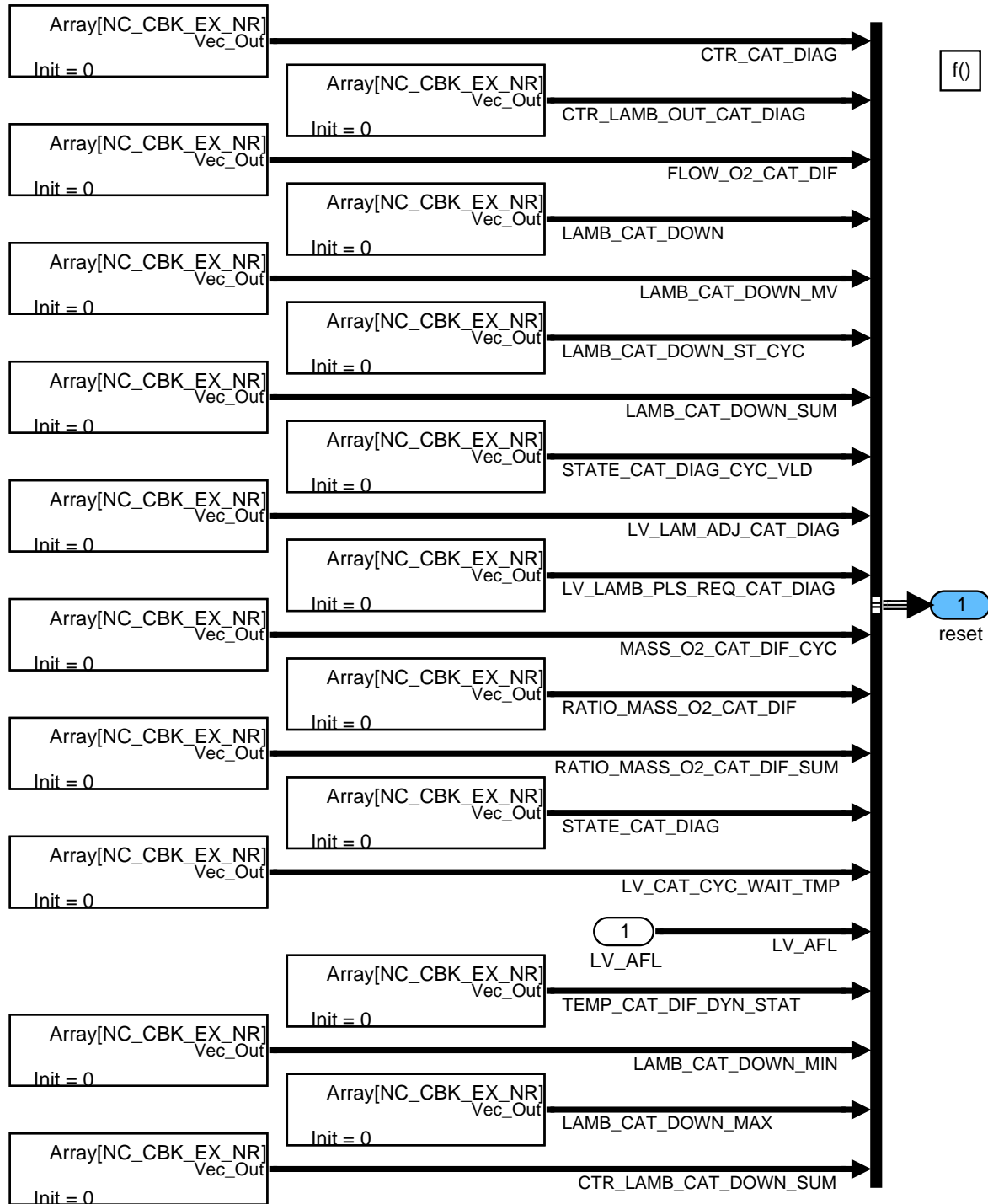


Figure B.46.5: :

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## B.46.3 SUBFUNCTION: operate

### B.46.3.1 EGTR\_FCTDGCEF0/OPERATE/EGTR\_FCTDGCEF0\_CBK\_MNG


#### B.46.3.1.1 Checking state:

Checking the transition conditions with aid of the state machine. Then, in case of changing the actual state, performing the respective transition actions and state actions for the new state.

##### B.46.3.1.1.1 State machine:

Checking the respective transition conditions in dependence on current state and evaluation of the new state in compliance with exclusion thresholds, i.e. with the engine speed, the counter for the minimum required monitoring cycles to complete the catalyst diagnosis and the counter numerating subsequently following invalid monitoring cycles.

Afterwards issue of the trigger vectors for transition actions and state actions.

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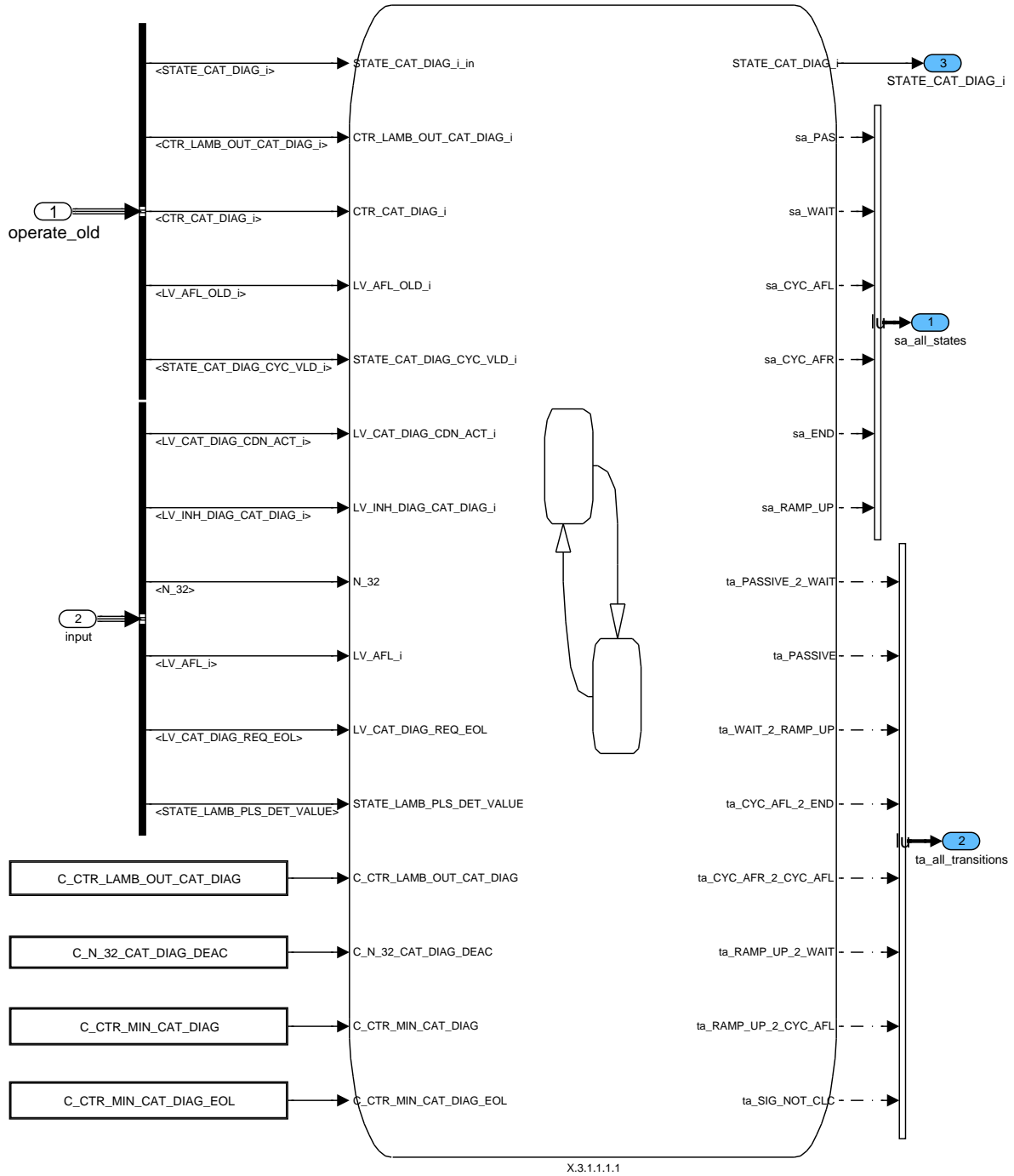


Figure B.46.6: :

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### B.46.3.1.1.1 Chart

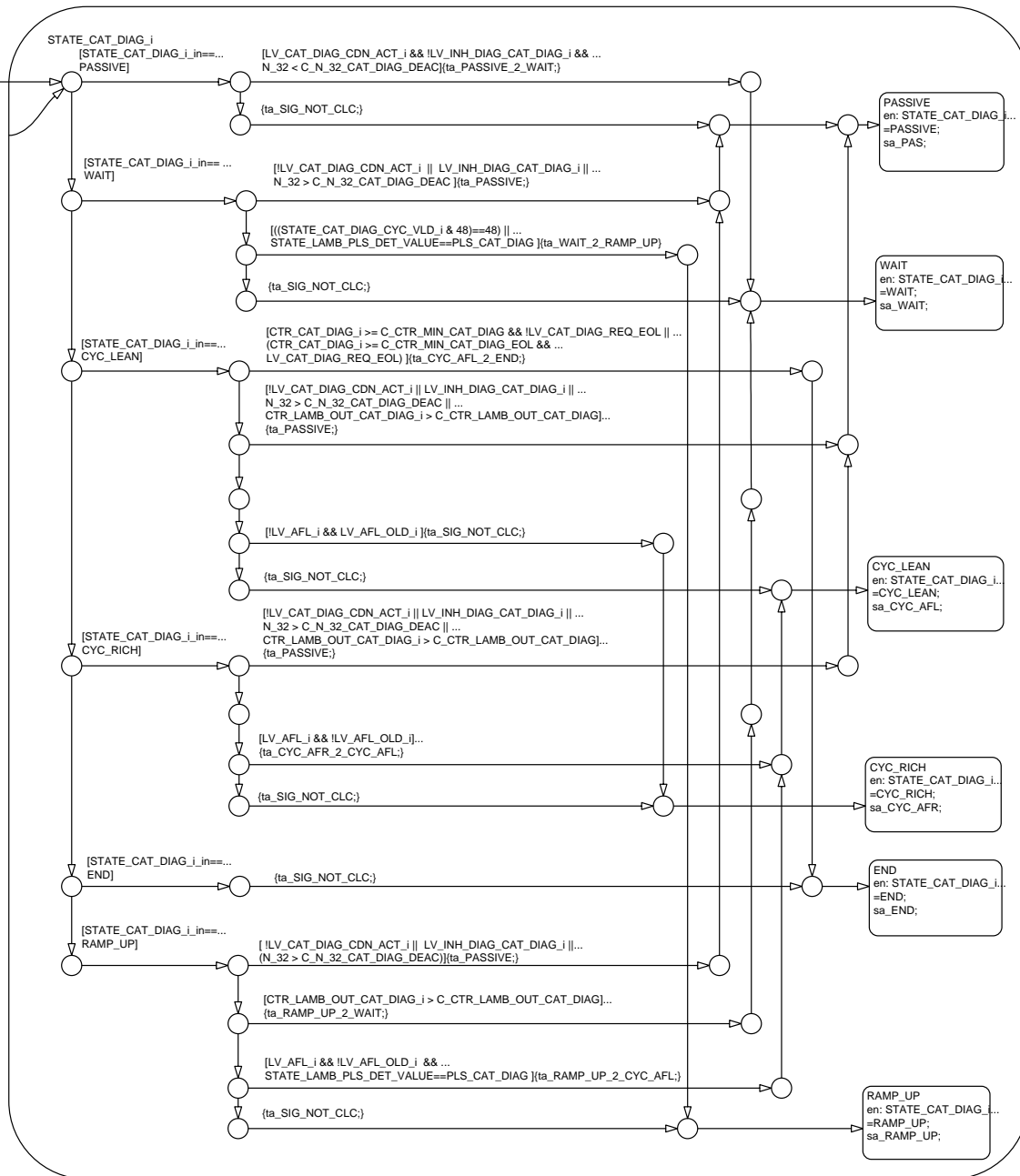


Figure B.46.7: :

#### B.46.3.1.1.2 Transition actions:

Performing the concerned transition action induced by the issued trigger vector.

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### B.46.3.1.1.2.1 EGTR\_FCTDGCEF0/OPERATE/EGTR\_FCTDGCEF0\_CBK\_MNG/EGTR\_FCTDGCEF0\_CBK\_SPC/TA\_CAT\_DIAG/TA1\_PASSIVE\_2\_WAIT

#### B.46.3.1.1.2.1.1 Transition action PASSIVE to WAIT:

Setting the temporary WAIT state flag to zero to indicate the downstream lambda sum of this monitoring cycle not to be complete (no valid mean value for the next cycle).

Initializing the downstream lambda sum and its counter to zero.

Storing the old value of LV\_AFL for edge detection.

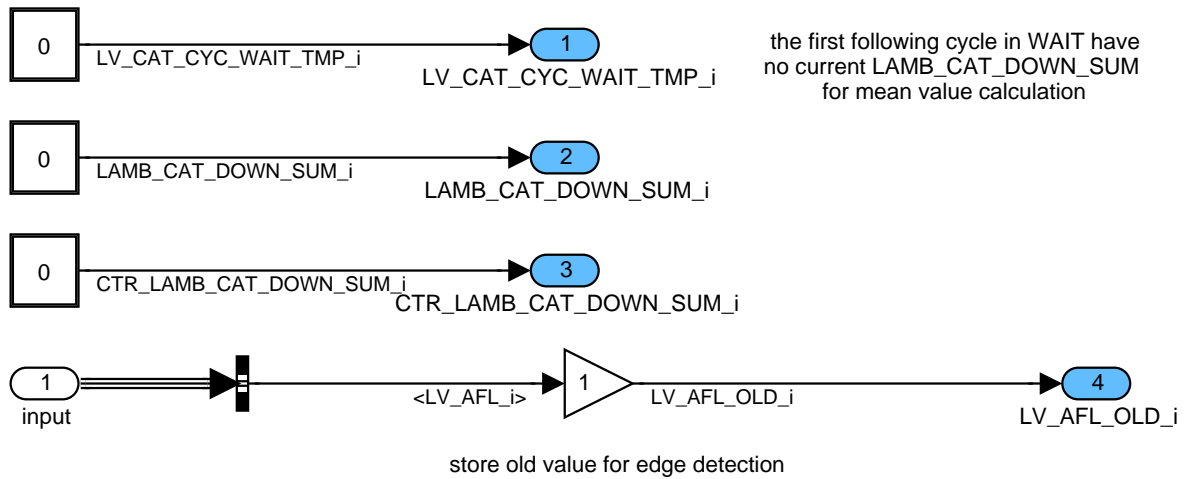


Figure B.46.8: :

### B.46.3.1.1.2.2 EGTR\_FCTDGCEF0/OPERATE/EGTR\_FCTDGCEF0\_CBK\_MNG/EGTR\_FCTDGCEF0\_CBK\_SPC/TA\_CAT\_DIAG/TA2\_RAMPUP\_2\_CYC\_LEAN

#### B.46.3.1.1.2.2.1 Transition action RAMP\_UP to CYC\_LEAN:

Calculation of the downstream lambda mean value of last cycle. Initializing the downstream lambda sum, its counter and the related oxygen mass to zero.

Storing the downstream lambda signal at start of the monitoring cycle and initializing the concerning min/max values to the same value.

Resetting the validity bits with regard to crossing events, setting the validity bit with regard to the permitted difference between the actual downstream lambda signal and the mean value of last cycle.

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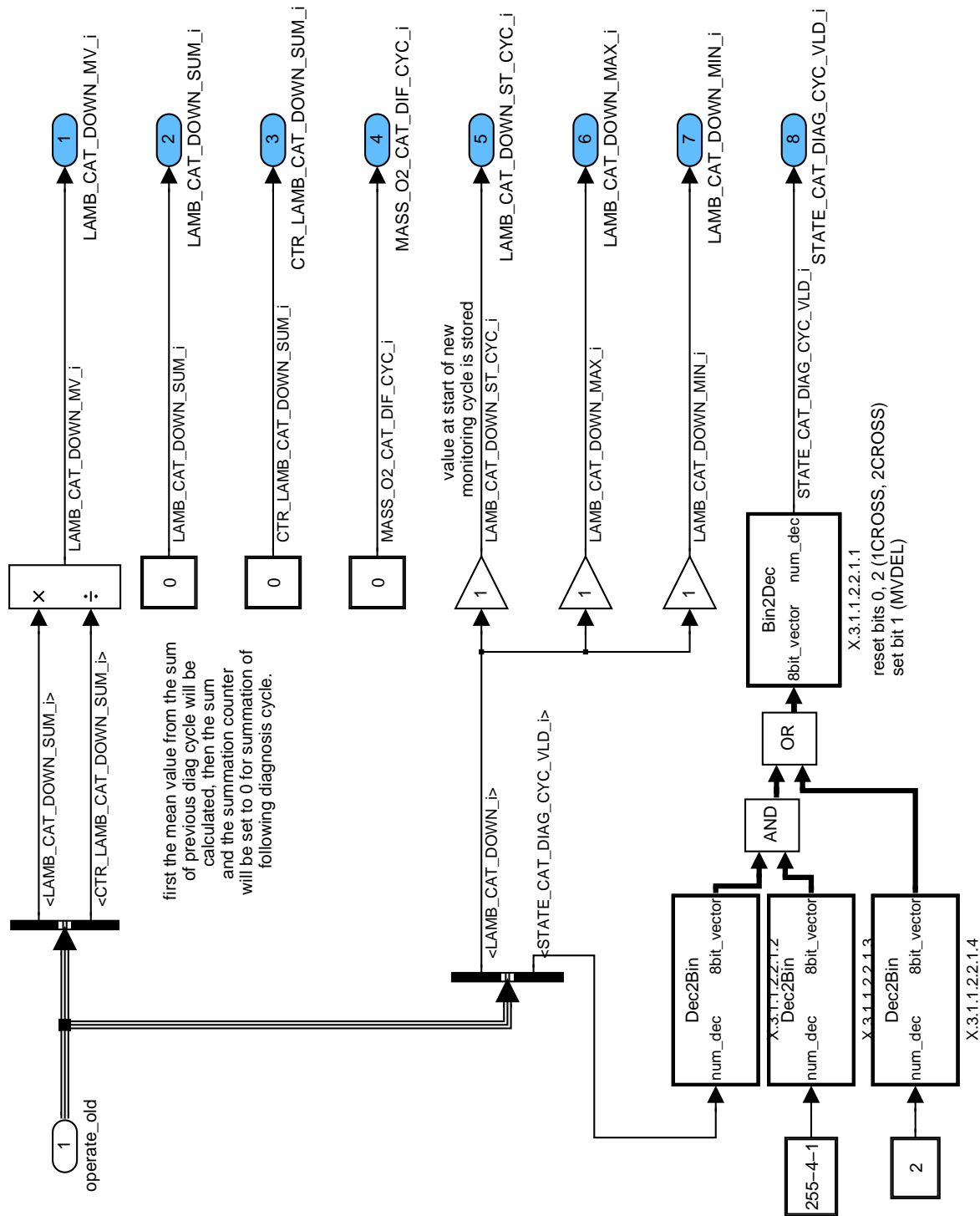


Figure B.46.9: :

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### B.46.3.1.1.2.3 EGTR\_FCTDGCEF0/OPERATE/EGTR\_FCTDGCEF0\_CBK\_MNG/EGTR\_FCTDGCEF0\_CBK\_SPC/TA\_CAT\_DIAG/TA4\_CYC\_LEAN\_2\_END

#### B.46.3.1.1.2.3.1 Transition action CYC\_LEAN to END:

Calculation of the new diagnosis value and incrementing the total number of completed diagnosis cycles since ECU programming by one.

Resetting forced stimulation and trim control parameters to nominal values and all validity bits to zero.

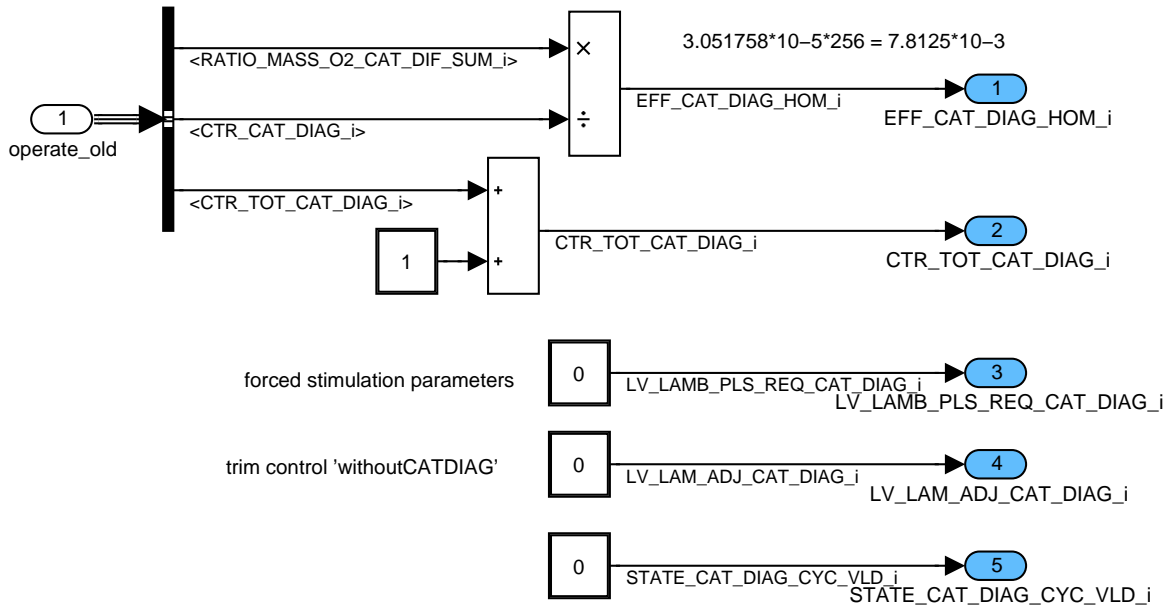


Figure B.46.10: :

### B.46.3.1.1.2.4 EGTR\_FCTDGCEF0/OPERATE/EGTR\_FCTDGCEF0\_CBK\_MNG/EGTR\_FCTDGCEF0\_CBK\_SPC/TA\_CAT\_DIAG/TA5\_CYC\_RICH\_2\_CYC\_LEAN

#### B.46.3.1.1.2.4.1 Transition action CYC\_RICH to CYC\_LEAN:

Start of a new monitoring cycle.

Calculation of the downstream lambda mean value of last cycle.

Evaluation of the diagnosis value merely related to last monitoring cycle. Computation of the actual temperature difference between dynamic and stationary catalyst temperature.

Incrementing/resetting the number of cycles showing lambda to be out of range and setting the validity bits. In case of validity sum up the diagnosis value and increment the counter of valid cycles by one.

Initializing the single cycle bound sums and counters for next cycle.

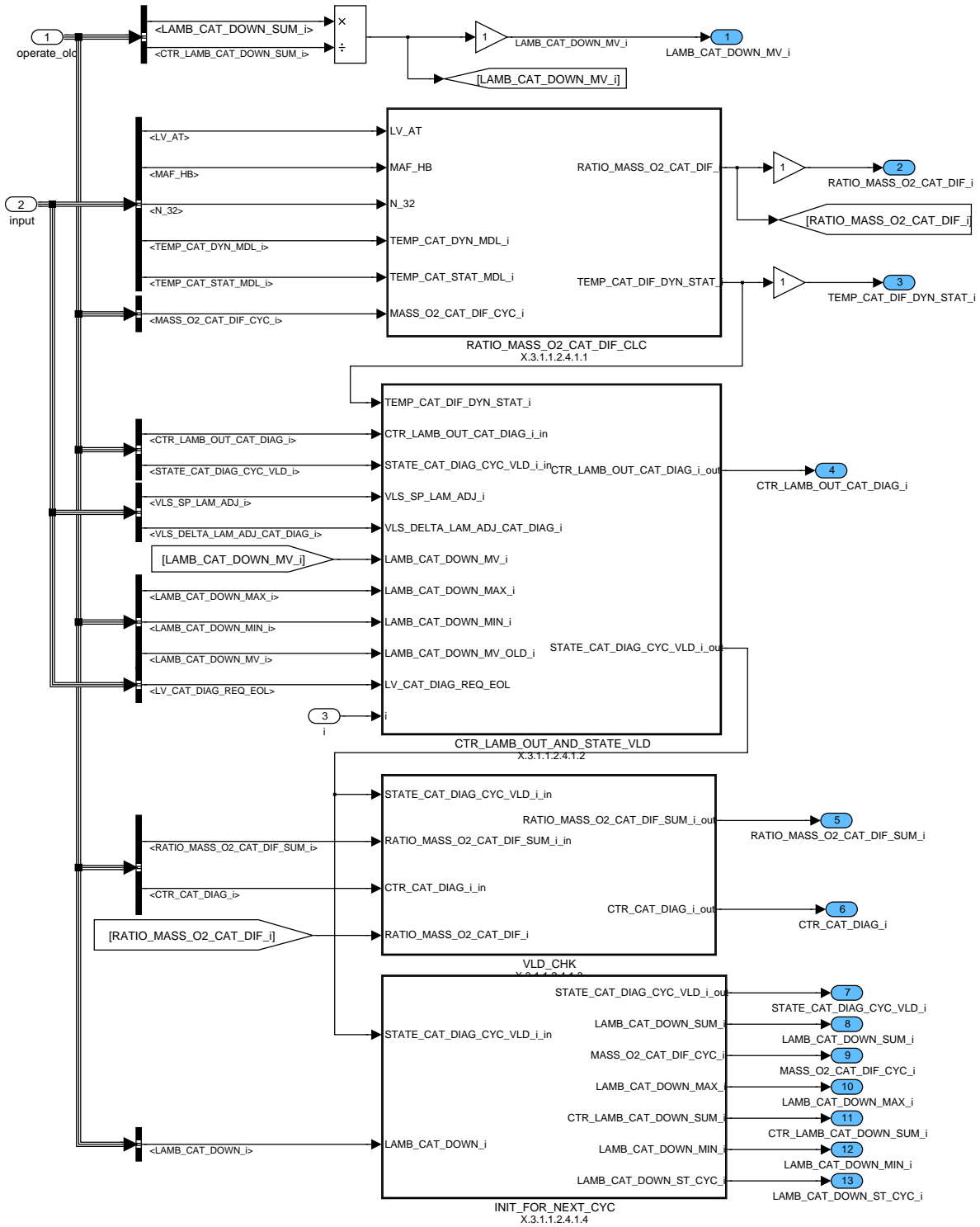


Figure B.46.11: :

**B.46.3.1.1.2.4.1.1 Weighting the diagnosis value:**

Weighting the diagnosis value related to last monitoring cycle, taking into account the concerning work-point and temperature dynamics.

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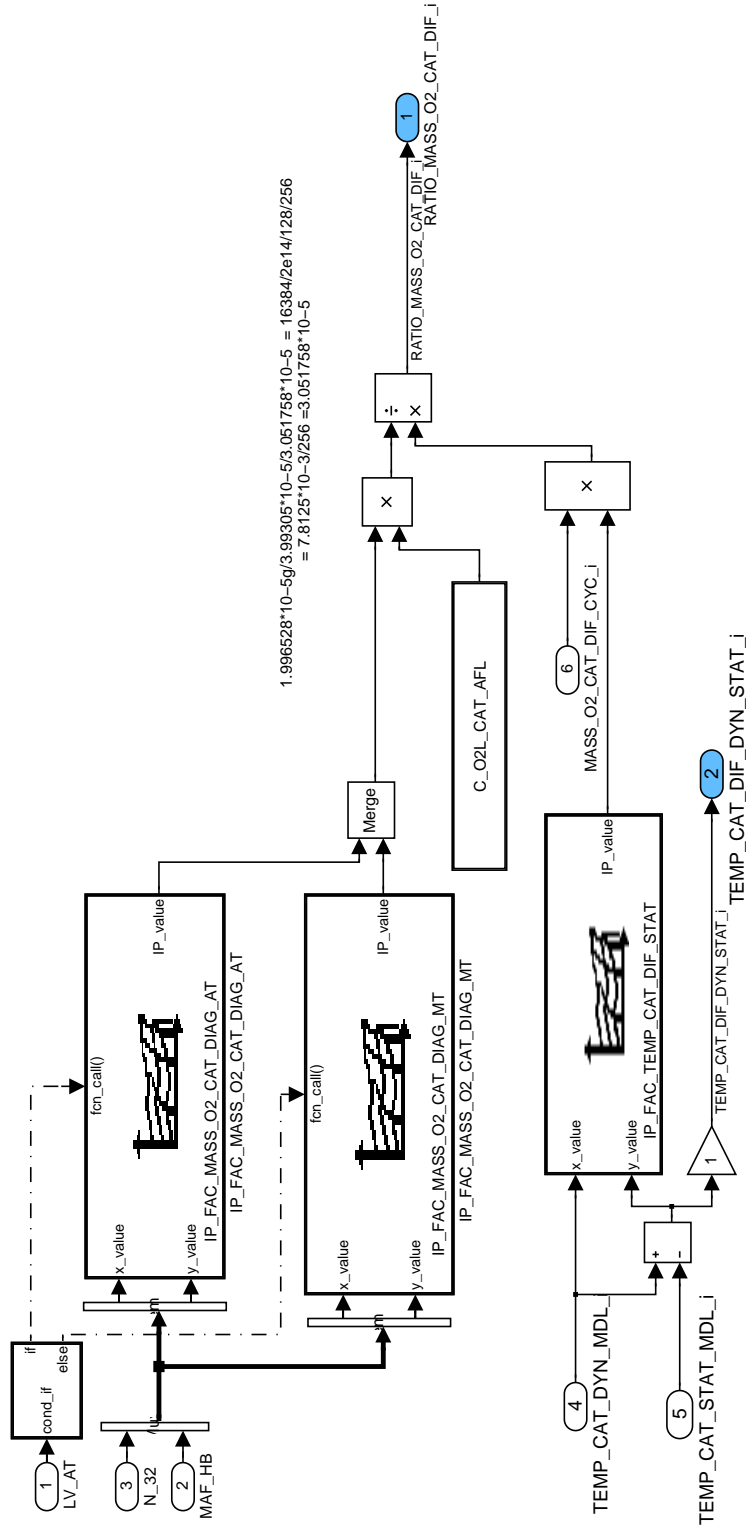


Figure B.46.12: :


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### B.46.3.1.1.2.4.1.2 Monitoring cycle validity:

Computing the absolute difference between downstream lambda mean value and the corrected lambda setpoint and comparing it to the stored maximally admissible difference. Setting the RANGE bit in dependence on the result. Incrementing/resetting the counter of monitoring cycles showing lambda to be out of range.

Comparing the stat/dyn temperature difference to the stored maximally allowed value and setting the TEMPERATURE bit accordingly.

Computing the difference between downstream lambda min/max and dividing by eight. Adding this to the stored maximum allowed if the temperature range is o.k. Comparing the result to the absolute difference between actual and old mean value and setting the cycle validity bit in correspondence with.

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 5493 of 8404</b>	
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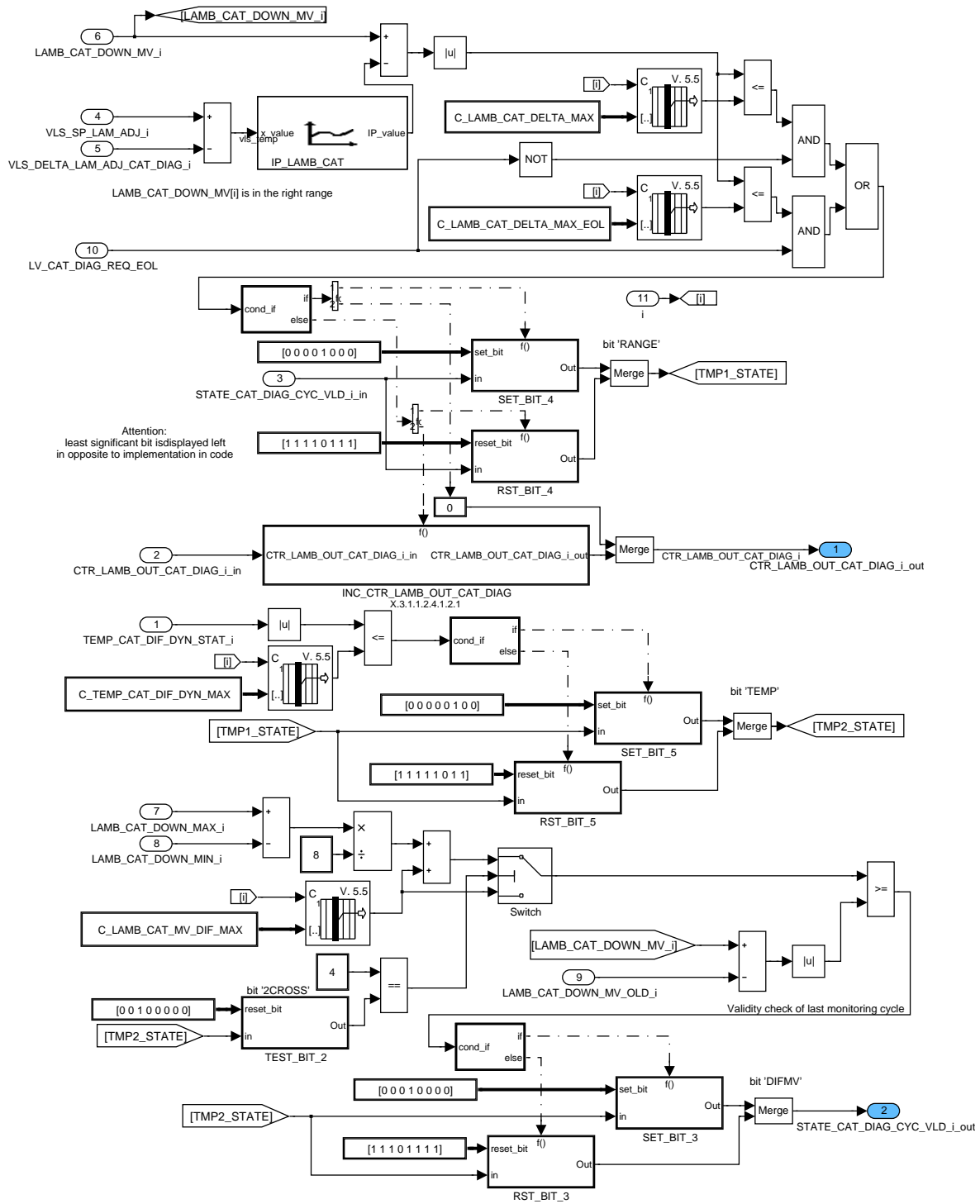


Figure B.46.13: :

**B.46.3.1.1.2.4.1.2.1 Incrementing/resetting counter:**

Incrementing/resetting the number of cycles showing lambda to be out of range.

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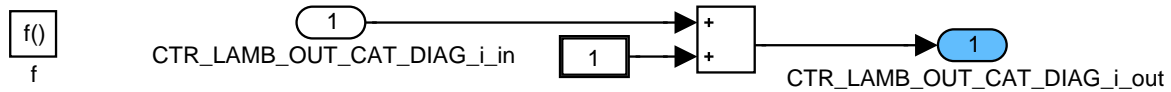


Figure B.46.14: :

**B.46.3.1.1.2.4.1.3 Validity Check:**

Checking last cycle for validity. If the last cycle is valid summing up the diagnosis value and adding one to the number of valid monitoring cycles.

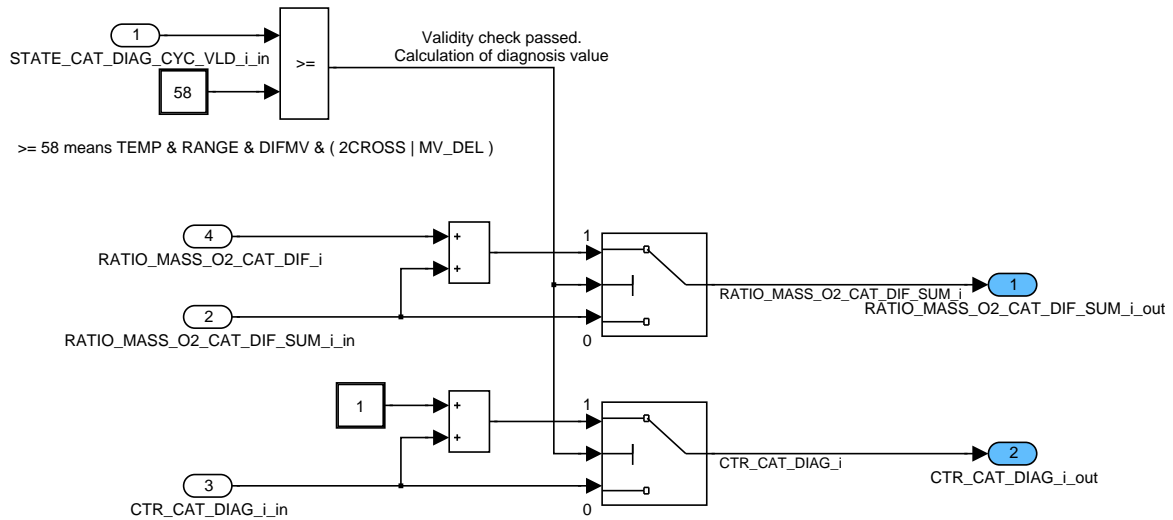


Figure B.46.15: :

**B.46.3.1.1.2.4.1.4 Initialization for next cycle:**

Resetting the validity bits with regard to crossing events, setting the validity bit with regard to the permitted difference between the actual downstream lambda signal and the mean value of last cycle.

Initializing the downstream lambda sum, its counter and the related oxygen mass to zero.

Storing the downstream lambda value at start of the monitoring cycle and initializing the concerning min/max values to the same value to detect crossing events.

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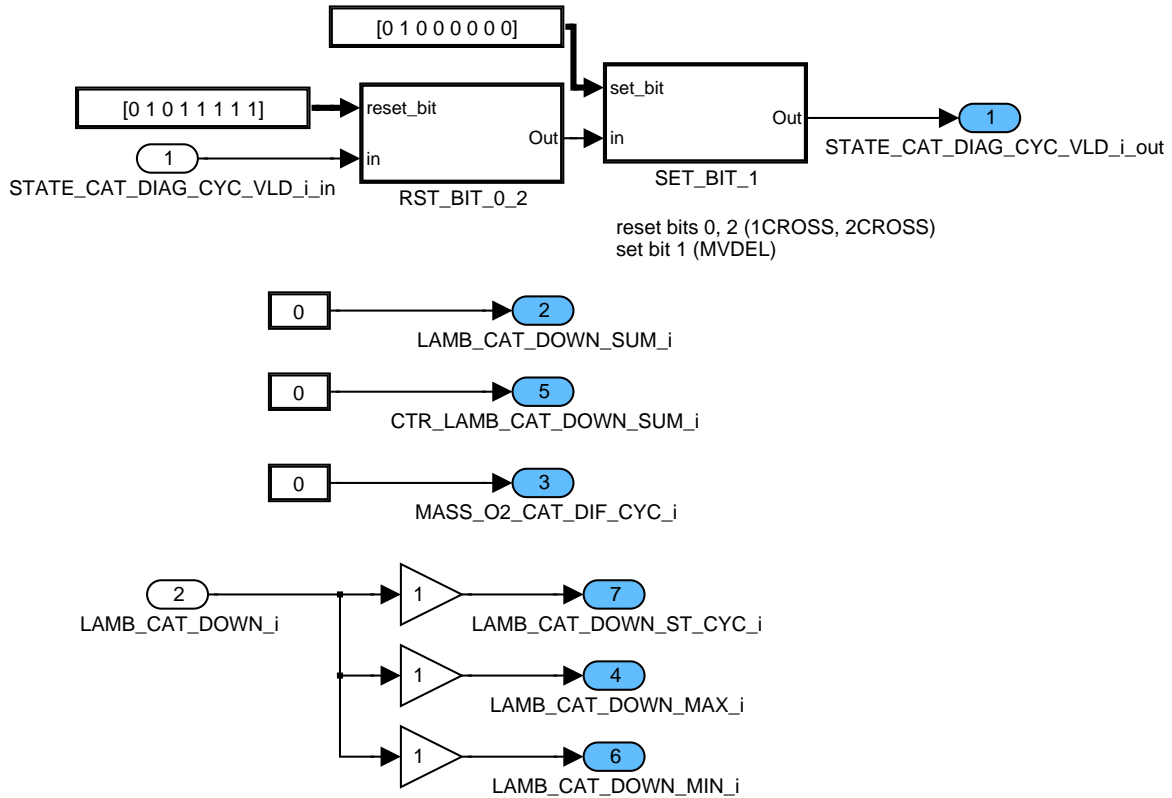


Figure B.46.16: :

**B.46.3.1.1.2.5 EGTR\_FCTDGCEF0/OPERATE/EGTR\_FCTDGCEF0\_CBK\_MNG/EGTR\_FCTDGCEF0\_CBK\_SPC/TA\_CAT\_DIAG/TA\_PASSIVE**

**B.46.3.1.1.2.5.1 Transition action X to PASSIVE:**

Resetting forced stimulation and trim control to nominal mode and all validity bits to zero.

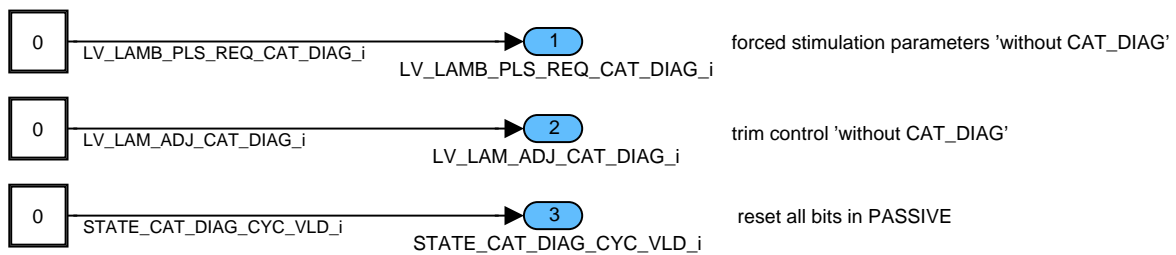


Figure B.46.17: :

**B.46.3.1.1.2.6 EGTR\_FCTDGCEF0/OPERATE/EGTR\_FCTDGCEF0\_CBK\_MNG/EGTR\_FCTDGCEF0\_CBK\_SPC/TA\_CAT\_DIAG/TA10\_WAIT\_2\_RAMPUP**

**B.46.3.1.1.2.6.1 Transition action WAIT to RAMP\_UP:**

Setting forced stimulation and trim control to catalyst diagnosis mode and the number of cycles showing lambda to be out of range to zero.

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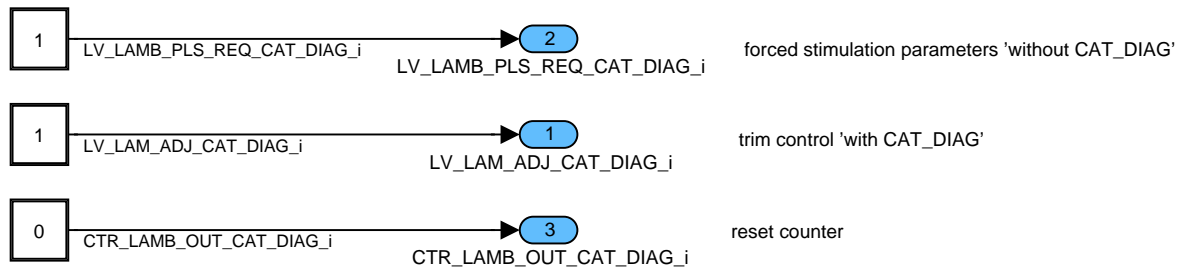


Figure B.46.18: :

### B.46.3.1.1.2.7 EGTR\_FCTDGCEF0/OPERATE/EGTR\_FCTDGCEF0\_CBK\_MNG/EGTR\_FCTDGCEF0\_CBK\_SPC/TA\_CAT\_DIAG/TA11\_RAMPUP\_2\_WAIT

#### B.46.3.1.1.2.7.1 Transition action RAMP\_UP to WAIT:

Resetting forced stimulation and trim control to nominal mode because of lambda being out of range. Resetting all validity bits to zero.

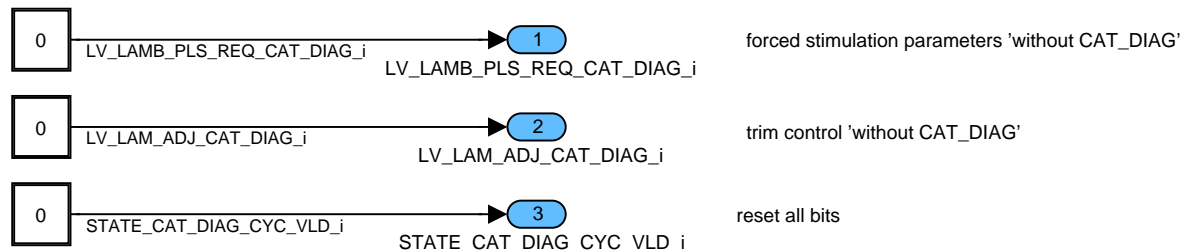


Figure B.46.19: :

#### B.46.3.1.1.3 State actions:

Performing the concerned state action induced by the issued trigger vector.

##### B.46.3.1.1.3.1 State action PASSIVE/END:

No performance of any action in states PASSIVE and END.

### B.46.3.1.1.3.2 EGTR\_FCTDGCEF0/OPERATE/EGTR\_FCTDGCEF0\_CBK\_MNG/EGTR\_FCTDGCEF0\_CBK\_SPC/SA\_CAT\_DIAG/WAIT

#### B.46.3.1.1.3.2.1 State action WAIT:

Converting the downstream sensor voltage to the related downstream lambda value.

Checking the flag for lean state and comparing with the allied old value. This action is checking for the start of a new monitoring cycle.

In case of a transition zero to one and validity of the cycle calculation of the downstream lambda mean value and resetting the downstream lambda sum and its counter afterwards. Calculating the new trim control setpoint the new trim control setpoint, the stat/dyn temperature difference and setting the validity bits.

In case of a transition zero to one and non validity of the cycle resetting the downstream lambda sum and its counter and marking the cycle as non valid.

Summing up downstream lambda and incrementing the counter in all other cases.

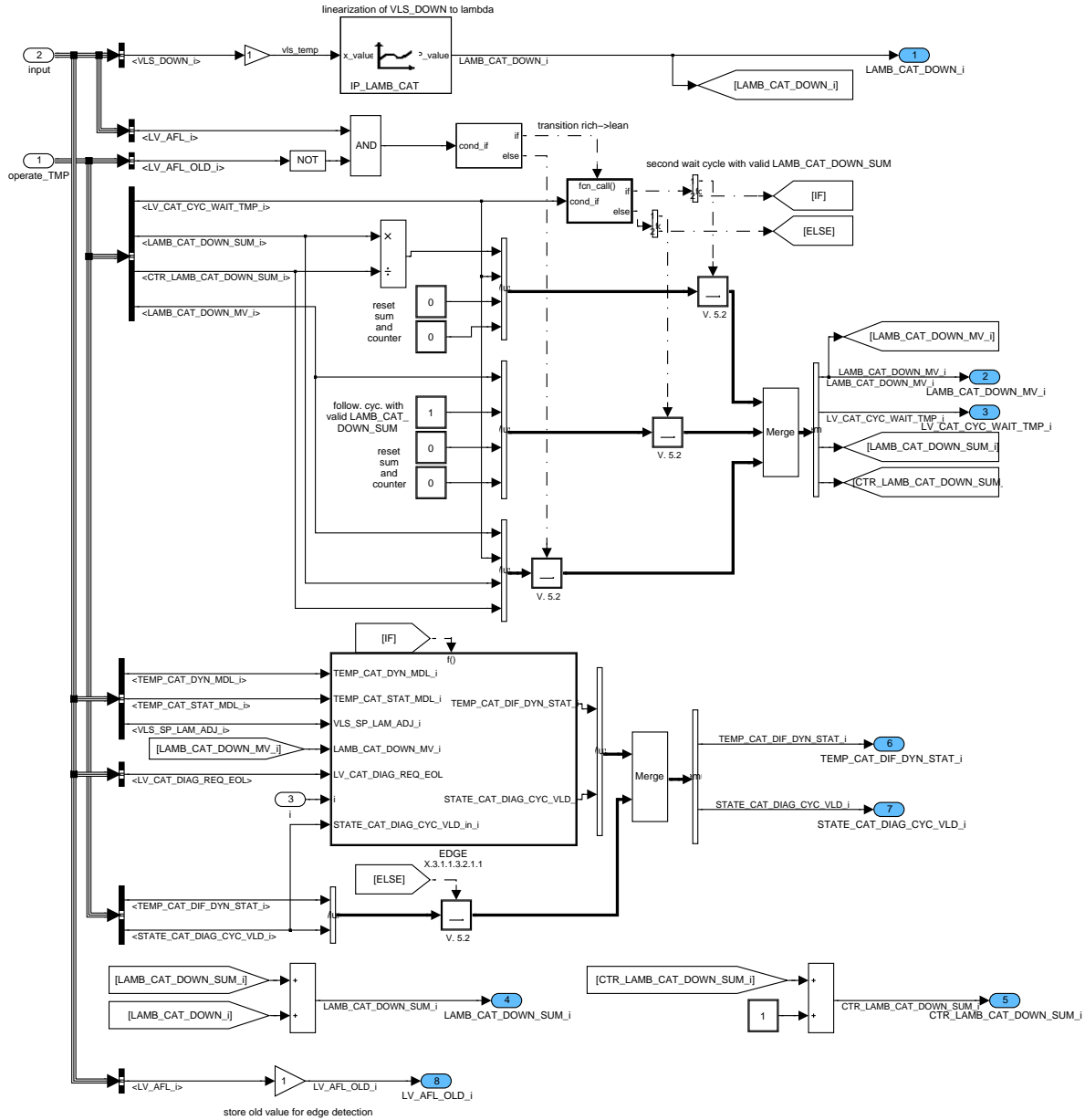


Figure B.46.20: :

### B.46.3.1.1.3.2.1.1 State action WAIT/edge action:

Computing the absolute difference between downstream lambda mean value and lambda setpoint and comparing it to the stored maximally admissible difference. Setting the RANGE bit in dependence on the result.

Comparing the stat/dyn temperature difference to the stored maximally allowed value and setting the TEMPERATURE bit accordingly.

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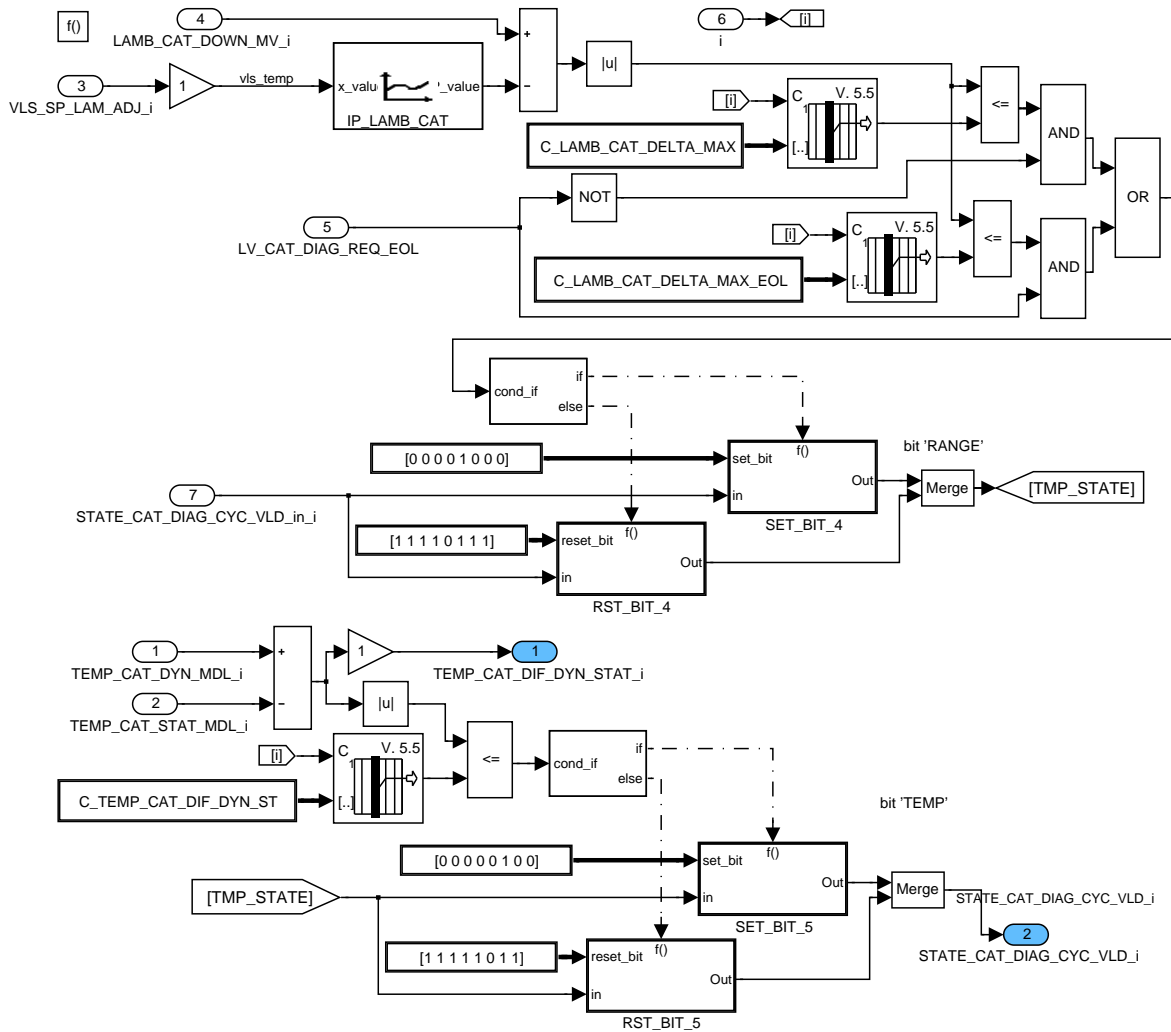


Figure B.46.21: :

### B.46.3.1.1.3.3 EGTR\_FCTDGCEF0/OPERATE/EGTR\_FCTDGCEF0\_CBK\_MNG/EGTR\_FCTDGCEF0\_CBK\_SPC/SA\_CAT\_DIAG/AFL\_AFR

#### B.46.3.1.1.3.3.1 State action AFL/AFR:

Converting the downstream sensor voltage to the related downstream lambda value.

Comparing the actual downstream lambda value with stored min/max values and overwriting in case of exceeding.

Summing up the actual downstream lambda value and incrementing the counter.

Calculation of the actual downstream oxygen mass flow and integrating the passed part of the cycle.

Setting of the summary validity bits.

Storing the old lean state flag for edge detection.

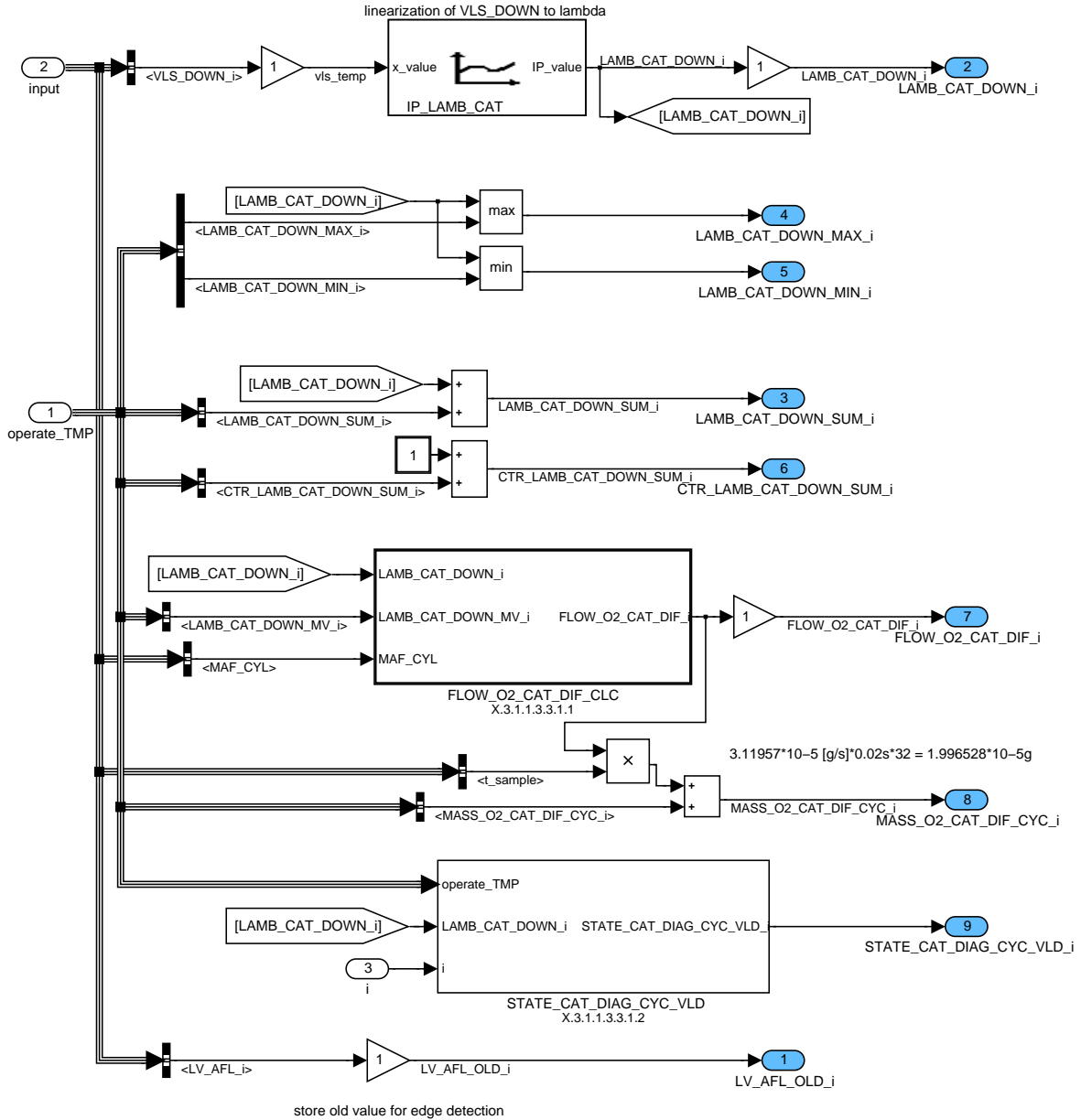
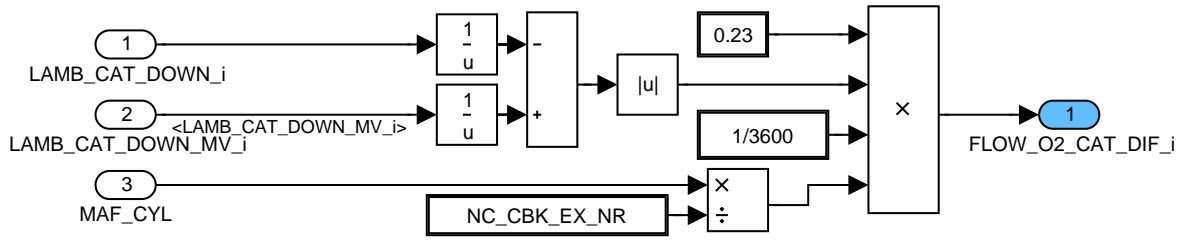


Figure B.46.22: :

**B.46.3.1.1.3.3.1.1 Downstream oxygen mass flow:**

Calculation of the actual downstream oxygen mass flow.

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calculation  $0.23 \cdot 2 / 65536 \cdot 0.03125 \cdot 1000 / 3600 \cdot 512 = 3.11957 \cdot 10^{-5}$  [g/s]

Figure B.46.23: :

**B.46.3.1.1.3.3.1.2 Check for cycle validity:**

Resetting the 1CROSS bit. Checking for 1CROSS AND 2CROSS. Comparing the absolute difference between downstream lambda and lambda mean value to the related stored maximum and setting the MVDEL bit accordingly.

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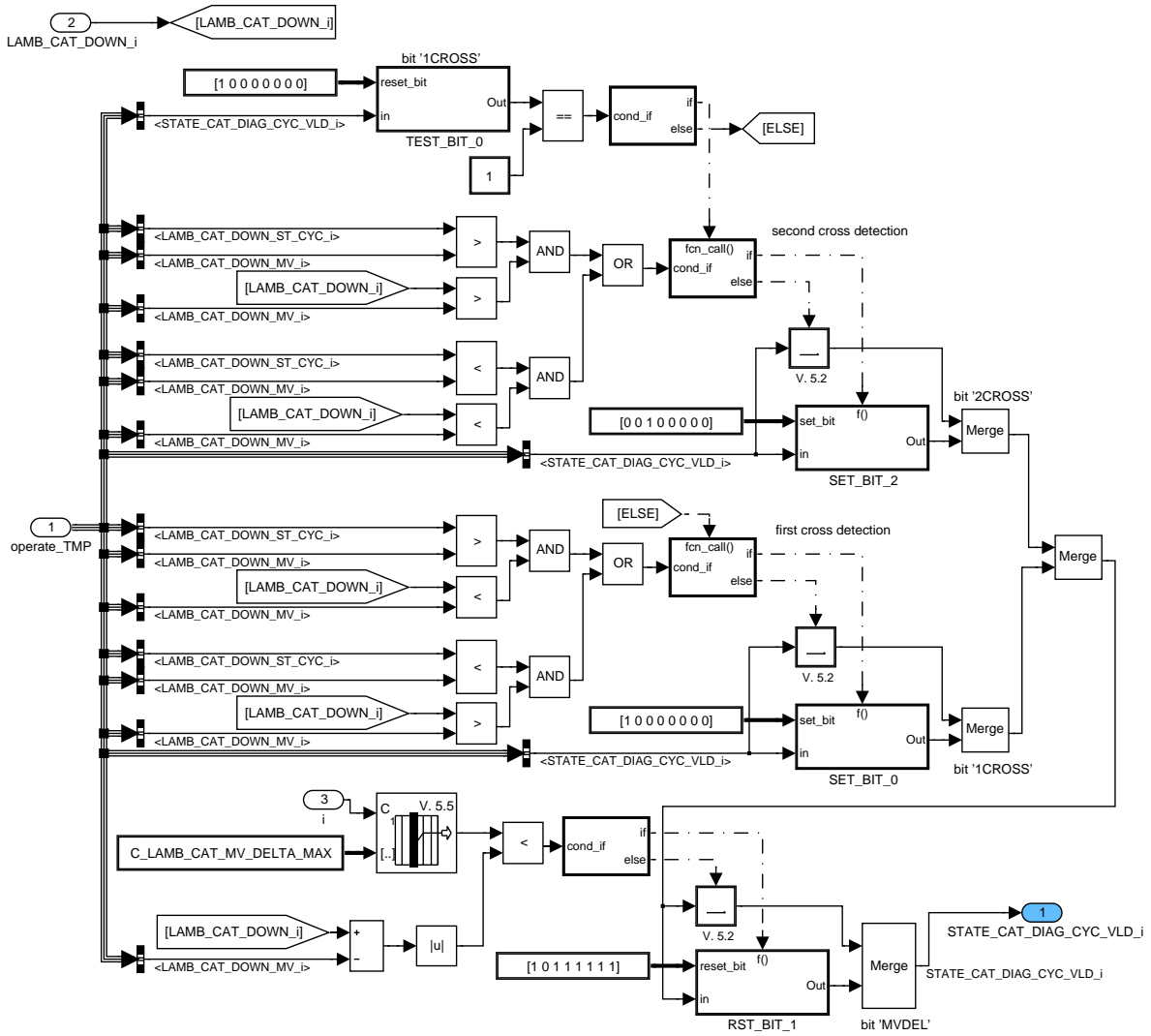


Figure B.46.24: :

**B.46.3.1.1.3.4 EGTR\_FCTDGCEF0/OPERATE/EGTR\_FCTDGCEF0\_CBK\_MNG/EGTR\_FCTDGCEF0\_CBK\_SPC/SA\_CAT\_DIAG/RAMP\_UP**

**B.46.3.1.1.3.4.1 State action RAMP\_UP:**

Converting the downstream sensor voltage to the related downstream lambda value.

Checking the flag for lean state and comparing with the allied old value (checking for the start of a new monitoring cycle).

In case of a transition zero to one calculation of the downstream lambda mean value, incrementing the counter of monitoring cycles showing lambda out of range, setting of the summary validity bits and summing up downstream lambda and its counter.

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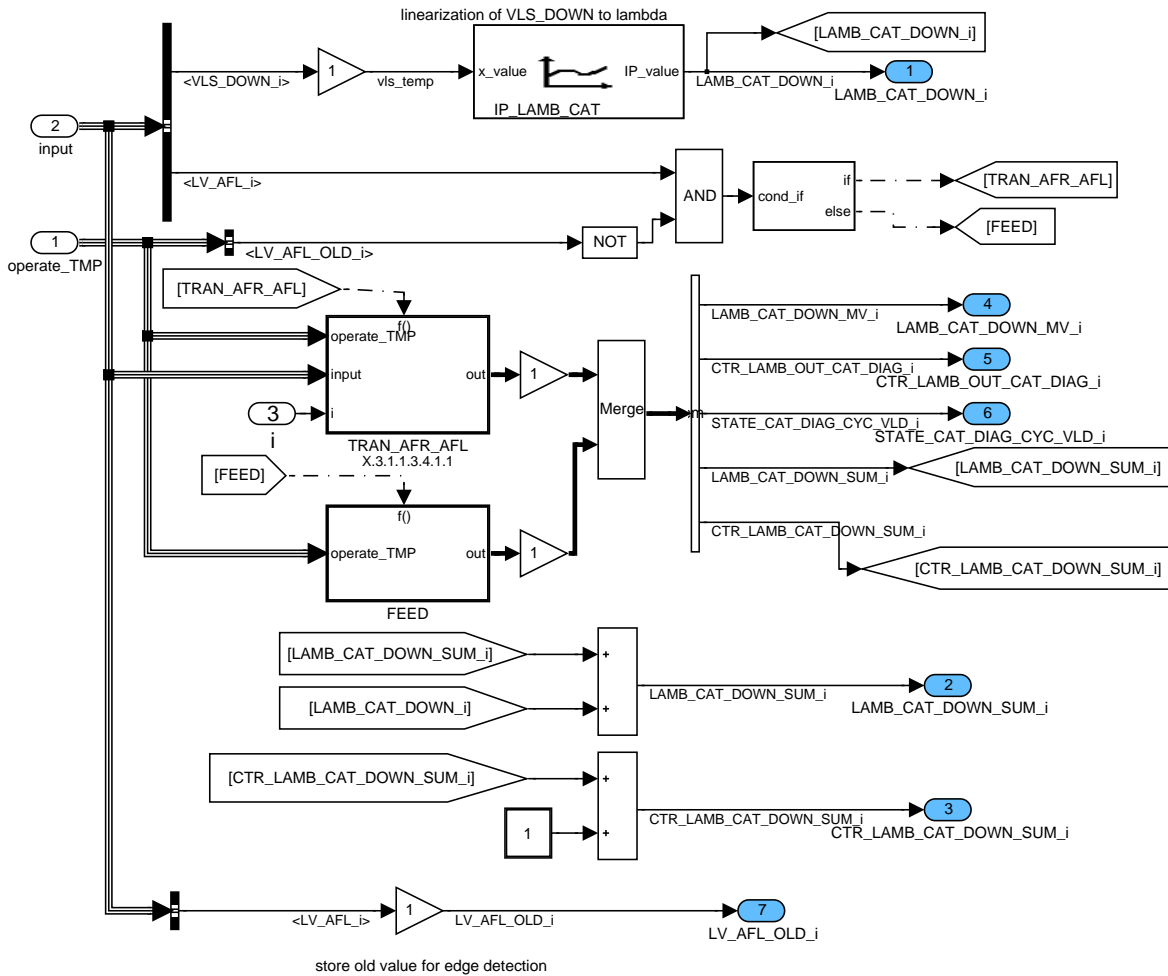


Figure B.46.25: :

**B.46.3.1.1.3.4.1.1 TRAN\_AFR\_AFL:**

Calculation of the downstream lambda mean value of last cycle and correcting the influence of asymmetric sensor characteristic.

Checking the actual sensor signal to be in the allowed range and setting the respective validity bit in accordance with as well as the counter of non valid monitoring cycles and the summary validity bits.

Resetting the downstream lambda sum and its counter to zero.

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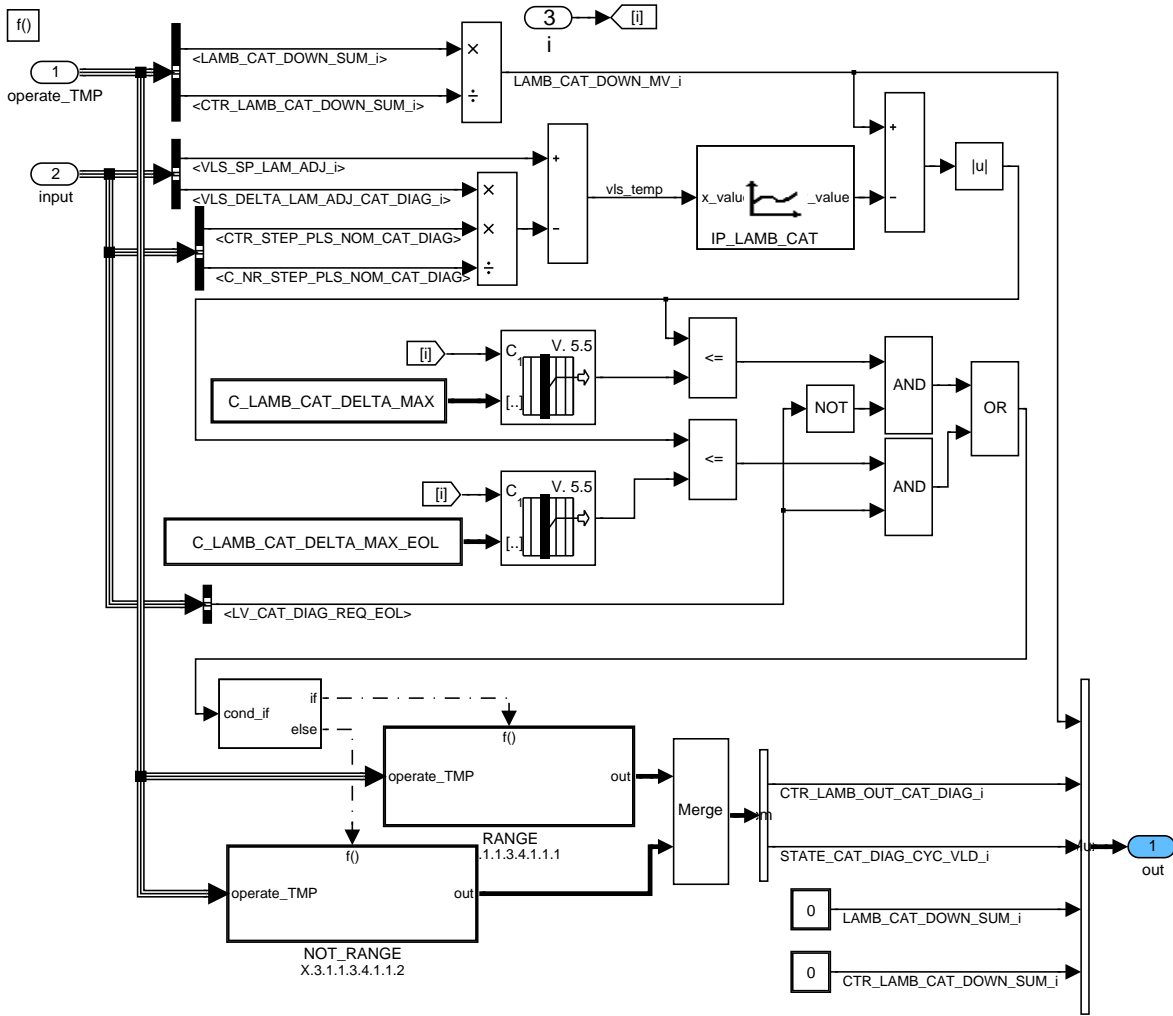


Figure B.46.26: :

**B.46.3.1.1.3.4.1.1.1 TRAN\_AFR\_AFL/RANGE**

Setting the counter of monitoring cycles showing lambda to be out of range to zero and the bit indicating that the diagnosis mean value is in the right range to one.

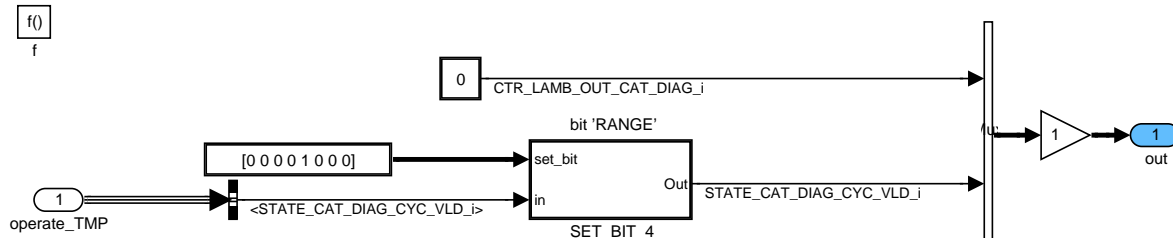


Figure B.46.27: :

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### B.46.3.1.1.3.4.1.1.2 TRAN\_AFR\_AFL/NOT\_RANGE

Adding one to the number of monitoring cycles showing lambda to be out of range and resetting the validity bit indicating that the diagnosis mean value is in the right range.

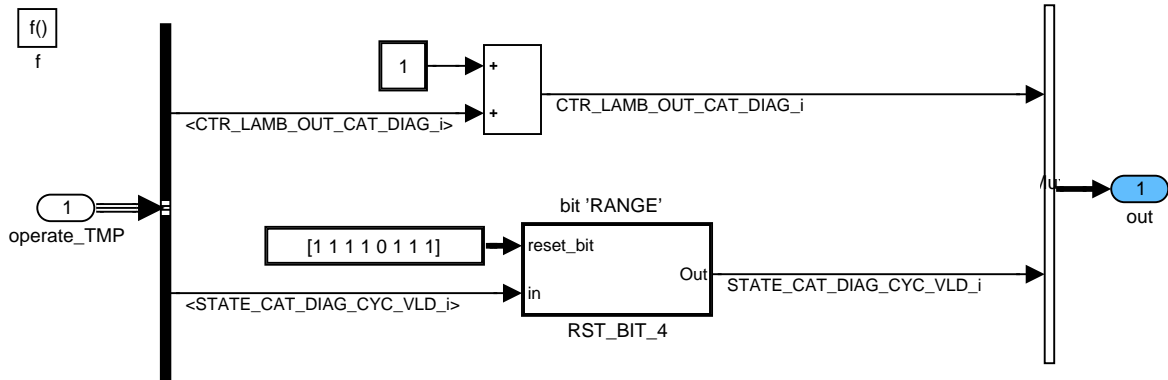


Figure B.46.28: :

## B.47 Catalyst efficiency diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LOAD_CAT_LDC	O/V	0... 3FFH	0... 99.90234375	0.09765625	%
Catalyst diagnosis specific load for limited dynamics calculation					
LV_INH_DIAG_CAT_DIAG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag to inhibit catalyst diagnosis function					
LV_INH_DIAG_RBM_CAT_DIAG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag to inhibit catalyst diagnosis function if there is a OBD failure					
STATE_RBM_CAT [NC_CBK_EX_NR]	O/V	0... FH	0... 15	1	-
Interface of EFF_CAT_DIAG[i] monitor with the Rate-Based Monitoring statistics					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	FAC_TQ_REQ {p. 6706}	LC_DIAG_DYN_LSL_UP_CAT_SYN {p. 5355}	LC_DIAG_PUE_ACT_LS_DOWN {p. 5191}
LV_CAT_DIAG_REQ_EOL {p. 799}	LV_DC {p. 5746}	LV_END_DIAG_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}	LV_END_DIAG_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}
LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT] {p. 1061}
LV_ERR_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CHG_LS_DOWN {p. 5388}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CHK_LS_DOWN [NC_CBK_EX_NR] {p. 5388}
LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_PER {p. 4432}
LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}
LV_ERR_EL_CPS {p. 4708}	LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}
LV_ERR_FTL_MIN {p. 4762}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}
LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}


LV_ERR_MAF_FRQ_EL [NC_MAF_NR] {p. 4815}	LV_ERR_MAF_FRQ_GRD [NC_MAF_NR] {p. 4815}	LV_ERR_MAF_FRQ_RNG [NC_MAF_NR] {p. 4815}	LV_ERR_MAP_PLAUS {p. 1062}
LV_ERR_MAP_TPS_PLAUS {p. 1062}	LV_ERR_MEC_IVVT_EX {p. 1062}	LV_ERR_MEC_IVVT_IN {p. 1062}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}
LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}	LV_ERR_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5198}
LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}
LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_ERR_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5297}	LV_ERR_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5169}	LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}
LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SLV_IVVT_EX {p. 4627}	LV_ERR_SLV_IVVT_IN {p. 4627}	LV_ERR_SWT_LS_DOWN [NC_CBK_EX_NR] {p. 5152}
LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}
LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}
LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VCV {p. 4729}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}
LV_ERR_VS {p. 5021}	LV_ERR_VS_PLAUS {p. 5021}	LV_INH_DIAG_RBM_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5377}	LV_LS_DIAG_REQ_INH_CAT_DIAG {p. 5349}
LV_MTC_CUR_OFF {p. 6565}	NC_CBK_EX_NR {p. 1829}	NC_MAF_NR {p. 834}	NC_NR_CAM_CBK {p. 1507}
NC_NR_CBK_IVVT {p. 604}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_INH_CAT_DIAG_MAN_DEAC	V	0... 1H	0 ...1	1	-
Manual deactivation of CAT diagnosis inhibition conditions					

**Import actions:**

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<b>ACTION_ERRM_CheckPendingStatus (IN&lt;PRM_XX&gt;,OUT&lt;PRM_PendingStatus&gt;)</b>
---

## General information

### B.47.1 Inhibition of diagnosis

#### General information:

The inhibition of the catalyst diagnosis can be deactivated by :

LC\_INH\_CAT\_DIAG\_MAN\_DEAC = 1.

For LC\_INH\_CAT\_DIAG\_MAN\_DEAC = 1 the catalyst diagnosis function is not inhibited by a component failure.

#### Description:

If one of the following components fail the catalyst efficiency diagnosis function is stopped by LV\_INH\_DIAG\_RBM\_CAT\_DIAG[i] = 1. The inhibition is calculated bank-wise.

#### Application conditions:

**Initialisation:** at reset all Variables shall be set to 0

**Activation:** LV\_DC transition 0 -> 1 (start driving cycle)

**Deactivation:** LV\_DC transition 1 -> 0 (driving cycle terminated)

**Recurrence:** 0.02 sec

#### Function description:

#### Formula section:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC\_CBK\_EX\_NR = 2), then

i = 1, for cylinder bank 1

i = 2, for cylinder bank 2

otherwise (NC\_CBK\_EX\_NR = 1)

i = 1, for single exhaust cylinder bank 1.

```

If          LV_ERR_AMP = 1
or          LV_ERR_AMP_PLAUS = 1
or          LV_ERR_CHG_LS_DOWN = 1
or          LV_ERR_CHG_LS_UP = 1
or          LV_ERR_CRK_PLAUS = 1
or          LV_ERR_CRK_SYN = 1
or          LV_ERR_CRK_TOOTH = 1
or          LV_ERR_CRK_TOOTH_PER = 1
or          LV_ERR_DIAGCPS = 1
or          LV_ERR_EL_CPS = 1
or          LV_ERR_FTL_MIN = 1
or          LV_ERR_FUP = 1
  
```

```

or      LV_ERR_FUP_MFP_PLAUS = 1
or      LV_ERR_FUP_ORNG = 1
or      LV_ERR_FUP_ST = 1
or      LV_ERR_H_PRS_SYS = 1
or      LV_ERR_LOAD_TPS_PLAUS = 1
or      LV_ERR_MAP_PLAUS = 1
or      LV_ERR_MAP_TPS_PLAUS = 1
or      LV_ERR_MTC_CTL_2 = 1
or      LV_ERR_MTC_CTL_3 = 1
or      LV_ERR_MTC_DR = 1
or      LV_ERR_TPS_1 = 1
or      LV_ERR_TPS_2 = 1
or      LV_ERR_TPS_AD = 1
or      LV_ERR_TPS_AD_BOL = 1
or      LV_ERR_TPS_MAF_1 = 1
or      LV_ERR_TPS_MAF_2 = 1
or      LV_ERR_TPS_RATIO = 1
or      LV_ERR_TPS_ST_CHK_2 = 1
or      LV_ERR_VCV = 1
or      LV_ERR_VS = 1
or      LV_ERR_VS_PLAUS = 1
or      LV_ERR_AIR_LSL_UP [i] = 1
or      LV_ERR_CHK_LS_DOWN [i] = 1
or      LV_ERR_CTL_LSL_UP [i] = 1
or      LV_ERR_DELTA_I_LAM [i] = 1
or      LV_ERR_DYN_VLD_LS_UP [i] = 1
or      LV_ERR_EL_LSL_UP [i] = 1
or      LV_ERR_FSD [i] = 1
or      LV_ERR_FSD_LAM_LIM [i] = 1
or      LV_ERR_LSH_DOWN [i] = 1
or      LV_ERR_LSH_UP [i] = 1
or      LV_ERR_LSL_UP_IF [i] = 1
or      LV_ERR_OBD_LSH_DOWN [i] = 1
or      LV_ERR_OBD_VLD_LSH_UP [i] = 1
or      LV_ERR_OC_LS_DOWN [i] = 1
or      LV_ERR_OC_LSL_UP [i] = 1
or      LV_ERR_OFS_LSL_UP [i] = 1
or      LV_ERR_PUC_LS_DOWN [i] = 1
or      LV_ERR_PUC_VLD_LS_UP [i] = 1
or      [LV_ERR_PUE_LS_DOWN [i] = 1
      and LC_DIAG_PUE_ACT_LS_DOWN = 1]
or      LV_ERR_SCG_LS_DOWN [i] = 1
or      LV_ERR_SCP_LS_DOWN [i] = 1
or      LV_ERR_SHIFT_AFR_LSL_UP [i] = 1
or      LV_ERR_SHIFT_AFL_LSL_UP [i] = 1
or      LV_ERR_SWT_LS_DOWN [i] = 1
or      LV_ERR_TTIP_MES_LSH_UP [i] = 1
or      LV_ERR_VLS_DOWN_DIF [i] = 1
or      LV_ERR_MAF_FRQ_EL [y] = 1 for all y
or      LV_ERR_MAF_FRQ_GRD [y] = 1 for all y
or      LV_ERR_MAF_FRQ_RNG [y] = 1 for all y
or      LV_ERR_CAM_CST_IVVT_IN [x] = 1 for all x
or      LV_ERR_CAM_CST_IVVT_EX [x] = 1 for all x
or      LV_ERR_MEC_IVVT_IN [x] = 1 for all x
or      LV_ERR_MEC_IVVT_EX [x] = 1 for all x
or      LV_ERR_SLV_IVVT_IN [x] = 1 for all x
or      LV_ERR_SLV_IVVT_EX [x] = 1 for all x
or      LV_ERR_PER_CAM_EX [k] = 1 for all k
or      LV_ERR_PER_CAM_IN [k] = 1 for all k
or      LV_ERR_PLAUS_CAM_EX [k] = 1 for all k
or      LV_ERR_PLAUS_CAM_IN [k] = 1 for all k

```

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```

or      LV_ERR_REF_CRK_CAM_EX[k] = 1 for all k
or      LV_ERR_REF_CRK_CAM_IN[k] = 1 for all k
or      LV_ERR_SYN_CAM_EX[k] = 1 for all k
or      LV_ERR_SYN_CAM_IN[k] = 1 for all k
or      LV_ERR_SYN_CRK_CAM_IN[k] = 1 for all k
or      LV_ERR_TOOTH_OFF_EX[k] = 1 for all k
or      LV_ERR_TOOTH_OFF_IN[k] = 1 for all k
or      LV_ERR_IV[0] = 1 for i = 1 and NC_CYL_NR = 6
or      LV_ERR_IV[2] = 1 for i = 1 and NC_CYL_NR = 6
or      LV_ERR_IV[4] = 1 for i = 1 and NC_CYL_NR = 6
or      LV_ERR_IV[1] = 1 for i = 2 and NC_CYL_NR = 6
or      LV_ERR_IV[3] = 1 for i = 2 and NC_CYL_NR = 6
or      LV_ERR_IV[5] = 1 for i = 2 and NC_CYL_NR = 6
or      LV_ERR_MIS[0] = 1 for i = 1 and NC_CYL_NR = 6
or      LV_ERR_MIS[2] = 1 for i = 1 and NC_CYL_NR = 6
or      LV_ERR_MIS[4] = 1 for i = 1 and NC_CYL_NR = 6
or      LV_ERR_MIS[1] = 1 for i = 2 and NC_CYL_NR = 6
or      LV_ERR_MIS[3] = 1 for i = 2 and NC_CYL_NR = 6
or      LV_ERR_MIS[5] = 1 for i = 2 and NC_CYL_NR = 6

```

```

Then      LV_INH_DIAG_RBM_CAT_DIAG[i] = 1
          (Catalyst efficiency diagnosis inhibited due to OBD error )
Else      LV_INH_DIAG_RBM_CAT_DIAG[i] = 0
          (Catalyst efficiency diagnosis not inhibited)
Endif

```

Inhibition due to environmental condition / calibration:

```

If LV_MTC_CUR_OFF = 1
  Or (LV_INH_DIAG_RBM_CAT_DIAG[i] = 1
    and LC_INH_CAT_DIAG_MAN_DEAC = 0)
  or (LV_LS_DIAG_REQ_INH_CAT_DIAG = 1
    and LV_CAT_DIAG_REQ_EOL = 0
    and [(LV_END_DIAG_DYN_VLD_LS_UP[1] = 0
      and LV_INH_DIAG_RBM_DYN_VLD_LS_UP[1] = 0)
      #IF NC_CBK_EX_NR = 2
      #THEN
      or (LV_END_DIAG_DYN_VLD_LS_UP[2] = 0
        and LV_INH_DIAG_RBM_DYN_VLD_LS_UP[2] = 0)
      #ENDIF]
    and LC_DIAG_DYN_LSL_UP_CAT_SYN = 0)
Then LV_INH_DIAG_CAT_DIAG[i] = 1 (Catalyst efficiency diagnosis inhibited)
Else LV_INH_DIAG_CAT_DIAG[i] = 0 (Catalyst efficiency diagnosis not inhibited)
Endif


```

Catalyst diagnosis specific load for limited dynamics calculation

LOAD\_CAT\_LDC = FAC\_TQ\_REQ

The definition of both variables are different, therefore a linear interpolation between the physical limits (min and max) of FAC\_TQ\_REQ shall be applied, i.e. LOAD\_CAT\_LDC = 0% if FAC\_TQ\_REQ = 0; LOAD\_CAT\_LDC = 99,9023438% if FAC\_TQ\_REQ = 1.999969.

## B.47.2 Interface for Rate – Based - Monitoring

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**General information:**

With this module the interface between the CAT\_DIAG\_i monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_CAT[i] data.

Within STATE\_RBM\_CAT[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)  
(depending on failure status: pending)
- Monitor individual RBM conditions encountered within this DC (bit 2)  
( not valid for catalyst diagnosis )

**Application conditions:**

**Initialisation:** at LV\_DC 0 @ 1 transition :  
bit 0, bit 1 and bit 2 of STATE\_RBM\_CAT[i] = 0  
on failure memory reset :  
bit 1 of STATE\_RBM\_CAT[i] = 0

**Activation:** LV\_DC 0 @ 1 transition **and** LV\_DC = 1

**Deactivation:** -

**Recurrence:** 1 s

**Function description:****Formula section:**

At LV\_DC 0 @ 1 transition

The pending status of the following failures has to be checked only once :

Dependence	Error			
	LV_ERR_AMP	LV_ERR_AMP_PLAUS	LV_ERR_CHG_LS_DOWN	LV_ERR_CHG_LS_UP
		LV_ERR_CRK_PLAUS	LV_ERR_CRK_SYN	LV_ERR_CRK_TOOTH
	LV_ERR_CRK_TOOTH_PER	LV_ERR_DIAGCPS	LV_ERR_EL_CPS	LV_ERR_FUP
	LV_ERR_FUP_MFP_PLAUS	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_SYS
	LV_ERR_LOAD_TPS_PLAUS	LV_ERR_MAP_PLAUS	LV_ERR_MAP_TPS_PLAUS	LV_ERR_MTC_CTL_2
	LV_ERR_MTC_CTL_3	LV_ERR_MTC_DR		
	LV_ERR_TPS_1	LV_ERR_TPS_2	LV_ERR_TPS_AD	LV_ERR_TPS_AD_BOL
	LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2	LV_ERR_TPS_RATIO	LV_ERR_TPS_ST_CHK_2
	LV_ERR_VCV	LV_ERR_VS	LV_ERR_VS_PLAUS	

Continued on next page

<b>NC_CBK_EX_NR</b>	LV_ERR_AIR_LSL_UP [i]	LV_ERR_CHK_LS_DOWN [i]	LV_ERR_CTL_LSL_UP [i]	LV_ERR_DELTA_I_LAM [i]
	LV_ERR_DYN_VLD_LS_UP [i]	LV_ERR_EL_LSL_UP [i]		LV_ERR_FSD [i]
	LV_ERR_FSD_LAM_LIM [i]	LV_ERR_LSH_DOWN [i]	LV_ERR_LSH_UP [i]	LV_ERR_LSL_UP_IF [i]
	LV_ERR_OBD_LSH_DOWN [i]	LV_ERR_OBD_VLD_LSH_UP	LV_ERR_OC_LS_DOWN [i]	LV_ERR_OC_LSL_UP
	LV_ERR_OFS_LSL_UP [i]	LV_ERR_PUC_LS_DOWN [i]	LV_ERR_PUC_VLD_LS_UP [i]	LV_ERR_PUE_LS_DOWN [i]
	LV_ERR_SCG_LS_DOWN [i]	LV_ERR_SCP_LS_DOWN [i]	LV_ERR_SHIFT_AFL_LSL_UP [i]	LV_ERR_SHIFT_AFR_LSL_UP [i]
	LV_ERR_SWT_LS_DOWN [i]	LV_ERR_TTIP_MES_LSH_UP [i]	LV_ERR_VLS_DOWN_DIF [i]	

For y = 1 to NC\_MAF\_NR (= for all i)

<b>NC_MAF_NR</b>	LV_ERR_MAF_FRQ_EL [y]	LV_ERR_MAF_FRQ_GRD [y]	LV_ERR_MAF_FRQ_RNG [y]	
------------------	-----------------------	------------------------	------------------------	--

For x = 1 to NC\_NR\_CBK\_IVVT (= for all i)

<b>NC_NR_CBK_IVVT</b>	LV_ERR_MEC_IVVT_IN [x]	LV_ERR_MEC_IVVT_EX [x]	LV_ERR_SLV_IVVT_IN [x]	LV_ERR_SLV_IVVT_EX [x]
	LV_ERR_CAM_CST_IVVT_IN [x]	LV_ERR_CAM_CST_IVVT_EX [x]		

For k = 1 to NC\_NR\_CAM\_CBK (= for all i)

<b>NC_NR_CAM_CBK</b>	LV_ERR_PER_CAM_EX [k]	LV_ERR_PER_CAM_IN [k]	LV_ERR_PLAUS_CAM_EX [k]	LV_ERR_PLAUS_CAM_IN [k]
	LV_ERR_REF_CRK_CAM_EX [k]	LV_ERR_REF_CRK_CAM_IN [k]	LV_ERR_SYN_CAM_EX [k]	LV_ERR_SYN_CAM_IN [k]
	LV_ERR_SYN_CRK_CAM_IN [k]		LV_ERR_TOOTH_OFF_EX [k]	LV_ERR_TOOTH_OFF_IN [k]

NC\_CBK\_EX\_NR = 1

<b>Dependence</b>	<b>Error</b>			
<b>NC_CYL_NR</b>	LV_ERR_MIS[0]	LV_ERR_MIS[2]	LV_ERR_MIS[4]	LV_ERR_IV[0]
Continued on next page				



	LV_ERR_IV[2]	LV_ERR_IV[4]		
--	--------------	--------------	--	--

NC\_CBK\_EX\_NR = 2

Dependence	Error			
NC_CYL_NR	LV_ERR_MIS[1]	LV_ERR_MIS[3]	LV_ERR_MIS[5]	LV_ERR_IV[1]
	LV_ERR_IV[3]	LV_ERR_IV[5]		

**If(1)** { CPU optimization at LV\_DC 0 @ 1 transition }  
CTR\_ERR\_DYN\_NR <> 0 { the dynamic failure memory isn't empty }

**Then(1)**

**While** bit 1 of STATE\_RBM\_CAT[i] = 0 **do**  
with each XX failure of the above list :  
ACTION\_ERRM\_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION

**If(2)** XX has a pending status

**Then(2)**

bit 1 of STATE\_RBM\_CAT[i] = 1

**Endif(2)**

For LV\_ERR\_PUE\_LS\_DOWN[i], do the following instead:

**If** LC\_DIAG\_PUE\_ACT\_LS\_DOWN = 1

**then**

ACTION\_ERRM\_CheckPendingStatus(IN<XX>,  
OUT<PendingStatus>, SYNCHRONIZATION<CALL>)

**If(3)** XX has a pending status

**Then(3)** bit 1 of STATE\_RBM\_CAT[i] = 1

**Endif(3)**

**Endif(2)**

**Endwhile**

**Else(1)**

{ the dynamic failure memory is empty }

No action

**Endif(1)**

Every 1 s :

**If** bit 0 of STATE\_RBM\_XX = 0

**Then**

**If** LV\_END\_DIAG\_CAT\_DIAG[i] = 1

**Then** bit 0 of STATE\_RBM\_CAT[i] = 1

**Endif**

**Endif**

**If** bit 1 of STATE\_RBM\_CAT[i] = 0

**Then**

**If** LV\_INH\_DIAG\_RBM\_CAT\_DIAG[i] = 1


**Then** bit 1 of STATE\_RBM\_CAT[i] = 1

**Endif**

**Endif**

bit 2 of STATE\_RBM\_XX = 1

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## B.48 Catalyst efficiency diagnosis (error interface)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_CAT_DIAG_OBD [NC_CBK_EX_NR]	O/V/S	0... FFH	0... 1.9921875	7.8125e-3	-
Cat. Diag. value for OBD Scantool Mod 6 output					
EFF_CAT_DIAG_SUM	V	0... FFH	0... 1.9921875	7.8125e-3	-
Common value for catalyst conversion capability of both cylinder banks (OBD emission limit)					
EFF_CAT_DIAG_TMP [NC_CBK_EX_NR]	-	0... FFH	0... 1.9921875	7.8125e-3	-
temporary Cat. Diag. value for OBD Scantool Mod 6 output					
EFF_CAT_MAX_DIAG_OBD [NC_CBK_EX_NR]	O/V/S	0... FFH	0... 1.9921875	7.8125e-3	-
Actually threshold for Scantool Mod 6 Output					
EFF_CAT_MAX_DIAG_TMP [NC_CBK_EX_NR]	-	0... FFH	0... 1.9921875	7.8125e-3	-
temporary actually threshold for Scantool Mod 6 Output					
ERR_SYM_CAT_DIAG [NC_CBK_EX_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected failure of each symptom: failure without filtering of diagnosis value catalyst diagnose					
LV_CDN_DIAG_CAT_DIAG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag condition for catalyst diagnosis active					
LV_END_DIAG_CAT_DIAG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag catalyst diagnosis finished for that driving cycle					
LV_ERR_CAT_DIAG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Present failure catalyst efficiency					
STATE_CAT_DIAG_OLD [NC_CBK_EX_NR]	-	0H 1H 2H 3H 4H 5H	PASSIVE WAIT CYC_LEAN CYC_RICH END RAMP_UP	-	-
old value of State of diagnosis for edge detection					

### Input data:

EFF_CAT_DIAG_HOM [NC_CBK_EX_NR] {p. 5473}	LV_CAT_DIAG_REQ_EOL {p. 799}	LV_DC {p. 5746}	LV_END_DIAG_LAM_ADJ [NC_CBK_EX_NR] {p. 5215}
LV_ERR_LAM_ADJ [NC_CBK_EX_NR] {p. 5216}	LV_ERR_LS_DOWN [NC_CBK_EX_NR] {p. 5449}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_LS_DOWN_DIAG_END [NC_CBK_EX_NR] {p. 5449}
LV_LS_UP_DIAG_END [NC_CBK_EX_NR] {p. 5449}	NC_CBK_EX_NR {p. 1829}	STATE_CAT_DIAG [NC_CBK_EX_NR] {p. 5474}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EFF_CAT_MAX_DIAG	-	0... FFH	0... 1.9921875	7.8125e-3	-
max. threshold for EFF_CAT_DIAG to detect a separate catalyst with OBD limit emissions					
C_EFF_CAT_MAX_DIAG_EOL	-	0... FFH	0... 1.9921875	7.8125e-3	-
max. threshold for EFF_CAT_DIAG[i] to detect a separate catalyst with OBD limit emissions at EOL Test					
C_EFF_CAT_MAX_SUM_DIAG	-	0... FFH	0... 1.9921875	7.8125e-3	-
max. threshold for EFF_CAT_DIAG to common detect of catalysts with vehicle OBD limit emissions					
IP_EFF_CAT_DIAG_SUM	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_EFF_CAT_DIAG_1_IP_EFF_CAT	6	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_EFF_CAT_DIAG_2_IP_EFF_CAT	6	0... FFH	0... 1.9921875	7.8125e-3	-
Map of common EFF_CAT_DIAG_SUM value depending from separate bank values for common OBD emiss. limit					
LC_CAT_DIAG_DIS	-	0... 1H	0 ...1	1	-
For report value to Scan tool: separate EFF_CAT_DIAG for each catalyst or common, if over OBD emiss. limit					
LC_CAT_DIAG_EOL_LS_USE	-	0... 1H	0 ...1	1	-
Boolean that considers if LS end flags are used for cat-diagnosis EOL test					
LC_CAT_DIAG_RESU	-	0... 1H	0 ...1	1	-
Switch over the failure memory setting: separate for each catalyst or common for OBD emiss. limit					

**General Information**

For 2 exhaust gas bank system 1 bank (catalyst) could be aged over OBD limit, but if other catalyst is O.K, emissions of whole vehicle need not be over OBD limit, so MIL needn t go on. A separate diagnosis of every cylinder bank(catalyst), or common diagnosis is switchable. A common EFF\_CAT\_DIAG\_SUM is calculated from separate EFF\_CAT\_DIAG[i] values of separate banks and error memory entered if common value is over the threshold.

Configuration for diagnostic symptoms:

Diagnostic CAT_DIAG[i]	Symptom description	Symptom	Filter type
Catalyst diagnosis	'CAT_EFFIC_LOW'	SYM_0	NO

NC\_CBK\_EX\_NR defines the number of exhaust banks.

For vector elements, the variable extension `_i` is used in the model instead of `[i]` as found in the textual description.

**Application Conditions**

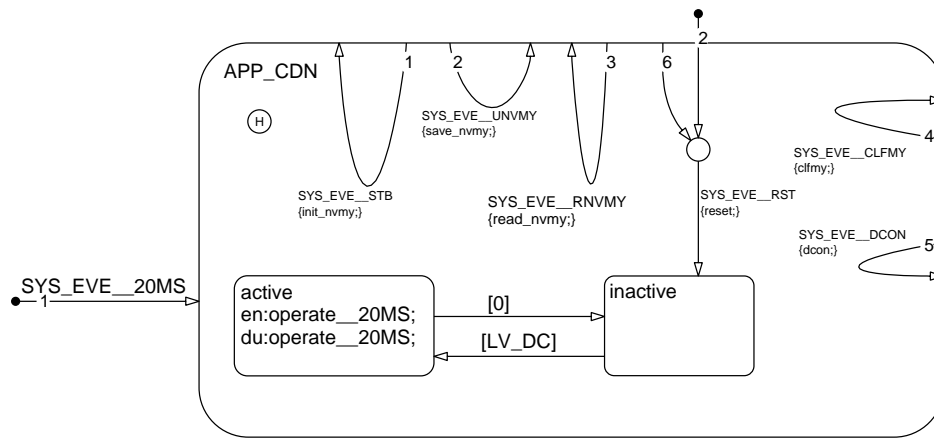


Figure B.48.1: : Path: EGTR\_FCTDGCEFIF0/APP\_CDN/Chart

**Function description**

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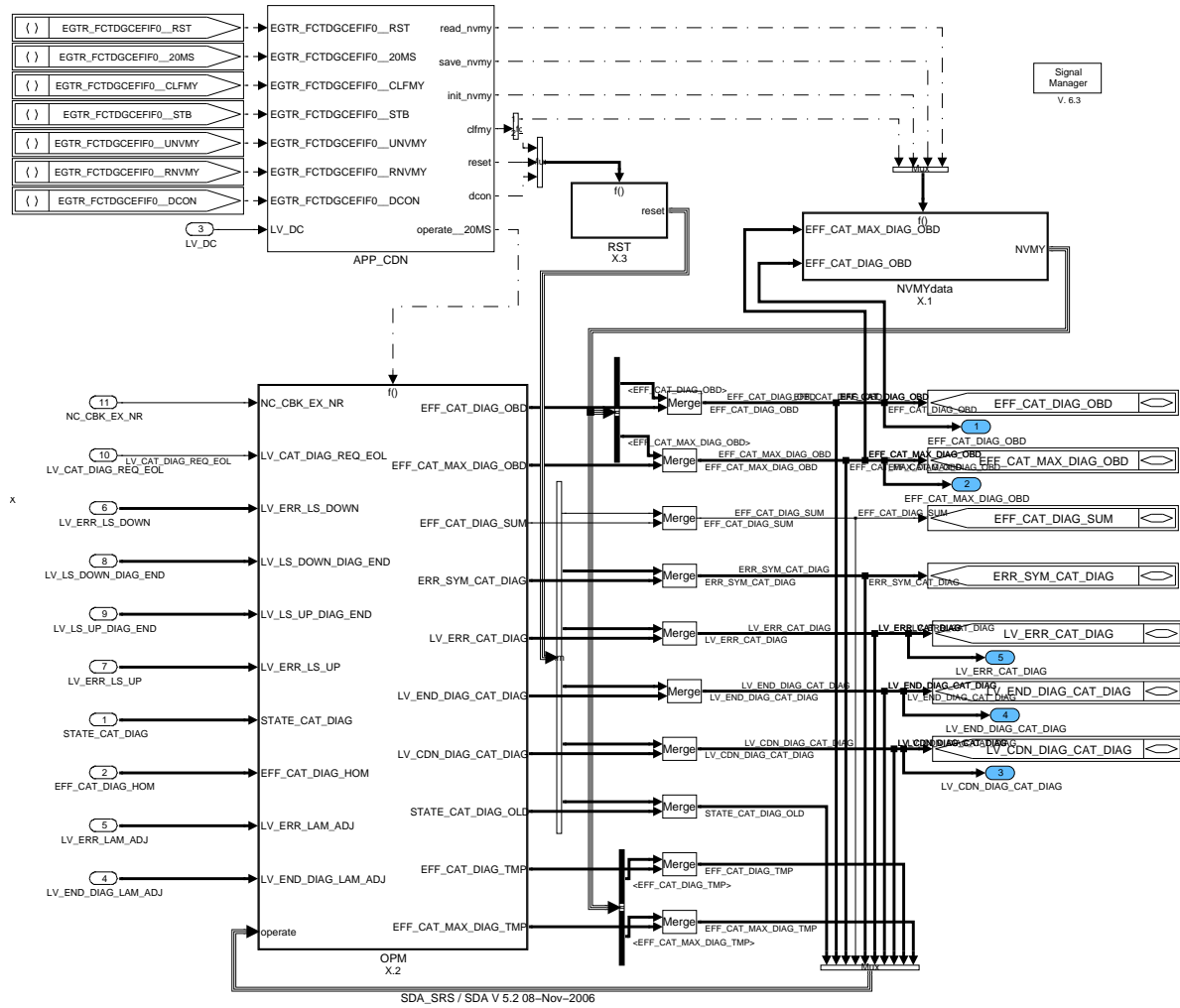


Figure B.48.2: : Path: EGTR\_FCTDGCEFI0

### B.48.1 NVMY Data

Init initialization at memory fault  
 Read restore from memory

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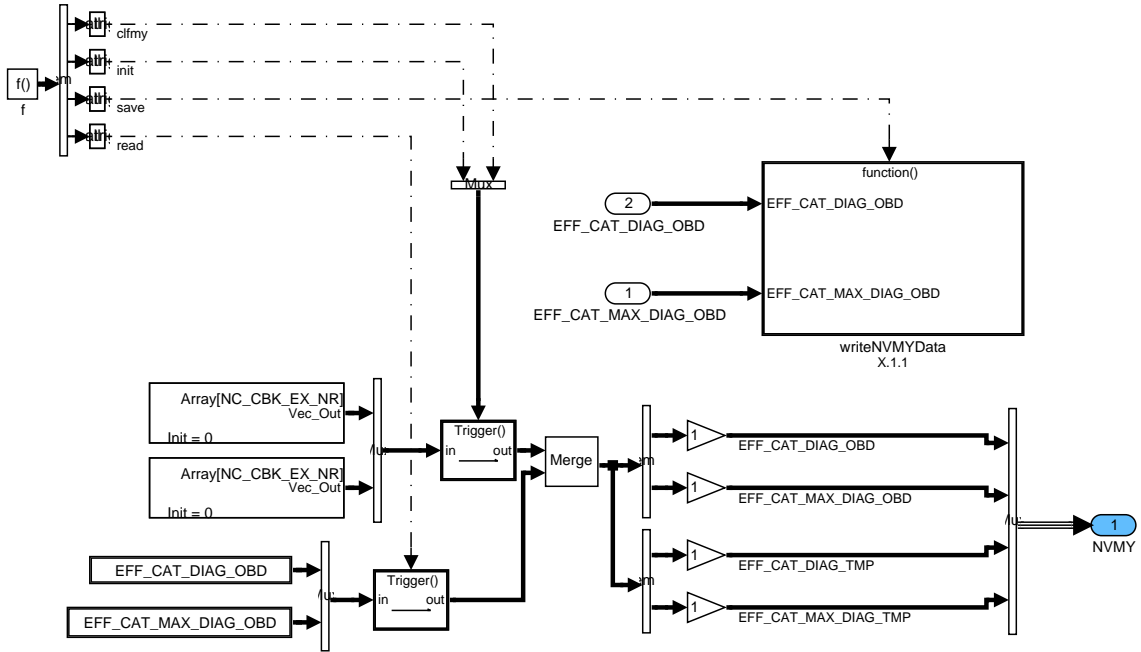


Figure B.48.3: : Path: EGTR\_FCTDGCEFIF0/NVMYdata

**B.48.1.1 No title given**

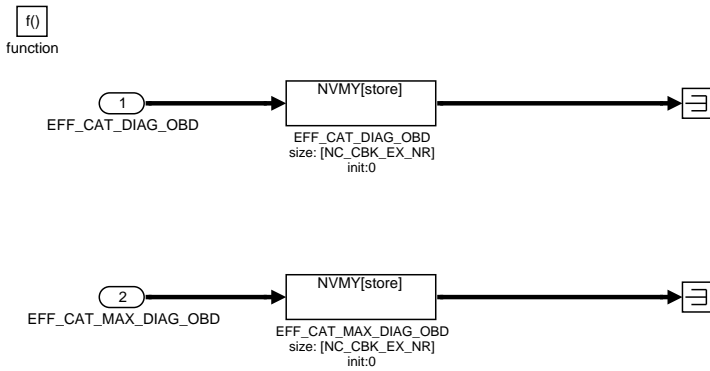


Figure B.48.4: : Path: EGTR\_FCTDGCEFIF0/NVMYdata/writeNVMYData

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### B.48.2 Formula Section

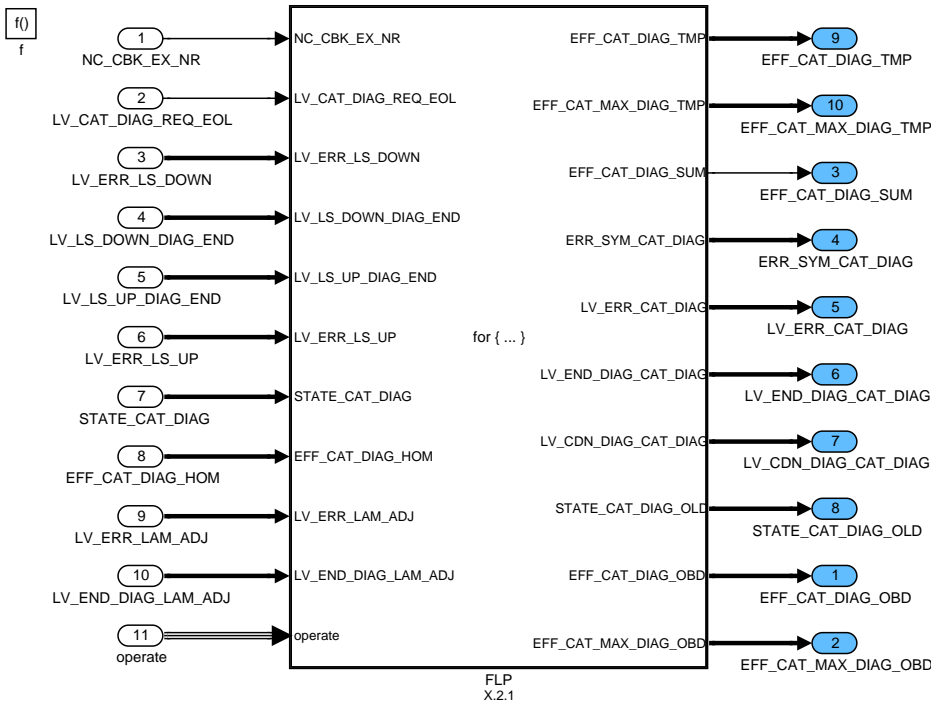


Figure B.48.5: : Path: EGTR\_FCTDGCEFIF0/OPM

#### B.48.2.1 Introduction multiple bank system

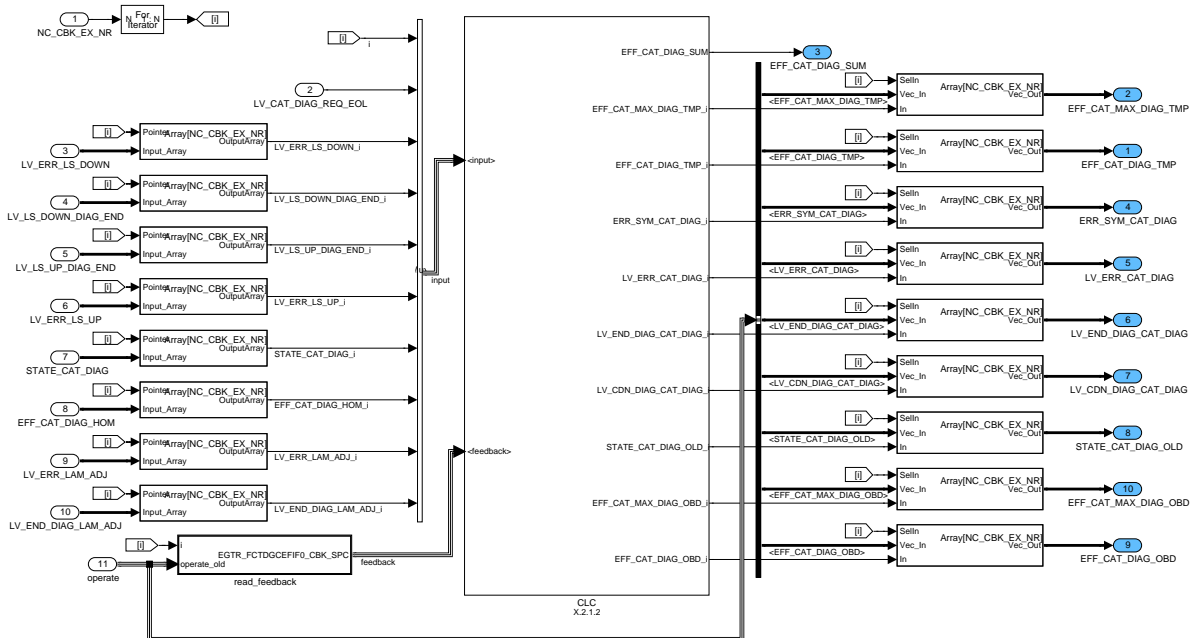


Figure B.48.6: : Path: EGTR\_FCTDGCEFIF0/OPM/FLP

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**B.48.2.1.1 Check general conditions**

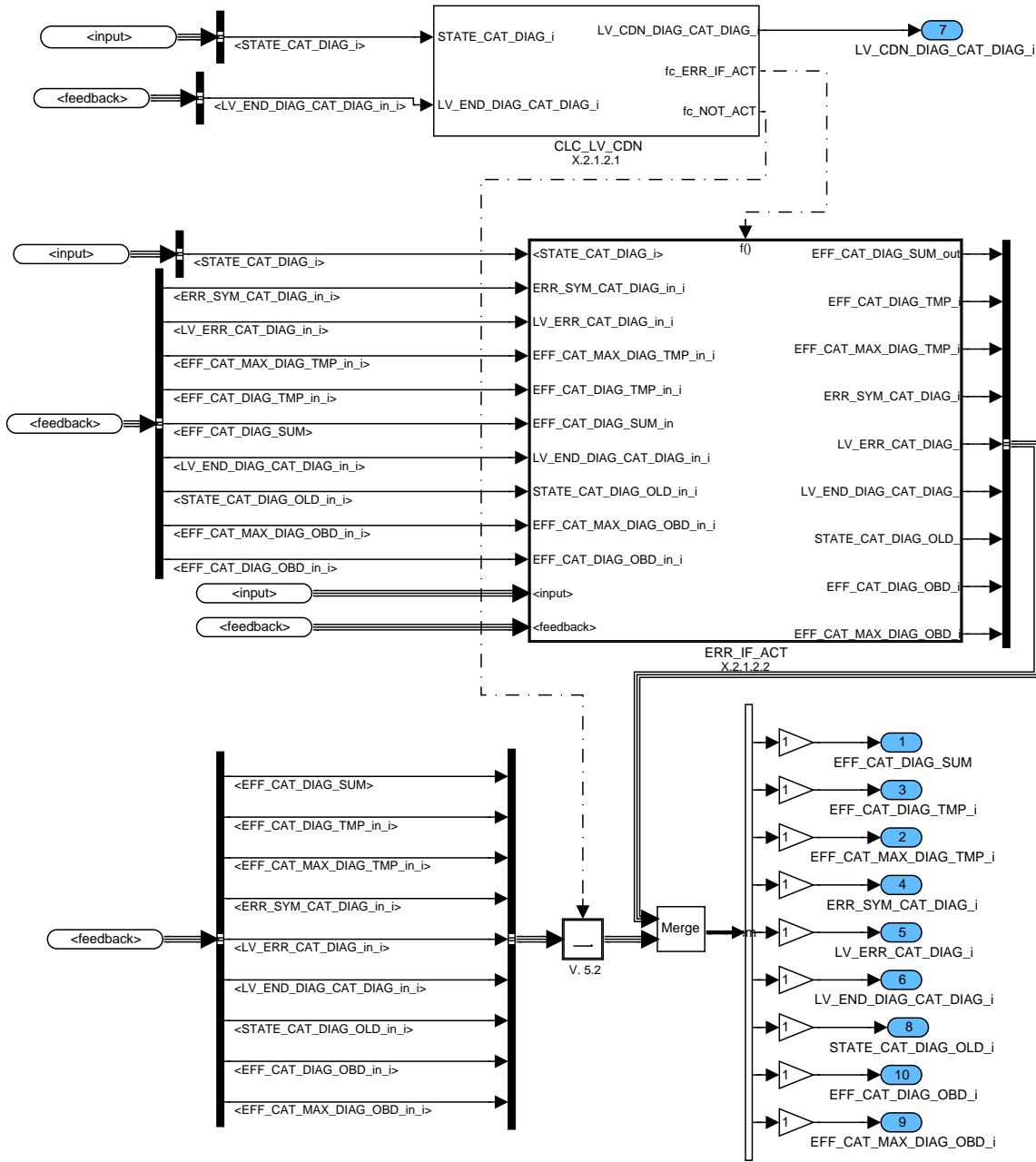


Figure B.48.7: : Path: EGTR\_FCTDGCEFI0/OPM/FLP/CLC

**B.48.2.1.1.1 Check state of the diagnosis**

ERR\_IF\_ACT: diagnosis not inhibited and not in passive state  
 NOT\_ACT: no calculations are done

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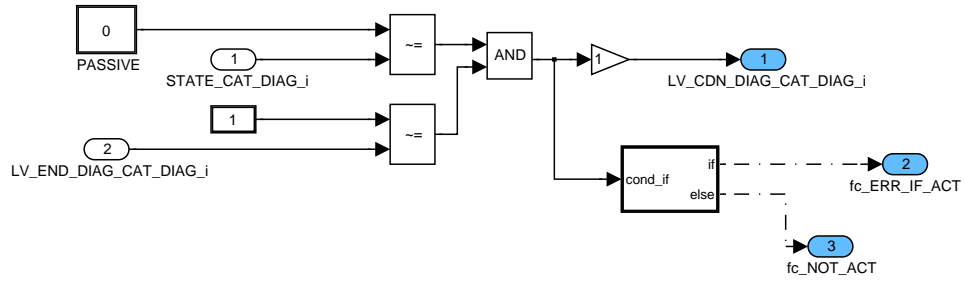



Figure B.48.8: : Path: EGTR\_FCTDGCEFIF0/OPM/FLP/CLC/CLC\_LV\_CDN

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 5522 of 8404</b>	
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**B.48.2.1.1.2 Calculations when diagnosis not inhibited and not in passive state (ERR\_IF\_ACT)**

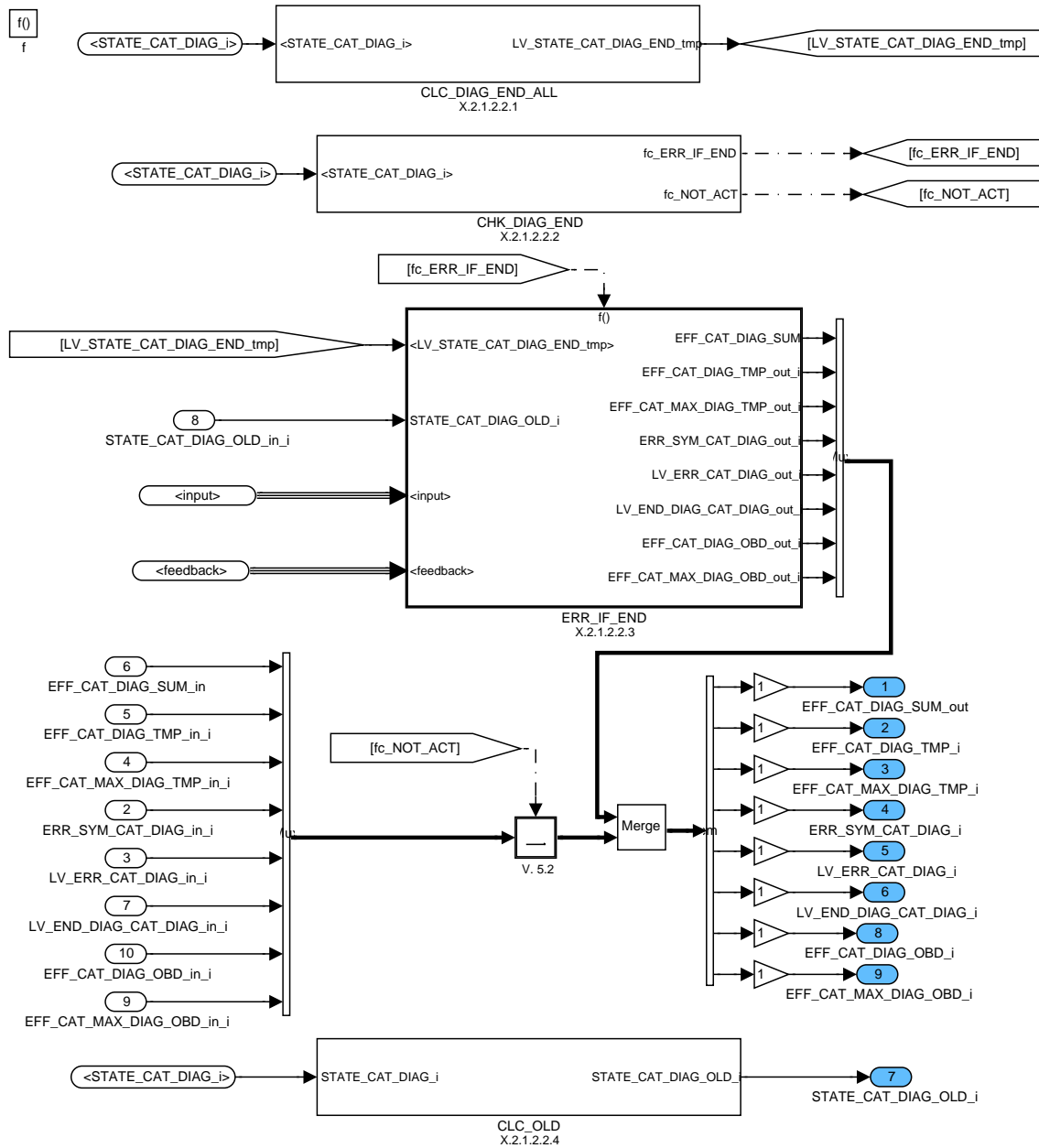


Figure B.48.9: : Path: EGTR\_FCTDGCIF0/OPM/FLP/CLC/ERR\_IF\_ACT

**B.48.2.1.1.2.1 Check of the diagnosis state for activation of calculations**

ERR\_IF\_END: calculation of error indicator after diagnosis is finished

NOT\_ACT: no calculations are done

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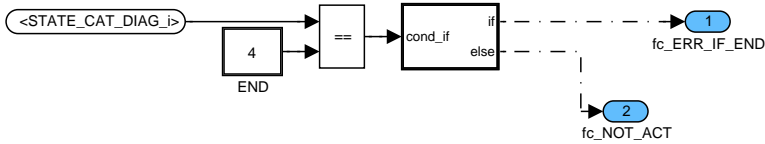


Figure B.48.10: : Path: EGTR\_FCTDGCEFIF0/OPM/FLP/CLC/ERR\_IF\_ACT/CHK\_DIAG\_END

**B.48.2.1.1.2.2 Calculation of temporary bit at diagnosis exits to end - bank crosscheck**

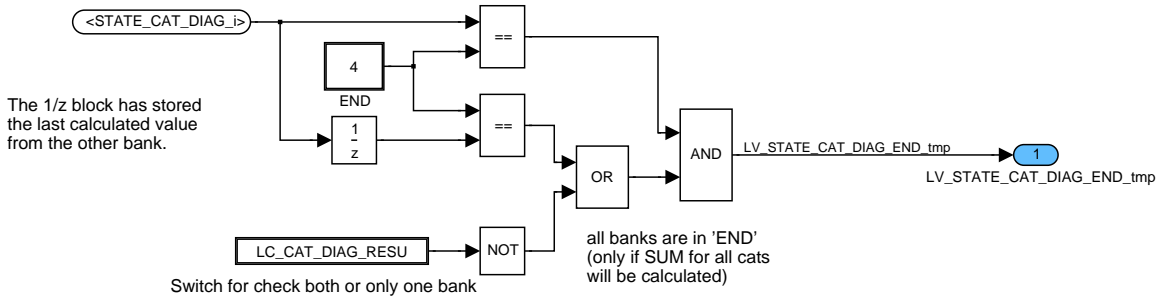


Figure B.48.11: : Path: EGTR\_FCTDGCEFIF0/OPM/FLP/CLC/ERR\_IF\_ACT/CLC\_DIAG\_END\_ALL

**B.48.2.1.1.2.3 Calculation old values**



Figure B.48.12: : Path: EGTR\_FCTDGCEFIF0/OPM/FLP/CLC/ERR\_IF\_ACT/CLC\_OLD

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### B.48.2.1.1.2.4 Calculation of error indicator after diagnosis is finished (ERR\_IF\_END)

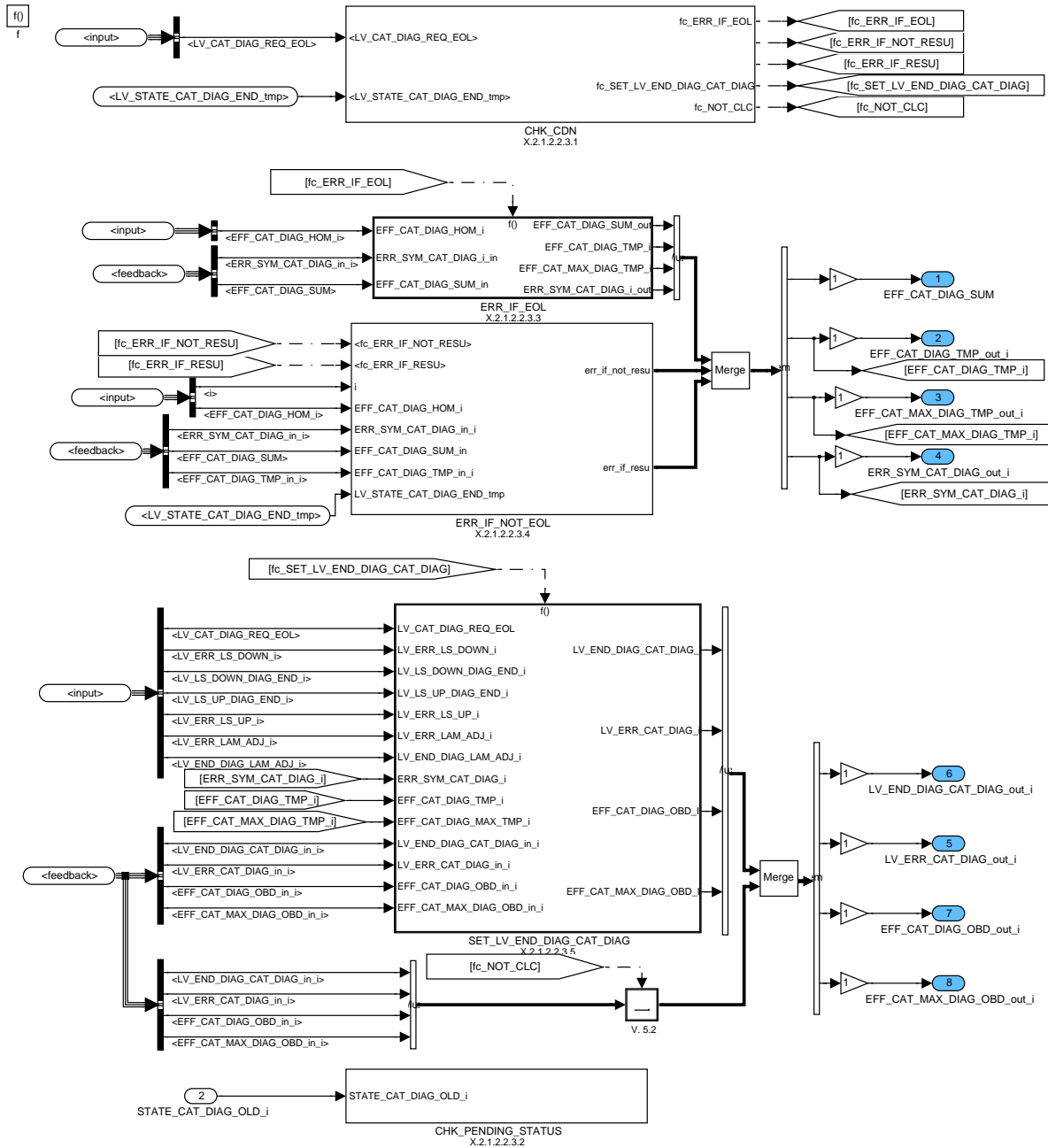


Figure B.48.13: : Path: EGTR\_FCTDGCEFI0/OPM/FLP/CLC/ERR\_IF\_ACT/ERR\_IF\_END

#### B.48.2.1.1.2.4.1 Check EOL request and temporary end bit from banks crosscheck

- ERR\_IF\_EOL: EOL test is active
- ERR\_IF\_NOT\_RESU: check of bank sum not active
- ERR\_IF\_RESU: check of bank sum active
- SET\_LV\_END\_DIAG\_CAT\_DIAG: calculation final result
- NOT\_CLC: no any calculation are done

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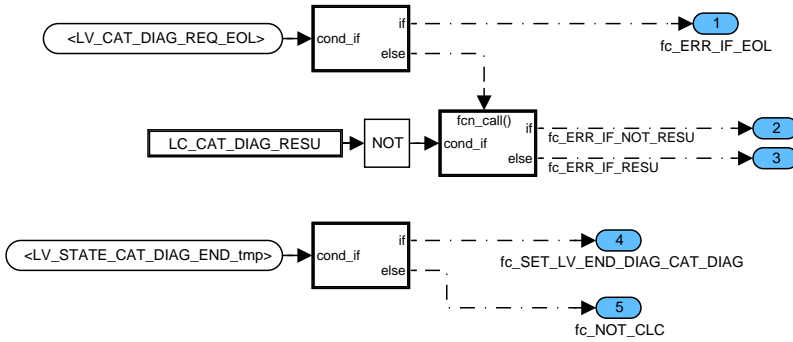


Figure B.48.14: : Path:  
EGTR\_FCTDGCEFIF0/OPM/FLP/CLC/ERR\_IF\_ACT/ERR\_IF\_END/CHK\_CDN

**B.48.2.1.1.2.4.2 Check pending status**

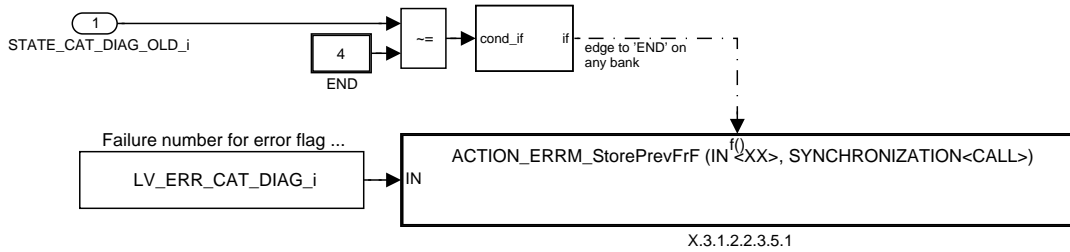


Figure B.48.15: : Path:  
EGTR\_FCTDGCEFIF0/OPM/FLP/CLC/ERR\_IF\_ACT/ERR\_IF\_END/CHK\_PENDING\_STATUS

**B.48.2.1.1.2.4.3 Calculations at EOL test (ERR\_IF\_EOL)**

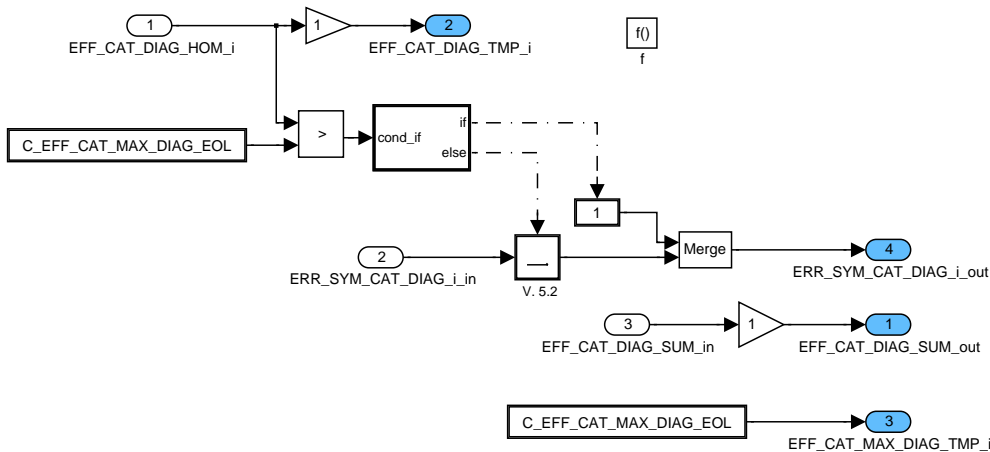


Figure B.48.16: : Path:  
EGTR\_FCTDGCEFIF0/OPM/FLP/CLC/ERR\_IF\_ACT/ERR\_IF\_END/ERR\_IF\_EOL

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**B.48.2.1.1.2.4.4 EOL test not active**

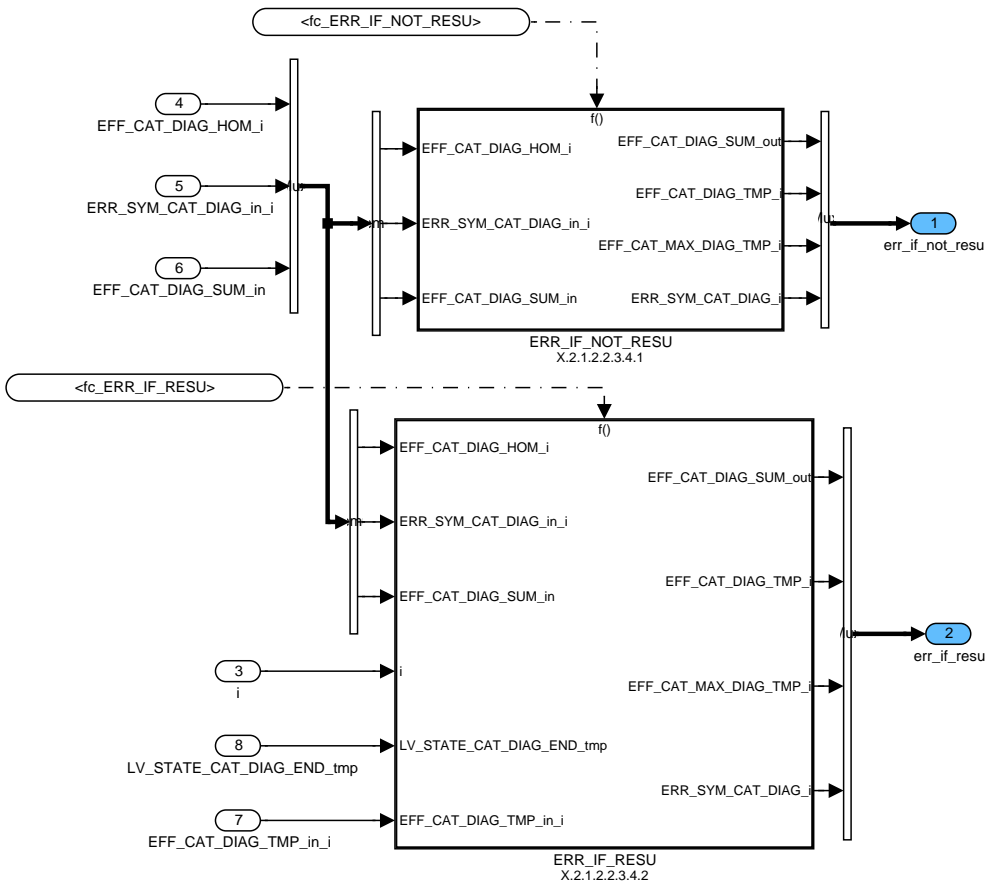


Figure B.48.17: : Path: EGTR\_FCTDGCEFIF0/OPM/FLP/CLC/ERR\_IF\_ACT/ERR\_IF\_END/ERR\_IF\_NOT\_EOL

**B.48.2.1.1.2.4.4.1 Check of bank sum not active (ERR\_IF\_NOT\_RESU)**

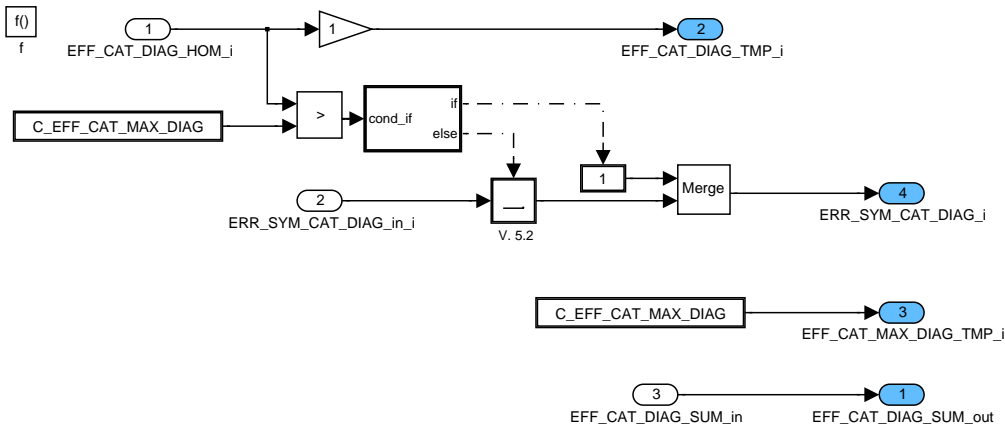


Figure B.48.18: : Path: EGTR\_FCTDGCEFIF0/OPM/FLP/CLC/ERR\_IF\_ACT/ERR\_IF\_END/ERR\_IF\_NOT\_EOL/ERR\_IF\_NOT\_RESU

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**B.48.2.1.1.2.4.4.2 Check of bank sum active (ERR\_IF\_RESU)**

f()

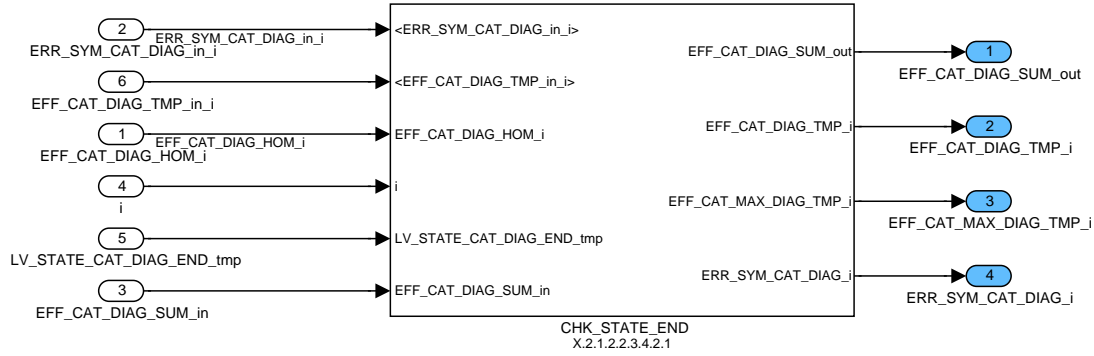


Figure B.48.19: : Path: EGTR\_FCTDGCEIF0/OPM/FLP/CLC/ERR\_IF\_ACT/ERR\_IF\_END/ERR\_IF\_NOT\_EOL/ERR\_IF\_RESU

**B.48.2.1.1.2.4.4.2.1 Check of temporary end bit from bank crosscheck**

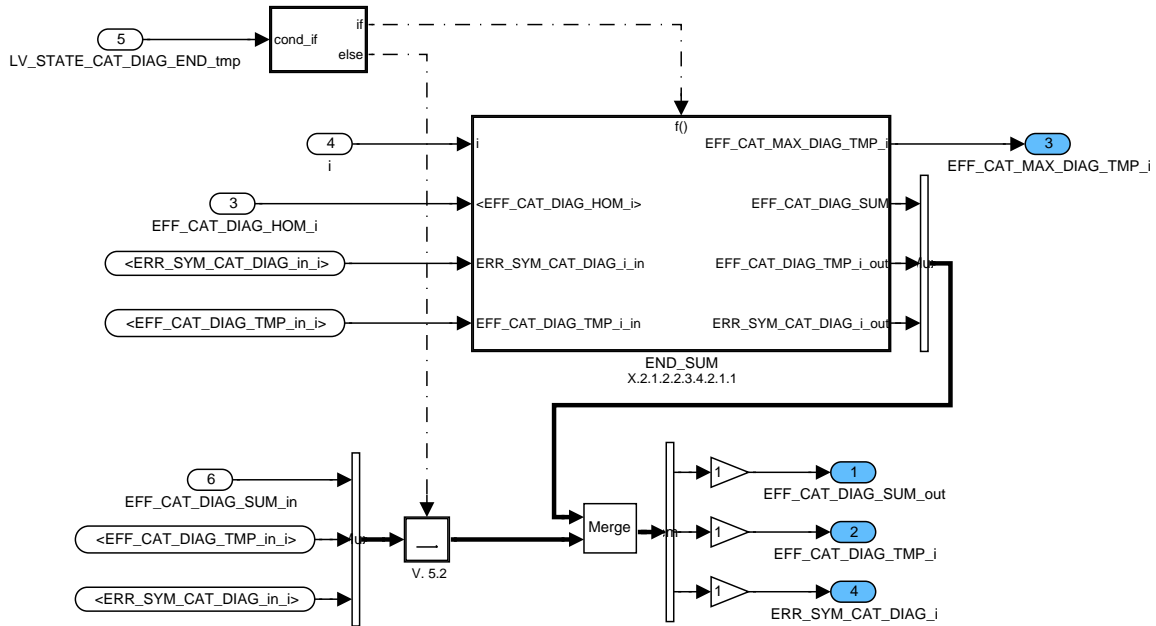


Figure B.48.20: : Path: EGTR\_FCTDGCEIF0/OPM/FLP/CLC/ERR\_IF\_ACT/ERR\_IF\_END/ERR\_IF\_NOT\_EOL/ERR\_IF\_RESU/CHK\_STATE\_END

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### B.48.2.1.1.2.4.2.1.1 Calculations active

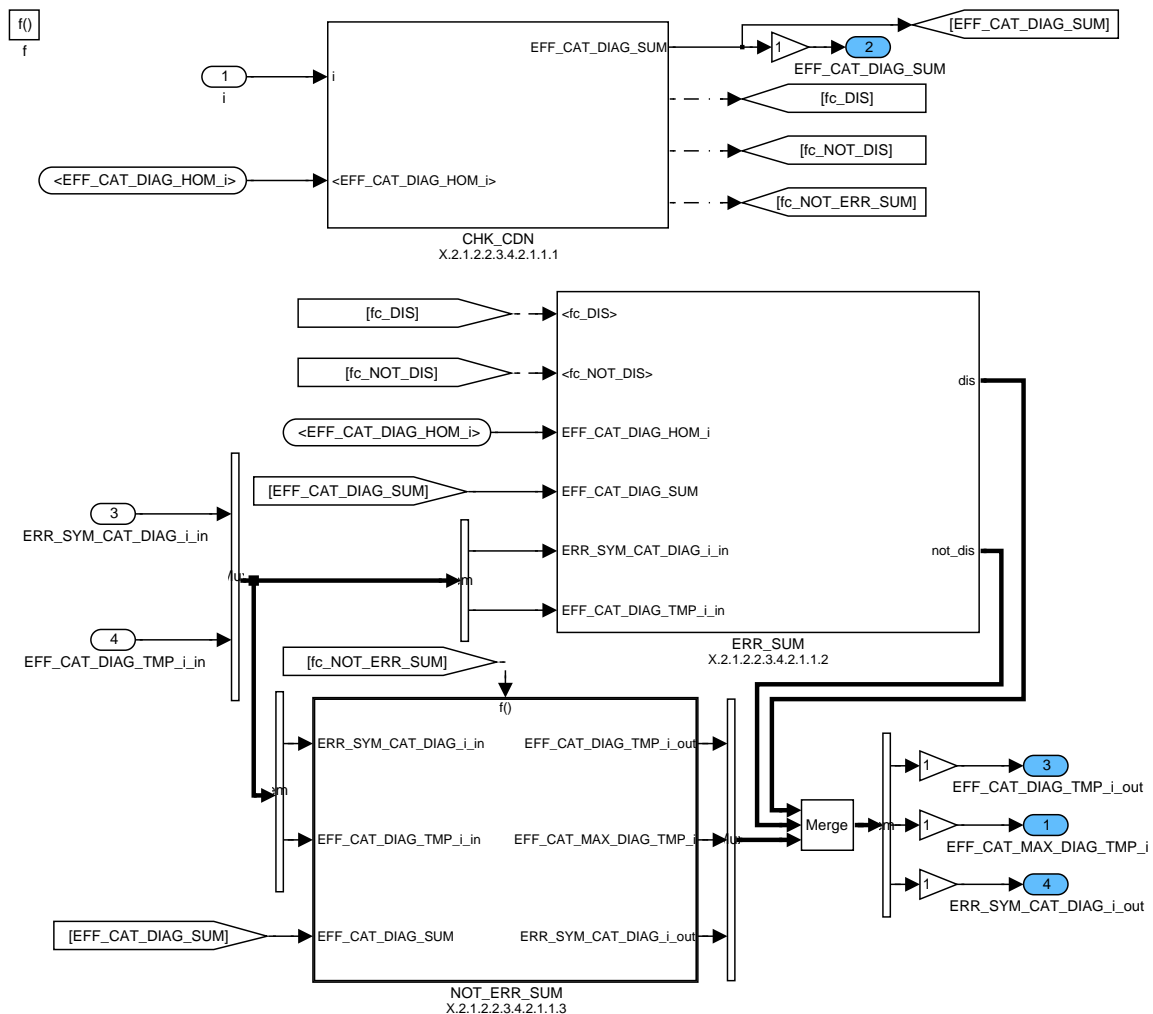


Figure B.48.21: : Path: EGTR\_FCTDGCEFI0/OPM/FLP/CLC/ERR\_IF\_ACT/ERR\_IF\_END/ERR\_IF\_NOT\_EOL/ERR\_IF\_RESU/CHK\_STATE\_END/END\_SUM

### B.48.2.1.1.2.4.2.1.2 Calculations of sum diagnosis results and check the threshold

This function is switch able with LC\_CAT\_DIAG\_RESU: separate comparison of EFF\_CAT\_DIAG[i] with threshold and separate failure for every cylinder bank is stored, or from separate EFF\_CAT\_DIAG[i] is a common EFF\_CAT\_DIAG\_SUM calculated and failure is stored only if common threshold C\_EFF\_CAT\_MAX\_DIAG\_SUM is exceeded. This module is to call immediately after module Catalyst efficiency diagnosis (OSC Method) is finished. For crossways question of symptoms  $i$  = the actually calculated bank and  $y$  = the other bank as actually calculated

DIS: check single bank active

NOT\_DIS: check single bank not active

NOT\_ERR\_SUM: Sum diagnosis result is not bigger then threshold

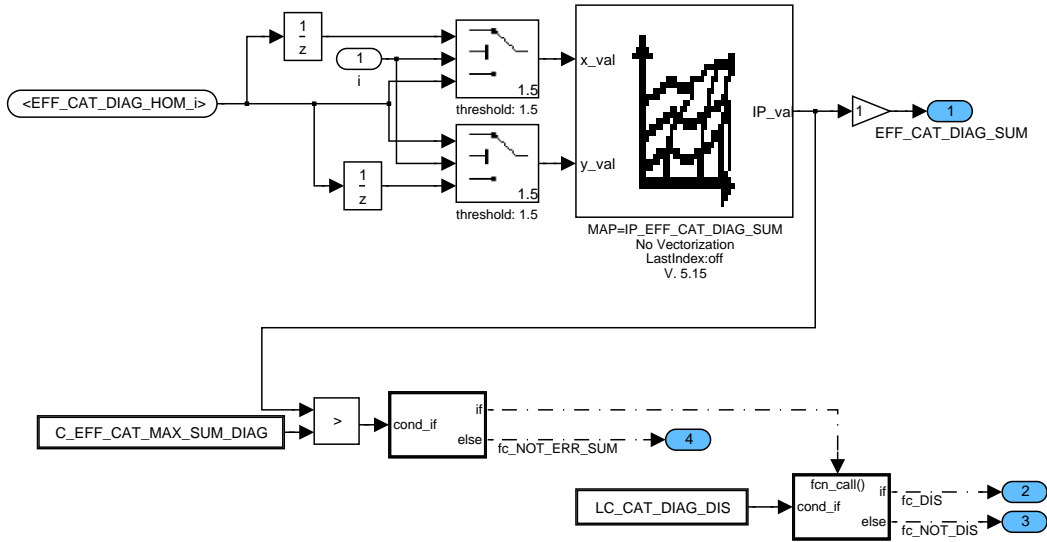


Figure B.48.22: : Path: EGTR\_FCTDGCEIF0/OPM/FLP/CLC/ERR\_IF\_ACT/ERR\_IF\_END/ERR\_IF\_NOT\_EOL/ERR\_IF\_RESU/CHK\_STATE\_END/END\_SUM/CHK\_CDN

**B.48.2.1.1.2.4.4.2.1.3 Sum diagnosis result is bigger then threshold (active are DIS and NOT\_DIS)**

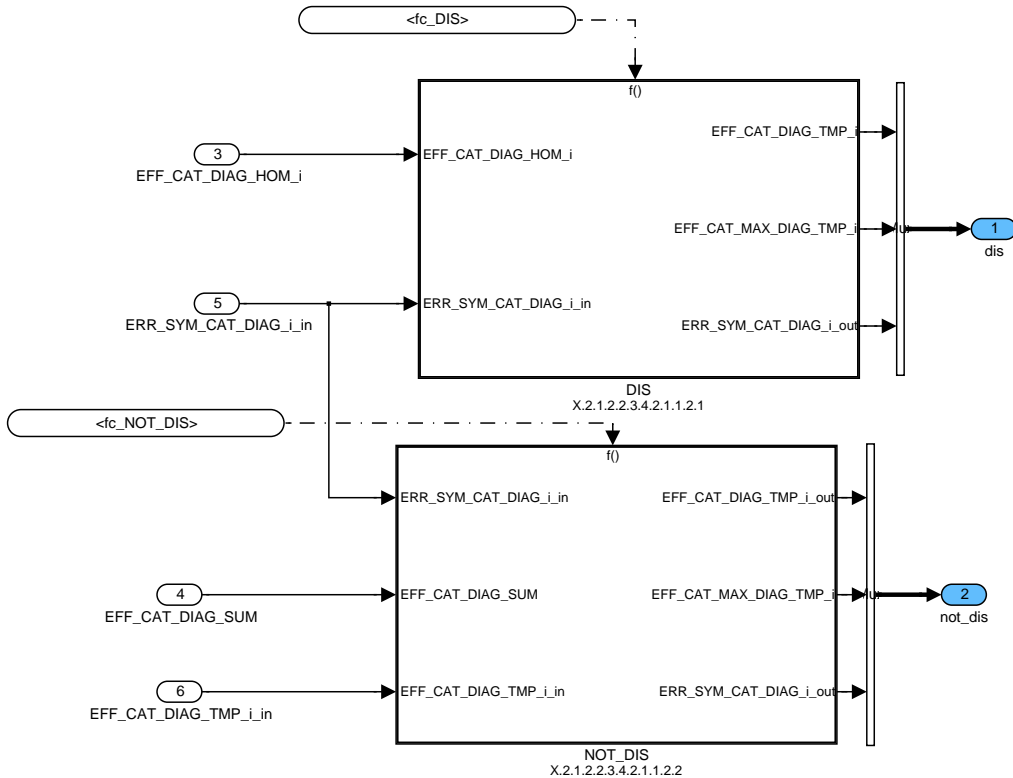


Figure B.48.23: : Path: EGTR\_FCTDGCEIF0/OPM/FLP/CLC/ERR\_IF\_ACT/ERR\_IF\_END/ERR\_IF\_NOT\_EOL/ERR\_IF\_RESU/CHK\_STATE\_END/END\_SUM/ERR\_SUM

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### B.48.2.1.1.2.4.4.2.1.4 Check single bank active (DIS)

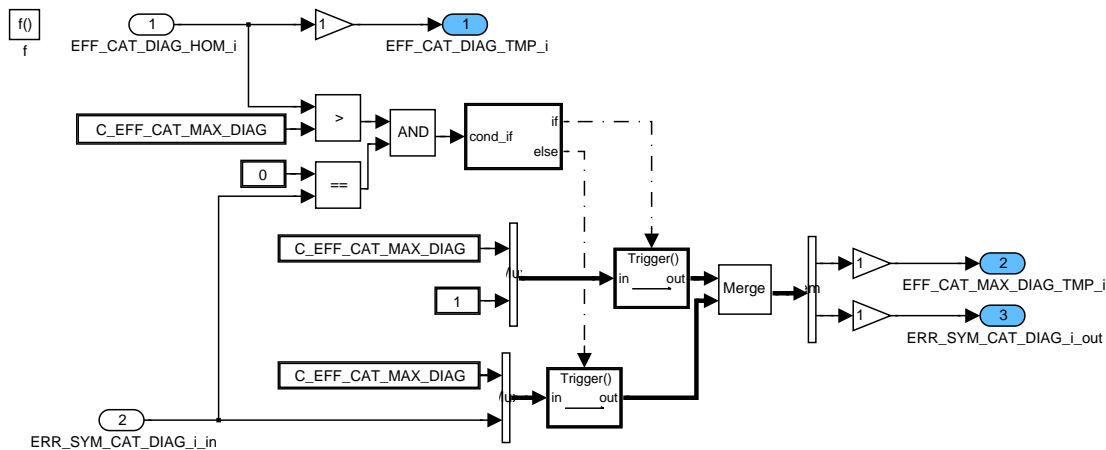


Figure B.48.24: : Path: EGTR\_FCTDGCEIF0/OPM/FLP/CLC/ERR\_IF\_ACT/ERR\_IF\_END/ERR\_IF\_NOT\_EOL/ERR\_IF\_RESU/CHK\_STATE\_END/END\_SUM/ERR\_SUM/DIS

### B.48.2.1.1.2.4.4.2.1.5 Check single bank not active (NOT\_DIS)

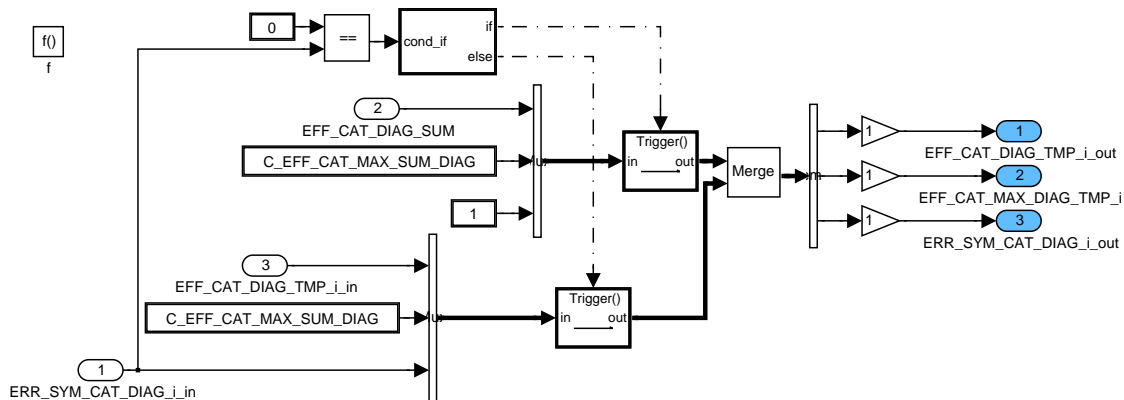


Figure B.48.25: : Path: EGTR\_FCTDGCEIF0/OPM/FLP/CLC/ERR\_IF\_ACT/ERR\_IF\_END/ERR\_IF\_NOT\_EOL/ERR\_IF\_RESU/CHK\_STATE\_END/END\_SUM/ERR\_SUM/NOT\_DIS

### B.48.2.1.1.2.4.4.2.1.6 Sum diagnosis result is not bigger then threshold (NOT\_ERR\_SUM)

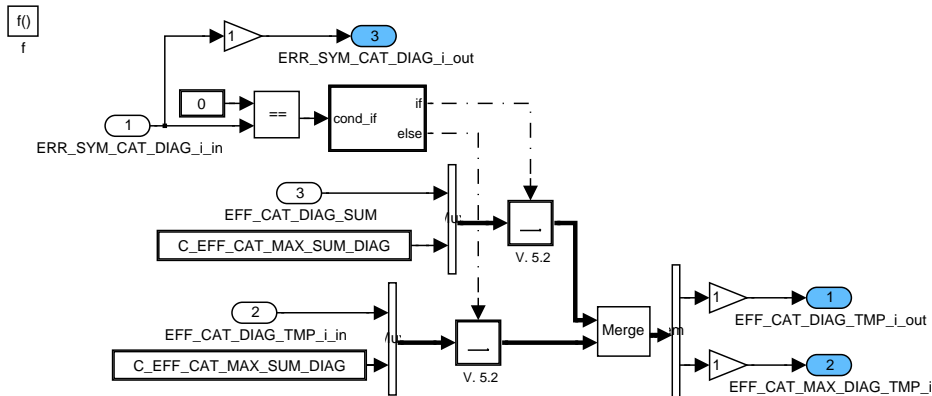


Figure B.48.26: : Path: EGTR\_FCTDGCEIF0/OPM/FLP/CLC/ERR\_IF\_ACT/ERR\_IF\_END/ERR\_IF\_NOT\_EOL/ERR\_IF\_RESU/CHK\_STATE\_END/END\_SUM/NOT\_ERR\_SUM

### B.48.2.1.1.2.4.5 Calculation final result (SET\_LV\_END\_DIAG\_CAT\_DIAG)

The readiness flag can be set to true only when all other diagnosis are finished and don't deliver error. In this case the current failure status is stored in the Error Management (by means of a service of ERRM). Otherwise, the catalyst diagnosis is not finished and the old diagnosis value is used.

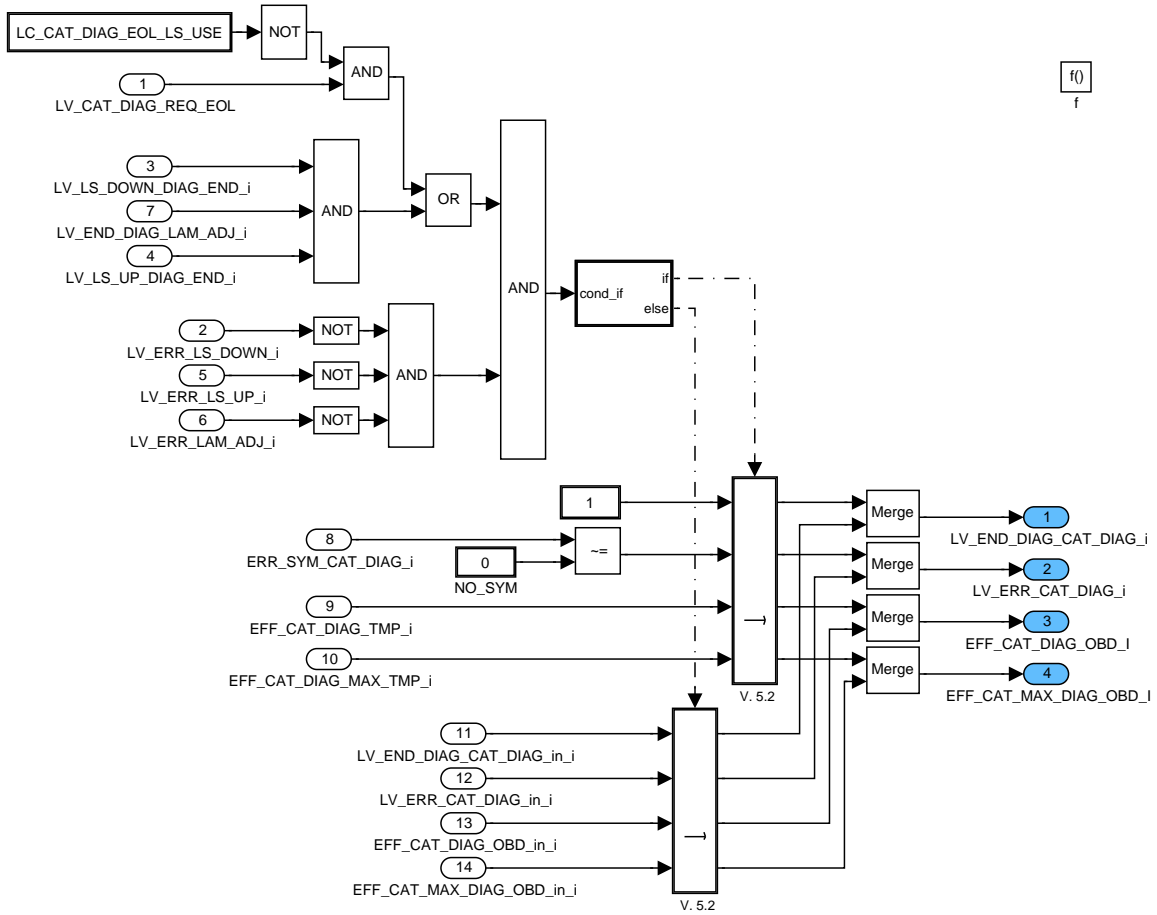


Figure B.48.27: : Path: EGTR\_FCTDGCEFIF0/OPM/FLP/CLC/ERR\_IF\_ACT/ERR\_IF\_END/SET\_LV\_END\_DIAG\_CAT\_DIAG

### B.48.3 Initialization at RESET

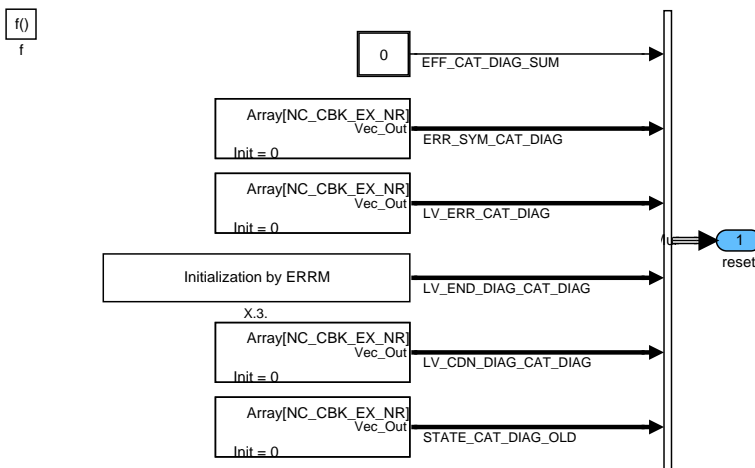


Figure B.48.28: : Path: EGTR\_FCTDGCEFIF0/RST

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### B.48.3.1 Initialization of ERRM relevant variables

Initialization with "0" for SDA model simulation only

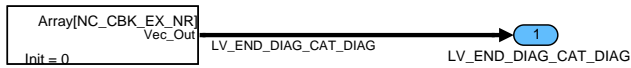



Figure B.48.29: : Path: EGTR\_FCTDGCEIF0/RST/INI\_ERRM

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 5534 of 8404</b>	
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## B.49 Coordination of catalyst efficiency value

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_CAT_DIAG [NC_CBK_EX_NR]	O/V/S	0... FFH	0... 1.9921875	7.8125e-3	-
At ended diagnosis final value for catalyst conversion capability					
ERR_SYM_CAT_DIAG_SUM [NC_CBK_EX_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom for TWC summary of HOM and AFL diagnosis					
LV_CDN_DIAG_CAT_DIAG_SUM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (seto to one when condition is fulfilled)					
LV_END_DIAG_CAT_DIAG_SUM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
TWC summary of HOM and AFL diagnosis performed at last one time					
LV_ERR_CAT_DIAG_SUM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Present failure after filtering of the summary of HOM and AFL TWC diagnosis					

### Input data:

EFF_CAT_DIAG_HOM [NC_CBK_EX_NR] {p. 5473}	ERR_SYM_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}	ERR_SYM_CAT_DIAG_AFL [NC_CBK_EX_NR] {p. 5561}	LV_END_DIAG_CAT_DIAG_AFL [NC_CBK_EX_NR] {p. 5561}
NC_CBK_EX_NR {p. 1829}	O2L_CAT_DIAG_AFL [NC_CBK_EX_NR] {p. 5562}	STATE_CAT_DIAG [NC_CBK_EX_NR] {p. 5474}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_CAT_DIAG_SUM	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_CAT_DIAG_SUM	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
IP_EFF_CAT_DIAG_HOM	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_O2L_CAT_DIAG_AFL_IP_EFF_CAT	6	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Conversion of lean cat diag result O2L_CAT_DIAG_AFL to lambda=1 cat diag result EFF_CAT_DIAG					
LC_CAT_DIAG_AFL_ACT_SUM	-	0... 1H	0 ...1	1	-
Activation of the AFL diagnosis for error calculation					
LC_CAT_DIAG_HOM_ACT_SUM	-	0... 1H	0 ...1	1	-
Activation of the HOM diagnosis for error calculation					
LC_EFF_CAT_DIAG_HOM_ENA	-	0... 1H	0 ...1	1	-
Use EFF_CAT_DIAG_HOM from linear cat diagnosis as result EFF_CAT_DIAG					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_O2L_CAT_DIAG_AFL_ENA	-	0... 1H	0 ...1	1	-
Use O2L_CAT_DIAG_AFL from lean cat diagnosis as result EFF_CAT_DIAG					

## General Information

This modul coordinates the results of both catalyst diagnosis methods

- lambda=1 catalyst diagnosis (HOM): EFF\_CAT\_DIAG\_HOM[NC\_CBK\_EX\_NR]

- lean catalyst diagnosis (AFL): O2L\_CAT\_DIAG\_AFL[NC\_CBK\_EX\_NR]

The common result is EFF\_CAT\_DIAG[NC\_CBK\_EX\_NR]

## Application Conditions

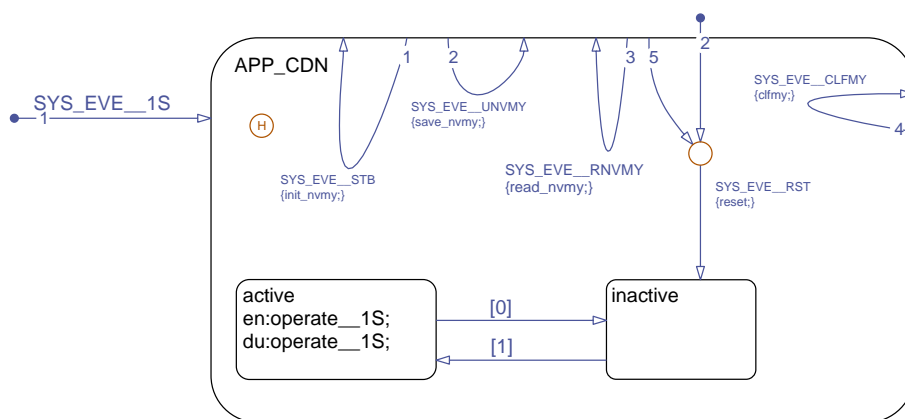


Figure B.49.1: : Path: EGTR\_FCTDGCEFC0/APP\_CDN/Chart

## Function description



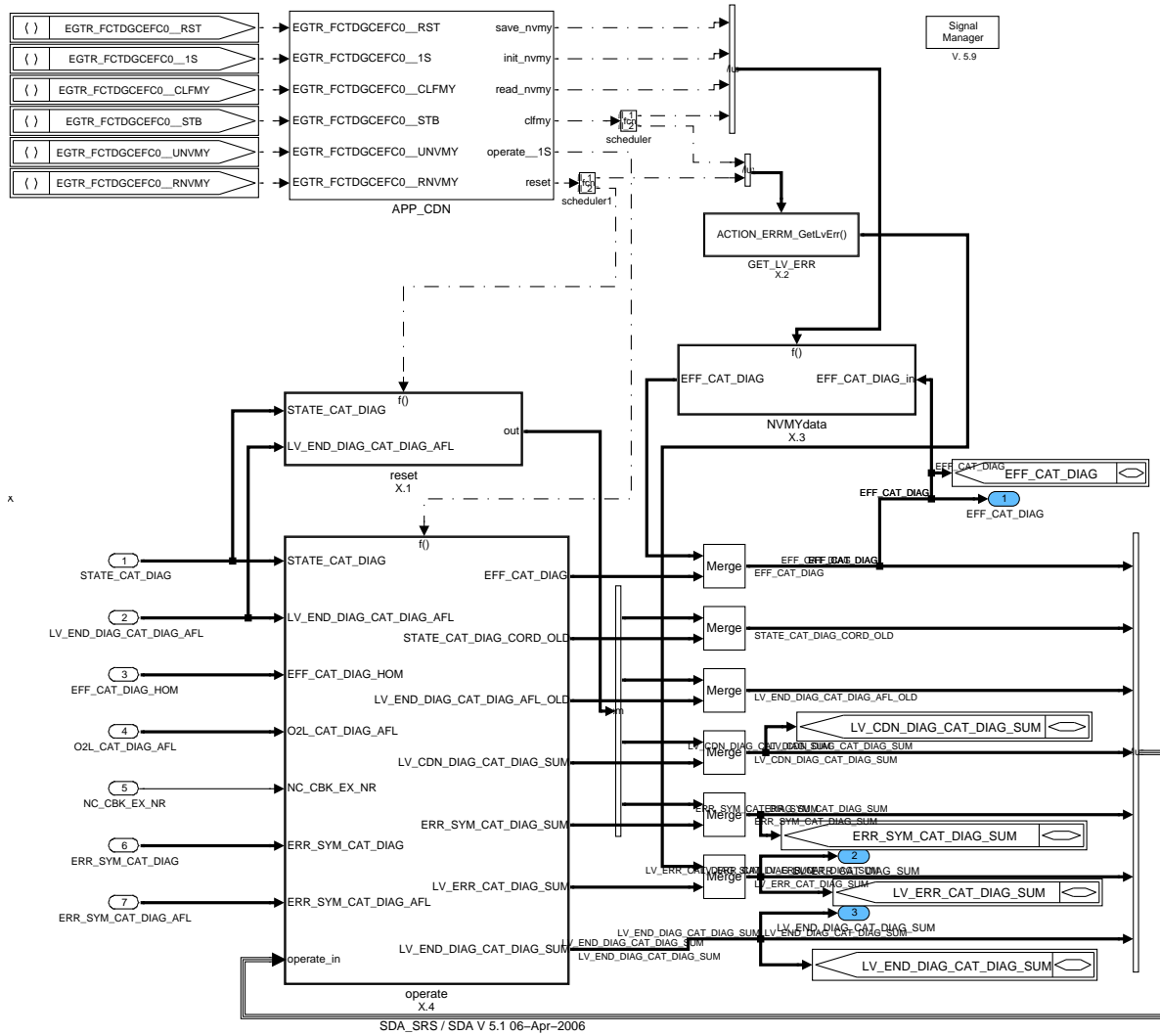


Figure B.49.2: : Path: EGTR\_FCTDGCEFC0

### B.49.1 Reset

The old values will be initialized with the regarding inputs, due to avoid an edge detection after reset.

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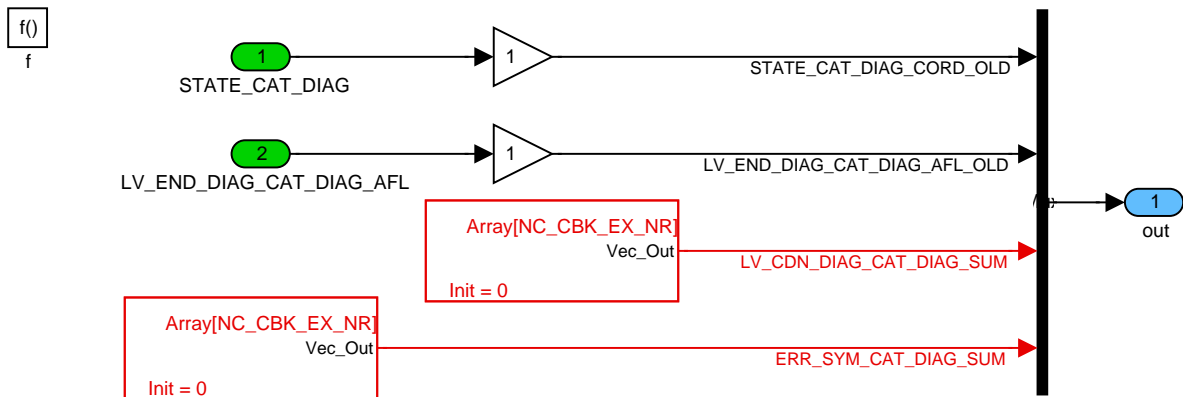


Figure B.49.3: : Path: EGTR\_FCTDGCEFC0/reset

## B.49.2 Synchronization of the LV\_ERR\_CAT\_DIAG\_SUM

Synchronisation between LV\_ERR\_CAT\_DIAG\_SUM and its result from ERRM is done using action ACTION\_ERRM\_GetLvErr() at reset and clrfmy.

## B.49.3 EFF\_CAT\_DIAG[NC\_CBK\_EX\_NR] will be stored in the non-volatile memory

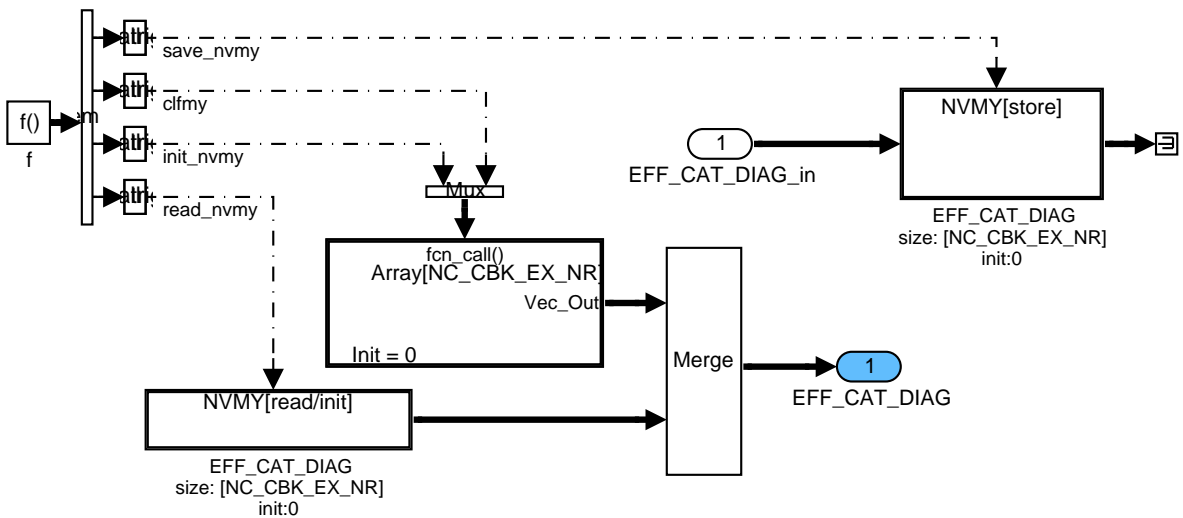


Figure B.49.4: : Path: EGTR\_FCTDGCEFC0/NVMYdata

## B.49.4 FORMULA SECTION

### B.49.4.1 Calculation of the summary diagnosis results

#### B.49.4.1.1 Calculation of the summary diagnosis "end" and "error symptom" outputs

The summary diagnosis is a combination of the TWC diagnosis of homogeneous and lean combustion modes. Last finished diagnosis saves the summary diagnosis result. When the ABC counter is calibrated to e.g. 2, then both diagnoses can influence the diagnosis result depending on which one is executed.

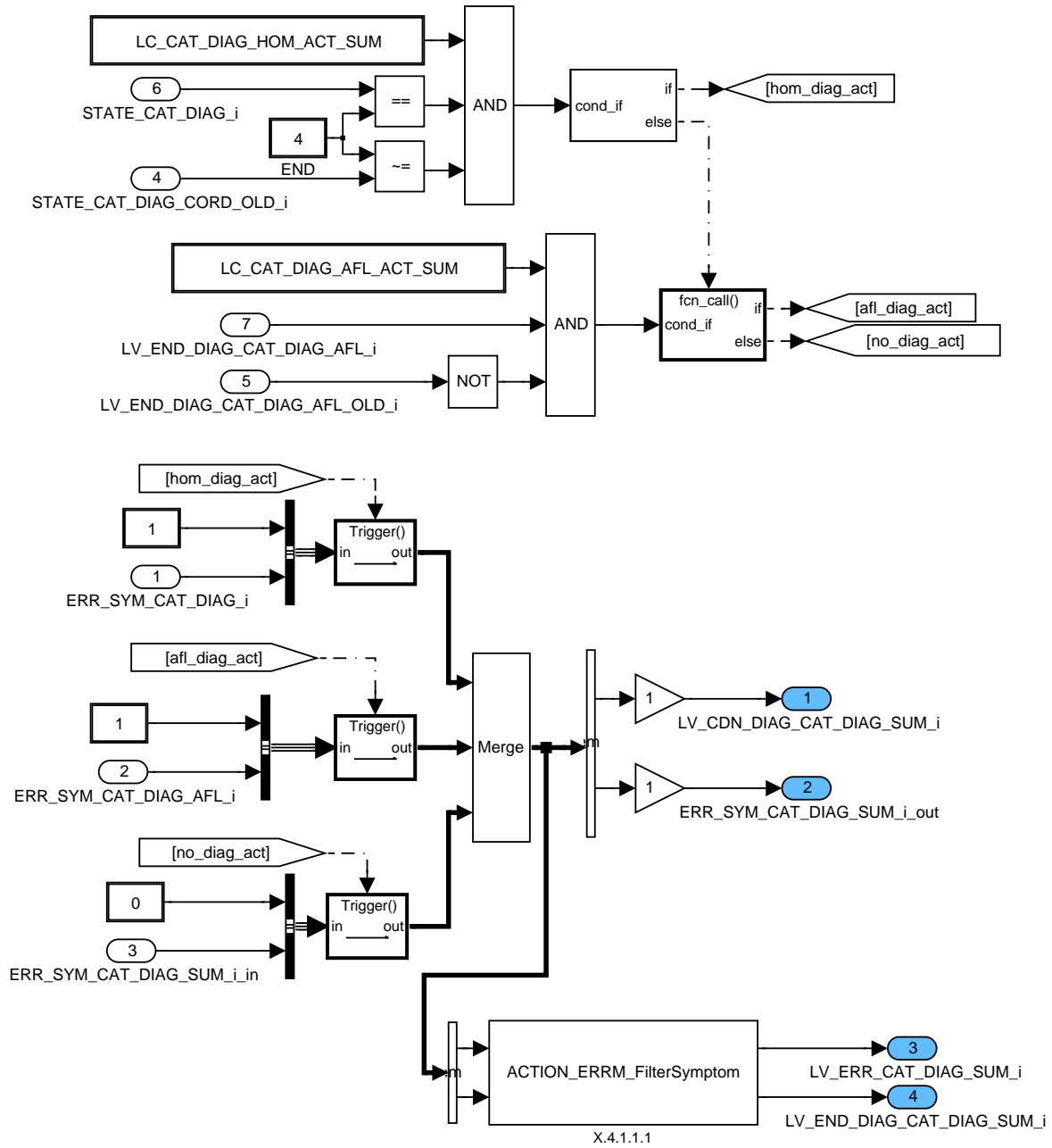


Figure B.49.5: : Path: EGTR\_FCTDGCEFC0/operate/CBK\_MNG/CLC0

**B.49.4.1.1.1 Call of the ERRM**

ACTION\_ERRM\_FilterSymptom(IN<XX>, IN<lv\_cdn\_diag\_XX>, IN<err\_sym\_XX >, IN<C\_ABC\_INC\_XX >, IN<C\_ABC\_DEC\_XX >, IN<C\_ABC\_MAX\_XX >, OUT<LV\_ERR\_XX>)

The action computes the elementary anti-bounce filter for one failure treatment and returns filter results

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Configuration for diagnostic symptoms:

Diagnostic CAT_DIAG_SUM[i]	Symptom description	Symptom	Filter type
Catalyst sum diagnosis	'CAT_EFFIC_LOW'	SYM_0	STD
	'CAT_DAMAGED'	SYM_1	
	Not used	SYM_2	
	Not used	SYM_3	

#### B.49.4.1.2 Calculation of the TWC efficiency

NC\_CBK\_EX\_NR = 1 (one-bank system): calculation for index  $i = 1$

NC\_CBK\_EX\_NR = 2 (two-bank system): calculation for index  $i = 1$  and 2

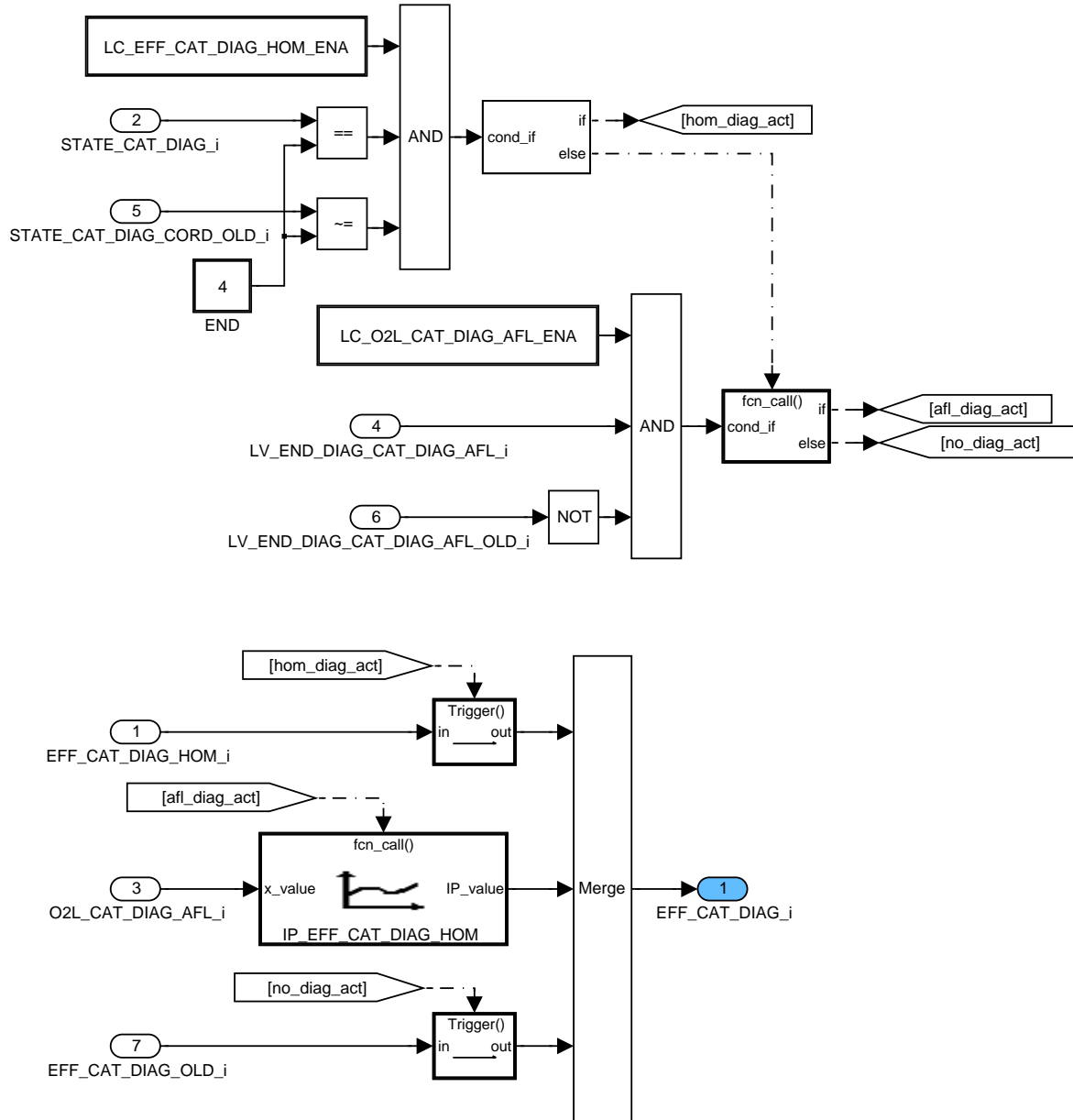


Figure B.49.6: : Path: EGTR\_FCTDGCEFC0/operate/CBK\_MNG/CLC1

### B.49.4.1.3 Calculation of the old values

The old values of the input signals will be stored for each bank.

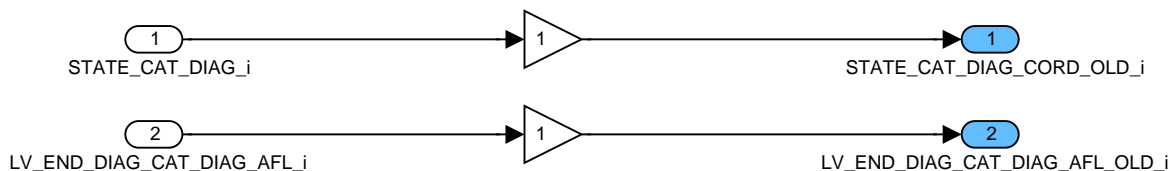


Figure B.49.7: : Path: EGTR\_FCTDGCEFC0/operate/CBK\_MNG/CLC2

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## B.50 Limited dynamic for catalyst efficiency and oxygen sensor diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LAM_MV_DELTA_CAT_LDC [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 49.9984741	0.00152588	%
Difference between filtered and not filtered FAC_LAM_MV[i] for lambda limited dynamic					
LOAD_GRD_CAT_LDC	V	200... 1FFFH	0... 1247.56	2.44140625	%/s
Load gradient for limited dynamics of catalyst diagnosis					
LOAD_GRD_SUM_CAT_LDC	V	0... FFFFH	0... 159998	2.44140625	%/s
sum value of LOAD gradient fro limited dynamics for catalyst diagnosis					
LV_CAT_LDC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
status of limited dynamics for catalyst efficiency diagnosis					
LV_FAC_LAM_CAT_LDC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Status limited dynamic FAC_LAM_MV[NC_CBK_EX_NR]					
LV_LOAD_GRD_CAT_LDC	V	0... 1H	0 ...1	1	-
Status limited dynamic LOAD_GRD_CAT_LDC					
LV_MAF_CAT_LDC	V	0... 1H	0 ...1	1	-
Status limited dynamic MAF					
LV_N_CAT_LDC	V	0... 1H	0 ...1	1	-
Status limited dynamic N					
MAF_INT_CAT_LDC [NC_CBK_EX_NR]	V	0... FFFFH	0 ...1	0.022222	g
integral of mass air flow since limited dynamic conditions fulfilled					
MAF_MMV_CAT_LDC	V	0... FFFFH	0... 1389	0.0211948	mg/stk
floating mean value for limited MAF					
N_MMV_CAT_LDC	V	0... 1FE0H	0... 8160	1	rpm
floating mean value for limited engine speed					

### Input data:

FAC_LAM_MV {p. 1014}	FAC_LAM_MV_MMV_LDC_DIAG [NC_CBK_EX_NR] {p. 2462}	LOAD_CAT_LDC {p. 5506}	LV_DC {p. 5746}
MAF {p. 8277}	MAF_CYL {p. 8277}	N {p. 1525}	NC_CBK_EX_NR {p. 1829}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_MAF_CAT_LDC	-	0... FFFFH	0... 0.999985	152.588e3	-
correlation constant for floating mean value calculation of air mass flow					
C_CRLC_N_CAT_LDC	-	0... FFFFH	0... 0.999985	152.588e3	-
correlation constant for floating mean value calculation of engine speed					
C_FAC_LAM_MV_DYW_CAT	-	0... FFFFH	0... 99.9984741	0.00152588	%
threshold limited dynamic lambda					
C_LOAD_GRD_DEC	-	0... 3FFFH	0... 2497.56	2.44140625	%/s
decrement for calculation LOAD_CAT_LDC gradient					
C_LOAD_GRD_MIN_SUM_CAT	-	0... 1FFFH	0... 1247.56	2.44140625	%/s
min. threshold for LOAD_GRD CAT_LDC summation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LOAD_GRD_SUM_MAX	-	0... FFFFH	0... 159998	2.44140625	%/s
max threshold limited dynamic LOAD_CAT_LDC gradient					
C_LOAD_GRD_SUM_MIN	-	0... FFFFH	0... 159998	2.44140625	%/s
min threshold limited dynamic LOAD_CAT_LDC gradient					
C_MAF_DYW_CAT_LDC	-	0... FFFFH	0... 1389	0.0211948	mg/stk
threshold limited dynamic engine MAF					
C_MAF_INT_MIN_CAT_LDC	-	0... FFFFH	0 ...1	0.022222	g
MAF integral after setting limited dynamic conditions LV_CAT_LDC[i] before starting the monitoring cycle					
C_N_DYW_CAT_LDC	-	0... 1FE0H	0... 8160	1	rpm
threshold limited dynamic engine speed					
C_T_LOAD_GRD_DEC_SUM	-	0... FFH	0... 5.1	0.02	s
time periods for calculation limited dynamic LOAD_CAT_LDC gradient					
LC_FAC_LAM_RST_CAT_LDC	-	0... 1H	0 ...1	1	-
Switch for active reset of filtered FAC_LAM to not filtered after lim. Dyn. over threshold					
LC_MAF_RST_CAT_LDC	-	0... 1H	0 ...1	1	-
Switch for active reset of filtered MAF to not filtered after lim. Dyn. over threshold					
LC_N_RST_CAT_LDC	-	0... 1H	0 ...1	1	-
Switch for active reset of filtered N to not filtered after lim. Dyn. over threshold					

### B.50.1 EGTR\_FCTDGCEFLD0

The limited dynamic conditions LV\_CAT\_LDC[i] for catalyst efficiency diagnosis is set if the limited dynamic conditions for engine speed, mass air flow and lambda controller output exist and a calibration threshold for the integral of the air flow is exceeded.

Moreover the summation of the throttle position gradient LOAD\_GRD\_SUM\_CAT\_LDC[i] must not exceed a calibration threshold.

NC\_CBK\_EX\_NR defines the number of exhaust banks.

For vector elements, the variable extension \_i is used in the model instead of [i] as found in the textual description.

### Function Description

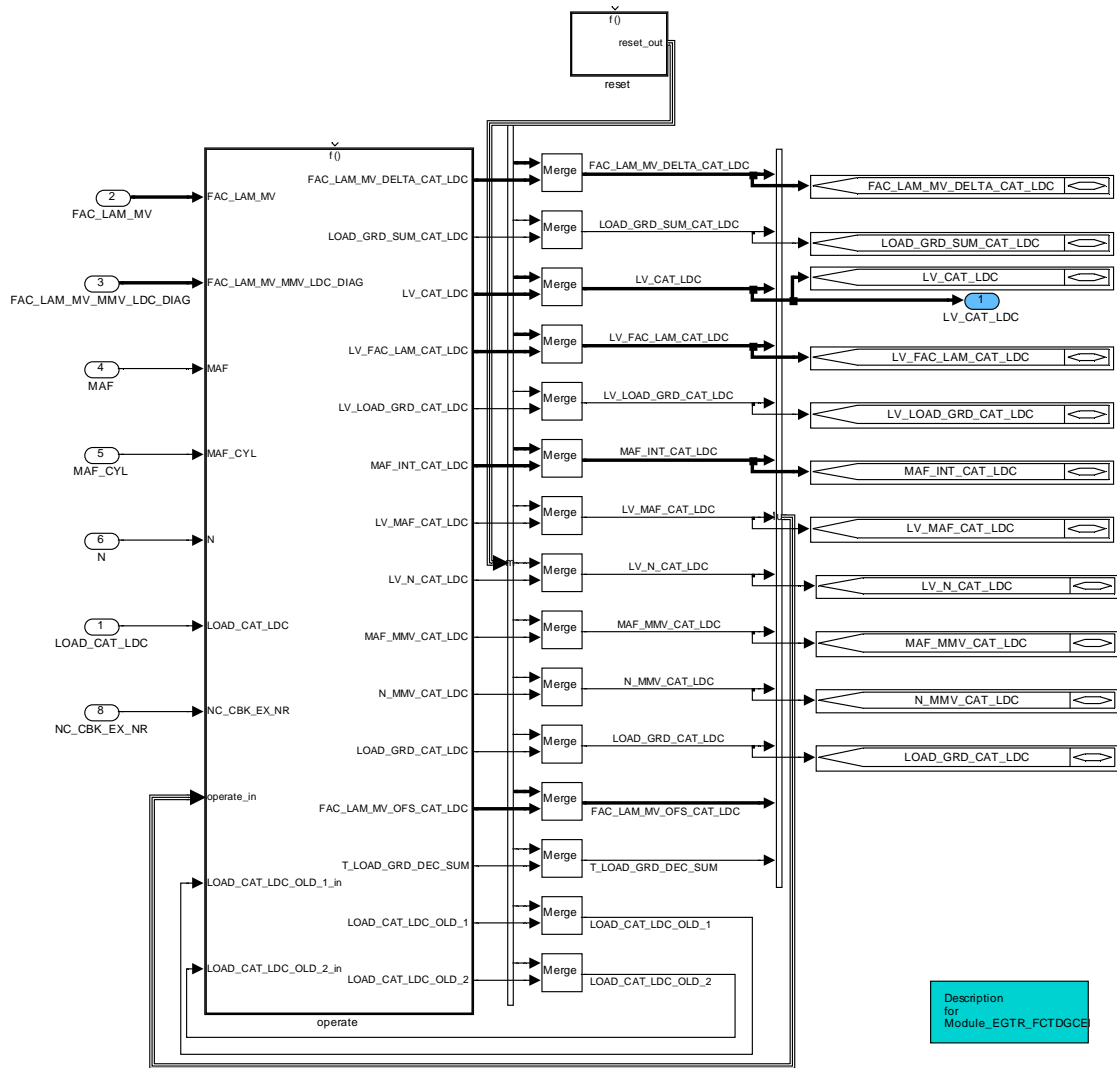
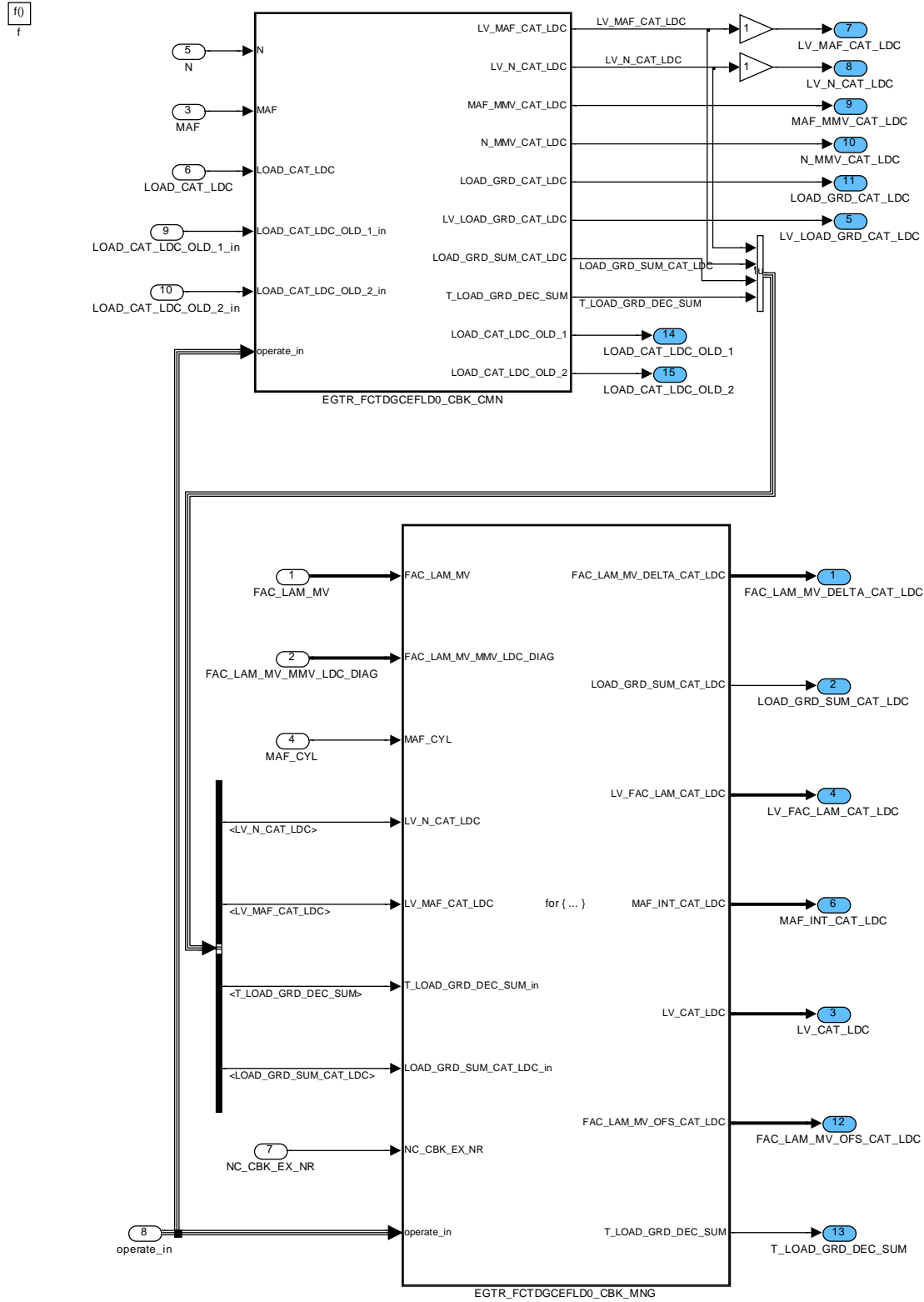


Figure B.50.1: EGTR\_FCTDGCEFLD0

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Figure B.50.2: EGTR\_FCTDGCEFLD0/operate

Cylinder bank independent calculation

Calculation of LOAD\_CAT\_LDC gradient:

The LOAD\_CAT\_LDC gradient is calculated with the recurrence T\_SAMPLE in [ms].

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To this effect, the LOAD\_CAT\_LDC values are written into the ring buffer. Thus, the last two LOAD\_CAT\_LDC values are available in addition to the current LOAD\_CAT\_LDC value. The LOAD\_CAT\_LDC gradient is based on a LOAD\_CAT\_LDC difference of twice T\_SAMPLE in [ms].

The LOAD\_GRD\_CAT\_LDC reflects the gradient of the actual driver's demand prior to the corrections. If C\_LOAD\_GRD\_SUM\_MIN is larger than C\_LOAD\_GRD\_SUM\_MAX the LOAD\_CAT\_LDC gradient summation LOAD\_GRD\_SUM\_CAT\_LDC will be no condition to determine the limited dynamic bit LV\_CAT\_LDC[i].

#### Limited engine speed (N) dynamics:


The floating mean value N\_MMV\_CAT\_LDC is computed using the filtering constant C\_N\_CRLC\_CAT\_LDC. The limited dynamics condition only exist while the engine speed N lies within the dynamics window around N\_MMV\_CAT\_LDC.

If the above limited dynamics condition is violated, the floating mean value N\_MMV\_CAT\_LDC is set to the current engine speed in order to reach the limited dynamics condition faster.

#### Limited mass air flow (MAF) dynamics:

The floating mean value MAF\_MMV\_CAT\_LDC is computed using the averaging constant C\_MAF\_CRLC\_CAT. The limited dynamics condition only exist while the air mass MAF stays within the dynamics window around MAF\_MMV\_CAT\_LDC.

If the above limited dynamics condition is violated, the floating mean value MAF\_MMV\_CAT\_LDC is set to the current airmass value in order to reach the limited dynamics condition faster.

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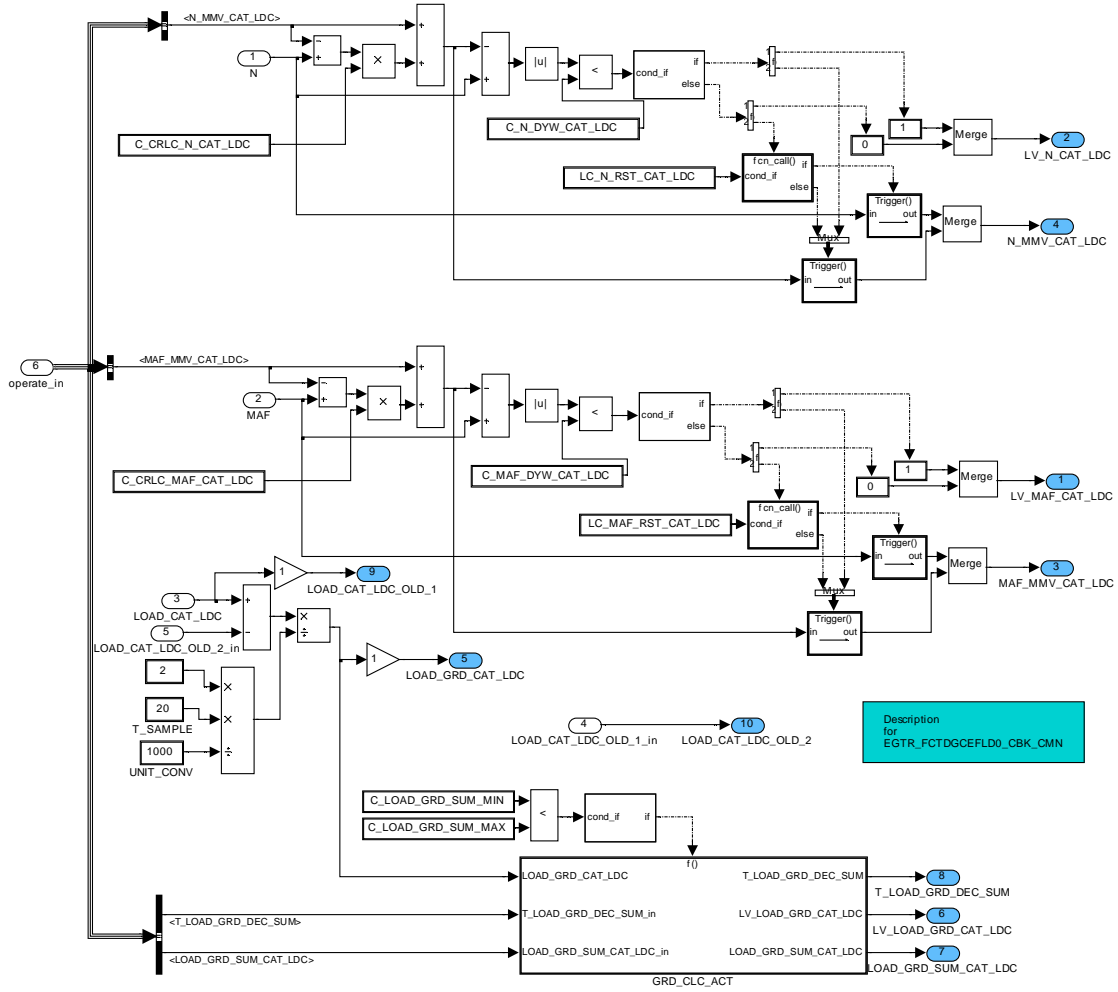


Figure B.50.3: EGTR\_FCTDGCEFLD0/operate/EGTR\_FCTDGCEFLD0\_CBK\_CMN

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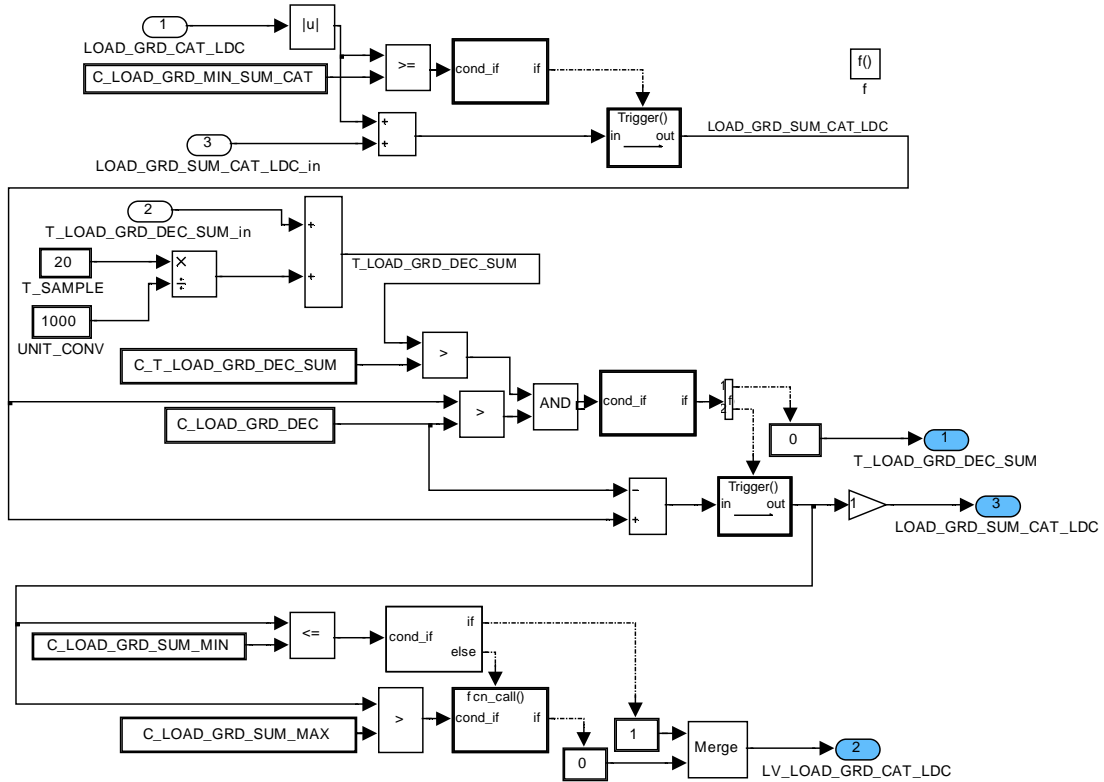


Figure B.50.4: EGTR\_FCTDGCEFLD0/operate/EGTR\_FCTDGCEFLD0\_CBK\_CMN/GRD\_CLC\_ACT

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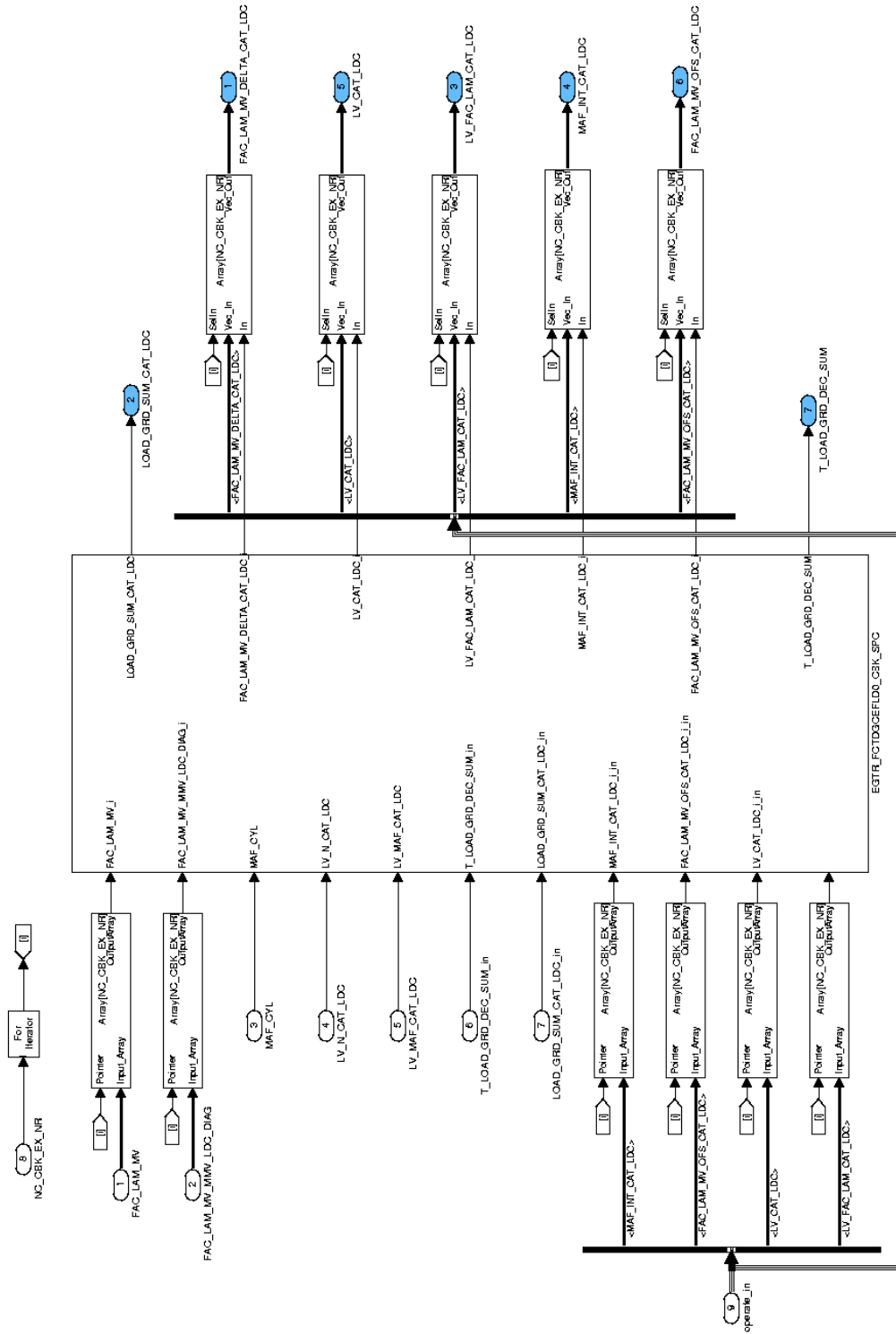



Figure B.50.5: EGTR\_FCTDGCEFLD0/operate/EGTR\_FCTDGCEFLD0\_CBK\_MNG  
Cylinder bank dependent calculation

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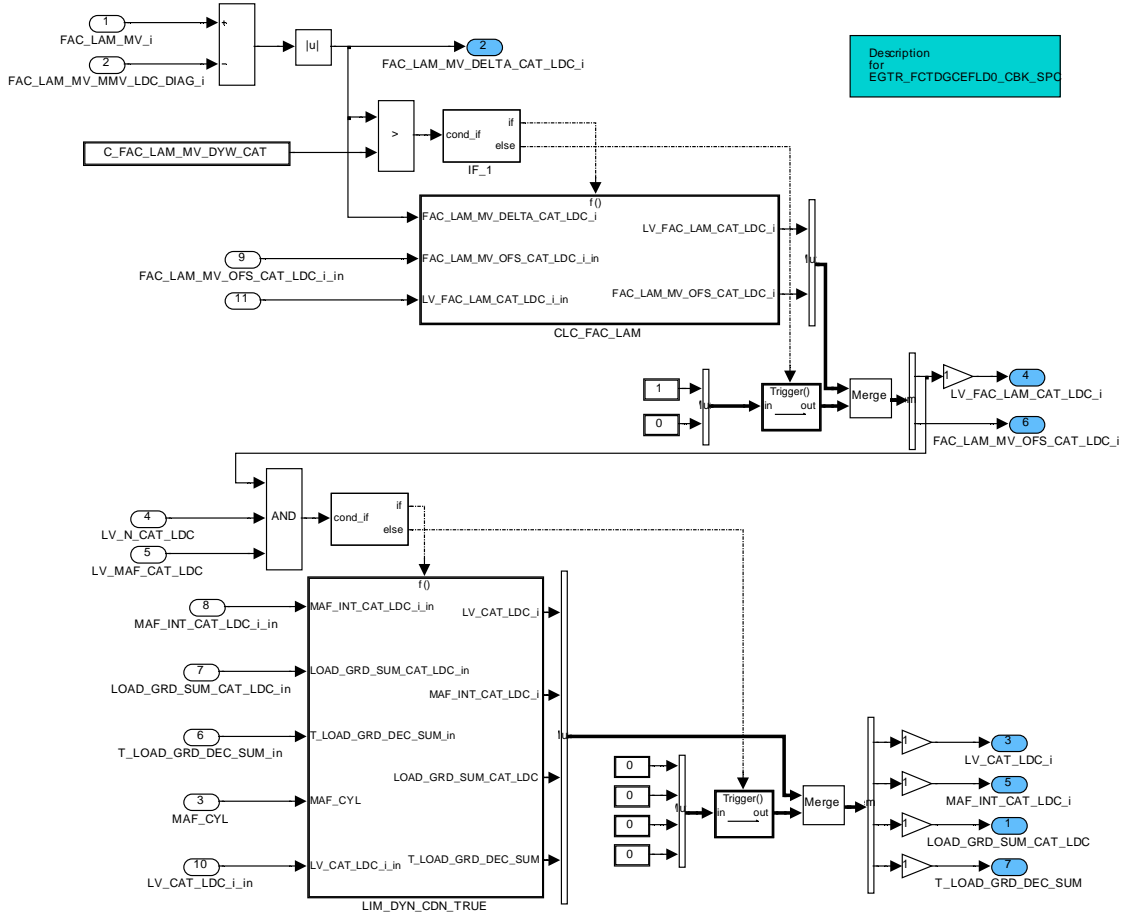


Figure B.50.6: EGTR\_FCTDGCEFLD0/operate/EGTR\_FCTDGCEFLD0\_CBK\_MNG/EGTR\_FCTDGCEFLD0\_CBK\_SPC

Limited mean oxygen value (FAC\_LAM\_MV[i]) dynamics

The floating mean value FAC\_LAM\_MV\_MMV\_CAT\_LDC[i] is computed inside the AGGR LACO.

The limited dynamics condition continues to exist while the mean oxygen value FAC\_LAM\_MV[i] stays within the dynamics window around FAC\_LAM\_MV\_DELTA\_CAT\_LDC[i].

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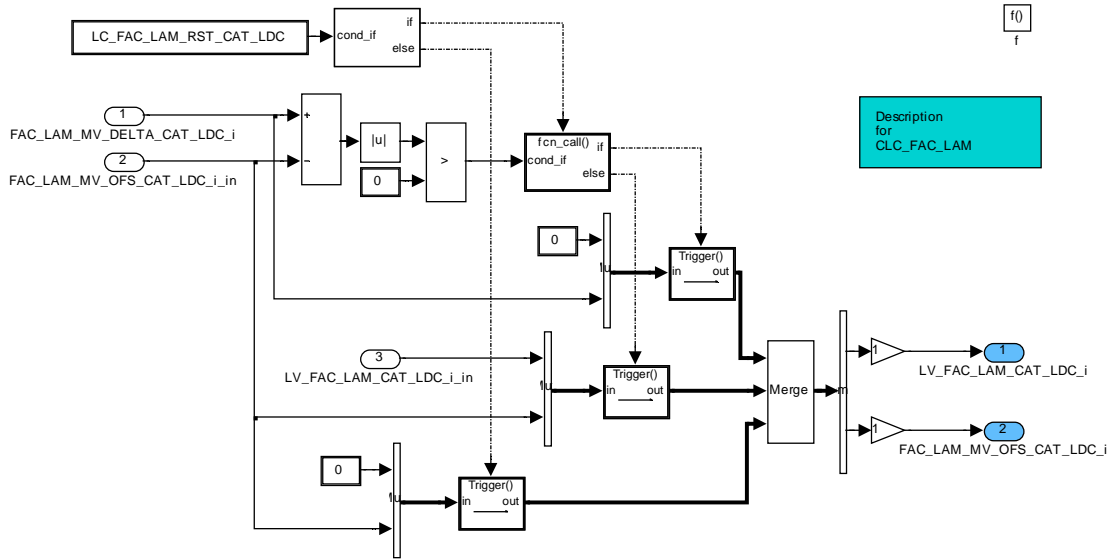


Figure B.50.7: EGTR\_FCTDGCEFLD0/operate/EGTR\_FCTDGCEFLD0\_CBK\_MNG/EGTR\_FCTDGCEFLD0\_CBK\_SPC/CLC\_FAC\_LAM

Setting of LV\_CAT\_LDC[i]

When the air mass flow integral exceeds a calibration limit the flag LV\_CAT\_LDC[i] is set to 1 indicating that the limited dynamics are fulfilled.

The recurrence time is defined by T\_SAMPLE in [ms].

For the calculation of the air mass flow integral the unit conversion:

$$[g] = [kg/h] * [ms] * [(g*h)/(kg*ms)] / 3600$$

has to be considered.

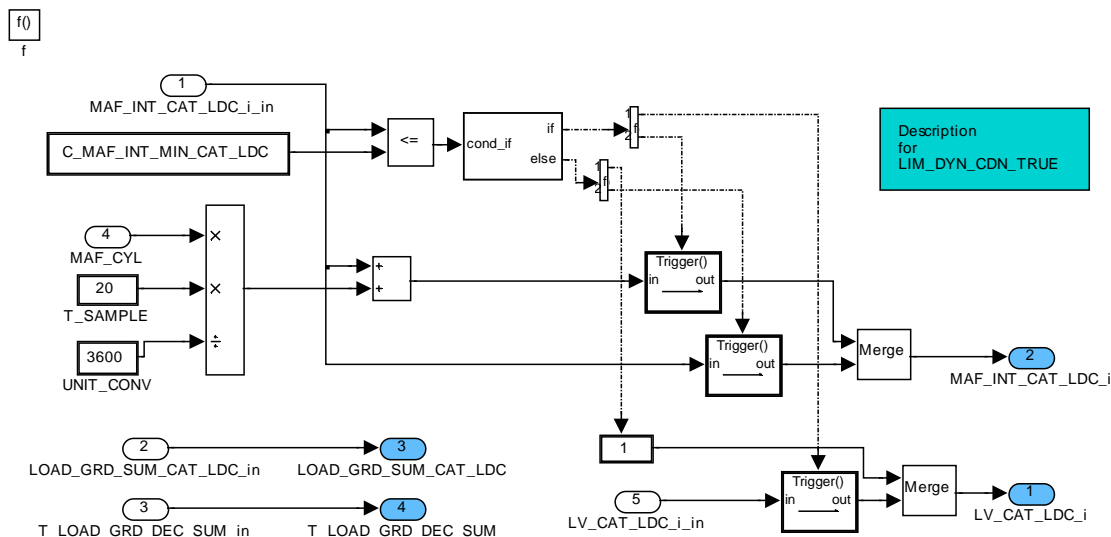



Figure B.50.8: EGTR\_FCTDGCEFLD0/operate/EGTR\_FCTDGCEFLD0\_CBK\_MNG/EGTR\_FCTDGCEFLD0\_CBK\_SPC/LIM\_DYN\_CDN\_TRUE

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## B.51 TWC diagnosis at lean operation - Activation conditions

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_O2L_CLC_ACT_CDN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
General activation flag for calculation of oxygen capacity					
LV_O2L_CLC_ACT_CMB_CDN	V	0... 1H	0 ...1	1	-
Activation for diagnosis regarding combustion conditions					
LV_O2L_CLC_ACT_LDC_TEMP_TMP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Activation for diagnosis regarding TWC temperature limited dynamic					
LV_O2L_CLC_ACT_MAF_INT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Activation for diagnosis regarding MAF integral after high load phase					
LV_O2L_CLC_ACT_OPP_TMP	V	0... 1H	0 ...1	1	-
Activation of the diagnosis regarding operating point conditions					
LV_O2L_CLC_ACT_TCO_TMP	V	0... 1H	0 ...1	1	-
Activation of the diagnosis regarding coolant temperature					
LV_O2L_CLC_ACT_TEMP_TMP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Activation for diagnosis regarding TWC temperature					
MAF_INT_CAT_DIAG_AFL [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.41666667	0.0277778	g
Maf integral after high load phase					
TEMP_LDC_CAT_DIAG_AFL [NC_CBK_EX_NR]	V	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Filtered modelled catalyst dynamic temperature					
TQI_LDC_CAT_DIAG_AFL	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Filtered TQI_AV					

### Input data:

EFF_CAT_DIAG [NC_CBK_EX_NR] {p. 5535}	LV_END_DIAG_AFL_TMP [NC_CBK_EX_NR] {p. 5561}	LV_END_DIAG_CAT_ DIAG_AFL [NC_CBK_EX_NR] {p. 5561}	LV_INH_DIAG_CAT_DIAG_ AFL [NC_CBK_EX_NR] {p. 5634}
LV_NT_ACT {p. 2982}	LV_ST_END {p. 1720}	MAF_CYL {p. 8277}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	NC_NT_NR {p. 644}	STATE_NOX {p. 2986}	TCO {p. 1100}
TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	TNT_MDL_MV_SNG [NC_NT_NR] {p. 8237}	TQI_AV {p. 981}	VS {p. 1176}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_TEMP_CAT_DIAG_AFL	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation constant for calculation of filtered TWC temperature					
C_CRLC_TQI_CAT_DIAG_AFL	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation constant for calculation of filtered TQI_AV					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_INT_MAX_CAT_DIAG_AFL	-	0... FFFFH	0... 1820.41666667	0.0277778	g
MAF_CYL integral for delay of the diagnosis activation after high load phase					
C_N_32_DOWN_LIM_CAT_DIAG_AFL	-	0... FFH	0... 8160	32	rpm
Lower limit of N_32 to allow of OSC calculation					
C_N_32_UP_LIM_CAT_DIAG_AFL	-	0... FFH	0... 8160	32	rpm
Upper limit of N_32 to allow of OSC calculation					
C_TCO_DOWN_LIM_CAT_DIAG_AFL	-	0... FEH	-48... 142.5	0.75	°C
Lower limit of TCO to allow of OSC calculation					
C_TCO_UP_LIM_CAT_DIAG_AFL	-	0... FEH	-48... 142.5	0.75	°C
Upper limit of TCO to allow of OSC calculation					
C_TEMP_DYN_H_THD_CAT_DIAG_AFL	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Maximal dynamic TWC temperature for activation of the diagnosis					
C_TEMP_LDC_CAT_DIAG_AFL	-	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Threshold for deactivation of OSC calculation regarding TWC temp. limited dynamic					
C_TEMP_UP_LIM_CAT_DIAG_AFL	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Upper limit of TWC temperature to allow of OSC calculation					
C_TNT_DOWN_LIM_CAT_DIAG_AFL	-	0... FFFFH	0... 1023.984375	0.015625	°C
Lower limit of NT temperature to allow of OSC calculation					
C_TNT_UP_LIM_CAT_DIAG_AFL	-	0... FFFFH	0... 1023.984375	0.015625	°C
Upper limit of NT temperature to allow of OSC calculation					
C_TQI_LDC_CAT_DIAG_AFL	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Threshold for deactivation of OSC calculation regarding TQI_AV limited dynamic					
C_VS_DOWN_LIM_CAT_DIAG_AFL	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed for activation of the diagnosis					
C_VS_UP_LIM_CAT_DIAG_AFL	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed for activation of the diagnosis					
IP_MAF_DOWN_LIM_CAT_DIAG_AFL	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDPM_N_32_IP_MAF	6	0... FFH	0... 8160	32	rpm
Lower limit of MAF for activation of the diagnosis					
IP_MAF_UP_LIM_CAT_DIAG_AFL	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDPM_N_32_IP_MAF	6	0... FFH	0... 8160	32	rpm
Upper limit of MAF for activation of the diagnosis					
IP_TEMP_DOWN_LIM_CAT_DIAG_AFL	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
LDP_EFF_CAT_DIAG_AFL_IP_TEMP	4	0... FFH	0... 1.9921875	7.8125e-3	-
Lower limit of the dynamic catalyst temperature depending on catalyst aging state					

## General Information

Activation condition for calculation of OSC values in module "TWC diagnosis at lean operation - OSC calculation".


If two separate exhaust bank systems are concerned, then:

i = 1, for cylinder bank 1

i = 2, for cylinder bank 2

Otherwise:

i = 1

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**Application Conditions**

Initialization: RST  
 Recurrence: 10MS  
 Activation: always  
 Deactivation: never

**Function description**

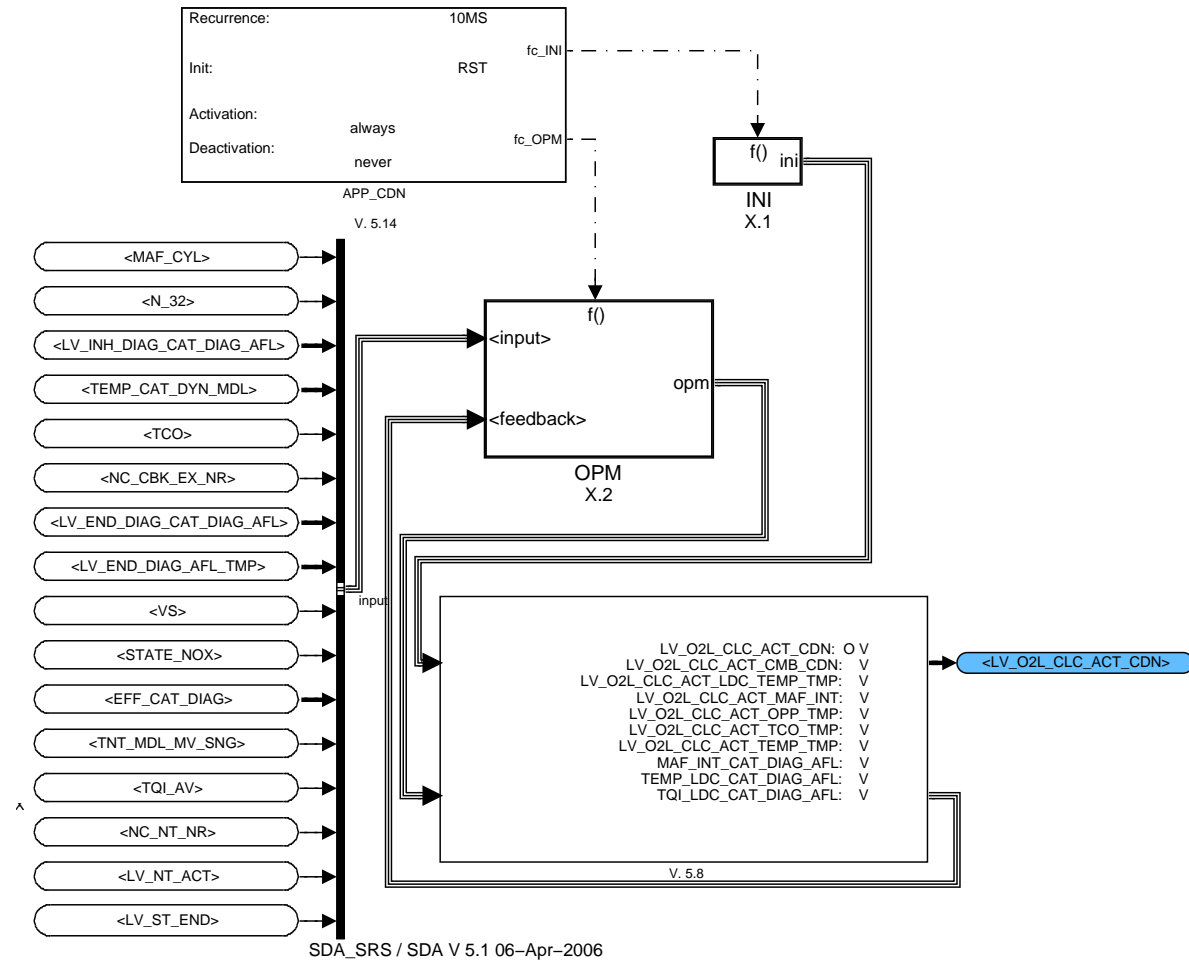


Figure B.51.1: : Overview level

**B.51.1 INITIALIZATION**

All variables are initialized with "0"

**B.51.2 FORMULA SECTION**

The bank specific and bank not specific calculations are done separate

**B.51.2.1 Function active - bank not specific calculations**

In this case are checked:

- Operating point
- Coolant temperature

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 5555 of 8404	
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Combustion conditions

**B.51.2.1.1 Check of the operating point**

Deactivation of the diagnosis, when the mass air flow and rotational speed exceed defined range. Additional, dynamic of the torque request are checken

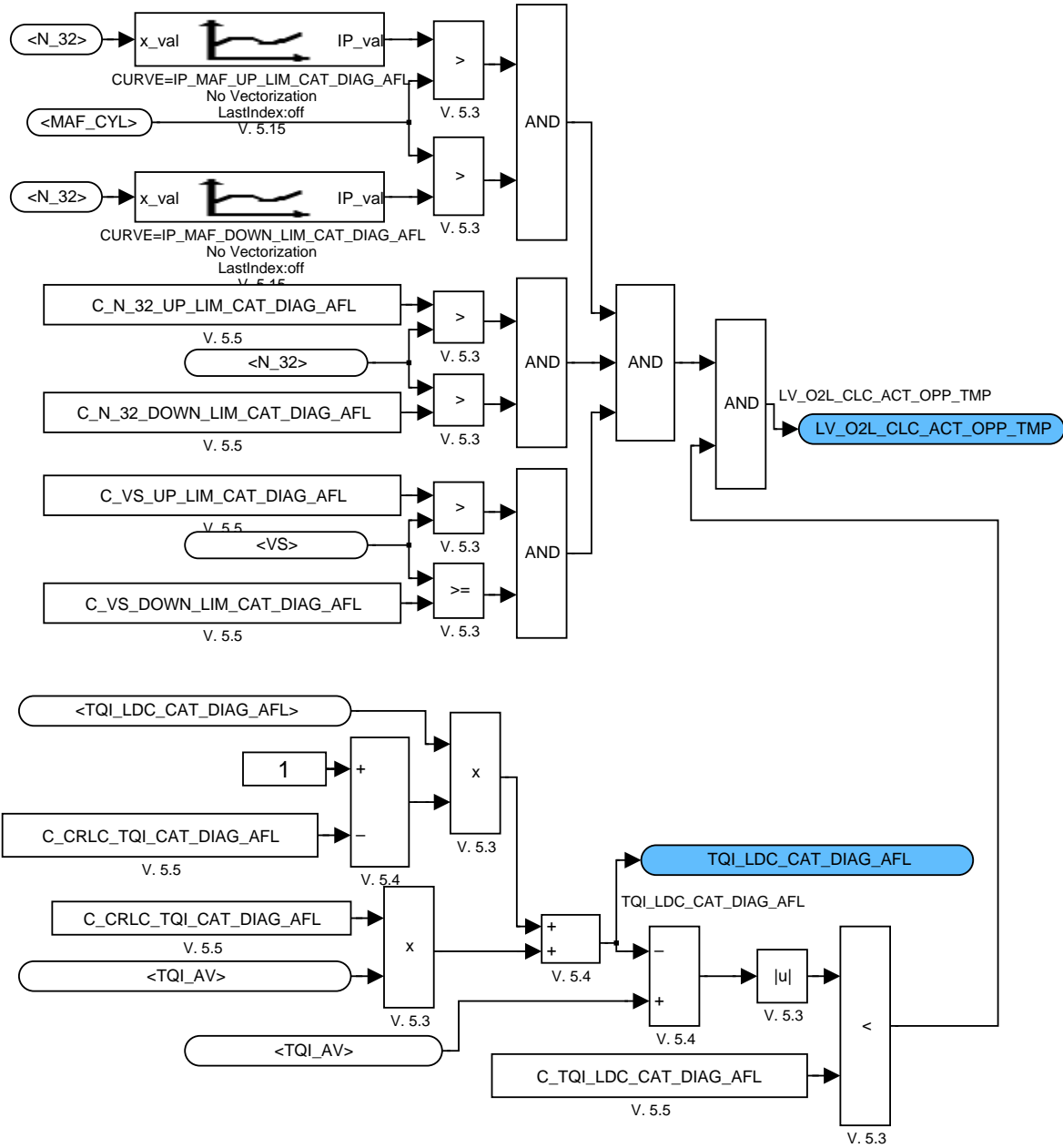


Figure B.51.2: :

**B.51.2.1.2 Check of coolant temperature**

Deactivation of the diagnosis, when the coolant temperature exceeds defined range

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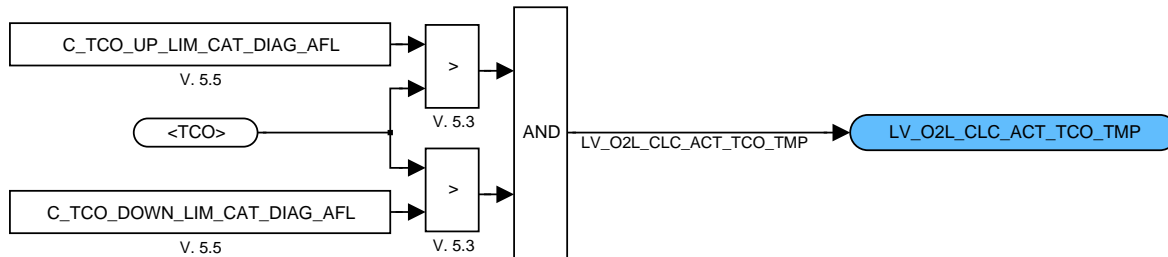


Figure B.51.3: :

### B.51.2.1.3 Check of the combustion conditions

Deactivation when the NOx after treatment equipment is not active

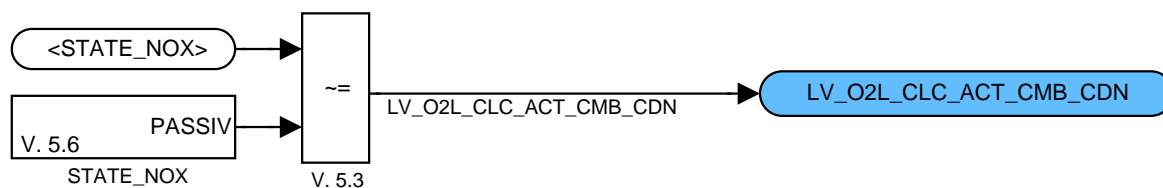


Figure B.51.4: :

## B.51.2.2 Function active - bank specific calculations

### B.51.2.2.1 Check of bank specific activation conditions

In this case:

- The static temperature of TWC monolith is checked
- The limited dynamic of TWC monolith temperature is checked
- The MAF integral is calculated after high load phase
- The final activation condition flag is calculated

#### B.51.2.2.1.1 Check of the TWC and NT monolith temperatures

Deactivation of the diagnosis, when the monolith temperatures of TWC and NT (NOx Trap) exceed defined range. For the NT, a mean value of the both monolith is used. In case of down limit of the TWC temperature, it can be different for catalysts with different aging state

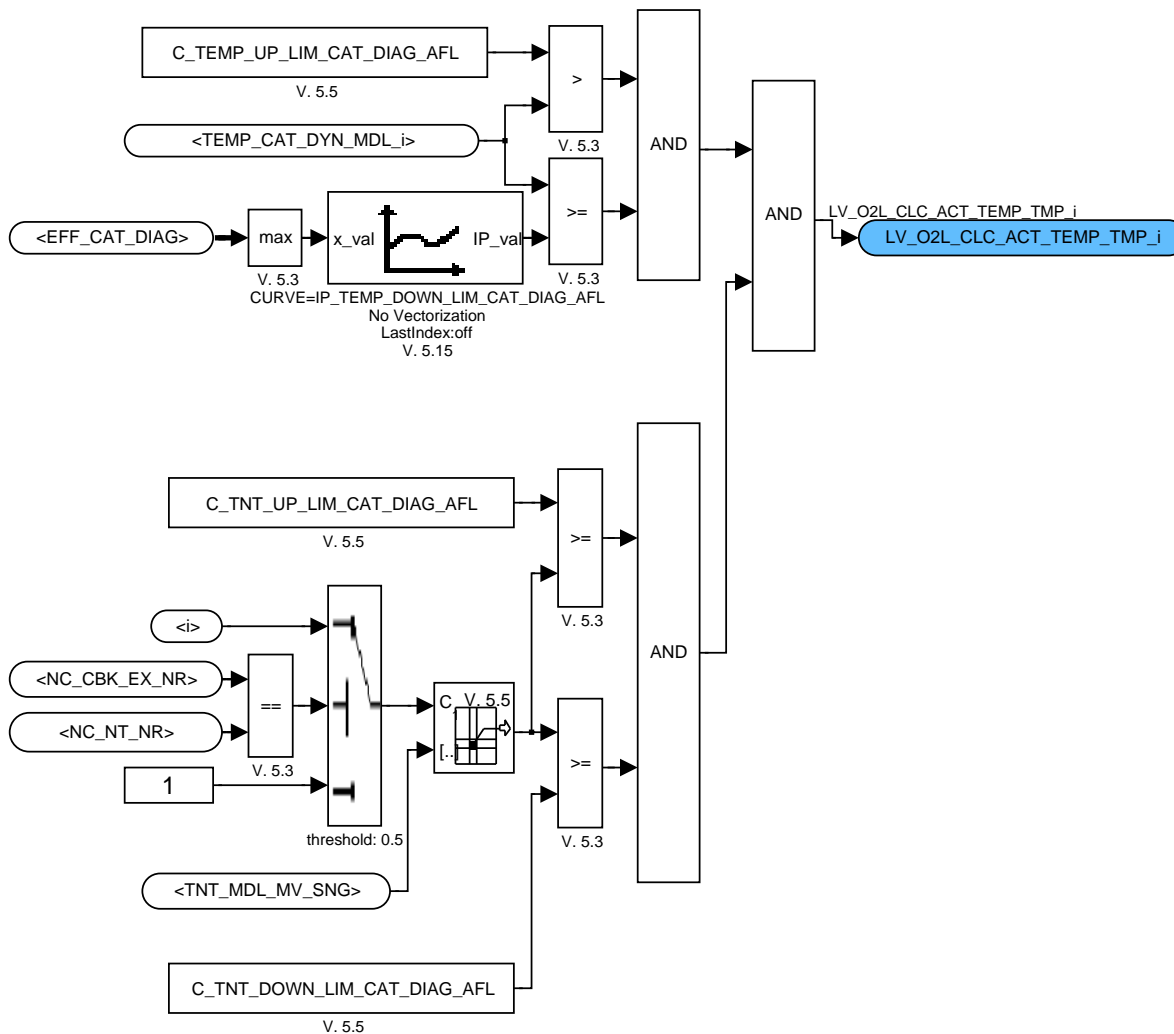


Figure B.51.5: :

**B.51.2.2.1.2 Check of the limited dynamic of the TWC monolith temperature**

The difference between filtered and not filtered TWC monolith temperature is shall not exceed defined threshold

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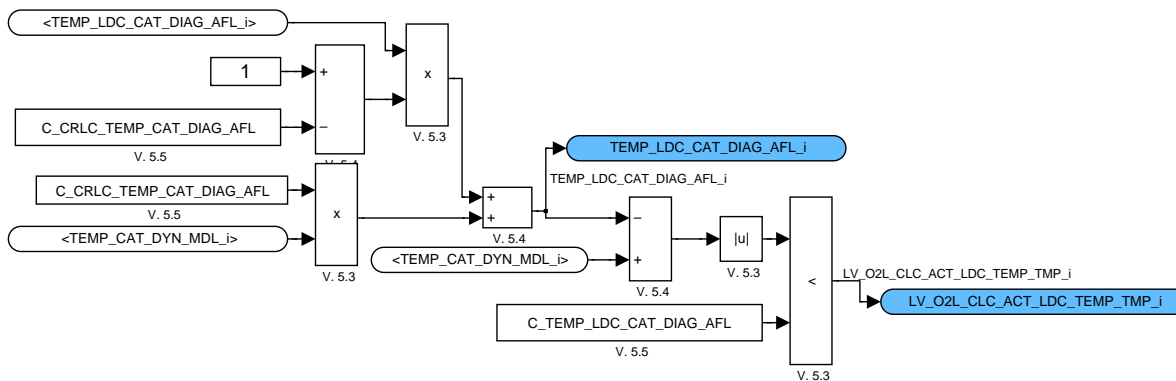


Figure B.51.6: :

### B.51.2.2.1.3 Check of the MAF integral

Deactivation of the diagnosis after high load phase till defined MAF integral is not released

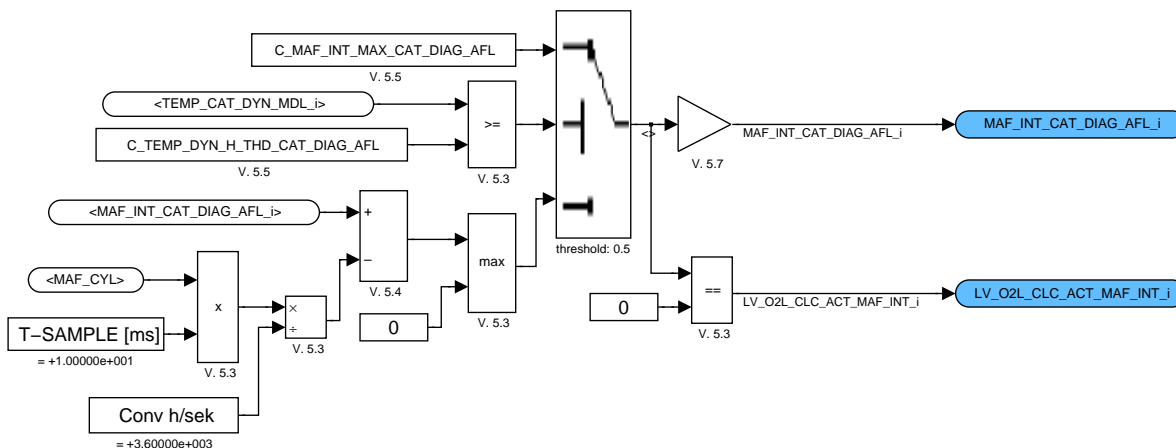


Figure B.51.7: :

### B.51.2.2.1.4 Calculation of the final activation flag

The end activation flag results from the condition checked in this module, the inhibition condition and the diagnosis end condition. The diagnosis is deactivated when the calculation of it results is finished

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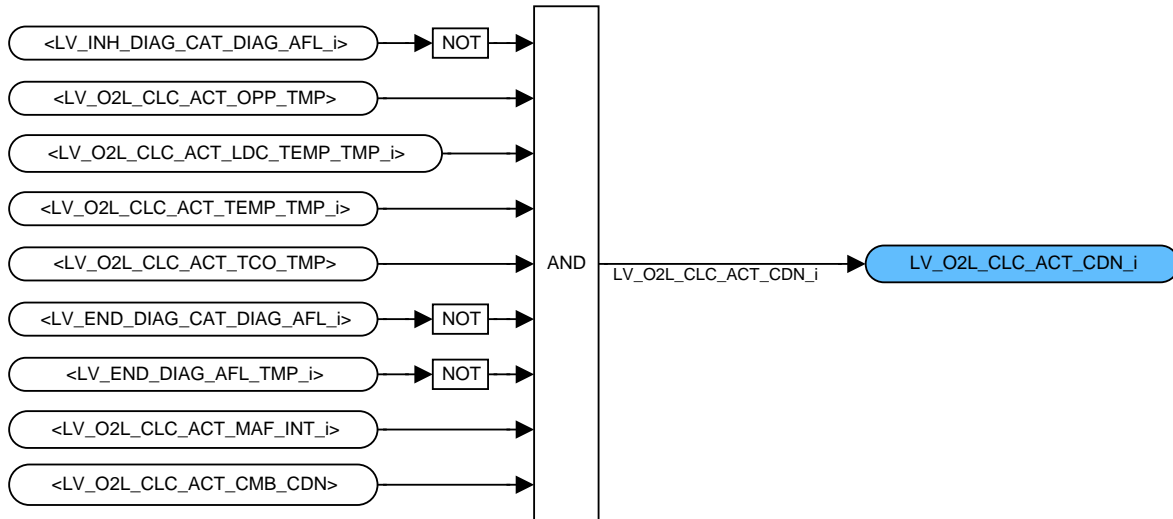


Figure B.51.8: :

### B.51.2.3 Check activation conditions

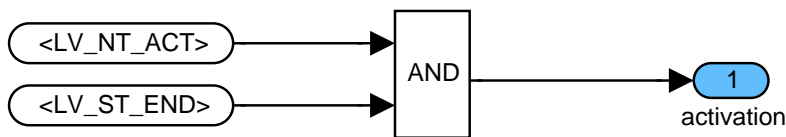


Figure B.51.9: :

### B.51.2.4 Function not active

All variables are set to "0"

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## B.52 TWC diagnosis at lean operation - Diagnosis value determination

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CYC_CAT_DIAG_AFL [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter of diagnosis cycles for calculation of error indicator					
CTR_O2L_SUM_H_AMPL [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for calculation of mean value of O2L calculated in high regeneration phases					
CTR_O2L_SUM_L_AMPL [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for calculation of mean value of O2L calculated in low regeneration phases					
CTR_O2L_SUM_LOAD [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for calculation of mean value of O2L calculated in load phases					
CTR_O2L_SUM_PARK [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for calculation of mean value of O2L calculated in park phases					
ERR_SYM_CAT_DIAG_AFL [NC_CBK_EX_NR]	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom for TWC lean diagnosis					
FAC_SUM_O2L_MMV_TMP [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Denominator for calculation of O2L_MMV_CAT_DIAG_AFL					
LV_CDN_DIAG_CAT_DIAG_AFL [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to one when condition is fulfilled)					
LV_END_DIAG_AFL_TMP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Temporary flag for end of the Diagnostic cycle without filtering					
LV_END_DIAG_CAT_DIAG_AFL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Diagnostic performed at last one time					
LV_ERR_CAT_DIAG_AFL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Present failure after filtering of diagnostic CAT_DIAG_AFL					
LV_ERR_CAT_DIAG_AFL_TMP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Temporary present failure of diagnostic CAT_DIAG_AFL					
LV_O2L_AFL_CDN_MAT [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Calculation of O2L_AFL_CDN_MAT was successful					
LV_O2L_CAT_DIAG_AFL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Calculation of general O2L value was successful					
LV_O2L_CAT_DIAG_AFL_SUM	V	0... 1H	0 ...1	1	-
Calculation of O2L_CAT_DIAG_AFL_SUM was successful					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_O2L_CLC_READY [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Calculation of general diagnosis value is finished					
LV_O2L_MV_CLC_END [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Calculation of mean values during diagnosis cycle has been done					
LV_RGN_NT_REQ_AFL_PREV	-	0... 1H	0 ...1	1	-
The previous value of LV_RGN_NT_REQ					
O2L_AFL_CDN_MAT [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Calculated O2L of PreCat in Lean Condition					
O2L_AFR_CDN_COR [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Corrected O2L value with mathematic method					
O2L_AFR_CDN_COR_MAT [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Corrected O2L value with empirical method					
O2L_CAT_DIAG_AFL [NC_CBK_EX_NR]	O/V/S	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Finally O2L value for calculation of Error Symptom					
O2L_CAT_DIAG_AFL_SUM	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Diagonal calculated O2L of both cylinder branches					
O2L_DELTA_AFR_CDN [NC_CBK_EX_NR]	V	0... FFFFH	-1.30844444444 ...1.3084	39.9306e-6	g
Delta between O2L values calculated during H_AMPL and L_AMPL regeneration phases					
O2L_H_AMPL_MV [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Mean value of O2L values calculated in regenerations with high amplitude phase					
O2L_H_AMPL_SUM [NC_CBK_EX_NR]	V	0... FFFFH	0... 20.93479	319.444e-6	g
Sum of O2L values calculated during regenerations with high amplitude phase					
O2L_L_AMPL_MV [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Mean value of O2L values calculated in regenerations with low amplitude phase					
O2L_L_AMPL_SUM [NC_CBK_EX_NR]	V	0... FFFFH	0... 20.93479	319.444e-6	g
Sum of O2L values calculated in regenerations with low amplitude phase					
O2L_LOAD_MV [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Mean value of O2L values calculated during load phases					
O2L_LOAD_SUM [NC_CBK_EX_NR]	V	0... FFFFH	0... 20.93479	319.444e-6	g
Sum of O2L values calculated during load phases					
O2L_MMV_CAT_DIAG_AFL [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Mean value of O2L values calculated in all phases					
O2L_NT_MAT	V	0... FFFFH	0... 20.93479	319.444e-6	g
Calculated O2L value of NOx catalyst					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
O2L_PARK_MV [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Mean value of O2L values calculated in park phases					
O2L_PARK_SUM [NC_CBK_EX_NR]	V	0... FFFFH	0... 20.93479	319.444e-6	g
Sum of O2L values calculated in park phases					
O2L_SUM_CAT_DIAG_AFL [NC_CBK_EX_NR]	V	0... FFFFH	0... 20.93479	319.444e-6	g
Sum of O2L values of all phases for calculation of O2L_MMV_CAT_DIAG_AFL					
STATE_CAT_DIAG_AFL_OLD [NC_CBK_EX_NR]	-	0H 1H 2H 3H	PASSIVE RICH_CDN LEAN_CDN WAIT	-	-
Old value for STATE_CAT_DIAG_AFL					
STATE_O2L_MV_CLC_VLD [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Collected bits due to calculation of mean values at each phase					

**Input data:**

C_STATE_EX_CONF {p. 5608}	C_STATE_SENS_DOWN_ MISS_CBK {p. 5608}	LV_DC {p. 5746}	LV_DIAG_END_SUM_ DIAG_AFL [NC_CBK_EX_NR] {p. 5634}
LV_DIAG_ERR_SUM_ DIAG_AFL [NC_CBK_EX_NR] {p. 5634}	LV_O2L_CLC_ACT_CDN [NC_CBK_EX_NR] {p. 5553}	LV_RGN_NT_REQ {p. 2983}	NC_CBK_EX_NR {p. 1829}
O2L_LOAD_PHA [NC_CBK_EX_NR] {p. 5607}	O2L_PARK_PHA [NC_CBK_EX_NR] {p. 5607}	O2L_RGN_H_AMPL_PHA [NC_CBK_EX_NR] {p. 5607}	O2L_RGN_L_AMPL_PHA [NC_CBK_EX_NR] {p. 5607}
STATE_CAT_DIAG_AFL [NC_CBK_EX_NR] {p. 5607}	STATE_O2L_CLC_VLD [NC_CBK_EX_NR] {p. 5608}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_CYC_CAT_DIAG_AFL	-	1... FFH	1... 255	1	-
Number of diagnosis cycles for calculation of error indicator					
C_CTR_O2L_CYC_DIAG_END_AFL [NC_CBK_EX_NR]	-	1... FFH	1... 255	1	-
Number of valid cycles of O2L calculation in lean phase for finishing of the whole one diagnosis cycle					
C_CTR_O2L_CYC_DIAG_END_AFR [NC_CBK_EX_NR]	-	1... FFH	1... 255	1	-
Number of valid cycles of O2L calculation in rich phase for finishing of the whole one diagnosis cycle					
C_CTR_O2L_MV_CLC	-	1... FFH	1... 255	1	-
Number of necessary O2L calculations for calculation of mean value of each phase					
C_FAC_AFR_CDN_MAT	-	0... FFH	0... 15.9375	0.0625	-
Factor for calculation of corrected diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_O2L_CAT_DIAG_AFL_MAX	-	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Maximal O2L value used for initialization of diagnosis value					
C_O2L_THD_ERR_CAT_DIAG_AFL [NC_CBK_EX_NR]	-	0... FFFFH	0... 2.61684895833	39.9306e-6	g
OBD threshold of diagnosis value to set the diagnosis error					
C_O2L_THD_ERR_CAT_DIAG_AFL_SUM	-	0... FFFFH	0... 2.61684895833	39.9306e-6	g
OBD threshold of diagnosis value to set of diagnosis error depending on diagonally O2L calculation					
C_O2L_THD_NOT_ERR_CAT_DIAG_AFL [NC_CBK_EX_NR]	-	0... FFFFH	0... 2.61684895833	39.9306e-6	g
O2L threshold saying that the storage capacity of TWC is enough big to pre-end the diagnosis					
C_STATE_DIAG_CYC_CLC_ENA [NC_CBK_EX_NR]	-	0... FFH	0... 255	1	-
Choice of phases for finishing diagnosis cycle					
C_STATE_O2L_ERR_CLC	-	0... FH	0... 15	1	-
State for choice of O2L calculation strategy for calculation of diagnosis error					
C_STATE_O2L_MMV_CLC_ENA	-	0... FFH	0... 255	1	-
State to allow the calculation of the mean value of the O2L integrals					
IP_FAC_O2L_AFR_CDN_COR	-	0... FFH	0... 15.9375	0.0625	-
LDP_O2L_DELTA_IP_FAC_COR	8	0... FFFFH	-1.30844444444 ...1.3084	39.9306e-6	g
Correction factor for calculation of O2L value					
IP_O2L_CAT_DIAG_AFL_SUM	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
LDP_O2L_CAT_DIAG_1_IP_O2L_SUM	8	0... FFFFH	0... 2.61684895833	39.9306e-6	g
LDP_O2L_CAT_DIAG_2_IP_O2L_SUM	8	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Diagonally calculation of O2L due to both cylinder branches					
LC_O2L_CAT_DIAG_AFL_SUM	-	0... 1H	0 ...1	1	-
Manually set calculation of diagonally O2L to valid					

## Action definition

<b>ACTION_EGTR_ClcO2L_SUMandMV</b> (IN<LV_O2L_MV_CLC_ACT_TMP_i>,IN<STATE_O2L_CLC_VLD_Bx_i>,IN<O2L_i>,OUT<LV_O2L_SUM_CLC_i>,INOUT<CTR_SUM_i>,INOUT<O2L_SUM_i>,INOUT<O2L_MV_i>)	Mode: O
Calculation of mean value fo O2L	

## Description for Actions

<b>ACTION_EGTR_ClcO2L_SUMandMV(IN &lt;LV_O2L_MV_CLC_ACT_TMP_i&gt;, IN &lt;STATE_O2L_CLC_VLD_Bx_i&gt;, IN &lt;O2L_i&gt;, OUT &lt;LV_O2L_SUM_CLC_i&gt;, INOUT &lt;CTR_SUM_i&gt;, INOUT &lt;O2L_SUM_i&gt;, INOUT &lt;O2L_MV_i&gt;)</b>					
Calculation of mean value fo O2L					
Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
LV_O2L_MV_CLC_ACT_TMP_i	IN	0... 1H	0... 1	1	[-]
Calculation of mean value allowed					
STATE_O2L_CLC_VLD_Bx_i	IN	0... 1H	0... 1	1	[-]
Read bit of STATE_O2L_CLC_VLD					
O2L_i	IN	0... FFFFH	0... 2.61684896	39.9306e-6	[g]
O2L value					
LV_O2L_SUM_CLC_i	OUT	0... 1H	0... 1	1	[-]
Sum calculation valid					
CTR_SUM_i	INOUT	0... FFH	0... 255	1	[-]
Counter for calculation of mean value of O2L					
O2L_SUM_i	INOUT	0... FFFFH	0... 20.93479	319.444e-6	[g]
Sum of O2L values					
O2L_MV_i	INOUT	0... FFFFH	0... 2.61684896	39.9306e-6	[g]
Mean value of O2L values					

## General Information

In this module the diagnosis values are calculated and the link to the error management is implemented.

The calculation of diagnosis value is possible in several ways. Only one method is taken for calculation of finally diagnosis value. Choice of method is partly depending on exhaust gas configuration and number of regeneration cycles during diagnosis cycle. The finally bank specific diagnosis value is after that taken for calculation of diagonally diagnosis value. At the end the error indicator and the error symptom are calculated using bank specific and bank diagonally diagnosis value and the error management is called with condition "true".

Short description of all methods, numbering is equal to value in C\_STATE\_O2L\_ERR\_CLC and bit in STATE\_O2L\_MV\_CLC\_VLD:

Method 0: Mean value of O2L calculated during regeneration with high amplitude phase (excepted configuration 2b)

Method 1: Mean value of O2L calculated during regeneration with low amplitude phase (excepted configuration 2b)

Method 2: Mean value of O2L calculated during park phase (excepted configuration 2b)

Method 3: Mean value of O2L calculated during load phase (excepted configuration 2b)

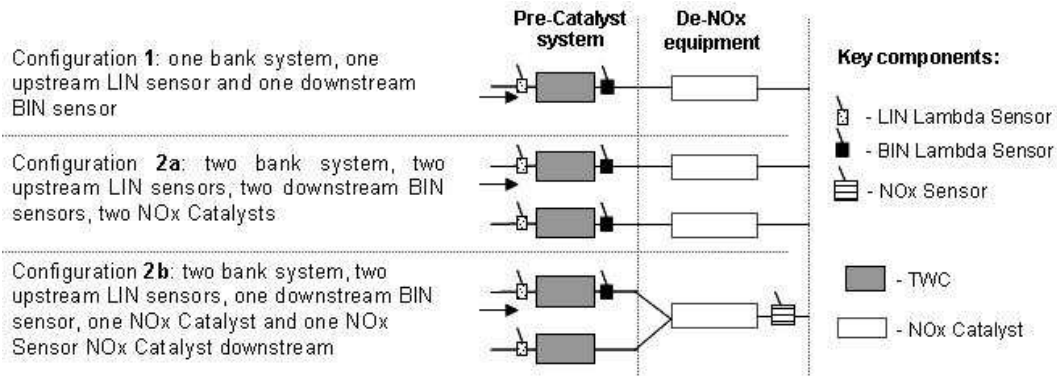
Method 4: Mean value of O2L mean values calculated in all occurred phases (excepted configuration 2b)

Method 5: Corrected O2L value with empirical method to compensate of lambda sensor dynamic using phases with high and low regeneration amplitude (except configuration 2b)

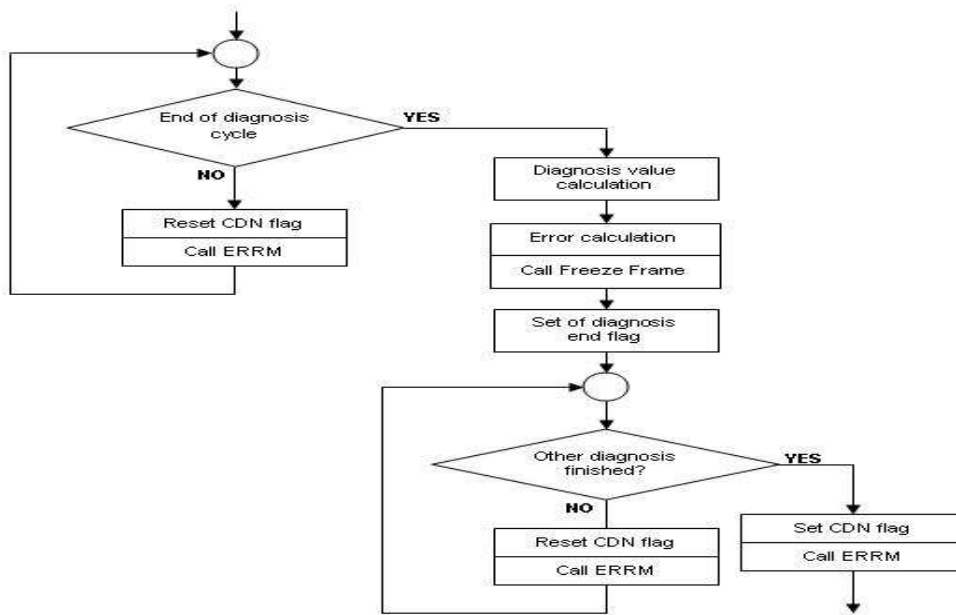
Method 6: Corrected O2L value with mathematical method to compensate of lambda sensor dynamic using phases with high and low regeneration amplitude (except configuration 2b)

Method 7: O2L calculated using TWC- and NOx-Catalyst oxygen storage capacity for calculating of O2L value for bank without downstream Lambda Sensor (only configuration 2b)

Picture 1: The diagnosis is able for following exhaust gas configurations:



Picture 2: Signal flow for calculation of Error Indicator



If two separate exhaust bank systems are concerned, then:

i = 1, for cylinder bank 1

i = 2, for cylinder bank 2

Otherwise:

i = 1

**Application Conditions**

Initialization: RST, NVMINI, NVMRES, NVMSTO, CLRFRM

Recurrence: 10MS

Activation: LV\_DC==1

Deactivation: LV\_DC==0

**Function description**

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 5566 of 8404	
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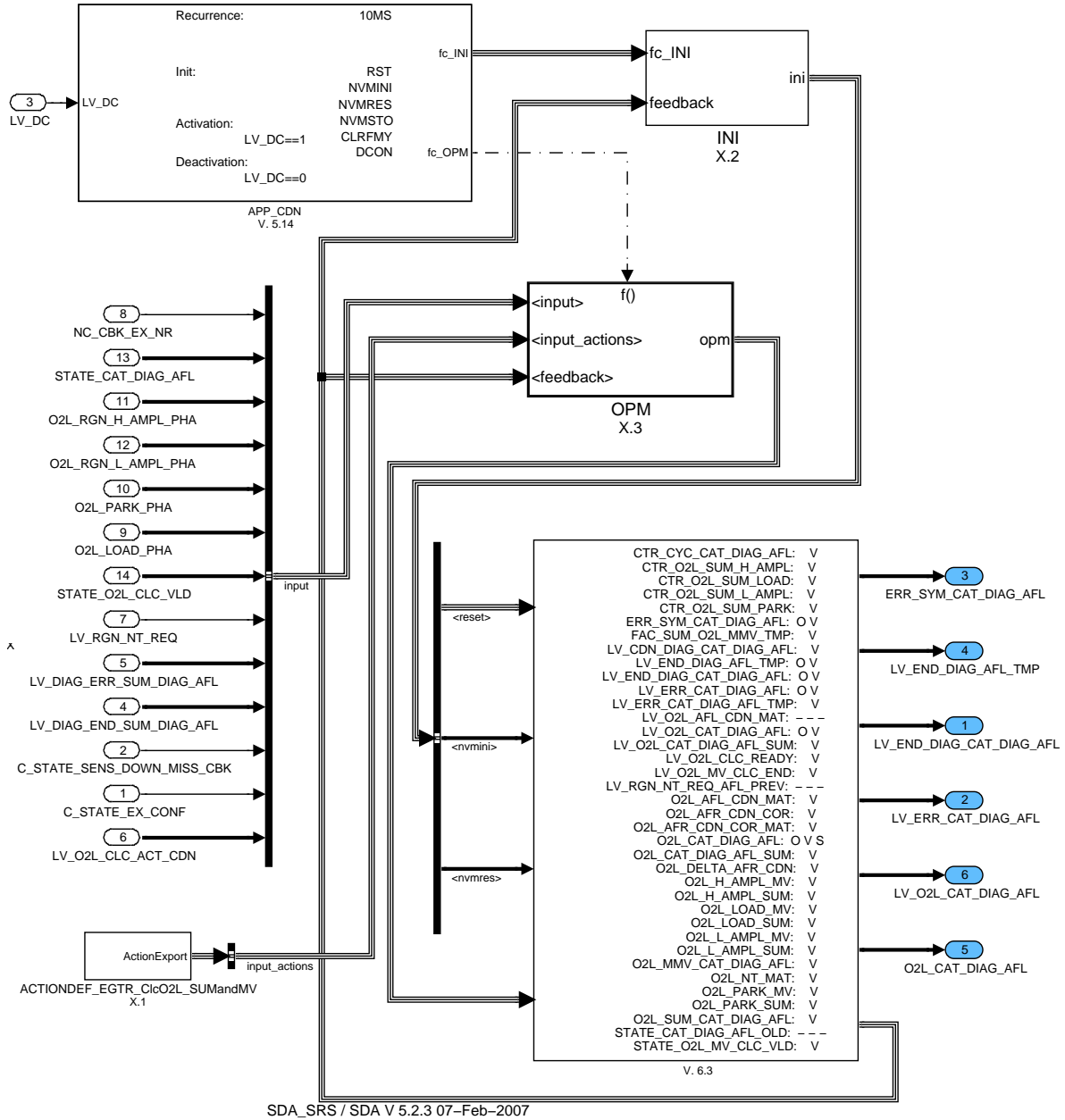


Figure B.52.1: :

## B.52.1 INITIALIZATION

### B.52.1.1 Initialization of NVMY data

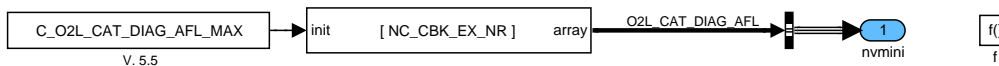


Figure B.52.2: :

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### B.52.1.2 Initialization at reset and function activation (start driving cycle)

At reset and function activation (DCON) all variables except NVMY data and diagnostic result are initialized with "0".

The diagnostic result is initialized according the filtering configuration.

### B.52.2 FORMULA SECTION

The formula section consists of two main sections:

Regeneration cycles counter, bank diagonally calculations inclusive calculation of method 7 and the final diagnosis result

Methods 1 to 6 and ERRM interface

#### B.52.2.1 Regeneration cycles counter, bank diagonally calculations inclusive method 7 and final diagnosis value

##### B.52.2.1.1 Counting of the regeneration cycles

##### B.52.2.1.1.1 Bank specific calculation of the regeneration cycles counter

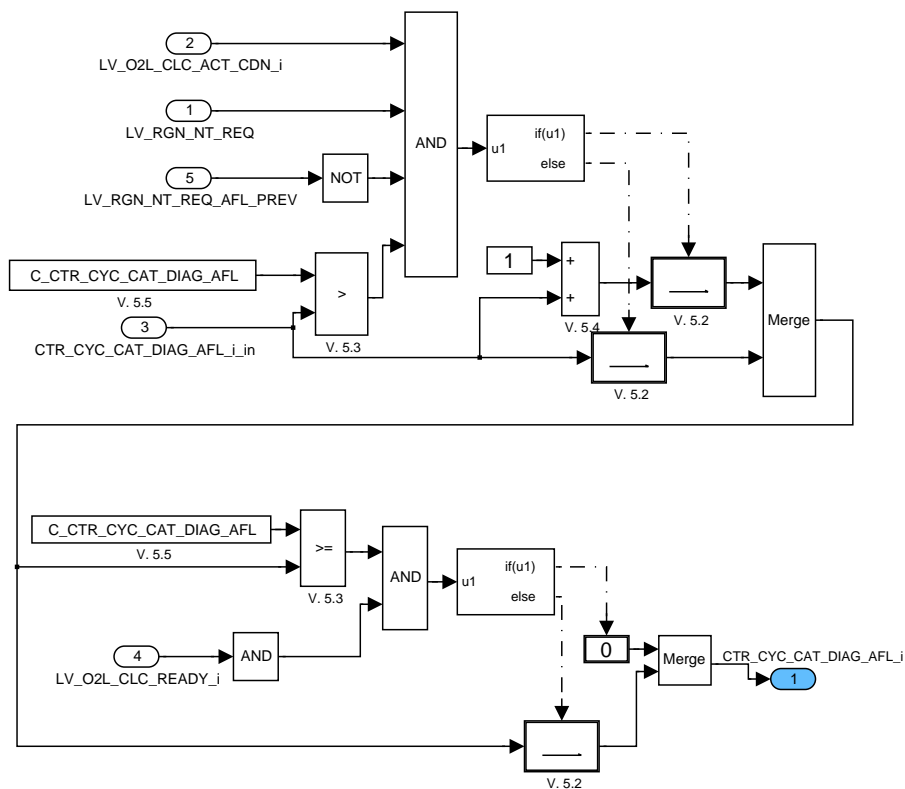


Figure B.52.3: :

##### B.52.2.1.2 Bank diagonally calculations inclusive method 7 and final diagnosis value

This section consists of:

Calculation of flag indicating, that diagnosis on any bank is finished

Calculation of O2L value of NOx-Catalyst in case of configuration 2b

Calculation of temporary O2L value for bank without binary downstream sensor in case of exhaust gas configuration 2b



Calculation of finally O2L value for both banks and validation bit in case of exhaust gas configuration 2b

Choice of method for calculation of finally diagnosis value

Calculation of sum diagnosis value over all banks

#### B.52.2.1.2.1 Calculation of flag indicating, that diagnosis on any bank is finished

The calculation of all banks is synchronized. This flag says that the calculation of all banks is finished. Then first the diagonal calculation and after that the calculation of diagnosis results is done.

This flag is active only for one cycle.

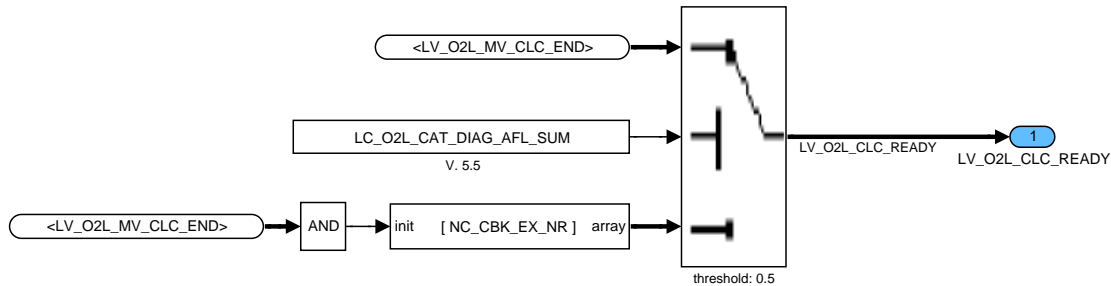


Figure B.52.4: :

#### B.52.2.1.2.2 Calculation of O2L value of NOx-Catalyst in case of configuration 2

The O2L value of NOx catalyst is a difference between O2L value of the whole line and O2L value of precatalyst calculated at bank with downstream binary sensor. The O2L value calculated at bank with downstream binary sensor is corrected according to the dynamic of this sensor. This is given using the IP\_FAC\_O2L\_AFR\_CDN\_COR (see also Method 5)

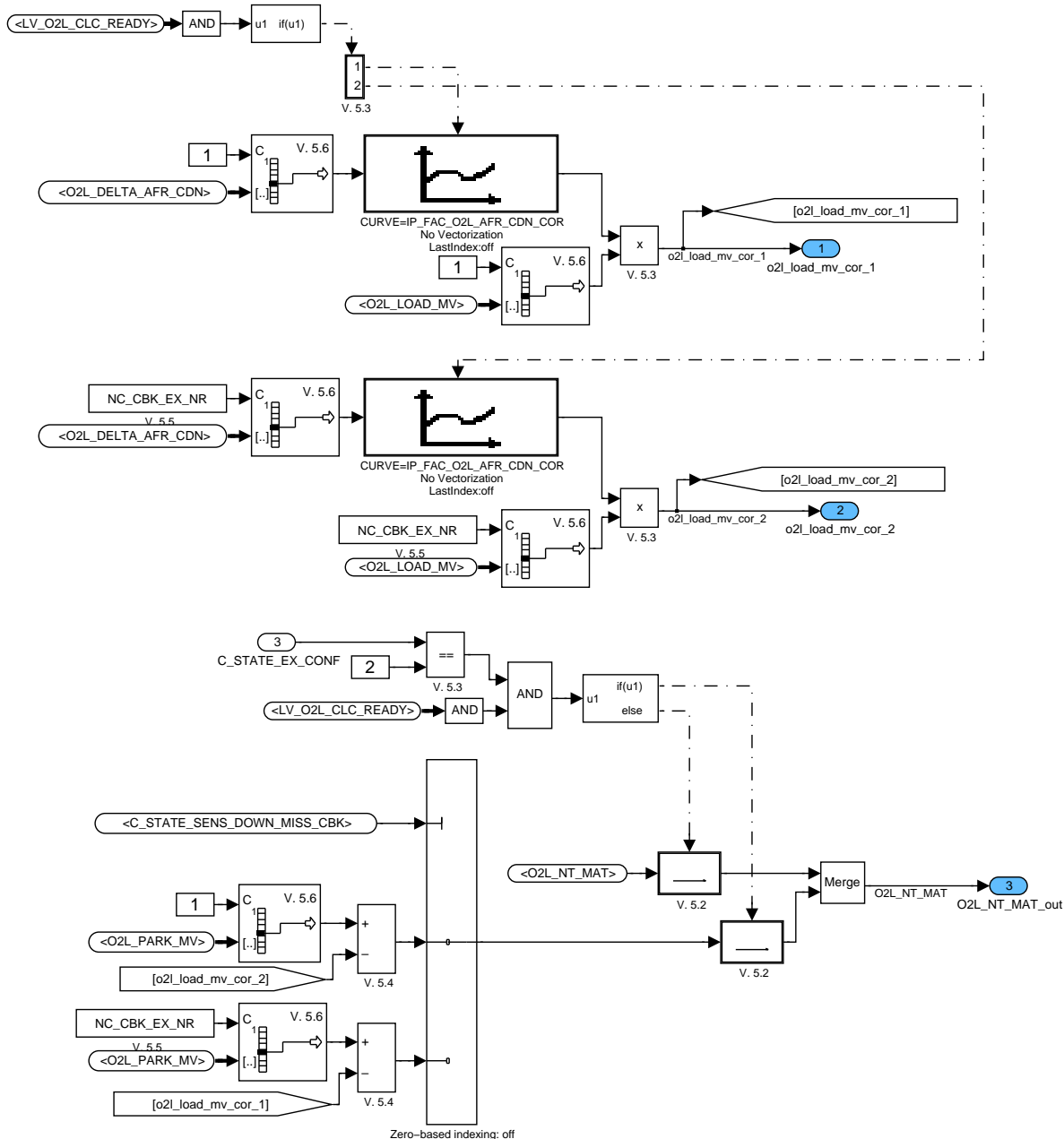


Figure B.52.5: :

**B.52.2.1.2.3 Calculation of temporary O2L value for bank without binary downstream sensor in case of exhaust gas configuration 2**

The O2L value of precatalyst is a difference between O2L value of the whole line and O2L value of NOx catalyst calculated at bank without downstream binary sensor

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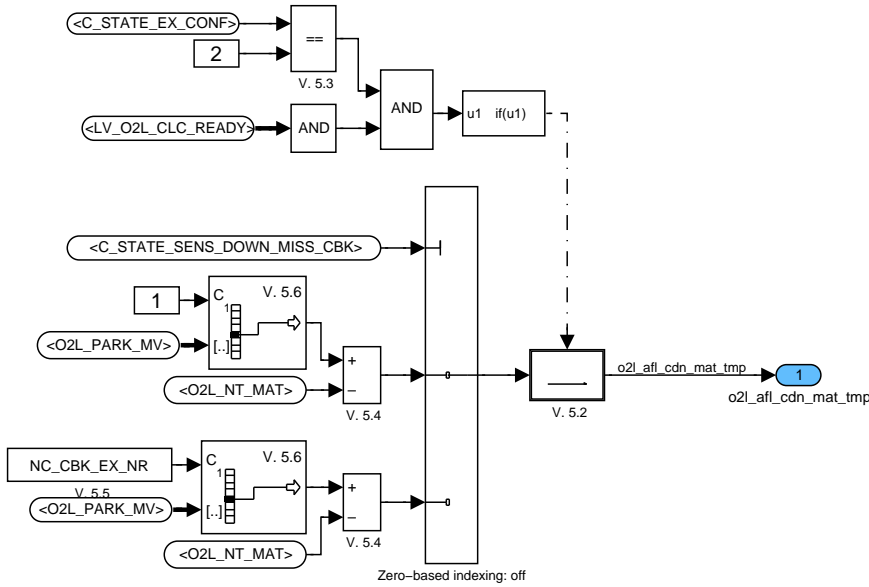


Figure B.52.6: :

**B.52.2.1.2.4 Calculation of finally O2L value for both banks and validation bit in case of exhaust gas configuration 2 (Method 7)**

After all diagonal calculations the result is checked, the diagnosis value of Method 7 is assigned and the valid flag is set for one recurrence.

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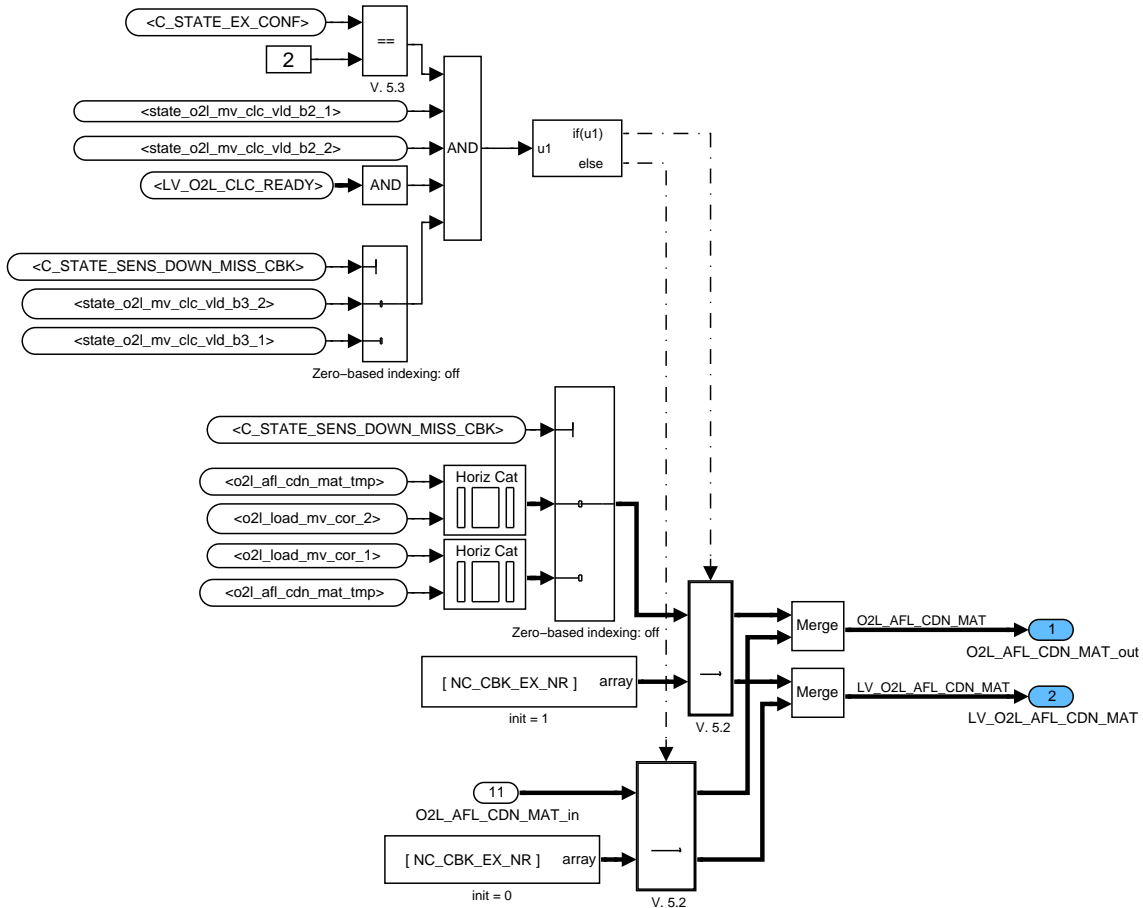



Figure B.52.7: :

**B.52.2.1.2.5 Choice of method for calculation of finally diagnosis value**

The O2L\_CAT\_DIAG\_AFL used for calculation of diagnosis results is represented by O2L\_XXX calculated by chosen method. The LV says that the calculation was plausible. This flag is stored in STATE\_O2L\_MV\_CLC\_VLD (when this diagnosis was finished before others) and the STATE is reset when the diagnosis condition was true.

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 5572 of 8404	
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**B.52.2.1.2.5.1 Choice of the method and calculation temporary diagnosis value**

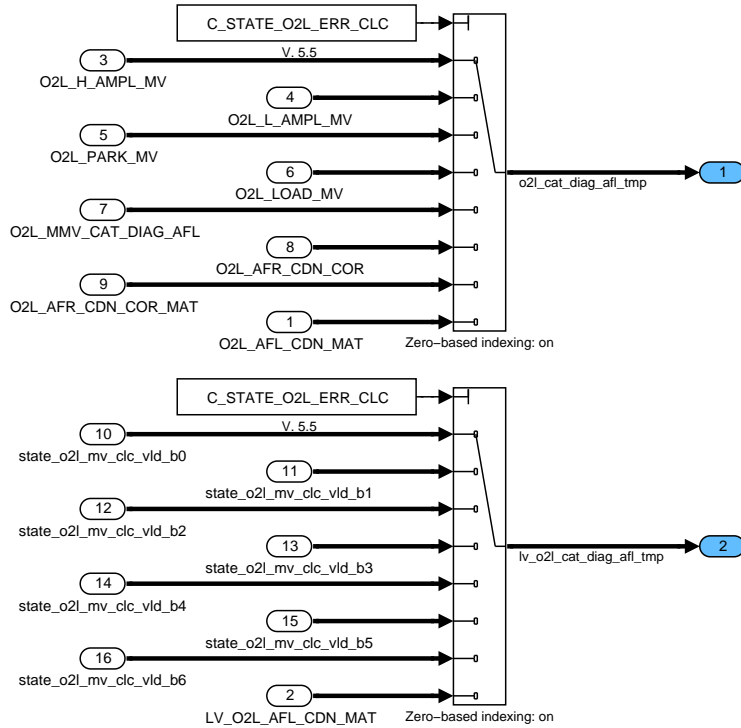


Figure B.52.8: :

**B.52.2.1.2.5.2 Final diagnosis value and plausibility indicator**

**B.52.2.1.2.5.2.1 Calculation**

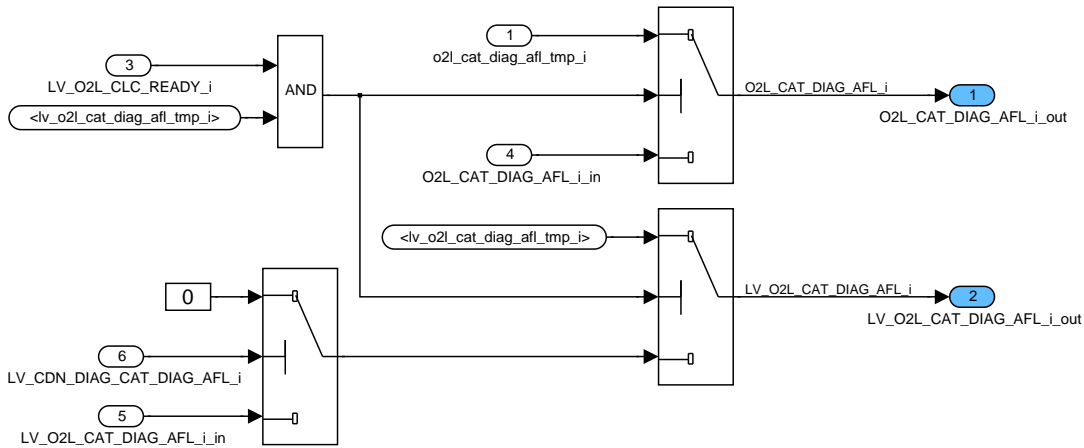


Figure B.52.9: :

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### B.52.2.1.2.6 Calculation of sum diagnosis value over all banks

Indexes "1" and "2" are used regarding cylinder bank 1 and 2. Sum diagnosis value considers all banks

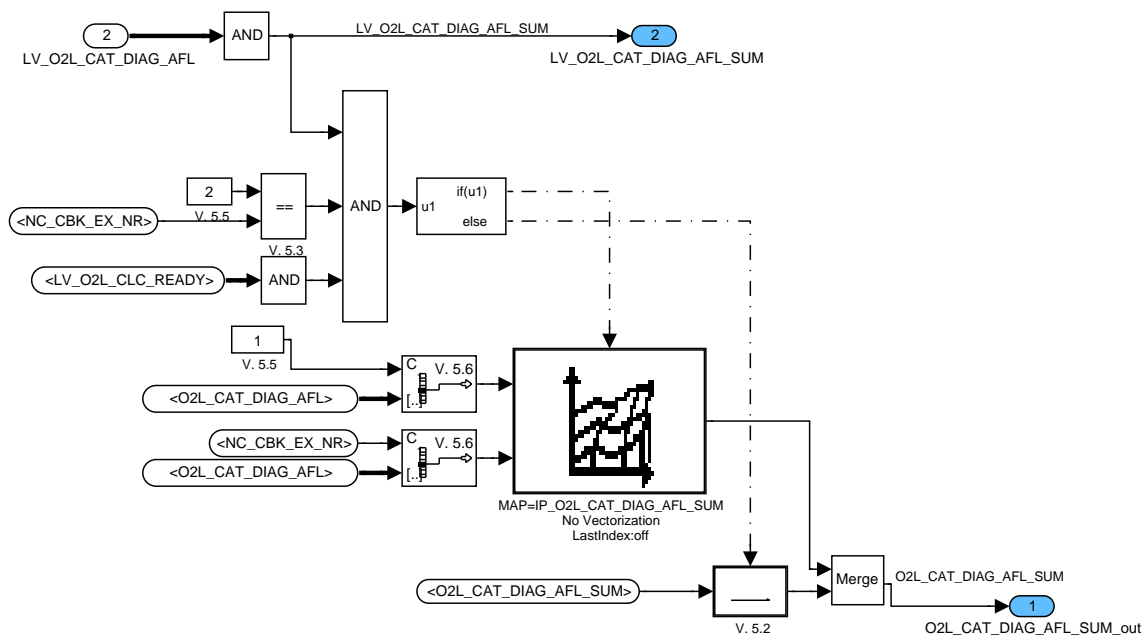


Figure B.52.10: :

## B.52.2.2 Multiple bank system calculation

### B.52.2.2.1 Methods 1 to 6 and ERRM interface

This section consists of three further sections:

Calculation of O2L sum and mean values

Calculation of corrected O2L values and set up of state including plausibility bits

Calculation of error symptom, condition flag and ERRM interface

#### B.52.2.2.1.1 Calculation of O2L sum and mean values

This section consists of:

Calculation of flag triggering calculation of mean values

Calculation of phase specific sum and mean values

Calculation of mean value of phase specific mean values (Method 4)

##### B.52.2.2.1.1.1 Calculation of flag triggering calculation of mean values

At the end of defined diagnosis cycles the flag triggering calculation of mean values (only one recurrence) is set for every bank separate (LV\_O2L\_MV\_CLC\_ACT\_TMP). The flag LV\_O2L\_MV\_CLC\_END saves the LV\_O2L\_MV\_CLC\_ACT\_TMP and is used in next cycle for calculation of summary flag of all banks (LV\_O2L\_CLC\_READY). After that the diagonal values and diagnosis results are calculated.

The flag triggering calculation of the mean values can be set by checking counter of regeneration cycles (independent of plausibility) or counter of valid O2L calculation cycles

### B.52.2.2.1.1.1 Check of regeneration cycles counter

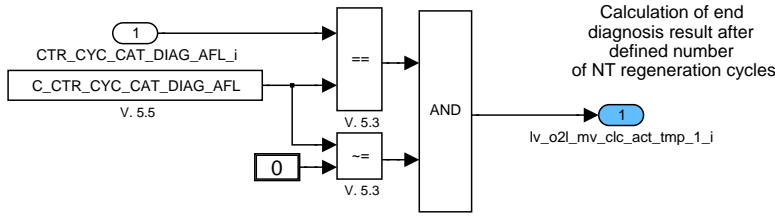


Figure B.52.11: :

### B.52.2.2.1.1.2 Check of counter of valid O2L calculation cycles

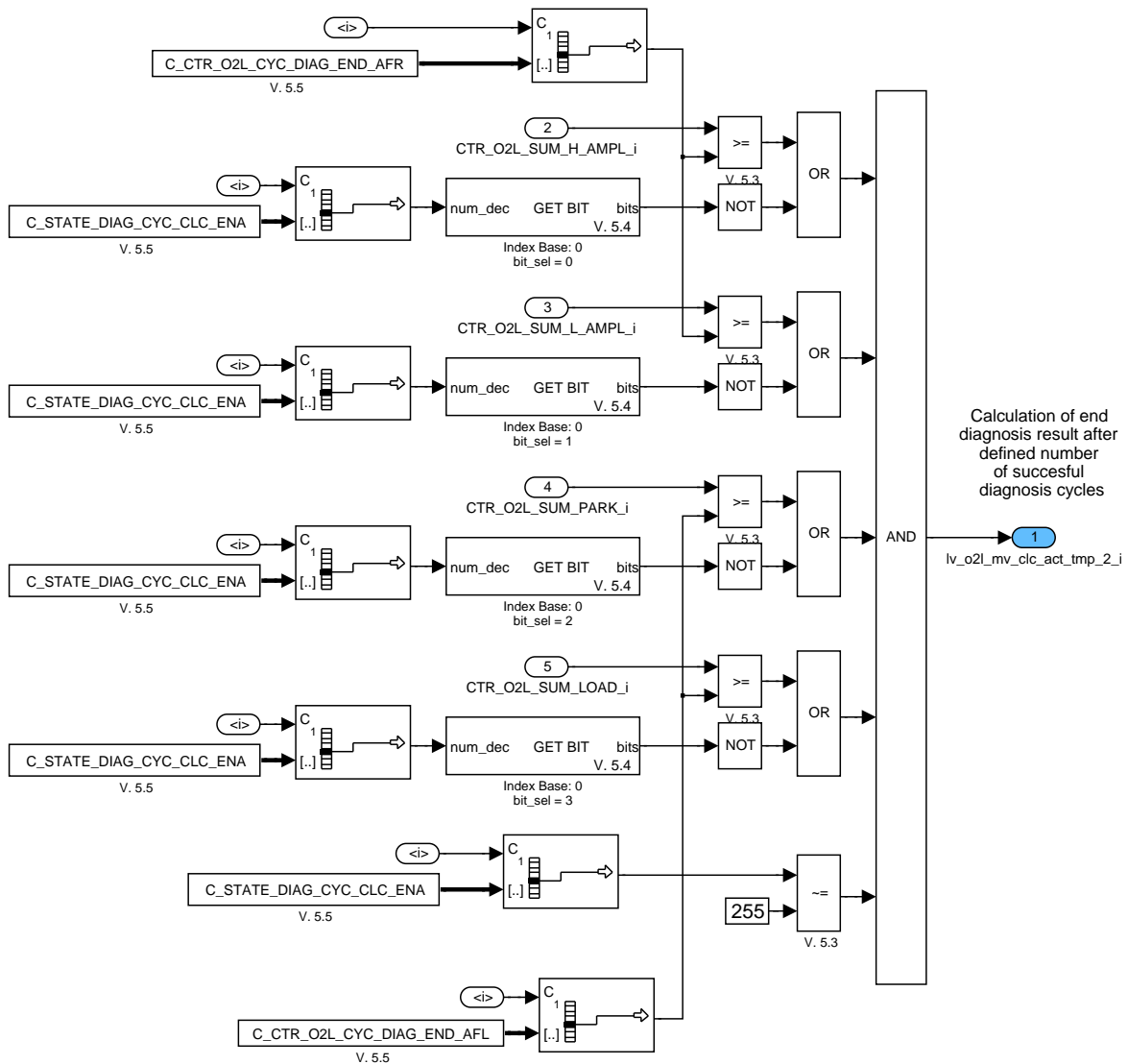


Figure B.52.12: :

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**B.52.2.2.1.1.1.3 Check of storage capacity of TWC for calculation of pre-end diagnosis result (no error present)**

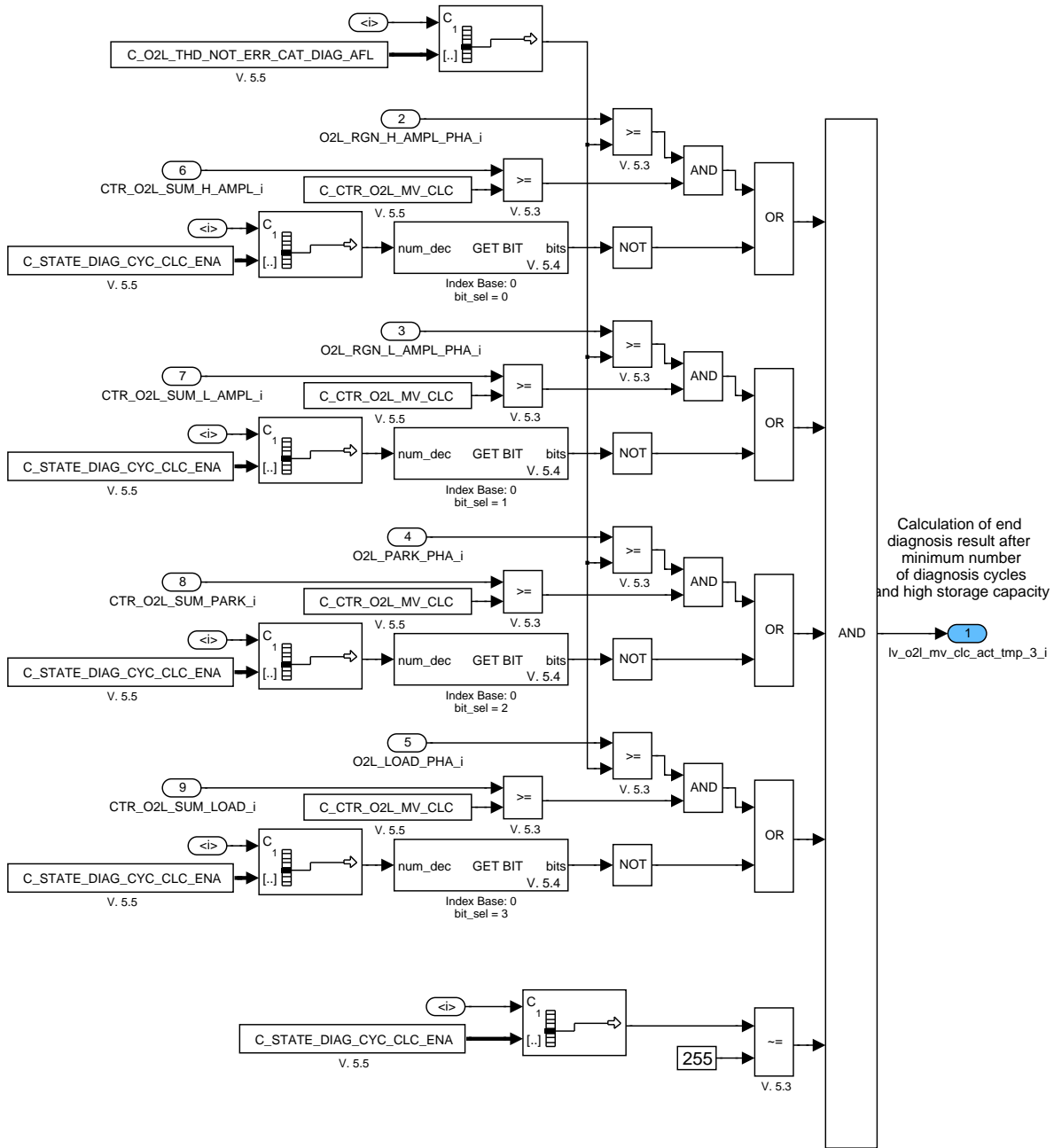


Figure B.52.13: :

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**B.52.2.2.1.1.4 Set final triggering flag for calculation of mean values**

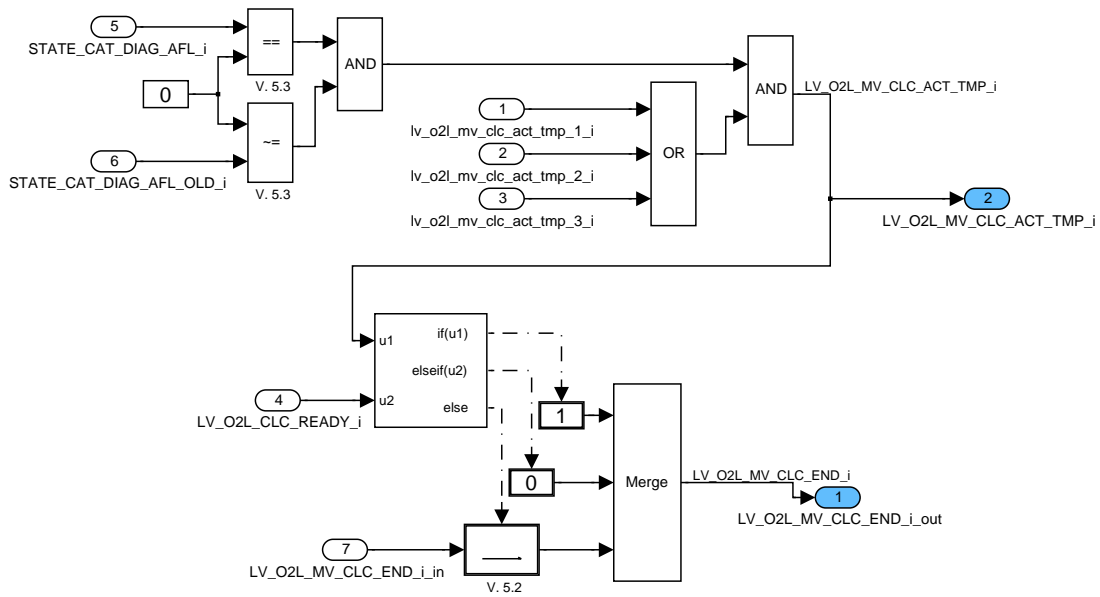



Figure B.52.14: :

**B.52.2.2.1.1.2 Calculation of phase specific sum and mean values**

The sum and mean values are calculated using local ACTION ClcO2L\_SUMandMV

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 5577 of 8404	
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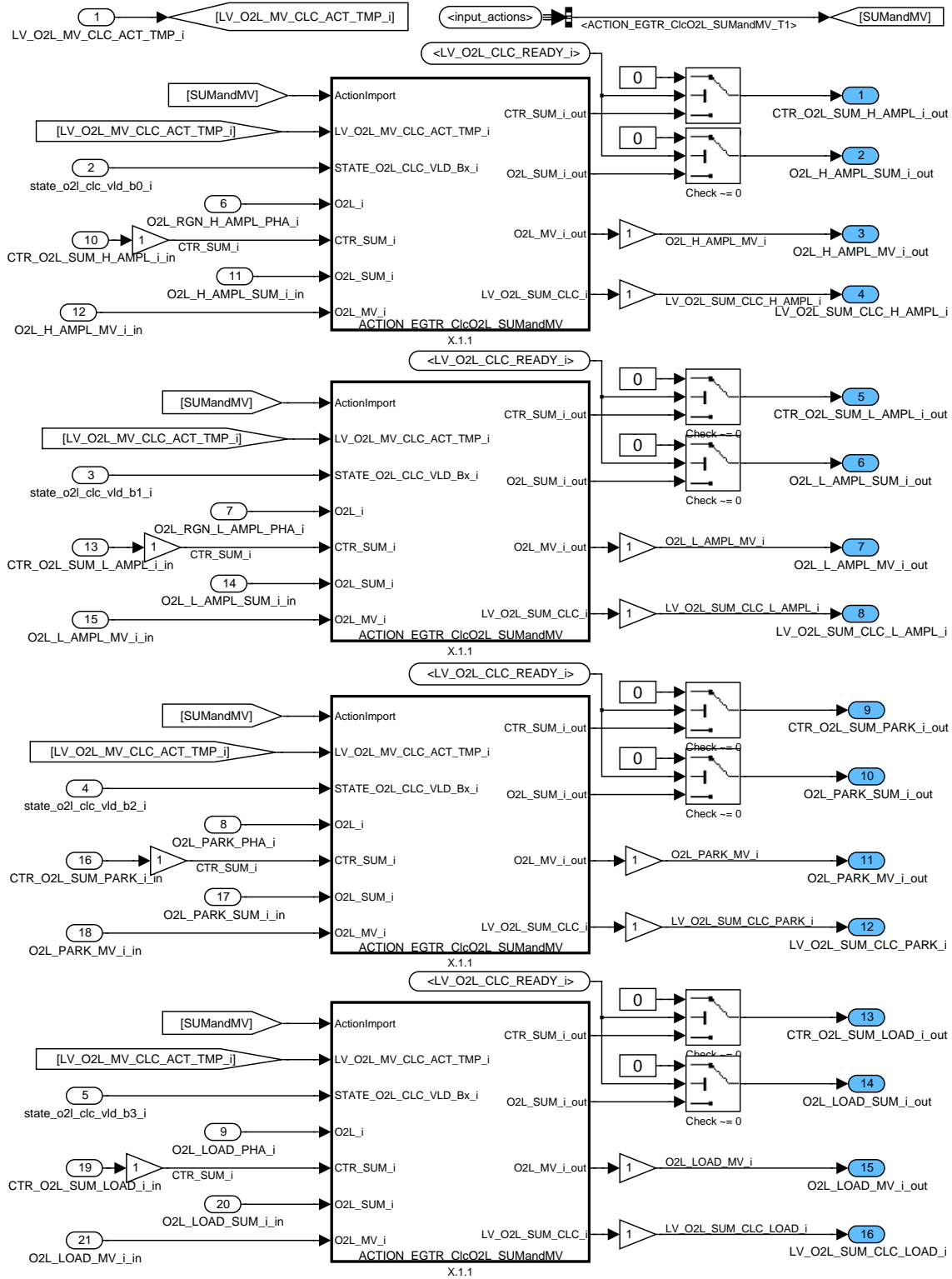


Figure B.52.15: :

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**B.52.2.2.1.1.3 Mean value of phase specific mean values (Method 4)**

This is calculation of the mean value of O2L values calculated in different phases (e.g. H\_AMPL and L\_AMPL). The phase, which is taken into the calculation, is chosen through C\_STATE\_O2L\_MMV\_CLC\_ENA

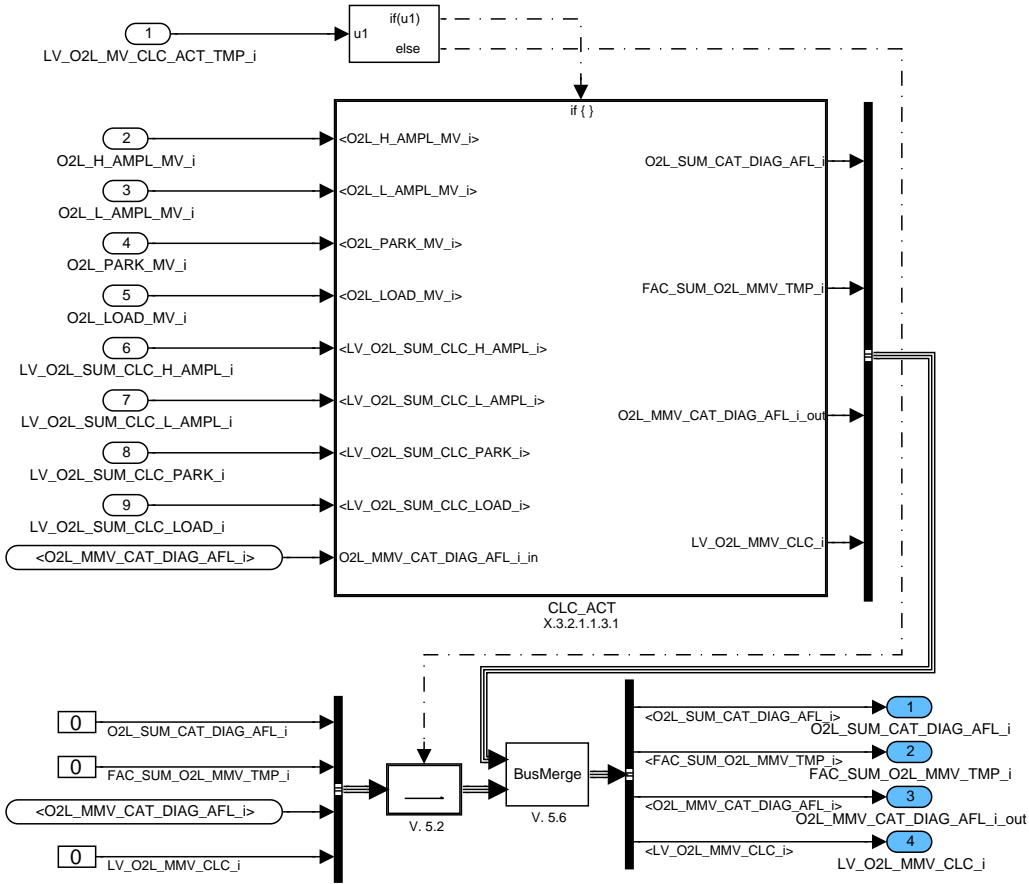


Figure B.52.16: :

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**B.52.2.2.1.1.3.1 Calculations**

**B.52.2.2.1.1.3.1.1 Calculation of sum**

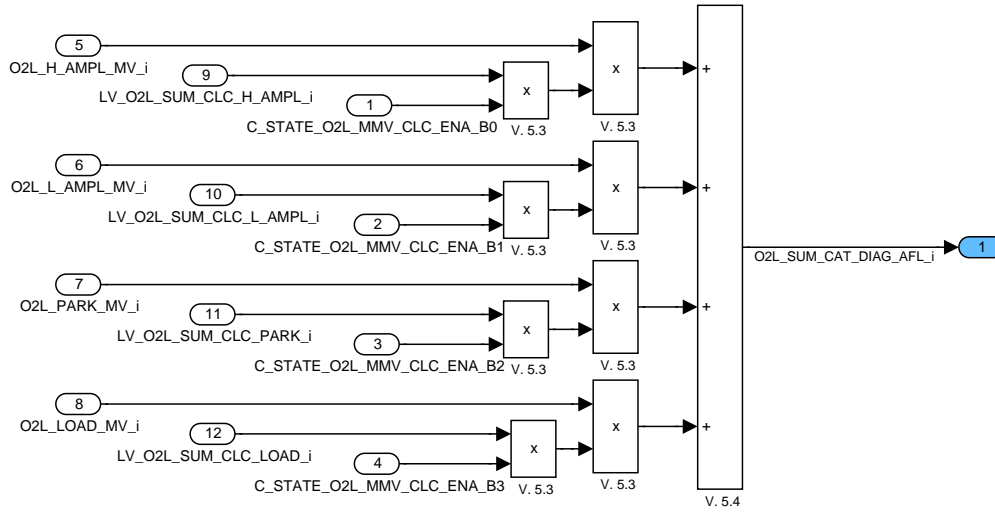


Figure B.52.17: :

**B.52.2.2.1.1.3.1.2 Calculation of denominator**

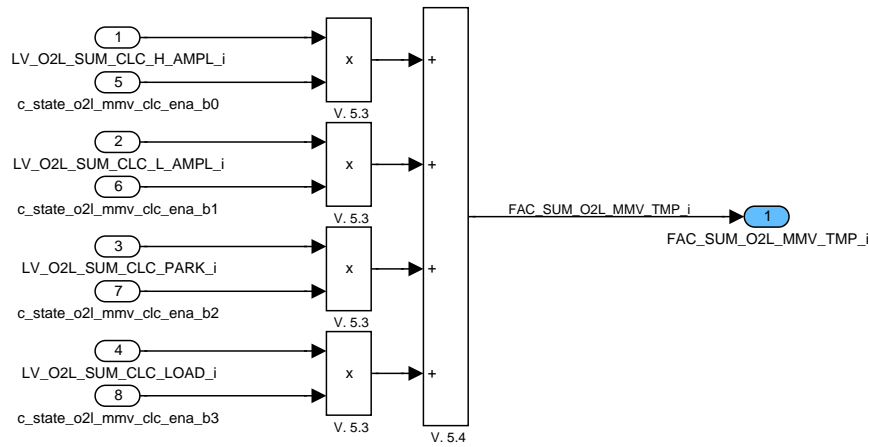


Figure B.52.18: :

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**B.52.2.2.1.1.3.1.3 Check denominator for calculation of MMV**

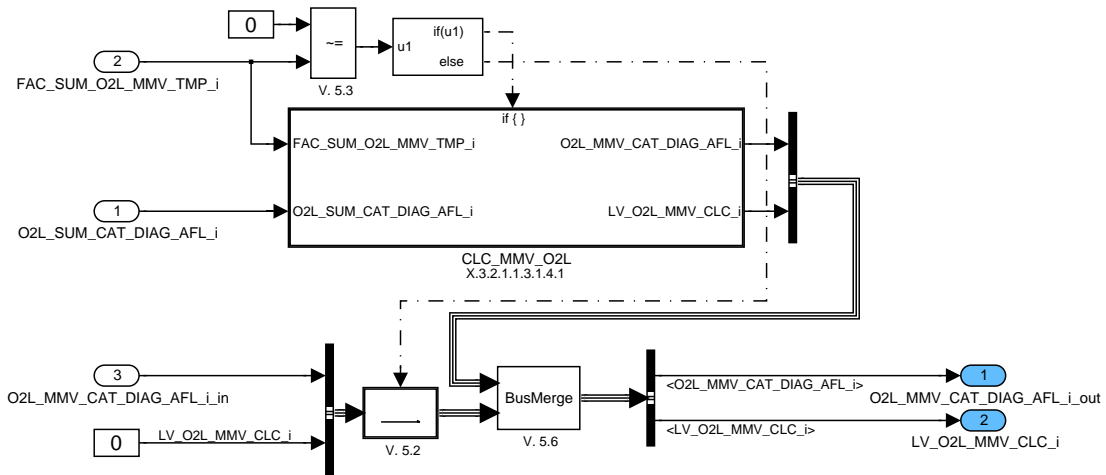


Figure B.52.19: :

**B.52.2.2.1.1.3.1.3.1 Calculation of MMV**

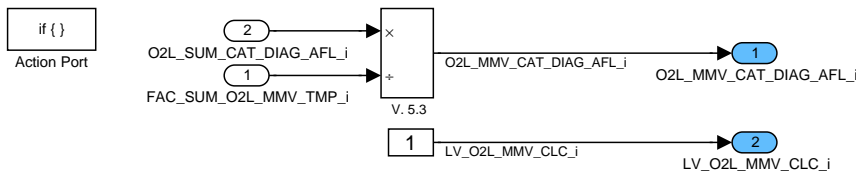


Figure B.52.20: :

**B.52.2.2.1.2 Calculation of corrected O2L values and set up of state including plausibility bits**

This section consists of:  
 Calculation of corrected O2L values  
 Set up of state including plausibility bits

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**B.52.2.2.1.2.1 Calculation of corrected O2L values (Methods 5, 6)**

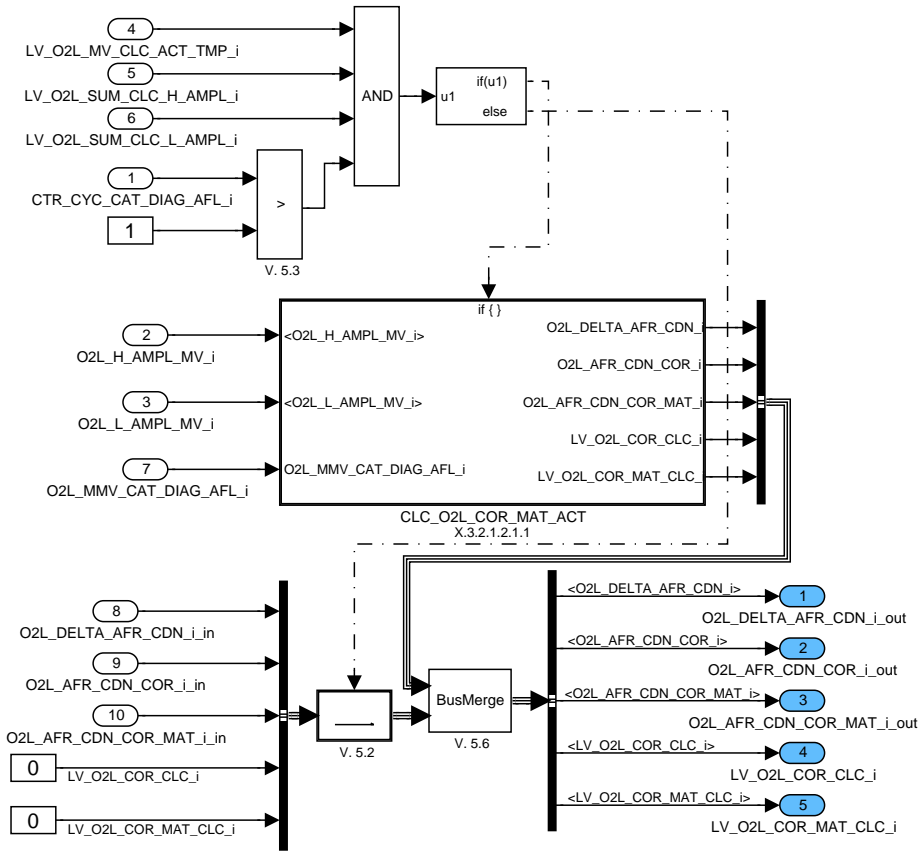


Figure B.52.21: :

**B.52.2.2.1.2.1.1 Calculations**

**B.52.2.2.1.2.1.1.1 Calculation of delta O2L between H\_AMPL and L\_AMPL**



Figure B.52.22: :

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### B.52.2.2.1.2.1.2 Calculation of corrected O2L value with method 5

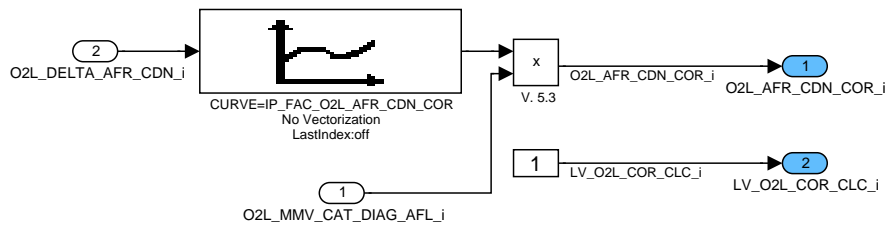


Figure B.52.23: :

### B.52.2.2.1.2.1.3 Calculation of corrected O2L value with method 6

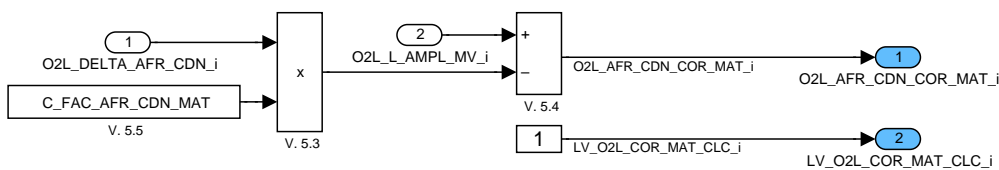


Figure B.52.24: :

### B.52.2.2.1.2.2 Collecting of validation bit of all O2L calculation methods into a state

For each method for calculation of final diagnosis value exists one validation bit:

- Bit 0: Using of O2L mean value from H\_AMPL phase
- Bit 1: Using of O2L mean value from L\_AMPL phase
- Bit 2: Using of O2L mean value from PARK phase
- Bit 3: Using of O2L mean value from LOAD phase
- Bit 4: Using of O2L mean value mean values of all phases
- Bit 5: Using of O2L value corrected with empirical method
- Bit 6: Using of O2L value corrected with mathematical method
- Bit 7: Using of O2L calculated in lean condition in case of configuration 2b

**B.52.2.2.1.2.2.1 Set up of the state**

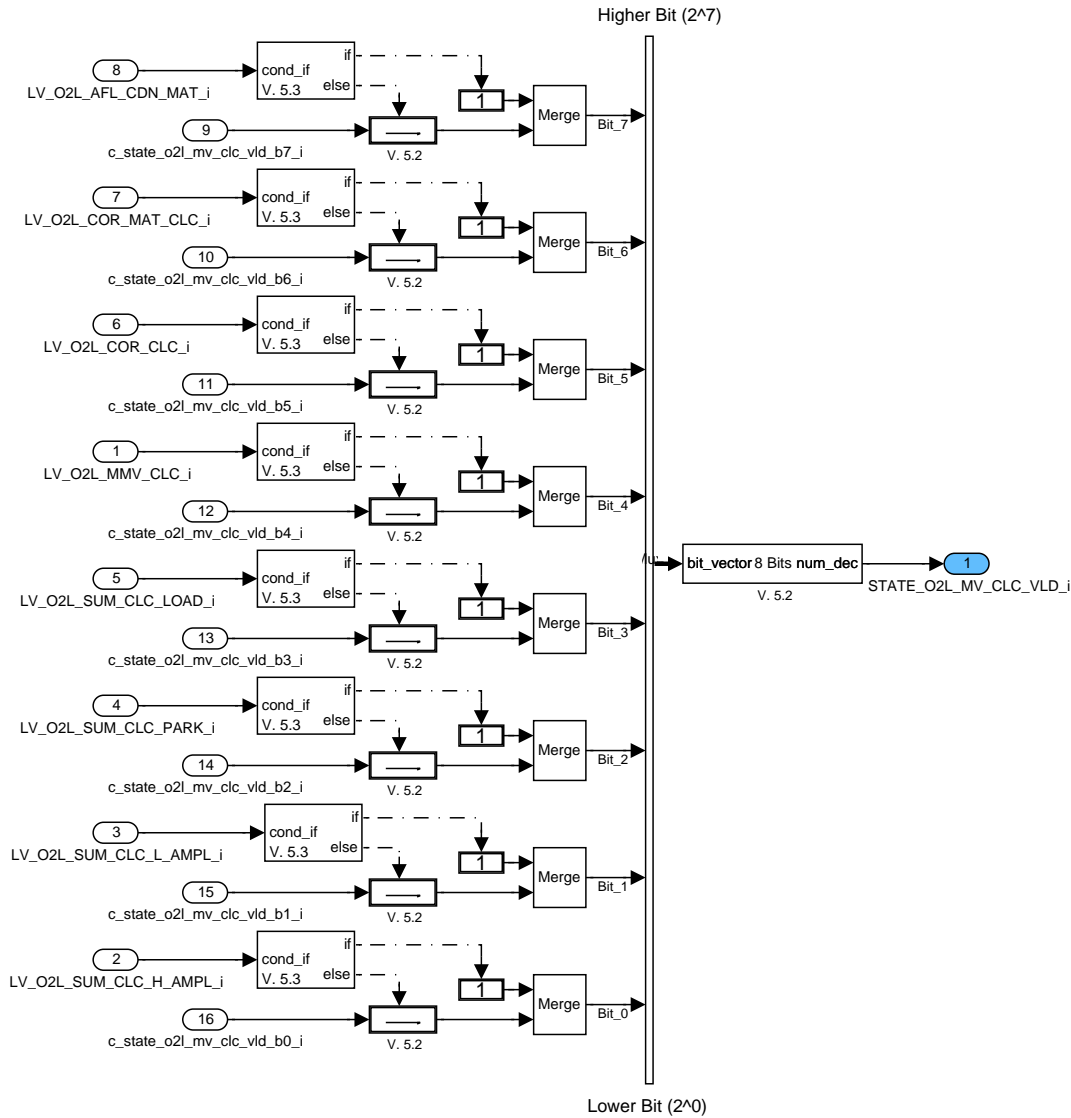


Figure B.52.25: :

**B.52.2.2.1.2.2.2 Reset of the state**

The STATE\_O2L\_MV\_CLC\_VLD is reset when the diagnosis condition bit was true in previous cycle

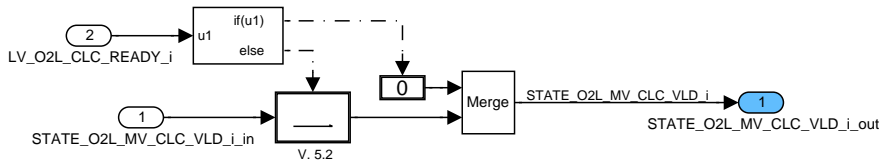


Figure B.52.26: :

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### B.52.2.2.1.3 Calculation of error symptom, condition flag and ERRM interface

This section consists of:

Calculation of temporary diagnosis error after finishing of diagnosis cycle

Calculation of temporary diagnosis end bit

Calculation of condition bit for calculation of error symptom using temporary error indicator after finishing of this and other relevant diagnosis

Interface to ERRM

#### B.52.2.2.1.3.1 Calculation of temporary diagnosis error after finishing of diagnosis cycle

The temporary diagnosis error is calculated at the end of diagnosis cycle. At this time, pre-store of environment data is executed

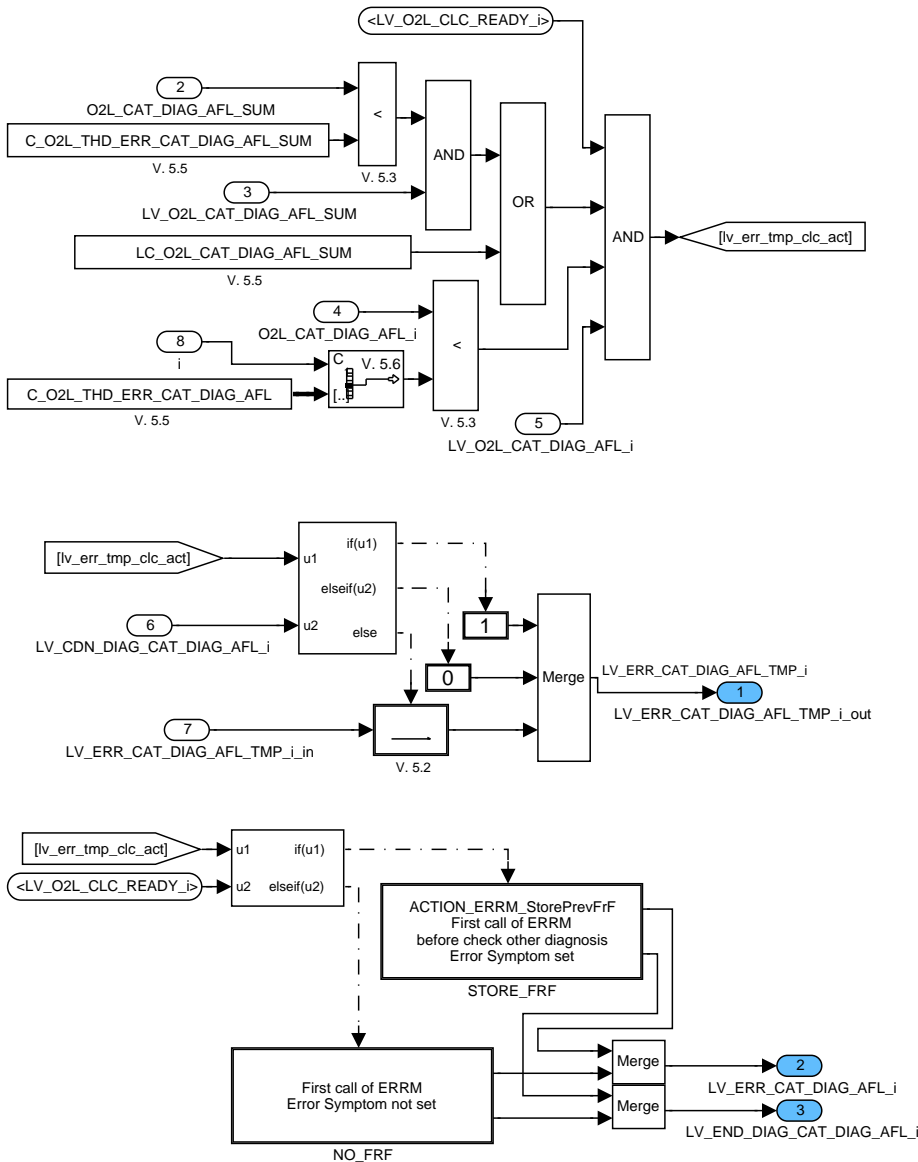


Figure B.52.27: :

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### B.52.2.2.1.3.2 Calculation of temporary diagnosis end bit

The temporary "end" bit is set when diagnosis cycle is finished and calculated O2L value is plausible.

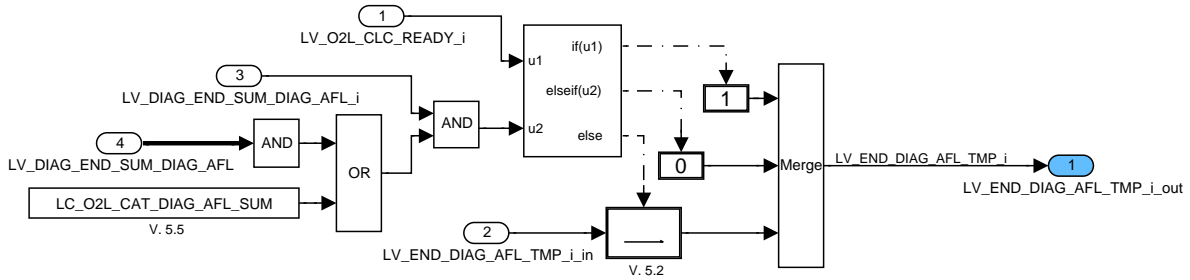


Figure B.52.28: :

### B.52.2.2.1.3.3 Calculation of diagnosis condition bit and diagnosis error symptom

The diagnosis condition bit can be set when all other relevant diagnosis are finished and the result of this diagnosis is plausible. The calculation of error symptom is done after set of condition bit.

The diagnosis condition bit is set only for one recurrence.

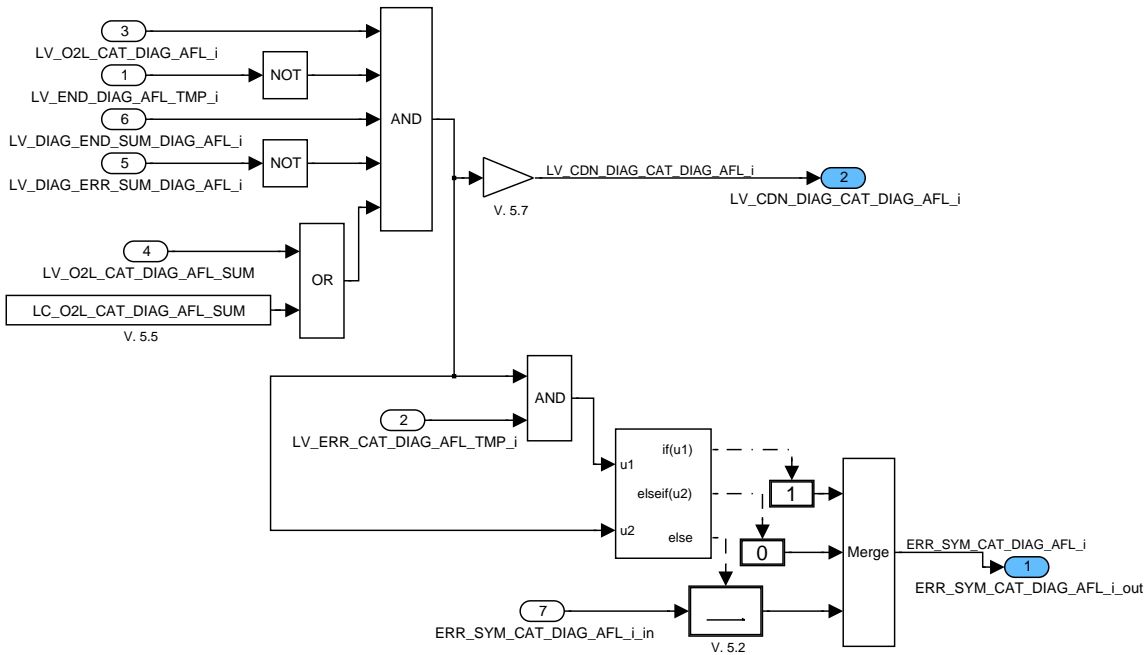


Figure B.52.29: :

### B.52.2.2.1.3.4 Interface to error management

The diagnosis values are valid when the diagnosis condition flag is true. In this case the error management will take the diagnosis values into account.

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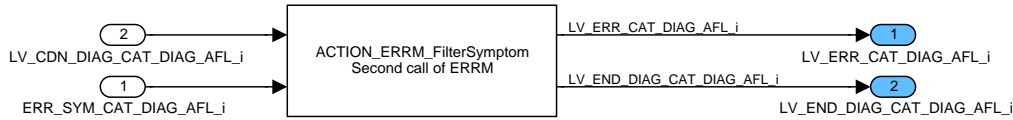


Figure B.52.30: :

### B.52.3 Detailed description for Action: ACTION\_EGTR\_ClcO2L\_SUMandMV

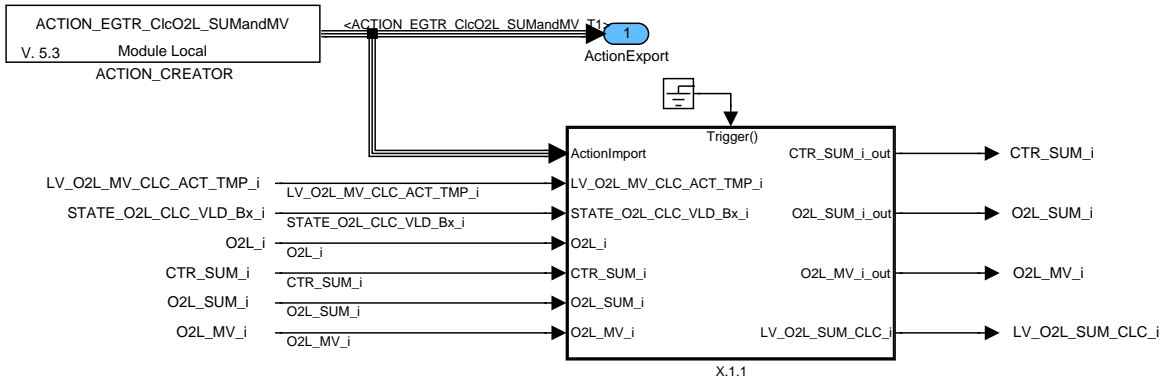


Figure B.52.31: :

#### B.52.3.1 Check of temporary trigger for calculation either sum, or mean o2l value

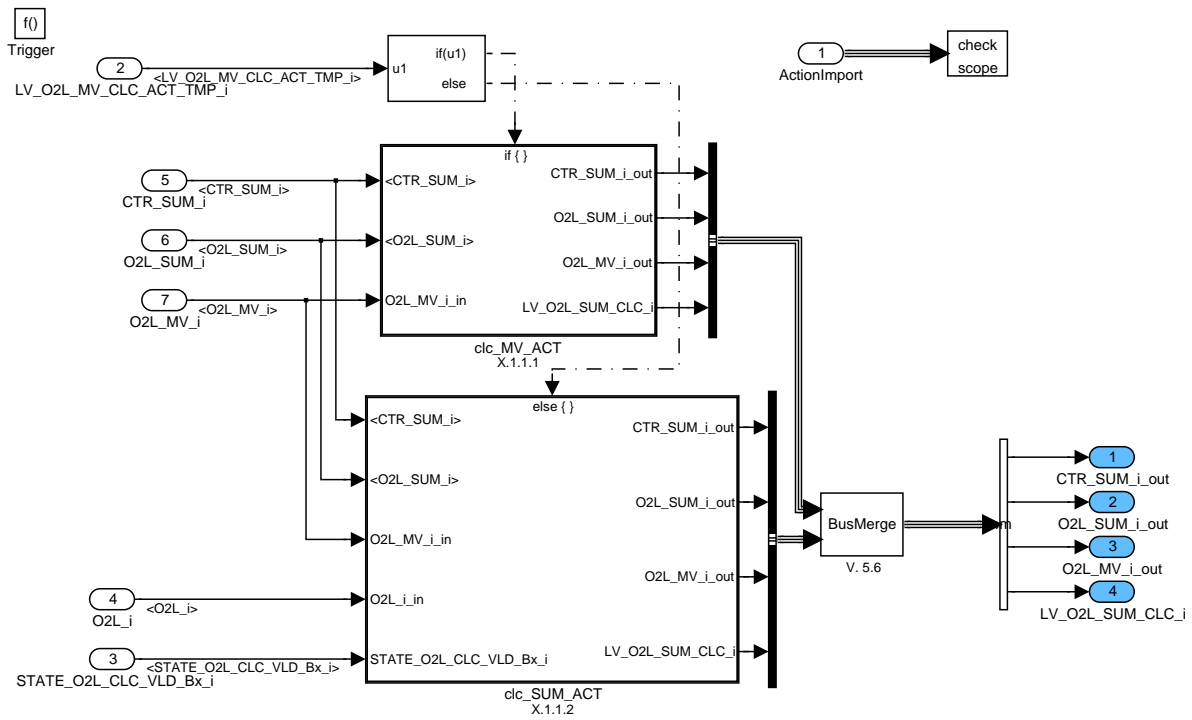


Figure B.52.32: :

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**B.52.3.1.1 Check number of calculated phases for calculation of o2l mean value**

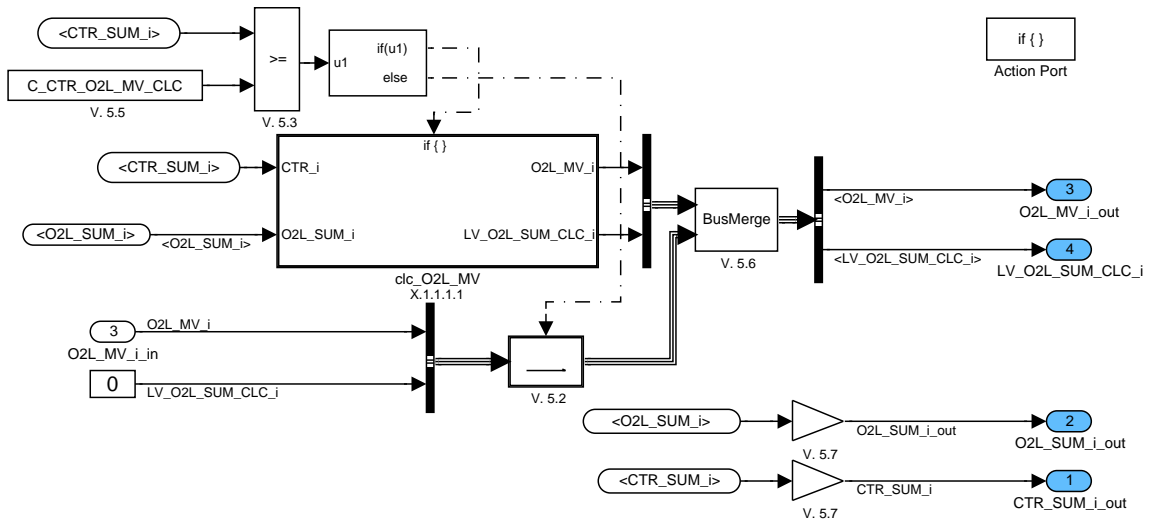


Figure B.52.33: :

**B.52.3.1.1.1 Calculation of mean o2l value**

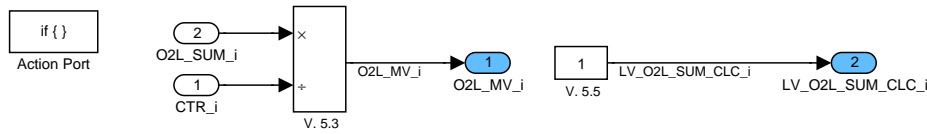


Figure B.52.34: :

**B.52.3.1.2 Calculation o2l sum values**

The sum value is just sum of o2l values calculated in several phases

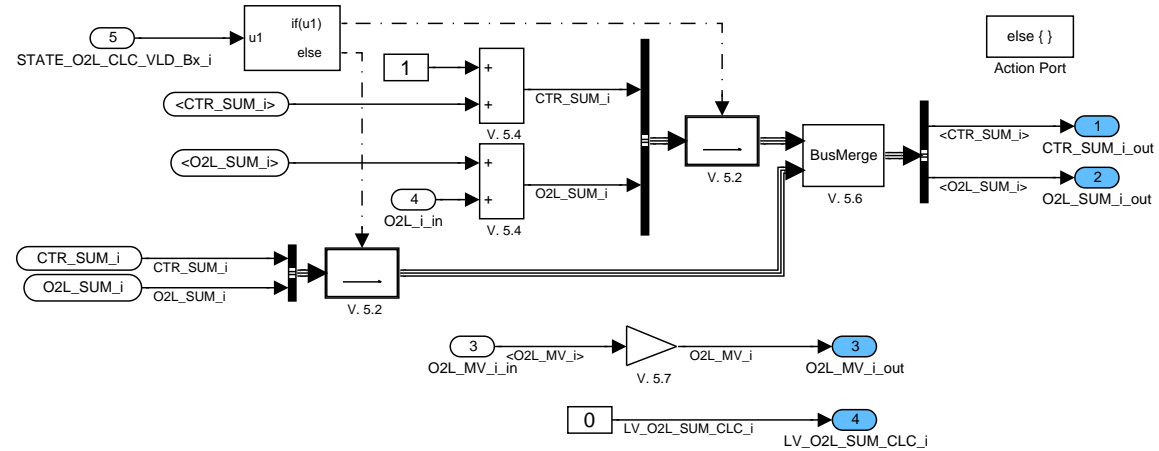


Figure B.52.35: :

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## B.53 TWC diagnosis at lean operation - Lambda Setpoint

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_SP_DIAG_AFL [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Lambda setpoint for precatlyst lean diagnosis					
LV_DIAG_AFL_REQ	O/V	0... 1H	0 ...1	1	-
Request for precatlyst lean diagnosis					
LV_LAMB_SP_DIAG_AFL_PARK [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Indicator of lambda value position at park state					
LV_MAF_INT_NT_AGI_0	-	0... 1H	0 ...1	1	-
Logical variable which is set if MAF_INT_THD_NT_AGI reached 0					
LV_NT_RGN_REQ_PREV	-	0... 1H	0 ...1	1	-
Value of LV_RGN_NT_REQ from previous calculation cycle					
MAF_INT_LAMB_SP_CAT_DIAG_AFL	V	0... FFFFH	0... 1820.42	0.0277778	g
MAF integral for keeping of rich lambda setpoint before switch to diagnosis					
MAF_INT_THD_NT_AGI	V	0... FFFFH	0... 1820.42	0.0277778	g
MAF integral threshold based on NOx trap aging factor					
STATE_RGN_CAT_DIAG_AFL [NC_CBK_EX_NR]	O/V	0... 3H	0 ...3	1	-
State for calculation of lean TWC diagnosis due state of system regeneration					

### Input data:

LV_LAMB_SP_SWI {p. 2885}	LV_NT_ACT {p. 2982}	LV_O2L_CLC_ACT_CDN [NC_CBK_EX_NR] {p. 5553}	LV_RGN_NT_REQ {p. 2983}
LV_ST_END {p. 1720}	MAF {p. 8277}	MAF_CYL {p. 8277}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}	NT_AGI {p. 3073}	STATE_CAT_DIAG_AFL [NC_CBK_EX_NR] {p. 5607}
STATE_RGN [NC_CBK_EX_NR] {p. 2885}	VLS_NS [NC_NOX_SENS_CONF] {p. 992}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_SP_DIAG_AFL_DIAG	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Lambda setpoint for lean part of the lean precatlyst diagnosis					
C_LAMB_SP_DIAG_AFL_PAS	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Lambda setpoint for passive part of the lean precatlyst diagnosis					
C_LAMB_SP_DIAG_PARK_AFR	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Lambda setpoint for preconditioning phase before switching to diagnosis conditions					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_SP_DIAG_PARK_BAS	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Basis lambda setpoint of lean precatalyst diagnosis at park phase					
C_LAMB_SP_DIAG_PARK_SHIFT	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Lambda shift from basis lambda at park phase of the precatalyst lean diagnosis					
C_MAF_INT_LAMB_SP_AFR	-	0... FFFFH	0... 1820.42	0.0277778	g
Threshold for MAF integral for keeping of the rich lambda setpoint					
C_STATE_RGN_DIAG_AFL_ACT	-	0... 3H	0 ...3	1	-
Value of STATE_RGN_CAT_DIAG_AFL for activation of diagnosis					
C_STATE_RGN_INI_DIAG_AFL [NC_CBK_EX_NR]	-	0... 3H	0 ...3	1	-
Initialization for the lambda setpoint for precatalyst lean diagnosis at active state					
C_STATE_RGN_INI_DIAG_AFL_PAS [NC_CBK_EX_NR]	-	0... 3H	0 ...3	1	-
Initialization for the lambda setpoint for precatalyst lean diagnosis at passive state					
C_VLS_NS_THD	-	0... 578H	-200 ...1200	1	mV
Threshold voltage of binary O2 sensor signal for lambda set point calculation					
IP_LAMB_SP_DIAG_PARK_I	V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDP_N_32_IP_LAMB_SP_DIAG_PARK_I	4	0... FFH	0... 8160	32	rpm
LDP_MAF_IP_LAMB_SP_DIAG_PARK_I	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Integration step for lambda setpoint for lean precatalyst diagnosis at park state					
IP_MAF_INT_THD_NT_AGI	-	0... FFFFH	0... 1820.42	0.0277778	g
LDP_NT_AGI_IP_MAF_INT_THD	4	0... FFFFH	0... 0.99998474121	15.2588e-6	-
MAF integral value based on NOx trap aging factor					
LC_DIAG_AFL_CBK_SYN	-	0... 1H	0 ...1	1	-
If true, reset of lambda setpoint flag after all banks finished, otherwise after first bank finished					
LC_MAF_INT_NT_AGI	-	0... 1H	0 ...1	1	-
Switch to enable lambda set point calculation based on NOx trap aging factor					
LC_STATE_RGN_DIAG_AFL	-	0... 1H	0 ...1	1	-
Switch between regeneration states for calculation of O2L values					

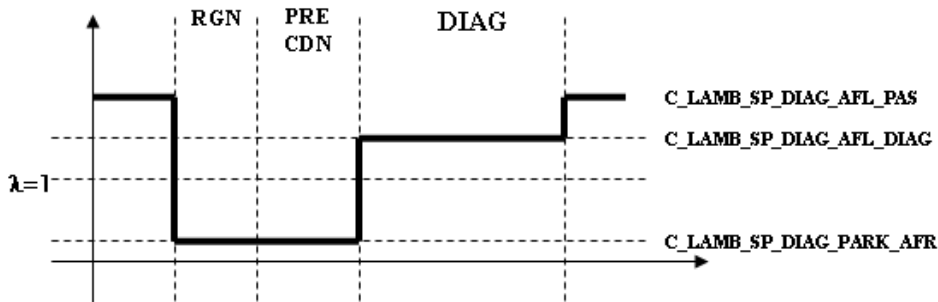
## General Information

For the configuration without binary sensor after one bank, phases with rich and lean lambda value are required. When this conditions are not given by NOx Catalyst Regeneration, then a separately lambda setpoint directly after regeneration is generated. Directly before switching to the diagnosis, rich precondition of the catalysts is possible. Moreover, for each bank is used different lambda setpoint strategy. While at first bank (Picture 1, diagnosis) are the O2L values of the precatalyst and of the whole exhaust line (precatalyst + NOx Trap) calculated, the second bank (Picture 2, park state) is parked to minimize it influence to the diagnosed bank. The strategy is successively switched between both banks.

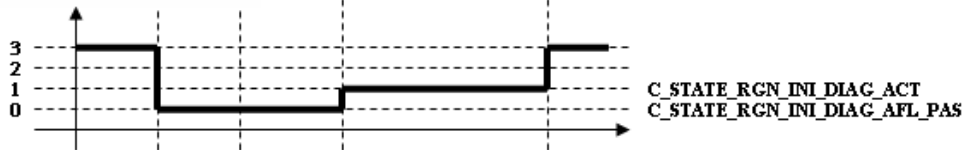
Picture 1: Lambda setpoint strategy for the diagnosed bank:

### Bank 1 - Diagnosis

LAMB\_SP\_DIAG\_AFL



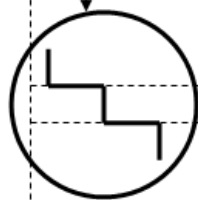
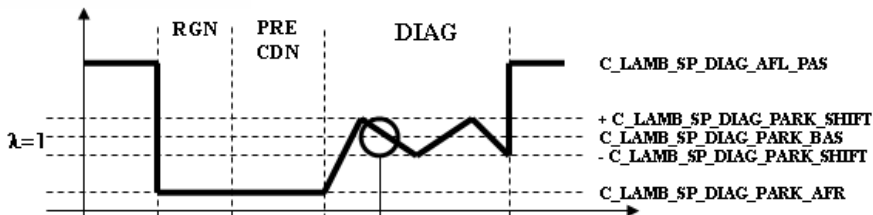
STATE\_RGN\_CAT\_DIAG\_AFL



Picture 2: Lambda setpoint strategy for the parked bank:

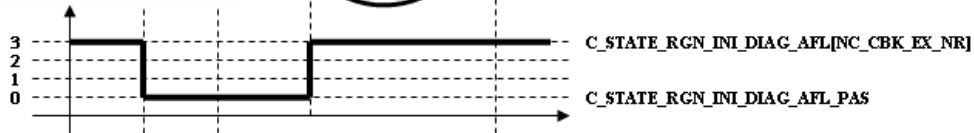
### Bank 2 - Park state

LAMB\_SP\_DIAG\_AFL



IP\_LAMB\_SP\_DIAG\_PARK\_I(N\_32, MAF)

STATE\_RGN\_CAT\_DIAG\_AFL



### Application Conditions

Initialization: RST


Recurrence: 10MS

Activation: LV\_ST\_END & LV\_NT\_ACT

Deactivation: !LV\_ST\_END || !LV\_NT\_ACT

### Function description

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 5591 of 8404	
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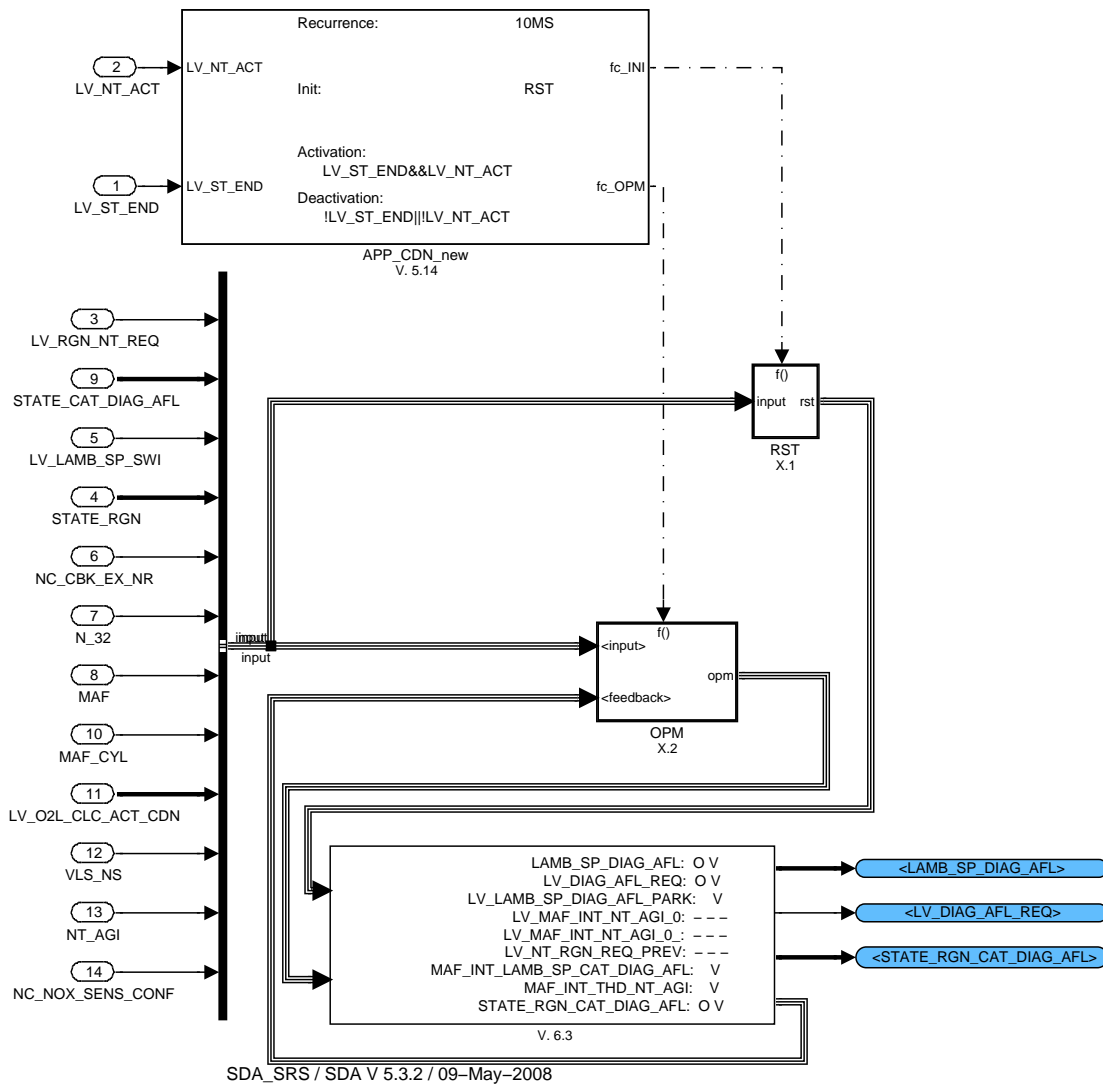


Figure B.53.1: :

### B.53.1 FORMULA SECTION

The calculation of the STATE\_RGN\_CAT\_DIAG is only active when the lambda behaviour during re-generation doesn't suit the requirements for the diagnosis. Otherwise the STATE\_RGN is taken for the other modules of this diagnosis.

Then the activation flag for calculation of O2L values is checked. If any bank is not active, all variables are initialized.

The function contains of two main sections:

1.2.1: Calculation of the lambda setpoint and the regeneration state for the diagnosis (LAMB\_SP\_CLC)

1.2.2: Passive state (LAMB\_SP\_NOT\_CLC)

1.2.3: Initialization when the activation conditions are not fulfilled



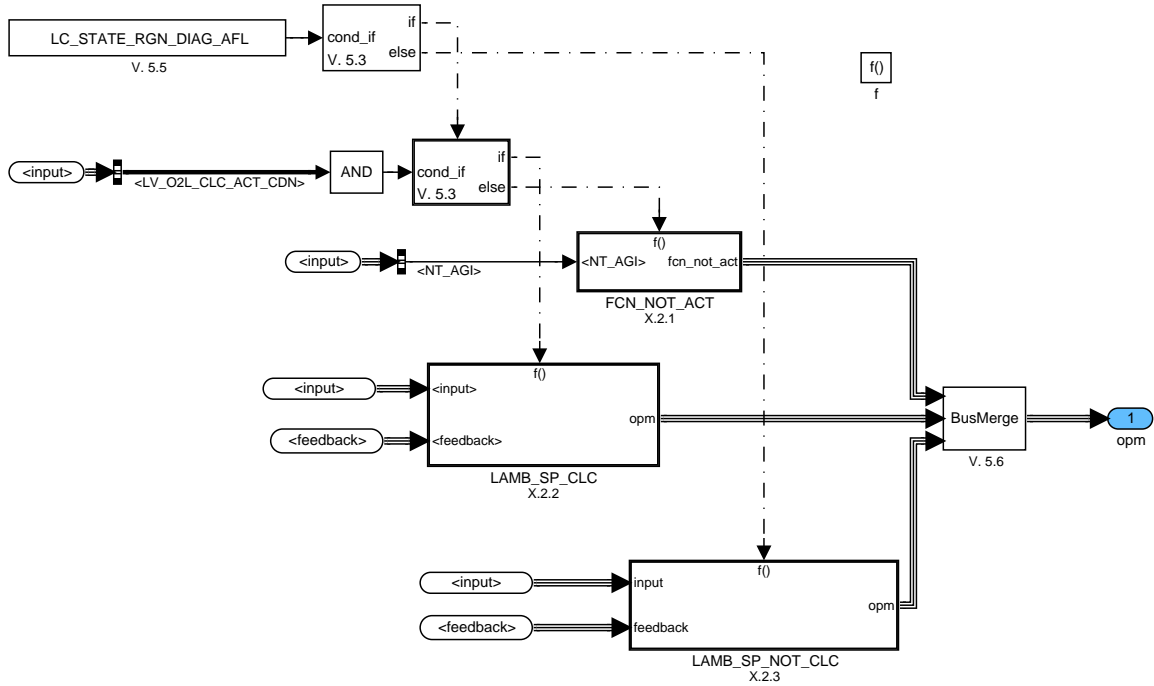


Figure B.53.2: :

**B.53.1.1 Initialization when the activation flag for O2L calculation at any bank is false**

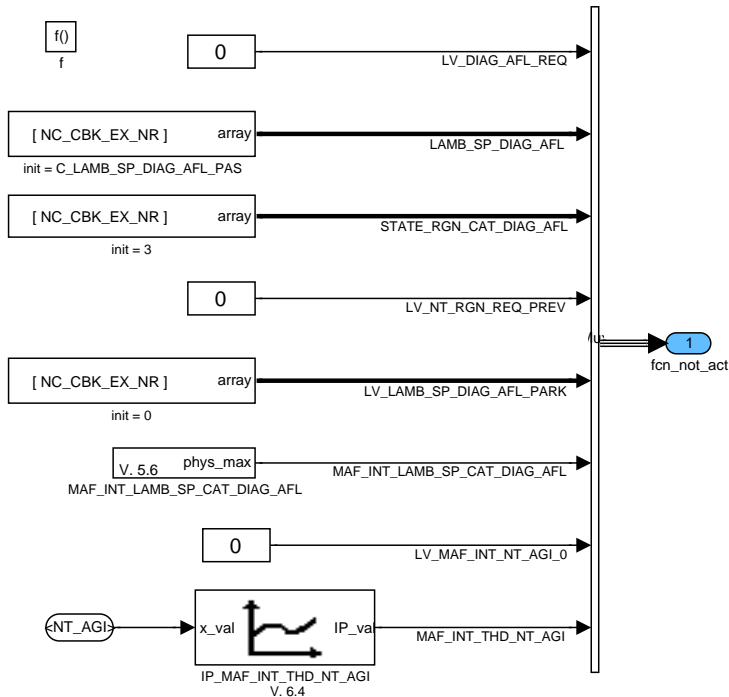


Figure B.53.3: :

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### B.53.1.2 CALCULATION OF THE LAMBDA SETPOINT AND THE REGENERATION STATE FOR THE DIAGNOSIS (LAMB\_SP\_CLC)

The calculation is split up into following sections:

- Request for the diagnosis
- Calculation of the regeneration state for the diagnosis
- Calculation of the lambda setpoint
- Calculation of MAF-integral in dependence of the age from the NOx trap
- Calculation of the old variables

#### B.53.1.2.1 Request for the diagnosis

As long as the request LV\_DIAG\_AFL\_REQ is set, the lambda set point for the system is defined by this function directly after regeneration is finished. This request is reset, when either all, or just any bank (depending on calibration) switches to STATE\_CAT\_DIAG\_AFL=PASSIVE

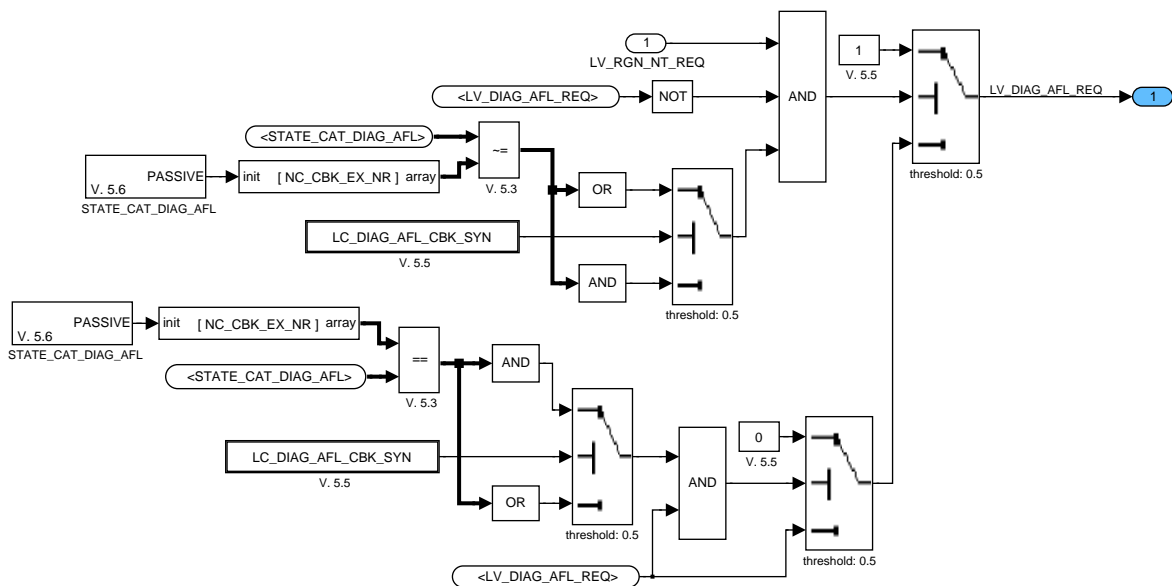


Figure B.53.4: :

#### B.53.1.2.2 Calculation of the regeneration state for the diagnosis

The own regeneration state for the diagnosis is initialized at the beginning of the NOx Trap regeneration. When the Nox Trap regeneration is finished, then depending on calibration a precondition phase is started. When the precondition is finished, then the own regeneration state is initialized accordingly for activation of the diagnosis at relevant bank and neutral park of the other

Structure level – no SW relevant information

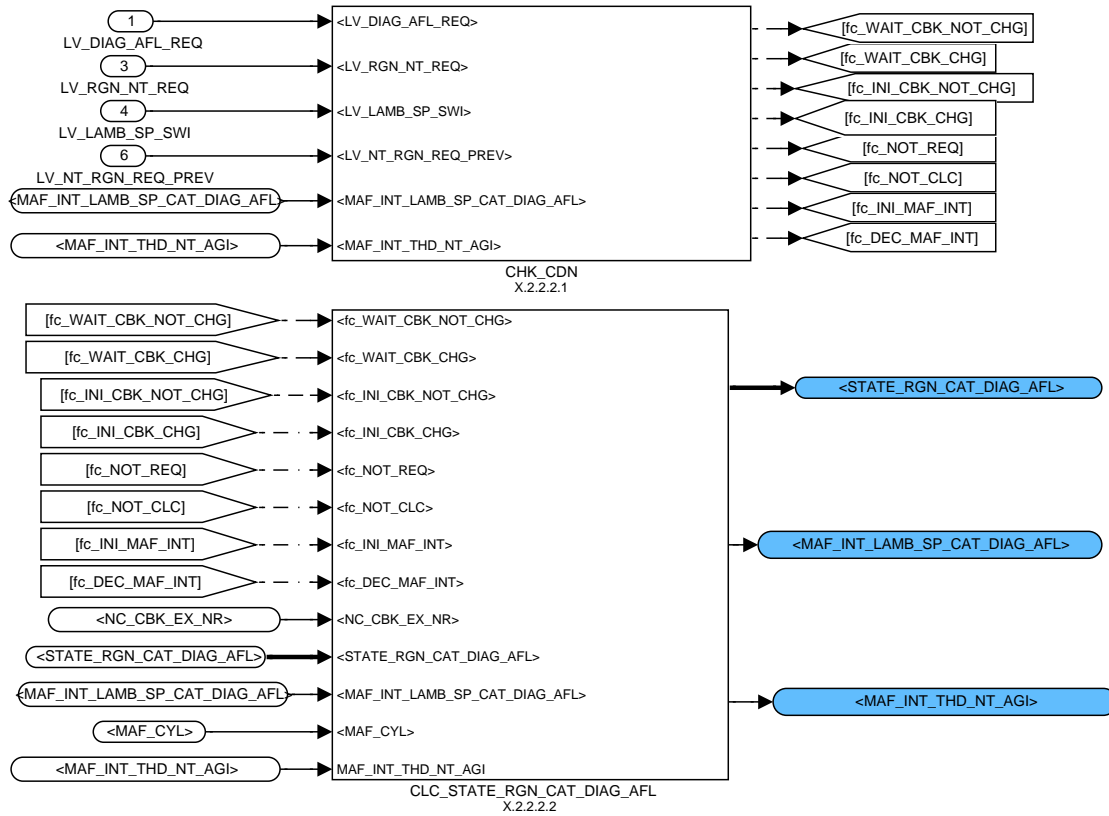


Figure B.53.5: :

B.53.1.2.2.1 Check conditions

Check of the NOx Trap regeneration state, precondition state and bank alternate bit. The calculations follow in next picture

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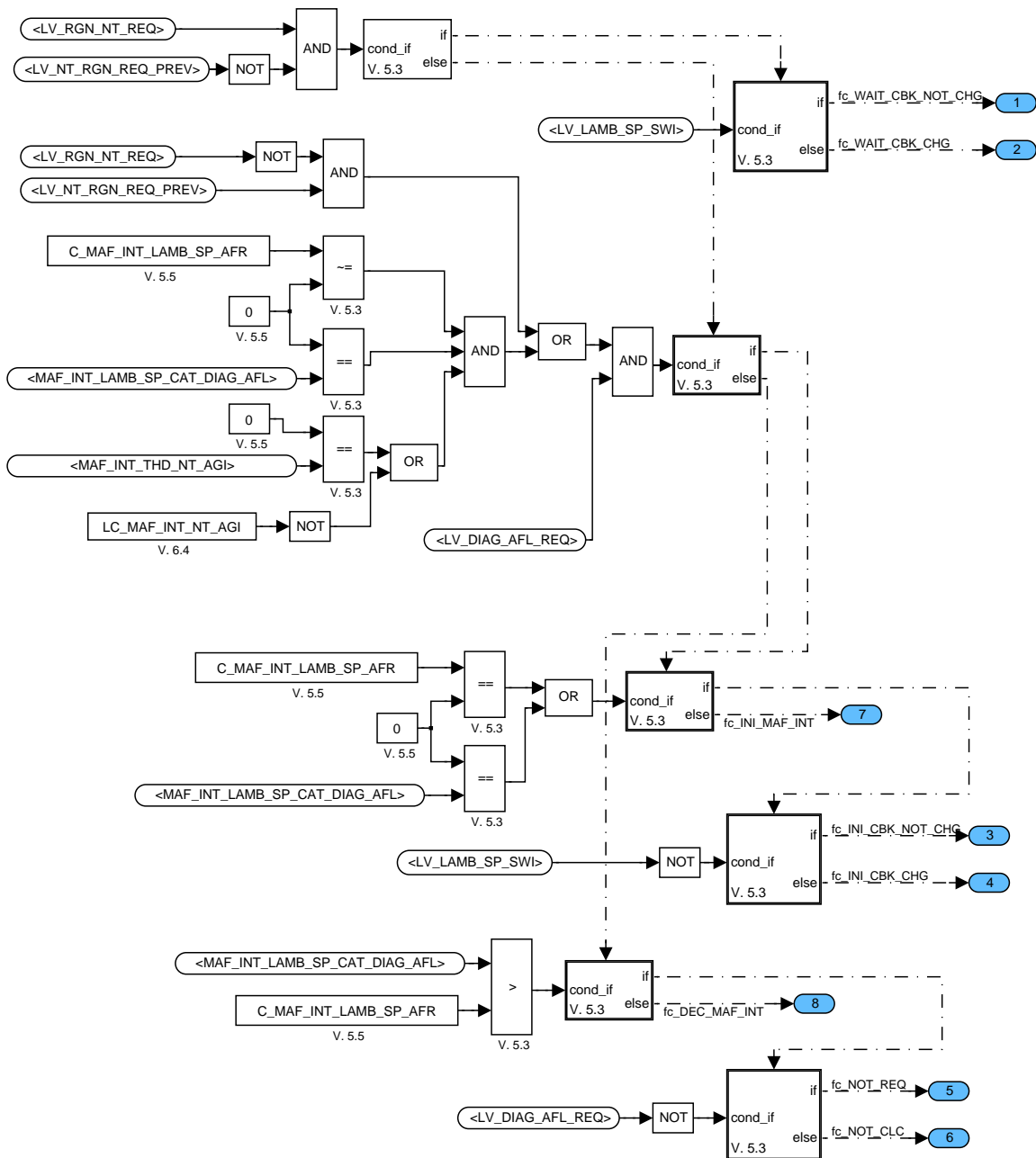


Figure B.53.6: :

### B.53.1.2.2.2 Calculations

Calculation of the own regeneration state, lambda set point and MAF integral is done in following cases:

- Waiting for the end of the Nox Trap regeneration and precondition, banks not interchanging
- Waiting for the end of the Nox Trap regeneration and precondition, banks interchanging accordingly to C\_STATE\_RGN\_INI\_DIAG\_AFL\_PAS
- Initialization for diagnosis state without interchanging of the banks
- Initialization for diagnosis state with interchanging of the banks accordingly to C\_STATE\_RGN\_INI\_DIAG\_AFL

- e) Request for the diagnosis doesn't exist
- f) Request for the diagnosis exists, but initializations don't take place
- g) Initialization of the MAF integral for precondition phase
- h) Decrementing of the MAF integral during precondition phase

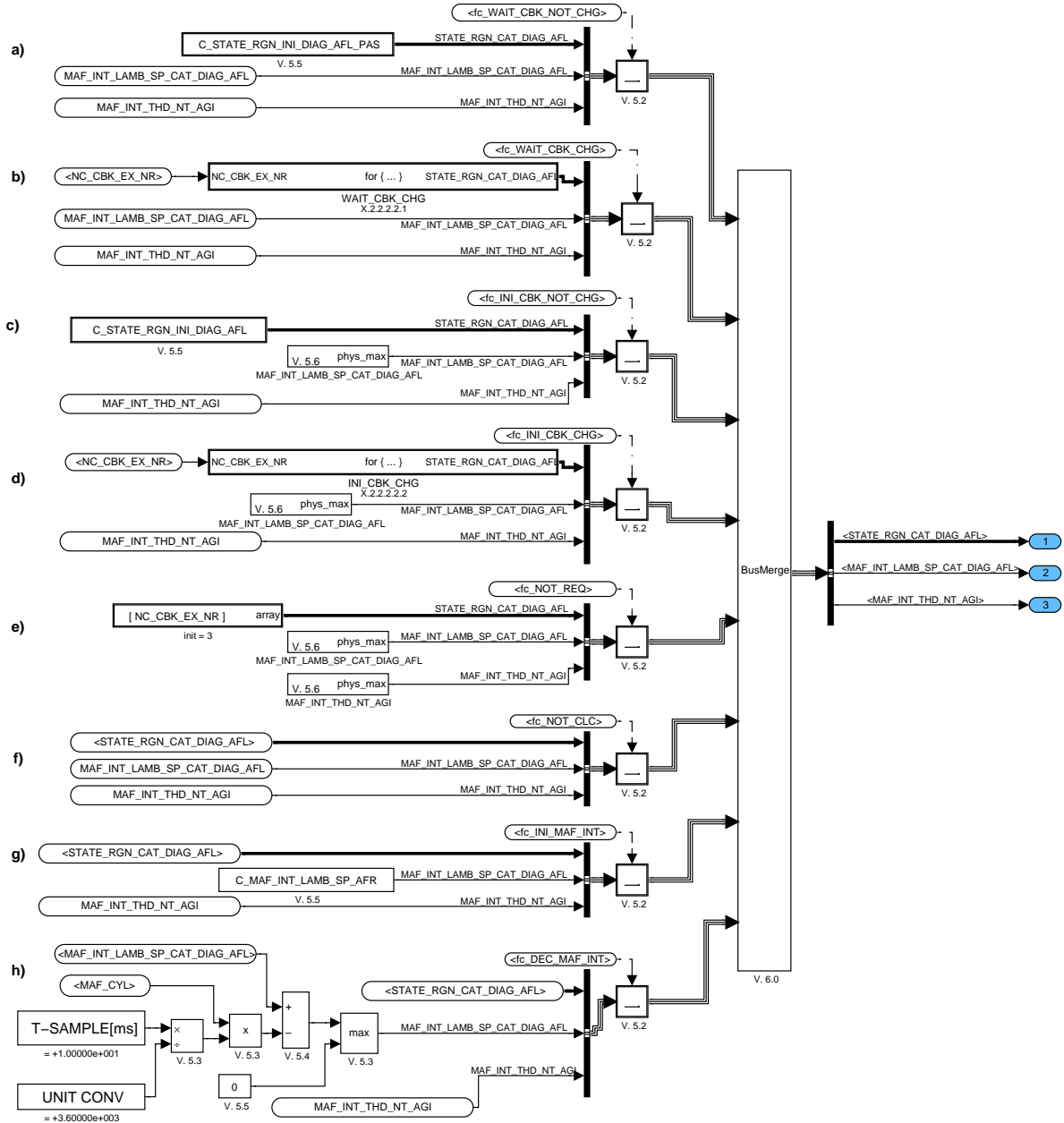


Figure B.53.7: :

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### B.53.1.2.2.1 Interchanging of the banks accordingly to C\_STATE\_RGN\_INI\_DIAG\_AFL

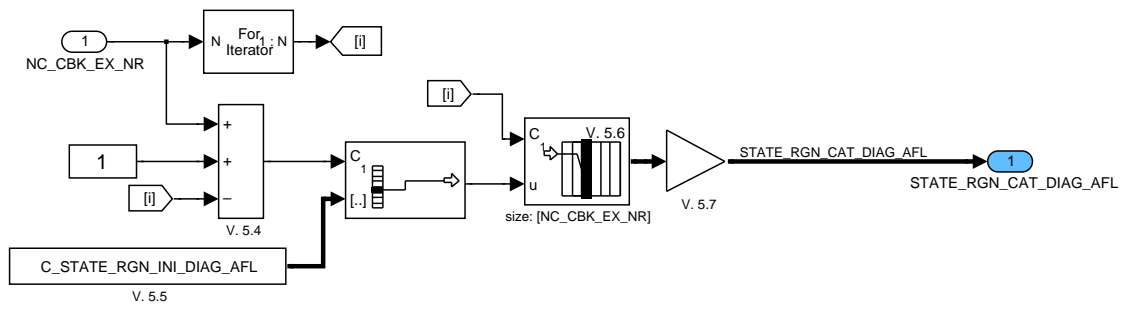


Figure B.53.8: :

### B.53.1.2.2.2 Interchanging of the banks accordingly to C\_STATE\_RGN\_INI\_DIAG\_AFL\_PAS

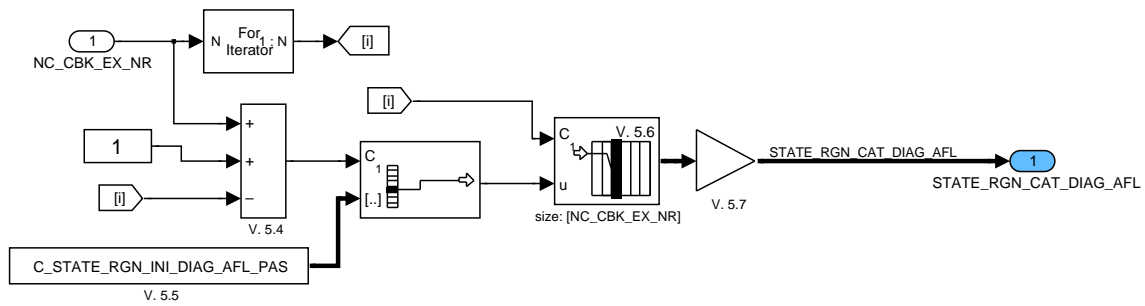


Figure B.53.9: :

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### B.53.1.2.3 Multiple bank system

#### Structure level – no SW relevant information

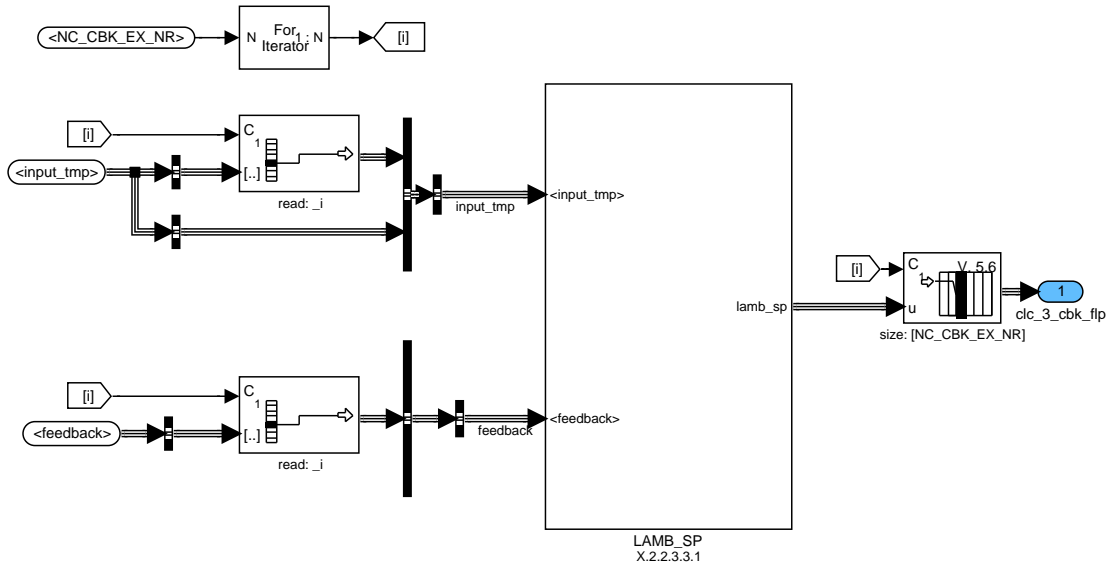


Figure B.53.10: :

#### B.53.1.2.3.1 Bank specific calculations - Lambda set point

The lambda set point for the precondition phase is active directly after Nox Trap regeneration. During this regeneration "WAIT" is active. After precondition the lambda set point for the diagnosed bank is calculated ("DIAG"), for the parked bank ("PARK") the calculations are done inside CLC\_LAMB\_PARK. When the request for the diagnosis isn't active, PASSIVE is called

#### Structure level – no SW relevant information

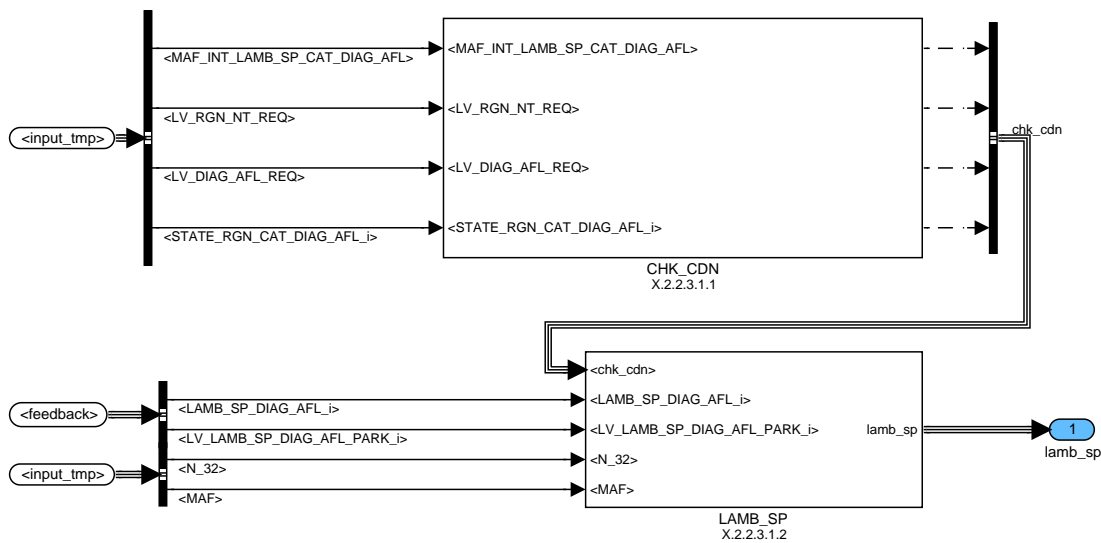


Figure B.53.11: :

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### B.53.1.2.3.1.1 Check of the regeneration and diagnosis requests

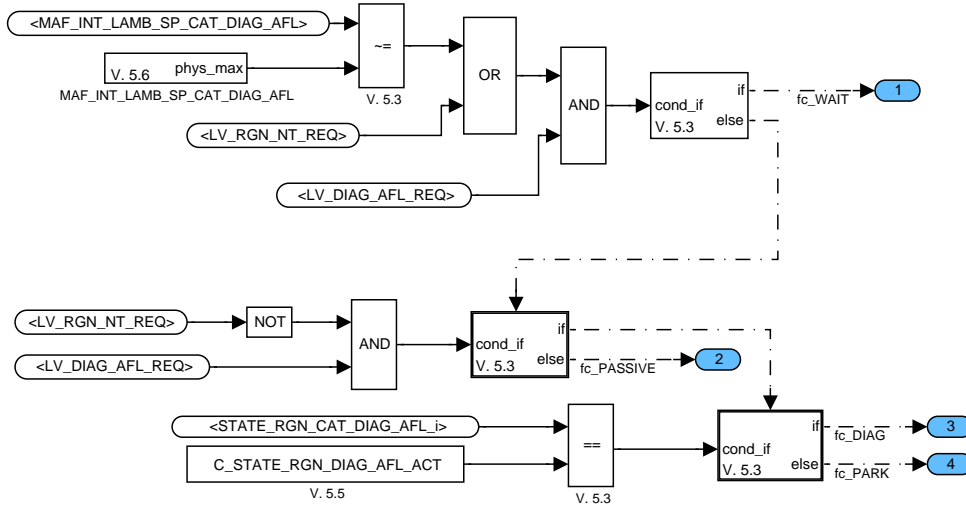


Figure B.53.12: :

### B.53.1.2.3.1.2 Calculation of the lambda set point

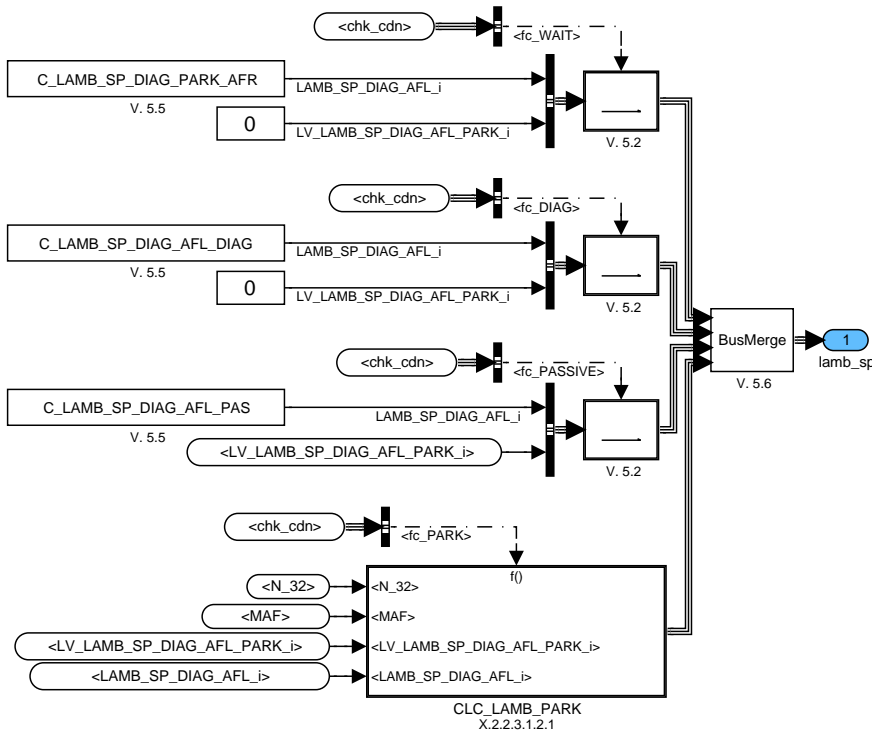


Figure B.53.13: :

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**B.53.1.2.3.1.2.1 Calculation of the lambda set point for the park state (CLC\_LAMB\_PARK)**

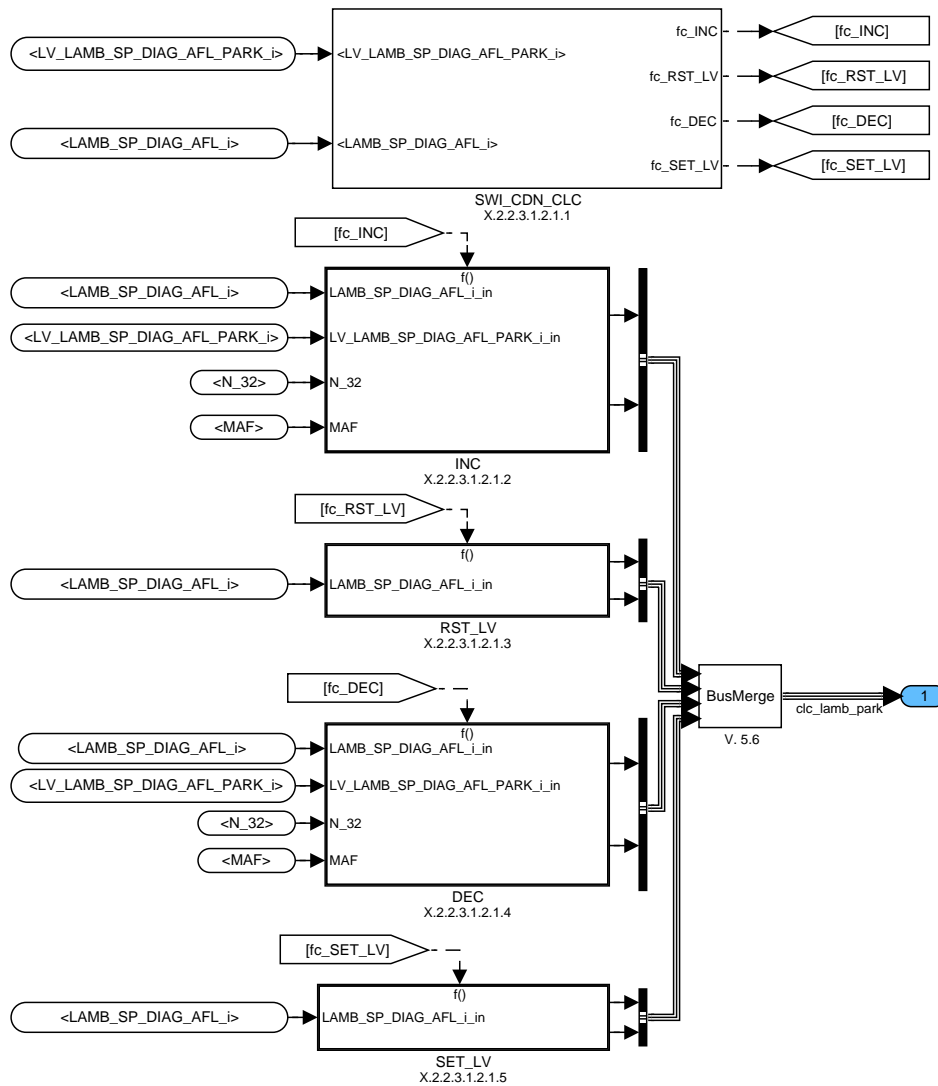


Figure B.53.14: :

**B.53.1.2.3.1.2.1.1 DEC: Decrementing of the lambda set point value**

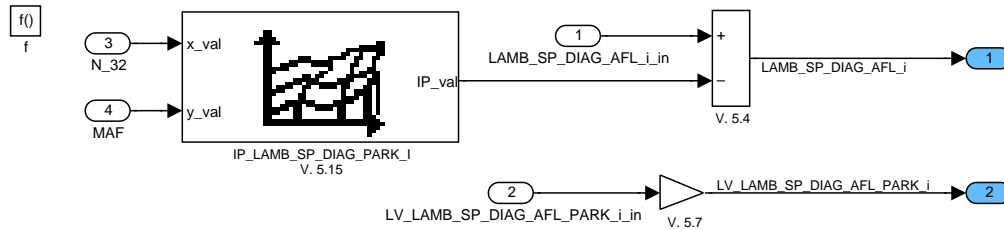


Figure B.53.15: :

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### B.53.1.2.3.1.2.1.2 INC: Incrementing of the lambda set point value

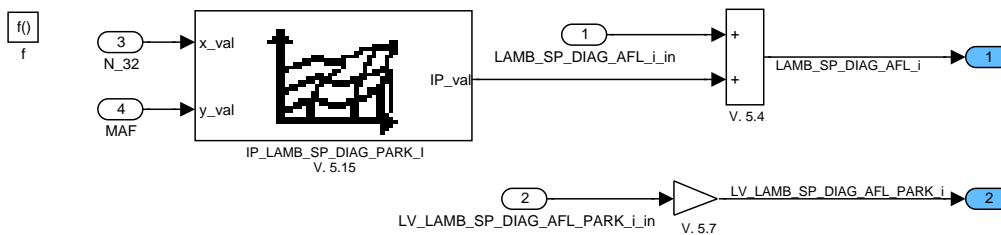


Figure B.53.16: :

### B.53.1.2.3.1.2.1.3 RST\_LV: Reset of the indicator flag for the lambda set point at maximum

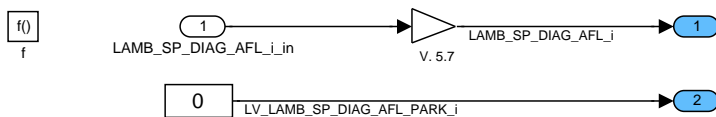


Figure B.53.17: :

### B.53.1.2.3.1.2.1.4 SET\_LV: Set of the indicator flag for the lambda set point at minimum

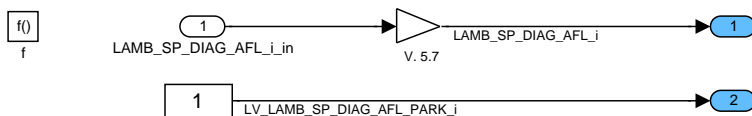


Figure B.53.18: :

### B.53.1.2.3.1.2.1.5 Checking of the actual lambda value

When the lambda is bigger as the minimum then the incrementing is called, when the lambda value is smaller as the maximum then the decrementing is called

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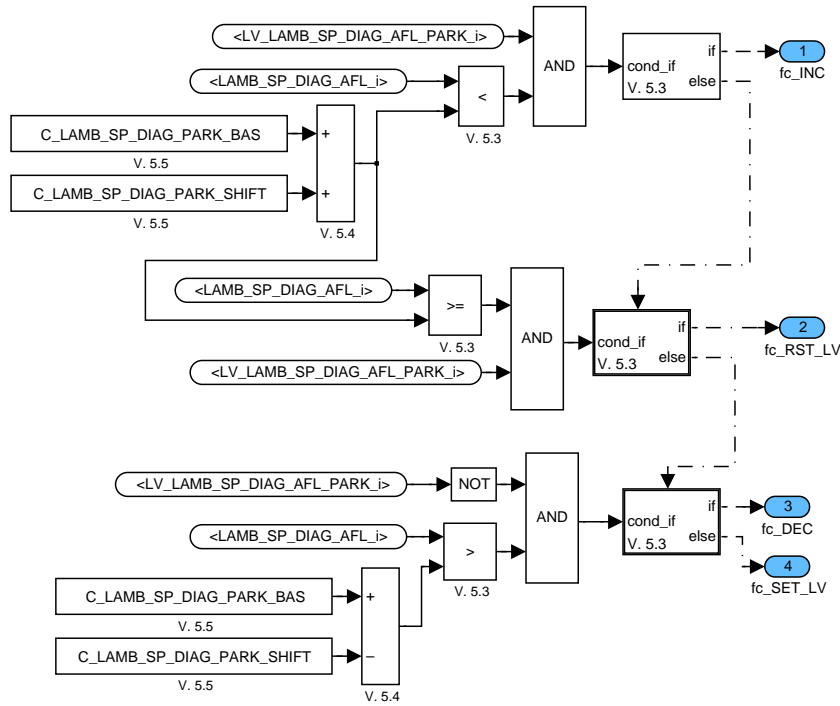


Figure B.53.19: :

**B.53.1.2.4 Calculation of the old variables**



Figure B.53.20: :

**B.53.1.2.5 EGTR\_DEFSPTDLLD0/OPM/LAMB\_SP\_CLC/CLC\_MAF\_NT\_AGI**

**CONTENT**

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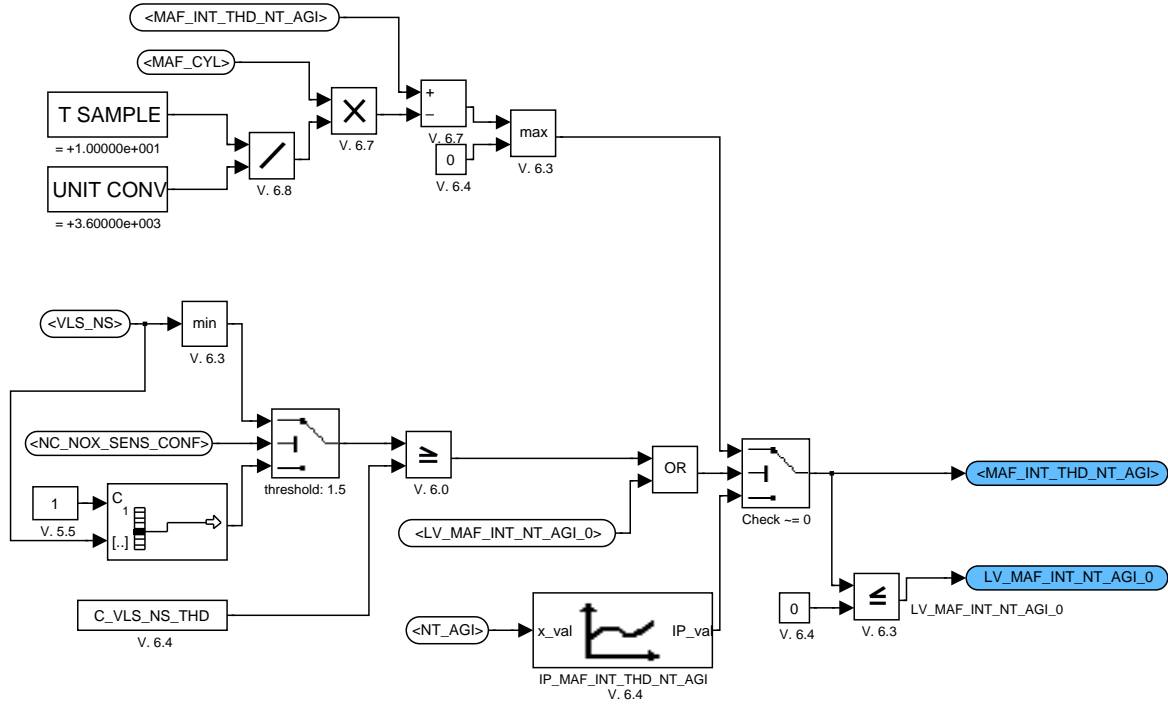


Figure B.53.21: :

**B.53.1.3 PASSIVE STATE (LAMB\_SP\_NOT\_CLC)**

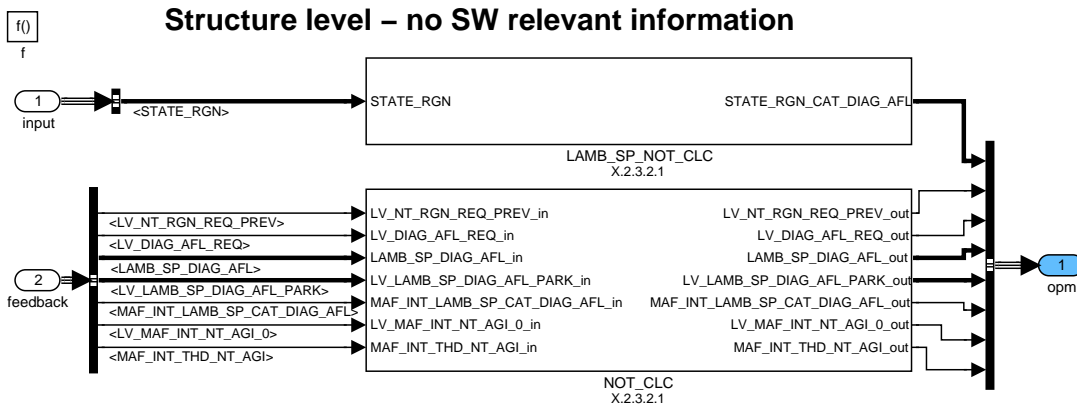


Figure B.53.22: :

**B.53.1.3.1 Calculation of the regeneration state for the diagnosis**

In case the extended lambda setpoint is not required for the diagnosis the regeneration state is also not calculated, but only copied from STATE\_RGN



Figure B.53.23: :

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### B.53.1.3.2 No title given

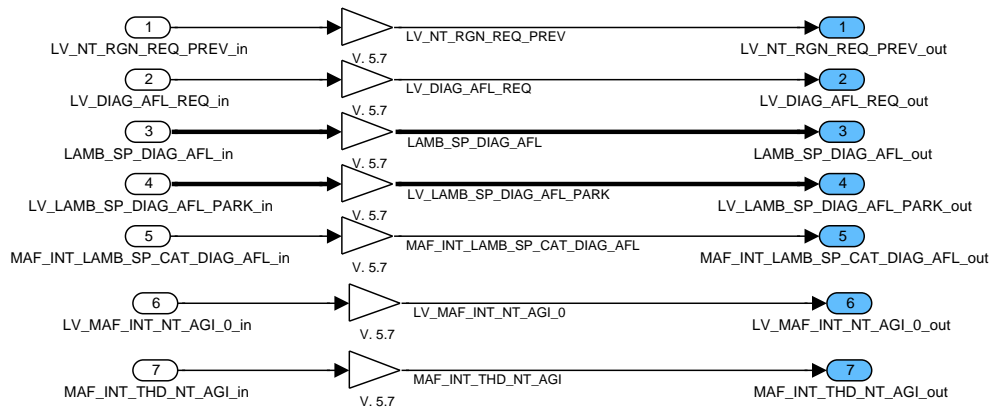


Figure B.53.24: :

### B.53.2 INITIALIZATION AT RESET

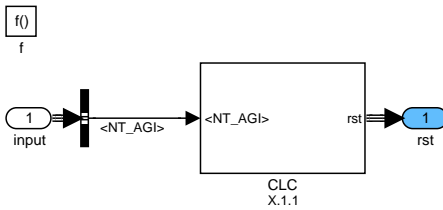


Figure B.53.25: :

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### B.53.2.1 No title given

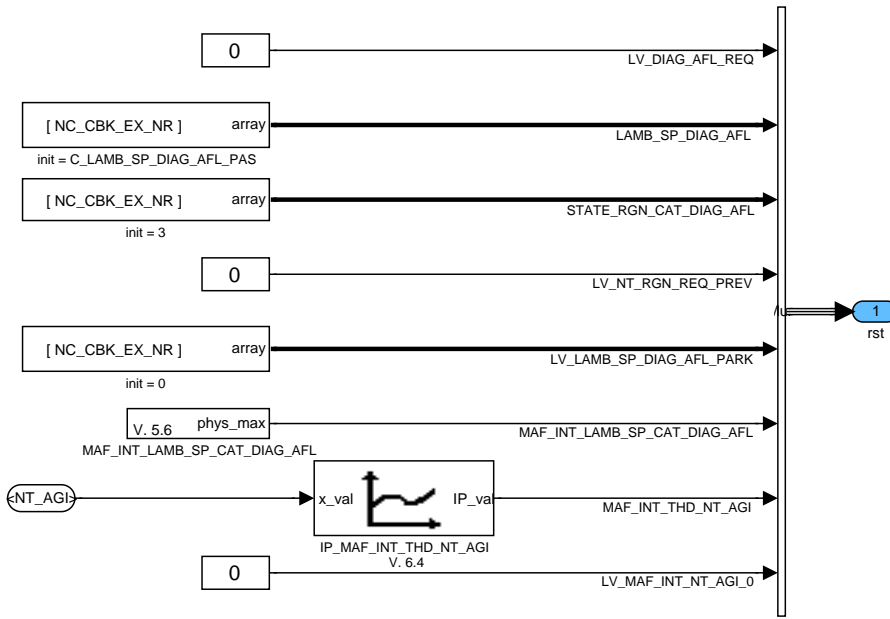


Figure B.53.26: :


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## B.54 TWC diagnosis at lean operation - Oxygen storage capacity calculation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_O2L_CLC_LOAD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for calculation of O2L during load phase					
LV_O2L_CLC_PARK [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for calculation of O2L during park phase					
LV_O2L_CLC_RGN_H_AMPL [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for calculation of O2L during high regeneration phase					
LV_O2L_CLC_RGN_L_AMPL [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for calculation of O2L during low regeneration phase					
O2L_INT_LOAD_PHA [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
O2L integral in the load phase					
O2L_INT_PARK_PHA [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
O2L integral in the park phase					
O2L_INT_RGN_H_AMPL_PHA [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
O2L integral in the high amplitude regeneration phase					
O2L_INT_RGN_L_AMPL_PHA [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
O2L integral in the low amplitude regeneration phase					
O2L_INT_THD_TMP_DIAG_AFL [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Corrected threshold for quit of the O2L integral calculation					
O2L_LOAD_PHA [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
O2L calculated during load phase					
O2L_PARK_PHA [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
O2L calculated during park phase					
O2L_RGN_H_AMPL_PHA [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
O2L calculated during high amplitude regeneration phase					
O2L_RGN_L_AMPL_PHA [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
O2L calculated during low amplitude regeneration phase					
STATE_CAT_DIAG_AFL [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H	PASSIVE RICH_CDN LEAN_CDN WAIT	-	-
OSC calculation state for TWC diagnosis at lean operation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_O2L_CLC_END [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
State for O2L calculation - calculation is finished					
STATE_O2L_CLC_VLD [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Validation state for O2L integral calculation					
STATE_RGN_CAT_DIAG_AFL_OLD [NC_CBK_EX_NR]	-	0... 3H	0 ...3	1	-
Old value of state for calculation of lean TWC diagnosis due state of system regeneration					
T_AFL_CDN_OUT [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Timer for exit from state LEAN_CDN					

**Input data:**

LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LV_HOM_AFL_ACT {p. 8136}	LV_NT_ACT {p. 2982}	LV_O2L_CLC_ACT_CDN [NC_CBK_EX_NR] {p. 5553}
LV_S_ACT {p. 8137}	LV_ST_END {p. 1720}	LV_T_AFL_MIN {p. 2983}	MAF_CYL {p. 8277}
MAF_FG_CYL {p. 1212}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}
NC_NT_NR {p. 644}	STATE_RGN_CAT_DIAG_AFL [NC_CBK_EX_NR] {p. 5589}	T_AFL {p. 2987}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}
TEMP_CAT_STAT_MDL [NC_CBK_EX_NR] {p. 8237}	TNT_MDL_MV_SNG [NC_NT_NR] {p. 8237}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_NOX_SENS [NC_NOX_SENS_CONF] {p. 1382}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_O2L_INT_CLC	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Threshold of linear upstream lambda signal for calculation of O2L integral					
C_O2L_INT_THD_TMP_DIAG_AFL	-	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Threshold to quit of the O2L integral calculation					
C_STATE_EX_CONF	-	1... 4H	1 ...4	1	-
Exhaust gas system configuration					
C_STATE_O2L_CLC_ENA	-	0... FFH	0... 255	1	-
State to allow of calculation of O2L integrals					
C_STATE_RGN_CAT_DIAG_AFL	-	0... 8H	0 ...8	1	-
Regenerations state for calculation PARK and LOAD at STATE_EX_CONF_2					
C_STATE_RGN_CAT_DIAG_AFR	-	0... 8H	0 ...8	1	-
Additional regenerations state for calculation H_AMPL phase					
C_STATE_SENS_DOWN_MISS_CBK	-	1... 4H	1 ...4	1	-
Indicator for bank without downstream lambda sensor					
C_T_AFL_CDN_OUT	-	0... FFFFH	0... 655.35	0.01	s
Maximal time to exit from LEAN_CDN state					
C_VLS_NOX_O2L_INT_CLC	-	0... 578H	-200 ...1200	1	mV
Threshold of binary NOx-Sensor lambda signal for calculation of O2L integral					




Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VLS_O2L_INT_CLC	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Threshold of binary downstream lambda signal for calculation of O2L integral					
IP_FAC_LAMB_DIAG_AFL	-	0... FFH	0... 3.984375	0.015625	-
LDP_LAMB_LS_UP_IP_FAC_DIAG_AFL	8	0... 7FFFH	0... 31.9990234375	976.563e-6	-
O2L correction factor depending on lambda					
IP_FAC_OPP_DIAG_AFL	V	0... FFH	0... 3.984375	0.015625	-
LDP_N_32_IP_FAC_DIAG_AFL	8	0... FFH	0... 8160	32	rpm
LDP_MAF_CYL_IP_FAC_DIAG_AFL	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
O2L correction factor depending on operating point					
IP_FAC_OPP_DIAG_AFL_SUM	V	0... FFH	0... 3.984375	0.015625	-
LDP_N_32_IP_FAC_DIAG_AFL	8	0... FFH	0... 8160	32	rpm
LDP_MAF_CYL_IP_FAC_DIAG_AFL	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
Correction factor of the O2L calculated in PARK phase depending on operating point conditions					
IP_FAC_T_AFL_DIAG_AFL	-	0... FFH	0... 15.9375	0.0625	-
LDP_T_AFL_IP_FAC_DIAG_AFL	8	0... FFFFH	0... 1310.7	0.02	s
Correction factor for calculation of O2L value depending on vehicle speed					
IP_FAC_TEMP_DIAG_AFL	V	0... FFH	0... 3.984375	0.015625	-
LDP_TEMP_STAT_IP_FAC_DIAG_AFL	8	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
LDP_TEMP_DIF_IP_FAC_DIAG_AFL	8	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
O2L correction factor depending on TWC temperature					
IP_FAC_TEMP_DIAG_AFL_SUM	V	0... FFH	0... 3.984375	0.015625	-
LDP_TEMP_STAT_IP_FAC_DIAG_AFL	8	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
LDP_TNT_MDL_IP_FAC_DIAG_AFL	8	0... FFFFH	0... 1023.984375	0.015625	°C
O2L correction factor depending on TWC and NT temperatures					

## Action definition

<b>ACTION_EGTR_ClcValidCheck</b> (IN<LV_O2L_CLC_OK_i_tmp>,IN<i>,IN<O2L_old_i>,IN<LV_PHA_i>,OUT<O2L_i>,OUT<STATE_O2L_CLC_VLD_Bx_i>,INOUT<O2L_INT_i>)	Mode: O
Local Action: Check of plausibility of O2L integral calculation and calculation of O2L end value	

<b>ACTION_EGTR_O2LIntegralCalc</b> (IN<i>,IN<O2L_INT_old_i>,OUT<O2L_INT_i>)	Mode: O
Local Action: Calculation of O2L Integral	

## Description for Actions

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
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<b>ACTION_EGTR_ClcValidCheck</b> (IN <LV_O2L_CLC_OK_i_tmp>, IN <i>, IN <O2L_old_i>, IN <LV_PHA_i>, OUT <O2L_i>, OUT <STATE_O2L_CLC_VLD_Bx_i>, INOUT <O2L_INT_i>)					
Local Action: Check of plausibility of O2L integral calculation and calculation of O2L end value					
Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
LV_O2L_CLC_OK_i_tmp	IN	0... 1H	0... 1	1	[-]
Calculation of O2L integral regarding upstream and downstream lambda passed					
i	IN	1... 4H	1... 4	1	[-]
Bank specific index					
O2L_old_i	IN	0... FFFFH	0... 2.61684896	39.9306e-6	[g]
Oxygen loading old value					
LV_PHA_i	IN	0... 1H	0... 1	1	[-]
Indicator of the park phase					
O2L_i	OUT	0... FFFFH	0... 2.61684896	39.9306e-6	[g]
Calculated oxygen loading of TWC					
STATE_O2L_CLC_VLD_Bx_i	OUT	0... 1H	0... 1	1	[-]
Read bit of STATE_O2L_CLC_VLD					
O2L_INT_i	INOUT	0... FFFFH	0... 2.61684896	39.9306e-6	[g]
Integral of O2L					

<b>ACTION_EGTR_O2LIntegralCalc</b> (IN <i>, IN <O2L_INT_old_i>, OUT <O2L_INT_i>)					
Local Action: Calculation of O2L Integral					
Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
i	IN	1... 4H	1... 4	1	[-]
Bank specific index					
O2L_INT_old_i	IN	0... FFFFH	0... 2.61684896	39.9306e-6	[g]
Integral of O2L - old value					
O2L_INT_i	OUT	0... FFFFH	0... 2.61684896	39.9306e-6	[g]
Integral of O2L					

## General Information


For calculation of O2L the fresh gas per cylinder, linear lambda signal (TWC upstream), binary lambda signal (TWC downstream or NOx-Trap downstream) are used. The O2L removal is calculated when the linear lambda signal upstream shows the rich mixture (less than 1) and the binary lambda signal downstream shows the lean mixture (less than 500 [mV]). The O2L addition is calculated when the linear lambda signal upstream shows lean mixture (greater than 1) and the binary lambda signal downstream shows the rich mixture (greater than 500 [mV]).

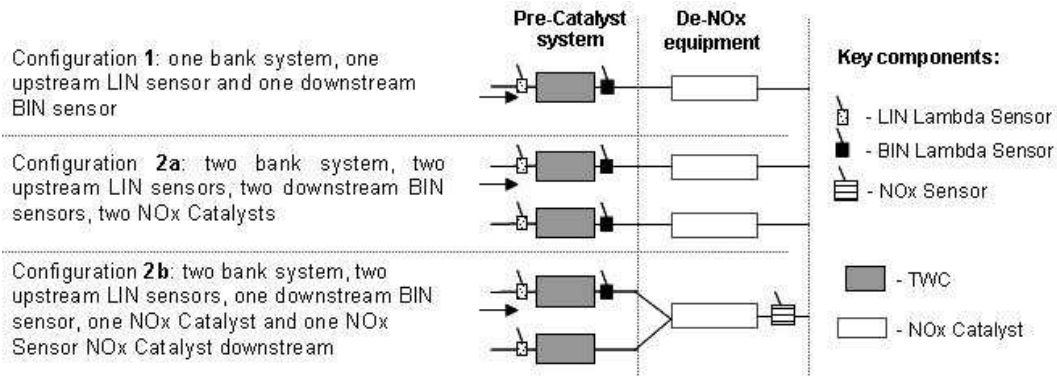
If two separate exhaust bank system are concerned, the diagnosis is relevant for two exhaust gas configurations switched with C\_STATE\_EX\_CONF:

CONF\_1: Exhaust gas configuration equipped with DeNOx technology, with two LIN-Sensors upstream TWC, two BIN-Sensors downstream TWC, two NOx Traps (NT) and one NOx-Sensor downstream NT (Picture 1, configuration 2a)

CONF\_2: Exhaust gas configuration equipped with DeNOx technology, with two LIN-Sensors upstream TWC, one BIN-Sensor downstream TWC, one NOx Traps (NT) and one NOx-Sensor downstream NT (Picture 1, configuration 2b)

Picture 1: Exhaust gas configurations

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The O2L-values are calculated in four cases:

Case 1: Regeneration with high amplitude

Case 2: Regeneration with low amplitude

Case 3: Park phase (for CONF\_1 calculated O2L concerns TWC, for CONF\_2 calculated O2L concerns sum of TWC and NT)

Case 4: Load phase

For each case for the calculation of O2L is one validation bit in STATE\_O2L\_CLC\_VLD[NC\_CBK\_EX\_NR] defined:

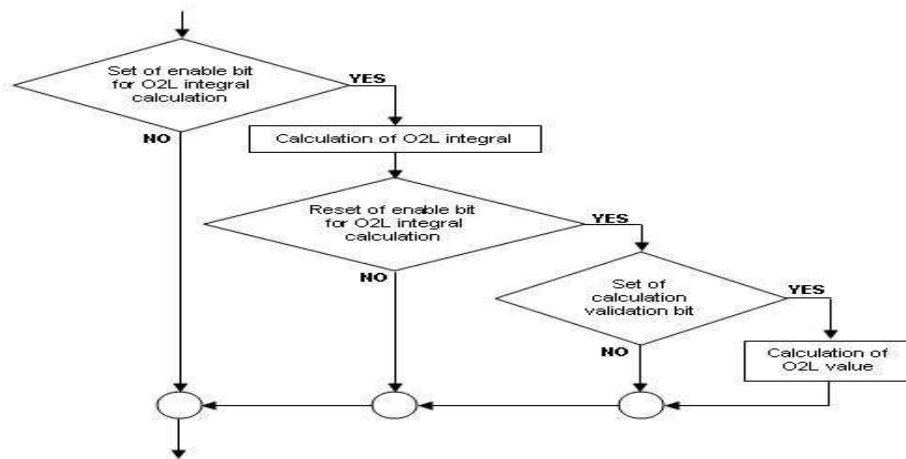
Bit 0 (STATE\_O2L\_CLC\_VLD\_B0): Case 1

Bit 1 (STATE\_O2L\_CLC\_VLD\_B1): Case 2

Bit 2 (STATE\_O2L\_CLC\_VLD\_B2): Case 3

Bit 3 (STATE\_O2L\_CLC\_VLD\_B3): Case 4

Picture 2: Signal flow for calculation of O2L values:



If two separate exhaust bank systems are concerned, then:

i = 1, for cylinder bank 1

i = 2, for cylinder bank 2

Otherwise:

i = 1

NC\_NOX\_SENS\_CONF is the number of NOx-Sensors. Therefore

NC\_NOX\_SENS\_CONF = 0, for no NOx-Sensor

NC\_NOX\_SENS\_CONF = 1 (n = 1), for one NOx-Sensor

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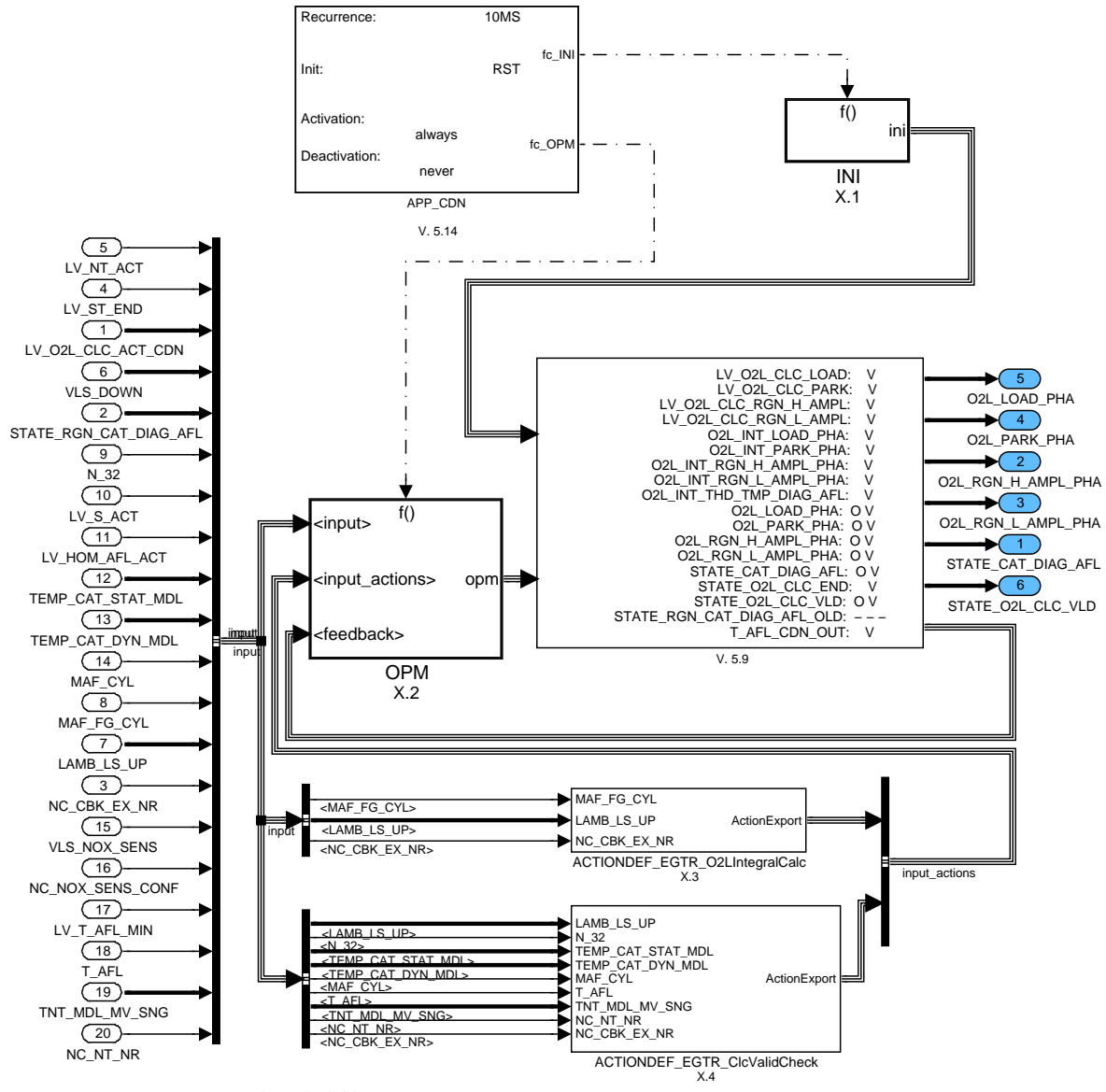
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NC\_NOX\_SENS\_CONF = 2 (n = i), for two NOx-Sensors

**Application Conditions**

Initialization: RST  
 Recurrence: 10MS  
 Activation: always  
 Deactivation: never

**Function description**




SDA\_SRS / SDA V 5.2.5 26-Feb-2007

Figure B.54.1: :

**B.54.1 Initialization**

O2L\_INT\_THD\_TMP\_DIAG\_AFL=C\_O2L\_INT\_THD\_TMP\_DIAG\_AFL

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All other variables are initialized with "0"

## B.54.2 Formula section

All calculations are bank specific

Additional information:

"i" is an indicator for current bank within of for loop depending on NC\_CBK\_EX\_NR.

"n" is an indicator for signals of NOx-Sensor. Therefore:

Case 1: If NC\_CBK\_EX\_NR=1 then n=1 (in system the number of NOx-Sensors can not be greater then number of exhaust bank).

Case 2a: If NC\_CBK\_EX\_NR=2 and NC\_NOX\_SENS\_CONF=1 then n=1

Case 2b: If NC\_CBK\_EX\_NR=2 and NC\_NOX\_SENS\_CONF=2 then n=i

### B.54.2.1 Check of the activation condition

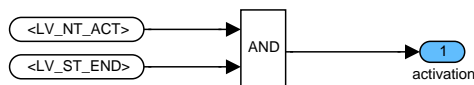


Figure B.54.2: :

### B.54.2.2 Activation condition fulfilled

#### B.54.2.2.1 Overview of the function structure

At first, checking of transition condition and generation of function call for the active state of state machine "STATE\_CAT\_DIAG\_AFL" are done. When the transition conditions are not fulfilled, the same state as in previous cycle is executed. In one calculation cycle only one state can be executed. The old value of STATE\_RGN (for each bank separate) is also calculated after calculating of STATE\_CAT\_DIAG\_AFL

##### B.54.2.2.1.1 STATE FLOW

Calculation of STATE\_CAT\_DIAG\_AFL and generation of the function call for execution of one of it states

### B.54.2.2.1.1 STATE\_CAT\_DIAG\_AFL

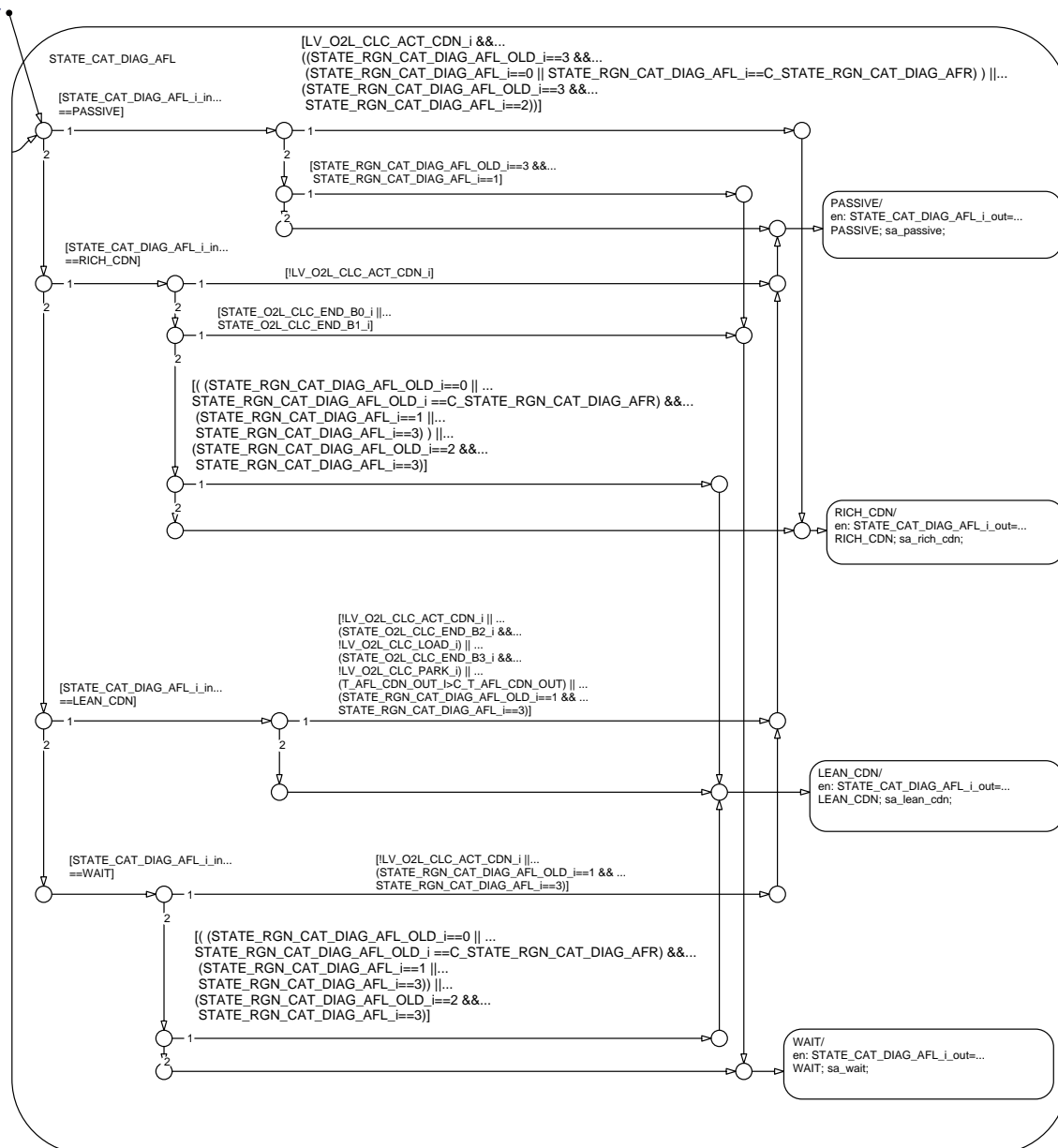


Figure B.54.3: :

### B.54.2.2.1.2 EXECUTION OF THE STATES OF "STATE\_CAT\_DIAG\_AFL"

`STATE_CAT_DIAG_AFL = PASSIVE`: Calculation of OSC is not active

`STATE_CAT_DIAG_AFL = RICH_CDN`: Calculation of OSC is done under rich operation conditions, O2L removal is calculated

`STATE_CAT_DIAG_AFL = LEAN_CDN`: Calculation of OSC is done under lean operation conditions, O2L addition is calculated

`STATE_CAT_DIAG_AFL = WAIT`: OSC calculation in RICH conditions is done, the system is waiting for change from rich to lean conditions

### B.54.2.2.1.2.1 STATE ACTION: STATE\_CAT\_DIAG\_AFL="PASSIVE"

#### B.54.2.2.1.2.1.1 Calculations

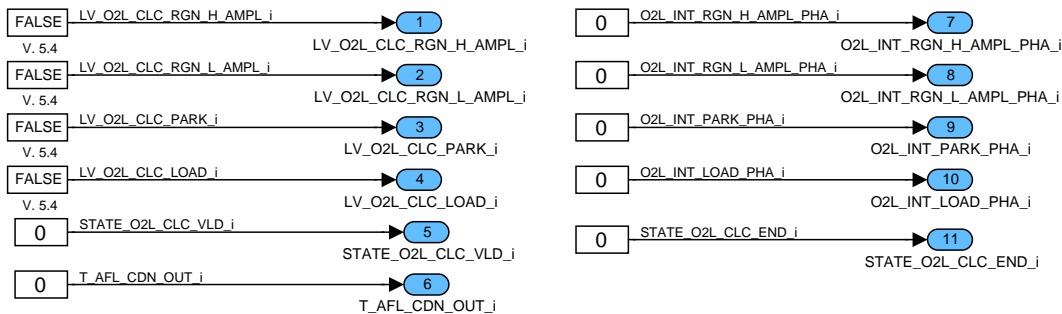


Figure B.54.4: :

#### B.54.2.2.1.2.2 STATE ACTION: STATE\_CAT\_DIAG\_AFL="RICH\_CDN"

In this states the O2L is calculated in one of two cases: either during high regeneration phase or during low regeneration phase.

For every of these phases are calculated separately:

- Activation flag
- O2L removal

For both phases:

- Validation bits of O2L is calculated (BIT 0 for high amplitude phase and BIT 1 for low amplitude phase, BIT 2 and 3 are not calculated)
- Counter for exit from LEAN-CDN is not changed
- Outputs of not active state are calculated (LEAN\_CDN)

##### B.54.2.2.1.2.2.1 OSC calculation in high amplitude regeneration - activation flag

Switching between exhaust gas configurations for calculation of the activation flag is done using C\_STATE\_EX\_CONF

**B.54.2.2.1.2.2.1.1 STATE\_EX\_CONF\_1**

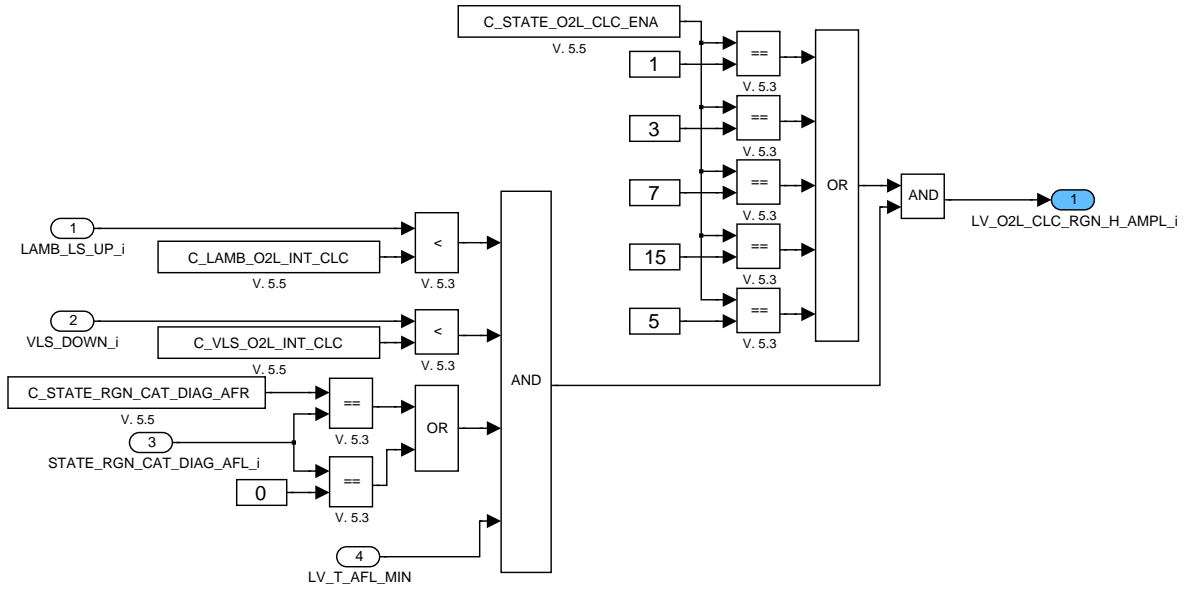


Figure B.54.5: :

**B.54.2.2.1.2.2.1.2 STATE\_EX\_CONF\_2**

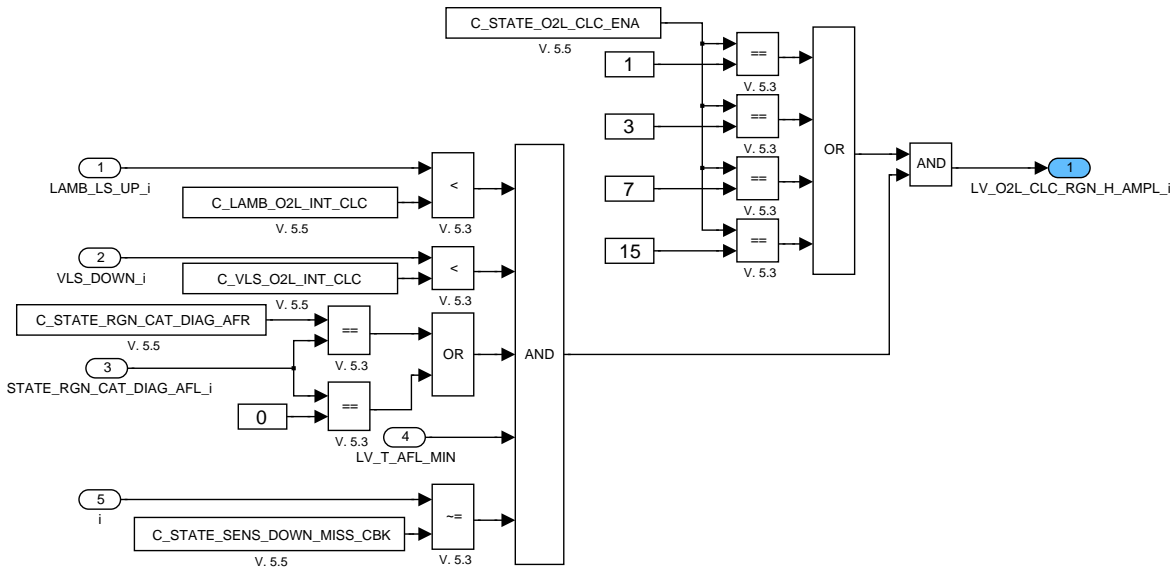


Figure B.54.6: :


**B.54.2.2.1.2.2.2 OSC calculation - regeneration with high amplitude**

The calculation of O2L is done in two steps:

Step 1: Calculation of O2L integral

Step 2: Calculation of O2L after calculating of O2L integral

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**B.54.2.2.1.2.2.1 Calculation of O2L-integral at regeneration with high amplitude**

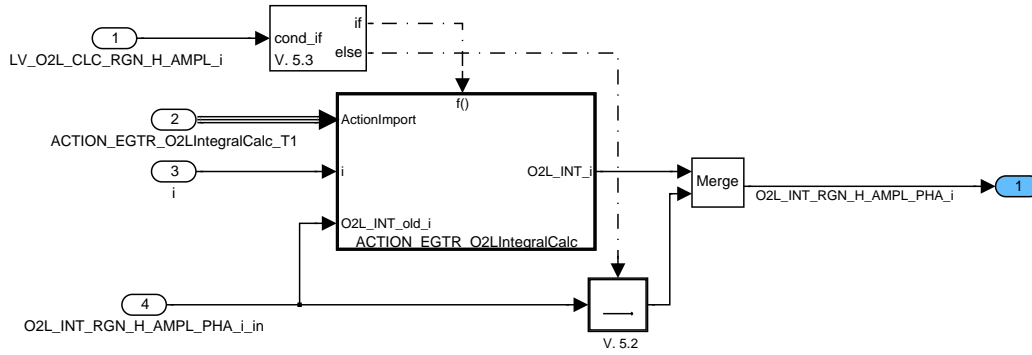


Figure B.54.7: :

**B.54.2.2.1.2.2.2 Calculation of O2L at regeneration with high amplitude (after calculating of O2L integral)**

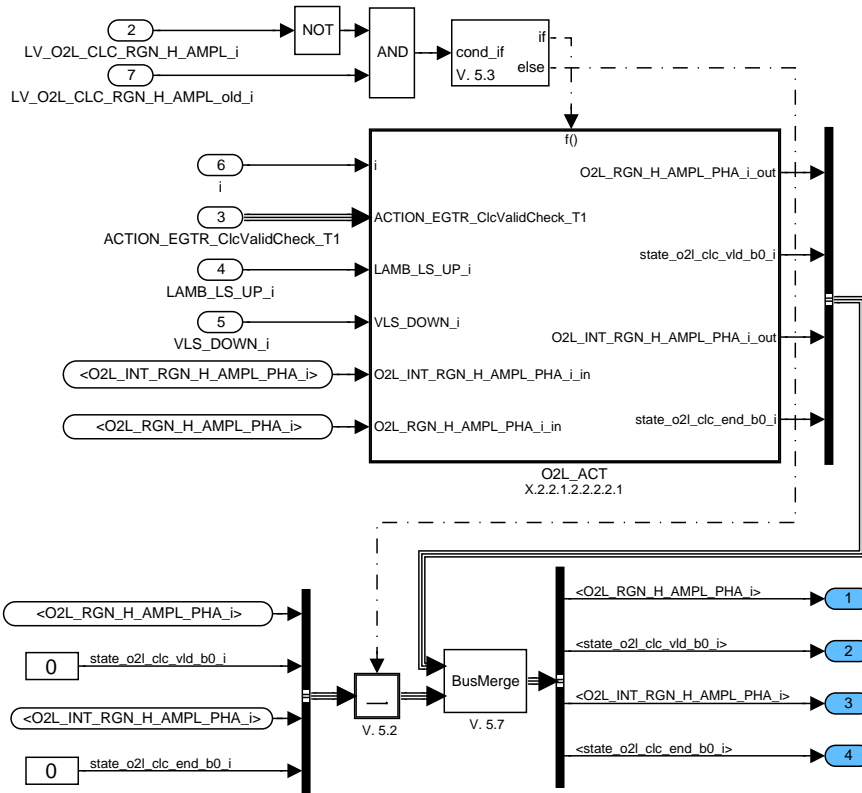


Figure B.54.8: :

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**B.54.2.2.1.2.2.2.1 Falling edge of the activation flag of integral calculation active**

**B.54.2.2.1.2.2.2.1.1 Check of the up and down lambda signal**

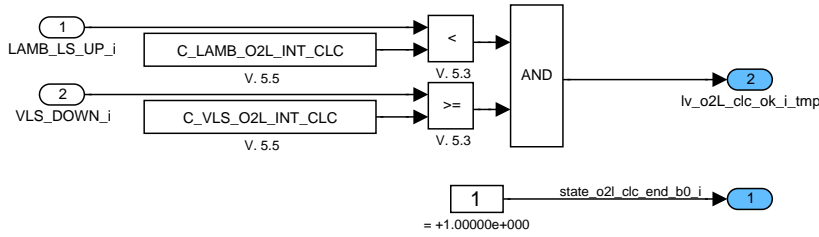


Figure B.54.9: :

**B.54.2.2.1.2.2.2.1.2 Calculation of the O2L of the H\_AMPL phase**

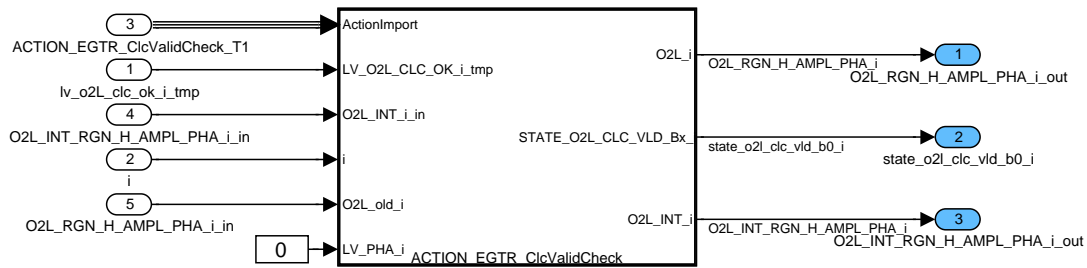


Figure B.54.10: :

**B.54.2.2.1.2.2.3 OSC calculation in low amplitude regeneration - activation flag**

Switching between exhaust gas configurations for calculation of the activation flag is done using C\_STATE\_EX\_CONF

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**B.54.2.2.1.2.2.3.1 STATE\_EX\_CONF\_1**

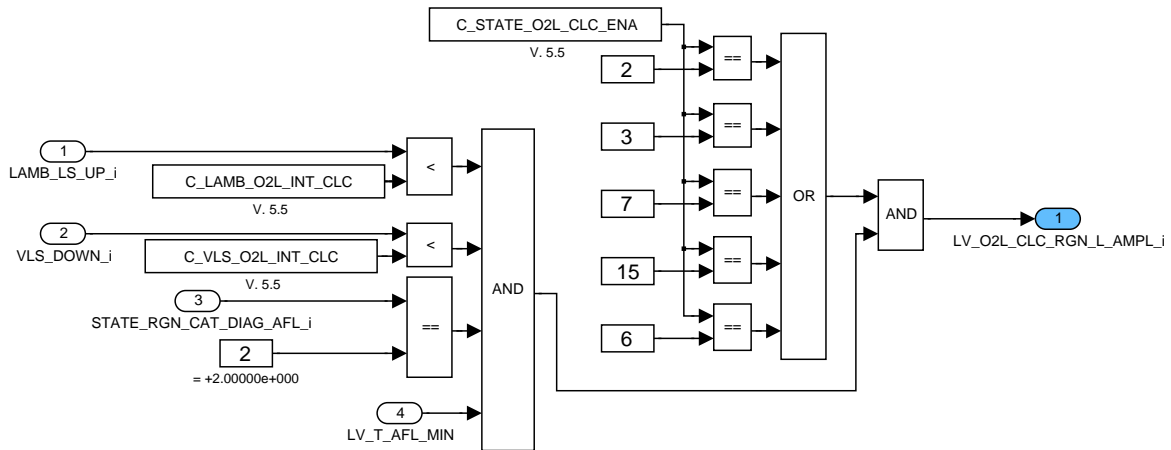


Figure B.54.11: :

**B.54.2.2.1.2.2.3.2 STATE\_EX\_CONF\_2**

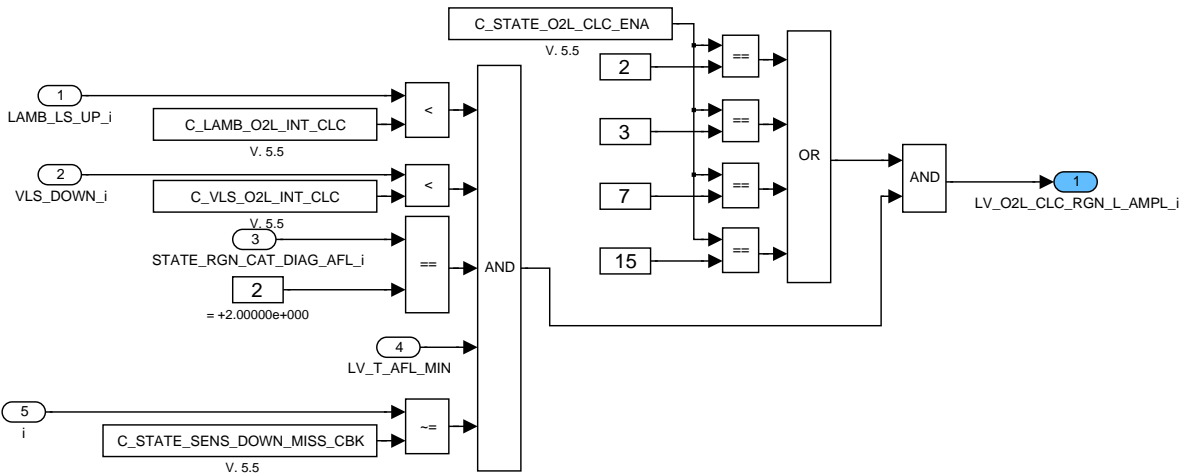


Figure B.54.12: :

**B.54.2.2.1.2.2.4 OSC calculation - regeneration with low amplitude**

The calculation of O2L is done in two steps:

Step 1: Calculation of O2L integral

Step 2: Calculation of O2L after calculation of O2L integral

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**B.54.2.2.1.2.2.4.1 Calculation of O2L-integral at regeneration with low amplitude**

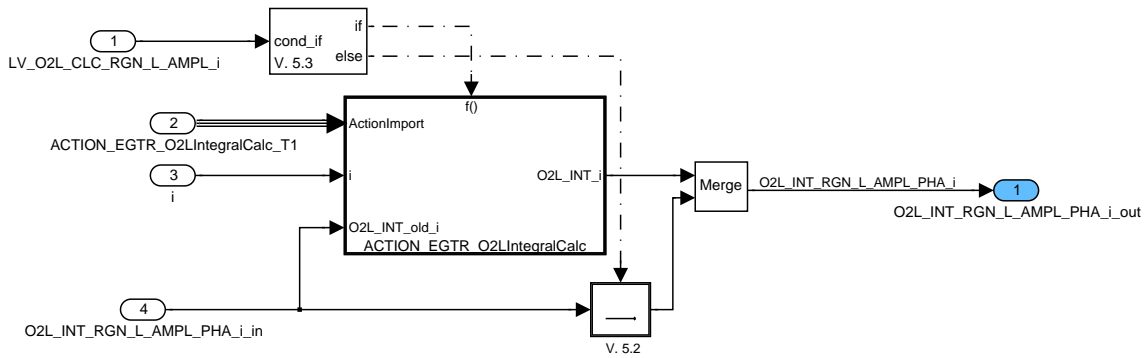


Figure B.54.13: :

**B.54.2.2.1.2.2.4.2 Calculation of O2L at regeneration with low amplitude (after calculating of O2L integral)**

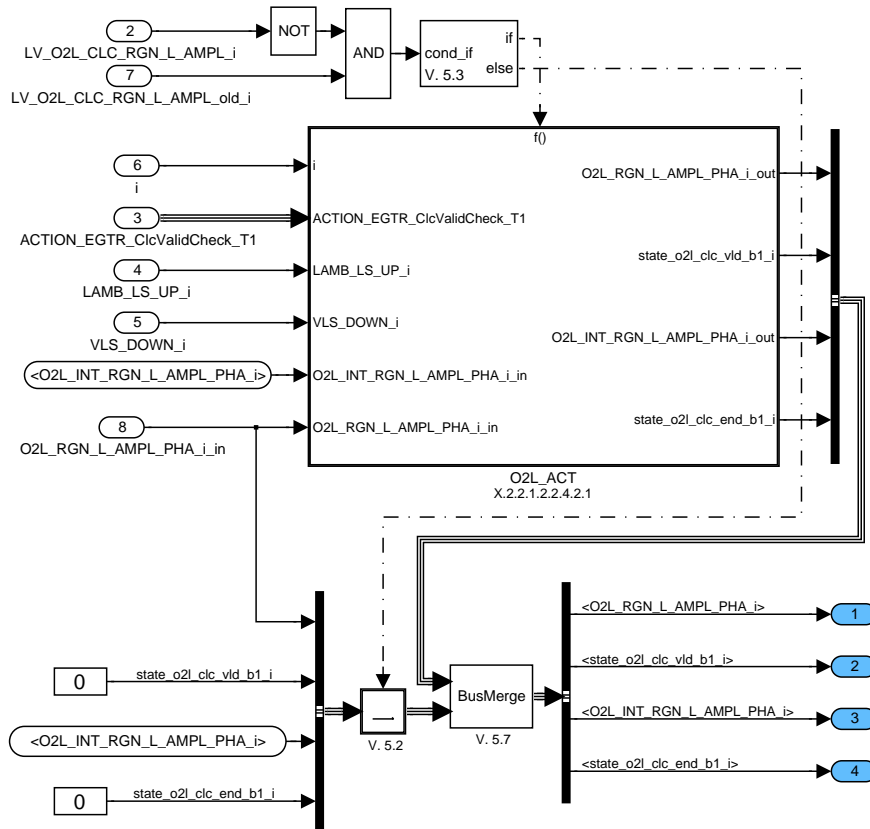


Figure B.54.14: :

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**B.54.2.2.1.2.2.4.2.1 Falling edge of the activation flag of integral calculation active**

**B.54.2.2.1.2.2.4.2.1.1 Check of the up and down lambda signal**

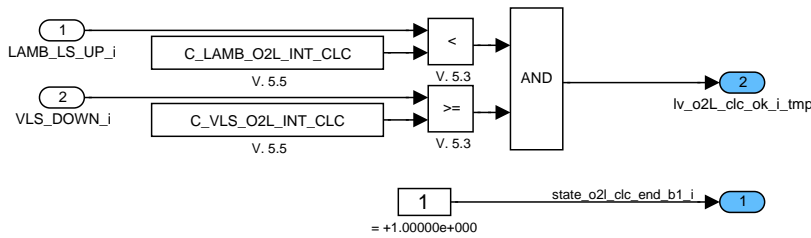


Figure B.54.15: :

**B.54.2.2.1.2.2.4.2.1.2 Calculation of the O2L of the L\_AMPL phase**

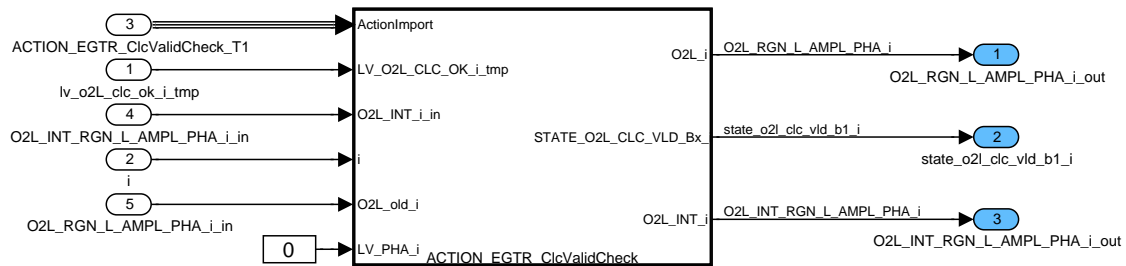


Figure B.54.16: :

**B.54.2.2.1.2.2.5 Calculation of outputs of not active state**

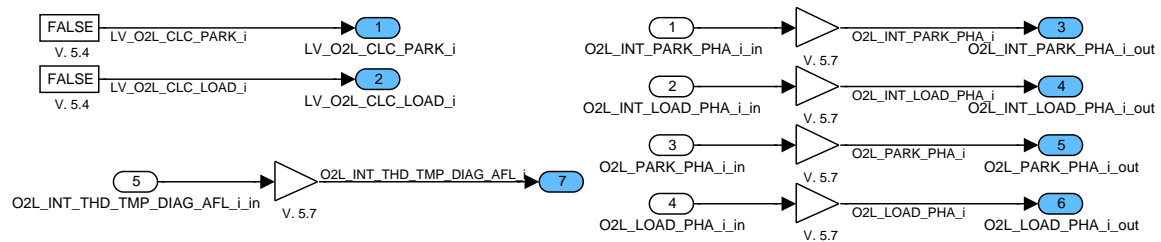


Figure B.54.17: :

**B.54.2.2.1.2.3 STATE ACTION: STATE\_CAT\_DIAG\_AFL="LEAN\_CDN"**

In this states the O2L is calculated in one of two cases: either during park phase or during load phase.

For every of these phases are calculated separately:

- a) Activation flag
- b) O2L addition

For both phases:

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- a) Validation bits of O2L (BIT 2 for park phase and BIT 3 for load phase, BIT 0 and BIT 1 are not calculated)
- b) Counter for exit from LEAN-CDN phase
- c) Outputs of not active state (RICH\_CDN)

### B.54.2.2.1.2.3.1 OSC calculation in park phase - activation flag

Switching between exhaust gas configurations for calculating of activation flag

#### B.54.2.2.1.2.3.1.1 STATE\_EX\_CONF\_1

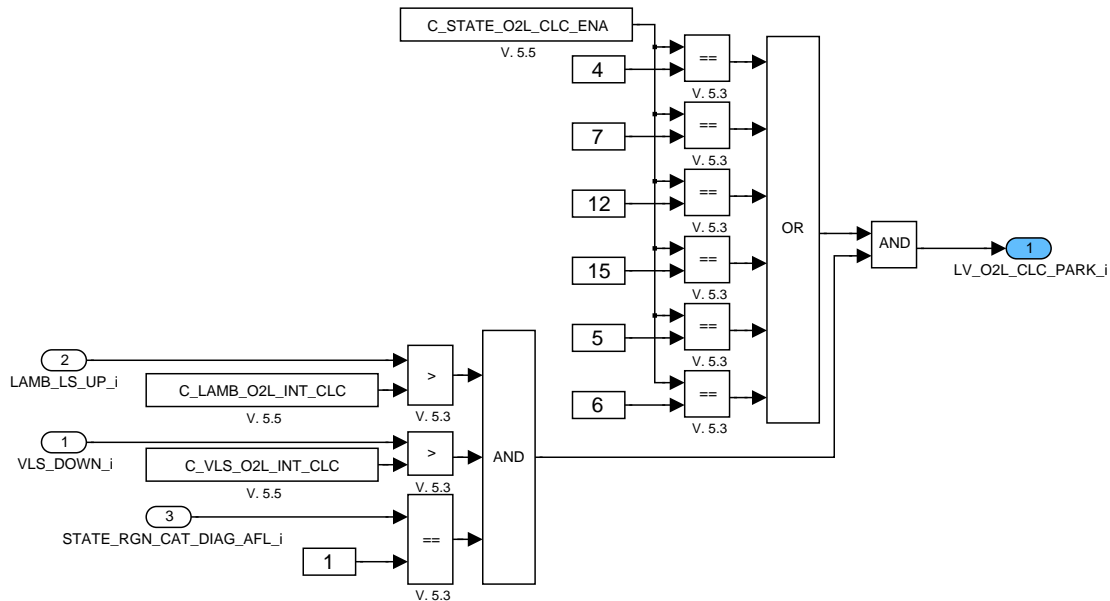


Figure B.54.18: :

#### B.54.2.2.1.2.3.1.2 STATE\_EX\_CONF\_2

Apart from common conditions for calculation of the O2L integral in PARK phase, the bit 2 (saying that the calculation is finished), is checked. It shall forbid a recalculation of the O2L integral in PARK phase. Additional, to optimize the diagnosis duration, the calculation can be stopped when the O2L integral reaches defined threshold

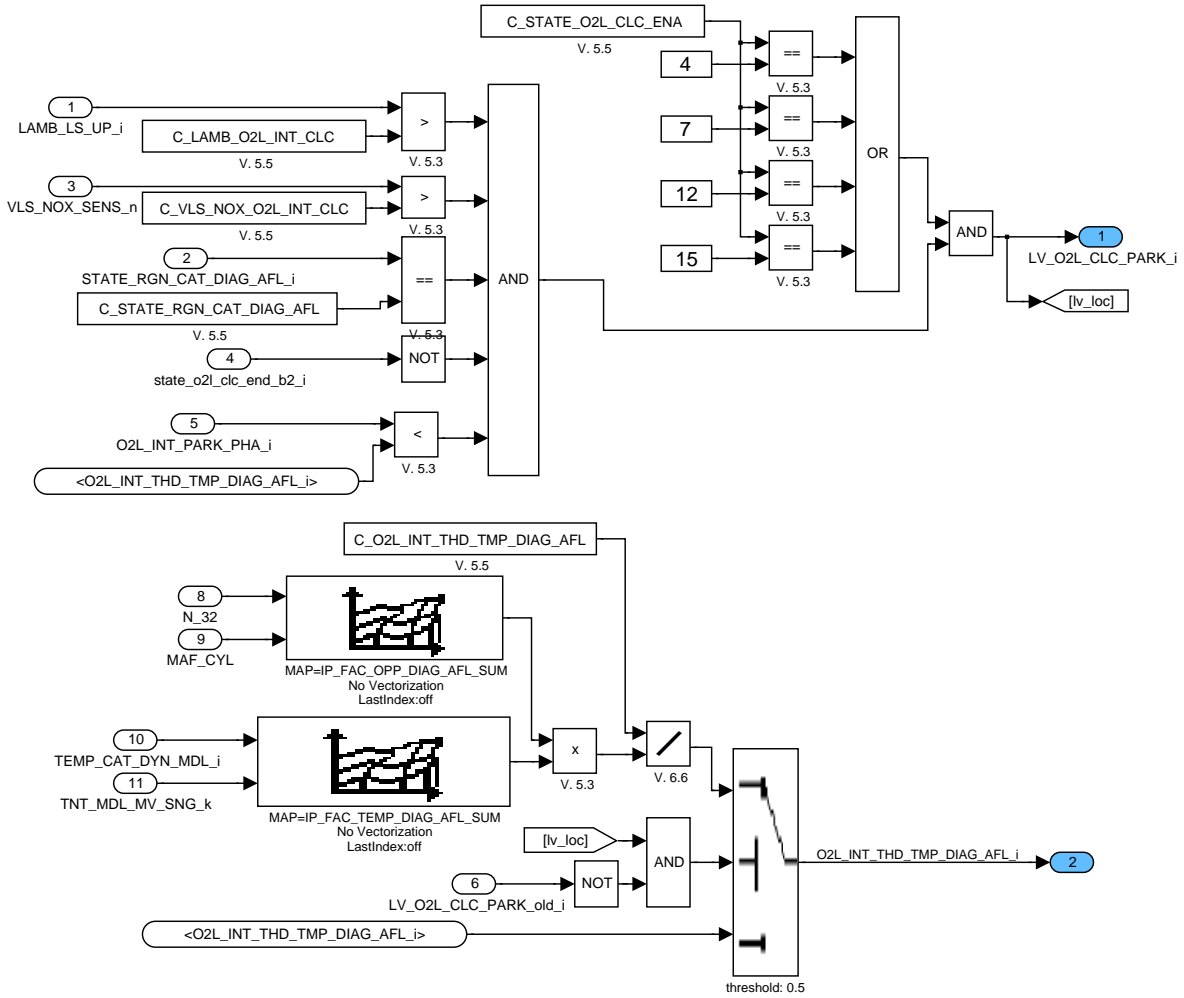


Figure B.54.19: :

**B.54.2.2.1.2.3.2 OSC calculation - park phase**

The calculation of O2L is done in two steps:

Step 1: Calculation of O2L integral

Step 2: Calculation of O2L after calculating of O2L integral

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**B.54.2.2.1.2.3.2.1 Calculation of O2L-integral at park phase**

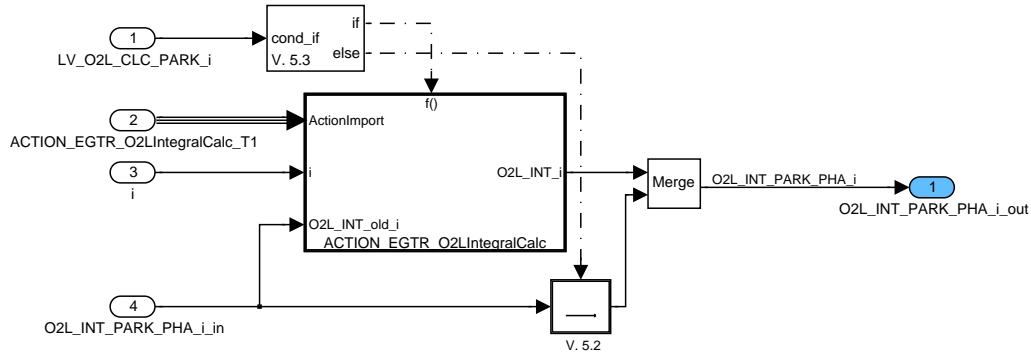


Figure B.54.20: :

**B.54.2.2.1.2.3.2.2 Calculation of O2L at park phase (after calculating of O2L integral)**

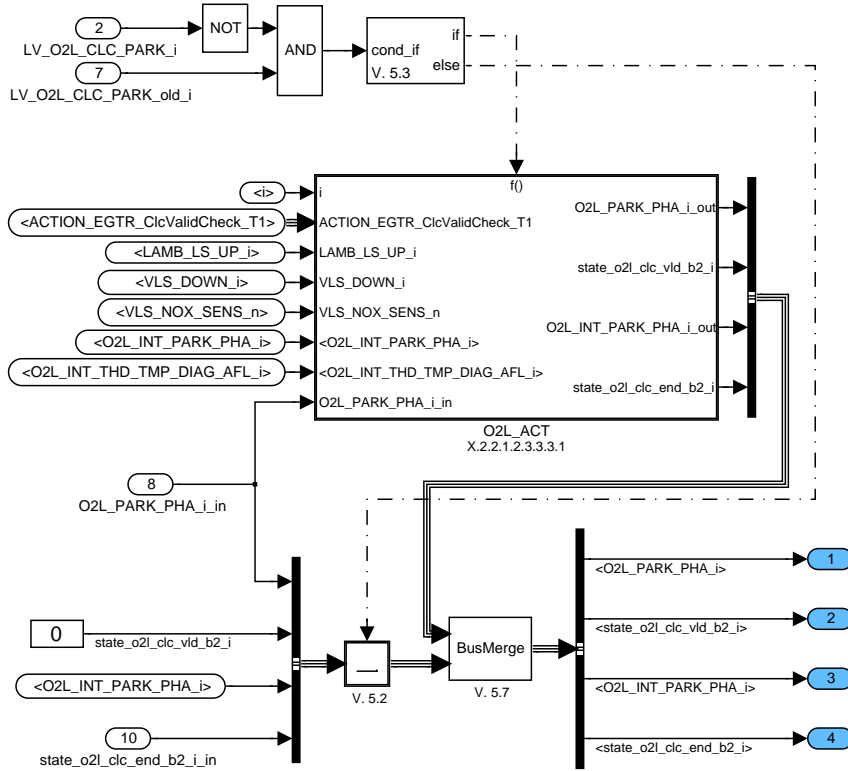


Figure B.54.21: :

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### B.54.2.2.1.2.3.2.2.1 Falling edge of the activation flag of integral calculation active

#### B.54.2.2.1.2.3.2.2.1.1 Check of the up and down lambda signal

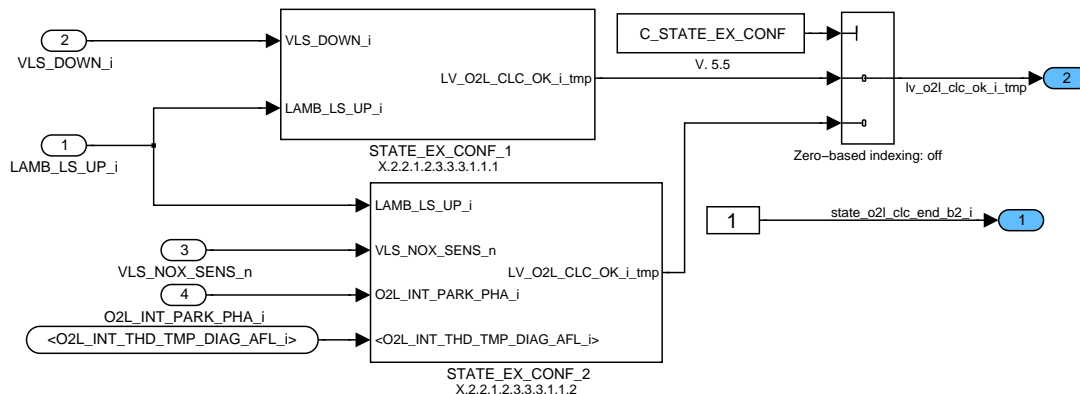


Figure B.54.22: :

#### B.54.2.2.1.2.3.2.2.1.2 STATE\_EX\_CONF\_1

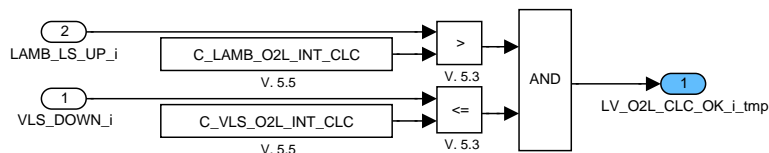


Figure B.54.23: :

#### B.54.2.2.1.2.3.2.2.1.3 STATE\_EX\_CONF\_2

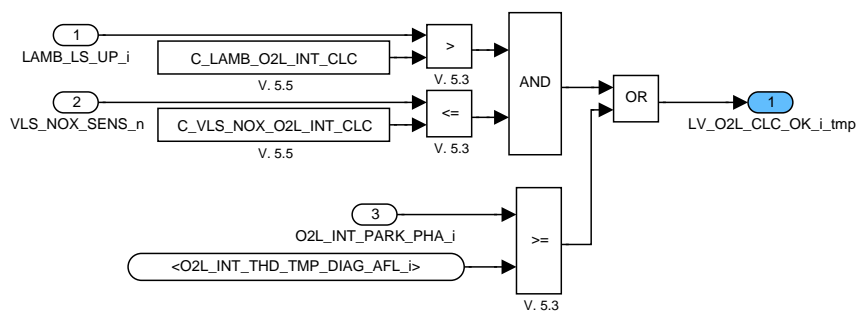


Figure B.54.24: :

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**B.54.2.2.1.2.3.2.1.4 Calculation of the O2L of the PARK phase**

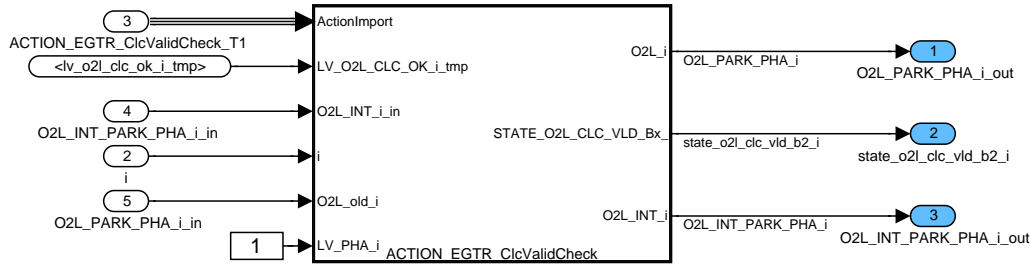


Figure B.54.25: :

**B.54.2.2.1.2.3.3 OSC calculation in load phase - activation flag**

Switching between exhaust gas configurations for calculation of the activation flag is done using C\_STATE\_EX\_CONF

**B.54.2.2.1.2.3.3.1 STATE\_EX\_CONF\_1**

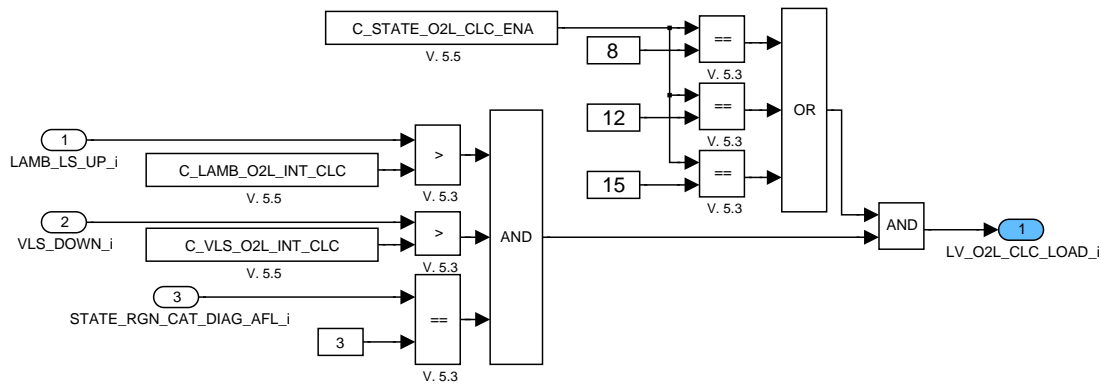


Figure B.54.26: :

**B.54.2.2.1.2.3.3.2 STATE\_EX\_CONF\_2**

Apart from common conditions for calculation of the O2L integral in LOAD phase, the bit 3 (saying that the calculation is finished), is checked. It shall forbid a recalculation of the O2L integral in LOAD phase.

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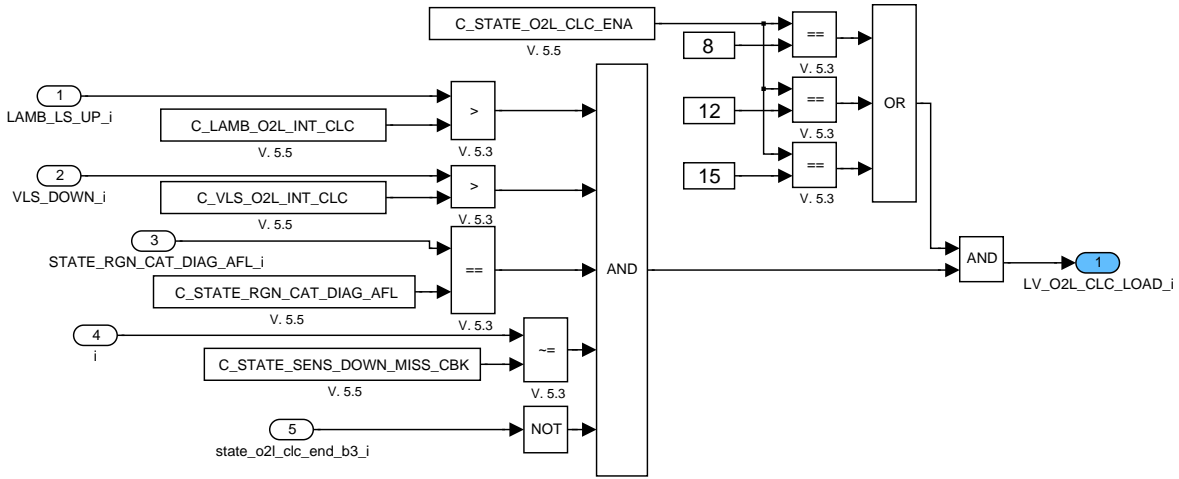


Figure B.54.27: :

**B.54.2.2.1.2.3.4 OSC calculation - load phase**

The calculation of O2L is done in two steps:  
 Step 1: Calculation of O2L integral  
 Step 2: Calculation of O2L after calculating of O2L integral

**B.54.2.2.1.2.3.4.1 Calculation of O2L-integral at load phase**

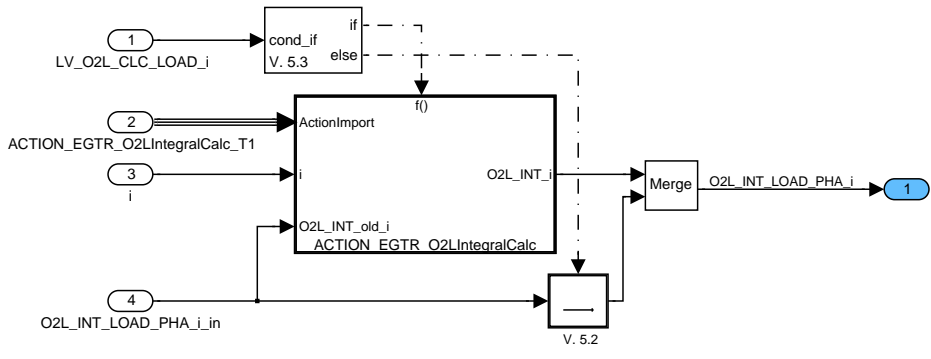


Figure B.54.28: :

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**B.54.2.2.1.2.3.4.2 Calculation of O2L at load phase (after calculating of O2L integral)**

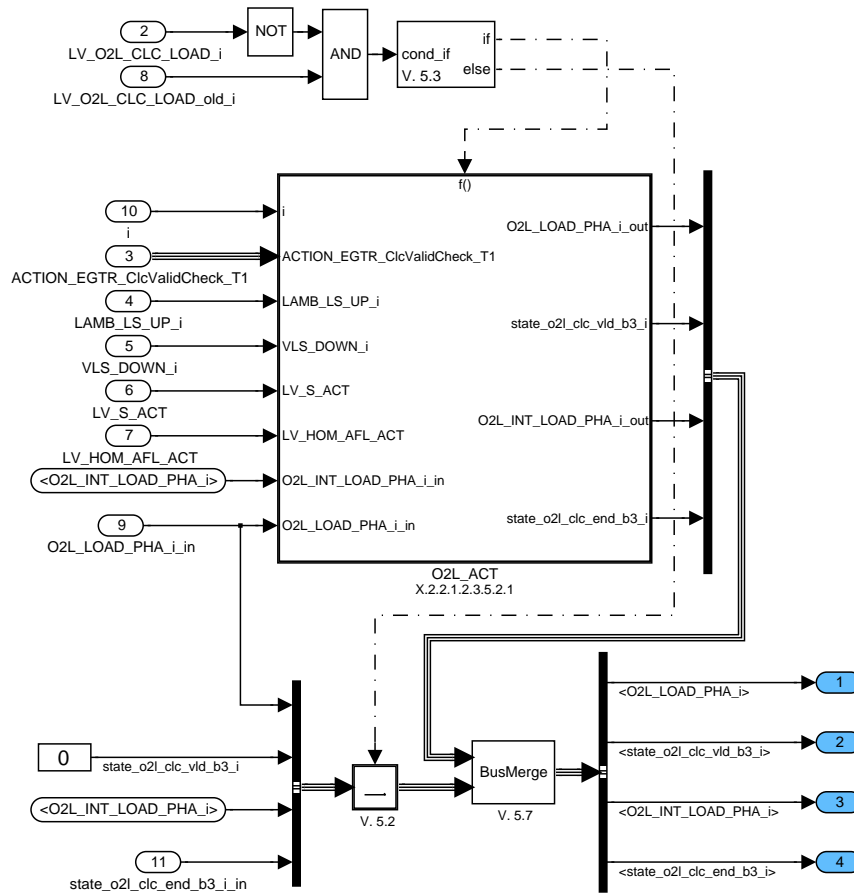


Figure B.54.29: :

**B.54.2.2.1.2.3.4.2.1 Falling edge of the activation flag of integral calculation active**

**B.54.2.2.1.2.3.4.2.1.1 Check of the up and down lambda signal**

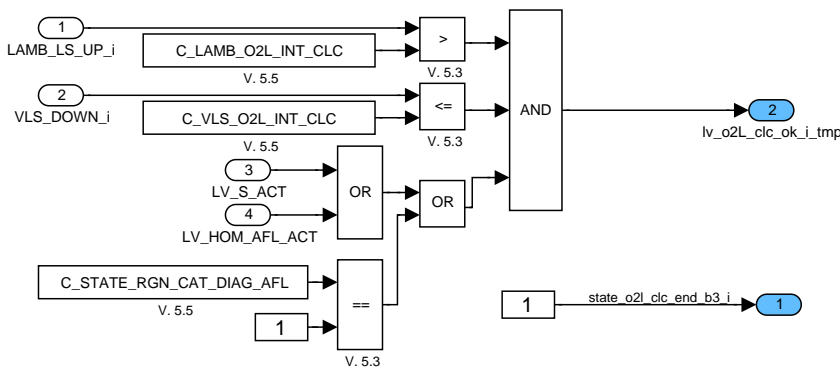


Figure B.54.30: :

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**B.54.2.2.1.2.3.4.2.1.2 Calculation of the O2L of the LOAD phase**

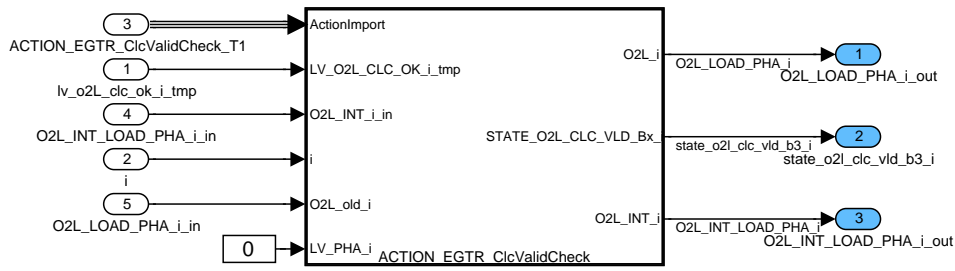


Figure B.54.31: :

**B.54.2.2.1.2.3.5 Calculation of the timer to out from LEAN\_CDN**

The timer is calculated to make possible out from LEAN\_CDN to PASSIVE if the calculation of OSC failed

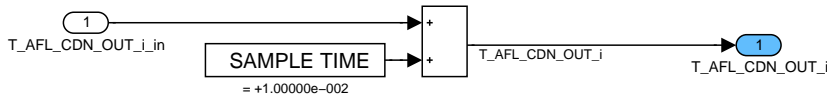


Figure B.54.32: :

**B.54.2.2.1.2.3.6 Calculation of outputs of not active state**

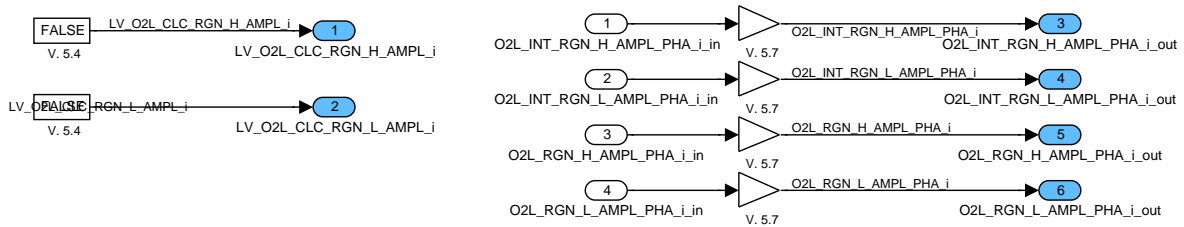


Figure B.54.33: :

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### B.54.2.2.1.2.4 STATE ACTION: STATE\_CAT\_DIAG\_AFL="WAIT"

#### B.54.2.2.1.2.4.1 Calculations

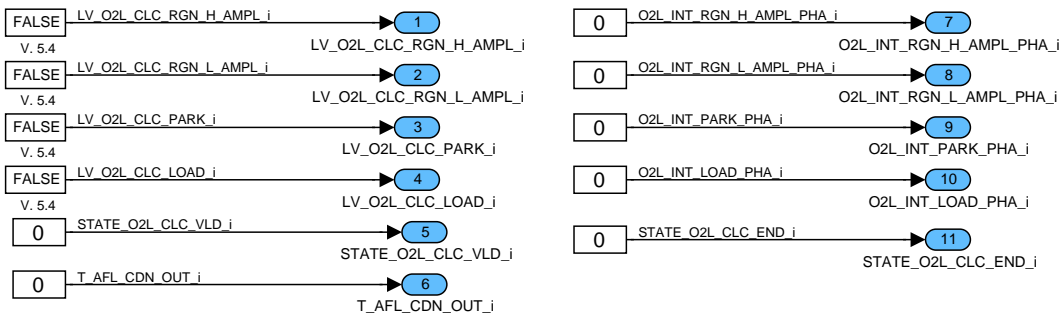


Figure B.54.34: :

### B.54.2.3 Activation condition not fulfilled

O2L\_INT\_THD\_TMP\_DIAG\_AFL=C\_O2L\_INT\_THD\_TMP\_DIAG\_AFL

All other variables are initialized with "0"

### B.54.3 Detailed description for Action: ACTION\_EGTR\_ClcValidCheck

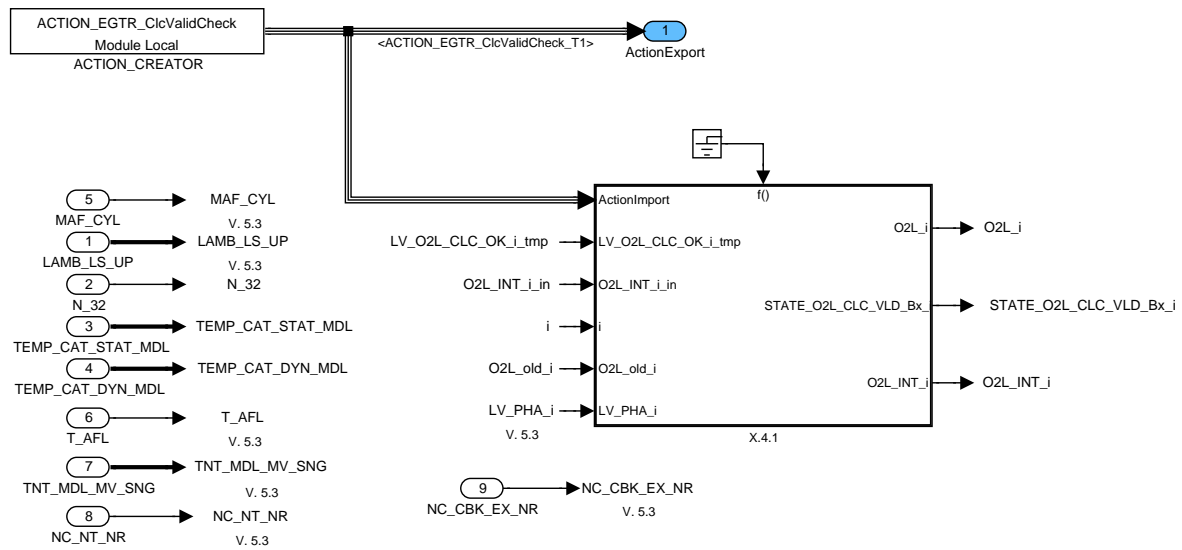


Figure B.54.35: :

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### B.54.3.1 Calculation of the O2L integral finished - check of the up and down lambda signal

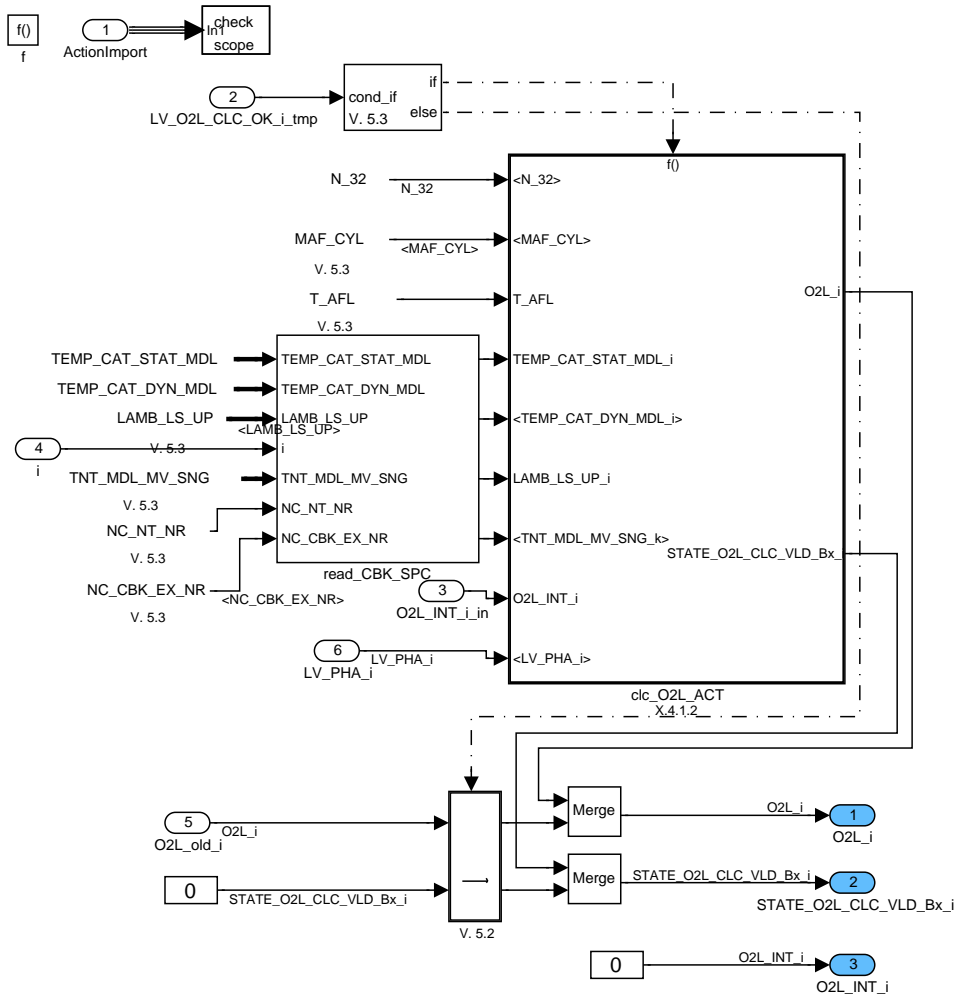


Figure B.54.36: :

#### B.54.3.1.1 Calculation and correction of the O2L value

Depending on the strategy for calculation of the O2L integral (configuration 1 and 2a or 2b), corresponding correction factors are used. For the configuration 2b, temperatures of TWC and NT are taken into account

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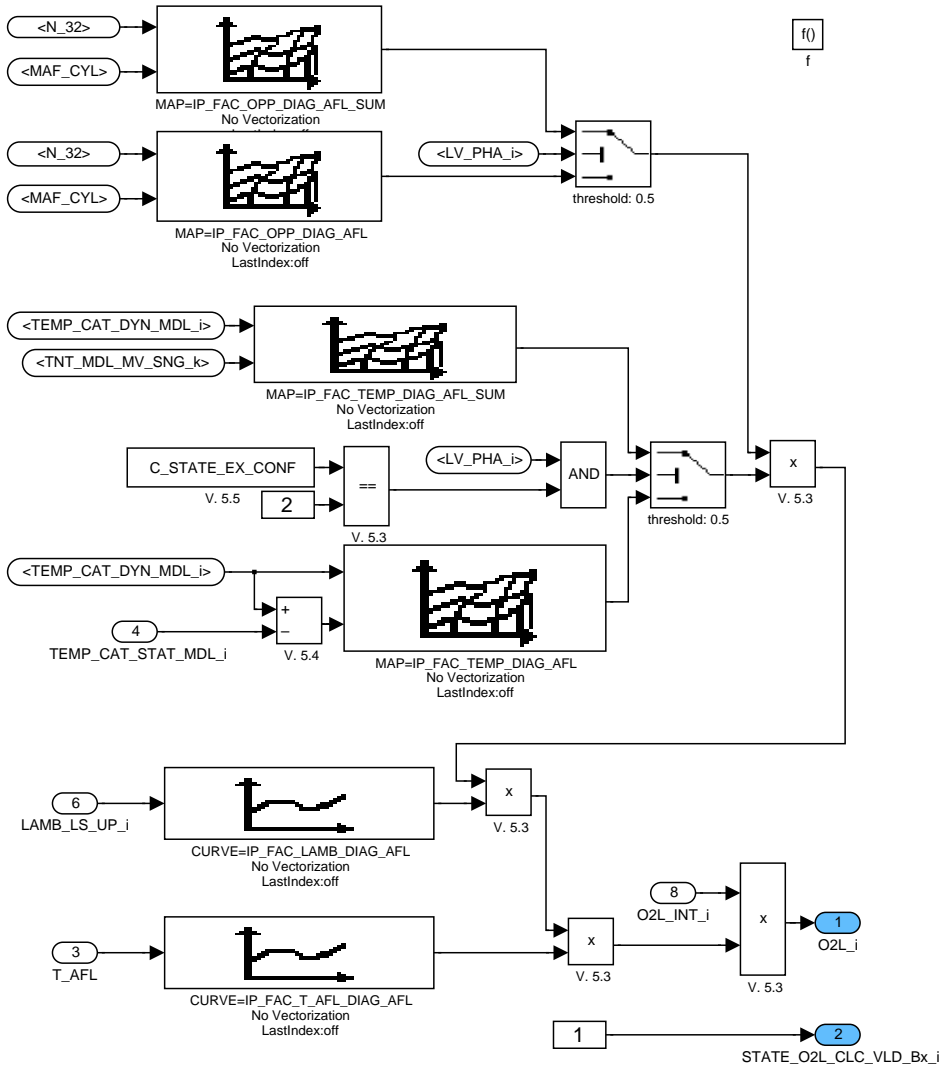


Figure B.54.37: :

### B.54.4 Detailed description for Action: ACTION\_EGTR\_O2LIntegralCalc

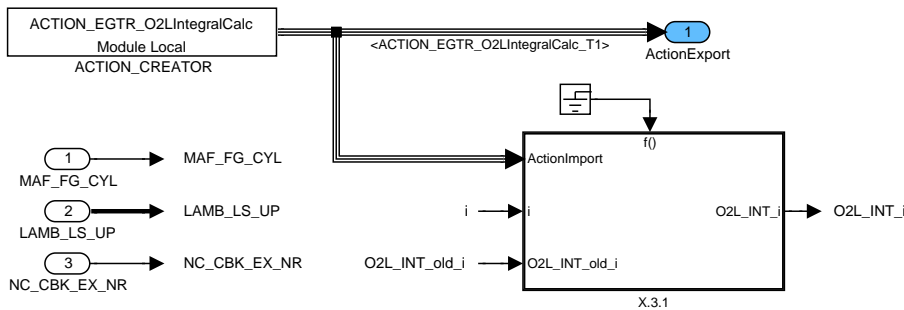


Figure B.54.38: :

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### B.54.4.1 Calculation of the O2L integral

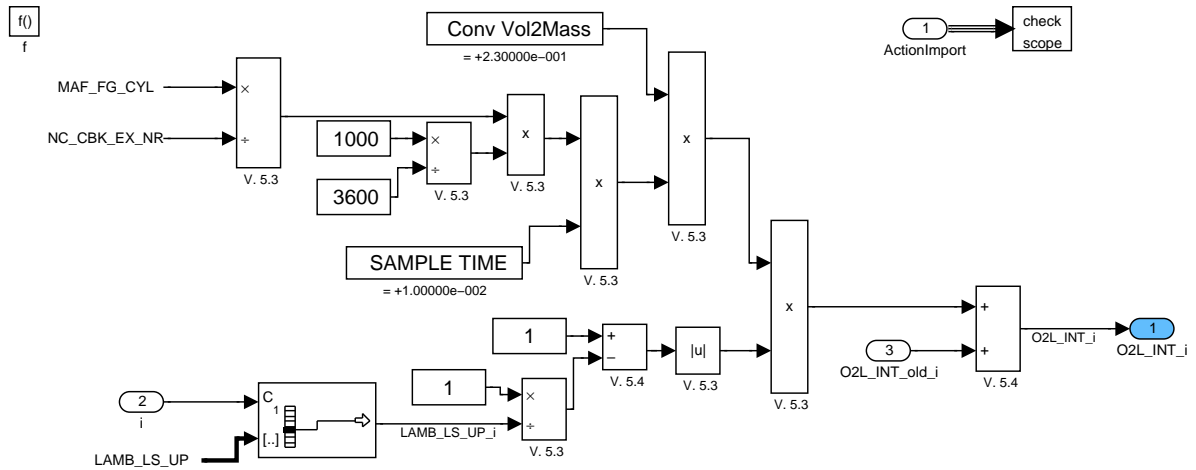


Figure B.54.39: :

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## B.55 TWC diagnosis at lean operation (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_END_SUM_DIAG_AFL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Collected flag that other relevant diagnosis are finished					
LV_DIAG_ERR_SUM_DIAG_AFL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Collected flag or errors of other relevant diagnosis					
LV_INH_DIAG_CAT_DIAG_AFL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the TWC lean diagnosis					

### Input data:

LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}
LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_ PER {p. 4432}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}
LV_ERR_EL_CPS {p. 4708}	LV_ERR_FL_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}
LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}
LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}	LV_ERR_LS_DOWN [NC_CBK_EX_NR] {p. 5449}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}
LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_MEC_IVVT_EX {p. 1062}	LV_ERR_MEC_IVVT_IN {p. 1062}	LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}
LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}
LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_ERR_REF_CRK_CAM_ EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_ IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}
LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SLV_IVVT_EX {p. 4627}	LV_ERR_SLV_IVVT_IN {p. 4627}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_TCO_EL {p. 4496}	LV_ERR_TCO_GRD {p. 4496}	LV_ERR_TCO_PLAUS {p. 5682}
LV_ERR_TCO_STUCK {p. 5691}	LV_ERR_TCO_STUCK_ RNG {p. 5675}	LV_ERR_TTIP_MES_LSH_ UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VCV {p. 4729}

LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_IGK {p. 906}	LV_LS_DOWN_DIAG_END [NC_CBK_EX_NR] {p. 5449}	LV_LS_UP_DIAG_END [NC_CBK_EX_NR] {p. 5449}
LV_MIS_STATE_A {p. 6238}	LV_MIS_STATE_B {p. 6238}	LV_VLS_NS_VLD [NC_NOX_SENS_CONF] {p. 992}	NC_CBK_EX_NR {p. 1829}
NC_CYL_NR {p. 1526}	NC_NOX_SENS_CONF {p. 643}	NC_NR_CAM_CBK {p. 1507}	NC_NR_CBK_IVVT {p. 604}
STATE_END_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}	STATE_ERR_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_CAT_DIAG_AFL	-	0... FFH	0... 255	1	-
Decrement value for antibounce counter					
C_ABC_INC_CAT_DIAG_AFL	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_CAT_DIAG_AFL	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_STATE_NS_OBD_2_DIAG_AFL	-	0... FFFFH	0... 65535	1	-
Choice of NS single diagnosis for calculation of summary bits					
LC_CAT_DIAG_NS_VLD	-	0... 1H	0 ...1	1	-
Switch to inhibit TWC lean diagnosis based on binary O2 signal					
LC_DIAG_CAT_DIAG_AFL_DEAC [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Deactivation flag for the TWC lean diagnosis					
LC_DIAG_SUM_DIAG_AFL	-	0... 1H	0 ...1	1	-
Manually set of end and error sum flags of other relevant diagnosis to passed					

**General Information**

The flag LV\_INH\_DIAG\_CAT\_DIAG\_AFL permit to deactivate the corresponding diagnosis.

If two separate exhaust bank systems are concerned, then:

i = 1, for cylinder bank 1

i = 2, for cylinder bank 2

Otherwise:

i = 1

**Application Conditions**

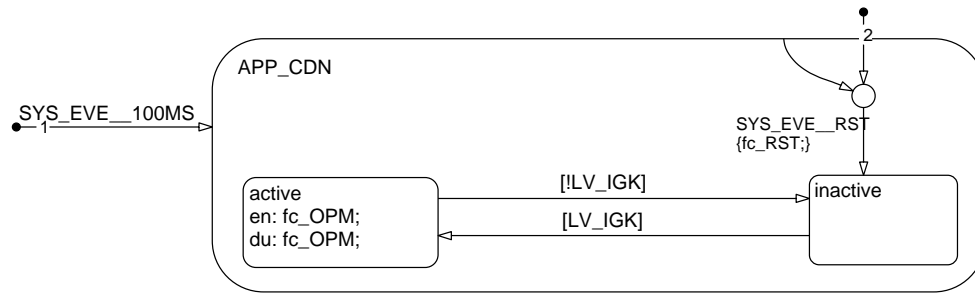



Figure B.55.1: :

**Function description**

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Released by <b>Tettenborn Frank</b>		Date <b>2013-02-13</b>	File <b>43B06G01.00E</b>
	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 5636 of 8404</b>	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

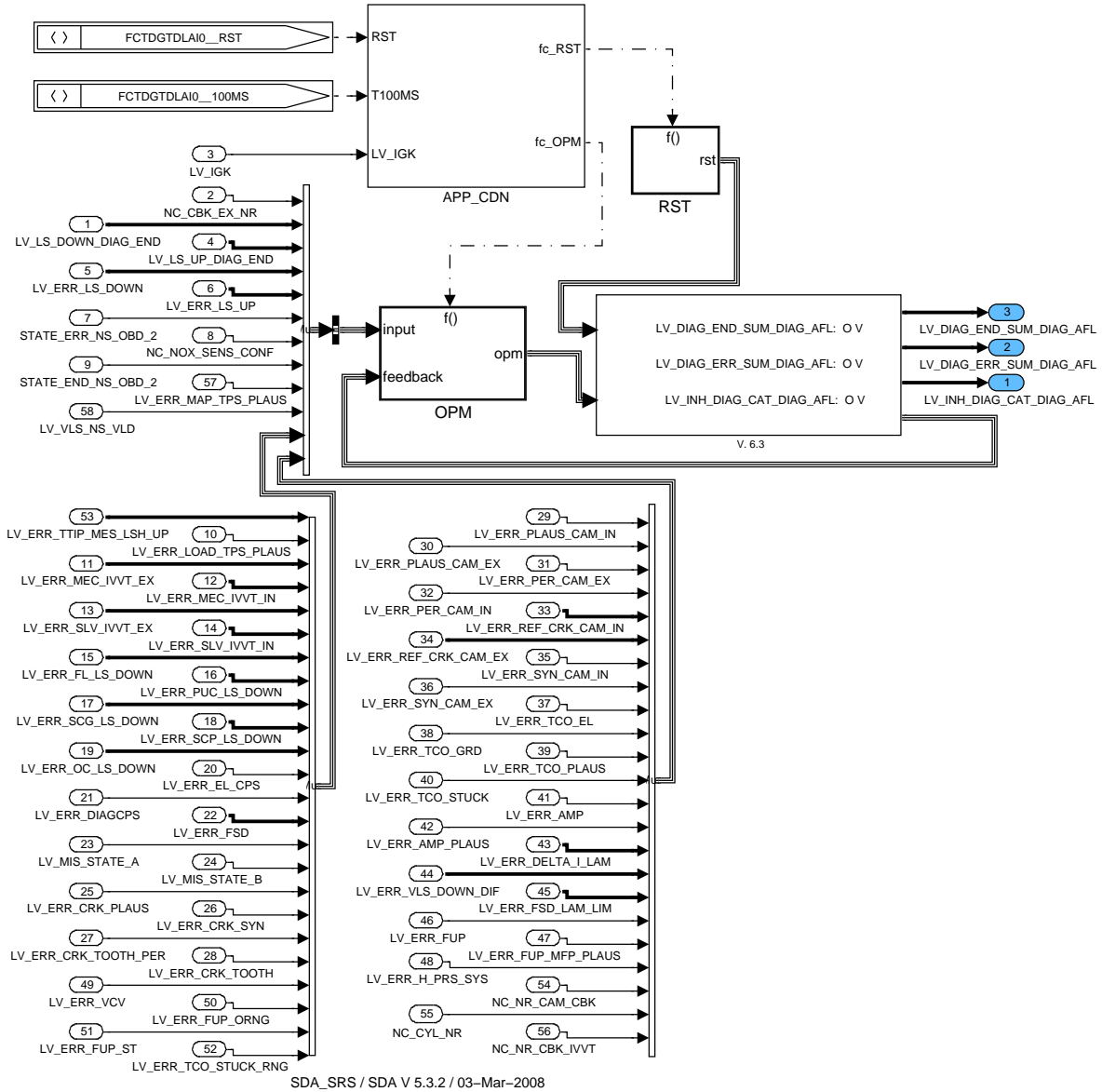


Figure B.55.2: :

### B.55.1 INITIALIZATION AT RESET

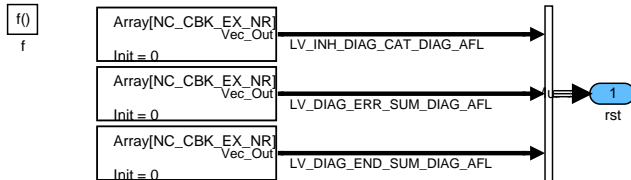


Figure B.55.3: :

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### B.55.2 FORMULA SECTION

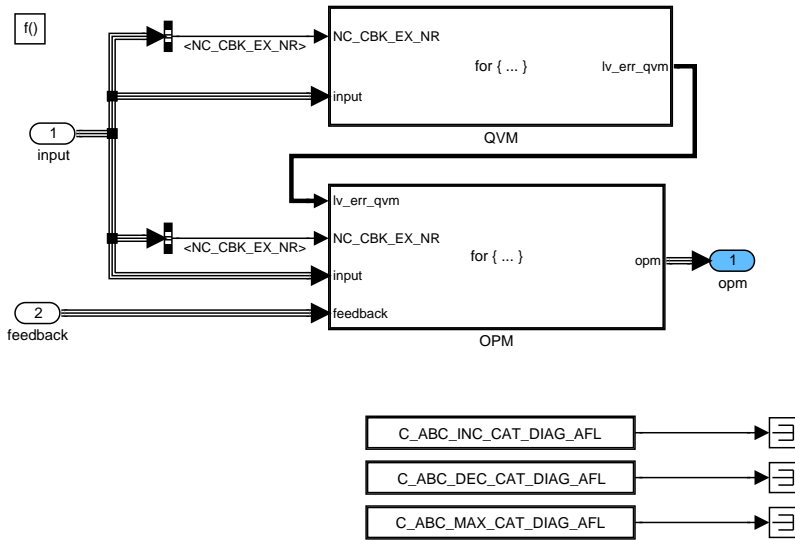


Figure B.55.4: :

#### B.55.2.1 EGTR\_FCTDGTDLAI0/OPM/OPM

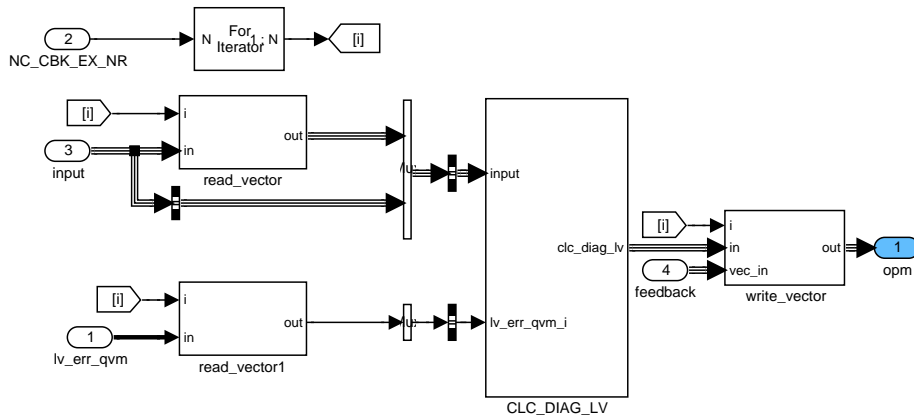


Figure B.55.5: :

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**B.55.2.1.1 No title given**

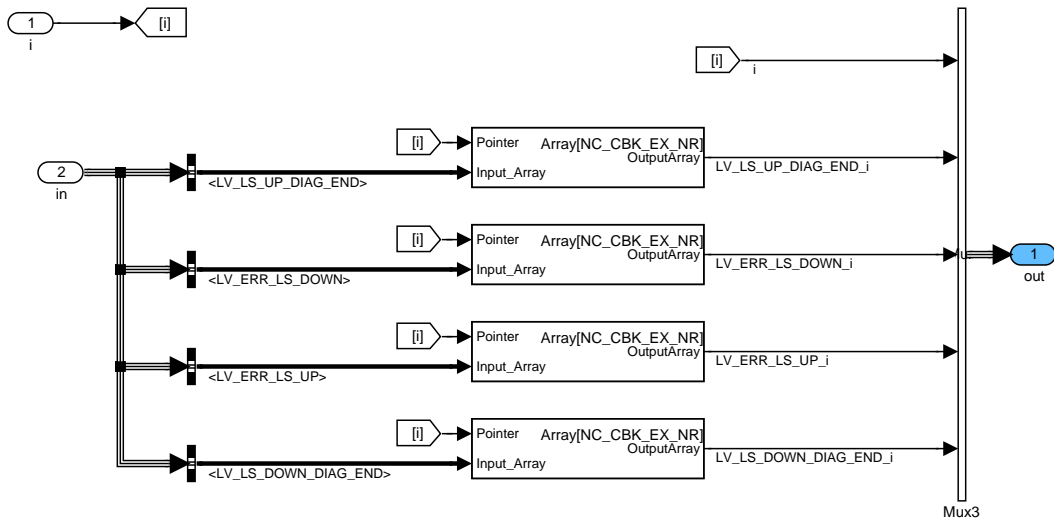


Figure B.55.6: :

**B.55.2.1.2 No title given**

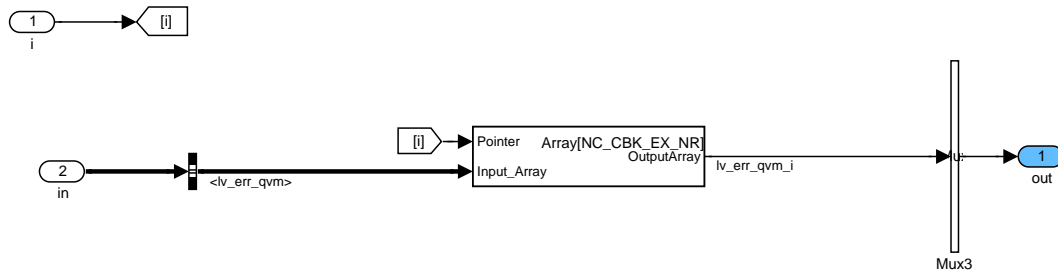


Figure B.55.7: :

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**B.55.2.1.3 EGTR\_FCTDGTDLAI0/OPM/OPM/CLC\_DIAG\_LV**

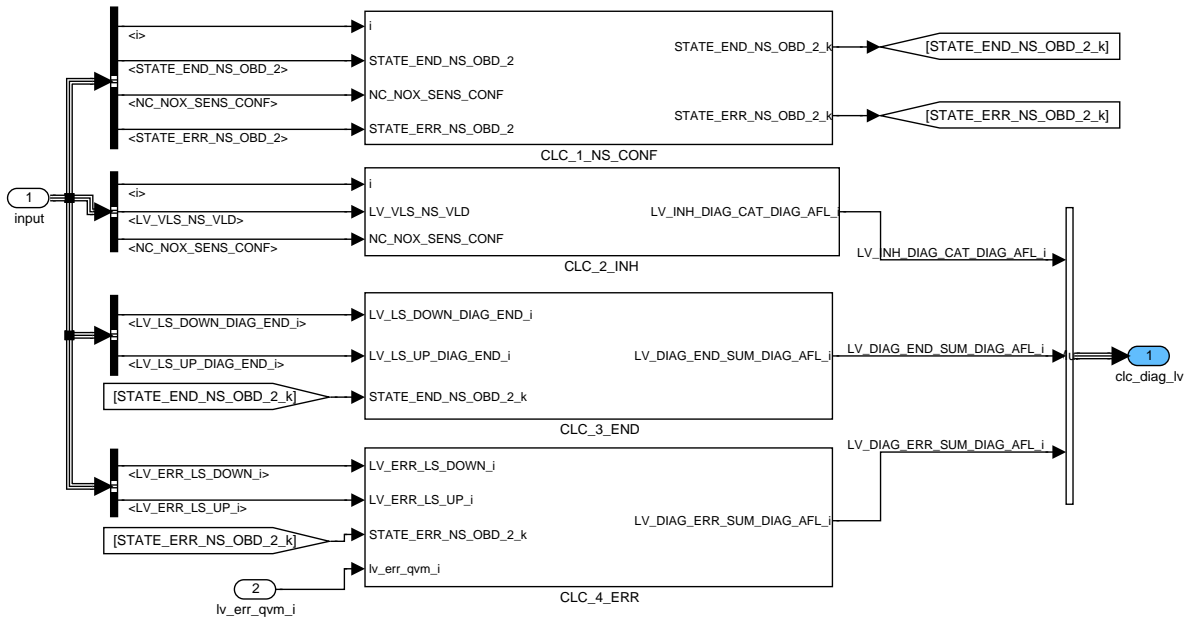


Figure B.55.8: :

**B.55.2.1.3.1 Calculation of the NOx Sensor specific variables**

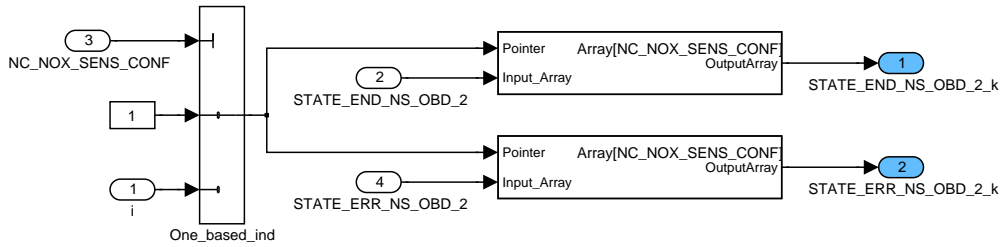


Figure B.55.9: :

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### B.55.2.1.3.2 Calculation of the inhibition flag

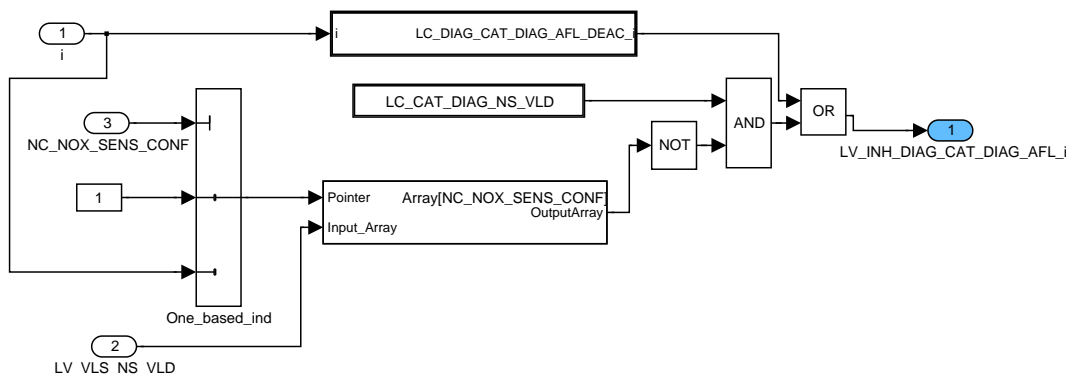


Figure B.55.10: :

### B.55.2.1.3.2.1 No title given

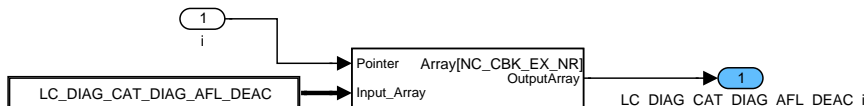


Figure B.55.11: :

### B.55.2.1.3.3 Check of the end bits of other relevant diagnosis

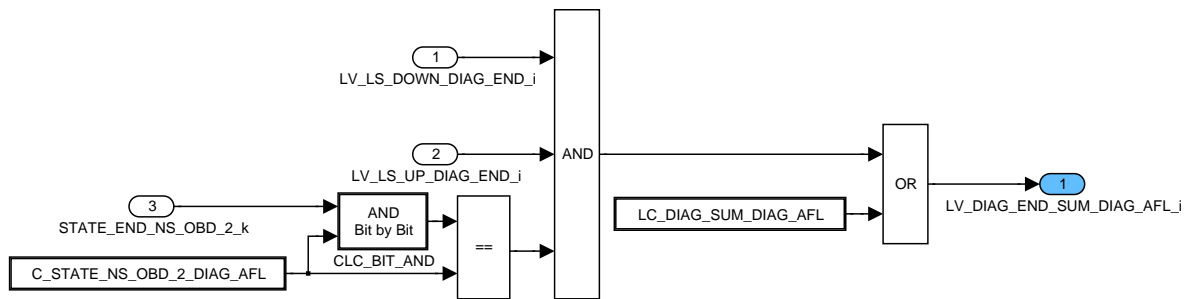


Figure B.55.12: :

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**B.55.2.1.3.3.1 No title given**

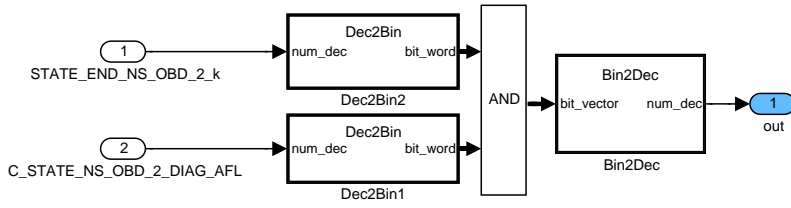


Figure B.55.13: :

**B.55.2.1.3.4 Check of the error bits of other relevant diagnosis**

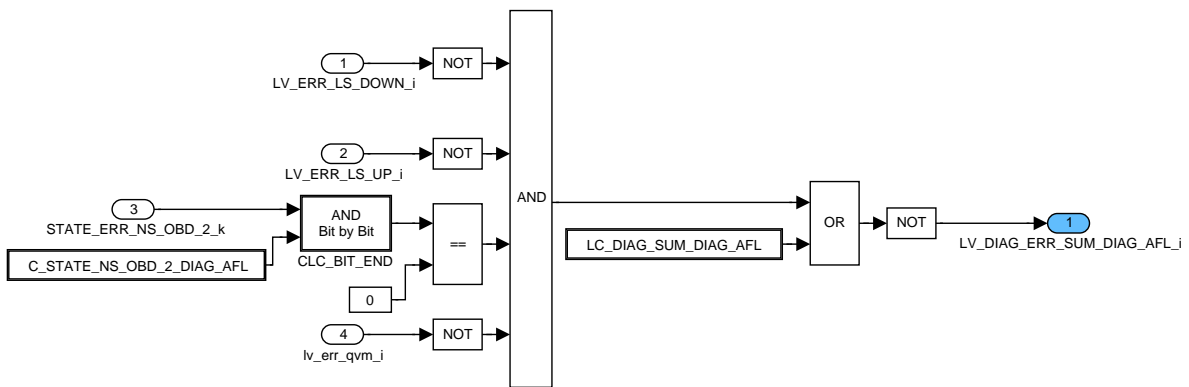


Figure B.55.14: :

**B.55.2.1.3.4.1 No title given**

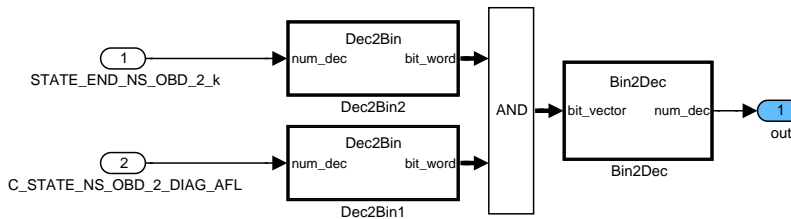


Figure B.55.15: :

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**B.55.2.1.4 No title given**

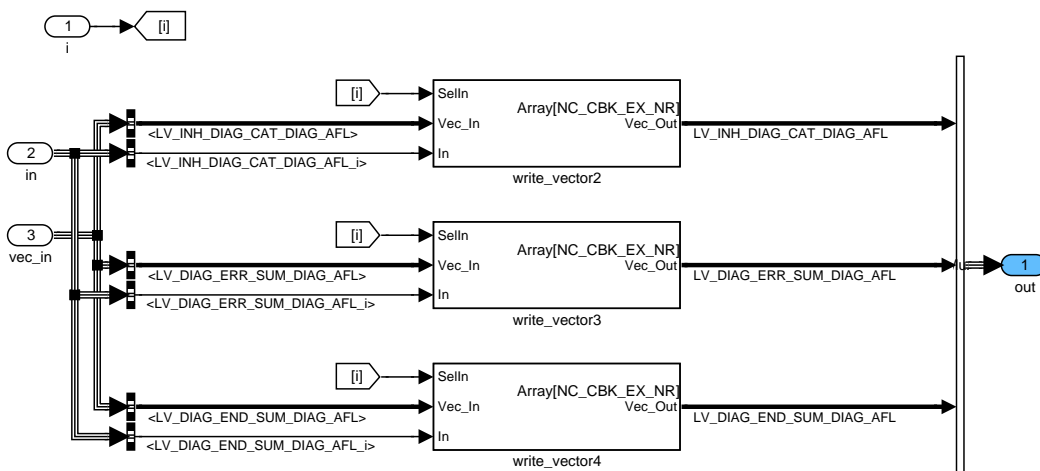


Figure B.55.16: :

**B.55.2.2 EGTR\_FCTDGTDLAI0/OPM/QVM**

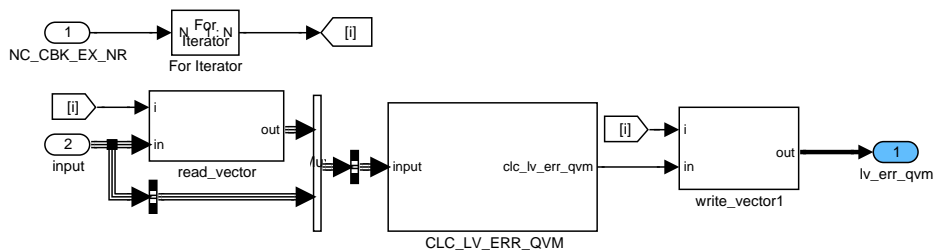


Figure B.55.17: :

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**B.55.2.2.1 No title given**

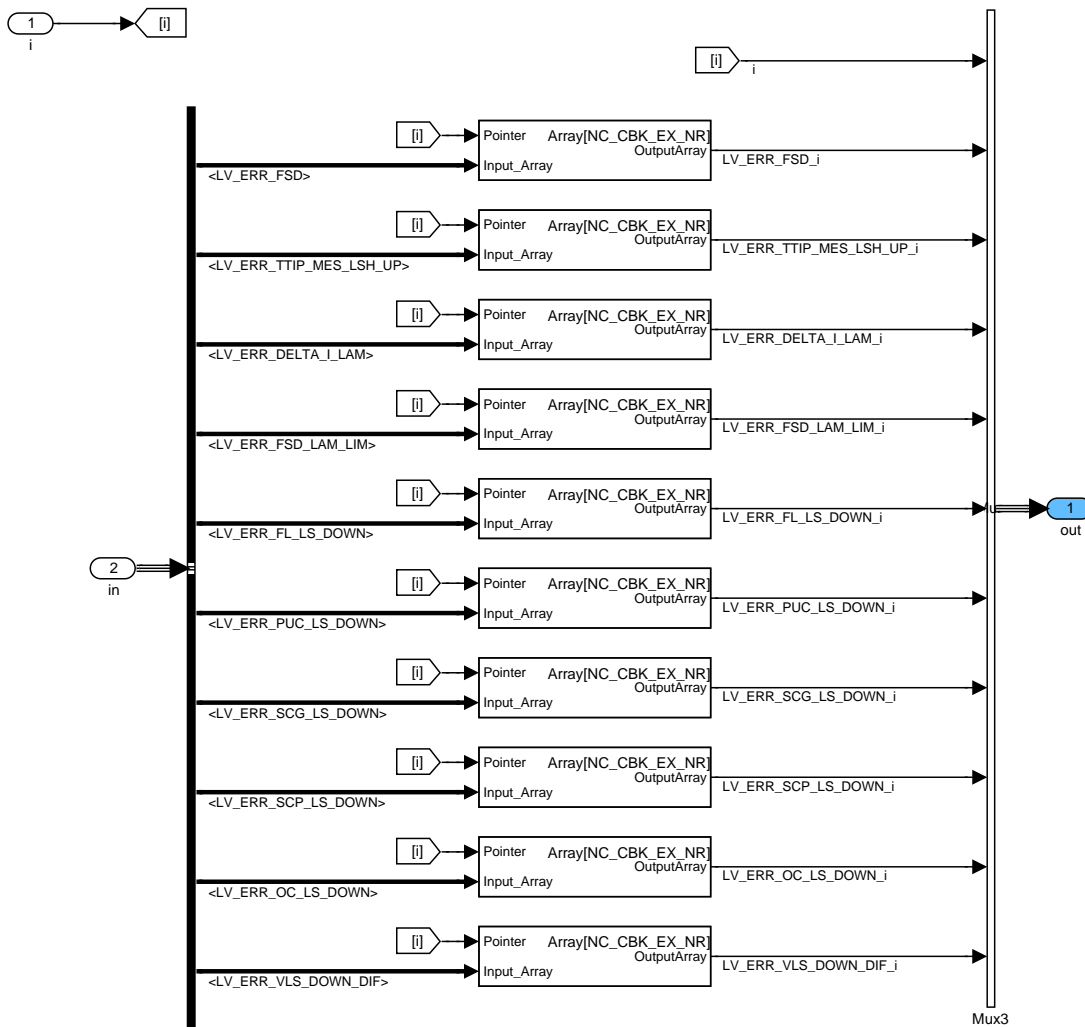


Figure B.55.18: :

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**B.55.2.2.2 EGTR\_FCTDGTDLAI0/OPM/QVM/CLC\_LV\_ERR\_QVM**

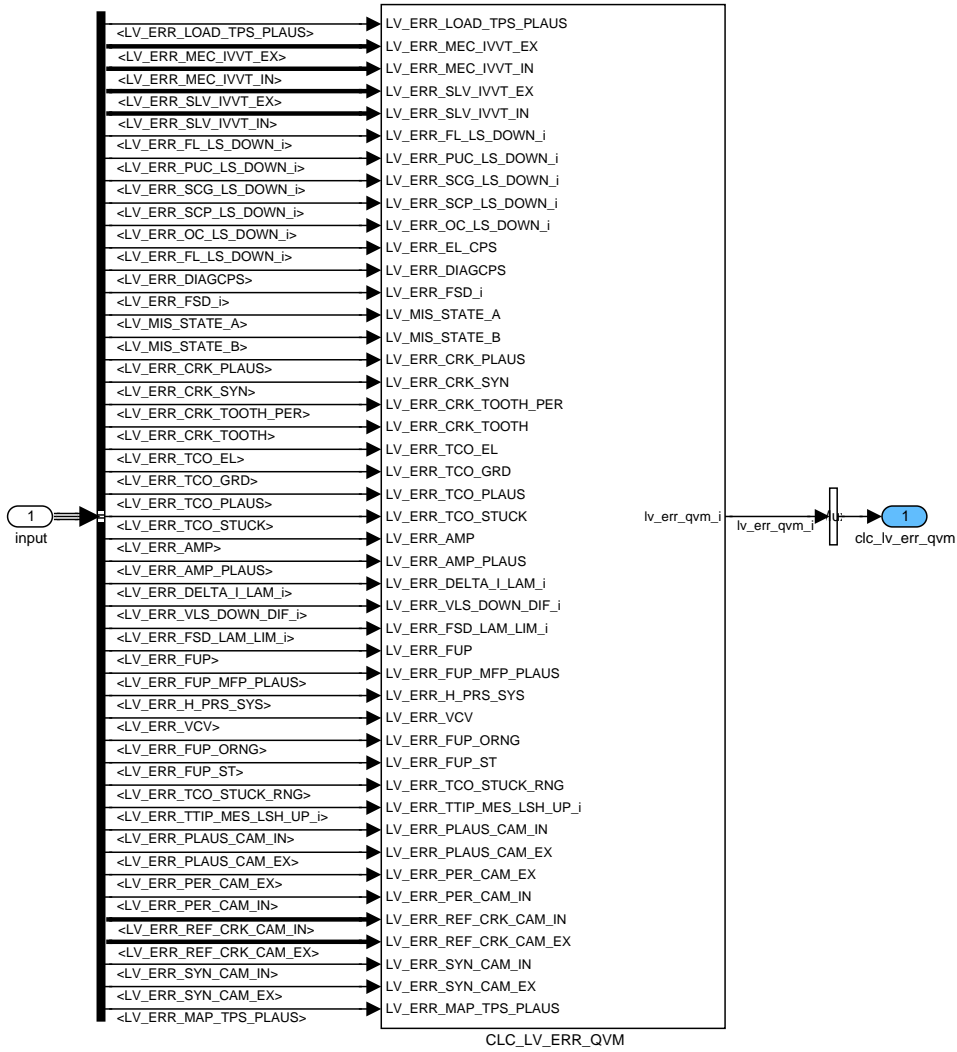


Figure B.55.19: :

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**B.55.2.2.1 Cross Interferences Matrix**

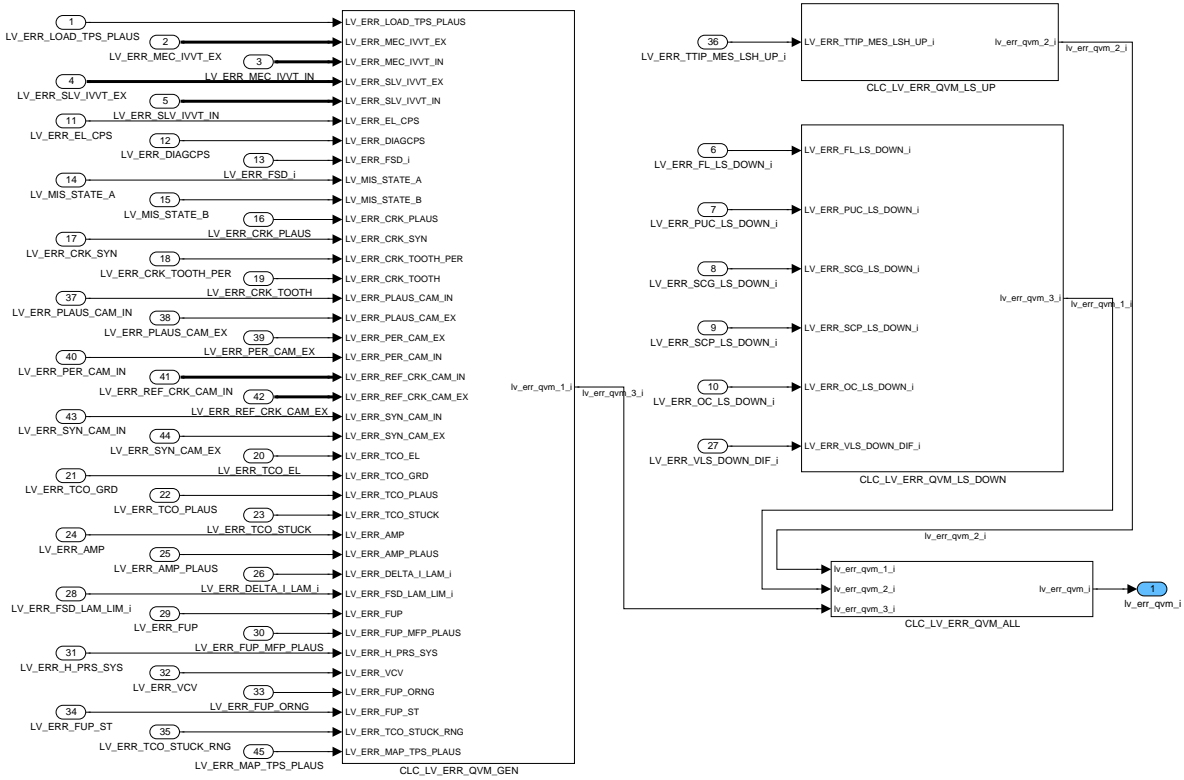


Figure B.55.20: :

**B.55.2.2.2.1.1 Summary flag of Cross Interferences Matrix**

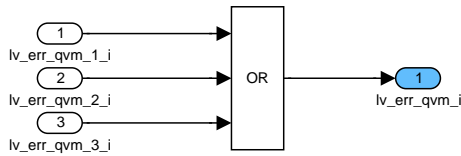


Figure B.55.21: :

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**B.55.2.2.1.2 Cross Interferences Matrix - General Flags**

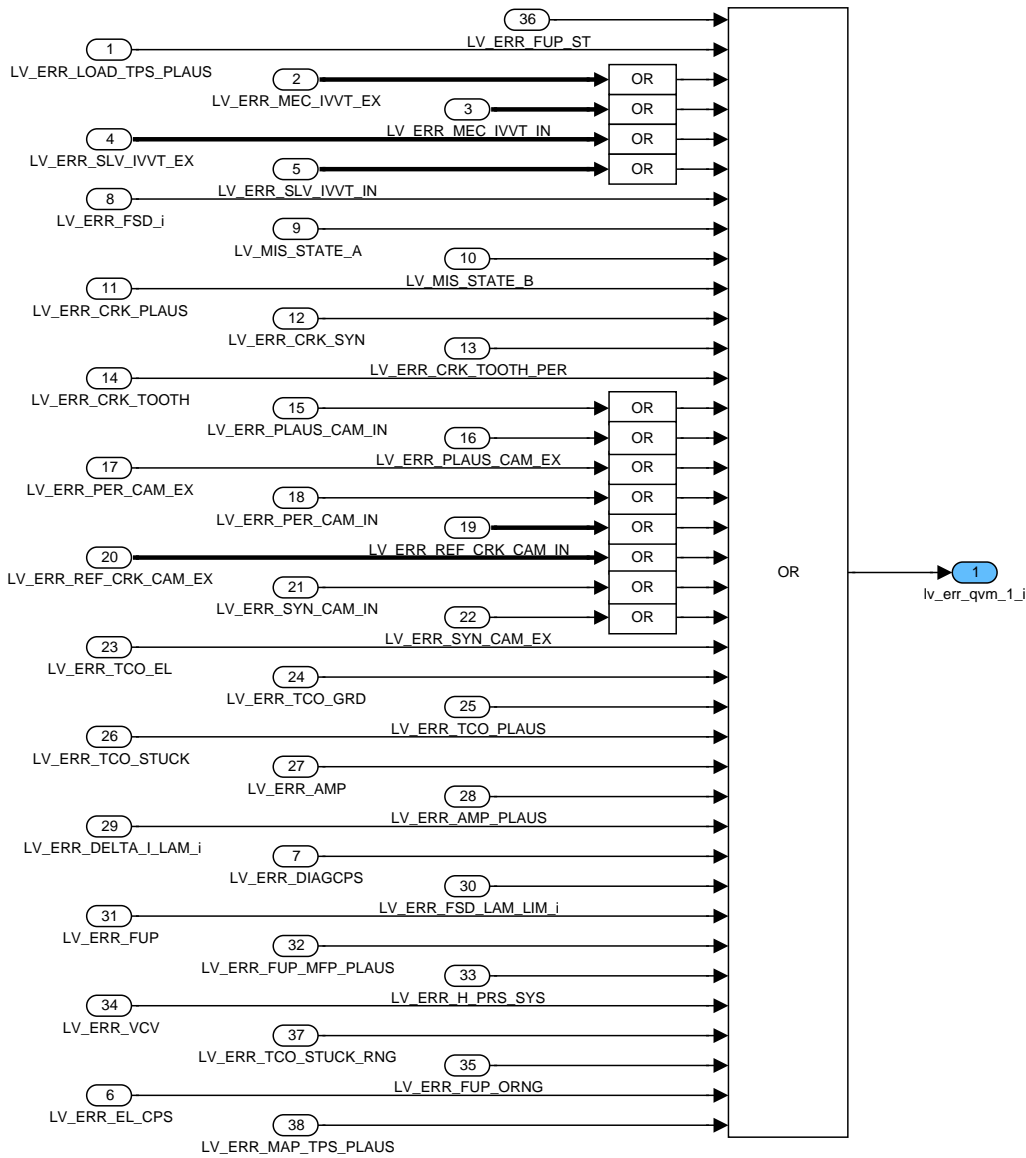


Figure B.55.22: :

**B.55.2.2.2.1.2.1 No title given**

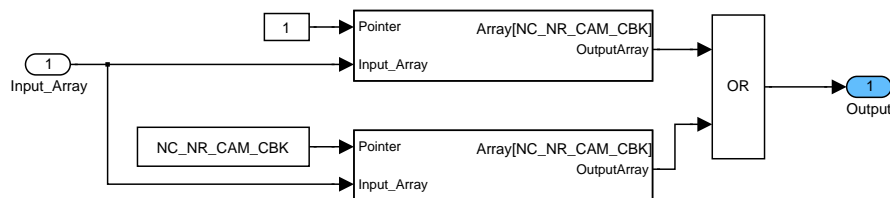


Figure B.55.23: :

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**B.55.2.2.2.1.2.2 No title given**

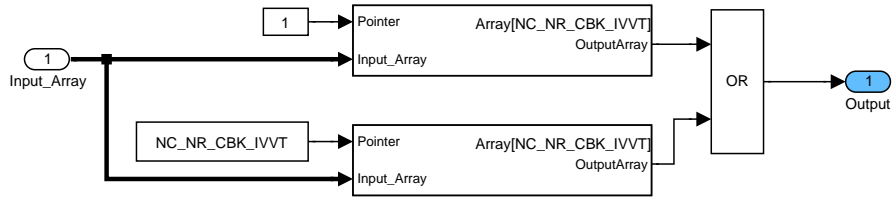


Figure B.55.24: :

**B.55.2.2.2.1.2.3 No title given**

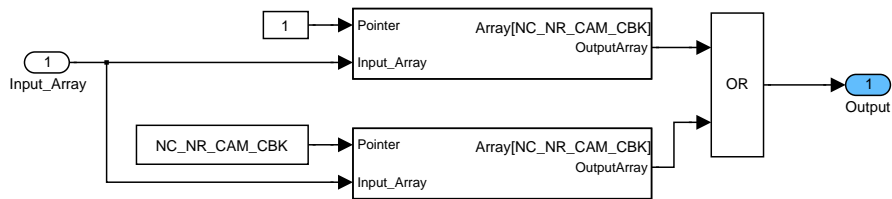


Figure B.55.25: :

**B.55.2.2.2.1.2.4 No title given**

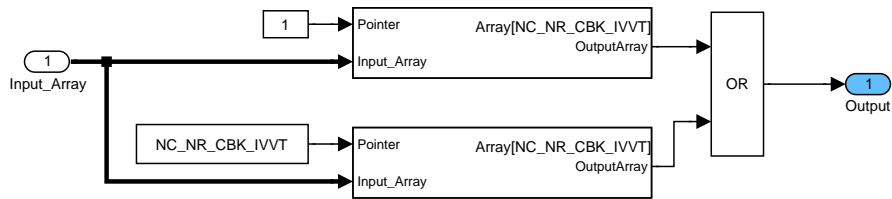


Figure B.55.26: :

**B.55.2.2.2.1.2.5 No title given**

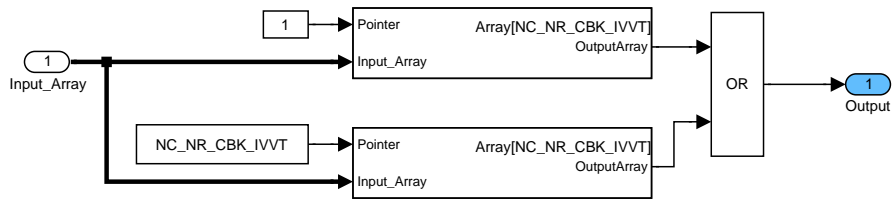


Figure B.55.27: :

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**B.55.2.2.2.1.2.6 No title given**

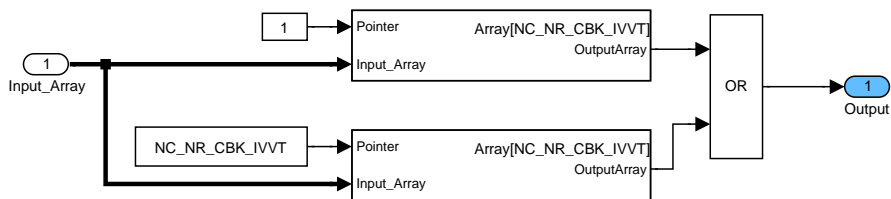


Figure B.55.28: :

**B.55.2.2.2.1.2.7 No title given**

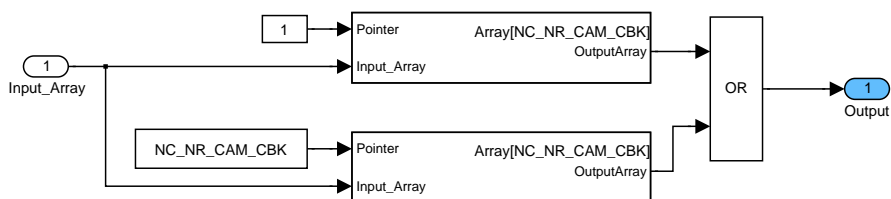


Figure B.55.29: :

**B.55.2.2.2.1.2.8 No title given**

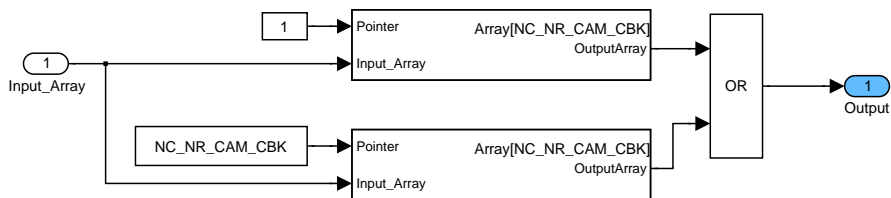


Figure B.55.30: :

**B.55.2.2.2.1.2.9 No title given**

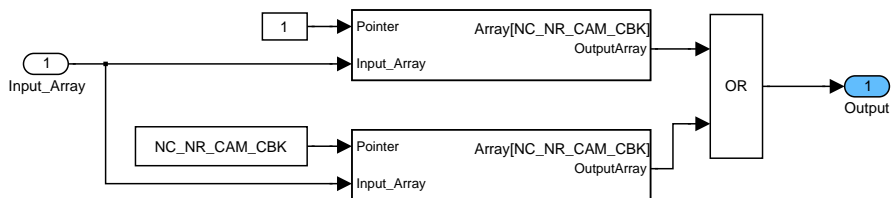


Figure B.55.31: :

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B.55.2.2.2.1.2.10 No title given

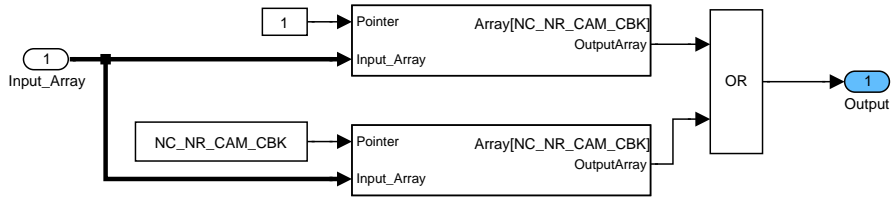


Figure B.55.32: :

B.55.2.2.2.1.2.11 No title given

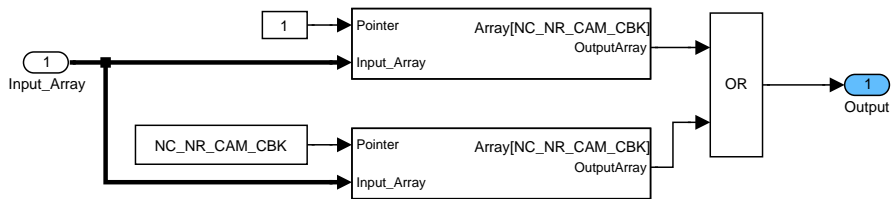


Figure B.55.33: :

B.55.2.2.2.1.2.12 No title given

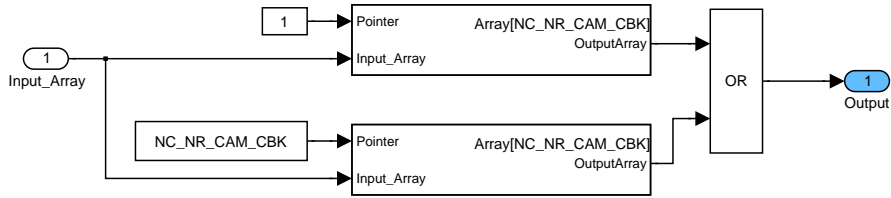


Figure B.55.34: :

B.55.2.2.2.1.3 Cross Interferences Matrix - Flags concerning downstream linear Sensor, not included in LV\_ERR\_LS\_DOWN

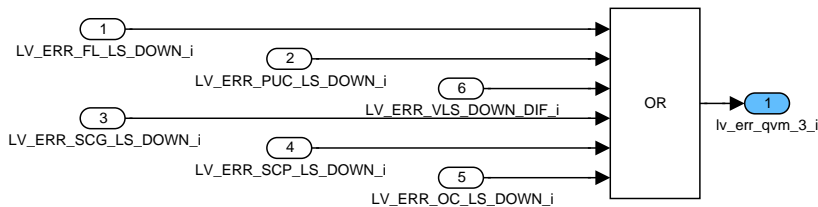


Figure B.55.35: :

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**B.55.2.2.2.1.4 Cross Interferences Matrix - Flags concerning upstream linear Sensor, not included in LV\_ERR\_LS\_UP**

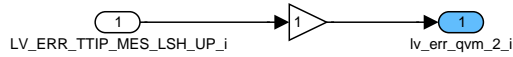


Figure B.55.36: :

**B.55.2.2.3 No title given**

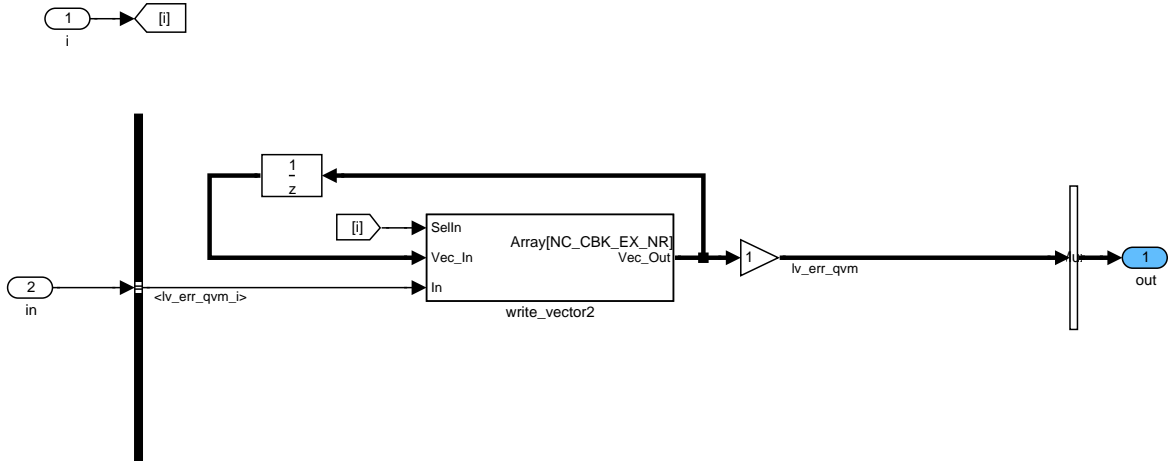


Figure B.55.37: :

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## B.56 Coolant thermostat monitoring

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TH	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptom for coolant thermostat error					
LV_ACT_DIAG_RBM_TH	O/V	0... 1H	0 ...1	1	-
Boolean for coolant thermostat diagnosis activated for RBM					
LV_ACT_DIAG_TH	O/V	0... 1H	0 ...1	1	-
Boolean for coolant thermostat diagnosis activated					
LV_CDN_DIAG_TH	O/V	0... 1H	0 ...1	1	-
Boolean for coolant thermostat diagnosis conditions					
LV_CNL_DIAG_TH	O/V	0... 1H	0 ...1	1	-
Boolean for coolant thermostat diagnosis cancelled					
LV_END_DIAG_RBM_TH	O/V	0... 1H	0 ...1	1	-
Boolean for end of coolant thermostat diagnosis for RBM					
LV_END_DIAG_RBM_TH_TMP	O/V	0... 1H	0 ...1	1	-
Temporary bit for end of coolant thermostat diagnosis for RBM					
LV_END_DIAG_TH	O/V	0... 1H	0 ...1	1	-
Boolean for end of coolant thermostat diagnosis					
LV_ERR_TH	O/V	0... 1H	0 ...1	1	-
Boolean for coolant thermostat error					
LV_TCO_DE_MAX_DIAG_TH	O/V	0... 1H	0 ...1	1	-
Boolean for high coolant temperature deviation for coolant thermostat diagnosis					
T_TCO_DE_DIAG_TH	O/V	0... FFFFH	0... 65535	1	s
Timer for coolant temperature deviation for coolant thermostat diagnosis					
TCO_DE_DIAG_TH	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature deviation value for coolant thermostat diagnosis					
TCO_DE_INI_DIAG_TH	O/V	0... FEH	-48... 142.5	0.75	°C
Initialization value for coolant temperature deviation for coolant thermostat diagnosis					
TCO_DIAG_TH	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature of the performed coolant thermostat diagnosis					
TIA_DE_DIAG_TH	O/V	0... FEH	-48... 142.5	0.75	°C
Intake air temperature deviation value for coolant thermostat diagnosis					
TIA_MIN_DIAG_TH	O/V	0... FEH	-48... 142.5	0.75	°C
Minimum intake air temperature value during coolant thermostat diagnosis					

### Input data:

LV_CDN_VB_OBD2 {p. 1185}	LV_INH_DIAG_TH {p. 5660}	LV_ST_END {p. 1720}	N {p. 1525}
N_REL_CWP {p. 4095}	RATIO_T_LOAD_MIN_AST {p. 4493}	RATIO_T_PUC_AST {p. 4493}	RATIO_T_VS_MAX_AST {p. 4493}
RATIO_T_VS_MIN_AST {p. 4493}	TAM {p. 1579}	TCO_MES {p. 1100}	TCO_ST {p. 1100}


TCO_SUB {p. 1105}	TIA_THR {p. 984}	TIA_THR_ST {p. 984}	
-------------------	------------------	---------------------	--

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_MAX_DIAG_TH	-	0... 1FE0H	0... 8160	1	rpm
Maximum engine speed for high coolant temperature deviation detection for coolant thermostat diagnosis					
C_N_REL_CWP_MAX_DIAG_TH	-	0... FFH	0... 255	1	-
Maximum cooling water pump speed for coolant thermostat diagnosis					
C_RATIO_T_VS_MAX_THD_DIAG_TH	-	0... FFH	0... 99.60937	0.390625	%
"Vehicle speed maximum" ratio threshold in per cent for coolant thermostat diagnosis					
C_T_TCO_DE_DIAG_TH	-	0... FFFFH	0... 65535	1	s
Time for high coolant temperature deviation detection for coolant thermostat diagnosis					
C_TCO_DE_MAX_DIAG_TH	-	0... FEH	-48... 142.5	0.75	°C
Maximum coolant temperature deviation for coolant thermostat diagnosis					
C_TCO_ST_MAX_DIAG_TH	-	0... FEH	-48... 142.5	0.75	°C
Maximum coolant temperature at start for coolant thermostat diagnosis					
C_TCO_ST_MIN_DIAG_TH	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature at start for coolant thermostat diagnosis					
C_TCO_WUP_MIN_DIAG_TH	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant warm up temperature for coolant thermostat diagnosis					
C_TIA_DE_MAX_DIAG_TH	-	0... FEH	-48... 142.5	0.75	°C
Maximum intake air temperature deviation for coolant thermostat diagnosis					
C_TIA_ST_MIN_DIAG_TH	-	0... FEH	-48... 142.5	0.75	°C
Minimum intake air temperature at start for coolant thermostat diagnosis					
IP_RATIO_T_LOAD_MIN_THD_DIAG_TH	-	0... FFH	0... 99.60937	0.390625	%
'Engine load minimum' ratio threshold in per cent for coolant thermostat diagnosis					
LDPM_TAM_IP_RATIO_DIAG_TH	4	0... FEH	-48... 142.5	0.75	°C
'Pull fuel cut off' ratio threshold in per cent for coolant thermostat diagnosis					
IP_RATIO_T_PUC_THD_DIAG_TH	-	0... FFH	0... 99.60937	0.390625	%
'Pull fuel cut off' ratio threshold in per cent for coolant thermostat diagnosis					
LDPM_TAM_IP_RATIO_DIAG_TH	4	0... FEH	-48... 142.5	0.75	°C
'Vehicle speed minimum' ratio threshold in per cent for coolant thermostat diagnosis					
IP_RATIO_T_VS_MIN_THD_DIAG_TH	-	0... FFH	0... 99.60937	0.390625	%
'Vehicle speed minimum' ratio threshold in per cent for coolant thermostat diagnosis					
LDPM_TAM_IP_RATIO_DIAG_TH	4	0... FEH	-48... 142.5	0.75	°C
Regulation temperature for coolant thermostat opening					
IP_TCO_TH_OPEN_DIAG_TH	-	0... FEH	-48... 142.5	0.75	°C
Regulation temperature for coolant thermostat opening					
LDPM_TAM_IP_RATIO_DIAG_TH	4	0... FEH	-48... 142.5	0.75	°C
Minimum coolant warm up temperature for coolant thermostat diagnosis					

**FUNCTION DESCRIPTION:****General information:**

Task of the coolant thermostat is to effect a quick engine warm up after start. The thermostat is closed after engine start to limit the cooling-liquid circulation until the thermostat regulating temperature is reached. The thermostat opens at this temperature and the limitation of the cooling-liquid circulation is finished. If an opened stuck thermostat occurs, the cooling-liquid circulation will not be limited after start. That means an increase of the engine warm up time and can cause emission increase as well.

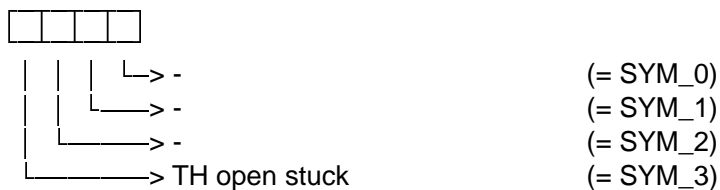
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To take this behaviour into consideration, an opened stuck thermostat must be detected if either other diagnosis functions are inhibited or the coolant temperature does not reach its operating temperature within 20°F. The conditions for inhibiting the diagnosis are described in the chapter Application incidences for coolant thermostat monitoring . The coolant temperature model (TCO\_SUB) must simulate the worst engine warm up temperature behaviour for a normal working thermostat (heating on. A/C on. etc.) after start until the thermostat opening temperature is reached.

### Description:

The error detection is done by a comparison between the raw value of the coolant temperature sensor and the value of the coolant temperature substitute model.

Error-symptoms are defined to this diagnosis function as following:



## B.56.1 Activation condition for thermostat monitoring

### FUNCTION DESCRIPTION:

#### General information:

The initialization of the function is performed as soon as EXIT\_ST is detected. In this case it is regardless if the actual thermostat diagnosis status is set to enabled or canceled.

Thermostat diagnosis is performed as soon as all conditions below are fulfilled at the same time. The function is enabled at once if LV\_ST\_END is set to 1 . A minimum and a maximum threshold for the coolant temperature at start are limiting the diagnosis activation range as well as a minimum threshold for the intake air temperature at start.

Thermostat monitoring is finished if either the logical value for thermostat diagnosis finished or the logical value for thermostat diagnosis cancelled equals to 1 . In this case the diagnosis activation bit is set to 0 (LV\_ACT\_DIAG\_TH = 0).


#### Application conditions

**Initialisation at EXIT\_ST:**

```

LV_ERR_TH = 0
LV_CDN_DIAG_TH = 0
LV_END_DIAG_TH = 0
ERR_SYM_TH = NO_SYM
LV_END_DIAG_RBM_TH = 0
LV_END_DIAG_RBM_TH_TMP = 0
LV_ACT_DIAG_RBM_TH = 0
LV_CNL_DIAG_TH = 0
LV_ACT_DIAG_TH = 0
TCO_DIAG_TH = -48°C
LV_TCO_DE_MAX_DIAG_TH = 0
  
```

**Recurrence:** 1000 ms

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**Activation:**  $LV\_ST\_END = 1$

**Deactivation:**  $LV\_ST\_END = 0$

### Formula section:

#### Calculation of the functionality check (RBM) enable condition:

```

if          TCO_ST > C_TCO_ST_MIN_DIAG_TH          and
              TCO_ST < C_TCO_ST_MAX_DIAG_TH          and
              TIA_THR_ST > C_TIA_ST_MIN_DIAG_TH      and
              LV_CDN_VB_OBD2 = 1                    and
              LV_INH_DIAG_TH = 0                    and
              LV_CNL_DIAG_TH = 0
then        LV_ACT_DIAG_RBM_TH = 1
else        LV_ACT_DIAG_RBM_TH = 0
endif

```

#### Calculation of the functionality check enable condition:

```

if          LV_ACT_DIAG_RBM_TH = 1                and
              LV_END_DIAG_TH = 0
then        LV_ACT_DIAG_TH = 1
else        LV_ACT_DIAG_TH = 0
endif

```

#### Calculation of the intake air temperature deviation:

```

if (1)      TCO_SUB <= IP_TCO_TH_OPEN_DIAG_TH    and
              LV_ACT_DIAG_RBM_TH = 1
then (1)
  if (2)      TIA_THR < TIA_MIN_DIAG_TH(n-1)
  then (2)    TIA_MIN_DIAG_TH(n) = TIA_THR
  else (2)    TIA_MIN_DIAG_TH(n) = TIA_MIN_DIAG_TH(n-1)
  endif (2)
else (1)    TIA_DE_DIAG_TH = TIA_MIN_DIAG_TH - TIA_THR_ST
endif (1)

```

#### Calculation of the coolant temperature deviation during high engine speed:

```

if (1)      TCO_SUB <= IP_TCO_TH_OPEN_DIAG_TH    and
              LV_ACT_DIAG_RBM_TH = 1
then (1)
  if (2)      N >= C_N_MAX_DIAG_TH
               OR N_REL_CWP > C_N_REL_CWP_MAX_DIAG_TH
  then (2)    (Trigger the coolant temperature deviation calculation)

```

### 1st. step: "Initialization" : No re-triggering until timer ends

```

TCO_DE_INI_DIAG_TH = TCO_MES
TCO_DE_DIAG_TH = TCO_MES - TCO_DE_INI_DIAG_TH
T_TCO_DE_DIAG_TH = C_T_TCO_DE_DIAG_TH
Timer T_TCO_DE_DIAG_TH starts

```

### 2nd. step: "Check for coolant temperature deviations"

TCO\_DE\_DIAG\_TH = TCO\_MES - TCO\_DE\_INI\_DIAG\_TH

```

if      (3)      TCO_DE_DIAG_TH < C_TCO_DE_MAX_DIAG_TH
then (3)      LV_TCO_DE_MAX_DIAG_TH = 1
                endif (3)
            endif (2)
endif (1)

```

#### Calculation of the diagnosis result:

```

if (1)      LV_ACT_DIAG_TH = 1
then (1)      // Coolant thermostat functionality check enabled
                // Calculation of chapter 1.2
endif (1)

```

#### Calculation of the diagnosis condition:

```

if (1)      LV_END_DIAG_TH = 1                or
                LV_INH_DIAG_TH = 1            or
                LV_CNL_DIAG_TH = 1
then (1)      LV_CDN_DIAG_TH = 0
                if(2)      TransitionLV_END_DIAG_TH = 0 to LV_END_DIAG_TH = 1
                then(2)      TCO_DIAG_TH = TCO_MES
                endif (2)
endif (1)


```

#### Calculation of end of diagnosis for RBM:

```

if (1)      LV_ACT_DIAG_RBM_TH = 1                and
                TCO_SUB > IP_TCO_TH_OPEN_DIAG_TH    and
                LV_END_DIAG_RBM_TH_TMP = 0          and
                LV_CNL_DIAG_TH = 0
then (1)      LV_END_DIAG_RBM_TH_TMP = 1
                if (2)      TCO_MES >= IP_TCO_WUP_MIN_DIAG_TH
                then (2)
                    if (3a)      RATIO_T_VS_MIN_AST <=
                                    IP_RATIO_T_VS_MIN_THD_DIAG_TH    and
                                    RATIO_T_LOAD_MIN_AST <=
                                    IP_RATIO_T_LOAD_MIN_THD_DIAG_TH
                    then (3a)      LV_END_DIAG_RBM_TH = 1
                    endif (3a)
                else (2)
                    if (3b)      RATIO_T_PUC_AST <=
                                    IP_RATIO_T_PUC_THD_DIAG_TH        and
                                    RATIO_T_LOAD_MIN_AST <=
                                    IP_RATIO_T_LOAD_MIN_THD_DIAG_TH    and
                                    RATIO_T_VS_MAX_AST <=
                                    C_RATIO_T_VS_MAX_THD_DIAG_TH        and
                                    TIA_DE_DIAG_TH >= C_TIA_DE_MAX_DIAG_TH and
                                    LV_TCO_DE_MAX_DIAG_TH = 0
                    then (3b)      LV_END_DIAG_RBM_TH = 1
                    endif (3b)
                endif (2)
endif (1)

```

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## B.56.2 Coolant thermostat functionality check

### FUNCTION DESCRIPTION:

#### General information:

Task of the functionality check is to detect a stuck open thermostat. Correct functionality is not guaranteed if the coolant temperature does not reach a specified warmed up temperature.

The thermostat functionality check is enabled as long as the boolean for coolant thermostat diagnosis activated is set to "1". As soon as EXIT\_ST is detected, all timers and initialization values are set to neutral values.

#### Application conditions


**Initialisation at EXIT\_ST:**

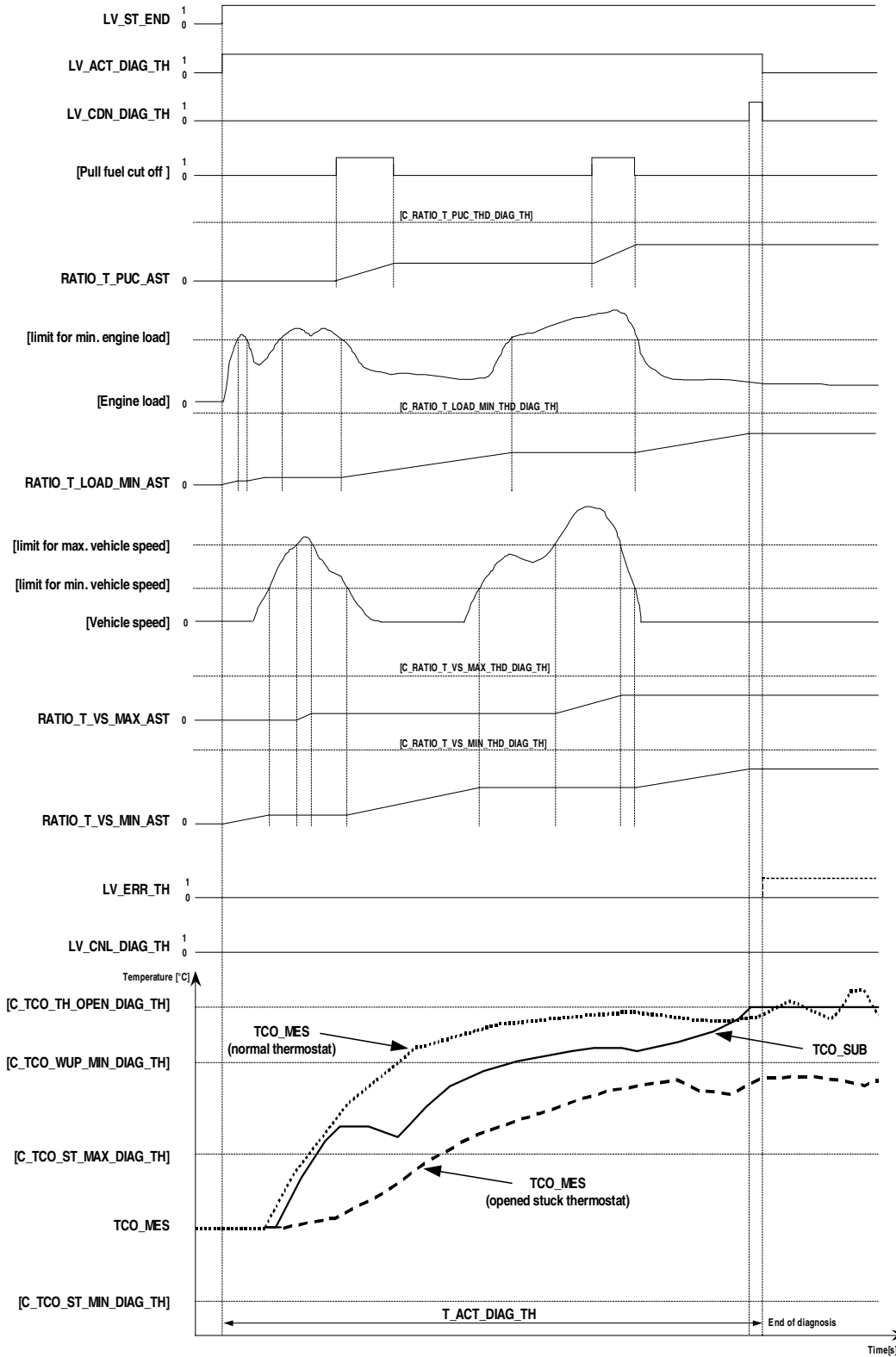
```
TIA_DE_DIAG_TH = 0°C
T_TCO_DE_DIAG_TH = 0s
TCO_DE_INI_DIAG_TH = 0°C
TCO_DE_DIAG_TH = 0°C
TIA_MIN_DIAG_TH = TIA_THR_ST
```

**Recurrence:** 1000 ms

**Activation:** LV\_ACT\_DIAG\_TH = 1  
(Coolant thermostat functionality check enabled)

**Deactivation:** LV\_ACT\_DIAG\_TH = 0  
(Coolant thermostat functionality check disabled)

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**Signal flow diagram:**

**Formula section:**

**Calculation of the diagnosis result:**

If (1)  $TCO\_MES > C\_TCO\_WUP\_MIN\_DIAG\_TH$

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```

then (1)
  if (2)
    RATIO_T_VS_MIN_AST > IP_RATIO_T_VS_MIN_THD_DIAG_TH
    or
    RATIO_T_LOAD_MIN_AST > IP_RATIO_T_LOAD_MIN_THD_DIAG_TH
  then (2)
    LV_CDN_DIAG_TH = 0
    LV_CNL_DIAG_TH = 1
  else (2)
    LV_CDN_DIAG_TH = 1
    ERR_SYM_TH = NO_SYM
    LV_CNL_DIAG_TH = 0
    LV_END_DIAG_TH = 1 (calculated in ABC)
  endif (2)
else (1)
  if (2)
    TCO_SUB > IP_TCO_TH_OPEN_DIAG_TH
  then (2)
    if (3)
      TCO_MES >= IP_TCO_WUP_MIN_DIAG_TH
    then (3)
      if
        RATIO_T_VS_MIN_AST > IP_RATIO_T_VS_MIN_THD_DIAG_TH
      or
        RATIO_T_LOAD_MIN_AST > IP_RATIO_T_LOAD_MIN_THD_DIAG_TH
      then
        LV_CDN_DIAG_TH = 0
        LV_CNL_DIAG_TH = 1
      else
        LV_CDN_DIAG_TH = 1
        ERR_SYM_TH = NO_SYM
        LV_END_DIAG_TH = 1 (calculated in ABC)
        LV_CNL_DIAG_TH = 0
      endif
    else (3) (In case of "TCO_MES less than IP_TCO_WUP_MIN_DIAG_TH")
      if
        ( RATIO_T_PUC_AST > IP_RATIO_T_PUC_THD_DIAG_TH
        or
        RATIO_T_LOAD_MIN_AST > IP_RATIO_T_LOAD_MIN_THD_DIAG_TH
        or
        RATIO_T_VS_MAX_AST > C_RATIO_T_VS_MAX_THD_DIAG_TH
        or
        TIA_DE_DIAG_TH < C_TIA_DE_MAX_DIAG_TH
        or
        LV_TCO_DE_MAX_DIAG_TH = 1 )
      then
        LV_CDN_DIAG_TH = 0
        LV_CNL_DIAG_TH = 1
      else
        LV_CDN_DIAG_TH = 1
        ERR_SYM_TH = SYM_3
        LV_ERR_TH = 1 (after debounce)
        LV_END_DIAG_TH = 1 (calculated in ABC)
        LV_CNL_DIAG_TH = 0
      endif
    endif (3)
  endif (2)
endif (1)

```

## B.57 Coolant thermostat monitoring ( Appl. Inc.)

### Data definition:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ECFPWM_INH_DIAG_TH	V	0... 1H	0 ...1	1	-
condition for ECFPWM exceeding threshold - for coolant thermostat diagnosis					
LV_ECTPWM_INH_DIAG_TH	V	0... 1H	0 ...1	1	-
Condition for ECTPWM exceeding threshold - for coolant thermostat diagnosis					
LV_INH_DIAG_RBM_TH	V	0... 1H	0 ...1	1	-
Boolean for coolant thermostat diagnosis inhibit due to OBD error					
LV_INH_DIAG_TH	O/V	0... 1H	0 ...1	1	-
Boolean for coolant thermostat diagnosis inhibit					
LV_N_REL_CWP_INH_DIAG_TH	V	0... 1H	0 ...1	1	-
Boolean for coolant thermostat diagnosis inhibit due high cooling water pump speed					
LV_TIA_DE_INH_DIAG_TH	V	0... 1H	0 ...1	1	-
Boolean for coolant thermostat diagnosis inhibit due high intake air temperature deviation					
MASS_VOL_CWP_DIAG_TH	V	0... FFFFH	0... 65535	1	-
Cooling water pump effected coolant mass volume for coolant thermostat diagnosis					
MASS_VOL_CWP_DIAG_TH_TMP	V	0... FFFFH	0... 65535	1	-
Cooling water pump effected coolant mass volumetric-flow for coolant thermostat diagnosis					
STATE_RBM_TH	O/V	0... 7H	0 ...7	1	-
Interface of thermostat monitoring with the RBM statistics, Bit0: cond. for monitoring are met long enough to detect malfunction, Bit1: inhib. of the monitor due to system failures, Bit2: indiv. RBM cond. of the monitor were encount. within this DC					
T_ECFPWM_INH_DIAG_TH	V	0... FFH	0... 255	1	s
Max. time for ECFPWM exceeding threshold - for coolant thermostat diagnosis					
T_ECTPWM_INH_DIAG_TH	V	0... FFH	0... 255	1	s
Max. time for ECTPWM exceeding threshold - for coolant thermostat diagnosis					
T_N_REL_CWP_MAX_DIAG_TH	V	0... FFH	0... 255	1	s
Max. time for CWP speed exceeding threshold before coolant thermostat diagnosis inhibition					
TIA_DE_INH_DIAG_TH	V	0... FEH	-48... 142.5	0.75	°C
Intake air temperature deviation value for coolant thermostat diagnosis inhibition					
TIA_MIN_INH_DIAG_TH	V	0... FEH	-48... 142.5	0.75	°C
Minimum Intake air temperature value during coolant thermostat diagnosis for inhibition					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	ECFPWM [NC_ECF_NR] {p. 3596}	ECTPWM {p. 3858}	LV_DC {p. 5746}
LV_END_DIAG_RBM_TH {p. 5652}	LV_ERR_BN_T_ICL {p. 4870}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_ECT_EL {p. 4530}
LV_ERR_LOAD_TPS_PLAUS {p. 1062}	LV_ERR_MAF {p. 4815}	LV_ERR_TAM {p. 5076}	LV_ERR_TCO {p. 4496}
LV_ERR_TIA {p. 4200}	LV_ERR_VS {p. 5021}	LV_IGK {p. 906}	LV_ST_END {p. 1720}
N_REL_CWP {p. 4095}	TAM {p. 1579}	TCO_SUB {p. 1105}	TIA_THR {p. 984}
TIA_THR_ST {p. 984}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TH	-	0... FFH	0... 255	1	-
Debounce counter increment value for the coolant thermostat diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_TH	-	1... FFH	1... 255	1	-
Debounce counter maximum value for the coolant thermostat diagnosis					
C_ECFPWM_INH_DIAG_TH [NC_ECF_NR]	-	0... FFH	0... 99.60937	0.390625	%
Max. ECFPWM to deactivate coolant thermostat diagnosis					
C_ECTPWM_INH_DIAG_TH	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Max. ECTPWM to deactivate coolant thermostat diagnosis					
C_MASS_VOL_CWP_MAX	-	0... FFFFH	0... 65535	1	-
C_MASS_VOL_CWP_MAX					
C_MASS_VOL_CWP_MIN_DIAG_TH	-	0... FFFFH	0... 65535	1	-
Minimum cooling water pump effected coolant mass volume for coolant thermostat diagnosis					
C_N_REL_CWP_MIN_DIAG_TH	-	0... FFH	0... 255	1	-
Minimum cooling water pump speed for coolant thermostat diagnosis					
C_T_ECFPWM_INH_DIAG_TH	-	0... FFH	0... 255	1	s
Max. time for ECFPWM exceeding threshold - for coolant thermostat diagnosis					
C_T_ECTPWM_INH_DIAG_TH	-	0... FFH	0... 255	1	s
Max. time for ECTPWM exceeding threshold - for coolant thermostat diagnosis					
C_T_N_REL_CWP_MAX_DIAG_TH	-	0... FFH	0... 255	1	s
Max. time for CWP speed exceeding threshold before coolant thermostat diagnosis inhibition					
C_TAM_MIN_DIAG_TH	-	0... FEH	-48... 142.5	0.75	°C
Minimum ambient air temperature for thermostat diagnosis					
C_TIA_DE_MAX_INH_DIAG_TH	-	0... FEH	-48... 142.5	0.75	°C
Maximum intake air temperature deviation for coolant thermostat diagnosis inhibition					
ID_N_REL_CWP_MAX_DIAG_TH	-	0... FFH	0... 255	1	-
LDP_TCO_SUB_ID_N_REL_CWP_MAX	6	0... FE00H	-48... 142.5	2.9297e-3	°C
Maximum cooling water pump speed for coolant thermostat diagnosis					

**Import actions:**

<b>ACTION_ERRM_CheckPendingStatus (IN&lt;PRM_IDX_DIAG&gt;,OUT&lt;PRM_LV_ERR_PND&gt;)</b>
--

**Error treatment:****Error debounce:**

Debounce counter increment:

C\_ABC\_INC\_TH

Debounce counter maximum value:

C\_ABC\_MAX\_TH

**Error type:**

Diagnosis	Symptom	N r	P-Code/ Failure	P-Code/ Symptom	Recurrence	Failure class A/B
Coolant Thermostat Monitoring	Not used	0				STD_INI
	Not used	1				
	TH open stuck	2				
TH Monitoring	Not used	3				

## B.57.1 Inhibition of diagnosis

### FUNCTION DESCRIPTION:

#### General information:

The coolant thermostat diagnosis is performed at transition from the logical value for engine stop from 1 to 0. If the engine stalls or one of the conditions for inhibiting the diagnosis is present, it will be stopped and starts again at the next engine start.

The diagnosis is finished as soon as the boolean for end of coolant thermostat diagnosis is set to 1. In this case the boolean for coolant thermostat error indicates either an open stuck thermostat (= 1) or a normal working thermostat (= 0).

Depending on project specific requirements, the coolant thermostat diagnosis can be inhibited by setting of LV\_INH\_DIAG\_TH.

Interface of thermostat monitoring with the RBM statistics:

Bit 0: cond. for monitoring are met long enough to detect malfunction (bit0=1)

Bit 1: inhib. of the monitor because of system failure(s) (bit1=1)

Bit 2: individual RBM cond. of the monitor were encountered within this DC (bit2=1)

#### Application conditions

##### **Initialisation:**

```

at RESET or EXIT_ST or LV_IGK = 0->1 or FMY clear:
  LV_INH_DIAG_TH = 0
  LV_INH_DIAG_RBM_TH = 0
  LV_TIA_DE_INH_DIAG_TH = 0
  LV_N_REL_CWP_INH_DIAG_TH = 0
  LV_ECTPWM_INH_DIAG_TH = 0
  LV_ECFPWM_INH_DIAG_TH = 0
  T_ECTPWM_INH_DIAG_TH = C_T_ECTPWM_INH_DIAG_TH
  T_ECFPWM_INH_DIAG_TH = C_T_ECFPWM_INH_DIAG_TH
  T_N_REL_CWP_MAX_DIAG_TH = C_T_N_REL_CWP_MAX_DIAG_TH
at RESET or EXIT_ST:
  MASS_VOL_CWP_DIAG_TH_TMP = 01
  MASS_VOL_CWP_DIAG_TH = 0I
  TIA_DE_INH_DIAG_TH = 0°C
  TIA_MIN_INH_DIAG_TH = TIA_THR_ST

```

##### **Recurrence:**

1000 ms

##### **Activation:**


LV\_ST\_END = 1

(Coolant thermostat monitoring (Appl. Inc.) function enabled)

##### **Deactivation:**

LV\_ST\_END = 0

(Coolant thermostat monitoring (Appl. Inc.) function disabled)

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**Formula section:**

Calculation of Cooling water pump effected coolant mass volumetric flow:

MASS\_VOL\_CWP\_DIAG\_TH\_TMP=(N\_REL\_CWP /255)\*C\_MASS\_VOL\_CWP\_MAX //phs!

Calculation of the maximum CWP speed for TH monitoring:

```

If          N_REL_CWP > ID_N_REL_CWP_MAX_DIAG_TH
Then       If          T_N_REL_CWP_MAX_DIAG_TH > 0
                Then          T_N_REL_CWP_MAX_DIAG_TH --           //count down
                Else          LV_N_REL_CWP_INH_DIAG_TH = 1           //set until next Ini
                Endif
Else       T_N_REL_CWP_MAX_DIAG_TH = C_T_N_REL_CWP_MAX_DIAG_TH
Endif

```

Calculation of the maximum intake air temperature deviation:

```

If          TIA_THR < TIA_MIN_INH_DIAG_TH(n-1)
then        TIA_MIN_INH_DIAG_TH(n) = TIA_THR
else        TIA_MIN_INH_DIAG_TH(n) = TIA_MIN_INH_DIAG_TH(n-1)
endif

```

TIA\_DE\_INH\_DIAG\_TH = TIA\_MIN\_INH\_DIAG\_TH - TIA\_THR\_ST

```

If          TIA_DE_INH_DIAG_TH < C_TIA_DE_MAX_INH_DIAG_TH
then        LV_TIA_DE_INH_DIAG_TH = 1           //set until next Ini
endif

```

Calculation of the minimum CWP volume for TH monitoring:

```

If (1)      LV_N_REL_CWP_INH_DIAG_TH = 0           and
                MASS_VOL_CWP_DIAG_TH(n) <=
                C_MASS_VOL_CWP_MIN_DIAG_TH

then (1)
                If (2)          N_REL_CWP > C_N_REL_CWP_MIN_DIAG_TH
                then (2)      MASS_VOL_CWP_DIAG_TH(n) =           //Integration
                                MASS_VOL_CWP_DIAG_TH(n-1) + MASS_VOL_CWP_DIAG_TH_TMP(n)
                else (2)      MASS_VOL_CWP_DIAG_TH(n) = 0
                endif (2)
else (1)          stop of integration, keep last value
endif (1)

```

Calculation of the ECTPWM condition for TH monitoring:

```

If          ECTPWM > C_ECTPWM_INH_DIAG_TH
then       if          T_ECTPWM_INH_DIAG_TH > 0
                then          T_ECTPWM_INH_DIAG_TH --
                else          LV_ECTPWM_INH_DIAG_TH = 1
                endif
else       T_ECTPWM_INH_DIAG_TH = C_T_ECTPWM_INH_DIAG_TH
Endif

```

Calculation of the ECFPWM condition for TH monitoring:

```

If          ECFPWM > C_ECFPWM_INH_DIAG_TH
then       if          T_ECFPWM_INH_DIAG_TH > 0
                then          T_ECFPWM_INH_DIAG_TH --
                else          LV_ECFPWM_INH_DIAG_TH = 1

```

```

    endif
else    T_ECFPWM_INH_DIAG_TH = C_T_ECFPWM_INH_DIAG_TH
endif

```

Calculation of diagnosis interface parameter:

```

if      LV_ERR_TCO = 1                or
      LV_ERR_MAF = 1                or
      LV_ERR_TIA = 1                or
      LV_ERR_VS = 1                 or
      LV_ERR_TAM = 1                or
      LV_ERR_ECT_EL = 1            or
      LV_ERR_BN_T_ICL              or
      LV_ERR_CAN_BOFF              or
      LV_ERR_LOAD_TPS_PLAUS or
then    LV_INH_DIAG_RBM_TH = 1
endif

if      LV_INH_DIAG_RBM_TH = 1                or
      LV_N_REL_CWP_INH_DIAG_TH = 1          or
      LV_TIA_DE_INH_DIAG_TH = 1            or
      TAM < C_TAM_MIN_DIAG_TH              or
      MASS_VOL_CWP_DIAG_TH(n) < C_MASS_VOL_CWP_MIN_DIAG_TH or
      LV_ECTPWM_INH_DIAG_TH = 1            or
      LV_ECFPWM_INH_DIAG_TH = 1
then    LV_INH_DIAG_TH = 1
else    LV_INH_DIAG_TH = 0
endif

```

## B.57.2 Rate Base Monitoring interface for thermostat monitoring.

### FUNCTION DESCRIPTION:

#### General information:

With this module the interface between the thermostat monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_TH data.

Within STATE\_RBM\_TH, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)


- Monitor individual RBM conditions encountered within this DC (bit 2)  
( not valid for TH diagnosis )

#### Application conditions:

*Initialisation :*

at ECU reset :

*bit 0, bit 1 and bit 2 of STATE\_RBM\_TH = 0*

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at LV\_DC 0 1 transition :

bit 0 and bit 1 of STATE\_RBM\_TH = 0

bit 2 of STATE\_RBM\_TH = 1

on failure memory reset :

bit 1 of STATE\_RBM\_TH = 0

Recurrence: 1 s

Activation: LV\_DC = 1

### Formula section:

#### At LV\_DC 0 1 transition

The pending status of the following failures has to be checked only once :

LV_ERR_TCO_EL	LV_ERR_TCO_GRD	LV_ERR_TCO_STUCK	LV_ERR_TCO_PLAUS
LV_ERR_TIA_EL	LV_ERR_TIA_PLAUS	LV_ERR_MAF_FRQ_RNG	LV_ERR_VS
LV_ERR_TAM_CAN	LV_ERR_TAM_PLAUS	LV_ERR_ECT_EL	LV_ERR_MAF_FRQ_GRD
LV_ERR_BN_T_ICL	LV_ERR_TIA_GRD	LV_ERR_TCO_STUCK_R	LV_ERR_MAF_FRQ_EL
LV_ERR_CAN_BOFF	LV_ERR_LOAD_TPS_PLA	US	

**If(1)** { CPU optimization at LV\_DC 0 1 transition }

CTR\_ERR\_DYN\_NR <> 0 { the dynamic failure memory isn t empty }

**Then(1)**

**While** bit 1 of STATE\_RBM\_TH = 0 **do**

with each XX failure of the above list :

ACTION\_ERRM\_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

**If(2)** XX has a pending status

**Then(2)**

bit 1 of STATE\_RBM\_TH = 1

**Endif(2)**

**Endwhile**

**Else(1)**

{ the dynamic failure memory is empty }

No action

**Endif(1)**

Every 1 s :

**If** bit 0 of STATE\_RBM\_TH = 0

**Then**

**If** LV\_END\_DIAG\_RBM\_TH = 1

**Then** bit 0 of STATE\_RBM\_TH = 1

**Endif**

**Endif**

**If** bit 1 of STATE\_RBM\_TH = 0

**Then**

**If** LV\_INH\_DIAG\_RBM\_TH = 1

**Then** bit 1 of STATE\_RBM\_TH = 1

**Endif**

**Endif**

## B.58 Coolant temperature sensor (radiator outlet) plausibility diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DLY_TCO_2_PLAUS	V	0... FFFFH	0... 65535	1	-
Delay counter before coolant temperature (radiator outlet) change is expected					
ERR_SYM_TCO_2_PLAUS	V	0H 1H 8H	NO_SYM SYM_0 SYM_3	-	-
Symptom for coolant temperature (radiator outlet) plausibility error					
LV_CDN_DIAG_TCO_2_PLAUS	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) plausibility diagnosis conditions					
LV_END_DIAG_RBM_TCO_2_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for end of coolant temperature (radiator outlet) plausibility diagnosis for RBM					
LV_END_DIAG_TCO_2_PLAUS	V	0... 1H	0 ...1	1	-
Boolean for end of coolant temperature (radiator outlet) plausibility diagnosis					
LV_ERR_TCO_2_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) plausibility error					
LV_TCO_2_PLAUS_ENA	V	0... 1H	0 ...1	1	-
Coolant temperature (radiator outlet) plausibility (long) enabled					
T_DLY_TCO_2_PLAUS	V	0... FFFFH	0... 65535	1	s
Coolant temperature (radiator outlet) plausibility diagnosis diagnostic window time					
TCO_2_DIF_TCO_2_PLAUS	V	0... FEH	0... 190.5	0.75	(C
Maximum measured coolant temperature (radiator outlet) gap in diagnosis window					
TCO_2_PLAUS_H	V	0... FEH	-48... 142.5	0.75	(C
Maximum latched measured coolant temperature (radiator outlet) value					
TCO_2_PLAUS_L	V	0... FEH	-48... 142.5	0.75	(C
Minimum latched measured coolant temperature (radiator outlet) value					

### Input data:

LV_CDN_VB_OBD2 {p. 1185}	LV_INH_DIAG_TCO_2_PLAUS {p. 5672}	LV_PL {p. 1720}	LV_ST_END {p. 1720}
LV_TCO_2_PLAUS_ENA_EXT {p. 5672}	N {p. 1525}	TCO {p. 1100}	TCO_2_MES {p. 1218}
TCO_2_MES_ST {p. 1218}	TCO_ST {p. 1100}	TIA_THR_ST {p. 984}	VS {p. 1176}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_DLY_INC_TCO_2_PLAUS	-	0... FFFFH	0... 65535	1	-
Increment for counter if drop out of diagnostic conditions					
C_CTR_DLY_TCO_2_PLAUS	-	0... FFFFH	0... 65535	1	-
Coolant system lag time before change in TCO_2_MES is expected					
C_N_MIN_TCO_2_PLAUS	-	0... 1FE0H	0... 8160	1	rpm
Min. engine speed needed to open thermostat relief valve					
C_T_DLY_TCO_2_PLAUS	-	0... FFFFH	0... 65535	1	s
Diagnostic window					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_2_DIF_MIN_TCO_2_PLAUS	-	0... FEH	0... 190.5	0.75	(C
Min. delta TCO_2_MES for plausibility					
C_TCO_MIN_TCO_2_PLAUS	-	0... FEH	-48... 142.5	0.75	(C
Opening temperature of coolant thermostat					
C_TCO_ST_DIF_MIN_TCO_2_PLAUS	-	0... FFH	-96... 95.5	0.75	(C
Min. difference between TCO_ST and TCO_2_MES_ST to diagnose fault at engine start					
C_TCO_ST_MAX_TCO_2_PLAUS	-	0... FEH	-48... 142.5	0.75	(C
Max. TCO_ST for TCO_2 plausibility check					
C_TCO_ST_MIN_TCO_2_PLAUS	-	0... FEH	-48... 142.5	0.75	(C
Min. TCO_ST for TCO_2 plausibility check					
C_TCO_ST_THD_TCO_2_PLAUS	-	0... FEH	-48... 142.5	0.75	(C
Max. TCO_ST for additional rationality check					
C_TIA_THR_ST_MAX_TCO_2_PLAUS	-	0... FEH	-48... 142.5	0.75	(C
Max. TIA_THR_ST for TCO_2 plausibility check					
C_TIA_THR_ST_MIN_TCO_2_PLAUS	-	0... FEH	-48... 142.5	0.75	(C
Min. TIA_THR_ST for TCO_2 plausibility check					
C_VS_MIN_TCO_2_PLAUS	-	0... FFH	0... 255	1	km/h
Min. vehicle speed needed to open thermostat relief valve					

## FUNCTION DESCRIPTION:

### General information:

The diagnosis is based on monitoring the alteration of TCO\_2\_MES (positive and negative change) at:

- During warm - up phase (long term check, no error detection)
- After opening of thermostat (long term check with error detection)
- Just after start (short test with error detection)

### B.58.1 Signal flow diagram:

TCO\_2\_DIF\_TCO\_2\_PLAUS

TCO\_2\_MES\_ST

C\_N\_MIN\_TCO\_2\_PLAUS

Idle speed setpoint

DE

**Initialisation at EXIT\_ST:**

```

LV_ERR_TCO_2_PLAUS = 0
LV_CDN_DIAG_TCO_2_PLAUS = 0
LV_END_DIAG_TCO_2_PLAUS = 0
ERR_SYM_TCO_2_PLAUS = NO_SYM
LV_END_DIAG_RBM_TCO_2_PLAUS = 0
LV_TCO_2_PLAUS_ENA = 0
TCO_2_DIF_TCO_2_PLAUS = 0 °C
TCO_2_PLAUS_H = -48°C
TCO_2_PLAUS_L = 142,5°C
CTR_DLY_TCO_2_PLAUS = C_CTR_DLY_TCO_2_PLAUS
T_DLY_TCO_2_PLAUS = C_T_DLY_TCO_2_PLAUS

```


**Recurrence:** 1000 ms**Activation:** LV\_ST\_END = 1**Deactivation:** LV\_ST\_END = 0**Description:**

- During warm - up phase (long term check, no error detection)

The TCO\_2 rationality diagnostic function will only run if TCO\_ST and TIA\_THR\_ST are within a tunable range after engine start. TCO\_2\_PLAUS\_H and TCO\_2\_PLAUS\_L are continuously updated from engine start, after first being initialized to TCO\_2\_ST at power up. The difference between these two values, TCO\_2\_DIF\_TCO\_2\_PLAUS, is also calculated. When this value exceeds a minimum threshold C\_TCO\_2\_DIF\_MIN\_TCO\_2\_PLAUS then the diagnosis is finished with a positive rationality check result.

- After opening of thermostat (long term check with error detection)

The error detection is based on a change of TCO\_2\_MES after the opening temperature of the thermostat is reached and following the vehicle/engine is driven under certain conditions (vehicle speed, part load, engine speed, opening of thermostat) for the delay time CTR\_DLY\_TCO\_2\_PLAUS. However, should one condition drop below the threshold or the engine exit part load state during this tunable period, then the timer is reinitialized/incremented.

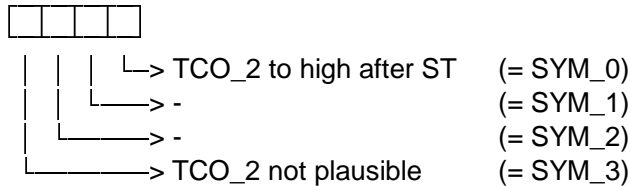
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Additional, at CTR\_DLY\_TCO\_2\_PLAUS = 0 a second delay timer is started (T\_DLY\_TCO\_2\_PLAUS) to wait for the change of TCO\_2\_MES. If the delay time is over and there is still no change in TCO\_2\_MES then the error is set.

- Just after start (short test with error detection)

Apart from the long term checks, an extra rationality check is carried out at engine start; if TCO\_ST is smaller than a threshold and TCO\_2\_MES\_ST - TCO\_ST is greater than a threshold then a fault is also detected.

Error-symptoms are defined to this diagnosis function as following:



### Formula section:

#### Calculation of diagnosis condition

```

IF          LV_INH_DIAG_TCO_2_PLAUS = 0                AND
            LV_END_DIAG_TCO_2_PLAUS = 0                AND
            LV_CDN_VB_OBD2 = 1
THEN        LV_CDN_DIAG_TCO_2_PLAUS = 1
ELSE        LV_CDN_DIAG_TCO_2_PLAUS = 0
ENDIF
  
```

#### Calculation of Diagnosis warm-up phase:

```

IF(1)       TCO_ST > C_TCO_ST_MIN_TCO_2_PLAUS          AND
            TCO_ST < C_TCO_ST_MAX_TCO_2_PLAUS          AND
            TIA_THR_ST > C_TIA_THR_ST_MIN_TCO_2_PLAUS  AND
            TIA_THR_ST < C_TIA_THR_ST_MAX_TCO_2_PLAUS  AND
            LV_END_DIAG_RBM_TCO_2_PLAUS = 0
THEN(1)     (calculation of formula section A, B, C and D - SYM_3 error check)
  
```

#### A Calculation of min. and max. TCO\_2\_MES and delta TCO\_2\_MES

```

IF(2a)      TCO_2_MES > TCO_2_PLAUS_H
THEN(2a)    TCO_2_PLAUS_H = TCO_2_MES
ELSE(2a)
IF(3a)      TCO_2_MES < TCO_2_PLAUS_L
THEN(3a)    TCO_2_PLAUS_L = TCO_2_MES
ENDIF(3a)
ENDIF(2a)
TCO_2_DIF_TCO_2_PLAUS = TCO_2_PLAUS_H - TCO_2_PLAUS_L
  
```

#### B Calculation of TCO\_2\_DIF\_TCO\_2\_PLAUS to end the diagnosis

```

IF(2b)      LV_CDN_DIAG_TCO_2_PLAUS = 1                AND
            TCO_2_DIF_TCO_2_PLAUS >= C_TCO_2_DIF_MIN_TCO_2_PLAUS
THEN(2b)    LV_END_DIAG_TCO_2_PLAUS = 1                // end of diagnosis
ENDIF(2b)
  
```

```

-----
C      Calculation of delay counter the reach conditions
IF(2c)      [ TCO > C_TCO_MIN_TCO_2_PLAUS          OR
             LV_TCO_2_PLAUS_ENA_EXT = 1 ]          AND
             LV_TCO_2_PLAUS_ENA = 0
THEN(2c)    //thermostat opening temperature has been reached
IF(3c)      N > C_N_MIN_TCO_2_PLAUS                AND
             LV_PL = 1                              AND
             VS >= C_VS_MIN_TCO_2_PLAUS
THEN(3c)    CTR_DLY_TCO_2_PLAUS = CTR_DLY_TCO_2_PLAUS - 1
             // conditions causing change in TCO_2_MES are satisfied, decrement
counter
IF(4c)      CTR_DLY_TCO_2_PLAUS = 0
THEN(4c)    LV_TCO_2_PLAUS_ENA = 1
ELSE(4c)    LV_TCO_2_PLAUS_ENA = 0
ENDIF(4c)
ELSE(3c)    CTR_DLY_TCO_2_PLAUS = CTR_DLY_TCO_2_PLAUS
             + C_CTR_DLY_INC_TCO_2_PLAUS
             // Conditions causing change in TCO_2_MES not fulfilled, increment counter

IF(5c)      CTR_DLY_TCO_2_PLAUS >=
C_CTR_DLY_TCO_2_PLAUS
THEN(5c)    CTR_DLY_TCO_2_PLAUS =
             C_CTR_DLY_TCO_2_PLAUS
ENDIF(5c)
ENDIF(3c)
ELSE(2c)    CTR_DLY_TCO_2_PLAUS = CTR_DLY_TCO_2_PLAUS      //freeze
ENDIF(2c)
-----

D      Start diagnostic window /Diagnostic check:
IF(2d)      LV_TCO_2_PLAUS_ENA = 1
THEN(2d)    T_DLY_TCO_2_PLAUS --
             //decrement timer for delay-time
             // lower decrement timer value limited to 0 s, no negative values possible
IF(3d)      T_DLY_TCO_2_PLAUS = 0                      AND
             LV_INH_DIAG_TCO_2_PLAUS = 0              AND
             LV_CDN_VB_OBD2 = 1
THEN(3d)
IF(4d)      LV_CDN_DIAG_TCO_2_PLAUS = 1
THEN(4d)    ERR_SYM_TCO_2_PLAUS = SYM_3
             LV_ERR_TCO_2_PLAUS = 1      // without debounce
             LV_END_DIAG_TCO_2_PLAUS = 1  // end of diagnosis
ENDIF(4d)
LV_END_DIAG_RBM_TCO_2_PLAUS = 1      // end of diagnosis for
RBM
ENDIF(3d)
ELSE(2d)    no start condition
ENDIF(2d)
-----

```

Calculation of Plausibility after start condition:

```

ELSEIF(1)      TCO_ST < C_TCO_ST_THD_TCO_2_PLAUS                AND
                TIA_THR_ST <= C_TIA_THR_ST_MIN_TCO_2_PLAUS    AND
                LV_END_DIAG_RBM_TCO_2_PLAUS = 0
THEN(1)       (calculation of formula section E - SYM_0 error check)

```

**E** Calculation of Plausibility after start :

```

IF(2e)         LV_CDN_DIAG_TCO_2_PLAUS = 1
THEN(2e)
  IF(3e)       TCO_2_MES_ST - TCO_ST > C_TCO_ST_DIF_MIN_TCO_2_PLAUS
  THEN(3e)     ERR_SYM_TCO_2_PLAUS = SYM_0
                LV_ERR_TCO_2_PLAUS = 1                // without debounce
  ENDIF(3e)
  LV_END_DIAG_TCO_2_PLAUS = 1                        // end of diagnosis
  LV_END_DIAG_RBM_TCO_2_PLAUS = 1                    // end of diagnosis for

```

RBM

ENDIF(2e)

```

ELSE(1)       (TCO_2 diagnosis finished or diagnosis conditions not met)
ENDIF(1)

```

## B.59 Coolant temperature sensor (radiator outlet) plaus. Diag. (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_RBM_TCO_2_PLAUS	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) signal plausibility diagnosis inhibit due to OBD error					
LV_INH_DIAG_TCO_2_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) signal plausibility diagnosis inhibit					
LV_TCO_2_PLAUS_ENA_EXT	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) signal plausibility diagnosis external enable					
STATE_RBM_TCO_2_PLAUS	O/V	0... 7H	0 ...7	1	-
Interface of TCO_2 monitor with the Rate-Based Monitoring statistics					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	ECPWM {p. 3858}	LV_CDN_CST_RBM {p. 5870}	LV_DC {p. 5746}
LV_END_DIAG_RBM_TCO_2_PLAUS {p. 5666}	LV_ERR_ECT {p. 4529}	LV_ERR_TCO {p. 4496}	LV_ERR_TCO_2_EL {p. 4572}
LV_ERR_TCO_2_GRD {p. 4572}	LV_ERR_TIA {p. 4200}	LV_ERR_VS {p. 5021}	LV_IGK {p. 906}
LV_ST_END {p. 1720}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ECTPWM_MIN_TCO_2_PLAUS	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Minimum ECTPWM to expect a change in TCO_2					

### Import actions:

<b>ACTION_ERRM_CheckPendingStatus</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR_PND>)
--

### B.59.1 Interface parameter

#### General information:

Depending on project specific requirements, the plausibility diagnosis of the coolant temperature sensor at radiator outlet can be inhibited by setting of the logical variable LV\_INH\_DIAG\_TCO\_2\_PLAUS. As a default value LV\_INH\_DIAG\_TCO\_2\_PLAUS is set as shown below.


#### Application conditions

#### Initialisation

at RESET **or** EXIT\_ST **or** LV\_IGK = 0 -> 1 **or** FMY clear:  
 LV\_INH\_DIAG\_TCO\_2\_PLAUS = 0  
 LV\_INH\_DIAG\_RBM\_TCO\_2\_PLAUS = 0  
 LV\_TCO\_2\_PLAUS\_ENA\_EXT = 0

#### Recurrence:

1000 ms

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**Activation:**                   LV\_ST\_END = 1  
   ( Calculation of the TCO\_2 plausi. diagnosis interface  
   parameter enabled)

**Deactivation:**               LV\_ST\_END = 0  
   ( Calculation of the TCO\_2 plausi. diagnosis interface  
   parameter disabled)

### Formula section:

Calculation of diagnosis interface parameter:

```

If          LV_ERR_TCO = 1                      or
              LV_ERR_TCO_2_EL = 1                or
              LV_ERR_TCO_2_GRD = 1              or
              LV_ERR_TIA = 1                    or
              LV_ERR_VS = 1                     or
              LV_ERR_ECT = 1
Then       LV_INH_DIAG_RBM_TCO_2_PLAUS = 1
Endif

If          LV_IGK = 0                          or
              LV_INH_DIAG_RBM_TCO_2_PLAUS = 1
Then       LV_INH_DIAG_TCO_2_PLAUS = 1
Endif

If          ECTPWM > C_ECTPWM_MIN_TCO_2_PLAUS
Then       LV_TCO_2_PLAUS_ENA_EXT = 1
Else      LV_TCO_2_PLAUS_ENA_EXT = 0
Endif
  
```

## B.59.2 Interface for Rate-based-monitoring

### General information:

With this module the interface between the TCO\_2 plausibility monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_TCO\_2\_PLAUS data.

Within STATE\_RBM\_TCO\_2\_PLAUS, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)

### Application conditions:

*Initialisation :*

at ECU reset :


*bit 0, bit 1 and bit 2 of STATE\_RBM\_TCO\_2\_PLAUS = 0*

at LV\_DC 0 1 transition :

*bit 0, bit 1 and bit 2 of STATE\_RBM\_TCO\_2\_PLAUS = 0*

on failure memory reset :

*bit 1 of STATE\_RBM\_TCO\_2\_PLAUS = 0*

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Recurrence: 1 s  
 Activation: LV\_DC = 1

### Formula section:

#### At LV\_DC 0 1 transition

The pending status of the following failures has to be checked only once:

LV_ERR_TCO_EL	LV_ERR_TCO_PLAUS	LV_ERR_TCO_GRD	LV_ERR_TCO_STUCK
LV_ERR_TCO_2_EL	LV_ERR_TCO_2_GRD	LV_ERR_TIA_EL	LV_ERR_TIA_PLAUS
LV_ERR_VS	LV_ERR_TH	LV_ERR_ECT_EL	LV_ERR_TCO_STUCK_RNG
LV_ERR_TIA_GRD			

```

If(1)      { CPU optimization at LV_DC 0 1 transition }
              CTR_ERR_DYN_NR <> 0      { the dynamic failure memory isn t empty }

Then(1)

  While      bit 1 of STATE_RBM_TCO_2_PLAUS = 0 do
    with each XX failure of the above list :
    ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

      If(2)      XX has a pending status
      Then(2)
        bit 1 of STATE_RBM_TCO_2_PLAUS = 1
      Endif(2)
    Endwhile

  Else(1)
    { the dynamic failure memory is empty }
    No action

  Endif(1)

Every 1 s :
If      bit 0 of STATE_RBM_TCO_2_PLAUS = 0
Then
  If      LV_END_DIAG_RBM_TCO_2_PLAUS = 1
  Then      bit 0 of STATE_RBM_TCO_2_PLAUS = 1
  Endif
Endif

If      bit 1 of STATE_RBM_TCO_2_PLAUS = 0
Then
  If      LV_INH_DIAG_RBM_TCO_2_PLAUS = 1
  Then      bit 1 of STATE_RBM_TCO_2_PLAUS = 1
  Endif
Endif

If      bit 2 of STATE_RBM_TCO_2_PLAUS = 0
Then
  If      LV_CDN_CST_RBM = 1
  Then      bit 2 of STATE_RBM_TCO_2_PLAUS = 1
  Endif
Endif
  
```

## B.60 Coolant temperature sensor stuck in range diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TCO_STUCK_RNG	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptom for coolant temperature signal stuck in range error					
LV_CDN_DIAG_TCO_STUCK_RNG	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature signal stuck in range diagnosis conditions					
LV_END_DIAG_TCO_STUCK_RNG	O/V	0... 1H	0 ...1	1	-
Boolean for end of coolant temperature signal stuck in range diagnosis					
LV_ERR_TCO_STUCK_RNG	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature signal stuck in range detected					
TCO_ST_STUCK_RNG	V	0... FEH	-48... 142.5	0.75	°C
Measured coolant temperature at start					

### Input data:

LV_CDN_VB_OBD2 {p. 1185}	LV_END_DIAG_TCO_EL {p. 4496}	LV_END_DIAG_TCO_GRD {p. 4496}	LV_IGK {p. 906}
LV_INH_DIAG_TCO_ STUCK_RNG {p. 5678}	LV_ST {p. 1720}	T_AST {p. 1766}	T_ES_CUS {p. 1444}
TAM_ST {p. 1214}	TCO_MES {p. 1100}	TIA_THR_ST {p. 984}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_AST_MIN_TCO_STUCK_RNG	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time after start to enable diagnosis					
C_T_ES_CUS_MAX_TCO_STUCK_RNG	-	0... FFFFH	0... 65535	1	min
Constant for maximum allowed engine off time for diagnosis					
C_T_ES_MIN_TCO_STUCK_RNG	-	0... FFFFH	0... 65535	1	min
Constant for minimum required engine off time for diagnosis					
C_TAM_ST_MIN_TCO_STUCK_RNG	-	0... FEH	-48... 142.5	0.75	°C
Constant for minimum ambient temperature at start					
C_TIA_TAM_DIF_MAX_TCO_STUCK_RNG	-	0... FEH	0... 190.5	0.75	°C
Constant for difference between intake air temperature and ambient temperature at start					
C_TIA_THR_ST_MAX_TCO_STUCK_RNG	-	0... FEH	-48... 142.5	0.75	°C
Constant for maximum intake air temperature at throttle at start					
C_TIA_THR_ST_MIN_TCO_STUCK_RNG	-	0... FEH	-48... 142.5	0.75	°C
Constant for minimum intake air temperature at throttle at start					
IP_TCO_ST_DIF_TIA_THR_ST	-	0... FEH	0... 190.5	0.75	°C
LDPM_T_ES_CUS_TCO_STUCK_RNG	4	0... FFFFH	0... 65535	1	min
Interpolation table for difference between coolant temperature and intake air temperature at start					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TCO_ST_TCO_STUCK_RNG	V	0... FEH	-48... 142.5	0.75	°C
LDPM_T_ES_CUS_TCO_STUCK_RNG	4	0... FFFFH	0... 65535	1	min
LDP_TIA_THR_ST_IP_TCO_ST	6	0... FEH	-48... 142.5	0.75	°C
Interpolation table for expected coolant temperature value depending on TIA_THR_ST and T_ES_CUS					

## FUNCTION DESCRIPTION:

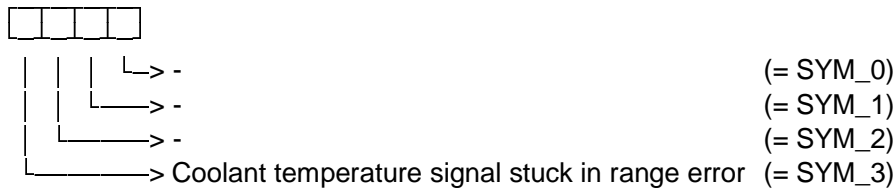
### General information:

The purpose of the signal stuck in range diagnosis is to detect a measured coolant temperature signal, which is stuck in range above the lowest maximum enable temperature. The diagnosis function checks, if the cooling behavior of the coolant temperature is plausible in comparison to the engine off time.

The diagnosis is performed only once per engine run. The symptom of the error code is not handled by an antibounce counter.

### Description:

Error-symptoms are defined to this diagnosis function as following:



## Application conditions

### Initialisation:

```

at Exit start (EXIT_ST)
LV_ERR_TCO_STUCK_RNG = 0
ERR_SYM_TCO_STUCK_RNG = "NO_SYM"
LV_CDN_DIAG_TCO_STUCK_RNG = 0
at reset:
TCO_ST_STUCK_RNG = 0
// LV_END_DIAG_TCO_STUCK_RNG is directly initialized by ERRM

```

### Recurrence:

100ms

### Activation:

LV\_IGK = 1

### Deactivation:

LV\_IGK = 0 **or**  
LV\_END\_DIAG\_TCO\_STUCK\_RNG = 1

**Formula section:**

```

If                LV_ST = 1
Then             TCO_ST_STUCK_RNG = TCO_MES
Endif

If                T_AST > C_T_AST_MIN_TCO_STUCK_RNG //delay-time to get a valid T_ES_CUS
CUS
Then
  If                LV_CDN_VB_OBD2 = 1
    and              TIA_THR_ST < C_TIA_THR_ST_MAX_TCO_STUCK_RNG
    and              TIA_THR_ST > C_TIA_THR_ST_MIN_TCO_STUCK_RNG
    and              LV_INH_DIAG_TCO_STUCK_RNG = 0
    and              TAM_ST > C_TAM_ST_MIN_TCO_STUCK_RNG
    and              |TIA_THR_ST - TAM_ST| < C_TIA_TAM_DIF_MAX_TCO_STUCK_RNG
    and              T_ES_CUS > C_T_ES_MIN_TCO_STUCK_RNG
  and              T_ES_CUS < C_T_ES_CUS_MAX_TCO_STUCK_RNG
  and              LV_END_DIAG_TCO_EL = 1
  and              LV_END_DIAG_TCO_GRD = 1
  Then              LV_CDN_DIAG_TCO_STUCK_RNG = 1
  Else              LV_CDN_DIAG_TCO_STUCK_RNG = 0
Endif

if(1)             LV_CDN_DIAG_TCO_STUCK_RNG = 1
then(1)
  if(2)             (TCO_ST_STUCK_RNG - TIA_THR_ST) > IP_TCO_ST_DIF_TIA_THR_ST
  1 - comparison of intake air and coolant temperature value)
  and
  TCO_ST_STUCK_RNG > IP_TCO_ST_TCO_STUCK_RNG
  (path 2 - comparison of engine off time to coolant temperature value)

  then(2)          LV_ERR_TCO_STUCK_RNG = 1
  ERR_SYM_TCO_STUCK_RNG = "SYM_3"
  LV_END_DIAG_TCO_STUCK_RNG = 1
  else(2)          LV_ERR_TCO_STUCK_RNG = 0
  ERR_SYM_TCO_STUCK_RNG = "NO_SYM"
  LV_END_DIAG_TCO_STUCK_RNG = 1
  endif(2)
endif(1)

```

## B.61 Coolant temperature sensor stuck in range diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_TCO_STUCK_RNG	O/V	0... 1H	0 ...1	1	-
Boolean for inhibition of coolant temperature signal stuck in range diagnosis					
STATE_RBM_TCO_STUCK_RNG	O/V	0... FFH	0... 255	1	-
Interface of TCO_STUCK_RNG monitor with the Rate-Based Monitoring statistics					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_CDN_CST_RBM {p. 5870}	LV_DC {p. 5746}	LV_END_DIAG_TCO_STUCK_RNG {p. 5675}
LV_ERR_BN_T_ICL {p. 4870}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_ECU_NVMY {p. 4232}	LV_ERR_T_ES {p. 4466}
LV_ERR_TAM_CAN {p. 5076}	LV_ERR_TAM_PLAUS {p. 5076}	LV_ERR_TCO_EL {p. 4496}	LV_ERR_TCO_GRD {p. 4496}
LV_ERR_TCO_PLAUS {p. 5682}	LV_ERR_TCO_STUCK {p. 5691}	LV_ERR_TIA_EL {p. 4194}	LV_ERR_TIA_GRD {p. 4194}
LV_ERR_TIA_PLAUS {p. 5093}	LV_IGK {p. 906}	LV_ST_END {p. 1720}	

### Import actions:

**ACTION\_ERRM\_CheckPendingStatus (IN<PRM\_IDX\_DIAG>,OUT<PRM\_LV\_ERR\_PND>)**

### Error treatment:


Diagnostic	Symptom description	Symptom	Filter type
<b>TCO_STUCK_RNG</b>			
<i>TCO sensor stuck in range diagnosis</i>			NO
	TCO sensor stuck in range error	SYM_3	

### B.61.1 Inhibition of diagnosis

#### FUNCTION DESCRIPTION:

#### FUNCTION DESCRIPTION:

#### General information:

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Depending on project specific requirements, the coolant temperature sensor stuck in range diagnosis can be inhibited by setting of the logical variable LV\_INH\_DIAG\_TCO\_STUCK\_RNG.

### Application conditions

**Initialisation** at RESET **or** EXIT\_ST **or** LV\_IGK = 0 -> 1 **or** FMY clear:  
LV\_INH\_DIAG\_TCO\_STUCK\_RNG = 0

**Recurrence:** 100 ms

**Activation:** LV\_IGK = 1  
(Calculation of the TCO\_STUCK\_RNG diag. interface parameter enabled)

**Deactivation:** LV\_IGK = 0 **or**  
LV\_END\_DIAG\_TCO\_STUCK\_RNG = 1  
(Calculation of the TCO\_STUCK\_RNG diag. interface parameter disabled)

### Formula section:

```

If          LV_ERR_TCO_EL = 1                               or
              LV_ERR_TCO_GRD = 1                             or
              LV_ERR_TIA_EL = 1                               or
LV_ERR_TIA_PLAUS = 1                                         or
              LV_ERR_TAM_CAN = 1                             or
              LV_ERR_TAM_PLAUS = 1                           or
              LV_ERR_BN_T_ICL = 1                             or
              LV_ERR_TIA_GRD = 1                             or
              LV_ERR_CAN_BOFF = 1                            or
              LV_ERR_T_ES = 1                                 or
              LV_ERR_ECU_NVMY = 1                             or
              (( LV_ST_END = 1                                and
              (LV_ERR_TCO_PLAUS = 1                           or
              LV_ERR_TCO_STUCK = 1))                          or
Then          LV_INH_DIAG_TCO_STUCK_RNG = 1
Endif

```

## B.61.2 Interface to rate-based monitoring

### FUNCTION DESCRIPTION:

#### General information:


With this module the interface between the TCO\_STUCK\_RNG monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_TCO\_STUCK\_RNG data.

Within STATE\_RBM\_TCO\_STUCK\_RNG, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)

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## Application conditions

**Initialisation:** at ECU reset:  
*bit 0, bit 1 and bit 2 of STATE\_RBM\_TCO\_STUCK\_RNG = 0*  
 at LV\_DC 0 1 transition:  
*bit 0, bit 1 and bit 1 of STATE\_RBM\_TCO\_STUCK\_RNG = 0*  
 on failure memory reset:  
*bit 1 of STATE\_RBM\_TCO\_STUCK\_RNG = 0*

**Recurrence:** 100ms

**Activation:** LV\_DC 0 1 transition **and** LV\_DC = 1

## Formula section:

At LV\_DC 0 1 transition

The pending status of the following failures has to be checked only once:

LV_ERR_TCO_EL	LV_ERR_TCO_GRD	LV_ERR_TCO_PLAUS	LV_ERR_TIA_PLAUS
LV_ERR_TCO_STUCK	LV_ERR_TIA_EL	LV_ERR_TAM_PLAUS	LV_ERR_TAM_CAN
LV_ERR_BN_T_ICL	LV_ERR_CAN_BOFF	LV_ERR_ECU_NVMY	LV_ERR_T_ES
LV_ERR_TIA_GRD			

**If(1)** { CPU optimization at LV\_DC 0 1 transition }  
 CTR\_ERR\_DYN\_NR <> 0 { the dynamic failure memory isn t empty }

**Then(1)**

**While** bit 1 of STATE\_RBM\_TCO\_STUCK\_RNG = 0 **do**

with each XX failure of the above list :

ACTION\_ERRM\_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

**If(2)** XX has a pending status

**Then(2)**

bit 1 of STATE\_RBM\_TCO\_STUCK\_RNG = 1

**Endif(2)**

**Endwhile**

**Else(1)**

{ the dynamic failure memory is empty }

No action

**Endif(1)**

Every 100ms:

**If** bit 0 of STATE\_RBM\_TCO\_STUCK\_RNG = 0

**Then**

**If** LV\_END\_DIAG\_TCO\_STUCK\_RNG = 1

**Then** bit 0 of STATE\_RBM\_TCO\_STUCK\_RNG = 1

**Endif**

**Endif**

**If** bit 1 of STATE\_RBM\_TCO\_STUCK\_RNG = 0

**Then**

**If** LV\_INH\_DIAG\_TCO\_STUCK\_RNG = 1

**Then** bit 1 of STATE\_RBM\_TCO\_STUCK\_RNG = 1

**Endif**

**Endif**

**If** bit 2 of STATE\_RBM\_TCO\_STUCK\_RNG = 0

**Then**

**If** LV\_CDN\_CST\_RBM = 1



```


Then    bit 2 of STATE_RBM_TCO_STUCK_RNG = 1
Endif

```

```

Endif

```

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## B.62 Coolant temperature sensor plausibility diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TCO_PLAUS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptom for coolant temperature plausibility error					
LV_CDN_DIAG_TCO_PLAUS	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature plausibility diagnosis conditions					
LV_END_DIAG_RBM_TCO_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for end of coolant temperature plausibility diagnosis for RBM					
LV_END_DIAG_TCO_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for end of coolant temperature plausibility diagnosis					
LV_ERR_TCO_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature plausibility error					
T_AST_DIAG_TCO_PLAUS	V	0... FFFFH	0... 65535	1	s
Time after start of the performed coolant temperature plausibility diagnosis					
T_AST_MAX_DIAG_TCO_PLAUS	V	0... FFFFH	0... 65535	1	s
Maximum time after start to reach closed-loop enable temperature for coolant temperature plausibility diagnosis					
T_MIN_DIAG_TCO_PLAUS	V	0... FFFFH	0... 65535	1	s
Minimum time to activate the coolant temperature plausibility diagnosis					
TCO_DIF_DIAG_TCO_PLAUS	V	80... 7FH	-96... 95.25	0.75	°C
Difference between closed-loop enable- and coolant temperature at start for coolant plausibility diagnosis					

### Input data:


LV_CDN_VB_OBD_2	LV_INH_DIAG_TCO_PLAUS {p. 5687}	LV_PUC {p. 1720}	LV_ST_END {p. 1720}
RATIO_T_IS_AST {p. 4493}	T_DIAG_AST {p. 4493}	TCO {p. 1100}	TCO_ST {p. 1100}
TCO_SUB {p. 1105}	TIA_THR_ST {p. 984}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_T_MAX_DIAG_TCO_PLAUS	-	1... FFFFH	1... 65535	1	s
LDP_TCO_DIF_DIAG_TCO_PLAUS_ID_T	4	0... FFH	-96... 95.25	0.75	°C
Time interval to reach closed-loop enable temperature for coolant temperature plausibility diagnosis					
ID_T_MIN_DIAG_TCO_PLAUS	-	1... FFFFH	1... 65535	1	s
LDP_TIA_THR_ST_ID_T_TCO_PLAUS	6	0... FEH	-48... 142.5	0.75	°C
Minimum time for coolant temperature plausibility diagnosis activation					
ID_TCO_MIN_DIAG_TCO_PLAUS	V	0... FEH	-48... 142.5	0.75	°C
LDP_TCO_ST_ID_TCO_MIN_DIAG_TCO	6	0... FEH	-48... 142.5	0.75	°C
LDP_RATIO_T_IS_AST_ID_TCO_DIAG	6	0... FFH	0... 99.60937	0.390625	%
Minimum coolant temperature threshold for coolant temperature plausibility diagnosis					

### Configuration data:

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_T_DLY_TCO_PLAUS	-	0... 1H	0 ...1	1	-
Logical calibration data to switch between delay timer based on absolute or relative temperature at start					
LC_TCO_PLAUS_TCO_SUB_DIAG_INH	-	0... 1H	0 ...1	1	-
Logical calibration data to inhibit the use of TCO_SUB condition for error detection					

## FUNCTION DESCRIPTION:

### General information:

To monitor the activation of the lambda control after start above a coolant temperature threshold (OBD II requirement), a plausibilization between the coolant temperature increase (TCO) and the calculated coolant temperature increase (TCO\_SUB) is made.

The coolant temperature plausibility diagnosis is performed once per engine run.

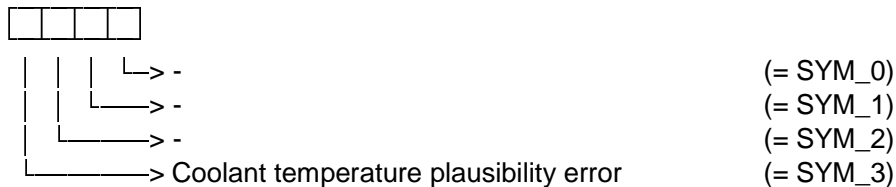
If the engine stalls and the coolant temperature plausibility diagnosis has not run out, then at the next engine start the timer will be initialized new and the diagnosis starts again. When the diagnosis is finished, the Boolean for end of coolant temperature plausibility diagnosis is set.

*Remark:* At the time when the TCO-plausibility diagnosis is performed, it is not possible to distinguish between a TCO-plausibility error and a Thermostat error (which can only be detected later). Therefore a TCO-plausibility error is entered, even if the problem may be related to the Thermostat (in order to activate the limp home in case there is really a problem with the coolant temperature sensor).

That means, if additionally to the TCO- plausibility error a Thermostat diagnosis error is detected, the TCO-plausibility error can be ignored.

### Description:

Error-symptoms are defined to this diagnosis function as following:



### Application conditions

#### Initialisation at EXIT\_ST:


```

LV_ERR_TCO_PLAUS = 0
LV_CDN_DIAG_TCO_PLAUS = 0
LV_END_DIAG_RBM_TCO_PLAUS = 0
ERR_SYM_TCO_PLAUS = NO_SYM
T_MIN_DIAG_TCO_PLAUS = ID_T_MIN_DIAG_TCO_PLAUS
T_AST_DIAG_TCO_PLAUS = 0
TCO_DIF_DIAG_TCO_PLAUS =
    ID_TCO_MIN_DIAG_TCO_PLAUS - TCO_ST
T_AST_MAX_DIAG_TCO_PLAUS = ID_T_MAX_DIAG_TCO_PLAUS

```

//LV\_END\_DIAG\_TCO\_PLAUS is directly initialized by ERRM

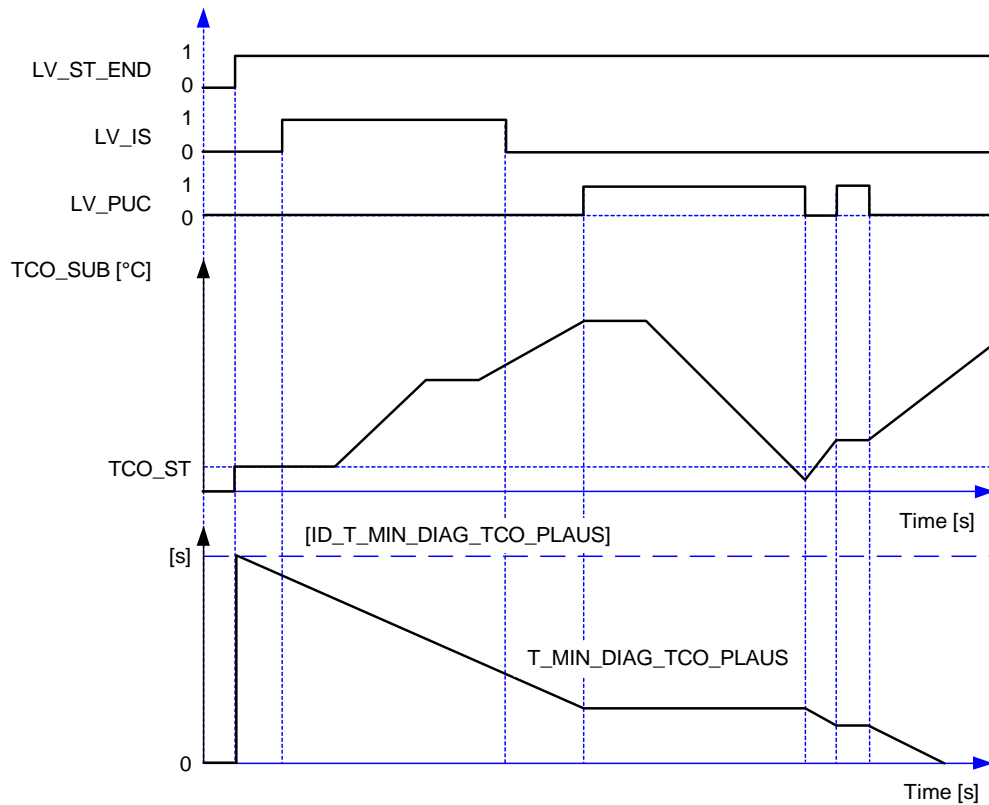
Recurrence: 1000 ms

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Activation: LV\_ST\_END = 1

Deactivation: LV\_ST\_END = 0

**Signal flow diagram:**



**Formula section:**

Calculation of plausibility diagnosis activation conditions:

```

if
    LV_INH_DIAG_TCO_PLAUS = 0
    LV_END_DIAG_TCO_PLAUS = 0
    LV_CDN_VB_OBD_2 = 1
then
    LV_CDN_DIAG_TCO_PLAUS = 1
else
    LV_CDN_DIAG_TCO_PLAUS = 0
endif
    
```

Calculation of minimum diagnosis time after engine start and end of diagnosis for RBM:

```

if(1)
    LV_END_DIAG_RBM_TCO_PLAUS = 0
    LV_INH_DIAG_TCO_PLAUS = 0
    LV_CDN_VB_OBD_2 = 1
then(1)
    if(2a)
        LV_PUC = 1
    then(2a)
        T_MIN_DIAG_TCO_PLAUS(n) = T_MIN_DIAG_TCO_PLAUS(n-1)
        T_AST_MAX_DIAG_TCO_PLAUS(n) = T_AST_MAX_DIAG_TCO_PLAUS(n-1)
    else(2a)
        T_MIN_DIAG_TCO_PLAUS(n) = T_MIN_DIAG_TCO_PLAUS(n-1) - 1 s
        T_AST_MAX_DIAG_TCO_PLAUS(n) = T_AST_MAX_DIAG_TCO_PLAUS(n-1) - 1 s
    
```

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```

// counter minimum value limited to zero, no overflow possible

endif(2a)
if(2b)      LC_T_DLY_TCO_PLAUS = 1
then(2b)    // only use of delay time based on absolute temperature at start
  if(2c)    T_MIN_DIAG_TCO_PLAUS = 0
            ( TCO_SUB   ID_TCO_MIN_DIAG_TCO_PLAUS           or
              LC_TCO_PLAUS_TCO_SUB_DIAG_INH = 1 )
            // default is LC_TCO_PLAUS_TCO_SUB_DIAG_INH = 1; this must also be kept
            // for US applications, except lambda activation by TCO is circumvented
  then(2c)  LV_END_DIAG_RBM_TCO_PLAUS = 1
            // end of diagnosis for RBM
  endif(2c)
else(2b)    // only use of delay time based on relative temperature at start
  if(2d)    T_AST_MAX_DIAG_TCO_PLAUS = 0           and
            ( TCO_SUB   ID_TCO_MIN_DIAG_TCO_PLAUS           or
              LC_TCO_PLAUS_TCO_SUB_DIAG_INH = 1 )
            // default is LC_TCO_PLAUS_TCO_SUB_DIAG_INH = 1; this must also
            // be kept for US applications, except lambda activation by TCO is circumvented
  then(2d)  LV_END_DIAG_RBM_TCO_PLAUS = 1
            // end of diagnosis for RBM
  endif(2d)
endif(2b)
endif(1)

```

Error detection:


```

if(1)      LV_CDN_DIAG_TCO_PLAUS = 1
then(1)
  if(2)    TCO > ID_TCO_MIN_DIAG_TCO_PLAUS
  then(2)  ERR_SYM_TCO_PLAUS = NO_SYM
            LV_ERR_TCO_PLAUS = 0           // without debounce
            LV_END_DIAG_TCO_PLAUS = 1     // end of diagnosis
            T_AST_DIAG_TCO_PLAUS = T_DIAG_AST

  else(2)
    if(3)   LC_T_DLY_TCO_PLAUS = 1
  then(3)   // only use of delay time based on absolute temperature at start

  if(4a)   T_MIN_DIAG_TCO_PLAUS = 0
            ( TCO_SUB   ID_TCO_MIN_DIAG_TCO_PLAUS           or
              LC_TCO_PLAUS_TCO_SUB_DIAG_INH = 1 )
            // default is LC_TCO_PLAUS_TCO_SUB_DIAG_INH = 1; this must also
            // be kept for US applications, except lambda activation by TCO is circumvented
  then(4a)  ERR_SYM_TCO_PLAUS = SYM_3
            LV_ERR_TCO_PLAUS = 1           // without debounce
            LV_END_DIAG_TCO_PLAUS = 1     // end of diagnosis
            T_AST_DIAG_TCO_PLAUS = T_DIAG_AST
  endif(4a)
  else(3)   // only use of delay time based on relative temperature at start
  if(4b)   T_AST_MAX_DIAG_TCO_PLAUS = 0           and
            ( TCO_SUB   ID_TCO_MIN_DIAG_TCO_PLAUS           or
              LC_TCO_PLAUS_TCO_SUB_DIAG_INH = 1 )
            // default is LC_TCO_PLAUS_TCO_SUB_DIAG_INH = 1; this must also
            // be kept for US applications, except lambda activation by TCO is circumvented

```


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```

then(4b)   ERR_SYM_TCO_PLAUS = SYM_3
             LV_ERR_TCO_PLAUS = 1           // without debounce
             LV_END_DIAG_TCO_PLAUS = 1     // end of diagnosis
             T_AST_DIAG_TCO_PLAUS = T_DIAG_AST

endif(4b)
endif(3)
endif(2)
endif(1)

```

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## B.63 Coolant temperature sensor plausibility diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_RBM_TCO_PLAUS	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature plausibility diagnosis inhibit due to OBD error					
LV_INH_DIAG_TCO_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature plausibility diagnosis inhibit					
STATE_RBM_TCO_PLAUS	O/V	0... 7H	0 ...7	1	-
Interface of TCO_PLAUS monitor with the Rate-Based Monitoring statistics					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_CDN_CST_RBM {p. 5870}	LV_CDN_DIAG_TCO_PLAUS {p. 5682}	LV_DC {p. 5746}
LV_END_DIAG_RBM_TCO_PLAUS {p. 5682}	LV_ERR_TCO_EL {p. 4496}	LV_ERR_TCO_GRD {p. 4496}	LV_ERR_TCO_STUCK {p. 5691}
LV_ERR_TCO_STUCK_RNG {p. 5675}	LV_ERR_TIA_EL {p. 4194}	LV_ERR_TIA_GRD {p. 4194}	LV_ERR_TIA_PLAUS {p. 5093}
LV_ES {p. 1720}	LV_IGK {p. 906}		

### Import actions:

<b>ACTION_ERRM_CheckPendingStatus</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR_PND>)
--

### Error treatment:

#### Error debounce:

no debounce

### B.63.1 Diagnosis inhibition

#### FUNCTION DESCRIPTION:

#### General information:

The coolant temperature sensor plausibility diagnosis is performed at transition from the logical value for Start from 1 to 0 . If the engine stalls or one of the conditions for inhibiting the diagnosis is present, it will be stopped and starts again at the next engine start.

The diagnosis is finished as soon as the boolean for end of coolant temperature sensor plausibility diagnosis is set to 1 . In this case the boolean for coolant temperature plausibility error indicates either a not plausible (= 1) or a normal (= 0) coolant temperature sensor signal.

Depending on project specific requirements, the coolant temperature sensor plausibility diagnosis can be inhibited by setting of LV\_INH\_DIAG\_TCO\_PLAUS.

## Application conditions

```

Initialisation:      If          Reset   or  Transition:  LV_IGK = 0 -> 1
                       then          LV_INH_DIAG_TCO_PLAUS= 0
                       endif

```

**Recurrence:** 1000 ms

### Activation:

```

If          LV_CDN_DIAG_TCO_PLAUS = 1
then          (Calculation of the TCO plausi. diagnosis interface parameter enabled)
endif

```

### Deactivation:

```

If          LV_CDN_DIAG_TCO_PLAUS = 0
then          (Calculation of the TCO plausi. diagnosis interface parameter disabled)
endif

```

## Formula section:

```

If          LV_ERR_TCO_EL = 0                                and
                LV_ERR_TCO_GRD = 0                            and
                LV_ERR_TCO_STUCK = 0                          and
                LV_ERR_TCO_STUCK_RNG = 0                      and
                LV_ERR_TIA_EL = 0                              and
                LV_ERR_TIA_PLAUS = 0                          and
                LV_ERR_TIA_GRD = 0
then          LV_INH_DIAG_RBM_TCO_PLAUS = 0
else          LV_INH_DIAG_RBM_TCO_PLAUS = 1
endif

If          LV_ES = 0                                        and
                LV_IGK = 1                                    and
                LV_INH_DIAG_RBM_TCO_PLAUS = 0
then          LV_INH_DIAG_TCO_PLAUS = 0
else          LV_INH_DIAG_TCO_PLAUS = 1
endif

```

## B.63.2 Interface for Rate - Based - Monitoring

### FUNCTION DESCRIPTION:

#### General information:


With this module the interface between the TCO\_PLAUS monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_TCO\_PLAUS data.

Within STATE\_RBM\_TCO\_PLAUS, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)

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**Application conditions:***Initialisation :*

at LV\_DC 0 1 transition :

bit 0, bit 1 and bit 2 of STATE\_RBM\_TCO\_PLAUS = 0

on failure memory reset :

bit 1 of STATE\_RBM\_TCO\_PLAUS = 0

*Recurrence:* 1 s

*Activation:* LV\_DC 0 1 transition **and** LV\_DC = 1

**Formula section:**At LV\_DC 0 1 transition

The pending status of the following failures has to be checked only once :

LV_ERR_TCO_EL	LV_ERR_TCO_STUCK	LV_ERR_TCO_GRD	LV_ERR_TIA_EL
LV_ERR_TIA_PLAUS	LV_ERR_TCO_STUCK_R NG	LV_ERR_TIA_GRD	

**If(1)** { CPU optimization at LV\_DC 0 1 transition }

CTR\_ERR\_DYN\_NR <> 0 { the dynamic failure memory isn t empty }

**Then(1)**

**While** bit 1 of STATE\_RBM\_TCO\_PLAUS = 0 **do**

with each XX failure of the above list :

ACTION\_ERRM\_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

**If(2)** XX has a pending status

**Then(2)**

bit 1 of STATE\_RBM\_TCO\_PLAUS = 1

**Endif(2)**

**Endwhile**

**Else(1)**

{ the dynamic failure memory is empty }

No action

**Endif(1)**

Every 1 s :

**If** bit 0 of STATE\_RBM\_TCO\_PLAUS = 0

**Then**

**If** LV\_END\_DIAG\_RBM\_TCO\_PLAUS = 1

**Then**

bit 0 of STATE\_RBM\_TCO\_PLAUS = 1

**Endif**

**Endif**

**If** bit 1 of STATE\_RBM\_TCO\_PLAUS = 0

**Then**

**If** LV\_INH\_DIAG\_RBM\_TCO\_PLAUS = 1

**Then**

bit 1 of STATE\_RBM\_TCO\_PLAUS = 1

**Endif**

**Endif**

**If** bit 2 of STATE\_RBM\_TCO\_PLAUS = 0

**Then**

**If** LV\_CDN\_CST\_RBM = 1

```


Then    bit 2 of STATE_RBM_TCO_PLAUS = 1
Endif

```

```

Endif

```

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## B.64 Temperature sensor stuck low diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TCO_STUCK	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Symptom for coolant temperature stuck signal error					
LV_CDN_DIAG_TCO_STUCK	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature stuck signal diagnosis conditions					
LV_END_DIAG_TCO_STUCK	O/V	0... 1H	0 ...1	1	-
Boolean for end of coolant temperature stuck signal diagnosis					
LV_ERR_TCO_STUCK	O/V	0... 1H	0 ...1	1	-
TCO Stuck signal detected					
TCO_MES_DIF_DIAG_TCO_STUCK	V	0... FEH	0... 190.5	0.75	°C
Difference of measured coolant temperature values for coolant temperature stuck signal diagnosis					
TCO_MES_MAX_DIAG_TCO_STUCK	V	0... FEH	-48... 142.5	0.75	°C
Measured coolant temperature maximum value for coolant temperature stuck signal diagnosis					
TCO_MES_MIN_DIAG_TCO_STUCK	V	0... FEH	-48... 142.5	0.75	°C
Measured coolant temperature minimum value for coolant temperature stuck signal diagnosis					
TCO_SUB_DIF_DIAG_TCO_STUCK	V	0... FEH	0... 190.5	0.75	°C
Difference of substitute coolant temperature values for coolant temperature stuck signal diagnosis					
TCO_SUB_MAX_DIAG_TCO_STUCK	V	0... FEH	-48... 142.5	0.75	°C
Substitute coolant temperature maximum value for coolant temperature stuck signal diagnosis					
TCO_SUB_MIN_DIAG_TCO_STUCK	V	0... FEH	-48... 142.5	0.75	°C
Substitute coolant temperature minimum value for coolant temperature stuck signal diagnosis					

### Input data:


LV_CDN_VB_MIN_DIAG {p. 1185}	LV_INH_DIAG_TCO_ STUCK {p. 4502}	LV_ST_END {p. 1720}	TCO_MES {p. 1100}
TCO_ST {p. 1100}	TCO_SUB {p. 1105}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TCO_MES_DIF_DIAG_TCO_STUCK	-	0... FEH	0... 190.5	0.75	°C
LDPM_TCO_ST_1_ENTE	6	0... FEH	-48... 142.5	0.75	°C
Minimum increase of the TCO value for the coolant temperature stuck signal diagnosis					
IP_TCO_SUB_DIF_DIAG_TCO_STUCK	-	0... FEH	0... 190.5	0.75	°C
LDPM_TCO_ST_1_ENTE	6	0... FEH	-48... 142.5	0.75	°C
Minimum increase of the TCO_SUB value for the coolant temperature stuck signal diagnosis					

### FUNCTION DESCRIPTION:

### General information:

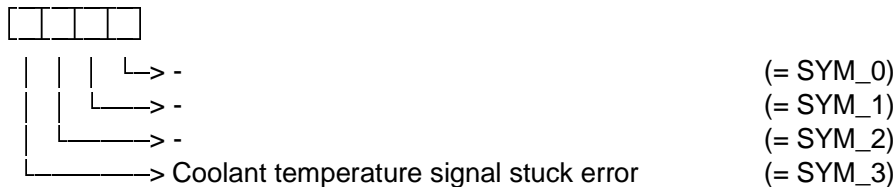
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The purpose of the signal stuck diagnosis is to detect a stuck measured coolant temperature sensor signal. The diagnosis function checks if after a variation of the calculated coolant temperature substitute value (TCO\_SUB) also a variation of the measured coolant temperature value (TCO\_MES) is detected.

The diagnosis is performed only once per engine run. The symptom of the error code is not handled by anti-bouncing.

### Description:

Error-symptoms are defined to this diagnosis function as following:



### Application conditions

**Initialisation at Exit start (EXIT\_ST):**

```

LV_ERR_TCO_STUCK = 0
LV_CDN_DIAG_TCO_STUCK = 0
LV_END_DIAG_TCO_STUCK = 0
ERR_SYM_TCO_STUCK = NO_SYM
TCO_MES_DIF_DIAG_TCO_STUCK = 0°C
TCO_SUB_DIF_DIAG_TCO_STUCK = 0°C
TCO_MES_MIN_DIAG_TCO_STUCK = 142.5°C
TCO_MES_MAX_DIAG_TCO_STUCK = -48°C
TCO_SUB_MIN_DIAG_TCO_STUCK = TCO_SUB
TCO_SUB_MAX_DIAG_TCO_STUCK = TCO_SUB

```

**Recurrence:** 1000 ms

**Activation:** LV\_ST\_END = 1

**Deactivation:** LV\_ST\_END = 0

### Formula section:

```

if                LV_CDN_VB_MIN_DIAG = 1                and
                   LV_INH_DIAG_TCO_STUCK = 0                and
                   LV_END_DIAG_TCO_STUCK = 0
then              LV_CDN_DIAG_TCO_STUCK = 1
else              LV_CDN_DIAG_TCO_STUCK = 0
endif

```

**IF(1)** LV\_CDN\_DIAG\_TCO\_STUCK = 1

**THEN(1)**

Calculation of the coolant temperature-boundary values:

**if(2)** TCO\_MES < TCO\_MES\_MIN\_DIAG\_TCO\_STUCK

**then(2)** TCO\_MES\_MIN\_DIAG\_TCO\_STUCK = TCO\_MES

**else(2)** TCO\_MES\_MIN\_DIAG\_TCO\_STUCK = TCO\_MES\_MIN\_DIAG\_TCO\_STUCK

**endif(2)**

**if(2)** TCO\_MES > TCO\_MES\_MAX\_DIAG\_TCO\_STUCK

**then(2)** TCO\_MES\_MAX\_DIAG\_TCO\_STUCK = TCO\_MES

```

else(2)      TCO_MES_MAX_DIAG_TCO_STUCK = TCO_MES_MAX_DIAG_TCO_STUCK
endif(2)
If(2)        TCO_SUB < TCO_SUB_MIN_DIAG_TCO_STUCK
then(2)      TCO_SUB_MIN_DIAG_TCO_STUCK = TCO_SUB
else(2)      TCO_SUB_MIN_DIAG_TCO_STUCK = TCO_SUB_MIN_DIAG_TCO_STUCK
endif(2)
If(2)        TCO_SUB > TCO_SUB_MAX_DIAG_TCO_STUCK
then(2)      TCO_SUB_MAX_DIAG_TCO_STUCK = TCO_SUB
else(2)      TCO_SUB_MAX_DIAG_TCO_STUCK = TCO_SUB_MAX_DIAG_TCO_STUCK
endif(2)

```

Calculation of the coolant temperature-difference values:

```

TCO_MES_DIF_DIAG_TCO_STUCK =
  | TCO_MES_MAX_DIAG_TCO_STUCK - TCO_MES_MIN_DIAG_TCO_STUCK |
TCO_SUB_DIF_DIAG_TCO_STUCK =
  | TCO_SUB_MAX_DIAG_TCO_STUCK - TCO_SUB_MIN_DIAG_TCO_STUCK |

```


Error detection:

```

If (2)      TCO_SUB_DIF_DIAG_TCO_STUCK >
             IP_TCO_SUB_DIF_DIAG_TCO_STUCK

then (2)
  if (3)    TCO_MES_DIF_DIAG_TCO_STUCK <
             IP_TCO_MES_DIF_DIAG_TCO_STUCK
  then (3)  LV_ERR_TCO_STUCK = 1                (without debounce)
             ERR_SYM_TCO_STUCK = SYM_3
             LV_END_DIAG_TCO_STUCK = 1
  else (3)  LV_ERR_TCO_STUCK = 0                (without debounce)
             ERR_SYM_TCO_STUCK = NO_SYM
             LV_END_DIAG_TCO_STUCK = 1
  endif (3)
endif (2)
ENDIF(1)

```

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## B.65 Communication interface

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_DTC [NC_NR_ERR_DYN]	-	0... FH	0... 15	1	-
Symptom calculation used by the API communication					
IDX_TMP_RBM	V	0... FFH	0... 255	1	-
Temporary current position, within the list [0 ... (NC_NR_DIAG_RBM-1)], of the monitor with the lowest ratio					
LV_MKD_MOD	O	0... 1H	0 ...1	1	-
Marked Mode					
RATIO_TMP_RBM	O	0... 200498A4H	0... 65535.0001	122e-6	-
Temporary variable used to store the lowest Numerator/Denominator ratio of the monitor located at IDX_TMP_RBM position					
SYM_CYL_DTC_MIS_A	-	0... FFFFH	0... 65535	1	-
Cylinder calculation with misfire A used by the API communication					
SYM_CYL_DTC_MIS_B1	-	0... FFFFH	0... 65535	1	-
Cylinder calculation with misfire B1 used by the API communication					
SYM_CYL_DTC_MIS_B4	-	0... FFFFH	0... 65535	1	-
Cylinder calculation with misfire B4 used by the API communication					

### Input data:

C_ERR_CLAS_XX {p. 5811}	CTR_ABC_END_DIAG_XX {p. 4640}	CTR_ABC_XX {p. 4640}	CTR_CDN_OBD_RBM {p. 5858}
CTR_CDN_RBM [NC_NR_DIAG_RBM] {p. 5858}	CTR_COMP_RBM [NC_NR_DIAG_RBM] {p. 5858}	CTR_DC [NC_NR_ERR_DYN] {p. 5767}	CTR_ERR_DYN_NR {p. 5767}
CTR_FRC [NC_NR_ERR_DYN] {p. 5767}	CTR_IGK_CYC_RBM {p. 5858}	CTR_WUP_CYC [NC_NR_ERR_DYN] {p. 5767}	DC_DEC_XX
DC_INC_XX	DC_MAX_XX	ENVD_CUS_CMN [NC_NR_ENVD_CUS_] CMN][NC_NR_ERR_DYN] {p. 5792}	ENVD_CUS_SET_CMN [NC_NR_ENVD_CUS_] SET_CMN][NC_NR_FRF_] SET][NC_NR_ERR_DYN] {p. 5792}
ENVD_CUS_SET_SPC [NC_NR_ENVD_CUS_] SET_SPC][NC_NR_FRF_] SET][NC_NR_ERR_DYN] {p. 5792}	ENVD_OBD [NC_NR_ENVD_OBD][NC_] NR_ERR_DYN] {p. 5792}	ERR_SYM_LST [NC_NR_ERR_DYN] {p. 5756}	ERR_SYM_MEM [NC_NR_ERR_DYN] {p. 5756}
ERR_SYM_PERM [NC_NR_ERR_PERM] {p. 5842}	ERR_SYM_XX {p. 4581}	ID_ERR_DTC_MIS {p. 5756}	ID_ERR_DTC_XX {p. 5757}
LV_CDN_DIAG_XX {p. 4581}	LV_DC {p. 5746}	LV_DC_MAX [NC_NR_ERR_DYN] {p. 5767}	LV_END_DIAG_XX {p. 4581}
LV_ERR_CFM [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_DC [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_DISA [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_MEM_XX {p. 5767}

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LV_ERR_TMP [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_XX	LV_READY_XX {p. 5881}	NC_CYL_NR {p. 1526}
NC_NR_DIAG_RBM {p. 5871}	NC_NR_DTC_FMT {p. 5757}	NC_RBM_BPA {p. 5871}	NC_RBM_CAT_1 {p. 5872}
NC_RBM_CAT_2 {p. 5872}	NC_RBM_EG_1 {p. 5872}	NC_RBM_EGR_VVT {p. 5872}	NC_RBM_EGR_VVT_DSL {p. 5872}
NC_RBM_EVAP {p. 5872}	NC_RBM_LS_DOWN_1 {p. 5872}	NC_RBM_LS_DOWN_2 {p. 5872}	NC_RBM_LS_UP_1 {p. 5872}
NC_RBM_LS_UP_2 {p. 5872}	NC_RBM_NMHC {p. 5872}	NC_RBM_NT {p. 5872}	NC_RBM_PF {p. 5872}
NC_RBM_RCAT {p. 5872}	NLC_OBD_DSL {p. 5789}	NLC_OBD_RBM_ENA {p. 645}	NLC_TREAT_DIAG_MIS {p. 6265}
PRI_CONF_XX {p. 5811}	STATE_READY_OBD_1 {p. 5881}	STATE_READY_OBD_2 {p. 5881}	STATE_READY_OBD_3 {p. 5881}
SYM_CYL_LST_MIS_A {p. 5756}	SYM_CYL_LST_MIS_B1 {p. 5756}	SYM_CYL_LST_MIS_B4 {p. 5756}	SYM_CYL_MEM_MIS_A {p. 5756}
SYM_CYL_MEM_MIS_B1 {p. 5756}	SYM_CYL_MEM_MIS_B4 {p. 5756}	SYM_CYL_PERM_MIS_A {p. 5842}	SYM_CYL_PERM_MIS_B1 {p. 5842}
SYM_CYL_PERM_MIS_B4 {p. 5842}	WAL_CONF_XX {p. 5811}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_READY_CMPL_OBD_1	-	0... FFH	0... 255	1	-
Readiness MIS, FSD, CC directly set to ready					
C_STATE_READY_OBD_1	-	0... FFH	0... 255	1	-
Status configuration for readiness code (continuous tests)					
C_STATE_READY_OBD_2	-	0... FFH	0... 255	1	-
Status configuration for readiness code (non continuous tests)					
C_STATE_READY_OBD_3	-	0... FFH	0... 255	1	-
Status configuration for customer specific readiness code					


**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ERR_DTC_REQ_CUS	-	0... 1H	0 ...1	1	-
This bit shall be set to 0 (SYMPTOM) to read customer DTC by symptom This bit shall be set to 1 (FAILURE) to read customer DTC by failure					
NC_ERR_DTC_REQ_OBD	-	0... 1H	0 ...1	1	-
This bit shall be set to 0 (SYMPTOM) to read OBD DTC by symptom This bit shall be set to 1 (FAILURE) to read OBD DTC by failure					
NLC_OBD_FRF_PND	-	0... 1H	0 ...1	1	-
Defines freeze frame strategy for OBD freeze frame for Mode 02h (0: FRF on confirmed error /1: FRF on pending error)					

**Action definition**

<b>ACTION_ERRM_ActivateMarkedMode</b> (<IN>,<MarkedMode>)	Mode: O
This API shall be used to activate/deactivate the marked mode.	

<b>ACTION_ERRM_ClearRbmStatistics</b> (<OUT>,<PRM_RESULTCLRINFO>)	Mode: O
This action clears all the Rate-Based Monitoring statistics	

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<b>ACTION_ERRM_ClrInfoByDtc</b> (<IN>,<DtclDtcIdentifier>,<IN>,<LevelOfDtc>,<OUT>,<ResultClrInfo>)	Mode: O
This action clear the failure in dynamic memory associated to a DTC number.	

<b>ACTION_ERRM_ClrInfoByTypeOfDtc</b> (<IN>,<TypeOfDtc>,<OUT>,<ResultClrInfo>)	Mode: O
This action clear all the failure in dynamic memory associated to DTC with a certain type.	

<b>ACTION_ERRM_ControlDtcSettings</b> (<IN>,<MarkedMode>)	Mode: O
This action allows to activate or deactivate the marked mode. In this mode all new failure which appears are marked and then erased when we leave this mode.	

<b>ACTION_ERRM_ReadDtcByDtc</b> (<IN>,<DtclDtcIdentifier>,<IN>,<LevelOfDtc>,<OUT>,<ResultDtc>)	Mode: O
This action returns a result to learn if a DTC number of a certain level is stored in memory.	

<b>ACTION_ERRM_ReadDtcByTypeOfDtc</b> (<IN>,<TypeOfDtc>,<IN>,<LevelOfDtc>,<INOUT>,<ListofDtc>,<OUT>,<ResultDtc>)	Mode: O
This action returns a list of DTC. All the DTC returns have the same type defined by the parameter TypeOfDtc	

<b>ACTION_ERRM_ReadDtcLevelByDtcLevel</b> (<IN>,<DtclDtcIdentifier>,<IN>,<LevelOfDtc>,<INOUT>,<ListofDtc>,<OUT>,<ResultDtc>)	Mode: O
This action returns a Customer DTCLevel of Law DTCLevel which is stored in dynamic memory or returns a Law DTCLevel of Customer DTCLevel which is stored in dynamic memory.	

<b>ACTION_ERRM_ReadFrFByDtc</b> (IN<PRM_TYPEOFFF> ,IN<PRM_FFIDENTIFIER> ,IN<PRM_DTCIDENTIFIER> ,IN<PRM_LEVELOFDTC> ,INOUT<PRM_FRF> ,OUT<PRM_RESULTFRF>)	Mode: O
This API returns a freeze frame or a part of freeze frame.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_TYPEOFFF	in	0... FFFFH	0... 65535	1	-
Type of Freeze Frame					
PRM_FFIDENTIFIER	in	0... FFH	0... 255	1	-
Freeze frame number					
PRM_DTCIDENTIFIER	in	0... FFH	0... 255	1	-
DTC number					
PRM_LEVELOFDTC	in	01H 02H	LAW CUS	-	-
OBD or Customer DTC					
PRM_FRF	inout	0... FFH	0... 255	1	-
Pointer to buffer for Freeze frame					
PRM_RESULTFRF	out	0... FFH	0... 255	1	-
Result of Freeze frame reading					

<b>ACTION_ERRM_ReadInfoByDtc</b> (<IN>,<DtclDtcIdentifier>,<IN>,<LevelOfDtc>,<IN>,<InfDtcIdentifier>,<INOUT>,<ListofDtcInfo>,<OUT>,<ResultDtc>)	Mode: O
This action returns a structure of data of a DTC, which is stored in dynamic memory.	

<b>ACTION_ERRM_ReadInfoByTypeOfDtc</b> (<IN>,<TypeOfDtc>,<IN>,<InfDtcIdentifier>,<INOUT>,<ListofDtcInfo>,<OUT>,<ResultDtc>)	Mode: O
This action returns a structure of data of DTCs. All the data returned are related to DTC, which have the same type defined by the parameter TypeOfDtc and which are stored in dynamic memory.	

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<b>ACTION_ERRM_ReadQuantityOfDtc</b> (IN<PRM_TYPEOFDTC>,IN<PRM_LEVELOFDTC>,INOUT<PRM_QUANTITY>, OUT<PRM_RESULTQUANTITY>)	Mode: O
This API returns the quantity of DTC with a certain type, which are stored in memory	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_TYPEOFDTC	in	1H	ALL	-	-
		8H	PRESENT		
		10H	PENDING		
		20H	CONFIRMED		
		40H	DISAPPEARED		
		80H	MARKED		
		100H	NOT_MARKED		
		200H	OBD		
400H	PERMANENT				
Type of Dtc					
PRM_LEVELOFDTC	in	01H	LAW	-	-
		02H	CUS		
Allowing to access to OBD error codes or customer error codes.					
PRM_QUANTITY	inout	0... FFH	0... 255	1	-
Software structure filled up with a quantity of DTC					
PRM_RESULTQUANTITY	out	0H	NO_DTC_	-	-
		1H	DTC_PRESENT		
Result to say if the result of the API is valid					

<b>ACTION_ERRM_ReadReadinessCodCus</b> (<INOUT>,<ReadinessCode>,<OUT>,<ResultReadinessCode>)	Mode: O
This action allows to read the customer specific readiness code information CARB_OTHER/NO_CARB	

<b>ACTION_ERRM_ReadReadinessCode</b> (INOUT<PRM_READINESSCODE>,OUT<PRM_RESULTREADINESSCODE>)	Mode: O				
This API returns the readiness code information required for service01h, PID01h, data B-D					
Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_READINESSCODE	inout	0... FFFFFFFFH	0... 4294967295	1	-
Software structure filled up with readiness code					
PRM_RESULTREADINESSCODE	out	0H	NEGATIVE_	-	-
		1H	POSITIVE_		
Result to say if the API is done or not					

<b>ACTION_ERRM_SelectRbmByGroup</b> (<IN>,<PRM_GROUPNAME>,<INOUT>,<PRM_NUMERATOR>,<INOUT>,<PRM_DENOMINATOR>,<OUT>,<PRM_RESULTRBMDBYGROUP>)	Mode: O
This action determines within one single group, the data with lowest ratios.	

<b>ACTION_ERRM_SelectRbmData</b> (<INOUT>,<PRM_CTR_MOD_9_RBM[36]>,<OUT>,<PRM_RES_MOD_9>)	Mode: O
This API calculates and returns the Rate-Based Monitoring data to be transmitted to the Scan-Tool, when requested by the Mode 09\$ (InfoType \$08).	

**Configuration data detailed description:**

NC\_ERR\_DTC\_REQ\_OBD : This bit shall be set to 0 (SYMPTOM) to read OBD DTC by symptom.  
This bit shall be set to 1 (FAILURE) to read OBD DTC by failure.

NC\_ERR\_DTC\_REQ\_CUS : This bit shall be set to 0 (SYMPTOM) to read Customer DTC by symptom.  
This bit shall be set to 1 (FAILURE) to read Customer DTC by failure.

NLC\_OBD\_FRF\_PND : Definition the EOBD/CARB freeze frame strategy, as follow :  
0 : EOBD/CARB freeze frame data of Mode 02h will be returned after detection of a confirmed failure.  
1 : EOBD/CARB freeze frame data of Mode 02h will be returned :  

- after detection of a confirmed emission relevant failure if confirmed in memory
- after pending emission relevant detection if not confirmed in memory

**B.65.1 Import Actions**

ACTION_ERRM_EraseErr ( IN <IDX> )
ACTION_ERRM_InitReadiness ( )
ACTION_ERRM_ClcPermanentByErr ( IN <PRM_IDX_ERR> )
ACTION_ERRM_GetReadyClass ( IN <PRM_IDX_ERR >, OUT <PRM_READY_CLAS> )
ACTION_ERRM_ClcPermanentIniErrm ( )

**FUNCTION DESCRIPTION:**

**General information:**

This chapter provides an open interface for other module which have link with error management functionality (communication module for instance). This interface is described with API (Application Programming Interface) to provide access to dynamic data flow in contrast to static data flow accessed directly through variable names.

By calling API, you can access in failure memory data related to Error Management such freeze frame and DTC stored, readiness code state and so on.

An API can have some input parameters.

Results returns by the API are defined as output parameters.

To returns functional results, a software structure (buffer) is used that allows to returns some data with not fixed size (a list of data for instance).

This structure is defined by the parameter in INOUT.

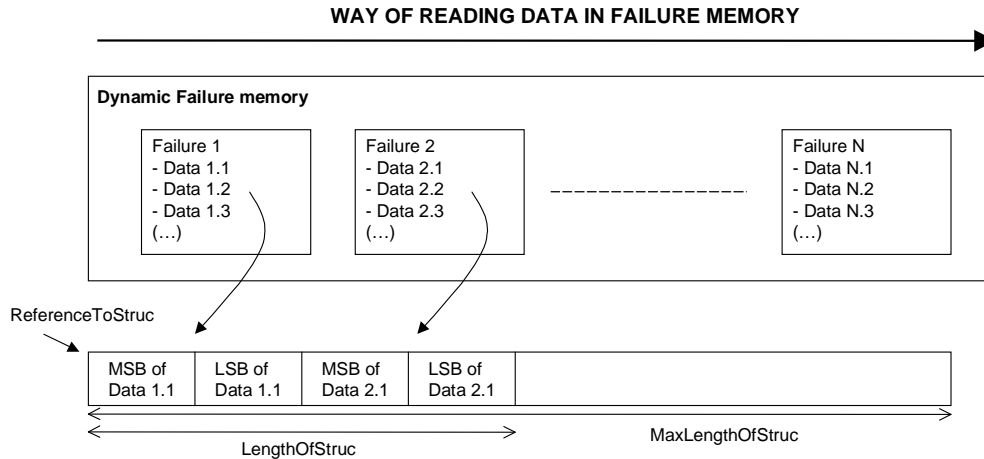
In the output parameter, a flag indicate if the software buffer is full or not.

**Way of reading the failure memory :**

API has to read through the failure memory to access some data related to Error Management.

In this case the failure memory is read in the order following the first failure entry, that means the oldest one. Thus the software structure is fill in first with data related to first failure entry (if need), then with data related to second failure entry (if need) and so on.

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**GENERAL IMPORTANT REMARK:**

**Please take care that the parameter PERMANENT is only linked to permanent memory (e.g. no impact on dynamic memory). For all services err\_sym\_dtc is still calculated with err\_sym\_mem and err\_sym\_lst (no link to err\_sym\_perm)**

For the APIs :

- ACTION\_ERRM\_ReadDtcByDtc,
- ACTION\_ERRM\_ReadInfoByTypeOfDtc,
- ACTION\_ERRM\_ReadInfoByDtc,
- ACTION\_ERRM\_ReadDtcLevelByDtcLevel,
- ACTION\_ERRM\_ClrInfoByTypeOfDtc

It's forbidden to use the parameter PERMANENT for TypeOfDTC

**For Mode 0Ah, the two APIs which must be used are**

- ACTION\_ERRM\_ReadQuantityOfDtc with PERMANENT parameter for TypeOfDtc
- ACTION\_ERRM\_ReadDtcByTypeOfDtc with PERMANENT parameter for TypeOfDtc

**Description of parameters IN, OUT, INOUT used by API:**


The INPUT parameters used by API and their authorised value are defined below :

TypeOfDtc : Type of Dtc

Authorised values for TypeOfDtc are :

- ALL : all the DTC stored in Dynamic memory.  
Failures concerned in error management : LV\_ERR\_MEM\_XX = 1
- ALL FIRST: all the DTC stored at the first time in Dynamic memory.  
Failures concerned in error management : LV\_ERR\_MEM\_XX = 1
- ALL LAST: all the DTC stored at the last time in Dynamic memory.  
Failures concerned in error management : LV\_ERR\_MEM\_XX = 1
- PRESENT : all the DTC of present failure stored in dynamic memory.  
Failures concerned in error management : LV\_ERR\_MEM\_XX = 1  
and LV\_ERR\_XX = 1
- PENDING : all the DTC of pending failure stored in dynamic memory.  
Failures concerned in error management : LV\_ERR\_MEM\_XX = 1

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and LV\_ERR\_PND[IDX] = 1

- TEMPORARY : all the DTC of temporary failure stored in dynamic memory.  
Failures concerned in error management : LV\_ERR\_MEM\_XX = 1  
and LV\_ERR\_TMP[IDX] = 1
- CONFIRMED : all the DTC of confirmed failure stored in dynamic memory.  
Failures concerned in error management : LV\_ERR\_MEM\_XX = 1  
and LV\_ERR\_CFM[IDX] = 1
- DISAPPEARED : all the DTC of disappeared failure stored in dynamic memory.  
Failures concerned in error management : LV\_ERR\_MEM\_XX = 1  
and LV\_ERR\_DISA[IDX] = 1
- MARKED : all DTC of failure marked and stored in dynamic memory.  
Failures concerned in error management : LV\_ERR\_MEM\_XX = 1  
and LV\_ERR\_MKD[IDX] = 1
- NOT MARKED : all DTC of failure not marked and stored in dynamic memory.  
Failures concerned in error management : LV\_ERR\_MEM\_XX = 1  
and LV\_ERR\_MKD[IDX] = 0
- OBD : all DTC related to emission relevant failure.  
Failures concerned in error management : LV\_ERR\_MEM\_XX = 1  
and a Carb/EOBD failure :  
(emission relevant)  
(definition see failure class specification)
- OBD FIRST: all the DTC stored at the first time in Dynamic memory related to emission relevant failure.  
Failures concerned in error management : LV\_ERR\_MEM\_XX = 1  
and a Carb/EOBD failure :  
(emission relevant)  
(definition see failure class specification)
- OBD LAST: all the DTC stored at the last time in Dynamic memory.related to emission relevant failure.  
Failures concerned in error management : LV\_ERR\_MEM\_XX = 1  
and a Carb/EOBD failure :  
(emission relevant)  
(definition see failure class specification)

- PERMANENT : all the DTC of permanent fault memory  
Failures concerned in error management : LV\_ERR\_PERM[IDX\_PERM] = 1
- Logical AND combination between these values.

For instance : PRESENT and CONFIRMED are failure in error management with flags : LV\_ERR\_MEM\_XX = 1 and LV\_ERR\_XX = 1 and LV\_ERR\_CFM[IDX] = 1.


*Calculation of ERR\_SYM\_DTC[IDX] and SYM\_CYL\_DTC\_XX following the TypeOfDtc parameter:*

For all failure except the misfiring failure treated by type :

**case** TypeOfDtc

ALL : ERR\_SYM\_DTC[IDX] = ERR\_SYM\_LST[IDX] **or** ERR\_SYM\_MEM[IDX]  
 ALL FIRST: ERR\_SYM\_DTC[IDX] = ERR\_SYM\_MEM[IDX]  
 ALL LAST : ERR\_SYM\_DTC[IDX] = ERR\_SYM\_LST[IDX]  
 PRESENT : ERR\_SYM\_DTC[IDX] = ERR\_SYM\_LST[IDX]  
 PENDING : ERR\_SYM\_DTC[IDX] = ERR\_SYM\_LST[IDX]  
 TEMPORARY : ERR\_SYM\_DTC[IDX] = ERR\_SYM\_MEM[IDX]  
 CONFIRMED : ERR\_SYM\_DTC[IDX] = ERR\_SYM\_MEM[IDX]

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DISAPPEARED : ERR\_SYM\_DTC[IDX] = ERR\_SYM\_MEM[IDX]  
 MARKED : ERR\_SYM\_DTC[IDX] =  
           ERR\_SYM\_LST[IDX] or ERR\_SYM\_MEM[IDX]  
 NOT MARKED : ERR\_SYM\_DTC[IDX] =  
           ERR\_SYM\_LST[IDX] or ERR\_SYM\_MEM[IDX]  
 OBD : ERR\_SYM\_DTC[IDX] = ERR\_SYM\_LST[IDX] or ERR\_SYM\_MEM[IDX]  
 OBD FIRST : ERR\_SYM\_DTC[IDX] = ERR\_SYM\_MEM[IDX]  
 OBD LAST : ERR\_SYM\_DTC[IDX] = ERR\_SYM\_LST[IDX]  
 (!! independant of dynamic memory !!)  
 PERMANENT : ERR\_SYM\_PERM[IDX\_PERM]

**End case**

For the misfiring failure treated by type (XX = MIS\_A, MIS\_B1 or MIS\_B4)

**IF** NLC\_TREAT\_DIAG\_MIS = 0

**case** TypeOfDtc

ALL : SYM\_CYL\_DTC\_XX = SYM\_CYL\_LST\_XX or SYM\_CYL\_MEM\_XX  
 ALL FIRST : SYM\_CYL\_DTC\_XX = SYM\_CYL\_MEM\_XX  
 ALL LAST : SYM\_CYL\_DTC\_XX = SYM\_CYL\_LST\_XX  
 PRESENT : SYM\_CYL\_DTC\_XX = SYM\_CYL\_LST\_XX  
     PENDING : SYM\_CYL\_DTC\_XX = SYM\_CYL\_LST\_XX  
 TEMPORARY : SYM\_CYL\_DTC\_XX = SYM\_CYL\_MEM\_XX  
 CONFIRMED : SYM\_CYL\_DTC\_XX = SYM\_CYL\_MEM\_XX  
 DISAPPEARED : SYM\_CYL\_DTC\_XX = SYM\_CYL\_MEM\_XX  
 MARKED : SYM\_CYL\_DTC\_XX = SYM\_CYL\_LST\_XX or SYM\_CYL\_MEM\_XX  
 NOT MARKED : SYM\_CYL\_DTC\_XX =  
           SYM\_CYL\_LST\_XX or SYM\_CYL\_MEM\_XX  
 OBD : SYM\_CYL\_DTC\_XX = SYM\_CYL\_LST\_XX or SYM\_CYL\_MEM\_XX  
 OBD FIRST : SYM\_CYL\_DTC\_XX = SYM\_CYL\_MEM\_XX  
 OBD LAST : SYM\_CYL\_DTC\_XX = SYM\_CYL\_LST\_XX  
 PERMANENT : SYM\_CYL\_DTC\_XX = SYM\_CYL\_MEM\_XX

**End case**

**ENDIF** { NLC\_TREAT\_DIAG\_MIS = 0 }

For the logical AND combination between the different TypeOfDtc values, the ERR\_SYM\_DTC[IDX] or SYM\_CYL\_DTC\_XX will be calculated with a binary logical AND from the associated carrier symptom.

For instance : PRESENT and CONFIRMED are failure in error management with flags : LV\_ERR\_MEM\_XX = 1 and LV\_ERR\_XX = 1 and LV\_ERR\_CFM[IDX] = 1.

It means : ERR\_SYM\_DTC[IDX] = ERR\_SYM\_LST[IDX] & ERR\_SYM\_MEM[IDX],  
           SYM\_CYL\_DTC\_XX = SYM\_CYL\_LST\_XX & SYM\_CYL\_MEM\_XX.

*Calculation of ERR\_SYM\_DTC[IDX] and SYM\_CYL\_DTC\_XX in case the API doesn't use the TypeOfDtc parameter :*

ERR\_SYM\_DTC[IDX] = ERR\_SYM\_LST or ERR\_SYM\_MEM[IDX]  
 SYM\_CYL\_DTC\_XX = SYM\_CYL\_LST\_XX or SYM\_CYL\_MEM\_XX

DtclIdentifier : Number of the DTC (identifier)


Authorised value for DtclIdentifier are : NO\_DTC, ...<integer>

TypeOfFF : Type of Freeze Frame

Authorised values for TypeOfFF are :

- LAW : part of the freeze frame defined by the law (Carb)

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- CUS\_CMN : part of the freeze frame defined for the customer and not in the set
- CUS\_SET : part of the freeze frame defined for the customer and in the set
- All combination of these values.

LevelOfDtc : Allowing to access to OBD error codes or customer error codes.

Authorised values for LevelOfDtc are :

- LAW : the DTC corresponds to a OBD DTC (Carb)
- CUS : the DTC corresponds to a specific customer DTC

FFIdentifier : Number of FF (identifier)

Authorised values for FFIdentifier are :

- FIRST : first freeze frame is requested
- SECOND : second freeze frame is request
- ...

MarkedMode : State of the marked mode


Authorised values for MarkedMode are :

- ON : marked mode activation : all failure stored are marked.
- OFF : marked mode deactivation (normal mode)

InfIdentifier : Identifier for the diagnosis related information which is returned by the API (only words are returned)

Authorised information for InfIdentifier are (only one information is returned by the API):

- CTR\_ABC\_XX
- CTR\_ABC\_END\_DIAG\_XX
- LV\_END\_DIAG\_XX
- LV\_READY\_XX
- LV\_CDN\_DIAG\_XX
- ERR\_SYM\_XX
- LV\_ERR\_XX
- LV\_ERR\_MEM\_XX
- CTR\_FRC[IDX]
- CTR\_DC[IDX]
- CTR\_WUP\_CYC[IDX]
- ERR\_SYM\_MEM[IDX]
- ERR\_SYM\_LST[IDX]
- ERR\_SYM\_DTC[IDX]
- LV\_ERR\_CFM[IDX]
- LV\_ERR\_DISA[IDX]
- LV\_ERR\_TMP[IDX]
- LV\_ERR\_PND[IDX]
- LV\_ERR\_PERM[IDX]
- LV\_DC\_MAX[IDX]
- LV\_ERR\_DC[IDX]
- LV\_ERR\_MKD[IDX]
- C\_ERR\_CLAS\_XX
- WAL\_CONF\_XX
- PRI\_CONF\_XX
- DC\_INC\_XX
- DC\_DEC\_XX
- DC\_MAX\_XX
- ID\_ERR\_DTC\_XX[0][0]
- ID\_ERR\_DTC\_XX[0][1]
- ID\_ERR\_DTC\_XX[0][2]
- ID\_ERR\_DTC\_XX[0][3]
- ID\_ERR\_DTC\_XX[0][4]

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**if** NC\_NR\_DTC\_FMT = 0  
(Manage 6 DTC per failure)

- ID\_ERR\_DTC\_XX[0][5]

**else**  
(Manage 10 DTC per failure)

- ID\_ERR\_DTC\_XX[1][0]
- ID\_ERR\_DTC\_XX[1][1]
- ID\_ERR\_DTC\_XX[1][2]
- ID\_ERR\_DTC\_XX[1][3]
- ID\_ERR\_DTC\_XX[1][4]

**endif**

Please note that some application incidences can provide additional project specific informations.

The OUTPUT parameters used by API and their authorised value are defined below :

ResultDtc : Result to say if there is some DTC in memory corresponding to the API request

Authorised values for ResultDtc are :

1<sup>st</sup> bit of ResultDtc :

- (0) NO\_DTC\_PRESENT : there is no DTC in memory corresponding to the API request
- (1) DTC\_PRESENT : there is some DTC in memory corresponding to the API request

2<sup>nd</sup> bit of ResultDtc :

- (0) NO\_BUFFER\_FULL : The software buffer used to return data is not full
- (1) BUFFER\_FULL : The software buffer used to return data is full

ResultFrf : Result to say if there is some Freeze Frame in memory corresponding to the API request

Authorised values for ResultFrf are :

1<sup>st</sup> bit of ResultFrf :

- (0) NO\_FRF\_PRESENT : there is no freeze frame in memory corresponding to the API request
- (1) FRF\_PRESENT : there is some freeze frame in memory corresponding to the API request

2<sup>nd</sup> bit of ResultFrf :

- (0) NO\_BUFFER\_FULL : The software buffer used to return data is not full
- (1) BUFFER\_FULL : The software buffer used to return data is full

ResultQuantity : Result to say if the result of the API is valid.

Authorised values for ResultQuantity are :

1<sup>st</sup> bit of ResultQuantity :

- (0) NO\_DTC\_PRESENT : there is no DTC in memory corresponding to the API request
- (1) DTC\_PRESENT : there is some DTC in memory corresponding to the API request

ResultClrInfo : Result to say if the clear DTC made by the API is done or not.

Authorised values for ResultClrInfo are :

1<sup>st</sup> bit of ResultClrInfo :

- (0) INFO\_CLEARED : DTC are cleared by the call of the API
- (1) INFO\_NOT\_CLEARED : no DTC is cleared by the call of the API

ResultReadinessCode : Result to say if the API is done or not.

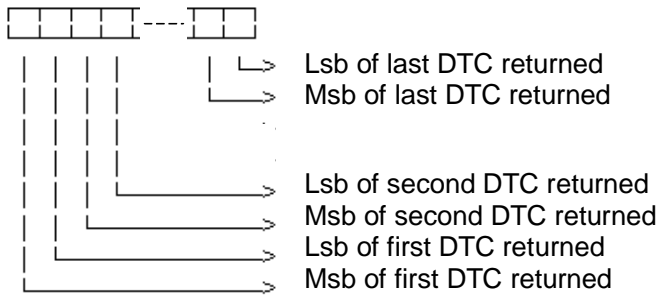
Authorised values for ResultReadinessCode are :

1<sup>st</sup> bit of ResultReadinessCode :

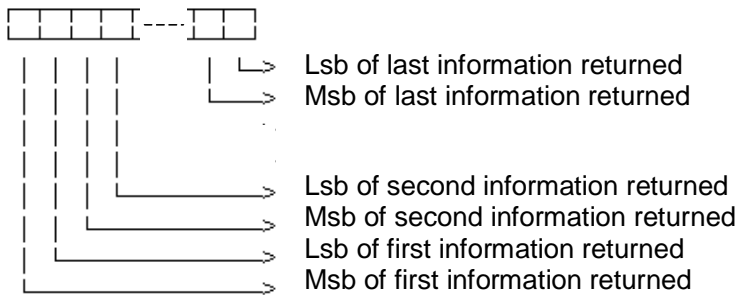
- (0) POSITIVE\_RESPONSE : the call of the API is successful
- (1) NEGATIVE\_RESPONSE : the call of the API is not successful

The INPUT/OUTPUT parameters used by API and their authorised value are defined below :

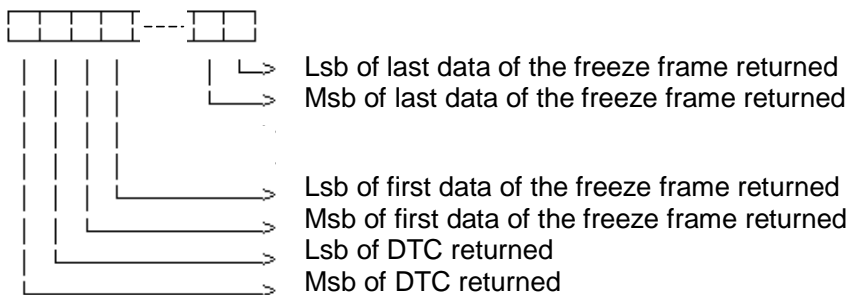
- ListOfDtc : Software structure filled up with a list of DTC



- ListOfDtcInfo : Software structure filled up with a list of DTCInfo



- Quantity : Software structure filled up with a quantity of DTC
- Frf : Software structure filled up with a freeze frame



- ReadinessCode : Software structure filled up with readiness code

## B.65.2 API for reading Diagnostic Trouble Code (DTC)


### B.65.2.1 Request a list of DTCs by type of DTC.

#### Description :

Syntax : ACTION\_ERRM\_ReadDtcByTypeOfDtc (  
 IN <TypeOfDtc>,  
 IN <LevelOfDtc>,  
 INOUT <ListOfDtc>,  
 OUT <ResultDtc> )

Parameter(in) : TypeOfDtc Type of DTC which is requested by the API.  
LevelOfDtc OBD or customer DTC is requested by the API  
 Parameter(out) : ResultDtc Boolean to say if some DTC is in memory

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Parameter(inout) : ListOfDtc                      Software structure fills up with a ListOfDtc

Short Description : This API returns a list of DTCs. All the DTC returns have the same type defined by the parameter TypeOfDtc and the same level defined in LevelOfDtc.

For each failure, if NC\_NR\_DTC\_FMT = 0 then 6 DTC are defined : one DTC for each symptom (OBD or Customer), one OBD global DTC, one customer global DTC else 10 DTC are defined : one OBD DTC for each symptom, one OBD global DTC, one customer specific DTC number for each symptom and one customer global DTC.

When LevelOfDtc = LAW : OBD Dtc is request

If NC\_ERR\_DTC\_REQ\_OBD = SYMPTOM, the DTC is build up following the detected symptom. If more than one symptom is detected, a DTC per symptom detected is returned. There is a particular case for Misfiring failure. For this failure, the DTC number is built up following the cylinder where the misfiring is detected.

If NC\_ERR\_DTC\_REQ\_OBD = FAILURE, the OBD global DTC is returned.

When LevelOfDtc = CUS : Customer Dtc is request

If NC\_ERR\_DTC\_REQ\_CUS = SYMPTOM, the DTC is build up following the detected symptom. If more than one symptom is detected, a DTC per symptom detected is returned. There is a particular case for Misfiring failure. For this failure, the DTC number is built up following the cylinder where the misfiring is detected.

If NC\_ERR\_DTC\_REQ\_CUS = FAILURE, the customer global DTC is returned.

**Application conditions**

**Deactivation :**                      -

**Initialization:**                    -

**Recurrence :**                      -

**Formula section :**

1<sup>st</sup> bit of ResultDtc = NO\_DTC\_PRESENT

2<sup>nd</sup> bit of ResultDtc = NO\_BUFFER\_FULL

**If** TypeOfDtc = PERMANENT

**Then**

**If** CTR\_ERR\_PERM\_NR > 0

**Then**

1<sup>st</sup> bit of ResultDtc = DTC\_PRESENT

**Endif**

**For** IDX\_PERM = 0 to CTR\_ERR\_PERM\_NR -1

**with** XX = ERR\_PERM[IDX\_PERM]

ACTION\_ERRM\_GetReadyClass(XX, PRM\_READY\_CLAS)

**If** PRM\_READY\_CLAS <> 00h (CARB\_MIS)

**Then** Condition for failure traitment is true

**Endif**

**If** NLC\_TREAT\_DIAG\_MIS = 1

**Then** Condition for failure traitment is true

**Endif**


**If** Condition for failure traitment is true

**Then If**                      LevelOfDtc = LAW      (OBD DTC is request)

**Then If** NC\_ERR\_DTC\_REQ\_OBD=SYMPTOM                      (access by symptom)

**Then For**                    each bit i which is set in

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```

ERR_SYM_PERM[IDX_PERM]
software structure fill up with
    ID_ERR_DTC_XX[ 0 ][ i ]
Endfor
Else (access by failure; NC_ERR_DTC_REQ_OBD = FAILURE)
software structure fill up with ID_ERR_DTC_XX[0][4]
Endif
Else (Customer DTC is request ; LevelOfDtc = CUS)
If NC_ERR_DTC_REQ_CUS = SYMPTOM (access by symptom)
Then For each bit i which is set in
ERR_SYM_PERM[IDX_PERM]
software structure fill up with
    ID_ERR_DTC_XX[ NC_NR_DTC_FMT ][ i ]
Endfor
Else (access by failure; NC_ERR_DTC_REQ_CUS = FAILURE)
software structure fill up with
    ID_ERR_DTC_XX
    [NC_NR_DTC_FMT][5-NC_NR_DTC_FMT]
Endif
Endif
Else (particular case for misfiring failure NLC_TREAT_DIAG_MIS = 0)
XX = F (IDX) with XX = MIS_A, MIS_B1 or MIS_B4
If LevelOfDtc = LAW (OBD DTC is request)
Then If SYM_CYL_PERM_XX [12]=1 (Random)
Then software structure fill up with
    ID_ERR_DTC_MIS [ 0 ][ NC_CYL_NR+1]
Endif
If SYM_CYL_PERM_XX [13]=1 (Multiple cylinder)
Then software structure fill up with
    ID_ERR_DTC_MIS [ 0 ][ NC_CYL_NR ]
Endif
For each cylinder bit i which is set in SYM_CYL_PERM_XX
software structure fill up with
    ID_ERR_DTC_MIS[ 0 ][ i ]
Endfor
Else (Customer DTC is request ; LevelOfDtc = CUS)
If SYM_CYL_PERM_XX [12]=1 (Random)
Then software structure fill up with
    ID_ERR_DTC_MIS [ 1 ][ NC_CYL_NR+1]
Endif
If SYM_CYL_PERM_XX [13]=1 (Multiple cylinder)
Then software structure fill up with
    ID_ERR_DTC_MIS [ 1 ][ NC_CYL_NR ]
Endif
For each cylinder bit i which is set in SYM_CYL_PERM_XX
software structure fill up with
    ID_ERR_DTC_MIS[ 1 ][ i ]
Endfor
Endif
Endif
Endfor
Else

```


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```

For each failure IDX stored in dynamic memory,
  If the failure belongs to failures group defined by the parameter TypeOfDtc
  Then 1st bit of ResultDtc = DTC_PRESENT
    ACTION_ERRM_GetReadyClass(XX, PRM_READY_CLAS)
    If PRM_READY_CLAS <> 00h (CARB_MIS)
    Then Condition for failure treatment is true
    Endif
    If NLC_TREAT_DIAG_MIS = 1
    Then Condition for failure treatment is true
    Endif
    If Condition for failure treatment is true
    Then If LevelOfDtc = LAW (OBD DTC is request)
      Then If NC_ERR_DTC_REQ_OBD=SYMPTOM (access by symptom)
        Then For each bit i which is set in ERR_SYM_DTC[IDX]
          software structure fill up with
          ID_ERR_DTC_XX[ 0 ][ i ]
        Endfor
        Else (access by failure; NC_ERR_DTC_REQ_OBD = FAILURE)
          software structure fill up with ID_ERR_DTC_XX[0][4]
        Endif
      Else (Customer DTC is request ; LevelOfDtc = CUS)
        If NC_ERR_DTC_REQ_CUS = SYMPTOM (access by symptom)
        Then For each bit i which is set in ERR_SYM_DTC[IDX]
          software structure fill up with
          ID_ERR_DTC_XX[ NC_NR_DTC_FMT ][ i ]
        Endfor
        Else (access by failure; NC_ERR_DTC_REQ_CUS = FAILURE)
          software structure fill up with
          ID_ERR_DTC_XX
          [NC_NR_DTC_FMT][5-NC_NR_DTC_FMT]
        Endif
      Endif
    Else (particular case for misfiring failure NLC_TREAT_DIAG_MIS = 0)
      XX = F (IDX) with XX = MIS_A, MIS_B1 or MIS_B4
    If LevelOfDtc = LAW (OBD DTC is request)
      Then If SYM_CYL_DTC_XX [12]=1 (Random)
        Then software structure fill up with
        ID_ERR_DTC_MIS [ 0 ][ NC_CYL_NR+1]
        Endif
        If SYM_CYL_DTC_XX [13]=1 (Multiple cylinder)
        Then software structure fill up with
        ID_ERR_DTC_MIS [ 0 ][ NC_CYL_NR ]
        Endif
        For each cylinder bit i which is set in SYM_CYL_DTC_XX
          software structure fill up with
          ID_ERR_DTC_MIS [ 0 ][ i ]
        Endfor
      Else (Customer DTC is request ; LevelOfDtc = CUS)
        If SYM_CYL_DTC_XX [12]=1 (Random)
        Then software structure fill up with
        ID_ERR_DTC_MIS [ 1 ][ NC_CYL_NR+1]
        Endif
    
```

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```

If      SYM_CYL_DTC_XX [13]=1  (Multiple cylinder)
Then   software structure fill up with
          ID_ERR_DTC_MIS [ 1 ] [ NC_CYL_NR ]
Endif
For    each cylinder bit i which is set in SYM_CYL_DTC_XX
          software structure fill up with
          ID_ERR_DTC_MIS[ 1 ] [ i ]
Endfor
Endif
Endif
Endif
Endfor
Endif

```

During all the software structure filling-in, if the software buffer is full then 2<sup>nd</sup> bit of ResultDtc is set to BUFFER\_FULL, software process is aborted.

If there is duplicated DTC then only the oldest is returned

### B.65.2.2 Request a DTC by DTC number

#### Description :

Syntax : ACTION\_ERRM\_ReadDtcByDtc (  
IN <DtclDtcIdentifier>,  
IN <LevelOfDtc>,  
OUT <ResultDtc> )

Parameter(in) : DtclDtcIdentifier Number of the DTC (identifier) which is requested.  
LevelOfDtc OBD or customer DTC is requested by the API

Parameter(out) : ResultDtc Boolean to say if there is the DTC in memory

Short Description : This API returns a result to learn if a DTC number of a certain level is stored in memory.

#### Application conditions

**Deactivation :** -

**Initialization:** -

**Recurrence :** -


#### Formula section :

1<sup>st</sup> bit of ResultDtc = NO\_DTC\_PRESENT  
2<sup>nd</sup> bit of ResultDTC = NO\_BUFFER\_FULL

```

For    each failure IDX stored in dynamic memory,
          ACTION_ERRM_GetReadyClass(XX, PRM_READY_CLAS)
If    PRM_READY_CLAS <> 00h (CARB_MIS)
Then  Condition for failure treatment is true
Endif
If    NLC_TREAT_DIAG_MIS = 1
Then  Condition for failure treatment is true
Endif

```

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```

If Condition for failure treatment is true
Then If LevelOfDtc = LAW (OBD DTC is request)
    Then If NC_ERR_DTC_REQ_OBD = SYMPTOM (access by symptom)
        Then For each bit i which is set in ERR_SYM_DTC[IDX]
            If DtcIdentifier = ID_ERR_DTC_XX [0][i]
                Then 1st bit of ResultDtc = DTC_PRESENT
            Endif
        Endfor
        Else (access by failure ; NC_ERR_DTC_REQ_OBD = FAILURE)
            If DtcIdentifier = ID_ERR_DTC_XX [0][4]
                Then 1st bit of ResultDtc = DTC_PRESENT
            Endif
        Endif
    Else (Customer DTC is request ; LevelOfDtc = CUS)
        If NC_ERR_DTC_REQ_CUS = SYMPTOM (access by symptom)
            Then For each bit i which is set in ERR_SYM_DTC[IDX]
                If DtcIdentifier = ID_ERR_DTC_XX [NC_NR_DTC_FMT][i]
                    Then 1st bit of ResultDtc = DTC_PRESENT
                Endif
            Endfor
            Else (access by failure ; NC_ERR_DTC_REQ_CUS = FAILURE)
                If DtcIdentifier = ID_ERR_DTC_XX
                    [NC_NR_DTC_FMT][5-NC_NR_DTC_FMT]
                    Then 1st bit of ResultDtc = DTC_PRESENT
                Endif
            Endif
        Endif
    Else (particular case for misfiring failure NLC_TREAT_DIAG_MIS = 0)
        XX = F (IDX) with XX = MIS_A, MIS_B1 or MIS_B4
        If LevelOfDtc = LAW (OBD DTC is request)
            Then If SYM_CYL_DTC_XX [12]=1 (Random)
                Then If DtcIdentifier=ID_ERR_DTC_MIS [0] [NC_CYL_NR+1]
                    Then 1st bit of ResultDtc = DTC_PRESENT
                Endif
            Endif
            If SYM_CYL_DTC_XX [13]=1 (Multiple cylinder)
                Then If DtcIdentifier=ID_ERR_DTC_MIS [0] [NC_CYL_NR]
                    Then 1st bit of ResultDtc = DTC_PRESENT
                Endif
            Endif
            For each cylinder bit i which is set in SYM_CYL_DTC_XX
                If DtcIdentifier = ID_ERR_DTC_MIS[0][i]
                    Then 1st bit of ResultDtc = DTC_PRESENT
                Endif
            Endfor
        Else (Customer DTC is request ; LevelOfDtc = CUS)
            If SYM_CYL_DTC_XX [12]=1 (Random)
                Then If DtcIdentifier=ID_ERR_DTC_MIS [1] [NC_CYL_NR+1]
                    Then 1st bit of ResultDtc = DTC_PRESENT
                Endif
            Else
                If SYM_CYL_DTC_XX [13]=1 (Multiple cylinder)

```

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```

Then If      DtclIdentifier=ID_ERR_DTC_MIS [1] [NC_CYL_NR]
      Then 1st bit of ResultDtc = DTC_PRESENT
      Endif
Endif
For each cylinder bit i which is set in      SYM_CYL_DTC_XX
      If      DtclIdentifier = ID_ERR_DTC_MIS[1][i]
      Then 1st bit of ResultDtc = DTC_PRESENT
      Endif
Endfor
Endif
Endif
Endfor

```

## B.65.3 API for reading the status of Diagnostic Trouble Code

### B.65.3.1 Request a list of status of DTCs by type of DTC

#### Description :

Syntax : ACTION\_ERRM\_ReadInfoByTypeOfDtc (  
           IN <TypeOfDtc>,  
           IN <Infoldentifier>,  
           INOUT <ListOfDtcInfo>,  
           OUT < ResultDtc> )

Parameter(in) :    TypeOfDtc                    Type of DTC which is requested by the API.

Infoldentifier                    Information which is returned by the API

Parameter(out) :    ResultDtc                    Boolean to say if there is the DTC in memory

Parameter(inout) : ListOfDtcInfo                    Software structure fill up with ListOfDtcInfo

Short Description : This API returns a diagnosis information. All the information returned are related to DTC which have the same type defined by the parameter TypeOfDtc and which are stored in memory.

Diagnosis information returned is defined by Infoldentifier parameter.

#### Application conditions:

*Deactivation :* -

*Initialization:* -

*Recurrence :* -

#### Formula section :

1<sup>st</sup> bit of ResultDtc = NO\_DTC\_PRESENT

2<sup>nd</sup> bit of ResultDtc = NO\_BUFFER\_FULL

**For** each failure stored in dynamic memory,

**If**            the failure belongs to group defined by the parameters TypeOfDtc

**Then** 1<sup>st</sup> bit of ResultDtc = DTC\_PRESENT

        ListOfDtcInfo is fill up with data of this failure corresponding to Infoldentifier.

**Endif**

**EndFor**

During all the software structure filling-in, if the software buffer is full then 2<sup>nd</sup> bit of ResultDtc is set to BUFFER\_FULL, software process is aborted.

### B.65.3.2 Request a status of a DTC by DTC number

#### Description :

**Syntax :** ACTION\_ERRM\_ReadInfoByDtc (  
IN <DtclDtcIdentifier>,  
IN <LevelOfDtc>,  
IN <InfoDtcIdentifier>,  
INOUT <ListOfDtcInfo>,  
OUT <ResultDtc> )

**Parameter(in) :** DtclDtcIdentifier      Number of the DTC (identifier) which is requested.  
LevelOfDtc      OBD or customer DTC is requested by the API  
InfoDtcIdentifier      Information which is returned by the API

**Parameter(out) :** ResultDtc      Boolean to say if there is the DTC in memory

**Parameter(inout) :** ListOfDtcInfo      Software structure fill up with ListOfDtcInfo

**Short Description :** This API returns a structure of diagnosis information related to a DTC which is stored in dynamic memory.

Diagnosis information returned is defined by InfoDtcIdentifier parameter.

#### Application conditions:

*Deactivation :* -

*Initialization:* -

*Recurrence :* -

#### Formula section :

1<sup>st</sup> bit of ResultDtc = NO\_DTC\_PRESENT

2<sup>nd</sup> bit of ResultDtc = NO\_BUFFER\_FULL

**For** each failure IDX stored in dynamic memory,

ACTION\_ERRM\_GetReadyClass(XX, PRM\_READY\_CLAS)

**If** PRM\_READY\_CLAS <> 00h (CARB\_MIS)

**Then** Condition for failure treatment is true

**Endif**

**If** NLC\_TREAT\_DIAG\_MIS = 1

**Then** Condition for failure treatment is true

**Endif**

**If** Condition for failure treatment is true

**Then If** LevelOfDtc = LAW (OBD DTC is request)

**Then If** NC\_ERR\_DTC\_REQ\_OBD = SYMPTOM (access by symptom)

**Then For** each bit i which is set in ERR\_SYM\_DTC[IDX]

**If** DtclDtcIdentifier = ID\_ERR\_DTC\_XX [0][i]

**Then** 1<sup>st</sup> bit of ResultDtc = DTC\_PRESENT

ListOfDtcInfo is fill up with data of this failure corresponding to InfoDtcIdentifier.

**Endif**

**Endfor**

**Else** (access by failure ; NC\_ERR\_DTC\_REQ\_OBD = FAILURE)

**If** DtclDtcIdentifier = ID\_ERR\_DTC\_XX [0][4]

**Then** 1<sup>st</sup> bit of ResultDtc = DTC\_PRESENT

ListOfDtcInfo is fill up with data of this failure

```

        corresponding to Infodentifier.
    Endif
Endif
Else (Customer DTC is request ; LevelOfDtc = CUS)
    If NC_ERR_DTC_REQ_CUS = SYMPTOM (access by symptom)
        Then For each bit i which is set in ERR_SYM_DTC[IDX]
            If DtcIdentifier = ID_ERR_DTC_XX [NC_NR_DTC_FMT][i]
                Then 1st bit of ResultDtc = DTC_PRESENT
                    ListOfDtcInfo is fill up with data of this failure
                    corresponding to Infodentifier.
            Endif
        Endfor
    Else (access by failure ; NC_ERR_DTC_REQ_CUS = FAILURE)
        If DtcIdentifier = ID_ERR_DTC_XX
            [NC_NR_DTC_FMT] [5-NC_NR_DTC_FMT]
        Then 1st bit of ResultDtc = DTC_PRESENT
            ListOfDtcInfo is fill up with data of this failure
            corresponding to Infodentifier.
        Endif
    Endif
Endif

Else (particular case for misfiring failure NLC_TREAT_DIAG_MIS = 0)
    XX = F (IDX) with XX = MIS_A, MIS_B1 or MIS_B4
    If LevelOfDtc = LAW (OBD DTC is request)
        Then If SYM_CYL_DTC_XX [13]=1 (Multiple cylinder)
            Then If DtcIdentifier=ID_ERR_DTC_MIS [0] [NC_CYL_NR]
                Then 1st bit of ResultDtc = DTC_PRESENT
                    ListOfDtcInfo is fill up with data of this failure
                    corresponding to Infodentifier.
            Endif
        Endif
        If SYM_CYL_DTC_XX [12]=1 (Random)
            Then If DtcIdentifier=ID_ERR_DTC_MIS[0][NC_CYL_NR+1]
                Then 1st bit of ResultDtc = DTC_PRESENT
                    ListOfDtcInfo is fill up with data of this failure
                    corresponding to Infodentifier.
            Endif
        Endif
        For each cylinder bit i which is set in SYM_CYL_DTC_XX
            If DtcIdentifier = ID_ERR_DTC_MIS[0][i]
                Then 1st bit of ResultDtc = DTC_PRESENT
                    ListOfDtcInfo is fill up with data of this failure
                    corresponding to Infodentifier.
            Endif
        Endfor
    Else (Customer DTC is request ; LevelOfDtc = CUS)
        If SYM_CYL_DTC_XX [13]=1 (Multiple cylinder)
            Then If DtcIdentifier=ID_ERR_DTC_MIS [1] [NC_CYL_NR]
                Then 1st bit of ResultDtc = DTC_PRESENT
                    ListOfDtcInfo is fill up with data of this failure
                    corresponding to Infodentifier.
            Endif
        Endif
    Endif
Endif

```



```

                Endif
            Endif
            If      SYM_CYL_DTC_XX [12]=1          (Random)
            Then If      DtclDentifier=ID_ERR_DTC_MIS[1][NC_CYL_NR+1]
                Then 1st bit of ResultDtc = DTC_PRESENT
                    ListOfDtcInfo is fill up with data of this failure
                    corresponding to InfDentifier.
                Endif
            Endif
            For each cylinder bit i which is set in SYM_CYL_DTC_XX
                If DtclDentifier = ID_ERR_DTC_MIS[1][i]
                    Then 1st bit of ResultDtc = DTC_PRESENT
                        ListOfDtcInfo is fill up with data of this failure
                        corresponding to InfDentifier.
                    Endif
                Endfor
            Endif
        Endfor
    Endif
Endfor

```

During all the software structure filling-in, if the software buffer is full then 2<sup>nd</sup> bit of ResultDtc is set to BUFFER\_FULL, software process is aborted.

When a failure is found in dynamic memory with the right DtclDentifier, the treatment is stopped. That means that only the status of the first DTC found (oldest DTC) is returned.

### B.65.3.3 Request a DTCLevel by an another DTCLevel

#### Description :

Syntax : ACTION\_ERRM\_ReadDtcLevelByDtcLevel (
   
IN <DtclDentifier>,
   
IN <LevelOfDtc>,
   
INOUT <ListOfDtc>,
   
OUT <ResultDtc> )

Parameter(in) : DtclDentifier                      Number of the DTC (identifier) which is requested.
   
LevelOfDtc    OBD or customer DTC is requested by the API

Parameter(out) : ResultDtc                              Boolean to say if there is the DTC in memory

Parameter(inout) : ListOfDtcInfo                              Software structure fill up with ListOfDtcInfo

Short Description : This API returns the customer DTC from the Law DTC or the DTC Law from the DTC customer following the 'levelofDTC' parameter.

#### Application conditions:


*Deactivation* : -

*Initialization* : -

*Recurrence* : -

#### Formula section :

1<sup>st</sup> bit of ResultDtc = NO\_DTC\_PRESENT

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2<sup>nd</sup> bit of ResultDtc = NO\_BUFFER\_FULL

```

For each failure IDX stored in dynamic memory,
  ACTION_ERRM_GetReadyClass(XX, PRM_READY_CLAS)
  If PRM_READY_CLAS <> 00h (CARB_MIS)
  Then Condition for failure treatment is true
  Endif
  If NLC_TREAT_DIAG_MIS = 1
  Then Condition for failure treatment is true
  Endif
  If Condition for failure treatment is true
  Then If LevelOfDtc = LAW (OBD DTC is request)
    Then If NC_ERR_DTC_REQ_OBD = SYMPTOM (access by symptom)
      Then For each bit i which is set in ERR_SYM_DTC[IDX]
        If DtcIdentifier = ID_ERR_DTC_XX [0][i]
        Then 1st bit of ResultDtc = DTC_PRESENT
          ListOfDtcInfo is fill up with
          If NC_NR_DTC_FMT = 0
          Then ID_ERR_DTC_XX[0][5]
          Else if NC_ERR_DTC_REQ_CUS=SYMPTOM
            Then ID_ERR_DTC_XX[1][i]
            Else ID_ERR_DTC_XX[1][4]
          Endif
        Endif
        Exit
      Endif
    Endfor
  Else (access by failure ; NC_ERR_DTC_REQ_OBD = FAILURE)
    If DtcIdentifier = ID_ERR_DTC_XX [0][4]
    Then 1st bit of ResultDtc = DTC_PRESENT
      ListOfDtc is fill up with
      If NC_ERR_DTC_REQ_CUS = SYMPTOM
        (access by symptom for the customer code)
      Then If only one bit is set in ERR_SYM_MEM[IDX]
        Then i = bit number which is set
          in ERR_SYM_MEM[IDX]
          ID_ERR_DTC_XX[NC_NR_DTC_FMT][i]
        Else(many or no bit is set in ERR_SYM_MEM[IDX])
          ID_ERR_DTC_XX
          [NC_NR_DTC_FMT][5-NC_NR_DTC_FMT]
        Endif
      else (access by failure for the customer code)
        ID_ERR_DTC_XX
        [NC_NR_DTC_FMT][5-NC_NR_DTC_FMT]
      Endif
    Endif
  Endif
  Else (Customer DTC is request ; LevelOfDtc = CUS)
    If NC_ERR_DTC_REQ_CUS = SYMPTOM (access by symptom)
    Then For each bit i which is set in ERR_SYM_DTC[IDX]
      If DtcIdentifier = ID_ERR_DTC_XX [NC_NR_DTC_FMT][i]
      Then 1st bit of ResultDtc = DTC_PRESENT
    
```


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```

ListOfDtcInfo is fill up with
    If      NC_NR_DTC_FMT = 0
    Then ID_ERR_DTC_XX[0][4]
    Else if  NC_ERR_DTC_REQ_OBD = SYMPTOM
    Then ID_ERR_DTC_XX[0][i]
    Else ID_ERR_DTC_XX[0][4]
    Endif
    Endif
    Exit
    Endif
Endfor
Else (access by failure ; NC_ERR_DTC_REQ_CUS = FAILURE)
    If      DtcIdentifier = ID_ERR_DTC_XX
    [NC_NR_DTC_FMT] [5-NC_NR_DTC_FMT]
    Then 1st bit of ResultDtc = DTC_PRESENT
    ListOfDtc is fill up with
    If      NC_ERR_DTC_REQ_OBD = SYMPTOM
    (access by symptom for the DTC law)
    If      only one bit is set in ERR_SYM_MEM[IDX]
    Then i = bit number which is set
    in ERR_SYM_MEM[IDX]
    ID_ERR_DTC_XX[0][i]
    Else (many or no bit is set
    in ERR_SYM_MEM[IDX])
    ID_ERR_DTC_XX[0][4]
    Endif
    else (access by failure for the customer code)
    ID_ERR_DTC_XX[0][4]
    Endif
    Endif
Endif
Endif

Else (particular case for misfiring failure)
XX = F (IDX) with XX = MIS_A, MIS_B1 or MIS_B4
If      LevelOfDtc = LAW (OBD DTC is request)
Then If  SYM_CYL_DTC_XX [12]=1 (Random)
    Then If  DtcIdentifier=ID_ERR_DTC_MIS [0] [NC_CYL_NR+1]
    Then 1st bit of ResultDtc = DTC_PRESENT
    ListOfDtc is fill up with ID_ERR_DTC_MIS[1] [NC_CYL_NR+1]
    Exit
    Endif
    Endif
If      SYM_CYL_DTC_XX [13]=1 (Multiple cylinder)
Then If  DtcIdentifier=ID_ERR_DTC_MIS [0] [NC_CYL_NR]
    Then 1st bit of ResultDtc = DTC_PRESENT
    ListOfDtc is fill up with ID_ERR_DTC_MIS[1] [NC_CYL_NR]
    Exit
    Endif
    Endif
For each cylinder bit i which is set in SYM_CYL_DTC_XX
If DtcIdentifier = ID_ERR_DTC_MIS[0][i]

```

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```

        Then 1st bit of ResultDtc = DTC_PRESENT
        ListOfDtc is fill up with ID_ERR_DTC_MIS[1][i]
        Exit
    Endif
Endfor
Else (Customer DTC is request ; LevelOfDtc = CUS)
    If SYM_CYL_DTC_XX [12]=1 (Random)
        Then If DtclDentifier=ID_ERR_DTC_MIS [1] [NC_CYL_NR+1]
            Then 1st bit of ResultDtc = DTC_PRESENT
            ListOfDtc is fill up with ID_ERR_DTC_MIS[0] [NC_CYL_NR+1]
            Exit
        Endif
    Endif
    If SYM_CYL_DTC_XX [13]=1 (Multiple cylinder)
        Then If DtclDentifier=ID_ERR_DTC_MIS [1] [NC_CYL_NR]
            Then 1st bit of ResultDtc = DTC_PRESENT
            ListOfDtc is fill up with ID_ERR_DTC_MIS[0] [NC_CYL_NR]
            Exit
        Endif
    Endif
    For each cylinder bit i which is set in SYM_CYL_DTC_XX
        If DtclDentifier = ID_ERR_DTC_MIS[1][i]
            Then 1st bit of ResultDtc = DTC_PRESENT
            ListOfDtc is fill up with ID_ERR_DTC_MIS[0][i]
            Exit
        Endif
    Endfor
Endif
Endfor

```

During all the software structure filling-in, if the software buffer is full then 2<sup>nd</sup> bit of ResultDtc is set to BUFFER\_FULL, software process is aborted.

When a failure is found in dynamic memory with the right DtclDentifier, the treatment is stopped. That means that only the status of the first DTC found (oldest DTC) is returned.


## B.65.4 API for reading the number of Diagnostic Trouble Code

### B.65.4.1 Request the quantity of DTC with a certain type stored in memory

#### Description :

Syntax : ACTION\_ERRM\_ReadQuantityOfDtc (  
 IN <TypeOfDtc>,  
 IN <LevelOfDtc>,  
 INOUT <Quantity>,  
 OUT <ResultQuantity> )

Parameter(in) : TypeOfDtc Type of DTC which is requested by the API.  
LevelOfDtc OBD or customer DTC is requested by the API  
Parameter(out) : ResultQuantity Boolean to say if there is at least 1 DTC in memory  
Parameter(inout) : Quantity Software structure fill up with quantity of Dtc

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**Short Description :** This API returns the quantity of DTCs with a certain type, which are stored in memory. Quantity of DTCs is the number of failures in memory. If failures have same DTC values then they are counted once.

**Application conditions:**

*Deactivation :* -  
*Initialization:* -  
*Recurrence :* -

**Formula section :**

Quantity = 0  
ResultQuantity = NO\_DTC\_PRESENT

**If** PRM\_TypeOfDtc = PERMANENT

**Then**

**If** CTR\_ERR\_PERM\_NR > 0

**Then**

1<sup>st</sup> bit of ResultDtc = DTC\_PRESENT

**For** IDX\_PERM = 0 to CTR\_ERR\_PERM\_NR -1

**with** XX = ERR\_PERM[IDX\_PERM]

ACTION\_ERRM\_GetReadyClass(XX, PRM\_READY\_CLAS)

**If** PRM\_READY\_CLAS <> 00h (CARB\_MIS)

**Then** Condition for failure treatment is true

**Endif**

**If** NLC\_TREAT\_DIAG\_MIS = 1

**Then** Condition for failure treatment is true

**Endif**

**If** Condition for failure treatment is true

**Then If** LevelOfDtc = LAW (OBD DTC is request)

**Then If** NC\_ERR\_DTC\_REQ\_OBD=SYMPTOM (access by symp-

tom)

**Then** Quantity = Quantity + j

with j = number of bit set in ERR\_SYM\_PERM[IDX\_PERM]

**Else** (access by failure; NC\_ERR\_DTC\_REQ\_OBD = FAILURE)

Quantity = Quantity +1

**Endif**

**Else** (Customer DTC is request ; LevelOfDtc = CUS)

**If** NC\_ERR\_DTC\_REQ\_CUS = SYMPTOM (access by symptom)

**Then** Quantity = Quantity + j

with j = number of bit set in ERR\_SYM\_PERM[IDX\_PERM]

**Else** (access by failure; NC\_ERR\_DTC\_REQ\_CUS = FAILURE)

Quantity = Quantity +1

**Endif**

**Endif**

**Else** (particular case for misfiring failure NLC\_TREAT\_DIAG\_MIS = 0)

= F (IDX) with XX = MIS\_A, MIS\_B1 or MIS\_B4

XX

**If** LevelOfDtc = LAW (OBD DTC is request)


**If** SYM\_CYL\_PERM\_XX [12]=1 (Random)

**Then**  
**Then**

Quantity = Quantity +1

**Endif**

**If** SYM\_CYL\_PERM\_XX [13]=1 (Multiple cylinder)


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```

    Then Quantity = Quantity + 1
    Endif
    If (many cylinder bit is set in SYM_CYL_PERM_XX)
        Quantity = Quantity + j
        With j = number of cylinder bit set
            in SYM_CYL_PERM_XX
        Endif
    Else (Customer DTC is request ; LevelOfDtc = CUS)
        If SYM_CYL_PERM_XX [12]=1 (Random) Then
            Quantity = Quantity + 1
            Endif
        If SYM_CYL_PERM_XX [13]=1 (Multiple cylinder)
            Then Quantity = Quantity + 1
            Endif
        If (many cylinder bit is set in SYM_CYL_PERM_XX)
            Quantity = Quantity + j
            With j = number of cylinder bit set
                in SYM_CYL_PERM_XX
            Endif
        Endif
    Endif
Endfor
Endif
Else
    For each failure IDX stored in dynamic memory,
    If the failure belongs to failures group defined by the parameter TypeOfDtc
    Then ResultQuantity = DTC_PRESENT
        ACTION_ERRM_GetReadyClass(XX, PRM_READY_CLAS)
        If PRM_READY_CLAS <> 00h (CARB_MIS)
            Then Condition for failure traitment is true
            Endif
            If NLC_TREAT_DIAG_MIS = 1
                Then Condition for failure traitment is true
                Endif
                If Condition for failure traitment is true
                    Then If LevelOfDtc = LAW (OBD DTC is request)
                        Then If NC_REQ_OBD = SYMPTOM (access by symptom)
                            Then Quantity = Quantity + j
                                with j = number of bit set in ERR_SYM_DTC_IDX
                            Else (access by failure ; NC_REQ_OBD = FAILURE )
                                Quantity = Quantity + 1
                            Endif
                        Else (Customer DTC is request ; LevelOfDtc = CUS)
                            If NC_REQ_CUS = SYMPTOM (access by symptom)
                                Then Quantity = Quantity + j
                                    with j = number of bit set in ERR_SYM_DTC_IDX
                                Else (access by failure ; NC_REQ_OBD = FAILURE )
                                    Quantity = Quantity + 1
                                Endif
                            Endif
                        Endif
                    Endif
                Endif
            Endif
        Endif
    Endif
    Else (particular case for misfiring failure)

```

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```

        XX = F (IDX) with XX = MIS_A, MIS_B1 or MIS_B4
    If LevelOfDtc = LAW (OBD DTC is request)
        Then If SYM_CYL_DTC_XX [12]=1 (Random)
            Then Quantity = Quantity + 1
            Endif
            If SYM_CYL_DTC_XX [13]=1 (Multiple cylinder)
                Then Quantity = Quantity + 1
            Endif
        Endif
        If (many cylinder bit is set in SYM_CYL_DTC_XX)
            Quantity = Quantity + j
            With j = number of cylinder bit set in SYM_CYL_DTC_XX
                Endif
        Endif
    Else (Customer DTC is request ; LevelOfDtc = CUS)
        If SYM_CYL_DTC_XX [12]=1 (Random)
            Then Quantity = Quantity + 1
            Endif
            If SYM_CYL_DTC_XX [13]=1 (Multiple cylinder)
                Then Quantity = Quantity + 1
            Endif
        Endif
        If (many cylinder bit is set in SYM_CYL_DTC_XX)
            Quantity = Quantity + j
            With j = number of cylinder bit set in SYM_CYL_DTC_XX
                Endif
        Endif
    Endif
Endif
Endif
Endif
EndFor
Endif

```

For each duplicated DTC, the corresponding quantity will be subtracted. Duplicated DTC will be counted once.

## B.65.5 API for reading the Freeze Frame

### B.65.5.1 Request a freeze frame with a certain type by DTC


#### Description :

**Syntax :** ACTION\_ERRM\_ReadFrfByDtc(  
 IN <TypeOfFF>,  
 IN <FFIdentifier>,  
 IN <DtclIdentifier>,  
 IN <LevelOfDtc>  
 INOUT <Frf>  
 OUT <ResultFrf> )

**Parameter(in) :** TypeOfFF Type of freeze frame which are request by the API  
FFIdentifier Identifier of freeze frame requested  
DtclIdentifier Identifier of DTC of the freeze frame requested  
LevelOfDtc OBD or customer DTC is requested by the API

**Parameter(out) :** ResultFrf Boolean to say if requested freeze frame is present  
**Parameter(inout) :** Frf Software structure fill with Freeze frame

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**Short Description :** This API returns a freeze frame or a part of freeze frame.

With the parameter TypeOfFF, some different part of a freeze frame (defined by the law or by the customer - including set or not ) can be returned.

The parameter FFIdentifier is not used (reserved for future improvement).

The freeze frame can be requested :

- by DTC ; in this case the parameters DtclIdentifier and LevelOfDtc should be fulfilled.
- for the CARB/EOBD request (mode 02h) ; in this case, the parameter DtclIdentifier has to be set to NO\_DTC, the parameter TypeOfFF has to be set to LAW, and the parameter FFIdentifier has to be set to FIRST.

The freeze frame associated to the oldest Carb failure among highest priority Carb failure is returned.

See definitions of freeze frame in module “Environmental data” module in “Error management” aggregate.

**Application conditions:**

*Deactivation :* -

*Initialization:* -

*Recurrence :* -

**Formula section :**

1<sup>st</sup> bit of ResultFrf = NO\_FRF\_PRESENT

2<sup>nd</sup> bit of ResultFrf = NO\_BUFFER\_FULL

**If** (FFIdentifier = FIRST **and** TypeOfFF = LAW **and** DtclIdentifier = NO\_DTC)

**Then** (Law freeze frame is requested)

**If** NLC\_OBD\_FRF\_PND = 0

**Then**

Find oldest Carb/EOBD failure (emission relevant, LC\_OBD\_ERR = 1) failure stored in dynamic memory and confirmed (LV\_ERR\_CFM[IDX] = 1). If a misfire or fuel system failure is in the memory with LV\_ERR\_CFM[IDX] = 1, then the oldest of these failures must be chosen.

**Else**

Find oldest Carb/EOBD failure (emission relevant, LC\_OBD\_ERR = 1) failure stored in dynamic memory and confirmed (LV\_ERR\_CFM[IDX] = 1). If a misfire or fuel system failure is in the memory with LV\_ERR\_CFM[IDX] = 1, then the oldest of these failures must be chosen.

If this failure isn't existing, find oldest Carb/EOBD failure (emission relevant, LC\_OBD\_ERR = 1) failure stored in dynamic memory and pending (LV\_ERR\_PND[IDX] = 1). If a misfire or fuel system failure is in the memory with LV\_ERR\_PND[IDX] = 1, then the oldest of these failures must be chosen.

**Endif**

ACTION\_ERRM\_GetReadyClass(XX, PRM\_READY\_CLAS)

**If** PRM\_READY\_CLAS <> 00h (CARB\_MIS)

**Then** Condition for failure treatment is true

**Endif**

**If** NLC\_TREAT\_DIAG\_MIS = 1


**Then** Condition for failure treatment is true

**Endif**

**If** Condition for failure treatment is true

**Then If** NC\_ERR\_DTC\_REQ\_OBD = SYMPTOM (access by symptom)

**Then If** only one bit is set in ERR\_SYM\_MEM[IDX]

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```


    Then i = bit number which is set in ERR_SYM_MEM[IDX]
        ReturnDtc = ID_ERR_DTC_XX [0][i]
    Else (many or no bit is set in ERR_SYM_MEM[IDX])
        ReturnDtc = ID_ERR_DTC_XX [0][4]
    Endif
    Else (access by failure ; NC_ERR_DTC_REQ_OBD = FAILURE)
        ReturnDtc = ID_ERR_DTC_XX [0][4]
    Endif
Else (particular case for misfiring failure)
    XX = F (IDX) with XX = MIS_A, MIS_B1 or MIS_B4
    If SYM_CYL_MEM_XX [12]=1 (Random)
    Then ReturnDtc = ID_ERR_DTC_MIS[0][NC_CYL_NR+1]
    Else if SYM_CYL_MEM_XX [13]=1 (Multiple cylinder)
        Or many cylinder bits are set in
        Then ReturnDtc = ID_ERR_DTC_MIS[0][NC_CYL_NR]
    Else (only one cylinder bit is set in SYM_CYL_MEM_XX)
        i = bit number which is set in SYM_CYL_MEM_XX
        ReturnDtc = ID_ERR_DTC_MIS[0][i]
    Endif
    Endif
Endif
Software structure is fill up with ReturnDtc + ENVD_OBD[u][IDX]
1st bit of ResultFrf = FRF_PRESENT

```

```

Else (others freeze frame is requested)
    For each failure IDX stored in dynamic memory,
    ACTION_ERRM_GetReadyClass(XX, PRM_READY_CLAS)
    If PRM_READY_CLAS <> 00h (CARB_MIS)
    Then Condition for failure traitment is true
    Endif
    If NLC_TREAT_DIAG_MIS = 1
    Then Condition for failure traitment is true
    Endif
    If Condition for failure traitment is true
    Then If LevelOfDtc = LAW (OBD DTC is request)
        Then If NC_ERR_DTC_REQ_OBD=SYMPTOM (access by symptom)
            Then For each bit i which is set in ERR_SYM_DTC[IDX]
                If DtclIdentifier = ID_ERR_DTC_XX[0][i]
                    Then 1st bit of ResultFrf = FRF_PRESENT
                    Software structure is filled-up with DtclIdentifier plus
                    freeze frame of failure according parameter Type-
                    OfFF
                    Exit
                Endif
            Endfor
        Else (access by failure; NC_ERR_DTC_REQ_OBD = FAILURE)
            If DtclIdentifier = ID_ERR_DTC_XX [0][4]
                Then 1st bit of ResultFrf = FRF_PRESENT
                Software structure is filled-up with DtclIdentifier plus freeze
                frame of failure according parameter TypeOfFF
            Endif
        Endif
    Endif
Endif

```

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```

Else (Customer DTC is request ; LevelOfDtc = CUS)
  If NC_ERR_DTC_REQ_CUS=SYMPTOM (access by symptom)
  Then For each bit i which is set in ERR_SYM_DTC[IDX]
    If DtclDentifier = ID_ERR_DTC_XX[NC_NR_DTC_FMT][i]
      Then 1st bit of ResultFrf = FRF_PRESENT
      Software structure is filled-up with DtclDentifier plus freeze
      frame of failure according parameter TypeOfFF
      Exit
    Endif
  Endfor
Else (access by failure; NC_ERR_DTC_REQ_CUS = FAILURE)
  If DtclDentifier = ID_ERR_DTC_XX
  [NC_NR_DTC_FMT][5-NC_NR_DTC_FMT]
  Then 1st bit of ResultFrf = FRF_PRESENT
  Software structure is filled-up with DtclDentifier plus freeze
  frame of failure according parameter TypeOfFF
  Endif
Endif

Else (particular case for misfiring failure)
  XX = F (IDX) with XX = MIS_A, MIS_B1 or MIS_B4
  If LevelOfDtc = LAW (OBD DTC is request)
  Then If SYM_CYL_DTC_XX [12]=1 (Random)
    Then If DtclDentifier=ID_ERR_DTC_MIS[0][NC_CYL_NR+1]
      Then 1st bit of ResultFrf = FRF_PRESENT
      Software structure is filled-up with DtclDentifier plus freeze
      frame of failure according parameter TypeOfFF
      Exit
    Endif
  Endif
  If SYM_CYL_DTC_XX [13]=1 (Multiple cylinder)
  Then If DtclDentifier=ID_ERR_DTC_MIS[0][NC_CYL_NR]
    Then 1st bit of ResultFrf = FRF_PRESENT
    Software structure is filled-up with DtclDentifier plus freeze
    frame of failure according parameter TypeOfFF
    Exit
  Endif
  Endif
  For each cylinder bit i which is set in SYM_CYL_DTC_XX
    If DtclDentifier = ID_ERR_DTC_MIS[0][i]
      Then 1st bit of ResultFrf = FRF_PRESENT
      Software structure is filled-up with DtclDentifier plus freeze
      frame of failure according parameter TypeOfFF
      Exit
    Endif
  Endfor
Else (Customer DTC is request ; LevelOfDtc = CUS)
  If SYM_CYL_DTC_XX [12]=1 (Random)
  Then If DtclDentifier=ID_ERR_DTC_MIS[1][NC_CYL_NR+1]
    Then 1st bit of ResultFrf = FRF_PRESENT
    Software structure is filled-up with DtclDentifier plus freeze
    frame of failure according parameter TypeOfFF
    Exit
  Endif

```

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```

    Endif
  Endif
  If      SYM_CYL_DTC_XX [13]=1 (Multiple cylinder)
  Then   If DtclIdentifier=ID_ERR_DTC_MIS[1][NC_CYL_NR]
        Then 1st bit of ResultFrF = FRF_PRESENT
        Software structure is filled-up with DtclIdentifier plus freeze
        frame of failure according parameter TypeOfFF
        Exit
      Endif
    Endif
  For each cylinder bit i which is set in SYM_CYL_DTC_XX
    If DtclIdentifier = ID_ERR_DTC_MIS[1][i]
      Then 1st bit of ResultFrF = FRF_PRESENT
      Software structure is filled-up with DtclIdentifier plus freeze
      frame of failure according parameter TypeOfFF
    Endif
  Endfor
Endif
Endfor
Endif
Endfor
Endif

```

“Software structure is filled-up with freeze frame of failure according parameter TypeOfFF” means :  
(for failure IDX)

Software structure is filled-up with DTCIdentifier plus the software structure defined below :

```


If      TypeOfFF = LAW
Then   Software structure is fill up with ENVD_OBD[u][IDX]
Endif
If      TypeOfFF = CUS_CMN
Then   Software structure is fill up with ENVD_CUS_CMN[v][IDX]
Endif
If      TypeOfFF = CUS_SET
Then   Software structure is fill up with
        ENVD_CUS_SET_CMN[w][z][IDX] + ENVD_CUS_SET_SPC[y][z][IDX]
Endif

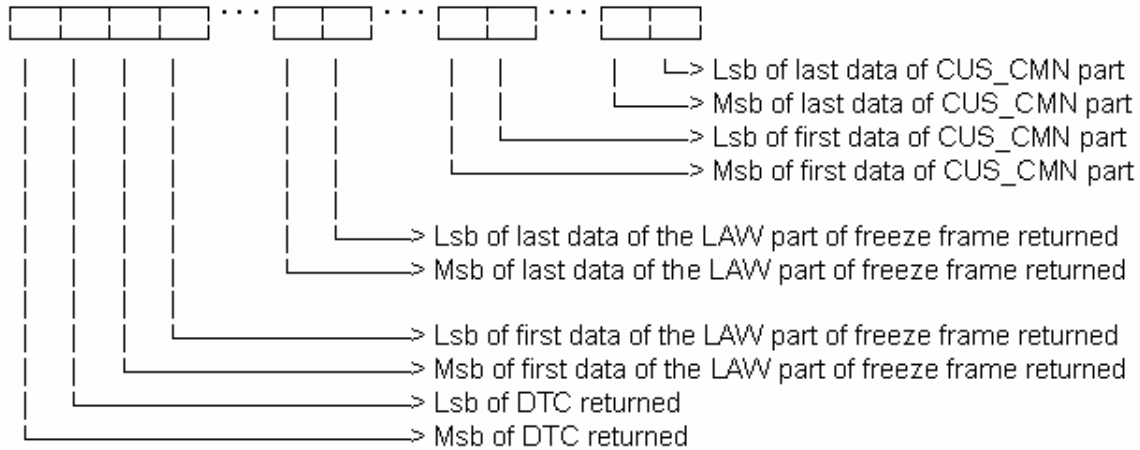
```

Combination of parameter Type OfFF is possible. For instance if TypeOfFF is equal to LAW and CUS\_CMN, both part are returned. In case of multiple part of freeze frame to returned, , the following order is respected :

- Part LAW of the freeze frame is returned first ;
- Part CUS\_CMN of the freeze frame is then returned ;
- Part CUS\_SET of the freeze frame is then returned .

Example : In the case of a request with TypeOfFF = LAW and CUS\_CMN then the following structure is returned :

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When a failure is found in dynamic memory with the right DtcIdentifier, the treatment is stopped. That means that only the freeze frame of the first DTC is found (oldest DTC) and returned by the API. During all the software structure filling-in, if the software buffer is full then 2<sup>nd</sup> bit of ResultFrF is set to BUFFER\_FULL, software process is aborted.

## B.65.6 API for erasing Diagnostic information

### B.65.6.1 Clear the failure associated to DTC with a certain type.

#### Description :

**Syntax :** ACTION\_ERRM\_ClrInfoByTypeOfDtc (   
 IN <TypeOfDtc>,   
 OUT < ResultClrInfo> )

**Parameter(in) :** TypeOfDtc Type of DTC which is requested by the API

**Parameter(out) :** ResultClrInfo Indicate if some DTC are cleared or not

**Short Description :** This API clear all the failure in dynamic memory associated to DTC with a certain type. It permits also to reinitialised all readiness code.

#### Remark :

For reason of design, and time resource, it's recommended to activate this API when engine stop. (Ref. SAE Mode \$04).

#### Application conditions:

**Deactivation :** -

**Initialization:** -

**Recurrence :** -

#### Formula section :

ResultClrInfo = INFO\_NOT\_CLEARED

**For** each failure stored in dynamic memory,

**If** the failure belongs to failures group defined by the parameter TypeOfDtc

**Then** ACTION\_ERRM\_EraseErr ( IN<IDX>, SYNCHRONIZATION<CALL> )

All data in static memory related to failure XX (with XX = F(IDX)) is also cleared

ACTION\_ERRM\_ClcPermanentByErr(XX)

ResultClrInfo = INFO\_CLEARED

**Endif**

**Endfor**

In the case TypeOfDTC = All, then, the whole static memory shall be cleared (same behavior as clear failure memory using LC\_ERR\_FMY\_CLR calibration bit)

{ Permanent calculation at ERRM clearing }

In case of TypeOfDTC = All, then call also ACTION\_ERRM\_ClcPermanentIniErrm( )

{ All readiness bit are reinitialised }

ACTION\_ERRM\_InitReadiness ( SYNCHRONIZATION<CALL> )

Retransmit "failure erase service received"

### B.65.6.2 Clear the failure associated to a DTC

#### Description :

Syntax : ACTION\_ERRM\_ClrInfoByDtc (   
 IN <DtclDtcIdentifier>,   
 IN <LevelOfDtc>,   
 OUT < ResultClrInfo> )

Parameter(in) : DtclDtcIdentifier Number of DTC which is requested (identifier)   
 LevelOfDtc OBD or customer DTC is requested by the API

Parameter(out) : ResultClrInfo to say if some DTC are cleared or not

Short Description : This API clear all the failure in dynamic memory associated to a DTC. The erasing is also applicable when there are identical DTC identifiers in the memory.

#### Application conditions:

*Deactivation* : -

*Initialization*: -

*Recurrence* : -

#### Formula section :

ResultClrInfo = INFO\_NOT\_CLEARED

{ All readiness bit are reinitialised }

ACTION\_ERRM\_InitReadiness ( SYNCHRONIZATION<CALL> )

**For** each failure stored in dynamic memory **do**

ACTION\_ERRM\_GetReadyClass(XX, PRM\_READY\_CLAS)

**If** PRM\_READY\_CLAS <> 00h (CARB\_MIS)

**Then** Condition for failure treatment is true

**Endif**

**If** NLC\_TREAT\_DIAG\_MIS = 1

**Then** Condition for failure treatment is true

**Endif**

**If** Condition for failure treatment is true

**Then If** LevelOfDtc = LAW (OBD DTC )

**Then If** NC\_ERR\_DTC\_REQ\_OBD = SYMPTOM (access by symptom)

**Then For** each bit i which is set in ERR\_SYM\_DTC[IDX]


**If** DtclDtcIdentifier = ID\_ERR\_DTC\_XX[0][i]

**Then** ACTION\_ERRM\_EraseErr ( IN<IDX> ,

```


        SYNCHRONIZATION<CALL> )
        All data in static memory related to failure XX (with XX =
        F(IDX)) is also cleared
        ACTION_ERRM_ClcPermanentByErr(XX)
        ResultClrInfo = INFO_CLEARED
        Exit
    Endif
Endfor
Else { access by failure : NC_ERR_DTC_REQ_OBD = FAILURE }
If DtcIdentifier = ID_ERR_DTC_XX[ 0 ][ 4 ] )
Then ACTION_ERRM_EraseErr ( IN<IDX>,
    SYNCHRONIZATION<CALL> )
    All data in static memory related to failure XX (with XX =
    F(IDX)) is also cleared
    ACTION_ERRM_ClcPermanentByErr(XX)
    ResultClrInfo = INFO_CLEARED
Endif
Endif
Else ( Customer DTC : LevelOfDtc = CUSTOMER)
If NC_ERR_DTC_REQ_CUS = SYMPTOM (access by symptom)
Then For each bit i which is set in ERR_SYM_DTC[IDX]
    If DtcIdentifier = ID_ERR_DTC_XX[NC_NR_DTC_FMT][i]
    Then ACTION_ERRM_EraseErr ( IN<IDX>,
        SYNCHRONIZATION<CALL> )
        All data in static memory related to failure XX (with XX =
        F(IDX)) is also cleared
        ACTION_ERRM_ClcPermanentByErr(XX)
        ResultClrInfo = INFO_CLEARED
        Exit
    Endif
Endfor
Else (access by failure : NC_ERR_DTC_REQ_OBD = FAILURE)
If DtcIdentifier = ID_ERR_DTC_XX
    [NC_NR_DTC_FMT][5-NC_NR_DTC_FMT]
Then ACTION_ERRM_EraseErr ( IN<IDX>,
    SYNCHRONIZATION<CALL> )
    All data in static memory related to failure XX (with XX = F(IDX)) is
    also cleared
    ACTION_ERRM_ClcPermanentByErr(XX)
    ResultClrInfo = INFO_CLEARED
Endif
Endif
Endif
Else (particular case for misfiring failure)
    XX = F (IDX) with XX = MIS_A, MIS_B1 or MIS_B4
    If LevelOfDtc = LAW (OBD DTC)
    Then If SYM_CYL_DTC_XX [12]=1 (Random)
        Then If DtcIdentifier=ID_ERR_DTC_MIS [0] [NC_CYL_NR+1]
        Then ACTION_ERRM_EraseErr ( IN<IDX>,
            SYNCHRONIZATION<CALL> )
            All data in static memory related to failure XX (with XX = F(IDX)) is
            also cleared
            ACTION_ERRM_ClcPermanentByErr(XX)

```

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```

        ResultClrInfo = INFO_CLEARED
        Exit
    Endif
Endif
If SYM_CYL_DTC_XX [13]=1 (Multiple cylinder)
Then If DtcIdentifier=ID_ERR_DTC_MIS [0] [NC_CYL_NR]
    Then ACTION_ERRM_EraseErr ( IN<IDX>,
        SYNCHRONIZATION<CALL> )
        All data in static memory related to failure XX (with XX = F(IDX)) is
        also cleared
        ACTION_ERRM_ClcPermanentByErr(XX)
        ResultClrInfo = INFO_CLEARED
        Exit
    Endif
Endif
For each cylinder bit i which is set in SYM_CYL_DTC_XX
    If DtcIdentifier = ID_ERR_DTC_MIS[0][i]
    Then ACTION_ERRM_EraseErr( IN<IDX>,
        SYNCHRONIZATION<CALL> )
        All data in static memory related to failure XX (with XX = F(IDX)) is
        also cleared
        ACTION_ERRM_ClcPermanentByErr(XX)
        ResultClrInfo = INFO_CLEARED
        Exit
    Endif
Endfor
Else (Customer DTC )
    If SYM_CYL_DTC_XX [12]=1 (Random)
    Then If DtcIdentifier=ID_ERR_DTC_MIS [1] [NC_CYL_NR+1]
        Then ACTION_ERRM_EraseErr ( IN<IDX>,
            SYNCHRONIZATION<CALL> )
            All data in static memory related to failure XX (with XX = F(IDX)) is
            also cleared
            ACTION_ERRM_ClcPermanentByErr(XX)
            ResultClrInfo = INFO_CLEARED
            Exit
        Endif
    Endif
    If SYM_CYL_DTC_XX [13]=1 (Multiple cylinder)
    Then If DtcIdentifier=ID_ERR_DTC_MIS [1] [NC_CYL_NR]
        Then ACTION_ERRM_EraseErr ( IN<IDX>,
            SYNCHRONIZATION<CALL> )
            All data in static memory related to failure XX (with XX = F(IDX)) is
            also cleared
            ACTION_ERRM_ClcPermanentByErr(XX)
            ResultClrInfo = INFO_CLEARED
            Exit
        Endif
    Endif
    For each cylinder bit i which is set in SYM_CYL_DTC_XX
        If DtcIdentifier = ID_ERR_DTC_MIS[1][i]
        Then ACTION_ERRM_EraseErr ( IN<IDX>,
            SYNCHRONIZATION<CALL> )
    
```

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```

All data in static memory related to failure XX (with XX = F(IDX)) is
also cleared
ACTION_ERRM_ClcPermanentByErr(XX)
ResultClrInfo = INFO_CLEARED
Exit
    Endif
  Endfor
Endif
Endif
Endfor

```

When a failure is found in dynamic memory with the right DtclIdentifier, the treatment is not stopped. That means that all failure with the right DTC are erased.

## B.65.7 API to manage the entry or exit of Marked Mode

### B.65.7.1 Activate/deactivate the marked mode with clear failure

#### Description :

Syntax : ACTION\_ERRM\_ControlDtcSettings ( IN <MarkedMode> )

Parameter(in) : MarkedMode State of marked mode

Short Description : This API permits to activate or deactivate the marked mode. In this mode all new failure which appears are marked and then erased when we leave this mode (useful in End Of Line phase). For errm inhibition, please refer to ACTION\_ERRM\_ActivateMarkedMode ().

#### Application conditions:

*Deactivation :* -

*Initialization:* -

*Recurrence :* -

#### Formula section :

```


If MarkedMode = ON
Then LV_MKD_MOD = 1
Else LV_MKD_MOD = 0
  For each failure (IDX) stored in dynamic memory,
    if LV_ERR_MKD[IDX] = 1
      Then ACTION_ERRM_EraseErr (IN<IDX>)
        All data in static memory related to failure XX (with XX = F(IDX)) is also cleared
        ACTION_ERRM_ClcPermanentByErr(XX)
    Endif
  EndFor
Endif

```

### B.65.7.2 Activate/deactivate the marked mode without clearing failures

#### Description :

Syntax : ACTION\_ERRM\_ActivateMarkedMode ( IN <MarkedMode> )

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**Parameter(in) :** MarkedMode State of marked mode ON or OFF

**Short Description :** This API shall be used to activate/deactivate the marked mode. In this mode, each new occurring failure is marked.

This is useful for ERRM inhibition. This inhibition may be used during a reprogramming phase.

**Application conditions:**

*Deactivation :* -  
*Initialization:* -  
*Recurrence :* -

**Formula section :**

```

If    MarkedMode = ON
Then  LV_MKD_MOD = 1
Else  LV_MKD_MOD = 0
Endif
    
```

**B.65.7.3 Deactivation of marked mode (security mechanism)**

**Description:**

Purpose of this module is to add a security mechanism regarding marked mode. Because marked mode permits to inhibit error management, a strategy shall be introduced to avoid wrong inhibition. This strategy is to deactivate marked mode at the end of driving cycle or at the next reset.

**Application conditions**

**Initialisation:** *none*  
**Recurrence:** *none*  
**Activation:** *at DCOFF event **or** at RST event*  
**Deactivation:** *none*

**Formula section:**

```

If    LV_MKD_MOD = ON
Then
    MarkedMode = OFF
    ACTION_ERRM_ControlDtcSettings (IN<MarkedMode>)
Endif
    
```


**B.65.8 API for reading readiness code**

**B.65.8.1 Read the readiness code information**

**Description :**

**Syntax :** ACTION\_ERRM\_ReadReadinessCode (  
INOUT <ReadinessCode>,  
OUT <ResultReadinessCode> )

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Parameter(inout) : ReadinessCode Software structure fill with readiness code  
Short Description : This API calculate and returns the readiness code information in the software structure.

Readiness code information are build from readiness flags.

Please see "Readiness Code" module of the "Error management" aggregate for more details.

**Application conditions:**

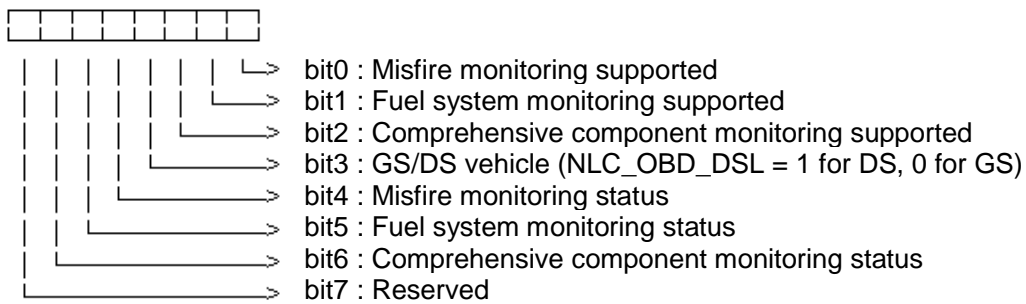
*Deactivation :* -  
*Initialization:* -  
*Recurrence :* -

**Formula section :**

ResultReadinessCode = NEGATIVE\_RESPONSE

(Calculation of STATE\_READY\_OBD\_1)

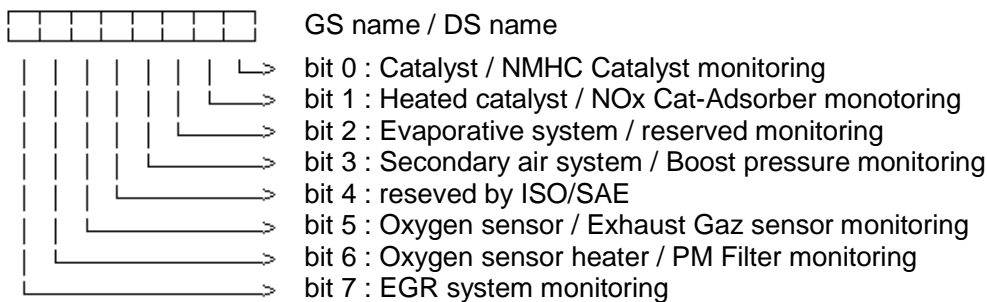
STATE\_READY\_OBD\_1 :



4 less significant bit of STATE\_READY\_OBD\_1 = 4 less significant bit of C\_STATE\_READY\_OBD\_1

4 most significant bit of STATE\_READY\_OBD\_1 = 4 less significant bit of C\_STATE\_READY\_OBD\_1

STATE\_READY\_OBD\_2:



STATE\_READY\_OBD\_2 = C\_STATE\_READY\_OBD\_2

The readiness code calculation is performed in two steps:

1. setting of readiness of a specific group CARB\_YY (e.g. CARB\_SA, CARB\_EVAP), depending on the dynamic Error Management. If at least one failure XX is confirmed with bit 4 of WAL\_CONF\_XX = 1 of the group CARB\_YY, then the readiness of this group can be set to ready.

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2. setting of readiness of a specific group CARB\_YY, depending on the failure XX individual readiness information LV\_READY\_XX. E.g. in case of a failure free system only step 2 is used for the readiness code calculation.

**Step 1:**

```

If CTR_ERR_DYN_NR != 0      (at least one failure stored in Error Management)
Then For IDX = 0 to CTR_ERR_DYN_NR - 1
    If bit 4 of WAL_CONF_XX = 1 (failure is emission relevant)
        with XX = DIAG_INST[IDX]
    and LV_ERR_CFM[IDX] = 1 (failure is confirmed)
    Then ACTION_ERRM_GetReadyClass(XX, PRM_READY_CLAS)
        case PRM_READY_CLAS
            00h (CARB_MIS) : Bit 4 of STATE_READY_OBD_1 = 0
            01h (CARB_FSD) : Bit 5 of STATE_READY_OBD_1 = 0
            02h (CARB_CC) : Bit 6 of STATE_READY_OBD_1 = 0
            03h (CARB_CAT/CARB_NMHC) : Bit 0 of STATE_READY_OBD_2 = 0
            04h (CARB_HC/CARB_NT) : Bit 1 of STATE_READY_OBD_2 = 0
            05h (CARB_EVAP) : Bit 2 of STATE_READY_OBD_2 = 0
            06h (CARB_SA/CARB_BPA) : Bit 3 of STATE_READY_OBD_2 = 0
            07h : Bit 4 reserved by ISO/SAE always 0
            08h (CARB_LS/CARB_EG) : Bit 5 of STATE_READY_OBD_2 = 0
            09h (CARB_LSH/CARB_PF) : Bit 6 of STATE_READY_OBD_2 = 0
            0Ah (CARB_EGR) : Bit 7 of STATE_READY_OBD_2 = 0
        Endif
    Endfor
Endif
    
```

**Step 2:**

Distinction between GS vehicle and DS vehicle  
 Bit 3 of STATE\_READY\_OBD\_1 = NLC\_OBD\_DSL

**For each failure XX call ACTION\_ERRM\_GetReadyClass(XX, PRM\_READY\_CLAS) to retrieve the readiness code group.**

Misfire monitoring status bit4 :

```


If Bit 4 of C_STATE_READY_CMPL_OBD_1 = 0
Then
    if (LV_READY_XX) = 0
        Take into account all LV_READY_XX which fulfill the following condition:
        PRM_READY_CLAS = 00h (CARB_MIS) and
        the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
    then Bit 4 of STATE_READY_OBD_1 = 0
    endif
Else
    Readiness for Misfire monitoring status is set
    Bit 4 of STATE_READY_OBD_1 = 0
Endif
    
```

Fuel system monitoring status bit5 :

```

If Bit 5 of C_STATE_READY_CMPL_OBD_1 = 0
Then
    
```

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```

if (LV_READY_XX) = 0
    Take into account all LV_READY_XX which fulfill the following condition:
    PRM_READY_CLAS = 01h (CARB_FSD) and
    the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
then Bit 5 of STATE_READY_OBD_1 = 0
endif
Else
    Readiness for Fuel system monitoring status is set
    Bit 5 of STATE_READY_OBD_1 = 0
Endif

```

Comprehensive component monitoring status bit6 :

```

If Bit 6 of C_STATE_READY_CMPL_OBD_1 = 0
Then
    if (LV_READY_XX) = 0
        Take into account all LV_READY_XX which fulfill the following condition:
        PRM_READY_CLAS = 02h (CARB_CC) and
        the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
        then Bit 6 of STATE_READY_OBD_1 = 0
        endif
    Else
        Readiness for Comprehensive component status is set
        Bit 6 of STATE_READY_OBD_1 = 0
    Endif

```

Bit 7 of STATE\_READY\_OBD\_1 is unchanged

(Calculation of STATE\_READY\_OBD\_2)

Catalyst monitoring bit 0 :

```

If (LV_READY_XX) = 0
    Take into account all LV_READY_XX which fulfill the following condition:
    PRM_READY_CLAS = 03h (CARB_CAT /CARB_NMHC) and
    the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
Then Bit 0 of STATE_READY_OBD_2 = 0
Endif

```

Heated catalyst bit 1 :

```

If (LV_READY_XX) = 0
    Take into account all LV_READY_XX which fulfill the following condition:
    PRM_READY_CLAS = 04h (CARB_HC /CARB_NT) and
    the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
Then Bit 1 of STATE_READY_OBD_2 = 0
Endif

```

Evaporative system monitoring bit2 :

```

If (LV_READY_XX) = 0
    Take into account all LV_READY_XX which fulfill the following condition:
    PRM_READY_CLAS = 05h (CARB_EVAP) and
    the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
Then Bit 2 of STATE_READY_OBD_2 = 0

```

**Endif**

Secondary air system monitoring bit3 :

**If** (LV\_READY\_XX) = 0  
     Take into account all LV\_READY\_XX which fulfill the following condition:  
     PRM\_READY\_CLAS = 06h (CARB\_SA /CARB\_BPA) **and**  
     the bit 4 of WAL\_CONF\_XX = 1 (CARB/EOBD failure)  
**Then** Bit 3 of STATE\_READY\_OBD\_2 = 0  
**Endif**

bit4 : Reserved by ISO/SAE

Oxygen sensor monitoring bit5 :

**If** (LV\_READY\_XX) = 0  
     Take into account all LV\_READY\_XX which fulfill the following condition:  
     PRM\_READY\_CLAS = 08h (CARB\_LS /CARB\_EG) **and**  
     the bit 4 of WAL\_CONF\_XX = 1 (CARB/EOBD failure)  
**Then** Bit 5 of STATE\_READY\_OBD\_2 = 0  
**Endif**

Oxygen sensor heater monitoring bit6 :

**If** LV\_READY\_XX = 0  
     Take into account all LV\_READY\_XX which fulfill the following condition:  
     PRM\_READY\_CLAS = 09h (CARB\_LSH /CARB\_PF) **and**  
     the bit 4 of WAL\_CONF\_XX = 1 (CARB/EOBD failure)  
**Then** Bit 6 of STATE\_READY\_OBD\_2 = 0  
**Endif**

EGR system monitoring bit7 :

**If** LV\_READY\_XX = 0 Take  
     into account all LV\_READY\_XX which fulfill the following condition:  
     PRM\_READY\_CLAS = 0Ah (CARB\_EGR) **and**  
     the bit 4 of WAL\_CONF\_XX = 1 (CARB/EOBD failure)  
**Then** Bit 7 of STATE\_READY\_OBD\_2 = 0  
**Endif**

ReadinessCode structure is filled up with : C\_STATE\_READY\_OBD\_2, STATE\_READY\_OBD\_1 and STATE\_READY\_OBD\_2.


ResultReadinessCode = POSITIVE\_RESPONSE

Definition of Readiness Code:

In C\_STATE\_READY\_OBD\_1, a bit set to 1 means that corresponding test is supported according to the J1979 standard.

C\_STATE\_READY\_OBD\_1 :

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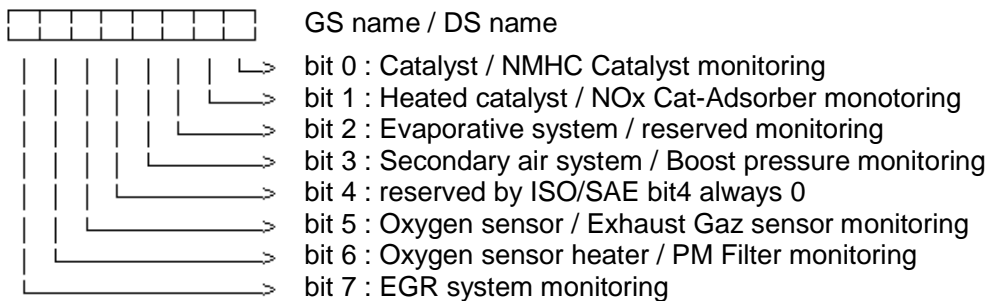
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- bit0 : Misfire monitoring supported
- bit1 : Fuel system monitoring supported
- bit2 : Comprehensive component monitoring supported
- bit3 = 0 (reserved)
- bit4 = 0 (reserved)
- bit5 = 0 (reserved)
- bit6 = 0 (reserved)
- bit7 = 0 (reserved)

With C\_STATE\_READY\_OBD\_CMPL\_OBD\_1, it's possible to set directly Misfire, Fuel system, and comprehensive component readiness codes to "ready" status.

In C\_STATE\_READY\_OBD\_2, a bit set to 1 means that corresponding test is supported according to the J1979 standard.

C\_STATE\_READY\_OBD\_2:

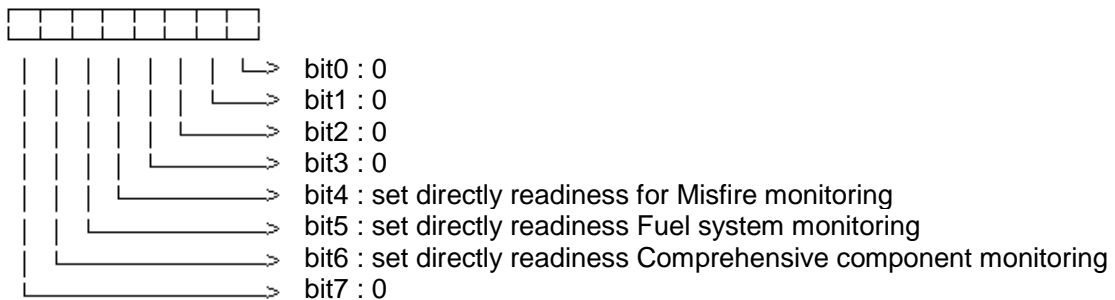


Calibration data detailed description for C\_STATE\_READY\_CMPL\_OBD\_1 :

Readiness code calculation for CARB\_MIS, CARB\_FSD, CARB\_CC diagnosis :

- 0: readiness of conserved group is calculated based on the readiness of each comprehensive component diagnostic
- 1: readiness of conserved group always indicates "ready"

C\_STATE\_READY\_CMPL\_OBD\_1:




### B.65.8.2 Read the readiness code information for customer specific purpose

**Description :**

**Syntax :** ACTION\_ERRM\_ReadReadinessCodCus(

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INOUT <ReadinessCode>,  
OUT <ResultReadinessCode> )

Parameter(inout): ReadinessCode Software structure filled-up with customer specific readiness code

Short Description : This API calculates and returns the readiness code information in the software structure.

Readiness code information are built thanks to readiness flags.

Please see "Readiness Code" module of the ERRM aggregate for more details.

**Application conditions:**

*Deactivation* : -

*Initialization*: -

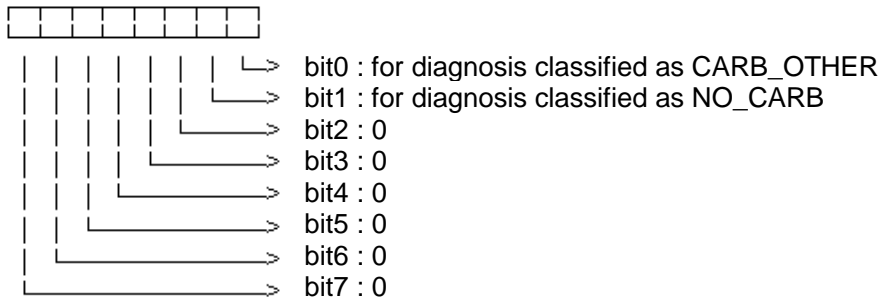
*Recurrence* : -

**Formula section :**

ResultReadinessCode = NEGATIVE\_RESPONSE

(Calculation of STATE\_READY\_OBD\_3)

STATE\_READY\_OBD\_3 :



STATE\_READY\_OBD\_3 = C\_STATE\_READY\_OBD\_3

**For each failure XX call ACTION\_ERRM\_GetReadyClass(XX, PRM\_READY\_CLAS) to retrieve the readiness code group.**

Diagnosis classified as CARB\_OTHER bit0:

**If** (LV\_READY\_XX) = 0

Take into account all LV\_READY\_XX which fulfill the following condition:

PRM\_READY\_CLAS = 0Bh (CARB\_OTHER) **and**  
the bit 4 of WAL\_CONF\_XX = 1 (CARB/EOBD failure)


**Then** Bit 0 of STATE\_READY\_OBD\_3 = 0

**Endif**

Diagnosis classified as NO\_CARB bit1

**If** (LV\_READY\_XX) = 0

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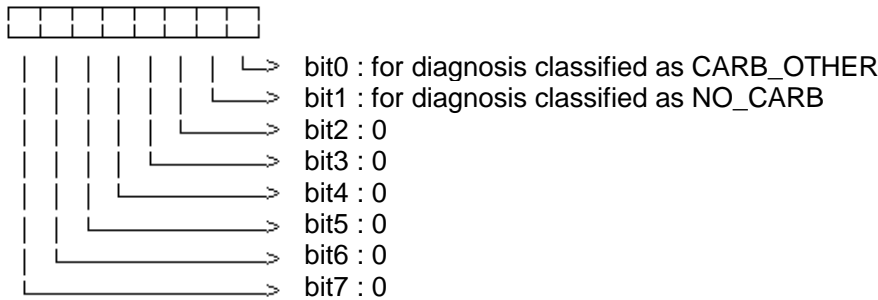
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Take into account all LV\_READY\_XX which fulfill the following condition:  
 PRM\_READY\_CLAS = 0Ch (NO\_CARB) **and**  
 the bit 4 of WAL\_CONF\_XX = 0 (CARB/EOBD failure)  
**Then** Bit 1 of STATE\_READY\_OBD\_3 = 0  
**Endif**

ReadinessCode structure is filled-up with : C\_STATE\_READY\_OBD\_3, STATE\_READY\_OBD\_3.  
 ResultReadinessCode = POSITIVE\_RESPONSE

Definition of Readiness Code:

This readiness code does not follow existing J1979 standard.  
 C\_STATE\_READY\_OBD\_3 :



**B.65.9 Rate-Based Monitoring - Communication interface**

**FUNCTION DESCRIPTION:**

**Description:**

The Rate-Based Monitoring statistics shall be reported to the Scan-Tool via the Mode \$09.  
 The data to be transmitted are :

- Ignition cycle counter
- General denominator
- For each group of monitors, individual numerator and denominator of the monitor which has the lowest In-Use Performance ratios.

These statistics are required and transmitted within Mode \$09 for the monitors of the following groups :

- |                                 |                              |
|---------------------------------|------------------------------|
| <i>Gasoline system</i>          | <i>Diesel system</i>         |
| Catalyst bank 1                 | NMHC catalyst                |
| Catalyst bank 2                 | NOx reduction catalyst       |
| Oxygen sensor upstream bank 1   | NOx adsorber                 |
| Oxygen sensor upstream bank 2   | Particulate matter filter    |
| EGR system and/or VVT system    | Exhaust gas sensor bank 1    |
| Secondary air system            | EGR system and/or VVT system |
| Evaporating system              | Boost pressure control       |
| Oxygen sensor downstream bank 1 |                              |
| Oxygen sensor downstream bank 2 |                              |

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The selection of data to be displayed on Scan-Tool shall respect some rules :

- For each group of monitors, the individual numerator and denominator of monitor which has the lowest numerical In-Use Performance ratio shall be reported.
- If two or more specific monitors of the same group have identical ratios, the corresponding numerator and denominator for the specific monitor that has the highest denominator shall be reported.
- Depending on system configurations, some components might not exist (e.g. O2 Sensor for bank 2 on vehicles with 1 bank engine). In this case the numerator and denominator shall be set to 0.

### B.65.9.1 API to select Rate-Based Monitoring data to be transmitted via Mode \$09

The following paragraph describes the data selection algorithm to be executed only once (for CPU load saving reason), upon external tool request via Mode \$09.

#### Description for action:

<b>ACTION_ERRM_SelectRbmData (&lt;PRM_CTR_MOD_9_RBM[36]&gt;, &lt;PRM_RES_MOD_9&gt;)</b>					
This API calculates and returns the Rate-Based Monitoring data to be transmitted to the Scan-Tool, when requested by the Mode 09\$ (InfoType \$08).					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_CTR_MOD_9_RBM[36]	INOUT	0..FFFFH	0..65535	1	[-]
Table of counters to be reported to Scan Tool with Mode \$09					
PRM_RES_MOD_9	OUT	0H 1H	NEGATIVE_RESPONSE POSITIVE_RESPONSE	1	[-]
Indicates if action has been executed or not					

PRM\_CTR\_MOD\_9\_RBM[36] detailed description:

Index	Byte n°	Diesel system (72 bytes)	Gasoline system (72 bytes)	
0	#0 #1	00H 00H	OBD Monitoring Conditions	MSB byte LSB byte
1	#2 #3	00H 00H	Ignition Counter	MSB byte LSB byte
2	#4 #5	00H 00H	Catalyst Bank 1 - Numerator	MSB byte LSB byte
3	#6 #7	00H 00H	Catalyst Bank 1 - Denominator	MSB byte LSB byte
4	#8 #9	00H 00H	Catalyst Bank 2 - Numerator	MSB byte LSB byte
5	#10 #11	00H 00H	Catalyst Bank 2 - Denominator	MSB byte LSB byte
6	#12 #13	00H 00H	Oxygen Sensor bank 1 - Numerator	MSB byte LSB byte
7	#14 #15	00H 00H	Oxygen Sensor bank 1 - Denominator	MSB byte LSB byte
8	#16 #17	00H 00H	Oxygen Sensor bank 2 - Numerator	MSB byte LSB byte
9	#18 #19	00H 00H	Oxygen Sensor bank 2 - Denominator	MSB byte LSB byte
10	#20 #21	00H 00H	EGR/VVT System - Numerator	MSB byte LSB byte
11	#22 #23	00H 00H	EGR/VVT System - Denominator	MSB byte LSB byte
12	#24 #25	00H 00H	Secondary Air - Numerator	MSB byte LSB byte
13	#26 #27	00H 00H	Secondary Air - Denominator	MSB byte LSB byte
14	#28 #29	00H 00H	Evaporating System - Numerator	MSB byte LSB byte
15	#30 #31	00H 00H	Evaporating System - Denominator	MSB byte LSB byte
16	#32 #33	00H 00H	Secondary Oxygen Sensor Bank 1 - Numerator	MSB byte LSB byte
17	#34 #35	00H 00H	Secondary Oxygen Sensor Bank 1 - Denominator	MSB byte LSB byte
18	#36 #37	00H 00H	Secondary Oxygen Sensor Bank 2 - Numerator	MSB byte LSB byte
19	#38 #39	00H 00H	Secondary Oxygen Sensor Bank 2 - Denominator	MSB byte LSB byte
20	#40 #41	OBD Monitoring Conditions	00H 00H	MSB byte LSB byte
21	#42 #43	Ignition Counter	00H 00H	MSB byte LSB byte
22	#44 #45	NMHC Catalyst - Numerator	00H 00H	MSB byte LSB byte
23	#46 #47	NMHC Catalyst - Denominator	00H 00H	MSB byte LSB byte
24	#48	NOx Catalyst - Numerator	00H	MSB byte

	#49		00H	LSB byte
25	#50 #51	NOx Catalyst - Denominator	00H 00H	MSB byte LSB byte
26	#52 #53	NOx Adsorber - Numerator	00H 00H	MSB byte LSB byte
27	#54 #55	NOx Adsorber - Denominator	00H 00H	MSB byte LSB byte
28	#56 #57	PM Filter - Numerator	00H 00H	MSB byte LSB byte
29	#58 #59	PM Filter - Denominator	00H 00H	MSB byte LSB byte
30	#60 #61	Exhaust Gas Sensor Bank 1 - Numerator	00H 00H	MSB byte LSB byte
31	#62 #63	Exhaust Gas Sensor Bank 1 - Denominator	00H 00H	MSB byte LSB byte
32	#64 #65	EGR/VVT System - Numerator	00H 00H	MSB byte LSB byte
33	#66 #67	EGR/VVT System - Denominator	00H 00H	MSB byte LSB byte
34	#68 #69	Boost Pressure Control - Numerator	00H 00H	MSB byte LSB byte
35	#70 #71	Boost Pressure Control - Denominator	00H 00H	MSB byte LSB byte

### Application conditions

**Initialization :**

```

For i = 0 to 35 do
    PRM_CTR_MOD_9_RBM[i] = 0000H
Endfor
PRM_RES_MOD_9 = NEGATIVE_RESPONSE

```

**Recurrence :** –

**Activation :** *at Action call*

**Deactivation :** –

### Formula section:

**If(1)** NLC\_OBD\_RBM\_ENA = 1

**If(2)** NLC\_OBD\_DSL = 0 (Gasoline engine)

**Then(2)**

PRM\_CTR\_MOD\_9\_RBM[0] = CTR\_CDN\_OBD\_RBM

PRM\_CTR\_MOD\_9\_RBM[1] = CTR\_IGK\_CYC\_RBM

ACTION\_ERRM\_SelectRbmByGroup (NC\_RBM\_CAT\_1, PRM\_CTR\_MOD\_9\_RBM[2], PRM\_CTR\_MOD\_9\_RBM[3], PRM\_RES\_MOD\_9)


ACTION\_ERRM\_SelectRbmByGroup (NC\_RBM\_CAT\_2, PRM\_CTR\_MOD\_9\_RBM[4], PRM\_CTR\_MOD\_9\_RBM[5], PRM\_RES\_MOD\_9)

ACTION\_ERRM\_SelectRbmByGroup (NC\_RBM\_LS\_UP\_1, PRM\_CTR\_MOD\_9\_RBM[6], PRM\_CTR\_MOD\_9\_RBM[7], PRM\_RES\_MOD\_9)

ACTION\_ERRM\_SelectRbmByGroup (NC\_RBM\_LS\_UP\_2, PRM\_CTR\_MOD\_9\_RBM[8], PRM\_CTR\_MOD\_9\_RBM[9], PRM\_RES\_MOD\_9)

ACTION\_ERRM\_SelectRbmByGroup (NC\_RBM\_EGR\_VVT, PRM\_CTR\_MOD\_9\_RBM[10], PRM\_CTR\_MOD\_9\_RBM[11], PRM\_RES\_MOD\_9)

ACTION\_ERRM\_SelectRbmByGroup (NC\_RBM\_SA, PRM\_CTR\_MOD\_9\_RBM[12], PRM\_CTR\_MOD\_9\_RBM[13], PRM\_RES\_MOD\_9)

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```

ACTION_ERRM_SelectRbmByGroup (NC_RBM_EVAP, PRM_CTR_MOD_9_RBM[14], CTR_
MOD_9_RBM[15], PRM_RES_MOD_9)
ACTION_ERRM_SelectRbmByGroup (NC_RBM_LS_DOWN_1, PRM_CTR_MOD_9_RBM[16],
PRM_CTR_MOD_9_RBM[17], PRM_RES_MOD_9)
ACTION_ERRM_SelectRbmByGroup (NC_RBM_LS_DOWN_2, PRM_CTR_MOD_9_RBM[18],
PRM_CTR_MOD_9_RBM[19], PRM_RES_MOD_9)
For i = 20 to 35 do
    PRM_CTR_MOD_9_RBM[i] = 0000H
Endfor
Else(2)
    (Diesel engine)
    For i = 0 to 19 do
        PRM_CTR_MOD_9_RBM[i] = 0000H
    Endfor
    PRM_CTR_MOD_9_RBM[20] = CTR_CDN_OBD_RBM
    PRM_CTR_MOD_9_RBM[21] = CTR_IGK_CYC_RBM
    ACTION_ERRM_SelectRbmByGroup (NC_RBM_NMHC, PRM_CTR_MOD_9_RBM[22],
    PRM_CTR_MOD_9_RBM[23], PRM_RES_MOD_9)
    ACTION_ERRM_SelectRbmByGroup (NC_RBM_RCAT, PRM_CTR_MOD_9_RBM[24], PRM_
    CTR_MOD_9_RBM[25], PRM_RES_MOD_9)
    ACTION_ERRM_SelectRbmByGroup (NC_RBM_NT, PRM_CTR_MOD_9_RBM[26], PRM_
    CTR_MOD_9_RBM[27], PRM_RES_MOD_9)
    ACTION_ERRM_SelectRbmByGroup (NC_RBM_PF, PRM_CTR_MOD_9_RBM[28], PRM_
    CTR_MOD_9_RBM[29], PRM_RES_MOD_9)
    ACTION_ERRM_SelectRbmByGroup (NC_RBM_EG_1, PRM_CTR_MOD_9_RBM[30],
    PRM_CTR_MOD_9_RBM[31], PRM_RES_MOD_9)
    ACTION_ERRM_SelectRbmByGroup (NC_RBM_EGR_VVT_DSL, PRM_CTR_MOD_9_
    RBM[32], PRM_CTR_MOD_9_RBM[33], PRM_RES_MOD_9)
    ACTION_ERRM_SelectRbmByGroup (NC_RBM_BPA, PRM_CTR_MOD_9_RBM[34], PRM_
    CTR_MOD_9_RBM[35], PRM_RES_MOD_9)

```

**Endif(2)**

**Else(1)**

**For** i = 0 to 35 **do**

PRM\_CTR\_MOD\_9\_RBM[i] = 0000H

**Endfor**

**Endif(1)**


PRM\_RES\_MOD\_9 = POSITIVE\_RESPONSE

### B.65.9.2 API to select RBM statistic with lowest in-use performance ratio within one single group

#### General information:

This API shall be used to determine, within one single group ( see specification “Rate-Based Monitoring (Appl. Inc.)” ), the counters of the monitor which has the lowest in-use performance ratio.

#### Description for action:

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<b>ACTION_ERRM_SelectRbmByGroup(&lt;PRM_GROUPNAME&gt;,&lt;PRM_NUMERATOR&gt;,&lt;PRM_DENOMINATOR&gt;,&lt;PRM_RESULTRBMDATABYGROUP&gt;)</b>					
This API calculates and returns the Rate-Based Monitoring data with lowest ratios, within one single group.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_GROUPNAME	IN	0...FFH	0...255	1	[-]
Group name					
PRM_NUMERATOR	INOUT	0...FFFFH	0...65535	1	[-]
Numerator of monitor with lowest ratio in the required group					
PRM_DENOMINATOR	INOUT	0...FFFFH	0...65535	1	[-]
Denominator of monitor with lowest ratio in the required group					
PRM_RESULTRBMDATABYGROUP	OUT	0H 1H	NEGATIVE_RESPONSE POSITIVE_RESPONSE	1	[-]
Indicates if the Action has been executed or not					

### Application conditions

**Initialization :** -  
**Recurrence :** -  
**Activation :** *at Action call*  
**Deactivation :** -

### Formula section:

**{ For CPU optimization reasons, this implementation assumes that belonging to a same group are joined. If this requirement isn't respected, data sent to the Scan-Tool might be erroneous }**

PRM\_RESULTRBMDATABYGROUP = NEGATIVE\_RESPONSE

m = 0

**While** m ≤ ( NC\_NR\_DIAG\_RBM - 1 ) **do**

**If(1)** m monitor belongs to PRM\_GROUPNAME

**Then(1)**

**If(2)** CTR\_CDN\_RBM[m] ≠ 0 { denominator is different from 0 }

**Then(2)**

RATIO\_TMP\_RBM = CTR\_COMP\_RBM[m] / CTR\_CDN\_RBM[m]

PRM\_NUMERATOR = CTR\_COMP\_RBM[m] and PRM\_DENOMINATOR = CTR\_CDN\_RBM[m]

**Else(2)**

RATIO\_TMP\_RBM = 200498A4H

PRM\_NUMERATOR = CTR\_COMP\_RBM[m] and PRM\_DENOMINATOR = 0

**Endif(2)**

IDX\_TMP\_RBM = m

**For** j = (m+1) to ( NC\_NR\_DIAG\_RBM - 1 ) **do**

**If(3)** j monitor belongs to PRM\_GROUPNAME

**Then(3)**

**If(4)** CTR\_CDN\_RBM[j] ≠ 0 { denominator is different from 0 }

**Then(4)**

{ case of one monitor with lower ratio than previous one found }

**If(5)** (( CTR\_COMP\_RBM[j] / CTR\_CDN\_RBM[j] ) < RATIO\_TMP\_RBM )

**Then(5)**

RATIO\_TMP\_RBM = CTR\_COMP\_RBM[j] / CTR\_CDN\_RBM[j]

IDX\_TMP\_RBM = j

```

PRM_NUMERATOR = CTR_COMP_RBM[j]
PRM_DENOMINATOR = CTR_CDN_RBM[j]
Else(5)
{ case of two monitors with same ratios }
If(6)    ( ( CTR_COMP_RBM[j] /CTR_CDN_RBM[j] ) = RATIO_
TMP_RBM )
Then(6)
If(7)    CTR_CDN_RBM[j] > CTR_CDN_RBM[IDX_TMP_
RBM]
Then(7)
PRM_NUMERATOR = CTR_COMP_RBM[j]
PRM_DENOMINATOR = CTR_CDN_RBM[j]
IDX_TMP_RBM = j
Endif(7)
Endif(6)
Endif(5)
Else(4)
{ denominator equals 0 }
Endif(4)
Endif(3)
Endfor
Exit while loop
Else(1)
{ m monitor doesn't belong to PRM_GROUPNAME }
m = m +1
PRM_NUMERATOR = 0 and PRM_DENOMINATOR = 0
Endif(1)
Endwhile
PRM_RESULTRBMDBYGROUP = POSITIVE_RESPONSE

```

### B.65.9.3 API to clear all Rate-Based Monitoring statistics

#### General information:


Regulation text :

*“Each number shall be reset to zero only when a non-volatile memory reset occurs (e.g., reprogramming event, etc.) or, if the numbers are stored in keep-alive memory (KAM), when KAM is lost due to an interruption in electrical power to the control module (e.g., battery disconnect, etc.). Numbers may not be reset to zero under any other circumstances including when a scan tool command to clear fault codes or reset KAM is received.”*

The service provided in this paragraph shall be used to clear all the Rate-Based Monitoring statistics after a reprogramming session of ECU software and/or calibration data.

This service shall not be called when a Scan Tool command to clear faults (Mode 04\$) is received.

#### Description for action:

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<b>ACTION_ERRM_ClearRbmStatistics (&lt; PRM_RESULTCLRINFO &gt; )</b>					
This function clears Rate-Based Monitoring statistics. Remark : For design and CPU resource reasons, this API shall be called while engine is stopped.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_RESULTCLRINFO	OUT	0H 1H	NOT_CLEARED CLEARED	1	[-]
This data informs about rate-based monitoring statistics clearing completion status					

**Application conditions**

**Initialization :** -  
**Recurrence :** -  
**Activation :** *at Action call*  
**Deactivation :** -

**Formula section:**

```

PRM_RESULTCLRINFO = STATISTICS_NOT_CLEARED
CTR_IGK_CYC_RBM = 0
CTR_CDN_OBD_RBM = 0
For m = 0 to ( NC_NR_DIAG_RBM -1 ) do
    CTR_CDN_RBM[m] = 0
    CTR_COMP_RBM[m] = 0
Endfor
PRM_RESULTCLRINFO = STATISTICS_CLEARED
    
```

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## B.66 Communication interface (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_TYPE_BYTE [NC_NR_ERR_DYN]	O	0... FFH	0... 255	1	-
Fault-type-byte					
ERR_TYPE_EXT_BYTE [NC_NR_ERR_DYN]	O	0... FFH	0... 255	1	-
Fault-type-extension-byte					

### Input data:

CTR_DC [NC_NR_ERR_DYN] {p. 5767}	CTR_WUP_CYC [NC_NR_ERR_DYN] {p. 5767}	ENVD_CUS_SET_CMN [NC_NR_ENVD_CUS_] SET_CMN][NC_NR_FRF_] SET][NC_NR_ERR_DYN] {p. 5792}	LV_CDN_DIAG_XX {p. 4581}
LV_DC_MAX [NC_NR_ERR_DYN] {p. 5767}	LV_END_DIAG_XX {p. 4581}	LV_ERR_CFM [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_DC [NC_NR_ERR_DYN] {p. 5767}
LV_ERR_MKD [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_TMP [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_XX	LV_READY_XX {p. 5881}
WAL_CONF_XX {p. 5811}			

### B.66.1 Communication interface for BMW diagnosis tool

#### FUNCTION DESCRIPTION:

#### General information:

This communication interface is to define the data contents needed for the BMW diagnosis information. The information in the Fault-type-byte and Fault-type-extension-byte is bit-coded and requested via KWP communication.

#### Application conditions

**Initialisation:** *managed in the specific chapters*

**Recurrence:** *managed in the specific chapters*

**Activation:** *see chapter KWP communication*

#### Formula section:

Definition of ERR\_TYPE\_BYTE[x]



Bit No:	Description	Input
0	Specifies the error symptom: 0001-Short circuit to VBATT or signal / value above threshold (Max)	<b>IF</b> ENVD_CUS_SET_CMN[1][x] = 1H
1	Specifies the error symptom: 0010-Short circuit to ground or signal / value below threshold (Min)	<b>IF</b> ENVD_CUS_SET_CMN[1][x] = 2H
2	Specifies the error symptom: 0100-Open circuit or no signal (Sig)	<b>IF</b> ENVD_CUS_SET_CMN[1][x] = 4H
3	Specifies the error symptom: 1000-Implausible signal / condition (Plaus)	<b>IF</b> ENVD_CUS_SET_CMN[1][x] = 8H
4	BMW Readiness flag. The bit is set to 0 if the test conditions are met and the diagnostic runs to completion at least once after the fault memory has been cleared, or after power failure	<b>IF</b> LV_READY_XX = 0
5	This bit is set when the fault has been saved to the fault memory as OBD debounced.	<b>IF</b> LV_DC_MAX[x] = 1
6	This bit is set when the fault is currently present	<b>IF</b> LV_ERR_XX = 1
7	MIL calibration status, specifies wheather the MIL is to be activated	<b>IF</b> MIL_ON bit of WAL_CONF_XX =1

#### Definition of ERR\_TYPE\_EXT\_BYTE[x]

Bit No:	Description	Input
0	Only for Diagnostic diagnosis; This bit is set if the diagnosis is currently running	<b>For diagnostic diagnosis**</b> LV_END_DIAG_XX = 0 <b>AND</b> LV_CDN_DIAG_XX = 1
1	Only for Diagnostic diagnosis; This bit is set if the diagnosis is interrupted for this driving cycle	<b>For diagnostic diagnosis**</b> Not defined yet
2	Cycle flag. The bit is set if the diagnosis runs to completion in this driving cycle	<b>IF</b> LV_END_DIAG_XX = 1
3	This bit is to be set if the fault is stored as a result of an action by an tester	<b>IF</b> LV_ERR_MKD[x] = 1
4	This bit is to be set if the fault is currently requesting the MIL to be illuminated.	<b>IF</b> LV_DC_MAX[x] = 1 <b>AND</b> MIL_ON bit of WAL_CONF_XX = 1
5	This bit is set if MIL debouncing has been achieved, the MIL is not currently being requested for this fault and output via the Scan Tool interface has not yet occured (HLC =0 & DLC >0). (former OBDII error)	<b>IF</b> LV_ERR_CFM[x] = 1 <b>AND</b> CTR_DC[x] = 0 <b>AND</b> MIL_ON bit of WAL_CONF_XX =1 <b>AND</b> CTR_WUP_CYC[x] > 0
6	Not yet defined	
7	Not yet defined	

\*\*Diagnostic diagnosis are all sequential diagnosis (see Table of failures - CARB status )

## B.67 Cycle manager

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DC	O/V	0... 1H	0 ...1	1	-
Driving cycle active					
LV_DC_PERM	O/V	0... 1H	0 ...1	1	-
Driving cycle including standardized vehicle operations for permanent fault code erasure after ERRM clearing					
LV_STATE_WUP	O/V	0... 1H	0 ...1	1	-
tco state for exceeding the warm-up cycle tco threshold					
LV_WUP_CYC	O/V	0... 1H	0 ...1	1	-
Warm-up cycle status flag					
STATE_DC_PERM	V	0... FFH	0... 255	1	-
Status information about all conditions necessary to set LV_DC_PERM					
T_AST_PERM	V	0... FFFFH	0... 6553.5	0.1	s
Cumulated time since engine start for permanent fault code erasing after Mode \$04					
T_IS_PERM	V	0... FFFFH	0... 6553.5	0.1	s
Continuous vehicle operation in idle >= C_T_IS_RBM for permanent fault code erasing after Mode \$04					
T_VS_PERM	V	0... FFFFH	0... 6553.5	0.1	s
Cumulated operation with vehicle speed >= C_T_VS_RBM for permanent fault code erasing after Mode \$04					

### Input data:

C_PV_IS_RBM {p. 5858}	C_T_AST_RBM {p. 5859}	C_T_IS_RBM {p. 5859}	C_T_VS_RBM {p. 5859}
C_VS_THD_IS_CDN_RBM {p. 5859}	C_VS_THD_RBM {p. 5859}	LV_ES {p. 1720}	LV_IGK {p. 906}
LV_INH_DC_PERM {p. 5753}	LV_INH_WUP_CYC {p. 5789}	LV_IS_PERM {p. 5753}	LV_PWL {p. 988}
LV_ST_END {p. 1720}	PV {p. 978}	TCO_DSL_CMN {p. 5789}	TCO_ST_DSL_CMN {p. 5789}
VS {p. 1176}			

### Calibration data:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_ST_MAX_INH_WUP_CYC	-	0... FEH	-48... 142.5	0.75	°C
maximum engine temperature at start to detect warm up cycle (customer requirement 71,1°C)					
C_TCO_WUP_INC	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature increase from engine starting for warm-up cycle detection					
C_TCO_WUP_THD	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature to be reached for warm-up cycle detection					

### Import actions:

ACTION_ERRM_ClcPermanentResetDC ()
------------------------------------

## B.67.1 Driving cycle

### FUNCTION DESCRIPTION:

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**General information:**

**Description:**

A driving cycle consists of a vehicle operation phase from engine startup to engine shutoff and includes the power-latch phase after the engine running phase (In order manage all OBD failures set only in PWL phase).

After key is on, the flag LV\_DC is set when the engine exits from “engine start” state.

The flag LV\_DC is reset at the end of the power-latch phase before the NVMY management. In case of a LV\_IGK 0→1 transition during the powerlatch phase or at ECU reset LV\_DC is also reseted.


**Remark :**

For simplification and global coherence, the following rule is applied:

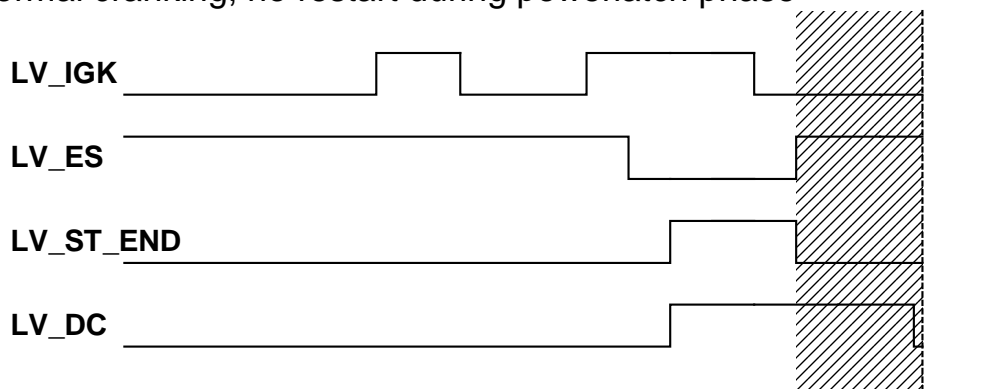
Engine stalling is ignored (if engine restarts after stalling, without key-off/key-on transition, the cycle is considered as the same driving cycle).

**Signal flow diagram:**

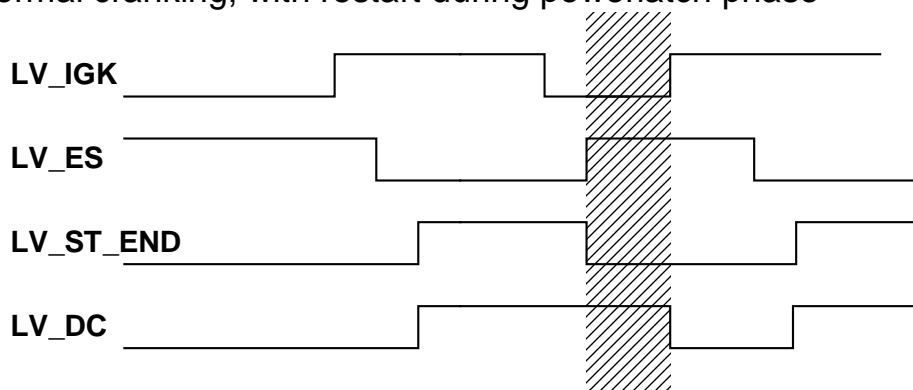
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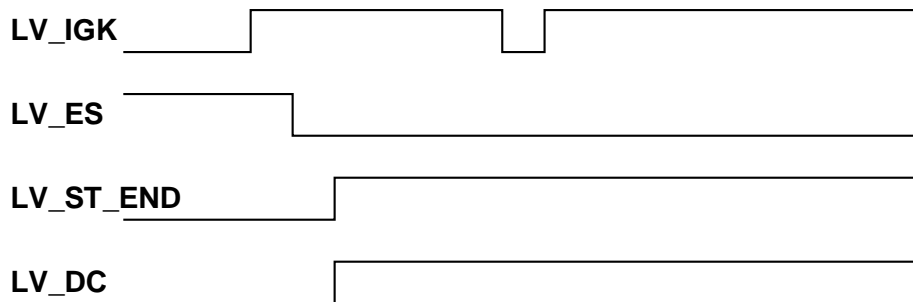
Normal cranking, no restart during powerlatch phase



Normal cranking, with restart during powerlatch phase



Short key off/on while engine is running



**Application conditions**

**Initialisation:**

At RST system event  
 LV\_DC = 0  
 Before storage of data of the error management within the NVMY the driving cycle is finished.


**Recurrence:**

-

**Activation:**

see Formula section

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**Formula section:**

Activation:

**If** LV\_ST\_END 0→1 transition

**Then**

LV\_DC = 1

**Endif**

Deactivation:

**If** LV\_IGK 0→1 transition

**and**  
LV\_ES =1

**Then**

LV\_DC = 0

Before clearing static and dynamic memory (e.g. LV\_END\_DIAG\_XX) call :  
ACTION\_ERRM\_ClcPermanentResetDC ()

**Endif**

**If** End of power-latch phase is reached (before NVMY storing)

**Then**

LV\_DC = 0

Before clearing static and dynamic memory (e.g. LV\_END\_DIAG\_XX) call :  
ACTION\_ERRM\_ClcPermanentResetDC ()

**Endif**

**B.67.2 Warm-Up Cycle and Warm-Up Status**

**FUNCTION DESCRIPTION:**

**General information:**

The detection of the warm-up cycle is based on the coolant temperature. The warm-up cycle is detected as soon as the coolant temperature reaches C\_TCO\_WUP\_THD and the change with regard to the starting temperature exceeds C\_TCO\_WUP\_INC. These values are defined by law, so a change of these values is only for development validation commodity.

The application must guarantee warm-up cycle detection when a coolant temperature sensor error exists.

Therefore if a coolant temperature sensor error has been debounced, the threshold for warm-up cycle detection are referred to the backup coolant temperature value computed by the engine control (see chapter "Diagnosis and emergency operation").

The warm-up status is needed for similar driving conditions test.

**Application conditions**


**Initialisation:** *At RST system event or LV\_DC 1→0 transition (after warm-up cycle counter management)*

LV\_WUP\_CYC =0  
LV\_STATE\_WUP = 0

**Recurrence:** *1 s*

**Activation:** *LV\_DC = 1*

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**Formula section:**

```

If   LV_INH_WUP_CYC = 0
Then
    If   TCO_DSL_CMN > C_TCO_WUP_THD
    Then
        LV_STATE_WUP = 1
        If   TCO_DSL_CMN > (TCO_ST_DSL_CMN + C_TCO_WUP_INC)
        and
            TCO_ST_DSL_CMN < C_TCO_ST_MAX_INH_WUP_CYC
        Then
            LV_WUP_CYC = 1
        Endif
    Endif
Endif
    
```

**Endif**

Calibration hint:

C\_TCO\_WUP\_THD =     at least 72 °C for gasoline engines     (OBD II requirement)  
                           at least 70 °C for gasoline engines     (EOBD requirement)  
                           at least 60 °C for diesel engines     (OBD II requirement)  
 C\_TCO\_WUP\_INC =     at least 23 °C for gasoline engines     (OBD II requirement)  
                           at least 22 °C for gasoline engines     (EOBD requirement)

Customer specific requirement for gasoline and diesel to inhibit the warm up cycle in case of TCO at engine start > C\_TCO\_ST\_MAX\_INH\_WUP\_CYC

C\_TCO\_ST\_MAX\_INH\_WUP\_CYC = 71,1 °C                             (customer specific requirement)

C\_TCO\_ST\_MAX\_INH\_WUP\_CYC = 142.5°C                             (generic no inhibition)

**B.67.3 Standardized vehicle operation for permanent fault code erasing after Mode \$04**

**FUNCTION DESCRIPTION:**

**General information:**

A special driving cycle (LV\_DC\_PERM) for permanent fault code clearing after Mode \$04 is defined, which is set, if the following standardized vehicle operations are fulfilled:


- Cumulated trip length (time since engine start) T\_AST\_PERM >= C\_T\_AST\_RBM  
(CARB : 600 s)
- Cumulative vehicle operation >= C\_VS\_THD\_RBM for minimum of C\_T\_VS\_RBM  
(CARB : >= 40 km/h (25mph) for at least 300 s)
- Continuous vehicle operation in idle equal or longer than C\_T\_IS\_RBM (accelerator pedal released and vehicle speed less or equal than 1 mph)  
(CARB : 30 s)

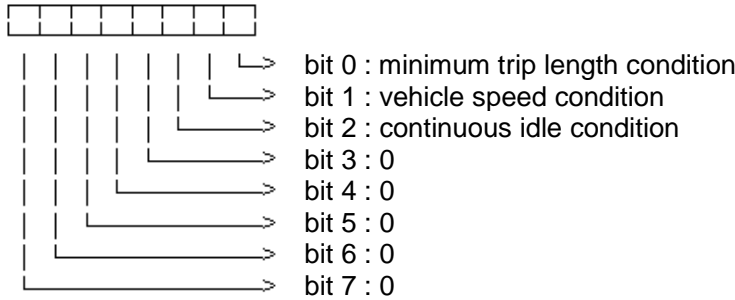
watsoever

- altitude condition is (no criteria for ambient pressure si defined)
- ambient temperature is (no criteria on ambient temperature is defined)

Within STATE\_DC\_PERM the different conditions necessary to set LV\_DC\_PERM are visualized.  
STATE\_DC\_PERM

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bit value = 0 condition not yet met; bit value = 1 condition met

### Application conditions

**Initialisation:** at LV\_DC 0 → 1 transition **or** RST system event

LV\_DC\_PERM = 0  
 STATE\_DC\_PERM = 0H  
 T\_AST\_PERM = 0 s  
 T\_VS\_PERM = 0 s  
 T\_IS\_PERM = 0 s

**Recurrence:** 100 ms

**Activation:** LV\_DC = 1 **and** LV\_DC\_PERM = 0 **and** LV\_INH\_DC\_PERM = 0  
**and** LV\_PWL = 0

### Formula section:

#### Minimum trip length

**If (1)** bit 0 of STATE\_DC\_PERM = 0 (minimum trip length not reached yet)

**Then (1)**

T\_AST\_PERM = T\_AST\_PERM + 100 ms

**If (2)** T\_AST\_PERM = C\_T\_AST\_RBM

**Then (2)**

bit 0 of STATE\_DC\_PERM = 1

**Endif (2)**

**Endif (1)**

#### Vehicle speed

**If (1)** bit 1 of STATE\_DC\_PERM = 0 (vehicle speed condition not met yet)

**and**

VS >= C\_VS\_THD\_RBM

**Then (1)**

T\_VS\_PERM = T\_VS\_PERM + 100 ms

**If (2)** T\_VS\_PERM = C\_T\_VS\_RBM

**Then (2)**

bit 1 of STATE\_DC\_PERM = 1

**Endif (2)**

**Endif (1)**

Continuous idle


```

If (1)    bit 2 of STATE_DC_PERM = 0      (continuous idle cond. not met yet)
Then (1)
    If (2)  LV_IS_PERM = 1 (engine in idle mode)
            and
            PV <= C_PV_IS_RBM   (accelerator pedal released)
            and
            VS <= C_VS_THD_IS_CDN_RBM (CARB: 1 mile/h)
    Then (2)
        T_IS_PERM = T_IS_PERM + 100 ms
        If (3)  T_IS_PERM = C_T_IS_RBM
        Then (3)
            bit 2 of STATE_DC_PERM = 1
        Endif (3)
    Else (2)
        T_IS_PERM = 0
    Endif (2)
Endif (1)
    
```

Global information about driving cycle including standardized vehicle operations

```

If (1)    STATE_DC_PERM = 07H   (all conditions are met)
Then (1)  LV_DC_PERM = 1
Endif (1)
    
```

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## B.68 Cycle manager (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DC_PERM	O/V	0... 1H	0 ...1	1	-
Inhibition of standardized vehicle operation for permanent fault code erasing after Mode \$04					
LV_IS_PERM	O/V	0... 1H	0 ...1	1	-
Engine operating state "Idle Speed" for permanent fault code computations					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_DC {p. 5746}	LV_ERR_PVS_DOUBLE {p. 4216}	LV_ERR_VS {p. 5021}
-----------------------------	-----------------	--------------------------------	---------------------

### Import actions:

<b>ACTION_ERRM_CheckPendingStatus</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR_PND>)
--

### General information

#### B.68.1 Inhibition of standardized vehicle operation operation for permanent fault code erasing after Mode \$04

### General information:

With the value LV\_INH\_DC\_PERM the inhibition of the standardized vehicle operation calculation for permanent fault code erasing after Mode \$04 is controlled. The OBD II system shall disable it if a malfunction of any component used to determine if the following criteria are satisfied (i.e., vehicle speed, idle operation, time of operation, ...) has been detected. Calculations shall resume as soon as the malfunction is no longer present.

Criteria required to set LV\_DC\_PERM (standardized vehicle operation for permanent code )

- Cumulated trip length (time since engine start)  $T\_AST\_PERM \geq C\_T\_AST\_RBM$   
(CARB : 600 s)
- Cumulative vehicle operation  $\geq C\_VS\_THD\_RBM$  for minimum of  $C\_T\_VS\_RBM$   
(CARB :  $\geq 40$  km/h (25mph) for at least 300s)
- Continuous vehicle operation in idle equal or longer than  $C\_T\_IS\_RBM$   
(accelerator pedal released and vehicle speed less or equal than 1 mph)  
(CARB : 30 s)

whatever

- altitude condition is (no criteria for ambient pressure is defined)
- ambient temperature is (no criteria on ambient temperature is defined)

**Application conditions:**

**Initialisation:** at RST system event  
                           LV\_INH\_DC\_PERM = 0  
                           at LV\_DC 0 → 1 transition  
                           LV\_INH\_DC\_PERM = 0

**Activation:** LV\_DC = 1 and LV\_INH\_DC\_PERM = 0

**Deactivation:** - -

**Recurrence:** 1s

**Function description:**

**Formula section:**

*At LV\_DC 0 → 1 transition :*

The pending status of the following failures has to be checked only once :

NC_IDX_DIAG_PVS_DOUBLE	NC_IDX_DIAG_VS		
------------------------	----------------	--	--

```

If (1)      CTR_ERR_DYN_NR <> 0 (the dynamic failure memory isn't empty)
Then (1)
    For each failure of the above list do
        ACTION_ERRM_CheckPendingStatus (IN<PRM_IDX_DIAG>,
        OUT<PRM_LV_ERR_PND>)
        If (2)      PRM_LV_ERR_PND = 1 (XX has a pending status)
        Then (2)
            LV_INH_DC_PERM = 1
            Exit For-loop
        Endif (2)
    Endfor
Else (1)  { the dynamic failure memory is empty }
    No action
Endif (1)
    
```

*Every 1 s :*

```

If      LV_ERR_PVS_DOUBLE = 1
    or
    LV_ERR_VS = 1
Then
    LV_INH_DC_PERM = 1
Endif
    
```

**B.68.2 Standardized vehicle operation adaptations**

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**General information:**

Due to new vehicles configurations encountered (Stop& Start, conventional combustio engine), CARB standardized vehicle operations (LV\_DC\_RBM) defined for conventional vehicles may be difficult to reach, mainly because some engine states are no more covered (idle mode).

CARB regulation:

*"For hybrid vehicles, vehicles that employ alternate engine start hardware or strategies (e.g., integrated starter and generators), or alternate fuel vehicles (e.g., dedicated, bi-fuel, or dual-fuel applications), the manufacturer may request Executive Officer approval to use alternate criteria to that set forth in section (d)(4.3.2)(B) above for incrementing the denominator. In general, the Executive Officer shall not approve alternate criteria for vehicles that only employ engine shut off at or near idle/vehicle stop conditions. Executive Officer approval of the alternate criteria shall be based on the equivalence of the alternate criteria to determine the amount of vehicle operation relative to the measure of conventional vehicle operation in accordance with the criteria in section (d)(4.3.2)(B) above."*

The purpose of the following formula section is to provide or re-build missing data so as to keep CARB standardized vehicle operation definition.

**Application conditions:**

**Initialisation:** at RST system event  
LV\_IS\_PERM = 1

**Activation:** all ECU states

**Deactivation:** -


**Recurrence:** 100 ms

**Function description:**

**Formula section:**

LV\_IS\_PERM = 1

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## B.69 Diagnostic trouble code management

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_DTC [NC_NR_ERR_DYN]	O/V/S	0... FFFFH	0... 65535	1	-
DTC code stored in memory for failure IDX					
ERR_SYM_LST [NC_NR_ERR_DYN]	O/V/S	0... FH	0... 15	1	-
Memorized the last detected symptom of the failure IDX (for the DTC building)					
ERR_SYM_MEM [NC_NR_ERR_DYN]	O/V/S	0... FH	0... 15	1	-
Memorized detected symptom of the failure IDX (for the DTC building)					
SYM_CYL_LST_MIS_A	O/V/S	0... FFFFH	0... 65535	1	-
Memorized the last cylinder of the misfire A failure (for the DTC building)					
SYM_CYL_LST_MIS_B1	O/V/S	0... FFFFH	0... 65535	1	-
Memorized the last cylinder of the misfire B1 failure (for the DTC building)					
SYM_CYL_LST_MIS_B4	O/V/S	0... FFFFH	0... 65535	1	-
Memorized the last cylinder of the misfire B4 failure (for the DTC building)					
SYM_CYL_MEM_MIS_A	O/V/S	0... FFFFH	0... 65535	1	-
memorized cylinder with misfire A (for the DTC building)					
SYM_CYL_MEM_MIS_B1	O/V/S	0... FFFFH	0... 65535	1	-
memorized cylinder with misfire B1 (for the DTC building)					
SYM_CYL_MEM_MIS_B4	O/V/S	0... FFFFH	0... 65535	1	-
memorized cylinder with misfire B4 (for the DTC building)					

### Input data:

ERR_SYM_XX {p. 4581}	NC_CYL_NR {p. 1526}	NLC_TREAT_DIAG_MIS {p. 6265}	SYM_CYL_MIS_A {p. 6239}
SYM_CYL_MIS_B1 {p. 6239}	SYM_CYL_MIS_B4 {p. 6239}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_ERR_DTC_MIS	V	0... FFFFH	0... 65535	1	-
LDP_NR_1_ID_ERR_DTC_MIS	2	0... FFH	0... 255	1	-
LDP_NR_2_ID_ERR_DTC_MIS	NC_ LDP_ 2_ DTC_ MIS_ TA- BLE_ SIZE	0... FFH	0... 255	1	-
DTC table declaration for misfiring diagnosis, J2012 shall be applied on OBD/CARB part					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_ERR_DTC_XX	V	0... FFFFH	0... 65535	1	-
LDP_NR_1_ID_ERR_DTC_XX	NC_ LDP_ 1_ DTC_ TA- BLE_ SIZE	0... FFH	0... 255	1	-
LDP_NR_2_ID_ERR_DTC_XX	NC_ LDP_ 2_ DTC_ TA- BLE_ SIZE	0... FFH	0... 255	1	-
DTC table declaration for the diagnosis instance XX, J2012 shall be applied on OBD/CARB part					

**Configuration data:**


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ERR_DTC_CONF	-	0... 5H	0 ...5	1	-
Type of DTCs displayed through ERR_DTC[IDX]					
NC_LDP_1_DTC_TABLE_SIZE	-	0... FH	0... 15	1	-
Table size definition for ID_ERR_DTC_XX; set to NC_NR_DTC_FMT+1					
NC_LDP_2_DTC_MIS_TABLE_SIZE	-	0... FH	0... 15	1	-
Table size definition for ID_ERR_DTC_MIS; set to NC_CYL_NR+2					
NC_LDP_2_DTC_TABLE_SIZE	-	0... FH	0... 15	1	-
Table size definition for ID_ERR_DTC_XX; set to 6-NC_NR_DTC_FMT					
NC_NR_DTC_FMT	-	0... 1H	0 ...1	1	-
Selection of 6 or 10 DTCs configurations					

**Action definition**

<b>ACTION_ERRM_EraseDtc (IN&lt;IDX&gt;)</b>	Mode: O
This action erases the memorized symptom of the failure IDX	
<b>ACTION_ERRM_StoreDtc (IN&lt;IDX&gt;)</b>	Mode: O
This action stores the memorized symptom of the first occurrence of the failure IDX to build the DTC	
<b>ACTION_ERRM_StoreDtcLst (IN&lt;IDX&gt;)</b>	Mode: O
This action stores the memorized symptom of the last occurrence of the failure IDX to build the DTC	

**FUNCTION DESCRIPTION:****General information:**

Purpose of this module is to catch some data (ERR\_SYM\_XX) when a failure occurs. Then, these data (ERR\_SYM\_MEM[IDX] and ERR\_SYM\_LST\_[IDX]) are used to generate a code called DTC upon

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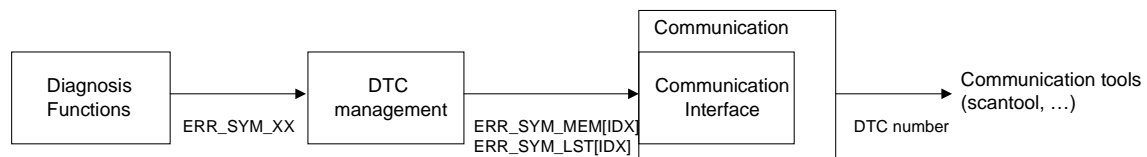
communication tool request (see Communication interface module). Additionally, for visualization (for communication tool, development purposes), a DTC code is stored in memory (ERR\_DTC\_[IDX]). The DTC is a code used to identify the symptom of the failure or the failure (global failure). It is an interface between the diagnosis and the communication.

The customer and/or EOBD/CARB according to the standard J2012 define this DTC.

DTC encoding for regulation EOBD/CARB shall be done using J2012 definition (2 bytes interpreted [0000h to FFFFh] in hex, [P0000 to U3FFF] in J2012).

DTC encoding for customer is free. It can be in decimal, or applying J2012 definition, or any other encoding definition.

### Signal flow diagram:



## B.69.1 DTC Storage

### B.69.1.1 DTC Storage /First occurrence

#### Description:

When the failure IDX gets present (1<sup>st</sup> occurrence), the detected of the first symptom is stored in the 2<sup>nd</sup> layer memory by calling the action ACTION\_ERRM\_StoreDtc (IN<IDX>). Additionally, a DTC code is stored in dynamic memory for visualization :

- related to the symptom DTC if NC\_ERR\_DTC\_CONF = 0
- related to the failure OBD DTC if NC\_ERR\_DTC\_CONF = 1
- related to the customer specific symptom DTC if NC\_ERR\_DTC\_CONF = 2
- related to the customer specific failure DTC if NC\_ERR\_DTC\_CONF = 3

**Syntax :** ACTION\_ERRM\_StoreDtc (IN <IDX>)

**Parameter (in) :** IDX Index of failure in 2<sup>nd</sup> layer memory to store the DTC

**Parameter (out) :** -

**Short description :** This action stores the memorised symptom of the first occurrence of the failure IDX to build the DTC

#### Application conditions

##### Initialization:

ERR\_SYM\_MEM[IDX] is restored from the NVMY  
SYM\_CYL\_MEM\_MIS\_A, SYM\_CYL\_MEM\_MIS\_B1 and  
SYM\_CYL\_MEM\_MIS\_B4 are restored from NVMY

In case of damaged NVMY, ERR\_SYM\_MEM[IDX] = 0

SYM\_CYL\_MEM\_MIS\_A = 0,  
SYM\_CYL\_MEM\_MIS\_B1 = 0,  
SYM\_CYL\_MEM\_MIS\_B4 = 0,  
ERR\_DTC[IDX] = 0

**Recurrence:** -  
**Activation:** at Action request

**Formula section:**

**If** NLC\_TREAT\_DIAG\_MIS = 0

(Misfire are treated by type (LV\_ERR\_MIS\_A, MIS\_B1 and MIS\_B4 is defined))

**Then**

For a misfiring diagnosis:

(XX stands for MIS\_A, MIS\_B1, and MIS\_B4) (Misfire by type NLC\_TREAT\_DIAG\_MIS=0)

SYM\_CYL\_MEM\_XX = SYM\_CYL\_XX

**If** NC\_ERR\_DTC\_CONF = 0 or 1 or 4 (J2012 DTC is stored)

**Then** **If** SYM\_CYL\_MEM\_XX [12] = 1 (Random)

**Then** ERR\_DTC[IDX] = ID\_ERR\_DTC\_MIS [ 0 ] [ NC\_CYL\_NR+1 ]

**Else** **If** SYM\_CYL\_MEM\_XX [13] = 1 (Multiple cylinder)

**Or** many cylinder bits are set in SYM\_CYL\_MEM\_XX

**Then** ERR\_DTC[IDX] = ID\_ERR\_DTC\_MIS [ 0 ] [ NC\_CYL\_NR ]

**Else** (only one cylinder bit is set in SYM\_CYL\_MEM\_XX)

i = bit number which is set in SYM\_CYL\_MEM\_XX

ERR\_DTC[IDX] = ID\_ERR\_DTC\_MIS [ 0 ] [ i ]

**Endif**

**Endif**

**Endif**

**If** NC\_ERR\_DTC\_CONF = 2 or 3 or 5 (customer encoded DTC is stored)

**Then** **If** SYM\_CYL\_MEM\_XX [12] = 1 (Random)

**Then** ERR\_DTC[IDX] = ID\_ERR\_DTC\_MIS [ 1 ] [ NC\_CYL\_NR+1 ]

**Else** **If** SYM\_CYL\_MEM\_XX [13] = 1 (Multiple cylinder)

**Or** many cylinder bits are set in SYM\_CYL\_MEM\_XX

**Then** ERR\_DTC[IDX] = ID\_ERR\_DTC\_MIS [ 1 ] [ NC\_CYL\_NR ]

**Else** (only one cylinder bit is set in SYM\_CYL\_MEM\_XX)

i = bit number which is set in SYM\_CYL\_MEM\_XX

ERR\_DTC[IDX] = ID\_ERR\_DTC\_MIS [ 1 ] [ i ]

**Endif**

**Endif**

**Endif**

**Endif**

For others diagnosis :

(also for misfire diagnosis if treated by cylinder (LV\_ERR\_MIS\_x is defined))

ERR\_SYM\_MEM[IDX] = ERR\_SYM\_XX

**If** NC\_ERR\_DTC\_CONF = 0 or 4 (1<sup>st</sup> symptom J2012 DTC is stored)

**Then** **If** only one bit is set in ERR\_SYM\_MEM[IDX]

**Then** i = bit number which is set in ERR\_SYM\_MEM[IDX]

ERR\_DTC[IDX] = ID\_ERR\_DTC\_XX [0] [ i ] with XX = F(IDX)


**Else** (many bit is set in ERR\_SYM\_MEM[IDX])

ERR\_DTC[IDX] = ID\_ERR\_DTC\_XX [0] [4] with XX = F(IDX)

**Endif**

**Endif**

**If** NC\_ERR\_DTC\_CONF = 1 (global J2012 DTC is stored)

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```

Then      ERR_DTC[IDX] = ID_ERR_DTC_XX [0] [4] with XX = F(IDX)
Endif

If      NC_ERR_DTC_CONF = 2 or 5      (customer encoded DTC is stored)
Then      If      only one bit is set in ERR_SYM_MEM[IDX]
Then      Then      i = bit number which is set in ERR_SYM_MEM[IDX]
              ERR_DTC[IDX] =
              ID_ERR_DTC_XX [NC_NR_DTC_FMT] [ i ] with XX = F(IDX)
Else (many bit is set in ERR_SYM_MEM[IDX])
              ERR_DTC[IDX] =
              ID_ERR_DTC_XX [NC_NR_DTC_FMT] [5 - NC_NR_DTC_FMT] with XX
              = F(IDX)
Endif
Endif

Endif

If      NC_ERR_DTC_CONF = 3      (global customer encoded DTC is stored)
Then      ERR_DTC[IDX] =
              ID_ERR_DTC_XX [NC_NR_DTC_FMT] [5 - NC_NR_DTC_FMT]
XX = F(IDX)
Endif

```

with

### B.69.1.2 DTC Storage /Last occurrence

#### Description:

For each occurrence of the failure IDX (Last occurrence), the detected of the last symptom is stored in the 2<sup>nd</sup> layer memory by calling the action ACTION\_ERRM\_StoreDtcLst (IN<IDX>).

**Syntax :** ACTION\_ERRM\_StoreDtcLst ( IN<IDX> )  
**Parameter (in) :** IDX Index of failure in 2<sup>nd</sup> layer memory to store the DTC  
**Parameter (out) :** -  
**Short description :** This action stores the memorised symptom of the last occurrence of the failure IDX to build the DTC

#### Application conditions

**Initialization:** ERR\_SYM\_LST[IDX] is restored from the NVMY  
 SYM\_CYL\_LST\_MIS\_A, SYM\_CYL\_LST\_MIS\_B1 and  
 SYM\_CYL\_LST\_MIS\_B4 are restored from NVMY  
 In case of damaged NVMY, ERR\_SYM\_LST[IDX] = 0  
 SYM\_CYL\_LST\_MIS\_A = 0,  
 SYM\_CYL\_LST\_MIS\_B1 = 0,  
 SYM\_CYL\_LST\_MIS\_B4 = 0,

**Recurrence:** -


**Activation:** at Action request

#### Formula section:

```

ERR_SYM_LST[IDX] = ERR_SYM_XX
if      NLC_TREAT_MIS_DIAG = 0
          (Misfire are treated by type)
then    For a misfiring diagnosis :

```

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(XX stands for MIS\_A, MIS\_B1 and MIS\_B4)  
 SYM\_CYL\_LST\_XX = SYM\_CYL\_XX

**endif**

**If** NLC\_TREAT\_DIAG\_MIS = 0

(Misfire are treated by type (LV\_ERR\_MIS\_A, MIS\_B1 and MIS\_B4 is defined))

**Then** For a misfiring diagnosis:

```

If NC_ERR_DTC_CONF = 4 (J2012 DTC is stored)
  Then
    If SYM_CYL_LST_XX [12] = 1 (Random)
      Then ERR_DTC[IDX] = ID_ERR_DTC_MIS [ 0 ] [ NC_CYL_NR+1 ]
    Else
      If SYM_CYL_LST_XX [13] = 1 (Multiple cylinder)
        Or many cylinder bits are set in SYM_CYL_LST_XX
          Then ERR_DTC[IDX] = ID_ERR_DTC_MIS [ 0 ] [ NC_CYL_NR ]
        Else (only one cylinder bit is set in SYM_CYL_LST_XX)
          i = bit number which is set in SYM_CYL_LST_XX
          ERR_DTC[IDX] = ID_ERR_DTC_MIS [ 0 ] [ i ]
      Endif
    Endif
  Endif

```

```

If NC_ERR_DTC_CONF = 5 (customer DTC is stored)
  Then
    If SYM_CYL_LST_XX [12] = 1 (Random)
      Then ERR_DTC[IDX] = ID_ERR_DTC_MIS [ 1 ] [ NC_CYL_NR+1 ]
    Else
      If SYM_CYL_LST_XX [13] = 1 (Multiple cylinder)
        Or many cylinder bits are set in SYM_CYL_LST_XX
          Then ERR_DTC[IDX] = ID_ERR_DTC_MIS [ 1 ] [ NC_CYL_NR ]
        Else (only one cylinder bit is set in SYM_CYL_LST_XX)
          i = bit number which is set in SYM_CYL_LST_XX
          ERR_DTC[IDX] = ID_ERR_DTC_MIS [ 1 ] [ i ]
      Endif
    Endif
  Endif

```

For others diagnosis :

(also for misfire diagnosis if treated by cylinder (LV\_ERR\_MIS\_x is defined))

```

If NC_ERR_DTC_CONF = 4 (last symptom J2012 DTC is stored)
  Then
    If only one bit is set in ERR_SYM_LST[IDX]
      Then i = bit number which is set in ERR_SYM_LST[IDX]
      ERR_DTC[IDX] = ID_ERR_DTC_XX [0] [ i ] with XX = F(IDX)
    Else (many bit is set in ERR_SYM_LST[IDX])
      ERR_DTC[IDX] = ID_ERR_DTC_XX [0] [4] with XX = F(IDX)
    Endif
  Endif

```

```

If NC_ERR_DTC_CONF = 5 (customer encoded DTC is stored)
  Then
    If only one bit is set in ERR_SYM_LST[IDX]
      Then i = bit number which is set in ERR_SYM_LST[IDX]
      ERR_DTC[IDX] =

```

```

        ID_ERR_DTC_XX [NC_NR_DTC_FMT] [ i ] with XX = F(IDX)
    Else (many bit is set in ERR_SYM_LST[IDX])
        ERR_DTC[IDX] =
        ID_ERR_DTC_XX [NC_NR_DTC_FMT] [5 - NC_NR_DTC_FMT] with XX
        = F(IDX)
    Endif
Endif

```

## B.69.2 DTC storage for the Misfiring (with NLC\_TREAT\_DIAG\_MIS = 0, Misfire by type)

### Description:

As describe above, the cylinder in default is memorised at the first occurrence. In this part each new cylinder in default will be memorised.

### Application conditions

**Initialization:** treated above

**Recurrence:** For Misfire A, B1 and B4:  
Misfire segmentsynchronous

**Activation:** -

### Formula section:

For a misfiring A diagnosis :

SYM\_CYL\_MEM\_MIS\_A is updated with the new additional bits (cylinder, multiple and random) of SYM\_CYL\_MIS\_A

For a misfiring B1 diagnosis :

SYM\_CYL\_MEM\_MIS\_B1 is updated with the new additional bits (cylinder, multiple and random) of SYM\_CYL\_MIS\_B1

For a misfiring B4 diagnosis :

SYM\_CYL\_MEM\_MIS\_B4 is updated with the new additional bits (cylinder, multiple and random) of SYM\_CYL\_MIS\_B4.

## B.69.3 DTC deleting

### Description:

When the failure IDX is erased from 2<sup>nd</sup> layer memory, the memorised detected symptom is also erased by calling the action ACTION\_ERRM\_EraseDtc (IN <IDX>).

**Syntax :** ACTION\_ERRM\_EraseDtc (IN <IDX>)

**Parameter (in) :** IDX Index of failure in 2<sup>nd</sup> layer memory to store the DTC


**Parameter (out) :** -

**Short description :** This action erases the memorised symptom of the failure IDX

### Application conditions

**Initialization:** -

**Recurrence:** -

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**Activation:** at Action request

**Formula section:**

```

If      NLC_TREAT_DIAG_MIS = 0
(Misfire are treated by type (LV_ERR_MIS_A, MIS_B1 and MIS_B4 is defined))
Then    For a misfiring A diagnosis :
          SYM_CYL_MEM_MIS_A = 0
          SYM_CYL_LST_MIS_A = 0
          ERR_DTC[IDX] = 0
          For a misfiring B1 diagnosis :
          SYM_CYL_MEM_MIS_B1 = 0
          SYM_CYL_LST_MIS_B1 = 0
          ERR_DTC[IDX] = 0
          For a misfiring B4 diagnosis :
          SYM_CYL_MEM_MIS_B4 = 0
          SYM_CYL_LST_MIS_B4 = 0
          ERR_DTC[IDX] = 0

```

**Endif**

For other diagnoses, including misfire diagnoses if treated by cylinder (LV\_ERR\_MIS\_x is defined) :

```

ERR_SYM_MEM[IDX] = 0
ERR_SYM_LST[IDX] = 0
ERR_DTC[IDX] = 0

```

## B.69.4 Calibratable DTC number

**Description:**

The DTC numbers are defined by a calibration table called ID\_ERR\_DTC\_XX.  
This table defined for each failure XX :

a) with NC\_NR\_DTC\_FMT = 0

- a DTC number for each symptom of the failure XX
- a global OBD DTC number for the failure XX
- a global customer specific DTC number

b) with NC\_NR\_DTC\_FMT = 1

- a OBD DTC number for each symptom of the failure XX
- a global OBD DTC number for the failure XX
- a customer specific DTC number for each symptom of the failure XX
- a global customer specific DTC number


When a DTC is request by a diagnostic tool, the Communication Interface module build up the DTC number with information :

- ERR\_SYM\_MEM[IDX] and /or ERR\_SYM\_LST[IDX] stored in 2<sup>nd</sup> layer memory ;
- Contents of table ID\_ERR\_DTC\_XX .

There is a particular case for misfiring (MIS\_A, MIS\_B1, MIS\_B4) diagnosis. The DTC numbers are defined by cylinder in a calibration table called ID\_ERR\_DTC\_MIS.

(used if NLC\_TREAT\_DIAG\_MIS = 0; Misfire by type)

- ID\_ERR\_DTC\_MIS[0] [ i ] is the DTC for misfiring detection on the cylinder number i +1
- ID\_ERR\_DTC\_MIS[0] [ NC\_CYL\_NR ] is the DTC for multiple misfiring
- ID\_ERR\_DTC\_MIS[0] [ NC\_CYL\_NR +1 ] is the DTC for random misfiring

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- ID\_ERR\_DTC\_MIS[1][i] is the customer DTC for misfiring detection on the cylinder number i+1
- ID\_ERR\_DTC\_MIS[1][NC\_CYL\_NR] is the customer DTC for multiple misfiring
- ID\_ERR\_DTC\_MIS[1][NC\_CYL\_NR + 1] is the customer DTC for random misfiring

**Example 1:**

The failure TCO (coolant temperature) is stored in the 2nd layer memory. The calibratable table of DTC has the following value :

a) with NC\_NR\_DTC\_FMT = 0

DTC of the 1 <sup>st</sup> symptom	DTC of the 2 <sup>nd</sup> symptom	DTC of the 3 <sup>rd</sup> symptom	DTC of the 4 <sup>th</sup> symptom	Global DTC of the failure	Specific customer code
ID_ERR_DTC_TCO [0] [0] = 0118h (P0118)	ID_ERR_DTC_TCO [0] [1] = 0117h (P0117)	ID_ERR_DTC_TCO [0] [2] = 0119h (P0119)	ID_ERR_DTC_TCO [0] [3] = 0116h (P0116)	ID_ERR_DTC_TCO [0] [4] = 0115h (P0115)	ID_ERR_DTC_TCO [0] [5] = 30

b) with NC\_NR\_DTC\_FMT = 1

	DTC of the 1 <sup>st</sup> symptom	DTC of the 2 <sup>nd</sup> symptom	DTC of the 3 <sup>rd</sup> symptom	DTC of the 4 <sup>th</sup> symptom	Global DTC of the failure
OBD DTC	ID_ERR_DTC_TCO [0] [0] = 0118h (P0118)	ID_ERR_DTC_TCO [0] [1] = 0117h (P0117)	ID_ERR_DTC_TCO [0] [2] = 0119h (P0119)	ID_ERR_DTC_TCO [0] [3] = 0116h (P0116)	ID_ERR_DTC_TCO [0] [4] = 0115h (P0115)
Customer DTC	ID_ERR_DTC_TCO [1] [0] = 31	ID_ERR_DTC_TCO [1] [1] = 32	ID_ERR_DTC_TCO [1] [2] = 33	ID_ERR_DTC_TCO [1] [3] = 34	ID_ERR_DTC_TCO [1] [4] = 30

Upon request from the diagnosis tool, the DTC number sent to the tool will be one of the numbers defined in ID\_ERR\_DTC\_TCO regards the symptom detected.

**Example 2 :**

One failure misfiring (LV\_ERR\_MIS\_A, LV\_ERR\_MIS\_B1 or LV\_ERR\_MIS\_B4) is stored in the 2nd layer memory. The application is a NC\_CYL\_NR -cylinder engine. The calibratable table of DTC has the following value :

	Misfiring on 1 <sup>st</sup> cylinder	Misfiring on 2 <sup>nd</sup> cylinder	Misfiring on 3 <sup>rd</sup> cylinder	Misfiring on 4 <sup>th</sup> cylinder	...	Misfiring on NC_CYL_NR <sup>th</sup> cylinder	Multiple Misfiring	Random Misfiring
OBD DTC	ID_ERR_DTC_MIS [0] [0] = 0301h (P0301)	ID_ERR_DTC_MIS [0] [1] = 0302h (P0302)	ID_ERR_DTC_MIS [0] [2] = 0303h (P0303)	ID_ERR_DTC_MIS [0] [3] = 0304h (P0304)	...	ID_ERR_DTC_MIS [0] [NC_CYL_NR - 1] = 03xxh (P03xx)	ID_ERR_DTC_MIS [0] [NC_CYL_NR] = 0300h (P0300)	ID_ERR_DTC_MIS [0] [NC_CYL_NR + 1] = 0300h (P0300)
Customer DTC	ID_ERR_DTC_MIS [1] [0] = 11	ID_ERR_DTC_MIS [1] [1] = 12	ID_ERR_DTC_MIS [1] [2] = 13	ID_ERR_DTC_MIS [1] [3] = 14	...	ID_ERR_DTC_MIS [1] [NC_CYL_NR - 1] = 16	ID_ERR_DTC_MIS [1] [NC_CYL_NR] = 10	ID_ERR_DTC_MIS [1] [NC_CYL_NR + 1] = 10

Upon request from the diagnosis tool, the DTC number sent to the tool will be one of the numbers defined in ID\_ERR\_DTC\_MIS regards the symptom detected.


With :

NC\_LDP\_1\_DTC\_TABLE\_SIZE = NC\_NR\_DTC\_FMT + 1

NC\_LDP\_2\_DTC\_TABLE\_SIZE = 6 - NC\_NR\_DTC\_FMT  
 NC\_LDP\_2\_DTC\_MIS\_TABLE\_SIZE = NC\_CYL\_NR + 2

**Configuration data detailed description:**

NC\_NR\_DTC\_FMT = 0            6 DTCs configuration.  
                   = 1            10 DTCs configuration.

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## B.70 Diagnostic trouble code management (Appl. Inc.)

### B.70.1 Definition of additional DTC information

#### FUNCTION DESCRIPTION:

#### General information:

For several diagnosis services it is necessary to transmit an additional information for each symptom.

#### Description:

These additional information can be calibrated for each symptom of a failure XX with the table ID\_ERR\_DTC\_INFO\_V\_TCO\_RNG\_XX.

For this project it s used to define the DTCFailureTypeByte according to ISO 14229.

Example for diagnostic instance V\_TCO\_RNG:

additional Info for SYM_0	additional Info for SYM_1	additional Info for SYM_2	additional Info for SYM_3
ID_ERR_DTC_INFO_V_TCO_RNG[0] = 05h	ID_ERR_DTC_INFO_V_TCO_RNG[1] = 01h	ID_ERR_DTC_INFO_V_TCO_RNG[2] = 00h	ID_ERR_DTC_INFO_V_TCO_RNG[3] = 00h

#### Formula section:

not used yet

## B.71 Dynamic error management core

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DC [NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Counter for driving cycle					
CTR_ERR_DYN_NR	O/V/S	0... FFH	0... 255	1	-
Number of failures stored in dynamic memory (2nd layer)					
CTR_FRC [NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Frequency counter : number of occurrences of present failure					
CTR_OCC [NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Occurrences number of transitions between diagnostic executed without fault and diagnostics with fault (pass -> fail)					
CTR_WUP_CYC [NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Counter for warm-up cycle					
DIAG_INST [NC_NR_ERR_DYN]	V	0... FFFFH	0... 65535	1	-
Index of diagnosis instance XX with XX = F(IDX)					
LV_DC_MAX [NC_NR_ERR_DYN]	O/V/S	0... 1H	0 ...1	1	-
Flag for the MIL state (on or off) related to failure IDX					
LV_ERR_CFM [NC_NR_ERR_DYN]	O/V/S	0... 1H	0 ...1	1	-
Confirmed failure status flag					
LV_ERR_DC [NC_NR_ERR_DYN]	O/V	0... 1H	0 ...1	1	-
Failure present status for this driving cycle					
LV_ERR_DC_PREV [NC_NR_ERR_DYN]	O/V/S	0... 1H	0 ...1	1	-
Error failure present at end of last driving cycle					
LV_ERR_DISA [NC_NR_ERR_DYN]	O/V/S	0... 1H	0 ...1	1	-
Disappeared failure status flag					
LV_ERR_LST_CLR_XX	O/V/S	0... 1H	0 ...1	1	-
Failure set at least once since last failure memory clear					
LV_ERR_MEM_XX	O/V/S	0... 1H	0 ...1	1	-
Failure is stored in dynamic memory (2nd layer)					
LV_ERR_MKD [NC_NR_ERR_DYN]	O/V/S	0... 1H	0 ...1	1	-
Marked failure status flag					
LV_ERR_PND [NC_NR_ERR_DYN]	O/V/S	0... 1H	0 ...1	1	-
Pending failure status flag					
LV_ERR_TMP [NC_NR_ERR_DYN]	O/V/S	0... 1H	0 ...1	1	-
Temporary failure status flag					

### Input data:

DC_DEC_XX	DC_INC_XX	DC_MAX_XX	LC_ENA_SCDN
LV_DC {p. 5746}	LV_END_DIAG_XX {p. 4581}	LV_ERR_XX	LV_MKD_MOD {p. 5694}
LV_WUP_CYC {p. 5746}	NLC_ENA_SCDN {p. 645}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_MAX_WUP_CYC	-	0... FFH	0... 255	1	-
Initialization value for the warm-up cycle of diagnostics					
LC_ERR_FMY_CLR	-	0... 1H	0 ...1	1	-
Boolean to clear failure memory when set to 1					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_ERR_DYN	-	1... FFH	1... 255	1	-
Maximum number of failure defined in dynamic structure (typical value : 10)					
NLC_CTR_OCC_ENA	-	0... 1H	0 ...1	1	-
Configuration to enable the CTR_OCC computation.					

**Action definition**

<b>ACTION_ERRM_CheckPendingStatus</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR_PND>)	Mode: O
-	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_IDX_DIAG	in	0... FFFFH	0... 65535	1	-
Diagnostic symptom instance.					
PRM_LV_ERR_PND	out	0... 1H	0 ...1	1	-
Error flag for diagnostic instance.					

<b>ACTION_ERRM_ClcLvErrDcPrev</b> ()	Mode: O
This action indicates if a failure was set at the end of previous DC	

<b>ACTION_ERRM_EraseErr</b> (IN<IDX>)	Mode: O

<b>ACTION_ERRM_GetErrLastClr</b> (<PRM_IDX_ERR>,<PRM_LV_ERR_LST_CLR>)	Mode: O
This action indicates if a failure has been set already once since the last failure memory clear.	

<b>ACTION_ERRM_IncrementDCctrScdn</b> (IN<PRM_IDX_ERR>)	Mode: O
This action is used to increment the driving cycle counter for failures using similar conditions functionality.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_IDX_ERR	in	0... FFFFH	0... 65535	1	-
Diagnostic failure instance.					

**Import actions:**

<b>ACTION_ERRM_ClcPermanentIniErrm</b> ()	
<b>ACTION_ERRM_ConfirmErrScdn</b> (OUT<DCconf>,IN<XX>)	
<b>ACTION_ERRM_DecrementDCctrScdn</b> (IN<PRM_IDX_ERR>,OUT<PRM_DCdec>)	
<b>ACTION_ERRM_EraseDtc</b> (IN<IDX>)	
<b>ACTION_ERRM_EraseFrfr</b> (IN<IDX>)	
<b>ACTION_ERRM_ErasePermanentCode</b> (IN<PRM_IDX_ERR>)	
<b>ACTION_ERRM_EraseScdn</b> (IN<PRM_IDX_ERR>)	
<b>ACTION_ERRM_GetMilRelevant</b> (IN<PRM_IDX_ERR>,OUT<PRM_LV_MIL_RLV>)	
<b>ACTION_ERRM_PrioRule</b> (OUT<RESP>,OUT<IDX>)	
Continued on next page	



<b>ACTION_ERRM_StoreDtc</b> (IN<IDX>)
<b>ACTION_ERRM_StoreDtcLst</b> (IN<IDX>)
<b>ACTION_ERRM_StoreFrF</b> (IN<IDX>)
<b>ACTION_ERRM_StoreHistory</b> (IN<IDX>)
<b>ACTION_ERRM_StorePermanentCode</b> (IN<PRM_IDX_ERR>)
<b>ACTION_ERRM_TrigErrDyn</b> (IN<XX>)
<b>ACTION_ERRM_TrigFarm</b> (IN<XX>)


## FUNCTION DESCRIPTION:

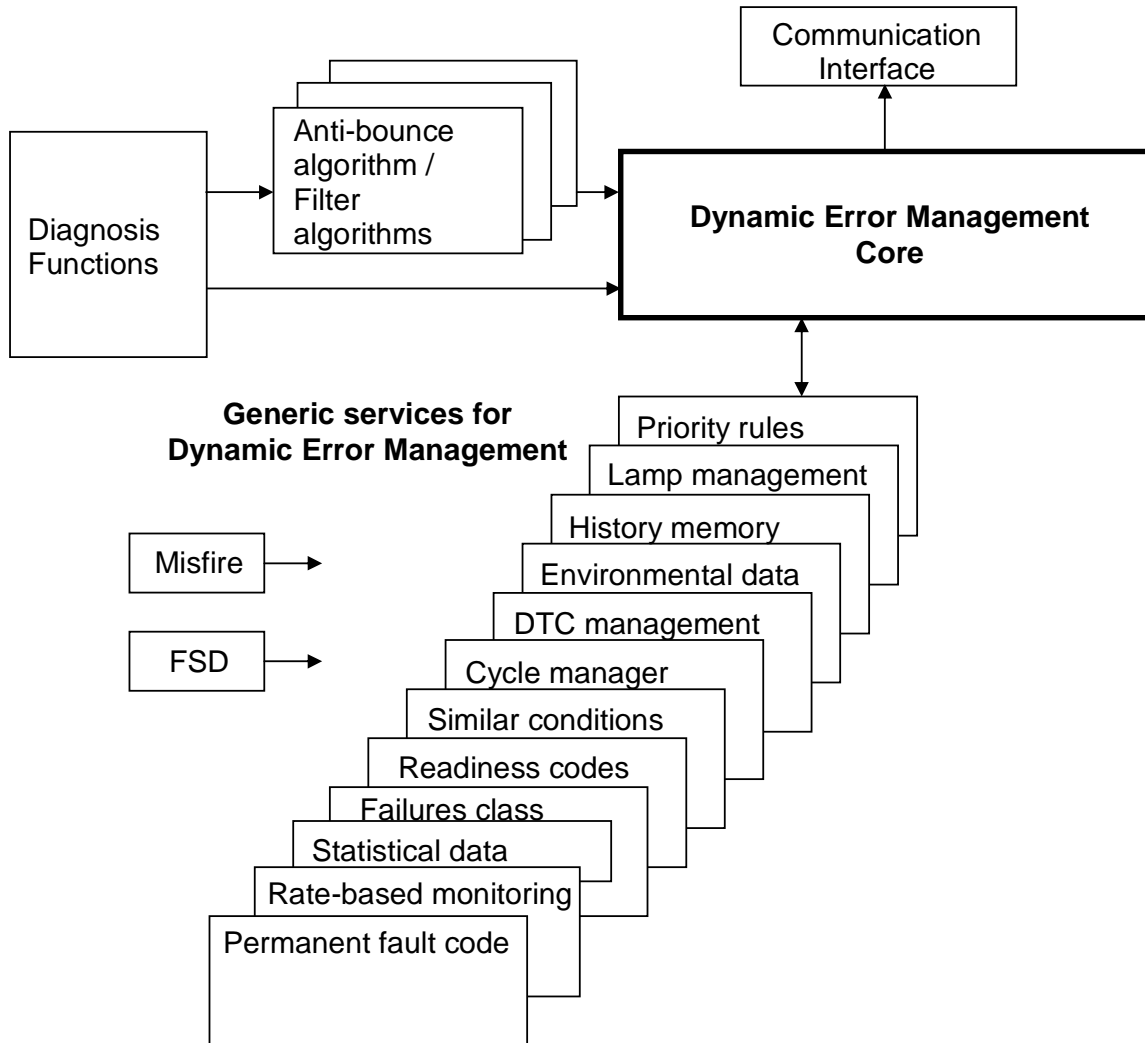
### General information:

This module is the heart of the dynamic error management function. It defines statement of principles and mechanism of dynamic error management function.

Dynamic error management receives results from diagnosis function (may be filtered by antibounce algorithm). These results are, in this module, managed as diagnosis failure following **CARB** and **EOBD** standards.

In addition, this module uses generic services defined by others modules (priority rules for example).

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## B.71.1 Diagnosis failure description

### B.71.1.1 Failures definition

#### Description:

Dynamic error management manages failures, which have different states.

#### Detected failure

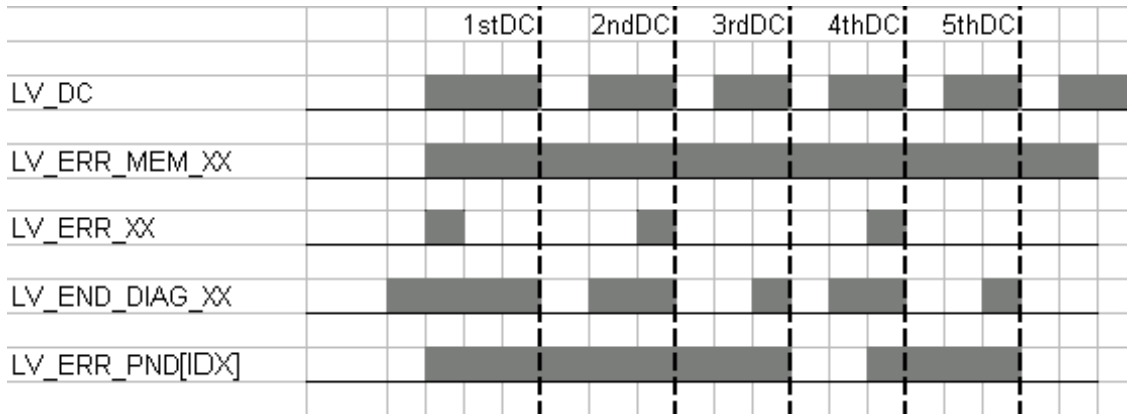
The detected failure is provided by a defective system (the error provided by this system is basic). It occurs when the diagnosis test and diagnosis condition of at least one symptom or more are true and disappears in other cases.

#### Present failure

The present failure is the detected failure after filtering. The real entry point of the error management is the present failure.

#### Pending failure

The pending failure is the detected failure after filtering. The failure shall stay pending until detection of a whole driving cycle without the failure present and the diagnosis done.



**Temporary failure**

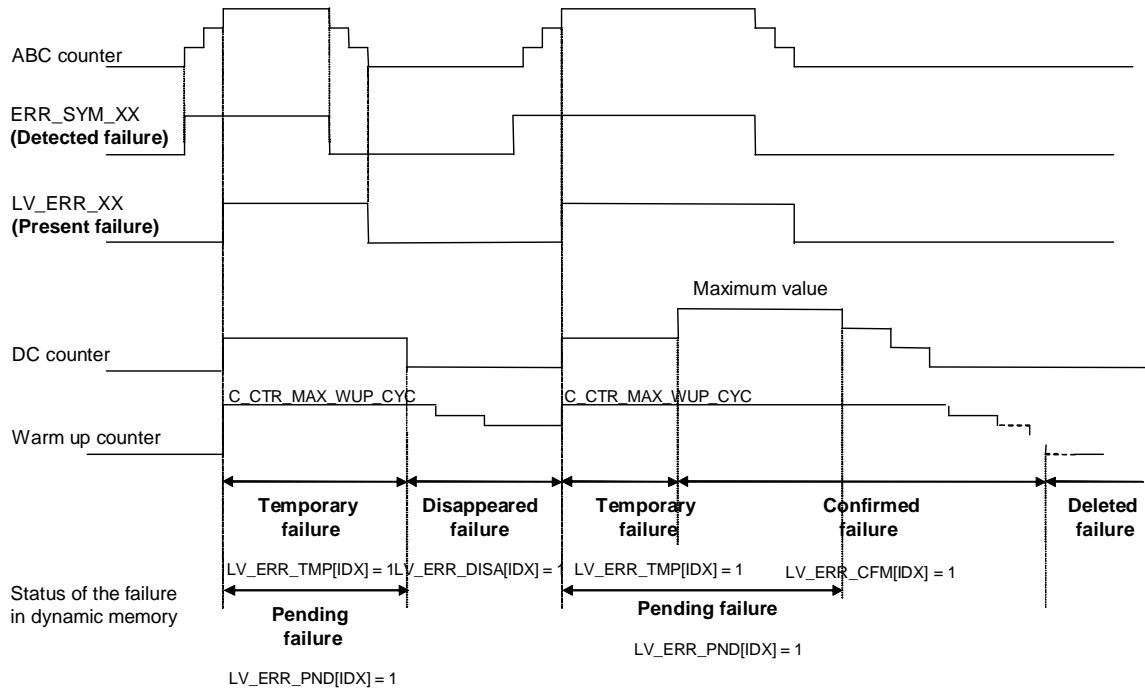
A failure is considered as temporary when this failure is present and leaves this state either when this failure is confirmed or disappeared (in this case, this failure isn't confirmed).

**Disappeared failure**

A failure is considered as disappeared, when no failure was detected during a complete driving cycle and the failure wasn't confirmed. It leaves this state either when the failure reoccurs or when the warm-up counter reaches 0.

**Confirmed failure**

A failure is considered as confirmed when the driving cycle counter reaches the maximum value and leaves this state when the warm-up counter reaches 0.



with XX = F(IDX)

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**B.71.1.2 Failures information**

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## Description:

Each failure is constituted of informations, which are stored in the memory.

Some informations are allocated in the static memory. It means that these informations are available for each failure.

Static memory: XX represents any failure defined in the application (index of XXξ[1...65535])

- ABC counter CTR\_ABC\_XX
- End of diagnosis counter CTR\_ABC\_END\_DIAG\_XX
- End of diagnosis flag LV\_END\_DIAG\_XX
- Readiness flag LV\_READY\_XX
- Diagnosis condition LV\_CDN\_DIAG\_XX
- Detected symptom ERR\_SYM\_XX
- Present failure LV\_ERR\_XX
- Failure is stored in dynamic memory LV\_ERR\_MEM\_XX
- Failure present at least one time since failure memory cleared LV\_ERR\_LST\_CLR\_XX

Some informations are allocated in the dynamic memory. It means that these informations are created in memory in case of a new dynamic failure entry (limited number of dynamic entries managed with priority rules).

Dynamic memory : IDXξ [0...NC\_NR\_ERR\_DYN-1]

- Frequency counters CTR\_FRC[IDX]  
CTR\_OCC[IDX]
- Driving cycle counter CTR\_DC[IDX]
- Warm up counter CTR\_WUP\_CYC[IDX]
- Memorized the first symptom (DTC) ERR\_SYM\_MEM[IDX]
- Memorized the last symptom (DTC) ERR\_SYM\_LST[IDX]
- Environmental data (Freeze frame) ENVD\_OBD[u][m]  
ENVD\_CUS\_CMN[v][m]  
ENVD\_CUS\_SET\_CMN[W][x][m]  
ENVD\_CUS\_SET\_SPC[y][z][m]
- Confirmed failure LV\_ERR\_CFM[IDX]
- Disappeared failure LV\_ERR\_DISA[IDX]
- Memorized MIL activation flag LV\_DC\_MAX[IDX]
- Failure during DC LV\_ERR\_DC[IDX]
- Temporary failure LV\_ERR\_TMP[IDX]
- Pending failure LV\_ERR\_PND[IDX]
- Marked failure LV\_ERR\_MKD[IDX]
- Error present at end of last DC LV\_ERR\_DC\_PREV[IDX]


## Remark :

To keep the link between the index of the failure in dynamic memory and the index of the failure in static memory, a transfer function is defined by : XX = F (IDX)

with m=IDX\_FRF[IDX]

## B.71.2 Memory management

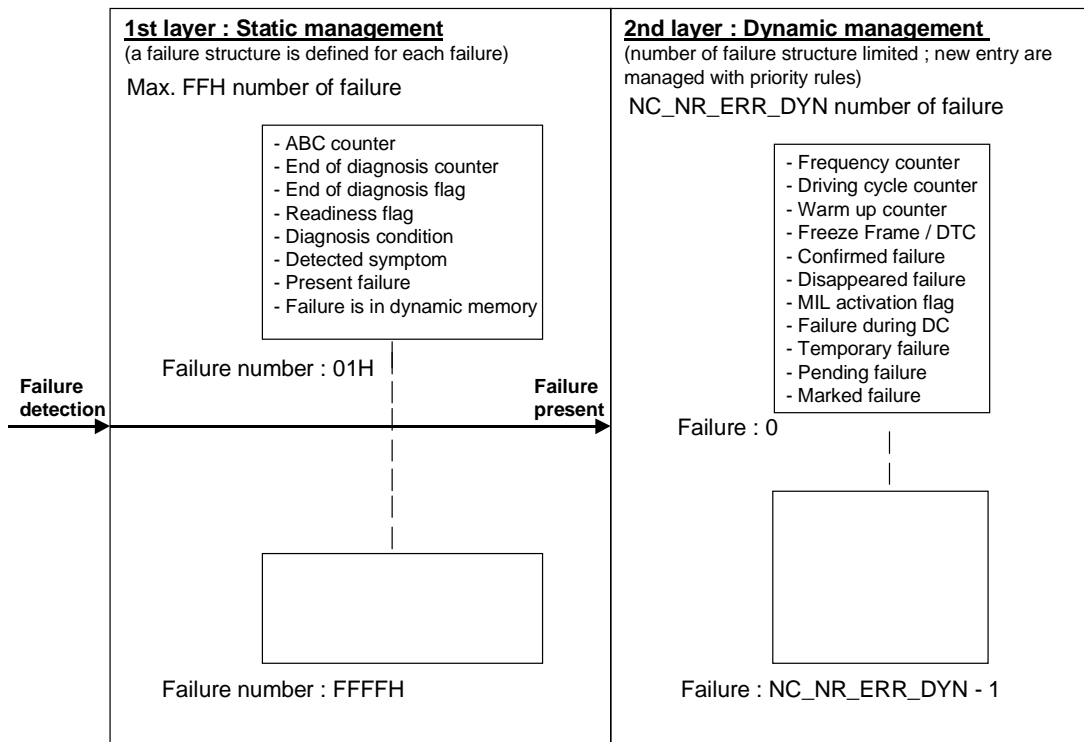
## Description:

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As explained above, the memory is managed as two layers.

The first layer is managed as static memory. According to failure detection, ABC counter and end of diagnosis counter are incremented or decremented. Present failure information is the output of this layer. All failures are managed in the first layer.

When a present failure appears, it may provoke a dynamic entry in the second layer (dynamic) of the memory. In this second layer, only present failures are managed. The number of failure structure is limited to a maximum value defined by NC\_NR\_ERR\_DYN.



### B.71.2.1 Failures configuration

#### Description:

For every diagnosis two bytes exist to configure the failure. The following items can be influenced :

- control of dashboard lamp (MIL and/or Warning lamp 1 and/or Warning lamp 2)
- the emission relevance of a failure
- failure priority, used for failure storage

The definition of these bytes is done in Failure Class module.

### B.71.2.2 Store /Erase a failure in 2nd layer memory

#### Description:


This module manages the "Entry" (storage) and "Exit" (deleting) of failures in the 2<sup>nd</sup> layer memory.

#### Storage :

Syntax : ACTION\_ERRM\_StoreErr (IN <XX>)

Parameter (in) : XX number of the failure to store in dynamic memory

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Parameter (out) : -

Short description :

If other modules call the action to store the failure XX with ACTION\_ERRM\_StoreErr (IN<XX>) then the failure XX (with XX = F(IDX)) is taken into the 2<sup>nd</sup> layer memory and :

- frequency counter (number of occurrences of present failure) is updated ;
- the DTC is stored with ACTION\_ERRM\_StoreDtc (IN<IDX>) (if needed) ;
- the Freeze Frame is stored with ACTION\_ERRM\_StoreFrf (IN<IDX>) ;
- the index of diagnosis instance XX is stored in DIAG\_INST[IDX] for visualisation

Deleting :

Syntax : ACTION\_ERRM\_EraseErr (IN <IDX>)

Parameter (in) : IDX index of failure in 2<sup>nd</sup> layer memory to erase

Parameter (out) : -

Short description :

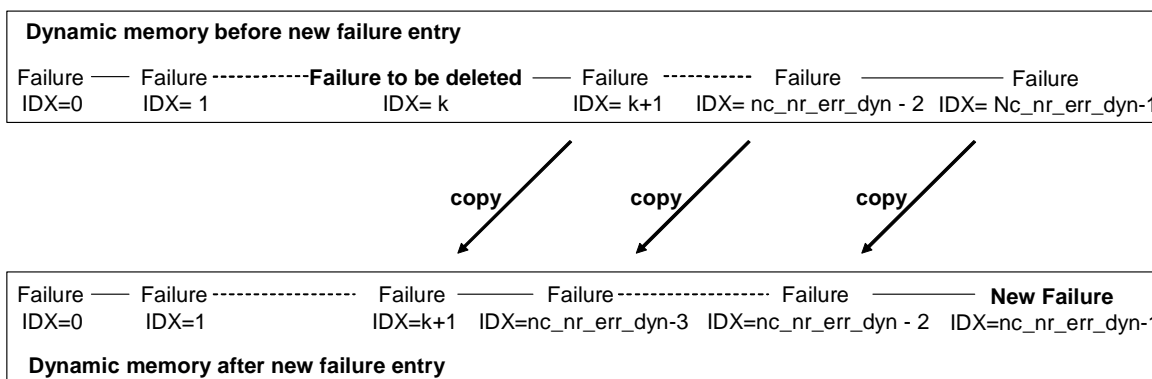
If other modules call the action to erase the failure XX with ACTION\_ERRM\_EraseErr (IN<IDX>) then the failure IDX is taken out of the 2<sup>nd</sup> layer memory and :

- the failure is stored in history memory with ACTION\_ERRM\_StoreHistory (IN<IDX>) ;
- the DTC of the failure is erased with ACTION\_ERRM\_EraseDtc (IN<IDX>) ;
- the Freeze Frame of the failure is erased with ACTION\_ERRM\_EraseFrf (IN<IDX>) ;
- similar conditions of the failure are erased with ACTION\_ERRM\_EraseScdn (IN<XX>) if existing

2<sup>nd</sup> layer memory description :

It is useful to sort the failures in the sequence in which they occurred ; first failure has index (IDX) number zero, second failure has index (IDX) number one, ... . For example, when a new failure entry is accepted (memory is full), one failure is deleted, sorting algorithm is respected and the new failure entry is stored in last position.

In any case, sorting algorithm must be always respected.



## Application conditions

**Initialization :**

On saved RAM lost  
 CTR\_ERR\_DYN\_NR = 0 ; LV\_ERR\_MEM\_XX = 0  
 CTR\_FRC[IDX] = 0; CTR\_OCC[IDX] = 0;  
 LV\_ERR\_TMP[IDX] = 0; LV\_ERR\_MKD[IDX] = 0  
 DIAG\_INST[IDX] = 0; LV\_ERR\_DC\_PREV[IDX] = 0;  
 LV\_ERR\_LST\_CLR\_XX = 0

**Recurrence:**

-

**Activation:**

at Action request

**Formula section:**

Store the failure in 2<sup>nd</sup> layer memory :  
ACTION\_ERRM\_StoreErr (IN <XX>) :

```

LV_ERR_LST_CLR_XX = 1
  If      LV_ERR_MEM_XX = 0
  Then   Failure XX is stored in 2nd layer memory in position IDX = CTR_ERR_DYN_NR
         LV_ERR_MEM_XX = 1
         LV_ERR_TMP[IDX] = 1
         DIAG_INST[IDX] = index of diagnosis instance XX (with XX=F(IDX))
         ACTION_ERRM_StoreDtc (IN<IDX>)
         CTR_ERR_DYN_NR = CTR_ERR_DYN_NR + 1
         If      LV_MKD_MOD = 1
         Then
             LV_ERR_MKD[IDX] = 1
         Endif
     Else (IDX compliant with XX = F(IDX))
     Endif
CTR_FRC[IDX] = CTR_FRC[IDX] + 1
If      CTR_FRC[IDX] > 255
Then   CTR_FRC[IDX] = 255
Endif
If      NLC_CTR_OCC_ENA = 1
Then
    If      LV_ERR_DC_PREV[IDX] = 0
    Then   CTR_OCC[IDX] = CTR_OCC[IDX] + 1
          If      CTR_OCC[IDX] > 254 (saturation to 254 : value 255 forbidden)
          Then   CTR_OCC[IDX] = 254
          Endif
    Endif
Endif
Endif
ACTION_ERRM_StoreFrf (IN<IDX>)
(previous failure status (if disappeared) necessary for freeze frame calculation)
If      LV_ERR_DISA[IDX] = 1
Then   LV_ERR_DISA[IDX] = 0
         LV_ERR_TMP[IDX] = 1
         ACTION_ERRM_StoreDtc (IN<IDX>)
         (Store DTC corresponding of the first occurrence of the failure)
Endif
LV_ERR_PND[IDX] = 1
ACTION_ERRM_StoreDtcLst (IN<IDX>)
(Store DTC corresponding of the last occurrence of the failure)


```

Clear the failure out of 2<sup>nd</sup> layer memory

```

ACTION_ERRM_EraseErr (IN<IDX>) :
ACTION_ERRM_StoreHistory (IN<IDX>)
ACTION_ERRM_EraseDtc (IN<IDX>)
ACTION_ERRM_EraseFrf (IN<IDX>)
  If      failure is using similar conditions functionality (see Similar conditions Appli.Inc.)
         (LC_ENA_SCDN=1 and NLC_ENA_SCDN=1)
  Then   ACTION_ERRM_EraseScdn (IN<XX>)
         (with XX=F(IDX))

```

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**Endif**

Failure XX (with XX=F(IDX)) is cleared (all data in 2<sup>nd</sup> layer memory related to failure IDX are filled with 0 ; all data in static memory related to failure XX are unchanged)

LV\_ERR\_MEM\_XX = 0 (with XX = F(IDX))  
CTR\_ERR\_DYN\_NR = CTR\_ERR\_DYN\_NR -1

Temporary flag management :

For each failure in 2<sup>nd</sup> layer memory

```

If      LV_ERR_CFM[IDX] = 1
           or
           LV_ERR_DISA[IDX] = 1
Then
           LV_ERR_TMP[IDX] = 0
Endif
    
```

**B.71.2.3 Clear failure memory**

Description:

For development conveniences, it is often useful to reinit all failure in the memory. This is possible by setting the calibration bit LC\_ERR\_FMY\_CLR to 1.

Application conditions

**Initialisation:** -  
**Recurrence:** -  
**Activation:** *LC\_ERR\_FMY\_CLR 0 → 1 transition*

Formula section:

Treatment performed at global clearing request (e.g. Mode\$04) :

```

If      LC_ERR_FMY_CLR = 1
Then    Reset failure memory (all data in 2nd layer memory and all data in static memory, e.g.
LV_ERR_LST_CLR)
           CTR_ERR_DYN_NR = 0
           ACTION_ERRM_ClcPermanentIniErrm()
Endif
    
```


**B.71.3 Failure management**

**B.71.3.1 State diagram**

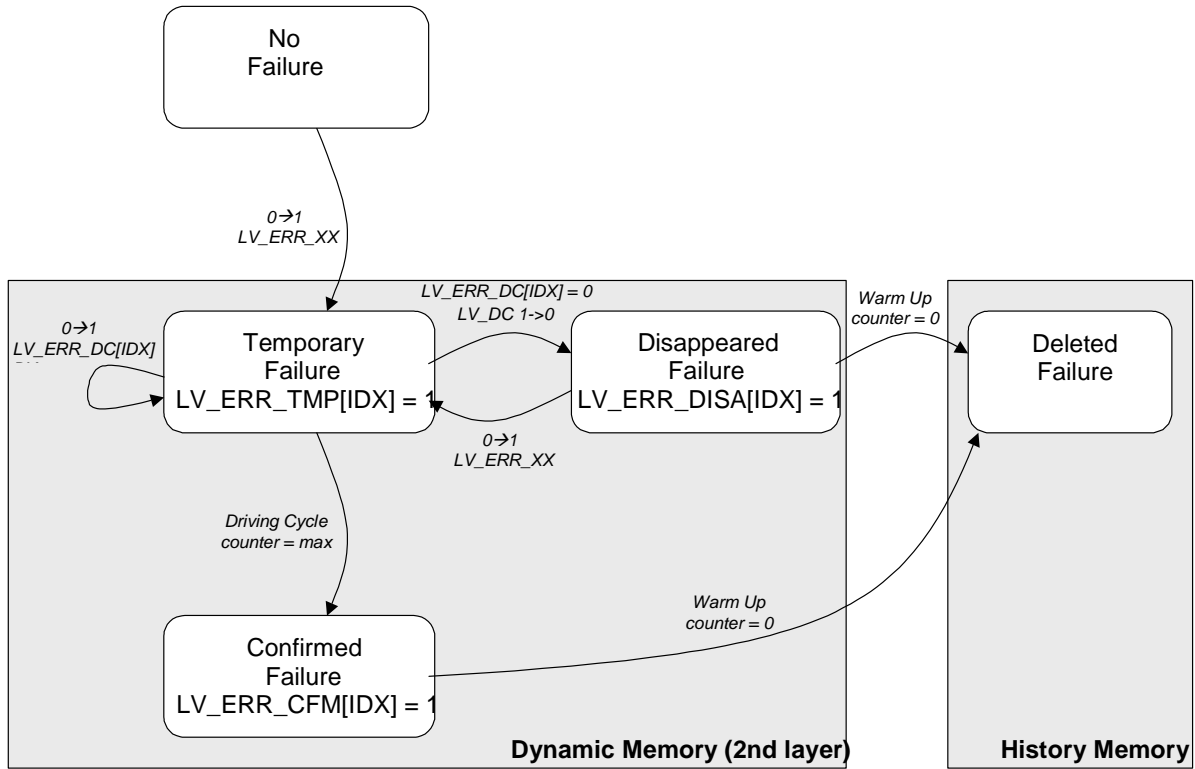
Description:

In the following diagram, the failure state progress is described.

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There are also additional transitions possible due to :

- Overwriting/Erasurement by priority rule or Tool Request :

- Temporary Failure Deleted Failure
- Disappeared Failure Deleted Failure
- Confirmed Failure Deleted Failure

	Driving Cycle counter value	Warm Up counter value
No Failure	0	0
Temporary Failure	[ 0, Max [ without having reached Max	Max
Confirmed Failure	[ 0, Max ] with having reached Max	] 0, Max ]
Disappeared Failure	0	] 0, Max ]
Deleted Failure	0	0

### B.71.3.2 Present failure occurred

#### Description:

When a failure occurs (becomes present), this failure shall be stored in the 2<sup>nd</sup> layer memory (if possible). If the 2<sup>nd</sup> layer memory is full and marked mode is not set, a choice is made in the module "Priority rules" :

- RESP is set to OK by priority rules, if the failure can be stored in the 2<sup>nd</sup> layer memory ; in this case IDX gives the index of the failure to be replaced into dynamic memory;

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- RESP is set to NOK by priority rules if the failure can't be stored in the 2<sup>nd</sup> layer memory.

To monitor the failure, ACTION\_ERRM\_TrigErrDyn shall be called when the failure occurs (the failure is evaluated or re-evaluated) or the failure is removed.

### Application conditions

**Initialisation:** -

**Recurrence:** -

**Activation:** at LV\_END\_DIAG\_XX 0 → 1 transition  
**with** ( LV\_ERR\_XX = 1 **and** LV\_ERR\_MEM\_XX = 1 )  
**or**  
 at LV\_ERR\_XX 1 → 0 transition  
 (due to the physical default disappears only: it means that a clear failure memory or diagnosis initialization aren't activation condition)

### Formula section:

ACTION\_ERRM\_TrigErrDyn (IN<XX>)

This action is called to indicate that a new failure has occurred, although failure is not stored.

### Application conditions

**Initialisation:** -

**Recurrence:** -

**Activation:** LV\_ERR\_XX 0 → 1 transition **with** LV\_END\_DIAG\_XX = 1  
**or**  
 LV\_END\_DIAG\_XX 0 → 1 transition  
**with** ( LV\_ERR\_XX = 1 **and** LV\_ERR\_MEM\_XX = 0 )

### Formula section:

```

If (1)      CTR_ERR_DYN_NR < NC_NR_ERR_DYN
              or      LV_ERR_MEM_XX = 1
Then (1)    ACTION_ERRM_StoreErr (IN<XX>)
Else (1)    If (2)      LV_MKD_MOD = 0
              Then (2)    ACTION_ERRM_PrioRule (OUT<RESP>, OUT<IDX>)
              If (3)      RESP = OK
              Then (3)    ACTION_ERRM_EraseErr (IN<IDX>)
                  ACTION_ERRM_StoreErr (IN<XX>)
              Endif (3)
              Endif (2)
Endif (1)
  
```

**Endif** (1)  
 ACTION\_ERRM\_TrigErrDyn (XX)

This action is called to indicate that a new failure has occurred.

### **B.71.3.3 Diagnostic passed without failure**

### Application conditions

**Initialisation:** -

**Recurrence:** -

**Activation:** at LV\_ERR\_XX 1 → 0 transition (whatever LV\_END\_DIAG\_XX value)  
**or**  
at LV\_END\_DIAG\_XX 0 → 1 with LV\_ERR\_XX = 0

### Formula section:

```
If NLC_CTR_OCC_ENA = 1
Then
  If LV_ERR_MEM_XX = 1
  Then
    LV_ERR_DC_PREV[IDX] = 0
  Endif
Endif
```

### **B.71.3.4 Present failure occurred**

#### Description:

FARM treatments are performed last

### Application conditions

**Initialisation:** -

**Recurrence:** -

**Activation:** at LV\_END\_DIAG\_XX 0 → 1 transition (independent of LV\_ERR value)

### Formula section:

call ACTION\_ERRM\_TrigFarm(XX)

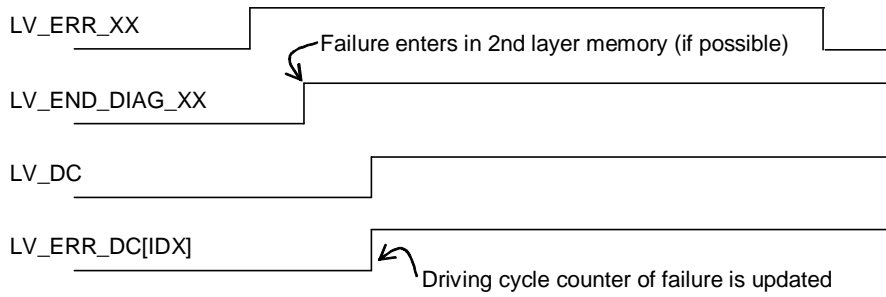
### **B.71.3.5 Error occurred during present driving cycle**

#### Description:

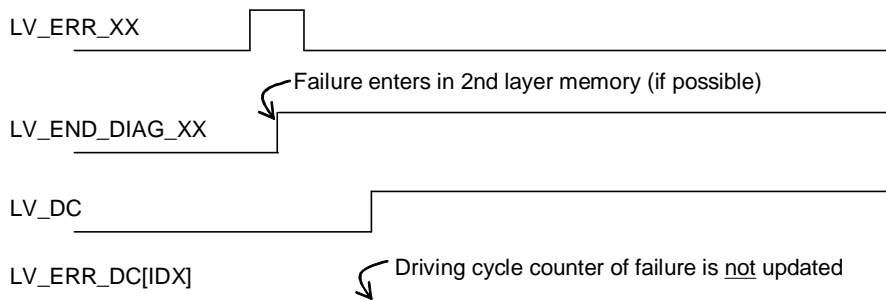
An active flag called LV\_ERR\_DC[IDX] indicates that an error XX (with XX = F(IDX)) has occurred during a driving cycle.

Even if the error disappears during the driving cycle, the flag remains active during the whole driving cycle.

### Failure present, then driving cycle is recognized, then failure not present



### Failure present, then failure not present, then driving cycle is recognized



## Application conditions

- Initialisation:** at ECU reset **or** transition LV\_DC 1->0 after treatment done at this event  
LV\_ERR\_DC[IDX] = 0
- Recurrence:** same as the diagnosis routine  
all failures are updated at transition 0->1 of LV\_DC
- Activation:** at every engine operating state

### Formula section:


**If** LV\_ERR\_XX = 1 (failure is present)  
**and** LV\_END\_DIAG\_XX = 1 (current diagnosis is available)  
**and** LV\_DC = 1 (within driving cycle)  
**and** LV\_ERR\_MEM\_XX = 1 (failure is stored in dynamic memory)

**Then** LV\_ERR\_DC[IDX] = 1 (it remains 1 until the next initialization)

**Endif**

## B.71.3.6 Driving Cycle Counter management

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**Description:**

The driving cycle counter CTR\_DC[IDX] is associated to each failure which has a structure defined in second layer of memory.

This counter is incremented at each driving cycle in the following way:

- for all failures not using SCDN functionality (with LC\_ENA\_SCDN=0 or NLC\_ENA\_SCDN=0), when the associated failure gets present (LV\_ERR\_DC[IDX]).
- for failures using SCDN functionality (with LC\_ENA\_SCDN=1 and NLC\_ENA\_SCDN=1)
- when the failure gets present the first time (and stored)
- when the failure gets present again in a following driving cycle
- when the failure gets present again in another driving cycle (not previous) (driving cycle counter of this failure is != 0/max before new occurrence), if the similar conditions functionality decides, that the incrementation is possible

The driving cycle counter is decremented at the end of a driving cycle in the following cases:

- for all failures not using SCDN functionality (or LC\_ENA\_SCDN=0 or NLC\_ENA\_SCDN=0), when the associated failure was not present the complete DC (LV\_ERR\_DC[IDX] = 0).
- for failures using SCDN functionality (with LC\_ENA\_SCDN=1 and NLC\_ENA\_SCDN=1)
- when similar conditions are encountered without failure (for failure with present MIL illumination)
- when the similar conditions functionality decides that the decrementation is possible (for temporary failure or confirmed failure with no present MIL illumination)

The driving cycle counter is useful for MIL management and warm-up counter management (see specific chapter).

With the calibration LC\_ENA\_SCDN it's possible to enable/disable the similar conditions functionality. If LC\_ENA\_SCDN = 0 the failures using SCDN functionality (see similar conditions Appl.Inc) are treated like normal failures in the driving cycle counter management.

**Application conditions**

**Initialization:**                    On saved RAM lost

```

LV_DC_MAX[IDX] = 0
CTR_DC[IDX] = 0
LV_ERR_DISA[IDX] = 0
LV_ERR_CFM[IDX] = 0

```

**Recurrence:**                    -

**Activation:**                    -

**Formula section:**

Treatment for all failures not using SCDN functionality (with LC\_ENA\_SCDN=0 or NLC\_ENA\_SCDN=0) stored in 2<sup>nd</sup> layer memory :

Conditions to increment the driving cycle counter :

**At LV\_ERR\_DC[IDX] 0 → 1 transition**

XX=f(IDX)

LV\_ERR\_DISA[IDX] = 0

**If**                    LV\_DC\_MAX[IDX]=1                    (for confirmed failure with MIL ON)

**Then**


CTR\_DC[IDX] = DC\_MAX\_XX                    (counter is forced to max.)

ACTION\_ERRM\_GetMILRelevant(XX,PRM\_LV\_MIL\_RLV)

**If** PRM\_LV\_MIL\_RLV= 1 (MIL illuminated and Failure OBD relevant)

**Then**

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```

Permanent fault code has to be stored, if not yet done due to memory full
ACTION_ERRM_StorePermanentCode (XX)
Endif
Else
CTR_DC[IDX] = CTR_DC[IDX] + DC_INC_XX
If CTR_DC[IDX] > DC_MAX_XX
Then
CTR_DC[IDX] = DC_MAX_XX
LV_DC_MAX[IDX] = 1 (failure becomes confirmed)
LV_ERR_CFM[IDX] = 1
ACTION_ERRM_GetMILRelevant(XX,PRM_LV_MIL_RLV)
If PRM_LV_MIL_RLV= 1 (MIL illuminated and Failure OBD relevant)
Then
Permanent fault code has to be stored
ACTION_ERRM_StorePermanentCode (XX)
Endif
Endif
Endif

```

Conditions to decrement the driving cycle counter :

**At transition LV\_DC 1 -> 0:**

```

If LV_ERR_DC[IDX] = 0
and LV_END_DIAG_XX = 1
Then LV_ERR_PND[IDX] = 0 (Pending fault is erased)
If LV_ERR_CFM[IDX] = 1 (for confirmed failure)
Then If LV_DC_MAX[IDX] = 1
Then CTR_DC[IDX] = CTR_DC[IDX] - DC_DEC_XX
If CTR_DC[IDX] <= 0
Then LV_DC_MAX[IDX] = 0
CTR_DC[IDX] = 0
ACTION_ERRM_ErasePermanentCode (XX)
Endif
Else CTR_DC[IDX] = 0
Endif
Else (for temporary failure)
CTR_DC[IDX] = 0
LV_ERR_DISA[IDX] = 1 (failure disappeared)
Endif
Endif

```


Treatment for failures using SCDN functionality (LC\_ENA\_SCDN=1 and NLC\_ENA\_SCDN=1) (running within DC) stored in 2<sup>nd</sup> layer memory.

Conditions to increment the driving cycle counter :

**Done upon ACTION\_ERRM\_IncrementDCctrSCDN call:**  
(see also similar conditions specification)

### Description:

Syntax : ACTION\_ERRM\_IncrementDCctrScdn (IN <XX>)

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**Parameter (in) :** XX failure in static memory with XX=F(IDX)

**Parameter (out) :**

**Short description:**

With the ACTION\_ERRM\_IncrementDCctrScdn (IN <XX>) the driving cycle counter for the failure XX stored in 2<sup>nd</sup> layer memory at position IDX, which is using similar conditions functionality, is incremented. This action is called at the end of a diagnosis window in the following cases :

- failure occurred and similar conditions are recorded
- failure already stored in a previous driving cycle. Now failure gets present again and was also present in last driving cycle.
- failure already stored in a previous driving cycle. Now failure gets present again with SCDN recognition for detected failure.
- failure already stored in a previous driving cycle and LV\_DC\_MAX[IDX] = 1 (MIL is illuminated, if LC\_MIL\_ON =1).

For details see similar conditions specification.

### Application conditions

**Initialization:** –

**Recurrence:** –

**Activation:** at action request

### Formula section:

ACTION\_ERRM\_IncrementDCctrScdn (IN<XX>) :

XX=f(IDX)

**If** LV\_ERR\_MEM\_XX = 1 (failure XX is stored in 2<sup>nd</sup> layer memory)

**Then** LV\_ERR\_DISA[IDX] = 0

**If** LV\_DC\_MAX[IDX] =1 (for confirmed failure with MIL on)

**Then**

CTR\_DC[IDX] = DC\_MAX\_XX (counter is forced to max.)

ACTION\_ERRM\_GetMILRelevant(XX,PRM\_LV\_MIL\_RLV)

**If** PRM\_LV\_MIL\_RLV= 1

(MIL illuminated and Failure OBD relevant)

**Then**

Permanent fault code has to be stored, if not yet done due to memory full

ACTION\_ERRM\_StorePermanentCode (XX)

**Endif**

**Else** ACTION\_ERRM\_ConfirmErrScdn (OUT<DCconf>, IN<XX>)  
(allows direct failure confirmation; see similar conditions Appl.Inc.)

**If** DCconf = YES

**Then**

CTR\_DC[IDX] = DC\_MAX\_XX (counter is forced to max.)

**Else**

CTR\_DC[IDX] = CTR\_DC[IDX] + DC\_INC\_XX

**Endif**


**If** CTR\_DC[IDX] DC\_MAX\_XX

**Then**

CTR\_DC[IDX] = DC\_MAX\_XX

LV\_DC\_MAX[IDX] = 1 (failure confirmed)

LV\_ERR\_CFM[IDX] = 1

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```

        LV_ERR_TMP[IDX] = 0
        ACTION_ERRM_GetMILRelevant(XX,PRM_LV_MIL_RLV)
        If PRM_LV_MIL_RLV= 1
        (MIL illuminated and Failure OBD relevant)
        Then
            Permanent fault code has to be stored
            ACTION_ERRM_StorePermanentCode (XX)
        Endif
    Endif
Endif

```

Conditions to decrement the driving cycle counter :

**At transition LV\_DC 1 -> 0:**

```

If      LV_ERR_DC[IDX] = 0
    and  LV_END_DIAG_XX = 1
Then    ACTION_ERRM_DecrementDCctrSCDN (OUT<DCdec>, IN<XX>)
        (with XX=F(IDX))
        The similar conditions functionality decides, if it's possible to decrement the driving cycle
        counter.
        If      DCdec = YES                                (decrementing is possible)
        Then    LV_ERR_PND[IDX] = 0                        (Pending fault is erased)
            If      LV_ERR_CFM[IDX] = 1                    (for confirmed failure)
            Then  If      LV_DC_MAX[IDX] = 1
                Then  CTR_DC[IDX] = CTR_DC[IDX] - DC_DEC_XX
                    If      CTR_DC[IDX] ≤ 0
                        Then  LV_DC_MAX[IDX] = 0
                            CTR_DC[IDX] = 0
                            ACTION_ERRM_ErasePermanentCode (XX)
                        Endif
                    Else
                        CTR_DC[IDX] = 0
                    Endif
                Else
                    CTR_DC[IDX] = 0
                Endif
            Else
                CTR_DC[IDX] = 0
            Endif
        Endif

```


### B.71.3.7 Warm-Up counter management

#### Description:

As soon as the failure gets present and stored in the memory, the warm-up cycle counter is initialized. With every valid warm-up cycle with no error occurrence, the warm-up cycle counter is decremented by 1. If the warm-up cycle counter reaches zero the error is deleted from the 2<sup>nd</sup> layer memory.

#### Application conditions

**Initialization:**                    on saved ram lost  
   CTR\_WUP\_CYC[IDX] = 0

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**Recurrence:** -  
**Activation:** only at transition LV\_DC 1 -> 0

**Formula section:**

Treatment for all failures not using SCDN functionality (or LC\_ENA\_SCDN = 0) stored in 2<sup>nd</sup> layer memory :

Condition to decrement the warm up counter :

The following treatment is done for all failure stored in 2<sup>nd</sup> layer memory **and only at transition LV\_DC 1 -> 0 (before treatment of driving cycle counter decrementing at end of driving cycle):**

```

If      ( LV_WUP_CYC = 1 and C_CTR_MAX_WUP_CYC != 255 )
           the warm-up cycle is recognised and failure healing is possible
Then   If      ( CTR_DC[IDX] = 0 and LV_ERR_DC[IDX] = 0 )
           the MIL is extinguished and no failure in this driving cycle
           or
           ( CTR_DC[IDX] != 0 and LV_DC_MAX[IDX] = 0
           case before the MIL may be illuminated
           and LV_ERR_DC[IDX] = 0 and LV_END_DIAG_XX = 1 )
           the failure is no more pending
           Then   CTR_WUP_CYC[IDX] = CTR_WUP_CYC[IDX] - 1
           If      CTR_WUP_CYC[IDX] = 0
           Then   ACTION_ERRM_EraseErr (IN<IDX>)
           Endif
           Endif
Endif
    
```

Treatment for failures using SCDN functionality (and LC\_ENA\_SCDN = 1) (running within DC) stored in 2<sup>nd</sup> layer memory.

Condition to decrement the warm up counter :

The following treatment is done for all failure stored in 2<sup>nd</sup> layer memory **and only at transition LV\_DC 1 -> 0 (before treatment of driving cycle counter decrementing at end of driving cycle):**

```

If      LV_WUP_CYC = 1
Then   If      CTR_DC_IDX = 0
           and LV_ERR_DC_IDX = 0
           Then   CTR_WUP_CYC_IDX = CTR_WUP_CYC_IDX - 1
           If      CTR_WUP_CYC_IDX = 0
           Then   ACTION_ERRM_EraseErr (IDX)
           Endif
           Endif
Endif
    
```

Condition to reload the warm up counter :


The following treatment is done for failure XX when it is stored in 2<sup>nd</sup> layer memory **when ACTION\_ERRM\_StoreErr (IN<XX>) is called :**

CTR\_WUP\_CYC[IDX] = C\_CTR\_MAX\_WUP\_CYC

**B.71.3.8 Treatments at end of driving cycle**

**FUNCTION DESCRIPTION:**

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**General information:**

End of driving cycle is reached when power-latch is ended, or in case on key off/on transition before the end of power-latch phase.  
For CTR\_OCC[IDX] computation, some treatments are executed each time a driving cycle is ended.

**Application conditions**

**Initialisation:** -  
**Recurrence:** -  
**Activation:** at end of power-latch phase (before NVMY storage) whatever LV\_DC value  
**or**  
( LV\_IGK 0→1 transition **and** LV\_ES = 1 **and** LV\_DC = 1 )

**Formula section:**

ACTION\_ERRM\_ClcLvErrDcPrev( )

**B.71.3.9 Calculation of LV\_ERR\_XX state at end of driving cycle**

**Description for ACTION\_ERRM\_ClcLvErrDcPrev**

<b>ACTION_ERRM_ClcLvErrDCPrev ( )</b>					
This action indicates if a failure was set at the end of previous driving cycle					
Parameter	Type	Hex. Limits	Phys. limits	Resol.	Unit
No Parameter					

**General information:**

This action indicates if a failure was set at the end of previous driving cycle.  
Only when NLC\_CTR\_OCC\_ENA = 1, this action must be called before any other treatment from ERRM.

**Formula section:**

**For**            IDX = 0 to CTR\_ERR\_DYN\_NR  
                  with XX = f(IDX)  
                  **If** LV\_END\_DIAG\_XX = 1  
                  **THEN** LV\_ERR\_DC\_PREV[IDX] = LV\_ERR\_XX  
                  **ENDIF**  
**Endfor**

**B.71.4 Miscellaneous services to get information**

**B.71.4.1 API for determination of pending status of failures**

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**General information:**

This API shall be called to determine if any XX failure is pending or not.

**Description:**

**Syntax:** ACTION\_ERRM\_CheckPendingStatus (IN <PRM\_IDX\_DIAG>, OUT <PRM\_LV\_ERR\_PND>)

**Parameter(in):** PRM\_IDX\_DIAG Diagnostic instance of the XX failure

**Parameter(out):** PRM\_LV\_ERR\_PND State of the failure :  
 = 1 failure is pending (or it's impossible to determine its status)  
 = 0 failure is not pending

**Short Description:** This API shall be used to verify if a failure stored in the dynamic memory has the pending status or not. When it impossible to determine if the fault is pending or not (failure not store because the dynamic memory is full), this failure should be considered as pending anyway.

**Application conditions**

**Initialisation:** -  
**Recurrence:** -  
**Activation:** *at action call*  
**Deactivation:** -

**Formula section:**

```

If (1)           { the XX failure analysed is present in the dynamic memory }
LV_ERR_MEM_XX = 1 ( with XX = F(IDX) )

Then (1)
If (2)           { IDX is the failure index, in the dynamic memory }
LV_ERR_PND[IDX] = 1

Then (2)
PRM_LV_ERR_PND = 1

Else (2)
PRM_LV_ERR_PND = 0

Endif (2)


Else (1)
{ failure not stored in the dynamic memory }
If (2)           LV_ERR_XX = 1
Then (2)
{ the failure is stored in the static memory but it's not present in the dynamic
memory : impossible to determine its status }
{ then the failure shall be considered as pending }
PRM_LV_ERR_PND = 1

Else (2)
{ the failure is neither stored in the static memory nor in the dynamic mem-
ory }
PRM_LV_ERR_PND = 0

Endif (2)

Endif (1)
    
```

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## B.71.4.2 Get the "Failure set since last clear" state

### Description for ACTION\_ERRM\_GetErrLastClr

ACTION_ERRM_GetErrLastClr (<PRM_IDX_ERR>, <PRM_LV_ERR_LST_CLR>)					
This action indicates if a failure has been set already once since the last failure memory clear.					
Parameter	Type	Hex. Limits	Phys. limits	Resol.	Unit
PRM_IDX_ERR	IN	0...FFFFH	0...65535	1	[-]
Diagnostic failure instance					
PRM_LV_ERR_LST_CLR	OUT	0...1H	0...1	1	[-]
Failure set at least once since last failure memory clear					

### General information:

This API shall be called to determine if any XX failure has been set at least one time since memory clear

### Formula section:

```

If   PRM_IDX_ERR != 0
Then
    with XX = PRM_IDX_ERR
        PRM_LV_ERR_LST_CLR = LV_ERR_LST_CLR_XX
Else
    PRM_LV_ERR_LST_CLR = 0
Endif
    
```

## B.72 Dynamic error management core (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_WUP_CYC	O/V	0... 1H	0 ...1	1	-
Warm-up cycles calculation inhibition					
TCO_DSL_CMN	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature ( used only in ERRM for GS-DS diversity)					
TCO_ST_DSL_CMN	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature at start ( used only in ERRM for GS-DS diversity)					

### Input data:

TCO {p. 1100}	TCO_ST {p. 1100}		
---------------	------------------	--	--

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_OBD_DSL	-	0... 1H	0 ...1	1	-
Selection of engine type : gasoline (0) or diesel (1)					

### Action definition

ACTION_ERRM_TrigErrDyn (IN<XX>)	Mode: O
---------------------------------	---------

ACTION_ERRM_TrigFarm (IN<XX>)	Mode: O
-------------------------------	---------

### Import actions:

ACTION_ERRM_CheckPendingStatus (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR_PND>)
ACTION_ERRM_GetLvEndDiag (IN<IDX_DIAG>,OUT<LV_END_DIAG>)
ACTION_ERRM_GetLvErr (IN<IDX_DIAG>,OUT<LV_ERR>)
ACTION_FARM_ReqInit ()
ACTION_FARM_TriggerOnEvent (IN<PRM_IDX_DIAG>,OUT<PRM_STATE_OLD>,OUT<PRM_STATE_NEW>)


### B.72.1 Selection of engine type : Gasoline /Diesel

NLC\_OBD\_DSL data is used to adapt OBD computations to engine type : gasoline (0) or diesel (1). It is used by Statistical Data, Failure Classes, Readiness code and Rate-based monitoring modules.

### B.72.2 Warm-up cycle inhibition

#### FUNCTION DESCRIPTION:

#### Description:

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The warm-up cycle is not inhibited

### Application conditions

**Initialisation:** at ECU reset  
                           LV\_INH\_WUP\_CYC = 0  
                           TCO\_DSL\_CMN = TCO  
                           TCO\_ST\_DSL\_CMN = TCO\_ST

**Recurrence:** 100 ms

**Activation:** LV\_IGK = 1

**Deactivation:** -

### Formula section:

LV\_INH\_WUP\_CYC = 0  
 TCO\_DSL\_CMN = TCO  
 TCO\_ST\_DSL\_CMN = TCO\_ST

## B.72.3 API for Trigger Event

### General information:

This file defines the Action "ACTION\_ERRM\_TrigErrDyn" called by the error management function when a failure occurs or disappears.

### Description:

**Syntax:** ACTION\_ERRM\_TrigErrDyn (IN <XX>)

**Parameter (in):** XX diagnostic instance of failure index of failure in static memory

**Parameter (out):** -

**Short description:** This action allows to inform the communication tools in line as soon as a failure occurs

### Application conditions

**Initialisation:** -

**Recurrence:** -

**Activation:** at action request

### Formula section:

ACTION\_ERRM\_TrigErrDyn (XX): **not used**

## B.72.4 Additional FARM interface functionality

### General information:

This part defines the interfaces between ERRM and FARM in case of FARM usage inside the project. This part must be empty if FARM is not used.

**Description:**

**Syntax:** ACTION\_ERRM\_TrigFarm (IN <XX>)

**Parameter (in):** XX diagnostic instance of failure index of failure in static memory

**Parameter (out):** -

**Short description:** This action indicates if a failure status has changed to inform FARM

**Application conditions**

**Initialisation:** at reset, after calculation of ERRM and diagnostics:  
ACTION\_FARM\_ReqInit ()

**Initialisation:** at clear failure memory, after calculation of ERRM and diagnostics:  
ACTION\_FARM\_ReqInit ()

**Initialisation:** at transition of LV\_DC from 0 to 1, after calculation of ERRM and diagnostics:  
ACTION\_FARM\_ReqInit ()  
**Reccurence:** -

**Activation :** none, FARM is not used

**Formula section:**

PRM\_STATE = 0

ACTION\_ERRM\_GetLvErr( IN< PRM\_IDX\_ERR >, OUT<PRM\_LV\_ERR>)

Bit 0 of PRM\_STATE = PRM\_LV\_ERR

ACTION\_ERRM\_CheckPendingStatus(IN<PRM\_IDX\_ERR>,OUT<PRM\_LV\_PMD> )

Bit 3 of PRM\_STATE = PRM\_LV\_PMD

ACTION\_ERRM\_GetLvEndDiag( IN<PRM\_IDX\_ERR>, OUT<PRM\_LV\_END>)

Bit 5 of PRM\_STATE = PRM\_LV\_END

ACTION\_FARM\_TriggerOnEvent(XX,PRM\_STATE,PRM\_STATE)

## B.73 Environmental data

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ENVD_CUS_CMN [NC_NR_ENVD_CUS_CMN][NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Freeze frame FRF_CUS_CMN : environmental data common to all failure (not fixed by law)					
ENVD_CUS_SET_CMN [NC_NR_ENVD_CUS_SET_CMN][NC_NR_FRF_SET][NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Freeze frame FRF_CUS_SET_CMN : environmental data common to all failure (not fixed by law) stored in set					
ENVD_CUS_SET_SPC [NC_NR_ENVD_CUS_SET_SPC][NC_NR_FRF_SET][NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Freeze frame FRF_CUS_SET_SPC : environmental data specific to each failure (not fixed by law) stored in set					
ENVD_OBD [NC_NR_ENVD_OBD][NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Freeze frame FRF_OBD : environmental data (fixed by law)					
ENVD_PREV_CUS_CMN [NC_NR_ENVD_CUS_CMN][NC_NR_ENVD_PREV]	O/S	0... FFH	0... 255	1	-
Prestored freeze frame FRF_PREV_CUS_CMN as content for FRF_CUS_CMN;					
ENVD_PREV_CUS_SET_CMN [NC_NR_ENVD_CUS_SET_CMN][NC_NR_ENVD_PREV]	O/S	0... FFH	0... 255	1	-
Prestored Freeze frame FRF_PREV_CUS_SET_CMN as content for FRF_CUS_SET_CMN					
ENVD_PREV_CUS_SET_SPC [NC_NR_ENVD_CUS_SET_SPC][NC_NR_ENVD_PREV]	O/S	0... FFH	0... 255	1	-
Prestored freeze frame FRF_PREV_CUS_SET_SPC :as content for FRF_CUS_SET_SPC					
ENVD_PREV_OBD [NC_NR_ENVD_OBD][NC_NR_ENVD_PREV]	O/S	0... FFH	0... 255	1	-
Prestored freeze frame FRF_PREV_OBD as content for FRF_OBD;					
IDX_FRF [NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Pointer to make the link between the failure and the freeze frame					

### Input data:

CTR_FRC [NC_NR_ERR_DYN] {p. 5767}	ENVD_CONF_CUS_CMN [NC_NR_ENVD_CUS_CMN] {p. 5801}	ENVD_CONF_CUS_SET_CMN [NC_NR_ENVD_CUS_SET_CMN] {p. 5801}	ENVD_CONF_OBD [NC_NR_ENVD_OBD] {p. 5801}
LV_ERR_DISA [NC_NR_ERR_DYN] {p. 5767}	NC_NR_ERR_DYN {p. 5768}		



**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_ERR_ENVD_XX	V/S	0... FFFFH	0... 65535	1	-
LDP_1_ID_ERR_ENVD_XX	NC_ NR_ ENVD_ CUS_ SET_ SPC	0... FFH	0... 255	1	-
Freeze frame FRF_CUS_SET_SPC : environmental data contents for failure XX					

**Configuration data:**


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_ENVD_FAC [65535]	-	1... FFH	1... 255	1	-
Possible stored environmental data in FRF_CUS_SET_SPC					
NC_ENVD_CUS_CMN_UPD	-	0... 1H	0 ...1	1	-
Selection of FRF_CUS_CMN update method					
NC_ID_ENVD_FAC	-	1... FFFFH	1... 65535	1	-
Size of ID_ENVD_FAC table					
NC_NR_ENVD_CUS_CMN	-	1... FFH	1... 255	1	-
Number of different environment data (in bytes) which are common for all diagnosis instance (stored one time)					
NC_NR_ENVD_CUS_SET_CMN	-	0... FFH	0... 255	1	-
Number of different environment data (in bytes) which are common for all diagnosis instance (stored many time)					
NC_NR_ENVD_CUS_SET_SPC	-	1... FFH	1... 255	1	-
number of different environment data (in bytes) which are specific to each diagnosis instance (stored many time)typical value is 4					
NC_NR_ENVD_OBD	-	1... FFH	1... 255	1	-
Number of different environment data (in bytes) which are fixed by the law (stored one time)					
NC_NR_ENVD_PREV	-	1... FFH	1... 255	1	-
Number of different failure instances XX using prestored freeze frameIf NC_NR_ENVD_PREV = 0 , then no prestored freeze frame functionality required					
NC_NR_FRF_SET	-	1... FFH	1... 255	1	-
Number of different environment data groups (set) which can be store for one freeze frametypical value is 3 ; the value 0 is forbidden					

**Action definition**

<b>ACTION_ERRM_EraseFrF (IN&lt;IDX&gt;)</b>	Mode: O
<b>ACTION_ERRM_StoreFrF (IN&lt;IDX&gt;)</b>	Mode: O
<b>ACTION_ERRM_StorePrevFrF (IN&lt;XX&gt;)</b>	Mode: O
This action stores the prestored freeze frame for the diagnosis instance XX	

**Note:**

The link between the failure stored in the dynamic error mangement at position *IDX* is made with *IDX\_FRF[IDX]*. E. g. a failure stored at the position *IDX* = 2 belongs to freeze frame

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ENVD\_...\_[m] with m = IDX\_FRF[2]

**FUNCTION DESCRIPTION:**

**General information:**

This module describes the structure of the freeze frame and manages the storage and deleting of the freeze frame.

A freeze frame is a group of vehicle environment data caught when a failure occurs.

Freeze frame is filled up with variables, which are not limp home values : the variables are set up before going to the limp home.

A freeze frame is made of many parts :

- FRF\_OBD: Environmental data, which are common to all failures and stored on time. It s only updated, if the failure has disappeared before and occurs again.

The content is defined by law. It s called usually CARB Freeze Frame and the content is according to SAE J1979.

Size of this part is defined by configuration data NC\_NR\_ENVD\_OBD affected value is in the Environmental data (Appl. Inc.) module.

Contents of this part is fixed and defined in Environmental data (Appl. Inc.) module.

- FRF\_CUS\_CMN : Environmental data, which are common to all failure.

It s stored one time, if NC\_ENVD\_CUS\_CMN\_UPD = 0.

With NC\_ENVD\_CUS\_CMN\_UPD = 1, FRF\_CUS\_CMN is updated, if the failure was disappeared before and occurs again.

The content is not required by law.

Size of this part is defined by configuration data NC\_NR\_ENVD\_CUS\_CMN; affected value is in the Environmental data (Appl. Inc.) file.

Contents of this part is fixed and defined in the Environmental data (Appl. Inc.) module.

- FRF\_CUS\_SET\_CMN : Environmental data, which are common to all failure and stored many times. The content is not required by law. For each failure occurrence several catches (called sets) can be done.

Size of this part is defined by configuration data, affected value is in the Environmental data (Appl. Inc.) module :

NC\_NR\_FRF\_SET for number of sets per freeze frame

NC\_NR\_ENVD\_CUS\_SET\_CMN for number of common data (in bytes) in each set

Contents of this part is fixed and defined in the Environmental data (Appl. Inc.) module.

- FRF\_CUS\_SET\_SPC : Environmental data, which are specific to each failure and stored many times. The content is not required by law. For each failure occurrence several catches (called sets) can be done.

Size of this part is defined by configuration data, affected value is in Environmental data (Appl. Inc.) module :


NC\_NR\_FRF\_SET for number of sets per freeze frame

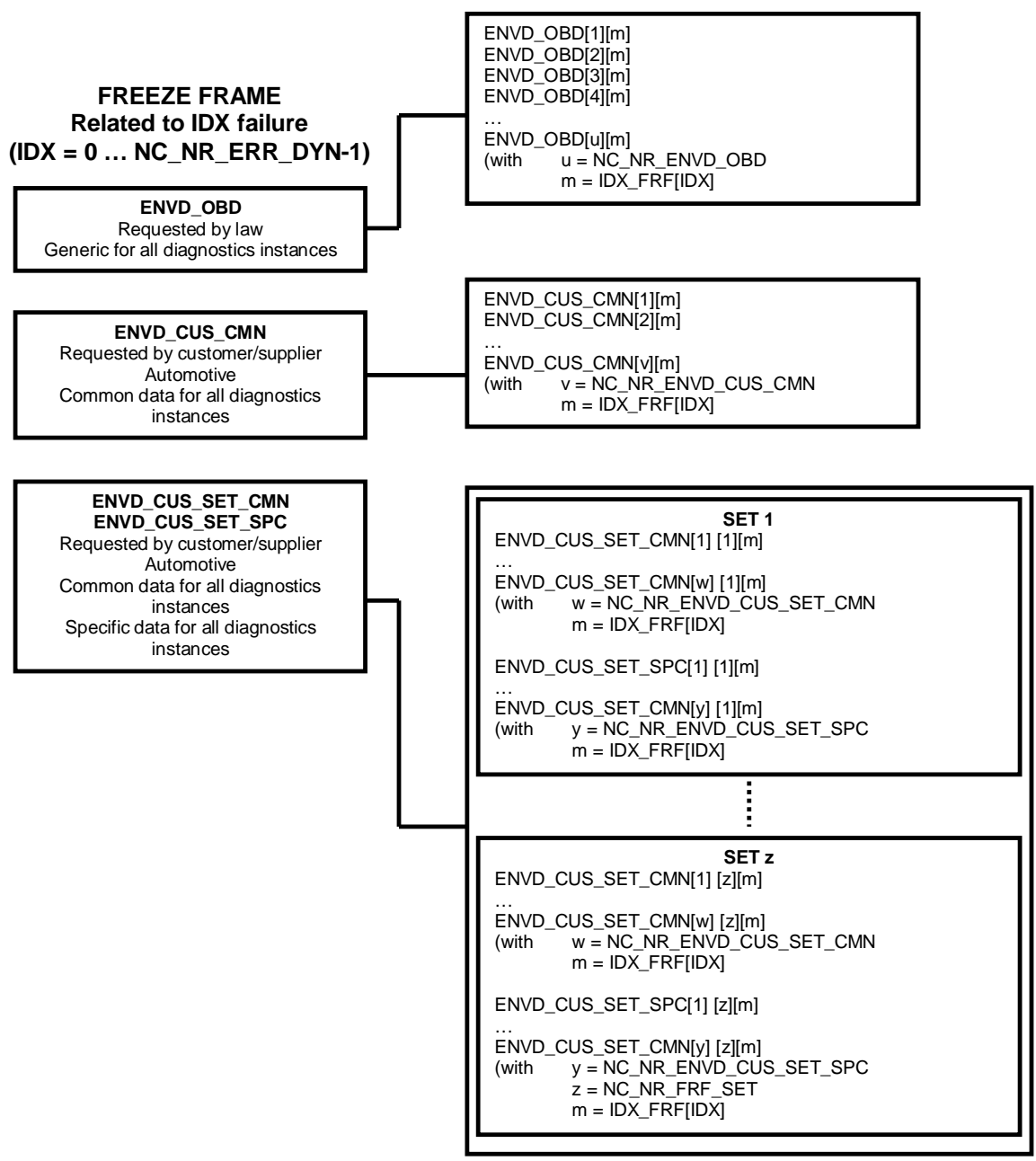
NC\_NR\_ENVD\_CUS\_SET\_SPC for number of specific data (in bytes) in each set

Contents of this part is defined by calibration, process is described in the last chapter of this module.

**Signal flow diagram:**

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Remark: This signal flow diagram doesn't include the prestored freeze frame functionality described in chapter 1.4.


### B.73.1 Freeze frame storage

**Description:**

**Syntax :** ACTION\_ERRM\_StoreFrF (IN <IDX>).  
**Parameter (in) :** IDX Index of failure in 2<sup>nd</sup> layer memory to store the freeze frame  
**Parameter (out) :** -  
**Short description :**

When the failure IDX gets present, the storage of a freeze frame is done in the 2<sup>nd</sup> layer memory by calling the action ACTION\_ERRM\_StoreFrF (IDX).

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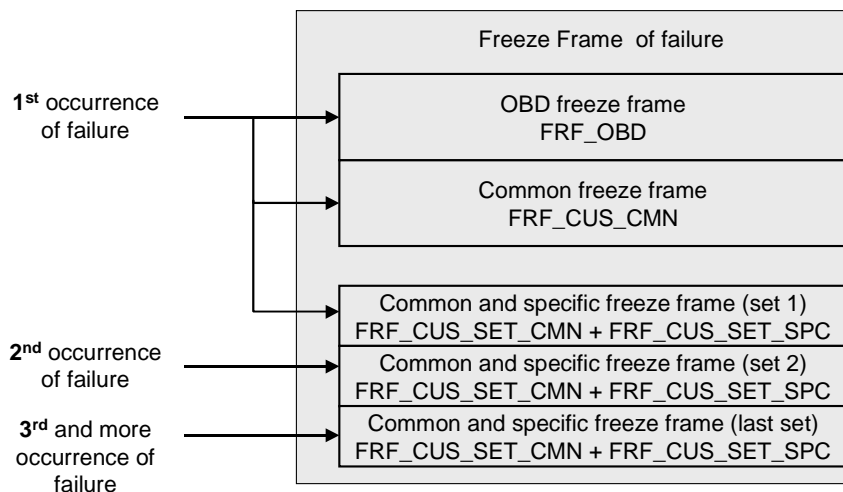
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If several failures occur (TCO sensor, injector 1, injector 4), a freeze frame is stored for each failure. For ram memory limitation, the number of freeze frame is limited to NC\_NR\_ERR\_DYN.

If same failure occurs several times (occurrence of the failure is defined by the frequency counter CTR\_FRC[IDX]), the following rules are applied :

- 1<sup>st</sup> occurrence :  
Store FRF\_OBD +FRF\_CUS\_CMN +FRF\_CUS\_SET\_CMN + FRF\_CUS\_SET\_SPC
- occurrence [2 to NC\_NR\_FRF\_SET]  
Store FRF\_CUS\_SET\_CMN + FRF\_CUS\_SET\_SPC
- occurrence > NC\_NR\_FRF\_SET  
Replace last FRF\_CUS\_SET\_CMN + FRF\_CUS\_SET\_SPC

Example with NC\_NR\_FRF\_SET set to 3



Freeze frame informations are available as long as the failure is not erased in 2<sup>nd</sup> layer memory.

Remark: Special behavior for FRF\_OBD and FRF\_CUS\_CMN in case of failure status change from disappeared to temporary/confirmed.

### Application conditions

**Initialization:** *after system initialization the freeze frame is restored from non volatile memory or in case of a damaged non volatile memory the freeze frame is with zero*

**Recurrence:** -

**Activation:** *at Action request*

### Formula section:

ACTION\_ERRM\_StoreFrf (IDX) :

If CTR\_FRC[IDX] = 1

Then ( 1<sup>st</sup> occurrence : storage

With u = 1 ... NC\_NR\_ENVD\_OBD

v = 1 ... NC\_NR\_ENVD\_CUS\_CMN

w = 1 ... NC\_NR\_ENVD\_CUS\_SET\_CMN

y = 1 ... NC\_NR\_ENVD\_CUS\_SET\_SPC )

```

If (NC_NR_ENVD_PREV != 0 and
XX = diagnosis instance XX using prestored freeze frame functionality (see Environ-
mental data (Appl. Inc.) module) with XX = F(IDX))
Then ENVD_OBD[u][m] = ENVD_PREV_OBD[u][t]
ENVD_CUS_CMN[v][m] = ENVD_PREV_CUS_CMN[v][t]
ENVD_CUS_SET_CMN[w][1][m] = ENVD_PREV_CUS_SET_CMN[w][t]
ENVD_CUS_SET_SPC[y][1][m] = ENVD_PREV_CUS_SET_SPC[y][t]
(with m=IDX_FRF[IDX]
with t related to failure XX, see Environmental data Appli.Inc.)

Else ENVD_OBD[u][m] = ENVD_CONF_OBD[u]
ENVD_CUS_CMN[v][m] = ENVD_CONF_CUS_CMN[v]
ENVD_CUS_SET_CMN[w][1][m] = ENVD_CONF_CUS_SET_CMN[w]
ENVD_CUS_SET_SPC[y][1][m] = ID_ERR_ENVD_XX[y]
(with XX = F(IDX) )

Endif

```

```

Else (occurrence 2 to NC_NR_FRF_SET
With w = 1 .. NC_NR_ENVD_CUS_SET_CMN
y = 1 ... NC_NR_ENVD_CUS_SET_SPC
z = CTR_FRC[IDX], if CTR_FRC[IDX] < NC_NR_FRF_SET : storage
z = NC_NR_FRF_SET, if CTR_FRC[IDX] > NC_NR_FRF_SET : update
( with m=IDX_FRF[IDX] )

```

```

If (NC_NR_ENVD_PREV != 0 and
XX = diagnosis instance XX using prestored freeze frame functionality
(see Environmental data (Appl. Inc.) module) with XX = F(IDX))

Then If (LV_ERR_DISA[IDX] = 1)
failure was in disappeared state before this occurrence
Then ENVD_OBD[u][m] = ENVD_PREV_OBD[u][t]
FRF_OBD is updated
If (NC_ENVD_CUS_CMN_UPD = 1)
Then ENVD_CUS_CMN[v][m] = ENVD_PREV_CUS_CMN[v][t]
FRF_CUS_CMN is updated
Endif
Endif
ENVD_CUS_SET_CMN[w][z][m] = ENVD_PREV_CUS_SET_CMN[w][t]
ENVD_CUS_SET_SPC[y][z][m] = ENVD_PREV_CUS_SET_SPC[y][t]
(with t related to failure XX, see Environmental data Appli.Inc.)

Else If (LV_ERR_DISA[IDX] = 1)
Failure was in disappeared state before this occurrence
Then ENVD_OBD[u][m] = ENVD_CONF_OBD[u]
Freeze frame ENVD_OBD is updated
If (NC_ENVD_CUS_CMN_UPD = 1)
Then ENVD_CUS_CMN[v][m]= ENVD_CONF_CUS_CMN[v]
FRF_CUS_CMN is updated
Endif
Endif
ENVD_CUS_SET_CMN[w][z][m] = ENVD_CONF_CUS_SET_CMN[w]
ENVD_CUS_SET_SPC[y][z][m] = ID_ERR_ENVD_XX [ y ]
(with XX = F(IDX))

```

**Endif**

**Endif**

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## B.73.2 Freeze frame deleting

### Description:

**Syntax :** ACTION\_ERRM\_EraseFrf (IN <IDX>).  
**Parameter (in) :** IDX Index of failure in 2<sup>nd</sup> layer memory to store the freeze frame  
**Parameter (out) :** -  
**Short description :**

When the failure IDX is erased from 2<sup>nd</sup> layer memory, the freeze frame of this failure is also erased by calling the action ACTION\_ERRM\_EraseFrf (IDX).

### Application conditions

**Initialization:** -  
**Recurrence:** -  
**Activation:** at Action request

### Formula section:

ACTION\_ERRM\_EraseFrf (IDX) :  
 ( Erase OBD freeze frame, common freeze frame and all specific freeze frame  
 With u = 1 ... NC\_NR\_ENVD\_OBD  
 v = 1 ... NC\_NR\_ENVD\_CUS\_CMN  
 w = 1 ... NC\_NR\_ENVD\_CUS\_SET\_CMN  
 y = 1 ... NC\_NR\_ENVD\_CUS\_SET\_SPC  
 z = 1 ... NC\_NR\_FRF\_SET )  
 ENVD\_OBD[u][m] = 0  
 ENVD\_CUS\_CMN[v][m] = 0  
 ENVD\_CUS\_SET\_CMN[w][z][m] = 0  
 ENVD\_CUS\_SET\_SPC[y][z][m] = 0

## B.73.3 Calibratable set of environmental data

### Description:

The freeze frame part called FRF\_CUS\_SET\_SPC contains environmental data, which are :

- specific to each failure, not required by law ;
- and calibratable.

This chapter describes how to define by calibration the contents of FRF\_CUS\_SET\_SPC .

The calibratable system of environmental data is managed via tables defined as following:


**ID\_ENVD\_FAC :** Configuration table, which describes all possible environmental data, which can be stored in a freeze frame (specific part) ;

Affected value defined in Environmental data (Appl. Inc.) module.

**ID\_ERR\_ENVD\_XX :** Calibration table, which defines for each failure XX a maximum of NC\_NR\_ENVD\_CUS\_SET\_SPC environmental data, which should be stored.

### Example :

To store the environmental data TIA and TCO\_ST in case of TCO failure ;  
 MAP and AMP in case of EGR failure ;

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First, you should defined the possible environmental data in ID\_ENVD\_FAC table :

```
ID_ENVD_FAC[1] = & TIA
ID_ENVD_FAC[2] = & TCO_ST
ID_ENVD_FAC[3] = & MAP
ID_ENVD_FAC[4] = & AMP
```

Then, you should declare for each failure, the environmental data to stored :

```
ID_ERR_ENVD_TCO[1] = 1 ; ID_ERR_ENVD_TCO [ 2 ] = 2
ID_ERR_ENVD_EGR[1] = 3 ; ID_ERR_ENVD_EGR [ 2 ] = 4
```

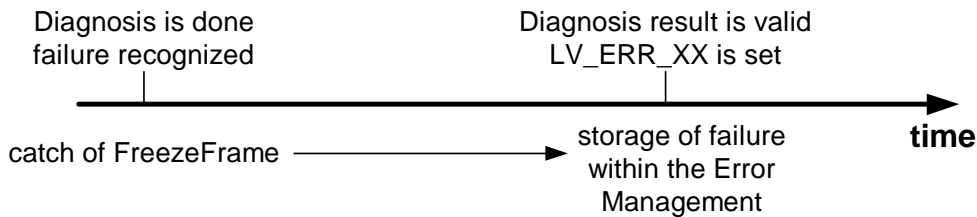
### B.73.4 Prestored freeze frame

#### FUNCTION DESCRIPTION:

##### General information:

Usually the content for the freeze frame is caught, when the failure is stored within the failure memory. In special cases, when the entry of a failure within the failure memory is delayed, it s necessary to catch the content for the freeze frame at the same time as the failure information is available.

Example:



##### Description:

**Syntax :** ACTION\_ERRM\_StorePrevFr (IN <XX>).

**Parameter (in) :** XX diagnosis instance

**Parameter (out) :** -

##### Short description :

If ACTION\_ERRM\_StorePrevFr (XX) is called by the diagnosis instance XX, a prestored freeze frame for diagnosis instance XX is stored. It s used as content for the freeze frame, if the failure is entered in the failure memory later.

##### Application conditions

**Initialization:** -

**Recurrence:** -


**Activation:** at Action request

##### Formula section:

ACTION\_ERRM\_StorePrevFr (XX) :  
with t related to failure XX, see Environmental data Appli.Inc.

$$ENVD\_PREV\_OBD[u][t] = ENVD\_CONF\_OBD[u]$$

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ENVD\_PREV\_CUS\_CMN[v][t] = ENVD\_CONF\_CUS\_CMN[v]  
 ENVD\_PREV\_CUS\_SET\_CMN[w][t] = ENVD\_CONF\_CUS\_SET\_CMN[w]  
 ENVD\_PREV\_CUS\_SET\_SPC[y][t] = ID\_ERR\_ENVD\_XX[y] (with XX = F(IDX))

Configuration data detailed description:

NC\_NR\_ENVD\_CUS\_SET\_SPC : Typical value is 4.

NC\_NR\_FRF\_SET : Typical value is 3.  
 The value 0 is forbidden.


NC\_ENVD\_CUS\_CMN\_UPD 0: FRF\_CUS\_CMN is not updated when failure status changes from "disappeared" to "temporary/confirmed".

1: FRF\_CUS\_CMN is updated when failure status changes from "disappeared" to "temporary/confirmed".

NC\_NR\_ENVD\_PREV 0: No pre-stored freeze frame functionality required

Size of ID\_ENVD\_FAC is defined according number of data in the table ; maximum size is 65535.

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## B.74 Environmental data (Appl Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DIST_KM	O/V	0... FFFFFFFH	0... 16777215	1	km
Calculated KM counter (1Km resolution)					
ENVD_CONF_CUS_CMN [NC_NR_ENVD_CUS_CMN]	O	0... FFH	0... 255	1	-
Freeze frame FRF_CUS_CMN : environmental common data contents					
ENVD_CONF_CUS_SET_CMN [NC_NR_ENVD_CUS_SET_CMN]	O	0... FFH	0... 255	1	-
Freeze frame FRF_CUS_SET_CMN : environmental calibrated data contents					
ENVD_CONF_OBD [NC_NR_ENVD_OBD]	O	0... FFH	0... 255	1	-
Freeze frame FRF_OBD : environmental OBD data contents					
FUP_H_SAE	O/V	0... FFFFH	0... 655350	10	kPA
PID23 Fuel rail pressure ( high range for Diesel and GDI )					
LOAD_ABSV	O/V	0... FFFFH	0... 25700	0.3921569	%
Absolute load					
LOAD_CLC	O/V	0... FFH	0... 99.60937	0.390625	%
Calculated load					
OBD_EGR_DIF	O/V	0... FFH	0... 99.60937	0.390625	%
EGR actual EGR commanded					
OBD_FTL	O/V	0... FFH	0... 99.60937	0.390625	%
Fuel level input					
OBD_PV_1	O/V	0... FFH	0... 99.60937	0.390625	%
Accelerator pedal position (sensor 1)					
OBD_PV_2	O/V	0... FFH	0... 99.60937	0.390625	%
Accelerator pedal position (sensor 2)					
OBD_TPS_1	O/V	0... FFH	0... 99.60937	0.390625	%
Absolute throttle position (sensor 1)					
OBD_TPS_2	O/V	0... FFH	0... 99.60937	0.390625	%
Absolute throttle position (sensor 2)					
OBD_TPS_REL	O/V	0... FFH	0... 99.60937	0.390625	%
Relative throttle position					
OBD_TPS_SP	O/V	0... FFH	0... 99.60937	0.390625	%
Commanded throttle position					

### Input data:

AMP {p. 982}	C_TPS_MAX {p. 1170}	C_TPS_SP_MAX {p. 6555}	CPPWM_CPS {p. 3749}
DIST {p. 1183}	DIST_KWP {p. 1183}	ERR_SYM_XX {p. 4581}	FAC_LAM_AD_SAE [NC_CBK_EX_NR] {p. 1014}
FAC_LAM_LIM_SAE [NC_CBK_EX_NR] {p. 1014}	FTL {p. 1564}	FUP_MES_SAE [NC_CBK_HPP_NR]	FUP_RNG_H_MES {p. 1283}
FUP_SP_SAE [NC_CBK_HPP_NR]	LAMB_DELTA_AD_LAM_ ADJ_SAE [NC_CBK_EX_NR] {p. 1014}	LAMB_SP_SAE {p. 1015}	LV_ERR_MAF {p. 4815}

LV_ERR_MAP {p. 982}	LV_ES {p. 1720}	MAF {p. 8277}	MAF_KGH_MES_SAE [NC_MAF_NR]
MAP_SAE {p. 1198}	N_32 {p. 1525}	N_SAE_BYTE_KWP {p. 7308}	NC_CYL_NR {p. 1526}
NC_ENVD_CUS_CMN_UPD {p. 5793}	NC_ID_ENVD_FAC {p. 5793}	NC_INJ_CONF {p. 626}	NC_NR_ENVD_CUS_CMN {p. 5793}
NC_NR_ENVD_CUS_SET_CMN {p. 5793}	NC_NR_ENVD_CUS_SET_SPC {p. 5793}	NC_NR_ENVD_PREV {p. 5793}	NC_NR_FRF_SET {p. 5793}
OBD_AMP {p. 7308}	OBD_FUP	OBD_IGA_IGC {p. 7308}	OBD_MAF {p. 7308}
OBD_N {p. 7308}	OBD_TAM {p. 1569}	OBD_TCO {p. 7308}	OBD_TIA {p. 7308}
OBD_VB {p. 7309}	OPG_DIF_ACR {p. 3580}	OPG_SP_ACR {p. 3573}	STATE_LS_SAE [NC_CBK_EX_NR] {p. 2448}
STATE_OBD_SA {p. 808}	STATE_PSN_FUP_SAE {p. 819}	STATE_PSN_MAF_SAE {p. 819}	STATE_PSN_TIA_SAE {p. 819}
STATE_PSN_TPS_SAE {p. 819}	T_ABSV_COM	T_AST_SAE {p. 1766}	TIA_MES_SAE [NC_SENS_NR_TIA]
TIA_THR_MES_SAE [NC_SENS_NR_TIA_THR]	TPS_AV {p. 1169}	TPS_REL_SAE [NC_ETC_NR]	TPS_SP_MDL {p. 8377}
TPS_SP_SAE [NC_ETC_NR]	USE_SW_VER {p. 605}	V_PVS_1 {p. 831}	V_PVS_2 {p. 831}
V_TPS_1 {p. 831}	V_TPS_2 {p. 831}	VS_SAE {p. 1176}	


**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FTL_REF_OBD	-	0... 7EH	0... 126	1	l
Maximum possible FTL in the vehicle					
C_MAF_REF_OBD	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Maximum air mass concerning cylinder displacement					
IP_LOAD_CLC_N_32_MAF	V	0... FFH	0... 0.99609	3.9062e-3	-
LDP_N_32_IP_LOAD_CLC	8	0... FFH	0... 8160	32	rpm
LDP_MAF_IP_LOAD_CLC	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Airflow ratio					
IP_LOAD_CLC_AMP_AMP	-	0... FFH	0... 1.99218	0.0078125	-
LDP_AMP_IP_LOAD_CLC_AMP	6	0... FFFFH	0... 5434	0.0829175	hPa
Atmospheric pressure ratio					

**B.74.1 Definition of OBD freeze frame content and size****Description:**

This file defines sizes and contents of Environmental data (freeze frame data) caught when a failure occurs.

**Formula section:**

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Freeze frame part	Characteristics	Value
FRF_OBD	Number of data (in bytes)	<b>NC_NR_ENVD_OBD = 40 if NC_CYL_NR = 4 or 6</b> <b>NC_NR_ENVD_OBD = 64 if NC_CYL_NR = 8</b> "= 40/64 OBD values, stored once, updated if failure was disappeared and occurs again"
	Contents	ENVD_CONF_OBD[1] = STATE_LS_SAE_1 <b>(PID 03) Fuel system status bank 1</b>
		ENVD_CONF_OBD[2] = STATE_LS_SAE_2 <b>(PID 03) Fuel system status bank 2</b>
		ENVD_CONF_OBD[3] = LOAD_CLC <b>(PID 04) Calculated load</b>
		ENVD_CONF_OBD[4] = OBD_TCO <b>(PID 05) Engine coolant temperature</b>
		ENVD_CONF_OBD[5] = FAC_LAM_LIM_SAE_1 <b>(PID 06) Short term fuel trim bank 1</b>
		ENVD_CONF_OBD[6] = FAC_LAM_AD_SAE_1 <b>(PID 07) Long term fuel trim bank 1</b>
		ENVD_CONF_OBD[7] = FAC_LAM_LIM_SAE_2 <b>(PID 08) Short term fuel trim bank 2</b>
		ENVD_CONF_OBD[8] = FAC_LAM_AD_SAE_2 <b>(PID 09) Long term fuel trim bank 2</b>
		ENVD_CONF_OBD[9] = OBD_FUP <b>(PID 0A) Fuel pressure</b>
		ENVD_CONF_OBD[10] = MAP_SAE <b>(PID 0B) Intake manifold absolute pressure</b>
		ENVD_CONF_OBD[11] = OBD_N <b>(PID 0C) Engine RPM (high byte)</b>
		ENVD_CONF_OBD[12] = OBD_N <b>(PID 0C) Engine RPM (low byte)</b>
		ENVD_CONF_OBD[13] = VS_SAE <b>(PID 0D) Vehicle speed</b>
		ENVD_CONF_OBD[14] = OBD_IGA_IGC <b>(PID 0E) Ignition timing advance cylinder 1</b>
		ENVD_CONF_OBD[15] = OBD_TIA <b>(PID 0F) Temperature intake air</b>
	ENVD_CONF_OBD[17] = OBD_MAF <b>(PID 10) Air flow rate mass air flow sensor (low byte)</b>	

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	ENVD_CONF_OBD[18] = OBD_TPS_1 <b>(PID 11)</b> Absolute Throttle position ( signal 1)
	ENVD_CONF_OBD[19] = STATE_OBD_SA <b>(PID 12)</b> Commanded secondary air status
	ENVD_CONF_OBD[20] = T_AST_SAE <b>(PID 1F)</b> Time since engine start (high byte)
	ENVD_CONF_OBD[21] = T_AST_SAE <b>(PID 1F)</b> Time since engine start (low byte)
	ENVD_CONF_OBD[22] = FUP_H_SAE <b>(PID 23)</b> Fuel Pressure High (high byte)
	ENVD_CONF_OBD[23] = FUP_H_SAE <b>(PID 23)</b> Fuel Pressure High (low byte)
	ENVD_CONF_OBD[24] = CPPWM_CPS <b>(PID 2E)</b> Commanded Evaporative Purge
	ENVD_CONF_OBD[25] = OBD_FTL <b>(PID 2F)</b> Fuel level input
	ENVD_CONF_OBD[26] = OBD_AMP <b>(PID 33)</b> Barometric pressure
	ENVD_CONF_OBD[27] = OBD_VB <b>(PID 42)</b> Control module voltage (high byte)
	ENVD_CONF_OBD[28] = OBD_VB <b>(PID 42)</b> Control module voltage (low byte)
	ENVD_CONF_OBD[29] = LOAD_ABSV <b>(PID 43)</b> Absolute load value (high byte)
	ENVD_CONF_OBD[30] = LOAD_ABSV <b>(PID 43)</b> Absolute load value (low byte)
	ENVD_CONF_OBD[31] = LAMB_SP_SAE <b>(PID 44)</b> Commanded equivalence ratio (high byte)
	ENVD_CONF_OBD[32] = LAMB_SP_SAE <b>(PID 44)</b> Commanded equivalence ratio (low byte)
	ENVD_CONF_OBD[33] = OBD_TPS_REL <b>(PID 45)</b> Relative Throttle position
	ENVD_CONF_OBD[34] = OBD_TAM <b>(PID 46)</b> Ambient air temperature
	ENVD_CONF_OBD[35] = OBD_TPS_2 <b>(PID 47)</b> Absolute throttle position (sensor 2)
	ENVD_CONF_OBD[36] = OBD_PV_1 <b>(PID 49)</b> Acceleration pedal position ( sensor 1)
	ENVD_CONF_OBD[37] = OBD_PV_2 <b>(PID 4A)</b> Acceleration pedal position ( sensor 2)

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	ENVD_CONF_OBD[38] = OBD_TPS_SP <b>(PID 4C)</b> Commanded throttle position
	ENVD_CONF_OBD[39] = LAMB_DELTA_AD_LAM_ADJ_SAE[1] <b>(PID 56)</b> Long term fuel trim - bank 1
	ENVD_CONF_OBD[40] = LAMB_DELTA_AD_LAM_ADJ_SAE[2] <b>(PID 58)</b> Long term fuel trim - bank 2
	ENVD_CONF_OBD[41] = STATE_PSN_MAF_SAE <b>(PID 66)</b> Mass air flow sensor - Support status
	ENVD_CONF_OBD[42] = MAF_KGH_MES_SAE[1] <b>(PID 66)</b> Mass air flow - sensor 1 (high-byte)
	ENVD_CONF_OBD[43] = MAF_KGH_MES_SAE[1] <b>(PID 66)</b> Mass air flow - sensor 1 (low-byte)
	ENVD_CONF_OBD[44] = MAF_KGH_MES_SAE[2] <b>(PID 66)</b> Mass air flow - sensor 2 (high-byte)
	ENVD_CONF_OBD[45] = MAF_KGH_MES_SAE[2] <b>(PID 66)</b> Mass air flow - sensor 2 (low-byte)
	ENVD_CONF_OBD[46] = STATE_PSN_TIA_SAE <b>(PID 68)</b> Intake air temperature - Support status
	ENVD_CONF_OBD[47] = TIA_MES_SAE[1] <b>(PID 68)</b> Intake air temperature - B1S1
	ENVD_CONF_OBD[48] = TIA_THR_MES_SAE[1] <b>(PID 68)</b> Intake air temperature - B1S2
	ENVD_CONF_OBD[49] = TIA_MES_SAE[2] <b>(PID 68)</b> Intake air temperature - B2S1
	ENVD_CONF_OBD[50] = TIA_THR_MES_SAE[1] <b>(PID 68)</b> Intake air temperature - B2S2
	ENVD_CONF_OBD[51] = STATE_PSN_TPS_SAE <b>(PID 6C)</b> Throttle - Support status

	<p>ENV_D_CONF_OBD[52] = TPS_SP_SAE[1] <b>(PID 6C) Throttle - Commanded THR 1</b></p>
	<p>ENV_D_CONF_OBD[53] = TPS_REL_SAE[1] <b>(PID 6C) Throttle - Rel. Position THR 1</b></p>
	<p>ENV_D_CONF_OBD[54] = TPS_SP_SAE[2] <b>(PID 6C) Throttle - Commanded THR 2</b></p>
	<p>ENV_D_CONF_OBD[55] = TPS_REL_SAE[2] <b>(PID 6C) Throttle - Rel. Position THR 2</b></p>
	<p>ENV_D_CONF_OBD[56] = STATE_PSN_FUP_SAE <b>(PID 6D) Fuel pressure - Support status</b></p>
	<p>ENV_D_CONF_OBD[57] = FUP_SP_SAE[1] <b>(PID 6D) Fuel pressure - Commanded B1 (high byte)</b></p>
	<p>ENV_D_CONF_OBD[58] = FUP_SP_SAE[1] <b>(PID 6D) Fuel pressure - Commanded B1 (low byte)</b></p>
	<p>ENV_D_CONF_OBD[59] = FUP_MES_SAE[1] <b>(PID 6D) Fuel pressure - Measured B1 (high byte)</b></p>
	<p>ENV_D_CONF_OBD[60] = FUP_MES_SAE[1] <b>(PID 6D) Fuel pressure - Measured B1 (low byte)</b></p>
	<p>ENV_D_CONF_OBD[61] = FUP_SP_SAE[2] <b>(PID 6D) Fuel pressure - Commanded B2 (high byte)</b></p>
	<p>ENV_D_CONF_OBD[62] = FUP_SP_SAE[2] <b>(PID 6D) Fuel pressure - Commanded B2 (low byte)</b></p>
	<p>ENV_D_CONF_OBD[63] = FUP_MES_SAE[2] <b>(PID 6D) Fuel pressure - Measured B2 (high byte)</b></p>
	<p>ENV_D_CONF_OBD[64] = FUP_MES_SAE[2] <b>(PID 6D) Fuel pressure - Measured B2 (low byte)</b></p>

Freeze frame part	Characteristics	Value
FRF_CUS_CMN	Number of data (in bytes)	<b>NC_NR_ENVD_CUS_CMN = 1</b> “= One common value for each diagnosis, stored at same event like FRF_OBD”
	Contents	ENVD_CONF_CUS_CMN[1] = N_SAE_BYTE_KWP Engine Speed (SAE resolution)
“Set of Freeze Frame”	Number of set	<b>NC_NR_FRF_SET = 3</b> “= First, second, last occurrence”
FRF_CUS_SET_CMN	Number of common data per set (in bytes)	<b>NC_NR_ENVD_CUS_SET_CMN = 10</b> “= ten common values for all diagnosis, stored at every occurrence”
	Contents	ENVD_CONF_CUS_SET_CMN[1] = ERR_SYM_XX Detected symptom
		ENVD_CONF_CUS_SET_CMN[2] = DIST_KWP Calculated Km counter [8km] (high-byte)
		ENVD_CONF_CUS_SET_CMN[3] = DIST_KWP Calculated Km counter [8km] (low-byte)
		ENVD_CONF_CUS_SET_CMN[4] = T_ABSV_COM Absolute lifetime of vehicle [1s] (byte 1 - MSB) //only L6
	ENVD_CONF_CUS_SET_CMN[5] = T_ABSV_COM Absolute lifetime of vehicle [1s] (byte 2) //only L6	
	ENVD_CONF_CUS_SET_CMN[6] = T_ABSV_COM Absolute lifetime of vehicle [1s] (byte 3) //only L6	
	ENVD_CONF_CUS_SET_CMN[7] = T_ABSV_COM Absolute lifetime of vehicle [1s] (byte 4 - LSB) //only L6	
	ENVD_CONF_CUS_SET_CMN[8] = DIST_KM Kilometer counter [1km resolution] (byte 1 -MSB) //only L6	

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		ENVD_CONF_CUS_SET_CMN[9] = DIST_KM Kilometer counter [1km resolution] (byte 2) //only L6
		ENVD_CONF_CUS_SET_CMN[10] = DIST_KM Kilometer counter [1km resolution] (byte 3) //only L6
FRF_CUS_SET_SPC	Number of specific data per set (in bytes)	<b>NC_NR_ENVD_CUS_SET_SPC = 4</b> " = 4 calibratable environmental data per failure"
	Contents	Define by calibration ID_ERR_ENVD_XX (see Environmental data module) Possible stored environmental data : NC_ID_ENVD_FAC [1] = see DDLI list NC_ID_ENVD_FAC [2] = see DDLI list ... NC_ID_ENVD_FAC [255] = see DDLI list

## B.74.2 Configuration of update of FRF\_CUS\_CMN

### FUNCTION DESCRIPTION:

#### Description:

This file defines the update of the FRF\_CUS\_CMN in case of failure status change from disappeared to temporary/confirmed.

<b>Update of FRF_CUS_CMN in case of failure status change from disappeared to temporary/confirmed.</b>	<b>NC_ENVD_CUS_CMN_UPD = 1</b> 0: no update 1: update
--	---

## B.74.3 Configuration for prestored freeze frame

### FUNCTION DESCRIPTION:

#### Description:

This file defines the usage of the prestored freeze frame functionality.



Number of diagnosis instances XX using prestored freeze frame	NC_NR_ENVD_PREV = 7 or 8 or 10, see below
Diagnosis instance XX	prestored freeze frame number (t)
ROUGH_LEAK	1
CAT_DIAG[1]	2 (If NC_INJ_CONF = 1) //only for MSD
CAT_DIAG[2]	3 (If NC_INJ_CONF = 1) //only for MSD
EFF_IGA_CST_IS	4
EFF_IGA_CST_PL	5
SMALL_LEAK	6
DMTL_PLAUS	7
DMTL_SIG	8 (If USE_SW_VER <> NC_4DC ) //not for MSD 81.0
DMTL_MIN	9 (If USE_SW_VER <> NC_4DC ) //not for MSD 81.0
DMTL_MAX	10 (If USE_SW_VER <> NC_4DC ) //not for MSD 81.0

**Remark:** The usage of the prestored freeze frame functionality must be limited for special diagnosis functions, because of memory consumption.

NC\_NR\_ENVD\_PREV = 7 for MSD81.0, NC\_NR\_ENVD\_PREV = 8 for MSVxx

## B.74.4 Definition of OBD - Systemvariables for MODE 1 /2

### General information:

The variables are used for OBD powertrain diagnostic data (MODE1) and OBD Freeze-frame calculation (MODE 2).

### Application conditions

**Initialisation:**            0 at reset  
**Recurrence:**                100ms  
**Activation:**                at every engine operating state

### Formula section:

All calculation done in physical way

```


IF      LV_ES = 1 OR
        LV_ERR_MAF= 1 OR
        LV_ERR_MAP = 1
THEN   LOAD_CLC = 0
        LOAD_ABSV = 0
ELSE   LOAD_CLC = IP_LOAD_CLC__N_32_MAF*IP_LOAD_CLC_AMP__AMP*100%
        LOAD_ABSV = (MAF /C_MAF_REF_OBD) * 100%
ENDIF

```

OBD\_TPS\_SP     = (TPS\_SP\_MDL /C\_TPS\_SP\_MAX) \* 100%

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OBD\_TPS\_1 =  $(V\_TPS\_1 / 5V) * 100\%$   
 OBD\_TPS\_2 =  $((5V - V\_TPS\_2) / 5V) * 100\%$   
 OBD\_TPS\_REL =  $(TPS\_AV / C\_TPS\_MAX) 100\%$   
 OBD\_FTL =  $(FTL / C\_FTL\_REF\_OBD) * 100\%$   
 OBD\_PV\_1 =  $(V\_PVS\_1 / 5V) * 100\%$   
 OBD\_PV\_2 =  $(V\_PVS\_2 / 2,5V) * 100\%$   
 OBD\_EGR\_DIF =  $I\_OPG\_DIF\_ACR / OPG\_SP\_ACR I * 100\%$   
 FUP\_H\_SAE = FUP\_RNG\_H\_MES

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## B.75 Failure classes

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DC_DEC_XX	O	0... FFH	0... 255	1	-
Decrement of the driving cycle counter for failure XX					
CTR_DC_INC_XX	O	0... FFH	0... 255	1	-
Increment of the driving cycle counter for failure XX					
CTR_DC_MAX_XX	O	0... FFH	0... 255	1	-
Maximum value of the driving cycle counter for failure XX					
PRI_CONF_XX	O	0... 7H	0 ...7	1	-
Priority configuration for failure XX					
WAL_CONF_XX	O	0... FFH	0... 255	1	-
Lamp configuration for failure XX					

### Input data:

NLC_OBD_DSL {p. 5789}			
-----------------------	--	--	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ERR_CLAS_2_XX	-	0... FFH	0... 255	1	-
Second Failure class number for failure XX					
C_ERR_CLAS_XX	-	0... FFH	0... 255	1	-
Failure class number for failure XX					
ID_ERR_CLAS_A_FMT	-	0... FFH	0... 255	1	-
LDPM_CLAS_A_ID_CLAS_FMY	16	0... FFFFH	0... 65535	1	-
Sub Class A definition					
ID_ERR_CLAS_B_FMT	V	0... FFH	0... 255	1	-
LDP_CLAS_B_ID_CLAS_FMY	4	0... FFFFH	0... 65535	1	-
LDPM_CLAS_A_ID_CLAS_FMY	16	0... FFFFH	0... 65535	1	-
Sub Class B definition					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ERR_PRI_H	-	0... 7H	0 ...7	1	-
Failures with priority greater or equal than NC_ERR_PRI_H are considered as high priority failures					

### Action definition

<b>ACTION_ERRM_GetMILRelevant</b> (IN<PRM_IDX_ERR>,OUT<PRM_LV_MIL_RLV>)	Mode: O
This action is used to know if the failure is MIL relevant or not	

<b>ACTION_ERRM_GetOBDRelevant</b> (IN<PRM_IDX_ERR>,OUT<PRM_LV_OBD_RLV>)	Mode: O
This action is used to know if the failure is OBD relevant or not (visible via scantools or not)	

<b>ACTION_ERRM_GetReadyClass</b> (IN<PRM_IDX_ERR>,OUT<PRM_READY_CLAS>)	Mode: O
This action returns the readiness code group	

**FUNCTION DESCRIPTION:**

**General information:**

Because the diagnosis system becomes more and more complex, to avoid multiplication of calibrations and to help the tuning team for simplifying the calibration process, each failure is defined via classes of failure.

Each class defines the type of this failure as emission relevant or not, as MIL handling or not, as using driving cycle for MIL illumination, and so on. It allows too to affect a readiness code group for each failure.

The configuration of a failure is defined by WAL\_CONF\_XX, PRI\_CONF\_XX, CTR\_DC\_INC\_XX, CTR\_DC\_DEC\_XX and CTR\_DC\_MAX\_XX.

Format of WAL_CONF_XX		
Bit	Logical value	Description
0	LC_WAL_1_ON	Enable WAL_1 (0 : Off / 1 : On) See details in "Lamp management" module.
1	LC_WAL_2_ON	Enable WAL_2 (0 : Off / 1 : On) See details in "Lamp management" module.
2	LC_MIL_ON	Enable MIL (0 : Off / 1 : On) See details in "Lamp management" module.
3	LC_MIL_FLL	Enable flash mode for MIL (0 : Off / 1 : On) See details in "Lamp management" module.
4	LC_OBD_ERR	Defines failure as a "CARB/EOBD failure" (emission relevant). (failure visible via scantool) 0 : failure is <u>not</u> considered as a "CARB/EOBD failure" 1 : failure is considered as a "CARB/EOBD failure"

Figure B.75.1: Format of PRI\_CONF\_XX

Format of PRI_CONF_XX		
Bit	Logical value	Description
0	LC_ERR_PRI_1	This option defines the priority of the XX diagnosis. It is used for storage of failure and freeze frame. 000: lowest priority for errors which are not significant for emission 011: highest priority for errors, which are not significant for emission 100: lowest priority for errors, which are significant for emission 111: highest priority which are significant for emission See details in "Priority rules" module.  For emission relevant (EOBD, CARB) failure : LC_ERR_PRI_3 = 1 For non emission relevant failure : LC_ERR_PRI_3 = 0
1	LC_ERR_PRI_2	
2	LC_ERR_PRI_3	

**B.75.1 Failure assignation**

For each failure XX, a failure class is allocated. The failure class number makes this affectation, which are the calibrations named C\_ERR\_CLAS\_XX and C\_ERR\_CLAS\_2\_XX.

**(The calibration C\_ERR\_CLAS\_2\_XX is present inside the SW but "hard coded" and not visible in INCA)**

This table is defined in the General Diagnosis Information .

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Diagnosis instance	Failure Class number Class A / Class B / Class C
Failure XX	C_ERR_CLAS_XX / C_ERR_CLAS_2_XX
Failure YY	C_ERR_CLAS_YY / C_ERR_CLAS_2_YY
...	...

The failure class number is a byte divided in two subclasses named class B (defined by the most significant quartet) and class A (defined by the less significant quartet).

Failure class number for failure XX

C\_ERR\_CLAS\_XX = 

--	--	--	--	--	--	--	--

### (Class B) (Class A)

C\_ERR\_CLAS\_2\_XX =

Reserved				Class C			

## B.75.2 Failure class definition

A failure class defines for a failure, which belongs to this failure class :

### Part sub-class A :

- if the failure have impact on MIL illumination or not ;
- if the failure have impact on MIL blinking or not ;
- if the failure have impact on Warning Lamp 1 or not ;
- if the failure have impact on Warning lamp 2 or not ;
- if the failure is considered as a CARB/EOBD failure (emission relevant)

(failure visible with scantool, failure can set OBD freeze frame for mode 2h)

### Part sub-class B :

- the increment value for driving cycle counter management ;
- the maximum value of driving cycle counter ;
- the decrement value for driving cycle counter management ;
- the priority of the failure.

### Part sub-class C :

- Readiness code group.

Each subclass of a failure class is composed of 4 bits, so 16 different values are possible for each subclass. For each subclass, some values are predefined and some values are reserved for improvement/validation and are managed by calibration.

### Sub Class A definition : ID\_ERR\_CLAS\_A\_FMT (1 byte x 16)

Subclass A Value (i) in hex / Name	Description	ID_ERR_CLAS_A_FMT [i]
0 / NO_LAMP	- <i>Predefined value</i> - Failure without impact on any lamp	%0000 0000 (in binary)
1 / WAL_1_ON	- <i>Predefined value</i> - Failure with impact on WAL1 lamp	%0000 0001 (in binary)
2 / WAL_2_ON	- <i>Predefined value</i> - Failure with impact on WAL2 lamp	%0000 0010 (in binary)
3 / MIL_ON	- <i>Predefined value</i> - Failure with impact on Mil (on)	%0001 0100 (in binary)
4 / MIL_ON_FLL	- <i>Predefined value</i> - Failure with impact on Mil (on & blinking)	%0001 1100 (in binary)
5 / LAMP_CUS_1	<i>Free for customer definition</i>	<i>Free for customer definition</i>
6 / LAMP_CUS_2	<i>Free for customer definition</i>	<i>Free for customer definition</i>
7 / LAMP_CUS_3	<i>Free for customer definition</i>	<i>Free for customer definition</i>
8 / LAMP_CUS_4	<i>Free for customer definition</i>	<i>Free for customer definition</i>
9 / LAMP_CUS_5	<i>Free for customer definition</i>	<i>Free for customer definition</i>
A / LAMP_CUS_6	<i>Free for customer definition</i>	<i>Free for customer definition</i>
B / LAMP_CUS_7	<i>Free for customer definition</i>	<i>Free for customer definition</i>
C / LAMP_CUS_8	<i>Free for customer definition</i>	<i>Free for customer definition</i>
D / LAMP_CUS_9	<i>Free for customer definition</i>	<i>Free for customer definition</i>
E / LAMP_CUS_10	<i>Free for customer definition</i>	<i>Free for customer definition</i>
F / LAMP_CUS_11	<i>Free for customer definition</i>	<i>Free for customer definition</i>

### Formula section:

For each failure XX allocated to the failure class number C\_ERR\_CLAS\_XX :

WAL\_CONF\_XX = ID\_ERR\_CLAS\_A\_FMT [ 4 Less Significant Bit of C\_ERR\_CLAS\_XX ]

### Sub Class B definition : ID\_ERR\_CLAS\_B\_FMT (4 bytes x 16)

Subclass B Value (i) in hex/ Name	Description	ID_ERR_CLAS_B_FMT			
		[i] [0] DC inc	[i] [1] DC max	[i] [2] DC dec	[i] [3] Priority
0 / NO_LAW_L	- Predefined value - Non Carb/EOBD failure with low priority	1	1	1	0
1 / NO_LAW_M	- Predefined value - Non Carb/EOBD failure with medium priority	1	1	1	1
2 / NO_LAW_H	- Predefined value - Non Carb/EOBD failure with high priority	1	1	1	2
3 / LAW_CC_L	- Predefined value - Carb/EOBD failure with low priority Comprehensive component	3	3	1	4
4 / LAW_L	- Predefined value - Carb/EOBD failure with low priority	3 / 2 *)	6	2	4
5 / LAW_M	- Predefined value - Carb/EOBD failure with medium priority	3 / 2 *)	6	2	5
6 / LAW_H	- Predefined value - Carb/EOBD failure with high priority	3 / 2 *)	6	2	6
7 / VALID	For validation	1	1	1	4
8 / NO_ERASE	- Predefined value - failure with high priority, not erasable by warm-up cycles.	3	3	0	6
9 / DC_CUS_1	Free for customer definition	-	-	-	-
A / DC_CUS_2	Free for customer definition	-	-	-	-
B / DC_CUS_3	Free for customer definition	-	-	-	-
C / DC_CUS_4	Free for customer definition	-	-	-	-
D / DC_CUS_5	Free for customer definition	-	-	-	-
E / DC_CUS_6	Free for customer definition	-	-	-	-
F / DC_CUS_7	Free for customer definition	-	-	-	-

### Formula section:

For each failure XX allocated to the failure class number C\_ERR\_CLAS\_XX :

CTR\_DC\_INC\_XX = ID\_ERR\_CLAS\_B\_FMT[4 Most Significant Bit of C\_ERR\_CLAS\_XX][0]

CTR\_DC\_MAX\_XX = ID\_ERR\_CLAS\_B\_FMT[4 Most Significant Bit of C\_ERR\_CLAS\_XX][1]

CTR\_DC\_DEC\_XX = ID\_ERR\_CLAS\_B\_FMT[4 Most Significant Bit of C\_ERR\_CLAS\_XX][2]

Bit 0,1,2 of PRI\_CONF\_XX = ID\_ERR\_CLAS\_B\_FMT [4 Most Significant Bit of C\_ERR\_CLAS\_XX][3]

**Remark:** The increment of the DC counter (\*) for the failures defined by the failure classes LAW\_L, LAW\_M and LAW\_H depends on the required regulation (Carb/EOBD).

### Sub Class C definition :

Value in hex	Name for GS (NLC_OBD_DSL = 0 for gasoline)	Name for DS (NLC_OBD_DSL = 1 for diesel)	Readiness code group description for GS	Readiness code group description for DS
0	CARB_MIS	CARB_MIS	Misfire	Misfire
1	CARB_FSD	CARB_FSD	Fuel system	Fuel system
2	CARB_CC	CARB_CC	Comprehensive component	Comprehensive component
3	CARB_CAT	CARB_NMHC	Catalyst	NMHC Catalyst
4	CARB_HC	CARB_NT	Heated catalyst	NOx Catalyst / Adsorber
5	CARB_EVAP	Reserved	Evaporative	Reserved
6	CARB_SA	CARB_BPA	Secondary air	Boost Pressure
7	-	-	(reserved by ISO)	(reserved by ISO)
8	CARB_LS	CARB_EG	Oxygen sensor	Exhaust gas sensor
9	CARB_LSH	CARB_PF	Oxygen sensor heater	PM filter
A	CARB_EGR	CARB_EGR	EGR system	EGR system
B	CARB_OTHER	CARB_OTHER	Customer specific readiness	Customer specific readiness
C	NO	NO	No readiness computation	No readiness computation
D	-	-	Reserved	Reserved
E	-	-	Reserved	Reserved
F	-	-	Reserved	Reserved

### B.75.3 Example

To define the failure MIS\_A (Misfiring A) as :

- a failure with high priority
- with only impact on MIL (On and Blinking)
- with CARB\_MIS readiness class

Set the failure MIS\_A in class number 64 (in hex) with C\_ERR\_CLAS\_MIS\_A = 64H and C\_ERR\_CLAS\_2\_MIS\_A = 00H

That means :

- The value of sub class A is 4H => Failure with impact on MIL (On and blinking)  
(failure visible via scantool):

WAL\_CONF\_MIS\_A = %0001 1100 (in binary)

- The value of sub class B is 6H => "Carb/EOBD failure with high priority":

DC\_INC\_MIS\_A = 3

DC\_MAX\_MIS\_A = 6

DC\_DEC\_MIS\_A = 2

PRI\_CONF\_MIS\_A = %0000 0110 (in binary)

- The value of sub class C is 0H => The value of sub class C is 0 ;

The readiness code group of the failure is "MIS" group (Misfire monitoring system)

### B.75.4 MIL relevant

#### Description for actions:

ACTION_ERRM_GetMILRelevant (<PRM_IDX_ERR >, <PRM_LV_MIL_RLV>)					
- This actions returns: 0 if the failure is not MIL relevant 1 if the failure is MIL relevant					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_IDX_ERR	IN	0...FFFFH	0...65535	1	[-]
Diagnostic failure instance					
PRM_LV_MIL_RLV	OUT	0...1H	0...1	1	[-]
Mil relevant failure					



**Formula section:**

```

PRM_LV_MIL_RLV = 0
if      PRM_IDX_ERR != 0
Then
    MIL relevant means enable MIL or enable flash mode for MIL and CARB/EOBD failure (visible via
    scantool)
    if   (bit 2 or bit 3 of WAL_CONF_XX = 1) and bit 4 of WAL_CONF_XX = 1
    Then PRM_LV_MIL_RLV = 1
    Endif
Endif
    
```

**B.75.5 OBD relevant**

**Description for actions:**

<b>ACTION_ERRM_GetOBDDRelevant (&lt;PRM_IDX_ERR &gt;, &lt;PRM_LV_OBD_RLV&gt;)</b>					
- This actions returns: 0 if the failure is not OBD relevant (failure not visible via scantool) 1 if the failure is OBD relevant (failure visible via scantool)					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_IDX_ERR	IN	0...FFFFH	0...65535	1	[-]
Diagnostic failure instance					
PRM_LV_OBD_RLV	OUT	0...1H	0...1	1	[-]
OBD relevant failure (failure visible via scantool)					

**Formula section:**

```

PRM_LV_OBD_RLV = 0
if      PRM_IDX_ERR != 0
Then
    OBD relevant means CARB/EOBD failure (failure visible via scantool)
    if   bit 4 of WAL_CONF_XX = 1
    Then PRM_LV_OBD_RLV = 1
    Endif
Endif
    
```

**B.75.6 Readiness code class**

**Description for actions:**

<b>ACTION_ERRM_GetReadyClass (&lt;PRM_IDX_ERR &gt;, &lt;PRM_READY_CLAS&gt;)</b>					
- This actions returns: The readiness code group					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_IDX_ERR	IN	0...FFFFH	0...65535	1	[-]
Diagnostic failure instance					
PRM_READY_CLAS	OUT	0...FH	0...15	1	[-]
Readiness code group					

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**Formula section:**

**If** PRM\_IDX\_ERR != 0

**Then**


Readiness code group for the failure IDX\_ERR

PRM\_READY\_CLAS = Bit 0,1,2,3 of C\_ERR\_CLAS\_2\_XX

**Else**

PRM\_READY\_CLAS = 0Fh

**Endif**

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## B.76 Failure classes (Appl. Inc.)

### B.76.1 Readiness class affectation

#### General information:

In this section, the calibrations C\_ERR\_CLAS\_2\_XX are "hard coded" inside the SW for this project. The list below describes how CARB class to affect for each failure.

#### Description:

For generation of the readiness-status of the OBD system in MODE 01h ( only done if the diagnosis instance is calibrated as emission relevant /visible for SCAN - tool => LC\_OBD\_ERR = 1 /C\_ERR\_CLAS\_xx , see Failure classes ) all diagnosis must be classified as:

- CARB\_CC - Comprehensive component, continuous test
- CARB\_MIS - Misfire monitoring, continuous test
- CARB\_FSD - Fuel system monitoring, continuous test
- CARB\_CAT - Catalyst monitoring, sequential test
- CARB\_EVAP - Evaporative system monitoring, sequential test
- CARB\_SA - Secondary air monitoring
- CARB\_LS - Oxygen sensor monitoring
- CARB\_LSH - Oxygen sensor heater monitoring
- CARB\_EGR - EGR /IVVT system monitoring, sequential test

#### Formula section:

All diagnosis instances are configured as **CARB\_CC**, except the list below

Diagnostic Instance Name(xx)	CARB classification for Readiness
MIS_0	CARB_MIS
MIS_1	
MIS_2	
MIS_3	
MIS_4	
MIS_5	
MIS_FTL_L	
MIS_MPL	
DELTA_I_LAM_1	CARB_FSD
DELTA_I_LAM_2	
FSD_1	
FSD_2	
FSD_LAM_LIM_1	
FSD_LAM_LIM_2	

CAT_DIAG_1	CARB_CAT
CAT_DIAG_2	
CAT_DIAG_AFL_1	
CAT_DIAG_AFL_2	
CAT_DIAG_SUM_1	
CAT_DIAG_SUM_2	
DIAGCPS	CARB_EVAP
DMTL_PUMP	
DMTLH	
DMTLS	
ROUGH_LEAK	
SMALL_LEAK	
DMTL_PLAUS	
DMTL_SIG	
DMTL_MIN	
DMTL_MAX	
not supported	CARB_SA
AIR_LSL_UP_1	CARB_LS
AIR_LSL_UP_2	
CHK_LS_DOWN_1	
CHK_LS_DOWN_2	
DYN_VLD_LS_UP_1	
DYN_VLD_LS_UP_2	
PUC_VLD_LS_UP_1	
PUC_VLD_LS_UP_2	
PUC_LS_DOWN_1	
PUC_LS_DOWN_2	
PUE_LS_DOWN_1	
PUE_LS_DOWN_2	
SHIFT_AFL_LSL_UP_1	
SHIFT_AFL_LSL_UP_2	
SHIFT_AFR_LSL_UP_1	
SHIFT_AFR_LSL_UP_2	
SWT_LS_DOWN_1	
SWT_LS_DOWN_2	
VLS_DOWN_DIF_1	
VLS_DOWN_DIF_2	
CHG_LS_DOWN	
OBD_LSH_DOWN_1	CARB_LSH
OBD_LSH_DOWN_2	
OBD_VLD_LSH_UP_1	
OBD_VLD_LSH_UP_2	
MEC_IVT_IN	CARB_EGR
MEC_IVT_EX	
TOOTH_OFF_IN_1	
TOOTH_OFF_EX_1	
REF_CRK_CAM_IN_1	
REF_CRK_CAM_EX_1	

## B.77 History memory

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ERR_HIS_NR	O/V/S	0... FFH	0... 255	1	-
Number of failures stored in the history memory					
ERR_HIS [NC_NR_ERR_HIS] [NC_NR_HIS]	O/V/S	0... FFH	0... 255	1	-
Array for data to be stored in history memory					
ERR_HIS_DTC [NC_NR_ERR_HIS]	O/V/S	0... FFFFH	0... 65535	1	-
DTC of failure in history memory					

### Input data:

ERR_DTC [NC_NR_ERR_DYN] {p. 5756}	ERR_HIS_CONF [NC_NR_HIS] {p. 5825}		
---	---------------------------------------	--	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_ERR_FMY_HIS_CLR	V	0... 1H	0 ...1	1	-
Calibration to clear the history memory (when set to 1)					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_ERR_HIS	-	0... FFH	0... 255	1	-
Max number of failure in the historic memory					
NC_NR_HIS	-	0... FFH	0... 255	1	-
Max number of data (in bytes) to stored for a failure in the historic memory					

### General information

### Export actions:

ACTION_ERRM_StoreHistory (IN <IDX>)
This action stores the failure IDX in the history memory

### Output data detailed description:

ERR\_HIS\_DTC[NC\_NR\_ERR\_HIS] array counts NC\_NR\_ERR\_HIS elements (1... NC\_NR\_ERR\_HIS).

ERR\_HIS[NC\_NR\_ERR\_HIS][NC\_NR\_HIS] array counts NC\_NR\_ERR\_HIS x NC\_NR\_HIS elements (1... NC\_NR\_ERR\_HIS, 1... NC\_NR\_HIS).

### B.77.1 History memory

### General information:

This module is called by the dynamic error management module just before erasing a failure in the 2<sup>nd</sup> layer memory (dynamic memory).

The principle is to copy some data related to this failure in a separate memory, called history memory. So the failure become historic failure.

The number of historic failure is limited to a maximum of NC\_NR\_ERR\_HIS. When this maximum number is reach, new historic failure entry deletes the oldest historic failure in memory ("first in first out" principle).

History memory is defined by :

- ERR\_HIS\_DTC[x]           with :   x = index of failure in history memory

A DTC number related to the failure.

- ERR\_HIS[x][y]           with :   x = index of failure in history memory  
                                  y = index of data stored for failure x in history memory

Some others data.

Contents of history memory is the same for each failure and defined in History memory (Appl. Inc.) module.

The history memory can be read and erased separately by dedicated diagnosis tool service.

The history memory can be deleted by setting the calibration LC\_ERR\_FMY\_HIS\_CLR to 1.

**Application conditions:**

**Initialisation:**           —

**Activation:**             —

**Deactivation:**          —

**Recurrence:**           —

**Function description:**

**Formula section:**


**B.77.2 Store a failure in history memory**

**General information:**

**Description:**

**Syntax :**                   ACTION\_ERRM\_StoreHistory (IN <IDX>)

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Parameter (in) :    IDX    Index of failure to store in history memory

Parameter(out) :    -

Short description : This action stores a failure in history memory

**Application conditions:**

**Initialisation:**            after system initialization the history memory is restored from non-volatile memory or in case of a damaged non volatile memory the history memory is initialized with zero

**Activation:**                at action request

**Deactivation:**             -

**Recurrence:**              -

**Function description:**

**Formula section:**

```

If     CTR_ERR_HIS_NR < NC_NR_ERR_HIS
Then   CTR_ERR_HIS_NR = CTR_ERR_HIS_NR + 1
Else   ERR_HIS_DTC[x] = ERR_HIS_DTC[x+1] ("first in first out" principle)
          ERR_HIS[x][y] = ERR_HIS[x+1][y]    (with x = 1..CTR_ERR_HIS_NR-1, y
                                                  = 1..NC_NR_HIS)

Endif
ERR_HIS_DTC[x] = ERR_DTC[IDX]
ERR_HIS[x][y] = ERR_HIS_CONF[y]
(with x = 1.. NC_NR_HIS, y = CTR_ERR_HIS_NR)

```

**B.77.3 Clear the History Memory**

**General information:**

The history memory can be erased by setting the calibration bit LC\_ERR\_FMY\_HIS\_CLR at 1

**Application conditions:**


**Initialisation:**            after system initialization the history memory is restored from non-volatile memory or in case of a damaged non volatile memory the history memory is initialized with zero

**Activation:**                at LC\_ERR\_FMY\_HIS\_CLR 0→1 transition

**Deactivation:**             -


**Recurrence:**              -

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**Function description:****Formula section:**

$$\begin{aligned} \text{ERR\_HIS\_DTC}[x] &= 0 \\ \text{ERR\_HIS}[x][y] &= 0 \\ &\quad (\text{with } x = 1 \dots \text{NC\_NR\_ERR\_HIS} \\ &\quad \quad y = 1 \dots \text{NC\_NR\_HIS}) \\ \text{CTR\_ERR\_HIS\_NR} &= 0 \end{aligned}$$

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## B.78 History memory (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_HIS_CONF [NC_NR_HIS]	O	0... FFH	0... 255	1	-
Contents of history memory					

### Input data:

C_ERR_CLAS_XX {p. 5811}	CTR_FRC_IDX	ENVD_CUS_SET_CMN [NC_NR_ENVD_CUS_ SET_CMN][NC_NR_FRF_ SET][NC_NR_ERR_DYN] {p. 5792}	ERR_TYPE_BYTE_IDX
NC_NR_ERR_HIS {p. 5821}	NC_NR_HIS {p. 5821}		

### FUNCTION DESCRIPTION:

### General information:

This file defines size and contents of the History memory.

History memory	Characteristics	Value
	Max number of failure	NC_NR_ERR_HIS = 10
	Number of data to store for a failure (in bytes)	NC_NR_HIS = 9
	Contents	ERR_HIS_CONF[1] = ERR_TYPE_BYTE_IDX <i>BMW error type byte</i>
		ERR_HIS_CONF[2] = CTR_FRC_IDX <i>Frequency counter of error IDX</i>
		ERR_HIS_CONF[3] = ENVD_CUS_SET_CMN_2_1_IDX <i>Freeze frame data km-counter (high byte) 1st. occur.</i>
		ERR_HIS_CONF[4] = ENVD_CUS_SET_CMN_3_1_IDX <i>Freeze frame data km-counter (low byte) 1st. occur.</i>
		ERR_HIS_CONF[5] = ENVD_CUS_SET_CMN_2_2_IDX <i>Freeze frame data km-counter (high byte) 2st. occur.</i>
		ERR_HIS_CONF[6] = ENVD_CUS_SET_CMN_3_2_IDX <i>Freeze frame data km-counter (low byte) 2st. occur.</i>
		ERR_HIS_CONF[7] = ENVD_CUS_SET_CMN_2_3_IDX <i>Freeze frame data km-counter (high byte) last occur.</i>
		ERR_HIS_CONF[8] = ENVD_CUS_SET_CMN_3_3_IDX <i>Freeze frame data km-counter (low byte) last occur.</i>
		ERR_HIS_CONF[9] = C_ERR_CLAS_XX <i>Error class</i>

## B.79 Lamp management

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DLY_MIL_READY	V	0... FFFFH	0... 32767.5	0.5	s
Delay time to unble MIL blinking during pre-drive check mode					
LV_MIL	O/V	0... 1H	0 ...1	1	-
Boolean indicating MIL physical output (0 : off /1 : on)					
LV_MIL_FLL_READY	O/V	0... 1H	0 ...1	1	-
Boolean indicating MIL shall blink during pre-drive check mode phase 2 (0 : not blink /1 : blink)					
LV_WAL_1	O/V	0... 1H	0 ...1	1	-
Boolean indicating WAL_1 physical output (0 : off /1 : on)					
LV_WAL_2	O/V	0... 1H	0 ...1	1	-
Boolean indicating WAL_2 physical output (0 : off /1 : on)					
LV_WAL_ST	O/V	0... 1H	0 ...1	1	-
Boolean indicating Pre-drive Check mode (0 : off /1 : on)					
STATE_MIL	O/V/S	0... 2H	0 ...2	1	-
State of MIL illumination commanded by error management (ON (1), OFF (0), MIL_FLL (2))					
STATE_WAL_1	O/V/S	0... 1H	0 ...1	1	-
State of WAL_1 illumination commanded by error management (ON (1), OFF (0))					
STATE_WAL_2	O/V/S	0... 1H	0 ...1	1	-
State of WAL_2 illumination commanded by error management (ON (1), OFF (0))					
T_WAL_ST	V	0... FFH	0... 127.5	0.5	s
Timer for pre-drive check duration					

### Input data:

C_CONF_MIL {p. 5827}	INH_IV_MIS {p. 6237}	LV_DC_MAX [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_XX
LV_ES {p. 1720}	LV_IGK {p. 906}	LV_MIL_ACT_REQ {p. 5840}	LV_MIS_STATE_A {p. 6238}
LV_STST_STOP_CYC {p. 805}	LV_WAL_1_ACT_REQ {p. 5840}	LV_WAL_2_ACT_REQ {p. 5840}	NLC_MIL_ACT_REQ {p. 5899}
STATE_READY_OBD_1 {p. 5881}	STATE_READY_OBD_2 {p. 5881}	SYM_CYL_MIS_A {p. 6239}	WAL_CONF_XX {p. 5811}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CONF_MIL	-	0... FFH	0... 255	1	-
Configuration of MIL					
C_CONF_WAL_1	-	0... FFH	0... 255	1	-
Configuration of warning lamp 1 (WAL_1)					
C_CONF_WAL_2	-	0... FFH	0... 255	1	-
Configuration of warning lamp 2 (WAL_2)					
C_DLY_INH_IV_MIS	-	0... FFH	0... 127.5	0.5	s
Delay for MIL blinking in case of misfiring present failure with cylinder cut off					
C_DLY_MIL_READY_1	-	0... FFH	0... 127.5	0.5	s
Delay to start MIL blinking for readiness display during pre-drive check Shall be in between 15 and 20 sec. Typical value 20sec					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DLY_MIL_READY_2	-	0... FFH	0... 127.5	0.5	s
MIL blinking duration for readiness display during pre-drive check Shall be in between 5 and 10 sec. Typical value 10sec					
C_T_MIN_WAL_ST	-	0... FFH	0... 127.5	0.5	s
Minimum time of pre-drive check duration					
LC_T_MAX_WAL_ST_ENA	-	0... 1H	0 ...1	1	-
Activation of maximum time of pre-drive check					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_MIL_CHK_TYP	-	0... 3H	0 ...3	1	-
Bit 0 = 0 : disable pre-drive check between "stalling event/engine start" Bit 0 = 1 : enable pre-drive check between "stalling event/engine start" Bit 1 = 0 : disable readiness status display during pre-drive check (MIL blinking) Bit 1 = 1 : enable readiness					

**Import actions:**

<b>ACTION_ERRM_MiIOffToOnTrans</b> (???)<No Name available>
---

**FUNCTION DESCRIPTION:****General information:**

It is possible to manage up to three different lamps. They are called:

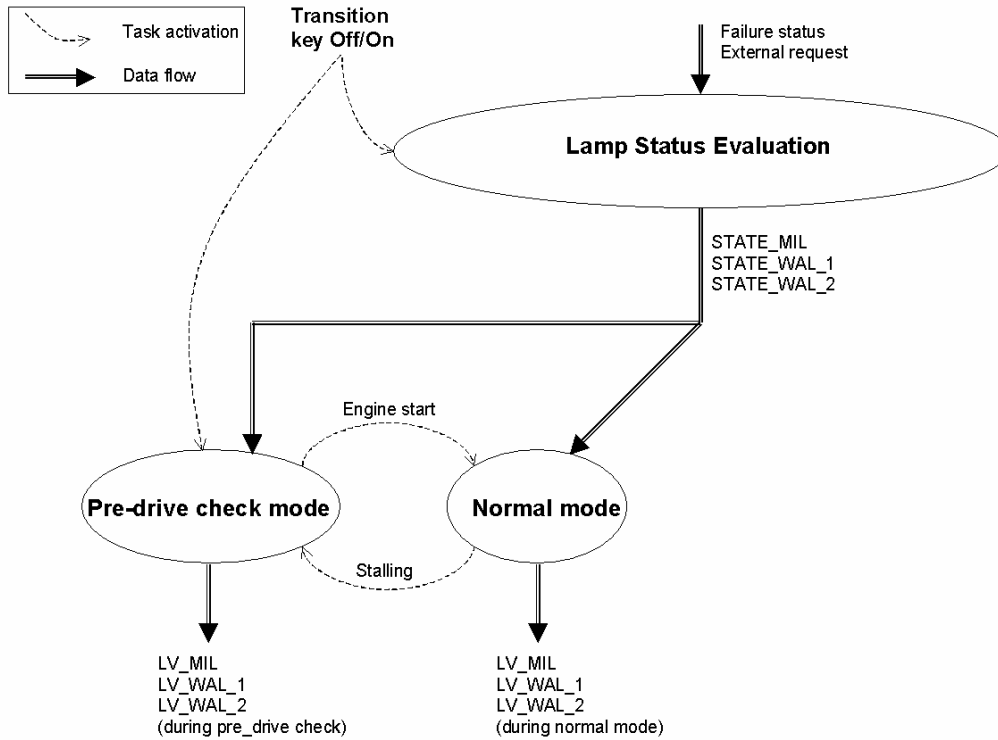
- MIL: Malfunction Indicator Lamp; this lamp is used to inform the vehicle driver in case of failures which can affect emissions.
- WAL\_1: Warning Lamp 1 and WAL\_2: Warning Lamp 2; these lamps are used to inform the vehicle driver in case of others failures.

For each lamp, a task evaluated the state of MIL, WAL\_1 and WAL\_2. These states STATE\_MIL, STATE\_WAL\_1 and STATE\_WAL\_2 are respectively what error management commanded to the lamps regard to failure status.

Then, the real physical state of each lamp (LV\_MIL for MIL, LV\_WAL\_1 for WAL\_1 and LV\_WAL\_2 for WAL\_2) is build related to the mode in which they are. Lamps behavior is based on two modes:

- A predrive check mode between transition LV\_IGK 0->1 and engine start; this mode is used to check the correct lamps working.
- A normal mode for the rest of the time.


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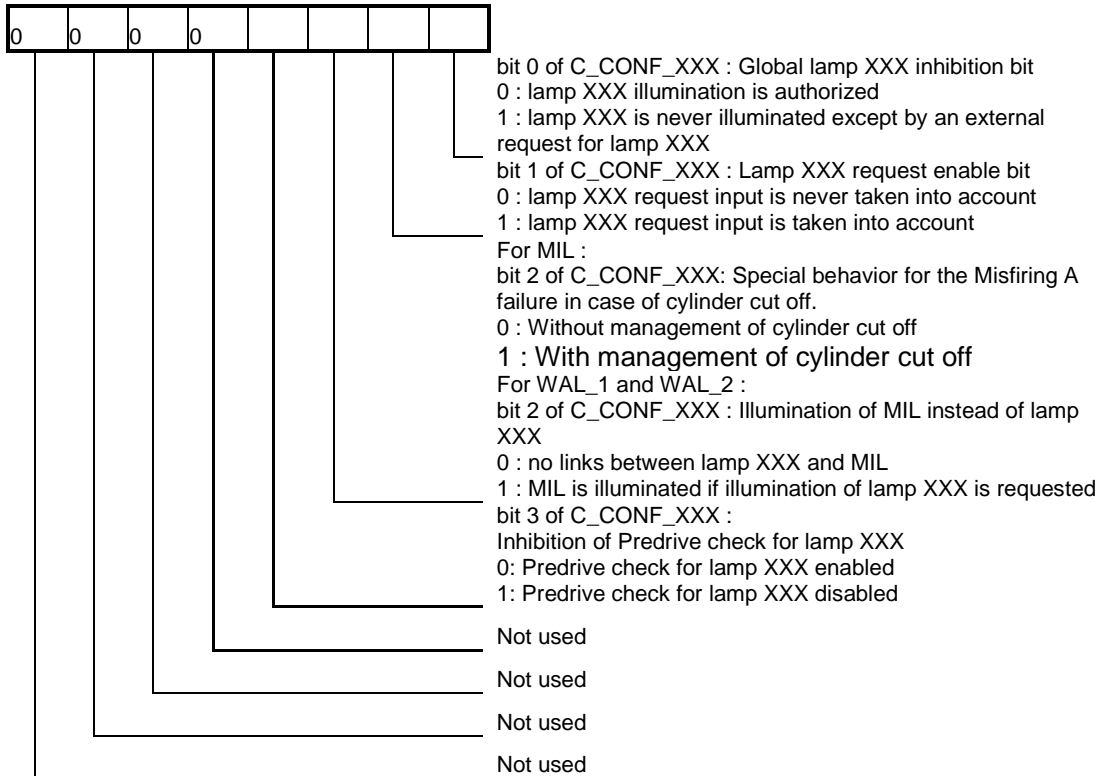


A configuration byte is defined for each lamp: C\_CONF\_XXX (with XXX = MIL C\_CONF\_MIL, WAL\_1 or WAL\_2, C\_CONF\_WAL\_1 C\_CONF\_WAL\_2).

It is then possible to inhibit a lamp illumination, to allow or not external request for lamp illumination and to link lamp illumination each other's.

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Impact of each failure on lamp is defined in WAL\_CONF\_XX byte:

- bit 0 : if set, the present failure may caused a WAL\_1 illumination ;
- bit 1 : if set, the present failure may caused a WAL\_2 illumination ;
- bit 2 : if set, the failure may caused a MIL illumination when driving cycle counter reaches maximum ;
- bit 3: if set, the present failure may cause a MIL blinking.

## B.79.1 Lamp Status Evaluation

### Description:

#### Management of WAL\_1 and WAL\_2

Behavior of WAL\_1 and WAL\_2 are identical. WAL\_1 and WAL\_2 may be illuminated (state is ON) or not (state is OFF). When the global lamp inhibition bit is not set, the lamp is requested to illuminate:

- if at least one failure is present (LV\_ERR\_XX) with the corresponding bit of WAL\_CONF\_XX (bit 0 for WAL\_1, bit 1 for WAL\_2) in enable position and this failure is stored in 2<sup>nd</sup> layer memory ;
- or in case of allowed lamp request.

#### Management of MIL

MIL internal management is based on 3 states:

- STATE\_MIL = OFF (MIL is requested continuously off)
- STATE\_MIL = ON (MIL is requested continuously on)
- STATE\_MIL = MIL\_FLL (MIL is requested blinking at 1 Hz)

When the global MIL inhibition bit is not set, the MIL is requested to illuminate (ON):

- if at least one failure has reached its driving cycle maximum value and is unequal to zero (LV\_DC\_MAX[IDX]) with the corresponding bit of WAL\_CONF\_XX (bit 2) in enable position and this failure is stored in 2<sup>nd</sup> layer memory ;
- or in case of allowed lamp request ;

- or WAL\_1 is requested to be illuminated and WAL\_1 is link with MIL ;
- or WAL\_2 is requested to be illuminated and WAL\_2 is link with MIL ;

When the global MIL inhibition bit is not set, the MIL is requested to be blinking at 1hz (MIL\_FLL):

- if at least one failure is present (LV\_ERR\_XX) with the corresponding bit of WAL\_CONF\_XX (bit 3) in enable position and this failure is stored in 2<sup>nd</sup> layer memory ;

A special calculation can be enabled for Misfire A failure with the management of cylinder shut off (bit 2 of C\_CONF\_MIL):

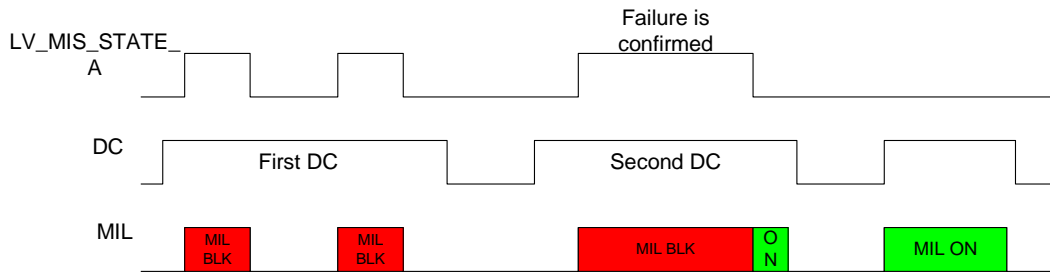
- bit 2 of C\_CONF\_MIL = 0: When a misfire A failure (LV\_MIS\_STATE\_A) is present, the MIL is blinking.
- bit 2 of C\_CONF\_MIL = 1: If Misfire A failure (LV\_MIS\_STATE\_A) is present with cylinder cut off, the MIL is blinking only for a calibratable time (C\_DLY\_INH\_IV\_MIS). After this time, the MIL is ON again.

**Beware:** The “blinking mode” is priority mode compared to “continuous on mode”.

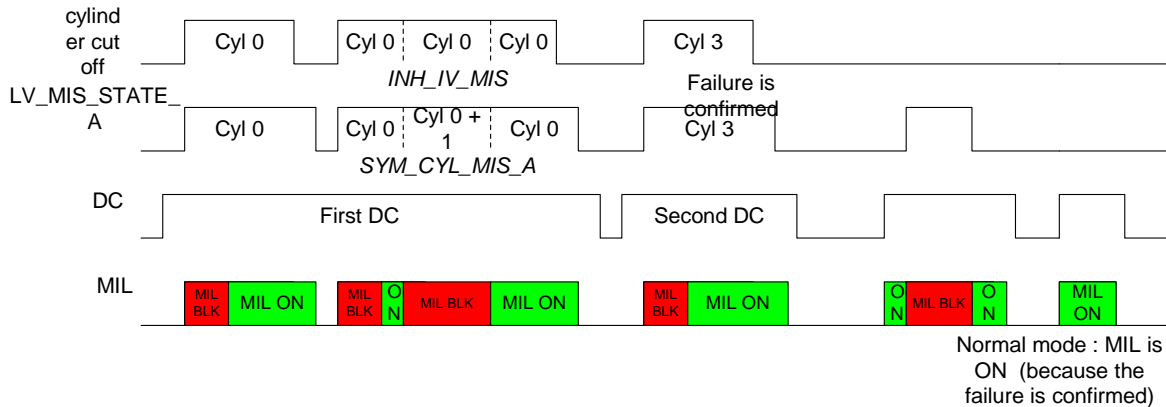
**Signal flow diagram:**

Special behavior for Misfire A failure with bit LC\_MIL\_INH\_IV\_MIS of C\_CONF\_MIL:

**Behavior of Misfiring failure MIS A without management of cylinder cut off (LC\_MIL\_INH\_IV\_MIS = 0)**




**Behavior of Misfiring A failure with management of cylinder cut off (LC\_MIL\_INH\_IV\_MIS = 1) :**



**Application conditions**

**Initialization:** –  
**Recurrence:** 500 ms  
**Activation:** –

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**Formula section:**

```

If          bit 0 of C_CONF_WAL_1 = 1      (lamp WAL_1 illumination not authorized)
Then       STATE_WAL_1 = OFF      (lamp WAL_1 is off)
Else       If          at least one failure in 2nd layer memory has:
                    (LV_ERR_XX and bit 0 of WAL_CONF_XX) = 1
                    (lamp WAL_1 illumination by a failure)
                Then STATE_WAL_1 = ON      (lamp WAL_1 is on)
                Else STATE_WAL_1 = OFF      (lamp WAL_1 is off)
                Endif
    
```

**Endif**

```


If          bit 0 of C_CONF_WAL_2 = 1      (lamp WAL_2 illumination not authorized)
Then       STATE_WAL_2 = OFF      (lamp WAL_2 is off)
Else       If          at least one failure in 2nd layer memory has:
                    (LV_ERR_XX and bit 1 of WAL_CONF_XX) = 1
                    (lamp WAL_2 illumination by a failure)
                Then STATE_WAL_2 = ON      (lamp WAL_2 is on)
                Else STATE_WAL_2 = OFF      (lamp WAL_2 is off)
                Endif
    
```

**Endif**

```

If          bit 0 of C_CONF_MIL = 1      (MIL illumination not authorized)
Then       STATE_MIL = OFF      (MIL is requested continuously off)
Else       If          at least one failure in 2nd layer memory has:
                    (LV_DC_MAX[IDX] and bit 2 of WAL_CONF_XX) = 1
                    (at least one failure request to illuminate the MIL)
                    or (STATE_WAL_1 = ON and bit 2 of C_CONF_WAL_1 = 1)
                    (a failure illuminates WAL_1 and WAL1 is linked with MIL)
                    or (STATE_WAL_2 = ON and bit 2 of C_CONF_WAL_2 = 1)
                    (a failure illuminates WAL_2 and WAL_2 is linked with MIL)
                Then STATE_MIL = ON      (MIL is requested continuously on)
                Else STATE_MIL = OFF      (MIL is requested continuously off)
                Endif
                If          LV_MIS_STATE_A = 1
                    (CARB A misfire failure criterion)
                then if      bit 2 of C_CONF_MIL = 0
                    (Without management of cylinder shut off for the misfiring A)
                    then STATE_MIL = MIL_FLL
                    (MIL is requested blinking at 1Hz)
                    else (Management of cylinder shut off for the misfiring A)
                        If      (any cylinder bit within SYM_CYL_MIS_A 0 -> 1
                        and      corresponding bit within INH_IV_MIS is set to 1)
                        Then STATE_MIL = MIL_FLL only during C_DLY_INH_IV_MIS
                        After C_DLY_INH_IV_MIS, STATE_MIL = ON
                        mode = 'blink mode during a delay + continuous ON'
                    Endif
                    if      any cylinder bit within SYM_CYL_MIS_A 0 -> 1
                        and corresponding bit within INH_IV_MIS is set to 0
                    then mode = 'blink mode'
                    Endif
    
```

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```

If mode = 'blink mode'
Then if any_cylinder bit SYM_CYL_MIS_A is set
    And
        corresponding bit within INH_IV_MIS remains to 0
        (no transition 1-> 0 of the corresponding bit during the
        failure)
    Then mode = 'blink mode'
    Else mode = 'blink mode during a delay + continuous ON'
    Endif
Endif
If mode = 'blink mode'
Then STATE_MIL = MIL_FLL
    (MIL is requested blinking at 1Hz)
else if C_DLY_INH_IV_MIS isn't achieved
    Then STATE_MIL = MIL_FLL
    (MIL is requested blinking at 1Hz)
    Else STATE_MIL = ON
    (MIL is requested continuously on)
    Endif
Endif
Endif
Endif
If at least one failure in 2nd layer memory has :
    (LV_ERR_XX and bit 3 of WAL_CONF_XX) = 1
    (at least one failure request to blink the MIL)
Then STATE_MIL = MIL_FLL
    (MIL is requested blinking at 1Hz)
Endif
Endif

```

**Endif**

**Remark:**

For the misfiring A failure (treated as a particular case), the Bit 3 of WAL\_CONF\_XX mustn't be set to 1 by calibration (only bit 2 for continuous MIL illumination).

**B.79.1.1 MIL transition from Off to On**


**Formula section:**

```

IF ((STATE_MIL transition OFF -> MIL_FLL or OFF -> ON) AND
LV_MIL_ACT_REQ = 0)
or (NLC_MIL_ACT_REQ = 1
and LV_MIL_ACT_REQ transition 0 -> 1 AND STATE_MIL = OFF
and bit 1 of C_CONF_MIL = 1)
(Hint: LV_MIL_ACT_REQ is stored in NVMY (defined in the Lamp management
Appl. Inc.)). To check the transition LV_MIL_ACT_REQ 0->1 the old value of this
flag (LV_MIL_ACT_REQ_OLD) has to be initialised with the value from NVMY at
reset !!!)
THEN
ACTION_ERRM_MilOffToOnTrans()
ENDIF

```

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## B.79.2 Lamp mode

### B.79.2.1 Predrive Check mode

#### Description:

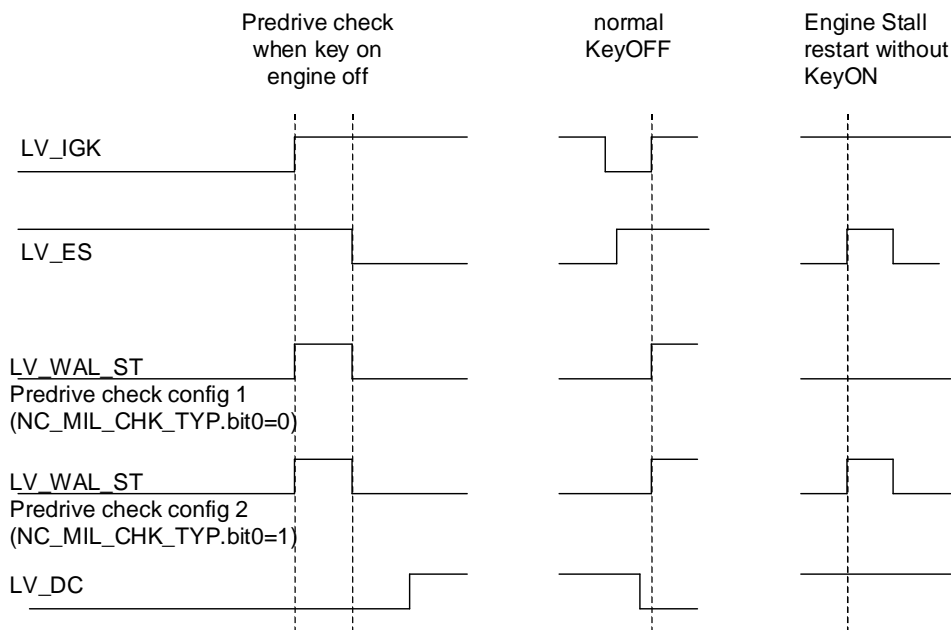
Predrive check mode is used to enable a visual check of the correct lamp working. Additionally it can be used to display readiness status as an option (MIL blinking).

Nevertheless a failure may also illuminate a lamp. Illumination of lamp during pre-drive check mode is performed only when :

- the global lamp inhibition bit is not set (bit 0 of C\_CONF\_XXX = 1) and the lamp individual predrive check inhibition is not set (bit 3 of C\_CONF\_XXX = 1)
- or error management commands a lamp
- or no inhibition because of active StartStop cycle LV\_STST\_STOP\_CYC = 1
- Configuration of predrive check behaviour in case of stalling event:  
with NC\_MIL\_CHK\_TYP (bit 0)

Predrive check mode phase can be defined in 2 ways:

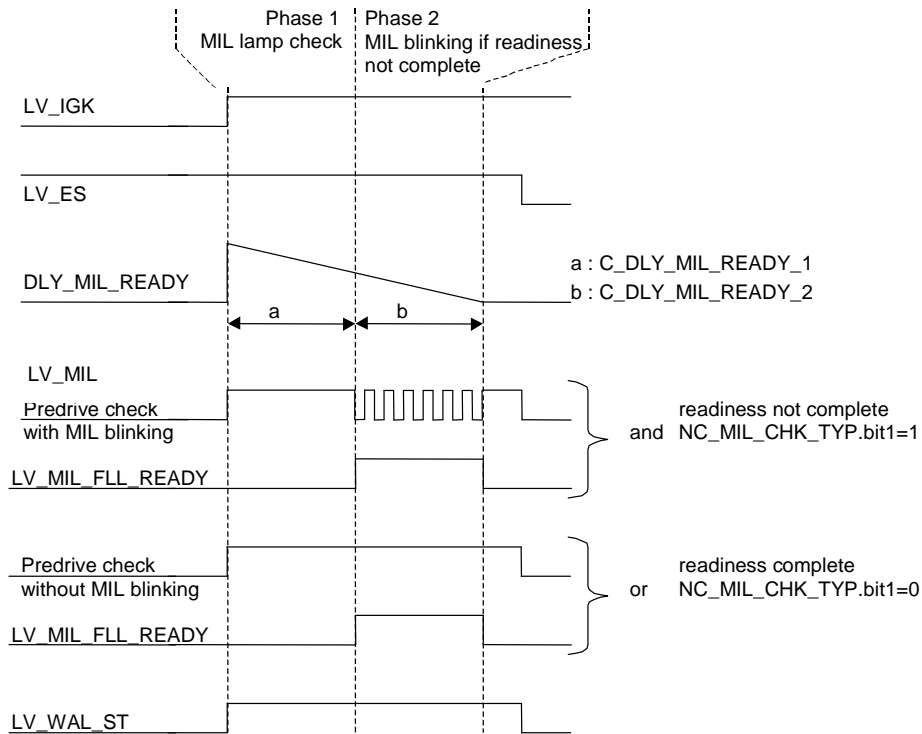
- between key on transition LV\_IGK 0->1 and engine start (bit 0 of NC\_MIL\_CHK\_TYP=0)
- or between key on transition LV\_IGK 0->1 and engine start, plus between an engine stall event and engine start (bit 0 of NC\_MIL\_CHK\_TYP=1)



#### 1. Configuration of MIL blinking readiness status functionality: with NC\_MIL\_CHK\_TYP (bit 1)

During predrive check mode, you can display the status of readiness codes through the MIL warning lamp : the MIL is blinking if readiness not complete.

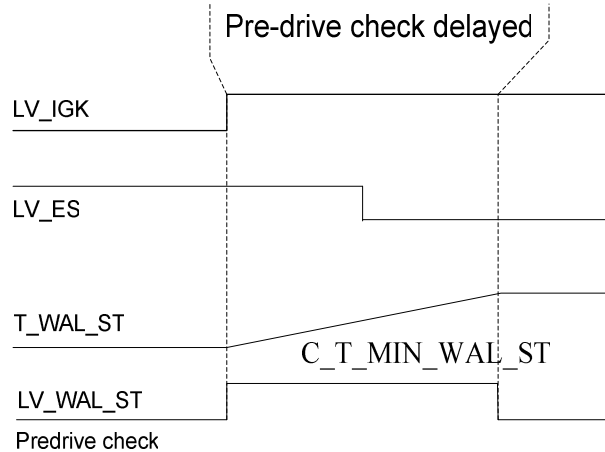
This strategy is part of predrive check and does not affect the MIL status (STATE\_MIL).



### 1. Management of minimum time of predrive check duration

-> only relevant after engine cranking (LV\_ES 1->0)

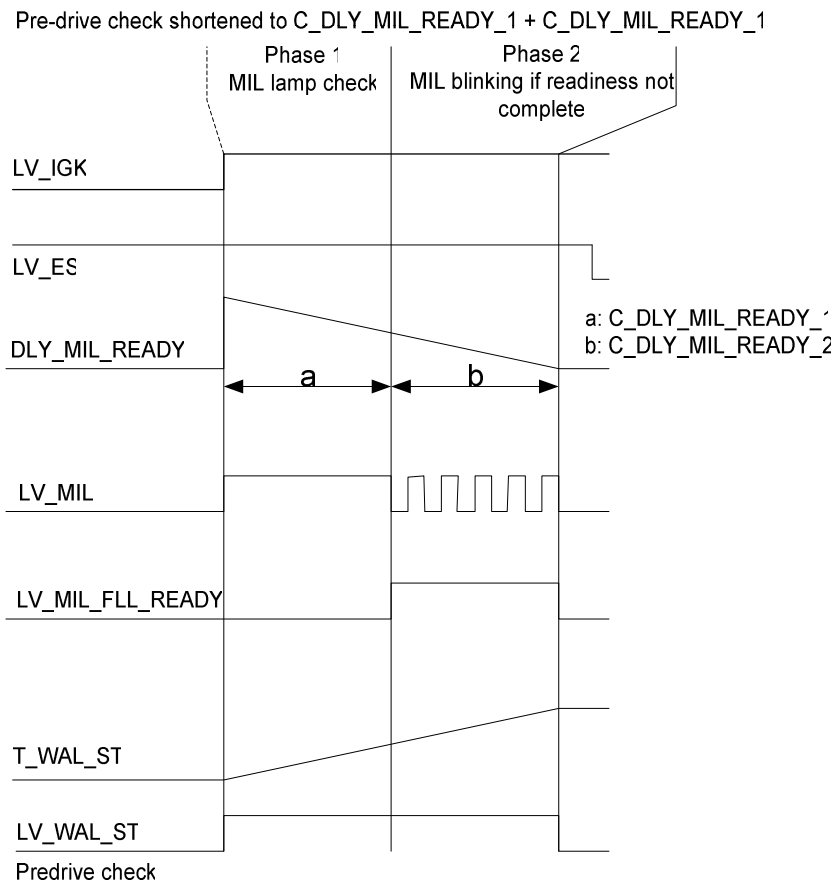
With the calibration C\_T\_MIN\_WAL\_ST it's possible to set a minimum time for the predrive check duration independent of engine cranking (LV\_ES 1->0). This gives the possibility to illuminate the Mil for predrive check (e.g. in case of a quick start).



### 1. Management of maximum time of predrive check duration

-> only relevant before engine cranking (LV\_ES = 0)

With the calibration LC\_T\_MAX\_WAL\_ST\_ENA, it's possible to activate the maximum time of predrive check functionality. If this functionality is activated (LC\_T\_MAX\_WAL\_ST\_ENA = 1) the maximum predrive check duration before engine cranking is C\_DLY\_MIL\_READY\_1 + C\_DLY\_MIL\_READY\_2. This gives the possibility to finish the predrive check before engine cranking e.g. in case of a long key on engine stop phase.



## Application conditions

### Initialization:

At LV\_IGK transition 0 to 1  
 $T\_WAL\_ST = 0$  and  $LV\_MIL\_FLL\_READY=0$   
 At LV\_ES transition 0 to 1  
 $T\_WAL\_ST = 0$   
 At LV\_IGK transition 1 to 0 or if reset  
 $LV\_WAL\_ST = 0$  (Pre-drive check mode deactivated)

### Recurrence:

500 ms and at LV\_IGK 0 -> 1 transition

### Activation:

( pre-drive check enable between "stalling event/ engine start" )

bit 0 of NC\_MIL\_CHK\_TYP=1  
 and  $LV\_IGK = 1$  and  $LV\_ES = 1$   
 and  $LV\_STST\_STOP\_CYC = 0$   
 and (  $T\_WAL\_ST < C\_DLY\_READY\_1 + C\_DLY\_READY\_2$   
 or  $LC\_T\_MAX\_WAL\_ST\_ENA = 0$  )  
 and ( bit 0 of C\_CONF\_WAL\_1 = 0  
 or bit 0 of C\_CONF\_WAL\_2 = 0  
 or bit 0 of C\_CONF\_MIL = 0 )

or

( pre-drive check disable between "stalling event/ engine start" )

bit 0 of NC\_MIL\_CHK\_TYP=0  
 and transition LV\_IGK 0 ->1 and  $LV\_ES = 1$   
 and (  $T\_WAL\_ST < C\_DLY\_READY\_1 + C\_DLY\_READY\_2$  )

```

    or LC_T_MAX_WAL_ST_ENA = 0)
and (bit 0 of C_CONF_WAL_1 = 0
    or bit 0 of C_CONF_WAL_2 = 0
    or bit 0 of C_CONF_MIL = 0)

```

```

Deactivation:      (LV_ES = 0                (engine not stopped)
                    and T_WAL_ST >= C_T_MIN_WAL_ST)
                    (minimum time of predrive check reached)
                    or
                    ((LV_ES = 1                (engine stopped)
                    and T_WAL_ST >= C_DLY_READY_1 + C_DLY_READY_2
                    and LC_T_MAX_WAL_ST_ENA = 1)
                    (maximum time of predrive check reached)
                    or LV_IGK=0                (or key off)

```

**Formula section:**

LV\_WAL\_ST=1 during activation of this formula section.

LV\_WAL\_ST=0 and LV\_MIL\_FLL\_READY=0 during deactivation of this formula section (end of predrive check).

$T\_WAL\_ST = T\_WAL\_ST + 0.5\text{ s}$

**If** bit 1 of NC\_MIL\_CHK\_TYP = 1 **(if readiness display enable)**

**Then**

**If** transition of LV\_WAL\_ST from 0 to 1 **(on beginning of predrive check)**

**Then** **(initialize time delay)**

Initialize Delay time DLY\_MIL\_READY with C\_DLY\_MIL\_READY\_1+C\_DLY\_MIL\_READY\_2

**Endif**

DLY\_MIL\_READY = DLY\_MIL\_READY - 0.5 s

**(check if delay is within the timing window)**

**If** DLY\_MIL\_READY < C\_DLY\_MIL\_READY\_2

**And** DLY\_MIL\_READY > 0

**Then**

**(check if some supported readiness status are "complete")**

**If** (bit 4 to 7 of STATE\_READY\_OBD\_1=0)

**And** (STATE\_READY\_OBD\_2=0)

**Then**

LV\_MIL\_FLL\_READY=0 **(if "complete" then MIL does not blink)**

**Else**

LV\_MIL\_FLL\_READY=1 **(if "not complete" then MIL lamp shall blink)**

**Endif**

**Else**

LV\_MIL\_FLL\_READY = 0 **(the readiness status phase is finished)**

**Endif**

**Endif**

**If** bit 0 of C\_CONF\_MIL = 0 (MIL not inhibit)  
**and** bit 3 of C\_CONF\_MIL = 0 (predrive check for MIL enable)  
**and** LV\_MIL\_FLL\_READY = 1 (readiness not complete)

**Then** LV\_MIL shall blink at 1Hz

**Endif**

**(“predrive check”: switch on warning lamps)**

**If** bit 0 of C\_CONF\_WAL\_1 = 0 (WAL\_1 not inhibit)  
**and** bit 3 of C\_CONF\_WAL\_1 = 0 (predrive check for WAL\_1 enabled)

**Then** LV\_WAL\_1 = 1

**Endif**

**If** bit 0 of C\_CONF\_WAL\_2 = 0 (WAL\_2 not inhibit)  
**and** bit 3 of C\_CONF\_WAL\_2 = 0 (predrive check for WAL\_2 enabled)

**Then** LV\_WAL\_2 = 1

**Endif**

**If** bit 0 of C\_CONF\_MIL = 0 (MIL not inhibit)  
**and** bit 3 of C\_CONF\_MIL = 0 (predrive check for MIL enabled)  
**and** LV\_MIL\_FLL\_READY = 0 (MIL not blinking readiness status)

**Then** LV\_MIL = 1

**Endif**

**B.79.2.2 Normal mode**

The normal mode is defined as “not to be in pre-drive check mode”.

**B.79.2.3 All modes**

**Description:**

The following treatment is done in pre-drive check mode and in normal mode.

**Application conditions**

**Initialization:** at transition LV\_IGK 1->0 or if reset  
 LV\_MIL = 0 (MIL is off)  
 LV\_WAL\_1 = 0 (WAL\_1 is off)  
 LV\_WAL\_2 = 0 (WAL\_2 is off)


**Recurrence:** 500 ms and at LV\_IGK 0 -> 1 transition

**Activation:** LV\_IGK=1

**Formula section:**

**If** STATE\_MIL = MIL\_FLL  
**Then** LV\_MIL blink at 1Hz  
**Else if** (STATE\_MIL = ON **or** (LV\_MIL\_ACT\_REQ = 1 **and** bit 1 of C\_CONF\_MIL = 1))  
 (allowed MIL request)  
**AND** (LV\_MIL\_FLL\_READY=0 **or** bit 3 of C\_CONF\_MIL = 1)  
 (case MIL blinking during the pre-drive check: readiness not completed)

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```

Then      LV_MIL = 1
Else If   we are in normal mode or bit 3 of C_CONF_MIL = 1
            (predrive check not authorized for MIL)
Then      LV_MIL = 0
Endif
Endif
Endif

If        STATE_WAL_1 = ON or (LV_WAL_1_ACT_REQ = 1 and bit 1 of C_CONF_WAL_1 = 1)
            (allowed lamp WAL_1 request)

Then      LV_WAL_1 = 1
Else If   we are in normal mode or bit 3 of C_CONF_WAL_1 = 1
            (pre drivecheck not authorized for WAL_1)
Then      LV_WAL_1 = 0
Endif
Endif

If        STATE_WAL_2 = ON or (LV_WAL_2_ACT_REQ = 1 and bit 1 of C_CONF_WAL_2 = 1)
            (allowed lamp WAL_2 request)

Then      LV_WAL_2 = 1
Else If   we are in normal mode or bit 3 of C_CONF_WAL_2 = 1
            (pre drivecheck not authorized for WAL_2)

Then      LV_WAL_2 = 0
Endif
Endif
    
```

**Configuration data detailed description:**

Bit 0 = 0 : disable pre-drive check between “stalling event/engine start”  
 Bit 0 = 1 : enable pre-drive check between “stalling event/engine start”  
 Bit 1 = 0 : disable readiness status display during pre-drive check (MIL blinking)  
 Bit 1 = 1 : enable readiness  
 Typical value bit 0 = 0, bit 1 = 0


**Calibration data detailed description:**

C\_DLY\_MIL\_READY\_1: Delay to start MIL blinking for readiness display during pre-drive check. Shall be tuned between 15 s and 20 s. Typical value 20 s.

C\_DLY\_MIL\_READY\_2: MIL blinking duration for readiness display during pre-drive check. Shall be tuned between 5 s and 10 s. Typical value 10 s.

LC\_T\_MAX\_WAL\_ST\_ENA: = 1: maximum time of predrive check with LV\_ES = 1 is C\_DLY\_MIL\_READY\_1 + C\_DLY\_MIL\_READY\_2  
 = 0: maximum time of predrive check with LV\_ES = 1 is unlimited

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## B.80 Lamp management (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_MIL_ACT_REQ	O/V	0... 1H	0 ...1	1	-
Request of MIL activation by others					
LV_MIL_ACT_REQ_DC	O	0... 1H	0 ...1	1	-
Request of MIL activation by others this DC					
LV_WAL_1_ACT_REQ	O/V	0... 1H	0 ...1	1	-
Request of WAL 1 activation by others					
LV_WAL_2_ACT_REQ	O/V	0... 1H	0 ...1	1	-
Request of WAL 2 activation by others					

### Input data:

LV_IGK {p. 906}	LV_MIL_REQ_ETCU {p. 1566}	LV_MIS_STATE_A {p. 6238}	LV_MIS_STATE_B1 {p. 6238}
LV_MIS_STATE_B4 {p. 6238}	STATE_ETCU_OBD {p. 1574}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_WAL_CONF_MIS	V	0... 7H	0 ...7	1	-
Constant for WAL_1 illumination by MISF					
LC_MIL_ACT_REQ_ETCU	V	0... 1H	0 ...1	1	-
logical constant for MIL illumination by ETCU					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_LAMP	-	0... 3H	0 ...3	1	-
Quantity of warning lamps					

### General information

The external request management of all lamps is done directly on the CAN output-signal, thus this function is now only used by the EGS - ECU.

### Application conditions:

#### Initialisation:

At ECU reset:  
 LV\_MIL\_ACT\_REQ = 0  
 LV\_WAL\_1\_ACT\_REQ = 0  
 LV\_WAL\_2\_ACT\_REQ = 0  
 LV\_MIL\_ACT\_REQ\_DC = 0

#### Activation:


LV\_IGK = 1

#### Deactivation:

LV\_IGK = 0 then set all outputs equal to 0

#### Recurrence:

100 ms

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**Function description:****Formula section:****MIL activation at Gear Request**

```

If      LV_MIL_REQ_ETCU = 1                or
          [ LC_MIL_ACT_REQ_ETCU = 1        and
            (STATE_ETCU_OBD = 0100 b      or
              STATE_ETCU_OBD = 0110 b) ]
Then    LV_MIL_ACT_REQ = 1
Else    LV_MIL_ACT_REQ = 0
Endif

```


```
LV_MIL_ACT_REQ_DC = 0                // not used
```

**WAL\_1 (EML) activation at active Misfire**

```

If      (bit 0 of C_WAL_CONF_MIS =1 and LV_MIS_STATE_A =1) or
          (bit 1 of C_WAL_CONF_MIS =1 and LV_MIS_STATE_B1 =1) or
          (bit 2 of C_WAL_CONF_MIS =1 and LV_MIS_STATE_B4 =1)
Then    LV_WAL_1_ACT_REQ = 1
Else    LV_WAL_1_ACT_REQ = 0
Endif

```

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## B.81 Permanent fault code

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ERR_PERM_NR	O/V/S	0... FFH	0... 255	1	-
Number of permanent fault codes stored					
ERR_PERM [NC_NR_ERR_PERM]	O/V/S	0... FFFFH	0... 65535	1	-
Permanent fault index					
ERR_SYM_PERM [NC_NR_ERR_PERM]	O/V/S	0... FH	0... 15	1	-
Permanent fault symptom					
LV_DC_PERM_MEM	V/S	0... 1H	0 ...1	1	-
Memorization of LV_DC_PERM until next ERRM clearing (Mode \$04,...)					
LV_ERR_CLR [NC_NR_ERR_PERM]	V/S	0... 1H	0 ...1	1	-
Failure is only permanent due ERRM data clearing					
LV_ERR_PERM [NC_NR_ERR_PERM]	O/V/S	0... 1H	0 ...1	1	-
Permanent fault code					
LV_ERR_PERM_CLR_OLD	-	0... 1H	0 ...1	1	-
Previous state of LC_ERR_PERM_CLR					
SYM_CYL_PERM_MIS_A	O/V/S	0... FFFFH	0... 65535	1	-
Permanent memorized cylinder with misfire A (for the DTC building)					
SYM_CYL_PERM_MIS_B1	O/V/S	0... FFFFH	0... 65535	1	-
Permanent memorized cylinder with misfire B1 (for the DTC building)					
SYM_CYL_PERM_MIS_B4	O/V/S	0... FFFFH	0... 65535	1	-
Permanent memorized cylinder with misfire B4 (for the DTC building)					

### Input data:

ERR_SYM_MEM [NC_NR_ERR_DYN] {p. 5756}	LV_DC_PERM {p. 5746}	LV_READY_XX {p. 5881}	NLC_TREAT_DIAG_MIS {p. 6265}
SYM_CYL_MEM_MIS_A {p. 5756}	SYM_CYL_MEM_MIS_B1 {p. 5756}	SYM_CYL_MEM_MIS_B4 {p. 5756}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_ERR_PERM_CLR	-	0... 1H	0 ...1	1	-
Calibration to clear permanent failure memory ( at 0->1 transition)					


### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_ERR_PERM	-	1... FFH	1... 255	1	-
Maximum number of failure defined in permanent failure memory structure (CARB required minimum value : 4)					

### Action definition

<b>ACTION_ERRM_ClcPermanentByErr (IN&lt;PRM_IDX_ERR&gt;)</b>	Mode: O
ACTION_ERRM_GetReadyClass (IN <PRM_IDX_ERR >, OUT <PRM_READY_CLAS>)	

<b>ACTION_ERRM_ClcPermanentIniErrm ()</b>	Mode: O
---	---------

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<b>ACTION_ERRM_ClcPermanentResetDC</b> ()	Mode: O
---	---------

<b>ACTION_ERRM_ErasePermanentCode</b> (IN<PRM_IDX_ERR>)	Mode: O
---	---------

<b>ACTION_ERRM_GetErrPerm</b> (OUT<PRM_LV_ERR_PERM>,IN<PRM_IDX_ERR>)	Mode: O
This action is called to know if a given failure has a permanent code stored or not.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_LV_ERR_PERM	out	0... 1H	0 ...1	1	-
Permanent status.					
PRM_IDX_ERR	in	0... FFFFH	0... 65535	1	-
Failure Index					

<b>ACTION_ERRM_StorePermanentCode</b> (IN<PRM_IDX_ERR>)	Mode: O
---	---------

### Import actions:

<b>ACTION_ERRM_GetErrLastClr</b> (<PRM_IDX_ERR>,<PRM_LV_ERR_LST_CLR>)
<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>,OUT<LV_END_DIAG>)
<b>ACTION_ERRM_GetReadyClass</b> (IN<PRM_IDX_ERR>,OUT<PRM_READY_CLAS>)

## FUNCTION DESCRIPTION:

### General information:

Any DTC that is commanding MIL on must be logged as a permanent fault code in non-volatile memory. A Permanent DTC can only be erased by the vehicle's OBD II system.


Vehicle owners and technicians would not be able to clear or erase permanent fault codes by any generic or manufacturer specific scan tool command (or by disconnecting the battery). Instead, these fault codes would only be allowed to be self-cleared by the OBD II system itself (ERRM), once the monitor responsible for setting that fault code has run enough times to confirm that the fault was no longer present.

The permanent fault code is set as soon as the failure gets the confirmed status (MIL is switched on). The permanent fault code is erased after self-healing of the failure, when the MIL goes off.

Subsequent to a clearing of the failure memory (e.g. Mode \$04), the permanent fault code is erased if the diagnostic that caused the permanent fault code to be stored has been fully executed and determined the malfunction is no longer present and special vehicle operation has been encountered (defined by LV\_DC\_PERM) such as :

- Cumulated trip length (time since engine start) T\_AST\_PERM  $\geq$  600 s
- Cumulative vehicle operation  $\geq$  40 km/h (25mph) for at least 300 s
- Continuous vehicle operation in idle  $\geq$  30 s (accelerator pedal released and vehicle speed less or equal than 1 mph)

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- Altitude condition is (no criteria for ambient pressure si defined)
- Ambient temperature is (no criteria on ambient temperature is defined)

A minimum of four permanent fault codes shall be retained by by the OBD II system (ERRM). But the permanent failure memory may be adjusted over the four elements size thanks to NC\_NR\_ERR\_PERM configuration data.

Permanent fault codes may not be erased when ECU is reprogrammed unless the readiness status for all monitored components is set to “not complete” in conjunction with the reprogramming event.

The permanent failure memory structure is defined as follow:

Index: IDX\_PERM ξ [1...NC\_NR\_ERR\_PERM]

- Permanent fault index	ERR_PERM[IDX_PERM]
- Permanent fault code	LV_ERR_PERM[IDX_PERM]
- Failure is only permanent due ERRM data clearing	LV_ERR_CLR[IDX_PERM]
- Permanent Fault symptom	ERR_SYM_PERM[IDX_PERM]
- Permanent memorized cylinder with misfire A, B1, B4	SYM_CYL_PERM_XX

### B.81.1 Permanent failure memory

#### FUNCTION DESCRIPTION:

##### General information:

The permanent failure memory is a data structure containing NC\_NR\_ERR\_PERM elements. Permanent faults codes are stored there, with a chronological order, but the clearing is done randomly, because it is based on the natural failure healing. When the data structure is full, no additional permanent fault code can be entered, until an empty space is freed within the structure. The permanent failure memory must retain at least four permanent faults codes.

##### Application conditions

##### **Initialisation:**

```

at NVMINI system event
CTR_ERR_PERM_NR = 0
LV_DC_PERM_MEM = 0
For IDX_PERM = 1 to NC_NR_ERR_PERM
    ERR_PERM[IDX_PERM] = 0
    LV_ERR_CLR[IDX_PERM] = 0
    LV_ERR_PERM[IDX_PERM] = 0
    ERR_SYM_PERM[IDX_PERM] = 0 (NO_SYM)
#IF NLC_TREAT_DIAG_MIS = 0
    SYM_CYL_PERM_MIS_A = 0,
    SYM_CYL_PERM_MIS_B1 = 0,
    SYM_CYL_PERM_MIS_B4 = 0
#ENDIF
Endfor
    
```

##### **Recurrence:**

–

##### **Activation:**

–

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**Formula section:**

No action specified.

**B.81.2 Storage of permanent fault code****Description for actions:**

<b>ACTION_ERRM_StorePermanentCode ( &lt; PRM_IDX_ERR &gt; )</b>					
This action shall be called in order to store a permanent fault code. When permanent memory is full, the permanent code storage is postponed until a free space within memory is released. Permanent codes are stored according the chronological appearance order.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_IDX_ERR	IN	0...FFFFH	0...65535	1	[-]
Failure index					

**Formula section:**

For IDX\_PERM = 1 to NC\_NR\_ERR\_PERM

**If(1)** ERR\_PERM[IDX\_PERM] = PRM\_IDX\_ERR

**Then(1)**

(Permanent failure related to PRM\_IDX\_ERR is already stored)

(If failure was only permanent due to a previous ERRM data clearing, this information is cleared to avoid permanent clearing at end of driving cycle)

LV\_ERR\_CLR[IDX\_PERM] = 0

LV\_ERR\_PERM[IDX\_PERM] = 1

**Exit**

**Else(1)**

**If(2)** CTR\_ERR\_PERM\_NR <> NC\_NR\_ERR\_PERM

**Then(2)**

(Permanent failure memory is not full)

**If(3)** LV\_ERR\_PERM[IDX\_PERM] = 0

**Then(3)**

(Empty area detected)

ERR\_PERM[IDX\_PERM] = PRM\_IDX\_ERR

LV\_ERR\_CLR[IDX\_PERM] = 0

LV\_ERR\_PERM[IDX\_PERM] = 1

**If** NLC\_TREAT\_DIAG\_MIS = 1

**Then**

"Conditions for treatment are true"

**Endif**

ACTION\_ERRM\_GetReadyClass(PRM\_IDX\_ERR, PRM\_READY\_CLAS)

**If** PRM\_READY\_CLAS <> CARB\_MIS

**Then**

"Conditions for treatment are true"

**Endif**

**If** "Conditions for treatment are true"

**Then**

with IDX\_DYN = f (PRM\_IDX\_ERR)

ERR\_SYM\_PERM[IDX\_PERM] = ERR\_SYM\_MEM[IDX\_DYN]

**Else**

```

    If PRM_IDX_ERR = MIS_A
    Then
        SYM_CYL_PERM_MIS_A = SYM_CYL_MEM_MIS_A
    Else If PRM_IDX_ERR = MIS_B1
    Then
        SYM_CYL_PERM_MIS_B1 = SYM_CYL_MEM_MIS_B1
    Else If PRM_IDX_ERR = MIS_B4
    Then
        SYM_CYL_PERM_MIS_B4 = SYM_CYL_MEM_MIS_B4
    Endif
    Endif
    If(4) CTR_ERR_PERM_NR < NC_NR_ERR_PERM
    Then(4)
        CTR_ERR_PERM_NR = CTR_ERR_PERM_NR + 1
    Else(4)
        CTR_ERR_PERM_NR = NC_NR_ERR_PERM
    Endif(4)
    Exit
    Else(3)
        (A permanent failure is already logged at this position)
    Endif(3)
    Else(2)
        (Permanent failure memory is full)
        (PRM_IDX_ERR failure can not be stored as permanent until a free space is released)
    Endif(2)
    Endif(1)
Endfor

```

### B.81.3 Erasing permanent fault code (self-clearing)

#### Description for actions:

<b>ACTION_ERRM_ErasePermanentCode ( &lt; PRM_IDX_ERR &gt; )</b>					
This action shall be called to erase a permanent fault code from memory. A permanent fault code is always self cleared. None external action can affect or delete this code.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_IDX_ERR	IN	0..FFFFH	0..65535	1	[-]
Failure index					

#### Formula section:

(Erasing permanent fault code)

**For** IDX\_PERM = 1 to NC\_NR\_ERR\_PERM

**If(1)** ERR\_PERM[IDX\_PERM] = PRM\_IDX\_ERR

**Then(1)**

(PRM\_IDX\_ERR error to be cleared has been found)

ERR\_PERM[IDX\_PERM] = 0

LV\_ERR\_CLR[IDX\_PERM] = 0

LV\_ERR\_PERM[IDX\_PERM] = 0

**If** NLC\_TREAT\_DIAG\_MIS = 1

**Then**

```

"Conditions for treatment are true"
Endif
ACTION_ERRM_GetReadyClass(PRM_IDX_ERR, PRM_READY_CLAS)
If PRM_READY_CLAS <> CARB_MIS
Then
    "Conditions for treatment are true"
    Endif
If "Conditions for treatment are true"
Then
    ERR_SYM_PERM[IDX_PERM] = 0 (NO_SYM)
    Else
        If PRM_IDX_ERR = MIS_A
        Then
            SYM_CYL_PERM_MIS_A = 0
        Else If PRM_IDX_ERR = MIS_B1
        Then
            SYM_CYL_PERM_MIS_B1 = 0
        Else If PRM_IDX_ERR = MIS_B4
        Then
            SYM_CYL_PERM_MIS_B4 = 0
        Endif
    Endif
If(2) CTR_ERR_PERM_NR > 0
Then(2)
    CTR_ERR_PERM_NR = CTR_ERR_PERM_NR - 1
Else(2)
    CTR_ERR_PERM_NR = 0
Endif(2)
(newly created empty place has IDX_PERM index value)
Exit
Endif(1)
Endfor

```

(Permanent failure memory sorting to remove empty space generated above)


```

If(1) IDX_PERM <> NC_NR_ERR_PERM
Then(1)
    For k = IDX_PERM to (NC_NR_ERR_PERM-1)
        ERR_PERM[k] = ERR_PERM[k+1]
        LV_ERR_CLR[k] = ERR_PERM[k+1]
        LV_ERR_PERM[k] = ERR_PERM[k+1]
        ERR_SYM_PERM[k] = ERR_SYM_PERM[k+1]
    Endfor
    ERR_PERM[NC_NR_ERR_PERM] = 0
    LV_ERR_CLR[NC_NR_ERR_PERM] = 0
    LV_ERR_PERM[NC_NR_ERR_PERM] = 0
    ERR_SYM_PERM[NC_NR_ERR_PERM] = 0 (NO_SYM)
Endif(1)

```

## B.81.4 Impact of error management data clearing inside permanent memory

### Description for actions:

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<b>ACTION_ERRM_ClcPermanentIniErrm ( )</b>					
This action is called when all error management data is cleared (e.g. Mode \$04 executed by scan tool). After an overall data clearing of error management data, permanent errors are marked in order to allow a self clearing at the end of next driving cycle, if the following conditioning are gathered: - diagnosis has run long enough to detect a possible malfunction - malfunction not present					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
No parameter					

**Formula section:**

LV\_DC\_PERM\_MEM = 0

For IDX\_PERM = 1 to NC\_NR\_ERR\_PERM

**If(1)** LV\_ERR\_PERM[IDX\_PERM] = 1

**Then(1)**

    (A permanent fault code is stored at IDX\_PERM position)

    LV\_ERR\_CLR[IDX\_PERM] = 1

**Else(1)**

    (No permanent fault code stored as from position IDX\_PERM until end)

**Exit**

**Endif(1)**

**Endfor**

### B.81.5 Impact of failure clearing (with diagnostic tool) inside permanent memory

**Description for actions:**

<b>ACTION_ERRM_ClcPermanentByErr ( &lt; PRM_IDX_ERR &gt; )</b>					
This action is called when one unique failure is cleared by a diagnostic tool. After clearing of any individual failure, the related permanent code is marked to allow a self clearing at the end of next driving cycle, if the following conditioning are gathered: - diagnosis has run long enough to detect a possible malfunction - malfunction not present					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_IDX_ERR	IN	0...FFFFH	0...65535	1	[-]
Failure index					

**Formula section:**

LV\_DC\_PERM\_MEM = 0

For IDX\_PERM = 1 to NC\_NR\_ERR\_PERM

**If(1)** ERR\_PERM[IDX\_PERM] = PRM\_IDX\_ERR

**Then(1)**

    LV\_ERR\_CLR[IDX\_PERM] = 1

**Exit**

**Endif(1)**

**Endfor**



## B.81.6 End of driving cycle computations

### Description for actions:

<b>ACTION_ERRM_ClcPermanentResetDC ( )</b>					
This action is called by dynamic error management core module to execute computations linked to the end of driving cycle.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
No parameter					

### Formula section:

(Has LV\_DC\_PERM already been set since last ERRM clearing (Mode \$04... ) ?)

**If(1)** LV\_DC\_PERM\_MEM = 0

**Then(1)**

LV\_DC\_PERM\_MEM = LV\_DC\_PERM

**Endif(1)**

(Clearing of permanent failure for which diagnostic has passed)

**For** IDX\_PERM = 1 to NC\_NR\_ERR\_PERM

**If(1)** (LV\_ERR\_PERM[IDX\_PERM] = 1 and LV\_ERR\_CLR[IDX\_PERM] = 1)

**Then(1)**

ACTION\_ERRM\_GetErrLastClr(ERR\_PERM[IDX\_PERM], PRM\_LV\_ERR\_LST\_CLR)

With XX = ERR\_PERM[IDX\_PERM]

**If(2)** PRM\_LV\_ERR\_LST\_CLR = 0

**Then(2)**

**If(3)** (LV\_DC\_PERM\_MEM = 1 and LV\_READY\_XX = 0)

**If(4)** NLC\_TREAT\_DIAG\_MIS = 1

**Then(4)**

"Conditions for treatment are true"

**Endif(4)**

ACTION\_ERRM\_GetReadyClass(ERR\_PERM[IDX\_PERM], PRM\_READY\_CLAS)

**If(4)** PRM\_READY\_CLAS <> CARB\_MIS

**Then(4)**

"Conditions for treatment are true"

**Endif(4)**

**If(4)** "Conditions for treatment are true"

**Then(4)**

ERR\_SYM\_PERM[IDX\_PERM] = 0 (NO\_SYM)

**Else(4)**

**If(5)** PRM\_IDX\_ERR = MIS\_A

**Then(5)**

SYM\_CYL\_PERM\_MIS\_A = 0

**Else If(5)** PRM\_IDX\_ERR = MIS\_B1

**Then(5)**

SYM\_CYL\_PERM\_MIS\_B1 = 0

**Else If(5)** PRM\_IDX\_ERR = MIS\_B4

**Then(5)**

SYM\_CYL\_PERM\_MIS\_B4 = 0

**Endif(5)**

**Endif(4)**

```

        (Permanent failure may be cleared)
        ERR_PERM[IDX_PERM] = 0
        LV_ERR_CLR[IDX_PERM] = 0
        LV_ERR_PERM[IDX_PERM] = 0
    (Permanent failure counter is decreased)
    If(4)   CTR_ERR_PERM_NR > 0
    Then(4)
        CTR_ERR_PERM_NR = CTR_ERR_PERM_NR - 1
    Else(4)
        CTR_ERR_PERM_NR = 0
    Endif(4)
Endif(3)
Else(2)
    (Failure has been encountered at least once since last ERRM clear)
    (Permanent code must be locked until next ERRM clearing (Mode $04,...))
    LV_ERR_CLR[IDX_PERM] = 0
Endif(2)
Endif(1)
Endfor

```

(Permanent failure memory sorting to remove empty spaces - "heapsorting")


```

For IDX_PERM = 1 to (NC_NR_ERR_PERM-1)
    If(1)   ERR_PERM[IDX_PERM] = 0
    Then(1)
        For k = (IDX_PERM + 1) to NC_NR_ERR_PERM
            If(2)   ERR_PERM[k] <> 0
            Then(2)
                (Swapping)
                ERR_PERM[IDX_PERM] = ERR_PERM[k]
                LV_ERR_CLR[IDX_PERM] = LV_ERR_CLR[k]
                LV_ERR_PERM[IDX_PERM] = LV_ERR_PERM[k]
                ERR_SYM_PERM[IDX_PERM] = ERR_SYM_PERM[k]
                (Clearing of swapped data)
                ERR_PERM[k] = 0
                LV_ERR_CLR[k] = 0
                LV_ERR_PERM[k] = 0
                ERR_SYM_PERM[k] = 0 (NO_SYM)
            Exit
            Endif(2)
        Endfor
    Endif(1)
Endfor

```

## B.81.7 Get failure permanent status

### Description for actions:

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<b>ACTION_ERRM_GetErrPerm ( &lt;PRM_IDX_ERR&gt;, &lt;PRM_LV_ERR_PERM&gt; )</b>					
This action is called to know if a given failure has a permanent code stored or not.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_IDX_ERR	IN	0...FFFFH	0...65535	1	[-]
Failure index					
PRM_LV_ERR_PERM	OUT	0...1H	0...1	1	[-]
Permanent status					

**Formula section:**

**For** IDX\_PERM = 1 to NC\_NR\_ERR\_PERM

**If**(1) ERR\_PERM[IDX\_PERM] = PRM\_IDX\_ERR

**Then**(1)

PRM\_LV\_ERR\_PERM = 1

**Exit**

**Else**(2)

PRM\_LV\_ERR\_PERM = 0

**Endif**(1)

**Endfor**

**B.81.8 Clearing of permanent failure memory, in development****FUNCTION DESCRIPTION:****Description:**

For development conveniences, it is often useful to reinitialise the permanent failure memory. This is possible by setting the calibration bit LC\_ERR\_PERM\_CLR to 1.

**Application conditions****Initialisation:**

at RST system event

LV\_ERR\_PERM\_CLR\_OLD = LC\_ERR\_PERM\_CLR

at IGKON system event

LV\_ERR\_PERM\_CLR\_OLD = LC\_ERR\_PERM\_CLR

**Recurrence:**

1 s

**Activation:**

Always

**Formula section:**

(Detection of LC\_ERR\_PERM\_CLR 0 → 1 transition)

**If** (LV\_ERR\_PERM\_CLR\_OLD = 0

**and**

LC\_ERR\_PERM\_CLR = 1)


**Then**

**For** IDX\_PERM = 1 to NC\_NR\_ERR\_PERM

ERR\_PERM[IDX\_PERM] = 0

LV\_ERR\_CLR[IDX\_PERM] = 0


LV\_ERR\_PERM[IDX\_PERM] = 0

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```

ERR_SYM_PERM[IDX_PERM] = 0 (NO_SYM)
Endfor
If NLC_TREAT_DIAG_MIS = 0
Then
  (XX stands for MIS_A, MIS_B1, and MIS_B4)
  SYM_CYL_PERM_XX = 0
Endif
CTR_ERR_PERM_NR = 0
LV_DC_PERM_MEM = 0
Endif
LV_ERR_PERM_CLR_OLD = LC_ERR_PERM_CLR

```

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## B.82 Priority rules

### Input data:

LV_DC_MAX [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_CFM [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_DISA [NC_NR_ERR_DYN] {p. 5767}	NC_ERR_PRI_H {p. 5811}
PRI_CONF_XX {p. 5811}	WAL_CONF_XX {p. 5811}		

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_INC_ERR_PRI	-	0... 1H	0 ...1	1	-
Enable(1)/disable(0) increased failure priority strategy					
NLC_OBD_ENA_PRI_PERM	-	0... 1H	0 ...1	1	-
Activation/deactivation of special priority rule treatment for failures which are permanent (0: permanent failures are not protected, 1: permanent failures are protected)					
NLC_OLD_ERR_PRI	-	0... 1H	0 ...1	1	-
Set this bit to 1 to give priority to old failure regards to new failureSet this bit to 0 to give priority to new failure regards to old failure					

### Import actions:

<b>ACTION_ERRM_GetErrPerm (OUT&lt;PRM_LV_ERR_PERM&gt;,IN&lt;PRM_IDX_ERR&gt;)</b>
--

### General information

### Export actions:

<b>ACTION_ERRM_PrioRule (OUT &lt;RESP&gt;, OUT &lt;IDX&gt;)</b>
This action performs priority rules, when failure memory is full, to say if the new failure is accepted or not.

### B.82.1 Priority rules

#### General information:

The dynamic error management module calls this module in case of present failure occurrence when the 2<sup>nd</sup> layer memory is full.

It defines criteria to store or not this failure in the 2<sup>nd</sup> layer memory (dynamic memory). Only one failure occurrence is stored.

Results of this module is either:

- “storage of new failure not possible”
- or (“storage of new failure possible” ; index of failure to delete in 2<sup>nd</sup> layer memory)

In case of new failure entry whereas the dynamic memory is full (number of stored failure = NC\_NR\_ERR\_DYN), different criteria are applied to prioritize the failure:

- A new failure is more important than a disappeared failure
- Failure priority as defined in PRI\_CONF\_XX ;
  - Chronological failure order

If NLC\_OLD\_ERR\_PRI = 1: old failure has priority regards of new failure;  
(Failure i older than failure j means failure i has entered 2<sup>nd</sup> layer memory before failure j)

If NLC\_OLD\_ERR\_PRI = 0: new failure has priority regards of old failure;  
(Failure i newer than failure j means failure i has entered 2<sup>nd</sup> layer memory after failure j)

- NLC\_OBD\_ENA\_PRI\_PERM
  - Set this bit to 1 in order to protect permanent failures within priority rules algorithm: permanent faults cannot be deleted by priority rules
  - NLC\_OBD\_ENA\_PRI\_PERM = 1 : Permanent faults are protected.  
Must be used with US applications
  - Set this bit to 0 to apply always priority rules even if failure to be removed is permanent.
  - NLC\_OBD\_ENA\_PRI\_PERM = 0 : Permanent faults not protected.
  - When the ERRM memory is full, this action manages failure entry based on priority rules. Then, based on action result, failure entry is authorized or rejected.


Additional features of this functionality:

- MIL can never be switched off
- Failure setting the OBD freeze frame (e.g. used for diagnostic communication with scantool /mode 2h) cannot be erased.
- The “increased priority” can be enabled with the configuration NLC\_INC\_ERR\_PRI. This priority is a final rule, which is used, if it’s not possible to enter a failure with any of the other possibilities. Then it’s possible (only for failure with priority >= 4) to store the failure, if a confirmed failure not of the highest priority (priority < NC\_ERR\_PRI\_H), which is not illumination the MIL anymore, can be erased instead. If the new failure entry is not accepted because of the priority, this failure will not be stored in the 2<sup>nd</sup> layer memory but limp home is activated, thus the freeze frame is not memorized and also no lamp management for this failure is possible.

**Application conditions:**

- Initialisation:** –
- Activation:** –
- Deactivation:** –
- Recurrence:** –

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**Function description:**

**Formula section:**

**B.82.2 Detailed description for Action: ACTION\_ERRM\_ClcPriorityRules**

**General information:**

**Syntax :** ACTION\_ERRM\_PrioRule (OUT <RESP>, OUT <IDX>)

**Parameter (in) :** -

**Parameter (out) :** RESP OK if storage is possible; NOK if storage is not possible  
IDX Index of failure in 2<sup>nd</sup> layer memory to delete

**Short description :** This action performs priority rules, when failure memory is full, to say if the new failure is accepted or not.

**Application conditions:**

**Initialisation:** -  
**Activation:** -  
**Deactivation:** at action request  
**Recurrence:** -

**Function description:**

**Formula section:**

ACTION\_ERRM\_PrioRule (RESP, IDX) :

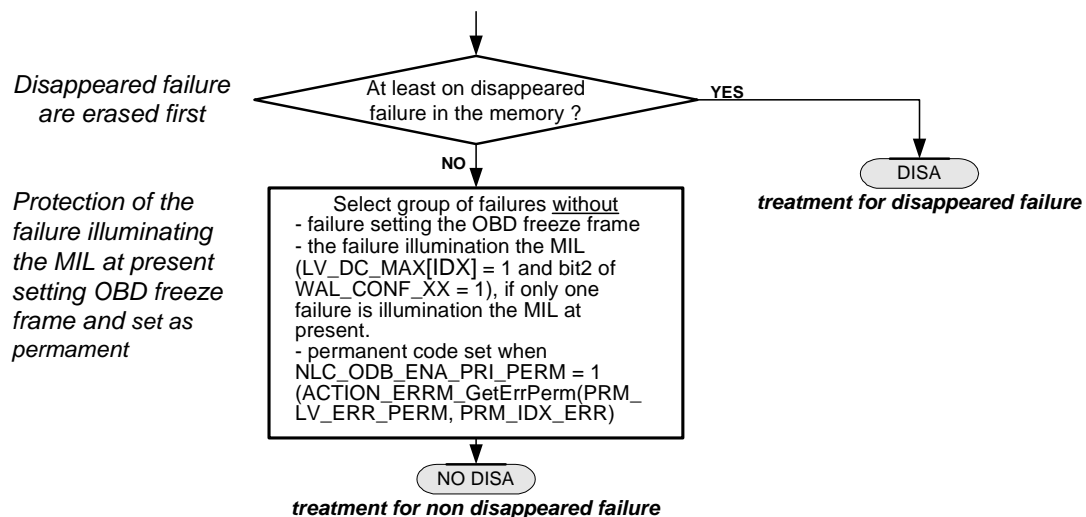



Figure B.82.1:

**Treatment for non disappeared failure:**

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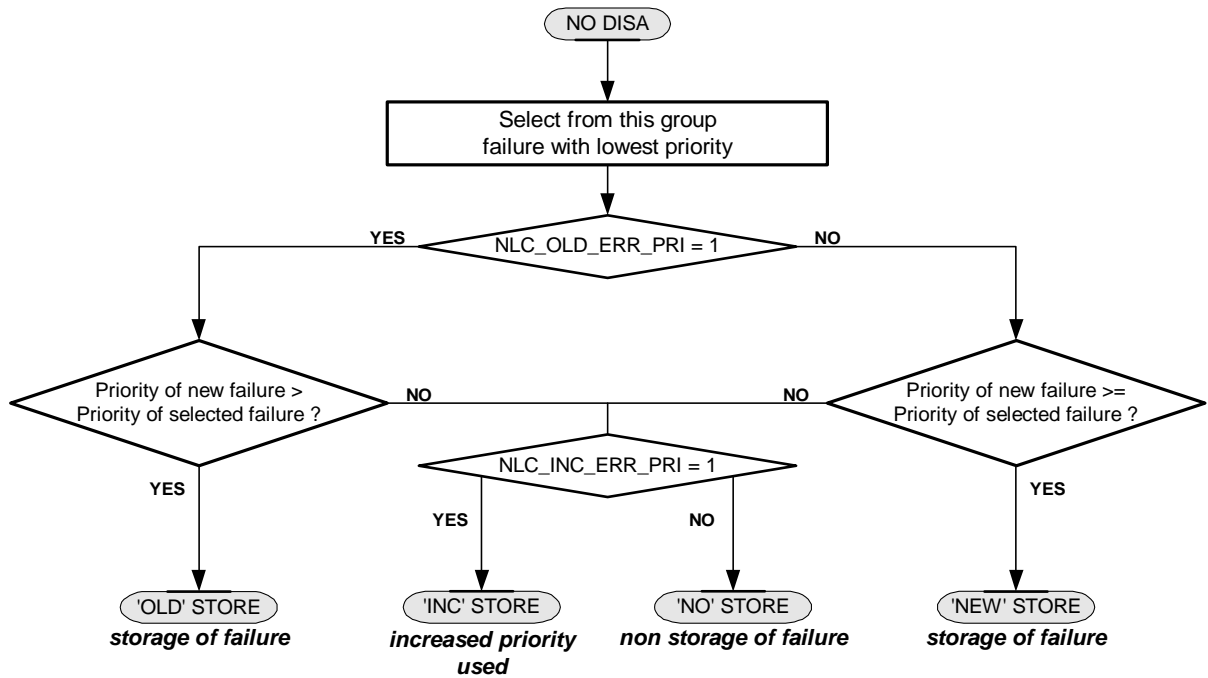


Figure B.82.2:

Treatment for disappeared failure:

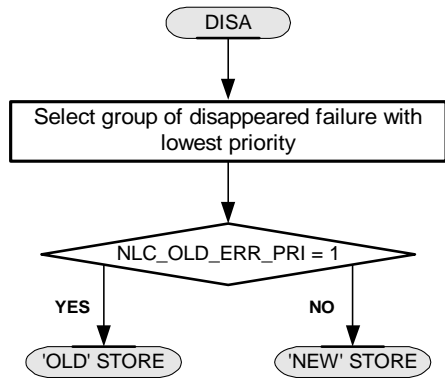


Figure B.82.3:

Storage /non storage of failure:

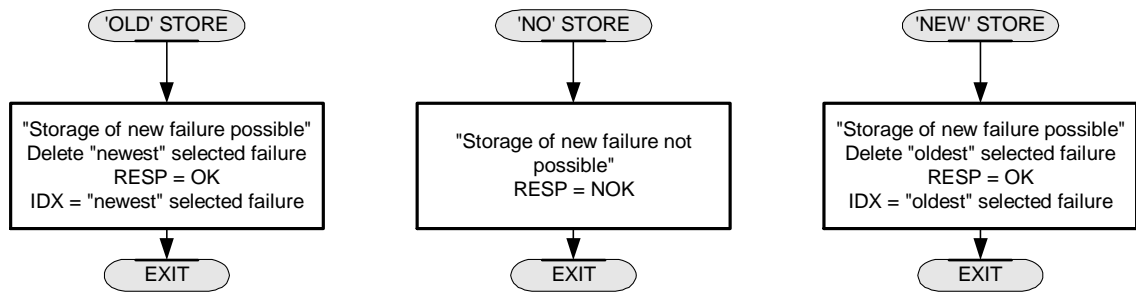


Figure B.82.4:

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Increased priority (with NLC\_INC\_ERR\_PRI = 1):

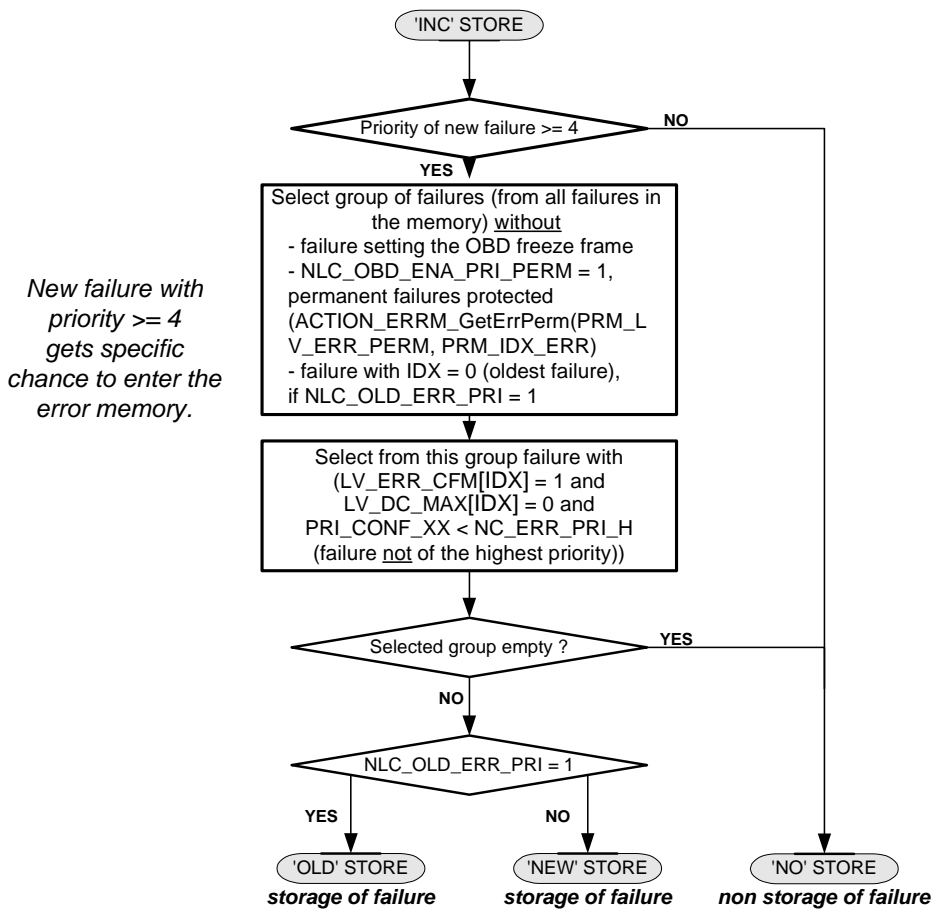


Figure B.82.5:

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## B.83 Rate based monitoring

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CDN_OBD_RBM	O/V/S	0... FFFFH	0... 65535	1	-
General denominator: Number of DC with valid standardized vehicle operations since first ECU power up					
CTR_CDN_RBM [NC_NR_DIAG_RBM]	O/V/S	0... FFFFH	0... 65535	1	-
Monitor individual denominator: Number of DC with convenient vehicle operation for monitor since first power up					
CTR_COMP_RBM [NC_NR_DIAG_RBM]	O/V/S	0... FFFFH	0... 65535	1	-
Monitor individual numerator: Number of DC with monitor done since first power up					
CTR_IGK_CYC_RBM	O/V/S	0... FFFFH	0... 65535	1	-
Ignition cycle counter: Number of DC since first ECU power up					
LV_DC_CDN_CST_RBM	O/V	0... 1H	0 ...1	1	-
Cold start conditions for individual denominator calculation					
LV_DC_RBM	O/V	0... 1H	0 ...1	1	-
DC including standardized vehicle operations for Rate-Based Monitoring					
LV_IGK_CYC_RBM	V	0... 1H	0 ...1	1	-
Boolean to indicate, that incrementation of CTR_IGK_CYC_RBM done this DC					
STATE_CTR_RBM [NC_NR_DIAG_RBM]	V	0... 3H	0 ...3	1	-
Information data for CTR_COMP_RBM					
STATE_DC_RBM	V	0... FFH	0... 255	1	-
Status information about all conditions necessary to set LV_DC_RBM					
T_AST_CST_RBM	V	0... FFFFH	0... 6553.5	0.1	s
Cumulative time since engine start (based on ambient temperature conditions)					
T_AST_RBM	V	0... FFFFH	0... 6553.5	0.1	s
Cumulated time since engine start with Rate-Based Monitoring conditions					
T_IS_RBM	V	0... FFFFH	0... 6553.5	0.1	s
Continuous vehicle operation in idle $\geq$ C_T_IS_RBM with Rate-Based Monitoring conditions					
T_VS_RBM	V	0... FFFFH	0... 6553.5	0.1	s
Cumulated vehicle operation with vehicle speed $\geq$ C_T_VS_RBM with Rate-Based Monitoring conditions					
TAM_ST_DSL_CMN	V	0... FEH	-48... 142.5	0	°C
Ambient temperature at engine start (used within ERRM only to handle GS/DS data types diversity)					

### Input data:

AMP {p. 982}	LV_DC {p. 5746}	LV_INH_DC_RBM {p. 5870}	LV_IS_RBM {p. 5870}
LV_PWL {p. 988}	NC_NR_DIAG_RBM {p. 5871}	PV {p. 978}	STATE_RBM [NC_NR_DIAG_RBM] {p. 5870}
TAM_DSL_CMN {p. 5870}	TCO_ST_DSL_CMN {p. 5789}	VS {p. 1176}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_MIN_RBM	-	0... FFFFH	0... 5434	0.0829175	hPa
Minimum ambient pressure for Rate-Based Monitoring (relation to altitude)					
C_DLY_AST_RBM	-	0... FFFFH	0... 6553.5	0.1	s
Time after start, necessary to increment the ignition cycle counter					
C_PV_IS_RBM	-	0... 3FFH	0... 99.90234	0.0976562	%
Minimum threshold to detect accelerator pedal released					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_AST_CST_RBM	-	0... FFFFH	0... 6553.5	0	s
Minimum cumulative time since engine start for cold start condition detection					
C_T_AST_RBM	-	0... FFFFH	0... 6553.5	0.1	s
Minimum trip length for Rate-Based Monitoring					
C_T_IS_RBM	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time of continuous idle operation for Rate-Based Monitoring					
C_T_VS_RBM	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time with VS_H_RES greater or equal than C_VS_THD_RBM for Rate-Based Monitoring					
C_TAM_MAX_CST_RBM	-	0... FEH	-48... 142.5	0	°C
Maximum ambient temperature threshold for for RBM cold start condition					
C_TAM_MIN_CST_RBM	-	0... FEH	-48... 142.5	0	°C
Minimum ambient temperature threshold for RBM cold start condition					
C_TAM_MIN_RBM	-	0... FEH	-48... 142.5	0.75	°C
Minimum ambient temperature for Rate-Based Monitoring					
C_TAM_ST_HYS_CST_RBM	-	0... FEH	-48... 142.5	0	°C
Ambient temperature hysteresis for RBM cold start condition					
C_TCO_ST_MAX_CST_RBM	-	0... FEH	-48... 142.5	0	°C
Maximum engine start temperature threshold for RBM cold start condition					
C_TCO_ST_MIN_CST_RBM	-	0... FEH	-48... 142.5	0	°C
Minimum engine start temperature threshold for RBM cold start condition					
C_VS_THD_IS_CDN_RBM	-	0... FFH	0... 25.5	0.1	km/h
Vehicle speed threshold for continuous idle speed operation, for Rate-Based Monitoring					
C_VS_THD_RBM	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed threshold to start timer T_VS_RBM					

### Output data detailed description:

STATE\_CTR\_RBM[NC\_NR\_DIAG\_RBM] : Information data for CTR\_COMP\_RBM[NC\_NR\_DIAG\_RBM] and CTR\_CDN\_RBM[NC\_NR\_DIAG\_RBM] calculations.

bit 0: incrementation of monitor individual numerator done in this DC

bit 1: incrementation of monitor individual denominator done in this DC

### FUNCTION DESCRIPTION:

#### General information:

To gain more information about the monitoring performance under real world conditions, CARB required to implement software algorithms to track and report in-use performance for the following monitors in a standardized format: Catalyst, Oxygen sensor, Evaporating system, EGR system, VVT system and Secondary air system.

For this kind of statistic different counters are necessary:

- Ignition cycle counter

*Counter that indicates the number of ignition cycles a vehicle has experienced*

- General denominator


*Measures the number of times a vehicle is operated under standardized conditions*

- Monitor individual numerator

*Measures the number of driving cycles in which the monitor was done*

- Monitor individual denominator

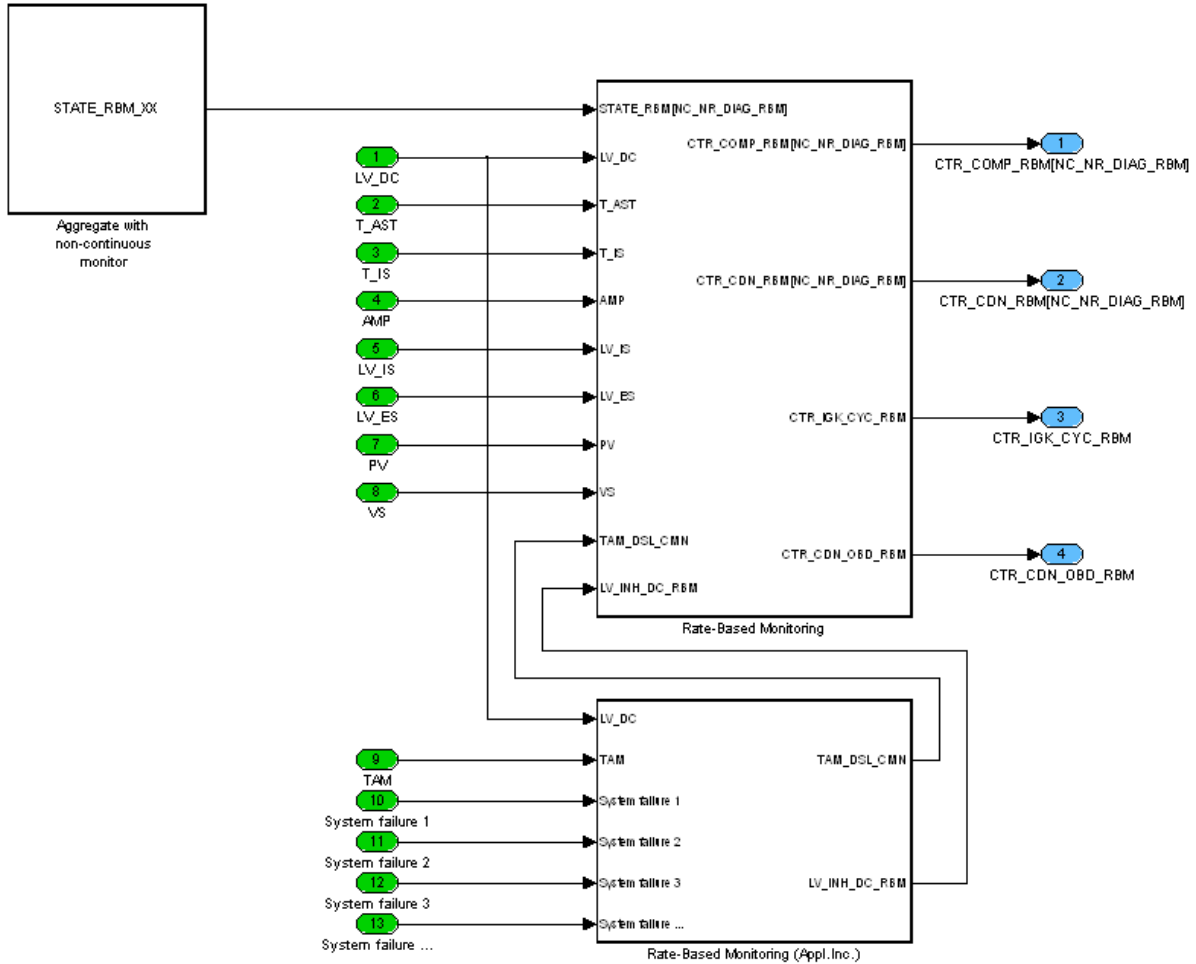
*Counter that indicates the number of times a vehicle is operated under monitor individual conditions.*

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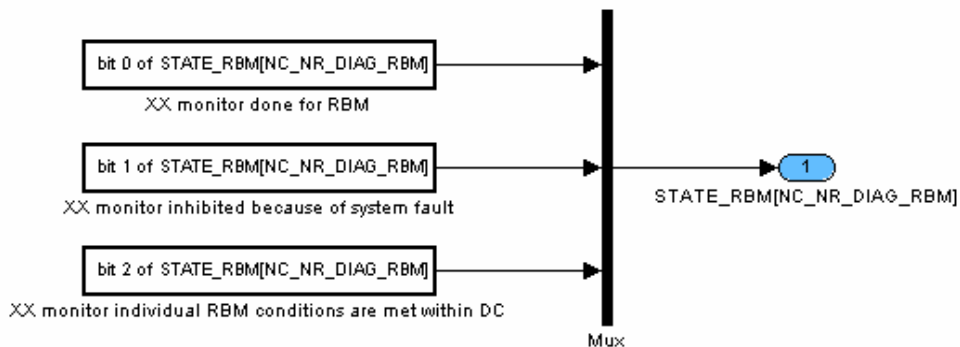
All these counters are set to zero only when a non-volatile memory reset occurs (e.g. reprogramming). They will not be initialized with zero on any other circumstances including when a scan-tool command to clear fault codes is received.

**Signal flow diagram:**

**Overview :**

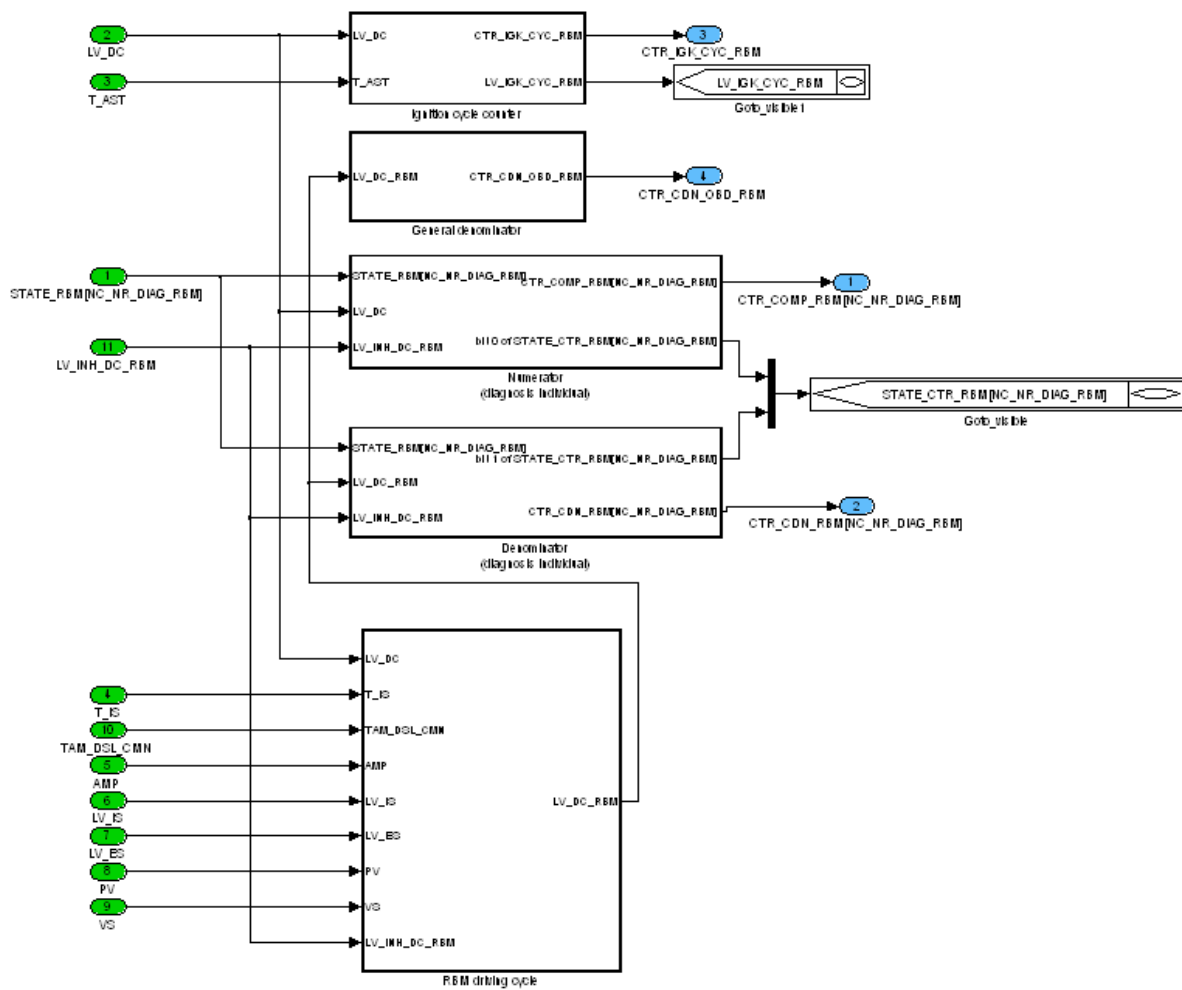


**STATE\_RBM[NC\_NR\_DIAG\_RBM] definition :**

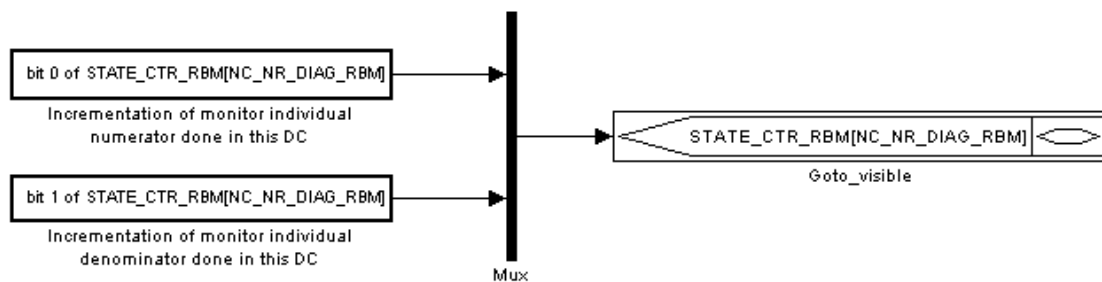


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### Modules of Rate-Based Monitoring :



### STATE\_CTR\_RBM[NC\_NR\_DIAG\_RBM] definition:




### B.83.1 Ignition cycle counter

#### Description:

The number of ignition cycles since the first ECU power up are counted within CTR\_IGK\_CYC\_RBM. The counter is incremented each time a driving cycle with engine running for at least 2 seconds ( $\pm 1s$ )

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(C\_DLY\_AST\_RBM) is detected. This value is only initialized with 0 on saved RAM lost (or reprogramming). If CTR\_IGK\_CYC\_RBM is incremented LV\_IGK\_CYC\_RBM is set to 1 to indicate that counter is already incremented within this driving cycle.

If the counter reaches its maximum value, the value is set to 0 on the next calculation.

### Application conditions

**Initialisation:**           at first ECU power up / on saved RAM lost (or reprogramming)  
                                  CTR\_IGK\_CYC\_RBM       = 0  
                                  at reset  
                                  CTR\_IGK\_CYC\_RBM       = restored from NVMY  
                                  at LV\_DC 0 → 1 transition and ECU reset  
                                  LV\_IGK\_CYC\_RBM = 0

**Recurrence:**             1 s

**Activation:**             LV\_DC = 1 **and** LV\_IGK\_CYC\_RBM = 0

### Formula section:

Quantity of driving cycles calculation:

**If** T\_AST >= C\_DLY\_AST\_RBM           (time after start at least C\_DLY\_AST\_RBM)

**Then**

**If** CTR\_IGK\_CYC\_RBM = 65535 (maximum value of CTR\_IGK\_CYC\_RBM)

**Then**

CTR\_IGK\_CYC\_RBM = 0

**Else**

CTR\_IGK\_CYC\_RBM = CTR\_IGK\_CYC\_RBM + 1

**Endif**

LV\_IGK\_CYC\_RBM = 1           (CTR\_IGK\_CYC\_RBM incremented this DC)

**Endif**

## B.83.2 General denominator calculation

### Description:

The counter for the general denominator CTR\_CDN\_OBD\_RBM is incremented each time a valid DC with standardized vehicle operation (LV\_DC\_RBM = 1) is recognized. The numbers of driving cycles are counted since the first ECU power up. This value is only initialized with 0 on saved RAM lost (or reprogramming).


If the counter reaches its maximum value, the value is set to 0 on the next calculation.

### Application conditions

**Initialisation:**           at first ECU power up / on saved RAM lost (or reprogramming)  
                                  CTR\_CDN\_OBD\_RBM       = 0  
                                  at reset  
                                  CTR\_CDN\_OBD\_RBM       = restored from NVMY

**Recurrence:**             -

**Activation:**             LV\_DC\_RBM 0→1 transition

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**Formula section:**

```

If          CTR_CDN_OBD_RBM = 65535 (maximum value of CTR_CDN_OBD_RBM)
Then
          CTR_CDN_OBD_RBM = 0
Else
          General denominator calculation:
          CTR_CDN_OBD_RBM      = CTR_CDN_OBD_RBM + 1
Endif
    
```

**B.83.3 Monitor individual numerator calculation**

**Description:**

For all monitors requiring Rate-Based Monitoring (m = 0 to (NC\_NR\_DIAG\_RBM - 1)) a numerator must be calculated. This numerator CTR\_COMP\_RBM[m] is incremented, if the conditions for the monitor were present for a sufficient time (bit 0 of STATE\_RBM[m] = 1), but only one time within the driving cycle. This value is only initialized with 0 on saved RAM lost (or reprogramming)  
 If the counter CTR\_CDN\_RBM[m] is halved, because of maximum value limitation, the value CTR\_COMP\_RBM[m] is also divided by 2 (positive rounded).

**Application conditions**

```

Initialisation:      at first ECU power up / on saved RAM lost (or reprogramming)
                          CTR_COMP_RBM[m] = 0
                          at reset
                          CTR_COMP_RBM[m] = restored from NVMY
                          at LV_DC 0 → 1 transition or ECU reset
                          STATE_CTR_RBM[m] = 0
                          with m = 0 to (NC_NR_DIAG_RBM - 1)
Recurrence:        10 s or LV_DC 1 → 0 transition
Activation:         LV_INH_DC_RBM = 0 and LV_DC = 1
    
```


**Formula section:**

```

For m = 0 to (NC_NR_DIAG_RBM - 1)
  all monitor requiring Rate-Based Monitoring
  { see specification "Rate-Based Monitoring (Appl. Inc.)" }
  If          bit 0 of STATE_CTR_RBM[m] = 0
                (Incrementation of CTR_COMP_RBM[m] not yet done in this DC)
  Then If     bit 0 of STATE_RBM[m] = 1
                (monitor is done for RBM)
                and bit 1 of STATE_RBM[m] = 0
                (monitor isn't inhibited because of a system fault)
                Then CTR_COMP_RBM[m] = CTR_COMP_RBM[m] + 1
                bit 0 of STATE_CTR_RBM[m] = 1
                (Incrementation of CTR_COMP_RBM[m] done in DC)
  Endif
Endif
Endfor
    
```

**B.83.4 Monitor individual denominator calculation**

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### Description:

In comparison to the counter CTR\_IGK\_CYC\_RBM, counting the numbers of driving cycles (longer C\_DLY\_AST\_RBM) since the first ECU power-up, the monitor individual denominator is counting the number of DC in which special vehicle/driving and ambient conditions are met individually for each monitor.

The counter CTR\_CDN\_RBM[m] is managed individually for each monitor (m = 0 to (NC\_NR\_DIAG\_RBM - 1)), for which the monitoring of the real in-use performance is made. To increment the monitor denominator, some common conditions must be fulfilled (LV\_DC\_RBM = 1) but also monitor individual conditions. These monitor individual conditions are managed within the monitor function (bit 2 of STATE\_RBM[m]). The value is only initialized with 0 on saved RAM lost (or reprogramming).

If the counter CTR\_COMP\_RBM[m] is halved, because of maximum value limitation, the value CTR\_CDN\_RBM[m] is also divided by 2 (positive rounded).

### Application conditions

**Initialisation:** at first ECU power up / on saved RAM lost (or reprogramming)  
CTR\_CDN\_RBM[m] = 0  
at reset  
CTR\_CDN\_RBM[m] = restored from NVMY  
with m = 0 to (NC\_NR\_DIAG\_RBM - 1)

**Recurrence:** 10 s **or** LV\_DC 1 → 0 transition (before LV\_DC\_RBM initialisation performed at LV\_DC 1 → 0)

**Activation:** LV\_INH\_DC\_RBM = 0 **and** LV\_DC\_RBM = 1


### Formula section:

**For** m = 0 to (NC\_NR\_DIAG\_RBM - 1)  
all monitor requiring Rate-Based Monitoring  
{ see specification "Rate-Based Monitoring (Appl. Inc.)" }  
**If** bit 1 of STATE\_CTR\_RBM[m] = 0  
(incrementation is not done yet)  
**Then If** bit 1 of STATE\_RBM[m] = 0  
(monitor is not inhibit, because of a system fault)  
**and** bit 2 of STATE\_RBM[m] = 1  
(monitor individual RBM conditions are met within this DC)  
**Then** CTR\_CDN\_RBM[m] = CTR\_CDN\_RBM[m] + 1  
bit 1 of STATE\_CTR\_RBM[m] = 1  
(incrementation is done within DC)  
**Endif**  
**Endif**  
**Endfor**

## **B.83.5 Counter overflow treatment for monitor individual numerator and denominator**

### Description:

If either the numerator or denominator for a specific component reaches the maximum value (65535), both numbers shall be divided by two before either is incremented again to avoid overflow problems.

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### Application conditions

**Initialisation:** -  
**Recurrence:** -  
**Activation:** LV\_DC 0 → 1 transition

### Formula section:

**For** m = 0 to (NC\_NR\_DIAG\_RBM - 1)  
 all monitor requiring Rate-Based Monitoring  
 { see specification "Rate-Based Monitoring (Appl. Inc.)" }  
**If** CTR\_CDN\_RBM[m] = 65535 (maximum value of CTR\_CDN\_RBM[m])  
 or  
 CTR\_COMP\_RBM[m] = 65535 (maximum value of CTR\_COMP\_RBM[m])  
**Then** CTR\_CDN\_RBM[m] = CTR\_CDN\_RBM[m] /2  
 CTR\_COMP\_RBM[m] = CTR\_COMP\_RBM[m] /2  
**Endif**  
**Endfor**

## B.83.6 Standardized vehicle operation for Rate-Based Monitoring

### FUNCTION DESCRIPTION:

#### General information:


For the calculation of the denominators for Rate-Based Monitoring, CARB standardized vehicle operations, which must be met to increment the denominator counter.

#### Description:

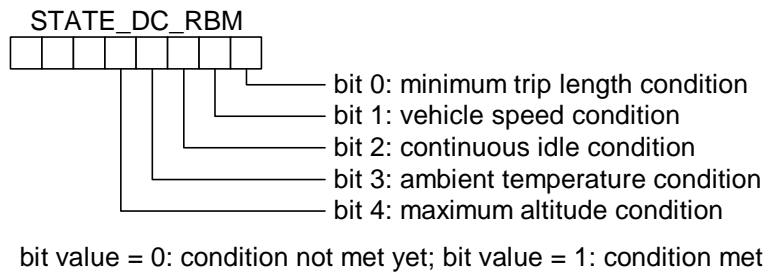
A special driving cycle (LV\_DC\_RBM) for Rate-Based Monitoring is defined, which is set, if the following standardized vehicle operations are fulfilled:

- Cumulated trip length (time since engine start) T\_AST\_RBM >= C\_T\_AST\_RBM  
(CARB : 600 s)
  - Cumulative vehicle operation >= C\_VS\_THD\_RBM for minimum of C\_T\_VS\_RBM  
(CARB : >= 40 km/h (25mph) for at least 300 s)
  - Continuous vehicle operation in idle equal or longer than C\_T\_IS\_RBM (accelerator pedal released and vehicle speed less or equal than 1 mph)  
(CARB : 30 s)
- with
- altitude such as ambient pressure AMP > C\_AMP\_MIN\_RBM  
(CARB : 8000 feet)
  - ambient temperature (TAM\_DSL\_CMN) >= C\_TAM\_MIN\_RBM  
(CARB : 20 °F)

Remark: to manage data type diversity between GS and DS divisions, TAM\_DSL\_CMN variable is updated with ambient temperature information every 100 ms.

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Within STATE\_DC\_RBM the different conditions necessary to set LV\_DC\_RBM are visualized.



### Application conditions

**Initialisation:**

at LV\_DC 0 → 1 transition **or** reset  
 LV\_DC\_RBM = 0  
 STATE\_DC\_RBM = 0H  
 T\_AST\_RBM = 0 s  
 T\_VS\_RBM = 0 s  
 T\_IS\_RBM = 0 s

at LV\_DC 1 → 0 transition  
**after** individual numerator/ denominator computations:  
 LV\_DC\_RBM = 0  
 STATE\_DC\_RBM = 0H

**Recurrence:** 100 ms

**Activation:**

LV\_DC = 1 **and** LV\_PWL = 0  
**and**  
 LV\_DC\_RBM = 0  
**and**  
 LV\_INH\_DC\_RBM = 0

### Formula section:

#### Ambient temperature

**If (1)** TAM\_DSL\_CMN >= C\_TAM\_MIN\_RBM (ambient temperature condition)  
**Then (1)** bit 3 of STATE\_DC\_RBM = 1 (ambient temperature condition reached)  
**Else (1)** bit 3 of STATE\_DC\_RBM = 0 (ambient temperature condition not reached)  
**Endif (1)**

#### Maximum altitude

**If (1)** AMP > C\_AMP\_MIN\_RBM (maximum altitude condition)  
**Then (1)** bit 4 of STATE\_DC\_RBM = 1 (maximum altitude condition reached)  
**Else (1)** bit 4 of STATE\_DC\_RBM = 0 (maximum altitude condition not reached)  
**Endif (1)**

**If (1)** bit 3 and bit 4 of STATE\_DC\_RBM = 1  
**Then (1)**

#### Minimum trip length

**If (2)** bit 0 of STATE\_DC\_RBM = 0 (minimum trip length not reached yet)  
**Then (2)**

T\_AST\_RBM = T\_AST\_RBM + 100 ms  
**If (3)** T\_AST\_RBM = C\_T\_AST\_RBM

**Then (3)**

bit 0 of STATE\_DC\_RBM = 1

**Endif (3)**

**Endif (2)**

Vehicle speed

**If (2)** bit 1 of STATE\_DC\_RBM = 0 (vehicle speed condition not met yet)

**and**

VS >= C\_VS\_THD\_RBM

**Then (2)**

T\_VS\_RBM = T\_VS\_RBM + 100 ms

**If (3)** T\_VS\_RBM = C\_T\_VS\_RBM

**Then (3)**

bit 1 of STATE\_DC\_RBM = 1

**Endif (3)**

**Endif (2)**

Continuous idle

**If (2)** bit 2 of STATE\_DC\_RBM = 0 (continuous idle cond. not met yet)

**Then (2)**

**If (3)** LV\_IS\_RBM = 1 (engine is considered as being in idle)

**and**

PV <= C\_PV\_IS\_RBM (accelerator pedal released)

**and**

VS <= C\_VS\_THD\_IS\_CDN\_RBM (CARB: 1 mile/h)

**Then (3)**

T\_IS\_RBM = T\_IS\_RBM + 100 ms

**If (4)** T\_IS\_RBM = C\_T\_IS\_RBM

**Then (4)**

bit 2 of STATE\_DC\_RBM = 1

**Endif (4)**

**Else (3)**

T\_IS\_RBM = 0

**Endif (3)**

**Endif (2)**

**Else (1)**

T\_IS\_RBM = 0 (ambient temperature and maximum altitude conditions not met during the whole continuous idle speed condition)

**Endif (1)**

Global information about DC including standardized vehicle operations

**If (1)** STATE\_DC\_RBM = 1FH (all conditions are met)


**Then (1)** LV\_DC\_RBM = 1

**Endif (1)**

## B.83.7 Cold start conditions detection

### FUNCTION DESCRIPTION:

#### General information:

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The individual monitor condition established for evaporative system denominator calculation (see §1968.2 - 4.3.2, section D) can be applied for other diagnoses (bit 2 calculation of STATE\_RBM\_xx) that require extended monitoring evaluation (e.g. coolant or intake air rationality).

### Description:

Cold start conditions are set within the driving cycle when: (see §1968.2 - 4.3.2, section D)

- Cumulative time since engine start is greater than or equal to 600 seconds while at an ambient temperature of greater than or equal to 40 degrees Fahrenheit but less than or equal to 95 degrees Fahrenheit
- Engine cold start occurs with engine coolant temperature at engine start greater than or equal to 40 degrees Fahrenheit but less than or equal to 95 degrees Fahrenheit and less than or equal to 12 degrees Fahrenheit higher than ambient temperature at engine start.

### Application conditions

**Initialisation:** at RST system event **or** at LV\_DC 0 → 1 transition  
 LV\_DC\_CDN\_CST\_RBM = 0  
 T\_AST\_CST\_RBM = 0 s  
 TAM\_ST\_DSL\_CMN = TAM\_DSL\_CMN

**Recurrence:** 100ms

**Activation:** LV\_DC = 1  
**and**  
 LV\_DC\_CDN\_CST\_RBM = 0  
**and**  
 LV\_INH\_DC\_RBM = 0  
*Deactivation:* LV\_DC = 0  
**or**  
 LV\_DC\_CDN\_CST\_RBM = 1  
**or**  
 LV\_INH\_DC\_RBM = 1

### Formula section:


**If(1)** C\_TAM\_MIN\_CST\_RBM <= TAM\_DSL\_CMN <= C\_TAM\_MAX\_CST\_RBM  
*(ambient temperature greater than or equal to 40 degrees Fahrenheit but less than or equal to 95 degrees Fahrenheit)*

**Then(1)**  
**If(2)** T\_AST\_CST\_RBM >= C\_T\_AST\_CST\_RBM  
*(time since start is greater than or equal to 600 seconds)*

**Then(2)** T\_AST\_CST\_RBM is frozen  
**If(3)** C\_TCO\_ST\_MIN\_CST\_RBM <= TCO\_ST\_DSL\_CMN <= C\_TCO\_ST\_MAX\_CST\_RBM  
*(engine coolant temperature at engine start is greater than or equal to 40 degrees but less than or equal to 95 degrees Fahrenheit)*  
**and**  
 TCO\_ST\_DSL\_CMN <= (TAM\_ST\_DSL\_CMN + C\_TAM\_ST\_HYS\_CST\_RBM)  
*(less than or equal to 12 degrees Fahrenheit higher than ambient temperature at engine start)*

**Then(3)**  
 LV\_DC\_CDN\_CST\_RBM = 1

**Endif(3)**

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**Else(2)**

T\_AST\_CST\_RBM = T\_AST\_CST\_RBM + 100ms

**Endif(2)****Else(1)**

T\_AST\_CST\_RBM is frozen

**Endif(1)**

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## B.84 Rate based monitoring (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_CST_RBM	O/V	0... 1H	0 ...1	1	-
Cold start conditions for individual denominator calculation					
LV_INH_DC_RBM	O/V	0... 1H	0 ...1	1	-
Inhibition of standardized vehicle operation calculation, due to a system failure that influences the conditions necessary to set LV_DC_RBM					
LV_IS_RBM	O/V	0... 1H	0 ...1	1	-
Adaptation for STST Hybrid Idle detection					
LV_OBD_IS_RBM_CUS_ADJ	O/V	0... 1H	0 ...1	1	-
Adaptation for customer specific idle detection used inside rbm cycle					
STATE_RBM [NC_NR_DIAG_RBM]	O	0... FH	0... 15	1	-
Monitor interface for the Rate-Based Monitoring statistics					
TAM_DSL_CMN	O/V	0... FEH	-48... 142.5	0.75	°C
Ambient temperature (used within ERRM only to support GS/DS data types diversity)					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_DC {p. 5746}	LV_DC_CDN_CST_RBM {p. 5858}	LV_DC_RBM {p. 5858}
LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_TAM_CAN {p. 5076}	LV_ERR_TAM_PLAUS {p. 5076}	LV_ERR_VS {p. 5021}
NC_CYL_NR {p. 1526}	NC_IDX_DIAG_XX	NC_INJ_CONF {p. 626}	STATE_RBM_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5285}
STATE_RBM_AMP_PLAUS {p. 6130}	STATE_RBM_ANG_CHK_ MAX_VVL	STATE_RBM_ANG_INST_ AD_VVL	STATE_RBM_CAM_CST_ IVVT_EX [NC_NR_CBK_IVVT] {p. 1063}
STATE_RBM_CAM_CST_ IVVT_IN [NC_NR_CBK_IVVT] {p. 1063}	STATE_RBM_CAT_DIAG [NC_CBK_EX_NR]	STATE_RBM_CHK_LS_ DOWN [NC_CBK_EX_NR] {p. 5407}	STATE_RBM_CS {p. 5018}
STATE_RBM_CSERS_INJ {p. 6117}	STATE_RBM_CYL_BAL_ LAM [NC_CYL_NR]	STATE_RBM_DIAGCPS {p. 5954}	STATE_RBM_DMTLM {p. 6037}
STATE_RBM_DYN_VLD_ LS_UP [NC_CBK_EX_NR] {p. 5378}	STATE_RBM_EAC	STATE_RBM_EFF_IGA_ CST_IS {p. 6508}	STATE_RBM_EFF_IGA_ CST_PL {p. 6508}
STATE_RBM_ER_BAL_ HOM [NC_NR_CBK_BAL_HOM]	STATE_RBM_FTL_OBD {p. 4757}	STATE_RBM_FUP_CH [NC_CBK_HPP_NR] {p. 6102}	STATE_RBM_ISC {p. 4392}
STATE_RBM_ISC_CST {p. 4392}	STATE_RBM_LOAD_TPS_ PLAUS {p. 1063}	STATE_RBM_MAF {p. 4820}	STATE_RBM_MAP_DIP_ PLAUS {p. 1063}

STATE_RBM_MAP_TPS_PLAUS [NC_MAP_SENS_NR]	STATE_RBM_MEC_IVVT_EX {p. 1063}	STATE_RBM_MEC_IVVT_IN {p. 1064}	STATE_RBM_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5210}
STATE_RBM_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5433}	STATE_RBM_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4252}	STATE_RBM_OC_LSL_UP [NC_CBK_EX_NR] {p. 4309}	STATE_RBM_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4252}
STATE_RBM_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5291}	STATE_RBM_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5190}	STATE_RBM_ROUGH_LEAK {p. 6037}	STATE_RBM_SA_SAFM
STATE_RBM_SA_SAP	STATE_RBM_SA_SAV	STATE_RBM_SA_SAV_LSL	STATE_RBM_SA_SYS
STATE_RBM_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4252}	STATE_RBM_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5340}	STATE_RBM_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5340}	STATE_RBM_SMALL_LEAK {p. 6037}
STATE_RBM_SWT_LS_DOWN [NC_CBK_EX_NR] {p. 5160}	STATE_RBM_T_ES {p. 4477}	STATE_RBM_T_ES_TCO_FAST {p. 4477}	STATE_RBM_T_ES_TCO_SLOW {p. 4477}
STATE_RBM_TAM_PLAUS {p. 5083}	STATE_RBM_TCO_2_PLAUS {p. 5672}	STATE_RBM_TCO_PLAUS {p. 5687}	STATE_RBM_TCO_STUCK {p. 4502}
STATE_RBM_TCO_STUCK_RNG {p. 5678}	STATE_RBM_TH {p. 5660}	STATE_RBM_TIA_MES_PLAUS [NC_SENS_NR_TIA]	STATE_RBM_TIA_PLAUS {p. 5103}
STATE_RBM_TIA_THR_MES_PLAUS [NC_SENS_NR_TIA_THR]	STATE_RBM_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4415}	STATE_RBM_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4415}	STATE_RBM_TPS {p. 5007}
STATE_RBM_TQ_CST {p. 1064}	STATE_RBM_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5229}	TAM {p. 1579}	


**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_RBM_CLR	-	0... 1H	0 ...1	1	-
reinit the rate base monitoring statistics at LC_RBM_CLR 0->1					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_TBL_DIAG_RBM [NC_NR_DIAG_RBM]	-	0... FFH	0... 255	1	-
Table of monitors connected to Rate-Based Monitoring function					
NC_NR_DIAG_RBM	-	1... FFH	1... 255	1	-
Instance number of monitor using RBM statistics					
NC_NR_DIST_RBM	-	1... FFH	1... 255	1	-
Number of diesel monitors with mileage criteria to increment denominator (Typical value : 1)					
NC_RBM_BPA	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for boost pressure control (diesel only)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_RBM_CAT_1	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for catalyst bank 1					
NC_RBM_CAT_2	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for catalyst bank 2					
NC_RBM_CUS	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for specific customer group (not displayed on Scan Tool)					
NC_RBM_EG_1	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for exhaust gas sensor bank 1 (diesel only)					
NC_RBM_EGR_VVT	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for EGR and VVT systems					
NC_RBM_EGR_VVT_DSL	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for EGR and VVT systems (diesel only)					
NC_RBM_EVAP	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for evaporative system					
NC_RBM_LS_DOWN_1	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for secondary oxygen sensor bank 1 (gasoline only)					
NC_RBM_LS_DOWN_2	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for secondary oxygen sensor bank 2 (gasoline only)					
NC_RBM_LS_UP_1	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for oxygen sensor bank 1					
NC_RBM_LS_UP_2	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for oxygen sensor bank 2					
NC_RBM_NMHC	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for NMHC catalyst (diesel only)					
NC_RBM_NT	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for NOx adsorber (NOx trap) (diesel only)					
NC_RBM_PF	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for PM particulate filter (diesel only)					
NC_RBM_RCAT	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for NOx reduction catalyst (diesel only)					
NC_RBM_SA	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for secondary air system					

### Import actions:

<b>ACTION_ERRM_CheckPendingStatus</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR_PND>)
<b>ACTION_ERRM_ClearRbmStatistics</b> (<OUT>,<PRM_RESULTCLRINFO>)

## B.84.1 Definition of diagnosis using RBM

### FUNCTION DESCRIPTION:

#### Description:

Depending on the system configuration and the customer requirements, the diagnosis individual counters for Rate-Based Monitoring, the numerator and denominator, must be calculated for specific monitors.

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Within this module the monitors using RBM statistics are defined.


### Application conditions

**Initialisation :** at ECU reset and LV\_DC 0 1 transition :  
**For** i = 0 to NC\_NR\_DIAG\_RBM **do**  
 STATE\_RBM[i] = 0  
**Endfor**

**Recurrence:** 10 s { always executed prior to Rate-Based Monitoring main module }


**Activation:** every engine operating state

### Formula section:

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	Interface byte	Group Name
1	STATE_RBM_CAT_DIAG_1	NC_RBM_CAT_1
2	STATE_RBM_CAT_DIAG_2	NC_RBM_CAT_2
3	STATE_RBM_DYN_VLD_LS_UP_1	NC_RBM_LS_UP_1
4	STATE_RBM_SHIFT_AFL_LSL_UP_1	NC_RBM_LS_UP_1
5	STATE_RBM_SHIFT_AFR_LSL_UP_1	NC_RBM_LS_UP_1
6	STATE_RBM_AIR_LSL_UP_1	NC_RBM_LS_UP_1
7	STATE_RBM_DYN_VLD_LS_UP_2	NC_RBM_LS_UP_2
8	STATE_RBM_SHIFT_AFL_LSL_UP_2	NC_RBM_LS_UP_2
9	STATE_RBM_SHIFT_AFR_LSL_UP_2	NC_RBM_LS_UP_2
10	STATE_RBM_AIR_LSL_UP_2	NC_RBM_LS_UP_2
11	STATE_RBM_SMALL_LEAK	NC_RBM_EVAP
12	STATE_RBM_MEC_IVVT_IN	NC_RBM_EGR_VVT (If NC_CYL_NR = 4 or 6)
13	STATE_RBM_MEC_IVVT_EX	NC_RBM_EGR_VVT (If NC_CYL_NR = 4 or 6)
14	STATE_RBM_MEC_IVVT_IN_1	NC_RBM_EGR_VVT (If NC_CYL_NR = 8)
15	STATE_RBM_MEC_IVVT_EX_1	NC_RBM_EGR_VVT (If NC_CYL_NR = 8)
16	STATE_RBM_MEC_IVVT_IN_2	NC_RBM_EGR_VVT (If NC_CYL_NR = 8)
17	STATE_RBM_MEC_IVVT_EX_2	NC_RBM_EGR_VVT (If NC_CYL_NR = 8)
18	STATE_RBM_TOOTH_OFF_IN_1	NC_RBM_EGR_VVT
19	STATE_RBM_TOOTH_OFF_EX_1	NC_RBM_EGR_VVT
20	STATE_RBM_TOOTH_OFF_IN_2	NC_RBM_EGR_VVT (If NC_CYL_NR = 8)
21	STATE_RBM_TOOTH_OFF_EX_2	NC_RBM_EGR_VVT (If NC_CYL_NR = 8)
22	STATE_RBM_SA_SYS	NC_RBM_SA (If NC_INJ_CONF = 0; //MSV80,90)
23	STATE_RBM_SA_SAFM	NC_RBM_SA (If NC_INJ_CONF = 0; //MSV80,90)
24	STATE_RBM_SA_SAV	NC_RBM_SA

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		(If NC_INJ_CONF = 0; //MSV80,90)
25	STATE_RBM_SA_SAP	NC_RBM_SA (If NC_INJ_CONF = 0; //MSV80,90)
26	STATE_RBM_SA_SAV_LSL	NC_RBM_SA (If NC_INJ_CONF = 0; //MSV80,90)
27	STATE_RBM_CHK_LS_DOWN_1	NC_RBM_LS_DOWN_1
28	STATE_RBM_SWT_LS_DOWN_1	NC_RBM_LS_DOWN_1
29	STATE_RBM_PUC_LS_DOWN_1	NC_RBM_LS_DOWN_1
30	STATE_RBM_PUE_LS_DOWN_1	NC_RBM_LS_DOWN_1
31	STATE_RBM_CHK_LS_DOWN_2	NC_RBM_LS_DOWN_2
32	STATE_RBM_SWT_LS_DOWN_2	NC_RBM_LS_DOWN_2
33	STATE_RBM_PUC_LS_DOWN_2	NC_RBM_LS_DOWN_2
34	STATE_RBM_PUE_LS_DOWN_2	NC_RBM_LS_DOWN_2
35	STATE_RBM_DIAGCPS	NC_RBM_CUS
36	STATE_RBM_ROUGH_LEAK	NC_RBM_CUS
37	STATE_RBM_DMTLM	NC_RBM_CUS
38	STATE_RBM_TH	NC_RBM_CUS
39	STATE_RBM_TCO_PLAUS	NC_RBM_CUS
40	STATE_RBM_TCO_STUCK	NC_RBM_CUS
41	STATE_RBM_TCO_2_PLAUS	NC_RBM_CUS
42	STATE_RBM_TAM_PLAUS	NC_RBM_CUS
43	STATE_RBM_VS_PLAUS	NC_RBM_CUS
44	STATE_RBM_FTL_OBD	NC_RBM_CUS
45	STATE_RBM_OBD_LSH_DOWN_1	NC_RBM_CUS
46	STATE_RBM_OBD_LSH_DOWN_2	NC_RBM_CUS
47	STATE_RBM_OBD_VLD_LSH_UP_1	NC_RBM_CUS
48	STATE_RBM_OBD_VLD_LSH_UP_2	NC_RBM_CUS
49	STATE_RBM_CS	NC_RBM_CUS
50	STATE_RBM_ISC	NC_RBM_CUS
51	STATE_RBM_MAF	NC_RBM_CUS
52	STATE_RBM_TIA_PLAUS	NC_RBM_CUS (If NC_CYL_NR = 4 or 6)
53	STATE_RBM_AMP_PLAUS	NC_RBM_CUS
54	STATE_RBM_LOAD_TPS_PLAUS	NC_RBM_CUS

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		(If NC_CYL_NR = 4 or 6)
55	STATE_RBM_LOAD_TPS_PLAUS_0	NC_RBM_CUS (If NC_CYL_NR = 8)
56	STATE_RBM_LOAD_TPS_PLAUS_1	NC_RBM_CUS (If NC_CYL_NR = 8)
57	STATE_RBM_MAP_DIP_PLAUS	NC_RBM_CUS (If NC_CYL_NR = 4 or 6)
58	STATE_RBM_MAP_TPS_PLAUS_0	NC_RBM_CUS (If NC_CYL_NR = 8)
59	STATE_RBM_MAP_TPS_PLAUS_1	NC_RBM_CUS (If NC_CYL_NR = 8)
60	STATE_RBM_VLS_DOWN_DIF_1	NC_RBM_CUS
61	STATE_RBM_VLS_DOWN_DIF_2	NC_RBM_CUS
62	STATE_RBM_T_ES	NC_RBM_CUS
63	STATE_RBM_TPS	NC_RBM_CUS (If NC_CYL_NR = 4 or 6)
64	STATE_RBM_TPS_0	NC_RBM_CUS (If NC_CYL_NR = 8)
65	STATE_RBM_TPS_1	NC_RBM_CUS (If NC_CYL_NR = 8)
66	STATE_RBM_ISC_CST	NC_RBM_CUS
67	STATE_RBM_TQ_CST	NC_RBM_CUS
68	STATE_RBM_TCO_STUCK_RNG	NC_RBM_CUS
69	STATE_RBM_ANG_INST_AD_VVL	NC_RBM_CUS (If NC_INJ_CONF = 0; //MSV80,90)
70	STATE_RBM_ANG_CHK_MAX_VVL	NC_RBM_CUS (If NC_INJ_CONF = 0; //MSV80,90)
71	STATE_RBM_EAC	NC_RBM_CUS (If NC_INJ_CONF = 0; //MSV80,90)
72	STATE_RBM_TIA_MES_PLAUS_0	NC_RBM_CUS (If NC_CYL_NR = 8)
73	STATE_RBM_TIA_MES_PLAUS_1	NC_RBM_CUS (If NC_CYL_NR = 8)
74	STATE_RBM_TIA_THR_MES_PLAUS_0	NC_RBM_CUS (If NC_CYL_NR = 8)
75	STATE_RBM_TIA_THR_MES_PLAUS_1	NC_RBM_CUS (If NC_CYL_NR = 8)
76	STATE_RBM_T_ES_TCO_FAST	NC_RBM_CUS
77	STATE_RBM_T_ES_TCO_SLOW	NC_RBM_CUS
78	STATE_RBM_FUP_CH_1	NC_RBM_CUS (If NC_INJ_CONF = 1)
79	STATE_RBM_FUP_CH_2	NC_RBM_CUS (If NC_CYL_NR = 8)

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80	STATE_RBM_EFF_IGA_CST_IS	NC_RBM_CUS
81	STATE_RBM_EFF_IGA_CST_PL	NC_RBM_CUS
82	STATE_RBM_CAM_CST_IVVT_IN_1	NC_RBM_CUS
83	STATE_RBM_CAM_CST_IVVT_IN_2	NC_RBM_CUS (If NC_CYL_NR = 8)
84	STATE_RBM_CAM_CST_IVVT_EX_1	NC_RBM_CUS
85	STATE_RBM_CAM_CST_IVVT_EX_2	NC_RBM_CUS (If NC_CYL_NR = 8)
86	STATE_RBM_ER_BAL_HOM_0	NC_RBM_CUS (If NC_CYL_NR = 8)
87	STATE_RBM_ER_BAL_HOM_1	NC_RBM_CUS (If NC_CYL_NR = 8)
88	STATE_RBM_CYL_BAL_LAM[0]	NC_RBM_CUS (If NC_INJ_CONF = 0; //MSV80,90)
89	STATE_RBM_CYL_BAL_LAM[1]	NC_RBM_CUS (If NC_INJ_CONF = 0; //MSV80,90)
90	STATE_RBM_CYL_BAL_LAM[2]	NC_RBM_CUS (If NC_INJ_CONF = 0; //MSV80,90)
91	STATE_RBM_CYL_BAL_LAM[3]	NC_RBM_CUS (If NC_INJ_CONF = 0; //MSV80,90)
92	STATE_RBM_CYL_BAL_LAM[4]	NC_RBM_CUS (If NC_INJ_CONF = 0; //MSV80,90)
93	STATE_RBM_CYL_BAL_LAM[5]	NC_RBM_CUS (If NC_INJ_CONF = 0; //MSV80,90)
94	STATE_RBM_PUC_VLD_LS_UP_1	NC_RBM_CUS (If NC_CYL_NR > 4)
95	STATE_RBM_PUC_VLD_LS_UP_2	NC_RBM_CUS (If NC_CYL_NR > 4)
96	STATE_RBM_OC_LS_DOWN_1	NC_RBM_CUS (If NC_CYL_NR > 4)
97	STATE_RBM_OC_LS_DOWN_2	NC_RBM_CUS (If NC_CYL_NR > 4)
98	STATE_RBM_SCG_LS_DOWN_1	NC_RBM_CUS (If NC_CYL_NR > 4)
99	STATE_RBM_SCG_LS_DOWN_2	NC_RBM_CUS (If NC_CYL_NR > 4)
100	STATE_RBM_OC_LSL_UP_1	NC_RBM_CUS (If NC_CYL_NR > 4)
101	STATE_RBM_OC_LSL_UP_2	NC_RBM_CUS (If NC_CYL_NR > 4)
102	STATE_RBM_CSERS_INJ	NC_RBM_CUS (If NC_INJ_CONF = 1; //all MSD)
4-cyl (MSD)	<b>59</b>	NC_NR_DIAG_RBM
6-cyl (MSD)	<b>67</b>	NC_NR_DIAG_RBM
6-cyl (MSV)	<b>79</b>	NC_NR_DIAG_RBM
8-cyl (MSD)	<b>82</b>	NC_NR_DIAG_RBM

## B.84.2 Clear rate base monitoring statistics

### Description:

For development conveniences, it is often useful to reinit the rate base monitoring statistics. This is possible by setting the calibration bit LC\_RBM\_CLR to 1.

### Application conditions

**Initialisation:** -  
**Recurrence:** -  
**Activation:** 0 1 transition of LC\_RBM\_CLR

### Formula section:

```

If          LC_RBM_CLR = 1
Then       ACTION_ERRM_ClearRbmStatistics ( OUT < ResultClrInfo > )
Endif
    
```

## B.84.3 Inhibition of standardized vehicle operation calculation

### FUNCTION DESCRIPTION:

#### General information:

The calculation of the standardized vehicle operation LV\_DC\_RBM, necessary for the calculation of the denominators for the Rate-Based Monitoring functionality, depends on different engine and ambient conditions.

#### Description:

With the value LV\_INH\_DC\_RBM the inhibition of the standardized vehicle operation calculation is controlled. An inhibition is possible due to a system failure that influences the conditions necessary to set LV\_DC\_RBM.

#### Application conditions


**Initialisation:** at ECU reset or LV\_DC 0 1 transition : LV\_INH\_DC\_RBM = 0  
**Recurrence:** 1 s  
**Activation:** LV\_DC = 1  
**and** LV\_INH\_DC\_RBM = 0

#### Formula section:

##### At LV\_DC 0 1 transition :

The pending status of the following failures has to be checked only once :

- LV\_ERR\_AMP
- LV\_ERR\_AMP\_PLAUS

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- LV\_ERR\_VS
- LV\_ERR\_TAM\_PLAUS
- LV\_ERR\_TAM\_CAN

**If(1)** { CPU optimization at LV\_DC 0 1 transition }  
 CTR\_ERR\_DYN\_NR <> 0 { the dynamic failure memory isn t empty }

**Then(1)**

**While** LV\_INH\_DC\_RBM = 0 **do**  
 with each XX failure of the above list : ACTION\_ERRM\_CheckPendingStatus(IN<XX>,  
 OUT<PendingStatus>, SYNCHRONIZATION<CALL>)  
**If(2)** XX has a pending status  
**Then(2)**  
 LV\_INH\_DC\_RBM = 1  
**Endif(2)**  
**Endwhile**

**Else(1)**  
 { the dynamic failure memory is empty }  
 No action

**Endif(1)**

Every 1 s :

**If** LV\_ERR\_AMP = 1  
**or** LV\_ERR\_AMP\_PLAUS = 1  
**or** LV\_ERR\_VS = 1  
**or** LV\_ERR\_TAM\_PLAUS = 1  
**or** LV\_ERR\_TAM\_CAN = 1  
**Then** LV\_INH\_DC\_RBM = 1  
**Endif**

### B.84.4 Calculation of cold start denominator

#### FUNCTION DESCRIPTION:

##### General information:

Calculation is done in generic part. LV\_CDN\_CST\_RBM is still defined due to interface reasons.

##### Application conditions

**Initialisation:** *at LV\_DC 0->1 transition or ECU reset set LV\_CDN\_CST\_RBM = 0*

**Recurrence:** *1s*


**Activation:** *LV\_DC = 1 and LV\_CDN\_CST\_RBM = 0*

##### Formula section:

LV\_CDN\_CST\_RBM = LV\_DC\_CDN\_CST\_RBM

### B.84.5 Ambient air temperature adaptation to handle GS/DS data types differences

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## FUNCTION DESCRIPTION:

### Description:

Some temperatures values can be delivered from Diesel or Gasoline system:

Ambient temperature TAM

As data types may be different, the following fomula section shall be used to allow adaptation to each environment.

### Application conditions

**Initialisation:** at ECU reset set TAM\_DSL\_CMN = TAM

**Recurrence:** 100 ms

**Activation:** always

### Formula section:

TAM\_DSL\_CMN = TAM

## **B.84.6 Standardized vehicle operation adaptations**

## FUNCTION DESCRIPTION:

### General information:

Due to new vehicles configurations encountered (Stop& Start, conventional combustio engine), CARB standardized vehicle operations (LV\_DC\_RBM) defined for conventional vehicles may be difficult to reach, mainly because some engine states are no more covered (idle mode).

CARB regulation:

*"For hybrid vehicles, vehicles that employ alternate engine start hardware or strategies (e.g., integrated starter and generators), or alternate fuel vehicles (e.g., dedicated, bi-fuel, or dual-fuel applications), the manufacturer may request Executive Officer approval to use alternate criteria to that set forth in section (d)(4.3.2)(B) above for incrementing the denominator. In general, the Executive Officer shall not approve alternate criteria for vehicles that only employ engine shut off at or near idle/vehicle stop conditions. Executive Officer approval of the alternate criteria shall be based on the equivalence of the alternate criteria to determine the amount of vehicle operation relative to the measure of conventional vehicle operation in accordance with the criteria in section (d)(4.3.2)(B) above."*

The purpose of the following formula section is to provide or re-build missing data so as to keep CARB standardized vehicle operation definition.

### Application conditions

**Initialisation:** at RST system event  
LV\_IS\_RBM = 1  
LV\_OBD\_IS\_RBM\_CUS\_ADJ = 1 (bit always to one)

**Recurrence:** 100 ms

**Activation:** all ECU states

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## B.85 Readiness codes

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_READY_XX	O/V/S	0... 1H	0 ...1	1	-
Readiness flag related to diagnosis XX					
STATE_READY_OBD_1	O/V/S	0... FFH	0... 255	1	-
Readiness code completion status 1					
STATE_READY_OBD_2	O/V/S	0... FFH	0... 255	1	-
Readiness code completion status 2					
STATE_READY_OBD_3	O/V/S	0... FFH	0... 255	1	-
Readiness code completion status 3					

### Input data:

LV_DC {p. 5746}	LV_DC_MAX [NC_NR_ERR_DYN] {p. 5767}	LV_END_DIAG_XX {p. 4581}	LV_EOL_OBD_DC {p. 1061}
LV_ERR_DC [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_MEM_XX {p. 5767}	LV_ERR_XX	

### Action definition

ACTION_ERRM_InitReadiness ()	Mode: O
------------------------------	---------

### Import actions:

ACTION_ERRM_ReadReadinessCodCus (<INOUT>,<ReadinessCode>,<OUT>,<ResultReadinessCode>)
ACTION_ERRM_ReadReadinessCode (INOUT<PRM_READINESSCODE>,<OUT><PRM_RESULTREADINESSCODE>)

## FUNCTION DESCRIPTION:

### General information:

Readiness flag allows to know if a full diagnostic check (not in EOL phase) has been done or not (minimum number of checks necessary for MIL illumination if failure is present).


A readiness flag is defined for each diagnosis (LV\_READY\_XX). Based on these flags, readiness code status (2 bytes STATE\_READY\_OBD\_1 and STATE\_READY\_OBD\_2) are generated in the Communication Interface (API) file for Carb mode.

Readiness flags are mainly used by after market service and inspections maintenance. When after market achieves a repair, the system should be controlled before to give back the car to its owner.

Because some failure need a long time (and may be 2 DC) to be diagnosed, the repair operator need an as quick as possible information meaning the repairs is OK.

The readiness flag indicates when it is set to 0 that :

- the diagnosis related to failure XX is done since the last clear DTC service received.

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- and if a failure XX is present, MIL would be illuminated.

For after market time optimisation, in case of no failure at all, the readiness flag is set to 0.  
The readiness flag indicates when it is set to 1 that :

- the diagnosis related to failure XX is not done since the last clear DTC service received.
- or if a failure XX is present, MIL is not still illuminated (may takes many driving cycle).

After failure erase, all bits associated to supported functions are set to 1.

When the system has executed enough driving cycles for determining if MIL should be switch On or not, all the readiness flags are in 0 state. At this occurrence, failures which may have switch on the MIL could be considered as repaired if MIL is Off.

### B.85.1 Readiness flag set to 0

#### Description:

The readiness flag LV\_READY\_XX is set to 0 when enough driving cycle has been done without failure XX.

#### Application conditions

**Initialization:** On saved ram lost  
LV\_READY\_XX = 1

**Recurrence:** at the recurrence of activation condition

**Activation:** at transition LV\_DC 0->1  
or at transition LV\_END\_DIAG\_XX 0->1

#### Formula section:

```

If      LV_READY_XX = 1                (diag XX not still ready)
and LV_DC = 1                        (driving cycle valid)
and LV_END_DIAG_XX = 1              (diag done)
and LV_EOL_OBD_DC = 0               (not in EOL tests)
Then    If      LV_ERR_MEM_XX = 1     (failure in 2nd layer memory)
Then    If LV_ERR_DC[IDX] = 0 (no failure present this DC)
        Then    LV_READY_XX = 0      (diag XX is ready)
        Else    If      LV_DC_MAX[IDX] = 1
                Then    LV_READY_XX = 0      (diag XX is ready)
        Endif
    Endif
    Else    If      LV_ERR_XX = 0
            Then    LV_READY_XX = 0      (diag XX is ready)
            Endif
    Endif
Endif
    
```


### B.85.2 Readiness flag reinitialisation (set to 1)

#### Description:

**Syntax :** ACTION\_ERRM\_InitReadiness ( )

**Parameter(in) :** No parameter

**Parameter(out) :** No parameter

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**Short description :**

The readiness flag LV\_READY\_XX is reinitialized (set to 1) upon communication tool request via the action ACTION\_ERRM\_InitReadiness ( ).

This reinitilisation is always done when all failure are erased from failure memory.

**Application conditions**

**Initialization:** -  
**Recurrence:** -  
**Activation:** at action request

**Formula section:**

For every failure : LV\_READY\_XX = 1

**B.85.3 Readiness code information update**

**Description:**

Purpose of this paragraph is to update readiness code completion status. This update shall be done :

- at end of driving cycle, for readiness status display,
- on action call, for customer tool and Scan Tool coherency with STATE\_READY\_OBD\_X.

**Important remark:** each time ACTION\_ERRM\_ReadReadinessCode is called Readiness codes completion status (STATE\_READY\_OBD\_1 and STATE\_READY\_OBD\_2) are calculated.

**Application conditions**

**Activation:** at LV\_DC 1 0 transition  
**Initialization:** on non-volatile memory reset/ lost **or** on failure erase service received  
STATE\_READY\_OBD\_1 = FFh,  
STATE\_READY\_OBD\_2 = FFh  
{FFh value indicates that readiness code is not yet computed}  
**Recurrence:** none, executed single time on activation.

**Formula section:**


{ Action call to update STATE\_READY\_OBD\_1 and STATE\_READY\_OBD\_2 }

Call ACTION\_ERRM\_ReadReadinessCode(INOUT<STATE\_READY\_OBD\_1, STATE\_READY\_OBD\_2>, OUT<ResultReadinessCode>)

**Application conditions**

**Activation :** at LV\_DC 1 0 transition  
**Initialization:** on non-volatile memory reset/ lost  
**or**  
on failure erase service received  
STATE\_READY\_OBD\_3 = FFh

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```
{ FFh value permits to indicate that readiness is not yet computed  
}
```


**Recurrence :** none, executed single time on activation.

**Formula section:**

```
{ Action call to update STATE_READY_OBD_3 }
```

```
Call ACTION_ERRM_ReadReadinessCodCus(INOUT<STATE_READY_OBD_3>, OUT<ResultReadinessCode>  
)
```

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## B.86 Similar conditions

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_SCDN_EQU [NC_NR_WIN_SCDN]	V	0... FFFFH	0... 65535	1	-
Number of times N/LOAD is within SCDN window					
CTR_SCDN_EQU_DC [NC_NR_WIN_SCDN]	V/S	0... FFH	0... 255	1	-
Counter of non occurrence of similar condition					
CTR_SCDN_SUM [NC_NR_WIN_SCDN]	V	0... FFFFH	0... 65535	1	-
Number of times the diagnosis condition are set					
LOAD_MAX_SCDN_EQU [NC_NR_WIN_SCDN]	V/S	0... FFH	0... 99.609375	0.390625	%
maximal load of similar conditions window					
LOAD_MIN_SCDN_EQU [NC_NR_WIN_SCDN]	V/S	0... FFH	0... 99.609375	0.390625	%
minimal load of similar conditions window					
LV_WUP_SCDN_EQU [NC_NR_WIN_SCDN]	V/S	0... 1H	0 ...1	1	-
Warm-up status for similar conditions for OBDII continuous error					
N_MAX_SCDN_EQU [NC_NR_WIN_SCDN]	V/S	0... 1FE0H	0... 8160	1	rpm
maximal engine speed of similar conditions window					
N_MIN_SCDN_EQU [NC_NR_WIN_SCDN]	V/S	0... 1FE0H	0... 8160	1	rpm
minimal engine speed of similar conditions window					
STATE_SCDN [NC_NR_WIN_SCDN]	V/S	0... 3FH	0... 63	1	-
Similar condition status					

### Input data:


CTR_DC [NC_NR_ERR_DYN] {p. 5767}	LC_ENA_SCDN	LOAD_SCDN {p. 5895}	LV_CDN_DIAG_XX {p. 4581}
LV_DC {p. 5746}	LV_ERR_DC [NC_NR_ERR_DYN] {p. 5767}	LV_STATE_WUP {p. 5746}	N {p. 1525}
NLC_ENA_SCDN {p. 645}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_SCDN_EQU_DC_MAX	V	0... FFH	0... 255	1	-
maximum value of the driving cycle counter for similar conditions erase					
C_CTR_SCDN_NOT_ERR_THD [NC_NR_WIN_SCDN]	V	0... FFH	0... 99.609375	0.390625	%
threshold for ratio CTR_SCDN_EQU[NC_NR_WIN_SCDN] /CTR_SCDN_SUM[NC_NR_WIN_SCDN] to recognize SCDN without failure					
C_LOAD_SCDN_EQU	V	0... FFH	0... 99.609375	0.390625	%
LOAD value for similar conditions detection (typical 20%)					
C_N_SCDN_EQU	V	0... 1FE0H	0... 8160	1	rpm
engine speed threshold for similar conditions detection (375 rpm)					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_WIN_SCDN	-	1... FFH	1... 255	1	-
Number of instances used for similar conditions calculation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

### Action definition

<b>ACTION_ERRM_CdnDiagScdn (IN&lt;PRM_IDX_DIAG&gt;)</b>	Mode: O
This action is used to calculate a ratio to recognize the similar condition without failure	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_IDX_DIAG	in	0... FFFFH	0... 65535	1	-
Diagnostic symptom instance.					

<b>ACTION_ERRM_DecrementDCctrScdn (IN&lt;PRM_IDX_ERR&gt;,OUT&lt;PRM_DCdec&gt;)</b>	Mode: O
This action calculates the possibility to decrement the driving cycle counter related to failure IDX_ERR	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_IDX_ERR	in	0... FFFFH	0... 65535	1	-
Failure Index					
PRM_DCdec	out	0H 1H	NO YES	-	-
Control of Driving cycle counter decrementation					

<b>ACTION_ERRM_EndWinScdn (IN&lt;PRM_IDX_ERR&gt;,IN&lt;PRM_EXC&gt;)</b>	Mode: O
This is used to store similar conditions and recognize similar condition with or without failure	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_IDX_ERR	in	0... FFFFH	0... 65535	1	-
Failure Index					
PRM_EXC	in	0... 1H	0 ...1	1	-
Exceedance reported from diagnostic function					

<b>ACTION_ERRM_EraseScdn (IN&lt;PRM_IDX_ERR&gt;)</b>	Mode: O
This action erase the similar conditions related to failure IDX_ERR	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_IDX_ERR	in	0... FFFFH	0... 65535	1	-
Failure Index					

### Import actions:


<b>ACTION_ERRM_IncrementDCctrScdn (IN&lt;PRM_IDX_ERR&gt;)</b>
---

### General information

STATE\_SCDN[k] : Similar conditions status for diagnostic instance k

- bit 0: 0: SCDN will be recorded (updated) at next failure occurrence  
1: SCDN are recorded
- bit 1: Recognition of similar conditions with failure detection this DC
- bit 2: Recognition of similar condition without failure/exceedance detection this DC

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It's also set after C\_CTR\_SCDN\_EQU\_DC\_MAX driving cycles without similar conditions without error

- bit 3: Failure XX was present last DC
- bit 4: Request to increment driving cycle counter of failure XX
- bit 5: "exceedance" of specific limit was reported for failure XX

### Similar Conditions

#### General Information:

The different states of a failure are managed regards their driving cycle and warm up cycle counters values (see Dynamic error management core for details).

For Misfire and Fuel system failures, some additional conditions should be fulfilled to increment and decrement their driving cycle counter. These additional conditions are related to engine conditions and are called similar conditions.

When similar conditions without failure are fulfilled for the failure XX already stored in the dynamic memory in a previous driving cycle, bit 2 of STATE\_SCDN[k] is set to 1. That means, that the driving cycle counter of failure XX could be decremented at the end of the driving cycle if the failure XX will not get present till this treatment. If an exceedance is reported by the diagnostic function (bit 5 of STATE\_SCDN[k] is set to 1), the driving cycle counter is not decremented at the end of the DC. Exception: Driving cycle counter decrementation linked with C\_CTR\_SCDN\_EQU\_DC\_MAX DCs, see description below.

Also the incrementation of the driving cycle counter of a failure stored in dynamic memory is controlled by the similar conditions functionality. The incrementation done in the error management core is triggered by the ACTION\_ERRM\_IncrementDCctrScdn (XX) in the following cases:

- Similar conditions are recorded (bit 0 of STATE\_SCDN[k] 0->1).
- A failure already stored in memory occurs again in the following driving cycle (bit 2 of STATE\_SCDN[k] = 1).
- A temporary failure or a confirmed failure with MIL off (LV\_DC\_MAX[IDX] = 0) occurs again not in the following driving cycle but with similar conditions with failure (bit 1 of STATE\_SCDN[k] = 1).
- A confirmed failure with MIL on (LV\_DC\_MAX[IDX] = 1) occurs again.


In all of these cases, the driving cycle counter is incremented (bit 4 of STATE\_SCDN[k] 0->1).

For a temporary failure or confirmed failure with MIL off (LV\_DC\_MAX[IDX] = 0), even if similar conditions are not recognized during a C\_CTR\_CDN\_EQU\_DC\_MAX number of driving cycles, the driving cycle counter of the failure can be decremented after C\_CTR\_CDN\_EQU\_DC\_MAX driving cycles.

Similar conditions functionality is inhibited when LC\_ENA\_SCDN=0 or NLC\_ENA\_SCDN=0.

#### Remark:

To keep the link between the index of the failure using the similar condition and the index of the failure in static memory, a transfer function is defined:  $k = Scdn(XX)$ . The link between the diagnosis instance and the similar conditions instance k is described in the application incidence of similar condition.

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## B.86.1 Ratio calculation to recognize the similar condition without failure

### General information:

For the recognition of similar conditions the current engine speed /load conditions are compared with the recorded similar conditions window.

Based on two counters calculated with this algorithm the SCDN recognition at end of the diagnostic window is done. (see next chapter)

- CTR\_SCDN\_EQU[k]

counting the number of times engine speed /load conditions are within the recorded similar conditions window (with LV\_CDN\_DIAG\_XX = 1)

- CTR\_SCDN\_SUM[k]  
counting the number of times the diagnosis conditions are set (LV\_CDN\_DIAG\_XX = 1)

The calculation of the counters is stopped, if an exceedance is reported from diagnostic function.

Syntax : ACTION\_ERRM\_CdnDiagScdn (IN <XX>)  
Parameter (in) : XX failure XX using similar condition instance XX  
Parameter (out) : -

### Short description:

This action is called at each diagnosis condition. It is used to calculate a ratio to recognize the similar condition with or without failure.

### Application conditions:

**Initialisation:** at transition LV\_DC 0 -> 1 or reset  
 bit 0, bit 3 of STATE\_SCDN[k] = restored from NVMY  
 bit 1, bit 2, bit 4, bit 5 of STATE\_SCDN[k] = 0

CTR\_SCDN\_EQU[k] = 0  
 CTR\_SCDN\_SUM[k] = 0


**Activation:** At action request **and** LV\_DC = 1  
**and** LC\_ENA\_SCDN = 1 and NLC\_ENA\_SCDN = 1  
 (similar conditions enable)

**Deactivation:** -

**Recurrence:** -

### Function description:

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**Formula section:**

```

k = Scdn (XX)
If bit 0 of STATE_SCDN[k] = 1 (similar conditions are
                                recorded for failure XX)
and bit 5 of STATE_SCDN[k] = 0 (no exceedance reported from
                                diagnostic function)

Then
    If LV_CDN_DIAG_XX = 1
        Then CTR_SCDN_SUM[k] ++
            (check if current N, LOAD_SCDN point is within SCDN window)
            If N <= N_SCDN_MAX_EQU[k]
                and N >= N_SCDN_MIN_EQU[k]
                and LOAD_SCDN <= LOAD_SCDN_MAX_EQU[k]
                and LOAD_SCDN >= LOAD_SCDN_MIN_EQU[k]
                Then CTR_SCDN_EQU[k] ++
            Endif
    Endif

```

**B.86.2 Record and recognition of similar conditions at end of diagnosis window**

**General information:**

The similar conditions are stored for a failure XX (or updated) in the following cases:

- The similar conditions are frozen within the window N/LOAD\_MAX/MIN\_SCDN\_EQU[k], if the corresponding failure is stored in the memory (failure gets present the first time)
- The similar conditions are stored again (updated) within the window N/LOAD\_MAX/MIN\_SCDN\_EQU[k], if the corresponding failure occurs again and the driving cycle counter of this failure was 0 before.


In both cases bit 0 of STATE\_SCDN[k] is 0 before the storage.

The recognition of similar conditions for detected failure is done by comparing, if the actual N/LOAD point is within the stored SCDN window. If also the same warmup status is reached at this time, similar conditions with failure are recognized. This calculation is done at the action call depending of the monitoring function, only in the following case:

- Similar conditions are stored in a previous driving cycle (bit 0 of STATE\_SCDN[k] = 1)
- and the same failure XX was not present the last driving cycle. In case of same failure present last driving cycle, the driving cycle counter is incremented without asking for similar conditions.
- and failure is not illuminating the MIL. In case failure is illuminating the MIL at present the driving cycle counter is set to the maximum without asking for similar conditions.
- and driving cycle counter not already incremented in this driving cycle

If no error is present at the end of the diagnosis window, the ratio (CTR\_SCDN\_EQU[k] /CTR\_SCDN\_SUM[k]) is compared with the threshold C\_CTR\_SCDN\_NOT\_ERR\_THD[k]. If the threshold and the same warmup status are reached at this time, similar conditions without failure are recognized.

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This calculation is done at the end of a diagnosis window, only if no failure XX is present in the following cases:

- Similar conditions are already recorded for failure XX (bit 0 of STATE\_SCDN[k] = 1) in a previous driving cycle
- Similar conditions were not already encountered within this driving cycle with no failure
- no exceedance reported from diagnostic function (bit 5 of STATE\_SCDN[k] = 0)
- Driving cycle counter was not incremented this driving cycle yet.

Syntax : ACTION\_ERRM\_EndWinScdn (IN <XX>, <EXC>)

Parameter (in) : XX failure XX using similar condition instance XX  
EXC Exceedance reported from Diagnostic function

Parameter (out) : -

Short description:

This action is called at each end of diagnosis windows if there's no failure or when the failure gets present or when an exceedance is recognized by the diagnostic function. This usage of this function depends on the diagnostic function. It is used for recognition of similar condition with or without failure

Application conditions:

- Initialisation:** -
- Activation:** At action request **and** LV\_DC = 1  
**and** LC\_ENA\_SCDN = 1 **and** NLC\_ENA\_SCDN = 1  
(similar conditions enable)
- Deactivation:** -
- Recurrence:** -


Function description:

Formula section:

```
k = Scdn(XX)
If EXC = 1 (Exceedance reported from Diagnostic function)
Then bit 5 of STATE_SCDN[k] = 1
Endif
If bit 4 of STATE_SCDN[k] = 0 (request to increment driving cycle
counter of failure XX not made)
and LV_ERR_XX = 1 (failure present)
Then If bit 0 of STATE_SCDN[k] = 1 (similar conditions recorded
for failure XX)
Then If bit 3 of STATE_SCDN[k] = 1
(failure present the last driving cycle)

or LV_DC_MAX[IDX] = 1
```

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(failure is confirmed with MIL on)

**Then** ACTION\_ERRM\_IncrementDCctrScdn (XX)  
(request to increment driving cycle counter  
for failure XX)

bit 4 of STATE\_SCDN[k] = 1  
(request to increment driving cycle counter of  
was made)

**Else** (recognition of similar conditions with failure)

(check if ratio to recognize SCDN is reached)

**If** N <= N\_MAX\_SCDN\_EQU[k]  
**and** N >= N\_MIN\_SCDN\_EQU[k]  
**and** LOAD\_SCDN <= LOAD\_MAX\_SCDN\_EQU[k]  
**and** LOAD\_SCDN >= LOAD\_MIN\_SCDN\_EQU[k]  
**and** LV\_WUP\_SCDN\_EQU[k] = LV\_STATE\_WUP  
**Then** bit 1 of STATE\_SCDN[k] = 1  
(similar conditions encountered with failure  
window)  
bit 2 of STATE\_SCDN[k] = 0  
(similar conditions not encountered with no  
failure)  
ACTION\_ERRM\_IncrementDCctrScdn (XX)  
(request to increment driving cycle counter for  
failure XX)  
bit 4 of STATE\_SCDN[k] = 1  
(request to increment driving cycle counter  
of was made)

**Endif**

**Endif**

**Else** (SCDN engine speed/ load point frozen)  
N\_SCDN\_MAX\_EQU[k] = N + C\_N\_SCDN\_EQU  
N\_SCDN\_MIN\_EQU[k] = N - C\_N\_SCDN\_EQU  
LOAD\_SCDN\_MAX\_EQU[k] = LOAD\_SCDN + C\_LOAD\_SCDN\_EQU  
LOAD\_SCDN\_MIN\_EQU[k] = LOAD\_SCDN - C\_LOAD\_SCDN\_EQU  
LV\_WUP\_SCDN\_EQU[k] = LV\_STATE\_WUP (warm-up status stored)  
CTR\_SCDN\_EQU\_DC[k] = C\_CTR\_SCDN\_EQU\_DC\_MAX  
bit0 of STATE\_SCDN[k] = 1 (similar conditions recorded  
for failure XX)  
ACTION\_ERRM\_IncrementDCctrScdn (XX)  
(request to increment driving cycle counter  
for failure XX)  
bit 4 of STATE\_SCDN[k] = 1  
(request to increment driving cycle counter  
was made)

**Endif**

**Else** (recognition of similar conditions without failure)

**If** bit 0 of STATE\_SCDN[k] = 1 (similar conditions recorded  
for failure XX)  
  
**and** bit 4 of STATE\_SCDN[k] = 0 (request to increment driving  
cycle counter of failure XX  
was not made)  
  
**and** bit 2 of STATE\_SCDN[k] = 0 (similar conditions not  
encountered with no failure)  
  
**and** LV\_ERR\_XX = 0 (no failure present)  
**and** bit 5 of STATE\_SCDN[k] = 0 (no exceedance reported from  
Diagnostic function)

```

Then If          CTR_SCDN_EQU[k]      /          CTR_SCDN_SUM[k]>=
C_CTR_SCDN_NOT_ERR_THD[k]
and          LV_STATE_WUP = LV_WUP_SCDN_EQU[k] (warm-up status)
Then          bit 2 of STATE_SCDN[k] = 1 (similar conditions
encountered with no failure)
Endif
Endif
Endif

If bit 0 of STATE_SCDN[k] = 1 (similar conditions recorded for failure XX)
Then          CTR_SCDN_EQU[k] = 0
                CTR_SCDN_SUM[k] = 0
Endif

```

### B.86.3 SCDN storage and recognition for detected failure performed last DC

#### General information:

According regulation the information, if a failure XX (using SCDN functionality) was present the last driving cycle, must be respected to increment the DC counter. In case of a new failure occurrence, if the same failure was present the last driving cycle, the driving cycle counter must be incremented (if not already incremented this driving cycle) independently of similar conditions.

#### Application conditions:

**Initialisation:** -

**Activation:** At LV\_DC transition 1 -> 0 **and**  
LC\_ENA\_SCDN = 1 **and** NLC\_ENA\_SCDN = 1  
(similar conditions enable)

**Deactivation:** -

**Recurrence:** -

#### Function description:

#### Formula section:

```


For k = 0 to NC_NR_WIN_SCDN - 1
k = Scdn(XX); XX = F(IDX)
If LV_ERR_DC[IDX] = 1 (failure present in this DC)
Then bit 3 of STATE_SCDN[k] = 1
(failure present the last driving cycle)

CTR_SCDN_EQU_DC[k] = C_CTR_SCDN_EQU_DC_MAX
re-initialization of similar conditions counters)

Else bit 3 of STATE_SCDN[k] = 0
(failure not present the last driving cycle)
Endif
EndFor

```

### B.86.4 SCDN usage to decrement driving cycle counter

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**General information:**

**Syntax :** ACTION\_ERRM\_DecrementDCctrScdn (OUT <DCdec>, IN <XX>)

**Parameter (in) :** XX number of failure to store in dynamic memory

**Parameter (out) :** DCdec YES if decrementation of DC counter is possible

NO if decrementation of DC counter is not possible

**Short description:**

At the end of a driving cycle (LV\_DC 1->0) the driving cycle counter for the failure XX can be decremented if similar conditions without failure are recognized and no exceedance reported from diagnostic function (bit 5 of STATE\_SCDN[k] = 0) (used for misfire monitoring). For temporary failure or confirmed failure with MIL off, even if similar conditions are not recognized during a C\_CTR\_CDN\_EQU\_DC\_MAX number of driving cycle, the driving cycle counter of the failure can be decremented after C\_CTR\_CDN\_EQU\_DC\_MAX driving cycles.

**Application conditions:**

- Initialisation:** -
- Activation:** at action request
- Deactivation:** -
- Recurrence:** -

**Function description:**

**Formula section:**

```

k = Scdn(XX)
DCdec = NO      (decrementation of DC counter is not possible)
If bit 2 of STATE_SCDN[k] = 1      (similar conditions encountered
                                     with no failure)
and bit 5 of STATE_SCDN[k] = 0      (no exceedance reported)
Then DCdec = YES      (decrementation of DC counter is possible)
Else If LV_DC_MAX[IDX] = 0 (failure is temporary or confirmed
                               with MIL off)
       Then CTR_SCDN_EQU_DC[k] = CTR_SCDN_EQU_DC[k] - 1
       If CTR_SCDN_EQU_DC[k] = 0
           bit 2 of STATE_SCDN[k] = 1
           DCdec = YES      (decrementation of DC counter is possible)
       Endif
       Endif
Endif

If DCdec = YES
and (LV_DC_MAX[IDX] = 0      (failure is temporary or confirmed with
                               MIL off and DC counter of failure will
                               be 0 after decrementation)


      or (LV_DC_MAX[IDX] = 1 and CTR_DC[IDX] <= DC_DEC_XX))

      (failure is confirmed with MIL on and
       MIL will be switched off after
       decrementation)

Then bit 0 of STATE_SCDN[k] = 0 (The SCDN window of failure XX will be
                                     updated With new engine conditions (N /
                                     LOAD (min/ max))at next failure
                                     occurrence)

Endif
    
```

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## B.86.5 Similar conditions erase

### General information:

Syntax : ACTION\_ERRM\_EraseScdn (IN <XX>)

Parameter (in) : XX number of failure to store in dynamic memory

Parameter (out) : -

### Short description:

The similar conditions are erased by calling the action ACTION\_ERRM\_EraseScdn :  
 - when saved ram lost (at initialization)  
 - when corresponding failure is erased (see dynamic error management core module)

### Application conditions:

**Initialisation:** -  
**Activation:** at action request  
**Deactivation:** -  
**Recurrence:** -

### Function description:

### Formula section:

k = Scdn (XX)  
 STATE\_SCDN [k] = 0  
 N\_MAX\_SCDN\_EQU [k] = 0 [rpm]  
 N\_MIN\_SCDN\_EQU [k] = 8160 [rpm]  
 LOAD\_MAX\_SCDN\_EQU [k] = 0 [%]  
 LOAD\_MIN\_SCDN\_EQU [k] = 99.60937 [%]  
 CTR\_SCDN\_EQU\_DC [k] = 0  
 LV\_WUP\_SCDN\_EQU [k] = 0  
 CTR\_SCDN\_EQU [k] = 0  
 CTR\_SCDN\_SUM [k] = 0

## B.87 Similar conditions (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LOAD_SCDN	O/V	0... FFH	0... 99.60937	0.390625	%
Engine load for SCDN calculation					

### Input data:

LOAD_CLC {p. 5801}	LV_CDN_DIAG_FSD [NC_CBK_EX_NR] {p. 6140}	LV_CDN_DIAG_FSD_ LAM_LIM [NC_CBK_EX_NR] {p. 6140}	LV_END_DIAG_WIN_FSD [NC_CBK_EX_NR] {p. 6140}
LV_END_DIAG_WIN_FSD_ LAM_LIM [NC_CBK_EX_NR] {p. 6140}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_INJ_CONF {p. 626}
NC_NR_WIN_SCDN {p. 5885}			

### Action definition

<b>ACTION_ERRM_ConfirmErrScdn</b> (OUT<DCconf>,IN<XX>)	Mode: O
--	---------

### Import actions:

<b>ACTION_ERRM_CdnDiagScdn</b> (IN<PRM_IDX_DIAG>)
<b>ACTION_ERRM_EndWinScdn</b> (IN<PRM_IDX_ERR>,IN<PRM_EXC>)

### FUNCTION DESCRIPTION:

#### General information:

This file defines the usage of the similar conditions functionality.

### B.87.1 Similar conditions window definition

#### B.87.1.1 Similar condition data definition

#### Description:

There is only some failure using the similar condition so this table allows to do the link between the index of the failure in static memory and the index of the failure using the similar condition:

<b>Diagnosis instances XX using similar conditions functionality</b>	NC_NR_WIN_SCDN = <b>8 (4 cyl or MSV)</b> NC_NR_WIN_SCDN = <b>10 (6 cyl)</b> NC_NR_WIN_SCDN = <b>12 (8 cyl)</b>
--	--

Diagnosis instance XX	similar conditions instance (k)
FSD_1	0
FSD_2	1
FSD_LAM_LIM_1	2 If NC_INJ_CONF = ! 0
FSD_LAM_LIM_2	3 If NC_INJ_CONF = ! 0
MIS_0	4
MIS_1	5
MIS_2	6
MIS_3	7
MIS_4	8 If NC_CYL_NR = 6 or 8
MIS_5	9 If NC_CYL_NR = 6 or 8
MIS_6	10 If NC_CYL_NR = 8
MIS_7	11 If NC_CYL_NR = 8
	(NC_NR_WIN_SCDN - 1)

One function is defined to do the link between the index of the failure in static memory and the index of the failure using the similar condition:  $k = Scdn(XX)$

### B.87.1.2 Load calculation for similar condition

#### Description:

The calculated load SAE1979 (LOAD\_CLC) is used for similar condition.

#### Application conditions

**Initialisation:** At reset:  $LOAD\_SCDN = LOAD\_CLC$

**Recurrence:** 100 ms

**Activation:** -

#### Formula section:

$LOAD\_SCDN = LOAD\_CLC$

### B.87.1.3 Treatment activated by the fuel system diagnosis for the similar condition

#### Description:



This treatment allows to call the two generic ACTION\_ERRM\_CdnDiagScdn (IN <XX>), ACTION\_ERRM\_EndWinScdn (IN <XX>, IN <EXC>) actions using for the similar condition.

**Application conditions**

**Initialisation:** -  
**Recurrence:** *fuel system diagnosis recurrency*  
**Activation:** -

**Formula section:**

**For** i = 0 to NC\_CBK\_EX\_NR - 1  
*Adaptation to calculate a ratio used to recognize the similar condition with or without failure:*  
**If** LV\_CDN\_DIAG\_FSD[i] = 1  
**Then** ACTION\_ERRM\_CdnDiagScdn (FSD[i])  
**Endif**  
**If** LV\_CDN\_DIAG\_FSD\_LAM\_LIM[i] = 1  
**Then** ACTION\_ERRM\_CdnDiagScdn (FSD\_LAM\_LIM[i])  
**Endif**

*Adaptation for the record and recognition of similar conditions:*  
**If** LV\_END\_DIAG\_WIN\_FSD[i] 0 ->1  
**Then**  
 Record and recognition of similar conditions at the end of diagnosis or when the failure is present:  
 ACTION\_ERRM\_EndWinScdn (FSD[i], 0)  
**Endif**  
**If** LV\_END\_DIAG\_WIN\_FSD\_LAM\_LIM[i] 0 ->1  
**Then**  
 Record and recognition of similar conditions at the end of diagnosis or when the failure is present:  
 ACTION\_ERRM\_EndWinScdn (FSD\_LAM\_LIM[i], 0)  
**Endif**  
**EndFor**

**B.87.2 SCDN usage for direct failure confirmation**

**Description:**


**Syntax :** ACTION\_ERRM\_ConfirmErrScdn (OUT <DCconf>, IN <XX>)  
**Parameter (in) :** XX number of failure to store in dynamic memory  
**Parameter (out) :** DCconf 1 if failure must be confirmed directly  
 0 if failure should not be confirmed directly

**Short description:**

With the ACTION\_ERRM\_ConfirmErrScdn (OUT <DCconf>, IN <XX>) the value DCconf is transmitted to the driving cycle counter management to give the possibility to confirm a failure directly by incrementing the driving cycle counter for the failure XX to the maximum. This treatment must be done in the following situation:


A temporary failure XX caused by misfire B is in the memory and a failure XX caused by misfire A occurs (not stored before). Then the misfire B depending failure can be erased and the misfire A failure can be confirmed directly.

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**Application conditions****Initialization:** -**Recurrence:** -**Activation:** *at action request***Formula section:**

DCconf = 0 (direct confirmation of failure XX is not possible)

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## B.88 Statistical data

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ACT_MIL	S	0... FFH	0... 255	1	-
Counter for warm up cycle with MIL Off					
CTR_WUP_DTC_CLR	O/V/S	0... FFH	0... 255	1	-
Number of warm-ups since diagnostic trouble codes cleared					
DIST_ACT_MIL	O/V/S	0... FFFFH	0... 65535	1	km
Global distance traveled while the MIL is illuminated					
DIST_DTC_CLR	O/V/S	0... FFFFH	0... 65535	1	km
Distance since diagnostic trouble codes cleared					
DIST_REL_ACT_MIL	S	0... FFFFFFFFH	0... 4294967295	1	km
Relative distance to calculate distance traveled while the MIL is illuminated					
DIST_REL_DTC_CLR	V/S	0... FFFFFFFFH	0... 4294967295	1	km
Distance at following event : diagnostic trouble codes cleared					
STATE_CMPL_OBD	O/V	0... FFFFH	0... 65535	1	-
Monitor completion status for the current driving cycle					
STATE_ENA_OBD	O/V	0... FFFFH	0... 65535	1	-
Monitor enable status for the current driving cycle					
T_ACT_MIL	O/V/S	0... FFFFH	0... 65535	1	min
Minutes run by the engine while MIL activated					
T_ACT_MIL_60	V/S	0... 3CH	0... 60	1	s
Seconds run by the engine while MIL activated for T_ACT_MIL calculation (0 ... 59)					
T_DTC_CLR	O/V/S	0... FFFFH	0... 65535	1	min
Time since diagnostic trouble codes cleared					

### Input data:

C_CTR_MAX_WUP_CYC {p. 5767}	C_STATE_READY_OBD_1 {p. 5695}	C_STATE_READY_OBD_2 {p. 5695}	DIST {p. 1183}
LV_DC {p. 5746}	LV_END_DIAG_XX {p. 4581}	LV_ES {p. 1720}	LV_MIL_ACT_REQ {p. 5840}
LV_MIL_ACT_REQ_DC {p. 5840}	LV_PWL {p. 988}	LV_STALL {p. 1766}	LV_WUP_CYC {p. 5746}
NLC_OBD_DSL {p. 5789}	STATE_MIL {p. 5827}	WAL_CONF_XX {p. 5811}	

### Calibration data:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_SET_CMPL_OBD	-	0... FFH	0... 255	1	-
Monitoring status MIS, FSD, CC directly set to ready					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_MIL_ACT_REQ	-	0... 1H	0 ...1	1	-
External MIL request is taken or not into account for DIST_ACT_MIL and T_ACT_MIL calculation (0 : not taken and 1 : taken)					

### Action definition

<b>ACTION_ERRM_MilOffToOnTrans ()</b>	Mode: O
This action describes the initialisation at MIL transition from OFF to FLL; OFF to ON.	

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**Import actions:**

<b>ACTION_ERRM_GetReadyClass</b> (IN<PRM_IDX_ERR>,OUT<PRM_READY_CLAS>)
<b>ACTION_ERRM_MonitorEnableStatus</b> (INOUT<PRM_MONITORENABLESTATUS>)

**FUNCTION DESCRIPTION:**

**General information:**

EObD/CARB official requirements include a list of statistical data related to Error Management. These statistical data are counters and timers related to Error Management events. You can find below, in the following chapters, a description of all these requirements.

**B.88.1 Time since diagnostic trouble codes cleared**

**Description:**

Purpose of this strategy is to compute the time accumulated by the vehicle since diagnostic trouble codes cleared (referenced in ISO15031 as Modes 01h & 02h PID4Eh). It is simply an indication for I/M (Inspection/Maintenance), of the last time an external test equipment was used to clear DTCs.

**Application conditions**

- Initialization:** on non-volatile memory reset or lost  
**or** on failure erase service received  
 T\_DTC\_CLR = 0
- Recurrence :** 1 minute ±1 second, after event : on "failure erase" service received
- Activation :** -
- Deactivation:** -

**Formula section :**

```
{ T_DTC_CLR is updated at required recurrence }
{ T_DTC_CLR shall saturate to its maximal value 65535 }

If          T_DTC_CLR < 65535
Then
          T_DTC_CLR = T_DTC_CLR + 1
Endif
```

**B.88.2 Distance counters since MIL activation and Minutes run by the engine with MIL activated**

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**Description:**

According to ISO/DIS 15031-5.8 (Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 5: Emissions-related diagnostic services), ECU must be able to indicate :

- the distance travelled while the MIL is activated
- the number of minutes run by the engine while MIL is activated

**Distance Travelled While MIL is Activated**

The purpose is to compute the covered distance while the MIL is illuminated (MIL blinking is considered as a MIL illumination). This mileage (DIST\_ACT\_MIL) is a global distance :

- which is not linked with any failure and is independent from the Pre-drive check
- which is dependent from the global inhibition MIL boolean
- which is dependent of the MIL request
- which is readable with Scan-Tool with kilometer as unit

Conditions for “Distance travelled” counter :

- reset to 0 when MIL state changes from deactivated to activated by this ECU
- accumulate counts in km if MIL is activated (ON)
- do not change value while MIL is not activated (OFF)
- reset to 0 if diagnostic information is cleared either by service 04h or 40 warm-up cycles without MIL activated
- do not wrap to 0 if value is FFFFh

**Minutes run by the engine while MIL activated**

The purpose is to compute the time accumulated while MIL is activated (Modes 01h & 02h PID4Dh). This duration shall be cleared when failure memory is erased and after 40 warm-up cycles.

Conditions for “Minutes run by the engine while MIL activated” counter :

- reset to 0 when MIL state changes from deactivated to activated by this ECU
- accumulate counts in minutes if MIL is activated (ON)
- do not change value while MIL is not activated (OFF)
- reset to 0 if diagnostic information is cleared either by service 04h or 40 warm-up cycles without MIL activated
- do not wrap to 0000h if value is FFFFh

**B.88.2.1 Initialisation at Transtion MIL OFF to ON or FLL (external MIL request)**

**Description for actions:**

<b>ACTION_ERRM_MilOffToOnTrans ()</b>
This action describes the initialisation at MIL transition from OFF to FLL; OFF to ON


**FUNCTION DESCRIPTION:**

This action is called from generic Lamp Management at MIL-transition from OFF2FFL and OFF2ON.

**Formula section:**

DIST\_REL\_ACT\_MIL = DIST  
 DIST\_ACT\_MIL = 0  
 CTR\_ACT\_MIL = C\_CTR\_MAX\_WUP\_CYC  
 T\_ACT\_MIL = 0

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T\_ACT\_MIL\_60 = 0

## B.88.2.2 Calculation of DIST\_ACT\_MIL and T\_ACT\_MIL

### Application conditions

**Initialization:** On saved ram lost  
**or** failure erase service received  
DIST\_REL\_ACT\_MIL = DIST  
DIST\_ACT\_MIL = 0  
CTR\_ACT\_MIL = C\_CTR\_MAX\_WUP\_CYC  
T\_ACT\_MIL = 0  
T\_ACT\_MIL\_60 = 0

**Recurrence:** upon LV\_DC 1→0 transition and 1 s

**Activation:** LV\_DC = 1 **and** LV\_PWL = 0 **and** (LV\_STALL = 0 **or** LV\_ES = 0)

### Formula section:

Each 1s:

**If(1)** STATE\_MIL = MIL\_FLL **or** STATE\_MIL = ON **or**  
(NLC\_MIL\_ACT\_REQ = 1 **and** LV\_MIL\_ACT\_REQ = 1  
**and** bit 1 of C\_CONF\_MIL = 1)

**Then(1)**

**If(2)** (DIST - DIST\_REL\_ACT\_MIL) < 65535  
**Then(2)**  
DIST\_ACT\_MIL = DIST - DIST\_REL\_ACT\_MIL  
**Else(2)**  
DIST\_ACT\_MIL = 65535

**Endif(2)**

T\_ACT\_MIL\_60 = T\_ACT\_MIL\_60 + 1 s

**If(2)** (T\_ACT\_MIL\_60 = 60)

**Then(2)**

T\_ACT\_MIL\_60 = 0

**If(3)** T\_ACT\_MIL < 65535

**Then(3)**

T\_ACT\_MIL = T\_ACT\_MIL + 1 min

**Else(3)**

T\_ACT\_MIL = 65535


**Endif(3)**

**Endif(2)**

**Endif(1)**

At LV\_DC 1→0 transition :

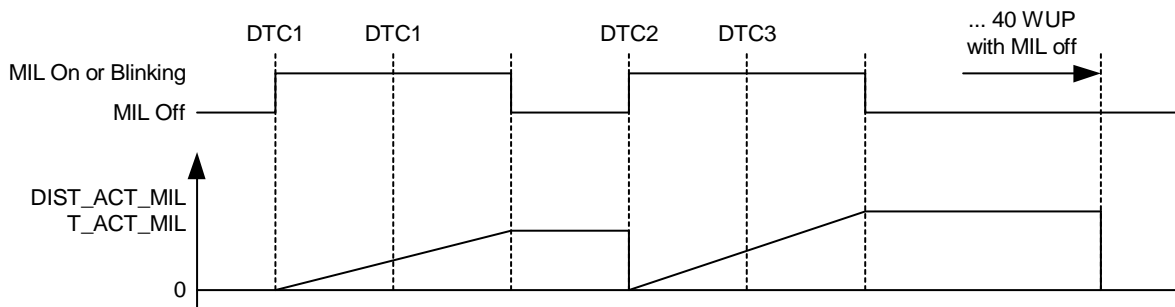
**If(1)** LV\_WUP\_CYC = 1  
**and**  
STATE\_MIL was OFF during all the warm-up cycle  
**and**  
(LV\_MIL\_ACT\_REQ\_DC = 0 during driving cycle  
**or** bit 1 of C\_CONF\_MIL = 0 **or** NLC\_MIL\_ACT\_REQ = 0)

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```

and
CTR_ACT_MIL > 0
Then(1)
CTR_ACT_MIL = CTR_ACT_MIL -1
If(2)  CTR_ACT_MIL = 0
Then(2)
DIST_REL_ACT_MIL = DIST
DIST_ACT_MIL = 0
T_ACT_MIL = 0
T_ACT_MIL_60 = 0
Endif(2)
Endif(1)

```



### B.88.3 Distance since diagnostic trouble codes cleared

#### Description :

Purpose of this strategy is to compute the distance accumulated by the vehicle since diagnostic trouble codes cleared (referenced in ISO15031 as mode01h& 02hPID31h). It is simply an indication for Inspection/Maintenance, of the last time an external test equipment was used to clear DTCs.

#### Application conditions

**Initialization:** on non-volatile memory reset or lost  
**or**  
on failure erase service received  
DIST\_DTC\_CLR = 0  
DIST\_REL\_DTC\_CLR = DIST

**Recurrence :** 1 second

**Activation :** -

**Deactivation:** -

#### Formula section :

{ DIST\_DTC\_CLR is updated regularly regarding DIST }  
{ DIST\_DTC\_CLR shall saturate to its maximal value 65535 km}

**If** DIST - DIST\_REL\_DTC\_CLR < 65535

**Then**

DIST\_DTC\_CLR = DIST - DIST\_REL\_DTC\_CLR

**Else**

DIST\_DTC\_CLR = 65535

**Endif**

## B.88.4 Number of warm-ups since diagnostic trouble codes cleared

### Description:

Purpose of this strategy is to compute number of warm-ups since diagnostic trouble codes cleared (referenced in ISO15031 as Modes 01h & 02h PID30h). It's just an indication for Inspection/Maintenance, to determine the last time an external test equipment was used to clear DTCs.

### Application conditions

**Activation :** On LV\_WUP\_CYC 0 → 1 transition

**Initialization:** On non-volatile memory reset or lost  
**or** on failure erase service received  
 CTR\_WUP\_DTC\_CLR=0

**Recurrence :** none, executed single time on activation.

### Formula section:

{ on detection of a warm-up cycle CTR\_WUP\_DTC\_CLR is incremented }  
 { CTR\_WUP\_DTC\_CLR shall saturate to its maximal value 255 }

**If** CTR\_WUP\_DTC\_CLR < 255

**Then**

CTR\_WUP\_DTC\_CLR = CTR\_WUP\_DTC\_CLR + 1

**Endif**

## B.88.5 Monitor enable/completion status for the current driving cycle

### General information:

Purpose of this strategy is to get the following informations :

- if a diagnosis (a monitor) is disabled for rest of this monitoring cycle or not (referenced in ISO15031 as Modes 01h & 02h PID41h).
- if a diagnosis (a monitor) is completed for the current monitoring cycle or not (referenced in ISO15031 as Modes 01h & 02h PID41h).


Each concerned diagnosis is part of a generic list : Misfire, Fuel system, Comprehensive component, Catalyst, Heated catalyst, Evaporative system, Secondary air system, A/C system refrigerant, Oxygen sensor, Oxygen sensor heater, EGR system monitoring.

### **MonitorEnableStatus :**

Each bit of STATE\_ENA\_OBD variable contains status for each predefined diagnosis as defined below :

Enable status of a diagnosis this monitoring cycle:

- NO (STATE\_ENA\_OBD[n]=0) means disabled for rest of this monitoring cycle or not supported in C\_STATE\_READY\_OBD\_1 & C\_STATE\_READY\_OBD\_2
- YES (STATE\_ENA\_OBD[n]=1) means enabled for this monitoring cycle.

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**MonitorCompletionStatus :**

Each bit of STATE\_CMPL\_OBD variable contains status for each predefined diagnosis as defined below :

Completion status of a diagnosis this monitoring cycle:

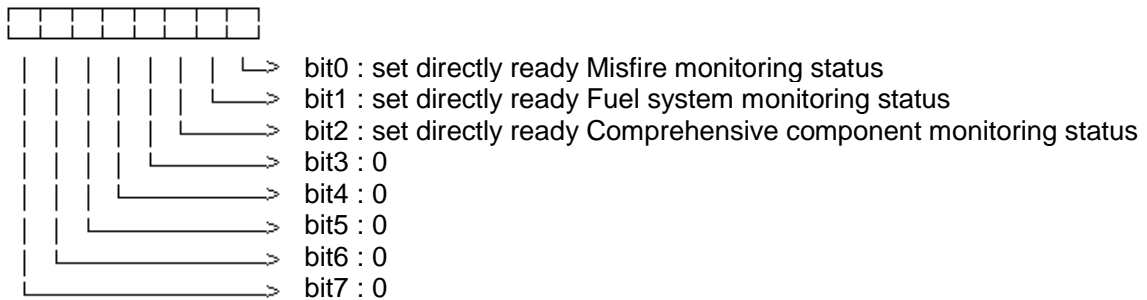
- YES (STATE\_CMPL\_OBD[n]=0) means monitor complete this monitoring cycle, or not supported in C\_STATE\_READY\_OBD\_1 & C\_STATE\_READY\_OBD\_2
- NO (STATE\_CMPL\_OBD[n]=1) means monitor not complete this monitoring cycle.

Calibration data detailed description for C\_STATE\_SET\_CMPL\_OBD :

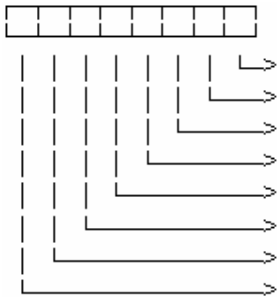
Completion status calculation for CARB\_MIS, CARB\_FSD, CARB\_CC diagnosis :

- 0: Completion status of conserved group is calculated based on the end of diagnosis of each group of diagnostic
- 1: Completion status of conserved group always indicates "completed"

C\_STATE\_SET\_CMPL\_OBD:



Bit 0 to 7 of STATE\_ENA\_OBD[0..7] :

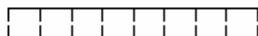


- bit0: Misfire monitoring
- bit1: Fuel system monitoring
- bit2: Comprehensive component monitoring
- bit3: GS/DS vehicle (NLC\_OBD\_DSL = 1 for DS: 0 for GS)
- bit4: reserved
- bit5: reserved
- bit6: reserved
- bit7: reserved

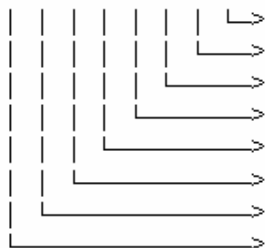
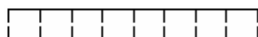
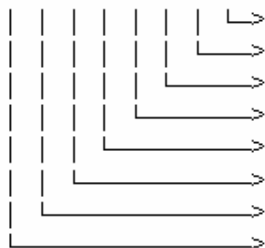
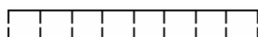
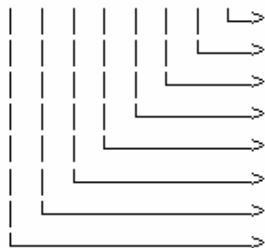
Bit 8 to 15 of STATE\_ENA\_OBD[8..15] :

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GS name / DS Name



- bit8: Catalyst /NMHC Catalyst monitoring
- bit9: Heated catalyst /NOx Cat-Adsorber monitoring
- bit10: Evaporative system /reserved monitoring
- bit11: Secondary air system /Boost pressure monitoring
- bit12: reserved
- bit13: Oxygen sensor /Exhaust Gaz sensor monitoring
- bit14: Oxygen sensor heater /PM Filter monitoring
- bit15: EGR system monitoring monitoring

Bit 0 to 7 of STATE\_CMPL\_OBD[0..7] :

- bit0: Misfire monitoring
- bit1: Fuel system monitoring
- bit2: Comprehensive component monitoring
- bit3: reserved
- bit4: reserved
- bit5: reserved
- bit6: reserved

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bit7: reserved

Bit 8 to 15 of STATE\_CMPL\_OBD[8..15] :  
GS name /DS Name

bit8: Catalyst /NMHC Catalyst monitoring  
bit9: Heated catalyst /NOx Cat-Adsorber monitoring  
bit10: Evaporative system /reserved monitoring  
bit11: Secondary air system /Boost pressure monitoring  
bit12: reserved  
bit13: Oxygen sensor /Exhaust Gaz sensor monitoring  
bit14: Oxygen sensor heater /PM Filter monitoring  
bit15: EGR system monitoring monitoring

### Application conditions

**Initialization:** on LV\_DC 1 → 0 transition  
STATE\_ENA\_OBD = 0  
STATE\_CMPL\_OBD = 0

**Recurrence :** 10 seconds

**Activation :** -

**Deactivation:** -

### Formula section :

```
{
{ Action call definition shall define strategy related to each supported diagnosis }
{ each bit of STATE_ENA_OBD shall be computed according diagnosis strategy }
```

```
{ STATE_ENA_OBD computation }
{ STATE_ENA_OBD is the result returned by ACTION_ERRM_MonitorEnableStatus action }
{ Please refer to ACTION_ERRM_MonitorEnableStatus definition in }
{ the Application Incidence file }
```

ACTION\_ERRM\_MonitorEnableStatus(INOUT<STATE\_ENA\_OBD>,  
SYNCHRONIZATION<CALL> )

```
{ STATE_CMPL_OBD computation }
{ Each bit of STATE_CMPL_OBD shall be computed according end diagnosis flags }
```

STATE\_CMPL\_OBD[0..7] = C\_STATE\_READY\_OBD\_1  
STATE\_CMPL\_OBD[8..15] = C\_STATE\_READY\_OBD\_2

### Distinction between GS vehicle and DS vehicle

Bit 3 of STATE\_ENA\_OBD = NLC\_OBD\_DSL

Bit 3 of STATE\_CMPL\_OBD = 0

Misfire monitoring status bit :

**If** bit 0 of C\_STATE\_SET\_CMPL\_OBD = 0

**Then**

**If** LV\_END\_DIAG\_XX=1 for all diagnosis XX defined below  
 Take into account all LV\_END\_DIAG\_XX which fulfill the following condition:  
 ACTION\_ERRM\_GetReadyClass(XX,PRM\_READY\_CLAS)  
 PRM\_READY\_CLAS = 00h (CARB\_MIS) **and**  
 the bit 4 of WAL\_CONF\_XX = 1 (CARB/EOBD failure)

**Then** Bit 0 of STATE\_CMPL\_OBD = 0

**Endif**

**Else**

Readiness for Misfire monitoring status is always set

Bit 0 of STATE\_CMPL\_OBD = 0

**Endif**

Fuel system monitoring status bit :

**If** bit 1 of C\_STATE\_SET\_CMPL\_OBD = 0

**Then**

**If** LV\_END\_DIAG\_XX=1 for all diagnosis XX defined below  
 Take into account all LV\_END\_DIAG\_XX which fulfill the following condition:  
 ACTION\_ERRM\_GetReadyClass(XX,PRM\_READY\_CLAS)  
 PRM\_READY\_CLAS = 01h (CARB\_FSD) **and**  
 the bit 4 of WAL\_CONF\_XX = 1 (CARB/EOBD failure)

**Then** Bit 1 of STATE\_CMPL\_OBD = 0

**Endif**

**Else**

Readiness for Misfire monitoring status is always set

Bit 1 of STATE\_CMPL\_OBD = 0

**Endif**

Comprehensive component monitoring status bit :

**If** bit 2 of C\_STATE\_SET\_CMPL\_OBD = 0

**Then**

**If** LV\_END\_DIAG\_XX = 1 for all diagnosis XX defined below  
 Take into account all LV\_END\_DIAG\_XX which fulfill the following condition:  
 ACTION\_ERRM\_GetReadyClass(XX,PRM\_READY\_CLAS)  
 PRM\_READY\_CLAS = 02h (CARB\_CC) **and**  
 the bit 4 of WAL\_CONF\_XX = 1 (CARB/EOBD failure)

**Then** Bit 2 of STATE\_CMPL\_OBD = 0

**Endif**

**Else**


Readiness for Misfire monitoring status is always set

Bit 2 of STATE\_CMPL\_OBD = 0

**Endif**

Catalyst monitoring bit :

**If** LV\_END\_DIAG\_XX = 1 for all diagnosis XX defined below

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Take into account all LV\_END\_DIAG\_XX which fulfill the following condition:  
 ACTION\_ERRM\_GetReadyClass(XX,PRM\_READY\_CLAS)  
 PRM\_READY\_CLAS = 03h (CARB\_CAT /CARB\_NMHC) **and**  
 the bit 4 of WAL\_CONF\_XX = 1 (CARB/EOBD failure)

**Then** Bit 8 of STATE\_CMPL\_OBD = 0  
**Endif**

Heated catalyst bit :

**If** LV\_END\_DIAG\_XX = 1 for all diagnosis XX defined below  
 Take into account all LV\_END\_DIAG\_XX which fulfill the following condition:  
 ACTION\_ERRM\_GetReadyClass(XX,PRM\_READY\_CLAS)  
 PRM\_READY\_CLAS = 04h (CARB\_HC /CARB\_NT) **and**  
 the bit 4 of WAL\_CONF\_XX = 1 (CARB/EOBD failure)

**Then** Bit 9 of STATE\_CMPL\_OBD = 0  
**Endif**

Evaporative system monitoring bit :

**If** LV\_END\_DIAG\_XX = 1 for all diagnosis XX defined below  
 Take into account all LV\_END\_DIAG\_XX which fulfill the following condition:  
 ACTION\_ERRM\_GetReadyClass(XX,PRM\_READY\_CLAS)  
 PRM\_READY\_CLAS = 05h (CARB\_EVAP) **and**  
 the bit 4 of WAL\_CONF\_XX = 1 (CARB/EOBD failure)

**Then** Bit 10 of STATE\_CMPL\_OBD = 0  
**Endif**

Secondary air system monitoring bit :

**If** LV\_END\_DIAG\_XX = 1 for all diagnosis XX defined below  
 Take into account all LV\_END\_DIAG\_XX which fulfill the following condition:  
 ACTION\_ERRM\_GetReadyClass(XX,PRM\_READY\_CLAS)  
 PRM\_READY\_CLAS = 06h (CARB\_SA /CARB\_BPA) **and**  
 the bit 4 of WAL\_CONF\_XX = 1 (CARB/EOBD failure)

**Then** Bit 11 of STATE\_CMPL\_OBD = 0  
**Endif**

Bit 12 of STATE\_CMPL\_OBD is reserved

Oxygen sensor monitoring bit :


**If** LV\_END\_DIAG\_XX = 1 for all diagnosis XX defined below  
 Take into account all LV\_END\_DIAG\_XX which fulfill the following condition:  
 ACTION\_ERRM\_GetReadyClass(XX,PRM\_READY\_CLAS)  
 PRM\_READY\_CLAS = 08h (CARB\_LS /CARB\_EG) **and**  
 the bit 4 of WAL\_CONF\_XX = 1 (CARB/EOBD failure)

**Then** Bit 13 of STATE\_CMPL\_OBD = 0  
**Endif**

Oxygen sensor heater monitoring bit :

**If** LV\_END\_DIAG\_XX = 1 for all diagnosis XX defined below  
 Take into account all LV\_END\_DIAG\_XX which fulfill the following condition:  
 ACTION\_ERRM\_GetReadyClass(XX,PRM\_READY\_CLAS)  
 PRM\_READY\_CLAS = 09h (CARB\_LSH /CARB\_PF) **and**  
 the bit 4 of WAL\_CONF\_XX = 1 (CARB/EOBD failure)

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**Then** Bit 14 of STATE\_CMPL\_OBD = 0  
**Endif**

EGR system monitoring bit :

**If** LV\_END\_DIAG\_XX = 1 for all diagnosis XX defined below  
Take into account all LV\_END\_DIAG\_XX which fulfill the following condition:  
ACTION\_ERRM\_GetReadyClass(XX,PRM\_READY\_CLAS)  
PRM\_READY\_CLAS = 0Ah (CARB\_EGR) **and**  
the bit 4 of WAL\_CONF\_XX = 1 (CARB/EOBD failure)

**Then** Bit 15 of STATE\_CMPL\_OBD = 0  
**Endif**

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## B.89 Statistical data (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DC_ERR_DET [NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Number of driving cycles since DTC detection					
CTR_DC_ERR_DET_DIAG_CDN [NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Number of DC since DTC detection with diag started					
CTR_DC_ERR_DET_DIAG_CMPL [NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Number of DC since DTC detection with diag completed					
LV_CDN_DIAG_DC [NC_NR_ERR_DYN]	O/V/S	0... 1H	0 ...1	1	-
Flag to detect that diag conditions have been met during DC					

### Input data:

AMP {p. 982}	C_AMP_MIN_CAT {p. 5459}	C_AMP_MIN_FSD {p. 6133}	C_AMP_MIN_MIS {p. 6226}
C_STATE_READY_OBD_1 {p. 5695}	C_STATE_READY_OBD_2 {p. 5695}	C_TAM_MIN_FSD {p. 6133}	LV_END_DIAG_XX {p. 4581}
LV_ERR_DC [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_MEM_XX {p. 5767}	LV_INH_DIAG_SA {p. 803}	TAM {p. 1579}

### Action definition

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_MONITORENABLESTATUS	inout	0... FFFFH	0... 65535	1	-

Monitor Enable Status

### General information

#### B.89.1 Diagnostic conditions have been met during the driving cycle

### General information:

Figure B.89.1:

Figure B.89.2:

Figure B.89.3:

		1stDC	2ndDC	3rdDC	4thDC	5thDC	
LV_DC		█	█	█	█	█	█
LV_ERR_XX		█				█	
LV_CDN_DIAG_XX		█		█	█	█	
LV_END_DIAG_XX		█			█	█	
CTR_DC_ERR_DET[IDX]		0 0 0 0	1 1 1	2 2 2	3 3 3	4 4 4	5 5
CTR_DC_ERR_DET_DIAG_CDN[IDX]		0 0 0 0	1 1 1	1 1 1	2 2 2	3 3 3	4 4
CTR_DC_ERR_DET_DIAG_CMPL[IDX]		0 0 0 0	1 1 1	1 1 1	1 1 1	2 2 2	3 3

Figure B.89.4:

Purpose of this formula section is to detect that diag. conditions have been met during driving cycle.

**Application conditions:**

**Initialisation:** at LV\_DC 1 -> 0 transition  
LV\_CDN\_DIAG\_DC[IDX]=0

**Activation:** at LV\_CDN\_DIAG\_XX 0 -> 1 transition  
and  
LV\_ERR\_MEM\_XX = 1

**Deactivation:** -

**Recurrence:** none, executed only once on activation

**Function description:**

**Formula section:**

#at detection of diagnosis conditions: LV\_CDN\_DIAG\_DC[IDX] is updated  
LV\_CDN\_DIAG\_DC[IDX] = 1

**B.89.2 Driving cycles counters since DTC present**

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**General information:**

Figure B.89.5:

Figure B.89.6:

Figure B.89.7:

	1stDC				2ndDC			3rdDC			4thDC			5thDC				
LV_DC	█				█			█			█			█				
LV_ERR_XX	█				█			█			█			█				
LV_CDN_DIAG_XX	█				█			█			█			█				
LV_END_DIAG_XX	█				█			█			█			█				
CTR_DC_ERR_DET[IDX]	0	0	0	0	1	1	1	2	2	2	3	3	3	4	4	4	5	5
CTR_DC_ERR_DET_DIAG_CDN[IDX]	0	0	0	0	1	1	1	1	1	1	2	2	2	3	3	3	4	4
CTR_DC_ERR_DET_DIAG_CMPL[IDX]	0	0	0	0	1	1	1	1	1	1	1	1	1	2	2	2	3	3

Figure B.89.8:

Purpose of this section is to compute the number of driving cycles regarding the following events :

- detection of diagnostic trouble codes (action call)
- detection of an error in last driving cycle (LV\_ERR\_DC[IDX])
- detection of diag. conditions have been met during last driving cycle (LV\_CDN\_DIAG\_DC[IDX])
- detection of diag. completion have been met during last driving cycle (LV\_END\_DIAG\_XX)

**Application conditions:**

**Initialisation:**

at NVMINI  
 or  
 on failure erase service received  
 or  
 on dynamic failure memory erase  
 CTR\_DC\_ERR\_DET[IDX] = 0  
 CTR\_DC\_ERR\_DET\_DIAG\_CDN[IDX] = 0  
 CTR\_DC\_ERR\_DET\_DIAG\_CMPL[IDX] = 0

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**Activation:** at LV\_DC 1 -> 0 transition  
**Deactivation:** -  
**Recurrence:** none, executed only once on activation

### Function description:

#### Formula section:

#Detection of an error in last driving cycle shall start counters

#On detection of an error in driving cycle counters are updated

#Saturation value of counters is 255

**If (0)** LV\_ERR\_DC[IDX] = 1 #error detection within driving cycle

**Then (0)**

**If (1a)** CTR\_DC\_ERR\_DET[IDX] < MAX(CTR\_DC\_ERR\_DET[IDX])

**Then (1a)**

CTR\_DC\_ERR\_DET[IDX] = CTR\_DC\_ERR\_DET[IDX] + 1

**Endif (1a)**

**If (1b)** CTR\_DC\_ERR\_DET\_DIAG\_CDN[IDX] < MAX(CTR\_DC\_ERR\_DET\_DIAG\_CDN[IDX])

**Then (1b)**

CTR\_DC\_ERR\_DET\_DIAG\_CDN[IDX] = CTR\_DC\_ERR\_DET\_DIAG\_CDN[IDX] + 1

**Endif (1b)**

**If (1c)** CTR\_DC\_ERR\_DET\_DIAG\_CMPL[IDX] < MAX(CTR\_DC\_ERR\_DET\_DIAG\_CMPL[IDX])

**Then (1c)**

CTR\_DC\_ERR\_DET\_DIAG\_CMPL[IDX] = CTR\_DC\_ERR\_DET\_DIAG\_CMPL[IDX] + 1

**Endif (1c)**

**Else (0)** #no error detection within driving cycle

#CTR\_DC\_ERR\_DET[IDX] update

#after error detection CTR\_DC\_ERR\_DET[IDX] is updated every driving cycle

#CTR\_DC\_ERR\_DET[IDX] shall saturate to its maximal value 255

**If (1a)** CTR\_DC\_ERR\_DET[IDX] > 0

**and**

CTR\_DC\_ERR\_DET[IDX] < MAX(CTR\_DC\_ERR\_DET[IDX])

**Then (1a)**

CTR\_DC\_ERR\_DET[IDX] = CTR\_DC\_ERR\_DET[IDX] + 1

**Endif (1a)**

#CTR\_DC\_ERR\_DET\_DIAG\_CDN[IDX] update

#on detection of diag. conditions in driving cycle after error detection

#CTR\_DC\_ERR\_DET\_DIAG\_CDN[IDX] is updated

#CTR\_DC\_ERR\_DET\_DIAG\_CDN[IDX] shall saturate to its maximal value 255

**If (1b)** CTR\_DC\_ERR\_DET\_DIAG\_CDN[IDX] > 0

**and**

LV\_CDN\_DIAG\_DC[IDX] = 1

**and**


CTR\_DC\_ERR\_DET\_DIAG\_CDN[IDX] < MAX(CTR\_DC\_ERR\_DET\_DIAG\_CDN[IDX])

**Then (1b)**

CTR\_DC\_ERR\_DET\_DIAG\_CDN[IDX] = CTR\_DC\_ERR\_DET\_DIAG\_CDN[IDX] + 1

**Endif (1b)**

#CTR\_DC\_ERR\_DET\_DIAG\_CMPL[IDX] update

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```

#on detection of diag. conditions in driving cycle after error detection
#CTR_DC_ERR_DET_DIAG_CMPL[IDX] is updated
#CTR_DC_ERR_DET_DIAG_CMPL[IDX] shall saturate to its maximal value 255

If (1c)   CTR_DC_ERR_DET_DIAG_CMPL[IDX] > 0
           and
           LV_END_DIAG_XX = 1
           and
           CTR_DC_ERR_DET_DIAG_CMPL[IDX] < MAX(CTR_DC_ERR_DET_DIAG_CMPL[IDX])
Then (1c)
           CTR_DC_ERR_DET_DIAG_CMPL[IDX] = CTR_DC_ERR_DET_DIAG_CMPL[IDX] + 1
Endif (1c)

Endif (0)

```

### B.89.3 Monitor enable status for the current driving cycle (PID41)

#### General information:

Purpose of this strategy is to get the following informations :

- if a diagnosis (a monitor) is disabled for rest of this monitoring cycle or not (referenced as Mode01h& 02hPID41h ISO15031).

Each concerned diagnosis is part of a generic list : Misfire, Fuel system, Comprehensive component, Catalyst, Heated catalyst, Evaporative system, Secondary air system, A/C system refrigerant, Oxygen sensor, Oxygen sensor heater, EGR /VVT system monitoring.

#### **MonitorEnableStatus :**

Each bit of MonitorEnableStatus variable contains status for each predefined diagnosis as defined below :

Enable status of a diagnosis this monitoring cycle: NO (MonitorEnableStatus[n]=0) means disabled for rest of this monitoring cycle, YES (MonitorEnableStatus[n]=1) means enabled for this monitoring cycle.

Bit 0 to 7 of MonitorEnableStatus[0..7] :

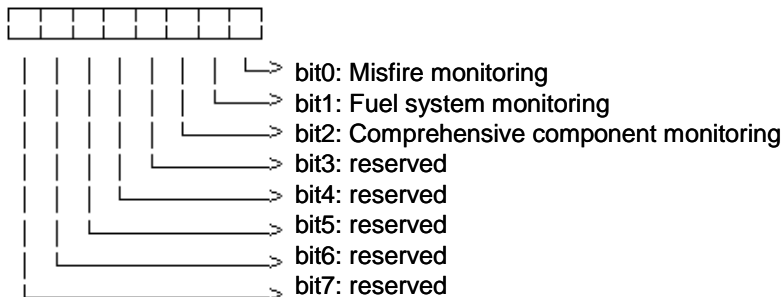


Figure B.89.9:

Bit 8 to 15 of MonitorEnableStatus[8..15] :

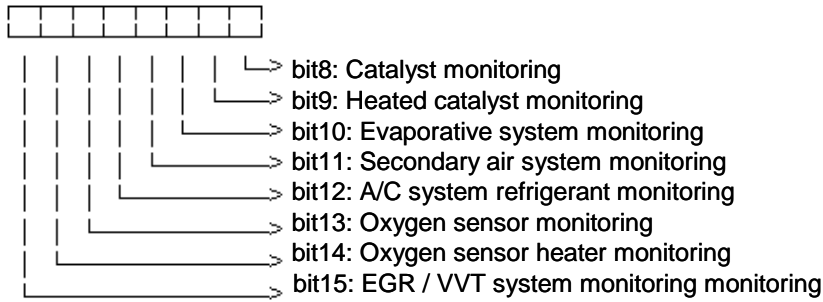


Figure B.89.10:

**Description :**

**Syntax:** ACTION\_ERRM\_MonitorEnableStatus (OUT < MonitorEnableStatus >)  
**Parameter (in):** No parameter  
**Parameter (out):** MonitorEnableStatus with the same format as MonitorEnableStatus  
**Short Description:** This API calculates and returns the monitor enable status result information in the software structure.

**Application conditions:**

**Initialisation:** all bits 0  
**Activation:** at ACTION request  
**Deactivation:** - -  
**Recurrence:** - -

**Function description:**

**Formula section:**

**Misfire monitoring status bit :**

```


if AMP > C_AMP_MIN_MIS
then Bit 0 of MonitorEnableStatus = 1
else Bit 0 of MonitorEnableStatus = 0
endif
    
```

**Fuel system monitoring status bit :**

```

if AMP > C_AMP_MIN_FSD and
    TAM > C_TAM_MIN_FSD
then Bit 1 of MonitorEnableStatus = 1
else Bit 1 of MonitorEnableStatus = 0
endif
    
```

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Comprehensive component monitoring status:

Bit 2 of MonitorEnableStatus = 1

Catalyst monitoring bit :

```

if      AMP > C_AMP_MIN_CAT
then    Bit 8 of MonitorEnableStatus = 1
else    Bit 8 of MonitorEnableStatus = 0
endif

```

Heated catalyst monitoring status bit6 :

Bit 9 of MonitorEnableStatus = 0

Evaporative system monitoring bit :

Bit 10 of MonitorEnableStatus = 1

Secondary air system monitoring bit :

```

if      LV_INH_DIAG_SA = 0
then    Bit 11 of MonitorEnableStatus = 1
else    Bit 11 of MonitorEnableStatus = 0
endif

```

A/C system refrigerant monitoring bit :

Bit 12 of MonitorEnableStatus = 0

Oxygen sensor monitoring bit :

Bit 13 of MonitorEnableStatus = 1

Oxygen sensor heater monitoring bit :


Bit 14 of MonitorEnableStatus = 1

EGR system monitoring bit :

Bit 15 of MonitorEnableStatus = 1

MonitorEnableStatus [0..7] = MonitorEnableStatus [0..7] and C\_STATE\_READY\_OBD\_1

MonitorEnableStatus [8..15] = MonitorEnableStatus 8..15] and C\_STATE\_READY\_OBD\_2

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## B.90 Evaporative system monitoring

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
AMP_CHK_FUC	O/V	0... FFFFH	0... 5434	0.0829175	hPa
ambient pressure difference during check fuc					
CTR_CHK_FUC_OPEN	O/V/S	0... FFH	0... 255	1	-
Number of tests cfc with result filler cap open					
CTR_DC_ENA_CHK_FUC	O/V/S	0... FFH	0... 255	1	-
Number of DC since CFC request					
ERR_SYM_CHK_FUC	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom					
LV_CDN_DIAG_CHK_FUC	V	0... 1H	0 ...1	1	-
Diagnosis condition					
LV_CHK_FUC_CLOSE	V	0... 1H	0 ...1	1	-
Filler cap close					
LV_CHK_FUC_END	V	0... 1H	0 ...1	1	-
Test filler cap ended					
LV_CHK_FUC_OPEN	O/V/S	0... 1H	0 ...1	1	-
Filler cap open					
LV_CHK_FUC_OPEN_ACT	O/V/S	0... 1H	0 ...1	1	-
Check filler cap lamp was already set					
LV_CHK_FUC_OPEN_CAN	O/V	0... 1H	0 ...1	1	-
Set check filler cap lamp in the ICL					
LV_CTR_DC_CHK_FUC	O/V/S	0... 1H	0 ...1	1	-
Indicator of driving cycle counter enabled					
LV_ENA_CHK_FUC_REFU	O/V/S	0... 1H	0 ...1	1	-
Valid refilling recognized					
LV_ENA_CHK_FUC_ROUGH_LEAK_MES	O/V	0... 1H	0 ...1	1	-
Rough leak request enabled due to check filler cap					
LV_END_DIAG_CHK_FUC	V	0... 1H	0 ...1	1	-
End of diagnosis					
LV_ERR_CHK_FUC	V	0... 1H	0 ...1	1	-
Error flag check filler cap (open filler cap)					
LV_REP_CHK_FUC	O/V/S	0... 1H	0 ...1	1	-
Healing test enabled					
LV_ROUGH_LEAK_SUSP_CHK_FUC	O/V/S	0... 1H	0 ...1	1	-
Evap emission system suspects rough leak					
LV_T_VS_CHK_FUC_OPEN_CAN	V	0... 1H	0 ...1	1	-
Min. vehicle speed for control cfc lamp reached					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_T_VS_CHK_FUC_OPEN_MAX	V	0... 1H	0 ...1	1	-
Recognized vehicle stops					

**Input data:**

AMP_MES {p. 1163}	FTL {p. 1564}	LC_CONF_DMTL	LV_CONF_DMTL {p. 654}
LV_CYC_ROUGH_LEAK_SUSP {p. 5963}	LV_ENA_CHK_FUC_ROUGH_LEAK {p. 5964}	LV_ERR_FTL {p. 5965}	LV_ERR_FTL_PLAUS {p. 5965}
LV_ERR_VS {p. 5021}	LV_REFU {p. 5966}	LV_REFU_VAL {p. 5967}	LV_ROUGH_LEAK_SUSP {p. 5967}
STATE_DMTL {p. 5969}	T_AST {p. 1766}	VS {p. 1176}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_CHK_FUC_MAX	-	0... FFFFH	0... 5434	0.0829175	hPa
maximum deviation of the ambient pressure during check fuc					
C_CTR_CHK_FUC_OPEN_MAX	-	0... FFH	0... 255	1	-
Threshold for number of tests cfc with result filler cap open					
C_CTR_DC_ENA_CHK_FUC_MAX	-	0... FFH	0... 255	1	-
Threshold for number of DC since CFC request					
C_FTL_DELTA_CHK_FUC_MAX	-	0... 7EH	0... 126	1	l
Max. difference between two consecutive FTL					
C_T_AST_DC_CHK_FUC	-	0... FFFFH	0... 6553.5	0.1	s
Threshold for AST to detect a DC					
C_T_CHK_FUC_OPEN_CAN	-	0... FFFFH	0... 6553.5	0.1	s
Duration of setting the cfc lamp					
C_T_VS_CHK_FUC_OPEN_CAN_MIN	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time for vehicle speed higher than threshold					
C_T_VS_CHK_FUC_OPEN_MIN	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time for vehicle speed lower than threshold					
C_VS_CHK_FUC_OPEN_CAN_MIN	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed for setting cfc lamp					
C_VS_CHK_FUC_OPEN_MAX	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed for setting the healing					
C_VS_DELTA_CHK_FUC_MAX	-	0... FFH	0... 255	1	km/h
Max. difference between two consecutive VS					
C_VS_ENA_CHK_FUC_OPEN_MAX	-	0... FFH	0... 255	1	km/h
Max. vehicle speed to enable cfc test					
C_VS_ENA_CHK_FUC_OPEN_MIN	-	0... FFH	0... 255	1	km/h
Min. vehicle speed to enable cfc test					
LC_COD_CHK_FUC	-	0... FFH	0... 255	1	-
Calibration codebyte for check filler cap test					

**General information:**

The function check filler cap during DC is part of the tank leakage detection package.

The function controls the conditions, which are responsible, to enable a check of open filler cap. If such a condition is available, a request LV\_ENA\_CHK\_FUC\_ROUGH\_LEAK\_MES can be set and a rough leak measurement shall be enabled.

The trigger for the check of open filler cap can be either a valid refueling or a given rough leak suspicion. Are the conditions available, which enable a check, that means low acceleration and low oscillation of the fuel tank level, then a check will be done, if a minimum speed of the vehicle is reached. A test request is still present for a calibratable number of driving cycles. In case of a detected open filler cap, a calibratable number of tests can be done, after a indication lamp in the instrument cluster was set.

## B.90.1 Rough leak request due to check filler cap during DC

### General information:

Conditions to set the test request LV\_ENA\_CHK\_FUC\_ROUGH\_LEAK\_MES:

- A valid refueling is given. Setting of the nv-bit LV\_ENA\_CHK\_FUC\_REFU. The resetting of this logical value is done, if a CFC-test has finished.
- Availability of a suspected rough leak from the tank leakage detection function. The request is stored until a CFC-test has finished.
- Setting of the test request, if the vehicle speed is greater or equal than a threshold.

Conditions to reset the test request LV\_ENA\_CHK\_FUC\_ROUGH\_LEAK\_MES:

- Vehicle speed is lower than a threshold
- Powerful acceleration of the vehicle
- high ambient pressure deviation

### FUNCTION DESCRIPTION:

#### Application conditions

**Initialisation:** in case of reset or LV\_IGK = 0 1:  
AMP\_CHK\_FUC = AMP\_MES, all other variables to 0  
Restore out of the NV-memory:  
LV\_ENA\_CHK\_FUC\_REFU, LV\_ROUGH\_LEAK\_SUSP\_CHK\_FUC  
LV\_CTR\_DC\_CHK\_FUC  
In case of clear FMY:  
All variables to 0  
AMP\_CHK\_FUC = AMP\_MES

**Recurrence:** 100 ms


**Activation:** LC\_CONF\_DMTL = 1, during all ECU states

#### Formula section:

```

If      LV_ROUGH_LEAK_SUSP = 1                AND                // suspected rough
leak
      LC_COD_CHK_FUC = 1. Bit
Then    LV_ROUGH_LEAK_SUSP_CHK_FUC = 1
Endif

If      LC_COD_CHK_FUC = 0. Bit                AND
LV_REFU = 1                AND                // valid refueling
LV_REFU_VAL = 1
Then    LV_ENA_CHK_FUC_REFU = 1
Endif
    
```

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```

If      LV_CHK_FUC_END = 1
Then    LV_ROUGH_LEAK_SUSP_CHK_FUC = 0
          LV_ENA_CHK_FUC_REFU = 0
Endif

If      [LV_ROUGH_LEAK_SUSP_CHK_FUC = 1           OR
(LC_COD_CHK_FUC = ! 0. Bit           AND
LC_COD_CHK_FUC = ! 1. Bit)           OR
LV_ENA_CHK_FUC_REFU = 1]           AND
VS_C_VS_ENA_CHK_FUC_OPEN_MIN
Then    LV_ENA_CHK_FUC_ROUGH_LEAK_MES = 1           // test request due to
cfc
          LV_CTR_DC_CHK_FUC = 1           // enabling DC-counter
If      STATE_DMTL = REF_LEAK_MES ? ROUGH_LEAK_MES
Then    AMP_CHK_FUC = AMP
Endif

Endif

If      VS < C_VS_ENA_CHK_FUC_OPEN_MAX           OR
|VS(n) - VS(n-1)| > C_VS_DELTA_CHK_FUC_MAX           OR
((LV_ERR_FTL = 0           AND
LV_ERR_FTL_PLAUS = 0           AND
LC_COD_CHK_FUC = 2. Bit)           AND
|FTL(n) - FTL(n-1)| > C_FTL_DELTA_CHK_FUC_MAX)           OR
LV_CHK_FUC_END = 1           OR
(LV_CHK_FUC_OPEN = 1           AND
LV_REP_CHK_FUC = 0)           OR
|AMP_MES - AMP_CHK_FUC| > C_AMP_CHK_FUC_MAX
Then    LV_ENA_CHK_FUC_ROUGH_LEAK_MES = 0           // reset of the test re-
quest
          AMP_CHK_FUC = AMP_MES

End

If      LV_CHK_FUC_END = 1           OR
LV_CHK_FUC_OPEN = 0 1
Then    LV_CTR_DC_CHK_FUC = 0

Endif

```

## B.90.2 Decision of check filler cap open or closed

### General information:

Conditions to set LV\_CHK\_FUC\_END:

- Number of the maximum DC are reached. This condition is reached, if the engine stops C\_CTR\_DC\_ENA\_CHK\_FUC\_MAX times, indicated by T\_AST. The number of the counted cycles is reseted, if the filler cap test has ended or in case of the error open filler cap .
- Cfc test successfully ended, to be recognized by the cycleflag of the rough leak test in common with no suspected rough leak
- End of the test with C\_CTR\_CHK\_FUC\_OPEN\_MAX times open filler cap.

Conditions to reset LV\_CHK\_FUC\_END:

- By initialisation of the ECU
- With recognition of a new valid refueling

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Conditions to set LV\_CHK\_FUC\_OPEN

- Cycle flag of the rough leak measurement
- Suspected rough leak

Condition to reset LV\_CHK\_FUC\_OPEN

- End of check filler cap test

## FUNCTION DESCRIPTION:

### Application conditions

**Initialisation:** in case of reset or LV\_IGK = 0 1:  
Restore out of the NV-memory:  
CTR\_DC\_ENA\_CHK\_FUC, CTR\_CHK\_FUC\_OPEN  
LV\_CHK\_FUC\_OPEN  
All other variables with 0  
In case of clear FMY:  
All variables to 0

**Recurrence:** 100 ms

**Activation:** LC\_CONF\_DMTL = 1, during all ECU states

### Formula section:

```
If      LV_CTR_DC_CHK_FUC = 1                AND
      LV_CTR_DC_ENA_CHK_FUC = 0
Then    CTR_DC_ENA_CHK_FUC ++                // driving cycle counter
      LV_CTR_DC_ENA_CHK_FUC = 1
```

**Endif**

```
If      LV_ROUGH_LEAK_SUSP = 0                AND
      LV_CYC_ROUGH_LEAK_SUSP = 0 1            AND
      LV_ENA_CHK_FUC_ROUGH_LEAK = 1
Then    LV_CHK_FUC_CLOSE = 1                // filler cap closed
Else    LV_CHK_FUC_CLOSE = 0
```

**Endif**

```
If      LV_ROUGH_LEAK_SUSP = 1                AND
      LV_CYC_ROUGH_LEAK_SUSP = 0 1            AND
      LV_ENA_CHK_FUC_ROUGH_LEAK = 1
Then    LV_CHK_FUC_OPEN = 1                // filler cap opened
      CTR_CHK_FUC_OPEN ++
```

**Endif**

```
If      CTR_DC_ENA_CHK_FUC = C_CTR_DC_ENA_CHK_FUC_MAX    OR
      LV_ERR_VS = 1                                        OR
      LV_CHK_FUC_CLOSE = 1                                OR
      CTR_CHK_FUC_OPEN = C_CTR_CHK_FUC_OPEN_MAX
Then    LV_CHK_FUC_END = 1                                // filler cap test ended
```

**Endif**

```
If      LC_COD_CHK_FUC = 0. Bit                AND
```

```

        LV_ENA_CHK_FUC_REFU = 0 1           // valid refueling recognized
    Then      LV_CHK_FUC_END = 0
Endif

If      LV_CHK_FUC_END = 1
Then    LV_CHK_FUC_OPEN = 0
Endif

If      LV_CHK_FUC_END = 1           OR
LV_CHK_FUC_OPEN = 0 1
Then    CTR_DC_ENA_CHK_FUC = 0
        CTR_CHK_FUC_OPEN = 0
Endif
    
```

### B.90.3 Control of the check filler cap lamp in the instrument cluster

#### General information:

Forming of the lamp control by LV\_CHK\_FUC\_OPEN and the stored value LV\_CHK\_FUC\_OPEN\_ACT. If an opened filler cap is recognized and the vehicle speed is higher than a threshold for a calibratable time, the indication lamp will be set for a calibratable time. To prevent a setting of the lamp after the lamp has burned once, this information is stored in LV\_CHK\_FUC\_OPEN\_ACT. This bit shall be reseted after the end of the check filler cap test.

#### FUNCTION DESCRIPTION:

#### Application conditions

**Initialisation:** in case of reset or LV\_IGK = 0 1:  
Restore out of the NV-memory:  
LV\_CHK\_FUC\_OPEN\_ACT, LV\_REP\_CHK\_FUC  
All other variables with 0  
In case of clear FMY:  
All variables to 0

**Recurrence:** 100 ms

**Activation:** LC\_CONF\_DMTL = 1, during all ECU states


#### Formula section:

```

If      VS C_VS_CHK_FUC_OPEN_CAN_MIN
Then    T_VS_CHK_FUC_OPEN_CAN_MIN ++
Else    T_VS_CHK_FUC_OPEN_CAN_MIN = 0
Endif

If      T_VS_CHK_FUC_OPEN_CAN_MIN C_T_VS_CHK_FUC_OPEN_CAN_MIN
Then    LV_T_VS_CHK_FUC_OPEN_CAN = 1
Else    LV_T_VS_CHK_FUC_OPEN_CAN = 0
Endif

If      VS C_VS_CHK_FUC_OPEN_MAX
Then    T_VS_CHK_FUC_OPEN_MAX ++
    
```

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```

Else      T_VS_CHK_FUC_OPEN_MAX = 0
Endif

If      T_VS_CHK_FUC_OPEN_MAX < C_T_VS_CHK_FUC_OPEN_MIN
Then      LV_T_VS_CHK_FUC_OPEN_MAX = 1
Else      LV_T_VS_CHK_FUC_OPEN_MAX = 0
Endif

If      LV_CHK_FUC_OPEN = 1                AND
LV_T_VS_CHK_FUC_OPEN_CAN = 1            AND
LV_CHK_FUC_OPEN_ACT = 0
Then      LV_CHK_FUC_OPEN_CAN = 1
          LV_CHK_FUC_OPEN_ACT = 1
          T_CHK_FUC_OPEN_CAN = C_T_CHK_FUC_OPEN_CAN
Else      T_CHK_FUC_OPEN_CAN --
If      T_CHK_FUC_OPEN_CAN = 0
Then      LV_CHK_FUC_OPEN_CAN = 0
Endif
Endif

If      LV_CHK_FUC_OPEN_ACT = 1            AND
LV_T_VS_CHK_FUC_OPEN_MAX = 1
Then      LV_REP_CHK_FUC = 1
Endif

If      LV_CHK_FUC_END = 1
Then      LV_REP_CHK_FUC = 0
Endif
If      LV_CHK_FUC_END = 1                OR
LV_CYC_ROUGH_LEAK_SUSP = 0 1            // sequencing ???
Then      LV_CHK_FUC_OPEN_ACT = 0
Endif

```

## B.90.4 Forming the error flag

### FUNCTION DESCRIPTION:


#### Application conditions

**Initialisation:** in case of reset or LV\_IGK = 0 1:

All other variables with 0  
In case of clear FMY:  
All variables to 0

**Recurrence:** 100 ms

**Activation:** LC\_CONF\_DMTL = 1, during all ECU states

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**Formula section:**

```


If      LV_ENA_CHK_FUC_ROUGH_LEAK = 1
Then    LV_CDN_DIAG_CHK_FUC = 1
Else    LV_CDN_DIAG_CHK_FUC = 0
Endif

If      LV_CHK_FUC_OPEN = 0 1           OR
LV_CHK_FUC_CLOSE = 0 1
Then    LV_END_DIAG_CHK_FUC = 1
Endif

If      LV_CHK_FUC_OPEN = 0 1           AND
LV_CHK_FUC_CLOSE = 0
Then    ERR_SYM_CHK_FUC = MAX
          LV_ERR_CHK_FUC = 0
          LV_ERR_CHK_FUC = 1
Endif

If      LV_CHK_FUC_OPEN = 0           AND
LV_CHK_FUC_CLOSE = 0 1
Then    ERR_SYM_CHK_FUC = NO_SYM
          LV_ERR_CHK_FUC = 0
Endif

```

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## B.91 Functional check canister purge solenoid

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CL_MMV_DIAGCPS_MAX_SAE	O/V/S	0... FFFFH	0... 1.99996	30.5e-6	-
Canister load max-value for Output mode06h					
CL_MMV_DIAGCPS_MIN_SAE	O/V/S	0... FFFFH	0... 1.99996	30.5e-6	-
Canister load min-value for Output mode06h					
CL_MMV_SAE	O/V/S	0... FFFFH	0... 1.99996	30.5e-6	-
Output mode06h - Step 1					
CL_MMV_TMP_SAE	V	0... FFFFH	0... 1.99996	0.0000305	-
Canister load mean value: Temporary auxiliary variable for STEP_1 not passed					
ERR_SYM_DIAGCPS	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected failure - functional check CPS					
FLOW_SP_CP_DIAGCPS	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Flow setpoint through the CPS during functional check CPS					
FLOW_SP_CPS_OLD	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Last EVAP-calculated flow setpoint through the CPS before start of FC CPS					
LV_ACT_DIAGCPS	O/V	0... 1H	0 ...1	1	-
Indication for functional check cps (step 2 or 3) being activated					
LV_CDN_DIAG_DIAGCPS	O/V	0... 1H	0 ...1	1	-
Condition of diagnosis - functional check CPS					
LV_DI_SUM_DIAGCPS	-	0... 1H	0 ...1	1	-
Auxiliary bit for step 2 - functional check CPS					
LV_DIAGCPS_MIN_MOD	O/V	0... 1H	0 ...1	1	-
Indication EVAC sent into MIN_PURGE by FC CPS					
LV_END_DIAG_DIAGCPS	O/V	0... 1H	0 ...1	1	-
End of diagnosis - functional check CPS					
LV_END_RBM_DIAGCPS	O/V	0... 1H	0 ...1	1	-
Indication for RBM that all three steps have been executed - functional check CPS					
LV_EOL_CPS_ERR	O/V	0... 1H	0 ...1	1	-
LV indicating error of functional check CPS (step 2) after EOL-test					
LV_EOL_CPS_INI	V	0... 1H	0 ...1	1	-
LV indicating EOL-requested functional check CPS					
LV_ERR_DIAGCPS	O/V	0... 1H	0 ...1	1	-
Indication for faulty functions - functional check CPS					
LV_INH_MAP_CTL_DIAGCPS	O/V	0... 1H	0 ...1	1	-
inhibition of MAP-control during step 2 - functional check CPS					
LV_LAM_DIAGCPS	V	0... 1H	0 ...1	1	-
Auxiliary bit for step 2 functional check CPS					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAM_SUM_DIAGCPS	V	0... 1H	0 ...1	1	-
Auxiliary bit for step 2 functional check CPS					
LV_MAF_DIAGCPS_0	V	0... 1H	0 ...1	1	-
Auxiliary bit for step 3 - functional check CPS					
LV_MAF_DIAGCPS_1	V	0... 1H	0 ...1	1	-
Auxiliary bit for step 3 - functional check CPS					
LV_MAF_SP_TQI_DYW_DIAGCPS	O/V	0... 1H	0 ...1	1	-
Indication for limited dynamic condition - functional check CPS					
LV_MAP_DIF_DIAGCPS	V	0... 1H	0 ...1	1	-
Auxiliary bit for step 2 - functional check CPS					
LV_MAP_DIF_DIAGCPS_1	-	0... 1H	0 ...1	1	-
Auxiliary bit for step 2 - functional check CPS					
LV_N_DIF_DIAGCPS	V	0... 1H	0 ...1	1	-
Auxiliary bit for step 2 - functional check CPS					
LV_N_DIF_DIAGCPS_1	-	0... 1H	0 ...1	1	-
Auxiliary bit for step 2 - functional check CPS					
LV_OPM_AV_CNG_DIAGCPS	V	0... 1H	0 ...1	1	-
LV indicating change of operation mode					
LV_OPM_AV_DIAGCPS_P_THR	V	0... 1H	0 ...1	1	-
LV indicating change of operation mode within OPM_AV = 1 (Teildrosselung in UGD)					
LV_SUPP_ACCIN_DIAGCPS	O/V	0... 1H	0 ...1	1	-
Bit to suppress the air conditioning compressor request signal - functional check CPS					
LV_T_DIAGCPS_RBM	V	0... 1H	0 ...1	1	-
Auxiliary bit timer for RBM - functional check CPS					
MAF_DIAGCPS	V	0... FFFFH	0... 1389	0.0211948	mg/stk
MAF value on start of step 3 - functional check CPS					
MAF_DIAGCPS_SAE	O/V/S	0... FFFFH	0... 1389	0.0211948	mg/stk
Output mode06h - Step 3					
MAF_DIAGCPS_THD_SAE	O/V/S	0... FFFFH	0... 1389	0.0211948	mg/stk
Output mode06h - Step 3					
MAF_SP_TQI_MMV_DIAGCPS	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Moving mean value of MAF_SP_TQI (RAM cell) - functional check CPS					
MAP_DIAGCPS	V	0... FFFFH	0... 5434	0.0829175	hPa
MAP value on starting the time C_T_DIAGCPS_N_MAP_2					
N_DIAGCPS	V	0... 1FE0H	0... 8160	1	rpm
N value on starting the time C_T_DIAGCPS_N_2					
PRS_IM_CTL_I_DIAGCPS	V	8000... 7FFFH	-2... 1.99993	61e-6	-
Pressure controller I-part value on starting the time C_T_DIAGCPS_N_MAP_2					
STATE_DIAGCPS	O/V	0H	STEP_INIT	-	-
		1H	STEP_1		
		2H	STEP_2		
		3H	STEP_3		
		4H	CPS_RAMP		
5H	LOCK_STEP				
State - functional check CPS					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_DIAGCPS_RBM	V	0H 1H 2H 3H 4H 5H	STEP_INIT STEP_1 STEP_2 STEP_3 CPS_RAMP LOCK_STEP	-	-
State - functional check CPS					
SUM_DIAG_DIAGCPS	V	0... FFH	0... 255	1	cyc
Number of diagnoses - functional check CPS					
SUM_DIAG_DIAGCPS_EOL	O/V	0... FFH	0... 255	1	cyc
Number of diagnoses if EOL-Test is active - functional check CPS					
SUM_DIAG_DIAGCPS_SAE	O/V/S	0... FFH	0... 255	1	cyc
Output mode06h - Step 2					
SUM_DIAGCPS_MAX_SAE	O/V/S	0... FFH	0... 255	1	cyc
Output mode06h - Step 2					
SUM_FLOW_SP_DIAGCPS	V	0... FFH	0... 255	1	cyc
Number of step 2 loops which have been passed - functional check CPS					
SUM_FLOW_SP_DIAGCPS_EOL	O/V	0... FFH	0... 255	1	cyc
Number of step 2 loops which have been passed if EOL-Test is active - functional check CPS					
SUM_MAF_DIAG_DIAGCPS_OFS	V	0... FFH	0... 255	1	cyc
Number of diagnoses results MAF within 1 offset - functional check CPS					
SUM_MAP_DIAG_DIAGCPS	V	0... FFH	0... 255	1	cyc
Number of diagnoses results MAP - functional check CPS					
SUM_MAP_DIAG_DIAGCPS_OFS	V	0... FFH	0... 255	1	cyc
Number of diagnoses results MAP within 1 offset - functional check CPS					
SUM_N_DIAG_DIAGCPS	V	0... FFH	0... 255	1	cyc
Number of diagnoses results N - functional check CPS					
SUM_N_DIAG_DIAGCPS_OFS	V	0... FFH	0... 255	1	cyc
Number of diagnoses results N within 1 offset - functional check CPS					
T_CL_MMV_DIAGCPS	O/V	0... FFH	0... 25.5	0.1	s
Timer to count how long the CL_MMV has been above the threshold in Step 1 (UGD)					
T_CL_MMV_DIAGCPS_2	O/V	0... FFH	0... 25.5	0.1	s
Timer to count how long the CL_MMV has been above the threshold in Step 1 (VVTNOTL1)					
T_DIAGCPS_DLY	V	1... FFH	0.1... 25.5	0.1	s
Delay time - functional check CPS					
T_DIAGCPS_DLY_1_RBM	V	1... FFH	0.1... 25.5	0.1	s
Delay time step 2 (RBM) - functional check CPS					
T_DIAGCPS_DLY_2_RBM	V	1... FFH	0.1... 25.5	0.1	s
Delay time step 3 (RBM) - functional check CPS					
T_DIAGCPS_LAM_1	V	1... FFH	0.1... 25.5	0.1	s
1st time interval for LAM-Diagnosis - functional check CPS					
T_DIAGCPS_MAF	V	1... FFH	0.1... 25.5	0.1	s
Time for active FLOW_SP offset - functional check CPS					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_DIAGCPS_MAF_RBM	V	1... FFH	0.1... 25.5	0.1	s
Time for active FLOW_SP offset step 3 (RBM) - functional check CPS					
T_DIAGCPS_N_MAP_1	V	1... FFH	0.1... 25.5	0.1	s
1st time interval for N-DIF-Diagnosis - functional check CPS					
T_DIAGCPS_N_MAP_1_RBM	V	1... FFFFH	0.1... 6553.5	0.1	s
time interval for N-DIF-Diagnosis step 2 (RBM) - functional check CPS					
T_DIAGCPS_N_MAP_2	V	1... FFH	0.1... 25.5	0.1	s
2nd time interval for N-DIF-Diagnosis - functional check CPS					
T_DIAGCPS_N_MAP_3	V	1... FFH	0.1... 25.5	0.1	s
3rd time interval for N-DIF-Diagnosis - functional check CPS					
TI_LAM_DIAGCPS_DIF [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
TI_LAM_COR_i - difference while CPS-opening during STEP_2 - functional check CPS					
TI_LAM_DIAGCPS_MAX [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
TI_LAM_COR_i - max-value while CPS-opening during STEP_2 - functional check CPS					
TI_LAM_DIAGCPS_MIN [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
TI_LAM_COR_i - min-value while CPS-opening during STEP_2 - functional check CPS					

**Input data:**

CL_MMV {p. 3698}	FLOW_SP_CPS {p. 3635}	LV_CH {p. 8232}	LV_CL_MDL_ACT {p. 3728}
LV_CL_MMV_CAL_ACT {p. 3699}	LV_CP_CLL {p. 3636}	LV_DC {p. 5746}	LV_DI_DIAGCPS {p. 5954}
LV_EOL_CPS {p. 7763}	LV_HOM_ACT {p. 8136}	LV_IGK {p. 906}	LV_INH_DIAGCPS {p. 5954}
LV_IS {p. 1720}	LV_TQ_ISC_I_TQ_PSTE {p. 3440}	MAF {p. 8277}	MAF_MES {p. 1192}
MAF_SP_TQI {p. 8390}	MAP_DIP_MES_BAS {p. 1198}	MAP_DIP_SP_MMV {p. 805}	N {p. 1525}
N_DIF {p. 1122}	PRS_IM_CTL_I {p. 8278}	STATE_OPM_ENG_CP {p. 3680}	T_DLY_PURGE_DIAGCPS {p. 1002}
TCO {p. 1100}	TI_LAM_COR [NC_CBK_EX_NR] {p. 1017}	VS {p. 1176}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_MMV_DIAGCPS	-	0... FFFFH	0... 1.99996	30.5e-6	-
Moving mean value of canister load for functional check CPS					
C_CL_MMV_DIAGCPS_VLD	-	0... FFFFH	0... 1.99996	30.5e-6	-
Threshold on CL_MMV to avoid going into Step 2 or Step 3 if the AKF is too full					
C_CRLC_MAF_SP_TQI_DIAGCPS	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for calculation of MAF_SP_TQI_MMV_DIAGCPS					
C_FLOW_SP_DIAGCPS_MAF	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Flow setpoint offset in step 3 - functional check CPS					
C_FLOW_SP_DIAGCPS_N	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Flow setpoint offset in step 2 - functional check CPS					
C_LGRD_FLOW_SP_NEG_DIAGCPS	-	1... FFFFH	0... 7.99987	122.1e-6	kg/h
Limitation gradient for closing the CPS- functional check CPS					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LGRD_FLOW_SP_POS_DIAGCPS	-	1... FFFFH	0... 7.99987	122.1e-6	kg/h
Limitation gradient for opening the CPS - functional check CPS					
C_MAF_DIAGCPS_2	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Delta MAF for MAF decrease - functional check CPS, gedrosselt					
C_MAF_MAX_DIAGCPS	-	0... FFFFH	0... 1389	0.0211948	mg/stk
MAF condition - functional check CPS					
C_MAP_DIAGCPS_1	-	0... FFFFH	0... 5434	0.0829175	hPa
Threshold for map difference in step 2 - functional check CPS, ungedrosselt					
C_MAP_DIAGCPS_2	-	0... FFFFH	0... 5434	0.0829175	hPa
Threshold for map difference in step 2 - functional check CPS, gedrosselt					
C_MAP_DIP_SP_MMV_DIAGCPS	-	8000... 7FFFH	-1280... 1279.96093	0.0390625	hPa
Threshold for map difference in step 2 - functional check CPS, gedrosselt					
C_N_DIAGCPS_2	-	0... 1FE0H	0... 8160	1	rpm
Threshold for engine speed increase in step 2 - functional check CPS, gedrosselt					
C_N_DIF_DIAGCPS	-	0... 1FE0H	0... 8160	1	rpm
Condition for IS engine speed difference - functional check CPS					
C_PRS_IM_CTL_I_DIAGCPS	-	0... FFFFH	0... 3.99993	61e-6	-
Threshold for Pressure controller I-part difference in step 2 - functional check CPS					
C_SUM_DIAGCPS_EOL	-	0... FFH	0... 255	1	cyc
EOL-test: Counter limit of SUM_DIAGCPS_EOL - functional check CPS					
C_SUM_DIAGCPS_MAX	-	0... FFH	0... 255	1	cyc
Counter limit of C_SUM_DIAGCPS - functional check CPS					
C_SUM_FLOW_SP_DIAGCPS_MAX	-	0... FFH	0... 255	1	cyc
Max. number of step 2 loops which have been passed - functional check CPS					
C_SUM_MAF_DIAG_DIAGCPS_OFS	-	0... FFH	0... 255	1	cyc
Counter for MAF-events per offset during STEP_2 - functional check CPS					
C_SUM_MAP_DIAG_DIAGCPS_OFS	-	0... FFH	0... 255	1	cyc
Counter for MAP-events per offset during STEP_2 - functional check CPS					
C_SUM_N_DIAG_DIAGCPS_OFS	-	0... FFH	0... 255	1	cyc
Counter for n-events per offset during STEP_2 - functional check CPS					
C_T_CL_MMV_DIAGCPS	-	0... FFH	0... 25.5	0.1	s
Timer to count how long the CL_MMV has been above the threshold in Step 1 (UGD)					
C_T_CL_MMV_DIAGCPS_2	-	0... FFH	0... 25.5	0.1	s
Timer to count how long the CL_MMV has been above the threshold in Step 1 (VVTNOTL1)					
C_T_DIAGCPS_DLY	-	1... FFH	0.1... 25.5	0.1	s
Delay time - functional check CPS					
C_T_DIAGCPS_MAF	-	1... FFH	0.1... 25.5	0.1	s
Time for active FLOW_SP offset C_FLOW_SP_DIAGCPS_MAF - functional check CPS					
C_T_DIAGCPS_N_MAP_1	-	1... FFH	0.1... 25.5	0.1	s
Time interval after expiry of which the cycle of step 2 is repeated - functional check CPS					
C_T_DIAGCPS_N_MAP_2	-	1... FFH	0.1... 25.5	0.1	s
Time for evaluation of N, MAP reaction - functional check CPS					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DIAGCPS_N_MAP_3	-	1... FFH	0.1... 25.5	0.1	s
Time for increasing FLOW_SP - functional check CPS					
C_T_DIAGCPS_N_MAP_4	-	1... FFH	0.1... 25.5	0.1	s
Time for evaluation of N, MAP reaction - functional check CPS					
C_T_INH_MAP_CTL_DIAGCPS	-	1... FFH	0.1... 25.5	0.1	s
time threshold for inhibition of MAP-control - functional check CPS					
C_TCO_MIN_DIAGCPS	-	0... FEH	-48... 142.5	0.75	°C
Min. temperature for functional check CPS					
C_TI_LAM_DIAGCPS_DIF	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Min. TI_LAM_COR_i - difference while CPS-opening during STEP_2 - functional check CPS					
LC_DIAGCPS_MAP_ACT_OPM_2	-	0... 1H	0...1	1	-
MAP monitoring activated during STEP_2 - throttled mode					

## FUNCTION DESCRIPTION:

### General Information:

The diagnosis is used for the functional test of the CP solenoid. Therefore the CPS is diagnosed via its effects on the engine.

The functional check of the CPS consists of 3 steps:

- Step 1: based on the ACF load degree
- Step 2: based on
  - the engine speed change at IS,
  - the deviation of lambda-controller and
  - the measured MAP before and during CPS-opening
- Step 3: based on the difference between the measured air mass flow before and during a CPS opening

If the CPS has been detected to be OK within a step or as not OK after step 3 then the function is exited irreversibly until the next engine start.

The steps 1, 2 and 3 are processed successively, i.e. the next step may only be performed if the preceding one has not been detected as OK. The only exception is step 1. Step 1 may also be performed parallel to step 2 and 3, which means:

After step 1 has been processed once and CPS has not been detected as OK then (if enable conditions are fulfilled) it is proceeded with step 2 and at the same time calculation of step 1 is started again. Calculation of step 1 is done until CPS is detected as OK within one of the steps (1, 2 or 3) or until CPS is detected as definitely not OK by the end of step 3.

If the CPS is detected to be not OK after all 3 steps have been passed (end of step 3), then the error is set.

The complete diagnosis "functional check CPS" is performed only once per driving cycle.

### Exception:

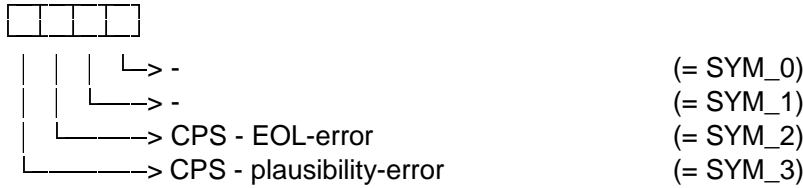
*Activation of functional check CPS via EOL-test (LV\_EOL\_CPS 0 --> 1):*

Through the EOL-test the functional check CPS can be triggered several times per engine operation.

The diagnosis is addressed via the serial interface. Only STEP\_2 will be performed.

For general enable conditions of the diagnosis see chapter "Appl. Inc. Functional Check CPS".

Error-symptoms are defined to this diagnosis function as following :



### Application conditions:

**Initialisation:** 1) on transition LV\_IGK OFF → ON or reset:

All variables from output-data-section have to be initialized with zero:

**except:** STATE\_DIAGCPS\_OLD = STEP\_1  
 STATE\_DIAGCPS = STEP\_INIT  
 T\_DIAGCPS\_DLY = C\_T\_DIAGCPS\_DLY  
 T\_CL\_MMV\_DIAGCPS = C\_T\_CL\_MMV\_DIAGCPS  
 T\_CL\_MMV\_DIAGCPS\_2 = C\_T\_CL\_MMV\_DIAGCPS\_2  
 CL\_MMV\_SAE = CL\_MMV\_SAE  
 CL\_MMV\_DIAGCPS\_MIN\_SAE = CL\_MMV\_DIAGCPS\_MIN\_SAE  
 CL\_MMV\_DIAGCPS\_MAX\_SAE = CL\_MMV\_DIAGCPS\_MAX\_SAE  
 SUM\_DIAG\_DIAGCPS\_SAE = SUM\_DIAG\_DIAGCPS\_SAE  
 SUM\_DIAGCPS\_MAX\_SAE = SUM\_DIAGCPS\_MAX\_SAE  
 MAF\_DIAGCPS\_SAE = MAF\_DIAGCPS\_SAE  
 MAF\_DIAGCPS\_THD\_SAE = MAF\_DIAGCPS\_THD\_SAE

2) on clearing failure memory

All variables from output-data-section have to be initialized with zero:

**except:** STATE\_DIAGCPS\_OLD = STEP\_1  
 STATE\_DIAGCPS = STEP\_INIT  
 T\_DIAGCPS\_DLY = C\_T\_DIAGCPS\_DLY  
 T\_CL\_MMV\_DIAGCPS = C\_T\_CL\_MMV\_DIAGCPS  
 T\_CL\_MMV\_DIAGCPS\_2 = C\_T\_CL\_MMV\_DIAGCPS\_2

**Recurrence:** 100 ms

**Activation:** LV\_DC = 1

**Deactivation:** LV\_DC = 0

### Conditions for End-of-line (EOL) - Test:

#### Description:

This is to secure that any time the functional check CPS is activated via EOL-Test :

- the functional check starts right from the beginning again
- only those steps of the functional check CPS are performed regarding the EOL-Test
- the diagnosis results of the functional check (issued via serial interface) are the results from the EOL-Test only

#### Formula section:

##### Detection of EOL-Request:

**IF** (LV\_EOL\_CPS(k-1) = 0 **AND** LV\_EOL\_CPS(k) = 1)

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```

THEN      LV_EOL_CPS_INI = 1
            STATE_DIAGCPS = STEP_INIT
ELSE      LV_EOL_CPS_INI = 0
ENDIF

```

**Detection of OPM-Change:**

// OPM = operation mode

```

IF      MAP_DIP_SP_MMV > C_MAP_DIP_SP_MMV_DIAGCPS
THEN    LV_OPM_AV_DIAGCPS_P_THR = 1      //GD, T-GD (gedrosselt); direct injection vehicles
ELSE    LV_OPM_AV_DIAGCPS_P_THR = 0      //UGD (ungedrosselt); VVT vehicles
ENDIF

```

```

IF      STATE_DIAGCPS = STEP_2      or
            STATE_DIAGCPS = STEP_3
THEN
IF      (LV_OPM_AV_DIAGCPS_P_THRk !=      // UGD ↓ T- GD or GD
            LV_OPM_AV_DIAGCPS_P_THRk-1)
THEN    LV_OPM_AV_CNG_DIAGCPS = 1
            STATE_DIAGCPS = STEP_INIT
ELSE    LV_OPM_AV_CNG_DIAGCPS = 0
ENDIF
ENDIF

```

The functionality in Step 1 which consists in counting the time during which the CL\_MMV is above the threshold C\_CL\_MMV\_DIAGCPS, needs to be reset in the following cases:

- transition between UGD/GD happens
- the system is in open loop (CL\_MMV frozen)
- the canister load model is active (CL\_MMV not reliable)

```

IF      (LV_OPM_AV_DIAGCPS_P_THRk !=
            LV_OPM_AV_DIAGCPS_P_THRk-1)      OR
            LV_CP_CLL = 0                        OR
            LV_CL_MDL_ACT = 1                    OR
            LV_CL_MMV_CAL_ACT = 0
THEN    T_CL_MMV_DIAGCPS = C_T_CL_MMV_DIAGCPS
            T_CL_MMV_DIAGCPS_2 = C_T_CL_MMV_DIAGCPS_2
ENDIF


```

**STEP\_INIT:**

```

LV_ACT_DIAGCPS = 0
LV_DIAGCPS_MIN_MOD = 0
LV_INH_MAP_CTL_DIAGCPS = 0
LV_MAF_DIAGCPS_i = 0
LV_EOL_CPS_ERR = 0
LV_N_DIF_DIAGCPS = 0
LV_N_DIF_DIAGCPS_1 = 0
LV_DI_SUM_DIAGCPS = 0
LV_MAP_DIF_DIAGCPS = 0
LV_MAP_DIF_DIAGCPS_1 = 0
SUM_MAP_DIAG_DIAGCPS_OFS = 0
SUM_N_DIAG_DIAGCPS_OFS = 0

```

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```


SUM_MAF_DIAG_DIAGCPS_OFS = 0
LV_SUPP_ACCIN_DIAGCPS = 0
LV_LAM_DIAGCPS = 0
MAF_DIAGCPS = 0
N_DIAGCPS = 0
MAP_DIAGCPS = 0
PRS_IM_CTL_I_DIAGCPS = 0
SUM_DIAG_DIAGCPS_EOL = 0
SUM_FLOW_SP_DIAGCPS_EOL = 0
T_DIAGCPS_N_MAP_1 = 0
T_DIAGCPS_N_MAP_2 = 0
T_DIAGCPS_N_MAP_3 = 0
T_DIAGCPS_LAM_1 = 0
T_DIAGCPS_MAF = 0
TI_LAM_DIAGCPS_DIF_i = 0
TI_LAM_DIAGCPS_MIN_i = 7FFFH
TI_LAM_DIAGCPS_MAX_i = 8000H
T_DIAGCPS_DLY = C_T_DIAGCPS_DLY
T_DIAGCPS_DLY_1_RBM = 0
T_DIAGCPS_DLY_2_RBM = 0
T_DIAGCPS_N_MAP_1_RBM = 0
T_DIAGCPS_MAF_RBM = 0
LV_T_DIAGCPS_RBM = 0
T_CL_MMV_DIAGCPS = C_T_CL_MMV_DIAGCPS
T_CL_MMV_DIAGCPS_2 = C_T_CL_MMV_DIAGCPS_2

```

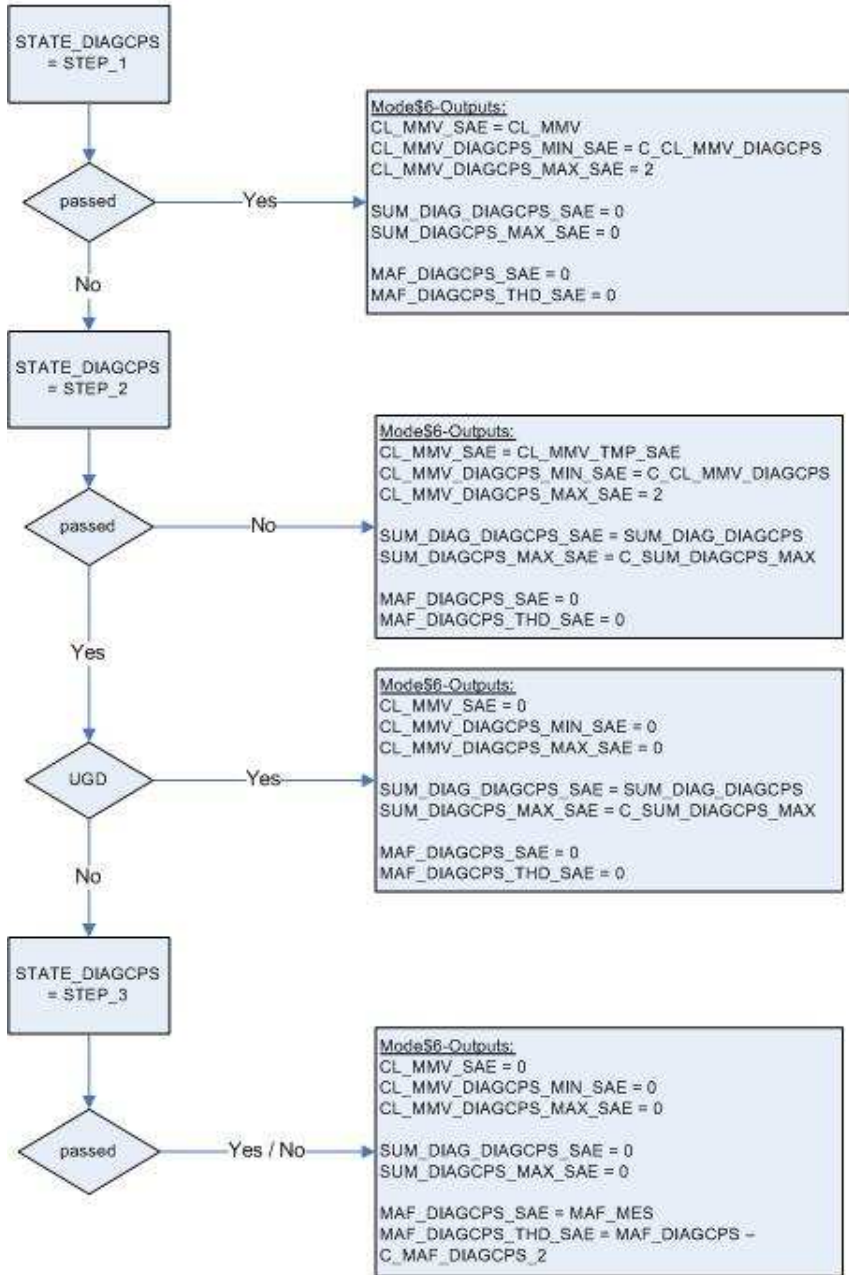
```

IF(1)          LV_INH_DIAGCPS = 1  OR  // Functional check CPS is exited irreversibly
                LV_EOL_CPS_INI = 1  OR  // EOL-Test active
                LV_OPM_AV_CNG_DIAGCPS = 1  // change of OPM_AV detected
THEN(1)       LV_EOL_CPS_INI = 0
                LV_OPM_AV_CNG_DIAGCPS = 0
                FLOW_SP_CP_DIAGCPS = 0
                FLOW_SP_CPS_OLD = 0
                SUM_DIAG_DIAGCPS = 0
                SUM_FLOW_SP_DIAGCPS = 0
                SUM_N_DIAG_DIAGCPS = 0
                SUM_MAP_DIAG_DIAGCPS = 0
                LV_LAM_SUM_DIAGCPS = 0
                except:          STATE_DIAGCPS_OLD = STEP_1
                                LV_ERR_DIAGCPS and ERR_SYM_DIAGCPS
                                must not be changed
ELSE(1)       FLOW_SP_CP_DIAGCPS = FLOW_SP_CPS_OLD
                IF(2)          LV_DI_DIAGCPS = 0
                THEN(2)       STATE_DIAGCPS = STEP_1
                ENDIF(2)
ENDIF(1)

```

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## Mode\$6-Output for TEV-Check: Helping hand




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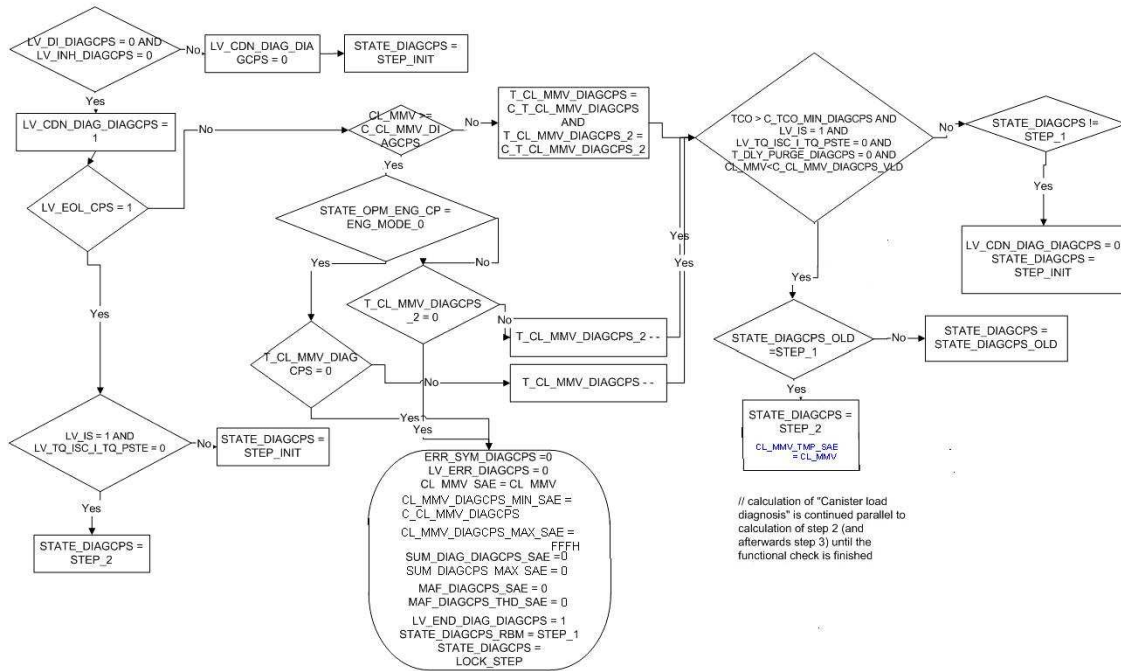
### Canister load diagnosis

#### Description:

Functional check of the CPS based on the ACF- load degree. The “Canister Load diagnosis” is calculated permanently until the functional check CPS is finished (LV\_END\_DIAGCPS = 1).

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**Overview:****Formula section:**

```

IF(1) LV_DI_DIAGCPS = 0      AND
      LV_INH_DIAGCPS = 0
THEN(1) LV_CDN_DIAG_DIAGCPS = 1
IF(2) LV_EOL_CPS = 1
THEN(2) IF(3a) LV_IS = 1      AND
          LV_TQ_ISC_I_TQ_PSTE = 0
          THEN(3a) STATE_DIAGCPS = STEP_2
          ELSE(3a) STATE_DIAGCPS = STEP_INIT
          ENDIF(3a)
ELSE(2) IF(3b) CL_MMV >= C_CL_MMV_DIAGCPS      //AKF load sufficiently high
          THEN(3b) IF(3c) STATE_OPM_ENG_CP = ENG_MODE_0
                   THEN(3c)
                     IF(3d) T_CL_MMV_DIAGCPS = 0
                     THEN(3d)
                       // STEP_1 passed
                       ERR_SYM_DIAGCPS = NO_SYM
                       LV_ERR_DIAGCPS = 0
                       LV_END_DIAG_DIAGCPS = 1
                       CL_MMV_SAE = CL_MMV
                       CL_MMV_DIAGCPS_MIN_SAE = C_CL_MMV_DIAGCPS
                       MMV_DIAGCPS_MAX_SAE = FFFFh
                       SUM_DIAG_DIAGCPS_SAE = 0
                       SUM_DIAGCPS_MAX_SAE = 0
                       MAF_DIAGCPS_SAE = MAF_DIAGCPS_THD_SAE = 0
                       STATE_DIAGCPS_RBM = STEP_1
                       STATE_DIAGCPS = LOCK_STEP

```




```

ELSE(3d)
  T_CL_MMV_DIAGCPS --
IF(3e) TCO > C_TCO_MIN_DIAGCPS      AND
LV_IS = 1                            AND
  LV_TQ_ISC_I_TQ_PSTE = 0          AND
  T_DLY_PURGE_DIAGCPS = 0          AND
  CL_MMV < C_CL_MMV_DIAGCPS_VLD
//STEP_1 not passed goto STEP_2
  THEN(3e)
IF(3f)      STATE_DIAGCPS_OLD = STEP_1
THEN(3f)    CL_MMV_TMP_SAE = CL_MMV
            STATE_DIAGCPS = STEP_2
ELSE(3f)    STATE_DIAGCPS =
            STATE_DIAGCPS_OLD

  ENDIF(3f)
ELSE(3e) IF(3g)      STATE_DIAGCPS != STEP_1
  THEN(3g) LV_CDN_DIAG_DIAGCPS = 0
            STATE_DIAGCPS = STEP_INIT
  ENDIF(3g)
ENDIF(3e)
ENDIF(3d)
ELSE(3c)
IF(3h) T_CL_MMV_DIAGCPS_2 = 0
THEN(3h)
  ERR_SYM_DIAGCPS = NO_SYM
  LV_ERR_DIAGCPS = 0
  LV_END_DIAG_DIAGCPS = 1
  CL_MMV_SAE = CL_MMV
  CL_MMV_DIAGCPS_MIN_SAE = C_CL_MMV_DIAGCPS
  MMV_DIAGCPS_MAX_SAE = FFFFH
  SUM_DIAG_DIAGCPS_SAE = 0
  SUM_DIAGCPS_MAX_SAE = 0
  MAF_DIAGCPS_SAE = MAF_DIAGCPS_THD_SAE = 0
  STATE_DIAGCPS_RBM = STEP_1
  STATE_DIAGCPS = LOCK_STEP
ELSE(3h)
  T_CL_MMV_DIAGCPS_2 --
IF(3i) TCO > C_TCO_MIN_DIAGCPS      AND
LV_IS = 1                            AND
  LV_TQ_ISC_I_TQ_PSTE = 0          AND
  T_DLY_PURGE_DIAGCPS = 0          AND
  CL_MMV < C_CL_MMV_DIAGCPS_VLD
//STEP_1 not passed goto STEP_2
  THEN(3i)
IF(3j)      STATE_DIAGCPS_OLD = STEP_1
THEN(3j)    CL_MMV_TMP_SAE = CL_MMV
            STATE_DIAGCPS = STEP_2
ELSE(3j)    STATE_DIAGCPS =
            STATE_DIAGCPS_OLD
  ENDIF(3j)
ELSE(3i) IF(3k)      STATE_DIAGCPS !=STEP_1
  THEN(3k) LV_CDN_DIAG_DIAGCPS = 0
            STATE_DIAGCPS = STEP_INIT

```

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```

                ENDIF(3k)
            ENDIF(3i)
        ENDIF(3h)
    ENDIF(3c)
ELSE(3b)    T_CL_MMV_DIAGCPS = C_T_CL_MMV_DIAGCPS
            T_CL_MMV_DIAGCPS_2 = C_T_CL_MMV_DIAGCPS_2
    IF(4a)   TCO > C_TCO_MIN_DIAGCPS    AND
            LV_IS = 1                    AND
            LV_TQ_ISC_I_TQ_PSTE = 0    AND
            T_DLY_PURGE_DIAGCPS = 0    AND
            CL_MMV < C_CL_MMV_DIAGCPS_VLD
    THEN(4a)                                     //STEP_1 not passed goto
    STEP_2
        IF(5a)    STATE_DIAGCPS_OLD = STEP_1
        THEN(5a)  CL_MMV_TMP_SAE = CL_MMV
                  STATE_DIAGCPS = STEP_2
        ELSE(5a)  STATE_DIAGCPS = STATE_DIAGCPS_OLD
        ENDIF(5a)
    ELSE(4a)
        IF(5b)    STATE_DIAGCPS != STEP_1
        THEN(5b)  LV_CDN_DIAG_DIAGCPS = 0
                  STATE_DIAGCPS = STEP_INIT
        ENDIF(5b)
    ENDIF(4a)
ENDIF(3b)
ENDIF(2)
ELSE(1)    LV_CDN_DIAG_DIAGCPS = 0
           STATE_DIAGCPS = STEP_INIT
ENDIF(1)

```


## STEP 2: N-DIF-/LAM-/MAP-Diagnosis

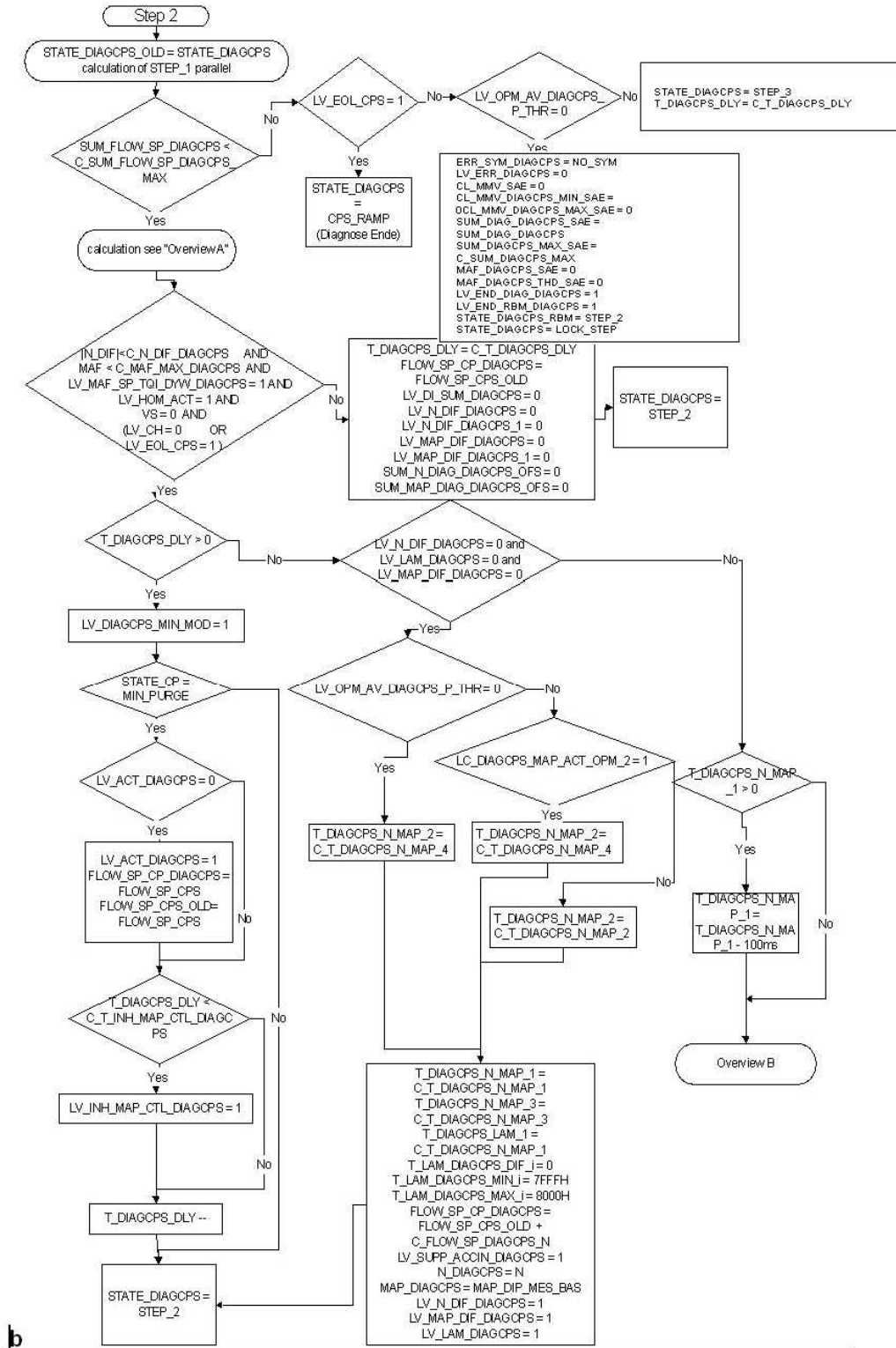
### Description:

In step 2, the CPS is evaluated based on the engine speed change (throttled mode), MAP change (unthrottled mode) and Lambda deviation at IS. To this effect, the CPS is opened for a short time and the engine speed monitored for a certain period.

After step 2 has been enabled for the first time, it is requested during each IS phase. This is repeated as long as a result has been reached in step 2. The function is not bound to one IS phase, but can be distributed to several IS phases.

### Overview:


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**Formula section:**


STATE\_DIAGCPS\_OLD = STATE\_DIAGCPS  
 calculate STEP\_1 parallelly

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```

IF(1)      SUM_FLOW_SP_DIAGCPS < C_SUM_FLOW_SP_DIAGCPS_MAX
THEN(1)IF(2a)  LV_LAM_SUM_DIAGCPS = 0 and LV_LAM_DIAGCPS = 1
THEN(2a)
IF(3a)  T_DIAGCPS_LAM_1 > 0
THEN(3a)T_DIAGCPS_LAM_1 -
    // Lamb-Monitoring:
    TI_LAM_DIAGCPS_MAX_1 =
    MAX (TI_LAM_DIAGCPS_MAX_1 N-1; TI_LAM_COR_1 N)
    TI_LAM_DIAGCPS_MAX_2 =
    MAX (TI_LAM_DIAGCPS_MAX_2 N-1; TI_LAM_COR_2 N)
    TI_LAM_DIAGCPS_MIN_1 =
    MIN (TI_LAM_DIAGCPS_MIN_1 N-1; TI_LAM_COR_1 N)
    TI_LAM_DIAGCPS_MIN_2 =
    MIN (TI_LAM_DIAGCPS_MIN_2 N-1; TI_LAM_COR_2 N)
ELSE(3a)LV_LAM_DIAGCPS = 0
    TI_LAM_DIAGCPS_DIF_1 = TI_LAM_DIAGCPS_MAX_1 -
    TI_LAM_DIAGCPS_MIN_1
    TI_LAM_DIAGCPS_DIF_2 = TI_LAM_DIAGCPS_MAX_2 -
    TI_LAM_DIAGCPS_MIN_2
IF(4a)  TI_LAM_DIAGCPS_DIF_1 > C_TI_LAM_DIAGCPS_DIF OR
    LAM_DIAGCPS_DIF_2 > C_TI_LAM_DIAGCPS_DIF
THEN(4a) LV_LAM_SUM_DIAGCPS = 1
    Jump to STEP_2B
ENDIF(4a)
ENDIF(3a)
ENDIF(2a)
IF(2b)      | N_DIF < C_N_DIF_DIAGCPS AND
    MAF < C_MAF_MAX_DIAGCPS AND
    LV_MAF_SP_TQI_DYW_DIAGCPS = 1 AND
    LV_HOM_ACT = 1 AND
    VS = 0 AND
    (LV_CH = 0 OR
    LV_EOL_CPS = 1)
THEN(2b)
IF(3b)  T_DIAGCPS_DLY > 0
THEN(3b)LV_DIAGCPS_MIN_MOD = 1
IF(4b)  STATE_CP = MIN_PURGE
THEN(4b)
IF(5a)  LV_ACT_DIAGCPS = 0
THEN(5a)LV_ACT_DIAGCPS = 1
    FLOW_SP_CP_DIAGCPS = FLOW_SP_CPS
    FLOW_SP_CPS_OLD = FLOW_SP_CPS
ENDIF(5a)
IF(5b)  T_DIAGCPS_DLY < C_T_INH_MAP_CTL_DIAGCPS
THEN(5b) LV_INH_MAP_CTL_DIAGCPS = 1
ENDIF(5b)
    T_DIAGCPS_DLY = T_DIAGCPS_DLY -
ENDIF(4b)
ELSE(3b)
IF(4c)      LV_N_DIF_DIAGCPS = 0 AND
    LV_LAM_DIAGCPS = 0 AND
    LV_MAP_DIF_DIAGCPS = 0

```

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**THEN(4c)**

**IF(5c)** LV\_OPM\_AV\_DIAGCPS\_P\_THR = 0

**Then(5c)** T\_DIAGCPS\_N\_MAP\_2 = C\_T\_DIAGCPS\_N\_MAP\_4

**Else(5c)**

**If(6a)** LC\_DIAGCPS\_MAP\_ACT\_OPM\_2 = 1

**Then(6a)** T\_DIAGCPS\_N\_MAP\_2 = C\_T\_DIAGCPS\_N\_MAP\_4

**Else(6a)** T\_DIAGCPS\_N\_MAP\_2 = C\_T\_DIAGCPS\_N\_MAP\_2

**Endif(6a)**

**Endif(5c)**

T\_DIAGCPS\_N\_MAP\_1 = C\_T\_DIAGCPS\_N\_MAP\_1

T\_DIAGCPS\_N\_MAP\_3 = C\_T\_DIAGCPS\_N\_MAP\_3

T\_DIAGCPS\_LAM\_1 = C\_T\_DIAGCPS\_N\_MAP\_1

TI\_LAM\_DIAGCPS\_MIN\_i = 7FFFH

TI\_LAM\_DIAGCPS\_MAX\_i = 8000H

FLOW\_SP\_CP\_DIAGCPS = FLOW\_SP\_CPS\_OLD +

C\_FLOW\_SP\_DI-

AGCPS\_N

LV\_SUPP\_ACCIN\_DIAGCPS = 1

N\_DIAGCPS = N

MAP\_DIAGCPS = MAP\_DIP\_MES\_BAS

PRS\_IM\_CTL\_I\_DIAGCPS = PRS\_IM\_CTL\_I

LV\_N\_DIF\_DIAGCPS = 1

LV\_MAP\_DIF\_DIAGCPS = 1

LV\_LAM\_DIAGCPS = 1

**ELSE(4c)**

**IF(5d)** T\_DIAGCPS\_N\_MAP\_1 > 0

**THEN(5d)** T\_DIAGCPS\_N\_MAP\_1 = T\_DIAGCPS\_N\_MAP\_1 --

**ENDIF(5d)**

**IF(5e)** T\_DIAGCPS\_N\_MAP\_2 > 0

**THEN(5e)** T\_DIAGCPS\_N\_MAP\_2 = T\_DIAGCPS\_N\_MAP\_2 --

**IF(6b)** T\_DIAGCPS\_N\_MAP\_3 > 0

**THEN(6b)** T\_DIAGCPS\_N\_MAP\_3 = T\_DIAGCPS\_N\_MAP\_3 --

**ELSE(6b)**

**IF(7a)** FLOW\_SP\_CP\_DIAGCPS > FLOW\_SP\_CPS\_OLD

**THEN(7a)** FLOW\_SP\_CP\_DIAGCPS =

FLOW\_SP\_CPS\_OLD

**ENDIF(7a)**

**ENDIF(6b)**


**IF(6c)** LV\_OPM\_AV\_DIAGCPS\_P\_THR = 0

**THEN(6c)**

**IF(7b)** MAP\_DIP\_MES\_BAS - MAP\_DIAGCPS >

//to use for MAF-System

C\_MAP\_DIAGCPS\_1 **OR**

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```

                PRS_IM_CTL_I_DIAGCPS - PRS_IM_CTL_I >
//to use for MAP-System                C_PRS_IM_CTL_I_DIAGCPS
THEN(7b) SUM_MAP_DIAG_DIAGCPS_OFS ++
                IF(8a) SUM_MAP_DIAG_DIAGCPS_OFS >
                C_SUM_MAP_DIAG_DIAGCPS_OFS
                Then(8a) LV_MAP_DIF_DIAGCPS_1 = 1
                Endif(8a)
                ENDIF(7b)
ELSE(6c)
                If(7c) LC_DIAGCPS_MAP_ACT_OPM_2 = 1
                Then(7c)
                IF(8b) MAP_DIP_MES_BAS - MAP_DIAGCPS >
MAP_DIAGCPS_2                OR
                PRS_IM_CTL_I_DIAGCPS - PRS_IM_CTL_I
                I > C_PRS_IM_CTL_I_DIAGCPS
                THEN(8b) SUM_MAP_DIAG_DIAGCPS_OFS ++


IF(9a) SUM_MAP_DIAG_DIAGCPS_OFS >                C_SUM_MAP_DIAG_DIAGCPS_OFS

Then(9a) LV_MAP_DIF_DIAGCPS_1 = 1

Endif(9a)

                ENDIF(8b)
                Else(7c)
                IF(8c) N_DIAGCPS - N > C_N_DIAGCPS_2
                THEN(8c) SUM_N_DIAG_DIAGCPS_OFS ++
                IF(9b) SUM_N_DIAG_DIAGCPS_OFS >
                C_SUM_N_DIAG_DIAGCPS_OFS
                Then(9b) LV_N_DIF_DIAGCPS_1 = 1
                Endif(9b)
                ENDIF(8c)
                Endif(7c)
ENDIF(6c)
                ELSE(5e)
IF(6d) LV_DI_SUM_DIAGCPS = 0
THEN(6d)
                IF(7d) LV_N_DIF_DIAGCPS_1 = 1
                THEN(7d) SUM_N_DIAG_DIAGCPS ++
                ENDIF(7d)
                IF(7e) LV_MAP_DIF_DIAGCPS_1 = 1
                THEN(7e) SUM_MAP_DIAG_DIAGCPS ++
                ENDIF(7e)
                SUM_FLOW_SP_DIAGCPS ++
                LV_DI_SUM_DIAGCPS = 1
ENDIF(6d)
                IF(6e) T_DIAGCPS_N_MAP_1 = 0
THEN(6e) LV_DI_SUM_DIAGCPS = 0
                LV_N_DIF_DIAGCPS = 0
                LV_N_DIF_DIAGCPS_1 = 0
                LV_MAP_DIF_DIAGCPS = 0
                LV_MAP_DIF_DIAGCPS_1 = 0
                SUM_MAP_DIAG_DIAGCPS_OFS = 0
                SUM_N_DIAG_DIAGCPS_OFS = 0

```

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```

                ENDIF(6e)
                ENDIF(5e)
                Jump to "STEP_2B"
            ENDIF(4c)
        ENDIF(3b)
    ELSE(2b)    T_DIAGCPS_DLY = C_T_DIAGCPS_DLY
              FLOW_SP_CP_DIAGCPS = FLOW_SP_CPS_OLD
              LV_DI_SUM_DIAGCPS = 0
              LV_N_DIF_DIAGCPS = 0
              LV_N_DIF_DIAGCPS_1 = 0
              LV_MAP_DIF_DIAGCPS = 0
              LV_MAP_DIF_DIAGCPS_1 = 0
              SUM_MAP_DIAG_DIAGCPS_OFS = 0
              SUM_N_DIAG_DIAGCPS_OFS = 0


    ENDIF(2b)
ELSE(1)IF(2c)    LV_EOL_CPS = 1
                THEN(2c)    STATE_DIAGCPS = CPS_RAMP    (Diagnose Ende)
                ELSE(2c)
                IF(3c)    LV_OPM_AV_DIAGCPS_P_THR = 0
                THEN(3c)
                    ERR_SYM_DIAGCPS = NO_SYM                //STEP2 passed
                    LV_ERR_DIAGCPS = 0
                    CL_MMV_SAE = 0
                    CL_MMV_DIAGCPS_MIN_SAE = CL_MMV_DIAGCPS_MAX_SAE = 0
                    SUM_DIAG_DIAGCPS_SAE = SUM_DIAG_DIAGCPS
                    SUM_DIAGCPS_MAX_SAE = C_SUM_DIAGCPS_MAX
                    MAF_DIAGCPS_SAE = MAF_DIAGCPS_THD_SAE = 0
                    LV_END_DIAG_DIAGCPS = 1
                    LV_END_RBM_DIAGCPS = 1
                    STATE_DIAGCPS_RBM = STEP_2
                    STATE_DIAGCPS = LOCK_STEP

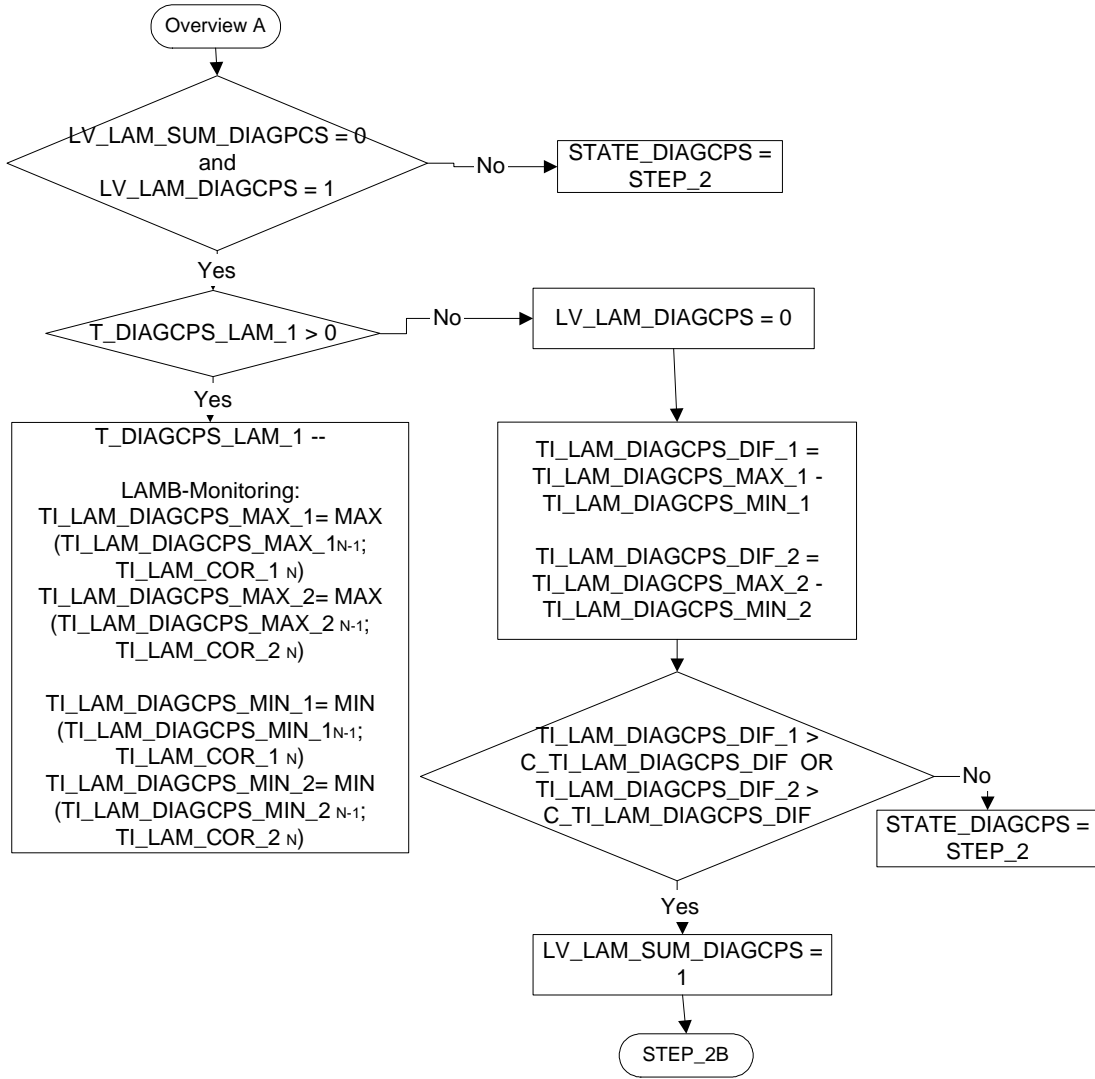
                ELSE(3c)                //STEP2 not passed goto STEP3
                    STATE_DIAGCPS = STEP_3
                    T_DIAGCPS_DLY = C_T_DIAGCPS_DLY

                ENDIF(3c)
            ENDIF(2c)
        ENDIF(1)

```


### Overview A:

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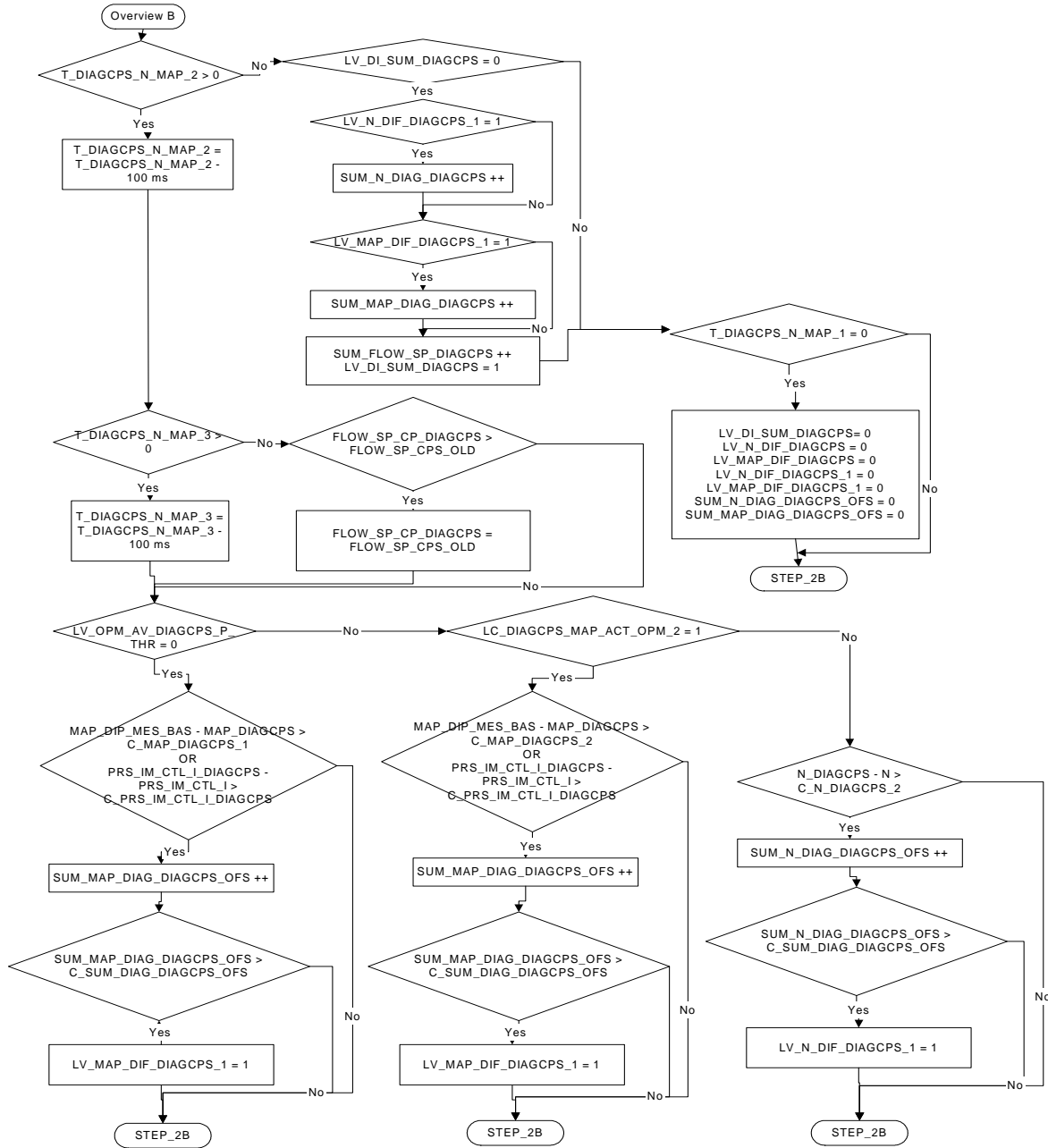


**Overview B :**

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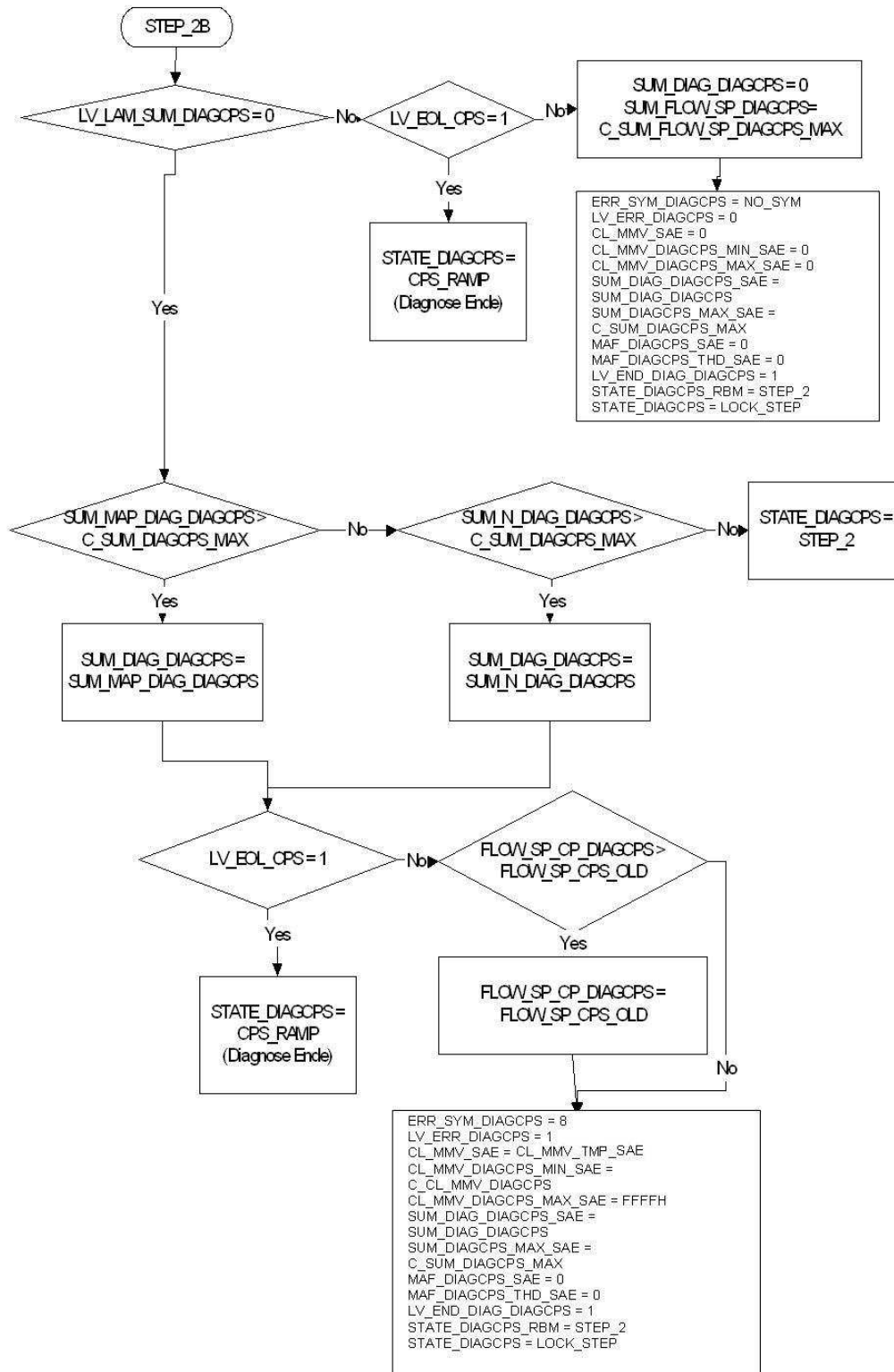
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**STEP\_2B:**

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**STEP\_2B:****IF(1) LV\_LAM\_SUM\_DIAGCPS = 0****THEN(1)IF(2a) SUM\_MAP\_DIAG\_DIAGCPS > C\_SUM\_DIAGCPS\_MAX**

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```

THEN(2a)    SUM_DIAG_DIAGCPS = SUM_MAP_DIAG_DIAGCPS
ELSE(2a)    IF(3a)        SUM_N_DIAG_DIAGCPS > C_SUM_DIAGCPS_MAX
THEN(3a)    SUM_DIAG_DIAGCPS = SUM_N_DIAG_DIAGCPS
ELSE(3a)    STATE_DIAGCPS = STEP_2
ENDIF(3a)

ENDIF(2a)
IF(2b)      SUM_DIAG_DIAGCPS > C_SUM_DIAGCPS_MAX
THEN(2b)    IF(3b)    LV_EOL_CPS = 1
THEN(3b)    STATE_DIAGCPS = CPS_RAMP
                (Diagnose Ende)
ELSE(3b)    IF(4a)    FLOW_SP_CP_DIAGCPS > FLOW_SP_CPS_OLD
THEN(4a)    FLOW_SP_CP_DIAGCPS =
                FLOW_SP_CPS_OLD
ENDIF(4a)    // STEP2 failed; irreversible diagnose

end

ERR_SYM_DIAGCPS = SYM_3 (cps_plaus error)
LV_ERR_DIAGCPS = 1
SUM_DIAG_DIAGCPS_SAE = SUM_DIAG_DIAGCPS
SUM_DIAGCPS_MAX_SAE = C_SUM_DIAGCPS_MAX
CL_MMV_SAE = CL_MMV_TMP_SAE CL_MMV_DIAGCPS_MIN_
SAE = C_CL_MMV_DIAGCPS
CL_MMV_DIAGCPS_MAX_SAE = FFFFH
MAF_DIAGCPS_SAE = MAF_DIAGCPS_THD_SAE = 0
LV_END_DIAG_DIAGCPS = 1
STATE_DIAGCPS_RBM = STEP_2
STATE_DIAGCPS = LOCK_STEP


ENDIF(3b)
ELSE(2b)    jump to beginning of STEP_2
ENDIF(2b)
ELSE(1)IF(2c)    LV_EOL_CPS = 1
THEN(2c)    STATE_DIAGCPS = CPS_RAMP
                (Diagnose Ende)
ELSE(2c)    SUM_DIAG_DIAGCPS = 0 // STEP_2 passed
                SUM_FLOW_SP_DIAGCPS = C_SUM_FLOW_SP_DIAGCPS_MAX
                ERR_SYM_DIAGCPS = 0
                LV_ERR_DIAGCPS = 0
                CL_MMV_SAE = 0
                CL_MMV_DIAGCPS_MIN_SAE = CL_MMV_DIAGCPS_MAX_SAE = 0
                SUM_DIAG_DIAGCPS_SAE = SUM_DIAG_DIAGCPS
                SUM_DIAGCPS_MAX_SAE = C_SUM_DIAGCPS_MAX
                MAF_DIAGCPS_SAE = MAF_DIAGCPS_THD_SAE = 0
                LV_END_DIAG_DIAGCPS = 1
                STATE_DIAGCPS_RBM = STEP_2
                STATE_DIAGCPS = LOCK_STEP

ENDIF(2c)
ENDIF(1)

```

### STEP 3: MAF-DIF\_Diagnosis

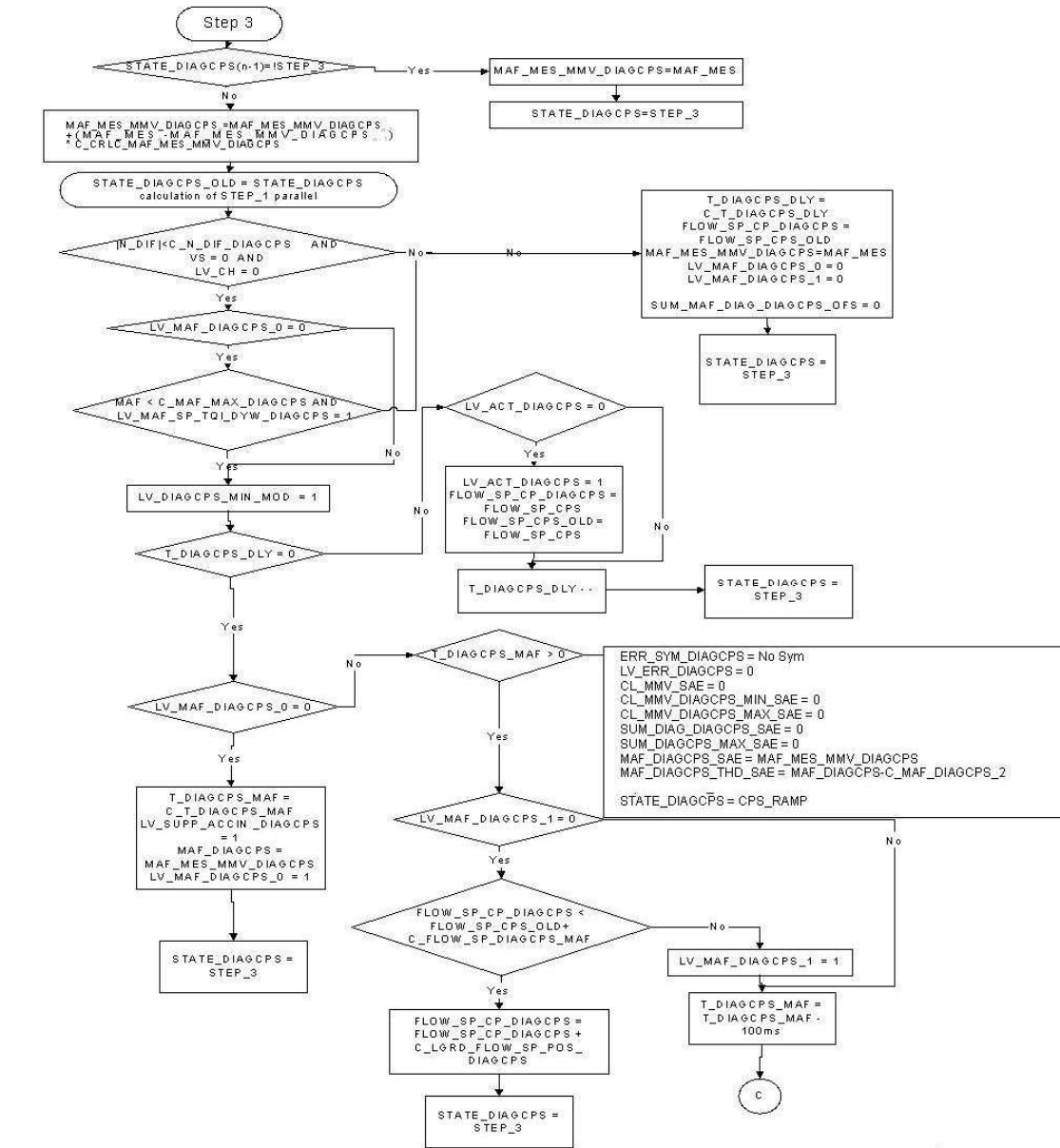
#### Description:

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If the functional check is not recognized as OK via step 1 and via step 2, but as not OK via both steps, then step 3 is requested.

In step 3 the CPS is considered on the basis of the measured mass air flow before and during a CPS opening phase.

**Overview:**




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**Formula Section:**

STATE\_DIAGCPS\_OLD = STATE\_DIAGCPS  
 calculate STEP\_1 parallelly


**IF(0)** |  $N\_DIF < C\_N\_DIF\_DIAGCPS$  **AND**  
 $VS = 0$  **AND**

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```

LV_CH = 0                                AND
[(LV_MAF_DIAGCPS_0 = 0                    AND
 MAF < C_MAF_MAX_DIAGCPS                  AND
 LV_MAF_SP_TQI_DYW_DIAGCPS = 1)          OR
 LV_MAF_DIAGCPS_0 = 1]
THEN(0) LV_DIAGCPS_MIN_MOD=1
IF(1) T_DIAGCPS_DLY = 0
THEN(1) IF(2a) LV_MAF_DIAGCPS_0 = 0
THEN(2a) T_DIAGCPS_MAF = C_T_DIAGCPS_MAF
          LV_SUPP_ACCIN_DIAGCPS = 1
          MAF_DIAGCPS = MAF_MES
          LV_MAF_DIAGCPS_0 = 1
ELSE(2a) IF(3a) T_DIAGCPS_MAF > 0
THEN(3a)IF(4a) LV_MAF_DIAGCPS_1 = 0 AND
          FLOW_SP_CP_DIAGCPS <
          FLOW_SP_CPS_OLD
          +
          C_FLOW_SP_DIAGCPS_MAF
THEN(4a) FLOW_SP_CP_DIAGCPS=
          FLOW_SP_CP_DIAGCPS +
          C_LGRD_FLOW_SP_POS_
          DIAGCPS
ELSE(4a) LV_MAF_DIAGCPS_1 = 1
          T_DIAGCPS_MAF = T_DIAGCPS_MAF - -
          Jump to C
ENDIF(4a)
// STEP_3 passed ELSE(3a) ERR_SYM_DIAGCPS = NO_SYM
          LV_ERR_DIAGCPS = 0
          MAF_DIAGCPS_SAE = MAF_MES
          MAF_DIAGCPS_THD_SAE =
          MAF_DIAGCPS-C_MAF_DIAGCPS_2
          CL_MMV_SAE = 0
MMV_DIAGCPS_MIN_SAE = 0
CL_MMV_DIAGCPS_MAX_SAE = 0
          SUM_DIAG_DIAGCPS_SAE = 0
          SUM_DIAGCPS_MAX_SAE = 0
          STATE_DIAGCPS = CPS_RAMP
ENDIF(3a)
ENDIF(2a)
ELSE(1)IF(2b) LV_ACT_DIAGCPS = 0
THEN(2b) LV_ACT_DIAGCPS = 1
          FLOW_SP_CP_DIAGCPS = FLOW_SP_CPS
          FLOW_SP_CPS_OLD = FLOW_SP_CPS
ENDIF(2b) T_DIAGCPS_DLY = T_DIAGCPS_DLY - 100ms
ENDIF(1)
Else(0) T_DIAGCPS_DLY = C_T_DIAGCPS_DLY
          FLOW_SP_CP_DIAGCPS = FLOW_SP_CPS_OLD
          LV_MAF_DIAGCPS_0 = 0
          LV_MAF_DIAGCPS_1 = 0
          SUM_MAF_DIAG_DIAGCPS_OFS = 0

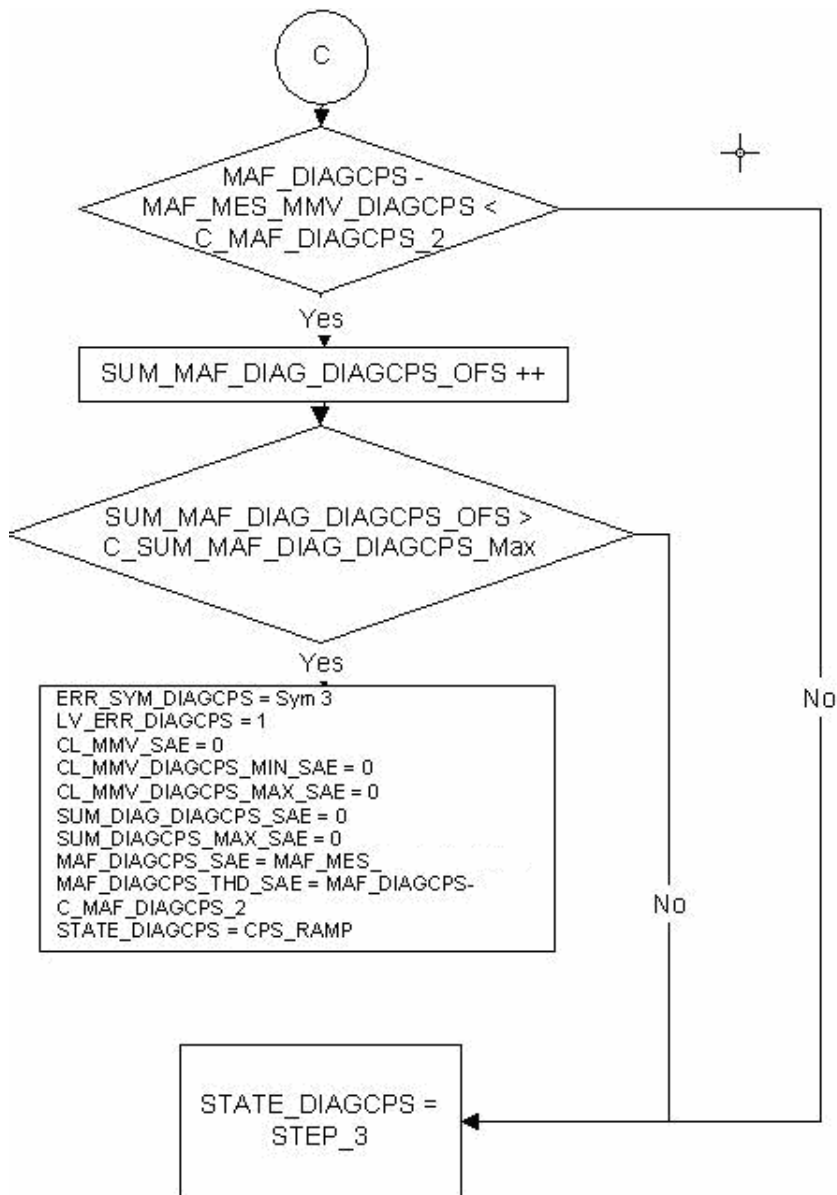
```

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STATE\_DIAGCPS = STEP\_3

Endif(0)

**Overview C :**



**C:**

```

IF(1)   MAF_DIAGCPS - MAF_MES < C_MAF_DIAGCPS_2
THEN(1) SUM_MAF_DIAG_DIAGCPS_OFS ++
IF(2)   SUM_MAF_DIAG_DIAGCPS_OFS > C_SUM_MAF_DIAG_DIAGCPS_OFS
THEN(2) ERR_SYM_DIAGCPS = SYM_3           // STEP_3 failed
        LV_ERR_DIAGCPS = 1
  
```

```

MAF_DIAGCPS_SAE = MAF_MES
MAF_DIAGCPS_THD_SAE = MAF_DIAGCPS - C_MAF_DIAGCPS_2
CL_MMV_SAE = 0
CL_MMV_DIAGCPS_MIN_SAE = CL_MMV_DIAGCPS_MAX_SAE = 0
SUM_DIAGCPS_MAX_SAE = SUM_DIAG_DIAGCPS_SAE = 0

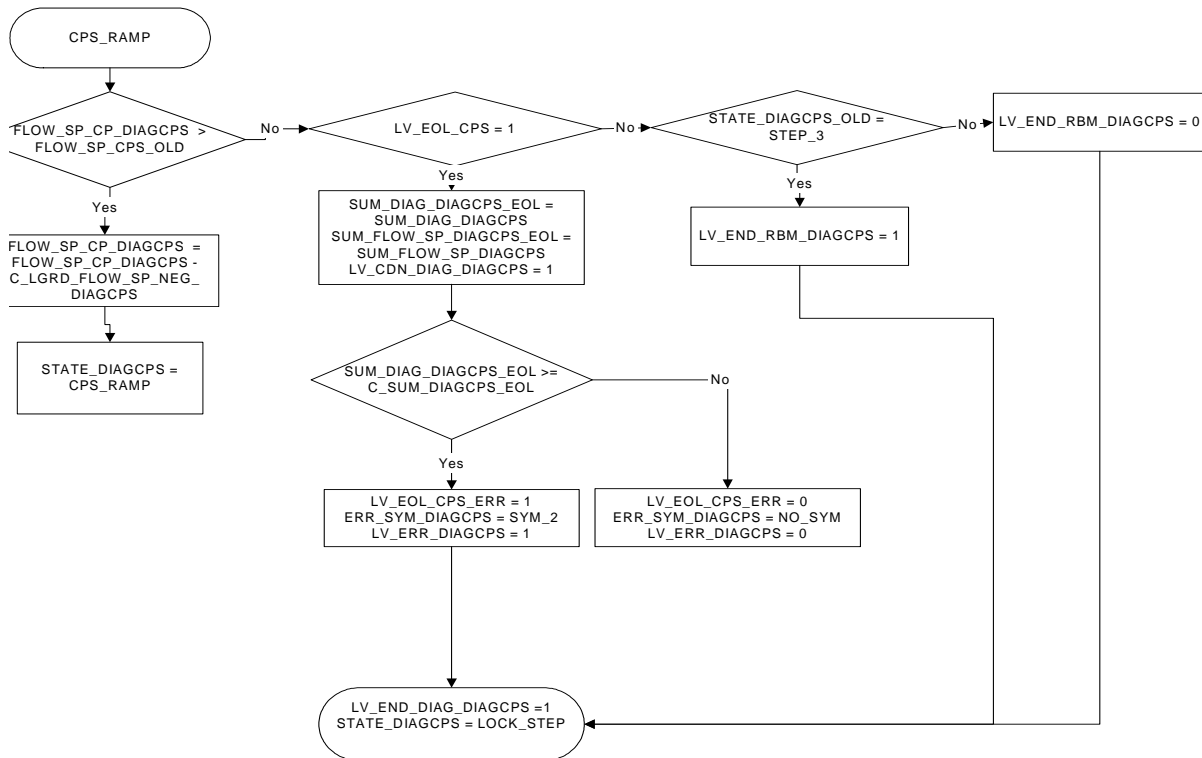
```

```

STATE_DIAGCPS = CPS_RAMP
ELSE(2) STATE_DIAGCPS = STEP_3
ENDIF(2)
ELSE(1) STATE_DIAGCPS = STEP_3
ENDIF(1)

```

### Overview:



### CPS-Ramp:

```

IF(1) FLOW_SP_CP_DIAGCPS > FLOW_SP_CPS_OLD
THEN(1) FLOW_SP_CP_DIAGCPS = FLOW_SP_CP_DIAGCPS -
        C_LGRD_FLOW_SP_NEG_DIAGCPS
ELSE(1) IF(2) LV_EOL_CPS = 1
THEN(2) SUM_DIAG_DIAGCPS_EOL = SUM_DIAG_DIAGCPS
        SUM_FLOW_SP_DIAGCPS_EOL = SUM_FLOW_SP_DIAGCPS
        LV_CDN_DIAG_DIAGCPS = 1
IF(3a) SUM_DIAG_DIAGCPS_EOL >= C_SUM_DIAGCPS_EOL
THEN(3a) LV_EOL_CPS_ERR = 1
        ERR_SYM_DIAGCPS = SYM_2

```



```

                LV_ERR_DIAGCPS = 1
ELSE(3a)      LV_EOL_CPS_ERR = 0
                ERR_SYM_DIAGCPS = NO_SYM
                LV_ERR_DIAGCPS = 0
ENDIF(3a)
ELSE(2)      IF(3b) STATE_DIAGCPS_OLD = STEP_3
                THEN(3b) LV_END_RBM_DIAGCPS = 1
                ELSE(3b) LV_END_RBM_DIAGCPS = 0
                ENDIF(3b)
ENDIF(2)
LV_END_DIAG_DIAGCPS = 1
STATE_DIAGCPS = LOCK_STEP
ENDIF(1)

```

Reset EOL-request-bit

### LOCK\_STEP:

#### Description:

```

FLOW_SP_CP_DIAGCPS = FLOW_SP_CPS_OLD
LV_ACT_DIAGCPS = 0
LV_DIAGCPS_MIN_MOD = 0
LV_INH_MAP_CTL_DIAGCPS = 0
LV_SUPP_ACCIN_DIAGCPS = 0

```

**// RBM in case of TEV-check ended with o.k. before all 3 STEPs have been completed**


```

IF          LV_T_DIAGCPS_RBM = 0
THEN       T_DIAGCPS_DLY_1_RBM = C_T_DIAGCPS_DLY
           T_DIAGCPS_DLY_2_RBM = C_T_DIAGCPS_DLY
           T_DIAGCPS_N_MAP_1_RBM = C_SUM_DIAGCPS_MAX
                                   * C_T_DIAGCPS_N_MAP_1
           T_DIAGCPS_MAF_RBM = C_T_DIAGCPS_MAF
           LV_T_DIAGCPS_RBM = 1
ENDIF

IF(1)     TCO > C_TCO_MIN_DIAGCPS      and
           LV_IS = 1                    and
           VS = 0                       and
           LV_CH = 0                    and
           LV_END_RBM_DIAGCPS = 0      and
           T_DLY_PURGE_DIAGCPS = 0

THEN(1)   IF(2)          STATE_DIAGCPS_RBM = STEP_1
           THEN(2)IF(3a) T_DIAGCPS_DLY_1_RBM > 0
           THEN(3a)     T_DIAGCPS_DLY_1_RBM --
           ELSE(3a)IF(4a) T_DIAGCPS_N_MAP_1_RBM > 0
           THEN(4a)     T_DIAGCPS_N_MAP_1_RBM --
           ELSE(4a)
               IF (5a)          LV_OPM_AV_DIAGCPS_P_THR = 0
               THEN(5a)        LV_END_RBM_DIAGCPS = 1

```

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```

ELSE(5a)    IF(6a) T_DIAGCPS_DLY_2_RBM > 0
            THEN(6a)T_DIAGCPS_DLY_2_RBM --
            ELSE(6a)
                IF(7a) T_DIAGCPS_MAF_RBM > 0
                THEN(7a)T_DIAGCPS_MAF_RBM --
                ELSE(7a)LV_END_RBM_DIAGCPS = 1
                ENDIF(7a)
            ENDIF(6a)
        ENDIF(5a)
    ENDIF(4a)
ENDIF(3a)
ELSE(2)IF(3b)    STATE_DIAGCPS_RBM = STEP_2
                THEN(3b)IF(4b)    T_DIAGCPS_DLY_2_RBM > 0
                THEN(4b)    T_DIAGCPS_DLY_2_RBM --
                ELSE(4b)IF(5b)    T_DIAGCPS_MAF_RBM > 0
                THEN(5b)    T_DIAGCPS_MAF_RBM --
                ELSE(5b)    LV_END_RBM_DIAGCPS = 1
                ENDIF(5b)
            ENDIF(4b)
        ENDIF(3b)
    ENDIF (2)
ENDIF(1)

```

## B.91.1 Limited dynamic condition LV\_MAF\_SP\_TQI\_DYW\_DIAGCPS

### FUNCTION DESCRIPTION:

#### Application conditions

**Initialisation:** at reset or at transition LV\_IGK OFF → ON  
LV\_MAF\_SP\_TQI\_DYW\_DIAGCPS = 0  
MAF\_SP\_TQI\_MMV\_DIAGCPS = 0

**Recurrence:** 100 ms

**Activation:** LV\_DC = 1

**Deactivation:** LV\_DC = 0

#### Formula section:

Calculation of MAF\_SP\_TQI\_MMV\_DIAGCPS:


$$\text{MAF\_SP\_TQI\_MMV\_DIAGCPS} = \text{MAF\_SP\_TQI\_MMV\_DIAGCPS} * (1 - \text{C\_CRLC\_MAF\_SP\_TQI\_DIAGCPS}) + \text{C\_CRLC\_MAF\_SP\_TQI\_DIAGCPS} * \text{MAF\_SP\_TQI}$$

**IF** MAF\_SP\_TQI - MAF\_SP\_TQI\_MMV\_DIAGCPS  
< C\_MAF\_SP\_TQI\_DYW\_DIAGCPS

**THEN** LV\_MAF\_SP\_TQI\_DYW\_DIAGCPS= 1

**ELSE** LV\_MAF\_SP\_TQI\_DYW\_DIAGCPS= 0  
MAF\_SP\_TQI\_MMV\_DIAGCPS = MAF\_SP\_TQI

**ENDIF**

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## B.92 Functional check canister purge solenoid (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DI_DIAGCPS	O/V	0... 1H	0 ...1	1	-
activation condition for functional check CPS, reversible					
LV_INH_DIAG_RBM_DIAGCPS	V	0... 1H	0 ...1	1	-
Flag to inhibit catalyst diagnosis function if there is a OBD failure					
LV_INH_DIAGCPS	O/V	0... 1H	0 ...1	1	-
activation condition for functional check CPS, irreversible					
OPM_AV_DIAGCPS	O/V	0... 2H	0 ...2	1	-
Operation mode DIAGCPS					
STATE_RBM_DIAGCPS	O/V	0... FFH	0... 255	1	-
Interface of DIAGCPS monitor with the Rate-Based Monitoring statistics					

### Input data:

C_TCO_MIN_DIAGCPS {p. 5931}	CTR_ERR_DYN_NR {p. 5767}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_CL_MMV {p. 1001}
LV_CP_ENA {p. 3737}	LV_DC {p. 5746}	LV_END_RBM_DIAGCPS {p. 5926}	LV_EOL_CPS {p. 7763}
LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_AMP_PLAUS_ CUS {p. 1061}	LV_ERR_CHK_FUC {p. 5918}
LV_ERR_DMTL_MIN {p. 5965}	LV_ERR_DMTL_PLAUS {p. 5965}	LV_ERR_DMTL_PUMP {p. 4626}	LV_ERR_DMTLH {p. 4626}
LV_ERR_DMTLS {p. 4627}	LV_ERR_ECU_RAM {p. 4232}	LV_ERR_EL_CPS {p. 4708}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}
LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_ISC {p. 4377}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}
LV_ERR_MAF {p. 4815}	LV_ERR_MAP_DIP_ PLAUS {p. 1062}	LV_ERR_MAP_DIP_SENS {p. 4824}	LV_ERR_MAP_DIP_SHIFT {p. 4824}
LV_ERR_MAP_PLAUS {p. 1062}	LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MIS_MPL {p. 6264}
LV_ERR_PVS_DOUBLE {p. 4216}	LV_ERR_ROUGH_LEAK {p. 5965}	LV_ERR_SMALL_LEAK {p. 5965}	LV_ERR_SPI_MPS {p. 4245}
LV_ERR_TCO {p. 4496}	LV_ERR_TPS {p. 4982}	LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_BOL {p. 4951}
LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_VCV {p. 4729}	LV_ERR_VS {p. 5021}	LV_IGK {p. 906}

LV_MTC_CUR_OFF {p. 6565}	LV_VAR_BN {p. 655}	OPM_AV {p. 8137}	STATE_CP {p. 3637}
TCO {p. 1100}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_SP_MAX_DIAGCPS	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Max. lambda setpoint for FC CPS/Step1 (CL diagnosis)					
C_LAMB_SP_MIN_DIAGCPS	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Min. lambda setpoint for FC CPS/Step1 (CL diagnosis)					
C_TCO_MIN_DIAGCPS_1	-	0... FEH	-48... 142.5	0.75	°C
Min. temperature for FC CPS/Step1 (CL diagnosis)					
ID_OPM_AV_DIAGCPS	-	0... 2H	0 ...2	1	-
LDPM_OPM_AV	8	0... 8H	0 ...8	1	-
Operation mode for which DIAGCPS is enabled (0H = never, 1H = UGD, 2H = GD)					

**Import actions:**

<b>ACTION_ERRM_CheckPendingStatus</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR_PND>)
--

**B.92.1 Diagnosis inhibition****FUNCTION DESCRIPTION:****General information:**

The functional check is used for the functional test of the CP solenoid which means that the CPS is diagnosed via its effects on the engine.

There are many errors which make it necessary to stop the functional check CPS when they occur. Therefore a diagnosis has to be made whether the functional check can be enabled or not.

If LV\_INH\_DIAGCPS = 0 and LV\_DI\_DIAGCPS = 0 then the functional check is enabled.

If the bit LV\_INH\_DIAGCPS = 1 is set through one of the errors listed below, then the functional check is exited irreversibly until the next engine start.

If the bit LV\_INH\_DIAGCPS=0 and LV\_DI\_DIAGCPS=1 then the functional check is exited reversibly until LV\_DI\_DIAGCPS = 0 (recurrence 100 ms).

If one of the OBD errors occurs as mentioned in the formula section the RBM of the functional check CPS diagnosis is inhibited by LV\_INH\_DIAG\_RBM\_DIAGCPS = 1.


**Application conditions**

**Initialisation:** at every LV\_IGK = 0→1 and reset all variables are initialized with 0

**Recurrence:** 100 ms

**Activation:** LV\_DC = 1

**Deactivation:** LV\_DC = 0

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**Formula section:**Inhibition due to OBDI error

```

If      LV_ERR_TPS = 1
          LV_ERR_MAF = 1
          LV_ERR_LOAD_TPS_PLAUS = 1
          LV_ERR_EL_CPS = 1
          LV_ERR_ROUGH_LEAK = 1
          LV_ERR_SMALL_LEAK = 1
          LV_ERR_DMTLH = 1
          LV_ERR_DMTL_PLAUS = 1
          LV_ERR_DMTL_MIN = 1
          LV_ERR_DMTL_PUMP = 1
          LV_ERR_DMTLS = 1
          LV_ERR_AMP = 1
          LV_ERR_VS = 1
          LV_ERR_TCO = 1
          LV_ERR_ISC = 1
          LV_ERR_FSD[NC_CBK_EX_NR] = 1
          LV_ERR_MAP_DIP_SENS = 1
          LV_ERR_MAP_DIP_PLAUS = 1
          LV_ERR_MAP_DIP_SHIFT = 1
          LV_ERR_PVS_DOUBLE = 1
          LV_ERR_FUP = 1
          LV_ERR_FUP_MFP_PLAUS = 1
          LV_ERR_H_PRS_SYS = 1
          LV_ERR_VCV = 1
          LV_ERR_FUP_ORNG = 1
          LV_ERR_FUP_ST = 1
          LV_ERR_MAP_TPS_PLAUS = 1
          LV_ERR_AMP_PLAUS_CUS = 1
          LV_ERR_AMP_PLAUS = 1
          LV_ERR_MAP_PLAUS = 1
          LV_ERR_CHK_FUC = 1
          LV_ERR_FSD_LAM_LIM[NC_CBK_EX_NR] = 1
          LV_ERR_MIS[NC_CYL_NR] = 1
          LV_ERR_MIS_MPL = 1
          LV_ERR_TPS_AD = 1
          LV_ERR_TPS_AD_BOL = 1
          LV_ERR_TPS_ST_CHK_2 = 1
          LV_ERR_SPI_MPS = 1
Then   LV_INH_DIAG_RBM_DIAGCPS = 1
Else   LV_INH_DIAG_RBM_DIAGCPS = 0
Endif


```

Inhibition due to environmental condition /calibration:

```

If      LV_INH_DIAG_RBM_DIAGCPS = 1
          LV_MTC_CUR_OFF = 1
Then   LV_INH_DIAGCPS = 1
Else   LV_INH_DIAGCPS = 0
Endif
OPM_AV_DIAGCPS = ID_OPM_AV_DIAGCPS

```

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```

If          LV_INH_DIAGCPS = 0                and
              (OPM_AV_DIAGCPS = 1H or OPM_AV_DIAGCPS = 2H)                and
              [ (TCO > C_TCO_MIN_DIAGCPS_1                and
                C_LAMB_SP_MIN_DIAGCPS < LAMB_SP[i] < C_LAMB_SP_MAX_DIAGCPS
                  and
                  STATE_CP > 1H                and
                  LV_CP_ENA = 1                and
                  LV_CL_MMV = 1)                or
                  LV_EOL_CPS = 1 ]
Then       LV_DI_DIAGCPS = 0
Else       LV_DI_DIAGCPS = 1
Endif

```

## B.92.2 Interface for Rate - Based - Monitoring

### FUNCTION DESCRIPTION:

#### General information:

With this module the interface between the DIAGCPS monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_DIAGCPS data.

Within STATE\_RBM\_DIAGCPS, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)  
( not valid for DIAGCPS diagnosis )

#### Application conditions

**Initialisation :**                   at LV\_DC 0 → 1 transition :  
bit 0, bit 1 and bit 2 of STATE\_RBM\_DIAGCPS = 0  
on failure memory reset :  
bit 1 of STATE\_RBM\_DIAGCPS = 0


**Recurrence:**                   1 s

**Activation:**                   LV\_DC 0 → 1 transition **and** LV\_DC = 1

#### Formula section:

##### At LV\_DC 0 → 1 transition

The pending status of the following failures has to be checked only once :

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LV_ERR_MAP_TPS_PLAUS	LV_ERR_TPS_RATIO	LV_ERR_AMP	LV_ERR_MAP_DIP_SHIFT
LV_ERR_TPS_1	LV_ERR_TPS_2	LV_ERR_LOAD_TPS_PLAUS	LV_ERR_FUP_ST
LV_ERR_TPS_MAF_2	LV_ERR_VS	LV_ERR_FUP	LV_ERR_DMTL_MIN
LV_ERR_ISC	LV_ERR_DMTL_PUMP	LV_ERR_DMTLH	LV_ERR_DMTLS
LV_ERR_TPS_MAF_1	LV_ERR_TCO_EL	LV_ERR_TCO_STUCK	LV_ERR_TCO_GRD
LV_ERR_TCO_PLAUS	LV_ERR_ROUGH_LEAK	LV_ERR_SMALL_LEAK	LV_ERR_TCO_STUCK_RING
LV_ERR_FUP_MFP_PLAUS	LV_ERR_H_PRS_SYS	LV_ERR_VCV	LV_ERR_PVS_DOUBLE
LV_ERR_MAP_DIP_SENS	LV_ERR_MAP_DIP_PLAUS	LV_ERR_FUP_ORNG	LV_ERR_FSD[NC_CBK_EX_NR]
LV_ERR_TPS_ST_CHK_2	LV_ERR_AMP_PLAUS_CUS	LV_ERR_MAP_PLAUS	LV_ERR_CHK_FUC
LV_ERR_MIS_MPL	LV_ERR_ECU_RAM	LV_ERR_MIS[NC_CYL_NR]	LV_ERR_TPS_AD_BOL
LV_ERR_AMP_PLAUS	LV_ERR_MAF_FRQ_EL_0	LV_ERR_MAF_FRQ_RNG_0	LV_ERR_FSD_LAM_LIM[i]
LV_ERR_TPS_AD	LV_ERR_MTC_CTL_2	LV_ERR_MTC_CTL_3	LV_ERR_MTC_DR
LV_ERR_ECU_CKS	LV_ERR_MAF_FRQ_GRD_0	LV_ERR_EL_CPS	LV_ERR_SPI_MPS
LV_ERR_DMTL_PLAUS			

**If(1)** { CPU optimization at LV\_DC 0 → 1 transition }  
 CTR\_ERR\_DYN\_NR <> 0 { the dynamic failure memory isn't empty }

**Then(1)**

**While** bit 1 of STATE\_RBM\_DIAGCPS = 0 **do**

with each XX failure of the above list :

ACTION\_ERRM\_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

**If(2)** XX has a pending status

**Then(2)** bit 1 of STATE\_RBM\_DIAGCPS = 1

**Endif(2)**

**Endwhile**

**Else(1)** { the dynamic failure memory is empty }

No action

**Endif(1)**

Every 1 s :

**If** bit 0 of STATE\_RBM\_DIAGCPS = 0

**Then**

**If** LV\_END\_RBM\_DIAGCPS = 1 **and**

**Then** bit 0 of STATE\_RBM\_DIAGCPS = 1

**Endif**

**Endif**

**If** bit 1 of STATE\_RBM\_DIAGCPS = 0

**Then**

**If** LV\_INH\_DIAG\_RBM\_DIAGCPS = 1

**Then** bit 1 of STATE\_RBM\_DIAGCPS = 1

**Endif**

**Endif**

bit 2 of STATE\_RBM\_DIAGCPS = 1

## B.93 Leakage detection pump function diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CNL_ROUGH_LEAK_MES_FUC	O/V/S	0... FFH	0... 255	1	-
Number of aborted check filler cap checks					
CTR_CNL_SMALL_LEAK_MES	O/V/S	0... FFH	0... 255	1	-
Number of aborted miniature leak measurements due to current fluctuations					
CTR_CUR_DMTL_REF_DIF_MAX	O/V/S	0... FFFFH	0... 65535	1	-
Number of aborted measurements due to current fluctuation					
CTR_DIAG_CFM_DMTL_MAX	O/V/S	0... FFH	0... 255	1	-
Remaining number of to be confirmed DMTL_MAX errors (after MIL-On due to DMTL_MAX) for deactivation of DMTL diagnosis					
CTR_DIAG_CFM_DMTL_MIN	O/V/S	0... FFH	0... 255	1	-
Remaining number of to be confirmed DMTL_MIN errors (after MIL-On due to DMTL_MIN) for deactivation of DMTL diagnosis					
CTR_DIAG_CFM_DMTL_PLAUS	O/V/S	0... FFH	0... 255	1	-
Remaining number of to be confirmed DMTL_PLAUS errors (after MIL-On due to DMTL_PLAUS) for deactivation of DMTL diagnosis					
CTR_DIAG_CFM_DMTL_SIG	O/V/S	0... FFH	0... 255	1	-
Remaining number of to be confirmed DMTL_SIG errors (after MIL-On due to DMTL_SIG) for deactivation of DMTL diagnosis					
CTR_DIAG_CFM_ROUGH_LEAK	O/V/S	0... FFH	0... 255	1	-
Remaining number of to be confirmed ROUGH_LEAK errors (after MIL-On due to ROUGH_LEAK) for deactivation of DMTL diagnosis					
CTR_DIAG_CFM_SMALL_LEAK	O/V/S	0... FFH	0... 255	1	-
Remaining number of to be confirmed SMALL_LEAK errors (after MIL-On due to SMALL_LEAK) for deactivation of DMTL diagnosis					
CTR_ENA_DMTL_CHK_FUC	V	0... FFH	0... 255	1	-
Number of enabled check filler cap checks					
CTR_ERR_DET_DMTL_MAX	O/V/S	0... FFH	0... 255	1	-
Number of consecutive DMTL_MAX errors					
CTR_ERR_DET_DMTL_MIN	O/V/S	0... FFH	0... 255	1	-
Number of consecutive DMTL_MIN errors					
CTR_ERR_DET_DMTL_PLAUS	O/V/S	0... FFH	0... 255	1	-
Number of consecutive DMTL_PLAUS errors					
CTR_ERR_DET_DMTL_SIG	O/V/S	0... FFH	0... 255	1	-
Number of consecutive DMTL_SIG errors					
CTR_ERR_DET_ROUGH_LEAK	O/V/S	0... FFH	0... 255	1	-
Number of consecutive ROUGH_LEAK errors					
CTR_ERR_DET_SMALL_LEAK	O/V/S	0... FFH	0... 255	1	-
Number of consecutive SMALL_LEAK errors					
CTR_REP_ROUGH_LEAK_MES_FUC	O/V/S	0... FFH	0... 255	1	-
Number of repeated check filler cap checks					
CTR_TCO_ST_DMTL	O/V/S	0... FFH	0... 255	1	-
Counter of recognized cold starts for DMTL small leak test					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CUR_DMTL	O/V	0... FFFFH	0... 399.99389	6.1035e-3	mA
Pump current tank leakage diagnosis					
CUR_DMTL_COMP_ROUGH_LEAK	O/V	0... FFFFH	0... 399.99389	6.1035e-3	mA
Pump current comparison in case of rough leak measurement					
CUR_DMTL_COMP_SMALL_LEAK_LEN	O/V	0... FFFFH	0... 399.99389	6.1035e-3	mA
Pump current comparison in case of 2. miniature leak measurement					
CUR_DMTL_COR	O/V	0... FFFFH	0... 399.99389	6.1e-3	mA
Corrected pump current					
CUR_DMTL_COR_FIL	O/V	0... FFFFFFFFH	0... 399.99999	93.1e-9	mA
Corrected and filtered pump current					
CUR_DMTL_COR_FIL_EOL	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Corrected and filtered pump current for tester tool					
CUR_DMTL_COR_FIL_MAX	O/V	0... FFFFH	0... 399.99389	6.1e-3	mA
Maximum pump current during reference leka measurement					
CUR_DMTL_COR_FIL_MIN	O/V	0... FFFFH	0... 399.99389	6.1e-3	mA
Minimum pump current during reference leak measurement					
CUR_DMTL_COR_FIL_REFU_HPF	O/V	7FFFH FFFF8000... H	199.98779 -200...	-	mA
Corrected, high-pass filtered pump current					
CUR_DMTL_DIF	O/V	0... FFFFH	0... 399.99389	6.1035e-3	mA
Differential pump current					
CUR_DMTL_DIF_REF_ROUGH_LEAK	O/V	0... FFFFH	0... 399.99389	6.1035e-3	mA
Difference, pump current between reference and min. in case of rough leak check					
CUR_DMTL_DMTLS_TEST	O/V	0... FFFFH	0... 399.99389	6.1035e-3	mA
Pump current during pump test					
CUR_DMTL_REF_DIF_MAX	V	0... FFFFH	0... 399.99389	6.1e-3	mA
Delta pump current during reference measurement					
CUR_DMTL_REF_LEAK	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Pump current reference leakage					
CUR_DMTL_REF_LEAK_EOL	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Pump current reference leakage for tester tool					
CUR_DMTL_ROUGH_LEAK_END	O/V	0... FFFFH	0... 399.99389	6.1e-3	mA
Pump current at the end of the rough leak measurement					
CUR_DMTL_ROUGH_LEAK_LEN_END	O/V	0... FFFFH	0... 399.99389	6.1e-3	mA
Pump current at the end of the rough leak measurement extension					
CUR_DMTL_ROUGH_LEAK_MIN	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Min. pump current in case of rough leak measurement					
CUR_DMTL_ROUGH_LEAK_MIN_EOL	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Min. pump current in case of rough leak measurement for tester tool					
CUR_DMTL_SMALL_LEAK_END	O/V	0... FFFFH	0... 399.99389	6.1e-3	mA
Pump current at the end of the miniature leak measurement					
CUR_DMTL_THD_DMTLS_TEST	O/V	0... FFFFH	0... 399.99389	6.1e-3	mA
Pump current threshold in case of DMTL valve check					




Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CUR_DMTL_THD_ROUGH_LEAK	O/V	0... FFFFH	0... 399.99389	6.1e-3	mA
Pump current threshold in case of rough leak measurement					
CUR_DMTL_THD_ROUGH_LEAK_LEN	O/V	0... FFFFH	0... 399.99389	6.1e-3	mA
Pump current threshold in case of rough leak measurement extension					
DIF_FCO_FTL	-	80... 7FH	-128 ...127	1	l
Fuel difference to determinate upper and lower threshold of the consumption diagnosis					
DIF_FTL_AST	-	80... 7FH	-128 ...127	1	l
Fuel tank level difference after start					
DIF_FTL_VST	-	80... 7FH	-128 ...127	1	l
Fuel tank level difference at vehicle stopped and under possible refuelling conditions at IGK on and FTL reading					
DIST_DMTL	O/V/S	0... FFFFFFFFH	0... 65535	15.3e-6	m
Distance covered for DMTL function					
ERR_SYM_DMTL_MAX	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected failure of each symptom for max-dmtl failure					
ERR_SYM_DMTL_MIN	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected failure of each symptom for min-dmtl failure					
ERR_SYM_DMTL_PLAUS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected failure of each symptom for plaus-dmtl failure					
ERR_SYM_DMTL_SIG	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected failure of each symptom for sig-dmtl failure					
ERR_SYM_ROUGH_LEAK	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected failure of each symptom for rough leak failure					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_SMALL_LEAK	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected failure of each symptom for small leak failure					
FCO_AV_DMTL	O/V/S	0... FFFFH	0... 4294.9	65.5e-3	l
Currently consumed fuel					
FTL_AV	-	0... 7FH	0... 127	1	l
Fuel tank level actual value					
FTL_INI	O/V/S	0... 7FH	0... 127	1	l
Ini value level for diagnostic cycle					
FTL_OLD	O/V/S	0... 7EH	0... 126	1	l
FTL for plausibility check					
FTL_ST	-	0... 7FH	0... 127	1	l
Fuel tank level at start					
FTL_VST_IN	-	0... 7FH	0... 127	1	l
Fuel tank level at vehicle stopped and under possible refuelling conditions at IGK on and FTL reading					
LV_CDN_DIAG_DMTL_MAX	V	0... 1H	0 ...1	1	-
Diagnosis condition for dmtl max diagnosis					
LV_CDN_DIAG_DMTL_MIN	V	0... 1H	0 ...1	1	-
Diagnosis condition for dmtl min diagnosis					
LV_CDN_DIAG_DMTL_PLAUS	V	0... 1H	0 ...1	1	-
Diagnosis condition for dmtl plausibility diagnosis					
LV_CDN_DIAG_DMTL_SIG	V	0... 1H	0 ...1	1	-
Diagnosis condition for dmtl signal diagnosis					
LV_CDN_DIAG_ROUGH_LEAK	O/V	0... 1H	0 ...1	1	-
Diagnosis condition for rough leak diagnosis					
LV_CDN_DIAG_SMALL_LEAK	O/V	0... 1H	0 ...1	1	-
Diagnosis condition for small leak diagnosis					
LV_CHK_DMTL_CUR_DMTL_VLD	O/V	0... 1H	0 ...1	1	-
Check of components on pump current thresholds valid					
LV_CHK_DMTL_CUR_DMTL_VLD_CFM	O/V	0... 1H	0 ...1	1	-
Confirmation bit (after check of refueling) for check of components on pump current thresholds valid					
LV_CHK_DMTL_VLD	O/V	0... 1H	0 ...1	1	-
Check of components on current fluctuations valid					
LV_CHK_DMTL_VLD_CFM	O/V	0... 1H	0 ...1	1	-
Confirmation bit (after check of refueling) for check of components on current fluctuations valid					
LV_CLR_FTL	-	0... 1H	0 ...1	1	-
set variable to reinitialize the FTL_Plau diagnosis after clr FMY or consumption higher than tank volume					
LV_CTR_CNL_SMALL_LEAK_MES	O/V/S	0... 1H	0 ...1	1	-
Threshold of aborted miniature leak measurements due to current fluctuations exceeded					
LV_CTR_CNL_SMALL_LEAK_MES_CFM	O/V	0... 1H	0 ...1	1	-
Confirmation bit (after refueling check) for threshold of aborted miniature leak measurements due to current fluctuations exceeded					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CUR_DMTL_DMTLS_TEST	O/V	0... 1H	0 ...1	1	-
Pump current threshold reached in case of DMTL-valve check					
LV_CUR_DMTL_REF_DIF_MAX	O/V/S	0... 1H	0 ...1	1	-
Condition "delta reference current" exceeded					
LV_CUR_DMTL_REF_MES_MAX	O/V	0... 1H	0 ...1	1	-
Upper pump current threshold reached during reference measurement					
LV_CUR_DMTL_REF_MES_MIN	O/V	0... 1H	0 ...1	1	-
Lower pump current threshold reached during reference measurement					
LV_CUR_DMTL_THD_DIF_MES	O/V/S	0... 1H	0 ...1	1	-
Decreasing pump current during measurement					
LV_CYC_ROUGH_LEAK_MODE6	O/V	0... 1H	0 ...1	1	-
Cycle flag, rough leak error					
LV_CYC_ROUGH_LEAK_SUSP	O/V	0... 1H	0 ...1	1	-
Cycle flag, rough leak suspected					
LV_CYC_SMALL_LEAK_MODE6	O/V	0... 1H	0 ...1	1	-
Cycle flag, miniature leak					
LV_CYC_SMALL_LEAK_MODE6_CFM	O/V	0... 1H	0 ...1	1	-
Cycle flag, miniature leak confirmed (after check of refueling)					
LV_DET_FUC_OPEN	O/V/S	0... 1H	0 ...1	1	-
Detection of fuel cap open					
LV_DET_REFU	O/V/S	0... 1H	0 ...1	1	-
Detection of refueling					
LV_DIST_DET_ROUGH_LEAK	O/V/S	0... 1H	0 ...1	1	-
Distance covered since rough leak detection					
LV_DIST_DMTL	O/V	0... 1H	0 ...1	1	-
Minimum distance after suspected rough leak or refueling					
LV_DMTL_ACT	O/V	0... 1H	0 ...1	1	-
DMTL state machine running					
LV_DMTL_ASA	O/V	0... 1H	0 ...1	1	-
Factory test active					
LV_DMTL_EOL	O/V	0... 1H	0 ...1	1	-
End of line test active					
LV_DMTL_PUMP	O/V	0... 1H	0 ...1	1	-
controlbit of the DMTL pump powerstage					
LV_DMTL_PUMP_ON	O/V	0... 1H	0 ...1	1	-
DMTL pump motor on					
LV_DMTL_RST_ROUGH_LEAK	O/V	0... 1H	0 ...1	1	-
Inhibit small leak diagnosis					
LV_DMTL_STOP	O/V/S	0... 1H	0 ...1	1	-
Abnormal termination of DMTL function					
LV_DMTLS	O/V	0... 1H	0 ...1	1	-
controlbit of the DMTL solenoid powerstage					
LV_DMTLS_ON	O/V	0... 1H	0 ...1	1	-
DMTL valve on					

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DR_DMTL	O/V	0... 1H	0 ...1	1	-
Enabling the output stages of the DMTL module					
LV_DR_DMTL_PUMP	O/V	0... 1H	0 ...1	1	-
DMTL pump activation					
LV_DR_DMTLS	O/V	0... 1H	0 ...1	1	-
DMTL solenoid valve activation					
LV_ENA_CHK_FUC_ROUGH_LEAK	O/V	0... 1H	0 ...1	1	-
Enable rough leak measurement due to Check Filler Cap					
LV_ENA_FCO_DIAG	O/V	0... 1H	0 ...1	1	-
Consumption diagnosis enable					
LV_ENA_FTL_DIAG	O/V	0... 1H	0 ...1	1	-
Fuel level diagnosis enable					
LV_ENA_FUC	O/V/S	0... 1H	0 ...1	1	-
Request check filler cap					
LV_ENA_FUC_ROUGH_LEAK_MES	O/V	0... 1H	0 ...1	1	-
Enable rough leak measurement due to Check Filler Cap					
LV_ENA_LEAK_DMTL	O/V	0... 1H	0 ...1	1	-
Enabling function request, coarse /miniature leakage measurement					
LV_ENA_MAIN_DMTL	O/V	0... 1H	0 ...1	1	-
DMTL main enabling					
LV_ENA_MAIN_DMTL_FUC	O/V	0... 1H	0 ...1	1	-
Main enabling DMTL Check Filler Cap					
LV_ENA_ROUGH_LEAK_1	O/V	0... 1H	0 ...1	1	-
Auxiliary bit enable condition for rough leak check is present					
LV_ENA_ROUGH_LEAK_2	O/V	0... 1H	0 ...1	1	-
Auxiliary bit enabling rough leak check through manual activation					
LV_ENA_ROUGH_LEAK_3	O/V	0... 1H	0 ...1	1	-
Auxiliary bit interruption of rough leak check					
LV_ENA_ROUGH_LEAK_MES	O/V	0... 1H	0 ...1	1	-
Enabling rough leak measurement					
LV_ENA_ROUGH_LEAK_MES_ONLY	O/V	0... 1H	0 ...1	1	-
Enable only rough leak measurement					
LV_ENA_SMALL_LEAK_1	O/V	0... 1H	0 ...1	1	-
Enable for miniature leak check via test unit intervention					
LV_ENA_SMALL_LEAK_MES	O/V/S	0... 1H	0 ...1	1	-
Enable miniature leak measurement					
LV_ENA_SMALL_LEAK_MES_END	O/V	0... 1H	0 ...1	1	-
End of enable miniature leak measurement					
LV_END_DIAG_DMTL_MAX	V	0... 1H	0 ...1	1	-
End of dmtl max diagnosis					
LV_END_DIAG_DMTL_MIN	V	0... 1H	0 ...1	1	-
End of dmtl min diagnosis					
LV_END_DIAG_DMTL_PLAUS	V	0... 1H	0 ...1	1	-
End of dmtl plaus diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_DMTL_SIG	V	0... 1H	0 ...1	1	-
End of dmtl sig diagnosis					
LV_END_DIAG_ROUGH_LEAK	O/V	0... 1H	0 ...1	1	-
End of rough leak diagnosis					
LV_END_DIAG_SMALL_LEAK	O/V	0... 1H	0 ...1	1	-
End of small leak diagnosis					
LV_ERR_DET_DMTL_MAX	O/V/S	0... 1H	0 ...1	1	-
Error maximum value DMTL					
LV_ERR_DET_DMTL_MIN	O/V/S	0... 1H	0 ...1	1	-
Error minimum value DMTL					
LV_ERR_DET_ROUGH_LEAK_MIN	O/V/S	0... 1H	0 ...1	1	-
Rough leak error					
LV_ERR_DET_SMALL_LEAK_MIN	O/V/S	0... 1H	0 ...1	1	-
Error, minimum value detected, miniature leakage					
LV_ERR_DET_SMALL_LEAK_MIN_CFM	O/V	0... 1H	0 ...1	1	-
Confirmation bit (after check of refueling) for small leak detected in tank					
LV_ERR_DMTL_MAX	O/V	0... 1H	0 ...1	1	-
Error Dmtl max					
LV_ERR_DMTL_MIN	O/V	0... 1H	0 ...1	1	-
Error Dmtl min					
LV_ERR_DMTL_PLAUS	O/V	0... 1H	0 ...1	1	-
Error Dmtl plaus					
LV_ERR_DMTL_SET	O/V/S	0... 1H	0 ...1	1	-
Indication bit for DMTLM diagnosis has run through w/wo error					
LV_ERR_DMTL_SIG	O/V	0... 1H	0 ...1	1	-
Error Dmtl sig					
LV_ERR_DMTLM	O/V/S	0... 1H	0 ...1	1	-
Error DMTL module					
LV_ERR_FTL	O/V/S	0... 1H	0 ...1	1	-
Tank level error					
LV_ERR_FTL_PLAUS	O/V/S	0... 1H	0 ...1	1	-
Tank level plausibility error					
LV_ERR_ROUGH_LEAK	O/V	0... 1H	0 ...1	1	-
Error rough leak					
LV_ERR_SIG_DMTL	O/V/S	0... 1H	0 ...1	1	-
Error signal DMTL					
LV_ERR_SMALL_LEAK	O/V	0... 1H	0 ...1	1	-
Error miniature leak					
LV_FCO_DIAG_MAX	O/V	0... 1H	0 ...1	1	-
Upper consumption diagnosis threshold					
LV_FCO_DIAG_MIN	O/V	0... 1H	0 ...1	1	-
Lower consumption diagnosis threshold					
LV_FCO_H_FTL	O/V	0... 1H	0 ...1	1	-
Consumed fuel greater than tank level					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_FTL_DEC	O/V	0... 1H	0 ...1	1	-
Tank volume has decreased					
LV_FTL_DEC_IGK_ON	O/V	0... 1H	0 ...1	1	-
Tank filling volume has decreased in case of ignition key ON					
LV_FTL_DIAG	O/V/S	0... 1H	0 ...1	1	-
Level sensor diagnosis					
LV_FTL_DMTL_MAX	O/V	0... 1H	0 ...1	1	-
Max. tank level for DMTL function					
LV_FTL_DMTL_MIN	O/V	0... 1H	0 ...1	1	-
Min. tank level for DMTL function					
LV_FTL_DMTL_VAL	O/V	0... 1H	0 ...1	1	-
Validated tank level for DMTL function					
LV_FTL_DYN	O/V	0... 1H	0 ...1	1	-
Level dynamics due to refueling					
LV_FTL_INC	O/V	0... 1H	0 ...1	1	-
Tank volume has increased					
LV_FTL_INC_IGK_ON	O/V	0... 1H	0 ...1	1	-
Tank filling volume has increased in case of ignition key ON					
LV_FUC_CAN	O/V	0... 1H	0 ...1	1	-
Tank cap open - display					
LV_FUC_OPEN	O/V/S	0... 1H	0 ...1	1	-
Filler cap open					
LV_HDMTL_ON	O/V	0... 1H	0 ...1	1	-
Heater DMTL					
LV_NO_PURGE_DMTL	O/V	0... 1H	0 ...1	1	-
Request for no_purge of the evap.-system					
LV_NO_PURGE_DMTL_ROUGH_LEAK	O/V	0... 1H	0 ...1	1	-
request bit for no_purge					
LV_NO_PURGE_DMTL_SMALL_LEAK	O/V	0... 1H	0 ...1	1	-
Request for no_purge					
LV_NO_PURGE_DR_DMTL	O/V	0... 1H	0 ...1	1	-
Pulse width modulation of canister-purge					
LV_RD_FTL	O/V	0... 1H	0 ...1	1	-
Level diagnosis active					
LV_REF_LEAK_ROUGH_LEAK_SUSP	O/V	0... 1H	0 ...1	1	-
Condition, second reference measurement due to "rough leak suspected"					
LV_REFU	O/V	0... 1H	0 ...1	1	-
Refueling					
LV_REFU_1	O/V	0... 1H	0 ...1	1	-
Refueling process, internal					
LV_REFU_DMTL	O/V/S	0... 1H	0 ...1	1	-
Condition refueling					
LV_REFU_DMTL_SMALL_LEAK	O/V/S	0... 1H	0 ...1	1	-
Refueling detection auxiliary bit for evaluation of small leak diagnostic result					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_REFU_DMTLM	O/V/S	0... 1H	0 ...1	1	-
Refueling detection auxiliary bit for evaluation of DMTL module diagnostic result					
LV_REFU_END	O/V	0... 1H	0 ...1	1	-
Refueling finished					
LV_REFU_RLS_DIAG	O/V	0... 1H	0 ...1	1	-
Refueling diagnosis possible					
LV_REFU_VAL	O/V	0... 1H	0 ...1	1	-
Refueling bit valid					
LV_REFU_VAL_1	O/V	0... 1H	0 ...1	1	-
Refueling bit valid, internal					
LV_REQ_ENA_ROUGH_LEAK	O/V	0... 1H	0 ...1	1	-
Request rough leak measurement					
LV_REQ_PWL_DMTL	O/V	0... 1H	0 ...1	1	-
Request of STG off delay, tank leakage diagnosis					
LV_REQ_PWL_ROUGH_LEAK	O/V	0... 1H	0 ...1	1	-
Request of STG off delay, rough leak diagnosis					
LV_REQ_PWL_SMALL_LEAK	O/V	0... 1H	0 ...1	1	-
Request of STG off delay, miniature leak test					
LV_REQ_ROUGH_LEAK	O/V	0... 1H	0 ...1	1	-
Request rough leak measurement (low volatile fuel)					
LV_ROUGH_LEAK_MES_LEN	O/V	0... 1H	0 ...1	1	-
Condition, extension rough leak measurement					
LV_ROUGH_LEAK_SUSP	O/V	0... 1H	0 ...1	1	-
Rough leak suspected					
LV_ROUGH_LEAK_SUSP_SET	O/V/S	0... 1H	0 ...1	1	-
Rough leak suspicion with cycle bit rough leak suspicion present					
LV_SDR_DMTL	O/V/S	0... 1H	0 ...1	1	-
Error plausibility DMTL					
LV_SMALL_LEAK_MES_LEN	O/V	0... 1H	0 ...1	1	-
Condition, extension miniature leak measurement					
LV_T_DLY_DMTL_PWL	O/V	0... 1H	0 ...1	1	-
Waiting time DMTL start finished					
LV_T_DMTL_MAX	O/V/S	0... 1H	0 ...1	1	-
Max. time for DMTL					
LV_TCO_ST_DMTL	O/V	0... 1H	0 ...1	1	-
Coldstart condition for DMTL fulfilled					
LV_VB_DIF_MAX	O/V/S	0... 1H	0 ...1	1	-
High battery voltage deviation					
LV_VB_RANGE_DMTL	O/V	0... 1H	0 ...1	1	-
DMTL does not start because battery is out of band width					
M6_CTR_CNL_SMALL_LEAK_MES	O/V/S	0... FFH	0... 255	1	-
mode06 - Module-diagnosis, Signal failure					
M6_CTR_CNL_SMALL_LEAK_MES_SAVE	O/V/S	0... FFH	0... 255	1	-
Store value mode06 - Module-diagnosis, Signal failure					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
M6_CUR_DMTL_COR_FIL_CID18	O/V/S	0... FFFFH	0... 399.99389	6.1e-3	mA
Mode06 - module diagnosis minimum failure					
M6_CUR_DMTL_COR_FIL_CID18_SAVE	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Store value Mode06 - module diagnosis minimum failure					
M6_CUR_DMTL_COR_FIL_CID19	O/V/S	0... FFFFH	0... 399.99389	6.1e-3	mA
Mode06 - module diagnosis maximum failure					
M6_CUR_DMTL_COR_FIL_CID19_SAVE	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Store value Mode06 - module diagnosis maximum failure					
M6_CUR_DMTL_DMTLS_TEST	O/V/S	0... FFFFH	0... 399.99389	6.1e-3	mA
Mode06 - module diagnosis plausibility failure					
M6_CUR_DMTL_DMTLS_TEST_SAVE	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Store value Mode06 - module diagnosis plausibility failure					
M6_CUR_DMTL_REF_LEAK	O/V/S	0... FFFFH	0... 399.99389	6.1e-3	mA
Mode06 - DMTL, Small leak thd					
M6_CUR_DMTL_REF_LEAK_SAVE	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Store value Mode06 - DMTL, Small leak thd					
M6_CUR_DMTL_ROUGH_LEAK_END	O/V/S	0... FFFFH	0... 399.99389	6.1e-3	mA
Mode06 - DMTL, Rough-leak short cycle					
M6_CUR_DMTL_ROUGH_LEAK_LEN_END	O/V/S	0... FFFFH	0... 399.99389	6.1e-3	mA
Mode06 - DMTL, Rough leak long cycle					
M6_CUR_DMTL_SMALL_LEAK_END	O/V/S	0... FFFFH	0... 399.99389	6.1e-3	mA
Mode06 - DMTL, Small leak					
M6_CUR_DMTL_SMALL_LEAK_END_SAVE	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Store value for Mode06 - DMTL, Small leak					
M6_CUR_DMTL_THD_DMTLS_TEST	O/V/S	0... FFFFH	0... 399.99389	6.1e-3	mA
Mode06 - module diagnosis plausibility diagnosis thd					
M6_CUR_DMTL_THD_DMTLS_TEST_SAVE	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Store value Mode06 - module diagnosis plausibility diagnosis thd					
M6_CUR_DMTL_THD_ROUGH_LEAK	O/V/S	0... FFFFH	0... 399.99389	6.1e-3	mA
Mode06 - DMTL, Rough-leak short cycle thd					
M6_CUR_DMTL_THD_ROUGH_LEAK_LEN	O/V/S	0... FFFFH	0... 399.99389	6.1e-3	mA
Mode06 - DMTL, Rough leak long cycle thd					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_DMTL	O/V	0H	START		
		1H	REF_LEAK_MES		
		2H	ROUGH_LEAK_MES		
		3H	ROUGH_LEAK_MES_LEN		
		4H	ROUGH_LEAK_MES_END		
		5H	SMALL_LEAK_MES		
		6H	SMALL_LEAK_MES_LEN		
		7H	REF_LEAK_MES_2	-	-
		8H	TANK_PROOFED		
		9H	SMALL_LEAK		
		AH	ROUGH_LEAK		
		BH	MODULE_ERROR		
		CH	END		
		undef3581d21630-5486473d75H	undef		
		undef3581d21630-5486473d77H	undef		
undef3581d21630-5486473d80H	undef				
undef3581d21630-5486473d82H	undef				
DMTL state					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit	
STATE_DMTL_EOL	O/V/S	0H	START			
		1H	REF_LEAK_MES			
		2H	ROUGH_LEAK_MES			
		3H	ROUGH_LEAK_MES_LEN			
		4H	ROUGH_LEAK_MES_END			
		5H	SMALL_LEAK_MES			
		6H	SMALL_LEAK_MES_LEN			
		7H	REF_LEAK_MES_2			
		8H	TANK_PROOFED			
		9H	SMALL_LEAK			
		AH	ROUGH_LEAK			
		BH	MODULE_ERROR			
		CH	END			
		11H	VB_OUT_OF_RANGE			
		12H	ELECTRICAL_ERR			
		21H	REFUELLING			
		22H	TANK_CAP_OPEN			
		23H	VB_GITTER			
		24H	T_DMTL_MAX			
		25H	CUR_REF_DIF_MAX			
		26H	THD_CUR_DMTL_DIF_MES			
		undef:1H	DMTL_DIF_MES			
		undef3581d21630	5486473d101H	undef		
		undef3581d21630	5486473d114H	undef		
		undef3581d21630	5486473d94H	undef		
		undef3581d21630	5486473d96H	undef		
undef3581d21630	5486473d99H	undef				
Status of DMTL EOL diagnosis						

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_ACT_CUR_DMTL_STAT	O/V	0... FFFFH	0... 6553.5	0.1	s
Current time, pump current stable					
T_ACT_LEAK_MES	O/V/S	0... FFFFH	0... 6553.5	0.1	s
Current time, leakage measurement					
T_ACT_REF_LEAK_MES	O/V	0... FFFFH	0... 6553.5	0.1	s
Current time, reference leakage measurement					
T_DMTL_EOL	V	0... FFFFH	0... 6553.5	0.1	s
Time used for end of line diagnosis after test unit initiation					
VB_DMTL_FIL	O/V	0... FFFFH	0... 25.9996	397e-6	V
Filtered battery voltage					
VB_DMTL_REF	O/V	0... FFFFH	0... 25.9996	397e-6	V
Filtered battery voltage on transition to reference leak measurement					

**Input data:**

AMP_MES {p. 1163}	CL_MMV_NORM_PURGE_END {p. 1001}	ECU_STATE {p. 1091}	FCO_DMTL {p. 3846}
FTL {p. 1564}	LV_ACT_DMTL_PUMP_EXT_ADJ {p. 7432}	LV_ACT_DMTLH_EXT_ADJ {p. 7432}	LV_ACT_DMTLS_EXT_ADJ {p. 7432}
LV_CLOSE_ACT_CP {p. 1000}	LV_CONF_DMTL {p. 654}	LV_DMTL_PUMP_EXT_ADJ {p. 7433}	LV_DMTLH_EXT_ADJ {p. 7433}
LV_DMTLS_EXT_ADJ {p. 7433}	LV_ENA_CHK_FUC_ROUGH_LEAK_MES {p. 5918}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}
LV_ERR_BN_KM_ICL {p. 4870}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DMTL_PUMP {p. 4626}	LV_ERR_DMTLS {p. 4627}
LV_ERR_EL_CPS {p. 4708}	LV_ERR_SPI_MPS {p. 4245}	LV_ERR_TAM {p. 5076}	LV_ERR_TCO {p. 4496}
LV_ERR_TOUT_ICL_2 {p. 802}	LV_ERR_VS {p. 5021}	LV_ES {p. 1720}	LV_FTL_CAN_ERR {p. 1565}
LV_IGK {p. 906}	LV_IS {p. 1720}	LV_PL {p. 1720}	LV_PU {p. 1720}
LV_PUC {p. 1720}	LV_ST_END {p. 1720}	LV_T_ES_NOT_PLAUS {p. 4467}	LV_T_REL_CAN_REG {p. 1567}
STATE_EFP_CRASH_CAN {p. 1573}	T_AST {p. 1766}	TAM {p. 1579}	TAM_ST {p. 1214}
TCO_ST {p. 1100}	TRT {p. 1504}	V_DMTL	VB {p. 1185}
VS {p. 1176}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_DMTL_MAX	-	0... FFFFH	0... 5434	0.0829175	hPa
Lower altitude threshold for DMTL function /upper ambient pressure for DMTL function					
C_CL_DMTL_MAX	-	0... FFFFH	0... 1.99996	30.5e-6	-
Maximum loading degree for the DMTL function					
C_COD_2_DMTL	-	0... FFH	0... 255	1	-
2nd application code word of DMTL function					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_COD_DMTL	-	0... FFH	0... 255	1	-
Calibration constant					
C_CRLC_CUR_DMTL_FIL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Time constant of pump current filtering					
C_CRLC_CUR_DMTL_FIL_LIM	-	0... FFFFH	0... 0.99998	15.3e-6	-
Time constant at the beginning of pump current filtering					
C_CRLC_CUR_DMTL_FIL_LIM	-	0... FFFFH	0... 0.99998	15.3e-6	-
Time constant at the beginning of pump current filtering					
C_CRLC_CUR_DMTL_FIL_REFU	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for pump current filtering in case of refueling detection					
C_CRLC_VB_DMTL_FIL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Time constant of VB filtering					
C_CRLC_VB_DMTL_FIL_LIM	-	0... FFFFH	0... 0.99998	15.3e-6	-
Time constant at the beginning of VB filtering					
C_CTR_DIAG_CFM_DMTLM_LEAK	-	0... FFH	0... 255	1	-
Calibratable number of to be confirmed DMTL_MIN/MAX/PLAUS/SIG and ROUGH/SMALL_LEAK error diagnostics (after MIL-On due to DMTL_MIN/MAX/PLAUS/SIG or ROUGH/SMALL_LEAK) for deactivation of DMTL diagnosis					
C_CTR_ENA_DMTL_CHK_FUC	-	0... FFH	0... 255	1	-
maximum number of enabled check filler cap checks					
C_CTR_ERR_DET_DMTLM_LEAK	-	0... FFH	0... 255	1	-
Calibratable threshold for number of consecutive errors (of dmtl_max/min/sig/plaus or rough/small_leak) from which activation of error-confirmation diagnostic loop is enabled					
C_CTR_TCO_ST_DMTL_MIN	-	0... FFH	0... 255	1	-
Threshold of recognized cold start for DMTL small leak test					
C_CUR_DMTL_COR_FIL_OFS_AMP	-	... 7FFFH FFFF8000H	Error State - 200...199.98779	-	mA
Pump current offset in case of ambient pressure					
C_CUR_DMTL_DIF_CUR_DMTL_STAT	-	0... FFFFH	0... 399.99389	6.1035e-3	mA
Delta pump current for pump current					
C_CUR_DMTL_DIF_THD_FUC	-	8000... 7FFFH	-200... 199.99389	6.1035e-3	mA
Threshold pump current change for fuel cap detection					
C_CUR_DMTL_DIF_THD_MES	-	0... FFFFH	0... 399.99389	6.1035e-3	mA
Current decrease threshold during measurement					
C_CUR_DMTL_DIF_THD_REFU	-	8000... 7FFFH	-200... 199.99389	6.1035e-3	mA
Threshold pump current change for refueling detection					
C_CUR_DMTL_REF_DIF_MAX	-	0... FFFFH	0... 399.99389	6.1035e-3	mA
Upper threshold of the Delta pump current					
C_CUR_DMTL_REF_LEAK_MAX	-	0... FFFFH	0... 399.99389	6.1035e-3	mA
Upper threshold of pump current for reference measurement					
C_CUR_DMTL_REF_LEAK_MIN	-	0... FFFFH	0... 399.99389	6.1035e-3	mA
Lower threshold of pump current for reference measurement					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CUR_DMTL_REF_OFS	-	0... FFFFH	0... 399.99389	6.1035e-3	mA
Reference pump current offset					
C_DIST_REFU_ROUGH_LEAK_MIN	-	0... FFFFH	0... 65535	1	m
Lower threshold of distance covered between refueling and rough leak suspicion					
C_ENA_FCO_DIAG	-	0... FFFFH	0... 4294.9	0.0655365	l
Threshold consumed fuel for diagnosis enable					
C_FAC_T_CUR_DMTL_STAT_LEN	-	0... FFFFH	0... 0.99998	15.3e-6	-
Factor for 2. stabilization					
C_FCO_DIAG_MAX	-	80... 7FH	-128 ...127	1	l
Upper tolerance variable for level sensor diagnosis					
C_FCO_DIAG_MIN	-	80... 7FH	-128 ...127	1	l
Lower tolerance variable for level sensor diagnosis					
C_FTL_DEC_FTL_DIAG_MIN	-	80... 7FH	-128 ...127	1	l
Minimum level decrease for refueling detection					
C_FTL_DIAG_MAX	-	0... 783H	0... 126	0.0655226	l
maximum tank level					
C_FTL_DIAG_MIN	-	80... 7FH	-128 ...127	1	l
Minimum fuel tank volume for refueling detection					
C_FTL_DMTL_MAX	-	0... 7EH	0... 126	1	l
Max. tank level for DMTL function					
C_FTL_DMTL_MIN	-	0... 7EH	0... 126	1	l
Min. tank level for DMTL function					
C_HYS_FTL_DMTL	-	0... 7EH	0... 126	1	l
Hysteresis for tank level bit for DMTL function					
C_R_DMTL	-	0... FFH	0... 50	0.1953125	Ohm
Resistance of pump current measurement					
C_SUM_CNL_LEAK_MES_FUC_MAX	-	0... FFH	0... 255	1	-
Maximum number of aborted check filler cap checks					
C_SUM_CNL_SMALL_LEAK_MES_MAX	-	0... FFH	0... 255	1	-
Max. number of aborted miniature leak checks due to current fluctuations					
C_SUM_REP_LEAK_MES_FUC_MAX	-	0... FFH	0... 255	1	-
Maximum number of repeated check filler cap checks					
C_T_ACT_ROUGH_LEAK	-	0... FFFFH	0... 6553.5	0.1	s
Time for rough leak measurement					
C_T_ACT_ROUGH_LEAK_CHK_FUC	-	0... FFFFH	0... 6553.5	0.1	s
Time for rough leak measurement in case of check filler cap					
C_T_ACT_SMALL_LEAK	-	0... FFFFH	0... 6553.5	0.1	s
Time for miniature leak measurement					
C_T_AST_DMTL_CHK_FUC	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time after start for enabling check filler cap check					
C_T_AST_DMTL_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Min. post-starting period for canister purge diagnosis					
C_T_CUR_DMTL_ROUGH_LEAK_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Max. time pump current check in rough leak phase					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_CUR_DMTL_ROUGH_LEAK_MIN	-	0... FFFFH	0... 6553.5	0.1	s
Min. time pump current check in rough leak phase					
C_T_CUR_DMTL_STAT	-	0... FFFFH	0... 6553.5	0.1	s
Time for pump current stable					
C_T_DLY_CUR_DMTL_DIF_MES	-	0... FFFFH	0... 6553.5	0.1	s
Current decrease detection delay during measurement					
C_T_DLY_DET_REFU	-	0... FFFFH	0... 6553.5	0.1	s
Wait period of refueling detection					
C_T_DLY_DMTLS	-	0... FFH	0... 25.5	0.1	s
Waiting time after change-over of solenoid valve					
C_T_DLY_ES_PWL	-	0... FFH	0... 25.5	0.1	s
Post-operating wait period until start of DMTL function					
C_T_DLY_FUC_CAN_OFF	-	0... FFFFH	0... 6553.5	0.1	s
Delay time with which Check filler Cap - light is switched off					
C_T_DLY_FUC_CAN_ON	-	0... FFFFH	0... 6553.5	0.1	s
Delay time with which Check filler Cap - light is switched on					
C_T_DLY_IGK_FTL	-	0... FFH	0... 25.5	0.1	s
Minimum time for which LV_IGK must be = 1 to issue a validated level					
C_T_DLY_REQ_PWL_DMTL	-	0... FFH	0... 25.5	0.1	s
Post-operating time after no request for extending the post-operating phase is present any longer					
C_T_DLY_STOP_REFU	-	0... FFFFH	0... 65535	1	s
Delay time stop before refueling					
C_T_DMTL_EOL_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Max. time for end of line diagnosis after test unit initiation					
C_T_DMTL_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time for DMTL diagnosis					
C_T_ENA_DMTL_CHK_FUC	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time between two chk filler cap checks					
C_T_ENA_DR_DMTL_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Max. time for function request DMTL output stages					
C_T_REF_LEAK_MES_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Time for reference leakage measurement					
C_T_REF_LEAK_MES_REP_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Time for repeat reference leakage measurement					
C_T_REF_TEST_ROUGH_LEAK	-	0... FFFFH	0... 6553.5	0.1	s
Time for reference test in case of rough leak check					
C_T_VB_DLY_DMTL	-	0... FFFFH	0... 6553.5	0.1	s
Time delay for Vbat monitoring					
C_TAM_DMTL_CHK_FUC_MIN	-	0... FEH	-48... 142.5	0.75	°C
Minimum ambient temperature for enabling check filler cap check					
C_TAM_DMTL_MAX	-	0... FEH	-48... 142.5	0.75	°C
Upper temperature threshold for the DMTL function					
C_TAM_DMTL_MIN	-	0... FEH	-48... 142.5	0.75	°C
Lower temperature threshold for the DMTL function					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_ST_DMTL_COLD	-	80... 7FH	-96... 95.25	0.75	°C
TCO_ST offset of TAM to enable a DMTL diagnosis					
C_TCO_ST_DMTL_MIN	-	0... FEH	-48... 142.5	0.75	°C
Min. TCO_ST for DMTL enable					
C_TRT_DMTL_EOL_MAX	-	0... FFFFFFFFH	0... 119304.64708	27.7999e-6	h
max. TRT time to run the end of line diagnosis					
C_VB_DMTL_ASA_MAX	-	0... FFH	0... 25.89843	0.1015625	V
Maximum battery threshold at end of line for DMTL					
C_VB_DMTL_ASA_MIN	-	0... FFH	0... 25.89843	0.1015625	V
Minimum battery threshold at end of line for DMTL					
C_VB_DMTL_CHK_FUC_MAX	-	0... FFH	0... 25.89843	0.1015625	V
Maximum battery voltage for enabling check filler cap check					
C_VB_DMTL_CHK_FUC_MIN	-	0... FFH	0... 25.89843	0.1015625	V
Minimum battery voltage for enabling check filler cap check					
C_VB_DMTL_DIF	-	0... FFFFH	0... 25.9996	396.7e-6	V
Delta VB threshold for DMTL					
C_VB_DMTL_DIF_CHK_FUC	-	0... FFFFH	0... 25.9996	396.7e-6	V
Delta VB threshold for DMTL in case of check filler cap					
C_VB_DMTL_MAX	-	0... FFH	0... 25.89843	0.1015625	V
Maximum battery threshold for the DMTL function					
C_VB_DMTL_MIN	-	0... FFH	0... 25.89843	0.1015625	V
Minimum battery threshold for the DMTL function					
C_VS_DMTL_MAX	-	0... FFH	0... 255	1	km/h
Max. vehicle speed					
C_VS_FTL_DIAG_MAX	-	0... FFH	0... 255	1	km/h
Max. VS threshold for FTL DIAG					
C_VS_FUC_CAN_MIN	-	0... FFH	0... 255	1	km/h
Minimum speed for activation Check filler cap					
IP_FAC_CUR_DMTL	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_VB_DMTL_FIL_FAC_CUR_DMTL	6	0... FFFFH	0... 25.9996	396.7e-6	V
Battery-voltage dependent correction factor for the pump current					
IP_FAC_CUR_DMTL_CHK_FUC_ROUGH	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_CUR_DMTLDIFREFROUGHLEAK_1	8	0... FFFFH	0... 399.99389	6.1035e-3	mA
Factor delta pump current for rough leak detection concerning reference in case of check filler cap test					
IP_FAC_CUR_DMTL_REF	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_CUR_DMTLDIFREFROUGHLEAK_1	8	0... FFFFH	0... 399.99389	6.1035e-3	mA
Factor delta pump current for rough leak detection concerning reference					
IP_FAC_CUR_DMTL_ROUGH	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_CUR_DMTLDIFREFROUGHLEAK_1	8	0... FFFFH	0... 399.99389	6.1035e-3	mA
Factor delta pump current for rough leak detection					
IP_T_ACT_ROUGH_LEAK	-	0... FFFFH	0... 6553.5	0.1	s
LDP_FTL__T_ROUGH_LEAK_TEST	6	0... 7EH	0... 126	1	l
Time for rough leak measurement					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_T_ACT_ROUGH_LEAK_CHK_FUC	-	0... FFFFH	0... 6553.5	0.1	s
LDP_FTL__T_ROUGH_LEAK_TEST	6	0... 7EH	0... 126	1	l
Time for rough leak measurement in case of check filler cap and error FTL					
IP_T_ACT_SMALL_LEAK__FTL	-	0... FFFFH	0... 6553.5	0.1	s
LDP_FTL__T_SMALL_LEAK_TEST	6	0... 7EH	0... 126	1	l
Time for miniature leak measurement					
IP_T_CUR_DMTL_STAT	V	0... FFFFH	0... 6553.5	0.1	s
LDP_FTL__T_CUR_DMTL_STAT	8	0... 7EH	0... 126	1	l
LDPM_CUR_DMTLDIFREFROUGHLEAK_1	8	0... FFFFH	0... 399.99389	6.1035e-3	mA
Time for pump current stable					

**Import actions:**

<b>ACTION_ERRM_StorePrevFr (IN&lt;XX&gt;)</b>
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**Error treatment:**


Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Diagnostic Mode for DMTL module, MAX	DMTL_MAX	MAX (SYM_0)	0	NO	EVAP
Diagnostic Mode for DMTL module, MIN	DMTL_MIN	MAX (SYM_1)	1	NO	EVAP
Diagnostic Mode for DMTL module, SIG	DMTL_SIG	MAX (SYM_2)	2	NO	EVAP
Diagnostic Mode for DMTL module, PLAUS	DMTL_PLAUS	MAX (SYM_3)	3	NO	EVAP
Tank leak error	SMALL_LEAK	-	0	NO	EVAP
		MIN	1		
		-	2		
		-	3		
Tank leak error	ROUGH_LEAK	MAX	0	NO	EVAP
		-	1		
		-	2		
		-	3		

Fields information (For more information refers to Error Management file Table of Failure) :

- ABC Type : STD\_INI, STD, MEM, MEM\_INI, DEC\_CAL, STC, NO, MPL\_STD\_INI
- CARB Class : MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO.

**How maximum error DMTL is built up****General information:**

In the scope of the legal requirements for On-Board Diagnosis (OBD II) it must be possible to detect a rough leak with a diameter of > 1.0 mm as well as a miniature leak with a diameter of > 0.5 mm within the tank system.

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The leakage diagnostic unit DMTL is installed to the fresh air connector of the CP. To measure a leakage within the tank system, an excess pressure is built up in the tank system after closing the canister purge valve and changing over a valve in the diagnostic module. An excess pressure of approx. 25 hPa is built up by means of the electrical pump in the diagnostic module. The pump's power consumption is used as a measure for the tank tightness. The power consumption in a defined reference leakage serves as a reference for stating the size of a leakage.

### Function description

The function is basically enabled via the variant bit LV\_CONF\_DMTL which is set to 1 via the data record if the DMTL module is installed.

The diagnostic sequence is controlled via the state machine of the central sequencing control system. It receives from the function enabling module the enable LV\_ENA\_SMALL\_LEAK\_MES for measuring the miniature leak, and the enable LV\_ENA\_ROUGH\_LEAK\_MES for measuring the rough leak. Subsequently, the state machine starts a reference leakage measurement. After the time C\_T\_REF\_LEAK\_MES\_MAX has elapsed, a transition to the rough leak diagnosis is performed, except in case the current monitoring detects a module error or the diagnosis is interrupted due to a detected diagnosis.

The system detects a rough leak suspect if the pump current does not exceed the threshold CUR\_DMTL\_THD\_ROUGH\_LEAK within the time T\_DMTL\_ROUGH\_LEAK and if the pump current does not reach the threshold CUR\_DMTL\_THD\_ROUGH\_LEAK\_LEN after the extension time T\_DMTL\_ROUGH\_LEAK. In case of a rough leak suspect a second reference measurement is performed on the basis of which the final decision on a rough leak suspect is made. Subsequently, a transition to the miniature leak diagnosis is performed. The tank system is detected to be tight if the pump current exceeds the reference current CUR\_DMTL\_REF\_LEAK.

If the pump current is detected to have reached steady state twice after the time T\_DMTL\_SMALL\_LEAK, a second reference measurement is performed. If a current increase is detected, a miniature leakage is diagnosed. In case of a current reduction, the tank system is detected to be tight.

At the end of the diagnosis, the pump motor is switched off and the change-over valve is reset to its regeneration position.

The errors are indicated with the logic variable LV\_ERR\_DMTLM for a DMTL module error, LV\_ERR\_ROUGH\_LEAK in case a rough leak is present, or LV\_ERR\_SMALL\_LEAK if a miniature leak has been detected.

A current diagnosis is indicated with the bit LV\_DMTL\_ACT; interruption of diagnosis is requested via the bit LV\_DMTL\_STOP. The diagnosis is interrupted if tank cover open has been detected, at the beginning of refueling, in case of an excessive battery voltage fluctuation during diagnosis, in case of decreasing pump current during the measuring phase or if a short-circuit of the pump output stage has been detected.


During the reference stage the function is finished without results if humidity has been detected.

The pump current CUR\_DMTL is filtered after conversion to a standard voltage of 12 V in the function block of the pump current filtering. At the beginning of the reference measurement and at the beginning of the rough leak measurement, a smaller time constant is used to enable short transient period of the filter.

Moreover, the filtered battery voltage is sampled at the end of the reference measurement, and the change is monitored in the following rough/miniature leak measurement for the threshold C\_VB\_DMTL\_DIF. The result LV\_VB\_DIF\_MAX = 1 results in interruption of the diagnosis.

During the reference leakage measurement it is taken care of current fluctuations which can lead to an interruption of the diagnosis.

The function block "Fuel cap and refueling check" differentiates the corrected pump current and checks for exceeding a positive threshold C\_THD\_CUR\_DMTL\_DIF\_REFU, i.e. for increasing pump current to detect "refueling", as the tank pressure and the pump current rise on refueling. When the tank cap is opened, the tank pressure collapses; thus the pump current is reduced. When the negative threshold C\_THD\_CUR\_DMTL\_DIF\_FUC is no longer reached, the logic variable LV\_DET\_FUC\_OPEN is set to indicate that the fuel cap is open.

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A slow decrease of C\_THD\_CUR\_DMTL\_DIF\_MES of the pump current leads to an interruption of the diagnosis.

The error and cycle flags are generated in the error block.

Enabling of the minimum leakage diagnosis is essentially initiated while the control unit is closed during off delay, below a certain level, while the vehicle does not run, if the CP is not excessively loaded, at ambient temperatures within a certain band width, the battery voltage within a certain band width and while the CPS is closed.

Moreover, the system checks whether a minimum time since engine start C\_T\_AST\_DMTL\_MIN has elapsed, a cold start was given and whether the engine is running.

When the bit LV\_REQ\_PWL\_DMTL is set, the extension of the post-operating phase is enforced up to the end of diagnosis. The diagnosis is started with the delay C\_T\_DLY\_ES\_PWL after engine start.

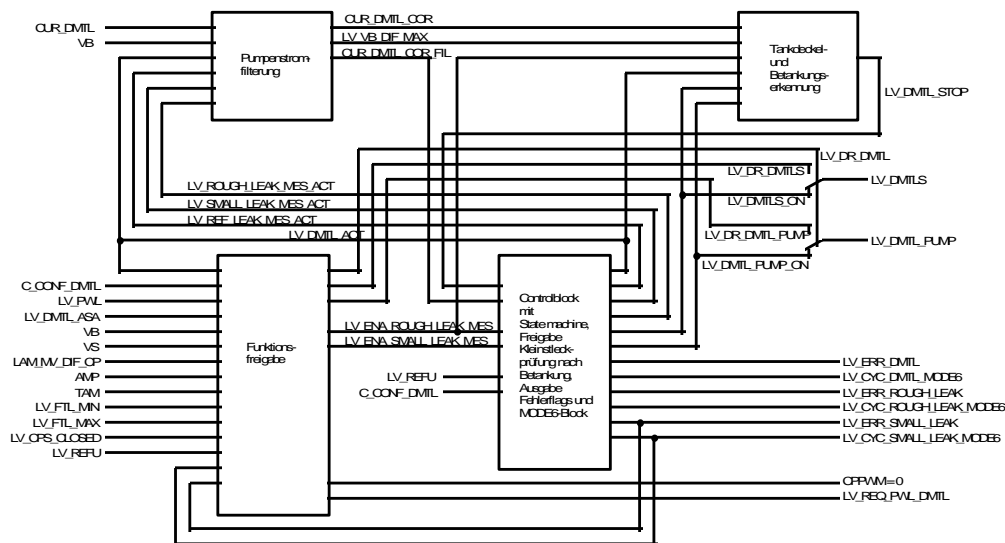
In the function block Demand rough leak check due to Check Filler Cap a rough leak check is activated after refuelling has been detected. With this check a tank cover check is performed. The error entry can be prevented while this check. If a rough leak has been detected a info in the instrument board will be activated in the combi instrument.

### Application conditions

**Recurrence:** 100 ms

**Activation:** LV\_CONF\_DMTL = 1

### Signal flow diagram:



### Formula section:

**If** LV\_DR\_DMTL = 1  
**Then** LV\_DMTLS = LV\_DR\_DMTLS  
 LV\_DMTL\_PUMP = LV\_DR\_DMTL\_PUMP  
**Else** LV\_DMTLS = LV\_DMTLS\_ON  
 LV\_DMTL\_PUMP = LV\_DMTL\_PUMP\_ON

**Endif**

### B.93.1 Central sequencing control



```

LV_CHK_DMTL_CUR_DMTL_VLD      = 0      Diagnostic module not fin-
ished
LV_CYC_ROUGH_LEAK_SUSP        = 0      Rough leak diagn. not fin-
ished
LV_CYC_SMALL_LEAK_MODE6       = 0      Miniature leak diag. not fin-
ished
LV_REF_LEAK_ROUGH_LEAK_SUSP = 0
If      LV_ERR_SIG_DMTL = 1
    Then
        LV_CUR_DMTL_REF_MES_MAX      = 0
        LV_CUR_DMTL_REF_MES_MIN      = 0
        LV_CUR_DMTL_DMTLS_TEST       = 0
    Endif

If      LV_CONF_DMTL = 0 (no DMTL - module installed)
    Then
        LV_CUR_DMTL_REF_MES_MAX      = 0
        LV_CUR_DMTL_REF_MES_MIN      = 0
        LV_CUR_DMTL_DMTLS_TEST       = 0
        LV_CHK_DMTL_CUR_DMTL_VLD     = 0
        LV_ERR_DET_SMALL_LEAK_MIN    = 0
        LV_CYC_SMALL_LEAK_MODE6      = 0      Miniature leakage diagn. not
finished
        LV_ROUGH_LEAK_SUSP           = 0
        LV_CYC_ROUGH_LEAK_SUSP       = 0      Rough leakage diagn. not
finished
    Endif

If      LV_ENA_ROUGH_LEAK_MES = 1
    Then
        Transition to state diagram
        reference leak measurement /STATE_DMTL = 1H
        LV_DMTL_ACT = 1                      Diagnosis active
        CUR_DMTL_REF_LEAK = 0
        CUR_DMTL_ROUGH_LEAK_MIN = 0
        T_ACT_LEAK_MES = 0
        LV_ERR_DET_SMALL_LEAK_MIN_CFM = 0
        LV_CYC_SMALL_LEAK_MODE6_CFM = 0
        LV_CTR_CNL_SMALL_LEAK_MES_CFM = 0
        LV_CHK_DMTL_CUR_DMTL_VLD_CFM = 0
        LV_CHK_DMTL_VLD_CFM = 0
    Else
        Remaining in state diagramm Start /STATE_DMTL = 0H
    Endif

```

### State diagram - reference leak measurement      STATE\_DMTL = 1H:

```

Initialization:  LV_DMTL_PUMP_ON      = 1      Pump ON
                  T_ACT_REF_LEAK_MES  = 0
                  CUR_DMTL_REF_LEAK    = 0
                  LV_ROUGH_LEAK_MES_LEN = 0

```

Calculations and conditions for setting:

```

T_ACT_REF_LEAK_MES = T_ACT_REF_LEAK_MES + T (= 100ms)
CUR_DMTL_REF_LEAK = CUR_DMTL_REF_LEAK_EOL =
CUR_DMTL_COR_FIL + C_CUR_DMTL_REF_OFS

```

```

If      T_ACT_REF_LEAK_MES > C_T_REF_LEAK_MES_MAX           max. time
                                                for reference leakage measurement elapsed

Then    M6_CUR_DMTL_COR_FIL_CID18_SAVE = CUR_DMTL_COR_FIL
          M6_CUR_DMTL_COR_FIL_CID19_SAVE = CUR_DMTL_COR_FIL
If      CUR_DMTL_REF_LEAK > C_CUR_DMTL_REF_LEAK_MAX
Then    LV_CUR_DMTL_REF_MES_MAX           = 1           max. error
detected

          LV_CUR_DMTL_REF_MES_MIN           = 0
          LV_CUR_DMTL_DMTLS_TEST           = 0           no plausibility error
          LV_CHK_DMTL_CUR_DMTL_VLD         = 1

Elseif  CUR_DMTL_REF_LEAK < C_CUR_DMTL_REF_LEAK_MIN:
Then    LV_CUR_DMTL_REF_MES_MAX           = 0
          LV_CUR_DMTL_REF_MES_MIN           = 1           min. error detected
          LV_CUR_DMTL_DMTLS_TEST           = 0           no plausibility error
          LV_CHK_DMTL_CUR_DMTL_VLD         = 1

Endif
Endif
Endif

If      LV_CUR_DMTL_REF_MES_MAX = 1           OR
          LV_CUR_DMTL_REF_MES_MIN = 1
Then    transition to the state diagram  module error DMTL_ERR /STATE_DMTL =
BH
Else    transition to state diagram  rough leak measurement /STATE_DMTL = 2H
Endif

```

### State diagram - rough leak diagnosis STATE\_DMTL = 2H:

```

Initialization:  LV_DMTLS_ON           = 1           Solenoid valve ON
                  T_ACT_LEAK_MES       = 0
CUR_DMTL_ROUGH_LEAK_MIN = CUR_DMTL_ROUGH_LEAK_MIN_EOL =
                  CUR_DMTL_COR_FIL     minimum current
CUR_DMTL_DIF_REF_ROUGH_LEAK = CUR_DMTL_REF_LEAK -
                  CUR_DMTL_ROUGH_LEAK_MIN
CUR_DMTL_ROUGH_LEAK_END = CUR_DMTL_COR_FIL
If      LV_ENA_CHK_FUC_ROUGH_LEAK = 0
Then    CUR_DMTL_THD_ROUGH_LEAK = CUR_DMTL_ROUGH_LEAK_MIN +
                  IP_FAC_CUR_DMTL_ROUGH *
                  CUR_DMTL_DIF_REF_ROUGH_LEAK
Else    CUR_DMTL_THD_ROUGH_LEAK = CUR_DMTL_ROUGH_LEAK_MIN +
                  IP_FAC_CUR_DMTL_CHK_FUC_ROUGH *
                  CUR_DMTL_DIF_REF_ROUGH_LEAK

Endif
CUR_DMTL_THD_DMTLS_TEST = CUR_DMTL_REF_LEAK +
                          C_CUR_DMTL_COR_FIL_OFS_AMP
CUR_DMTL_DMTLS_TEST = CUR_DMTL_ROUGH_LEAK_MIN

```

Calculations and conditions for setting:

```

T_ACT_LEAK_MES = T_ACT_LEAK_MES + T
CUR_DMTL_ROUGH_LEAK_END = CUR_DMTL_COR_FIL           Rough leak current

```

```

If      CUR_DMTL_COR_FIL < CUR_DMTL_ROUGH_LEAK_MIN
Then    CUR_DMTL_ROUGH_LEAK_MIN =
          CUR_DMTL_ROUGH_LEAK_MIN_EOL = CUR_DMTL_COR_FIL
          CUR_DMTL_DIF_REF_ROUGH_LEAK = CUR_DMTL_REF_LEAK -
          CUR_DMTL_ROUGH_LEAK_MIN

          If      LV_ENA_CHK_FUC_ROUGH_LEAK = 0
          Then    CUR_DMTL_THD_ROUGH_LEAK = CUR_DMTL_ROUGH_LEAK_
          MIN + IP_FAC_CUR_DMTL_ROUGH *
          CUR_DMTL_DIF_REF_ROUGH_LEAK
          Else    CUR_DMTL_THD_ROUGH_LEAK = CUR_DMTL_ROUGH_LEAK_
          MIN + IP_FAC_CUR_DMTL_CHK_FUC_ROUGH *
          CUR_DMTL_DIF_REF_ROUGH_LEAK
          Endif
          CUR_DMTL_DMTLS_TEST      = CUR_DMTL_ROUGH_LEAK_MIN
Endif

```

Checks:

```

If      T_ACT_LEAK_MES > C_T_CUR_DMTL_ROUGH_LEAK_MIN      AND
          T_ACT_LEAK_MES < C_T_CUR_DMTL_ROUGH_LEAK_MAX      AND

```

```

Then
          M6_CUR_DMTL_DMTLS_TEST_SAVE = CUR_DMTL_DMTLS_TEST
          M6_CUR_DMTL_THD_DMTLS_TEST_SAVE = CUR_DMTL_THD_DMTLS_TEST
Endif

```

```

If      T_ACT_LEAK_MES > C_T_CUR_DMTL_ROUGH_LEAK_MIN      AND
          T_ACT_LEAK_MES < C_T_CUR_DMTL_ROUGH_LEAK_MAX      AND
          CUR_DMTL_DMTLS_TEST >= CUR_DMTL_THD_DMTLS_TEST

```

```

Then
          LV_CUR_DMTL_REF_MES_MAX      = 0      no maximum error, DMTL
          module LV_CUR_DMTL_REF_MES_MIN = 0      no minimum error, DMTL
          module
          LV_CUR_DMTL_DMTLS_TEST      = 1      Plausibility error, DMTL
          LV_CHK_DMTL_CUR_DMTL_VLD    = 1      Module diagn. concluded
          Transition to the state diagram
          module error DMTL_ERR /STATE_DMTL = BH
Endif

```

```

If      LV_ENA_CHK_FUC_ROUGH_LEAK = 0
Then    If      T_ACT_LEAK_MES > T_ACT_ROUGH_LEAK      AND
          CUR_DMTL_ROUGH_LEAK_END < CUR_DMTL_THD_ROUGH_LEAK
          Then    Transition to state diagram
          rough leak diagnosis extension /STATE_DMTL = 3H
          Endif

```

```


Else    If      T_ACT_LEAK_MES > T_ACT_ROUGH_LEAK      AND
          CUR_DMTL_ROUGH_LEAK_END < CUR_DMTL_THD_ROUGH_LEAK
          Then    Transition to state diagram
          rough leak detected /STATE_DMTL = AH
          Endif
Endif

```

```

If      T_ACT_LEAK_MES > C_T_REF_TEST_ROUGH_LEAK      AND

```

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```

CUR_DMTL_ROUGH_LEAK_END >= CUR_DMTL_THD_ROUGH_LEAK
Then      Transition to state diagram
          end of rough leak diagnosis /STATE_DMTL = 4H

```

**Endif**

### State diagram - rough leak diagnosis extension

**STATE\_DMTL = 3H:**

```

Initialization:  LV_ROUGH_LEAK_MES_LEN = 1
                 LV_DMTLS_ON = 1
                 CUR_DMTL_THD_ROUGH_LEAK_LEN = CUR_DMTL_REF_LEAK -
                                                  CUR_DMTL_DIF_REF_ROUGH_LEAK

```

\*

```

IP_FAC_CUR_DMTL_REF
CUR_DMTL_ROUGH_LEAK_LEN_END = CUR_DMTL_COR_FIL

```

Calculations and conditions for setting:

```

T_ACT_LEAK_MES = T_ACT_LEAK_MES + T
CUR_DMTL_ROUGH_LEAK_LEN_END = CUR_DMTL_COR_FIL
If      CUR_DMTL_COR_FIL < CUR_DMTL_ROUGH_LEAK_MIN
Then    CUR_DMTL_ROUGH_LEAK_MIN =
        CUR_DMTL_ROUGH_LEAK_MIN_EOL = CUR_DMTL_COR_FIL
        CUR_DMTL_DIF_REF_ROUGH_LEAK = CUR_DMTL_REF_LEAK -
                                        CUR_DMTL_ROUGH_LEAK_MIN

        CUR_DMTL_THD_ROUGH_LEAK_LEN = CUR_DMTL_REF_LEAK -
                                        IP_FAC_CUR_DMTL_REF *
                                        CUR_DMTL_DIF_REF_ROUGH_LEAK

```

**Endif**

Checks:

```

If      CUR_DMTL_ROUGH_LEAK_LEN_END >= CUR_DMTL_THD_ROUGH_LEAK_LEN
Then    Transition to state diagram
        end of rough leak diagnosis /STATE_DMTL = 4H
Else if T_ACT_LEAK_MES > T_ACT_SMALL_LEAK
Then    LV_REF_LEAK_ROUGH_LEAK_SUSP = 1
        Transition to state diagram
        2. reference leak diagnosis /STATE_DMTL = 7H

```

**Endif**

**Endif**

### State diagram - rough leak diagnosis end

**STATE\_DMTL = 4H:**

```

Initialization:  LV_ROUGH_LEAK_SUSP           = 0
                 LV_CYC_ROUGH_LEAK_SUSP      = 1
If      LV_ENA_SMALL_LEAK_MES = 0             no miniature leak check
Then    LV_CUR_DMTL_DMTLS_TEST = 0           no plausibility error DMTL
        LV_CUR_DMTL_REF_MES_MIN = 0         no minimum error, DMTL
module
        LV_CUR_DMTL_REF_MES_MAX = 0         no maximum error, DMTL
module
        LV_CHK_DMTL_CUR_DMTL_VLD = 1       Module diagn. concluded
        Transition to state diagram end /STATE_DMTL = CH

```

**Else** LV\_ROUGH\_LEAK\_MES\_LEN = 0  
 Transition to state diagram  
 miniature leak diagnosis /STATE\_DMTL = 5H

**Endif**

**State diagram - miniature leak diagnosis STATE\_DMTL = 5H:**

Initialization: T\_ACT\_CUR\_DMTL\_STAT = 0  
 CUR\_DMTL\_DIF = 0  
 CUR\_DMTL\_COMP\_ROUGH\_LEAK = CUR\_DMTL\_COR\_FIL  
 LV\_CYC\_ROUGH\_LEAK\_SUSP = 0  
 LV\_DMTLS\_ON = 1

Calculations and conditions for setting:  
 T\_ACT\_CUR\_DMTL\_STAT = T\_ACT\_CUR\_DMTL\_STAT + T  
 CUR\_DMTL\_DIF = |CUR\_DMTL\_COR\_FIL -  
 CUR\_DMTL\_COMP\_ROUGH\_LEAK|  
 T\_ACT\_LEAK\_MES = T\_ACT\_LEAK\_MES + T

Checks:

**If** CUR\_CMTL\_COR\_FIL > CUR\_DMTL\_REF\_LEAK  
**Then** CUR\_DMTL\_SMALL\_LEAK\_END = CUR\_DMTL\_COR\_FIL  
 LV\_CUR\_DMTL\_DMTLS\_TEST = 0 no plausibility error, DMTL  
 LV\_CUR\_DMTL\_REF\_MES\_MIN = 0 no minimum error, DMTL  
 LV\_CUR\_DMTL\_REF\_MES\_MAX = 0 no maximum error DMTL  
 LV\_CHK\_DMTL\_CUR\_DMTL\_VLD = 1 module diagn. concluded  
 Transition to state diagram tank is tight /STATE\_DMTL = 8H

**Endif**

**If** CUR\_DMTL\_DIF >= C\_CUR\_DMTL\_DIF\_CUR\_DMTL\_STAT  
**Then** Transition to state diagram  
 miniature leak diagnosis /STATE\_DMTL = 5H

**Endif**

**If** T\_ACT\_CUR\_DMTL\_STAT > T\_CUR\_DMTL\_STAT **AND**  
 T\_ACT\_LEAK\_MES > T\_ACT\_SMALL\_LEAK  
**Then** CUR\_DMTL\_COMP\_ROUGH\_LEAK = CUR\_DMTL\_COR\_FIL  
 Transition to state diagram  
 miniature leak diagnosis extension /STATE\_DMTL = 6H

**Endif**

**State diagram - miniature leak diagnosis extension STATE\_DMTL = 6H:**

Initialization: CUR\_DMTL\_DIF = 0  
 T\_ACT\_CUR\_DMTL\_STAT = 0  
 CUR\_DMTL\_COMP\_SMALL\_LEAK\_LEN = CUR\_DMTL\_COR\_FIL  
 LV\_SMALL\_LEAK\_MES\_LEN = 1

Calculations and conditions for setting:  
 T\_ACT\_CUR\_DMTL\_STAT = T\_ACT\_CUR\_DMTL\_STAT + T  
 T\_ACT\_LEAK\_MES = T\_ACT\_LEAK\_MES + T  
 CUR\_DMTL\_DIF = |CUR\_DMTL\_COR\_FIL -  
 CUR\_DMTL\_COMP\_SMALL\_LEAK\_LEN|



## Checks:

```

If      CUR_DMTL_DIF > C_CUR_DMTL_DIF_CUR_DMTL_STAT
Then    LV_SMALL_LEAK_MES_LEN = 0
           Transition to state diagram
           miniature leak diagnosis /STATE_DMTL = 5H

Endif

If      T_ACT_CUR_DMTL_STAT > T_CUR_DMTL_STAT *
           C_FAC_T_CUR_DMTL_STAT_LEN
Then    LV_SMALL_LEAK_MES_LEN = 0
           CUR_DMTL_ROUGH_LEAK_END = CUR_DMTL_COR_FIL
           Transition to state diagram
           2. reference leak measurement /STATE_DMTL = 7H

Endif

```

**State diagram - 2. reference leak measurement STATE\_DMTL = 7H:**

```

Initialization:  T_ACT_REF_LEAK_MES           = 0
                 CUR_DMTL_REF_LEAK           = 0
                 LV_DMTLS_ON                 = 0
                 LV_CHK_DMTL_CUR_DMTL_VLD    = 0

```

## Calculations and conditions for setting:

```

T_ACT_REF_LEAK_MES = T_ACT_REF_LEAK_MES + T
CUR_DMTL_REF_LEAK = CUR_DMTL_REF_LEAK_EOL =
DMTL_COR_FIL + C_CUR_DMTL_REF_OFS
CUR_DMTL_ROUGH_LEAK_MIN = CUR_DMTL_REF_LEAK -
DMTL_DIF_REF_ROUGH_LEAK

```

```

CUR_DMTL_THD_ROUGH_LEAK = CUR_DMTL_ROUGH_LEAK_MIN +
CUR_DMTL_DIF_REF_ROUGH_LEAK *
IP_FAC_CUR_DMTL_ROUGH

```

```

CUR_DMTL_THD_ROUGH_LEAK_LEN = CUR_DMTL_REF_LEAK -
CUR_DMTL_DIF_REF_ROUGH_LEAK *
IP_FAC_CUR_DMTL_REF

```

Checks:

```

If      T_ACT_REF_LEAK_MES > C_T_REF_LEAK_MES_MAX           max. time
           for reference leakage measurement elapsed

```

```

Then    M6_CUR_DMTL_COR_FIL_CID18_SAVE = CUR_DMTL_COR_FIL
           M6_CUR_DMTL_COR_FIL_CID19_SAVE = CUR_DMTL_COR_FIL

```


**Endif**

```

If      T_ACT_REF_LEAK_MES > C_T_REF_LEAK_MES_REP_MAX           AND
           CUR_DMTL_REF_LEAK > C_CUR_DMTL_REF_LEAK_MAX
Then    LV_CUR_DMTL_DMTLS_TEST           = 0           no plausibility error,

```

DMTL

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```

        LV_CUR_DMTL_REF_MES_MIN      = 0      no minimum error, DMTL
module
        LV_CUR_DMTL_REF_MES_MAX      = 1      maximum error, DMTL mod-
ule
        LV_CHK_DMTL_CUR_DMTL_VLD     = 1      module diagn. concluded
        Transition to the state diagram
        module error DMTL_ERR /STATE_DMTL = BH
Endif

If      T_ACT_REF_LEAK_MES > C_T_REF_LEAK_MES_REP_MAX      AND
        CUR_DMTL_REF_LEAK < C_CUR_DMTL_REF_LEAK_MIN
Then    LV_CUR_DMTL_DMTLS_TEST      = 0      no plausibility error,
DMTL
        LV_CUR_DMTL_REF_MES_MIN      = 1      minimum error, DMTL mod-
ule
        LV_CUR_DMTL_REF_MES_MAX      = 0      no maximum error, DMTL
module
        LV_CHK_DMTL_CUR_DMTL_VLD     = 1      module diagn. concluded
        Transition to the state diagram
        module error DMTL_ERR /STATE_DMTL = BH
Endif

If      [T_ACT_REF_LEAK_MES > C_T_REF_LEAK_MES_REP_MAX      AND
        CUR_DMTL_ROUGH_LEAK_LEN_END <
        CUR_DMTL_THD_ROUGH_LEAK_LEN      AND
        LV_ROUGH_LEAK_MES_LEN = 1]
OR
        [T_ACT_REF_LEAK_MES > C_T_REF_LEAK_MES_REP_MAX      AND
        CUR_DMTL_ROUGH_LEAK_END < CUR_DMTL_THD_ROUGH_LEAK AND
        LV_ROUGH_LEAK_MES_LEN = 0]
Then    LV_CUR_DMTL_DMTLS_TEST      = 0      no plausibility error,
DMTL
        LV_CUR_DMTL_REF_MES_MIN      = 0      no minimum error, DMTL
module
        LV_CUR_DMTL_REF_MES_MAX      = 0      no maximum error, DMTL
module
        LV_CHK_DMTL_CUR_DMTL_VLD     = 1      module diagn. concluded
        Transition to state diagram rough leak detected /STATE_DMTL = AH
Endif

If      T_ACT_REF_LEAK_MES > C_T_REF_LEAK_MES_REP_MAX      AND
        CUR_DMTL_ROUGH_LEAK_END >= CUR_DMTL_THD_ROUGH_LEAK AND
        LV_REF_LEAK_ROUGH_LEAK_SUSP = 1
Then    LV_REF_LEAK_ROUGH_LEAK_SUSP      = 0
        T_ACT_LEAK_MES      = 0
        Transition to state diagram
        end of rough leak diagnosis /STATE_DMTL = 4H
Endif

If      T_ACT_REF_LEAK_MES > C_T_REF_LEAK_MES_REP_MAX      AND
        CUR_DMTL_COMP_ROUGH_LEAK <= CUR_DMTL_REF_LEAK      AND
        LV_REF_LEAK_ROUGH_LEAK_SUSP = 0
Then    CUR_DMTL_SMALL_LEAK_END = CUR_DMTL_COMP_ROUGH_LEAK
        LV_CUR_DMTL_DMTLS_TEST      = 0      no plausibility error, DMTL

```

```

module          LV_CUR_DMTL_REF_MES_MIN      = 0      no minimum error, DMTL
module          LV_CUR_DMTL_REF_MES_MAX      = 0      no maximum error, DMTL
                LV_CHK_DMTL_CUR_DMTL_VLD     = 1      module diagn. concluded
                Transition to state diagram
                miniature leak detected /STATE_DMTL = 9H
Endif

If      T_ACT_REF_LEAK_MES > C_T_REF_LEAK_MES_REP_MAX      AND
CUR_DMTL_COMP_ROUGH_LEAK > CUR_DMTL_REF_LEAK      AND
LV_REF_LEAK_ROUGH_LEAK_SUSP = 0
Then    CUR_DMTL_SMALL_LEAK_END = CUR_DMTL_COMP_ROUGH_LEAK
LV_CUR_DMTL_DMTLS_TEST      = 0      no plausibility error, DMTL
LV_CUR_DMTL_REF_MES_MIN     = 0      no minimum error, DMTL
module          LV_CUR_DMTL_REF_MES_MAX      = 0      no maximum error, DMTL
module          LV_CHK_DMTL_CUR_DMTL_VLD     = 1      module diagn. concluded
                Transition to state diagram tank is tight /STATE_DMTL = 8H
Endif

```

**State diagram - tank is tight STATE\_DMTL = 8H:**

```

LV_ERR_DET_SMALL_LEAK_MIN      = 0      no miniature leak detected
LV_CYC_SMALL_LEAK_MODE6        = 1      miniature leak diagnosis finished
Transition to state diagram end /STATE_DMTL = CH

```

**State diagram - miniature leak detected STATE\_DMTL = 9H:**

```

LV_ERR_DET_SMALL_LEAK_MIN      = 1      miniature leak detected
LV_CYC_SMALL_LEAK_MODE6        = 1
ERR_SYM_SMALL_LEAK = MIN
Transition to state diagram end /STATE_DMTL = CH

```

**State diagram - rough leak detected STATE\_DMTL = AH:**

```

LV_ROUGH_LEAK_SUSP             = 1      Rough leak suspected
LV_CYC_ROUGH_LEAK_SUSP         = 1      Rough leak diagnosis finished
Transition to state diagram end /STATE_DMTL = CH

```

**State diagram - module error DMTL\_ERR STATE\_DMTL = BH:**

```

Transition to state diagram end /STATE_DMTL = CH

```

**State diagram - end STATE\_DMTL = CH:**

```

LV_DMTL_PUMP_ON                = 0      Pump OFF
LV_DMTLS_ON                    = 0      valve OFF

```

LV\_DMTL\_ACT = 0 Diagnosis finished

## B.93.2 Pump current of DMTL module

### General information:

The most important analog input of the "tank leakage diagnostic function" represents the pump current of the DMTL module. The current to be evaluated is recorded and calculated by voltage measurement at the corresponding shunts. Subsequently, the calculated current is corrected and filtered before it is included in calculation of the function as an input variable.

### B.93.2.1 Pump current DMTL

#### General information:

The current of the pump motor by means of which an excess pressure is built up in the tank system serves as measure for the detection of a leakage in the tank system.

To detect the equivalent current from the measured voltage V\_DMTL which is generated in the control unit using the measurement shunt, this requirement is taken into consideration via the calibratable constant C\_R\_DMTL.

The module is calculated with a time base of 10 ms.

#### Application conditions

**Initialisation:**  $CUR\_DMTL = 0$   
**Recurrence:**  $100\ ms$   
**Activation:**  $LV\_CONF\_DMTL = 1$

#### Formula section:

$CUR\_DMTL = V\_DMTL / C\_R\_DMTL$

### B.93.2.2 Filtering of pump current


#### General information:

The pump current is filtered after conversion to the referenced battery voltage. At the beginning and at the end of the reference measurement, a greater time constant is used to ensure a short filter settling time.

A correction factor for the pump current is taken as a function of the calculated value VB\_DMTL\_FIL via a characteristic IP\_FAC\_CUR\_DMTL. Thus, the pump current CUR\_DMTL is corrected depending on the battery voltage, and results in relation to CUR\_DMTL\_COR.

#### Application conditions

**Initialisation:**  $CUR\_DMTL\_COR = 0$   
 $CUR\_DMTL\_COR\_FIL = 0$   
**Recurrence:**  $100\ ms$   
**Activation:**  $LV\_CONF\_DMTL = 1$

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**Formula section:**

```

If                LV_DMTL_ACT = 0  1
    Then           T_DLY_VB_DMTL_FIL = C_T_DLY_DMTLS
Endif
If                LV_DMTL_ACT = 1 AND T_DLY_VB_DMTL > 0
    Then           VB_DMTL_FIL(n) =          VB_DMTL_FIL(n-1) +
                    (VB(n) - VB_DMTL_FIL(n-1)) * C_CRCLC_VB_DMTL_FIL_LIM
                    T_DLY_VB_DMTL = T_DLY_VB_DMTL - 100 ms
Endif

If                LV_DMTL_ACT = 1 AND T_DLY_VB_DMTL = 0
    Then           VB_DMTL_FIL(n) =          VB_DMTL_FIL(n-1) +
                    (VB(n) - VB_DMTL_FIL(n-1)) * C_CRCLC_VB_DMTL_FIL
Endif

If                STATE_DMTL = 1H  2H          OR
                    STATE_DMTL = 7H  4H
    Then           VB_DMTL_REF = VB_DMTL_FIL
    Else           VB_DMTL_REF = VB_DMTL_REF
Endif

If                [STATE_DMTL = 2H          OR
                    STATE_DMTL = 3H          OR
                    STATE_DMTL = 5H          OR
                    STATE_DMTL = 6H] AND
    [If            LV_ENA_CHK_FUC_ROUGH_LEAK = 0
    Then           |VB_DMTL_REF - VB_DMTL_FIL| > C_VB_DMTL_DIF
    Else           |VB_DMTL_REF - VB_DMTL_FIL| > C_VB_DMTL_DIF_CHK_FUC
    Endif]
    Then           LV_VB_DIF_MAX = 1
    Else           LV_VB_DIF_MAX = 0
Endif

If                LV_DMTL_ACT = 0  1
    Then           LV_VB_DIF_MAX = 0
Endif

```


**B.93.3 Interruption of function due to current fluctuations****General information:**

The function block monitors the filtered and corrected pump current for excessively high current fluctuations during the reference leakage measurement. If this case is detected, the tank leakage diagnosis is aborted. The interruption is cumulated in a counter.

**Application conditions**

**Initialisation:** *LV\_CUR\_DMTL\_REF\_DIF\_MAX is restored out of NVMY  
CTR\_CUR\_DMTL\_REF\_DIF\_MAX is restored out of NVMY*

**Recurrence:** *100 ms*

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**Activation:**  $LV\_DMTL\_ACT = 1$

**Formula section:**

```

If          STATE_DMTL = 0H 1H      OR
              STATE_DMTL = 3H 7H      OR
              STATE_DMTL = 6H 7H
Then       T_DLY_CUR_DMTL_REF_DIF = C_T_DLY_DMTLS
Endif

```

```

If          [STATE_DMTL = 1H      OR
              STATE_DMTL = 7H]      AND
              T_DLY_CUR_DMTL_REF_DIF > 0
Then       CUR_DMTL_COR_FIL_MAX = CUR_DMTL_COR_FIL
              CUR_DMTL_COR_FIL_MIN = CUR_DMTL_COR_FIL
              T_DLY_CUR_DMTL_REF_DIF = T_DLY_CUR_DMTL_REF_DIF - 100 ms
Endif

```

```

If          [STATE_DMTL = 1H      OR
              STATE_DMTL = 7H]      AND
Then       T_DLY_CUR_DMTL_REF_DIF = 0
              CUR_DMTL_REF_DIF_MAX =
              MAX(CUR_DMTL_COR_FIL. CUR_DMTL_COR_FIL_MAX) -
              MIN(CUR_DMTL_COR_FIL. CUR_DMTL_COR_FIL_MIN)
Endif

```

```

If          CUR_DMTL_REF_DIF_MAX > C_CUR_DMTL_REF_DIF_MAX
Then       LV_CUR_DMTL_REF_DIF_MAX = 1
Else       LV_CUR_DMTL_REF_DIF_MAX = 0
Endif

```

```

If          LV_DMTL_ACT = 0 1
Then       LV_CUR_DMTL_REF_DIF_MAX = 0
Endif

```

```

If          LV_CUR_DMTL_REF_DIF_MAX = 0 1      OR
              LV_CUR_DMTL_THD_DIF_MES = 0 1
Then       CTR_CUR_DMTL_REF_DIF_MAX = CTR_CUR_DMTL_REF_DIF_MAX + 1
Else       CTR_CUR_DMTL_REF_DIF_MAX = CTR_CUR_DMTL_REF_DIF_MAX
Endif

```

## B.93.4 Function enabling

### Application conditions

**Recurrence:**  $100\ ms$

**Activation:**  $LV\_CONF\_DMTL = 1$

### General information:

The enabling of the tank leakage diagnostic function is to be represented here in terms of an overview. The individual bits comprised are explained subsequently in the following chapters. Some remarkable points are to be mentioned in this context.

### Formula section:

```

If          ECU_STATE != PWL      ECU_STATE = PWL
  Then      T_DLY_ES_PWL = C_T_DLY_ES_PWL
Endif

```

```

If          ECU_STATE = PWL      AND
  T_DLY_ES_PWL > 0
  Then      T_DLY_ES_PWL = T_DLY_ES_PWL - 100 ms
  LV_T_DLY_DMTL_PWL = 0
  Else     LV_T_DLY_DMTL_PWL = 1
Endif

```

```

If          LV_REQ_PWL_ROUGH_LEAK = 1      OR
  LV_REQ_PWL_SMALL_LEAK = 1
  Then      LV_REQ_PWL_DMTL = 1
  T_DLY_REQ_PWL_DMTL = 0
Endif

```

```

If          LV_REQ_PWL_DMTL = 1      AND
  LV_REQ_PWL_ROUGH_LEAK = 0      AND
  LV_REQ_PWL_SMALL_LEAK = 0
  Then      T_DLY_REQ_PWL_DMTL = T_DLY_REQ_PWL_DMTL + 100 ms
  Else     T_DLY_REQ_PWL_DMTL = 0
Endif

```

```

If          T_DLY_REQ_PWL_DMTL > C_T_DLY_REQ_PWL_DMTL
  Then      LV_REQ_PWL_DMTL = 0
Endif

```

```

If          LV_ENA_SMALL_LEAK_MES = 1      OR
  LV_ENA_ROUGH_LEAK_MES_ONLY = 1
  Then      LV_ENA_ROUGH_LEAK_MES = 1
  Else     LV_ENA_ROUGH_LEAK_MES = 0
Endif

```


```

If          LV_NO_PURGE_DMTL_ROUGH_LEAK = 1      OR
  LV_NO_PURGE_DMTL_SMALL_LEAK = 1      OR
  LV_NO_PURGE_DR_DMTL = 1
  Then      LV_NO_PURGE_DMTL = 1
  Else     LV_NO_PURGE_DMTL = 0
Endif

```

### Signal flow diagram:

## B.93.5 Main switch-on conditions

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**Application conditions**

**Initialisation:**            *LV\_ENA\_MAIN\_DMTL = 0*  
                                  *LV\_ENA\_LEAK\_DMTL = 0*  
                                  *LV\_ENA\_MAIN\_DMTL\_FUC = 0*

**Recurrence:**             *100 ms*

**Activation:**              *LV\_CONF\_DMTL = 1*

**Formula section:**

```

If      CTR_DIAG_CFM_SMALL_LEAK = 0      OR
          CTR_DIAG_CFM_ROUGH_LEAK = 0      OR
          CTR_DIAG_CFM_DMTL_MAX = 0        OR
          CTR_DIAG_CFM_DMTL_MIN = 0        OR
          CTR_DIAG_CFM_DMTL_SIG = 0        OR
          CTR_DIAG_CFM_DMTL_PLAUS = 0

Then   LV_ENA_LEAK_DMTL = 0

Else   If      LV_ERR_EL_CPS = 0          AND
          LV_ERR_DIAGCPS = 0              AND
          LV_ERR_DMTLS = 0                AND
          LV_ERR_DMTL_PUMP = 0            AND
          LV_ERR_DMTLH = 0                AND
          LV_ERR_SPI_MPS = 0


          Then   LV_ENA_LEAK_DMTL = 1
          Else   LV_ENA_LEAK_DMTL = 0
          Endif

Endif

If      ECU_STATE = PWL                  AND
          [AMP_MES > C_AMP_DMTL_MAX]      AND
ERR_AMP = 0                               AND
          LV_ERR_AMP_PLAUS = 0]           AND
          [LV_ERR_TAM = 0                 AND
          C_TAM_DMTL_MIN < TAM <= C_TAM_DMTL_MAX] AND
          [TCO_ST >= C_TCO_ST_DMTL_MIN    OR
          LV_TCO_ST_LIH = 1 in case of determination TCO_ST] AND
          CL_MMV_NORM_PURGE_END < C_CL_DMTL_MAX AND
          [[LV_FTL_DMTL_MIN = 0           AND
          LV_FTL_DMTL_VAL = 1]           OR
          LV_ERR_FTL = 1]                OR
          LV_ERR_FTL_PLAUS = 1]          AND
          LV_DMTL_ASA = 0                 AND
          [VS < C_VS_DMTL_MAX             OR
          LV_ERR_VS = 1]                  AND
          STATE_EFP_CRASH_CAN 2          AND
          [C_VB_DMTL_MIN < VB <= C_VB_DMTL_MAX OR
          C_VB_DMTL_MIN >= VB > C_VB_DMTL_MAX for maximum] AND
          C_T_VB_DLY_DMTL]               AND
          LV_ENA_LEAK_DMTL = 1

Then   LV_ENA_MAIN_DMTL_FUC = 1
Else   LV_ENA_MAIN_DMTL_FUC = 0
Endif

```

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```

If          [[LV_FTL_DMTL_MAX = 0          AND
               LV_FTL_DMTL_VAL = 1]
               LV_ERR_FTL = 1                OR
               LV_ERR_FTL_PLAUS = 1]         OR
               T_AST >= C_T_AST_DMTL_MAX    AND
               LV_ENA_MAIN_DMTL_FUC = 1     AND
Then        LV_ENA_MAIN_DMTL = 1
Else        LV_ENA_MAIN_DMTL = 0
Endif

```

## B.93.6 Tank level sensor

### General information:

The function enabling of the tank leakage diagnostic function depends, amongst other things, on the tank being filled to between 15 % and 85 % of its capacity. The tank level information is transferred to the control unit via CAN in the INSTR2 message. If a level error is transmitted by CAN or if the CAN message is not issued, then the bit is set for a validated tank level LV\_FTL\_DMTL\_VAL = 0.

### Application conditions

**Initialisation:**

```

LV_FTL_DMTL_VAL = 0
LV_FTL_DMTL_MAX = 0
LV_FTL_DMTL_MIN = 0

```

**Recurrence:** 1 s

**Activation:** LV\_IGK = 1

### Formula section:

```

If          LV_IGK = 0 1
Then        T_DLY_IGK_FTL = C_T_DLY_IGK_FTL
               LV_FTL_DMTL_VAL = 0
Endif

```

```

If          LV_IGK = 1          AND
               T_DLY_IGK_FTL > 0
Then        T_DLY_IGK_FTL = T_DLY_IGK_FTL - 1 s
Endif

```

```

If          LV_ERR_FTL = 0      AND
               T_DLY_IGK_FTL = 0
Then        LV_FTL_DMTL_VAL = 1
Else        LV_FTL_DMTL_VAL = 0
Endif

```

```

If          LV_ERR_FTL = 0
Then        LV_FTL_DMTL_MAX = LV_FTL_DMTL_MAX
               LV_FTL_DMTL_MIN = LV_FTL_DMTL_MIN
Else        LV_FTL_DMTL_MAX = 0
               LV_FTL_DMTL_MIN = 0

```

**Endif**

```

If          FTL > C_FTL_DMTL_MAX + C_HYS_FTL_DMTL
  Then      LV_FTL_DMTL_MAX = 1

```

**Endif**

```

If          FTL < C_FTL_DMTL_MAX - C_HYS_FTL_DMTL
  Then      LV_FTL_DMTL_MAX = 0

```

**Endif**

```

If          FTL < C_FTL_DMTL_MIN + C_HYS_FTL_DMTL
  Then      LV_FTL_DMTL_MIN = 1

```

**Endif**

```

If          FTL > C_FTL_DMTL_MIN - C_HYS_FTL_DMTL
  Then      LV_FTL_DMTL_MIN = 0

```

**Endif****B.93.7 Tank level plausibility check**

For the tank diagnostic function, it is necessary to detect a refueling process, to obtain certain tank level bits and to perform a plausibility check of the tank level signal.

**B.93.7.1 Initialization of diagnostic quantities****Application conditions**

**Initialisation:** *FCO\_AV\_DMTL is restored out of NVMY*  
*FCO\_DMTL\_INI = 0 - FCO\_AV\_DMTL*

**Recurrence:** *1 s*


**Activation:** *LV\_IGK = 1*

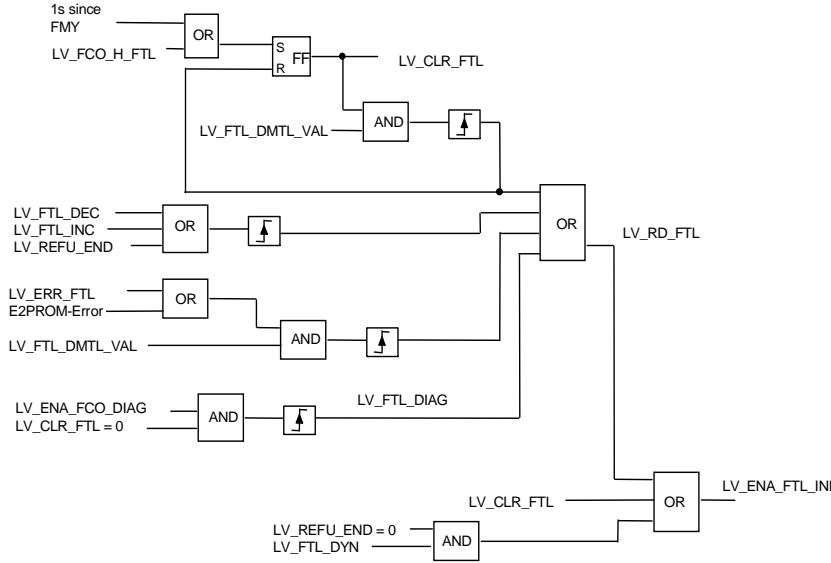
**Deactivation:** *LV\_IGK = 1 ( 0*

**General information:**

To perform a plausibility check of the level signal, a fuel consumption resulting from the difference between two fuel level values is compared with the fuel consumption resulting from the injection calculation.

**Signal flow diagram:**

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In case of the initial initialization or an EEPROM error, FCO\_AV\_DMTL = FCO\_DMTL\_INI = FTL\_INI = 0 is set.

In case the failure memory is deleted, FTL\_INI = 0.

**Formula section:**

**If** FCO\_AV\_DMTL > C\_FTL\_DIAG\_MAX  
**Then** LV\_FCO\_H\_FTL = 1  
**Endif**

**If** FMY is cleared **OR**  
 LV\_FCO\_H\_FTL = 1  
**Then** LV\_CLR\_FTL = 1  
**Endif**


**If** LV\_CLR\_FTL = 1<sub>(n-1)</sub> **AND**  
 LV\_FTL\_DMTL\_VAL = 1  
**Then** LV\_RD\_FTL\_1 = 1  
 LV\_CLR\_FTL = 0<sub>(n)</sub>  
**Endif**

**If** LV\_FTL\_DEC = 1 **OR**  
 LV\_FTL\_INC = 1 **OR**  
 LV\_REFU\_END = 1  
**Then** LV\_RD\_FTL\_2 = 1  
**Endif**

**If** LV\_ERR\_FTL = 1 **AND**  
 LV\_FTL\_DMTL\_VAL = 1  
**Then** LV\_RD\_FTL\_3 = 1  
**Endif**

**If** LV\_ENA\_FCO\_DIAG = 1 **AND**  
 LV\_CLR\_FTL = 0  
**Then** LV\_RD\_FTL\_4 = 1  
 LV\_FTL\_DIAG = 1

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**Endif**

```

If          LV_RD_FTL_1 = 0 1          OR
              LV_RD_FTL_2 = 0 1          OR
              LV_RD_FTL_3 = 0 1          OR
              LV_RD_FTL_4 = 0 1(n-1)    OR
              LV_CLR_FTL = 1             OR
              [LV_REFU_END = 0           AND
              LV_FTL_DYN = 1]
Then          LV_ENA_FTL_INI = 1

```

**Endif**

```

If          LV_ENA_FTL_INI = 1
Then          FTL_INI = FTL
              FCO_AV_DMTL = 0
              FCO_DMTL_INI = FCO_DMTL
Else         FTL_INI = FTL_INI
              FCO_AV_DMTL = FCO_DMTL - FCO_DMTL_INI

```

**Endif****B.93.7.2 Refueling detection case of ignition key ON and level reading****Application conditions**

**Recurrence:** 1 s

**Activation:** LV\_IGK = 1

**Initialization:** DIF\_FTL\_VST = 0 in case of LV\_IGK off to on  
on ERU to PWL:  
LV\_REFU\_RLS\_DIAG = 0 (and falling edge as well)

**Formula section:**

```

If          VS < C_VS_FTL_DIAG_MAX    UND    LV_FTL_DMTL_VAL = 1
              for a period longer than C_T_DLY_STOP_REFU
Then          LV_REFU_RLS_DIAG = 1

```

**Endif**

```

If          LV_FTL_DMTL_VAL = 0          OR
              LV_ERR_VS = 1                OR
              VS >= C_VS_FTL_DIAG_MAX
Then          LV_REFU_RLS_DIAG = 0

```

**Endif**

```

If          LV_REFU_RLS_DIAG = 0        AND    LV_FTL_DYN = 1
Then          LV_REFU_END = 1
Else         LV_REFU_END = 0


```

**Endif**

```

If          LV_ERR_VS = 1                OR
              LV_ENA_FTL_DIAG = 0
Then          FTL_AV = FTL_VST_IN = DIF_FTL_VST = 0

```

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**Endif**

```

If          LV_REFU_RLS_DIAG = 0  1
  Then      FTL_VST_IN = FTL
             FCO_VST = FCO_DMTL

```

**Endif**

```

If          LV_REFU_RLS_DIAG = 1
  Then      FTL_AV = FTL
             DIF_FTL_VST = FTL_AV - (FTL_VST_IN - (FCO_DMTL - FCO_VST))

```

**Endif**

Subsequently the following interrogations are processed:

```

If          LV_ERR_VS = 0                                AND
             LV_ENA_FTL_DIAG = 1                          AND
             DIF_FTL_VST > C_FTL_DIAG_MIN
  Then      LV_FTL_INC_IGK_ON = 1
  Else      LV_FTL_INC_IGK_ON = 0

```

**Endif**

```

If          LV_ERR_VS = 0                                AND
             LV_ENA_FTL_DIAG = 1                          AND
             DIF_FTL_VST < C_FTL_DEC_FTL_DIAG_MIN
  Then      LV_FTL_DEC_IGK_ON = 1
  Else      LV_FTL_DEC_IGK_ON = 0

```

**Endif**

```

If          LV_FTL_INC_IGK_ON = 1      OR              LV_FTL_DEC_IGK_ON =
1
  Then      LV_FTL_DYN = 1
  Else      LV_FTL_DYN = 0

```

**Endif**

In case of "delete failure memory", the following occurs:

```

LV_REFU_END = LV_FTL_DYN = FTL_VST_IN = FTL_AV = DIF_FTL_VST = LV_FTL_DEC_IGK_ON
= LV_FTL_INC_IGK_ON = LV_REFU_RLS_DIAG = 0

```

**B.93.7.3 Refueling detection after restart****Application conditions**


**Recurrence:** 1 s

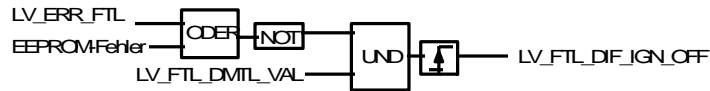
**Activation:** LV\_IGK = 1

**Function description:**

In the case of an EEPROM error or on initial initialization, this refueling detection must not be performed.

**Signal flow diagram:**

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### Formula section:

```

If          [LV_FTL_DMTL_VAL = 1 for minimum one second] AND
              [LV_ST_END = 1] OR
              [LV_CLR_FTL = 1] AND
              [LV_FTL_DIF_IGN_OFF = 1]
Then      FTL_OLD = FTL
Endif

```

```

If          LV_FTL_DIF_IGN_OFF = 1
Then      FTL_ST = FTL
              DIF_FTL_AST = FTL_ST - FTL_OLD
Endif

```

```

If          LV_FTL_DIF_IGN_OFF = 1
then      If          LV_ENA_FTL_DIAG = 1 AND
              DIF_FTL_AST > C_FTL_DIAG_MIN
Then      LV_FTL_INC = 1
Else      LV_FTL_INC = 0
Endif
If          LV_ENA_FTL_DIAG = 1 AND
              DIF_FTL_AST < C_FTL_DEC_FTL_DIAG_MIN
Then      LV_FTL_DEC = 1
Else      LV_FTL_DEC = 0
Endif
Endif

```

```

If          LV_REFU_RLS_DIAG = 0 → 1
Then      LV_FTL_DEC = 0
              LV_FTL_INC = 0
              DIF_FTL_AST = 0
Endif

```

In case of the initial initialization or an EEPROM error, FTL\_OLD = 0 is initialized.

In case of "delete failure memory", the following occurs:


LV\_FTL\_IN = FTL\_OLD = LV\_FTL\_DEC = LV\_FTL\_INC = FTL\_ST = DIF\_FTL\_AST = 0

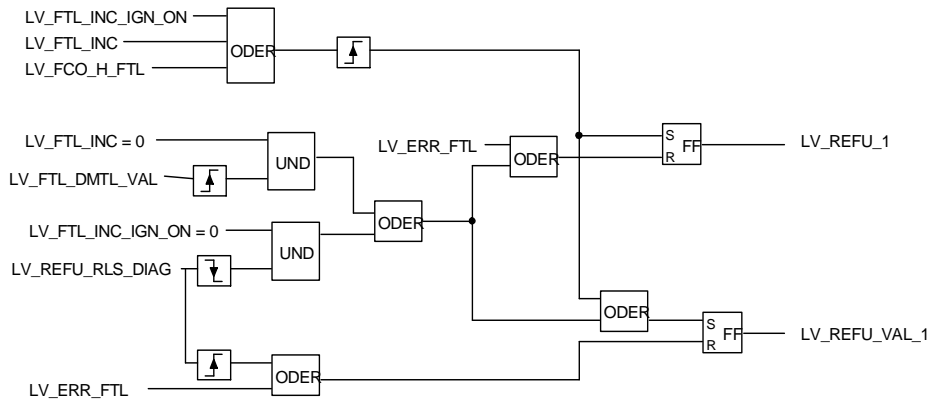
### B.93.7.4 Refueling flag output

#### Application conditions

**Recurrence:** 1 s

**Activation:** LV\_IGK = 1

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**Signal flow diagram:**

The output of the refueling bits LV\_REFU and LV\_REFU\_VAL depends on the level diagnosis enable state.

The following logic is derived therefrom:

```

If          LV_ENA_FTL_DIAG = 1      AND      LV_REFU_1 = 1
Then       LV_REFU = 1
Else       LV_REFU = 0
Endif

```

```

If          LV_ENA_FTL_DIAG = 1      AND      LV_REFU_VAL_1 = 1
Then       LV_REFU_VAL = 1
Else       LV_REFU_VAL = 0
Endif

```

If no diagnosis has been enabled LV\_ENA\_FTL\_DIAG = 0, then the refueling bits LV\_REFU = 0 and LV\_REFU\_VAL = 0 are issued.

In case of "delete failure memory", the following occurs:

LV\_REFU\_1 = LV\_REFU\_VAL\_1 = 0

In case of ERU to PWL:

LV\_REFU\_VAL\_1 = 0

In case of igkOff2on:

LV\_REFU\_VAL = 0

**B.93.7.5 Fuel level diagnosis****Application conditions**

**Recurrence:** 1 s

**Activation:** LV\_IGK = 1

**Formula section:**



Consumption diagnosis enable:

```

If          LV_FTL_DMTL_VAL = 1          AND
              [LV_FTL_DYN = 0          OR
              LV_REFU_END = 1]          AND
              FCO_AV_DMTL > C_ENA_FCO_DIAG          AND
              LV_ENA_FTL_DIAG = 1
Then       LV_ENA_FCO_DIAG = 1
Else       LV_ENA_FCO_DIAG = 0
Endif

```

Upper and lower threshold of the consumption diagnosis:

```

If          LV_FTL_DIAG = 1          AND          LV_ENA_FTL_DIAG = 1
Then       If          DIF_FCO_FTL = FCO_AV_DMTL - (FTL_INI - FTL) > C_FCO_DIAG_MAX
              Then       LV_FCO_DIAG_MAX = 1
              Else       LV_FCO_DIAG_MAX = 0
              Endif
              If          DIF_FCO_FTL = FCO_AV_DMTL - (FTL_INI - FTL) < C_FCO_DIAG_MIN
              Then       LV_FCO_DIAG_MIN = 1
              Else       LV_FCO_DIAG_MIN = 0
Else       LV_FCO_DIAG_MAX = 0          AND          LV_FCO_DIAG_MIN = 0
Endif

```

In case of "delete failure memory", the following occurs:

LV\_FCO\_DIAG\_MAX = LV\_FCO\_DIAG\_MIN = LV\_ENA\_FCO\_DIAG = DIF\_FCO\_FTL = 0

### B.93.7.6 Fuel level diagnosis enable

#### Application conditions

**Recurrence:** 1 s  
**Activation:** LV\_IGK = 1

#### Formula section:

```

If          LV_CONF_DMTL = 1
Then       LV_ENA_FTL_DIAG = 1
Else       LV_ENA_FTL_DIAG = 0
Endif

```

### B.93.7.7 Tank level error

#### Application conditions

**Initialisation:** restored out of FMY  
**Recurrence:** 1 s  
**Activation:** LV\_IGK = 1

**Formula section:**

```

If          LV_FTL_CAN_ERR = 1          OR
              LV_ERR_TOUT_ICL_2 = 1      OR
              LV_ERR_BN_KM_ICL = 1
Then       LV_ERR_FTL = 1
Else       LV_ERR_FTL = 0
Endif

If          LV_FTL_DIAG = 1
Then       If          [LV_FCO_DIAG_MAX = 1          OR
                        LV_FCO_DIAG_MIN = 1]          AND
                        LV_ERR_TOUT_ICL_2 = 0          AND
                        LV_ERR_BN_KM_ICL = 0
Then       LV_ERR_FTL_PLAUS = 1
Else       LV_ERR_FTL_PLAUS = 0
Endif
Endif

```

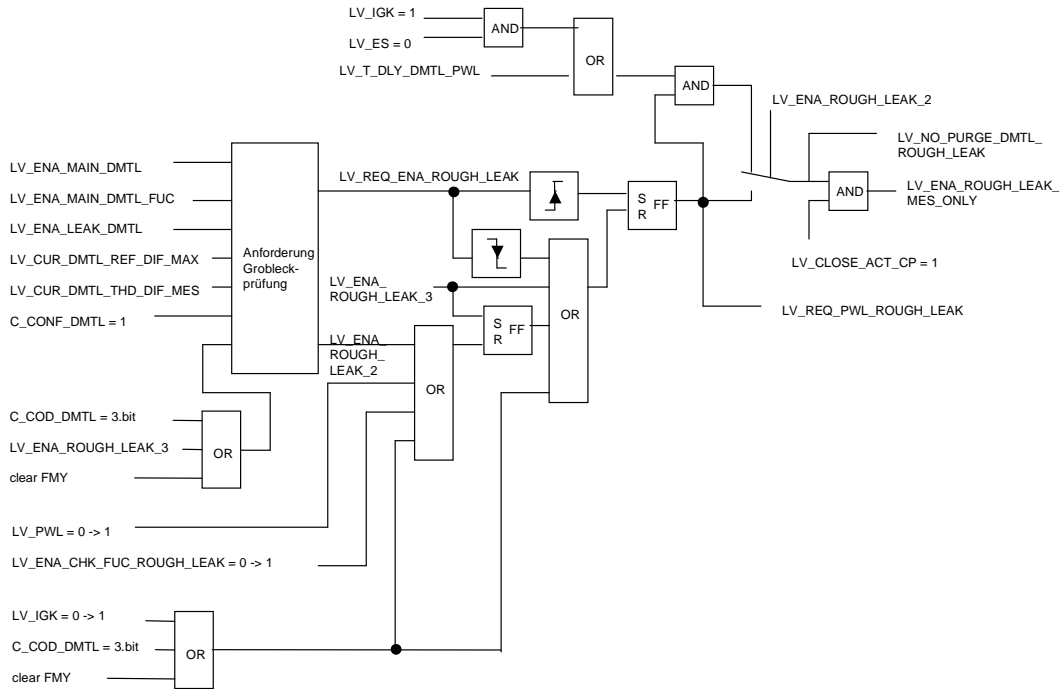
**B.93.8 Enabling the rough leak check****Application conditions**

**Initialisation:**            *at ERU to PWL:*  
                                  LV\_REQ\_PWL\_ROUGH\_LEAK = 0  
                                  LV\_INH\_ROUGH\_LEAK\_MES = 0

**Recurrence:**                *100 ms*

**Activation:**                *LV\_CONF\_DMTL = 1*

**Signal flow diagram:**



**Formula section:**


**If**                    LV\_REQ\_ENA\_ROUGH\_LEAK = 0 1  
                   **Then**                    LV\_REQ\_PWL\_ROUGH\_LEAK = 1  
**Endif**

**If**                    LV\_REQ\_ENA\_ROUGH\_LEAK = 1 0                    **OR**  
                   LV\_ENA\_ROUGH\_LEAK\_3 = 1                    **OR**  
                   LV\_INH\_ROUGH\_LEAK\_MES = 1                    **OR**  
                   LV\_IGK = 0 1                    **OR**  
                   C\_COD\_DMTL = 3.bit                    **OR**  
                   clear FMY  
                   **Then**                    LV\_REQ\_PWL\_ROUGH\_LEAK = 0  
**Endif**

**If**                    LV\_ENA\_ROUGH\_LEAK\_3 = 1  
                   **Then**                    LV\_INH\_ROUGH\_LEAK\_MES= 1  
**Endif**

**If**                    LV\_ENA\_ROUGH\_LEAK\_2 = 1                    **OR**  
                   LV\_IGK = 0 1                    **OR**  
                   C\_COD\_DMTL = 3.bit                    **OR**  
                   clear FMY                    **OR**  
                   ECU\_STATE != PWL    ECU\_STATE = PWL                    **OR**  
                   LV\_ENA\_CHK\_FUC\_ROUGH\_LEAK = 0 1                    **OR**  
                   **Then**                    LV\_INH\_ROUGH\_LEAK\_MES= 0  
**Endif**

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```

If          [LV_REQ_PWL_ROUGH_LEAK = 1          AND
              LV_ENA_ROUGH_LEAK_2 = 1]          OR
              [LV_REQ_PWL_ROUGH_LEAK = 1          AND
              [LV_T_DLY_DMTL_PWL = 1          OR
              [LV_IGK = 1          AND
              LV_ES = 0]]          AND
              LV_ENA_ROUGH_LEAK_2 = 0]
Then          LV_NO_PURGE_DMTL_ROUGH_LEAK = 1
Endif

```

```

If          LV_CLOSE_ACT_CP = 1          AND
              LV_NO_PURGE_DMTL_ROUGH_LEAK = 1
Then          LV_ENA_ROUGH_LEAK_MES_ONLY = 1
Else          LV_ENA_ROUGH_LEAK_MES_ONLY = 0
Endif

```

```

If          LV_DMTL_ACT = 1 0
Then          LV_ENA_ROUGH_LEAK_3 = 1
Else          LV_ENA_ROUGH_LEAK_3 = 0
Endif

```

## B.93.9 Request rough leak check

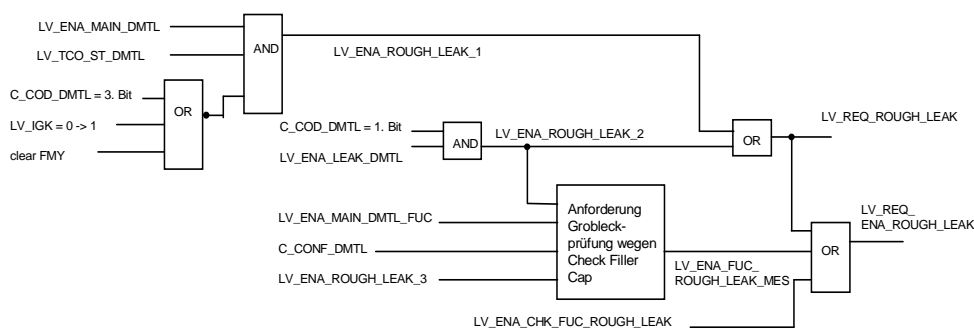
### Application conditions

**Initialisation:**  $LV\_ENA\_ROUGH\_LEAK\_1 = 0$   
 $LV\_TCO\_ST\_DMTL = 0$  in case of reset and  $LV\_IGK = 0 \quad 1$

**Recurrence:**  $100 \text{ ms}$

**Activation:**  $LV\_CONF\_DMTL = 1$

### Signal flow diagram:



### Formula section:

```

If          TCO_ST TAM_ST + C_TCO_ST_DMTL_COLD
Then          LV_TCO_ST_DMTL = 1
Else          LV_TCO_ST_DMTL = 0
Endif

```

```

If          LV_ENA_MAIN_DMTL = 1          AND
              LV_TCO_ST_DMTL = 1          AND
              NOT(C_COD_DMTL = 3. bit    OR
              LV_IGK = 0 → 1            OR
              no clear FMY)
Then       LV_ENA_ROUGH_LEAK_1 = 1
Else       LV_ENA_ROUGH_LEAK_1 = 0
Endif

If          LV_ENA_LEAK_DMTL = 1          AND
              C_COD_DMTL = 1. bit
Then       LV_ENA_ROUGH_LEAK_2 = 1
Else       LV_ENA_ROUGH_LEAK_2 = 0
Endif

Then       LV_ENA_ROUGH_LEAK_1 = 1          OR
              LV_ENA_ROUGH_LEAK_2 = 1
Else       LV_REQ_ROUGH_LEAK = 1
              LV_REQ_ROUGH_LEAK = 0
Endif

If          LV_REQ_ROUGH_LEAK = 1          OR
              LV_ENA_FUC_ROUGH_LEAK_MES = 1 OR
              LV_ENA_CHK_FUC_ROUGH_LEAK = 1
Then       LV_REQ_ENA_ROUGH_LEAK = 1
Else       LV_REQ_ENA_ROUGH_LEAK = 0
Endif

```

## B.93.10 Rough leak check request due to Check Filler Cap

### Application conditions

**Initialisation:**     *CTR\_CNL\_ROUGH\_LEAK\_MES\_FUC is restored out of the NVMY*  
                           *CTR\_REP\_ROUGH\_LEAK\_MES\_FUC is restored out of the NVMY*  
                           *LV\_ENA\_FUC is restored out of the NVMY*

**Recurrence:**         100 ms

**Activation:**         LV\_CONF\_DMTL = 1


### Signalflußdiagramm :

### Formula section:

```

If          [LV_REFU = 1          AND
              LV_REFU_VAL = 1]
              [LV_ERR_DET_ROUGH_LEAK_MIN = 1          OR
              LV_CYC_ROUGH_LEAK_MODE6 = 1]          AND
Then       LV_ENA_FUC_1 = 1
Else       LV_ENA_FUC_1 = 0
Endif

```

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```

If          LV_ENA_FUC_1 = 0 1          AND
              C_COD_2_DMTL = 6.bit
Then       LV_ENA_FUC = 1
Endif

If          LV_ENA_FUC = 1          AND
              LV_ENA_MAIN_DMTL_FUC = 1    AND
              LV_REQ_ROUGH_LEAK = 0      AND
              LV_ENA_SMALL_LEAK_MES = 0  AND
              no clear FMY
Then       LV_ENA_FUC_ROUGH_LEAK_MES = 1
Else       LV_ENA_FUC_ROUGH_LEAK_MES = 0
Endif

If          LV_ENA_ROUGH_LEAK_MES_ONLY = 1    AND
              LV_REQ_ROUGH_LEAK = 0
Then       LV_CTR_CNL_ROUGH_LEAK_MES_FUC = 1
Else       LV_CTR_CNL_ROUGH_LEAK_MES_FUC = 0
Endif

If          LV_CTR_CNL_ROUGH_LEAK_MES_FUC = 0 1
Then       CTR_CNL_ROUGH_LEAK_MES_FUC =
              CTR_CNL_ROUGH_LEAK_MES_FUC +1
Else       CTR_CNL_ROUGH_LEAK_MES_FUC = CTR_CNL_ROUGH_LEAK_MES_FUC
Endif

If          LV_CYC_ROUGH_LEAK_SUSP = 1 0          OR
              LV_ENA_FUC_1 = 0 1          OR
              clear FMY
Then       CTR_CNL_ROUGH_LEAK_MES_FUC = 0
Endif

If          LV_ROUGH_LEAK_SUSP = 1          AND
              LV_CYC_ROUGH_LEAK_SUSP = 1    AND
              LV_REQ_ROUGH_LEAK = 0        AND
              LV_ENA_SMALL_LEAK_MES = 0    AND
              no clear FMY
Then       LV_CTR_REP_ROUGH_LEAK_MES_FUC = 1
Else       LV_CTR_REP_ROUGH_LEAK_MES_FUC = 0
Endif

If          LV_CTR_REP_ROUGH_LEAK_MES_FUC = 0 1
Then       CTR_REP_ROUGH_LEAK_MES_FUC =
              CTR_REP_ROUGH_LEAK_MES_FUC +1
Else       CTR_REP_ROUGH_LEAK_MES_FUC = CTR_REP_ROUGH_LEAK_MES_FUC
Endif

If          LV_ENA_FUC_1 = 0 1          OR
              clear FMY
Then       CTR_REP_ROUGH_LEAK_MES_FUC = 0
Endif

```

```

If          [[CTR_CNL_ROUGH_LEAK_MES_FUC >
C_SUM_CNL_LEAK_MES_FUC_MAX          OR
CTR_REP_ROUGH_LEAK_MES_FUC >
C_SUM_REP_LEAK_MES_FUC_MAX]          AND
LV_ENA_ROUGH_LEAK_3 = 1]              OR
[[LV_ROUGH_LEAK_SUSP = 0          AND
LV_CYC_ROUGH_LEAK_SUSP = 1 0]      OR
clear FMY]
Then        LV_ENA_FUC = 0
Endif

```

### B.93.11 Rough leak check request due to Check Filler Cap during trip

#### Application conditions

##### Initialisation:

```

CTR_ENA_DMTL_CHK_FUC = 0 at LV_IGK = 0 1 and clr fmy
LV_ENA_CHK_FUC_ROUGH_LEAK = 0 at LV_IGK = 0 1 and clr fmy

```

```

LV_T_ENA_DMTL_CHK_FUC = 0 at LV_IGK = 0 1 and clr fmy
LV_CTR_ENA_DMTL_CHK_FUC = 0 at LV_IGK = 0 1 and clr fmy

```

```

T_ENA_DMTL_CHK_FUC = 0 at LV_IGK = 0 1 and clr fmy
LV_T_ENA_DMTL_CHK_FUC = 0 at LV_IGK = 0 1 and clr fmy
LV_T_ENA_AST_DMTL_CHK_FUC = 0 at LV_IGK = 0 1 and clr fmy

```

**Recurrence:** 100 ms

**Activation:** LV\_CONF\_DMTL = 1

#### Formula section:

```


If          LV_ES = 0          and
[LV_ERR_TAM = 1          or
TAM > C_TAM_DMTL_CHK_FUC_MIN] and
STATE_EFP_CRASH_CAN 2    and
C_COD_2_DMTL = 0. bit    and
C_VB_DMTL_CHK_FUC_MIN VB C_VB_DMTL_CHK_FUC_MAX and
CTR_ENA_DMTL_CHK_FUC < C_CTR_ENA_DMTL_CHK_FUC and
LV_ENA_LEAK_DMTL = 1     and
LV_DMTL_ASA = 0          and
LV_ENA_CHK_FUC_ROUGH_LEAK_MES = 1 and
LV_T_ENA_DMTL_CHK_FUC = 1
Then        LV_ENA_CHK_FUC_ROUGH_LEAK = 1
Else        LV_ENA_CHK_FUC_ROUGH_LEAK = 0
Endif

```

```

If          LV_DMTL_ACT = 1          and
LV_ENA_CHK_FUC_ROUGH_LEAK = 1
Then        LV_CTR_ENA_DMTL_CHK_FUC = 1
Else        LV_CTR_ENA_DMTL_CHK_FUC = 0
Endif

```

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```

If          LV_CTR_ENA_DMTL_CHK_FUC = 0  1
Then       CTR_ENA_DMTL_CHK_FUC ++
Endif

```

```

If          LV_DMTL_ACT = 1  0      or
            ECU_STATE = PWL
Then       T_ENA_DMTL_CHK_FUC = 0
            LV_T_ENA_AST_DMTL_CHK_FUC = 0
            LV_ENA_CHK_FUC_ROUGH_LEAK = 0
Endif

```

```

If          LV_ENA_CHK_FUC_ROUGH_LEAK = 0      and
            LV_IGK = 1                          and
            LV_ES = 0
Then       T_ENA_DMTL_CHK_FUC ++
Endif

```

```

If          T_AST = C_T_AST_DMTL_CHK_FUC
Then       LV_T_ENA_AST_DMTL_CHK_FUC = 1
Endif

```

```

If          T_ENA_DMTL_CHK_FUC  C_T_ENA_DMTL_CHK_FUC      or
            LV_T_ENA_AST_DMTL_CHK_FUC = 1
Then       LV_T_ENA_DMTL_CHK_FUC = 1
Else      LV_T_ENA_DMTL_CHK_FUC = 0
Endif

```


## B.93.12 Enable of miniature leak check

### Application conditions

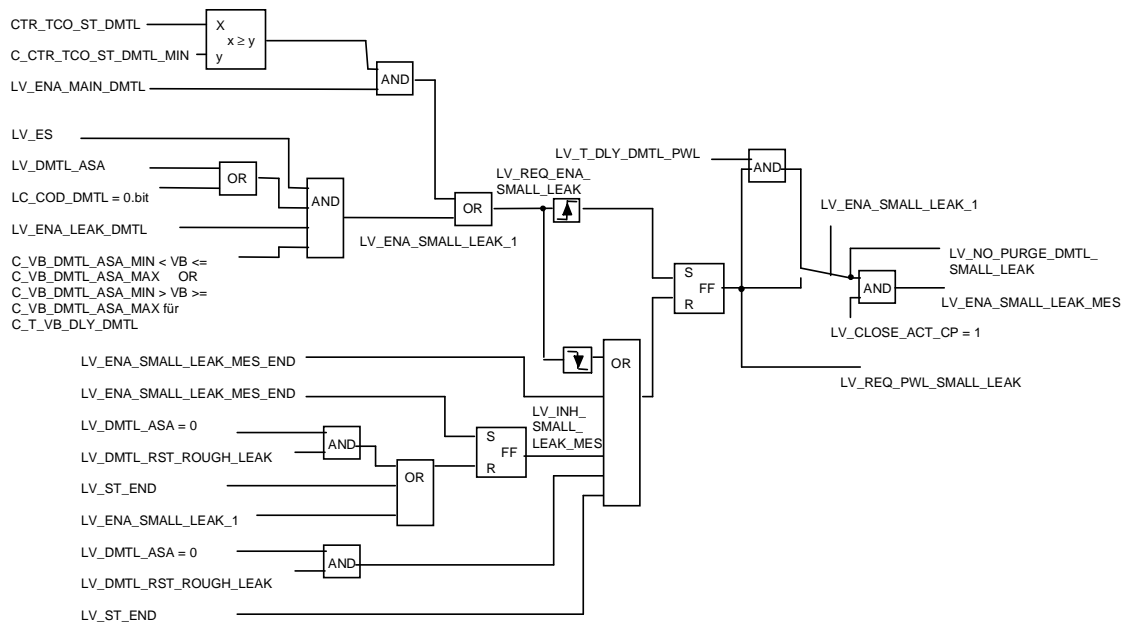
**Initialisation:** LV\_ENA\_SMALL\_LEAK\_MES is restored out of the NVMY  
CTR\_TCO\_ST\_DMTL is restored out of the NVMY

**Recurrence:** 100 ms

**Activation:** LV\_CONF\_DMTL = 1

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**Signal flow diagram:****Formula section:**

**If** LV\_TCO\_ST\_DMTL = 0 1  
**Then** CTR\_TCO\_ST\_DMTL ++  
**Endif**

**If** LV\_CYC\_SMALL\_LEAK\_MODE6 = 1 OR  
 LV\_DMTL\_RST\_ROUGH\_LEAK = 1  
**Then** CTR\_TCO\_ST\_DMTL = 0  
**Endif**

**If** [CTR\_TCO\_ST\_DMTL C\_CTR\_TCO\_ST\_DMTL\_MIN AND  
 LV\_ENA\_MAIN\_DMTL] OR  
 LV\_ENA\_SMALL\_LEAK\_1 = 1  
**Then** LV\_REQ\_ENA\_SMALL\_LEAK = 1  
**Else** LV\_REQ\_ENA\_SMALL\_LEAK = 0  
**Endif**

**If** LV\_ES = 1 AND  
 [LV\_DMTL\_ASA = 1 OR  
 C\_COD\_DMTL = 0.bit] AND  
 LV\_ENA\_LEAK\_DMTL AND  
 [C\_VB\_DMTL\_ASA\_MIN < VB C\_VB\_DMTL\_ASA\_MAX OR  
 C\_VB\_DMTL\_ASA\_MIN > VB >= C\_VB\_DMTL\_ASA\_MAX for maximum  
 C\_T\_VB\_DLY\_DMTL]  
**Then** LV\_ENA\_SMALL\_LEAK\_1 = 1  
**Else** LV\_ENA\_SMALL\_LEAK\_1 = 0  
**Endif**

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```

If          [LV_DMTL_ASA = 0                AND
              LV_DMTL_RST_ROUGH_LEAK = 1]    OR
              LV_ST_END = 1                  OR
              LV_ENA_SMALL_LEAK_1
Then        LV_INH_SMALL_LEAK_MES = 0
Endif

If          LV_DMTL_ACT = 0                AND
              LV_ENA_SMALL_LEAK_MES(n-1) = 1
Then        LV_ENA_SMALL_LEAK_MES_END = 1
              LV_INH_SMALL_LEAK_MES = 1
Endif

If          C_COD_DMTL = 2.bit            OR
              clear FMY
Then        LV_DMTL_RST_ROUGH_LEAK = 1
Else        LV_DMTL_RST_ROUGH_LEAK = 0
Endif

If          LV_REQ_ENA_SMALL_LEAK = 0 1
Then        LV_REQ_PWL_SMALL_LEAK = 1
Endif

If          LV_REQ_ENA_SMALL_LEAK = 1 0    OR
              LV_ENA_SMALL_LEAK_MES_END = 1 OR
              LV_INH_SMALL_LEAK_MES = 1     OR
              LV_ST_END = 0 1               OR
              [LV_DMTL_ASA = 0              AND
              LV_DMTL_RST_ROUGH_LEAK = 1]
Then        LV_REQ_PWL_SMALL_LEAK = 0
Endif

If          [LV_REQ_PWL_SMALL_LEAK = 1    AND
              LV_ENA_SMALL_LEAK_1 = 1]    OR
              [LV_REQ_PWL_SMALL_LEAK = 1  AND
              LV_T_DLY_DMTL_PWL = 1       AND
              LV_ENA_SMALL_LEAK_1 = 0]
Then        LV_NO_PURGE_DMTL_SMALL_LEAK = 1
Endif

If          LV_CLOSE_ACT_CP = 1          AND
              LV_NO_PURGE_DMTL_SMALL_LEAK = 1
Then        LV_ENA_SMALL_LEAK_MES = 1
Else        LV_ENA_SMALL_LEAK_MES = 0
Endif

If          C_VB_DMTL_ASA_MIN > VB > C_VB_DMTL_ASA_MAX    OR
              C_VB_DMTL_ASA_MIN < VB < C_VB_DMTL_ASA_MAX for maximum
              C_T_VB_DLY_DMTL
Then        LV_VB_RANGE_DMTL = 1
Else        LV_VB_RANGE_DMTL = 0

```

**Endif**

### B.93.13 Miniature leak check request due to abnormal termination through current fluctuations

#### Application conditions

**Initialisation:** *LV\_CTR\_CNL\_SMALL\_LEAK\_MES is restored out of the NVMY  
CTR\_CNL\_SMALL\_LEAK\_MES is restored out of the NVMY*

**Recurrence:** *100 ms*

**Activation:** *LV\_CONF\_DMTL = 1*

#### Signal flow diagram:

#### Formula section:

```

If          [LV_CUR_DMTL_THD_DIF_MES = 0 1           OR
               LV_CUR_DMTL_REF_DIF_MAX = 0 1]         AND
               LV_ENA_CHK_FUC_ROUGH_LEAK = 0
Then        CTR_CNL_SMALL_LEAK_MES = CTR_CNL_SMALL_LEAK_MES + 1
Else        CTR_CNL_SMALL_LEAK_MES = CTR_CNL_SMALL_LEAK_MES

```

**Endif**

```

If          [LV_CUR_DMTL_THD_DIF_MES = 0           AND
               LV_CUR_DMTL_REF_DIF_MAX = 0           AND
               LV_ENA_ROUGH_LEAK_3 = 1]             OR
               clear FMY                             OR
               LV_CTR_CNL_SMALL_LEAK_MES = 1(n-1)
Then        CTR_CNL_SMALL_LEAK_MES = 0
Else        CTR_CNL_SMALL_LEAK_MES = CTR_CNL_SMALL_LEAK_MES

```

**Endif**

```

If          CTR_CNL_SMALL_LEAK_MES > C_SUM_CNL_SMALL_LEAK_MES_MAX
Then        LV_CTR_CNL_SMALL_LEAK_MES = 1

```

**Endif**

```

If          [LV_CUR_DMTL_THD_DIF_MES = 0           AND
               LV_CUR_DMTL_REF_DIF_MAX = 0           AND
               LV_ENA_ROUGH_LEAK_3 = 1]             OR
               clear FMY                             OR
               LV_CTR_CNL_SMALL_LEAK_MES = 1(n-1)           OR
               [[LV_ERR_DET_DMTL_MIN = 1           OR
                 LV_ERR_DET_DMTL_MAX = 1           OR
                 LV_SDR_DMTL = 1]                 AND
               LV_CTR_CNL_SMALL_LEAK_MES = 0(n) ]
Then        LV_CTR_CNL_SMALL_LEAK_MES = 0

```

**Endif**

```

If          LV_ENA_CHK_FUC_ROUGH_LEAK = 1           OR
               LV_ENA_FUC_ROUGH_LEAK_MES = 1         OR

```

```

        LV_DMTL_STOP = 1
    Then
        LV_INH_CHK_DMTL_VLD = 1
Endif
If
    LV_ENA_ROUGH_LEAK_3 = 1 → 0
    ECU_STATE != PWL → ECU_STATE = PWL
    LV_IGK = 0 → 1
Then
    LV_INH_CHK_DMTL_VLD = 0
Endif
If
    (LV_INH_CHK_DMTL_VLD = 0
     LV_ENA_ROUGH_LEAK_3 = 1)
    LV_CTR_CNL_SMALL_LEAK_MES = 1
Then
    LV_CHK_DMTL_VLD = 1
Else
    LV_CHK_DMTL_VLD = 0
Endif

```

### B.93.14 Function request "output stage test"

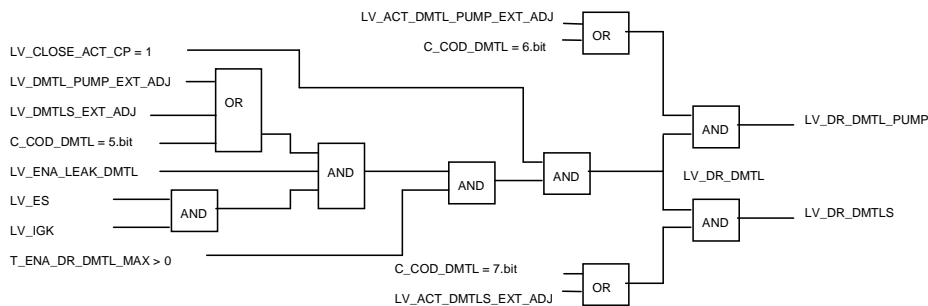
#### Application conditions

**Initialisation:**  $LV\_DR\_DMTL\_PUMP = 0$   
 $LV\_DR\_DMTLS = 0$

**Recurrence:**  $100\ ms$

**Activation:**  $LV\_CONF\_DMTL = 1$

#### Signal flow diagram:



#### Formula section:

```

If
    [LV_DMTL_PUMP_EXT_ADJ = 1
     LV_DMTLS_EXT_ADJ = 1
     C_COD_DMTL = 5.bit]
    LV_ENA_LEAK_DMTL = 1
    [LV_ES = 1
     LV_IGK = 1]
Then
    T_ENA_DR_DMTL_MAX = T_ENA_DR_DMTL_MAX + 100 ms
    LV_NO_PURGE_DR_DMTL = 1
Endif

If
    [LV_DMTL_PUMP_EXT_ADJ = 1
     LV_DMTLS_EXT_ADJ = 1]

```

```

        C_COD_DMTL = 5.bit]                AND
        LV_ENA_LEAK_DMTL = 1                AND
        [LV_ES = 1                          AND
         LV_IGK = 1]                        AND
        T_ENA_DR_DMTL_MAX < C_T_ENA_DR_DMTL_MAX AND
        LV_CLOSE_ACT_CP = 1
    Then      LV_DR_DMTL = 1
    Else      LV_DR_DMTL = 0
Endif

If          LV_DR_DMTL = 1                AND
           [LV_ACT_DMTL_PUMP_EXT_ADJ = 1  OR
            C_COD_DMTL = 6.bit]
    Then     LV_DR_DMTL_PUMP = 1
    Else     LV_DR_DMTL_PUMP = 0
Endif

If          LV_DR_DMTL = 1                AND
           [LV_ACT_DMTLS_EXT_ADJ = 1      OR
            C_COD_DMTL = 7.bit]
    Then     LV_DR_DMTLS = 1
    Else     LV_DR_DMTLS = 0
Endif

```

## B.93.15 Fuel cap and refueling detection

### Application conditions

**Initialisation:** *LV\_DMTL\_STOP is restored out of the NVMY*  
*LV\_DET\_FUC\_OPEN is restored out of the NVMY*  
*LV\_DET\_REFU is restored out of the NVMY*  
*LV\_CUR\_DMTL\_THD\_DIF\_MES is restored out of the NVMY*  
*LV\_T\_DMTL\_MAX is restored out of the NVMY*

#### *Initialisation at*

*clear FMY:* LV\_DMTL\_STOP = 1

*Recurrence:* 100 ms for calculation of the currents  
 100 ms for the use of the currents

*Activation:* LV\_CONF\_DMTL = 1


### Signal flow diagram:

### Formula section:

```

If          LV_DMTL_PUMP_ON = 1          AND
           LV_DMTLS_ON = 1
    Then     T_DLY_DET_REFU = T_DLY_DET_REFU + 100 ms
    Else     T_DLY_DET_REFU = 0
Endif

```

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```

If          LV_DMTL_ACT = 1
Then       CUR_DMTL_COR_FIL_REFU(n) =      CUR_DMTL_COR_FIL_REFU(n-1) +
              (CUR_DMTL_COR(n) - CUR_DMTL_COR_FIL_REFU(n-1)) *
              C_CRLC_CUR_DMTL_FIL_LIM

```

**Endif**

```

If          LV_DMTL_PUMP_ON = 1      AND
              LV_DMTLS_ON = 1        AND
Then       T_DLY_DET_REFU < C_T_DLY_DET_REFU
              CUR_DMTL_COR_FIL_REFU_FIL(n) =
              CUR_DMTL_COR_FIL_REFU_FIL(n-1) +
              (CUR_DMTL_COR_FIL_REFU(n) - CUR_DMTL_COR_FIL_REFU_FIL(n-1)) *
              C_CRLC_CUR_DMTL_FIL_LIM
              T_DLY_VB_DMTL = T_DLY_VB_DMTL - 100 ms

```

**Endif**

```

If          LV_DMTL_PUMP_ON = 1      AND
              LV_DMTLS_ON = 1        AND
Then       T_DLY_DET_REFU < C_T_DLY_DET_REFU
              CUR_DMTL_COR_FIL_REFU_FIL(n) =
              CUR_DMTL_COR_FIL_REFU_FIL(n-1) +
              (CUR_DMTL_COR_FIL_REFU(n) - CUR_DMTL_COR_FIL_REFU_FIL(n-1)) *
              C_CRLC_CUR_DMTL_FIL_REFU

```

**Endif**

```

CUR_DMTL_COR_FIL_REFU_HPF =      CUR_DMTL_COR_FIL_REFU -
                                CUR_DMTL_COR_FIL_REFU_FIL

```

```

If          CUR_DMTL_COR_FIL_REFU_HPF >
              C_CUR_DMTL_DIF_THD_REFU      AND
              T_DLY_DET_REFU < C_T_DLY_DET_REFU
Then       LV_DET_REFU = 1

```

**Endif**

```

If          LV_DMTL_ACT = 0  1
Then       LV_DET_REFU = 0
              LV_DET_FUC_OPEN = 0
              LV_CUR_DMTL_THD_DIF_MES = 0
              T_DLY_CUR_DMTL_DIF_MES = 0
              LV_T_DMTL_MAX = 0

```

**Endif**

```

If          CUR_DMTL_COR_FIL_REFU_HPF <
              C_CUR_DMTL_DIF_THD_FUC      AND
              T_DLY_DET_REFU < C_T_DLY_DET_REFU      AND
              LV_DMTL_ASA = 0
Then       LV_DET_FUC_OPEN = 1

```

**Endif**

```

If          T_DLY_DET_REFU < C_T_DLY_DET_REFU

```

```

Then      CUR_DMTL_COR_FIL_MES_MAX =
          MAX (CUR_DMTL_COR_FIL(n), CUR_DMTL_COR_FIL(n-1)) -
          CUR_DMTL_COR_FIL(n)

Endif

If        CUR_DMTL_COR_FIL_MES_MAX >
          C_CUR_DMTL_DIF_THD_MES
          T_DLY_DET_REFU C_T_DLY_DET_REFU      AND
          LV_DMTL_ASA = 0                      AND

Then      T_DLY_CUR_DMTL_DIF_MES = T_DLY_CUR_DMTL_DIF_MES + 100 ms
Else      T_DLY_CUR_DMTL_DIF_MES = 0

Endif

If        T_DLY_CUR_DMTL_DIF_MES > C_T_DLY_CUR_DMTL_DIF_MES
Then      LV_CUR_DMTL_THD_DIF_MES = 1

Endif

If        LV_DMTL_ACT = 1
Then      T_DMTL_MAX = T_DMTL_MAX + 100 ms
Else      T_DMTL_MAX = 0

Endif

If        T_DMTL_MAX > C_T_DMTL_MAX
Then      LV_T_DMTL_MAX = 1

Endif

If        [LV_DET_REFU = 1
          LV_DET_FUC_OPEN = 1
          LV_VB_DIF_MAX = 1
          LV_CUR_DMTL_REF_DIF_MAX = 1
          LV_CUR_DMTL_THD_DIF_MES = 1
          LV_T_DMTL_MAX = 1]
          OR
          OR
          OR
          OR
          AND
Then      LV_DMTL_STOP = 1

Endif

If        LV_ENA_ROUGH_LEAK_MES = 0 1
Then      LV_DMTL_STOP = 0


Endif

```

## B.93.16 Generating rough leak error from suspected rough leak error

### Application conditions

**Initialisation:** LV\_ERR\_DET\_ROUGH\_LEAK\_MIN is restored out of the NVMY  
 LV\_REFU\_DMTL is restored out of the NVMY  
 LV\_DIST\_DET\_ROUGH\_LEAK is restored out of the NVMY  
 LV\_ROUGH\_LEAK\_SUSP\_SET is restored out of the NVMY  
 DIST\_DMTL is restored out of the NVMY  
 LV\_REFU\_DMTL\_SMALL\_LEAK restored from NVMY  
 LV\_REFU\_DMTLM restored from NVMY  
 at clr fmy:

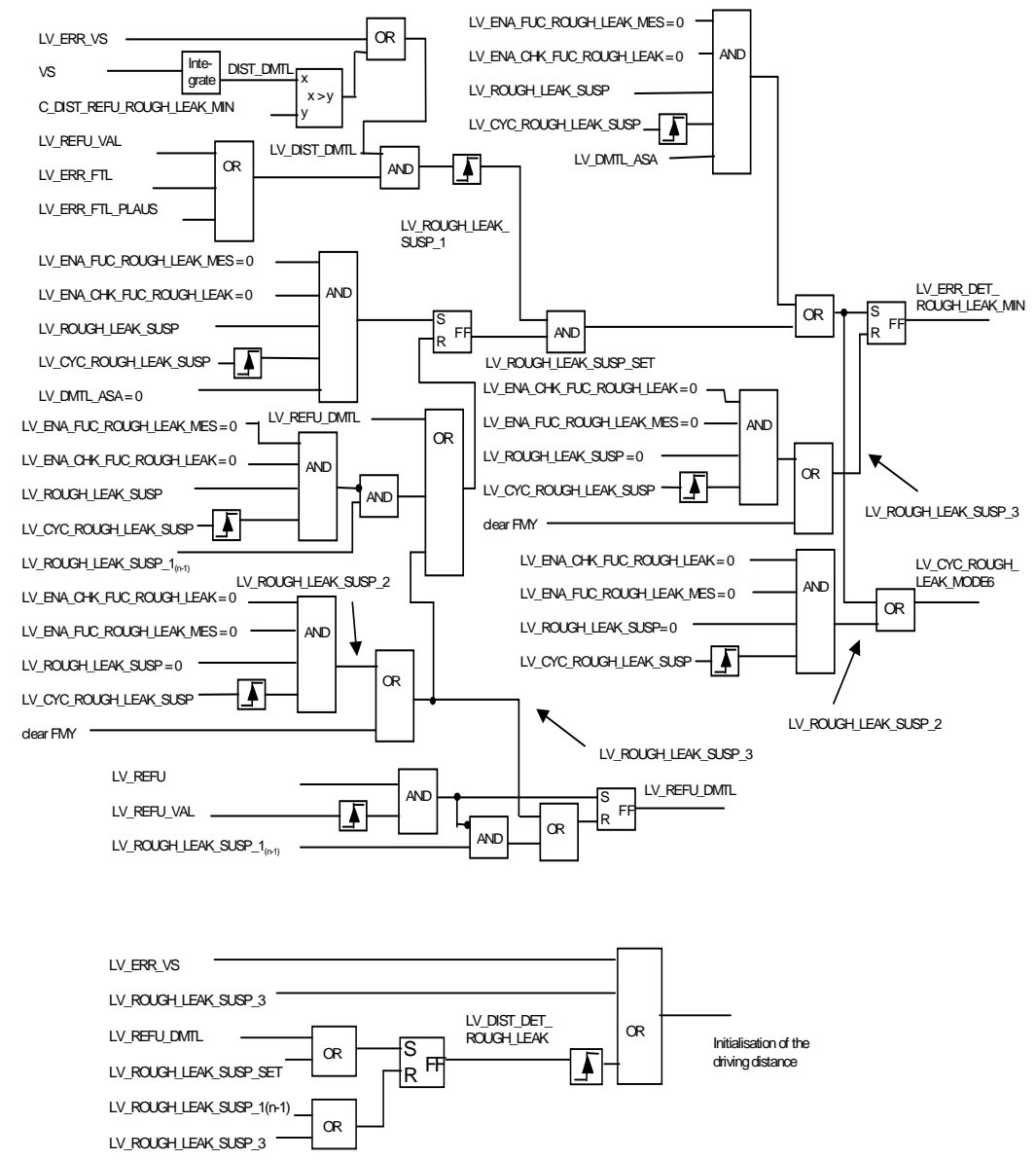
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LV\_REFU\_DMTL\_SMALL\_LEAK = 0  
 LV\_REFU\_DMTLM = 0

**Recurrence:** 100 ms

**Activation:** LV\_CONF\_DMTL = 1

**Signal flow diagram:**



**Formula section:**

**If** LV\_VS\_RUN = 1  
**Then** DIST\_DMTL<sub>(n)</sub> = DIST\_DMTL<sub>(n-1)</sub> + VS / 36  
**Else** DIST\_DMTL<sub>(n)</sub> = DIST\_DMTL<sub>(n-1)</sub>  
**Endif**

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```

If          DIST_DMTL > C_DIST_REFU_ROUGH_LEAK_MIN          OR
                LV_ERR_VS = 1
Then          LV_DIST_DMTL = 1
Else          LV_DIST_DMTL = 0
Endif

If          [LV_DIST_DMTL = 1          AND
                [LV_REFU_VAL = 1          OR
                LV_ERR_FTL = 1          OR
                LV_ERR_FTL_PLAUS = 1]] once          AND
                LV_ROUGH_LEAK_SUSP_1(n-1) = 0
Then          LV_ROUGH_LEAK_SUSP_1 = 1
Else          LV_ROUGH_LEAK_SUSP_1 = 0
Endif

If          LV_ENA_FUC_ROUGH_LEAK_MES = 0          AND
                LV_ENA_CHK_FUC_ROUGH_LEAK = 0          AND
                LV_ROUGH_LEAK_SUSP = 1          AND
                LV_CYC_ROUGH_LEAK_SUSP = 0 1          AND
                LV_DMTL_ASA = 0
Then          LV_ROUGH_LEAK_SUSP_SET = 1
                LV_CDN_DIAG_ROUGH_LEAK = 1
                ERR_SYM_ROUGH_LEAK = MAX
                ACTION_ERRM_StorePrevFrF (ROUGH_LEAK)
                This action stores the prestored freeze frame for the diagnosis instance ROUGH_LEAK,
                see chapter Environmental data, OBDII functions
                LV_CDN_DIAG_ROUGH_LEAK = 0
Endif

If          LV_REFU_DMTL = 1          OR
                [Not [LV_ENA_FUC_ROUGH_LEAK_MES = 0          AND
                LV_ENA_CHK_FUC_ROUGH_LEAK = 0          AND
                LV_ROUGH_LEAK_SUSP = 1          AND
                LV_CYC_ROUGH_LEAK_SUSP = 0 1]          AND
                LV_ROUGH_LEAK_SUSP_1(n-1)]          OR
                LV_ROUGH_LEAK_SUSP_3]
Then          LV_ROUGH_LEAK_SUSP_SET = 0
Endif

If          [LV_ROUGH_LEAK_SUSP_1 = 1          AND
                LV_ROUGH_LEAK_SUSP_SET = 1]          OR
                [LV_ENA_FUC_ROUGH_LEAK_MES = 0          AND
                LV_ENA_CHK_FUC_ROUGH_LEAK = 0          AND
                LV_ROUGH_LEAK_SUSP = 1          AND
                LV_CYC_ROUGH_LEAK_SUSP = 0 1          AND
                LV_DMTL_ASA = 1]
Then          LV_ERR_DET_ROUGH_LEAK_MIN = 1
Endif

If          LV_ROUGH_LEAK_SUSP_3 = 1
Then          LV_ERR_DET_ROUGH_LEAK_MIN = 0
Endif

```

```

If          [LV_ROUGH_LEAK_SUSP_1 = 1                AND
LV_ROUGH_LEAK_SUSP_SET = 1]                OR
[LV_ENA_FUC_ROUGH_LEAK_MES = 0            AND
LV_ENA_CHK_FUC_ROUGH_LEAK = 0            AND
LV_ROUGH_LEAK_SUSP = 1                    AND
LV_CYC_ROUGH_LEAK_SUSP = 0 1             AND
LV_DMTL_ASA = 1]                            OR
LV_ROUGH_LEAK_SUSP_2
Then          LV_CYC_ROUGH_LEAK_MODE6 = 1
Else          LV_CYC_ROUGH_LEAK_MODE6 = 0
Endif

If          LV_ENA_FUC_ROUGH_LEAK_MES = 0            AND
LV_ENA_CHK_FUC_ROUGH_LEAK = 0            AND
LV_ROUGH_LEAK_SUSP = 0                    AND
LV_CYC_ROUGH_LEAK_SUSP = 0 1
Then          LV_ROUGH_LEAK_SUSP_2 = 1
Else          LV_ROUGH_LEAK_SUSP_2 = 0
Endif

If          LV_ROUGH_LEAK_SUSP_2 = 1                OR
clear FMY
Then          LV_ROUGH_LEAK_SUSP_3 = 1
Else          LV_ROUGH_LEAK_SUSP_3 = 0
Endif

If          LV_REFU = 1                            AND
LV_REFU_VAL = 0 1
Then          LV_REFU_SET = 1
LV_REFU_DMTL = 1
If          LV_ERR_DET_SMALL_LEAK_MIN = 1
Then          LV_REFU_DMTL_SMALL_LEAK = 1
Endif
If          LV_ERR_DMTL_SET = 1
Then          LV_REFU_DMTLM = 1
Endif
Else          LV_REFU_SET = 0
Endif

If          [LV_REFU_SET = 0                            AND
LV_ROUGH_LEAK_SUSP_1(n-1) = 1]                OR
LV_ROUGH_LEAK_SUSP_3 = 1
Then          LV_REFU_DMTL = 0
Endif

If          LV_REFU_DMTL = 1                            OR
LV_ROUGH_LEAK_SUSP_SET = 1
Then          LV_DIST_DET_ROUGH_LEAK = 1
Endif

If          LV_ROUGH_LEAK_SUSP_1(n-1) = 1            OR
LV_ROUGH_LEAK_SUSP_3 = 1

```

```

Then      LV_DIST_DET_ROUGH_LEAK = 0
Endif

If        LV_ERR_VS = 1                OR
          LV_ROUGH_LEAK_SUSP_3 = 1     OR
          LV_DIST_DET_ROUGH_LEAK = 0 1 OR
          STATE_DMTL = MODULE_ERROR   OR
          STATE_DMTL = SMALL_LEAK_DETECTED OR
          STATE_DMTL = ROUGH_LEAK_DETECTED OR
          LV_ERR_SIG_DMTL = 0 1
Then      DIST_DMTL = 0
Endif

```

### B.93.17 Combi-display activate Check Filler Cap

#### Application conditions

**Initialisation:** *LV\_FUC\_OPEN is restored out of the NVMY*

**Recurrence:** *100 ms*

**Activation:** *LV\_CONF\_DMTL = 1*

#### FUNCTION DESCRIPTION:

If a rough leak suspect is detected the module has to indicate, via the CAN-signal of the combi instrument, to the driver that possibly the tank cap has not been adjusted properly.


#### Formula section:

```

If        LV_FUC_CAN = 0
then      if      LV_FUC_INT = 0
           then    T_DLY_FUC_CAN = C_T_DLY_FUC_CAN_ON
           else    T_DLY_FUC_CAN = T_DLY_FUC_CAN -
                   If      T_DLY_FUC_CAN = 0
                   then    LV_FUC_CAN = 1
                           T_DLY_FUC_CAN = C_T_DLY_FUC_CAN_OFF
                   endif
           endif
else      T_DLY_FUC_CAN = T_DLY_FUC_CAN -
           if      T_DLY_FUC_CAN = 0                OR
                 (LV_ROUGH_LEAK_SUSP = 0 AND
                  LV_CYC_ROUGH_LEAK_SUSP = 0 → 1)
           then    LV_FUC_CAN = 0
                   T_DLY_FUC_CAN = C_T_DLY_FUC_CAN_ON
           endif
endif

If        LV_FUC_CAN = 1 → 0                OR
clr FMY
then      LV_FUC_OPEN = 0
else      if      LV_CYC_ROUGH_LEAK_MODE6 = 0 → 1
           then    if      LV_ERR_ROUGH_LEAK = 0

```

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```

                then      LV_FUC_OPEN = 0
                else      LV_FUC_OPEN = 1
                endif

            endif

endif

if          LV_FUC_OPEN = 1                AND
            VS > C_VS_FUC_CAN_MIN          AND
            LV_IGK = 1

Then      LV_FUC_INT = 1
Else      LV_FUC_INT = 0
Endif

```


## B.93.18 Output of the errorflags

### Application conditions

```

Initialisation:      If          LV_CONF_DMTL = 1
                        Then
LV_ERR_DMTLM is restored out of the NVMY
LV_ERR_DET_DMTL_MAX is restored out of the NVMY
LV_ERR_DET_DMTL_MIN is restored out of the NVMY
LV_SDR_DMTL is restored out of the NVMY
LV_ERR_SIG_DMTL is restored out of the NVMY
LV_ERR_DET_SMALL_LEAK_MIN is restored from NVMY
LV_ERR_DMTL_SET is restored from NVMY
M6_CTR_CNL_SMALL_LEAK_MES is restored from NVMY
M6_CTR_CNL_SMALL_LEAK_MES_SAVE is restored from NVMY
M6_CUR_DMTL_COR_FIL_CID18 is restored from NVMY
M6_CUR_DMTL_COR_FIL_CID18_SAVE is restored from NVMY
M6_CUR_DMTL_COR_FIL_CID19 is restored from NVMY
M6_CUR_DMTL_COR_FIL_CID19_SAVE is restored from NVMY
M6_CUR_DMTL_DMTLS_TEST is restored from NVMY
M6_CUR_DMTL_DMTLS_TEST_SAVE is restored from NVMY
M6_CUR_DMTL_THD_DMTLS_TEST is restored from NVMY
M6_CUR_DMTL_THD_DMTLS_TEST_SAVE is restored from NVMY
M6_CUR_DMTL_SMALL_LEAK_END_SAVE is restored from NVMY
M6_CUR_DMTL_REF_LEAK_SAVE is restored from NVMY
M6_CUR_DMTL_SMALL_LEAK_END is restored from NVMY
M6_CUR_DMTL_REF_LEAK is restored from NVMY
CTR_ERR_DET_DMTL_MAX/ MIN/ PLAUS/ SIG are restored from NVMY
CTR_ERR_DET_ROUGH/ SMALL_LEAK are restored from NVMY
CTR_DIAG_CFM_DMTL_MAX/ MIN/ PLAUS/ SIG are restored from NVMY
CTR_DIAG_CFM_ROUGH/ SMALL_LEAK are restored from NVMY
                        Endif
                        At clr fmy:
LV_ERR_DMTLM = 0
LV_ERR_DET_DMTL_MAX = 0
LV_ERR_DET_DMTL_MIN = 0
LV_SDR_DMTL = 0
LV_ERR_SIG_DMTL = 0
LV_ERR_DMTLM = 0
LV_ERR_DMTL_MAX/ MIN/ PLAUS/ SIG = 0
LV_ERR_ROUGH/ SMALL_LEAK = 0
LV_CTR_CNL_SMALL_LEAK_MES_CFM = 0
LV_CHK_DMTL_CUR_DMTL_VLD_CFM = 0
LV_CHK_DMTL_VLD_CFM = 0
LV_ERR_DMTL_SET = 0

```

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```


M6_CTR_CNL_SMALL_LEAK_MES = 0
M6_CTR_CNL_SMALL_LEAK_MES_SAVE = 0
M6_CUR_DMTL_COR_FIL_CID18 = 0
M6_CUR_DMTL_COR_FIL_CID18_SAVE = 0
M6_CUR_DMTL_COR_FIL_CID19 = 0
M6_CUR_DMTL_COR_FIL_CID19_SAVE = 0
M6_CUR_DMTL_DMTLS_TEST = 0
M6_CUR_DMTL_DMTLS_TEST_SAVE = 0
M6_CUR_DMTL_THD_DMTLS_TEST = 0
M6_CUR_DMTL_THD_DMTLS_TEST_SAVE = 0
M6_CUR_DMTL_SMALL_LEAK_END_SAVE = 0
M6_CUR_DMTL_REF_LEAK_SAVE = 0
M6_CUR_DMTL_SMALL_LEAK_END = 0
M6_CUR_DMTL_REF_LEAK = 0
LV_ERR_DET_SMALL_LEAK_MIN = 0
LV_ERR_DET_SMALL_LEAK_MIN_CFM = 0
LV_CYC_SMALL_LEAK_MODE6_CFM = 0
LV_CYC_SMALL_LEAK_MODE6 = 0
CTR_ERR_DET_DMTL_MAX/ MIN/ PLAUS/ SIG = 0
CTR_ERR_DET_ROUGH/ SMALL_LEAK = 0
CTR_DIAG_CFM_DMTL_MAX/ MIN/ PLAUS/ SIG = 0
CTR_DIAG_CFM_ROUGH/ SMALL_LEAK = 0
In case of LV_IGK = 0 -> 1:
clear ERR_SYM, LV_CDN_DIAG of
- ROUGH_LEAK
- SMALL_LEAK
- DMTL_MAX/ MIN/ PLAUS/ SIG
LV_ERR_DET_SMALL_LEAK_MIN_CFM = 0
LV_CYC_SMALL_LEAK_MODE6_CFM = 0
LV_CTR_CNL_SMALL_LEAK_MES_CFM = 0
LV_CHK_DMTL_CUR_DMTL_VLD_CFM = 0
LV_CHK_DMTL_VLD_CFM = 0

```

**Recurrence:** 100 ms

**Activation:** LV\_CONF\_DMTL = 1

### Signal flow diagram:

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**Formula section:**

```

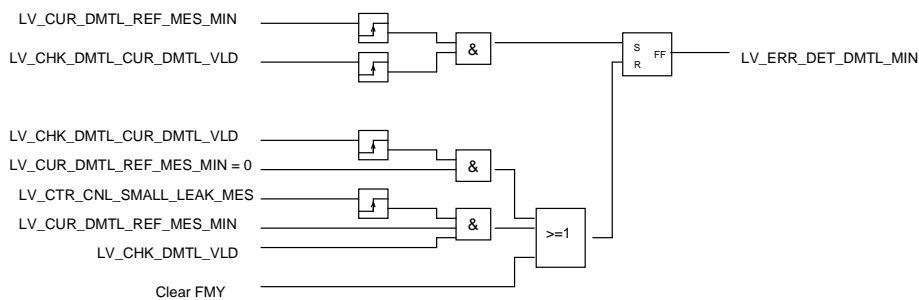
If          LV_CUR_DMTL_REF_MES_MAX = 0 1          AND
              LV_CHK_DMTL_CUR_DMTL_VLD = 0 1
Then       LV_ERR_DET_DMTL_MAX = 1
              ERR_SYM_DMTL_MAX = "MAX"
              LV_CDN_DIAG_DMTL_MAX = 1
              ACTION_ERRM_StorePrevFrF (DMTL_MAX)
** action is only called if specified in ERRM of project. For example, in MSD81-6 it is not
processed **
              LV_CDN_DIAG_DMTL_MAX = 0
Endif

```

```

If          [LV_CHK_DMTL_CUR_DMTL_VLD = 0 1          AND
              LV_CUR_DMTL_REF_MES_MAX = 0]          OR
              [LV_CTR_CNL_SMALL_LEAK_MES = 0 1          AND
              LV_CUR_DMTL_REF_MES_MAX = 1          AND
              LV_CHK_DMTL_VLD = 1]          OR
              clear FMY
Then       LV_ERR_DET_DMTL_MAX = 0
Endif

```

**How minimum error DMTL is built up****Signal flow diagram:****Formula section:**

```

If          LV_CUR_DMTL_REF_MES_MIN = 0 1          AND
              LV_CHK_DMTL_CUR_DMTL_VLD = 0 1
Then       LV_ERR_DET_DMTL_MIN = 1
              ERR_SYM_DMTL_MIN = "MIN"
              LV_CDN_DIAG_DMTL_MIN = 1
              ACTION_ERRM_StorePrevFrF (DMTL_MIN)
** action is only called if specified in ERRM of project. For example, in MSD81-6 it is
not processed **
              LV_CDN_DIAG_DMTL_MIN = 0
Endif

```

```

If          [LV_CHK_DMTL_CUR_DMTL_VLD = 0 1          AND
              LV_CUR_DMTL_REF_MES_MIN = 0]          OR
              [LV_CTR_CNL_SMALL_LEAK_MES = 0 1          AND
              LV_CUR_DMTL_REF_MES_MIN = 0]          AND
              Clear FMY

```

```

LV_CUR_DMTL_REF_MES_MIN = 1          AND
LV_CHK_DMTL_VLD = 1]                OR
    clear FMY
Then      LV_ERR_DET_DMTL_MIN = 0
Endif

```

### How plausibility error DMTL is built up

#### Signal flow diagram:

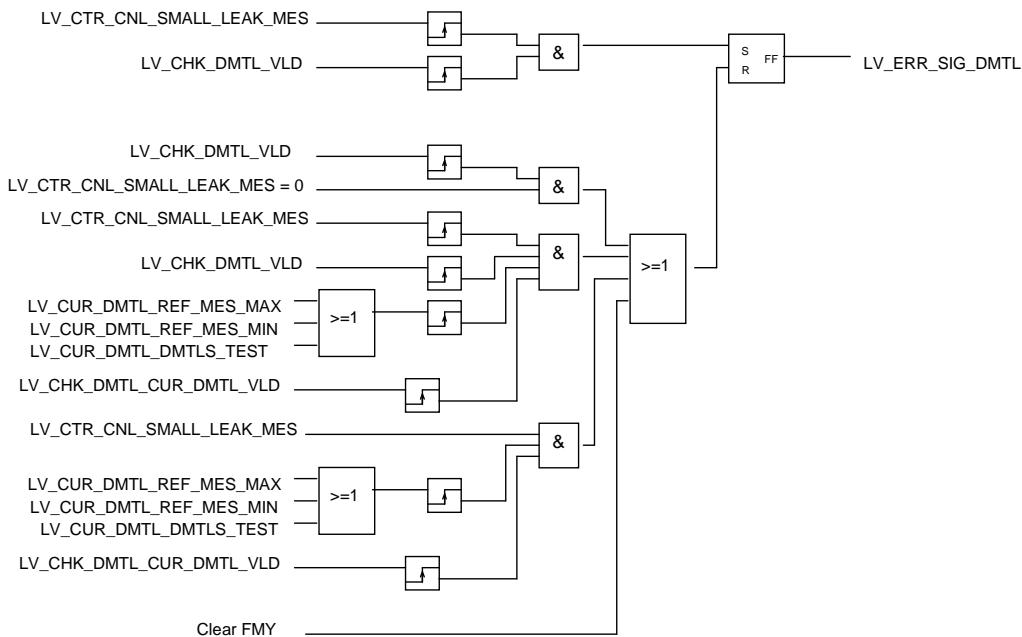
#### Formula section:

```

If      LV_CUR_DMTL_DMTLS_TEST = 0 1          AND
LV_CHK_DMTL_CUR_DMTL_VLD = 0 1
Then    LV_SDR_DMTL = 1
        ERR_SYM_DMTL_PLAUS = "PLAUS"
        LV_CDN_DIAG_DMTL_PLAUS = 1
        ACTION_ERRM_StorePrevFrf (DMTL_PLAUS)
        LV_CDN_DIAG_DMTL_PLAUS = 0
Endif
If      [LV_CHK_DMTL_CUR_DMTL_VLD = 0 1      AND
LV_CUR_DMTL_DMTLS_TEST = 0]                  OR
[LV_CTR_CNL_SMALL_LEAK_MES = 0 1          AND
LV_CUR_DMTL_DMTLS_TEST = 1                AND
LV_CHK_DMTL_VLD = 1]                        OR
    clear FMY
Then    LV_SDR_DMTL = 0
Endif

```

### How signal error DMTL is built up

**Signal flow diagram:****Formula section:**

```

If          LV_CTR_CNL_SMALL_LEAK_MES = 0  1      AND
              LV_CHK_DMTL_VLD = 0  1
Then       LV_ERR_SIG_DMTL = 1
              ERR_SYM_DMTL_SIG = "SIG"
              LV_CDN_DIAG_DMTL_SIG = 1

```

**ACTION\_ERRM\_StorePrevFrF (DMTL\_SIG)**

**\*\* action is only called if specified in ERRM of project. For example, in MSD81-6 it is not processed \*\***

```

LV_CDN_DIAG_DMTL_SIG = 0


```

**Endif**

```

If          [LV_CHK_DMTL_VLD = 0  1      AND
              LV_CTR_CNL_SMALL_LEAK_MES = 0] OR
              [LV_CTR_CNL_SMALL_LEAK_MES = 0  1      AND
              LV_CHK_DMTL_VLD = 0  1      AND
              [LV_CUR_DMTL_REF_MES_MIN = 0  1      OR
              LV_CUR_DMTL_REF_MES_MAX = 0  1      OR
              LV_CUR_DMTL_DMTLS_TEST = 0  1]      AND
              LV_CHK_DMTL_CUR_DMTL_VLD = 0  1]      OR
              [LV_CTR_CNL_SMALL_LEAK_MES = 1      AND
              [LV_CUR_DMTL_REF_MES_MIN = 0  1      OR
              LV_CUR_DMTL_REF_MES_MAX = 0  1      OR
              LV_CUR_DMTL_DMTLS_TEST = 0  1]      AND
              LV_CHK_DMTL_CUR_DMTL_VLD = 0  1]      OR
              clear FMY
Then       LV_ERR_SIG_DMTL = 0

```

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**Endif****How the error DMTL module is built up****Signal flow diagram:****Formula section:**

```

If          LV_SDR_DMTL = 1                OR
              LV_ERR_DET_DMTL_MIN = 1      OR
              LV_ERR_DET_DMTL_MAX = 1
Then       LV_ERR_DET_DMTL_1 = 1
Else       LV_ERR_DET_DMTL_1 = 0
Endif


If          [LV_ERR_DET_DMTL_1 = 0  1      AND
              LV_CTR_CNL_SMALL_LEAK_MES = 1] OR
              [LV_ERR_SIG_DMTL = 0          AND
              LV_CHK_DMTL_CUR_DMTL_VLD = 1] OR
              [LV_ERR_SIG_DMTL = 1          AND
              LV_CHK_DMTL_VLD = 1]         OR
              [LV_ERR_SIG_DMTL = 1  0      AND
              LV_CHK_DMTL_VLD = 0  1]
Then       LV_ERR_DET_DMTL_2 = 1
Else       M6_CTR_CNL_SMALL_LEAK_MES_SAVE = CTR_CNL_SMALL_LEAK_MES
Endif

IF         LV_ERR_DET_DMTL_2 = 0 -> 1      AND
              LV_ENA_CHK_FUC_ROUGH_LEAK = 0
THEN
              LV_ERR_DMTL_SET = 1
ENDIF

LV_CHK_DMTL_VLD_CFM = 0

IF(1a) LV_ERR_DMTL_SET = 1
THEN(1a)
IF(2a)      (LV_ERR_DET_DMTL_MAX = 1      OR
              LV_ERR_DET_DMTL_MIN = 1      OR
              LV_SDR_DMTL = 1              OR
              LV_ERR_SIG_DMTL = 1)
THEN(2a)
IF(3a) [ LV_DIST_DMTL = 1      AND
          LV_ES = 0          AND
          (( LV_REFU_VAL = 1      AND
            LV_REFU_VAL(n-1) = 1 AND
            LV_FTL_DMTL_VAL = 1) OR
            LV_ERR_FTL = 1        OR
            LV_ERR_FTL_PLAUS )]] OR

```

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```

LV_DMTL_EOL = 1
THEN(3a)
  IF(4) LV_REFU_DMTLM = 0 OR
    LV_DMTL_EOL = 1
      THEN(4)
        IF(5) LV_ERR_DET_DMTL_MAX = 1
          THEN(5)
            IF(6a) LV_ERR_DMTL_MAX = 1
              THEN(6a)
                LV_CDN_DIAG_DMTL_MAX = 1
                LV_ERR_DMTL_MAX = 0
                ERR_SYM_DMTL_MAX = MAX
                LV_END_DIAG_DMTL_MAX = 1
              ENDIF(6a)

                LV_CDN_DIAG_DMTL_MAX = 1
                LV_ERR_DMTL_MAX = 1
                ERR_SYM_DMTL_MAX = MAX
                LV_END_DIAG_DMTL_MAX = 1

                LV_ERR_DMTLM = 1


                LV_ERR_DET_DMTL_MAX = 0
                LV_CHK_DMTL_CUR_DMTL_VLD_CFM = 1
                CTR_ERR_DET_DMTL_MAX =
                  CTR_ERR_DET_DMTL_MAX + 1
            ELSE(5)
              IF(6b) LV_ERR_DET_DMTL_MIN = 1
                THEN(6b)
                  IF(7a) LV_ERR_DMTL_MIN = 1
                    THEN(7a)
                      LV_CDN_DIAG_DMTL_MIN = 1
                      LV_ERR_DMTL_MIN = 0
                      ERR_SYM_DMTL_MIN = MIN
                      LV_END_DIAG_DMTL_MIN = 1
                    ENDIF(7a)

                      LV_CDN_DIAG_DMTL_MIN = 1
                      ERR_SYM_DMTL_MIN = MIN"
                      LV_ERR_DMTL_MIN = 1
                      LV_END_DIAG_DMTL_MIN = 1

                      LV_ERR_DMTLM = 1

                      LV_ERR_DET_DMTL_MIN = 0
                      LV_CHK_DMTL_CUR_DMTL_VLD_CFM = 1
                      CTR_ERR_DET_DMTL_MIN =
                        CTR_ERR_DET_DMTL_MIN + 1
                  ELSE(6b)
                    IF(7b) LV_SDR_DMTL = 1
                      THEN(7b)
                        IF(8a) LV_ERR_DMTL_PLAUS = 1

```

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```

THEN(8a)
    LV_CDN_DIAG_DMTL_PLAUS = 1
    LV_ERR_DMTL_PLAUS = 0
ERR_SYM_DMTL_PLAUS = PLAUS
    LV_END_DIAG_DMTL_PLAUS = 1
ENDIF(8a)

LV_CDN_DIAG_DMTL_PLAUS = 1
ERR_SYM_DMTL_PLAUS = PLAUS
LV_ERR_DMTL_PLAUS = 1
LV_END_DIAG_DMTL_PLAUS = 1

LV_ERR_DMTLM = 1


LV_SDR_DMTL = 0
LV_CHK_DMTL_CUR_DMTL_VLD_CFM = 1
    CTR_ERR_DET_DMTL_PLAUS =
        CTR_ERR_DET_DMTL_PLAUS + 1
ELSE(7b)
    IF(8b) LV_ERR_SIG_DMTL = 1
        THEN(8b)
            IF(9) LV_ERR_DMTL_SIG = 1
                THEN(9)
                    LV_CDN_DIAG_DMTL_SIG = 1
                    LV_ERR_DMTL_SIG = 0
                    ERR_SYM_DMTL_SIG = SIG
                    LV_END_DIAG_DMTL_SIG = 1
                ENDIF(9)
            ENDIF(9)
            ERR_SYM_DMTL_SIG = SIG
            LV_ERR_DMTL_SIG = 1
            LV_CDN_DIAG_DMTL_SIG = 1
            LV_END_DIAG_DMTL_SIG = 1

            LV_ERR_DMTLM = 1

            LV_ERR_SIG_DMTL = 0
            LV_CTR_CNL_SMALL_LEAK_MES_CFM = 1
                CTR_ERR_DET_DMTL_SIG =
                    ERR_DET_DMTL_SIG + 1
            ENDIF(8b)
        ENDIF(7b)
    ENDIF(6b)
ENDIF(5)
LV_CDN_DIAG_DMTL_MAX/MIN/PLAUS/SIG = 0

M6_CTR_CNL_SMALL_LEAK_MES =
    M6_CTR_CNL_SMALL_LEAK_MES_SAVE
M6_CUR_DMTL_COR_FIL_CID18 =
    M6_CUR_DMTL_COR_FIL_CID18_SAVE
M6_CUR_DMTL_COR_FIL_CID19 =
    M6_CUR_DMTL_COR_FIL_CID19_SAVE

```

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```

M6_CUR_DMTL_DMTLS_TEST =
    M6_CUR_DMTL_DMTLS_TEST_SAVE
M6_CUR_DMTL_THD_DMTLS_TEST =
    M6_CUR_DMTL_THD_DMTLS_TEST_SAVE

LV_ERR_DMTL_SET = 0
LV_CHK_DMTL_VLD_CFM = 1
LV_REFU_DMTLM = 0
ELSE(4)
    LV_ERR_DET_DMTL_MAX = 0
    LV_ERR_DET_DMTL_MIN = 0
    LV_SDR_DMTL = 0
    LV_ERR_SIG_DMTL = 0
    LV_ERR_DMTL_SET = 0
    LV_REFU_DMTLM = 0
ENDIF(4)
ENDIF(3a)
ELSE(2a)
    LV_CDN_DIAG_DMTL_MAX/MIN/PLAUS/SIG = 1
    ERR_SYM_DMTL_MAX/MIN/PLAUS/SIG = "NO_SYM"
    LV_ERR_DMTL_MAX/MIN/PLAUS/SIG = 0
    LV_END_DIAG_DMTL_MAX/MIN/PLAUS/SIG = 1
    LV_CDN_DIAG_DMTL_MAX/MIN/PLAUS/SIG = 0

LV_ERR_DMTLM = 0


CTR_ERR_DET_DMTL_MAX = CTR_ERR_DET_DMTL_MAX - 1
CTR_ERR_DET_DMTL_MIN = CTR_ERR_DET_DMTL_MIN - 1
CTR_ERR_DET_DMTL_SIG = CTR_ERR_DET_DMTL_SIG - 1
CTR_ERR_DET_DMTL_PLAUS = CTR_ERR_DET_DMTL_PLAUS - 1

LV_ERR_DMTL_SET = 0
LV_REFU_DMTLM = 0
LV_CHK_DMTL_CUR_DMTL_VLD_CFM = 1
LV_CHK_DMTL_VLD_CFM = 1

M6_CTR_CNL_SMALL_LEAK_MES =
    M6_CTR_CNL_SMALL_LEAK_MES_SAVE
M6_CUR_DMTL_COR_FIL_CID18 = M6_CUR_DMTL_COR_FIL_CID18_SAVE
M6_CUR_DMTL_COR_FIL_CID19 = M6_CUR_DMTL_COR_FIL_CID18_SAVE
M6_CUR_DMTL_DMTLS_TEST = M6_CUR_DMTL_DMTLS_TEST_SAVE
M6_CUR_DMTL_THD_DMTLS_TEST =
    M6_CUR_DMTL_THD_DMTLS_TEST_SAVE
ENDIF(2a)
ENDIF(1a)

IF(1b) CTR_ERR_DET_DMTL_MAX > C_CTR_ERR_DET_DMTLM_LEAK
THEN(1b)
    IF(2b) LV_END_DIAG_DMTL_MAX = 0 --> 1
    THEN(2b)
        IF(3b) LV_ERR_DMTL_MAX = 1
        THEN(3b) CTR_DIAG_CFM_DMTL_MAX = CTR_DIAG_CFM_DMTL_MAX - 1

```

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```

ELSE(3b) CTR_DIAG_CFM_DMTL_MAX = C_CTR_DIAG_CFM_DMTLM_LEAK
ENDIF(3b)
ENDIF(2b)
ELSE(1b) CTR_DIAG_CFM_DMTL_MAX = C_CTR_DIAG_CFM_DMTLM_LEAK
ENDIF(1b)

IF(1c) CTR_ERR_DET_DMTL_MIN > C_CTR_ERR_DET_DMTLM_LEAK
THEN(1c)
IF(2c) LV_END_DIAG_DMTL_MIN = 0 --> 1
THEN(2c)
IF(3c) LV_ERR_DMTL_MIN = 1
THEN(3c) CTR_DIAG_CFM_DMTL_MIN = CTR_DIAG_CFM_DMTL_MIN - 1
ELSE(3c) CTR_DIAG_CFM_DMTL_MIN = C_CTR_DIAG_CFM_DMTLM_LEAK
ENDIF(3c)
ENDIF(2c)
ELSE(1c) CTR_DIAG_CFM_DMTL_MIN = C_CTR_DIAG_CFM_DMTLM_LEAK
ENDIF(1c)


IF(1d) CTR_ERR_DET_DMTL_PLAUS > C_CTR_ERR_DET_DMTLM_LEAK
THEN(1d)
IF(2c) LV_END_DIAG_DMTL_PLAUS = 0 --> 1
THEN(2c)
IF(3d) LV_ERR_DMTL_PLAUS = 1
THEN(3d) CTR_DIAG_CFM_DMTL_PLAUS = CTR_DIAG_CFM_DMTL_PLAUS - 1
ELSE(3d) CTR_DIAG_CFM_DMTL_PLAUS = C_CTR_DIAG_CFM_DMTLM_LEAK
ENDIF(3d)
ENDIF(2c)
ELSE(1d) CTR_DIAG_CFM_DMTL_PLAUS = C_CTR_DIAG_CFM_DMTLM_LEAK
ENDIF(1d)

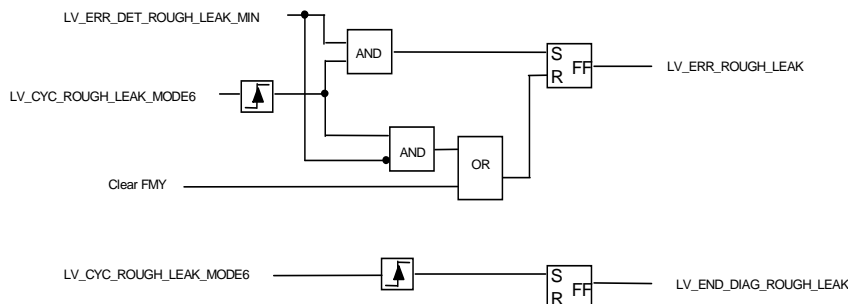
IF(1e) CTR_ERR_DET_DMTL_SIG > C_CTR_ERR_DET_DMTLM_LEAK
THEN(1e)
IF(2d) LV_END_DIAG_DMTL_SIG = 0 --> 1
THEN(2d)
IF(3e) LV_ERR_DMTL_SIG = 1
THEN(3e) CTR_DIAG_CFM_DMTL_SIG = CTR_DIAG_CFM_DMTL_SIG - 1
ELSE(3e) CTR_DIAG_CFM_DMTL_SIG = C_CTR_DIAG_CFM_DMTLM_LEAK
ENDIF(3e)
ENDIF(2d)
ELSE(1e) CTR_DIAG_CFM_DMTL_SIG = C_CTR_DIAG_CFM_DMTLM_LEAK
ENDIF(1e)

```

## How rough leak error is built

### Signal flow diagram:

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### Formula section:

If<sub>(1a)</sub> LV\_ERR\_DET\_ROUGH\_LEAK\_MIN = 1 AND  
 LV\_CYC\_ROUGH\_LEAK\_MODE6 = 1

Then<sub>(1a)</sub> IF<sub>(2a)</sub> LV\_ERR\_ROUGH\_LEAK = 1  
 THEN<sub>(2a)</sub>

LV\_CDN\_DIAG\_ROUGH\_LEAK = 1  
 LV\_ERR\_ROUGH\_LEAK = 0  
 ERR\_SYM\_ROUGH\_LEAK = MAX  
 LV\_END\_DIAG\_ROUGH\_LEAK = 1

ENDIF<sub>(2a)</sub>  
 LV\_CDN\_DIAG\_ROUGH\_LEAK = 1  
 LV\_ERR\_ROUGH\_LEAK = 1  
 ERR\_SYM\_ROUGH\_LEAK = MAX  
 LV\_END\_DIAG\_ROUGH\_LEAK = 1  
 LV\_CDN\_DIAG\_ROUGH\_LEAK = 0  
 CTR\_ERR\_DET\_ROUGH\_LEAK = CTR\_ERR\_DET\_ROUGH\_LEAK + 1

Endif<sub>(1a)</sub>

If<sub>(1b)</sub> [LV\_ERR\_DET\_ROUGH\_LEAK\_MIN = 0 AND  
 LV\_CYC\_ROUGH\_LEAK\_MODE6 = 1]

Then<sub>(1b)</sub> LV\_CDN\_DIAG\_ROUGH\_LEAK = 1  
 LV\_ERR\_ROUGH\_LEAK = 0  
 ERR\_SYM\_ROUGH\_LEAK = NO\_SYM  
 LV\_END\_DIAG\_ROUGH\_LEAK = 1  
 LV\_CDN\_DIAG\_ROUGH\_LEAK = 0  
 CTR\_ERR\_DET\_ROUGH\_LEAK = CTR\_ERR\_DET\_ROUGH\_LEAK - 1

Endif<sub>(1b)</sub>

IF<sub>(1c)</sub> CTR\_ERR\_DET\_ROUGH\_LEAK > C\_CTR\_ERR\_DET\_DMTLM\_LEAK  
 THEN

IF<sub>(2b)</sub> LV\_END\_DIAG\_ROUGH\_LEAK = 0 --> 1  
 THEN<sub>(2b)</sub>  
 IF<sub>(3)</sub> LV\_ERR\_ROUGH\_LEAK = 1  
 THEN<sub>(3)</sub> CTR\_DIAG\_CFM\_ROUGH\_LEAK =  
 CTR\_DIAG\_CFM\_ROUGH\_LEAK - 1  
 ELSE<sub>(3)</sub> CTR\_DIAG\_CFM\_ROUGH\_LEAK =

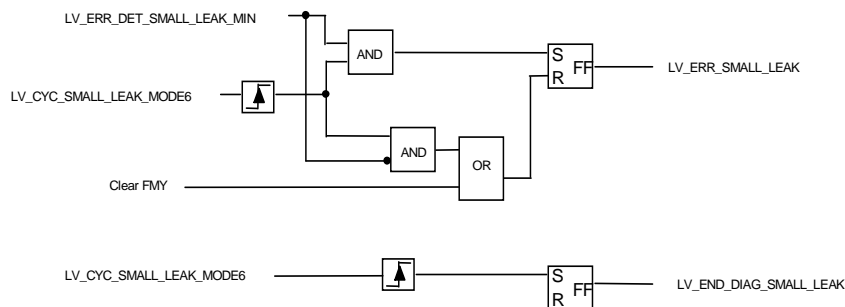
```

                                C_CTR_DIAG_CFM_DMTLM_LEAK
    ENDIF(3)
    ENDIF(2b)
    ELSE(1c)      CTR_DIAG_CFM_ROUGH_LEAK = C_CTR_DIAG_CFM_DMTLM_LEAK
    ENDIF(1c)

```

## How small leak error is built

### Signal flow diagram:



### Formula section:

```

If(1a)      LV_ERR_DET_SMALL_LEAK_MIN = 1           AND
                LV_CYC_SMALL_LEAK_MODE6 = 1
Then(1a)    ERR_SYM_SMALL_LEAK = SMALL_LEAK
                LV_CDN_DIAG_SMALL_LEAK = 1
                ACTION_ERRM_StorePrevFrF(SMALL_LEAK)
                LV_CDN_DIAG_SMALL_LEAK = 0
                M6_CUR_DMTL_SMALL_LEAK_END_SAVE = CUR_DMTL_SMALL_LEAK_END
                M6_CUR_DMTL_REF_LEAK_SAVE = CUR_DMTL_REF_LEAK

```

**Endif**<sup>(1a)</sup>

LV\_CYC\_SMALL\_LEAK\_MODE6\_CFM = 0

```

If(1b)      [LV_ERR_DET_SMALL_LEAK_MIN = 0           AND
                LV_CYC_SMALL_LEAK_MODE6 = 1]
Then(1b)    LV_CDN_DIAG_SMALL_LEAK = 1
                LV_ERR_SMALL_LEAK = 0
                ERR_SYM_SMALL_LEAK = NO_SYM
                LV_END_DIAG_SMALL_LEAK = 1
                LV_CDN_DIAG_SMALL_LEAK = 0

```

```

LV_ERR_DET_SMALL_LEAK_MIN_CFM = 0
LV_CYC_SMALL_LEAK_MODE6_CFM = 1
LV_REFU_DMTL_SMALL_LEAK = 0
CTR_ERR_DET_SMALL_LEAK = CTR_ERR_DET_SMALL_LEAK -.1

```

```

M6_CUR_DMTL_SMALL_LEAK_END_SAVE = CUR_DMTL_SMALL_LEAK_END
M6_CUR_DMTL_REF_LEAK_SAVE = CUR_DMTL_REF_LEAK
M6_CUR_DMTL_SMALL_LEAK_END =
    M6_CUR_DMTL_SMALL_LEAK_END_SAVE
M6_CUR_DMTL_REF_LEAK = M6_CUR_DMTL_REF_LEAK_SAVE

```

**Endif**<sub>(1b)</sub>

```

IF(1c)    LV_ERR_DET_SMALL_LEAK_MIN = 1    AND
           LV_ES = 0

```

**THEN**<sub>(1c)</sub>

```

IF(2a)    [ LV_DIST_DMTL = 1    AND
  ( (LV_REFU_VAL = 1    AND
    LV_REFU_VAL(n-1) = 1    AND
      LV_FTL_DMTL_VAL = 1)    OR
      LV_ERR_FTL = 1    OR
      LV_ERR_FTL_PLAUS )]    OR
    LV_DMTL_EOL = 1

```

**THEN**<sub>(2a)</sub>

```

IF(3a)    LV_REFU_DMTL_SMALL_LEAK = 0 OR
           LV_DMTL_EOL = 1

```

**THEN**<sub>(3a)</sub>

```

IF(4)    LV_ERR_SMALL_LEAK = 1
THEN(4)
    LV_CDN_DIAG_SMALL_LEAK = 1
    LV_ERR_SMALL_LEAK = 0
    ERR_SYM_SMALL_LEAK = MIN
    LV_END_DIAG_SMALL_LEAK = 1

```

**ENDIF**<sub>(4)</sub>

```

LV_CDN_DIAG_SMALL_LEAK = 1
LV_ERR_SMALL_LEAK = 1
ERR_SYM_SMALL_LEAK = MIN
LV_END_DIAG_SMALL_LEAK = 1
LV_CDN_DIAG_SMALL_LEAK = 0

```

```

LV_ERR_DET_SMALL_LEAK_MIN = 0
LV_ERR_DET_SMALL_LEAK_MIN_CFM = 1
LV_CYC_SMALL_LEAK_MODE6_CFM = 1
LV_REFU_DMTL_SMALL_LEAK = 0
CTR_ERR_DET_SMALL_LEAK =
    CTR_ERR_DET_SMALL_LEAK + 1
M6_CUR_DMTL_SMALL_LEAK_END =
M6_CUR_DMTL_SMALL_LEAK_END_SAVE
M6_CUR_DMTL_REF_LEAK =
    M6_CUR_DMTL_REF_LEAK_SAVE

```

**ELSE**<sub>(3a)</sub>

```


LV_ERR_DET_SMALL_LEAK_MIN = 0
LV_REFU_DMTL_SMALL_LEAK = 0

```

**ENDIF**<sub>(3a)</sub>

**ENDIF**<sub>(2a)</sub>

**ENDIF**<sub>(1c)</sub>

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```

IF(1d)      CTR_ERR_DET_SMALL_LEAK > C_CTR_ERR_DET_DMTLM_LEAK
THEN(1d)
  IF(2b)      LV_END_DIAG_SMALL_LEAK = 0 --> 1
  THEN(2b)
    IF(3b)      LV_ERR_SMALL_LEAK = 1
    THEN(3b)    CTR_DIAG_CFM_SMALL_LEAK = CTR_DIAG_CFM_SMALL_LEAK- 1
    ELSE(3b)    CTR_DIAG_CFM_SMALL_LEAK = C_CTR_DIAG_CFM_DMTLM_LEAK
    ENDIF(3b)
  ENDIF(2b)
  ELSE(1d)    CTR_DIAG_CFM_SMALL_LEAK = C_CTR_DIAG_CFM_DMTLM_LEAK
ENDIF(1d)

```

### B.93.19 End of line test and factory test of DMTL function

#### Application conditions

**Recurrence:** 100 ms

**Activation:** LV\_CONF\_DMTL = 1

**Initialisation:** LV\_DMTL\_ASA = 0

#### FUNCTION DESCRIPTION:

The end of line test and the factory test must permit execution of the tank leak diagnostic function via test unit.

The fundamental difference is the fact that at the end of line, the timeout monitoring of the test unit signal is deleted and that a change-over of "ignition key" into both directions does not interrupt the function. Another particularity of the end of line function is the fact that the function is started anew without any further test unit intervention if it has been aborted due to "engine speed detected, but START not exited", provided that all enable conditions are present.

On the other hand, activation in the factory is only admissible with the test unit connected and ignition key ON.

#### Formula section:

```

If          (STATE_EOL_KWP_DMTL      = 0 (Start Command from Tester received) )
Then       LV_DMTL_ASA = 1
Else if    (STATE_EOL_KWP_DMTL      = 7 (Stop Command from Tester received) )
Then       LV_DMTL_ASA = 0
Endif

```

```


If          LV_DMTL_ASA = 1      AND
           TRT < C_TRT_DMTL_EOL_MAX
Then       LV_DMTL_EOL = 1
Endif

```

```

If          LV_PUC = 1 OR LV_PU = 1 OR LV_PL = 1 OR LV_IS = 1      OR
           LV_DMTL_ACT = 1 0      OR

```


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```

                LV_DMTL_STOP = 1
                (STATE_EOL_KWP_DMTL = 7 (Stop Command from Tester received) ) OR
                T_DMTL_EOL > C_T_DMTL_EOL_MAX
    Then
    Endif
LV_DMTL_EOL = 0
If
    Then
        T_DMTL_EOL = T_DMTL_EOL + 100 ms
    Else
        T_DMTL_EOL = 0
Endif

If LV_DMTL_EOL
    Then
        /*DIAGNOSIS CURRENTLY RUNNING,
        OUTPUT OF STATE VARIABLE */
        STATE_DMTL_EOL = STATE_DMTL
    Else /* DIAGNOSIS CANCELLED OR FINISHED */
        If !LV_VB_RANGE_DMTL
            Then
                /* VB IS OUT OF RANGE FOR EOLT */
                STATE_DMTL_EOL = VB_OUT_OF_RANGE;
            Else
                If !LV_ENA_LEAK_DMTL
                    Then
                        /* ELECTRICAL ERROR */
                        STATE_DMTL_EOL = ELECTRICAL_ERR;
                    Else
                        If T_DMTL_EOL >= C_T_DMTL_EOL_MAX
                            Then
                                /* MAX. DURATION OF DIAGNOSIS REACHED */
                                STATE_DMTL_EOL = T_DMTL_MAX;
                            Else
                                If LV_DET_REFU
                                    Then
                                        /* REFUELLMENT */
                                        STATE_DMTL_EOL = REFUELLING;
                                    Else
                                        If LV_VB_DIF_MAX
                                            Then
                                                /* GITTER VB TOO LARGE */
                                                STATE_DMTL_EOL = VB_GITTER;
                                            Else
                                                If LV_CUR_DMTL_REF_DIF_MAX
                                                    Then
                                                        /* GITTER REFERENCE CURRENT TOO
                                                        LARGE */
                                                        STATE_DMTL_EOL = CUR_REF_DIF_MAX;

```

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```

Else
If (LV_CUR_DMTL_THD_DIF_MES)
Then
/* FALLING CURRENT DURING
MEASUREMENT */
STATE_DMTL_EOL =
THD_CUR_DMTL_DIF_MES;
Endif
Endif
Endif
Endif
Endif
Endif
Endif
Endif

```

## B.93.20 Heater DMTL module

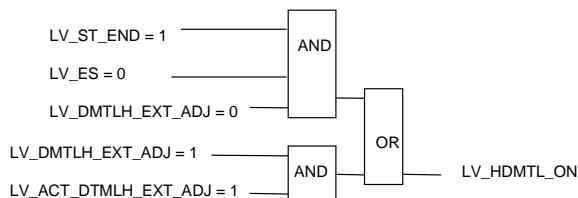
### Application conditions

**Recurrence:** 100 ms

**Activation:** LV\_CONF\_DMTL = 1

**Initialisation:** LV\_HDMTL\_ON = 0

### Signal flow diagram:



### Formula section:

```

If
    [(1) LV_DMTLH_EXT_ADJ = 1
    LV_ACT_DMTLH_EXT_ADJ = 1] (1)
    [(6) LV_DMTLH_EXT_ADJ = 0
    LV_ST_END = 1
    LV_ES = 0]
Then
    LV_HDMTL_ON = 1
Else
    LV_HDMTL_ON = 0
Endif

```

**AND**  
**OR**  
**AND**  
**AND**

## B.93.21 Mode06 DMTL

**General information:**

Testvalues and Tresholds has to be prepared for output via obdII-communication mode06.  
All M6\_XX has to be set to 0 in case of clearing failure memory.

**Formula section:**

Module-Diagnosis, minimum failure: (see "State machine" chapter "How the error DMTL module is built up")

M6\_CUR\_DMTL\_COR\_FIL\_CID18

Module-Diagnosis, maximum failure: (see "State machine" chapter "How the error DMTL module is built up")

M6\_CUR\_DMTL\_COR\_FIL\_CID19

Module-Diagnosis, plausibility failure: (see "State machine" chapter "How the error DMTL module is built up")

M6\_CUR\_DMTL\_DMTLS\_TEST  
M6\_CUR\_DMTL\_THD\_DMTLS\_TEST

Module-Diagnosis, plausibility failure: (see chapter "How the error DMTL module is built up")

M6\_CTR\_CNL\_SMALL\_LEAK\_MES

DMTL, Rough-leak, short cycle:

```

IF      LV_CYC_ROUGH_LEAK_MODE6 = 1 AND LV_ROUGH_LEAK_MES_LEN = 0
  THEN
    M6_CUR_DMTL_ROUGH_LEAK_END = CUR_DMTL_ROUGH_LEAK_END
    M6_CUR_DMTL_THD_ROUGH_LEAK = CUR_DMTL_THD_ROUGH_LEAK
  ELSE
    m6_cur_dmtl_rough_leak_end = m6_cur_dmtl_rough_leak_end
    m6_cur_dmtl_thd_rough_leak = M6_cur_dmtl_thd_rough_leak
ENDIF

```

DMTL, Small-leak: (see chapter "How small leak error is built up")

M6\_CUR\_DMTL\_SMALL\_LEAK\_END  
M6\_CUR\_DMTL\_REF\_LEAK


DMTL, Rough-leak, long cycle:

```

IF      LV_CYC_ROUGH_LEAK_MODE6 = 1 AND LV_ROUGH_LEAK_MES_LEN = 1
  THEN
    M6_CUR_DMTL_ROUGH_LEAK_LEN_END = CUR_DMTL_ROUGH_LEAK_LEN_END
    M6_CUR_DMTL_THD_ROUGH_LEAK_LEN = CUR_DMTL_THD_ROUGH_LEAK_LEN
  ELSE
    M6_CUR_DMTL_ROUGH_LEAK_LEN_END = M6_CUR_DMTL_ROUGH_LEAK_LEN_END

    M6_CUR_DMTL_THD_ROUGH_LEAK_LEN=M6_CUR_DMTL_THD_ROUGH_LEAK_LEN
ENDIF

```

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## B.94 Leakage detection pump function diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CNL_SMALL_LEAK_MES_VIRT	O/V/S	0... FFH	0... 255	1	-
Virtual number of aborted miniature leak measurements dur to current fluctuations					
LV_CHK_DMTL_CUR_DMTL_VLD_VIRT	O/V/S	0... 1H	0 ...1	1	-
Virtual check of component concerning valid pump current					
LV_CTR_CNL_SMALL_LEAK_VIRT	O/V/S	0... 1H	0 ...1	1	-
Virtual aborted miniature leak measurements due to current fluctuations exceeded					
LV_DET_NO_ROUGH_LEAK	O/V/S	0... 1H	0 ...1	1	-
Condition leak check done and no rough leak detected					
LV_DET_NO_SMALL_LEAK	O/V/S	0... 1H	0 ...1	1	-
Stored bit, that in the last DC no small leak was recognized					
LV_DET_SMALL_LEAK	O/V/S	0... 1H	0 ...1	1	-
Stored bit, that in the last DC small leak was recognized					
LV_INH_DIAG_RBM_DMTL	O/V	0... 1H	0 ...1	1	-
Flag to inhibit DMTL diagnosis function if there is a OBD failure					
STATE_RBM_DMTLM	O/V	0... 7H	0 ...7	1	-
Interface of DMTLM monitor with the Rate-Based Monitoring statistics					
STATE_RBM_ROUGH_LEAK	O/V	0... 7H	0 ...7	1	-
Interface of ROUGH_LEAK monitor with the Rate-Based Monitoring					
STATE_RBM_SMALL_LEAK	O/V	0... 7H	0 ...7	1	-
Interface of SMALL_LEAK monitor with the Rate-Based Monitoring statistics					
T_AST_DMTL_RBM	V	0... FFFFH	0... 6553.5	0.1	s
cumulative time since engine start for incrementation of the evaporative system monitor denominator					

### Input data:

C_DIST_REFU_ROUGH_LEAK_MIN {p. 5973}	C_SUM_CNL_SMALL_LEAK_MES_MAX {p. 5973}	CTR_ERR_DYN_NR {p. 5767}	LV_CHK_DMTL_CUR_DMTL_VLD_CFM {p. 5962}
LV_CHK_DMTL_VLD_CFM {p. 5962}	LV_CTR_CNL_SMALL_LEAK_MES_CFM {p. 5962}	LV_CYC_ROUGH_LEAK_MODE6 {p. 5963}	LV_CYC_SMALL_LEAK_MODE6_CFM {p. 5963}
LV_DC {p. 5746}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_DET_ROUGH_LEAK_MIN {p. 5965}
LV_ERR_DET_SMALL_LEAK_MIN_CFM {p. 5965}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DMTL_PUMP {p. 4626}	LV_ERR_DMTLH {p. 4626}
LV_ERR_DMTLM {p. 5965}	LV_ERR_DMTLS {p. 4627}	LV_ERR_EL_CPS {p. 4708}	LV_ERR_SPI_MPS {p. 4245}
LV_ERR_TAM_CAN {p. 5076}	LV_ERR_TAM_PLAUS {p. 5076}	LV_ERR_TCO {p. 4496}	LV_ERR_TCO_STUCK_RNG {p. 5675}
LV_ERR_VS {p. 5021}	LV_FTL_DMTL_VAL {p. 5966}	LV_IGK {p. 906}	LV_REFU {p. 5966}

LV_REFU_VAL {p. 5967}	T_ES_CUS {p. 1444}	TAM {p. 1579}	TAM_ST {p. 1214}
TCO_ST {p. 1100}	VS {p. 1176}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_COD_DMTL_RBM	-	0... FFH	0... 255	1	-
configuration byte for DMTL RBM					
C_T_AST_DMTL_RBM	-	0... FFFFH	0... 6553.5	0.1	s
Minimum cumulative time since engine start for incrementation of the evaporative system monitor denominator					
C_T_DLY_FTL_DMTL_VAL	-	0... FFFFH	0... 6553.5	0.1	s
Delay time for a valid FTL for DMTL_RBM					
C_T_ES_DMTL_DIAG_MAX	-	0... FFFFH	0... 65535	1	min
Maximum time for a DMTL diagnosis					
C_TAM_MAX_DMTL_RBM	-	0... FEH	-48... 142.5	0.75	°C
Maximum ambient temperature threshold for DMTL_RBM					
C_TAM_MIN_DMTL_RBM	-	0... FEH	-48... 142.5	0.75	°C
Minimum ambient temperature threshold for DMTL_RBM					
C_TAM_ST_HYS_DMTL_RBM	-	80... 7FH	-96... 95.25	0.75	°C
Ambient temperature hysteresis for DMTL_RBM					
C_TCO_ST_MAX_DMTL_RBM	-	0... FEH	-48... 142.5	0.75	°C
Maximum engine start temperature threshold for DMTL_RBM					
C_TCO_ST_MIN_DMTL_RBM	-	0... FEH	-48... 142.5	0.75	°C
Minimum engine start temperature threshold for DMTL_RBM					

**Import actions:**

<b>ACTION_ERRM_CheckPendingStatus</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR_PND>)
--

**B.94.1 Inhibition of diagnosis****FUNCTION DESCRIPTION:****Description:**

If one of the following components fail the DMTL diagnosis function is stopped by LV\_INH\_DIAG\_RBM\_DMTL = 1.


**Application conditions**

**Initialization:** 0 at reset

**Recurrence:** 0.1 sec

**Activation:** LV\_DC transition 0 -> 1 (start driving cycle)

**Deactivation:** LV\_DC transition 1 -> 0 (driving cycle terminated)

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**Formula section:**Inhibition due to OBDI error

```

if          LV_ERR_EL_CPS = 1
or         LV_ERR_DIAGCPS = 1
or         LV_ERR_DMTLS = 1
or         LV_ERR_DMTL_PUMP = 1
or         LV_ERR_TCO = 1
or         LV_ERR_VS = 1
or         LV_ERR_SPI_MPS = 1
or         LV_ERR_TAM = 1
or         LV_ERR_AMP = 1
or         LV_ERR_AMP_PLAUS = 1
or         LV_ERR_DMTLH = 1
Then      LV_INH_DIAG_RBM_DMTL = 1
              (DMTL diagnosis inhibited due to OBD error)
Else      LV_INH_DIAG_RBM_DMTL = 0
              (DMTL diagnosis not inhibited)
Endif

```

**B.94.2 Interface for Rate - Based - Monitoring****FUNCTION DESCRIPTION:****General information:**

With this module the interface between the tank leakage detection monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_DMTLM, STATE\_RBM\_ROUGH\_LEAK and STATE\_RBM\_SMALL\_LEAK data.

Within STATE\_RBM\_xxx, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)  
( not valid for DMTL function )

**Application conditions:****Initialisation :**


at LV\_DC 0 1 transition :

```

bit 0, bit 1 and bit 2 of STATE_RBM_DMTLM = 0
bit 0, bit 1 and bit 2 of STATE_RBM_ROUGH_LEAK = 0
bit 0, bit 1 and bit 2 of STATE_RBM_SMALL_LEAK = 0
T_AST_DMTL_RBM = 0
LV_REFU_VAL_DC = 0
LV_DET_ROUGH_LEAK_VIRT = 0
LV_DET_SMALL_LEAK_VIRT = 0
DIST_DET_ROUGH_LEAK_VIRT = 0
T_DLY_FTL_DMTL_VAL = C_T_DLY_FTL_DMTL_VAL

```

on failure memory reset :

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bit 1 of STATE\_RBM\_DMTLM = 0  
 bit 1 of STATE\_RBM\_ROUGH\_LEAK = 0  
 bit 1 of STATE\_RBM\_SMALL\_LEAK = 0  
 CTR\_CNL\_SMALL\_LEAK\_MES\_VIRT = 0  
 LV\_CTR\_CNL\_SMALL\_LEAK\_VIRT = 0  
 LV\_CHK\_DMTL\_CUR\_DMTL\_VLD\_VIRT = 0  
 LV\_DET\_SMALL\_LEAK = 0  
 LV\_DET\_NO\_SMALL\_LEAK = 0  
 LV\_DET\_NO\_ROUGH\_LEAK = 0  
 LV\_DET\_ROUGH\_LEAK = 0  
 DIST\_DET\_ROUGH\_LEAK\_VIRT = 0

at reset:

CTR\_CNL\_SMALL\_LEAK\_MES\_VIRT out of NVMY  
 LV\_CTR\_CNL\_SMALL\_LEAK\_VIRT out of NVMY  
 LV\_CHK\_DMTL\_CUR\_DMTL\_VLD\_VIRT out of NVMY  
 LV\_DET\_SMALL\_LEAK out of NVMY  
 LV\_DET\_NO\_SMALL\_LEAK out of NVMY  
 LV\_DET\_NO\_ROUGH\_LEAK out of NVMY  
 T\_DLY\_FTL\_DMTL\_VAL = C\_T\_DLY\_FTL\_DMTL\_VAL

Recurrence: 100ms

Activation: LV\_DC 0 1 transition and LV\_DC = 1

### Formula section:

#### At LV\_DC 0 1 transition

The pending status of the following failures has to be checked only once :

LV_ERR_DIAGCPS	LV_ERR_EL_CPS	LV_ERR_TCO_EL	LV_ERR_TCO_GRD
LV_ERR_TCO_STUCK	LV_ERR_TCO_PLAUS	LV_ERR_VS	LV_ERR_DMTLS
LV_ERR_DMTL_PUMP	LV_ERR_SPI_MPS	LV_ERR_DMTLH	LV_ERR_TCO_STUCK_R NG
LV_ERR_TAM_CAN	LV_ERR_TAM_PLAUS	LV_ERR_AMP	LV_ERR_AMP_PLAUS

**If(1)** { CPU optimization at LV\_DC 0 1 transition }  
 CTR\_ERR\_DYN\_NR <> 0 { the dynamic failure memory isn t empty }

**Then(1)**

**While** bit 1 of STATE\_RBM\_DMTLM = 0 **do**

with each XX failure of the above list :

ACTION\_ERRM\_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

**If(2)** XX has a pending status

**Then(2)**

bit 1 of STATE\_RBM\_DMTLM = 1

**Endif(2)**

**Endwhile**

**Else(1)**

{ the dynamic failure memory is empty }

No action

**Endif(1)**

**If(1)** { CPU optimization at LV\_DC 0 1 transition }  
 CTR\_ERR\_DYN\_NR <> 0 { the dynamic failure memory isn t empty }

**Then(1)**



```

While          bit 1 of STATE_RBM_ROUGH_LEAK = 0 do
  with each XX failure of the above list :
  ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

    If(2)          XX has a pending status
    Then(2)
      bit 1 of STATE_RBM_ROUGH_LEAK = 1
    Endif(2)
  Endwhile

Else(1)
  { the dynamic failure memory is empty }
  No action

Endif(1)

If(1)          { CPU optimization at LV_DC 0 1 transition }
  CTR_ERR_DYN_NR <> 0          { the dynamic failure memory isn t empty }

Then(1)
  While          bit 1 of STATE_RBM_SMALL_LEAK = 0 do
    with each XX failure of the above list :
    ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

      If(2)          XX has a pending status
      Then(2)
        bit 1 of STATE_RBM_SMALL_LEAK = 1
      Endif(2)
    Endwhile

  Else(1)
    { the dynamic failure memory is empty }
    No action

  Endif(1)


### numerator calculation DMTL module error
Every 100 ms
If          LV_CHK_DMTL_VLD_CFM = 0 → 1
Then          CTR_CNL_SMALL_LEAK_MES_VIRT ++
Endif

If          CTR_CNL_SMALL_LEAK_MES_VIRT >
  C_SUM_CNL_SMALL_LEAK_MES_MAX
Then          LV_CTR_CNL_SMALL_LEAK_VIRT = 1
  CTR_CNL_SMALL_LEAK_MES_VIRT = 0
Endif

If          (LV_CHK_DMTL_VLD_CFM = 1                                AND
  LV_CTR_CNL_SMALL_LEAK_MES_CFM = 1)
Then          CTR_CNL_SMALL_LEAK_MES_VIRT = 0
Endif

If          LV_CHK_DMTL_CUR_DMTL_VLD_CFM = 0 → 1                                OR
  LV_CTR_CNL_SMALL_LEAK_MES_CFM = 0 → 1
Then          LV_CHK_DMTL_CUR_DMTL_VLD_VIRT = 1
Endif

```

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```

If          bit 0 of STATE_RBM_DMTLM = 0
Then
  If          [LV_CTR_CNL_SMALL_LEAK_VIRT = 1                                OR
                [LV_ERR_DMTLM = 1          AND
                LV_CHK_DMTL_CUR_DMTL_VLD_VIRT = 1]]
                LV_IGK = 1                                AND
  Then          bit 0 of STATE_RBM_DMTLM = 1
                LV_CTR_CNL_SMALL_LEAK_VIRT = 0
                LV_CHK_DMTL_CUR_DMTL_VLD_VIRT = 0
  Endif
Endif

```

### numerator calculation DMTL rough leak error

Every 100 ms:

```

If          LV_FTL_DMTL_VAL = 0
Then          T_DLY_FTL_DMTL_VAL -
  If          T_DLY_FTL_DMTL_VAL > 0
  Then          LV_FTL_DMTL_VAL_VIRT = 0
  Else          LV_FTL_DMTL_VAL_VIRT = 1
  Endif
Else          T_DLY_FTL_DMTL_VAL = C_T_DLY_FTL_DMTL_VAL
                LV_FTL_DMTL_VAL_VIRT = 0
Endif

If          ((LV_REFU_VAL_DC = 0          AND
                LV_REFU = 0              AND
                LV_REFU_VAL = 1)        OR
                (LV_FTL_DMTL_VAL_VIRT = 1 AND
                C_COD_DMTL_RBM = 0. bit)) AND
                T_ES_CUS > C_T_ES_DMTL_DIAG_MAX
Then          LV_T_ES_NO_REFU = 1
Else          LV_T_ES_NO_REFU = 0
Endif

If          LV_ERR_DET_ROUGH_LEAK_MIN = 0          AND
                LV_CYC_ROUGH_LEAK_MODE6 = 1
Then          LV_DET_NO_ROUGH_LEAK = 1
Endif

If          LV_DET_NO_ROUGH_LEAK = 1
Then          If          LV_REFU_VAL = 0 1          AND
                LV_REFU = 1
  Then          DIST_DET_ROUGH_LEAK_VIRT = 0
  Endif

  If          [LV_FTL_DMTL_VAL = 1          AND
                LV_ERR_VS = 0              AND
                LV_IGK = 1                AND
                LV_VS_RUN = 1]
  Then          DIST_DET_ROUGH_LEAK_VIRT(n) =

```

```

        DIST_DET_ROUGH_LEAK_VIRT(n-1) + (VS /36)
    Endif

    If      LV_ERR_VS = 1                OR
           LV_FTL_DMTL_VAL_VIRT = 1    OR
           DIST_DET_ROUGH_LEAK_VIRT
           C_DIST_REFU_ROUGH_LEAK_MIN
    Then    LV_DIST_DMTL_VIRT = 1
    Else    LV_DIST_DMTL_VIRT = 0
    Endif

Endif

If      LV_ERR_DET_ROUGH_LEAK_MIN = 1    AND
       LV_CYC_ROUGH_LEAK_MODE6 = 1
Then    LV_DET_ROUGH_LEAK = 1
       LV_DET_NO_ROUGH_LEAK = 0
Endif

If      LV_DET_NO_ROUGH_LEAK = 1        AND
       LV_T_ES_NO_REFU = 1
Then    LV_DET_ROUGH_LEAK_VIRT = 1
Endif

If      bit 0 of STATE_RBM_ROUGH_LEAK = 0
Then
    If      [[LV_DIST_DMTL_VIRT = 1        AND
             LV_DET_ROUGH_LEAK_VIRT = 1]   OR
            LV_DET_ROUGH_LEAK = 1]        AND
           LV_IGK = 1
    Then    bit 0 of STATE_RBM_ROUGH_LEAK = 1
           LV_DET_NO_ROUGH_LEAK = 0
           LV_DET_ROUGH_LEAK = 0
    Endif

Endif

If      [T_ES_CUS ≤ C_T_ES_DMTL_DIAG_MAX    OR
       (LV_REFU_VAL_DC = 0                    AND
        LV_REFU = 1                            AND
        LV_REFU_VAL = 1)]                    AND
       LV_IGK = 1
Then    LV_T_ES_REFU = 1
       LV_DET_NO_ROUGH_LEAK = 0
Else    LV_T_ES_REFU = 0
Endif

```

### numerator calculation DMTL small leak error

Every 100 ms

```

If      LV_ERR_DET_SMALL_LEAK_MIN_CFM = 1    AND
       LV_CYC_SMALL_LEAK_MODE6_CFM = 1
Then    LV_DET_SMALL_LEAK = 1
       LV_DET_NO_SMALL_LEAK = 0
Endif

If      LV_ERR_DET_SMALL_LEAK_MIN_CFM = 0    AND

```

```

                LV_CYC_SMALL_LEAK_MODE6_CFM = 1
    Then          LV_DET_NO_SMALL_LEAK = 1
    Endif
    If            LV_DET_NO_SMALL_LEAK = 1                AND
                LV_T_ES_NO_REFU = 1
    Then          LV_DET_SMALL_LEAK_VIRT = 1
    Endif

    If            bit 0 of STATE_RBM_SMALL_LEAK = 0
    Then          If            [LV_DET_SMALL_LEAK = 1                OR
                            LV_DET_SMALL_LEAK_VIRT = 1]            AND
                            LV_IGK = 1
    Then          bit 0 of STATE_RBM_SMALL_LEAK = 1
                LV_DET_SMALL_LEAK = 0
                LV_DET_NO_SMALL_LEAK = 0
    Endif
    Endif

    If            LV_T_ES_REFU = 1
    Then          LV_DET_NO_SMALL_LEAK = 0
    Endif
    If            LV_REFU_VAL = 1
    Then          LV_REFU_VAL_DC = 1
    Endif

```

```

If            bit 1 of STATE_RBM_DMTLM = 0
Then
    If            LV_INH_DIAG_RBM_DMTL = 1
    Then          bit 1 of STATE_RBM_DMTLM = 1
    Endif
Endif

If            bit 1 of STATE_RBM_ROUGH_LEAK = 0
Then
    If            LV_INH_DIAG_RBM_DMTL = 1
    Then          bit 1 of STATE_RBM_ROUGH_LEAK = 1
    Endif
Endif

If            bit 1 of STATE_RBM_SMALL_LEAK = 0
Then
    If            LV_INH_DIAG_RBM_DMTL = 1
    Then          bit 1 of STATE_RBM_SMALL_LEAK = 1
    Endif
Endif

```

### ### denominator definition

```

If            C_TAM_MIN_DMTL_RBM ≤ TAM ≤ C_TAM_MAX_DMTL_RBM                AND
    LV_ST_END = 1
Then          if            T_AST_DMTL_RBM < C_T_AST_DMTL_RBM
                T_AST_DMTL_RBM ++

```

**Endif****Endif**

```

If          bit 2 of STATE_RBM_DMTLM = 0
Then If     TCO_ST < TAM_ST + C_TAM_ST_HYS_DMTL_RBM                AND
              C_TCO_ST_MIN_DMTL_RBM ≤ TCO_ST ≤ C_TCO_ST_MAX_DMTL_RBM  AND
              T_AST_DMTL_RBM ≥ C_T_AST_DMTL_RBM
Then       bit 2 of STATE_RBM_DMTLM = 1
Endif

```

**Endif**

```

If          bit 2 of STATE_RBM_ROUGH_LEAK = 0
Then If     TCO_ST < TAM_ST + C_TAM_ST_HYS_DMTL_RBM                AND
              C_TCO_ST_MIN_DMTL_RBM ≤ TCO_ST ≤ C_TCO_ST_MAX_DMTL_RBM  AND
              T_AST_DMTL_RBM ≥ C_T_AST_DMTL_RBM
Then       bit 2 of STATE_RBM_ROUGH_LEAK = 1
Endif

```


**Endif**

```

If          bit 2 of STATE_RBM_SMALL_LEAK = 0
Then If     TCO_ST < TAM_ST + C_TAM_ST_HYS_DMTL_RBM                AND
              C_TCO_ST_MIN_DMTL_RBM ≤ TCO_ST ≤ C_TCO_ST_MAX_DMTL_RBM  AND
              T_AST_DMTL_RBM ≥ C_T_AST_DMTL_RBM
Then       bit 2 of STATE_RBM_SMALL_LEAK = 1
Endif

```

**Endif**

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## B.95 Fuel system pressure diagnosis for low pressure (Appl. Inc.)

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_EFPPWM_PLAUS	V	0... FFH	0... 255	1	-
Increment of the plausibility check of EFPPWM anti-bounce counter					
C_ABC_INC_FUP_EFP_NOT_PLAUS	V	0... FFH	0... 255	1	-
Increment of the loose contact check of FUP EFP anti-bounce counter					
C_ABC_INC_L_PRS_SYS	V	0... FFH	0... 255	1	-
Increment of low pressure system monitoring anti-bounce counter					
C_ABC_MAX_EFPPWM_PLAUS	V	1... FFH	1... 255	1	-
Threshold to be reached, before plausibility check error of EFPPWM					
C_ABC_MAX_FUP_EFP_NOT_PLAUS	V	1... FFH	1... 255	1	-
Threshold to be reached, before FUP_EFP loose contact					
C_ABC_MAX_L_PRS_SYS	V	1... FFH	1... 255	1	-
Threshold to be reached, before permanently activating low pressure system monitoring error					

### General Information

The low pressure system diagnosis is not inhibited.

Error treatment:

Error debounce:

Debounce counter increment: C\_ABC\_INC\_L\_PRS\_SYS

Debounce counter maximum value: C\_ABC\_MAX\_L\_PRS\_SYS

Debounce counter increment: C\_ABC\_INC\_EFPPWM\_PLAUS

Debounce counter maximum value: C\_ABC\_MAX\_EFPPWM\_PLAUS

- Debounce counter increment: C\_ABC\_INC\_FUP\_EFP\_NOT\_PLAUS

- Debounce counter maximum value: C\_ABC\_MAX\_FUP\_EFP\_NOT\_PLAUS

**Configuration for diagnostic symptoms:**

Diagnosis	Symptom	nr	P-Code/ Failure	P-Code/ Symptom	Failure class A/B
<i>EFPPWM plausibility check</i>	integral part of EFPPWM out of range	0		P0002	0/NO_LAM P/10h
	adaptive integral part of EFPPWM out of range	1		P0002	
	adaptive minimum EFPPWM out of range	2		P0002	
EFPPWM_PLAUS					

Diagnosis	Symptom	nr	P-Code/ Failure	P-Code/ Symptom	Failure class A/B
<i>Low pressure system monitoring</i>	FUP_EFP top limit 1 reached	0		P0088	0/NO_LAM P/10h
	FUP_EFP top limit 2 reached	1		P0215	
	FUP_EFP bottom limit 1 reached	2		P0087	
L_PRS_SYS					

Diagnosis	Symptom	nr	P-Code/ Failure	P-Code/ Symptom	Failure class A/B
<i>FUP EFP loose contact</i>	Low pressure sensor loose contact	0		P0000	STD_INI
FUP_EFP_NOT_PLAUS					

**Application Conditions**

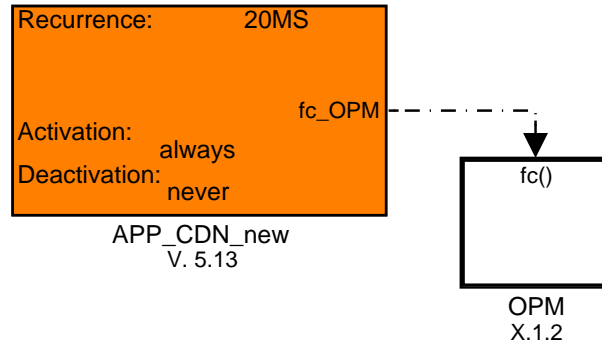
Initialization: all outputs to zero at RST

Recurrence: 20MS

Activation: 1

Deactivation: 0


**Function description**



SDA\_SRS / SDÄ V 5.0.4 24-Mar-2006

Figure B.95.1: : Path: FUSL\_MB073

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### B.95.1 CALCULATION

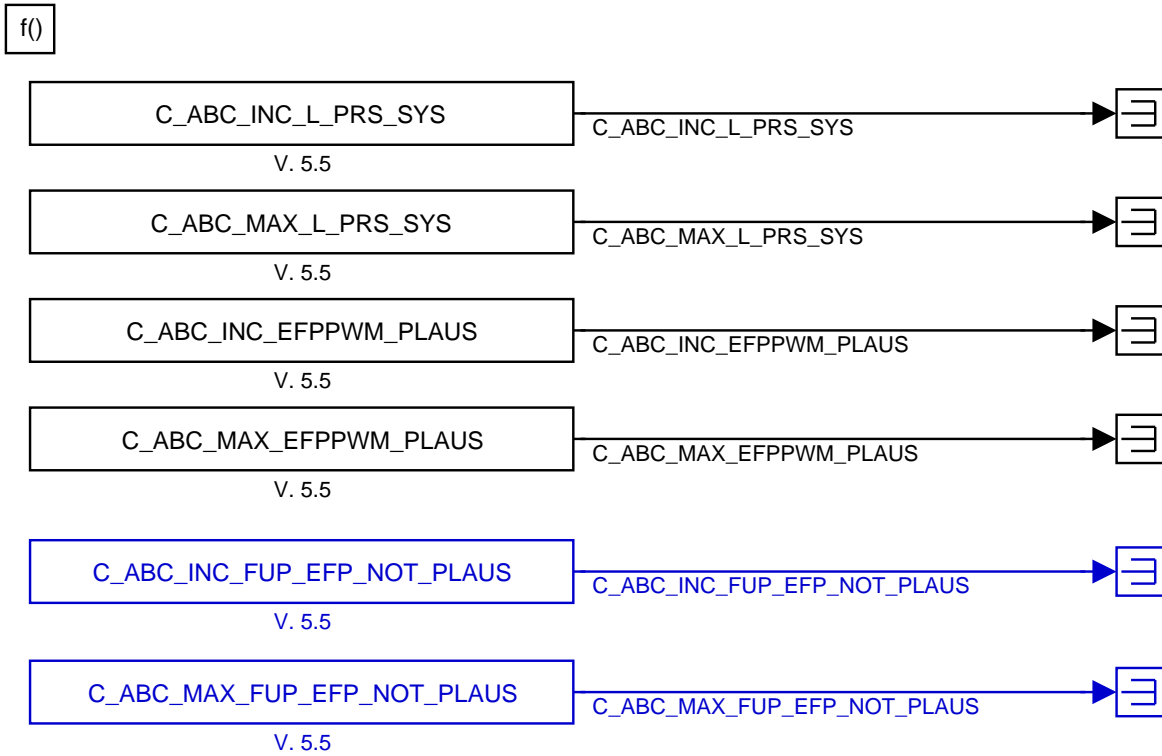


Figure B.95.2: : Path: FUSL\_MB073/OPM

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## B.96 Fuel system pressure diagnosis for low pressure

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_EFPPWM_PLAUS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom EFPPWM plausibility check					
ERR_SYM_FUP_EFP_NOT_PLAUS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom for FUP_EFP_NOT_PLAUS diagnosis					
ERR_SYM_L_PRS_SYS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom for low pressure system monitoring					
FUP_EFP_NOT_PLAUS	V	0... FFFFH	0... 173888	2.65336079	hPa
Filtered FUP_EFP for FUP_EFP_NOT_PLAUS diagnosis					
LV_CDN_DIAG_EFPPWM_PLAUS	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for EFPPWM plausibility check					
LV_CDN_DIAG_FUP_EFP_NOT_PLAUS	V	0... 1H	0 ...1	1	-
Condition flag for FUP_EFP_NOT_PLAUS diagnosis					
LV_CDN_DIAG_L_PRS_SYS	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for low pressure system monitoring					
LV_END_DIAG_EFPPWM_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis flag for EFPPWM plausibility check					
LV_END_DIAG_FUP_EFP_NOT_PLAUS	V	0... 1H	0 ...1	1	-
End diag flag for FUP_EFP_NOT_PLAUS diagnosis					
LV_END_DIAG_L_PRS_SYS	V	0... 1H	0 ...1	1	-
End of diagnosis flag for low pressure system monitoring					
LV_ERR_EFPPWM_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean that indicates inconsistencies of the EFPPWM signal					
LV_ERR_FUP_EFP_NOT_PLAUS	O/V	0... 1H	0 ...1	1	-
Error flag for FUP_EFP_NOT_PLAUS diagnosis					
LV_ERR_L_PRS_SYS	O/V	0... 1H	0 ...1	1	-
Boolean that indicates abnormal fuel pressure value in low pressure fuel system					
T_EFPPWM_PLAUS_0	V	0... FFH	0... 5.1	0.02	s
Delaytime for EFPPWM_PLAUS SYM 0					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_FUP_EFP_NOT_PLAUS_PWM_SWI	V	0... FFFFH	0... 1310.7	0.02	s
Timer for delay after STATE_PWM_SWI to allow FUP_EFP_NOT_PLAUS diagnosis					
T_PUC_END	V	0... FFH	0... 5.1	0.02	s
Timer EFPPWM plausibility check inhibition after PUC					

**Input data:**

EFPPWM_I {p. 3796}	EFPPWM_I_AD {p. 3796}	EFPPWM_MIN_AD {p. 3796}	FTL {p. 1564}
FUP_EFP {p. 1290}	FUP_EFP_MES {p. 1290}	FUP_EFP_SP {p. 3792}	LV_ECU_LOCK
LV_ECU_SLA {p. 800}	LV_EFPPWM_I_AD_VLD {p. 3796}	LV_EFPPWM_MIN_VLD {p. 3797}	LV_ERR_CAN_BOFF {p. 4846}
LV_ERR_COM_2_BOFF {p. 801}	LV_ERR_COM_2_EFP {p. 801}	LV_ERR_COM_3_BOFF {p. 801}	LV_ERR_COM_3_EFP {p. 801}
LV_ERR_EFP {p. 4721}	LV_ERR_FUP_EFP {p. 4733}	LV_FUP_LIH_HOM_VCV_ OPEN_REQ {p. 4001}	LV_FUP_LIH_L_PRS_ CTL_REQ {p. 4001}
LV_IGK {p. 906}	LV_PUC {p. 1720}	LV_VAR_EFP_COM_2 {p. 805}	LV_VAR_EFP_COM_3 {p. 805}
MFF_SP_FUP_CTL {p. 2151}	N_32 {p. 1525}	NC_STATE_ECU_MST_ SLA {p. 806}	STATE_EFP {p. 3797}
STATE_PWM_VCV {p. 3955}	T_AST {p. 1766}	TCO {p. 1100}	VFF_MFF_SP_FUP_CTL {p. 3881}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FUP_EFP_NOT_PLAUS	V	0... FFH	0... 0.99609375	0.00390625	-
Correlation constant for FUP_EFP_NOT_PLAUS calculation					
C_EFPPWM_I_AD_DIAG_MAX	V	8000... 7FFFH	-50... 49.998474121093	0.00152587	%
Maximum threshold for adaptive I-part of the EFPPWM					
C_EFPPWM_I_AD_DIAG_MIN	V	8000... 7FFFH	-50... 49.998474121093	0.00152587	%
Minimum threshold for adaptive I-part of the EFPPWM					
C_EFPPWM_I_DIAG_MAX	V	8000... 7FFFH	-50... 49.998474121093	0.00152587	%
Maximum threshold for I-part of the EFPPWM					
C_EFPPWM_I_DIAG_MIN	V	8000... 7FFFH	-50... 49.998474121093	0.00152587	%
Minimum threshold for I-part of the EFPPWM					
C_EFPPWM_MIN_AD_DIAG_MAX	V	0... FFFFH	0... 99.998474121093	0.00152587	%
Maximum threshold for adaptive minimum EFPPWM					
C_EFPPWM_MIN_AD_DIAG_MIN	V	0... FFFFH	0... 99.998474121093	0.00152587	%
Minimum threshold for adaptive minimum EFPPWM					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FTL_MIN_EFPPWM_PLAUS_DIAG	V	0... 7FH	0... 127	1	l
Minimum fuel tank level for the EFPPWM plausibility diagnosis					
C_FTL_MIN_L_PRS_SYS_DIAG	V	0... 7FH	0... 127	1	l
Minimum fuel tank level for the low pressure system diagnosis					
C_FUP_EFP_BOL_1	V	0... FFFFH	0... 173888	2.65336079	hPa
Bottom fuel pressure threshold 1					
C_FUP_EFP_NOT_PLAUS_DEV_MAX	V	0... FFFFH	0... 173888	2.65336079	hPa
Maximum FUP EFP deviation for FUP_EFP_NOT_PLAUS error					
C_FUP_EFP_SP_DIF_DIAG_FUP_EFP	V	0... FFFFH	0... 173888	2.65336079	hPa
Condition for stable FUP EFP for NOT_PLAUS error					
C_FUP_EFP_SP_MAX_EFPPWM_PLAUS	V	0... FFFFH	0... 173888	2.65336079	hPa
Maximum fuel pressure setpoint of electrical fuel pump for the plausibility check					
C_FUP_EFP_SP_MIN_EFPPWM_PLAUS	V	0... FFFFH	0... 173888	2.65336079	hPa
Minimum fuel pressure setpoint of electrical fuel pump for the plausibility check					
C_FUP_EFP_TOL_1	V	0... FFFFH	0... 173888	2.65336079	hPa
Top fuel pressure threshold 1					
C_FUP_EFP_TOL_2	V	0... FFFFH	0... 173888	2.65336079	hPa
Top fuel pressure threshold 2					
C_MFF_SP_MAX_EFPPWM_PLAUS	V	0... FFFFH	0... 1389	0.02119478	mg/stk
Maximum mass fuel flow setpoint of fuel pressure control used for the plausibility check					
C_MFF_SP_MAX_FUP_EFP_NOT_PLAUS	V	0... FFFFH	0... 1389	0.02119478	mg/stk
Maximum injected fuel mass for the FUP_EFP_NOT_PLAUS diagnosis					
C_MFF_SP_MIN_EFPPWM_PLAUS	V	0... FFFFH	0... 1389	0.02119478	mg/stk
Minimum mass fuel flow setpoint of fuel pressure control used for the plausibility check					
C_MFF_SP_MIN_FUP_EFP_NOT_PLAUS	V	0... FFFFH	0... 1389	0.02119478	mg/stk
Minimum injected fuel mass for the FUP_EFP_NOT_PLAUS diagnosis					
C_N_32_FUP_EFP_DIAG	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for EFPPWM plausibility check (Default value 800)					
C_N_32_MAX_EFPPWM_PLAUS	V	0... FFH	0... 8160	32	rpm
Maximum engine speed for the plausibility check					
C_N_32_MAX_FUP_EFP_NOT_PLAUS	V	0... FFH	0... 8160	32	rpm
Maximum engine speed for the FUP_EFP_NOT_PLAUS diagnosis					
C_N_32_MAX_L_PRS_SYS	V	0... FFH	0... 8160	32	rpm
Maximum engine speed for the plausibility check					
C_N_32_MIN_EFPPWM_PLAUS	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for the plausibility check					
C_N_32_MIN_FUP_EFP_NOT_PLAUS	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for the FUP_EFP_NOT_PLAUS diagnosis					
C_N_32_MIN_L_PRS_SYS	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for the plausibility check					
C_T_AST_FUP_EFP_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
Time for inhibit diagnosis for the low pressure system					
C_T_AST_FUP_EFP_NOT_PLAUS	V	0... FFFFH	0... 6553.5	0.1	s
Time after start to allow FUP_EFP_NOT_PLAUS diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_EFPPWM_PLAUS_0	V	0... FFH	0... 5.1	0.02	s
INI value of delaytime for EFPPWM_PLAUS SYM 0					
C_T_FUP_EFP_NOT_PLAUS_PWM_SWI	V	0... FFFFH	0... 1310.7	0.02	s
Time after STATE_PWM_SWI to allow FUP_EFP_NOT_PLAUS diagnosis					
C_T_PUC_END_EFPPWM_PLAUS	V	0... FFH	0... 5.1	0.02	s
Time of EFPPWM plausibility check inhibition after PUC					
C_TCO_MAX_EFPPWM_PLAUS	V	0... FEH	-48... 142.5	0.75	°C
Maximum temperature for the plausibility check					
C_TCO_MIN_EFPPWM_PLAUS	V	0... FEH	-48... 142.5	0.75	°C
Minimum temperature for the plausibility check					
C_VFF_SP_MAX_EFPPWM_PLAUS	V	0... FFFFH	0... 255	0.00389105	l/h
Maximum volume fuel flow through the injectors for the plausibility check					
C_VFF_SP_MIN_EFPPWM_PLAUS	V	0... FFFFH	0... 255	0.00389105	l/h
Minimum volume fuel flow through the injectors for the plausibility check					
LC_EFPPWM_I_AD_ENA	V	0... 1H	0 ...1	1	-
Logical constant for enabling of the I-Part adaptive					
LC_EFPPWM_MIN_ENA	V	0... 1H	0 ...1	1	-
Logical constant for enabling of the minimum EFPPWM					

## General information

The purpose of this module is to diagnose mechanical errors in the low pressure system.

Specific diagnostic information for the project is defined in chapters 'Diagnosis information' (freeze frame, DTC, error code number, symptom number, data for MIL management, ...).

After debounce, the corresponding error bit LV\_ERR... is set to 1, and the corresponding symptom is active.

Only if the driving cycle is finished, the error bit LV\_ERR... and the debounced counter are set to 0, and the corresponding symptom is not active.

## B.96.1 Fuel system pressure diagnosis for low pressure

### General information:

If the software works in a master/slave ECU environment, the compiler switch NC\_STATE\_ECU\_MST\_SLA has a value > 0.

In this case, the module will not be activated on the slave ECU, and all outputs will remain 0.

### Application conditions:


#### Initialisation:

All values are initialized at ECU Reset, according Filter-type  
STD\_INI

T\_PUC\_END = C\_T\_PUC\_END\_EFPPWM\_PLAUS

#### Activation:

**If** ( NC\_STATE\_ECU\_MST\_SLA = 0 // no master/ slave system  
**or** LV\_ECU\_SLA = 0 ) // master ECU  
**and** ( LV\_IGK = 1 **and** N\_32 > C\_N\_32\_FUP\_EFP\_DIAG )

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**Deactivation:**                   *activation condition not fulfilled*

*at deactivation:* LV\_CDN\_DIAG\_EFPPWM\_PLAUS = 0  
   LV\_CDN\_DIAG\_L\_PRS\_SYS = 0  
   LV\_CDN\_DIAG\_FUP\_EFP\_NOT\_PLAUS = 0  
   T\_EFPPWM\_PLAUS\_0 = 0

**Recurrence:**                   20ms

**Function description:**

**Formula section:**

**B.96.2 Plausibility check EFPPWM**

**General information:**

The plausibility check for the EFPPWM consists out of three parts:  
 1) A check of the I-part of the controller is done, which indicates mainly rapid changes in the performance of the pump or other low pressure system related topics.  
 2) The adaptive integral part can be used as an indicator for life time topics of the fuel pump.  
 3) The adaptive minimum EFPPWM gives the functionality of the fuel pump at 'zero delivery' to the high pressure system.

**Application conditions:**

**Initialisation:**                 –  
**Activation:**                     –  
**Deactivation:**                 –  
**Recurrence:**                  –

**Function description:**

**Formula section:**


The calculation of the plausibility check is only done, if the function is activated, otherwise the plausibility check is stopped and all values are stored until reactivation.

```
timeout after trailing throttle fuel cut-off
If (1)      LV_PUC = 0
then (1)    T_PUC_END -- //decrement timer until 0s
else (1)    T_PUC_END = C_T_PUC_END_EFPPWM_PLAUS
endif (1)

condition for plausibility check EFPPWM
If (1)      LV_ERR_EFPPWM_PLAUS = 0
              LV_ERR_FUP_EFP = 0
              LV_ERR_CAN_BOFF = 0
              LV_FUP_LIH_HOM_VCV_OPEN_REQ = 0
              LV_FUP_LIH_L_PRS_CTL_REQ = 0
```

**and**  
**and**  
**and**  
**and**  
**and**

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```

C_N_32_MAX_EFPPWM_PLAUS >= N_32 >= C_N_32_MIN_EFPPWM_PLAUS and
C_TCO_MAX_EFPPWM_PLAUS >= TCO >= C_TCO_MIN_EFPPWM_PLAUS and
FUP_EFP_SP >= C_FUP_EFP_SP_MIN_EFPPWM_PLAUS and
FUP_EFP_SP <= C_FUP_EFP_SP_MAX_EFPPWM_PLAUS and
MFF_SP_FUP_CTL >= C_MFF_SP_MIN_EFPPWM_PLAUS and
MFF_SP_FUP_CTL <= C_MFF_SP_MAX_EFPPWM_PLAUS and
VFF_MFF_SP_FUP_CTL >= C_VFF_SP_MIN_EFPPWM_PLAUS and
VFF_MFF_SP_FUP_CTL <= C_VFF_SP_MAX_EFPPWM_PLAUS and
LV_PUC = 0 and T_PUC_END = 0 and
STATE_EFP = EFP_ON (2H) and
T_AST > C_T_AST_FUP_EFP_DIAG and
FTL > C_FTL_MIN_EFPPWM_PLAUS_DIAG and
( ( LC_EFPPWM_MIN_ENA = 0 and LV_EFPPWM_MIN_VLD = 1 )
or LC_EFPPWM_MIN_ENA = 1 ) and
( ( LC_EFPPWM_I_AD_ENA = 0 and LV_EFPPWM_I_AD_VLD = 1 )
or LC_EFPPWM_I_AD_ENA = 1 ) and
(
  ( LV_VAR_EFP_COM_2 = 1 and LV_ERR_COM_2_BOFF = 0 and
    LV_ERR_COM_2_EFP = 0 )
or
  ( LV_VAR_EFP_COM_3 = 1 and LV_ERR_COM_3_BOFF = 0 and
    LV_ERR_COM_3_EFP = 0 )
)
then(1) LV_CDN_DIAG_EFPPWM_PLAUS = 1
else(1) LV_CDN_DIAG_EFPPWM_PLAUS = 0
endif(1)

failure detection for plausibility check EFPPWM
If(1) LV_CDN_DIAG_EFPPWM_PLAUS = 1
then(1) If(2) EFPPWM_I < C_EFPPWM_I_DIAG_MIN or
          EFPPWM_I > C_EFPPWM_I_DIAG_MAX

then(2) check of integral part of EFPPWM
If(3) T_EFPPWM_PLAUS_0 < C_T_EFPPWM_PLAUS_0
then(3) T_EFPPWM_PLAUS_0 ++
          //increment timer until C_T_EFPPWM_PLAUS_0
else(3) symptom "integral part of EFPPWM out of range" active
          ERR_SYM_EFPPWM_PLAUS = SYM_0
          increment anti-bounce counter
          apply filter on current symptom
If(4) filtering result available (after debounce)
then(4) LV_ERR_EFPPWM_PLAUS = filtering result
          LV_END_DIAG_EFPPWM_PLAUS = 1
          deliver diagnostic result to error management

endif(4)
endif(3)

else(2) check of adaptive integral part of EFPPWM
          T_EFPPWM_PLAUS_0 = 0
If(3) EFPPWM_I_AD < C_EFPPWM_I_AD_DIAG_MIN or
          EFPPWM_I_AD > C_EFPPWM_I_AD_DIAG_MAX
then(3) symptom "adaptive integral part of EFPPWM out of range"
          active
          ERR_SYM_EFPPWM_PLAUS = SYM_1
          increment anti-bounce counter
          apply filter on current symptom
If(4) filtering result available (after debounce)
then(4) LV_ERR_EFPPWM_PLAUS = filtering result
          LV_END_DIAG_EFPPWM_PLAUS = 1
          deliver diagnostic result to error management

endif(4)

```

```

else (3)  check of adaptive minimum of EFPPWM
If (4)   EFPPWM_MIN_AD < C_EFPPWM_MIN_AD_DIAG_MIN or
           EFPPWM_MIN_AD > C_EFPPWM_MIN_AD_DIAG_MAX
then (4) symptom "adaptive minimum EFPPWM out of range" active
           ERR_SYM_EFPPWM_PLAUS = SYM_2
           increment anti-bounce counter
           apply filter on current symptom
If (5)   filtering result available (after debounce)
then (5) LV_ERR_EFPPWM_PLAUS = filtering result
           LV_END_DIAG_EFPPWM_PLAUS = 1
           deliver diagnostic result to error management

endif (5)

else (4)  no symptom active
           ERR_SYM_EFPPWM_PLAUS = NO_SYM
           decrement anti-bounce counter

endif (4)
endif (3)
endif (2)
else (1)  T_EFPPWM_PLAUS_0 = 0
endif (1)

```

### B.96.3 LP system monitoring

#### General information:

Certain pressure thresholds are monitored, in order to detect mechanical faults of the components of the fuel circuit.

There are two pressure limits to detect overpressure, and there is one to detect that pressure is too low:

- 1)  $FUP\_EFP > Tol2$  : Indicates an overpressure with an error in the LP pump pressure relief valve. The pressure is higher than the pressure at which the relief valve should open.
- 2)  $Tol1 < FUP\_EFP < Tol2$  : Indicates a pressure which is below the critical value of the LP pump pressure relief valve. This could happen when there is a mechanical fault, but the overpressure relief valve is still ok.
- 3)  $FUP < Bo11$  : Indicates an excessive loss of pressure. Mechanical failure in the pump or regulator, or fuel leakage, can be detected this way.

#### Application conditions:


**Initialisation:**           —

**Activation:**               —

**Deactivation:**           —

**Recurrence:**             —

#### Function description:

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**Formula section:**

condition for LP system monitoring

```

If (1)   LV_ERR_L_PRS_SYS = 0
           LV_ERR_FUP_EFP = 0
           LV_FUP_LIH_HOM_VCV_OPEN_REQ = 0
           C_N_32_MAX_L_PRS_SYS >= N_32 >= C_N_32_MIN_L_PRS_SYS
           STATE_EFP = EFP_ON (2H)
           T_AST > C_T_AST_FUP_EFP_DIAG
           FTL > C_FTL_MIN_L_PRS_SYS_DIAG
           (( NC_STATE_ECU_MST_SLA = 0 or LV_ECU_LOCK = 0 ) or
           // no master/ slave system or current bank is enabled
then (1) LV_CDN_DIAG_L_PRS_SYS = 1
else (1) LV_CDN_DIAG_L_PRS_SYS = 0
endif (1)

```

failure detection for LP system monitoring

```

If (1)   LV_CDN_DIAG_L_PRS_SYS = 1
then (1)  check of top limit 2 error
           If (2)   (FUP_EFP > C_FUP_EFP_TOL_2)
           then (2)  symptom "FUP_EFP top limit 2 reached" active
                       ERR_SYM_L_PRS_SYS = SYM_1
                       increment anti-bounce counter
                       apply filter on current symptom
           If (3)   filtering result available (after debounce)
           then (3)  LV_ERR_L_PRS_SYS = filtering result
                       LV_END_DIAG_L_PRS_SYS = 1
                       deliver diagnostic result to error management
           endif (3)


           else (2)  check of top limit 1 error
           If (3)   (FUP_EFP > C_FUP_EFP_TOL_1)
           then (3)  symptom "FUP_EFP top limit 1 reached" active
                       ERR_SYM_L_PRS_SYS = SYM_0
                       increment anti-bounce counter
                       apply filter on current symptom
           If (4)   filtering result available (after debounce)
           then (4)  LV_ERR_L_PRS_SYS = filtering result
                       LV_END_DIAG_L_PRS_SYS = 1
                       deliver diagnostic result to error management
           endif (4)

           else (3)  check bottom limit 1 error
           If (4)   (FUP_EFP < C_FUP_EFP_BOL_1)
           then (4)  symptom "FUP_EFP bottom limit 1 reached" active
                       ERR_SYM_L_PRS_SYS = SYM_2
                       increment anti-bounce counter
                       apply filter on current symptom
           If (5)   filtering result available (after debounce)
           then (5)  LV_ERR_L_PRS_SYS = filtering result
                       LV_END_DIAG_L_PRS_SYS = 1
                       deliver diagnostic result to error management
           endif (5)

           else (4)  no symptom active
                       ERR_SYM_L_PRS_SYS = NO_SYM
                       decrement anti-bounce counter
           endif (4)
           endif (3)
           endif (2)
endif (1)

```

**B.96.4 FUP\_EFP\_NOT\_PLAUS monitoring**

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**General information:**

Diagnosis to detect wire break at low fuel pressure sensor.

**Application conditions:**

**Initialisation:** -  
**Activation:** -  
**Deactivation:** -  
**Recurrence:** -

**Function description:****Formula section:**

condition for FUP\_EFP\_NOT\_PLAUS monitoring


```
If (1) STATE_PWM_VCVn = STATE_PWM_VCVn-1
then (1) T_FUP_EFP_NOT_PLAUS_PWM_SWI - - //decrement timer until 0s
else (1) T_FUP_EFP_NOT_PLAUS_PWM_SWI = C_T_FUP_EFP_NOT_PLAUS_PWM_SWI
endif (1)
```

```
If (1) LV_ERR_EFP = 0 and
LV_ERR_FUP_EFP = 0 and
C_N_32_MAX_FUP_EFP_NOT_PLAUS
>= N_32 >=
C_N_32_MIN_FUP_EFP_NOT_PLAUS and
C_MFF_SP_MAX_FUP_EFP_NOT_PLAUS
>= MFF_SP_FUP_CTL >=
C_MFF_SP_MIN_FUP_EFP_NOT_PLAUS and
T_AST > C_T_AST_FUP_EFP_NOT_PLAUS and
T_FUP_EFP_NOT_PLAUS_PWM_SWI = 0
then (1) LV_CDN_DIAG_FUP_EFP_NOT_PLAUS = 1
else (1) LV_CDN_DIAG_FUP_EFP_NOT_PLAUS = 0
endif (1)
```

failure detection for FUP\_EFP\_NOT\_PLAUS monitoring

```
If (1) LV_CDN_DIAG_FUP_EFP_NOT_PLAUS = 1
then (1) If (2) LV_CDN_DIAG_FUP_EFP_NOT_PLAUSn-1 = 0
then (2) FUP_EFP_NOT_PLAUS = FUP_EFP_MES
else (2) FUP_EFP_NOT_PLAUS = FUP_EFP_NOT_PLAUSn-1
+ C_CRLC_FUP_EFP_NOT_PLAUS
* ( FUP_EFP_MES - FUP_EFP_NOT_PLAUSn-1)
endif (2)

If (2) check of "FUP_EFP_NOT_PLAUS top limit 1 reached" error
Abs( FUP_EFP_SPn - FUP_EFP_SPn-1)
< C_FUP_EFP_SP_DIF_DIAG_FUP_EFP and
Abs( FUP_EFP_MES - FUP_EFP_NOT_PLAUS )
> C_FUP_EFP_NOT_PLAUS_DEV_MAX
then (2) symptom "FUP_EFP_NOT_PLAUS top limit 1 reached" active
ERR_SYM_FUP_EFP_NOT_PLAUS = SYM_0
increment anti-bounce counter
apply filter on current symptoms
If (3) filtering result available (after debounce)
then (3) LV_ERR_FUP_EFP_NOT_PLAUS = filtering result
LV_END_DIAG_FUP_EFP_NOT_PLAUS = 1
```


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```

                                deliver diagnostic result to error management
endif (3)

else (2)  no symptom active
                                ERR_SYM_FUP_EFP_NOT_PLAUS = NO_SYM
                                decrement anti-bounce counter
endif (2)
endif (1)

```


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## B.97 Fuel system pressure diagnosis

### Data definition:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_FUP_MFP_PLAUS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom FUP/MFP plausibility check					
ERR_SYM_FUP_ORNG	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom FUP_ORNG check					
ERR_SYM_FUP_ST_DLY	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom delayed FUP start					
ERR_SYM_FUP_ST_H_PRS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom of FUP start diagnosis - fuel pressure at high pressure start is too low					
ERR_SYM_FUP_ST_NO_RISE	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom FUP_ST_NO_RISE					
ERR_SYM_FUP_STOP	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom FUP check after engine stop					
ERR_SYM_H_PRS_SYS_PRE	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom for high pressure system monitoring					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_VCV_PLAUS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom for adaptation plausibility check					
FAC_LAM_DIF_MFP_PLAUS	V	8000... 7FFFH	-50... 49.998474121093	1.52587e-3	%
Deviation of fuel mass controller for MFP_PLAUS					
LV_CDN_DIAG_FUP_MFP_PLAUS	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for FUP/MFP plausibility check					
LV_CDN_DIAG_FUP_MFP_PLAUS_1	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for FUP/MFP plausibility check SYM 1					
LV_CDN_DIAG_FUP_ORNG	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for FUP_ORNG check					
LV_CDN_DIAG_FUP_ST_DLY	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for delayed FUP start					
LV_CDN_DIAG_FUP_ST_H_PRS	V	0... 1H	0 ...1	1	-
Conditions fulfilled for detection of fault or fault-free state of FUP start diagnosis - fuel pressure at high pressure start is too low					
LV_CDN_DIAG_FUP_ST_NO_RISE	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for FUP_ST_NO_RISE					
LV_CDN_DIAG_FUP_STOP	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for FUP check after engine stop					
LV_CDN_DIAG_H_PRS_SYS_PRE	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for high pressure system monitoring					
LV_CDN_DIAG_H_PRS_SYS_PRE_2	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for high pressure system monitoring SYM 2					
LV_CDN_DIAG_VCV_PLAUS	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for VCV adaption plausibility check					
LV_END_DIAG_FUP_MFP_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis flag for FUP/MFP plausibility check					
LV_END_DIAG_FUP_ORNG	V	0... 1H	0 ...1	1	-
End of diagnosis flag for FUP sensor ORNG check					
LV_END_DIAG_FUP_ST_DLY	V	0... 1H	0 ...1	1	-
End of diagnosis flag for delayed FUP too low at engine start					
LV_END_DIAG_FUP_ST_H_PRS	V	0... 1H	0 ...1	1	-
End of diagnosis flag FUP start diagnosis - fuel pressure at high pressure start is too low					
LV_END_DIAG_FUP_ST_NO_RISE	V	0... 1H	0 ...1	1	-
End of diagnosis flag for FUP_ST_NO_RISE					
LV_END_DIAG_FUP_STOP	V	0... 1H	0 ...1	1	-
End of diagnosis flag for FUP check after engine stop					
LV_END_DIAG_H_PRS_SYS_PRE	V	0... 1H	0 ...1	1	-
End of diagnosis flag for high pressure system monitoring					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_VCV_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis flag for daption plausibility check					
LV_ERR_FUP_MFP_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean that indicates inconsistencies between fuel pressure and mass fuel pump					
LV_ERR_FUP_ORNG	O/V	0... 1H	0 ...1	1	-
Boolean that indicates fuel pressure out of range					
LV_ERR_FUP_ST	O/V	0... 1H	0 ...1	1	-
Error flag for fuel pressure at start too low					
LV_ERR_FUP_ST_DLY	O/V	0... 1H	0 ...1	1	-
Error flag for delayed fuel pressure at start too low					
LV_ERR_FUP_ST_H_PRS	O/V	0... 1H	0 ...1	1	-
Error flag for FUP start diagnosis - fuel pressure at high pressure start is too low					
LV_ERR_FUP_ST_NO_RISE	O/V	0... 1H	0 ...1	1	-
Error flag for no rising fuel pressure at start					
LV_ERR_FUP_STOP	O/V	0... 1H	0 ...1	1	-
Boolean that indicates to high fuel pressure after engine stop					
LV_ERR_H_PRS_SYS	O/V	0... 1H	0 ...1	1	-
Boolean that indicates abnormal fuel pressure value in fuel system					
LV_ERR_H_PRS_SYS_PRE	O/V	0... 1H	0 ...1	1	-
Boolean that indicates abnormal fuel pressure value in fuel system					
LV_ERR_VCV_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean that indicates abnormal value of the VCV adaptation					
T_DLY_ERR_SYM_FUP_ST_DLY	V	0... FFH	0... 2550	10	ms
Delay timer for setting delayed fuel pressure at start too low symptom					
T_FUP_STOP	V	0... FFFFH	0... 1310.7	0.02	s
Time for detection of to high fuel pressure in the power latch					
VFF_VCV_DIAG_CLC	V	0... FFFFH	0... 255	3.89105e-3	l/h
Calculated VCV flow for diagnosis					

**Input data:**

CUR_VCV_BAS {p. 3953}	CUR_VCV_BAS_AD_VAR_2_ADD {p. 3953}	CUR_VCV_DIF_REL {p. 3953}	CUR_VCV_MIN_AD {p. 3953}
ERR_SYM_FSD [NC_CBK_EX_NR] {p. 6140}	ERR_SYM_FSD_H_RNG [NC_CBK_EX_NR] {p. 6140}	ERR_SYM_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6140}	FAC_CUR_VCV_BAS_AD_VAR_2 {p. 3953}
FAC_LAM_AD_OUT [NC_CBK_EX_NR] {p. 2461}	FAC_LAM_LIM [NC_CBK_EX_NR] {p. 2461}	FAC_MFF_ADD_LAM_AD_OUT [NC_CBK_EX_NR] {p. 2641}	FUEL_MASS_REQ_CTL {p. 3908}
FUP {p. 1283}	FUP_DIF {p. 3909}	LV_CAT_PURGE_ACT [NC_CBK_EX_NR] {p. 2927}	LV_CH {p. 8232}
LV_DC {p. 5746}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_H_RNG [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}
LV_ERR_FUP_CH {p. 6102}	LV_IGK {p. 906}	LV_INH_FUP_MFP_PLAUS {p. 6095}	LV_INH_FUP_ORNG {p. 6095}

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LV_INH_FUP_ST_BOL {p. 6095}	LV_INH_FUP_STOP {p. 6095}	LV_INH_H_PRS_SYS_PRE {p. 6095}	LV_INH_VCV_PLAUS {p. 6095}
LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_PWL {p. 988}	LV_ST_END {p. 1720}	LV_ST_H_PRS {p. 8242}
LV_ST_INJ_AUTH {p. 8242}	LV_SYM_FUP_ST_NO_RISE {p. 8262}	LV_TI_1_HOM_MIN {p. 2000}	LV_TI_2_HOM_MIN {p. 2000}
MFF_SP_FUP_CTL {p. 2151}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_IDX_DIAG_FUP_MFP_PLAUS
NC_IDX_DIAG_FUP_ORNG	NC_IDX_DIAG_FUP_ST_DLY	NC_IDX_DIAG_FUP_ST_H_PRS	NC_IDX_DIAG_FUP_ST_NO_RISE
NC_IDX_DIAG_FUP_STOP	NC_IDX_DIAG_H_PRS_SYS_PRE	NC_IDX_DIAG_VCV_PLAUS	STATE_FUP_CTL {p. 3881}
STATE_PWM_VCV {p. 3955}	T_AST {p. 1766}	TCO_ST {p. 1100}	TFU {p. 1232}
VFF_MFF_SP_FUP_CTL {p. 3881}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_FUP_MFP_PLAUS	V	0... FFH	0... 255	1	-
Increment of the plausibility check of FUP/MFP anti-bounce counter					
C_ABC_INC_FUP_ORNG	V	0... FFH	0... 255	1	-
Increment of the FUP ORNG anti-bounce counter					
C_ABC_INC_FUP_ST_DLY	V	0... FFH	0... 255	1	-
Increment of delayed FUP at start monitoring anti-bounce counter					
C_ABC_INC_FUP_ST_H_PRS	V	0... 7FH	0... 127	1	-
Debounce counter increment of FUP start diagnosis - fuel pressure at high pressure start is too low					
C_ABC_INC_FUP_ST_NO_RISE	V	0... FFH	0... 255	1	-
Increment for no rising fuel pressure at start monitoring anti-bounce counter					
C_ABC_INC_FUP_STOP	V	0... FFH	0... 255	1	-
Increment of the FUP_STOP check anti-bounce counter					
C_ABC_INC_H_PRS_SYS_PRE	V	0... FFH	0... 255	1	-
Increment of high pressure system monitoring anti-bounce counter					
C_ABC_INC_VCV_PLAUS	V	0... FFH	0... 255	1	-
Increment of the VCV adaption check anti-bounce counter					
C_ABC_MAX_FUP_MFP_PLAUS	V	1... FFH	1... 255	1	-
Threshold to be reached, before plausibility check error of FUP/MFP					
C_ABC_MAX_FUP_ORNG	V	1... FFH	1... 255	1	-
Threshold to be reached, before FUP ORNG error					
C_ABC_MAX_FUP_ST_DLY	V	1... FFH	1... 255	1	-
Threshold to be reached, before permanently activating delayed FUP too low at start monitoring error					
C_ABC_MAX_FUP_ST_H_PRS	V	1... 7FH	1... 127	1	-
Debounce counter maximum of FUP start diagnosis - fuel pressure at high pressure start is too low					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_FUP_ST_NO_RISE	V	1... FFH	1... 255	1	-
Threshold to be reached, before permanently activating no rising fuel pressure at start monitoring error					
C_ABC_MAX_FUP_STOP	V	1... FFH	1... 255	1	-
Threshold to be reached, before FUP_STOP check error					
C_ABC_MAX_H_PRS_SYS_PRE	V	1... FFH	1... 255	1	-
Threshold to be reached, before permanently activating high pressure system monitoring error					
C_ABC_MAX_VCV_PLAUS	V	1... FFH	1... 255	1	-
Threshold to be reached, before VCV adaption check error					
C_CUR_VCV_AD_MFP_DIAG_MAX	V	8000... 7FFFH	-32.768 ...32.767	0.001	A
Maximum adapted additive curent value					
C_CUR_VCV_AD_MFP_DIAG_MAX_1	V	8000... 7FFFH	-32.768 ...32.767	0.001	A
Maximum adapted additive curent value SYM 1					
C_CUR_VCV_AD_MFP_DIAG_MAX_2	V	8000... 7FFFH	-32.768 ...32.767	0.001	A
Maximum adapted additive curent value SYM 2					
C_CUR_VCV_AD_MFP_DIAG_MIN	V	8000... 7FFFH	-32.768 ...32.767	0.001	A
Minimum adapted additive curent value					
C_CUR_VCV_BAS_AD_VCV_PLAUS_MAX	V	8000... 7FFFH	-32.768 ...32.767	0.001	A
Maximum adapted additive curent value					
C_CUR_VCV_BAS_AD_VCV_PLAUS_MIN	V	8000... 7FFFH	-32.768 ...32.767	0.001	A
Minimum adapted additive curent value					
C_CUR_VCV_DIF_REL_DIAG_MAX	V	8000... 7FFFH	-2... 1.9999389648437	61.0351e-6	-
Maximum relative current deviation to enable FUP_MFP_PLAUS and H_PRS_SYS diagnosis					
C_CUR_VCV_MIN_AD_VCV_PLAUS_MAX	V	8000... 7FFFH	-32.768 ...32.767	0.001	A
Maximum adapted minimum curent value					
C_CUR_VCV_MIN_AD_VCV_PLAUS_MIN	V	8000... 7FFFH	-32.768 ...32.767	0.001	A
Minimum adapted minimum curent value					
C_DLY_ERR_SYM_FUP_ST_DLY	V	0... FFH	0... 2550	10	ms
Delay time for setting delayed fuel pressure at start too low symptom					
C_FAC_CUR_VCV_AD_MFP_DIAG_MAX	V	8000... 7FFFH	-2... 1.9999389648437	61.0351e-6	-
Maximum adapted factor value					
C_FAC_CUR_VCV_AD_MFP_DIAG_MAX_1	V	8000... 7FFFH	-2... 1.9999389648437	61.0351e-6	-
Maximum adapted factor value SYM 1					
C_FAC_CUR_VCV_AD_MFP_DIAG_MAX_2	V	8000... 7FFFH	-2... 1.9999389648437	61.0351e-6	-
Maximum adapted factor value SYM 2					
C_FAC_CUR_VCV_AD_MFP_DIAG_MIN	V	8000... 7FFFH	-2... 1.9999389648437	61.0351e-6	-
Minimum adapted factor value					
C_FAC_CUR_VCV_PLAUS_MAX	V	8000... 7FFFH	-2... 1.9999389648437	61.0351e-6	-
Maximum adapted factor value					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_CUR_VCV_PLAUS_MIN	V	8000... 7FFFH	-2... 1.9999389648437	61.0351e-6	-
Minimum adapted factor value					
C_FAC_LAM_AD_MFP_PLAUS_0	V	8000... 7FFFH	-50... 49.998474121093	1.52587e-3	%
Limit of FAC Lambda contr. range for MFP_PLAUS SYM_0					
C_FAC_LAM_AD_MFP_PLAUS_1	V	8000... 7FFFH	-50... 49.998474121093	1.52587e-3	%
Limit of FAC Lambda contr. range for MFP_PLAUS SYM_1					
C_FAC_LAM_H_PRS_SYS_PRE_MAX_0	V	8000... 7FFFH	-50... 49.998474121093	1.52587e-3	%
Limit of Lambda contr. range for H_PRS_SYS_PRE SYM_0					
C_FAC_LAM_H_PRS_SYS_PRE_MAX_1	V	8000... 7FFFH	-50... 49.998474121093	1.52587e-3	%
Limit of Lambda contr. range for H_PRS_SYS_PRE SYM_1					
C_FAC_LAM_H_PRS_SYS_PRE_MAX_2	V	8000... 7FFFH	-50... 49.998474121093	1.52587e-3	%
Limit of Lambda contr. range for H_PRS_SYS_PRE SYM_2					
C_FAC_LAM_H_PRS_SYS_PRE_MIN_0	V	8000... 7FFFH	-50... 49.998474121093	1.52587e-3	%
Limit of Lambda contr. range for H_PRS_SYS_PRE SYM_0					
C_FAC_LAM_H_PRS_SYS_PRE_MIN_1	V	8000... 7FFFH	-50... 49.998474121093	1.52587e-3	%
Limit of Lambda contr. range for H_PRS_SYS_PRE SYM_1					
C_FAC_LAM_H_PRS_SYS_PRE_MIN_2	V	8000... 7FFFH	-50... 49.998474121093	1.52587e-3	%
Limit of Lambda contr. range for H_PRS_SYS_PRE SYM_2					
C_FUEL_REQ_CTL_MFP_DIAG_MAX	V	8000... 7FFFH	- 694.5105973907 ...694.48940260929	21.1947e-3	mg
Maximum threshold for highpressure controller					
C_FUEL_REQ_CTL_MFP_DIAG_MAX_1	V	8000... 7FFFH	- 694.5105973907 ...694.48940260929	21.1947e-3	mg
Maximum threshold for highpressure controller SYM1					
C_FUEL_REQ_CTL_MFP_DIAG_MAX_2	V	8000... 7FFFH	- 694.5105973907 ...694.48940260929	21.1947e-3	mg
Maximum threshold for highpressure controller SYM 2					
C_FUEL_REQ_CTL_MFP_DIAG_MIN	V	8000... 7FFFH	- 694.5105973907 ...694.48940260929	21.1947e-3	mg
Minimum threshold for highpressure controller					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUEL_REQ_CTL_MFP_DIAG_MIN_0	V	8000... 7FFFH	- 694.5105973907 ...694.48940260929	21.1947e-3	mg
Minimum threshold for highpressure controller SYM0					
C_FUP_BOL_1	V	0... FFFFH	0... 347776	5.30672159	hPa
Bottom fuel pressure threshold 1					
C_FUP_DIF_BOL	V	8000... 7FFFH	-173890 ...173884	5.30669108	hPa
Min FUP difference for H_PRS_SYS SYM 0					
C_FUP_DIF_TOL	V	8000... 7FFFH	-173890 ...173884	5.30669108	hPa
Top limit of FUP difference					
C_FUP_STOP	V	0... FFFFH	0... 347776	5.30672159	hPa
Constant for the limit of fuel pressure after engine stop					
C_FUP_TOL_1	V	0... FFFFH	0... 347776	5.30672159	hPa
Top fuel pressure threshold 1					
C_FUP_TOL_2	V	0... FFFFH	0... 347776	5.30672159	hPa
Top fuel pressure threshold 2					
C_MFF_SP_FUP_MFP_PLAUS_MAX	V	0... FFFFH	0... 1389	21.1947e-3	mg/stk
Maximum Mass fuel flow for FUP_MFP_PLAUS diagnosis					
C_MFF_SP_FUP_MFP_PLAUS_MAX_1	V	0... FFFFH	0... 1389	21.1947e-3	mg/stk
Maximum Mass fuel flow for FUP_MFP_PLAUS diagnosis SYM_1					
C_MFF_SP_FUP_MFP_PLAUS_MIN	V	0... FFFFH	0... 1389	21.1947e-3	mg/stk
Minimum Mass fuel flow for FUP_MFP_PLAUS diagnosis					
C_MFF_SP_FUP_MFP_PLAUS_MIN_1	V	0... FFFFH	0... 1389	21.1947e-3	mg/stk
Minimum Mass fuel flow for FUP_MFP_PLAUS diagnosis SYM_1					
C_MFF_SP_H_PRS_SYS_PRE_BOL_0	V	0... FFFFH	0... 1389	21.1947e-3	mg/stk
Bottom limit of MFF for detection of stucked VCV					
C_MFF_SP_H_PRS_SYS_PRE_BOL_2	V	0... FFFFH	0... 1389	21.1947e-3	mg/stk
Bottom limit of MFF for detection of stucked VCV					
C_MFF_SP_H_PRS_SYS_PRE_MAX_2	V	0... FFFFH	0... 1389	21.1947e-3	mg/stk
Maximum Mass fuel flow for FUP_MFP_PLAUS diagnosis SYM_2					
C_MFF_SP_H_PRS_SYS_PRE_MIN_2	V	0... FFFFH	0... 1389	21.1947e-3	mg/stk
Minimum Mass fuel flow for FUP_MFP_PLAUS diagnosis SYM_2					
C_N_32_FUP_DIAG	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for FUP/FPAPWM plausibility check (Default value 800)					
C_N_32_FUP_MFP_PLAUS_MAX	V	0... FFH	0... 8160	32	rpm
Maximum engine speed for the plausibility check					
C_N_32_FUP_MFP_PLAUS_MAX_1	V	0... FFH	0... 8160	32	rpm
Maximum engine speed for the plausibility check SYM_1					
C_N_32_FUP_MFP_PLAUS_MIN	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for the plausibility check					
C_N_32_FUP_MFP_PLAUS_MIN_1	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for the plausibility check SYM_1					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_32_H_PRS_SYS_PRE_MAX_2	V	0... FFH	0... 8160	32	rpm
Maximum engine speed for the plausibility check SYM_2					
C_N_32_H_PRS_SYS_PRE_MIN_2	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for the plausibility check SYM_2					
C_N_32_VCV_PLAUS_MAX	V	0... FFH	0... 8160	32	rpm
Maximum engine speed for the VCV adaption plausibility check					
C_N_32_VCV_PLAUS_MIN	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for VCV adaption plausibility check					
C_N_MIN_ERR_SYM_FUP_ST_DLY	V	0... FFH	0... 8160	32	rpm
Minimum engine speed threshold for setting FUP_ST_DLY error immediately					
C_T_AST_FUP_DIAG_ENA	V	0... FFFFH	0... 6553.5	0.1	s
Threshold for deactivating high pressure start diagnostics after start					
C_T_FUP_STOP	V	0... FFFFH	0... 1310.7	0.02	s
Time constant for detection of the fuel low pressure in the power latch					
C_T_MAX_H_PRS_SYS_PRE_0	V	1... FFFFH	0... 655.35	0.01	s
Maximum delay time to debounce H_PRS_SYS_PRE SYM_0					
C_T_MAX_H_PRS_SYS_PRE_1	V	1... FFFFH	0... 655.35	0.01	s
Maximum delay time to debounce H_PRS_SYS_PRE SYM_1					
C_T_MAX_H_PRS_SYS_PRE_2	V	1... FFFFH	0... 655.35	0.01	s
Maximum delay time to debounce H_PRS_SYS_PRE SYM_2					
C_TFU_VCV_PLAUS_MAX	V	0... FEH	-48... 142.5	0.75	°C
Maximum threshold for the VCV adaption plausibility check					
C_TFU_VCV_PLAUS_MIN	V	0... FEH	-48... 142.5	0.75	°C
Minimum threshold for the VCV adaptatin plausibility check					
C_VFF_VCV_DIF_DIAG_0	V	0... FFFFH	-127.5 ...127.5	3.89105e-3	l/h
Threshold of VCV flow deviation to detect SYM 0					
C_VFF_VCV_DIF_DIAG_1	V	0... FFFFH	-127.5 ...127.5	3.89105e-3	l/h
Threshold of VCV flow deviation to detect SYM 1					
C_VFF_VCV_DIF_DIAG_2	V	0... FFFFH	-127.5 ...127.5	3.89105e-3	l/h
Threshold of VCV flow deviation to detect SYM 2					
C_VFF_VCV_DIF_DIAG_MAX	V	0... FFFFH	-127.5 ...127.5	3.89105e-3	l/h
Threshold of VCV flow deviation to detect FUP_MFP_PLAUS_SYM_1					
C_VFF_VCV_DIF_DIAG_MIN	V	0... FFFFH	-127.5 ...127.5	3.89105e-3	l/h
Threshold of VCV flow deviation to detect FUP_MFP_PLAUS_SYM_0					
IP_FLOW_CUR_BAS_VCV	V	0... FFFFH	0... 255	3.89105e-3	l/h
LDP_CUR_VCV_IP_FLOW_CUR_BAS	16	0... FFFFH	0... 65.535	0.001	A
Map to convert CUR_VCV_BAS into VFF_VCV_DIAG_CLC					
IP_FUP_ST_BOL	V	0... FFFFH	0... 347776	5.30672159	hPa
LDP_TCO_ST_IP_FUP_ST_BOL	6	0... FEH	-48... 142.5	0.75	°C
Threshold to detect FUP at start to low					
LC_ERR_SYM_FUP_ST_DLY	V	0... 1H	0 ...1	1	-
Manual switch for enabling delayed fuel pressure at start too low diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_FUP_MFP_PLAUS_VAR_2_ACT	V	0... 1H	0 ...1	1	-
Switch to enable the second variant of MFP_PLAUS and H_PRS_SYS diagnosis					
LC_INH_FUP_DIAG_ON_CH	V	0... 1H	0 ...1	1	-
High pressure system diagnoses (FUP_MFP_PLAUS and H_PRS_SYS) are inhibited during catalyst heating, if set to 1					
LC_MOD_ERR_H_PRS_SYS	V	0... 1H	0 ...1	1	-
Defines behaviour of LV_ERR_H_PRS_SYS (0 = H_PRS_SYS_PRE, 1 = H_PRS_SYS_PRE or FUP_CH)					

### Import actions:

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetLvErr</b> (IN<IDX_DIAG>,OUT<LV_ERR>)

### General information:

The purpose is to diagnose mechanical errors.

Specific diagnosis information to the project are defined in chapters Diagnosis information (Freeze frame, DTC, error code number, symptom number, data for MIL management ...).

General information:

After debounce the corresponding error bit LV\_ERR... is set to 1 and the corresponding symptom is active. Only if the driving cycle is finished the error bit LV\_ERR... and the debounced counter are set to 0 and the corresponding symptom is not active.

The fuel system pressure diagnosis will be executed in dependency on the status of the fuel pressure sensor.


If the diagnosis is not prohibited the MFP plausibility check, the FUP sensor plausibility check and the HP system monitoring can be executed. The MFP plausibility check will be calculated only in state MFP\_CTL.

The high-pressure system check indicates mainly an abnormal fuel pressure value in fuel system.

If a plausibility check error or the high-pressure system check error is detected a request for Lambda=1 mode is set to identify the origin of the non-plausibility.

The flags LV\_CDN\_DIAG\_XXX except the flag for FUP\_STOP are ==0 if the function is not active. LV\_CDN\_DIAG\_FUP\_STOP == 1 if the function is not active.

### Application conditions:

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl
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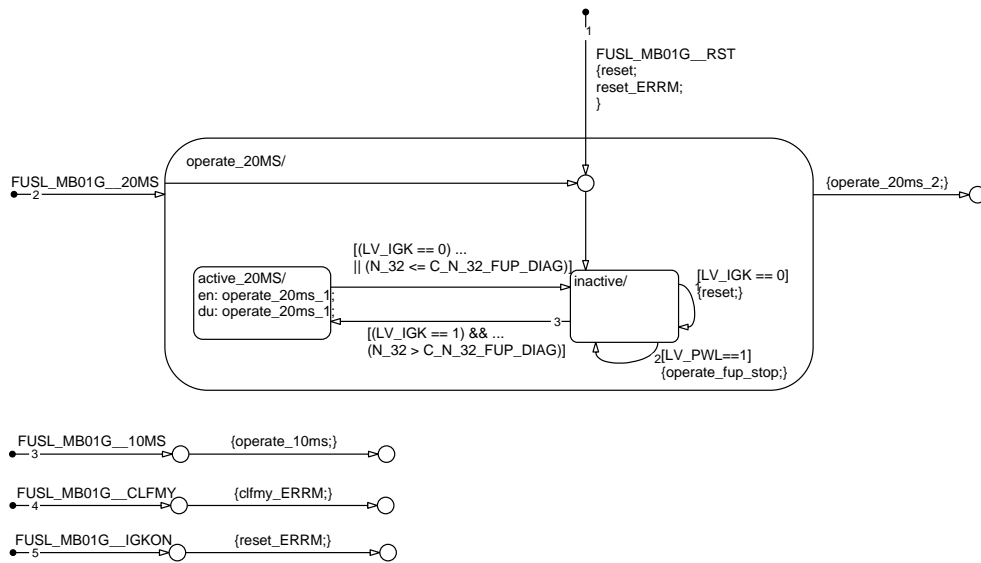


Figure B.97.1: :

**Function description:**

**Formula section:**

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	Document key 10171571 SPE 000 AO	Pages Page 6069 of 8404	
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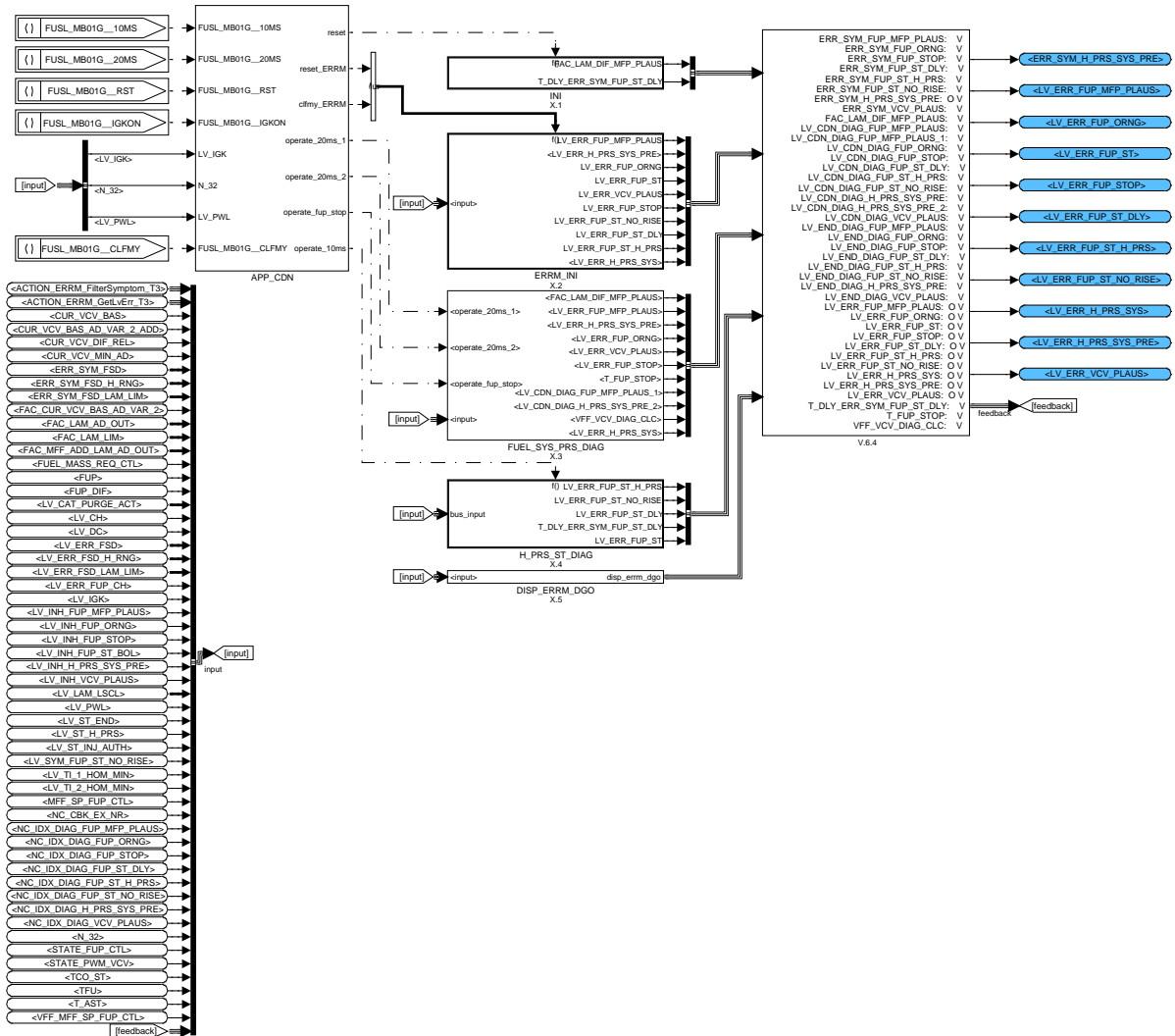


Figure B.97.2: :

### B.97.1 Initialization

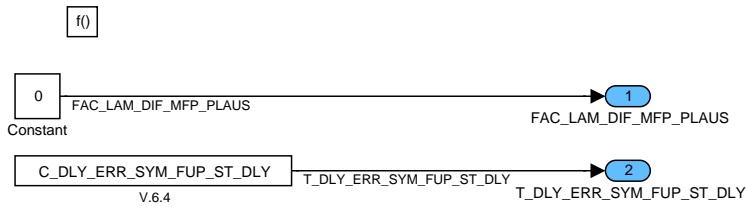
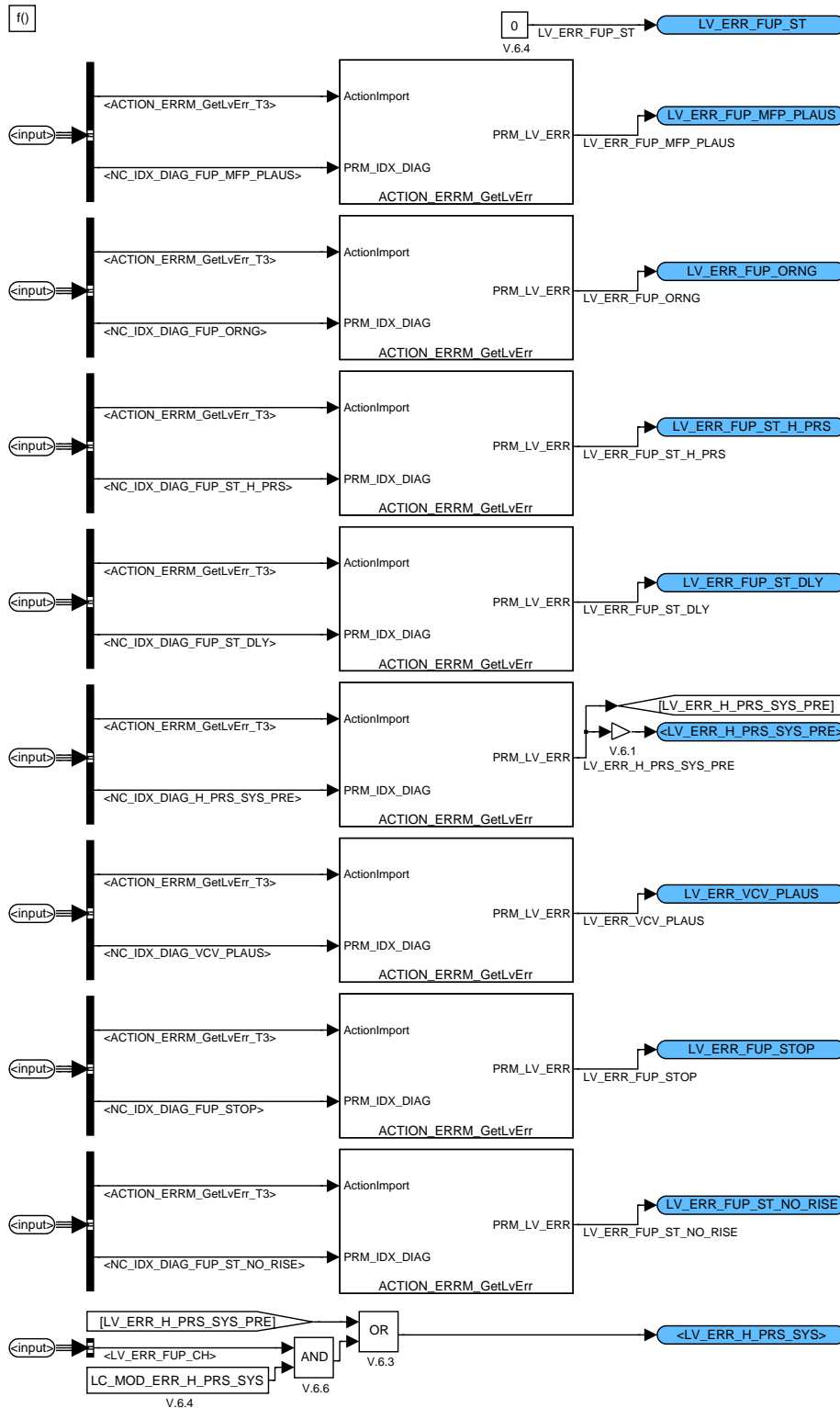


Figure B.97.3: :

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### B.97.2 SUBFUNCTION: ERRM\_INI

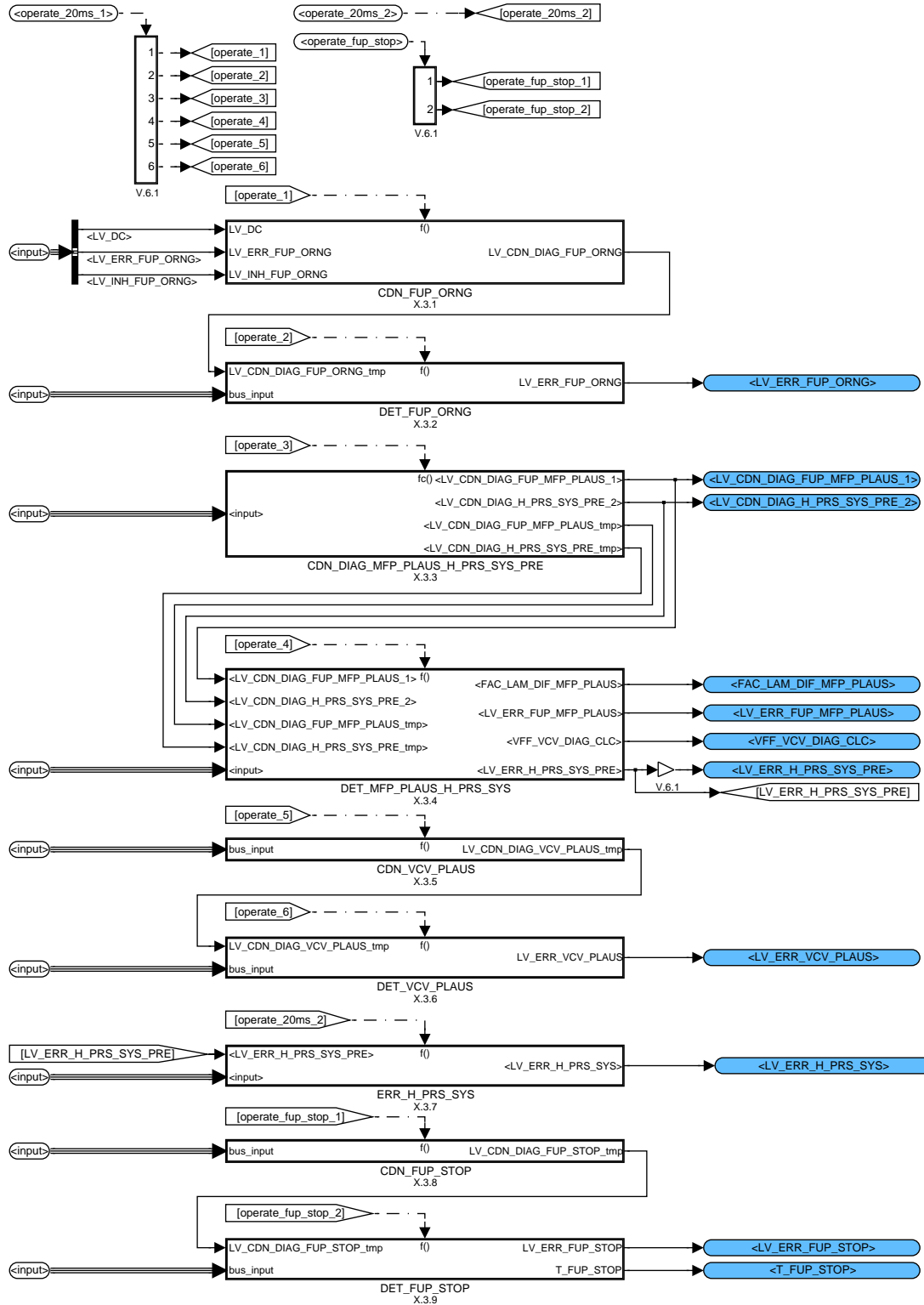


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Figure B.97.4: :


### B.97.3 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG

General overview of the parts of the diagnosis function.



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Figure B.97.5: :

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### B.97.3.1 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/CDN\_FUP\_ORNG

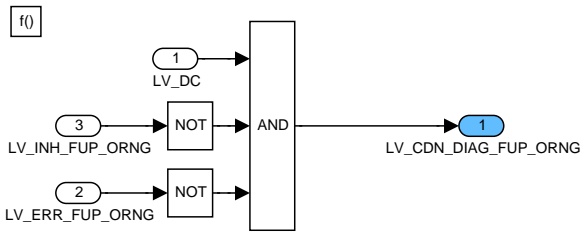


Figure B.97.6: :

### B.97.3.2 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/DET\_FUP\_ORNG

Detection of fuel pressure out of range.

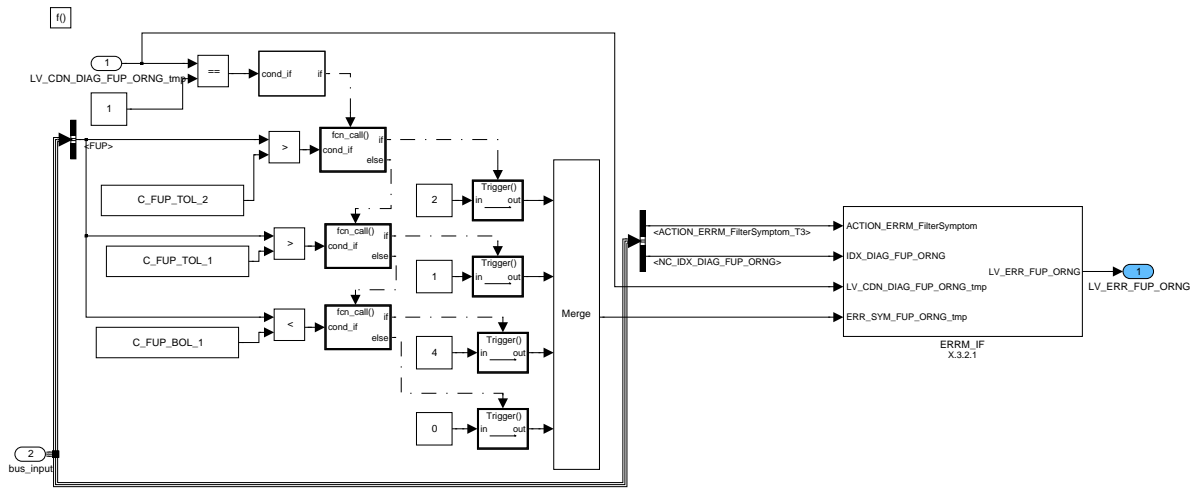


Figure B.97.7: :

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### B.97.3.2.1 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/DET\_FUP\_ORNG/ERRM\_IF

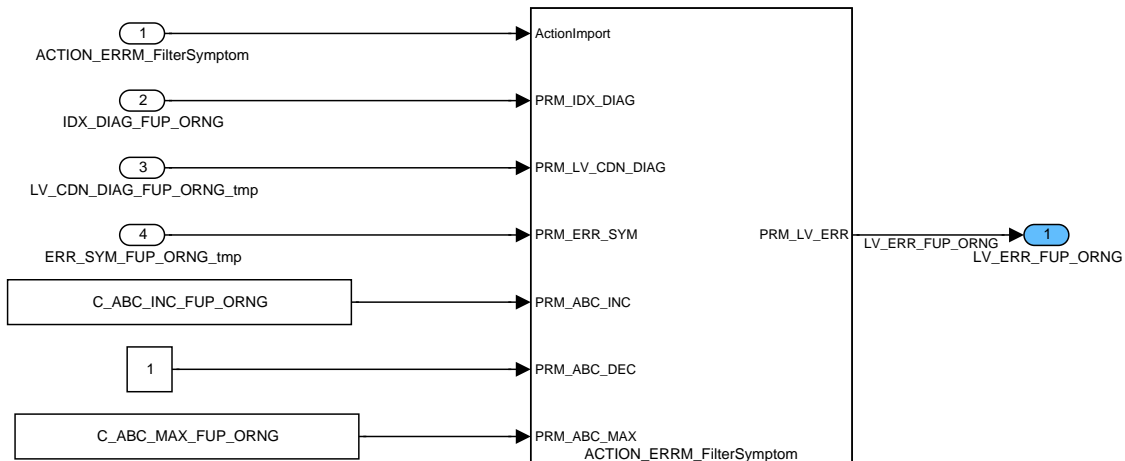


Figure B.97.8: :

### B.97.3.3 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/CDN\_DIAG\_MFP\_PLAUS\_H\_PRS\_SYS

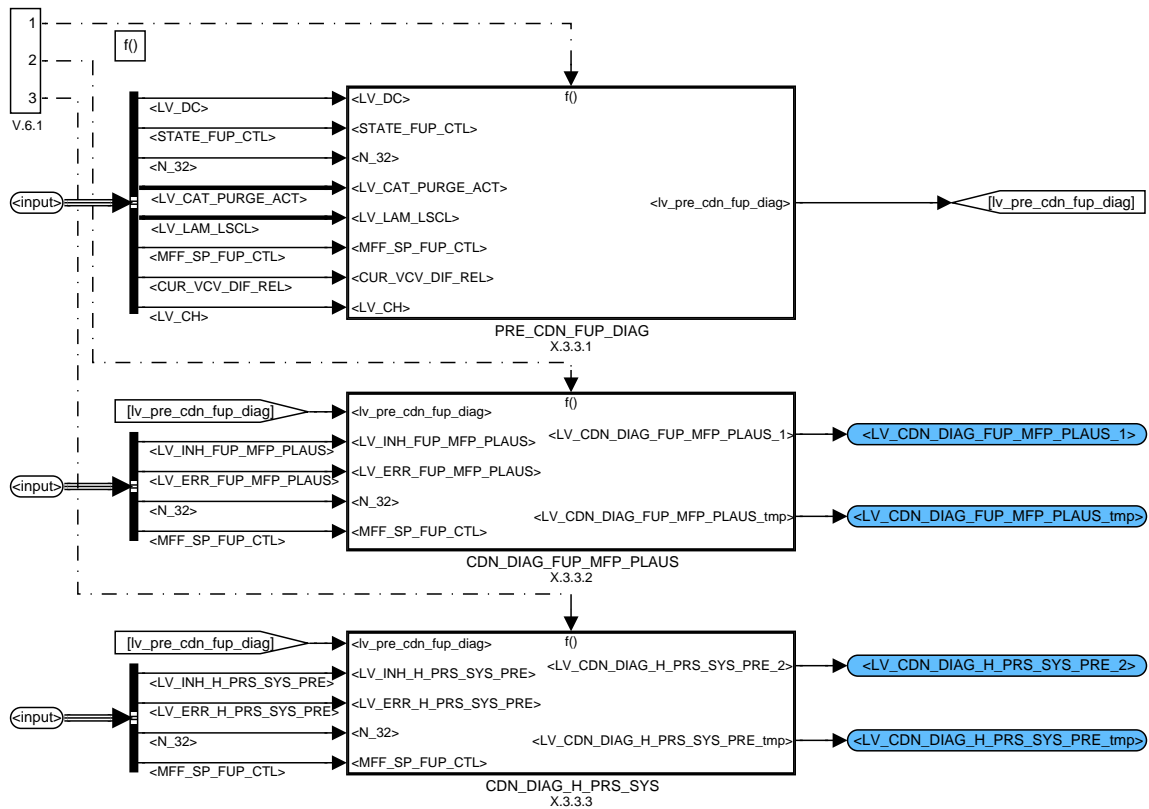


Figure B.97.9: :

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### B.97.3.3.1 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/CDN\_DIAG\_MFP\_PLAUS\_H\_PRS\_SYS/PRE\_CDN\_FUP\_DIAG

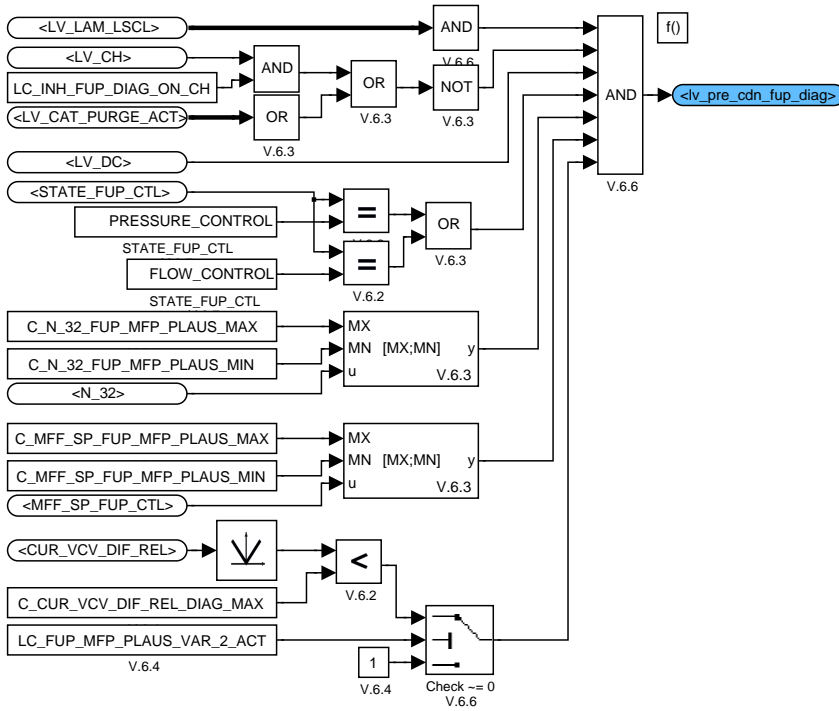


Figure B.97.10: :

### B.97.3.3.2 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/CDN\_DIAG\_MFP\_PLAUS\_H\_PRS\_SYS/CDN\_DIAG\_FUP\_MFP\_PLAUS

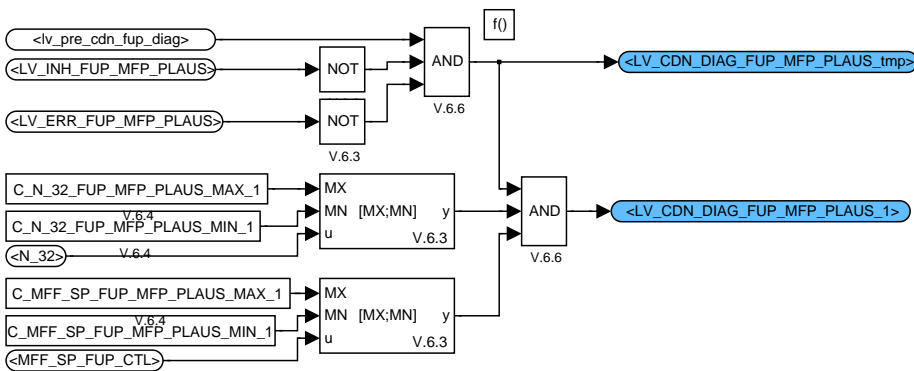


Figure B.97.11: :

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**B.97.3.3.3 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/CDN\_DIAG\_MFP\_PLAUS\_H\_PRS\_SYS/CDN\_DIAG\_H\_PRS\_SYS**

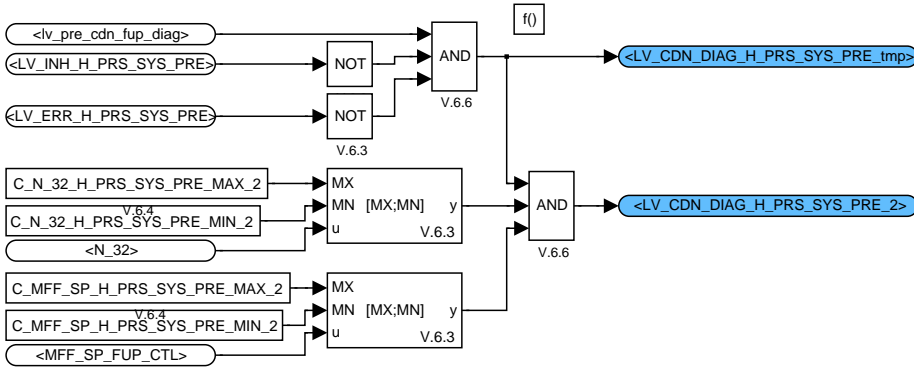



Figure B.97.12: :

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 6076 of 8404</b>	
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### B.97.3.4 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/DET\_MFP\_PLAUS\_H\_PRS\_SYS

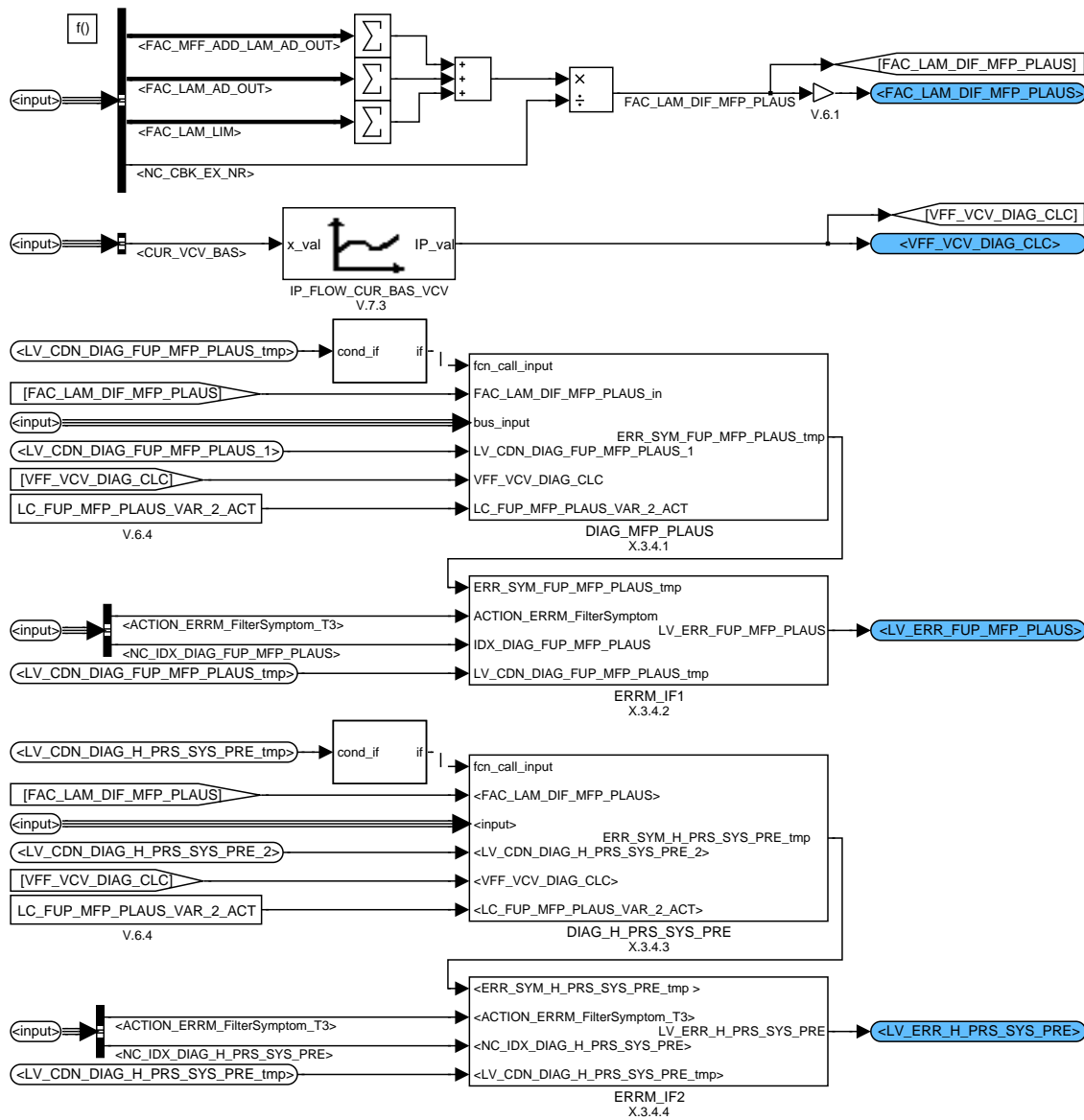


Figure B.97.13: :

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**B.97.3.4.1 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/DET\_MFP\_PLAUS\_H\_PRS\_SYS/DIAG\_MFP\_PLAUS**

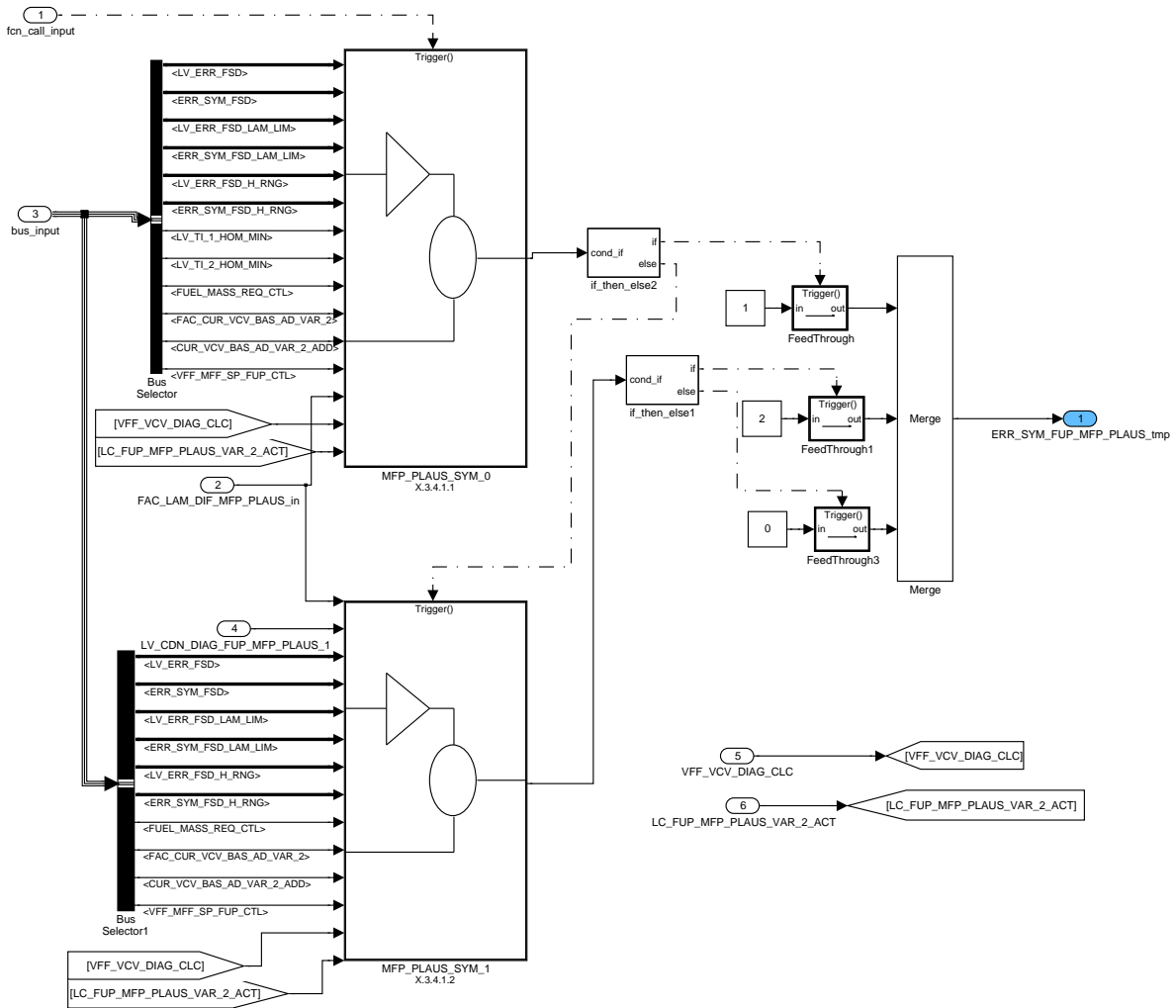


Figure B.97.14: :

**B.97.3.4.1.1 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/DET\_MFP\_PLAUS\_H\_PRS\_SYS/DIAG\_MFP\_PLAUS/MFP\_PLAUS\_SYM\_0**

Detection of FUP\_MFP\_PLAUS SYM\_0, FUP sensor shows a too high value.

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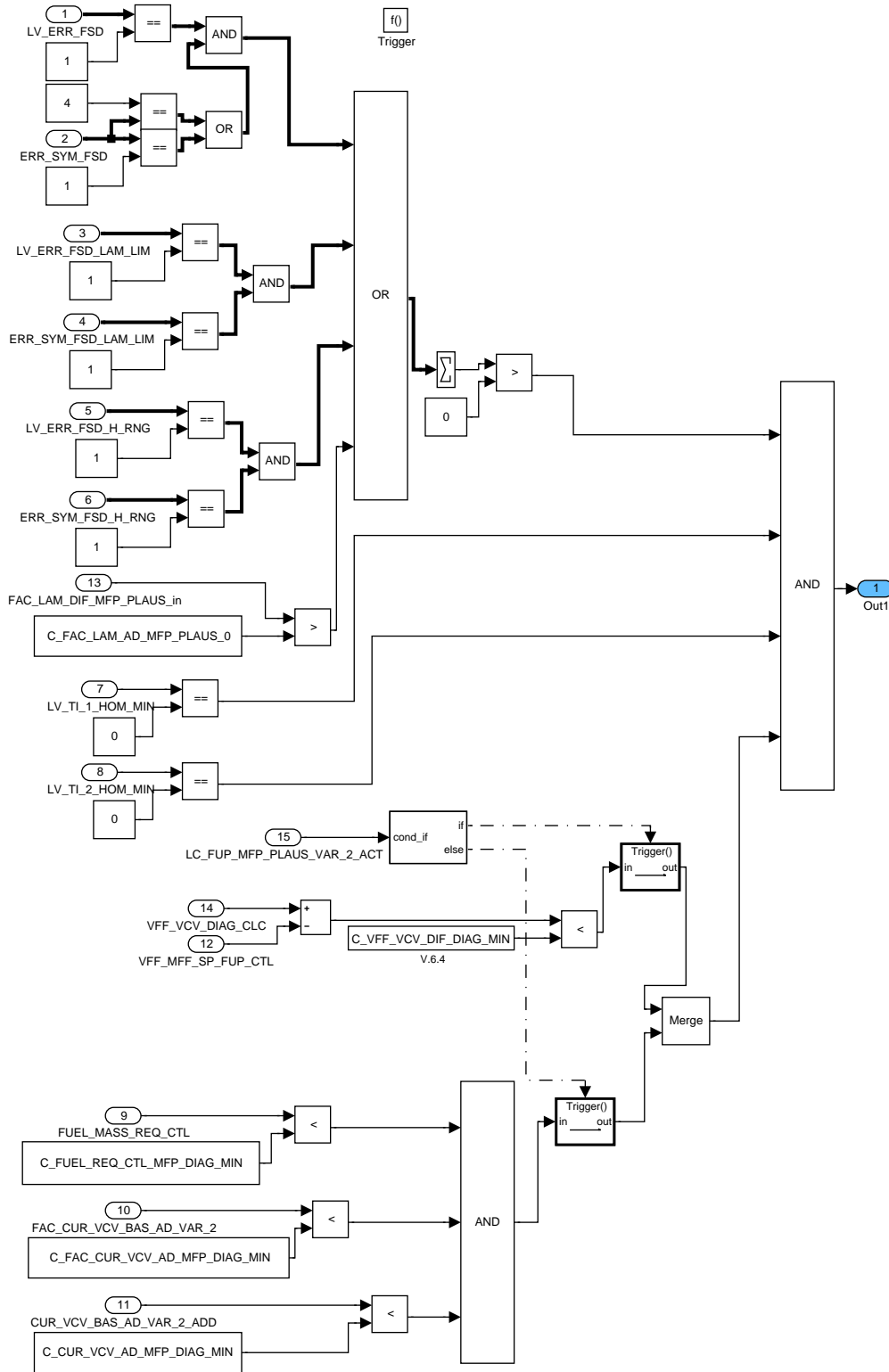
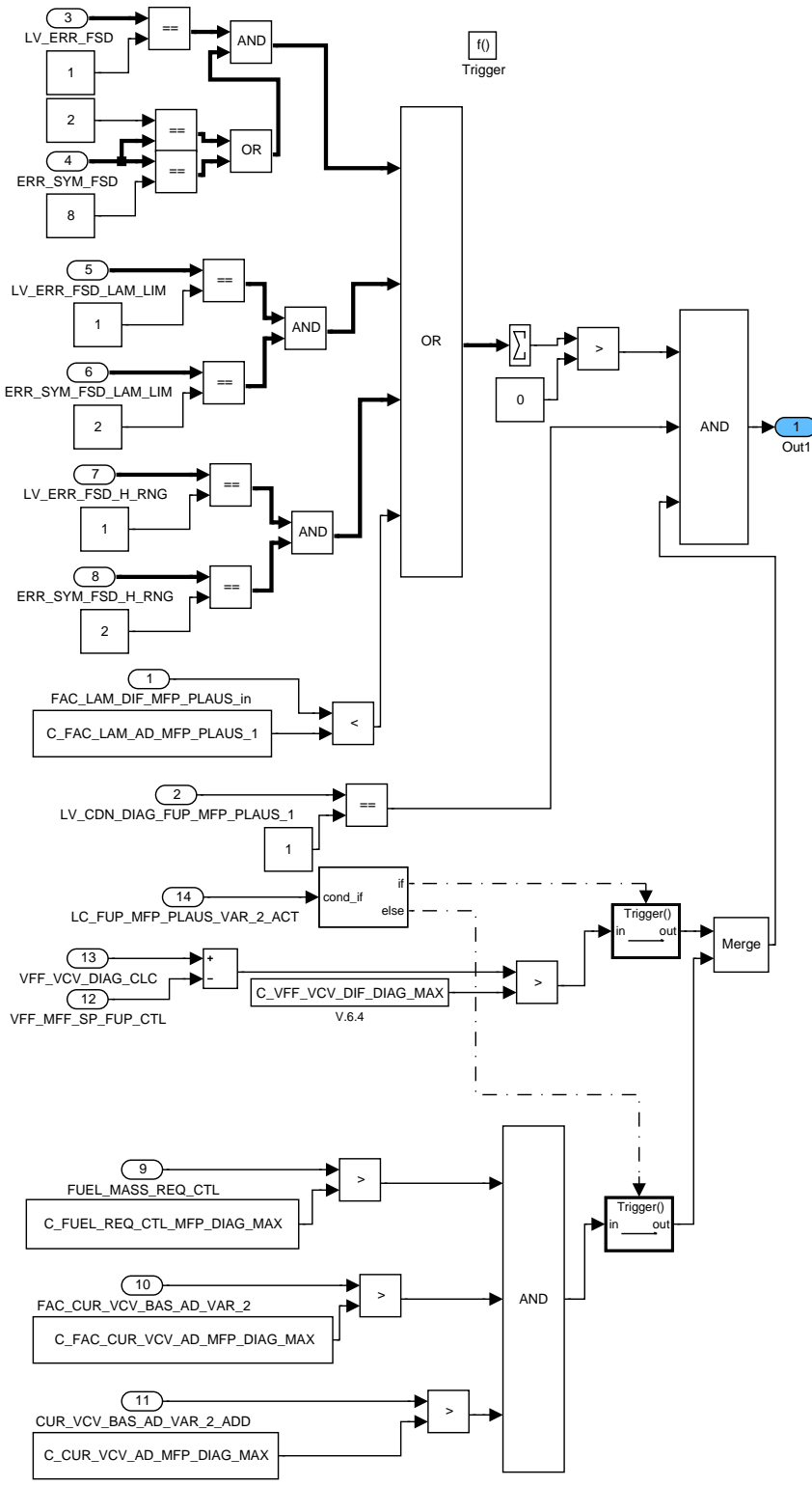


Figure B.97.15: :

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**B.97.3.4.1.2 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/DET\_MFP\_PLAUS\_H\_PRS\_SYS/DIAG\_MFP\_PLAUS/MFP\_PLAUS\_SYM\_1**

Detection of FUP\_MFP\_PLAUS SYM\_1, FUP sensor shows a too low value.



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Figure B.97.16: :

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 6080 of 8404</b>	
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**B.97.3.4.2 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/DET\_MFP\_PLAUS\_H\_PRS\_SYS/ERRM\_IF1**

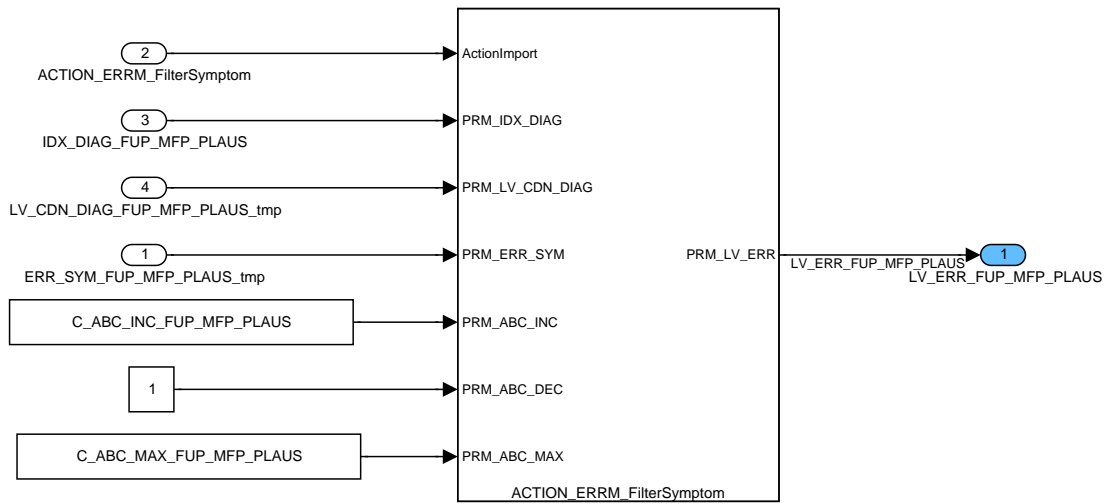


Figure B.97.17: :

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**B.97.3.4.3 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/DET\_MFP\_PLAUS\_H\_PRS\_SYS/DIAG\_H\_PRS\_SYS**



Figure B.97.18: :

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### B.97.3.4.3.1 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/DET\_MFP\_PLAUS\_H\_PRS\_SYS/DIAG\_H\_PRS\_SYS/H\_PRS\_SYS\_SYM\_2

Detection of H\_PRS\_SYS SYM\_2, delivery of pump is too low, or OPV is open, or VCV stuck at low delivery.

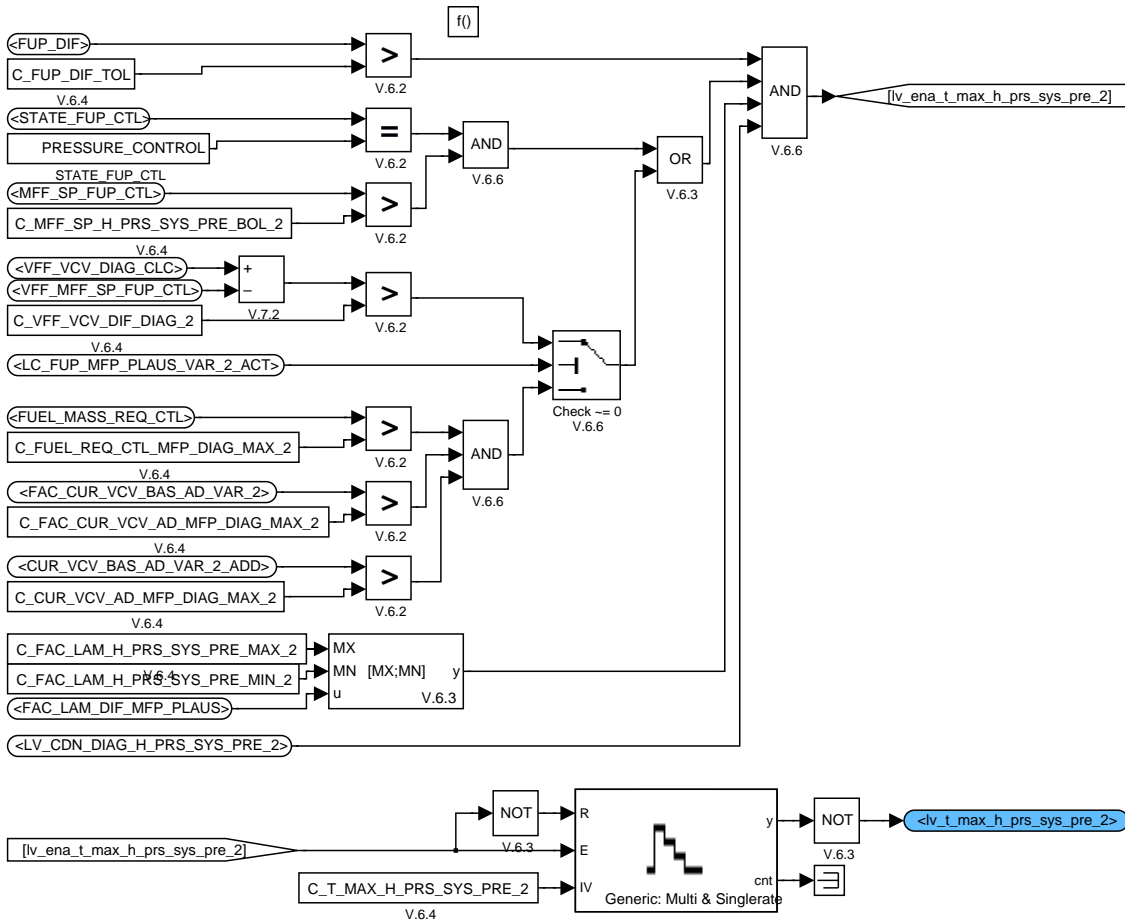


Figure B.97.19: :

### B.97.3.4.3.2 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/DET\_MFP\_PLAUS\_H\_PRS\_SYS/DIAG\_H\_PRS\_SYS/H\_PRS\_SYS\_SYM\_1

Detection of H\_PRS\_SYS SYM\_1, delivery of pump is too low.

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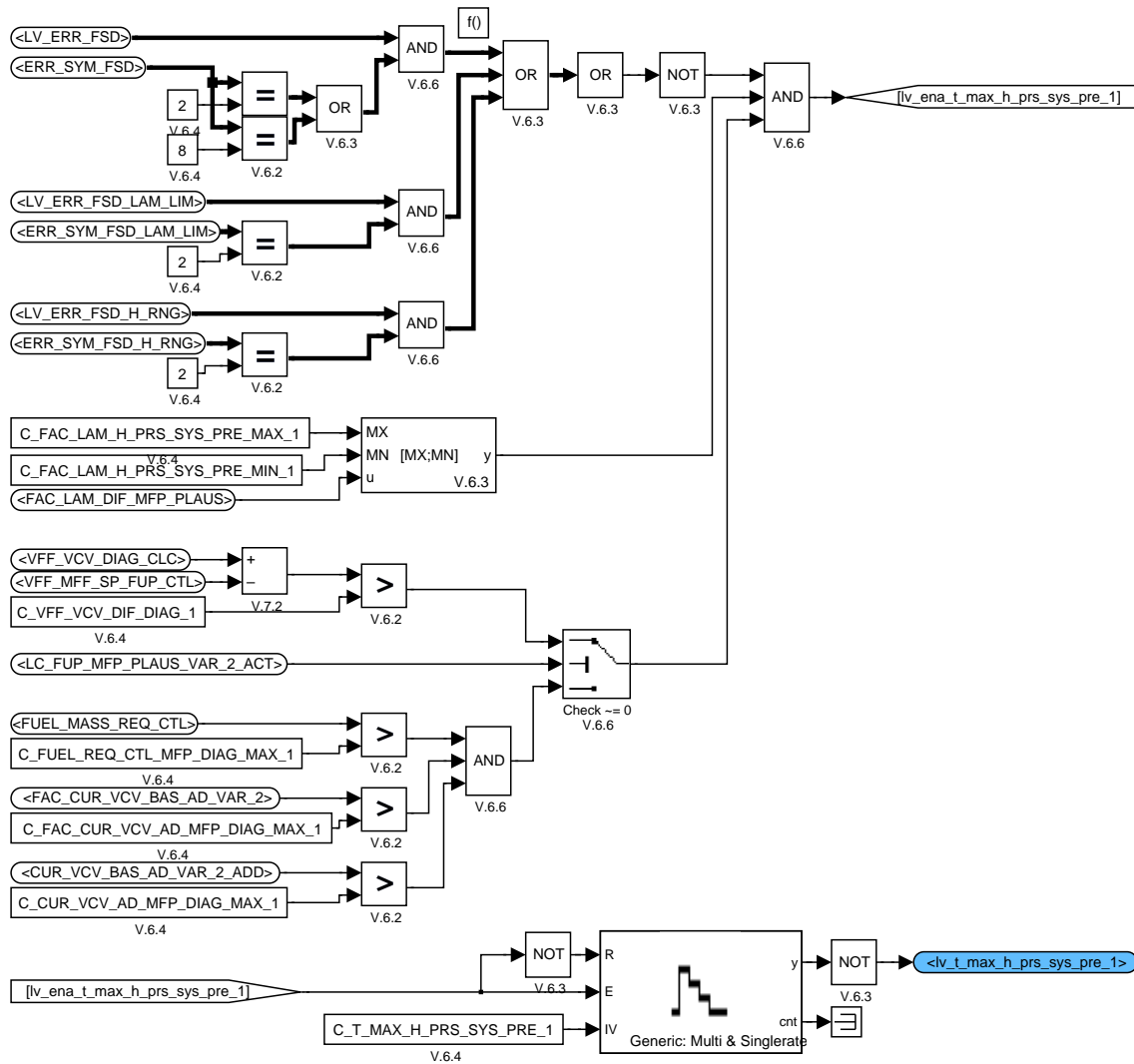



Figure B.97.20: :

**B.97.3.4.3.3 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/DET\_MFP\_PLAUS\_H\_PRS\_SYS/DIAG\_H\_PRS\_SYS/H\_PRS\_SYS\_SYM\_0**

Detection of H\_PRS\_SYS SYM\_0, delivery of pump is too high.

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 6084 of 8404	
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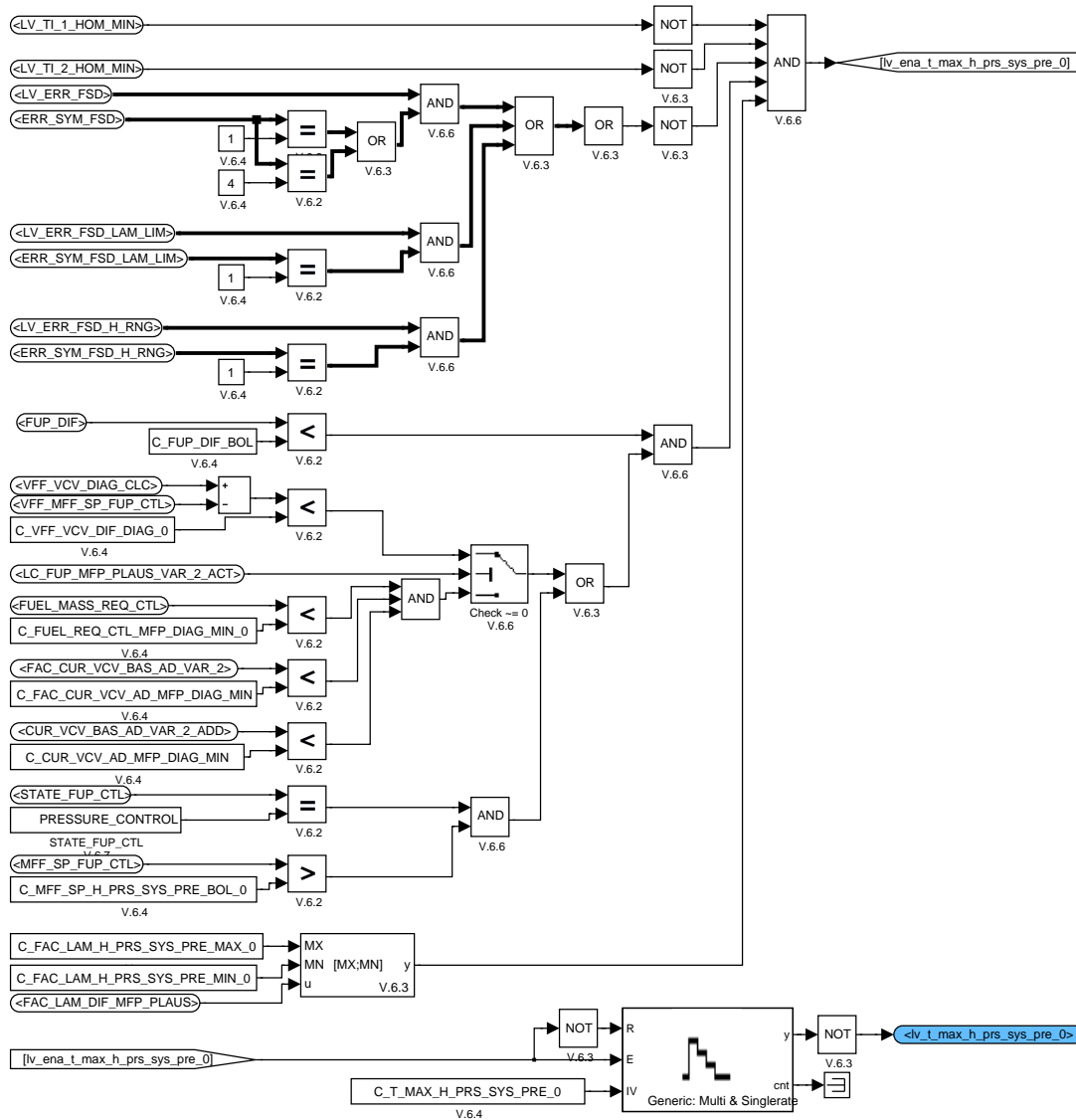


Figure B.97.21: :

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**B.97.3.4.4 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/DET\_MFP\_PLAUS\_H\_PRS\_SYS/ERRM\_IF2**

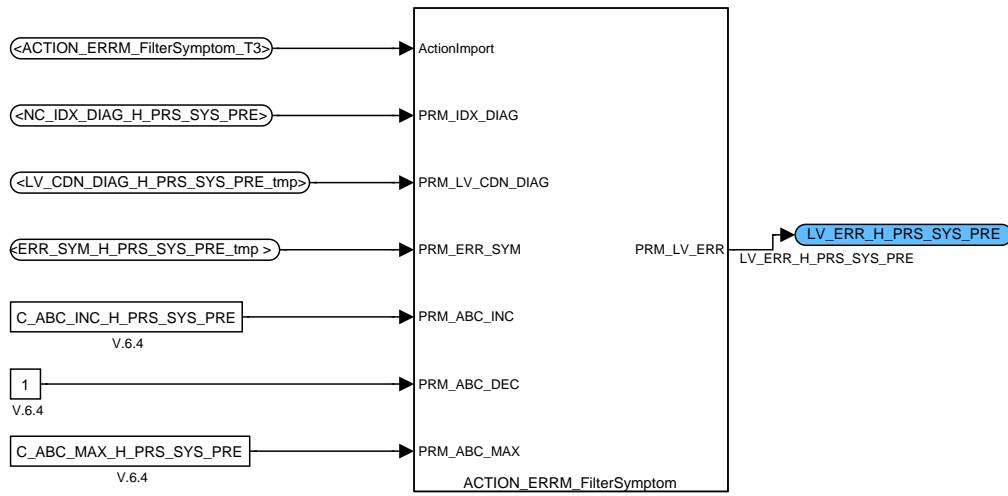


Figure B.97.22: :

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### B.97.3.5 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/CDN\_VCV\_PLAUS

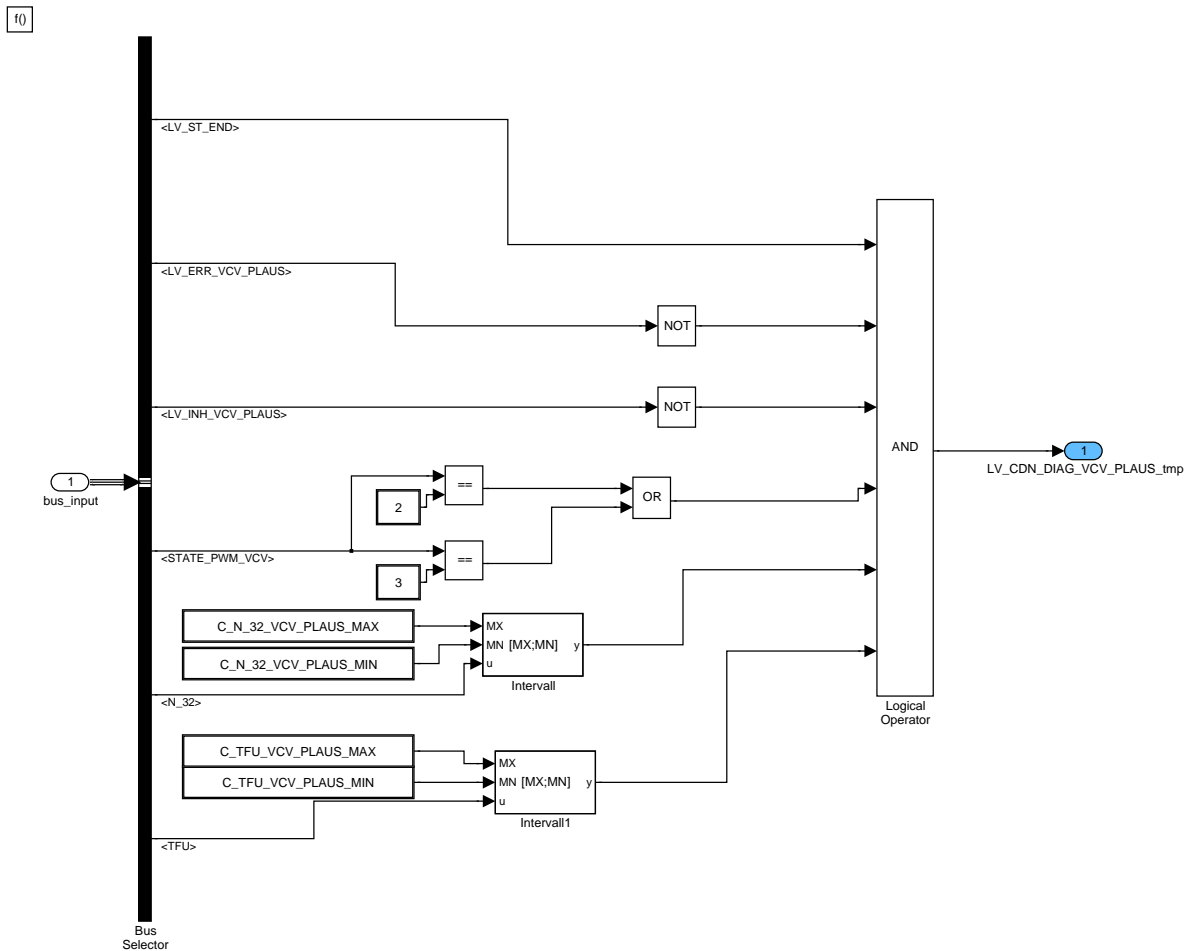


Figure B.97.23: :

### B.97.3.6 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/DET\_VCV\_PLAUS

Plausibility check of VCV adaptation values.

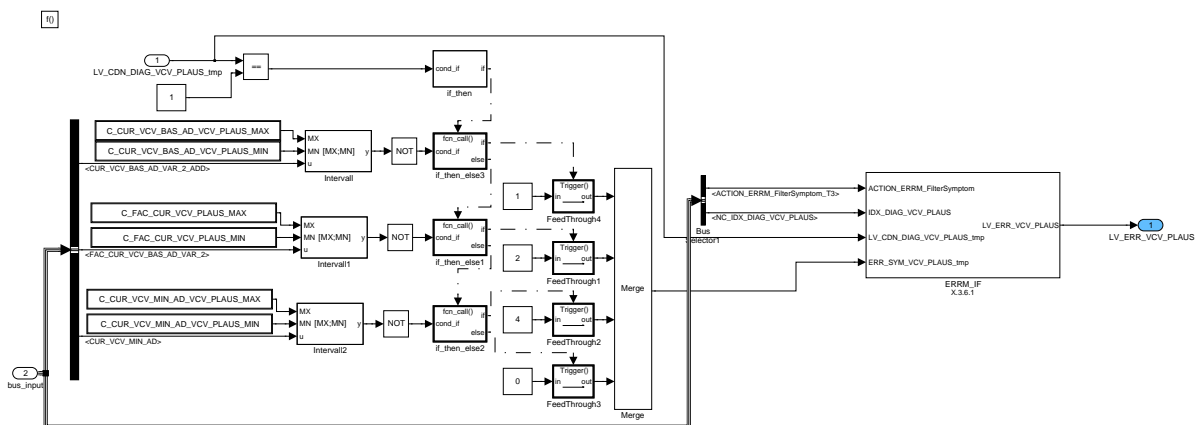


Figure B.97.24: :

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### B.97.3.6.1 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/DET\_VCV\_PLAUS/ERRM\_IF

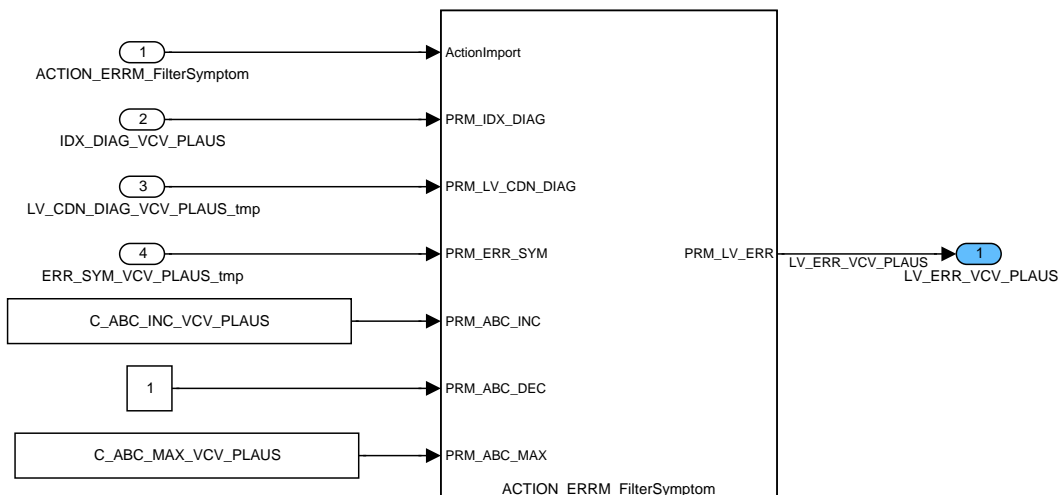


Figure B.97.25: :

### B.97.3.7 Calculation of LV\_ERR\_H\_PRS\_SYS

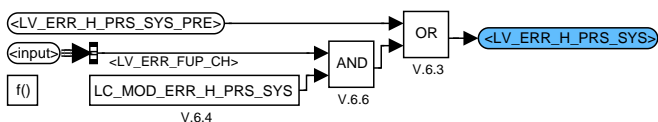


Figure B.97.26: :

### B.97.3.8 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/CDN\_FUP\_STOP

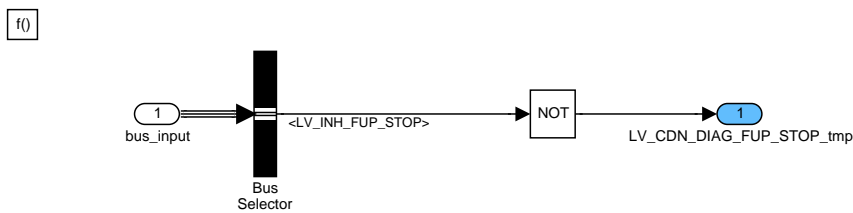


Figure B.97.27: :

### B.97.3.9 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/DET\_FUP\_STOP

Detection of fuel pressure at engine stop to high.

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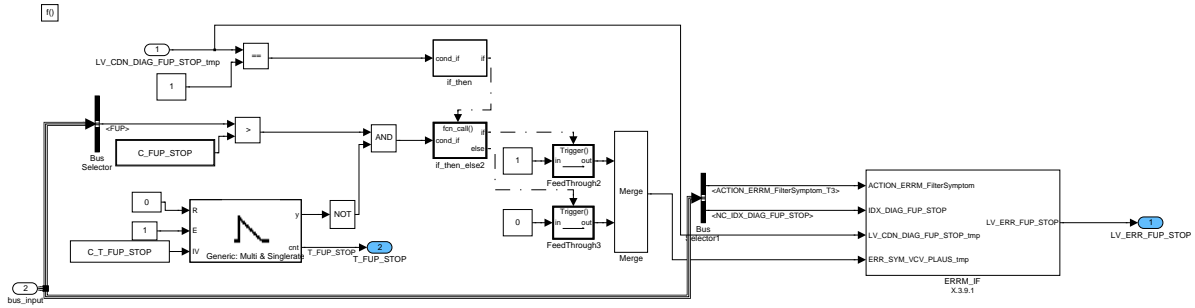


Figure B.97.28: :

**B.97.3.9.1 FUSL\_MB01G/FUEL\_SYS\_PRS\_DIAG/DET\_FUP\_STOP/ERRM\_IF**

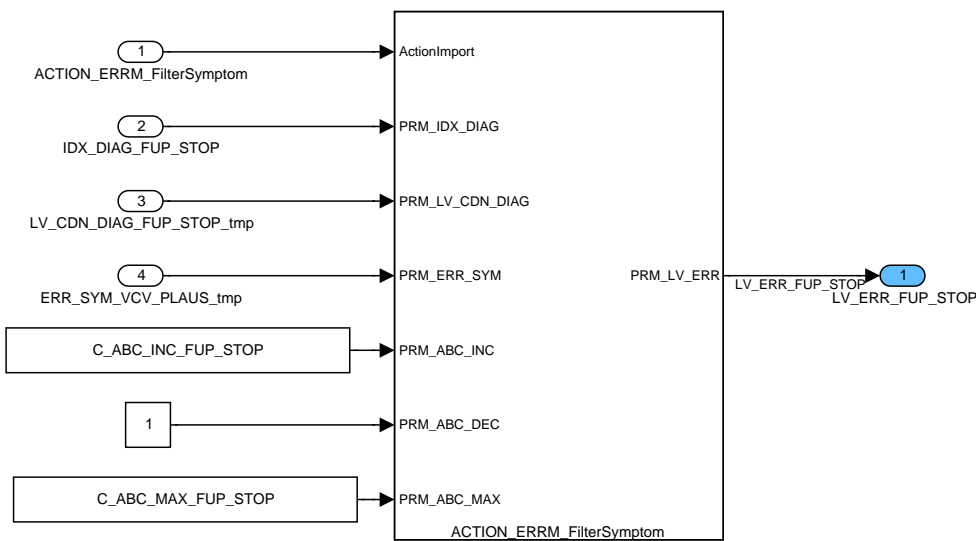


Figure B.97.29: :

**B.97.4 FUSL\_MB01G/H\_PRS\_ST\_DIAG**

Detection of fuel pressure at start of injection is too low.  
 The calibration C\_DLY\_ERR\_SYM\_FUP\_ST\_DLY has to be calibrated smaller than C\_T\_AST\_FUP\_DIAG\_ENA

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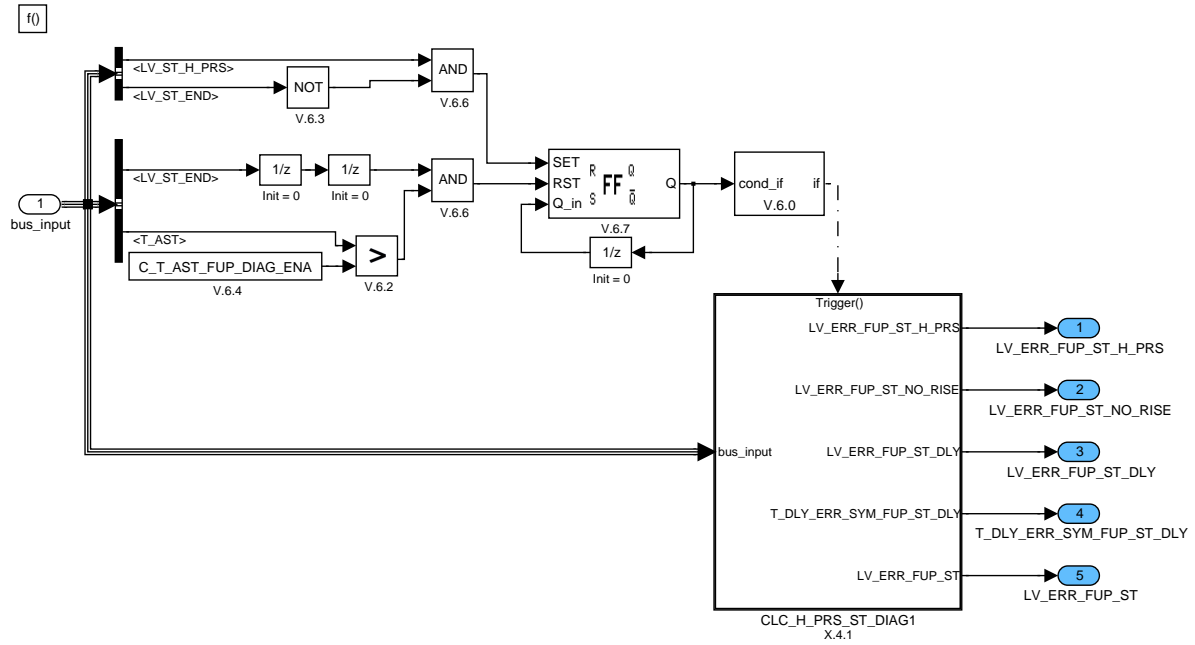
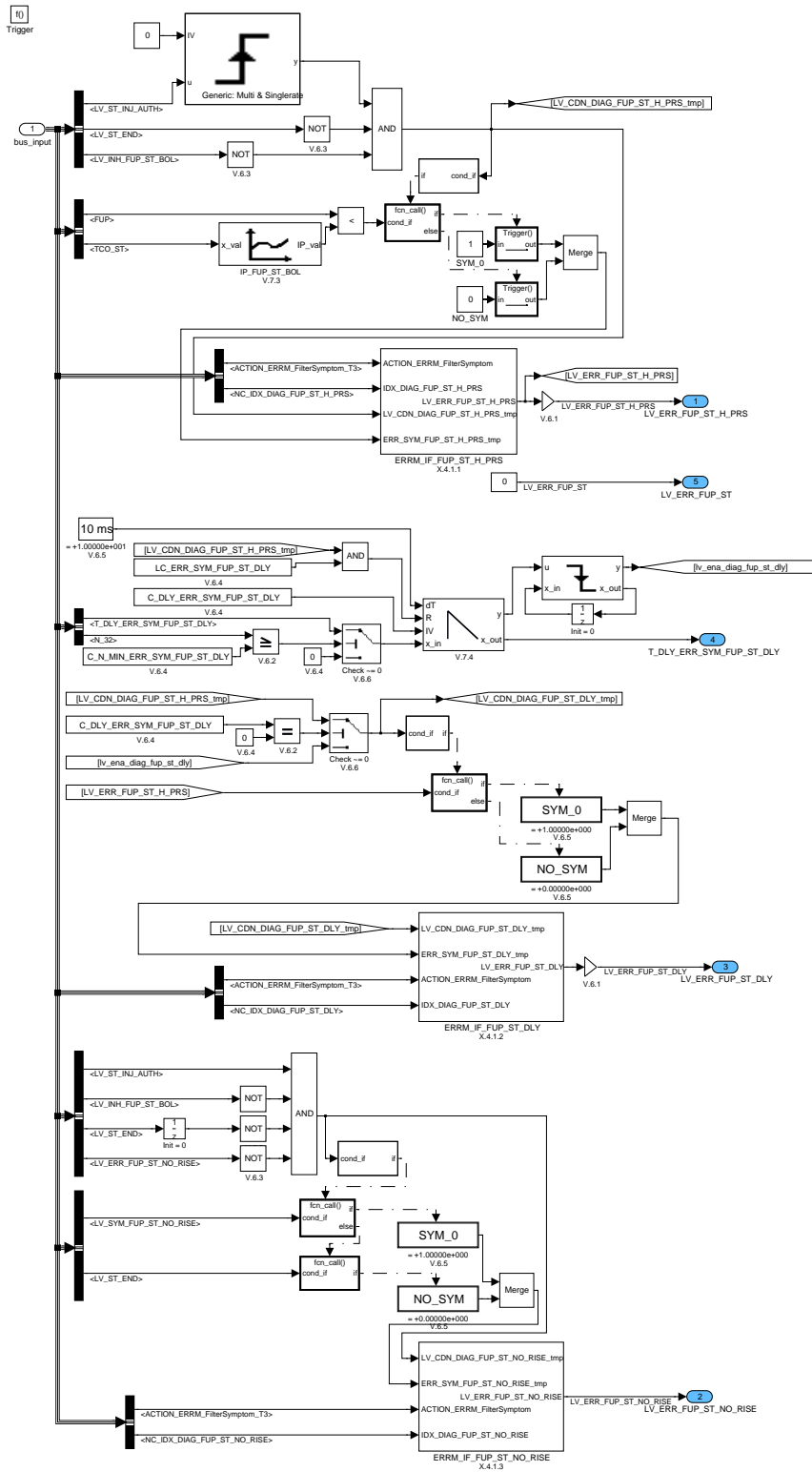


Figure B.97.30: : Function sequencing for fuel pressure diagnostics at start


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### B.97.4.1 Fuel pressure diagnostics at start



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Figure B.97.31: :

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 6091 of 8404</b>	
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### B.97.4.1.1 FUSL\_MB01G/H\_PRS\_ST\_DIAG/ERRM\_IF\_FUP\_ST\_H\_PRS

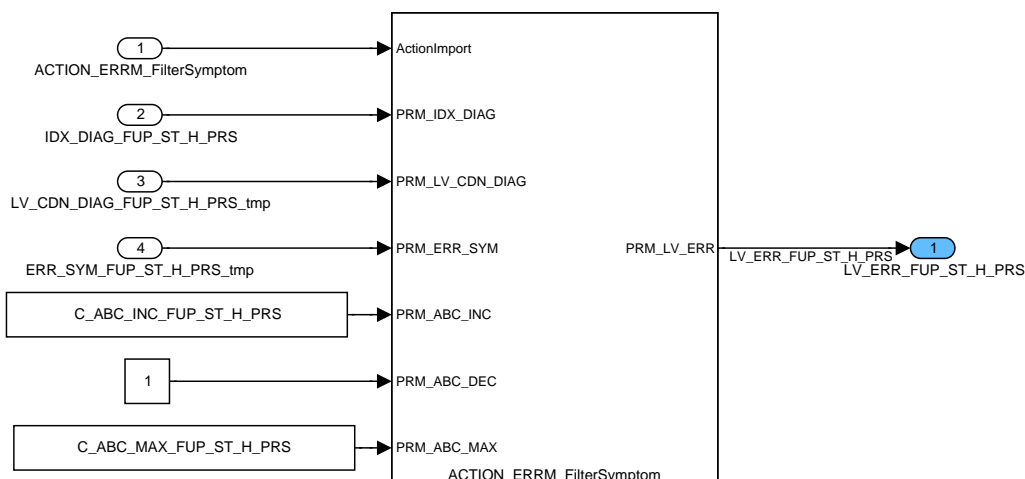


Figure B.97.32: :

### B.97.4.1.2 FUSL\_MB01G/H\_PRS\_ST\_DIAG/ERRM\_IF\_FUP\_ST\_DLY

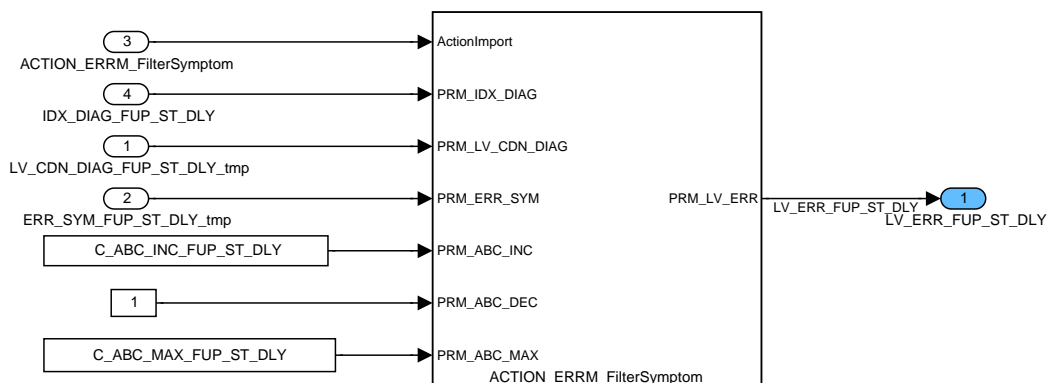


Figure B.97.33: :

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**B.97.4.1.3 FUSL\_MB01G/H\_PRS\_ST\_DIAG/ERRM\_IF\_FUP\_ST\_NO\_RISE**

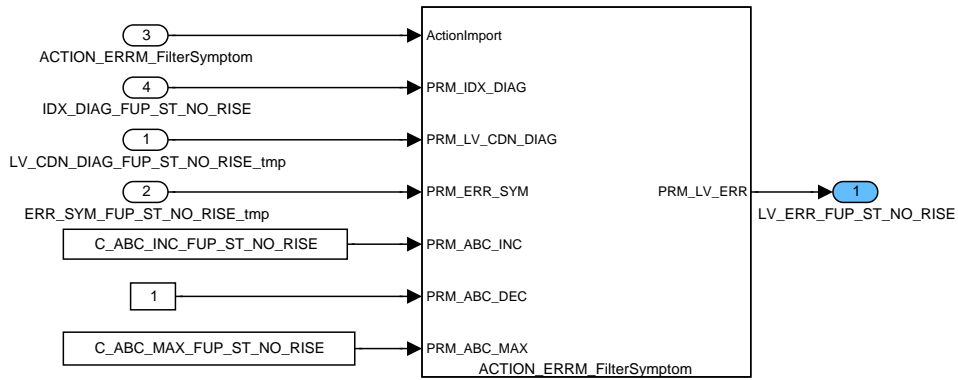


Figure B.97.34: :

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## B.97.5 SUBFUNCTION: DISP\_ERRM\_DGO

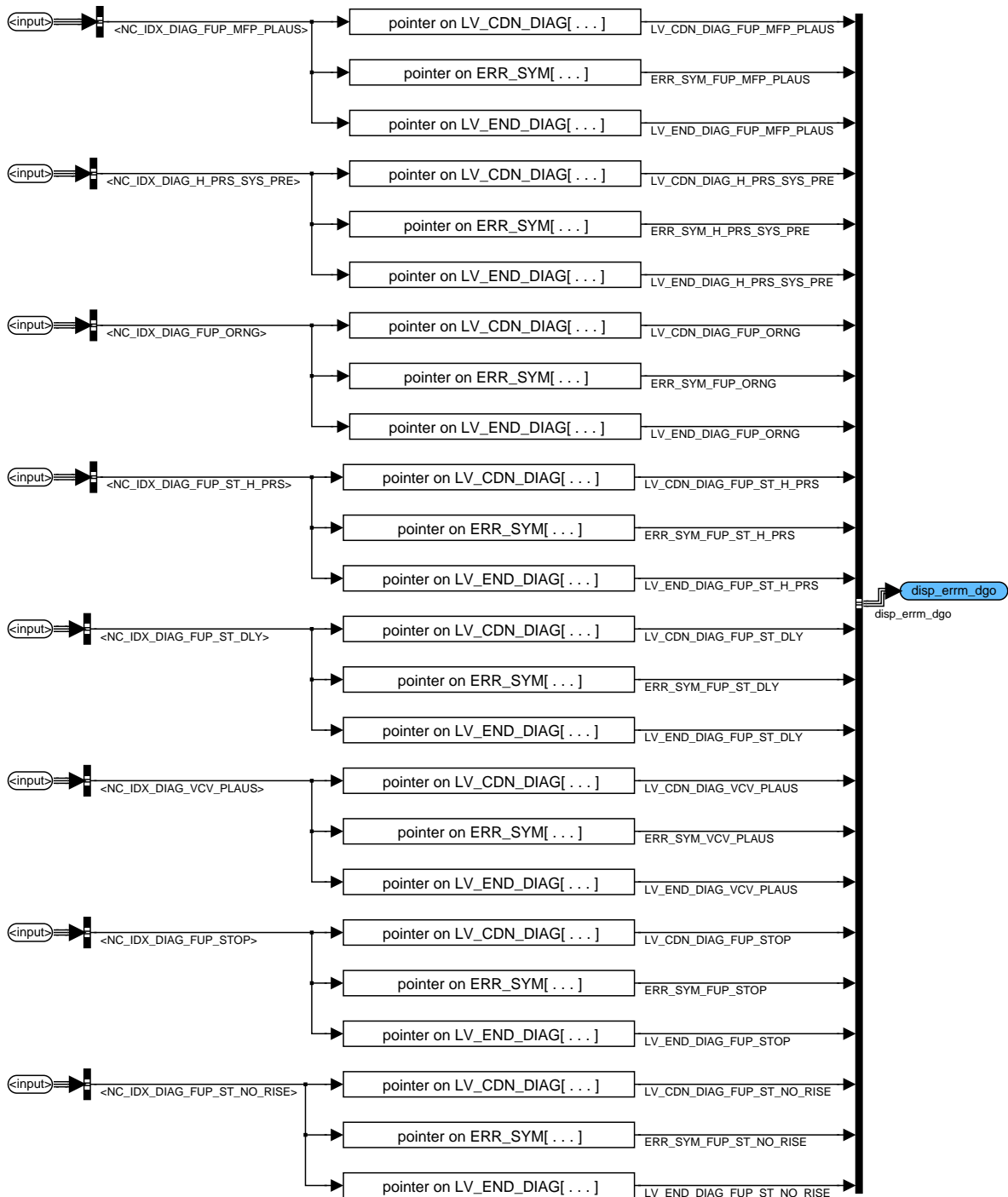


Figure B.97.35: :

## B.98 Fuel system pressure diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_FUP_MFP_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean flag to stop the plausibility check of FUP/MFP					
LV_INH_FUP_ORNG	O/V	0... 1H	0 ...1	1	-
Boolean flag to stop the FUP ORNG check					
LV_INH_FUP_SENS_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean flag to stop the FUP sensor plausibility check					
LV_INH_FUP_ST_BOL	O/V	0... 1H	0 ...1	1	-
Boolean flag to stop the diagnosis of FUP at start of injection					
LV_INH_FUP_STOP	O/V	0... 1H	0 ...1	1	-
Boolean flag to stop the FUP_STOP check					
LV_INH_H_PRS_SYS_PRE	O/V	0... 1H	0 ...1	1	-
Boolean flag to stop the high pressure system monitoring					
LV_INH_VCV_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean flag to stop the VCV_PLAUS check					

### Input data:

CL_MMV {p. 3698}	FUP_SP {p. 3868}	LV_ACT_DIAGCPS {p. 5926}	LV_ERR_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}
LV_ERR_EL_CPS {p. 4708}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_LS_DOWN [NC_CBK_EX_NR] {p. 5449}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_ERR_MEC_OPEN_ CPS {p. 1001}	LV_ERR_RLY_VCV {p. 988}
LV_ERR_VCV {p. 4729}	LV_IGK {p. 906}	LV_VCV_RLY {p. 988}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	STATE_CP {p. 3637}	STATE_ERR_IV {p. 4803}	T_AST {p. 1766}
VFF_MFF_SP_FUP_CTL {p. 3881}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_MAX_DIAG_MFP_PLAUS	-	0... FFFFH	0... 7.9998779296875	122.07e-6	-
Maximum canister load to detect a fault in highpressure system					
C_FUP_SP_DIAG_MAX	-	0... FFFFH	0... 347776	5.30672159	hPa
Maximum FUP_SP to enable high pressure dianosis					
C_FUP_SP_DIAG_MIN	-	0... FFFFH	0... 347776	5.30672159	hPa
Minimum FUP_SP to enable high pressure dianosis					
C_T_AST_H_PRS_DIAG_INH	-	0... FFFFH	0... 6553.5	0.1	s
Inhibit time for deactivation of the high pressure system diagnosis					
C_T_FUP_ORNG_DIAG_INH	-	0... FFFFH	0... 1310.7	0.02	s
Inhibit time for deactivation of the FUP ORNG diagnosis					
C_T_H_PRS_DIAG_INH	-	0... FFFFH	0... 1310.7	0.01	s
Inhibit time for deactivation of the high pressure system diagnosis					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_VFF_MAX_FUP_DIAG	-	0... FFFFH	0... 255	3.89105e-3	l/h
LDP_N_32_IP_VFF_MAX_FUP_DIAG	4	0... FFH	0... 8160	32	rpm
Maximun fuel flow to enable high pressure diagnosis					

**Error treatment:**



Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>						
FUP_MFP_PLAUS	High pressure sensor inappropriately high	0				
<i>Fuel pressure/mass fuel pump plausibility check</i>	High pressure sensor inappropriately low	1			STD_INI	CC
		2				
		3				
<b>Diagnostic Identifier</b>	<b>Symptom Description</b>	<b>Nr</b>	<b>OBD Sym DTC</b>	<b>OBD Global DTC</b>	<b>Filter Type</b>	<b>CARB class</b>
<b>Diagnostic Description</b>						
FUP_ORNG	FUP top limit 1 reached	0				
<i>Fuel pressure out of range</i>	FUP top limit 2 reached	1			STD_INI	CC
	FUP bottom limit 1 reached	2				
		3				
<b>Diagnostic Identifier</b>	<b>Symptom Description</b>	<b>Nr</b>	<b>OBD Sym DTC</b>	<b>OBD Global DTC</b>	<b>Filter Type</b>	<b>CARB class</b>
<b>Diagnostic Description</b>						
FUP_ST_DLY	FUP at start too low	0				
<i>FUP_ST_H_PRS follow-up failure entry</i>		1			STD_INI	CC
		2				
		3				
<b>Diagnostic Identifier</b>	<b>Symptom Description</b>	<b>Nr</b>	<b>OBD Sym DTC</b>	<b>OBD Global DTC</b>	<b>Filter Type</b>	<b>CARB class</b>
<b>Diagnostic Description</b>						
FUP_ST_H_PRS	FUP at high pressure start too low	0				
<i>Fuel pressure at high pressure start</i>		1			STD_INI	CC
		2				
		3				
<b>Diagnostic Identifier</b>	<b>Symptom Description</b>	<b>Nr</b>	<b>OBD Sym DTC</b>	<b>OBD Global DTC</b>	<b>Filter Type</b>	<b>CARB class</b>
<b>Diagnostic Description</b>						
FUP_ST_NO_RISE	No fuel pressure increase at start detected, high pressure start abortion active	0				
<i>High pressure start abortion</i>		1			STD_INI	CC
		2				
		3				
<b>Diagnostic Identifier</b>	<b>Symptom Description</b>	<b>Nr</b>	<b>OBD Sym DTC</b>	<b>OBD Global DTC</b>	<b>Filter Type</b>	<b>CARB class</b>
<b>Diagnostic Description</b>						
FUP_STOP	FUP at engine stop too high	0				
<i>Fuel pressure stop</i>		1			STD_INI	CC
		2				
		3				
<b>Diagnostic Identifier</b>	<b>Symptom Description</b>	<b>Nr</b>	<b>OBD Sym DTC</b>	<b>OBD Global DTC</b>	<b>Filter Type</b>	<b>CARB class</b>
<b>Diagnostic Description</b>						
H_PRS_SYS_PRE	VCV stuck open	0			STD_INI	CC

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 6097 of 8404</b>	
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<i>High pressure system monitoring</i>	VCV stuck closed	1				
	VCV stuck closed or OPV defect	2				
		3				
<b>Diagnostic Identifier</b>	<b>Symptom Description</b>	<b>Nr</b>	<b>OBD Sym DTC</b>	<b>OBD Global DTC</b>	<b>Filter Type</b>	<b>CARB class</b>
<b>Diagnostic Description</b>						
VCV_PLAUS	ADD adaptation out of range	0				
<i>VCV plausibility check</i>	FAC adaptation out of range	1			STD_INI	CC
	Pressure curve adaptation out of range	2				
		3				

### General information:

To inhibit the fuel system pressure diagnosis, several Diagnostic errors examined.

### Application conditions:

*Initialisation:* RST  
*Recurrence:* 10MS  
*Activation:* LV\_IGK==1  
*Deactivation:* LV\_IGK==0

### Function description:

### Formula section:

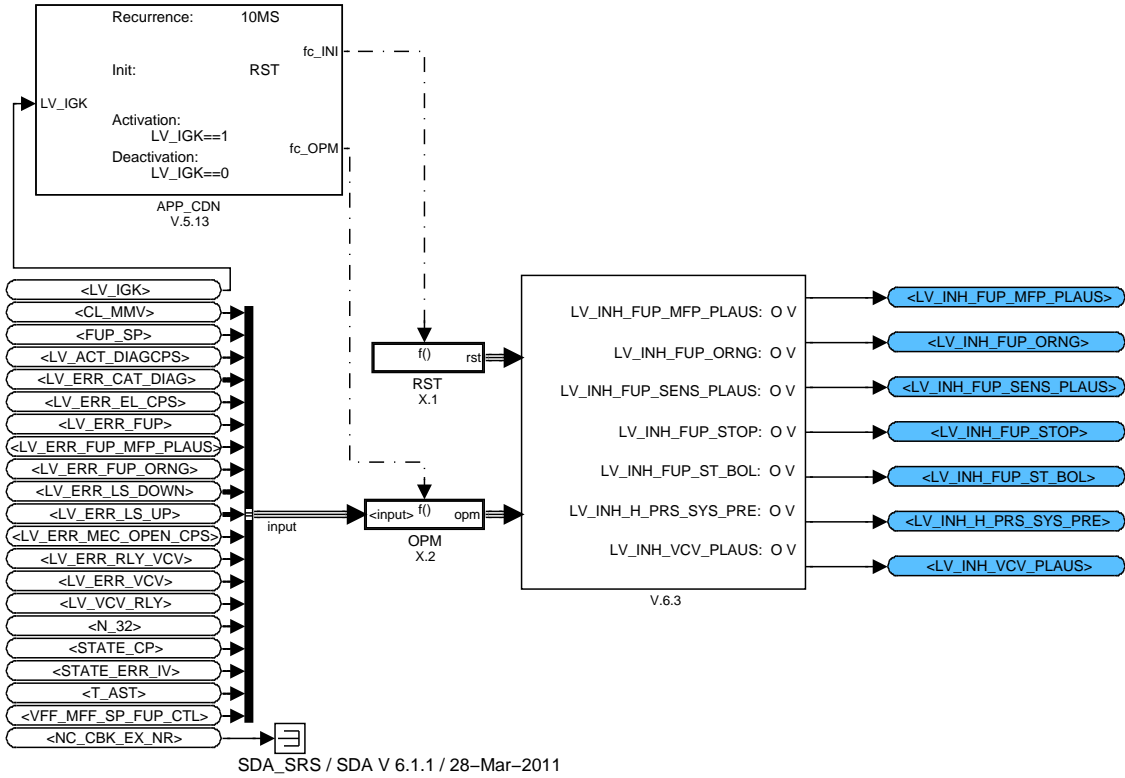


Figure B.98.1: :

**B.98.1 Initialisation:**

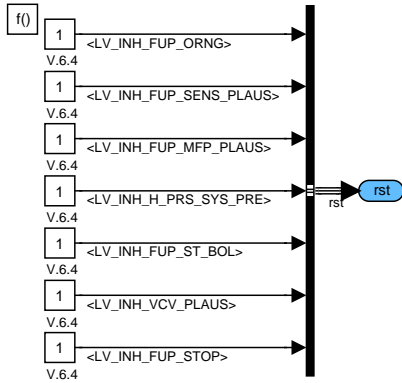



Figure B.98.2: :

**Function Description:**

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	Document key 10171571 SPE 000 AO	Pages Page 6099 of 8404	
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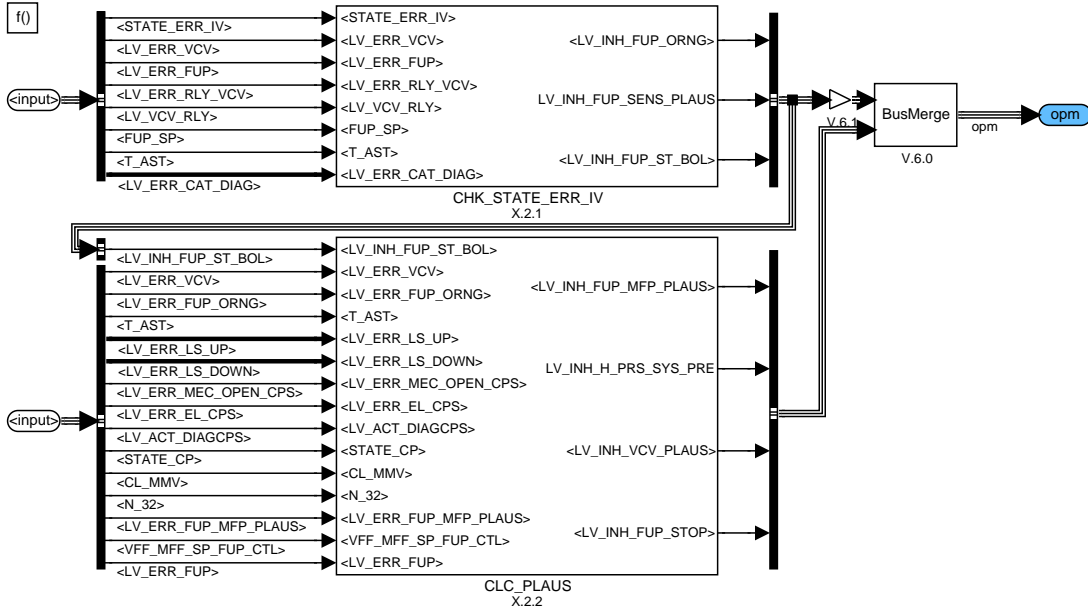


Figure B.98.3: :

### B.98.2 Calculation of inhibition fuel pressure:

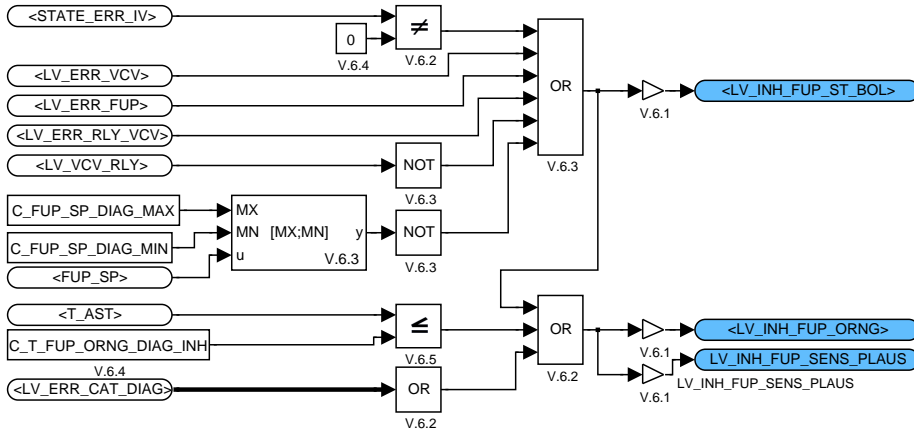


Figure B.98.4: :

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### B.98.3 Calculation for mass fuel pump:

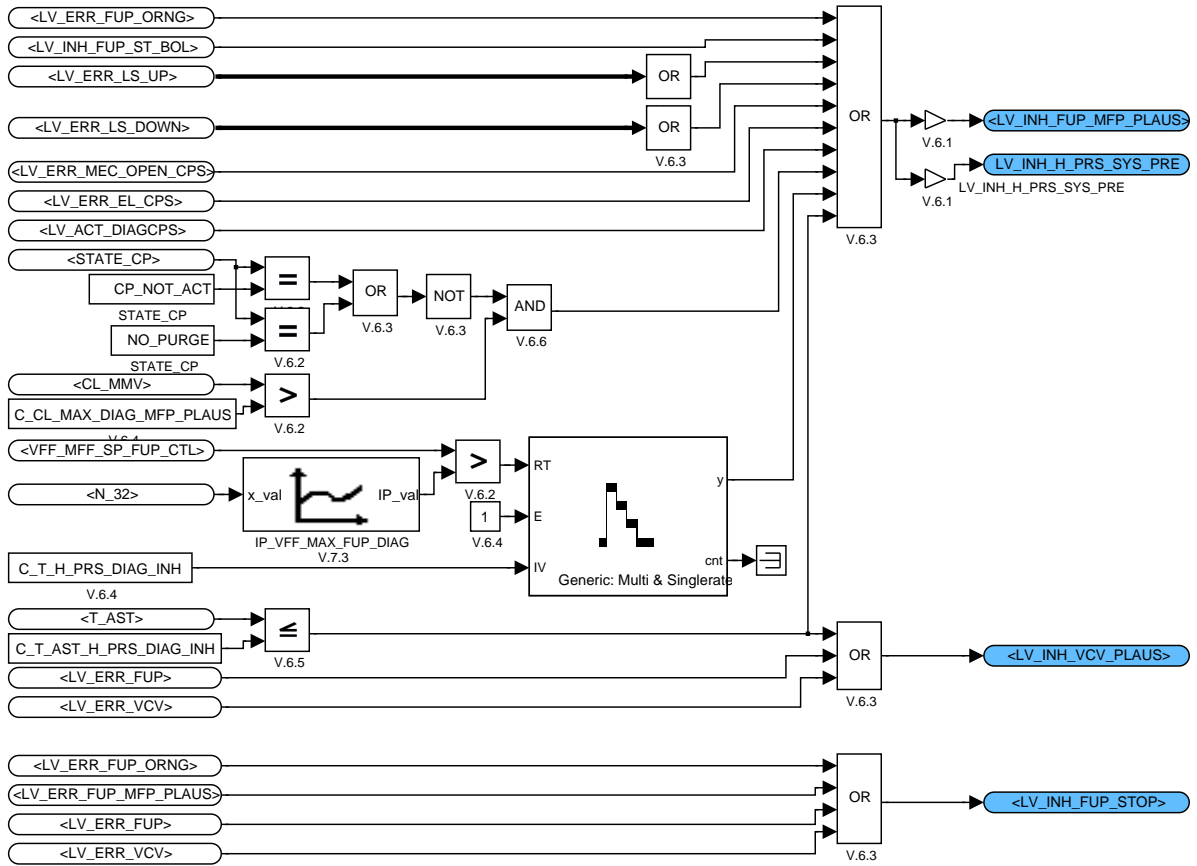


Figure B.98.5: :

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## B.99 FUSL rate based monitoring interface

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_FUP_CH	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected symptom FUP_CH					
LV_CDN_DIAG_FUP_CH	V	0... 1H	0 ...1	1	-
Status of diagnosis for FUP monitoring during CH					
LV_END_DIAG_FUP_CH	V	0... 1H	0 ...1	1	-
End of diagnosis flag for FUP check during CH					
LV_END_DIAG_RBM_FUP_CH	V	0... 1H	0 ...1	1	-
End of diagnosis flag for FUP check during CH for RBM					
LV_ERR_FUP_CH	O/V	0... 1H	0 ...1	1	-
Boolean that indicates a deviation in fuel pressure during CH					
LV_INH_DIAG_RBM_FUP_CH	O/V	0... 1H	0 ...1	1	-
FUP_CH plausibility diagnosis inhibition condition for RBM interface definition					
STATE_RBM_FUP_CH [NC_CBK_HPP_NR]	O/V	0... FFH	0... 255	1	-
Interface of 'fuel pressure during CH' monitor with the Rate-Based Monitoring statistics.					
T_END_DIAG_RBM_FUP_CH	V	0... FFFFH	0... 6553.5	0.1	s
Timer for setting the RBM diagnosis end flag for FUP_CH					
T_FUP_CH_DIAG_MAX	V	0... FFFFH	0... 1310.7	0.02	s
Timer indicating time with too high fuel pressure					
T_FUP_CH_DIAG_MIN	V	0... FFFFH	0... 1310.7	0.02	s
Timer indicating time with too low fuel pressure					

### Input data:

C_N_32_FUP_DIAG {p. 6066}	CTR_ERR_DYN_NR {p. 5767}	FUP_DIF {p. 3909}	LV_CH {p. 8232}
LV_DC {p. 5746}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_H_PRS_SYS_ PRE {p. 6062}	LV_ERR_VCV {p. 4729}	LV_IGK {p. 906}	N_32 {p. 1525}
NC_CBK_HPP_NR [1] {p. 812}	T_AST {p. 1766}	TCO {p. 1100}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_FUP_CH	-	0... FFH	0... 255	1	-
Increment of the FUP_CH anti-bounce counter					
C_ABC_MAX_FUP_CH	-	1... FFH	1... 255	1	-
Threshold to be reached, before FUP_CH error					
C_FUP_DIF_DIAG_MAX	-	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Maximum threshold for FUP_DIF					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUP_DIF_DIAG_MIN	-	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Minimum threshold for FUP_DIF					
C_T_AST_MIN_FUP_CH	-	0... FFFFH	0... 6553.5	0.1	s
Min T_AST treshold for fuel pressure diagnosis during CH					
C_T_AST_RBM_FUP_CH	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time to increment the RBM denominator for FUP_CH diagnosis					
C_T_END_DIAG_RBM_FUP_CH	-	0... FFFFH	0... 6553.5	0.1	s
Timer for setting the RBM diagnosis end flag for FUP_CH					
C_T_FUP_CH_DIAG_MAX	-	0... FFFFH	0... 1310.7	0.02	s
Timer threshold for pre-debouncing of FUP_CH diagnosis					
C_T_FUP_CH_DIAG_MIN	-	0... FFFFH	0... 1310.7	0.02	s
Timer threshold for pre-debouncing of FUP_CH diagnosis					
C_TCO_MIN_FUP_CH	-	0... FEH	-48... 142.5	0.75	°C
Min TCO threshold for fuel pressure diagnosis during CH					

### Import actions:

<b>ACTION_ERRM_CheckPendingStatus</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR_PND>)
<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetLvErr</b> (IN<IDX_DIAG>,OUT<LV_ERR>)

### Error treatment:

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Fuel pressure monitoring during catalyst heating	FUP_CH	Fuel pressure too high	0	STD_INI	CC
		Fuel pressure too low	1		

Fields information (For more information refers to Error Management file "Table of Failure") :

- ABC Type : STD\_INI, STD, MEM, MEM\_INI, DEC\_CAL, STC, NO, MPL\_STD\_INI
- CARB Class : MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO.

## B.99.1 Rate Based Monitoring interface for FUP\_CH diagnosis

### STATE\_RBM\_xx definition

*Bit 0*: conditions for monitoring are met long enough to detect malfunction ('bit 0' = 1)

*Bit 1*: inhibition of the monitor because of system failure(s) ('bit 1' = 1)

*Bit 2*: individual RBM conditions of the monitor were encountered within this DC ('bit 2' = 1)

### B.99.1.1 Calculation of LV\_END\_DIAG\_RBM\_XX and LV\_INH\_DIAG\_RBM\_XX

**FUNCTION DESCRIPTION:****General information:**

To inhibit the monitoring of fuel system pressure diagnosis, several Diagnostic errors examined.

**Application conditions**

**Initialisation:** on transition LV\_IGK OFF → ON **OR** reset **OR** Failure memory cleared

All output variables initialized to 0h excepted:  
ACTION\_ERRM\_GetLvErr(NC\_IDX\_DIAG\_FUP\_CH, LV\_ERR\_FUP\_CH)  
T\_END\_DIAG\_RBM\_FUP\_CH initialised with C\_T\_END\_DIAG\_RBM\_FUP\_CH

**Recurrence:** 100 ms

**Activation:** LV\_DC = 1

*Deactivation:* LV\_DC = 0

**Formula section:**

**IF** LV\_CDN\_DIAG\_FUP\_CH= 1 **AND** LV\_END\_DIAG\_RBM\_FUP\_CH= 0  
**THEN** decrement the timer T\_END\_DIAG\_RBM\_FUP\_CH

**ENDIF**

**IF** LV\_CDN\_DIAG\_FUP\_CH= 0 **AND** LV\_END\_DIAG\_RBM\_FUP\_CH= 0  
**THEN** T\_END\_DIAG\_RBM\_FUP\_CH= C\_T\_END\_DIAG\_RBM\_FUP\_CH

**ENDIF**

**IF** T\_END\_DIAG\_RBM\_FUP\_CH = 0  
**THEN** LV\_END\_DIAG\_RBM\_FUP\_CH = 1

**ENDIF**

**if** LV\_ERR\_FUP = 1 **or**  
LV\_ERR\_H\_PRS\_SYS\_PRE = 1 **or**  
LV\_ERR\_FUP\_MFP\_PLAUS = 1 **or**  
LV\_ERR\_FUP\_ORNG = 1 **or**  
LV\_ERR\_VCV = 1


**then** LV\_INH\_DIAG\_RBM\_FUP\_CH = 1  
**else** LV\_INH\_DIAG\_RBM\_FUP\_CH = 0

**endif**

**B.99.1.2 Calculation of STATE\_RBM\_XX****FUNCTION DESCRIPTION:****General information:**

With this module the interface between the monitor XX and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_XX data.

Within STATE\_RBM\_XX three different information are defined:

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Information about bit 0 of STATE\_RBM\_XX:

Conditions for monitoring are met long enough to detect malfunction (no intrusive operation, no short trip)

Information about bit 1 of STATE\_RBM\_XX:

Monitor disabled because of system malfunction (depending on failure status: pending)

Information about bit 2 of STATE\_RBM\_XX:

Monitor individual RBM conditions encountered within this DC

Only calculation of STATE\_RBM\_FUP\_CH[0] supported. If NC\_CBK\_HPP\_NR=2, than STATE\_RBM\_FUP\_CH[1]=0.

Application conditions**Initialisation:**

at ECU reset :  
bit 0, bit 1 and bit 2 of STATE\_RBM\_FUP\_CH[0] = 0

at LV\_DC 0 -> 1 transition :

bit 0, bit 1, bit 2 of STATE\_RBM\_FUP\_CH[0] = 0  
On failure memory reset :

bit 1 of STATE\_RBM\_FUP\_CH[0] = 0

```

if          NC_CBK_HPP_NR >1
then       STATE_RBM_FUP_CH[1]=0
endif

```

**Recurrence:**

1 s (excepted parts where the recurrence is given explicitly)

**Activation:**

LV\_DC = 1

**Deactivation:**

LV\_DC = 0

Formula section:FUP\_CHAt LV\_DC 0 → 1 transition

The pending status of the following failures has to be checked only once:

LV_ERR_H_PRS_SYS_P E	LV_ERR_FUP	LV_ERR_VCV	LV_ERR_FUP_ORNG
LV_ERR_FUP_MFP_PLAU S			

**If(1)** { CPU optimization at LV\_DC 0 → 1 transition }  
CTR\_ERR\_DYN\_NR <> 0 { the dynamic failure memory isn't empty }

**Then(1)**

**While** bit 1 of STATE\_RBM\_FUP\_CH[0] = 0 **do**

with each failure of the above list :

ACTION\_ERRM\_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

**If(2)** XX has a pending status

**Then(2)**

bit 1 of STATE\_RBM\_FUP\_CH[0] = 1

**Endif(2)**

**Endwhile**

**Else(1)**

{ the dynamic failure memory is empty }

No action

**Endif(1)**

Every 1 s :

**If** bit 0 of STATE\_RBM\_FUP\_CH[0] = 0

**Then**

**If** LV\_END\_DIAG\_RBM\_FUP\_CH = 1

**Then** bit 0 of STATE\_RBM\_FUP\_CH[0] = 1

**Endif**

**Endif**

**If** bit 1 of STATE\_RBM\_FUP\_CH[0] = 0

**Then**

**If** LV\_INH\_DIAG\_RBM\_FUP\_CH = 1

**Then** bit 1 of STATE\_RBM\_FUP\_CH[0] = 1

**Endif**

**Endif**

Every 100 ms:

**If** bit 2 of STATE\_RBM\_FUP\_CH[0] = 0

**Then**

**If** LV\_CH = 1 **And**

T\_AST > C\_T\_AST\_RBM\_FUP\_CH

**Then** bit 2 of STATE\_RBM\_FUP\_CH[0] = 1

**Endif**

**Endif**

## B.99.2 FUP diagnosis during catalyst heating (LV\_ERR\_FUP\_CH)

### General information:

During catalyst heating a deviation in FUP\_SP to FUP (FUP\_DIF) is observed. If the deviation is smaller or greater than a threshold for a defined time the corresponding symptom and error will be set after debounce.

### Application conditions:

*Initialisation:* STD\_INI, all other at reset with 0

*Recurrence:* 20ms

*Activation:* (LV\_IGK = 1) **and** (N\_32 > C\_N\_32\_FUP\_DIAG)

*Deactivation:* **If** (LV\_IGK = 0) **or** (N\_32 <= C\_N\_32\_FUP\_DIAG)

**Then** LV\_CDN\_DIAG\_FUP\_CH = 0

T\_FUP\_CH\_DIAG\_MIN = 0 ms

T\_FUP\_CH\_DIAG\_MAX = 0 ms

**Endif**

**Formula section:**

```

If      LV_INH_DIAG_RBM_FUP_CH = 0  and
          LV_ERR_FUP_CH = 0           and
          LV_CH = 1                   and
          TCO > C_TCO_MIN_FUP_CH     and
          T_AST > C_T_AST_MIN_FUP_CH

```

```

Then    // check if FUP is too low:
          If      FUP_DIF > C_FUP_DIF_DIAG_MAX
          Then    T_FUP_CH_DIAG_MIN ++ (until max reached)
          Else    T_FUP_CH_DIAG_MIN = 0 ms
          Endif

          // check if FUP is too high:
          If      FUP_DIF < C_FUP_DIF_DIAG_MIN
          Then    T_FUP_CH_DIAG_MAX ++ (until max reached)
          Else    T_FUP_CH_DIAG_MAX = 0 ms
          Endif


          // setting of error symptom:
          If      T_FUP_CH_DIAG_MAX > C_T_FUP_CH_DIAG_MAX
          Then    symptom FUP is too high is detected:
                  LV_CDN_DIAG_FUP_CH = 1
                  ERR_SYM_FUP_CH = SYM_0
          Else    If      T_FUP_CH_DIAG_MIN > C_T_FUP_CH_DIAG_MIN
                  Then    symptom FUP is too low is detected:
                          LV_CDN_DIAG_FUP_CH = 1
                          ERR_SYM_FUP_CH = SYM_1
                  Else    no symptom detected:
                          If      (T_FUP_CH_DIAG_MIN == 0 AND
T_FUP_CH_DIAG_MAX == 0)
                          Then
                                  LV_CDN_DIAG_FUP_CH = 1
ERR_SYM_FUP_CH = NO_SYM
                          Else
                                  LV_CDN_DIAG_FUP_CH = 0
                          Endif
                  Endif
          Endif

Else
          LV_CDN_DIAG_FUP_CH = 0

          reset of timers:
          T_FUP_CH_DIAG_MIN = 0 ms
          T_FUP_CH_DIAG_MAX = 0 ms


Endif

```

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*LV\_ERR\_XXX[i] and LV\_END\_XXX[i] be set by ERRM after debounce. For failure and error management treatment the anti-bounce mechanism is called (ABC\_DEC=1):*

*ACTION\_ERRM\_FilterSymptom( IN<NC\_IDX\_DIAG>, IN<LV\_CDN\_DIAG\_FUP\_CH>, IN<ERR\_SYM\_FUP\_CH>, IN<ABC\_INC>, IN<ABC\_DEC>, IN<ABC\_MAX>, OUT<LV\_ERR\_FUP\_CH>)*

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## B.100 Cold start emission reduction strategy diagnosis for injection

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ANG_INJ_CSERS_MAX [NC_NR_IV_PLS] [NC_CYL_NR]	V	0... 780H	0... 720	0.375	°CRK
Maximum possible angle setpoint for a CSERS angle evaluation cycle					
ANG_INJ_CSERS_MIN [NC_NR_IV_PLS] [NC_CYL_NR]	V	0... 780H	0... 720	0.375	°CRK
Minimum possible angle setpoint for a CSERS angle evaluation cycle					
ANG_MEM [NC_NR_IV_PLS]	V	0... 780H	0... 720	0.375	°CRK
Memorized angle set point used for two consecutive evaluation cycles.					
CTR_CSERS_INJ_ERR	V	0... FFFFH	0... 65535	1	-
Error counter, increments one time per segment if error of CSERS multiple injection in phasing or timing or pulse number occurs					
CTR_SEG_CH	V	0... FFFFH	0... 65535	1	-
Segment counter, increments if catalyst heating segment with valid CSERS multiple injection diagnosis occurs					
LV_SYM_CSERS_INJ_DIAG	O/V	0... 1H	0 ...1	1	-
Symptom of CSERS multiple injection diagnosis					
LV_T_CH_ACT	O/V	0... 1H	0 ...1	1	-
CSERS multiple injection diagnosis was long enough valid. CSERS multiple injection diagnosis returns valid symptom					
RATIO_CSERS_INJ_ERR	V	0... FFFFH	0 ...1	15.259e-6	-
Error ratio of detected errors to evaluated catalyst heating segments					
TI_4_CSERS_MAX [NC_NR_IV_PLS] [NC_CYL_NR]	V	0... FFFFH	0... 262.14	0.004	ms
Maximum possible timing setpoint for a CSERS timing evaluation cycle					
TI_4_CSERS_MIN [NC_NR_IV_PLS] [NC_CYL_NR]	V	0... FFFFH	0... 262.14	0.004	ms
Minimum possible timing setpoint for a CSERS timing evaluation cycle					
TI_4_MEM [NC_NR_IV_PLS]	V	0... FFFFH	0... 262.14	0.004	ms
Memorized timing set point used for two consecutive evaluation cycles.					

### Input data:

ANG_INJ [NC_NR_INJ_CMB] [NC_NR_IV_PLS] [NC_CYL_NR] {p. 6117}	EOI_MES_CSERS [NC_NR_IV_PLS] [NC_CYL_NR] {p. 6117}	LF_INJ_PLS_ENA_SP_ CYL [NC_NR_INJ_CMB] [NC_CYL_NR] {p. 6117}	LV_CDN_PRE_CSERS_ INJ_DIAG {p. 6117}
NC_CYL_NR {p. 1526}	NC_NR_INJ_CMB {p. 627}	NC_NR_IV_PLS {p. 627}	NLC_INJ_MPI_AUX {p. 629}
SEG_NR {p. 1525}	SOI_MES_CSERS [NC_NR_IV_PLS] [NC_CYL_NR] {p. 6117}	STATE_PLS_TYP_SP_CYL [NC_NR_INJ_CMB] [NC_NR_IV_PLS] [NC_CYL_NR] {p. 6117}	TI_4 [NC_NR_INJ_CMB] [NC_NR_IV_PLS] [NC_CYL_NR] {p. 6118}
TI_MES_4 [NC_NR_IV_PLS] [NC_CYL_NR] {p. 6118}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ANG_INJ_CSERS_DELTA_THD	V	0... 780H	0... 720	0.375	°CRK
Error in phasing is detected for CSEERS multiple injection if measured angle of pulse exceeds threshold					
C_CTR_CH_ACT_THD	V	0... FFFFH	0... 65535	1	-
Threshold indicating that CSERS multiple injection diagnosis was long enough valid. CSERS multiple injection diagnosis returns valid symptom if threshold is exceeded.					
C_RATIO_CSERS_INJ_ERR_THD	V	0... FFFFH	0 ...1	15.259e-6	-
An error symptom is set for CSERS multiple injection diagnosis if threshold is exceeded					
C_SEG_DELTA_INJ_BAS	V	0... FH	0... 15	1	-
Calibrated constant assigning the package of set points which will be used for CSERS multiple injection diagnosis					
C_T_INJ_PLS_NOT_RUN	V	0... FFFFH	0... 262.14	0.004	ms
TI_MES equates to TI = 0ms if threshold is not exceeded					
C_TI_4_CSERS_DELTA_THD	V	0... FFFFH	0... 262.14	0.004	ms
Error in timing is detected for CSEERS multiple injection if measured duration of pulse exceeds threshold					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_MAX_SEG_CSERS_INJ	-	0... FFH	0... 255	1	-
Number of segments which have to be waited until first CSERS multiple injection diagnosis run can be made					

**Action definition**

<b>ACTION_INJR_ChkInjSp (IN&lt;PRM_CYL&gt;)</b>	Mode: -
Diagnosis action comparing ASW set points to BSW measurement values, returning error symptom if CSERS conditions for INJR are not met	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_CYL	in	0... FFH	0... 255	1	-
This action relates to cylinder Cyl.					

<b>ACTION_INJR_InIInjSpMem (IN&lt;PRM_CYL&gt;)</b>	Mode: -
Action stores last possible set points in cycle to be used as first possible set points in following cycle for CSERS diagnosis.	


Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_CYL	in	0... FFH	0... 255	1	-
This action relates to cylinder Cyl.					

<b>ACTION_INJR_SetIInjSP (IN&lt;PRM_CYL&gt;)</b>	Mode: -
Copy memorised injection set points to min/max calculation of new cycle.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_CYL	in	0... FFH	0... 255	1	-
This action relates to cylinder Cyl.					

<b>ACTION_INJR_UplInjSpMinMax (IN&lt;PRM_CYL&gt;)</b>	Mode: -
Update of min and max set points	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_CYL	in	0... FFH	0... 255	1	-
This action relates to cylinder Cyl.					

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## General information

For a comparison of set point values to the actual value, the set point values have to be prepared. Reason for this is that the set point values are calculated for each segment, but used only once each motor cycle. It is not known in ASW which set point value is taken in BSW. Therefore, all calculated set points have to be taken into account.

This is done by storing min and max values of each possible used set point for each single motor cycle. The acquisition separates set points for cylinders and pulses.

## Application conditions:

**Initialisation:** at reset, clear FMY, IGK on to off:  
 CTR\_SEG\_CH = 0  
 CTR\_CSERS\_INJ\_ERR = 0  
 RATIO\_CSERS\_INJ\_ERR = 0  
 LV\_SYM\_CSERS\_INJ\_DIAG = 0  
 LV\_T\_CH\_ACT = 0

**Activation:** always

**Deactivation:** never

**Recurrence:** segment

## Function description:

### Signal flow diagram:

For a robust diagnosis, we have to take account segment jitter, jitter of injbas-event (interrupt or task at 180° after TDC of each cylinder where BSW passes measured values of last injection cycle to ASW), wide ranges of phasing set points and injection times.

Furthermore, regarding set point variation, different update behaviour is configured for different injection modes. So, the actually executed injection times and phasing of the different pulses usually not match the respective set points calculated at a certain segment, but depend on the set point variation over several segments of an injection.

For example:

1) Supposed is SOI = 500°CEK and TI = 3ms and BSW has started the pulse. During execution of the pulse we get a new set point SOI = 480°CRK, TI = 4ms.


BSW maybe configured in such a way that 4ms are applied but SOI = 500°CRK since the pulses had already started. So we have a mixture of two set points. If the pulse is configured as an EOI-pulse, than the EOI would not correspond to any of the two set points.

2) Supposed is an update between two pulses. The first pulse might be executed according to the first set point, the second pulse according to the second set point. In update mode "update" the TI difference of the first pulse might be applied to the second pulse. So the second pulse might not correspond to any set point.

3) Supposed is an EOI\_TI pulse with EOI = 400°CRK and TI = 5ms. Further, an angular frequency of 10°CRK/1ms (N=1667/min) is supposed. As result, the set point SOI = 450°CRK. At 430° another set point is requested with EOI = 420° and TI = 7ms.

BSW will prolong the actually performed pulse to 7ms, so the performed pulse is SOI = 450°CRK, EOI = 380°CRK. This is 20° less than the minimum of both EOI set points and will lead with high probability to an increment of the error counter.

4) There are lots of cases in terms of pulse collisions, collisions with SOI\_LIM, EOI\_LIM, maximum injection range violations in current or past cycles, application of TI\_T or T\_TI pulses, special update mode configurations where a wrong failure symptom may be detected. So an adequate calibration of the error ratio threshold C\_RATIO\_CSERS\_INJ\_ERR\_THD has to be considered

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So, the following algorithm is applied for the diagnosis:

LV\_CDN\_PRE\_CSERS\_INJ\_DIAG must be 1 for at least NC\_CYL\_NR + 1 segments (no inhibits, same mode for all cylinders, no electrical defects, . . . , see Appl. Inc.). Set points for injection angles and times are sampled over NC\_NR\_CL + 1 segments and the respective minimum and maximum values are calculated for each cylinder. For the error evaluation it is checked if the measured values of injection angles and times are in between [min - threshold; max + threshold]. If this is not the case, an error counter is incremented.

The figure below shows where the sampled set points take place referring to the segment where the evaluation is done ( typical scenario for a 4-cylinder engine).

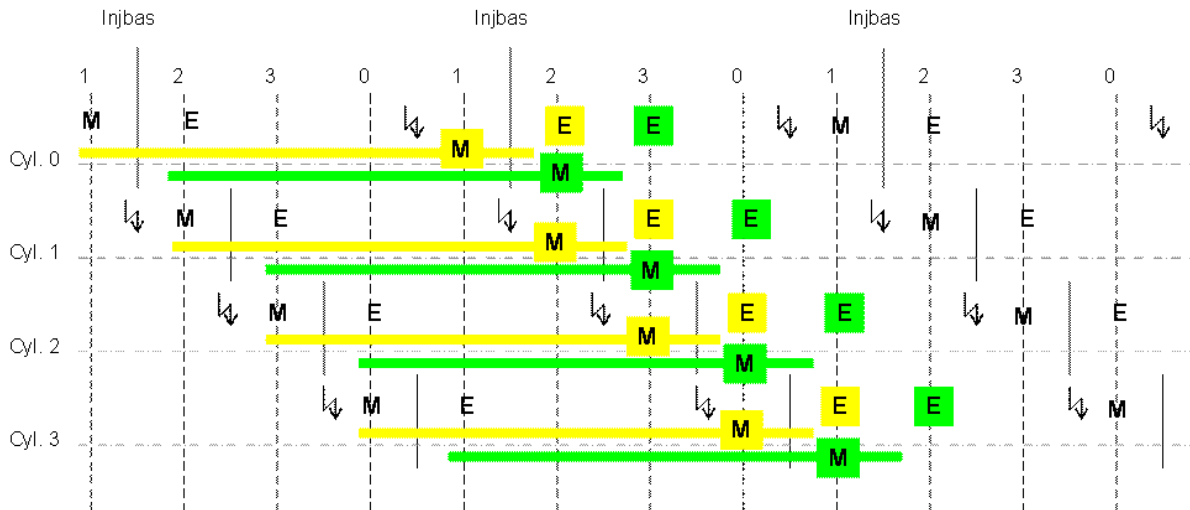


Figure B.100.1:

The injbas-event of a certain cylinder is  $180^\circ\text{CRK}$  after TDC. Here, the BSW passes the measured values of the last injection cycle to the ASW.

For cylinder 0: SEG\_NR = s is the first segment after injbas\_0 (figure above: s = 2).

a) If s is more than  $30^\circ\text{CRK}$  after injbas\_0, evaluation is done at segment s = 2 (calibratable via C\_SEG\_DELTA\_INJ\_BAS = 2, yellow line in figure above) and set point sampling is done every segment, from 1 up to NC\_CYL\_NR + 1 segments before.

b) If s is less than  $30^\circ\text{CRK}$  after injbas\_0, evaluation is done at segment s + 1 (= 3 in figure above, calibratable via C\_SEG\_DELTA\_INJ\_BAS = 3, green line). Set point sampling is done from 1 up to NC\_CYL\_NR + 1 segments before.

So it is guaranteed that the measured values are up-to-date for evaluation (E in figure) and that all relevant set points have been sampled.

As NC\_CYL\_NR + 1 samples of set points are necessary for the diagnosis evaluation, the injection parameter of the last segment have to be memorized and used for the next consecutive evaluation cycle again (marked with M in figure above).

#### Calibration hint for C\_SEG\_DELTA\_INJ\_BAS:

For low engine speed, measure CRK\_PSN\_INJ\_BAS\_0 and SEG\_NR (update rate every segment) in the application system. If the biggest value of CRK\_PSN\_INJ\_BAS\_0 is smaller than  $690^\circ\text{CRK}$  ( note that  $0^\circ\text{CRK}$  is considered as  $720^\circ\text{CRK}$ ), than set C\_SEG\_DELTA\_INJ\_BAS to the respective SEG\_NR of the biggest value (= 2 in the example above).

Otherwise set C\_SEG\_DELTA\_INJ\_BAS to the next SEG\_NR (= 3 in the example above).



**Formula section:**

```

#IF NLC_INJ_MPI_AUX == 0 /* no MPI */
#THEN NC_MAX_SEG_CSERS_INJ = NC_CYL_NR
#ELSE NC_MAX_SEG_CSERS_INJ = 2 * NC_CYL_NR /* SDI together with MPI */
#ENDIF

IF(1) LV_CDN_PRE_CSERS_INJ_DIAG /* diagnosis pre condition */
THEN(1)

FOR i = 0 to NC_CYL_NR - 1
IF(2) i = 0
THEN(2) x = NC_CYL_NR + SEG_NR - C_SEG_DELTA_INJ_BAS /* actual evaluated cylinder
*/
/* x E [1, 2*NC_CYL_NR - 1] */

IF(3) x >= NC_CYL_NR
THEN(3) x = x - NC_CYL_NR
ENDIF(3)

IF(4) ctr_cdn > NC_MAX_SEG_CSERS_INJ /* wait some time after valid pre condition*/
THEN(4) Call ACTION_INJR_ChkInjSp(IN<x>, OUT<LV_SYM_CSERS_INJ_DIAG>)
/* Evaluation of CSERS diagnosis for INJR */

ENDIF(4)

Call ACTION_INJR_SetIniInjSp(IN<x>) /* Copy last set point of last cycle to new cycle
*/

ELSE(2) x = x + 1 /* not evaluated cylinders */
IF(5) x >= NC_CYL_NR
THEN(5) x = 0
ENDIF(5)

IF(6) i = 1
THEN(6) Call ACTION_INJR_IniInjSpMem(IN<x>) /* memorize set point (M)*/
ENDIF(6)
ENDIF(2)


Call ACTION_INJR_UpdInjSpMinMax(IN<x>) /* calculation of min and max set points
of
one engine cycle */

ENDFOR

IF(7) ctr_cdn <= NC_MAX_SEG_CSERS_INJ
THEN(7) ctr_cdn ++
ENDIF(7)

ELSE(1) ctr_cdn = 0

```

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**ENDIF(1)**

### B.100.1 ACTION\_INJR\_IniInjSpMem

#### Formula section:

```

FOR    pls = 0 to NC_NR_IV_PLS - 1
ANG_MEM[pls] = ANG_INJ[0][pls][x]
TI_4_MEM[pls] = TI_4[0][pls][x]
ENDFOR

```

### B.100.2 ACTION\_INJR\_SetIniInjSP

#### Formula section:

```

FOR    pls = 0 to NC_NR_IV_PLS - 1
  ANG_INJ_CSERS_MIN[pls][x] = ANG_MEM[pls]
  ANG_INJ_CSERS_MAX[pls][x] = ANG_MEM[pls]

  TI_4_CSERS_MIN[pls][x] = TI_4_MEM[pls]
  TI_4_CSERS_MAX[pls][x] = TI_4_MEM[pls]
ENDFOR

```

### B.100.3 ACTION\_INJR\_UpInjSpMinMax

#### Formula section:

```

FOR    pls = 0 to NC_NR_IV_PLS - 1
  ANG_INJ_CSERS_MIN[pls][x] =
    MIN(ANG_INJ_CSERS_MIN[pls][x], ANG_INJ[0][pls][x])
  ANG_INJ_CSERS_MAX[pls][x] =
    MAX(ANG_INJ_CSERS_MAX[pls][x], ANG_INJ[0][pls][x])


  TI_4_CSERS_MIN[pls][x] = MIN(TI_4_CSERS_MIN[pls][x], TI_4[0][pls][x])
  TI_4_CSERS_MAX[pls][x] = MAX(TI_4_CSERS_MAX[pls][x], TI_4[0][pls][x])
ENDFOR

```

### B.100.4 ACTION\_INJR\_ChkInjSp

An error counter should be incremented exactly one time, if at least one of the following parameters is wrong:

- injection angle
- injection timing

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- number of pulses

Wrong injection angle is detected, if the minimum difference between min and max injection phase set point and BSW injection phase measurement value for an engine cycle exceeds a calibratable threshold.

Wrong injection timing is detected, if the minimum difference between min and max injection time set point and BSW injection time measurement value for an engine cycle exceeds a calibratable threshold.

Wrong number of pulses is detected via previous checks if an enabled pulse is not executed and via a check that BSW injection time measurement does not exceed a threshold for a disabled pulse.

For error evaluation, the error counter is compared relative to the number of combustions which were driven since the diagnosis started. If the error ratio exceeds a calibratable threshold, the error symptom for CSERS for multiple injection is set.

The error symptom must not be set before catalyst heating was active for a minimum time.

### Formula section:

```
CTR_SEG_CH ++          /* SW: limit counter to max value */
tmp_err_flag = 0
```

```
FOR pls = 0 to NC_NR_IV_PLS - 1
```

```
  IF(1) LF_INJ_PLS_ENA_SP_CYL[0][x][bit pls] = 1
```

```
  THEN(1) /* pulse enabled */
```

```
    IF(2) STATE_PLS_TYP_SP_CYL[0][pls][x] = "SOI_TI" OR "TI_T"
```

```
    THEN(2) tmp_ang = SOI_MES_CSERS[pls][x]
```

```
    ELSE(2) tmp_ang = EOI_MES_CSERS[pls][x]
```

```
  ENDIF(2)
```

```
  IF(3) tmp_ang > (ANG_INJ_CSERS_MAX[pls][x] + C_ANG_INJ_CSERS_DELTA_THD) OR
        /* phasing error - pulse to early */
```

```
    tmp_ang < (ANG_INJ_CSERS_MIN[pls][x] - C_ANG_INJ_CSERS_DELTA_THD) OR
        /* phasing error - pulse to late */
```

```
    TI_MES_4[pls][x] > (TI_4_CSERS_MAX[pls][x] + C_TI_4_CSERS_DELTA_THD) OR
        /* timing error - pulse too long */
```

```
    TI_MES_4[pls][x] < (TI_4_CSERS_MIN[pls][x] - C_TI_4_CSERS_DELTA_THD)
        /* timing error - pulse too short */
```

```
  THEN(3) tmp_err_flag = 1
```

```
  ENDIF(3)
```

```
ELSE(1) /* pulse disabled */
```

```
  IF(4) TI_MES_4[pls][x] > C_T_INJ_PLS_NOT_RUN /* measured pulse is higher (0ms + noise)
  */
```

```
  THEN(4) tmp_err_flag = 1 /* wrong number of pulses */
```

```
  ENDIF(4)
```


```
ENDIF(1)
```

```
ENDFOR
```

```
IF(1) tmp_err_flag == 1
```

```
THEN(2) CTR_CSERS_INJ_ERR ++ /* SW: limit counter to max value */
```


```
ENDIF(2)
```

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```

RATIO_CSERS_INJ_ERR = CTR_CSERS_INJ_ERR /CTR_SEG_CH
IF(3) CTR_SEG_CH > C_CTR_CH_ACT_THD
THEN(3) LV_T_CH_ACT = 1
    IF(4) RATIO_CSERS_INJ_ERR > C_RATIO_CSERS_INJ_ERR_THD
    THEN(4) LV_SYM_CSERS_INJ_DIAG = 1
    ELSE(4) LV_SYM_CSERS_INJ_DIAG = 0
    ENDIF(4)
ENDIF(3)

```

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## B.101 Cold start emission reduction strategy diagnosis for INJ (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ANG_INJ [NC_NR_INJ_CMB] [NC_NR_IV_PLS] [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Injection angle (SOI or EOI).					
EOI_MES_CSERS [NC_NR_IV_PLS] [NC_CYL_NR]	O	0... 780H	0... 720	0.375	°CRK
Actual performed EOI, estimated; for CSERS_INJ diagnosis					
ERR_SYM_CSERS_INJ	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom of CSERS multiple injection diagnosis filtered with LV_CDN_DIAG_CSERS_INJ					
LF_INJ_PLS_ENA_SP_CYL [NC_NR_INJ_CMB] [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Field to indicate if respective injection puls is active (=1) or inactive (=0).					
LV_CDN_DIAG_CSERS_INJ	V	0... 1H	0 ...1	1	-
Condition of CSERS multiple injection diagnosis					
LV_CDN_PRE_CSERS_INJ_DIAG	O/V	0... 1H	0 ...1	1	-
Pre condition indicating if CSERS multiple injection diagnosis is allowed					
LV_CH_FIRST_DEAC	V	0... 1H	0 ...1	1	-
Flag indicating that catalyst heating was active at least one time					
LV_CSERS_INJ_PLS_TEST_MOD_ENA	O/V	0... 1H	0 ...1	1	-
Flag indicating that injection demo test mode for CSERS multiple injection diagnosis is enabled					
LV_END_DIAG_CSERS_INJ	V	0... 1H	0 ...1	1	-
End of CSERS multiple injection diagnosis					
LV_ERR_CSERS_INJ	O/V	0... 1H	0 ...1	1	-
Error flag of CSERS multiple injection diagnosis					
SOI_MES_CSERS [NC_NR_IV_PLS] [NC_CYL_NR]	O	0... 780H	0... 720	0.375	°CRK
Actual performed SOI, estimated, for CSERS_INJ diagnosis					
STATE_PLS_TYP_SP_CYL [NC_NR_INJ_CMB] [NC_NR_IV_PLS] [NC_CYL_NR]	O/V	0H 1H 2H 3H	EOI_TI SOI_TI T_TI TI_T	-	-
Pulse type of injection pulses cylinder individual					
STATE_RBM_CSERS_INJ	O/V	0... FFH	0... 255	1	-
Interface of CSERS_INJ monitor with the Rate-Based Monitoring statistics					
T_STATE_CSERS_INJ_RBM	V	0... FFH	0... 255	1	s
Timer indicating running time of RBM for CSERS multiple injection diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TI_4 [NC_NR_INJ_CMB] [NC_NR_IV_PLS] [NC_CYL_NR]	O/V	0... FFFFH	0... 262.14	0.004	ms
Injection time for respective mode, pulse and cylinder.					
TI_MES_4 [NC_NR_IV_PLS] [NC_CYL_NR]	O/V	0... FFFFH	0... 262.14	0.004	ms
Performed cylinder individual injection time					

**Input data:**

CTR_CYL_NR_ST_CLC {p. 1754}	CTR_CYL_NR_STOP_CLC {p. 1754}	CTR_ERR_DYN_NR {p. 5767}	EOI_1_HOM {p. 2122}
EOI_1_MES [NC_CYL_NR] {p. 2036}	EOI_2_HOM [NC_CYL_NR] {p. 2130}	EOI_2_MES [NC_CYL_NR] {p. 2036}	EOI_3_HOM [NC_CYL_NR] {p. 2133}
EOI_POST_MES [NC_CYL_NR] {p. 2037}	INH_INJ {p. 2295}	INJ_MOD_SP [NC_CYL_NR] {p. 3328}	LV_CH {p. 8232}
LV_DC {p. 5746}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_PBK_IV [NC_PBK_IV_NR] {p. 4797}	LV_ES {p. 1720}
LV_IGK {p. 906}	LV_ST_END {p. 1720}	LV_SYM_CSERS_INJ_ DIAG {p. 6109}	LV_T_CH_ACT {p. 6109}
NC_CYL_NR {p. 1526}	NC_IDX_DIAG_IV [NC_CYL_NR]	NC_IDX_DIAG_PBK_IV [NC_PBK_IV_NR]	NC_INJ_MOD_MASK_2 {p. 2045}
NC_INJ_MOD_SINGLE {p. 2045}	NC_NR_INJ_CMB {p. 627}	NC_NR_IV_PLS {p. 627}	NC_PBK_IV_NR {p. 628}
SOI_1_HOM [NC_CYL_NR] {p. 2122}	SOI_1_MES [NC_CYL_NR] {p. 2039}	SOI_2_MES [NC_CYL_NR] {p. 2039}	SOI_POST_MES [NC_CYL_NR] {p. 2039}
STATE_DIAG_IV {p. 4803}	STATE_DIAG_PBK_IV {p. 4797}	STATE_ERR_IV {p. 4803}	STATE_ERR_PBK_IV {p. 4797}
TI_1_HOM [NC_CYL_NR] {p. 2002}	TI_1_MES [NC_CYL_NR] {p. 2040}	TI_2_HOM [NC_CYL_NR] {p. 2003}	TI_2_MES [NC_CYL_NR] {p. 2040}
TI_3_HOM [NC_CYL_NR] {p. 2003}	TI_POST_MES [NC_CYL_NR] {p. 2041}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_STATE_CSERS_INJ_RBM	V	0... FFH	0... 255	1	s
Calibratable limit for CSERS multiple injection diagnosis RBM timer to allow increment of denominator					
LC_CH_CSERS_INJ_TEST_ENA	V	0... 1H	0 ...1	1	-
Switch to enable catalyst heating independent test of CSERS multiple injection diagnosis					
LC_CSERS_INJ_DIAG_ENA	V	0... 1H	0 ...1	1	-
Enable switch to allow CSERS multiple injection diagnosis					
LC_CSERS_INJ_PLS_TEST_MOD_ENA	V	0... 1H	0 ...1	1	-
Switch to enable injection demo test mode for CSERS multiple injection diagnosis					

**Import actions:**

<b>ACTION_ERRM_CheckPendingStatus</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR_PND>)
<b>ACTION_ERRM_NoFilterReset</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR>)
Continued on next page

<b>ACTION_ERRM_NoFilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_LV_ERR_SET>,IN<PRM_LV_ERR_RST>,IN<PRM_LV_END_DIAG>,OUT<PRM_LV_ERR>)
---

## Error treatment

Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
<b>Diagnostic Description</b>						
CSERS_INJ	CSERS thresholds for INJR are exceeded	0			NO_FIL	CC
CSERS diagnosis for multiple injection		1				
		2				
		3				

## General information

In this specification following functions are handled:

- calculation of project specific diagnosis condition
- mapping of project specific set points and measurement variables to generic CSERS diagnosis variables
- project specific error handling

### **B.101.1 Variable mapping**

#### General information:

Variable mapping has to be done for "old" INJR pulse concept. In this function, the names of the old set point variables are mapped to the names which are also used in the CSERS for multiple injection diagnosis core specification.

#### Application conditions:

**Initialisation:** -

**Activation:** always

**Deactivation:** never

**Recurrence:** every segment;  
before calculation of CSERS core spec and after calculation  
of iftrans0

**Function description:****Formula section:**

**IF(1)** (LV\_CH OR LC\_CH\_CSERS\_INJ\_TEST\_ENA) == 1 /\* catalyst heating or test mode active \*/

**THEN(1)**

**FOR** pls = 0 to NC\_NR\_IV\_PLS - 1

**FOR** x = 0 to NC\_CYL\_NR - 1

**IF(2)** pls == 0 /\* project specific cases if pulses are SOI or EOI based, for 4D9 catalyst heating

is only driven in homogenous mode, so 1st pulse is SOI, all further pulses EOI based

\*/

**THEN(2)** STATE\_PLS\_TYP\_SP\_CYL[0][pls][x] = "SOI\_TI"

**IF(3)** pls == 0

**THEN(3)** ANG\_INJ[0][pls][x] = SOI\_1\_HOM[x]

**ELSE(3)**

**IF(4)** pls == 1

**THEN(4)** ANG\_INJ[0][pls][x] = 0°CRK /\* SOI\_2\_HOM[x] not available \*/

**ELSE(4)** ANG\_INJ[0][pls][x] = 0°CRK /\* SOI\_3\_HOM[x] not available \*/

**ENDIF(4)**

**ENDIF(3)**

**ELSE(2)** STATE\_PLS\_TYP\_SP\_CYL[0][pls][x] = "EOI\_TI"

**IF(5)** pls == 0

**THEN(5)** ANG\_INJ[0][pls][x] = EOI\_1\_HOM[x]

**ELSE(5)**

**IF(6)** pls == 1

**THEN(6)** ANG\_INJ[0][pls][x] = EOI\_2\_HOM[x]

**ELSE(6)** ANG\_INJ[0][pls][x] = EOI\_3\_HOM[x]

**ENDIF(6)**

**ENDIF(5)**

**ENDIF(2)**

**IF(7)** pls == 0

**THEN(7)** TI\_4[0][pls][x] = TI\_1\_HOM[x] /\* note for SW: different resolutions have to be mapped

TI\_MES\_4[pls][x] = TI\_1\_MES[x] /\* note for SW: different resolutions have to be mapped \*/

SOI\_MES\_CSERS[pls][x] = SOI\_1\_MES[x]

EOI\_MES\_CSERS[pls][x] = EOI\_1\_MES[x]

**ELSE(7)**

**IF(8)** pls == 1


**THEN(8)** TI\_4[0][pls][x] = TI\_2\_HOM[x] /\* note for SW: different resolutions

TI\_MES\_4[pls][x] = TI\_2\_MES[x] /\* note for SW: different resolutions have to be mapped \*/

SOI\_MES\_CSERS[pls][x] = SOI\_2\_MES[x]

EOI\_MES\_CSERS[pls][x] = EOI\_2\_MES[x]

**ELSE(8)** TI\_4[0][pls][x] = TI\_3\_HOM[x] /\* note for SW: different resolutions

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```

TI_MES_4[pls][x] = TI_POST_MES[x] /* note for SW: different resolutions have to
                                   be mapped */
SOI_MES_CSERS[pls][x] = SOI_POST_MES[x]
EOI_MES_CSERS[pls][x] = EOI_POST_MES[x]
ENDIF(8)
ENDIF(7)
ENDFOR
ENDFOR

FOR x = 0 to NC_CYL_NR - 1
  tmp_nr = INJ_MOD_SP[x] bitwise_AND NC_INJ_MOD_MASK_2
  IF(9) tmp_nr == 1
    THEN(9) LF_INJ_PLS_ENA_SP_CYL[0][x] = 1
  ELSE(9)
    IF(10) tmp_nr == 2
      THEN(10) LF_INJ_PLS_ENA_SP_CYL[0][x] = 3
    ELSE(10) LF_INJ_PLS_ENA_SP_CYL[0][x] = 7
    ENDIF(10)
  ENDIF(9)
ENDFOR

ENDIF(1)

```

## B.101.2 Condition calculation of CSERS diagnosis for INJR

### General information:

Condition for CSERS multiple injection diagnosis is given if:

- start ended ...AND
- engine state is catalyst heating or if test mode is activated ...AND
- no injection inhibition is active ...AND
- more than one injection pulses are active ...AND
- injection modes are equal for all cylinders ...AND
- catalyst heating was not deactivated yet in driving cycle ...AND
- no injection valve failure symptom or debounced error is present ...AND
- no injection power stage bank failure symptom or debounced error is present

Due to hardware constraints on some power stages (e.g. ATIC21) STATE\_DIAG\_IV != 0 or STATE\_DIAG\_PBK\_IV != 0 would cause false failure recognition. Accordingly the diagnosis is faded out then.

### Application conditions:


**Initialisation:** at reset, clear FMY, IGK off to on:

```
LV_CDN_PRE_CSERS_INJ_DIAG = 0
```

```
LV_CH_FIRST_DEAC = 0
```

**Activation:** always

**Deactivation:** never

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**Recurrence:** every segment;  
before calculation of CSERS core spec and after calculation  
of iftrans0

### Function description:

### Formula section:

```
LV_CDN_PRE_CSERS_INJ_DIAG = 1      /* initialize pre cdn with 1 and reset if cdn is not given */

IF(1)  !LV_ST_END                                OR
        !(LV_CH OR LC_CH_CSERS_INJ_TEST_ENA)      OR
        INH_INJ != 0                              OR
        CTR_CYL_NR_ST_CLC != 0 OR CTR_CYL_NR_STOP_CLC != NC_CYL_NR -1      OR
        (state_inj_mod_csers bitwise_AND NC_INJ_MOD_MASK_2) <= 1          OR
        ! ( !LV_CH_FIRST_DEAC OR LC_CH_CSERS_INJ_TEST_ENA)                OR
        STATE_DIAG_IV != 0 OR STATE_ERR_IV != 0                              OR
        STATE_DIAG_PBK_IV != 0 OR STATE_ERR_PBK_IV != 0

THEN(1) LV_CDN_PRE_CSERS_INJ_DIAG = 0      /* non-cylinder individual condition is not given
*/

ELSE(1)                                     /* check cylinder individual conditions */
  FOR x = 0 to NC_CYL_NR -1
    IF(2)  INJ_MOD_SP[x] != state_inj_mod_csers                                OR
           LF_INJ_PLS_ENA_SP_CYL[0][x] != lf_inj_pls_ena_csers
    THEN(2) LV_CDN_PRE_CSERS_INJ_DIAG = 0      /* cylinder individual condition is not given
*/
  ENDIF(2)
ENDFOR
ENDIF(1)

state_inj_mod_csers = INJ_MOD_SP[0]
lf_inj_pls_ena_csers = LF_INJ_PLS_ENA_SP_CYL[0][0]
```


## B.101.3 CSERS\_INJ demo test mode activation

### General information:

Here, the condition for enabling the CSERS multiple injection diagnosis demo test mode is calculated.

Condition for enabling the CSERS multiple injection diagnosis demo test mode is:

- multiple injection is active
- catalyst heating is active
- demo test mode is activated by calibration

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**Application conditions:**

**Initialisation:** -

**Activation:** always

**Deactivation:** never

**Recurrence:** every segment  
before calculating "Transfer to basic software"

**Function description:****Formula section:**

```

IF(1) (LV_CH AND LC_CSERS_INJ_PLS_TEST_MOD_ENA) == 1
THEN(1) LV_CSERS_INJ_PLS_TEST_MOD_ENA = 1
  FOR x = 0 to (NC_CYL_NR - 1)
    IF(2) (INJ_MOD_SP[x] BitwiseAND NC_INJ_MOD_MASK_2) != NC_INJ_MOD_SINGLE
    THEN(2) Do nothing
    ELSE(2) LV_CSERS_INJ_PLS_TEST_MOD_ENA = 0
    ENDIF(2)
  ENDFOR
ELSE(1) LV_CSERS_INJ_PLS_TEST_MOD_ENA = 0
ENDIF(1)

```

**B.101.4 Error handling****General information:**

Error-symptoms are defined to this diagnostic function as following :

```

┌-T-T-T-┐
└-┬-┬-┬-┘

```

```

|||└-> CSERS thresholds for INJR are exceeded           (= SYM_0)
||└----> (not used or give here the symptom 1 description)   (= SYM_1)
|└-----> (not used or give here the symptom 2 description) (= SYM_2)
└-----> (not used or give here the symptom 3 description)  (= SYM_3)

```


**Application conditions:**

**Initialisation:** at reset, clear FMY, IGK off to on:  
LV\_CDN\_DIAG\_CSERS\_INJ = 0  
LV\_ERR\_CSERS\_INJ = ACTION\_ERRM\_NoFilterReset (IN<NC\_IDX\_DIAG\_CSERS\_INJ>, OUT <LV\_ERR\_CSERS\_INJ>)

**Activation:** always

**Deactivation:** never

**Recurrence:** every segment; after calculation of CSERS core spec

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**Function description:****Formula section:****Condition calculation:**

**IF(1)** LV\_T\_CH\_ACT = 1 */\* catalyst heating was active for a minimum time \*/*

**THEN(1)** LV\_CDN\_DIAG\_CSERS\_INJ = 1

**ELSE(1)** LV\_CDN\_DIAG\_CSERS\_INJ = 0

**ENDIF(1)**

**Error symptom calculation:**

**IF(2)** LV\_SYM\_CSERS\_INJ\_DIAG = 1

**THEN(2)** ERR\_SYM\_CSERS\_INJ = SYM\_0

**ELSE(2)** ERR\_SYM\_CSERS\_INJ = NO\_SYM

**ENDIF(2)**

*/\* Error function call at end of catalyst heating, if CSERS\_INJ diagnosis is enabled*

*\*/*

**IF(3)** LV\_CH 1 -> 0 transition **AND** LC\_CSERS\_INJ\_DIAG\_ENA == 1 **AND**  
LV\_CH\_FIRST\_DEAC == 0 **AND** LV\_ST\_END == 1

**THEN(3)** LV\_ERR\_CSERS\_INJ =

**ACTION\_ERRM\_NoFilterSymptom**( IN<CSERS\_INJ>, IN<LV\_CDN\_DIAG\_CSERS\_INJ>,  
IN <ERR\_SYM\_CSERS\_INJ>,  
IN<set = LV\_SYM\_CSERS\_INJ\_DIAG **AND** LV\_CDN\_DIAG\_CSERS\_INJ>,  
IN<reset = **NOT**(LV\_SYM\_CSERS\_INJ\_DIAG) **AND** LV\_CDN\_DIAG\_CSERS\_INJ>,  
IN<end = LV\_T\_CH\_ACT>,  
OUT<LV\_ERR\_CSERS\_INJ> )

LV\_CH\_FIRST\_DEAC = 1

*/\* LV\_END\_DIAG\_CSERS\_INJ = LV\_T\_CH\_ACT Note: is produced in ERRM by action call*

*\*/*

**ENDIF(3)**

**IF(4)** LC\_CSERS\_INJ\_DIAG\_ENA == 0


**THEN(4)** LV\_ERR\_CSERS\_INJ =

**ACTION\_ERRM\_NoFilterSymptom**( IN<CSERS\_INJ>, IN<cdn = 1>,  
IN <sym = 0>, IN<set = 0>, IN<reset = 1>, IN<end = 1>, OUT<LV\_ERR\_CSERS\_INJ> )

*/\* LV\_END\_DIAG\_CSERS\_INJ = 1 Note: is produced in ERRM by action call \*/*

**ENDIF(4)**

**B.101.5 Rate based monitoring****General information:**

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With this module the interface between the XX monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_XX data.

Within STATE\_RBM\_XX, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)  
(depending on failure status: pending)
- Monitor individual RBM conditions encountered within this DC (bit 2)

### Application conditions:

**Initialisation:** reset: bit 0, bit 1 and bit 2 of STATE\_RBM\_CSERS\_INJ = 0  
LV\_DC 0 -> 1 transition: bit 0, bit 1 and bit 2 of STATE\_RBM\_CSERS\_INJ = 0  
CLR\_FMY: bit 1 of STATE\_RBM\_CSERS\_INJ = 0

reset, LV\_DC 0 ->1, CLR\_FMY: T\_STATE\_CSERS\_INJ\_RBM = 0

**Activation:** LV\_DC 0 -> 1 transition and LV\_DC = 1

**Deactivation:** never

**Recurrence:** 1s

### Function description:

#### Formula section:

##### Monitor disablement because of system malfunction

##### At LV\_DC 0 -> 1 transition

The pending status of the following failures has to be checked only once:

NC_IDX_DIAG_IV[NC_CYL_ NR]	NC_IDX_DIAG_PBK_IV[NC_PBK_IV_NR]		
----------------------------	----------------------------------	--	--

**If(1)** CTR\_ERR\_DYN\_NR <> 0 /\* the dynamic failure memory isn't empty \*/

**Then(1)**

**For** each failure of the above list **do**

**ACTION\_ERRM\_CheckPendingStatus**(IN<PRM\_IDX\_DIAG>, OUT<PRM\_LV\_ERR\_PND>)

**If(2)** PRM\_LV\_ERR\_PND = 1 /\* pending fault \*/

**Then(2)** bit 1 of STATE\_RBM\_CSERS\_INJ = 1

**Exit** For-loop

**Endif(2)**

**Endfor**

**Endif(1)**

Conditions for monitoring are met long enough to detect malfunction

Every 1s

**If(3)** bit 0 of STATE\_RBM\_CSERS\_INJ == 0**Then(3)**

**If(4)** LV\_END\_DIAG\_CSERS\_INJ == 1 /\* SW: use ACTION\_ERRM\_GetLvEndDiag  
(IN<IDX\_DIAG\_CSERS\_INJ>,  
OUT<LV\_END\_DIAG\_CSERS\_INJ>) \*/

**Then(4)** bit 0 of STATE\_RBM\_CSERS\_INJ = 1**Endif(4)****Ednif(3)****If(5)** bit 1 of STATE\_RBM\_CSERS\_INJ == 0**Then(5)****For** x = 0 to NC\_CYL\_NR - 1**For** p = 0 to NC\_PBK\_IV\_NR - 1**If(6)** LV\_ERR\_IV[x] **OR** LV\_ERR\_PBK\_IV[p]**Then(6)** bit 1 of STATE\_RBM\_CSERS\_INJ = 1**Endif(6)****Endfor****Endfor****Ednif(5)**Additional requirements**If(7)** bit 2 of STATE\_RBM\_CSERS\_INJ == 0**Then(7)**

**If(8)** T\_STATE\_CSERS\_INJ\_RBM >= C\_T\_STATE\_CSERS\_INJ\_RBM  
/\* CSERS\_INJ active time more than 10 seconds \*/

**Then(8)**

bit 2 of STATE\_RBM\_CSERS\_INJ = 1


**Endif(8)****Endif(7)**

**IF(9)** LV\_CH == 1 **AND** LV\_CH\_FIRST\_DEAC == 0 **AND** LC\_CSERS\_INJ\_DIAG\_ENA == 1 **AND**  
LV\_ES == 0


**THEN(9)**

tmp\_cdn = 1

**FOR** x = 0 to NC\_CYL\_NR - 1**IF(10)** (INJ\_MOD\_SP[x] **bitwise AND** NC\_INJ\_MOD\_MASK\_2) <= 1**THEN(10)** tmp\_cdn = 0**ENDIF(10)****ENDFOR****IF(11)** tmp\_cdn == 1**THEN(11)** T\_STATE\_CSERS\_INJ\_RBM = T\_STATE\_CSERS\_INJ\_RBM + 1s**ENDIF(11)****ENDIF(9)**

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## B.102 Ambient and manifold pressure plausibility diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
AMP_MMV_PLAUS	V	0... FFFFH	0... 5434	0.0829175	hPa
Mean moving value of AMP_MES					
ERR_SYM_AMP_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom Ambient pressure plausibility					
LV_CDN_DIAG_AMP_PLAUS	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for Ambient pressure plausibility					
LV_END_DIAG_AMP_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis flag for Ambient pressure plausibility diagnosis					
LV_ERR_AMP_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for detected error Ambient pressure plausibility diagnosis					

### Input data:

AMP_MES {p. 1163}	LV_IGK {p. 906}	LV_INH_DIAG_AMP_PLAUS {p. 6130}	VS {p. 1176}
-------------------	-----------------	------------------------------------	--------------

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_AMP_PLAUS	-	0... FFH	0... 255	1	-
Anti bounce increment AMP_PLAUS					
C_ABC_MAX_AMP_PLAUS	-	1... FFH	1... 255	1	-
Anti bounce maximum AMP_PLAUS					
C_AMP_PLAUS_DIF_ERR	-	0... FFFFH	0... 5434	0.0829175	hPa
Maximum allowed offset to detect a unplausible AMP_MES					
IP_CLRC_AMP_PLAUS	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_VS_IP_CLRC_AMP_PLAUS	4	0... FFH	0... 255	1	km/h
Filter constant for mean moving calculation of AMP_MES					


## FUNCTION DESCRIPTION:

### General information:

Due to CARB requirements the diagnosis detects unplausible ambient pressures which cannot be detected by electrical diagnosis.

The diagnosis is based gradient monitoring of AMP\_MES.

### Description:

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AMP\_MMV\_PLAUS is the mean-moving value of AMP\_MES and represents the maximum possible change of AMP if the car is driving uphill or downhill.

If AMP\_MES is below or upper AMP\_MMV\_PLAUS +/- calibratable offset C\_AMP\_PLAUS\_DIF\_ERR the sensor is detected as not plausible and ERR\_SYM\_AMP\_PLAUS is set.

### Application conditions

**Initialisation:** according ABC - type **"MEM"** (all 0 at LV\_IGK 0->1, error is set irreversible)  
AMP\_MMV\_PLAUS = AMP\_MES at LV\_IGK 0->1 **or** Reset

**Recurrence:** 1s

**Activation:** LV\_IGK = 1 **and** LV\_INH\_DIAG\_AMP\_PLAUS = 0

**Deactivation:** LV\_IGK = 0 **or** LV\_INH\_DIAG\_AMP\_PLAUS = 1  
(set LV\_CDN\_DIAG\_AMP\_PLAUS = 0 at deactivation)

### Formula section:

Continuous gradient monitoring:

LV\_CDN\_DIAG\_AMP\_PLAUS = 1

AMP\_MMV\_PLAUS(n) = AMP\_MMV\_PLAUS(n-1)  
+ IP\_CLRC\_AMP\_PLAUS \* (AMP\_MES - AMP\_MMV\_PLAUS(n-1))

**If** AMP\_MES > AMP\_MMV\_PLAUS + C\_AMP\_PLAUS\_DIF\_ERR

**Then** ERR\_SYM\_AMP\_PLAUS = SYM\_0

**Elseif** AMP\_MES < AMP\_MMV\_PLAUS - C\_AMP\_PLAUS\_DIF\_ERR

**Then** ERR\_SYM\_AMP\_PLAUS = SYM\_1

**Else** ERR\_SYM\_AMP\_PLAUS = NO\_SYM

**Endif**

LV\_ERR\_AMP\_PLAUS, LV\_END\_DIAG\_AMP\_PLAUS is calculated by error management.

## B.103 Ambient and manifold pressure plausibility diagnosis (Appl.Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_AMP_PLAUS	O/V	0... 1H	0 ...1	1	-
Inhibition of AMP_PLAUS diagnosis					
STATE_RBM_AMP_PLAUS	O/V	0... 7H	0 ...7	1	-
Interface of AMP_PLAUS monitor with the Rate-Based Monitoring statistics					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_DC {p. 5746}	LV_END_DIAG_AMP_ PLAUS {p. 6128}	LV_ERR_AMP {p. 4822}
LV_ERR_VS {p. 5021}	LV_IGK {p. 906}	LV_INH_DIAG_AMP_ PLAUS {p. 6130}	

### Import actions:

<b>ACTION_ERRM_CheckPendingStatus (IN&lt;PRM_IDX_DIAG&gt;,OUT&lt;PRM_LV_ERR_PND&gt;)</b>
--

### B.103.1 Inhibition of diagnosis

#### Description:

LV\_INH\_DIAG\_AMP\_PLAUS is set to 1 if AMP\_PLAUS diagnosis is inhibited due to a present OBD1 error.

#### Application conditions

**Initialisation:** *0 at reset*

**Recurrence:** *1s*

**Activation:** *LV\_IGK = 1*

**Deactivation:** *LV\_IGK = 0*

#### Formula section:

**If**                    LV\_ERR\_VS = 1                    **or**  
                           LV\_ERR\_AMP = 1  
**Then**                LV\_INH\_DIAG\_AMP\_PLAUS = 1  
**Else**                LV\_INH\_DIAG\_AMP\_PLAUS = 0  
**Endif**

### B.103.2 Interface for Rate-based-monitoring

**General information:**

With this module the interface between the AMP\_PLAUS plausibility monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_AMP\_PLAUS data.

Within STATE\_RBM\_AMP\_PLAUS, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)  
( not valid for AMP\_PLAUS diagnosis )

**Application conditions:**

*Initialisation :*

at ECU reset :

*bit 0, bit 1 and bit 2 of STATE\_RBM\_AMP\_PLAUS = 0*

at LV\_DC 0 1 transition :

*bit 0 and bit 1 of STATE\_RBM\_AMP\_PLAUS = 0*

*bit 2 of STATE\_RBM\_AMP\_PLAUS = 1*

on failure memory reset :

*bit 1 of STATE\_RBM\_AMP\_PLAUS = 0*

*Recurrence:* 1 s

*Activation:* LV\_DC = 1

**Formula section:**

At LV\_DC 0 1 transition

The pending status of the following failures has to be checked only once :

LV_ERR_AMP	LV_ERR_VS		
------------	-----------	--	--

**If(1)** { CPU optimization at LV\_DC 0 1 transition }

CTR\_ERR\_DYN\_NR <> 0 { the dynamic failure memory isn t empty }

**Then(1)**

**While** bit 1 of STATE\_RBM\_AMP\_PLAUS = 0 **do**

with each XX failure of the above list :

ACTION\_ERRM\_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

**If(2)** XX has a pending status

**Then(2)**

bit 1 of STATE\_RBM\_AMP\_PLAUS = 1

**Endif(2)**

**Endwhile**

**Else(1)**

{ the dynamic failure model memory is empty }

No action

**Endif(1)**

Every 1 s :

**If** bit 0 of STATE\_RBM\_AMP\_PLAUS = 0

**Then**

```

If          LV_END_DIAG_AMP_PLAUS = 1
Then       bit 0 of STATE_RBM_AMP_PLAUS = 1
Endif

```

**Endif**

```

If          bit 1 of STATE_RBM_AMP_PLAUS = 0
Then


```

```

If          LV_INH_DIAG_AMP_PLAUS = 1
Then       bit 1 of STATE_RBM_AMP_PLAUS = 1
Endif

```

**Endif**

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## B.104 Activation of fuel system monitoring

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_STOP_FSD	O/V/S	0... FFH	0... 255	1	-
Counter value as a measure of the oil dilution under cold start conditions					
DLY_DEC_FSD_STOP_OIL	V	0... FFH	0... 255	1	s
Time delay for decreasing the debounce counter for oil dilution detection in fuel system diagnosis					
LV_FSD_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Global activation flag for fuel system diagnosis					
LV_FSD_STOP_OIL_ES_OLD	-	0... 1H	0 ...1	1	-
Value of last recurrence of LV_ES					
LV_INH_FSD_STOP_OIL	O/V	0... 1H	0 ...1	1	-
Inhibition flag for fuel system diagnosis due to oil dilution under cold start conditions					
T_DEC_FSD_STOP_OIL	V	0... FFH	0... 255	1	s
Timer for decreasing the debounce counter for oil dilution detection in fuel system diagnosis					

### Input data:

AMP {p. 982}	LV_ES {p. 1720}	LV_INH_DIAG_FSD [NC_CBK_EX_NR] {p. 6199}	LV_INH_DIAG_FSD_CP [NC_CBK_EX_NR] {p. 6199}
LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	MAF_HB {p. 805}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}
TAM {p. 1579}	TCO {p. 1100}	TCO_ST {p. 1100}	TIA_IM {p. 984}
TOIL {p. 8204}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_MIN_FSD	-	0... FFFFH	0... 5434	0.08291752	hPa
Minimum ambient pressure threshold for fuel system diagnosis					
C_CTR_MAX_FSD_STOP_OIL	-	0... FFH	0... 255	1	-
Maximum value for the debounce counter for oil dilution detection in fuel system diagnosis					
C_MAF_MIN_FSD	-	0... FFH	0... 1389	5.44705882	mg/stk
Mass air flow threshold for fuel system diagnosis					
C_N_MIN_FSD	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for fuel system diagnosis					
C_TAM_MIN_FSD	-	0... FEH	0... 142.5	0.75	°C
Minimum ambient temperature threshold for fuel system diagnosis					
C_TCO_MIN_FSD	-	0... FEH	0... 142.5	0.75	°C
Minimum threshold of TCO for fuel system diagnosis					
C_TIA_MIN_FSD	-	0... FEH	0... 142.5	0.75	°C
Minimum intake air temperature threshold for fuel system diagnosis					
C_TOIL_MIN_DEC_FSD_STOP_OIL	-	0... C8H	0... 160	1	°C
Minimum oil temperature threshold to activate timer to debounce oil dilution detection in fuel system diagnosis					
ID_CTR_INC_FSD_STOP_OIL	-	0... FFH	0... 255	1	-
LDP_TCO_ST_ID_CTR_INC_FSD_STOP	4	0... FEH	0... 142.5	0.75	°C
Increasing value for the debounce counter for oil dilution detection in fuel system diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_DLY_DEC_FSD_STOP_OIL	-	0... FFH	0... 255	1	s
LDP_TOIL_ID_DLY_DEC_FSD_OIL	4	0... C8H	0... 160	1	°C

Time delay for decreasing the debounce counter for oil dilution detection in fuel system diagnosis

### General information

This function checks all necessary activation conditions in order to activate fuel system diagnosis. High rate of evaporated fuel during rich warmup phase under cold start conditions could lead to wrong failure detection and therefore a special inhibition flag for that case is generated.

NC\_CBK\_EX\_NR defines the number of exhaust banks.

For vector elements the variable extension `_i` is used in the model instead of `[i]` as found in the textual description.

### Application Condition

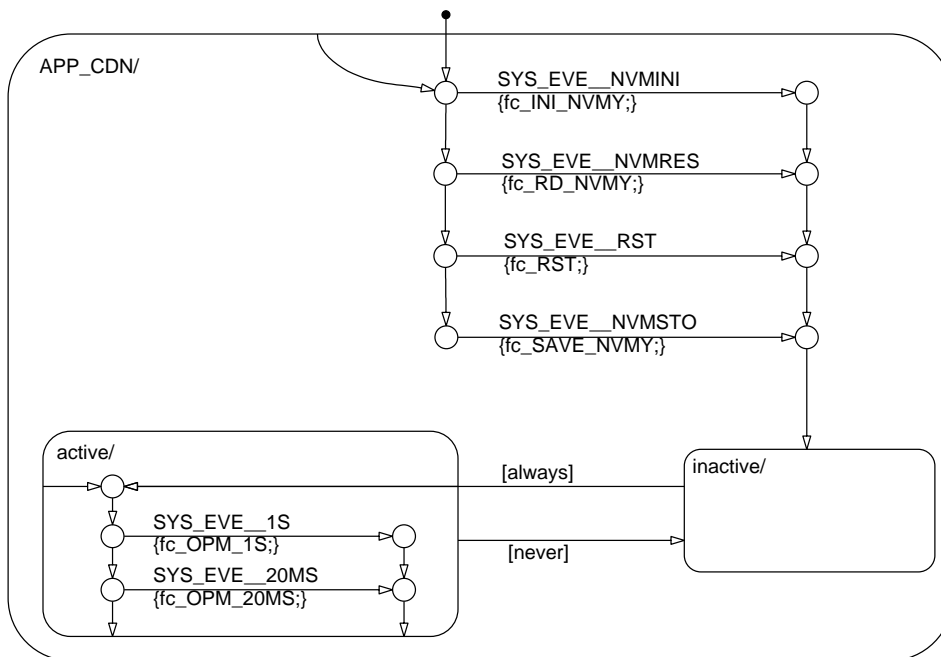
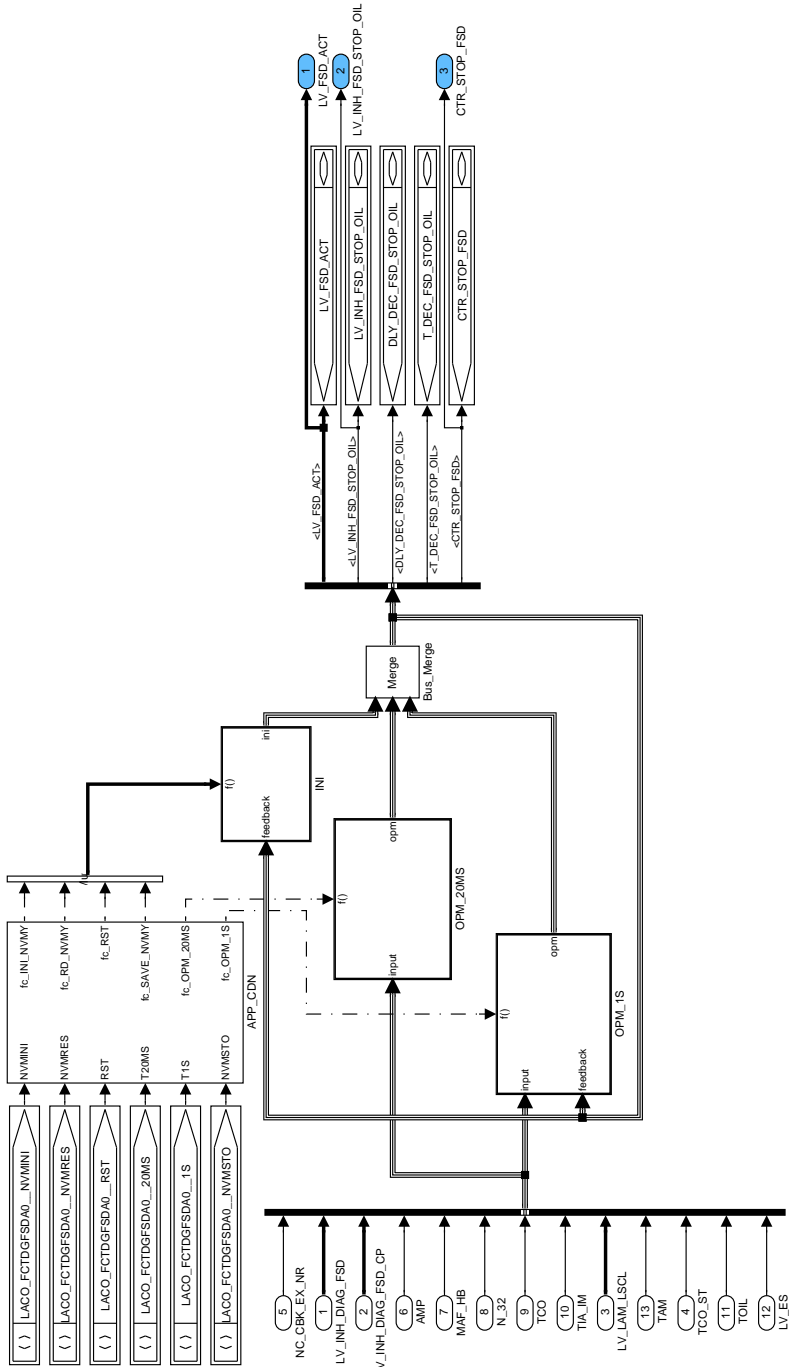


Figure B.104.1: LACO\_FCTDGFSDA0/APP\_CDN/Chart

### Function Description




SDA\_SRS / SDA.4.0.11-Jan-2006

Figure B.104.2: LACO\_FCTDGFSDA0

### B.104.1 Initialization

#### Initialization at ECU reset

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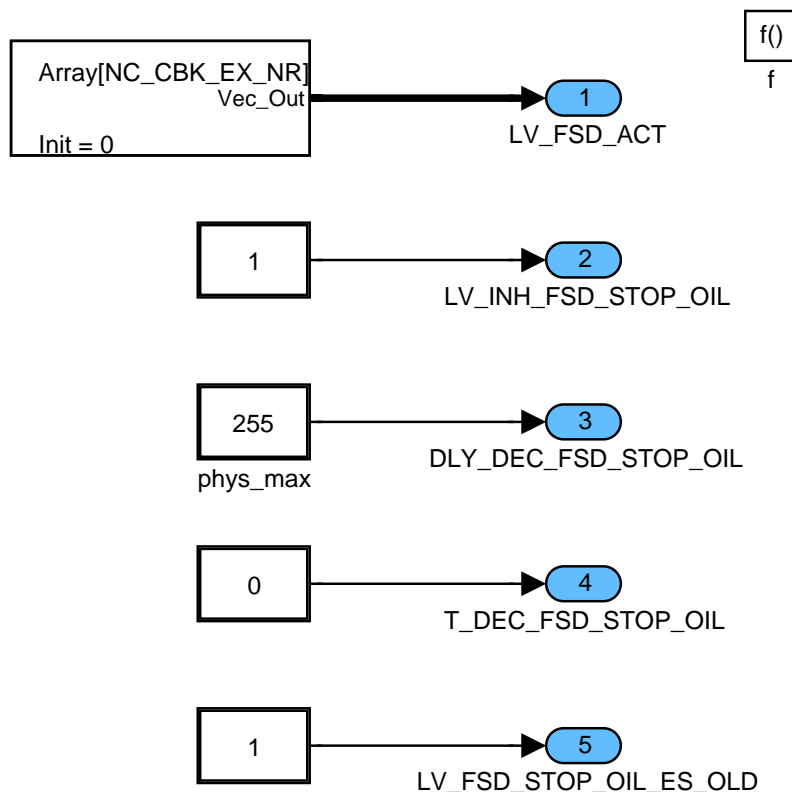


Figure B.104.3: LACO\_FCTDGFSDA0/INI/RST

**Initialize NVMY data**

CTR\_STOP\_FSD is set to 0 in case of failure in the nonvolatile memory data storage.

**Read NVMY data**

CTR\_STOP\_FSD is restored from the nonvolatile memory data storage after reset.

**Store NVMY data**

CTR\_STOP\_FSD is saved in the nonvolatile memory data storage during PWL phase.

**B.104.2 Formula section for 20ms task****Exhaust bank specific functionality****Activation of fuel system diagnosis****Calculation of LV\_FSD\_ACT[i]**



In order to activate fuel system diagnosis no inhibition must be present, lambda controller must be active and ambient pressure, air mass flow, engine speed, coolant temperature and intake air temperature must be above their thresholds.

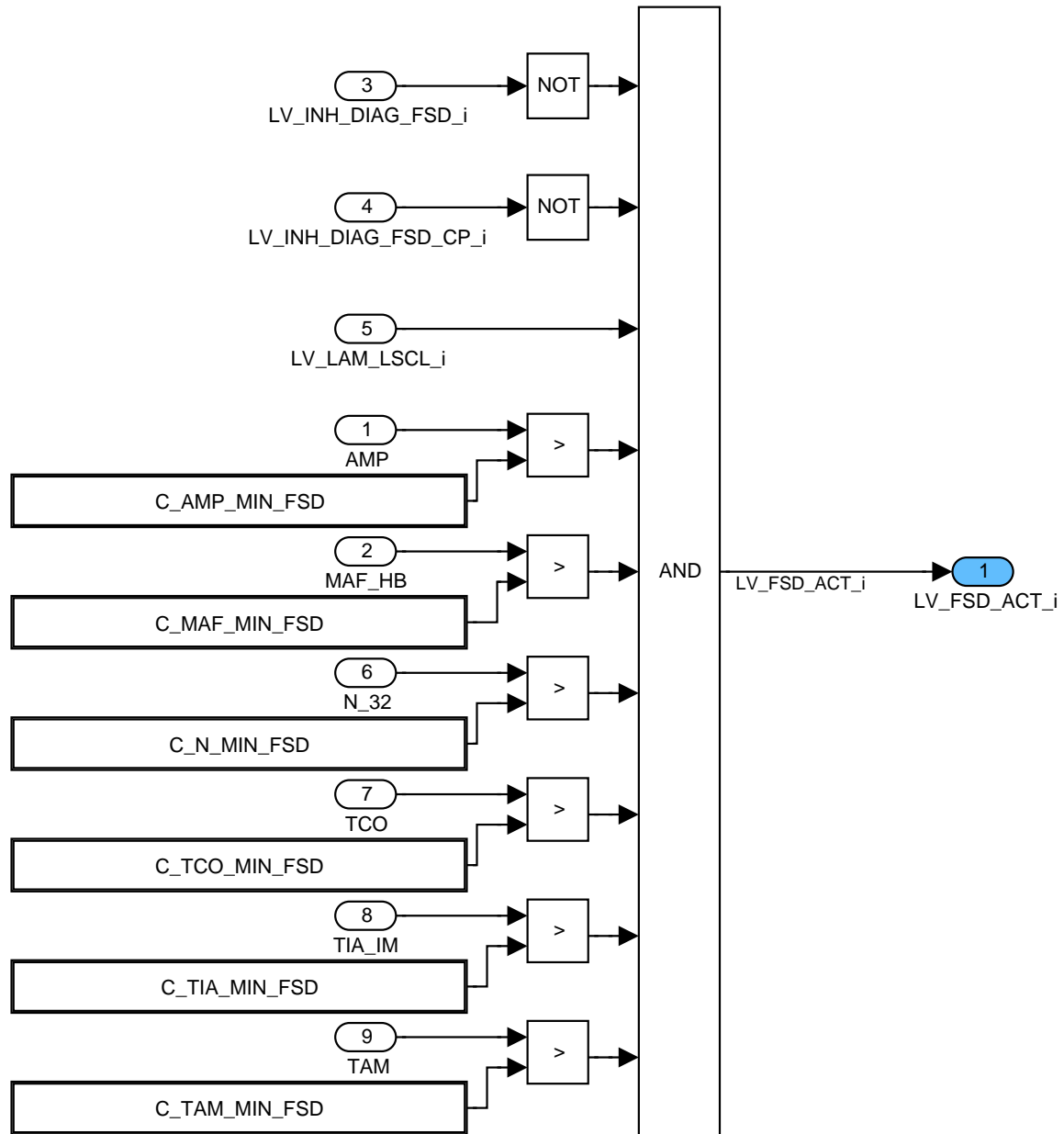


Figure B.104.4: LACO\_FCTDGFSDA0/OPM\_20MS/OPM/FSD\_ACT/FSD\_ACT

### B.104.3 Formula section for 1s task

For high rate of evaporated fuel (diluted in the engine oil) during rich warmup phase under cold start conditions lambda controller and adaptation may reach the negative limits relevant for FSD (MIN limits). In order to prevent an error detection in that case the flag LV\_INH\_FSD\_STOP\_OIL used by FSD is set. The counter CTR\_STOP\_FSD is a measure for the amount of diluted fuel in the engine oil.

#### Increment of CTR\_STOP\_FSD

At each transition from engine stop to engine run (LV\_ES switches from 1 to 0) the counter CTR\_CTOP\_FSD is incremented by the TCO\_ST depending map value ID\_CTR\_INC\_FSD\_STOP\_OIL.

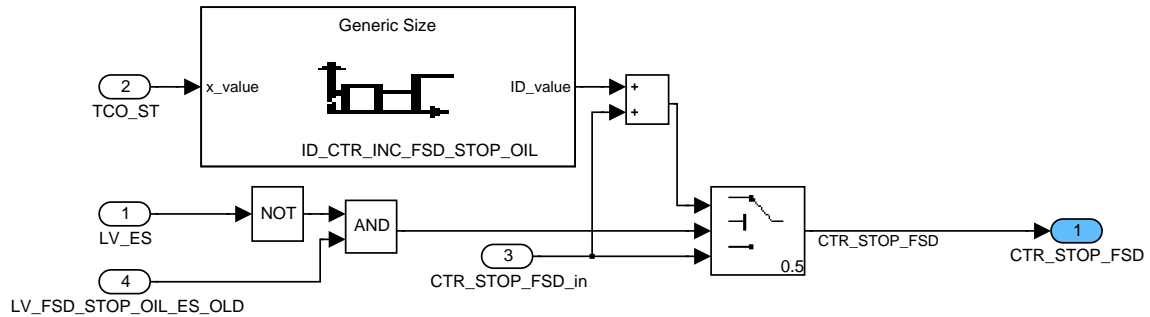


Figure B.104.5: LACO\_FCTDGFSDA0/OPM\_1S/INC\_CTR

### Decrement CTR\_STOP\_FSD

ID\_DLY\_DEC\_FSD\_STOP\_OIL defines the time to elapse at a certain TOIL range for decrementing CTR\_STOP\_FSD by 1. The TOIL range is defined by 2 adjacent map break points. At engine stop and as long as the oil temperature is below a threshold this timer is set to 0 in order to not run the increment functionality. The timer is reset to 0 as soon the threshold is reached.

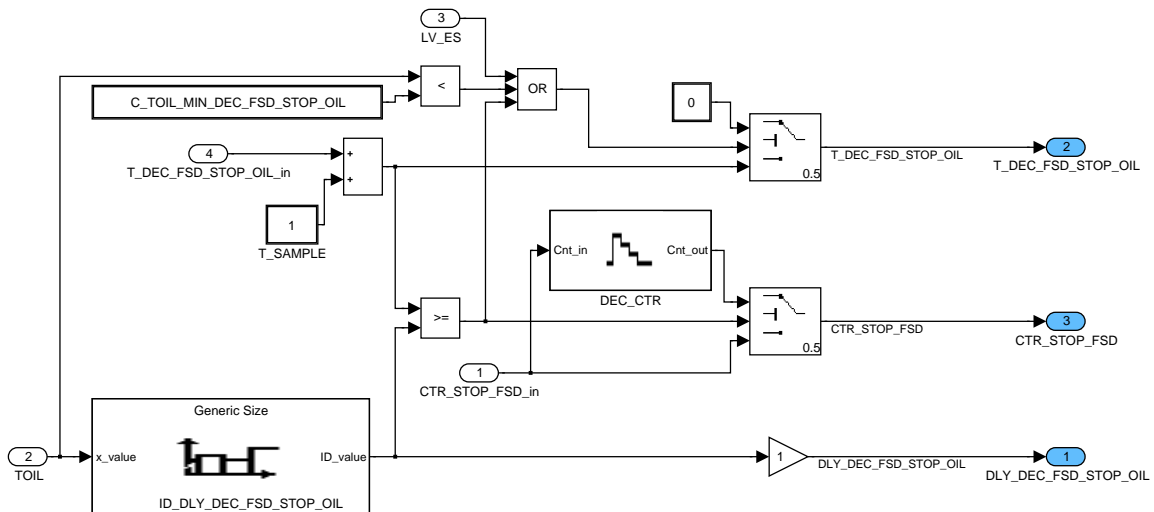


Figure B.104.6: LACO\_FCTDGFSDA0/OPM\_1S/DEC\_CTR

### Inhibition of fuel system diagnosis

The flag LV\_INH\_FSD\_STOP\_OIL is set if the counter CTR\_STOP\_FSD reaches a calibration threshold.

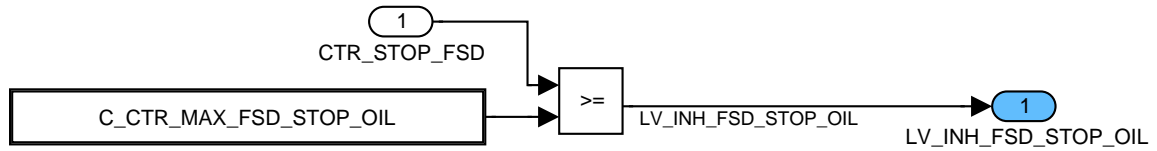



Figure B.104.7: LACO\_FCTDGFSDA0/OPM\_1S/INH\_FSD

## B.105 Fuel system monitoring

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_LAM_LIM_LAM_AD_REQ [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Counter for activation of forced lambda adaptation					
ERR_SYM_FSD [NC_CBK_EX_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected failure of each symptom in case for lambda adaptation monitoring relevant to MIL					
ERR_SYM_FSD_H_RNG [NC_CBK_EX_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected failure of each symptom in upper multiplicative adaptation learning area					
ERR_SYM_FSD_LAM_LIM [NC_CBK_EX_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected failure of each symptom in case of lambda control in dead stop relevant to MIL					
LV_CDN_DIAG_FSD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Diagnosis conditions for lambda adaptation monitoring					
LV_CDN_DIAG_FSD_H_RNG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Diagnosis conditions in upper multiplicative adaptation learning area					
LV_CDN_DIAG_FSD_LAM_LIM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Diagnosis conditions in the area where the lambda control output concerned relevant to MIL					
LV_END_DIAG_FSD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
End of first diagnosis cycle in case of lambda adaptation monitoring					
LV_END_DIAG_FSD_H_RNG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
End of first diagnosis cycle in upper multiplicative adaptation learning area					
LV_END_DIAG_FSD_LAM_LIM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
End of first diagnosis cycle in the area where the lambda control output concerned					
LV_END_DIAG_WIN_FSD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End of diagnosis cycle for similar conditions window in additive adaptation learning area					
LV_END_DIAG_WIN_FSD_LAM_LIM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End of diagnosis cycle for similar conditions window in case of lambda control in dead stop					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_FSD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Failure of lambda adaptation monitoring relevant to malfunction indication light					
LV_ERR_FSD_H_RNG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Failure in upper multiplicative adaptation learning area					
LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Failure for lambda controller in dead stop relevant to malfunction indication light					
LV_LAM_LIM_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request for forced lambda adaptation					
LV_LAM_ORNG_LAM_AD_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that request timer for forced lambda adaptation expired (lambda controller out of range for defined time)					
T_LAM_AD_ACT_FSD [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer indicating the forced lambda adaptation is running					
T_SUM_END_DIAG_WIN_FSD [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Counter for the diagnosis window relevant to MIL					
T_SUM_END_DIAG_WIN_FSD_ADD [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Counter for the diagnosis window additive adaptation learning area					
T_SUM_END_DIAG_WIN_FSD_FAC_L [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Counter for the diagnosis window lower multiplicative adaptation learning area					
T_SUM_END_DIAG_WIN_FSD_H_RNG [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Counter for the diagnosis window upper multiplicative adaptation learning area					
T_SUM_END_DIAG_WIN_FSD_LAM [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Counter for the diagnosis window lambda control in dead stop					
T_SUM_MAX_FSD [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Total duration of LV_MFF_ADD_LIM_MAX_LAM_AD[i] = 1 or LV_FAC_L_RNG_LIM_MAX_LAM_AD[i] = 1					
T_SUM_MAX_FSD_H_RNG [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Total duration of LV_FAC_H_RNG_LIM_MAX_LAM_AD[i] = 1					
T_SUM_MAX_FSD_LAM_LIM [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Total duration of LV_FAC_LAM_LIM_MAX[i] = 1					
T_SUM_MIN_FSD [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Total duration of LV_MFF_ADD_LIM_MIN_LAM_AD[i] = 1 or LV_FAC_L_RNG_LIM_MIN_LAM_AD[i] = 1					
T_SUM_MIN_FSD_H_RNG [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Total duration of LV_FAC_H_RNG_LIM_MIN_LAM_AD[i] = 1					
T_SUM_MIN_FSD_LAM_LIM [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Total duration of LV_FAC_LAM_LIM_MIN[i] = 1					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_SUM_RST_FSD [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer to reset the counter of total duration in MIL area					
T_SUM_RST_FSD_H_RNG [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer to reset the counter of total duration in H_RNG area					
T_SUM_RST_FSD_LAM_LIM [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer to reset the counter of total duration for lambda control in dead stop					

**Input data:**

FAC_LAM_MV_MMV [NC_CBK_EX_NR] {p. 2462}	LV_FAC_H_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	LV_FAC_H_RNG_LIM_MAX_LAM_AD [NC_CBK_EX_NR] {p. 2641}	LV_FAC_H_RNG_LIM_MIN_LAM_AD [NC_CBK_EX_NR] {p. 2641}
LV_FAC_L_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	LV_FAC_L_RNG_LIM_MAX_FSD [NC_CBK_EX_NR] {p. 6199}	LV_FAC_L_RNG_LIM_MIN_FSD [NC_CBK_EX_NR] {p. 6199}	LV_FAC_LAM_LIM_MAX [NC_CBK_EX_NR] {p. 2463}
LV_FAC_LAM_LIM_MIN [NC_CBK_EX_NR] {p. 2463}	LV_FSD_ACT [NC_CBK_EX_NR] {p. 6133}	LV_INH_FSD_STOP_OIL {p. 6133}	LV_MFF_ADD_LIM_MAX_FSD [NC_CBK_EX_NR] {p. 6199}
LV_MFF_ADD_LIM_MIN_FSD [NC_CBK_EX_NR] {p. 6199}	LV_MFF_ADD_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2642}	LV_STALL {p. 1766}	NC_CBK_EX_NR {p. 1829}
NC_IDX_DIAG_FSD [NC_CBK_EX_NR] {p. 6200}	NC_IDX_DIAG_FSD_H_RNG [NC_CBK_EX_NR]	NC_IDX_DIAG_FSD_LAM_LIM [NC_CBK_EX_NR]	STATE_LAM_AD [NC_CBK_EX_NR] {p. 2643}
TCO {p. 1100}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_T_SUM_WIN_FSD_RST	-	0... FFH	0... 0.99609375	0.00390625	-
Minimal fraction of counter threshold that must be spent in ADD as well as L_RNG for error healing					
C_CTR_DEC_LAM_LIM_LAM_AD_REQ	-	0... FFFFH	0... 65535	1	-
Counter decrement for activation of forced lambda adaptation					
C_CTR_INC_LAM_LIM_LAM_AD_REQ	-	0... FFFFH	0... 65535	1	-
Counter increment for activation of forced lambda adaptation					
C_CTR_MAX_LAM_LIM_LAM_AD_REQ	-	0... FFFFH	0... 65535	1	-
Counter threshold for activation of forced lambda adaptation					
C_T_LAM_AD_ACT_MIN_FSD	-	1... FFFFH	0.02... 1310.7	0.02	s
Minimum threshold of active forced lambda adaptation to reset the request flag					
C_T_SUM_MAX_THD_FSD	-	1... FFFFH	0.02... 1310.7	0.02	s
Maximum value of counter for ADD , FAC_L and FAC_H adaptation area (upper limit)					
C_T_SUM_MAX_THD_FSD_LAM_LIM	-	1... FFFFH	0.02... 1310.7	0.02	s
Maximum value of counter in case of lambda control dead stop (upper limit)					
C_T_SUM_MIN_THD_FSD	-	1... FFFFH	0.02... 1310.7	0.02	s
Maximum value of counter for ADD , FAC_L and FAC_H adaptation area (lower limit)					

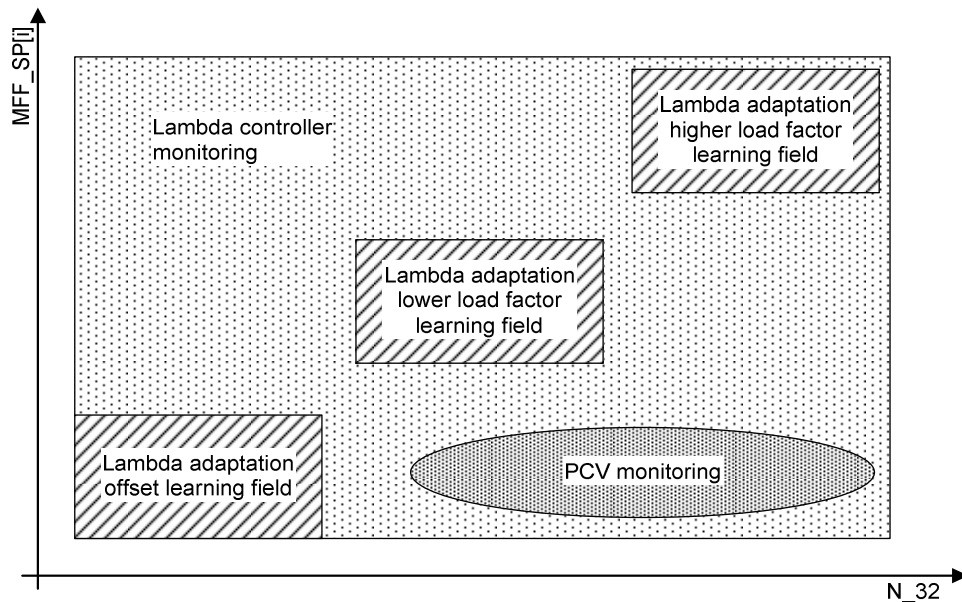
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_SUM_MIN_THD_FSD_LAM_LIM	-	1... FFFFH	0.02... 1310.7	0.02	s
Maximum value of counter in case of lambda control dead stop (lower limit)					
C_T_SUM_RST_FSD	-	1... FFFFH	0.02... 1310.7	0.02	s
Calibration threshold to reset anti bounce timers					
IP_FAC_LAM_OUT_MAX_FSD	-	0... FFFFH	0... 49.9984741	0.00152588	%
LDPM_TCO_4_LACO	6	0... FEH	0... 142.5	0.75	°C
The upper limit of lambda controller output to request forced lambda adaptation					
IP_FAC_LAM_OUT_MIN_FSD	-	0... FFFFH	0... 49.9984741	0.00152588	%
LDPM_TCO_4_LACO	6	0... FEH	0... 142.5	0.75	°C
The lower limit of lambda controller output to request forced lambda adaptation					

### Import actions:

<b>ACTION_ERRM_GetLvErr</b> (IN<IDX_DIAG>,OUT<LV_ERR>)
<b>ACTION_ERRM_NoFilterReset</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_NoFilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_LV_ERR_SET>,IN<PRM_LV_ERR_RST>,IN<PRM_LV_END_DIAG>,OUT<PRM_LV_ERR>)

### General information

The objective of the fuel system diagnosis is to monitor the lambda control output and the lambda adaptation values in various areas. It should also cover the PCV monitoring where the lambda control output is considered in the idle range.



### Monitoring area of fuel system diagnosis

Breaking the adaptation and lambda controller limits for a long time, which may have been caused by failures in the fuel or intake system will involve emission rise and therefore shall be diagnosed by fuel system diagnosis.

FSD errors are located in three failure memories with two and four symptoms each:

#### ERR\_SYM\_FSD[i]:

NO\_SYM: no symptom  
 SYM\_0: maximum limit of additive adaptation value reached  
 SYM\_1: minimum limit of additive adaptation value reached  
 SYM\_2: maximum limit of multiplicative adaptation value (lower area) reached  
 SYM\_3: minimum limit of multiplicative adaptation value (lower area) reached

#### ERR\_SYM\_FSD\_H\_RNG[i]:

NO\_SYM: no symptom  
 SYM\_0: maximum limit of multiplicative adaptation value (upper area) reached  
 SYM\_1: minimum limit of multiplicative adaptation value (upper area) reached

#### ERR\_SYM\_FSD\_LAM\_LIM[i]:

NO\_SYM: no symptom  
 SYM\_0: lambda control in dead stop (upper limit)  
 SYM\_1: lambda control in dead stop (lower limit)

NC\_CBK\_EX\_NR defines the number of exhaust banks.

For vector elements the variable extension `_i` is used in the model instead of `[i]` as found in the textual description.

### Application Condition

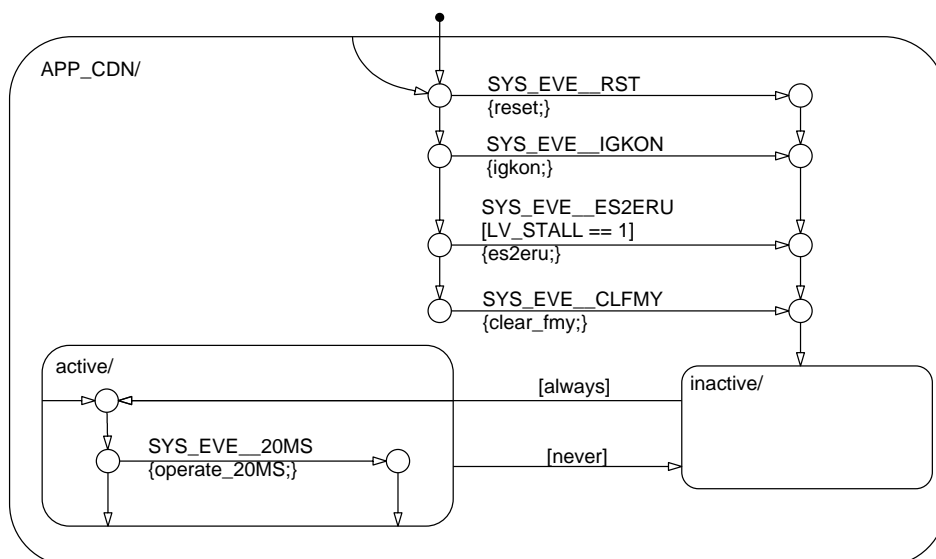


Figure B.105.1: LACO\_FCTDGFSD0/APP\_CDN/Chart

### Function Description



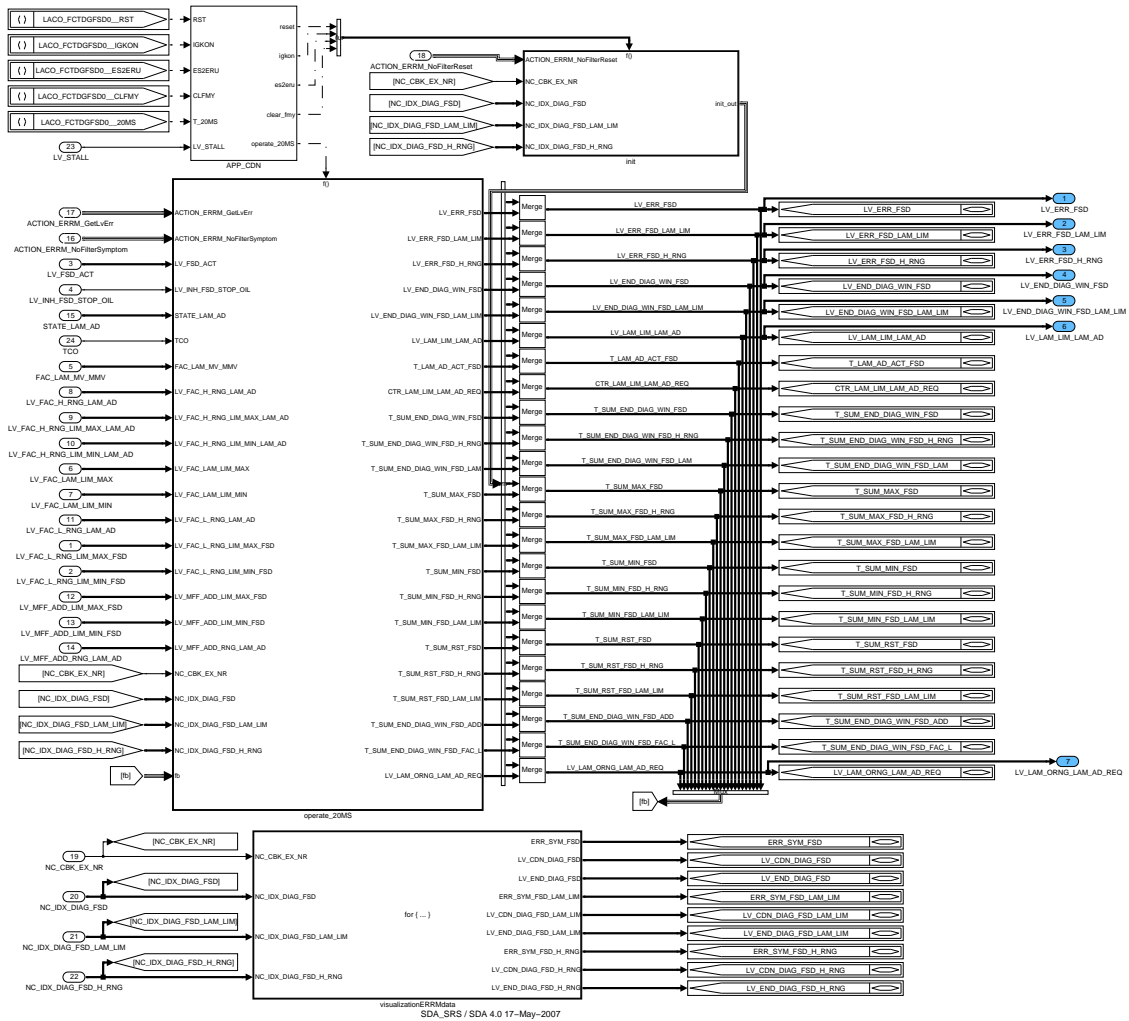
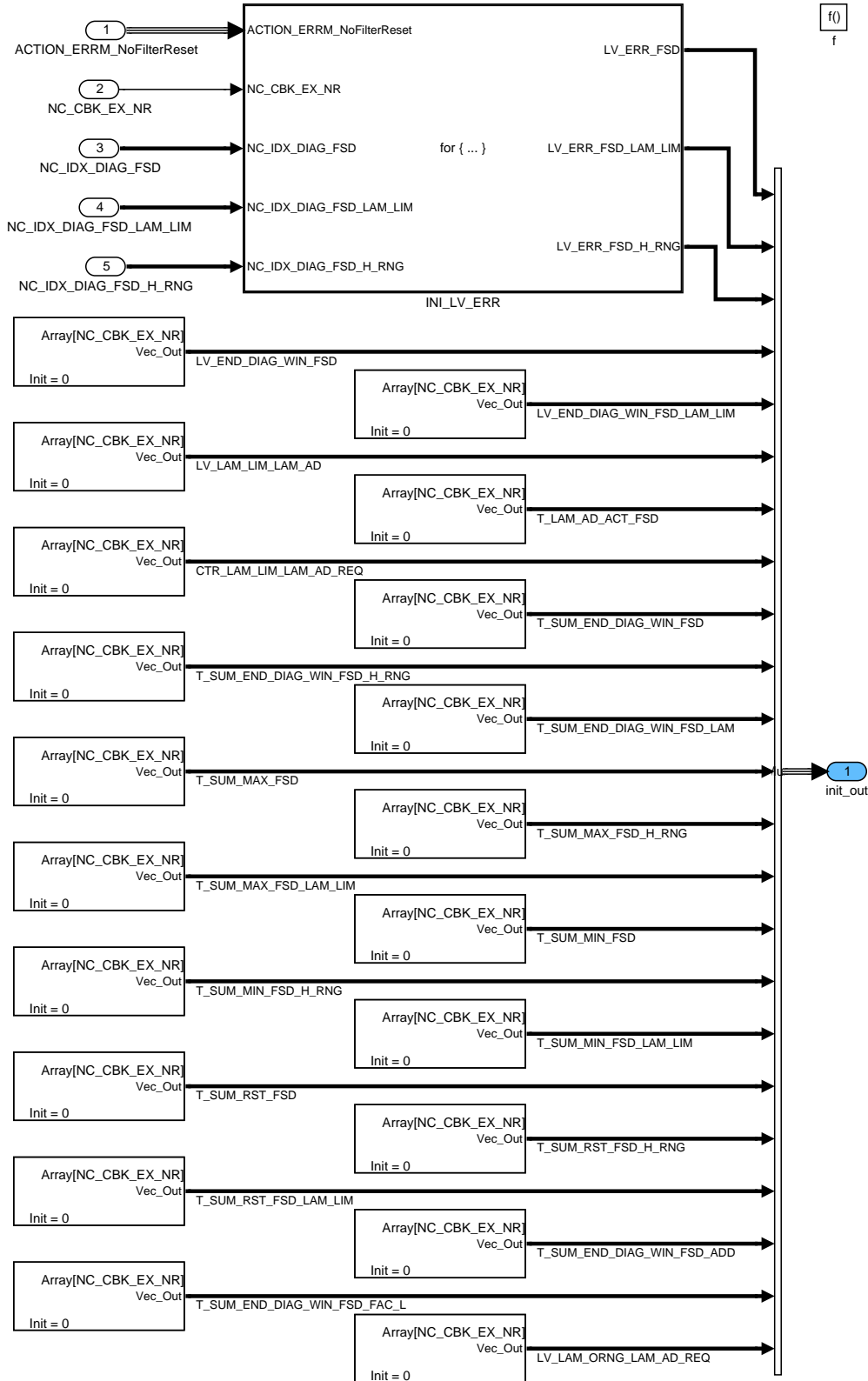


Figure B.105.2: LACO\_FCTDGFSD0

### B.105.1 Initialization

At ECU reset, IGKON, ES2ERU while LV\_STALL is set (in order to cover engine stalling) and at clearance of failure memory all variables are initialized with 0.

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Figure B.105.3: LACO\_FCTDGFSD0/init

**Initialization of error flags**

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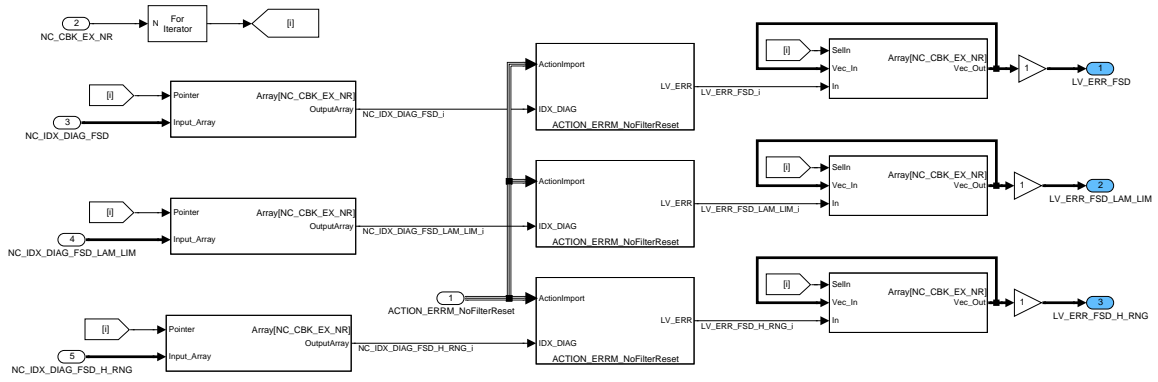


Figure B.105.4: LACO\_FCTDGFSD0/init/INI\_LV\_ERR

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### B.105.2 Formula section

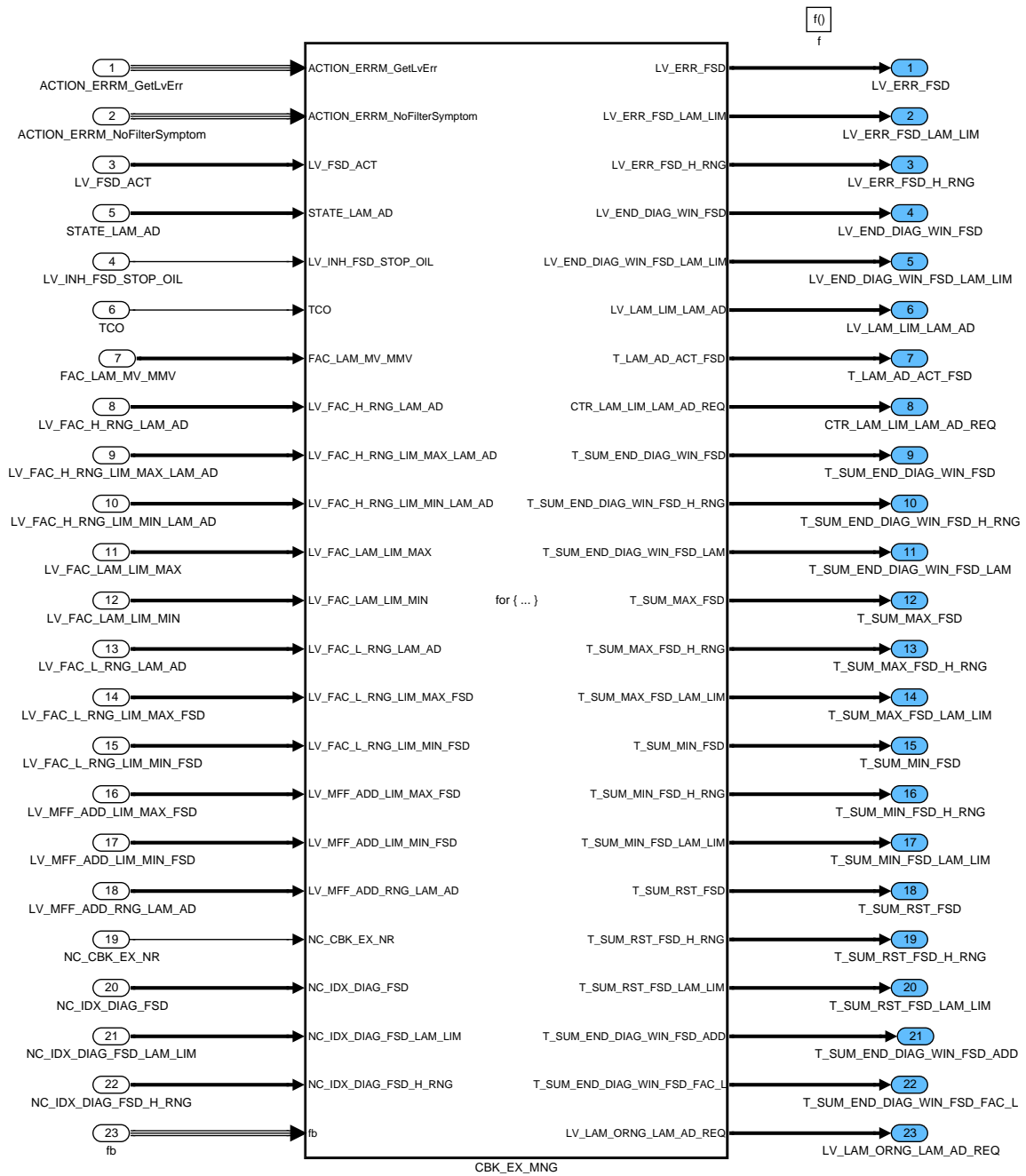


Figure B.105.5: LACO\_FCTDGFSD0/operate\_20MS

### Exhaust bank specific functionality

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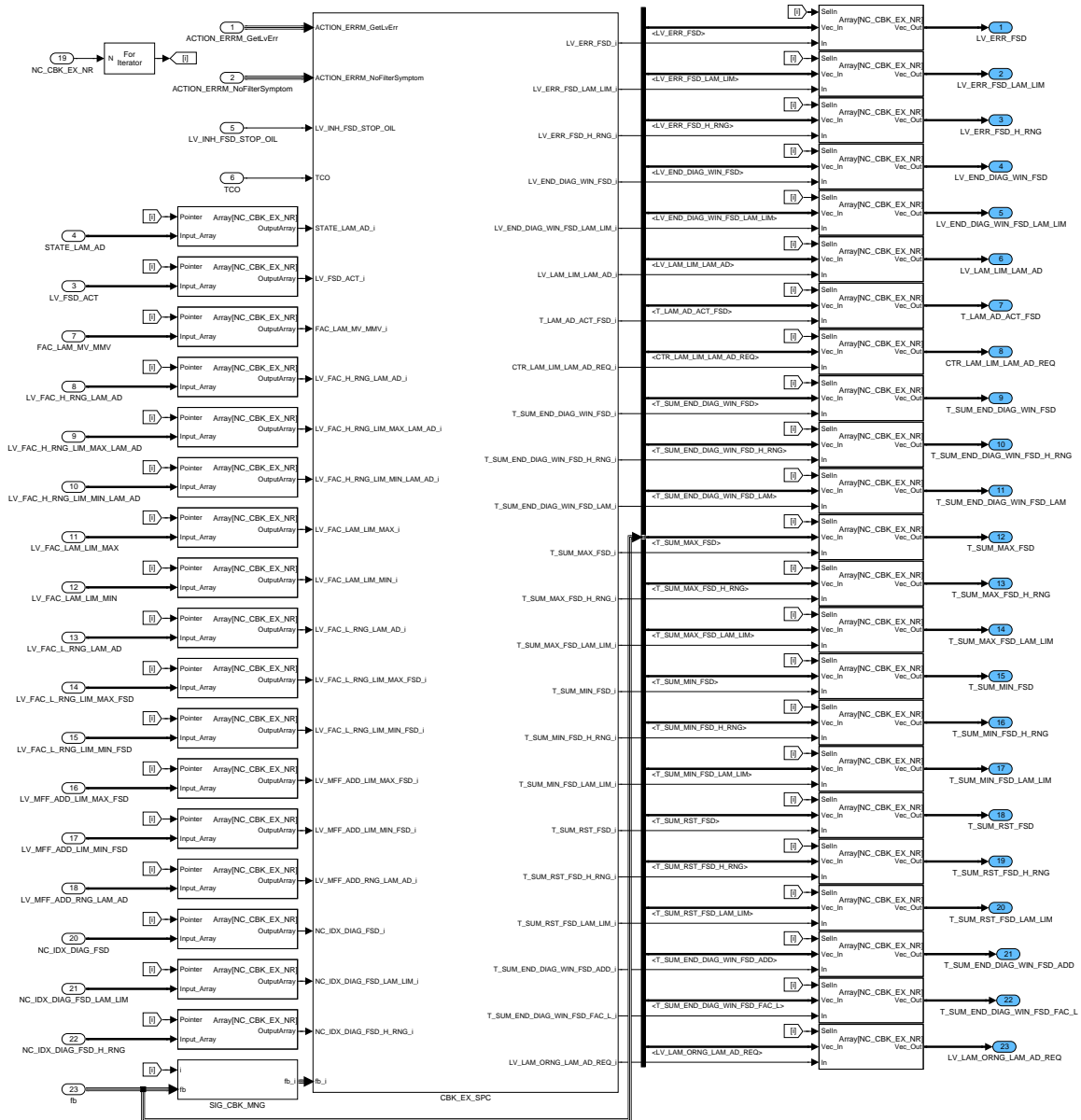


Figure B.105.6: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG

### Overview about the diagnostics

The diagnosis function is split into 4 blocks.

1. By means of an interface functionality to the lambda adaptation the forced lambda adaptation can be requested by the FSD. This functionality runs independent of the rest.
2. The diagnosis conditions for all failure location are evaluated separately from each other.
3. The main block is the evaluation of the error symptom and the management of the end of diagnosis information. The decision about present errors is also part of this block.
4. The interface to the error management ERRM is handled in this block. My means of ACTION calls the relevant information is transmitted to the ERRM.

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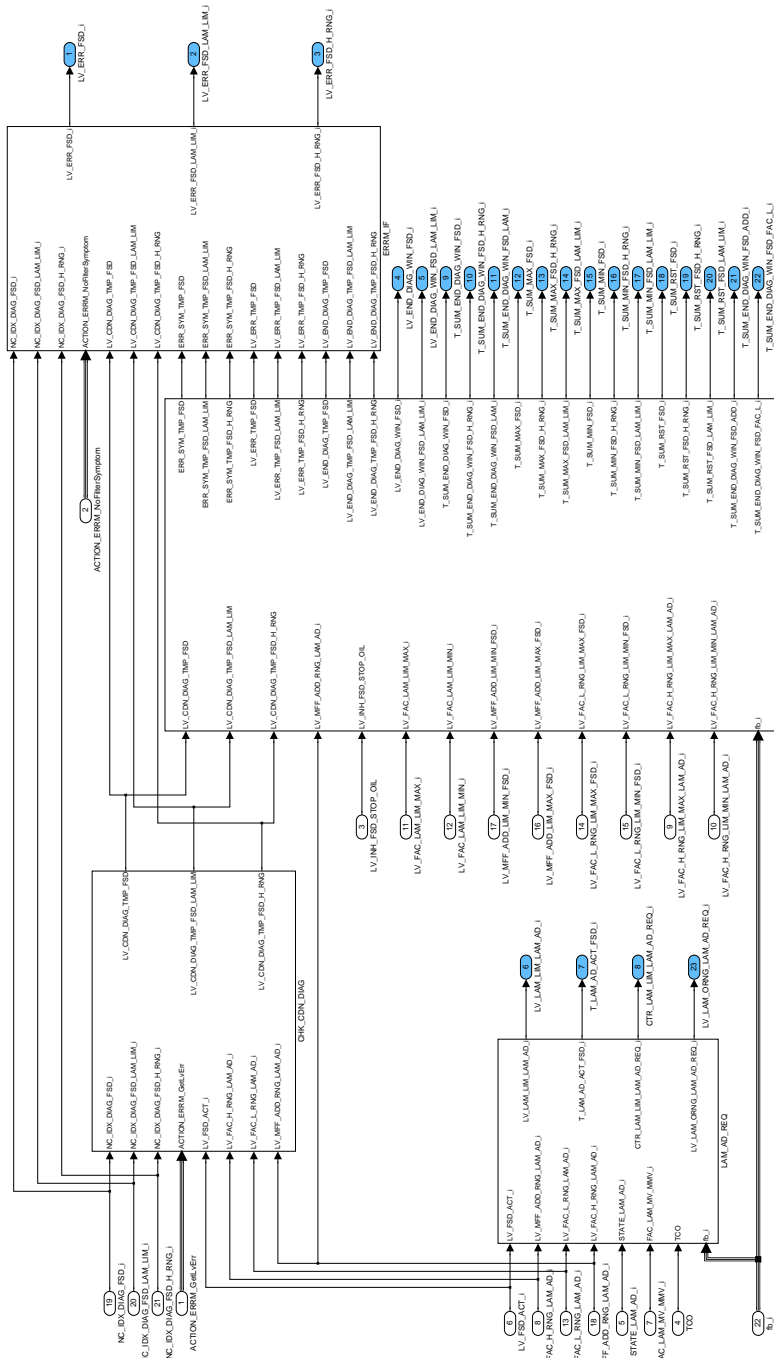



Figure B.105.7: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC

### Interface to lambda adaptation

When the lowpass filtered lambda controller output exceeds a minimum or maximum calibration threshold the lambda adaptation shall be forced by the FSD to get active and adapt the lambda controller deviation in order to confirm to lambda excursion. The request for this forced lambda adaptation is controlled by an antibounce mechanism.

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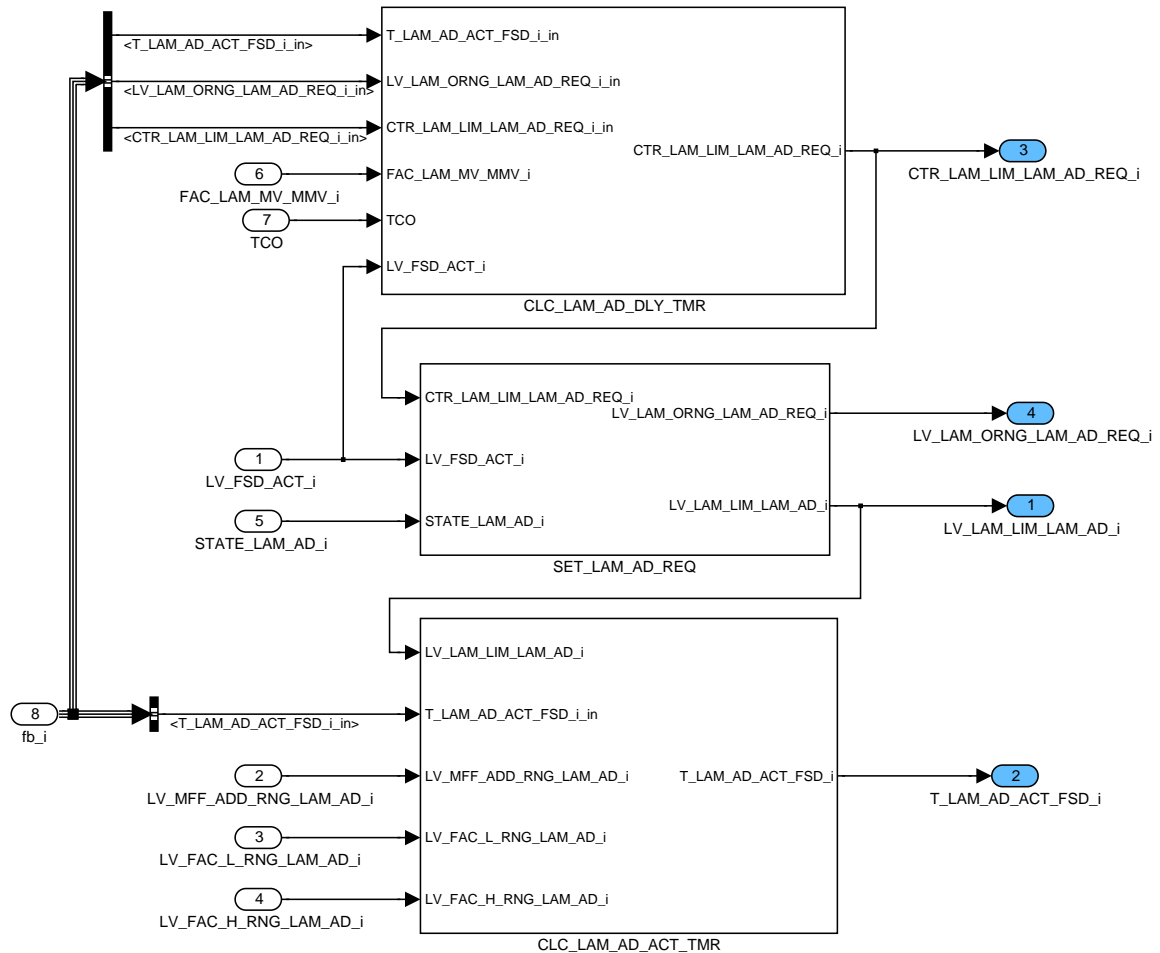


Figure B.105.8: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/LAM\_AD\_REQ

### Request counter

The request counter  $CTR\_LAM\_LIM\_LAM\_AD\_REQ[i]$  is reset to 0 as soon as the activation timer  $T\_LAM\_AD\_ACT\_FSD[i]$  expires.

As long as

the request counter is not yet expired

(indicated by the flag  $LV\_LAM\_ORNG\_LAM\_AD\_REQ[i]$ ),

fuel system diagnosis is active ( $LV\_FSD\_ACT[i] = 1$ ) and

lambda controller output is not zero

the counter is either incremented or decremented depending on whether lambda controller output is inside or outside the permitted range. The incrementation /decrementation speed is tunable.

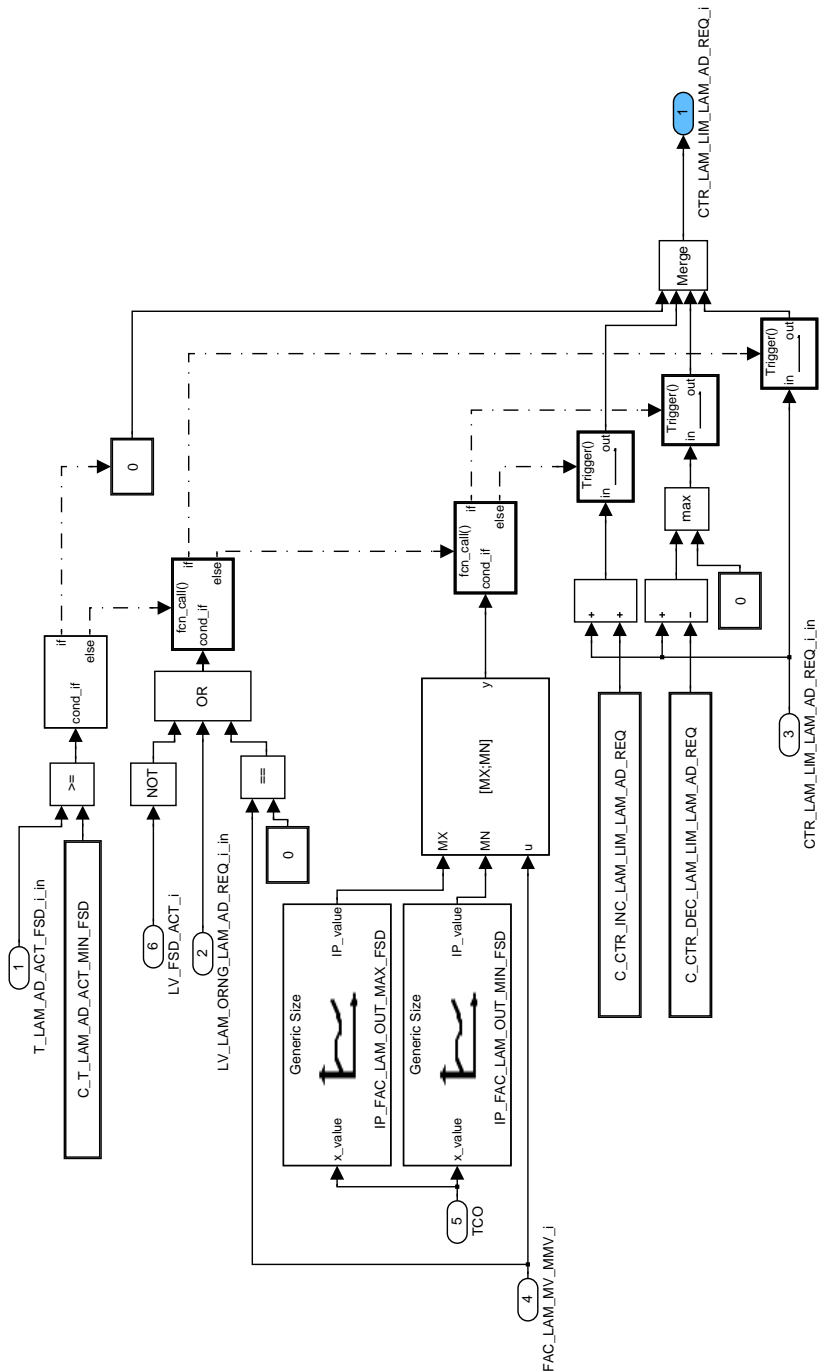



Figure B.105.9: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/LAM\_AD\_REQ/CLC\_LAM\_AD\_DLY\_TMR

**Request flag /Lamda controller out of range flag**

If the request counter is expired, fuel system diagnosis is active and the lambda adaptation is inside one of its learning fields (either state CDN\_FAC\_L, CDN\_FAC\_H, CDN\_ADD, ADAPT\_FAC\_L, ADAPT\_FAC\_H or ADAPT\_ADD indicated by STATE\_LAM\_AD[i] >= CDN\_FAC\_L), the flag LV\_LAM\_LIM\_LAM\_AD[i] that requests the forced lambda adaptation is set to 1.

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As soon as request counter reaches the calibration threshold the flag LV\_LAM\_ORNG\_LAM\_AD\_REQ[i] indicating that the request timer expired is set.

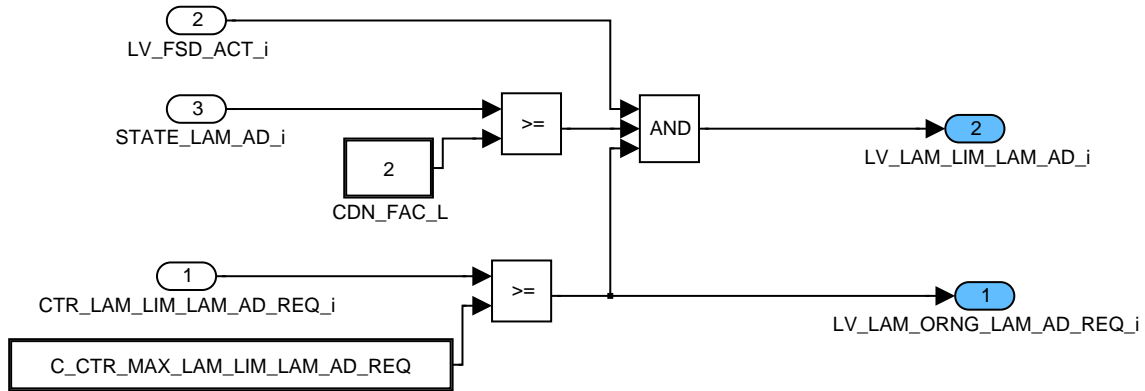


Figure B.105.10: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/LAM\_AD\_REQ/SET\_LAM\_AD\_REQ

### Activation timer

The activation timer T\_LAM\_AD\_ACT\_FSD[i] is incremented as long as the request flag for forced lambda adaptation is set and lambda adaptation is active. As soon as the activation timer expires it is reset to 0.

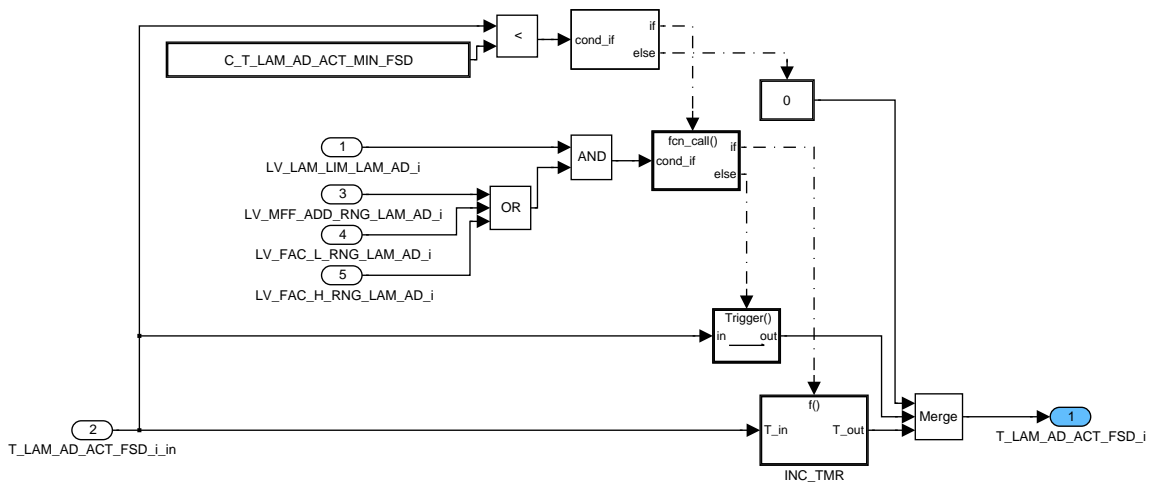


Figure B.105.11: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/LAM\_AD\_REQ/CLC\_LAM\_AD\_ACT\_TMR

### Increment timer

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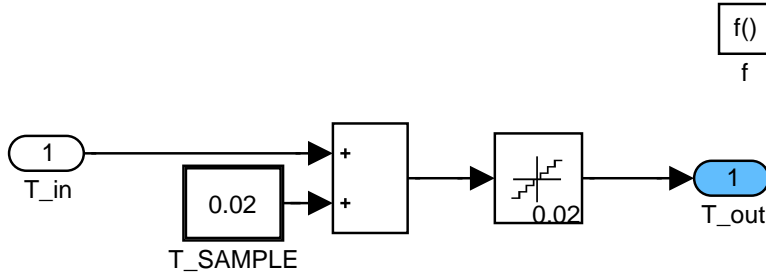


Figure B.105.12: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/LAM\_AD\_REQ/CLC\_LAM\_AD\_ACT\_TMR/INC\_TMR

**Check diagnostic conditions**

For each failure location the diagnostic condition is evaluated separately.

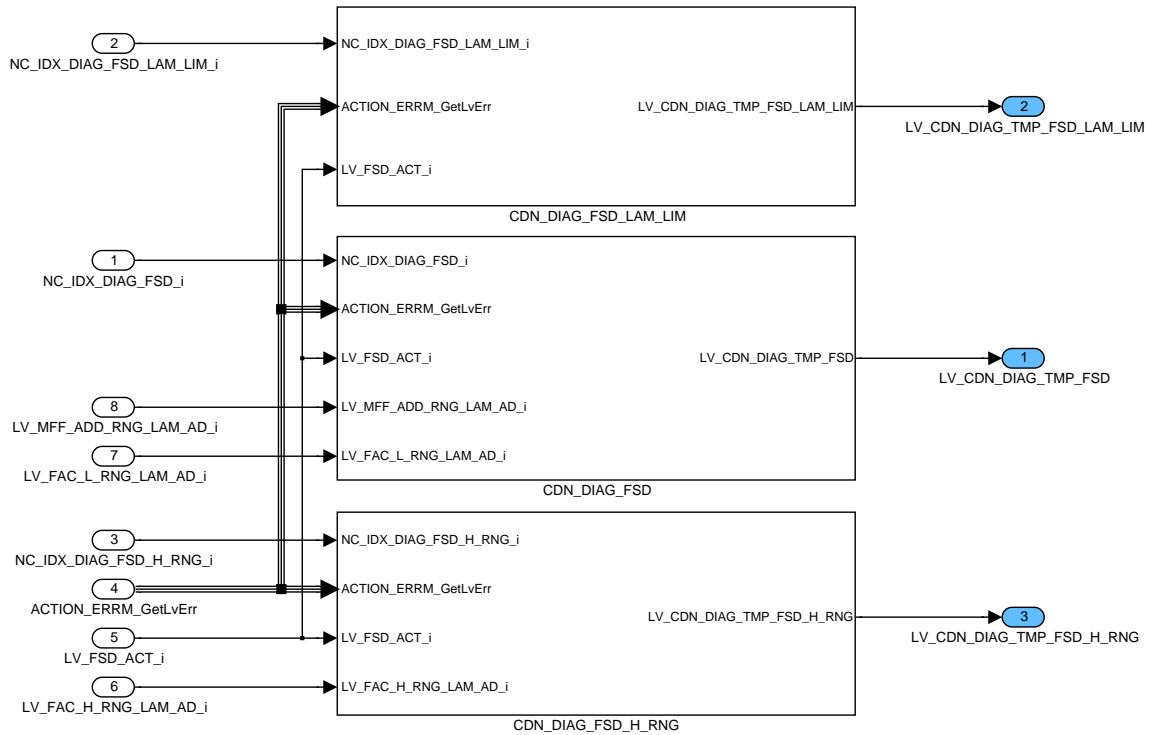


Figure B.105.13:  
LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/CHK\_CDN\_DIAG

**Check conditions for lambda adaptation monitoring**

Conditions are fulfilled when no error is present, the global activation conditions are fulfilled and the lambda adaptation is either in the offset or lower load factor learning field.

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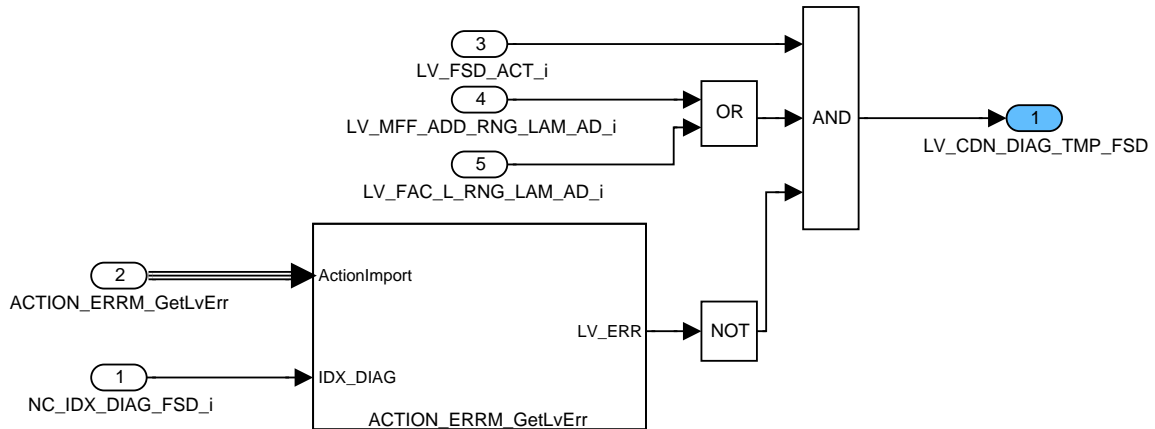


Figure B.105.14: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/CHK\_CDN\_DIAG/CDN\_DIAG\_FSD

### Check conditions for lambda controller monitoring

Conditions are fulfilled when no error is present and the global activation conditions are fulfilled. The lambda controller monitoring is executed in the whole operating range.

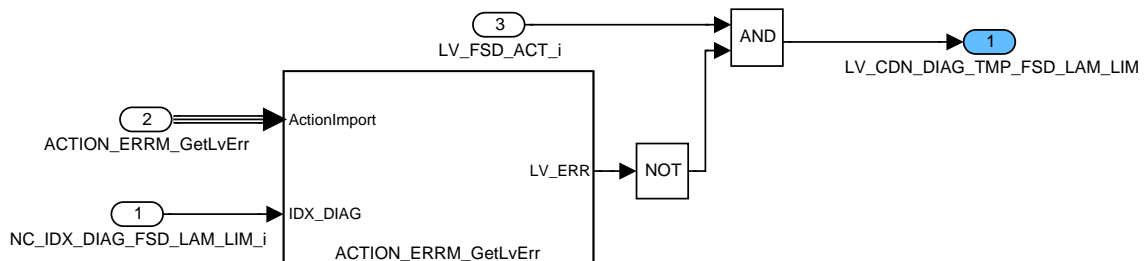


Figure B.105.15: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/CHK\_CDN\_DIAG/CDN\_DIAG\_FSD\_LAM\_LIM

### Check conditions for lambda adaptation high load monitoring

Conditions are fulfilled when no error is present, the global activation conditions are fulfilled and the lambda adaptation is in the higher load factor learning field.

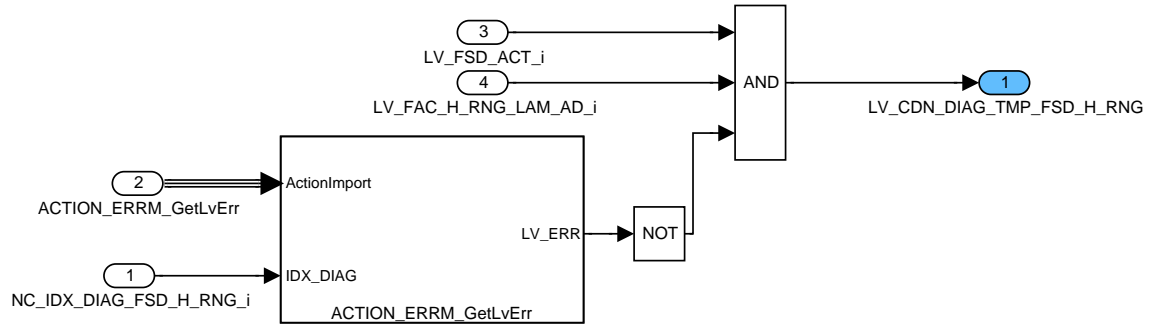



Figure B.105.16: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/CHK\_CDN\_DIAG/CDN\_DIAG\_FSD\_H\_RNG

**Error detection and end of diagnosis management**

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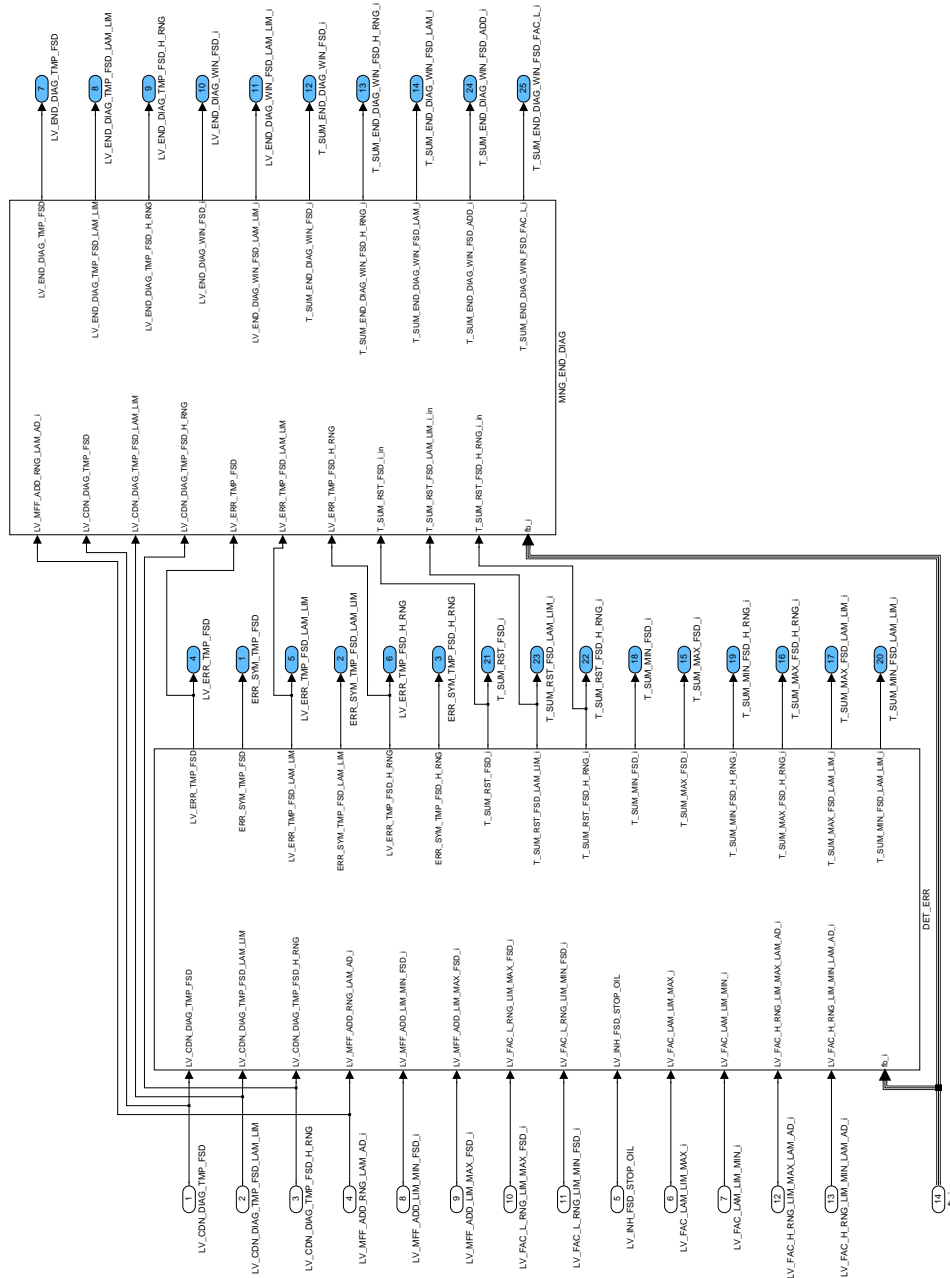



Figure B.105.17: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG

### Error symptom detection

For each failure location the symptom detection is executed separately.

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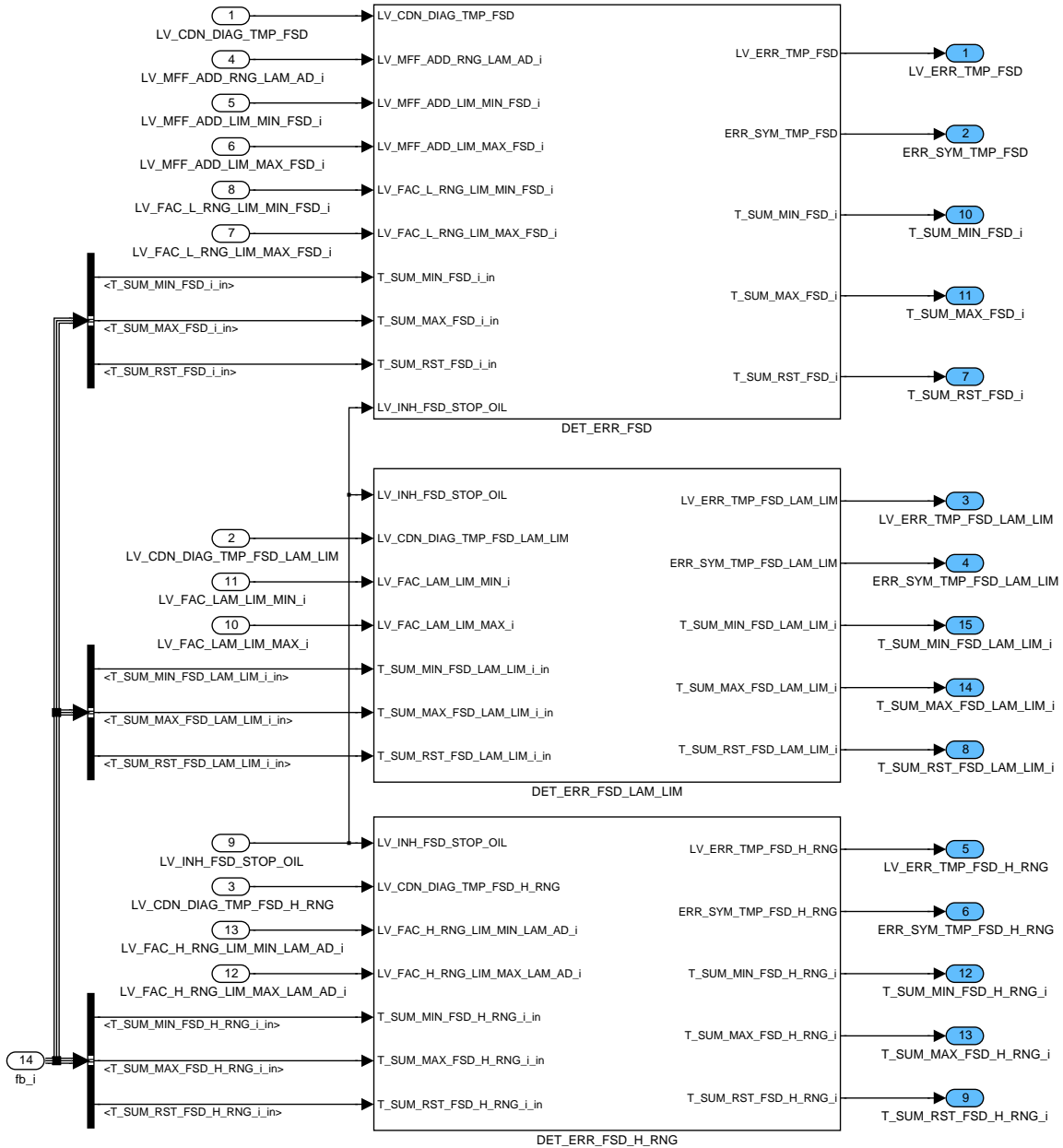


Figure B.105.18: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR

**Error symptom detection for lambda adaptation monitoring**

In case the conditions are not fulfilled all timers remain unchanged and the temporary error flag and symptom have no relevance.

Depending on whether lambda adaptation is in the offset or lower load factor learning field different but similar functionalities are executed.

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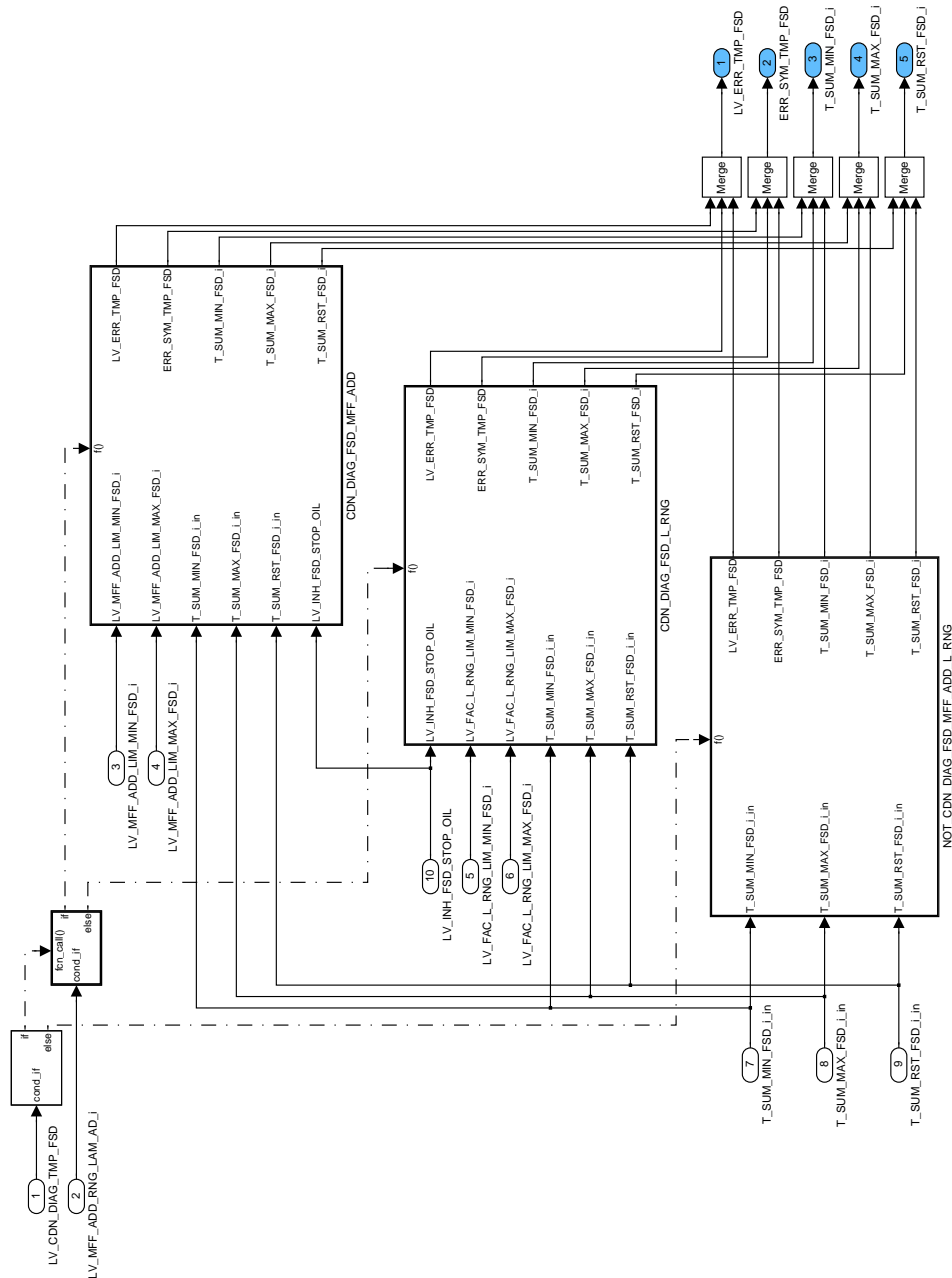


Figure B.105.19:  
LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD

### Conditions for lambda adaptation offset monitoring fulfilled

Between 3 different cases must be distinguished:

1. Lambda adaptation factor for lower load is at its minimum threshold (indicated by the flag LV\_MFF\_ADD\_LIM\_MIN\_LAM\_AD[i]) and no inhibition due to oil dilution under cold start conditions.
2. Lambda adaptation factor for lower load is at its maximum threshold (indicated by the flag LV\_MFF\_ADD\_LIM\_MAX\_LAM\_AD[i]).
3. No limitation of the lambda adaptation factor for lower load.

Independent of these cases the antibounce timers used to finally set the error are evaluated afterwards.

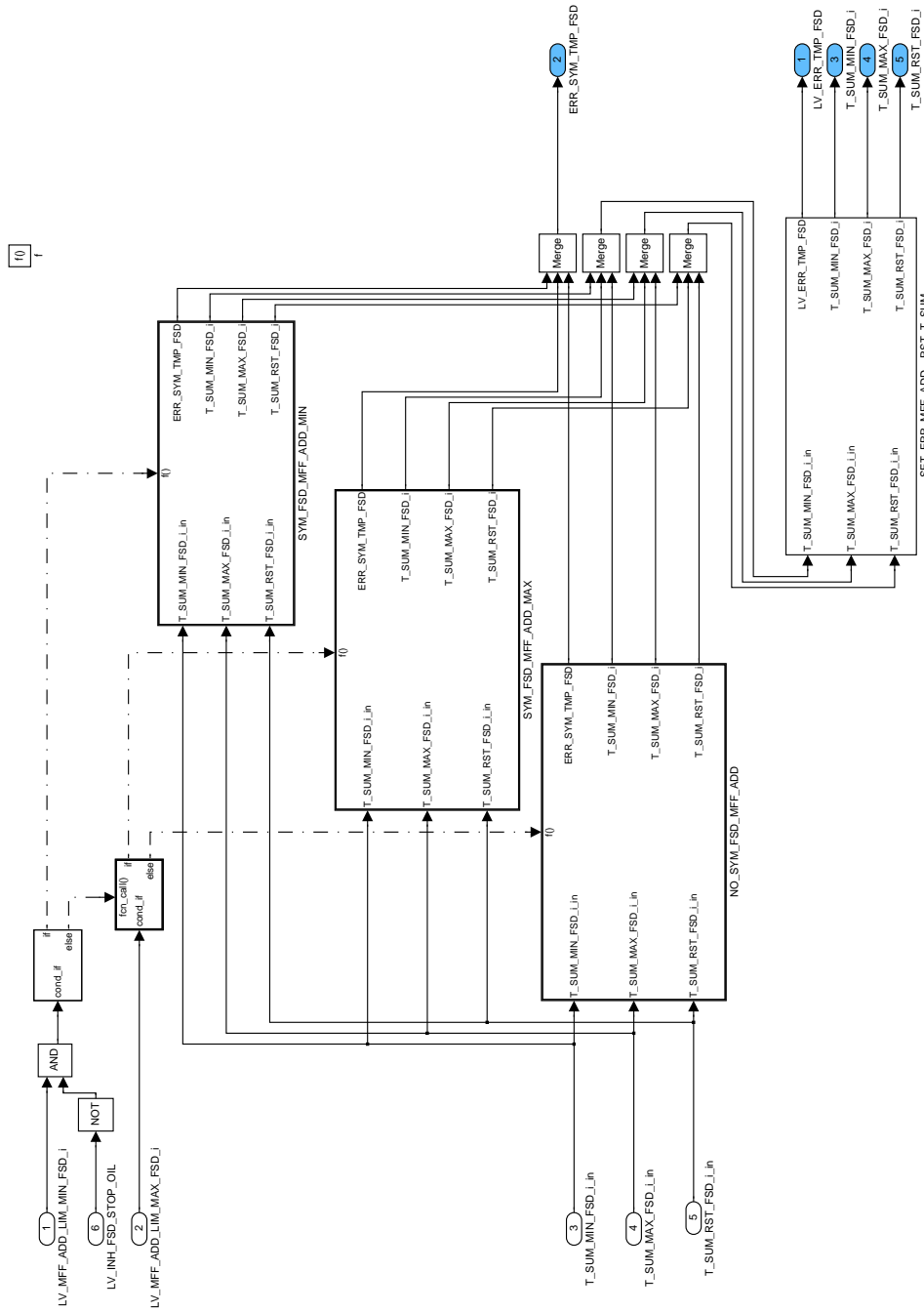



Figure B.105.20: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD/CDN\_DIAG\_FSD\_MFF\_ADD

**Set error symptom for lambda adaptation offset at the minimum**

The error symptom is set to the respective value (SYM\_1). The timer indicating that the minimum threshold is reached and the reset timer are both increased.

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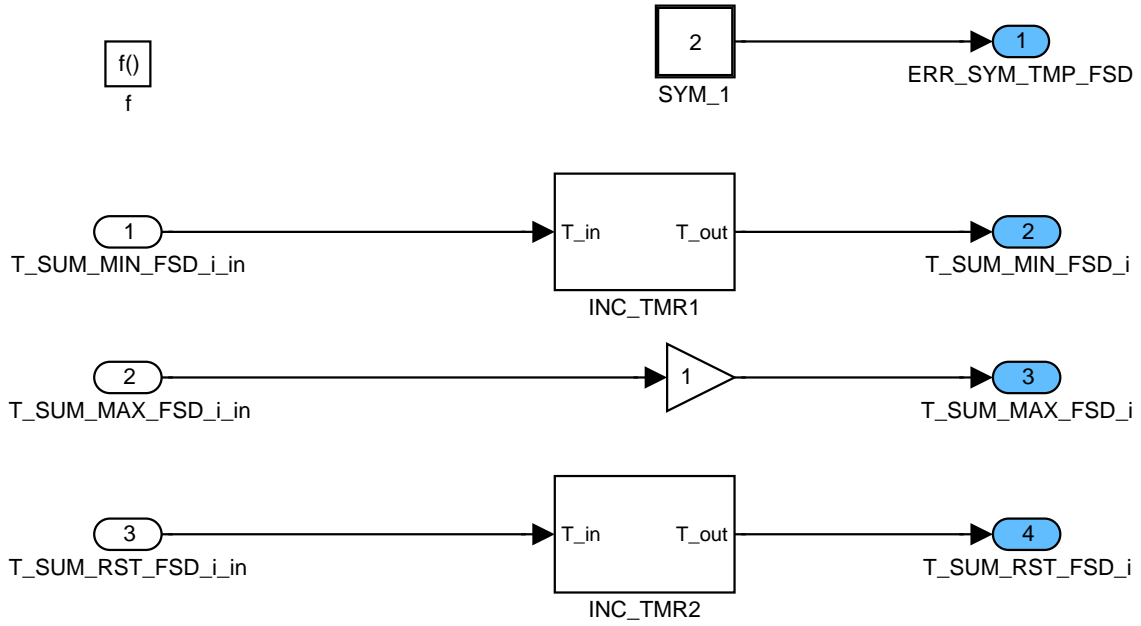


Figure B.105.21: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD/CDN\_DIAG\_FSD\_MFF\_ADD/SYM\_FSD\_MFF\_ADD\_MIN

**Increment timer**

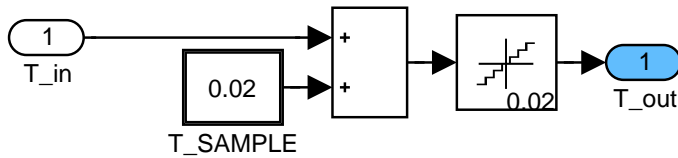


Figure B.105.22: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD/CDN\_DIAG\_FSD\_MFF\_ADD/SYM\_FSD\_MFF\_ADD\_MIN/INC\_TMR1

**Increment timer**

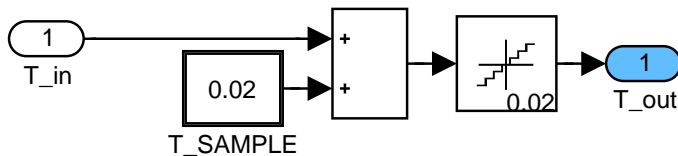


Figure B.105.23: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD/CDN\_DIAG\_FSD\_MFF\_ADD/SYM\_FSD\_MFF\_ADD\_MIN/INC\_TMR2

**Set error symptom for lambda adaptation offset at the maximum**

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The error symptom is set to the respective value (SYM\_0). The timer indicating that the maximum threshold is reached and the reset timer are both increased.

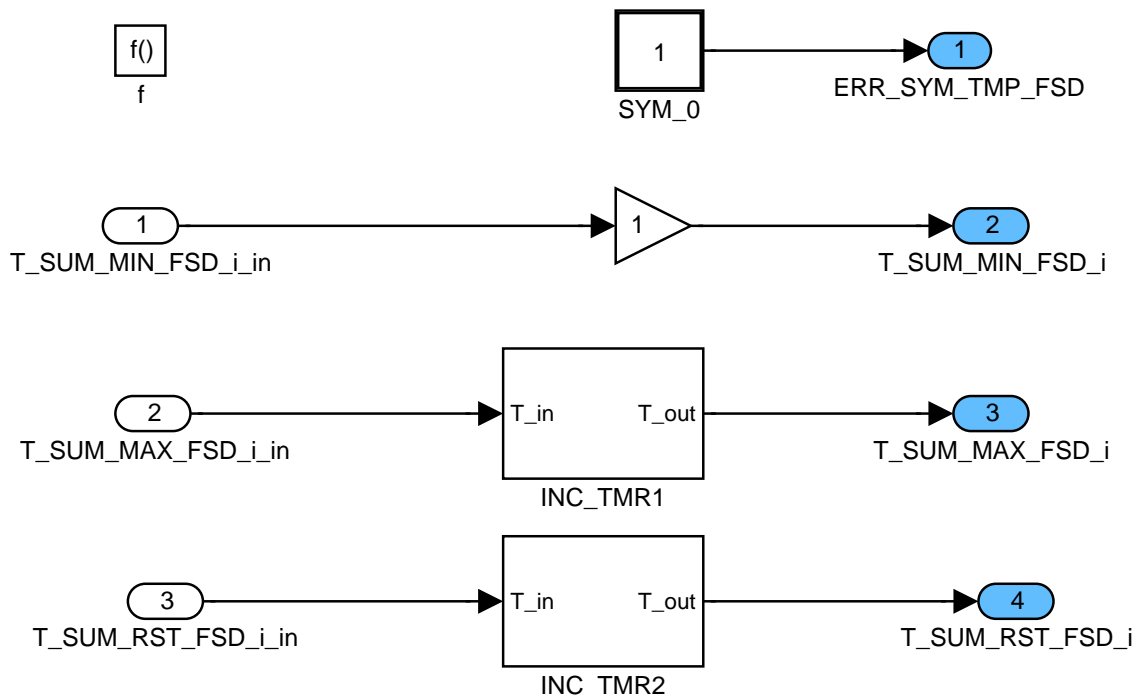


Figure B.105.24: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD/CDN\_DIAG\_FSD\_MFF\_ADD/SYM\_FSD\_MFF\_ADD\_MAX

**Increment timer**

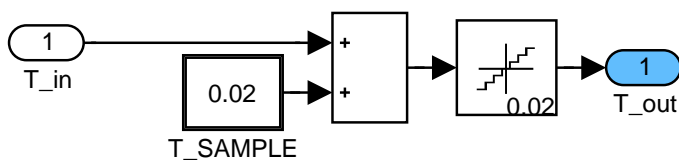


Figure B.105.25: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD/CDN\_DIAG\_FSD\_MFF\_ADD/SYM\_FSD\_MFF\_ADD\_MAX/INC\_TMR1

**Increment timer**

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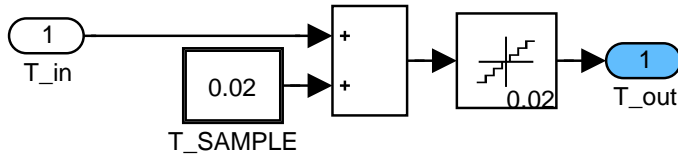


Figure B.105.26: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD/CDN\_DIAG\_FSD\_MFF\_ADD/SYM\_FSD\_MFF\_ADD\_MAX/INC\_TMR2

**No error symptom for lambda adaptation offset**

The error symptom is set to NO\_SYM and the reset timer is increased in case it is already different from 0. In that case the error symptom was at least one time different from NO\_SYM.

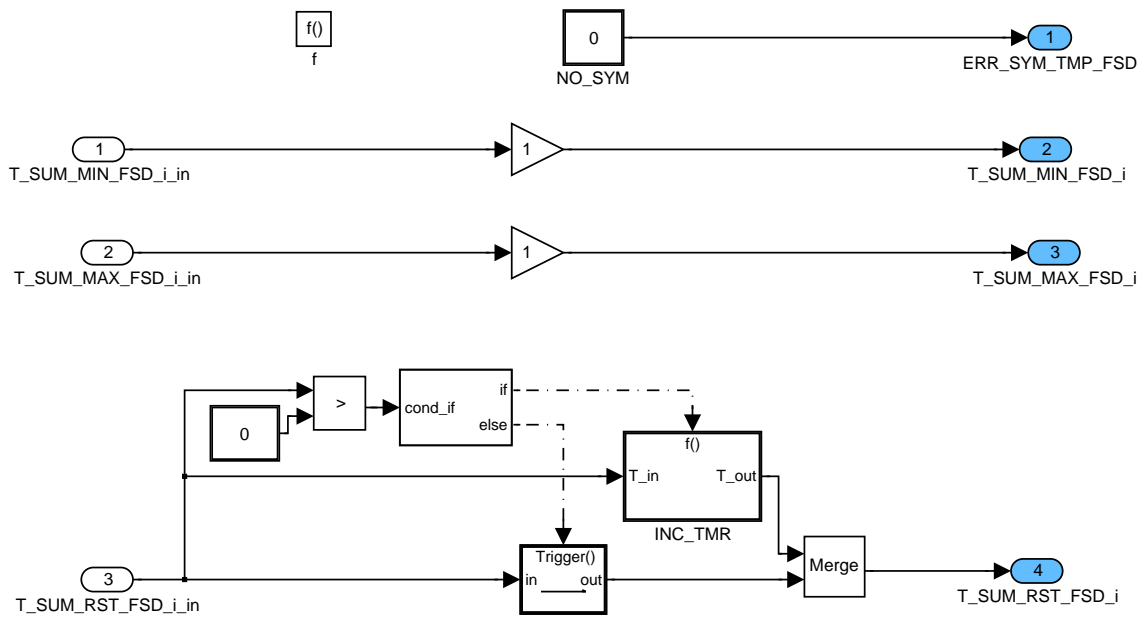


Figure B.105.27: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD/CDN\_DIAG\_FSD\_MFF\_ADD/NO\_SYM\_FSD\_MFF\_ADD

**Increment timer**

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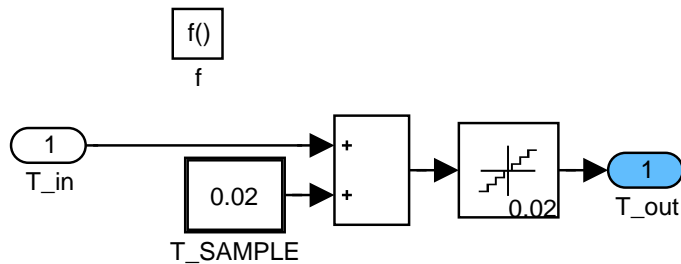


Figure B.105.28: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD/CDN\_DIAG\_FSD\_MFF\_ADD/NO\_SYM\_FSD\_MFF\_ADD/INC\_TMR

### Set error flag for lambda adaptation offset monitoring

The temporary error flag is set if the lambda adaptation factor was either too long at its maximum or at its minimum.

When the reset timer reaches the threshold C\_T\_SUM\_RST\_FSD all timers are reset to 0.

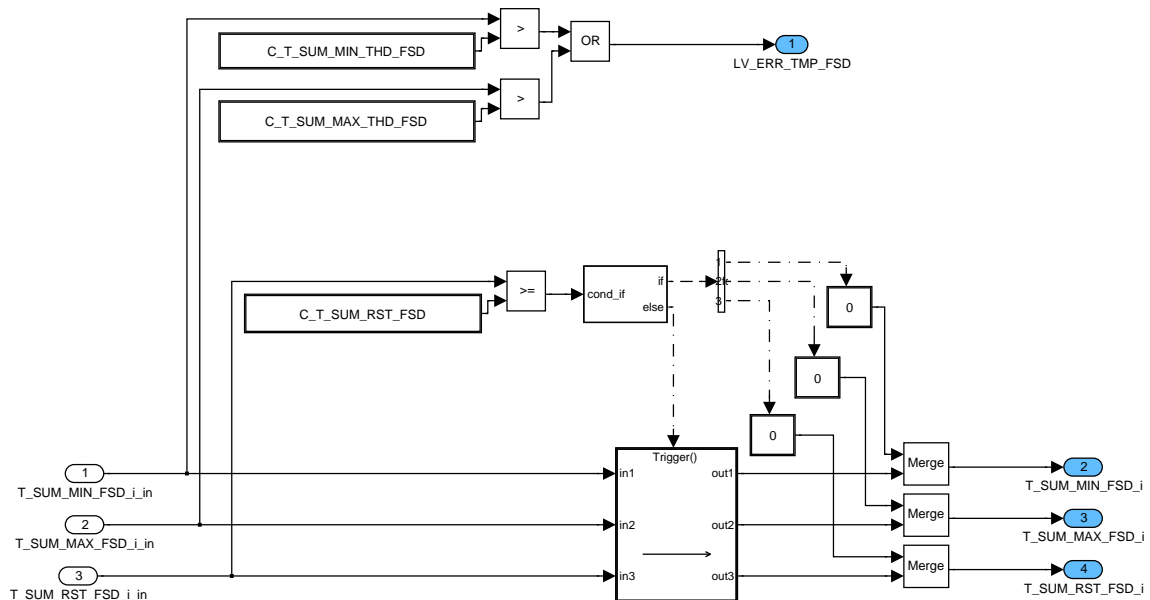


Figure B.105.29: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD/CDN\_DIAG\_FSD\_MFF\_ADD/SET\_ERR\_MFF\_ADD\_RST\_T\_SUM

### Conditions for lambda adaptation low range monitoring fulfilled

Between 3 different cases must be distinguished:

1. Lambda adaptation factor for lower load is at its minimum threshold (indicated by the flag LV\_FAC\_L\_RNG\_LIM\_MIN\_FSD[i] which is assigned in the application incidences) and no inhibition due to oil dilution under cold start conditions.
2. Lambda adaptation factor for lower load is at its maximum threshold (indicated by the flag LV\_FAC\_L\_RNG\_LIM\_MAX\_FSD[i] which is assigned in the application incidences).
3. No limitation of the lambda adaptation factor for lower load.

Independent of these cases the antibounce timers used to finally set the error are evaluated afterwards.

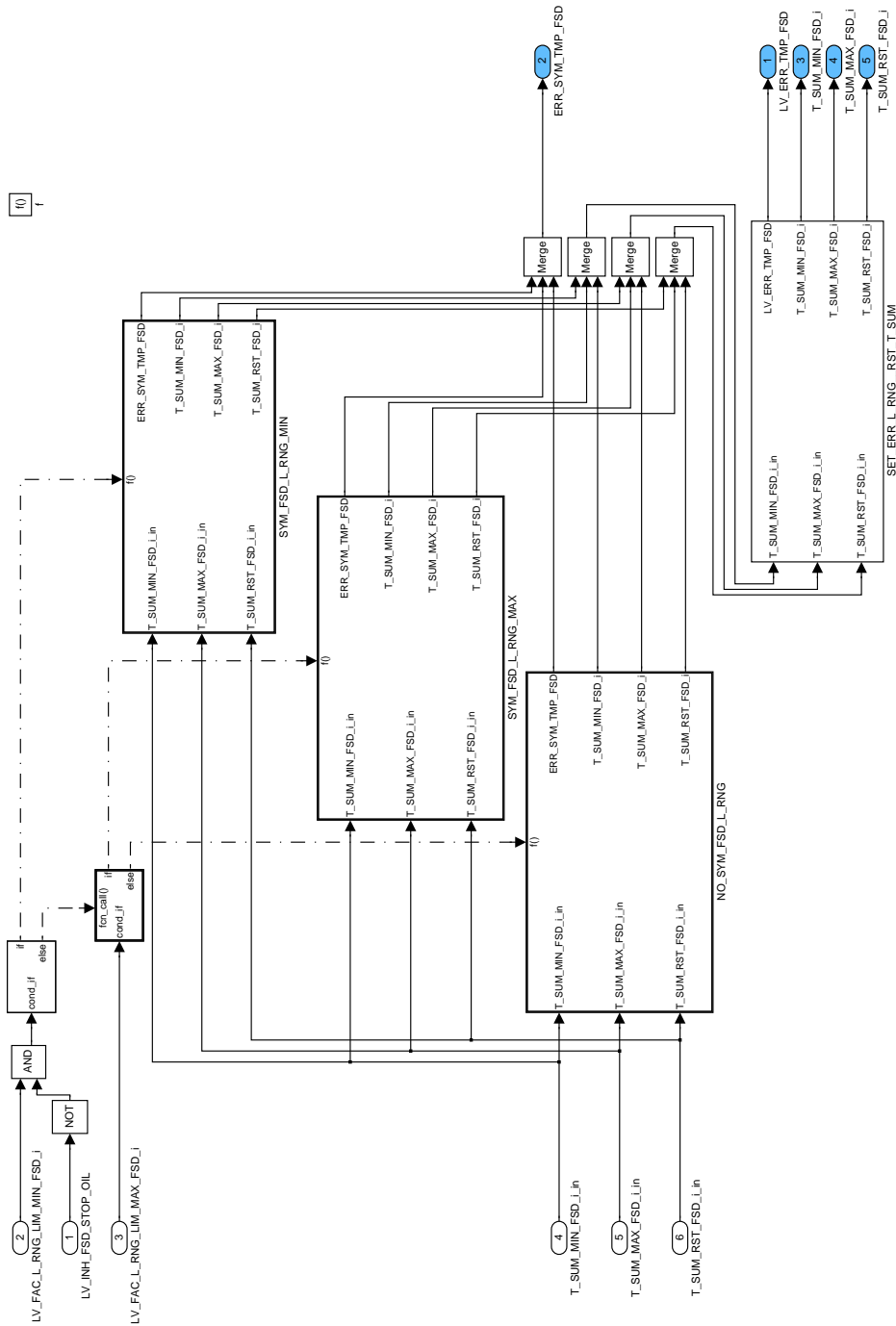



Figure B.105.30: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD/CDN\_DIAG\_FSD\_L\_RNG

**Set error symptom for lambda adaptation low range at the minimum**

The error symptom is set to the respective value (SYM\_3). The timer indicating that the minimum threshold is reached and the reset timer are both increased.

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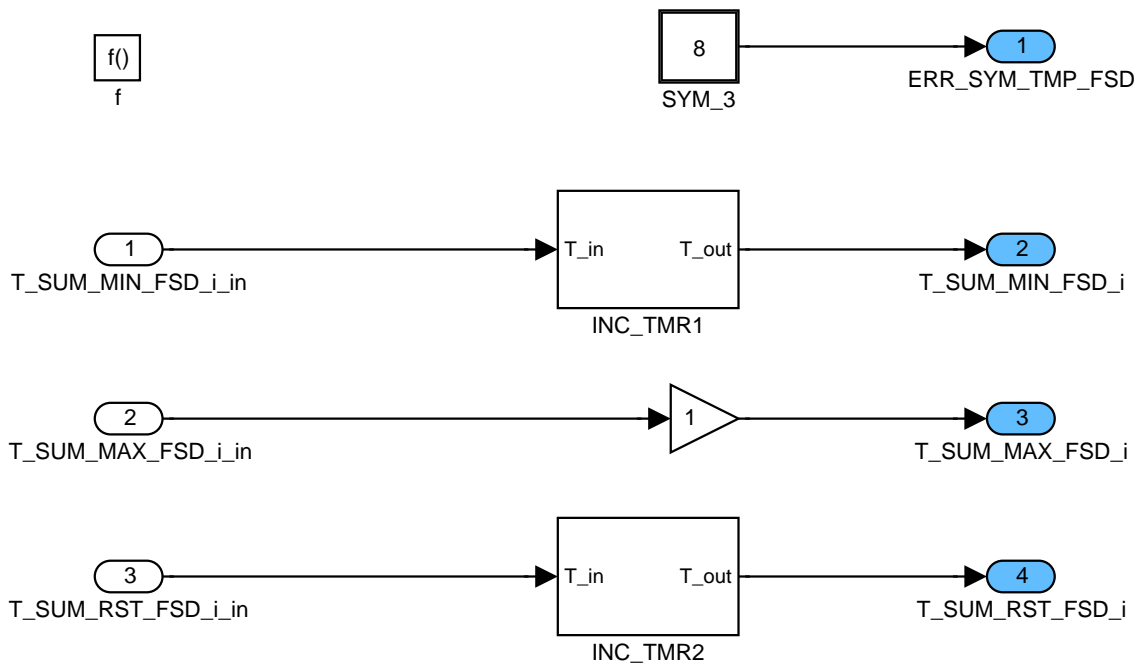


Figure B.105.31: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD/CDN\_DIAG\_FSD\_L\_RNG/SYM\_FSD\_L\_RNG\_MIN

**Increment timer**

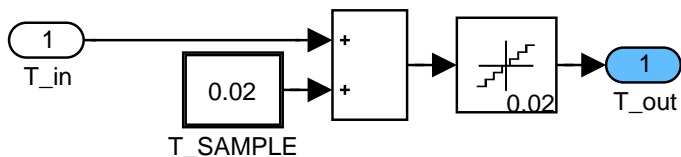


Figure B.105.32: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD/CDN\_DIAG\_FSD\_L\_RNG/SYM\_FSD\_L\_RNG\_MIN/INC\_TMR1

**Increment timer**

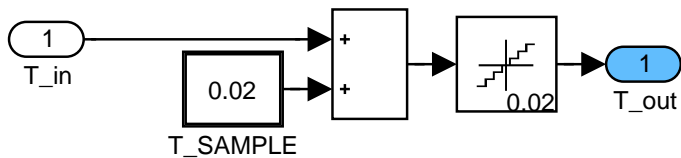


Figure B.105.33: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD/CDN\_DIAG\_FSD\_L\_RNG/SYM\_FSD\_L\_RNG\_MIN/INC\_TMR2

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### Set error symptom for lambda adaptation low range at the maximum

The error symptom is set to the respective value (SYM\_2). The timer indicating that the maximum threshold is reached and the reset timer are both increased.

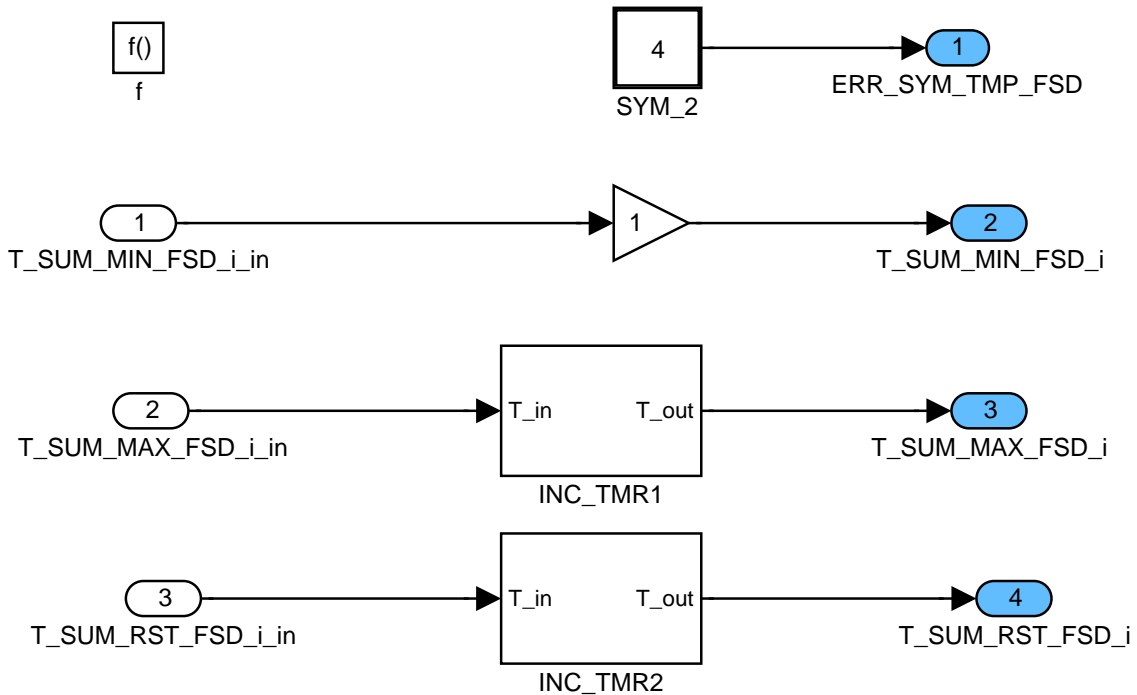


Figure B.105.34: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD/CDN\_DIAG\_FSD\_L\_RNG/SYM\_FSD\_L\_RNG\_MAX

### Increment timer

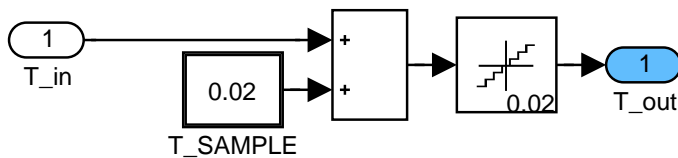


Figure B.105.35: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD/CDN\_DIAG\_FSD\_L\_RNG/SYM\_FSD\_L\_RNG\_MAX/INC\_TMR1

### Increment timer

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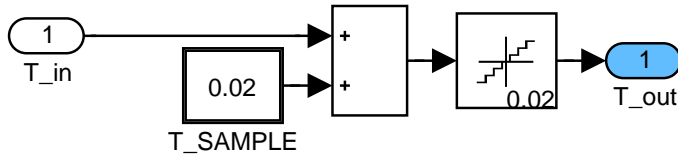


Figure B.105.36: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD/CDN\_DIAG\_FSD\_L\_RNG/SYM\_FSD\_L\_RNG\_MAX/INC\_TMR2

**No error symptom for lambda adaptation low range**

The error symptom is set to NO\_SYM and the reset timer is increased in case it is already different from 0. In that case the error symptom was at least one time different from NO\_SYM.

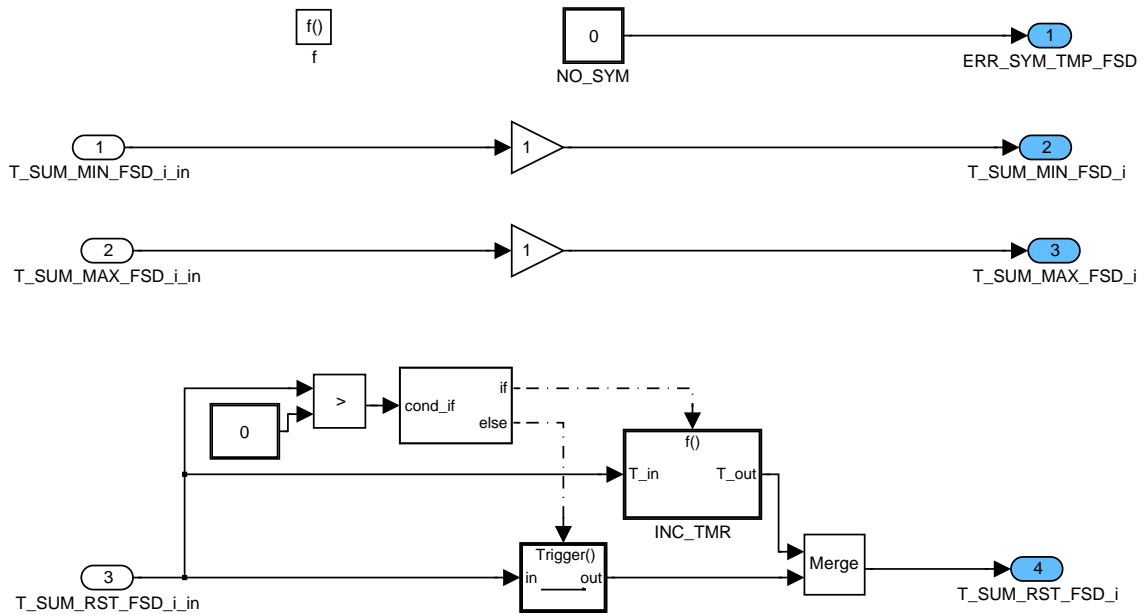


Figure B.105.37: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD/CDN\_DIAG\_FSD\_L\_RNG/NO\_SYM\_FSD\_L\_RNG

**Increment timer**

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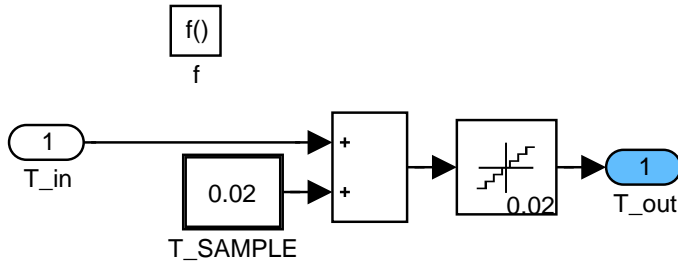


Figure B.105.38: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD/CDN\_DIAG\_FSD\_L\_RNG/NO\_SYM\_FSD\_L\_RNG/INC\_TMR

**Set error flag for lambda adaptation low range monitoring**

The temporary error flag is set if the lambda adaptation factor was either too long at its maximum or at its minimum.

When the reset timer reaches the threshold C\_T\_SUM\_RST\_FSD all timers are reset to 0.

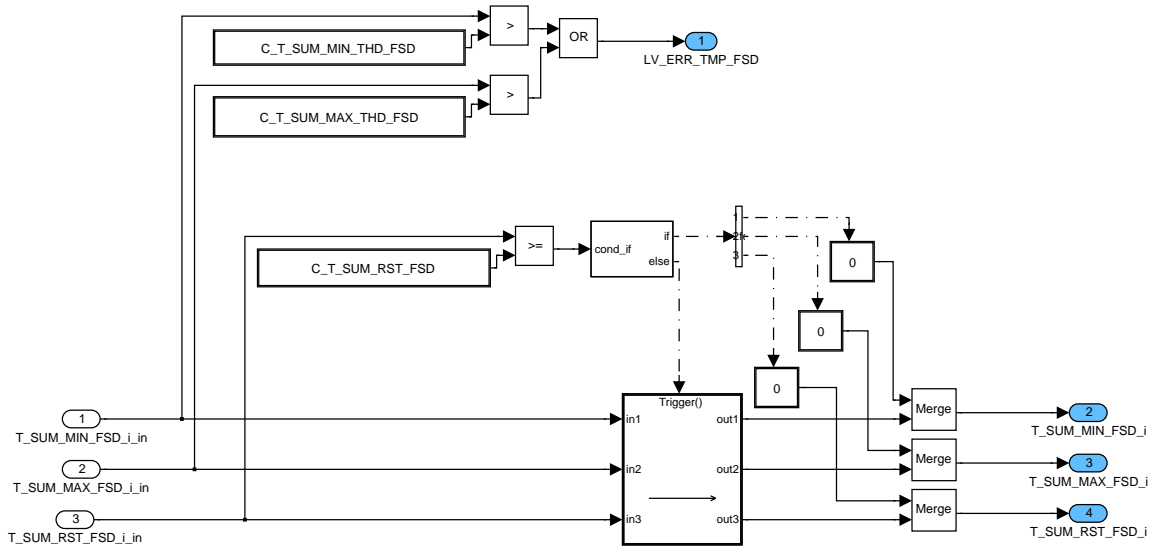


Figure B.105.39: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD/CDN\_DIAG\_FSD\_L\_RNG/SET\_ERR\_L\_RNG\_RST\_T\_SUM

**Conditions for lambda adaptation monitoring not fulfilled**

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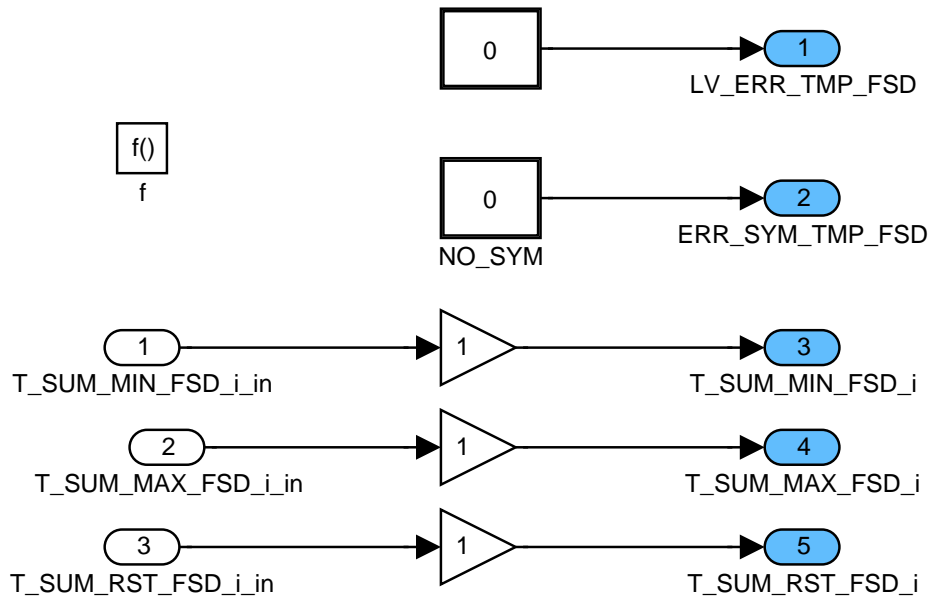


Figure B.105.40: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD/NOT\_CDN\_DIAG\_FSD\_MFF\_ADD\_L\_RNG

**Error symptom detection for lambda controller monitoring**

In case the conditions are not fulfilled all timers remain unchanged and the temporary error flag and symptom have no relevance.

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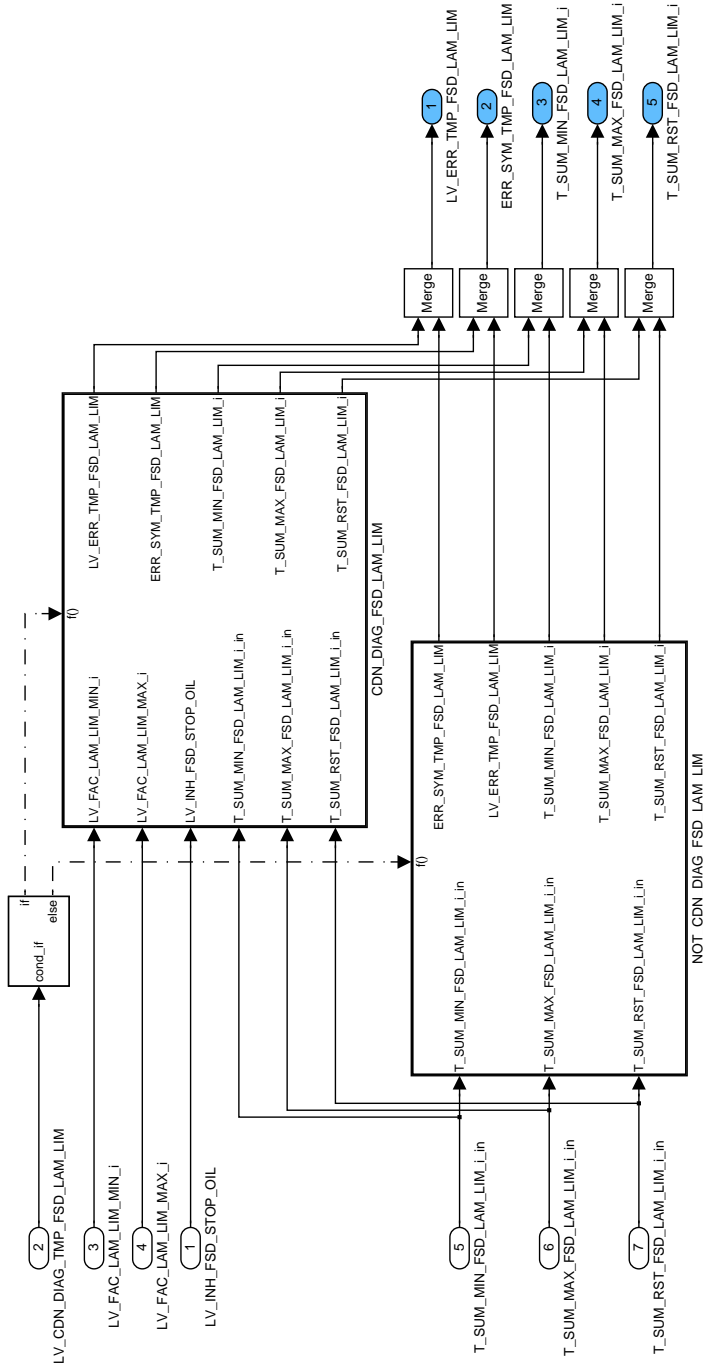



Figure B.105.41: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD\_LAM\_LIM

**Conditions for lambda controller monitoring fulfilled**

Between 3 different cases must be distinguished:

1. Lambda controller is at its minimum threshold (indicated by the flag LV\_FAC\_LAM\_LIM\_MIN[i]) and no inhibition due to oil dilution under cold start conditions.
2. Lambda controller is at its maximum threshold (indicated by the flag LV\_FAC\_LAM\_LIM\_MAX[i]).

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3. No limitation of the lambda controller.

Independent of these cases the antibounce timers used to finally set the error are evaluated afterwards.

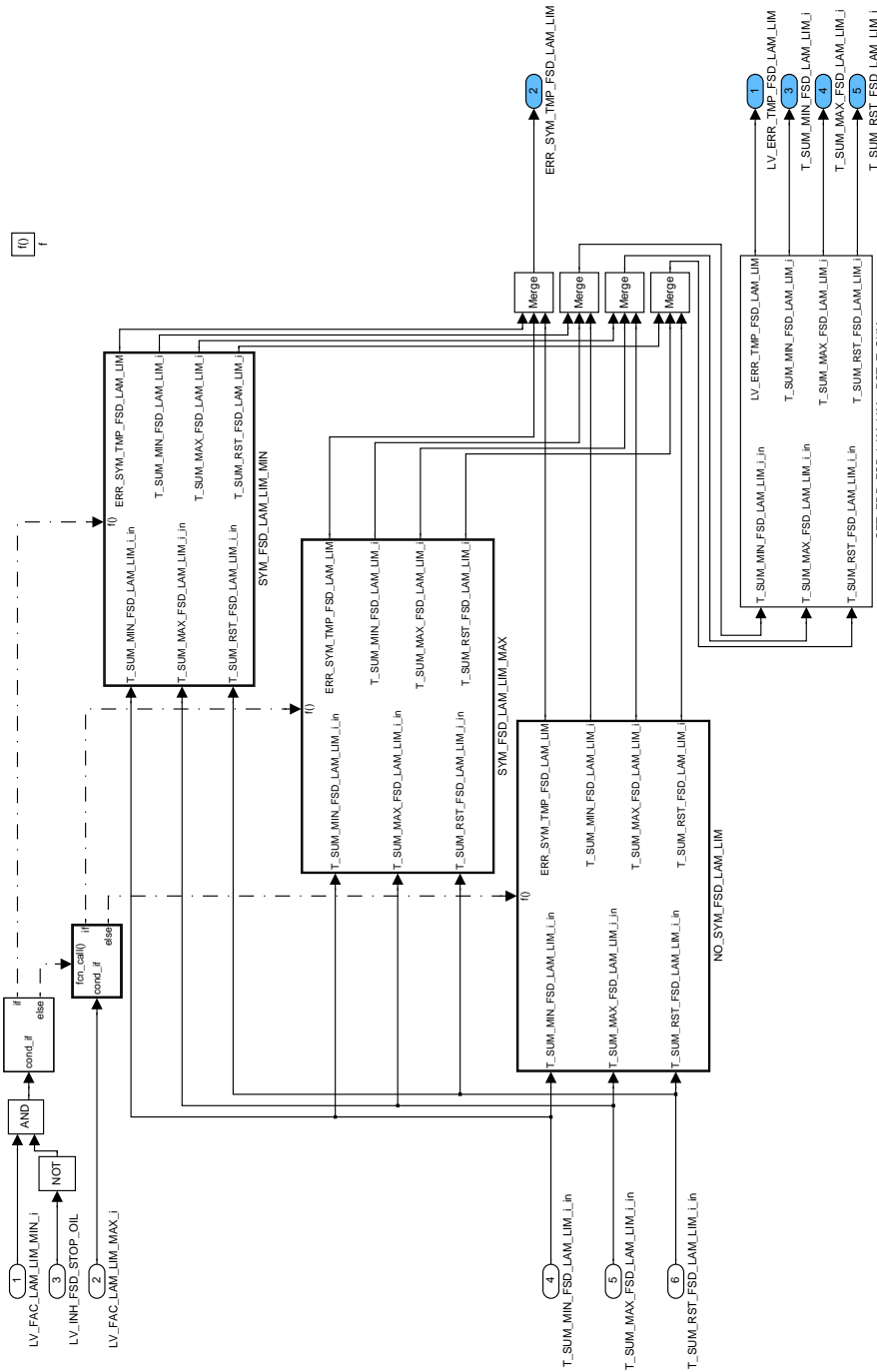



Figure B.105.42: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD\_LAM\_LIM/CDN\_DIAG\_FSD\_LAM\_LIM

**Set error symptom for lambda controller at the minimum**

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The error symptom is set to the respective value (SYM\_1). The timer indicating that the minimum threshold is reached and the reset timer are both increased.

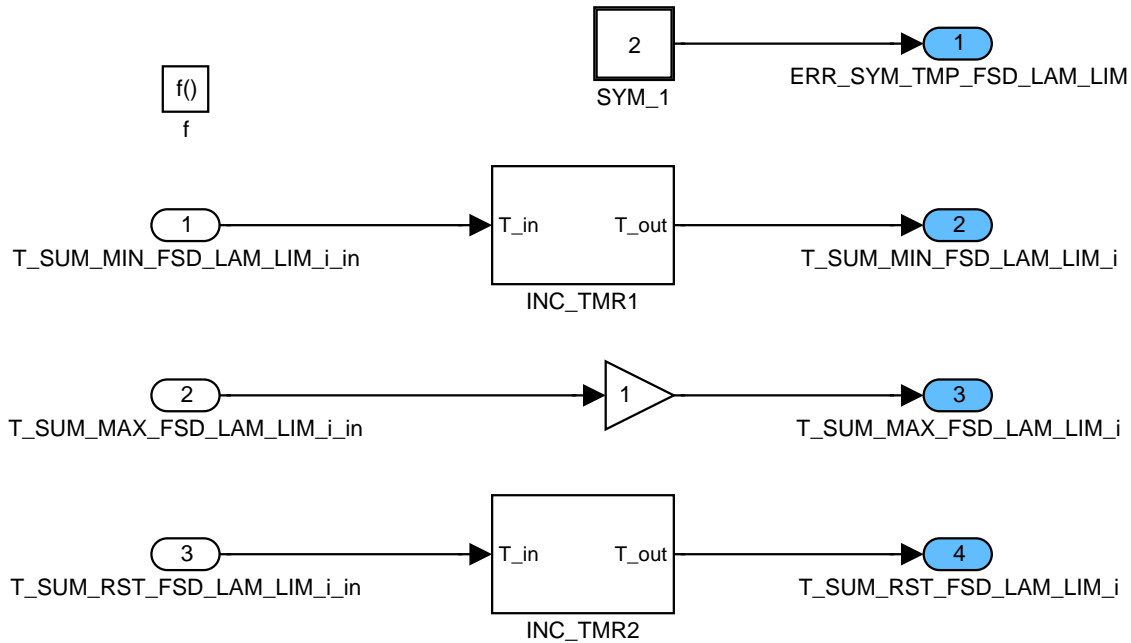


Figure B.105.43: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD\_LAM\_LIM/CDN\_DIAG\_FSD\_LAM\_LIM/SYM\_FSD\_LAM\_LIM\_MIN

**Increment timer**

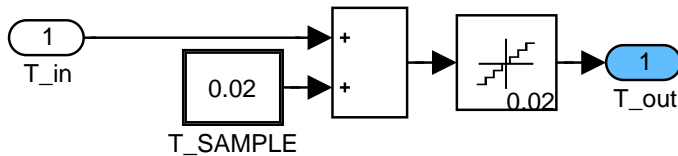


Figure B.105.44:  
LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/  
DET\_ERR\_FSD\_LAM\_LIM/CDN\_DIAG\_FSD\_LAM\_LIM/SYM\_FSD\_LAM\_LIM\_MIN/INC\_TMR1

**Increment timer**

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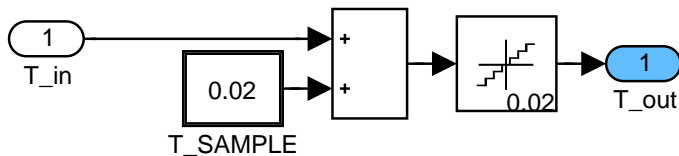


Figure B.105.45: -  
 LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/  
 DET\_ERR\_FSD\_LAM\_LIM/CDN\_DIAG\_FSD\_LAM\_LIM/SYM\_FSD\_LAM\_LIM\_MIN/INC\_TMR2

**Set error symptom for lambda controller at the maximum**

The error symptom is set to the respective value (SYM\_0). The timer indicating that the maximum threshold is reached and the reset timer are both increased.

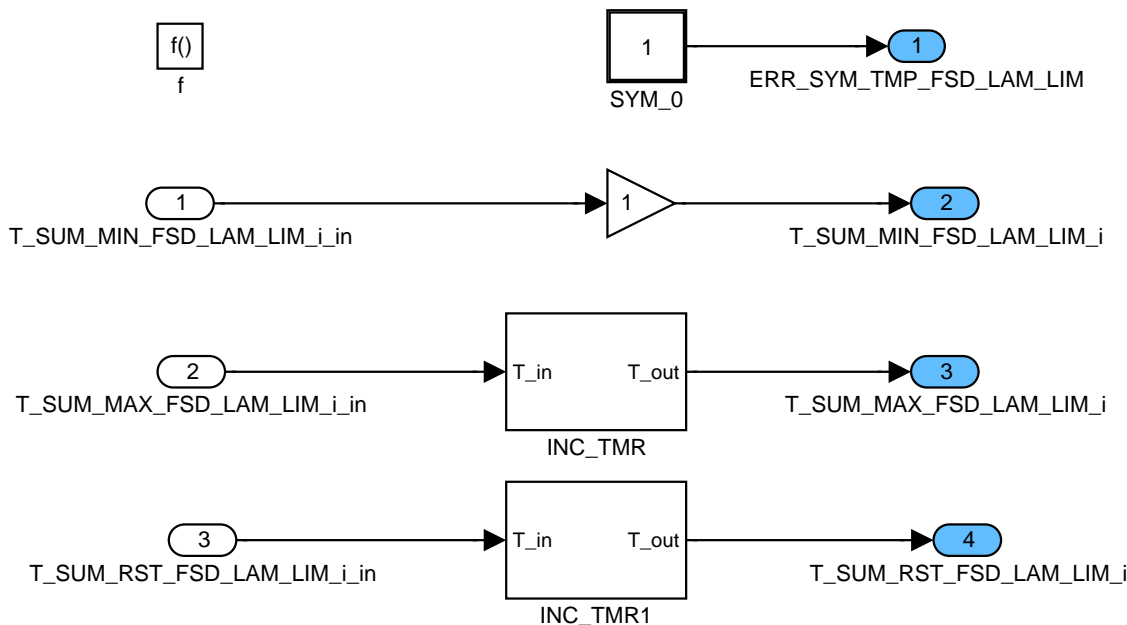


Figure B.105.46: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/  
 DET\_ERR/DET\_ERR\_FSD\_LAM\_LIM/CDN\_DIAG\_FSD\_LAM\_LIM/SYM\_FSD\_LAM\_LIM\_MAX

**Increment timer**

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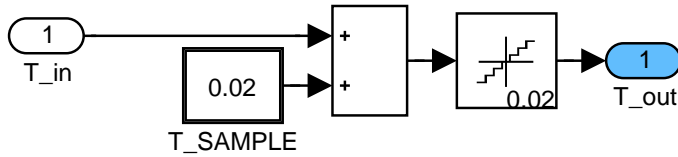


Figure B.105.47:

LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/  
DET\_ERR\_FSD\_LAM\_LIM/CDN\_DIAG\_FSD\_LAM\_LIM/SYM\_FSD\_LAM\_LIM\_MAX/INC\_TMR

**Increment timer**

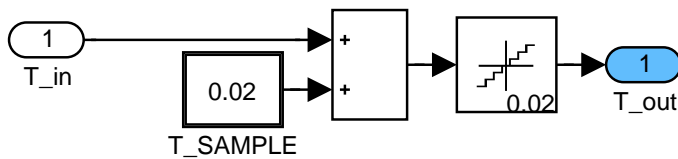


Figure B.105.48:

LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/  
DET\_ERR\_FSD\_LAM\_LIM/CDN\_DIAG\_FSD\_LAM\_LIM/SYM\_FSD\_LAM\_LIM\_MAX/INC\_TMR1

**No error symptom for lambda controller monitoring**

The error symptom is set to NO\_SYM and the reset timer is increased in case it is already different from 0. In that case the error symptom was at least one time different from NO\_SYM.

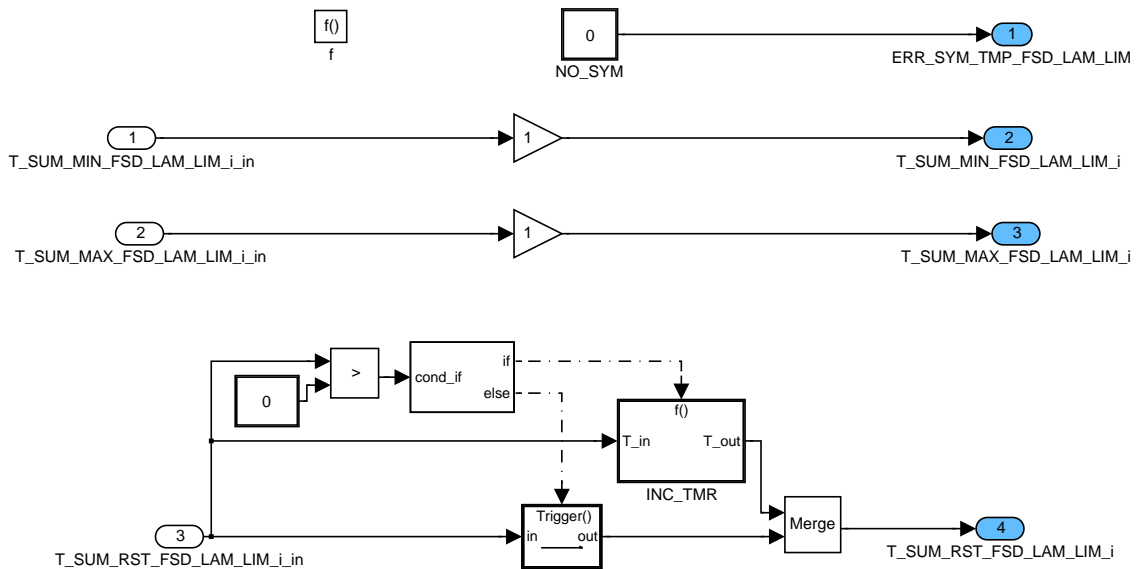


Figure B.105.49: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/  
DET\_ERR/DET\_ERR\_FSD\_LAM\_LIM/CDN\_DIAG\_FSD\_LAM\_LIM/NO\_SYM\_FSD\_LAM\_LIM

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**Increment timer**

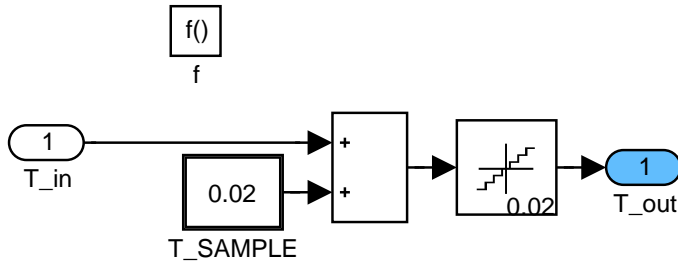


Figure B.105.50:  
LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/  
DET\_ERR\_FSD\_LAM\_LIM/CDN\_DIAG\_FSD\_LAM\_LIM/NO\_SYM\_FSD\_LAM\_LIM/INC\_TMR

**Set error flag for lambda controller monitoring**

The temporary error flag is set if the lambda controller was either too long at its maximum or at its minimum.

When the reset timer reaches the threshold C\_T\_SUM\_RST\_FSD all timers are reset to 0.

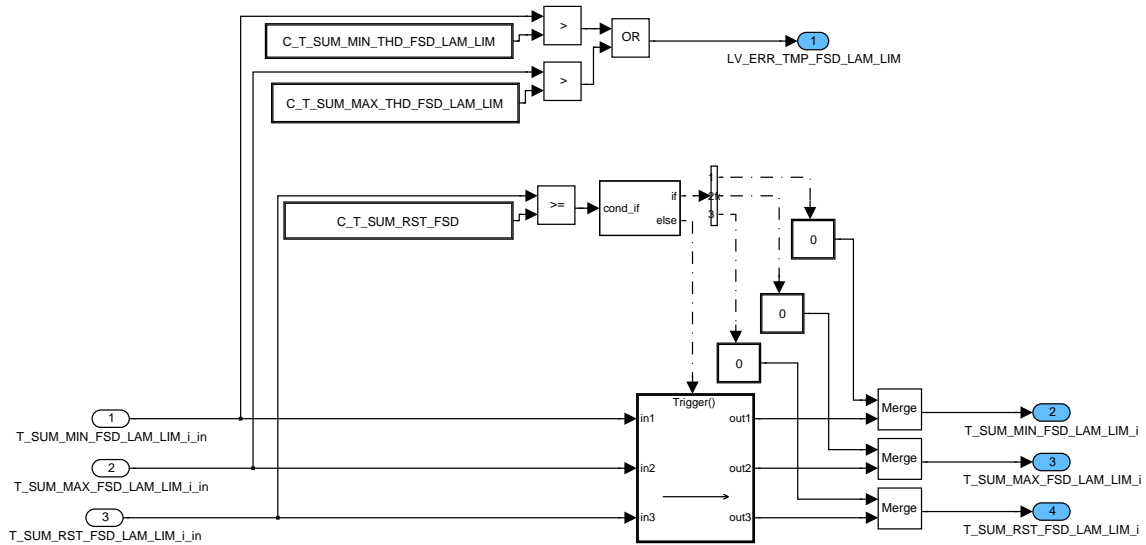


Figure B.105.51:  
LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/  
DET\_ERR\_FSD\_LAM\_LIM/CDN\_DIAG\_FSD\_LAM\_LIM/SET\_ERR\_FSD\_LAM\_LIM\_\_RST\_T\_SUM

**Conditions for lambda controller monitoring not fulfilled**

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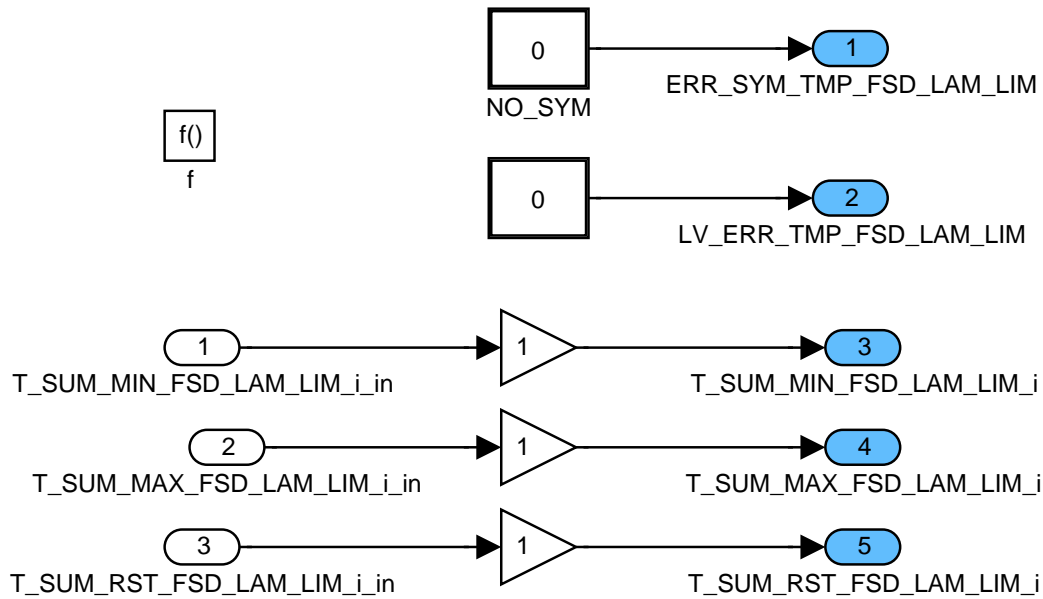


Figure B.105.52: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD\_LAM\_LIM/NOT\_CDN\_DIAG\_FSD\_LAM\_LIM

**Error symptom detection for lambda adaptation high range monitoring**

In case the conditions are not fulfilled all timers remain unchanged and the temporary error flag and symptom have no relevance.

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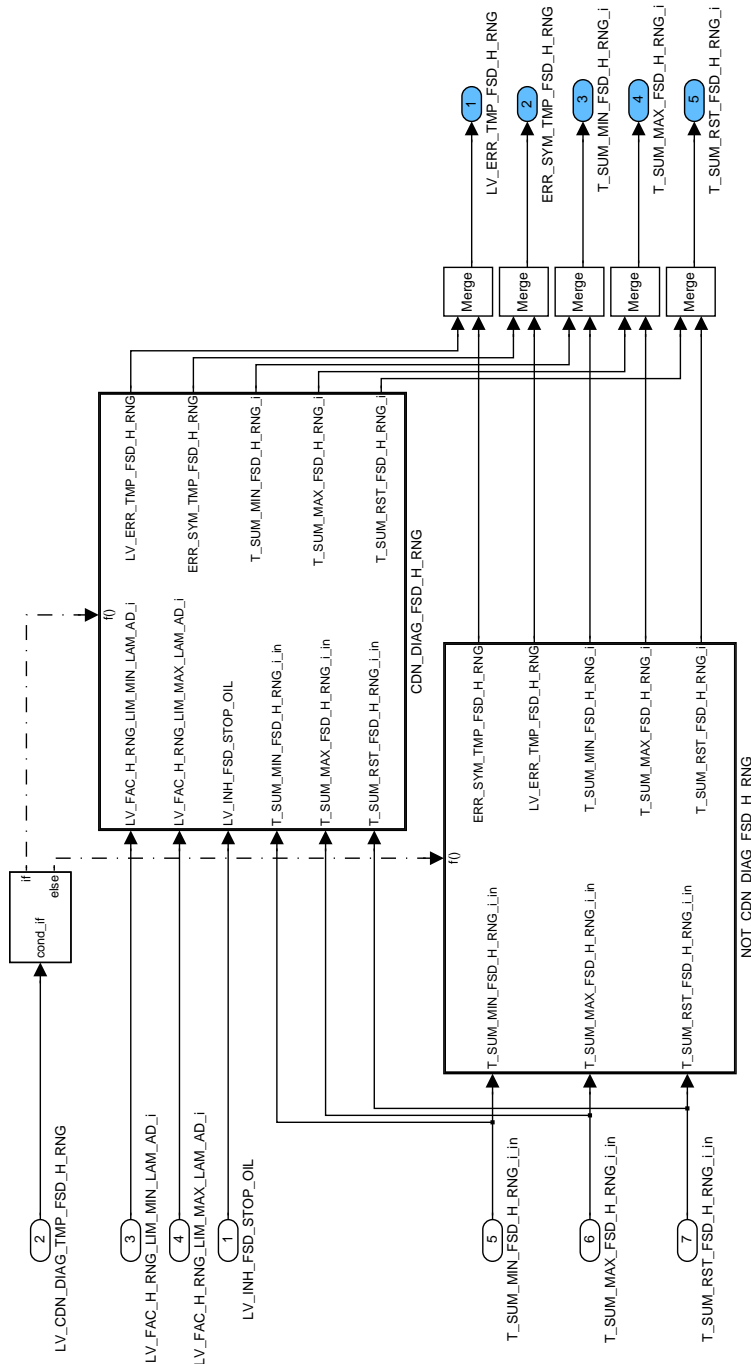



Figure B.105.53: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD\_H\_RNG

**Conditions for lambda adaptation high range monitoring fulfilled**

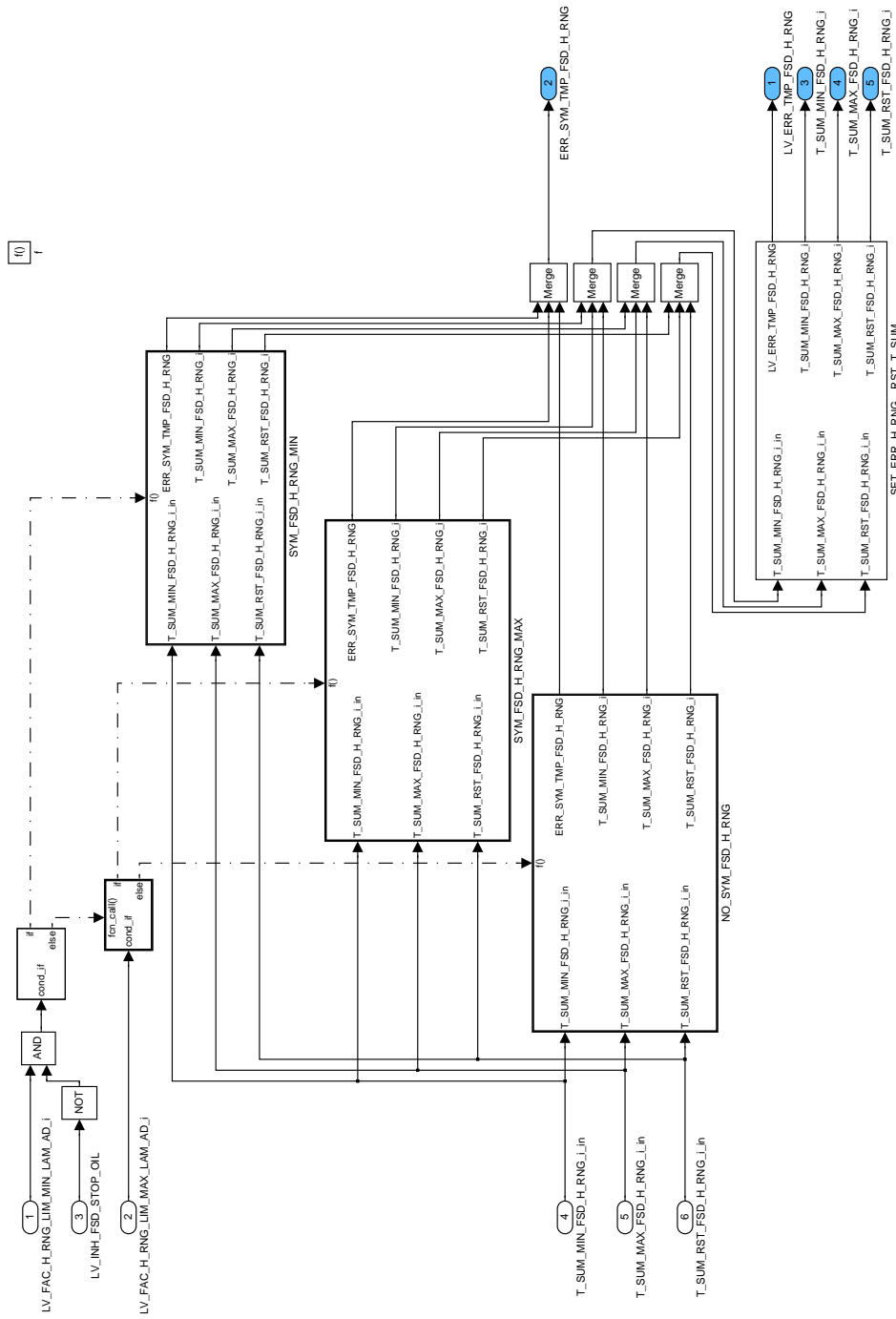
Between 3 different cases must be distinguished:

1. Lambda adaptation factor for higher load is at its minimum threshold (indicated by the flag LV\_FAC\_H\_RNG\_LIM\_MIN\_LAM\_AD[i]) and no inhibition due to oil dilution under cold start conditions.

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2. Lambda adaptation factor for higher load is at its maximum threshold (indicated by the flag LV\_FAC\_H\_RNG\_LIM\_MAX\_LAM\_AD[i]).
  3. No limitation of the lambda adaptation factor for higher load.
- Independent of these cases the antibounce timers used to finally set the error are evaluated afterwards.



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Figure B.105.54: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD\_H\_RNG/CDN\_DIAG\_FSD\_H\_RNG

**Set error symptom for lambda adaptation high range at the minimum**

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The error symptom is set to the respective value (SYM\_1). The timer indicating that the minimum threshold is reached and the reset timer are both increased.

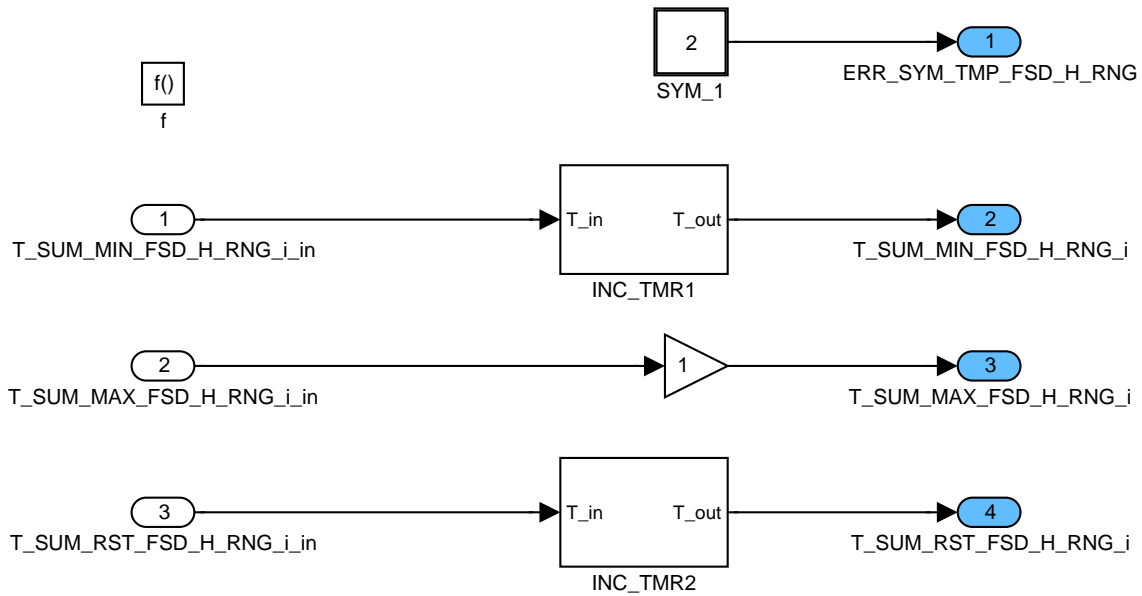


Figure B.105.55: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD\_H\_RNG/CDN\_DIAG\_FSD\_H\_RNG/SYM\_FSD\_H\_RNG\_MIN

**Increment timer**

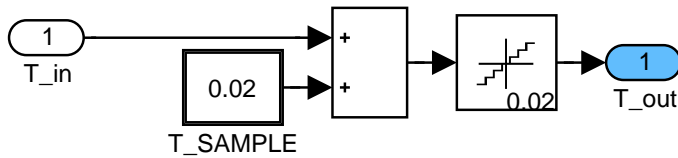


Figure B.105.56: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD\_H\_RNG/CDN\_DIAG\_FSD\_H\_RNG/SYM\_FSD\_H\_RNG\_MIN/INC\_TMR1

**Increment timer**

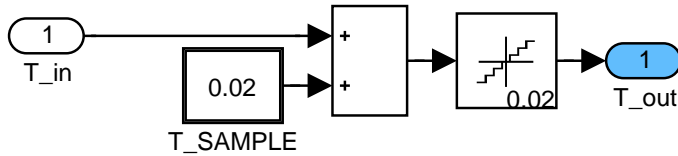


Figure B.105.57: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD\_H\_RNG/CDN\_DIAG\_FSD\_H\_RNG/SYM\_FSD\_H\_RNG\_MIN/INC\_TMR2

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### Set error symptom for lambda adaptation high range at the maximum

The error symptom is set to the respective value (SYM\_0). The timer indicating that the maximum threshold is reached and the reset timer are both increased.

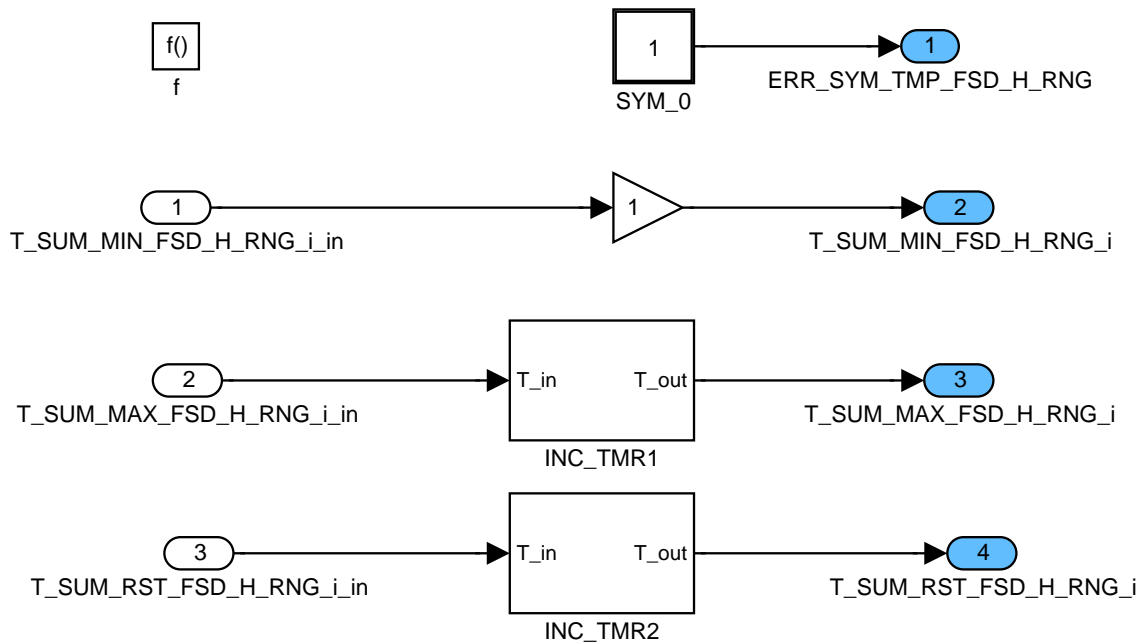


Figure B.105.58: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD\_H\_RNG/CDN\_DIAG\_FSD\_H\_RNG/SYM\_FSD\_H\_RNG\_MAX

### Increment timer

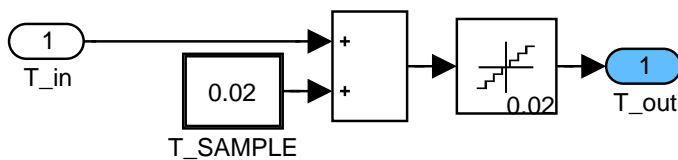


Figure B.105.59: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD\_H\_RNG/CDN\_DIAG\_FSD\_H\_RNG/SYM\_FSD\_H\_RNG\_MAX/INC\_TMR1

### Increment timer

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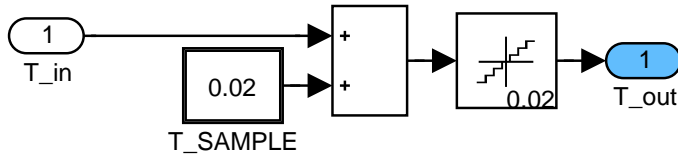


Figure B.105.60: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD\_H\_RNG/CDN\_DIAG\_FSD\_H\_RNG/SYM\_FSD\_H\_RNG\_MAX/INC\_TMR2

**No error symptom for lambda adaptation high range**

The error symptom is set to NO\_SYM and the reset timer is increased in case it is already different from 0. In that case the error symptom was at least one time different from NO\_SYM.

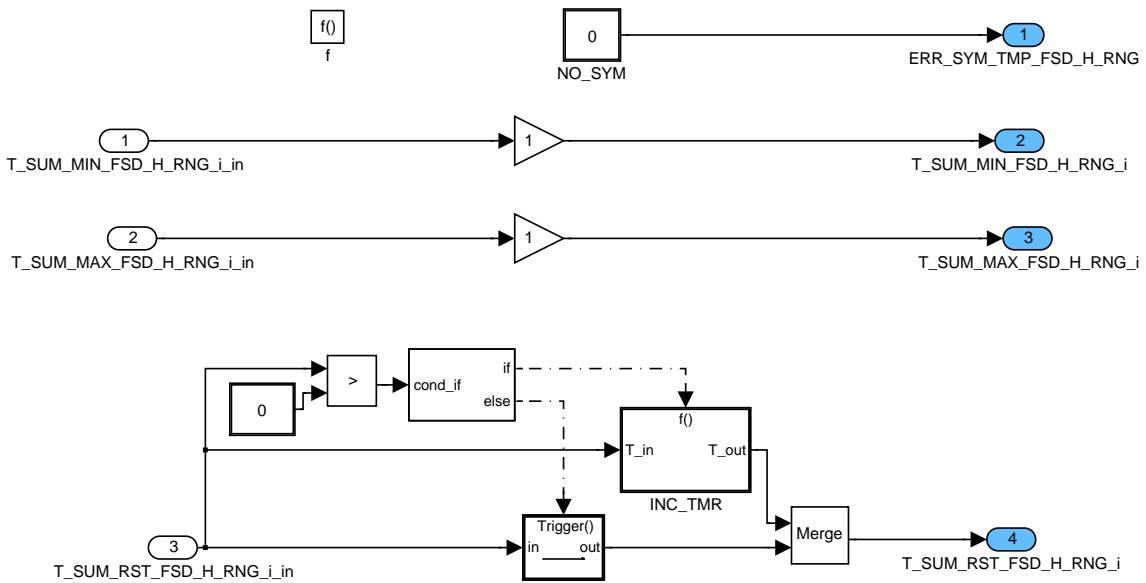


Figure B.105.61: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD\_H\_RNG/CDN\_DIAG\_FSD\_H\_RNG/NO\_SYM\_FSD\_H\_RNG

**Increment timer**

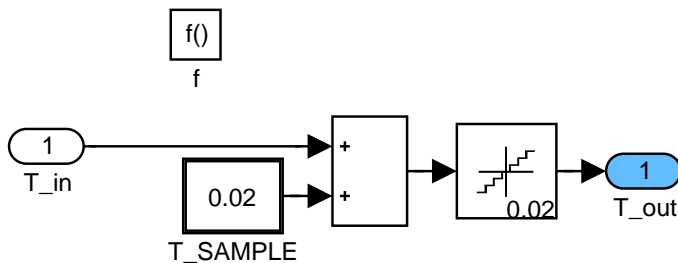


Figure B.105.62: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD\_H\_RNG/CDN\_DIAG\_FSD\_H\_RNG/NO\_SYM\_FSD\_H\_RNG/INC\_TMR

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### Set error flag for lambda adaptation high range monitoring

The temporary error flag is set if the lambda adaptation factor was either too long at its maximum or at its minimum.

When the reset timer reaches the threshold C\_T\_SUM\_RST\_FSD all timers are reset to 0.

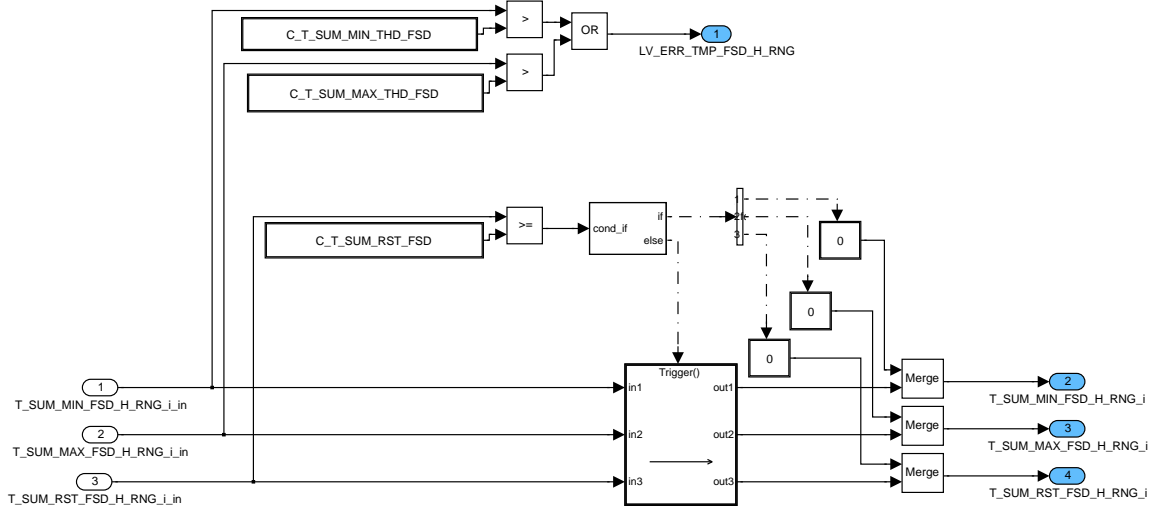


Figure B.105.63: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD\_H\_RNG/CDN\_DIAG\_FSD\_H\_RNG/SET\_ERR\_H\_RNG\_RST\_T\_SUM

### Conditions for lambda adaptation high range monitoring not fulfilled

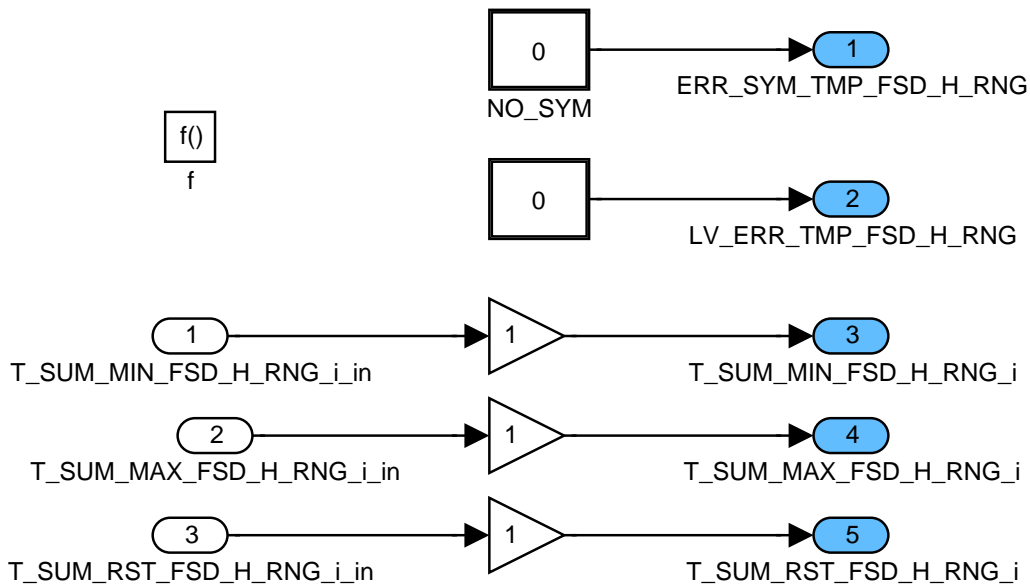


Figure B.105.64: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/DET\_ERR/DET\_ERR\_FSD\_H\_RNG/NOT\_CDN\_DIAG\_FSD\_H\_RNG

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### Management of end of diagnosis flags

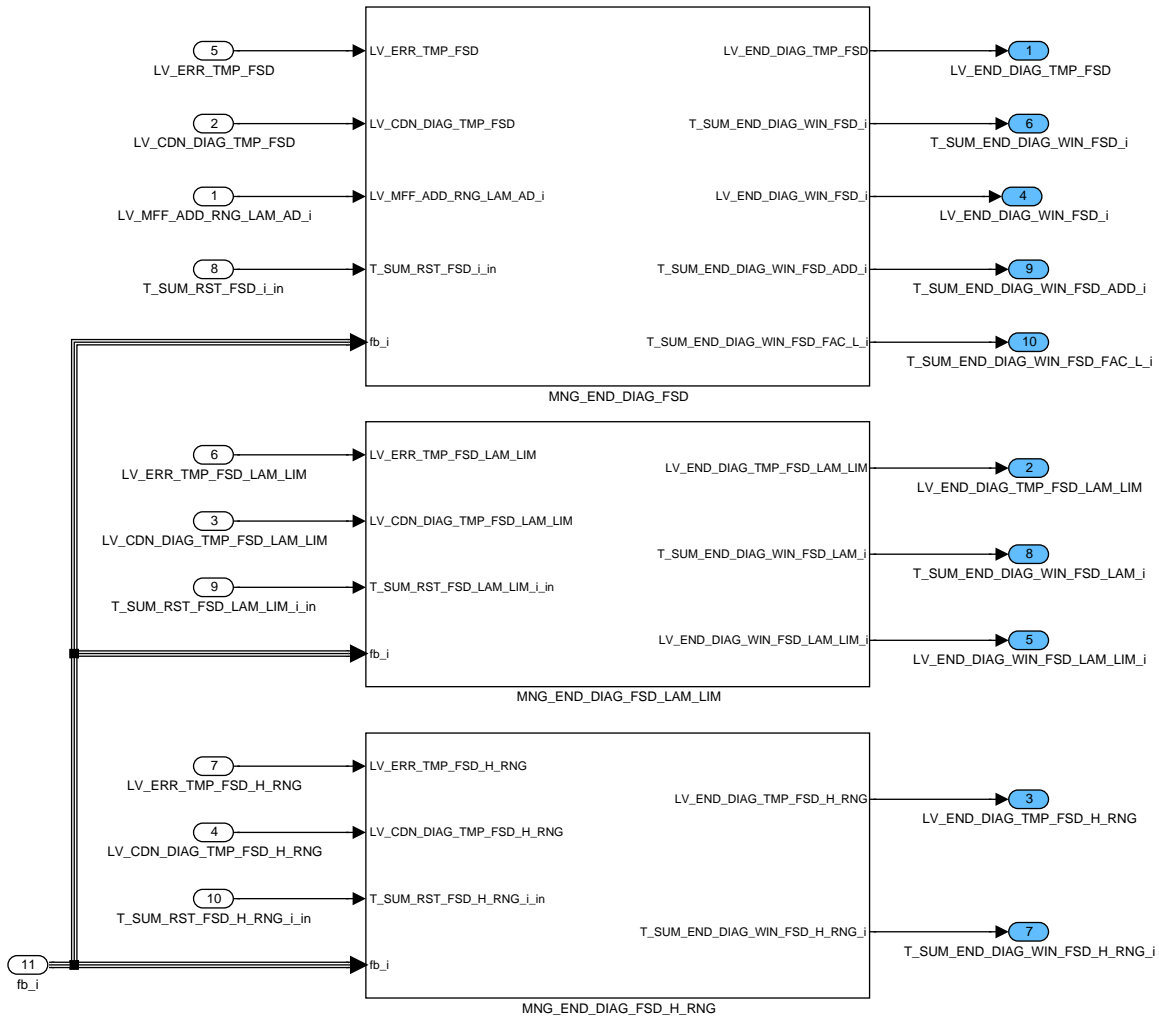


Figure B.105.65:  
LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/MNG\_END\_DIAG

### Manage end flags for lambda adaptation monitoring

First the end flag timers are calculated and then the conditions to set the end flags are evaluated.

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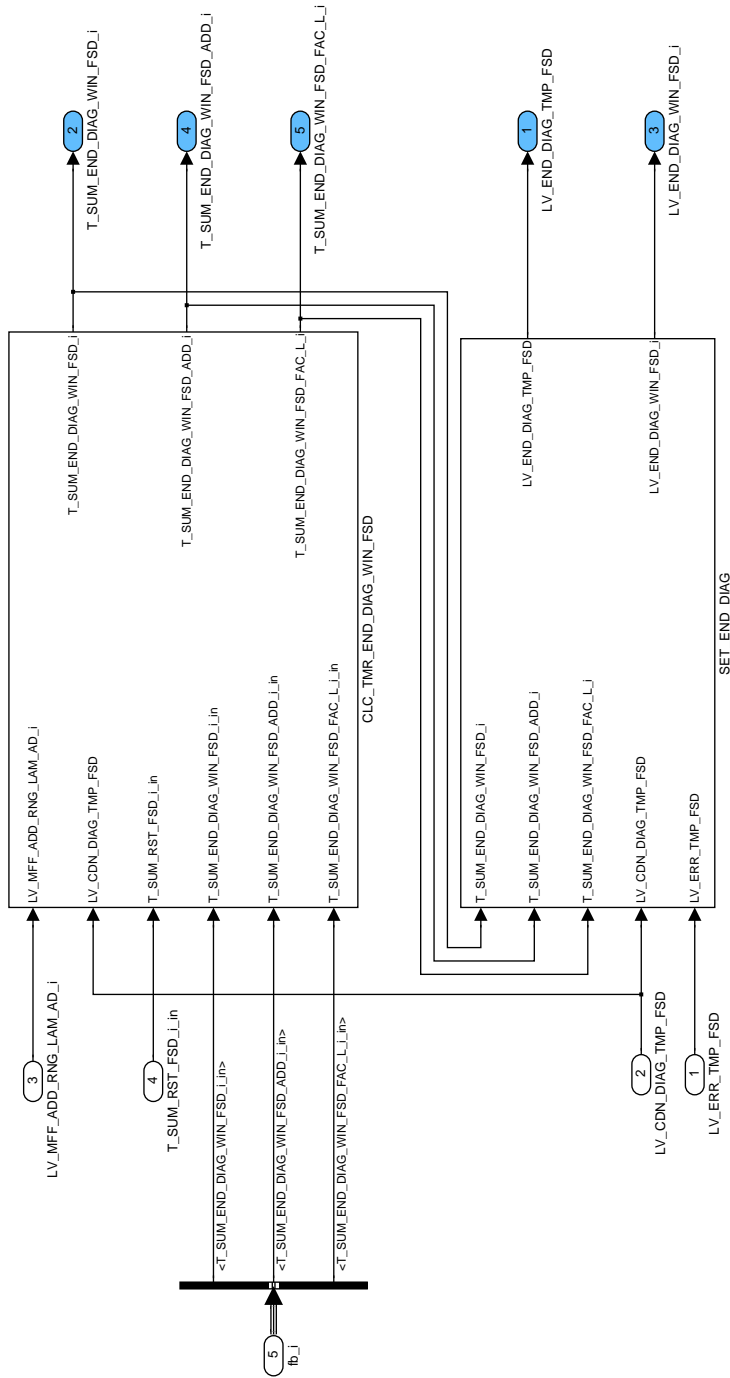



Figure B.105.66: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/MNG\_END\_DIAG/MNG\_END\_DIAG\_FSD

**Calculate end of diagnosis timers for lambda adaptation monitoring**

If the conditions are not fulfilled all timers T\_SUM\_END\_DIAG\_WIN\_FSD[j], T\_SUM\_END\_DIAG\_WIN\_FSD\_ADD[j] and T\_SUM\_END\_DIAG\_WIN\_FSD\_FAC\_L[j] remain unchanged.

The end timers are reset (to one sample step) either if the calibration threshold is reached by T\_SUM\_END\_DIAG\_WIN\_FSD[j] and both timers T\_SUM\_END\_DIAG\_WIN\_FSD\_ADD[j] and T\_SUM\_

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END\_DIAG\_WIN\_FAC\_L[i] were above the threshold defined by C\_T\_SUM\_RST\_FSD and C\_CRCLC\_T\_SUM\_WIN\_FSD\_RST or when the reset timer was started to be incremented.  
 In all other cases the timers are incremented as described in the corresponding subsystem.

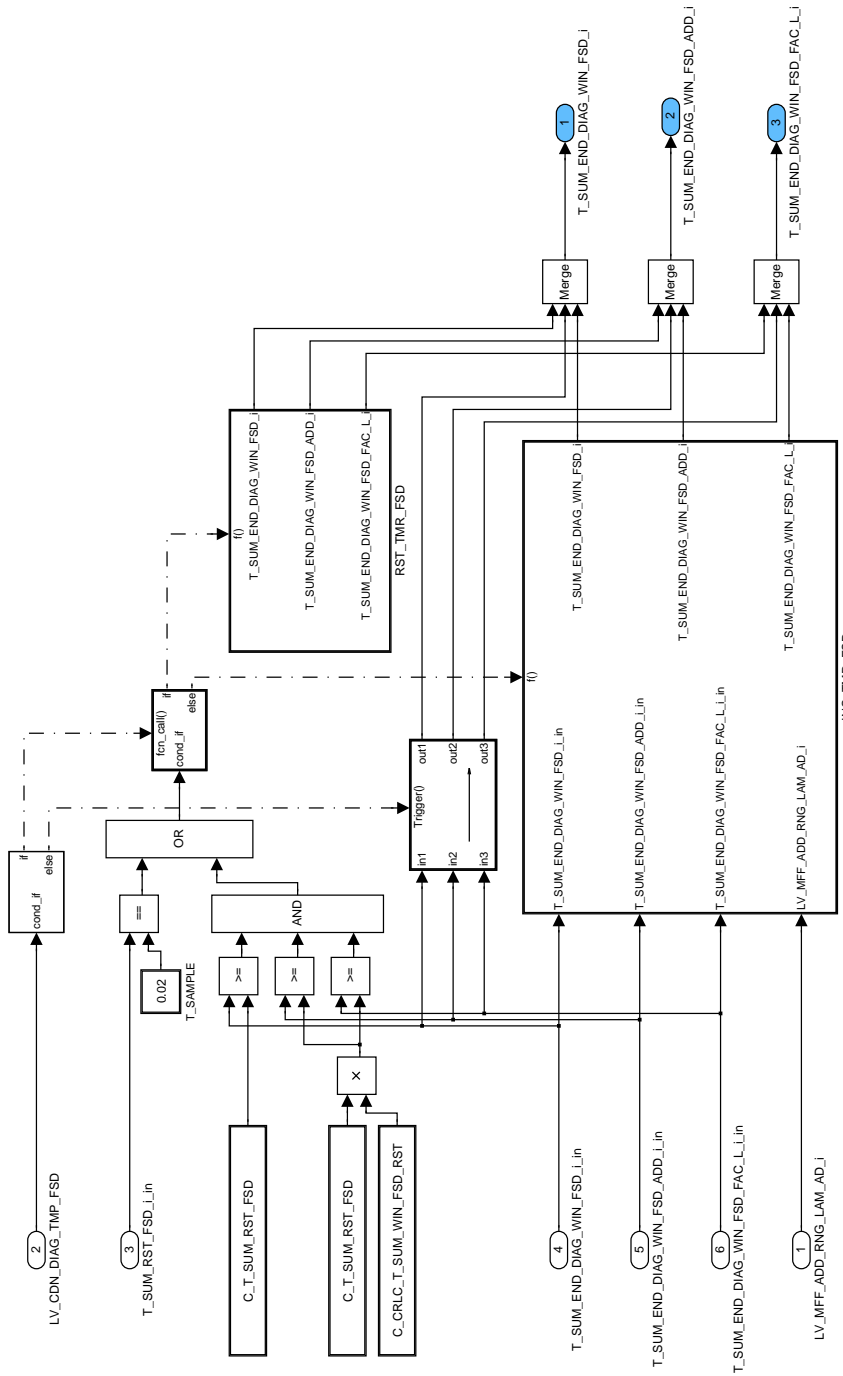



Figure B.105.67: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/MNG\_END\_DIAG/MNG\_END\_DIAG\_FSD/CLC\_TMR\_END\_DIAG\_WIN\_FSD

**Reset end of diagnosis timers for lambda adaptation monitoring**

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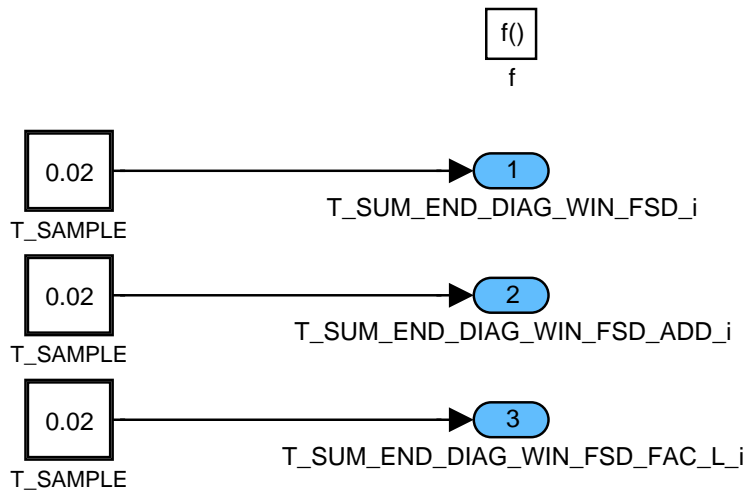


Figure B.105.68: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/MNG\_END\_DIAG/MNG\_END\_DIAG\_FSD/CLC\_TMR\_END\_DIAG\_WIN\_FSD/RST\_TMR\_FSD

### Increment end of diagnosis timers for lambda adaptation monitoring

$T\_SUM\_END\_DIAG\_WIN\_FSD[i]$  is incremented without restrictions.

$T\_SUM\_END\_DIAG\_WIN\_FSD\_ADD[i]$  is incremented when the lambda adaptation is in the offset learning field.

$T\_SUM\_END\_DIAG\_WIN\_FSD\_FAC\_L[i]$  is incremented when the lambda adaptation is in the lower load factor learning field.

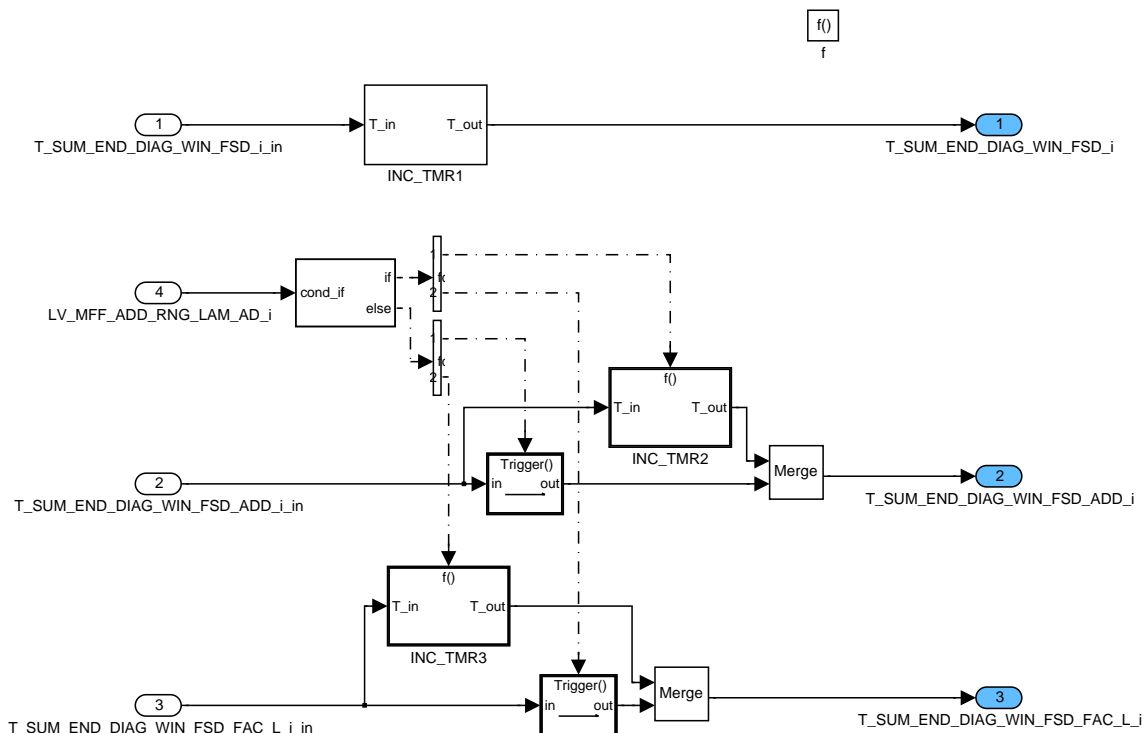


Figure B.105.69: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/MNG\_END\_DIAG/MNG\_END\_DIAG\_FSD/CLC\_TMR\_END\_DIAG\_WIN\_FSD/INC\_TMR\_FSD

**Increment timer**

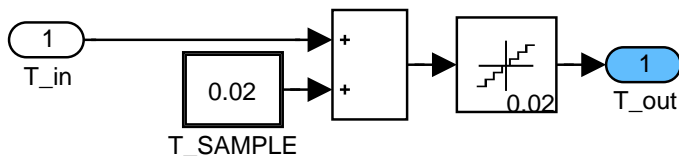


Figure B.105.70: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/MNG\_END\_DIAG/MNG\_END\_DIAG\_FSD/CLC\_TMR\_END\_DIAG\_WIN\_FSD/INC\_TMR\_FSD/INC\_TMR1

**Increment timer**

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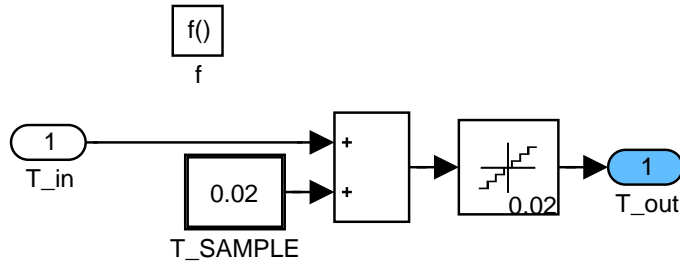


Figure B.105.71:  
LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/MNG\_END\_DIAG/  
MNG\_END\_DIAG\_FSD/CLC\_TMR\_END\_DIAG\_WIN\_FSD/INC\_TMR\_FSD/INC\_TMR2

### Increment timer

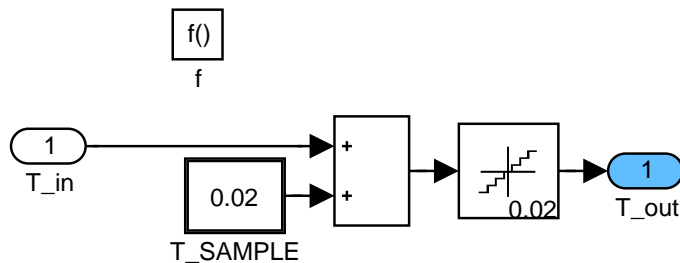


Figure B.105.72:  
LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/MNG\_END\_DIAG/  
MNG\_END\_DIAG\_FSD/CLC\_TMR\_END\_DIAG\_WIN\_FSD/INC\_TMR\_FSD/INC\_TMR3

### Set end of diagnosis for lambda adaptation monitoring

The condition to set the temporary end flag  $LV\_END\_DIAG\_TMP\_FSD$  are: Diagnostic condition must be fulfilled and either an error was detected (temporary end flag  $LV\_ERR\_TMP\_FSD$  is 1) or the timer  $T\_SUM\_END\_DIAG\_WIN\_FSD[i]$  has reached the calibration threshold.

If  $LV\_END\_DIAG\_TMP\_FSD$  is set once, the corresponding error flag of the error management remain set for the rest of the driving cycle.

In order to set the end flag for similar conditions  $LV\_END\_DIAG\_WIN\_FSD[i]$  the diagnostic conditions must be fulfilled too and either the temporary error flag was set or the timer  $T\_SUM\_END\_DIAG\_WIN\_FSD[i]$  has reached the calibration threshold and both timers  $T\_SUM\_END\_DIAG\_WIN\_FSD\_ADD[i]$  and  $T\_SUM\_END\_DIAG\_WIN\_FAC\_L[i]$  were above the threshold defined by  $C\_T\_SUM\_RST\_FSD$  and  $C\_CRLC\_T\_SUM\_WIN\_FSD\_RST$ .

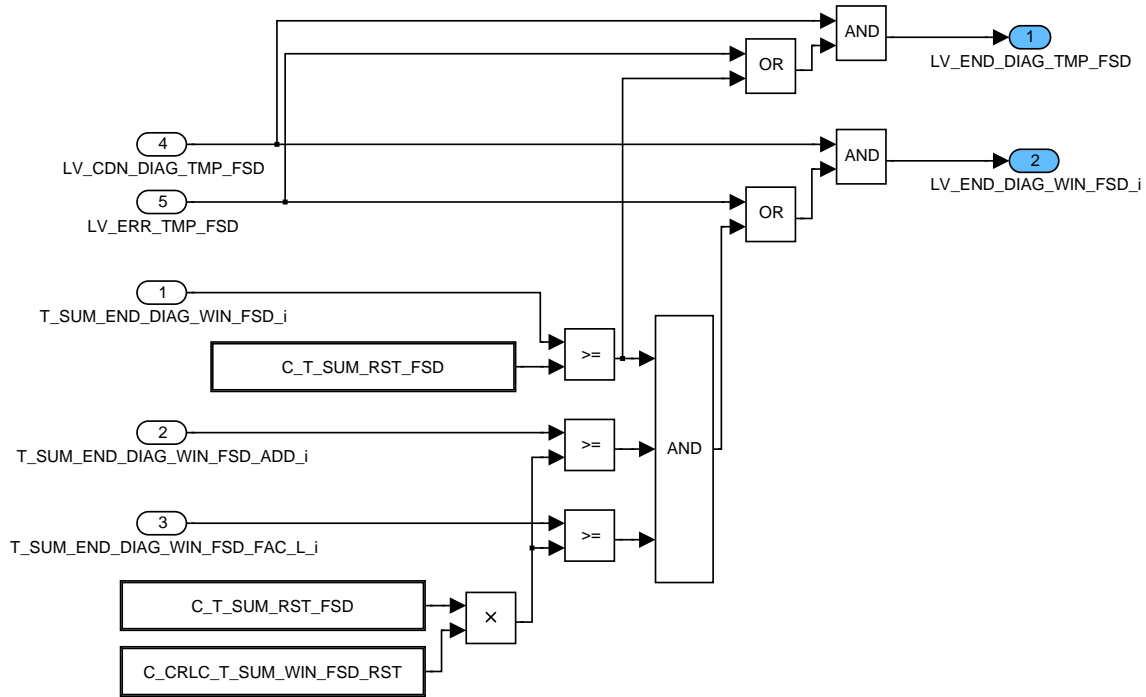


Figure B.105.73: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/MNG\_END\_DIAG/MNG\_END\_DIAG\_FSD/SET\_END\_DIAG

**Manage end flags for lambda controller monitoring**

First the end flag timers are calculated and then the conditions to set the end flags are evaluated.

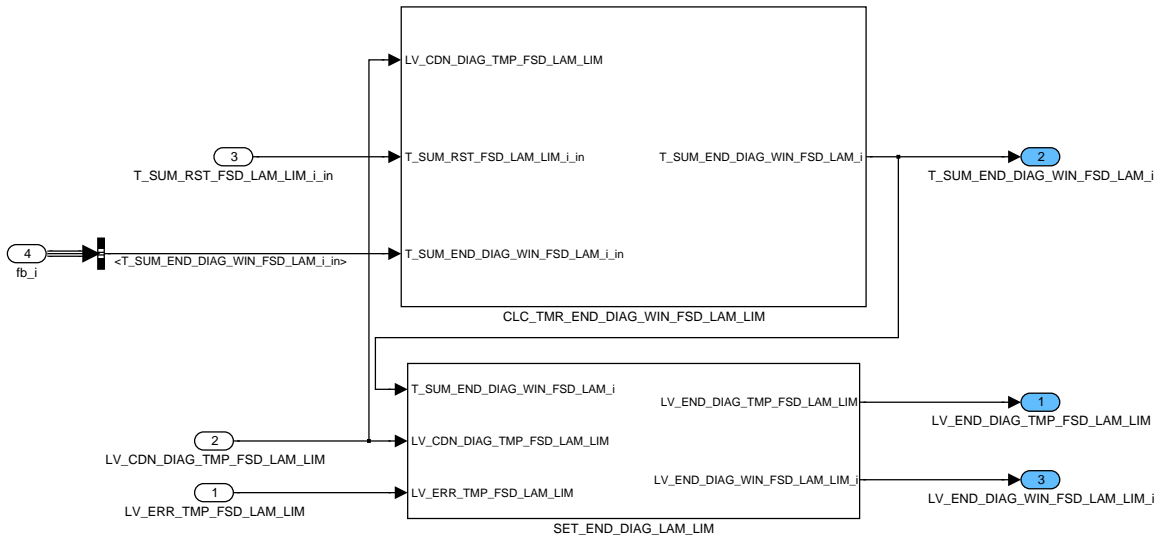


Figure B.105.74: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/MNG\_END\_DIAG/MNG\_END\_DIAG\_FSD\_LAM\_LIM

**Calculate end of diagnosis timers for lambda controller monitoring**

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If the conditions are not fulfilled the timer  $T\_SUM\_END\_DIAG\_WIN\_FSD\_LAM\_LIM[i]$  remains unchanged.

The end timer is reset (to one sample step) either if the calibration threshold is reached or when the reset timer was started to be incremented.

In all other cases the timer is incremented.

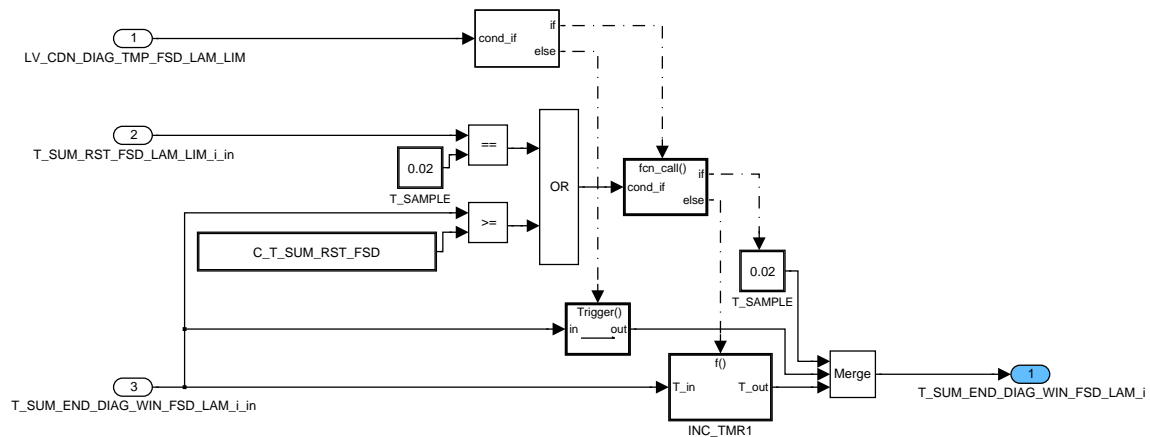


Figure B.105.75: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/MNG\_END\_DIAG/MNG\_END\_DIAG\_FSD\_LAM\_LIM/CLC\_TMR\_END\_DIAG\_WIN\_FSD\_LAM\_LIM

### Increment timer

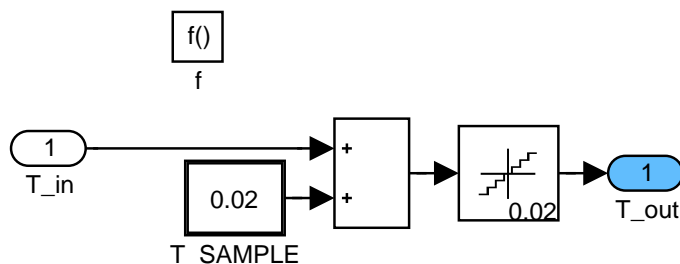


Figure B.105.76:  
LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/MNG\_END\_DIAG/  
MNG\_END\_DIAG\_FSD\_LAM\_LIM/CLC\_TMR\_END\_DIAG\_WIN\_FSD\_LAM\_LIM/INC\_TMR1

### Set end of diagnosis for lambda controller monitoring

The temporary end flag  $LV\_END\_DIAG\_TMP\_FSD\_LAM\_LIM$  and the end flag for similar conditions  $LV\_END\_DIAG\_WIN\_FSD\_LAM\_LIM[i]$  are set when the same conditions are fulfilled. If  $LV\_END\_DIAG\_TMP\_FSD\_LAM\_LIM$  is set once, the corresponding error flag of the error management remain set for the rest of the driving cycle.  $LV\_END\_DIAG\_WIN\_FSD\_LAM\_LIM[i]$  is only set for one recurrence.

The condition to set the end flags are: Diagnostic condition must be fulfilled and either an error was detected (temporary end flag  $LV\_ERR\_TMP\_FSD\_LAM\_LIM$  is 1) or the timer  $T\_SUM\_END\_DIAG\_WIN\_FSD\_LAM\_LIM[i]$  has reached the calibration threshold.

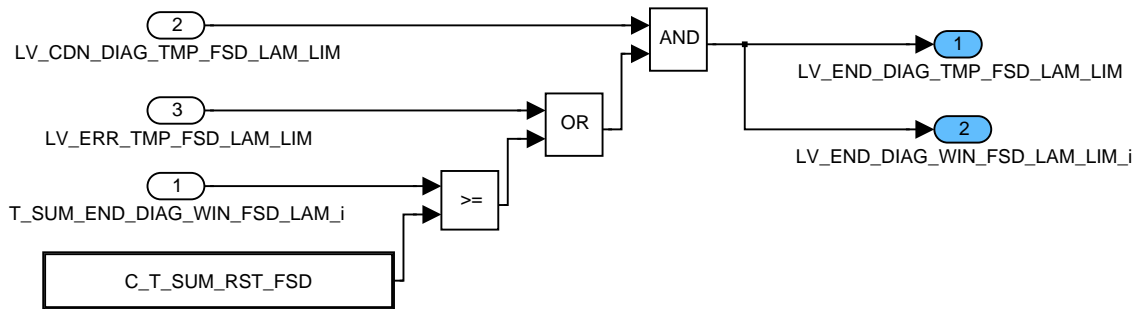


Figure B.105.77: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/MNG\_END\_DIAG/MNG\_END\_DIAG\_FSD\_LAM\_LIM/SET\_END\_DIAG\_LAM\_LIM

**Manage end flags for lambda adaptation high range monitoring**

First the end flag timers are calculated and then the conditions to set the end flags are evaluated.

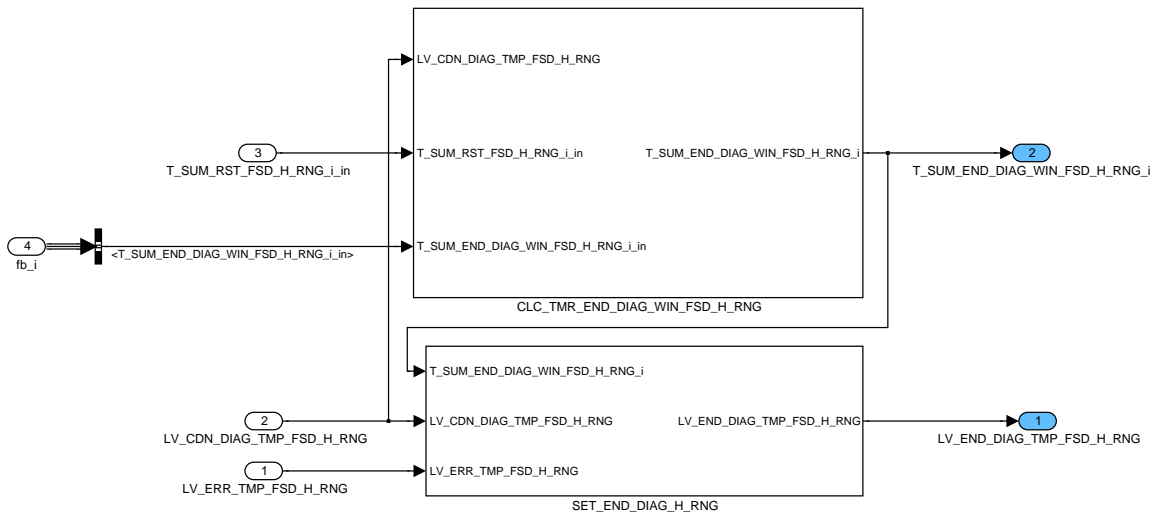


Figure B.105.78: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/MNG\_END\_DIAG/MNG\_END\_DIAG\_FSD\_H\_RNG

**Calculate end of diagnosis timers for lambda adaptation high range monitoring**

If the conditions are not fulfilled the timer T\_SUM\_END\_DIAG\_WIN\_FSD\_H\_RNG[i] remains unchanged. The end timer is reset (to one sample step) either if the calibration threshold is reached or when the reset timer was started to be incremented. In all other cases the timer is incremented.

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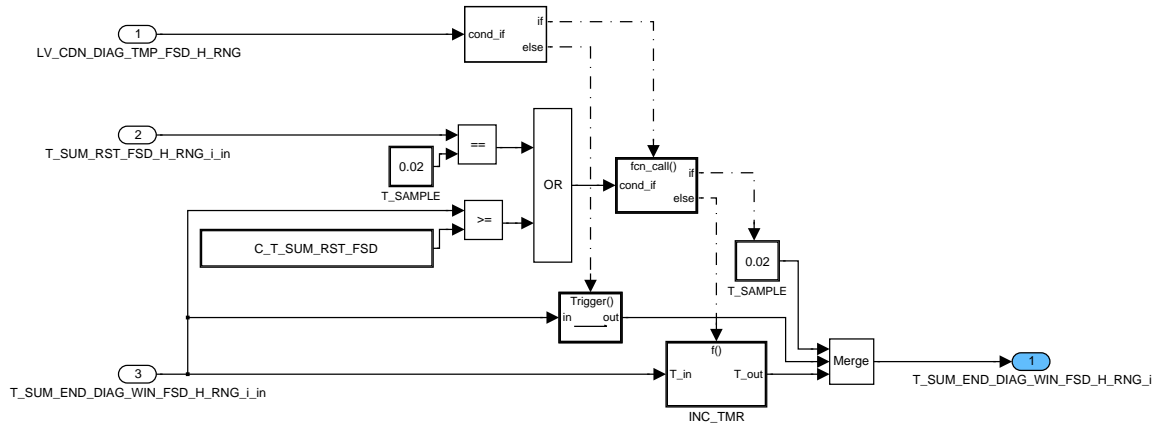


Figure B.105.79: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/MNG\_END\_DIAG/MNG\_END\_DIAG\_FSD\_H\_RNG/CLC\_TMR\_END\_DIAG\_WIN\_FSD\_H\_RNG

**Increment timer**

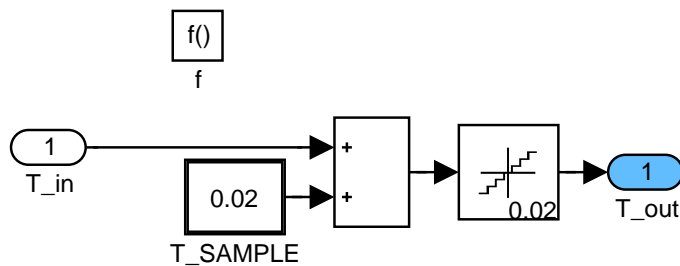



Figure B.105.80: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/MNG\_END\_DIAG/MNG\_END\_DIAG\_FSD\_H\_RNG/CLC\_TMR\_END\_DIAG\_WIN\_FSD\_H\_RNG/INC\_TMR

**Set end of diagnosis for lambda adaptation high range monitoring**

The condition to set the temporary end flag LV\_END\_DIAG\_TMP\_FSD\_H\_RNG are: Diagnostic condition must be fulfilled and either an error was detected (temporary end flag LV\_ERR\_TMP\_FSD\_H\_RNG is 1) or the timer T\_SUM\_END\_DIAG\_WIN\_FSD\_H\_RNG[i] has reached the calibration threshold. If LV\_END\_DIAG\_TMP\_FSD\_LAM\_LIM is set once, the corresponding error flag of the error management remain set for the rest of the driving cycle.

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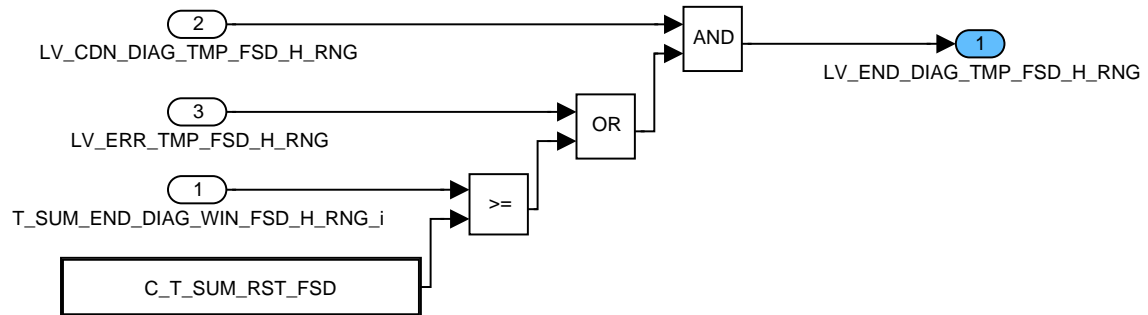


Figure B.105.81: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/DIAG/MNG\_END\_DIAG/MNG\_END\_DIAG\_FSD\_H\_RNG/SET\_END\_DIAG\_H\_RNG

### Interface to error management

For each failure location a separate ACTION is called. By means of the temporary condition and error flags and the temporary error symptom all relevant information is transmitted to the error management. The output of each ACTION is the error information for each failure location.

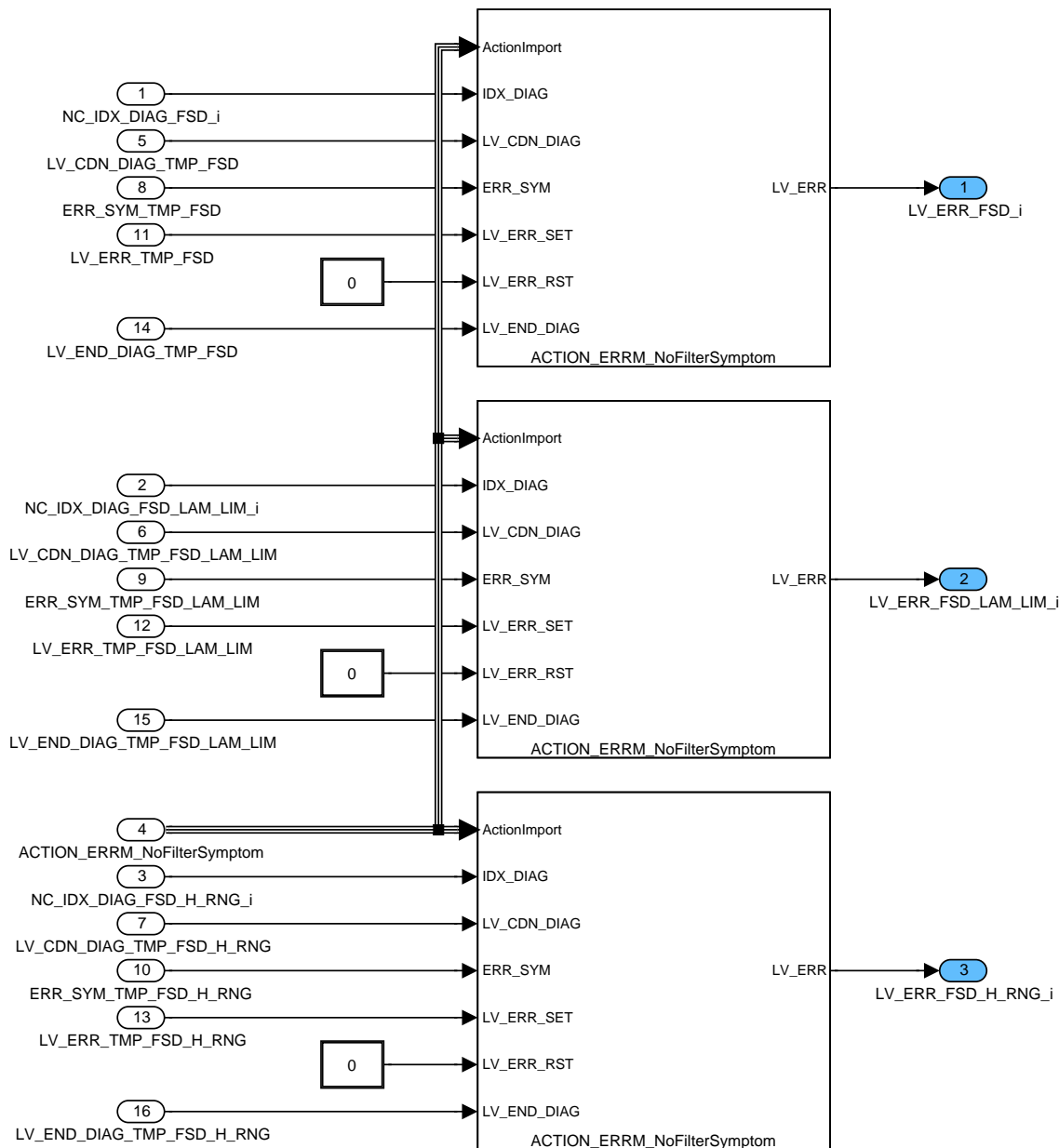
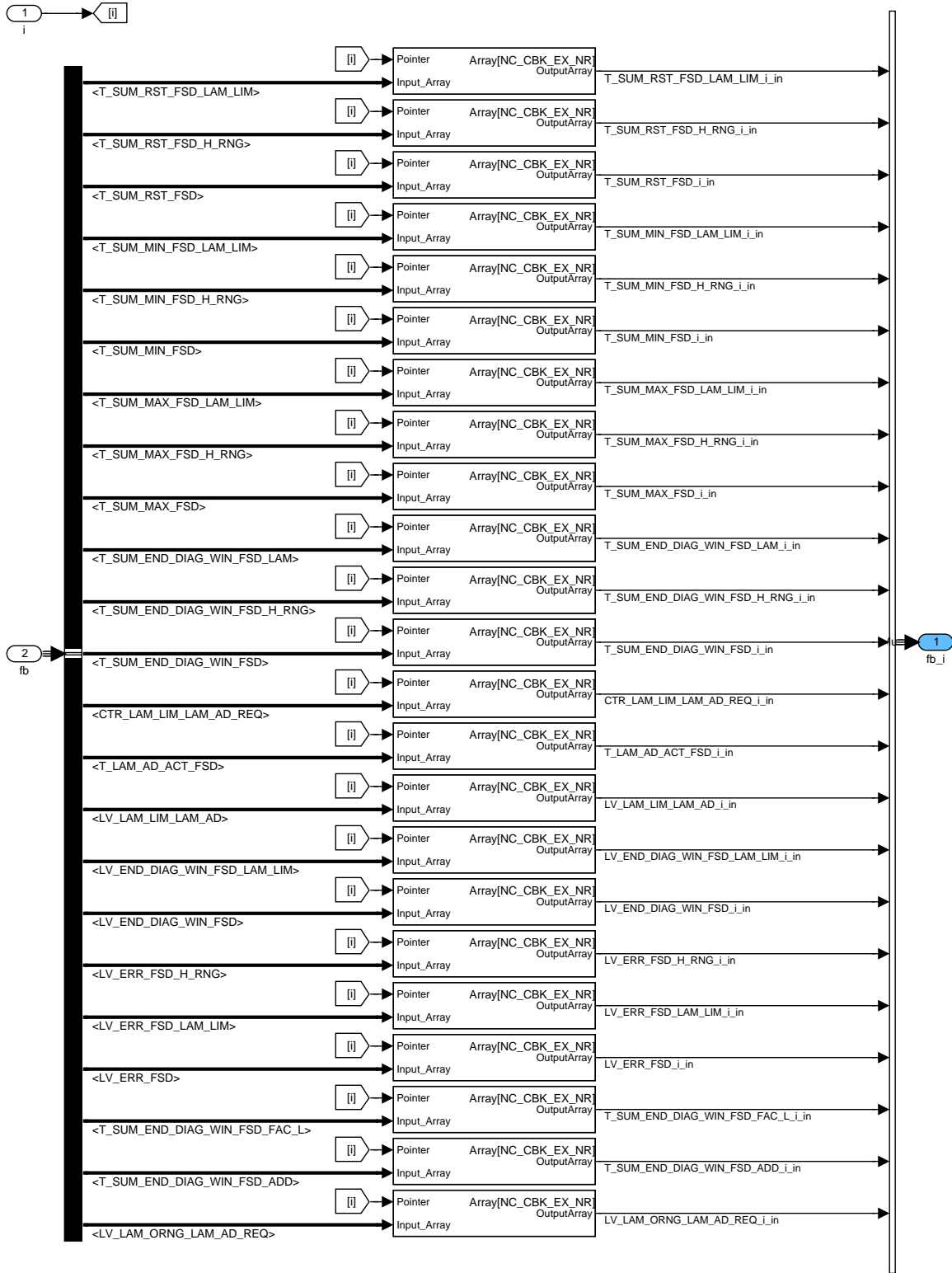


Figure B.105.82: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/CBK\_EX\_SPC/ERRM\_IF

**Read bank specific output values of last recurrence**

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Figure B.105.83: LACO\_FCTDGFSD0/operate\_20MS/CBK\_EX\_MNG/SIG\_CBK\_MNG

### B.105.3 Visualization of ERRM data

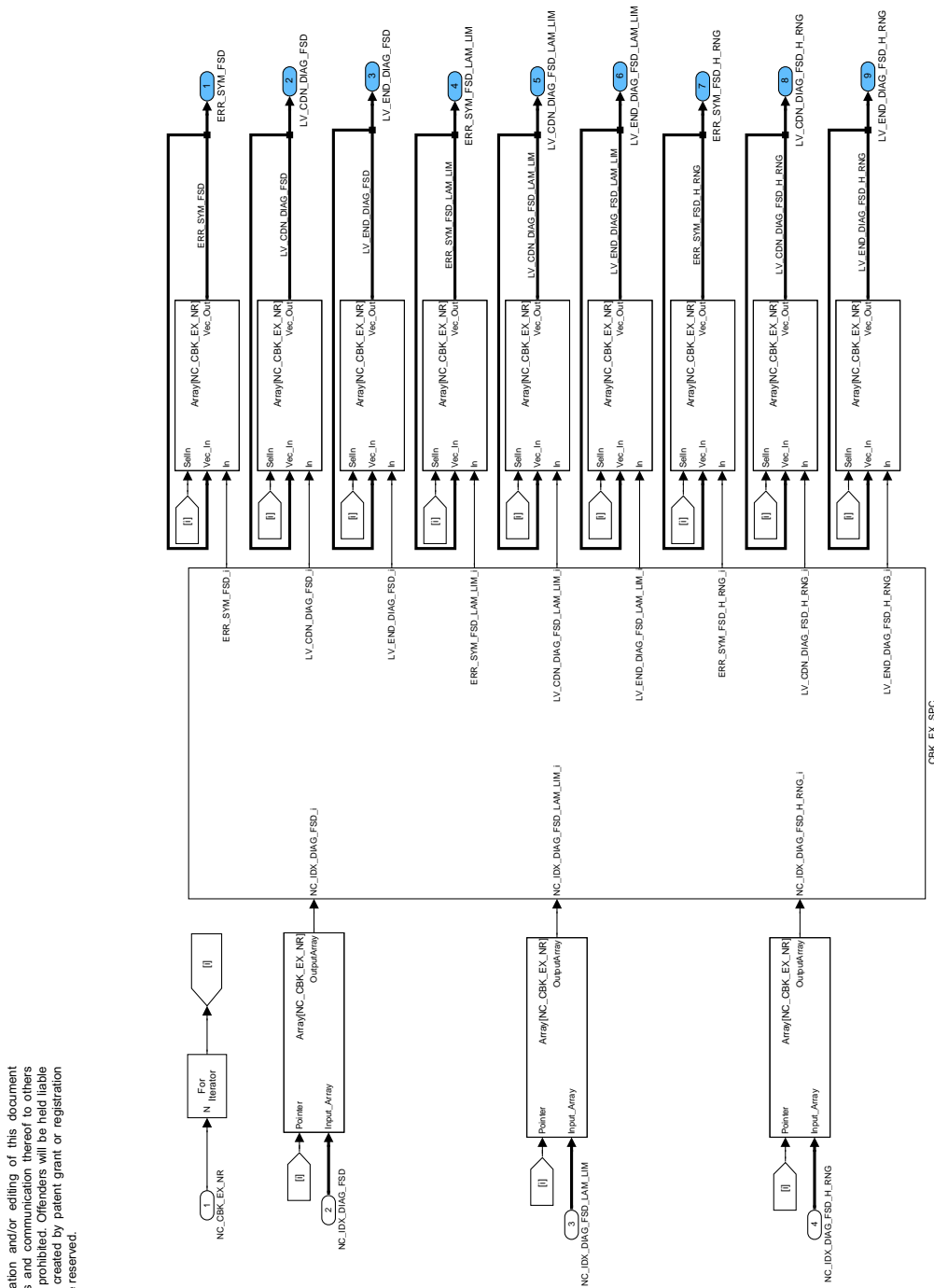



Figure B.105.84: LACO\_FCTDGFSD0/visualizationERRMdata

#### Pointer on ERRM data

The error management variables, that are only visible (no output), are visualized by means of a pointer on the respective entry in the ERRM array structure.

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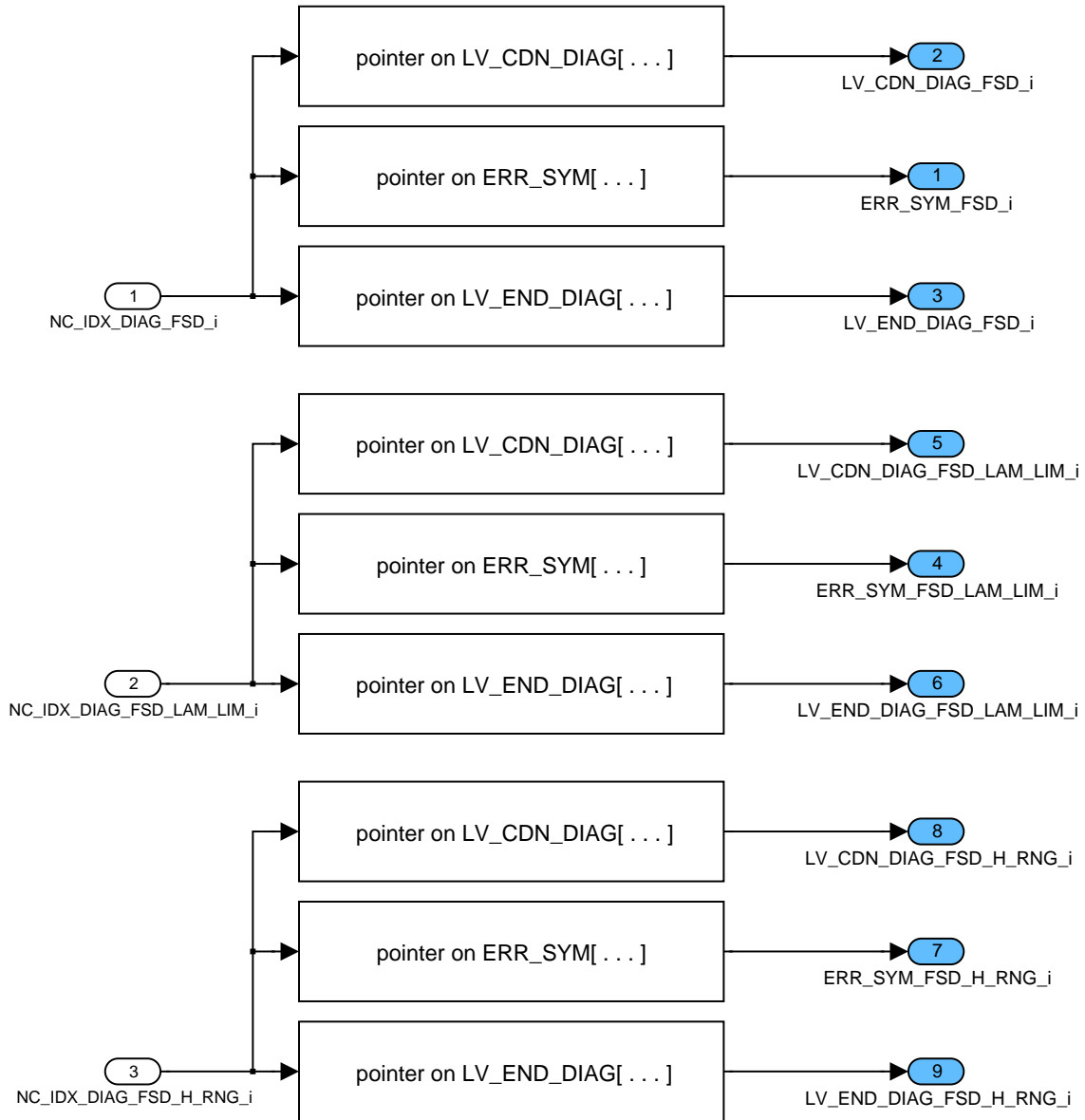


Figure B.105.85: LACO\_FCTDGFSD0/visualizationERRMdata/CBK\_EX\_SPC

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## B.106 Fuel system monitoring (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_FAC_L_RNG_LIM_MAX_FSD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating maximum limitation of lambda adaptation used by fuel system diagnosis					
LV_FAC_L_RNG_LIM_MIN_FSD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating minimum limitation of lambda adaptation used by fuel system diagnosis					
LV_INH_DIAG_FSD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibition flag for fuel system diagnosis					
LV_INH_DIAG_FSD_CP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibition flag for fuel system diagnosis due to internal states of canister purge function					
LV_MFF_ADD_LIM_MAX_FSD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating top limitation of lambda adaptation for FSD module					
LV_MFF_ADD_LIM_MIN_FSD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating bottom limitation of lambda adaptation for FSD module					
T_FSD_SET_END_DIAG [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer to force end of diagnostic for FSD					

### Input data:

CL_MMV {p. 3698}	ERR_INH_FSD [NC_CBK_EX_NR] {p. 1014}	LV_ACT_SA_EOL {p. 7763}	LV_CP_CLOSE_ACT {p. 3749}
LV_FAC_L_RNG_LIM_MAX_EXT_LAM_AD [NC_CBK_EX_NR] {p. 1016}	LV_FAC_L_RNG_LIM_MAX_LAM_AD [NC_CBK_EX_NR] {p. 2642}	LV_FAC_L_RNG_LIM_MIN_EXT_LAM_AD [NC_CBK_EX_NR] {p. 1016}	LV_FAC_L_RNG_LIM_MIN_LAM_AD [NC_CBK_EX_NR] {p. 2642}
LV_FAC_LAM_LIM_MAX [NC_CBK_EX_NR] {p. 2463}	LV_FAC_LAM_LIM_MIN [NC_CBK_EX_NR] {p. 2463}	LV_FSD_ACT [NC_CBK_EX_NR] {p. 6133}	LV_LAM_AD_EXT {p. 1016}
LV_MFF_ADD_LIM_MAX_LAM_AD [NC_CBK_EX_NR] {p. 2642}	LV_MFF_ADD_LIM_MIN_LAM_AD [NC_CBK_EX_NR] {p. 2642}	NC_CBK_EX_NR {p. 1829}	STATE_CP {p. 3637}
STATE_LAM_AD [NC_CBK_EX_NR] {p. 2643}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_MMV_MAX_FSD	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Maximum value for CL_MMV to permit FSD					
C_T_MAX_FSD_SET_END_DIAG	-	0... FFFFH	0... 1310.7	0.02	s
Timer threshold to force end of diagnostic for FSD					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_FSD_SET_END_DIAG_ENA	-	0... 1H	0 ...1	1	-
Calibration flag to enable forced setting of end of diagnostic for FSD					
LC_INH_FSD_MAN_DEAC	-	0... 1H	0 ...1	1	-
Manual deactivation of fuel system diagnosis inhibition					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_DIAG_FSD [NC_CBK_EX_NR]	-	0... FFFFH	0... 65535	1	-
ERRM diagnosis identifier of fuel system diagnosis					

**Import actions:**

<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>,OUT<LV_END_DIAG>)
<b>ACTION_ERRM_NoFilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_LV_ERR_SET>,IN<PRM_LV_ERR_RST>,IN<PRM_LV_END_DIAG>,OUT<PRM_LV_ERR>)


**General information:**

This function manages the inhibition of the fuel system diagnosis (FSD) due to system errors and canister purge states.

NC\_CBK\_EX\_NR defines the number of exhaust banks.

For vector elements the variable extension `_i` is used in the model instead of `[i]` as found in the textual description.

Configuration for diagnostic symptoms:

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Diagnostic FSD[i]	Symptom description	Symptom	Filter type
Fuel System Diagnosis for lambda adaptation monitoring - relevant to malfunction indication light	maximum limit of additive adaptation value reached	SYM_0	NO
	minimum limit of additive adaptation value reached	SYM_1	
	maximum limit of multiplicative adaptation value (lower area) reached	SYM_2	
	minimum limit of multiplicative adaptation value (lower area) reached	SYM_3	
Diagnostic FSD_LAM_LIM[i]	Symptom description	Symptom	Filter type
Fuel System Diagnosis in area where lambda controller output is concerned - relevant to malfunction indication light	lambda control in dead stop (upper limit)	SYM_0	NO
	lambda control in dead stop (lower limit)	SYM_1	
Diagnostic FSD_H_RNG[i]	Symptom description	Symptom	Filter type
Fuel System Diagnosis in upper multiplicative adaptation learning area	maximum limit of multiplicative adaptation value (upper area) reached	SYM_0	NO
	minimum limit of multiplicative adaptation value (upper area) reached	SYM_1	

### Application conditions:

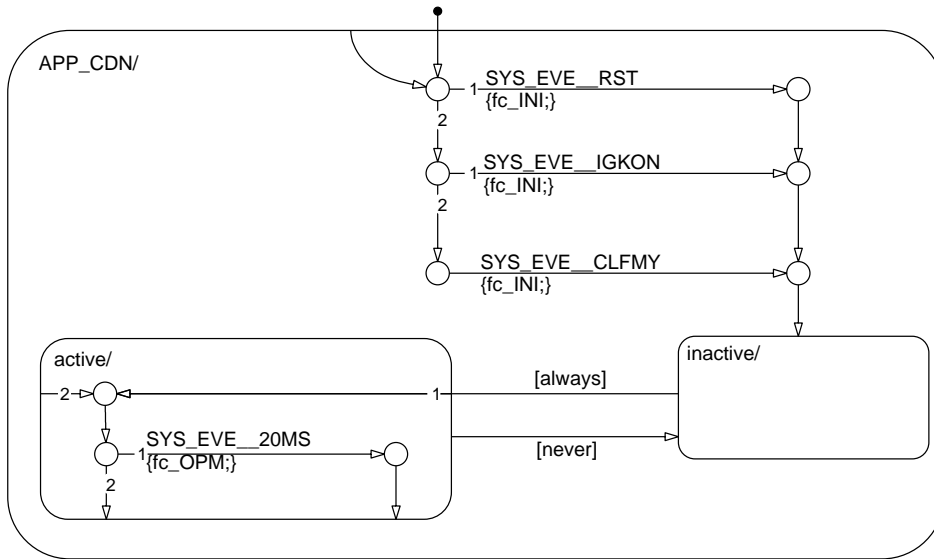



Figure B.106.1: :

**Function description:**

**Formula section:**

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 6202 of 8404</b>	
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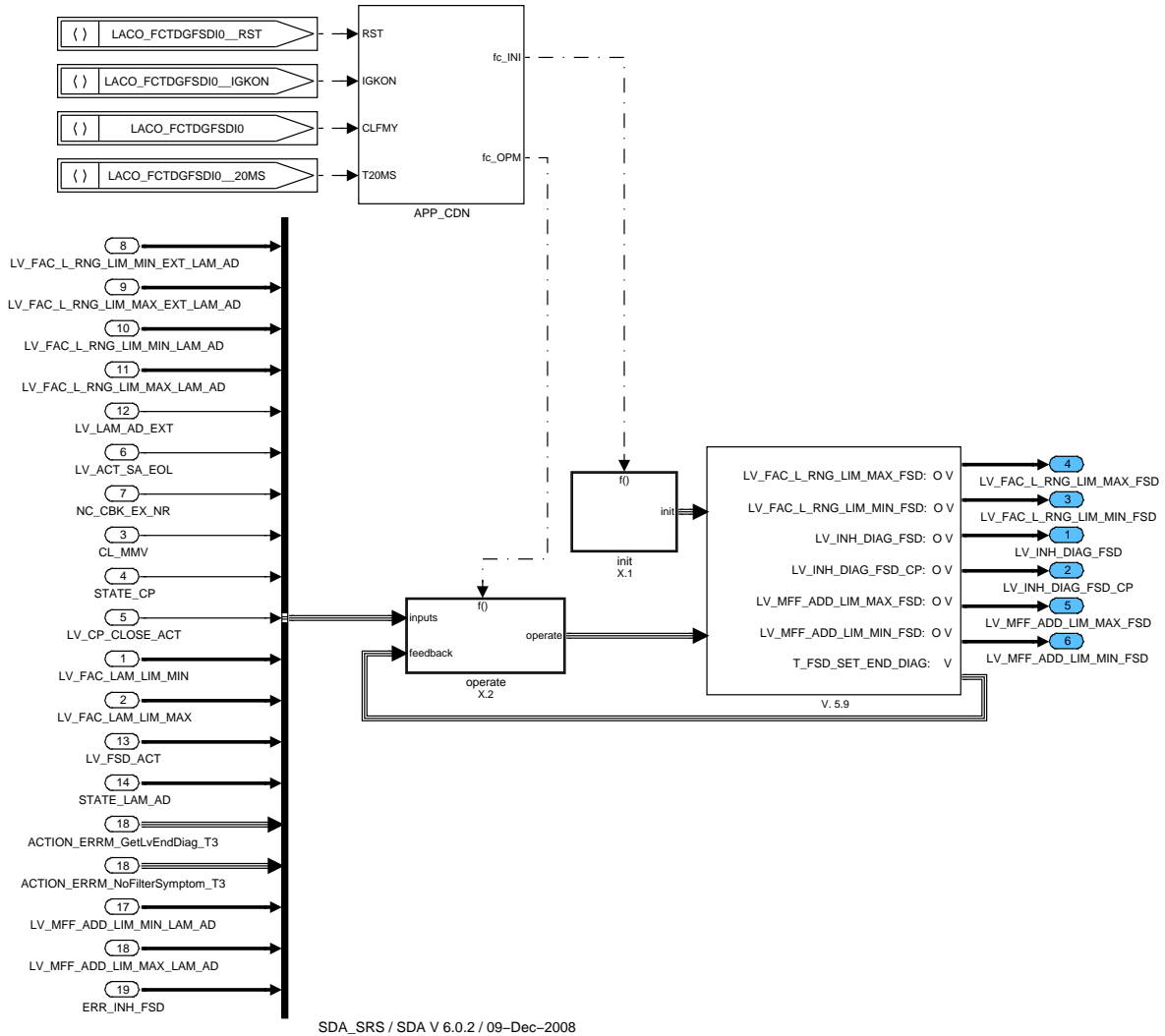


Figure B.106.2: :

### B.106.1 Initialization

The inhibition flags LV\_INH\_DIAG\_FSD[i] and LV\_INH\_DIAG\_FSD\_CP[i] are both set to 1. All other variables are initialized with 0.

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### B.106.1.1 Calculation of initialization

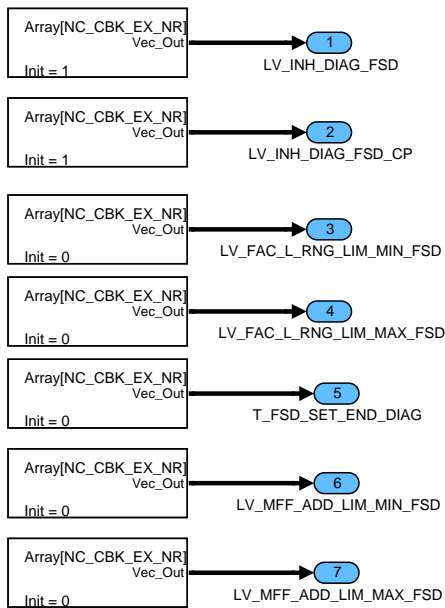


Figure B.106.3: :

## B.106.2 Formula section

### B.106.2.1 Inhibition of fuel system diagnosis

LV\_INH\_DIAG\_FSD[i] represents the influence of errors deactivating the fuel system diagnosis.

All exhaust bank independent errors are summarized in the temporary and not visible variable LV\_INH\_DIAG\_FSD\_NOT\_CBK\_SPC.

The temporary and not visible inhibition flag affects the relevant exhaust bank for FSD.

If LC\_INH\_FSD\_MAN\_DEAC is set to 1 fuel system diagnosis is not inhibited by a present error.

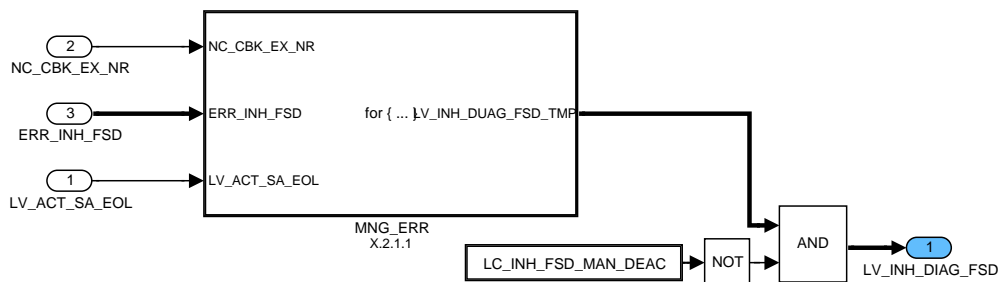


Figure B.106.4: :

#### B.106.2.1.1 Exhaust bank specific inhibition

The temporary and not visible inhibition flags.

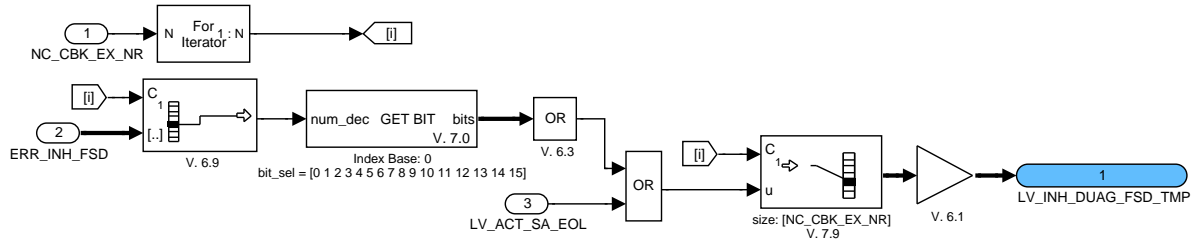


Figure B.106.5: :

### B.106.2.2 Inhibition of fuel system diagnosis due to canister purge

#### B.106.2.2.1 Exhaust bank specific functionality

LV\_INH\_DIAG\_FSD\_CP[i] respects the influence of canister purge on FSD. The inhibition flag is not set when the canister purge valve is closed, in MAX PURGE at low charcoal canister load and in MIN\_PURGE when the lambda controller is at one of its limits.

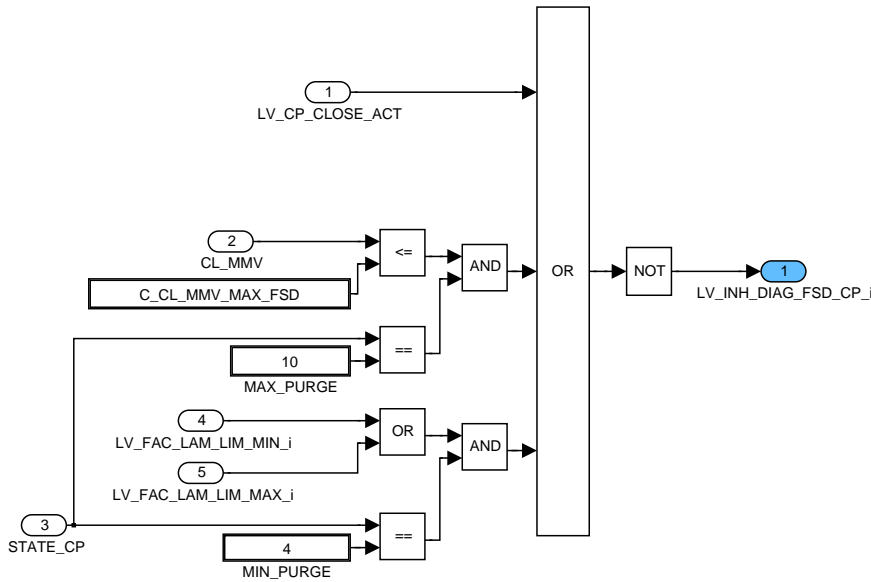


Figure B.106.6: :

### B.106.2.3 Determination of limitation flags for lambda adaption (in- /outside LACO)

Determination if indicator flag for minimum and maximum limitation of lambda adaption used by fuel system diagnosis is calculated inside of outside of LACO, according to LV\_LAM\_AD\_EXT.

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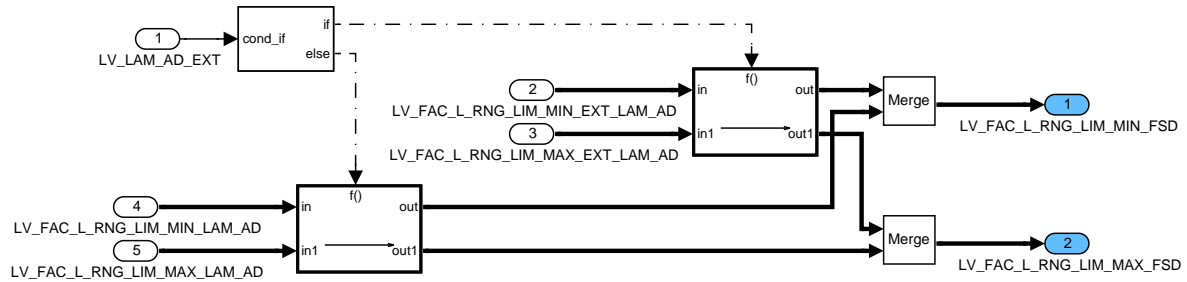


Figure B.106.7: :

## B.106.2.4 Force FSD end diag flag to 1

### B.106.2.4.1 Exhaust bank specific functionality

#### B.106.2.4.1.1 Increment timer

The timer  $T\_SET\_END\_DIAG\_FSD[i]$  that forces FSD end of diagnostic flag to 1 is incremented if general FSD activation conditions are fulfilled and engine is running in one of the lambda adaptation fields independent whether adaptation is active or not.

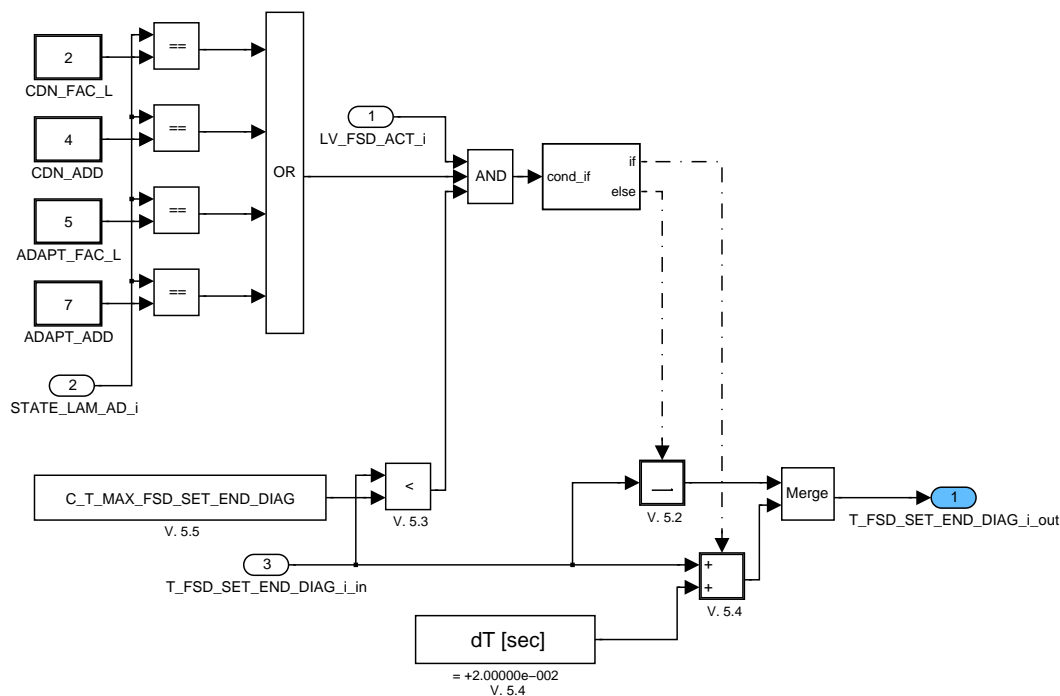


Figure B.106.8: :

#### B.106.2.4.1.2 Timer elapsed

As soon as the timer  $T\_SET\_END\_DIAG\_FSD[i]$  reaches a calibration threshold the error management is called to set the end of diagnosis information (if not yet set).

This feature can be disabled by the calibration flag  $LC\_FSD\_SET\_END\_DIAG\_ENA$ .

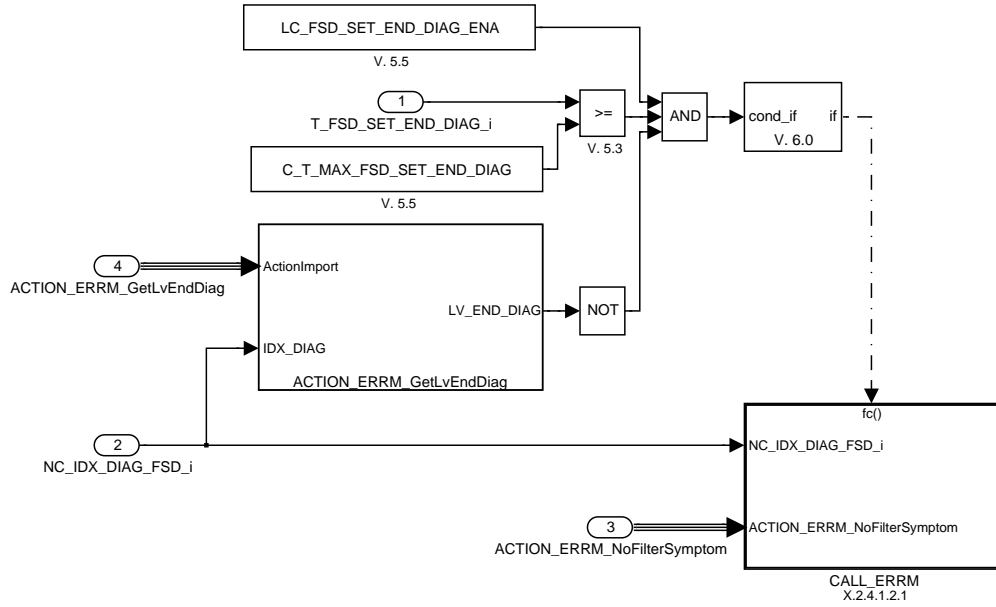


Figure B.106.9: :

### B.106.2.4.1.2.1 Call Error Management

Error management is called with action NoFilterSymptom in order to set end of FSD diagnostic information.

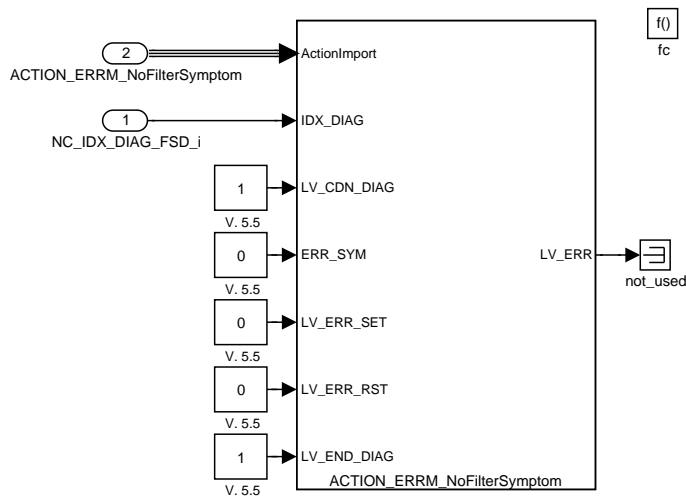


Figure B.106.10: :

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### B.106.2.5 Calculation of LV\_MFF\_ADD\_LIM\_MIN\_FSD and LV\_MFF\_ADD\_LIM\_MAX\_FSD

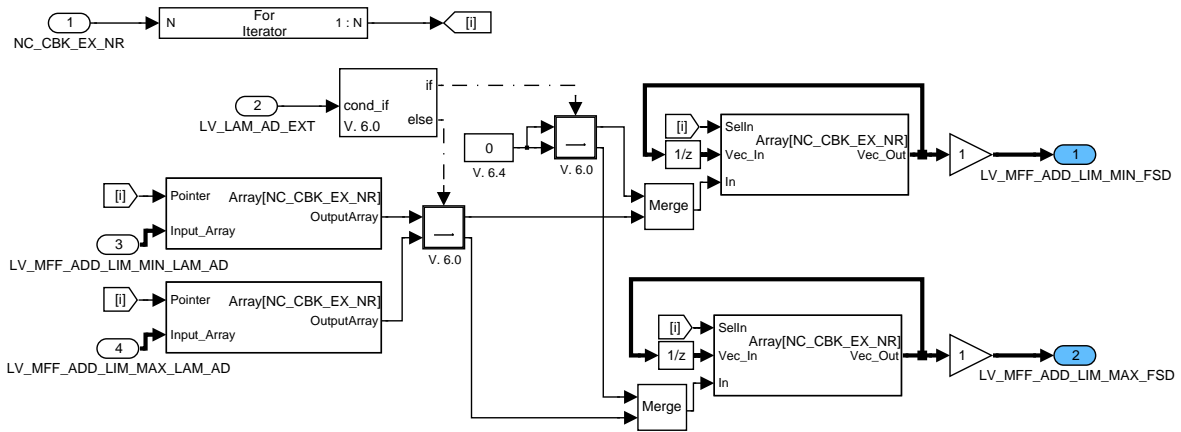


Figure B.106.11: :

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## B.107 Crankshaft oscillation detection

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_TDC_CRK_OSC_ACT	V	0... FFH	0... 255	1	-
TDC counter to enable crankshaft oscillation detection after misfiring detection					
DRV0_ER_SUM_OSC	V	0... FFFFH	0... 65535	1	µs
Integrated DRV0_ER value for amplitude criterion reseted every sign change or DRV0					
DRV0_ER_SUM_THD_OSC	V	0... FFFFH	0... 65535	1	µs
Threshold for DRV0_ER_SUM_OSC to fulfill amplitude criteria					
LV_AMPL_CRIT_CRK_OSC	V	0... FFH	0... 255	1	-
Critical crankshaft oscillation amplitude detected					
LV_CRK_OSC_DET_ACT	V	0... 1H	0 ...1	1	-
Crankshaft oscillation detection active					
LV_FRQ_CRIT_CRK_OSC	V	0... FFH	0... 255	1	-
Critical crankshaft oscillation frequency detected					
LV_STATE_CRK_OSC	O/V	0... 1H	0 ...1	1	-
Status of crankshaft oscillation condition					
RATIO_VS_N_CRK_OSC	V	0... FFH	0... 0.05	196e-6	(km/h)/rpm
Ratio VS /N for gear area determination					
SEG_SUM_FRQ_CRK_OSC	V	0... FFH	0... 255	1	-
Segment counter for frequency criterion reseted every sign change or DRV0					

### Input data:

DRV0_ER {p. 1454}	LC_MIS_INH {p. 6277}	LOAD_MIS {p. 6213}	LV_DET_CFM_MIS {p. 6237}
LV_ENA_ER {p. 1454}	LV_INH_CRK_OSC_DET {p. 6283}	N {p. 1525}	N_32 {p. 1525}
VS {p. 1176}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DLY_TDC_CRK_OSC	-	0... FFH	0... 255	1	-
Active TDC s of crankshaft oscillation status after detection triggering					
C_N_MAX_CRK_OSC	-	0... FFH	0... 8160	32	rpm
Maximum speed for crankshaft oscillation calculation					
C_NR_TDC_MAX_CRK_OSC	-	0... FFH	0... 255	1	-
Maximum TDC after detected misfire to activate crankshaft oscillation detection process					
C_RATIO_VS_N_MIN_CRK_OSC	-	0... FFH	0... 0.05	196e-6	(km/h)/rpm
Minimum VS /N ratio to activate crankshaft oscillation detection					
IP_DRV0_ER_THD_OSC	V	0... FFFFH	0... 65535	1	µs
LDP_N_32_IP_DRV0_ER_THD_OSC	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_MIS_IP_DRV0_ER_THD_OSC	6	0... 7FFFH	0... 99.99694	3.05e-3	%
DRV0 amplitude threshold to detect critical crankshaft oscillation amplitude					
IP_SEG_MIN_FRQ_CRK_OSC	-	0... FFH	0... 255	1	-
LDP_N_32_IP_SEG_MIN_FRQ_CRK_OSC	4	0... FFH	0... 8160	32	rpm
Minimum number of segment after turn of speed direction for detecting critical high frequency					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_USE_CRK_OSC_MIS	-	0... 1H	0 ...1	1	-
Crankshaft oscillation detection module used (=1) or stub version (=0)					

**General information**

The misfire detection based on engine roughness index (ER) may be disturbed by crankshaft oscillations when single misfire (random) occurs, especially for front drive vehicles crankshaft in the low engine speed /high engine load area (in combination with a 3rd, 4th or 5th gear ratio). A single misfire acts as a drivetrain /crankshaft oscillations trigger, in this case the ER index is disturbed by these oscillations, in some conditions it is practically not possible to distinguish on ER index, real misfire towards speed drop caused through crankshaft speed oscillations.

The trigger for such oscillations can be a single misfire, an obstacle, a big torque change or others instantaneous conditions.

The principle of this crankshaft /drivetrain oscillation detection is to detect such an oscillation and then to fade-out the misfire detection for a short period to avoid over-detection.

**Initialisation:** on ECU reset, on LC\_MIS\_INH 0 to 1 transition

SEG\_SUM\_FRQ\_CRK\_OSC = 0

DRV0\_ER\_SUM\_OSC = 0

LV\_STATE\_CRK\_OSC = 0

**Application conditions:**

*Activation/Deactivation:*

RATIO\_VS\_N\_CRK\_OSC = VS/N

**If** LV\_DET\_CFM\_MIS = 1

**Then** CTR\_TDC\_CRK\_OSC\_ACT = C\_NR\_TDC\_MAX\_CRK\_OSC

**Elseif** CTR\_TDC\_CRK\_OSC\_ACT 0

**Then** CTR\_TDC\_CRK\_OSC\_ACT = CTR\_TDC\_CRK\_OSC\_ACT - 1

**Endif**

**If** LV\_ENA\_ER = 1

**And** LC\_MIS\_INH = 0

**And** LV\_INH\_CRK\_OSC\_DET = 0

**And** N\_32 < C\_N\_MAX\_CRK\_OSC

**And** RATIO\_VS\_N\_CRK\_OSC > C\_RATIO\_VS\_N\_MIN\_CRK\_OSC

**And** CTR\_TDC\_CRK\_OSC\_ACT 0

**Then** LV\_CRK\_OSC\_DET\_ACT = 1 // Crankshaft oscillation detection active

**Else** LV\_CRK\_OSC\_DET\_ACT = 0 // Crankshaft oscillation detection inactive

SEG\_SUM\_FRQ\_CRK\_OSC = 0

DRV0\_ER\_SUM\_OSC = 0


**Endif**

*Update rate:* Segment

**B.107.1 Detection description**

The final decision about crankshaft oscillation consists of two parts:

- The detection of a critical engine roughness oscillation frequency.
- The detection of a critical engine roughness oscillation amplitude.

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If both parts fulfilled at the same time their own detection criterion, a crankshaft oscillation is detected. The reason therefore is, that even at constant speed due to normal little speed variations a high frequency or at a normal acceleration phase a big amplitude is possible.

### B.107.1.1 Determination of a critical engine roughness frequency

#### Application conditions

**Activation:**  $LV\_CRK\_OSC\_DET\_ACT = 1$

**Deactivation:**  $LV\_CRK\_OSC\_DET\_ACT = 0$

#### Formula section:

```

If      Bit sign between  $DRV0\_ER_{(n-1)}$  and  $DRV0\_ER_{(n)}$  changes
Then     $SEG\_SUM\_FRQ\_CRK\_OSC = IP\_SEG\_MIN\_FRQ\_CRK\_OSC(N\_32)$ 
Elseif   $SEG\_SUM\_FRQ\_CRK\_OSC = 0$ 
Then     $SEG\_SUM\_FRQ\_CRK\_OSC = SEG\_SUM\_FRQ\_CRK\_OSC - 1$ 
Endif

If       $SEG\_SUM\_FRQ\_CRK\_OSC = 0$ 
Then     $LV\_FRQ\_CRIT\_CRK\_OSC = 1$            // Critical crankshaft frequency status is active
Else     $LV\_FRQ\_CRIT\_CRK\_OSC = 0$ 
Endif
    
```

### B.107.1.2 Determination of a critical engine roughness oscillation amplitude

#### Application conditions

**Activation:**  $LV\_CRK\_OSC\_DET\_ACT = 1$

**Deactivation:**  $LV\_CRK\_OSC\_DET\_ACT = 0$

#### Formula section:

```

If      Bit sign between  $DRV0\_ER_{(n-1)}$  and  $DRV0\_ER_{(n)}$  changes
Then     $DRV0\_ER\_SUM\_OSC_{(n)} = DRV0\_ER_{(n)}$ 
Else     $DRV0\_ER\_SUM\_OSC_{(n)} = DRV0\_ER\_SUM\_OSC_{(n-1)} + DRV0\_ER_{(n)}$ 
           // with saturation
Endif

 $DRV0\_ER\_SUM\_THD\_OSC = IP\_DRV0\_ER\_THD\_OSC(N\_32, LOAD\_MIS)$ 
If       $DRV0\_ER\_SUM\_OSC > DRV0\_ER\_SUM\_THD\_OSC$ 
Then     $LV\_AMPL\_CRIT\_CRK\_OSC = 1$            // Critical crankshaft amplitude status is active
Else     $LV\_AMPL\_CRIT\_CRK\_OSC = 0$ 
Endif
    
```

### B.107.1.3 Determination of crankshaft oscillation final status

#### Application conditions

**Activation:**  $LV\_CRK\_OSC\_DET\_ACT = 1$

**Deactivation:**  $LV\_CRK\_OSC\_DET\_ACT = 0$

**Formula section:**

If in the same time, both conditions are active, a crankshaft oscillation status is triggered :

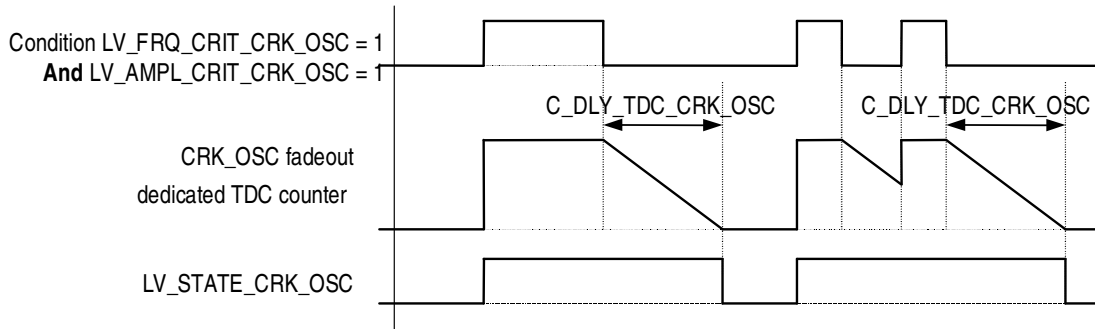
**If** LV\_FRQ\_CRIT\_CRK\_OSC = 1

**And** LV\_AMPL\_CRIT\_CRK\_OSC = 1

**Then** After condition rising edge triggering, LV\_STATE\_CRK\_OSC flag is set to 1 as long as condition is true.

After condition falling edge triggering, LV\_STATE\_CRK\_OSC flag is hold to 1 for a period of C\_DLY\_TDC\_CRK\_OSC tdc's, even if LV\_CRK\_OSC\_DET\_ACT is then set to 0.

**EndIf**



## B.108 Generic misfire parameters and fade-out conditions

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA_BAS_DIF_MIS	V	0... FFH	-35.625 ...60	0.375	°CRK
Ignition angle difference between IGA_BAS_COR_MV and IGA_AV, segment sample					
IGA_DIF_MIS	V	0... FFH	0... 95.625	0.375	°CRK
Absolute Ignition angle difference between 2 misfire segment tasks					
IGA_MIS	V	0... FFH	-35.625 ...60	0.375	°CRK
Ignition angle at current misfire segment					
IGA_MIS_1	-	0... FFH	-35.625 ...60	0.375	°CRK
Ignition angle 1 misfire segment before					
IGA_MIS_2	-	0... FFH	-35.625 ...60	0.375	°CRK
Ignition angle 2 misfire segment before					
LOAD_GRD_MIS	O/V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Normalised engine load gradient for misfire detection					
LOAD_MIS	O/V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Normalised engine load for misfire detection - sampled at current misfire segment					
LOAD_MIS_1	-	0... 7FFFH	0... 99.99694	3.0518e-3	%
Normalised engine load for misfire detection - 1 misfire segment before					
LOAD_MIS_2	-	0... 7FFFH	0... 99.99694	3.0518e-3	%
Normalised engine load for misfire detection - 2 misfire segment before					
LOAD_MIS_3	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Normalised engine load for misfire detection - 3 misfire segment before					
LV_INH_ACC_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to Air Conditionner transient condition					
LV_INH_IGA_DIF_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to IGA_DIF condition					
LV_INH_LOAD_GRD_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to LOAD_GRD_MIS condition					
LV_INH_MAP_DIF_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to MAP_DIF condition					
LV_INH_TPS_GRD_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to TPS gradient condition					
LV_REQ_APP_INH_MIS	O/V	0... 1H	0 ...1	1	-
Misfire detection APP INC fade out request flag					
MAP_DIF_MIS	V	0... FFFFH	0... 5434	0.0829175	hPa
Manifold air pressure difference between 2 misfire segment tasks					
MIS_DET_CDN_APP_INH	V	0... FFFFH	0... 65535	1	-
Misfiring APP INC detection fade out requests carrier word (before masking)					
MIS_DET_CDN_APP_INH_NR	V	0... FFH	0... 255	1	-
Misfiring APP INC detection fade out requests number (after masking)					

### Input data:

AMP {p. 982}	CTR_T_ZDLY_MIS {p. 6225}	FAC_GAIN_LOAD_MIS {p. 6283}	IGA_AV [NC_CYL_NR] {p. 1005}
IGA_BAS_COR_MV {p. 6283}	LC_MIS_INH {p. 6277}	LV_ACCOUT_RLY {p. 3589}	LV_ENA_ER {p. 1454}

LV_ENA_SEG_T_MES {p. 1447}	LV_IGA_GRD_ACT {p. 1828}	LV_INH_APP_DET_MIS {p. 6283}	LV_INH_CMB_TRA_MIS {p. 6283}
LV_INH_FTL_L_DET_MIS {p. 6283}	LV_INH_OBD_DET_MIS {p. 6283}	LV_IS {p. 1720}	LV_S_ACT {p. 8137}
LV_STATE_CRK_OSC {p. 6209}	LV_STATE_RR {p. 6301}	MAF {p. 8277}	MAP {p. 8278}
N {p. 1525}	N_32 {p. 1525}	NC_CMB_CONF {p. 812}	SEG_NR {p. 1525}
TCO {p. 1100}	TPS_AV {p. 1169}	TPS_GRD {p. 1169}	TQI_AV {p. 981}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CONF_LOAD_MIS	-	0... 2H	0 ...2	1	-
LOAD_MIS switch configuration versus engine combustion mode: (=0) LOAD_MIS always relative to TQI_AV (=1) LOAD_MIS relative to MAF in homog. & rel. to TQI_AV in stratif. mode, (=2) LOAD_MIS relative to MAP in homog. & rel. to TQI_AV in stratif. mode					
C_MAP_MAX_MIS	-	0... FFFFH	0... 5434	0.0829175	hPa
Maximum manifold air pressure value to determine engine load ratio scale for misfire detection					
C_MASK_APP_INH_DET_MIS	-	0... FFFFH	0... 65535	1	-
MIS_DET_CDN_APP_INH carrier structure fade out configuration mask (detection in nominal phase out of IS)					
C_MASK_APP_INH_DET_MIS_IS	-	0... FFFFH	0... 65535	1	-
MIS_DET_CDN_APP_INH carrier structure fade out configuration mask (detection in nominal phase & in IS)					
C_MASK_APP_INH_DET_ZDLY_MIS	-	0... FFFFH	0... 65535	1	-
MIS_DET_CDN_APP_INH carrier structure fade out configuration mask (misfire detection in zero delay phase)					
C_N_32_MAX_IGA_IS_MIS	-	0... FFH	0... 8160	32	rpm
Maximum engine speed to apply iga_dif_mis in idle speed					
C_NR_TDC_IGA_BAS_DIF_MIS	-	0... FFH	0... 255	1	-
Fade out duration when absolute IGA criterion has been detected					
C_NR_TDC_IGA_DIF_IS_MIS	-	0... FFH	0... 255	1	-
Fade out duration when relative IGA criterion in idle speed has been detected					
C_NR_TDC_IGA_DIF_MIS	-	0... FFH	0... 255	1	-
Fade out duration when IGA difference per TDC has been detected.					
C_T_ACCOUT_DLY_MIS	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when air - conditioning compressor has been switched on.					
C_T_LOAD_GRD_HOM_DLY_MIS	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when maximum LOAD_GRD_MIS has been detected in homogeneous combustion modes					
C_T_LOAD_GRD_S_DLY_MIS	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when maximum LOAD_GRD_MIS has been detected in stratified combustion mode					
C_T_MAP_DIF_DLY_MIS	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when manifold air pressure gradient has been detected.					
C_T_TPS_GRD_DLY_MIS	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when maximum throttle gradient has been detected.					
C_T_TPS_GRD_DLY_ZDLY_MIS	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when maximum throttle gradient has been detected during zero delay starting phase					
IP_DELTA_IGA_BAS_MIS	V	0... FFH	-35.625 ...60	0.375	°CRK
LDP_N_32_IP_DELTA_IGA_BAS_MIS	8	0... FFH	0... 8160	32	rpm
LDP_LOAD_IP_DELTA_IGA_BAS_MIS	8	0... 7FFFH	0... 99.99694	3.0518e-3	%
Absolute spark advance angle difference for misfire inhibition					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_DELTA_IGA_IS_MIS	V	0... FFH	0... 95.625	0.375	°CRK
LDP_TCO_IP_DELTA_IGA_IS_MIS	4	0... FEH	-48... 142.5	0.75	°C
LDP_LOAD_IP_DELTA_IGA_IS_MIS	4	0... 7FFFH	0... 99.99694	3.0518e-3	%
Spark advance angle difference in idle speed for misfire inhibition					
IP_DELTA_IGA_MIS	V	0... FFH	0... 95.625	0.375	°CRK
LDP_N_32_IP_DELTA_IGA_MIS	8	0... FFH	0... 8160	32	rpm
LDP_LOAD_MIS_IP_DELTA_IGA_MIS	8	0... 7FFFH	0... 99.99694	3.0518e-3	%
Spark advance angle difference at part load for misfire inhibition					
IP_LOAD_GRD_MIS	-	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_LOAD_MIS_IP_LOAD_GRD_MIS	12	0... 7FFFH	0... 99.99694	3.0518e-3	%
Maximum LOAD_MIS gradient for fade out condition in homogeneous combustion modes					
IP_LOAD_GRD_S_MIS	-	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_LOAD_MIS_IP_LOAD_GRD_S_MIS	12	0... 7FFFH	0... 99.99694	3.0518e-3	%
Maximum LOAD_MIS gradient for fade out condition in stratified combustion mode					
IP_MAF_MAX_MIS	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_32_IP_MAF_MAX_MIS	6	0... FFH	0... 8160	32	rpm
Maximum air mass value to determine engine load ratio scale for misfire detection					
IP_MAP_DIF_MAX_MIS	-	0... FFFFH	0... 5434	0.0829175	hPa
LDP_MAP_IP_MAP_DIF_MAX_MIS	12	0... FFFFH	0... 5434	0.0829175	hPa
Maximum MAP gradient for fade out condition.					
IP_TPS_GRD_MAX_MIS	-	0... FFH	0... 2987.5	11.715686	°TPS/s
LDP_TPS_AV_IP_TPS_GRD_MAX_MIS	10	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Maximum throttle gradient threshold for fade out condition.					
IP_TPS_GRD_ZDLY_MIS	-	0... FFH	0... 2987.5	11.715686	°TPS/s
LDP_TPS_AV_IP_TPS_GRD_ZDLY_MIS	6	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Maximum throttle gradient threshold for fade out condition during zero delay misfire monitoring activation					
IP_TQI_AV_MAX_MIS	-	0... 7FFFH	0... 1023.97	0.03125	Nm
LDP_N_32_IP_TQI_AV_MAX_MIS	8	0... FFH	0... 8160	32	rpm
Maximum torque value to determine engine load ratio scale for misfire detection					

## B.108.1 Misfire detection engine parameters

### FUNCTION DESCRIPTION:


In order to cover all the combustion states of an engine (Hom. AFS, AFL & Strat.) in torque based engine control, a general variable LOAD\_MIS that represents the ratio of engine load - whatever should be the load definition depending on engine combustion state (eg. MAF in Hom. and TQI\_AV in Strat.) - is defined for the purpose of the Misfire function and the calculation of the ER-misfire detection thresholds.

Depending on the project choice configuration (with C\_CONF\_LOAD\_MIS), in Homogenous combustion mode this Misfire load variable should be either MAF, MAP or TQI\_AV. In the other hand this Misfire load variable is always TQI\_AV in Stratified combustion mode.

Legally, the presence of engine misfire in the engine operating region is bounded by the positive torque line (i.e. engine load with the transmission in neutral) and an engine speed value.

The zero load line is a function of the engine speed and depends on the engine combustion mode (for GDI application), coolant temperature and atmospheric pressure.

### Application conditions

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**Initialisation:** All variables are initialised to 0 at reset, at engine stop  
**Or** at LC\_MIS\_INH 0 to 1 transition  
 LOAD\_GRD\_MIS is first time calculated when LOAD\_MIS stack have been fill in (4 segments).

**Recurrence:** every segment task

**Activation:** LV\_ENA\_SEG\_T\_MES = 1  
**And** LC\_MIS\_INH = 0

**Deactivation:** LV\_ENA\_SEG\_T\_MES = 0  
**Or** LC\_MIS\_INH = 1

### Formula section:

#### *Normalised engine load dedicated to misfire detection*

*For each misfire segment, the following stack is serviced:*

```

LOAD_MIS_3 = LOAD_MIS_2
LOAD_MIS_2 = LOAD_MIS_1
LOAD_MIS_1 = LOAD_MIS
if      C_CONF_LOAD_MIS = 0
  Or    LV_S_ACT = 1
Then   LOAD_MIS_Temp = TQI_AV / IP_TQI_AV_MAX_MIS(N_32)      // TQI_AV based
Elseif C_CONF_LOAD_MIS = 1
Then   LOAD_MIS_Temp = MAF / IP_MAF_MAX_MIS(N32)              // MAF based
Else   LOAD_MIS_Temp = MAP / C_MAP_MAX_MIS                    // MAP based
Endif
LOAD_MIS = FAC_GAIN_LOAD_MIS * LOAD_Temp                      // Application incidence correction
LOAD_GRD_MIS = | LOAD_MIS - LOAD_MIS_3 |
Note : LOAD_MIS calculation steps are checked against division by zero
          LOAD_MIS_Temp is a non visible, temporary value

```

## B.108.2 Generic fade out conditions for misfire detection

### General information:

Generic fade out (LV\_REQ\_APP\_INH\_MIS) is based on all conditions who could create unreliable conditions for misfire detection :

- Engine gradients (engine load, throttle, combustion mode & ignition angle transients).
- Crankshaft jolt effects who can disturb detection process (rough road, drivetrain oscillations, air conditioner & accessories activation/deactivation).
- OBDI errors on one of the sensors used by the misfire monitoring process.

All these different conditions are merge into a carrier (MIS\_DET\_CDN\_APP\_INH).

### Application conditions

**Initialisation:** at ECU reset, at Engine Stop **Or** at LC\_MIS\_INH 0 to 1 transition

```

LV_REQ_APP_INH_MIS = 1
MIS_DET_CDN_APP_INH = 2047
MIS_DET_CDN_APP_INH_NR = 11
MAP_DIF_MIS = 0
IGA_DIF_MIS = 0
IGA_BAS_DIF_MIS = 0
IGA_MIS_2 = 0
IGA_MIS_1 = 0
IGA_MIS = 0

```

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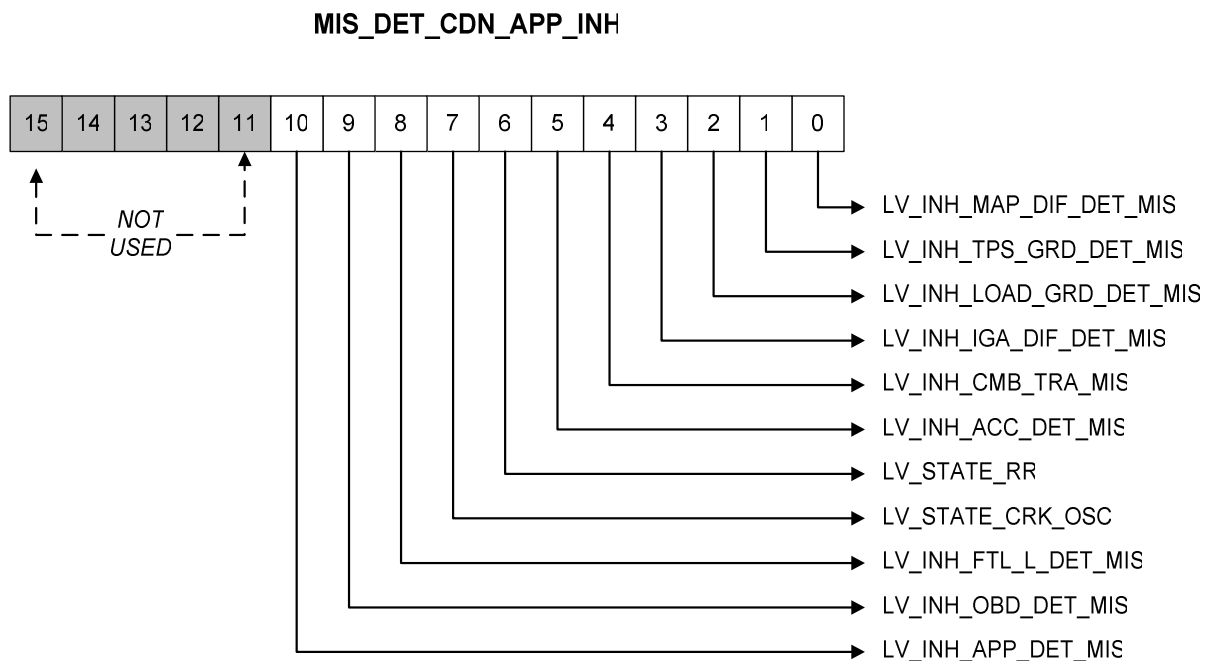
**Recurrence:** segment task for data process  
10 ms for free running timers

**Activation:** LV\_ENA\_ER = 1  
**And** LC\_MIS\_INH = 0

**Deactivation:** LV\_ENA\_ER = 0  
**Or** LC\_MIS\_INH = 1

*Remark : Timers used for delay are 10 ms free running decouplers, they are not linked to activation/ deactivation conditions described above.*

### B.108.2.1 Generic fade out condition carrier definition



*remark : MIS\_DET\_CDN\_APP\_INH is updated at current misfire task*

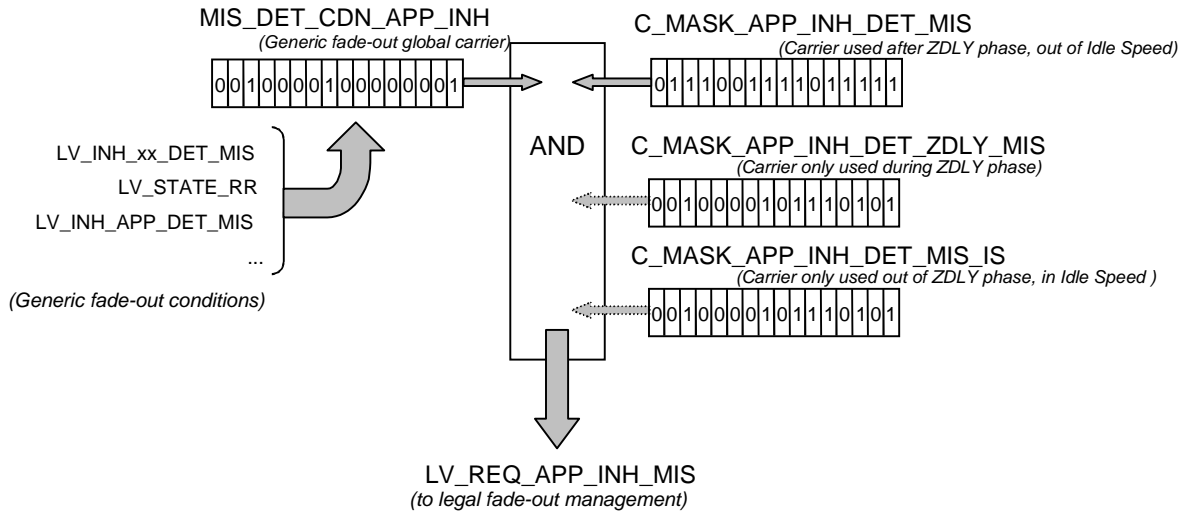
### B.108.2.2 Configurable generic fade-out management

Generic fade out management during zero delay phase, nominal phase & idle speed engine state can be configured via 3 bitfield masks that allow to take in account or not some conditions in a phase and not in the other.

If the corresponding bit in the MIS\_DET\_CDN\_APP\_INH carrier structure is set to 0 in C\_MASK\_APP\_INH\_DET\_ZDLY\_MIS, C\_MASK\_APP\_INH\_DET\_MIS or C\_MASK\_APP\_INH\_DET\_MIS\_IS calibration, then the corresponding condition will not fade-out misfire detection.

For the definition of C\_MASK\_APP\_INH\_DET\_ZDLY\_MIS, C\_MASK\_APP\_INH\_DET\_MIS & C\_MASK\_APP\_INH\_DET\_MIS\_IS masks please refer to the legal requirements & customer recommendations.

#### **Overview:**



### Formula section:

```

If(1)      CTR_T_ZDLY_MIS != 0
Then(1)    // ZDLY phase
  MIS_DET_CDN_APP_INH_NR =
    sum(MIS_DET_CDN_APP_INH & C_MASK_APP_INH_DET_ZDLY_MIS)
  (bitfield operations)
Else(1)
  If(2)    LV_IS = 1
  Then(2)  // Idle Speed engine state
    MIS_DET_CDN_APP_INH_NR =
      sum(MIS_DET_CDN_APP_INH & C_MASK_APP_INH_DET_MIS_IS)
    (bitfield operations)
  Else(2)  // Out of idle speed engine state
    MIS_DET_CDN_APP_INH_NR =
      sum(MIS_DET_CDN_APP_INH & C_MASK_APP_INH_DET_MIS)
    (bitfield operations)
  EndIf(2)
EndIf(1)

If MIS_DET_CDN_APP_INH_NR != 0
Then  LV_REQ_APP_INH_MIS = 1
Else  LV_REQ_APP_INH_MIS = 0
EndIf

```

### B.108.2.3 Maximum manifold air-pressure gradient

Due to trailing throttle /acceleration transition problems, it could be necessary to disable misfire detection for a short period when the manifold air-pressure gradient exceeds an applicable value.

#### Application conditions:

In all homogeneous combustion mode, Misfire detection is disabled when the amount of the MAP gradient exceeds IP\_MAP\_DIF\_MAX\_MIS(MAP)

**Initialisation:** at ECU reset, at Engine Stop **Or** at LC\_MIS\_INH 0 to 1 transition  
 LV\_INH\_MAP\_DIF\_DET\_MIS = 1

**Formula section:**

$MAP\_DIF\_MIS = | MAP_{(n)} - MAP_{(n-2)} |$

**If** LV\_S\_ACT = 0

**And** MAP\_DIF\_MIS > IP\_MAP\_DIF\_MAX\_MIS(MAP)

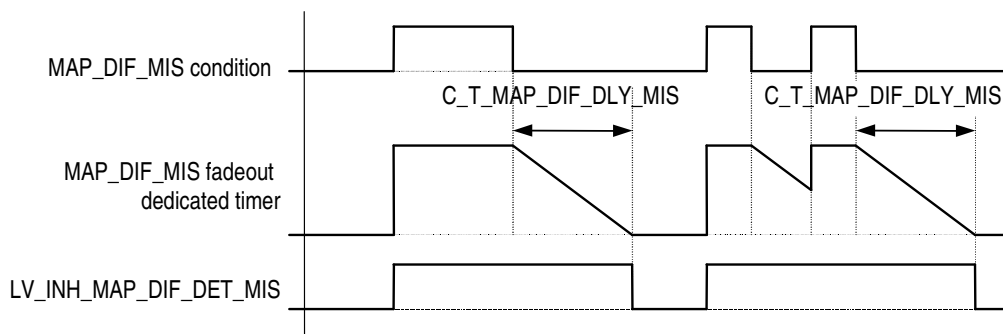
**Then**

After condition rising edge triggering, LV\_INH\_MAP\_DIF\_DET\_MIS flag is set to 1 as long as condition is true.

After condition falling edge triggering, LV\_INH\_MAP\_DIF\_DET\_MIS flag is hold to 1 for a period of C\_T\_MAP\_DIF\_DLY\_MIS.

**Endlf**

**Fade out behaviour summary:**



### B.108.2.4 Maximum throttle gradient

Due to trailing throttle /acceleration transient problems at low load, it is necessary to disable misfire detection for a short period when the throttle gradient exceeds an applicable value.

**Application conditions:**

Misfire detection can be disabled when the amount of the throttle gradient exceeds the applicable value hereunder mentioned. But during the 0-delay activation of the misfire monitoring, driver-induced fade-out is allowed:

**Initialisation:** at ECU reset, at Engine Stop **Or** at LC\_MIS\_INH 0 to 1 transition  
 LV\_INH\_TPS\_GRD\_DET\_MIS = 1

**Formula section:**

**If(1)** CTR\_T\_ZDLY\_MIS = 0

**Then(1)**

**If(2)** TPS\_GRD > IP\_TPS\_GRD\_MAX\_MIS(TPS\_AV)

**Then(2)**

After condition rising edge triggering, LV\_INH\_TPS\_GRD\_DET\_MIS flag is set to 1 as long as condition is true.

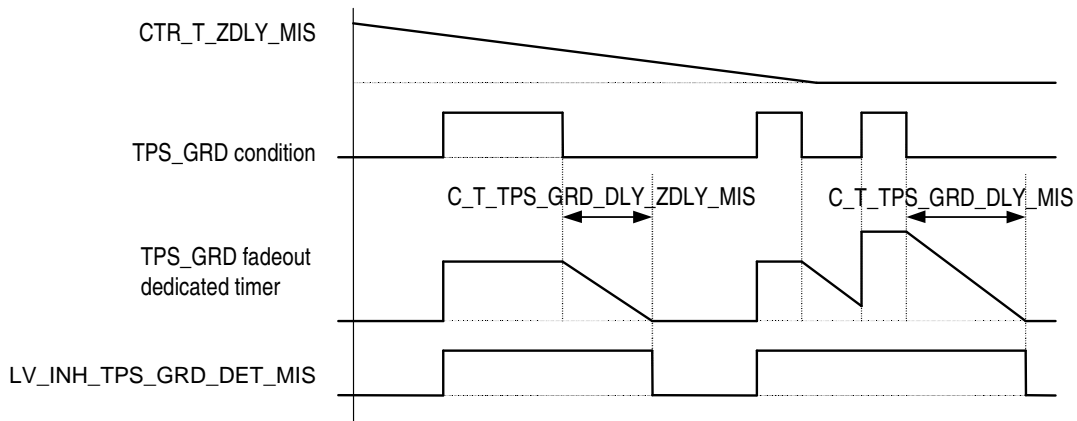
After condition falling edge triggering, LV\_INH\_TPS\_GRD\_DET\_MIS flag is hold to 1 for a period of C\_T\_TPS\_GRD\_DLY\_MIS.

```

Endlf(2)
Else(1)
  If(2)   TPS_GRD > IP_TPS_GRD_ZDLY_MIS(TPS_AV)
  Then(2)
    After condition rising edge triggering, LV_INH_TPS_GRD_DET_MIS flag is set to 1 as long
    as condition is true.
    After condition falling edge triggering, LV_INH_TPS_GRD_DET_MIS flag is hold to 1 for a
    period of C_T_TPS_GRD_DLY_ZDLY_MIS.
  Endlf(2)
Endlf(1)

```

**Fade out behaviour summary:**



**B.108.2.5 Maximum engine load gradient**

Due to trailing throttle /acceleration transient problems at low load, it could be necessary to disable misfire detection for a short period when the engine load exceeds an applicable value.

**Application conditions:**

Misfire detection can be disabled when the amount of engine load gradient exceeds a calibration value, this value is switched according combustion mode. Fade out delay is also specific to combustion mode.

**Initialisation:** at ECU reset, at Engine Stop **Or** at LC\_MIS\_INH 0 to 1 transition  
 LV\_INH\_LOAD\_GRD\_DET\_MIS = 1


**Formula section:**

```

If(1) LV_S_ACT = 0
Then(1)
  If(2)   LOAD_GRD_MIS > IP_LOAD_GRD_MIS(LOAD_MIS)
  Then(2)
    After condition rising edge triggering, LV_INH_LOAD_GRD_DET_MIS flag is set to 1 as
    long as condition is true.
    After condition falling edge triggering, LV_INH_LOAD_GRD_DET_MIS flag is hold to 1 for
    a period of C_T_LOAD_GRD_HOM_DLY_MIS.
  Endlf(2)

```

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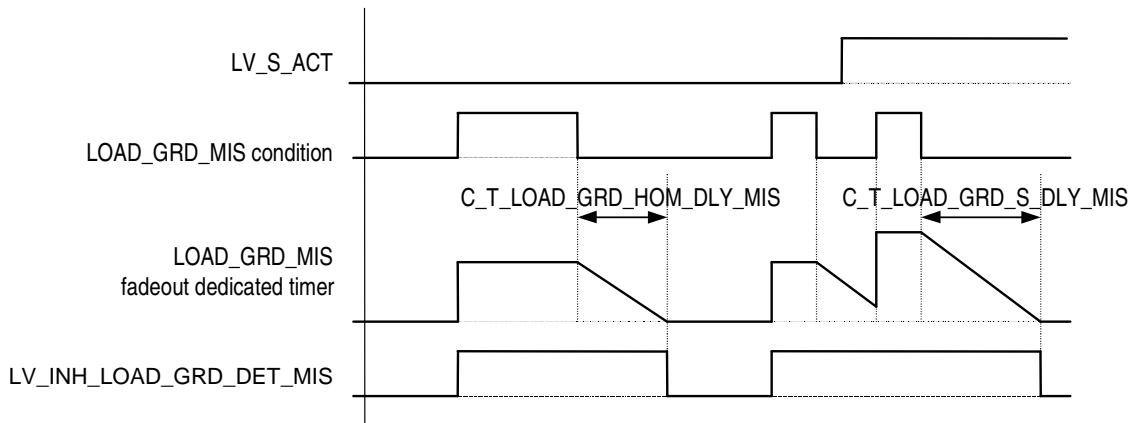
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```

Endlf(1)
#if NC_CMB_CONF = AFS_S Or AFS_AFL_S
  If(1) LV_S_ACT = 1
  Then(1)
    If(2) LOAD_GRD_MIS > IP_LOAD_GRD_S_MIS(LOAD_MIS)
    Then(2)
      After condition rising edge triggering, LV_INH_LOAD_GRD_DET_MIS flag is set
      to 1 as long as condition is true.
      After condition falling edge triggering, LV_INH_LOAD_GRD_DET_MIS flag is hold
      to 1 for a period of C_T_LOAD_GRD_S_DLY_MIS.
    Endlf(2)
  Endlf(1)
#Endlf

```

**Fade out behaviour summary:**



**B.108.2.6 Ignition retardation without change limitation**

Various functions or CAN requests (e.g.. gear-shift signal. torque reduction. etc...) cause an ignition - timing retardation, without change limitation. Misfire detection can be disabled when the amount of the ignition timing retardation is too important.

Several criterion are available to disable the misfire monitoring according the ignition angle behaviour. Two relative criterions dedicated to focus on IGA transients, one in idle speed and one in part load, plus one absolute criterion dedicated to focus on too important IGA values compared to the

**Initialisation:** at ECU reset, at Engine Stop **Or** at LC\_MIS\_INH 0 to 1 transition

LV\_INH\_IGA\_DIF\_DET\_MIS = 1

**Formula section:**

For each TDC, the following stacks are serviced after having calculated IGA\_AV\_x.


$IGA\_DIF\_MIS = | IGA\_MIS\_2 - IGA\_MIS |$   
 $IGA\_BAS\_DIF\_MIS = IGA\_BAS\_COR\_MV - IGA\_MIS$   
 $IGA\_MIS\_2 = IGA\_MIS\_1$   
 $IGA\_MIS\_1 = IGA\_MIS$   
 $IGA\_MIS = IGA\_AV[SEG\_NR]$

```

If(1) LV_S_ACT = 0
Then(1)

```

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```

If(2)   LV_IS = 1
          And N_32 < C_N_32_MAX_IGA_IS_MIS
          Then(2)
            If(3)   IGA_DIF_MIS > IP_DELTA_IGA_IS_MIS(TCO, LOAD_MIS_2)
            Then(3)   After condition rising edge triggering, LV_INH_IGA_DIF_DET_MIS flag is
                        set to 1 as long as condition is true.
            Else(3)   After condition falling edge triggering, LV_INH_IGA_DIF_DET_MIS flag is
                        hold to 1 for a period of C_NR_TDC_IGA_DIF_IS_MIS.
                        When this period is exceeded without retriggering, LV_INH_IGA_DIF_DET_
                        MIS releases to 0.

            EndIf(3)
          Else(2) // out of idle speed conditions
            If(3)   IGA_DIF_MIS > IP_DELTA_IGA_MIS(N_32, LOAD_MIS)
            Then(3)   After condition rising edge triggering, LV_INH_IGA_DIF_DET_MIS flag is
                        set to 1 as long as condition is true.
            Else(3)   After condition falling edge triggering, LV_INH_IGA_DIF_DET_MIS flag is
                        hold to 1 for a period of C_NR_TDC_IGA_DIF_MIS.
                        When this period is exceeded without retriggering, LV_INH_IGA_DIF_DET_
                        MIS releases to 0.


            EndIf(3)
          EndIf(2)
If(2)   LV_IGA_GRD_ACT = 0           // out of IGA engine start calculation phase
          And   IGA_BAS_DIF_MIS > IP_DELTA_IGA_BAS_MIS(N_MIS,LOAD_MIS)
          Then(2)   After condition rising edge triggering, LV_INH_IGA_DIF_DET_MIS flag is set to 1
                    as long as condition is true.
          Else(2)   After condition falling edge triggering, LV_INH_IGA_DIF_DET_MIS flag is hold to
                    1 for a period of C_NR_TDC_IGA_BAS_DIF_MIS.
                    When this period is exceeded without retriggering, LV_INH_IGA_DIF_DET_MIS
                    releases to 0.

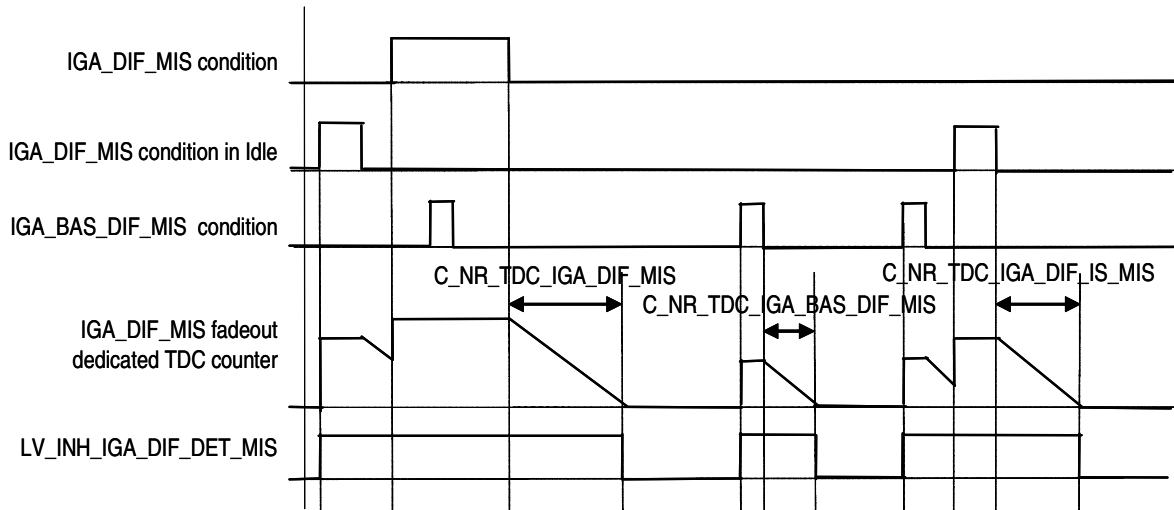
          EndIf (2)
EndIf(1)

// note: the TDC decoupler is retriggered only if the considered preload calibration is greater than the
decounter actual value.

```

### Fade out behaviour summary:

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 6222 of 8404</b>	
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### B.108.2.7 Combustion mode transients

#### Application conditions:

While the combustion manager is in transient state, the misfire detection can be disabled to have a proper base for evaluation of the ER-misfire detection thresholds, which are defined for the stationary modes (AFS, AFL & S). See definition in Application Incidences file. (LV\_INH\_CMB\_TRA\_MIS = 1).

### B.108.2.8 Air - conditioning compressor activation

When the air - conditioning compressor is switched on, an additional load is briefly applied to the engine.

This load jump can cause a segment period jump and crankshaft vibration, depending on the engine operating state and load request.

#### Application conditions:

Misfire detection can be suppressed for the applicable constant period C\_T\_ACCOUT\_DLY\_MIS, starting if the air - conditioning compressor is switched on or off (LV\_ACCOUT\_RLY changes from 0 to 1 or from 1 to 0), during this period LV\_INH\_ACC\_DET\_MIS is set to 1.

**Initialisation:** at ECU reset, at Engine Stop **Or** at LC\_MIS\_INH 0 to 1 transition

LV\_INH\_ACC\_DET\_MIS = 1

#### Formula section:

**If** LV\_ACCOUT\_RLY = 0 -> 1

**Or** LV\_ACCOUT\_RLY = 1 -> 0

**Then** LV\_INH\_ACC\_DET\_MIS is set to 1 during C\_T\_ACCOUT\_DLY\_MIS

**EndIf**

### B.108.2.9 Rough road detection

#### Application conditions:

Misfire detection can be suppressed when the status of the *rough road detection* is active (LV\_STATE\_RR = 1).

### B.108.2.10 Crankshaft oscillation detection

#### Application conditions:

Misfire detection can be suppressed when the status of the *crankshaft oscillation detection* is active (LV\_STATE\_CRK\_OSC = 1).

### B.108.2.11 Low fuel level

#### Application conditions:

Misfire detection can be suppressed when the low fuel level is detected (LV\_INH\_FTL\_L\_DET\_MIS=1).

### B.108.2.12 OBDI diagnosis fade-out


#### Application conditions:

LV\_INH\_OBD\_DET\_MIS combines all OBD project specific error bits to generate an input for the generic misfire detection fade-out conditions. See *definition in Misfire detection - Application Incidences file*. Misfiring detection can be suppressed if LV\_INH\_OBD\_DET\_MIS = 1

### B.108.2.13 Application incidences fade-out

#### Application conditions:

LV\_INH\_APP\_DET\_MIS combines all project specific special conditions to generate an input for the generic misfire detection fade-out conditions. See *definition in Misfire detection - Application Incidences file*. Misfiring detection can be suppressed if LV\_INH\_APP\_DET\_MIS = 1

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## B.109 Legal misfire detection fade-out conditions

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_T_ZDLY_MIS	O/V	0... FFFFH	0... 655.35	0.01	s
10 ms decoupler for diagnostic fade out (general purpose)					
CTR_TDC_ZDLY_MIS	V	0... FFFFH	0... 65535	1	-
TDC decoupler for disabled diagnostic					
LV_DIAG_MIS	O/V	0... 1H	0 ...1	1	-
Nominal Misfire Monitoring Phase					
LV_INH_AMP_MIN_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to minimum atmospheric pressure condition					
LV_INH_IV_OFF_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to cylinder shut-off condition					
LV_INH_LOAD_MIN_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to zero load line condition					
LV_INH_N_MAX_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to maximum engine speed condition					
LV_INH_N_MIN_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to minimum engine speed condition					
LV_INH_ST_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to engine start condition					
LV_INH_TCO_MIN_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to minimum temperature condition					
LV_IV_OFF_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out flag due to cylinder shut-off, phased with misfire detection index					
LV_PUC_DET_MIS	V	0... 1H	0 ...1	1	-
Fuel Cut-Off dedicated to misfire detection, including a delay time for fuel reactivation					
LV_REQ_INH_MIS	O/V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag					
LV_ZDLY_DIAG_MIS	O/V	0... 1H	0 ...1	1	-
Zero Delay Misfire Monitoring Phase					
MIS_DET_CDN_INH	V	0... 3FH	0... 63	1	-
Misfiring detection fade out requests carrier byte (before masking)					
MIS_DET_CDN_INH_NR	V	0... FFH	0... 255	1	-
Misfiring detection fade out requests number (after masking)					
STATE_DIAG_MIS	V	0H 1H 2H 3H 4H	INI_PHA PREP_0_DLY 0_DLY_MON PREP_MON NOM_MON	-	-
Misfire Detection Phase State Machine					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**Input data:**

AMP {p. 982}	LC_MIS_INH {p. 6277}	LOAD_MIN_MIS {p. 6283}	LOAD_MIS {p. 6213}
LV_AT {p. 654}	LV_DC {p. 5746}	LV_ES {p. 1720}	LV_INJ_CUT {p. 2295}
LV_REQ_APP_INH_MIS {p. 6213}	LV_RUN_ENG {p. 1505}	LV_ST {p. 1720}	N {p. 1525}
NC_CYL_NR {p. 1526}	PREV_STATE_IV {p. 2039}	SEG_NR {p. 1525}	SUM_INH_INJ {p. 2295}
TCO {p. 1100}	TCO_ST {p. 1100}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_MIN_MIS	-	0... FFFFH	0... 5434	82.8999e-3	hPa
Minimum atmospheric pressure for misfire detection					
C_MASK_INH_DET_MIS	-	0... FFH	0... 255	1	-
MIS_DET_CDN_INH carrier structure fade out configuration mask (misfire detection nominal phase)					
C_MASK_INH_DET_ZDLY_MIS	-	0... FFH	0... 255	1	-
MIS_DET_CDN_INH carrier structure fade out configuration mask (misfire detection zero delay phase)					
C_N_MAX_MIS_AT	-	0... 1FE0H	0... 8160	1	rpm
Maximum engine speed for misfire detection /automatic transmission.					
C_N_MAX_MIS_MT	-	0... 1FE0H	0... 8160	1	rpm
Maximum engine speed for misfire detection /manual transmission.					
C_N_MIN_MIS	-	0... 1FE0H	0... 8160	1	rpm
Minimum engine speed for misfire detection.					
C_N_MIN_ZDLY_MIS	-	0... 1FE0H	0... 8160	1	rpm
Minimum monitoring engine speed for engine start monitoring phase					
C_NR_TDC_INH_MIS	-	0... FFH	0... 255	1	-
Fade out duration in TDC when engine speed rise up to C_N_MIN_ZDLY_MIS					
C_NR_TDC_IV_OFF_DET_MIS	-	0... 7H	0 ...7	1	-
TDC delay to synchronise cylinder shut-off information with the misfire detection index					
C_NR_TDC_ZDLY_MIS	-	0... FFH	0... 255	1	-
Standard TDC count disablement tdc number before monitoring (engine start phase)					
C_SEG_NR_OFS_PREV_STATE_IV	-	0... BH	0... 11	1	-
Offset to correct index of PREV_STATE_IV with reference to segment number					
C_SUM_INH_IV_MAX_MIS	-	0... 8H	0 ...8	1	-
Maximum number of cylinders in shut-off to fade-out					
C_T_DLY_IV_OFF_MIS	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration after injection is back on.					
C_T_DLY_ST_MIS	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when engine operating state start LV_ST has been exited.					
C_T_ZDLY_MIS	-	0... FFFFH	0... 655.35	0.01	s
Duration for engine start specific misfire monitoring (5s according CARB)					
C_TCO_MIN_MIS	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature for misfire detection					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_WUP_MIN_MIS	-	0... FEH	-48... 142.5	0.75	°C
Minimum warm up coolant temperature for misfire detection					
LC_REQ_ZDLY_MIS	-	0... 1H	0 ...1	1	-
Activation of CARB-required 0-delay monitoring					

## General information

This chapter is relative to misfire detection fade out management as defined by legal texts linked to functional OBD diagnosis (OBDII, EOBD...).

Continuous misfire monitoring from engine starting instant:

- **Engine start instant** : the point when the engine reaches a speed 150 rpm below the normal, warmed-up idle speed (as determined in the drive position for vehicles equipped with an automatic transmission) (CARB definition).
- One engine cycle (2 crankshaft revolutions) is allowed to initialise misfire detection process (see CTR\_TDC\_ZDLY\_MIS using).

Fade out conditions may disable misfire monitoring with the following conditions:

- **Minimum engine speed** : N\_IS\_SP - 150 rpm (US)
- **Maximum engine speed** : Redline engine speed (US) or -00 rpm (EC)
- **Minimum engine load** :

Zero load line (engine positive torque line)

A line joining the point (3000 rpm, zero load) and a point (6000 rpm, 135 hPa (or 4 inches Hg) above the zero load line)

- **Minimum coolant or ambient temperature**

Below 20°F (US) or -7°C (EC) (equivalent),

Or If Engine start coolant temperature is below 20°F, until current temperature reaches warm up engine temperature 70°F.

- **Minimum atmospheric pressure**

Elevations above 8000 feet above sea level (US) or 2 500 meters (EC)

- **Time after start**

A 5s time after start fade-out can be allowed for EC market

Such kind of fade out is prohibited for US market (see CARB requirement for zero delay misfire monitoring activation)

- **Cylinder shut-off**

During fuel cut-off phase, on a specific cylinder shut-off or the number of cylinder in shut-off is too important, misfire diagnosis may be fade out (no injection/combustion occurs)


## B.109.1 Misfire detection fade out management

### FUNCTION DESCRIPTION:

CARB requests an activation of the misfire monitoring and diagnosis as off engine start. Particular fade-out conditions are required during the first 5 seconds since engine running. In this section the flag representing the request is defined, and is used in several other modules that are concerned with this requirement (LC\_REQ\_ZDLY\_MIS = 1).

For non-CARB applications, this special monitoring is not required and has to be de-activated (LC\_REQ\_ZDLY\_MIS = 0).

A state-based approach is taken for the activation of the misfire detection algorithms, distinguishing the separate monitoring during the first 5 seconds and the 'nominal' monitoring afterwards, and preparatory phases. During the monitoring phases, the normal fade-out mechanisms are used, corrected for some fade-outs that are not allowed during the first 5 seconds.

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**Application conditions:***Activation:*

Engine Start LV\_RUN\_ENG = 1

*Deactivation:*

Engine Stop LV\_RUN\_ENG = 0 Or ECU reset

**Remark:** At deactivation, ALL internal and external variables related to the legal fade out misfire detection conditions must be reset to 0.

In nominal mode (after engine start and zero delay period), the state machine executes no operations.

**Formula section:**

At engine start-up (LV\_RUN\_ENG switches from 0 to 1) the system starts in STATE\_DIAG\_MIS = 0 (initialisation phase).

In the case of a CARB-application, special monitoring takes place during C\_T\_ZDLY\_MIS seconds. The timer is started at detection of engine running:

```

If          LC_REQ_ZDLY_MIS = 1
      And      STATE_DIAG_MIS = 0
Then        CTR_T_ZDLY_MIS = C_T_ZDLY_MIS
EndIf

```

Transition initialisation state to preparation states for 0-delay OR to nominal monitoring

```

If          LC_REQ_ZDLY_MIS = 1
      And      STATE_DIAG_MIS = 0
      And      N > C_N_MIN_ZDLY_MIS
Then        Zero-Delay Activation of Misfire Detection
              STATE_DIAG_MIS = 1
              CTR_TDC_ZDLY_MIS = C_NR_TDC_ZDLY_MIS
ElseIf     LC_REQ_ZDLY_MIS = 0
      And      STATE_DIAG_MIS = 0
      And      N > C_N_MIN_ZDLY_MIS
Then        Standard Activation of Misfire Detection
              STATE_DIAG_MIS = 3
              CTR_TDC_ZDLY_MIS = C_NR_TDC_ZDLY_MIS
Else       Initialisation Phase
              LV_DIAG_MIS = 0
              LV_ZDLY_DIAG_MIS = 0

```

**EndIf**

Transition back to the initialisation phase

```

If          LV_ES = 1
      And      STATE_DIAG_MIS <> 0
Then        In case of engine stop, return to initialisation phase
              STATE_DIAG_MIS = 0

```

**EndIf**


Transition preparation state 0-delay monitoring to 0-delay monitoring state

```

If          LC_REQ_ZDLY_MIS = 1          CARB application
      And      STATE_DIAG_MIS = 1          0-delay preparation state
      And      N > C_N_MIN_ZDLY_MIS        engine speed over threshold
      And      CTR_TDC_ZDLY_MIS = 0        1 engine cycle passed
Then        STATE_DIAG_MIS = 2
              LV_ZDLY_DIAG_MIS = 1

```

**EndIf**

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Transition preparation nominal state to nominal monitoring state

```

If          LC_REQ_ZDLY_MIS = 0          standard application
      And      STATE_DIAG_MIS = 3          preparation monitoring state
      And      N > C_N_MIN_ZDLY_MIS       engine speed over threshold
      And      CTR_TDC_ZDLY_MIS = 0       1 engine cycle passed
Then       STATE_DIAG_MIS = 4
              LV_DIAG_MIS = 1
  
```

**Endif**Transition 0-delay monitoring state to nominal monitoring state

```

If          LC_REQ_ZDLY_MIS = 1          CARB application
      And      STATE_DIAG_MIS = 2          0-delay monitoring state
      And      N > C_N_MIN_ZDLY_MIS       engine speed over threshold
      And      CTR_TDC_ZDLY_MIS = 0       1 engine cycle passed
      And      CTR_T_ZDLY_MIS = 0         timer finished (typically 5 seconds)
Then       STATE_DIAG_MIS = 4
              LV_DIAG_MIS = 1
              LV_ZDLY_DIAG_MIS = 0
  
```

**Endif**

The counter CTR\_T\_ZDLY\_MIS is decremented at every time instance of 10 ms when STATE\_DIAG\_MIS != 0.

The counter CTR\_TDC\_ZDLY\_MIS is decremented with 1 at every TDC.

(both counters are saturated to 0)

**Remark:** During the 0-delay misfire detection, no fade-outs are allowed for crankshaft oscillation, rough road detection and zero-load line conditions (see appropriate sections). However, it is allowed to have so-called driver-induced fade-outs (e.g. gradient on pedal value). This latter section has been added.

At hot resets, the system starts again in the initialisation phase.

**B.109.2 Misfire detection legal fade out conditions****FUNCTION DESCRIPTION:****General information:**

Legal fade out (LV\_REQ\_INH\_MIS) is based on all fade out conditions allowed by the legal texts for continuous misfire monitoring.

All these different fade-out conditions are merge into a global carrier (MIS\_DET\_CDN\_INH).

Timers used for fade-out conditions delays are free running timers who are not deactivated according following conditions.

**Application conditions:** (global to Misfire detection legal fade out conditions chapter)

**Initialisation:** at Reset, Engine Stop, **Or** on Deactivation event


```

LV_PUC_DET_MIS = 0
LV_IV_OFF_DET_MIS = 1
LV_REQ_INH_MIS = 1
MIS_DET_CDN_INH = 127
MIS_DET_CDN_INH_NR = 7
  
```

**Recurrence:** every segment task

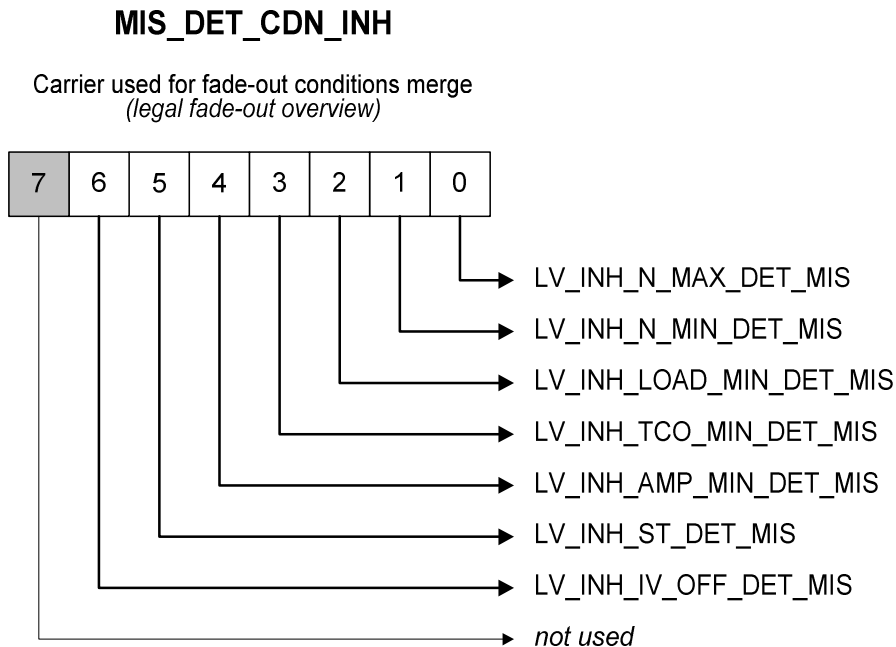
**Activation:** LC\_MIS\_INH = 0

**Deactivation:** LC\_MIS\_INH = 1

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## B.109.2.1 Fade out carrier definition

### Misfire fade out conditions carrier:



## B.109.2.2 Configurable Fade-out Management

### Application conditions:

Fade out management during zero delay phase & nominal phase can be configured via 2 bitfield masks that allow to take in account or not some conditions in a phase and not in the other.

If the corresponding bit in the MIS\_DET\_CDN\_INH carrier structure is set to 0 in C\_MASK\_INH\_DET\_ZDLY\_MIS or C\_MASK\_INH\_DET\_MIS calibration, then the corresponding condition will not fade-out misfire detection.

For the definition of C\_MASK\_INH\_DET\_ZDLY\_MIS & C\_MASK\_INH\_DET\_MIS masks please refer to the legal requirements & customer recommendations.

### Formula section:

**If** CTR\_T\_ZDLY\_MIS ? 0

**Then**

MIS\_DET\_CDN\_INH\_NR = sum(MIS\_DET\_CDN\_INH & C\_MASK\_INH\_DET\_ZDLY\_MIS)

(bitfield operations)

**Else**

MIS\_DET\_CDN\_INH\_NR = sum(MIS\_DET\_CDN\_INH & C\_MASK\_INH\_DET\_MIS)

(bitfield operations)

**Endif**

**If** MIS\_DET\_CDN\_INH\_NR 0

```

    Or      LV_REQ_APP_INH_MIS = 1           // Fade out request linked to misfire de-
tection method
Then      LV_REQ_INH_MIS = 1               // General fade out request
Else      LV_REQ_INH_MIS = 0
EndIf

```

### B.109.2.3 Maximum engine speed fade-out

#### Application conditions:

The misfire monitoring can be inhibited when the engine speed reaches the maximum engine speed imposed by the market target : Redline engine speed for US applications or -00 rpm for EC applications. Moreover this information is use to stop misfire monitoring process for high speed if not required (limitation of cpu load especially for european application).

#### Formula section:

```

If      ( LV_AT = 1           And      N > C_N_MAX_MIS_AT )
      Or      ( LV_AT = 0           And      N > C_N_MAX_MIS_MT )
Then    LV_INH_N_MAX_DET_MIS = 1
Else    LV_INH_N_MAX_DET_MIS = 0
EndIf

```

### B.109.2.4 Minimum engine speed fade-out

The irregular engine operation test is performed as soon as the above-mentioned condition is disabled.

#### Important:

- C\_N\_MIN\_MIS is defined by the current configuration of the index used for misfire detection in the current application. C\_N\_MIN\_MIS should be lower than C\_N\_MIN\_ZDLY\_MIS.
- C\_N\_MIN\_ZDLY\_MIS is defined as the engine speed set-point for a warm engine minus 150 rpm. After passing below the C\_N\_MIN\_ZDLY\_MIS threshold, one is allowed one engine cycle (meaning for example for a 4-cylinder engine 4 tdc's) before reactivating the output of the misfire detection algorithm. Misfire detection is suppressed for a period of C\_NR\_TDC\_INH\_MIS tdc's.
- It should be checked in each application that within the allowed number of TDC's proper misfire detection index values have been re-obtained. Typically, it should be possible to restart misfire detection earlier.

#### Application conditions:


$N < C\_N\_MIN\_ZDLY\_MIS$

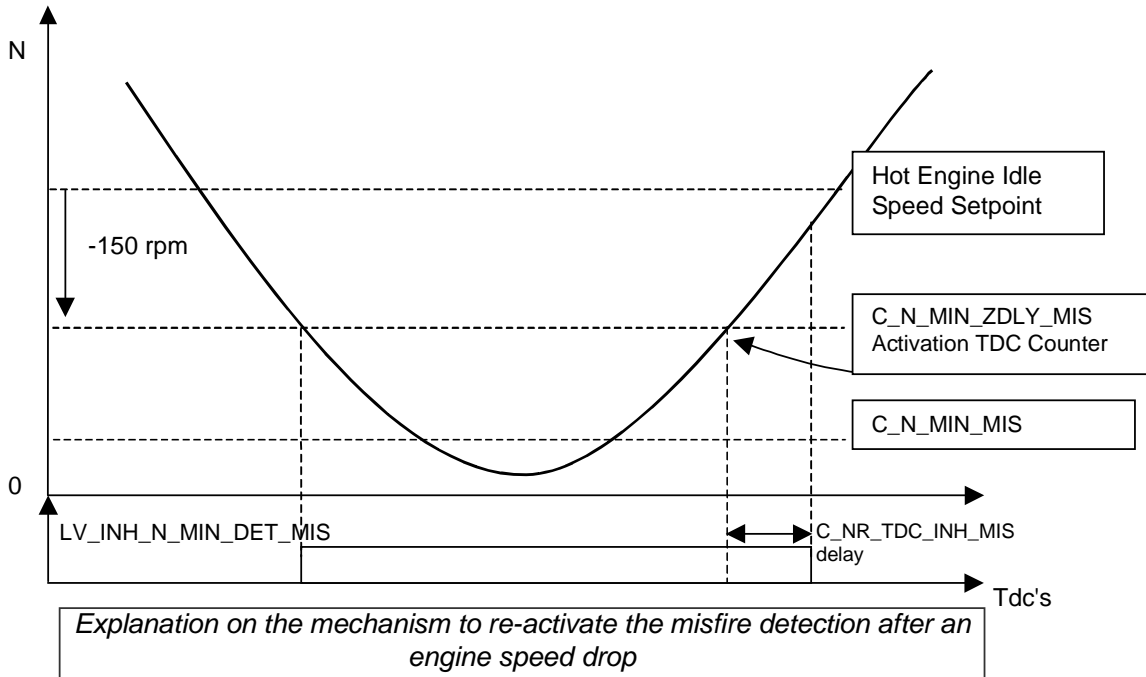
Engine speed below CARB requirements (*used for US applications*).

Typically, once  $N < C\_N\_MIN\_ZDLY\_MIS$ , the output of the misfire detection is inhibited, although the calculation is still valid. C\_NR\_TDC\_ZDLY\_MIS tdc's decoupler is started at passing engine speed C\_N\_MIN\_ZDLY\_MIS again. Once the decoupler is at 0, misfire detection index output is allowed.

$N < C\_N\_MIN\_MIS$

Engine speed below misfire detection index resolution (*used for CE applications*). If the engine speed falls below C\_N\_MIN\_MIS.

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As the misfiring test is not mandatory and risky over a certain engine speed threshold, a fade out condition is tested on engine rpm (not allowed for US market).

Activation:  $LV\_INH\_N\_MAX\_DET\_MIS = 0$

Deactivation:  $LV\_INH\_N\_MAX\_DET\_MIS = 1$

Action on deactivation event:  $LV\_INH\_N\_MIN\_DET\_MIS = 1$

#### Formula section:

If  $N < C\_N\_MIN\_ZDLY\_MIS$

Or  $N < C\_N\_MIN\_MIS$

Then  $LV\_INH\_N\_MIN\_DET\_MIS = 1$

Else  $LV\_INH\_N\_MIN\_DET\_MIS = 0$

caution : see specific reactivation conditions above when

$N > C\_N\_MIN\_ZDLY\_MIS$ ,  $C\_NR\_TDC\_INH\_MIS$  delay used

EndIf

#### B.109.2.5 Minimum engine load

##### Application conditions:

Below a specific load (zero load), fluctuations in engine speed cannot be detected, even in the event of misfire. In this case, the misfire detection is disabled.

Activation:  $LV\_INH\_N\_MAX\_DET\_MIS = 0$

Deactivation:  $LV\_INH\_N\_MAX\_DET\_MIS = 1$

Action on deactivation event:  $LV\_INH\_LOAD\_MIN\_DET\_MIS = 1$

##### Formula section:

If  $LOAD\_MIS < LOAD\_MIN\_MIS$

Then  $LV\_INH\_LOAD\_MIN\_DET\_MIS = 1$

Else  $LV\_INH\_LOAD\_MIN\_DET\_MIS = 0$



**Endf**

### B.109.2.6 Minimum coolant temperature

#### Application conditions:

Misfire detection can be disabled when the coolant temperature is below a threshold (20°F /-7°C). Additionally when the coolant temperature at engine start is below this threshold, the misfire monitoring can be disabled on that driving cycle until the current engine temperature reaches a warm up temperature threshold (70°F /21°C):

Activation:  $LV\_INH\_N\_MAX\_DET\_MIS = 0$   
 Deactivation:  $LV\_INH\_N\_MAX\_DET\_MIS = 1$   
 Action on deactivation event:  $LV\_INH\_TCO\_MIN\_DET\_MIS = 1$

#### Formula section:

*LV\_TEMP* : temporary bit used to check only one occurrence per engine start

Initialisation :  $LV\_TEMP = 0$  at ECU reset **Or**  $LV\_DC\ 0 \rightarrow 1$

```

If      TCO < C_TCO_MIN_MIS
Or      ( TCO_ST < C_TCO_MIN_MIS
           And      TCO < C_TCO_WUP_MIN_MIS
           And      LV_TEMP = 0 )
Then    LV_INH_TCO_MIN_DET_MIS = 1
Else    LV_INH_TCO_MIN_DET_MIS = 0
           LV_TEMP = 1
Endf

```

### B.109.2.7 Minimum atmospheric pressure

#### Application conditions:

Misfire detection can be disabled when the atmospheric pressure is below a threshold:

Activation:  $LV\_INH\_N\_MAX\_DET\_MIS = 0$   
 Deactivation:  $LV\_INH\_N\_MAX\_DET\_MIS = 1$   
 Action on deactivation event:  $LV\_INH\_AMP\_MIN\_DET\_MIS = 1$

#### Formula section:

```


If      AMP < C_AMP_MIN_MIS
           Then    LV_INH_AMP_MIN_DET_MIS = 1
Else    LV_INH_AMP_MIN_DET_MIS = 0
Endf

```

### B.109.2.8 After start

#### Application conditions

**Activation:**  $LV\_INH\_N\_MAX\_DET\_MIS = 0$   
**Deactivation:**  $LV\_INH\_N\_MAX\_DET\_MIS = 1$   
**Action on deactivation event:**  $LV\_INH\_ST\_DET\_MIS = 1$

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Misfire detection can be suppressed (see legal requirements - forbidden for CARB zero delay requirements) for a C\_T\_DLY\_ST\_MIS duration after the engine exits the operating state start (LV\_ST), during this period LV\_INH\_ST\_DET\_MIS is set to 1, even if C\_T\_DLY\_ST\_MIS = 0.

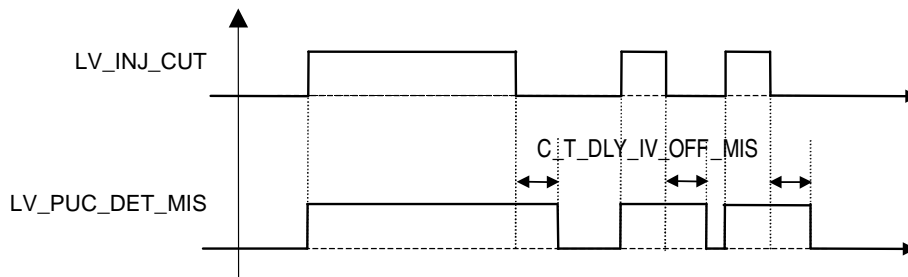
### B.109.2.9 Injection shut-off

#### Application conditions:

Misfire detection can be suppressed for the cylinder(s), for which injection has been shut-off.

#### General fuel shut-off:

LV\_INJ\_CUT indicates a general fuel shut-off. LV\_PUC\_DET\_MIS bit includes a calibration delay time (C\_T\_DLY\_IV\_OFF\_MIS) triggered at fuel cut-off condition falling edge, in a way to start the misfire detection only after crankshaft oscillations due to fuel reactivation.

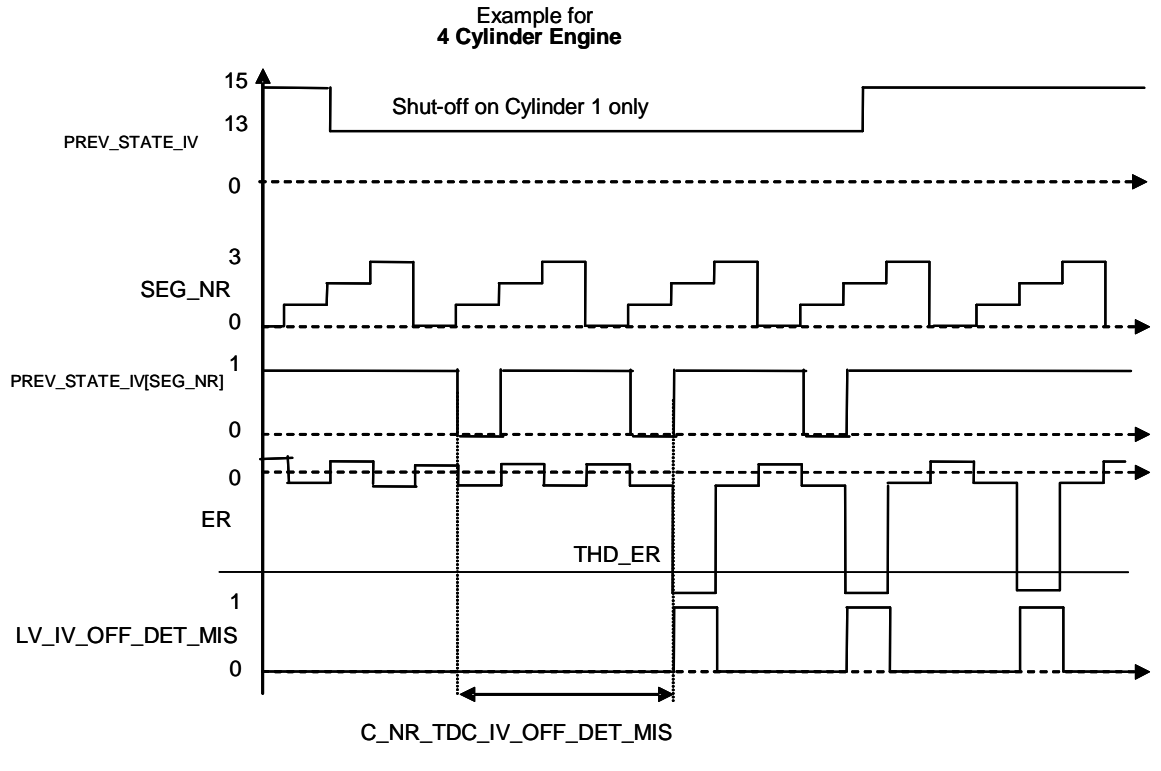


#### Cylinder specific shut-off:

If the current cylinder checked by misfire detection is shut-off by any EMS function even MISF limp home functionality), a fade-out can be apply for the misfire detection of this cylinder.

Due to the delay between the misfire index and the injection current informations, a calibration delay (C\_NR\_TDC\_IV\_OFF\_DET\_MIS) has been introduced on LV\_IV\_OFF\_DET\_MIS.

This delay synchronises MISF & INJR informations in a way to apply correctly the fade-out on the proper cylinder during individual cylinder shut-off operations, and to be able the perform the misfire monitoring on the other cylinders who are not in shut-off mode.



#### Limit number of cylinders shut-off:

If the number of shut-off cylinders reaches a calibration data (C\_SUM\_INH\_IV\_MAX\_DET\_MIS), reliable misfire detection is impossible. In such case is preferable to inhibit misfire detection.

#### Formula section:

##### General fuel shut-off:

```

If          LV_INJ_CUT = 1           // All cylinders are shut off
Then       LV_PUC_DET_MIS = 1
Else       LV_PUC_DET_MIS = 0 after C_T_DLY_IV_OFF_MIS delay time
EndIf

```

##### Cylinder fuel shut-off:

```

If          PREV_STATE_IV[(SEG_NR+C_SEG_NR_OFS_PREV_STATE_IV)%NC_CYL_NR] = 0 //
indexed by cylinder bit position
Then       LV_IV_OFF_DET_MIS = 1 after a C_NR_TDC_IV_OFF_DET_MIS delay
Else       LV_IV_OFF_DET_MIS = 0 after a C_NR_TDC_IV_OFF_DET_MIS delay
EndIf

```

```

Activation:   LV_INH_N_MAX_DET_MIS = 0
Deactivation: LV_INH_N_MAX_DET_MIS = 1
Action on deactivation event: LV_INH_IV_OFF_DET_MIS = 1

```

#### Formula section:

##### General definition:

```


If          LV_PUC_DET_MIS = 1
Or          LV_IV_OFF_DET_MIS = 1
Or          SUM_INH_INJ >= C_SUM_INH_IV_MAX_MIS

```

```

Then      LV_INH_IV_OFF_DET_MIS = 1
Else      LV_INH_IV_OFF_DET_MIS = 0
EndIf

```

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## B.110 Misfire rate determination and error management

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CHK_MIS_A	V	0... FFH	0... 255	1	-
CARB A windows occurrence counter					
CTR_CHK_MIS_B4	V	0... FFH	0... 255	1	-
CARB B4 window occurrence counter					
CTR_DET_MIS_A	V	0... FFH	0... 255	1	-
CARB A misfire criterion detected counter					
CTR_DET_MIS_B4	V	0... FFH	0... 255	1	-
CARB B4 misfire criterion detected counter					
CTR_FTP_CDN_MIS_A	V	0... FFFFH	0... 65535	1	-
TDC counter for FTP condition detection					
CTR_MIS_A_LIH_CYL [NC_CYL_NR]	V	0... FFH	0... 255	1	-
Cylinder dedicated counters for CARB A Limp-home phases on current DC					
CTR_MIS_DC_CYL [NC_CYL_NR]	O/V/S	0... FFFFH	0... 65535	1	-
Former /current driving cycle misfire detection cylinder counters (ISO15031 Data \$0C)					
CTR_MIS_DC_MMV_CYL [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Exponential weighted moving average (EWMA) misfire counters (ISO15031 Data \$0B)					
CTR_MIS_DC_MMV_CYL_IT [NC_CYL_NR]	V/S	0... 63FF9CH	0... 65535	0.01	-
Exponential internal weighted moving average (EWMA) misfire counters (ISO15031 Data \$0B)					
CTR_MIS_TOT_DC	O/V/S	0... FFFFH	0... 65535	1	-
Former /current driving cycle overall misfire detection counter					
CTR_MIS_TOT_NVMY	V/S	0... FFFFFFFFH	0... 4294967295	1	-
Overall misfire detection counter					
FAC_IGC_DIAG_MIS	V	0... FFH	0... 1.99218	0.0078125	-
Reliability weighting factor for ignition diagnosis (ignition failure detected)					
FAC_IV_DIAG_MIS	V	0... FFH	0... 1.99218	0.0078125	-
Reliability weighting factor for injection valve (injection valve failure detected)					
INH_IV_MIS	O/V	0... FFH	0... 255	1	-
Identification of cylinders shut off by misfire CARB A					
LV_DET_CFM_MIS	O/V	0... 1H	0 ...1	1	-
Flag for individual confirmed misfire detection after crossed diagnosis					
LV_DET_MIS_A	V	0... 1H	0 ...1	1	-
CARB A misfire criterion detected in actual 200 rev. window (not debounced)					
LV_DET_MIS_B4	V	0... 1H	0 ...1	1	-
CARB B4 misfire criterion detected in actual 1000 rev. window, (not debounced)					
LV_END_MIS_A	O/V	0... 1H	0 ...1	1	-
CARB A misfire criterion determination end					
LV_END_MIS_B1	O/V	0... 1H	0 ...1	1	-
CARB B1 misfire criterion determination end					
LV_END_MIS_B4	O/V	0... 1H	0 ...1	1	-
CARB B4 misfire criterion determination end					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_WIN_MIS_A	O/V	0... 1H	0 ...1	1	-
End of CARB A window for similar condition					
LV_END_WIN_MIS_B1	O/V	0... 1H	0 ...1	1	-
End of CARB B1 window for similar condition					
LV_END_WIN_MIS_B4	O/V	0... 1H	0 ...1	1	-
End of CARB B4 window for similar condition					
LV_ERR_IN_WIN_MIS_A	O/V	0... 1H	0 ...1	1	-
End during CARB A window for similar condition					
LV_ERR_IN_WIN_MIS_B1	V	0... 1H	0 ...1	1	-
Error during CARB B1 window for similar condition					
LV_ERR_IN_WIN_MIS_B4	V	0... 1H	0 ...1	1	-
Error during CARB B4 window for similar condition					
LV_ERR_MIS_A_IN_WIN_B	O/V	0... 1H	0 ...1	1	-
Error MIS_A during CARB B1/B4 window for similar condition					
LV_FTP_MIS_A	V	0... 1H	0 ...1	1	-
Boolean for FTP emission cycle condition status at the end of CARB A window					
LV_INH_IV_MIS_A	O/V	0... 1H	0 ...1	1	-
At least one cylinder is shut-off by a CARB A misfire criterion confirmed					
LV_MIS_STATE_A	O/V	0... 1H	0 ...1	1	-
CARB A misfire criterion confirmed (debounced)					
LV_MIS_STATE_B	O/V	0... 1H	0 ...1	1	-
CARB B (B1 or B4) misfire criterion confirmed (debounced)					
LV_MIS_STATE_B1	O/V	0... 1H	0 ...1	1	-
CARB B1 misfire criterion confirmed					
LV_MIS_STATE_B4	O/V	0... 1H	0 ...1	1	-
CARB B4 misfire criterion confirmed (debounced)					
MIS_A_FAC	V	0... 64H	0... 100	1	-
Catalyst damage weighting factor to increment cylinder specific counters when misfire is detected					
MIS_A_FAC_BUF [NC_SIZE_THD_ER_BUF]	V	0... 64H	0... 100	1	-
Catalyst damage weighting factor buffer					
MIS_CTR_A [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Misfire sums (cylinder individual) after combination and weighting in CARB A window.					
MIS_CTR_B [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Misfire sums (cylinder individual) after combination in CARB B window					
MIS_NR_TDC_A	V	0... FFFFH	0... 65535	1	-
TDC counter CARB A window (200 crankshaft revolutions).					
MIS_NR_TDC_B	V	0... FFFFH	0... 65535	1	-
TDC counter CARB B window (1000 crankshaft revolutions)					
MIS_SUM_A	O/V	0... FFFFH	0... 65535	1	-
CARB A misfire weighted sum (global)					
MIS_SUM_A_CBK [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
CARB A misfire weighted sum (dedicated to Exhaust cylinder bank)					
MIS_SUM_B	O/V	0... FFFFH	0... 65535	1	-
CARB B misfire sum (global)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MIS_SUM_B_CBK [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
CARB B misfire sum (exhaust cylinder bank dedicated)					
SEG_NR_CBK_ER	V	0... FFH	0... 255	1	-
Exhaust cylinder bank reference for misfire monitoring					
SUM_FAC_DIAG_MIS	V	0... 2FDH	0... 5.97656	0.0078125	-
Sum of the weighting factor from diagnosis combinations for final misfire decision.					
SYM_CYL_MIS_A	O/V	0... FFFFH	0... 65535	1	-
CARB A misfire criterion symptoms					
SYM_CYL_MIS_B1	O/V	0... FFFFH	0... 65535	1	-
CARB B1 misfire criterion symptoms					
SYM_CYL_MIS_B4	O/V	0... FFFFH	0... 65535	1	-
CARB B4 misfire criterion symptoms					

**Input data:**

FAC_ER_DIAG_MIS {p. 6263}	FAC_MIS_A_APP {p. 6263}	FAC_MIS_A_THD_IND_ APP {p. 6263}	FAC_MIS_SUM_A_THD_ APP {p. 6263}
FAC_MIS_SUM_B1_THD_ APP {p. 6263}	FAC_MIS_SUM_B4_THD_ APP {p. 6263}	IGC_DIAG_MIS {p. 4772}	INH_INJ {p. 2295}
LC_MIS_INH {p. 6277}	LOAD_MIS {p. 6213}	LV_AT {p. 654}	LV_CDN_MIS_A {p. 6264}
LV_CDN_MIS_B1 {p. 6264}	LV_CDN_MIS_B4 {p. 6264}	LV_DC {p. 5746}	LV_DET_MIS {p. 6276}
LV_ENA_ER {p. 1454}	LV_ES {p. 1720}	LV_INH_IGC_DIAG_MIS {p. 6264}	LV_INH_IV_DIAG_MIS {p. 6264}
LV_MIS_B_DIAG_REQ_ APP {p. 6264}	LV_PUC {p. 1720}	LV_REQ_APP_CTR_MIS_ A {p. 6264}	LV_SYN_ENG {p. 1506}
N {p. 1525}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}
NLC_ENA_SCDN_NEW {p. 645}	SEG_NR_ER {p. 1454}	STATE_DIAG_IV {p. 4803}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LOAD_MIS_FTP	-	0... 7FFFH	0... 99.99694	3.0518e-3	%
FTP cycle engine load threshold					
C_MIS_A_IND_THD_AT	-	0... FFFFH	0... 65535	1	-
Cylinder individual threshold used for cylinder shut-off during CARB A criterion window with AT					
C_MIS_A_IND_THD_MT	-	0... FFFFH	0... 65535	1	-
Cylinder individual threshold used for cylinder shut-off during CARB A criterion window with MT					
C_MIS_A_MIN_NR	-	0... FFH	0... 99.60937	0.390625	%
Cylinder identification ratio for CARB A criterion detection					
C_MIS_B1_MIN_NR	-	0... FFH	0... 99.60937	0.390625	%
Cylinder identification ratio for CARB B1 criterion detection					
C_MIS_B4_MIN_NR	-	0... FFH	0... 99.60937	0.390625	%
Cylinder identification ratio for CARB B4 criterion detection					
C_MIS_MAX_NR_OFF_IV	-	0... 4H	0... 4	1	-
Maximum number of allowed cylinder to be shut-off after detection of the misfire status CARB A.					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MIS_MIN_NR_PUC	-	1... FFH	1... 255	1	-
Minimum number of trailing throttle fuel cut-off phases LV_PUC before cancelling cylinder(s) shut-off.					
C_MIS_NR_OFF_IV_IGCFB	-	0... 8H	0...8	1	-
Threshold for number of cylinders shut off due to misfire					
C_MIS_SUM_A_CBK_THD_AT	-	0... FFFFH	0... 65535	1	-
Exhaust cylinder bank threshold for misfire status CARB A detection with AT					
C_MIS_SUM_A_CBK_THD_MT	-	0... FFFFH	0... 65535	1	-
Exhaust cylinder bank threshold for misfire status CARB A detection with MT					
C_MIS_SUM_A_THD_AT	-	0... FFFFH	0... 65535	1	-
Cylinder global threshold for misfire status CARB A detection with AT					
C_MIS_SUM_A_THD_MT	-	0... FFFFH	0... 65535	1	-
Cylinder global threshold for misfire status CARB A detection with MT					
C_MIS_SUM_B1_CBK_THD	-	0... FFFFH	0... 65535	1	-
Exhaust cylinder bank threshold for CARB B1 misfire criterion detection					
C_MIS_SUM_B1_THD_AT	-	0... FFFFH	0... 65535	1	-
Global threshold for CARB B1 misfire criterion detection, LV_AT = 1					
C_MIS_SUM_B1_THD_MT	-	0... FFFFH	0... 65535	1	-
Global threshold for CARB B1 misfire criterion detection, LV_AT = 0					
C_MIS_SUM_B4_CBK_THD	-	0... FFFFH	0... 65535	1	-
Exhaust cylinder bank threshold for CARB B4 misfire criterion detection					
C_MIS_SUM_B4_THD_AT	-	0... FFFFH	0... 65535	1	-
Global threshold for CARB B4 misfire criterion detection, LV_AT = 1					
C_MIS_SUM_B4_THD_MT	-	0... FFFFH	0... 65535	1	-
Global threshold for CARB B4 misfire criterion detection, LV_AT = 0					
C_N_MIS_FTP	-	0... 1FE0H	0... 8160	1	rpm
FTP cycle engine speed threshold					
C_NR_CYL_MPL_MIS_A	-	0... FFH	0... 255	1	-
Number of cylinder in MIS_A to set the multiple misfire CARB A status (typical: 2)					
C_NR_CYL_MPL_MIS_B	-	0... FFH	0... 255	1	-
Number of cylinder in MIS_Bx to set the multiple misfire CARB Bx status (typical: 2)					
C_NR_DET_MAX_MIS_A	-	0... FFH	0... 255	1	-
Maximum value to confirm misfire CARB A status detection (typical: 3) for long term protection					
C_NR_DET_MAX_MIS_B4	-	0... FFH	0... 255	1	-
Maximum value of CTR_DET_MIS_B4 for misfire CARB B4 status detection (typical: 4)					
C_NR_MAX_MIS_A_LIH_CYL	-	0... FFH	0... 255	1	-
Maximum number of MIS_A cylinder limp-home cycle to disable fuel reactivation during current DC					
C_RATIO_FTP_CDN_IND_MIS_AT	-	0... FFH	0... 99.60937	0.390625	%
Covering ratio to detect FTP conditions for short term protection with AT vehicle					
C_RATIO_FTP_CDN_IND_MIS_MT	-	0... FFH	0... 99.60937	0.390625	%
Covering ratio to detect FTP conditions for short term protection with MT vehicle					
C_RATIO_FTP_CDN_MIS_AT	-	0... FFH	0... 99.60937	0.390625	%
Covering ratio to detect FTP conditions for long term protection with AT vehicle					
C_RATIO_FTP_CDN_MIS_MT	-	0... FFH	0... 99.60937	0.390625	%
Covering ratio to detect FTP conditions for long term protection with MT vehicle					




Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MIS_MIN_PUC	-	1... 3E8H	0.1 ...100	0.1	s
Minimum duration of trailing throttle fuel cut-off phase to be validated like this.					
ID_NR_DET_ENA_MIS_A_LIH_AT	-	0... FFH	0... 255	1	-
LDPM_N_32_1_MISF	8	0... FFH	0... 8160	32	rpm
Number of CARB-A detections to enable MIS_A cylinder switch-off limp-home for AT					
ID_NR_DET_ENA_MIS_A_LIH_MT	-	0... FFH	0... 255	1	-
LDPM_N_32_1_MISF	8	0... FFH	0... 8160	32	rpm
Number of CARB-A detections to enable MIS_A cylinder switch-off limp-home for MT					
IP_FAC_IGC_DIAG_MIS	V	0... FFH	0... 1.99218	0.0078125	-
LDP_N_32_IP_FAC_IGC_DIAG_MIS	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_IP_FAC_IGC_DIAG_MIS	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for ignition diagnosis (ignition failure detected).					
IP_FAC_IV_DIAG_MIS	V	0... FFH	0... 1.99218	0.0078125	-
LDP_N_32_IP_FAC_IV_DIAG_MIS	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_MIS_IP_FAC_IV_DIAG_MIS	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for injection valve diagnosis (injection valve failure detected).					
LC_CONF_INH_IV_MIS	-	0... 1H	0 ...1	1	-
Cylinder switch back on configuration mode : switch back on at the end of driving cycle (=0) or after a defined number of fuel cut-off phases (=1)					
LC_CONF_MIS_A_LIH	-	0... 1H	0 ...1	1	-
Configuration to select MIL mode in case of cylinder shut-off (=0, LV_MIS_STATE_A=0, MIL is not set by cylinder shut-off function), (=1, LV_MIS_STATE_A=1, MIL is ON until end of cylinder shut-off, see mode chosen with LC_CONF_INH_IV_MIS)					
LC_CONF_MIS_STATE_B	-	0... 1H	0 ...1	1	-
Configuration for LV_MIS_STATE_B setting (=0, setting by MIS_B1 only when end of MIS_B4 isn't reached, then only set by MIS_B4) (=1, setting by MIS_B1 or MIS_B4 in any case)					
LC_CONF_MPL_DET_MIS_A	-	0... 1H	0 ...1	1	-
Configuration for multiple cylinder status set in SYM_CYL_MIS_A (multiple misfire pattern Pcode saved) (=1)					
LC_CONF_MPL_DET_MIS_B	-	0... 1H	0 ...1	1	-
Configuration for multiple cylinder status set in SYM_CYL_MIS_Bx (multiple misfire pattern Pcode saved) (=1)					
LC_CONF_RND_DET_MIS_A	-	0... 1H	0 ...1	1	-
Configuration for random cylinder detection when no specific cylinder identified, (=0) Cyl. with the highest value is identified in SYM_CYL_MIS_A or (=1) No identification is realised and RDN bit is set to 1 in SYM_CYL_MIS_A					
LC_CONF_RND_DET_MIS_B	-	0... 1H	0 ...1	1	-
Configuration for random cylinder detection when no specific cylinder identified,: (=0) Cyl. with the highest value is identified in SYM_CYL_MIS_B1 or SYM_CYL_MIS_B4 or (=1) No identification is realised and RDN bit is set to 1 in SYM_CYL_MIS_B1/B4					
LC_ENA_MIS_A_IND_LIH	-	0... 1H	0 ...1	1	-
Enable the misfire cylinder limp home process during the CARB A window (short term catalyst protection) (=1, active)					
LC_ENA_MIS_A_LIH	-	0... 1H	0 ...1	1	-
Enable the misfire cylinder limp home process at the end of the CARB A window (long term catalyst protection) (=1, active)					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CBK_EX_NR_MISF [NC_CYL_NR]	-	0... FFH	0... 255	1	-
Exhaust cylinder bank allocation according misfire segment phasing					

**General information:**

The misfire rate determination and misfire specific error management are applied to the following CARB misfire legal definitions:

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- **CARB A misfire failure criterion (LV\_MIS\_STATE\_A):**

Risk of catalyst damage, monitoring interval over 200 crankshaft revolutions (= 200 \* NC\_CYL\_NR /2 TDCs) during the driving cycle.


- **CARB B1 misfire failure criterion (LV\_MIS\_STATE\_B1):**

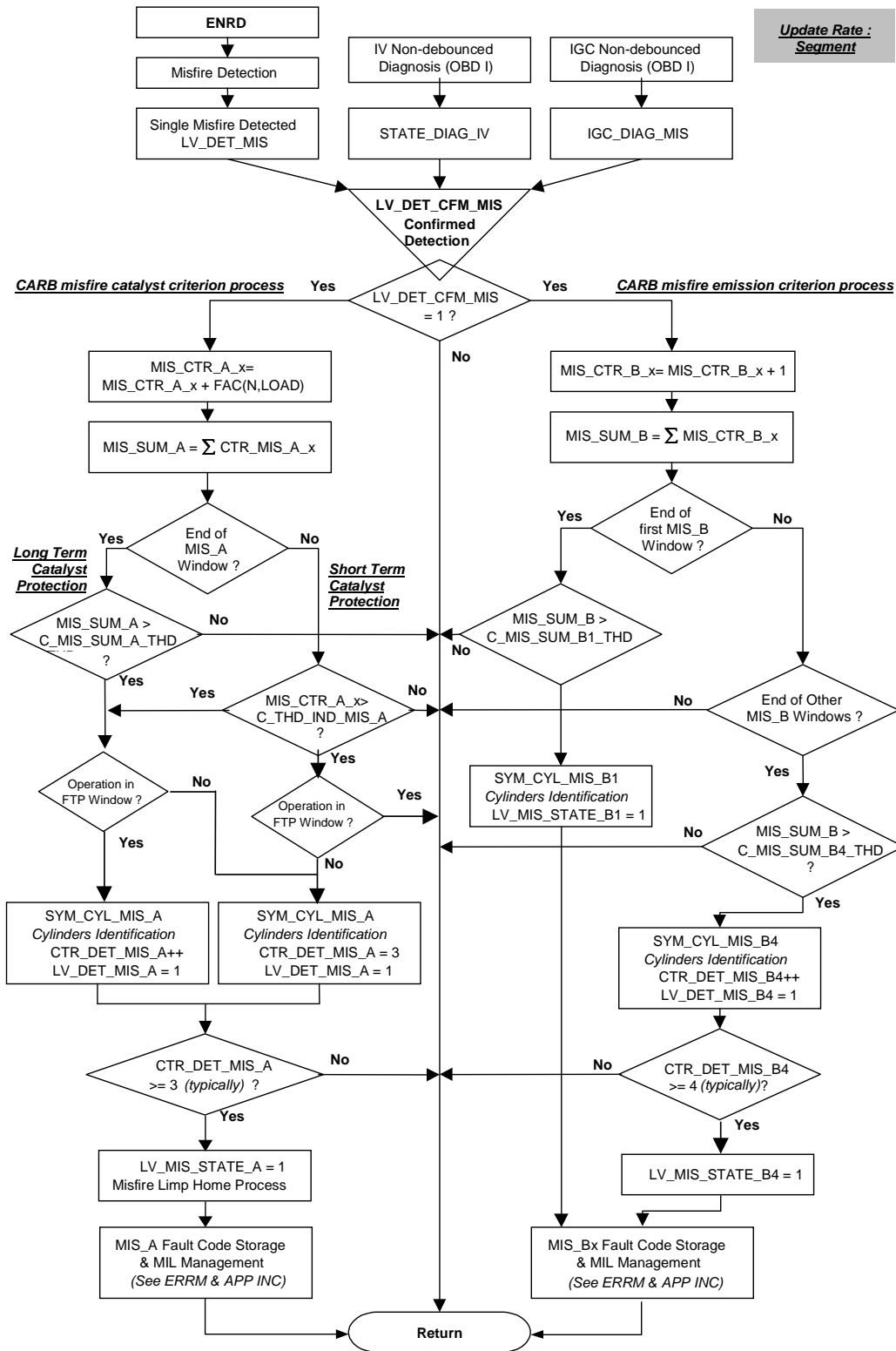
Emission increase, monitoring interval over the first 1000 crankshaft revolutions (= 1000 \* NC\_CYL\_NR /2 TDCs) of the driving cycle.

- **CARB B4 misfire failure criterion (LV\_MIS\_STATE\_B4):**

Emission increase, monitoring interval over 1000 crankshaft revolutions (= 1000 \* NC\_CYL\_NR /2 TDCs). For criterion confirmation, misfire must be take place for 4 monitoring intervals (consecutive or not).

### MIS\_A, MIS\_B1 & MIS\_B4 Handling Flowchart diagram:

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### B.110.1 Combination of different diagnosis reliability levels (misfire detection, ignition, injection)

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## FUNCTION DESCRIPTION:

### General information:

Due to their physical principle, the individual diagnostic functions have a different diagnostic relevance depending on the operating point.

To achieve the best possible detection of misfires, the individual diagnostic methods are combined. Here with an assumed misfire of a part function, an operating point dependent weighting factor, which reflects the reliability of this part function in the current operating point, is taken from a map. If the sum of these three values now exceeds a threshold for one combustion, then misfire is detected.

The value which is not debounced is used as input value of the IV and IGCFB diagnoses. The injection for a cylinder is cut off exclusively by the CARB error mechanism and not by the IV and IGCFB diagnostic functions.

### Application conditions:

Misfire segment after detection, before CARB diagnosis

### Application conditions

**Update rate:** *every segment*

**Activation:**

LC\_MIS\_INH = 0

**Deactivation:**

LC\_MIS\_INH = 1

**Initialisation on ECU reset, on LV\_DC 0 to 1 transition and on LC\_MIS\_INH 0 to 1 transition:**

SUM\_FAC\_DIAG\_MIS = 0

FAC\_IGC\_DIAG\_MIS = 0

FAC\_IV\_DIAG\_MIS = 0

LV\_DET\_CFM\_MIS = 0

### Formula section:

The output from the misfire detection, injection and ignition diagnosis functions is influenced by weighting interpolated table, giving the reliability of the individual functions.

- A weighting value of **0** means that detection is not possible for this engine operating point.
- A value equal to or greater than **1** indicates reliable detection.
- The values in between represent the corresponding levels of reliability.

#### **- Irregular engine operation weighting (LV\_DET\_MIS = 1):**


If misfiring is suspected by the irregular engine operation test, a weighting factor for the corresponding engine operating point is applied. This factor is derived from tables according combustion mode and determine in application incidence. The corresponding result is in FAC\_ER\_DIAG\_MIS data.

#### **- Ignition diagnosis weighting (IGC\_DIAG\_MIS):**

IGC\_DIAG\_MIS is the not debounced carrier from Ignition diagnosis, which has to be delayed due to misfire detection (*according segment reference SEG\_NR\_ER-1, cylinder x compression phase*). If misfiring is suspected by the ignition diagnosis function, a weighting factor for the corresponding engine operating point is applied.

This factor is derived from IP\_FAC\_IGC\_DIAG\_MIS table.

For the time the number of cylinders shut off due to misfire detection limp home reaches or exceeds the applicable number of C\_MIS\_NR\_OFF\_IV\_IGCFB, FAC\_IGC\_DIAG factor is forced to **1** (*test based on INH\_IV\_MIS carrier*).

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```

If(1)      IGC_DIAG_MIS[SEG_NR_ER] = 1
             And LV_INH_IGC_DIAG_MIS = 0
Then(1)
             If(2)      number of bits set to "1" in INH_IV_MIS carrier structure >= C_MIS_NR_OFF_IV_IGCFB

Then(2)      FAC_IGC_DIAG_MIS = 1
Else(2)      FAC_IGC_DIAG_MIS = IP_FAC_IGC_DIAG_MIS(N_32, LOAD_MIS)
EndIf(2)
Else(1)      FAC_IGC_DIAG_MIS = 0
EndIf(1)
    
```

**- Injection diagnosis weighting (STATE\_DIAG\_IV) :**

STATE\_DIAG\_IV is a not debounced carrier from Injection valves diagnosis.

Injection valve in default is identified according segment reference SEG\_NR\_ER within the bitfield structure STATE\_DIAG\_IV.

If misfiring is suspected by the injection valve diagnosis function, a weighting factor for the corresponding engine combustion mode is applied.

```

If          STATE_DIAG_IV[SEG_NR_ER] = 1
             And          LV_INH_IV_DIAG_MIS = 0
Then        FAC_IV_DIAG_MIS = IP_FAC_IV_DIAG_MIS(N_32, LOAD_MIS)
Else        FAC_IV_DIAG_MIS = 0
EndIf
    
```

**- Formation of a cylinder - specific diagnosis weighting sum :**

The sum of the three weighting values SUM\_FAC\_DIAG\_MIS is performed for the individual cylinder. as soon as one of the three diagnosis function suspects misfiring.

```

SUM_FAC_DIAG_MIS = FAC_ER_DIAG_MIS
                  + FAC_IGC_DIAG_MIS
                  + FAC_IV_DIAG_FAC
    
```

```

If          SUM_FAC_DIAG_MIS >= 1
Then        LV_DET_CFM_MIS = 1           misfire status is confirmed
Else        LV_DET_CFM_MIS = 0           no misfire
EndIf
    
```

## B.110.2 Misfire detection counters (ISO 15031 Data)

### FUNCTION DESCRIPTION:

#### General information:

These counters are incremented at each misfire detection based on misfire index evaluation (*after crossed diagnosis with IGC & IV OBDI diags evaluation*). Thus, it is possible to determine the total number of misfire detected during engine lifetime and during current driving cycle.

Moreover, cylinder misfire counters have been introduced for Mode 6 communication service, as described in last ISO specification available (ISO/DIS 15031-5.8).

The calculation of CTR\_MIS\_DC\_MMV\_CYL (resolution=1) is rounded to 1 and that leads to a loss of information, since only when CTR\_MIS\_DC\_CYL reaches 10 the MMV value will count up one time.

To avoid this, the calculation must be done, like the described in the CARB requirement, with an intermediate variable with higher resolution to keep the information.

*Note: CTR\_MIS\_TOT\_DC & CTR\_MIS\_DC\_CYL[NC\_CYL\_NR] are initialised only at engine running to keep the information after engine stop.*

### B.110.2.1 NVMY Data Formatting

On non volatile memory formatting or on NV memory corruption detection:

```
CTR_MIS_TOT_NVMY = 0
CTR_MIS_TOT_DC = 0
For(1) x = 0 : NC_CYL_NR-1
    CTR_MIS_DC_CYL[x] = 0
    CTR_MIS_DC_MMV_CYL_IT[x] = 0
    CTR_MIS_DC_MMV_CYL[x] = CTR_MIS_DC_MMV_CYL_IT[x]
EndFor(1)
```

### B.110.2.2 Initialisation of former /current driving cycle counters

#### Initialisations:

- NVMY data loading loading at NVMY\_READ event
  - Read all the counters from NVMY
  - Write NVMY high resolution counter to non-NVMY low resolution counter
  - For(1) x = 0 : NC\_CYL\_NR-1
    - // round-off to nearest integer (ceil or floor the value to integer value)
    - CTR\_MIS\_DC\_MMV\_CYL[x] = CTR\_MIS\_DC\_MMV\_CYL\_IT[x]
  - EndFor(1)
- NVMY data store at NVMY\_STO event
  - Store all the counters to NVMY
- at LV\_DC 0 -> 1 transition event
  - CTR\_MIS\_TOT\_DC = 0
  - For(1) x = 0 : NC\_CYL\_NR-1
    - CTR\_MIS\_DC\_CYL[x] = 0
  - EndFor(1)

### B.110.2.3 Increment of misfire counters during current driving cycle

#### Application conditions

**Activation:**  $LV\_ENA\_ER = 1$   
**And**  $LC\_MIS\_INH = 0$

**Deactivation:**  $LV\_ENA\_ER = 0$   
**Or**  $LC\_MIS\_INH = 1$

**Update rate:** Segment task

#### Formula section:

```
If LV_DET_CFM_MIS = 1
Then CTR_MIS_TOT_DC = CTR_MIS_TOT_DC + 1 // with saturation
     CTR_MIS_TOT_NVMY = CTR_MIS_TOT_NVMY + 1 // with saturation
     CTR_MIS_DC_CYL[SEG_NR_ER] = CTR_MIS_DC_CYL[SEG_NR_ER] + 1
                                     // with saturation
EndIf
```

### B.110.2.4 Update of the EWMA misfire counters

Exponential weighted moving average (EWMA) misfire counters are updated at the beginning of the driving cycle based on former driving cycle values.

**Update rate:** at LV\_DC 0 -> 1 transition event before CTR\_MIS\_DC\_CYL[x] reset (section "Initializations" above)

**For** x = 0 : NC\_CYL\_NR-1

CTR\_MIS\_DC\_MMV\_CYL\_IT[x] =  
0.9 \* CTR\_MIS\_DC\_MMV\_CYL\_IT[x] + 0.1 \* CTR\_MIS\_DC\_CYL[x]

//Write high resolution counter to low resolution counter

// round-off to nearest integer (ceil or floor the value to integer value)

CTR\_MIS\_DC\_MMV\_CYL[x] = CTR\_MIS\_DC\_MMV\_CYL\_IT[x]

**EndFor**

### B.110.3 Exhaust cylinder bank reference for misfire detection

#### FUNCTION DESCRIPTION:

For catalyst damage and/or emission criterion, misfire diagnosis functions can be set via calibration data in a way to be able to detect criterions according exhaust cylinder bank phasing instead of a global criterion detection.

Exhaust cylinder bank reference for misfire detection allows to increase these criterions on the dedicated cylinder bank weighting factor if the misfire detected has effect on the impacted cylinder bank and not on the other (if multiple exhaust cylinder bank design).

#### Description:

The exhaust cylinder bank reference SEG\_NR\_CBK\_ER is determinate according the segment reference SEG\_NR\_ER. It already includes the delay introduced by the misfire index chosen.

#### Application conditions

**Update rate:** *Segment task*

**Activation:** LV\_SYN\_ENG = 1

**Deactivation:** LV\_SYN\_ENG = 0

*Initialisation on Deactivation condition:*

SEG\_NR\_CBK\_ER = 0

**Initialisation:** at ECU reset, at DCON, at LC\_MIS\_INH 0->1, clearing failure memory

SEG\_NR\_CBK\_ER = 0

#### Formula section:


SEG\_NR\_CBK\_ER = NC\_CBK\_EX\_NR\_MISF[SEG\_NR\_ER]

### B.110.4 Determination of CARB A misfire criterion, causing catalyst damage

#### Description:

With a CARB A misfire rate criterion, the emissions are increased and there is a risk of catalyst damage if the cylinder causing the failure criterion can not be shut off.

Detection:

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The check for misfire rate violation **CARB A** comprises 200 crankshaft revolutions ( $100 * NC\_CYL\_NR$  tdc's) for statistic misfiring and cyclewise monitoring for best possible catalyst protection.

If a confirmed misfiring is detected on ER current TDC (LV\_DET\_CFM\_MIS=1), a weighting factor (MIS\_A\_FAC) is added to the cylinder-specific counter MIS\_CTR\_A[SEG\_NR\_ER], extracted from an interpolated table (see APP. INC.) who depends on engine combustion mode and current operating point. The increment represents the severity of catalyst damage.

#### Statistic:

The monitoring for Misfire **CARB A** is performed continuously in intervals of 200 crankshaft revolutions.

#### Monitoring during CARB A window:

To guarantee best possible catalyst protection, the cylinder-specific counters are monitored each cycle. For that purpose, MIS\_CTR\_A[SEG\_NR\_ER] is compared to the applicable value C\_MIS\_A\_IND\_THD representing the critical threshold for single cylinder misfiring.

If the threshold is reached outside of the FTP cycle, the concerning cylinder is shut off immediately. CARB A misfire criterion is confirmed, else the criterion will be evaluated at the end of the 200 crankshaft revolution window.

#### Monitoring at the end of 200 crankshaft revolutions:

At the end of each monitoring interval the cylinder-specific sums MIS\_CTR\_A[NC\_CYL\_NR] and the global sum (MIS\_SUM\_A) are available.

If the sum MIS\_SUM\_A is greater than the threshold C\_MIS\_SUM\_A\_THD, the cylinder with the highest misfire rate is determined (by comparing the different MIS\_CTR\_A[NC\_CYL\_NR] values).

Then operation inside/outside of the FTP-area is checked by comparison of the counter CTR\_FTP\_CDN\_MIS\_A / MIS\_NR\_TDC\_A with the threshold C\_RATIO\_FTP\_CDN\_MIS\_A. If the FTP tdc's ratio is lower than the threshold, not enough operating points have been inside the FTP-window and therefore operation outside FTP-area is detected (LV\_FTP\_MIS\_A=0). This is done in order to fulfil the CARB-regulations, which require MIL-illumination at first threshold exceeding outside the FTP-area and at third exceeding inside the FTP-area.

Therefore the counter CTR\_DET\_MIS\_A is incremented inside the FTP-area at each threshold exceeding. That means it reaches the maximum of C\_NR\_DET\_MAX\_MIS\_A = 3 only if the threshold is exceeded in 3 succeeding monitoring intervals.

Outside the FTP-area the failure CARB A is validated immediately. The counter is reset only after an ECU-reset.

Even if we are inside the FTP-area, a specific application request (according catalyst temperature or else) LV\_REQ\_APP\_CTR\_MIS\_A can force to validate immediately the failure CARB A (see legal requirements & customer wishes). This request is defined in associated Application Incidences file.

**Note:** cylinder and Exhaust cylinder bank specific counters are respectively indexed with SEG\_NR\_ER and SEG\_NR\_CBK\_ER phase reference counters to take in account ERND delay in misfire monitoring process

## Application conditions


### Initialisation:

at ECU reset, at LV\_DC 0 - > 1 transition, at LC\_MIS\_INH 0 to 1 transition & at MIS\_A or MIS\_[NC\_CYL\_NR] errors clearing

```

SYM_CYL_MIS_A      = 0
INH_IV_MIS         = 0
MIS_NR_TDC_A       = 0
MIS_SUM_A          = 0
CTR_FTP_CDN_MIS_A = 0
CTR_DET_MIS_A      = 0
CTR_CHK_MIS_A      = 0
LV_END_WIN_MIS_A   = 0
  LV_END_MIS_A      = 0
  LV_FTP_MIS_A      = 0
LV_MIS_STATE_A     = 0
LV_INH_IV_MIS_A    = 0
  LV_DET_MIS_A      = 0

```

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```

LV_ERR_IN_WIN_MIS_A      = 0
For x = 0 : NC_CYL_NR-1
  MIS_CTR_A[x] = 0 // All cylinder specific counters
  CTR_MIS_A_LIH_CYL[x] = 0 // All cylinder specific counters
EndFor
For i = 0 : NC_CBK_EX_NR-1
  MIS_SUM_A_CBK[i] = 0 // All Exhaust cylinder bank specific
counters
EndFor

```

**Update rate:** *segment task*

*Activation:*

```

LV_DC = 1
And LC_MIS_INH = 0

```

*Deactivation:*

```

LV_DC = 0
Or LC_MIS_INH = 1

```

### B.110.4.1 Determination of catalyst damage weighting factor

Catalyst damage weighting factor is determined according engine combustion mode & buffered to take in account admission phase (SEG\_NR\_ER - 2).

MIS\_A\_FAC\_BUF is managed as a rotary buffer, MIS\_A\_FAC\_BUF[0] is the weighting factor for the actual segment value.

At each ER segment recurrence:

FAC\_MIS\_A\_APP depends on the combustion mode and determine in application incidence (must be calculated first)

MIS\_A\_FAC\_BUF is managed as a rotary buffer

```

MIS_A_FAC_BUF[current_position] = FAC_MIS_A_APP

```

```

MIS_A_FAC = MIS_A_FAC_BUF [oldest_position] // points on the oldest value of the
buffer

```

### B.110.4.2 CARB A window management (main process)

```

if(1) LV_CDN_MIS_A = 1 // MIS_A monitoring active (see App Inc file)

```

```

Then(1)

```

```

if(2) LV_DET_CFM_MIS = 1 // Individual misfire detected

```

```

Then(2) Call 'CARB A Misfire counters increment process' (see description below)

```

```

Else(2) MIS_A Misfire counters unchanged

```

```

EndIf(2)

```

```

if(2) MIS_NR_TDC_A < 100 * NC_CYL_NR

```

```

Then(2) MIS_NR_TDC_A = MIS_NR_TDC_A + 1

```

```

LV_END_WIN_MIS_A = 0 // End of window not reached

```

```

if(3) LOAD_MIS < C_LOAD_MIS_FTP

```

```

And N < C_N_MIS_FTP // FTP window conditions

```

```

Then(3) CTR_FTP_CDN_MIS_A = CTR_FTP_CDN_MIS_A + 1

```

```

EndIf(3)

```

```

call 'Monitoring process during CARB A window'(see description below)

```

```

Else(2) call 'Monitoring process at CARB A window end'(see description below)

```

```

call 'CARB A criterion end detection process'(see description below)

```

```

call 'CARB A window reset process'(see description below)

```

```

EndIf(2)

```

```


Else(1) no process // Counters & flags unchanged

```

```

EndIf(1)

```

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### B.110.4.3 CARB A Misfire counters increment process

```
MIS_SUM_A = MIS_SUM_A + MIS_A_FAC
MIS_SUM_A_CBK[SEG_NR_CBK_ER] =
    MIS_SUM_A_CBK[SEG_NR_CBK_ER] + MIS_A_FAC
    // Assign only ER current specific Exhaust cylinder bank counter
MIS_CTR_A[SEG_NR_ER] = MIS_CTR_A[SEG_NR_ER] + MIS_A_FAC
    // Assign only ER current specific cylinder counter
```

### B.110.4.4 Monitoring process during CARB A window (short term catalyst protection & limp home)

```
If(1)    { [ LV_MIS_A_DIAG_REQ_APP = 0
    And( ( LV_AT = 0 And MIS_CTR_A[SEG_NR_ER] C_MIS_A_IND_THD_MT )
        Or
        ( LV_AT = 1 And MIS_CTR_A[SEG_NR_ER] C_MIS_A_IND_THD_AT ) ) ]
    // Test based only on ER current specific cylinder counter
```

```
Or [ LV_MIS_A_DIAG_REQ_APP = 1
    And( ( LV_AT = 0 And MIS_CTR_A[SEG_NR_ER]
        FAC_MIS_A_THD_IND_APP * C_MIS_A_IND_THD_MT )
        Or ( LV_AT = 1 And MIS_CTR_A[SEG_NR_ER]
        FAC_MIS_A_THD_IND_APP * C_MIS_A_IND_THD_AT ) ) ] }
```

Then(1)

Short term FTP conditions check

```
    If(2) [ LV_AT = 1 And
        CTR_FTP_CDN_MIS_A/MIS_NR_TDC_A < C_RATIO_FTP_CDN_IND_MIS_AT ]
    Or [ LV_AT = 0 And
        CTR_FTP_CDN_MIS_A/MIS_NR_TDC_A < C_RATIO_FTP_CDN_IND_MIS_MT ]
    // Out of FTP cycle inside CARB A window
```

Then(2) Set concerned cylinder bit in structure SYM\_CYL\_MIS\_A to 1

```
LV_DET_MIS_A = 1    // Misfire CARB A criterion detected
LV_MIS_STATE_A = 1 // Misfire CARB A criterion confirmed
LV_ERR_IN_WIN_MIS_A = 1
```

```
CTR_DET_MIS_A = max(CTR_DET_MIS_A+1, C_NR_DET_MAX_MIS_A)
LV_END_MIS_A = 1
```

*// Subtract Current cylinder MIS\_A & MIS\_SUM\_A\_CBK counters on global & cylinder bank MIS\_A sums to avoid wrong global MIS\_A detection at end of current Long term diagnosis*

```
MIS_SUM_A = MIS_SUM_A - MIS_CTR_A[SEG_NR_ER]
MIS_SUM_A_CBK[SEG_NR_CBK_ER] =
    MIS_SUM_A_CBK[SEG_NR_CBK_ER] - MIS_CTR_A[SEG_NR_ER]
MIS_CTR_A[SEG_NR_ER] = 0
```

*// Avoid to retrigger criterion until end of the current*

window

```
    If(3)    LC_ENA_MIS_A_IND_LIH = 1
```

Then(3)

Shut off cylinder indexed by SEG\_NR\_ER via INH\_IV\_MIS carrier  
Evaluate **'Misfire Cylinder Limp Home process'**

(see description afterwards)

EndIf(3)

```
    Else(2)    no operation    // MIS_A criterion evaluated at the end of MIS_A
```

window or

*// at the next cylinder evaluation*

```

EndIf(2)
Else(1)          flags & data unchanged
EndIf(1)
    
```

```

#If(1)          NLC_ENA_SCDN_NEW = 1
                In this case, we do exactly the same operations that those done in "Monitoring
process at CARB A window end".
    
```

```

#EndIf(1)
    
```

### B.110.4.5 Monitoring process at CARB A window end (long term catalyst protection & limp home)

#### Global CARB A FTP conditions check

```

If      [ LV_AT = 1 And
           CTR_FTP_CDN_MIS_A / MIS_NR_TDC_A C_RATIO_FTP_CDN_MIS_AT ]
Or      [ LV_AT = 0 And
           CTR_FTP_CDN_MIS_A / MIS_NR_TDC_A C_RATIO_FTP_CDN_MIS_MT ]
Then    LV_FTP_MIS_A = 1
Else    LV_FTP_MIS_A = 0
EndIf
    
```

#### Criterion detection process


// Be careful, the counter of window A (CTR\_CHK\_MIS\_A) is incremented only at the end of the window and not during.

```

CTR_CHK_MIS_A = CTR_CHK_MIS_A + 1
    
```

```

If(1)    { LV_MIS_A_DIAG_REQ_APP = 0
            And    [ ( LV_AT = 0 And
                    ( MIS_SUM_A C_MIS_SUM_A_THD_MT
                      Or MIS_SUM_A_CBK[0...NC_CBK_EX_NR-1]
                        C_MIS_SUM_A_CBK_THD_MT ) // Check for each exhaust CBK
                    )
                Or ( LV_AT = 1 And
                    ( MIS_SUM_A C_MIS_SUM_A_THD_AT
                      Or MIS_SUM_A_CBK[0...NC_CBK_EX_NR-1]
                        C_MIS_SUM_A_CBK_THD_AT ) // Check for each exhaust CBK )
                ]
            }
Or    { LV_MIS_A_DIAG_REQ_APP = 1
          And    [ ( LV_AT = 0 And
                    ( MIS_SUM_A FAC_MIS_SUM_A_THD_APP * C_MIS_SUM_A_THD_MT
                      Or MIS_SUM_A_CBK[0...NC_CBK_EX_NR-1]
                        FAC_MIS_SUM_A_THD_APP * C_MIS_SUM_A_CBK_THD_MT ) //
                    Check for each exhaust CBK )
                Or    ( LV_AT = 1 And
                    ( MIS_SUM_A FAC_MIS_SUM_A_THD_APP * C_MIS_SUM_A_THD_AT
                      Or MIS_SUM_A_CBK[0...NC_CBK_EX_NR-1]
                        FAC_MIS_SUM_A_THD_APP * C_MIS_SUM_A_CBK_THD_AT
                    ) // Check for each exhaust CBK ) ]
          }
Then(1)
    If(2) LV_ERR_IN_WIN_MIS_A = 0
    Then(2)
    
```

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```

LV_DET_MIS_A = 1
LV_ERR_IN_WIN_MIS_A = 1

```

As soon as the misfire criterion detected counter reached his threshold, we directly set the error. To avoid to stored it in the same window a second time, we used *lv\_err\_in\_win\_mis\_a* flag.

```

If(3)      LV_FTP_MIS_A = 0                                // Outside of FTP cycle
Or         LV_REQ_APP_CTR_MIS_A = 1                       // Application specific request
Then(3)     CTR_DET_MIS_A=max(CTR_DET_MIS_A+1, C_NR_DET_MAX_MIS_A)
Else(3)     CTR_DET_MIS_A = CTR_DET_MIS_A + 1
EndIf(3)
If(3)      CTR_DET_MIS_A  C_NR_DET_MAX_MIS_A
Then(3)     // Global MIS_A default
LV_MIS_STATE_A = 1
// MIS_A cylinder identification
For(4)x = 0 to NC_CYL_NR - 1      // Check for each cylinder x
If(5)      MIS_CTR_A[x] > C_MIS_A_MIN_NR * MIS_SUM_A
Then(5)     Set in SYM_CYL_MIS_A the cylinder x concerned bit to 1
If(6)      LC_ENA_MIS_A_LIH = 1 And
[ LV_AT = 0 And
CTR_DET_MIS_A          ID_NR_DET_ENA_MIS_A_LIH_MT(N_32)
]
Or[ LV_AT = 1 And
CTR_DET_MIS_A          ID_NR_DET_ENA_MIS_A_LIH_AT(N_32) ]
Then(6)     Shut off cylinder x via INH_IV_MIS carrier
Evaluate 'Misfire Cylinder Limp Home process'
                                                (see description afterwards)
Else(6)     No operation
EndIf(6)
EndIf(5)
EndFor(4)
// MIS_A random cylinder pattern
If(4) No specific cylinder counters comply with C_MIS_A_MIN_NR * MIS_SUM_A criterion
Then(4)
If(5)      LC_CONF_RND_DET_MIS_A = 0
Then(5)     EvaluateCylinder with the highest MIS_CTR_A[x] value
Set concerned cylinder bit to 1 in SYM_CYL_MIS_A carrier
Set RDN bit (random) to 0 in SYM_CYL_MIS_A carrier
Else(5)     Set RDN bit (random) to 1 in SYM_CYL_MIS_A carrier
EndIf(5)
Else(4)     Set RDN bit (random) to 0 in SYM_CYL_MIS_A carrier
EndIf(4)
EndIf(3)
EndIf(2)
Else(1)
// Be carefull, the 3 following datas are reseted only at the end of the window and not during.
SYM_CYL_MIS_A = 0
LV_DET_MIS_A = 0
LV_MIS_STATE_A = 0
EndIf(1)
// MIS_A default management in case of cylinder shut-off
If      INH_IV_MIS 0      And LC_CONF_MIS_A_LIH = 1
Then     LV_DET_MIS_A = 1
LV_MIS_STATE_A = 1

```

```

        Set in SYM_CYL_MIS_A the cylinder bit(s) who are set in INH_IV_MIS (OR mask)
Else          no action
EndIf
// MIS_A multiple cylinder identification
If      LC_CONF_MPL_DET_MIS_A = 1
  And    Number of cylinder(s) set to 1 in SYM_CYL_MIS_A is equal or over C_NR_CYL_MPL_MIS_A
  Then      Set MPL bit (multiple) to 1 in SYM_CYL_MIS_A carrier
  Else      Set MPL bit (multiple) to 0 in SYM_CYL_MIS_A carrier
End
    
```

#### B.110.4.6 CARB A end detection process

```

If      LV_FTP_MIS_A = 0
  Or      CTR_DET_MIS_A   C_NR_DET_MAX_MIS_A
  Or      CTR_CHK_MIS_A   C_NR_DET_MAX_MIS_A
Then    LV_END_MIS_A = 1
EndIf
LV_END_WIN_MIS_A = 1           // Set for one segment
    
```

#### B.110.4.7 CARB A window reset process

```

MIS_NR_TDC_A = 0
MIS_SUM_A = 0
CTR_FTP_CDN_MIS_A = 0
LV_ERR_IN_WIN_MIS_A = 0
For x = 0 : NC_CYL_NR-1
  MIS_CTR_A[x] = 0           // All cylinder specific counters
EndFor
For i = 0 : NC_CBK_EX_NR-1
  MIS_SUM_A_CBK[i] = 0      // All exhaust cylinder bank specific counters
EndFor
    
```

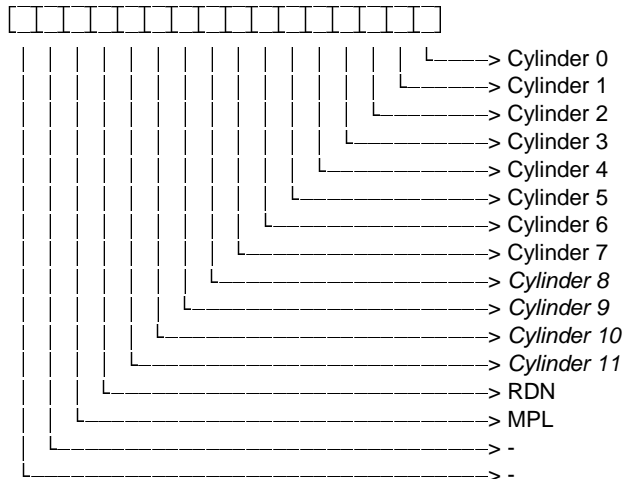
Reset of Misfire Status:

The Misfire Status CARB A is resetted at the end of the driving cycle see formula section

#### B.110.4.8 Misfire Cylinder Identification SYM\_CYL\_MIS\_A

The location of detected cylinders with misfire status CARB A is coded in a carrier word:

SYM\_CYL\_MIS\_A



#### B.110.4.9 Misfire Cylinder Limp Home process:

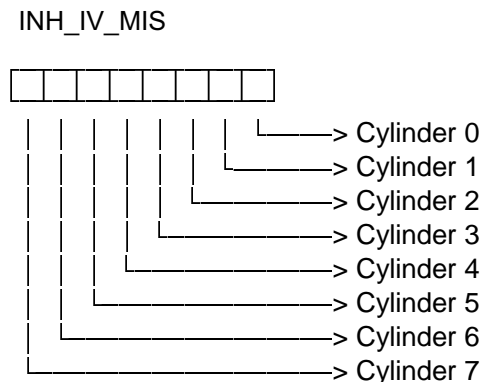
Cylinder shut off is limited by a C\_MIS\_MAX\_NR\_OFF\_IV maximum number of cylinders that can be shut-off simultaneously

Each time, the misfire cylinder limp home process on one (or more) cylinder(s) is triggered, the corresponding cylinder counter(s) CTR\_MIS\_A\_LIH\_CYL[NC\_CYL\_NR] is(are) unitary incremented.

The location of switched off Cylinder(s) x is set to 1 in INH\_IV\_MIS, other cylinder bits are set to 0.

On the same driving cycle, if after a cylinder shut-off cancellation, a new cylinder MIS\_A criterion occurs during CARB A window, the system must shut-off this cylinder once more.

#### Carrier structure :



#### B.110.4.10 Conditions for Cylinder switch back on

Update rate: every 100ms, independently of MIS\_A window process & conditions

Cylinder(s) x can be switched on according two different methods:

1. Cylinder(s) x can be switched back on at the end of the driving cycle

**LC\_CONF\_INH\_IV\_MIS = 0**

1. Cylinder(s) x can be switched back on after a defined number of fuel cut-off phases **and** at the end of the driving cycle

**LC\_CONF\_INH\_IV\_MIS = 1**

For this purpose, the system performs a test for the applicable number C\_MIS\_MIN\_NR\_PUC of trailing throttle fuel cut-off LV\_PUC cycles, since the last cylinder(s) shutoff.

Therefore, the trailing throttle fuel cut-off LV\_PUC flag must have been active for the applicable minimum period C\_T\_MIS\_MIN\_PUC.

If the condition concerning the minimum number of trailing throttle fuel cut-off events is met. Cylinder shut-off is cancelled at the end of the last trailing throttle fuel cut-off phase only for cylinders who answer to the conditions  $CTR\_MIS\_A\_LIH\_CYL[x] < C\_NR\_MAX\_MIS\_A\_LIH\_CYL$  (*check for all cylinders*), all other cylinders stay in fuel cut-off up to end of the driving cycle.

Cylinder shut-off is also cancelled after engine stopped LV\_ES.

#### B.110.4.11 Process on cylinder shut-off cancellation

Update rate: every TDC, independently of MIS\_A window process & conditions

```

If      Any 1 -> 0 cylinder bit(s) transition within INH_IV_MIS
      And LC_CONF_MIS_A_LIH = 1
Then    Corresponding bit(s) within SYM_CYL_MIS_A is set to 0
      If      LC_CONF_MPL_DET_MIS_A = 1
      And    Number of remaining cylinder bit(s) set to 1 in SYM_CYL_MIS_A is less than C_NR_CYL_MPL_MIS_A cylinders
Then    Set MPL bit (multiple) to 0 in SYM_CYL_MIS_A carrier
EndIf

If No more cylinder bit(s) or RNDbit are set to 1 within SYM_CYL_MIS_A structure
      Then      LV_DET_MIS_A = 0
                LV_MIS_STATE_A = 0
EndIf

Else      No action
EndIf

If      Any cylinder bit(s) within INH_IV_MIS is set to 1
      And      Corresponding bit(s) within INH_INJ is (are) also set to 1
Then    LV_INH_IV_MIS_A = 1
Else    LV_INH_IV_MIS_A = 0
EndIf
    
```

### B.110.5 Determination of CARB B1 & B4 misfire criterions, causing increased emissions

#### Description:

The purpose is to detect a misfire rate causing an emission increase. The failure criterion entry is performed by direct statistical evaluation.

#### Detection:

The check for misfire rate violation CARB comprises 1.000 crankshaft revolutions (500\*NC\_CYL\_NR tdc's).

Each combustion during these 1.000 crankshaft revolutions is monitored for misfiring.


If a confirmed misfiring is detected on ER current TDC (LV\_DET\_CFM\_MIS=1), the cylinder-specific misfire counter MIS\_CTR\_B[SEG\_NR\_ER] is incremented by one.

In every driving cycle a distinction is made between misfires detected during the first 1000 crankshaft revs after engine start (**CARB B1**) and misfires detected in later observing intervals. In the second case, a misfire rate violation must take place during four monitoring intervals to recognise misfire (**CARB B4**).

#### Statistic:

At the end of the first 1.000 crankshaft revolutions, the added cylinder-specific sums are evaluated. If the sum exceeds the applicable value C\_THD\_MIS\_B1\_AT/MT, **CARB B1** misfire criterion is detected.

At the end of each following 1.000 crankshaft revolutions interval, the added cylinder-specific sums are evaluated. If the sum exceeds the applicable value C\_THD\_MIS\_B1\_AT/MT the anti-bounce counter

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CTR\_DET\_MIS\_B4 will be incremented till its maximum C\_NR\_DET\_MAX\_MIS\_B4 (typical = 3) is reached. If the sum does not exceed C\_THD\_MIS\_B1\_AT/MT, CTR\_DET\_MIS\_B4 remains unchanged. To filter out those cylinders with low misfire rates, the cylinder-specific counters MIS\_CTR\_B[NC\_CYL\_NR] shall be compared to the applicable value C\_THD\_MIS\_B\_MIN before storage takes place. If none of the cylinder-specific counters is higher than C\_THD\_MIS\_B\_MIN, a maximum choice is done and the cylinder with the highest misfire rate is entered into failure memory.

### Application conditions

#### Initialisation:

*at ECU reset, at LV\_DC 0 -> 1 transition, at LC\_MIS\_INH 0 to 1 transition & at MIS\_B1/ B4 or MIS\_[NC\_CYL\_NR] errors clearing*

```

LV_MIS_STATE_B1 = 0
LV_DET_MIS_B4 = 0
LV_MIS_STATE_B4 = 0
LV_MIS_STATE_B = 0
SYM_CYL_MIS_B1 = 0
SYM_CYL_MIS_B4 = 0
MIS_NR_TDC_B = 0
MIS_SUM_B = 0
CTR_DET_MIS_B4 = 0
CTR_CHK_MIS_B4 = 0
LV_END_MIS_B1 = 0
LV_END_MIS_B4 = 0
LV_END_WIN_MIS_B1 = 0
LV_END_WIN_MIS_B4 = 0
LV_ERR_IN_WIN_MIS_B1 = 0
LV_ERR_IN_WIN_MIS_B4 = 0
LV_ERR_MIS_A_IN_WIN_B = 0

```

**For** x = 0 : NC\_CYL\_NR-1

MIS\_CTR\_B[x] = 0 // All cylinder specific counters

**EndFor**

**For** i = 0 : NC\_CBK\_EX\_NR-1

MIS\_SUM\_B\_CBK[i] = 0 // All Exhaust cylinder bank specific counters

**EndFor**

#### Update rate:

*every segment*

#### Activation:


LV\_DC = 1

**And** LC\_MIS\_INH = 0

#### Deactivation:

LV\_DC = 0

**Or** LC\_MIS\_INH = 1

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**Formula section:****B.110.5.1 CARB B1/B4 windows management (main process)**

```

If(1) LV_CDN_MIS_B1 = 1           // CARB B1 monitoring active (see App Inc file)
Or LV_CDN_MIS_B4 = 1           // CARB B4 monitoring active (see App Inc file)
Then(1)
    If(2) LV_DET_CFM_MIS = 1       // Misfire detected
    Then(2) call 'CARB B1/B4 Misfire counters increment process'
        (see description below)
    Else(2) MIS_B1/B4 counters unchanged
    EndIf(2)
    If(2) LV_ERR_IN_WIN_MIS_A = 1
    Then(2) LV_ERR_MIS_A_IN_WIN_B = 1
    EndIf(2)
    If(2) MIS_NR_TDC_B < 500 * NC_CYL_NR
    Then(2) MIS_NR_TDC_B = MIS_NR_TDC_B + 1
        LV_END_WIN_MIS_B1 = 0
        LV_END_WIN_MIS_B4 = 0
    If(3) NLC_ENA_SCDN_NEW = 1


```

**'Monitoring process during CARB B1/B4 window'**

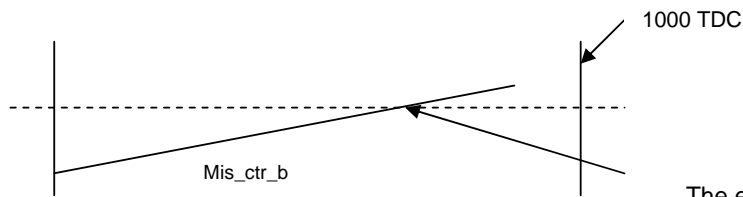
```

EndIf(3)
    (End of windows not reached)
Else(2) call 'Monitoring process at CARB B1/B4 window end'
    (see description below)
    call 'CARB B1/B4 ends detection process'
    (see description below)
    call 'CARB B1/B4 window reset process' (see description below)
EndIf(2)
If(1) [ LV_MIS_STATE_B1 = 1
        And ( LV_END_MIS_B4 = 0 Or LC_CONF_MIS_STATE_B = 1 ) ]
    Or LV_MIS_STATE_B4 = 1
    Then(1) LV_MIS_STATE_B = 1
    Else(1) LV_MIS_STATE_B = 0
    EndIf(1)
Else(1) no process (Counters & flags unchanged)
EndIf(1)

```

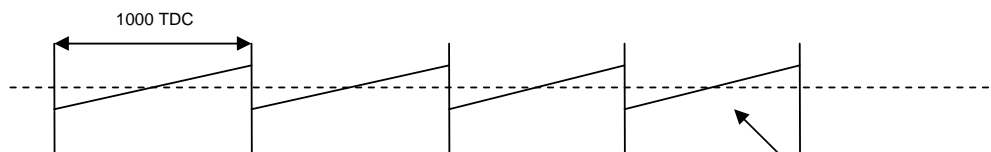
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## MIS\_B1 Management



The error is directly stored without waiting the end of the B1 window

## MIS\_B4 Management



The error is stored without waiting the end of B4 window, but during the fourth window with misfire detected.

### B.110.5.2 CARB B1/B4 Misfire counters increment process

$MIS\_SUM\_B = MIS\_SUM\_B + 1$

$MIS\_SUM\_B\_CBK[SEG\_NR\_CBK\_ER] = MIS\_SUM\_B\_CBK[SEG\_NR\_CBK\_ER] + 1$

*// Assign only ER current specific exhaust cylinder bank counter*

$MIS\_CTR\_B[SEG\_NR\_ER] = MIS\_CTR\_B[SEG\_NR\_ER] + 1$

*// Assign only ER current specific cylinder counter*

### B.110.5.3 Monitoring process at CARB B1/B4 window end

**If(1)**  $LV\_END\_MIS\_B1 = 0$  *// End of CARB B1 window*

**Then(1)**

**If(2)** {  $LV\_MIS\_B\_DIAG\_REQ\_APP = 0$  **And**

[ ( $MIS\_SUM\_B\_C\_MIS\_SUM\_B1\_THD\_MT$  **And**  $LV\_AT = 0$  )

**Or** ( $MIS\_SUM\_B\_C\_MIS\_SUM\_B1\_THD\_AT$  **And**  $LV\_AT = 1$  )

**Or**  $MIS\_SUM\_B\_CBK[0...NC\_CBK\_EX\_NR-1]$

$C\_MIS\_SUM\_B1\_CBK\_THD$  ] }

*// Check for each exhaust cylinder banks*

**Or**

{  $LV\_MIS\_B\_DIAG\_REQ\_APP = 1$  **And**

[ ( $MIS\_SUM\_B$

(  $FAC\_MIS\_SUM\_B1\_THD\_APP * C\_MIS\_SUM\_B1\_THD\_MT$  )

**And**  $LV\_AT = 0$  )

**Or** ( $MIS\_SUM\_B$

(  $FAC\_MIS\_SUM\_B1\_THD\_APP * C\_MIS\_SUM\_B1\_THD\_AT$  )

**And**  $LV\_AT = 1$  )

**Or**  $MIS\_SUM\_B\_CBK[0...NC\_CBK\_EX\_NR-1]$

$FAC\_MIS\_SUM\_B1\_THD\_APP * C\_MIS\_SUM\_B1\_CBK\_THD$  ] }

```

// Check for each exhaust cylinder banks

Then(2)      call 'CARB B1 criterion determination process' (see description below)
Else(2)      no criterion detection
              LV_MIS_STATE_B1 = 0

EndIf(2)

Else(1)
// Be carefull, the counter of window B4 (CTR_CHK_MIS_B4 ) is incremented only at the end of the
// window and not during.
CTR_CHK_MIS_B4 = CTR_CHK_MIS_B4 + 1 // at the End of CARB B4 window
If(2)        { LV_MIS_B_DIAG_REQ_APP = 0 And
              [ ( MIS_SUM_B C_MIS_SUM_B4_THD_MT And LV_AT = 0 )
                Or   ( MIS_SUM_B C_MIS_SUM_B4_THD_AT And LV_AT = 1 )
                Or   MIS_SUM_B_CBK[0...NC_CBK_EX_NR-1]
                  C_MIS_SUM_B4_CBK_THD ] }
              // Check for each exhaust cylinder banks
Or
{ LV_MIS_B_DIAG_REQ_APP = 1 And
  [ ( MIS_SUM_B
    ( FAC_MIS_SUM_B4_THD_APP * C_MIS_SUM_B4_THD_MT )
    And LV_AT = 0 )
    Or ( MIS_SUM_B
    ( FAC_MIS_SUM_B4_THD_APP * C_MIS_SUM_B4_THD_AT )
    And LV_AT = 1 )
    Or   MIS_SUM_B_CBK[0...NC_CBK_EX_NR-1]
      FAC_MIS_SUM_B4_THD_APP * C_MIS_SUM_B4_CBK_THD ] }
  // Check for each exhaust cylinder banks

Then(2)      call 'CARB B4 criterion determination process' (see description below)
Else(2)      no criterion detection
              // Be carefull, the 3 following datas are reseted only at the end of the window and not
              // during.
              LV_DET_MIS_B4 = 0
              LV_MIS_STATE_B4 = 0
              SYM_CYL_MIS_B4 = 0

EndIf(2)
EndIf(1)

```

#### B.110.5.4 Monitoring process during CARB B1/B4 window

This part is realized during CARB B1/B4 window when NLC\_ENA\_SCDN\_NEW=1.

In this case, we do exactly the same operations that those done in "Monitoring process at CARB B1/B4 window end".

#### B.110.5.5 CARB B1 criterion determination process:

*// Global CARB B1 default*


*As soon as an error occurs during B1 window, we set the error.*

*But if the error enters again, we do not want to store it again. This is realized by lv\_err\_in\_win\_mis\_b1 flag.*

```

if(1) (LV_ERR_IN_WIN_MIS_B1 = 0)
  Then(1)

```

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```

LV_MIS_STATE_B1 = 1
LV_ERR_IN_WIN_MIS_B1 = 1
// CARB B1 cylinder identification
For x = 0 to NC_CYL_NR - 1 // Check for each cylinder x
    If(2) MIS_CTR_B[x] > C_MIS_B1_MIN_NR * MIS_SUM_B
        Then(2) Set in SYM_CYL_MIS_B1 the cylinder x concerned bit to 1
        EndIf(2)
    EndFor
// CARB B1 random cylinder pattern
If No specific cylinder counters comply with C_MIS_B1_MIN_NR * MIS_SUM_B criterion
    Then
        If(3) LC_CONF_RND_DET_MIS_B = 0
            Then(3) EvaluateCylinder with the highest MIS_CTR_B[x] value
            Set concerned cylinder bit to 1 in SYM_CYL_MIS_B1 carrier
            Set RDN bit (random) to 0 in SYM_CYL_MIS_B1 carrier
        Else(3) Set RDN bit (random) to 1 in SYM_CYL_MIS_B1 carrier
        EndIf(3)
    Else Set RDN bit (random) to 0 in SYM_CYL_MIS_B1 carrier
    EndIf
// CARB B1 multiple cylinder identification
If LC_CONF_MPL_DET_MIS_B = 1
And number of cylinder(s) set to 1 in SYM_CYL_MIS_B1 is equal or over C_NR_CYL_MPL_MIS_B
    Then Set MPL bit (multiple) to 1 in SYM_CYL_MIS_B1 carrier
    Else Set MPL bit (multiple) to 0 in SYM_CYL_MIS_B1 carrier
    End
EndIf(1)

```

### B.110.5.6 CARB B4 criterion determination process

```

If(1) (LV_ERR_IN_WIN_MIS_B4 = 0)
Then(1)
    CTR_DET_MIS_B4 = CTR_DET_MIS_B4 + 1
    LV_DET_MIS_B4 = 1
    LV_ERR_IN_WIN_MIS_B4 = 1

```

As soon as the misfire criterion detected counter reached his threshold, we directly set the error. To avoid to stored it in the same window a second time, we used *lv\_err\_in\_win\_mis\_b4* flag.

```

If(2) (CTR_DET_MIS_B4 > C_NR_DET_MAX_MIS_B4)
Then(2)
    // Global CARB B4 default
    LV_MIS_STATE_B4 = 1
    // CARB B4 cylinder identification
    For(3) x = 0 to NC_CYL_NR-1 // Check for each cylinder x
        If(4) MIS_CTR_B[x] > C_MIS_B4_MIN_NR * MIS_SUM_B
            Then(4) Set in SYM_CYL_MIS_B4 the cylinder x concerned bit to 1
        EndIf(4)
    EndFor(3)
    // CARB B4 random cylinder pattern
If(3) No specific cylinder counters comply with C_MIS_B4_MIN_NR * MIS_SUM_B criterion
    Then (3)
        If(4) LC_CONF_RND_DET_MIS_B = 0
            Then(4) EvaluateCylinder with the highest MIS_CTR_B[x] value

```

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```

        Set concerned cylinder bit to 1 in SYM_CYL_MIS_B4 carrier
        Set RDN bit (random) to 0 in SYM_CYL_MIS_B4 carrier
    Else(4)      Set RDN bit (random) to 1 in SYM_CYL_MIS_B4 carrier
    Endif(4)
    Else(3)      Set RDN bit (random) to 0 in SYM_CYL_MIS_B4 carrier
    Endif(3)
    // CARB B4 multiple cylinder identification
    If(3)      LC_CONF_MPL_DET_MIS_B = 1
    And      number of cylinder(s) set to 1 in SYM_CYL_MIS_B4 is equal or over C_NR_CYL_
MPL_MIS_B
    Then(3)      Set MPL bit (multiple) to 1 in SYM_CYL_MIS_B4 carrier
    Else(3)      Set MPL bit (multiple) to 0 in SYM_CYL_MIS_B4 carrier
    End(3)
    Else(2)
        SYM_CYL_MIS_B4 = 0
        LV_MIS_STATE_B4 = 0
    Endif(2)
Endif(1)

```

### B.110.5.7 CARB B1/B4 ends detection process

```

If(1)      LV_END_MIS_B1 = 0
Then(1)      LV_END_MIS_B1 = 1
            LV_END_WIN_MIS_B1 = 1 (set for one segment)
Else(1)
    LV_END_WIN_MIS_B4 = 1 (set for one segment)
    If(2)      CTR_DET_MIS_B4  C_NR_DET_MAX_MIS_B4
            Or CTR_CHK_MIS_B4  C_NR_DET_MAX_MIS_B4
    Then(2)      LV_END_MIS_B4 = 1
    Endif(2)
Endif(1)

```

### B.110.5.8 CARB B1/B4 window reset process

```

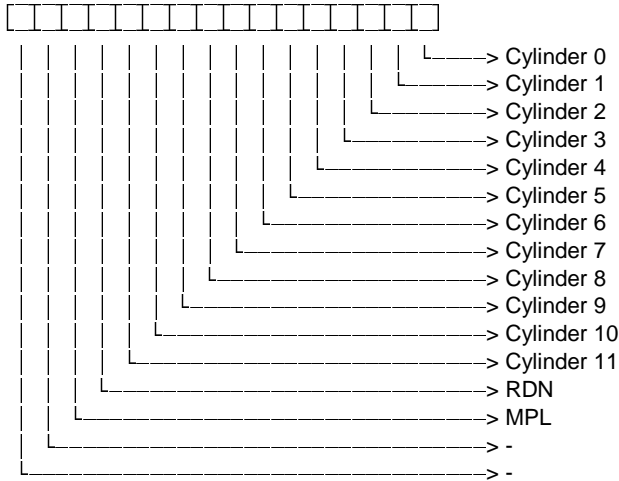
MIS_NR_TDC_B = 0
MIS_SUM_B = 0
LV_ERR_IN_WIN_MIS_B1 = 0
LV_ERR_IN_WIN_MIS_B4 = 0
LV_ERR_MIS_A_IN_WIN_B = 0
For x = 0 : NC_CYL_NR-1
    MIS_CTR_B[x] = 0           // All cylinder specific counters
EndFor
For i = 0 : NC_CBK_EX_NR-1
    MIS_SUM_B_CBK[i] = 0     // All exhaust cylinder bank specific counters
EndFor

```


### B.110.5.9 SYM\_CYL\_MIS\_B1 and SYM\_CYL\_MIS\_B4 carriers definition

The location of detected cylinders with misfire status CARB B is coded in two carrier bytes:

SYM\_CYL\_MIS\_B1, SYM\_CYL\_MIS\_B4



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## B.111 Misfire rate determination and error management (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_MIS_DET	O/V/S	0... FFFFH	0... 65535	1	-
Number of misfire events of all cylinders in one DC					
CTR_MIS_DET_CYL [NC_CYL_NR]	O/V/S	0... FFFFH	0... 65535	1	-
Number of lifetime misfire events per cylinder					
CTR_SEG_MIS_ACT	O/V/S	0... FFFFFFFFH	0... 4294967295	1	-
Number of segments with active misfire detection					
ERR_SYM_MIS [NC_CYL_NR]	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom specific cylinder misfire					
ERR_SYM_MIS_FTL_L	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom misfire with low fuel					
ERR_SYM_MIS_MPL	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom multiple cylinder misfire					
FAC_ER_DIAG_MIS	O/V	0... FFH	0... 1.99218	0.0078125	-
Reliability weighting factor for detection based on misfire detection index (ER)					
FAC_MIS_A_APP	O/V	0... 64H	0... 100	1	-
Catalyst damage weighting factor used to increment counters for MIS_A criterion pending application specific conditions					
FAC_MIS_A_THD_IND_APP	O/V	0... 1FFH	0... 1.99609	3.9063e-3	-
Cylinder individual threshold used for cylinder shut-off during CARB A criterion window pending application specific conditions					
FAC_MIS_SUM_A_THD_APP	O/V	0... 1FFH	0... 1.99609	3.9063e-3	-
Global threshold used for CARB A criterion pending application specific conditions					
FAC_MIS_SUM_B1_THD_APP	O/V	0... 1FFH	0... 1.99609	3.9063e-3	-
Global threshold used for CARB B1 criterion pending application specific conditions					
FAC_MIS_SUM_B4_THD_APP	O/V	0... 1FFH	0... 1.99609	3.9063e-3	-
Global threshold used for CARB B4 criterion pending application specific conditions					
LV_CDN_DIAG_MIS [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Diagnosis condition specific cylinder misfire					
LV_CDN_DIAG_MIS_FTL_L	O/V	0... 1H	0 ...1	1	-
Diagnosis condition misfire with low fuel					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_MIS_MPL	O/V	0... 1H	0 ...1	1	-
Diagnosis condition multiple cylinder misfire					
LV_CDN_MIS_A	O/V	0... 1H	0 ...1	1	-
CARB A misfire criterion monitoring condition					
LV_CDN_MIS_B1	O/V	0... 1H	0 ...1	1	-
CARB B1 misfire criterion monitoring condition					
LV_CDN_MIS_B4	O/V	0... 1H	0 ...1	1	-
CARB B4 misfire criterion monitoring condition					
LV_END_DIAG_MIS [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
End of diagnosis flag					
LV_END_DIAG_MIS_FTL_L	O/V	0... 1H	0 ...1	1	-
End of diagnosis flag					
LV_END_DIAG_MIS_MPL	O/V	0... 1H	0 ...1	1	-
End of diagnosis flag					
LV_ERR_MIS [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Present error flag specific cylinder misfire					
LV_ERR_MIS_FTL_L	O/V	0... 1H	0 ...1	1	-
Present error flag misfire with low fuel					
LV_ERR_MIS_MPL	O/V	0... 1H	0 ...1	1	-
Present error flag multiple cylinder misfire					
LV_INH_IGC_DIAG_MIS	O/V	0... 1H	0 ...1	1	-
Inhibition of misfire crossed diagnosis with IGC OBD I errors					
LV_INH_IV_DIAG_MIS	O/V	0... 1H	0 ...1	1	-
Inhibition of misfire crossed diagnosis with IV OBD I errors					
LV_MIS_A_DIAG_REQ_APP	O/V	0... 1H	0 ...1	1	-
Specific request to evaluate CARB A criterion with project specific calibration set according external conditions (bad fuel quality...)					
LV_MIS_B_DIAG_REQ_APP	O/V	0... 1H	0 ...1	1	-
Specific request to evaluate CARB B1 & B4 criterions with project specific calibration set according external conditions (bad fuel quality...)					
LV_REQ_APP_CTR_MIS_A	O/V	0... 1H	0 ...1	1	-
Specific request to allow out of FTP counting mode even if we are within FTP area					

**Input data:**

LC_CONF_MPL_DET_MIS_A {p. 6241}	LC_CONF_MPL_DET_MIS_B {p. 6241}	LC_MIS_INH {p. 6277}	LOAD_MIS {p. 6213}
LV_DC {p. 5746}	LV_DET_MIS {p. 6276}	LV_END_MIS_B1 {p. 6237}	LV_END_MIS_B4 {p. 6237}
LV_END_WIN_MIS_B1 {p. 6238}	LV_END_WIN_MIS_B4 {p. 6238}	LV_ERR_IN_WIN_MIS_A {p. 6238}	LV_ERR_IN_WIN_MIS_B4 {p. 6238}
LV_ERR_MIS_A_IN_WIN_B {p. 6238}	LV_FTL_L_DIAG_MIS {p. 6283}	LV_INH_DET_MIS {p. 6276}	LV_MIS_STATE_A {p. 6238}
LV_MIS_STATE_B1 {p. 6238}	LV_MIS_STATE_B4 {p. 6238}	LV_REQ_INH_MIS {p. 6225}	LV_RUN_ENG {p. 1505}
N {p. 1525}	N_32 {p. 1525}	NC_CMB_CONF {p. 812}	NLC_ENA_SCDN_NEW {p. 645}



OPM_AV {p. 8137}	SEG_NR_ER {p. 1454}	SYM_CYL_MIS_A {p. 6239}	SYM_CYL_MIS_B1 {p. 6239}
SYM_CYL_MIS_B4 {p. 6239}	TEG_CAT_UP_MDL_MAX {p. 1939}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TEG_CAT_UP_MIS_A_MAX	-	0... 7FF0H	0... 2047	0.0625	°C
TEG Threshold for Misfire A counter management					
IP_FAC_ER_AFS_DIAG_MIS	V	0... FFH	0... 1.99218	0.0078125	-
LDP_N_32_IP_FAC_ER_AFS_DIAG_MIS	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_IP_FAC_ER_AFS_DIAG_MIS	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for irregular engine operation (engine speed analysis) in AFS combustion mode					
IP_FAC_ER_HOM_S_DIAG_MIS	V	0... FFH	0... 1.99218	0.0078125	-
LDP_N_32_IP_FAC_ER_HOM_S_MIS	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_IP_FAC_ER_HOM_S_MIS	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for irregular engine operation (engine speed analysis) in HOM_S combustion mode					
IP_FAC_ER_S_DIAG_MIS	V	0... FFH	0... 1.99218	0.0078125	-
LDP_N_32_IP_FAC_ER_S_DIAG_MIS	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_IP_FAC_ER_S_DIAG_MIS	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for irregular engine operation (engine speed analysis) in S combustion mode					
IP_MIS_A_FAC_AFS	V	0... 64H	0... 100	1	-
LDP_N_MIS_A_FAC_AFS	6	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS_MIS_A_FAC_AFS	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Catalyst damage weighting factor used for MIS_A counters increment (AFS combustion mode)					
IP_MIS_A_FAC_HOM_S	V	0... 64H	0... 100	1	-
LDP_N_MIS_A_FAC_HOM_S	6	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS_MIS_A_FAC_HOM_S	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Catalyst damage weighting factor used for MIS_A counters increment (HOM_S combustion mode)					
IP_MIS_A_FAC_S	V	0... 64H	0... 100	1	-
LDP_N_MIS_A_FAC_S	6	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS_MIS_A_FAC_S	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Catalyst damage weighting factor used for MIS_A counters increment (Stratified combustion mode)					
LC_CTR_CONF_DIAG_MIS	-	0... 1H	0 ...1	1	-
Diagnosis TDC counting mode : counting all TDCs (=0) or only diagnosed TDC's (=1)					
LC_CTR_CONF_OSC_MIS	-	0... 1H	0 ...1	1	-
Diagnosis TDC counting mode when crankshaft oscillations occurs: stop counting TDC's (=0) or counting allowed TDC's (=1)					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_TREAT_DIAG_MIS	-	0... 1H	0 ...1	1	-
Misfire default failures generated per symptoms CARB_A, CARB_B1 & CARB_B4 (NLC_TREAT_DIAG_MIS = 0) or per specific cylinder misfire errors (NLC_TREAT_DIAG_MIS = 1)					

**Import actions:**

<b>ACTION_ERRM_CdnDiagScdn (IN&lt;PRM_IDX_DIAG&gt;)</b>
Continued on next page

<b>ACTION_ERRM_EndWinScdn (IN&lt;PRM_IDX_ERR&gt;,IN&lt;PRM_EXC&gt;)</b>
---

## B.111.1 Application Incidences data for diagnosis

### Description:

LV\_REQ\_APP\_CTR\_MIS\_A is used for Misfire A calculation considering the load for the catalyst due to exhaust temperature.

### Application conditions

**Initialisation:** *0 at reset*

**Recurrence:** ENRD segment synchronous,  
*After* misfire detection, *Before* misfire diagnosis

**Activation:** *LC\_MIS\_INH = 0 and LV\_DC = 1*

**Deactivation:** *LC\_MIS\_INH = 1 or LV\_DC = 0*

### Formula section:

LV\_INH\_IV\_DIAG\_MIS = LV\_INH\_DET\_MIS  
 LV\_INH\_IGC\_DIAG\_MIS = LV\_INH\_DET\_MIS  
Calculation of LV\_REQ\_APP\_CTR\_MIS\_A  
**If** TEG\_CAT\_UP\_MDL\_MAX > C\_TEG\_CAT\_UP\_MIS\_A\_MAX  
**Then** LV\_REQ\_APP\_CTR\_MIS\_A = 1  
**Else** LV\_REQ\_APP\_CTR\_MIS\_A = 0  
**Endif**

Request to evaluate CARB A criterion with project specific calibration set

LV\_MIS\_A\_DIAG\_REQ\_APP = 0  
 FAC\_MIS\_A\_THD\_IND\_APP = 0  
 FAC\_MIS\_SUM\_A\_THD\_APP = 0

Request to evaluate CARB B1 & B4 criterions with project specific calibration set

LV\_MIS\_B\_DIAG\_REQ\_APP = 0  
 FAC\_MIS\_SUM\_B1\_THD\_APP = 0  
 FAC\_MIS\_SUM\_B4\_THD\_APP = 0

## B.111.2 Combustion mode influence on the catalyst damage weighting factor

At each ER segment recurrence:

FAC\_MIS\_A\_APP must be calculated before "Determination of catalyst damage weighting factor" in the generic specification named **Misfire rate and error management**

*Convention for combustion mode determination:*

```
#if NC_CMB_CONF = AFS_AFL Or AFS_AFL_S
  If OPM_AV = 3 (homogeneous-stratified)
  Then xx = "HOM_S"
  Endif
#Endif
```

```

#If      NC_CMB_CONF = AFS_S Or AFS_AFL_S
If      OPM_AV = 1                (stratified)
Then    xx = "S"
EndIf

#EndIf
If      OPM_AV <> 1 and OPM_AV <> 3      (homogeneous)
Then    xx = "AFS"
EndIf

```

FAC\_MIS\_A\_APP= IP\_MIS\_A\_FAC\_xx(N, LOAD\_MIS)

### B.111.3 Combustion mode gestion for combination of different diagnosis reliability level

#### FUNCTION DESCRIPTION:

##### General information:

FAC\_ER\_DIAG\_MIS must be calculated before the determination of SUM\_FAC\_DIAG\_MIS (in the generic specification named Misfire rate determination and error management)

##### Application conditions:

Misfire segment after detection, before CARB diagnosis

*Update rate:* every segment

*Activation:*

LC\_MIS\_INH = 0

*Deactivation:*

LC\_MIS\_INH = 1

##### Formula section:

*Initialisation on ECU reset, on LV\_DC 0 to 1 transition and on LC\_MIS\_INH 0 to 1 transition:*

FAC\_ER\_DIAG\_MIS = 0

##### ***Irregular engine operation weighting (LV\_DET\_MIS = 1):***

If misfiring is suspected by the irregular engine operation test, a weighting factor for the corresponding engine operating point is applied. This factor is derived from tables according combustion mode.

*Convention for combustion mode determination:*


```

#If      NC_CMB_CONF = AFS_AFL Or AFS_AFL_S
If      OPM_AV = 3                (homogeneous-stratified)
Then    xx = "HOM_S"
EndIf

#EndIf
#If      NC_CMB_CONF = AFS_S Or AFS_AFL_S
If      OPM_AV = 1                (stratified)
Then    xx = "S"
EndIf

#EndIf
If      OPM_AV <> 1 and OPM_AV <> 3      (homogeneous)
Then    xx = "AFS"

```

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**Endlf**

```

If      LV_DET_MIS = 1
Then   FAC_ER_DIAG_MIS = IP_FAC_ER_xx_DIAG_MIS(N_32, LOAD_MIS)
Else   FAC_ER_DIAG_MIS = 0
Endlf

```

### B.111.4 Determination of CARB misfire criterion monitoring conditions (ER algorithm integration, NC\_MISF\_VERS = 1)

**Description:**

Depending on customers & legal requirements reached, two Tdc's counting modes are available :

- counting each Tdc's even if some aren't diagnosed (*LC\_CTR\_CONF\_DIAG\_MIS = 0*)
- counting only diagnosed Tdc's (*LC\_CTR\_CONF\_DIAG\_MIS = 1*)

LV_DC	LC_CTR_CONF_DIAG_MIS	LV_INH_DET_MIS	LC_CTR_CONF_OSC_MIS	LV_STATE_CRK_OSC	LV_CDN_MIS_A LV_CDN_MIS_B1 LV_CDN_MIS_B4	MIS_A, MIS_B1 & MIS_B4 Monitoring Modes
0	x	x	x	x	0	Out of Driving Cycle
1	0	x	x	x	1	All TDC's Counting Mode
1	1	1	x	x	0	Diagnosed TDC's Counting Mode / Classical Fade Out
1	1	0	0	0	1	Diagnosed TDC's Counting Mode / No Fade Out
1	1	0	0	1	0	Classical Fade Out <u>with</u> CRK_OSC / Diagnosed TDC's Counting Mode
1	1	0	1	0	1	Diagnosed TDC's Counting Mode / No Fade Out
1	1	0	1	1	1	Classical Fade Out <u>without</u> CRK_OSC / Diagnosed TDC's Counting Mode

**Application conditions**

**Initialization:** 0 at LV\_DC 0->1 **or** reset **or** LC\_MIS\_INH 0 to 1 transition

**Recurrence:** ENRD segment synchronous,  
After misfire detection, Before misfire diagnosis

**Activation:** LC\_MIS\_INH = 0 **and** LV\_DC = 1

**Deactivation:** LC\_MIS\_INH = 1 **or** LV\_DC = 0


**Formula section:**

**If** NC\_MISF\_VERS = 1

Module Integrated

**Else**

Module Not Integrated

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**Endlf**

```

If(1)      LC_CTR_CONF_DIAG_MIS = 0                // Counting each TDC s
Or
{ ( LC_CTR_CONF_DIAG_MIS = 1 And LV_INH_DET_MIS = 0 )
And
[ LC_CTR_CONF_OSC_MIS = 1
  Or ( LC_CTR_CONF_OSC_MIS = 0 And LV_STATE_CRK_OSC = 0 ) ] }
  // if Crankshaft oscillation detection module integrated, to be deleted if not

Then(1)
  LV_CDN_MIS_A = 1                // Carb A diagnosis active
If(2)      LV_END_MIS_B1 = 0
Then(2)
  LV_CDN_MIS_B1 = 1                // Carb B1 diagnosis active
  LV_CDN_MIS_B4 = 0                // Carb B4 diagnosis inactive

Else(2)
  LV_CDN_MIS_B1 = 0                // Carb B1 diagnosis inactive
  LV_CDN_MIS_B4 = 1                // Carb B4 diagnosis active

Endlf(2)
Else(1)
  LV_CDN_MIS_A = 0                // Carb A diagnosis inactive
  LV_CDN_MIS_B1 = 0                // Carb B1 diagnosis inactive
  LV_CDN_MIS_B4 = 0                // Carb B4 diagnosis inactive

Endlf(1)

```

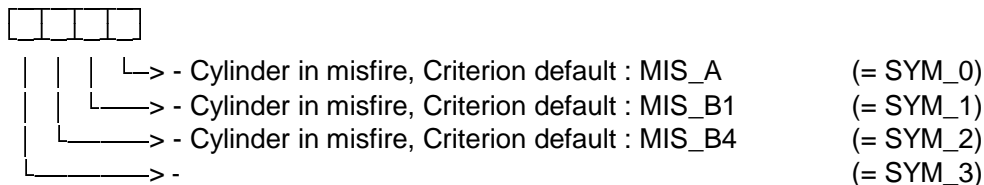
**B.111.5 Specific cylinder misfire errors****FUNCTION DESCRIPTION:****General information:**


There is one LV\_ERR\_MIS[x] for each cylinder (x = 0, 1, 2, 3, 4, 5), thus a separate calibration of P-codes for each symptom is possible.

**Description:**

If Misfire criterion is detected on one cylinder with at least one of the CARB\_A, CARB\_B1 or CARB4 default criterions, the corresponding cylinder error is set (error is set directly without debounce). The symptom is always corresponding to the last error occurrence, and the error is reseted only when all misfire criterions on this cylinder have disappeared.

Error-symptoms are defined to this diagnosis function as following :

**Formula section:**

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**Initialisation:** at ECU reset **or** LV\_DC 0 -> 1 **or** LC\_MIS\_INH 0 -> 1 for all cylinders

```

LV_CDN_DIAG_MIS[x]      = 0
LV_END_DIAG_MIS[x]      = 0
LV_ERR_MIS[x]           = 0
ERR_SYM_MIS[x]          = 0

```

**Recurrence:** The application recurrence is **ENRD segment**  
After misfire detection, after misfire diagnosis !

**Activation:**

```

If(1)          LV_DC = 1
And           LC_MIS_INH = 0
And           ( LV_CDN_MIS_A = 1
Or           LV_CDN_MIS_B4 = 1
Or           LV_CDN_MIS_B1 = 1 )
Then(1)       For(2)x = 0 ... NC_CYL_NR-1
                LV_CDN_DIAG_MIS[x] = 1           // Diagnosis is active for all cylinders
                If(3)NLC_ENA_SCDN_NEW = 1
                Then(3) ACTION_ERRM_CdnDiagScdn (MIS[x])
                EndIf(3)
                EndFor(2)
Else(1)       For(2)x = 0 ... NC_CYL_NR-1
                LV_CDN_DIAG_MIS[x] = 0           // Diagnosis is passive for all cylinders
                EndFor(2)
EndIf(1)

```

### Formula section:

**Remark:**

**Note :** CARRIER[x] = 1, stands for bit dedicated to cylinder x inside CARRIER structure is set to 1

ERR\_SYM[x][0] = 1, stands for symptom 0 inside ERR\_SYM[x] structure is set to 1  
*[x]* (*italic*) stands for bit assignment within a data, [x] stands for data assignment within an array

### Individual cylinder errors set in case of MIS\_A failure

```

If(1)          LV_MIS_STATE_A = 1           // MIS_A failure criterion
For(2)         x = 0 to NC_CYL_NR - 1       // Check for each cylinder x
                If(3)          SYM_CYL_MIS_A[x] = 1
                Then(3) LV_ERR_MIS[x] = 1     // MIS failure on Cyl x
                ERR_SYM_MIS[x][0] = 1       // MIS_A symptom on Cyl x
                Delivery the result to Error Management
                If(4) (NLC_ENA_SCDN_NEW=1 and LV_ERR_MIS[x]=0 ->1)
                Then(4)          ACTION_ERRM_EndWinScdn(MIS[x],1)
                End If(4)
Else(3) If(4)   SYM_CYL_MIS_B1[x] = 0
                And SYM_CYL_MIS_B4[x] = 0
                Then(4) LV_ERR_MIS[x] = 0
                ERR_SYM_MIS[x] = 0H
                Delivery the result to Error Management

```


```

                Else(4)                                ERR_SYM_MIS[x][0] = 0                                // MIS_
A symptom on Cyl x
                Delivery the result to Error Management
                EndIf(4)

                EndIf(3)

                EndFor(2)
            Else(1) // No MIS_A failure criterion
                For(2) x = 0 to NC_CYL_NR - 1 // Check for each cylinder x
                    If(3) SYM_CYL_MIS_B1[x] = 0
                        And SYM_CYL_MIS_B4[x] = 0
                            Then(3) LV_ERR_MIS[x] = 0
                                ERR_SYM_MIS[x] = 0H
                                Delivery the result to Error Management
                            Else(3) ERR_SYM_MIS[x][0] = 0 // Symptom MIS_A erased
                                Delivery the result to Error Management
                            EndIf(3)
                        EndFor(2)
                    EndIf(1)
                EndIf(1)
            Individual cylinder errors set in case of MIS_B1 failure
            If(1) (LV_END_MIS_B1 = 0 or LV_END_WIN_MIS_B1 = 1) // Diagnosis during window MIS_
            B1
            Then(1)
                If(2) LV_MIS_STATE_B1 = 1 // MIS_B1 failure criterion
                    For(3) x = 0 to NC_CYL_NR - 1 // Check for each cylinder x
                        If(4) SYM_CYL_MIS_B1[x] = 1
                            Then(4) LV_ERR_MIS[x] = 1 // MIS failure on Cyl x
                                ERR_SYM_MIS[x][1] = 1 // MIS_B1 symptom on Cyl x
                                Delivery the result to Error Management
                            EndIf(4)
                        EndFor(3)
                    Else(2) // No MIS_B1 failure criterion, MIS_B1 symptom on Cyl x evaluated once per driving
                    cycle
                    No operation
                EndIf(2)
                If(5) NLC_ENA_SCDN_NEW = 1
                    Then(5)
                        For(6) x = 0 to NC_CYL_NR - 1
                            If(7) (LV_ERR_MIS[x]=0→1 or LV_END_WIN_MIS_B1 = 1)
                                ACTION_ERRM_EndWinScdn(MIS[x],LV_ERR_MIS[x]+
                                LV_ERR_MIS_A_IN_WIN_Bold) // Check for each cylinder
                            EndIf(7)
                        EndFor(6)
                    EndIf(5)
                EndIf(1)
            Individual cylinder errors set in case of MIS_B4 failure
            If(1) LV_MIS_STATE_B4 = 1 // MIS_B4 failure criterion
                For(2) x = 0 to NC_CYL_NR - 1 // Check for each cylinder x
                    If(3) SYM_CYL_MIS_B4[x] = 1
                        Then(3) LV_ERR_MIS[x] = 1 // MIS failure on Cyl x
                            ERR_SYM_MIS[x][2] = 1 // MIS_B4 symptom on Cyl x
                    EndIf(3)
                EndFor(2)
            EndIf(1)

```

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**Delivery** the result to Error Management

```

Else(3) If(4)      SYM_CYL_MIS_A[x] = 0
                  And SYM_CYL_MIS_B1[x] = 0
Then(4) LV_ERR_MIS[x] = 0
        ERR_SYM_MIS[x] = 0H
        Delivery the result to Error Management

Else(4)          ERR_SYM_MIS[x][2] = 0    // MIS_B4 symptom on Cyl x
                Delivery the result to Error Management
                EndIf(4)
            EndIf(3)
        EndFor(2)
    Else(1)      // No MIS_B4 failure criterion
        For(2)  x = 0 to NC_CYL_NR - 1                // Check for each cylinder x
            If(3) SYM_CYL_MIS_A[x] = 0
                And SYM_CYL_MIS_B1[x] = 0
            Then(3) LV_ERR_MIS[x] = 0
                    ERR_SYM_MIS[x] = 0H
            Delivery the result to Error Management
            Else(3) ERR_SYM_MIS[x][2] = 0            // Symptom MIS_B4 erased
            Delivery the result to Error Management
            EndIf(3)
        EndFor(2)
    EndIf(1)
    If(1) (NLC_ENA_SCDN_NEW = 1)
    Then(1)
        For(2) x = 0 to NC_CYL_NR - 1
            If(3) (LV_ERR_MIS[x]=0 & LV_END_WIN_MIS_B4=1 )
                Then(3) ACTION_ERRM_EndWinScdn (MIS[x], LV_ERR_IN_WIN_MIS_B4old +
                    LV_ERR_MIS_A_IN_WIN_Bold )
                    // previous values of lv_err_mis_a_in_win_b and lv_err_in_win_mis_b4.
            Else If(4) (LV_ERR_MIS[x]=1 & LV_ERR_IN_WIN_MIS_B4=0->1 )
                ACTION_ERRM_EndWinScdn (MIS[x], LV_ERR_IN_WIN_MIS_B4)
            End If(4)
            End If(3)
        EndFor(2)
    End If(1)

End of Diagnosis:


If      LV_ERR_MIS[x] = 1
Then    LV_END_DIAG_MIS[x] = 1                // for all cylinders
Else    LV_END_DIAG_MIS[x] = LV_END_MIS_B4    // for all cylinders
EndIf

```

## B.111.6 Multiple cylinder misfire

### Description:

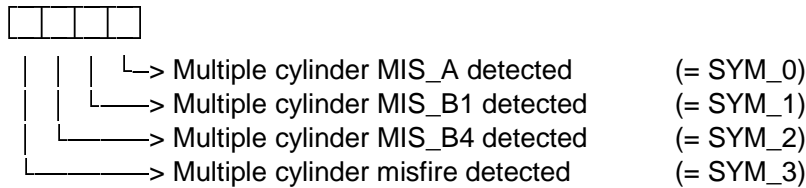
If at the end of the concerned checking range (LV\_END\_WIN\_MIS\_A), misfire is detected on two or more cylinders, then the Multiple cylinder misfire is detected.

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Depending if only MIS\_A, MIS\_B1, MIS\_B4 or a combination is active, the concerned bits are set. The error is set directly without debounce.

Error-symptoms are defined to this diagnosis function as following :



### Application conditions

**Initialisation:** *all outputs with 0 at LV\_DC 0->1 or reset*

**Recurrence:** The application recurrence is **ENRD segment**,  
 After misfire detection, After misfire diagnosis

**Activation:**

```

If    LV_DC = 1
And   LV_CDN_MIS_A = 1
And   LC_MIS_INH = 0
And   ( LC_CONF_MPL_DET_MIS_A = 1           or
          LC_CONF_MPL_DET_MIS_B = 1 )
And   LV_END_WIN_MIS_A = 1
Then  LV_CDN_DIAG_MIS_MPL = 1           // diagnosis is active
Else  LV_CDN_DIAG_MIS_MPL = 0           // diagnosis is passive
Endif
  
```

### Formula section:

#### Error detection Multiple misfire without symptom detection

```

If    LV_CDN_DIAG_MIS_MPL = 1
Then
  If    at least two Multiple Misfire Bits are active (Bits MPL are set in
          SYM_CYL_MIS_A, SYM_CYL_MIS_B1, SYM_CYL_MIS_B4)
    Then  ERR_SYM_MIS_MPL = SYM_3
           LV_ERR_MIS_MPL = 1
  
```

#### Error detection Multiple misfire MIS\_A

```

Else If onlyMPL Misfire MIS_A is active (Bit MPL is set in SYM_CYL_MIS_A)
Then    ERR_SYM_MIS_MPL = SYM_0
           LV_ERR_MIS_MPL = 1
  
```

#### Error detection Multiple misfire MIS\_B1

```

Else If only MPL Misfire MIS_B1 is active (Bit MPL is set in SYM_CYL_MIS_B1)
Then    ERR_SYM_MIS_MPL = SYM_1
           LV_ERR_MIS_MPL = 1
  
```

#### Error detection Multiple misfire MIS\_B4

```

Else If only MPL Misfire MIS_B4 is active (Bit MPL is set in SYM_CYL_MIS_B4)
Then    ERR_SYM_MIS_MPL = SYM_2
           LV_ERR_MIS_MPL = 1
  
```

#### No Multiple misfire

```

Else If no BIT Multiple Misfire is active (all Bits MPL are 0)
Then    ERR_SYM_MIS_MPL = NO_SYM
           LV_ERR_MIS_MPL = 0
  
```

**Endif**

```

Else      waiting for diagnosis condition ( end of diagnosis window MIS_A)
Endif
End of Diagnosis
If          LV_ERR_MIS_MPL = 1      or
          LV_END_MIS_B4 = 1
Then      LV_END_DIAG_MIS_MPL = 1
Endif

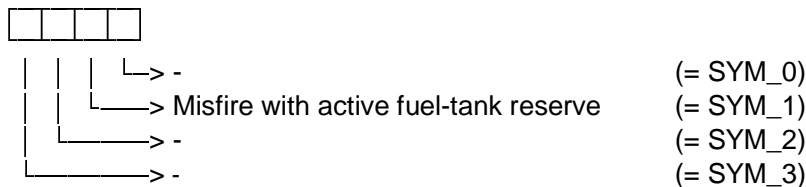
```

### B.111.7 Misfire with low fuel signal active

#### Description:

If Misfire is detected (CARB\_A /CARB\_B1/4) with low fuel signal active then a error bit is set in order to supply a own P-code requested by CARB (error is set directly without debounce)

Error-symptoms are defined to this diagnosis function as following :



#### Application conditions

**Initialisation:** *all outputs with 0 at LV\_DC 0->1 or reset*

**Recurrence:** The application recurrence is **ENRD segment**,  
*After misfire detection, After misfire diagnosis*

**Activation:**

```

If          LV_DC = 1
And        LV_CDN_MIS_A = 1
And        LC_MIS_INH = 0
Then      LV_CDN_DIAG_MIS_FTL_L = 1      (diagnosis
is active)
Else      LV_CDN_DIAG_MIS_FTL_L = 0      (diagnosis is passive)
Endif

```

#### Formula section:

##### Error detection

```

If          ( LV_MIS_STATE_A = 1      or
          LV_MIS_STATE_B1 = 1      or
          LV_MIS_STATE_B4 = 1 )
and
          LV_FTL_L_DIAG_MIS = 1      fuel reseve active and calibrated
Then      ERR_SYM_MIS_FTL_L = SYM_1
          LV_ERR_MIS_FTL_L = 1      set directly
Else      ERR_SYM_MIS_FTL_L = NO_SYM
          LV_ERR_MIS_FTL_L = 0      reset
Endif

```

End of Diagnosis

```

If                LV_ERR_MIS_FTL_L = 1      or
                   LV_END_MIS_B4          = 1
Then             LV_END_DIAG_MIS_FTL_L = 1
Endif

```

**B.111.8 Misfire event counters**Description:

The counters should be used for reading out diagnosis data in the workshop. All Data are stored in NVMY. The DC - related counters (CTR\_SEG\_MIS\_ACT and CTR\_MIS\_DET) are initialized if engine is started or if NVMY is cleared.

Application conditions

**Initialisation:** CTR\_SEG\_MIS\_ACT and CTR\_MIS\_DET are initialized from MVMY and set to 0 at LV\_RUN\_ENG 0->1 **or** at clearing misfire NVMY variables. CTR\_MIS\_DET\_CYL[i] are initialized from MVMY and only set to 0 at clearing misfire NVMY variables

**Recurrence:** *ER segment task, after ER determination process & Misfire detection*

**Activation:** LV\_REQ\_INH\_MIS = 0 *increment counters*

**Deactivation:** LV\_REQ\_INH\_MIS = 1 *counters are unchanged*

Formula section:Calculation of CTR\_SEG\_MIS\_ACT

```

CTR_SEG_MIS_ACT n = CTR_SEG_MIS_ACT n-1 + 1
//counting every segment if MSF detetion is active

```

Calculation of CTR\_MIS\_DET

```

If                LV_DET_MIS = 1
Then             CTR_MIS_DET n = CTR_MIS_DET n-1 + 1
                   CTR_MIS_DET_CYL[SEG_NR_ER] n =
                   CTR_MIS_DET_CYL[SEG_NR_ER] n-1 + 1

```

**Endif**Remark for all counters:

If the counters reaches the end of Hex-limit, then the inrementing process is stopped and value remain on max value.

## B.112 Misfire detection

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_THD_ER	V	0... 400H	0 ...4	3.91e-3	?????
Global gain multiplicative correction applied to basic misfire detection thresholds					
LV_DET_MIS	O/V	0... 1H	0 ...1	1	-
Single misfire detected and confirmed (after fade out test)					
LV_DET_THD_MIS	V	0... 1H	0 ...1	1	-
Single misfire detected based only on threshold criterion (before fade out test)					
LV_INH_DET_MIS	O/V	0... 1H	0 ...1	1	-
General misfire detection fade out					
MIS_DET_CYL_INH	V	0... FFH	0... 255	1	-
Cylinder misfiring detection inhibition carrier byte when a fade out condition occurred (after masking & delay)					
MIS_STATE_ER	V	0... FFH	0... 255	1	-
Status carrier byte of actual detected misfire through engine roughness index - 1 bit /cylinder					
THD_ER	O/V	8000... 7FFFH	-32768 ...32767	1	-
Misfire detection threshold for current ER value					
THD_ER_BUF [NC_SIZE_THD_ER_BUF]	V	8000... 7FFFH	-32768 ...32767	1	-
Misfire detection threshold stack for ER evaluation					
THD_ER_CYL [NC_CYL_NR]	V	8000... 7FFFH	-32768 ...32767	1	-
Cylinder Misfire detection threshold for current ER value					

### Input data:

ER {p. 1454}	ER_STND {p. 1454}	FAC_THD_APP_ER {p. 6283}	INH_INJ {p. 2295}
LC_MIS_INH {p. 6277}	LOAD_MIS {p. 6213}	LV_AT {p. 654}	LV_CVT
LV_DIAG_MIS {p. 6225}	LV_DRI {p. 1302}	LV_ENA_ER {p. 1454}	LV_ENA_SEG_T_MES {p. 1447}
LV_ER_CLC_MIS_DET_ CUS_SPC {p. 8360}	LV_HOM_AFL_ACT {p. 8136}	LV_IS {p. 1720}	LV_REQ_INH_MIS {p. 6225}
LV_S_ACT {p. 8137}	LV_VAR_4WD {p. 655}	LV_ZDLY_DIAG_MIS {p. 6225}	MIS_STATE_CUS_SPC {p. 8360}
N {p. 1525}	N_32 {p. 1525}	NC_CMB_CONF {p. 812}	NC_CYL_NR {p. 1526}
SEG_NR_ER {p. 1454}	TCO {p. 1100}	THD_ER {p. 6276}	THD_ER_CLC {p. 6283}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_THD_IV_ER	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_N_32_IP_FAC_THD_IV_ER	6	0... FFH	0... 8160	32	rpm
Factor for adaptation of the threshold in case of active cylinder cut-off					
IP_FAC_THD_IV_S_ER	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_N_32_IP_FAC_THD_IV_S_ER	6	0... FFH	0... 8160	32	rpm
Factor for adaptation of the threshold in case of active cylinder cut-off in stratified combustion mode					
IP_FAC_THD_TCO_ER	-	0... 1FFH	0... 1.99609	3.9063e-3	-
LDP_TCO_IP_FAC_THD_TCO_ER	8	0... FEH	-48... 142.5	0.75	°C
Temperature-dependent threshold reduction					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_MIS_INH	-	0... 1H	0 ...1	1	-
Global switch to disable all misfire monitoring related modules (Inhibition with = 1)					
LC_MIS_INH_CUS_SPC	-	0... 1H	0 ...1	1	-
Global switch to disable customer specific misfire monitoring (Inhibition with = 1)					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_SIZE_THD_ER_BUF	-	0... 8H	0 ...8	1	-
Misfire detection threshold buffer size					
NLC_USE_ER_STND_MIS	-	0... 1H	0 ...1	1	-
Misfire detection integration mode (based on ER index = 0, based on ER_STND index = 1)					

### B.112.1 Global fade out switch for misfire detection and monitoring

**Description:**

There is one global switch which can be used for inhibiting all the MISF aggregate modules:

- Generic misfire parameters & fade-out conditions : Aggr MISF, chapter OBDII
- Legal misfire detection fade-out conditions : Aggr MISF, chapter OBDII
- Rough road detection : Aggr MISF, chapter OBDII
- Crankshaft oscillation detection : Aggr MISF, chapter OBDII
- Misfire detection : Aggr MISF, chapter OBDII
- Appl. Inc. for misfire detection : Aggr MISF, chapter OBDII
- Misfire rate and criterions determination : Aggr MISF, chapter OBDII
- Appl. Inc. for Misfire rate and criterions determination : Aggr MISF, chapter OBDII

### B.112.2 Misfire detection thresholds determination for engine roughness index

**Function description:**

ER strategy misfire detection is based on a comparison between a cylinder specific ER value (nominal or normalised) and a threshold who is relative to the engine parameters when this same cylinder was in intake phase (threshold relative to combustion conditions image).

The engine roughness value ER depends strongly on the current operating point, both in its spread during undisturbed engine operation, and in the signal amplitude in case of an actual misfire.

ER misfire detection thresholds are defined according basic threshold maps and threshold corrections:

- *A basic threshold map:*

This map is function of engine load and speed which are calibrated for engine at operating temperature as well as for adapted transmitter gear. One map is assigned through the vehicle transmission type, idle speed condition & the combustion mode.


- *A threshold temperature correction:*

A temperature correction is applied to compensate larger signal amplitudes arise of ER values at lower engine temperatures. This correction is relative to TCO value.

- *A threshold correction during active injection valve cut-off:*

If one or several injection valves are cut off selectively by the engine management system (IV diagnoses ...), then the cylinder or cylinders are excluded from the misfire check. Due to the system, the signal amplitude of the ER value is reduced with a misfire at another cylinder. To improve the detection for this period, the absolute amount of the threshold can be reduced multiplicatively with the factor IP\_

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 6277 of 8404	
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FAC\_THD\_IV\_ER(N\_32) or IP\_FAC\_THD\_IV\_S\_ER(N\_32) (in stratified mode). FAC\_THD\_IV\_ER is a temporary data.

- A threshold correction defined in application incidences:

FAC\_THD\_APP\_ER is a threshold multiplicative correction who is defined in the misfire detection application incidences file.

### B.112.2.1 Multiplicative correction for misfire thresholds

#### Application conditions

**Initialisation:** FAC\_THD\_IV\_ER = 1

**Recurrence:** every ENRD segment task

**Activation:** LV\_ENA\_SEG\_T\_MES = 1  
**And** LC\_MIS\_INH = 0

**Deactivation:** LV\_ENA\_SEG\_T\_MES = 0  
**Or** LC\_MIS\_INH = 1

#### Formula section:

```
#IF NC_CMB_CONF = AFS_S Or AFS_AFL_S
  If INH_INJ = 0
    Then FAC_THD_IV_ER = 1
  Elseif LV_S_ACT = 1
    Then FAC_THD_IV_ER = IP_FAC_THD_IV_S_ER(N_32)
  Else FAC_THD_IV_ER = IP_FAC_THD_IV_ER(N_32)
  Endif
#ELSE
  If INH_INJ = 0
    Then FAC_THD_IV_ER = 1
  Else FAC_THD_IV_ER = IP_FAC_THD_IV_ER(N_32)
  Endif
#ENDIF
FAC_THD_ER = IP_FAC_THD_TCO_ER(TCO) * FAC_THD_IV_ER * FAC_THD_APP_ER
```

### B.112.2.2 Misfire detection threshold buffers management

To manage the delay between cylinder intake phase and cylinder ER values, buffers are used to store threshold values before using for detection.

THD\_ER\_BUF[NC\_SIZE\_THD\_ER\_BUF] buffer is managed as a FIFO stack.


THD\_ER\_BUF[0] threshold value is the one obtained at current segment.

THD\_ER is threshold value delayed and who will be used for detection with current segment ER value. This delay between ER value and cylinder corresponding threshold depends on engine cylinder number (NC\_CYL\_NR).

### B.112.2.3 Misfire detection threshold based on engine roughness value (THD\_ER)

By using the ER value for misfire detection, the engine speed has the greatest influence on basic thresholds definition. On the other hand, by using the ER\_STND values for misfire detection, the engine load has the greatest influence on basic thresholds definition.

The influence of the engine load on the detection thresholds can change rapidly during instationary operation, it is urgently necessary to determine and to temporarily store the threshold values already at the time of the actual combustion before the calculatory check.

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note: at each ER segment occurrence, THD\_ER\_BUF is shifted with one memory unit (FIFO management) before determination process.

**Application conditions**

```

Initialisation:          at ECU reset Or engine stop
                          THD_ER = -32768
                          // ER Threshold buffer init on ER buffer reinitialisation
For k = 0 : NC_SIZE_THD_ER_BUF-1
                          THD_ER_BUF[k] = -32768 // For all buffer cells
                          EndFor
For x = 0 : NC_CYL_NR-1
                          THD_ER_CYL[x] = -32768 // For all cylinders
                          EndFor
    
```

**Recurrence:** every ENRD segment task

```

Activation:          LV_ENA_SEG_T_MES = 1
                          And LC_MIS_INH = 0
    
```

```

Deactivation:       LV_ENA_SEG_T_MES = 0
                          Or LC_MIS_INH = 1
    
```

Actions on Deactivation event:

```

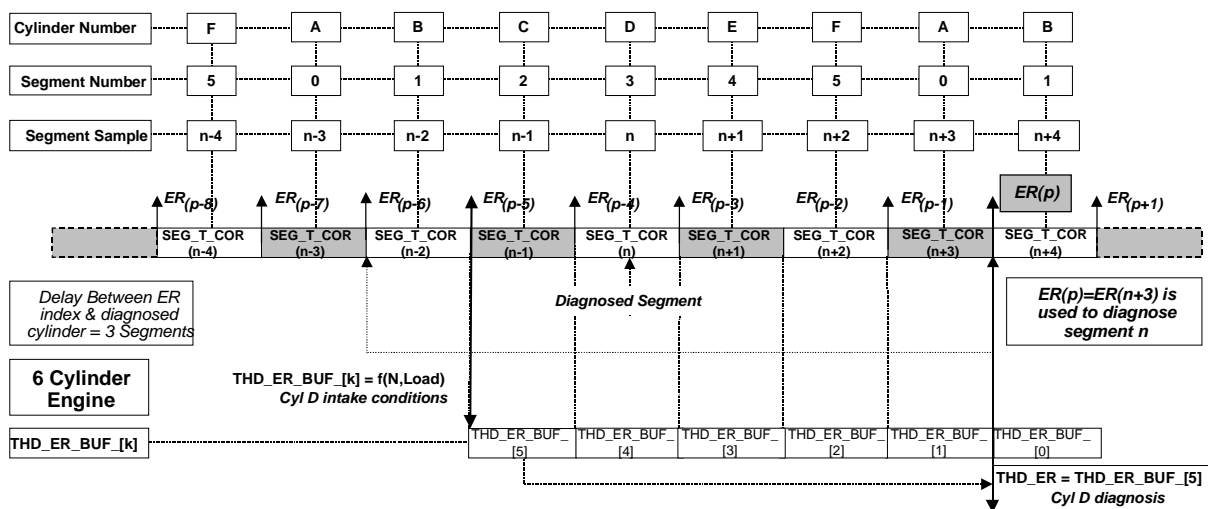
THD_ER = -32768
// ER Threshold buffer init on ER buffer reinitialisation
For k = 0 : NC_SIZE_THD_ER_BUF-1
    THD_ER_BUF[k] = -32768 // For all buffer cells
EndFor
For x = 0 : NC_CYL_NR-1
    THD_ER_CYL[x] = -32768 // For all cylinders
EndFor
    
```

**Formula section:**

```

THD_ER_BUF[0] = THD_ER_CLC * FAC_THD_ER
THD_ER = THD_ER_BUF[NC_SIZE_THD_ER_BUF-1] // Last cell of THD_ER buffer
THD_ER_CYL[SEG_NR_ER] = THD_ER
    
```

**6 cylinder engine example**



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## B.112.3 Misfire detection based on engine roughness evaluation

### General information:

The system identifies misfiring by monitoring engine roughness index. Misfiring causes the angular velocity of the crankshaft to drop in an angular range specific to the cylinder in question. Misfire detection is based on nominal engine roughness (ER) by using THD\_ER detection threshold. The identification of the cylinder(s) detected in misfire is realised according SEG\_NR\_ER segment reference (see definition and scheme in ENRD aggregate) (*Chapter system variables*). THD\_ER is already phased according ER delay (see *detection thresholds management*).

### Application conditions

**Initialisation:** *at ECU reset, at Engine Stop Or at Deactivation Event*

```
LV_DET_MIS = 0
LV_DET_THD_MIS = 0
LV_INH_DET_MIS = 1
MIS_STATE_ER = 0
MIS_DET_CYL_INH = 2NC_CYL_NR - 1
```

**Recurrence:** *every segment task*

**Activation:** *LV\_ENA\_ER = 1  
And LC\_MIS\_INH = 0*

**Deactivation:** *LV\_ENA\_ER = 0  
Or LC\_MIS\_INH = 1*

### Update rate:

ENRD segment task

### Formula section:

#### Misfire detection criterion

**#IF NLC\_USE\_ER\_STND\_MIS = 0 // ER based detection**

```
If ( ER < THD_ER )
    OR
    {
        LC_MIS_INH_CUS_SPC = 0 AND
        LV_ER_CLC_MIS_DET_CUS_SPC = 1 AND
        (Bit(SEG_NR_ER) of MIS_STATE_CUS_SPC = 1 )
    }
```

*// Read bit position of MIS\_STATE\_CUS\_SPC*

**Then** LV\_DET\_THD\_MIS = 1 *// basic detection before fade-out*

**Else** LV\_DET\_THD\_MIS = 0

**Endif**

**#ELSE // ER\_STND based detection**

```
If ( ER_STND < THD_ER )
    OR
    {
        LC_MIS_INH_CUS_SPC = 0 AND
        LV_ER_CLC_MIS_DET_CUS_SPC = 1 AND
        (Bit(SEG_NR_ER) of MIS_STATE_CUS_SPC = 1 )
    }
```

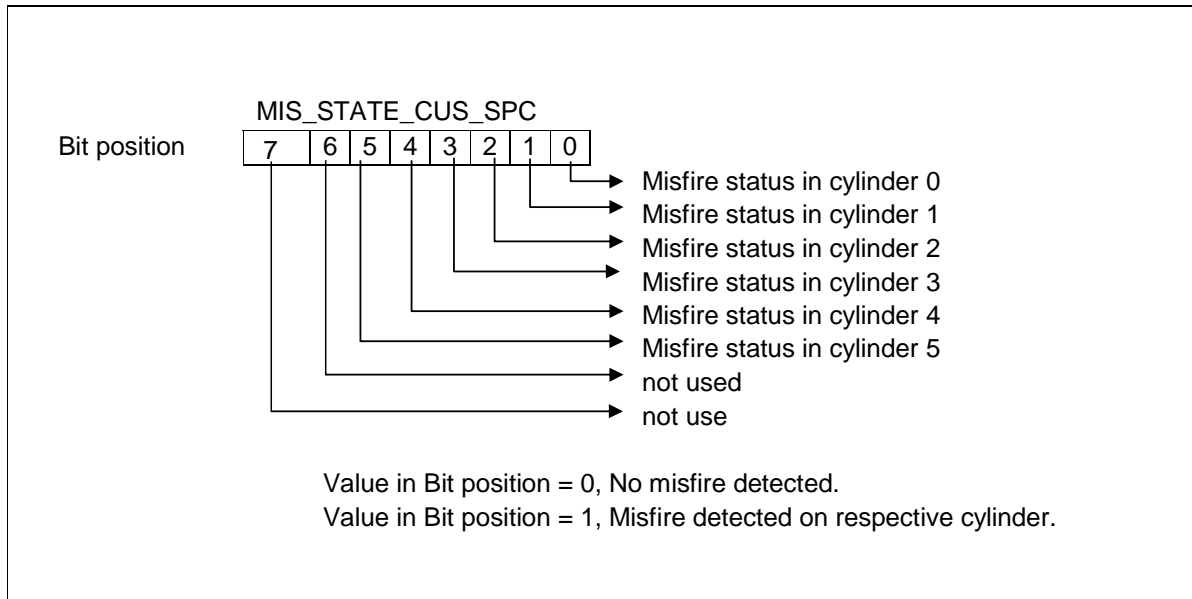


```

// Read bit position of MIS_STATE_CUS_SPC
Then LV_DET_THD_MIS = 1 // basic detection before fade-out
Else LV_DET_THD_MIS = 0
Endif
#ENDIF

```

// Customer specific misfire detection algorithm, has been introduced in this release, If there is catalyst heating and all related conditions are met, then LV\_ER\_CLC\_MIS\_DET\_CUS\_SPC is set to 1. This enables customer specific algorithm. MIS\_STATE\_CUS\_SPC is a status byte, and the information from the misfiring cylinder are stored in it.



#### General fade-out management

```

If LV_REQ_INH_MIS = 0 // no fade-out request on going (legal and generic)
And ( LV_ZDLY_DIAG_MIS = 1 Or LV_DIAG_MIS = 1 ) // diagnosis phase started
Then
LV_INH_DET_MIS = 0
MIS_DET_CYL_INH[SEG_NR_ER] = 0
(corresponding cylinder bit in MIS_DET_CYL_INH structure is set to 0,
misfire detection will be enabled on this cylinder)
Else
LV_INH_DET_MIS = 1
MIS_DET_CYL_INH[SEG_NR_ER] = 1
(corresponding cylinder bit in MIS_DET_CYL_INH structure is set to 1,
misfire detection will be disabled on this cylinder)
Endif

```

#### Misfire detection & cylinder identification

```

If LV_DET_THD_MIS = 1
And LV_INH_DET_MIS = 0 // no fade out on monitored cylinder
Then
LV_DET_MIS = 1 // an instantaneous misfiring is detected
MIS_STATE_ER[SEG_NR_ER] = 1
Cylinder specific bit in MIS_STATE_ER carrier structure is set to 1 according SEG_NR_ER
segment reference.
Else
LV_DET_MIS = 0
MIS_STATE_ER[SEG_NR_ER] = 0

```

Cylinder specific bit in MIS\_STATE\_ER carrier structure is set to 0 according SEG\_NR\_ER segment reference.

**Endlf**

**Misfire cylinder fade out carrier definition:**

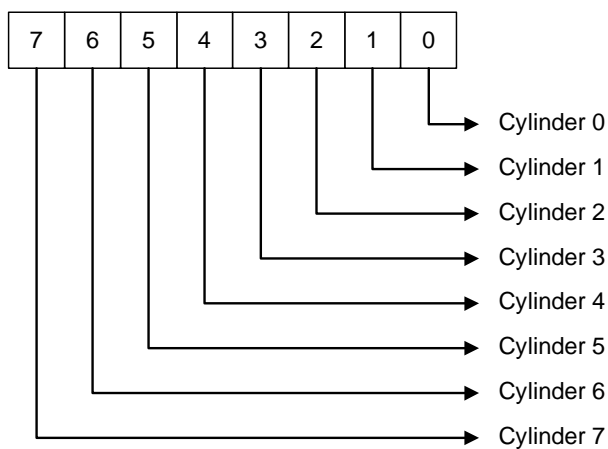
**MIS\_DET\_CYL\_INH** : Carrier used for cylinder fade-out reference

Shows the cylinders that will be in fade-out during the detection phase

**MIS\_STATE\_ER** : Carrier used for identification of the cylinder detected in misfire

Shows the cylinders that will be detected in misfire

Carrier structure valid for  
**MIS\_STATE\_ER**  
 and  
**MIS\_DET\_CYL\_INH**



## B.113 Misfire detection (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_TOT_MIS	V/S	0... FFFFFFFFH	0... 4294967295	1	-
Overall misfire detection counter					
FAC_GAIN_LOAD_MIS	O/V	0... 1FFH	0... 1.99609	3.9063e-3	-
Correction gain of the normalised engine load for misfire, specific to application					
FAC_THD_APP_ER	O/V	0... 1FFH	0... 1.99609	3.9063e-3	-
Misfire detection threshold correction gain specific to application					
IGA_BAS_COR_MV	O/V	0... FFH	-35.625 ...60	0.375	°CRK
Mean value of the corrected basic ignition angles					
LOAD_MIN_MIS	O/V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Normalised engine "zero" load for misfire detection					
LV_ER_CLC_PREV_INI	-	0... 1H	0 ...1	1	-
Boolean for initialisation of THD_ER_CLC_PREV at start of gradient limitation					
LV_FTL_L_DIAG_MIS	O/V	0... 1H	0 ...1	1	-
Request to allow error management of misfire occurrence with low fuel tank level					
LV_INH_APP_DET_MIS	O/V	0... 1H	0 ...1	1	-
Misfire detection process inhibition flag (application specific).					
LV_INH_APP_RR	O/V	0... 1H	0 ...1	1	-
Rough road detection appl. Inc. fade out					
LV_INH_CMB_TRA_MIS	O/V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to combustion mode transients					
LV_INH_CRK_OSC_DET	O/V	0... 1H	0 ...1	1	-
Crankshaft oscillation detection fade out					
LV_INH_FTL_L_DET_MIS	O/V	0... 1H	0 ...1	1	-
Misfire detection inhibition flag in case of low fuel tank level					
LV_INH_OBD_DET_MIS	O/V	0... 1H	0 ...1	1	-
OBD I misfire detection process inhibition flag					
LV_MIS_INH_CS	V	0... 1H	0 ...1	1	-
Misfire detection process inhibition during clutch transition.					
LV_MIS_INH_IV_KNK	V	0... 1H	0 ...1	1	-
Misfire detection process inhibition due to injection shut of from knock control					
THD_ER_CLC	O/V	8000... 7FFFH	-32768 ...32767	1	-
Value of the table used for Misfire detection threshold at current segment					
THD_ER_CLC_PREV	V	8000... 7FFFH	-32768 ...32767	1	-
Previous value of the table used for misfire detection threshold at current segment					

### Input data:


AMP {p. 982}	IGA_BAS_COR {p. 8266}	INH_IV_KNK {p. 1960}	LC_MIS_INH {p. 6277}
LOAD_MIS {p. 6213}	LV_AT {p. 654}	LV_CS_CUS {p. 1419}	LV_DET_MIS {p. 6276}
LV_ENA_ER {p. 1454}	LV_ENA_SEG_T_MES {p. 1447}	LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}
LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_ PER {p. 4432}	LV_ERR_IVVT {p. 1062}	LV_ERR_MTC_CTL_2 {p. 4977}

LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}	LV_ERR_SEG_AD_ER {p. 4367}	LV_ERR_T_SEG_ER {p. 4367}
LV_ERR_TPS {p. 4982}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}
LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_MON_1 {p. 6859}
LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_VS {p. 5021}	LV_FTL_OBD_INH_L {p. 1565}
LV_GS {p. 1565}	LV_IS {p. 1720}	LV_S_ACT {p. 8137}	LV_VAR_TCT {p. 656}
N {p. 1525}	N_32 {p. 1525}	NC_CMB_CONF {p. 812}	OPM_AV {p. 8137}
STATE_CC {p. 1571}	TCO {p. 1100}	TQ_ADD_CH {p. 6582}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_32_MAX_IS_MIS	-	0... FFH	0... 8160	32	rpm
Maximum engine speed to apply specific ER detection threshold in idle speed					
C_N_THD_MIS_INH	-	0... FFH	0... 8160	32	rpm
Global condition for inhibiting (deactivation) of all misfire modules					
C_NR_TDC_CMB_TRA_AFL_MIS	-	0... FFH	0... 255	1	-
Fade out TDC's duration when engine combustion manager enter or leave air/fuel lean combustion mode					
C_NR_TDC_CMB_TRA_HOM_MIS	-	0... FFH	0... 255	1	-
Fade out TDC s duration when engine combustion manager enter in homogen combustion mode					
C_NR_TDC_CMB_TRA_S_MIS	-	0... FFH	0... 255	1	-
Fade out TDC's duration when engine combustion manager enter or leave stratified combustion mode					
C_NR_TDC_IV_OFF_DET_MIS_KNK	-	0... FFH	0... 255	1	-
TDC delay to synchronise cylinder shut-off (from Knock control) information with the misfire detection index					
C_T_AMT_GS_DLY_MIS	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when gearshift of AMT has been detected					
C_T_CS_DLY_MIS	-	0... FFH	0... 255	1	-
No. of TDC,s for which misfire is deactivated during clutch transition.					
C_THD_ER_CLC_GRD	-	0... 7FFFH	0... 32767	1	µs
Gradient to limit the misfire detection threshold THD_ER_CLC in positive direction					
IP_FAC_THD_ER_CH	-	0... 1FFH	0... 1.99609	3.9063e-3	-
LDP_TQ_ADD_CH_IP_FAC_THD_ER_CH	4	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Threshold correction depending on TQ_ADD_CH for catalyst heating					
IP_LOAD_MIN_MIS_AFS_AT	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_N_IP_LOAD_MIN_MIS_AFS_AT	8	0... 1FE0H	0... 8160	1	rpm
LDP_TCO_IP_LOAD_MIN_MIS_AFS_AT	6	0... FEH	-48... 142.5	0.75	°C
Zero load curve vs engine speed and coolant temperature in AFS combustion mode, with AT vehicle					
IP_LOAD_MIN_MIS_AFS_MT	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_N_IP_LOAD_MIN_MIS_AFS_MT	8	0... 1FE0H	0... 8160	1	rpm
LDP_TCO_IP_LOAD_MIN_MIS_AFS_MT	6	0... FEH	-48... 142.5	0.75	°C
Zero load curve vs engine speed and coolant temperature in AFS combustion mode, with MT vehicle					
IP_LOAD_MIN_MIS_AFS_TCT	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_N_IP_LOAD_MIN_MIS_AFS_TCT	8	0... 1FE0H	0... 8160	1	rpm
LDP_TCO_IP_LOAD_MIN_MIS_AFS_TCT	6	0... FEH	-48... 142.5	0.75	°C
Zero load curve vs engine speed and coolant temperature in AFS combustion mode, with TCT vehicle					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_LOAD_MIN_MIS_HOM_S_AT	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_N_32_IP_LOAD_MIN_HOM_S_AT	6	0... FFH	0... 8160	32	rpm
LDP_TCO_IP_LOAD_MIN_HOM_S_AT	6	0... FEH	-48... 142.5	0.75	°C
Zero load curve vs engine speed and coolant temperature in HOM_S combustion mode, with AT vehicle					
IP_LOAD_MIN_MIS_HOM_S_MT	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_N_32_IP_LOAD_MIN_HOM_S_MT	6	0... FFH	0... 8160	32	rpm
LDP_TCO_IP_LOAD_MIN_HOM_S_MT	6	0... FEH	-48... 142.5	0.75	°C
Zero load curve vs engine speed and coolant temperature in HOM_S combustion mode, with MT vehicle					
IP_LOAD_MIN_MIS_HOM_S_TCT	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_N_32_IP_LOAD_MIN_HOM_S_TCT	6	0... FFH	0... 8160	32	rpm
LDP_TCO_IP_LOAD_MIN_HOM_S_TCT	6	0... FEH	-48... 142.5	0.75	°C
Zero load curve vs engine speed and coolant temperature in HOM_S combustion mode, with TCT vehicle					
IP_LOAD_MIN_MIS_S_AT	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_N_32_IP_LOAD_MIN_MIS_S_AT	6	0... FFH	0... 8160	32	rpm
LDP_TCO_IP_LOAD_MIN_MIS_S_AT	6	0... FEH	-48... 142.5	0.75	°C
Zero load curve vs engine speed and coolant temperature in S combustion mode, with AT vehicle					
IP_LOAD_MIN_MIS_S_MT	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_N_32_IP_LOAD_MIN_MIS_S_MT	6	0... FFH	0... 8160	32	rpm
LDP_TCO_IP_LOAD_MIN_MIS_S_MT	6	0... FEH	-48... 142.5	0.75	°C
Zero load curve vs engine speed and coolant temperature in S combustion mode, with MT vehicle					
IP_LOAD_MIN_MIS_S_TCT	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_N_32_IP_LOAD_MIN_MIS_S_TCT	6	0... FFH	0... 8160	32	rpm
LDP_TCO_IP_LOAD_MIN_MIS_S_TCT	6	0... FEH	-48... 142.5	0.75	°C
Zero load curve vs engine speed and coolant temperature in S combustion mode, with TCT vehicle					
IP_THD_AFS_ER_AT_CC_CLOSE	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_AFS_ER_AT_CLOSE	12	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_AFS_ER_AT_CLOSE	8	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in AFS mode, AT vehicle transmission type and converter clutch in state closed					
IP_THD_AFS_ER_AT_CC_CTL	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_AFS_ER_AT_CTL	12	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_AFS_ER_AT_CTL	8	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in AFS mode, AT vehicle transmission type and converter clutch in state controlled					
IP_THD_AFS_ER_AT_CC_OPEN	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_AFS_ER_AT_OPEN	12	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_AFS_ER_AT_OPEN	8	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in AFS mode, AT vehicle transmission type and converter clutch in state open					
IP_THD_AFS_ER_IS_AT_CC_CLOSE	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_AFS_ER_IS_AT_CLOSE	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_AFS_ER_IS_AT_CLOSE	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in AFS combustion mode & in idle speed, AT vehicle and converter clutch state close.					
IP_THD_AFS_ER_IS_AT_CC_CTL	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_AFS_ER_IS_AT_CTL	4	0... 1FE0H	0... 8160	1	rpm

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_LOAD_IP_AFS_ER_IS_AT_CTL	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in AFS combustion mode & in idle speed, AT vehicle and converter clutch state controlled.					
IP_THD_AFS_ER_IS_AT_CC_OPEN	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_AFS_ER_IS_AT	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_AFS_ER_IS_AT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in AFS combustion mode & in idle speed, AT vehicle and converter clutch open state.					
IP_THD_AFS_ER_IS_MT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_AFS_ER_IS_MT	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_AFS_ER_IS_MT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in AFS combustion mode & in idle speed, MT vehicle					
IP_THD_AFS_ER_IS_TCT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_AFS_ER_IS_TCT	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_AFS_ER_IS_TCT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in AFS combustion mode & in idle speed, TCT vehicle					
IP_THD_AFS_ER_MT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_AFS_ER_MT	12	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS_IP_THD_AFS_ER_MT	8	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in AFS mode, MT vehicle transmission type					
IP_THD_AFS_ER_TCT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_AFS_ER_TCT	12	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS_IP_THD_AFS_ER_TCT	8	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in AFS mode, TCT vehicle transmission type					
IP_THD_HOM_S_ER_AT_CC_CLOSE	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_HOM_S_ER_AT_CLOSE	9	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_HOM_S_ER_AT_CLOSE	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in HOM_S mode, AT vehicle transmission type and converter clutch state closed.					
IP_THD_HOM_S_ER_AT_CC_CTL	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_HOM_S_ER_AT_CTL	9	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_HOM_S_ER_AT_CTL	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in HOM_S mode, AT vehicle transmission type and converter clutch state controlled.					
IP_THD_HOM_S_ER_AT_CC_OPEN	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_HOM_S_ER_AT_OPEN	9	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_HOM_S_ER_AT_OPEN	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in HOM_S mode, AT vehicle transmission type and converter clutch state open.					
IP_THD_HOM_S_ER_IS_AT_CC_CLOSE	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_HOM_S_ER_IS_AT_CLOSE	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_HOM_S_ER_IS_CLOSE	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in HOM_S combustion mode & in idle speed, AT vehicle transmission type and converter clutch state closed					
IP_THD_HOM_S_ER_IS_AT_CC_CTL	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_HOM_S_ER_IS_AT_CTL	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_HOM_S_ER_IS_AT_CTL	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in HOM_S combustion mode & in idle speed, AT vehicle transmission type and converter clutch state controlled					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_THD_HOM_S_ER_IS_AT_CC_OPEN	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_HOM_S_ER_IS_AT_OPEN	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_HOM_S_ER_IS_AT_OPEN	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in HOM_S combustion mode & in idle speed, AT vehicle transmission type and converter clutch state open					
IP_THD_HOM_S_ER_IS_MT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_HOM_S_ER_IS_MT	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_HOM_S_ER_IS_MT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in HOM_S combustion mode & in idle speed, MT vehicle transmission type					
IP_THD_HOM_S_ER_IS_TCT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_HOM_S_ER_IS_TCT	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_HOM_S_ER_IS_TCT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in HOM_S combustion mode & in idle speed, TCT vehicle transmission type					
IP_THD_HOM_S_ER_MT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_HOM_S_ER_MT	9	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS_IP_THD_HOM_S_ER_MT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in HOM_S mode, MT vehicle transmission type					
IP_THD_HOM_S_ER_TCT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_HOM_S_ER_TCT	9	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_HOM_S_ER_TCT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in HOM_S mode, TCT vehicle transmission type					
IP_THD_S_ER_AT_CC_CLOSE	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_S_ER_AT_CLOSE	9	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_S_ER_AT_CLOSE	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in S mode, AT vehicle transmission type and converter clutch state closed					
IP_THD_S_ER_AT_CC_CTL	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_S_ER_AT_CTL	9	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS_IP_THD_S_ER_AT_CTL	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in S mode, AT vehicle transmission type and converter clutch state controlled					
IP_THD_S_ER_AT_CC_OPEN	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_S_ER_AT_OPEN	9	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_S_ER_AT_OPEN	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in S mode, AT vehicle transmission type and converter clutch state open					
IP_THD_S_ER_IS_AT_CC_CLOSE	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_S_ER_IS_AT_CLOSE	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_S_ER_IS_AT_CLOSE	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in S combustion mode & in idle speed, AT vehicle transmission type and converter clutch state closed					
IP_THD_S_ER_IS_AT_CC_CTL	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_S_ER_IS_AT_CTL	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_S_ER_IS_AT_CTL	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in S combustion mode & in idle speed, AT vehicle transmission type and converter clutch state controlled					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_THD_S_ER_IS_AT_CC_OPEN	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_S_ER_IS_AT_OPEN	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_S_ER_IS_AT_OPEN	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in S combustion mode & in idle speed, AT vehicle transmission type and converter clutch state open					
IP_THD_S_ER_IS_MT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_S_ER_IS_MT	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS_IP_THD_S_ER_IS_MT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in S combustion mode & in idle speed, MT vehicle transmission type					
IP_THD_S_ER_IS_TCT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_S_ER_IS_TCT	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS_IP_THD_S_ER_IS_TCT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in S combustion mode & in idle speed, TCT vehicle transmission type					
IP_THD_S_ER_MT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_S_ER_MT	9	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS_IP_THD_S_ER_MT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in S mode, MT vehicle transmission type					
IP_THD_S_ER_TCT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_S_ER_TCT	9	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS_IP_THD_S_ER_TCT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in S mode, TCT vehicle transmission type					
LC_FTL_L_DET_MIS	-	0... 1H	0 ...1	1	-
Inhibition of misfire detection in case of low fuel tank level					
LC_FTL_L_DIAG_MIS	-	0... 1H	0 ...1	1	-
Enable error management of misfire with low fuel tank level					
LC_MIS_INH_CS	-	0... 1H	0 ...1	1	-
Switch to enable misfire deactivation during Clutch transition					
LC_MIS_INH_GS	-	0... 1H	0 ...1	1	-
Switch to enable misfire deactivation during gear shift.					
LC_MIS_INH_IV_KNK	-	0... 1H	0 ...1	1	-
Switch to enable misfire deactivation due to injection switch off from knock control					
LC_USE_IVVT_INH_MIS	-	0... 1H	0 ...1	1	-
Enable IVVT diagnosis for Inhibition of misfire detection					


## B.113.1 Global fade out condition ( N\_32 threshold )

### FUNCTION DESCRIPTION:

#### General information:

There is one global condition  $N_{32} > C_{N\_THD\_MIS\_INH}$  which can be used for inhibition (deactivation) of the following modules:

- Appl. Inc. for engine roughness calc. : chapter System variables
- Engine roughness calculation : chapter System variables
- Appl. Inc. for misfire detection : chapter OBDII
- Misfire detection : chapter OBDII
- Misfire rate detection and error handling : chapter OBDII

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**Formula section:**

```

If           N_32 > C_N_THD_MIS_INH
Then        Engine roughness/Misfire detection is inhibited
Else        no inhibition due to this condition
Endif
    
```

**B.113.2 Misfire detection threshold correction gain specific to application**

**Description:**

To ensure misfire detection during active catalyst heating in IS (in homogenous mode only), the threshold is multiplied with a factor depending on the torque reserve at catalyst heating TQ\_ADD\_CH.

**Application conditions**

```

Initialization:    all 1 at reset and at each activation and deactivation
                      Recurrency:      segment
Activation:       LV_ENA_SEG_T_MES = 1          and          LC_MIS_INH = 0
Deactivation:     LV_ENA_SEG_T_MES = 0          or           LC_MIS_INH = 1
    
```

**Formula section:**

```

If           LV_IS = 1          and
                LV_S_ACT = 0
Then        FAC_THD_APP_ER = IP_FAC_THD_ER_CH(TQ_ADD_CH)
Else        FAC_THD_APP_ER = 1
Endif
    
```

**B.113.3 Misfire detection inhibition related to OBDI diagnosis**

**Description:**

Misfire detection process is inhibited when one of the following OBD I errors occurs. Depending on calibration, IVVT diagnosis is considered for inhibition or not.

**Application conditions**

```


Initialization:    all 0 at reset and at each activation and deactivation
                      Recurrency:      updated every segment before misfire detection
                      function
Activation:       LV_ENA_ER = 1          and          LC_MIS_INH = 0
Deactivation:     LV_ENA_ER = 0          or           LC_MIS_INH = 1
    
```

**Formula section:**

```

If           LV_ERR_TPS = 1          // throttle error
OR           [ LV_ERR_IVVT = 1 and LC_USE_IVVT_INH_MIS = 1 ]          // VANOS error
OR           LV_ERR_SEG_AD_ER = 1          // Segment adaptation error
OR           LV_ERR_CRK_PLAUS = 1
    
```

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```

OR      LV_ERR_CRK_SYN = 1
OR      LV_ERR_CRK_TOOTH = 1
OR      LV_ERR_CRK_TOOTH_PER = 1
OR      LV_ERR_TPS_1 = 1
OR      LV_ERR_TPS_2 = 1
OR      LV_ERR_TPS_AD = 1
OR      LV_ERR_TPS_MAF_1 = 1
OR      LV_ERR_TPS_MAF_2 = 1
OR      LV_ERR_TPS_MON_1 = 1
OR      LV_ERR_TPS_RATIO = 1
OR      LV_ERR_TPS_ST_CHK_2 = 1
OR      LV_ERR_T_SEG_ER = 1
OR      LV_ERR_MTC_CTL_2 = 1
OR      LV_ERR_MTC_CTL_3 = 1
OR      LV_ERR_MTC_DR = 1
OR      LV_ERR_TPS_AD_BOL = 1
Then    LV_INH_OBD_DET_MIS = 1
Else    LV_INH_OBD_DET_MIS = 0
Endlf

```

## B.113.4 Misfire detection inhibition related to AMT gearshift intervention

### FUNCTION DESCRIPTION:

#### General information:

LV\_INH\_APP\_DET\_MIS is used for project-specific inhibition of Misfire detection, e.g.:

- AMT gearshift intervention

#### Description:

When AMT gearshift intervention is detected (LV\_GS = 1) misfire detection can be suppressed because this load jump can cause a segment period jump and crankshaft vibration, depending on the engine operating state and load request.

If AMT gearshift intervention has been detected (LV\_GS changes from 1 to 0 or 0 to 1), Misfire detection can be suppressed for the applicable constant period C\_T\_AMT\_GS\_DLY\_MIS starting at transition LV\_GS 1->0.

#### Application conditions

**Initialization:** all 0 at reset and at each activation and deactivation


**Recurrence:** updated every segment *before* misfire detection function

**Activation:** LV\_ENA\_ER = 1                      **and**                      LC\_MIS\_INH = 0

**Deactivation:** LV\_ENA\_ER = 0                      **or**                      LC\_MIS\_INH = 1

#### Formula section:

##### Cylinder fuel shut-off:

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// if any one cylinder is switched off from Knock control function, then misfire is deactivated. This can be activated using the switch LC\_MIS\_INH\_IV\_KNK.

**NOTE: The Activation by LC\_MIS\_INH\_IV\_KNK has to be checked with CARB**

```

If(1)      INH_IV_KNK > 0           // indexed by cylinder bit position
Then(1)    LV_MIS_INH_IV_KNK = 1 after a delay of C_NR_TDC_IV_OFF_DET_MIS_KNK
TDC,s
Else(1)    LV_MIS_INH_IV_KNK = 0 after a delay of C_NR_TDC_IV_OFF_DET_MIS_KNK
TDC,s

EndIf(1)

```

```

If(2) ( ( LV_CS_CUS 1->0 or LV_CS_CUS 0->1 ) AND LC_MIS_INH_CS=1 )

```

```

Then(2) LV_MIS_INH_CS = 1 for C_T_CS_DLY_MIS   TDC,s

```

```

Else(2) LV_MIS_INH_CS = 0

```

```

EndIf(2)

```

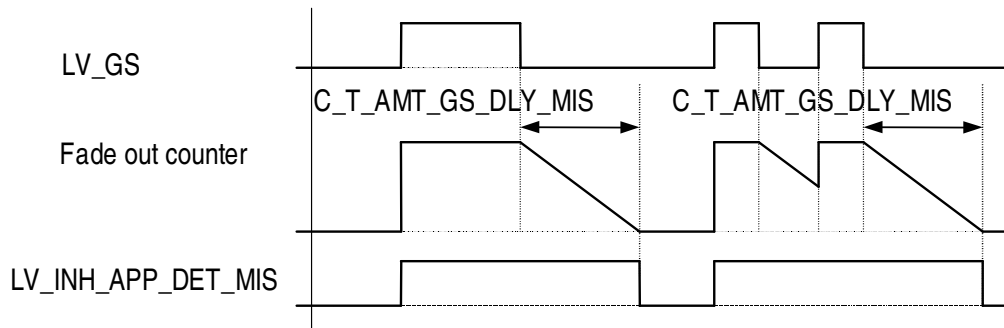
// inhibition of misfire function during gear change, is not allowed for CARB applications.

```

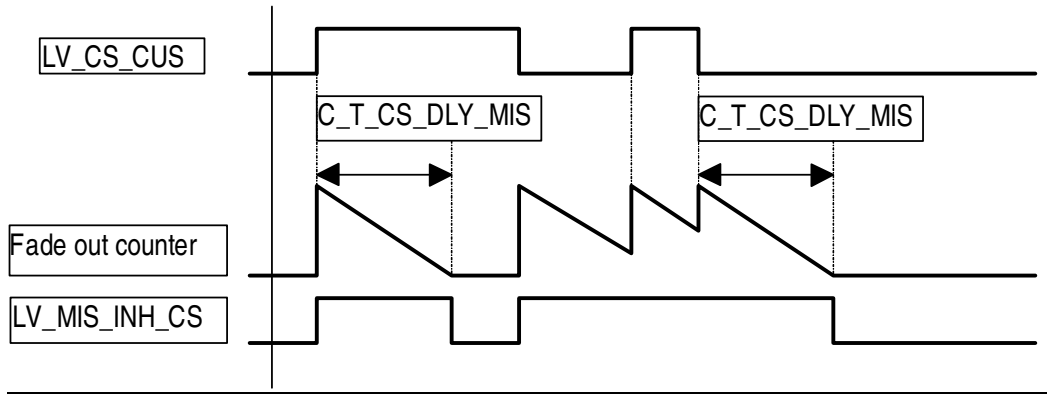
If(3)      ( LV_GS = 1 and LC_MIS_INH_GS=1 and LV_VAR_TCT=1)
Or         ( ( LV_GS 1->0 and Time C_T_AMT_GS_DLY_MIS is active) and
              LC_MIS_INH_GS=1 and LV_VAR_TCT=1 )
Or         LV_MIS_INH_IV_KNK =1 AND LC_MIS_INH_IV_KNK = 1
Or         LV_MIS_INH_CS = 1
Then(3)    LV_INH_APP_DET_MIS = 1
Else(3)    LV_INH_APP_DET_MIS = 0
EndIf(3)

```

#### Fade out behaviour summary for AMT gear shift :



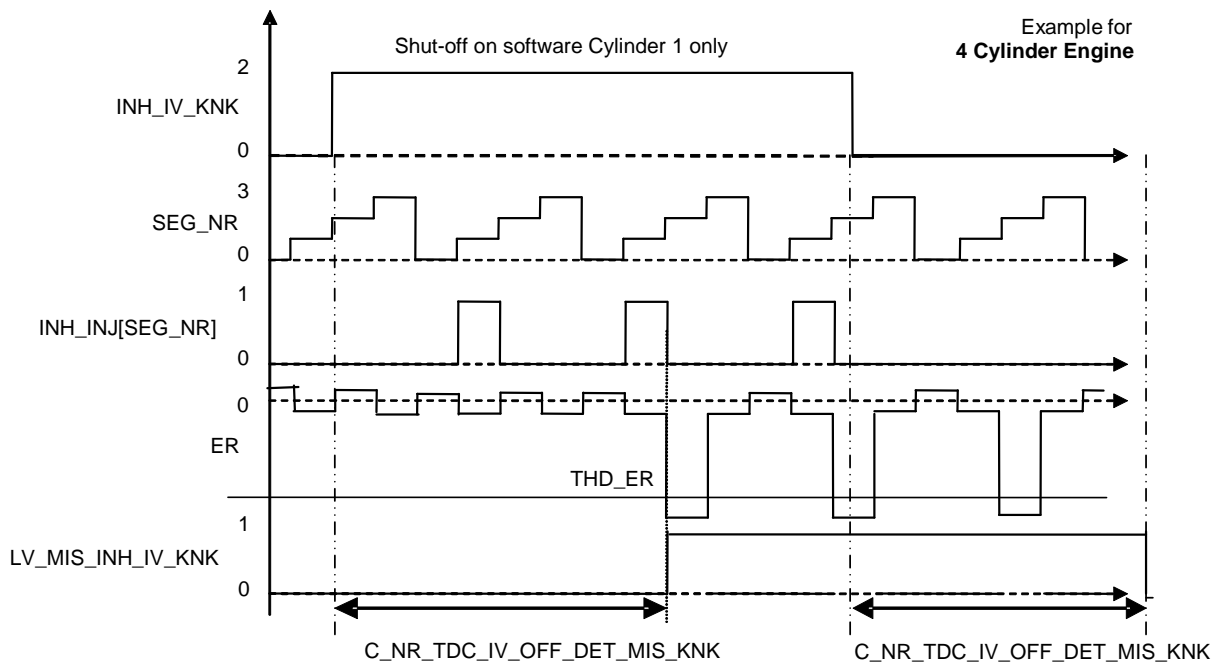
#### Fade out behaviour summary for MT - Change in clutch signal



// Initial appliation value for C\_NR\_TDC\_IV\_OFF\_DET\_MIS\_KNK, should be taken from C\_NR\_TDC\_IV\_OFF\_DET\_MIS + NC\_CYL\_NR-2

There is a delay of 2 segments for calculation of INH\_IV\_KNK, hence delay of NC\_CYL\_NR-2 segments to shut off the injector. Injection switch off only in the next segment calculation.

Further there is a delay of C\_NR\_TDC\_IV\_OFF\_DET\_MIS TDC,s for ER calculation. Hence total delay is C\_NR\_TDC\_IV\_OFF\_DET\_MIS + NC\_CYL\_NR-2




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### B.113.5 Rough road detection fade out condition

#### Description:

Rough road detection is inhibited if no VS signal is available (LV\_ERR\_VS = 1).

#### Application conditions

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**Initialisation:** *all 0 at reset and at each activation and deactivation*  
**Recurrence:** *same as rough road detection update rate*  
**Activation:** *LC\_MIS\_INH = 0*  
**Deactivation:** *LC\_MIS\_INH = 1*

**Formula section:**

```

If          LV_ERR_VS = 1
Then       LV_INH_APP_RR = 1
Else       LV_INH_APP_RR = 0
Endif
    
```

**B.113.6 Misfire low fuel tank level informations**

**Description:**

- Misfire detection can be suppressed if low fuel is detected ( LV\_INH\_FTL\_L\_DET\_MIS ).
- Low fuel signal can be used to calculate P-Code Misfire with low fuel P313.

**Application conditions**

**Initialisation:** *all 0 at reset and at each activation and deactivation*  
**Recurrence:** *200ms //same as fuel tank level information*  
**Activation:** *LC\_MIS\_INH = 0*  
**Deactivation:** *LC\_MIS\_INH = 1*

**Formula section:**

Low fuel tank level information for misfire detection inhibition

```

If          LV_FTL_OBD_INH_L = 1
And         LC_FTL_L_DET_MIS = 1
Then       LV_INH_FTL_L_DET_MIS = 1
Else       LV_INH_FTL_L_DET_MIS = 0
Endif
    
```

Low fuel tank level information for error management of symptom "misfire with low fuel tank level".


```

If          LV_FTL_OBD_INH_L = 1
And         LC_FTL_L_DIAG_MIS = 1
Then       LV_FTL_L_DIAG_MIS = 1
Else       LV_FTL_L_DIAG_MIS = 0
Endif
    
```

**B.113.7 Total counter misfire detection**

**FUNCTION DESCRIPTION:**

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**General information:**

This counter is incremented at each misfire detection based on misfire index evaluation (*before crossed diagnosis with IGC & IV OBDI diags evaluation*). Thus, it is possible to determine the total number of misfire detected during engine lifetime.

**Application conditions**

**Initialisation:** *restored from NVMY*  
**Recurrence:** *updated every segment after LV\_DET\_MIS calculation*  
**Activation:** *LC\_MIS\_INH = 0*  
**Deactivation:** *LC\_MIS\_INH = 1*

**Formula section:**

On NV memory formatting or on NV memory corruption detection :  
 CTR\_TOT\_MIS = 0

Processing :  
 at each transition LV\_DET\_MIS 0 -> 1  
 CTR\_TOT\_MIS = CTR\_TOT\_MIS + 1

**B.113.8 Crankshaft oscillation detection fade-out**

**FUNCTION DESCRIPTION:**

Crankshaft oscillation detection process can be inhibited when one function and/or error requires an inhibition.

Note : This bit is necessary only if the crankshaft oscillation detection module is used in the project (NLC\_USE\_CRK\_OSC\_MIS = 1)

**Application conditions**


**Initialisation:** *all 0 at reset and at each activation and deactivation*  
**Recurrence:** *Segment, before Crankshaft oscillation detection*  
**Activation:** *LC\_MIS\_INH = 0*  
**Deactivation:** *LC\_MIS\_INH = 1*

**Formula section:**

**If** LV\_ERR\_VS = 1  
**Then** LV\_INH\_CRK\_OSC\_DET = 1  
**Else** LV\_INH\_CRK\_OSC\_DET = 0  
**EndIf**

**B.113.9 Mean value of the corrected basic ignition angles**

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**Application conditions**

**Initialisation:**  $IGA\_BAS\_COR\_MV = 0$  at reset  
**Recurrence:** 10 ms  
**Activation:**  $LV\_IGK = 1$

**Formula section:**

$IGA\_BAS\_COR\_MV = IGA\_BAS\_COR$

**B.113.10 Correction gain for engine load specific to application**

**Description:**

Here can be defined a gain who can change the normalised engine load dedicated to misfire monitoring according specific load corrections.

This correction can be applied during torque reduction sequences specific to project.

**Application conditions**

**Activation:**  $LV\_ENA\_SEG\_T\_MES = 1$   
**And**  $LC\_MIS\_INH = 0$   
**Deactivation:**  $LV\_ENA\_SEG\_T\_MES = 0$   
**Or**  $LC\_MIS\_INH = 1$   
**Initialisation:**  $FAC\_GAIN\_LOAD\_MIS = 1$   
**Recurrency:** -

**B.113.11 Current Misfire Detection Threshold**

**General information:**

THD\_ER\_CLC represents the current value used for determination of the misfire detection threshold. This data must be calculated before THD\_ER calculation and after LOAD\_MIS calculation.

**Description:**

Keyword configuration table:

NC_CMB_CONF	OPM_AV	xx
AFS	2	AFS
AFS_AFL	2	AFS
AFS_AFL	3	HOM_S
AFS_S	1	S
AFS_S	2	AFS
AFS_AFL_S	1	S
AFS_AFL_S	2	AFS
AFS_AFL_S	3	HOM_S

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### Application conditions

**Initialisation:** at ECU reset **Or** engine stop  
 THD\_ER\_CLC = -32768  
 THD\_ER\_CLC\_PREV = -32768  
 LV\_ER\_CLC\_PREV\_INI = 1

**Recurrence:** every ENRD segment task

**Activation:** LV\_ENA\_SEG\_T\_MES = 1  
**And** LC\_MIS\_INH = 0

**Deactivation:** LV\_ENA\_SEG\_T\_MES = 0  
**Or** LC\_MIS\_INH = 1

*Actions on Deactivation event:*  
 THD\_ER\_CLC = -32768  
 LV\_ER\_CLC\_PREV\_INI = 1

### Formula section:

*Convention for combustion mode determination:*

```
#if NC_CMB_CONF = AFS_AFL Or AFS_AFL_S
  If OPM_AV = 3 (homogeneous-stratified)
    Then xx = "HOM_S"
  Endif
#Endif
#if NC_CMB_CONF = AFS_S Or AFS_AFL_S
  If OPM_AV = 1 (stratified)
    Then xx = "S"
  Endif
#Endif
If OPM_AV <> 1 and OPM_AV <> 3 (homogeneous)
  Then xx = "AFS"
Endif
```

*Convention for transmission type determination:*

```
If(1) LV_AT = 1
Then(1)
```

// Based on the state of converter clutch in AT vehicle, an appropriate map is selected.//

STATE_CC	yy
0H (converter clutch open)	AT_CC_OPEN
1H (converter clutch controlled)	AT_CC_CTL
2H (converter clutch closed)	AT_CC_CLOSE
3H (not defined or Signal not valid or Error)	AT_CC_OPEN

```
Elseif(2) LV_VAR_TCT = 1
  Then(2)
  yy= TCT
  Else(2)
  yy= MT
```



## Endif(2)

### Endif(1)

Calculation of THD\_ER\_CLC:

```

If          LV_IS = 1
Then       THD_ER_CLC = IP_THD_xx_ER_IS_yy(N,LOAD_MIS)
Else       THD_ER_CLC = IP_THD_xx_ER_yy(N,LOAD_MIS)
End
    
```

Initialisation of THD\_ER\_CLC\_PREV:

```

If          LV_ER_CLC_PREV_INI = 1
then       THD_ER_CLC_PREV = THD_ER_CLC
            LV_ER_CLC_PREV_INI = 0
    
```

**endif**

Positive gradient limitation of THD\_ER\_CLC:

```

If          THD_ER_CLC - THD_ER_CLC_PREV > C_THD_ER_CLC_GRD
then       THD_ER_CLC = THD_ER_CLC_PREV + C_THD_ER_CLC_GRD
else       if          THD_ER_CLC > THD_ER_CLC_PREV +
                    C_THD_ER_CLC_GRD
            then       THD_ER_CLC = THD_ER_CLC_PREV +
                    C_THD_ER_CLC_GRD
            else       THD_ER_CLC = THD_ER_CLC // no change!
            endif
    
```

**endif**

Store previous value of THD\_ER\_CLC:

```
THD_ER_CLC_PREV = THD_ER_CLC
```

## B.113.12 Zero Load Line for Misfire detection

### FUNCTION DESCRIPTION:

The zero load line is a function of the engine speed and depends on the engine combustion mode (for GDI application), coolant temperature and atmospheric pressure.

### Application conditions

**Initialisation:** Variable is initialised to 0 at reset, at engine stop **Or** at LC\_MIS\_INH 0 to 1 transition

**Recurrence:** every segment task

**Activation:** LV\_ENA\_SEG\_T\_MES = 1  
**And** LC\_MIS\_INH = 0

**Deactivation:** LV\_ENA\_SEG\_T\_MES = 0  
**Or** LC\_MIS\_INH = 1


### Formula section:

Minimum engine load and zero load lines

Convention for combustion mode determination:

```

#if       NC_CMB_CONF = AFS_AFL Or AFS_AFL_S
If       OPM_AV = 3 (homogeneous-stratified)
Then     xx = "HOM_S"
Endif
    
```

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```

#EndIf
#If      NC_CMB_CONF = AFS_S Or AFS_AFL_S
  If      OPM_AV = 1                (stratified)
  Then    xx = "S"
        EndIf
#EndIf

If      OPM_AV <> 1 and OPM_AV <> 3    (homogeneous)
Then    xx = "AFS"
EndIf

```

Convention for transmission type determination:

```

If(1)    LV_AT = 1
Then(1)
  yy= AT
Elseif(2) LV_VAR_TCT = 1
  Then(2)
  yy= TCT
  Else(2)
  yy= MT
        Endif(2)
Endif(1)

```

LOAD\_MIN\_MIS = IP\_LOAD\_MIN\_MIS\_xx\_yy(N, TCO)

### B.113.13 Misfire Combustion mode transients informations

#### Application conditions:

While the combustion manager is in transient state, the misfire detection can be disabled to have a proper base for evaluation of the ER-misfire detection thresholds, which are defined for the stationary modes (AFS, AFL & S).

This function must be called before the generic specification named "Generic fade out conditions for misfire detection"

**Initialisation:** at ECU reset, at Engine Stop **Or** at LC\_MIS\_INH 0 to 1 transition

LV\_INH\_CMB\_TRA\_MIS = 1


#### Formula section:

```

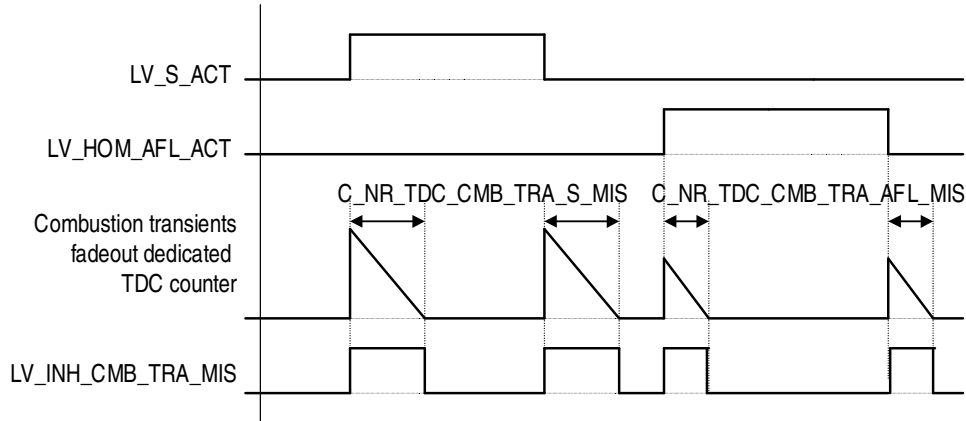
#If      NC_CMB_CONF = AFS_S Or AFS_AFL_S
  If      OPM_AV = x -> 1          (x is different of 1)
  Then    LV_INH_CMB_TRA_MIS is set to 1 during C_NR_TDC_CMB_TRA_S_MIS tdc's
  EndIf
#EndIf

#If      NC_CMB_CONF = AFS_AFL Or AFS_AFL_S
  If      OPM_AV = x -> 3          (x is different of 3)
  Then    LV_INH_CMB_TRA_MIS is set to 1 during C_NR_TDC_CMB_TRA_AFL_MIS tdc's
  EndIf
#EndIf


```

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**If** OPM\_AV = x -> 2 (x is different of 2)  
**Then** LV\_INH\_CMB\_TRA\_MIS is set to 1 during C\_NR\_TDC\_CMB\_TRA\_HOM\_MIS tdc's  
**Endif**



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## B.114 Rough road detection

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DLY_ER_RR	V	0... FFFFH	0... 655.35	0.01	s
Fade out time for engine roughness after rough road detection					
ERR_SYM_WHEEL_GRD_FR_LE	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
error symptoms of diagnostic instance WHEEL_GRD_FR_LE					
ERR_SYM_WHEEL_GRD_FR_RI	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
error symptoms of diagnostic instance WHEEL_GRD_FR_RI					
ERR_SYM_WHEEL_GRD_RE_LE	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
error symptoms of diagnostic instance WHEEL_GRD_RE_LE					
ERR_SYM_WHEEL_GRD_RE_RI	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
error symptoms of diagnostic instance WHEEL_GRD_RE_RI					
LV_CDN_DIAG_WHEEL_GRD_FR_LE	V	0... 1H	0 ...1	1	-
Boolean for wheel gradient signal diagnosis front left					
LV_CDN_DIAG_WHEEL_GRD_FR_RI	V	0... 1H	0 ...1	1	-
Boolean for wheel gradient signal diagnosis front right					
LV_CDN_DIAG_WHEEL_GRD_RE_LE	V	0... 1H	0 ...1	1	-
Boolean for wheel gradient signal diagnosis rear left					
LV_CDN_DIAG_WHEEL_GRD_RE_RI	V	0... 1H	0 ...1	1	-
Boolean for wheel gradient signal diagnosis rear right					
LV_END_DIAG_WHEEL_GRD_FR_LE	V	0... 1H	0 ...1	1	-
Boolean for wheel gradient signal diagnosis front left					
LV_END_DIAG_WHEEL_GRD_FR_RI	V	0... 1H	0 ...1	1	-
Boolean for wheel gradient signal diagnosis front right					
LV_END_DIAG_WHEEL_GRD_RE_LE	V	0... 1H	0 ...1	1	-
Boolean for wheel gradient signal diagnosis rear left					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_WHEEL_GRD_RE_RI	V	0... 1H	0 ...1	1	-
Boolean for wheel gradient signal diagnosis rear right					
LV_ERR_WHEEL_GRD_FR_LE	O/V	0... 1H	0 ...1	1	-
error on wheel gradient signal front left					
LV_ERR_WHEEL_GRD_FR_RI	O/V	0... 1H	0 ...1	1	-
error on wheel gradient signal front right					
LV_ERR_WHEEL_GRD_RE_LE	O/V	0... 1H	0 ...1	1	-
error on wheel gradient signal rear left					
LV_ERR_WHEEL_GRD_RE_RI	O/V	0... 1H	0 ...1	1	-
error on wheel gradient signal rear right					
LV_RR_PREV_INI	V	0... 1H	0 ...1	1	-
Boolean for initialisation of VS_RR_EDGE_T/CTR_AV(n-1) at activation of function					
LV_STATE_RR	O/V	0... 1H	0 ...1	1	-
Boolean for state of rough road detection (No : Yes).					
N_WHEEL_GRD_FN_LE	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
calculated gradient from N_WHEEL_FN_LE					
N_WHEEL_GRD_FN_RI	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
calculated gradient from N_WHEEL_FN_RI					
N_WHEEL_GRD_RE_LE	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
calculated gradient from N_WHEEL_RE_LE					
N_WHEEL_GRD_RE_RI	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
calculated gradient from N_WHEEL_RE_RI					
RATIO_FR_LE	V	0... FFH	0 ...1	3.9216e-3	-
calculated ratio wheel front left					
RATIO_FR_RI	V	0... FFH	0 ...1	3.9216e-3	-
calculated ratio wheel front right					
RATIO_RE_LE	V	0... FFH	0 ...1	3.9216e-3	-
calculated ratio wheel rear left					
RATIO_RE_RI	V	0... FFH	0 ...1	3.9216e-3	-
calculated ratio wheel rear right					
SEG_T_MES_0_RR	V	0... 1FFFFFFFH	0... 4294967288	8	µs
Actual segment time measurement from the wheel speed signal.					
SEG_T_MES_1_RR	V	0... 1FFFFFFFH	0... 4294967288	8	µs
Previous segment time measurement from the wheel speed signal.					
SUM_RR	V	0... FFH	0... 255	1	-
Counter of rough road detection events.					
T_WHEEL_GRD_FR_LE_ERR_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
timer to detect the wheel gradient error					
T_WHEEL_GRD_FR_RI_ERR_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
timer to detect the wheel gradient error					
T_WHEEL_GRD_RE_LE_ERR_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
timer to detect the wheel gradient error					
T_WHEEL_GRD_RE_RI_ERR_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
timer to detect the wheel gradient error					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VS_RR_EDGE_CTR_AV	V	0... FFFFH	0... 65535	1	-
actual value of vehicle speed tooth counter on rough road (free running counter)					
VS_RR_EDGE_T_AV	V	0... FFFFFFFFH	0... 34359738.36	0.008	ms
actual timestamp of last tooth on rough road (free running timer)					
VS_RR_EDGE_T_AV_MAX	V	0... FFFFFFFFH	0... 34359738.36	0.008	ms
actual maximum timestamp of last tooth on rough road (free running timer)					
WHEEL_GRD	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
Wheel speed gradient maximum					
WHEEL_GRD_MMV	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
Rough road value					
WHEEL_GRD_MMV_FR_LE	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
Rough road moving mean value front left					
WHEEL_GRD_MMV_FR_RI	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
Rough road moving mean value front right					
WHEEL_GRD_MMV_RE_LE	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
Rough road moving mean value rear left					
WHEEL_GRD_MMV_RE_RI	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
Rough road moving mean value rear right					
WHEEL_GRD_MMV_THD	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
Rough road value threshold					
WHEEL_GRD_MMV_THD_DIAG	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
Rough road diagnosis value threshold					

**Input data:**

LV_AT {p. 654}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_VS_PLAUS {p. 5021}	LV_ST_END {p. 1720}
VS {p. 1176}	WHEEL_CAN_FN_LE {p. 1583}	WHEEL_CAN_FN_RI {p. 1583}	WHEEL_CAN_RE_LE {p. 1583}
WHEEL_CAN_RE_RI {p. 1583}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_WHEEL_GRD_FR_LE	-	0... FFH	0... 255	1	-
anti bounce counter increment for diagnosis instance WHEEL_GRD_FR_LE					
C_ABC_INC_WHEEL_GRD_FR_RI	-	0... FFH	0... 255	1	-
anti bounce counter increment for diagnosis instance WHEEL_GRD_FR_RI					
C_ABC_INC_WHEEL_GRD_RE_LE	-	0... FFH	0... 255	1	-
anti bounce counter increment for diagnosis instance WHEEL_GRD_RE_LE					
C_ABC_INC_WHEEL_GRD_RE_RI	-	0... FFH	0... 255	1	-
anti bounce counter increment for diagnosis instance WHEEL_GRD_RE_RI					
C_ABC_MAX_WHEEL_GRD_FR_LE	-	1... FFH	1... 255	1	-
anti bounce counter maximum for diagnosis instance WHEEL_GRD_FR_LE					
C_ABC_MAX_WHEEL_GRD_FR_RI	-	1... FFH	1... 255	1	-
anti bounce counter maximum for diagnosis instance WHEEL_GRD_FR_RI					
C_ABC_MAX_WHEEL_GRD_RE_LE	-	1... FFH	1... 255	1	-
anti bounce counter maximum for diagnosis instance WHEEL_GRD_RE_LE					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_WHEEL_GRD_RE_RI	-	1... FFH	1... 255	1	-
anti bounce counter maximum for diagnosis instance WHEEL_GRD_RE_RI					
C_DLY_ER_RR	-	0... FFFFH	0... 655.35	0.01	s
Fade out time for engine roughness after rough road detection					
C_MIN_WHEEL_GRD	-	0... FFH	0 ...1	3.9216e-3	-
treshold for ratio to detect gradient failure					
C_T_WHEEL_GRD_ERR_DIAG	-	0... FFFFH	0... 6553.5	0.1	s
timer treshold for wheel gradient error					
C_VS_MAX_RR	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed for rough road detection.					
C_VS_MIN_RR	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed for rough road detection.					
C_WHEEL_GRD_CLC_DIAG	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation factor for floating averaging of the monitored rough road mmv values					
C_WHEEL_GRD_CLC_RR	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation factor for floating averaging of the rough road raw values					
IP_WHEEL_GRD_MMV_THD_AT_VS	-	0... 3FFFH	0... 999.93896	0.0610352	°/oo
LDPM_VS_WHEEL_GRD_MMV_THD	9	0... FFH	0... 255	1	km/h
Threshold versus vehicle speed for rough road detection, automatic transm.					
IP_WHEEL_GRD_MMV_THD_DIAG_AT_VS	-	0... 3FFFH	0... 999.93896	0.0610352	°/oo
LDPM_VS_WHEEL_GRD_MMV_THD	9	0... FFH	0... 255	1	km/h
Threshold versus vehicle speed for rough road failure detection, automatic transm.					
IP_WHEEL_GRD_MMV_THD_DIAG_MT_VS	-	0... 3FFFH	0... 999.93896	0.0610352	°/oo
LDPM_VS_WHEEL_GRD_MMV_THD	9	0... FFH	0... 255	1	km/h
Threshold versus vehicle speed for rough road failure detection, manual transm.					
IP_WHEEL_GRD_MMV_THD_MT_VS	-	0... 3FFFH	0... 999.93896	0.0610352	°/oo
LDPM_VS_WHEEL_GRD_MMV_THD	9	0... FFH	0... 255	1	km/h
Threshold versus vehicle speed for rough road detection, manual transm.					
LC_ENA_WHEEL_GRD_DIAG	-	0... 1H	0 ...1	1	-
global switch to activate WHEEL_GRD_DIAG (activation with = 1)					
LC_SWI_RR_CAN	-	0... 1H	0 ...1	1	-
global switch for wheel gradient calculation					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_SEG_TOOTH_RR	-	1... FFH	1... 255	1	-
Number of wheel speed signal teeth to build one segment, typical value = 4					

**Import actions:**

**ACTION\_INFR\_GetVsRrPulsStamp** (OUT<vs\_rr\_edge\_ctr\_av>,OUT<vs\_rr\_edge\_t\_av>,OUT<vs\_rr\_edge\_t\_av\_max>)

**Error treatment:**

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
wheel gradient monitoring	WHEEL_GRD_FR_RI	wheel gradient not plausible	0	MEM	CC
			1		
			2		
			3		

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
wheel gradient monitoring	WHEEL_GRD_FR_LE	wheel gradient not plausible	0	MEM	CC
			1		
			2		
			3		

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
wheel gradient monitoring	WHEEL_GRD_RE_RI	wheel gradient not plausible	0	MEM	CC
			1		
			2		
			3		

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
wheel gradient monitoring	WHEEL_GRD_RE_LE	wheel gradient not plausible	0	MEM	CC
			1		
			2		
			3		

Fields information (For more information refers to Error Management file "Table of Failure") :

- ABC Type : STD\_INI, STD, MEM, MEM\_INI, DEC\_CAL, STC, NO, MPL\_STD\_INI
- CARB Class : MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO.

The above imported action is defined in the VHMD - IRS (Infrastructure Requirement Specification)

**FUNCTION DESCRIPTION:**

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### General information:

Rough road conditions must be detected to prevent erroneous misfire detection because of the influence jolty tracks have on the crankshaft as a result of transmission via the drive train. The speed disturbance of one wheel can be used to calculate the road conditions. Therefore, the control unit uses the signal from the driven wheel on the right side (ABS sensor or an additive sensor for the version without ABS) because the probability of the presence of a jolty track is greater than left.

However, transmission from the left to the right side has also been observed depending on the chassis and other circumstances, so that a limited detection of unilateral rough-road conditions on the left side is also possible.

The minimum number of integrated teeth for one segment depends on the number of teeth per revolution of the wheel speed. An angle of about 30 ° is preferable (e.g. an integration of 4 teeth is used for a wheel with 48 teeth). This number is determined by the non calibrateable constant NC\_SEG\_TOOTH\_RR.

At higher speed ranges the number of integrated teeth for one segment is determined by the recurrence time of 10 ms.

## B.114.1 Rough road detection

### Application conditions

**Initialisation:** SUM\_RR = 0 at ECU-reset  
 LV\_RR\_PREV\_INI = 1 at ECU-reset and at function deactivation  
 all other outputs = 0 at ECU-reset and at function deactivation

**Recurrence:** 10 ms

**Activation:** LV\_ERR\_VS\_PLAUS = 0 **and**  
 VS C\_VS\_MIN\_RR **and**  
 VS < C\_VS\_MAX\_RR **and**  
 LV\_ST\_END = 1

**Deactivation:** LV\_ERR\_VS\_PLAUS = 1 **or**  
 VS < C\_VS\_MIN\_RR **or**  
 VS > C\_VS\_MAX\_RR **or**  
 LV\_ST\_END = 0

Remark: to avoid unnecessary burden of the micro controller it is recommended to calibrate C\_VS\_MAX\_RR according the needs. At vehicle speeds above approximately 100 km/h there is no more feed back from wheels to crankshaft.

### Formula section:

**IF(1) LC\_SWI\_RR\_CAN = 0**  
**THEN(1)**

**ACTION\_INFR\_GetVsRrPulsStamp(VS\_RR\_EDGE\_CTR\_AV, VS\_RR\_EDGE\_T\_AV,**  
**VS\_RR\_EDGE\_T\_AV\_MAX)**

*Initialisation of VS\_RR\_EDGE\_T\_AV/CTR(n-1) and new\_rr\_clc:*

**If** LV\_RR\_PREV\_INI = 1  
**then** VS\_RR\_EDGE\_T\_AV(n-1) = VS\_RR\_EDGE\_T\_AV(n)  
 VS\_RR\_EDGE\_CTR\_AV(n-1) = VS\_RR\_EDGE\_CTR\_AV(n)  
 new\_rr\_clc = 2  
 LV\_RR\_PREV\_INI = 0

**endif**

### a) Segment period acquisition

The function uses consecutive segment times for calculation of a wheel speed gradient. The segments are built with a minimum number of NC\_SEG\_TOOTH\_RR edges and afterwards normalized to a length of 8 teeth.

**If** VS\_RR\_EDGE\_CTR\_AV<sub>n</sub> - VS\_RR\_EDGE\_CTR\_AV<sub>n-1</sub> >= NC\_SEG\_TOOTH\_RR  
**then**

$$SEG\_T\_MES\_0\_RR = \left| \frac{(VS\_RR\_EDGE\_T\_AV_n - VS\_RR\_EDGE\_T\_AV_{n-1}) * 8}{VS\_RR\_EDGE\_CTR\_AV_n - VS\_RR\_EDGE\_CTR\_AV_{n-1}} \right|$$

SEG\_T\_MES\_1\_RR is the segment period preceding SEG\_T\_MES\_0\_RR.

**endif**

### b) Calculation of rough road value

$$WHEEL\_GRD = \left| \frac{SEG\_T\_MES\_1\_RR - SEG\_T\_MES\_0\_RR}{SEG\_T\_MES\_1\_RR} \right| * 1000 [\%]$$

The raw values WHEEL\_GRD are used in a floating averaging, to restrict suppression to actual rough road conditions.

**ELSE(1)** //calculation of rough road values with CAN signals in 20ms  
because WHEEL\_CAN\_XX\_XX signals will be updated every 20ms  
(that's the reason for the internal CTR\_CALC)

CTR\_CALC++

**If** CTR\_CALC = 2  
**Then**

**If** LV\_ERR\_WHEEL\_GRD\_RE\_RI = 0 **and**

WHEEL\_CAN\_RE\_RI<sub>(n)</sub> ≠ 0 **and** //only values different from zero (physical)  
WHEEL\_CAN\_RE\_RI<sub>(n-1)</sub> ≠ 0 **are allowed to abort division by zero!**

**Then**

$$N\_WHEEL\_GRD\_RE\_RI = \left| \frac{WHEEL\_CAN\_RE\_RI_{(n-1)} - WHEEL\_CAN\_RE\_RI_{(n)}}{WHEEL\_CAN\_RE\_RI_{(n-1)}} \right| * 1000 [\%]$$

**Else** N\_WHEEL\_GRD\_RE\_RI = 0

**If** LV\_ERR\_WHEEL\_GRD\_RE\_LE = 0 **and**

$WHEEL\_CAN\_RE\_LE_{(n)} \neq 0$                       **and**    //only values different from zero (physical)  
 $WHEEL\_CAN\_RE\_LE_{(n-1)} \neq 0$                       are allowed to abort division by zero!

**Then**

$$N\_WHEEL\_GRD\_RE\_LE = \left| \frac{WHEEL\_CAN\_RE\_LE_{(n-1)} - WHEEL\_CAN\_RE\_LE_{(n)}}{WHEEL\_CAN\_RE\_LE_{(n-1)}} \right| * 1000[\%]$$

**Else**  $N\_WHEEL\_GRD\_RE\_LE = 0$

**If**  $LV\_ERR\_WHEEL\_GRD\_FR\_RI = 0$                       **and**

$WHEEL\_CAN\_FN\_RI_{(n)} \neq 0$                       **and**    //only values different from zero (physical)  
 $WHEEL\_CAN\_FN\_RI_{(n-1)} \neq 0$                       are allowed to abort division by zero!

**Then**

$$N\_WHEEL\_GRD\_FN\_RI = \left| \frac{WHEEL\_CAN\_FN\_RI_{(n-1)} - WHEEL\_CAN\_FN\_RI_{(n)}}{WHEEL\_CAN\_FN\_RI_{(n-1)}} \right| * 1000[\%]$$

**Else**  $N\_WHEEL\_GRD\_FN\_RI = 0$

**If**  $LV\_ERR\_WHEEL\_GRD\_FR\_LE = 0$                       **and**

$WHEEL\_CAN\_FN\_LE_{(n)} \neq 0$                       **and**    //only values different from zero (physical)  
 $WHEEL\_CAN\_FN\_LE_{(n-1)} \neq 0$                       are allowed to abort division by zero!

**Then**

$$N\_WHEEL\_GRD\_FN\_LE = \left| \frac{WHEEL\_CAN\_FN\_LE_{(n-1)} - WHEEL\_CAN\_FN\_LE_{(n)}}{WHEEL\_CAN\_FN\_LE_{(n-1)}} \right| * 1000[\%]$$

**Else**  $N\_WHEEL\_GRD\_FN\_LE = 0$

$WHEEL\_GRD = \text{MAX}(N\_WHEEL\_GRD\_RE\_RI; N\_WHEEL\_GRD\_RE\_LE;$   
 $N\_WHEEL\_GRD\_FN\_RI; N\_WHEEL\_GRD\_FN\_LE)$

calculation of the values used in Diagnosis function:

$$\text{WHEEL\_GRD\_MMV\_RE\_RI}_n = \text{WHEEL\_GRD\_MMV\_RE\_RI}_{n-1} + \text{C\_WHEEL\_GRD\_CLC\_DIAG} * (\text{N\_WHEEL\_GRD\_RE\_RI}_n - \text{WHEEL\_GRD\_MMV\_RE\_RI}_{n-1})$$

$$\text{WHEEL\_GRD\_MMV\_RE\_LE}_n = \text{WHEEL\_GRD\_MMV\_RE\_LE}_{n-1} + \text{C\_WHEEL\_GRD\_CLC\_DIAG} * (\text{N\_WHEEL\_GRD\_RE\_LE}_n - \text{WHEEL\_GRD\_MMV\_RE\_LE}_{n-1})$$

$$\text{WHEEL\_GRD\_MMV\_FR\_RI}_n = \text{WHEEL\_GRD\_MMV\_FR\_RI}_{n-1} + \text{C\_WHEEL\_GRD\_CLC\_DIAG} * (\text{N\_WHEEL\_GRD\_FN\_RI}_n - \text{WHEEL\_GRD\_MMV\_FR\_RI}_{n-1})$$

$$\text{WHEEL\_GRD\_MMV\_FR\_LE}_n = \text{WHEEL\_GRD\_MMV\_FR\_LE}_{n-1} + \text{C\_WHEEL\_GRD\_CLC\_DIAG} * (\text{N\_WHEEL\_GRD\_FN\_LE}_n - \text{WHEEL\_GRD\_MMV\_FR\_LE}_{n-1})$$

CTR\_CALC = 0

//When the calculation is stopped due to the vehicle speed condition (see above), the calculation of WHEEL\_GRD and WHEEL\_GRD\_MMV\_XX\_XX is stopped.

**Else**

no calculation

### c) Calculation of moving mean value

$$\text{WHEEL\_GRD\_MMV}_n = \text{WHEEL\_GRD\_MMV}_{n-1} + \text{C\_WHEEL\_GRD\_CRLC\_RR} * (\text{WHEEL\_GRD}_n - \text{WHEEL\_GRD\_MMV}_{n-1})$$

The following information is regarding the calc. in THEN(1) path with HW signals:

When the calculation of the wheel speed segment duration is stopped due to the vehicle speed condition (see above), the calculation of WHEEL\_GRD and WHEEL\_GRD\_MMV is stopped as well until again 2 consecutive segment durations could be determined (realised by the internal SW counter new\_rr\_clc).

Set of VS\_RR\_EDGE\_T\_AV/CTR(n-1) after each calculation of WHEEL\_GRD(\_MMV):

$$\text{VS\_RR\_EDGE\_T\_AV}(n-1) = \text{VS\_RR\_EDGE\_T\_AV}(n)$$

$$\text{VS\_RR\_EDGE\_CTR\_AV}(n-1) = \text{VS\_RR\_EDGE\_CTR\_AV}(n)$$

### d) Detection of rough road status//calc. complete formula section in 10ms

$$\text{WHEEL\_GRD\_MMV\_THD} = \text{IP\_WHEEL\_GRD\_MMV\_THD\_XX\_VS}$$

(XX = AT for automatic transmission, LV\_AT = 1 ; XX = MT for manual transmission, LV\_AT = 0)

```

if WHEEL_GRD_MMV < WHEEL_GRD_MMV_THD
then LV_STATE_RR = 1 and timer DLY_ER_RR becomes started and increment SUM_RR by one
elseif timer DLY_ER_RR > 0
then LV_STATE_RR = 1 and decrement timer DLY_ER_RR
else LV_STATE_RR = 0
endif
endif
    
```

The start value of the timer DLY\_ER\_RR is C\_DLY\_ER\_RR.  
//LV\_STATE\_RR is calc. in 10ms so DLY\_ER\_RR must also calc. in 10ms

## B.114.2 Wheel Gradient diagnosis for rough road detection

### General information:

Wheel Gradient monitoring for rough road detection:

With the rough road detection function it is possible to calculate a wheel gradient which indicates rough road. If this gradient exceeds a THD, then rough road is detected and MISF monitoring is disabled. To confirm CARB requirements it is necessary to monitor the calculated wheel gradient value to avoid wrong MISF inhibition.

### Application conditions:

```

Initialisation:    all = 0, except RATIO_XX_XX = 1
                  at RESET
                  at LV_IGK = 0 -> 1
                  at CLRFRMY
                  at function deactivation
Recurrence:       100 ms
Activation:        LV_IGK == 1                               and
                  LV_ERR_CAN_BOFF == 0                       and
                  LC_ENA_WHEEL_GRD_DIAG == 1
Deactivation:     if activation condition not true
    
```

### Function description:

#### Formula section:

$$\text{max}_1 = \text{MAX}(\text{WHEEL\_GRD\_MMV\_RE\_RI}; \text{WHEEL\_GRD\_MMV\_RE\_LE}; \\ \text{WHEEL\_GRD\_MMV\_FR\_RI}; \text{WHEEL\_GRD\_MMV\_FR\_LE})$$

WHEEL\_GRD\_MMV\_THD\_DIAG = IP\_WHEEL\_GRD\_MMV\_THD\_DIAG\_XX\_VS  
(XX = AT for automatic transmission, LV\_AT = 1 ; XX = MT for manual transmission, LV\_AT = 0)

remark: calc. for all wheels in one subfunction

```


If                LV_ERR_WHEEL_GRD_RE_RI = 0                and
                  LV_ERR_VS_PLAUS = 0                        and
                  VS ≥ C_VS_MIN_RR                           and
                  VS ≤ C_VS_MAX_RR
and
                  LV_ST_END = 1
Then              LV_CDN_DIAG_WHEEL_GRD_RE_RI = 1
Else              LV_CDN_DIAG_WHEEL_GRD_RE_RI = 0
Endif
If(1)            max_1 = WHEEL_GRD_MMV_RE_RI                and
                  WHEEL_GRD_MMV_RE_RI > WHEEL_GRD_MMV_THD_DIAG
    
```

```

Then(1) max_2 = MAX( WHEEL_GRD_MMV_FR_LE; WHEEL_GRD_MMV_FR_RI;
                    WHEEL_GRD_MMV_RE_LE)
                    RATIO_RE_RI = (max_2/max_1)
If(2) (RATIO_RE_RI < C_MIN_WHEEL_GRD          and
        LV_ERR_WHEEL_GRD_RE_LE = 0             and
        LV_ERR_WHEEL_GRD_FR_LE = 0             and
        LV_ERR_WHEEL_GRD_FR_RI = 0)
Then(2) T_WHEEL_GRD_RE_RI_ERR_DIAG++
Else(2) T_WHEEL_GRD_RE_RI_ERR_DIAG reset
        ERR_SYM_WHEEL_GRD_RE_RI = no_sym
        RATIO_RE_RI = 1
Endif(2)
Else(1) T_WHEEL_GRD_RE_RI_ERR_DIAG reset
        ERR_SYM_WHEEL_GRD_RE_RI = no_sym
        RATIO_RE_RI = 1
Endif(1)
If T_WHEEL_GRD_RE_RI_ERR_DIAG > C_T_WHEEL_GRD_ERR_DIAG
Then ERR_SYM_WHEEL_GRD_RE_RI = sym_0
Endif
ACTION_ERRM_FilterSymptom( IN< IDX_DIAG >, IN< LV_CDN_DIAG_WHEEL_GRD_RE_RI >,
IN< ERR_SYM_WHEEL_GRD_RE_RI >, IN< C_ABC_INC_WHEEL_GRD_RE_RI >, IN< 1 >,
IN< C_ABC_MAX_WHEEL_GRD_RE_RI >, OUT< LV_ERR_WHEEL_GRD_RE_RI > )

If LV_ERR_WHEEL_GRD_RE_LE = 0          and
    LV_ERR_VS_PLAUS = 0                  and
    VS ≥ C_VS_MIN_RR                    and
    VS ≤ C_VS_MAX_RR
and
    LV_ST_END = 1
Then LV_CDN_DIAG_WHEEL_GRD_RE_LE = 1
Else LV_CDN_DIAG_WHEEL_GRD_RE_LE = 0
Endif
If(1) max_1 = WHEEL_GRD_MMV_RE_LE          and
        WHEEL_GRD_MMV_RE_LE > WHEEL_GRD_MMV_THD_DIAG
Then(1) max_2 = MAX( WHEEL_GRD_MMV_FR_RI; WHEEL_GRD_MMV_FR_LE;
                    WHEEL_GRD_MMV_RE_RI)
                    RATIO_RE_LE = (max_2/max_1)
If(2) (RATIO_RE_LE < C_MIN_WHEEL_GRD          and
        LV_ERR_WHEEL_GRD_FR_RI = 0             and
        LV_ERR_WHEEL_GRD_FR_LE = 0             and
        LV_ERR_WHEEL_GRD_RE_RI = 0)
Then(2) T_WHEEL_GRD_RE_LE_ERR_DIAG++
Else(2) T_WHEEL_GRD_RE_LE_ERR_DIAG reset
        ERR_SYM_WHEEL_GRD_RE_LE = no_sym
        RATIO_RE_LE = 1
Endif(2)
Else(1) T_WHEEL_GRD_RE_LE_ERR_DIAG reset
        ERR_SYM_WHEEL_GRD_RE_LE = no_sym
        RATIO_RE_LE = 1
Endif(1)
If T_WHEEL_GRD_RE_LE_ERR_DIAG > C_T_WHEEL_GRD_ERR_DIAG
Then ERR_SYM_WHEEL_GRD_MON_RE_LE = sym_0

```

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**Endif**

ACTION\_ERRM\_FilterSymptom( IN< IDX\_DIAG >, IN< LV\_CDN\_DIAG\_WHEEL\_GRD\_RE\_LE >, IN< ERR\_SYM\_WHEEL\_GRD\_RE\_LE >, IN< C\_ABC\_INC\_WHEEL\_GRD\_RE\_LE >, IN< 1 >, IN< C\_ABC\_MAX\_WHEEL\_GRD\_RE\_LE >, OUT< LV\_ERR\_WHEEL\_GRD\_RE\_LE > )

**If** LV\_ERR\_WHEEL\_GRD\_FR\_RI = 0 **and**  
 LV\_ERR\_VS\_PLAUS = 0 **and**  
 VS ≥ C\_VS\_MIN\_RR **and**  
 VS ≤ C\_VS\_MAX\_RR

**and**

LV\_ST\_END = 1

**Then** LV\_CDN\_DIAG\_WHEEL\_GRD\_FR\_RI = 1**Else** LV\_CDN\_DIAG\_WHEEL\_GRD\_FR\_RI = 0**Endif**

**If**(1) max\_1 = WHEEL\_GRD\_MMV\_FR\_RI **and**  
 WHEEL\_GRD\_MMV\_FR\_RI > WHEEL\_GRD\_MMV\_THD\_DIAG

**Then**(1) max\_2 = MAX( WHEEL\_GRD\_MMV\_FR\_LE; WHEEL\_GRD\_MMV\_RE\_RI;  
 WHEEL\_GRD\_MMV\_RE\_LE)  
 RATIO\_FR\_RI = (max\_2/max\_1)

**If**(2) (RATIO\_FR\_RI < C\_MIN\_WHEEL\_GRD **and**  
 LV\_ERR\_WHEEL\_GRD\_FR\_LE = 0 **and**  
 LV\_ERR\_WHEEL\_GRD\_RE\_LE = 0 **and**  
 LV\_ERR\_WHEEL\_GRD\_RE\_RI = 0)

**Then**(2) T\_WHEEL\_GRD\_FR\_RI\_ERR\_DIAG++

**Else**(2) T\_WHEEL\_GRD\_FR\_RI\_ERR\_DIAG reset  
 ERR\_SYM\_WHEEL\_GRD\_FR\_RI = no\_sym  
 RATIO\_FR\_RI = 1

**Endif**(2)

**Else**(1) T\_WHEEL\_GRD\_FR\_RI\_ERR\_DIAG reset  
 ERR\_SYM\_WHEEL\_GRD\_FR\_RI = no\_sym  
 RATIO\_FR\_RI = 1

**Endif**(1)**If** T\_WHEEL\_GRD\_FR\_RI\_ERR\_DIAG > C\_T\_WHEEL\_GRD\_ERR\_DIAG**Then** ERR\_SYM\_WHEEL\_GRD\_FR\_RI = sym\_0**Endif**

ACTION\_ERRM\_FilterSymptom( IN< IDX\_DIAG >, IN< LV\_CDN\_DIAG\_WHEEL\_GRD\_FR\_RI >, IN< ERR\_SYM\_WHEEL\_GRD\_FR\_RI >, IN< C\_ABC\_INC\_WHEEL\_GRD\_FR\_RI >, IN< 1 >, IN< C\_ABC\_MAX\_WHEEL\_GRD\_FR\_RI >, OUT< LV\_ERR\_WHEEL\_GRD\_FR\_RI > )

**If** LV\_ERR\_WHEEL\_GRD\_FR\_LE = 0 **and**  
 LV\_ERR\_VS\_PLAUS = 0 **and**  
 VS ≥ C\_VS\_MIN\_RR **and**  
 VS ≤ C\_VS\_MAX\_RR

**and**

LV\_ST\_END = 1

**Then** LV\_CDN\_DIAG\_WHEEL\_GRD\_FR\_LE = 1**Else** LV\_CDN\_DIAG\_WHEEL\_GRD\_FR\_LE = 0**Endif**

**If**(1) max\_1 = WHEEL\_GRD\_MMV\_FR\_LE **and**  
 WHEEL\_GRD\_MMV\_FR\_LE > WHEEL\_GRD\_MMV\_THD\_DIAG

**Then**(1) max\_2 = MAX( WHEEL\_GRD\_MMV\_FR\_RI; WHEEL\_GRD\_MMV\_RE\_RI;  
 WHEEL\_GRD\_MMV\_RE\_LE)

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```

                RATIO_FR_LE = (max_2/max_1)
If(2)   (RATIO_FR_LE < C_MIN_WHEEL_GRD           and
                LV_ERR_WHEEL_GRD_FR_RI = 0           and
                LV_ERR_WHEEL_GRD_RE_LE = 0           and
                LV_ERR_WHEEL_GRD_RE_RI = 0)
Then(2) T_WHEEL_GRD_FR_LE_ERR_DIAG++
Else(2) T_WHEEL_GRD_FR_LE_ERR_DIAG reset
                ERR_SYM_WHEEL_GRD_FR_LE = no_sym
                RATIO_FR_LE = 1
Endif(2)
Else(1) T_WHEEL_GRD_FR_LE_ERR_DIAG reset
                ERR_SYM_WHEEL_GRD_FR_LE = no_sym
                RATIO_FR_LE = 1
Endif(1)
If       T_WHEEL_GRD_FR_LE_ERR_DIAG > C_T_WHEEL_GRD_ERR_DIAG
Then    ERR_SYM_WHEEL_GRD_FR_LE = sym_0
Endif

ACTION_ERRM_FilterSymptom( IN< IDX_DIAG >, IN< LV_CDN_DIAG_WHEEL_GRD_FR_LE >,
IN< ERR_SYM_WHEEL_GRD_FR_LE >, IN< C_ABC_INC_WHEEL_GRD_FR_LE >, IN< 1 >,
IN< C_ABC_MAX_WHEEL_GRD_FR_LE >, OUT< LV_ERR_WHEEL_GRD_FR_LE > )

// remark: LV_ERR_XX and LV_END_DIAG_XX are calculated by ERRM after debouncing

```

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## B.115 NOx sensor OBDII diagnosis - Sensor version check

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_NS_VERS [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom for NOx sensor version check diagnosis					
LV_CDN_DIAG_NS_VERS [NC_NOX_SENS_CONF]	V	0... 1H	0...1	1	-
Diagnostic condition to start symptom detection (seto to one when condition is fulfilled)					
LV_END_DIAG_NS_VERS [NC_NOX_SENS_CONF]	O/V	0... 1H	0...1	1	-
NOx sensor version check diagnosis was performed at last one time					
LV_ERR_NS_VERS [NC_NOX_SENS_CONF]	O/V	0... 1H	0...1	1	-
Present failure after filtering of NOx sensor. NOx-Sensor version check					
NOX_CAN_SW_VERS_DIAG_BOL_SAE [NC_NOX_SENS_CONF]	O/V/S	0... FFH	0... 255	1	-
Mode 06 - minimum value of test limit for NOx sensor version check diagnosis					
NOX_CAN_SW_VERS_DIAG_SAE [NC_NOX_SENS_CONF]	O/V/S	0... FFH	0... 255	1	-
Mode 06 - test value of NOx sensor version check diagnosis					
STATE_NS_VERS [NC_NOX_SENS_CONF]	O/V	0... FFH	0... 255	1	-
State for NOx Sensor version check diagnosis					


### Input data:

C_STATE_NS_MASK_ MODE_3_A {p. 1400}	C_STATE_NS_MASK_ MODE_3_B {p. 1400}	CAN_STATE_NS_TMP [NC_NOX_SENS_CONF] {p. 1398}	CAN_SW_NS [NC_NOX_SENS_CONF] {p. 1398}
LV_DC {p. 5746}	LV_INH_DIAG_NS_OBD_ 2_VERS [NC_NOX_SENS_CONF] {p. 6468}	NC_NOX_SENS_CONF {p. 643}	T_AST_SAE {p. 1766}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_NS_VERS	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_NS_VERS	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_NOX_NS_DIAG_VERS_SW_THD	-	0... FFH	0... 255	1	-
Theshold for NOx sensor version check diagnosis value					
C_T_AST_MIN_NS_VERS_DIAG	-	0... FFFFH	0... 65535	1	s
Minimum value of PID1F Cumulated time					
LC_NS_VERS_CHK_REP	-	0... 1H	0...1	1	-
switch for request of NOx Sensor version check diagnosis value					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**General Information**

This is evaluation of NOx sensor software version. In case of too less version, an error shall be generated.

Meaning of states:

PAS passive state, no actions are executed

REQ request for NOx sensor software version

CHK check of the NOx sensor software version and calculation of diagnosis values

END diagnosis finished

**Application Conditions**

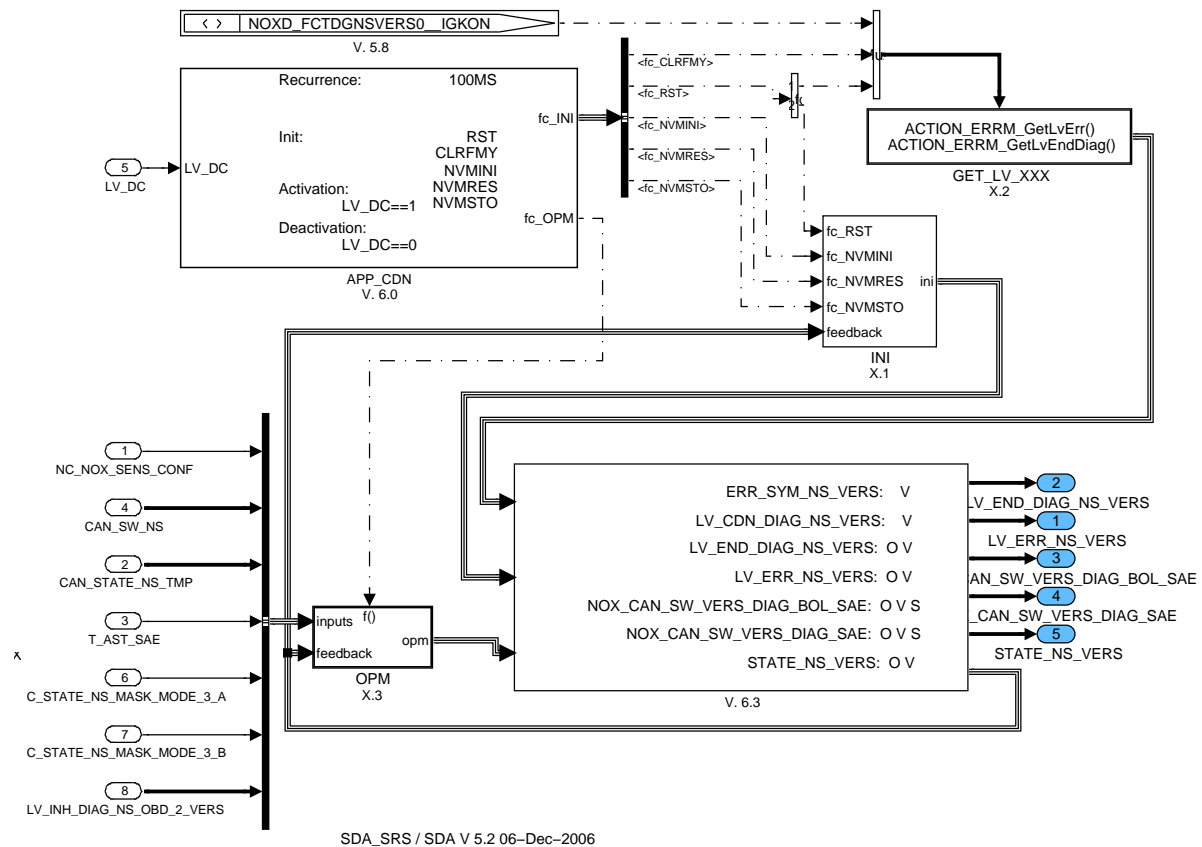
Initialization: RST, CLRFRMY, NVMINI, NVMRES, NVMSTO

Recurrence: 100MS

Activation: LV\_DC==1

Deactivation: LV\_DC==0

**Function description**



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Figure B.115.1: :

## B.115.1 Initialization and Management of nonvolatile memory

### B.115.1.1 Initialization at Reset

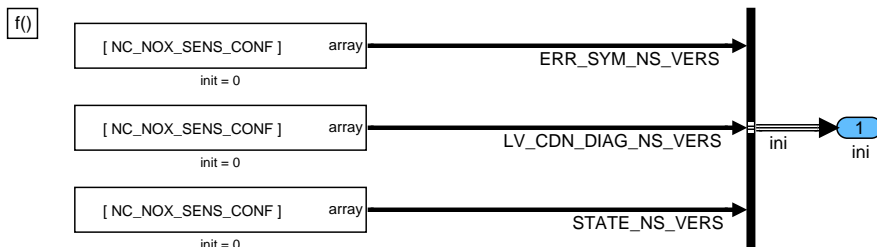


Figure B.115.2: :

### B.115.1.2 Initialization of NVMY data

All Mode 6 values will be stored in the nonvolatile memory. The values will be reset to zero, if failure memory will be cleared.

## B.115.2 Synchronization of the LV\_ERR\_NS\_VERS and LV\_END\_DIAG\_NS\_VERS

Synchronisation between LV\_ERR\_NS\_VERS and its result from ERRM is done using action ACTION\_ERRM\_GetLvErr() similarly synchronisation between LV\_END\_DIAG\_NS\_VERS and its result from ERRM is done using action ACTION\_ERRM\_GetLvEndDiag() at RESET ,IGKON and CLRFRMY events.

## B.115.3 Operation at 100ms

### B.115.3.1 Introduction of multiple sensor system

#### B.115.3.1.1 Calculation of the diagnosis results

##### B.115.3.1.1.1 Determination of diagnostic condition

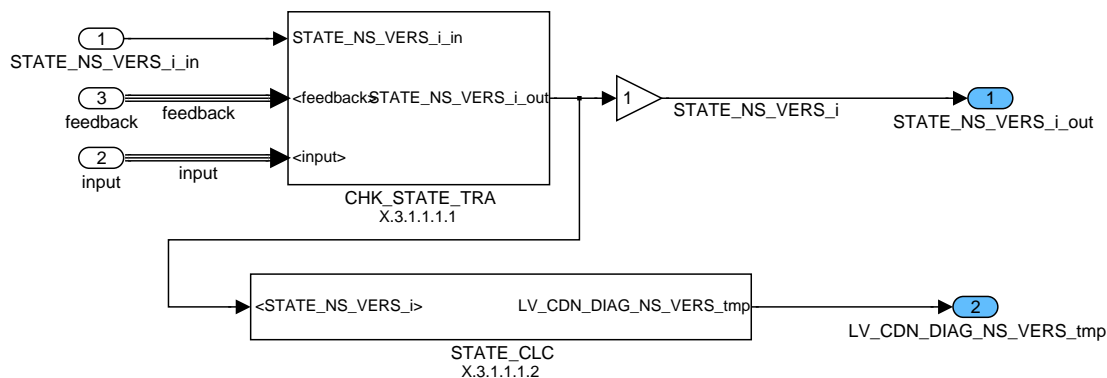


Figure B.115.3: :

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### B.115.3.1.1.1.1 Check transition conditions of STATE\_NS\_VERS

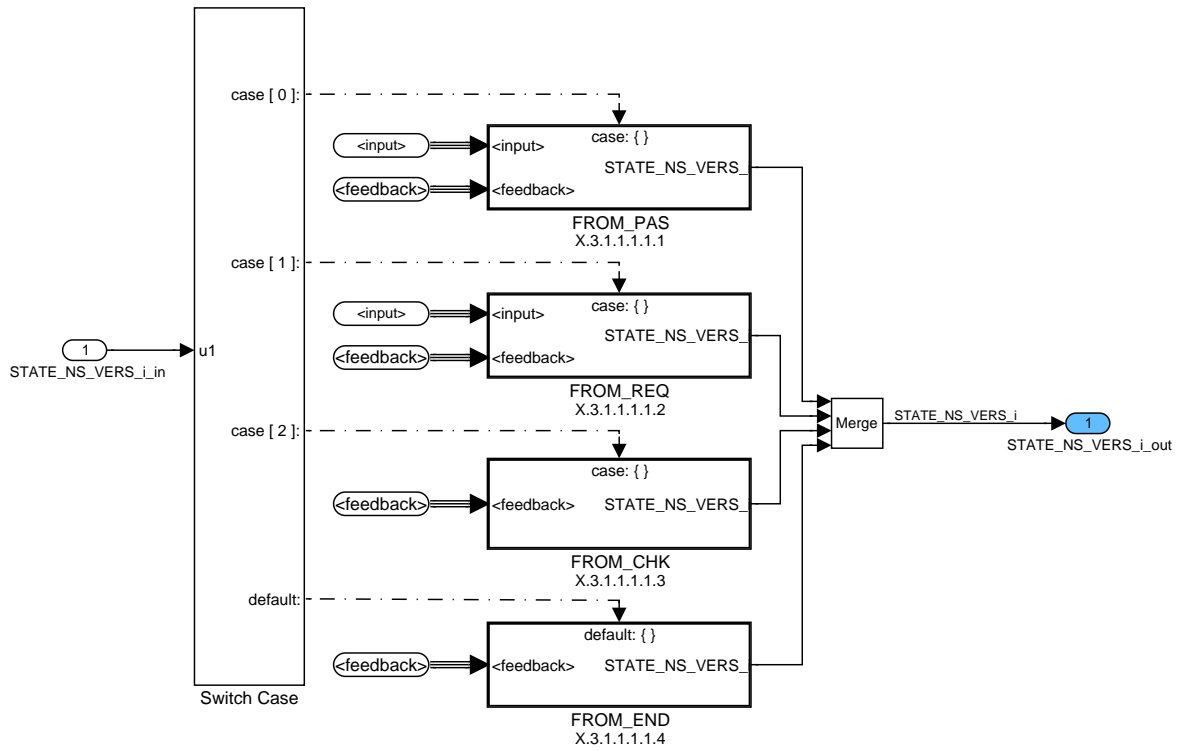


Figure B.115.4: :

### B.115.3.1.1.1.1.1 From PASSIVE

#### B.115.3.1.1.1.1.1.1 Check transition conditions from PASSIVE and Transition PASSIVE to REQUEST actions

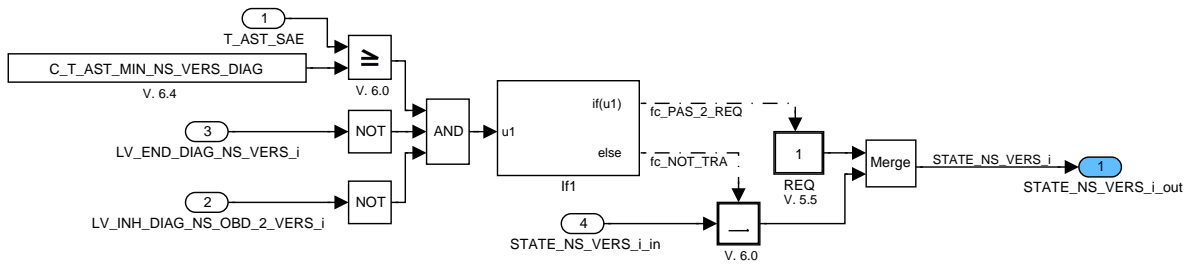


Figure B.115.5: :

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**B.115.3.1.1.1.2 From REQUEST**

**B.115.3.1.1.1.1.2.1 Check transition conditions from REQUEST and Transition REQUEST to CHECK actions**

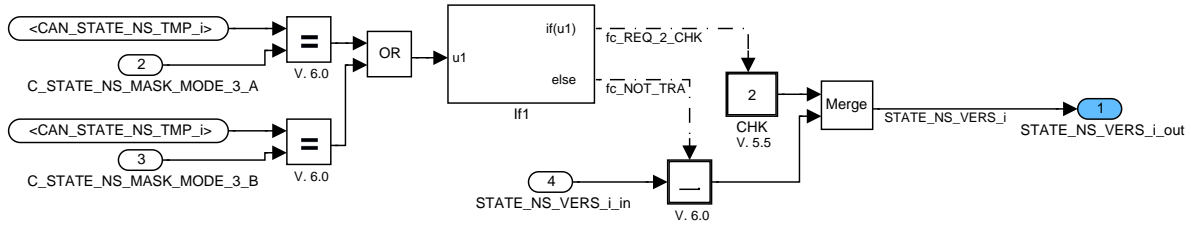


Figure B.115.6: :

**B.115.3.1.1.1.1.3 From CHECK**

**B.115.3.1.1.1.1.3.1 Check transition conditions from CHECK and Transition CHECK to END actions**

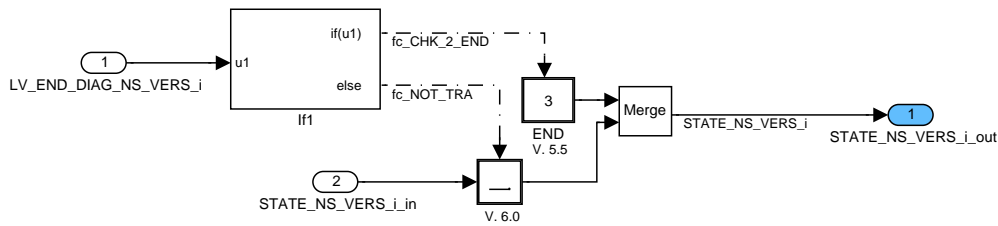


Figure B.115.7: :

**B.115.3.1.1.1.1.4 From END**

**B.115.3.1.1.1.1.4.1 Check transition conditions from END and Transition END to PASSIVE actions**

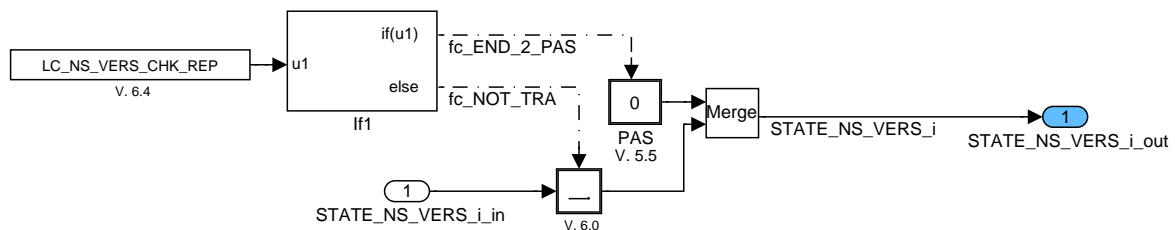



Figure B.115.8: :

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### B.115.3.1.1.2 Actions calculation of STATE\_NS\_VERS

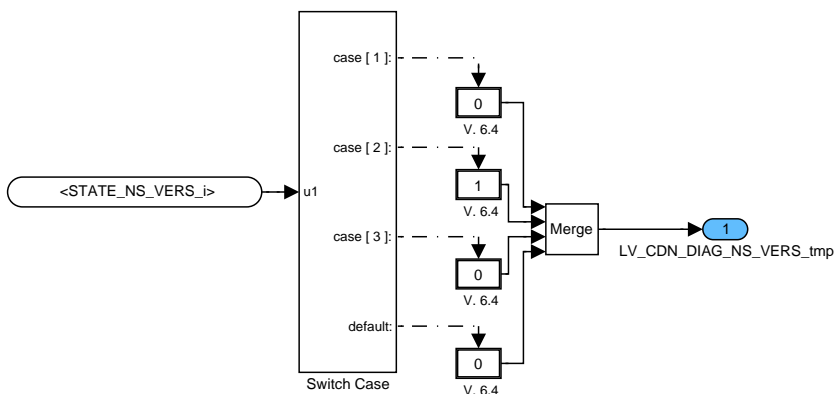


Figure B.115.9: :

### B.115.3.1.1.2 Determination of error symptom

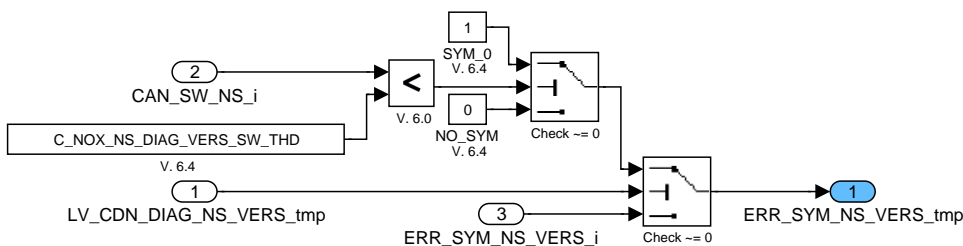


Figure B.115.10: :

### B.115.3.1.1.3 Call for ERRM

ACTION\_ERRM\_FilterSymptom(IN<XX>, IN<lv\_cdn\_diag\_XX>, IN<err\_sym\_XX >, IN<C\_ABC\_INC\_XX >, IN<C\_ABC\_DEC\_XX >, IN<C\_ABC\_MAX\_XX >, OUT<LV\_ERR\_XX>)

The action computes the elementary anti-bounce filter for one failure treatment and returns filter results

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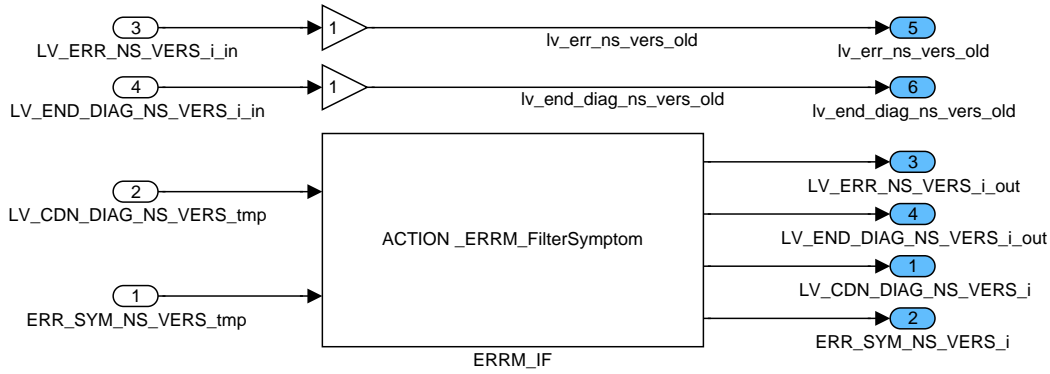


Figure B.115.11: :

**B.115.3.1.1.4 Diagnosis Mode 6 handling**

Mode 6 values will be stored, if error management is finishing the diagnosis or is setting an error.

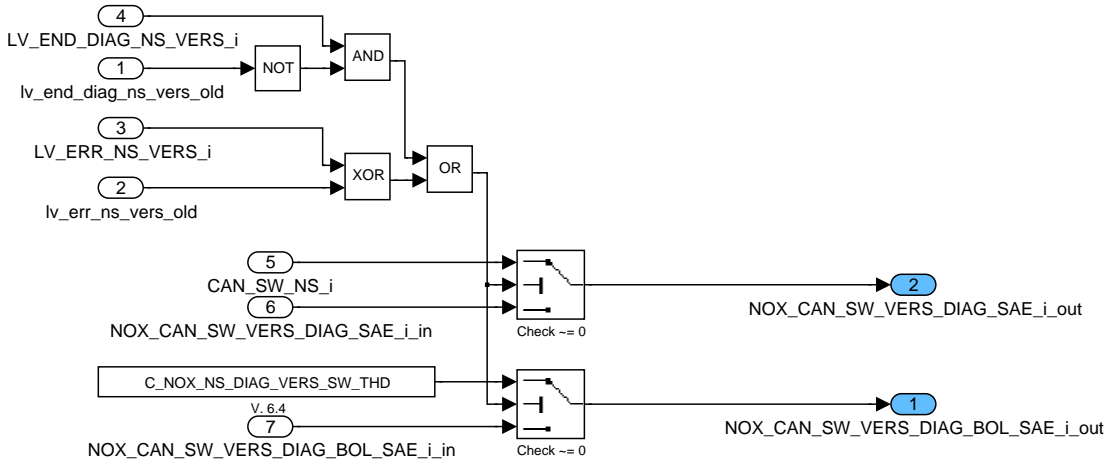


Figure B.115.12: :

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## B.116 NOx sensor OBDII diagnosis - General


### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_NS_OBD_2_ERR [NC_NOX_SENS_CONF]	O/V/S	0... FFH	0... 255	1	-
Number of consecutive driving cycles at which a NOx sensor failure was detected					
LAMB_LS_UP_MMV_NS [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234	976.563e-6	-
Moving mean value of upstream lambda					
LV_ERR_NS_OBD_2 [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Result of NOx sensor OBD II diagnosis					
LV_LAMB_LS_UP_LDC	V	0... 1H	0 ...1	1	-
Limited dynamic of signal LAMB_LS_UP (one condition for all exhaust banks)					
LV_LAMB_LS_UP_LDC_SNG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Limited dynamic of signal LAMB_LS_UP (one condition for each exhaust bank)					
LV_NS_LDC [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Limited dynamics for NOx sensor state evaluation					
MAF_INT_LDC_DLY_NS [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 1820.42	0.02777778	g
Integral of air mass flow since limited dynamic conditions are fulfilled					
MAF_MMV_NS	V	0... FFFFH	0... 1389	0.02119478	mg/stk
Moving mean value of mass air flow					
N_MMV_NS	V	0... 1FE0H	0... 8160	1	rpm
Moving mean value of engine speed					
STATE_END_NS_OBD_2 [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 65535	1	-
Collection of all diagnosis end bits of OBDII diagnosis					
STATE_ERR_NS_OBD_2 [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 65535	1	-
Collection of all error bits of OBDII diagnosis					

### Input data:

LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LV_END_DIAG_NS_ACT [NC_NOX_SENS_CONF] {p. 6358}	LV_END_DIAG_NS_AFR [NC_NOX_SENS_CONF] {p. 6389}	LV_END_DIAG_NS_AVL [NC_NOX_SENS_CONF] {p. 6368}
LV_END_DIAG_NS_GAIN [NC_NOX_SENS_CONF] {p. 6377}	LV_END_DIAG_NS_HTP [NC_NOX_SENS_CONF] {p. 6330}	LV_END_DIAG_NS_LSL_ UP_DOWN [NC_NOX_SENS_CONF] {p. 6396}	LV_END_DIAG_NS_OFS [NC_NOX_SENS_CONF] {p. 6378}
LV_END_DIAG_NS_PUC [NC_NOX_SENS_CONF] {p. 6405}	LV_END_DIAG_NS_RAW [NC_NOX_SENS_CONF]	LV_END_DIAG_NS_SHIFT [NC_NOX_SENS_CONF] {p. 6412}	LV_END_DIAG_NS_STOP [NC_NOX_SENS_CONF] {p. 6347}
LV_END_DIAG_NS_VERS [NC_NOX_SENS_CONF] {p. 6313}	LV_END_DIAG_NS_VLS_ DYN [NC_NOX_SENS_CONF] {p. 6338}	LV_ERR_NS_ACT [NC_NOX_SENS_CONF] {p. 6358}	LV_ERR_NS_AFR [NC_NOX_SENS_CONF] {p. 6389}

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LV_ERR_NS_AVL [NC_NOX_SENS_CONF] {p. 6368}	LV_ERR_NS_GAIN [NC_NOX_SENS_CONF] {p. 6377}	LV_ERR_NS_HTP [NC_NOX_SENS_CONF] {p. 6330}	LV_ERR_NS_LSL_UP_ DOWN [NC_NOX_SENS_CONF] {p. 6396}
LV_ERR_NS_OFS [NC_NOX_SENS_CONF] {p. 6378}	LV_ERR_NS_PUC [NC_NOX_SENS_CONF] {p. 6405}	LV_ERR_NS_RAW [NC_NOX_SENS_CONF]	LV_ERR_NS_SHIFT [NC_NOX_SENS_CONF] {p. 6412}
LV_ERR_NS_STOP [NC_NOX_SENS_CONF] {p. 6347}	LV_ERR_NS_VERS [NC_NOX_SENS_CONF] {p. 6313}	LV_ERR_NS_VLS_DYN [NC_NOX_SENS_CONF] {p. 6338}	LV_INH_DIAG_NS_OBD_ 2_PLAUS [NC_NOX_SENS_CONF] {p. 6468}
LV_NOX_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}	LV_ST_END {p. 1720}	MAF {p. 8277}	MAF_KGH {p. 1195}
N {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}	


**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_LAMB_LS_UP_MMV_NS	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
Filter constant for calculation of moving mean value of upstream lambda					
C_CRLC_MAF_MMV_NS	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
filter constant for calculation of moving mean value of mass air flow					
C_CRLC_N_MMV_NS	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
filter constant for calculation of moving mean value of engine speed					
C_CTR_NS_OBD_2_ERR_MAX	-	0... FFH	0... 255	1	-
Maximum number of consecutive driving cycles at which a NOx sensor failure was detected					
C_ERR_END_NS_OBD_2_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of end of diagnosis signal that will be evaluated before decrement counter					
C_ERR_RST_NS_OBD_2	-	0... 2H	0 ...2	1	-
Selection of reset strategy of global NOx sensor OBD2 error					
C_MAF_DYW_NS	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Limited dynamic threshold of MAF					
C_MAF_INT_LDC_DLY_NS	-	0... FFFFH	0... 1820.42	0.02777778	g
MAF integral threshold after reaching limited dynamic conditions, before LV_NS_LDC is set					
C_N_DYW_NS	-	0... 1FE0H	0... 8160	1	rpm
Limited dynamic threshold of engine speed					
C_STATE_ERR_NS_OBD_2_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of STATE_ERR_NS_OBD_2 error bits					
IP_LAMB_LS_UP_DYW_NS	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
LDP_LAMB_LS_UP_IP_LAMB_DYW_NS	4	0... 7FFFH	0... 31.9990234	976.563e-6	-
Lambda signal value of the WRAF sensor					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_FAC_MAF_INT_LDC	-	0... FFFFH	0... 1.02398437	15.625e-6	s
normalization factor for calculation of integral of MAF_KGH					

**General information**

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This module consists a limited dynamics evaluation for the NOx sensor and the global NOx sensor OBD II error flag.

The reset strategy of this error bit LV\_ERR\_NS\_OBD\_2\_i can be selected by C\_ERR\_RST\_NS\_OBD\_2\_i. It can be chosen between following possibilities for error bit reset:

- reset only at clear of error memory
- reset at every start of new driving cycle
- manual reset, permanent reset.

### Application Condition

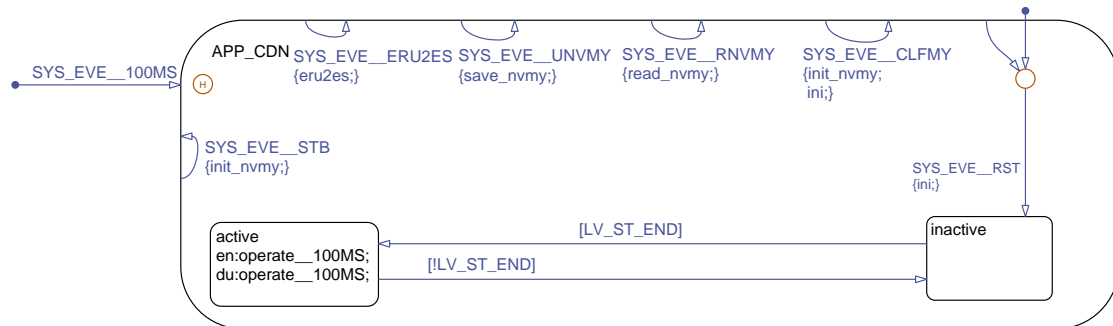


Figure B.116.1: NOXD\_MODULB07G/APP\_CDN/Chart

### Function Description

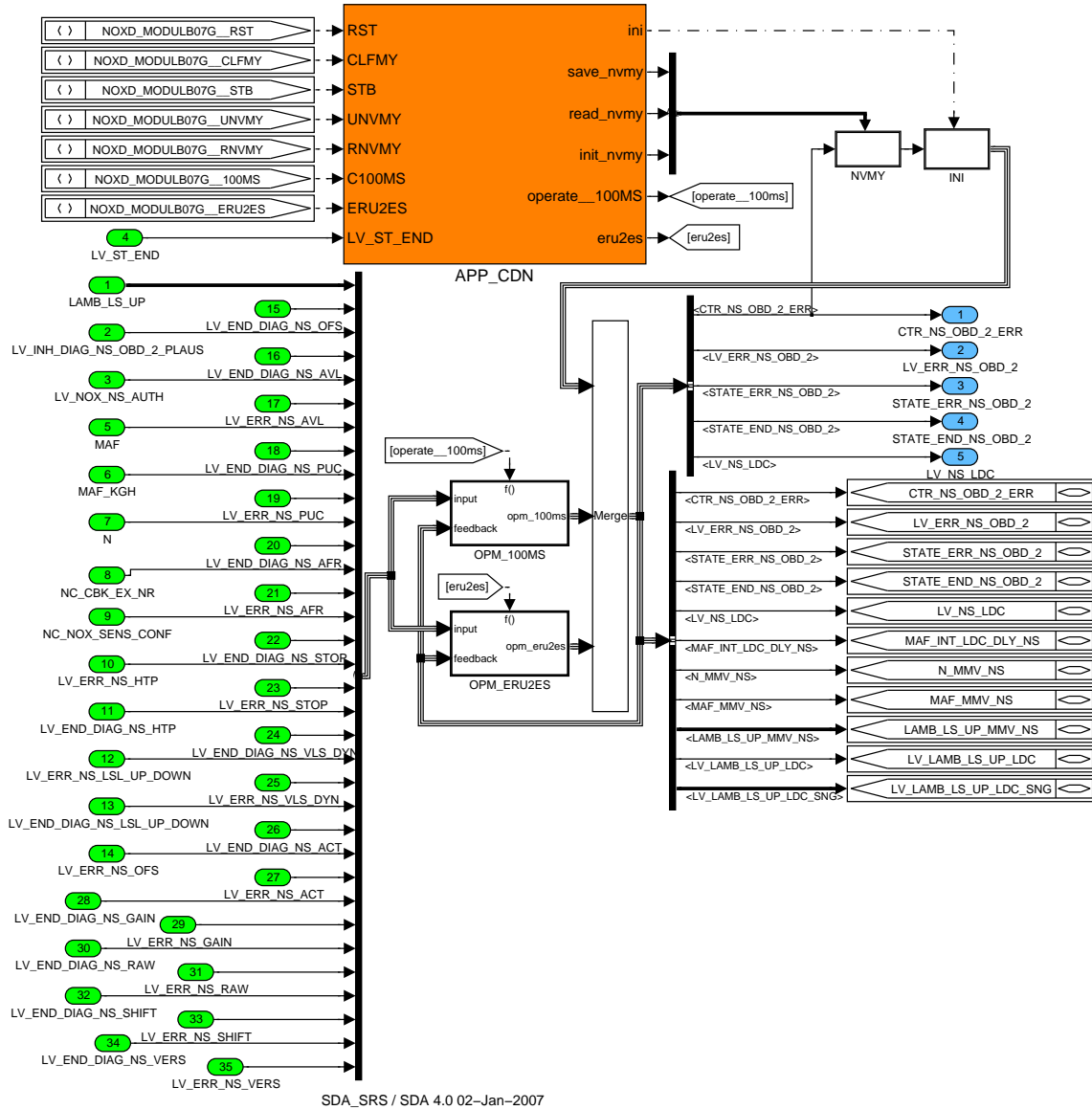


Figure B.116.2: NOXD\_MODULB07G

### B.116.1 Initialization at reset or at clear failure memory

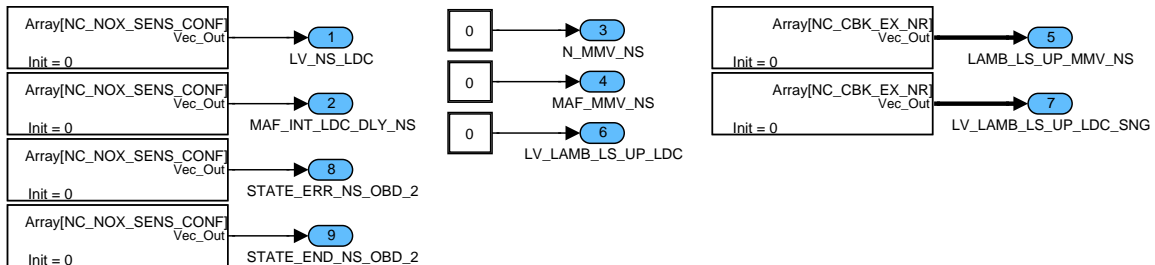


Figure B.116.3: NOXD\_MODULB07G/INI/CLC1

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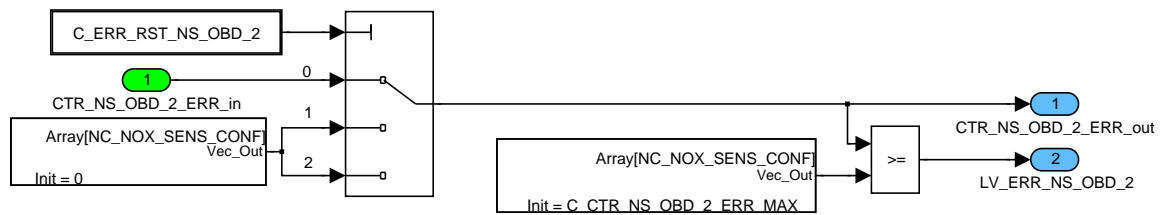


Figure B.116.4: NOXD\_MODULB07G/INI/CLC2

### B.116.2 Management of non-volatile memory

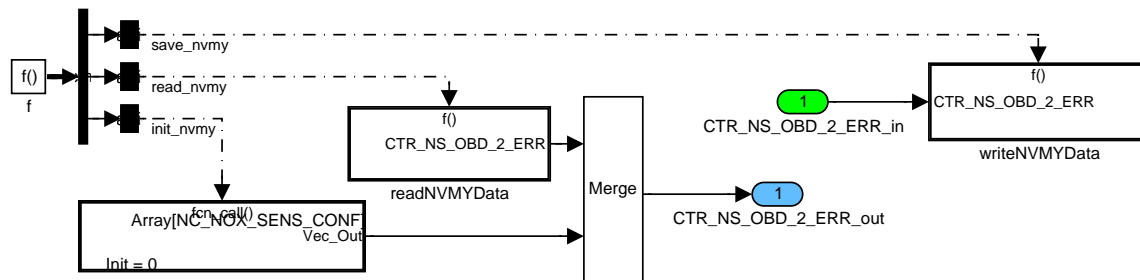


Figure B.116.5: NOXD\_MODULB07G/NVMY

### B.116.3 Loop control 100 ms

The calculation inside FOR\_LOOP\_LS have to be done for each upstream lambda sensor, controlled by configuration data NC\_CBK\_EX\_NR.

If NC\_CBK\_EX\_NR = 1, then calculation for i = 1.

If NC\_CBK\_EX\_NR = 2, then calculation for i = 1 and 2.

The calculation inside NO\_LOOP have to be done only once.

The calculation inside FOR\_LOOP\_NS have to be done for each NOx sensor, controlled by configuration data NC\_NOX\_SENS\_CONF.

If NC\_NOX\_SENS\_CONF = 1, then calculation for i = 1.

If NC\_NOX\_SENS\_CONF = 2, then calculation for i = 1 and 2.

NC\_NOX\_SENS\_CONF cannot be greater than NC\_CBK\_EX\_NR.

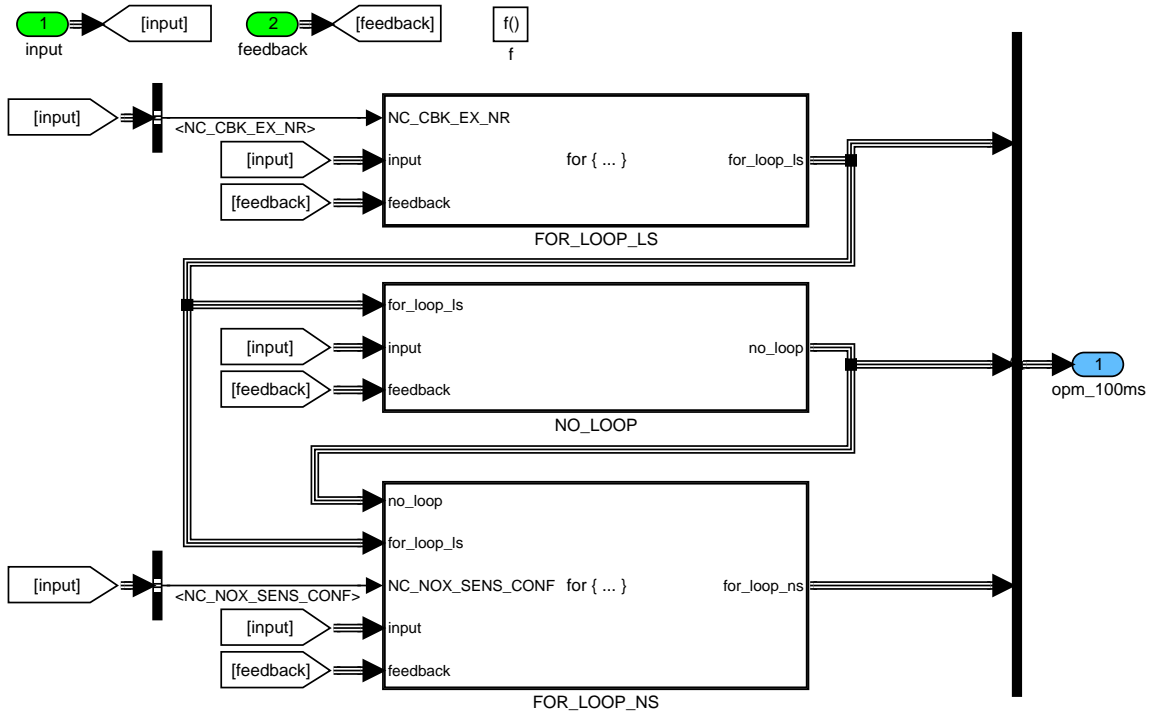


Figure B.116.6: NOXD\_MODULB07G/OPM\_100MS

**Calculation for each upstream lambda sensor**

**Filter for upstream lambda**

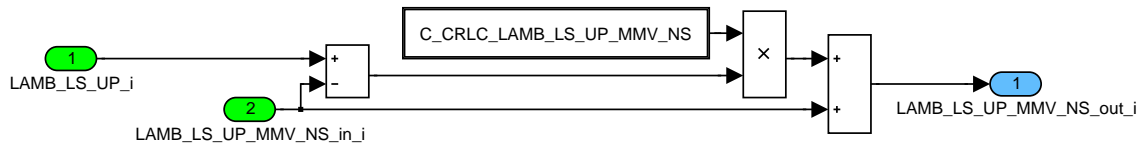


Figure B.116.7: NOXD\_MODULB07G/OPM\_100MS/FOR\_LOOP\_LS/CLC1

**Check of deviation of upstream lambda from its mean value**

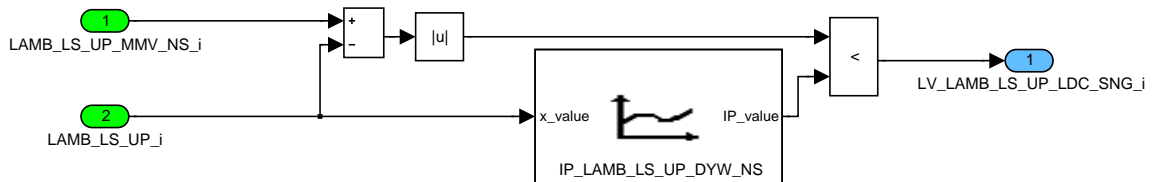


Figure B.116.8: NOXD\_MODULB07G/OPM\_100MS/FOR\_LOOP\_LS/CLC2

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### Bank independent calculation

#### Filter of motor speed

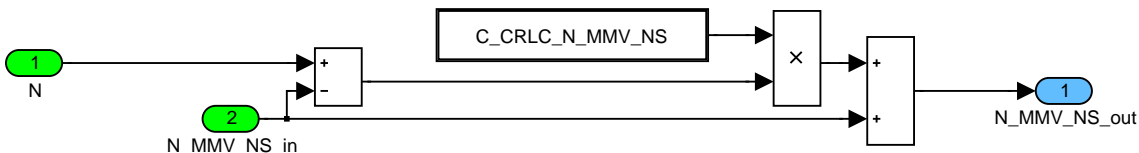


Figure B.116.9: NOXD\_MODULB07G/OPM\_100MS/NO\_LOOP/CLC1

#### Filter of mass air flow

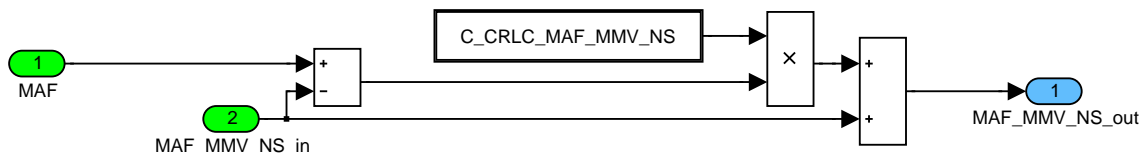


Figure B.116.10: NOXD\_MODULB07G/OPM\_100MS/NO\_LOOP/CLC2

#### Lambda deviation signal for all banks

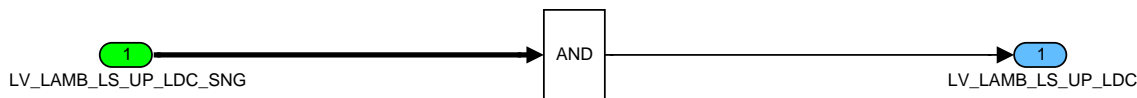


Figure B.116.11: NOXD\_MODULB07G/OPM\_100MS/NO\_LOOP/CLC3

### Calculation for each NOx sensor

#### Evaluation of limited dynamics

The dynamic is limited if several conditions are valid for a longer time, controlled by the MAF integral.

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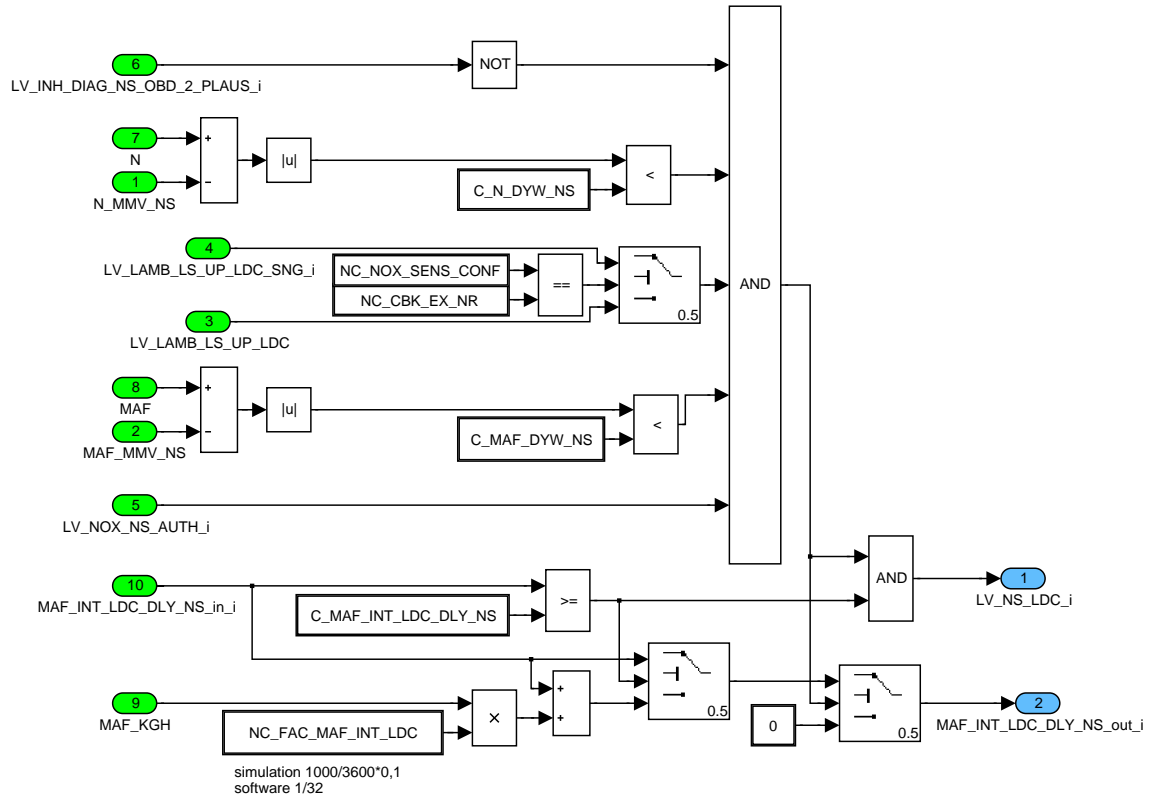


Figure B.116.12: NOXD\_MODULB07G/OPM\_100MS/FOR\_LOOP\_NS/CLC1

**Collection of error information of all OBD II diagnosis types**

The results of all diagnosis types will be collected in two status variables.

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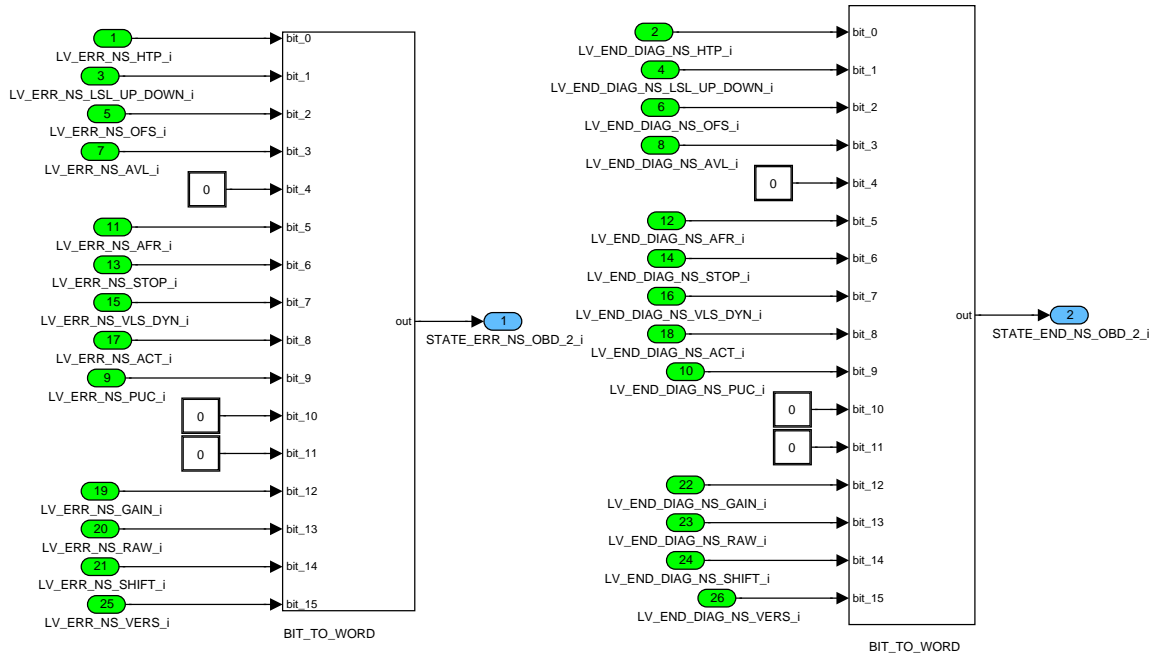


Figure B.116.13: NOXD\_MODULB07G/OPM\_100MS/FOR\_LOOP\_NS/CLC2

**Global OBD II error bit**

If any diagnosis detects an error, then the global error bit will be set.

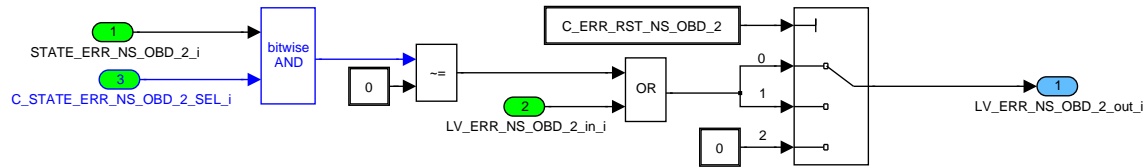


Figure B.116.14: NOXD\_MODULB07G/OPM\_100MS/FOR\_LOOP\_NS/CLC3

**B.116.4 Loop control at engine run to engine stop**

The calculation inside FOR\_LOOP\_NS have to be done for each NOx sensor, controlled by configuration data NC\_NOX\_SENS\_CONF.

If NC\_NOX\_SENS\_CONF = 1, then calculation for i = 1.

If NC\_NOX\_SENS\_CONF = 2, then calculation for i = 1 and 2.

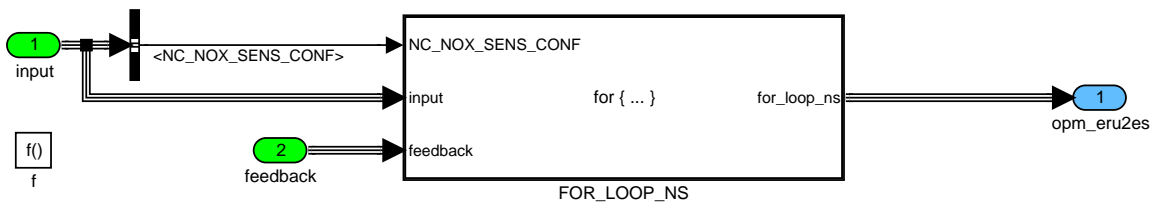


Figure B.116.15: NOXD\_MODULB07G/OPM\_ERU2ES

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### Error counter

For each NOx sensor a counter will be incremented if any OBD II error was detected or decremented if all selected end of OBD II diagnosis signals are valid. This is only done once at the end of the driving cycle. This selection will be done with the bit mask C\_ERR\_END\_NS\_OBD\_2\_BIT\_SEL\_i.

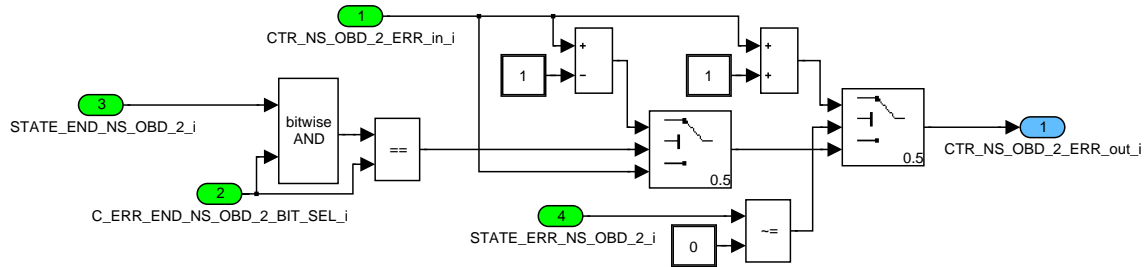


Figure B.116.16: NOXD\_MODULB07G/OPM\_ERU2ES/FOR\_LOOP\_NS/CLC1

### Error flag for next driving cycle

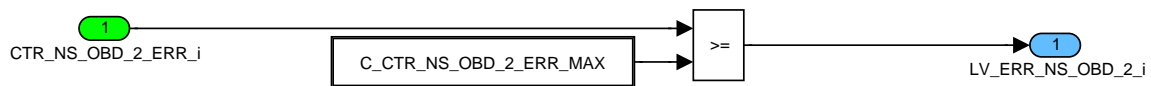


Figure B.116.17: NOXD\_MODULB07G/OPM\_ERU2ES/FOR\_LOOP\_NS/CLC2

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## B.117 NOx sensor OBDII diagnosis - Heater diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_NS_HTP [NC_NOX_SENS_CONF]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom for the NOx sensor heater diagnosis					
LV_CDN_DIAG_NS_HTP [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnosis condition of NOx sensor heater diagnosis					
LV_END_DIAG_NS_HTP [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
End of NOx sensor heater diagnosis					
LV_ERR_NS_HTP [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Error flag of NOx sensor heater diagnosis					
STATE_NS_HTP_DIAG [NC_NOX_SENS_CONF]	V	0H	OFF	-	-
		1H	START		
		2H	PASSIVE		
		3H	ACTIVE		
		4H	POWER		
State of heater performance diagnosis at normal operation					
T_NS_HTP_DIAG [NC_NOX_SENS_CONF]	V	0... FFH	0... 255	1	s
Timer for NOx sensor heater diagnosis					

### Input data:

LV_INH_DIAG_NS_OBD_2_HTP [NC_NOX_SENS_CONF] {p. 6468}	LV_PUC {p. 1720}	LV_ST_END {p. 1720}	LV_TEMP_NS_OK [NC_NOX_SENS_CONF] {p. 991}
LV_TNT_MIN_THD_2 {p. 3181}	LV_VB_NS_OK [NC_NOX_SENS_CONF] {p. 991}	MAF_INT_PUC_ACT {p. 2942}	NC_IDX_DIAG_NS_HTP [NC_NOX_SENS_CONF]
NC_NOX_SENS_CONF {p. 643}	TNT_MDL_L {p. 8237}	VB {p. 1185}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_NS_HTP	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx sensor heater diagnosis					
C_ABC_INC_NS_HTP	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx sensor heater diagnosis					
C_ABC_MAX_NS_HTP	-	1... FFH	1... 255	1	-
Anti bounce counter maximum for the NOx sensor heater diagnosis					
C_MAF_INT_PUC_HTP_MAX	-	0... FFFFH	0... 2912.67	0.04444444	g
MAF threshold for break off a heater performance diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_NS_HTP_MAX	-	0... FFH	0... 255	1	s
Maximum time of invalid sensor temperature at normal operation					
C_T_NS_HTP_ST_MAX	-	0... FFH	0... 255	1	s
Maximum heating up time of NOx sensor					
C_TNT_MDL_HTP_MIN	-	0... FFFFH	0... 1023.98	0.015625	°C
Minimum temperature of NOx catalyst, at which a NOx sensor heater test can be started					
C_VB_MAX_NS	-	0... FFH	0... 25.8984375	0.1015625	V
Maximum battery voltage for correct NOx sensor operation					
C_VB_MIN_NS	-	0... FFH	0... 25.8984375	0.1015625	V
Minimum battery voltage for correct NOx sensor operation					

### Import actions:

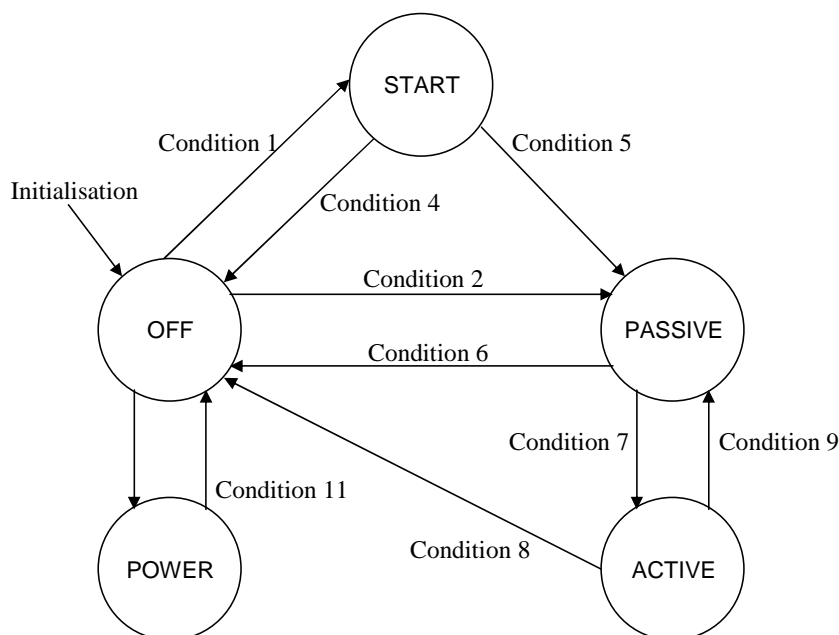
<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>,OUT<LV_END_DIAG>)
<b>ACTION_ERRM_GetLvErr</b> (IN<IDX_DIAG>,OUT<LV_ERR>)

### General information

If the sensor is OK, then the diagnosis state machine is in the state PASSIVE, see next picture. If the temperature of the sensor is not OK, then a diagnosis will be made inside state ACTIVE. If the power supply is not OK, then a diagnosis will be made inside state POWER.

Additionally, at start-up a diagnosis of the sensor temperature behaviour will be made inside state START.

Signal flow diagram:



### Application Condition

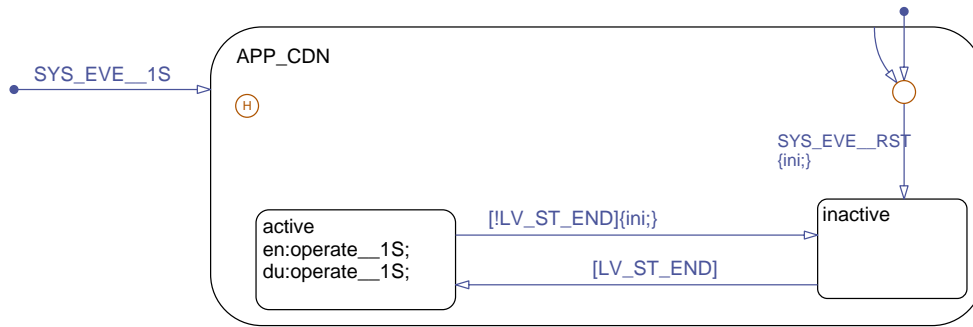
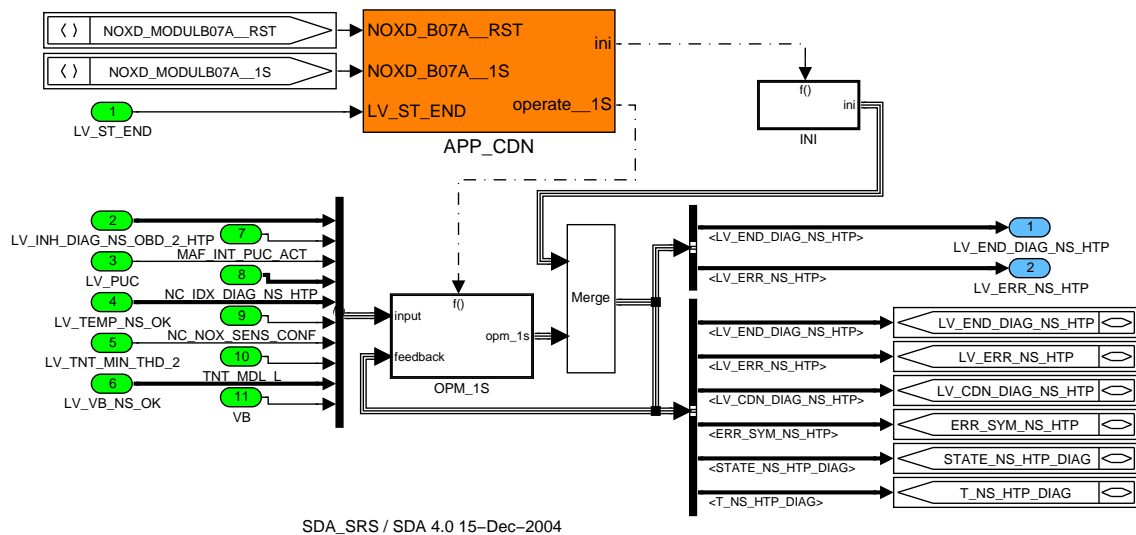


Figure B.117.1: NOXD\_MODULB07A/APP\_CDN/Chart

### Function Description



SDA\_SRS / SDA 4.0 15-Dec-2004

Figure B.117.2: NOXD\_MODULB07A

### B.117.1 Initialization at reset and deactivation

These actions initialized the diagnostic data according filtering configuration :

ACTION\_ERRM\_GetLvErr( IN<NC\_IDX\_DIAG\_XX>, OUT< LV\_ERR\_XX > )

ACTION\_ERRM\_GetLvEndDiag( IN<NC\_IDX\_DIAG\_XX>, OUT< LV\_END\_DIAG\_XX > )



Figure B.117.3: NOXD\_MODULB07A/INI/CLC

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### B.117.2 Calculation for each NOx sensor

The calculation have to be done for each NOx sensor, controlled by configuration data NC\_NOX\_SENS\_CONF.

If NC\_NOX\_SENS\_CONF = 1, then calculation for i = 1.

If NC\_NOX\_SENS\_CONF = 2, then calculation for i = 1 and 2.

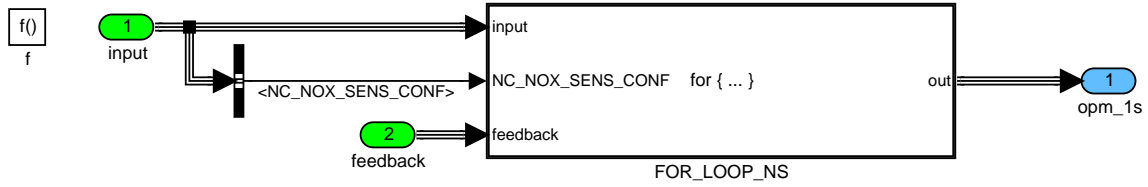


Figure B.117.4: NOXD\_MODULB07A/OPM\_1S

#### Main calculation

If the diagnosis is inhibited, then all values will be set to zero, else the diagnosis will be calculated.

LV\_ERR\_NS\_HTP will be get by ACTION\_ERRM\_GetLvErr and LV\_END\_DIAG\_NS\_HTP will be get by ACTION\_ERRM\_GetLvEndDiag.

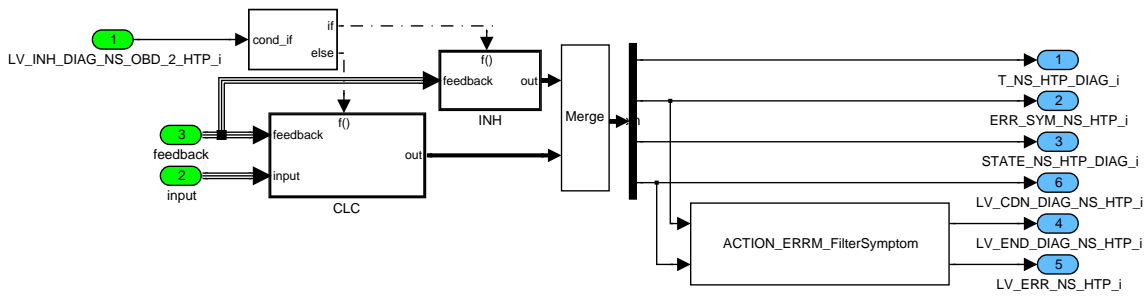


Figure B.117.5: NOXD\_MODULB07A/OPM\_1S/FOR\_LOOP\_NS/MAIN

#### Diagnosis inhibited

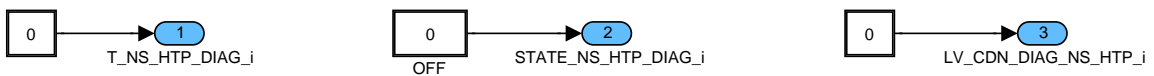


Figure B.117.6: NOXD\_MODULB07A/OPM\_1S/FOR\_LOOP\_NS/MAIN/INH/CLC

#### State machine

The default case is case 0 (OFF).

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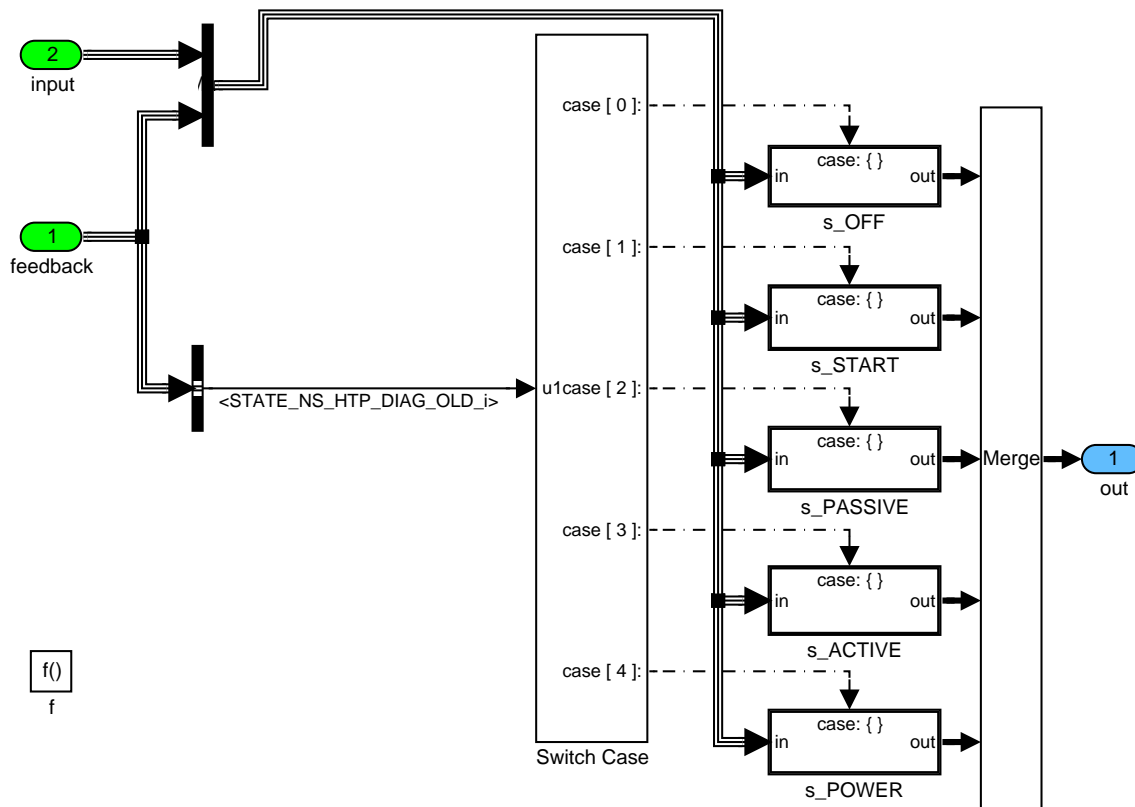


Figure B.117.7: NOXD\_MODULB07A/OPM\_1S/FOR\_LOOP\_NS/MAIN/CLC

**STATE\_NS\_HTP\_DIAG\_i = 0 (OFF)**

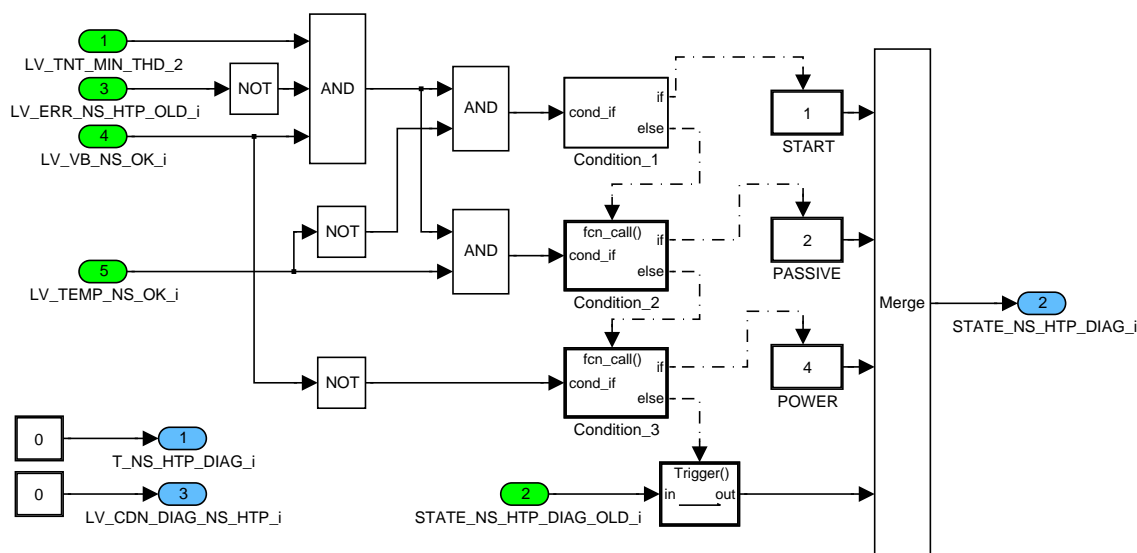



Figure B.117.8: NOXD\_MODULB07A/OPM\_1S/FOR\_LOOP\_NS/MAIN/CLC/s\_OFF/CLC

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**STATE\_NS\_HTP\_DIAG i = 1 (START)**

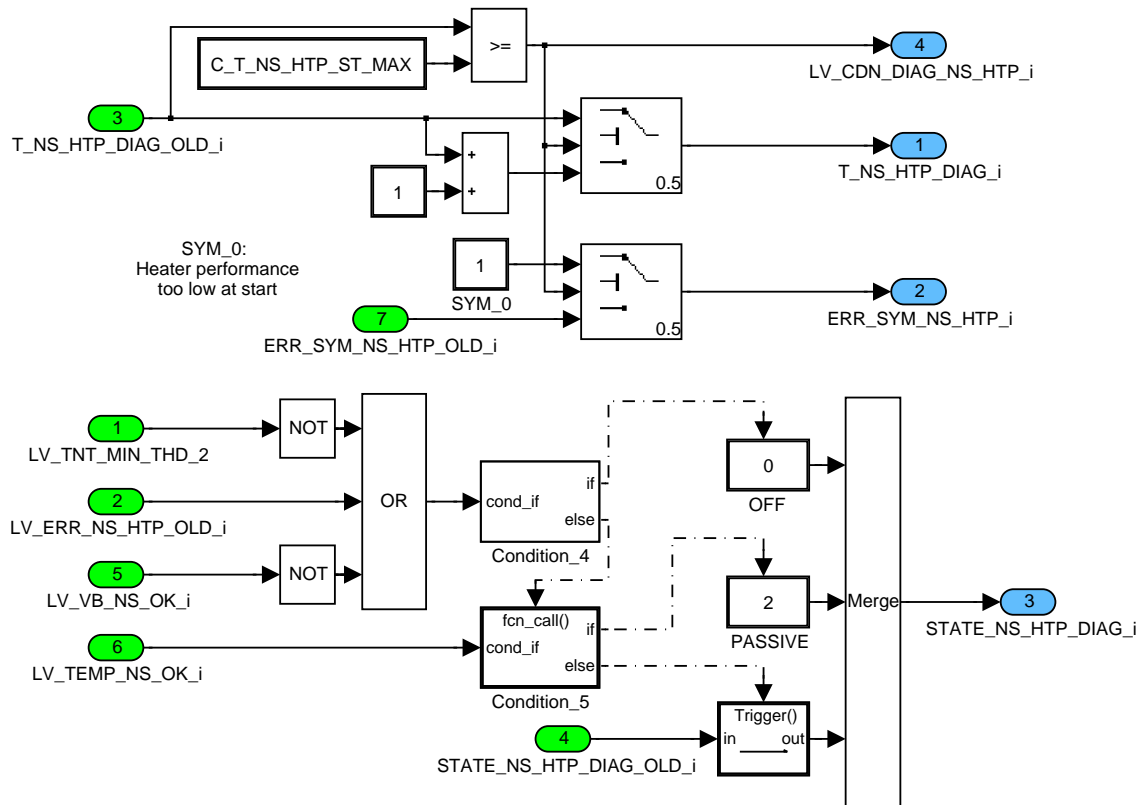


Figure B.117.9: NOXD\_MODULB07A/OPM\_1S/FOR\_LOOP\_NS/MAIN/CLC/s\_START/CLC

**STATE\_NS\_HTP\_DIAG i = 2 (PASSIVE)**

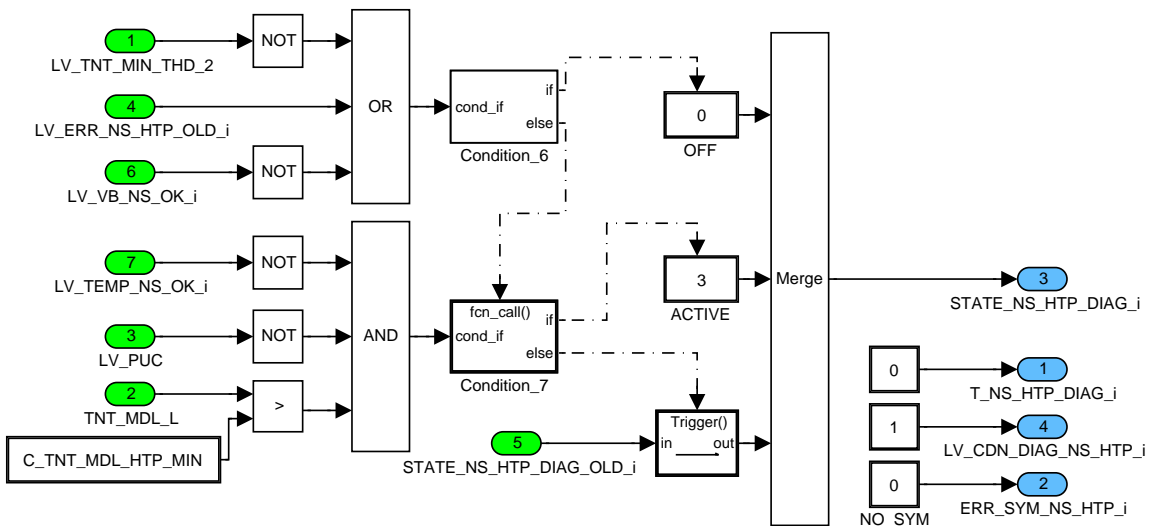


Figure B.117.10: NOXD\_MODULB07A/OPM\_1S/FOR\_LOOP\_NS/MAIN/CLC/s\_PASSIVE/CLC

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**STATE\_NS\_HTP\_DIAG i = 3 (ACTIVE)**

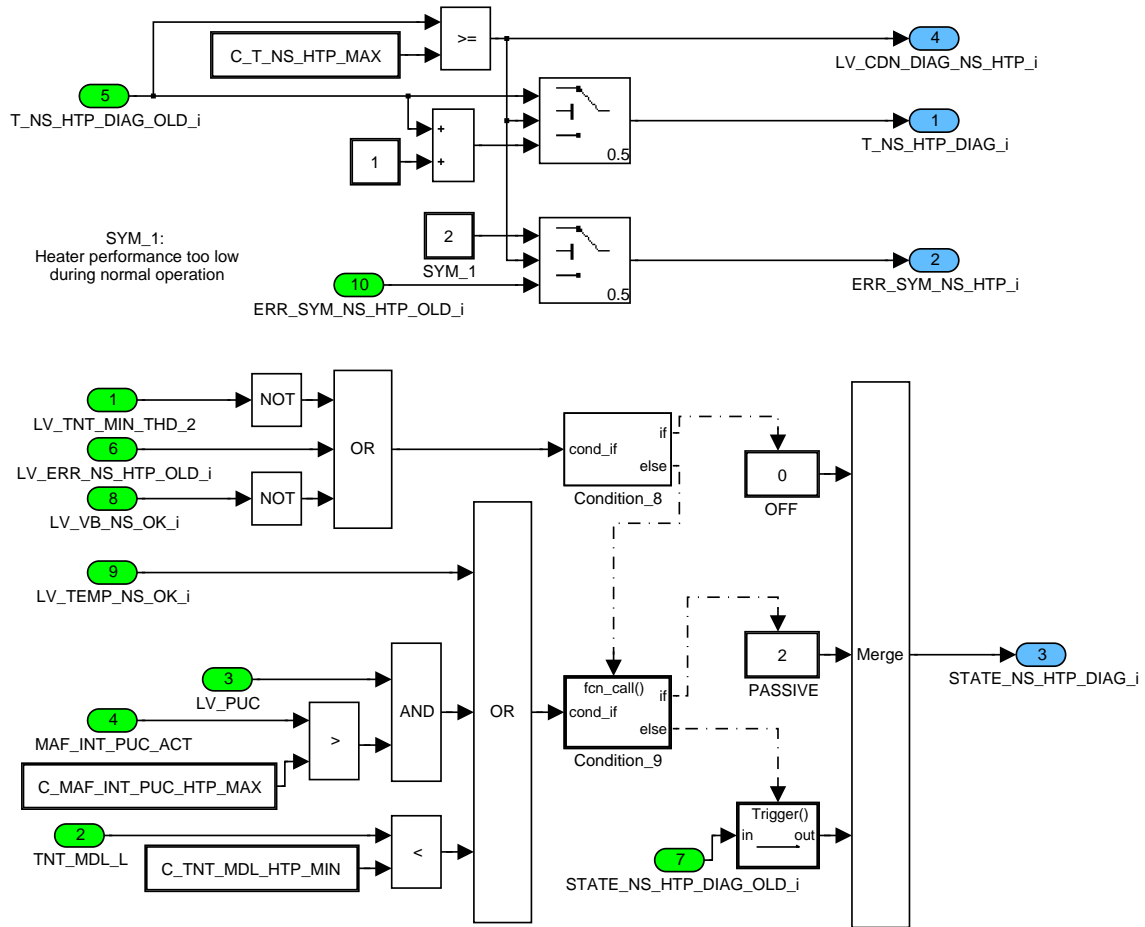


Figure B.117.11: NOXD\_MODULB07A/OPM\_1S/FOR\_LOOP\_NS/MAIN/CLC/s\_ACTIVE/CLC

**STATE\_NS\_HTP\_DIAG i = 4 (POWER)**

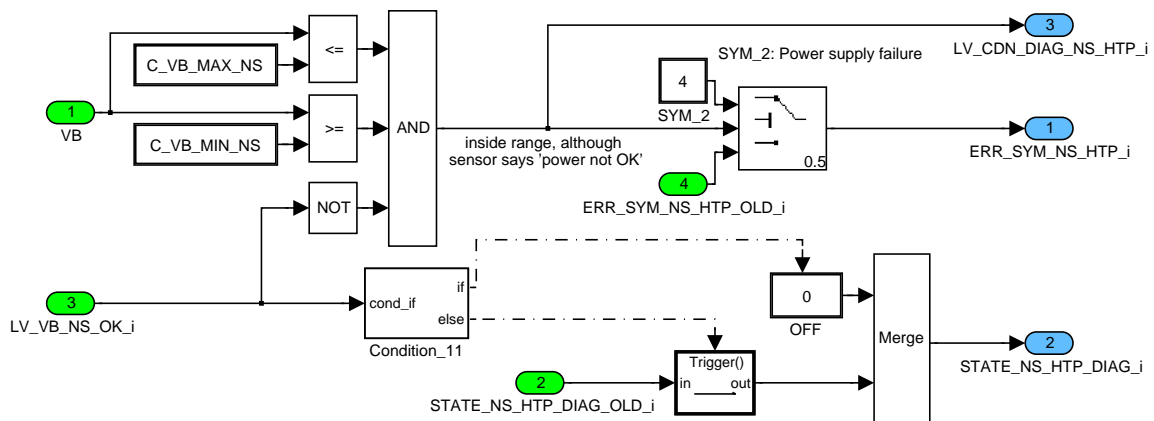



Figure B.117.12: NOXD\_MODULB07A/OPM\_1S/FOR\_LOOP\_NS/MAIN/CLC/s\_POWER/CLC

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## B.118 NOx sensor OBDII diagnosis - Lambda signal dynamic

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_NS_VLS_DYN [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the NOx sensor dynamic diagnosis of binary signal					
LV_CDN_DIAG_NS_VLS_DYN [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnosis condition of NOx sensor dynamic diagnosis of binary signal					
LV_END_DIAG_NS_VLS_DYN [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
End of NOx sensor dynamic diagnosis of binary signal					
LV_ERR_NS_VLS_DYN [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Error flag of NOx sensor dynamic diagnosis of binary signal					
LV_NT_RGN_REQ_OLD	-	0... 1H	0 ...1	1	-
Old value of LV_NT_RGN_REQ for edge detection					
STATE_VLS_RGN_NT_DIAG [NC_NOX_SENS_CONF]	V	0H 1H 2H	WAIT INIT DIAG	-	-
State of dynamic diagnosis for binary signal					
T_VLS_NS_SWI [NC_NOX_SENS_CONF]	V	0... FFH	0... 5.1	0.02	s
Timer for signal switch time measurement					
T_WAIT_VLS_DYN [NC_NOX_SENS_CONF]	V	0... FFH	0... 5.1	0.02	s
Timer for waiting of stratified mode activation					
VLS_NS_RGN_NT_END [NC_NOX_SENS_CONF]	V	0... 578H	-200 ...1200	1	mV
NOx sensor binary O2 signal voltage at the time of leaving NOx catalyst regeneration phase					

### Input data:

LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LV_INH_DIAG_NS_OBD_2_DYN [NC_NOX_SENS_CONF] {p. 6468}	LV_NOX_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}	LV_NT_RGN_REQ {p. 996}
LV_NT_RGN_REQ_AD {p. 996}	LV_S_ACT {p. 8137}	LV_ST_END {p. 1720}	LV_VLS_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}
MAF_KGH {p. 1195}	NC_CBK_EX_NR {p. 1829}	NC_IDX_DIAG_NS_VLS_DYN [NC_NOX_SENS_CONF]	NC_NOX_SENS_CONF {p. 643}
STATE_NOX {p. 2986}	T_VLS_NS_HLD [NC_NOX_SENS_CONF] {p. 992}	VLS_NS_DIAG [NC_NOX_SENS_CONF] {p. 992}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_NS_VLS_DYN	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx sensor dynamic diagnosis of binary signal					
C_ABC_INC_NS_VLS_DYN	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx sensor dynamic diagnosis of binary signal					
C_ABC_MAX_NS_VLS_DYN	-	1... FFH	1... 255	1	-
Anti bounce counter maximum for the NOx sensor dynamic diagnosis of binary signal					
C_LAMB_VLS_NS_DYN_MIN	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Minimum upstream WRAF signal value during the dynamic diagnosis					
C_T_VLS_NS_HLD_DYN_DIAG	-	0... 7FFFH	0... 327.67	0.01	s
Time with binary O2 signal state = "invalid", after which a diagnosis is started					
C_T_WAIT_VLS_DYN_MAX	-	0... FFH	0... 5.1	0.02	s
Maximum time for waiting of stratified mode activation					
C_VLS_NS_DIAG_SWI_END	-	0... 578H	-200 ...1200	1	mV
Binary O2 signal threshold for stop of switch time diagnosis					
C_VLS_NS_DIAG_SWI_ST	-	0... 578H	-200 ...1200	1	mV
Binary O2 signal threshold for start of switch time diagnosis					
C_VLS_NS_RGN_NT_END_MIN	-	0... 578H	-200 ...1200	1	mV
Minimum binary O2 signal voltage after a NOx catalyst regeneration for start a switch time diagnosis					
IP_T_VLS_NS_SWI_MAX	-	0... FFH	0... 5.1	0.02	s
LDP_MAF_KGH_IP_T_VLS_NS_SWI_MAX	6	0... FFFFH	0... 2047.97	0.03125	kg/h
Diagnosis threshold for binary O2 signal switch time diagnosis					
LC_VLS_NS_DYN_VLD_ON	-	0... 1H	0 ...1	1	-
Valid binary O2 signal of NOx-Sensor necessary for this diagnosis					

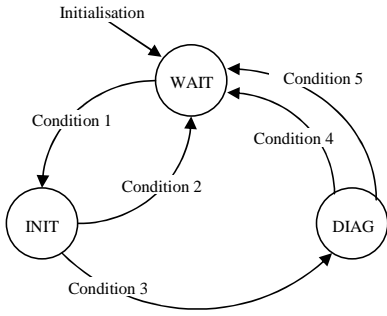
**Import actions:**

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,<OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>,<OUT<LV_END_DIAG>)
<b>ACTION_ERRM_GetLvErr</b> (IN<IDX_DIAG>,<OUT<LV_ERR>)

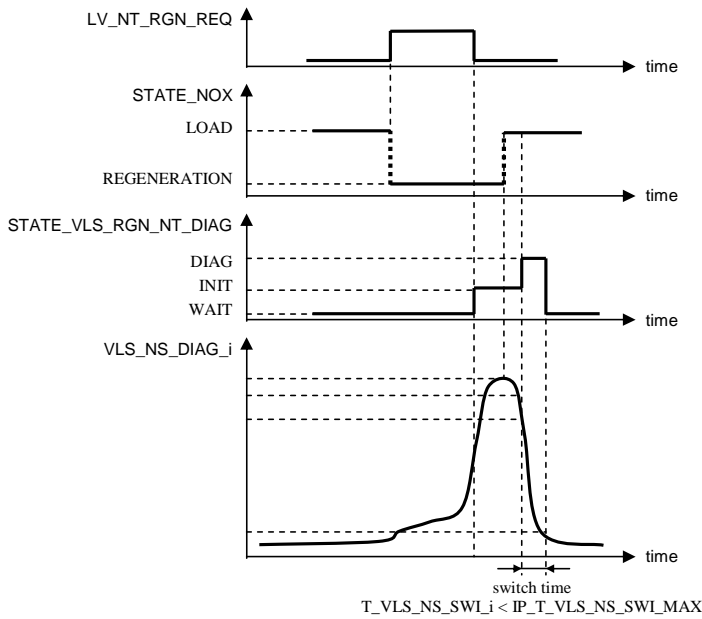
**B.118.1 General description**

This diagnosis observes the dynamic of the binary O2 signal of NOx sensor after a NOx catalyst regeneration.

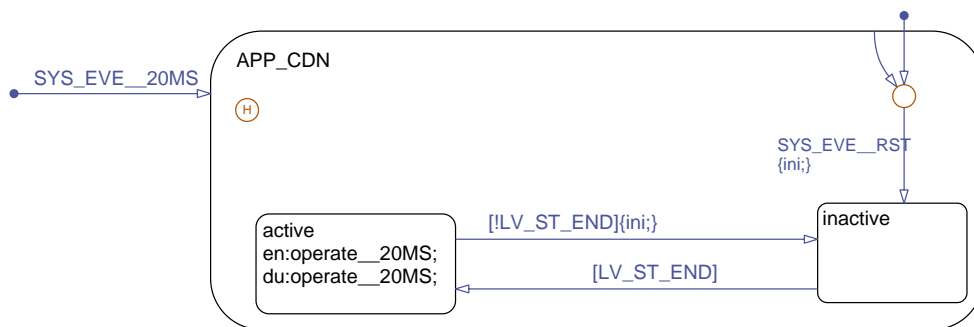
Signal flow:



Characteristic signals:



Application Condition



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Figure B.118.1: NOXD\_MODULB07E/APP\_CDN/Chart

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### Function Description

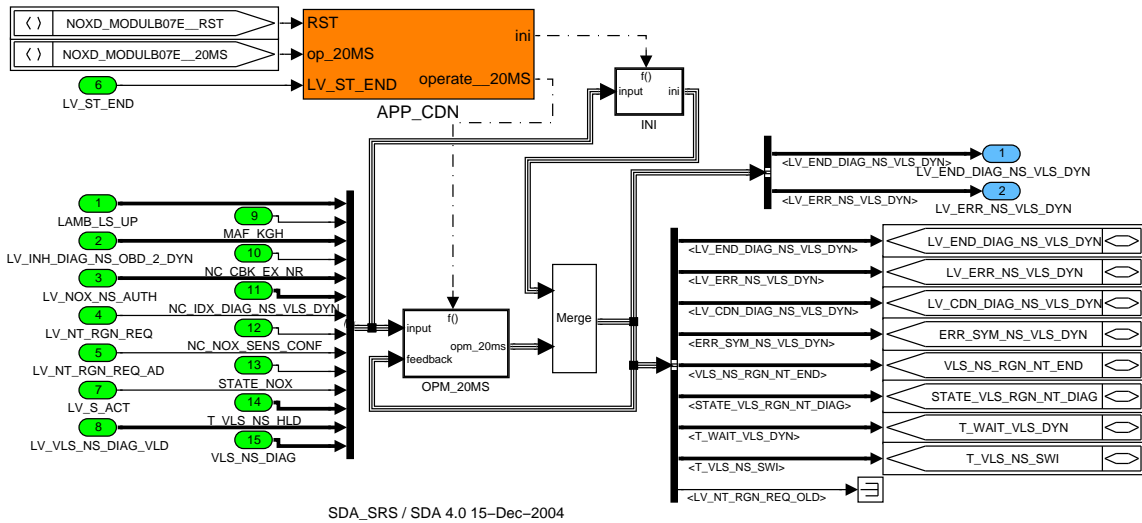


Figure B.118.2: NOXD\_MODULB07E

#### B.118.1.1 Initialization at reset and deactivation

These actions initialized the diagnostic data according filtering configuration :

ACTION\_ERRM\_GetLvErr( IN<NC\_IDX\_DIAG\_XX>, OUT< LV\_ERR\_XX >)

ACTION\_ERRM\_GetLvEndDiag( IN<NC\_IDX\_DIAG\_XX>, OUT< LV\_END\_DIAG\_XX >)

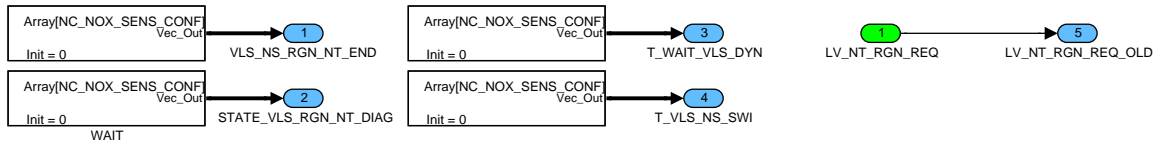


Figure B.118.3: NOXD\_MODULB07E/INI/CLC

#### B.118.1.2 Loop control

The calculation inside both NO\_LOOP subsystems have to be done only once.

The calculation inside FOR\_LOOP\_NS have to be done for each NOx sensor, controlled by configuration data NC\_NOX\_SENS\_CONF.

If NC\_NOX\_SENS\_CONF = 1, then calculation for i = 1.

If NC\_NOX\_SENS\_CONF = 2, then calculation for i = 1 and 2.

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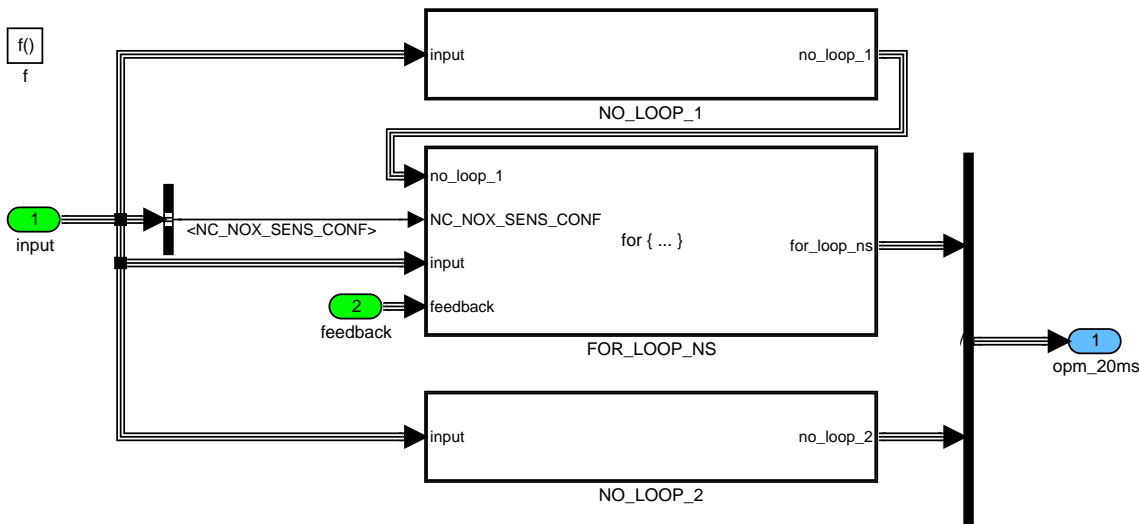


Figure B.118.4: NOXD\_MODULB07E/OPM\_20MS

**Bank independent calculation (part 1)**

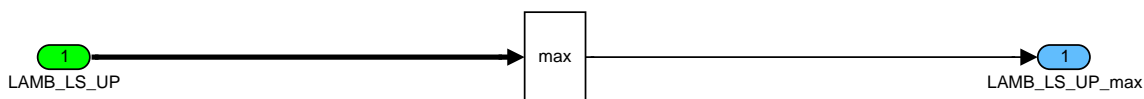


Figure B.118.5: NOXD\_MODULB07E/OPM\_20MS/NO\_LOOP\_1/CLC

**Calculation for each NOx sensor**

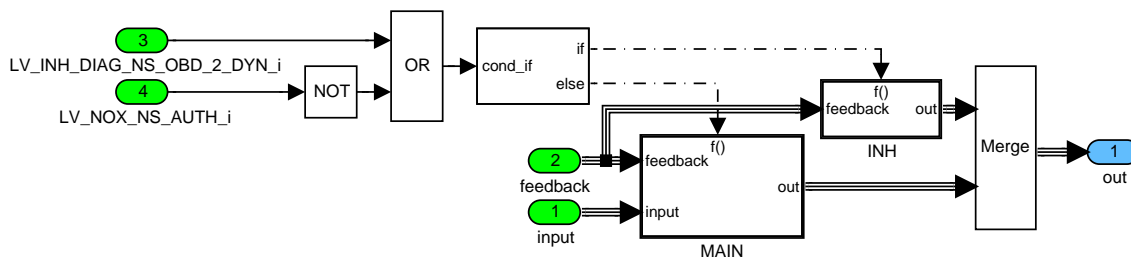


Figure B.118.6: NOXD\_MODULB07E/OPM\_20MS/FOR\_LOOP\_NS/CLC

**Inhibition of diagnosis for one sensor**

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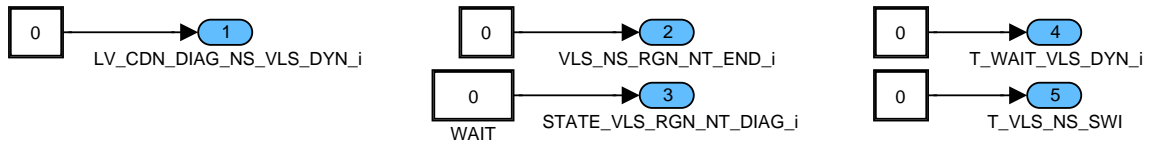


Figure B.118.7: NOXD\_MODULB07E/OPM\_20MS/FOR\_LOOP\_NS/CLC/INH/CLC

**State machine**

This diagnosis is divided into 3 states:

- WAIT: waiting for the end of a regeneration phase of NOx catalyst
- INIT: regeneration phase left, initial conditions for diagnosis present
- DIAG: Diagnosis runs

The default case is is case 0 (WAIT).

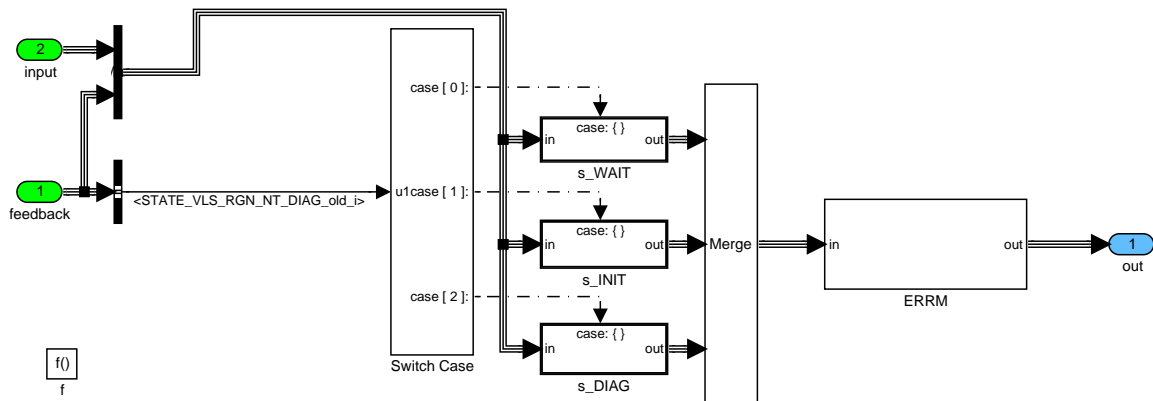


Figure B.118.8: NOXD\_MODULB07E/OPM\_20MS/FOR\_LOOP\_NS/CLC/MAIN

**STATE\_VLS\_RGN\_NT\_DIAG\_i = 0 (WAIT)**

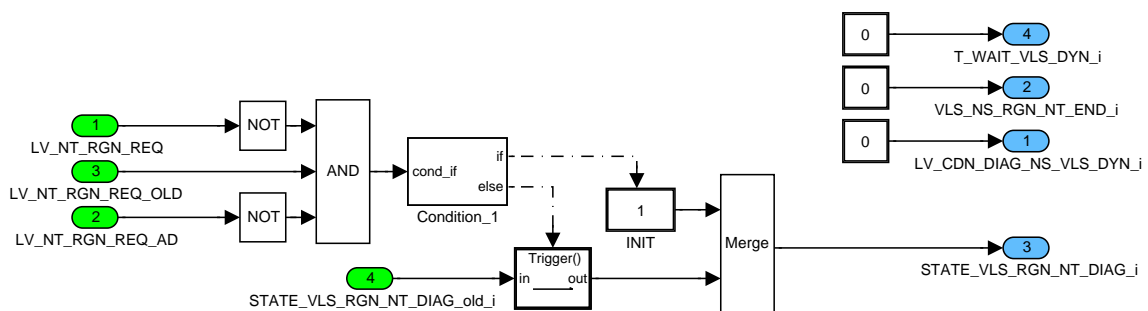


Figure B.118.9: NOXD\_MODULB07E/OPM\_20MS/FOR\_LOOP\_NS/CLC/MAIN/s\_WAIT/CLC

**STATE\_VLS\_RGN\_NT\_DIAG\_i = 1 (INIT)**

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This timer limits the phase INIT. If no diagnosis will be started in this time, then the state machine switches back to WAIT.

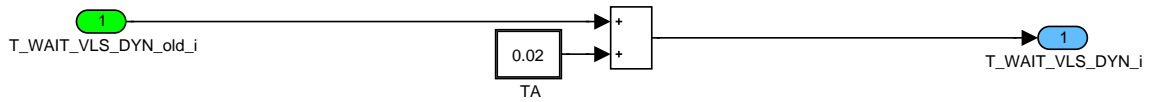


Figure B.118.10: NOXD\_MODULB07E/OPM\_20MS/FOR\_LOOP\_NS/CLC/MAIN/s\_INIT/CLC1

During the waiting the binary O2 signal voltage is checked on their validity. If the signal is valid or if a special condition is fulfilled then the last binary O2 signal value is stored.

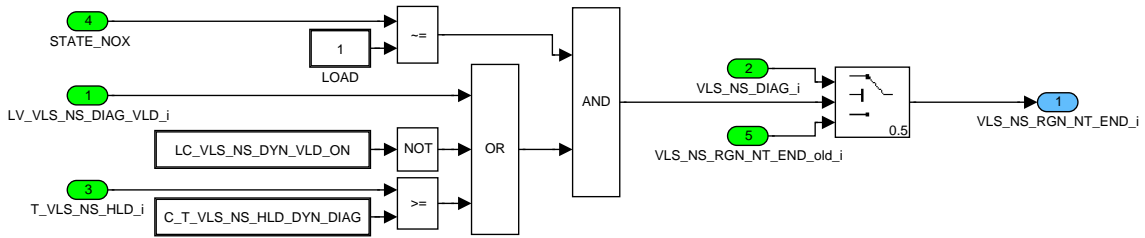


Figure B.118.11: NOXD\_MODULB07E/OPM\_20MS/FOR\_LOOP\_NS/CLC/MAIN/s\_INIT/CLC2

The diagnosis will be started if the binary signal has a suitable behaviour. The threshold **C\_VLS\_NS\_DIAG\_SWI\_ST** defines the start of the gradient check.

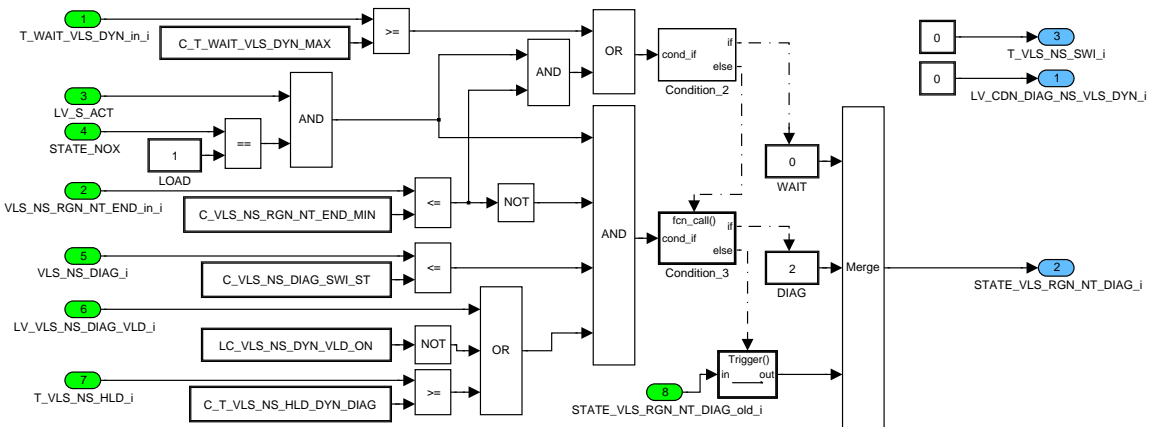


Figure B.118.12: NOXD\_MODULB07E/OPM\_20MS/FOR\_LOOP\_NS/CLC/MAIN/s\_INIT/CLC3

**STATE\_VLS\_RGN\_NT\_DIAG\_i = 2 (DIAG)**

The time of the gradient of the binary signal will be measured.

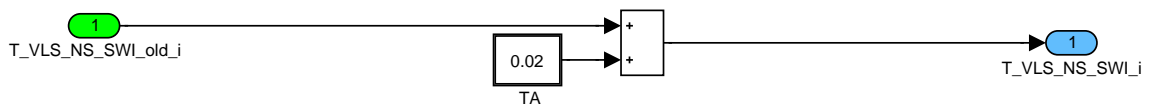


Figure B.118.13: NOXD\_MODULB07E/OPM\_20MS/FOR\_LOOP\_NS/CLC/MAIN/s\_DIAG/CLC1

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The threshold  $C\_VLS\_NS\_DIAG\_SWI\_END$  defines the end of the gradient check. The elapsed time for the gradient will be evaluated to decide whether the sensor dynamic is OK or not.

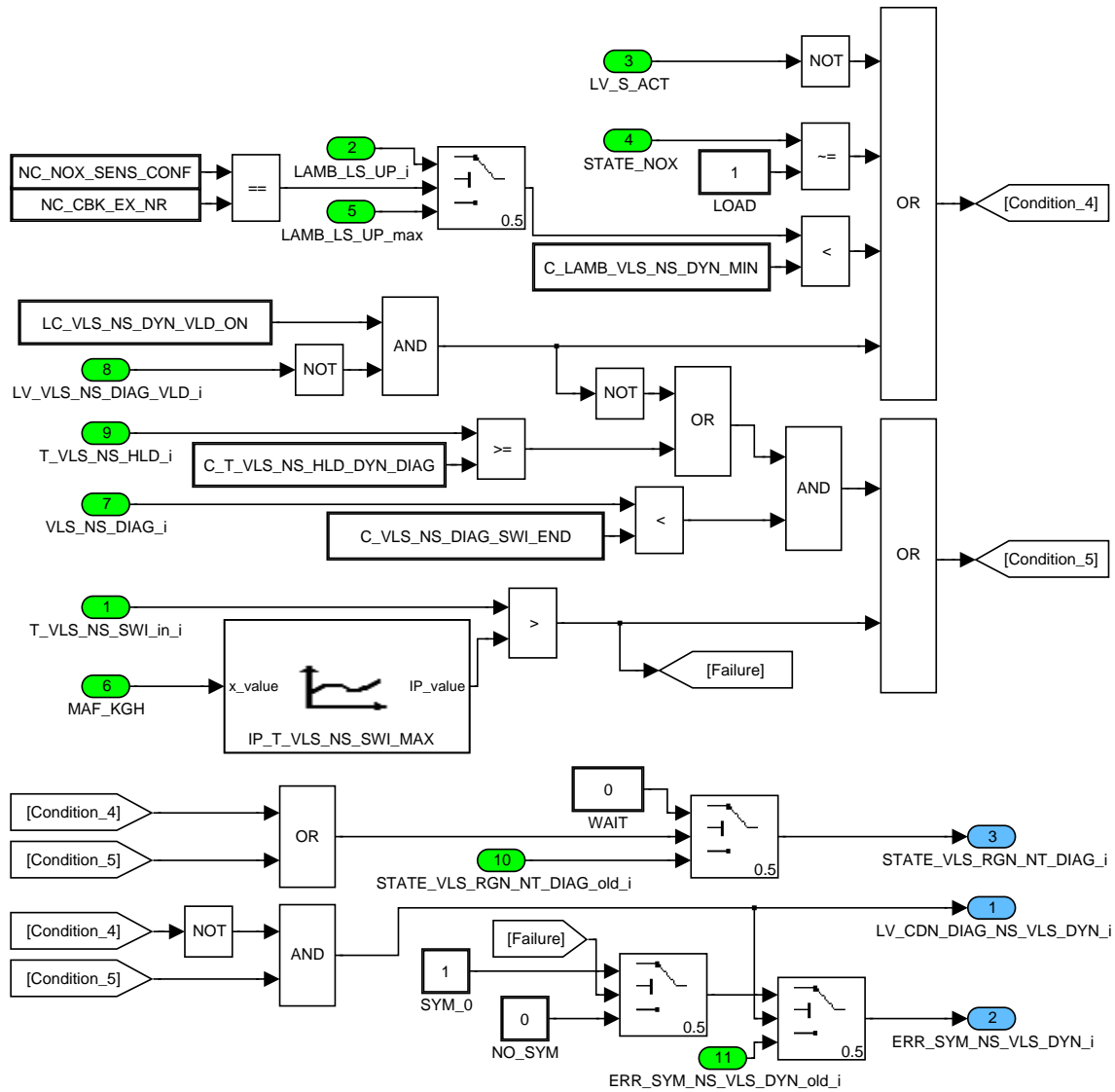


Figure B.118.14: NOXD\_MODULB07E/OPM\_20MS/FOR\_LOOP\_NS/CLC/MAIN/s\_DIAG/CLC2

**Error management**

LV\_ERR\_NS\_VLS\_DYN will be get by ACTION\_ERRM\_GetLvErr and LV\_END\_DIAG\_NS\_VLS\_DYN will be get by ACTION\_ERRM\_GetLvEndDiag.

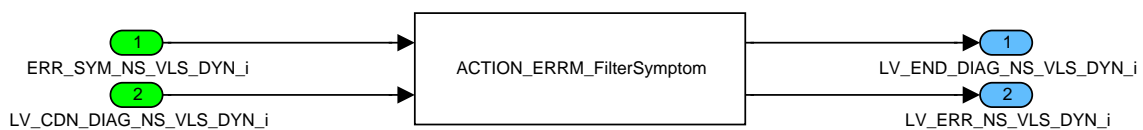


Figure B.118.15: NOXD\_MODULB07E/OPM\_20MS/FOR\_LOOP\_NS/CLC/MAIN/ERRM/CLC

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**Bank independent calculation (part 2)**

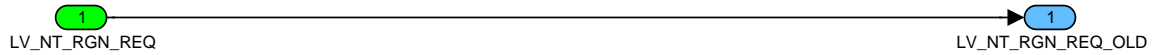



Figure B.118.16: NOXD\_MODULB07E/OPM\_20MS/NO\_LOOP\_2/CLC

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 6346 of 8404</b>	
Regensburg (RGB)		Copyright ( C ) Continental AG,2007	A4: 2007-11

## B.119 NOx sensor OBDII diagnosis - Regeneration stop observation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_RGN_STOP_MDL [NC_NOX_SENS_CONF]	V	0... FFH	0... 255	1	-
Number of successive regenerations, which are stopped by model					
ERR_SYM_NS_STOP [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the NOx sensor plausibility diagnosis at regeneration stop					
LV_CDN_DIAG_NS_STOP [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnosis condition of NOx sensor plausibility diagnosis at regeneration stop					
LV_END_DIAG_NS_STOP [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
End of NOx sensor plausibility diagnosis at regeneration stop					
LV_ERR_NS_STOP [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Error flag of NOx sensor diagnosis at regeneration stop					
LV_INH_NT_RGN_STOP_MDL_DIAG [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Request to NOx catalyst management to inhibit the model based NOx regeneration stop					
LV_INH_NTL_DEC_INT_DIAG [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Inhibition of signal diagnosis by regeneration agent integral because of high NOx catalyst temperature difference					
LV_NS_STOP_DIAG_RUN [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Indicator that regeneration stop observation is running					
NTL_DEC_INT_THD [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 10485.6	0.16	mg
Integral of the lack of oxygen during regeneration phase					
T_MAF_KGH_RGN_MIN [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 655.35	0.01	s
Timer which measures the regeneration duration at which the mass air flow is higher than a threshold					

### Input data:

LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_NS [NC_NOX_SENS_CONF] {p. 991}	LV_HOM_AFS_ACT {p. 8136}	LV_INH_DIAG_NS_OBD_2_PLAUS [NC_NOX_SENS_CONF] {p. 6468}
LV_LAMB_NS_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_NOX_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}	LV_NT_MDL_AFR {p. 996}	LV_NT_RGN_REQ {p. 996}
LV_NT_RGN_STOP_SENS {p. 996}	LV_NT_SENS_AFR [NC_NT_NR] {p. 996}	LV_NT_TOUT_AFR {p. 996}	LV_ST_END {p. 1720}

LV_VLS_NS_VLD [NC_NOX_SENS_CONF] {p. 992}	MAF_KGH {p. 1195}	NC_IDX_DIAG_NS_STOP [NC_NOX_SENS_CONF]	NC_NOX_SENS_CONF {p. 643}
NC_NT_NR {p. 644}	NTL_DEC_INT [NC_NT_NR] {p. 2985}	NTL_RGN_ST {p. 2986}	T_RGN {p. 2885}
TNT_MDL_1 [NC_NT_NR] {p. 8237}	TNT_MDL_2 [NC_NT_NR] {p. 8237}	TNT_MDL_H {p. 8237}	TNT_MDL_L {p. 8237}
TNT_MDL_MV {p. 8237}	TNT_MDL_MV_SNG [NC_NT_NR] {p. 8237}	VLS_NS [NC_NOX_SENS_CONF] {p. 992}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_NS_STOP	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx sensor diagnosis at regeneration stop					
C_ABC_INC_NS_STOP	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx sensor diagnosis at regeneration stop					
C_ABC_MAX_NS_STOP	-	1... FFH	1... 255	1	-
Anti bounce counter maximum for the NOx sensor diagnosis at regeneration stop					
C_CTR_RGN_STOP_MDL_MAX	-	0... FFH	0... 255	1	-
maximum number of successive regenerations, which are stopped by model					
C_LAMB_LS_UP_NS_STOP_DIAG	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Lambda signal threshold for counting time of rich exhaust gas with not too low flow					
C_LAMB_NS_RGN_STOP_DIAG	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Diagnosis threshold for detection of WRAF signal capability to stop a regeneration					
C_MAF_KGH_RGN_MIN	-	0... FFFFH	0... 2047.97	0.03125	kg/h
Minimum mass air flow for set free of failure count					
C_NTL_DEC_INT_DFT_THD	-	0... FFFFH	0... 10485.6	0.16	mg
Default diagnosis threshold					
C_NTL_RGN_ST_MIN	-	0... FFFFH	0... 10485.6	0.16	mg
Threshold for switch between default and calculated diagnosis threshold					
C_STATE_SENS_AFR_NS_DIAG [NC_NOX_SENS_CONF]	-	0H	VLS_DOWN	-	-
	-	1H	VLS_NOX_SENS		
	-	2H	LAMB_NOX_SENS		
	-	3H	LS_NT_DOWN		
	-	4H	NONE		
bench-selective mode to determine rich exhaust gas downstream NOx trap					
C_T_MAF_KGH_RGN_MIN	-	0... FFFFH	0... 655.35	0.01	s
Time threshold for set free of failure count					
C_T_RGN_NS_RGN_STOP_DIAG	-	0... FFFFH	0... 655.35	0.01	s
Minimum regeneration duration for activation of regeneration stop observation					
C_TNT_MDL_DIF_MAX	-	0... FFFFH	0... 1023.98	0.015625	°C
Temperature threshold for set free of signal diagnosis by regeneration agent integral					
C_TNT_NS_DIAG_STOP_MAX	-	0... FFFFH	0... 1023.98	0.015625	°C
Threshold for disabling NOx sensor regeneration stop diagnosis at high NOx trap temperature					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VLS_NS_RGN_STOP_DIAG	-	0... 578H	-200 ...1200	1	mV
Diagnosis threshold for detection of binary Lambda signal capability to stop a regeneration					
IP_FAC_NTL_RGN_ST	-	0... FFFFH	0... 255	0.00389105	-
LDP_TNT_MDL_MV_IP_FAC_NTL_RGN	6	0... FFFFH	0... 1023.98	0.015625	°C
Temperature dependent factor for calculation of diagnosis threshold					

### Import actions:

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>,OUT<LV_END_DIAG>)
<b>ACTION_ERRM_GetLvErr</b> (IN<IDX_DIAG>,OUT<LV_ERR>)

## B.119.1 General description

This diagnosis observes the Lambda signal of NOx sensor, which was selected to stop a NOx catalyst regeneration. The signal is checked on its capability to stop a NOx catalyst regeneration. It is possible that the signal can not exceed the NOx catalyst regeneration stop threshold because of sensor aging or a defect. In this case the regeneration is stopped by a time limit. If this problem is present then it is not possible to fulfil the emission regulations. Then it is necessary to inhibit the engine lean burn operation mode and to mark the NOx sensor as defect .

### Application Condition

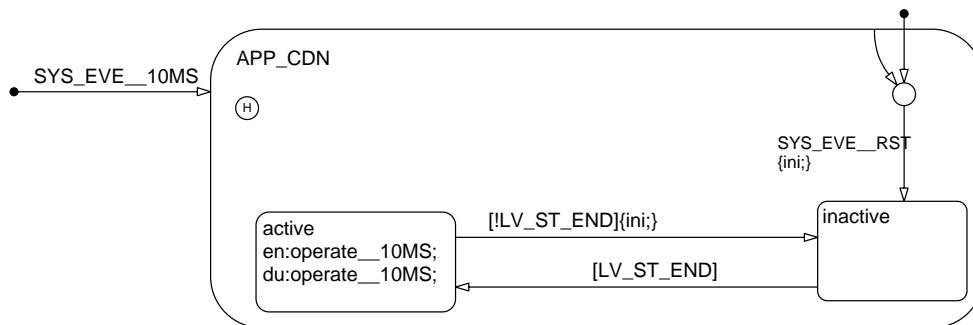


Figure B.119.1: NOXD\_MODULB080/APP\_CDN/Chart

### Function Description

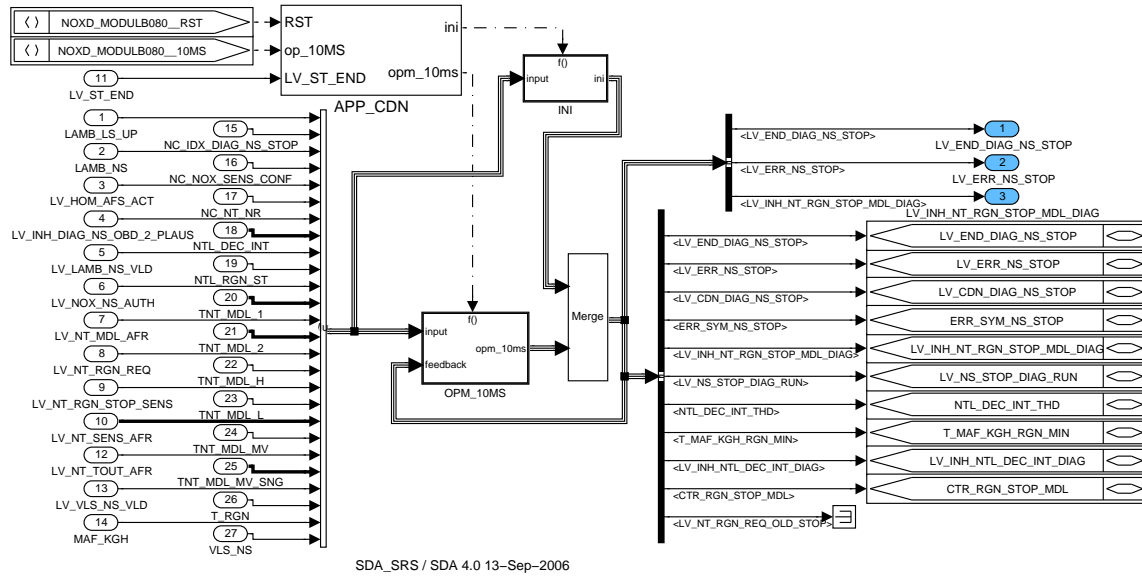


Figure B.119.2: NOXD\_MODULB080

**B.119.1.1 Initialization at reset and deactivation**

These actions initialized the diagnostic data according filtering configuration :

ACTION\_ERRM\_GetLvErr( IN<NC\_IDX\_DIAG\_XX>, OUT< LV\_ERR\_XX >)

ACTION\_ERRM\_GetLvEndDiag( IN<NC\_IDX\_DIAG\_XX>, OUT< LV\_END\_DIAG\_XX >)

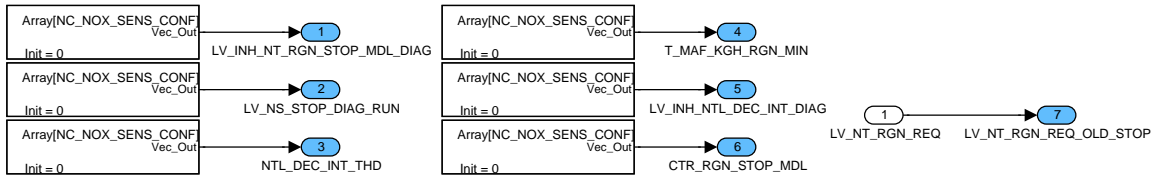


Figure B.119.3: NOXD\_MODULB080/INI/CLC

**B.119.1.2 Loop control**

The calculation inside both NO\_LOOP subsystems have to be done only once.

The calculation inside FOR\_LOOP\_NS have to be done for each NOx sensor, controlled by configuration data NC\_NOX\_SENS\_CONF.

If NC\_NOX\_SENS\_CONF = 1, then calculation for i = 1.

If NC\_NOX\_SENS\_CONF = 2, then calculation for i = 1 and 2.

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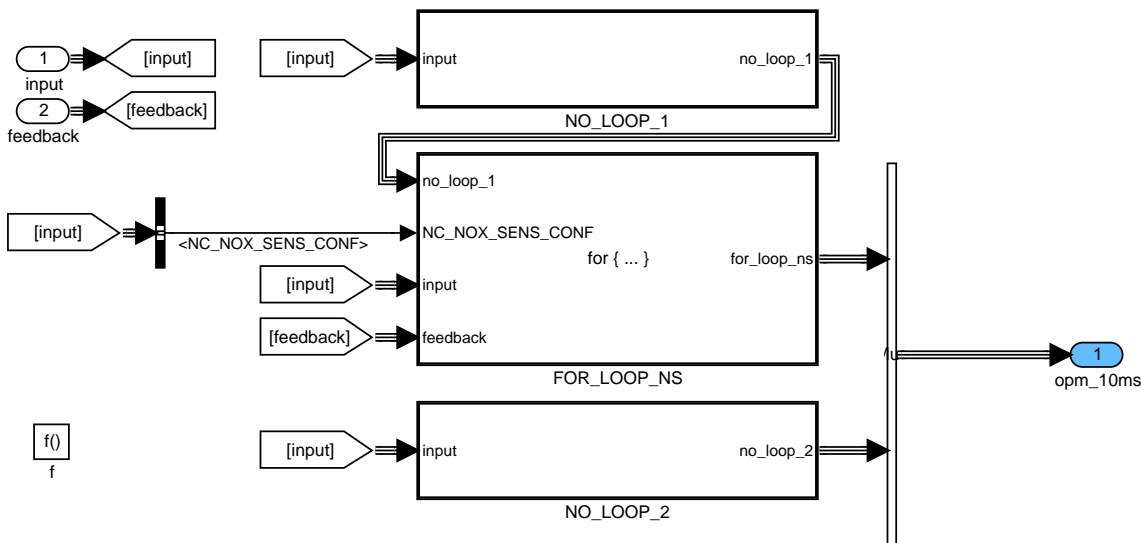


Figure B.119.4: NOXD\_MODULB080/OPM\_10MS

**Bank independent calculation (part 1)**

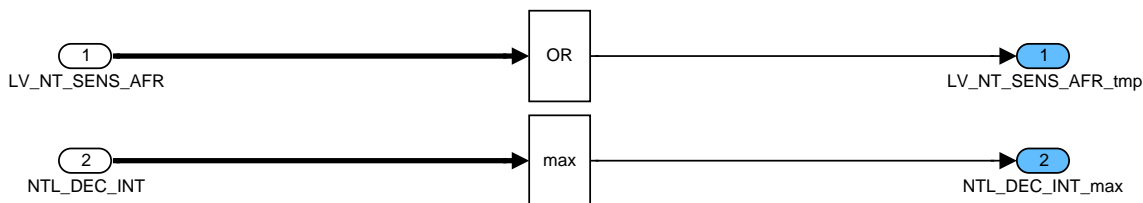


Figure B.119.5: NOXD\_MODULB080/OPM\_10MS/NO\_LOOP\_1/CLC

**Calculation for each NOx sensor**

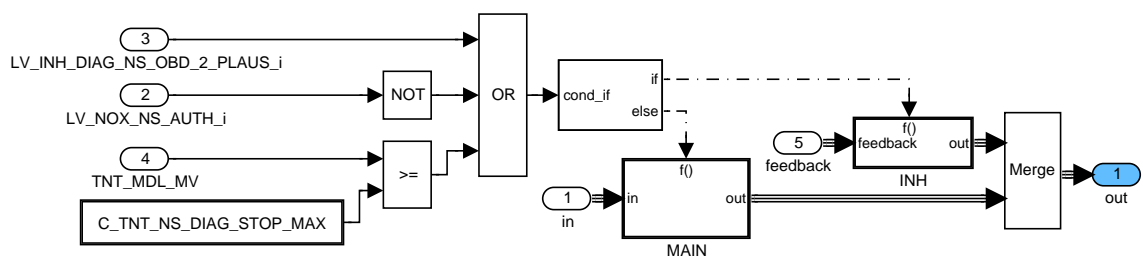


Figure B.119.6: NOXD\_MODULB080/OPM\_10MS/FOR\_LOOP\_NS/CLC

**Inhibition of diagnosis for one sensor**

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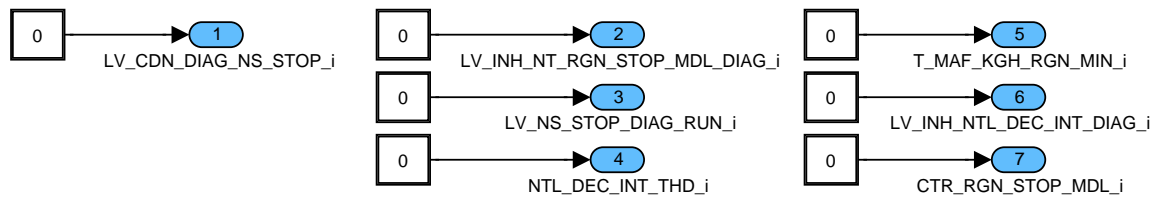


Figure B.119.7: NOXD\_MODULB080/OPM\_10MS/FOR\_LOOP\_NS/CLC/INH/CLC

## Main part of diagnosis

### Start of regeneration stop observation

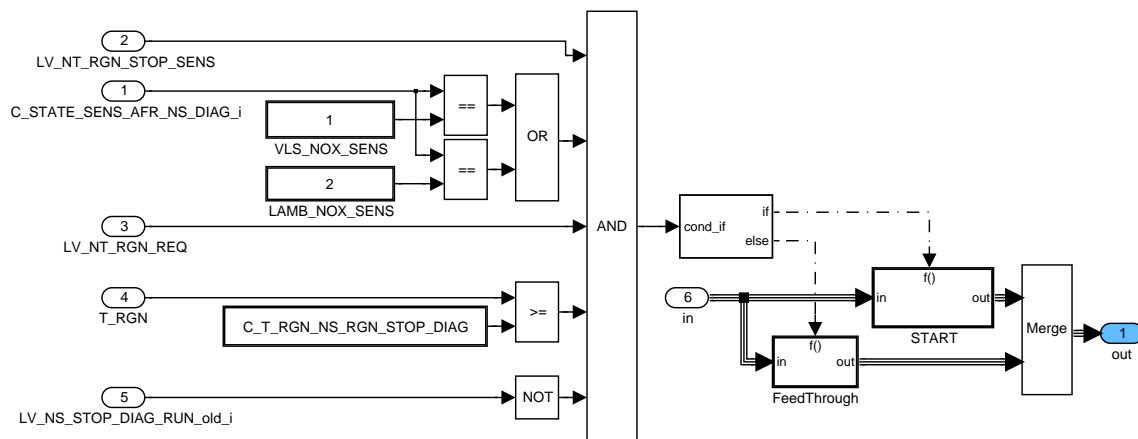


Figure B.119.8: NOXD\_MODULB080/OPM\_10MS/FOR\_LOOP\_NS/CLC/MAIN/CLC1

The diagnosis threshold (maximum necessary amount of regeneration agent) `NTL_DEC_INT_THD_i` is calculated by the absolute NOx and O2 loading of NOx catalyst at start of regeneration `NTL_RGN_ST` and a safety factor. The safety factor depends on the mean NOx catalyst monolith temperature in order to consider the NOx storage capability of catalyst.

Additionally the temperature difference between first and second NOx catalyst monolith is determined at the start of regeneration. If this temperature threshold is higher than the threshold `C_TNT_MDL_DIF_MAX` then regeneration agent diagnosis is inhibited because the NOx catalyst regeneration behaviour is not exactly predictable.

At the first regeneration (after warm up of catalyst) `NTL_RGN_ST` is about 0. Then the default diagnosis threshold `C_NTL_DEC_INT_DFT_THD` is used.



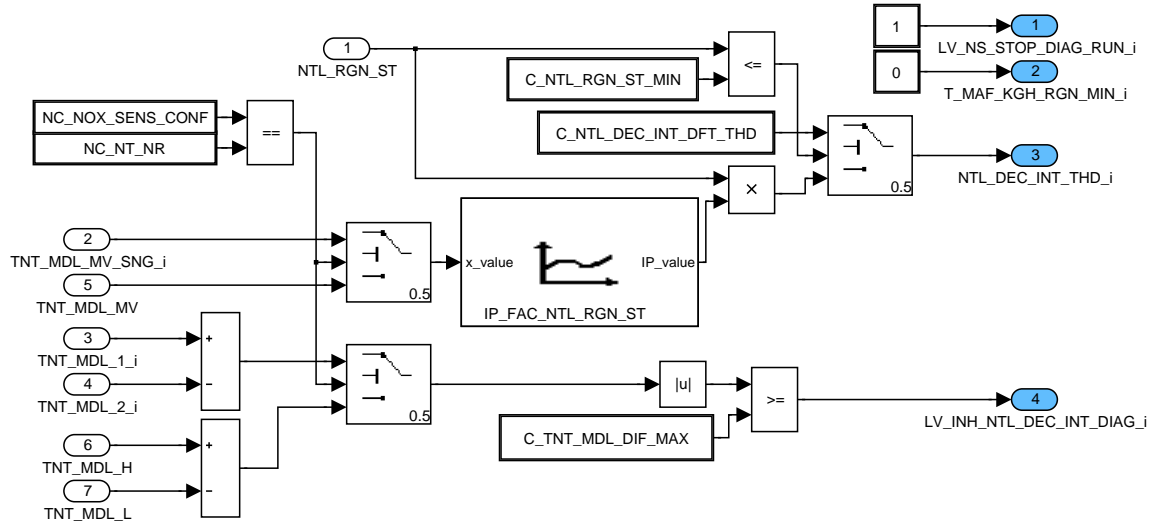


Figure B.119.9: NOXD\_MODULB080/OPM\_10MS/FOR\_LOOP\_NS/CLC/MAIN/CLC1/START/CLC

**Observation of regeneration agent integral during regeneration**

The system knows the absolute loading of NOx catalyst with NOx and O2. On this base it is possible to determine the necessary amount of regeneration agent. When this amount of regeneration agent was transferred to the NOx catalyst then the NOx catalyst shall be cleared from NOx and O2. Now the sensor signal must stop the NOx regeneration by exceeding of regeneration stop threshold. Otherwise the sensor signal is wrong.

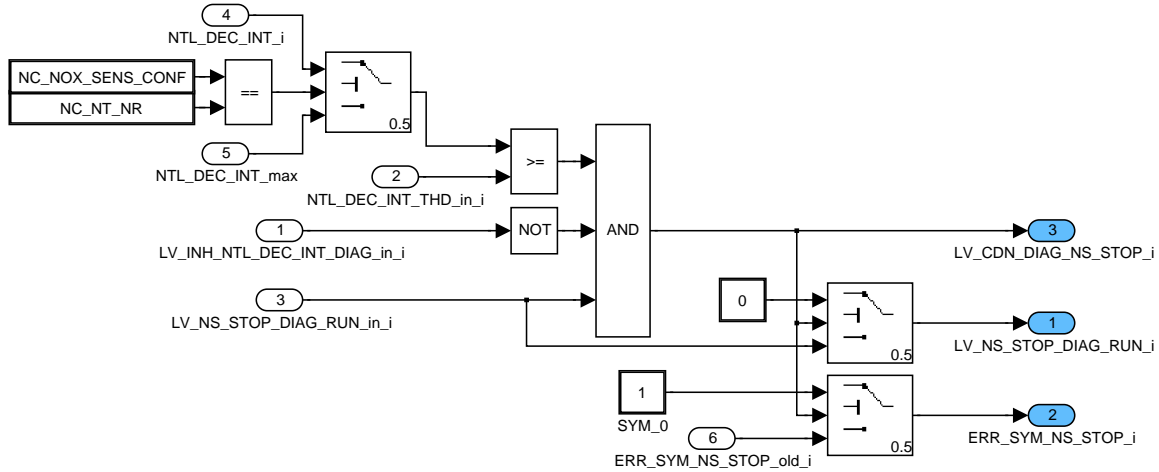


Figure B.119.10: NOXD\_MODULB080/OPM\_10MS/FOR\_LOOP\_NS/CLC/MAIN/CLC2

**Observation of air flow and lambda during regeneration**

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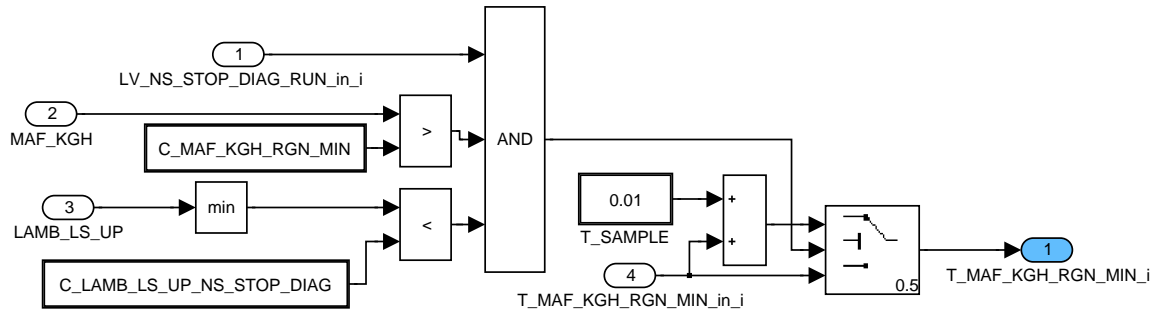


Figure B.119.11: NOXD\_MODULB080/OPM\_10MS/FOR\_LOOP\_NS/CLC/MAIN/CLC3

**Detection of regeneration stop**

The NOx catalyst regeneration stop can be caused by  
 - rich exhaust gas, which is detected by a sensor based lambda signal  
 - NOx catalyst model  
 - maximum regeneration duration (time out).

The NOx catalyst management indicates the regeneration stop method by the bits LV\_SENS\_AFR\_i (sensor stop), LV\_NT\_MDL\_AFR (catalyst model) and LV\_T\_OUT\_AFR (time out). This bits are used to observe the lambda signals of NOx sensor on its capability to stop a NOx catalyst regeneration.

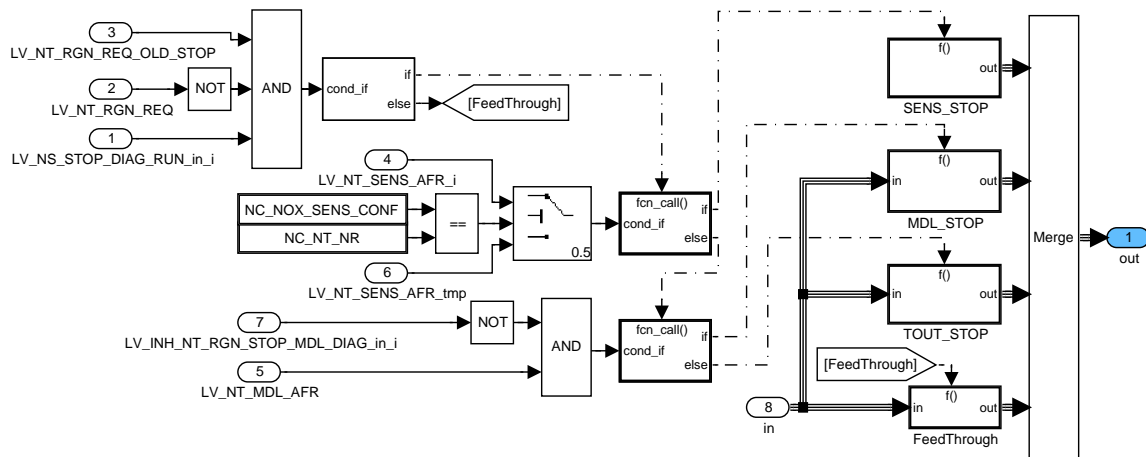


Figure B.119.12: NOXD\_MODULB080/OPM\_10MS/FOR\_LOOP\_NS/CLC/MAIN/CLC4

**Regeneration stop by sensor**

Normally the NOx catalyst regeneration is stopped by a sensor signal. Then the sensor is classified as OK.

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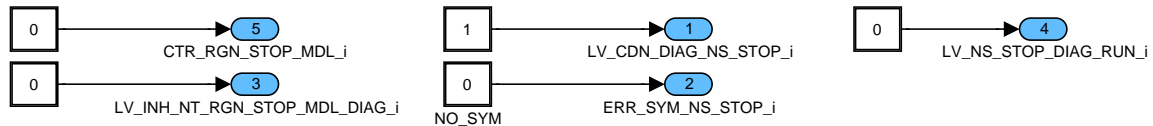


Figure B.119.13:  
NOXD\_MODULB080/OPM\_10MS/FOR\_LOOP\_NS/CLC/MAIN/CLC4/SENS\_STOP/CLC

### Regeneration stop by model

If the regeneration was stopped by the NOx catalyst model, then it is not possible to classify the sensor as OK or defect. Hence the number of successive regenerations, which are stopped by model, is determined by CTR\_RGN\_STOP\_MDL\_i. If CTR\_RGN\_STOP\_MDL\_i exceeds a threshold then the regeneration stop by model is inhibited by set of LV\_INH\_NT\_RGN\_STOP\_MDL\_DIAG\_i. Now the next regeneration can be stopped only by sensor (LV\_SENS\_AFR\_i) or by time out (LV\_T\_OUT\_AFR). If the next regeneration is stopped by sensor then the sensor is OK. Remark: In this case the calibration values and/or adaptation values of model should be checked.

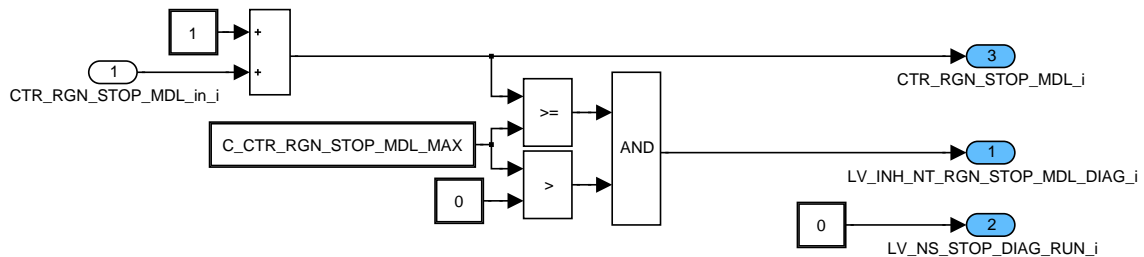


Figure B.119.14:  
NOXD\_MODULB080/OPM\_10MS/FOR\_LOOP\_NS/CLC/MAIN/CLC4/MDL\_STOP/CLC

### Regeneration stop by time out

If the regeneration is stopped by time out then the sensor is not able to stop the regeneration (sensor is defect) or the calibration of maximum regeneration duration is too short. Especially regenerations with a low air flow (idle speed) are critical. Hence the mass air flow is observed during the regenerations. The observation measures the time at which the mass air flow is higher than the threshold C\_MAF\_KGH\_RGN\_MIN. If a regeneration time out is reached now then it is checked the duration at which the mass air flow was higher than the threshold C\_MAF\_KGH\_RGN\_MIN. When the regeneration duration with a sufficient mass air flow is lower than C\_T\_MAF\_KGH\_MIN then this signal diagnosis is inhibited, the failure counter is not incremented. When the regeneration duration with a sufficient mass air flow is higher than C\_T\_MAF\_KGH\_MIN then the sensor is classified as defect and the failure counter is incremented.

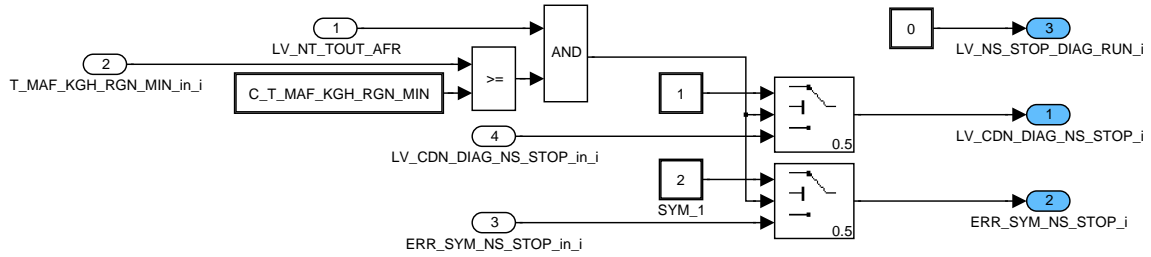


Figure B.119.15:  
NOXD\_MODULB080/OPM\_10MS/FOR\_LOOP\_NS/CLC/MAIN/CLC4/TOUT\_STOP/CLC

**Lambda 1 operation**

It is possible that the Lambda signals of NOx-Sensor exceeds the regeneration stop threshold at homogeneous Lambda = 1.0 engine operation. This fact is used to classify the sensor as OK.

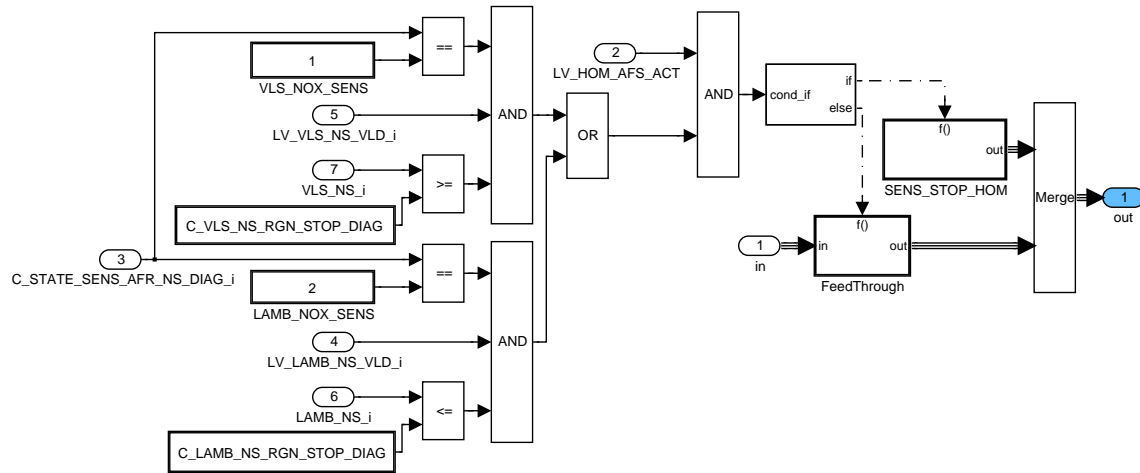


Figure B.119.16: NOXD\_MODULB080/OPM\_10MS/FOR\_LOOP\_NS/CLC/MAIN/CLC5



Figure B.119.17:  
NOXD\_MODULB080/OPM\_10MS/FOR\_LOOP\_NS/CLC/MAIN/CLC5/SENS\_STOP\_HOM/CLC

**Error management**

LV\_ERR\_NS\_STOP will be get by ACTION\_ERRM\_GetLvErr and LV\_END\_DIAG\_NS\_STOP will be get by ACTION\_ERRM\_GetLvEndDiag.

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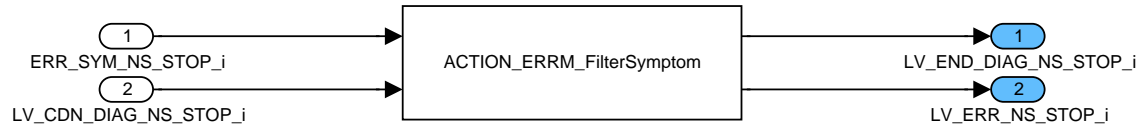


Figure B.119.18: NOXD\_MODULB080/OPM\_10MS/FOR\_LOOP\_NS/CLC/MAIN/CLC6

**Bank independent calculation (part 2)**

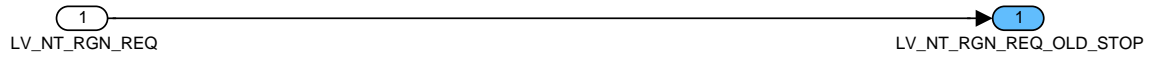



Figure B.119.19: NOXD\_MODULB080/OPM\_10MS/NO\_LOOP\_2/CLC

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 6357 of 8404</b>	
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## B.120 NOx sensor OBDII diagnosis - Signal activity

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_NOX_RGN_DIAG_ACT [NC_NOX_SENS_CONF]	V	0... FFH	0... 255	1	-
Number of suitable regenerations during activity diagnosis					
ERR_SYM_NS_ACT [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the NOx sensor activity diagnosis					
LV_CDN_DIAG_NS_ACT [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnosis condition of NOx sensor activity diagnosis					
LV_END_DIAG_NS_ACT [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
End of NOx sensor activity diagnosis					
LV_ERR_NS_ACT [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Error flag of NOx sensor activity diagnosis					
LV_NOX_NS_ACT [NC_NOX_SENS_CONF]	O/V/S	0... 1H	0 ...1	1	-
NOx signal activity detected					
LV_NOX_NS_ACT_NVMY [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Value LV_NOX_NS_ACT from last driving cycle stored in non-volatile memory					
LV_NT_RGN_REQ_ACT_OLD	V	0... 1H	0 ...1	1	-
Old value of LV_NT_RGN_REQ for edge detection, used for activity diagnosis					
NOX_NS_DIAG_ACT_GRD_MAX [NC_NOX_SENS_CONF]	V	0... 5DCH	0... 1500	1	ppm
Maximum NOx signal gradient during activity diagnosis					
NOX_NS_DIAG_ACT_MAX [NC_NOX_SENS_CONF]	V	0... 5DCH	0... 1500	1	ppm
Maximum NOx signal value during activity diagnosis					
NOX_NS_DIAG_ACT_MMV [NC_NOX_SENS_CONF]	V	0... 5DCH	0... 1500	1	ppm
Filtered value of NOx concentration measured by NOx sensor for diagnosis functions					
NOX_NS_DIAG_ACT_OLD [NC_NOX_SENS_CONF]	V	FF9C... 5DCH	-100 ...1500	1	ppm
Old value of NOx concentration value for diagnosis, used for activity diagnosis					
T_NS_DIAG_ACT [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for NOx sensor activity diagnosis					
T_RGN_ACT_OLD	V	0... FFFFH	0... 655.35	0.01	s
Old value of time counter for regeneration active					

### Input data:

LV_INH_DIAG_NS_OBD_2_ACT [NC_NOX_SENS_CONF] {p. 6468}	LV_NOX_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}	LV_NT_RGN_REQ {p. 996}	LV_PL {p. 1720}
---	--	------------------------	-----------------

LV_SENS_AFR [NC_NT_NR] {p. 2983}	LV_ST_END {p. 1720}	NC_IDX_DIAG_NS_ACT [NC_NOX_SENS_CONF]	NC_NOX_SENS_CONF {p. 643}
NC_NT_NR {p. 644}	NOX_NS_DIAG [NC_NOX_SENS_CONF] {p. 992}	T_RGN {p. 2885}	TNT_MDL_H {p. 8237}
TNT_MDL_L {p. 8237}			


**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_NS_ACT	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx sensor activity diagnosis					
C_ABC_INC_NS_ACT	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx sensor activity diagnosis					
C_ABC_MAX_NS_ACT	-	1... FFH	1... 255	1	s
Anti bounce counter maximum for the NOx sensor activity diagnosis					
C_CRLC_NOX_NS_DIAG_ACT	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
Filter constant for calculation of moving mean value of NOx value for diagnosis					
C_CTR_NOX_RGN_DIAG_ACT_MAX	-	0... FFH	0... 255	1	-
Maximum number of regenerations for NOx signal activity diagnosis					
C_NOX_NS_DIAG_ACT_GRD_MIN	-	0... 5DCH	0... 1500	1	ppm
Minimum NOx signal gradient for registration of maximum NOx signal value					
C_NOX_NS_DIAG_ACT_MIN	-	0... 5DCH	0... 1500	1	ppm
Minimum NOx signal value as diagnosis threshold					
C_NOX_NS_DIAG_GRD_MIN	-	0... 5DCH	0... 1500	1	ppm
Minimum NOx signal gradient as diagnosis threshold					
C_T_NS_DIAG_ACT_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Time threshold to enable the lean operation possibility without successful NOx signal activity diagnosis					
C_T_RGN_DIAG_ACT_MIN	-	0... FFFFH	0... 655.35	0.01	s
Minimum regeneration duration for counting the regeneration within the NOx signal activity diagnosis					
C_TNT_DIAG_ACT_MAX	-	0... FFFFH	0... 1023.98	0.015625	°C
Maximum NOx trap temperature for NOx sensor activity diagnosis					
C_TNT_DIAG_ACT_MIN	-	0... FFFFH	0... 1023.98	0.015625	°C
Minimum NOx trap temperature for NOx sensor activity diagnosis					
LC_NOX_NS_ACT_INI	-	0... 1H	0 ...1	1	-
Init value for LV_NOX_NS_ACT at initialization of non-volatile memory					
LC_NOX_NS_ACT_RST	-	0... 1H	0 ...1	1	-
Selection of reset strategy for LV_NOX_NS_ACT					
LC_SENS_AFR_DIAG_ACT_OFF	-	0... 1H	0 ...1	1	-
Switch if LV_SENS_AFR will be used for counting of regenerations					

**Import actions:**

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>,OUT<LV_END_DIAG>)
<b>ACTION_ERRM_GetLvErr</b> (IN<IDX_DIAG>,OUT<LV_ERR>)

**General information**

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 6359 of 8404	
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This diagnosis observes the NOx signal and the NOx signal gradient in order to check that the NOx signal is able to generate a NOx catalyst regeneration request.

**Application Condition**

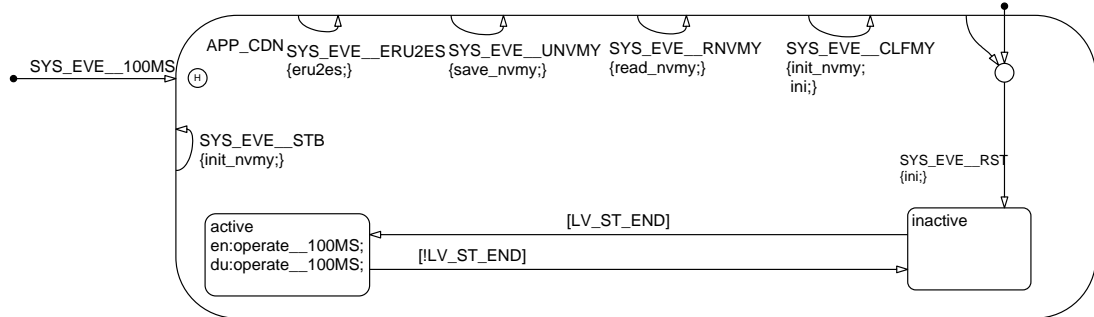



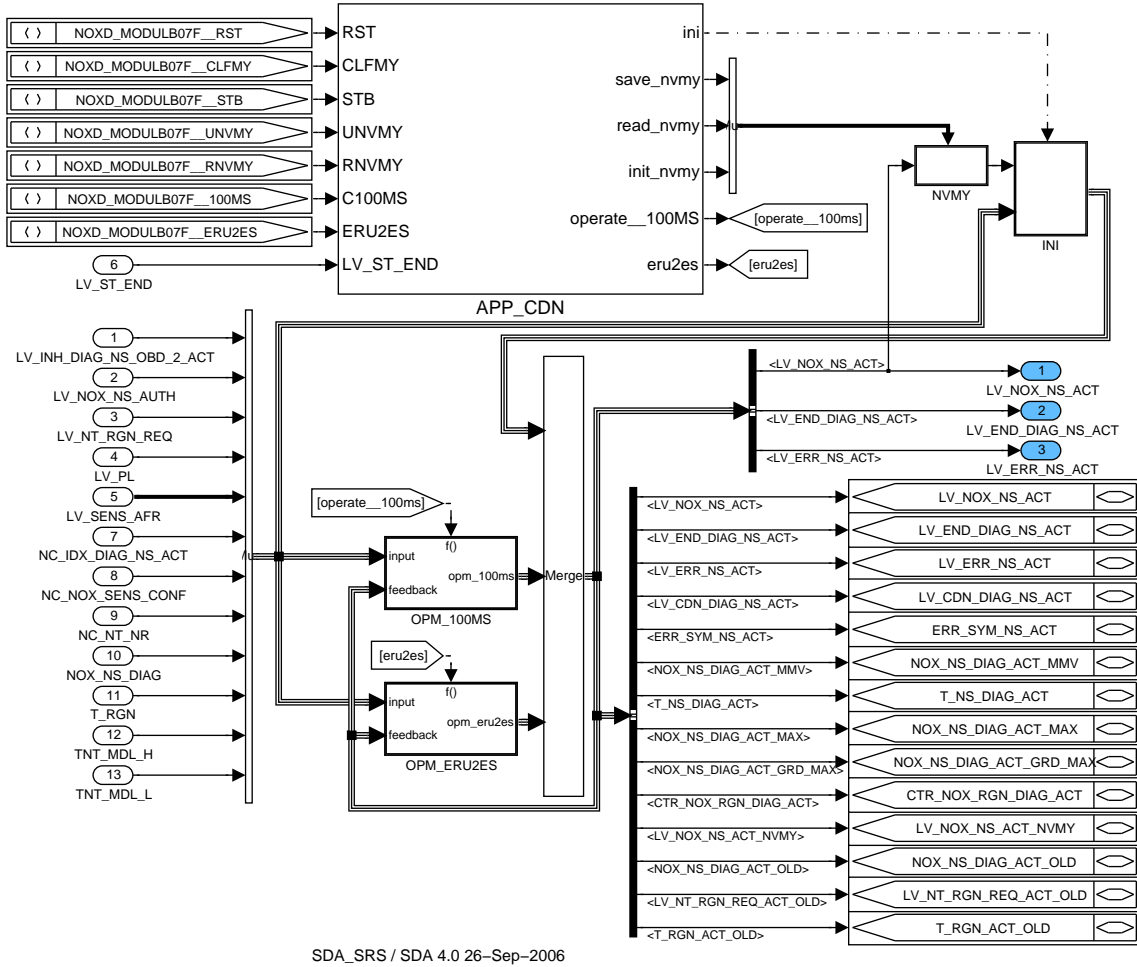
Figure B.120.1: NOXD\_MODULB07F/APP\_CDN/Chart

**Function Description**

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SDA\_SRS / SDA 4.0 26-Sep-2006

Figure B.120.2: NOXD\_MODULB07F

### B.120.1 Management of non-volatile memory

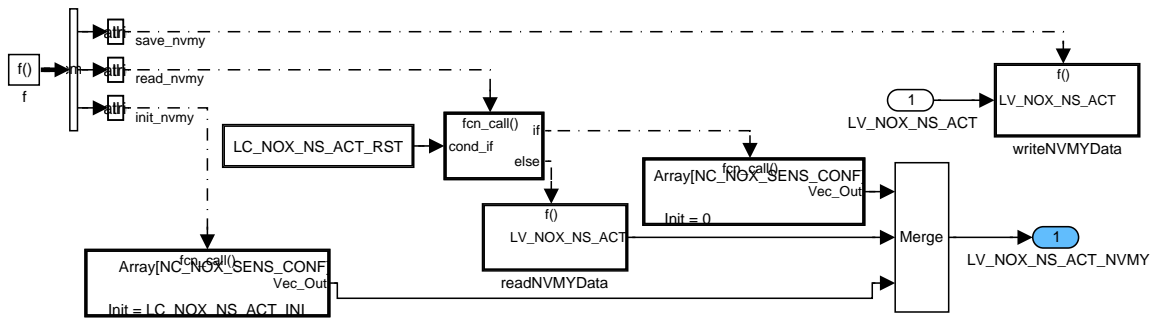


Figure B.120.3: NOXD\_MODULB07F/NVMY

### B.120.2 Initialization at activation

These actions initialized the diagnostic data according filtering configuration :  
 ACTION\_ERRM\_GetLvErr( IN<NC\_IDX\_DIAG\_XX>, OUT< LV\_ERR\_XX >)

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ACTION\_ERRM\_GetLvEndDiag( IN<NC\_IDX\_DIAG\_XX>, OUT<LV\_END\_DIAG\_XX >) with XX=NS\_ ACT

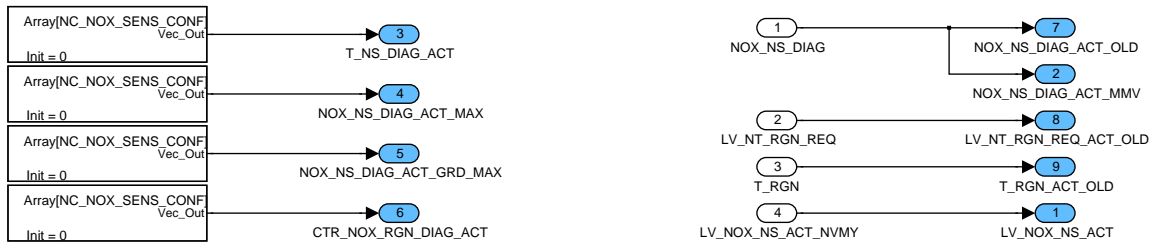


Figure B.120.4: NOXD\_MODULB07F/INI/CLC

### B.120.3 Loop control 100 ms

The calculation inside FLP\_NS have to be done for each NOx sensor, controlled by configuration data NC\_NOX\_SENS\_CONF.

If NC\_NOX\_SENS\_CONF = 1, then calculation for i = 1.

If NC\_NOX\_SENS\_CONF = 2, then calculation for i = 1 and 2.

The calculation inside NOT\_FLP have to be done only once.

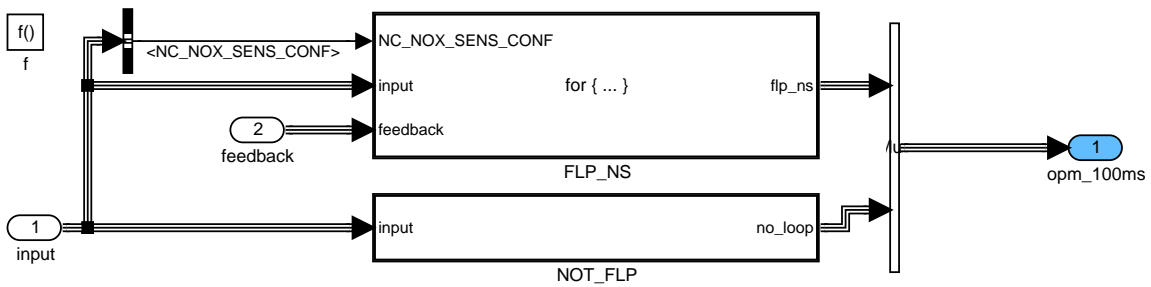


Figure B.120.5: NOXD\_MODULB07F/OPM\_100MS

### Calculation for each NOx sensor

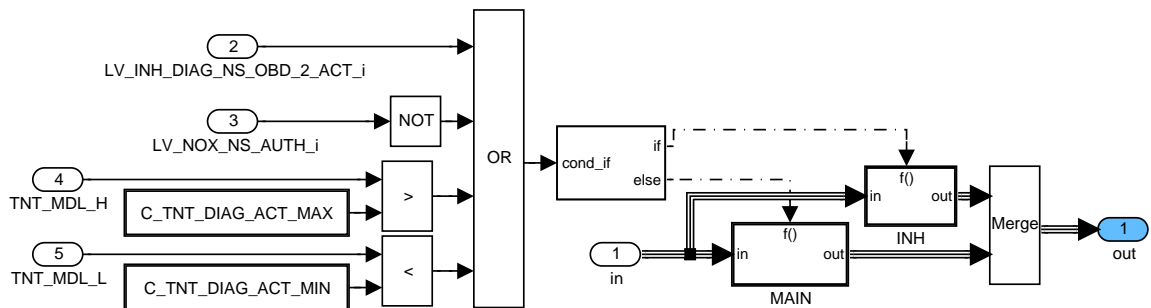


Figure B.120.6: NOXD\_MODULB07F/OPM\_100MS/FLP\_NS/CLC

### Diagnosis inhibited for one sensor

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Figure B.120.7: NOXD\_MODULB07F/OPM\_100MS/FLP\_NS/CLC/INH/CLC

**Main calculation**

**Filter of NOx signal for diagnosis**

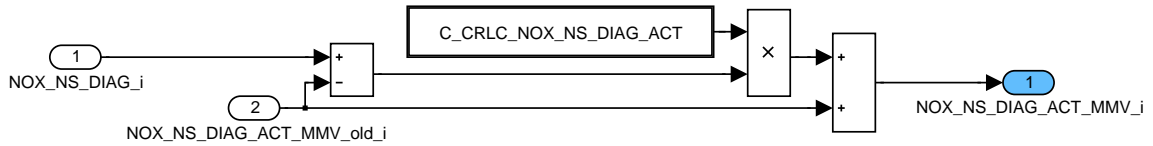


Figure B.120.8: NOXD\_MODULB07F/OPM\_100MS/FLP\_NS/CLC/MAIN/CLC1

**Maximum of NOx signal gradient**

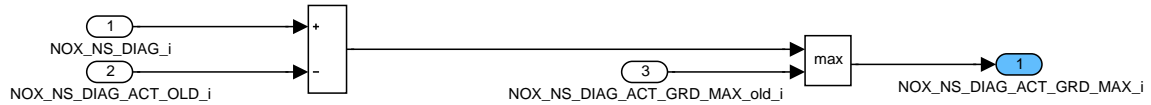


Figure B.120.9: NOXD\_MODULB07F/OPM\_100MS/FLP\_NS/CLC/MAIN/CLC2

**Maximum of NOx signal**

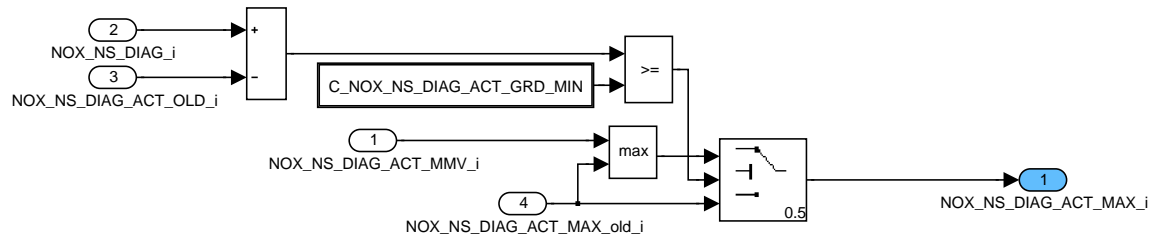


Figure B.120.10: NOXD\_MODULB07F/OPM\_100MS/FLP\_NS/CLC/MAIN/CLC3

**Diagnosis thresholds**

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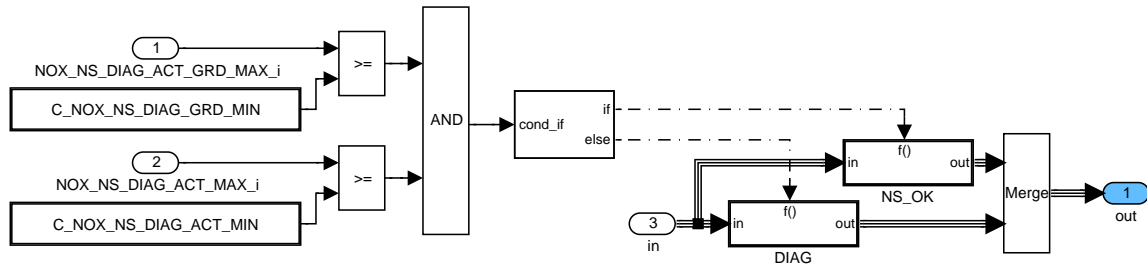


Figure B.120.11: NOXD\_MODULB07F/OPM\_100MS/FLP\_NS/CLC/MAIN/CLC4

**NOx sensor is OK**

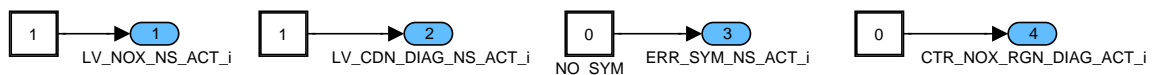


Figure B.120.12: NOXD\_MODULB07F/OPM\_100MS/FLP\_NS/CLC/MAIN/CLC4/NS\_OK/CLC

**NOx sensor diagnosis is running**

The maximum detection will be divided into two periods. The first period is a calibrated time of part load. The second period is a calibrated number of suitable regenerations. A NOx sensor activity error will be set if during both periods the maxima have not reached the diagnosis thresholds.

**Time of part load is measured**

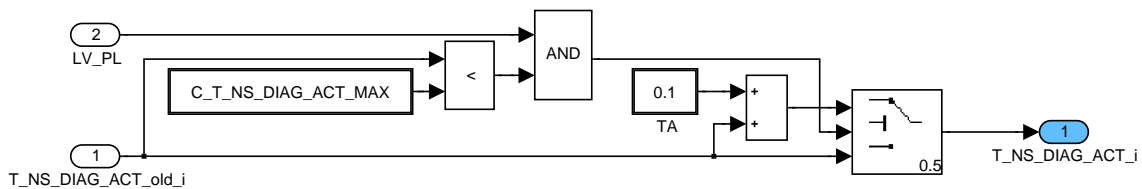


Figure B.120.13: NOXD\_MODULB07F/OPM\_100MS/FLP\_NS/CLC/MAIN/CLC4/DIAG/CLC1

**NOx sensor error decision**

After the calibrated number of regenerations the error will be set.



Figure B.120.14: NOXD\_MODULB07F/OPM\_100MS/FLP\_NS/CLC/MAIN/CLC4/DIAG/CLC2

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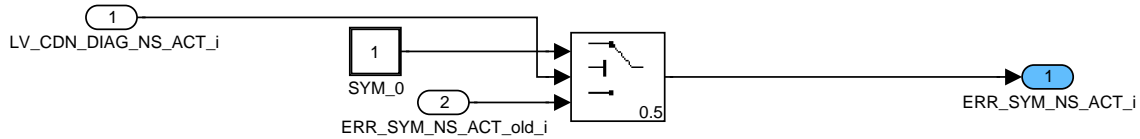


Figure B.120.15: NOXD\_MODULB07F/OPM\_100MS/FLP\_NS/CLC/MAIN/CLC4/DIAG/CLC3

**Control of stratified mode**

If an error after the second period will be detected, then the stratified mode will be inhibited. Otherwise, if the first period is over, then the stratified mode will be allowed, although no activity was detected during the first period. In this period activity of the NOx signal should be monitored due to the stimulation by regeneration.

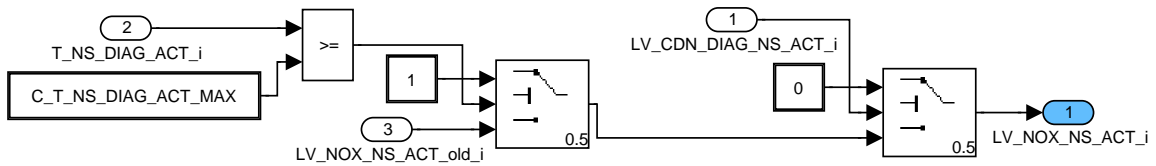


Figure B.120.16: NOXD\_MODULB07F/OPM\_100MS/FLP\_NS/CLC/MAIN/CLC4/DIAG/CLC4

**Regeneration counter**

During the second period the number of suitable regenerations will be counted.

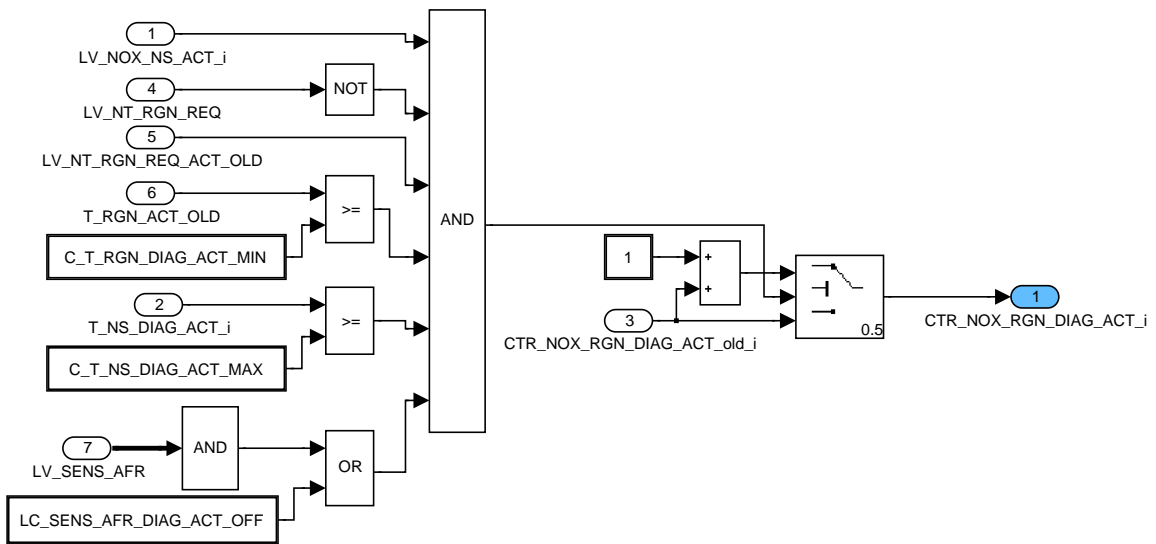



Figure B.120.17: NOXD\_MODULB07F/OPM\_100MS/FLP\_NS/CLC/MAIN/CLC4/DIAG/CLC5

**Error management**

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LV\_ERR\_NS\_ACT will be get by ACTION\_ERRM\_GetLvErr and LV\_END\_DIAG\_NS\_ACT will be get by ACTION\_ERRM\_GetLvEndDiag.

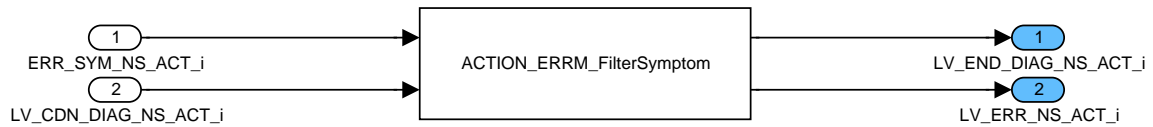


Figure B.120.18: NOXD\_MODULB07F/OPM\_100MS/FLP\_NS/CLC/MAIN/CLC5

### Old value for gradient calculation



Figure B.120.19: NOXD\_MODULB07F/OPM\_100MS/FLP\_NS/CLC/MAIN/CLC6

### Bank independent calculation

The old values of the inputs will be stored for edge detection and because the regeneration time before the edge is needed.

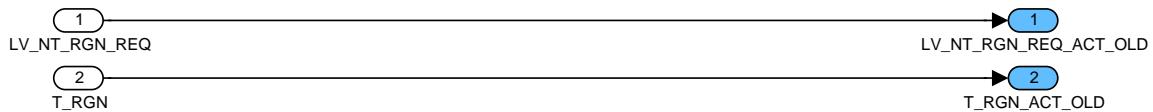


Figure B.120.20: NOXD\_MODULB07F/OPM\_100MS/NOT\_FLP/CLC

## B.120.4 Loop control at engine run to engine stop

The calculation inside FLP\_NS have to be done for each NOx sensor, controlled by configuration data NC\_NOX\_SENS\_CONF.

If NC\_NOX\_SENS\_CONF = 1, then calculation for i = 1.

If NC\_NOX\_SENS\_CONF = 2, then calculation for i = 1 and 2.

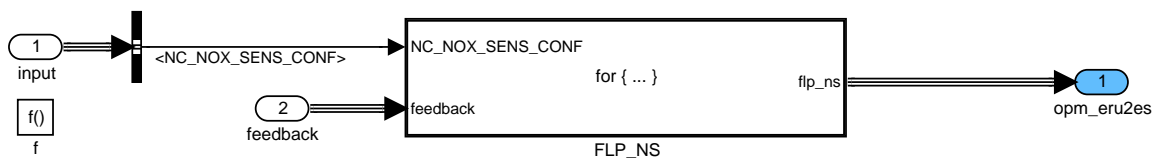


Figure B.120.21: NOXD\_MODULB07F/OPM\_ERU2ES

### Decision about storage of diagnosis result

The new activity result will be stored in the non-volatile memory if the diagnosis was finished. Otherwise the stored value from the last driving cycle will be kept.

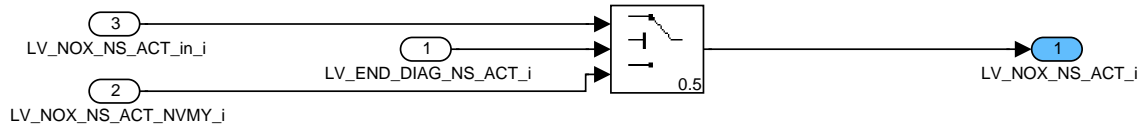



Figure B.120.22: NOXD\_MODULB07F/OPM\_ERU2ES/FLP\_NS/CLC

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## B.121 NOx sensor OBDII diagnosis - Signal availability

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_NS_AVL [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the NOx sensor availability diagnosis					
FRC_NS_AVL [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 65535	1	-
Frequency counter for NOx signal available					
LV_CDN_DIAG_NS_AVL [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnosis condition of NOx sensor availability diagnosis					
LV_END_DIAG_NS_AVL [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
End of NOx sensor availability diagnosis					
LV_ERR_NS_AVL [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Error flag of NOx sensor availability diagnosis					
STATE_NS_DIAG_AVL [NC_NOX_SENS_CONF]	V	0H 1H 2H 3H	INIT PASSIVE START ACTIVE	-	-
State of NOx sensor availability diagnosis					
TCC_NS_AVL [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 65535	1	-
Maximum test cycle counter value; used for detection of end of diagnosis					

### Input data:

LV_HOM_AFS_ACT {p. 8136}	LV_HOM_AFS_REQ {p. 8136}	LV_INH_DIAG_NS_OBD_ 2_AVL [NC_NOX_SENS_CONF] {p. 6468}	LV_INH_NT_RGN_REQ {p. 996}
LV_MIS_STATE_A {p. 6238}	LV_MIS_STATE_B1 {p. 6238}	LV_MIS_STATE_B4 {p. 6238}	LV_NOX_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}
LV_NOX_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_PU {p. 1720}	LV_S_REQ_EGR {p. 804}	LV_SCC [NC_CBK_EX_NR] {p. 2295}
LV_ST_END {p. 1720}	LV_T_NS_VLD_TMP [NC_NOX_SENS_CONF] {p. 3193}	LV_TEMP_MIN_THD_CAN [NC_NOX_SENS_CONF] {p. 991}	LV_TEMP_NS_OK [NC_NOX_SENS_CONF] {p. 991}
LV_VB_NS_OK [NC_NOX_SENS_CONF] {p. 991}	NC_CBK_EX_NR {p. 1829}	NC_IDX_DIAG_NS_AVL [NC_NOX_SENS_CONF]	NC_NOX_SENS_CONF {p. 643}
STATE_NOX {p. 2986}	T_NOX_NS_HLD [NC_NOX_SENS_CONF] {p. 992}		



**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_NS_AVL	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx sensor availability diagnosis					
C_ABC_INC_NS_AVL	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx sensor availability diagnosis					
C_ABC_MAX_NS_AVL	-	1... FFH	1... 255	1	-
Anti bounce counter maximum for the NOx sensor availability diagnosis					
C_FRC_NS_AVL_MAX	-	0... FFFFH	0... 65535	1	-
Maximum number of cycles with an invalid NOx signal during a NOx signal availability evaluation					
C_T_NOX_NS_ST_DIAG_AVL	-	0... FFFFH	0... 655.35	0.01	s
Minimum time of full NOx-Sensor readiness to stop the NOx-Sensor start up diagnosis					
C_TCC_NS_AVL_MAX	-	0... FFFFH	0... 65535	1	-
Number of test cycles for a NOx signal availability evaluation					
C_TCC_NS_AVL_ST_MAX	-	0... FFFFH	0... 65535	1	-
Maximum number of test cycles after start after which the NOx signal must be available					

**Import actions:**

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>,OUT<LV_END_DIAG>)
<b>ACTION_ERRM_GetLvErr</b> (IN<IDX_DIAG>,OUT<LV_ERR>)

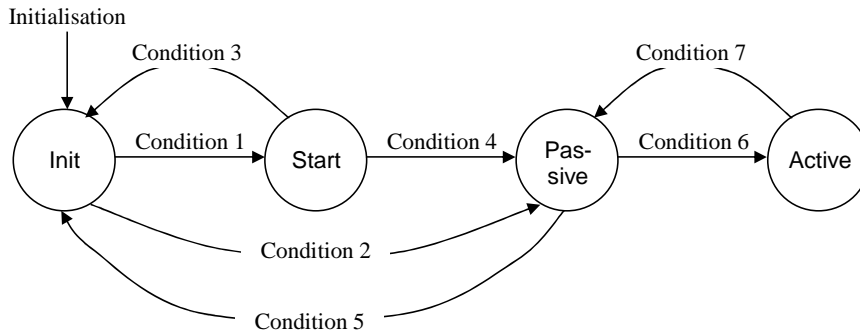
**General information**

This diagnosis observes the availability of NOx signal after the start and during the LOAD phases of NOx catalyst. This function shall detect when the NOx sensor is not able to transmit valid signals because of controller problems such as oscillations.

In normal operation mode the diagnosis is in state ACTIVE if suitable lean conditions are reached, otherwise the state PASSIVE is set. Inside ACTIVE the signal LV\_NOX\_NS\_DIAG\_VLD\_i will be observed by a statistical method.

At the start-up the diagnosis observes the time which the sensor needs in order to reach the full readiness. This is necessary in order to detect NOx sensors with instable control loops. It will be done inside the state START.

Signal flow diagram:



**Application Condition**

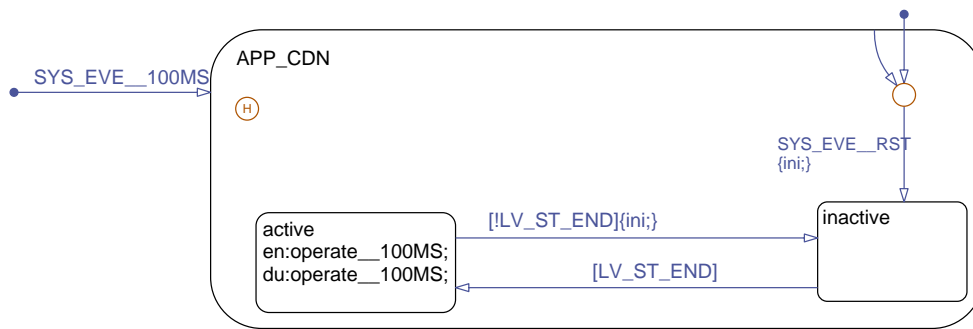


Figure B.121.1: NOXD\_MODULB07B/APP\_CDN/Chart

**Function Description**

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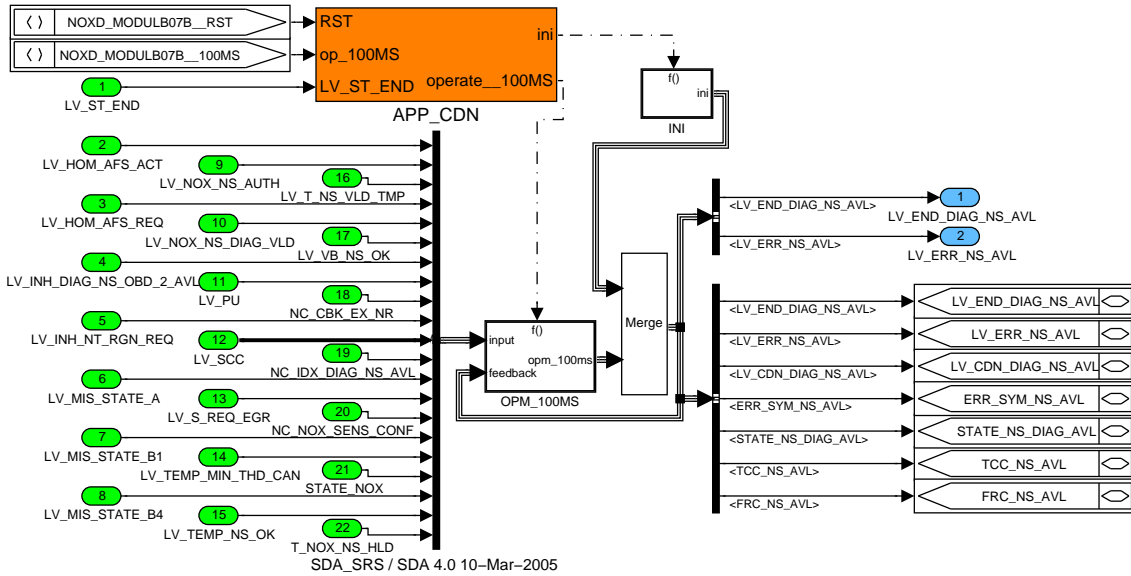


Figure B.121.2: NOXD\_MODULB07B

### B.121.1 Initialization at reset and deactivation

These actions initialized the diagnostic data according filtering configuration :

ACTION\_ERRM\_GetLvErr( IN<NC\_IDX\_DIAG\_XX>, OUT< LV\_ERR\_XX >)

ACTION\_ERRM\_GetLvEndDiag( IN<NC\_IDX\_DIAG\_XX>, OUT< LV\_END\_DIAG\_XX >)

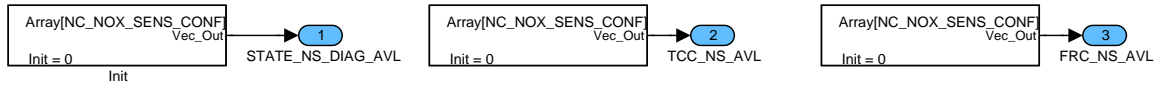


Figure B.121.3: NOXD\_MODULB07B/INI/CLC

### B.121.2 Loop control

The calculation inside FOR\_LOOP\_NS have to be done for each NOx sensor, controlled by configuration data NC\_NOX\_SENS\_CONF.

If NC\_NOX\_SENS\_CONF = 1, then calculation for i = 1.

If NC\_NOX\_SENS\_CONF = 2, then calculation for i = 1 and 2.

The calculation inside NO\_LOOP have to be done only once.

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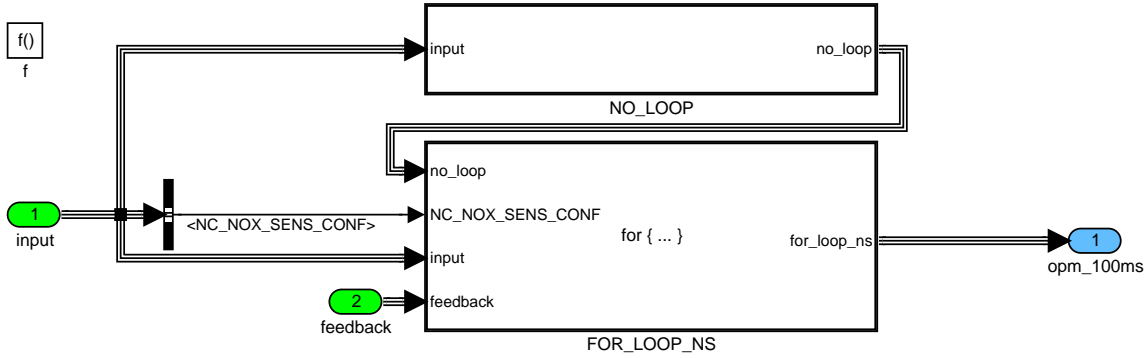


Figure B.121.4: NOXD\_MODULB07B/OPM\_100MS

**Bank independent calculation**

This condition forces the state machine for each NOx sensor to INIT or PASSIVE and prevent the transition to state START or ACTIVE.

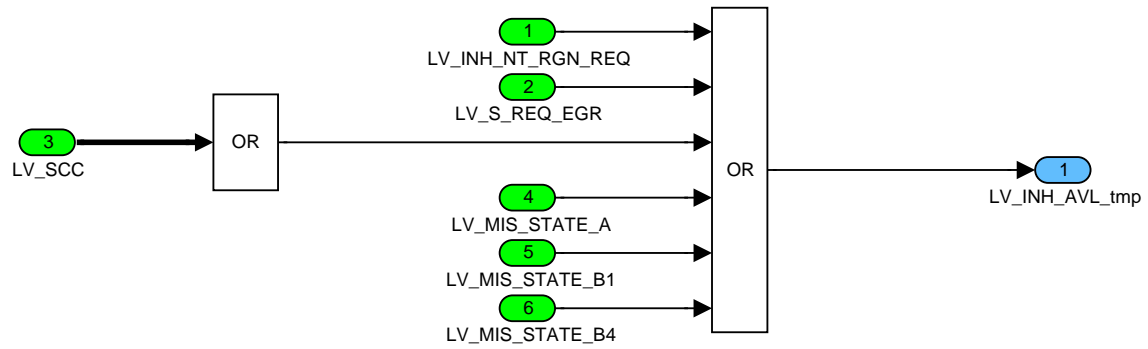


Figure B.121.5: NOXD\_MODULB07B/OPM\_100MS/NO\_LOOP/CLC

**Calculation for each NOx sensor**

If the diagnosis for a bank is inhibited, then all values will be set to zero, else the diagnosis will be calculated.

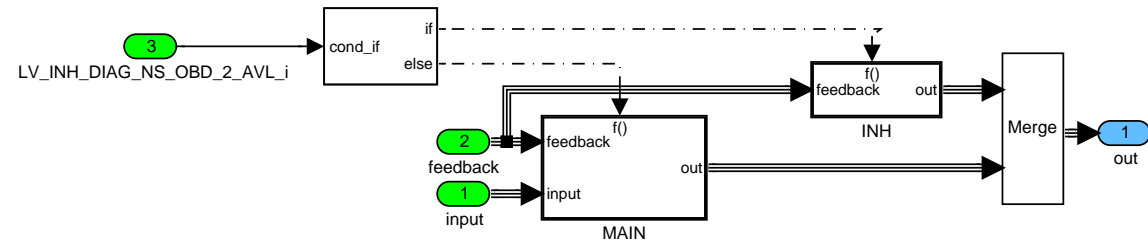



Figure B.121.6: NOXD\_MODULB07B/OPM\_100MS/FOR\_LOOP\_NS/CLC

**Diagnosis inhibited**

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 6372 of 8404	
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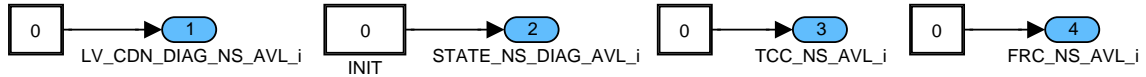


Figure B.121.7: NOXD\_MODULB07B/OPM\_100MS/FOR\_LOOP\_NS/CLC/INH/CLC

**State machine**

The default case is is case 0 (INIT).

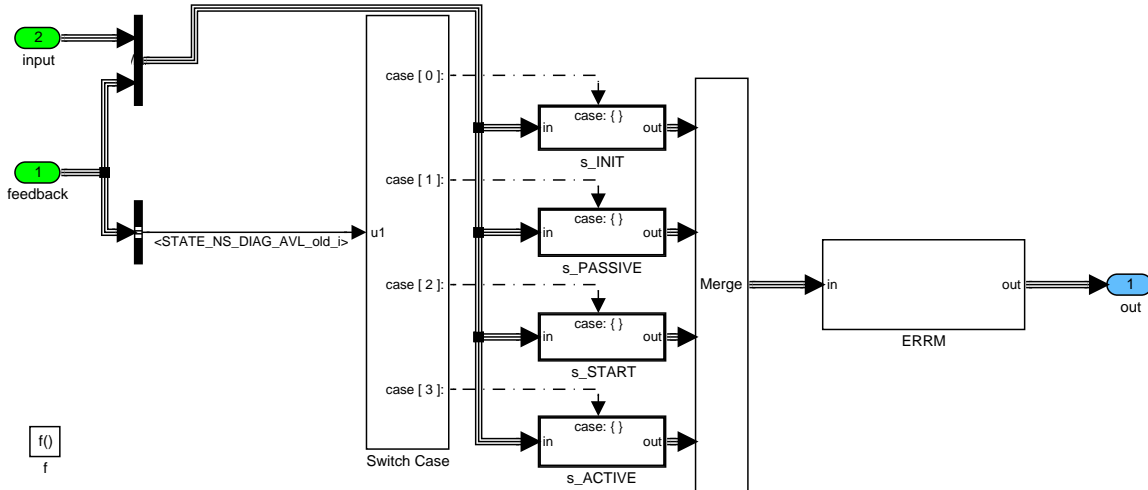


Figure B.121.8: NOXD\_MODULB07B/OPM\_100MS/FOR\_LOOP\_NS/CLC/MAIN

**STATE\_NS\_DIAG\_AVL\_i = 0 (INIT)**

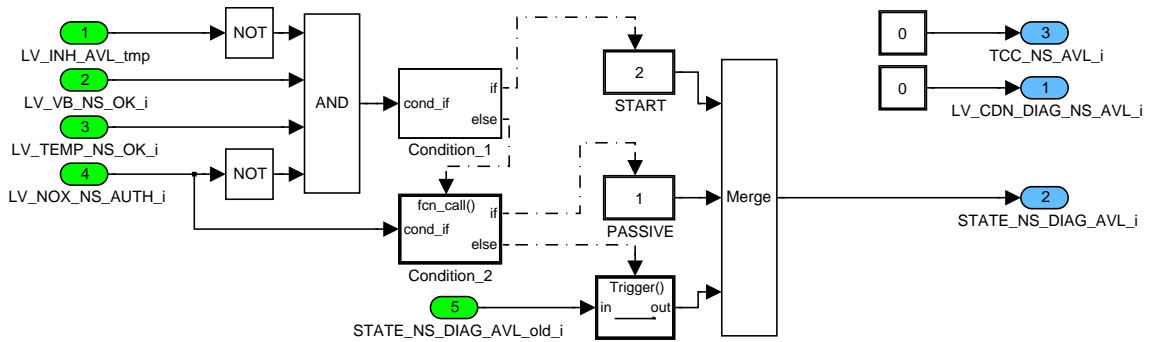


Figure B.121.9: NOXD\_MODULB07B/OPM\_100MS/FOR\_LOOP\_NS/CLC/MAIN/s\_INIT/CLC

**STATE\_NS\_DIAG\_AVL\_i = 1 (PASSIVE)**

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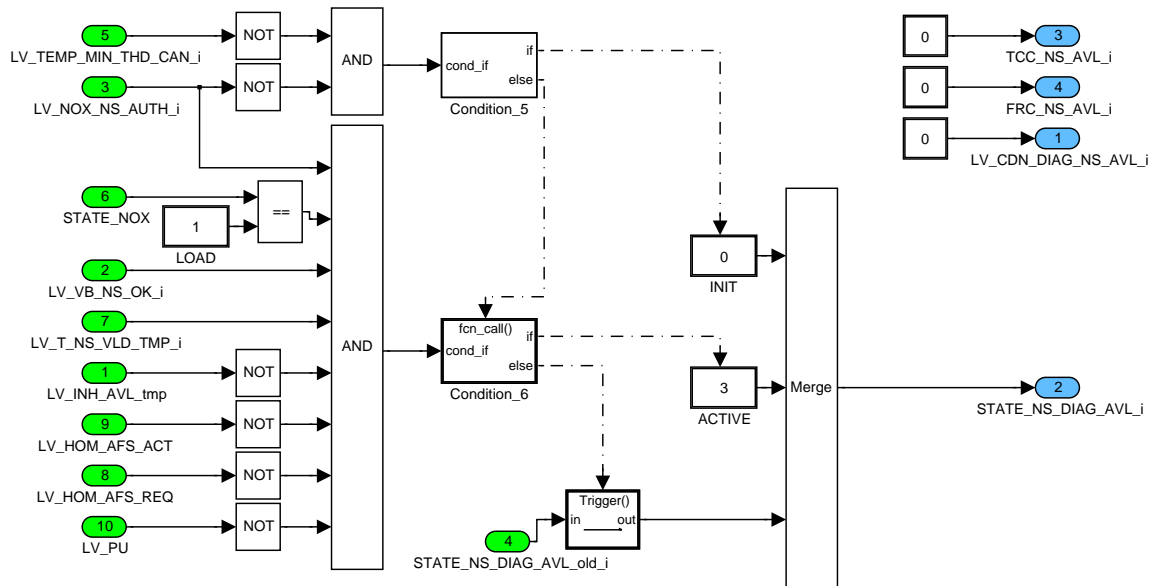


Figure B.121.10: NOXD\_MODULB07B/OPM\_100MS/FOR\_LOOP\_NS/CLC/MAIN/s\_PASSIVE/CLC

**STATE\_NS\_DIAG\_AVL\_i = 2 (START)**

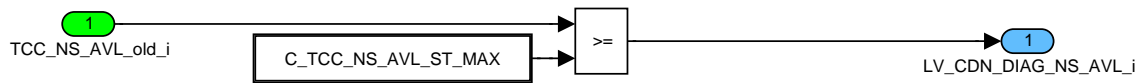


Figure B.121.11: NOXD\_MODULB07B/OPM\_100MS/FOR\_LOOP\_NS/CLC/MAIN/s\_START/CLC1

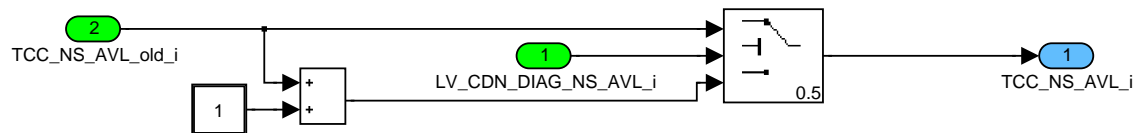


Figure B.121.12: NOXD\_MODULB07B/OPM\_100MS/FOR\_LOOP\_NS/CLC/MAIN/s\_START/CLC2

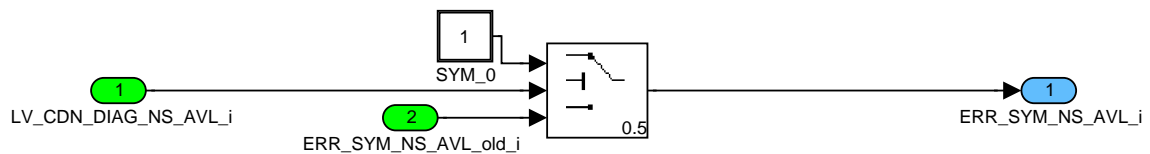


Figure B.121.13: NOXD\_MODULB07B/OPM\_100MS/FOR\_LOOP\_NS/CLC/MAIN/s\_START/CLC3

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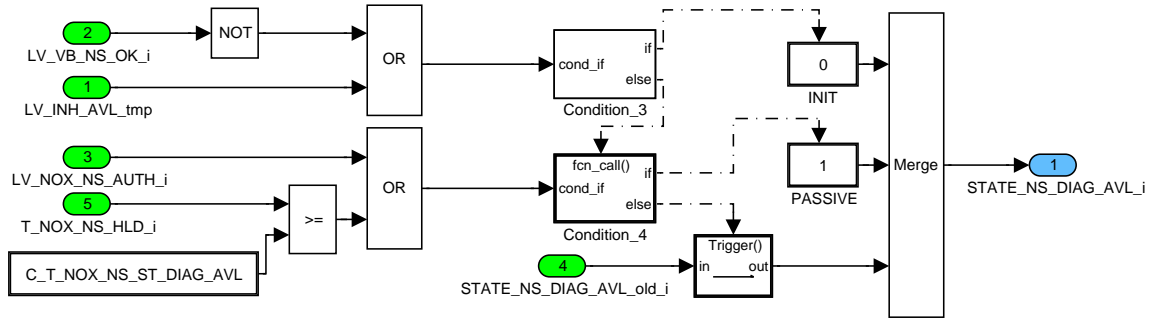


Figure B.121.14: NOXD\_MODULB07B/OPM\_100MS/FOR\_LOOP\_NS/CLC/MAIN/s\_START/CLC4

**STATE\_NS\_DIAG\_AVL\_i = 3 (ACTIVE)**

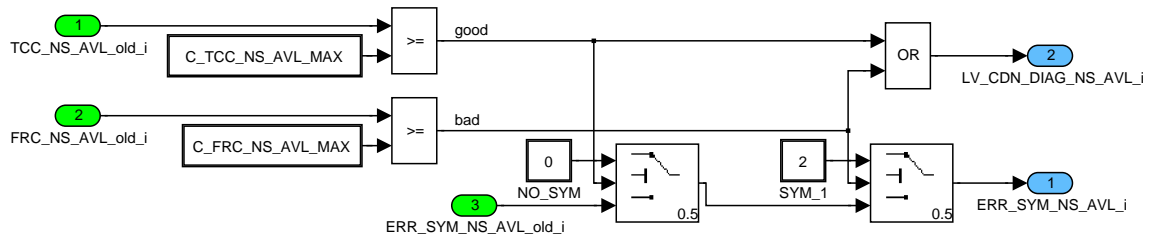


Figure B.121.15: NOXD\_MODULB07B/OPM\_100MS/FOR\_LOOP\_NS/CLC/MAIN/s\_ACTIVE/CLC1

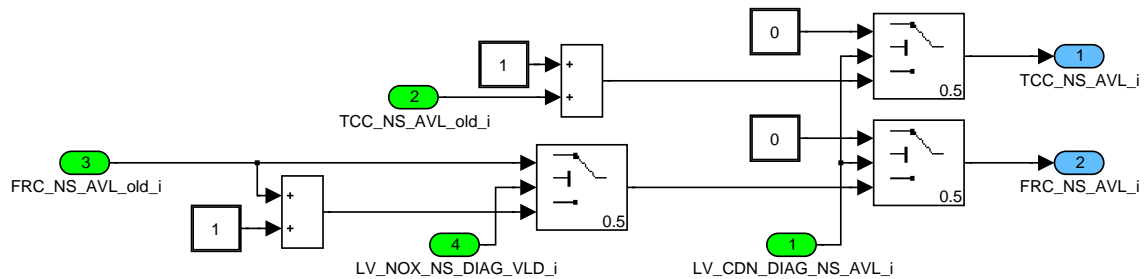


Figure B.121.16: NOXD\_MODULB07B/OPM\_100MS/FOR\_LOOP\_NS/CLC/MAIN/s\_ACTIVE/CLC2

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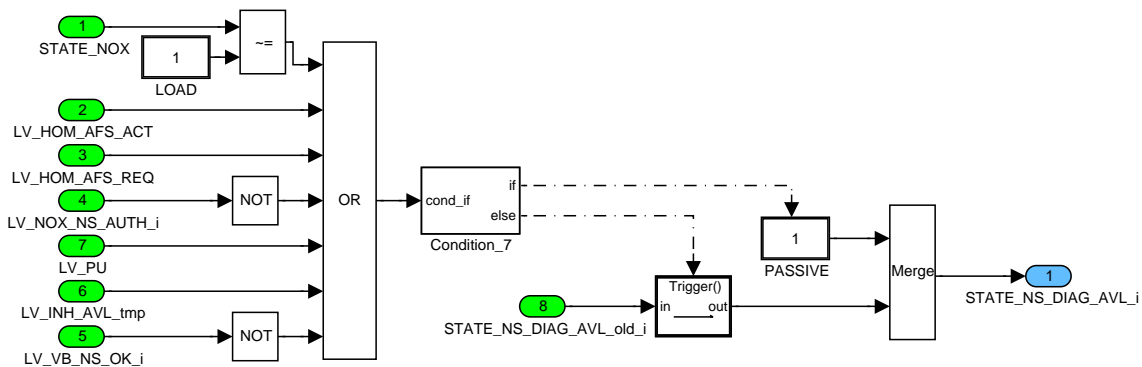


Figure B.121.17: NOXD\_MODULB07B/OPM\_100MS/FOR\_LOOP\_NS/CLC/MAIN/s\_ACTIVE/CLC3

**Error management**

LV\_ERR\_NS\_AVL will be get by ACTION\_ERRM\_GetLvErr and LV\_END\_DIAG\_NS\_AVL will be get by ACTION\_ERRM\_GetLvEndDiag.

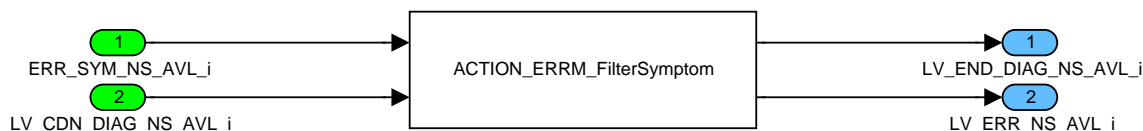


Figure B.121.18: NOXD\_MODULB07B/OPM\_100MS/FOR\_LOOP\_NS/CLC/MAIN/ERRM/CLC

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## B.122 NOx sensor OBDII diagnosis - Signal gain

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_NS_GAIN [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Diagnostic performed at last one time for NOx signal gain adaptation					
LV_ERR_NS_GAIN [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Present failure after filtering of the NOx signal gain adaptation diagnosis					

### Input data:

NC_NOX_SENS_CONF {p. 643}			
------------------------------	--	--	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_NOX_NS_AD_AFS_MAX	-	0... FFFFH	0... 127.99804	1.9531e-3	-
NOx signal adaptation factor - maximum value - for requesting Lambda=1.0 operation					
C_FAC_NOX_NS_AD_AFS_MIN	-	0... FFFFH	0... 127.99804	1.9531e-3	-
NOx signal adaptation factor - minimum value - for requesting Lambda=1.0 operation					

## FUNCTION DESCRIPTION:

### General information:

Stub module for recourse optimization

### Application conditions

**Initialisation:** at reset:  
 $LV\_END\_DIAG\_NS\_GAIN[i] = 0$   
 $LV\_ERR\_NS\_GAIN[i] = 0$

**Recurrence:**

**Activation:**

**Deactivation:**

### Formula section:

--

## B.123 NOx sensor OBDII diagnosis - Signal offset

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_RGN_INH_OFS_DIAG	O/V/S	0... FFH	0... 255	1	-
Counter for regenerations after a too long lean phase before NOx sensor offset diagnosis will be enabled					
ERR_SYM_NS_OFS [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the NOx sensor offset diagnosis					
LV_CDN_DIAG_NS_OFS [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnosis condition of NOx sensor offset diagnosis					
LV_DIAG_NS_OFS_VLD	V	0... 1H	0 ...1	1	-
Offset diagnosis result is valid if the NOx raw emissions are low enough to store them in the NOx catalyst					
LV_END_DIAG_NS_OFS [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
End of NOx sensor offset diagnosis					
LV_ERR_NS_OFS [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Error flag of NOx sensor offset diagnosis					
LV_SENS_AFR_INH_OFS_DIAG	V	0... 1H	0 ...1	1	-
downstream sensor measures rich exhaust gas on all branches to detect successful regeneration					
NOX_OFS_LOAD_DIAG [NC_NOX_SENS_CONF]	V	FF9C... 5DCH	-100 ...1500	1	ppm
NOx signal minimum for offset diagnosis					
T_AFL_INH_OFS_DIAG	V	0... FFFFH	0... 655.35	0.01	s
elapsed lean time since last successful regeneration					
T_NOX_OFS_DIAG_MIN [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 655.35	0.01	s
Time for active minimum observation for NOx signal offset diagnosis					
TCC_NS_OFS [NC_NOX_SENS_CONF]	O/V	0... FFH	0... 255	1	-
Maximum test cycle counter value; used for detection of end of diagnosis					

### Input data:


CTR_NT_AGI_AD_CMPL_SUM {p. 3072}	LV_INH_DIAG_NS_OBD_2_OFS [NC_NOX_SENS_CONF] {p. 6468}	LV_NOX_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}	LV_NOX_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}
LV_NT_HOM_INI {p. 2982}	LV_SENS_AFR [NC_NT_NR] {p. 2983}	NC_IDX_DIAG_NS_OFS [NC_NOX_SENS_CONF]	NC_NOX_SENS_CONF {p. 643}
NC_NT_NR {p. 644}	NOX_COR_RED {p. 2984}	NOX_NS [NC_NOX_SENS_CONF] {p. 992}	NOX_NS_AD [NC_NOX_SENS_CONF] {p. 3193}
NOX_NS_DIAG [NC_NOX_SENS_CONF] {p. 992}	NT_AGI {p. 3073}	NT_AGI_SUL {p. 3073}	NT_AGI_SUL_SNG [NC_NT_NR] {p. 3073}

NT_SUL {p. 3113}	NT_SUL_32 [NC_NT_NR] {p. 3113}	NTLD {p. 2986}	STATE_NOX {p. 2986}
T_AFL {p. 2987}	T_NOX_NS_MDL [NC_NOX_SENS_CONF] {p. 992}	T_NOX_NS_OSC [NC_NOX_SENS_CONF] {p. 1381}	TNT_MDL_H {p. 8237}
TNT_MDL_L {p. 8237}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_NS_OFS	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx sensor offset diagnosis					
C_ABC_INC_NS_OFS	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx sensor offset diagnosis					
C_ABC_MAX_NS_OFS	-	1... FFH	1... 255	1	-
Anti bounce counter maximum for the NOx sensor offset diagnosis					
C_CTR_NT_AGI_AD_CMPL_SUM_MIN	-	0... FFFFH	0... 65535	1	-
Minimum completed sulphur adaptations for set free of NOx signal offset diagnosis					
C_CTR_RGN_INH_OFS_DIAG	-	0... FFH	0... 255	1	-
Number of regenerations after a too long lean phase before NOx sensor offset diagnosis will be enabled					
C_NOX_MAX_NS_DIAG_OFS	-	0... FFFFH	0... 1023.98	0.015625	mg/s
NOx raw emission limit to allow NOx sensor offset diagnosis					
C_NOX_NS_OFS_MAX_THD	-	FF9C... 5DCH	-100 ...1500	1	ppm
NOx signal offset threshold for positive NOx signal values					
C_NOX_NS_OFS_MIN_THD	-	FF9C... 5DCH	-100 ...1500	1	ppm
NOx signal offset threshold for negative NOx signal values					
C_NOX_OFS_DIAG_SEL	-	0H 1H 2H	NOX_NS_AD NOX_NS NOX_NS_DIAG	-	-
Selection of diagnosis signal					
C_NOX_OFS_LOAD_OK_MAX	-	FF9C... 5DCH	-100 ...1500	1	ppm
Positive NOx signal offset threshold for counting the diagnosis result as "ok"					
C_NOX_OFS_LOAD_OK_MIN	-	FF9C... 5DCH	-100 ...1500	1	ppm
Negative NOx signal offset threshold for counting the diagnosis result as "ok"					
C_NT_AGI_NOX_OFS_DIAG_MIN	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
Threshold for NOx trap aging factor					
C_NT_AGI_SUL_NOX_OFS_MIN	-	0... FFFFFFFFH	0 ...1	232.83e-12	-
Minimum NOx catalyst aging factor due to sulphur for set free of NOx signal offset diagnosis					
C_NT_SUL_NOX_OFS_MAX	-	0... FFFFH	0... 10485.6	0.16	mg
Maximum NOx catalyst sulphur load for set free of NOx signal offset diagnosis					
C_NTLD_INH_OFS_DIAG	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
Maximum NOx trap loading degree to detect too long lean phase					
C_SYM_NS_OFS	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the NOx sensor offset diagnosis (see NOx sensor OBDII diag - Appl. Inc.)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_AFL_INH_OFS_DIAG	-	0... FFFFH	0... 655.35	0.01	s
Maximum elapsed lean time since last successful regeneration to detect too long lean phase					
C_T_AFL_NOX_OFS_DIAG_MIN	-	0... FFFFH	0... 1310.7	0.02	s
Threshold for lean mixture cycle time					
C_T_AFL_NOX_OFS_NEG_MIN	-	0... FFFFH	0... 1310.7	0.02	s
Minimum lean engine operation time for evaluation of negative NOx signal offset threshold					
C_T_AFL_NOX_OFS_OK_MIN	-	0... FFFFH	0... 1310.7	0.02	s
Minimum lean engine operation time for counting the diagnosis result as "ok"					
C_T_NOX_NS_DIAG_OFS	-	0... FFFFH	0... 655.35	0.01	s
Threshold for timer T_NOX_NS_MDL to activate minimum acquisition					
C_T_NOX_NS_OSC_OFS_DIAG	-	0... FFFFH	0... 655.35	0.01	s
Waiting time after last detection of an oscillation of NOx signal for offset diagnosis					
C_T_NOX_OFS_DIAG_MIN	-	0... FFFFH	0... 655.35	0.01	s
Minimum time for active minimum observation for NOx signal offset diagnosis					
C_TCC_NS_OFS_MAX	-	0... FFH	0... 255	1	-
Maximum test cycle counter value; used for detection of end of diagnosis					
C_TNT_MDL_NOX_OFS_DIAG_MAX	-	0... FFFFH	0... 1023.98	0.015625	°C
Maximum threshold for modelled NOx catalyst monolith temperatures					
C_TNT_MDL_NOX_OFS_DIAG_MIN	-	0... FFFFH	0... 1023.98	0.015625	°C
Minimum threshold for modelled NOx catalyst monolith temperatures					
LC_CTR_RGN_INH_OFS_DIAG_RST	-	0... 1H	0 ...1	1	-
counter of valid regenerations will be reset at initialization					
LC_NT_HOM_INI_DIAG_SEL	-	0... 1H	0 ...1	1	-
manual flag: NOx trap initialised due to sufficient hom. stoic. operation (accumulation effects eliminated)					


### Import actions:

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,>OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>,>OUT<LV_END_DIAG>)
<b>ACTION_ERRM_GetLvErr</b> (IN<IDX_DIAG>,>OUT<LV_ERR>)

### General information

This diagnosis checks the NOx signal behaviour after the start of a NOx catalyst LOAD phase. The use of NOx signal for generation of a NOx catalyst regeneration request is blocked for a limited time after the start of a NOx catalyst LOAD phase. This is necessary because of NH3 cross sensitivity of sensor. This cross sensitivity pushes up the NOx signal up to the upper limit at the end of a NOx catalyst regeneration. Hence the sensor needs a recovery time after the start of next NOx catalyst LOAD phase. During this recovery time the NOx signal must go to a level which is lower than the threshold for start of a new regeneration. Otherwise it is a sensor failure present.

### Application Condition

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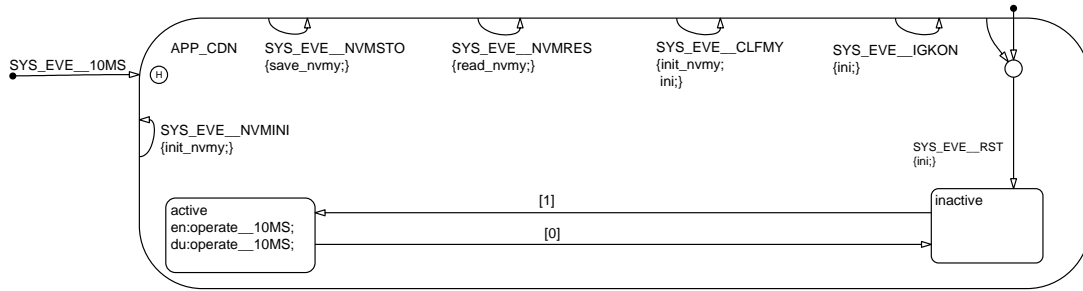


Figure B.123.1: NOXD\_MODULB07D/APP\_CDN/Chart

**Function Description**

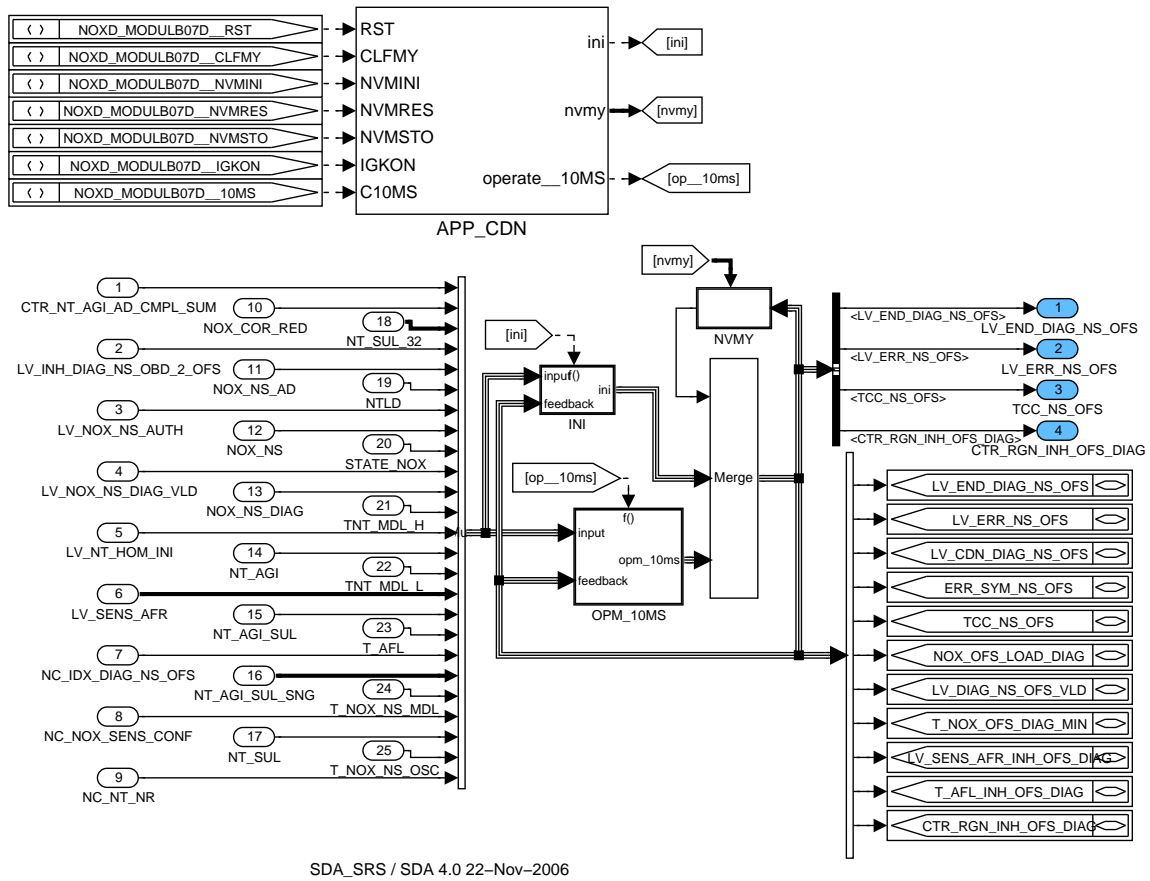


Figure B.123.2: NOXD\_MODULB07D

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### B.123.1 Management of non-volatile memory

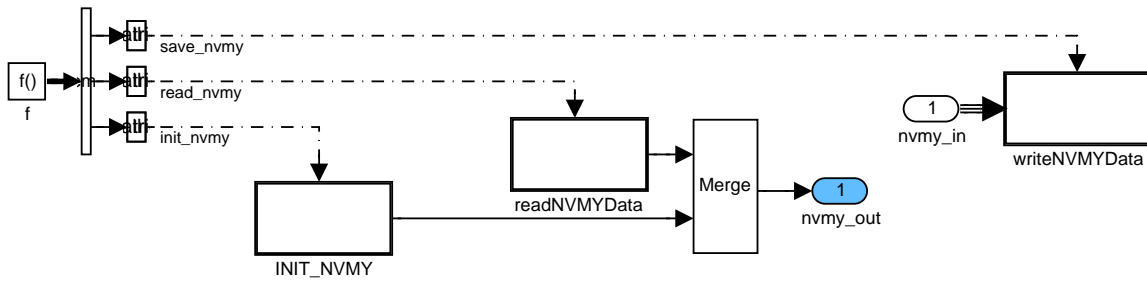


Figure B.123.3: NOXD\_MODULB07D/NVMY

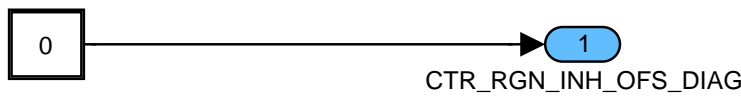


Figure B.123.4: NOXD\_MODULB07D/NVMY/INIT\_NVMY/CLC

### B.123.2 Initialization

These actions initialized the diagnostic data according filtering configuration :

ACTION\_ERRM\_GetLvErr( IN<NC\_IDX\_DIAG\_XX>, OUT< LV\_ERR\_XX >)

ACTION\_ERRM\_GetLvEndDiag( IN<NC\_IDX\_DIAG\_XX>, OUT< LV\_END\_DIAG\_XX >)

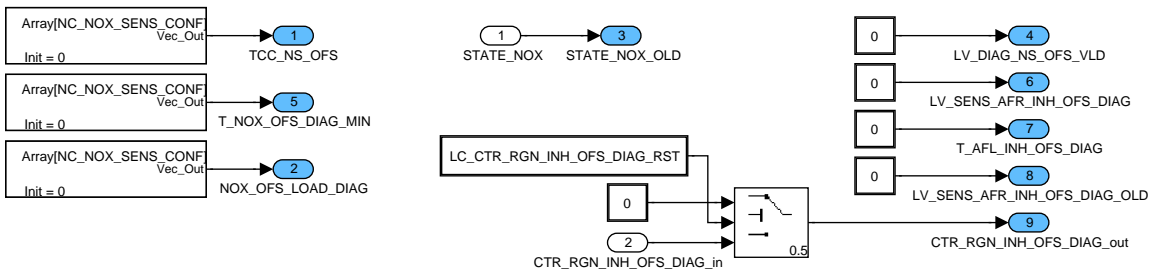


Figure B.123.5: NOXD\_MODULB07D/INI/CLC

### B.123.3 Loop control

The calculation inside FOR\_LOOP\_NS have to be done for each NOx sensor, controlled by configuration data NC\_NOX\_SENS\_CONF.

If NC\_NOX\_SENS\_CONF = 1, then calculation for i = 1.

If NC\_NOX\_SENS\_CONF = 2, then calculation for i = 1 and 2.

The calculation inside NO\_LOOP have to be done only once.

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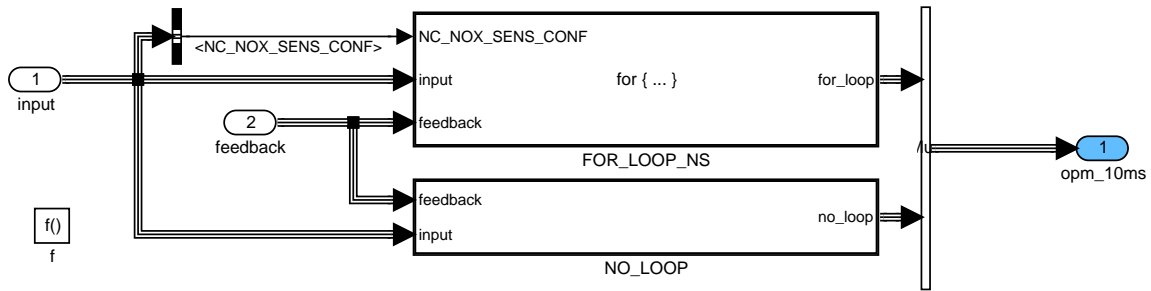


Figure B.123.6: NOXD\_MODULB07D/OPM\_10MS

### Calculation for each NOx sensor

#### Minimum search

The minimum of the selected NOx signal during the load phase will be calculated.

#### NOX\_NS\_AD:

The signal NOX\_NS\_AD\_i is a 'strong' filtered and offset adapted NOx signal. The lower limit of NOX\_NS\_AD\_i value range is 0 ppm. Hence this selection does not allow to diagnose a negative NOx signal offset.

#### NOX\_NS:

The signal NOX\_NS\_i is a 'strong' filtered NOx signal. This selection allows to diagnose a negative NOx signal offset.

#### NOX\_NS\_DIAG:

The signal NOX\_NS\_DIAG\_i is a 'light' filtered NOx signal. This selection allows to diagnose a negative NOx signal offset.

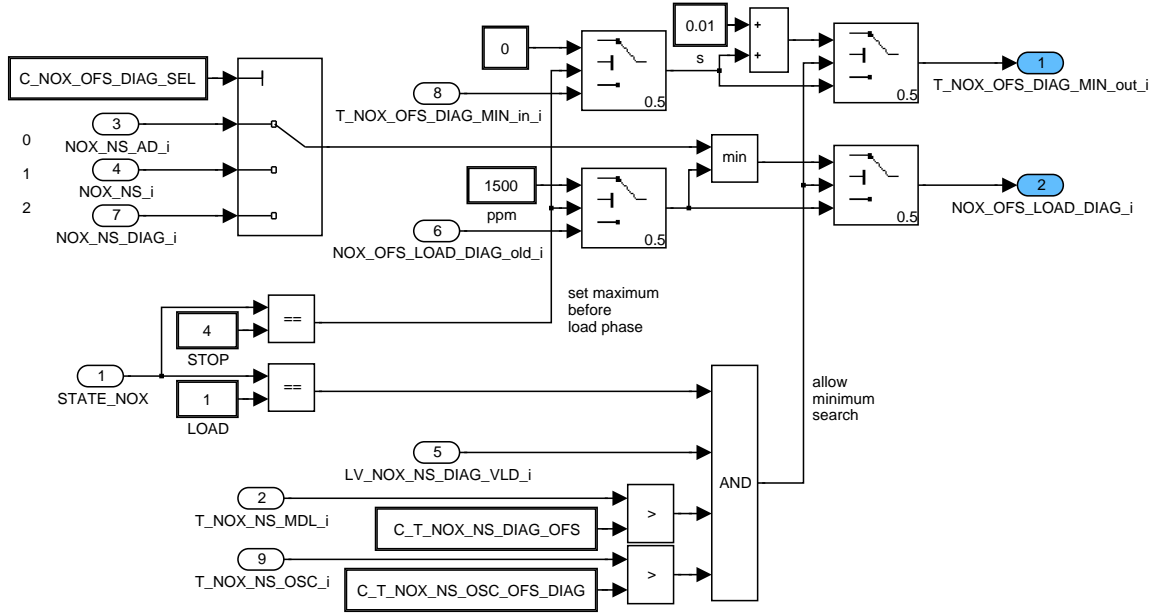


Figure B.123.7: NOXD\_MODULB07D/OPM\_10MS/FOR\_LOOP\_NS/CLC1

**Condition for evaluation of the diagnosis result**

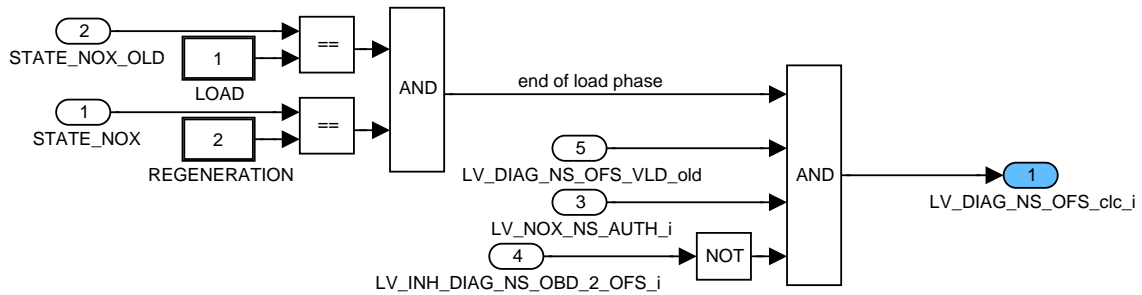


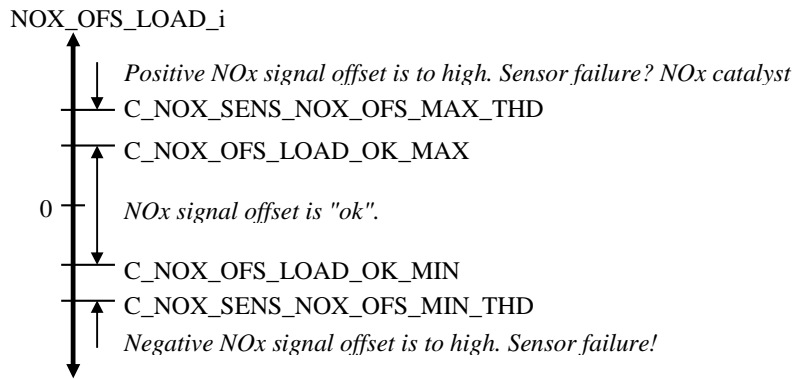
Figure B.123.8: NOXD\_MODULB07D/OPM\_10MS/FOR\_LOOP\_NS/CLC2

**Minimum validation**

At the end of the load phase the minimum of the NOx signal will be evaluated to get the result if the sensor is OK.


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Application hint: The constant C\_NOX\_NS\_OFS\_MIN\_THD shall be set to a negative value. So it is possible to detect a high negative NOx signal offset.

Application hint: The constant C\_SYM\_NS\_OFS has to be set to the symptom as described in NOx sensor OBDII (Appl. Inc.).

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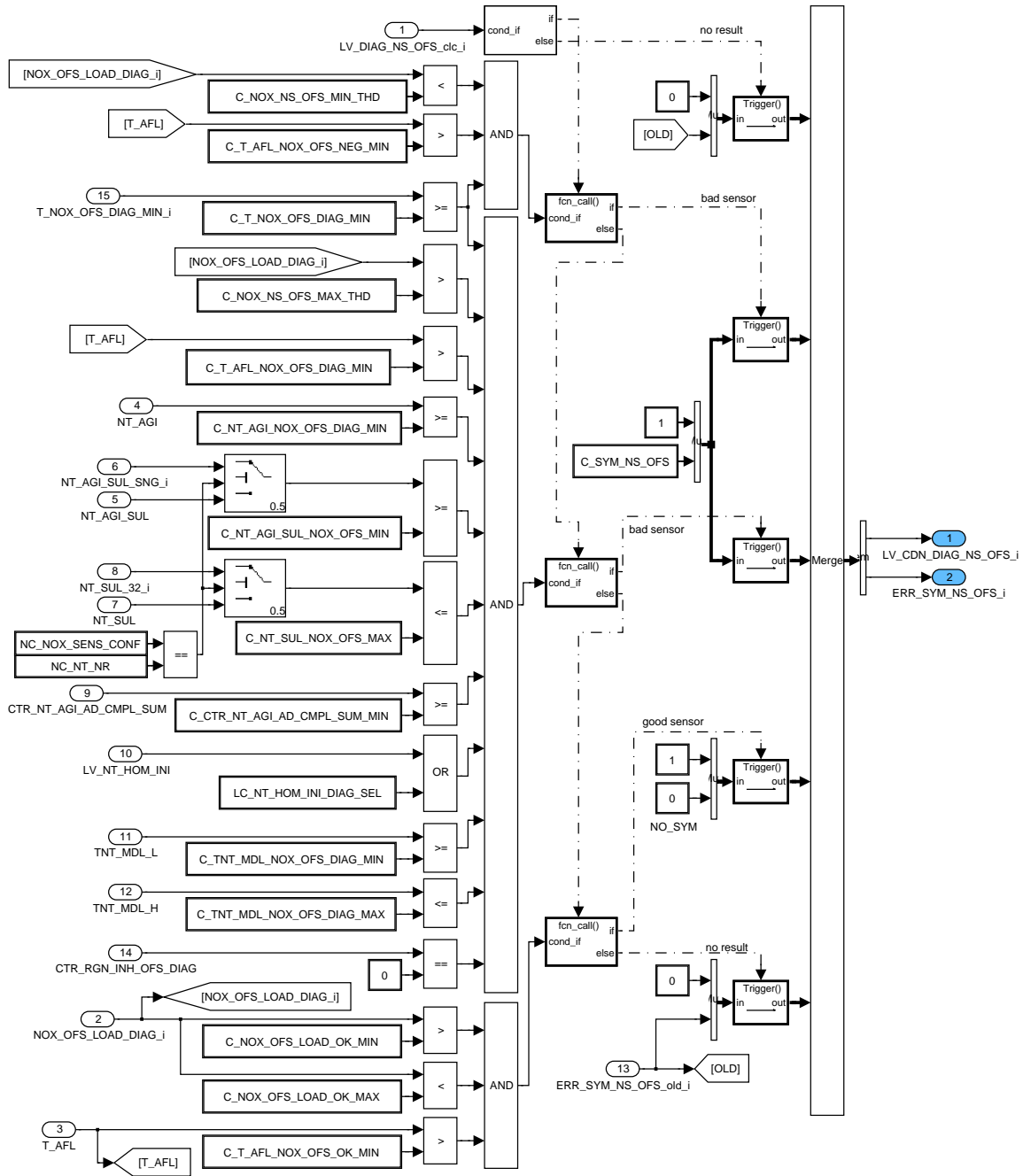


Figure B.123.9: NOXD\_MODULB07D/OPM\_10MS/FOR\_LOOP\_NS/CLC3

**Test cycle counter**

The test cycle counter TCC\_NS\_OFS\_i counts the number of completed offset diagnoses. This information is needed for detection of diagnosis readiness and decrementation of counter for consecutive driving cycles with or without a NOx sensor failure.

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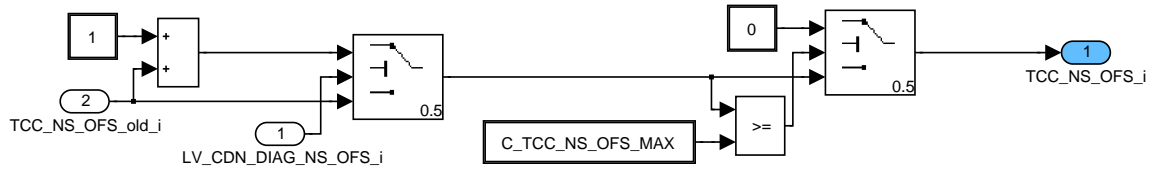


Figure B.123.10: NOXD\_MODULEB07D/OPM\_10MS/FOR\_LOOP\_NS/CLC4

**Error management**

LV\_ERR\_NS\_OFS will be get by ACTION\_ERRM\_GetLvErr and LV\_END\_DIAG\_NS\_OFS will be get by ACTION\_ERRM\_GetLvEndDiag.



Figure B.123.11: NOXD\_MODULEB07D/OPM\_10MS/FOR\_LOOP\_NS/CLC5

**Bank independent calculation**

**Observation of valid LOAD-REGERNERATION cycle**

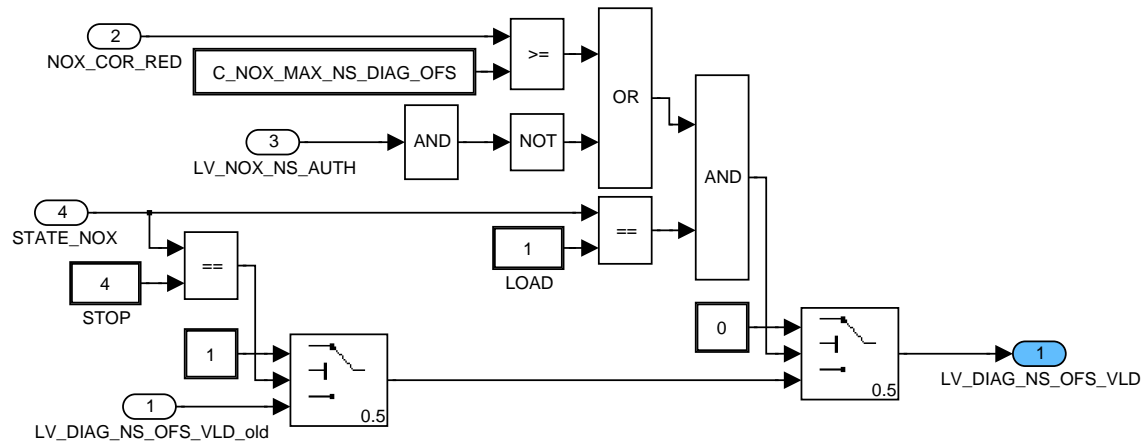


Figure B.123.12: NOXD\_MODULEB07D/OPM\_10MS/NO\_LOOP/CLC1

**Detection of valid regeneration of all NOx traps**

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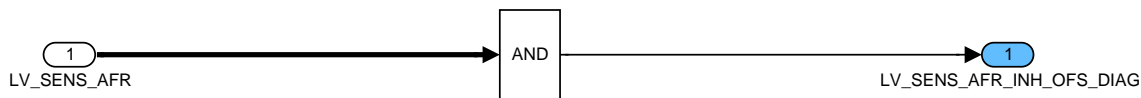


Figure B.123.13: NOXD\_MODULB07D/OPM\_10MS/NO\_LOOP/CLC2

**Lean time between two valid regenerations**

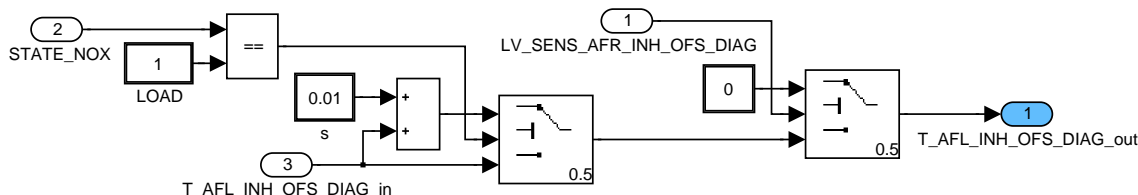


Figure B.123.14: NOXD\_MODULB07D/OPM\_10MS/NO\_LOOP/CLC3

**Counter of valid regenerations after a too long lean phase**

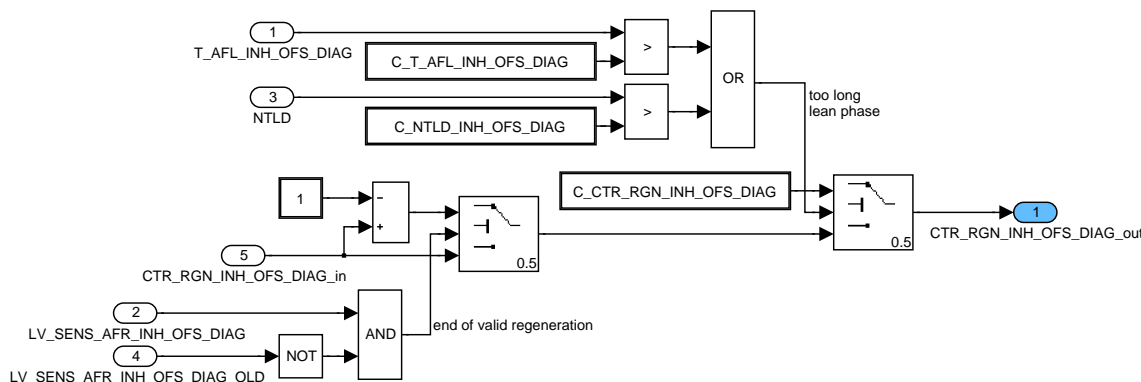


Figure B.123.15: NOXD\_MODULB07D/OPM\_10MS/NO\_LOOP/CLC4

**Old values for edge detection**

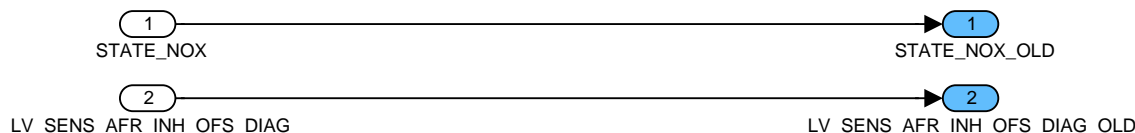


Figure B.123.16: NOXD\_MODULB07D/OPM\_10MS/NO\_LOOP/CLC5

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## B.124 NOx sensor OBDII diagnosis - Signal plausibility at rich conditions


### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_NS_AFR [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the NOx sensor plausibility diagnosis at rich condition					
LV_CDN_DIAG_NS_AFR [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnosis condition of NOx sensor plausibility diagnosis at rich condition					
LV_END_DIAG_NS_AFR [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
End of NOx sensor plausibility diagnosis at rich condition					
LV_ERR_NS_AFR [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Error flag of NOx sensor rich diagnosis					
LV_FAC_RANGE_AFR_SNG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Signal FAC_LSL_GAIN_AD is inside the desired range for diagnosis at rich condition					
LV_LAMB_VLD_AFR_SNG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Lambda signal is valid for diagnosis at rich condition (bench selective)					
LV_MAF_AFR_DIAG_VLD	V	0... 1H	0 ...1	1	-
Mass air flow higher than threshold to allow diagnosis					
MAF_INT_AFR_DIAG [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 7281.67	0.11111111	g
Sucked air mass after leaving rich condition					
TCC_NS_AFR_DIAG [NC_NOX_SENS_CONF]	V	0... FFH	0... 255	1	-
Test cycle counter for plausibility checks at actual rich phase					

### Input data:

FAC_LSL_GAIN_AD [NC_CBK_EX_NR] {p. 2371}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_NS_DIAG [NC_NOX_SENS_CONF] {p. 991}	LV_INH_DIAG_NS_OBD_2_PLAUS [NC_NOX_SENS_CONF] {p. 6468}
LV_LAMB_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_NOX_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}	LV_NOX_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_VLS_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}
MAF_KGH {p. 1195}	NC_CBK_EX_NR {p. 1829}	NC_IDX_DIAG_NS_AFR [NC_NOX_SENS_CONF]	NC_NOX_SENS_CONF {p. 643}
NOX_NS_DIAG [NC_NOX_SENS_CONF] {p. 992}	T_LAMB_NS_HLD [NC_NOX_SENS_CONF] {p. 992}	T_NOX_NS_HLD [NC_NOX_SENS_CONF] {p. 992}	T_VLS_NS_HLD [NC_NOX_SENS_CONF] {p. 992}

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VLS_NS_DIAG [NC_NOX_SENS_CONF] {p. 992}			
---	--	--	--

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_NS_AFR	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx sensor plausibility diagnosis at rich condition					
C_ABC_INC_NS_AFR	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx sensor plausibility diagnosis at rich condition					
C_ABC_MAX_NS_AFR	-	1... FFH	1... 255	1	-
Anti bounce counter maximum for the NOx sensor plausibility diagnosis at rich condition					
C_FAC_LSL_GAIN_AD_AFR_MAX	-	0... FFFFH	0... 1.99996948	30.5175e-6	-
Maximum WRAF sensor gain adaptation factor for activation of plausibility check at rich condition					
C_FAC_LSL_GAIN_AD_AFR_MIN	-	0... FFFFH	0... 1.99996948	30.5175e-6	-
Minimum WRAF sensor gain adaptation factor for activation of plausibility check at rich condition					
C_LAMB_AFR_PLAUS_MAX	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Maximum upstream Lambda value to start the NOx sensor rich check					
C_LAMB_NS_DIAG_AFR_MAX	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Maximum lambda value of NOx sensor at rich condition					
C_MAF_INT_AFR_DIAG_MIN	-	0... FFFFH	0... 7281.67	0.11111111	g
MAF threshold for starting the rich diagnosis					
C_MAF_KGH_AFR_DIAG_MIN	-	0... FFFFH	0... 2047.97	0.03125	kg/h
Threshold of mass air flow to allow NOx sensor diagnosis at rich conditions					
C_NOX_NS_DIAG_AFR_MIN	-	FF9C... 5DCH	-100 ...1500	1	ppm
Minimum NOx concentration signal value of NOx sensor at rich condition					
C_T_LAMB_NS_HLD_DIAG_AFR	-	0... 7FFFH	0... 327.67	0.01	s
Time with lambda signal state = invalid, after which a plausibility diagnosis at rich condition is started					
C_T_NOX_NS_HLD_DIAG_AFR	-	0... 7FFFH	0... 327.67	0.01	s
Time with NOx signal state = invalid, after which a plausibility diagnosis at rich condition is started					
C_T_VLS_NS_HLD_DIAG_AFR	-	0... 7FFFH	0... 327.67	0.01	s
Time with binary O2 signal state = invalid, after which a plausibility diagnosis at rich condition is started					
C_TCC_NS_AFR_DIAG_MAX	-	0... FFH	0... 255	1	-
Maximum number of test cycles per rich phase					
C_VLS_NS_DIAG_AFR_MIN	-	0... 578H	-200 ...1200	1	mV
Minimum binary O2 signal voltage of NOx sensor at rich condition					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_FAC_MAF_INT_AFR	-	0... FFFFH	0... 1.02398437	15.625e-6	s
normalization factor for calculation of integral of MAF_KGH					

**Import actions:**

<b>ACTION_ERRM_FilterSymptom</b>	(IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetLvEndDiag</b>	(IN<IDX_DIAG>,OUT<LV_END_DIAG>)
<b>ACTION_ERRM_GetLvErr</b>	(IN<IDX_DIAG>,OUT<LV_ERR>)

### General information

This plausibility test checks the sensor signals at rich exhaust gas. With this check shall be detected a sensor poisoning.

### Application Condition

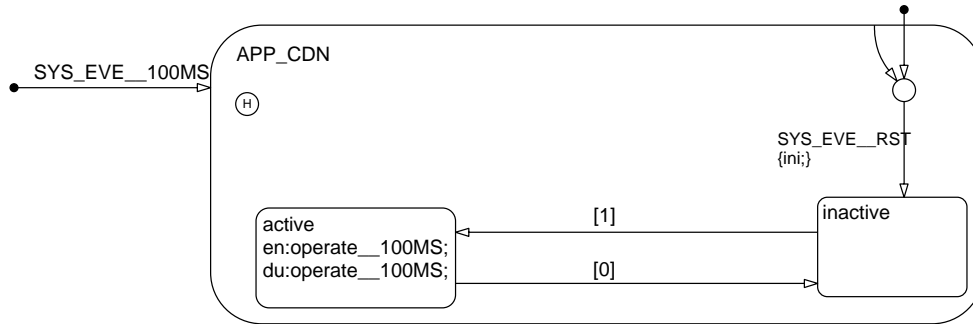


Figure B.124.1: NOXD\_MODULB07Z/APP\_CDN/Chart

### Function Description

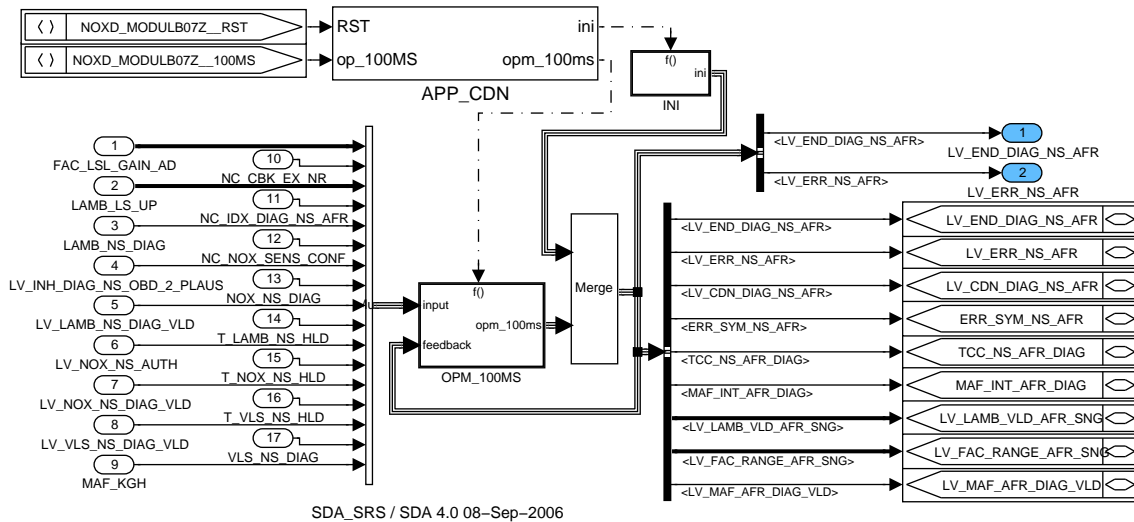


Figure B.124.2: NOXD\_MODULB07Z

### B.124.1 Initialization at reset and deactivation

These actions initialized the diagnostic data according filtering configuration :

ACTION\_ERRM\_GetLvErr( IN<NC\_IDX\_DIAG\_XX>, OUT< LV\_ERR\_XX >)

ACTION\_ERRM\_GetLvEndDiag( IN<NC\_IDX\_DIAG\_XX>, OUT< LV\_END\_DIAG\_XX >)

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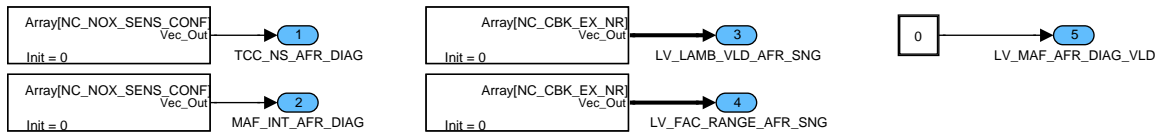


Figure B.124.3: NOXD\_MODULB07Z/INI/CLC

## B.124.2 Loop control

The calculation inside FOR\_LOOP\_LS have to be done for each upstream lambda sensor, controlled by configuration data NC\_CBK\_EX\_NR.

If NC\_CBK\_EX\_NR = 1, then calculation for i = 1.

If NC\_CBK\_EX\_NR = 2, then calculation for i = 1 and 2.

The calculation inside both NO\_LOOP subsystems have to be done only once.

The calculation inside FOR\_LOOP\_NS have to be done for each NOx sensor, controlled by configuration data NC\_NOX\_SENS\_CONF.

If NC\_NOX\_SENS\_CONF = 1, then calculation for i = 1.

If NC\_NOX\_SENS\_CONF = 2, then calculation for i = 1 and 2.

NC\_NOX\_SENS\_CONF cannot be greater than NC\_CBK\_EX\_NR.

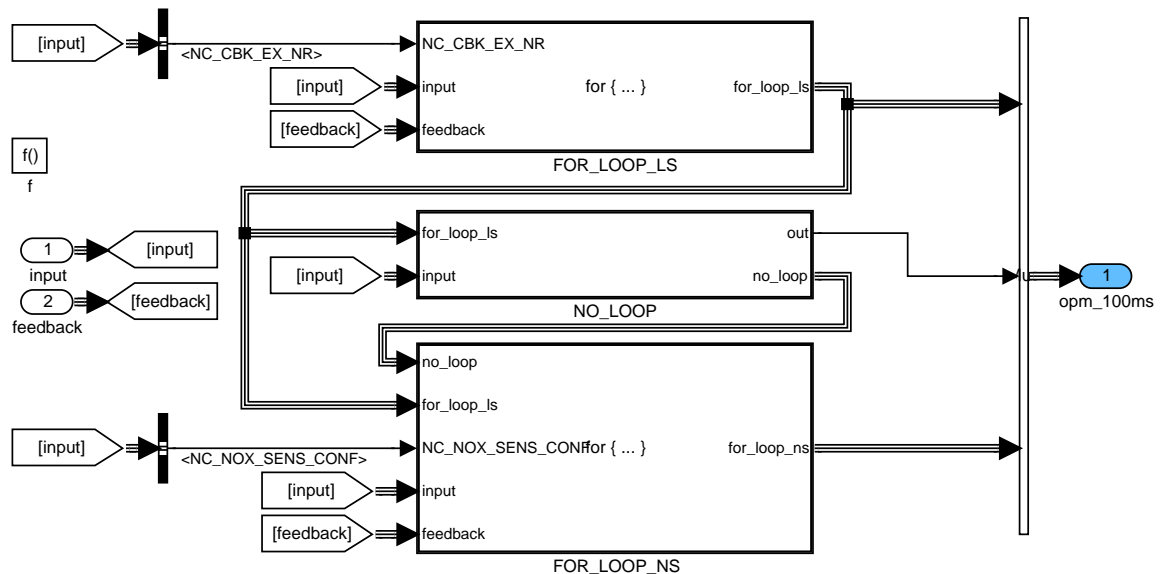


Figure B.124.4: NOXD\_MODULB07Z/OPM\_100MS

### Calculation for each upstream lambda sensor

#### Lambda sensor rich check



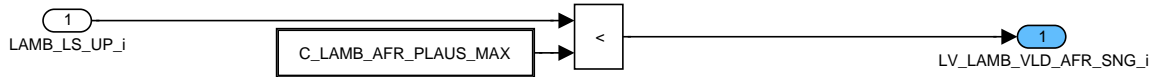


Figure B.124.5: NOXD\_MODULB07Z/OPM\_100MS/FOR\_LOOP\_LS/CLC1

**Lambda controller gain adaptation**

The lambda controller gain adaptation have to be in a desired range to avoid a wrong diagnosis result for the NOx sensor.

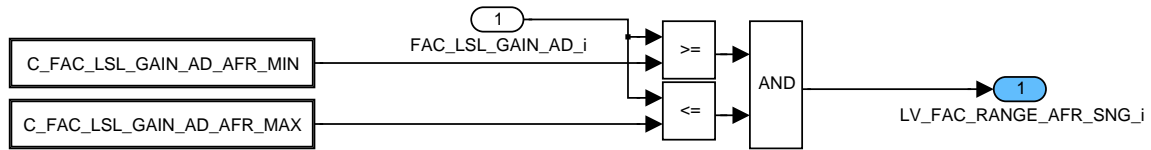


Figure B.124.6: NOXD\_MODULB07Z/OPM\_100MS/FOR\_LOOP\_LS/CLC2

**Bank independent calculation**

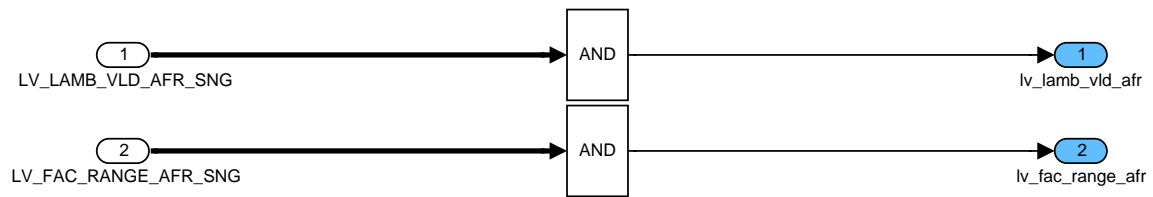


Figure B.124.7: NOXD\_MODULB07Z/OPM\_100MS/NO\_LOOP/CLC1

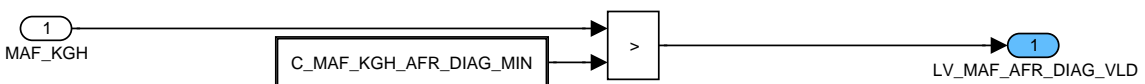


Figure B.124.8: NOXD\_MODULB07Z/OPM\_100MS/NO\_LOOP/CLC2

**Calculation for each NOx sensor**

**MAF integral and plausibility check counter**

At every rich phase the number of plausibility checks will be counted with this counter and limited with C\_MAF\_INT\_AFR\_DIAG\_MIN.

The MAF integral will start if the upstream lambda becomes higher than the rich threshold due to identify, when the rich exhaust gas should be arrived at the NOx sensor.

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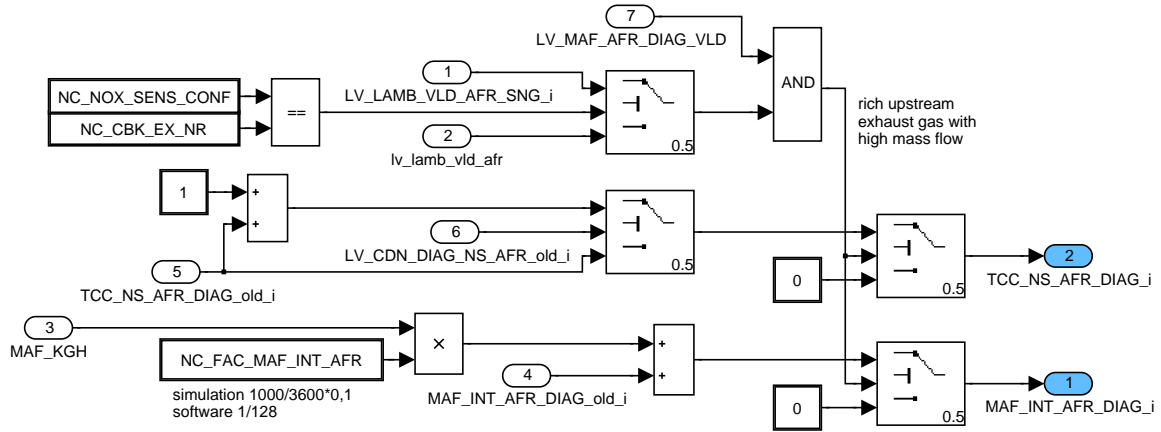


Figure B.124.9: NOXD\_MODULB07Z/OPM\_100MS/FOR\_LOOP\_NS/CLC1


**Diagnosis evaluation**

The NOx sensor may only be identified as defect if the lambda control adaptation is inside the desired range. Outside this range the sensor may only be identified as OK.

The check of the NOx threshold C\_NOX\_NS\_DIAG\_AFR\_MIN uses the NOx sensor cross sensitivity on NH3, which is originate in the catalyst at rich exhaust gas conditions.

Application hint: The constant C\_MAF\_INT\_AFR\_DIAG\_MIN shall be calibrated so that this diagnosis is not activated during a NOx catalyst regeneration.

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 6394 of 8404</b>	
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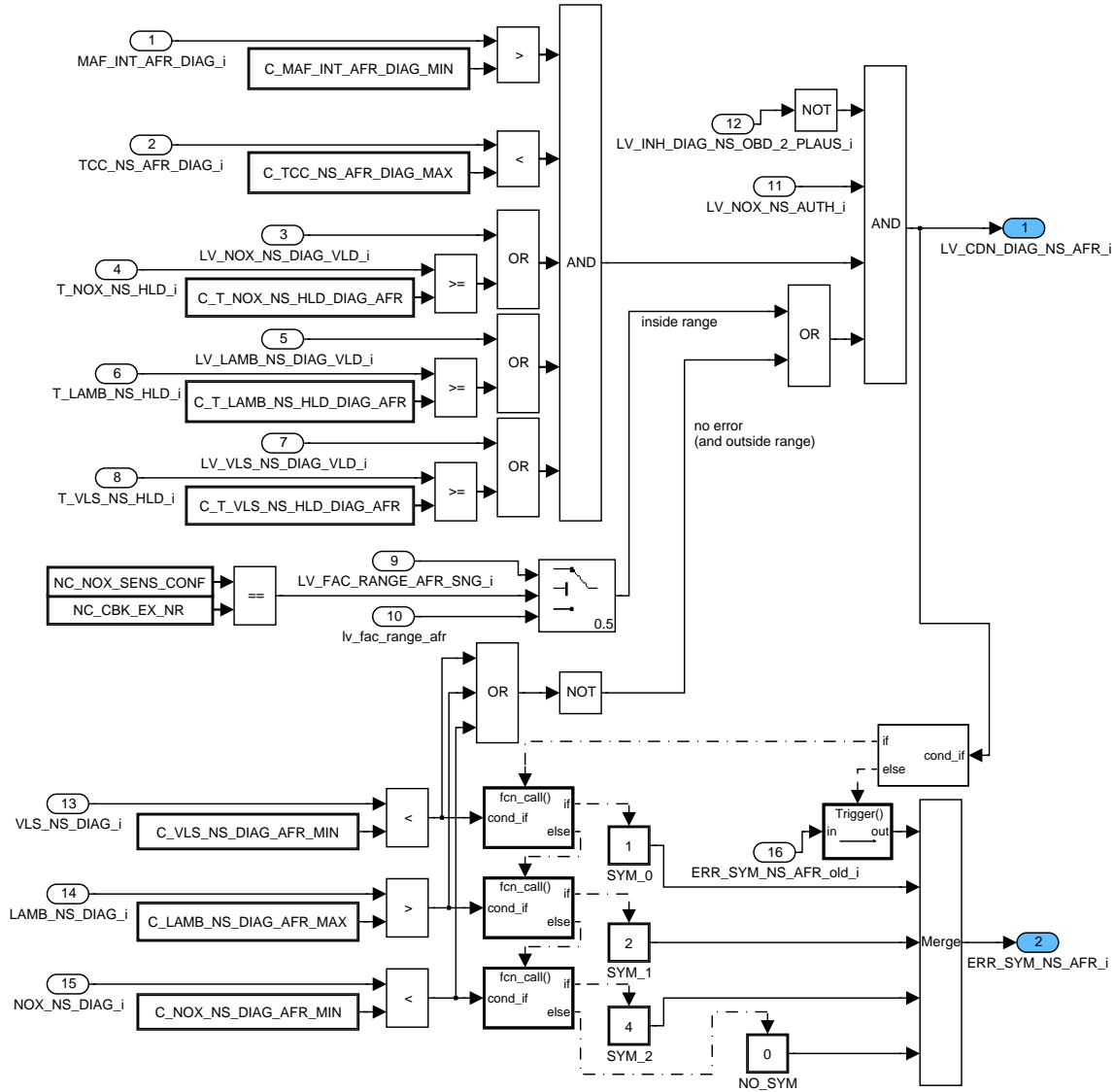


Figure B.124.10: NOXD\_MODULB07Z/OPM\_100MS/FOR\_LOOP\_NS/CLC2

**Error management**

LV\_ERR\_NS\_AFR will be get by ACTION\_ERRM\_GetLvErr and LV\_END\_DIAG\_NS\_AFR will be get by ACTION\_ERRM\_GetLvEndDiag.

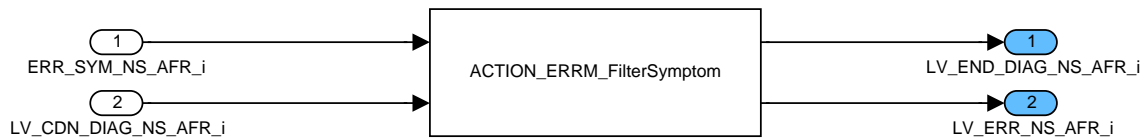


Figure B.124.11: NOXD\_MODULB07Z/OPM\_100MS/FOR\_LOOP\_NS/CLC3

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## B.125 NOx sensor OBDII diagnosis - Signal plausibility up/down

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_NS_LSL_UP_DOWN [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the plausibility diagnosis between upstream and downstream WRAF signal					
LV_CDN_DIAG_NS_LSL_UP_DOWN [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnosis condition of plausibility diagnosis between upstream and downstream WRAF signal					
LV_END_DIAG_NS_LSL_UP_DOWN [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
End of NOx sensor plausibility diagnosis between upstream and downstream WRAF signal					
LV_ERR_NS_LSL_UP_DOWN [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Error flag of plausibility diagnosis between upstream and downstream WRAF signal					
LV_FAC_RANGE_SNG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Signal FAC_LSL_GAIN_AD is inside the desired range for diagnosis					
LV_LAMB_NOT_PLAUS_SNG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Lambda signals are not plausible					
LV_LAMB_RANGE_SNG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Lambda signals are inside the desired range for diagnosis					
LV_LAMB_VLD_TMP	V	0... 1H	0 ...1	1	-
Bank independent values are valid for diagnosis					
MAF_INT_LAMB_LS_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.42	0.02777778	g
Integral of air mass flow for plausibility diagnosis between upstream and downstream WRAF signal					
TCC_NS_LSL_UP_DOWN [NC_NOX_SENS_CONF]	V	0... FFH	0... 255	1	-
Test cycle counter for plausibility check of WRAF signals					

### Input data:

FAC_LSL_GAIN_AD [NC_CBK_EX_NR] {p. 2371}	LAMB_DELTA_I_LAM_ADJ [NC_CBK_EX_NR] {p. 2589}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_NS_DIAG [NC_NOX_SENS_CONF] {p. 991}
LV_INH_DIAG_NS_OBD_2_PLAUS [NC_NOX_SENS_CONF] {p. 6468}	LV_LAMB_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_NOX_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}	LV_NS_LDC [NC_NOX_SENS_CONF] {p. 6320}
LV_PU {p. 1720}	LV_ST_END {p. 1720}	MAF {p. 8277}	MAF_KGH {p. 1195}
N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_IDX_DIAG_NS_LSL_UP_DOWN [NC_NOX_SENS_CONF]	NC_NOX_SENS_CONF {p. 643}

STATE_CMB_CTL {p. 8137}	T_LAMB_NS_HLD [NC_NOX_SENS_CONF] {p. 992}		
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**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_NS_LSL_UP_DOWN	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx sensor plausibility diagnosis between WRAF signals					
C_ABC_INC_NS_LSL_UP_DOWN	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx sensor plausibility diagnosis between WRAF signals					
C_ABC_MAX_NS_LSL_UP_DOWN	-	1... FFH	1... 255	1	-
Anti bounce counter maximum for the NOx sensor plausibility diagnosis between WRAF signals					
C_FAC_LSL_GAIN_AD_MAX	-	0... FFFFH	0... 1.99996948	30.5175e-6	-
Maximum WRAF sensor gain adaptation factor for activation of plausibility check					
C_FAC_LSL_GAIN_AD_MIN	-	0... FFFFH	0... 1.99996948	30.5175e-6	-
Minimum WRAF sensor gain adaptation factor for activation of plausibility check					
C_LAMB_DIF_MAX_LSL_UP_DOWN	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Activation threshold for lambda difference between both banks					
C_LAMB_PLAUS_LSL_UP_DOWN_MAX	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Maximum lambda threshold for deactivation of plausibility check					
C_LAMB_PLAUS_LSL_UP_DOWN_MIN	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Minimum lambda threshold for deactivation of plausibility check					
C_MAF_INT_LAMB_PLAUS	-	0... FFFFH	0... 1820.42	0.02777778	g
MAF threshold for starting the Lambda plausibility diagnosis of NOx-Sensor					
C_T_LAMB_NS_HLD_DIAG_PLAUS	-	0... 7FFFH	0... 327.67	0.01	s
Time with lambda signal state = invalid, after which a plausibility diagnosis is started					
C_TCC_NS_LSL_UP_DOWN_MAX	-	0... FFH	0... 255	1	-
Maximum number of test cycles per steady state phase					
IP_LAMB_LS_UP_PLAUS_GRD_MAX	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
LDP_LAMB_LS_UP_IP_LAMB_GRD	4	0... 7FFFH	0... 31.9990234	976.563e-6	-
Maximum allowed gradient of LAMB_LS_UP to calculate the MAF integral					
IP_LAMB_PLAUS_LSL_UP_DOWN	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
LDP_LAMB_LS_UP_IP_LAMB_UP_DOWN	4	0... 7FFFH	0... 31.9990234	976.563e-6	-
Signal tolerance between upstream and downstream WRAF signal					
IP_MAF_MIN_LAMB_LS_UP_PLAUS	-	0... FFFFH	0... 1389	0.02119478	mg/stk
LDP_N_32_IP_MAF_MIN_LAMB_PLAUS	6	0... FFH	0... 8160	32	rpm
Minimum MAF threshold for activation of upstream and downstream WRAF signal plausibility check					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_FAC_MAF_INT_PLAUS	-	0... FFFFH	0... 1.02398437	15.625e-6	s
normalization factor for calculation of integral of MAF_KGH					

**Import actions:**

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>,OUT<LV_END_DIAG>)
Continued on next page

**ACTION\_ERRM\_GetLvErr (IN<IDX\_DIAG>,OUT<LV\_ERR>)**

**General information**

This signal plausibility check compares the upstream oxygen signal (WRAF sensor) with the WRAF signal of NOx-Sensor, which is downstream of NOx catalyst. The result of this check can indicate a strong discrepancy between the two sensors, which can be caused by reference air contamination.

**Application Condition**

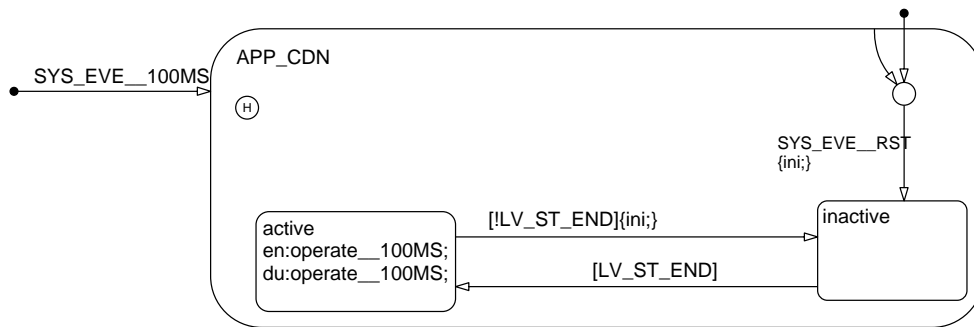


Figure B.125.1: NOXD\_MODULB07X/APP\_CDN/Chart

**Function Description**

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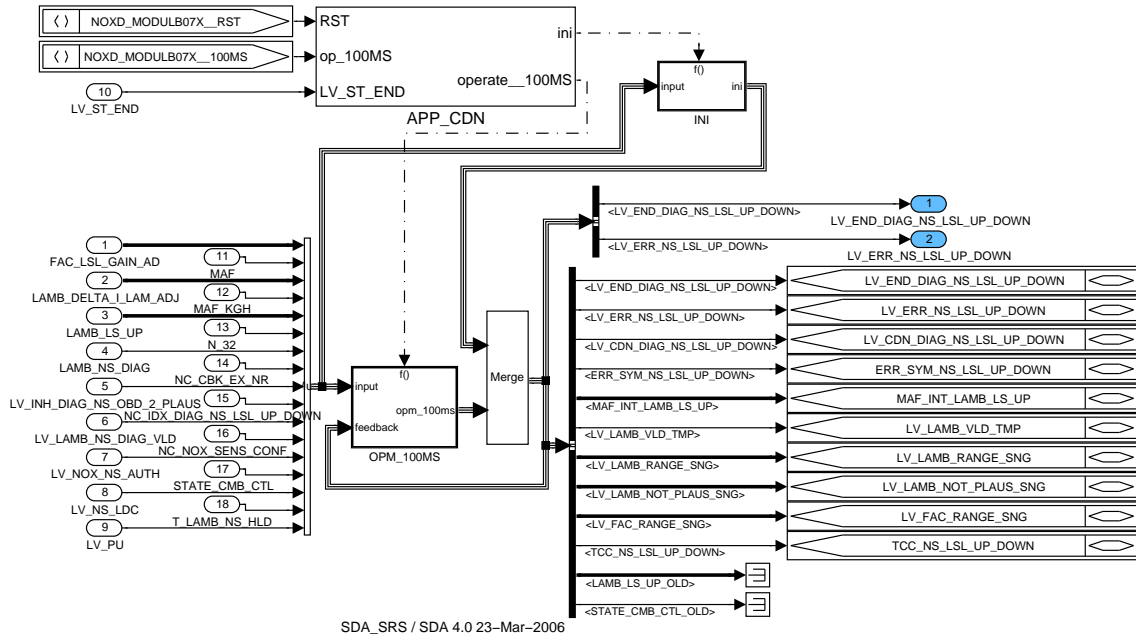


Figure B.125.2: NOXD\_MODULB07X

### B.125.1 Initialization at reset and deactivation

These actions initialized the diagnostic data according filtering configuration :

ACTION\_ERRM\_GetLvErr( IN<NC\_IDX\_DIAG\_XX>, OUT< LV\_ERR\_XX >)

ACTION\_ERRM\_GetLvEndDiag( IN<NC\_IDX\_DIAG\_XX>, OUT< LV\_END\_DIAG\_XX >)

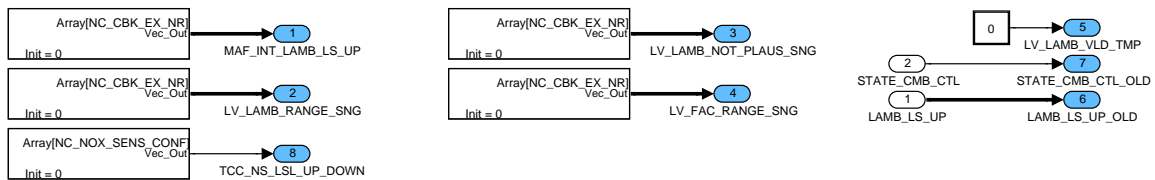


Figure B.125.3: NOXD\_MODULB07X/INI/CLC

### B.125.2 Loop control

The calculation inside FOR\_LOOP\_LS have to be done for each upstream lambda sensor, controlled by configuration data NC\_CBK\_EX\_NR.

If NC\_CBK\_EX\_NR = 1, then calculation for i = 1.

If NC\_CBK\_EX\_NR = 2, then calculation for i = 1 and 2.

The calculation inside both NO\_LOOP subsystems have to be done only once.

The calculation inside FOR\_LOOP\_NS have to be done for each NOx sensor, controlled by configuration data NC\_NOX\_SENS\_CONF.

If NC\_NOX\_SENS\_CONF = 1, then calculation for i = 1.

If NC\_NOX\_SENS\_CONF = 2, then calculation for i = 1 and 2.

NC\_NOX\_SENS\_CONF cannot be greater than NC\_CBK\_EX\_NR.

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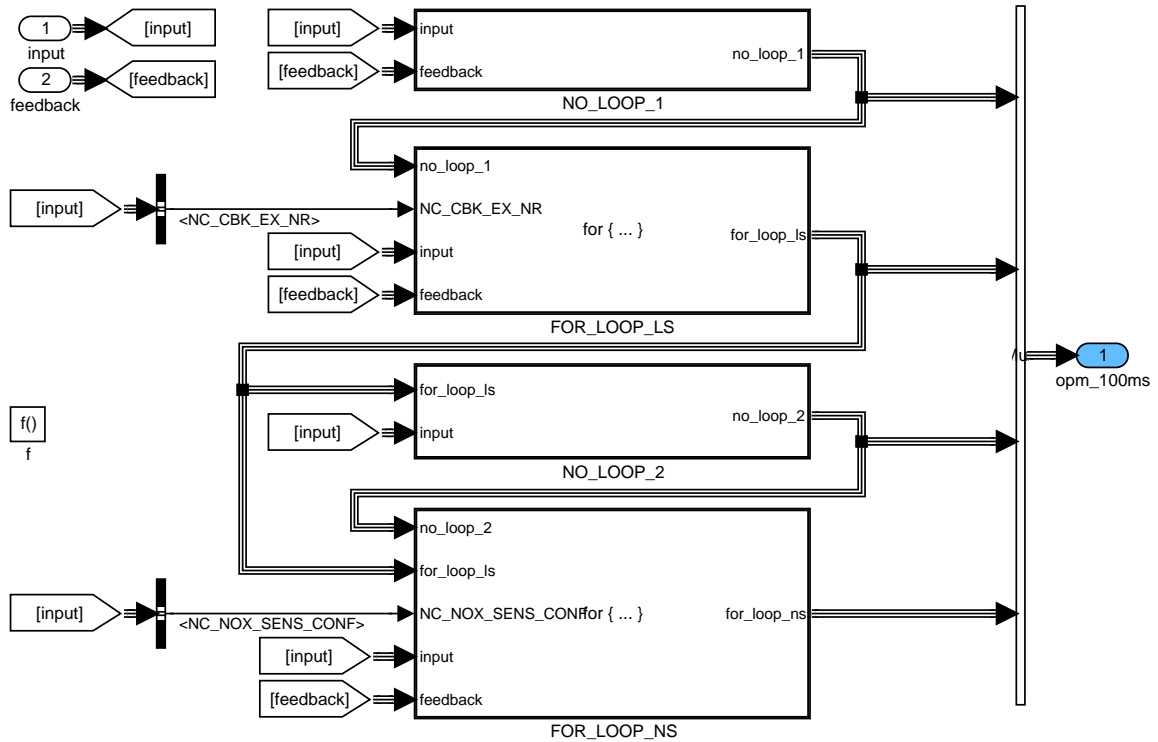


Figure B.125.4: NOXD\_MODULB07X/OPM\_100MS

**Bank independent calculation (part 1)**

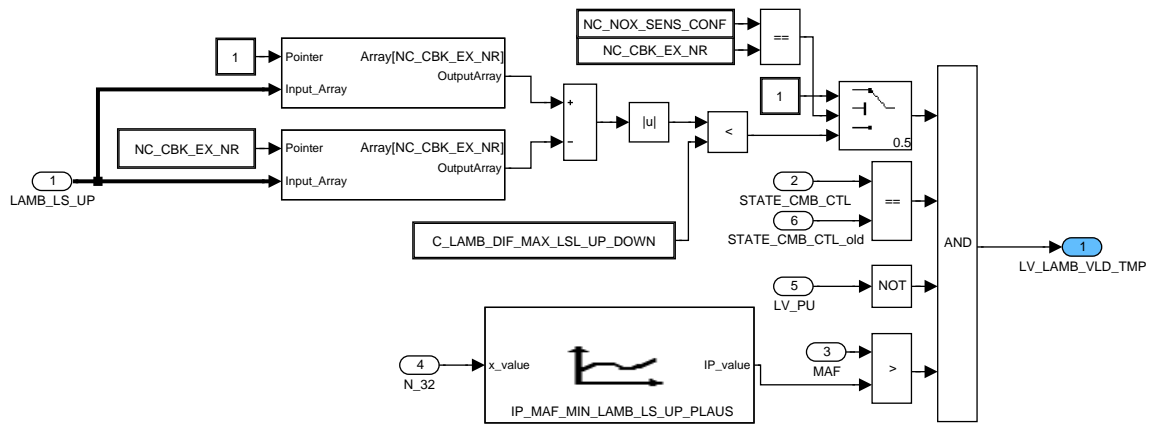


Figure B.125.5: NOXD\_MODULB07X/OPM\_100MS/NO\_LOOP\_1/CLC

**Calculation for each upstream lambda sensor**

**Integral of air mass flow**

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The MAF integral will be calculated if the operating condition are nearly stationary, otherwise the integral will be reset.

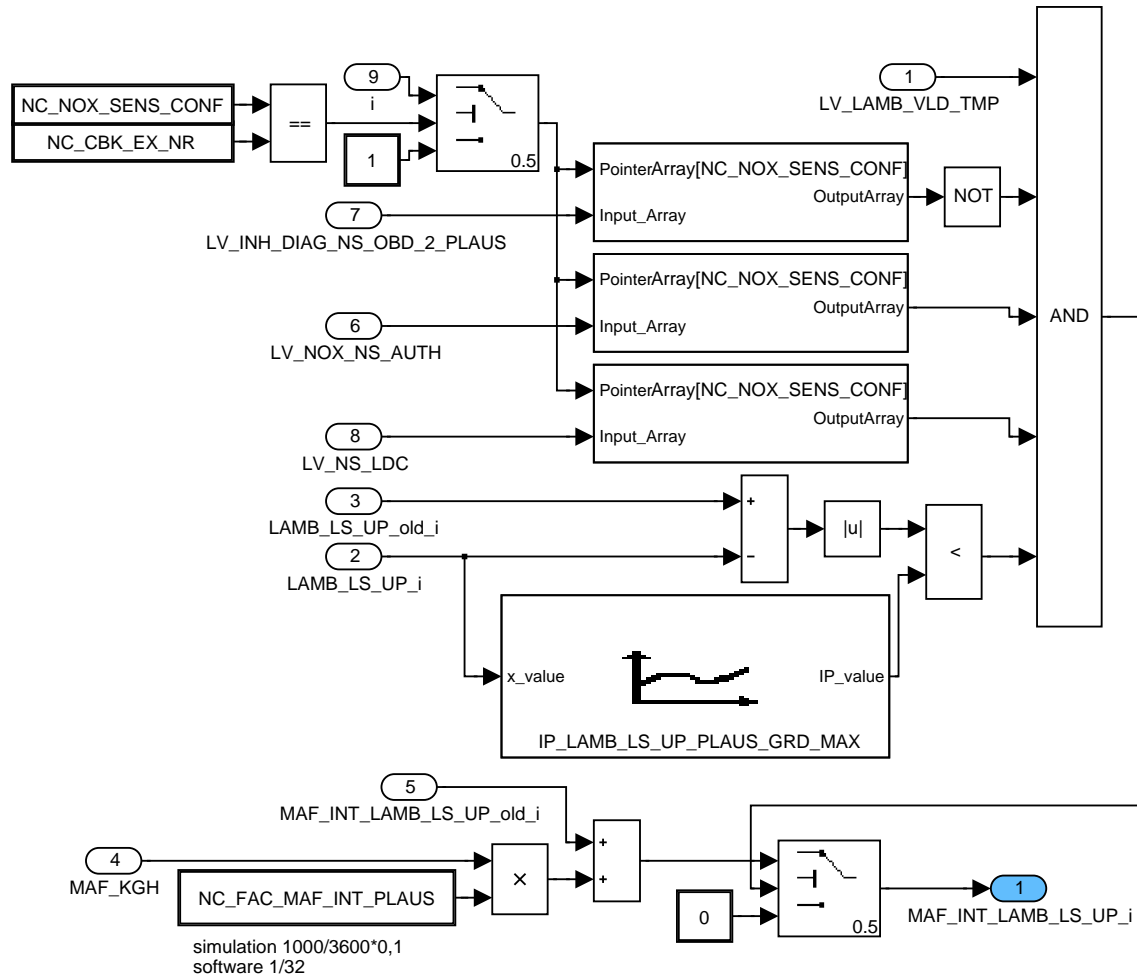


Figure B.125.6: NOXD\_MODULB07X/OPM\_100MS/FOR\_LOOP\_LS/CLC1

**Lambda range**

The diagnosis will be activated if the upstream lambda is in a desired range and the MAF integral shows that also behind the NOx trap should be the same lambda.

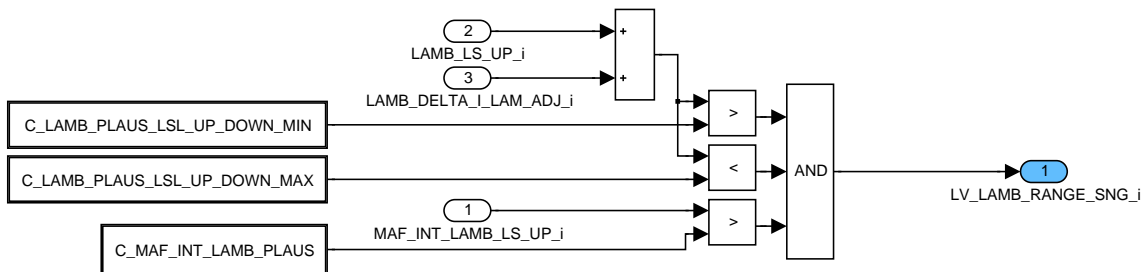


Figure B.125.7: NOXD\_MODULB07X/OPM\_100MS/FOR\_LOOP\_LS/CLC2

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### Lambda comparison

The linear lambda of the NOx sensor will be compared with the upstream lambda to get the diagnosis result.

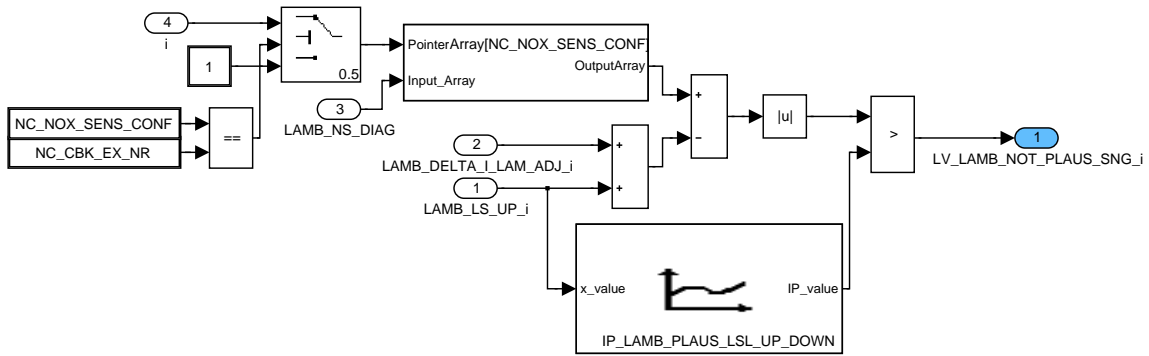


Figure B.125.8: NOXD\_MODULB07X/OPM\_100MS/FOR\_LOOP\_LS/CLC3

### Lambda controller gain adaptation

The lambda controller gain adaptation have to be in a desired range to avoid a wrong diagnosis result for the NOx sensor during the comparison with the upstream lambda sensor.

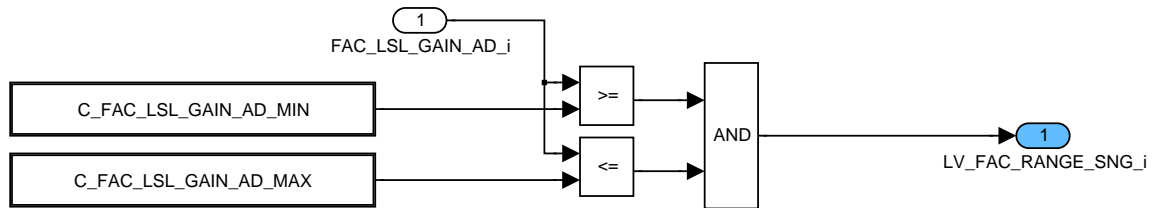


Figure B.125.9: NOXD\_MODULB07X/OPM\_100MS/FOR\_LOOP\_LS/CLC4

### Bank independent calculation (part 2)

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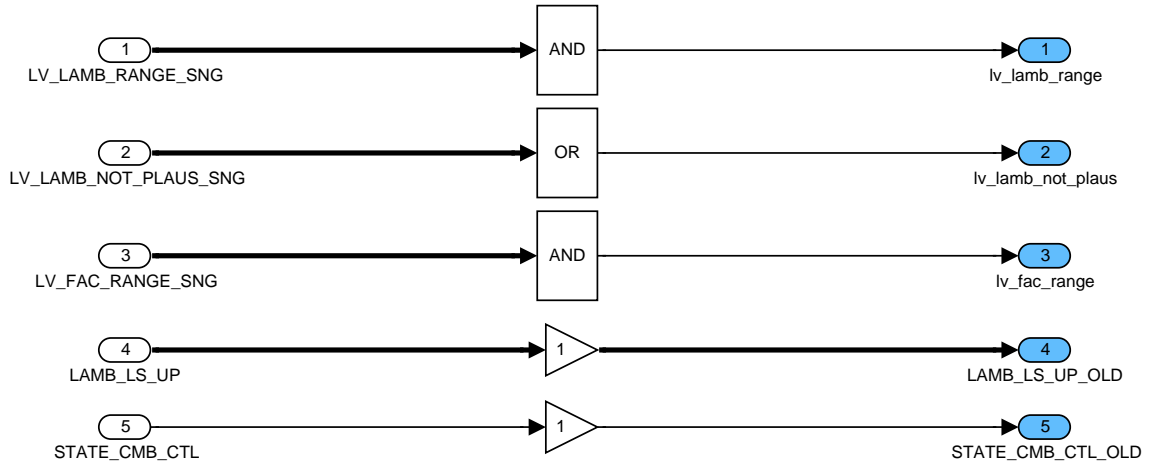


Figure B.125.10: NOXD\_MODULB07X/OPM\_100MS/NO\_LOOP\_2/CLC

**Calculation for each NOx sensor**

**Diagnosis evaluation**

For each NOx sensor diagnosis result have to be used either the signals of the same bank or resulting signals if a NOX sensor sees the exhaust gas from more than one bank.

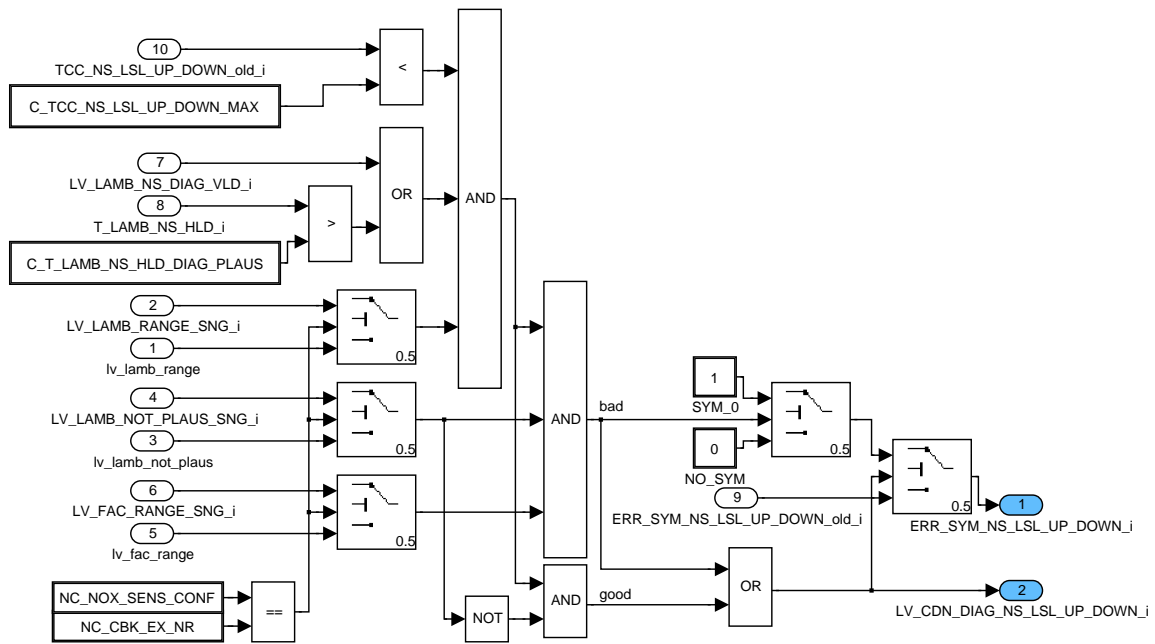


Figure B.125.11: NOXD\_MODULB07X/OPM\_100MS/FOR\_LOOP\_NS/CLC1

**Test cycle counter**

The number of test cycles per steady state phase may be calibrated.

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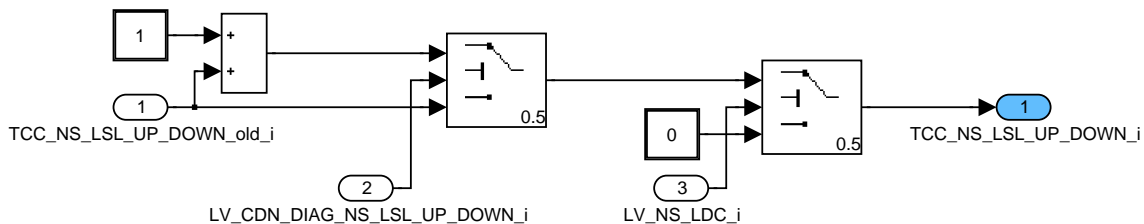


Figure B.125.12: NOXD\_MODULEB07X/OPM\_100MS/FOR\_LOOP\_NS/CLC2

**Error management**

LV\_ERR\_NS\_LSL\_UP\_DOWN will be get by ACTION\_ERRM\_GetLvErr and LV\_END\_DIAG\_NS\_LSL\_UP\_DOWN will be get by ACTION\_ERRM\_GetLvEndDiag.

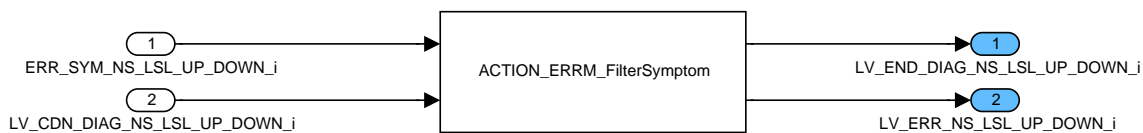


Figure B.125.13: NOXD\_MODULEB07X/OPM\_100MS/FOR\_LOOP\_NS/CLC3

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## B.126 NOx sensor OBDII diagnosis - Signal plausibility at pull fuel cutoff

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_NS_PUC [NC_NOX_SENS_CONF]	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom for the NOx sensor plausibility diagnosis at PUC					
LV_CDN_DIAG_NS_PUC [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnosis condition of NOx sensor plausibility diagnosis at PUC					
LV_END_DIAG_NS_PUC [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
End of NOx sensor plausibility diagnosis at PUC					
LV_ERR_NS_PUC [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Error flag of NOx sensor plausibility diagnosis at PUC					
LV_LAMB_VLD_PUC	V	0... 1H	0 ...1	1	-
All lambda signals are valid for diagnosis at PUC					
LV_LAMB_VLD_PUC_SNG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Lambda signal is valid for diagnosis at PUC (bench selective)					
TCC_NS_PUC_DIAG [NC_NOX_SENS_CONF]	V	0... FFH	0... 255	1	-
Test cycle counter for plausibility checks at actual PUC phase					

### Input data:

CTR_NT_AGI_AD_CMPL_SUM {p. 3072}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_NS_DIAG [NC_NOX_SENS_CONF] {p. 991}	LV_INH_DIAG_NS_OBD_2_PLAUS [NC_NOX_SENS_CONF] {p. 6468}
LV_LAMB_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_NOX_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}	LV_NOX_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_NT_HOM_INI {p. 2982}
LV_PUC {p. 1720}	LV_VLS_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}	MAF_INT_PUC_ACT {p. 2942}	NC_CBK_EX_NR {p. 1829}
NC_IDX_DIAG_NS_PUC [NC_NOX_SENS_CONF]	NC_NOX_SENS_CONF {p. 643}	NOX_NS_DIAG [NC_NOX_SENS_CONF] {p. 992}	NTLD {p. 2986}
T_LAMB_NS_HLD [NC_NOX_SENS_CONF] {p. 992}	T_NOX_NS_HLD [NC_NOX_SENS_CONF] {p. 992}	T_VLS_NS_HLD [NC_NOX_SENS_CONF] {p. 992}	TNT_MDL_MV {p. 8237}
VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_NS_DIAG [NC_NOX_SENS_CONF] {p. 992}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_NS_PUC	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx sensor plausibility diagnosis at PUC					
C_ABC_INC_NS_PUC	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx sensor plausibility diagnosis at PUC					
C_ABC_MAX_NS_PUC	-	1... FFH	1... 255	1	-
Anti bounce counter maximum for the NOx sensor plausibility diagnosis at PUC					
C_CTR_NT_AGI_AD_CMPL_SUM_NS_PUC	-	0... FFFFH	0... 65535	1	-
Minimum threshold of completed aging adaptations for NOx sensor PUC diagnosis					
C_LAMB_NS_DIAG_PUC_MIN	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Minimum Lambda value of NOx-Sensor at PUC					
C_LAMB_PUC_PLAUS_MIN	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Minimum upstream Lambda value to start the NOx-Sensor PUC check					
C_MAF_INT_PUC_PLAUS_MIN	-	0... FFFFH	0... 1820.42	0.02777778	g
MAF threshold for starting the PUC diagnosis					
C_NOX_NS_DIAG_PUC_MAX	-	FF9C... 5DCH	-100 ...1500	1	ppm
Maximum NOx concentration signal value of NOx-Sensor at PUC					
C_NOX_NS_DIAG_PUC_MIN	-	FF9C... 5DCH	-100 ...1500	1	ppm
Minimum NOx concentration signal value of NOx-Sensor at PUC					
C_NTLD_NS_PLAUS_PUC	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
Maximum NOx loading of NOx catalyst for detecting a NOx signal failure					
C_T_LAMB_NS_HLD_DIAG_PUC	-	0... 7FFFH	0... 327.67	0.01	s
Time with lambda signal state = invalid, after which a PUC diagnosis is started					
C_T_NOX_NS_HLD_DIAG_PUC	-	0... 7FFFH	0... 327.67	0.01	s
Time with NOx signal state = invalid, after which a PUC diagnosis is started					
C_T_VLS_NS_HLD_DIAG_PUC	-	0... 7FFFH	0... 327.67	0.01	s
Time with binary O2 signal state = invalid, after which a PUC diagnosis is started					
C_TCC_NS_PUC_DIAG	-	0... FFH	0... 255	1	-
Number of test cycles at a PUC phase					
C_TNT_MDL_MV_NS_PUC_MAX	-	0... FFFFH	0... 1023.98	0.015625	°C
Maximum threshold of NOx trap temperature for NOx sensor PUC diagnosis					
C_VLS_DOWN_PUC_PLAUS_MAX [NC_CBK_EX_NR]	-	0... 3FFH	0... 4.99511719	0.00488281	V
Maximum VLS_DOWN signal value to start the NOx-Sensor PUC check					
C_VLS_NS_DIAG_PUC_MAX	-	0... 578H	-200 ...1200	1	mV
Maximum binary O2 signal voltage of NOx-Sensor at PUC					
LC_NT_HOM_INI_PUC_PLAUS	-	0... 1H	0 ...1	1	-
NOx signal plausibility diagnosis at PUC runs only after a complete NOx catalyst regeneration					

**Import actions:**

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>,OUT<LV_END_DIAG>)
<b>ACTION_ERRM_GetLvErr</b> (IN<IDX_DIAG>,OUT<LV_ERR>)

**General information**

This signal check tests all NOx sensor measurement signals on their plausibility at the special engine operating state pull fuel cut-off (PUC). With this check shall be detected a sensor poisoning or signal offset problems.

**Application Condition**

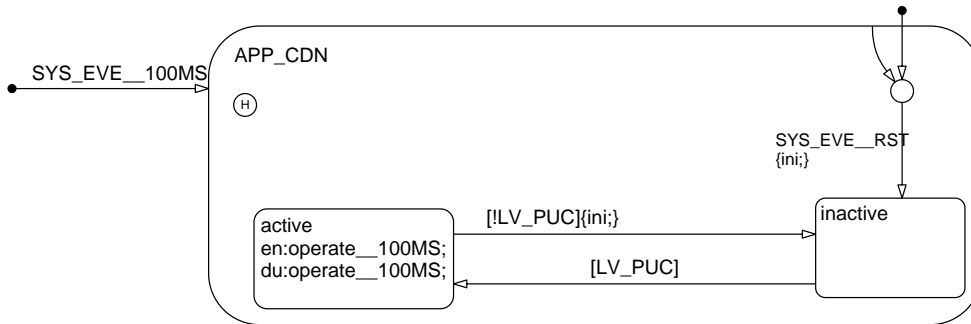
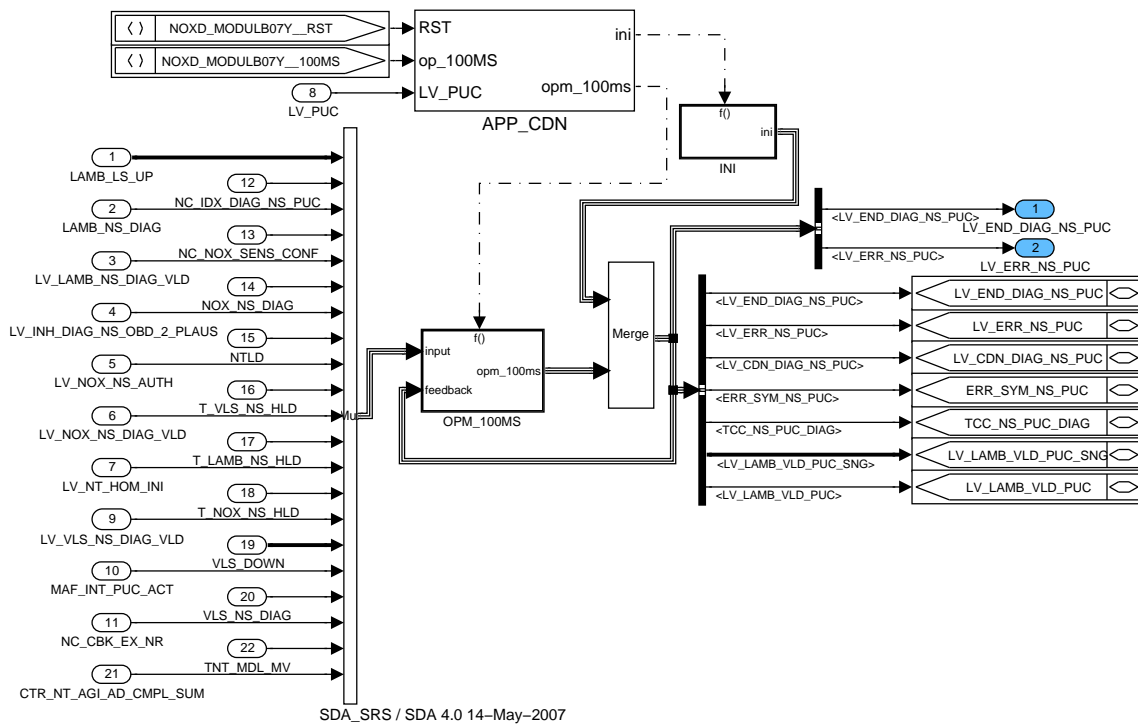


Figure B.126.1: NOXD\_MODULB07Y/APP\_CDN/Chart

**Function Description**



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Figure B.126.2: NOXD\_MODULB07Y

## B.126.1 Initialization at reset and deactivation

These actions initialized the diagnostic data according filtering configuration :

ACTION\_ERRM\_GetLvErr( IN<NC\_IDX\_DIAG\_XX>, OUT< LV\_ERR\_XX >)

ACTION\_ERRM\_GetLvEndDiag( IN<NC\_IDX\_DIAG\_XX>, OUT< LV\_END\_DIAG\_XX >)

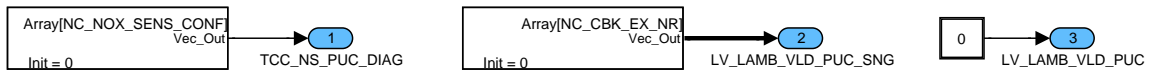


Figure B.126.3: NOXD\_MODULB07Y/INI/CLC

## B.126.2 Loop control

The calculation inside FOR\_LOOP\_LS have to be done for each upstream lambda sensor, controlled by configuration data NC\_CBK\_EX\_NR.

If NC\_CBK\_EX\_NR = 1, then calculation for i = 1.

If NC\_CBK\_EX\_NR = 2, then calculation for i = 1 and 2.

The calculation inside both NO\_LOOP subsystems have to be done only once.

The calculation inside FOR\_LOOP\_NS have to be done for each NOx sensor, controlled by configuration data NC\_NOX\_SENS\_CONF.

If NC\_NOX\_SENS\_CONF = 1, then calculation for i = 1.

If NC\_NOX\_SENS\_CONF = 2, then calculation for i = 1 and 2.

NC\_NOX\_SENS\_CONF cannot be greater than NC\_CBK\_EX\_NR.

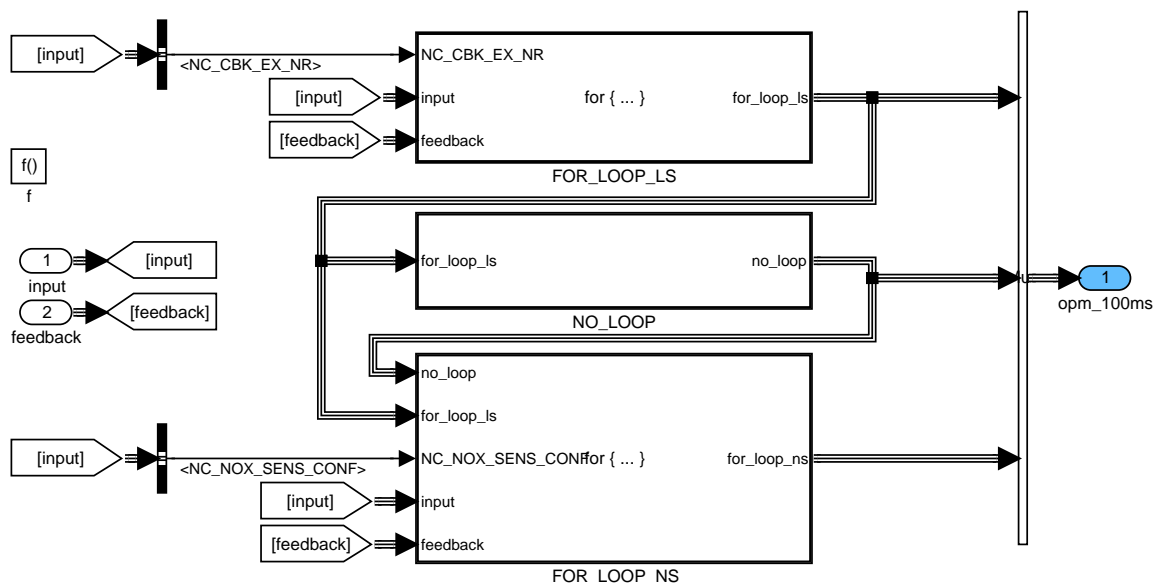



Figure B.126.4: NOXD\_MODULB07Y/OPM\_100MS

### Calculation for each upstream lambda sensor

#### Lambda sensor lean check

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Linear as well as binary lambda sensors of a bank will be checked if PUC is active.

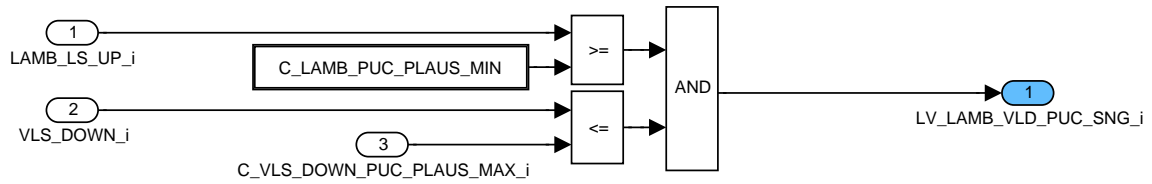


Figure B.126.5: NOXD\_MODULB07Y/OPM\_100MS/FOR\_LOOP\_LS/CLC

**Bank independent calculation**

The signal shows that all lambda sensors of all banks measures lean exhaust gas due to PUC.

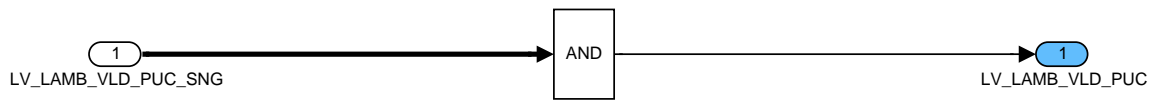



Figure B.126.6: NOXD\_MODULB07Y/OPM\_100MS/NO\_LOOP/CLC

**Calculation for each NOx sensor**

**Activation of diagnosis**

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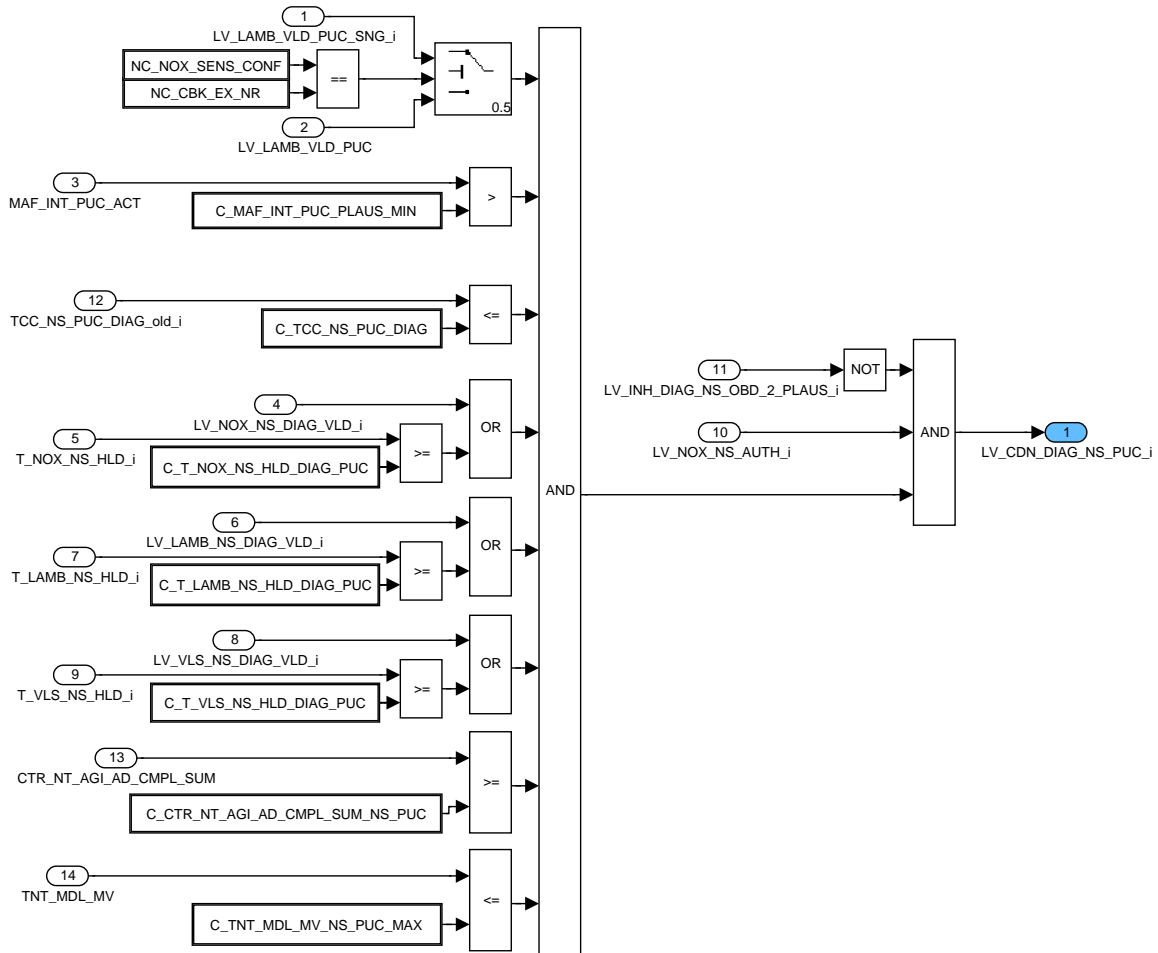


Figure B.126.7: NOXD\_MODULB07Y/OPM\_100MS/FOR\_LOOP\_NS/CLC1

**Plausibility check counter**

At every PUC phase the number of plausibility checks is counted with this counter and limited with C\_TCC\_NS\_PUC\_DIAG.

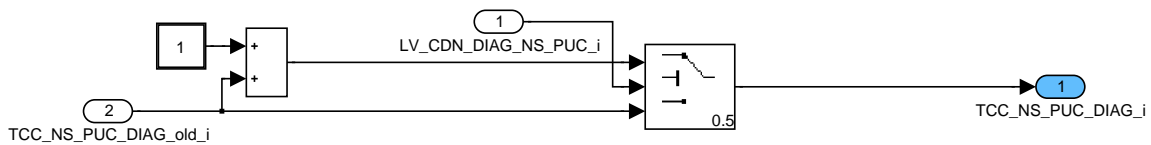


Figure B.126.8: NOXD\_MODULB07Y/OPM\_100MS/FOR\_LOOP\_NS/CLC2

**Signal diagnosis**

Both lambda signals of the NOx sensor will be compared with a threshold. The NOx signal will be checked with a range. If the signal is higher than the top limit, then a special check have to be done. The reason is a NOx loading of NOx storage catalyst at start of 'pull fuel cut-off' phase and the fact that the NOx catalyst

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loses a part of its stored NOx at 'pull fuel cut-off'. Hence a NOx signal, which is higher than the diagnosis threshold at 'pull fuel cut-off' diagnosis time, shall be interpreted as sensor failure only if the NOx loading of NOx catalyst is low at start of 'pull fuel cut-off' diagnosis time.

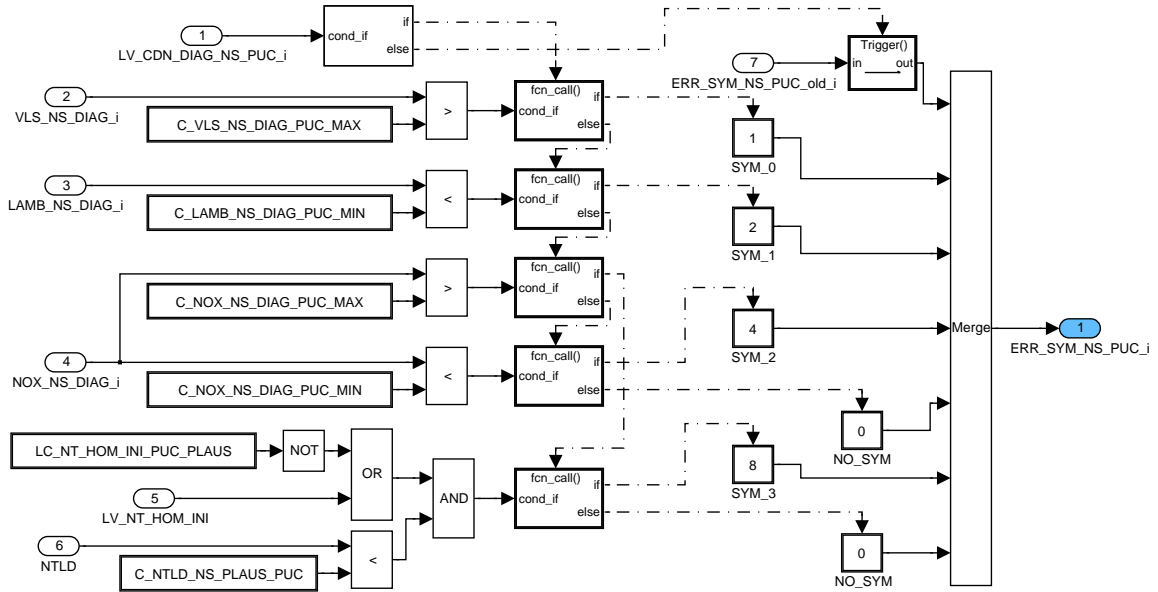


Figure B.126.9: NOXD\_MODULB07Y/OPM\_100MS/FOR\_LOOP\_NS/CLC3

**Error management**

LV\_ERR\_NS\_PUC will be get by ACTION\_ERRM\_GetLvErr and LV\_END\_DIAG\_NS\_PUC will be get by ACTION\_ERRM\_GetLvEndDiag.

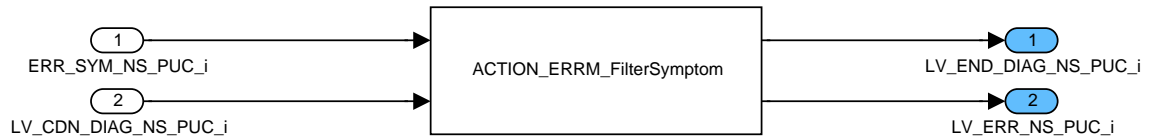


Figure B.126.10: NOXD\_MODULB07Y/OPM\_100MS/FOR\_LOOP\_NS/CLC4

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## B.127 NOx sensor OBDII diagnosis - Setpoint shift

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRLC_RATIO_MMV_NS_SHIFT_DIAG [NC_NOX_SENS_CONF]	O/V	0... FFH	0 ...1	3.92157e-3	-
Correlation constant of NOx signal shift diagnosis mean value					
CTR_RATIO_MMV_DIAG_NS_SHIFT [NC_NOX_SENS_CONF]	O/V/S	0... FFH	0... 255	1	-
Counter of single diagnosis cycles for calculation of mean value					
ERR_SYM_NS_SHIFT [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom for NOx signal internal setpoint shift diagnosis					
LV_CDN_DIAG_NS_SHIFT [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (seto to one when condition is fulfilled)					
LV_END_DIAG_NS_SHIFT [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor internal setpoint shift diagnosis was performed at last one time					
LV_ERR_NS_SHIFT [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Present failure after filtering of the NOx sensor internal setpoint shift diagnosis					
LV_NS_SHIFT_DIAG_MMV_EXT_ADJ [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
External values of MMV values for the NOx signal shift diagnosis available					
LV_NS_SHIFT_DIAG_MMV_INI [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Initialization of MMV values for the NOx signal shift diagnosis					
LV_RATIO_SUM_CLC_ACT [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Calculation of RATIO active					
RATIO_MMV_NS_SHIFT_DIAG [NC_NOX_SENS_CONF]	O/V/S	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	-
NOx signal shift diagnosis mean value					
RATIO_NS_SHIFT_DIAG [NC_NOX_SENS_CONF]	O/V	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	-
NOx signal shift diagnosis value					
RATIO_NS_SHIFT_DIAG_BOL_SAE [NC_NOX_SENS_CONF]	O/V/S	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	-
Mode 06 - minimum value of test limit					
RATIO_NS_SHIFT_DIAG_SAE [NC_NOX_SENS_CONF]	O/V/S	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	-
Mode 06 - test value					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
RATIO_NS_SHIFT_DIAG_TOL_SAE [NC_NOX_SENS_CONF]	O/V/S	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	-
Mode 06 - maximum value of test limit					
RATIO_SUM_NS_SHIFT_DIAG [NC_NOX_SENS_CONF]	O/V/S	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	-
Numerator for calculation of diagnosis mean value					
STATE_NS_SHIFT_DIAG_OLD [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Old value of STATE_NS_SHIFT_DIAG					

**Input data:**

CAN_NOX_DIAG_NS [NC_NOX_SENS_CONF] {p. 1398}	CAN_NOX_REF_NS [NC_NOX_SENS_CONF] {p. 1398}	LV_INH_DIAG_NS_OBD_2_SHIFT [NC_NOX_SENS_CONF] {p. 6468}	LV_NS_SHIFT_DIAG_ACT_EXT_ADJ [NC_NOX_SENS_CONF] {p. 6426}
LV_NS_SHIFT_DIAG_ERR [NC_NOX_SENS_CONF] {p. 1381}	MAF_CYL {p. 8277}	NC_NOX_SENS_CONF {p. 643}	RATIO_MMV_NS_SHIFT_DIAG_EXT_ADJ [NC_NOX_SENS_CONF] {p. 7683}
STATE_NS_SHIFT_DIAG [NC_NOX_SENS_CONF] {p. 6427}	TNT_MDL_MV {p. 8237}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_NS_SHIFT	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_NS_SHIFT	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_ABC_MAX_NS_SHIFT_EXT_ACT	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter - for external manual activation					
C_CRLC_RATIO_NS_SHIFT_DIAG_MIN	-	0... FFH	0 ...1	3.92157e-3	-
Minimum Correlation constant for NOx signal shift diagnosis mean value					
C_CTR_RATIO_MMV_DIAG_NS_SHIFT	-	1... FFH	1... 255	1	-
Maximum of single diagnosis cycles for calculation of mean value					
C_CTR_RATIO_MMV_SHIFT_EXT_ACT	-	1... FFH	1... 255	1	-
Maximum of single diagnosis cycles for calculation of mean value - external activation					
C_RATIO_NS_SHIFT_DIAG_AFS_MAX	-	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	-
Maximal threshold for NOx signal shift diagnosis for requesting Lambda=1.0 operation					
C_RATIO_NS_SHIFT_DIAG_AFS_MIN	-	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	-
Minimal threshold for NOx signal shift diagnosis for requesting Lambda=1.0 operation					
C_RATIO_NS_SHIFT_DIAG_THD_MAX	-	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	-
Maximal threshold for NOx signal shift diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_RATIO_NS_SHIFT_DIAG_THD_MIN	-	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	-
Minimal threshold for NOx signal shift diagnosis					
IP_CRLC_RATIO_MMV_NS_SHIFT_DIAG	V	0... FFH	0 ...1	3.92157e-3	-
LDP_RATIO_DIF_IP_CRLC_RATIO_MMV	6	0... FFFFH	-1... 0.99996948	30.5176e-6	-
LDP_RATIO_IP_CRLC_RATIO_MMV	4	0... FFFFH	-1... 0.99996948	30.5176e-6	-
Filter constant for NOx signal shift diagnosis mean value					
IP_FAC_MAF_NS_SHIFT	-	0... FFH	0... 3.984375	0.015625	-
LDP_MAF_IP_FAC_NS_SHIFT	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
Correction factor of NOx signal depending on MAF_CYL					
IP_FAC_TNT_MDL_MV_NS_SHIFT	-	0... FFH	0... 3.984375	0.015625	-
LDP_TNT_MDL_MV_IP_NS_SHIFT	8	0... FFFFH	0... 1023.984375	0.015625	°C
Correction factor of NOx signal depending on TNT_MDL_MV					
LC_NS_SHIFT_DIAG_ERR_ACT	-	0... 1H	0 ...1	1	-
Switch to result of diagnosis coming from NOx sensor software					

## Action definition

<b>ACTION_NOXD_CleanMMVNSAdapt ()</b>	Mode: O
Initialization of NOx signal shift MMV diagnosis values	

<b>ACTION_NOXD_WriteMMVNSExtAdj ()</b>	Mode: O
Write external adjustment values to NOx signal shift MMV diagnosis values	

## Description for Actions

<b>ACTION_NOXD_CleanMMVNSAdapt()</b>
Initialization of NOx signal shift MMV diagnosis values

<b>ACTION_NOXD_WriteMMVNSExtAdj()</b>
Write external adjustment values to NOx signal shift MMV diagnosis values

## General Information

### Application Conditions


Initialization: RST, CLRFRMY, NVMINI, NVMRES, NVMSTO

Recurrence: 100MS

Activation: always

Deactivation: never

### Function description

Released by Tettenborn Frank		Date 2013-02-13	File 02B0A301.00F
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 6414 of 8404	
Regensburg (RGB)		Copyright ( C ) Continental AG,2007	A4: 2007-11

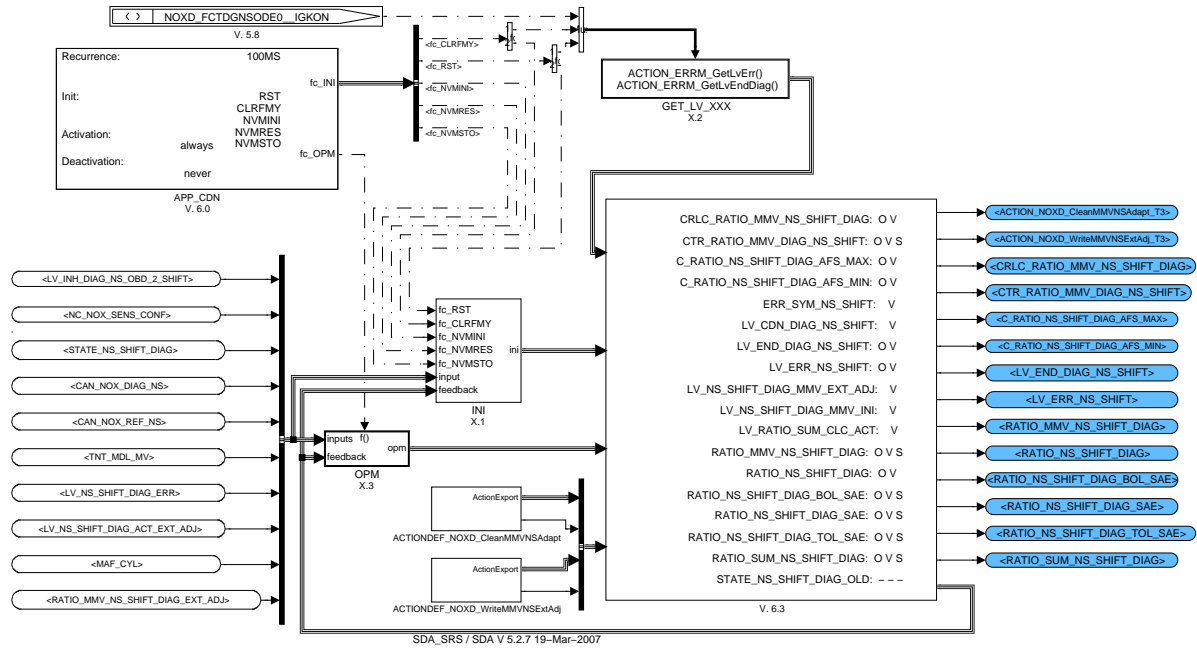



Figure B.127.1: :

## B.127.1 Initialization and Management of nonvolatile memory

### B.127.1.1 Initialization at Reset

The old values will be initialized with the regarding inputs, due to avoid an edge detection after reset.

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 6415 of 8404	
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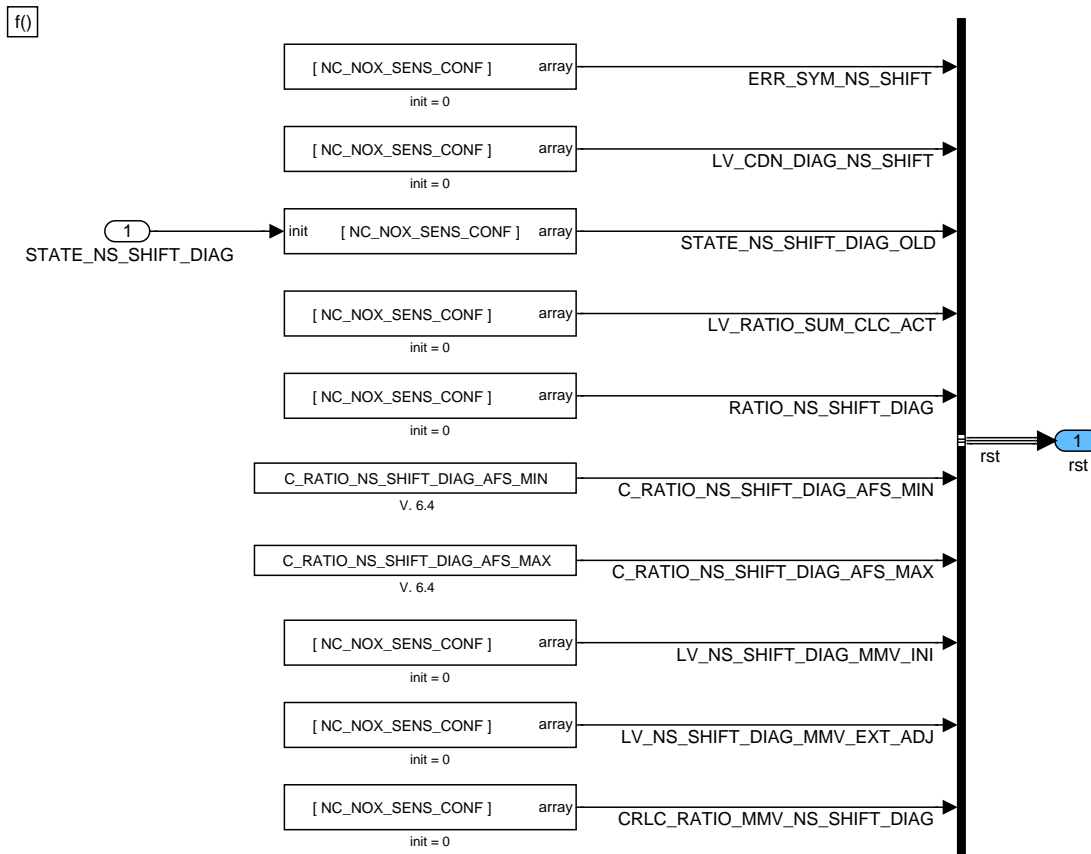


Figure B.127.2: :

### B.127.1.2 Initialization of NVMY variables

All Mode 6 values will be stored in the nonvolatile memory. The values will be reset to zero, if failure memory will be cleared.

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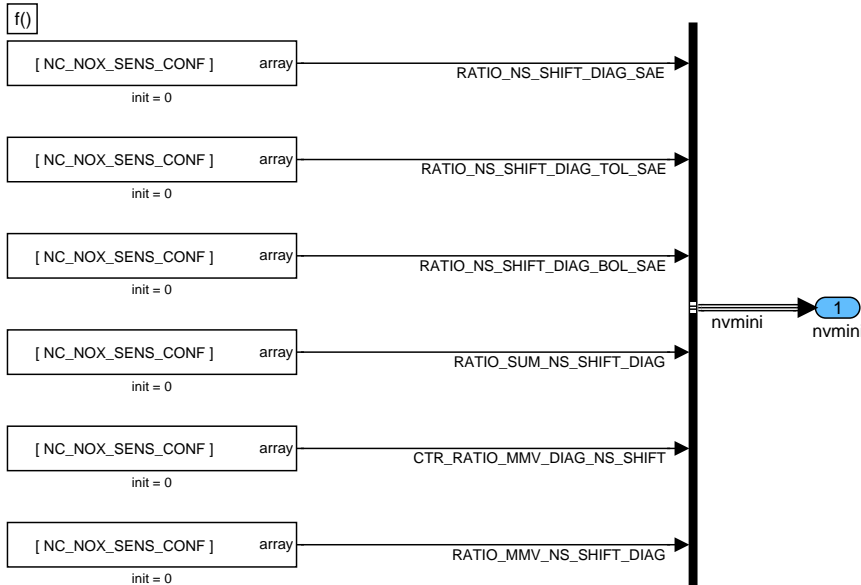


Figure B.127.3: :

### B.127.1.3 Actions at clear fault memory

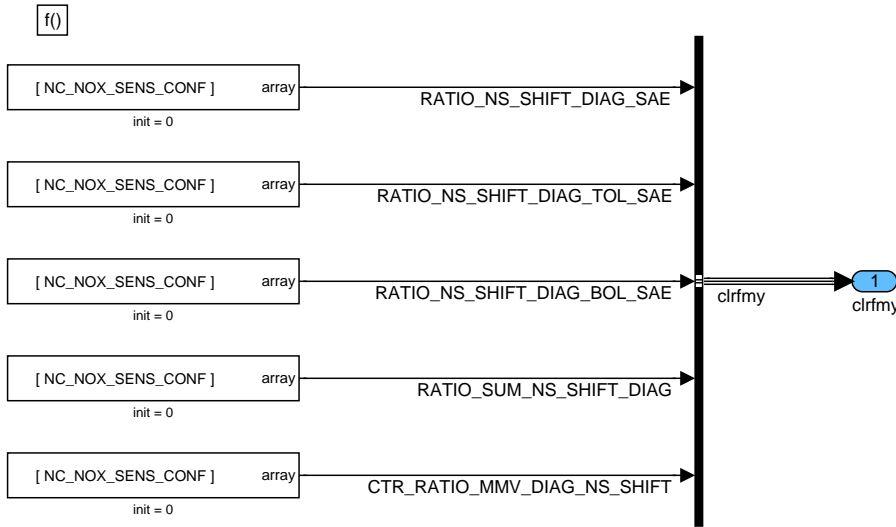


Figure B.127.4: :

### B.127.2 Synchronization of the LV\_ERR\_NS\_SHIFT and LV\_END\_DIAG\_NS\_SHIFT

Synchronisation between `LV_ERR_NS_SHIFT` and its result from `ERRM` is done using action `ACTION_ERRM_GetLvErr()` similarly synchronisation between `LV_END_DIAG_NS_SHIFT` and its result from `ERRM` is done using action `ACTION_ERRM_GetLvEndDiag()` at `RESET`, `IGKON` and `CLRFMY` events.

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## B.127.3 Operation at 100MS

### B.127.3.1 Introduction of multiple sensor system

#### B.127.3.1.1 Calculation of the diagnosis results

##### B.127.3.1.1.1 Determination of diagnostic condition and calculation of counter

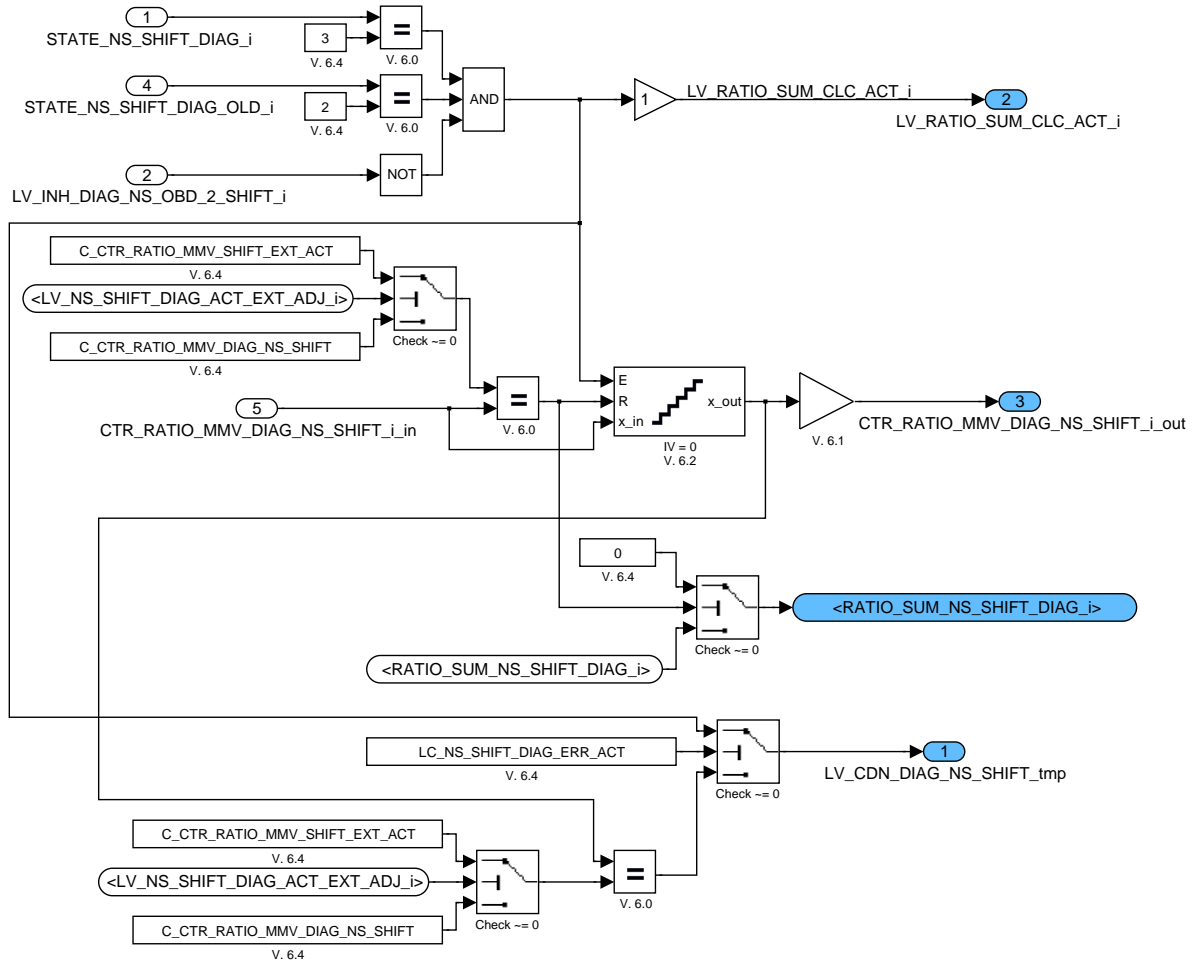


Figure B.127.5: :

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### B.127.3.1.1.2 Calculation of single diagnosis value

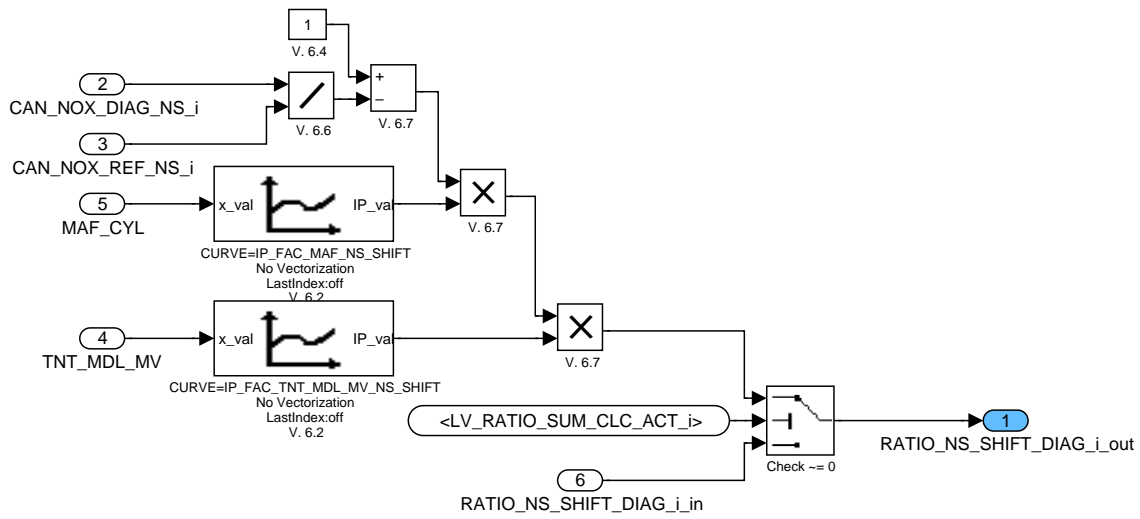



Figure B.127.6: :

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 6419 of 8404</b>	
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### B.127.3.1.1.3 Calculation of mean value over defined number of single diagnosis values

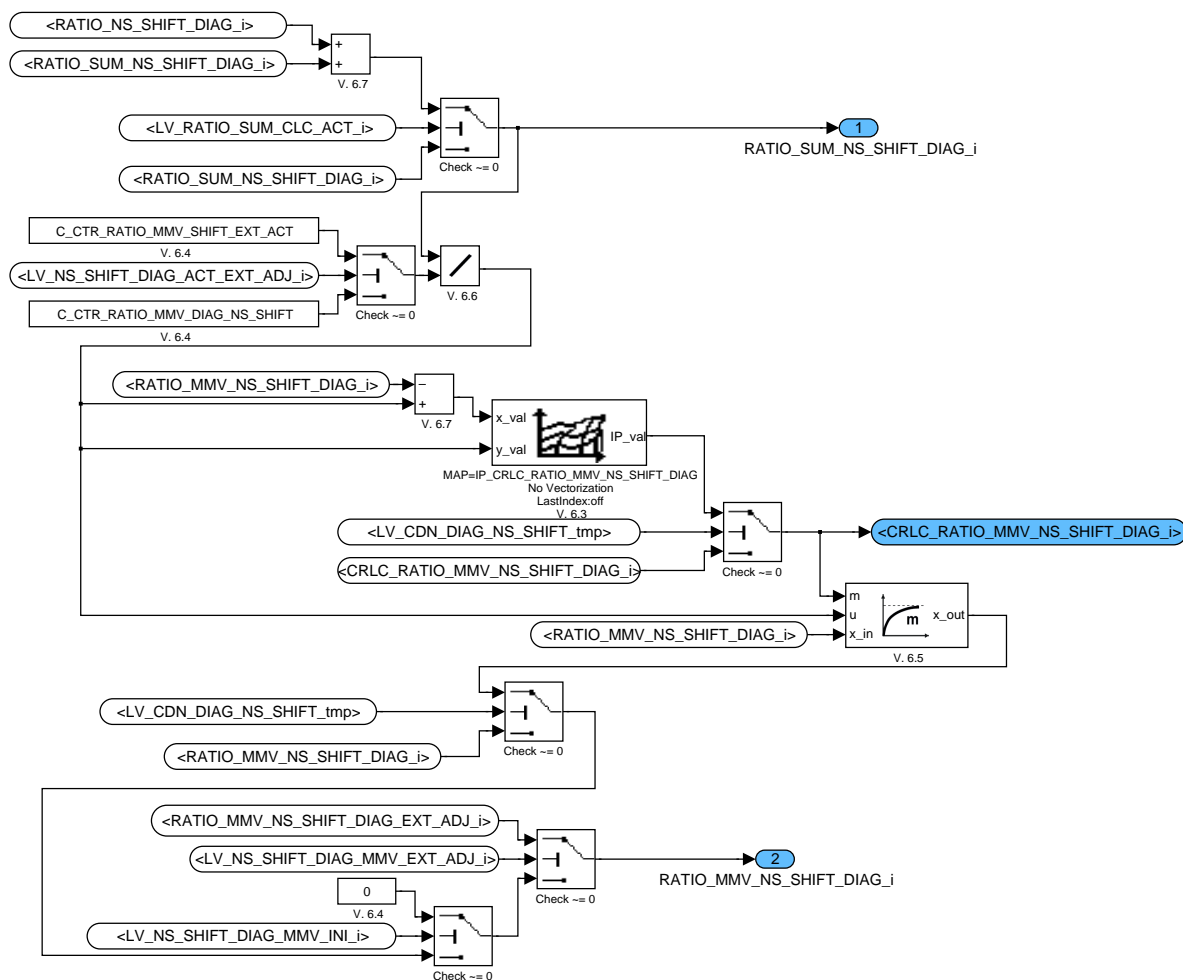


Figure B.127.7: :

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### B.127.3.1.1.4 Determination of error symptom

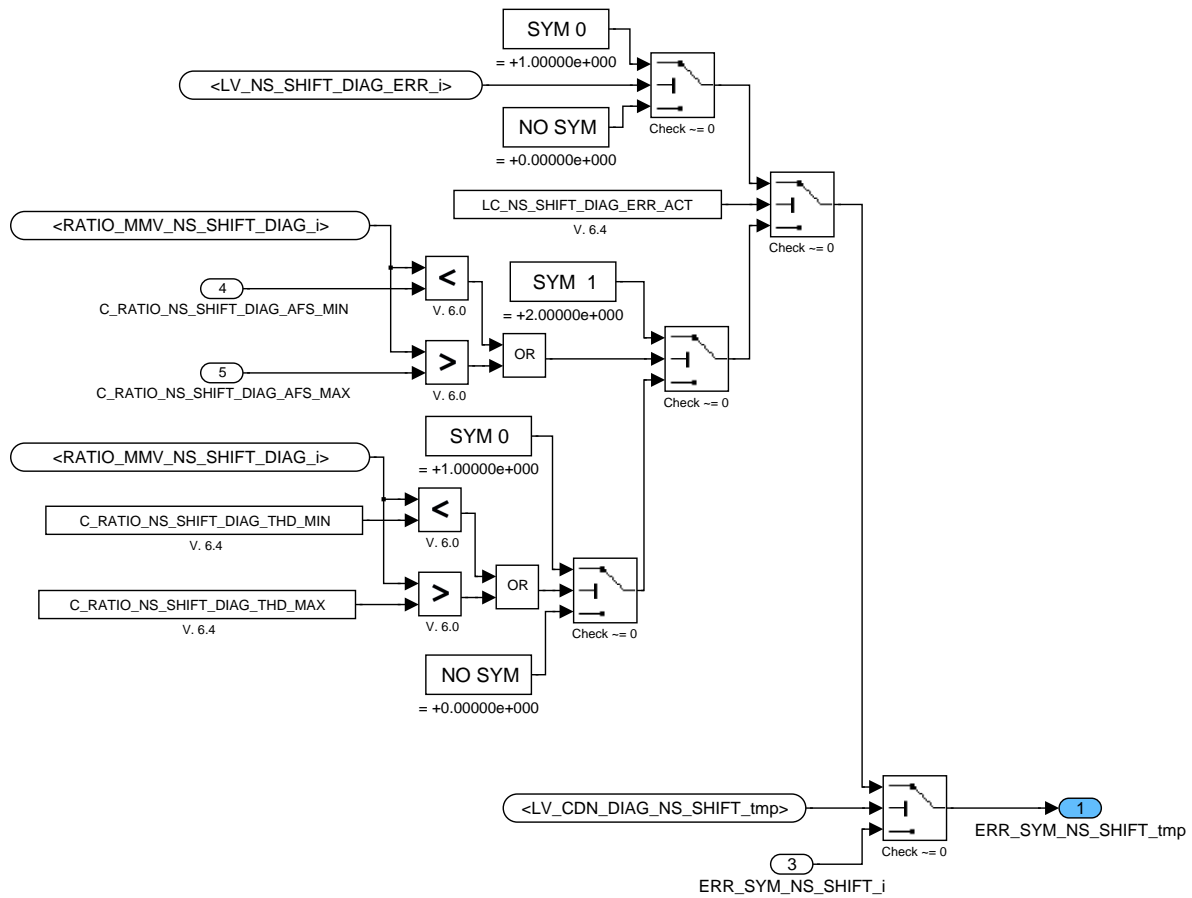


Figure B.127.8: :

### B.127.3.1.1.5 Call for ERRM

`ACTION_ERRM_FilterSymptom(IN<XX>, IN<lv_cdn_diag_XX>, IN<err_sym_XX >, IN<C_ABC_INC_XX >, IN<C_ABC_DEC_XX >, IN<C_ABC_MAX_XX >, OUT<LV_ERR_XX>)`

The action computes the elementary anti-bounce filter for one failure treatment and returns filter results

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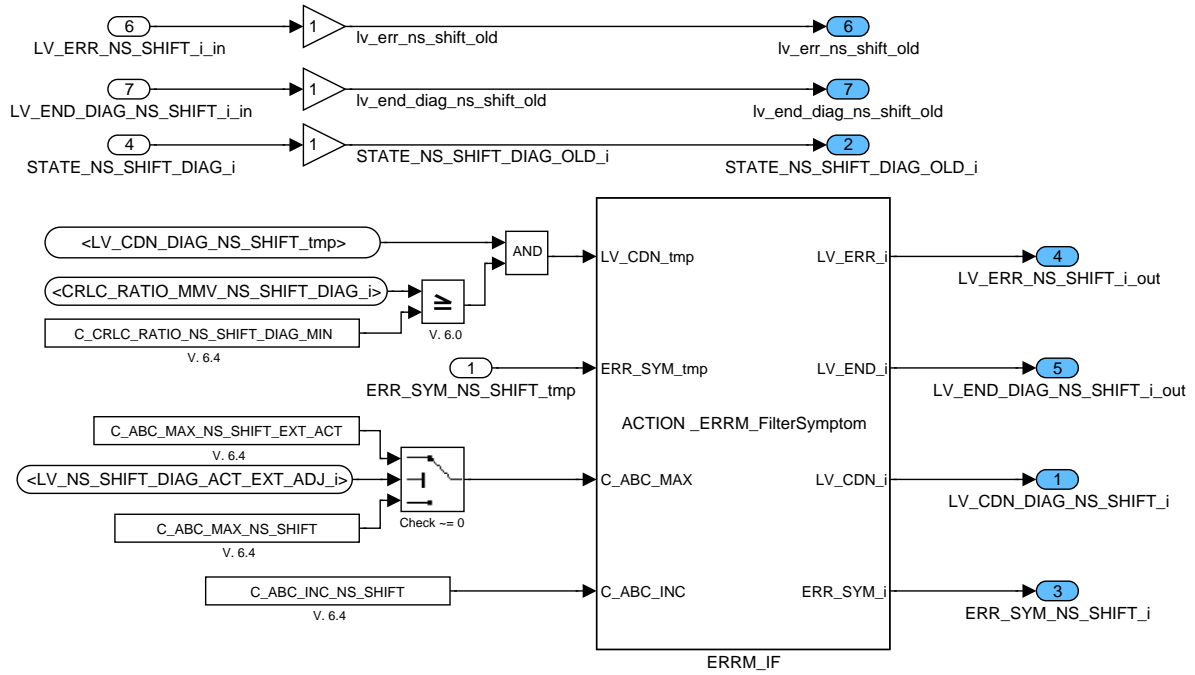


Figure B.127.9: :

### B.127.3.1.1.6 Diagnosis Mode 6 handling

Mode 6 values will be stored, if error management is finishing the diagnosis or is setting an error.

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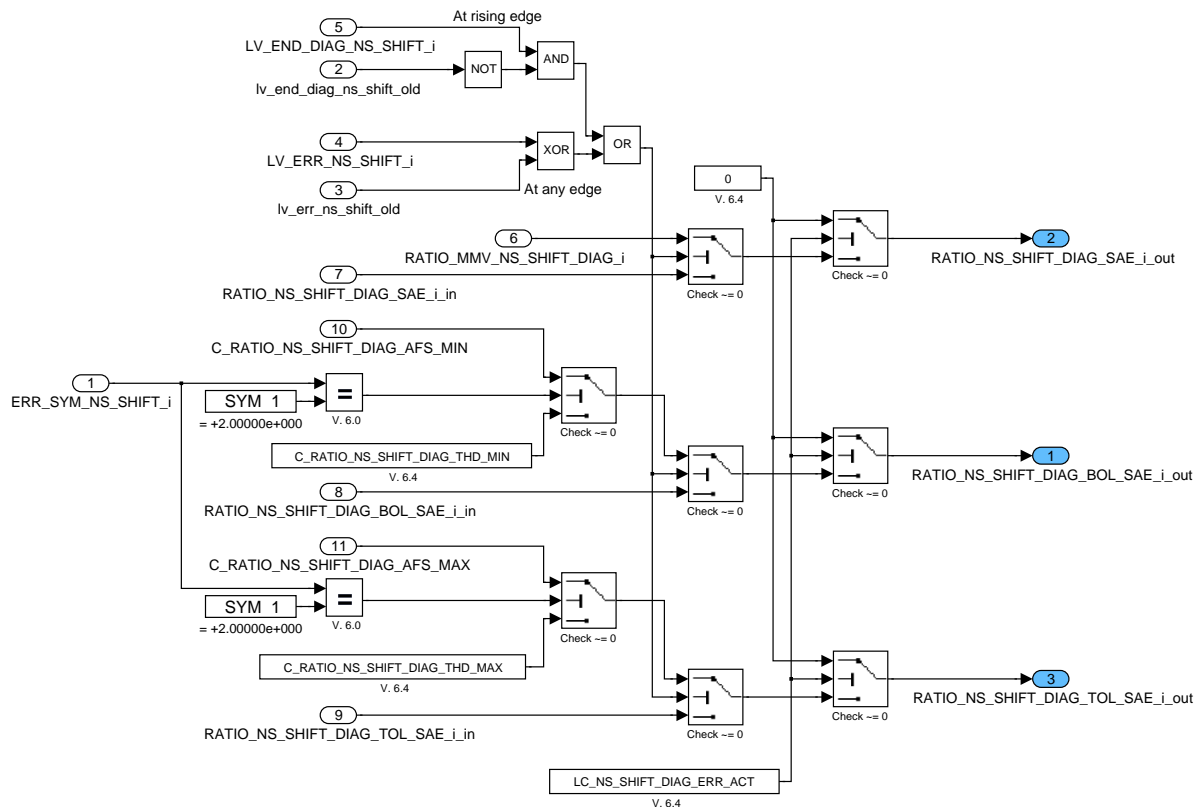


Figure B.127.10: :

**B.127.3.1.1.7 Reset bits for writing external values or initialization of MMV values**

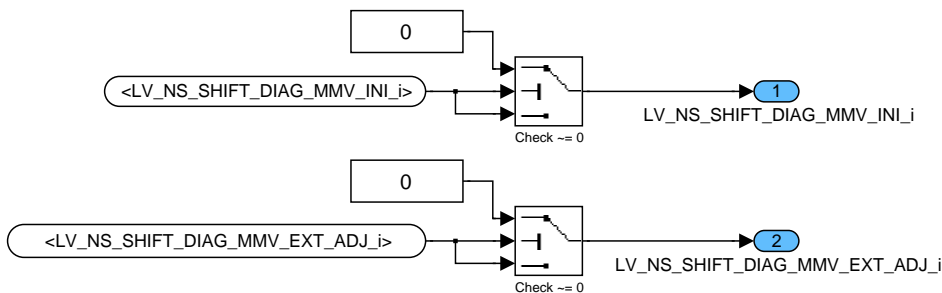


Figure B.127.11: :

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### B.127.4 Detailed description for Action: ACTION\_NOXD\_CleanMMVNSAdapt

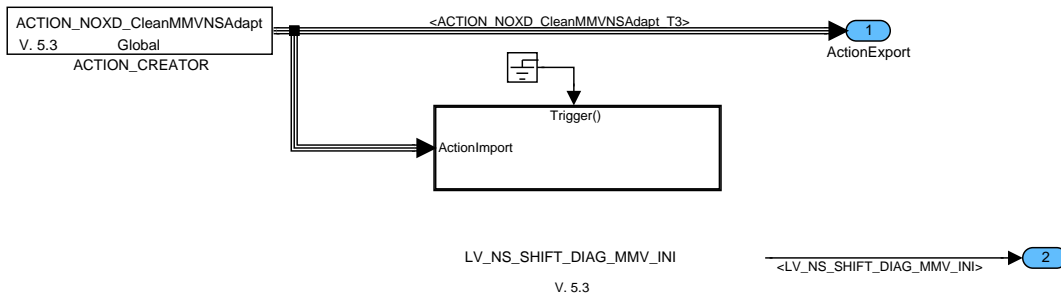


Figure B.127.12: :

#### B.127.4.1 No title given

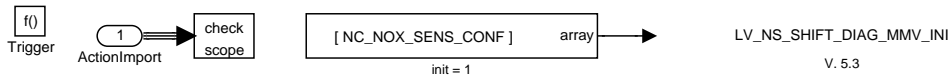


Figure B.127.13: :

### B.127.5 Detailed description for Action: ACTION\_NOXD\_WriteMMVNSExtAdj

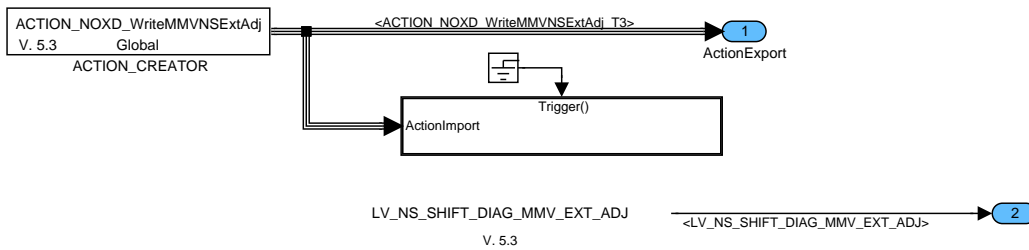


Figure B.127.14: :

#### B.127.5.1 No title given

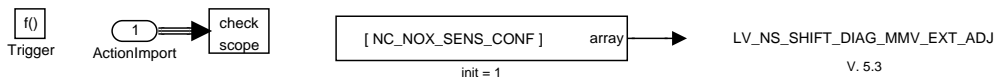


Figure B.127.15: :

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## B.128 NOx sensor setpoint shift diagnosis manager

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_NS_SHIFT_CYC [NC_NOX_SENS_CONF]	O/V/S	0... FFFFH	0... 65535	1	-
Counter of finished NOx signal shift diagnosis					
CTR_NS_SHIFT_CYC_NOT_VLD [NC_NOX_SENS_CONF]	V	0... FFH	0... 255	1	-
Counter for not valid diagnosis cycles					
CTR_NS_SHIFT_CYC_VLD [NC_NOX_SENS_CONF]	V	0... FFH	0... 255	1	-
Counter of valid diagnosis cycles					
CTR_NS_SHIFT_DIAG_INH	V	0... FFH	0... 255	1	-
Counter of successful regenerations					
DIST_NT_NS_SHIFT [NC_NOX_SENS_CONF]	O/V/S	0... FFFFH	0... 524280	8	km
Distance between two active NOx signal diagnosis					
FCO_DELTA_NS_SHIFT [NC_NOX_SENS_CONF]	O/V	0... FFFFFFFFH	0... 4294970000	1	µl
Additional fuel consumption for NOx signal shift diagnosis					
LAMB_NS_MMV_NS_SHIFT [NC_NOX_SENS_CONF]	V	0... 7FFFFFFFH	0... 31.9999999851	14.9012e-9	-
Filtered LAMB_NS signal					
LAMB_NS_MMV_NS_SHIFT_DIF_ABSV [NC_NOX_SENS_CONF]	V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Absolut value of difference between filtered and origin LAMB_NS signals					
LV_DIAG_ACT_CDN_DYN_NS_TMP [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Dynamic activation conditions for the shift diagnosis due to NOx Sensor check					
LV_DIAG_ACT_CDN_DYN_TMP	V	0... 1H	0 ...1	1	-
Dynamic activation conditions for the shift diagnosis					
LV_DIAG_ACT_CDN_STAT_NS_TMP [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Static activation conditions for the shift diagnosis due to NOx Sensor check					
LV_DIAG_ACT_CDN_STAT_TMP	V	0... 1H	0 ...1	1	-
Static activation conditions for the shift diagnosis					
LV_DIAG_ACT_CDN_SUM [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Summary activation conditions for the shift diagnosis					
LV_DIAG_ACT_CDN_VLS_DOWN_TMP	V	0... 1H	0 ...1	1	-
Dynamic activation conditions for the shift diagnosis					
LV_DIAG_NS_SHIFT_END [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
The diagnosis was executed last time					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_REQ_NS_SHIFT [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Request for NOx sensor for active signal shift diagnosis					
LV_END_DIAG_NS_SHIFT_MNG_OLD [NC_NOX_SENS_CONF]	-	0... 1H	0 ...1	1	-
Old value of LV_END_DIAG_NS_SHIFT					
LV_ERR_NS_SHIFT_MNG_OLD [NC_NOX_SENS_CONF]	-	0... 1H	0 ...1	1	-
Old value of LV_ERR_NS_SHIFT					
LV_LAMB_REQ_DEAC_NS [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Deactivation combustion request due to NOx sensor binary signal					
LV_NS_SHIFT_CMB_INT_REQ	O/V	0... 1H	0 ...1	1	-
Request for combustion management					
LV_NS_SHIFT_CMB_INT_REQ_SNG [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Request for combustion management, NOx sensor specific					
LV_NS_SHIFT_DIAG_ACT_EXT_ADJ [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Activation of the diagnosis by service tool					
LV_NS_SHIFT_DIAG_DEAC_EXT_ADJ [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Manual deactivation of the diagnosis by service tool					
LV_NS_SHIFT_DIAG_EXT_ADJ [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
External adjustment values for NOx signal shift diagnosis available					
LV_NS_SHIFT_DIAG_INI [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Initialization of NOx signal shift diagnosis variables					
MAF_CYL_INT_NS_SHIFT	V	0... FFFFH	0... 1820.41666667	0.0277778	g
MAF integral for inhibition of the diagnosis after PUC phase					
MAF_CYL_INT_NS_SHIFT_DYN [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 1820.41666667	0.0277778	g
MAF integral during limited dynamics are fulfilled					
MAF_MMV_NS_SHIFT	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Filtered MAF signal					
MAF_MMV_NS_SHIFT_DIF_ABSV	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Absolut value of limited dynamic value of MAF					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_EOL_KWP_NS_SHIFT_DIAG [NC_NOX_SENS_CONF]	O/V	0H	NOT_START	-	-
		1H	ST_INH		
		2H	PAR_NOT_PLAUS		
		3H	WAIT_REL		
		4H	UNDEF		
		5H	ACT		
		6H	END_WOUT_RESULT		
		7H	ABORTED		
		8H	END_WOUT_ERR		
9H	END_WITH_ERR				
State of NOx-SensorShiftDiagnosis					
STATE_NS_SHIFT_CMB_REQ	O/V	0... FFFFH	0... 65535	1	-
Requested mode for combustion manager					
STATE_NS_SHIFT_DIAG [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 65535	1	-
NOx signal shift diagnosis state					
T_AFL_NS_SHIFT_DIAG_INH	V	0... FFFFH	0... 6553.5	0.1	s
Time since last successful regeneration					
T_NS_SHIFT_CMB_INT_REQ	V	0... FFFFH	0... 6553.5	0.1	s
Time for calculation of combustion request					
T_NS_SHIFT_CMB_INT_REQ_SUM	V	0... FFFFH	0... 6553.5	0.1	s
Timer of active request in one DC					
T_NS_SHIFT_DEAC_SO2P	V	0... FFFFH	0... 6553.5	0.1	s
Timer after desulphurization					
T_NS_SHIFT_DEAC_TEMP [NC_NOX_SENS_CONF]	V	0... 9FFH	0... 255	0.1	s
Timer for activation of the NOx signal shift diagnosis after set of the dew point					
T_NS_SHIFT_READY_WAIT [NC_NOX_SENS_CONF]	V	0... FFH	0... 25.5	0.1	s
Timer for waiting for sensor readiness					
T_NS_SHIFT_WAIT_REP [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for repetition of NOx signal shift diagnosis					
T_NS_SHIFT_WAIT_REP_REQ [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for repetition of NOx signal shift diagnosis combustion request					
TQI_MMV_NS_SHIFT	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Filtered TQI_AV_signal					
TQI_MMV_NS_SHIFT_DIF_ABSV	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Absolut value of limited dynamic value of TQI					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VLS_DOWN_MMV_NS_SHIFT [NC_CBK_EX_NR]	V	0... FFFFH	0... 4.99992371	76.2939e-6	V
Filtered VLS_DOWN signal					
VLS_NS_MMV_NS_SHIFT [NC_NOX_SENS_CONF]	V	80000000... 7FFFFFFFH	-1200... 1199.99999944	558.794e-9	mV
Filtered VLS_NS_REF_MMV_NS_SHIFT signal					
VLS_NS_MMV_NS_SHIFT_DIF_ABSV [NC_NOX_SENS_CONF]	V	8000... 7FFFH	-1200... 1199.96337891	0.0366211	mV
Absolut value of difference between first and second filtered VLS_NS signal					
VLS_NS_REF_CHK_DIAG_VLD [NC_NOX_SENS_CONF]	V	8000... 7FFFH	-1200... 1199.96337891	0.0366211	mV
Reference VLS_NS signal for check of the diagnosis validity					
VLS_NS_REF_MMV_NS_SHIFT [NC_NOX_SENS_CONF]	V	8000... 7FFFH	-1200... 1199.96337891	0.0366211	mV
Filtered VLS_NS signal					
VLS_NS_REF_MMV_NS_SHIFT_MAX [NC_NOX_SENS_CONF]	V	8000... 7FFFH	-1200... 1199.96337891	0.0366211	mV
Maximum reference value for check validation of the NOx sensor binary signal					
VLS_NS_REF_MMV_NS_SHIFT_MIN [NC_NOX_SENS_CONF]	V	8000... 7FFFH	-1200... 1199.96337891	0.0366211	mV
Minimum reference value for check validation of the NOx sensor binary signal					

**Input data:**

AMP {p. 982}	CTR_NS_SHIFT_CYC_ EXT_ADJ [NC_NOX_SENS_CONF] {p. 7679}	DIST_NS_NEW {p. 3193}	DIST_NT {p. 3180}
DIST_NT_NS_SHIFT_ EXT_ADJ [NC_NOX_SENS_CONF] {p. 7679}	EFF_CAT_DIAG_HOM [NC_CBK_EX_NR] {p. 5473}	FCO {p. 3846}	FCO_AV_1 {p. 3846}
FCO_AV_2 {p. 3846}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_NS [NC_NOX_SENS_CONF] {p. 991}	LV_END_DIAG_NS_SHIFT [NC_NOX_SENS_CONF] {p. 6412}
LV_ERR_NS_SHIFT [NC_NOX_SENS_CONF] {p. 6412}	LV_INH_DIAG_NS_OBD_ 2_SHIFT [NC_NOX_SENS_CONF] {p. 6468}	LV_LAM_ADJ_ACT [NC_CBK_EX_NR] {p. 2589}	LV_NS_AD_REQ {p. 3189}
LV_PUC {p. 1720}	LV_RGN_NT_REQ {p. 2983}	LV_SENS_AFR [NC_NT_NR] {p. 2983}	LV_SO2P_REQ {p. 3129}
LV_TEMP_NS_OK [NC_NOX_SENS_CONF] {p. 991}	MAF {p. 8277}	MAF_CYL {p. 8277}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_NOX_SENS_CONF {p. 643}	NOX_NS_AD [NC_NOX_SENS_CONF] {p. 3193}

NOX_NS_DIAG [NC_NOX_SENS_CONF] {p. 992}	NT_AGI_THERMO {p. 3073}	NTLD {p. 2986}	O2L_CAT_DIAG_AFL [NC_CBK_EX_NR] {p. 5562}
OPM_AV {p. 8137}	OPM_REQ_CUS {p. 8137}	STATE_NOX {p. 2986}	STATE_NS [NC_NOX_SENS_CONF] {p. 1381}
T_AST_SAE {p. 1766}	TCO_ST {p. 1100}	TCO_ST_DC {p. 1100}	TIA {p. 1226}
TNT_MDL_MV {p. 8237}	TQI_AV {p. 981}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_NS [NC_NOX_SENS_CONF] {p. 992}
VS {p. 1176}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_MIN_NS_SHIFT_DIAG_ACT	-	0... FFFFH	0... 5434	0.0829175	hPa
Minimum ambient pressure for activation of the diagnosis					
C_CRLC_LAMB_NS_MMV_NS_SHIFT	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation factor for LAMB_NS filtering					
C_CRLC_MAF_MMV_NS_SHIFT	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation factor for MAF filtering					
C_CRLC_TQI_MMV_NS_SHIFT	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation factor for TQI filtering					
C_CRLC_VLS_DOWN_MMV_NS_SHIFT	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation factor for VLS_DOWN filtering					
C_CRLC_VLS_NS_MMV_NS_SHIFT	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation factor for VLS_NS second filtering					
C_CRLC_VLS_NS_REF_MMV_NS_SHIFT	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation factor for VLS_NS first filtering					
C_CTR_NS_SHIFT_CYC_NOT_VLD_EXT	-	0... FFH	0... 255	1	-
Maximal number of additional not valid diagnosis cycles - valid at activation by service tool					
C_CTR_NS_SHIFT_CYC_NOT_VLD_MAX	-	0... FFH	0... 255	1	-
Maximal number of additional not valid diagnosis cycles					
C_CTR_NS_SHIFT_CYC_VLD_EXT	-	0... FFH	0... 255	1	-
Maximal number of additional valid diagnosis cycles - valid at activation by service tool					
C_CTR_NS_SHIFT_CYC_VLD_MAX	-	0... FFH	0... 255	1	-
Maximal number of additional valid diagnosis cycles					
C_CTR_THD_NS_SHIFT_DIAG_INH	-	0... FFH	0... 255	1	-
Minimum number of successful regenerations for activation of the NOx signal shift diagnosis					
C_DIST_NT_NS_SHIFT_MIN	-	0... FFFFH	0... 524280	8	km
Minimum distance between two active NOx signal diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DIST_NT_NS_SHIFT_MIN_NEW	-	0... FFFFH	0... 524280	8	km
Minimum distance for activation first active NOx signal diagnosis					
C_EFF_CAT_MAX_DIAG_HOM_NS_SHIFT [NC_CBK_EX_NR]	-	0... FFH	0... 1.9921875	7.8125e-3	-
Maximum homogeneous catalyst diagnosis value for activation of the diagnosis					
C_FAC_AGI_MIN_THERMO_NS_SHIFT	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Minimum thermal aging factor of NT for activation of the diagnosis					
C_LAMB_MAX_NS_SHIFT_DIAG_ACT	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Maximum lambda threshold for activation of the NOx signal shift diagnosis					
C_LAMB_MIN_NS_SHIFT_DIAG_ACT	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Minimum lambda threshold for activation of the NOx signal shift diagnosis					
C_LAMB_NS_MMV_THD_LDC_ABSV	-	0... FFFFH	0... 31.9995117188	488.281e-6	-
Limited dynamic threshold for LAMB_NS signal					
C_LAMB_NS_THD_NS_SHIFT_MAX	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Maximum NOx sensor lambda signal for activation of the diagnosis					
C_LAMB_NS_THD_NS_SHIFT_MIN	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Minimum NOx sensor lambda signal for activation of the diagnosis					
C_MAF_CYL_INT_NS_SHIFT_INI	-	0... FFFFH	0... 1820.41666667	0.0277778	g
Initialization value of MAF integral after PUC phase					
C_MAF_MMV_THD_NS_SHIFT	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Threshold for limited dynamic of MAF					
C_MAF_THD_MAX_NS_SHIFT	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Upper MAF threshold for activation of the diagnosis					
C_MAF_THD_MIN_NS_SHIFT	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Lower MAF threshold for activation of the diagnosis					
C_N_32_MAX_NS_SHIFT_DIAG_ACT	-	0... FFH	0... 8160	32	rpm
Maximum N_32 value for activation of the diagnosis					
C_N_32_MIN_NS_SHIFT_DIAG_ACT	-	0... FFH	0... 8160	32	rpm
Minimum N_32 value for activation of the diagnosis					
C_NOX_MAX_NS_SHIFT_DIAG_ACT	-	FF9C... 5DCH	-100 ...1500	1	ppm
Maximum value of NOx signal for activation of the diagnosis					
C_NTLD_THD_MAX_NS_SHIFT	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Allowed NOx trap loading grad for activation of the NOx signal shift diagnosis					
C_NTLD_THD_MAX_NS_SHIFT_ACT_REQ	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Allowed NOx trap loading degree for active NOx signal shift diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NTLD_THD_MIN_NS_SHIFT_ACT_REQ	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Minimum allowed NOx trap loading degree for active NOx signal shift diagnosis					
C_NTLD_THD_NS_SHIFT_DIAG_INH	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Minimum NTLD value for recognition of long lean phase					
C_O2L_CAT_MIN_DIAG_AFL_NS_SHIFT [NC_CBK_EX_NR]	-	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Minimum lean catalyst diagnosis value for activation of the diagnosis					
C_STATE_NS_REP_INI_NS_SHIFT	-	0... FFH	0... 255	1	-
Initialization of repetition timer in state DIAG					
C_STATE_NS_SHIFT_CMB_REQ	-	0... FFFFH	0... 65535	1	-
Combustion mode request for NOx signal internal shift diagnosis					
C_T_AFL_THD_NS_SHIFT_DIAG_INH	-	0... FFFFH	0... 6553.5	0.1	s
Minimum lean time since last successful regeneration for inhibition of the NOx signal shift diagnosis					
C_T_MIN_NS_SHIFT_DEAC_SO2P	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time for inhibition of the diagnosis after desulphurization					
C_T_NS_SHIFT_CMB_INT_REQ_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time for set of combustion request for NOx signal shift diagnosis					
C_T_NS_SHIFT_CMB_MAX_NS_CHK	-	0... FFFFH	0... 6553.5	0.1	s
Waiting time for valid binary NOx sensor signal					
C_T_NS_SHIFT_DEAC_TEMP_MIN	-	0... 9F6H	0... 255	0.1	s
Minimum time for activation of the NOx signal shift diagnosis after set of dew point					
C_T_NS_SHIFT_READY_WAIT_MAX	-	0... FFH	0... 25.5	0.1	s
Maximum time for waiting for NOx sensor readiness for diagnosis					
C_T_NS_SHIFT_WAIT_REP_MIN	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time for repetition of the NOx sensor shift diagnosis					
C_T_NS_SHIFT_WAIT_REP_MIN_REQ	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time for repetition of the HOM request for NOx sensor shift diagnosis					
C_TIA_MAX_NS_SHIFT_DIAG_ACT	-	0... FEH	-48... 142.5	0.75	°C
Maximum TIA value for activation of the diagnosis					
C_TIA_MIN_NS_SHIFT_DIAG_ACT	-	0... FEH	-48... 142.5	0.75	°C
Minimum TIA value for activation of the diagnosis					
C_TNT_THD_MAX_NS_SHIFT	-	0... FFFFH	0... 1023.984375	0.015625	°C
Upper TNT threshold for activation of the diagnosis					
C_TNT_THD_MIN_NS_SHIFT	-	0... FFFFH	0... 1023.984375	0.015625	°C
Lower TNT threshold for activation of the diagnosis					
C_TQI_MMV_THD_HOM_REQ_NS_SHIFT	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limited dynamic threshold of TQI for set of the HOM request					
C_TQI_MMV_THD_NS_SHIFT	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Threshold for limited dynamic of TQI_AV					
C_VLS_DOWN_MAX_NS_SHIFT [NC_CBK_EX_NR]	-	0... FFFFH	0... 4.99992371	76.2939e-6	V
Maximum threshold for VLS_DOWN for activation of the function					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VLS_DOWN_MIN_NS_SHIFT [NC_CBK_EX_NR]	-	0... FFFFH	0... 4.99992371	76.2939e-6	V
Maximum threshold for VLS_DOWN for activation of the function					
C_VLS_NS_MMV_THD_LDC_ABSV	-	8000... 7FFFH	-1200... 1199.96337891	0.0366211	mV
Limited dynamic threshold for LAMB_NS signal					
C_VLS_NS_THD_CMB_REQ_NS_SHIFT	-	8000... 7FFFH	-1200... 1199.96337891	0.0366211	mV
Threshold of binary NOx sensor signal for re-activation of the combustion request					
C_VLS_NS_THD_NS_SHIFT_EXT	-	0... 578H	-200 ...1200	1	mV
Maximum threshold for VLS_NS for activation of the diagnosis, for external manual activation					
C_VLS_NS_THD_NS_SHIFT_MAX	-	8000... 7FFFH	-1200... 1199.96337891	0.0366211	mV
Maximum threshold for VLS_NS for activation of the diagnosis					
C_VLS_NS_THD_NS_SHIFT_MIN	-	8000... 7FFFH	-1200... 1199.96337891	0.0366211	mV
Minimum threshold for VLS_NS for activation of the diagnosis					
C_VS_MAX_NS_SHIFT_DIAG_ACT	-	0... FFH	0... 255	1	km/h
Maximum VS value for activation of the diagnosis					
C_VS_MIN_NS_SHIFT_DIAG_ACT	-	0... FFH	0... 255	1	km/h
Minimum VS value for activation of the diagnosis					
IP_FCO_DELTA_NS_SHIFT_MAX	-	0... FFFFFFFFH	0... 4294970000	1	µl
LDP_FCO_IP_FCO_DELTA_NS_SHIFT	6	0... FFFFFFFFH	0... 4294970000	1	µl
Maximal allowed additional fuel consumption for NOx signal shift diagnosis					
IP_MAF_CYL_INT_NS_SHIFT_INI_DYN	-	0... FFFFH	0... 1820.42	0.0277778	g
LDP_N_32_IP_MAF_CYL_INT_SHIFT	4	0... FFH	0... 8160	32	rpm
Initialization value of MAF integral for diagnosis activation due to limited dynamics					
IP_T_AST_MIN_NS_SHIFT	-	0... FFFFH	0... 65535	1	s
LDP_TCO_ST_IP_T_AST_MIN_SHIFT	6	0... FEH	-48... 142.5	0.75	°C
Minimum time after engine start for function activation					
IP_T_NS_SHIFT_CMB_INT_REQ_SUM	-	0... FFFFH	0... 6553.5	0.1	s
LDP_T_AST_SAE_IP_T_NS_SHIFT	6	0... FFFFH	0... 65535	1	s
Inhibition of combustion request due to total request time					
IP_VLS_NS_THD_DELTA_MAX_MMV	-	0... FFFFH	-1200... 1199.96337891	0.0366211	mV
LDPM_VLS_NS_IP_VLS_NS_VLD	4	0... FFFFH	-1200... 1199.96337891	0.0366211	mV
Threshold to check difference between maximum and actual value of binary NOx sensor signal					
IP_VLS_NS_THD_DELTA_MAX_REF	-	0... FFFFH	-1200... 1199.96337891	0.0366211	mV
LDPM_VLS_NS_IP_VLS_NS_VLD	4	0... FFFFH	-1200... 1199.96337891	0.0366211	mV
Threshold to check difference between maximum and reference of binary NOx sensor signal					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_VLS_NS_THD_DELTA_MIN_REF	-	0... FFFFH	-1200... 1199.96337891	0.0366211	mV
Threshold to check difference between reference and minimum of binary NOx sensor signal					
LDPM_VLS_NS_IP_VLS_NS_VLD	4	0... FFFFH	-1200... 1199.96337891	0.0366211	mV
Activation of saving of distance value between diagnosis at writing of SAE values					
LC_DIST_NT_SHIFT_DIAG_ACT	-	0... 1H	0 ...1	1	-
Manual deactivation of check of trim controller					
LC_LAM_ADJ_ACT_NS_SHIFT [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Manual choice of NOx signal for activation					
LC_NS_AD_REQ_MAN_DEAC	-	0... 1H	0 ...1	1	-
Manual deactivation of inhibition during NOx signal gain adaptation					
LC_NS_SHIFT_SET_HOM_REQ	-	0... 1H	0 ...1	1	-
Activation of keeping of the HOM request independently on it set conditions					
LC_SWI_REP_ENA_DIAG_END	-	0... 1H	0 ...1	1	-
Manual deactivation of check of readiness flag of the NOx signal shift OBDII diagnosis					
LC_SWI_REP_ENA_NS_SHIFT	-	0... 1H	0 ...1	1	-
Manual reinitialization of the finished diagnosis					
LC_TCO_SWI_NS_SHIFT	-	0... 1H	0 ...1	1	-
Switch between TCO_ST and TCO_ST_DC					

## Action definition

<b>ACTION_NOXD_CleanNSShiftAdapt ()</b>	Mode: O
Initialization of NOx signal shift diagnosis values	
<b>ACTION_NOXD_EndNSShiftDiag ()</b>	Mode: O
Manual end of the NOx signal Shift Diagnosis	
<b>ACTION_NOXD_StartNSShiftDiag ()</b>	Mode: O
Manual initialization of the NOx signal Shift Diagnosis	
<b>ACTION_NOXD_WriteNSShiftDiagExtAdj ()</b>	Mode: O
Write external adjust values for NOx Sensor shift diagnosis	

## Description for Actions

<b>ACTION_NOXD_CleanNSShiftAdapt()</b>
Initialization of NOx signal shift diagnosis values
<b>ACTION_NOXD_EndNSShiftDiag()</b>
Manual end of the NOx signal Shift Diagnosis

**ACTION\_NOXD\_StartNNShiftDiag()**

Manual initialization of the NOx signal Shift Diagnosis

**ACTION\_NOXD\_WriteNSShiftDiagExtAdj()**

Write external adjust values for NOx Sensor shift diagnosis

**General Information**

Introduction of NOx signal internal setpoint shift diagnosis.

When activation conditions are fulfilled, then a request for the NOx signal shift is generated. In this case, via modification of NOx sensor internal signals the diagnosis is executed. After the NOx sensor delivered it status, the diagnosis is either finished or paused, depending on allowed length.

Description of the STATE\_NS\_SHIFT\_DIAG actions:

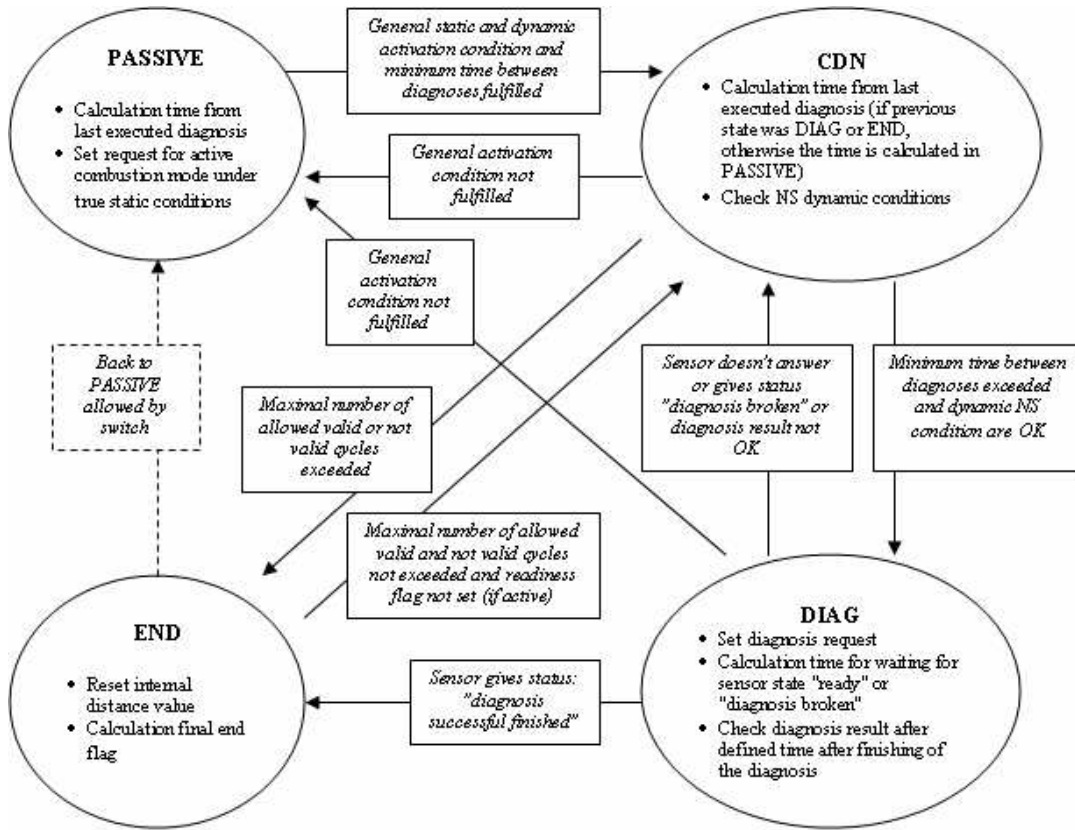
PASSIVE: check of activation condition, especially combustion state

CDN: if the combustion conditions are fulfilled, switch to DIAG state is done after minimum time between two diagnoses. In case of executed maximum of valid or not valid diagnoses, switch to END state is done.

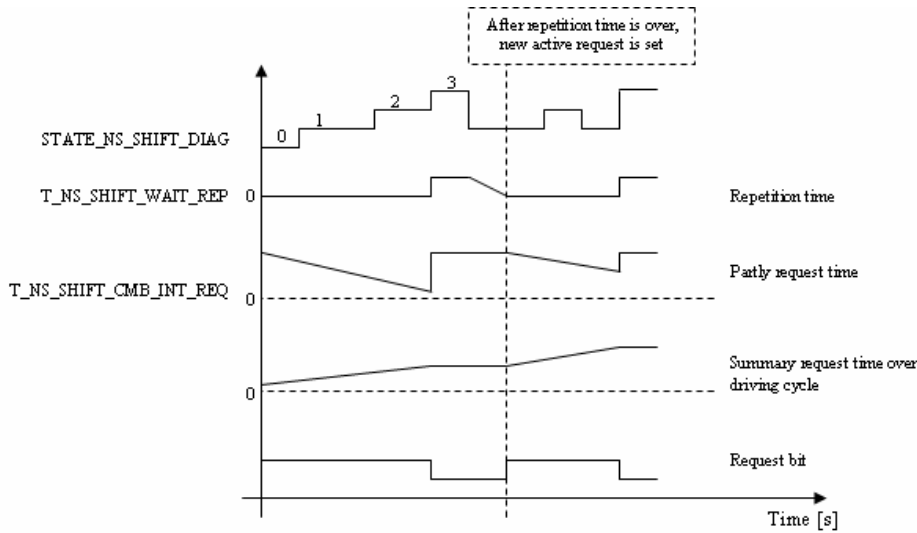
DIAG: if the combustion conditions are fulfilled, request for the diagnosis is sent to the NOx sensor. If the sensor doesn't confirm it readiness, transition to the CDN is performed and counter for not valid cycle calculated. In case of valid diagnosis cycle, transition to the END state is done

END: if maximum number of not valid or valid diagnoses is not exceeded, transition to the CDN state is done. In all other cases (except manual switch), no any transition is done and the diagnosis is finally finished

Short overview of states:

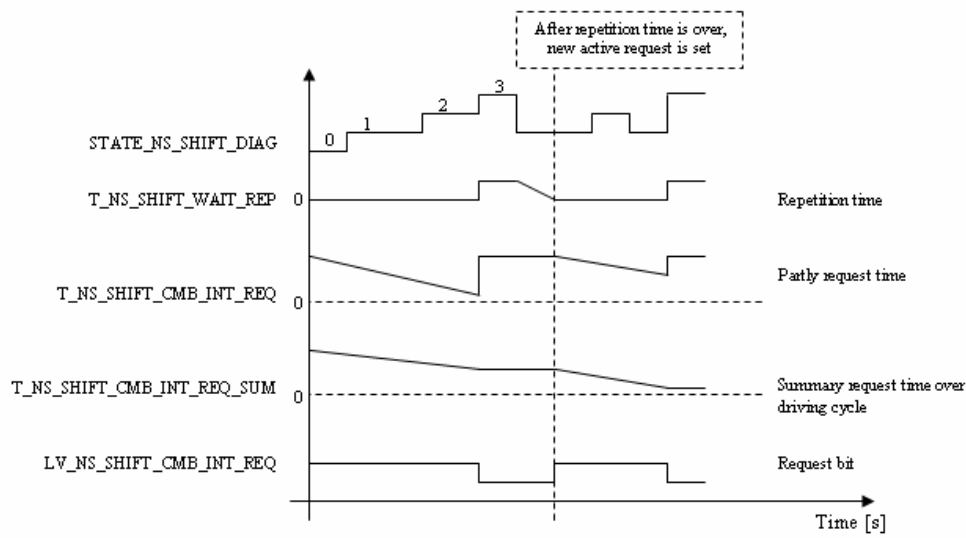


Short overview of valid and not valid counters:



Short overview of timers:

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**Application Conditions**

Initialization: RST, NVMINI, NVMRES, NVMSTO

Recurrence: 100MS

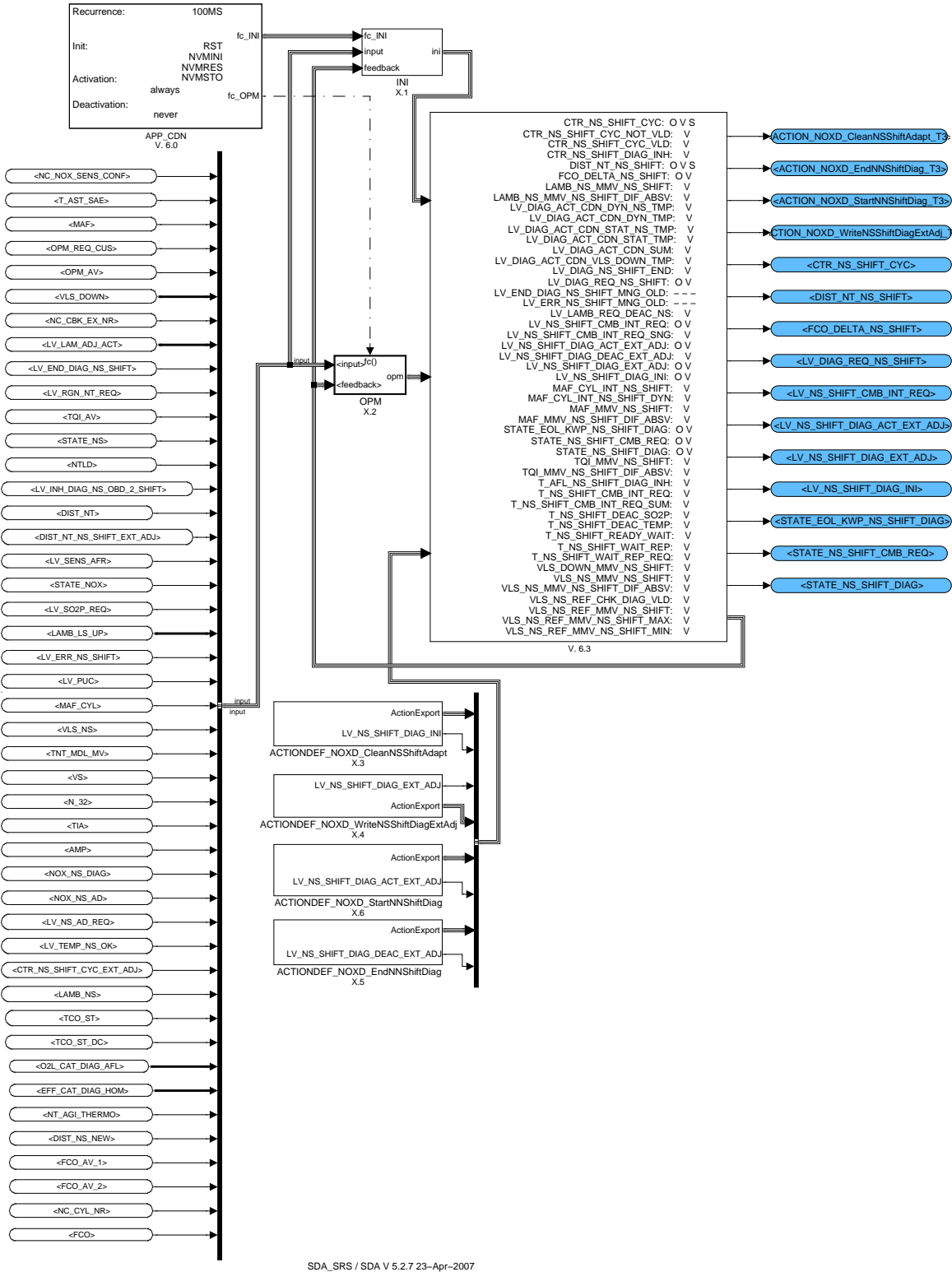
Activation: always

Deactivation: never

**Function description**

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Figure B.128.1: :

## B.128.1 INITIALIZATION

### B.128.1.1 Initialization at RESET

All variables except listed below are initialized by "0"

#### B.128.1.1.1 List of variables which are not initialized by "0"

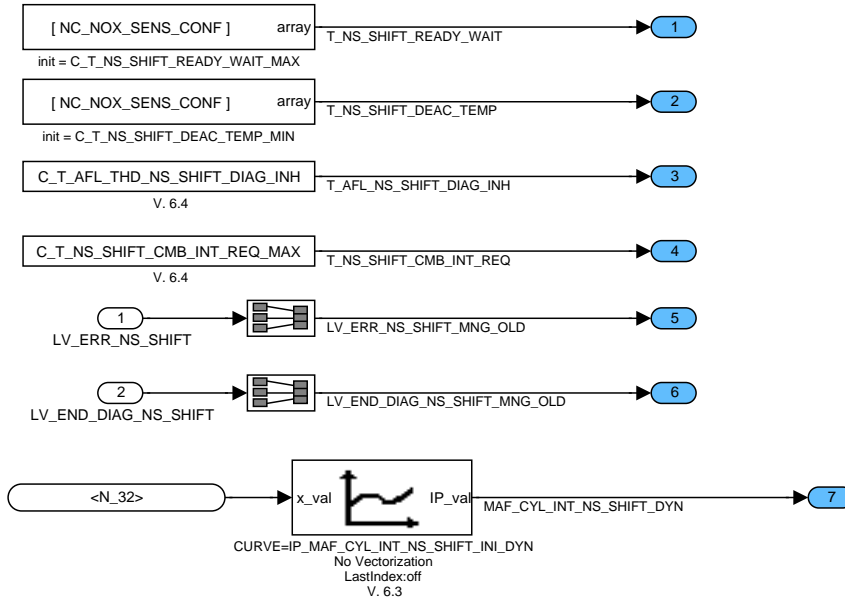


Figure B.128.2: :

### B.128.1.2 Initialization of NVMY data at memory fault

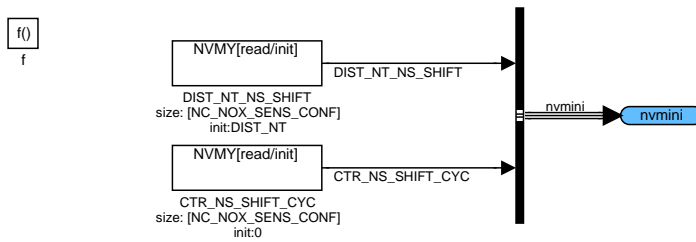


Figure B.128.3: :

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## B.128.2 Formula section

### B.128.2.1 General activation condition

#### B.128.2.1.1 Check of loading degree of the NOx storage catalyst after long lean phase

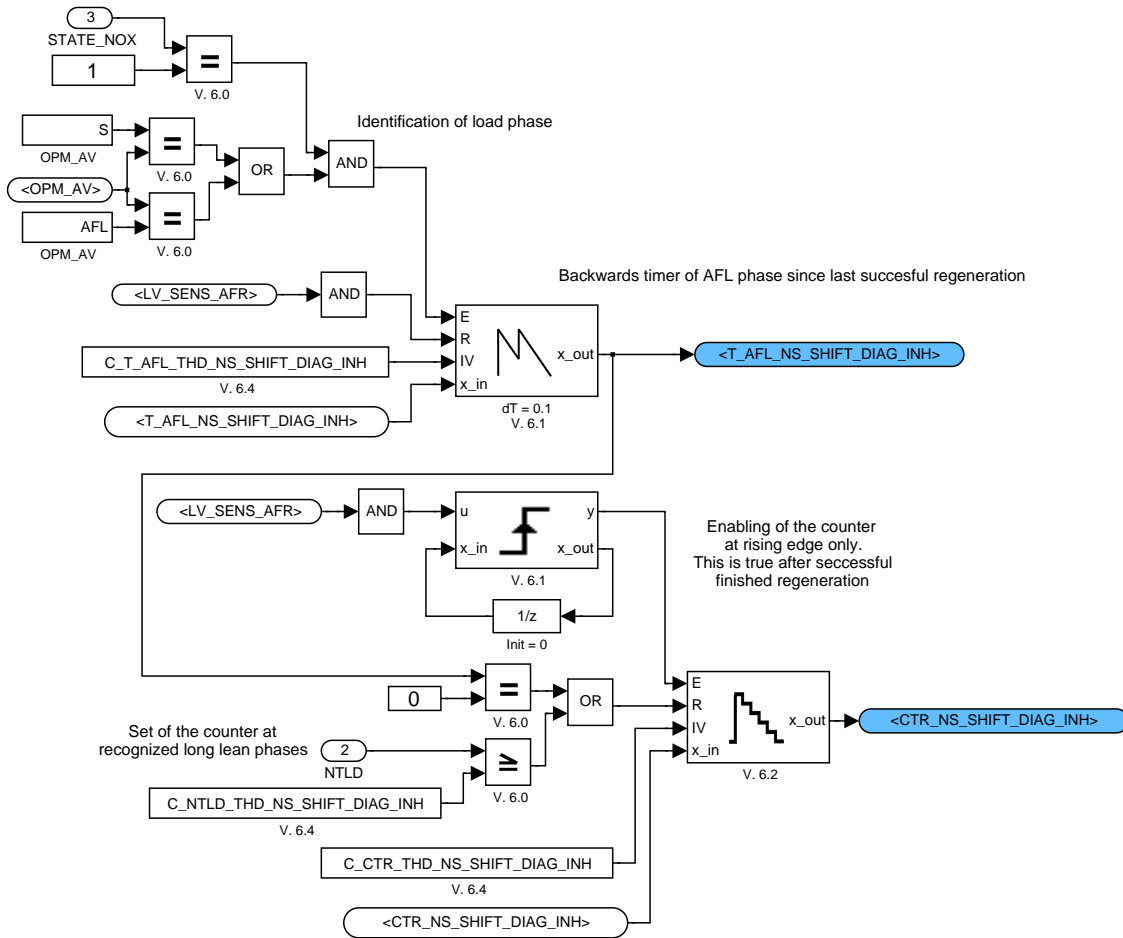


Figure B.128.4: :

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**B.128.2.1.2 Calculation of limited dynamics**

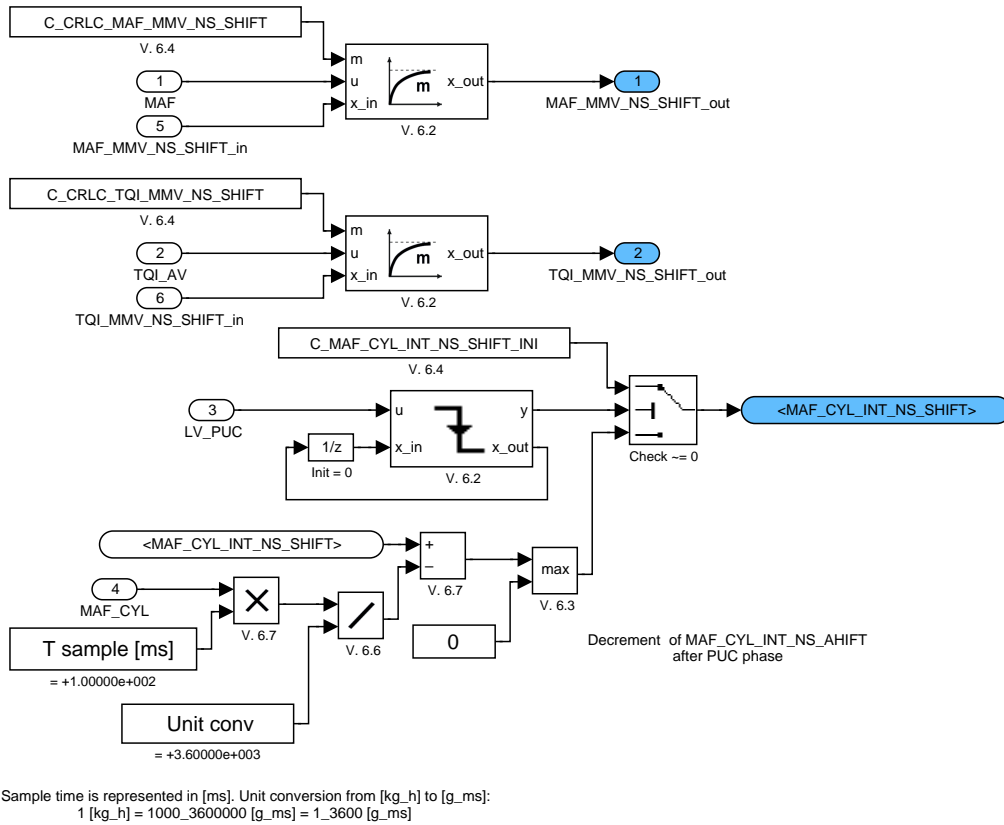


Figure B.128.5: :

**B.128.2.1.3 Calculation of timer after desulphurization**

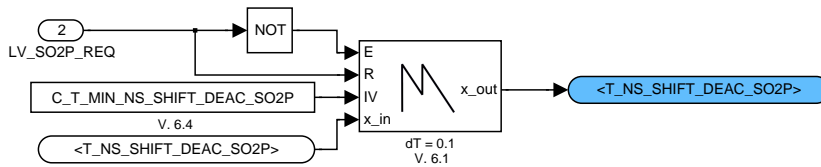
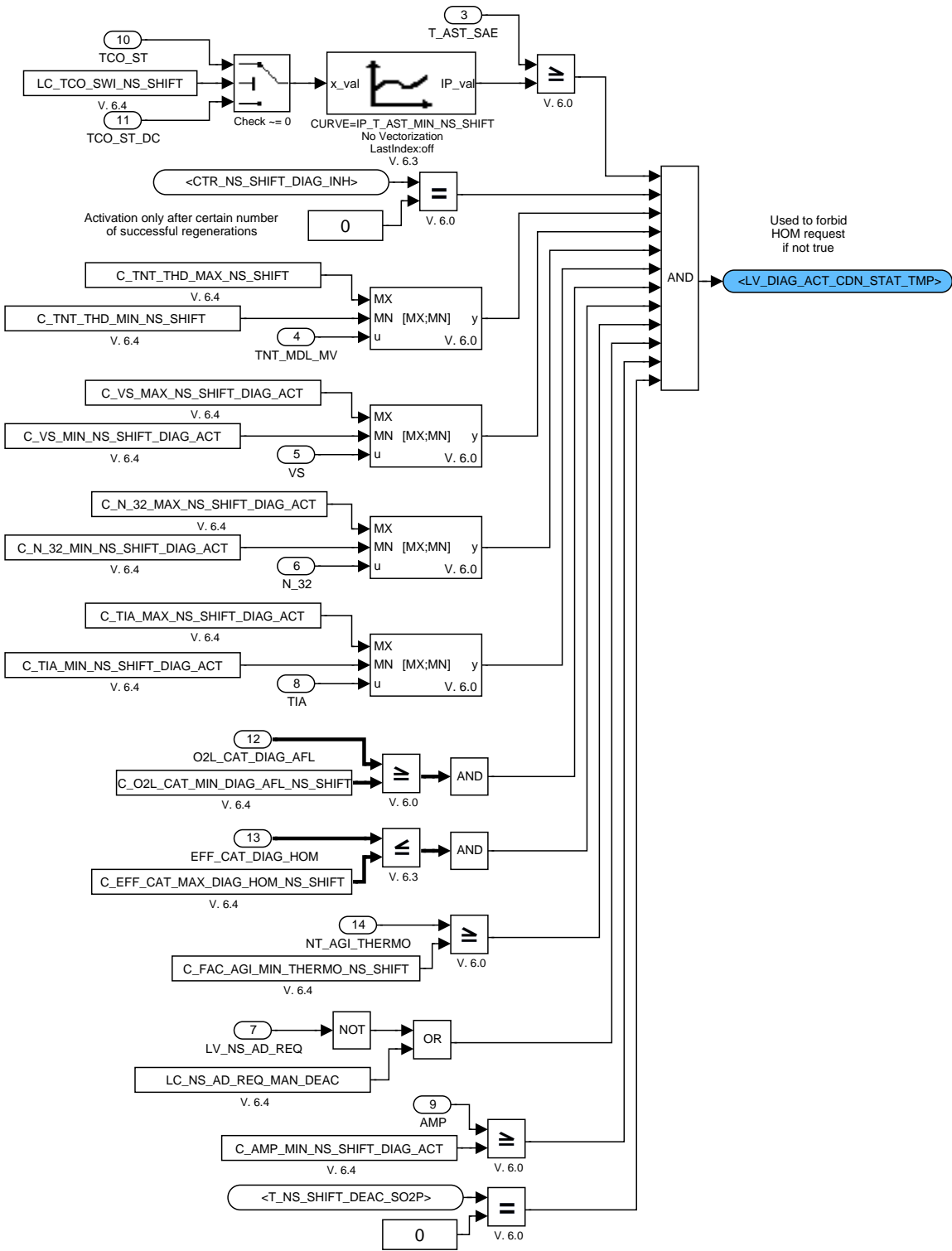


Figure B.128.6: :

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**B.128.2.1.4 Check static conditions**



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Figure B.128.7: :

**B.128.2.1.5 Dynamic conditions**

**B.128.2.1.5.1 Calculation dynamic conditions**

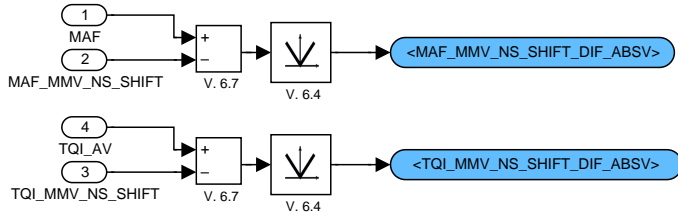


Figure B.128.8: :

**B.128.2.1.5.2 Check dynamic conditions**

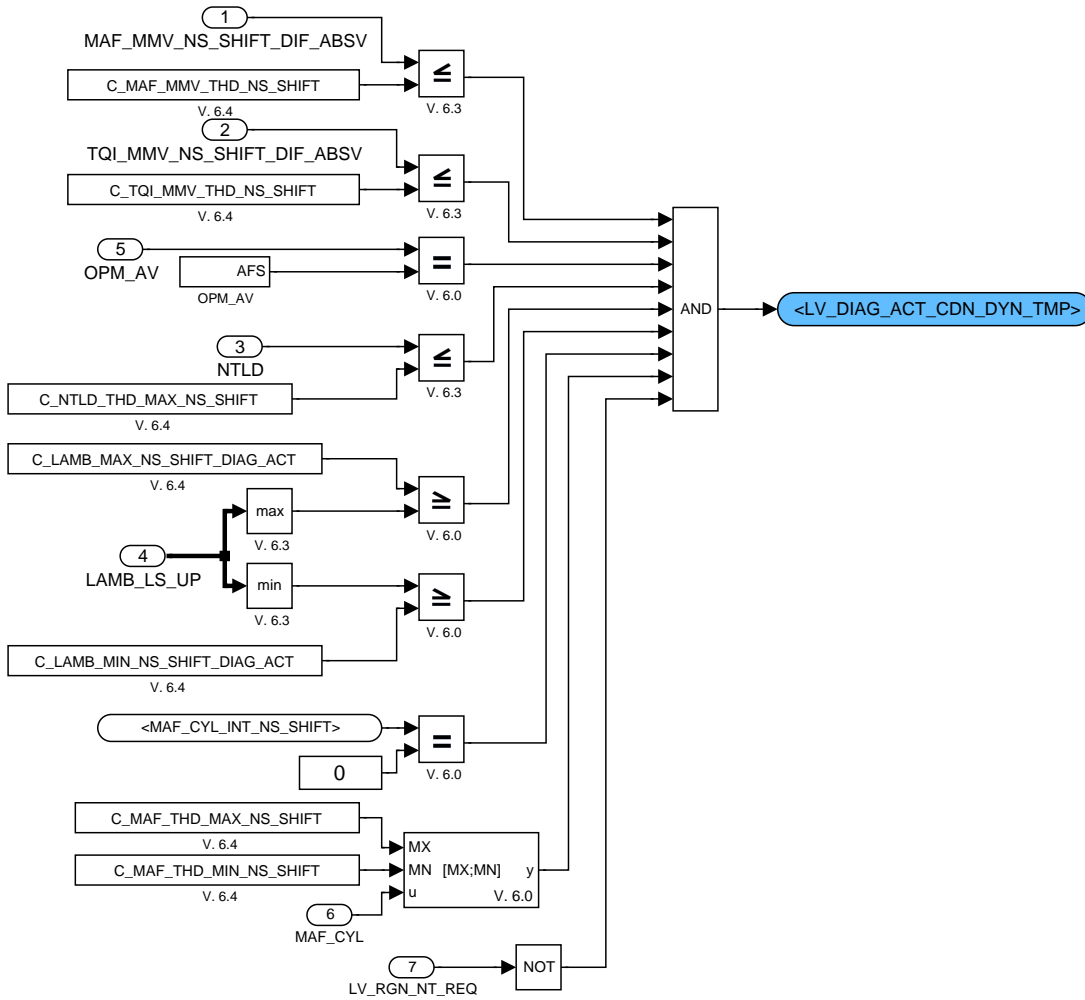


Figure B.128.9: :

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### B.128.2.1.6 Introduction multiple bank system for check binary lambda signal

#### B.128.2.1.6.1 Check binary lambda signal after pre-catalyst

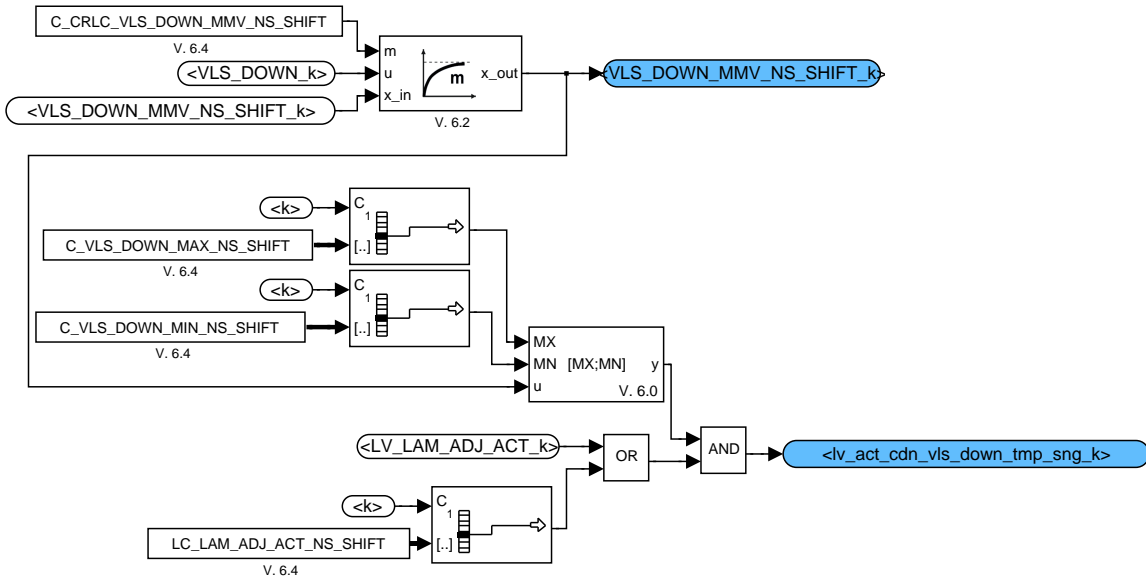


Figure B.128.10: :

#### B.128.2.1.7 Check activation due VLS\_DOWN signal over all exhaust banks

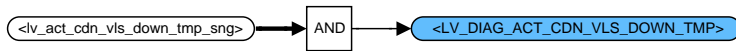


Figure B.128.11: :

### B.128.2.2 Introduction multiple sensor system

#### B.128.2.2.1 Summary activation flag

##### B.128.2.2.1.1 Check static and dynamic conditions of NOx sensor signal

###### B.128.2.2.1.1.1 Static conditions

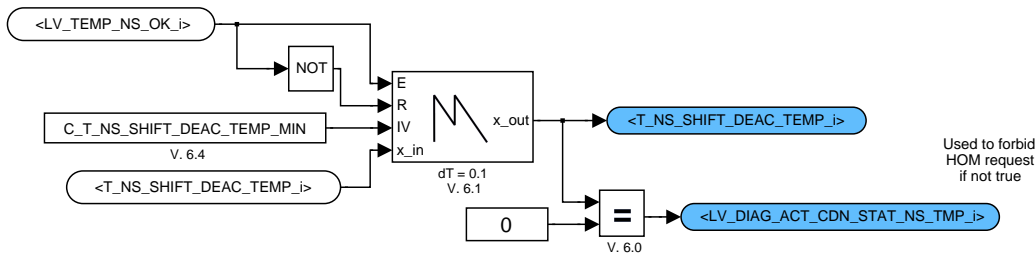


Figure B.128.12: :

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### B.128.2.2.1.1.2 Filtering of the VLS\_NS signal

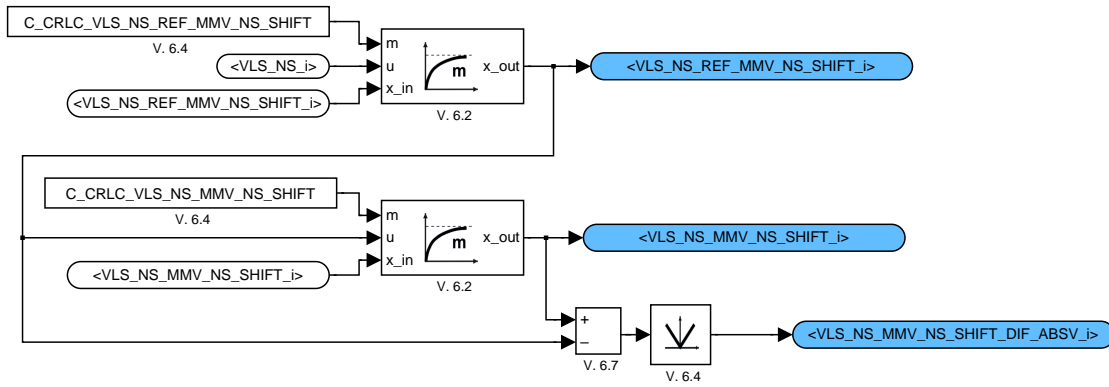


Figure B.128.13: :

### B.128.2.2.1.1.3 Dynamic of NOx sensor lambda signal

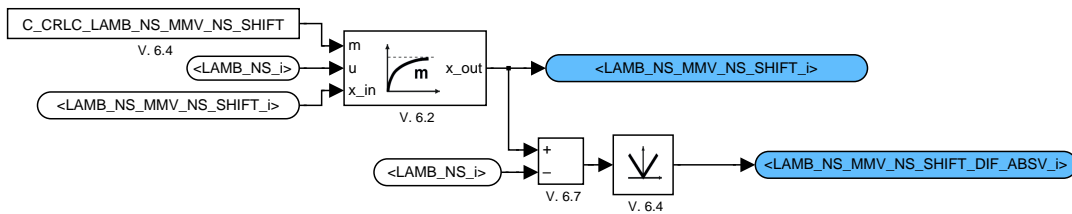


Figure B.128.14: :

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### B.128.2.2.1.1.4 Calculation MAF integral at fulfilled dynamic conditions

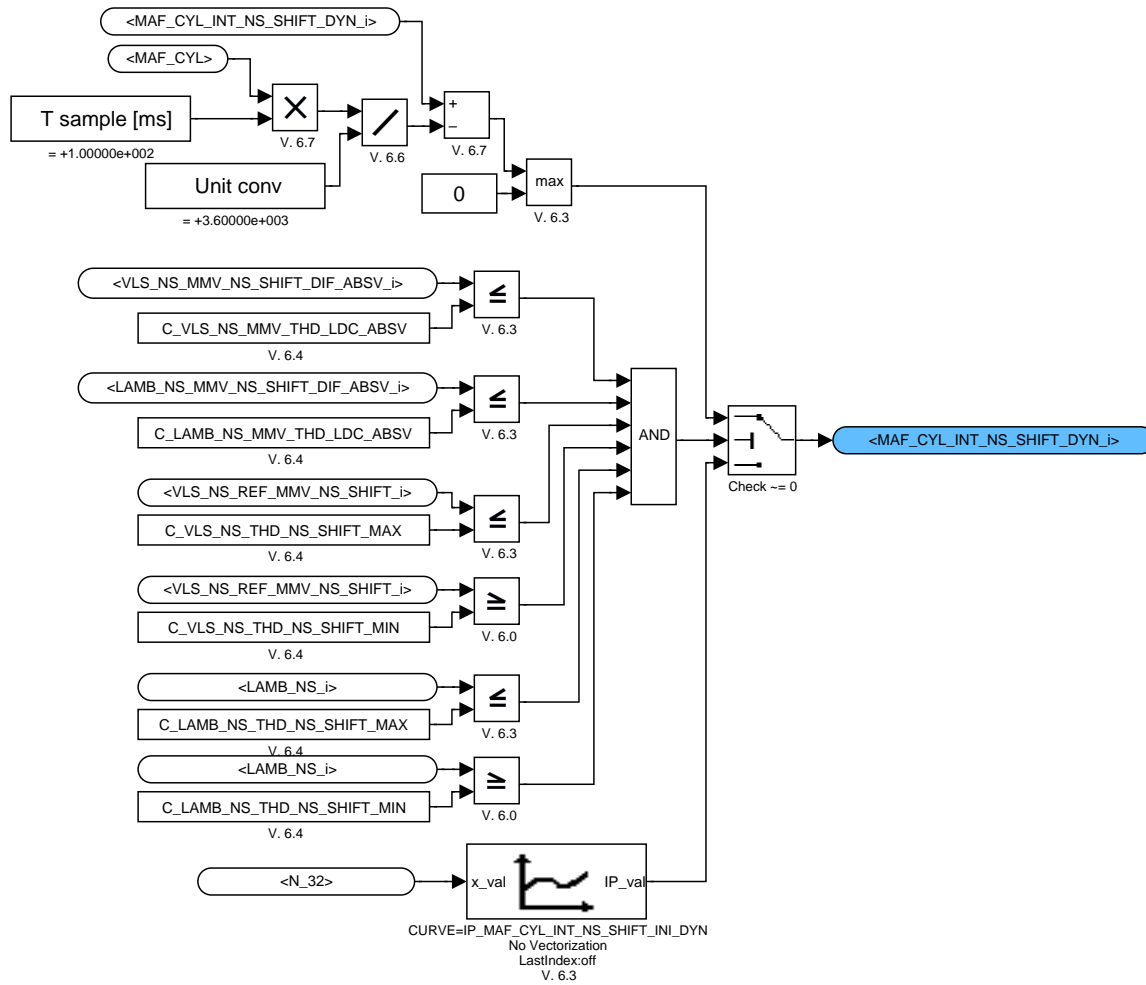


Figure B.128.15: :

### B.128.2.2.1.1.5 Calculation of the repetition timer

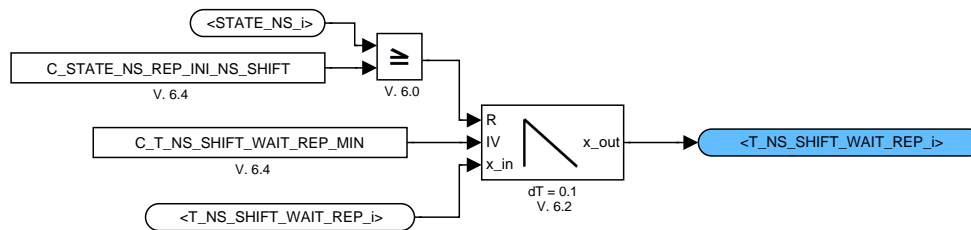


Figure B.128.16: :

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**B.128.2.2.1.1.6 Final dynamic conditions**

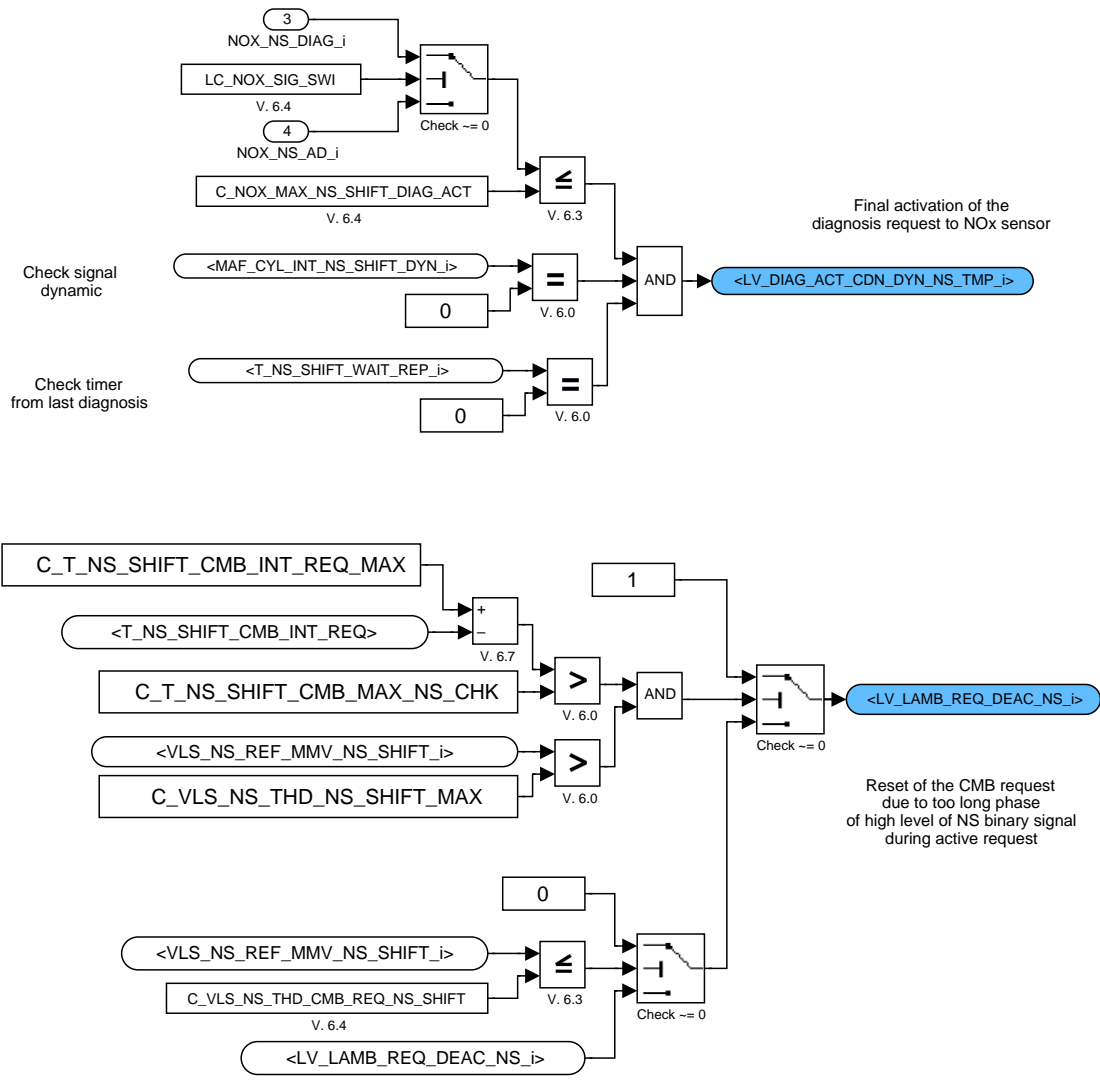


Figure B.128.17: :

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### B.128.2.2.1.1.7 Calculation of additional fuel consumption for activation of combustion request

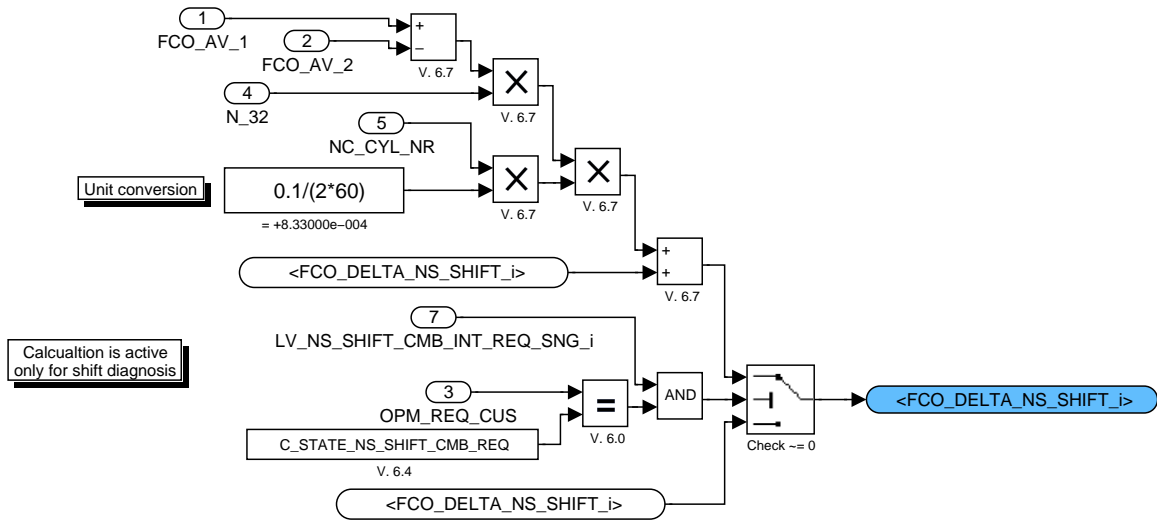


Figure B.128.18: :

### B.128.2.2.1.2 Check summary activation conditions

Parallel to the common activation condition, the diagnosis can be activated by service tool

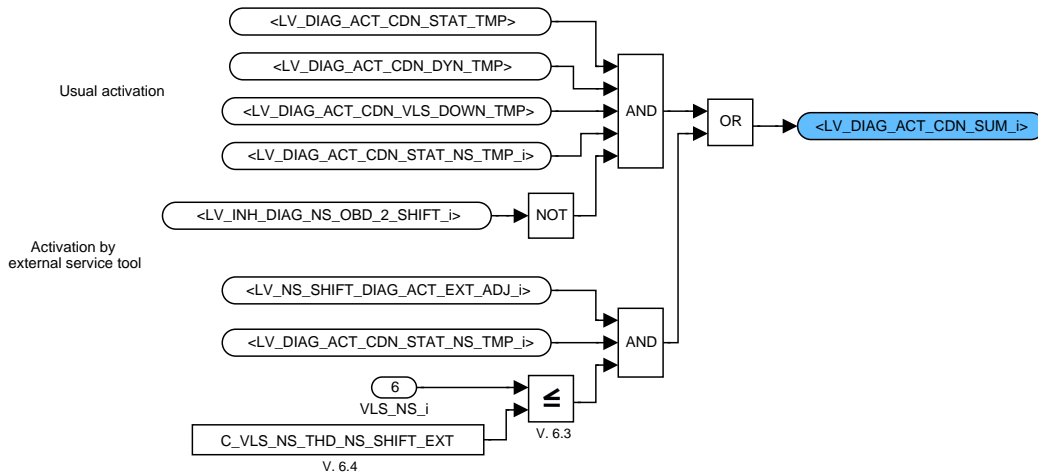


Figure B.128.19: :

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### B.128.2.2.2 Check transition conditions of STATE\_NS\_SHIFT\_DIAG

#### B.128.2.2.2.1 From PASSIVE

##### B.128.2.2.2.1.1 Check transition conditions from PASSIVE

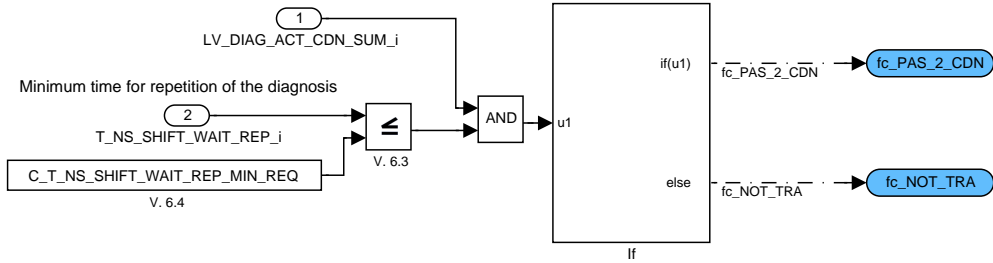


Figure B.128.20: :

##### B.128.2.2.2.1.2 Transition PASSIVE to CDN - actions

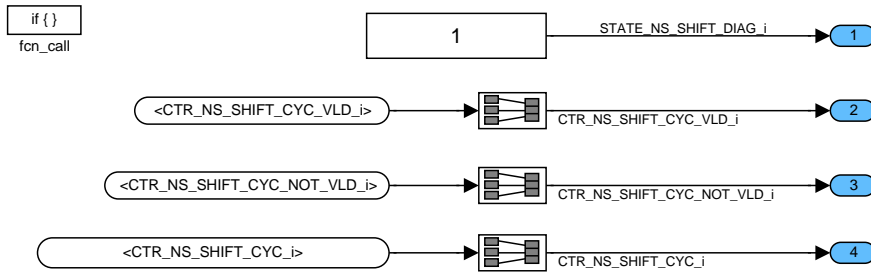


Figure B.128.21: :

##### B.128.2.2.2.1.3 Actions at no transition from PASSIVE

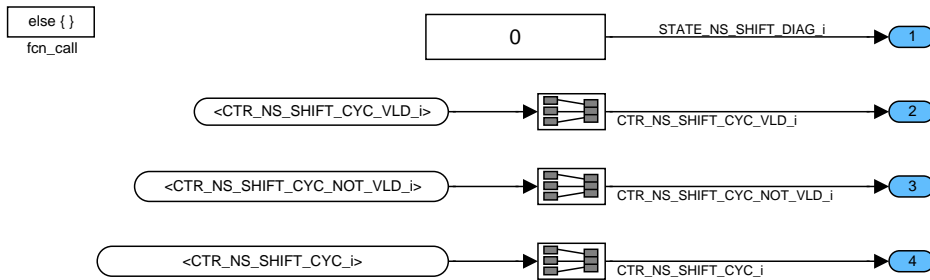


Figure B.128.22: :

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### B.128.2.2.2 From CDN

#### B.128.2.2.2.1 Check transition conditions from CDN

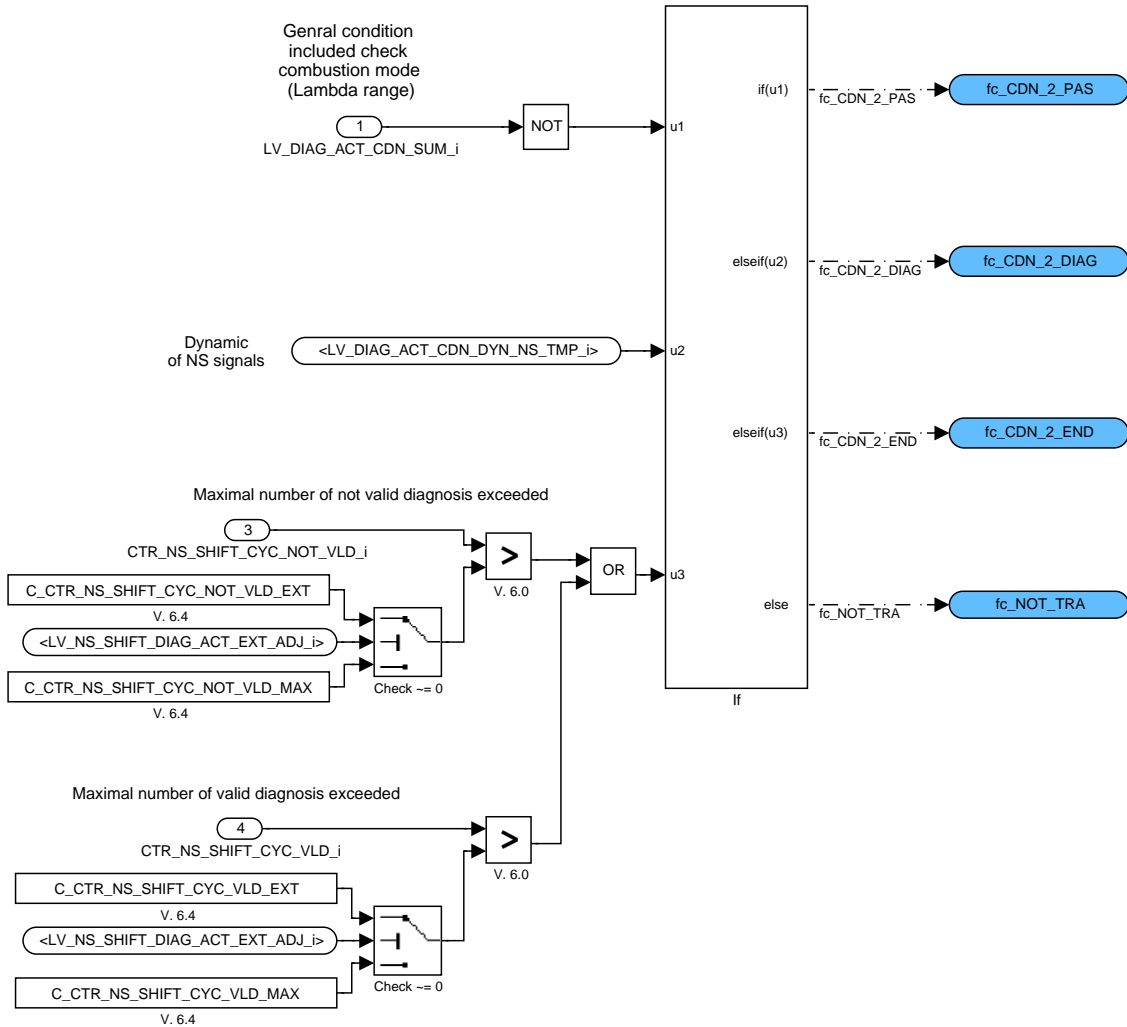


Figure B.128.23: :

#### B.128.2.2.2.2 Transition CDN to PASSIVE - actions

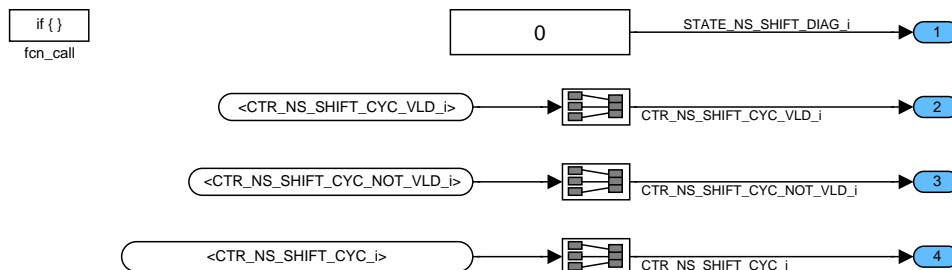


Figure B.128.24: :

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### B.128.2.2.2.3 Transition CDN to DIAG - actions

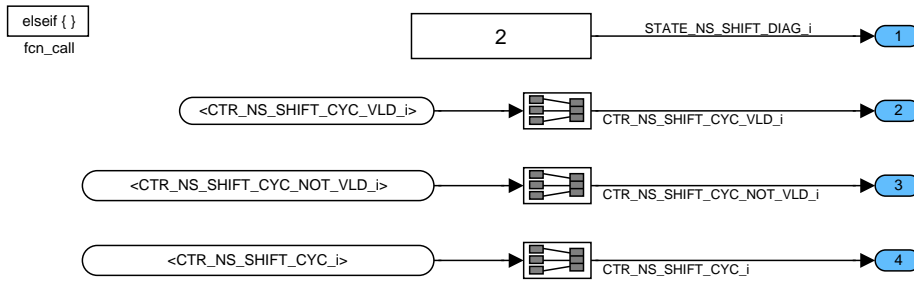


Figure B.128.25: :

### B.128.2.2.2.4 Transition CDN to END - actions

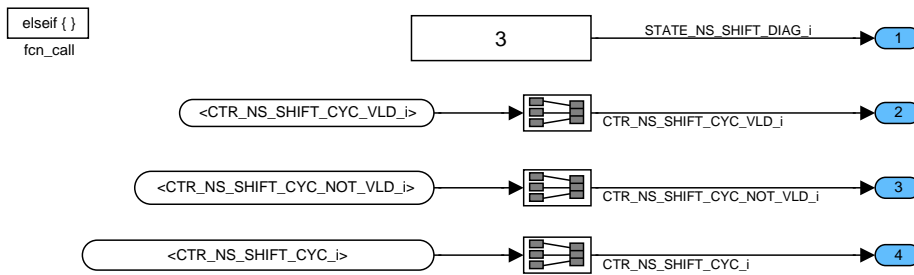


Figure B.128.26: :

### B.128.2.2.2.5 Actions at no transition from CDN

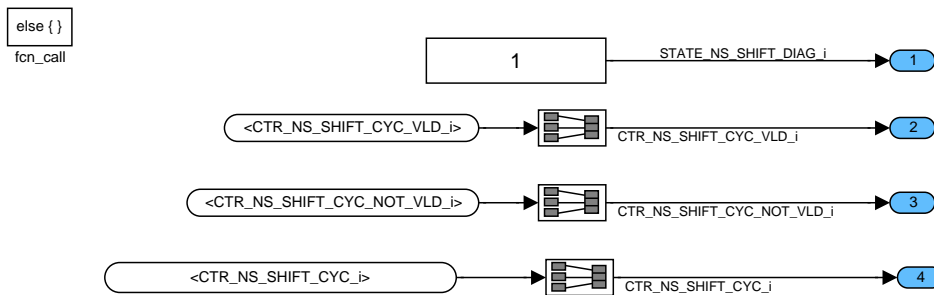


Figure B.128.27: :

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### B.128.2.2.2.3 From DIAG

#### B.128.2.2.2.3.1 Check transition conditions from DIAG

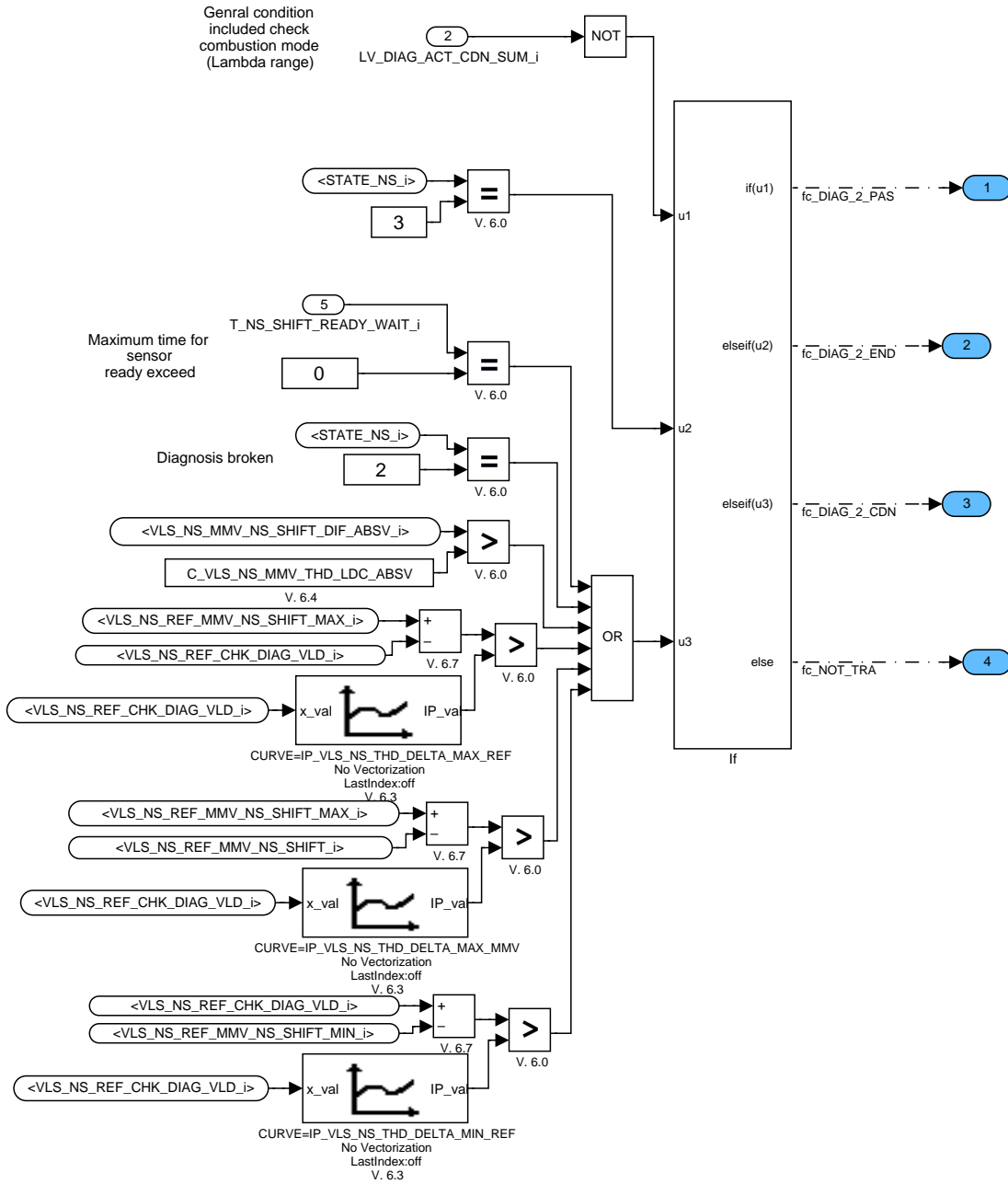


Figure B.128.28: :

### B.128.2.2.3.2 Transition DIAG to PASSIVE - actions

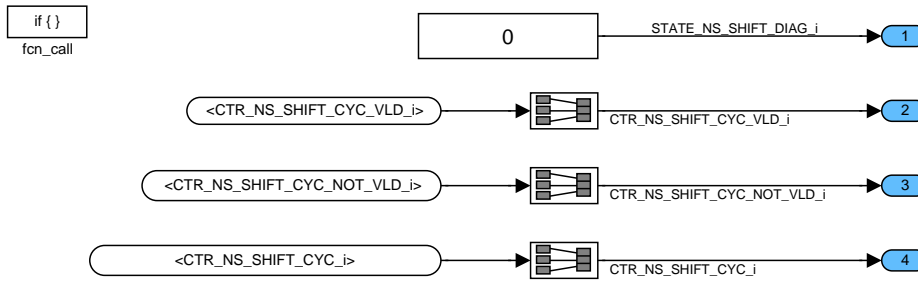


Figure B.128.29: :

### B.128.2.2.3.3 Transition DIAG to CDN - actions

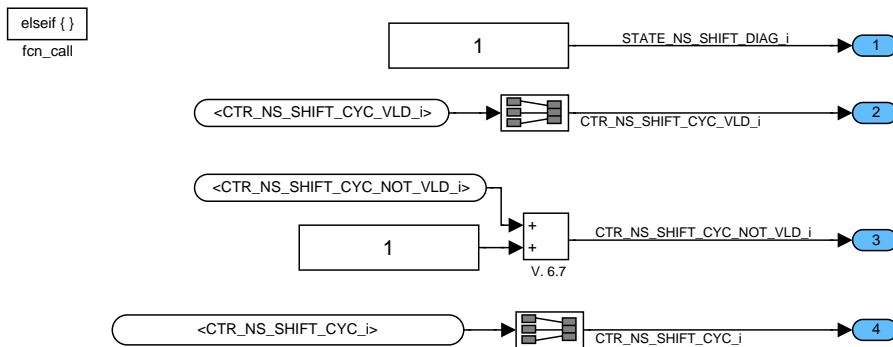


Figure B.128.30: :

### B.128.2.2.3.4 Transition DIAG to END - actions

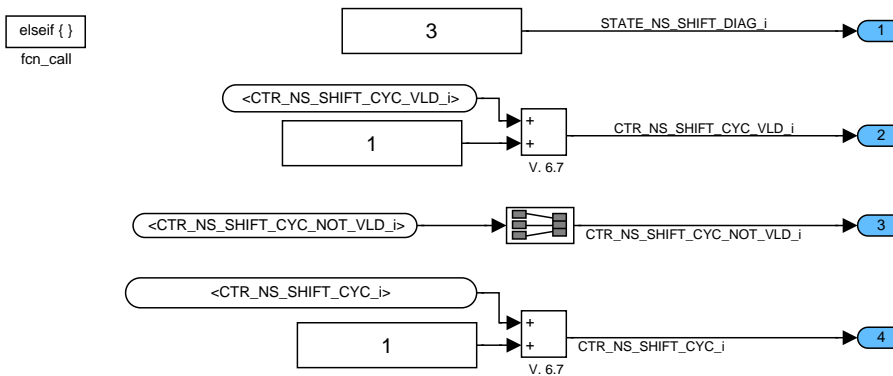


Figure B.128.31: :

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### B.128.2.2.3.5 Actions at no transition from DIAG

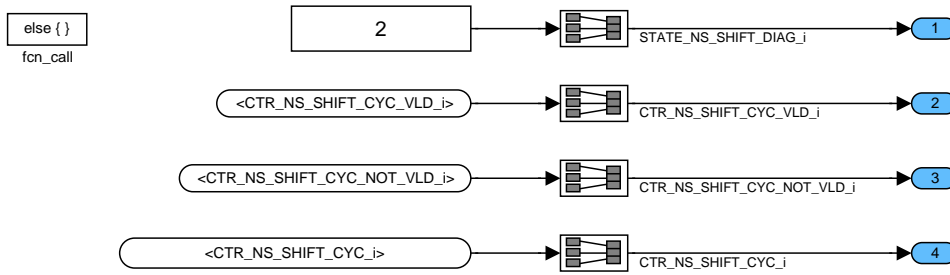


Figure B.128.32: :

### B.128.2.2.4 From END

#### B.128.2.2.4.1 Check transition conditions from END

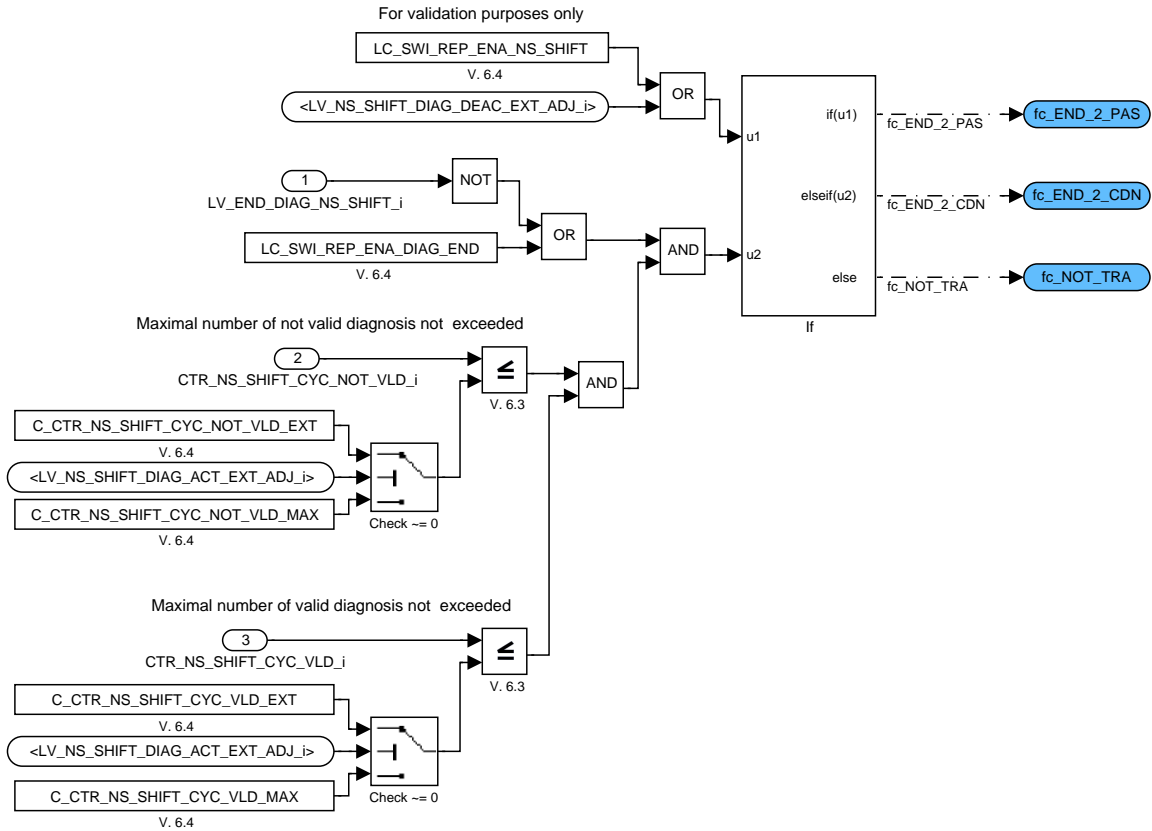


Figure B.128.33: :

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### B.128.2.2.4.2 Transition END to PASSIVE - actions

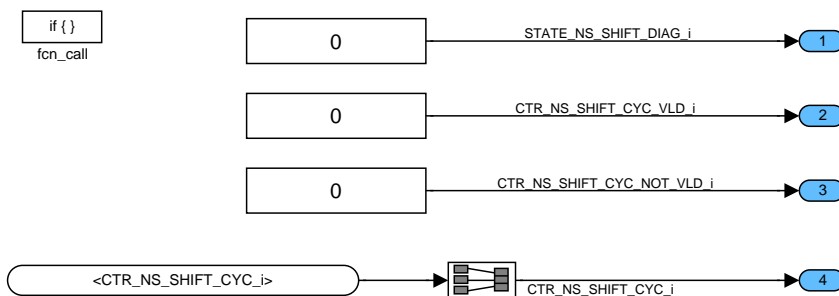


Figure B.128.34: :

### B.128.2.2.4.3 Transition END to CDN - actions

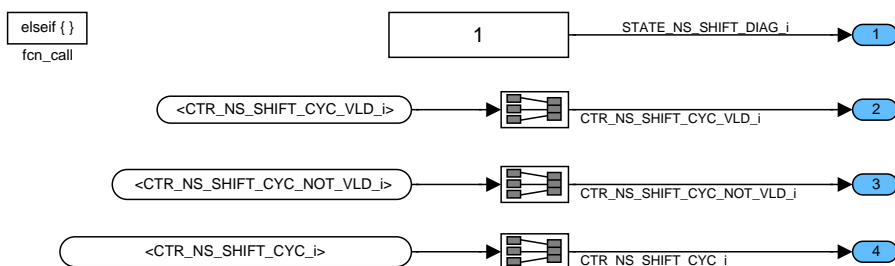


Figure B.128.35: :

### B.128.2.2.4.4 Actions at no transition from END

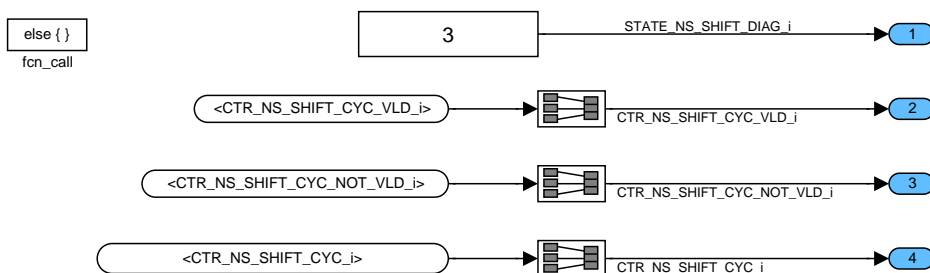


Figure B.128.36: :

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### B.128.2.2.3 Actions calculation of STATE\_NS\_SHIFT\_DIAG

#### B.128.2.2.3.1 State PASSIVE

##### B.128.2.2.3.1.1 Calculation request of homogeneous mode

###### B.128.2.2.3.1.1.1 Combustion request repetition timer

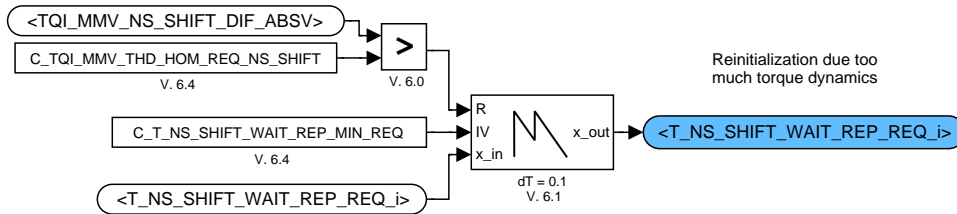


Figure B.128.37: :

### B.128.2.2.3.1.1.2 Check condition for combustion request

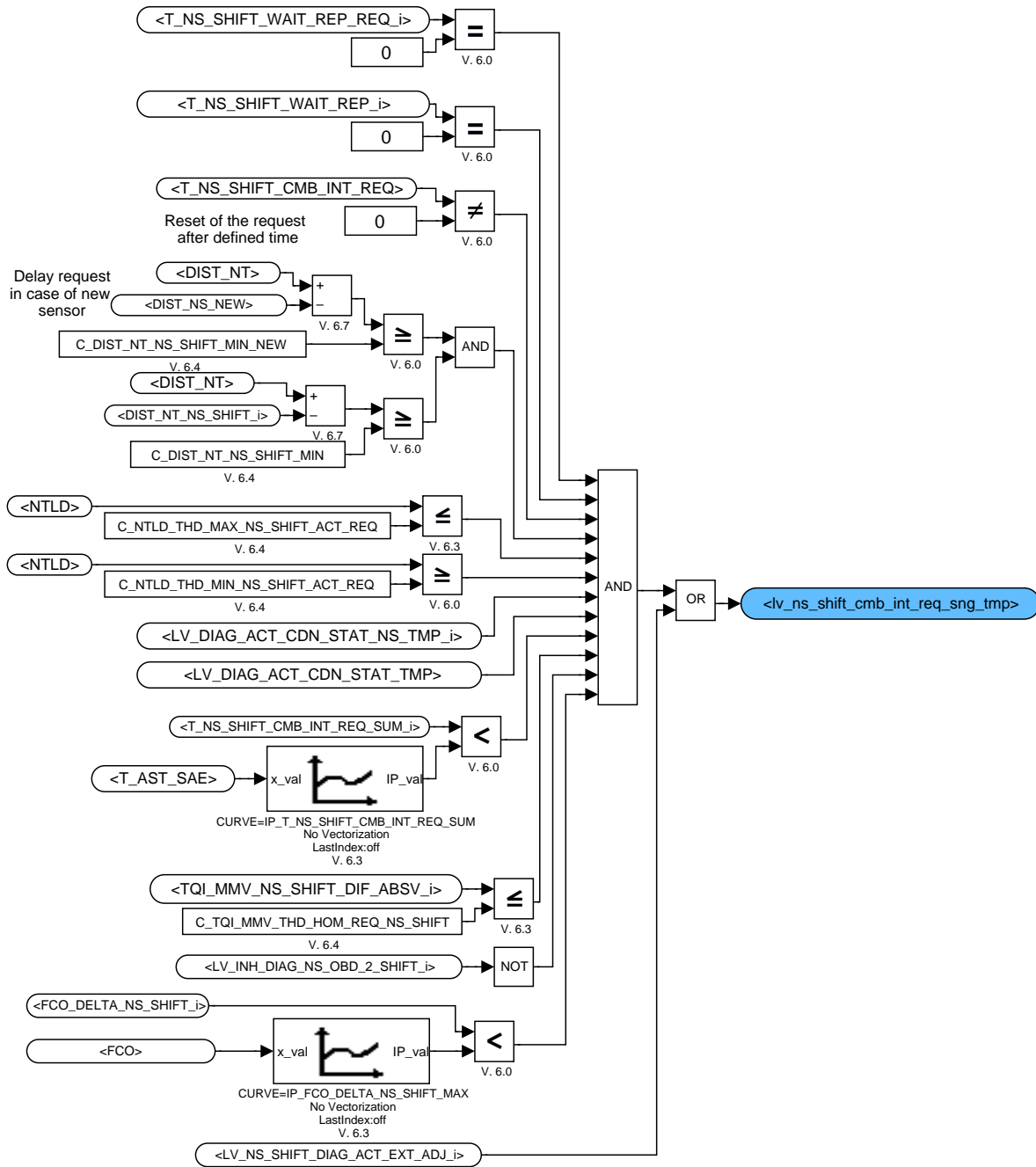


Figure B.128.38: :

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### B.128.2.2.3.1.1.3 Set/Reset of the combustion request

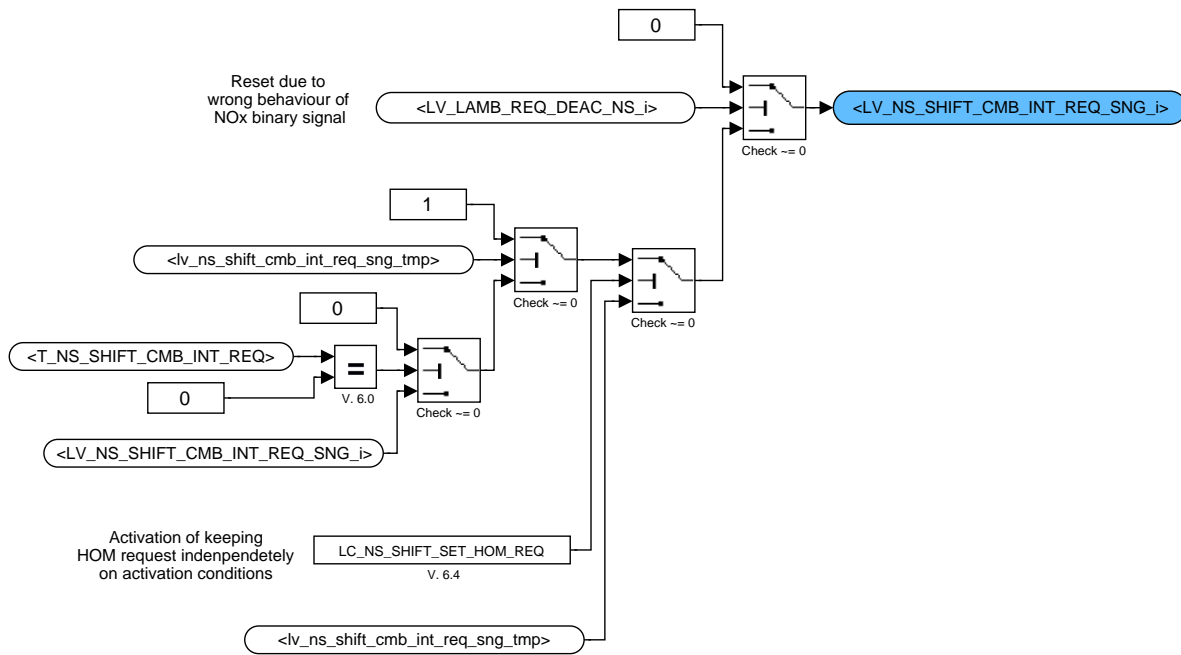
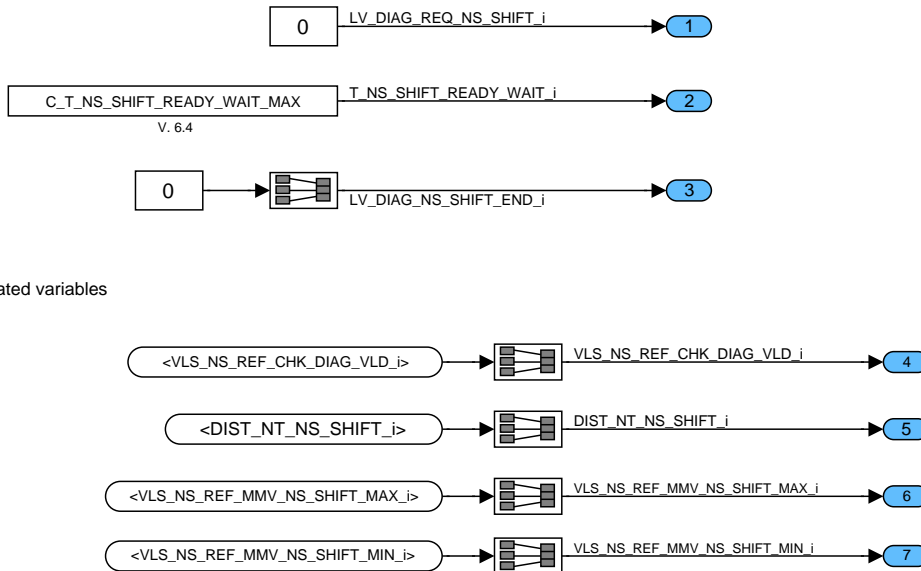


Figure B.128.39: :

### B.128.2.2.3.1.2 Calculation of timers and initialization other variables



Not calculated variables

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Figure B.128.40: :

### B.128.2.2.3.2 State CDN

#### B.128.2.2.3.2.1 Calculations

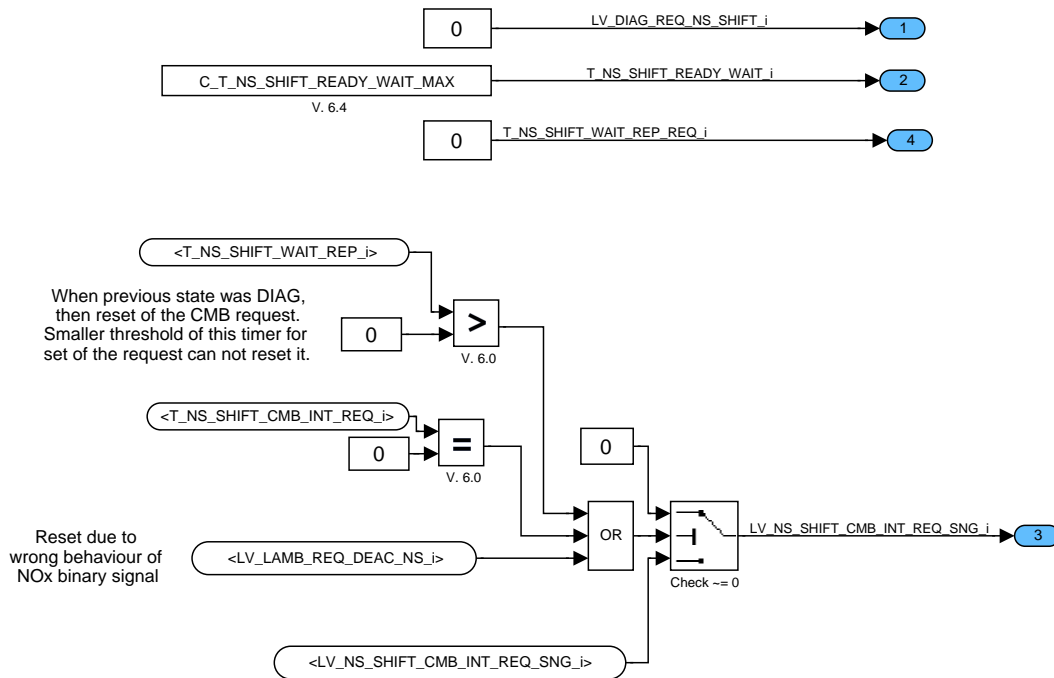


Figure B.128.41: :

#### B.128.2.2.3.2.2 Not calculated variables

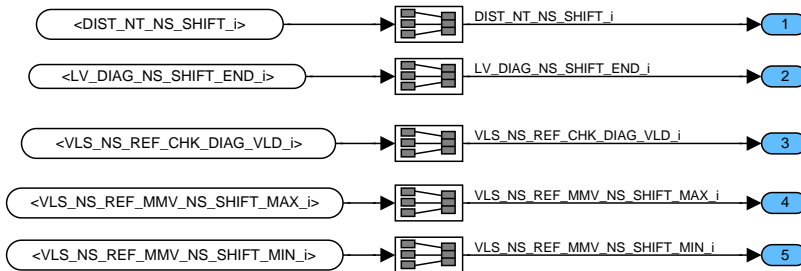


Figure B.128.42: :

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### B.128.2.2.3.3 State DIAG

#### B.128.2.2.3.3.1 Calculation timers for waiting and repetition

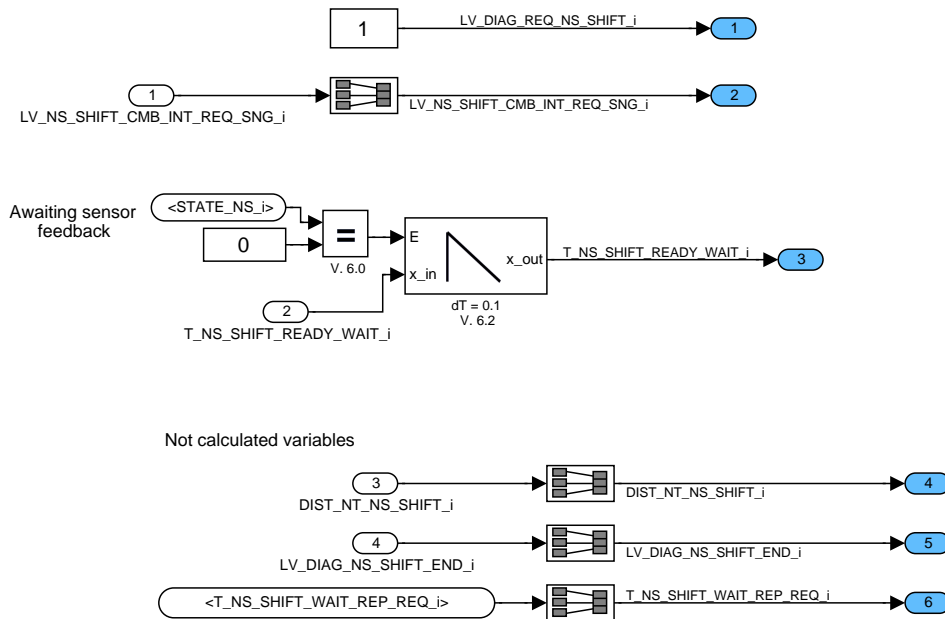


Figure B.128.43: :

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### B.128.2.2.3.3.2 Check validation of diagnosis result

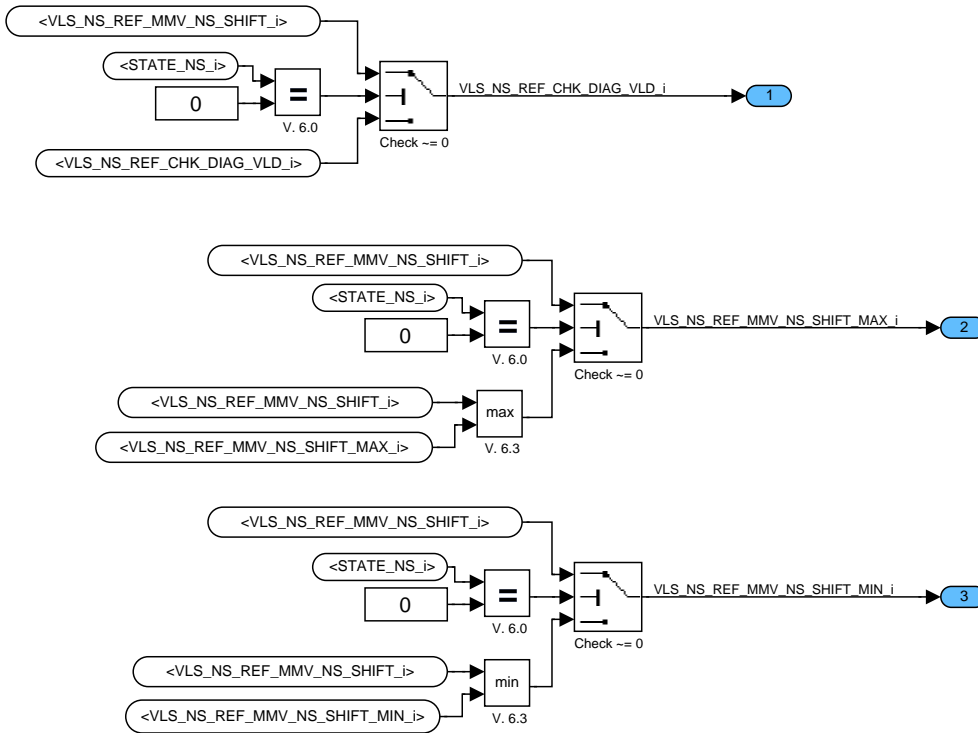


Figure B.128.44: :

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### B.128.2.2.3.4 State END

#### B.128.2.2.3.4.1 Calculations

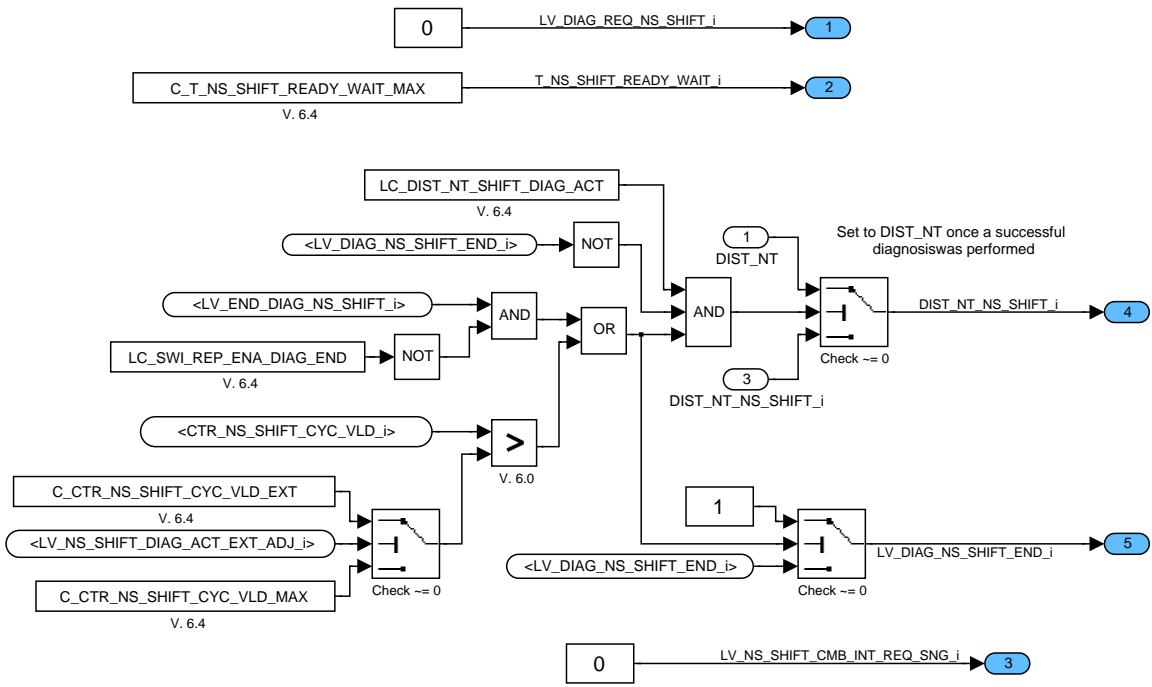


Figure B.128.45: - :

#### B.128.2.2.3.4.2 Not calculated variables

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### B.128.2.2.4 Calculations at availability of external values

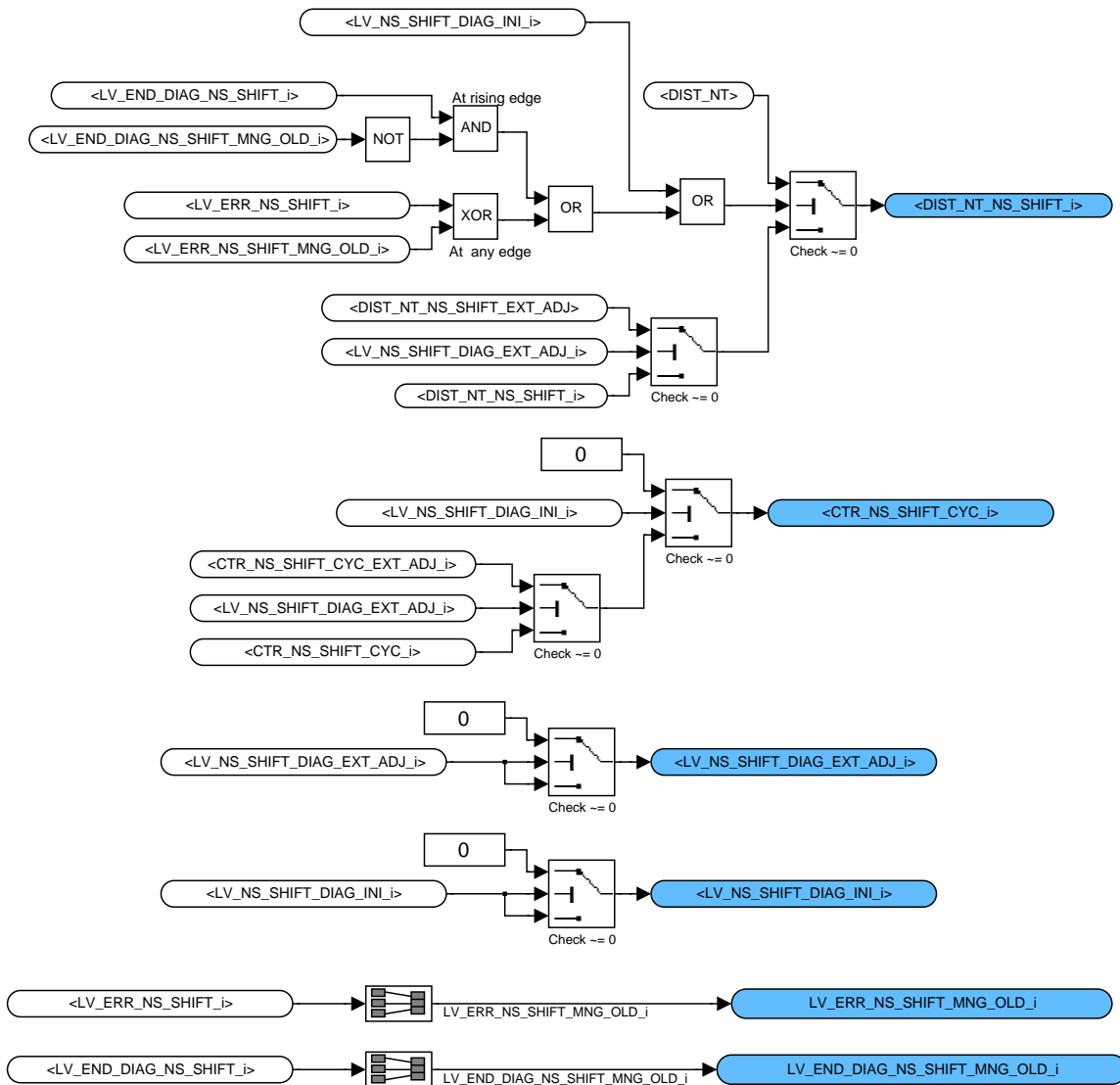


Figure B.128.46: :

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### B.128.2.2.5 Calculation of diagnosis status for external service tool

#### B.128.2.2.5.1 Managing of the START and STOP switches

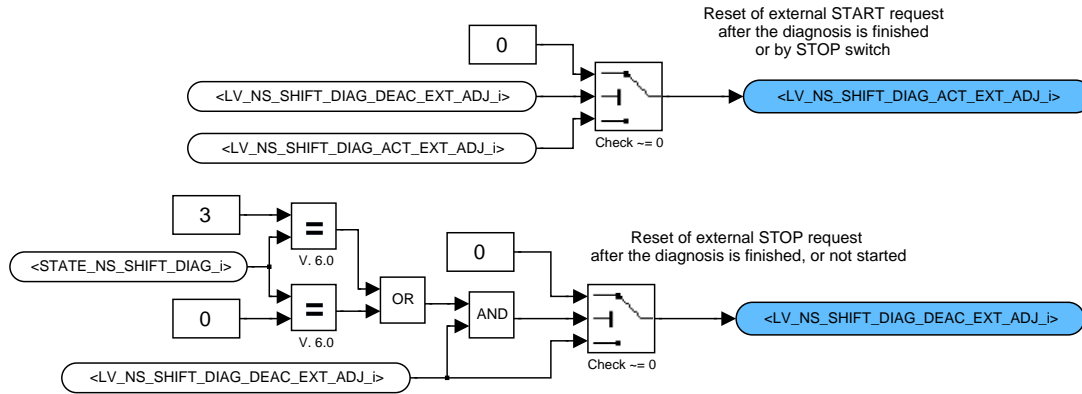


Figure B.128.47: :

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**B.128.2.2.5.2 KWP value calculation**

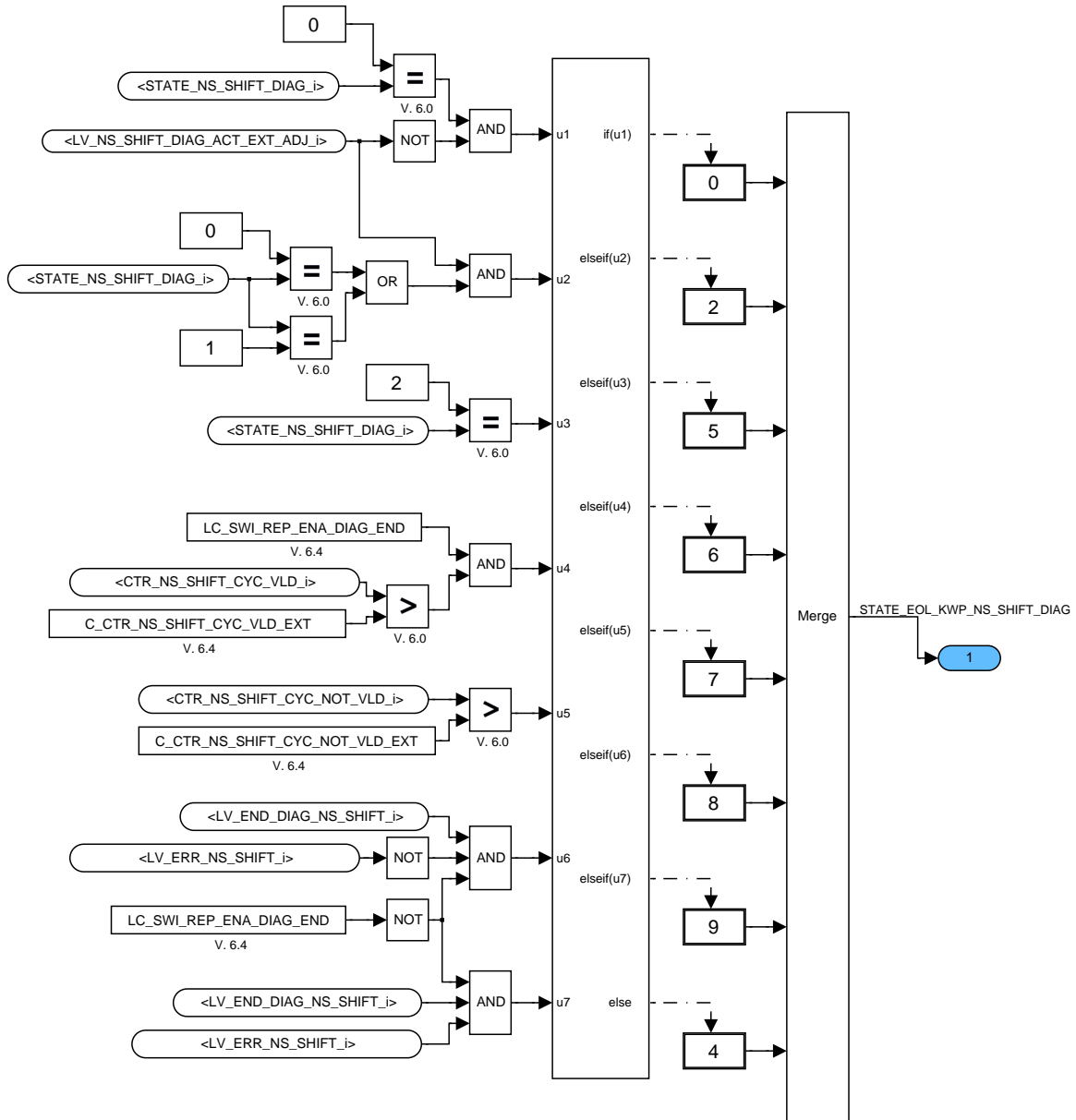


Figure B.128.48: :

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### B.128.2.3 Synchronization of all sensors and generation summary request for combustion manager

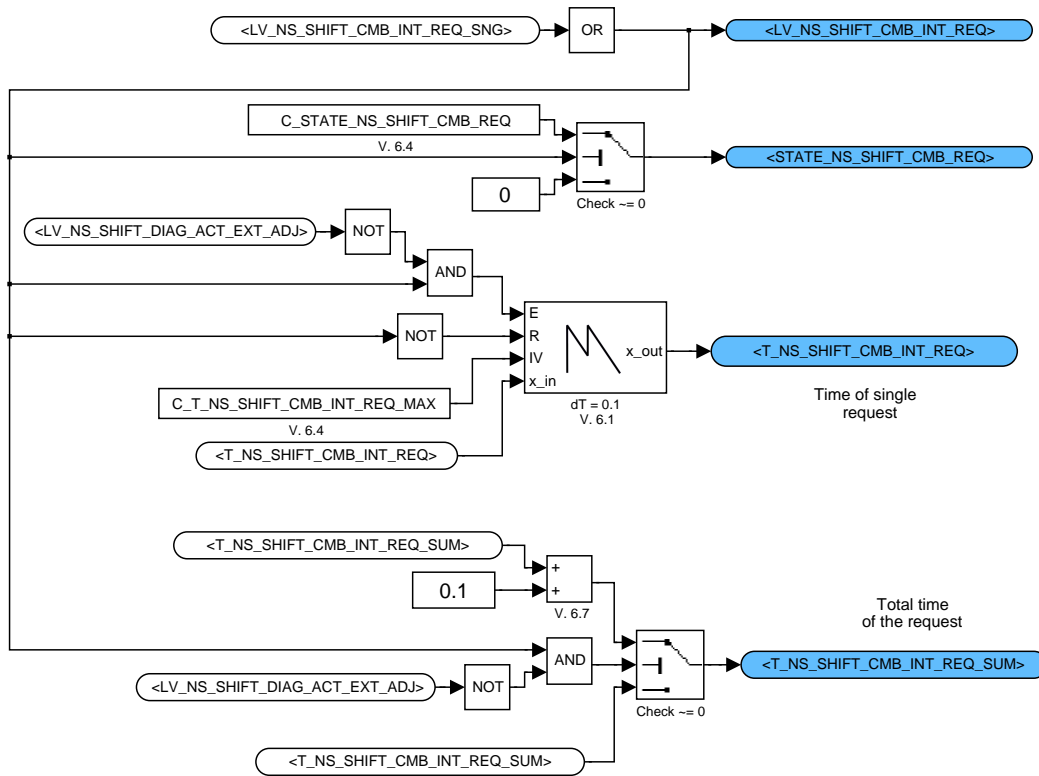


Figure B.128.49: :

### B.128.3 Detailed description for Action: ACTION\_NOXD\_CleanNSShiftAdapt

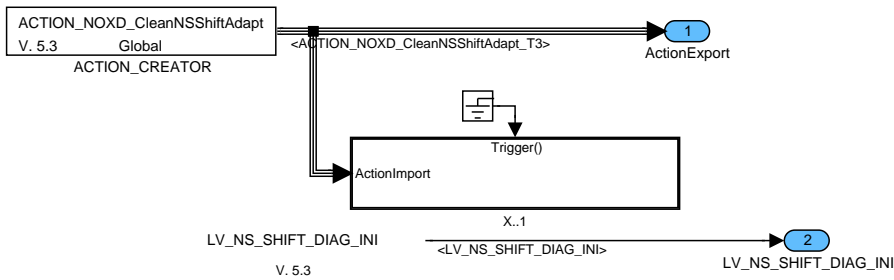


Figure B.128.50: :

#### B.128.3.1 Calculations in ACTION\_NOXD\_CLEANNSSHIFTADAPT

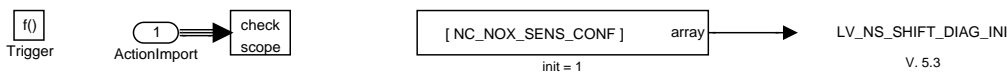


Figure B.128.51: :

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### B.128.4 Detailed description for Action: ACTION\_NOXD\_EndNNShiftDiag

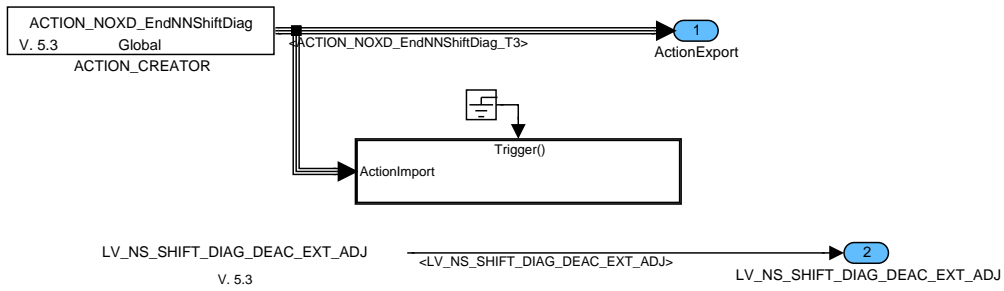


Figure B.128.52: :

#### B.128.4.1 Calculation in ACTION\_NOXD\_ENDNNSHIFTDIAG

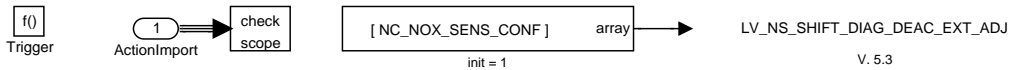


Figure B.128.53: :

### B.128.5 Detailed description for Action: ACTION\_NOXD\_StartNNShiftDiag

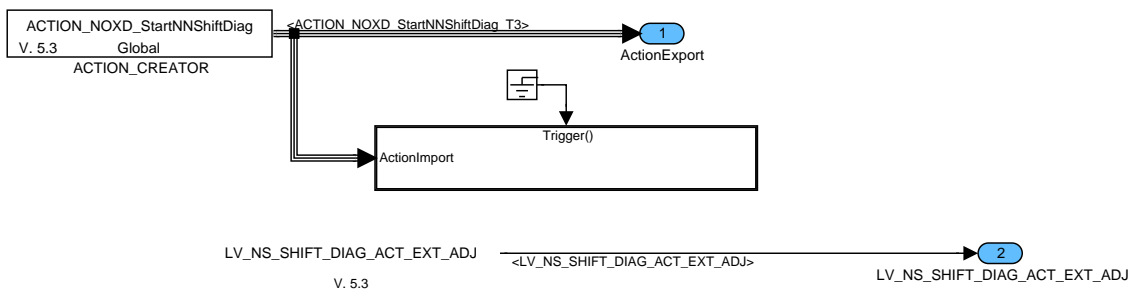


Figure B.128.54: :

#### B.128.5.1 Calculation in ACTION\_NOXD\_STARTNNSHIFTDIAG

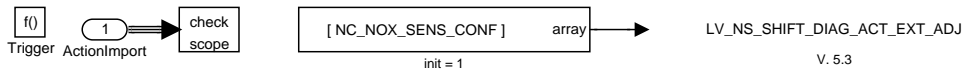


Figure B.128.55: :

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	Document key 10171571 SPE 000 AO	Pages Page 6466 of 8404	
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### B.128.6 Detailed description for Action: ACTION\_NOXD\_WriteNSShiftDiagExtAdj

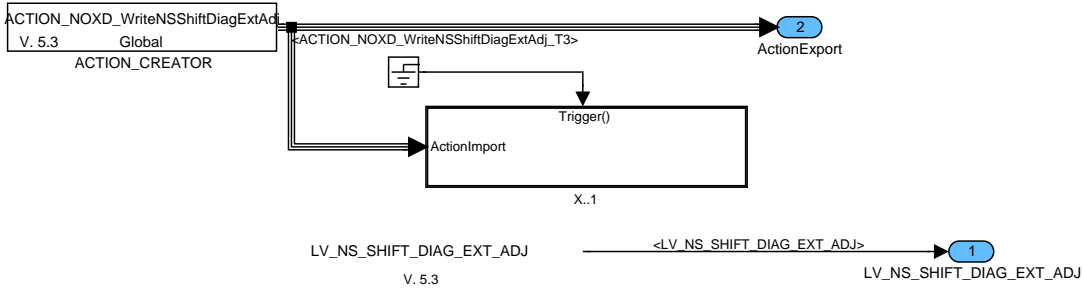


Figure B.128.56: :

#### B.128.6.1 Calculation in ACTION\_NOXD\_WRITENSSHIFTDIAGEXTADJ

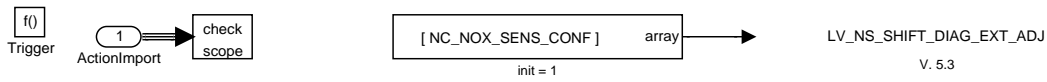


Figure B.128.57: :

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## B.129 NOx sensor OBDII diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_PV_GRD_ABSV_INT	V	0... FFFFH	0... 65535	1	-
Integral of absolute value of pedal gradient for detection of vandalism					
LV_ERR_FUEL_TMP	V	0... 1H	0 ...1	1	-
Error on any fuel component detected					
LV_ERR_LAMB_TMP	V	0... 1H	0 ...1	1	-
Error on any lambda sensor detected					
LV_INH_DIAG_NS_OBD_2_ACT [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx sensor activity diagnosis					
LV_INH_DIAG_NS_OBD_2_AVL [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx sensor availability diagnosis					
LV_INH_DIAG_NS_OBD_2_DYN [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx sensor dynamic diagnosis					
LV_INH_DIAG_NS_OBD_2_GAIN [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx sensor - NOx signal gain diagnosis					
LV_INH_DIAG_NS_OBD_2_HTP [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx sensor heater performance diagnosis					
LV_INH_DIAG_NS_OBD_2_OFS [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx sensor offset diagnosis					
LV_INH_DIAG_NS_OBD_2_PLAUS [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx-Sensor plausibility diagnosis					
LV_INH_DIAG_NS_OBD_2_RAW [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx sensor - NOx raw emission diagnosis					
LV_INH_DIAG_NS_OBD_2_SHIFT [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx sensor internal setpoint shift diagnosis					
LV_INH_DIAG_NS_OBD_2_VERS [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx sensor version diagnosis					
LV_PV_GRD_NS_DIAG	V	0... 1H	0 ...1	1	-
Pedal gradient disables diagnosis					
PV_AV_OLD_AVL	-	0... FFH	0... 99.60937	0.390625	%
Old value of global degree of activation of the accelerator pedal (low resolution)					
T_LAMB_LS_UP_NOT_VLD [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Time since LAMB_VLS_UP is not valid					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_WOUT_NS_AD	V	0... FFFFH	0... 65535	1	s
Time after last NOx sensor gain adaptation					

**Input data:**

LV_ERR_CAT_DIAG_AFL [NC_CBK_EX_NR] {p. 5561}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}
LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_LS_DOWN [NC_CBK_EX_NR] {p. 5449}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_ERR_MAF {p. 4815}
LV_ERR_MAP {p. 982}	LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_NS_CAN_BOFF {p. 991}	LV_ERR_NS_CAN_MSG_ LOST [NC_NOX_SENS_CONF] {p. 991}
LV_ERR_NS_OBD_1 [NC_NOX_SENS_CONF] {p. 4915}	LV_ERR_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}	LV_ERR_NT_AGI {p. 6485}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_TEG_PCAT_ DOWN {p. 4713}	LV_ERR_TTIP_MES_LSH_ UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VCV {p. 4729}	LV_LAM_ADJ_CAT_DIAG [NC_CBK_EX_NR] {p. 5473}
LV_LAMB_LS_UP_VLD [NC_CBK_EX_NR] {p. 2352}	LV_NS_AD_REQ {p. 3189}	LV_SO2P_REQ {p. 3129}	LV_ST_END {p. 1720}
NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}	NTLD {p. 2986}	PV_AV {p. 1269}
STATE_ERR_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}	STATE_INH_NS_OBD_2_ EXT_ADJ [NC_NOX_SENS_CONF]	STATE_NS [NC_NOX_SENS_CONF] {p. 1381}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ERR_NS_ACT_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit activity diagnosis					
C_ERR_NS_AVL_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit availability diagnosis					
C_ERR_NS_DYN_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit dynamic diagnosis					
C_ERR_NS_GAIN_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit NOx signal gain diagnosis					
C_ERR_NS_HTP_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit heater diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ERR_NS_OFS_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit offset diagnosis					
C_ERR_NS_PLAUS_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit plausibility diagnosis					
C_ERR_NS_RAW_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit NOx raw emission diagnosis					
C_ERR_NS_SHIFT_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit NOx sensor internal setpoint shift diagnosis					
C_ERR_NS_VERS_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit NOx sensor version diagnosis					
C_FAC_PV_GRD_ABSV_INT_DEC	-	0... FFFFH	0... 65535	1	-
Decrement value for integral of absolute value of pedal gradient for detection of vandalism					
C_FAC_PV_GRD_ABSV_INT_MAX	-	0... FFFFH	0... 65535	1	-
Maximum threshold for integral of absolute value of pedal gradient for detection of vandalism					
C_FAC_PV_GRD_ABSV_INT_MIN	-	0... FFFFH	0... 65535	1	-
Minimum threshold for integral of absolute value of pedal gradient for detection of vandalism					
C_NTLD_T_WOUT_NS_AD	-	0... FFFFH	0... 0.99998	15.3e-6	-
NOx trap loading degree for detection of active gain adaptation for calculation of time after gain adaptation					
C_STATE_INH_NS_ACT [NC_NOX_SENS_CONF]	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx sensor activity diagnosis					
C_STATE_INH_NS_AVL [NC_NOX_SENS_CONF]	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx sensor availability diagnosis					
C_STATE_INH_NS_DYN [NC_NOX_SENS_CONF]	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx sensor dynamic diagnosis					
C_STATE_INH_NS_GAIN [NC_NOX_SENS_CONF]	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx sensor - NOx signal gain diagnosis					
C_STATE_INH_NS_HTP [NC_NOX_SENS_CONF]	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx sensor heater diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_INH_NS_OFS [NC_NOX_SENS_CONF]	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx sensor offset diagnosis					
C_STATE_INH_NS_PLAUS [NC_NOX_SENS_CONF]	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx sensor plausibility diagnosis					
C_STATE_INH_NS_RAW [NC_NOX_SENS_CONF]	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx sensor - NOx raw emission diagnosis					
C_STATE_INH_NS_SHIFT [NC_NOX_SENS_CONF]	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx sensor internal setpoint shift diagnosis					
C_STATE_INH_NS_VERS [NC_NOX_SENS_CONF]	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx sensor version diagnosis					
C_T_LAMB_LS_UP_NOT_VLD_MAX	-	0... FFFFH	0... 655.35	0.01	s
Time since LAMB_VLS_UP is not valid					
C_T_WOUT_NS_AD_INH_NS_DIAG	-	0... FFFFH	0... 65535	1	s
Time after last NOx sensor gain adaptation					
LC_NS_DIAG_EXT_ADJ_ENA	-	0... 1H	0 ...1	1	-
Enable inhibition of NOx sensor diags by external adjustment					
LC_NS_SHIFT_INH_CAT_DIAG	-	0... 1H	0 ...1	1	-
Shift diagnosis will be inhibited if cat diagnosis is active					
LC_T_WOUT_NS_AD	-	0... 1H	0 ...1	1	-
Enable signal LV_NS_AD_REQ for detection of active gain adaptation for calculation of time after gain calculation					

**Error treatment:****Heater diag (B07A)**

Diagnostic	Symptom description	Symptom	Filter type
NS_HTP			
NOx sensor heater diagnosis	Heater performance too low at start	SYM_0	STD_INI
	Heater performance too low during normal operation	SYM_1	
	Power supply failure	SYM_2	
		SYM_3	

Figure B.129.1: Diagnostic

Diagnostic	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NS_HTP NOx sensor heater diagnosis	Heater performance too low at start	SYM_0						
	Heater performance too low during normal operation	SYM_1						
	Power supply failure	SYM_2						
		SYM_3						

### Signal availability (B07B)

Diagnostic	Symptom description	Symptom	Filter type
NS_AVL NOx sensor availability diagnosis	Signal not available at start	SYM_0	STD_INI
	Signal not available during normal operation	SYM_1	
		SYM_2	
		SYM_3	

Figure B.129.2: Diagnostic

Diagnostic	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NS_AVL NOx sensor availability diagnosis	Signal not available at start	SYM_0						
	Signal not available during normal operation	SYM_1						
		SYM_2						
		SYM_3						

### Signal offset (B07D)

Diagnostic	Symptom description	Symptom	Filter type
NS_OFS NOx sensor offset diagnosis	NOx signal offset failure	SYM_0	STD_INI
		SYM_1	
		SYM_2	
		SYM_3	

Figure B.129.3: Diagnostic

Diagnostic	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NS_OFS NOx sensor offset diagnosis	NOx signal offset failure	SYM_0						
		SYM_1						
		SYM_2						
		SYM_3						

### Binary lambda signal dynamic (B07E)



Diagnostic	Symptom description	Symptom	Filter type
<b>NS_VLS_DYN</b>			
NOx sensor binary dynamic diagnosis	Binary dynamic too low	SYM_0	STD_INI
		SYM_1	
		SYM_2	
		SYM_3	

Figure B.129.4: Diagnostic

Diagnostic	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
<b>NS_VLS_DYN</b>								
NOx sensor binary dynamic diagnosis	Binary dynamic too low	SYM_0						
		SYM_1						
		SYM_2						
		SYM_3						

**Signal activity (B07F)**

Diagnostic	Symptom description	Symptom	Filter type
<b>NS_ACT</b>			
NOx sensor activity diagnosis	NOx signal activity too low	SYM_0	STD_INI
		SYM_1	
		SYM_2	
		SYM_3	

Figure B.129.5: Diagnostic

Diagnostic	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
<b>NS_ACT</b>								
NOx sensor activity diagnosis	NOx signal activity too low	SYM_0						
		SYM_1						
		SYM_2						
		SYM_3						

**Signal plausibility up/down (B07X)**

Diagnostic	Symptom description	Symptom	Filter type
<b>NS_LSL_UP_DOWN</b>			
NOx sensor plausibility up/down diagnosis	Lambda signal up/downstream not plausible	SYM_0	STD_INI
		SYM_1	
		SYM_2	
		SYM_3	

Figure B.129.6: Diagnostic

Diagnostic	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NS_LSL_UP_DOWN  NOx sensor plausibility up/down diagnosis	Lambda signal up/downstream not plausible	SYM_0						
		SYM_1						
		SYM_2						
		SYM_3						

### Signal plausibility at PUC (B07Y)

Diagnostic	Symptom description	Symptom	Filter type
NS_PUC  NOx sensor plausibility diagnosis at PUC	Binary lambda signal too rich	SYM_0	STD_INI
	Linear lambda too rich	SYM_1	
	NOx signal too low	SYM_2	
	NOx signal too high	SYM_3	

Figure B.129.7: Diagnostic

Diagnostic	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NS_PUC  NOx sensor plausibility diagnosis at PUC	Binary lambda signal too rich	SYM_0						
	Linear lambda too rich	SYM_1						
	NOx signal too low	SYM_2						
	NOx signal too high	SYM_3						

### Signal plausibility at rich conditions (B07Z)

Diagnostic	Symptom description	Symptom	Filter type
NS_AFR  NOx sensor plausibility diagnosis at rich conditions	Binary lambda signal too lean	SYM_0	STD_INI
	Linear lambda too lean	SYM_1	
	NOx signal too low	SYM_2	
		SYM_3	

Figure B.129.8: Diagnostic

Diagnostic	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NS_AFR  NOx sensor plausibility diagnosis at rich conditions	Binary lambda signal too lean	SYM_0						
	Linear lambda too lean	SYM_1						
	NOx signal too low	SYM_2						
		SYM_3						

### Regeneration stop observation (B080)

Diagnostic	Symptom description	Symptom	Filter type
<b>NS_STOP</b>			
NOx sensor diagnosis at regeneration stop	Regeneration agent failure	SYM_0	STD_INI
	Time out	SYM_1	
		SYM_2	
		SYM_3	

Figure B.129.9: Diagnostic

Diagnostic	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
<b>NS_STOP</b>								
NOx sensor diagnosis at regeneration stop	Regeneration agent failure	SYM_0						
	Time out	SYM_1						
		SYM_2						
		SYM_3						

**NOx signal gain (B0A0)**

Diagnostic	Symptom description	Symptom	Filter type
<b>NS_GAIN</b>			
NOx signal gain diagnosis	NOx signal gain failure	SYM_0	STD_INI
		SYM_1	
		SYM_2	
		SYM_3	

Figure B.129.10: Diagnostic

Diagnostic	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
<b>NS_GAIN</b>								
NOx signal gain diagnosis	NOx signal gain failure	SYM_0						
		SYM_1						
		SYM_2						
		SYM_3						

**NOx raw emission (B0A1)**

Diagnostic	Symptom description	Symptom	Filter type
<b>NS_RAW</b>			
NOx raw emission	NOx raw emission plausibility failure	SYM_0	STD_INI
		SYM_1	
		SYM_2	
		SYM_3	

Figure B.129.11: Diagnostic

Diagnostic	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NS_GAIN								
NOx raw emission	NOx raw emission plausibility failure	SYM_0						
		SYM_1						
		SYM_2						
		SYM_3						

### NOx sensor setpoint shift (B0A3)

Diagnostic	Symptom description	Symptom	Filter type
NS_SHIFT			
NOx sensor setpoint shift	Setpoint shift failure	SYM_0	STD_INI
		SYM_1	
		SYM_2	
		SYM_3	

Figure B.129.12: Diagnostic

Diagnostic	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NS_SHIFT								
NOx sensor setpoint shift	Setpoint shift failure	SYM_0						
		SYM_1						
		SYM_2						
		SYM_3						

### NOx sensor version (B0A4)

Diagnostic	Symptom description	Symptom	Filter type
NS_VERS			
NOx sensor version	Wrong version	SYM_0	STD_INI
		SYM_1	
		SYM_2	
		SYM_3	

Figure B.129.13: Diagnostic

Diagnostic	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NS_VERS								
NOx sensor version	Wrong version	SYM_0						
		SYM_1						
		SYM_2						
		SYM_3						

### General information:

Each type of OBDII diagnosis will be inhibited, if any used input signal is not valid. Additionally, each diagnosis may be enabled or disabled without any cross dependencies.

The calculation have to be done for each NOx sensor, controlled by configuration data NC\_NOX\_SENS\_CONF.

If NC\_NOX\_SENS\_CONF = 1, then calculation for i = 1.

If NC\_NOX\_SENS\_CONF = 2, then calculation for i = 1 and 2.

### Application conditions

**Initialisation:** at reset:

```

FAC_PV_GRD_ABSV_INT = 0
PV_AV_OLD_AVL = 0
T_LAMB_LS_UP_NOT_VLD[k] = 0          k = 1...NC_CBK_EX_
NR

```

**Recurrence:** 10 ms

**Activation:**

**Deactivation:**

### Formula section:

$$\begin{aligned} \text{FAC\_PV\_GRD\_ABSV\_INT} = & \text{FAC\_PV\_GRD\_ABSV\_INT} \\ & + 16 * \text{ABS}(PV\_AV - PV\_AV\_OLD\_AVL) \\ & - C\_FAC\_PV\_GRD\_ABSV\_INT\_DEC \end{aligned}$$

$PV\_AV\_OLD\_AVL = PV\_AV$

The values PV\_AV and PV\_AV\_OLD\_AVL should be normalized to the resolution, which results in an easy addition of the hex values.

For each lambda sensor: k = 1...NC\_CBK\_EX\_NR

```

If      LV_LAMB_LS_UP_VLD[k]
Then    T_LAMB_LS_UP_NOT_VLD[k] = 0
Else    increment T_LAMB_LS_UP_NOT_VLD[k]          10ms
Endif

```

### Application conditions

**Initialisation:** at reset and at deactivation:

```

LV_INH_DIAG_NS_OBD_2_HTP[i] = 1
LV_INH_DIAG_NS_OBD_2_AVL[i] = 1
LV_INH_DIAG_NS_OBD_2_OFS[i] = 1
LV_INH_DIAG_NS_OBD_2_DYN[i] = 1
LV_INH_DIAG_NS_OBD_2_ACT[i] = 1
LV_INH_DIAG_NS_OBD_2_PLAUS[i] = 1
LV_INH_DIAG_NS_OBD_2_GAIN[i] = 1
LV_INH_DIAG_NS_OBD_2_RAW[i] = 1
LV_INH_DIAG_NS_OBD_2_SHIFT[i] = 1
LV_PV_GRD_NS_DIAG = 0
T_WOUT_NS_AD = 65535s

```

**Recurrence:** 1 s

**Activation:** LV\_ST\_END = 1

**Deactivation:** LV\_ST\_END = 0

**Formula section:***Temporary flag (shows an error on any lambda sensor)***#if** NC\_CBK\_EX\_NR = 1

```

LV_ERR_LAMB_TMP = LV_ERR_LS_UP[1]
                  LV_ERR_LS_DOWN[1]
                  LV_ERR_TTIP_MES_LSH_UP[1]
                  LV_ERR_CTL_LSL_UP[1]
                  LV_ERR_OFS_LSL_UP[1]
                  T_LAMB_LS_UP_NOT_VLD[1] > C_T_LAMB_LS_UP_NOT_VLD_

```

MAX

**#endif****#if** NC\_CBK\_EX\_NR = 2

```

LV_ERR_LAMB_TMP = (LV_ERR_LS_UP[1] OR LV_ERR_LS_UP[2])
                  (LV_ERR_LS_DOWN[1] OR LV_ERR_LS_DOWN[2])
                  (LV_ERR_TTIP_MES_LSH_UP[1]
                  LV_ERR_TTIP_MES_LSH_UP[2])
                  LV_ERR_CTL_LSL_UP[1]
                  LV_ERR_CTL_LSL_UP[2]
                  LV_ERR_OFS_LSL_UP[1]
                  LV_ERR_OFS_LSL_UP[2]
                  T_LAMB_LS_UP_NOT_VLD[1] > C_T_LAMB_LS_UP_NOT_VLD_MAX

```

OR

```

T_LAMB_LS_UP_NOT_VLD[2] > C_T_LAMB_LS_UP_NOT_VLD_MAX

```

**#endif***Temporary flag for fuel depending errors*

```

LV_ERR_FUEL_TMP = LV_ERR_EL_CPS
                  LV_ERR_DIAGCPS
                  LV_ERR_FUP
                  LV_ERR_FUP_MFP_PLAUS
                  LV_ERR_H_PRS_SYS
                  LV_ERR_FUP_ORNG
                  LV_ERR_FUP_ST
                  LV_ERR_VCV

```

*Time after last NOx sensor gain adaptation*

```

if (LV_NS_AD_REQ = 1 AND LC_T_WOUT_NS_AD = 1)
    NTLD > C_NTLD_T_WOUT_NS_AD
Then T_WOUT_NS_AD = 0
Else T_WOUT_NS_AD = T_WOUT_NS_AD + 1s
Endif

```

*Inhibition mode of Heater diagnosis***case selection** on C\_STATE\_INH\_NS\_HTP[i]

C\_STATE\_INH\_NS\_HTP[i] = 0 ('AUTO'):

```

if LV_ERR_NS_OBD_1[i] = 1

```

```

LV_ERR_NS_CAN_MSG_LOST[i] = 1

```

```

LV_ERR_NS_CAN_BOFF = 1

```

```

LV_ERR_MAF = 1
LV_ERR_MAP = 1
LV_ERR_MAP_TPS_PLAUS = 1

```

**OR**  
**OR**  
**OR**

```

1) (Bit 0 (STATE_INH_NS_OBD_2_EXT_ADJ[i]) = 1 AND LC_NS_DIAG_EXT_ADJ_ENA =
    OR
    (STATE_ERR_NS_OBD_2[i] bitwise AND C_ERR_NS_HTP_BIT_SEL[i]) != 0
then LV_INH_DIAG_NS_OBD_2_HTP[i] = 1
else LV_INH_DIAG_NS_OBD_2_HTP[i] = 0
endif

```

```

C_STATE_INH_NS_HTP[i] = 1 ('DISABLE'):
LV_INH_DIAG_NS_OBD_2_HTP[i] = 1

```

```

C_STATE_INH_NS_HTP[i] = 2 ('ENABLE'):
LV_INH_DIAG_NS_OBD_2_HTP[i] = 0

```

**end case selection**

*Inhibition mode of signal availability diagnosis*

**case selection** on C\_STATE\_INH\_NS\_AVL[i]

```

C_STATE_INH_NS_AVL[i] = 0 ('AUTO'):

```

```

If FAC_PV_GRD_ABSV_INT < C_FAC_PV_GRD_ABSV_INT_MIN
Then LV_PV_GRD_NS_DIAG = 0
Else If FAC_PV_GRD_ABSV_INT > C_FAC_PV_GRD_ABSV_INT_MAX
Then LV_PV_GRD_NS_DIAG = 1
Endif

```

**Endif**

```

if LV_ERR_NS_OBD_1[i] = 1

```

```

LV_ERR_NS_CAN_MSG_LOST[i] = 1

```

**OR**

```

LV_ERR_NS_CAN_BOFF = 1

```

**OR**

```

LV_PV_GRD_NS_DIAG = 1

```

**OR**

```

1) (Bit 3 (STATE_INH_NS_OBD_2_EXT_ADJ[i]) = 1 AND LC_NS_DIAG_EXT_ADJ_ENA =
    OR
    (STATE_ERR_NS_OBD_2[i] bitwise AND C_ERR_NS_AVL_BIT_SEL[i]) != 0
then LV_INH_DIAG_NS_OBD_2_AVL[i] = 1
else LV_INH_DIAG_NS_OBD_2_AVL[i] = 0
endif

```

```

C_STATE_INH_NS_AVL[i] = 1 ('DISABLE'):
LV_INH_DIAG_NS_OBD_2_AVL[i] = 1

```

```

C_STATE_INH_NS_AVL[i] = 2 ('ENABLE'):
LV_INH_DIAG_NS_OBD_2_AVL[i] = 0

```

**end case selection**

*Inhibition mode of signal offset diagnosis*

**case selection** on C\_STATE\_INH\_NS\_OFS[i]

```

C_STATE_INH_NS_OFS[i] = 0 ('AUTO'):

```

```

if LV_ERR_NS_OBD_1[i] = 1 OR
    LV_ERR_NS_CAN_MSG_LOST[i] = 1 OR
    LV_ERR_NS_CAN_BOFF = 1 OR
    (Bit 2 (STATE_INH_NS_OBD_2_EXT_ADJ[i]) = 1 AND LC_NS_DIAG_EXT_ADJ_ENA =
    1) OR
    (STATE_ERR_NS_OBD_2[i] bitwise AND C_ERR_NS_OFS_BIT_SEL[i]) != 0
then LV_INH_DIAG_NS_OBD_2_OFS[i] = 1
else LV_INH_DIAG_NS_OBD_2_OFS[i] = 0
endif

```

```

C_STATE_INH_NS_OFS[i] = 1 ('DISABLE'):
    LV_INH_DIAG_NS_OBD_2_OFS[i] = 1

```

```

C_STATE_INH_NS_OFS[i] = 2 ('ENABLE'):
    LV_INH_DIAG_NS_OBD_2_OFS[i] = 0

```

**end case selection**

*Inhibition mode of signal dynamic diagnosis*

**case selection** on C\_STATE\_INH\_NS\_DYN[i]

C\_STATE\_INH\_NS\_DYN[i] = 0 ('AUTO'):

```

if LV_ERR_NS_OBD_1[i] = 1 OR
    LV_ERR_NS_CAN_MSG_LOST[i] = 1 OR
    LV_ERR_NS_CAN_BOFF = 1 OR
    LV_ERR_LAMB_TMP = 1 OR
    LV_ERR_FUEL_TMP = 1 OR
    ERR_MAF = 1 OR
    LV_ERR_MAP = 1 OR
    LV_ERR_MAP_TPS_PLAUS = 1 OR
    (Bit 7 (STATE_INH_NS_OBD_2_EXT_ADJ[i]) = 1 AND LC_NS_DIAG_EXT_ADJ_ENA =
    1) OR
    (STATE_ERR_NS_OBD_2[i] bitwise AND C_ERR_NS_DYN_BIT_SEL[i]) != 0
then LV_INH_DIAG_NS_OBD_2_DYN[i] = 1
else LV_INH_DIAG_NS_OBD_2_DYN[i] = 0
endif

```

```

C_STATE_INH_NS_DYN[i] = 1 ('DISABLE'):
    LV_INH_DIAG_NS_OBD_2_DYN[i] = 1

```

```

C_STATE_INH_NS_DYN[i] = 2 ('ENABLE'):
    LV_INH_DIAG_NS_OBD_2_DYN[i] = 0

```

**end case selection**

*Inhibition mode of signal activity diagnosis*

**case selection** on C\_STATE\_INH\_NS\_ACT[i]

C\_STATE\_INH\_NS\_ACT[i] = 0 ('AUTO'):

```

if LV_ERR_NS_OBD_1[i] = 1 OR
    LV_ERR_NS_CAN_MSG_LOST[i] = 1 OR

```



```

LV_ERR_NS_CAN_BOFF = 1 OR

1) (Bit 8 (STATE_INH_NS_OBD_2_EXT_ADJ[i]) = 1 AND LC_NS_DIAG_EXT_ADJ_ENA =
    OR
    (STATE_ERR_NS_OBD_2[i] bitwise AND C_ERR_NS_ACT_BIT_SEL[i]) != 0
then LV_INH_DIAG_NS_OBD_2_ACT[i] = 1
else LV_INH_DIAG_NS_OBD_2_ACT[i] = 0
endif

C_STATE_INH_NS_ACT[i] = 1 ('DISABLE'):
LV_INH_DIAG_NS_OBD_2_ACT[i] = 1

C_STATE_INH_NS_ACT[i] = 2 ('ENABLE'):
LV_INH_DIAG_NS_OBD_2_ACT[i] = 0
end case selection

```

*Inhibition mode of signal plausibility diagnosis (LSL\_UP\_DOWN, PUC, AFR, STOP)*

**case selection** on C\_STATE\_INH\_NS\_PLAUS[i]

C\_STATE\_INH\_NS\_PLAUS[i] = 0 ('AUTO'):

```

if LV_ERR_NS_OBD_1[i] = 1 OR
OR
LV_ERR_NS_CAN_MSG_LOST[i] = 1 OR
OR
LV_ERR_NS_CAN_BOFF = 1 OR
OR
LV_ERR_LAMB_TMP = 1 OR
LV_ERR_FUEL_TMP = 1 OR
ERR_MAF = 1 OR
LV_ERR_MAP = 1 OR
LV_ERR_MAP_TPS_PLAUS = 1 OR
OR

```

```

1) (Bit 1 (STATE_INH_NS_OBD_2_EXT_ADJ[i]) = 1 AND LC_NS_DIAG_EXT_ADJ_ENA =
    OR
    T_WOUT_NS_AD < C_T_WOUT_NS_AD_INH_NS_DIAG

```

```

STATE_NS[i] != 0 OR
(State_ERR_NS_OBD_2[i] bitwise AND C_ERR_NS_PLAUS_BIT_SEL[i]) != 0
then LV_INH_DIAG_NS_OBD_2_PLAUS[i] = 1
else LV_INH_DIAG_NS_OBD_2_PLAUS[i] = 0
endif

```

C\_STATE\_INH\_NS\_PLAUS[i] = 1 ('DISABLE'):  
LV\_INH\_DIAG\_NS\_OBD\_2\_PLAUS[i] = 1

C\_STATE\_INH\_NS\_PLAUS[i] = 2 ('ENABLE'):  
LV\_INH\_DIAG\_NS\_OBD\_2\_PLAUS[i] = 0

**end case selection**

*Inhibition mode of NOx signal gain diagnosis*


**case selection** on C\_STATE\_INH\_NS\_GAIN[i]

C\_STATE\_INH\_NS\_GAIN[i] = 0 ('AUTO'):

```

if LV_ERR_NS_OBD_1[i] = 1 OR
OR

```

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```

LV_ERR_NS_CAN_MSG_LOST[i] = 1                                     OR
LV_ERR_NS_CAN_BOFF = 1                                         OR
LV_ERR_LAMB_TMP = 1                                           OR
LV_ERR_FUEL_TMP = 1                                           ORLV_
ERR_MAF = 1                                                    OR
LV_ERR_MAP = 1                                                 OR
LV_ERR_MAP_TPS_PLAUS = 1                                       OR
LV_ERR_NT_AGI = 1                                             OR
LV_ERR_NS_OBD_2[i] = 1                                         OR
LV_ERR_CAT_DIAG_AFL[1] = 1                                     OR
(NC_CBK_EX_NR = 2 AND LV_ERR_CAT_DIAG_AFL[2] = 1)
LV_ERR_TEG_PCAT_DOWN = 1                                       OR
LV_SO2P_REQ = 1                                               OR
(Bit 12 (STATE_INH_NS_OBD_2_EXT_ADJ[i]) = 1 AND LC_NS_DIAG_EXT_ADJ_ENA =
1)
OR
(State_ERR_NS_OBD_2[i] bitwise AND C_ERR_NS_GAIN_BIT_SEL[i]) != 0
then LV_INH_DIAG_NS_OBD_2_GAIN[i] = 1
else LV_INH_DIAG_NS_OBD_2_GAIN[i] = 0
endif
C_STATE_INH_NS_GAIN[i] = 1 ('DISABLE'):
LV_INH_DIAG_NS_OBD_2_GAIN[i] = 1
C_STATE_INH_NS_GAIN[i] = 2 ('ENABLE'):
LV_INH_DIAG_NS_OBD_2_GAIN[i] = 0
end case selection

```

*Inhibition mode of NOx raw emission diagnosis*

**case selection** on C\_STATE\_INH\_NS\_RAW[i]

C\_STATE\_INH\_NS\_RAW[i] = 0 ('AUTO'):

```

if
LV_ERR_NS_OBD_1[i] = 1                                         OR
LV_ERR_NS_CAN_MSG_LOST[i] = 1                                     OR
LV_ERR_NS_CAN_BOFF = 1                                         OR
LV_ERR_LAMB_TMP = 1                                           OR
LV_ERR_FUEL_TMP = 1                                           ORLV_
ERR_MAF = 1                                                    OR
LV_ERR_MAP = 1                                                 OR
LV_ERR_MAP_TPS_PLAUS = 1                                       OR
(Bit 13 (STATE_INH_NS_OBD_2_EXT_ADJ[i]) = 1 AND LC_NS_DIAG_EXT_ADJ_ENA
= 1)
OR
(State_ERR_NS_OBD_2[i] bitwise AND C_ERR_NS_RAW_BIT_SEL[i]) != 0
then LV_INH_DIAG_NS_OBD_2_RAW[i] = 1
else LV_INH_DIAG_NS_OBD_2_RAW[i] = 0
endif

```

```
C_STATE_INH_NS_RAW[i] = 1 ('DISABLE'):
  LV_INH_DIAG_NS_OBD_2_RAW[i] = 1
```

```
C_STATE_INH_NS_RAW[i] = 2 ('ENABLE'):
  LV_INH_DIAG_NS_OBD_2_RAW[i] = 0
```

**end case selection**

*Inhibition mode of NOx sensor internal setpoint shift diagnosis*

**case selection** on C\_STATE\_INH\_NS\_SHIFT[i]

```
C_STATE_INH_NS_SHIFT[i] = 0 ('AUTO'):
```

```
  if
    LV_ERR_NS_OBD_1[i] = 1 OR
    LV_ERR_NS_CAN_MSG_LOST[i] = 1 OR
    LV_ERR_NS_CAN_BOFF = 1 OR
    LV_ERR_LAMB_TMP = 1 OR
    LV_ERR_FUEL_TMP = 1 OR
    ERR_MAF = 1 OR
    LV_ERR_MAP = 1 OR
    LV_ERR_MAP_TPS_PLAUS = 1 OR
    (LC_NS_SHIFT_INH_CAT_DIAG
     ( LV_LAM_ADJ_CAT_DIAG[1] = 1 OR
       (NC_CBK_EX_NR = 2 AND LV_LAM_ADJ_CAT_DIAG[2] = 1) ))
    14 (STATE_INH_NS_OBD_2_EXT_ADJ[i]) = 1 AND LC_NS_DIAG_EXT_ADJ_ENA = 1
    (STATE_ERR_NS_OBD_2[i] bitwise AND C_ERR_NS_SHIFT_BIT_SEL[i]) != 0
  then LV_INH_DIAG_NS_OBD_2_SHIFT[i] = 1
  else LV_INH_DIAG_NS_OBD_2_SHIFT[i] = 0
  endif
```

```
C_STATE_INH_NS_SHIFT[i] = 1 ('DISABLE'):
  LV_INH_DIAG_NS_OBD_2_SHIFT[i] = 1
```

```
C_STATE_INH_NS_SHIFT[i] = 2 ('ENABLE'):
  LV_INH_DIAG_NS_OBD_2_SHIFT[i] = 0
```


**end case selection**

*Inhibition mode of NOx sensor version diagnosis*

**case selection** on C\_STATE\_INH\_NS\_VERS[i]

```
C_STATE_INH_NS_VERS[i] = 0 ('AUTO'):
```


```
  if
    1 OR
    LV_ERR_NS_CAN_MSG_LOST[i] =
    LV_ERR_NS_CAN_BOFF = 1 OR
    (Bit 15 (STATE_INH_NS_OBD_2_EXT_ADJ[i]) = 1 AND LC_NS_DIAG_EXT_ADJ_ENA
    = 1) OR
    (STATE_ERR_NS_OBD_2[i] bitwise AND C_ERR_NS_VERS_BIT_SEL[i]) != 0
  then LV_INH_DIAG_NS_OBD_2_VERS[i] = 1
  else LV_INH_DIAG_NS_OBD_2_VERS[i] = 0
  endif
```

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```
C_STATE_INH_NS_VERS[i] = 1 ('DISABLE');
  LV_INH_DIAG_NS_OBD_2_VERS[i] = 1
```

```
C_STATE_INH_NS_VERS[i] = 2 ('ENABLE');
  LV_INH_DIAG_NS_OBD_2_VERS[i] = 0
```

```
end case selection
```

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## B.130 NOx storage catalyst diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_NT_AGI	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom for the NOx catalyst aging diagnosis					
ERR_SYM_NT_SO2P	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom for the NOx catalyst missing desulfation diagnosis					
LV_CDN_DIAG_NT_AGI	V	0... 1H	0 ...1	1	-
Diagnosis condition of NOx catalyst aging diagnosis					
LV_CDN_DIAG_NT_SO2P	V	0... 1H	0 ...1	1	-
Diagnosis condition of NOx catalyst missing desulfation diagnosis					
LV_END_DIAG_NT_AGI	O/V	0... 1H	0 ...1	1	-
End of NOx catalyst aging diagnosis					
LV_END_DIAG_NT_SO2P	O/V	0... 1H	0 ...1	1	-
End of NOx catalyst missing desulfation diagnosis					
LV_ERR_NT_AGI	O/V	0... 1H	0 ...1	1	-
Error flag of NOx catalyst aging diagnosis					
LV_ERR_NT_SO2P	O/V	0... 1H	0 ...1	1	-
Error flag of NOx catalyst missing desulfation diagnosis					

### Input data:

LV_INH_DIAG_NT_AGI {p. 6490}	LV_INH_DIAG_NT_SO2P {p. 6490}	LV_NT_AFS_REQ_AGI_ TMP_3 {p. 3072}	LV_ST_END {p. 1720}
NC_IDX_DIAG_NT_AGI	NC_IDX_DIAG_NT_SO2P	NT_AGI_SUL {p. 3073}	NT_AGI_THERMO {p. 3073}
NT_SUL {p. 3113}	NT_SUL_H {p. 3113}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_NT_AGI	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx catalyst aging diagnosis					
C_ABC_DEC_NT_SO2P	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx catalyst missing desulfation diagnosis					
C_ABC_INC_NT_AGI	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx catalyst aging diagnosis					
C_ABC_INC_NT_SO2P	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx catalyst missing desulfation diagnosis					
C_ABC_MAX_NT_AGI	-	1... FFH	1... 255	1	-
Anti bounce counter maximum for the NOx catalyst aging diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_NT_SO2P	-	1... FFH	1... 255	1	-
Anti bounce counter maximum for the NOx catalyst missing desulfation diagnosis					
C_FAC_NT_AGI_ERR_SO2P	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx trap aging factor threshold for the missing desulfation error					
IP_SUL_H_NT_MIN_ERR_SO2P	-	0... FFFFH	0... 10485.6	0.16	mg
LDPM_NT_AGI_THERMO_IP_SUL_ERR	6	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx Trap sulphur loading threshold (for high sulphured fuel) for missing desulfation error					
IP_SUL_NT_MAX_ERR_SO2P	-	0... FFFFH	0... 10485.6	0.16	mg
LDPM_NT_AGI_THERMO_IP_SUL_ERR	6	0... FFFFH	0... 0.99998474	15.2587e-6	-
Sulphur model threshold for missing desulfation error					

### Import actions:

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>,OUT<LV_END_DIAG>)
<b>ACTION_ERRM_GetLvErr</b> (IN<IDX_DIAG>,OUT<LV_ERR>)

### General information

If the stratified combustion mode is irreversible forbidden due to NOx catalyst aging, a failure mode entry is done.

If the NOx trap is aged reversible by sulfur, a failure mode entry is done.

### Application Condition

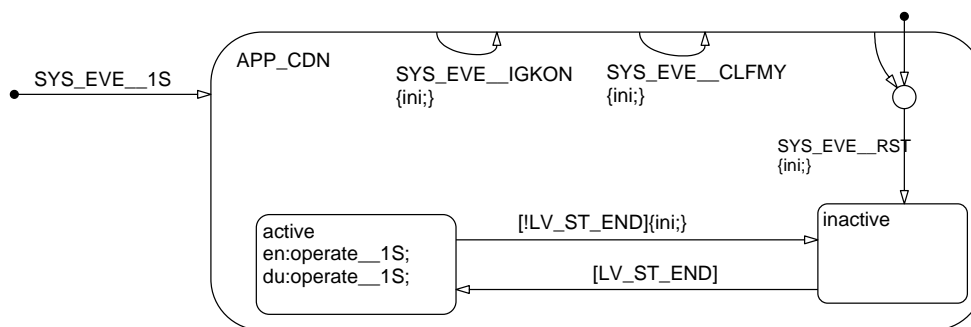


Figure B.130.1: NOXM\_MODULB01Z/APP\_CDN/Chart

### Function Description

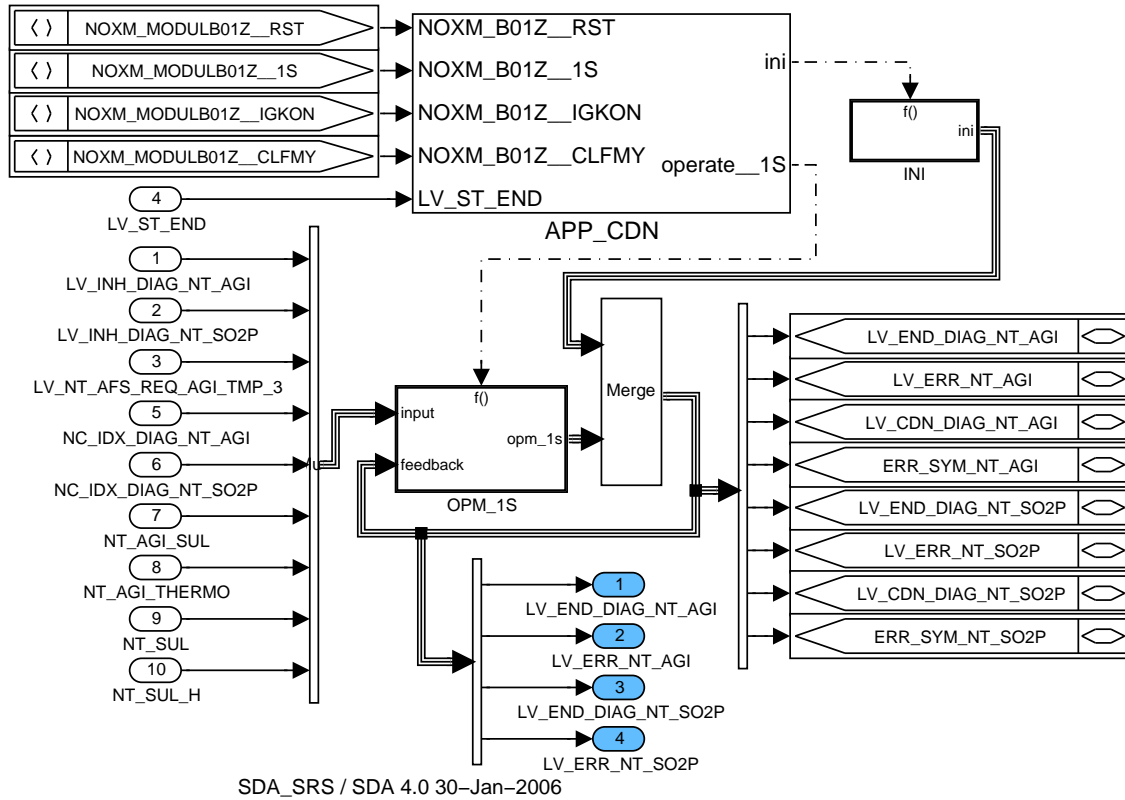


Figure B.130.2: NOXM\_MODULB01Z

### B.130.1 Initialization at reset and deactivation

These actions initialized the diagnostic data according filtering configuration :

ACTION\_ERRM\_GetLvErr( IN<NC\_IDX\_DIAG\_XX>, OUT<LV\_ERR\_XX>)

ACTION\_ERRM\_GetLvEndDiag( IN<NC\_IDX\_DIAG\_XX>, OUT<LV\_END\_DIAG\_XX>)

### B.130.2 Calculation at 1 s

#### 1.1.2.1 Enabling of aging diagnosis

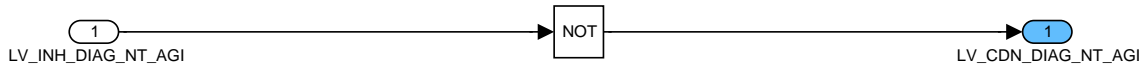


Figure B.130.3: NOXM\_MODULB01Z/OPM\_1S/CLC1

#### 1.1.2.2 Error symptom for aging diagnosis

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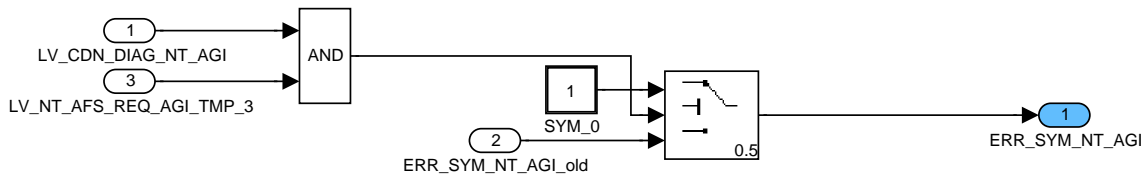


Figure B.130.4: NOXM\_MODULB01Z/OPM\_1S/CLC2

**1.1.2.3 Error management for aging diagnosis**

LV\_ERR\_NT\_AGI will be get by ACTION\_ERRM\_GetLvErr and LV\_END\_DIAG\_NT\_AGI will be get by ACTION\_ERRM\_GetLvEndDiag.

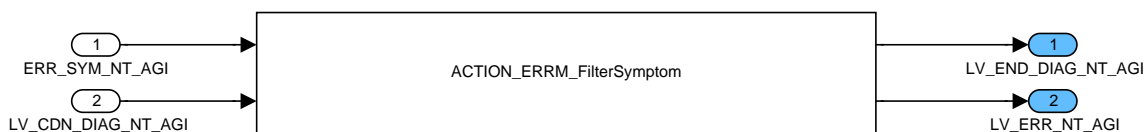


Figure B.130.5: NOXM\_MODULB01Z/OPM\_1S/CLC3

**1.1.2.4 Enabling of missing desulfation diagnosis**

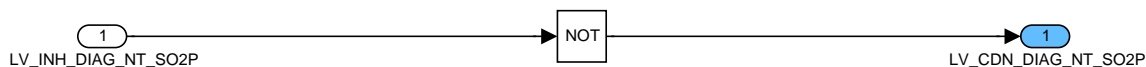


Figure B.130.6: NOXM\_MODULB01Z/OPM\_1S/CLC4

**1.1.2.5 Error symptom for missing desulfation diagnosis**

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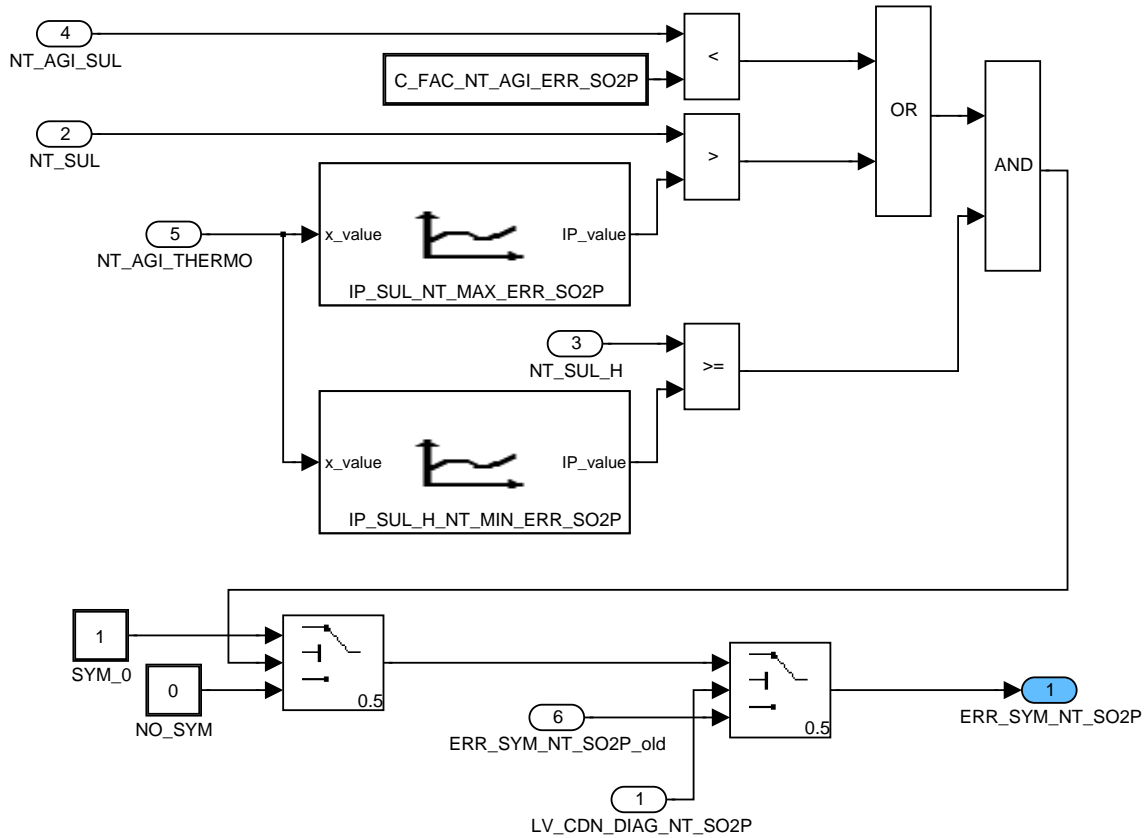


Figure B.130.7: NOXM\_MODULB01Z/OPM\_1S/CLC5

### 1.1.2.6 Error management for missing desulfation diagnosis

LV\_ERR\_NT\_AGI will be get by ACTION\_ERRM\_GetLvErr and LV\_END\_DIAG\_NT\_AGI will be get by ACTION\_ERRM\_GetLvEndDiag.

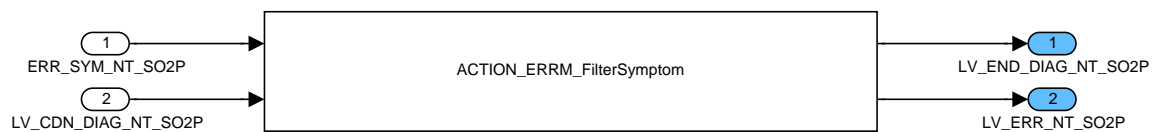


Figure B.130.8: NOXM\_MODULB01Z/OPM\_1S/CLC6

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## B.131 NOx storage catalyst diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_NT_AGI	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx catalyst aging diagnosis					
LV_INH_DIAG_NT_SO2P	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx catalyst diagnosis for missing desulfation					

### Input data:

LV_ST_END {p. 1720}			
---------------------	--	--	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_INH_NT_AGI	-	0H	AUTO	-	-
		1H	DISABLE		
		2H	ENABLE		
Switch for selection of inhibition mode of NOx catalyst aging diagnosis					
C_STATE_INH_NT_SO2P	-	0H	AUTO	-	-
		1H	DISABLE		
		2H	ENABLE		
Switch for selection of inhibition mode of NOx catalyst diagnosis for missing desulfation					

### Error treatment:

Diagnostic	Symptom description	Symptom	Filter type
NT_AGI			
NOx storage catalyst diagnosis	NOx storage capacity too low	SYM_0	STD
		SYM_1	
		SYM_2	
		SYM_3	

Figure B.131.1: Diagnostic

Diagnostic	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NT_AGI								
NOx storage catalyst diagnosis	NOx storage capacity too low	SYM_0						
		SYM_1						
		SYM_2						
		SYM_3						

Figure B.131.2: Diagnostic

Diagnostic	Symptom description	Symptom	Filter type
NT_SO2P			
NOx storage catalyst diagnosis	NOx trap sulfur load too high	SYM_0	STD
		SYM_1	
		SYM_2	
		SYM_3	

Figure B.131.3: Diagnostic

Diagnostic	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NT_SO2P								
NOx storage catalyst diagnosis	NOx trap sulfur load too high	SYM_0						
		SYM_1						
		SYM_2						
		SYM_3						

### General information:

Both diagnoses will be inhibited, if any used input signal is not valid. Additionally, the diagnosis may be enabled or disabled without any cross dependencies.

### Application conditions

**Initialisation:** at reset and at deactivation:  
LV\_INH\_DIAG\_NT\_AGI = 1  
LV\_INH\_DIAG\_NT\_SO2P = 1

**Recurrence:** 1 s

**Activation:** LV\_ST\_END = 1

**Deactivation:** LV\_ST\_END = 0

### Formula section:

**case selection** on C\_STATE\_INH\_NT\_AGI

C\_STATE\_INH\_NT\_AGI = 0 ('AUTO');

LV\_INH\_DIAG\_NT\_AGI = 0

(no cross dependencies)

C\_STATE\_INH\_NT\_AGI = 1 ('DISABLE');

LV\_INH\_DIAG\_NT\_AGI = 1

C\_STATE\_INH\_NT\_AGI = 2 ('ENABLE');

LV\_INH\_DIAG\_NT\_AGI = 0

**end case selection**

**case selection** on C\_STATE\_INH\_NT\_SO2P

C\_STATE\_INH\_NT\_SO2P = 0 ('AUTO');

LV\_INH\_DIAG\_NT\_SO2P = 0

(no cross dependencies)


C\_STATE\_INH\_NT\_SO2P = 1 ('DISABLE');

```
LV_INH_DIAG_NT_SO2P = 1
```

```
C_STATE_INH_NT_SO2P = 2 ('ENABLE');
```

```
LV_INH_DIAG_NT_SO2P = 0
```

```
end case selection
```

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## B.132 Ignition angle efficiency diagnosis

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_SUM_EFF_IGA_CST_IS	V	80000000... 7FFFFFFFH	-65536... 65535.9999695	30.5176e-6	-
Integral of EFF_IGA_DIF at idle speed					
CTR_SUM_EFF_IGA_CST_PL	V	80000000... 7FFFFFFFH	-65536... 65535.9999695	30.5176e-6	-
Integral of EFF_IGA_DIF at part load					
CTR_SUM_TQ_DIF_P_D_FAST	V	0... FFFFH	0... 65535	1	-
Accumulated sum of the signal TQ_DIF_P_D_FAST_IS					
CTR_T_EFF_IGA_CST_IS	V	0... FFFFH	0... 6553.5	0.1	s
Cumulated counted step amount at idle speed with active catalyst heating for EFF_IGA_CST diagnosis					
CTR_T_EFF_IGA_CST_PL	V	0... FFFFH	0... 6553.5	0.1	s
Cumulated counted step amount at part load with active catalyst heating for EFF_IGA_CST diagnosis					
EFF_IGA_CST_QUO_IS	O/V	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Quotient of Ignition angle efficiency integral and time at idle speed					
EFF_IGA_CST_QUO_IS_MAX	O/V/S	0... FFH	0... 255	1	%
Maximum quotient of ignition angle efficiency integral and time at idle speed (relative to the maximum threshold in percent)					
EFF_IGA_CST_QUO_PL	O/V	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Quotient of Ignition angle efficiency integral and time in part load					
EFF_IGA_CST_QUO_PL_MAX	O/V/S	0... FFH	0... 255	1	%
Maximum quotient of ignition angle efficiency integral and time in part load (relative to the maximum threshold in percent)					
EFF_IGA_DIF	V	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Difference of EFF_IGA_AV and EFF_IGA_SP_CH					
EFF_IGA_SP_CH	O/V	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Setpoint of ignition angle efficiency due to catalyst heating request					
LF_STATE_DGO_EFF_IGA_CST_IS	O/V	0... FFFFH	0... 65535	1	-
State of ignition angle efficiency monitoring at cold start - idle speed					
LF_STATE_DGO_EFF_IGA_CST_PL	O/V	0... FFFFH	0... 65535	1	-
State of ignition angle efficiency monitoring at cold start - part load					
LV_CTR_HLD_EFF_IGA_CST	V	0... 1H	0 ...1	1	-
Resulting hold set by engine speed or load dynamic detection for stopping the ignition angle diagnosis in idle and part load					
LV_MAF_CTR_HLD_EFF_IGA_CST	V	0... 1H	0 ...1	1	-
Hold set by load dynamic detection for stopping the ignition angle diagnosis in idle and part load					
LV_N_CTR_HLD_EFF_IGA_CST	V	0... 1H	0 ...1	1	-
Hold set by engine speed dynamic detection for stopping the ignition angle diagnosis in idle and part load					
LV_T_MIN_CH_CST	O/V	0... 1H	0 ...1	1	-
Boolean indicating minimum time in catalyst heating reached					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_T_MIN_EFF_IGA_CST_IS	V	0... 1H	0 ...1	1	-
Logical flag indicating minimum time reached for ignition angle efficiency diagnosis for catalyst heating in part load					
LV_T_MIN_EFF_IGA_CST_PL	V	0... 1H	0 ...1	1	-
Logical flag indicating minimum time reached for ignition angle efficiency diagnosis for catalyst heating in part load					
MAF_SP_FIL_CST	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Filtered value of the air mass setpoint for load dynamic detection					
N_FIL_CST	V	0... 1FE0H	0... 8160	1	rpm
Filtered value of engine speed for engine speed dynamic detection					
T_CH_CST	V	0... FFFFH	0... 6553.5	0.1	s
Time since the activation of cold start catalyst heating					
TQ_DIF_SUM_P_D_FAST	V	0... FFFFFFFH	0... 52428.796875	3.125e-3	Nm*s
High resolution accumulated sum of the signal TQ_DIF_P_D_FAST_IS					

**Input data:**

AMP {p. 982}	EFF_IGA_AV {p. 1845}	EFF_IGA_MIN {p. 1845}	LV_IGK {p. 906}
LV_INH_DIAG_EFF_IGA_CST {p. 6508}	LV_IS {p. 1720}	LV_PL {p. 1720}	LV_PU {p. 1720}
LV_ST_END {p. 1720}	LV_STATE_STST_ENG_STOP {p. 804}	MAF_SP {p. 8278}	N {p. 1525}
PQ {p. 8278}	STATE_CH {p. 1777}	TCO_ST {p. 1100}	TQ_ADD_CH_DIAG {p. 6582}
TQ_DIF_P_D_FAST_IS {p. 3441}	TQ_LOSS {p. 8385}	TQI_REQ_TRA {p. 8192}	VS {p. 1176}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_MIN_EFF_IGA_CST	-	0... FFFFH	0... 5434	0.0829175	hPa
Minimum value for ambient pressure for the diagnosis to run					
C_CRLC_MAF_SP_FIL_CST	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlation constant for detection of the load dynamic via difference with the not filtered air mass setpoint					
C_CRLC_N_FIL_CST	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlation constant for detection of the engine speed dynamic via difference with the not filtered engine speed					
C_CTR_T_EFF_IGA_CST_IS	-	0... FFFFH	0... 6553.5	0.1	s
Minimum counted step amount at idle speed with active catalyst heating for EFF_IGA_CST diagnosis					
C_CTR_T_EFF_IGA_CST_PL	-	0... FFFFH	0... 6553.5	0.1	s
Minimum counted step amount at part load with active catalyst heating for EFF_IGA_CST diagnosis					
C_EFF_IGA_SP_CH_THD_IS	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Ignition angle efficiency upper bound for the cold start diagnosis at idle speed					
C_EFF_IGA_SP_CH_THD_PL	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Ignition angle efficiency upper bound for the cold start diagnosis in part load mode					
C_MAF_SP_GRD_THD_CST	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass-air-flow setpoint gradient threshold for dynamic behaviour detection					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_GRD_THD_CST	-	0... 1FE0H	0... 8160	1	rpm
Engine speed gradient threshold for dynamic behaviour detection					
C_T_MAF_CTR_HLD_EFF_IGA_CST	-	0... FFFFH	0... 6553.5	0.1	s
Calibratable value for the hold time caused by a preliminary detection of load dynamic					
C_T_N_CTR_HLD_EFF_IGA_CST	-	0... FFFFH	0... 6553.5	0.1	s
Calibratable value for the hold time caused by a preliminary detection of engine speed dynamic					
C_T_RBM_EFF_IGA_CST	-	0... FFFFH	0... 6553.5	0.1	s
RBM Diagnose threshold for the time since state catalyst heating active					
C_VS_EFF_IGA_CST_THD_PL	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed threshold for running the integral and cumulated counted step amount at part load					
IP_FAC_EFF_IGA_DIF	-	0... FFH	0... 0.99609375	3.90625e-3	-
LDP_SUM_TQ_DIF_P_D_IS	3	0... FFFFH	0... 65535	1	-
Weighting factor used to reduce the cold start diagnosis error due to slipping clutch					
IP_FAC_PQ_EFF_IGA_CST_THD_IS	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
LDP_TQ_LOSS_IP_FAC_PQ_EFF_IGA	6	0... 8000H	-1024 ...0	0.03125	Nm
Maximum relative filling threshold, torque loss dependant for running the integral and cumulated counted step amount at idle					
IP_INT_EFF_IGA_SP_CH_QUO_IS_MAX	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
LDPM_TCO_ST_1	8	0... FEH	-48... 142.5	0.75	°C
Maximum threshold map for quotient of EFF_IGA integral and cumulated time at idle speed of ignition angle diagnosis for catalyst heating					
IP_INT_EFF_IGA_SP_CH_QUO_PL_MAX	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
LDPM_TCO_ST_1	8	0... FEH	-48... 142.5	0.75	°C
Maximum threshold map for quotient of EFF_IGA integral and cumulated time in part load of ignition angle diagnosis for catalyst heating					
LC_INH_SYM_EFF_IGA_CST	-	0... 1H	0 ...1	1	-
Inhibition bit for suppressing ERRM-interaction of eff_iga_cst diagnosis					

### Action definition:

ACTION TQDR_ResetMainEffIgaCst(IN <PRM_STATE_INI>)					Mode: O
Action to initialize main function of ignition angle efficiency monitoring					
Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_STATE_INI	IN	0... FFH	0... 255	1	-
Type of initialization (Clear: CLR; restart: REST)					


### General information:

Legal requirement according to California code regulation 1968.2 (e) (11):

Cold start emission reduction strategy monitoring.

If a vehicle incorporates a specific engine control strategy to reduce cold start emissions, the OBD II system shall monitor the commanded elements for proper function (e.g., increased engine idle speed, commanded ignition timing retard, etc.), other than secondary air, while the control strategy is active to ensure proper operation of the control strategy.


This module describes the technical solution of the ignition angle efficiency monitoring to fulfill the legal requirement.

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**Application conditions:**

*Initialisation:* RST, NVMINI, NVMRES, NVMSTO  
*Recurrence:* 100MS  
*Activation:* always  
*Deactivation:* if activation not true

**Function description:****Formula section:**

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 6496 of 8404</b>	
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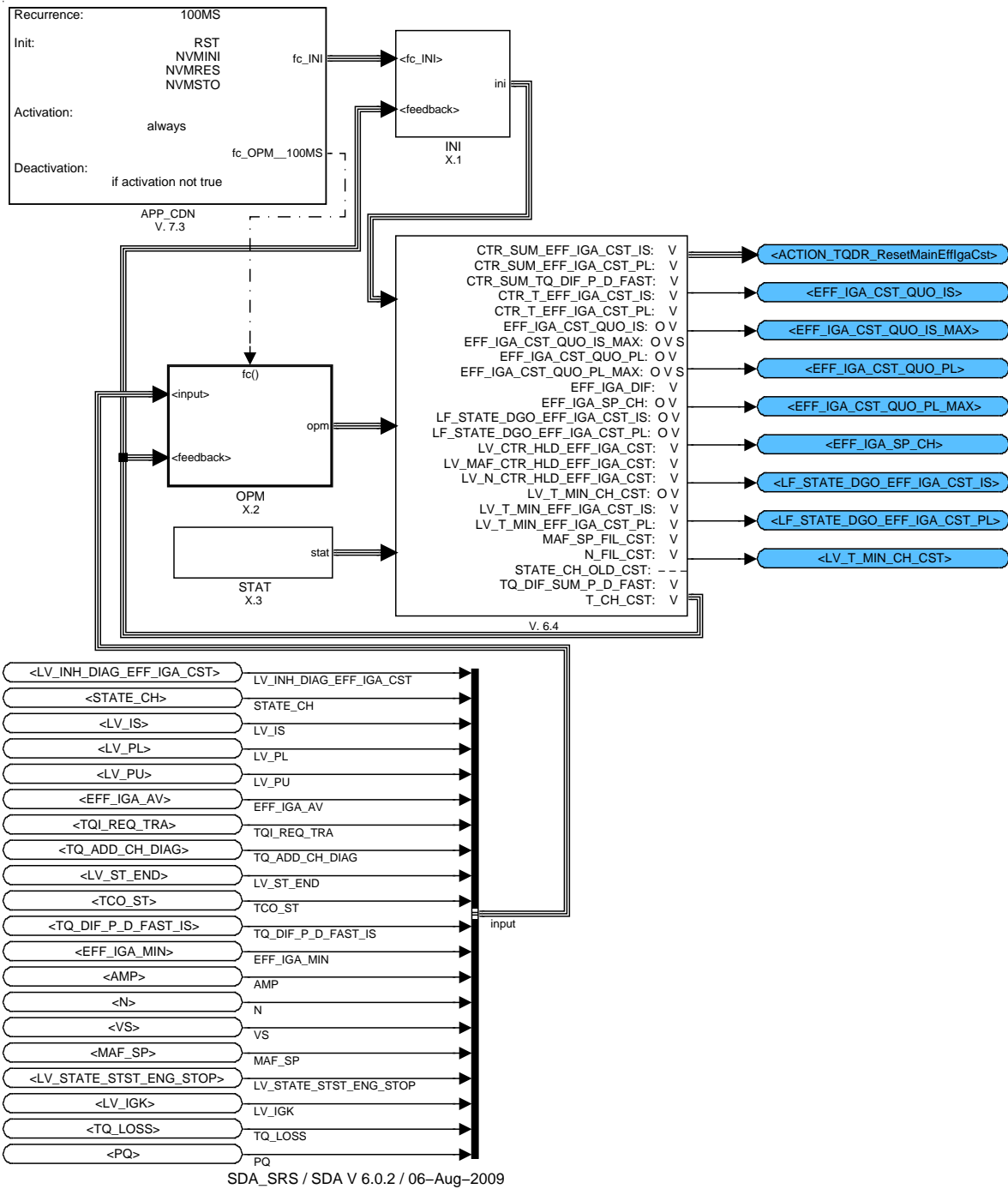


Figure B.132.1: :

## B.132.1 Initialization

### B.132.1.1 At ECU reset

Variables which are initialized only once at ECU reset are listed here. All other variables are initialized by means of an action call (TQDR\_ResetMainEffIgaCst) from ERRM interface (the action itself is defined in this module).

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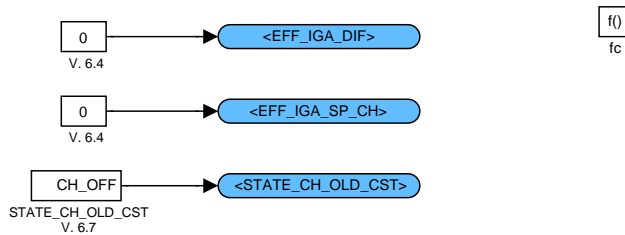


Figure B.132.2: :

### B.132.1.2 Initialization of NVMY data in case of EEPROM error

Default values in case of check-sum error are 0.

### B.132.1.3 Restore NVMY data

At ECU reset EFF\_IGA\_CST\_QUO\_IS/PL\_MAX are restored from NVMY memory.

### B.132.1.4 Store NVMY data

At end of power-latch phase EFF\_IGA\_CST\_QUO\_IS/PL\_MAX are stored into NVMY.

## B.132.2 Formula section

### B.132.2.1 Calculation of ignition angle efficiency due to catalyst heating request

The torque reserve for catalyst heating TQ\_ADD\_CH\_DIAG is transformed into a set point for the ignition angle efficiency EFF\_IGA\_SP\_CH used to realize this reserve.

#### B.132.2.1.1 Set point calculation

EFF\_IGA\_SP\_CH is calculated based on TQ\_ADD\_CH\_DIAG from EXTC. The set point is limited to maximum value of 1.

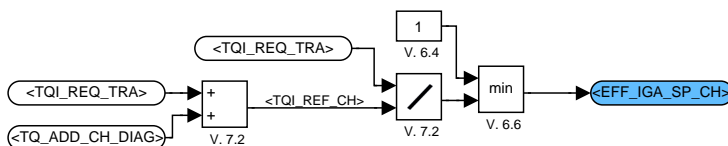


Figure B.132.3: :

#### B.132.2.1.2 Calculation of minimum time during catalyst heating

During catalyst heating the timer T\_CH\_CST is increased when EFF\_IGA\_SP\_CH is below 1. The timer starts to run when LV\_ST\_END switches to 1.

When the timer reaches the threshold C\_T\_RBM\_EFF\_IGA\_CST the flag LV\_T\_MIN\_CH\_CST is set. This flag is evaluated for RBM indicating that minimum time during catalyst heating was reached.

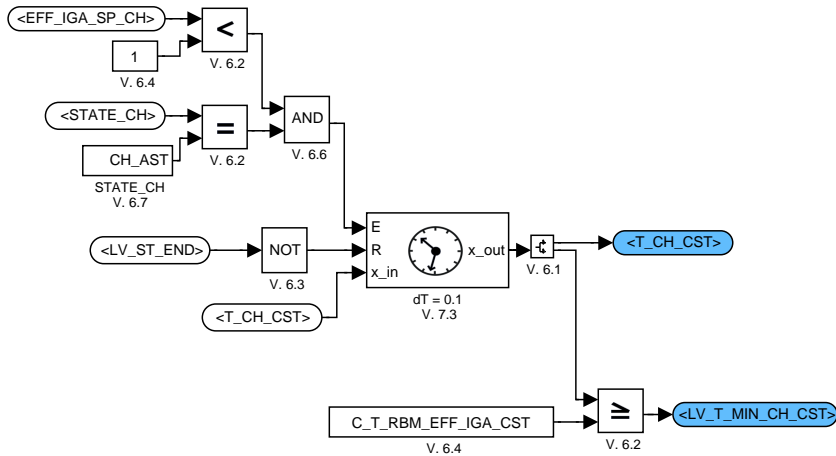


Figure B.132.4: :

### B.132.2.2 Diagnostic function

The difference between the actual ignition angle efficiency and set point, limited by the minimum ignition angle efficiency, is integrated for the engine phases "idle speed" and "part load" separately. The integrated values are normalized by division with the accumulated time spent in the respective engine phases. The symptoms LV\_SYM\_EFF\_IGA\_CST\_IS/PL are set accordingly if the normalized integration values exceed the respective maximum thresholds. The maximum drag indicators are stored in the nonvolatile memory. The drag indicators can be cleared by calibration or customer test interface.

Three cases are distinguished:

1. Catalyst heating active
2. End of catalyst heating (1 recurrence after Catalyst heating active)
3. Diagnostic not active

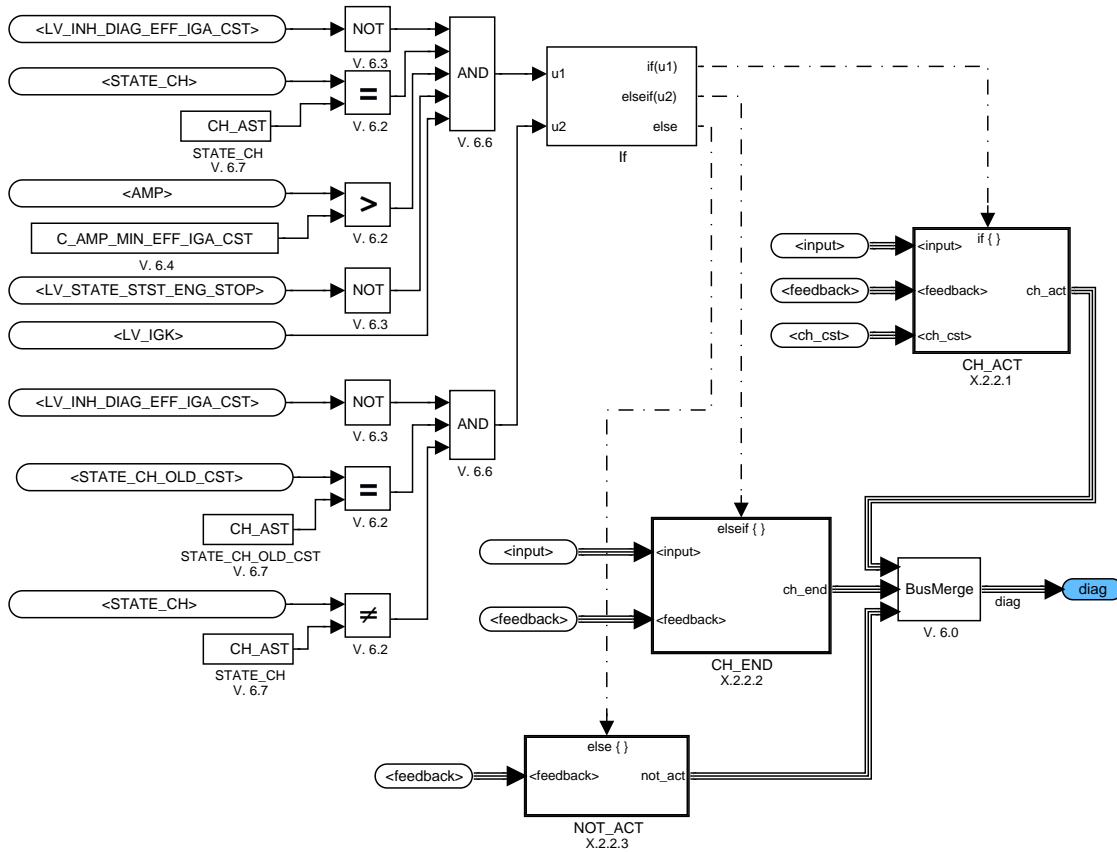


Figure B.132.5: :

### B.132.2.2.1 Catalyst heating active

Following functionality is executed when catalyst heating is active and no inhibition of the diagnostic is present.

#### B.132.2.2.1.1 Calculation of ignition angle efficiency difference

The difference between ignition angle actual value and catalyst heating set point is calculated. This difference is weighted with a factor depending on the accumulated PD-part for fast-path of torque coordination. This accumulated PD-part is normalized to unit [-] in the variable CTR\_SUM\_TQ\_DIF\_P\_D\_FAST.

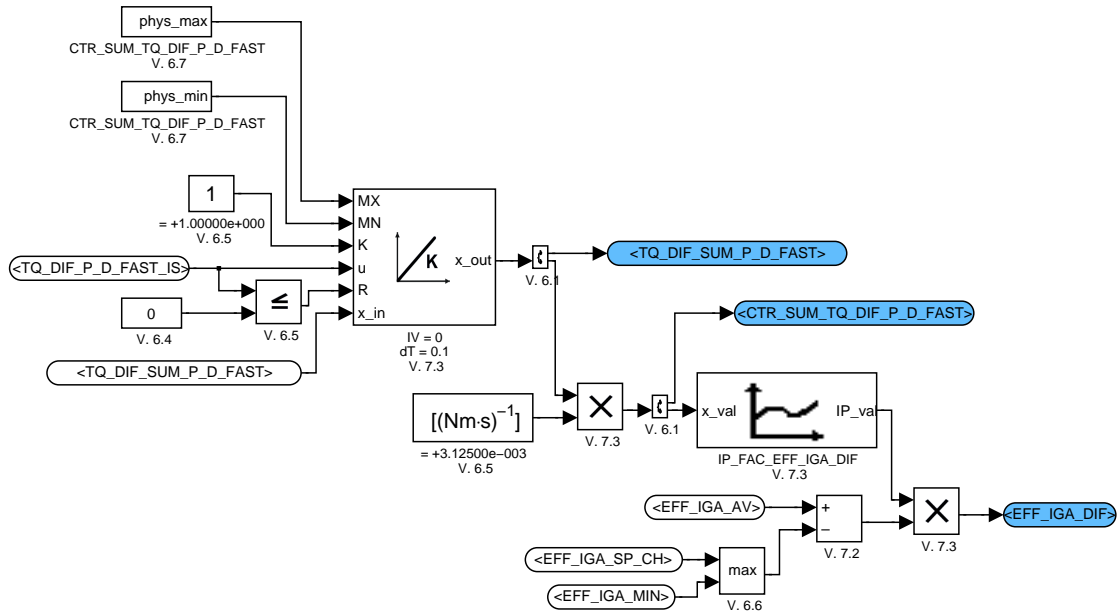


Figure B.132.6: :

### B.132.2.2.1.2 Ignition angle efficiency quotient in idle speed

Ignition angle efficiency difference is integrated and normalized with the variable CTR\_SUM\_EFF\_IGA\_CST\_IS. Enabling condition for the integrator is that the ignition angle efficiency set point is below the maximum C\_EFF\_IGA\_SP\_CH\_THD\_IS and engine state is IS or PU. When these conditions are fulfilled a timer is running in order to calculate the quotient of integrated ignition angle efficiency CTR\_SUM\_EFF\_IGA\_CST\_IS and to set a flag when minimum time during catalyst heating for the diagnostic is reached.

Furthermore bit 0 of LF\_STATE\_DGO\_EFF\_IGA\_CST\_IS is set the enabling conditions in order to indicate that diagnostic conditions are fulfilled and bit 2 is set to 1 in order to indicate that the diagnostic result is not yet de-bounced.

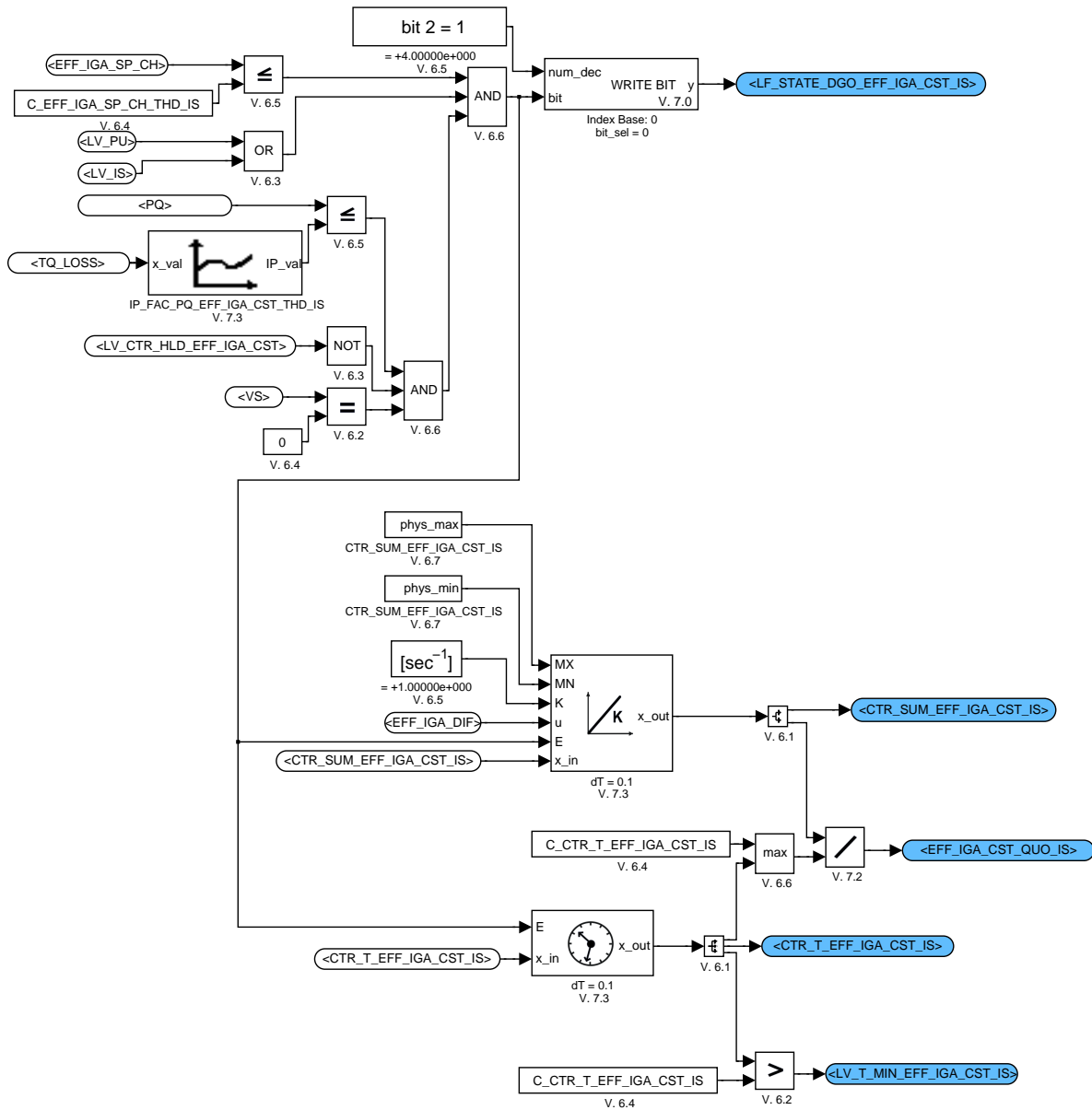


Figure B.132.7: :

**B.132.2.2.1.3 Ignition angle efficiency quotient in part load**

Ignition angle efficiency difference is integrated and normalized with the variable CTR\_SUM\_EFF\_IGA\_CST\_PL. Enabling condition for the integrator is that the ignition angle efficiency set point is below the maximum C\_EFF\_IGA\_SP\_CH\_THD\_PL and engine state is part load. When these conditions are fulfilled a timer is running in order to calculate the quotient of integrated ignition angle efficiency CTR\_SUM\_EFF\_IGA\_CST\_PL and to set a flag when minimum time during catalyst heating for the diagnostic is reached.

Furthermore bit 0 of LF\_STATE\_DGO\_EFF\_IGA\_CST\_PL is set the enabling conditions in order to indicate that diagnostic conditions are fulfilled and bit 2 is set to 1 in order to indicate that the diagnostic result is not yet de-bounced.

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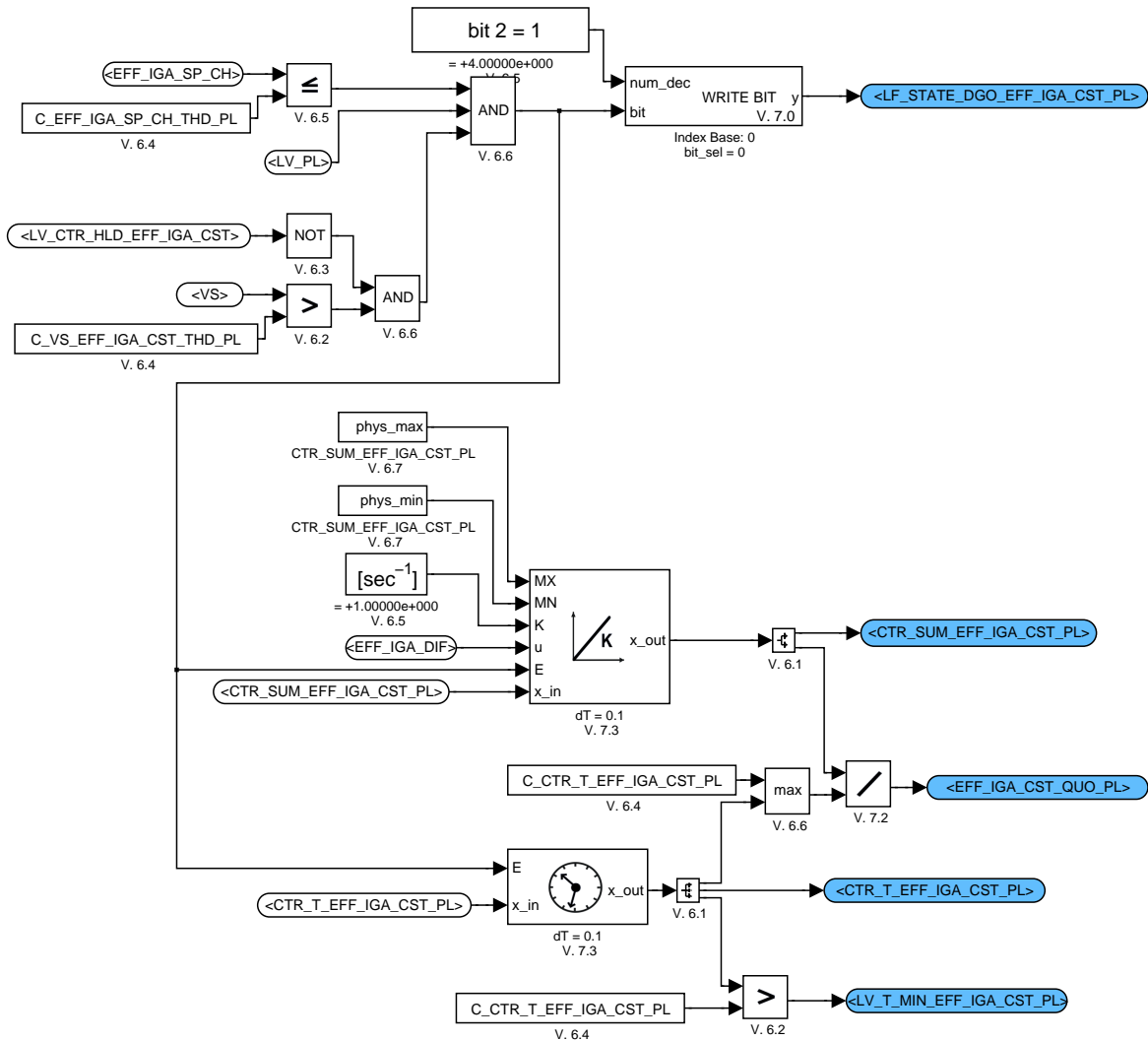


Figure B.132.8: :

### B.132.2.2.1.4 Hold flag calculation

The hold flag is set by engine speed or load dynamic detection for stopping the ignition angle diagnosis in idle and part load.

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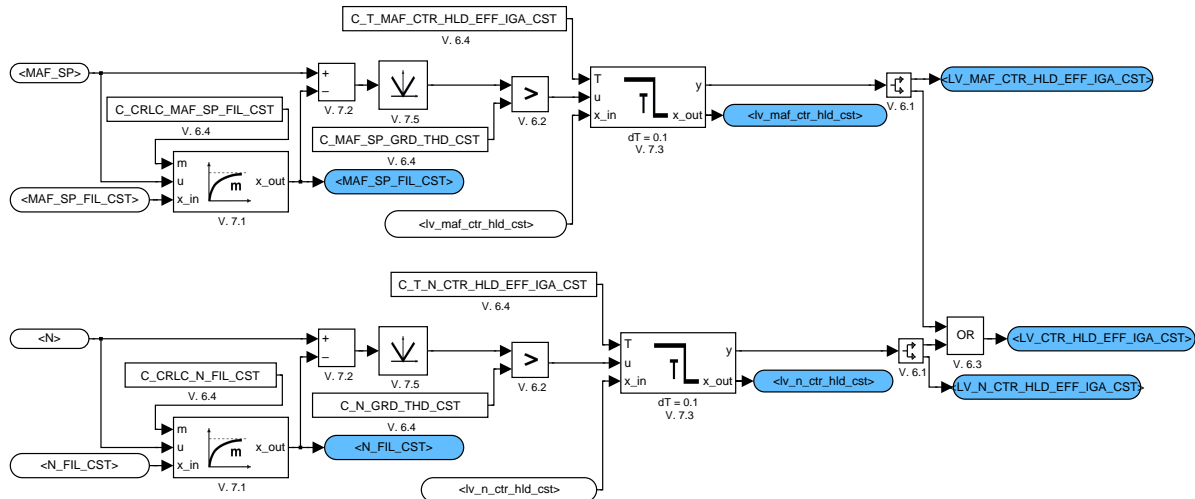


Figure B.132.9: :

### B.132.2.2.2 Symptom evaluation at end of catalyst heating

The symptom detection and calculation of the drag indicators is done at the end of every catalyst heating phase once (if diagnosis was not inhibited). For error-free field trial of the catalyst heating quality the symptom delivery to ERRM can be suppressed by calibration.

#### B.132.2.2.2.1 Symptom evaluation for idle speed

If the quotient of ignition angle efficiency integral is above the threshold defined by `IP_INT_EFF_IGA_SP_CH_QUO_IS_MAX` the symptom is present. It can be suppressed by mean of the calibration switch `LC_INH_SYM_EFF_IGA_CST`.

The maximum quotient is stored to the variable `EFF_IGA_CST_QUO_IS_MAX` (in [%]) as trailing indicator.

The symptom information is stored in bit 1 of `LF_STATE_DGO_EFF_IGA_CST_IS` and the information that the symptom was de-bounced (`LV_T_MIN_EFF_IGA_CST_IS=1`; means time during catalyst heating long enough) is stored in bit 2 (set to 0 if `LV_T_MIN_EFF_IGA_CST_IS=1`).



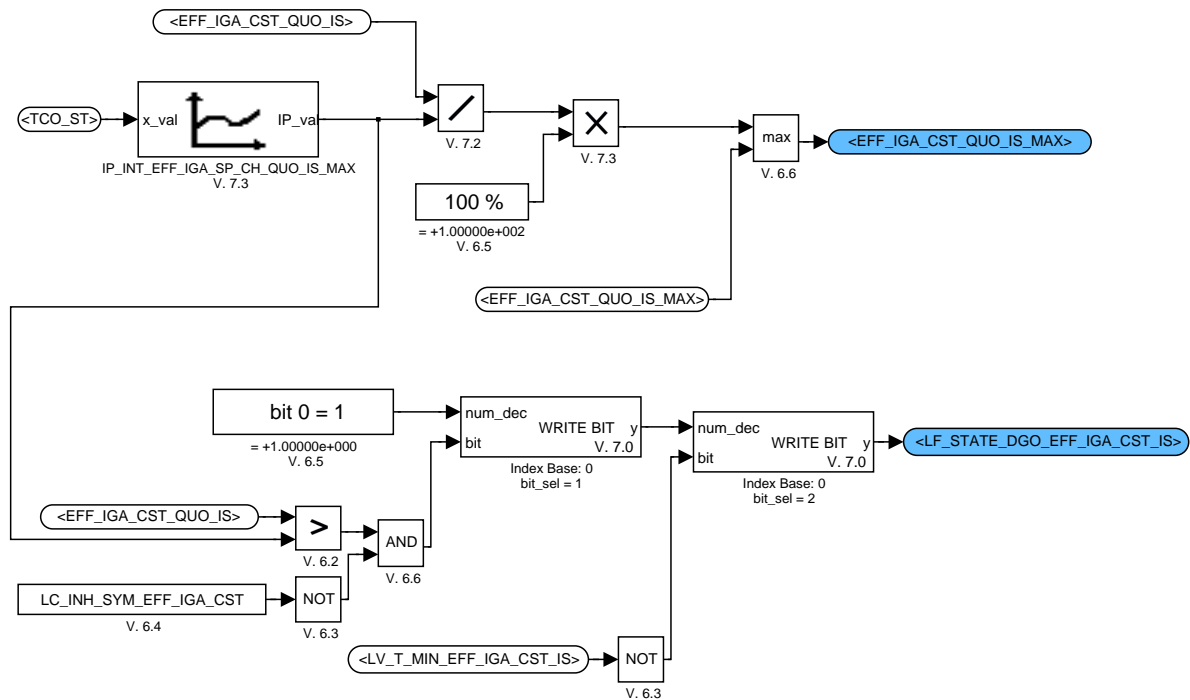


Figure B.132.10: :

### B.132.2.2.2.2 Symptom evaluation for part load

If the quotient of ignition angle efficiency integral is above the threshold defined by  $IP\_INT\_EFF\_IGA\_SP\_CH\_QUO\_PL\_MAX$  the symptom is present. It can be suppressed by mean of the calibration switch  $LC\_INH\_SYM\_EFF\_IGA\_CST$ .

The maximum quotient is stored to the variable  $EFF\_IGA\_CST\_QUO\_PL\_MAX$  (in [%]) as trailing indicator.

The symptom information is stored in bit 1 of  $LF\_STATE\_DGO\_EFF\_IGA\_CST\_PL$  and the information that the symptom was de-bounced ( $LV\_T\_MIN\_EFF\_IGA\_CST\_PL=1$ ; means time during catalyst heating long enough) is stored in bit 2 (set to 0 if  $LV\_T\_MIN\_EFF\_IGA\_CST\_PL=1$ ).

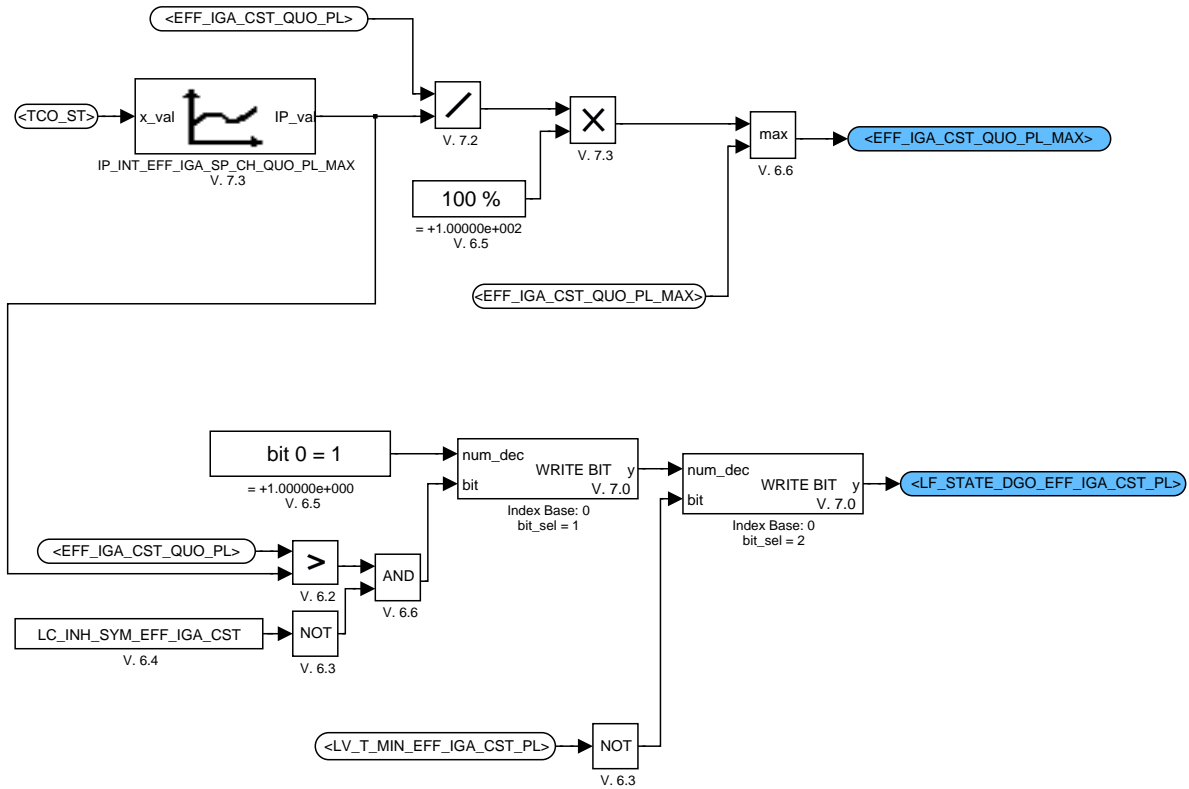


Figure B.132.11: :

### B.132.2.2.3 Diagnostic not active

#### B.132.2.2.3.1 Reset LF\_STATE\_DGO\_...

If the diagnosis is not running interface variables LF\_STATE\_DGO\_EFF\_IGA\_CST\_IS/PL are set to passive values (=0; no delivery to ERRM).

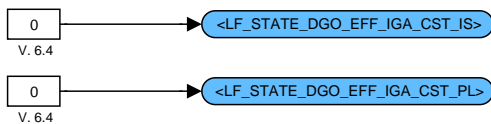


Figure B.132.12: :

## B.132.3 Action definition

### B.132.3.1 Detailed description for Action: ACTION\_TQDR\_ResetMainEffIgaCst

#### B.132.3.1.1 Formula section for action

##### B.132.3.1.1.1 Initialization of all module variables

In order to allow initialization of the module from other functions this action is provided.

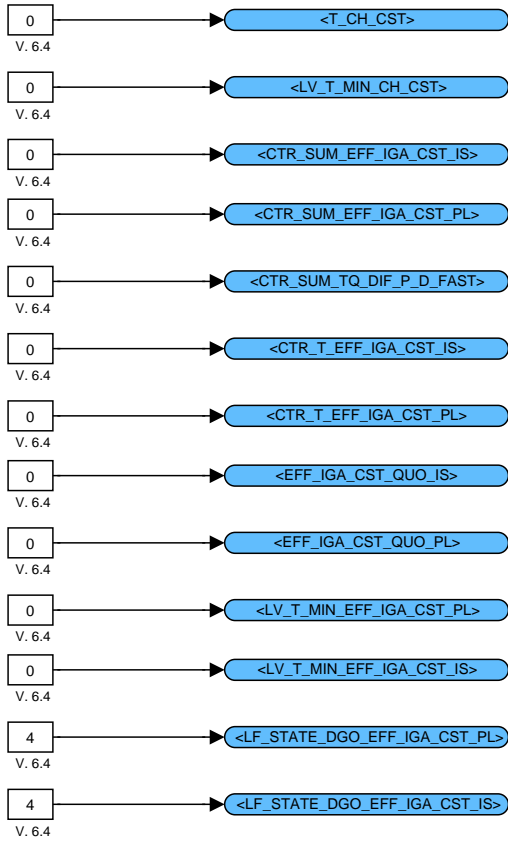


Figure B.132.13: :

## B.133 Ignition angle efficiency diagnosis (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_CST_ACT	O/V	0... 1H	0 ...1	1	-
Condition for cold start diagnosis active					
LV_INH_DIAG_EFF_IGA_CST	O/V	0... 1H	0 ...1	1	-
Flag for inhibition of the Ignition angle efficiency Diagnosis					
LV_INH_DIAG_RBM_EFF_IGA_CST	V	0... 1H	0 ...1	1	-
Deactivation of RBM of EFF_IGA_CST-Montior by cross dependency					
STATE_EOL_DGNC_CH_DIAG	O/V	0H	NOT_START	-	-
		1H	ST_INH		
		2H	PAR_NOT_		
			PLAUS		
		3H	WAIT_REL		
		4H	UNDEF		
		5H	ACT		
		6H	END_WOUT_		
			RESULT		
			ABORTED		
	8H	END_WOUT_			
		ERR			
		9H	END_WITH_		
		undef:1H	ERR		
State of catalyst heating diagnosis					
STATE_RBM_EFF_IGA_CST_IS	O/V	0... FFH	0... 255	1	-
Rate-Based Monitoring statistics for idle speed mode: monitoring conditions met long enough (bit 0 = 1) monitoring inhibition because of system failure(s) (bit 1 = 1) individual RBM monitoring conditions encountered within this DC (bit 2 = 1)					
STATE_RBM_EFF_IGA_CST_PL	O/V	0... FFH	0... 255	1	-
Rate-Based Monitoring statistics for part load mode: monitoring conditions met long enough (bit 0 = 1) monitoring inhibition because of system failure(s) (bit 1 = 1) individual RBM monitoring conditions encountered within this DC (bit 2 = 1)					

### Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_CH_DIAG_EXT_ACT {p. 6597}	LV_CH_DIAG_EXT_REQ {p. 7482}	LV_DC {p. 5746}
LV_END_DIAG_EFF_IGA_CST_IS {p. 6517}	LV_END_DIAG_EFF_IGA_CST_PL {p. 6517}	LV_ERR_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT] {p. 1061}
LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_PER {p. 4432}
LV_ERR_EFF_IGA_CST_IS {p. 6517}	LV_ERR_EFF_IGA_CST_PL {p. 6517}	LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}

LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_ISC {p. 4377}	LV_ERR_ISC_CST {p. 4377}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}
LV_ERR_MAF_FRQ_EL [NC_MAF_NR] {p. 4815}	LV_ERR_MAF_FRQ_GRD [NC_MAF_NR] {p. 4815}	LV_ERR_MAF_FRQ_RNG [NC_MAF_NR] {p. 4815}	LV_ERR_MAP_DIP_ PLAUS {p. 1062}
LV_ERR_MAP_DIP_SENS {p. 4824}	LV_ERR_MAP_DIP_SHIFT {p. 4824}	LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_MEC_IVVT_EX {p. 1062}
LV_ERR_MEC_IVVT_IN {p. 1062}	LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}
LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PUT_EL {p. 4828}	LV_ERR_PUT_PLAUS {p. 1062}	LV_ERR_PVS_1 {p. 4216}
LV_ERR_PVS_2 {p. 4216}	LV_ERR_REF_CRK_CAM_ EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_ IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_SLV_IVVT_EX {p. 4627}
LV_ERR_SLV_IVVT_IN {p. 4627}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CRK_CAM_ EX [NC_NR_CAM_CBK] {p. 4447}
LV_ERR_SYN_CRK_CAM_ IN [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_TCO_EL {p. 4496}	LV_ERR_TCO_GRD {p. 4496}	LV_ERR_TCO_STUCK {p. 5691}
LV_ERR_TCO_STUCK_ RNG {p. 5675}	LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TPS_1 {p. 4990}
LV_ERR_TPS_2 {p. 4990}	LV_T_MIN_CH_CST {p. 6493}	STATE_CH {p. 1777}	T_AST {p. 1766}
TCO_ST {p. 1100}			


**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_AST_MIN_EFF_IGA_CST	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time after start for active ignition angle efficiency diagnosis for catalyst heating					
C_TCO_ST_MAX_DIAG_CST	-	0... FEH	-48... 142.5	0.75	°C
Maximum temperature threshold for ignition angle efficiency diagnosis					
C_TCO_ST_MIN_DIAG_CST	-	0... FEH	-48... 142.5	0.75	°C
Minimum temperature threshold for ignition angle efficiency diagnosis					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_DIAG_EFF_IGA_CST_IS	-	1... FFFFH	1... 65535	1	-
Diagnostic EFF_IGA_CST at idle speed					
NC_IDX_DIAG_EFF_IGA_CST_PL	-	1... FFFFH	1... 65535	1	-
Diagnostic EFF_IGA_CST in part load					

**Import actions:**

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<b>ACTION_ERRM_CheckPendingStatus (IN&lt;PRM_IDX_DIAG&gt;,OUT&lt;PRM_LV_ERR_PND&gt;)</b>
--

## FUNCTION DESCRIPTION:

### General information:

The ignition angle efficiency diagnosis for catalystr heating at coldstart CSERS

### Application conditions

#### **Initialisation:**

At RST or with IGKON event

LV\_DIAG\_CST\_ACT = 0

LV\_INH\_DIAG\_EFF\_IGA\_CST = 1

#### *Recurrence:*

100MS

#### *Activation:*

always

#### *Deactivation:*

never

### Formula section:

Calculation of diagnosis interface parameter:

```

IF                STATE_CH=1 and
                    TCO_ST >=C_TCO_ST_MIN_DIAG_CST
                    and TCO_ST<=C_TCO_ST_MAX_DIAG_CST

THEN

                    LV_DIAG_CST_ACT = 1

ELSE


                    LV_DIAG_CST_ACT = 0

ENDIF

IF                LV_DIAG_CST_ACT = 0 or LV_INH_DIAG_RBM_EFF_IGA_CST = 1 or
                    T_AST <= C_T_AST_MIN_EFF_IGA_CST

THEN              LV_INH_DIAG_EFF_IGA_CST = 1

ELSE              LV_INH_DIAG_EFF_IGA_CST = 0
  
```

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**ENDIF****B.133.1 Rate Base Monitoring interface for Ignition angle efficiency monitoring****FUNCTION DESCRIPTION:****General information:**

With this module the interface between the EFF\_IGA\_CST monitor and the Rate-Based Monitoring statistics is defined with STATE\_RBM\_EFF\_IGA\_CST\_IS/PL data.

Within STATE\_RBM\_EFF\_IGA\_CST\_IS/PL, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)  
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)

**Application conditions:***Initialisation :*

at ECU reset :

bit 0, bit 1 and bit 2 of STATE\_RBM\_EFF\_IGA\_CST\_IS = 0

bit 0, bit 1 and bit 2 of STATE\_RBM\_EFF\_IGA\_CST\_PL = 0

at LV\_DC 0 1 transition:

bit 0, bit 1 and bit 2 of STATE\_RBM\_EFF\_IGA\_CST\_IS = 0

bit 0, bit 1 and bit 2 of STATE\_RBM\_EFF\_IGA\_CST\_PL = 0

LV\_INH\_DIAG\_RBM\_EFF\_IGA\_CST = 0

on failure memory reset :

bit 1 of STATE\_RBM\_EFF\_IGA\_CST\_IS = 0

bit 1 of STATE\_RBM\_EFF\_IGA\_CST\_PL = 0

LV\_INH\_DIAG\_RBM\_EFF\_IGA\_CST = 0


*Recurrence:* 1 S

*Activation:* LV\_DC = 1

*Deactivation:* LV\_DC = 0

**Formula section:****At LV\_DC 0 1 transition**

The pending status of the following failures has to be checked only once:

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LV_ERR_PUT_EL	LV_ERR_PVS_1	LV_ERR_PVS_2	LV_ERR_ISC
LV_ERR_ISC_CST	LV_ERR_CRK_PLAUS	LV_ERR_CRK_SYN	LV_ERR_CRK_TOOTH
LV_ERR_CRK_TOOTH_PERR	LV_ERR_PER_CAM_EX[1...NC_NR_CAM_CBK]	LV_ERR_PER_CAM_IN[1...NC_NR_CAM_CBK]	LV_ERR_PLAUS_CAM_EX[1...NC_NR_CAM_CBK]
LV_ERR_PLAUS_CAM_IN[1...NC_NR_CAM_CBK]	LV_ERR_REF_CRK_CAM_EX[1...NC_NR_CAM_CBK]	LV_ERR_REF_CRK_CAM_IN[1...NC_NR_CAM_CBK]	LV_ERR_SYN_CAM_EX[1...NC_NR_CAM_CBK]
LV_ERR_SYN_CAM_IN[1...NC_NR_CAM_CBK]	LV_ERR_SYN_CRK_CAM_EX[1...NC_NR_CAM_CBK]	LV_ERR_SYN_CRK_CAM_IN[1...NC_NR_CAM_CBK]	LV_ERR_TOOTH_OFF_EX[1...NC_NR_CAM_CBK]
LV_ERR_TOOTH_OFF_IN[1...NC_NR_CAM_CBK]	LV_ERR_TCO_EL	LV_ERR_TCO_GRD	LV_ERR_MAF_FRQ_GRD
LV_ERR_TCO_STUCK	LV_ERR_TCO_STUCK_RNG	LV_ERR_LOAD_TPS_PLAUS[1...NC_MAF_NR]	LV_ERR_MAP_DIP_PLAUS
LV_ERR_MAP_TPS_PLAUS	LV_ERR_MEC_IVVT_EX[1...NC_NR_CBK_IVVT]	LV_ERR_MEC_IVVT_IN[1...NC_NR_CBK_IVVT]	LV_ERR_SLV_IVVT_EX[1...NC_NR_CBK_IVVT]
LV_ERR_SLV_IVVT_IN[1...NC_NR_CBK_IVVT]	LV_ERR_PUT_PLAUS[1...NC_ETC_NR]	LV_ERR_FUP_MFP_PLAUS[0...NC_CBK_HPP_NR-1]	LV_ERR_FUP_ORNG[0...NC_CBK_HPP_NR-1]
LV_ERR_H_PRS_SYS[0...NC_CBK_HPP_NR-1]	LV_ERR_MAF_FRQ_EL[1...NC_MAF_NR]	LV_ERR_MAF_FRQ_RNG[1...NC_MAF_NR]	LV_ERR_MAP_DIP_SENS
LV_ERR_TPS_1[1...NC_ETC_NR]	LV_ERR_TPS_2[1...NC_ETC_NR]	LV_ERR_MAP_DIP_SHIFT	LV_ERR_CAM_CST_IVVT_IN[1...NC_NR_CBK_IVVT]
LV_ERR_CAM_CST_IVVT_EX[1...NC_NR_CBK_IVVT]			

**If(1)** { CPU optimization at LV\_DC 0 1 transition }  
CTR\_ERR\_DYN\_NR <> 0 { the dynamic failure memory isn't empty }

**Then(1)**

**While** bit 1 of STATE\_RBM\_EFF\_IGA\_CST\_IS = 0 **do**

with each XX failure of the above list :

ACTION\_ERRM\_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

**If(2)** XX has a pending status

**Then(2)**

bit 1 of STATE\_RBM\_EFF\_IGA\_CST\_IS = 1

**Endif(2)**

**Endwhile**

**While** bit 1 of STATE\_RBM\_EFF\_IGA\_CST\_PL = 0 **do**

with each XX failure of the above list :

ACTION\_ERRM\_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

**If(2)** XX has a pending status

**Then(2)**

bit 1 of STATE\_RBM\_EFF\_IGA\_CST\_PL = 1

**Endif(2)**

**Endwhile**

**Else(1)**

{ the dynamic failure memory is empty }

No action

**Endif(1)**

Every 1S :

**If** at least one of the following LV\_ERR\_xx-Bits is set to 1



LV_ERR_PUT_EL	LV_ERR_PVS_1	LV_ERR_PVS_2	LV_ERR_ISC
LV_ERR_ISC_CST	LV_ERR_CRK_PLAUS	LV_ERR_CRK_SYN	LV_ERR_CRK_TOOTH
LV_ERR_CRK_TOOTH_PERR	LV_ERR_PER_CAM_EX[1...NC_NR_CAM_CBK]	LV_ERR_PER_CAM_IN[1...NC_NR_CAM_CBK]	LV_ERR_PLAUS_CAM_EX[1...NC_NR_CAM_CBK]
LV_ERR_PLAUS_CAM_IN[1...NC_NR_CAM_CBK]	LV_ERR_REF_CRK_CAM_EX[1...NC_NR_CAM_CBK]	LV_ERR_REF_CRK_CAM_IN[1...NC_NR_CAM_CBK]	LV_ERR_SYN_CAM_EX[1...NC_NR_CAM_CBK]
LV_ERR_SYN_CAM_IN[1...NC_NR_CAM_CBK]	LV_ERR_SYN_CRK_CAM_EX[1...NC_NR_CAM_CBK]	LV_ERR_SYN_CRK_CAM_IN[1...NC_NR_CAM_CBK]	LV_ERR_TOOTH_OFF_EX[1...NC_NR_CAM_CBK]
LV_ERR_TOOTH_OFF_IN[1...NC_NR_CAM_CBK]	LV_ERR_TCO_EL	LV_ERR_TCO_GRD	LV_ERR_MAF_FRQ_GRD
LV_ERR_TCO_STUCK	LV_ERR_TCO_STUCK_RNG	LV_ERR_LOAD_TPS_PLAUS[1...NC_MAF_NR]	LV_ERR_MAP_DIP_PLAUS
LV_ERR_MAP_TPS_PLAUS	LV_ERR_MEC_IVVT_EX[1...NC_NR_CBK_IVVT]	LV_ERR_MEC_IVVT_IN[1...NC_NR_CBK_IVVT]	LV_ERR_SLV_IVVT_EX[1...NC_NR_CBK_IVVT]
LV_ERR_SLV_IVVT_IN[1...NC_NR_CBK_IVVT]	LV_ERR_PUT_PLAUS[1...NC_ETC_NR]	LV_ERR_FUP_MFP_PLAUS[0...NC_CBK_HPP_NR-1]	LV_ERR_FUP_ORNG[0...NC_CBK_HPP_NR-1]
LV_ERR_H_PRS_SYS[0...NC_CBK_HPP_NR-1]	LV_ERR_MAF_FRQ_EL[1...NC_MAF_NR]	LV_ERR_MAF_FRQ_RNG[1...NC_MAF_NR]	LV_ERR_MAP_DIP_SENS
LV_ERR_TPS_1[1...NC_ETC_NR]	LV_ERR_TPS_2[1...NC_ETC_NR]	LV_ERR_MAP_DIP_SHIFT	LV_ERR_CAM_CST_IVVT_IN[1...NC_NR_CBK_IVVT]
LV_ERR_CAM_CST_IVVT_EX[1...NC_NR_CBK_IVVT]			

```

Then      LV_INH_DIAG_RBM_EFF_IGA_CST = 1
Else      LV_INH_DIAG_RBM_EFF_IGA_CST = 0
Endif

```

```

If        bit 0 of STATE_RBM_EFF_IGA_CST_IS = 0           { numerator }
Then

```

```

    If      LV_END_DIAG_EFF_IGA_CST_IS = 1
    Then    bit 0 of STATE_RBM_EFF_IGA_CST_IS = 1
    Endif

```

```
Endif
```

```

If        bit 0 of STATE_RBM_EFF_IGA_CST_PL = 0           { numerator }
Then

```

```

    If      LV_END_DIAG_EFF_IGA_CST_PL = 1
    Then    bit 0 of STATE_RBM_EFF_IGA_CST_PL = 1
    Endif

```

```
Endif
```

```

If        bit 1 of STATE_RBM_EFF_IGA_CST_IS = 0           { monitoring inhibit }
Then

```

```

    If      LV_INH_DIAG_RBM_EFF_IGA_CST = 1
    Then    bit 1 of STATE_RBM_EFF_IGA_CST_IS = 1
    Endif

```

```
Endif
```

```

If        bit 1 of STATE_RBM_EFF_IGA_CST_PL = 0           { monitoring inhibit }
Then

```

```

    If      LV_INH_DIAG_RBM_EFF_IGA_CST = 1
    Then    bit 1 of STATE_RBM_EFF_IGA_CST_PL = 1
    Endif

```

```
Endif
```

```

If          bit 2 of STATE_RBM_EFF_IGA_CST_IS = 0           {individual RBM conditions
                                                             or CSERS-specific denominator}
Then
    If          LV_T_MIN_CH_CST=1
    Then        bit 2 of STATE_RBM_EFF_IGA_CST_IS = 1
    Endif
Endif

If          bit 2 of STATE_RBM_EFF_IGA_CST_PL = 0          {individual RBM conditions
                                                             or CSERS-specific denominator}
Then
    If          LV_T_MIN_CH_CST=1
    Then        bit 2 of STATE_RBM_EFF_IGA_CST_PL = 1
    Endif
Endif

```

## B.133.2 Service Response Calculation for Ignition angle efficiency monitoring

### FUNCTION DESCRIPTION:

#### General information:

With this state machine the feedback STATE\_EOL\_DGNC\_CH\_DIAG for the tester service CSERS will be calculated. The communication part with the tester will be done at the diagnosis specification.

#### Application conditions

#### Initialisation:

At RESET or with IGKON event

STATE\_EOL\_DGNC\_CH\_DIAG = "NOT\_START"

#### Recurrence:

1s

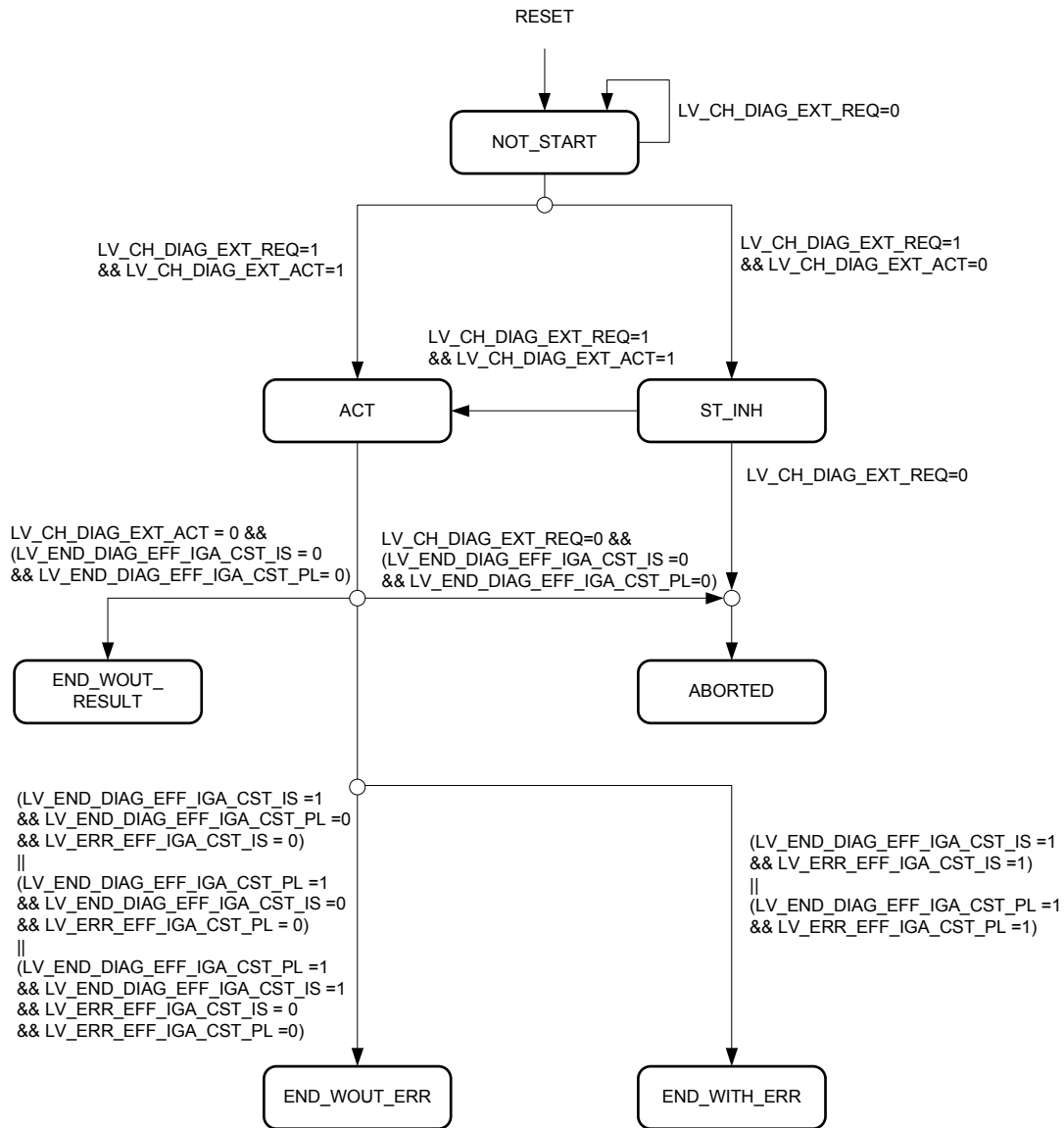
#### Activation:

LV\_CH\_DIAG\_EXT\_REQ<sub>n-1</sub> == 0 **AND** LV\_CH\_DIAG\_EXT\_REQ<sub>n</sub> == 1

#### Deactivation:

STATE\_EOL\_DGNC\_CH\_DIAG == "ABORTED" OR  
 STATE\_EOL\_DGNC\_CH\_DIAG == "END\_WOUT\_RESULT" OR  
 STATE\_EOL\_DGNC\_CH\_DIAG == "END\_WOUT\_ERR" OR  
 STATE\_EOL\_DGNC\_CH\_DIAG == "END\_WITH\_ERR"

#### Formula section:



The variable STATE\_EOL\_DGNC\_CH\_DIAG can contain following states:

**STATE "NOT START":**

CSERS Service is not started

**STATE "ACT":**

CSERS Service is activated and running

**STATE "ST\_INH":**

Start of the CSERS Service is inhibited

**STATE "ABORTED":**

CSERS Service was aborted (not completely finished)

**STATE "END\_WOUT\_RESULT":**

Catalyst heating was finished without the minimum required time to complete the CSERS Service.

## STATE "END\_WOUT\_ERR":

CSERS Service was finished (no errors detected)


For "END\_WOUT\_ERR" state, no error is allowed at the end of the test. This means, that three cases have to be checked.

Good cases are: \_IS test finished with no error, \_PL test finished with no error, \_IS and \_PL finished with no errors

## STATE "END\_WITH\_ERR":

CSERS Service was finished (errors were detected)

For the "END\_WITH\_ERR" state it is enough, if one of the two tests has finished with an error.

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## B.134 Ignition angle efficiency diagnosis (error management interface)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_EFF_IGA_CST_IS	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom ignition angle efficiency diagnosis after coldstart in idle speed mode					
ERR_SYM_EFF_IGA_CST_PL	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Detected error symptom ignition angle efficiency diagnosis after coldstart in part load mode					
LV_CDN_DIAG_EFF_IGA_CST_IS	O/V	0... 1H	0 ...1	1	-
Diagnosis conditions fulfilled Ignition angle efficiency at coldstart - idle speed					
LV_CDN_DIAG_EFF_IGA_CST_PL	O/V	0... 1H	0 ...1	1	-
Diagnosis conditions fulfilled Ignition angle efficiency at coldstart - part load					
LV_END_DIAG_EFF_IGA_CST_IS	O/V	0... 1H	0 ...1	1	-
Coldstart diagnosis in idle speed mode done completely at least one time					
LV_END_DIAG_EFF_IGA_CST_PL	O/V	0... 1H	0 ...1	1	-
Coldstart diagnosis in part load mode done completely at least one time					
LV_ERR_EFF_IGA_CST_IS	O/V	0... 1H	0 ...1	1	-
Boolean variable indicating that ignition angle efficiency is too high during the cold start diagnosis in idle speed mode					
LV_ERR_EFF_IGA_CST_PL	O/V	0... 1H	0 ...1	1	-
Boolean variable indicating that ignition angle efficiency is too high during the cold start diagnosis in part load mode					
LV_STATE_INH_CALL_IS	V	0... 1H	0 ...1	1	-
Inhibit the triggering of the Pre-Freeze Frame in 100MS raster after first time shooting of the Pre-Freeze Frame in idle					
LV_STATE_INH_CALL_PL	V	0... 1H	0 ...1	1	-
Inhibit the triggering of the Pre-Freeze Frame in 100MS raster after first time shooting of the Pre-Freeze Frame in part load					

### Input data:

EFF_IGA_CST_QUO_IS {p. 6493}	EFF_IGA_CST_QUO_PL {p. 6493}	IP_INT_EFF_IGA_SP_CH_ QUO_IS_MAX {p. 6495}	IP_INT_EFF_IGA_SP_CH_ QUO_PL_MAX {p. 6495}
LC_INH_SYM_EFF_IGA_ CST {p. 6495}	LF_STATE_DGO_EFF_ IGA_CST_IS {p. 6493}	LF_STATE_DGO_EFF_ IGA_CST_PL {p. 6493}	NC_IDX_DIAG_EFF_IGA_ CST_IS {p. 6509}
NC_IDX_DIAG_EFF_IGA_ CST_PL {p. 6509}	TCO_ST {p. 1100}		

### Import actions:

<b>ACTION_ERRM_GetLvCdnDiag (IN&lt;IDX_DIAG&gt;,OUT&lt;LV_CDN_DIAG&gt;)</b>
Continued on next page

<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>,OUT<LV_END_DIAG>)
<b>ACTION_ERRM_NoFilterReset</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_NoFilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_LV_ERR_SET>,IN<PRM_LV_ERR_RST>,IN<PRM_LV_END_DIAG>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_StorePrevfrf</b> (IN<PRM_IDX_ERR>)
<b>ACTION_TQDR_ResetMainEffigaCst</b> (IN<PRM_STATE_INI>)

### General information:

This module defines the interface functionality between main module for Ignition angle efficiency monitoring and error management (ERRM). This variant covers for ERRM 4.x.

Main interface variable is LF\_STATE\_DGO\_EFF\_IGA\_CST\_IS and LF\_STATE\_DGO\_EFF\_IGA\_CST\_PL.

These bit coded variables have following meaning:

Bit 0: Condition fulfilled if set to 1

Bit 1: Failure symptom present if set to 1

Bit 2: Failure not yet de-bounced if set to 1; only used if filter service from ERRM not used.

Examples:

LF\_STATE\_DGO\_EFF\_IGA\_CST\_IS/PL set to ...

0: no diagnostic condition

1: condition and no symptom, diagnostic passed.

3: condition and symptom present; diagnostic failed

5: condition and no symptom, not yet de-bounced


7: condition and symptom present, not yet de-bounced

### Application conditions:

<i>Initialisation:</i>	RST, IGKON, CLRFRMY
<i>Recurrence:</i>	100MS, 1S
<i>Activation:</i>	always
<i>Deactivation:</i>	never

### Function description:

### Formula section:

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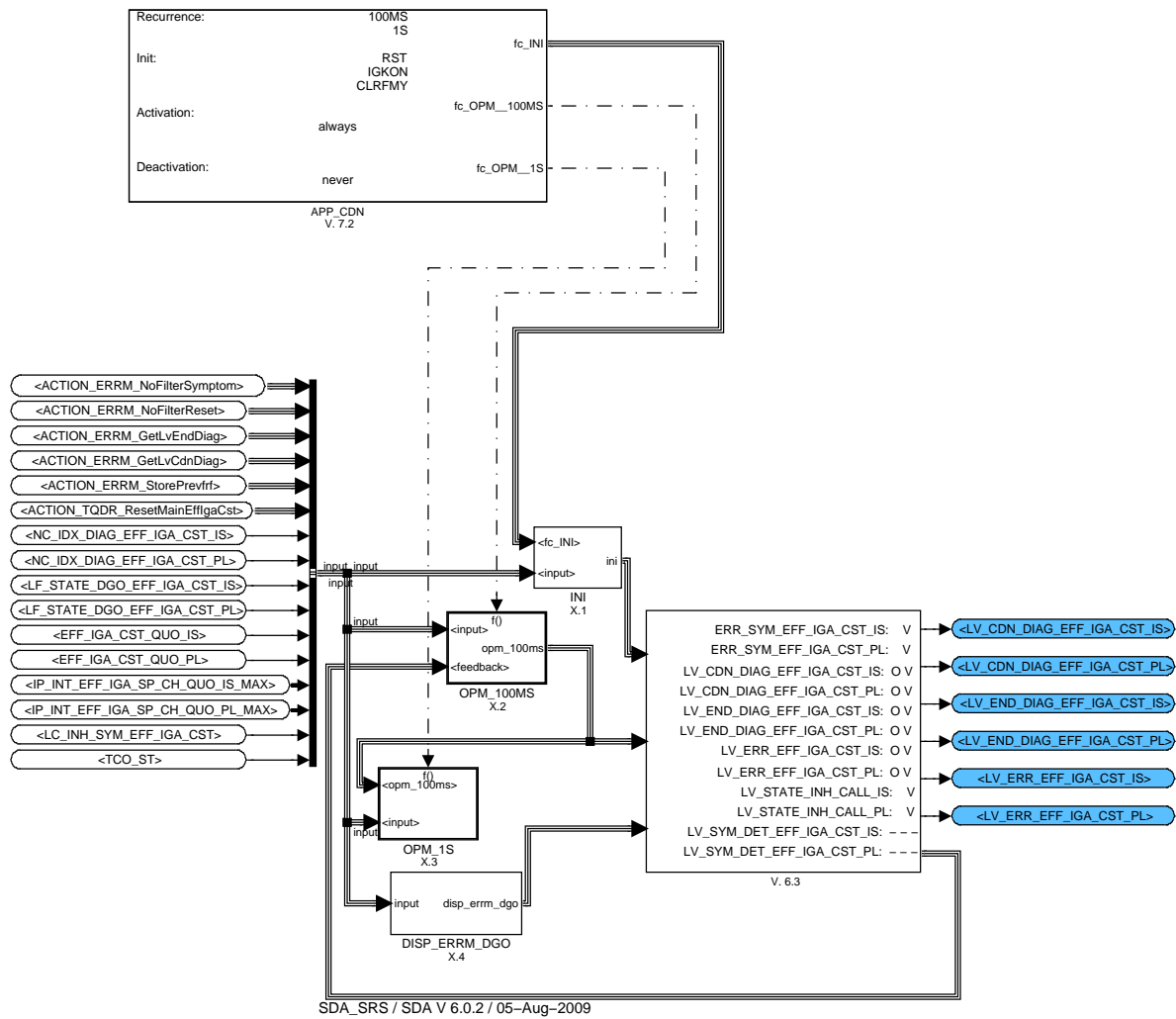


Figure B.134.1: :

### B.134.1 Initialization

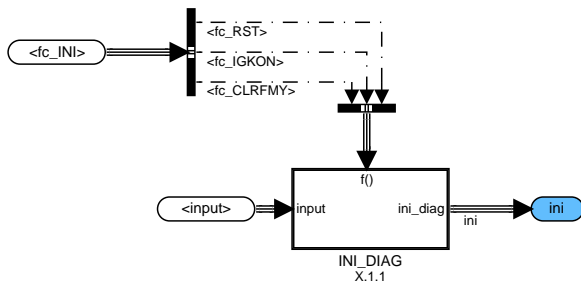


Figure B.134.2: :

#### B.134.1.1 Initialization of diagnosis

Get the old value of LV\_ERR, LV\_END\_DIAG and ERR\_SYM.

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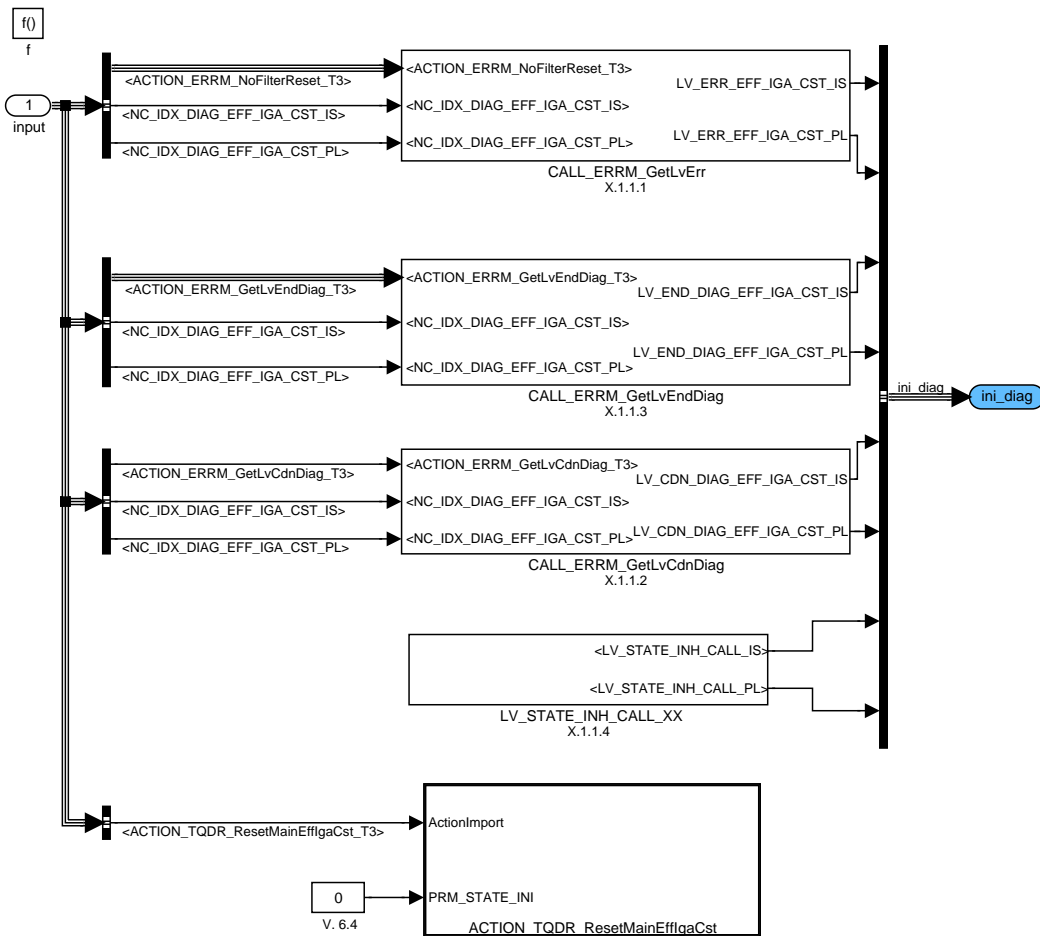


Figure B.134.3: :

**B.134.1.1.1 Call Action GetLvErr**

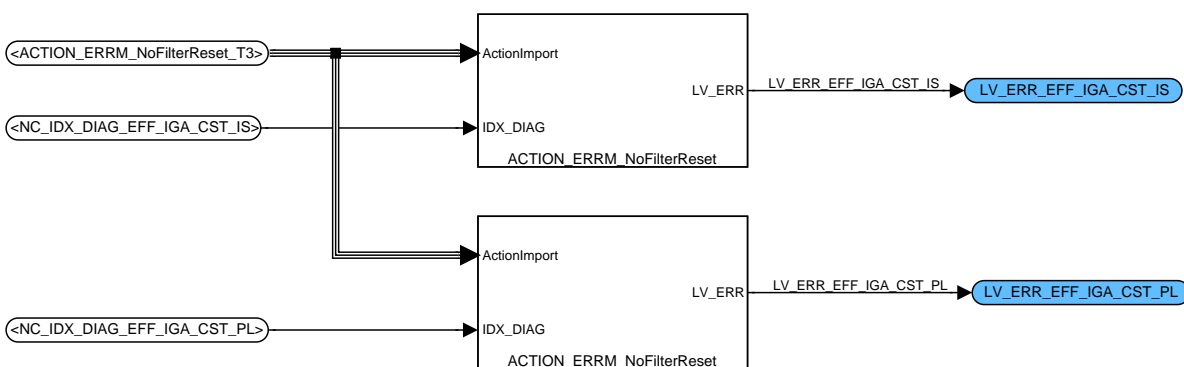


Figure B.134.4: :

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### B.134.1.1.2 Call Action GetLvCdnDiag

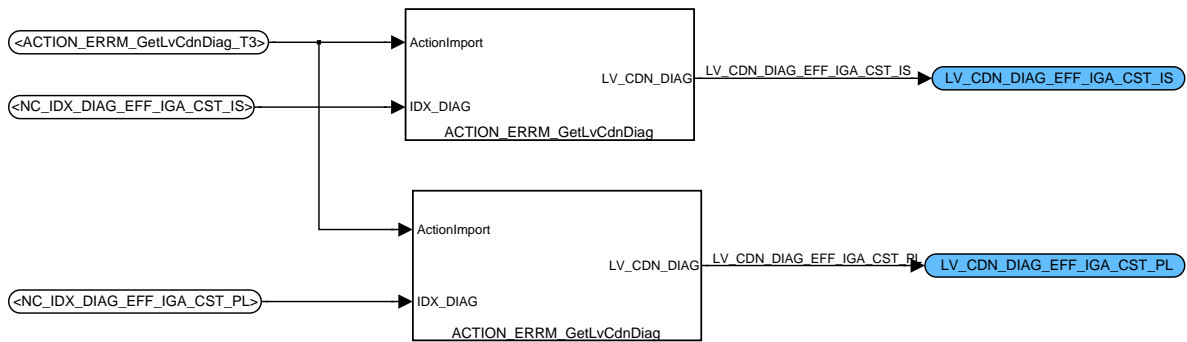


Figure B.134.5: :

### B.134.1.1.3 Call Action GetLvEndDiag

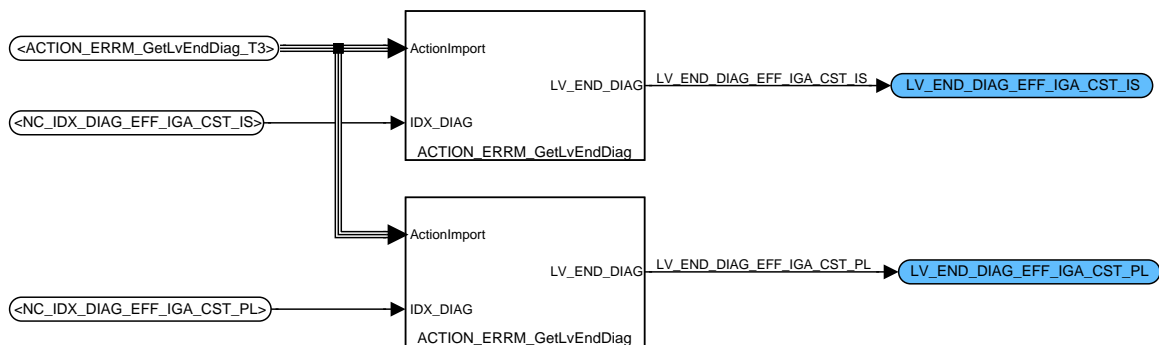


Figure B.134.6: :

### B.134.1.1.4 INI of LV\_STATE\_INH\_CALL\_XX

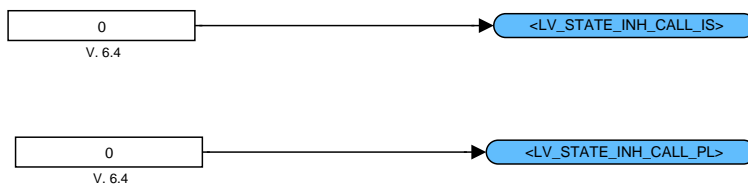


Figure B.134.7: :

## B.134.2 Operating mode 100MS

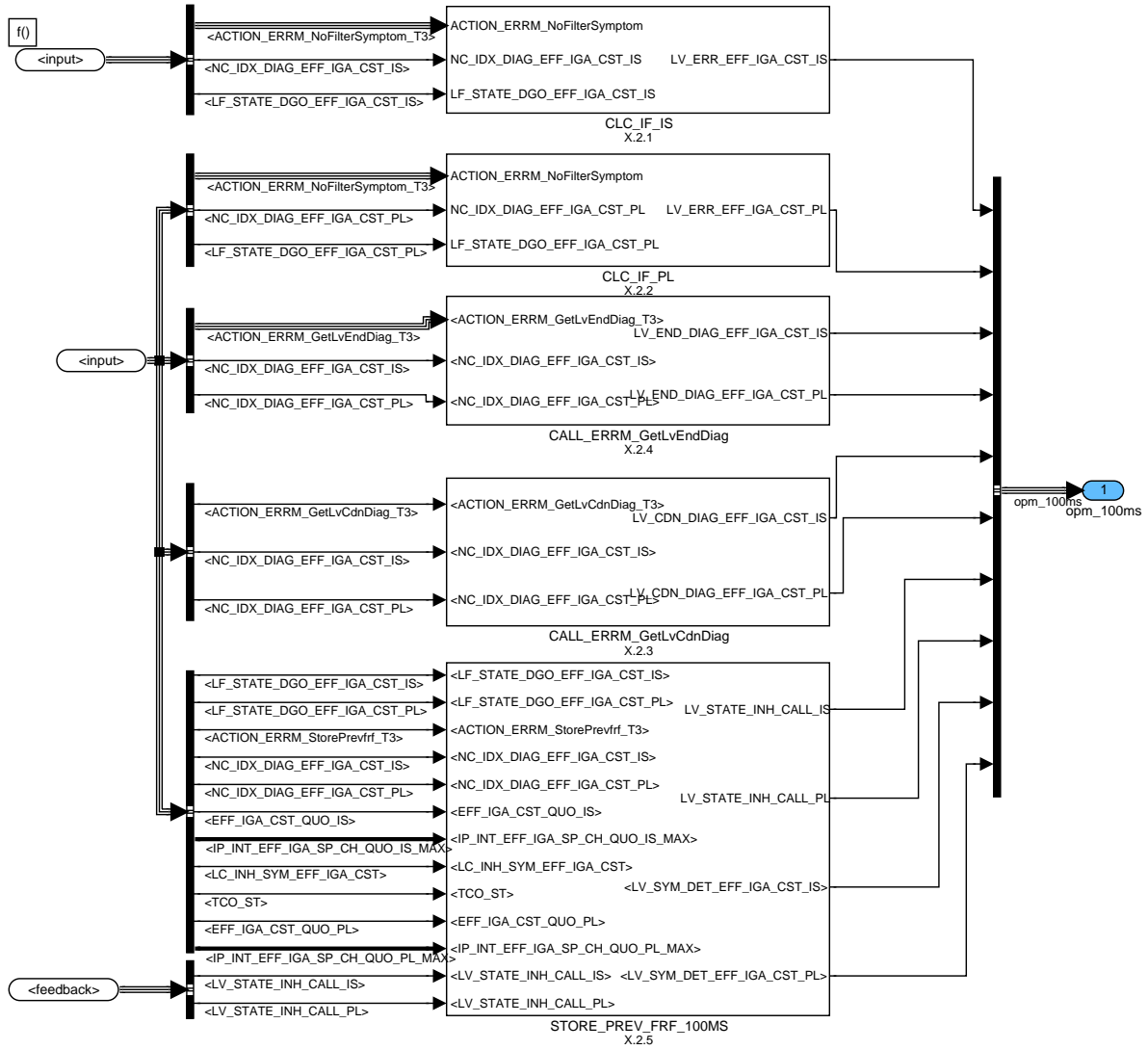


Figure B.134.8: :

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### B.134.2.1 Write Error Indication for Diagnosis in Idle Speed Mode

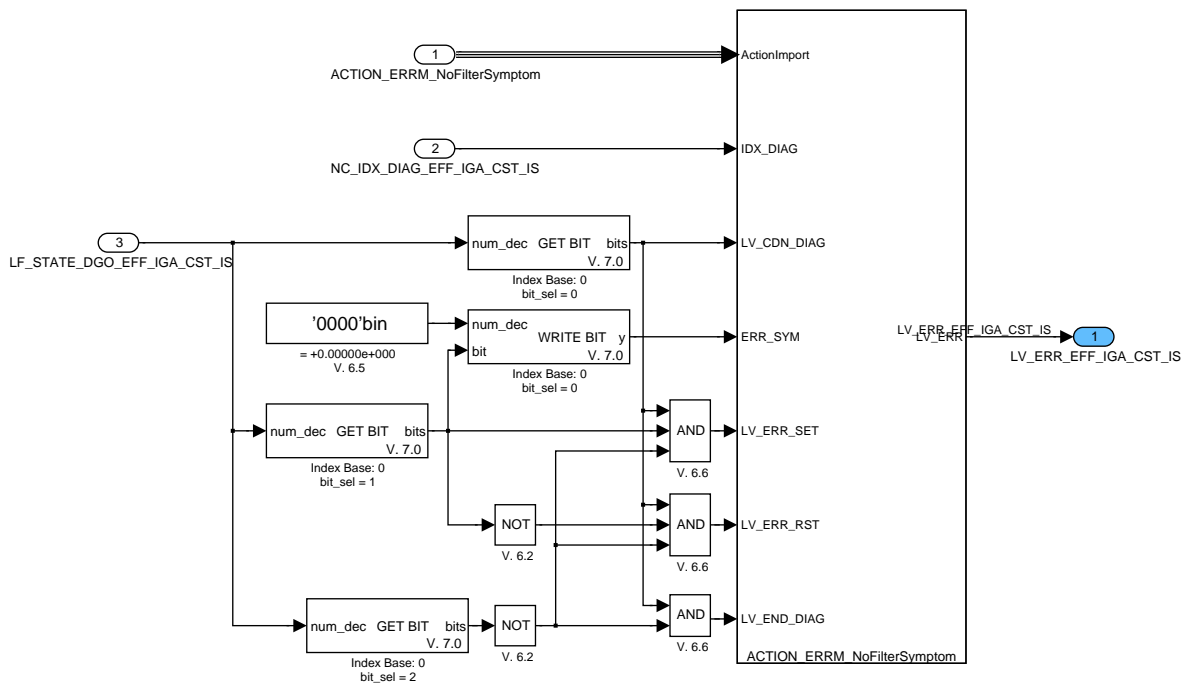


Figure B.134.9: :

### B.134.2.2 Write Error Indication for Diagnosis in Part Load Mode

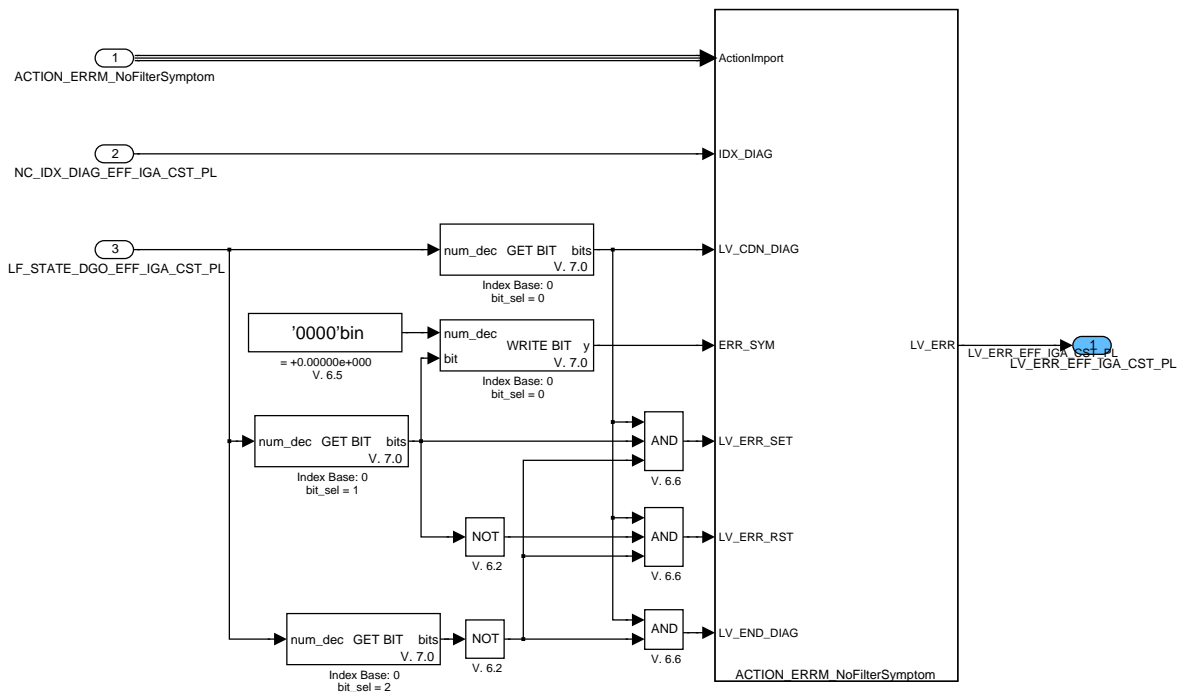


Figure B.134.10: :

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### B.134.2.3 Call Action GetLvCdnDiag

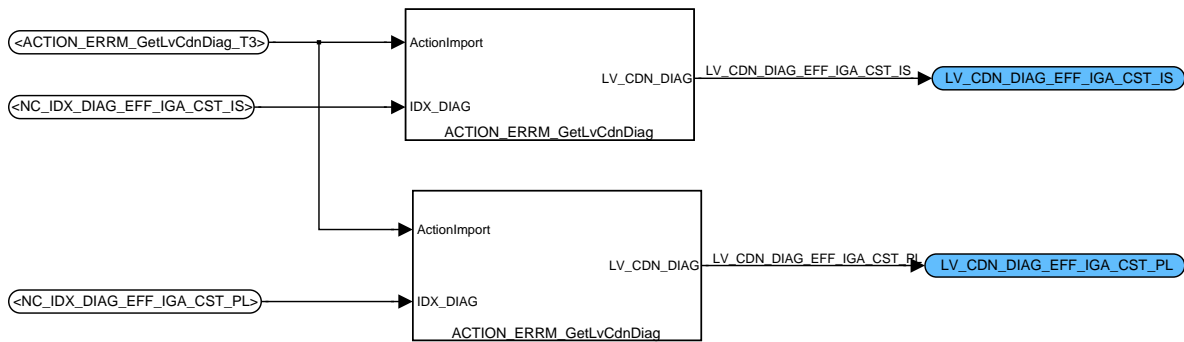


Figure B.134.11: :

### B.134.2.4 Call Action GetLvEndDiag

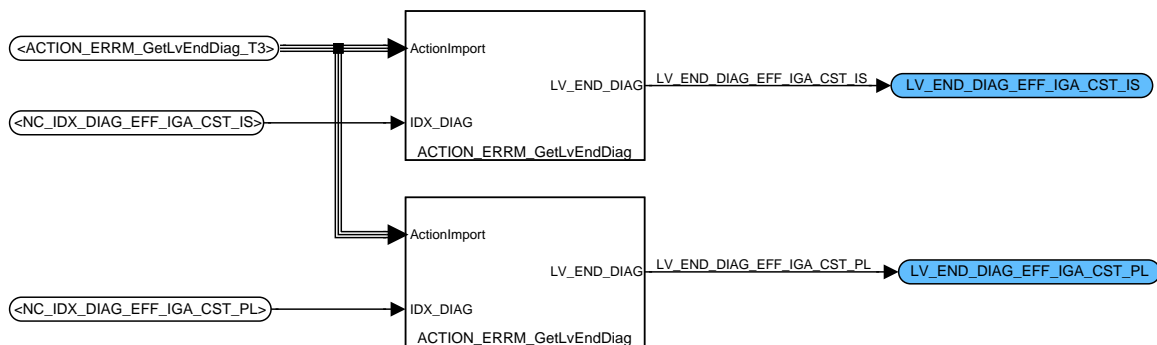


Figure B.134.12: :

### B.134.2.5 Freeze Frame Triggering in 100MS Raster

For catching the environmental data by first overriding the diagnostic threshold in the actual driving area a Pre-Freeze Frame must be shot. By the first time shooting of the Pre-Freeze Frame an inhibition flag will be set which deactivates the triggering of the Pre-Freeze Frame action call in 100MS raster. The action will still be continuously triggered in 1s raster by meeting the diagnosis conditions for a certain area and by diagnostic threshold overridden.

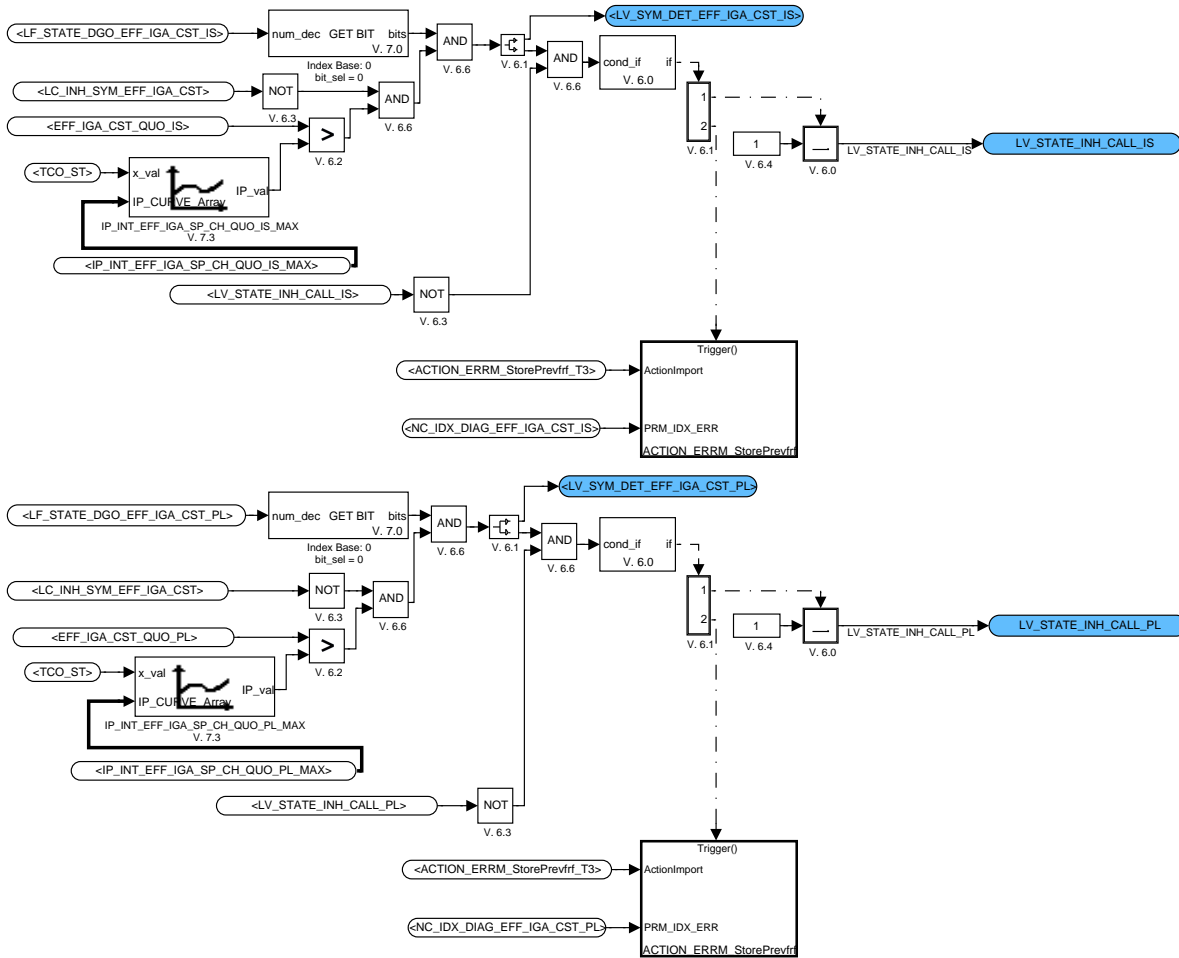


Figure B.134.13: :

### B.134.3 Operating mode 1S

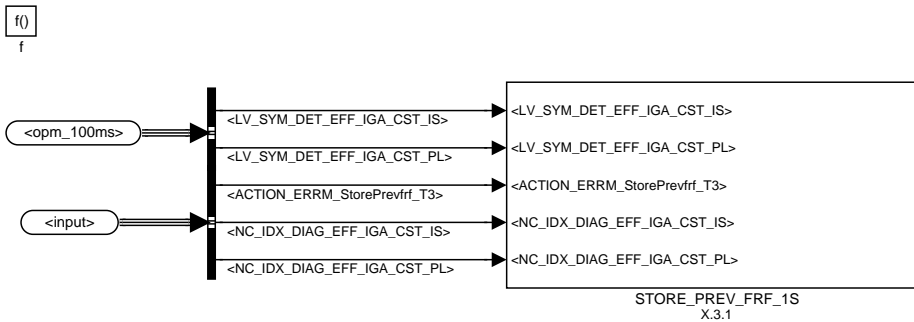


Figure B.134.14: :

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### B.134.3.1 Freeze Frame Triggering in 1s Raster

The diagnostic evaluation is done for both areas (idle and part-load) at the end of catalyst heating. For catching the environmental data by overriding the diagnostic threshold a Pre-Freeze Frame must be shot continuously in both areas.

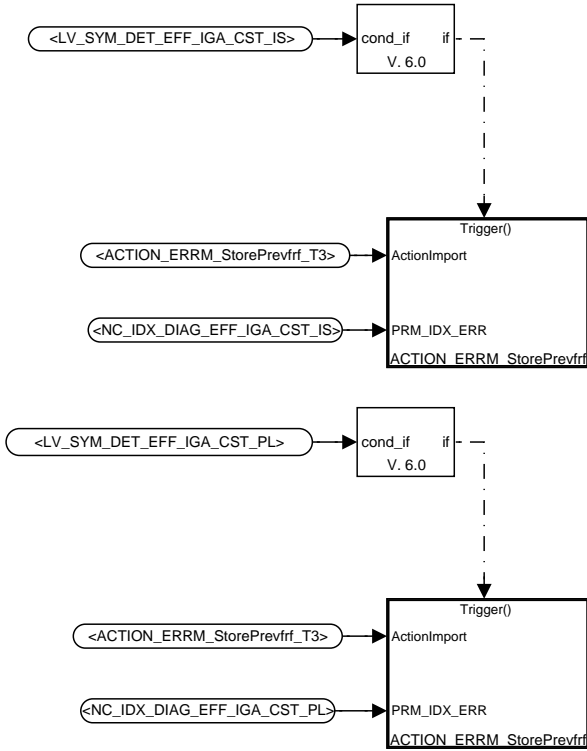


Figure B.134.15: :

### B.134.4 Visualization of ERRM data

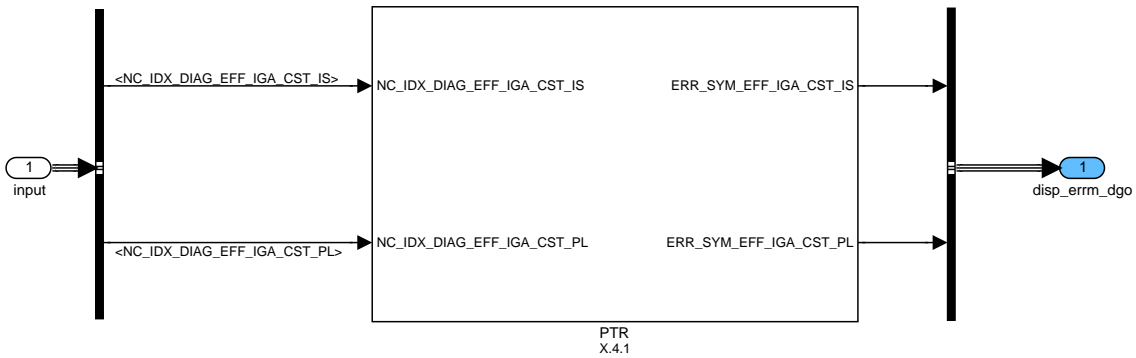


Figure B.134.16: :

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### B.134.4.1 Pointer

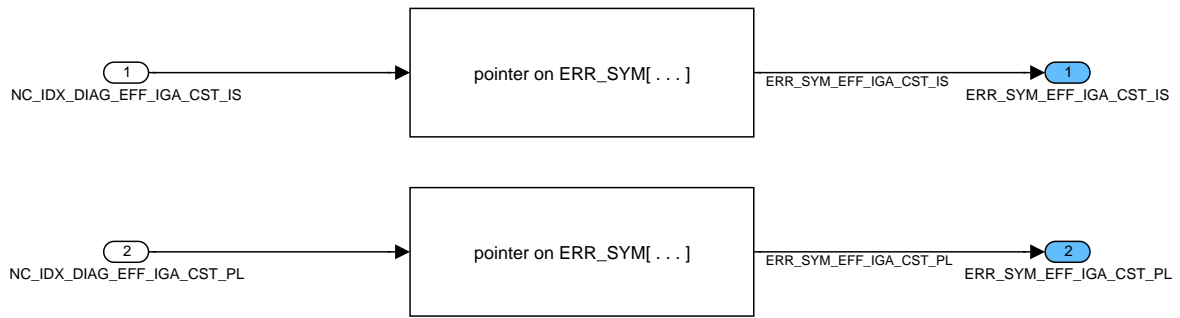




Figure B.134.17: :

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## C.1 Mass air flow correction for catalyst heating in stratified mode

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MAF_DIF_S_CH	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass air flow difference for cat. heating in stratified mode (possibly with post injection)					

### Input data:

NC_CYL_NR {p. 1526}	STATE_CH {p. 1777}	STATE_CH_MOD {p. 1796}	
---------------------	--------------------	------------------------	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_DIF_ADD_MFF_POST_CH_L	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass of post injection depending correction for MAF_DIF					
C_MAF_DIF_S_CH_L_BAS	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic difference of mass of air flow for low load stratified catalyst heating					
C_MAF_DIF_S_CH_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Manual setting of MAF-difference for stratified catalyst heating					
LC_MAF_DIF_S_CH_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of MAF-difference for stratified catalyst heating					

### General Information

During catalyst heating in stratified mode (possibly with post injection) it is necessary to reduce the mass of air flow and so the cooling effect. In this module the difference of MAF is generated.

### Application Conditions

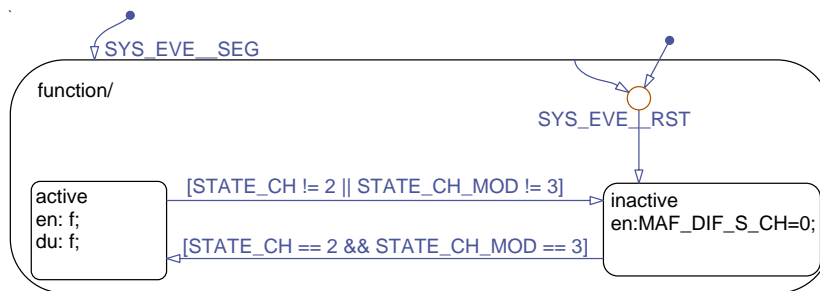
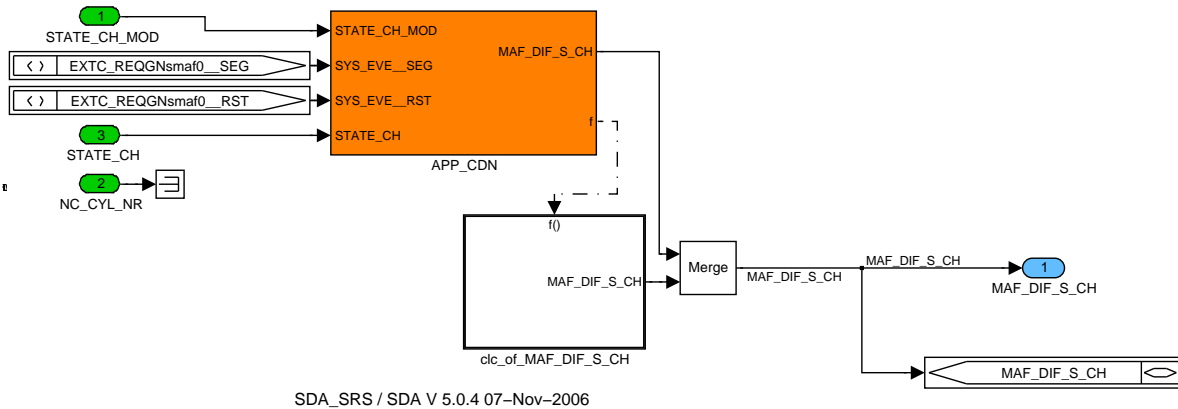


Figure C.1.1: : Path: EXTC\_REQGNsmaf0/APP\_CDN/Chart

### Function description



SDA\_SRS / SDA V 5.0.4 07–Nov–2006

Figure C.1.2: : Path: EXTC\_REQGNsmaf0

### C.1.1 Calculation of MAF\_DIF\_S\_CH in low load catalyst heating

There is a load/engine speed depending map, an external correction that is not used up to now and a 2nd correction depending on the actual mass of post injection. The read\_vector block picks out one element (here the 1st) of the cylinder individuell MFF\_POSTvector.

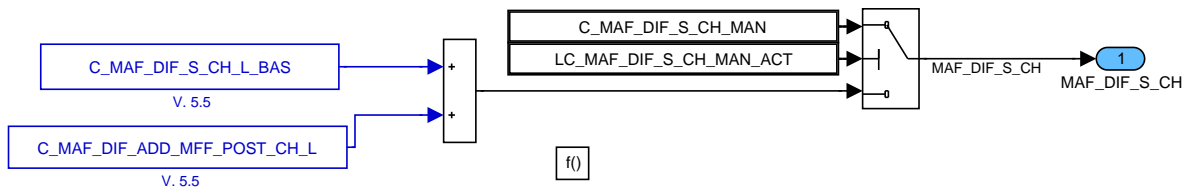


Figure C.1.3: : Path: EXTC\_REQGNsmaf0/clc\_of\_MAF\_DIF\_S\_CH

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## C.2 Electronic throttle control jam detection

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_MTC_HEAT_ACT	V	0... FH	0... 15	1	-
Counter active cycle throttle housing heater					
CTR_RLY_MTC_HEAT	V	0... FFFFH	0... 6553.5	0.1	s
Counter throttle housing heater relay active					
CTR_TPS_JAM_DET_ACT	O/V/S	0... FFFFH	0... 65535	1	-
The variable indicates the number of activations and is saved in the non-volatile memory					
CTR_TPS_JAM_INH	V	0... FFH	0... 255	1	-
Inhibition counter locks the ice-breaking functionality for a defined time					
CTR_TPS_JAM_PER	V	0... FFH	0... 255	1	-
Counter variable indicates the current number of rectangle pulses					
CTR_TPS_JAM_PER_MAX	V	0... FFH	0... 255	1	-
The counter variable includes the half period of the rectangle pulse					
CTR_TPS_JAM_PLS	V	0... FFH	0... 255	1	-
The counter variable is used for the calculation of the rectangle pulses					
ERR_SYM_TPS_JAM_DET	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
For each symptom : status of failure (set to 1 when failure symptom is detected)					
LV_CDN_DIAG_TPS_JAM_DET	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled)					
LV_END_DIAG_TPS_JAM_DET	V	0... 1H	0 ...1	1	-
Diagnostic done completely at least one time					
LV_ERR_TPS_JAM_DET	O/V	0... 1H	0 ...1	1	-
Present safety critical failure without filtering of ETC jam diagnostic					
LV_MTC_HEAT_READY	O/V	0... 1H	0 ...1	1	-
Throttle housing heater cycle finished (1:engine start enabled, 0: engine start disabled)					
LV_N_LIM_TPS_JAM_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable requests engine speed limitation from the module ETC limp-home management					
LV_RLY_MTC_HEAT	O/V	0... 1H	0 ...1	1	-
Throttle housing heater relay (1:activated, 0:deactivated)					
LV_TPS_JAM_DET_DEAC	V	0... 1H	0 ...1	1	-
Deactivation condition of the ETC jam detection					
LV_TPS_JAM_OPEN_DIR	O/V	0... 1H	0 ...1	1	-
Logical variable indicates a disturbance of the throttle flap in opening direction					
LV_TPS_SP_JAM	O/V	0... 1H	0 ...1	1	-
Logical variable indicates a throttle position setpoint request for ETC jam detection					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_MTC_HEAT	O/V	0H	HEAT_OFF	-	-
		1H	HEAT_OFF_DLY		
		2H	HEAT_ON_DLY		
		3H	HEAT_ON		
		4H	HEAT_EXT_ADJ		
STATE throttle housing heater relay					
STATE_TPS_JAM_DET	O/V	0H	INIT	-	-
		1H	ICE_BREAK		
		2H	SP_LIMIT		
State variable indicates the current state of the ETC jam detection					
TPS_JAM_ACT	V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Throttle position indicates the location of the jammed position					
TPS_JAM_PLS	V	C001... 3FFFH	-119.5 ... 119.5	7.2941e-3	°TPS
Height of the rectangle pulse during active ice-breaking					
TPS_SP_JAM	O/V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Throttle position setpoint request in case of a jammed ETC actuator					
TPS_SP_JAM_TMP	-	C001... 3FFFH	-119.5 ... 119.5	7.2941e-3	°TPS
Throttle position setpoint request in case of a jammed ETC actuator					


**Input data:**

ECU_STATE {p. 1091}	LV_ACT_RLY_MTC_HEAT_EXT_ADJ {p. 7432}	LV_AST_END {p. 2100}	LV_CTR_TPS_JAM_DET_ACT_EXT_ADJ {p. 7482}
LV_ERR_RLY_MTC_HEAT {p. 5004}	LV_IGK {p. 906}	LV_KEY_VLD {p. 1566}	LV_RLY_MTC_HEAT_EXT_ADJ {p. 7434}
LV_ST {p. 1720}	LV_TPS_JAM_DET_ACT {p. 6543}	LV_TPS_JAM_DET_DI {p. 6543}	T_MTCPWM_PI_DIAG {p. 4977}
TCO {p. 1100}	TIA {p. 1226}	TPS_AV {p. 1169}	TPS_DIF {p. 6546}
TPS_SP_MDL {p. 8377}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_MTC_HEAT_ACT	-	0... FH	0... 15	1	-
Number of MTC heater cycle					
C_CTR_REAC_MTC_HEAT	-	0... FFFFH	0... 6553.5	0.1	s
Reactivation time limit for MTC heater					
C_CTR_TPS_JAM_INH	-	0... FFH	0... 255	1	-
Inhibition counter for the locking of active ice-breaking					
C_CTR_TPS_JAM_PER_CLOSE	-	1... FFH	1... 255	1	-
Half period of the rectangle pulse in throttle flap closing direction					
C_CTR_TPS_JAM_PER_OPEN	-	1... FFH	1... 255	1	-
Half period of the rectangle pulse in throttle flap opening direction					
C_CTR_TPS_JAM_PLS_MAX	-	0... FFH	0... 255	1	-
Maximum number of possible rectangle pulse					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DLY_RLY_MTC_HEAT	-	0... FFH	0... 255	1	-
Number of recurrences until activation conditions MTC Heater are met ( default = 2 )					
C_TCO_MAX_MTC_HEAT	-	0... FEH	-48... 142.5	0.75	°C
Maximal cooling water temperature for MTC heater					
C_TIA_MAX_MTC_HEAT	-	0... FEH	-48... 142.5	0.75	°C
Maximal intake air temperature for MTC heater					
C_TIA_REAC_MTC_HEAT	-	0... FEH	-48... 142.5	0.75	°C
Reactivation intake air temperature for MTC heater					
C_TPS_JAM_HYS	-	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Throttle position hysteresis for the deactivation of the ice-function					
C_TPS_JAM_OF5	-	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Throttle position offset for the new throttle position setpoint definition					
C_TPS_JAM_PLS_CLOSE	-	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Rectangle pulse height in throttle flap closing direction					
C_TPS_JAM_PLS_OPEN	-	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Rectangle pulse height in throttle flap opening direction					
LC_CTR_TPS_JAM_DET_ACT_CLR	-	0... 1H	0 ...1	1	-
Logical constant for initializing the activation counter for jam detection					
LC_MTC_HEAT_ST_INH	-	0... 1H	0 ...1	1	-
Logical switch MTC heater at start active (=0 heater active)					

### General information:

The described module is used for the detection or the removing of ice between throttle flap and body.

### C.2.1 Import Actions

<b>ACTION_INFR_SetMTCHEAT(IN &lt;lv_rly_mtc_heat&gt;)</b> This action sets the output pin for the "MTC_HEAT Switch"
--

Note: The imported actions are defined in the THRO - IRS (infrastructure requirement specification).

<b>ACTION_ERRM_NoFilterSymptom( IN&lt; XX &gt;, IN&lt; lv_cdn_diag_XX &gt;, IN&lt; err_sym_XX &gt;, IN&lt; lv_err_set_XX &gt;, IN&lt; lv_err_reset_XX &gt;, IN&lt; lv_end_diag_XX &gt;, OUT&lt; LV_ERR_XX &gt; )</b>
--

### C.2.2 Throttle housing heater relay control

#### General information:

Under very cold conditions it is possible that the throttle valve ices due to the humidity in the blow by gas. Additionally after engine stop a accumulation of water is possible between flap and housing. When the dew point drops the water freezes and the detection of the ETC bottom limit is disturbed. The described module is used for the removing of ice between throttle flap and body.

To ensure the function of the ETC the housing is heated before engine start. The ECU controls a relay through the Pin A\_S\_BBH. This is done immediately after unlocking the vehicle and the wake up of the ECU. If the ECU is locked after powerlatch no control is done.

The heater relay is deactivated.

In order to take care of the battery capacity the heater is only activated in defined time intervals. An often re-activation shall be avoid.

Hint: The output of the air temperature sensor VP\_TIA and cooling water sensor VP\_TCO are calculated by using the action infrastructure ACTION\_INFR\_GetVpTia (VP\_TIA) and ACTION\_INFR\_GetVpTco (VP\_TCO). To ensure the availability of TIA and TCO in ECU\_STATE **WAKE\_UP** the action calls are active after ECU reset.

### Application conditions

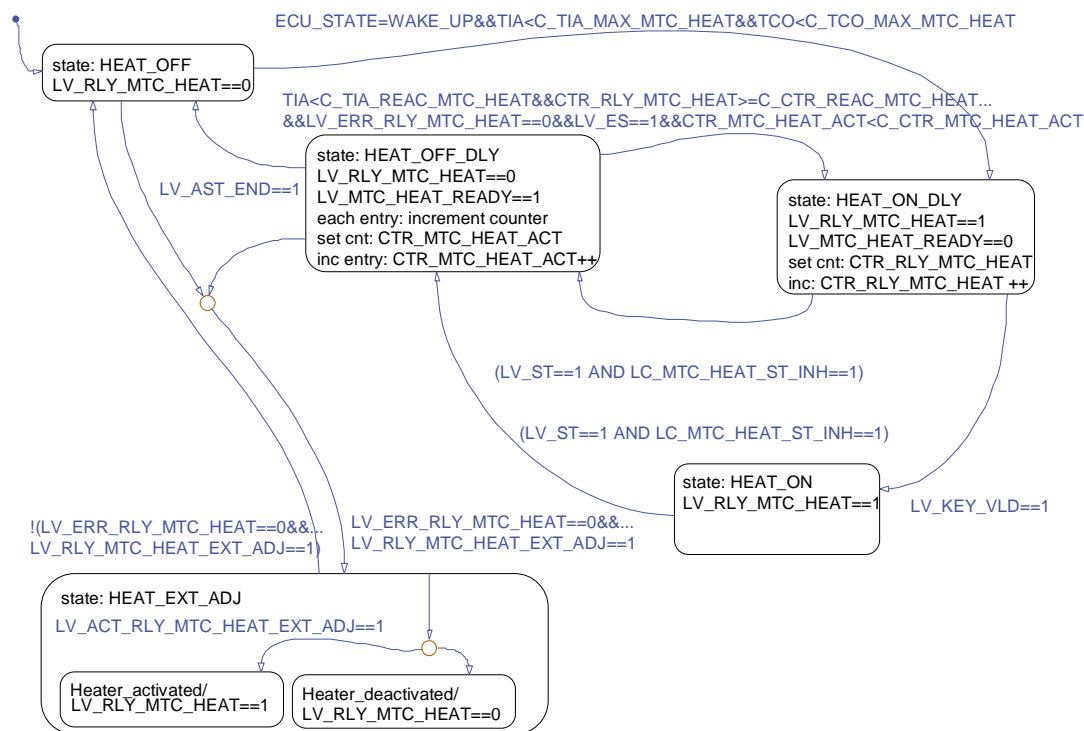
**Initialization:** at reset, all variables are initialized with 0,  
but LV\_MTC\_HEAT\_READY = 1  
set delay counter for C\_DLY\_RLY\_MTC\_HEAT

**Recurrence:** 100 ms

**Activation:** after reset, every engine operating state  
Activation conditions are met for the  
C\_DLY\_RLY\_MTC\_HEAT recurrence

**Deactivation:**

### Signal flow diagram:



### Formula section:

see also signal flow diagram

*Heater deactivated*

**STATE\_MTC\_HEAT = HEAT\_OFF**

LV\_RLY\_MTC\_HEAT = 0

**ACTION\_INFR\_SetMTCHEAT(IN < LV\_RLY\_MTC\_HEAT >)**



```
(LV_ERR_RLY_MTC_HEAT = 0          AND
LV_RLY_MTC_HEAT_EXT_ADJ = 1)
```

#### External adjustment

```
STATE_MTC_HEAT = HEAT_EXT_ADJ
If          LV_ACT_RLY_MTC_HEAT_EXT_ADJ = 1
Then       LV_RLY_MTC_HEAT = 1
Else       LV_RLY_MTC_HEAT = 0
Endif
ACTION_INFR_SetMTCHEAT(IN < LV_RLY_MTC_HEAT >)
```

#### Exit to HEAT\_OFF:

```
(LV_ERR_RLY_MTC_HEAT = 1          OR
LV_RLY_MTC_HEAT_EXT_ADJ = 0)
```

### C.2.3 ETC ice breaking

#### FUNCTION DESCRIPTION:


##### General information:

In case of very low temperatures it is possible that the throttle actuator is jammed by ice. The described module is used for the detection and the removing of ice between throttle flap and body. The functionality is able to detect the location of the throttle flap disturbance. We can distinguish ice in closing and opening throttle flap direction.

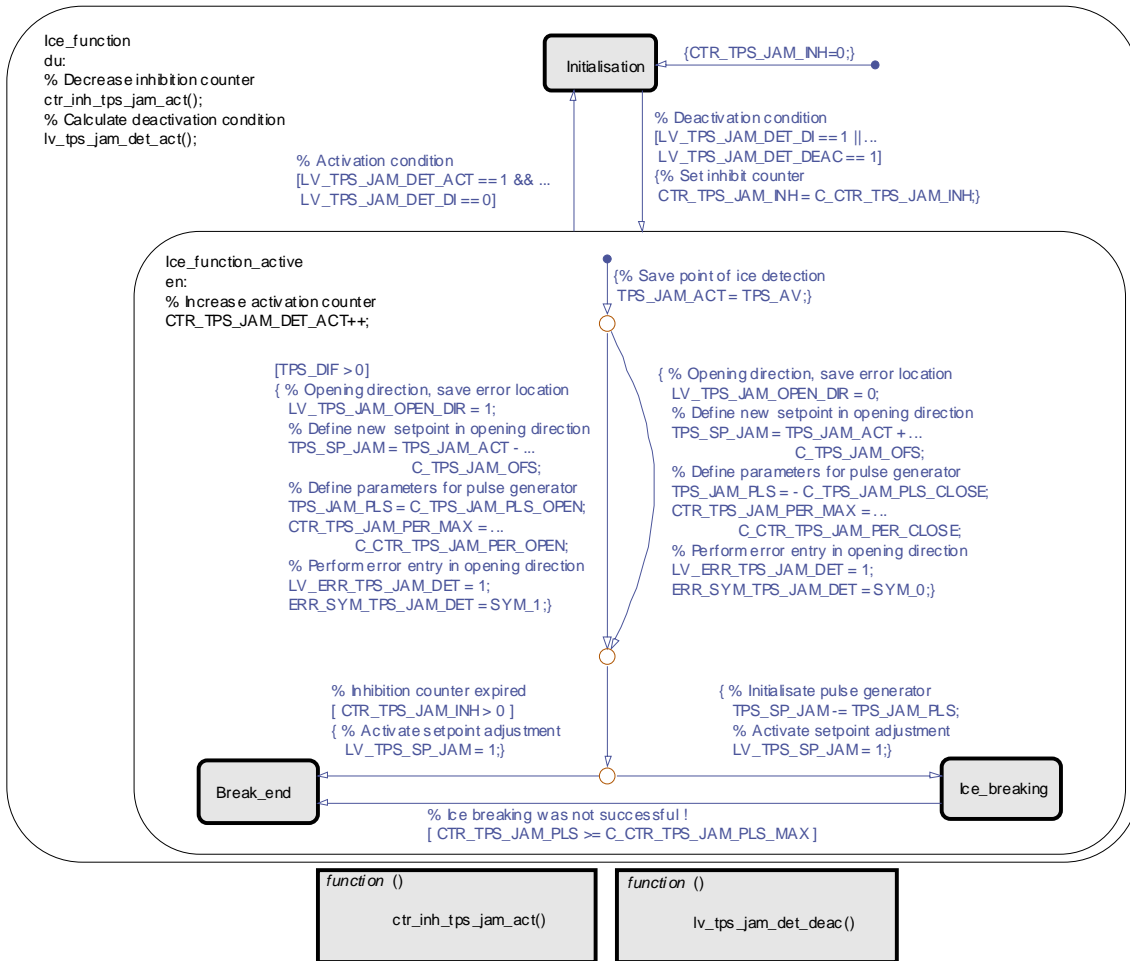
The ice shall be removed with a variation of the setpoint for the digital position controller.

CTR\_TPS\_JAM\_DET\_ACT is used to count these events. It needs to be saved reset resistant AND in NVMY !

##### Signal flow diagram:

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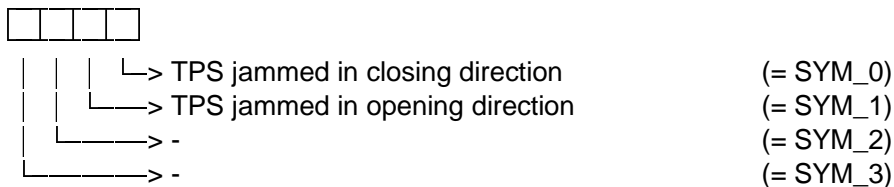


### C.2.4 Diagnosis conditions and error symptom definition

#### Description:

The diagnostic conditions of the ETC jam detection are true as long as the general disable condition isn't set. The error symptoms are defined for this diagnosis as:

ERR\_SYM\_TPS\_JAM\_DET



#### Application conditions

**Initialisation:** at IGTKON or RST set all error variables ...TPS\_JAM\_DET to zero ( done by the error - management function )

**Recurrence:** 20 ms

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**Activation:** `LV_IGK == 1`

**Deactivation:** `When the activation condition isn't fulfilled !`

#### Formula section:

```

if LV_TPS_JAM_DET_DI == 0
then { Set condition and end of diagnosis information }
    LV_CDN_DIAG_TPS_JAM_DET = 1
    lv_end_diag_tps_jam_det = 1
    ERR_SYM_TPS_JAM_DET(k) = ERR_SYM_TPS_JAM_DET(k-1)
else { remove condition diagnosis information }
    LV_CDN_DIAG_TPS_JAM_DET = 0
endif

```

## C.2.5 Control condition for ETC jam detection

### Description:

The following section describes the deactivation condition and the continuously part of the ETC jam detection. The aim is to control the state machine and the ice-breaking function.

### Application conditions

**Initialisation:** `at IGKON or RST set all to zero`

**Recurrence:** `20 ms`

**Activation:** `LV_IGK == 1`

**Deactivation:** `When the activation condition isn't fulfilled !`


### Formula section:

```

{ Calculate blocking time for active ice-breaking }
if CTR_TPS_JAM_INH > 0
then CTR_TPS_JAM_INH -= 1H { counter is decremented }
endif
{ Calculate deactivation condition for ETC jam detection }
if LV_TPS_JAM_OPEN_DIR == 1
then { Deactivation in opening direction }
    LV_TPS_JAM_DET_DEAC = ( ...
        TPS_SP_MDL < TPS_JAM_ACT - C_TPS_JAM_HYS or
        TPS_AV > TPS_JAM_ACT + C_TPS_JAM_HYS )
else { Deactivation in closing direction }
    LV_TPS_JAM_DET_DEAC = ( ...
        TPS_SP_MDL > TPS_JAM_ACT + C_TPS_JAM_HYS or
        TPS_AV < TPS_JAM_ACT - C_TPS_JAM_HYS )
endif

```

## C.2.6 State machine for ETC jam detection

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**Description:**

This section describes the state machine of the ETC jam detection functionality. The state machine is used for the coordination of the different requirements during the detection of jammed ETC throttle actuator. Additionally the function manages all kind of requests to the remaining software system, that are engine speed limitation, throttle position setpoint adjustment and the inhibition of selected functions. The state machine distinguishes the following states:

STATE_TPS_JAM_DET	Note
INIT	The initialisation state initialises all important variables and checks the transition conditions to the other states.
ICE_BREAK	The ice-breaking state is used for an active breaking of ice in the throttle actuator. For this case the throttle position setpoint is varied by a rectangle function. If the ice-breaking is not successful after a defined number of rectangle pulses the function changes into the state throttle position setpoint limitation. During the active ice-breaking engine speed limitation is requested !
BREAK_END	The ice-breaking was not successful or the inhibition counter for ice-breaking isn't yet expired.

**Application conditions**

**Initialisation:** at IGKON or RST set all to zero with exception of CTR\_TPS\_JAM\_DET\_ACT and STATE\_TPS\_JAM\_DET = INIT

**Recurrence:** 20 ms

**Activation:** LV\_IGK == 1

**Deactivation:** When the activation condition isn't fulfilled !

**Formula section:**

```
{ Reset of the activation counter in service }
if LC_CTR_TPS_JAM_DET_ACT_CLR == 1 or
LV_CTR_TPS_JAM_DET_ACT_EXT_ADJ == 1
Then { The throttle has been changed in service ! The activation counter is reset ! }
CTR_TPS_JAM_DET_ACT = 0
```

EndIf

```
switch( STATE_TPS_JAM_DET ) { State machine of ETC jam detection ! }
case INIT: { ETC jam detection is in the initialisation state }
{ Remove engine speed limitation request }
LV_N_LIM_TPS_JAM_REQ = 0
{ Remove throttle position setpoint request }
LV_TPS_SP_JAM = 0
{ Remove error entry }
lv_err_tps_jam_det = 0
ERR_SYM_TPS_JAM_DET = NO_SYM
{ Initialisation of the counter variables }
CTR_TPS_JAM_PLS = 0
CTR_TPS_JAM_PER = 0
{ Calculate transitions to the setpoint limitation and ice-breaking function }
```

```

if    LV_TPS_JAM_DET_ACT == 1    and
        LV_TPS_JAM_DET_DI == 0
then  { A jammed ETC actuator has been detected ! At first the throttle position of the
        ice detection is saved for the further function ! }
        TPS_JAM_ACT = TPS_AV
        if    TPS_DIF > 0
        then  { The throttle actuator is jammed in opening direction }
            LV_TPS_JAM_OPEN_DIR = 1
            { Define new setpoint in opening direction }
            TPS_SP_JAM_TMP = TPS_JAM_ACT - C_TPS_JAM_OFS
            { Define parameters for throttle position setpoint pulse generator }
            TPS_JAM_PLS          = C_TPS_JAM_PLS_OPEN
            CTR_TPS_JAM_PER_MAX  = C_CTR_TPS_JAM_PER_OPEN
            { Perform error entry in opening direction }
            lv_err_tps_jam_det    = 1
            ERR_SYM_TPS_JAM_DET  = SYM_1
        else  { The throttle actuator is jammed in closing direction }
            LV_TPS_JAM_OPEN_DIR = 0
            { Define new setpoint in closing direction }
            TPS_SP_JAM_TMP = TPS_JAM_ACT + C_TPS_JAM_OFS
            { Define parameters for throttle position setpoint pulse generator }
            TPS_JAM_PLS          = - C_TPS_JAM_PLS_CLOSE
            CTR_TPS_JAM_PER_MAX  = C_CTR_TPS_JAM_PER_CLOSE
            { Perform error entry in closing direction }
            lv_err_tps_jam_det    = 1
            ERR_SYM_TPS_JAM_DET  = SYM_0
        endif
        { Increase activation counter }
        CTR_TPS_JAM_DET_ACT + = 1H
        { Selection between setpoint limitation and active ice-breaking depend on the
        function inhibition counter ! }
        if    CTR_TPS_JAM_INH > 0
        then  { End of Ice breaking ! }
            STATE_TPS_JAM_DET = BREAK_END
        else  { Initialisate pulse generator }
            TPS_SP_JAM_TMP - = TPS_JAM_PLS
            { Ice-breaking function will be started ! }
            STATE_TPS_JAM_DET = ICE_BREAK
        endif
        { Activate throttle position setpoint request }
        LV_TPS_SP_JAM = 1

endif
break
case  ICE_BREAK: { ETC jam detection requests ice-breaking ! }
        { Engine speed limitation is requested only in closing direction ! }
        if    LV_TPS_JAM_OPEN_DIR == 0
        then  LV_N_LIM_TPS_JAM_REQ = 1
        endif

```

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```

    { Increase period counter of the rectangle pulse sequence }
    CTR_TPS_JAM_PER + = 1H;
    { Generate throttle position setpoint pulse sequence for the active ice-breaking ! }
    if      CTR_TPS_JAM_PER == CTR_TPS_JAM_PER_MAX
    then    { Half period of the rectangle pulse is finished, change throttle position setpoint
    }
            TPS_SP_JAM_TMP + = 2 * TPS_JAM_PLS
    endif
    if      CTR_TPS_JAM_PER >= 2 * CTR_TPS_JAM_PER_MAX
    then    { Increase pulse counter }
            CTR_TPS_JAM_PLS + = 1H;
            { Calculate transition to the setpoint limitation function }
            if      CTR_TPS_JAM_PLS >= C_CTR_TPS_JAM_PLS_MAX
            then    { The maximum pulse number has been performed, the function has to
                    go in End of Ice breaking, ice-breaking was not successful ! }
                    STATE_TPS_JAM_DET = BREAK_END
                    { Set final throttle position setpoint }
                    TPS_SP_JAM_TMP - = TPS_JAM_PLS
            else    { Full period of the rectangle pulse is finished, change throttle position
                    setpoint }
                    TPS_SP_JAM_TMP - = 2 * TPS_JAM_PLS
                    { Reset period counter of the rectangle pulse sequence }
                    CTR_TPS_JAM_PER = 0H;
            endif
    endif
    { Calculate transition to the initialisation state }
    if      LV_TPS_JAM_DET_DI      == 1      or
            LV_TPS_JAM_DET_DEAC   == 1
    then    { The ETC jam detection is deactivated ! }
            STATE_TPS_JAM_DET = INIT
            { Initialise inhibition counter for the next activation }
            CTR_TPS_JAM_INH = C_CTR_TPS_JAM_INH
    endif
    break
    case   BREAK_END: { End of Ice breaking }
    { ETC jam detection is not requested ! }
    LV_TPS_SP_JAM = 0
    { Engine speed limitation is not requested ! }
    LV_N_LIM_TPS_JAM_REQ = 0
    { Calculate transition to the initialisation state }
    if      LV_TPS_JAM_DET_DI      == 1      or
            LV_TPS_JAM_DET_DEAC   == 1
    then    { The ETC jam detection is deactivated ! }
            STATE_TPS_JAM_DET = INIT
            { Initialise inhibition counter for the next activation }
            CTR_TPS_JAM_INH = C_CTR_TPS_JAM_INH
    endif
    break
    default
end switch
{ Finally copy throttle position setpoint ! }
TPS_SP_JAM = TPS_SP_JAM_TMP

```

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For error management treatment the following action is called:

ACTION\_ERRM\_NoFilterSymptom( ...

*TPS\_JAM\_DET*, *LV\_CDN\_DIAG\_TPS\_JAM\_DET*, *ERR\_SYM\_TPS\_JAM\_DET*, ***lv\_err\_tps\_jam\_det***, *~lv\_err\_tps\_jam\_det*, *lv\_end\_diag\_tps\_jam\_det*, *LV\_ERR\_TPS\_JAM\_DET* )

This algorithm sets

*LV\_ERR\_TPS\_JAM\_DET* and *LV\_END\_DIAG\_TPS\_JAM\_DET*  
according the diagnostic result and delivers the result to Error Management.

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## C.3 Electronic throttle control jam detection (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DLY_TPS_JAM	V	0... FFH	0... 255	1	-
Time delay for the detection of abnormal engine operating state					
LV_TPS_JAM_DET_ACT	O/V	0... 1H	0 ...1	1	-
Activation condition of the ETC jam detection					
LV_TPS_JAM_DET_DI	O/V	0... 1H	0 ...1	1	-
Disable condition of the ETC jam detection					
LV_TPS_SP_JAM_OFF	V	0... 1H	0 ...1	1	-
Irreversible lock condition after detection of abnormal engine operating state					

### Input data:

CTR_TPS_JAM_DET_ACT {p. 6531}	GEAR {p. 1302}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP {p. 982}
LV_ERR_TIA_THR {p. 984}	LV_IGK {p. 906}	LV_IS {p. 1720}	LV_MTC_CUR_OFF {p. 6565}
MTCPWM {p. 6546}	N {p. 1525}	T_MTCPWM_PI_DIAG {p. 4977}	TCO {p. 1100}
TIA_THR {p. 984}	VS {p. 1176}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_MAX_GEAR_TPS_JAM	-	0... FFH	0... 255	1	-
Counter maximum for TPS jam detection being active with gear engaged and engine speed too high					
C_CTR_MAX_NEUT_TPS_JAM	-	0... FFH	0... 255	1	-
Counter maximum for TPS jam detection being active with gear not engaged and engine speed too high					
C_CTR_TPS_JAM_DET_ACT_MAX	-	0... FFFFH	0... 65535	1	-
Counter maximum for TPS jam detection being active to prevent ETC damage					
C_N_MAX_GEAR_TPS_JAM	-	0... 1FE0H	0... 8160	1	rpm
Maximum engine speed for TPS jam detection being active with gear engaged					
C_N_MAX_NEUT_TPS_JAM	-	0... 1FE0H	0... 8160	1	rpm
Maximum engine speed for TPS jam detection being active with gear not engaged					
C_PWM_ETC_TPS_JAM	-	0... 7FFFH	0... 99.99694	3.0518e-3	%
PWM_ETC activation threshold for ETC jam detection function					
C_T_MIN_DIAG_TPS_JAM	-	0... FFH	0... 2.55	0.01	s
Debounce timer activation threshold for TPS jam detection function					
C_VS_MAX_TPS_JAM	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed for TPS jam detection being active					
IP_TIA_MAX_TPS_JAM	-	0... FEH	-48... 142.5	0.75	°C
LDP_TCO_IP_TIA_MAX_TPS_JAM	4	0... FEH	-48... 142.5	0.75	°C
TIA activation threshold for ETC jam detection dependent on TCO					

### Error treatment:

LV\_MTC\_CUR\_OFF == 1 )

### Configuration for diagnostic symptoms:

Diagnostic	Symptom description	Symptom	Filter type
TPS_JAM_DET			
ETC jam detection	TPS jammed in closing direction	SYM_0	NO
	TPS jammed in opening direction	SYM_1	
	-	SYM_2	
	-	SYM_3	

### FUNCTION DESCRIPTION:

#### General information:

The following module described the application incidence of the ETC jam detection and should be used for the control of the ice-breaking algorithm.

### C.3.1 Engine Speed Monitoring for TPS Jam Function being active

#### General information:

The following functionality is used for the detection of abnormal engine operating state, in this case the ETC jam detection functionality will be locked and the ETC actuator diagnosis must indicate an ETC actuator error.

#### Application conditions


**Initialisation:** at RST set all to zero  
**Recurrence:** 20 ms  
**Activation:** All engine operating states  
**Deactivation:** No deactivation

#### Formula section:

```

if LV_IGK == 1
then if LV_IS == 1 and
      VS < C_VS_MAX_TPS_JAM and
      ( N > C_N_MAX_NEUT_TPS_JAM and GEAR == 0 or
        N > C_N_MAX_GEAR_TPS_JAM and GEAR ~ = 0 )
then CTR_DLY_TPS_JAM += 1H
else CTR_DLY_TPS_JAM = 0
endif
if GEAR == 0
then if CTR_DLY_TPS_JAM < C_CTR_MAX_NEUT_TPS_JAM
then LV_TPS_SP_JAM_OFF = 1 { set for the driving cycle }
endif
else if CTR_DLY_TPS_JAM < C_CTR_MAX_GEAR_TPS_JAM
then LV_TPS_SP_JAM_OFF = 1 { set for the driving cycle }

```

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```

        endif
    endif
else { Re-initialize function variables }
    LV_TPS_SP_JAM_OFF = 0; CTR_DLY_TPS_JAM = 0
endif

```

### C.3.2 Control condition for ETC jam detection

#### Description:

The following section describes the control conditions of the ETC jam detection. The aim is to gather all activation and inhibition conditions for an efficient control of the algorithm.

#### Application conditions

**Initialisation:** *at RST set all to zero*

**Recurrence:** *20 ms*

**Activation:** *All engine operating states*

**Deactivation:** *No deactivation*

#### Formula section:

{ Calculate activation condition for ETC jam detection }

```

LV_TPS_JAM_DET_ACT = (
    TIA_THR < IP_TIA_MAX_TPS_JAM and
    | MTCPWM | > C_PWM_ETC_TPS_JAM and
    T_MTCPWM_PI_DIAG > C_T_MIN_DIAG_TPS_JAM and
    CTR_TPS_JAM_DET_ACT < C_CTR_TPS_JAM_DET_ACT_MAX)

```

{ Calculate disable condition for ETC jam detection }

```

LV_TPS_JAM_DET_DI = ( LV_IGK == 0 or
    LV_ERR_TIA_THR == 1 or
    LV_ERR_MAF == 1 or
    LV_ERR_MAP == 1 or
    LV_TPS_SP_JAM_OFF == 1 or
    LV_MTC_CUR_OFF == 1 )

```

## C.4 Electronic throttle control position controller

### Data definition:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_MTCPWM_CLOSE_ACT	O/V	0... 1H	0 ...1	1	-
logical variable (is set, if closing duty cycle is active)					
LV_TPS_CHG_POS	V	0... 1H	0 ...1	1	-
detection of changed direction from LV_TPS_SP_POS					
LV_TPS_SP_POS	V	0... 1H	0 ...1	1	-
position detection of TPS-setpoint (0: below LIH; 1: above LIH)					
MTCPWM	O/V	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
duty cycle MTC					
MTCPWM_ADD	V	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
Tastverhältnis der Feed-Forward-Steuerung					
MTCPWM_CTL	V	E0000... 1FFFFH	-400 ...400	0.00305	%
duty cycle of PID-control					
MTCPWM_D	V	8000... 7FFFH	-400... 399.98779	0.012207	%
duty cycle of D-share					
MTCPWM_I	V	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
duty cycle of I-share					
MTCPWM_I_ADD	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
additive friction compensation of I-share					
MTCPWM_P	V	8000... 7FFFH	-400... 399.98779	0.012207	%
duty cycle of P-share					
MTCPWM_VB_FAC	V	0... FFH	0... 1.99218	0.0078125	-
battery voltage correction					
T_MTCPWM_CLOSE_ACT	V	0... 3FEH	0... 5110	5	ms
time counter for closing condition					
TPS_AV_LIH_DIF	V	0... 7FFEh	-119.5 ...119.5	7.2941e-3	°TPS
difference between TPS_AV and TPS_LIH					
TPS_DIF	O/V	0... 7FFEh	-119.5 ...119.5	7.2941e-3	°TPS
controller deviation					
TPS_DIF_GRD	V	0... 7FFEh	-119.5 ...119.5	7.2941e-3	°TPS
gradient of controller deviation					
TPS_SP_CTL	V	C001... 3FFFH	-119.5 ...119.5	7.2941e-3	°TPS
throttle position setpoint ( + or - )					
TPS_SP_LIH_DIF	V	0... 7FFEh	-119.5 ...119.5	7.2941e-3	°TPS
difference between TPS_SP and TPS_LIH					

### Input data:

C_TPS_SP_LGRD_STOP {p. 6555}	LV_IGK {p. 906}	LV_MTC_CUR_OFF {p. 6565}	TPS_AV {p. 1169}
TPS_AV_CTL {p. 1169}	TPS_LIH {p. 1169}	TPS_SP {p. 6555}	VB {p. 1185}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MTCPWM_ADD_FIL	-	0... FFH	0... 0.99609	3.9063e-3	-
PT1-filtering constant					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MTCPWM_CLOSE	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
closing duty cycle					
C_MTCPWM_CLOSE_MAX	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
duty cycle limitation at bottom mechanical limit					
C_MTCPWM_HYS	-	0... 7FFFH	0... 99.99694	3.0518e-3	%
hysteresis to prevent MTCPWM-switching according to VB-changes					
C_MTCPWM_I_ADD	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
friction compensation of I-share					
C_MTCPWM_I_INI	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
initialization of MTCPWM_I					
C_MTCPWM_I_MAX_NEG	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
limitation of I-share downwards					
C_MTCPWM_I_MAX_POS	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
limitation of I-share upwards					
C_T_MTCPWM_CLOSE_ACT_MAX	-	0... 3E8H	0 ...5	0.005	s
timer-threshold for switching to closing duty cycle					
C_TPS_SP_CTL_MAX	-	FFFFC001... 0H	-119.5 ...0	0.0073	°TPS
limitation of TPS_SP_CTL					
C_TPS_SP_LIH_DIF_HYS	-	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
hysteresis at LIH-position for I-share initialization					
C_TPS_SP_STOP_HYS	-	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
setpoint hysteresis for closing throttle					
C_TPS_SP_STOP_MAX	-	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
threshold for testing duty cycle on value					
IP_MTCPWM_ADD__TPS_SP_LIH_DIF	-	0... FFFFH	-100... 99.99694	3.0518e-3	%
LDPM_TPS_SP_LIH_DIF__MTCPWM_ADD	8	0... 7FFEHE	-119.5 ...119.5	7.2941e-3	°TPS
feed-forward-control at positive moving direction					
IP_MTCPWM_D__TPS_DIF_GRD	-	0... FFFFH	-400... 399.98779	0.012207	%
LDP_TPS_DIF_GRD__MTCPWM_D	8	0... 7FFEHE	-119.5 ...119.5	7.2941e-3	°TPS
position controller D-share					
IP_MTCPWM_I__TPS_DIF	-	0... FFFFH	-100... 99.99694	3.0518e-3	%
LDP_TPS_DIF__MTCPWM_I	8	0... 7FFEHE	-119.5 ...119.5	7.2941e-3	°TPS
position controller I-share					
IP_MTCPWM_I_FAC__TPS_AV_LIH_DIF	-	0... FFH	0... 7.97	0.03125	-
LDP_TPS_AV_LIH_DIF__MTCPWM_I	8	0... 7FFEHE	-119.5 ...119.5	0.0073	°TPS
LIH-correction of I-share					
IP_MTCPWM_P__TPS_DIF	-	0... FFFFH	-400... 399.98779	0.012207	%
LDP_TPS_DIF__MTCPWM_P	8	0... 7FFEHE	-119.5 ...119.5	7.2941e-3	°TPS
position controller P-share					
IP_MTCPWM_VB_FAC__VB	-	0... FFH	0... 1.99218	0.0078125	-
LDP_VB__MTCPWM_VB_FAC	8	0... FFH	0... 25.89843	0.1015625	V
battery voltage correction					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

## FUNCTION DESCRIPTION:

### General information:

The position controller is an adaptive PID-controller with a feed forward control.

### Application conditions

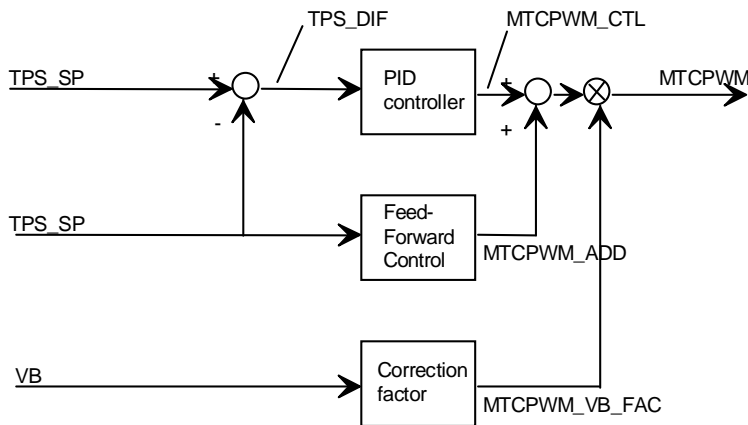
**Initialisation:** *at deactiavtion or LV\_IGK 0->1 or ECU reset*

**Recurrence:** *5 ms*

**Activation:** *If LV\_MTC\_CUR\_OFF = 0*

**Deactivation:** *If LV\_MTC\_CUR\_OFF = 1*  
**Then** Initialization of variables:  
 [ MTCPWM, MTCPWM\_P, MTCPWM\_I, MTCPWM\_I\_ADD  
 MTCPWM\_D, MTCPWM\_ADD, MTCPWM\_CTL ] with 0  
 TPS\_SP\_CTL = (S16) C\_TPS\_SP\_STOP\_HYS  
 T\_MTCPWM\_CLOSE\_ACT = 0  
 LV\_MTCPWM\_CLOSE\_ACT = 0  
 TPS\_DIF = 0x3FFF  
 TPS\_DIF\_GRD = 0x3FFF

### Signal flow diagram:



## C.4.1 PID-Controller

## Description:

The PID-controller is nonlinear. It consists of three parts: P-part, I-part and D-part P- and I-part depend on deviation. The D-part depends on deviation gradient.

Near the mechanical bottom limit the controller deviation is calculated with an offset on the actual throttle position that is equal to the setpoint gradient limitation, even if setpoint value is at its lower limit. So the throttle is moving to the stop with a defined velocity. To calculate the controller deviation a value of the throttle position that can also be negativ is formed.

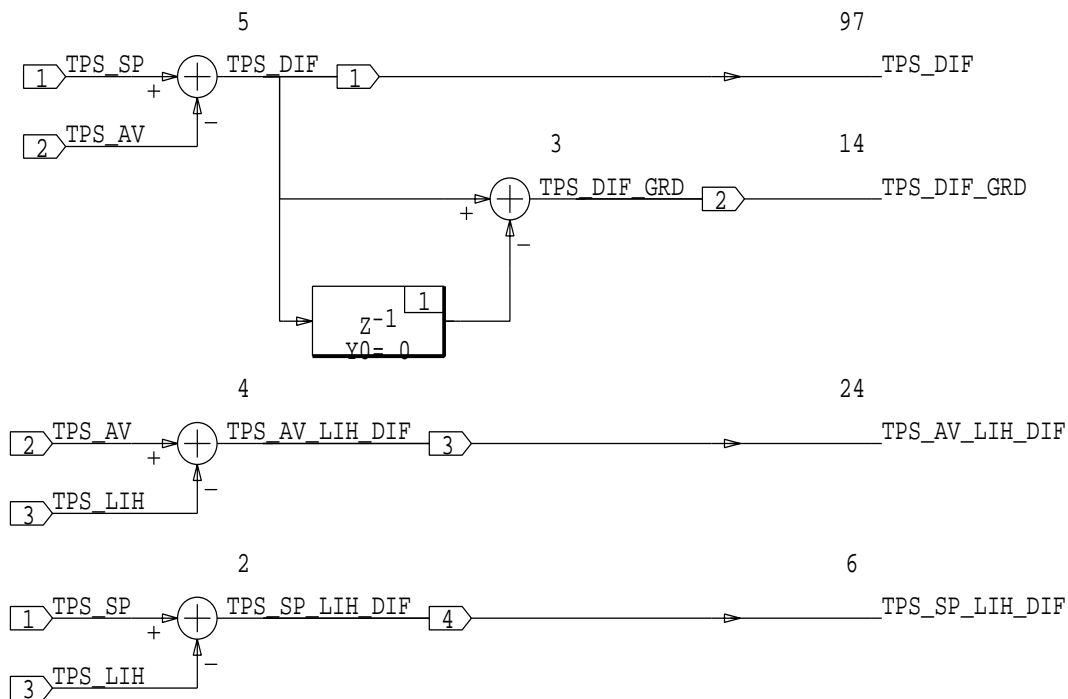
The time where duty cycle is above the closing value is measured. If meanwhile the setpoint leaves the lower bottom limit, the time counter is set back to zero.

### C.4.1.1 Calculation of Deviation

#### Signal flow diagram:

16-NOV-98

Discrete Procedure SuperBlock Deviation	Procedure Class Standard	Inputs 3	Outputs 4
--	-----------------------------	-------------	--------------



#### Formula section:

##### controller deviation:

```

if          TPS_SP > C_TPS_SP_STOP_HYS
then       TPS_DIF = TPS_SP - TPS_AV
              TPS_SP_CTL = C_TPS_SP_STOP_HYS
else       TPS_SP_CTL = TPS_SP_CTL - C_TPS_SP_LGRD_STOP
              TPS_DIF = MAX(TPS_SP_CTL;C_TPS_SP_CTL_MAX) - TPS_AV_CTL
endif

```

**Remark:**  $C\_TPS\_SP\_STOP\_HYS$  should be calibrated nearly to 0.

gradient of the controller deviation:

$$\text{TPS\_DIF\_GRD} = \text{TPS\_DIF}_n - \text{TPS\_DIF}_{n-1}$$

difference between the actual value and the limp home position:

$$\text{TPS\_AV\_LIH\_DIF} = \text{TPS\_AV} - \text{TPS\_LIH}$$

$$\text{TPS\_SP\_LIH\_DIF} = \text{TPS\_SP} - \text{TPS\_LIH}$$

### C.4.1.2 Duty Cycle Supervision /Set Timer

#### Description:

Below the threshold C\_TPS\_SP\_STOP\_MAX is supervised if the throttle is at bottom mechanical limit, i.e. if the duty cycle has exceeded the threshold C\_MTCPWM\_CLOSE \* MTCPWM\_VB\_FAC. In that case a time counter is started.

#### Formula section:

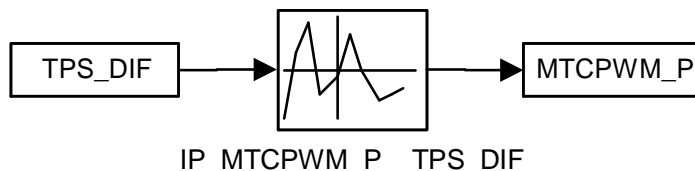
```

if (1)                TPS_SP C_TPS_SP_STOP_MAX
then (1)
  if (2)                MTCPWM <= C_MTCPWM_CLOSE * MTCPWM_VB_FAC +
                        C_MTCPWM_HYS
    then (2)            T_MTCPWM_CLOSE_ACT = T_MTCPWM_CLOSE_ACT + 5ms
    else (2)            T_MTCPWM_CLOSE_ACT = 0
    endif (2)
else (1)              T_MTCPWM_CLOSE_ACT = 0
endif (1)

```

**Remark:** It is not allowed to calibrate C\_TPS\_SP\_STOP\_MAX smaller than C\_TPS\_SP\_STOP\_HYS!

### C.4.1.3 P-share:



#### Signal flow diagram:

#### Formula section:

$$\text{MTCPWM\_P} = \text{IP\_MTCPWM\_P\_TPS\_DIF}$$

### C.4.1.4 I- share:

#### Formula section:

detection of the TPS\_SP direction :

```

if (1)                TPS_SP_LIH_DIF < - C_TPS_SP_LIH_DIF_HYS

```

```

then (1)          LV_TPS_SP_POS = 0
else (1)
  if (2)          TPS_SP_LIH_DIF > C_TPS_SP_LIH_DIF_HYS
    then (2)      LV_TPS_SP_POS = 1
    endif (2)
  endif (1)

if (1)          LV_TPS_SP_POSn < LV_TPS_SP_POSn-1
then (1)      LV_TPS_CHG_POS = 1
  if (2)          LV_TPS_SP_POSn < LV_TPS_SP_POSn-1
    and          MTCPWM_I -C_MTCPWM_I_ADD
    then (2)      MTCPWM_I_ADD = -C_MTCPWM_I_ADD
  else (2)
    if (3)          LV_TPS_SP_POSn > LV_TPS_SP_POSn-1
      and          MTCPWM_I C_MTCPWM_I_ADD
      then (3)      MTCPWM_I_ADD = C_MTCPWM_I_ADD
    endif (3)
  endif (2)
else (1)      MTCPWM_I_ADDn = MTCPWM_In-1
                LV_TPS_CHG_POS = 0
endif (1)
MTCPWM_I        =      MTCPWM_I_ADD + IP_MTCPWM_I__TPS_DIF
IP_MTCPWM_I_FAC__TPS_AV_LIH_DIF

```

#### Limitation of I-share:

I-share is limited to a range C\_MTCPWM\_I\_MAX\_NEG, C\_MTCPWM\_I\_MAX\_POS.

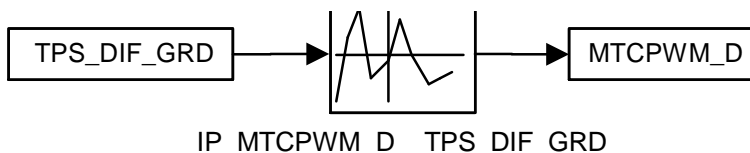
```

if (1)          MTCPWM_I > C_MTCPWM_I_MAX_POS
then (1)      MTCPWM_I = C_MTCPWM_I_MAX_POS
else (1)
  if(2)          MTCPWM_I < C_MTCPWM_I_MAX_NEG
  then (2)      MTCPWM_I = C_MTCPWM_I_MAX_NEG
  else (2)      MTCPWM_I = MTCPWM_I
  endif (2)
endif (1)

```

#### C.4.1.5 D-share:

#### Signal flow diagram:



#### Formula section:

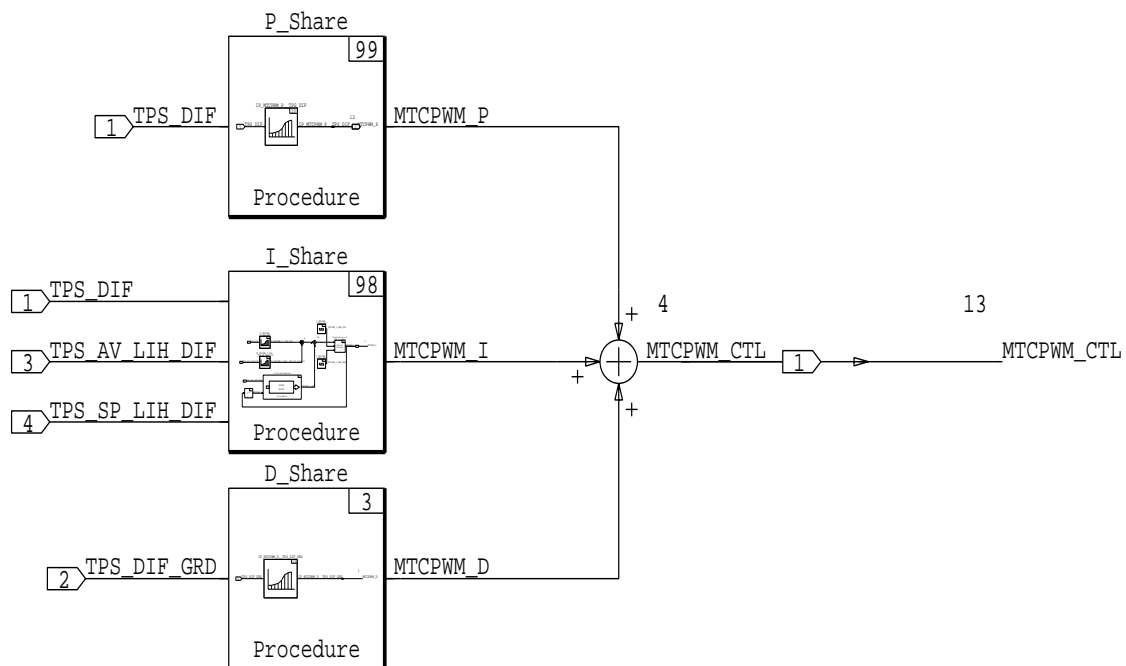
$$\text{MTCPWM}_D = \text{IP\_MTCPWM}_D\_TPS\_DIF\_GRD$$

### C.4.1.6 Calculation of Controller Value:

#### Signal flow diagram:

16-NOV-98

Discrete Procedure SuperBlock PID_controller	Procedure Class Standard	Inputs 4	Outputs 1
---	-----------------------------	-------------	--------------



#### Formula section:

$$\text{MTCPWM\_CTL} = \text{MTCPWM\_P} + \text{MTCPWM\_I} + \text{MTCPWM\_D}$$

### C.4.1.7 Initialization of Position Controller after mechanical limitation stop respectively closing mode

If the throttle is opening beginning at bottom mechanical limit and exceeds the calibratable threshold  $C\_TPS\_SP\_STOP\_HYS$  the I-share is initialized with  $C\_MTCPWM\_I\_INI$ ,  $TPS\_DIF\_GRD$  is set to actual  $TPS\_DIF$  and  $T\_MTCPWM\_CLOSE\_ACT$  is set to zero.

```


if                TPS_SP > C_TPS_SP_STOP_HYS
and                T_MTCPWM_CLOSE_ACT > 0
then               MTCPWM_I = C_MTCPWM_I_INI
                    TPS_DIF_GRD = TPS_DIF
                    T_MTCPWM_CLOSE_ACT = 0

```

**endif**

### C.4.2 Feed - Forward Control of the MTC

#### Description:

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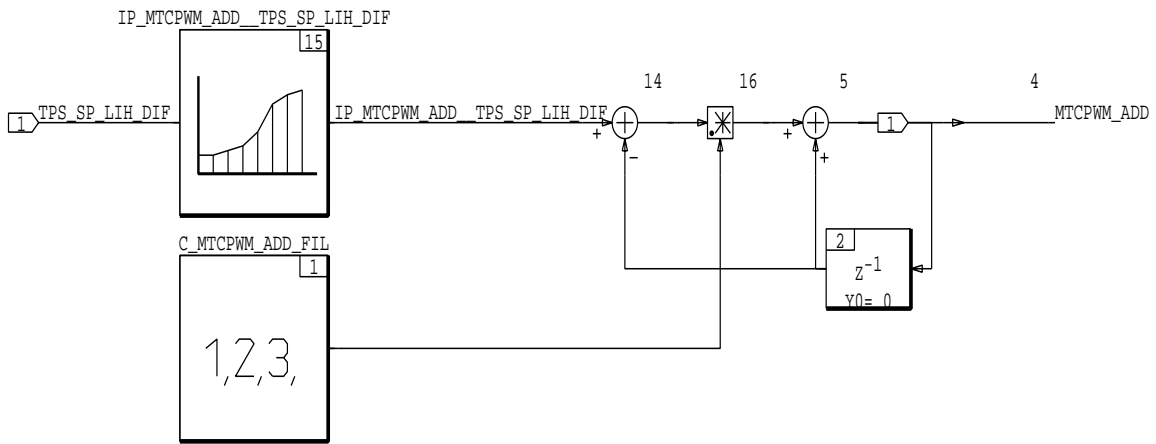


The friction torque of the bearing and of the spring set a very strong non-linearization of the control course. To compensate this and to avoid instability a feed-forward-control is used dependent on the throttle setpoint deviation to LIH-position (TPS\_SP\_LIH\_DIF). For to take into consideration the dynamic behavior a PT1-filter with the time constant C\_MTCPWM\_ADD\_FIL is used.

**Signal flow diagram:**

16-NOV-98

Discrete Procedure SuperBlock	Procedure Class	Inputs	Outputs
Feed_Forward_Controller	Standard	1	1



**Formula section:**

$$MTCPWM\_ADD_n = MTCPWM\_ADD_{n-1} + (IP\_MTCPWM\_ADD\_TPS\_SP\_LIH\_DIF_n - MTCPWM\_ADD_{n-1}) * C\_MTCPWM\_ADD\_FIL$$

**C.4.3 Battery Voltage Correction**

**Description:**

The control duty cycle will be corrected through the battery voltage VB.

**Signal flow diagram:**

**Formula section:**

$$MTCPWM\_VB\_FAC = IP\_MTCPWM\_VB\_FAC\_VB$$

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## C.4.4 Calculation of MTCPWM

### Description:

The duty cycle that controls the main throttle is the sum of a feed-forward-controller value and the PID-controller value. This sum is corrected by a factor depending on battery voltage.

Is the throttle position for sure at the lower mechanical stop, the duty cycle is limited to the allowed value. A rise of the duty cycle over the maximum value marks that the throttle position has reached the mechanical stop. The maximum duty cycle is allowed only for a defined time. Then the duty cycle is switched back to the closing level.

### Formula section:


MTCPWM = (MTCPWM\_CTL+ MTCPWM\_ADD) \* MTCPWM\_VB\_FAC

LV\_MTCPWM\_CLOSE\_ACT = 0

```

if (1)          T_MTCPWM_CLOSE_ACT > 0
then (1)      MTCPWM =      MAX{(C_MTCPWM_CLOSE_MAX * MTCPWM_VB_
FAC);           MTCPWM}
if(2)          T_MTCPWM_CLOSE_ACT > C_T_MTCPWM_CLOSE_ACT_MAX
then(2)      MTCPWM = C_MTCPWM_CLOSE * MTCPWM_VB_FAC
                LV_MTCPWM_CLOSE_ACT = 1
endif(2)
endif (1)

```

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## C.5 Electronic throttle control setpoint selection

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TPS_SP	O/V	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Throttle position setpoint for MTC position controller					
TPS_SP_LIM	V	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Limited throttle position setpoint					
TPS_SP_LIM_1	V	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Throttle position setpoint after absolute value limitation					
TPS_SP_LIM_2	V	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Throttle position setpoint after gradient limitation over whole operating range					
TPS_SP_SEL	O/V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Selected throttle position setpoint before limitation					

### Input data:

LV_ES {p. 1720}	LV_TPS_AD_ACT {p. 4951}	LV_TPS_AD_REQ {p. 4951}	LV_TPS_PWL {p. 6565}
LV_TPS_SP_EXT {p. 6565}	LV_TPS_SP_JAM {p. 6531}	LV_TPS_SP_LIH {p. 6565}	TPS_AV {p. 1169}
TPS_LIH {p. 1169}	TPS_SP_AD {p. 4952}	TPS_SP_ES {p. 6565}	TPS_SP_EXT {p. 6565}
TPS_SP_JAM {p. 6532}	TPS_SP_MDL {p. 8377}	TPS_SP_PWL {p. 6565}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TPS_AV_BOL	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Lower limit (actual value) of the closing speed limitation of the throttle setpoint					
C_TPS_AV_TOL	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Upper limit (actual value) of the opening speed limitation of the throttle setpoint					
C_TPS_SP_BOL	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Lower limit of opening velocity limitation of throttle position setpoint					
C_TPS_SP_BOL_TPS_AD_REQ	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Lower limit of opening velocity limitation of throttle position setpoint without throttle adaptation					
C_TPS_SP_LGRD_STOP	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS/ 10ms
max. admissible gradient of throttle position setpoint for range of top and bottom stop					
C_TPS_SP_LGRD_TOT	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS/ 10ms
max. admissible gradient of throttle position setpoint for whole operating range					
C_TPS_SP_MAX	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Upper limit of throttle position setpoint					
C_TPS_SP_MAX_TPS_AD_REQ	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Upper limit of throttle position setpoint without throttle adaptation					
C_TPS_SP_MIN	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Lower limit of throttle position setpoint					
C_TPS_SP_MIN_TPS_AD_REQ	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Lower limit of throttle position setpoint without throttle adaptation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TPS_SP_TOL	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Upper limit of opening velocity limitation of throttle position setpoint					
C_TPS_SP_TOL_TPS_AD_REQ	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Upper limit of opening velocity limitation of throttle position setpoint without throttle adaptation					

## FUNCTION DESCRIPTION:

### General information:

This module is describing the generation of the throttle position setpoint TPS\_SP which is used as an input variable in the module ETC Position Controller.

The module consists of two blocks (see figure 1): In a first step the setpoint is selected depending on the engine state, in a second step the selected value is limited. This limitation acts as protection so that the throttle blade does not hit the mechanical stops with too high energy. Otherwise the throttle could be damaged.

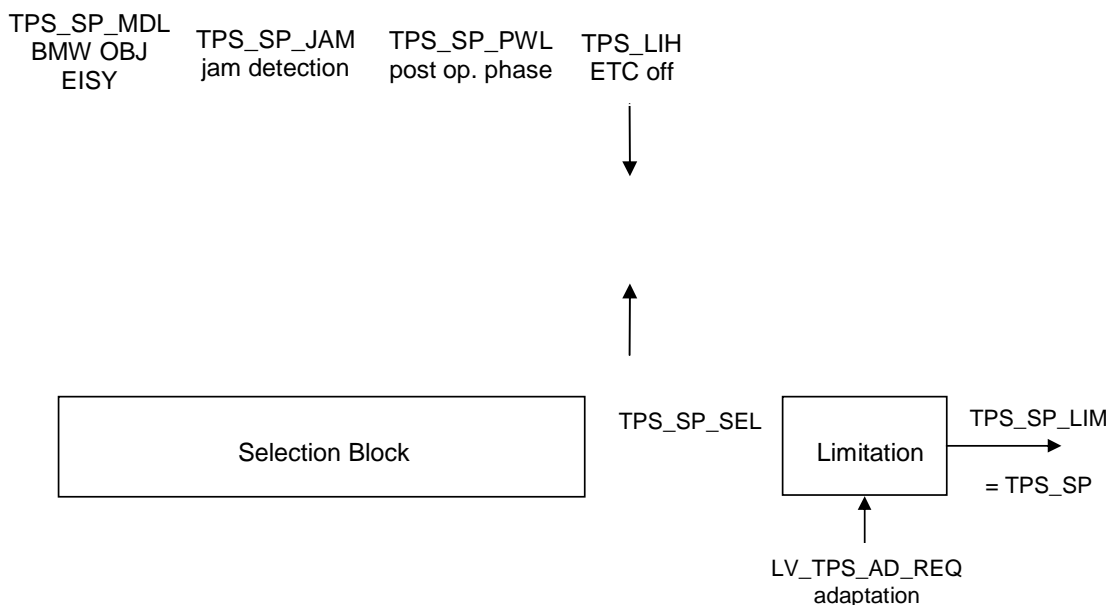
The setpoint before limitation TPS\_SP\_SEL is selected from the following variables:

1. Basic throttle position setpoint: TPS\_SP\_MDL (output of BMW OBJ EISY)
2. Throttle position setpoint for engine stopped: TPS\_SP\_ES
3. Throttle position setpoint for jam detection: TPS\_SP\_JAM
4. Throttle position setpoint during adaptation: TPS\_SP\_AD
5. Throttle position setpoint in case of external activation: TPS\_SP\_EXT
6. Throttle position setpoint during the post operating phase: TPS\_SP\_PWL
7. Throttle position setpoint when the position controller is switched off: TPS\_LIH

From TPS\_SP\_SEL the final setpoint TPS\_SP is generated by means of a limitation function which is including a limitation by absolute values and by gradients.

The setpoint is determined every 10 ms, except during adaptation (5ms).

### Signal flow diagram:



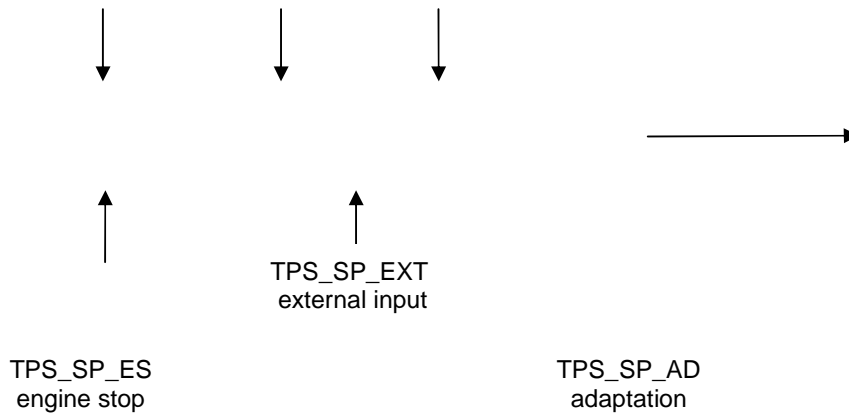


Figure C.5.1: : Throttle position setpoint selection and limitation.

### Application conditions

<b>Activation:</b>	<i>at every engine state</i>
<b>Deactivation:</b>	–
<b>Initialisation:</b>	–
<b>Update rate:</b>	10 ms (5ms during adaptation)

### C.5.1 Throttle position setpoint selection

For the selection logic see figure 2.

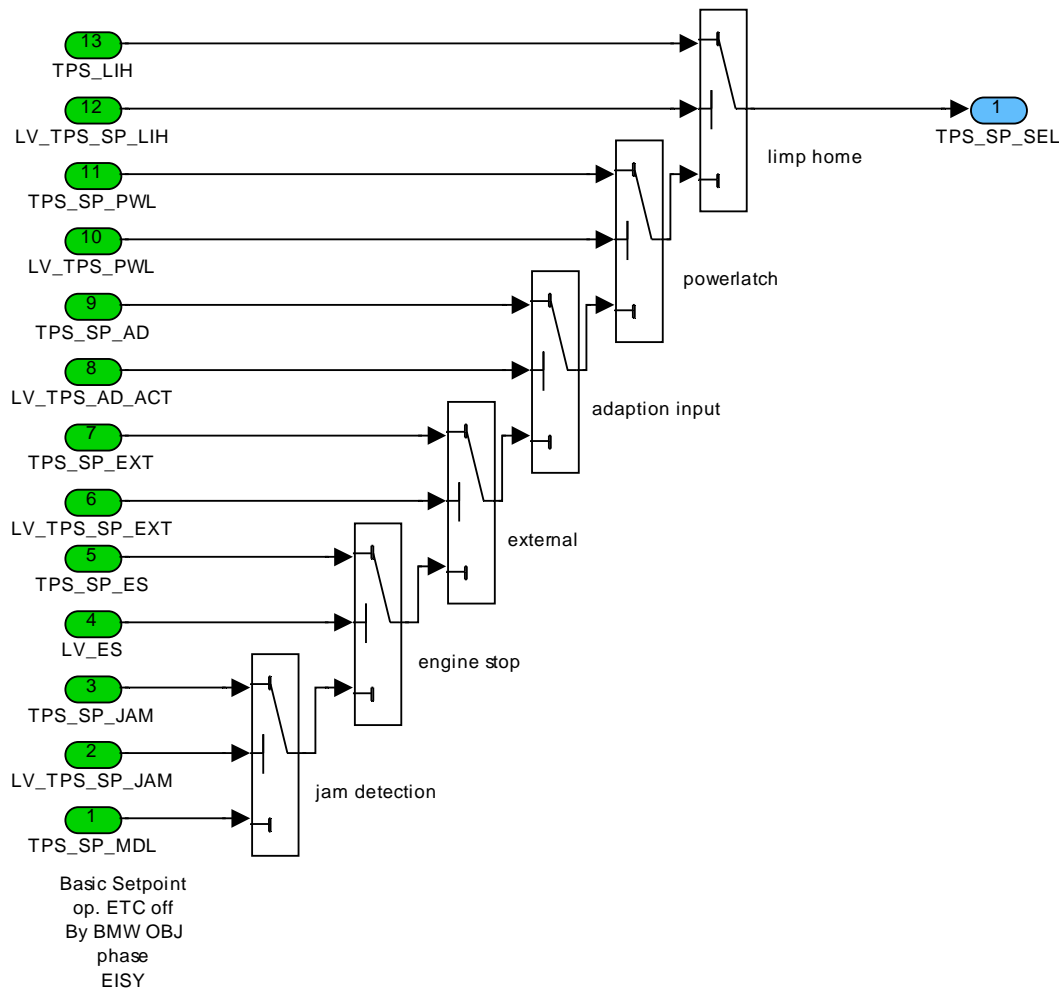


Figure C.5.2: : Throttle position setpoint selection block.

### C.5.1.1 Throttle position setpoint for jam detection

During jam detection the throttle position setpoint is set from the jam detection module.

#### Formula section:

```

if      (LV_TPS_SP_JAM = 1           and
        LV_ES = 0                   and
        LV_TPS_SP_EXT = 0           and
        LV_TPS_AD_ACT = 0           and
        LV_TPS_PWL = 0              and
        LV_TPS_SP_LIH = 0)         and

then    TPS_SP_SEL = TPS_SP_JAM

else    TPS_SP_SEL = TPS_SP_MDL

endif

```

### C.5.1.2 Throttle position setpoint for engine stopped

During the engine state "Engine stopped" (LV\_ES = 1) the throttle position setpoint is determined by the special variable TPS\_SP\_ES.

**Formula section:**

```

if          (LV_ES = 1          and
               LV_TPS_SP_EXT = 0    and
               LV_TPS_AD_ACT= 0     and
               LV_TPS_PWL = 0       and
               LV_TPS_SP_LIH = 0 )

then      TPS_SP_SEL = TPS_SP_ES
    
```

**endif**

### C.5.1.3 Throttle position setpoint by external device

In case of request by an external device the throttle position setpoint is set by the value TPS\_SP\_EXT.

**Formula section:**

```

if          ( LV_TPS_SP_EXT = 1    and
               LV_TPS_AD_ACT= 0     and
               LV_TPS_PWL = 0       and
               LV_TPS_SP_LIH = 0 )

then      TPS_SP_SEL = TPS_SP_EXT
    
```

**endif**

### C.5.1.4 Throttle position setpoint during adaptation

During TPS adaptation the throttle position setpoint is set from the adaptation module.

**Formula section:**

```

if          (LV_TPS_AD_ACT= 1    and
               LV_TPS_PWL = 0     and
               LV_TPS_SP_LIH = 0 )

then      TPS_SP_SEL = TPS_SP_AD
    
```

**endif**

### C.5.1.5 Throttle position setpoint during post operating phase


To avoid that for 'Pin 15 Off' the throttle blade is currentless and set to limp home position, a throttle position setpoint during the post operating phase is available.

**Formula section:**

```

if          ( LV_TPS_PWL = 1          and
    
```

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```

LV_TPS_SP_LIH = 0 )

then    TPS_SP_SEL = TPS_SP_PWL

endif

```

### C.5.1.6 Throttle position setpoint for ETC controller switched off

In case of the ETC controller switched off the TPS setpoint is set to the limp home position TPS\_LIH.

#### Formula section:

```

if      LV_TPS_SP_LIH = 1

then    TPS_SP_SEL = TPS_LIH

endif

```

## C.5.2 Throttle position setpoint limitation

The task of this function is a protection mechanism for the throttle blade. Therefore, it must be evaluated after the TPS setpoint selection.

For adjusting the setpoint to the physics of the throttle the variable TPS\_SP\_SEL is limited by

1. absolute values, for the non adapted throttle (LV\_TPS\_AD\_REQ =1 remains set after adaptation) the values indicated by "(\_TPS\_AD\_REQ)" are used,
2. a gradient valid for the whole operating range,
3. a gradient valid for the range of upper and lower stop.

The intermediate results of the limitation actions mentioned above are stored in the following way:

```

a)          b)          c)
TPS_SP_SEL --> TPS_SP_LIM_1 --> TPS_SP_LIM_2 --> TPS_SP_LIM = TPS_SP

```



For illustration see figure 3.

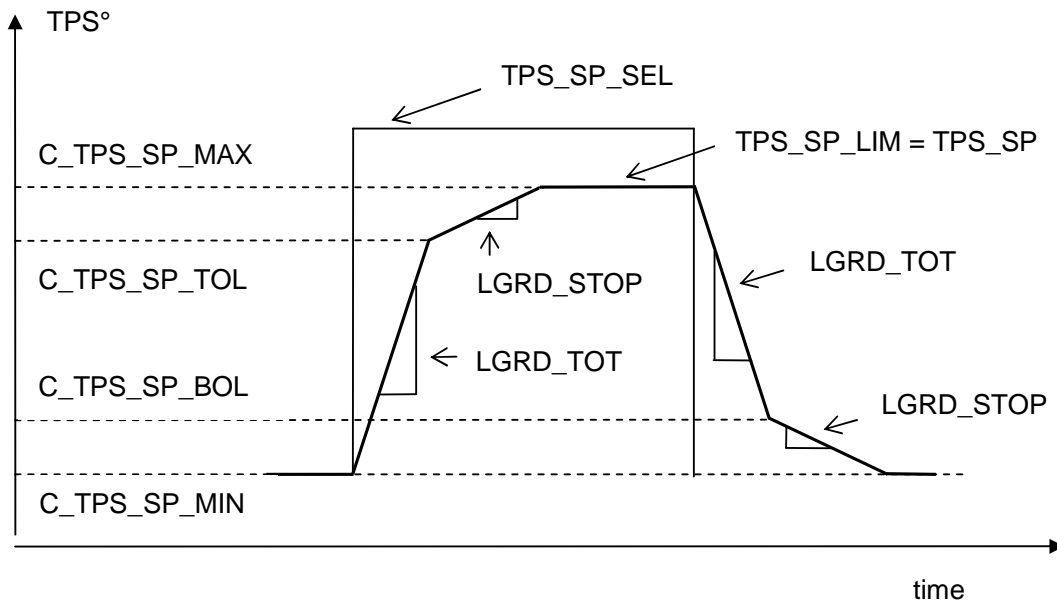



Figure C.5.3: : Throttle position setpoint limitation.

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### C.5.2.1 Limitation using absolute values

The throttle position setpoint may not fall below the value  $C\_TPS\_SP\_MIN(\_TPS\_AD\_REQ)$  or exceed  $C\_TPS\_SP\_MAX(\_TPS\_AD\_REQ)$ .

#### Formula section:

```

if      ( TPS_SP_SEL > C_TPS_SP_MAX(_TPS_AD_REQ) )

then    TPS_SP_LIM_1 = C_TPS_SP_MAX(_TPS_AD_REQ)

else    if      TPS_SP_SEL < C_TPS_SP_MIN(_TPS_AD_REQ)

        then    TPS_SP_LIM_1 = C_TPS_SP_MIN(_TPS_AD_REQ)

        else    TPS_SP_LIM_1 = TPS_SP_SEL

    endif

endif

```

### C.5.2.2 Gradient limitation over whole operating range

The gradient of the throttle position setpoint is limited throughout the whole operating range. A maximum change of  $C\_TPS\_SP\_LGRD\_TOT$  is permitted.

#### Formula section:

```

if      TPS_SP_LIM_1 > TPS_SP_LIMi-1

then    TPS_SP_LIM_2 =
        MIN(TPS_SP_LIM_1, TPS_SP_LIMi-1 + C_TPS_SP_LGRD_TOT)

else    TPS_SP_LIM_2 =
        MAX(TPS_SP_LIM_1, TPS_SP_LIMi-1 - C_TPS_SP_LGRD_TOT)


endif

```

### C.5.2.3 Gradient limitation near upper and lower position

The throttle position gradient is additionally limited as soon as the throttle position is near the upper or lower stop position: If  $TPS\_SP\_LIM\_2$  is close to the stop positions, for one step the setpoint  $TPS\_SP\_LIM$  is set to the value  $C\_TPS\_SP\_TOL(\_TPS\_AD\_REQ)$  or  $C\_TPS\_SP\_BOL(\_TPS\_AD\_REQ)$ , respectively. When  $TPS\_SP\_LIM\_2$  is further moving towards the stops a gradient  $C\_TPS\_SP\_LGRD\_STOP < C\_TPS\_SP\_LGRD\_TOT$  is permitted. Thus a mechanical collision of blade and stops should be avoided (at least when  $TPS\_AV$  is close to  $TPS\_SP$ ).

An additional protection mechanism near the mechanical stops is taking into account also the actual position  $TPS\_AV$  of the throttle blade. If the difference between the desired  $TPS\_SP$  and the actual  $TPS\_AV$  is too high, the ETC controller will react aggressively. This reaction could lead to banging the throttle against the mechanical stops. To avoid such a behaviour the following algorithm is implemented: If  $TPS\_AV$  is too far away from  $TPS\_SP\_LIM\_2$  (near the lower stop:  $TPS\_AV > C\_TPS\_AV\_BOL > C\_TPS\_SP\_BOL$  whereas  $TPS\_SP\_LIM\_2 \approx C\_TPS\_SP\_BOL$ ; near the upper stop:  $TPS\_AV < C\_TPS\_AV\_TOL < C\_TPS\_SP\_TOL$  whereas  $TPS\_SP\_LIM\_2 \approx C\_TPS\_SP\_TOL$ ), then  $TPS\_SP\_LIM$  is kept on the value  $C\_TPS\_SP\_BOL$  (or  $C\_TPS\_SP\_TOL$ , respectively) until  $TPS\_AV$

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is arriving below  $C\_TPS\_AV\_BOL$  (or above  $C\_TPS\_AV\_TOL$ ) such that the difference between desired and actual position is small enough to have no strong ETC controller reactions. For illustration of the algorithm see figure 4.

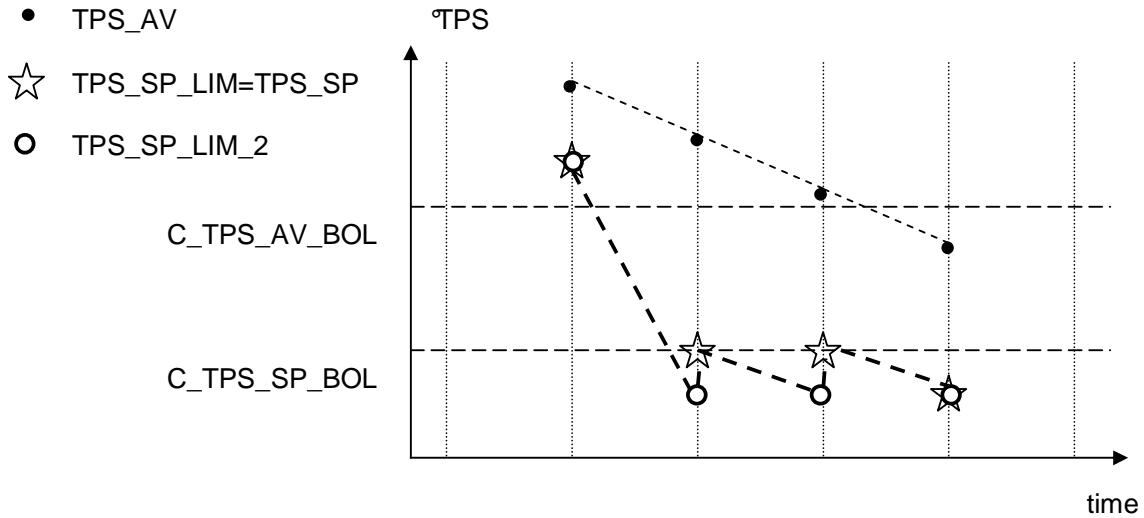


Figure 4:  $TPS\_SP$  limitation mechanism at lower mechanical stop depending on  $TPS\_AV$ .

#### Formula section:

```

if     $TPS\_SP\_LIM\_2 > C\_TPS\_SP\_TOL\_(\_TPS\_AD\_REQ)$            {above top limit}

then  if    ( $TPS\_SP\_LIM_{i-1} < C\_TPS\_SP\_TOL\_(\_TPS\_AD\_REQ)$       or
            $TPS\_AV < C\_TPS\_AV\_TOL$  )

      then   $TPS\_SP\_LIM = C\_TPS\_SP\_TOL\_(\_TPS\_AD\_REQ)$ 

      else   $TPS\_SP\_LIM = MIN(TPS\_SP\_LIM\_2,$ 
                              $TPS\_SP\_LIM_{i-1} + C\_TPS\_SP\_LGRD\_STOP)$ 
      endif

else  if     $TPS\_SP\_LIM\_2 < C\_TPS\_SP\_BOL\_(\_TPS\_AD\_REQ)$  {below bottom limit}

      then  if    ( $TPS\_SP\_LIM_{i-1} > C\_TPS\_SP\_BOL\_(\_TPS\_AD\_REQ)$  or
                  $TPS\_AV > C\_TPS\_AV\_BOL$  )

            then   $TPS\_SP\_LIM = C\_TPS\_SP\_BOL\_(\_TPS\_AD\_REQ)$ 

            else   $TPS\_SP\_LIM = MAX(TPS\_SP\_LIM\_2,$ 
                                     $TPS\_SP\_LIM_{i-1} - C\_TPS\_SP\_LGRD\_STOP)$ 
            endif

      else   $TPS\_SP\_LIM = TPS\_SP\_LIM\_2$ 

      endif

endif

```


**Remark:** For correct working of the algorithm the following settings **must** be chosen:

- C\_TPS\_SP\_BOL(\_TPS\_AD\_REQ) < C\_TPS\_AV\_BOL < TPS\_LIH
- C\_TPS\_SP\_TOL(\_TPS\_AD\_REQ) > C\_TPS\_AV\_TOL

#### C.5.2.4 Output of limited setpoint

##### Formula section:

$$\text{TPS\_SP} = \text{TPS\_SP\_LIM}$$

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## C.6 Electronic throttle control setpoint selection (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_T_TPS_PWL	O	0... FFH	0... 255	1	s
Timer after engine stop					
LV_MTC_CUR_OFF	O/V	0... 1H	0 ...1	1	-
The logical variable indicate the state of the ETC power stage					
LV_TPS_PWL	O/V	0... 1H	0 ...1	1	-
Bit for throttle position setpoint in post operating phase active					
LV_TPS_SP_EXT	O/V	0... 1H	0 ...1	1	-
Bit active for external input of throttle position setpoint					
LV_TPS_SP_LIH	O/V	0... 1H	0 ...1	1	-
Bit collecting the requests of all 3 monitoring levels to switch off MTC					
TPS_SP_ES	O/V	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Throttle position setpoint for engine stopped					
TPS_SP_EXT	O/V	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Throttle position setpoint of external device					
TPS_SP_PWL	O/V	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Throttle position setpoint during post operating phase					

### Input data:

C_TPS_SP_MAX {p. 6555}	LV_ERR_ECU_CKS {p. 4232}	LV_ERR_ECU_RAM {p. 4232}	LV_ERR_MU_MC {p. 7072}
LV_ERR_TMP_MU_MC {p. 7072}	LV_ES {p. 1720}	LV_IGK {p. 906}	LV_MC_SOPC_INH_DI {p. 7186}
LV_MTC_CUR_OFF {p. 6565}	LV_MTC_CUR_OFF_REQ {p. 4982}	LV_OFF_MTC_MON {p. 6877}	LV_TPS_AD_ACT {p. 4951}
LV_TPS_AD_CUR_OFF {p. 4951}	LV_TPS_PWL {p. 6565}	LV_TPS_SP_EXT {p. 6565}	LV_TPS_SP_EXT_ADJ {p. 7435}
N_32 {p. 1525}	PV_AV {p. 1269}	TCO {p. 1100}	TPS_SP_EXT_ADJ {p. 7438}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_PV_AV_EXT_ADJ_MIN	-	0... FFH	0... 99.60937	0.390625	%
Min. threshold for external adjustment about PV_AV					
C_T_MTC_ISA_OFF	-	0... FFH	0... 255	1	s
Active time period for throttle position setpoint during post operating phase					
C_TPS_SP_AS_MAN	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Manual throttle setpoint					
C_TPS_SP_EXT_ADJ_ENA	-	0... 3H	0 ...3	1	-
Variable enabled for throttle position setpoint manual or about PV_AV					
C_TPS_SP_PWL_LGRD	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS/ 10ms
Gradient limitation TPS					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TPS_SP_PWL_UP	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Threshold opening throttle after power latch					
IP_TPS_SP_ES	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
LDPM_TCO_1_THRO	8	0... FEH	-48... 142.5	0.75	°C
Throttle position setpoint for engine stopped					
IP_TPS_SP_EXT_ADJ	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
LDP_PV_AV_TPS_SP_EXT	6	0... FFH	0... 99.60937	0.390625	%
External adjustment setpoint					
IP_TPS_SP_PWL	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
LDP_N_32_TPS_SP_PWL	4	0... FFH	0... 8160	32	rpm
Throttle position setpoint during post operating phase					

## C.6.1 Throttle position setpoint for engine stopped

### FUNCTION DESCRIPTION:

#### General information:

For engine stopped TPS\_SP\_ES is generated from a TCO dependent map. The TPS\_SP\_ES value must be chosen with respect to the expected TPS\_SP\_ST. A sensible choice diminishes the transient time when the TPS\_AV is approaching TPS\_SP\_ST.

#### Application conditions

**Initialisation:** -  
**Recurrence:** 10 ms  
**Activation:** in every engine state

#### Formula section:

```

if LV_ES = 1
    then TPS_SP_ES = IP_TPS_SP_ES

```

**endif**


## C.6.2 Throttle position setpoint by external device

### Description:

For different tasks during calibration phase and for service procedures at the workshops, it is necessary to implement an external adjustment at throttle position.

Throttle position can be influenced via serial tester (KWP) or manual in the following way:

C\_TPS\_SP\_EXT\_ADJ\_ENA = 0 : no manual adjustment  
 C\_TPS\_SP\_EXT\_ADJ\_ENA = 1 : manual setpoint via application system

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C\_TPS\_SP\_EXT\_ADJ\_ENA = 2 : manual setpoint via PV\_AV

C\_TPS\_SP\_EXT\_ADJ\_ENA = 3 : manual setpoint via PV\_AV and application system

### Application conditions

**Initialisation:** 0  
**Recurrence:** 10ms  
**Activation:** LV\_IGK = 1

### Formula section:

```

If(1)          LV_TPS_SP_EXT_ADJ = 1
Then(1)       LV_TPS_SP_EXT = 1
                TPS_SP_EXT = (TPS_SP_EXT_ADJ /100%) * C_TPS_SP_MAX
                //to convert from % into °TPS
Else(1)       If(2)  C_TPS_SP_EXT_ADJ_ENA = 1      and
                LV_ES = 1
                Then(2)  TPS_SP_EXT = C_TPS_SP_AS_MAN
                LV_TPS_SP_EXT = 1
                Else(2)  If(3)  C_TPS_SP_EXT_ADJ_ENA = 2      and
                PV_AV > C_PV_AV_EXT_ADJ_MIN and
                LV_ES = 1
                then(3) TPS_SP_EXT = IP_TPS_SP_EXT_ADJ
                LV_TPS_SP_EXT = 1
                else(3)   If(4)  C_TPS_SP_EXT_ADJ_ENA = 3      and
                PV_AV > C_PV_AV_EXT_ADJ_MIN
                then(4) TPS_SP_EXT = C_TPS_SP_AS_MAN +
                IP_TPS_SP_EXT_ADJ
                LV_TPS_SP_EXT = 1
                else(4) LV_TPS_SP_EXT = 0
                TPS_SP_EXT = 0
                endif(4)
                endif(3)
                endif(2)
endif(1)

```

## C.6.3 Throttle position setpoint during post operating phase

### General information:


To avoid that for ‚Power Down‘ the currentless throttle is set to the limp home position, for a tuneable time period a throttle position setpoint during the post operating phase is available.

A time counter is started on detection of ignition key OFF and  $N < 32$  rpm (engine stopped). If the counter reaches its maximum C\_T\_MTC\_ISA\_OFF, the throttle is actuated to the setpoint C\_TPS\_SP\_PWL\_UP by the current TPS\_SP and then de-energized. Thus, it is ensured that the throttle are closed until a defined time after ignition key OFF and engine stopped.

If the throttle is already deenergized when ignition key OFF is detected, it is not re-energized.

### Formula section:

**If (1)** LV\_IGK = 0 **and**

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```

        LV_MTC_CUR_OFF = 0; at LV_IGK = 1 to 0
Then(1) LV_TPS_PWL =1
    If(2) LV_ES = 0
        Then(2) TPS_SP_PWL = IP_TPS_SP_PWL
        Else (2) Timer started (LV_ES = 1 to 0)
            if (3) (CTR_T_TPS_PWL < C_T_MTC_ISA_OFF)
                Then(3) TPS_SP_PWL = IP_TPS_SP_PWL
                Else (3)
                    Begin TPS_SP_PWLn = TPS_SP_PWLn-1 + C_TPS_SP_PWL_LGRD
                    Until TPS_SP_PWL ≥ C_TPS_SP_PWL_UP
                    Then LV_TPS_PWL =0
            Endif
        Endif
    Else(1) LV_TPS_PWL =0
Endif

```

## C.6.4 Throttle position setpoint and conditions for ETC switched off

### Application conditions

**Initialisation:** 1  
**Recurrence:** 5 ms  
**Activation:** in every engine state

### Formula section:

```

If(1) LV_ES = 1
    LV_IGK = 1
    LV_TPS_AD_ACT = 0
    LV_TPS_SP_EXT = 0
    LV_TPS_AD_CUR_OFF = 1
    LV_MTC_CUR_OFF_REQ = 1
    (LV_IGK = 0 and LV_TPS_PWL = 0)
    LV_OFF_MTC_MON = 1
    LV_ERR_ECU_RAM = 1
    LV_ERR_ECU_CKS = 1
    LV_ERR_TMP_MU_MC =1
    LV_ERR_MU_MC= 1
    and //Engine stopped
    and //Key ON
    and //No TPS adaptation active
    or //No external adjustment TPS active
    or //Adaption-step with MTC off active
    or //Request from TPS/MTC diagnosis
    or //No activation in PWL
    or //bit set by monitoring level 2
    or //ECU RAM error
    or //ECU CKS error
    or //bits set by monitoring level 3

```

```

then(1) LV_MTC_CUR_OFF = 1
else(1) LV_MTC_CUR_OFF = 0
endif(1)

```

```
LV_TPS_SP_LIH = LV_MTC_CUR_OFF
```

```


If(2) LV_MC_SOPC_INH_DI = 1
then(2) switch MTC HBR on, because MTC is disabled by MU
else(2) switch MTC HBR according LV_MTC_CUR_OFF
endif(2)

```



# D - Torque Management

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## D.1 Pedal value interpretation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_REQ_DRIV	O/V	0... FFFFH	0... 1.999969	305.176e3	-
scaling factor for requested torque at clutch from driver					
LV_RNG_L_REQ	O/V	0... 1H	0 ...1	1	-
Activation condition for low range mode					

### Input data:

LV_RNG_L {p. 1302}	LV_RNG_L_AT {p. 1302}	LV_SOF_SWI_REQ {p. 3851}	N {p. 1525}
PV_AV_GRD {p. 1269}	PV_CUS {p. 1269}	STATE_GEAR_REV_AT_ AMT {p. 1302}	STATE_GEAR_REV_CAN {p. 1574}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQ_REQ_DRIV_SOF_MAX	-	0... FFFFH	0... 1.999969	305.176e3	-
scaling factor treshold for activation IP_FAC_TQ_REQ_DRIV_RNG_L					
C_PV_AV_GRD_SOF_MAX	-	0... FFH	0... 1240.23	9.765625	%/s
Pedal value gradient threshold for recognition of LV_RNG_L					
C_PV_CUS_SOF_MIN	-	0... FFFFH	0... 99.9984741	0.00152588	%
PV_CUS threshold for activation IP_FAC_TQ_REQ_DRIV_RNG_L					
C_T_PV_AV_GRD_SOF_MAX	-	0... FFFFH	0... 655.35	0.01	s
Minimum time for pedal value gradient for recognition of LV_RNG_L					
IP_FAC_TQ_REQ_DRIV	-	0... FFFFH	0... 1.999969	305.176e3	-
LDPM_N_FAC_TQ_REQ_DRIV	12	0... 1FE0H	0... 8160	1	rpm
LDPM_PV_CUS_FAC_TQ_REQ_DRIV	12	0... FFFFH	0... 99.9984741	0.00152588	%
Scaling factor for requested torque at clutch from driver					
IP_FAC_TQ_REQ_DRIV_RNG_L	-	0... FFFFH	0... 1.999969	305.176e3	-
LDPM_N_FAC_TQ_REQ_DRIV	12	0... 1FE0H	0... 8160	1	rpm
LDPM_PV_CUS_FAC_TQ_REQ_DRIV	12	0... FFFFH	0... 99.9984741	0.00152588	%
Scaling factor for requested torque at clutch from driver in low range mode					
LC_RNG_L_MAN_AS	-	0... 1H	0 ...1	1	-
Calibration constant for to activate IP_FAC_TQ_REQ_DRIV_RNG_L (low range mode) in case if LV_RNG_L = 0 (default value = 0)					

### FUNCTION DESCRIPTION:

#### General information:

The scaling factor FAC\_TQ\_REQ\_DRIV is the interpretation of the driver torque demand depending on engine speed and pedal value. Depending on gear mode LV\_RNG\_L (LV\_RNG\_L =1 if low range is engaged) two maps can be calibrated with different pedal value interpretation for normal and low range mode.

#### Application Condition

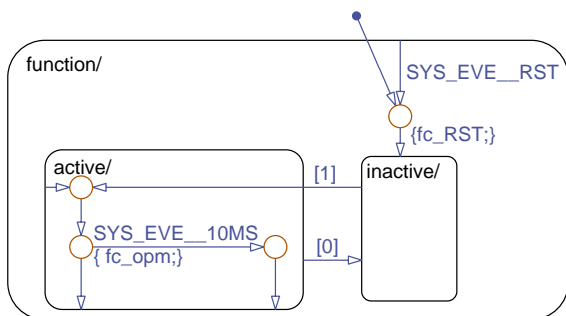


Figure D.1.1: DRRQ\_MD00P/APP\_CDN/Chart

**Function Description**

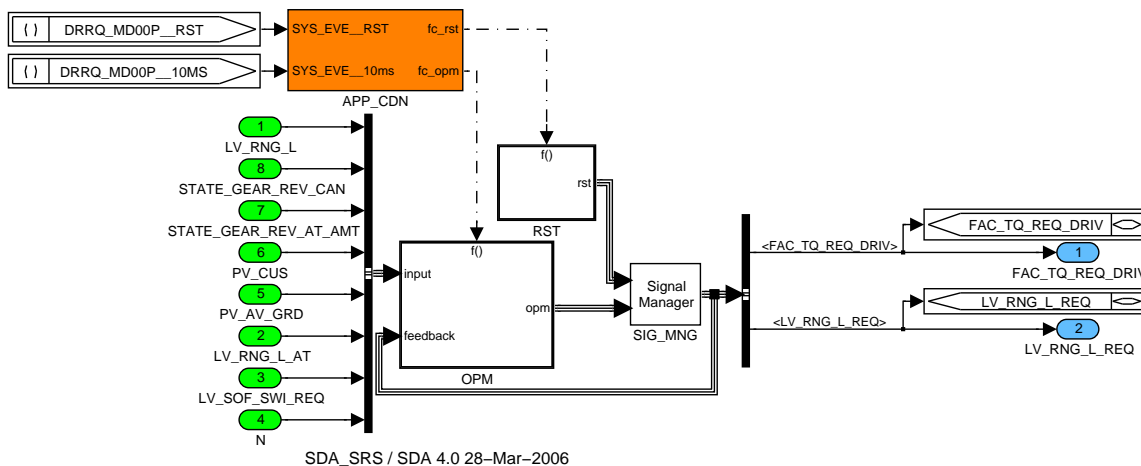


Figure D.1.2: DRRQ\_MD00P

**D.1.1 Initialisation**

Scaling factor FAC\_TQ\_REQ\_DRIV is initialised to 0 at reset

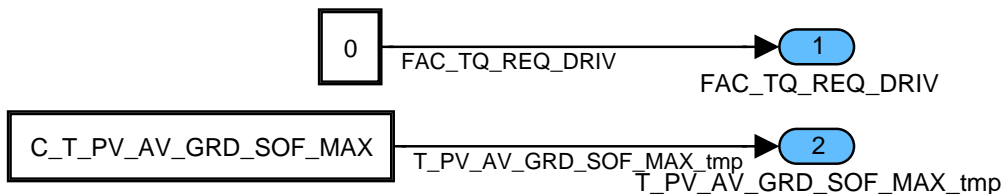
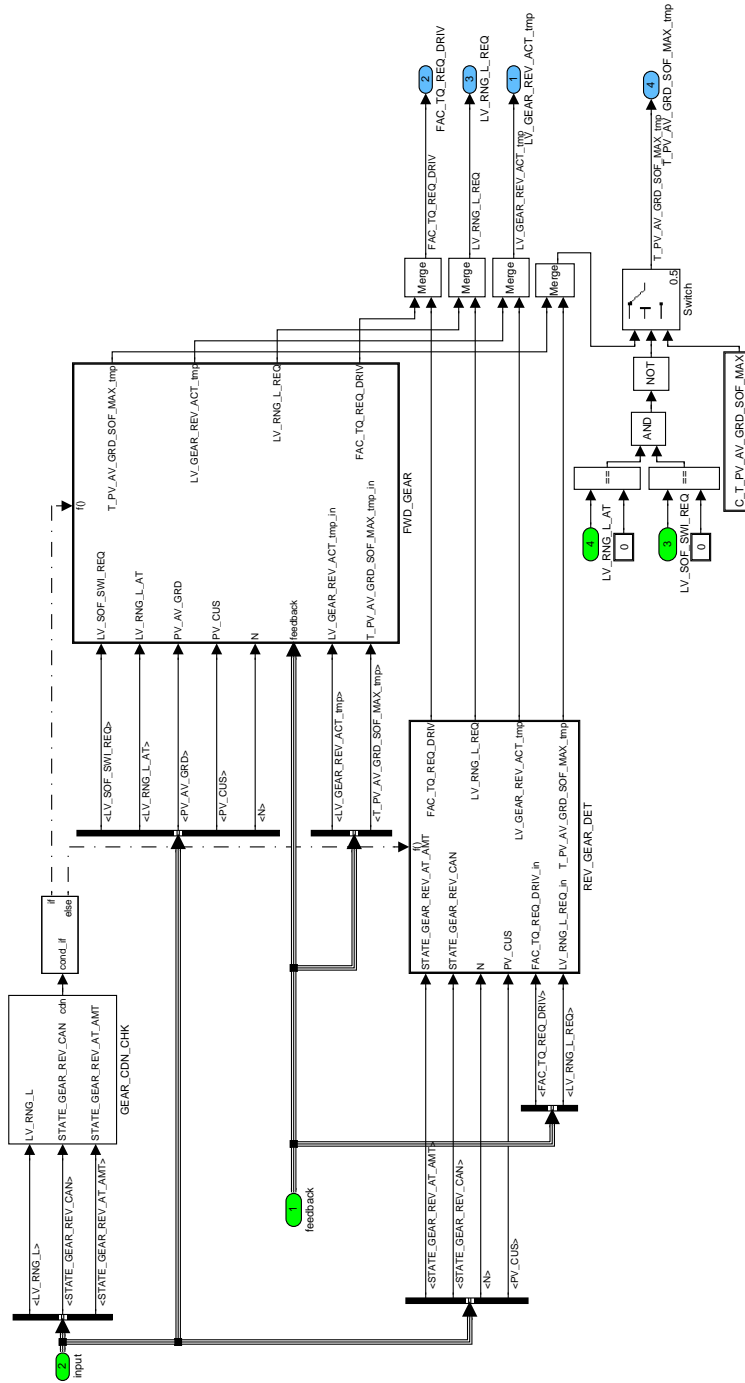


Figure D.1.3: DRRQ\_MD00P/RST/INI

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## D.1.2 Formula section


### Gear mode detection



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Figure D.1.4: DRRQ\_MD00P/OPM/OPM\_10MS

### Detection of gear condition

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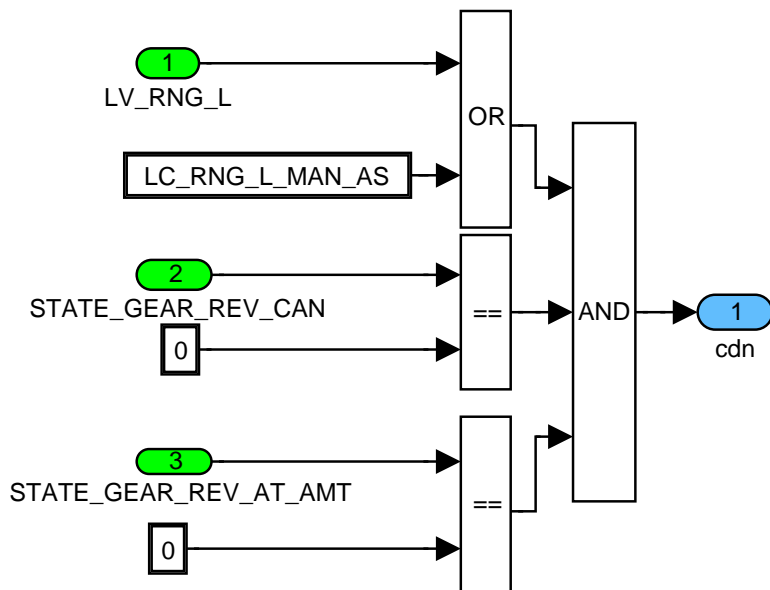


Figure D.1.5: DRRQ\_MD00P/OPM/OPM\_10MS/GEAR\_CDN\_CHK

**Forward gear detection**

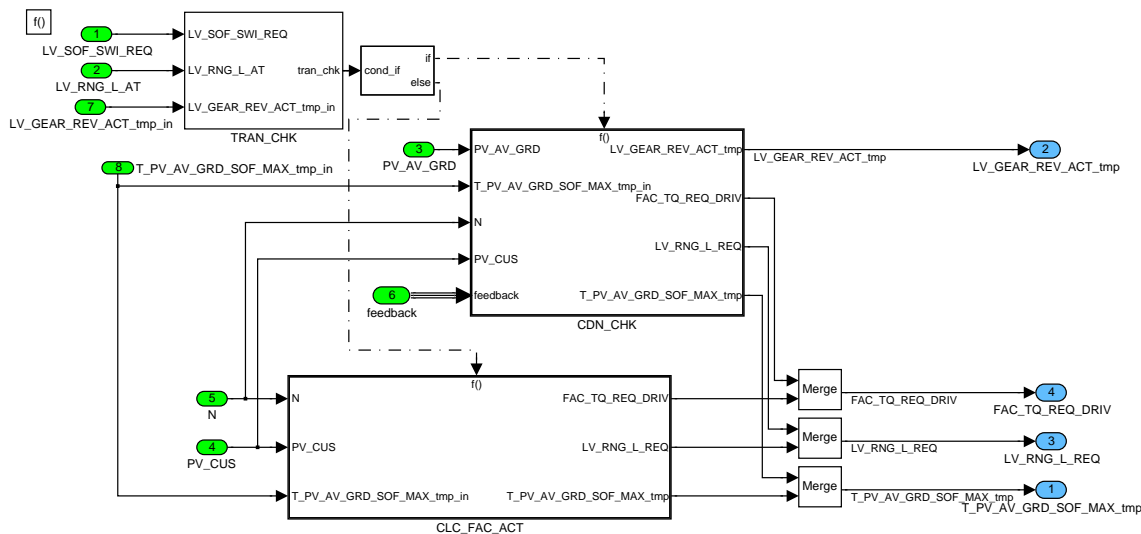



Figure D.1.6: DRRQ\_MD00P/OPM/OPM\_10MS/FWD\_GEAR

**Transition check**

Transition of LV\_SOF\_SWI\_REQ, LV\_RNG\_L\_AT & Reverse gear to forward gear are checked.

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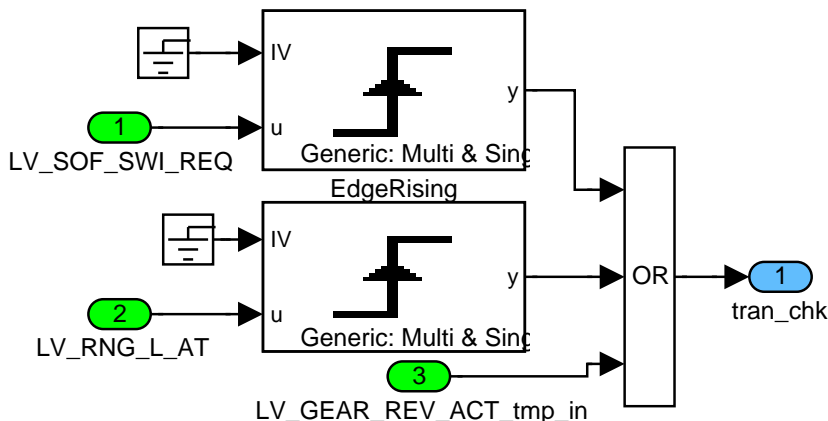


Figure D.1.7: DRRQ\_MD00P/OPM/OPM\_10MS/FWD\_GEAR/TRAN\_CHK

**Formula section**

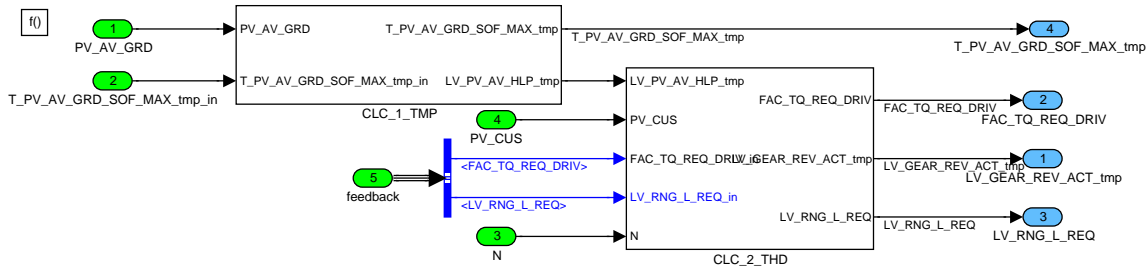


Figure D.1.8: DRRQ\_MD00P/OPM/OPM\_10MS/FWD\_GEAR/CDN\_CHK

**Timer calculation**

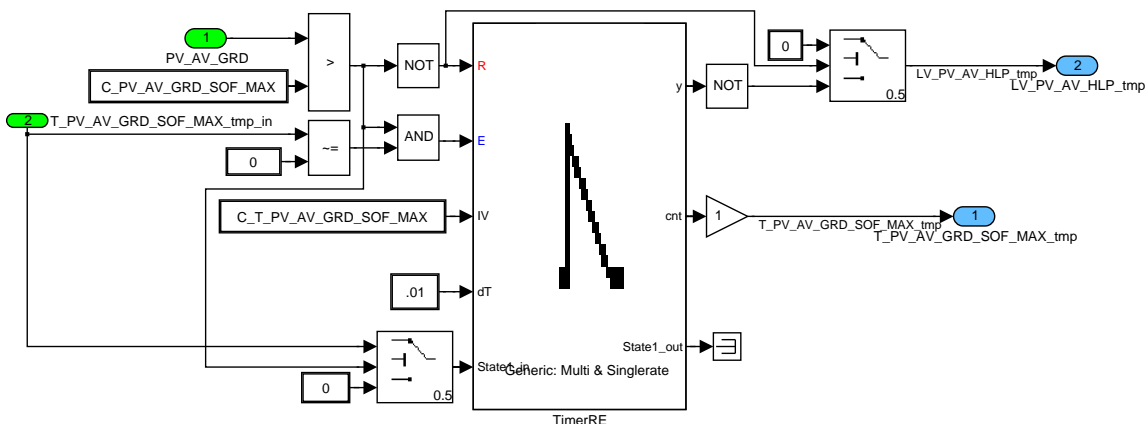



Figure D.1.9: DRRQ\_MD00P/OPM/OPM\_10MS/FWD\_GEAR/CDN\_CHK/CLC\_1\_TMP

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### PV\_CUS threshold calculation

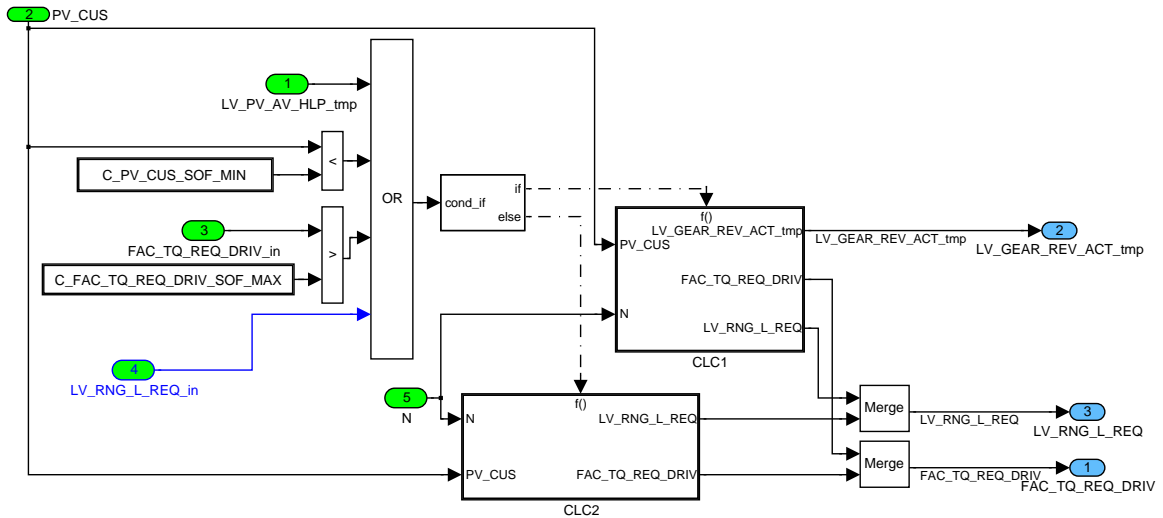


Figure D.1.10: DRRQ\_MD00P/OPM/OPM\_10MS/FWD\_GEAR/CDN\_CHK/CLC\_2\_THD

### Calculation of scaling factor and activation condition

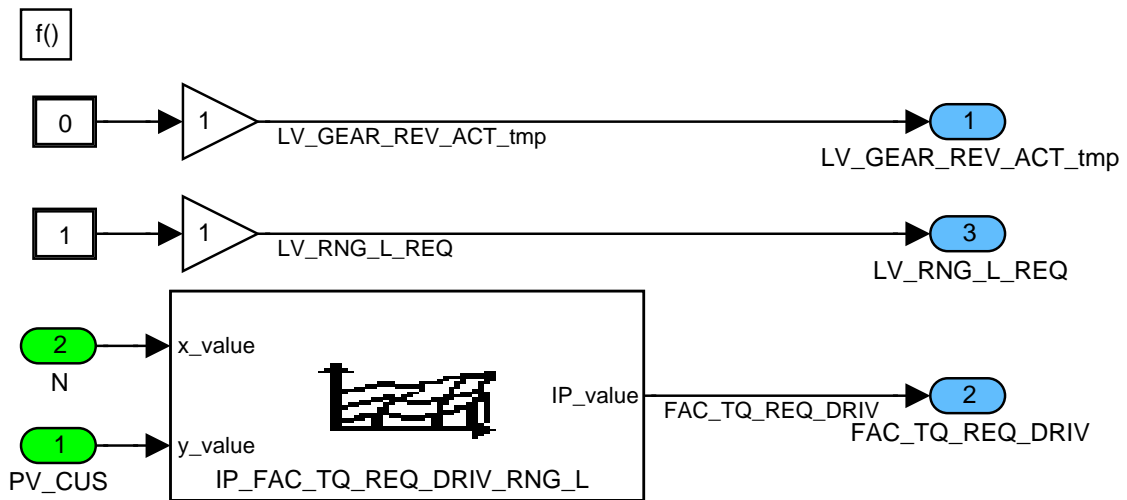


Figure D.1.11: DRRQ\_MD00P/OPM/OPM\_10MS/FWD\_GEAR/CDN\_CHK/CLC\_2\_THD/CLC1

### Calculation of scaling factor and activation condition

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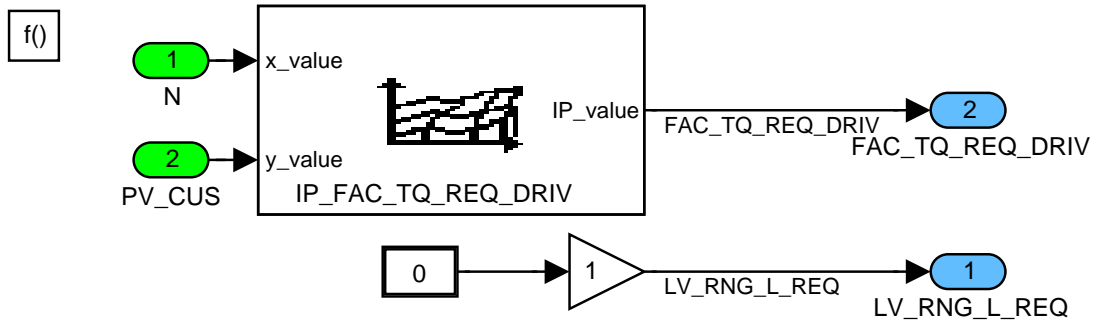


Figure D.1.12: DRRQ\_MD00P/OPM/OPM\_10MS/FWD\_GEAR/CDN\_CHK/CLC\_2\_THD/CLC2

**Calculation of scaling factor & activation condition**

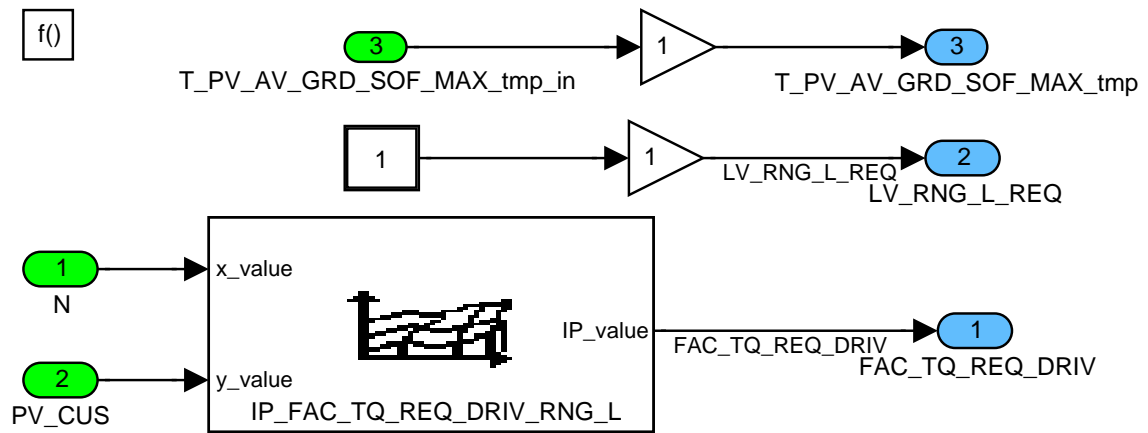


Figure D.1.13: DRRQ\_MD00P/OPM/OPM\_10MS/FWD\_GEAR/CLC\_FAC\_ACT

**Reverse gear detection**

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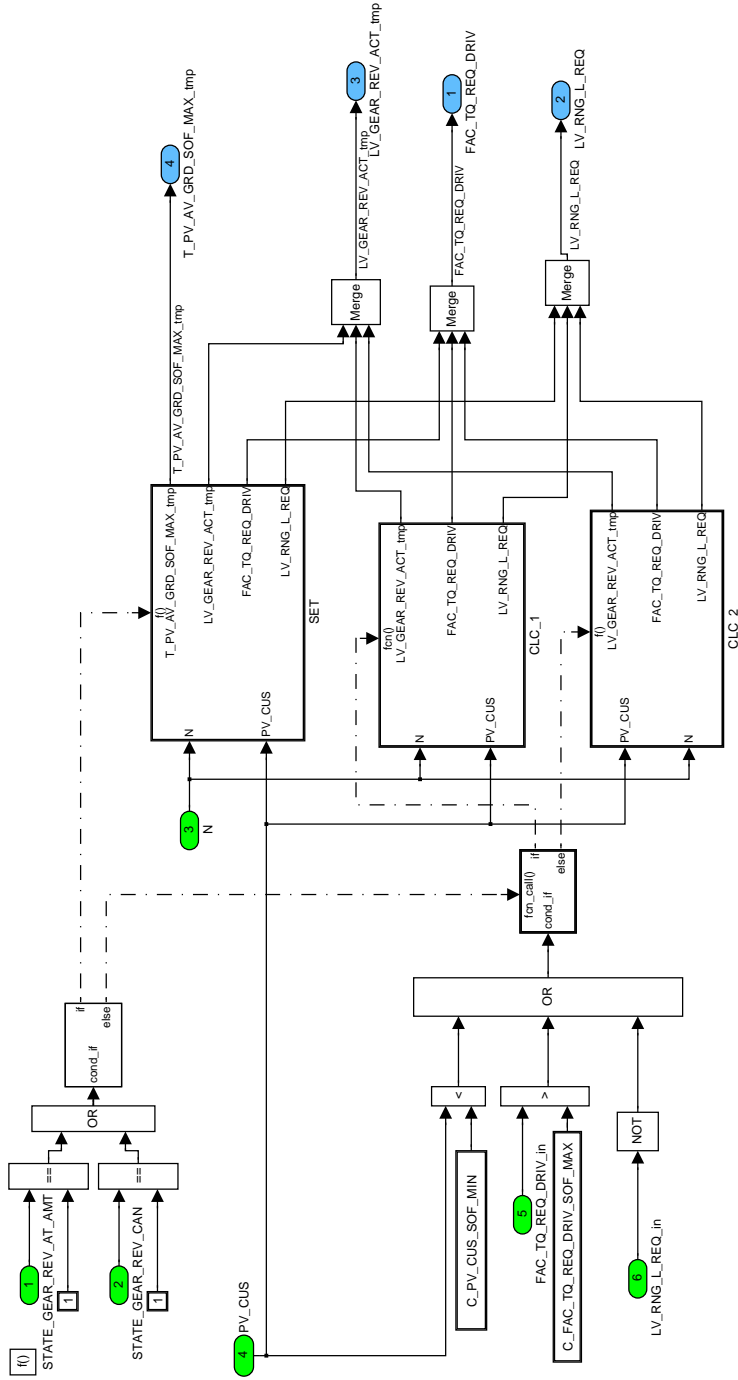



Figure D.1.14: DRRQ\_MD00P/OPM/OPM\_10MS/REV\_GEAR\_DET

**Calculation of LV\_GEAR\_REV\_ACT\_tmp & T\_PV\_AV\_GRD\_SOF\_MAX\_tmp**

Both these variables are temporary variables & used only in this module

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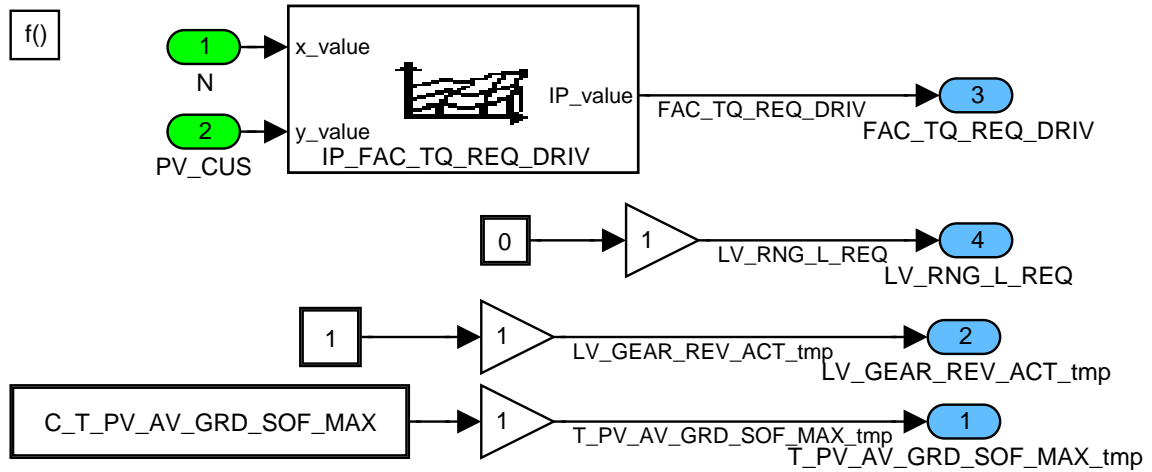


Figure D.1.15: DRRQ\_MD00P/OPM/OPM\_10MS/REV\_GEAR\_DET/SET

**Calculation of scaling factor and activation condition**

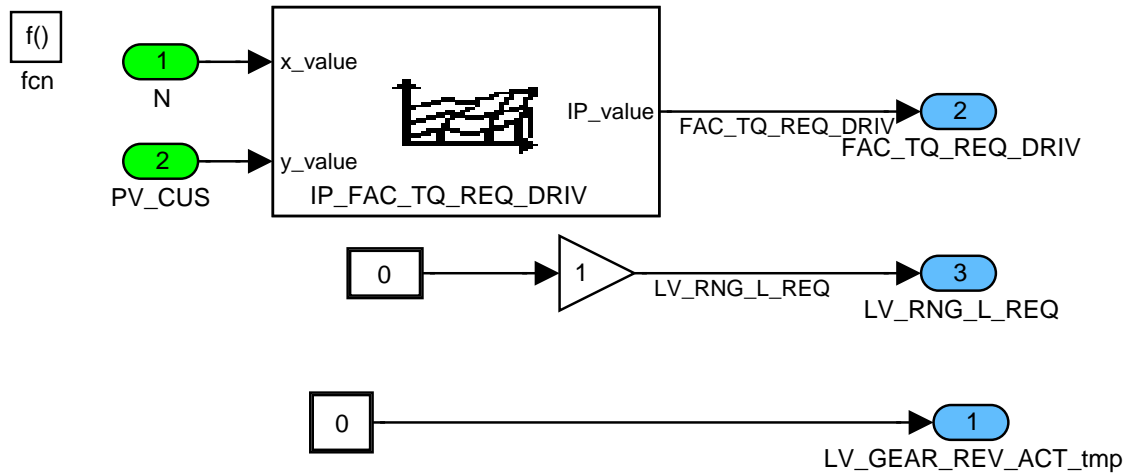


Figure D.1.16: DRRQ\_MD00P/OPM/OPM\_10MS/REV\_GEAR\_DET/CLC\_1

**Calculation of scaling factor and activation condition**

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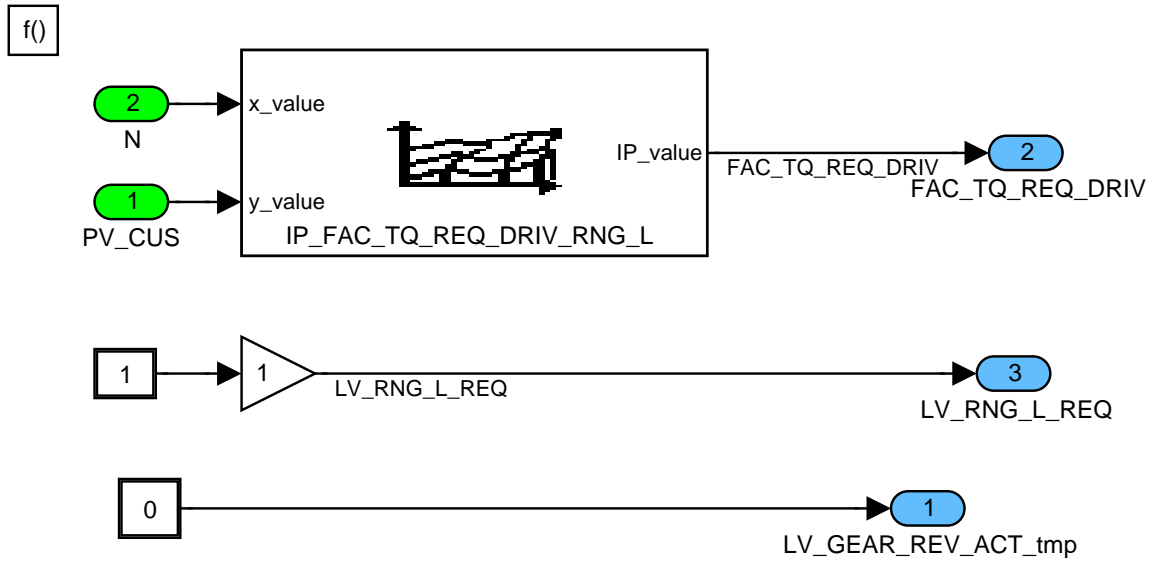



Figure D.1.17: DRRQ\_MD00P/OPM/OPM\_10MS/REV\_GEAR\_DET/CLC\_2

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## D.2 Torque loss electric cooling fan

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_LOSS_ECF	O/V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Torque loss of the electronic controlled cooling fan(s)					

### Input data:

ECFPWM [NC_ECF_NR] {p. 3596}	LV_ES {p. 1720}	LV_IGK {p. 906}	LV_POW_CORD_INH
N {p. 1525}	NC_ECF_NR {p. 576}	STATE_ALTER {p. 8368}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LGRD_TQ_LOSS_ECF	-	0... 7FFF H	0... 1023.97	0.03125	Nm/ 100ms
ECF torque loss limitation gradient					
IP_POW_LOSS_ECF	-	0... FF H	0... -5100	20	W
LDP_ECFPWM [1]_POW_LOSS_EC]	8	0... FF H	0... 99.6	0.39	%
ECF power consumption					

## FUNCTION DESCRIPTION:

### General information:

TQ\_LOSS\_ECF represents the engine torque loss due to power consumption by the electric cooling fan (ECF).

### Application conditions

**Activation:**  $LV\_IGK = 1$  and  $LV\_ES = 0$

**Deactivation:** -

**Initialisation:**  $TQ\_LOSS\_ECF = 0$  Nm at reset

**Recurrence:** 100 ms

(see: ENTE scheduler )

### Formula section:

#### Annotation:

At the MSV70 project only one electronic controlled cooling fan is available. The number of cooling fans is configured with 1 therefore. In this case the following condition is permitted:


$$ECFPWM[NC\_ECF\_NR] = ECFPWM[1] = ECFPWM\_1$$

#### Calculation of the torque loss:

**If**  $( LV\_POW\_CORD\_INH = 0$  and  $STATE\_ALTER = 0 )$  **or**  
 $N = 0$

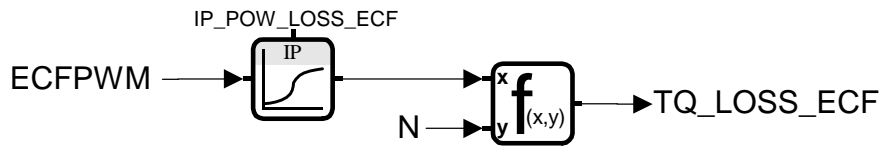
**then**  $TQ\_LOSS\_ECF = 0$  Nm

**else**  $TQ\_LOSS\_ECF = ( IP\_POW\_LOSS\_ECF * 60 ) / ( 2 * 3.141828 * N )$

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**endif**

The change of TQ\_LOSS\_ECF is limited by limitation gradient C\_LGRD\_TQ\_LOSS\_ECF

**Signal flow diagram:**

## D.3 Torque based catalyst heating

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_ADD_CH	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for catalyst heating					
TQ_ADD_CH_DIAG	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for catalyst heating for ignition angle efficiency monitoring					
TQ_ADD_SO2P	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve requested for desulfatation catalyst heating					
TQ_ADD_SO2P_I	V	8000... 7FFFH	-128... 127.9961	3.90625e-3	Nm
I-share of torque reserve for desulfation catalyst heating					
TQ_ADD_SO2P_MAX	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum limit of torque reserve for desulfatation catalyst heating					
TQ_ADD_SO2P_P	V	8000... 7FFFH	-128... 127.9961	3.90625e-3	Nm
P-share of torque reserve for desulfation catalyst heating					
TQ_ADD_SO2P_PCTL	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Precontrolled torque reserve for desulfation catalyst heating					
TQ_ADD_SO2P_RAW	V	3FFFF... C0000H	-1024 ...1024	3.90624e-3	Nm
Torque reserve for desulfation catalyst heating - in high resolution					

### Input data:


AMP {p. 982}	CTR_KM_CAN {p. 1563}	FAC_CH_DIAG_EXT_ADJ_ IS {p. 7482}	FAC_CH_DIAG_EXT_ADJ_ PL {p. 7482}
FAC_TQ_ADD_SO2P_EXT {p. 8232}	LAMB_SP_CH [NC_CBK_EX_NR] {p. 2169}	LC_CH_DIAG_EXT_MAN {p. 6598}	LV_AT {p. 654}
LV_CH_AST_REQ_TCHA_ DIAG {p. 8232}	LV_CH_DIAG_EXT_ACT {p. 6597}	LV_DRI {p. 1302}	LV_IS {p. 1720}
LV_LAMB_COP [NC_CBK_EX_NR] {p. 8233}	LV_NT_SO2P_EXT_ADJ_ ACT {p. 3144}	LV_PU {p. 1720}	LV_PUC {p. 1720}
N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	STATE_CH {p. 1777}	STATE_CH_MOD {p. 1796}
STATE_CH_MOD_REQ {p. 1796}	T_AST_COR_CH {p. 1801}	TCO_ST {p. 1100}	TEMP_CAT_DIF_CH_L {p. 1777}
TNT_DIF_CH_L {p. 1777}	TNT_DIF_CH_SO2P {p. 1813}	TQ_ADD_CH_TCHA_DIAG {p. 8233}	TQ_ADD_MAX {p. 8390}
TQI_REQ_TRA {p. 8192}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_CH_DIAG_EXT_MAN_IS	-	0... FFH	0... 1.9921875	7.8125e-3	-
Manual manipulation factor of CH torque reserve for ignition angle efficiency monitoring in IS					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_CH_DIAG_EXT_MAN_PL	-	0... FFH	0... 1.9921875	7.8125e-3	-
Manual manipulation factor of CH torque reserve for ignition angle efficiency monitoring in PL					
C_FAC_TQ_ADD_CH_L	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Difference between cat. temperatures and target temp. depending correction for TQ_ADD_CH_L					
C_FAC_TQ_ADD_SO2P_PCTL_MPLH	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Factor to weigh the precontrolled torque reserve in case of homogen split - mode					
C_TQ_ADD_CH_HOM_MAN	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Manual setting of torque reserve for catalyst heating in homogeneous mode					
C_TQ_ADD_CH_L_HOM	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Basic torque reserve for homogenous low load catalyst heating					
C_TQ_ADD_CH_L_LGRD	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitation gradient for torque reserve in low load cat. heating					
C_TQ_ADD_CH_LGRD_OFF	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Gradient for decreasing TQ_ADD_CH in after start catalyst heating					
C_TQ_ADD_CH_LGRD_ON	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Gradient for increasing TQ_ADD_CH in after start catalyst heating					
C_TQ_ADD_CH_MPLH_MAN	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Manual setting of torque reserve for catalyst heating in homogeneous mode with split injection					
C_TQ_ADD_SO2P_I	-	0... FFFFH	0 ...1	15.259e-6	Nm/K
Correlation constant for the I-share of the controller					
C_TQ_ADD_SO2P_I_MAX	-	0... 7FFFH	0... 127.9961	3.90625e-3	Nm
Maximum of the I-share of the controller					
C_TQ_ADD_SO2P_MAX_EXT_ADJ	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Maximum torque reserve for desulfation catalyst heating in case of external adjustment					
C_TQ_ADD_SO2P_P	-	0... FFFFH	0 ...2	30.518e-6	Nm/K
Correlation constant for the P-share of the controller					
C_TQ_ADD_SO2P_P_MAX	-	0... 7FFFH	0... 127.9961	3.90625e-3	Nm
Maximum of the P-share of the controller					
C_TQ_ADD_SO2P_PCTL_EXT_ADJ	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Precontrolled torque reserve for desulfation catalyst heating in case of external adjustment					
C_TQ_ADD_SO2P_RAMP_DEC	-	0... FFFFH	0... 255.99609	3.90625e-3	Nm/ 100ms
Ramp gradient for gradual decrease of the torque reserve					
C_TQ_ADD_SO2P_RAMP_INC	-	0... FFFFH	0... 255.99609	3.90625e-3	Nm/ 100ms
Ramp gradient for gradual increase of the torque reserve					
IP_FAC_TQ_ADD_CH_AMP	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDP_TCO_ST_IP_FAC_TQ_ADD_CH_AMP	8	0... FEH	-48... 142.5	0.75	°C
LDP_AMP_IP_FAC_TQ_ADD_CH_AMP	6	0... FFFFH	0... 5434	0.0829175	hPa
Reduction of torque reserve due to ambient pressure					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_TQ_ADD_CH_CTR_KM	-	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_CTR_KM_CAN_1_EXTC	4	0... FFFFH	0... 655350	10	km
Reduction of torque reserve depending on catalyst age					
IP_FAC_TQ_ADD_CH_HOM	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_T_AST_COR_CH_1_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_4_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Coolant temperature and time after start depending correction TQ_ADD_CH					
IP_FAC_TQ_ADD_CH_HOM_AT	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_T_AST_COR_CH_1_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_4_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Coolant temperature and time after start depending correction TQ_ADD_CH, for AT					
IP_FAC_TQ_ADD_CH_HOM_DRI	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_N_32_3_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_TRA_1_EXTC	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Factor on torque reserve for homogeneous catalyst heating at engaged drivetrain (only for AT relevant)					
IP_FAC_TQ_ADD_CH_L_RGN	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
LDP_LAMB_DIF_IP_TQ_ADD_CH_L	4	0... 7FFFH	-16... 15.9990234375	976.563e-6	-
Factor on TQ_ADD_CH_L depending on the split up of lambda setpoints for catalyst heating					
IP_FAC_TQ_ADD_CH_MPLH	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_T_AST_COR_CH_1_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_4_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Coolant temperature and time after start depending correction TQ_ADD_CH_HSP					
IP_FAC_TQ_ADD_CH_MPLH_AT	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_T_AST_COR_CH_1_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_4_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Coolant temperature and time after start depending correction TQ_ADD_CH, for AT					
IP_FAC_TQ_ADD_CH_MPLH_DRI	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_N_32_3_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_TRA_1_EXTC	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Factor on torque increase for catalyst heating at homogeneous split injection at engaged drivetrain (only for AT relevant)					
IP_TQ_ADD_CH_HOM	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_N_32_3_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_TRA_1_EXTC	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Basic torque reserve for homogeneous catalyst heating					
IP_TQ_ADD_CH_HOM_AT	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_N_32_3_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_TRA_1_EXTC	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Basic torque reserve for homogeneous catalyst heating with automatic transmission					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TQ_ADD_CH_HOM_IS	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_N_32_5_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_TRA_2_EXTC	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Basic torque reserve for homogeneous catalyst heating in idle speed					
IP_TQ_ADD_CH_L_HOM_IS	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_IP_TQ_ADD_CH_L_IS	6	0... FFH	0... 8160	32	rpm
LDP_TQI_REQ_IP_TQ_ADD_CH_L_IS	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque reserve for low load catalyst heating in idle speed					
IP_TQ_ADD_CH_MPLH	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_N_32_3_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_TRA_1_EXTC	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Basic torque increase for catalyst heating at homogeneous split injection					
IP_TQ_ADD_CH_MPLH_AT	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_N_32_3_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_TRA_1_EXTC	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Basic torque increase for catalyst heating at homogeneous split injection with automatic transmission					
IP_TQ_ADD_CH_MPLH_IS	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_N_32_5_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_TRA_2_EXTC	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Basic torque increase for catalyst heating for homogeneous split					
IP_TQ_ADD_SO2P_MAX	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_IP_TQ_SO2P_MAX	6	0... FFH	0... 8160	32	rpm
LDP_TQI_REQ_TRA_IP_TQ_SO2P_MAX	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Maximum torque reserve for desulfation catalyst heating					
IP_TQ_ADD_SO2P_PCTL	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_IP_TQ_SO2P_PCTL	6	0... FFH	0... 8160	32	rpm
LDP_TQI_REQ_TRA_IP_TQ_SO2P_PCTL	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Precontrolled torque reserve for desulfation catalyst heating					
LC_TQ_ADD_CH_HOM_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of torque reserve for catalyst heating in homogeneous mode					
LC_TQ_ADD_CH_MPLH_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of torque reserve for catalyst heating in homogeneous mode, split injection					

### General information:

This module concerns the calculation of a torque reserve which causes an ignition angle retardation and so exhaust gas temperature increase.

There are three functional parts: Cat. heating after (cold-) start, low load and for desulfation.

### Signal flow diagram:

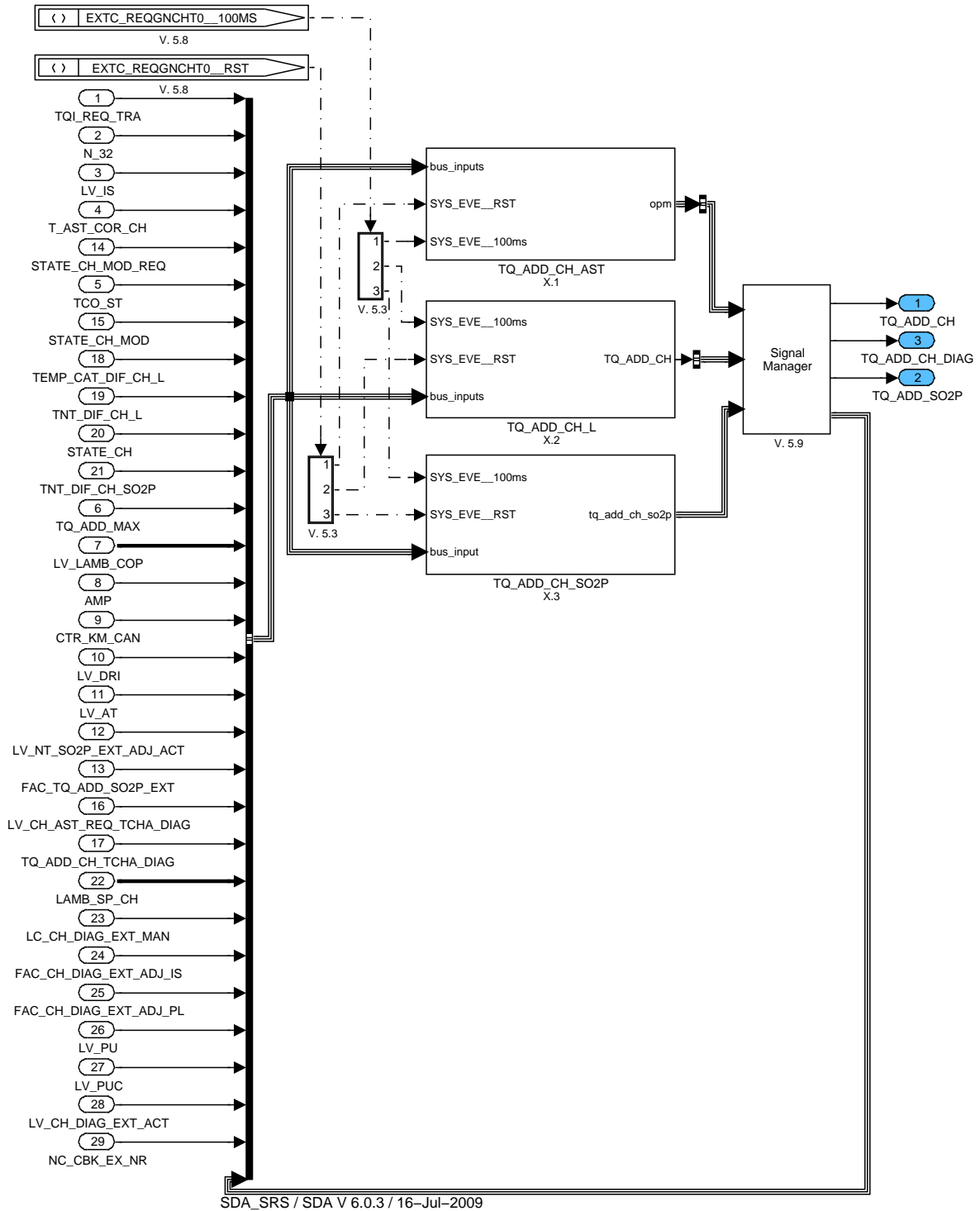



Figure D.3.1: :

### D.3.1 Catalyst heating after start

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There are several setpoints for single and multiple injection. The output is ramped via a difference limiter.

### Application conditions:

*Initialisation:* RST  
*Recurrence:* 100MS  
*Activation:* STATE\_CH == 1  
*Deactivation:* (STATE\_CH==0 && TQ\_ADD\_CH==0) || STATE\_CH>1

### Function description:

### Formula section:

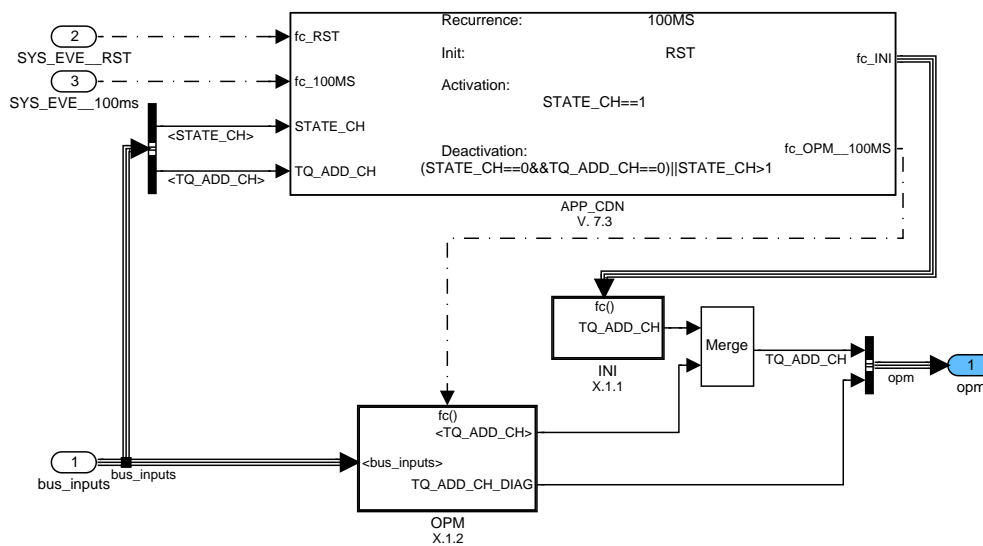


Figure D.3.2: :

### D.3.1.1 Initialisation

The output variable TQ\_ADD\_CH is set to 0.

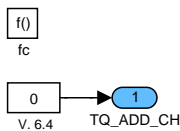


Figure D.3.3: :

### D.3.1.2 Subsystem of OPM for Torque catalyst heating

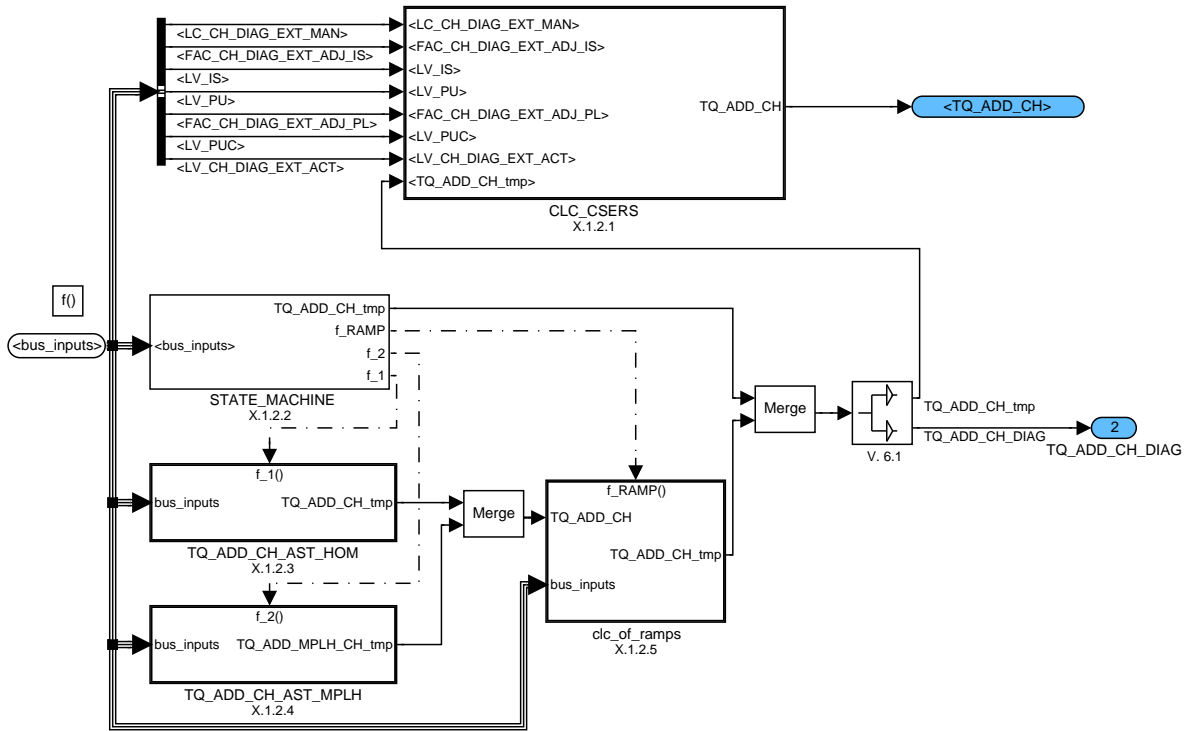


Figure D.3.4: :

#### D.3.1.2.1 CSERS implementation

Legal requirement concerning OBD-II system LH3.1.

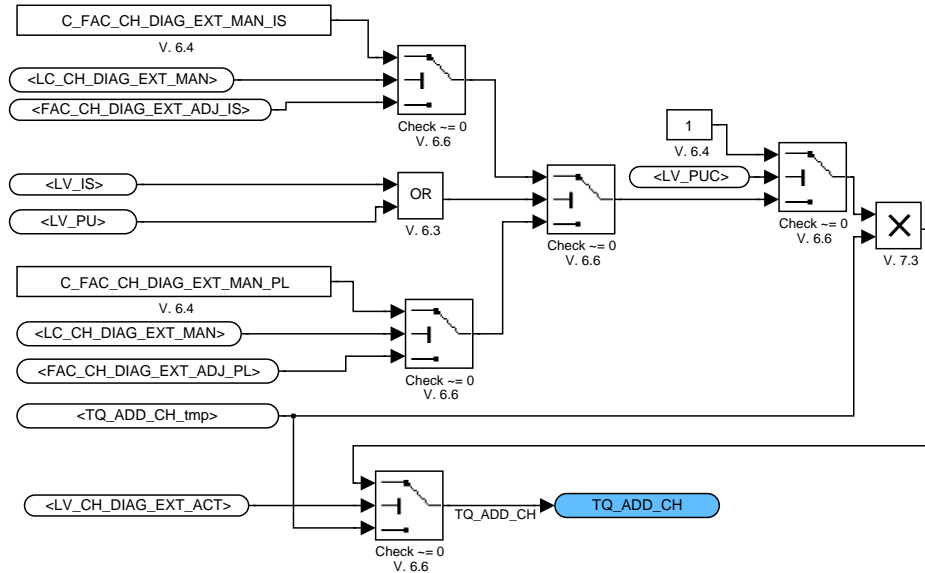


Figure D.3.5: :

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### D.3.1.2.2 Subsystem STATE\_MACHINE

#### D.3.1.2.2.1 STATE\_MACHINE\_CHART

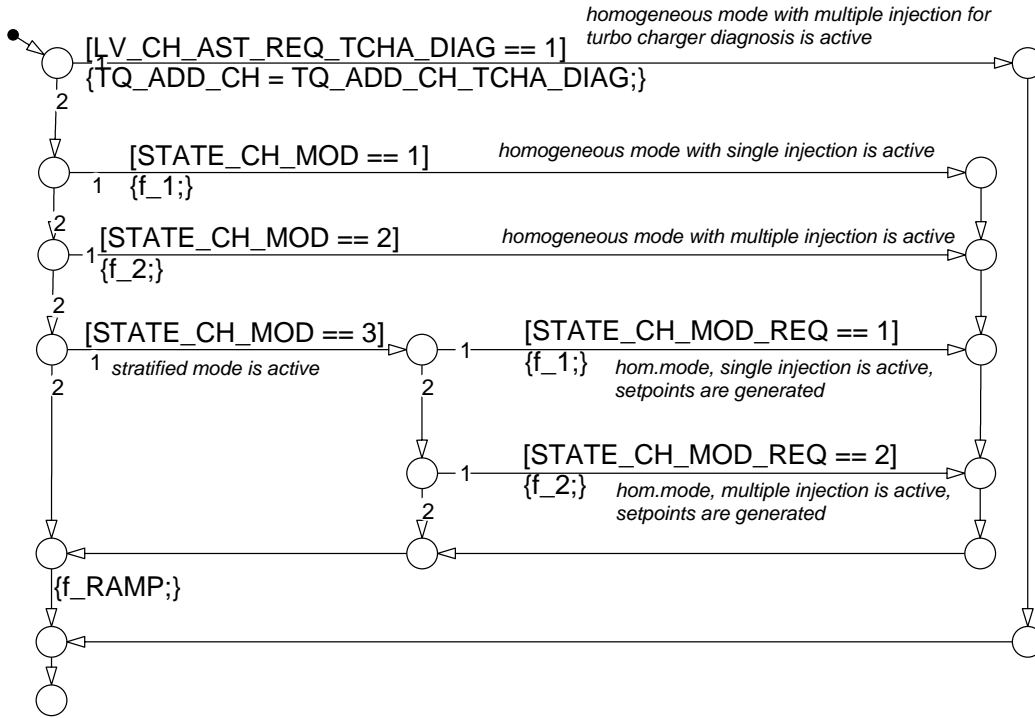


Figure D.3.6: :

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### D.3.1.2.3 Homogenous mode, single injection

#### D.3.1.2.3.1 Homogenous mode, single injection - Subsystem

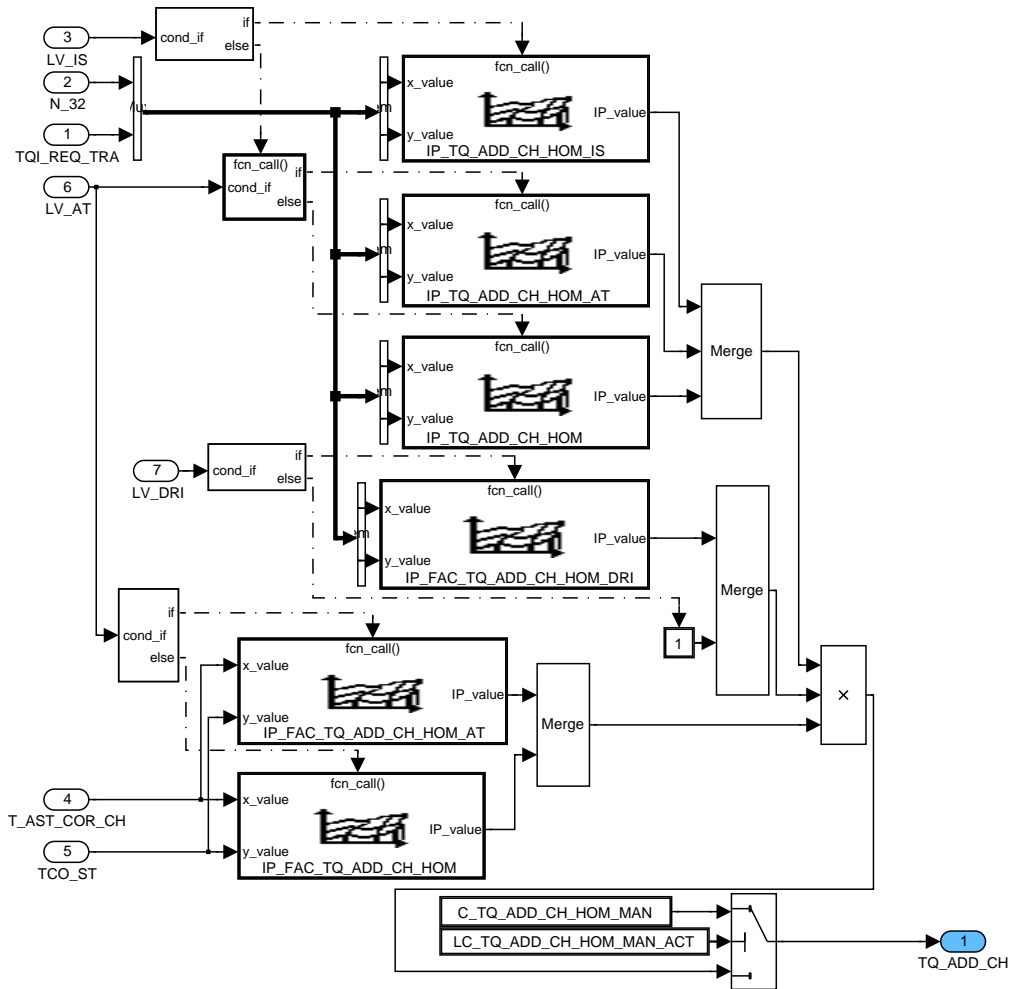


Figure D.3.7: :

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### D.3.1.2.4 Homogenous mode, multiple injection

#### D.3.1.2.4.1 Homogenous mode, multiple injection - Subsystem

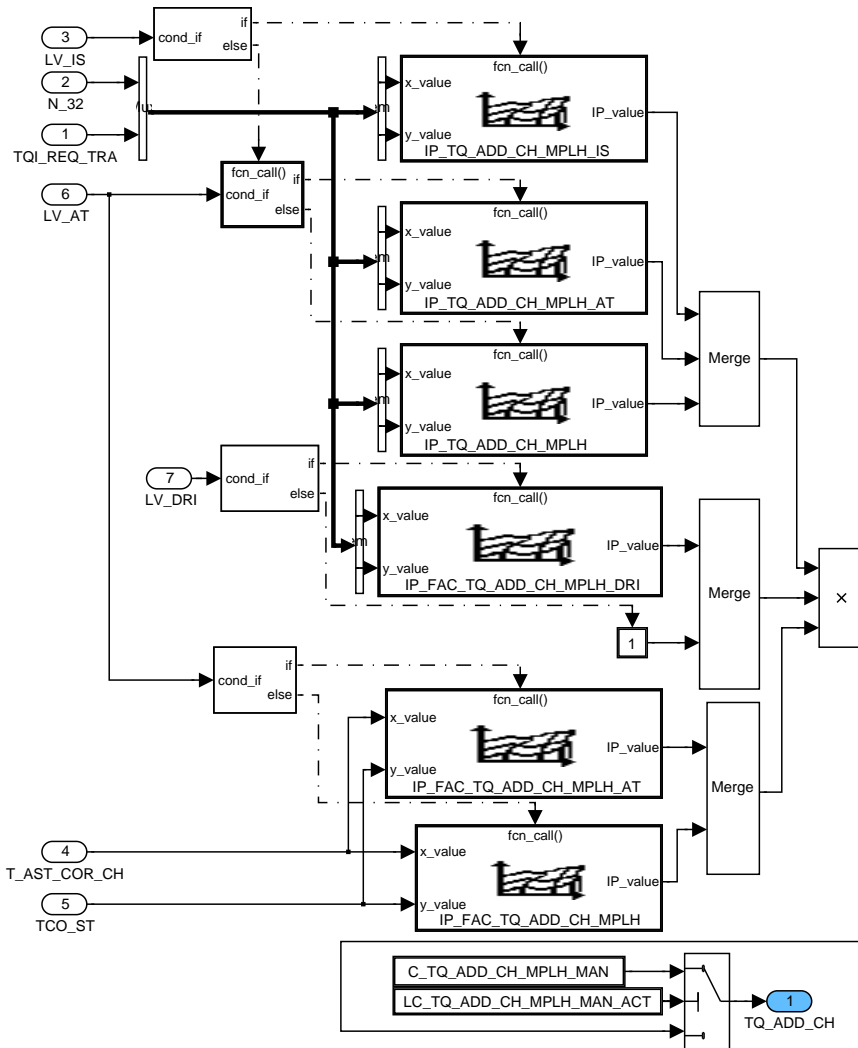



Figure D.3.8: :

### D.3.1.2.5 Ramp-function

#### D.3.1.2.5.1 Ramp-function - Subsystem

With IP\_FAC\_TQ\_ADD\_CH\_AMP the torque reserve can be reduced with decreasing ambient pressure and so increasing elevation. The resulting torque reserve is filtered by a difference limiter.

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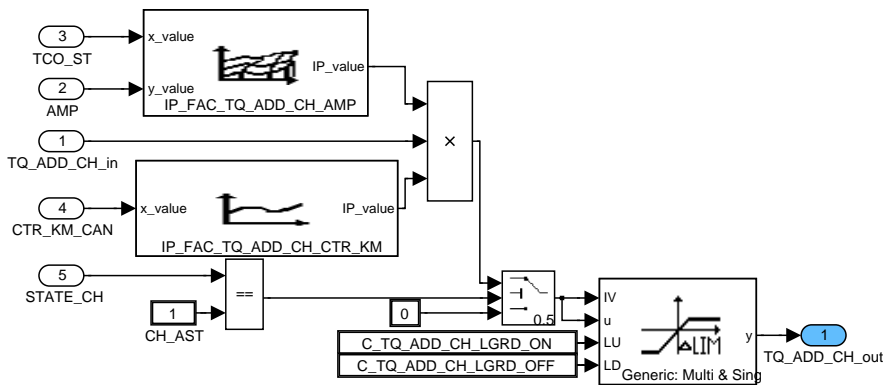


Figure D.3.9: :

### D.3.2 Catalyst heating in low load

#### General information:

In low load catalyst heating there is no homogeneous mode with split injection.

#### Application conditions:

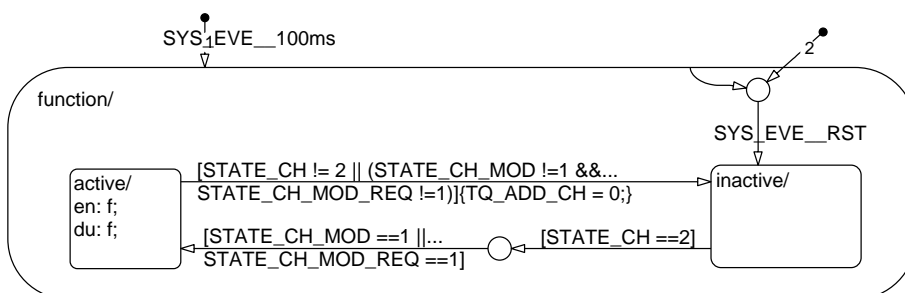


Figure D.3.10: :

#### Function description:

#### Formula section:

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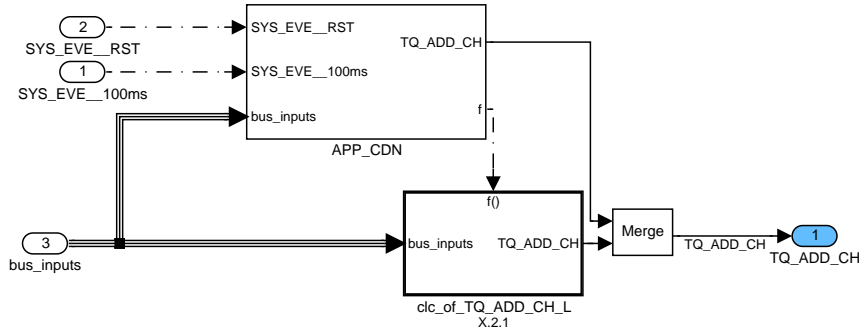


Figure D.3.11: :

### D.3.2.1 Torque reserve at low load catalyst heating

#### D.3.2.1.1 Torque reserve at low load catalyst heating - Subsystem

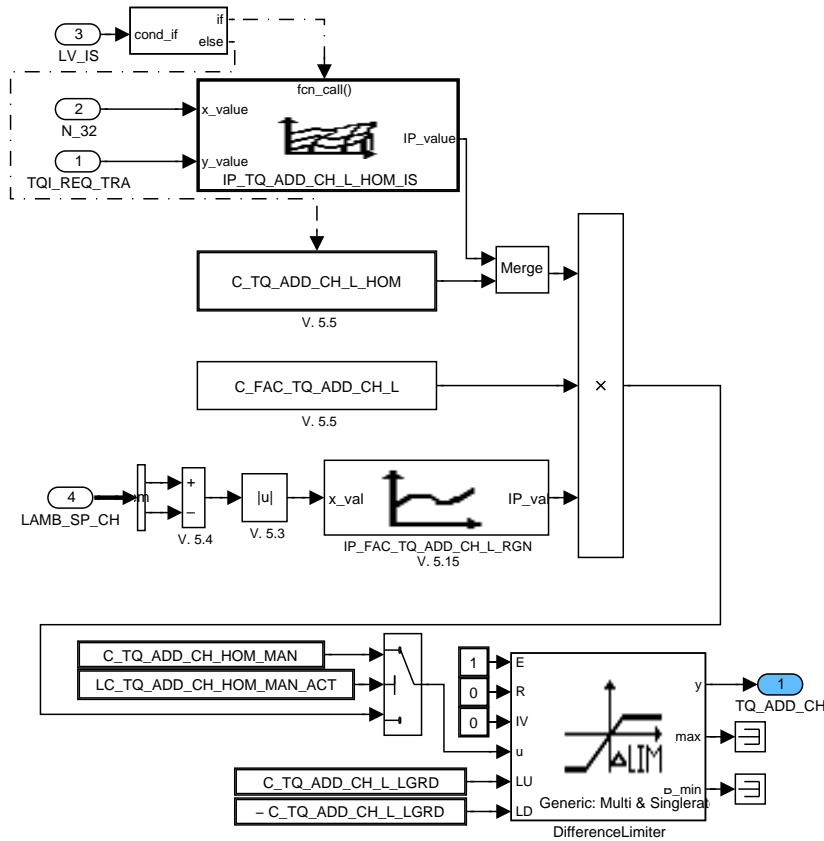



Figure D.3.12: :

### D.3.3 Catalyst heating for desulfation

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TQ\_ADD\_CH is set by a controller, which controls the lowest NOx-trap temperature. Therefore TNT\_DIF\_CH\_SO2P is the difference between the temperature setpoint for desulfation and the actual temperature (set in "Catalyst heating for desulfation strategy"). It is negative if temperature is too low.

**Application conditions:**

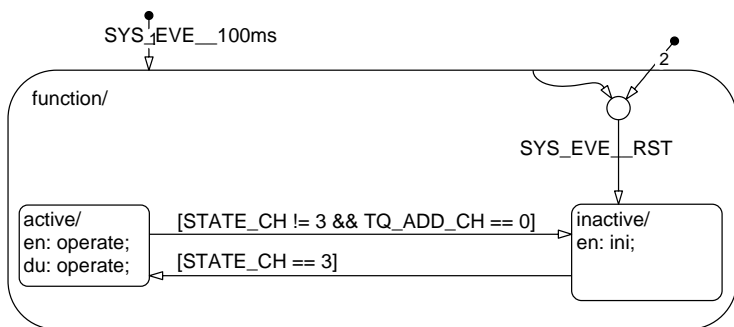


Figure D.3.13: :

**Function description:**

**Formula section:**

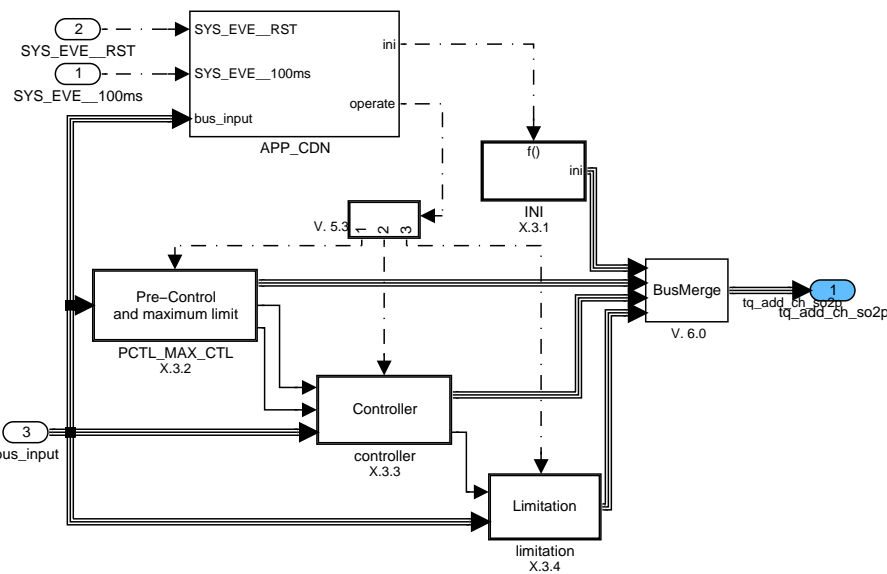



Figure D.3.14: :

**D.3.3.1 Initialisation**

The values are set to 0 at reset and once at function deactivation.

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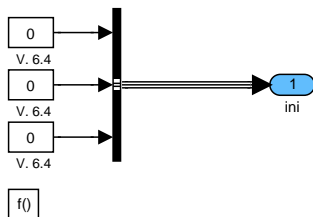


Figure D.3.15: :

### D.3.3.2 Precontrol and maximum limit

#### D.3.3.2.1 Precontrol and maximum limit - Subsystem

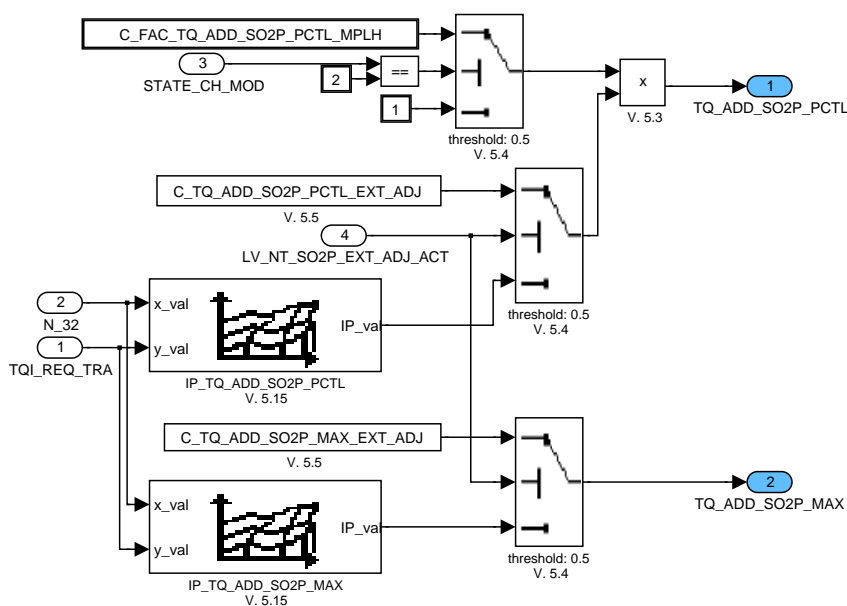


Figure D.3.16: :

### D.3.3.3 Controller of NOx-trap temperature

#### D.3.3.3.1 Controller of NOx-trap temperature - Subsystem

The controller consists of an integral and a proportional part (PI-controller). The I-part is frozen if the overall controller output exceeds the maximum available torque reserve  $TQ\_ADD\_MAX$  or the map-value.

The pre-controlled value for  $TQ\_ADD\_SO2P$  is added to the PI-controller output.

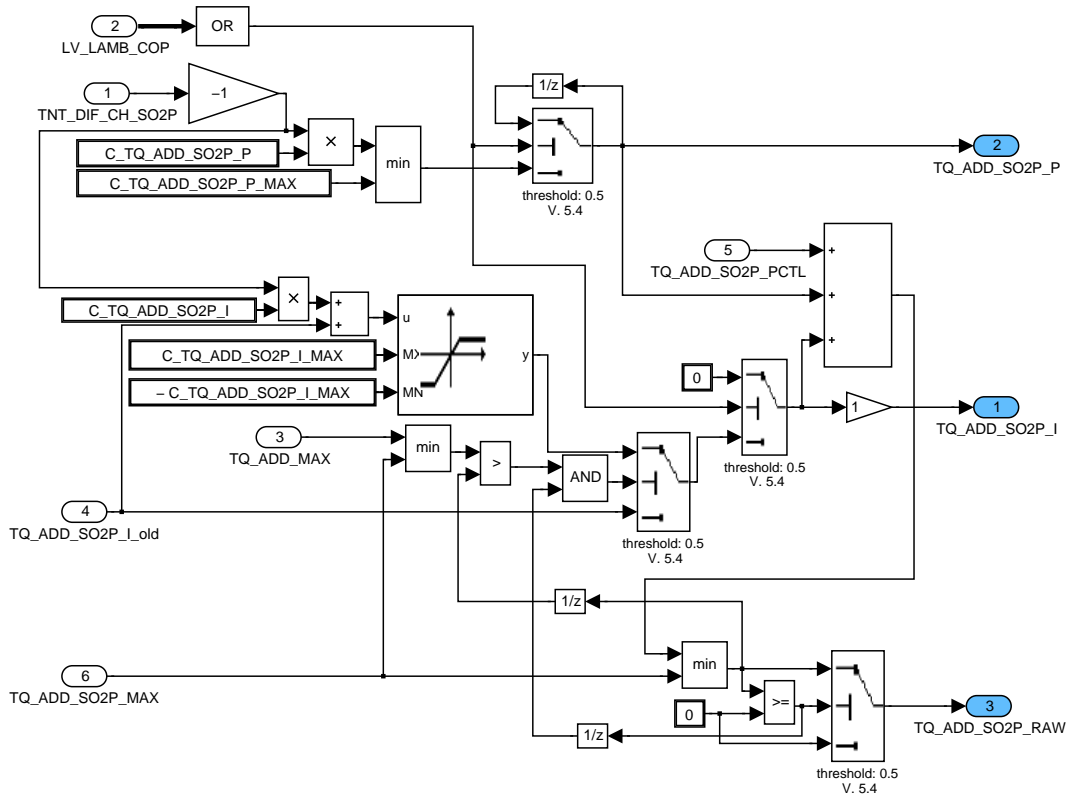


Figure D.3.17: :

### D.3.3.4 Limitation

#### D.3.3.4.1 Limitation - Subsystem

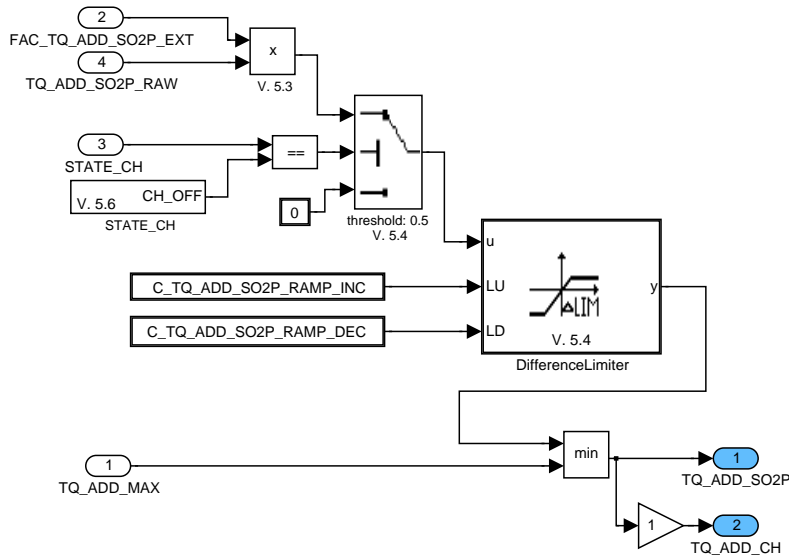


Figure D.3.18: :

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## D.4 Torque based catalyst heating (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_IGA_CST_LIM	V	0... FFFFH	0... 1.99996	30.5e-6	-
Limited ignition angle efficiency for torque limitation during catalyst heating					
LV_CH_DIAG_EXT_ACT	O/V	0... 1H	0 ...1	1	-
Status bit for ignition angle efficiency monitoring - demo-mode active					
TQ_ADD_MIN_CH	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Minimum torque reserve for catalyst heating					

### Input data:

EFF_IGA_CST_LIM_EXT_ADJ {p. 7482}	EFF_IGA_CST_QUO_IS {p. 6493}	EFF_IGA_CST_QUO_PL {p. 6493}	EFF_IGA_SP_CH {p. 6493}
EFF_TOT_WOUT_IGA {p. 981}	IP_INT_EFF_IGA_SP_CH_QUO_IS_MAX {p. 6495}	IP_INT_EFF_IGA_SP_CH_QUO_PL_MAX {p. 6495}	LV_CDN_DIAG_EFF_IGA_CST_IS {p. 6517}
LV_CDN_DIAG_EFF_IGA_CST_PL {p. 6517}	LV_CH_DIAG_EXT_REQ {p. 7482}	LV_IS {p. 1720}	LV_PU {p. 1720}
LV_PUC {p. 1720}	STATE_CH {p. 1777}	TCO_ST {p. 1100}	TQ_ADD_CH {p. 6582}
TQI_BAS {p. 6661}	TQI_REF {p. 8380}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EFF_IGA_CST_LIM_EXT_MAN	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Manual adjusted efficiency limitation during demo-mode					
C_FAC_TQ_ADD_MIN_CH	-	0... FFH	0... 0.99609375	3.90625e-3	-
Factor on TQ_ADD_CH for limitation					
C_TQ_ADD_MIN_CH_CST_LGRD	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitation gradient for TQ_ADD_MIN_CH for cold start monitoring					
C_TQ_ADD_MIN_CH_LGRD	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitation gradient for TQ_ADD_MIN_CH					
IP_INT_QUO_EFF_IGA_CST_IS	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
LDPM_EFF_IP_INT_QUO_EFF_IGA_CST	6	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Cold start diagnosis efficiency limitation in idle speed					
IP_INT_QUO_EFF_IGA_CST_PL	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
LDPM_EFF_IP_INT_QUO_EFF_IGA_CST	6	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Cold start diagnosis efficiency limitation in part load					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_CH_DIAG_EXT_ENA	-	0... 1H	0 ...1	1	-
Enable efficiency limitation and CH torque reserve manipulation by external device					
LC_CH_DIAG_EXT_MAN	-	0... 1H	0 ...1	1	-
Manual switch to start ignition angle efficiency monitoring - demo-mode					
LC_EFF_IGA_CST_LIM_ENA	-	0... 1H	0 ...1	1	-
Global enable bit of ignition angle efficiency limitation during coldstart					

### General information:


This module provides project specific functions related to the torque request for catalyst heating.

### Application conditions:

*Initialisation:* RST, Deactivation  
*Recurrence:* 100MS  
*Activation:* STATE\_CH==1  
*Deactivation:* STATE\_CH==0

### Function description:

### Formula section:

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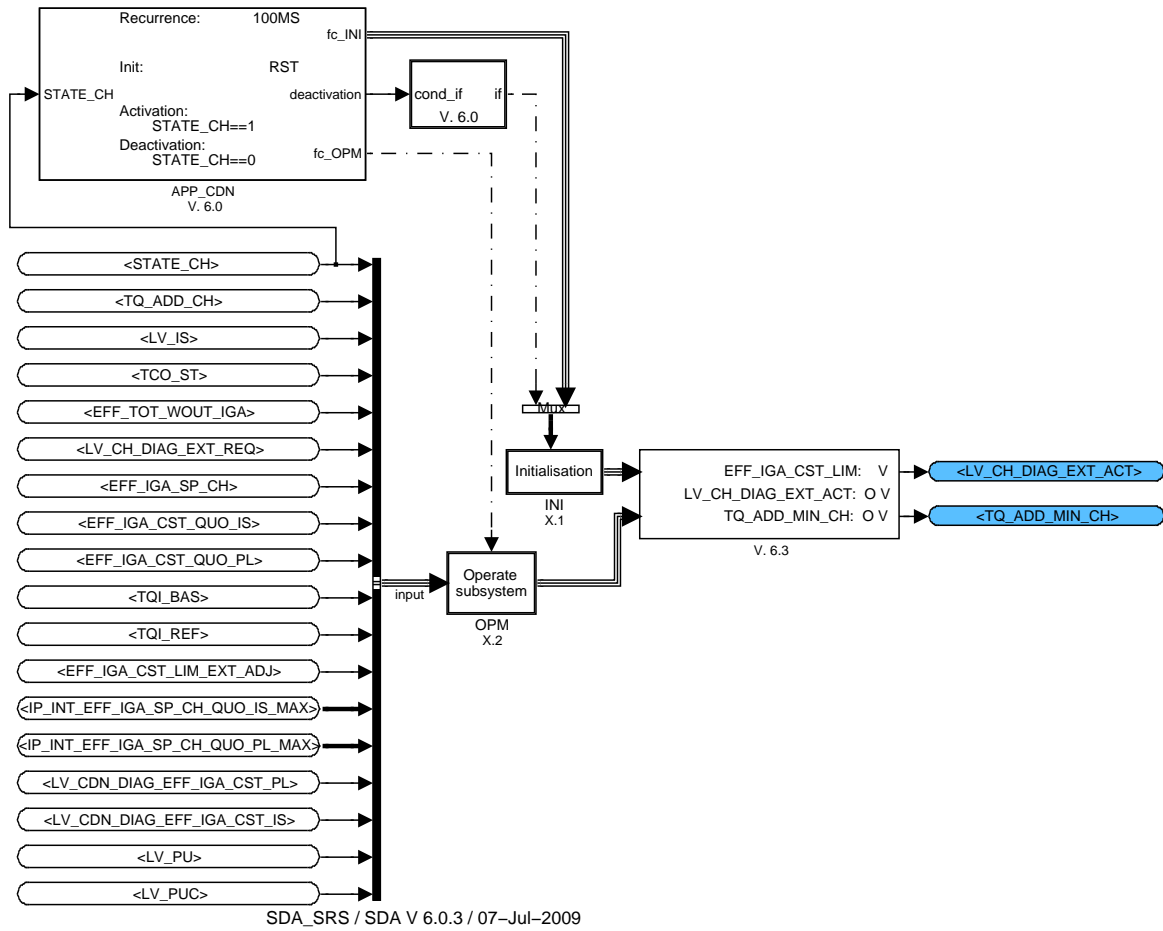


Figure D.4.1: :

### D.4.1 INI

#### D.4.1.1 INI

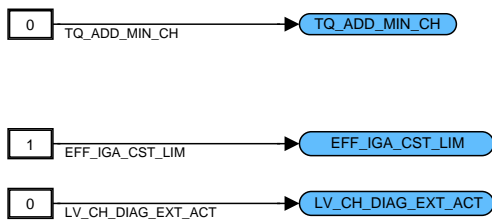


Figure D.4.2: :

### D.4.2 OPM

#### D.4.2.1 Ignition angle efficiency limitation for CSERS

Due to requirements of the Cold Start Emission Reduction Strategy (CSERS), the applied torque request on ignition path (TQI\_SP) is limited via the interface TQ\_ADD\_MIN\_CH to ensure the requested torque reserve for catalyst heating under all circumstances. Therefore a limited ignition angle efficiency is

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calculated in this module based on the diagnosed deviation integral delivered from the "Ignition angle efficiency monitoring" diagnosis.

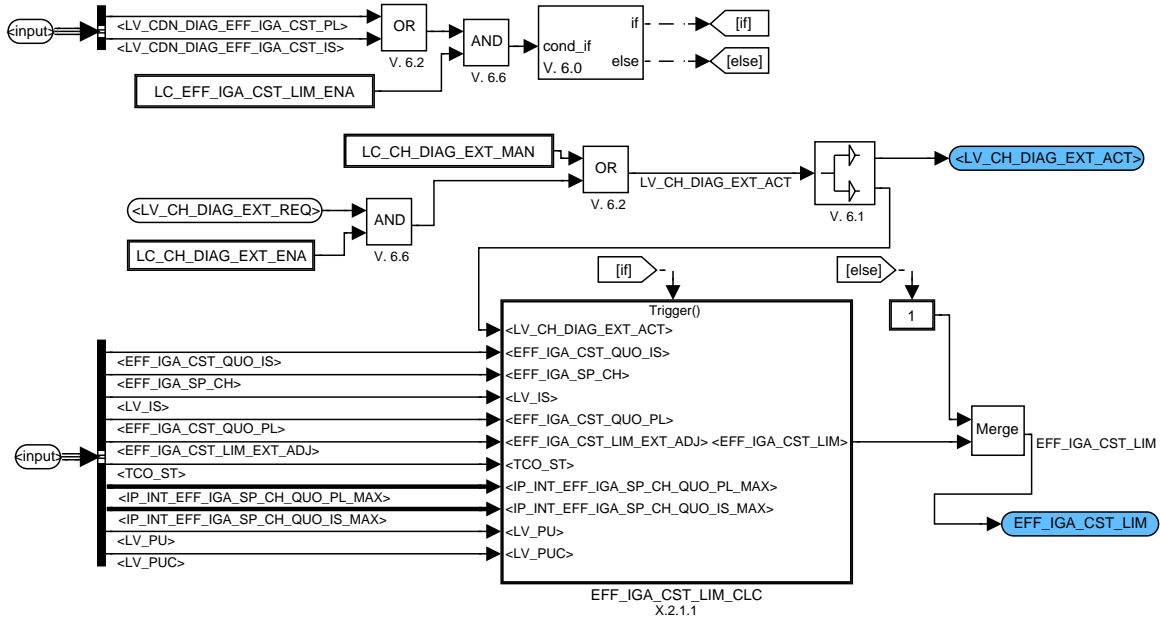


Figure D.4.3: :

D.4.2.1.1 Calculation of EFF\_IGA\_CST\_LIM

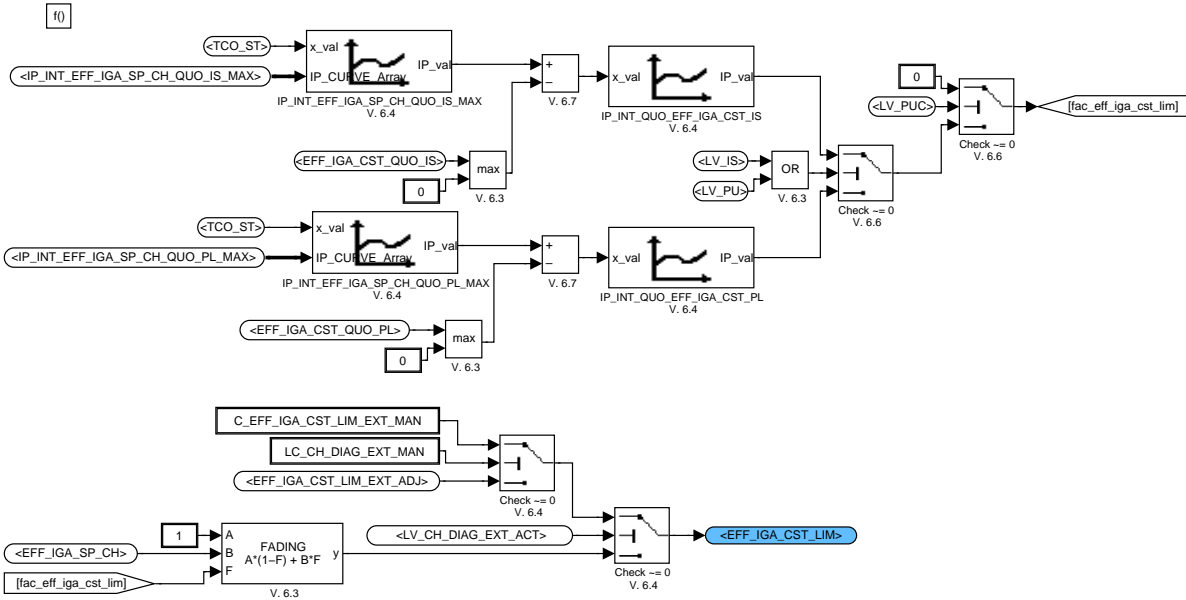


Figure D.4.4: :

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### D.4.2.2 Calculation of minimum torque reserve for catalyst heating

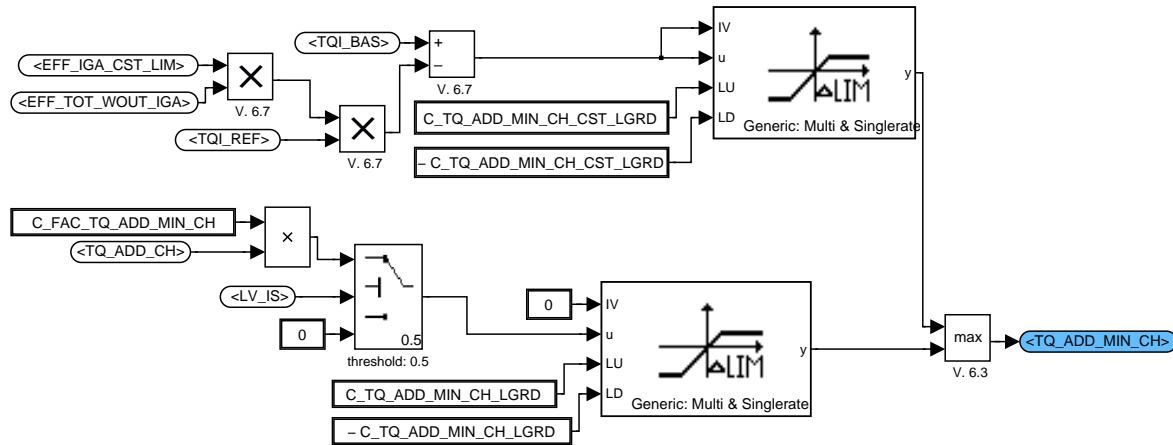


Figure D.4.5: :

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## D.5 Torque loss and reserve for air conditioning compressor

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_SP_N_PSTE	O/V	0... FFH	0... 1.9921875	7.8125e-3	-
Factor of engine speed relative to setpoint					
LV_REQ_HEAT_ACC_ENA	O/V	0... 1H	0 ...1	1	-
LV indicating that the conditions for additional heating are fulfilled					
LV_TOUT_REQ_HEAT_ACC	O/V	0... 1H	0 ...1	1	-
logical variable to start deactivation of torque reserve TQ_ADD_HEAT_ACC					
T_REQ_HEAT_ACC	O/V	0... FFFFFFFFH	0... 42949672.95	0.01	s
Timer for duration of torque reserve TQ_ADD_HEAT_ACC calculation					
TQ_ADD_ACC	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for switching on air conditioning compressor					
TQ_ADD_HEAT_ACC	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for switching on additional heating by ACC					
TQ_LOSS_ACC	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque losses air conditioning compressor					
TQ_LOSS_ACC_INP	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
ACC torque loss due to engine-speed and ACC torque demand					

### Input data:

LV_ACCOUT_RLY {p. 3589}	LV_ACCOUT_RLY_ENA {p. 3589}	LV_REQ_HEAT {p. 1567}	LV_TOUT_ACC {p. 3589}
N {p. 1525}	N_32 {p. 1525}	N_SP_IS {p. 1122}	T_ACC {p. 3589}
TAM {p. 1579}	TCO {p. 1100}	TQ_ACCIN_CAN {p. 1580}	TQ_DIF_IS_AD_ACC {p. 3518}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_TQ_LOSS_ACC_INP	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlation Factor for tQ_ACCIN_CAN calculation					
C_N_SP_IS_PSTE	-	0... FFH	0... 8160	32	rpm
Idle speed setpoint power steering, only for FAC_SP_N_PSTE calculation					
C_T_REQ_HEAT_ACC	-	0... FFFFFFFFH	0... 42949672.95	0.01	s
time for duration of torque reserve TQ_ADD_HEAT_ACC calculation					
C_TAM_MIN_REQ_HEAT_ACC	-	0... FEH	-48... 142.5	0.75	°C
TAM threshold for enabling additional heat request					
C_TCO_MIN_REQ_HEAT_ACC	-	0... FEH	-48... 142.5	0.75	°C
TCO threshold for enabling additional heat request					
C_TQ_ADD_ACC_LGRD	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitation gradient for TQ_ADD_ACC decrease after deactivation					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TQ_ADD_ACC_LGRD_ON	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitation gradient for TQ_ADD_ACC increase at activation					
C_TQ_ADD_HEAT_ACC_LGRD	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitation gradient for TQ_ADD_HEAT_ACC decrease after deactivation					
C_TQ_LOSS_MAX_ACC	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum TQ_LOSS_ACC					
IP_FAC_TQ_LOSS_ACC_OFF	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDPM_T_ACC_FAC_TQ_LOSS_ACC	8	0... FFFFH	0... 655.35	0.01	s
TQ_LOSS_ACC weighting factor at ACC deactivation					
IP_FAC_TQ_LOSS_ACC_ON	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDPM_T_ACC_FAC_TQ_LOSS_ACC_ON	8	0... FFFFH	0... 655.35	0.01	s
LDP_FAC_SP_N_PSTE_IP_FAC_TQ	8	0... FFH	0... 1.9921875	7.8125e-3	-
TQ_LOSS_ACC weighting factor for A/C compressor clutch time behavior at activation					
IP_TQ_ADD_ACC	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_TQ_ADD_ACC	6	0... FFH	0... 8160	32	rpm
LDP_TQ_LOSS_ACC_INP_TQ_ADD_ACC	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for switching on air conditioning compressor depending on expected A/C torque loss					
IP_TQ_ADD_HEAT_ACC	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_TQ_ADD_HEAT_ACC	6	0... FFH	0... 8160	32	rpm
Torque reserve for switching on additional heating					
IP_TQ_LOSS_ACC_INP	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_TQ_LOSS_ACC	6	0... FFH	0... 8160	32	rpm
LDP_TQ_ACCIN_CAN_TQ_LOSS_ACC	6	0... FFH	0... 127.5	0.5	Nm
ACC torque loss due to engine-speed and ACC torque demand					
LC_FAC_SP_N_PSTE_SWI	-	0... 1H	0 ...1	1	-
LC to switch between use of N_SP_IS or C_N_SP_IS_PSTE(1:N_SP_IS)					

## General Information

## Application Conditions

Initialization: RST  
 Recurrence: 10MS  
 Activation: always  
 Deactivation: never

## Function description

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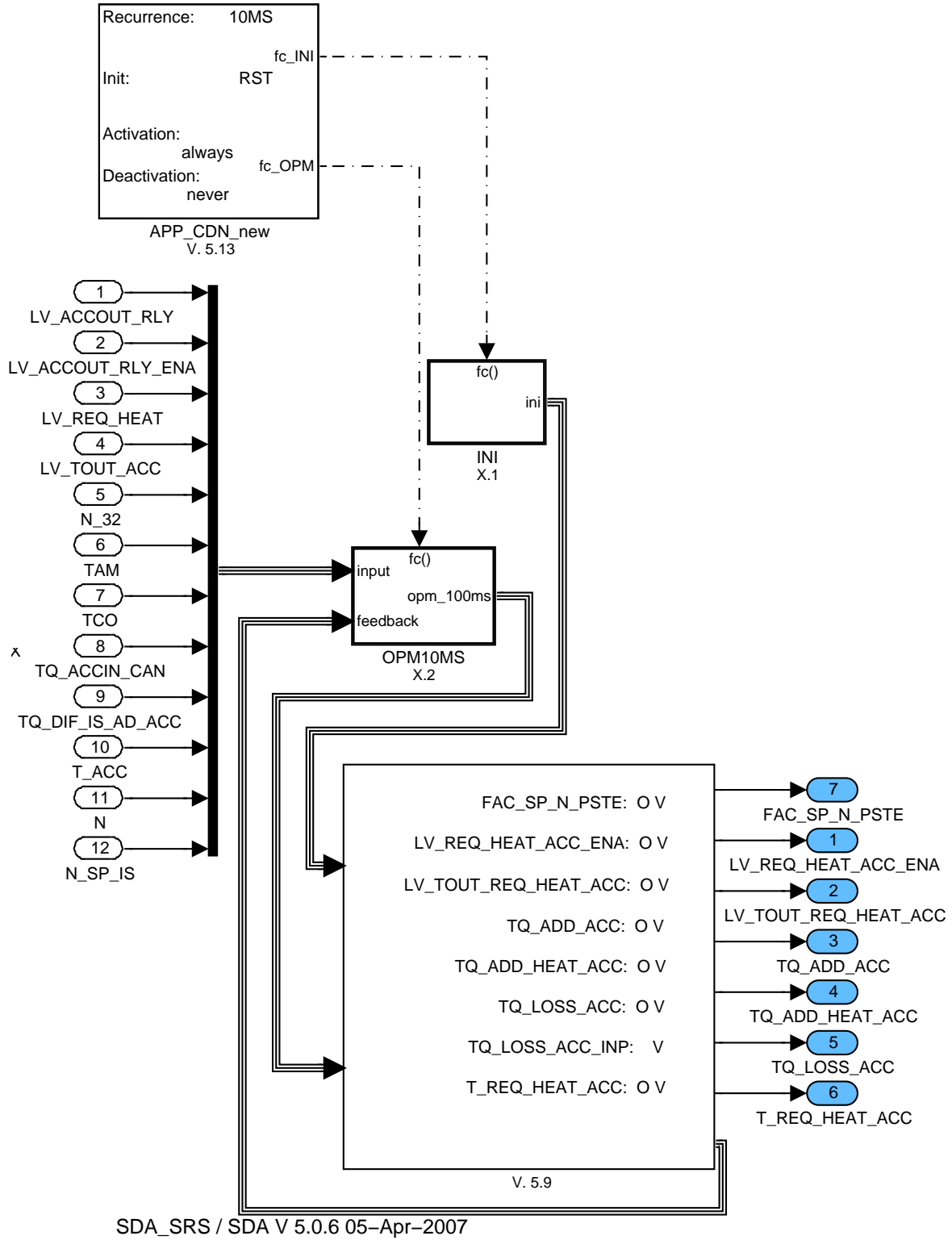


Figure D.5.1: :

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## D.5.1 Initialisation

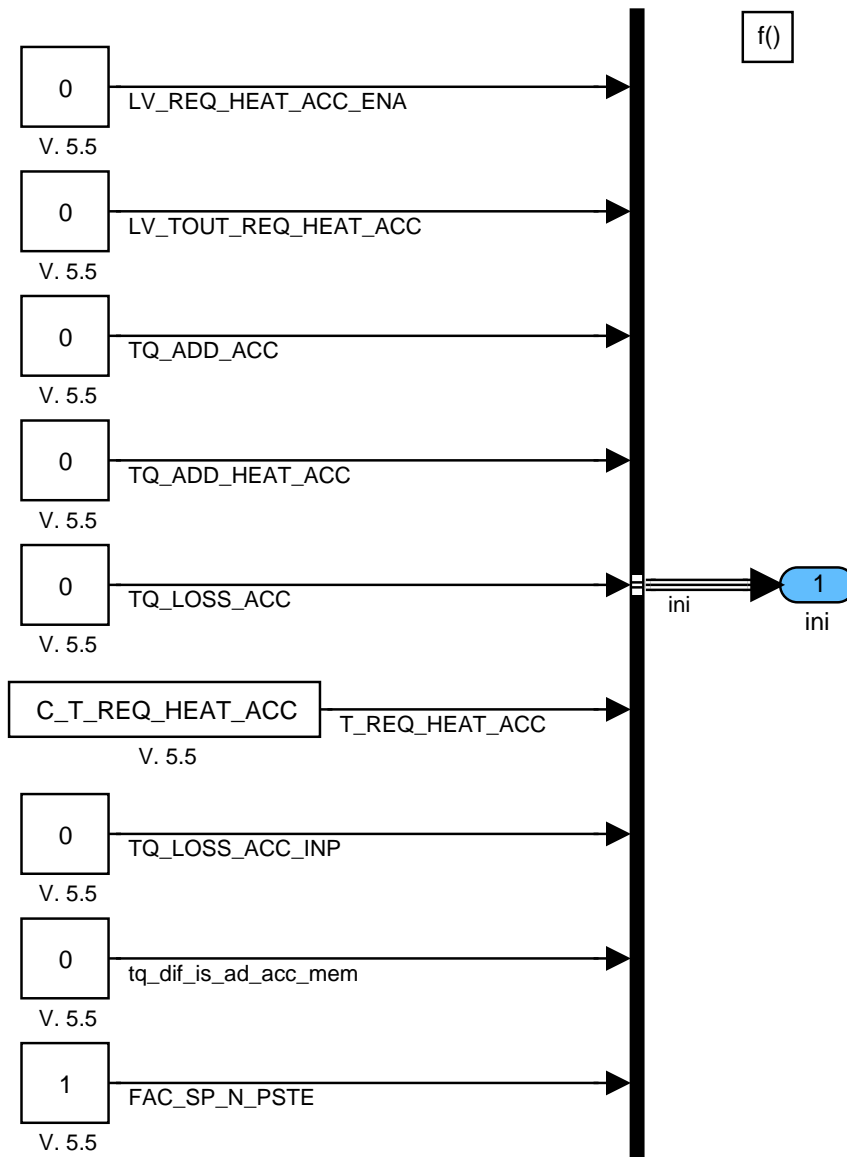


Figure D.5.2: :

## D.5.2 Calculation of torque loss and reserve for Air conditioning compressor:

1. Determination of torque loss ACC
2. Determination of torque reserve for ACC
  - 2.1 Determination of torque reserve ACC
  - 2.2 Determination of REQ\_HEAT by ACC

### D.5.2.1 Determination of Torque Loss ACC

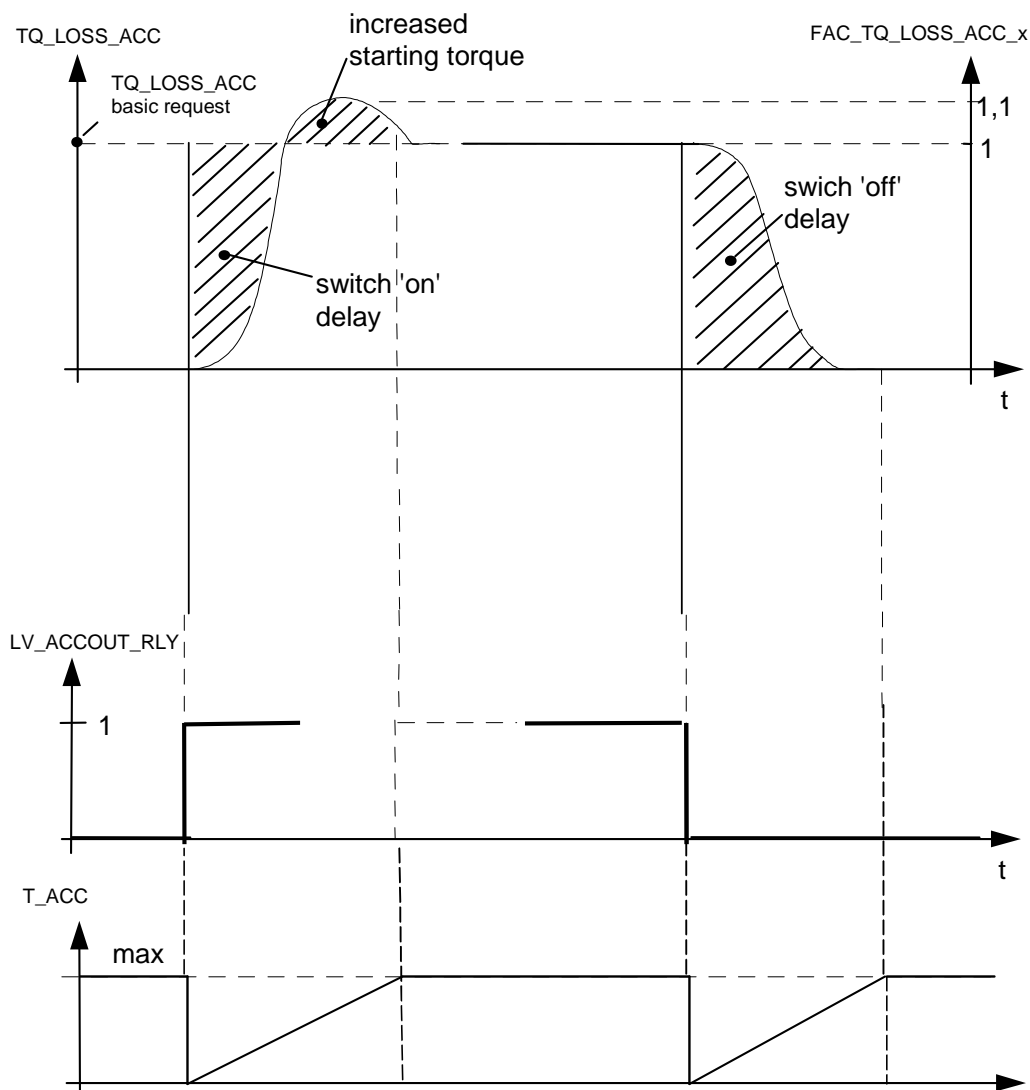
#### FUNCTION DESCRIPTION:

The calculation of `TQ_LOSS_ACC` starts already at transition `LV_ACCOUT_RLY_ENA =`

0 -> 1. The adaptation value  $TQ\_DIF\_IS\_AD\_ACC$ , determined in the module "idle speed adaptation", is added to the A/C compressor torque  $TQ\_LOSS\_ACC\_INP$  which depends on ACC-torque from CAN and on engine speed ( $N_{32}$ ).

The A/C-compressor is switched ON and OFF using an electro-magnetic clutch. If the clutch is closing the starting torque overshoots the torque calculated for steady state conditions (basic request) due to the inertia of compressor, which has to be accelerated. This overshoot is taken into account by the weighting factor  $IP\_FAC\_TQ\_LOSS\_ACC\_ON$  depending on time  $T\_ACC$  and by relative engine speed due to dynamic torque loss depending on target compressor speed (engine speed). The transient correction for clutch switching ON is always active as long as  $LV\_ACCOUT\_RLY\_ENA = 1$ . So  $IP\_FAC\_TQ\_LOSS\_ACC\_ON$  has to be 1 at steady state conditions are reached, at latest at  $T\_ACC = 2.55s$ . At opening clutch the time delay until A/C compressor torque loss has reached 0 Nm is pre-controlled by  $IP\_FAC\_TQ\_LOSS\_ACC\_OFF$  depending on  $T\_ACC$ . The transient correction for clutch switching OFF is always active as long as  $LV\_ACCOUT\_RLY\_ENA = 0$ . So  $IP\_FAC\_TQ\_LOSS\_ACC\_OFF$  has to be 0 at latest at  $T\_ACC = 2.55s$ .

Signal flow diagram:



**D.5.2.1.1 Calculation of ACC torque loss due to engine speed and ACC torque demand**

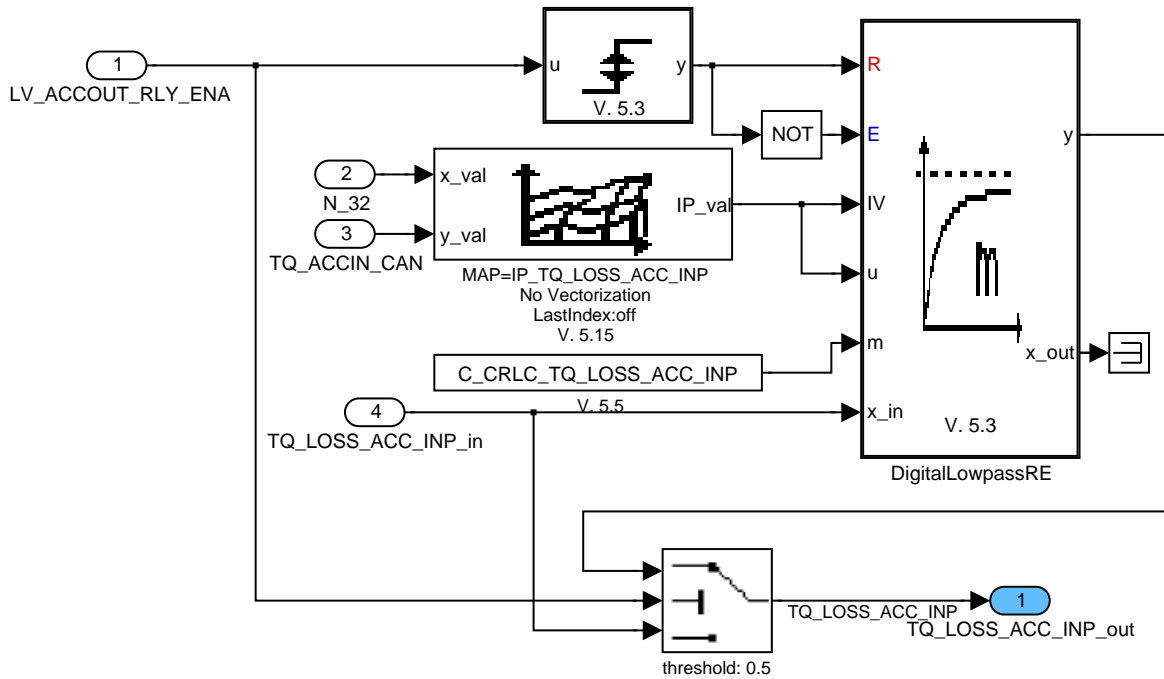
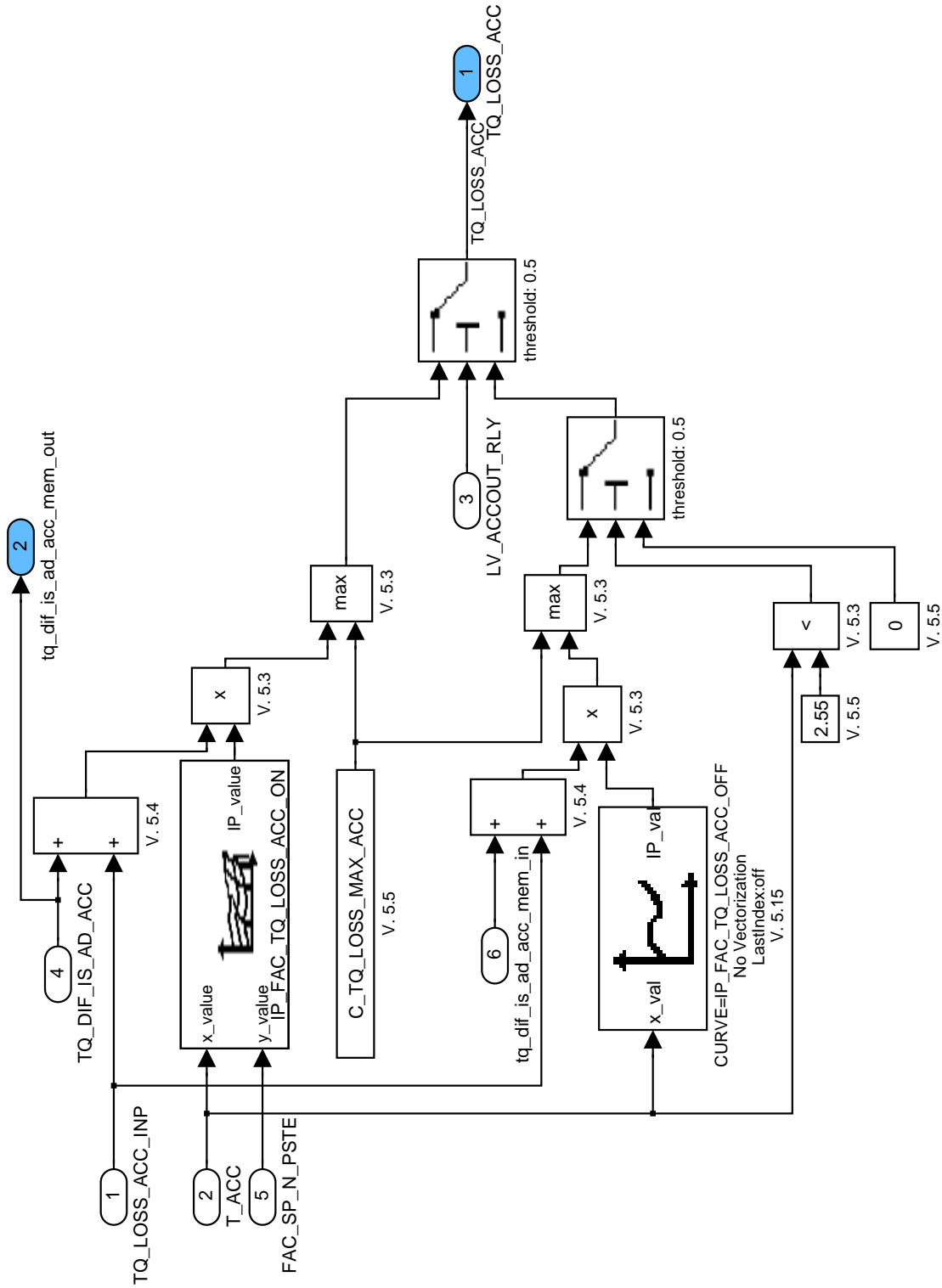


Figure D.5.3: :


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D.5.2.1.2 Calculation of torque loss of air conditioning compressor



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Figure D.5.4: :

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### D.5.2.1.3 Calculation of factor of engine speed relative to setpoint

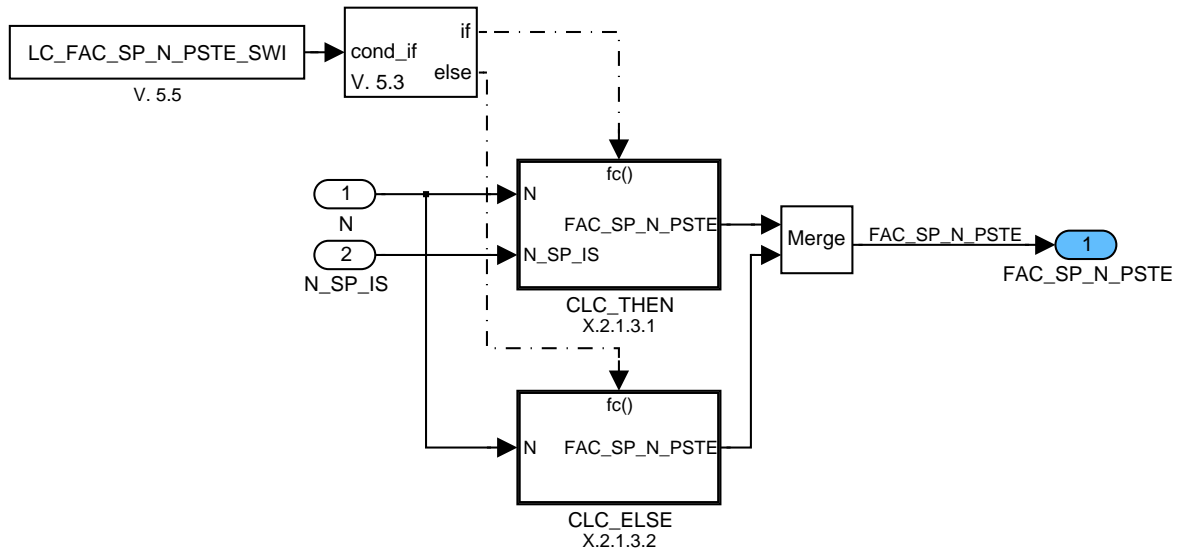


Figure D.5.5: :

#### D.5.2.1.3.1 Calculate FAC\_N\_SP\_PSTE based on idle speed setpoint

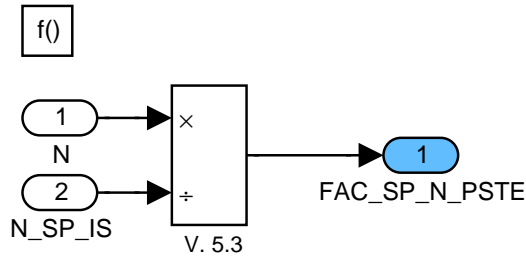


Figure D.5.6: :

#### D.5.2.1.3.2 Calculate FAC\_N\_SP\_PSTE based on constant for idle speed setpoint

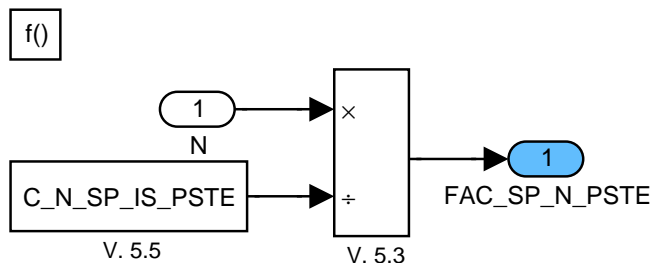


Figure D.5.7: :

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### D.5.2.2 Determination of Torque reserve for ACC

Torque reserve ACC

FUNCTION DESCRIPTION:

General information:

To guarantee idle quality during A/C compressor clutch switching ON a positive torque reserve can be requested. To avoid fast spark advance/retard ramps are used for activation/deactivation of TQ\_ADD\_ACC.

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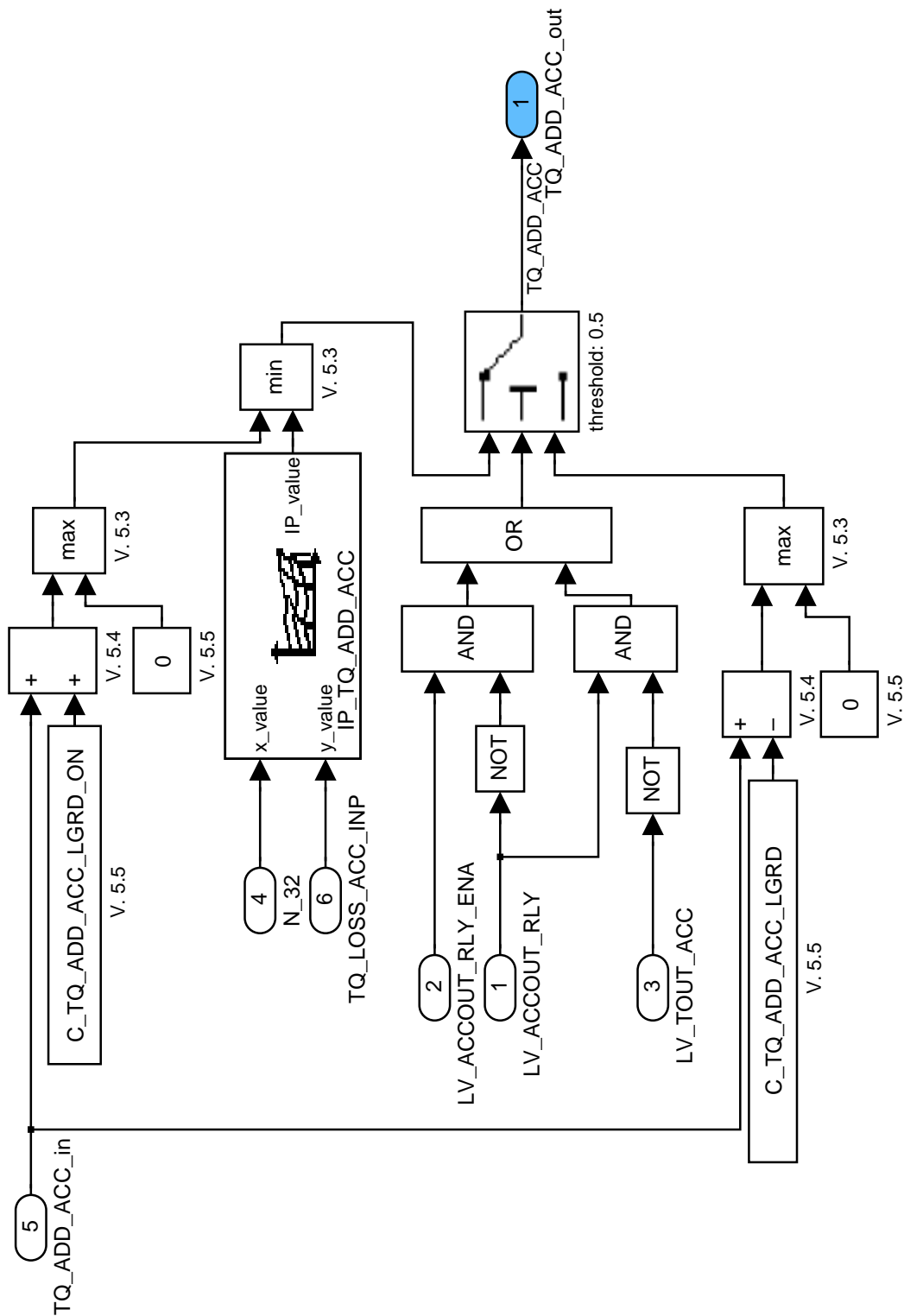



Figure D.5.8: :

### D.5.2.3 Determination of Torque reserve REQ\_HEAT by ACC


Torque reserve REQ\_HEAT by ACC  
 FUNCTION DESCRIPTION:

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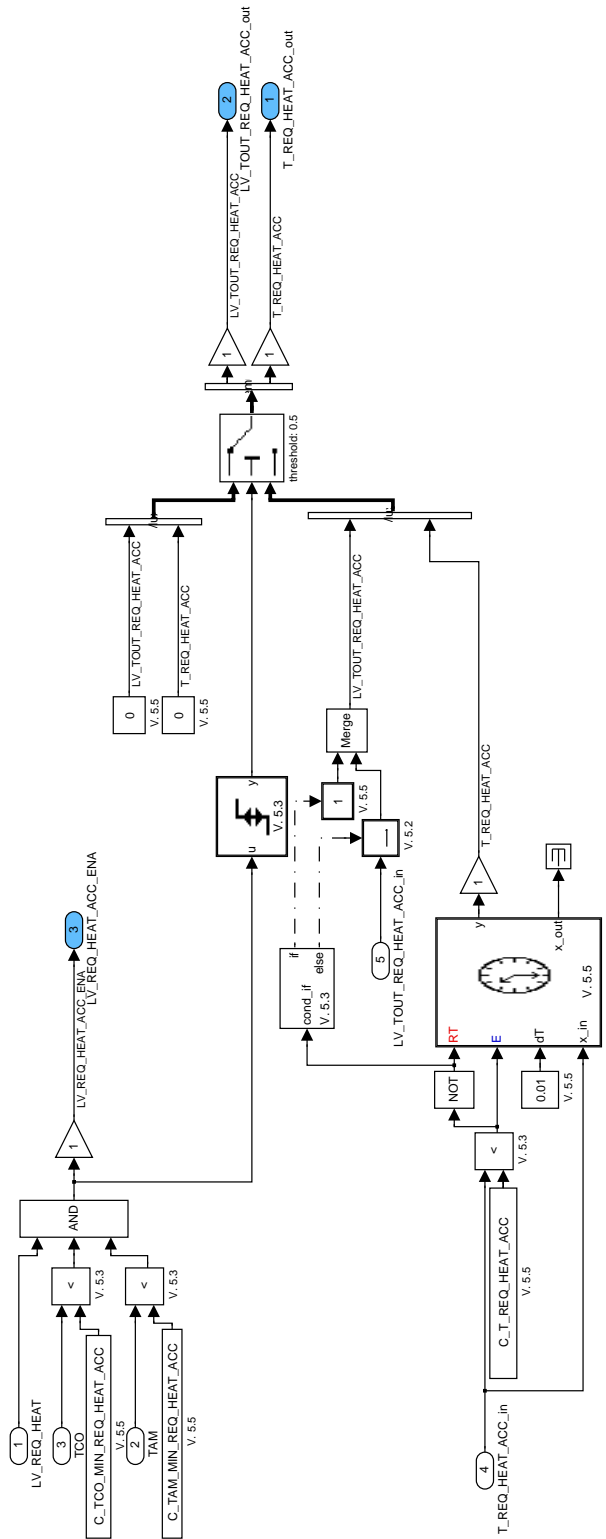
### General information:

To guarantee idle quality during additional heating being present (required by INSTR3-message/CAN11H or IHKA/BN2000) a positive torque reserve can be requested.

At transition LV\_REQ\_HEAT\_ACC\_ENA = 0 - -> 1 the timer T\_REQ\_HEAT\_ACC is set to zero and starts to count until its maximum value is reached. The timer s maximum value is hold until transition LV\_REQ\_HEAT\_ACC\_ENA = 1 - -> 0. Then the timer is set to zero and and starts again until its maximum value.


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### D.5.2.3.1 Calculation of LV\_REQ\_HEAT\_ACC\_ENA



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Figure D.5.9: :

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### D.5.2.3.2 Calculation of toeque reserve for switching on additional heating by ACC

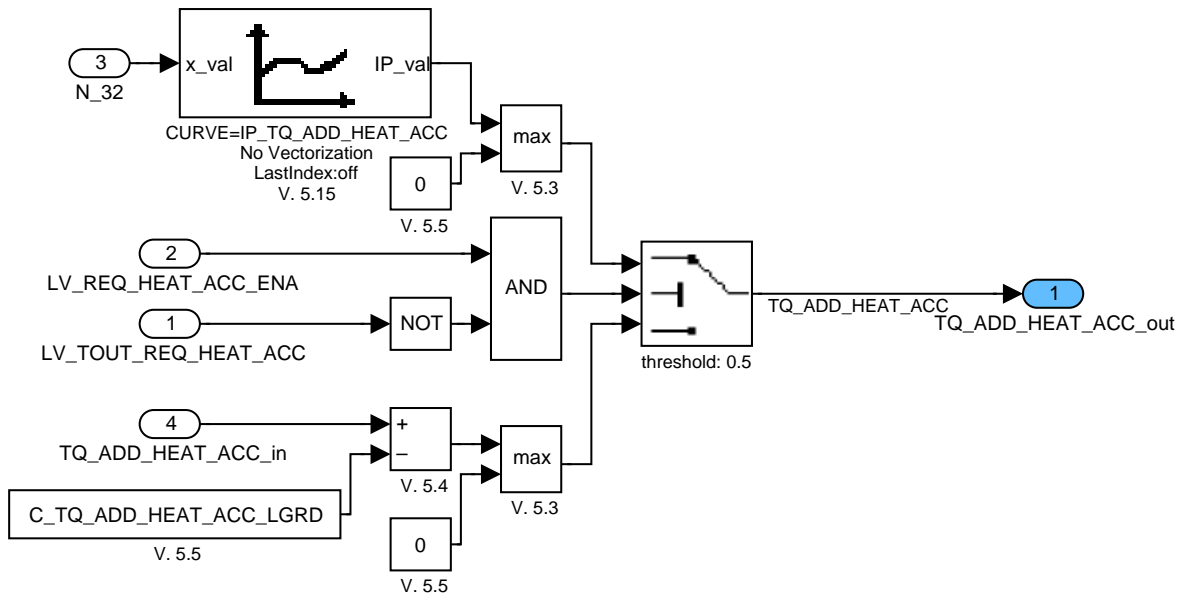


Figure D.5.10: :

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## D.6 Torque request from IPM

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LDM_ACT	O/V	0... 1H	0 ...1	1	-
Logical variable for torque intervention due to LDM					
LV_LDM_DISABLE_CAN	O/V	0... 1H	0 ...1	1	-
Logical variable for disabling LDM intervention due to CAN error					
LV_LDM_ENA	O/V	0... 1H	0 ...1	1	-
Logical variable for increased torque intervention due to LDM					
LV_LDM_LIH	O/V	0... 1H	0 ...1	1	-
Logical variable for torque intervention LIH due to LDM					
LV_LDM_PUC_INH	O/V	0... 1H	0 ...1	1	-
Logical variable for PUC-inhibit due to LDM					
STATE_TQ_LDM_PLAUS	O/V	0... FFH	0... 255	1	-
Bitwise coded State for LDM intervention state					
T_LDM_LIH_CTR	V	0... FFH	0... 2.55	0.01	s
Time counter delay time					
TQ_SP_WHEEL	O/V	8000... 7FFFH	-32768 ...32767	1	Nm
wheel torque setpoint					
TQ_WHEEL_LDM_REQ	V	8000... 7FFFH	-32768 ...32767	1	Nm
Torque increase for torque intervention during LDM					


### Input data:

LV_CDN_VB_CAN_TQ_DIAG {p. 1185}	LV_ERR_BN_LDM {p. 4870}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_LDM_INH_MON {p. 6983}
LV_IGK {p. 906}	LV_LDM_BRAKE_PLAUS_ERR {p. 5054}	LV_LDM_ENA_PLAUS_ERR {p. 5054}	LV_LDM_LIH_CAN {p. 1566}
LV_LDM_OFF_ECU {p. 5054}	LV_TQ_WHEEL_LDM_BN_ERR {p. 1568}	LV_TQ_WHEEL_LDM_REQ {p. 1568}	LV_VAR_BN_LDM {p. 655}
STATE_DI_PUC {p. 1572}	STATE_ENGG_POS {p. 8289}	TQ_WHEEL_LDM_BN {p. 1582}	TQ_WHEEL_LDM_INC_DEC_BN {p. 1711}

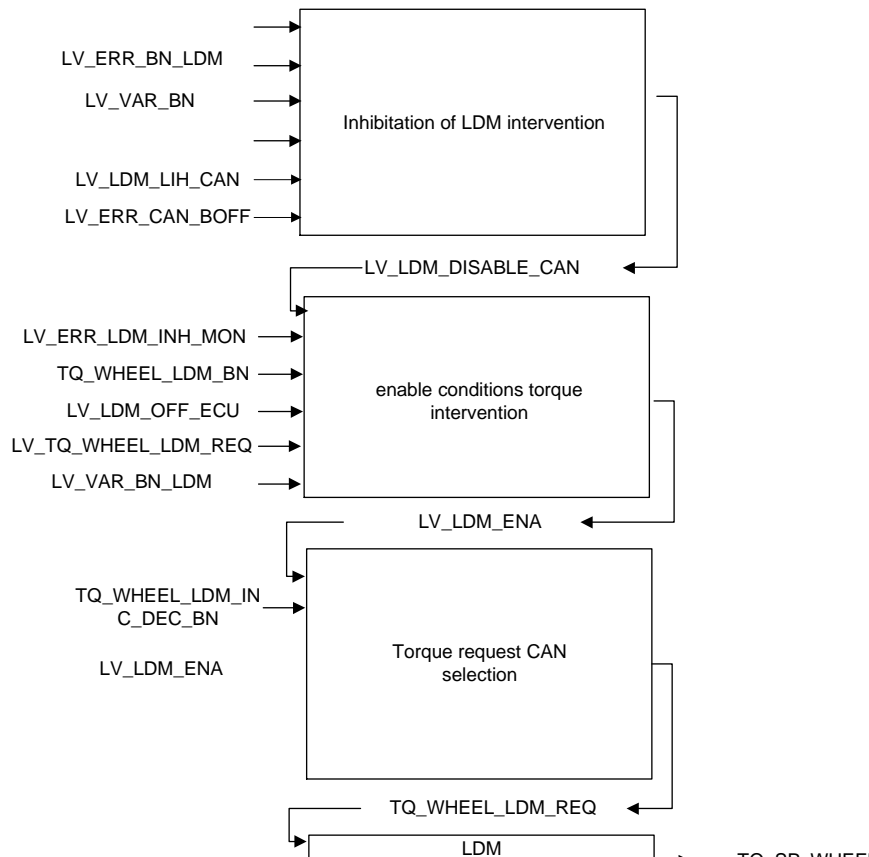
### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LGRD_LIH_LDM	-	0... 7FFFH	0... 1023.96875	0.03125	Nm/10ms
Limiting gradient for LDM emergency ramp function (default 0.6 Nm/10ms)					
C_STATE_DI_PUC_ACT	-	0... 3H	0 ...3	1	-
State disable IS/PU/PUC engine states					
C_T_DLY_LIH_LDM	-	0... FFH	0... 2.55	0.01	s
Delay time for activation of LDM emergency ramp function (default 0s)					
LC_LDM_OFF_CLU	-	0... 1H	0 ...1	1	-
Switch for using LDM clutch info to deactivate LDM torque intervention					

### General information:


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The LDM unit delivers a torque request via BN. This module serves the enable conditions and the torque request which will be used in the torque request selection.



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**Signal flow diagram:**

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## D.6.1 Enable conditions

### D.6.1.1 Inhibition LDM intervention

#### FUNCTION DESCRIPTION:

If the EMS detects an error on the CAN messages, the logical variable LV\_LDM\_DISABLE\_CAN is set to 1.

#### Application conditions

**Initialisation:**  $LV\_LDM\_DISABLE\_CAN = 0$  **at reset**

**Recurrence:** 10 ms

**Activation:**  $LV\_IGK = 1$  and  $LV\_VAR\_BN\_LDM = 1$

**Deactivation:** -

#### Formula section:

CAN enviroment LDM inhibition:

```

if      LV_ERR_BN_LDM           = 1      or
        LV_ERR_CAN_BOFF        = 1      or
        LV_LDM_LIH_CAN         = 1      or
        LV_CDN_VB_CAN_TQ_DIAG = 0

```

```

then      LV_LDM_DISABLE_CAN = 1
else      LV_LDM_DISABLE_CAN = 0
endif

```

### D.6.1.2 enable conditions torque intervention

#### FUNCTION DESCRIPTION:

Depending on the configuration and plausible torque interfaces an increased torque intervention is possible.

#### Application conditions

**Initialisation:**  $LV\_LDM\_ENA = 0$  **at reset**

**Recurrence:** 10 ms

**Activation:**  $LV\_IGK = 1$  and  $LV\_VAR\_BN\_LDM = 1$


#### Formula section:

Torque increase intervention:

```

if      LV_LDM_OFF_ECU = 0      and
        LV_TQ_WHEEL_LDM_REQ = 1  and
        LV_LDM_DISABLE_CAN = 0  and
        LV_TQ_WHEEL_LDM_BN_ERR = 0 and
        LV_ERR_LDM_INH_MON = 0  and

```

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```

                (STATE_ENGG_POS != 2H or LC_LDM_OFF_CLU = 0)
then          LV_LDM_ENA = 1
else          LV_LDM_ENA = 0
endif

```

#### STATE\_TQ\_LDM\_PLAUS

```

if   LV_LDM_BRAKE_PLAUS_ERR = 1           BIT [00] set
if   LV_LDM_ENA_PLAUS_ERR = 1           BIT [01] set
if   LV_LDM_OFF_ECU = 1                 BIT [03] set
if   LV_TQ_WHEEL_LDM_REQ = 1   and
        LV_TQ_WHEEL_LDM_BN_ERR = 1           BIT [05] set
else
endif                                     BIT [04] set

```

## D.6.2 Torque request CAN selection

### FUNCTION DESCRIPTION:

If the LDM intervention is enabled (LV\_LDM\_ENA = 1), the torque request is received from CAN and copied into TQ\_SP\_WHEEL.

After LV\_LDM\_ACT changes back to 0, TQ\_SP\_WHEEL becomes its minimum value again.

### Application conditions

**Initialisation:** at reset and LV\_IGK off - -> on  
TQ\_WHEEL\_LDM\_REQ = -32000 Nm

**Recurrence:** 10 ms

**Activation:** at LV\_IGK = 1 and LV\_VAR\_BN\_LDM = 1

**Deactivation:** -

### Formula section:

```

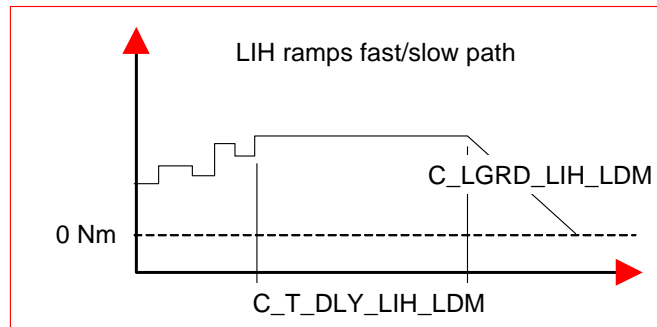
IF          LV_LDM_ENA = 1
Then       TQ_WHEEL_LDM_REQ = TQ_WHEEL_LDM_INC_DEC_BN
Else       TQ_WHEEL_LDM_REQ = -32000 Nm
Endif

```

### D.6.2.1 LDM increased intervention and emergency operation

### FUNCTION DESCRIPTION:

If during an active LDM intervention an LDM or an EMS error occurs, the current torque offset is continued for the time C\_T\_DLY\_LIH\_LDM and then subsequently decreased to TQ\_SP\_WHEEL = -32000 Nm using C\_LGRD\_LIH\_LDM. The LDM unit itself controls the torque leading during active LV\_TQ\_WHEEL\_LDM\_REQ therefore you won't have a plausible Torque request without LV\_LDM\_ENA.

**Signal flow diagram:****Application conditions**

**Initialisation:** at reset or at transition LV\_IGK off -> on  
 $LV\_LDM\_LIH = 0$   
 $LV\_LDM\_ACT = 0$   
 $TQ\_SP\_WHEEL = -32000 \text{ Nm}$   
 $T\_LDM\_LIH\_CTR = C\_T\_DLY\_LIH\_LDM$

**Recurrence:** 10 ms

**Activation:**  $LV\_IGK = 1$  and  $LV\_VAR\_BN\_LDM = 1$

**Formula section:**

LDM\_INC intervention and detection of LDM\_INC limp home operation :

```

if(1)      LV_LDM_OFF_ECU = 1
then(1)
  if(2)      TQ_SP_WHEEL > -32000 Nm
  then(2)      LV_LDM_LIH = 1
    if(3)      T_LDM_LIH_CTR = 0 (time delay)
    then(3)      TQ_SP_WHEEL_N = TQ_SP_WHEEL_{N-1} - C_LGRD_LIH_LDM (till TQ_SP_WHEEL = -32000Nm)
    else(3)      TQ_SP_WHEEL_N = TQ_SP_WHEEL_{N-1} (last valid value)
                 T_LDM_LIH_CTR_N = T_LDM_LIH_CTR_{N-1} - 10 ms
    ( till T_LDM_LIH_CTR = C_T_DLY_LIH_LDM )
  endif(3)
  else(2)      LV_LDM_LIH = 0
                 T_LDM_LIH_CTR = C_T_DLY_LIH_LDM
  endif(2)
else(1)      LV_LDM_LIH = 0
                 T_LDM_LIH_CTR = C_T_DLY_LIH_LDM
                 TQ_SP_WHEEL = TQ_WHEEL_LDM_REQ
endif(1)

```

LDM intervention active (LV\_LDM\_ACT) :

```

if      TQ_SP_WHEEL > -32000Nm
then    LV_LDM_ACT = 1

```

```

else      LV_LDM_ACT      = 0
endif


```

*LDM inhibition of PUC active (LV\_LDM\_PUC\_INH) :*

```

if      (LV_LDM_ACT = 1  and
STATE_DI_PUC = C_STATE_DI_PUC_ACT )
then    LV_LDM_PUC_INH  = 1
else    LV_LDM_PUC_INH  = 0
endif

```

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## D.7 Torque loss power steering

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_PSTE_2_DISABLE	O/V	0... 1H	0 ...1	1	-
LV for disabling PSTE intervention due to EMS error					
LV_PSTE_2_DISABLE_CAN	O/V	0... 1H	0 ...1	1	-
LV for disabling PSTE intervention due to CAN error					
LV_PSTE_2_ENA	O/V	0... 1H	0 ...1	1	-
LV for enabling PSTE intervention					
LV_PSTE_3_DISABLE	O/V	0... 1H	0 ...1	1	-
LV for disabling PSTE intervention due to EMS error					
LV_PSTE_3_DISABLE_CAN	O/V	0... 1H	0 ...1	1	-
LV for disabling PSTE 3 intervention due to CAN error					
LV_PSTE_3_ENA	O/V	0... 1H	0 ...1	1	-
LV for enabling PSTE intervention					
LV_PSTE_DISABLE	O/V	0... 1H	0 ...1	1	-
LV for disabling PSTE intervention due to EMS error					
LV_PSTE_DISABLE_CAN	O/V	0... 1H	0 ...1	1	-
LV for disabling PSTE intervention due to CAN error					
LV_PSTE_ENA	O/V	0... 1H	0 ...1	1	-
LV for enabling PSTE intervention					
LV_TQ_ADD_PSTE_IS_AD_INH	O/V	0... 1H	0 ...1	1	-
Flag for inhibition of IS-control adaptations due to torque reserve PSTE					
LV_TQ_LOSS_PSTE_IS_AD_INH	O/V	0... 1H	0 ...1	1	-
Flag for inhibition of IS-control adaptations due to torque losses PSTE					
STATE_TQ_PSTE_2_PLAUS	O/V	0... FFH	0... 255	1	-
Bitwise coded State for PSTE_2 intervention state					
STATE_TQ_PSTE_3_PLAUS	O/V	0... FFH	0... 255	1	-
Bitwise coded State for PSTE_3 intervention state					
T_PSTE_2	O/V	0... FFH	0... 2.55	0.01	s
SP AV Timer PSTE_2					
T_PSTE_3	O/V	0... FFH	0... 2.55	0.01	s
SP AV Timer PSTE_3					
TQ_ADD_PSTE	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque reserve for power steering					
TQ_ADD_PSTE_1	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque reserve for power steering					
TQ_ADD_PSTE_2	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm/10ms
Engine torque reserve active front steering					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_ADD_PSTE_3	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque reserve for electric power steering (EHB3)					
TQ_LOSS_PSTE	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Summary Engine torque losses power steering					
TQ_LOSS_PSTE_1	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses power steering					
TQ_LOSS_PSTE_2	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses active front steering					
TQ_LOSS_PSTE_2_AV	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses active front steering active value					
TQ_LOSS_PSTE_2_DIF	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses active front steering difference					
TQ_LOSS_PSTE_2_GRD	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm/10ms
Engine torque losses active front steering gradient					
TQ_LOSS_PSTE_2_RAW	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm/10ms
Engine torque losses active front steering					
TQ_LOSS_PSTE_2_SP	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses active front steering set point					
TQ_LOSS_PSTE_2_TMP	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Intermediate LABEL used as input 2nd axis of IP_TQ_ADD_PSTE_2_TMP					
TQ_LOSS_PSTE_3	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses for electric power steering (EHB3)					
TQ_LOSS_PSTE_3_AV	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses actual value for electric power steering (EHB3)					
TQ_LOSS_PSTE_3_DIF	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses difference for electric power steering (EHB3)					
TQ_LOSS_PSTE_3_GRD	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses gradient for electric power steering (EHB3)					
TQ_LOSS_PSTE_3_RAW	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses for electric power steering (EHB3)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_LOSS_PSTE_3_SP	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses electric power steering setpoint					

**Input data:**

ANG_PSTE_STND {p. 1420}	FAC_SP_N_PSTE {p. 6602}	LV_CDN_VB_CAN_TQ_ DIAG {p. 1185}	LV_DI_TQ_REQ_CAN_ MPI_GDI {p. 800}
LV_ERR_ANG_PSTE_CAN {p. 1565}	LV_ERR_BN_ANG_PSTE {p. 4869}	LV_ERR_BN_TQ_PSTE_2 {p. 4871}	LV_ERR_BN_TQ_PSTE_3 {p. 4871}
LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_TOUT_PSTE_1 {p. 802}	LV_ES {p. 1720}	LV_IGK {p. 906}
LV_PSTE_2_ERR {p. 1567}	LV_ST {p. 1720}	LV_TCS_DISABLE_CAN {p. 6741}	LV_TQ_PSTE_3_CAN_DI {p. 1568}
LV_TQ_PSTE_3_CAN_LIH {p. 1568}	LV_TQI_REQ_CAN_INH {p. 6687}	LV_VAR_BN {p. 655}	LV_VAR_PSTE {p. 656}
LV_VAR_PSTE_2 {p. 656}	LV_VAR_PSTE_3 {p. 656}	N {p. 1525}	N_32 {p. 1525}
STATE_PSTE_2_INTV {p. 1575}	STATE_PSTE_3_INTV {p. 1576}	STATE_PSTE_3_SRC {p. 1576}	STATE_SENS_ANG_PSTE {p. 1576}
TQ_LOSS_PSTE_2_AV_ CAN {p. 1581}	TQ_LOSS_PSTE_2_SP_ CAN {p. 1581}	TQ_LOSS_PSTE_3_AV_ CAN {p. 1581}	TQ_LOSS_PSTE_3_SP_ CAN {p. 1581}
VEL_ANG_PSTE_COR {p. 1420}	VS {p. 1176}		

**Calibration data:**


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQ_LOSS_PSTE_2_DIF	-	0... FFH	-2... 1.984375	0.015625	-
Correction value differences					
C_FAC_TQ_LOSS_PSTE_2_GRD	-	0... FFH	-2... 1.984375	0.015625	-
Correction value gradient					
C_FAC_TQ_LOSS_PSTE_3_DIF	-	0... FFH	-2... 1.984375	0.015625	-
Correction value differences					
C_FAC_TQ_LOSS_PSTE_3_GRD	-	0... FFH	-2... 1.984375	0.015625	-
Correction value gradient					
C_T_PSTE_DLY_AD	-	0... FFH	0... 2.55	0.01	s
Threshold torque losses PSTE for inhibition of IS-control adaptations					
C_TQ_ADD_PSTE_1_LIH	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limp home value torque reserve					
C_TQ_ADD_PSTE_AD	-	0... 7FFFH	0... 1023.97	0.03125	Nm
threshold torque reserve PSTE for inhibition of IS-control adaptations					
C_TQ_LOSS_PSTE_1_LIH	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Limp home value torque losses					
C_TQ_LOSS_PSTE_2_LIH	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Limp home value torque losses					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TQ_LOSS_PSTE_2_SP_MIN	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Min torque threshold for timer reset					
C_TQ_LOSS_PSTE_3_LIH	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Limp home value torque losses					
C_TQ_LOSS_PSTE_3_SP_MIN	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Min torque threshold for timer reset					
C_TQ_LOSS_PSTE_AD	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
threshold torque losses PSTE for inhibition of IS-control adaptations					
IP_FAC_TQ_ADD_PSTE_2_VS	-	0... FFH	0... 3.984375	0.015625	-
LDP_VS_TQ_LOSS_PSTE_2	6	0... FFH	0... 255	1	km/h
Active power steering torque loss correction					
IP_FAC_TQ_ADD_PSTE_3_VS_PSTE	-	0... FFH	0... 3.984375	0.015625	-
LDP_VS_TQ_LOSS_PSTE_3	6	0... FFH	0... 255	1	km/h
electric power steering torque loss correction					
IP_FAC_TQ_ADD_PSTE_3_VS_PSTE_2	-	0... FFH	0... 3.984375	0.015625	-
LDP_VS_TQ_LOSS_PSTE_3	6	0... FFH	0... 255	1	km/h
electric power steering torque loss correction					
IP_FAC_TQ_LOSS_PSTE	-	0... FFH	0... 3.984375	0.015625	-
LDP_N_FAC_TQ_LOSS_PSTE	8	0... 1FE0H	0... 8160	1	rpm
factor for weighting the torque request in dependance of speed ( $P=M^*$ )					
IP_FAC_TQ_LOSS_PSTE_2	V	0... FFH	0... 3.984375	0.015625	-
LDP_VS_TQ_LOSS_PSTE_2	6	0... FFH	0... 255	1	km/h
LDPM_N_32_PSTE_2	8	0... FFH	0... 8160	32	rpm
Factor active power steering torque loss correction vs					
IP_FAC_TQ_LOSS_PSTE_2_ANG	V	0... FFH	0... 3.984375	0.015625	-
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDPM_VEL_ANG_PSTE_TQLO	8	0... FFFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
factor active power steering torque loss correction °STW					
IP_FAC_TQ_LOSS_PSTE_2_AV	V	0... FFH	-2... 1.984375	0.015625	-
LDPM_N_32_PSTE_2_1	4	0... FFH	0... 8160	32	rpm
LDPM_T_PSTE_2_PSTE_2	4	0... FFH	0... 2.55	0.01	s
Active power steering torque loss correction AV					
IP_FAC_TQ_LOSS_PSTE_2_SP	V	0... FFH	-2... 1.984375	0.015625	-
LDPM_N_32_PSTE_2_1	4	0... FFH	0... 8160	32	rpm
LDPM_T_PSTE_2_PSTE_2	4	0... FFH	0... 2.55	0.01	s
Active power steering torque loss correction SP					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_TQ_LOSS_PSTE_2_VS	V	0... FFH	0... 3.984375	0.015625	-
LDPM_VS_TQ_LOSS_PSTE_2	6	0... FFH	0... 255	1	km/h
LDPM_N_32_PSTE_2	8	0... FFH	0... 8160	32	rpm
Factor active power steering torque loss correction vs					
IP_FAC_TQ_LOSS_PSTE_3_AV	V	0... FFH	-2... 1.984375	0.015625	-
LDPM_N_32_PSTE_3_1	4	0... FFH	0... 8160	32	rpm
LDPM_T_PSTE_3_PSTE_3	4	0... FFH	0... 2.55	0.01	s
Electric power steering torque loss correction AV					
IP_FAC_TQ_LOSS_PSTE_3_COR_PSTE	V	0... FFH	0... 3.984375	0.015625	-
LDP_VS_TQ_LOSS_PSTE_3	6	0... FFH	0... 255	1	km/h
LDPM_FAC_SP_N_PSTE_1_STSY	8	0... FFH	0... 1.9921875	7.8125e-3	-
Factor electric power steering (EHB 3) torque loss correction vs					
IP_FAC_TQ_LOSS_PSTE_3_COR_PSTE2	V	0... FFH	0... 3.984375	0.015625	-
LDP_VS_TQ_LOSS_PSTE_3	6	0... FFH	0... 255	1	km/h
LDPM_FAC_SP_N_PSTE_1_STSY	8	0... FFH	0... 1.9921875	7.8125e-3	-
Factor electric power steering (EHB 3) torque loss correction vs					
IP_FAC_TQ_LOSS_PSTE_3_MDL_PSTE	V	0... FFH	0... 3.984375	0.015625	-
LDP_VS_TQ_LOSS_PSTE_3	6	0... FFH	0... 255	1	km/h
LDPM_FAC_SP_N_PSTE_1_STSY	8	0... FFH	0... 1.9921875	7.8125e-3	-
Factor electric power steering (EHB 3) torque loss correction vs					
IP_FAC_TQ_LOSS_PSTE_3_MDL_PSTE2	V	0... FFH	0... 3.984375	0.015625	-
LDP_VS_TQ_LOSS_PSTE_3	6	0... FFH	0... 255	1	km/h
LDPM_FAC_SP_N_PSTE_1_STSY	8	0... FFH	0... 1.9921875	7.8125e-3	-
Factor electric power steering (EHB 3) torque loss correction vs					
IP_FAC_TQ_LOSS_PSTE_3_PSTE	V	0... FFH	0... 3.984375	0.015625	-
LDP_VS_TQ_LOSS_PSTE_3	6	0... FFH	0... 255	1	km/h
LDPM_FAC_SP_N_PSTE_1_STSY	8	0... FFH	0... 1.9921875	7.8125e-3	-
Factor electric power steering (EHB 3) torque loss correction vs					
IP_FAC_TQ_LOSS_PSTE_3_PSTE_2	V	0... FFH	0... 3.984375	0.015625	-
LDP_VS_TQ_LOSS_PSTE_3	6	0... FFH	0... 255	1	km/h
LDPM_FAC_SP_N_PSTE_1_STSY	8	0... FFH	0... 1.9921875	7.8125e-3	-
Factor electric power steering (EHB 3) torque loss correction vs					
IP_FAC_TQ_LOSS_PSTE_3_SP	V	0... FFH	-2... 1.984375	0.015625	-
LDPM_N_32_PSTE_3_1	4	0... FFH	0... 8160	32	rpm
LDPM_T_PSTE_3_PSTE_3	4	0... FFH	0... 2.55	0.01	s
Electric power steering torque loss correction SP					
IP_TQ_ADD_PSTE	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDPM_ANG_PSTE_STND_TQLO_1	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
Power steering torque reserve depending on engine-speed					
IP_TQ_ADD_PSTE_2	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm

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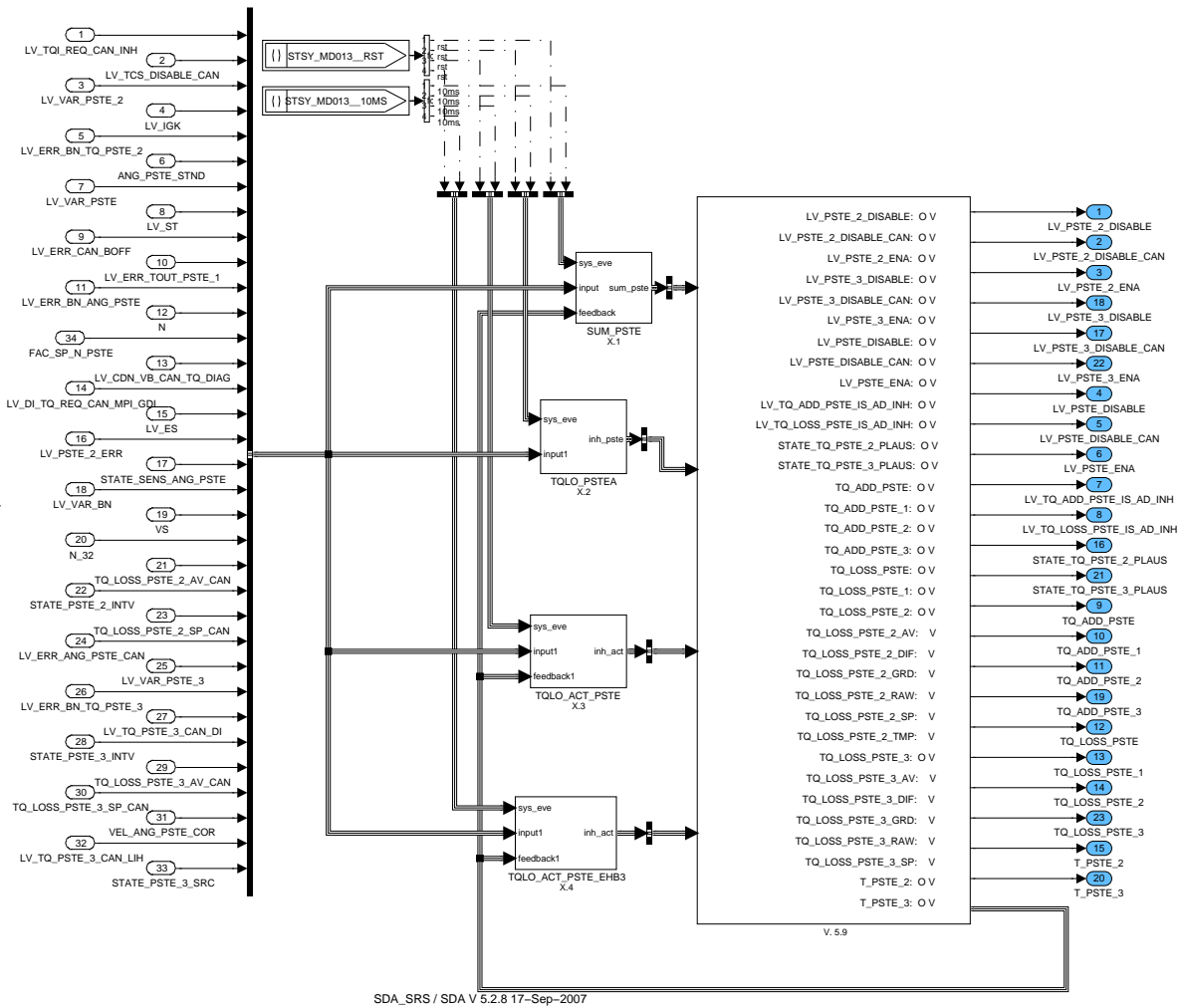
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	Document key 10171571 SPE 000 AO	Pages Page 6625 of 8404	
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDP_TQ_LOSS_PSTE_2_SP_CAN	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Active power steering torque reserve					
IP_TQ_ADD_PSTE_2_LIH	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_VS_TQ_LOSS_PSTE_2	6	0... FFH	0... 255	1	km/h
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
Factor active power steering torque loss correction vs					
IP_TQ_ADD_PSTE_2_TMP	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDP_TQ_LOSS_PSTE_2_TMP	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Active power steering torque reserve using different 2nd axis					
IP_TQ_ADD_PSTE_3_LIH	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_VS_TQ_LOSS_PSTE_3	6	0... FFH	0... 255	1	km/h
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
Factor electric power steering (EHB 3) torque loss correction vs					
IP_TQ_ADD_PSTE_3_PSTE	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDP_TQ_LOSS_PSTE_3_SP_CAN	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
electric power steering torque reserve					
IP_TQ_ADD_PSTE_3_PSTE_2	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDP_TQ_LOSS_PSTE_3_SP_CAN	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
electric power steering torque reserve					
IP_TQ_LOSS_PSTE	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_ANG_PSTE_STND_TQLO_1	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDP_VEL_ANG_PSTE_TQLO_1	8	0... FFFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
power steering torque loss versus engine-speed					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TQ_LOSS_PSTE_2	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDPM_VEL_ANG_PSTE_TQLO	8	0... FFFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
Active power steering torque loss correction					
IP_TQ_LOSS_PSTE_3_ANG_PSTE	V	0... FFH	0... 3.984375	0.015625	-
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDPM_VEL_ANG_PSTE_TQLO	8	0... FFFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
electric power steering torque loss correction					
IP_TQ_LOSS_PSTE_3_ANG_PSTE_2	V	0... FFH	0... 3.984375	0.015625	-
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDPM_VEL_ANG_PSTE_TQLO	8	0... FFFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
electric power steering torque loss correction					
IP_TQ_LOSS_PSTE_3_COR_PSTE	V	0... FFH	0... 3.984375	0.015625	-
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDPM_VEL_ANG_PSTE_TQLO	8	0... FFFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
electric power steering torque loss correction					
IP_TQ_LOSS_PSTE_3_COR_PSTE_2	V	0... FFH	0... 3.984375	0.015625	-
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDPM_VEL_ANG_PSTE_TQLO	8	0... FFFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
electric power steering torque loss correction					
IP_TQ_LOSS_PSTE_3_MDL_PSTE	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDPM_VEL_ANG_PSTE_TQLO	8	0... FFFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
electric power steering torque loss correction					
IP_TQ_LOSS_PSTE_3_MDL_PSTE_2	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDPM_VEL_ANG_PSTE_TQLO	8	0... FFFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
electric power steering torque loss correction					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_PSTE_2_ENA	-	0... 1H	0 ...1	1	-
Logical variable for inhibition of active power steering					
LC_PSTE_2_MAN_ACT	-	0... 1H	0 ...1	1	-
Logical variable for manual activation of PSTE_2 conditions independent of PSTE_2 messages					
LC_PSTE_3_ENA	-	0... 1H	0 ...1	1	-
Logical variable for inhibition of electric power steering EHB 3					
LC_PSTE_ENA	-	0... 1H	0 ...1	1	-
Logical variable for enabling of power steering					
LC_TQ_ADD_PSTE_2_SWI	-	0... 1H	0 ...1	1	-
Switch to change 2nd axis of IP_TQ_ADD_PSTE_2					
LC_TQ_LOSS_PSTE_2_SWI	-	0... 1H	0 ...1	1	-
Configuration AFS switch					
LC_TQ_LOSS_PSTE_3_SWI	-	0... 1H	0 ...1	1	-
Configuration EHB3 switch					

Overview



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Figure D.7.1: :

**General Information**

**D.7.1 Summary of power steering losses**

FUNCTION DESCRIPTION:

**Application Conditions**

Initialization: RST

Recurrence: 10MS

Activation: LV\_IGK & (LV\_VAR\_PSTE\_2 || LV\_VAR\_PSTE || LV\_VAR\_PSTE\_3)

Deactivation: never

**Function description**

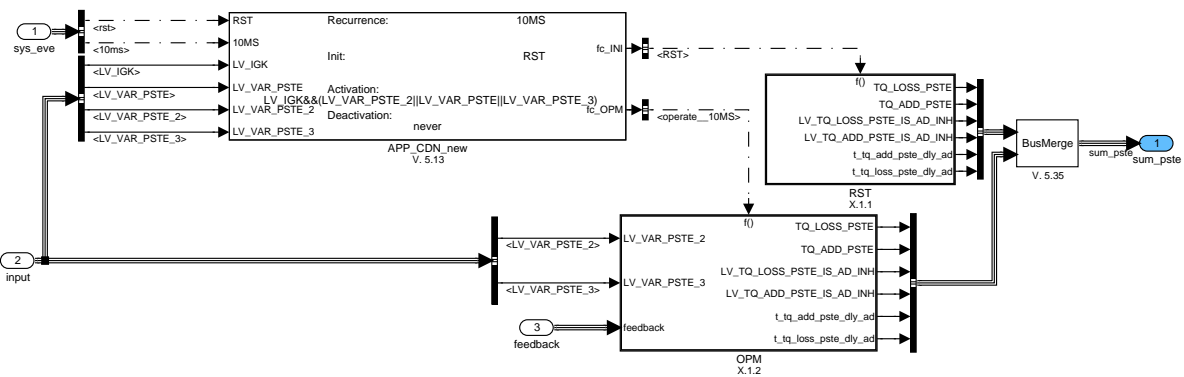


Figure D.7.2: :

**D.7.1.1 Reset of variables is done here.**

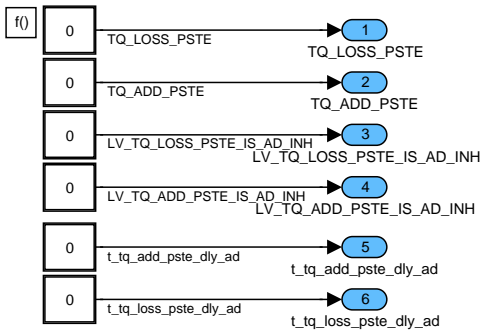


Figure D.7.3: :

**D.7.1.2 Formula section:**

"TQ\_LOSS\_PSTE\_1, TQ\_LOSS\_PSTE\_2 and TQ\_LOSS\_PSTE\_3 have to be calculate before TQ\_LOSS\_PSTE (using current values)."

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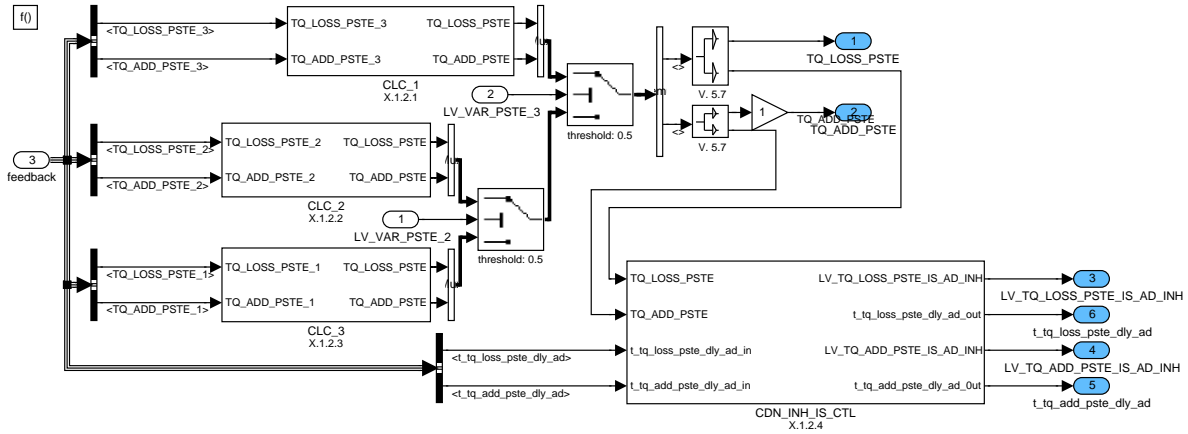


Figure D.7.4: :

**D.7.1.2.1 Calculation of TQ\_LOSS\_PSTE and TQ\_ADD\_PSTE when LV\_VAR\_PSTE\_3 is set**

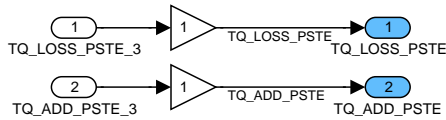


Figure D.7.5: :

**D.7.1.2.2 Calculation of TQ\_LOSS\_PSTE and TQ\_ADD\_PSTE when LV\_VAR\_PSTE\_2 is set**

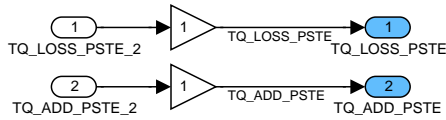


Figure D.7.6: :

**D.7.1.2.3 Calculation of TQ\_LOSS\_PSTE and TQ\_ADD\_PSTE when LV\_VAR\_PSTE\_2 is reset**

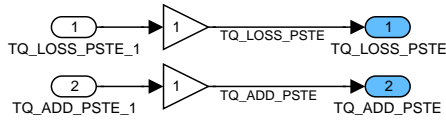


Figure D.7.7: :

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**D.7.1.2.4 Condition for inhibition of IS-control adaptations:**

**D.7.1.2.4.1 Calculation of LV\_TQ\_LOSS\_PSTE\_IS\_AD\_INH and TIMER**

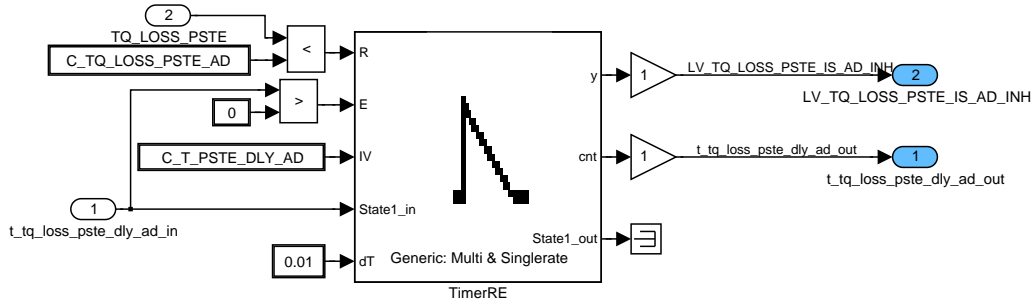


Figure D.7.8: :

**D.7.1.2.4.2 Calculation of LV\_TQ\_ADD\_PSTE\_IS\_AD\_INH and TIMER**

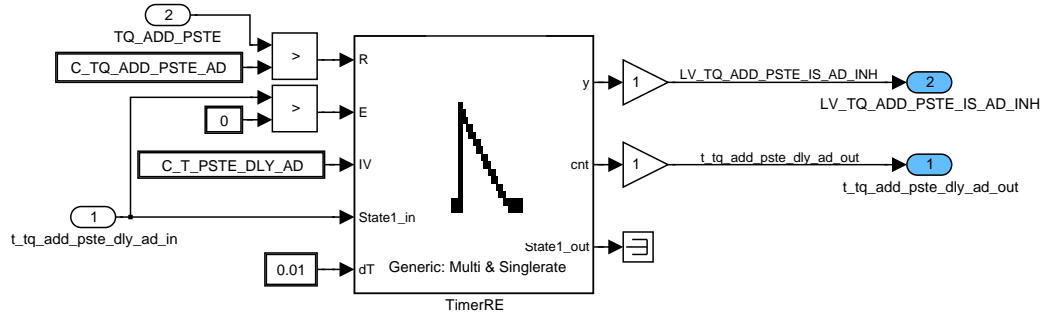


Figure D.7.9: :

**D.7.2 Torque losses power steering assistance**

**Application Conditions**

Initialization: RST  
 Recurrence: 10MS  
 Activation: LV\_IGK & LV\_VAR\_PSTE  
 Deactivation: never

**Function description**

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### D.7.2.1 Reset of variables

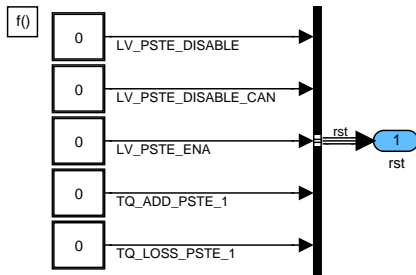


Figure D.7.10: :

#### Function description.

### D.7.2.2 Inhibition of power steering

General information:

TQ\_LOSS\_PSTE\_1 describes the needed torque during activation of power steering. ANG\_PSTE is the angle of power steering and VEL\_ANG\_PSTE the velocity of ANG\_PSTE.

#### D.7.2.2.1 CAN environment error PSTE inhibition:

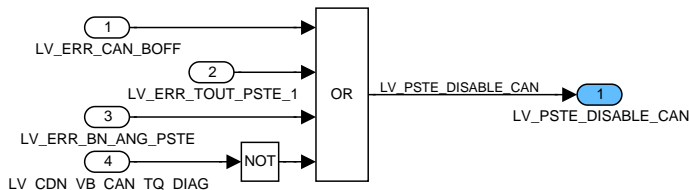


Figure D.7.11: :

#### D.7.2.2.2 General PSTE inhibition:

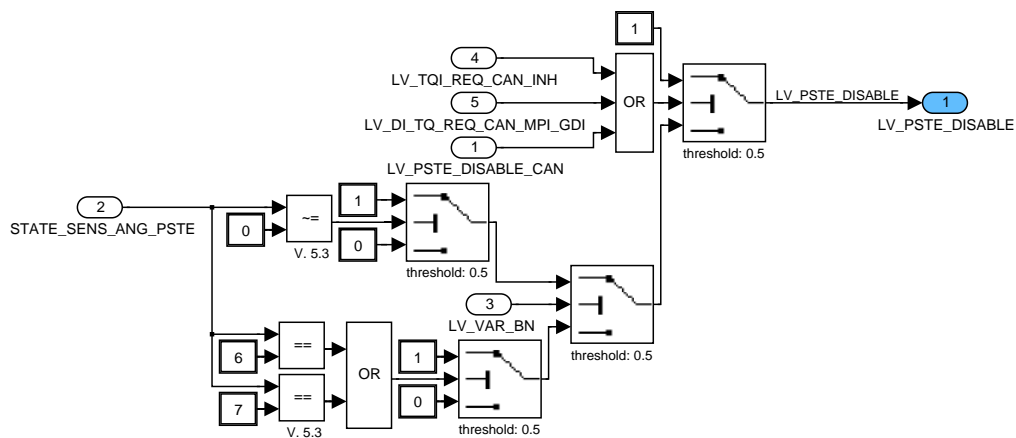



Figure D.7.12: :

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 6632 of 8404	
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### D.7.2.3 Enable conditions PSTE intervention

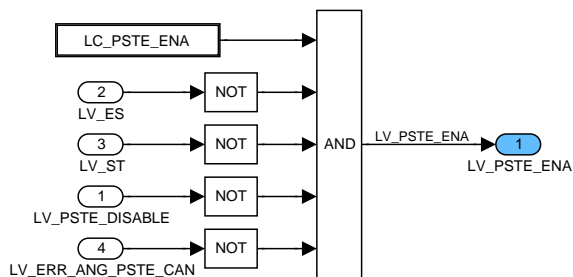


Figure D.7.13: :

### D.7.2.4 Torque loss & reserve for power steering assistance

Calculation of TQ\_LOSS\_PSTE\_1 and TQ\_ADD\_PSTE\_1.

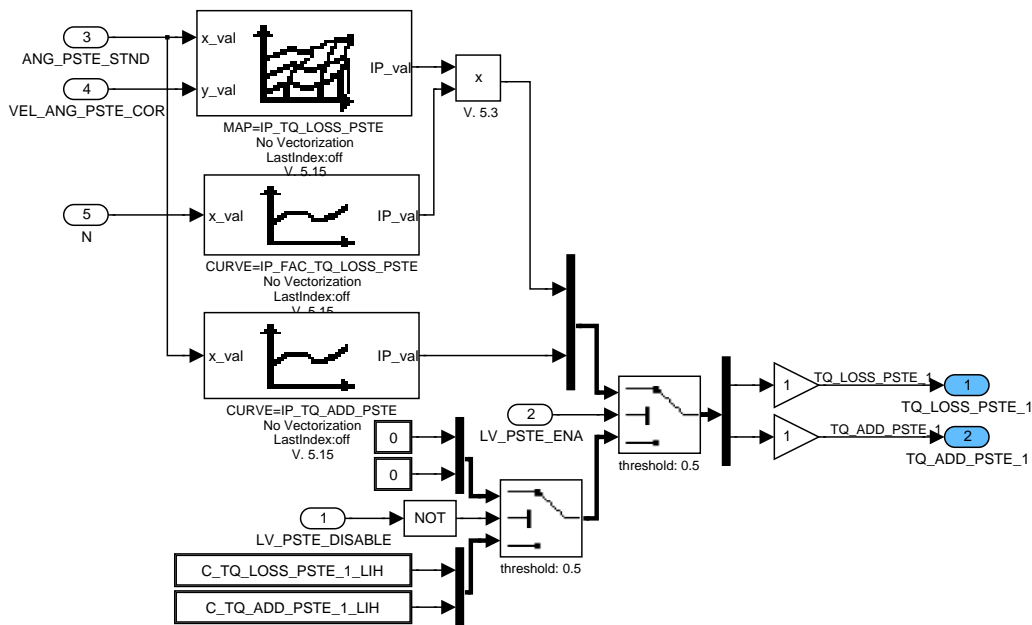


Figure D.7.14: :

### D.7.3 Torque Loss for active power steering (BN 2000)

General information:

TQ\_LOSS\_PSTE\_2 describes the torque demand and losses of active power steering. There are two informations the predicted and the Active Torque losses.

#### Application Conditions

Initialization: RST

Recurrence: 10MS

Activation: LV\_IGK & & LV\_VAR\_BN & & LV\_VAR\_PSTE\_2

Deactivation: never

**Function description**

**D.7.3.1 Reset of variables.**

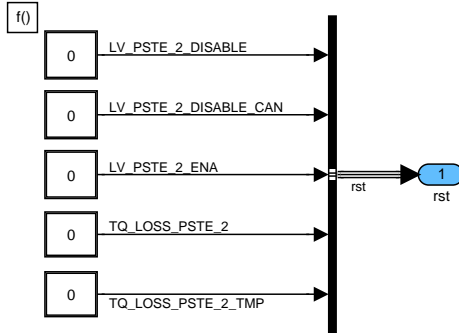


Figure D.7.15: :

**Function description**

**D.7.3.2 Inhibition of active power steering**

**D.7.3.2.1 CAN environment error PSTE\_2 inhibition:**

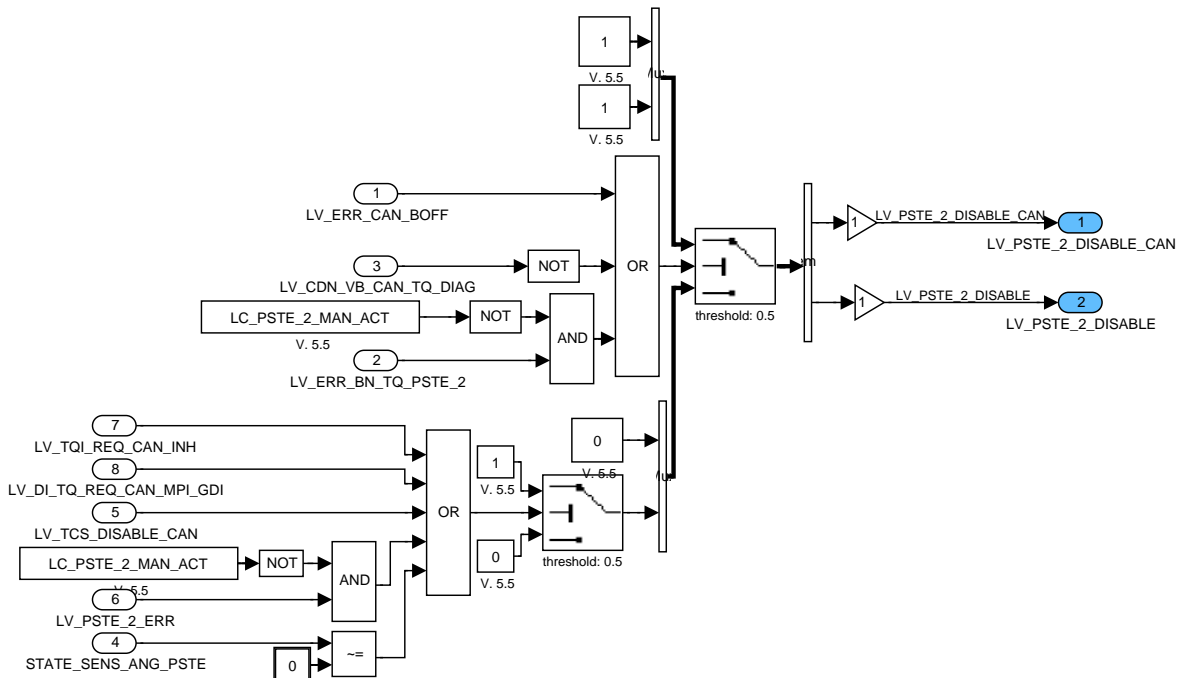



Figure D.7.16: :

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 6634 of 8404</b>	
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### D.7.3.3 Enable conditions PSTE intervention

#### FUNCTION DESCRIPTION:

The State STATE\_TQ\_PSTE\_2\_PLAUS indicates the interrupted condition which is responsible for enable Bit = 0. The [ x ] Value shows the HEX address inside the Bitwise coded State.

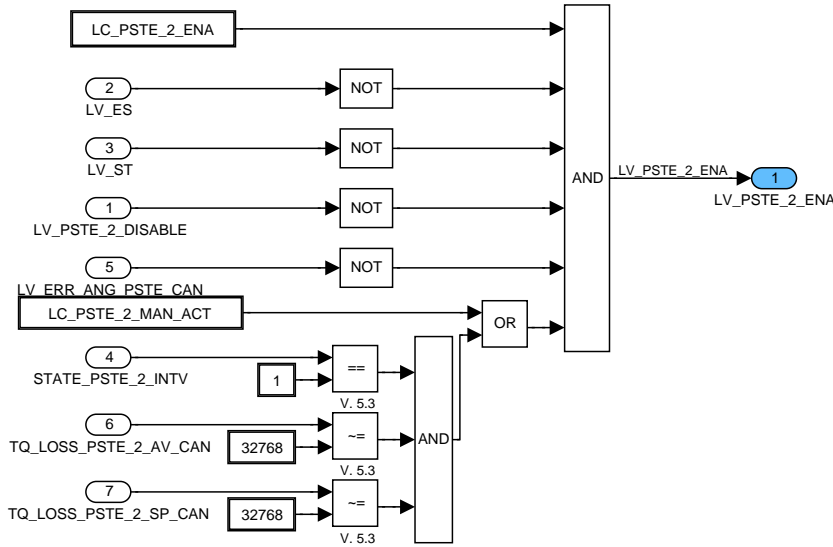
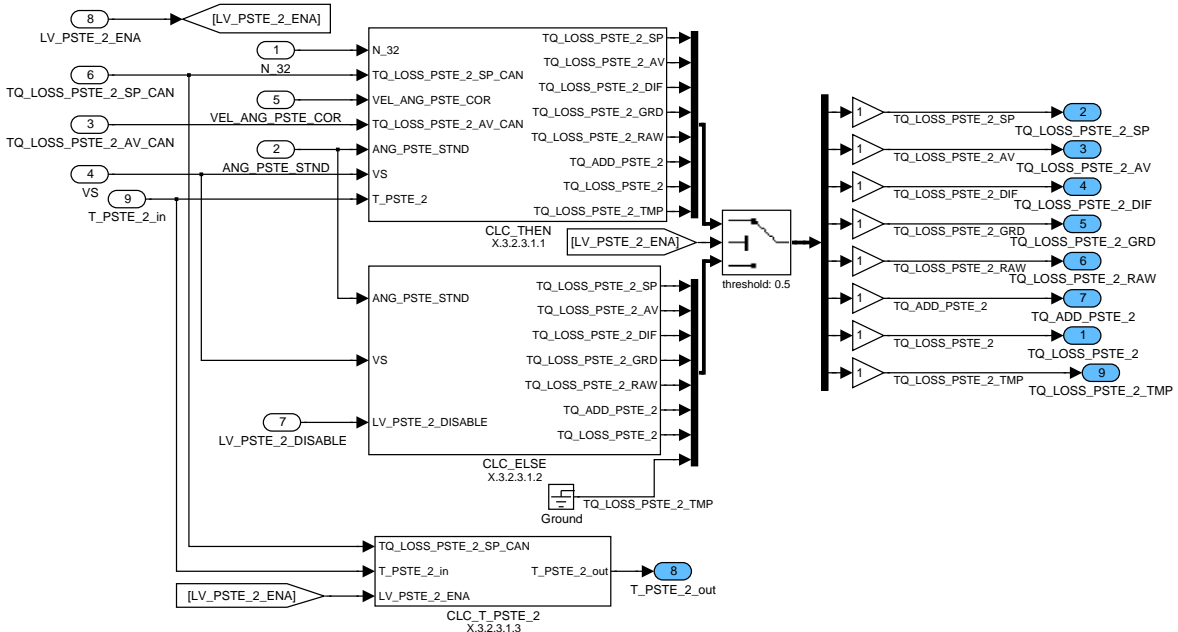


Figure D.7.17: :

### D.7.3.4 Torque loss active PSTE\_2

#### D.7.3.4.1 Calculation depending on LV\_PSTE\_2\_ENA



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Figure D.7.18: :

D.7.3.4.1.1 Calculation when LV\_PSTE\_2\_ENA is true.

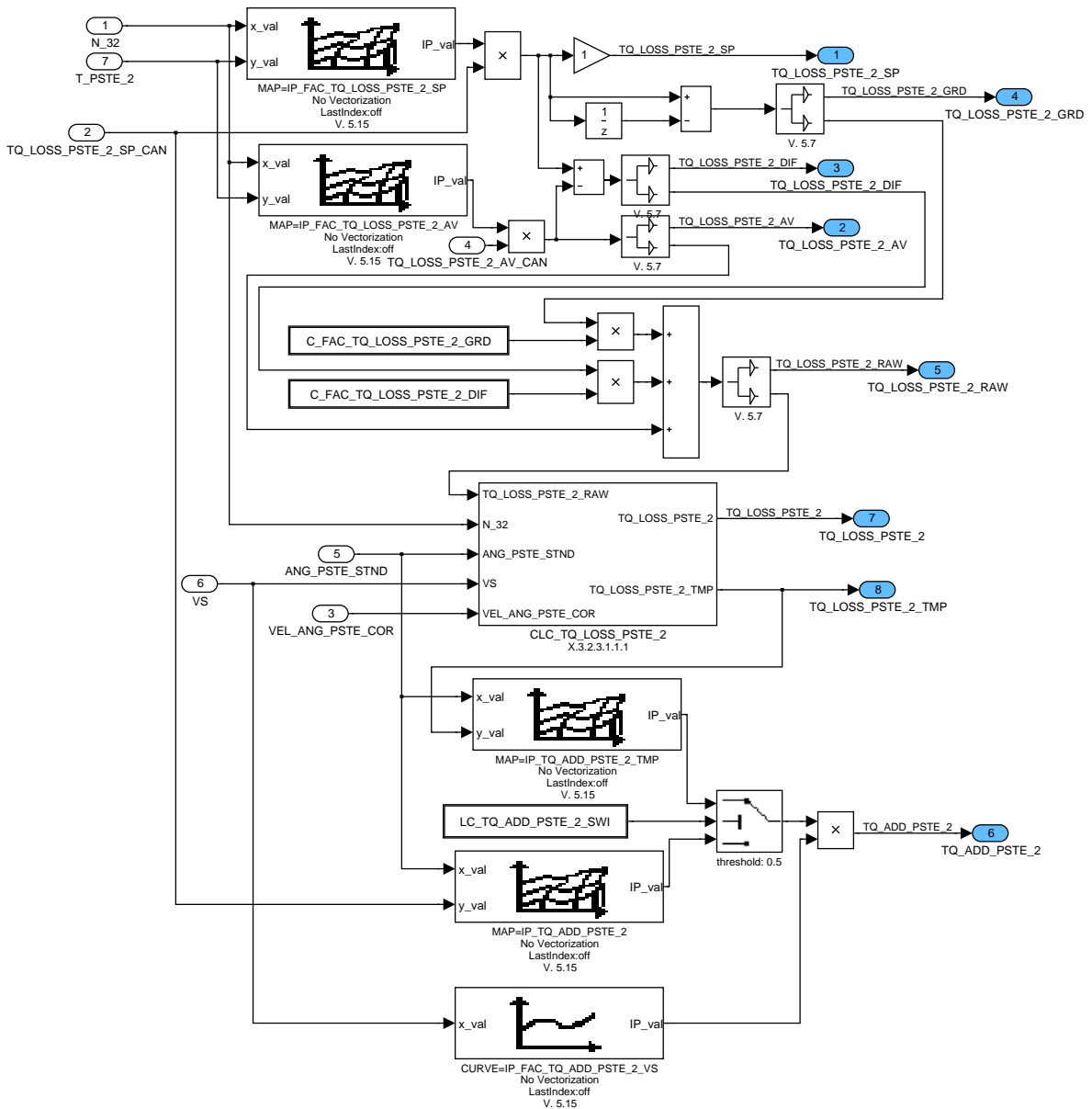


Figure D.7.19: :

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D.7.3.4.1.1.1 Calculation of TQ\_LOSS\_PSTE\_2

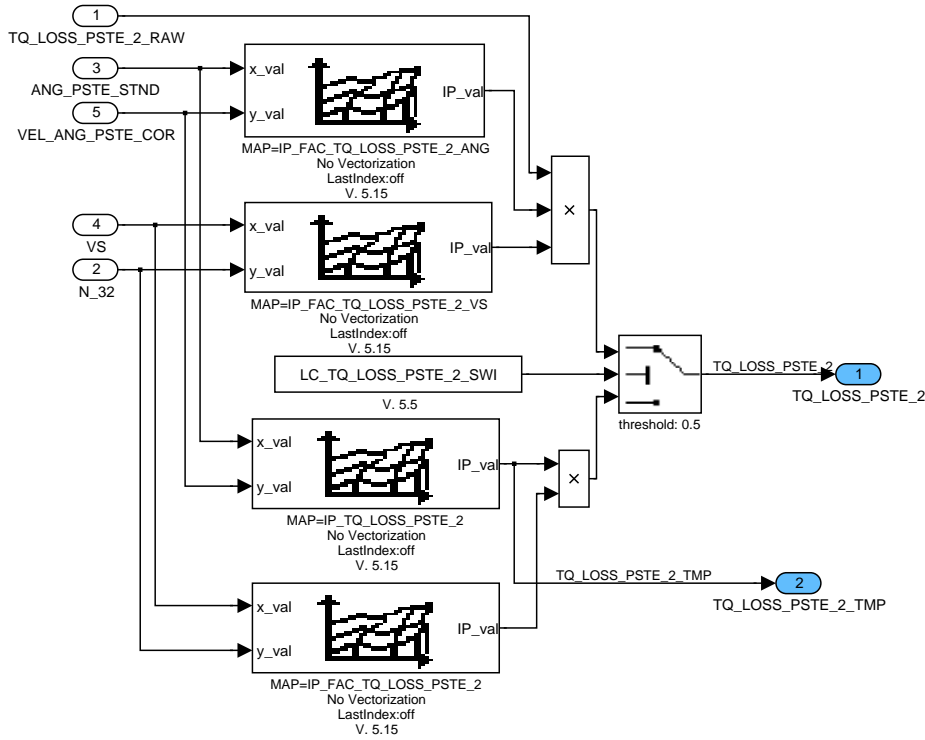


Figure D.7.20: :

D.7.3.4.1.2 Calculation when LV\_PSTE\_2\_ENA is false.

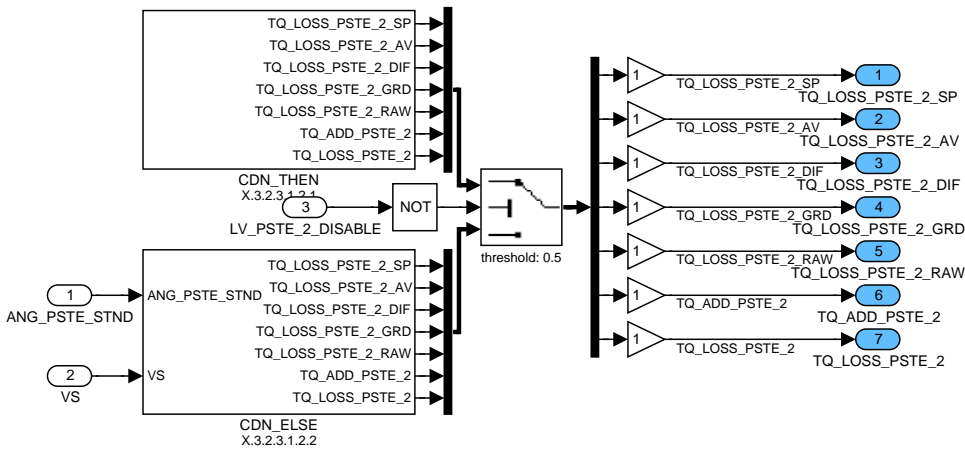


Figure D.7.21: :

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**D.7.3.4.1.2.1 Calculation when LV\_PSTE\_2\_DISABLE is true.**

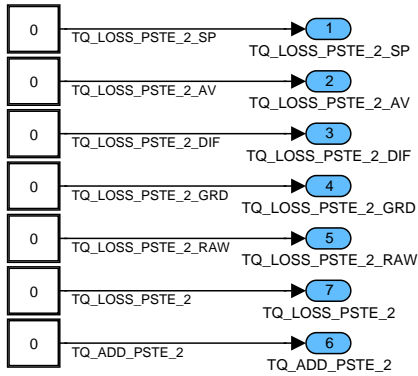


Figure D.7.22: :

**D.7.3.4.1.2.2 Calculation depending on LV\_PSTE\_2\_DISABLE.**

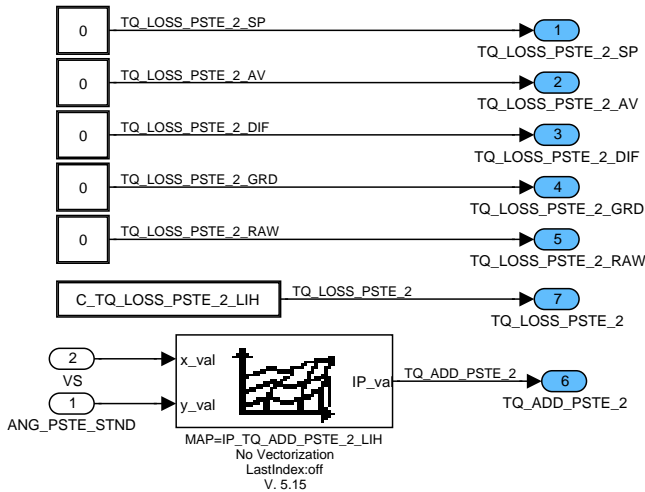


Figure D.7.23: :

**D.7.3.4.1.3 Timer calculation.**

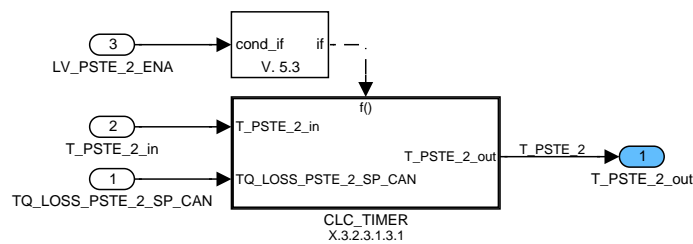


Figure D.7.24: :

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### D.7.3.4.1.3.1 Calculation of timer T\_PSTE\_2.

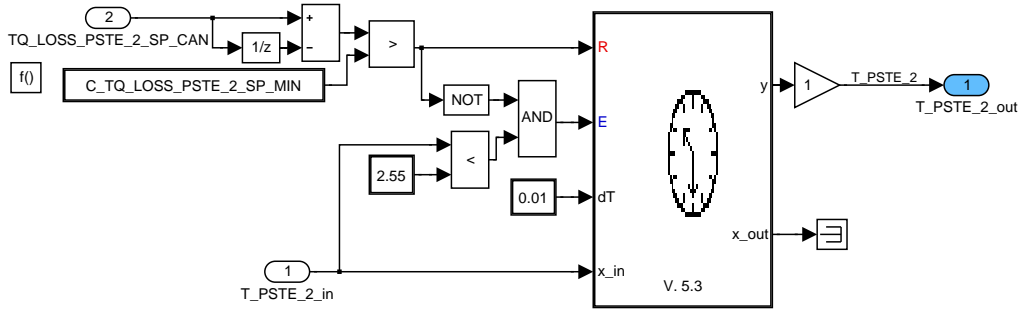


Figure D.7.25: :

### D.7.3.5 STATE\_TQ\_PSTE\_2\_PLAUS

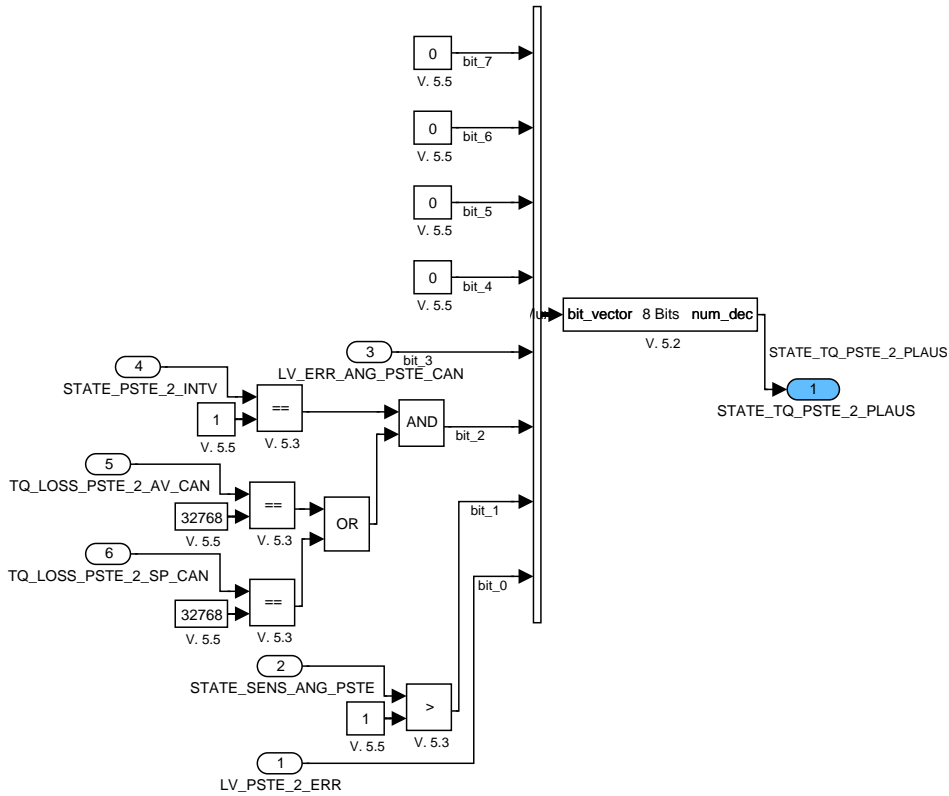


Figure D.7.26: :


## D.7.4 Torque Loss for active power steering via EHB3 Control Unit (BN 2000)

General information:

TQ\_LOSS\_PSTE\_3 describes the torque demand and losses of active power steering. Torque loss and reserve are calculated via torque request from EHB3-CPU.

### Application Conditions

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	Document key 10171571 SPE 000 AO	Pages Page 6639 of 8404	
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Initialization: RST

Recurrence: 10MS

Activation: LV\_IGK & LV\_VAR\_PSTE\_3

Deactivation: never

## Function description

### D.7.4.1 Reset of variables.

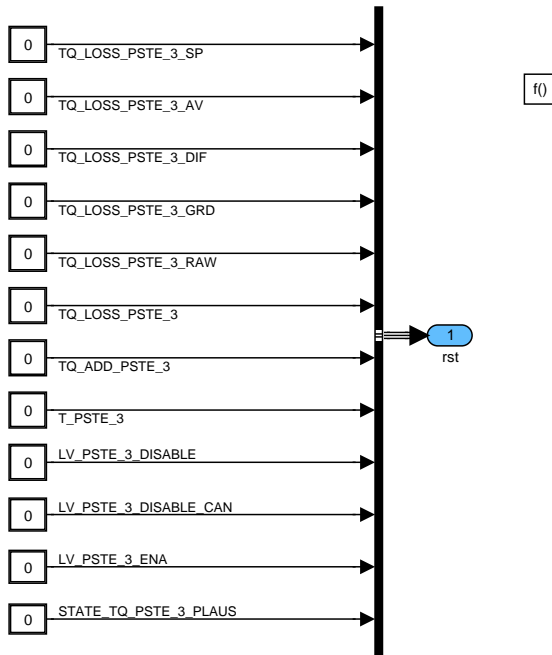


Figure D.7.27: :

## Function description.



### D.7.4.2 Inhibition of active power steering

#### D.7.4.2.1 CAN environment error PSTE\_3 inhibition:

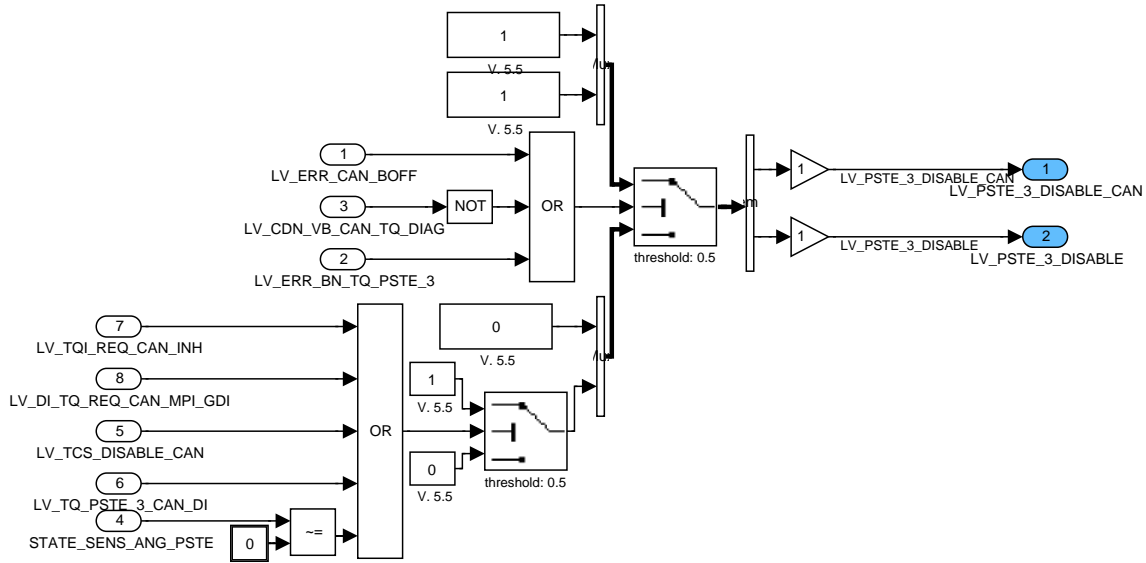


Figure D.7.28: :

#### D.7.4.3 Enable conditions PSTE\_3 intervention

FUNCTION DESCRIPTION:

The State STATE\_TQ\_PSTE\_3\_PLAUS indicates the interrupted condition which is responsible for enable Bit = 0. The [ x ] Value shows the HEX address inside the Bitwise coded State.

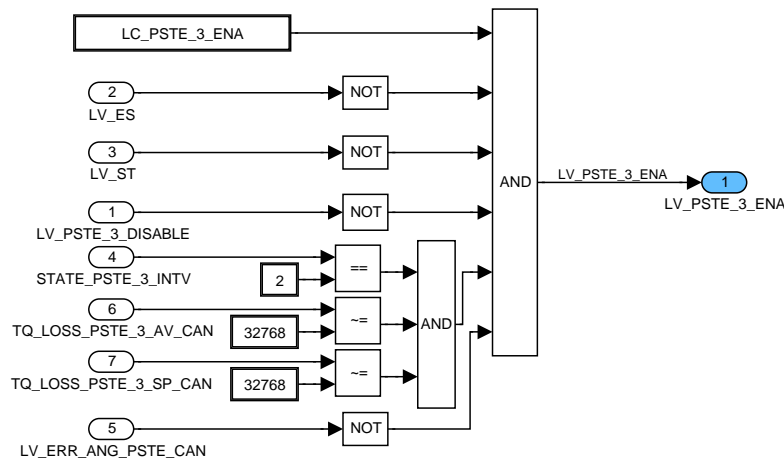


Figure D.7.29: :

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### D.7.4.4 Torque loss active PSTE\_3 (EHB3)

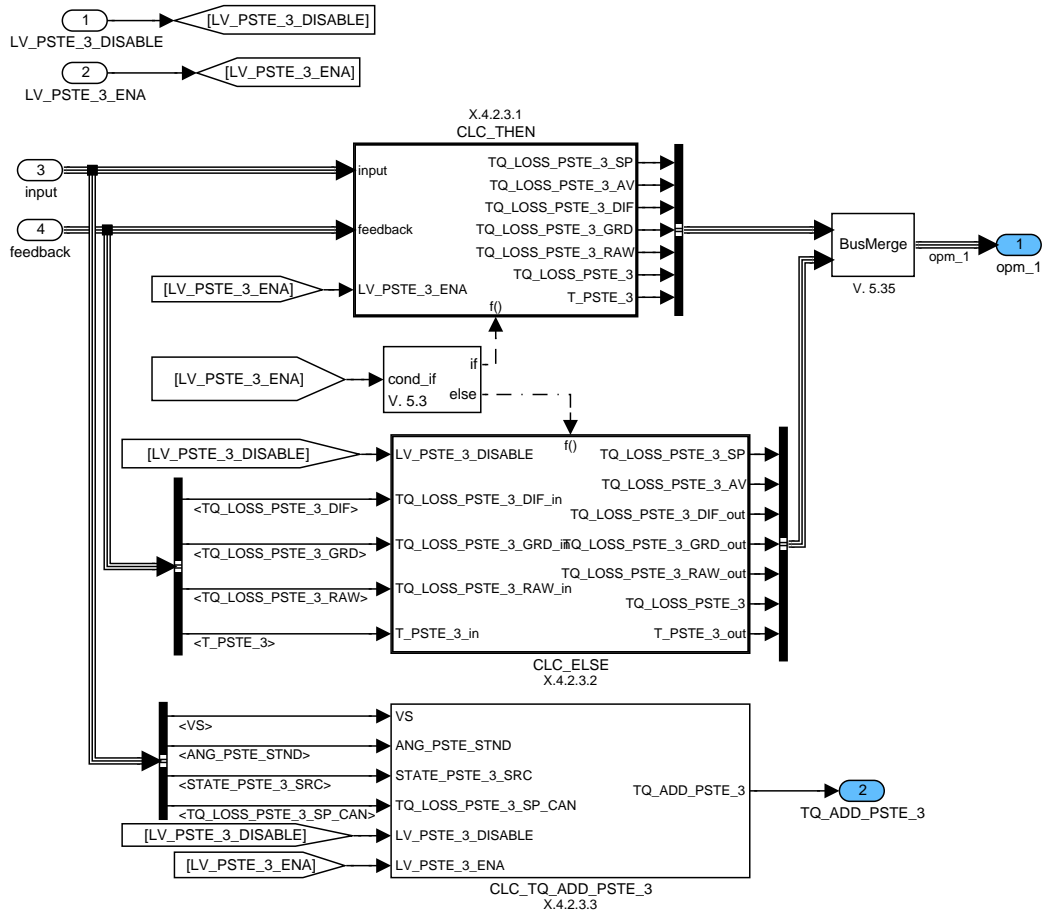


Figure D.7.30: :

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**D.7.4.4.1 Calculation when LV\_PSTE\_3\_ENA is set.**

**D.7.4.4.1.1 Calculation part.**

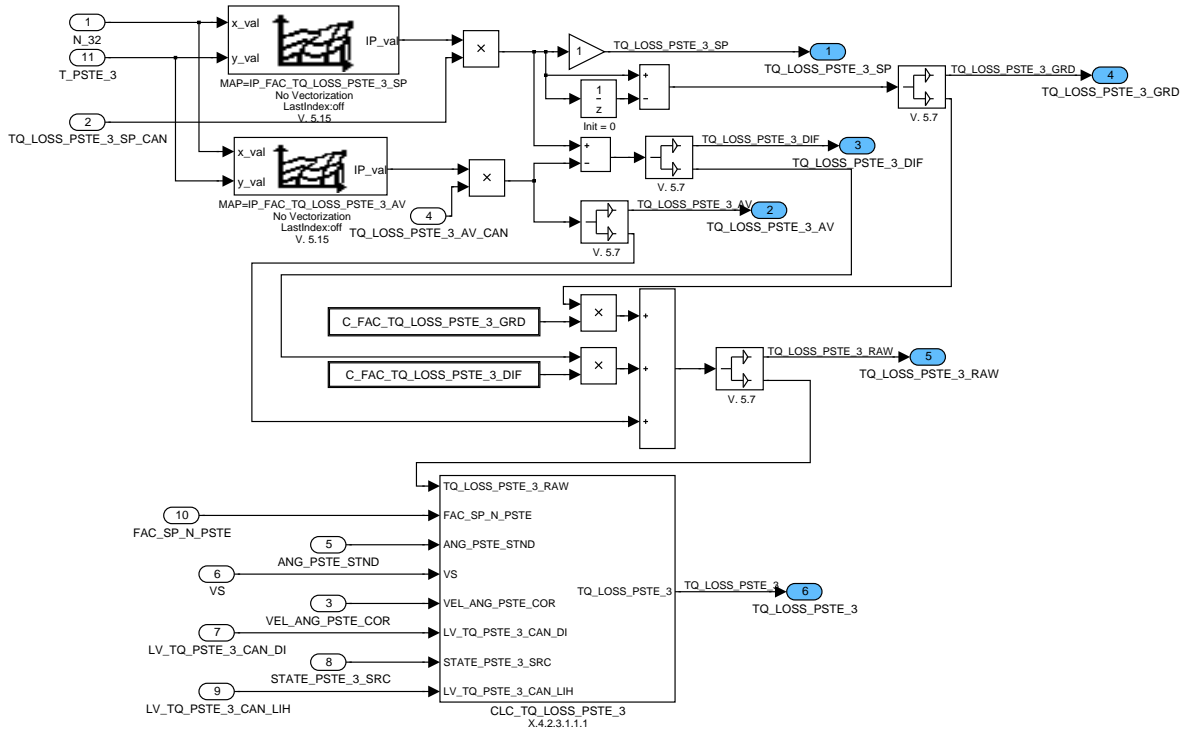


Figure D.7.31: :

**D.7.4.4.1.1.1 Calculation of TQ\_LOSS\_PSTE\_3**

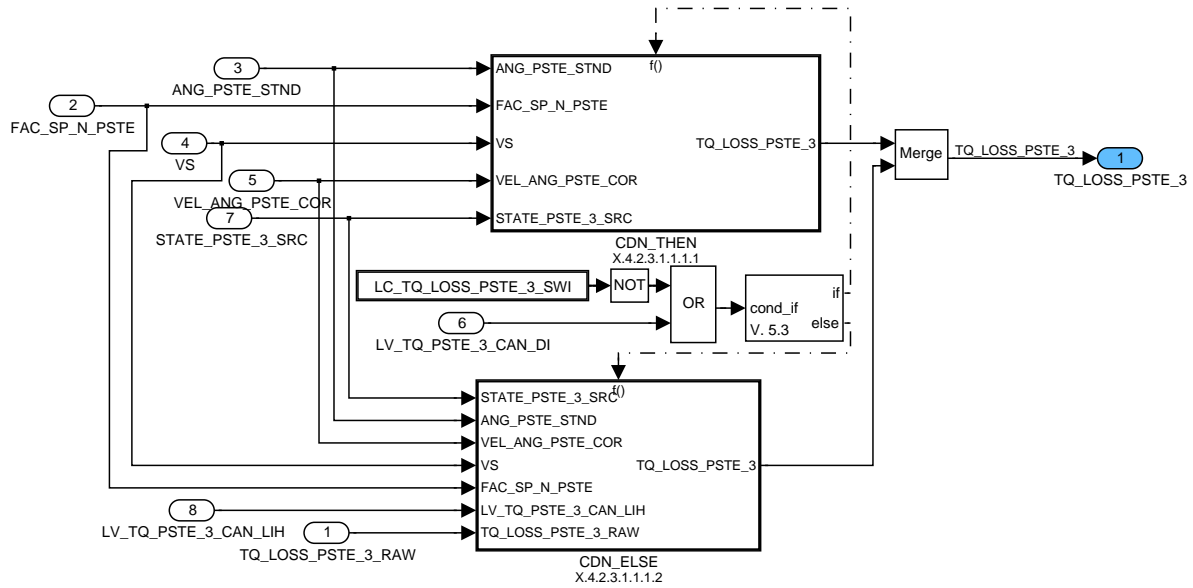


Figure D.7.32: :

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**D.7.4.4.1.1.1 Calculation of TQ\_LOSS\_PSTE\_3 depending on the state variable.**

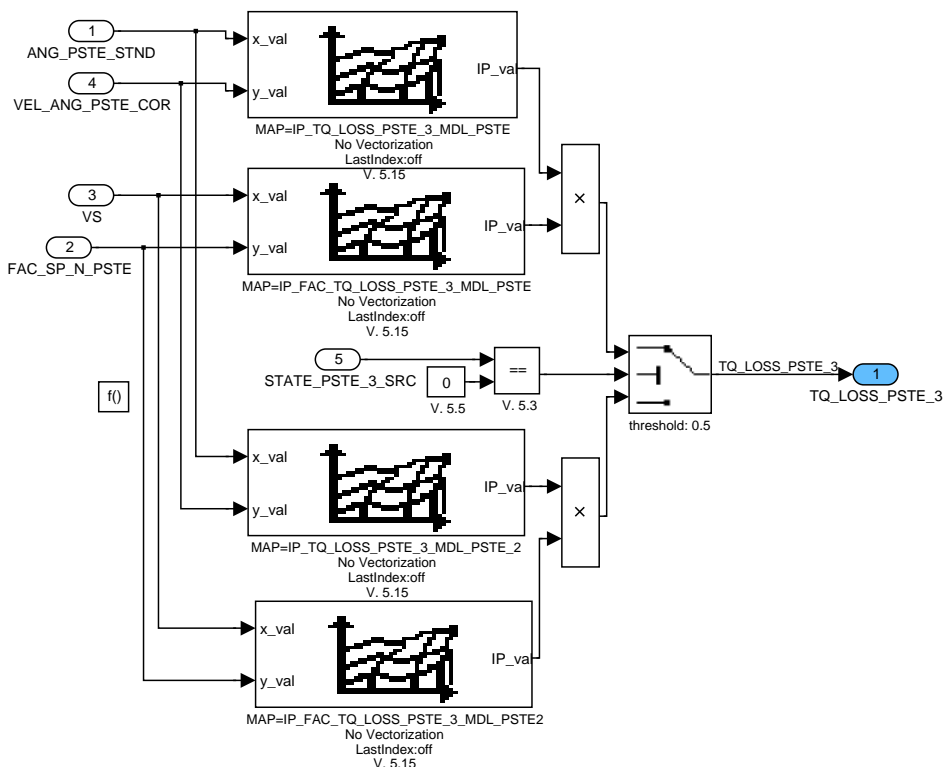


Figure D.7.33: :

**D.7.4.4.1.1.2 Calculation of TQ\_LOSS\_PSTE\_3 depending on LV\_TQ\_PSTE\_3\_CAN\_LIH.**

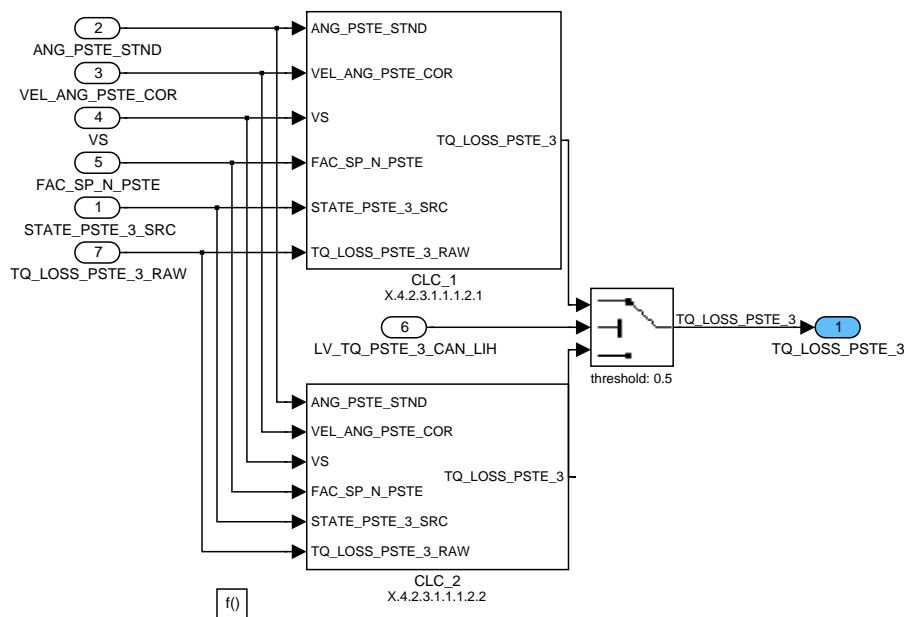


Figure D.7.34: :

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**D.7.4.4.1.1.2.1 Calculation of TQ\_LOSS\_PSTE\_3 depending on the state variable.**

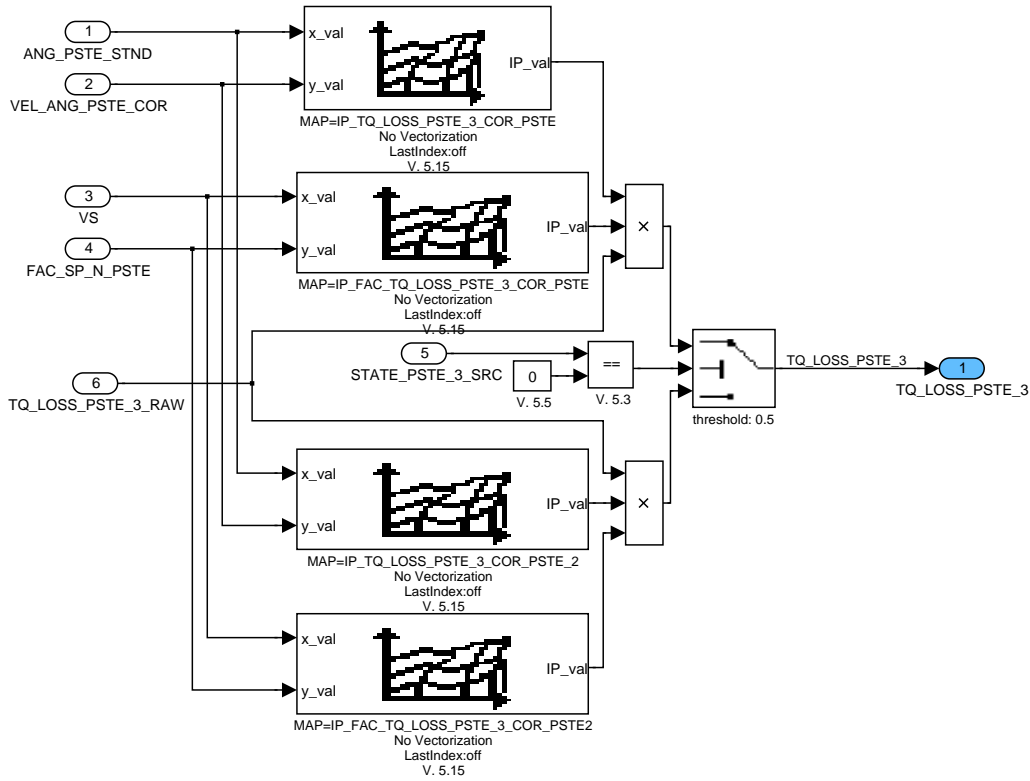


Figure D.7.35: :

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**D.7.4.4.1.1.2.2 Calculation of TQ\_LOSS\_PSTE\_3 depending on the state variable.**

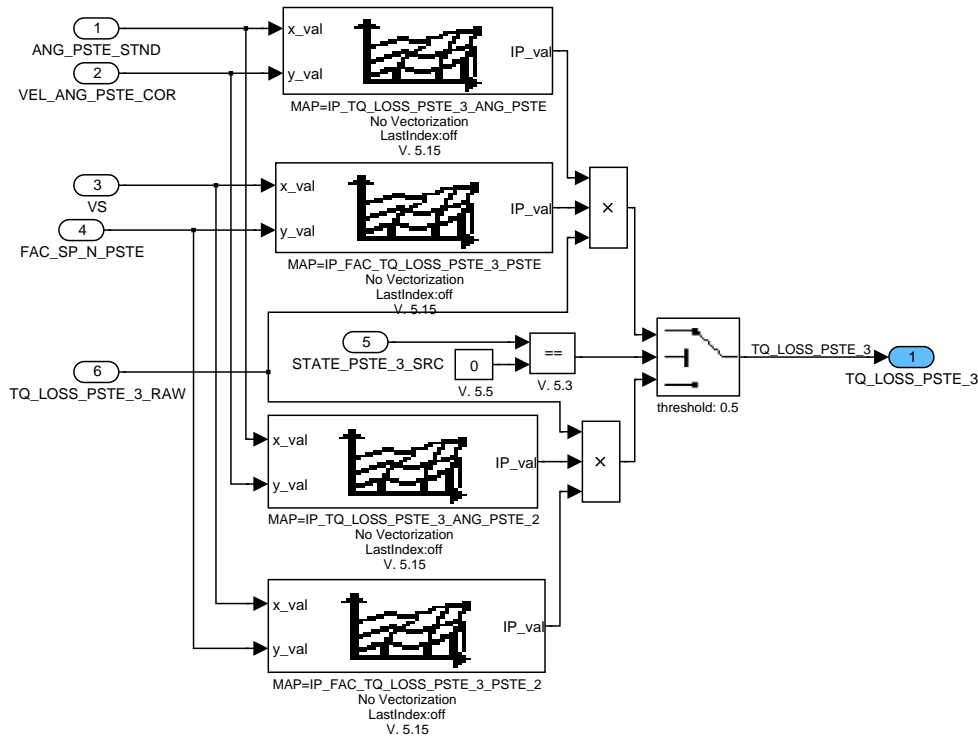


Figure D.7.36: :

**D.7.4.4.1.2 Calculation of timer.**

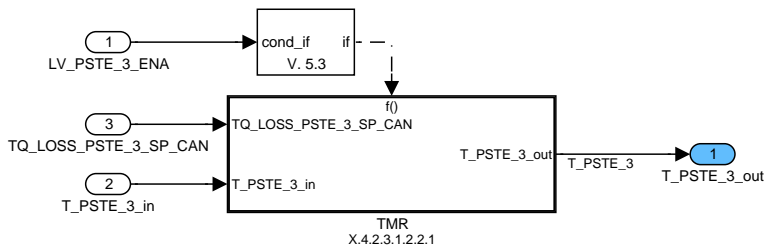


Figure D.7.37: :

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**D.7.4.4.1.2.1 Calculation of timer T\_PSTE\_3.**

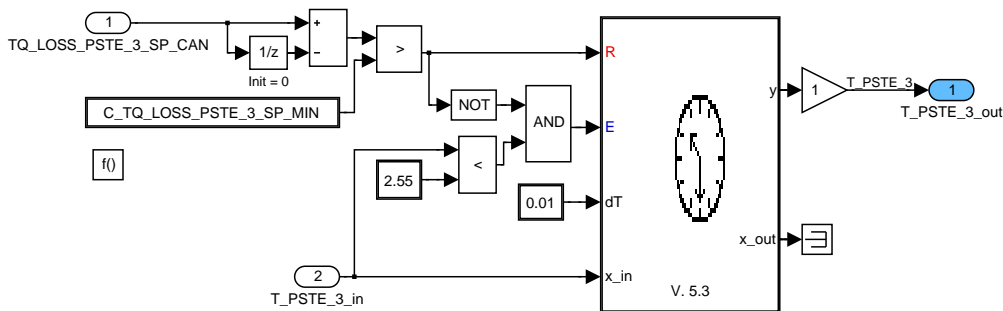


Figure D.7.38: :

**D.7.4.4.2 Calculation depending on LV\_PSTE\_3\_ENA.**

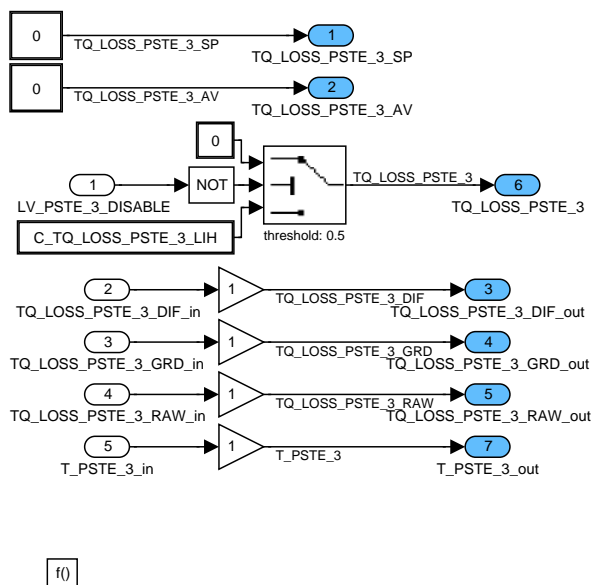


Figure D.7.39: :

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### D.7.4.4.3 Calculation of TQ\_ADD\_PSTE\_3

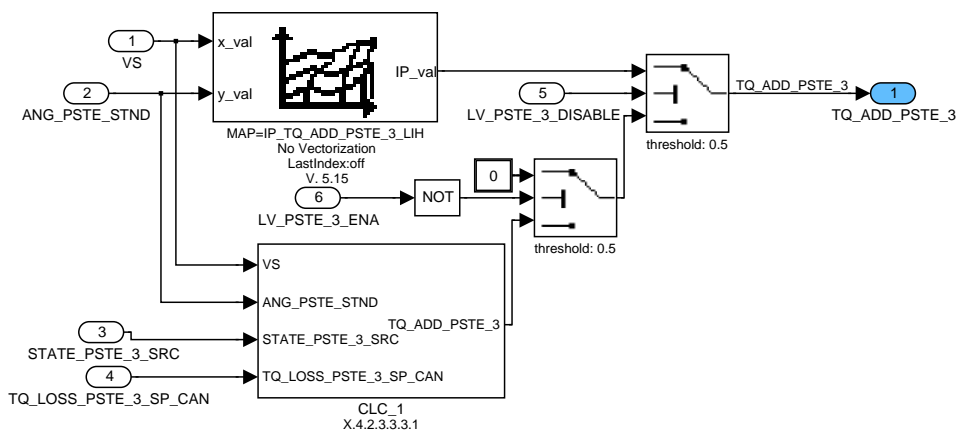


Figure D.7.40: :

#### D.7.4.4.3.1 Calculation of TQ\_ADD\_PSTE\_3 depending on the state variable.

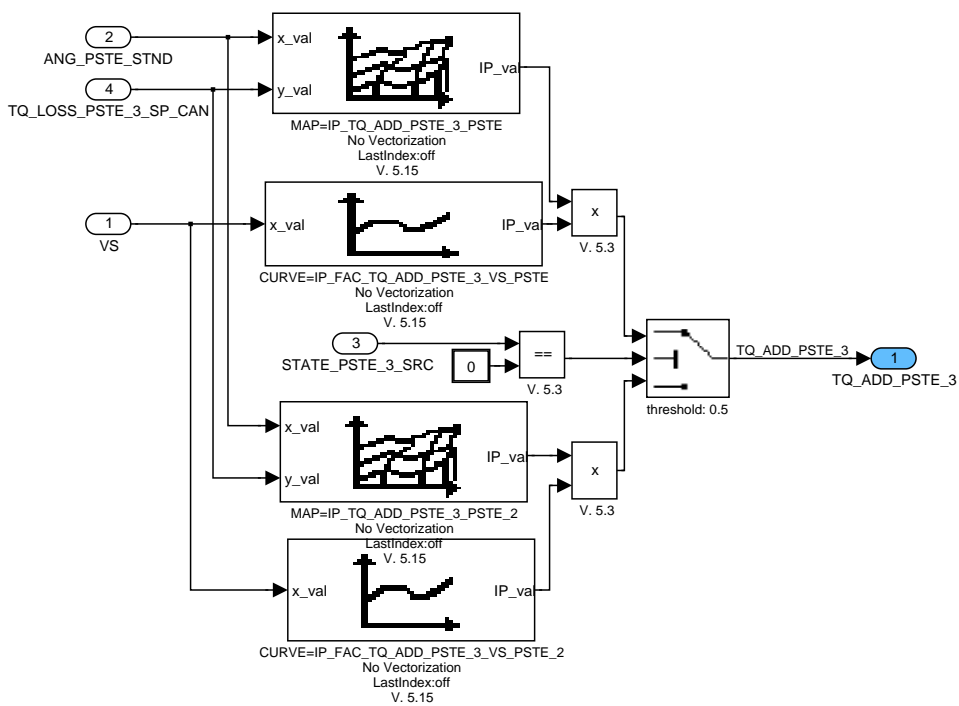


Figure D.7.41: :

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### D.7.4.5 STATE\_TQ\_PSTE\_3\_PLAUS

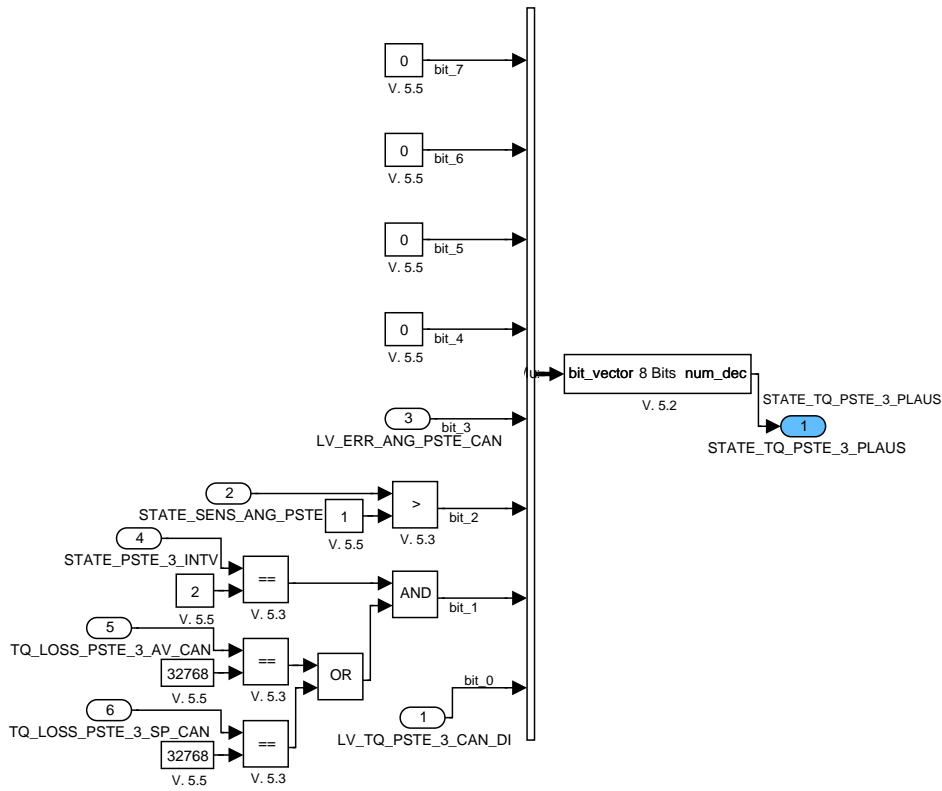


Figure D.7.42: :

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## D.8 Torque loss - Anti roll stabilisation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ARS_DISABLE	O/V	0... 1H	0 ...1	1	-
logical variable for disabling ARS intervention due to EMS error					
LV_ARS_DISABLE_CAN	O/V	0... 1H	0 ...1	1	-
logical variable for disabling ARS intervention due to CAN error					
LV_ARS_ENA	O/V	0... 1H	0 ...1	1	-
logical variable for ARS intervention enabling					
LV_TQ_LOSS_ARS_IS_AD_INH	O/V	0... 1H	0 ...1	1	-
flag for inhibition of IS-control adaptations due to torque losses ARS					
LV_TQ_MAX_ARS	O/V	0... 1H	0 ...1	1	-
logical variable indicating maximum torque request - ARS					
STATE_TQ_ARS_PLAUS	O/V	0... FFH	0.. 255	1	-
Bitwise coded State for ARS intervention state					
T_DLY_TQ_MAX_ARS	O/V	0... FFFFH	0... 655.35	0.01	s
Delay time for activation of LV_TQ_MAX_ARS					
TQ_LOSS_ARS	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque loss by ARS-intervention					
TQ_LOSS_ARS_AV_MAX	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
ARS actual value of torque loss - maximum (considering offset)					
TQ_LOSS_ARS_AV_MAX_1	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
ARS actual value of torque loss - maximum					
TQ_LOSS_ARS_DIF	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Difference torque loss TQ_LOSS_ARS_SP_CAN - TQ_LOSS_ARS_AV_CAN					
TQ_LOSS_ARS_GRD	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque loss gradient - ARS					
TQ_LOSS_ARS_SP_CAN_MAX	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque loss SP via CAN by ARS-intervention					
TQ_LOSS_ARS_SP_MAX	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
ARS target torque loss - maximum (considering offset)					
TQ_LOSS_ARS_SP_MAX_1	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
ARS target torque loss - maximum					

### Input data:

AC_VEH_TRV_TCS {p. 1561}	LV_CDN_VB_CAN_TQ_ DIAG {p. 1185}	LV_DI_TQ_REQ_CAN_ MPI_GDI {p. 800}	LV_ERR_BN_ARS {p. 4869}
LV_ERR_BN_VS_TCS {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_TQ_LOSS_ARS_ AV_CAN {p. 1565}	LV_ERR_TQ_LOSS_ARS_ SP_CAN {p. 1565}

LV_ES {p. 1720}	LV_IGK {p. 906}	LV_ST {p. 1720}	LV_TCS_DISABLE_CAN {p. 6741}
LV_TQI_REQ_CAN_INH {p. 6687}	LV_VAR_ARS {p. 655}	LV_VAR_BN {p. 655}	N_32 {p. 1525}
STATE_ARS_CAN {p. 1570}	TQ_LOSS_ARS_AV_CAN {p. 1581}	TQ_LOSS_ARS_SP_CAN {p. 1581}	VS_FIL {p. 1176}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQ_LOSS_ARS_DIF	-	0... FFFFH	0... 0.99998	15.3e-6	-
ARS torque loss actual value - correction factor					
C_FAC_TQ_LOSS_ARS_GRD	-	0... FFFFH	0... 0.99998	15.3e-6	-
ARS torque loss gradient - correction factor					
C_N_MAX_ARS_DIAG	-	0... FFH	0... 8160	32	rpm
engine speed limit threshold for diagnosis					
C_T_ARS_DLY_AD	-	0... FFH	0... 2.55	0.01	s
threshold torque losses PSTE for inhibition of IS-control adaptations					
C_T_DLY_TQ_MAX_ARS	-	0... FFFFH	0... 655.35	0.01	s
Time delay for activating LV_TQ_MAX_ARS					
C_TQ_LOSS_ARS_AD	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
threshold torque losses PSTE for inhibition of IS-control adaptations					
C_TQ_LOSS_ARS_AV_OFS	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Offset for TQ_LOSS_ARS_AV					
C_TQ_LOSS_ARS_SP_OFS	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Offset for TQ_LOSS_ARS_SP					
C_V_MAX_ARS_DIAG	-	0... FFFFH	0... 511.99218	0.0078125	km/h
filtered vehicle speed threshold for diagnosis					
IP_TQ_LOSS_ARS_AV_CAN_MAX	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_TQ_LOSS_ARS_AV_CAN_MAX	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_N_32_TQ_LOSS_ARS	4	0... FFH	0... 8160	32	rpm
ARS torque loss depending on torque loss (AV) via CAN and engine speed					
IP_TQ_LOSS_ARS_AV_MAX	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_AC_VEH_TRV_TCS	8	10... FFF0H	-51.175 ...51.175	0.0015625	m/s**2
LDP_VS_FIL	8	0... FFFFH	0... 511.99218	0.0078125	km/h
ARS Actual value of torque loss - maximum					
IP_TQ_LOSS_ARS_SP_CAN_MAX	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_TQ_LOSS_ARS_SP_CAN	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_N_32_TQ_LOSS_ARS	4	0... FFH	0... 8160	32	rpm
ARS torque loss depending on torque loss (SP) via CAN and engine speed					
IP_TQ_LOSS_ARS_SP_MAX	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_AC_VEH_TRV_TCS	8	10... FFF0H	-51.175 ...51.175	0.0015625	m/s**2
LDP_VS_FIL	8	0... FFFFH	0... 511.99218	0.0078125	km/h
ARS target torque loss - maximum					

## FUNCTION DESCRIPTION:

### General information:

TQ\_LOSS\_ARS represents the engine torque loss due to power consumption by the ARS control unit during anti-roll-stabilisation intervention.

## D.8.1 Enable conditions

### D.8.1.1 Inhibition ARS intervention

## FUNCTION DESCRIPTION:

### Application conditions

**Initialisation:** LV\_ARS\_DISABLE = 0 , LV\_ARS\_DISABLE\_CAN = 0 **at reset**

**Update Rate:** 10 ms

**Activation:** LV\_VAR\_BN = 1 **and** LV\_IGK = 1

**Deactivation:** -

### Formula section:

#### CAN environment error ARS inhibition:

```

If          LV_ERR_CAN_BOFF          = 1    or
              LV_ERR_BN_ARS            = 1    or
              LV_CDN_VB_CAN_TQ_DIAG = 0
Then       LV_ARS_DISABLE_CAN = 1
Else       LV_ARS_DISABLE_CAN = 0
Endif


```

#### General ARS inhibition:

```

If          LV_TQI_REQ_CAN_INH      = 1    or
              LV_DI_TQ_REQ_CAN_MPI_GDI = 1    or
              LV_ARS_DISABLE_CAN      = 1    or
              LV_TCS_DISABLE_CAN      = 1    or
              LV_ERR_TQ_LOSS_ARS_SP_CAN = 1    or
              LV_ERR_TQ_LOSS_ARS_AV_CAN = 1
Then       LV_ARS_DISABLE = 1
Else       LV_ARS_DISABLE = 0

```

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**Endif****D.8.1.2 Enable conditions ARS intervention****FUNCTION DESCRIPTION:**

The State STATE\_TQ\_ARS\_PLAUS indicates the interrupted condition which is responsible for enable Bit = 0. The [ x ] Value shows the HEX adress inside the Bitwise coded State.

**Application conditions**

**Initialisation:** LV\_ARS\_ENA = 0 **at reset**

**Update Rate:** 10 ms

**Activation:** LV\_VAR\_ARS **and** LV\_IGK = 1

**Deactivation:** -

**Formula section:****Enable conditions for ARS intervention:**

**If** LV\_ES = 0 **and**  
 LV\_ST = 0 **and**  
 LV\_ARS\_DISABLE = 0 **and**  
 LV\_TQ\_MAX\_ARS = 0 **and**  
 STATE\_ARS\_CAN = 01H

**Then** LV\_ARS\_ENA = 1

**Else** LV\_ARS\_ENA = 0

**STATE\_TQ\_ARS\_PLAUS:**

**If** LV\_ERR\_TQ\_LOSS\_ARS\_SP\_CAN = 1 **or** BIT [00] set  
 LV\_ERR\_TQ\_LOSS\_ARS\_AV\_CAN = 1 BIT [01] set

**If** LV\_TQ\_MAX\_ARS = 1 BIT [02] set

**Then If** STATE\_ARS\_CAN = 01H BIT [03] set

**D.8.2 Maximum Torque Request****FUNCTION DESCRIPTION:**

If either:

- the target torque loss via CAN is bigger than the minimum selection of maximum target torque loss (depending on VS\_FIL, AC\_VEH\_TRV\_TCS) and 100 Nm

or:

- the actual value of torque loss via CAN is bigger than the minimum selection of the actual value (maximum) of torque loss (depending on VS\_FIL, AC\_VEH\_TRV\_TCS) and 100 Nm

then after a time delay (C\_T\_DLY\_TQ\_MAX\_ARS) LV\_MAX\_ARS is set to 1.

LV\_MAX\_ARS is indicating whether maximum torque request is present or not. The logical variable is used for validating the status of ARS.

## Application conditions

**Initialisation:** LV\_TQ\_MAX\_ARS = 0  
 TQ\_LOSS\_ARS\_SP\_MAX = 0 Nm  
 TQ\_LOSS\_ARS\_SP\_MAX\_1 = 0 Nm  
 TQ\_LOSS\_ARS\_AV\_MAX = 0 Nm  
 TQ\_LOSS\_ARS\_AV\_MAX\_1 = 0 Nm  
 T\_DLY\_TQ\_MAX\_ARS = C\_T\_DLY\_TQ\_MAX\_ARS **at reset**

**Update Rate:** 10 ms

**Activation:** LV\_VAR\_ARS = 1 **and** LV\_IGK = 1

**Deactivation:** -

## Formula section:

**If** VS\_FIL ≤ C\_V\_MAX\_ARS\_DIAG **and**  
 N\_32 < C\_N\_MAX\_ARS\_DIAG  
**Then** TQ\_LOSS\_ARS\_SP\_MAX = TQ\_LOSS\_ARS\_SP\_MAX\_1 +  
 C\_TQ\_LOSS\_ARS\_SP\_OFS  
 TQ\_LOSS\_ARS\_AV\_MAX = TQ\_LOSS\_ARS\_AV\_MAX\_1 +  
 C\_TQ\_LOSS\_ARS\_AV\_OFS  
**Else** TQ\_LOSS\_ARS\_SP\_MAX = TQ\_LOSS\_ARS\_SP\_MAX\_1  
 TQ\_LOSS\_ARS\_AV\_MAX = TQ\_LOSS\_ARS\_AV\_MAX\_1

**Endif**

TQ\_LOSS\_ARS\_SP\_MAX\_1 = IP\_TQ\_LOSS\_ARS\_SP\_MAX  
 TQ\_LOSS\_ARS\_AV\_MAX\_1 = IP\_TQ\_LOSS\_ARS\_AV\_MAX

**If** TQ\_LOSS\_ARS\_SP\_CAN > MIN(TQ\_LOSS\_ARS\_SP\_MAX, 100 Nm) **or**  
 TQ\_LOSS\_ARS\_AV\_CAN > MIN(TQ\_LOSS\_ARS\_AV\_MAX, 100 Nm)  
**Then** T\_DLY\_TQ\_MAX\_ARS = T\_DLY\_TQ\_MAX\_ARS - 10ms  
**If** T\_DLY\_TQ\_MAX\_ARS ≤ 0  
**Then** LV\_TQ\_MAX\_ARS = 1  
**Else** LV\_TQ\_MAX\_ARS = 0  
**Endif**  
**Else** T\_DLY\_TQ\_MAX\_ARS = C\_T\_DLY\_TQ\_MAX\_ARS  
 LV\_TQ\_MAX\_ARS = 0

**Endif**

## D.8.3 Torque Loss ARS

### FUNCTION DESCRIPTION:

### General information:

TQ\_LOSS\_ARS represents the engine torque loss due to power consumption by the ARS control unit during anti-roll-stabilisation intervention.

## Application conditions

**Activation:**  $LV\_VAR\_ARS = 1$  **and**  $LV\_IGK = 1$

**Deactivation:** -

**Initialisation:**  $TQ\_LOSS\_ARS = 0$  Nm **at reset**

**Update Rate:** 10 ms

## Formula section:

### Calculation of TQ\_LOSS\_ARS:

```

If          LV_ARS_ENA = 1
Then       TQ_LOSS_ARS_SP_CAN_MAX = IP_TQ_LOSS_ARS_SP_CAN_MAX
              TQ_LOSS_ARS_GRD = TQ_LOSS_ARS_SP_CAN_MAXN -
                              TQ_LOSS_ARS_SP_CAN_MAXN-1
              TQ_LOSS_ARS_DIF = IP_TQ_LOSS_ARS_SP_CAN_MAX -
                              IP_TQ_LOSS_ARS_AV_CAN_MAX
              TQ_LOSS_ARS = TQ_LOSS_ARS_DIF * C_FAC_TQ_LOSS_ARS_DIF +
                              IP_TQ_LOSS_ARS_AV_CAN_MAX + TQ_LOSS_ARS_GRD *
                              C_FAC_TQ_LOSS_ARS_GRD
Else       TQ_LOSS_ARS_GRD = 0 Nm
              TQ_LOSS_ARS_DIF = 0 Nm
              TQ_LOSS_ARS = 0 Nm
  
```

**Endif**

### Condition for inhibition of IS-control adaptations:

```

If          TQ_LOSS_ARS < C_TQ_LOSS_ARS_AD
Then       T_TQ_LOSS_ARS_DLY_AD = C_T_ARS_DLY_AD
              LV_TQ_LOSS_ARS_IS_AD_INH = 1
Else       If      T_TQ_LOSS_ARS_DLY_AD > 0
              Then  decrement timer to zero
              Else  LV_TQ_LOSS_ARS_IS_AD_INH = 0
              Endif
  
```

**Endif**

## D.9 Actual engine torque

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_TOT_AV	V	0... FFFF H	0... 1.999969	30.518e-6	-
Total actual efficiency (in homogeneous mode)					
TQ_AV	O/V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Actual engine torque static at clutch					
TQE	O/V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Effective engine torque at clutch					
TQE_DIF	V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Difference effective engine torque at clutch					

### Input data:

EFF_IGA_AV {p. 1845}	EFF_LAMB_AV {p. 8379}	EFF_SCC_AV {p. 6665}	LV_HOM_RUN {p. 8136}
LV_S_ACT {p. 8137}	N_GRD {p. 1525}	TQ_LOSS {p. 8385}	TQI_AV {p. 981}
TQI_AV_HOM {p. 8380}	TQI_AV_S {p. 8380}	TQI_REF {p. 8380}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQE	-	0... FF H	0... 0.249	976.47e-6	kg*m <sup>2</sup> /s
Effective engine torque at clutch					

## FUNCTION DESCRIPTION:

### General information:

TQI\_AV is the actual indicated engine torque produces either in homogeneous or stratified combustion mode. The combustion mode is indicated by the logical variable LV\_S\_ACT (1 ... stratified combustion; 0 ... homogeneous combustion). TQ\_AV is the actual static effective torque at clutch. TQE is the actual effective torque at clutch inclusive inertia.

These values are used for external units (e.g. traction control and gear box) as a feedback signal.

### Application conditions

<b>Activation:</b>	<i>at every engine state</i>
<b>Deactivation:</b>	-
<b>Initialization</b>	at reset TQ_AV = TQE = TQE_DIF = 0 Nm
<b>Update rate:</b>	10 ms

### Formula section:

$$\begin{aligned} \text{EFF\_TOT\_AV} &= \text{EFF\_IGA\_AV} * \text{EFF\_SCC\_AV} * \text{EFF\_LAMB\_AV} \\ \text{TQ\_AV} &= \text{TQI\_AV} + \text{TQ\_LOSS} \\ \text{TQE\_DIF} &= \text{C\_FAC\_TQE} * \text{N\_GRD} \\ \text{TQE} &= \text{TQ\_AV} - \text{TQE\_DIF} \end{aligned}$$




The dynamic torque is derived as follows:

$$TQE\_DIF = J \text{ (kg*m}^2\text{)} * d/dt \text{ (1/s}^2\text{)}$$

$$TQE\_DIF = J \text{ (kg*m}^2\text{)} * /30*N\_GRD \text{ (1/min/s)}$$

$$TQE\_DIF = C\_FAC\_TQE \text{ (kg*m}^2\text{*min)} * N\_GRD \text{ (1/min/s)}$$

$$C\_FAC\_TQE = J \text{ (kg*m}^2\text{)} * /30$$

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## D.10 Initialization module

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ACP	O/V	0... FFH	0... 127.5	0.5	bar
AC-fluid pressure					
ACP_MMV	O/V	0... FFH	0... 127.5	0.5	bar
AC-fluid pressure					
EFF_EGR_S	O/V	0... FFFFH	0... 1.999969	30.517e-6	-
No description given					
EFF_PHA_S	O/V	0... FFFFH	0... 1.999969	30.517e-6	-
No description given					
LAMB_BAS_COR_MAX	O/V	0... 7FFFH	0... 31.9990234	0,00098	-
Maximum value basic lambda value					
LV_ACP_ORNG	O/V	0... 1H	0 ...1	1	-
No description given					
LV_AMT_ACT	O/V	0... 1H	0 ...1	1	-
AMT intervention active					
LV_CAN_GS_ACK	O/V	0... 1H	0 ...1	1	-
No description given					
LV_ERR_ACP	O/V	0... 1H	0 ...1	1	-
No description given					
LV_GS_ACT	O/V	0... 1H	0 ...1	1	-
Gs intervention active					
LV_IGA_CH_SO2P_STB	O/V	0... 1H	0 ...1	1	-
No description given					
LV_TQ_GS_IGA	O/V	0... 1H	0 ...1	1	-
Torque intervention due gear shift about IGA					
LV_TQ_GS_SCC	O/V	0... 1H	0 ...1	1	-
Torque intervention due gear shift about SCC					
LV_TQ_SCC_INH	O/V	0... 1H	0 ...1	1	-
No description given					
LV_TQ_SCC_REQ	O/V	0... 1H	0 ...1	1	-
No description given					
TACE	O/V	0... FEH	-48... 142.5	0,75	°C
ACC LOW pressure side temperature					
TQ_AD_ADD_S_SWI	O/V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Adaptive engine torque value for switch between hom. and strat.					
TQ_ADD_REQ_ACT_FIL_CH	O/V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
No description given					
TQ_LOSS_CWP_EL	O/V	8000... 0H	-1024 ...0	0.03125	Nm
Engine torque losses electric water pump					
TQ_LOSS_SCHA	O/V	8000... 0H	-1024 ...0	0.03125	Nm
Torque losses super-charger					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_LOSS_THERMO	O/V	8000... 0H	-1024 ...0	0.03125	Nm
Engine torque losses thermostat					
TQ_LOSS_WIN_HEAT	O/V	8000... 0H	-1024 ...0	0.03125	Nm
Engine torque losses rear window heater					
TQI_CAT_PROT	O/V	0... 7FFFH	0... 1023.97	0.03125	Nm
No description given					
TQI_VS_MAX	O/V	0... 7FFFH	0... 1023.97	0.03125	Nm
No description given					

**Input data:**

LV_AMT_DEC_ACT {p. 799}	LV_AMT_INC_ACT {p. 799}	LV_GS_DEC_ACT {p. 6718}	LV_S_RUN {p. 8137}
----------------------------	-------------------------	----------------------------	--------------------

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TQ_AD_ADD_S_SWI	-	8000... 7FFFH	-1024... 1023.97	0,03125	Nm
Adaptive engine torque value for switch between hom. and strat.					

**FUNCTION DESCRIPTION:****General information:**

The initialization module is a temporary software module which is gradually reduced in that amount how functionality of the MS-CP software is growing.

It generates output data (torque values, state bits and other values) as substitute input values for existing SW modules. The source modules will be realized in future.

**Application conditions****Recurrence:**


**Activation:** *at every engine operating state*

**Initialisation:**

```

at reset
ACP = ACP_MMV = 0      bar
TACE = 142,5 °C
EFF_EGR_S = 1
EFF_PHA_S = 1
LAMB_BAS_COR_MAX = 2
LV_ACP_ORNG = 1
LV_CAN_GS_ACK = 0
LV_TQ_FAST_ENA = 1
LV_TQ_IGA_ENA = 1
LV_TQ_SCC_INH = 0
LV_TQ_SCC_ENA = 0
LV_ERR_ACP = 0
TQ_AD_ADD_S_SWI = C_TQ_AD_ADD_S_SWI
TQ_LOSS_SCHA = 0      Nm
TQ_LOSS_THERMO = 0      Nm
TQ_LOSS_WIN_HEAT = 0      Nm
TQ_LOSS_CWP_EL = 0      Nm
TQI_CAT_PROT = 1024      Nm


```

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```

TQI_VS_MAX      =      1024      Nm
LV_TQ_GS_IGA   = LV_TQ_GS_SCC =  LV_GS_ACT
LV_GS_ACT      =  LV_GS_DEC_ACT
LV_AMT_ACT     = LV_AMT_INC_ACT or LV_AMT_DEC_ACT
LV_IGA_CH_SO2P_STB =0

```

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## D.11 Reference and basic torque

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_TOT_BAS	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
Total basic efficiency					
EFF_TOT_BAS_SLOW	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
Total basic efficiency for feedback to slow torque path					
TQI_BAS	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Basic indicated engine torque					
TQI_REF_IGA	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Indicated engine torque corrected by EFF_IGA_BAS_COR					
TQI_REF_IGA_LAMB	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Indicated engine torque corrected by EFF_IGA_BAS_COR and EFF_LAMB_BAS					
TQI_REF_IGA_MIN_LAMB	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Indicated engine torque corrected by EFF_IGA_MIN and EFF_LAMB_BAS					
TQI_REF_IGA_SCC	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Indicated engine torque corrected by EFF_IGA_BAS_COR and EFF_SCC_BAS					
TQI_REF_LAMB	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Indicated engine torque corrected by EFF_LAMB_BAS					
TQI_REF_LAMB_SCC	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Indicated engine torque corrected by EFF_LAMB_BAS and EFF_SCC_BAS					
TQI_REF_SCC	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Indicated engine torque corrected by EFF_SCC_BAS					

### Input data:

EFF_IGA_BAS_COR {p. 1845}	EFF_IGA_BAS_COR_ KNK_FIL {p. 1845}	EFF_IGA_MIN {p. 1845}	EFF_LAMB_AV {p. 8379}
EFF_LAMB_BAS_COR {p. 8379}	EFF_LAMB_SP_BAS {p. 8379}	EFF_SCC_AV {p. 6665}	EFF_SCC_BAS {p. 6665}
LV_HOM_RUN {p. 8136}	TQI_REF {p. 8380}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_MOD_EFF_AV	-	0... 1H	0 ...1	1	-
Logical constant to switch to EFF_LAMB_AV and EFF_SCC_AV calculation mode for TQI_BAS					

### D.11.1 TQDR\_MD001

#### General information:

This module delivers the basic indicated engine torque TQI\_BAS and other basic torque values for the torque model in homogeneous combustion mode.

#### Application Condition

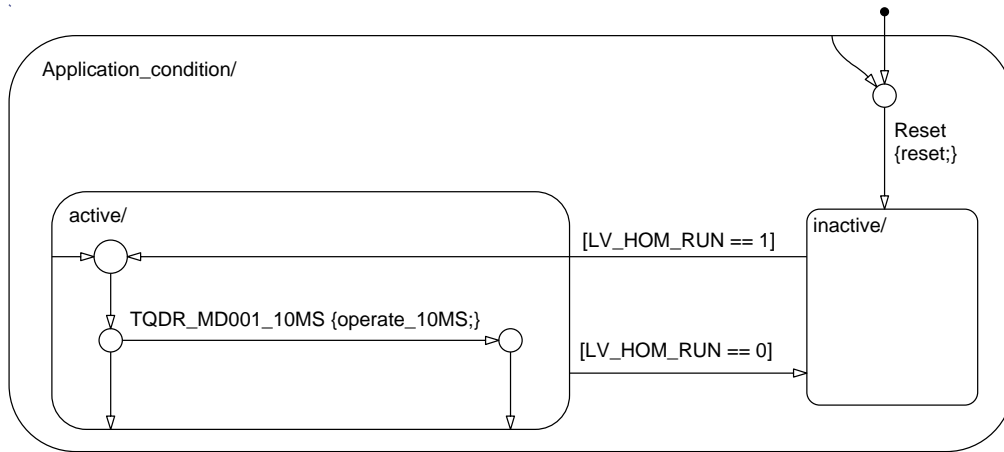
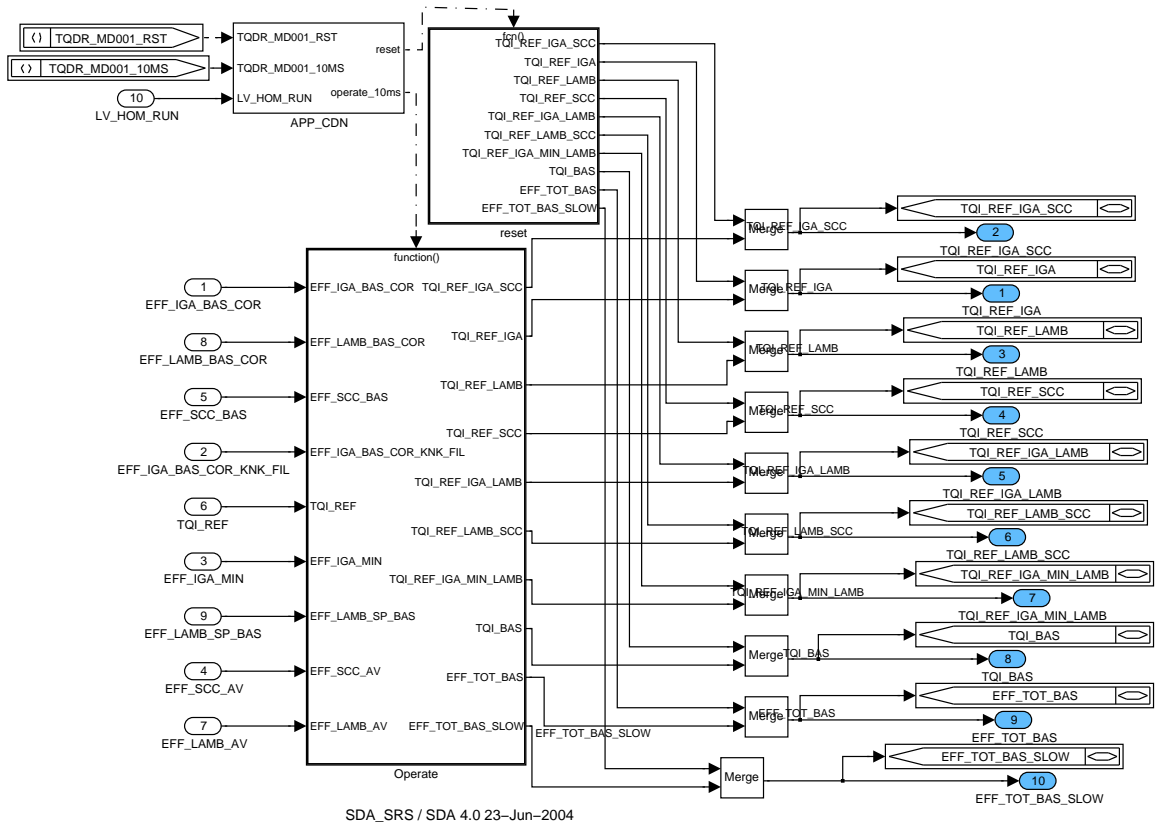


Figure D.11.1: TQDR\_MD001/APP\_CDN/APPCND

Function Description



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Figure D.11.2: TQDR\_MD001

### D.11.1.1 SUBFUNCTION: Operate

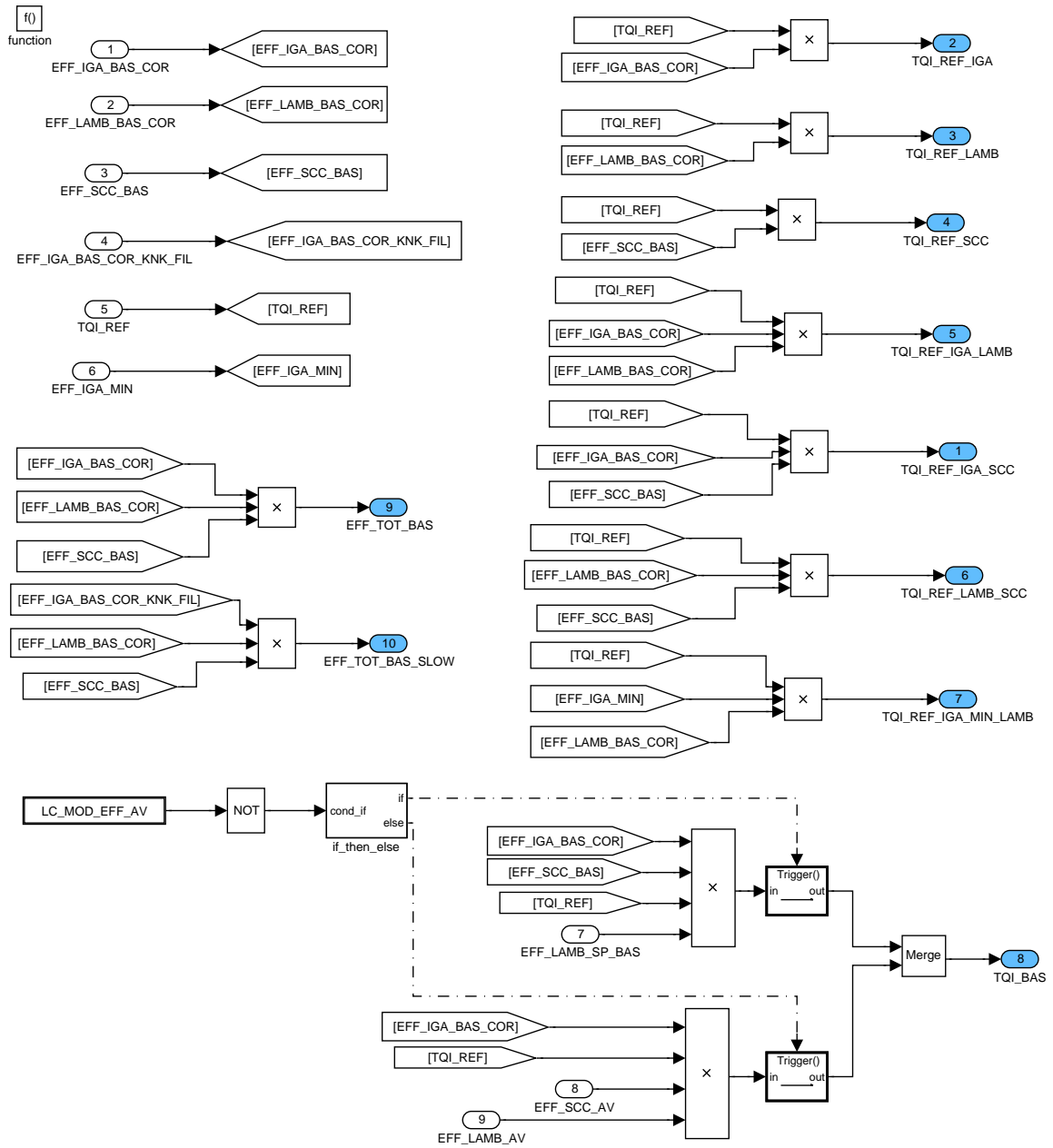


Figure D.11.3: TQDR\_MD001/Operate

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### D.11.1.2 SUBFUNCTION: reset

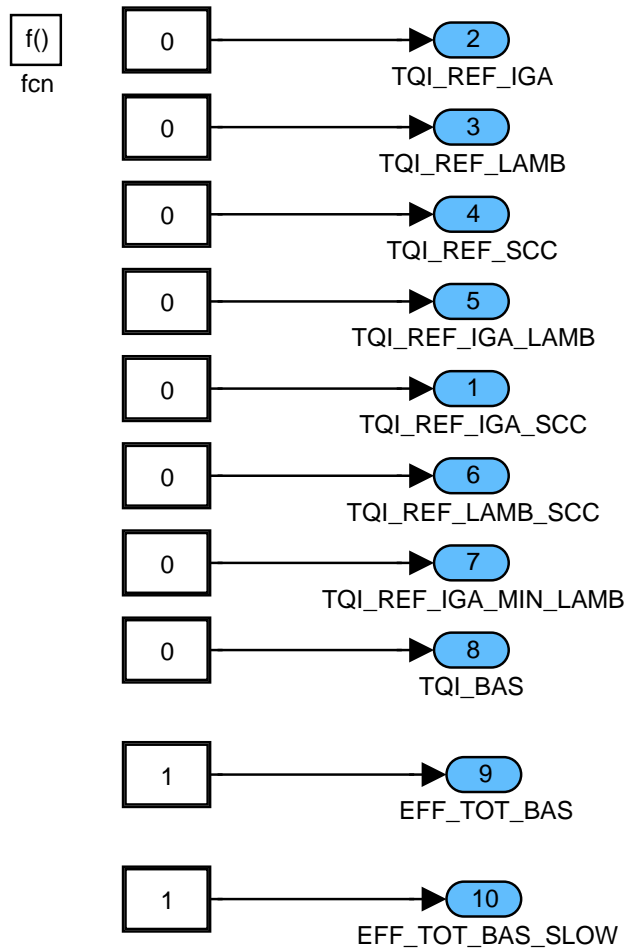


Figure D.11.4: TQDR\_MD001/reset

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## D.12 Torque based pattern calculation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_SCC_AV	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Actual efficiency fuel cut-off					
EFF_SCC_AV_CAN	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Actual efficiency fuel cut-off					
EFF_SCC_BAS	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
basic efficiency fuel cut-off					
EFF_SCC_SP	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Setpoint efficiency fuel cut-off pattern					
EFF_SCC_SP_HYS	V	0... FFFFH	0... 1.99996	30.5e-6	-
Setpoint efficiency fuel cut-off pattern with hysteresis					
FAC_IGA_MIN_TEG_IGA_BAS	V	0... FFFFH	0... 1.99996	30.5e-6	-
scaling factor for efficiency calculation with EFF_IGA_MIN_TEG and EFF_IGA_BAS_COR					
INH_IV_TOT	V	0... FFFFH	0... 65535	1	-
Overall shut off pattern (static and dynamic)					
LV_AUTH_TQ_PAT	V	0... 1H	0 ...1	1	-
logical variable for authorizing fuel cut-off pattern					
NR_PAT_SCC	O/V	0... FFH	0... 255	1	-
Selected index of fuel cut-off pattern					
SUM_INH_IV_BAS	V	0... 8H	0 ...8	1	-
Sum of cylinders which are shut off due to malfunctions					
SUM_INH_IV_TOT	V	0... 8H	0 ...8	1	-
Sum of cylinders which are shut off either by means of static or dynamic fuel cut-off pattern					

### Input data:

EFF_IGA_BAS_COR {p. 1845}	EFF_IGA_MIN_TEG {p. 1845}	EFF_LAMB_BAS_COR {p. 8379}	EFF_SCC_BAS {p. 6665}
INH_IV {p. 2295}	INH_IV_DIAG_ERR {p. 4810}	INH_IV_IGC {p. 4780}	INH_IV_MIS {p. 6237}
INH_SWI_IV {p. 2295}	LV_AMT_ACT {p. 6658}	LV_ASR_ACT {p. 6741}	LV_DCC_INC_ACT {p. 6731}
LV_DCC_PUC_INH {p. 1565}	LV_FCUT_FAST {p. 6675}	LV_GS {p. 1565}	LV_GS_ACT {p. 6658}
LV_HOM_ACT {p. 8136}	LV_INH_FCUT_AMT {p. 803}	LV_INH_FCUT_GS {p. 6718}	LV_LDM_ACT {p. 6615}
LV_LDM_PUC_INH {p. 6615}	LV_N_MAX {p. 3779}	LV_TQ_GS_IGA {p. 6658}	LV_TQ_GS_SCC {p. 6658}
LV_TQ_LIM_INTV {p. 6692}	LV_TQ_SCC_INH {p. 6658}	LV_TQ_SCC_REQ {p. 6658}	LV_VAR_TCT {p. 656}
NC_CYL_NR {p. 1526}	TQI_MIN_S {p. 8380}	TQI_REF {p. 8380}	TQI_REQ_FAST {p. 8391}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EFF_SCC_BAS_MAN	-	0... FFFFH	0... 1.99996	30.5e-6	-
manually adjusted basic efficiency fuel cut-off					
C_EFF_SCC_SP_HYS	-	0... FFFFH	0... 1.99996	30.5e-6	-
hysteresis applied on EFF_SCC_SP for NR_PAT_SCC calculation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EFF_SCC_SP_MAN	-	0... FFFFH	0... 1.99996	30.5e-6	-
setpoint for efficiency of fuel cut-off set by application intervention					
C_FAC_IGA_MIN_TEG_IGA_BAS	-	0... 8000H	0...1	30.5e-6	-
Manually adjusted scaling factor for efficiency calculation with EFF_IGA_MIN_TEG and EFF_IGA_BAS_COR					
C_HYS_EFF_IGA_MIN_TEG	-	0... FFFFH	0... 1.99996	30.5e-6	-
hysteresis in falling direction for IGA_MIN_TEG correction					
C_MIN_DEC_EFF_IGA_MIN_TEG_1	-	0... FFFFH	0... 1.99996	30.5e-6	-
minimum decrement for first decrease phase					
C_MIN_DEC_EFF_IGA_MIN_TEG_2	-	0... FFFFH	0... 1.99996	30.5e-6	-
minimum decrement for second decrease phase					
ID_NR_PAT_SCC	-	0... FFH	0... 255	1	-
LDP_EFF_SCC_SP_NR_PAT_SCC	13	0... FFFFH	0... 1.99996	30.5e-6	-
SCC pattern depending on SCC efficiency					
LC_EFF_SCC_BAS_SWI_CLC	-	0... 1H	0...1	1	-
logical variable for deactivation of basic efficiency fuel cut-off calculation through missfire pattern					
LC_EFF_SCC_SP_MAN	-	0... 1H	0...1	1	-
flag for setting EFF_SCC_SP by application system					
LC_ENA_EFF_SCC_BAS_MAN	-	0... 1H	0...1	1	-
logical variable for manually adjusting basic efficiency fuel cut-off					
LC_ENA_Fcut_TOT_AMT	-	0... 1H	0...1	1	-
logical variable for setting scaling factor due to AMT					
LC_ENA_Fcut_TOT_ASR	-	0... 1H	0...1	1	-
logical variable for setting scaling factor due to ASR					
LC_ENA_Fcut_TOT_DCC	-	0... 1H	0...1	1	-
logical variable for setting scaling factor due to DCC					
LC_ENA_Fcut_TOT_FAST	-	0... 1H	0...1	1	-
logical variable for setting scaling factor due to fast fuel cut-off					
LC_ENA_Fcut_TOT_GS	-	0... 1H	0...1	1	-
logical variable for setting scaling factor due to gear shift intervention					
LC_ENA_Fcut_TOT_LDM	-	0... 1H	0...1	1	-
logical variable for setting scaling factor due to LDM					
LC_ENA_Fcut_TOT_N_MAX	-	0... 1H	0...1	1	-
logical variable for setting scaling factor due to engine speed limitation					
LC_INH_Fcut_AMT	-	0... 1H	0...1	1	-
inhibition flag for fuel cut-off due to AMT intervention					
LC_INH_Fcut_ASR	-	0... 1H	0...1	1	-
inhibition flag for fuel cut-off due to ASR					
LC_INH_Fcut_DCC	-	0... 1H	0...1	1	-
inhibition flag for fuel cut-off due to DCC intervention					
LC_INH_Fcut_FAST	-	0... 1H	0...1	1	-
inhibition flag for fuel cut-off due fast fuel cut-off					
LC_INH_Fcut_GS	-	0... 1H	0...1	1	-
inhibition flag for fuel cut-off due to gear shift intervention					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_INH_FCUT_GS_IGA	-	0... 1H	0 ...1	1	-
inhibition flag for fuel cut-off due to gear shift intervention with spark retarding					
LC_INH_FCUT_LDM	-	0... 1H	0 ...1	1	-
inhibition flag for fuel cut-off due to LDM intervention					
LC_INH_FCUT_N_MAX	-	0... 1H	0 ...1	1	-
inhibition flag for fuel cut-off due to speed limitation					
LC_INH_FCUT_TCT	-	0... 1H	0 ...1	1	-
Inhibition flag for fuel cut-off due to TCT intervention					
LC_TQ_SCC_ENA_MAN	-	0... 1H	0 ...1	1	-
flag for enabling SCC by application system					
LC_TQ_SCC_INH_MAN	-	0... 1H	0 ...1	1	-
inhibition flag for fuel cut-off due to torque management					

## D.12.1 Pattern calculation

### FUNCTION DESCRIPTION:

#### General information:

The objective of this module is to generate a torque intervention by fuel cut-off pattern.

This torque intervention could be caused by several conditions which are summarized in the label LV\_AUTH\_TQ\_PAT (see chapter 1.1.1 "Authorization for single cylinder cut-off"). The label LV\_FCUT\_FAST can be used for project specific fast fuel cut-off conditions (see module "Torque based pattern calculation (Appl. Inc.)").

Based on the TQI\_REQ\_FAST and the TQI\_REF corrected with the basic a/f ratio efficiency and the ignition angle efficiency an efficiency setpoint for the single cylinder cut-off EFF\_SCC\_SP is calculated, which leads to the pattern index NR\_PAT\_SCC (see chapter 1.1.3 "Setpoint efficiency fuel cut-off").

In general, a torque reduction could be realized by spark retarding or single cylinder cut-off. With the scaling factor FAC\_IGA\_MIN\_TEG\_IGA\_BAS a scaling between earliest cylinder cut-off (no spark retarding) and latest cylinder cut-off (full spark retarding up to IGA\_MIN) can be realized (see chapter 1.1.2 "Determination of scaling factor").

#### Application conditions


<b>Activation:</b>	<i>at every engine state</i>
<b>Deactivation:</b>	-
<b>Initialization:</b>	EFF_SCC_SP = 1 at reset EFF_SCC_SP_HYS = 1 at reset NR_PAT_SCC = 0 at reset
<b>Update rate:</b>	10 ms

### D.12.1.1 Authorization for single cylinder cut-off

#### General information:

The authorization flag is set depending on:

- a manual enabling => LV\_TQ\_SCC\_ENA\_MAN
- a request from traction control (ASR) => LV\_ASR\_ACT

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- a request from gear shift intervention (GS), if gear shift intervention is not explicitly inhibited because gear shift intervention should only work via spark retarding => LV\_GS\_ACT and LV\_TQ\_GS\_IGA (see module "Torque request for gear shift intervention")
- a request from engine speed limitation (N\_MAX) => LV\_N\_MAX
- other project specific requests for fast fuel cut-off => LV\_FCUT\_FAST (see module "Torque based pattern calculation (Appl. Inc.)")
- a request from torque management => LV\_TQ\_SCC\_REQ and LV\_TQ\_SCC\_INH
- a request from safety concept => LV\_TQ\_LIM\_INTV (see module "Torque request for safety")

Due to logical calibration constants nearly all of these request can be inhibited, except of the requests from torque management and safety concept.

### Formula section:

```

IF      LC_TQ_SCC_ENA_MAN == 1
OR      LV_TQ_LIM_INTV == 1
OR      (LV_TQ_SCC_INH == 0
AND     LC_TQ_SCC_INH_MAN == 0
AND     LV_TQ_SCC_REQ == 1)
OR      (LV_ASR_ACT == 1 AND LC_INH_FCUT_ASR == 0)
OR      (LV_N_MAX == 1 AND LC_INH_FCUT_N_MAX == 0)
OR      [LV_AMT_ACT == 1
AND     (LV_INH_FCUT_AMT = 0 OR LC_INH_FCUT_AMT == 0)]
OR      [LV_VAR_TCT == 1
LV_GS = 1
AND     (LV_INH_FCUT_GS = 0 OR LC_INH_FCUT_TCT == 0)]
OR      (LV_DCC_INC_ACT == 1 and LV_DCC_PUC_INH = 0
AND     LC_INH_FCUT_DCC == 0)
OR      (LV_LDM_ACT == 1 and LV_LDM_PUC_INH = 0
AND     LC_INH_FCUT_LDM == 0)
OR      (LV_FCUT_FAST == 1 AND LC_INH_FCUT_FAST == 0)
OR      (LV_GS_ACT == 1 AND LV_VAR_TCT == 0
AND     LC_INH_FCUT_GS == 0
AND     NOT(LV_TQ_GS_IGA == 1 AND LC_INH_FCUT_GS_IGA == 0))

THEN    LV_AUTH_TQ_PAT = 1
ELSE    LV_AUTH_TQ_PAT = 0
ENDIF

```


### D.12.1.2 Determination of scaling factor

#### General information:

The factor FAC\_IGA\_MIN\_TEG\_IGA\_BAS is used to scale between the efficiencies EFF\_IGA\_MIN\_TEG (corrected basic minimum ignition angle including spark retard limitation due to exhaust gas temperature) and EFF\_IGA\_BAS\_COR (corrected basic minimum ignition angle without spark retard limitation due to exhaust gas temperature). For a torque intervention due to gear shift, traction control, engine speed limitation and fast fuel cut-off the possibility of deactivating this scaling factor must be realized. So the scaling factor can be set equal to "1", if one of that interventions is active and if this method will be allowed (LC\_ENA\_FCUT\_TOT\_... = 1). It is also set equal to "1", if the basic efficiency for fuel cut-off is smaller than "1".

#### Formula section:

```
IF      EFF_SCC_BAS < 1.0
```

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```

OR    (LV_GS_ACT == 1
      AND LC_ENA_Fcut_TOT_GS == 1
      AND LV_TQ_GS_SCC == 1)
OR    (LV_ASR_ACT == 1 AND LC_ENA_Fcut_TOT_ASR == 1)
OR    (LV_N_MAX == 1 AND LC_ENA_Fcut_TOT_N_MAX == 1)
OR    (LV_AMT_ACT == 1 AND LC_ENA_Fcut_TOT_AMT == 1)
OR    (LV_DCC_INC_ACT == 1 and LV_DCC_PUC_INH == 0
      AND LC_ENA_Fcut_TOT_DCC == 1)
OR    (LV_LDM_ACT == 1 and LV_LDM_PUC_INH == 0
      AND LC_ENA_Fcut_TOT_LDM == 1)
OR    (LV_Fcut_FAST == 1 AND LC_ENA_Fcut_TOT_FAST == 1)
THEN  FAC_IGA_MIN_TEG_IGA_BAS = 1
ELSE  FAC_IGA_MIN_TEG_IGA_BAS = C_FAC_IGA_MIN_TEG_IGA_BAS
ENDIF

```

### D.12.1.3 Setpoint efficiency fuel cut-off

#### Overview

#### Description:

Depending on the authorization flag LV\_AUTH\_TQ\_PAT the efficiency EFF\_SCC\_SP is set to the calculated value EFF\_SCC\_SP\_1 or is set equal to "1". Additionally, two application labels allow to manipulate the efficiency setpoint (LC\_EFF\_SCC\_SP\_MAN and C\_EFF\_SCC\_SP\_MAN). Depending on the efficiency setpoint a pattern is calculated. To avoid uncomfortable jumps of pattern, if the setpoint EFF\_SCC\_SP jitters, the calculation of the pattern index NR\_PAT\_SCC is done by applying a hysteresis C\_EFF\_SCC\_SP\_HYS on EFF\_SCC\_SP (see figure 1).

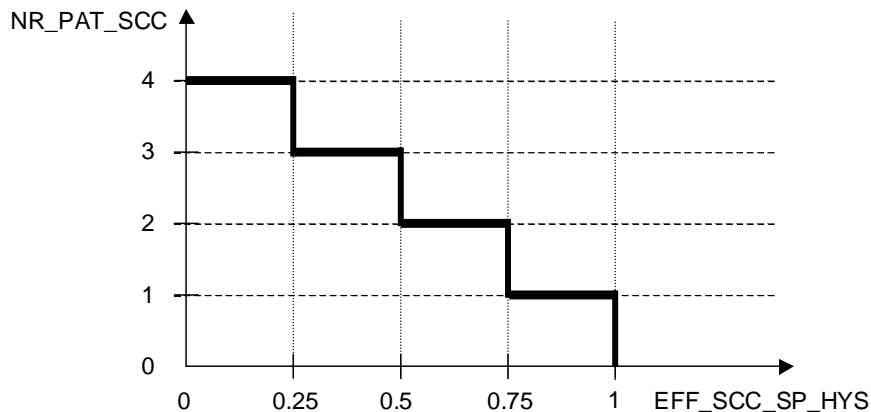


Figure D.12.1: : Example for a four cylinder engine

#### Formula section:

```

IF    LV_AUTH_TQ_PAT == 1
THEN  EFF_SCC_SP_2 = EFF_SCC_SP_1
ELSE  EFF_SCC_SP_2 = 1.0
ENDIF

```

```

IF          LC_EFF_SCC_SP_MAN == 1
THEN       EFF_SCC_SP = C_EFF_SCC_SP_MAN
ELSE       EFF_SCC_SP = EFF_SCC_SP_2
ENDIF

```

```

IF          (EFF_SCC_SP - EFF_SCC_SP_HYS > C_EFF_SCC_SP_HYS)
OR         (EFF_SCC_SP > 1 - C_EFF_SCC_SP_HYS)
OR         (EFF_SCC_SP < EFF_SCC_SP_HYS)
THEN       EFF_SCC_SP_HYS = EFF_SCC_SP
ELSE       EFF_SCC_SP_HYS = EFF_SCC_SP_HYS
ENDIF

```

```

NR_PAT_SCC = ID_NR_PAT_SCC(EFF_SCC_SP_HYS)

```

### D.12.1.3.1 Calculation of efficiency for single cylinder cut-off

#### Description:

The efficiency for single cylinder cut-off depends on the ratio between TQI\_REQ\_FAST and TQI\_REF corrected with the basic efficiencies for a/f ratio and ignition angle. Generally, a scaling between EFF\_IGA\_MIN\_TEG and EFF\_IGA\_BAS\_COR is possible. The philosophy of this function is to give the customer the possibility to work with minimum ignition angle before fuel cut-off or to work with the basic ignition angle.

#### Formula section:

```

IF          LV_HOM_ACT = 1
THEN       EFF_SCC_SP_1 = TQI_REQ_FAST /
                (TQI_REF
                 * EFF_LAMB_BAS_COR
                 * (FAC_IGA_MIN_TEG_IGA_BAS
                   * EFF_IGA_BAS_COR
                   + (1.0 - FAC_IGA_MIN_TEG_IGA_BAS)
                   * EFF_IGA_MIN_TEG_LGRD))
ELSE       EFF_SCC_SP_1 = TQI_REQ_FAST /
                TQI_MIN_S
ENDIF

```

```


IF          EFF_SCC_SP_1 > 1.0
THEN       EFF_SCC_SP_1 = 1.0
ELSEIF     EFF_SCC_SP_1 < 0.0
THEN       EFF_SCC_SP_1 = 0.0
ENDIF

```

### D.12.1.3.2 Rate limitations for negative gradients

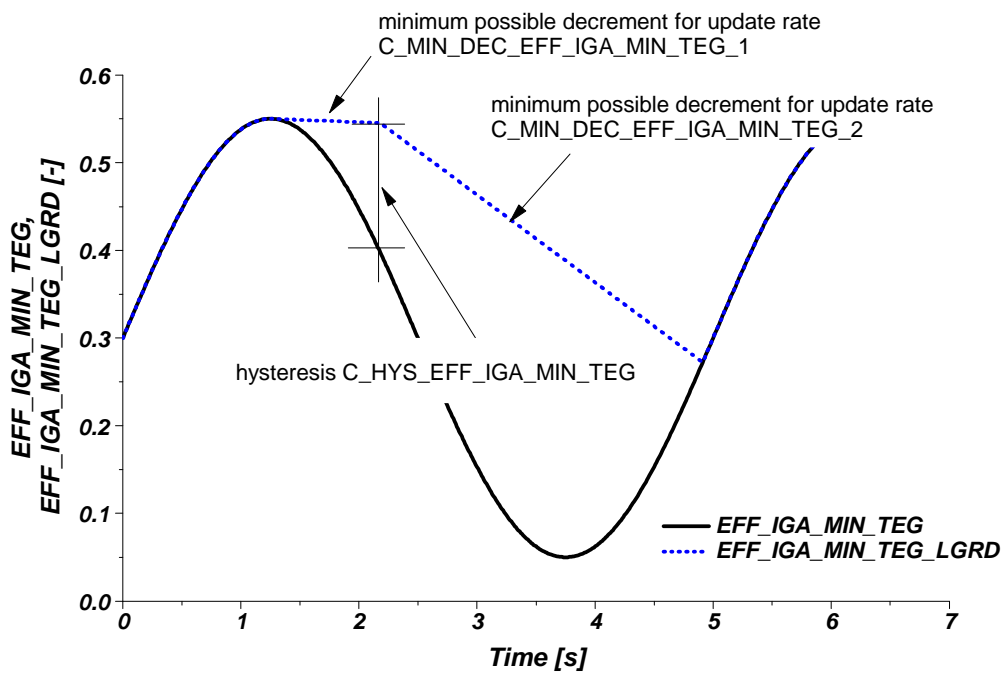
#### Description:

Changes of the efficiency EFF\_IGA\_MIN\_TEG has to be limited in falling direction to avoid high frequent jumps between pattern and spark retarding. Therefore a calibratable rate limit function is added. The principle application parameters for these rate limitations are C\_MIN\_DEC\_EFF\_IG\_MIN\_TEG\_1, C\_


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MIN\_DEC\_EFF\_IG\_MIN\_TEG\_2 and C\_LGRD\_EFF\_IGA\_MIN\_TEG. The background is illustrated in figure 2.

**Figure 2:** Rate limitations for EFF\_IGA\_MIN\_TEG



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**Formula section:**

```

IF          (EFF_IGA_MIN_TEG_LGRD_1k-1 > EFF_IGA_MIN_TEGk)
THEN IF      ((EFF_IGA_MIN_TEG_LGRD_1k-1 - EFF_IGA_MIN_TEGk)
                > C_MIN_DEC_EFF_IGA_MIN_TEG_1)
THEN EFF_IGA_MIN_TEG_LGRD_1k = EFF_IGA_MIN_TEG_LGRD_1k-1
                - C_MIN_DEC_EFF_IGA_MIN_TEG_1
ELSE EFF_IGA_MIN_TEG_LGRD_1k = EFF_IGA_MIN_TEGk
ENDIF
ELSE EFF_IGA_MIN_TEG_LGRD_1k = EFF_IGA_MIN_TEGk
ENDIF
    
```

```

IF          ((EFF_IGA_MIN_TEGk-1 < EFF_IGA_MIN_TEGk)
OR
                (C_HYS_EFF_IGA_MIN_TEG
                <= (EFF_IGA_MIN_TEG_LGRD_1 - EFF_IGA_MIN_TEG)))
THEN EFF_IGA_MIN_TEG_LGRD_2 = EFF_IGA_MIN_TEG
ELSE EFF_IGA_MIN_TEG_LGRD_2 = EFF_IGA_MIN_TEG_LGRD_1
ENDIF
    
```

```

IF          (EFF_IGA_MIN_TEG_LGRDk-1 > EFF_IGA_MIN_LGRD_2k)
THEN IF      ((EFF_IGA_MIN_TEG_LGRDk-1 - EFF_IGA_MIN_LGRD_2k)
                > C_MIN_DEC_EFF_IGA_MIN_TEG_2)
THEN EFF_IGA_MIN_TEG_LGRDk = EFF_IGA_MIN_TEG_LGRDk-1
                - C_MIN_DEC_EFF_IGA_MIN_TEG_2
ELSE EFF_IGA_MIN_TEG_LGRDk = EFF_IGA_MIN_LGRD_2k
ENDIF
ELSE EFF_IGA_MIN_TEG_LGRDk = EFF_IGA_MIN_LGRD_2k
ENDIF
    
```

**D.12.2 Basic efficiency fuel cut-off**

**General information:**

EFF\_SCC\_BAS is the basic efficiency for single cylinder fuel cut-off. It is calculated by count of opened injectors divided by the number of cylinders (NC\_CYL\_NR), whereas only injectors which are shut off due to failures (e.g. failure on injector /ignition output stage) are considered.

*Activation:* at every engine state  
*Deactivation:* -  
*Initialization:* EFF\_SCC\_BAS = 1.0 at reset and LV\_IGK = 0 -> 1  
*Update rate:* 10 ms

**Formula section:**


SUM\_INH\_IV\_BAS = bitwise summation (Bits 0 to (NC\_CYL\_NR-1)) of:  
 INH\_IV\_MIS or INH\_IV\_DIAG\_ERR or INH\_IV\_IGC

*Maximal possible value:* NC\_CYL\_NR

```

If          LC_EFF_SCC_BAS_SWI_CLC = 1
Then If      LC_ENA_EFF_SCC_BAS_MAN = 1
Then EFF_SCC_BAS = C_EFF_SCC_BAS_MAN
Else EFF_SCC_BAS = 1.0
    
```

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```

Endif
Else     EFF_SCC_BAS = 1- (SUM_INH_IV_BAS /NC_CYL_NR)
Endif
    
```

### D.12.3 Actual efficiency fuel cut-off

#### FUNCTION DESCRIPTION:

##### General information:

EFF\_SCC\_AV is the actual efficiency from fuel cut-off interventions. The value is calculated by count of opened injectors divided by the number of cylinders (NC\_CYL\_NR). The input value INH\_IV defines the status of each injector during the next injection cycle due to static fuel cut-off. The input value INH\_SWI\_IV defines the status of all injectors during the next injection cycle due to dynamic fuel cut-off.

Further information see in chapter "Basic SW inputs and Outputs" in subchapter "Injection information".

Every static fuel cut-off request intervention deriving from pattern (engine speed limitation, ASR and GS), trailing throttle fuel cut-off, misfire, engine stop, etc. is considered by means of INH\_IV.

Every dynamic fuel cut-off request intervention deriving from "torque based pattern"- and/or "sequential fuel cut off and restart fuel feed"-interventions is considered by means of INH\_SWI\_IV.

The pattern INH\_IV\_TOT is the bitwise OR of all pattern (static and dynamic) and SUM\_INH\_IV\_TOT is the corresponding sum of cylinders which are shut off.

The EFF\_SCC\_AV\_CAN is calculated like EFF\_SCC\_AV only at external intervention the efficiency is not regarded.

*Activation:* at every engine state except engine stopped  
*Deactivation:* at engine stopped  
*Initialization:* at reset or at engine stop  
*Update rate:* 10 ms

#### Formula section:

```

If           INH_IV = 1           (bitwise)   or
                INH_SWI_IV = 1      (bitwise)
Then        INH_IV_TOT = 1      (bitwise)
Else        INH_IV_TOT = 0      (bitwise)
Endif
    
```

SUM\_INH\_IV\_TOT = bitwise summation of INH\_IV\_TOT (Bits 0 to (NC\_CYL\_NR-1))

*Maximal possible value:* NC\_CYL\_NR


EFF\_SCC\_AV = 1- (SUM\_INH\_IV\_TOT /NC\_CYL\_NR)

Calculation of EFF\_SCC\_AV\_CAN for CAN Torque:

```

If           LV_GS_ACT = 1           or
                LV_AMT_ACT = 1         or
                LV_ASR_ACT = 1         or
                (LV_DCC_INC_ACT = 1     and
                 LV_DCC_PUC_INH = 0)   or
                (LV_LDM_ACT = 1         and
    
```


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```

Then      LV_LDM_PUC_INH = 0)
Else      EFF_SCC_AV_CAN = 1
Endif     EFF_SCC_AV_CAN = EFF_SCC_AV

```

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## D.13 Torque based pattern calculation (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CS_CHG	V	0... 1H	0 ...1	1	-
Logical variable for detection of clutch switch state change					
LV_CT_CHG	V	0... 1H	0 ...1	1	-
Logical variable for detection of accelerator pedal released state change					
LV_FCUT_FAST	O/V	0... 1H	0 ...1	1	-
Logical variable for authorizing fuel cut-off pattern					
T_MAX_FCUT_FAST	V	0... FFH	0... 2.55	0.01	s
Time counter for clutch switch observation fast fuel cut-off					
T_MAX_FCUT_FAST_TCHA	V	0... FFH	0... 2.55	0.01	s
Time counter for gear shift observation fast fuel cut-off turbo charger					

### Input data:

LV_CS {p. 8394}	LV_CT {p. 1442}	LV_GS_ACT_FL {p. 8379}	LV_PL {p. 1720}
LV_PU {p. 1720}	LV_VAR_AMT {p. 655}	LV_VAR_TCHA {p. 656}	LV_VAR_TCT {p. 656}
MAF {p. 8277}	MAF_MES {p. 1192}	MAF_MMV {p. 1195}	N {p. 1525}
TCO {p. 1100}	VS {p. 1176}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_DIF_MIN_FCUT_FAST	-	0... FFFFH	0... 1389	0.0211948	mg/stk
min. load decrease fast fuel cut-off					
C_T_MAX_FCUT_FAST	-	0... FFH	0... 2.55	0.01	s
max. time clutch switch observation fast fuel cut-off					
C_T_MAX_FCUT_FAST_TCHA	-	0... FFH	0... 2.55	0.01	s
max. time gear shift observation fast fuel cut-off turbo charger					
C_TCO_MIN_FCUT_FAST	-	0... FEH	-48... 142.5	0.75	°C
min. coolant temperature fast fuel cut-off					
C_VS_MIN_FCUT_FAST	-	0... FFH	0... 255	1	km/h
min veh. speed fuel cut-off					
C_VS_MIN_FCUT_FAST_TCHA	-	0... FFH	0... 255	1	km/h
min veh. speed fuel cut-off turbo charger					
ID_MAF_N_MIN_FCUT_FAST	V	0... 1H	0 ...1	1	-
LDP_MAF_MIN_FCUT_FAST	4	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_MIN_FCUT_FAST	4	0... 1FE0H	0... 8160	1	rpm
engine speed -load threshold for fast fuel cut-off					


### General Information

#### General information:

The objective of this module is to define the application incidences for the module "Torque based pattern calculation" including determination of Fast fuel cut off -condition .

### Application Conditions

Initialization: RST

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Recurrence: 10MS  
 Activation: always  
 Deactivation: never

**Function description**

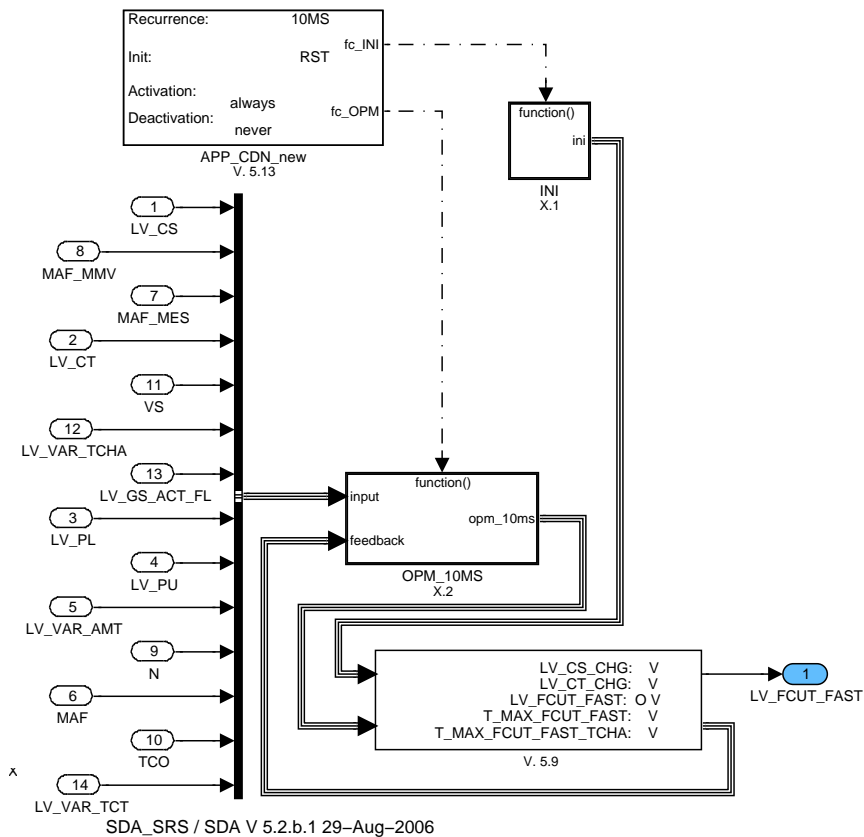


Figure D.13.1: :

**D.13.1 Initialisation at reset**

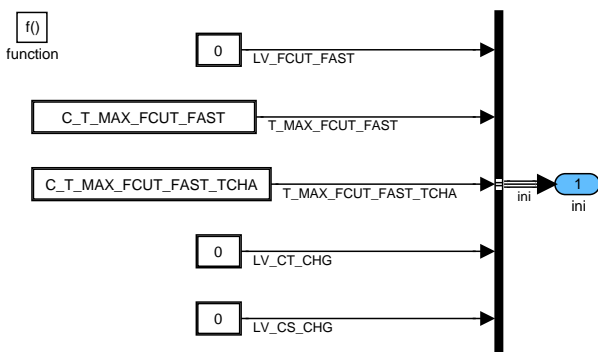


Figure D.13.2: :

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## D.13.2 Recurrence 10 ms

Determination of fast fuel cut-off conditions

General information:

The objective of this module is to define the condition for fast fuel cut-off. This function shall prevent engine speed overshooting during gear shift with manual transmission vehicles. If fast fuel cut-off is enabled, cylinder deactivation will be managed by the torque management.

Description:


The fast fuel cut-off will be enabled for the following situation:

the coolant temperature must exceed a calibratable threshold (see activation conditions) and the load must decrease

the accelerator pedal must be released and the clutch has to be opened; these conditions have to be happen within a maximum time frame

if the clutch pedal has been pushed during this observation time and if it is still pushed the fast fuel cut-off is possible

the variant turbo regards the flag LV\_GS\_ACT\_FL in order to set fast fuel cut-off

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### D.13.2.1 Activation conditions for calculation

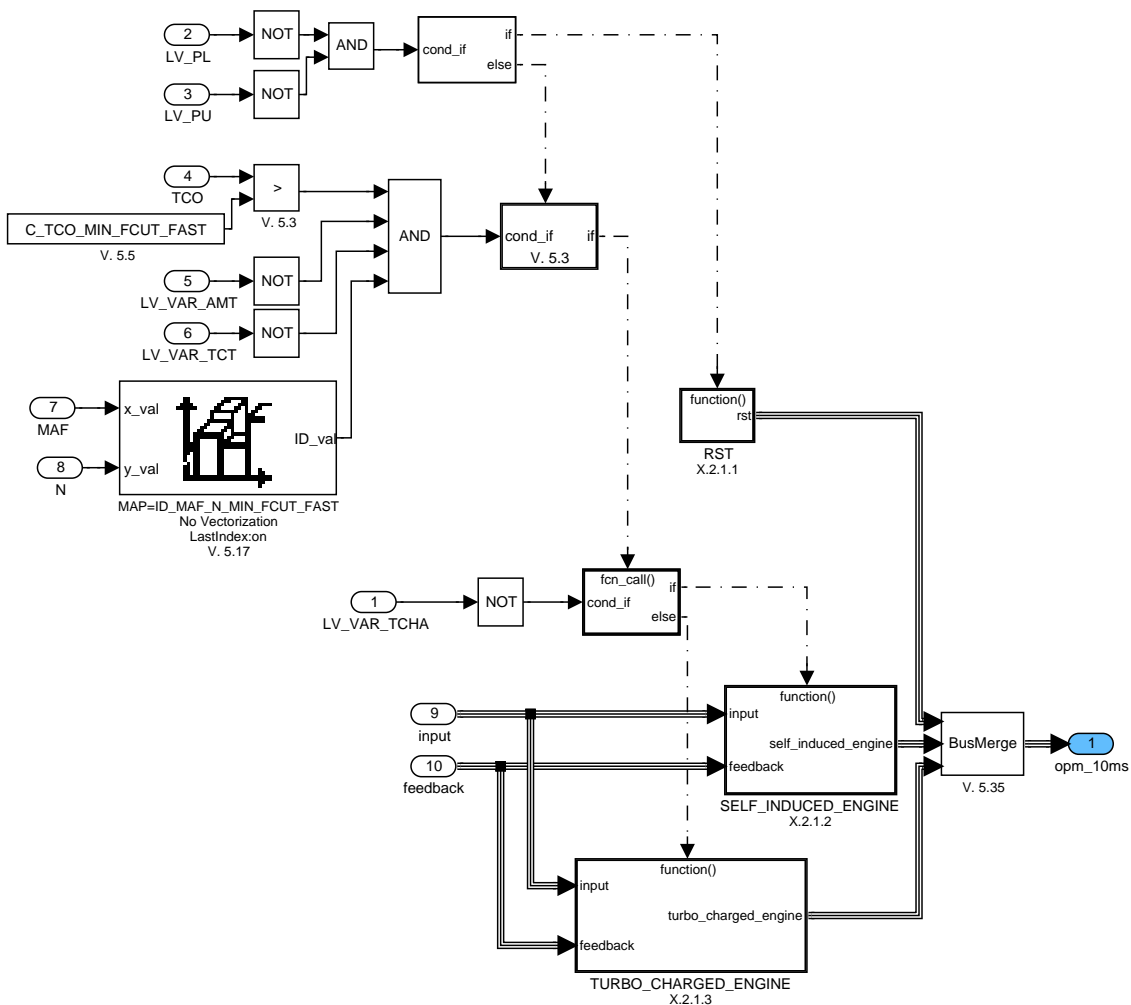


Figure D.13.3: :

#### D.13.2.1.1 Reset at LV\_PL = 0 and LV\_PU = 0

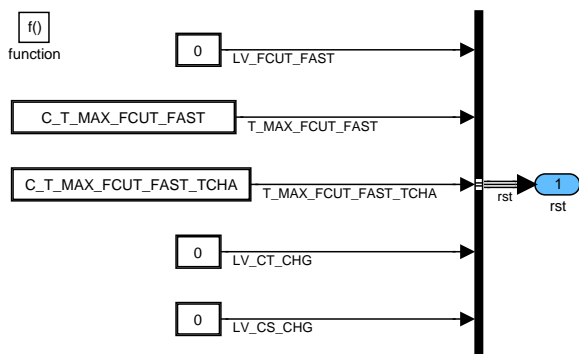



Figure D.13.4: :

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### D.13.2.1.2 Self induced engine

#### D.13.2.1.2.1 Calculation of self induced engine

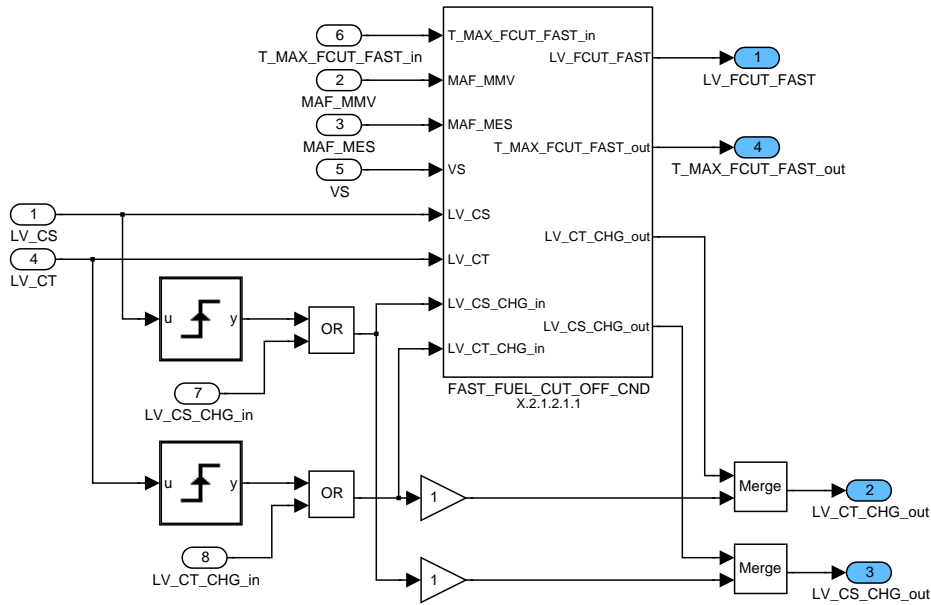



Figure D.13.5: :

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**D.13.2.1.2.1 Determination of fast fuel cut off conditions**

**D.13.2.1.2.1.1 Determination\_of\_fast\_fuel\_cut\_off\_conditions**

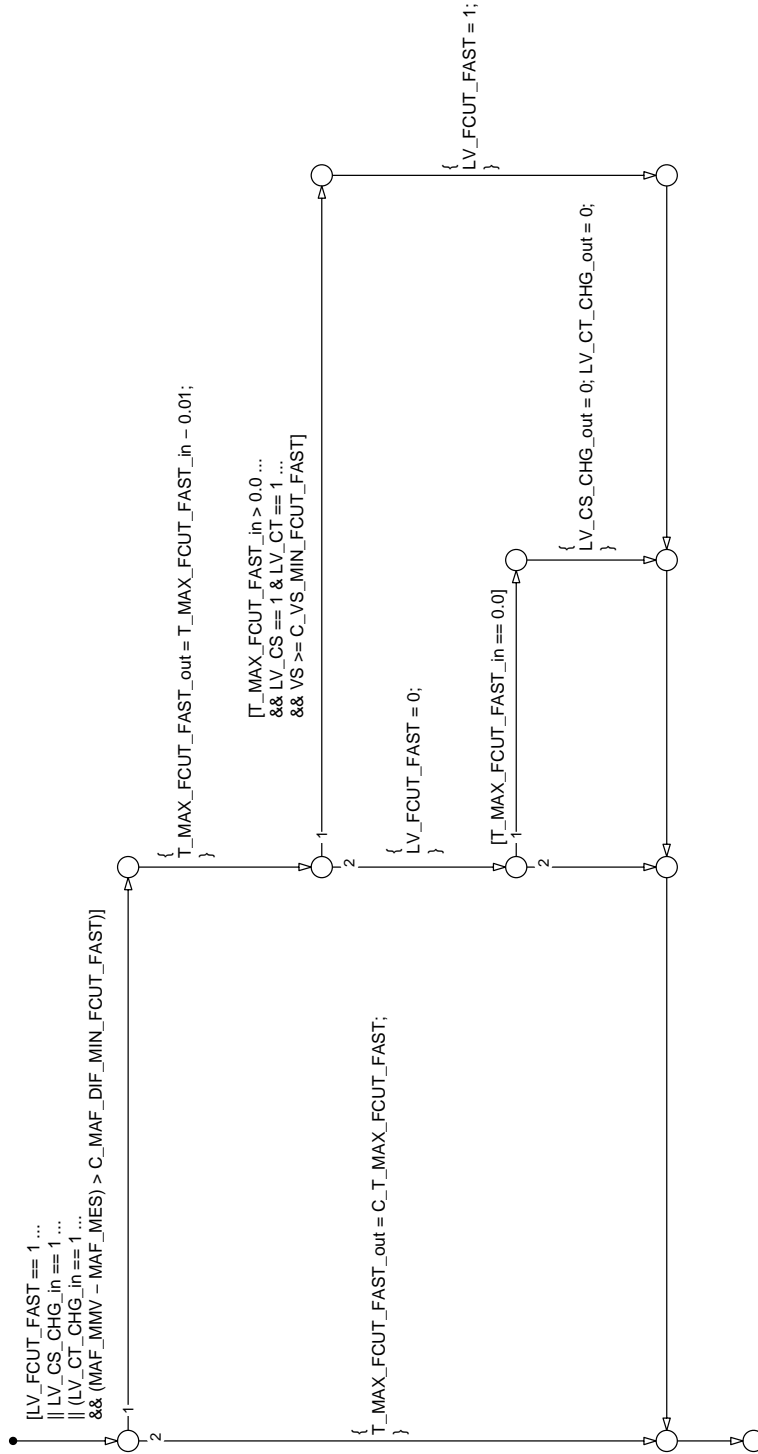



Figure D.13.6: :

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### D.13.2.1.3 Turbo charged engine

#### D.13.2.1.3.1 Calculation of turbo charged engine

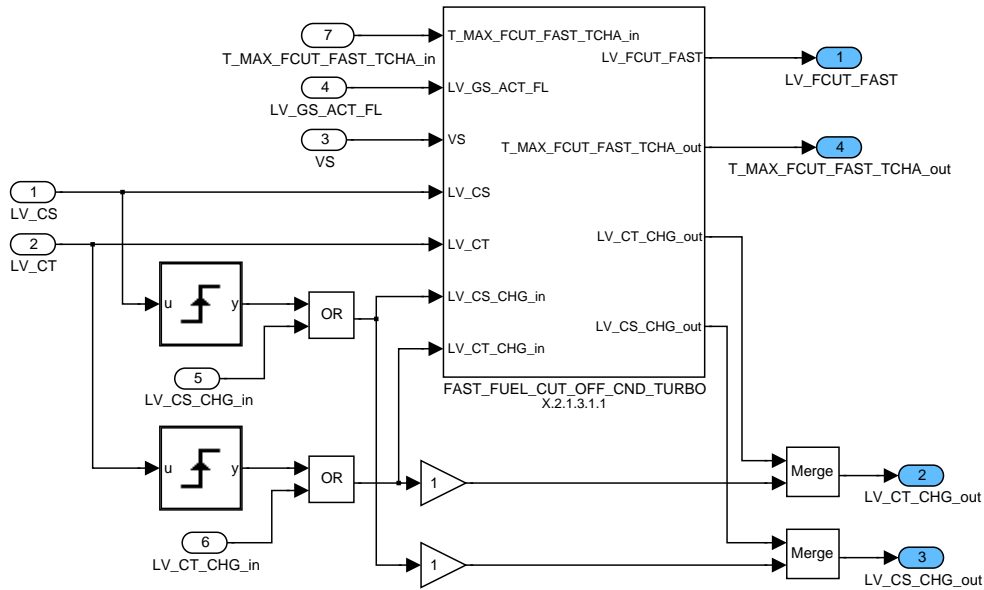


Figure D.13.7: :

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**D.13.2.1.3.1.1 Fast fuel cut off conditions turbo**

**D.13.2.1.3.1.1.1 fast\_fuel\_cut\_off\_conditions\_turbo**

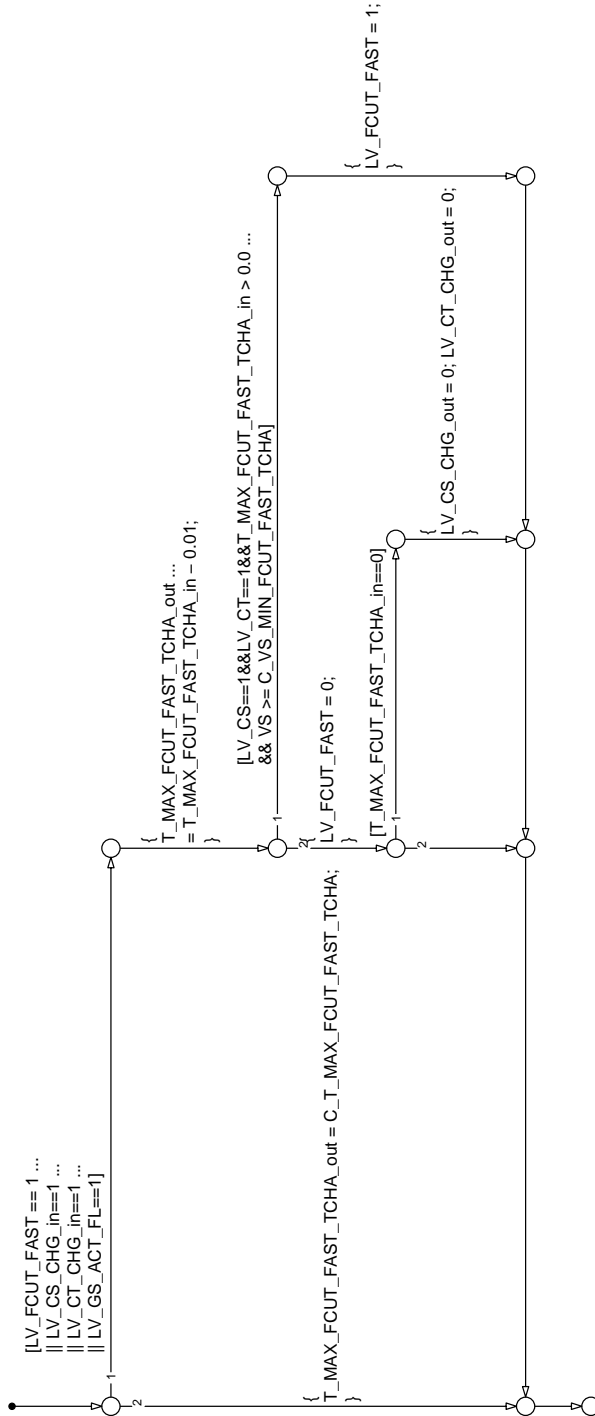



Figure D.13.8: :

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## D.14 Torque control at start

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
OPM_AV_SEL_TQ_ST	V	1... 8H	1...8	1	-
Operation mode ( selektiert )					
TQ_ST	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Engine Start Torque					
TQ_ST_1	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Engine Start Torque raw value					

### Input data:

LV_AT {p. 654}	LV_ST {p. 1720}	LV_TQ_MIN_CLU {p. 8379}	N_DIF {p. 1122}
OPM_AV {p. 8137}	TCO {p. 1100}		

### Calibration data:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_TQ_ST	-	0... FFH	0... 0.99609375	0.00390625	-
Correlation constant for negative PT1 filtering					
ID_OPM_AV_TQ_ST	-	1... 8H	1...8	1	-
LDPM_OPM_AV	8	0... 8H	0...8	1	-
Operation mode matrix (actual)					
IP_TQ_ST_AT_OPM_1	-	0... FFFFH	0... 1023.97	0.03125	Nm
LDPM_N_DIF_IP_TQ_ST	8	0... FFFFH	0... 32767	1	rpm
LDPM_TCO_IP_TQ_ST	8	0... FEH	0... 142.5	0.75	°C
Engine torque at start for automatic transmission in engine operation mode 1					
IP_TQ_ST_AT_OPM_2	-	0... FFFFH	0... 1023.97	0.03125	Nm
LDPM_N_DIF_IP_TQ_ST	8	0... FFFFH	0... 32767	1	rpm
LDPM_TCO_IP_TQ_ST	8	0... FEH	0... 142.5	0.75	°C
Engine torque at start for automatic transmission in engine operation mode 2					
IP_TQ_ST_MT_OPM_1	-	0... FFFFH	0... 1023.97	0.03125	Nm
LDPM_N_DIF_IP_TQ_ST	8	0... FFFFH	0... 32767	1	rpm
LDPM_TCO_IP_TQ_ST	8	0... FEH	0... 142.5	0.75	°C
Engine torque at start for manual transmission in engine operation mode 1					
IP_TQ_ST_MT_OPM_2	-	0... FFFFH	0... 1023.97	0.03125	Nm
LDPM_N_DIF_IP_TQ_ST	8	0... FFFFH	0... 32767	1	rpm
LDPM_TCO_IP_TQ_ST	8	0... FEH	0... 142.5	0.75	°C
Engine torque at start for manual transmission in engine operation mode 2					

### D.14.1 TQSP\_MD00S

#### General information:

The engine start torque TQ\_ST influences the torque at clutch during start phase as a result it determines the engine speed transient response. It is calculated from a one dimensional map versus engine speed difference N\_DIF.

TQ\_ST is imported into module Minimum Torque at Clutch in order to increase engine speed during start phase. To bring the engine speed to its setpoint at idle the engine speed overshoot can be limited supported by the tuning data IP\_TQ\_ST\_MT(AT)\_XY which depend on engine operation mode OPM\_AV\_SEL\_TQ\_ST.

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**Application conditions:**

Activation: LV\_TQ\_MIN\_CLU = 0  
 Deactivation: LV\_TQ\_MIN\_CLU = 1  
 Initialization: TQ\_ST = 0 Nm at transition LV\_ST = 0 to 1  
 Update rate: 10 ms

**Application Condition**

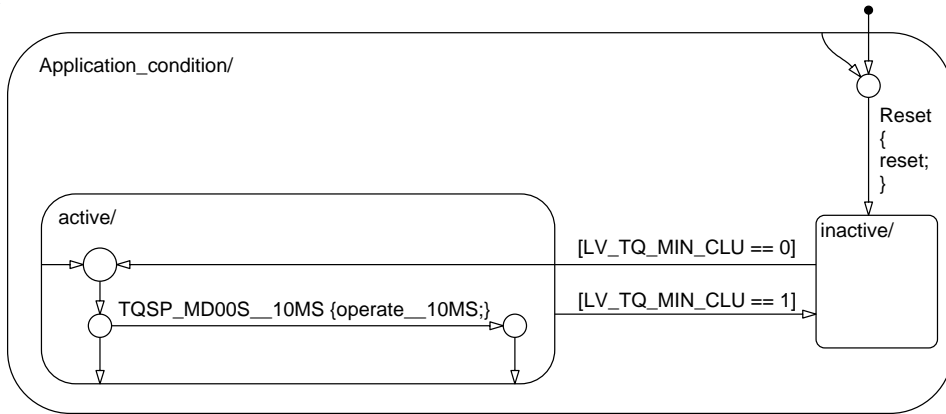


Figure D.14.1: TQSP\_MD00S/APP\_CDN/APPCND

**Function Description**

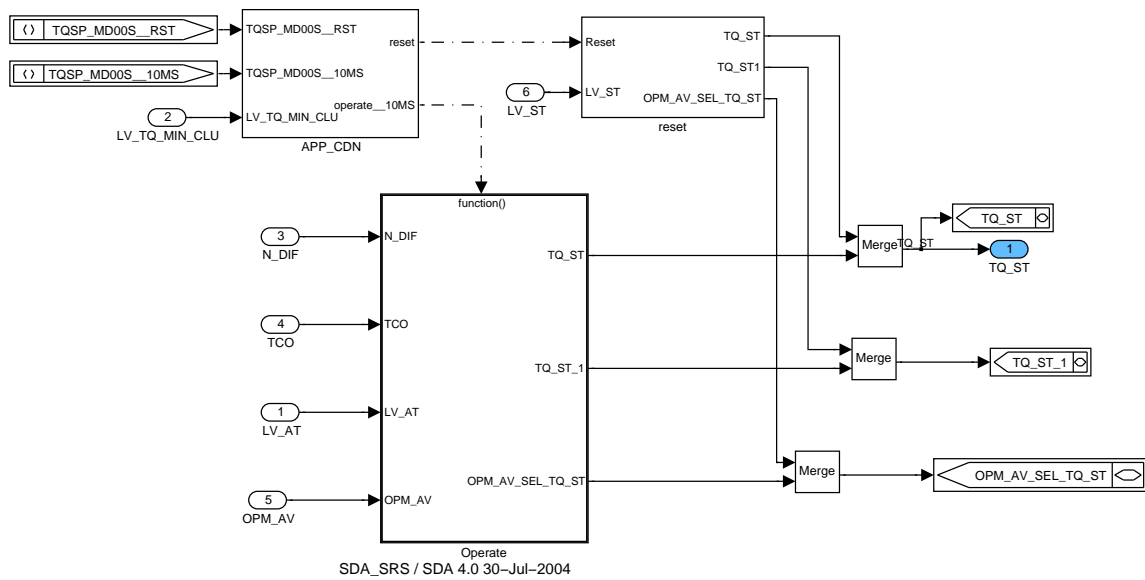


Figure D.14.2: TQSP\_MD00S

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### D.14.1.1 SUBFUNCTION: Operate

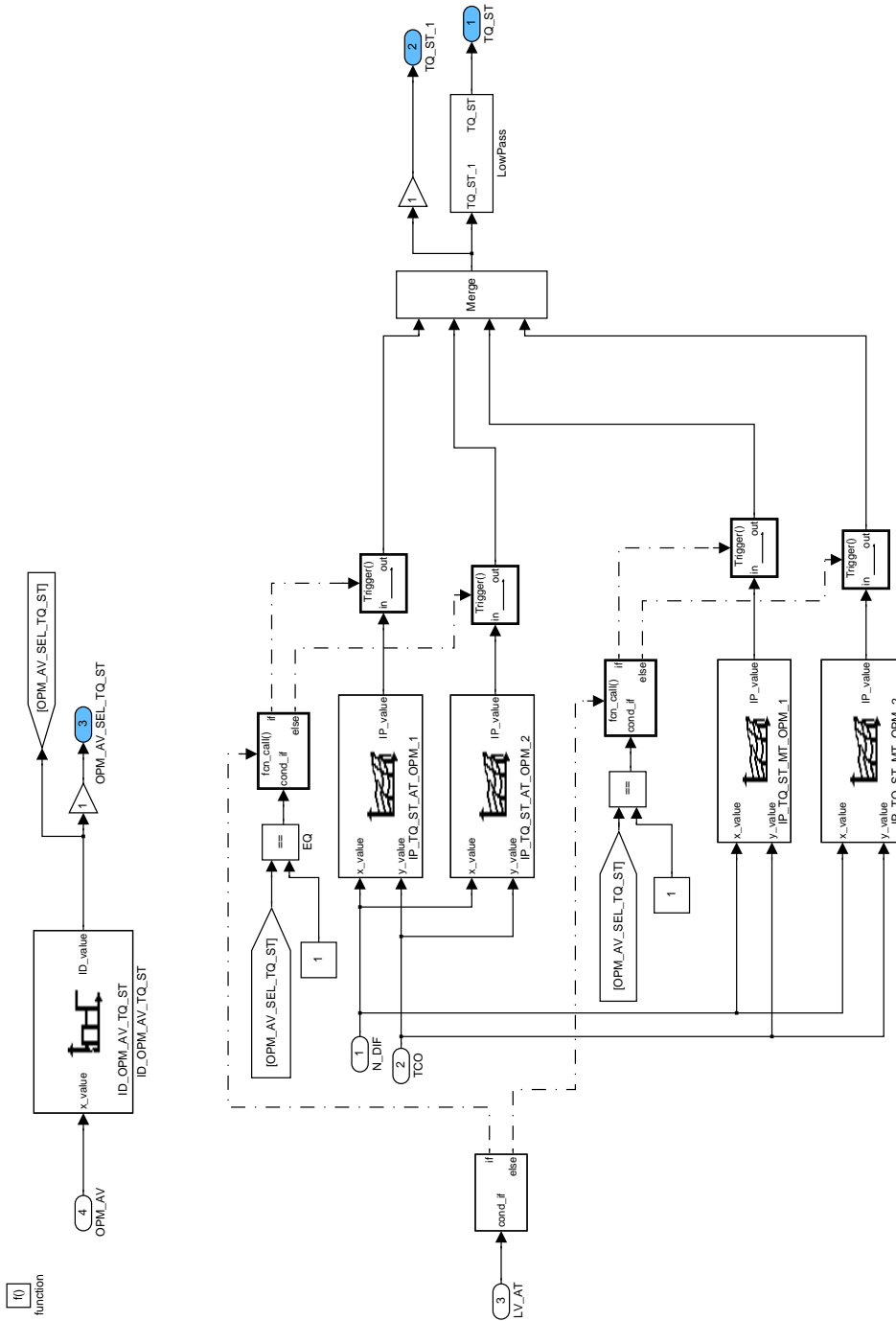


Figure D.14.3: TQSP\_MD00S/Operate

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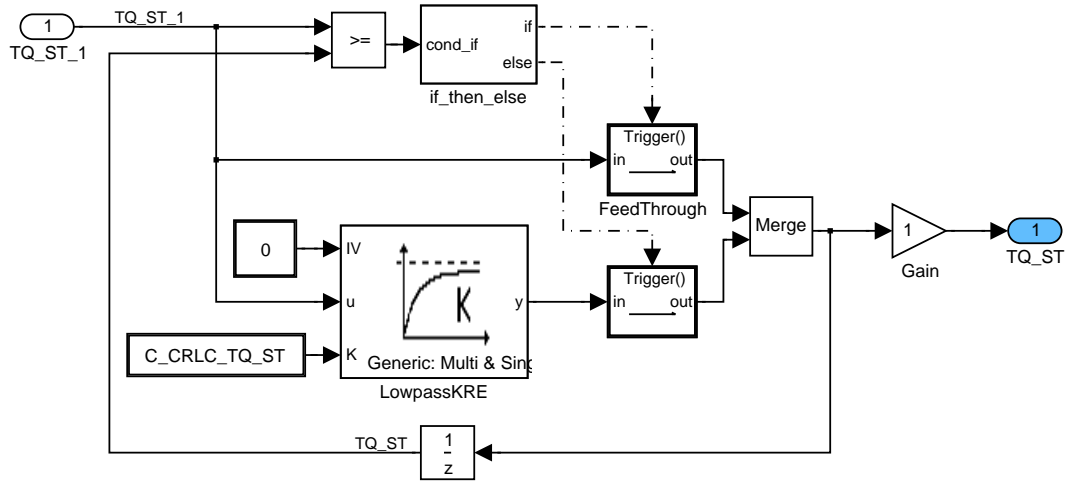


Figure D.14.4: TQSP\_MD00S/Operate/LowPass

**D.14.1.2 SUBFUNCTION: reset**

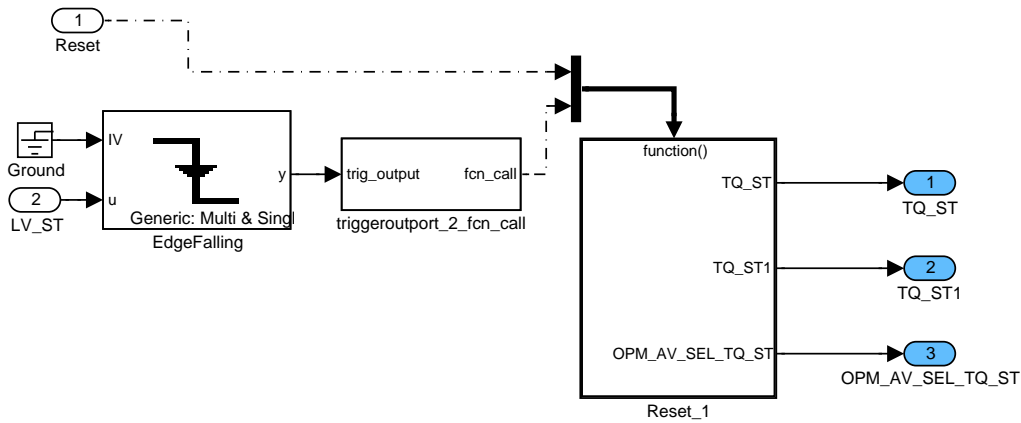


Figure D.14.5: TQSP\_MD00S/reset

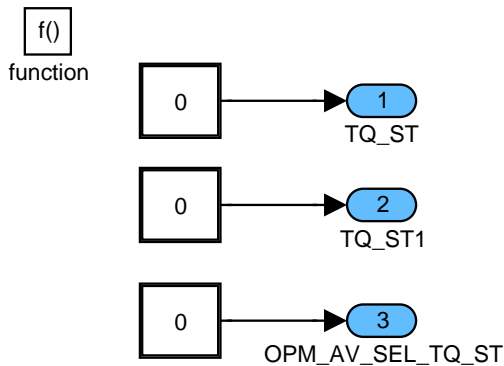


Figure D.14.6: TQSP\_MD00S/reset/Reset\_1

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## D.15 Torque coordination

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_TQI_REQ_CAN_INH	O/V	0... 1H	0 ...1	1	-
general flag for inhibition of external torque requests					

### Input data:

LV_ERR_MTC_CTL_1 {p. 4977}	SF_TQD {p. 6741}		
-------------------------------	------------------	--	--

### FUNCTION DESCRIPTION:

#### General information:

LV\_TQI\_REQ\_CAN\_INH collects all states or flags within engine management which shall lead to ignoring external torque requests.

#### Application conditions

**Initialisation:** *LV\_TQI\_REQ\_CAN\_INH = 0 for LV\_IGK 0 - -> 1 or at reset*  
**Recurrence:** *10ms*  
**Activation:** *at every engine state*  
**Deactivation:** *otherwise*

#### Formula section:

```

if          SF_TQD = 3          or          // - -> see remark *
              LV_ERR_MTC_CTL_1 = 1

then       LV_TQI_REQ_CAN_INH = 1

else       LV_TQI_REQ_CAN_INH = 0

Endif
    
```

#### Remark:

For detailed calculation of SF\_TQD see chapter "Torque request for traction control"


SF\_TQD = 3 H is set if

```

STATE_ETC_LIH      = ETC_LIH_1          or
STATE_ETC_LIH      = ETC_LIH_2_REV     or
STATE_ETC_LIH      = ETC_LIH_2        or
LV_OFF_MTC_MON     = 1                  or
LV_SF_TQD_MON      = 1
    
```

(see Chapter: "Appl. Inc of process monitoring" and "Fault reaction of Process monitoring")

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## D.16 Torque coordination general

### General information:

The torque structure introduces the engine torque as a fundamental quantity . Either torque at clutch or indicated engine torque is used depending on the needs for the coordination structure.

Every external or internal torque requests are coordinated in the torque coordination modules where several criteria such as emissions, fuel consumption, engine protection and driveability are considered. Then torque request is distributed to the different regulated quantities load, ignition, mixture and fuel cut-off.

In this way the complexity can be reduced by the modular approach of the torque structure.

Every subfunction is linked by a torque interface to the torque structure (e.g. idle speed control, anti jerk function, engine speed limitation or catalyst heating, etc.). So the mutual interference of the subfunctions disappear because there is no direct link anymore to the different regulated quantities which decrease the tuning effort.

For the following overview of the torque structure only the most important modules and interface variables are mentioned to show the main track through the structure.

### Pedal value interpretation

The Driver requests his driving wish by manipulation of the driving pedal. As a result a certain pedal value PV\_AV is observed which is transformed by different functions into a scaling factor FAC\_TQ\_REQ\_DRIV (0...1).

### Coordination of scaling factors for requested torque

This module coordinates different "driver" wishes coming from the manual driver, cruise control or variable vehicle speed limitation.

The result is a coordinated scaling factor FAC\_TQ\_REQ.

### Torque request at clutch general

The structure "Torque request at clutch general" consists of the modules "Maximum torque at clutch" and "Minimum torque at clutch". By the scaling factor FAC\_TQ\_REQ the requested torque at clutch TQ\_REQ\_CLU is calculated.

### Torque Transient


The driver torque request TQ\_REQ\_CLU is filtered to protect the powertrain from jerking. The step response of the torque transient function are linear ramps. The slope of the ramps are a function of gear ratio, engine speed, torque range and torque increase and decrease state.

The outputs are TQ\_REQ\_CLU\_TRA and TQI\_REQ\_TRA (TQ\_REQ\_CLU\_TRA - TQ\_LOSS) which is the indicated torque representation.

Parallel a torque reserve can be activated by "Torque reserve for torque transient" with the output variable TQ\_ADD\_TRA. This torque reserve minimizes the difference between torque setpoint TQI\_REQ\_TRA and the actual engine torque TQI\_AV which leads to a better response behavior of the engine at positive torque jump requests.

### Torque reserve coordination

The torque reserve builds up an additional load which can be used when a fast torque increase is necessary (e.g. idle speed control) or if the ignition efficiency has to be reduced like for catalyst heating.

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The torque reserve quantities TQ\_ADD\_XXX are added to the requested torque value inside the slow torque path. Automatically parallel to the load increase a spark retard is done which will compensate the torque. To build up a torque reserve is a torque neutral process.

### Minimum /Maximum torque request selection

This module collects all torque requests to generate the torque setpoint for the slow path TQI\_REQ\_SLOW and TQI\_REQ\_FAST for the fast path.

#### External torque requests:

- |  |                           |
|--|---------------------------|
| - driver torque request                        | TQI_REQ_TRA , TQI_ADD_ACT |
| - traction control (torque reduction/increase) | TQI_ASR/MSR_FAST/SLOW     |
| - automatic transmission (gear support)        | TQI_GS_FAST/SLOW_INC/DEC  |

#### Internal torque requests:

- |  |                       |
|--|-----------------------|
| - engine speed limitation              | TQI_N_MAX             |
| - vehicle speed limitation             | TQI_VS_MAX            |
| - cruise control (optional)            |                       |
| - engine power limitation              | TQI_P_MAX             |
| - catalyst protection                  | TQI_CAT_PROT          |
| - torque plausibility check in level 1 | TQI_REQ_LIM_SLOW/FAST |

### Minimum indicated engine torque at trailing throttle

This module will provide a minimum indicated engine torque TQI\_MIN\_PU to limit the throttle opening to a minimum value to ensure a safe combustion and to limit the intake manifold pressure.

For the engine operation states the status bit LV\_TQI\_BOL\_SET is delivered to prepare the trailing throttle fuel cut-off. It indicates that the torque setpoint TQI\_SP is below the minimum torque TQI\_BOL at minimum ignition efficiency.

### Torque coordination


The coordinated torque values TQI\_REQ\_SLOW and TQI\_REQ\_FAST are entered into the slow and fast torque path where they are confronted with

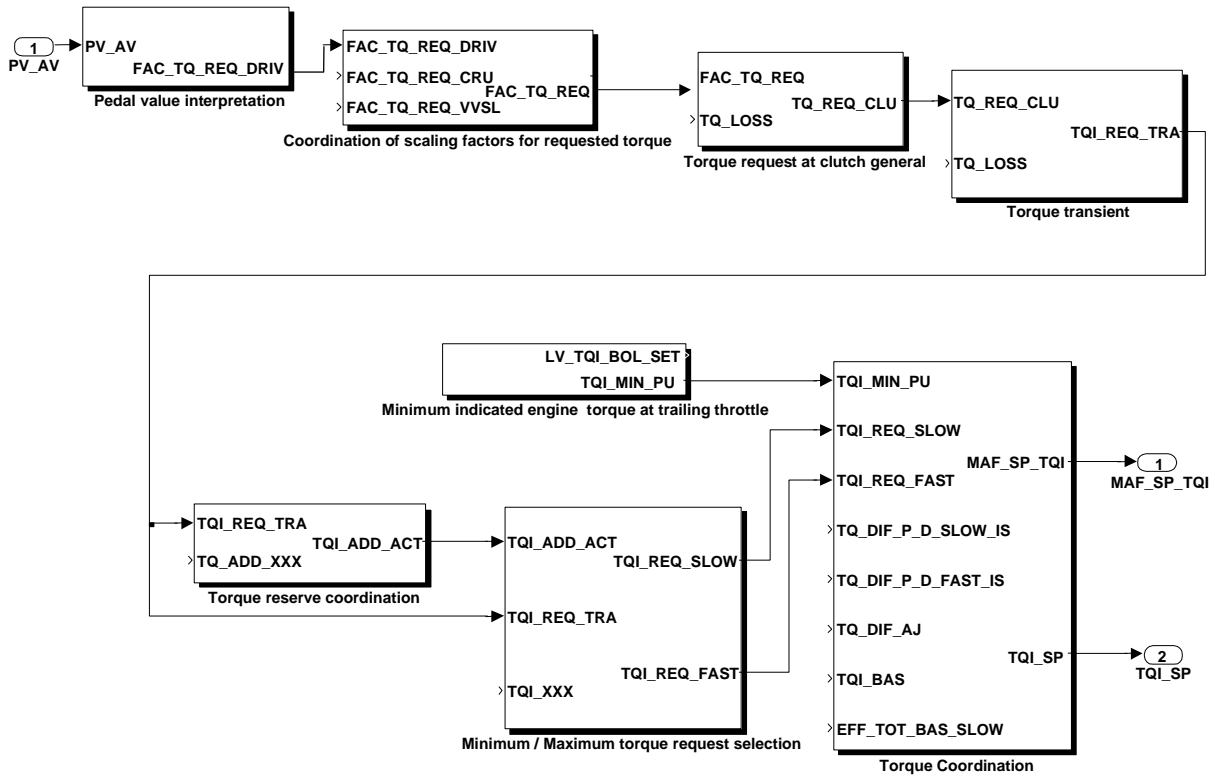
- torque limitations TQI\_MIN\_PU, TQI\_BAS
- idle speed control TQ\_DIF\_P\_D\_SLOW\_IS, TQ\_DIF\_P\_D\_FAST\_IS
- standardization to efficiency 1.00 by EFF\_TOT\_BAS\_SLOW (for the air path torque TQI\_REQ\_SLOW)
- anti jerk correction TQ\_DIF\_AJ

The output from the slow path is MAF\_SP\_TQI which is an input into the inverse air path to determine the throttle opening.

TQI\_SP the final target torque is the output from the fast torque path to be obtained in homogeneous mode. It serves as an input for the fast torque path like ignition angle, lambda adjustment (where it is necessary) and fuel cut-off pattern calculations.


### Overview torque structure:

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## D.17 Torque request for safety

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_TQ_LIM_INTV	O/V		-	-	-
Bit for torque intervention for safety active					
LV_TQ_LIM_INTV_1	V		-	-	-
Result for TQI_AV > TQI_SP_MON					
LV_TQ_LIM_INTV_2	V		-	-	-
ON-Delayed (40ms) result for TQI_AV > TQI_SP_MON					
SUM_TQI_REQ_LIM	O/V/S	0... FFFF H	0... 65535	1	-
Event counter of active torque limitations (stored in non volatile memory)					
T_TQ_LIM_INTV	V	0... FFFFH	0... 2621.4	0.04	s
Decrement time counter after transition LV_TQ_LIM_INTV_2 1 --> 0 to set LV_TQ_LIM_INTV = 0					
T_TQI_REQ_LIM	V	0... FFFFH	0... 2621.4	0.04	s
Increment time counter after transition LV_TQ_LIM_INTV_2 0 --> 1 to set LV_TQ_LIM_INTV = 0					
T_TQI_REQ_LIM_MAX	O/V/S	0... FFFFH	0... 2621.4	0.04	s
max time counter after transition LV_TQ_LIM_INTV_2 0 --> 1 to set LV_TQ_LIM_INTV = 0					
TQI_DIF_LIM	V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Torque offset for recognition torque intervention active					
TQI_REQ_LIM_1	V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Intermediate value 1 for requested torque for safety					
TQI_REQ_LIM_2	V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Intermediate value 2 for requested torque for safety					
TQI_REQ_LIM_3	V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Intermediate value 3 for requested torque for safety					
TQI_REQ_LIM_4	V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Intermediate value 4 for requested torque for safety					
TQI_REQ_LIM_DIF	V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
difference of torque request for safety					
TQI_REQ_LIM_DIF_MAX	O/V/S	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Max difference of torque request for safety					
TQI_REQ_LIM_DIF_OFS	-	0... 1FE0 H	0... 255	0.03125	Nm
Permitted deviation offset					
TQI_REQ_LIM_FAST	O/V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Requested torque for safety for fast path					
TQI_REQ_LIM_SLOW	O/V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Requested torque for safety for slow path					

### Input data:

LC_AD_CLR_TQ	LV_ES {p. 1720}	LV_IGK {p. 906}	LV_MTC_CUR_OFF {p. 6565}
LV_TQ_LIM_EXT_ADJ	N_32 {p. 1525}	TQI_AV {p. 981}	TQI_SP_MON {p. 6851}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DEC_TQI_LIM_DIF_MAX	-	20... 1FE0H	1... 255	0,03125	Nm
decrement after start condition					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_TQ_LIM_INTV	-	0... FFFF H	0... 2621.4	0.04	s
Time after active torque intervention to reset LV_TQ_LIM_INTV					
C_TQ_LIM_DEC	-	0... 7FFF H	0... 1023.97	0.03125	Nm
Maximum negative gradient of the requested torque TQI_REQ_LIM_SLOW					
C_TQ_LIM_INC	-	0... 7FFF H	0... 1023.97	0.03125	Nm
Maximum positive gradient of the requested torque TQI_REQ_LIM					
C_TQI_DIF_LIM_MAX_OFS	-	0... 1FE0 H	0... 255	0.03125	Nm
Offset after start condition					
C_TQI_REQ_LIM_PAS	-	0... 7FFF H	0... 1023.97	0.03125	Nm
Passive torque request for no torque intervention					
IP_TQI_DIF_LIM	V	0... FFFF H	-1024... 1023.97	0.03125	Nm
LDP_N_32_TQI_DIF_TQI_LIM	4	0... FF H	0... 8160	32	rpm
LDP_TQI_SP_MON_TQI_DIF_TQI_LIM	4	0... FF H	0... 510	2	Nm
Torque threshold depending on TQI_SP_MON					
LC_TQ_LIM_INH	-	0... 1 H	0 ...1	1	-
Logical constant inhibition torque intervention for safety in general					
LC_TQ_LIM_INH_FAST	-	0... 1 H	0 ...1	1	-
Logical constant inhibition torque intervention for safety for fast path					
LC_TQ_LIM_INH_SLOW	-	0... 1 H	0 ...1	1	-
Logical constant inhibition torque intervention for safety for slow path					

## FUNCTION DESCRIPTION:

### General information:

The ETC safety concept monitors the torque generation of the engine by comparing the actual indicated engine torque TQI\_AV to the desired indicated engine torque TQI\_SP\_MON. In order to avoid a false diagnosis decision caused by tolerances and disturbances this torque intervention function is introduced.

The module *Torque Request for Safety* delivers two torque request values TQI\_REQ\_LIM\_FAST for the fast torque path (ignition and fuel cut-off) and TQI\_REQ\_LIM\_SLOW for the slow torque path (air path) which leads to a torque intervention if the actual reference torque TQI\_AV exceeds the setpoint TQI\_SP\_MON by more than a specified threshold.

This state is indicated by the bit LV\_TQ\_LIM\_INTV\_1. It is set if TQI\_AV is bigger than the setpoint TQI\_SP\_MON plus the offset TQI\_DIF\_LIM.

The bit LV\_TQ\_LIM\_INTV is set to 1 if LV\_TQ\_LIM\_INTV\_2 = 1 and set to 0 C\_T\_TQ\_LIM\_INTV seconds after an transition of LV\_TQ\_LIM\_INTV\_2 to 0 to prevent LV\_TQ\_LIM\_INTV from to fast jittering if the torque limitation goes on off on ... and is used for diagnosis. LV\_TQ\_LIM\_INTV\_2 is used to activate ignition or fuel cut of intervention.

TQI\_AV is calculated from the reference torque value TQI\_REF which includes the actual engine speed N\_32 and MAF and actual efficiencies of lambda ignition and cylinder shut off.

TQI\_DIF\_LIM is the safety offset which is the sum of TQI\_SP\_MON and IP\_TQI\_DIF\_LIM which depends on N\_32 and TQI\_SP\_MON itself.

If the actual torque TQI\_AV is inside the permitted range (LV\_TQ\_LIM\_INTV\_1 = 0) then TQI\_REQ\_LIM\_2 is set to the calibratable value C\_TQI\_REQ\_LIM\_PAS (e.g. max. engine torque + 10%).

The torque increase of TQI\_REQ\_LIM\_3 is realized by a change limitation (C\_TQ\_LIM\_INC) to avoid positive torque jumps if the limitation condition disappears.

TQI\_REQ\_LIM\_SLOW is also limited by a rate limiter to avoid negative jumps of the throttle.

By the tuneable logical constants LC\_TQ\_LIM\_INH\_FAST and LC\_TQ\_LIM\_INH\_SLOW either the fast torque output or the slow torque output or both can be inhibited (set to passive values) for further investigations.

*ON-Delay:*

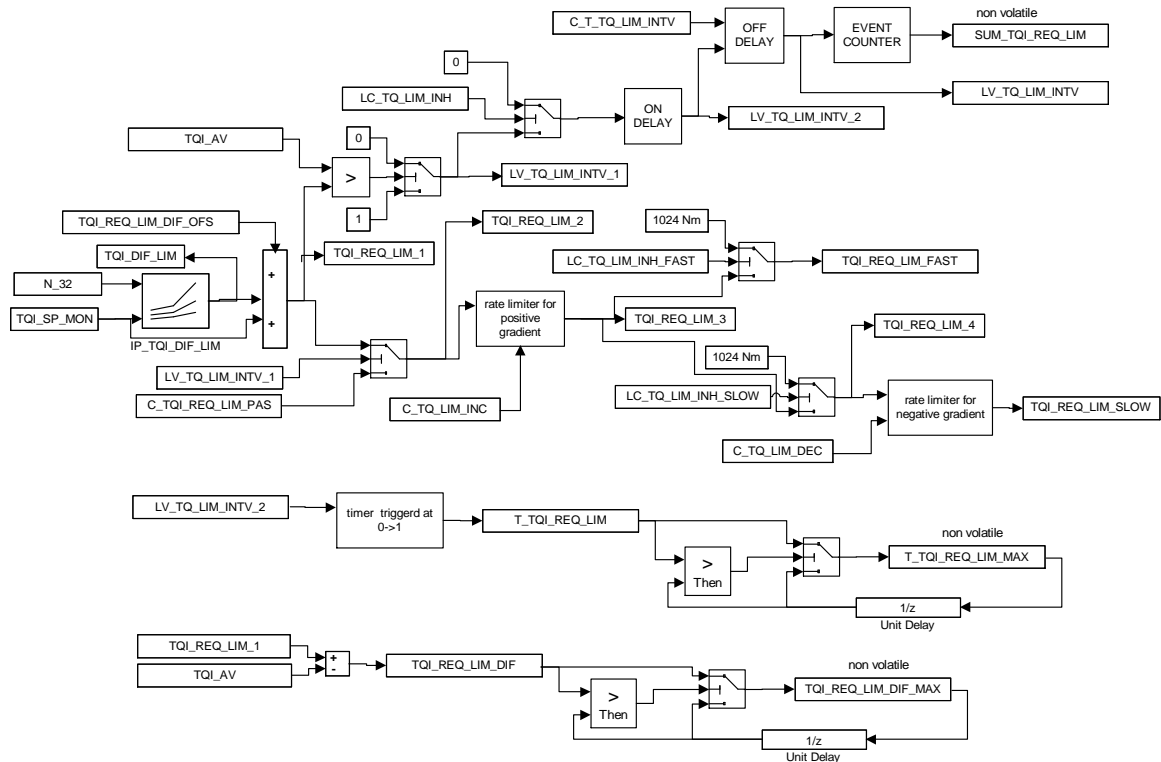
Released by Tetenborn Frank		Date 2013-02-13	File 17D01A01.00B
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 6693 of 8404	
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The ON-Delay is necessary because of this module is not synchronized to the module Desired indicated engine torque of level 2. This could cause inaccurate torque limitation in case of a high positive torque gradient in level 1 while TQI\_SP\_MON is not updated yet.

#### Drag Pointer functions:

Within the tuning phase is reliable a statistical evaluation of interventions. Therefore some drag pointers information are available.

#### Signal flow diagram:



#### Application conditions:

Activation:  $LV\_IGK = 1$  and  $LV\_ES = 0$  and  $LV\_MTC\_CUR\_OFF = 0$

Deactivation: otherwise

Initialization:

at reset or  $LV\_IGK = 0$  or  $LV\_ES = 1$  or  $LV\_MTC\_CUR\_OFF = 1$   
 then  $LV\_TQ\_LIM\_INTV = 0$

$LV\_TQ\_LIM\_INTV\_1 = 0$

$LV\_TQ\_LIM\_INTV\_2 = 0$

$TQI\_REQ\_LIM\_FAST = C\_TQI\_REQ\_LIM\_PAS$

$TQI\_REQ\_LIM\_SLOW = C\_TQI\_REQ\_LIM\_PAS$

$TQI\_REQ\_LIM\_3 = C\_TQI\_REQ\_LIM\_PAS$

$T\_TQ\_LIM\_INTV = 0\text{ s}$

$T\_TQI\_REQ\_LIM = 0\text{ s}$

$TQI\_REQ\_LIM\_DIF = 0\text{ Nm}$

$TQI\_REQ\_LIM\_DIF\_OFS = C\_TQI\_DIF\_LIM\_MAX\_OFS$

Update-Rate: 40 ms

**Formula section:**

$$TQI\_REQ\_LIM\_DIF\_OFS_n = \text{MAX}(TQI\_REQ\_LIM\_DIF\_OFS_{(n-1)} - C\_DEC\_TQI\_LIM\_DIF\_MAX; 0Nm)$$

Request-Calculation (I):

$$TQI\_REQ\_LIM\_1 = TQI\_SP\_MON + IP\_TQI\_DIF\_LIM(N\_32; TQI\_SP\_MON) + TQI\_REQ\_LIM\_DIF\_OFS$$

$$TQI\_REQ\_LIM\_DIF = TQI\_REQ\_LIM\_1 - TQI\_AV$$

```

IF          LC_TQ_LIM_INH == 1
THEN       LV_TQ_LIM_INTV_1k = 0
ELSE      IF          TQI_AV > TQI_REQ_LIM_1
           THEN       LV_TQ_LIM_INTV_1k = 1
           ELSE       LV_TQ_LIM_INTV_1k = 0
           ENDIF

```

ENDIF

ON-Delay:

```

IF          [(LV_TQ_LIM_INTV_1k-2 == 1) AND (LV_TQ_LIM_INTV_1k-1 == 1) AND
(LV_TQ_LIM_INTV_1k == 1)]
           {delay by 2 recurrences of the module}
THEN       LV_TQ_LIM_INTV_2k = 1
ELSE       LV_TQ_LIM_INTV_2k = 0
ENDIF

```

Off-Delay:

```

IF          LV_TQ_LIM_INTV_2k == 1
THEN       (LV_TQ_LIM_INTV = 1
           T_TQ_LIM_INTV = C_T_TQ_LIM_INTV)
ELSE       (T_TQ_LIM_INTV = T_TQ_LIM_INTV - [update rate]           {limited to 0}
           IF          T_TQ_LIM_INTV == 0
           THEN       LV_TQ_LIM_INTV = 0
           ENDIF)
ENDIF

```

ENDIF

Request-Calculation (II):

```

IF          LV_TQ_LIM_INTV_2k == 1
THEN       TQI_REQ_LIM_2 = TQI_REQ_LIM_1
ELSE       TQI_REQ_LIM_2 = C_TQI_REQ_LIM_PAS
ENDIF

```

Rate limiter for positive gradient:

```

IF          (TQI_REQ_LIM_2 > (TQI_REQ_LIM_3k-1 + C_TQ_LIM_INC))
THEN       TQI_REQ_LIM_3k = TQI_REQ_LIM_3k-1 + C_TQ_LIM_INC
ELSE       TQI_REQ_LIM_3k = TQI_REQ_LIM_2
ENDIF

```

TQI\_REQ\_LIM\_FAST calculation:

```

IF          LC_TQ_LIM_INH_FAST == 1           {fast torque request path disabled}
THEN       TQI_REQ_LIM_FAST = 1023.97       {upper limit}
ELSE       TQI_REQ_LIM_FAST = TQI_REQ_LIM_3k
ENDIF

```

TQI\_REQ\_LIM\_4 calculation:

```

IF          LC_TQ_LIM_INH_SLOW == 1           {slow torque request path disabled}
THEN       TQI_REQ_LIM_4 = 1023.97           {upper limit}
ELSE       TQI_REQ_LIM_4 = TQI_REQ_LIM_3k
ENDIF

```

Rate limiter for negative gradient:

```

IF          (TQI_REQ_LIM_4 < (TQI_REQ_LIM_SLOWk-1 - C_TQ_LIM_DEC))
THEN       TQI_REQ_LIM_SLOWk = TQI_REQ_LIM_SLOWk-1 - C_TQ_LIM_DEC
ELSE       TQI_REQ_LIM_SLOWk = TQI_REQ_LIM_4
ENDIF

```

Event counter active torque limitation: SUM\_TQI\_REQ\_LIM

```

At transition LV_TQ_LIM_INTV = 0 -> 1
THEN       increment SUM_TQI_REQ_LIM by 1
ELSE       SUM_TQI_REQ_LIM unchanged
ENDIF

```

The counter SUM\_TQI\_REQ\_LIM is stored in non volatile memory till error memory is erased or is reseted at external adjustment or LC\_AD\_CLR\_TQ

Drag pointer of torque intervention:

```

IF LV_TQ_LIM_INTV_2 = 1 and TQI_REQ_LIM_DIF < TQI_REQ_LIM_DIF_MAX
Then       TQI_REQ_LIM_DIF_MAX = TQI_REQ_LIM_DIF
else       TQI_REQ_LIM_DIF_MAX unchanged
endif

```

```

IF(1) LV_TQ_LIM_INTV_2n = 1 and LV_TQ_LIM_INTV_2n-1 = 0
Then(1)   T_TQI_REQ_LIM = 0s           ("reset at activation")
Else(1) IF(2)   LV_TQ_LIM_INTV_2n = 1
  Then (2) T_TQI_REQ_LIM = T_TQI_REQ_LIM + Update rate
    IF(3) T_TQI_REQ_LIM > T_TQI_REQ_LIM_MAX
      Then(3) T_TQI_REQ_LIM_MAX = T_TQI_REQ_LIM
      Else(3)   T_TQI_REQ_LIM_MAX unchanged
    Else(2)   T_TQI_REQ_LIM unchanged

```

**Endif**

The drag pointers TQI\_REQ\_LIM\_DIF\_MAX and T\_TQI\_REQ\_LIM\_MAX are stored in non volatile memory till error memory is erased or a reset is done at external adjustment or LC\_AD\_CLR\_TQ .



## D.18 Torque based engine power limitation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ACT_TQI_PBR_MAX	V	0... 1H	0 ...1	1	-
Bit indicating conditions for torque limitation due to PBR fulfilled					
STATE_MOD_GB_WLC	O/V	0H 1H 2H 3H 7H	SSC_SBC_ OFF SSC_ON SBC_ON SSC_SBC_ON INVALID_ SIGNAL	-	-
State mode gearbox for torque limitation due to WLC error (AT)					
TQ_LIM_AT	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Maximum allowed torque at clutch in case of TCU limp home (autarkic transmission protection for AT)					
TQ_LIM_TCT	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Maximum allowed torque at clutch in case of TCU limp home (autarkic transmission protection for TCT)					
TQ_LIM_WLC	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Maximum allowed torque at clutch in case of wandler launch control (WLC) error for AT					
TQI_P_MAX	O/V	0... 7FFFH	0... 1023.97	0.03125	Nm
maximum allowed indicated torque due to torque limitation					
TQI_PBR_MAX	O/V	0... 7FFFH	0... 1023.97	0.03125	Nm
maximum allowed indicated torque due to PBR					

### Input data:

AC_WHEEL_PBR {p. 1561}	C_CTR_KM_CAN_EGY_2_ MAX {p. 1149}	CTR_KM_CAN {p. 1563}	ERR_SYM_BN_ETCU {p. 4861}
ERR_SYM_BN_TQ_ETCU {p. 4864}	ERR_SYM_BN_TQ_TCS {p. 4865}	ERR_SYM_BN_VS_TCS {p. 4865}	GEAR {p. 1302}
LV_AT {p. 654}	LV_CFT_MOD_PBR {p. 1564}	LV_CS {p. 8394}	LV_CS_2 {p. 1565}
LV_DRI {p. 1302}	LV_ETCU_DISABLE_CAN {p. 6718}	LV_TCS_DISABLE_CAN {p. 6741}	LV_VAR_TCT {p. 656}
N_32 {p. 1525}	STATE_EGY_MIN_KWP {p. 7483}	STATE_HLD_PBR {p. 1574}	STATE_MOD_GB {p. 1575}
STATE_PBR {p. 1575}	STATE_PBR_ACT {p. 1575}	STATE_PBR_ACT_QLY {p. 1575}	STATE_ST_TQ_LIM_GS {p. 1577}
STATE_TQ_WHEEL_PBR_ QLY {p. 1578}	TQ_LOSS {p. 8385}	VS {p. 1176}	VS_FIL {p. 1176}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_TQ_LIM_TOUT_AT	-	0... FFFFH	0... 655.35	0.01	s
Delay time for TCU limp - home (AT)					
C_T_TQ_LIM_TOUT_TCT	-	0... FFFFH	0... 655.35	0.01	s
Delay time for TCU limp - home (TCT)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_TQ_LIM_WLC	-	0... FFFFH	0... 655.35	0.01	s
Delay time for torque limitation due to WLC error (AT)					
C_TQ_LIM_AT_LGRD	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitating gradient at end of AT torque limitation					
C_TQ_LIM_TCT_LGRD	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitating gradient at end of TCT torque limitation					
C_TQ_LIM_TOUT_AT_LGRD	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitation gradient for TCU limp - home (AT)					
C_TQ_LIM_TOUT_TCT_LGRD	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitation gradient for TCU limp - home (TCT)					
C_TQ_LIM_WLC_LGRD	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitation gradient for WLC error (AT)					
C_TQI_PBR_MAX	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
maximum allowed TQI_PBR_MAX					
C_VS_MAX_TQ_LIM_PBR	-	0... FFH	0... 255	1	km/h
Threshold of vehicle speed limitation for PBR					
C_VS_MIN_TQI_LIM_PBR	-	0... FFH	0... 255	1	km/h
Minimum threshold of vehicle speed limitation for PBR					
ID_TQ_P_MAX_AT	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDPM_GEAR_TQ_P_MAX	13	0... CH	0... 12	1	-
maximum allowed torque at clutch due to torque limitation depending on gear ratio by AT					
ID_TQ_P_MAX_MT	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDPM_GEAR_TQ_P_MAX	13	0... CH	0... 12	1	-
maximum allowed torque at clutch due to torque limitation depending on gear ratio by MT					
IP_TQ_LIM_AT	V	0... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_VS_FIL_IP_TQ_LIM_AT	8	0... FFFFH	0... 511.9921875	7.8125e-3	km/h
LDPM_N_32_IP_TQ_LIM_AT	8	0... FFH	0... 8160	32	rpm
Maximum allowed torque at clutch in case of TCU limp - home (autarkic transmission protection for AT)					
IP_TQ_LIM_TCT	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDPM_VS_FIL_IP_TQ_LIM_TCT	8	0... FFFFH	0... 511.9921875	7.8125e-3	km/h
LDPM_N_32_IP_TQ_LIM_TCT	8	0... FFH	0... 8160	32	rpm
Maximum allowed torque at clutch in case of TCU limp - home (autarkic transmission protection for TCT)					
IP_TQ_LIM_TOUT_AT	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDPM_VS_FIL_IP_TQ_LIM_AT	8	0... FFFFH	0... 511.9921875	7.8125e-3	km/h
LDPM_N_32_IP_TQ_LIM_AT	8	0... FFH	0... 8160	32	rpm
Maximum allowed torque at clutch before TCU limp - home (AT)					
IP_TQ_LIM_TOUT_TCT	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDPM_VS_FIL_IP_TQ_LIM_TCT	8	0... FFFFH	0... 511.9921875	7.8125e-3	km/h
LDPM_N_32_IP_TQ_LIM_TCT	8	0... FFH	0... 8160	32	rpm
Maximum allowed torque at clutch before TCU limp - home (TCT)					
IP_TQ_LIM_WLC	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDP_N_32_IP_TQ_LIM_WLC	8	0... FFH	0... 8160	32	rpm
Maximum allowed torque at clutch in case of wandler launch control (WLC) error (AT)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TQ_P_MAX_EGY_2	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDP_N_32_IP_TQ_P_MAX_EGY_2	8	0... FFH	0... 8160	32	rpm
Maximum allowed torque due to energy spare mode 2					
LC_TQI_P_MAX_INH_AS	-	0... 1H	0 ...1	1	-
switch for torque limitation ON/OFF ( 0 = ON )					

### General information:


Due to customer- or hardware- (gear box) request the maximum torque at clutch depending on gear ratio and transmission type can be limited.

### Application conditions:

*Initialisation:* RST, IGKON  
*Recurrence:* 10MS  
*Activation:* always  
*Deactivation:* never

### Function description:

### Formula section:

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 6699 of 8404	
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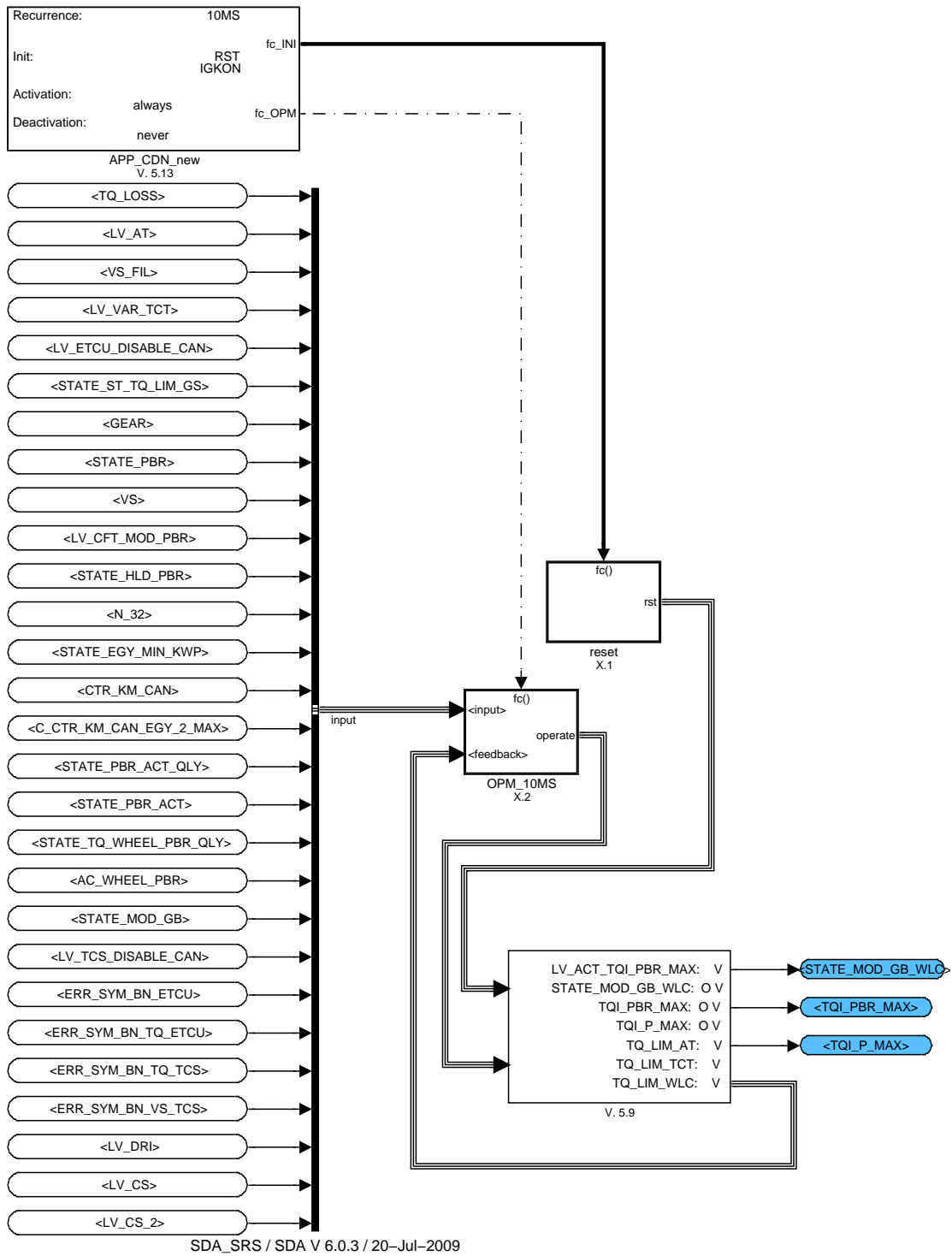


Figure D.18.1: :

### D.18.1 Initialisation at reset or LV\_IGK = 0 to 1

TQI\_P\_MAX = 1023,97 Nm  
 TQ\_PBR\_MAX = 1023,97 Nm  
 TQ\_LIM\_AT = 1023,97 Nm

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 6700 of 8404	
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TQ\_LIM\_TCT = 1023,97 Nm  
 LV\_ACT\_TQI\_PBR\_MAX = 0

### D.18.2 Recurrence:10 ms

#### D.18.2.1 Calculation of TQ\_LIM\_WLC

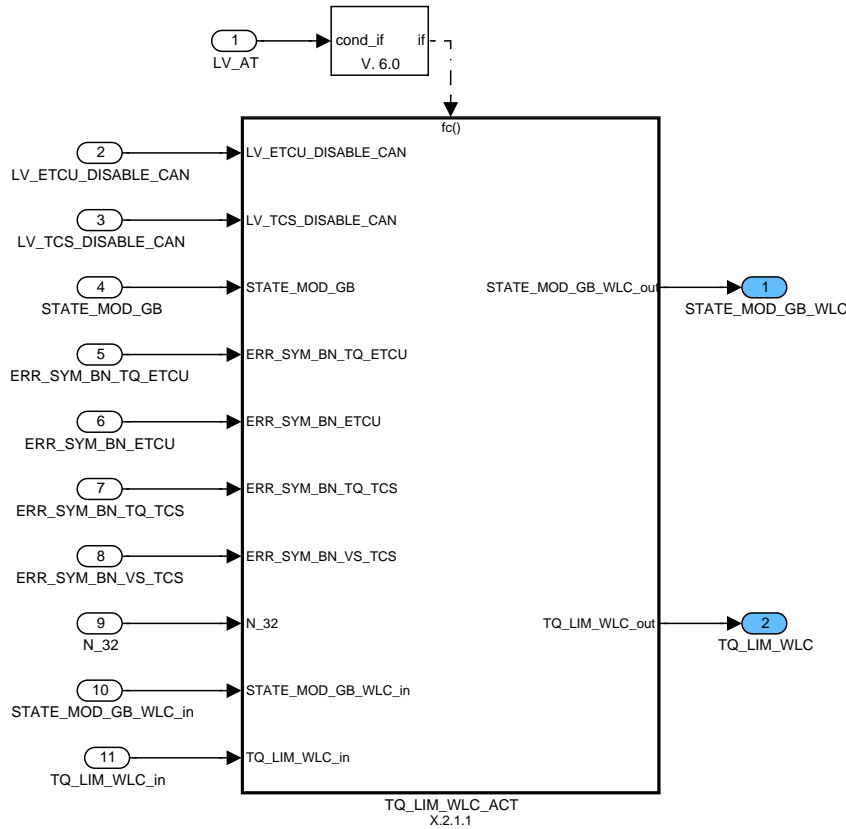


Figure D.18.2: :

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### D.18.2.1.1 Calculation of the torque limitation at clutch in case of wandler launch control error

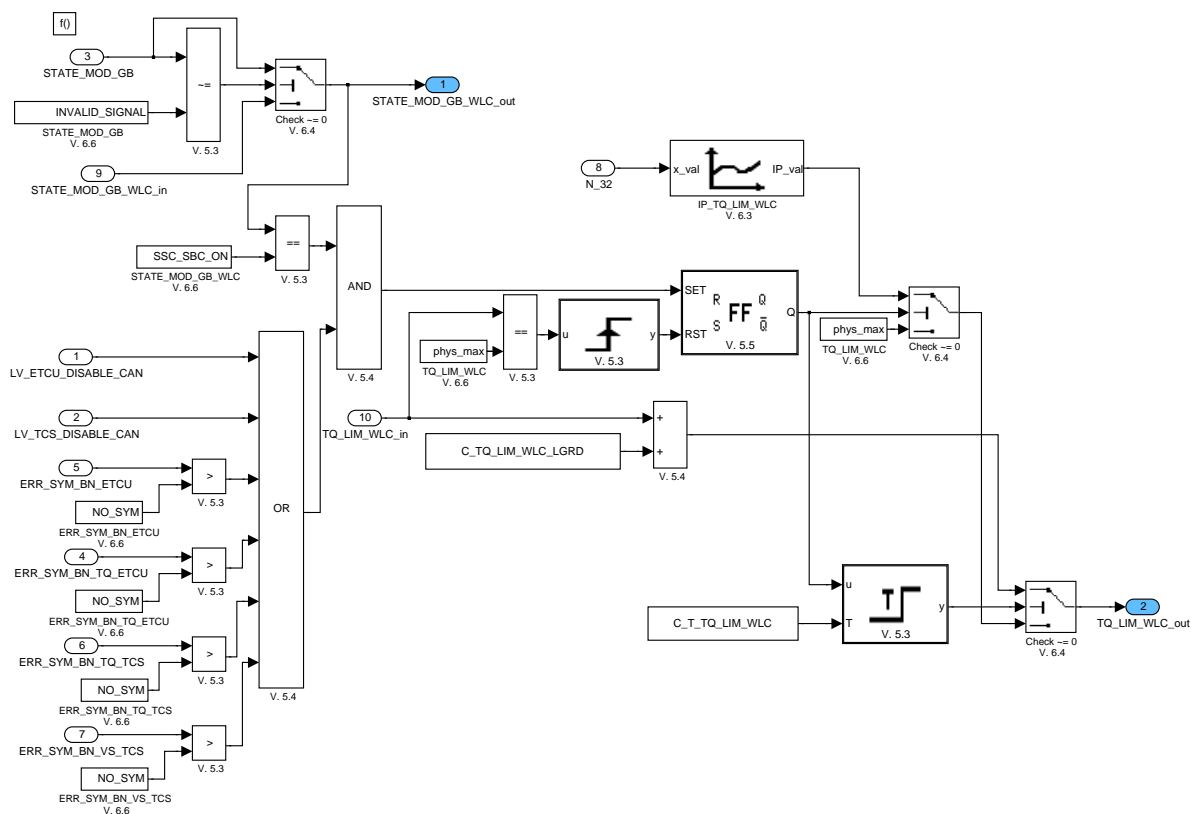


Figure D.18.3: :

### D.18.2.2 Calculation of torque limitation for automatic shifted transmission

Maximum allowed torque at clutch in case of TCU limp home. Autarkic transmission protection for AT.

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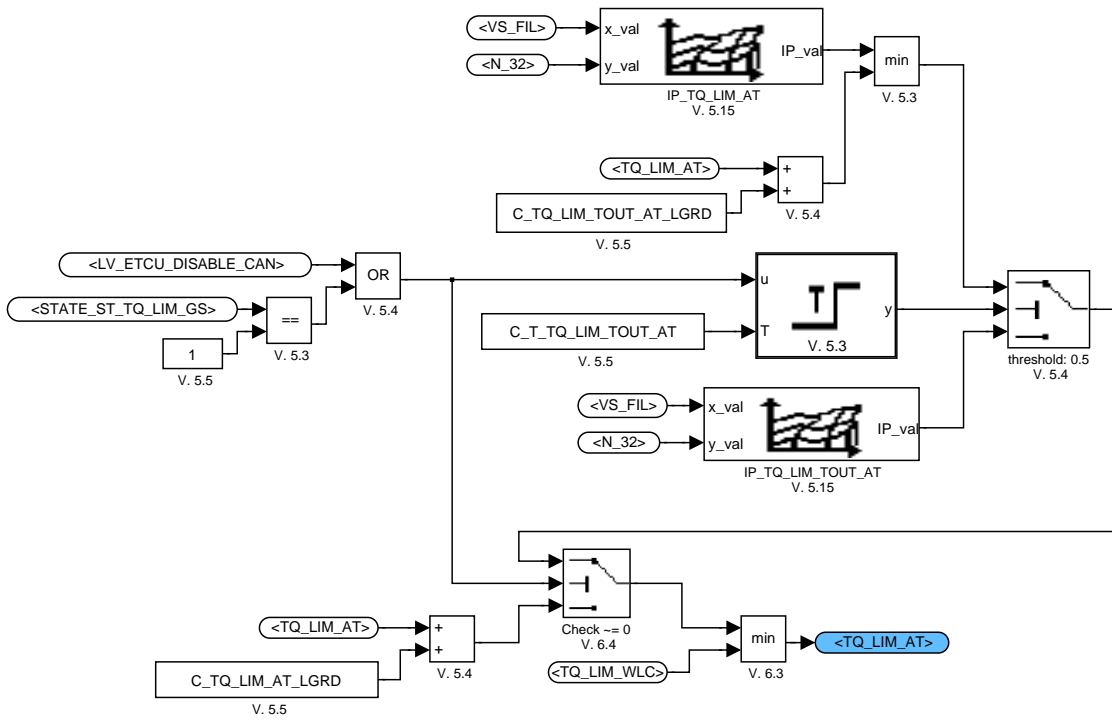


Figure D.18.4: :

### D.18.2.3 Calculation of torque limitation for twin clutch transmission

Maximum allowed torque at clutch in case of TCU limp home. Autarkic transmission protection for TCT.

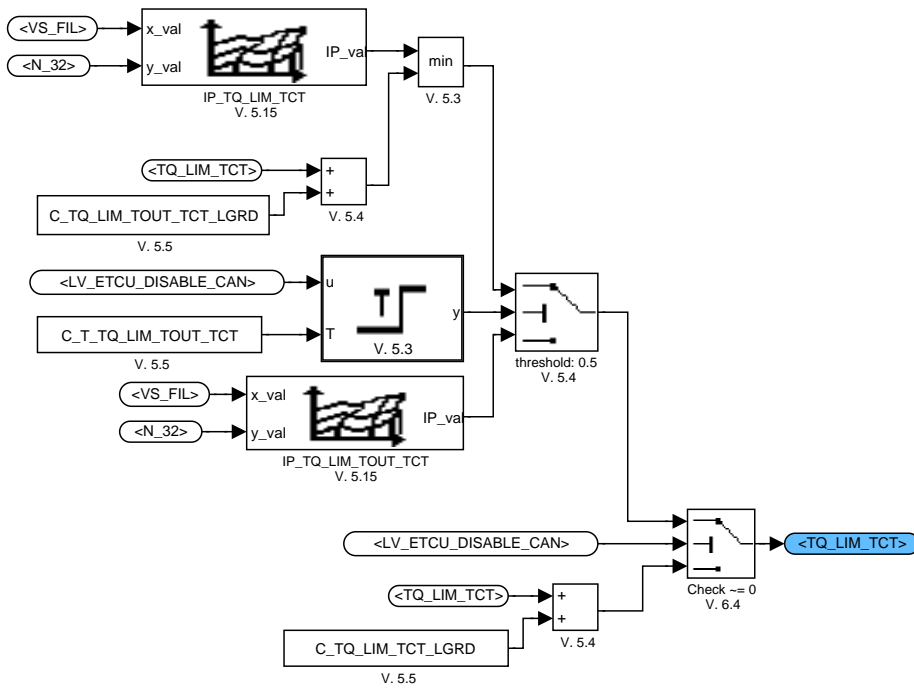



Figure D.18.5: :

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	Document key 10171571 SPE 000 AO	Pages Page 6703 of 8404	
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### D.18.2.4 Calculation of TQI\_P\_MAX\_CLC

Calculation of the maximum indicated engine torque proportional part.

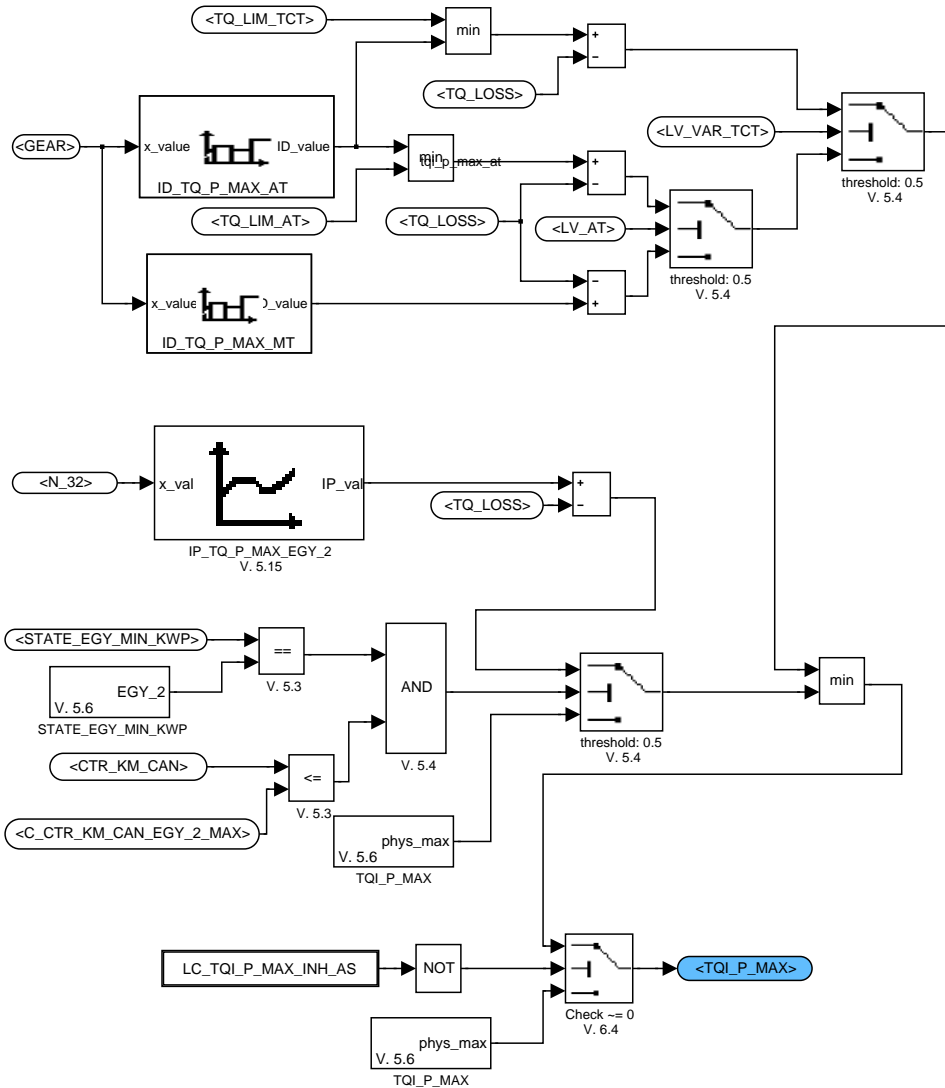


Figure D.18.6: :

### D.18.2.5 Calculation of TQI\_PBR\_MAX

Calculation of the maximum indicated engine torque for PBR.

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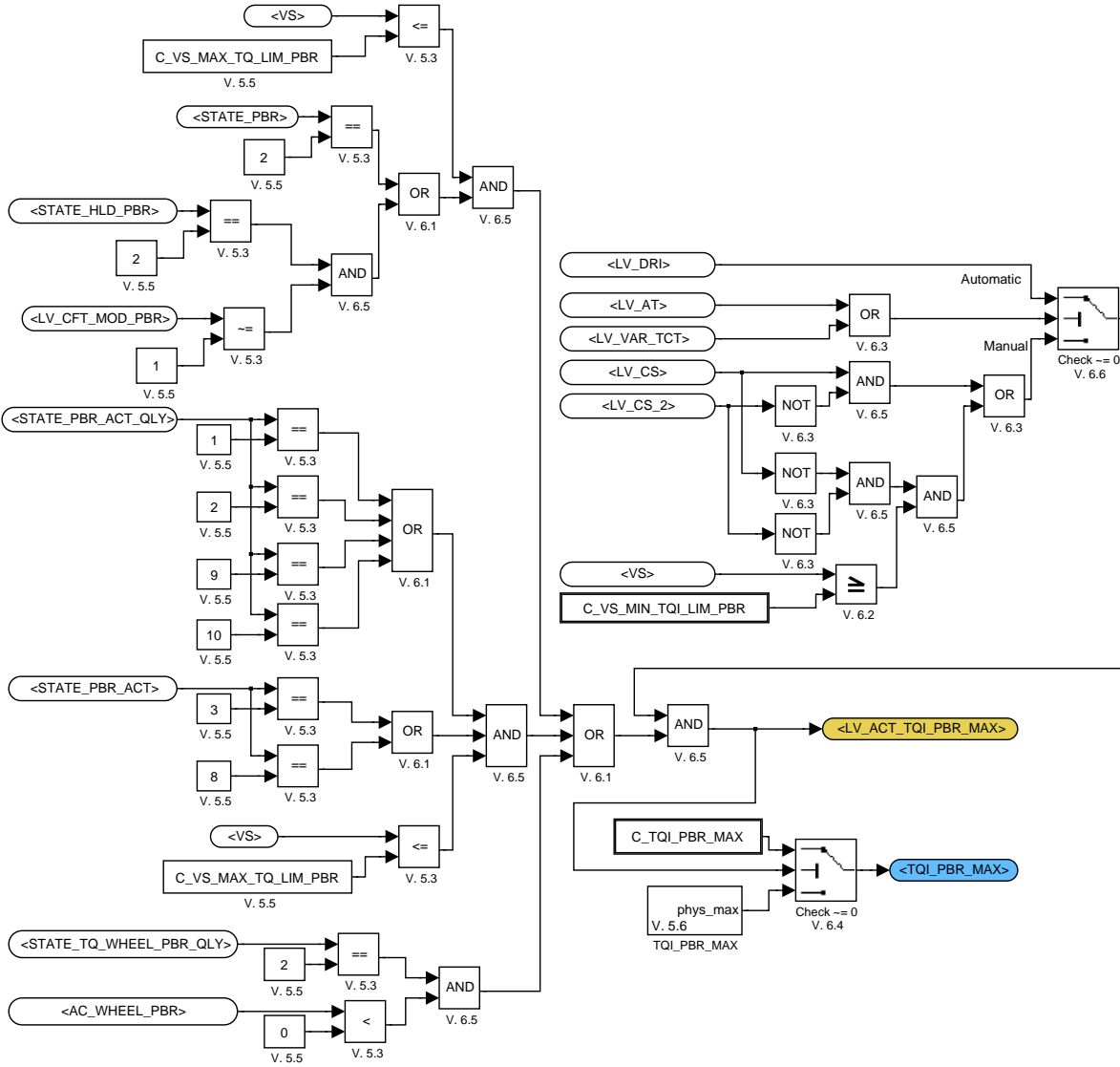


Figure D.18.7: :

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## D.19 Torque request at clutch general

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_REQ	O/V	0... FFFFH	0... 1.99996948	30.5175e-6	-
Torque factor from pedal value interpretation and cruise control					
FAC_TQ_REQ_CLU	O/V	0... FFFFH	0... 1.99996948	30.5175e-6	-
Torque scaling factor for calculation requested torque at clutch					
FAC_TQ_REQ_CLU_LDM	O/V	0... FFFFH	0... 1.99996948	30.5175e-6	-
Torque scaling factor for calculation requested torque at clutch for LDM					
LV_TQ_CRU_ACT	O/V	0... 1H	0 ...1	1	-
Logical variable cruise control active					

### Input data:

FAC_TQ_REQ_CRU {p. 6737}	FAC_TQ_REQ_DCC {p. 6737}	FAC_TQ_REQ_DRIV {p. 6570}	LV_LDM_ENA {p. 6615}
LV_MAF_BLS_DIAG {p. 4820}			

### D.19.1 TQSP\_MD00L

#### General information:

The module "Torque Request at Clutch General" supplies the BMW torque structure with the torque scaling factor FAC\_TQ\_REQ\_CLU from the driver or a cruise control.

FAC\_TQ\_REQ is exported and can be used from a transmission control unit for calculation of gear shifting points.

If a MAF error is detected and brake is active then the torque request is set to zero.

#### Application conditions

<b>Initialisation:</b>	<i>all = 0 at reset</i>
<b>Recurrence:</b>	<i>10 ms</i>
<b>Activation:</b>	<i>at every engine state</i>
<b>Deactivation:</b>	<i>-</i>

#### Application Condition

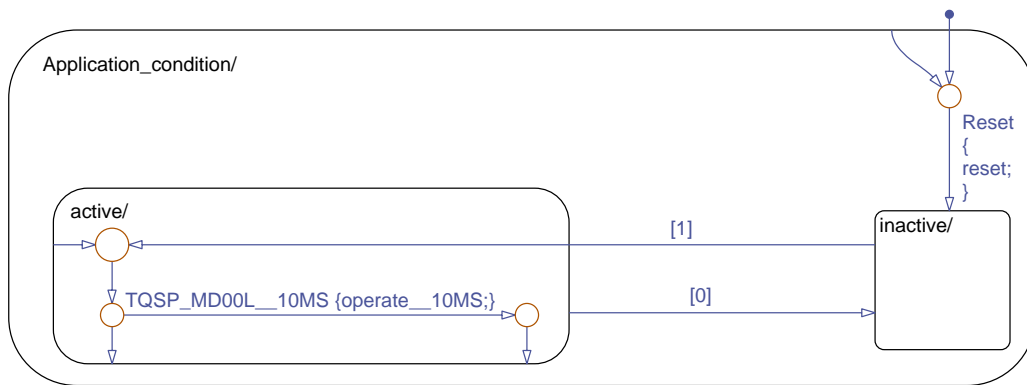


Figure D.19.1: TQSP\_MD00L/APP\_CDN/APPCND

**Function Description**

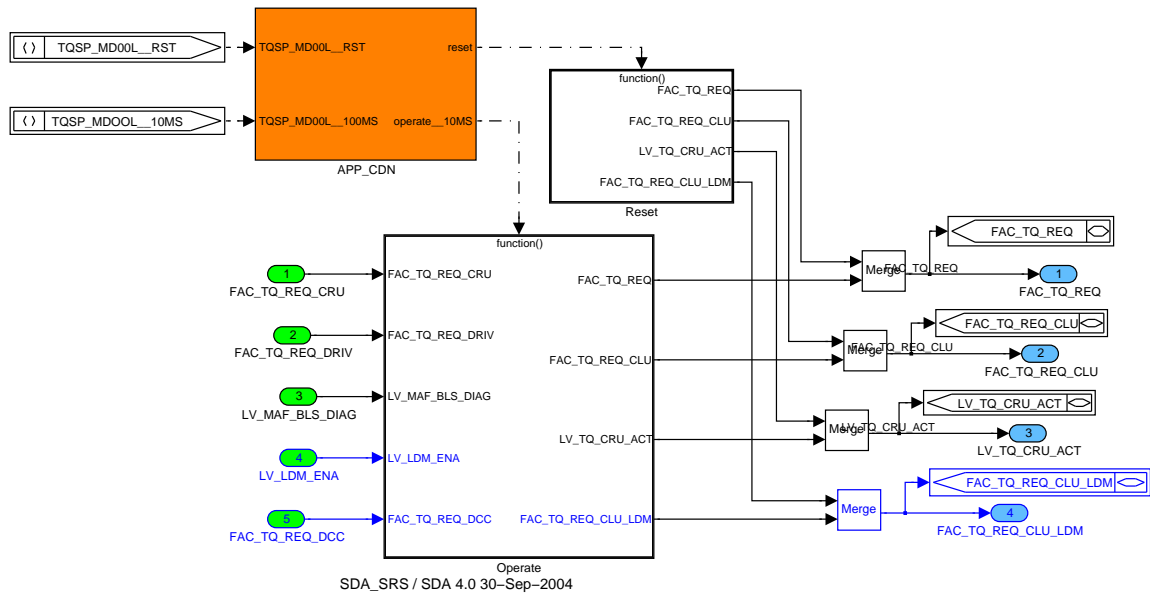


Figure D.19.2: TQSP\_MD00L

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### D.19.1.1 SUBFUNCTION: Operate

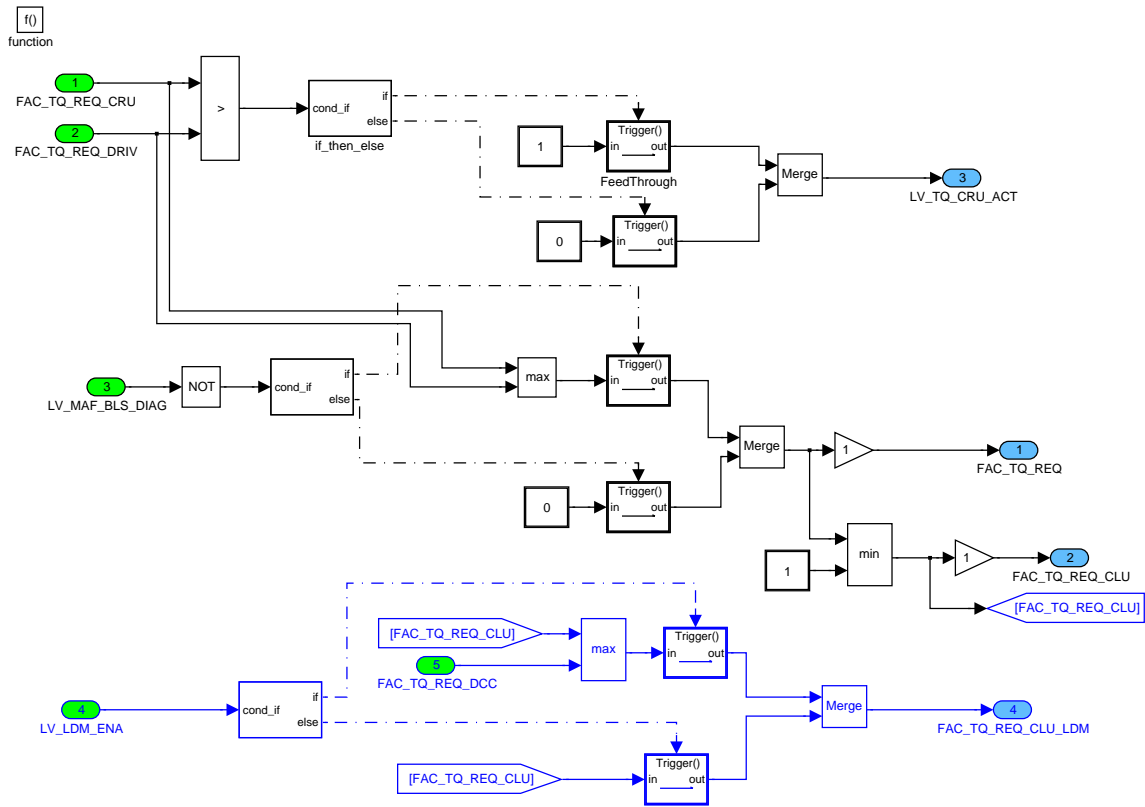


Figure D.19.3: TQSP\_MD00L/Operate

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### D.19.1.2 SUBFUNCTION: Reset

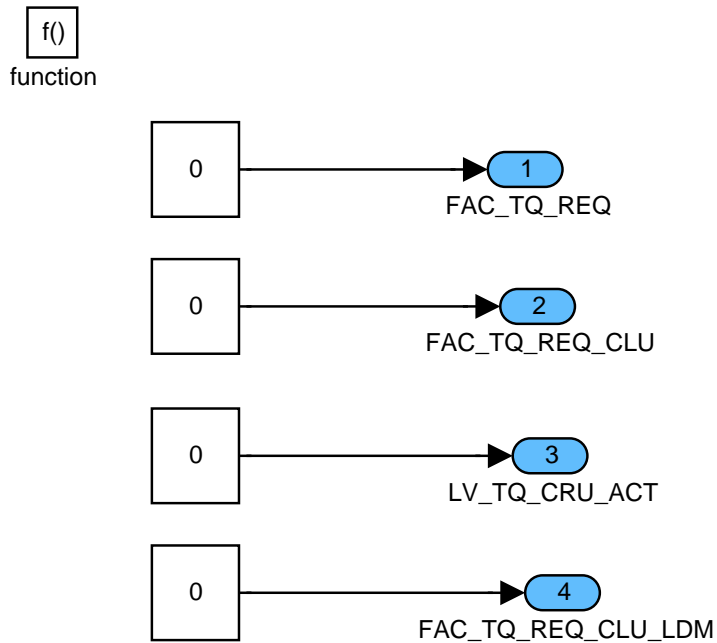


Figure D.19.4: TQSP\_MD00L/Reset

## D.20 Converter torque

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_DIF_IS_AD_CONV_LGRD	V	0... FFFFH	0 ...1	15.3e-6	-
Convergence factor for ramping of TQ_DIF_IS_AD_CONV in case of LV_DRI=1					
LV_DLY_N_SP_IS	O/V	0... 1H	0 ...1	1	-
Logical variable idle speed setpoint change					
LV_TOUT_CONV	V	0... 1H	0 ...1	1	-
Logical variable to start deactivation of torque reserve and condition for switch off TQ_CONV calculation					
LV_TOUT_TCT	V	0... 1H	0 ...1	1	-
Logical variable to start deactivation of torque reserve and condition for switch off TCT calculation					
LV_TQ_DIF_IS_AD_CONV_ACT	V	0... 1H	0 ...1	1	-
Flag indicating IS adaptation value TQ_DIF_IS_AD_CONV is included in TQ_CONV					
T_CONV	V	0... 1FEH	0... 5.1	0.01	s
Timer for duration of transient TQ_LOSS_CONV correction					
T_TCT	V	0... 1FEH	0... 5.1	0.01	s
Timer for duration of transient TQ_ADD_TCT correction					
TQ_ADD_CONV	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for switching converter Torque					
TQ_ADD_CONV_2	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for switching converter Torque					
TQ_ADD_TCT	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for TCT					
TQ_ADD_TRANS	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for Transmission					
TQ_CONV	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Converter torque					
TQ_CONV_CAN_1	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Converter torque of CAN					
TQ_CONV_STN	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Calculated converter torque					

### Input data:

AC_CRU {p. 7215}	GR_AT {p. 1302}	LV_AT {p. 654}	LV_DRI {p. 1302}
LV_ERR_BN_TQ_ETCU {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_TOUT_ETCU_1 {p. 802}	LV_ST {p. 1720}
LV_VAR_TCT {p. 656}	N_32 {p. 1525}	N_GRD {p. 1525}	N_SP_IS {p. 1122}
STATE_ETCU_CLU {p. 1573}	STATE_TCT_INTV {p. 1578}	TOIL {p. 8204}	TQ_ADD_CONV {p. 6710}
TQ_ADD_CONV_2 {p. 6710}	TQ_ADD_TCT {p. 6710}	TQ_CONV_CAN {p. 1581}	TQ_DIF_IS_AD_CONV {p. 3519}

TQ_TCT_CAN {p. 1582}	VS {p. 1176}		
----------------------	--------------	--	--

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQ_DIF_IS_AD_CONV_LGRD	-	0... FFFFH	0 ...1	15.3e-6	-
Convergence factor (delta per sample) for ramping of TQ_DIF_IS_AD_CONV in case of LV_DRI=1					
C_TQ_ADD_CONV_LGRD	-	0... 7FFFH	0... 1023.97	0.03125	Nm
Limitation gradient for TQ_ADD_CONV decrease after deactivation					
C_TQ_ADD_TCT_LGRD	-	0... 7FFFH	0... 1023.97	0.03125	Nm
Limitation gradient for TQ_ADD_TCT decrease after deactivation					
C_TQ_CONV_CAN_THD	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Threshold for TQ_CONV_CAN regarding the consideration of TQ_DIF_IS_AD_CONV in case of LV_DRI=1					
C_TQ_TCT_CAN_THD_CONV	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Threshold for TQ_TCT_CAN to detect transmission not in gear					
IP_FAC_CONV_TOIL	-	0... FFFFH	0... 0.00048	7.4464e-9	Nm/ rpm**2
LDP_TOIL_FAC_CONV	8	0... C8H	-40 ...160	1	°C
Converter characteristic at P /N (LV_DRI = 0 )					
IP_FAC_CONV_DRI_TOIL	-	0... FFFFH	0... 0.00048	7.4464e-9	Nm/ rpm**2
LDP_TOIL_FAC_CONV	8	0... C8H	-40 ...160	1	°C
Converter characteristic at engaged gear					
IP_FAC_TQ_ADD_CONV_TOIL	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_TOIL_TQ_ADD_CONV	6	0... C8H	-40 ...160	1	°C
Torque reserve for switch GS					
IP_FAC_TQ_CONV_N_RATIO_CONV	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_N_RATIO_CONV_FAC_TQ_CONV	8	0... FFH	0... 0.99609	3.9063e-3	-
Torque request factor					
IP_N_TUR_GR_AT_VS	V	0... FFFFH	0... 65535	1	rpm
LDP_GR_AT_N_TUR	9	0... 8H	0 ...8	1	-
LDP_VS_N_TUR	2	0... FFH	0... 255	1	km/h
turbine speed					
IP_T_DLY_CONV_TOIL	-	0... FFH	0... 2550	10	ms
LDP_TOIL_T_DLY_CONV	8	0... C8H	-40 ...160	1	°C
time delay for TQ_CONV activation					
IP_T_DLY_N_SP_IS_TOIL	-	0... FFH	0... 2550	10	ms
LDP_TOIL_T_DLY_N_SP_IS	8	0... C8H	-40 ...160	1	°C
time delay for change of idle speed setpoint					
IP_T_RAMP_CONV_NEG_TOIL	-	0... FFH	0... 2550	10	ms
LDP_TOIL_T_RAMP_CONV_NEG	8	0... C8H	-40 ...160	1	°C
ramp after shift disengaging					
IP_T_RAMP_CONV_POS_TOIL	-	0... FFH	0... 2550	10	ms
LDP_TOIL_T_RAMP_CONV_POS	8	0... C8H	-40 ...160	1	°C
ramp after shift engaging					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TQ_ADD_CONV	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_IP_TQ_ADD_ACC	6	0... FFH	0... 8160	32	rpm
LDPM_TOIL_TQ_ADD_CONV	6	0... C8H	-40 ...160	1	°C
Torque reserve for switch GS					
IP_TQ_ADD_CONV_AC	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_AC_CRU_TQ_ADD_CONV	6	0... FFFFH	-15.72... 15.71952	479.7e-6	m/s**2
LDPM_VS_TQ_ADD_CONV	6	0... FFH	0... 255	1	km/h
Torque reserve for switch GS by AC_CRU					
IP_TQ_ADD_CONV_N_GRD	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_GRD_TQ_ADD_CONV	6	0... FFH	-4096 ...4064	32	rpm/s
LDPM_VS_TQ_ADD_CONV	6	0... FFH	0... 255	1	km/h
Torque reserve for switch GS by N_GRD					
IP_TQ_ADD_TCT	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_IP_TQ_ADD_ACC	6	0... FFH	0... 8160	32	rpm
Torque reserve for TCT					
IP_TQ_CONV_CAN	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_TQ_CONV	8	0... FFH	0... 8160	32	rpm
LDP_TQ_CONV_CAN_TQ_CONV	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Corrected Converter torque via N_32					
LC_TQ_CONV_CAN_INH	-	0... 1H	0 ...1	1	-
Logical constant converter torque by CAN-interface inhibit					
LC_TQ_CONV_DRI_INH	-	0... 1H	0 ...1	1	-
Logical constant converter torque calculation at LV_DRI = 0 inhibit					

## FUNCTION DESCRIPTION:


### General information:

TQ\_CONV describes the hydraulic torque losses inside the converter of an automatic gearbox due to speed difference between converter turbine and pump. There are two kinds of transmission types with and w/o a relevant torque loss at P/N. So the calculation of TQ\_CONV\_STN at LV\_DRI = 0 (= P/N) can be inhibited by LC\_TQ\_CONV\_DRI\_INH = 1. Additional to the calculated converter torque TQ\_CONV\_STN a converter torque transmitted via CAN TQ\_CONV\_CAN can be used by setting LC\_TQ\_CONV\_CAN\_INH to zero. In case of TQ\_CONV\_CAN is enabled (LC\_TQ\_CONV\_CAN\_INH = 0) and a timeout CAN-message ETCU1- or CAN bus off error is recognized TQ\_CONV = TQ\_CONV\_STN as calculated in ECU.

In order to assist the idle speed controller, TQ\_CONV\_STN is calculated for a reference condition with an engine speed set to N\_SP\_IS. As a result, TQ\_CONV\_STN is bigger than the real converter torque for  $N < N_{SP\_IS}$  and smaller for  $N > N_{SP\_IS}$ .

The converter torque adaptation TQ\_DIF\_IS\_AD\_CONV is calculated in the idle speed adaptation module.

After a delay of IP\_T\_DLY\_CONV, TQ\_CONV is reached following a ramp with the length IP\_T\_RAMP\_CONV\_POS (The calibration parameter IP\_T\_RAMP\_CONV\_POS is used to calculate the ramp gradi-

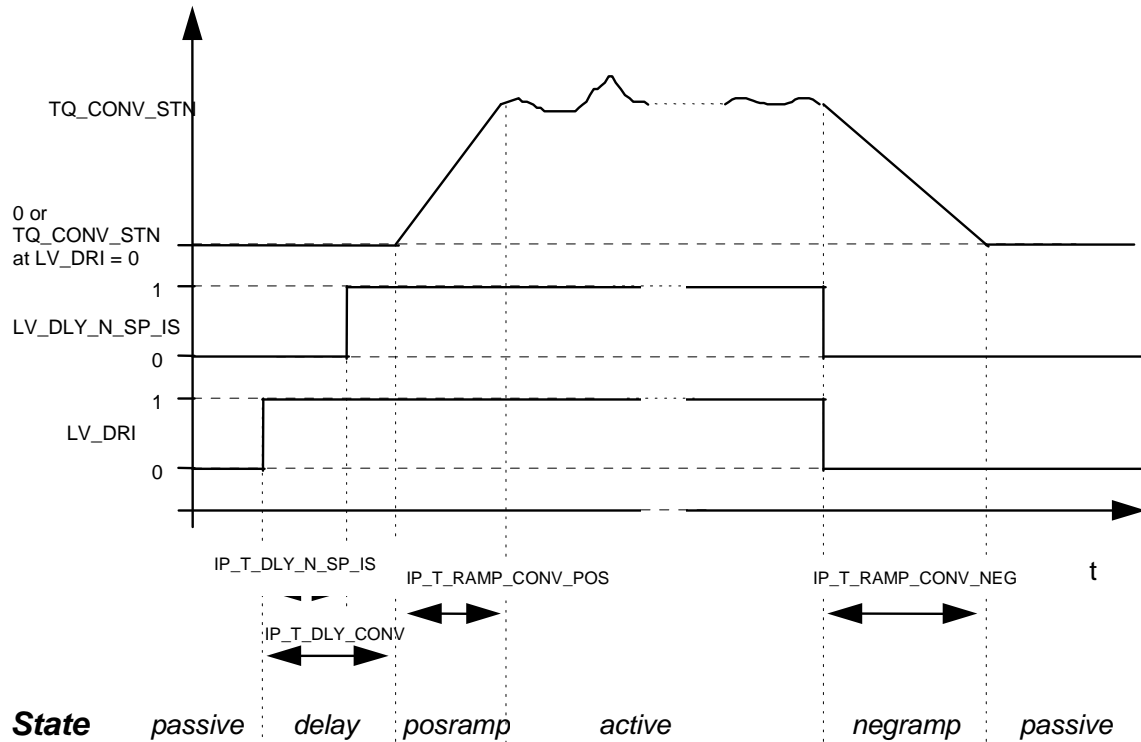
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ent, which is kept constant for this ramp, even if TQ\_CONV\_STN changes during this time. Therefore, the observed ramp length may differ from IP\_T\_RAMP\_CONV\_POS ). After disengaging the gear it is suppressed without any time delay, following a ramp with the length IP\_T\_RAMP\_CONV\_NEG. In case of LC\_TQ\_CONV\_CAN\_INH = 0 no ramps are calculated!

The change of the idle speed setpoint N\_SP\_IS during gearshift is synchronised with the converter torque request by application of a time delay T\_DLY\_N\_SP\_IS after engaging the gear.

The present model is valid for open converter clutch only. However, the latter normally can be closed or slips only in an operating range  $N \gg N\_SP\_IS$ , in which  $TQ\_CONV\_STN \rightarrow 0$  (or  $TQ\_CONV\_STN$  in case of  $LC\_TQ\_CONV\_DRI\_INH = 0$  ).



**Application conditions:**

**Activation:** at every engine state (LV\_AT = 1 or LV\_VAR\_TCT = 1)

**Deactivation:** -

**Initialisation:** at reset  
 TQ\_CONV = 0 Nm  
 LV\_DLY\_N\_SP\_IS = 0  
 TQ\_CONV\_STN = 0 Nm  
 TQ\_CONV\_CAN\_1 = 0 Nm  
 FAC\_TQ\_DIF\_IS\_AD\_CONV\_LGRD = 0  
 LV\_TQ\_DIF\_IS\_AD\_CONV\_ACT = 0


**Update rate:** 10 ms

**Formula section:**

selection of converter torque interface :

**if** LV\_VAR\_TCT = 0  
**then if** LV\_ERR\_TOUT\_ETCU\_1 = 0  
**and** LV\_ERR\_BN\_TQ\_ETCU = 0

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```

    and LV_ERR_CAN_BOFF = 0
  and LC_TQ_CONV_CAN_INH = 0
  then if LV_DRI = 1
        and TQ_CONV_CAN > C_TQ_CONV_CAN_THD
        then if (1 - FAC_TQ_DIF_IS_AD_CONV_LGRDn-1) >=
              C_FAC_TQ_DIF_IS_AD_CONV_LGRD
              then FAC_TQ_DIF_IS_AD_CONV_LGRDn =
                   FAC_TQ_DIF_IS_AD_CONV_LGRDn-1
                   + C_FAC_TQ_DIF_IS_AD_CONV_LGRD
                   TQ_CONV = TQ_CONV_CAN_1 +
                           (TQ_DIF_IS_AD_CONV
                            * FAC_TQ_DIF_IS_AD_CONV_LGRDn)
              else TQ_CONV = TQ_CONV_CAN_1 +
                   TQ_DIF_IS_AD_CONV
                   FAC_TQ_DIF_IS_AD_CONV_LGRDn = 1
              endif
        else TQ_CONV = TQ_CONV_CAN_1
            FAC_TQ_DIF_IS_AD_CONV_LGRDn = 0
        endif
    else TQ_CONV = TQ_CONV_STN
    endif
  else if STATE_TCT_INTV = 06h (N_REGULATION)
    then TQ_CONVn = TQ_CONVn-1
         LV_TQ_DIF_IS_AD_CONV_ACTn = LV_TQ_DIF_IS_AD_CONV_ACTn-1
    else if LV_DRI = 1 and TQ_TCT_CAN <> 0
          then LV_TQ_DIF_IS_AD_CONV_ACTn = 1
          endif
    if LV_DRI = 0 and TQ_TCT_CAN <= C_TQ_TCT_CAN_THD_CONV
      then LV_TQ_DIF_IS_AD_CONV_ACTn = 0
      endif
    if LV_TQ_DIF_IS_AD_CONV_ACTn = 1
      then TQ_CONVn = TQ_TCT_CAN + TQ_DIF_IS_AD_CONV
      else TQ_CONVn = TQ_TCT_CAN
    endif
  endif
endif
endif

```

TQ\_CONV\_CAN\_1 = IP\_TQ\_CONV\_CAN

```

if LV_DRI = 0 and LC_TQ_CONV_DRI_INH = 0
  then TQ_CONV_STN = IP_FAC_CONV * IP_FAC_TQ_CONV * N_SP_IS2
              + TQ_DIF_IS_AD_CONV
  else TQ_CONV_STN = IP_FAC_CONV_DRI * IP_FAC_TQ_CONV * N_SP_IS2
              + TQ_DIF_IS_AD_CONV
endif

```

```

IP_FAC_TQ_CONV = f(N_RATIO_CONV)
N_RATIO_CONV = IP_N_TUR / N_SP_IS
IP_N_TUR = f(GR_AT,VS)

```

## D.20.1 Torque Reserve for Transmission

### D.20.1.1 Determination of Torque reserve for AT Transmission

#### FUNCTION DESCRIPTION:

##### General information:

To guarantee idle quality during gear shift a positive torque reserve can be requested.

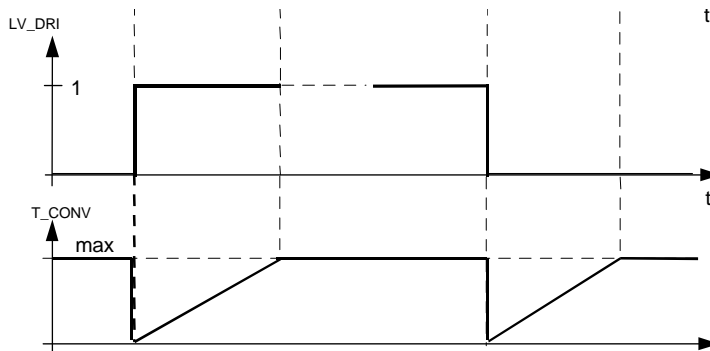
##### Application conditions

**Initialisation:** at reset  
 $TQ\_ADD\_CONV = 0 \text{ Nm}$   
 $LV\_TOUT\_CONV = 0$   
 $T\_CONV = 0 \text{ s}$   
 $TQ\_ADD\_CONV\_2 = 0 \text{ Nm}$

**Recurrence:** 10 ms

**Activation:**  $LV\_DRI = 1$  and  $LV\_ST = 0$  and  $LV\_AT = 1$

**Deactivation:** [ $LV\_DRI = 0$  and  $TQ\_ADD\_CONV = 0 \text{ Nm}$  and  $TQ\_ADD\_CONV\_2 = 0 \text{ Nm}$ ]



##### Formula section:

```

IF T_CONV < 1FEH
Then    LV_TOUT_CONV = 0
Else    LV_TOUT_CONV = 1
endif

if      [ LV_DRI = 1 and LV_TOUT_CONV = 0 ]
then    TQ_ADD_CONV = max [ IP_TQ_ADD_CONV; 0 Nm ]
          TQ_ADD_CONV_2 = MAX ( IP_TQ_ADD_CONV_N_GRD;
                               IP_TQ_ADD_CONV_AC * IP_FAC_TQ_ADD_CONV_TOIL
else    TQ_ADD_CONV_N = max [ ( TQ_ADD_CONV_{N-1} - C_TQ_ADD_CONV_LGRD );
                               0 Nm ]
          TQ_ADD_CONV_2_N =
            max [ ( TQ_ADD_CONV_2_{N-1} - C_TQ_ADD_CONV_LGRD );
                 0 Nm ]
    
```

endif

### D.20.1.2 Determination of Torque reserve for TCT

#### FUNCTION DESCRIPTION:

#### General information:

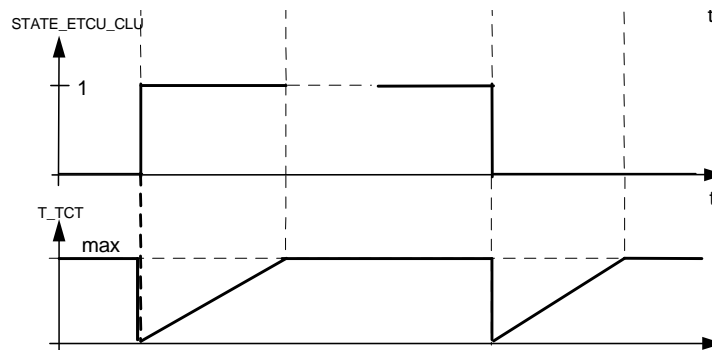
To guarantee idle quality during gear shift a positive torque reserve can be requested.

#### Application conditions

**Initialisation:**           at reset  
                                   TQ\_ADD\_TCT = 0 Nm  
                                   LV\_TOUT\_TCT = 0  
                                   T\_TCT = 0 s

**Recurrence:**             10 ms

**Activation:**             { [STATE\_ETCU\_CLU = 1 and LV\_ST = 0]  
                                   and LV\_VAR\_TCT = 1 }



#### Formula section:

```

IF T_TCT < 1FEH
Then    LV_TOUT_TCT = 0
Else    LV_TOUT_TCT = 1
endif


if      LV_TOUT_TCT = 0
then   TQ_ADD_TCT = max [ IP_TQ_ADD_TCT; 0 Nm ]
else   TQ_ADD_TCTN = max [ ( TQ_ADD_TCTN-1 - C_TQ_ADD_TCT_LGRD );
                          0 Nm ]
endif
    
```

### D.20.1.3 Determination of Torque reserve for GS Transmission

To serve the torque reserve interface it is switch between TCT and AT transmissions.

*Initialisation:*           at reset

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$TQ\_ADD\_TRANS = 0 \text{ Nm}$   
*Recurrence:* 10 ms  
*Activation:*  $LV\_AT = 1$  or  $LV\_VAR\_TCT = 1$

**Formula section:**

```

IF LV_VAR_TCT = 1
Then    TQ_ADD_TRANS = TQ_ADD_TCT
Else IF LV_AT = 1
    Then TQ_ADD_TRANS = TQ_ADD_CONV + TQ_ADD_CONV_2
    Else TQ_ADD_TRANS = 0Nm
endif

```


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## D.21 Gearbox torque intervention

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ETCU_DISABLE	O/V	0... 1H	0 ...1	1	-
Logical variable for disabling GS intervention due to EMS error					
LV_ETCU_DISABLE_CAN	O/V	0... 1H	0 ...1	1	-
Logical variable for disabling GS intervention due to CAN error					
LV_GS_DEC_ACT	O/V	0... 1H	0 ...1	1	-
Logical variable for torque intervention due to gear shift					
LV_GS_DEC_LIH	V	0... 1H	0 ...1	1	-
Logical variable for torque intervention LIH due to gear shift					
LV_GS_ENA	V	0... 1H	0 ...1	1	-
Logical variable for gear shift intervention enabling					
LV_GS_ENA_DEC	O/V	0... 1H	0 ...1	1	-
Logical variable for decreased torque intervention due to gear shift					
LV_GS_ENA_INC	O/V	0... 1H	0 ...1	1	-
Logical variable for increased torque intervention due to gear shift					
LV_GS_INC_ACT	O/V	0... 1H	0 ...1	1	-
Logical variable for torque intervention due to gear shift					
LV_GS_INC_LIH	O/V	0... 1H	0 ...1	1	-
Logical variable for torque intervention LIH due to gear shift					
LV_INH_FCUT_GS	O/V	0... 1H	0 ...1	1	-
Logical variable inhibiting FCUT during TCT-intervention					
STATE_TQ_ETCU_PLAUS	O/V	0... FFH	0... 255	1	-
Bitwise coded State for ETCU intervention state					
T_GS_DEC_LIH_CTR	V	0... FFH	0... 2.55	0.01	s
Delay time for activation of GS emergency ramp function					
T_GS_INC_LIH_CTR	V	0... FFH	0... 2.55	0.01	s
Delay time for activation of GS emergency ramp function					
T_TQR_GS_INTV	V	0... FFFFH	0... 655.35	0.01	s
Duration of gear shift torque intervention					
TQI_GS_FAST_DEC	O/V	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque decrement for fast torque intervention during gear shift					
TQI_GS_FAST_DEC_REQ	V	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque decrement for fast torque intervention during gear shift					
TQI_GS_FAST_DEC_REQ_1	O	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque decrement for fast torque intervention during gear shift					
TQI_GS_FAST_INC	O/V	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque increase for fast torque intervention during gear shift					
TQI_GS_FAST_INC_REQ	V	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque increase for fast torque intervention during gear shift					
TQI_GS_FAST_INC_REQ_1	O	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque increase for fast torque intervention during gear shift					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQI_GS_SLOW_DEC	O/V	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque decrement for slow torque intervention during gear shift					
TQI_GS_SLOW_DEC_REQ	V	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque decrement for slow torque intervention during gear shift					
TQI_GS_SLOW_DEC_REQ_1	O	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque decrement for slow torque intervention during gear shift					
TQI_GS_SLOW_INC	O/V	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque increase for slow torque intervention during gear shift					
TQI_GS_SLOW_INC_REQ	O/V	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque increase for slow torque intervention during gear shift					
TQI_GS_SLOW_INC_REQ_1	O	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque increase for slow torque intervention during gear shift					

**Input data:**

LV_AT {p. 654}	LV_CDN_VB_CAN_TQ_ DIAG {p. 1185}	LV_DI_TQ_REQ_CAN_ MPI_GDI {p. 800}	LV_ERR_BN_ETCU {p. 4870}
LV_ERR_BN_TQ_ETCU {p. 4871}	LV_ERR_BN_TQ_TCT {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_TOUT_ETCU_1 {p. 802}
LV_ERR_TOUT_ETCU_2 {p. 802}	LV_ES {p. 1720}	LV_ETCU_LIH_CAN {p. 1565}	LV_IGK {p. 906}
LV_ST {p. 1720}	LV_TCT_LIH_CAN {p. 1568}	LV_TQ_GS_DEC_REQ {p. 1568}	LV_TQ_GS_INC_REQ {p. 1568}
LV_TQI_REQ_CAN_INH {p. 6687}	LV_VAR_BN {p. 655}	LV_VAR_TCT {p. 656}	TQ_GS_FAST_BN {p. 1581}
TQ_GS_FAST_DEC_BN {p. 1710}	TQ_GS_FAST_INC_BN {p. 1710}	TQ_GS_SLOW_BN {p. 1581}	TQ_GS_SLOW_DEC_BN {p. 1710}
TQ_GS_SLOW_INC_BN {p. 1710}	TQ_LOSS {p. 8385}	TQI_GS_FAST_REQ {p. 810}	TQI_GS_FAST_REQ_CAN {p. 810}
TQI_GS_SLOW_REQ {p. 810}	TQI_GS_SLOW_REQ_1 CAN {p. 810}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LGRD_LIH_GS_DEC	-	0... 7FFFH	0... 1023.96875	0.03125	Nm/10ms
Limiting gradient for GS emergency ramp function (default 0.6 Nm/10ms)					
C_LGRD_LIH_GS_INC	-	0... 7FFFH	0... 1023.96875	0.03125	Nm/10ms
Limiting gradient for GS emergency ramp function (default 0.6 Nm/10ms)					
C_T_DLY_LIH_GS_DEC	-	0... FFH	0... 2.55	0.01	s
Delay time for activation of GS emergency ramp function (default 0s)					
C_T_DLY_LIH_GS_INC	-	0... FFH	0... 2.55	0.01	s
delay time for activation of GS emergency ramp function (default 0s)					
C_T_MAX_TQR_GS_INTV	-	0... FFFFH	0... 655.35	0.01	s
Maximum duration of torque reduction due gear shift intervention					
C_TQ_TCT_FAST_INH_FCUT	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Threshold for inhibiting FCUT during TCT intervention					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TQ_TCT_SLOW_INH_FCUT	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Threshold for inhibiting FCUT during TCT intervention					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_GS_ENA_INC_DEC	-	0H	NO	-	-
		1H	DEC		
		2H	INC		
		3H	DEC_INC		
Enable switch GS intervention					


**FUNCTION DESCRIPTION:****General information:**

There are two different gearbox control units: the common electronic transmission control unit (LV\_AT) and the twin clutch transmission control unit (LV\_VAR\_TCT). Depending which variant is active the torque request for gear shift is requested by AT or TCT.

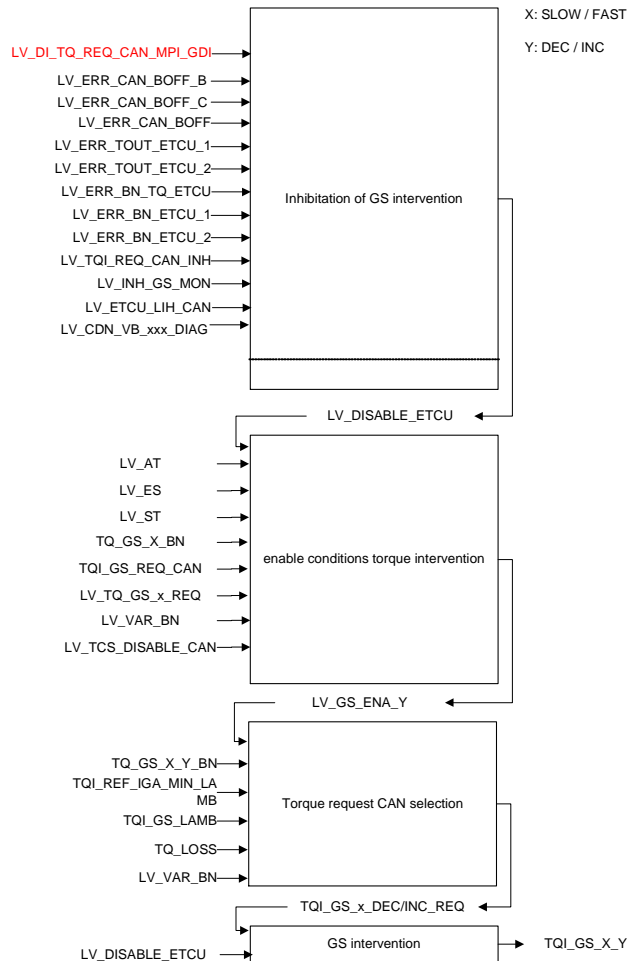
During a gear shift operation of the automatic transmission a low engine torque helps the transmission to perform a smooth gear shift and avoids sudden changes of wheel slip that could cause problems on certain road surfaces, i.e. wet or icy roads. A transmission control unit (ETCU) torque reduction or increase demand via CAN is realized by spark retard (fast path) or charge intervention by ETC (slow path). A decision can be done which path is realized. Normally the intervention is done only by spark retard. By configuration of BN 2000 the Slow and fast path are own signals of CAN messages.

Some plausibilities are done for validation and limitation of torque requests.

**Signal flow diagram:**

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## D.21.1 Enable conditions

### D.21.1.1 Inhibition GS intervention

#### FUNCTION DESCRIPTION:

If the EMS detects a safety relevant error at throttle, no automatic transmission vehicle or pedal value sensor the logical variable LV\_ETCU\_DISABLE is set to 1 in order to indicate a static EMS error.

Gear shift intervention function is enabled if engine state is not “engine stopped”, “start” or “idle speed”, if LV\_ETCU\_DISABLE is not set, no CAN error is present and automatic transmission is detected. Additional a time condition during torque intervention is check which limits the duration of torque intervention.

#### Application conditions

**Initialisation:**  $LV\_ETCU\_DISABLE / CAN = 0;$  **at reset**

**Recurrence:** 10 ms

**Activation:**  $(LV\_AT = 1 \text{ or } LV\_VAR\_TCT = 1) \text{ and } LV\_IGK = 1$

**Deactivation:** -

**Formula section:**

CAN enviroment error GS inhibition:

```

if          LV_ERR_CAN_BOFF          = 1          or
              LV_ERR_TOUT_ETCU_1      = 1          or          LV_ERR_TOUT_ETCU_
2          = 1          or          LV_ERR_BN_TQ_ETCU          = 1          or
              LV_ERR_BN_TQ_TCT        = 1          or
              LV_ERR_BN_ETCU           = 1          or
              LV_CDN_VB_CAN_TQ_DIAG   = 0
    
```

```

then          LV_ETCU_DISABLE_CAN    = 1
else          LV_ETCU_DISABLE_CAN    = 0
endif
    
```

Generell GS inhibition:

```

if          LV_TQI_REQ_CAN_INH       = 1          or
              LV_DI_TQ_REQ_CAN_MPI_GDI = 1          or
              LV_ERR_GS_INH_MON        = 1          or
              LV_ETCU_DISABLE_CAN      = 1          or
              LV_ETCU_LIH_CAN           = 1          or
              LV_TCT_LIH_CAN            = 1
    
```

```

then          LV_ETCU_DISABLE = 1
else          LV_ETCU_DISABLE = 0
endif
    
```

**D.21.1.2 enable conditions torque intervention**

**FUNCTION DESCRIPTION:**

Depending on the configuration and plausible torque interfaces an inc. or decreased torque intervention is possible.  
 The State STATE\_TQ\_ETCU\_PLAUS indicates the interrupted condition which is responsible for enable Bit = 0. The [ x ] Value shows the HEX adress inside the Bitwise coded State.

**Application conditions**

```

Initialisation:          LV_GS_ENA/ _INC/ _DEC = 0          at reset
Recurrence:             10 ms
Activation:             (LV_AT = 1 or LV_VAR_TCT = 1) and
                             LV_IGK = 1 and
                             C_GS_ENA_INC_DEC = not 0H
    
```

**Formula section:**

```

C_GS_ENA_INC_DEC = No          no GS Torque intervention
                       DEC      only decreasing torque intervention possible
                       INC      only increasing torque intervention possible
                       DEC_INC   both interventions possible
    
```

Enable conditions for GS intervention:

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**if** (LV\_AT = 1 **or** LV\_VAR\_TCT = 1) **and**

LV\_ES = 0 **and**

LV\_ST = 0 **and**

LV\_ETCU\_DISABLE = 0

**then** LV\_GS\_ENA = 1

**else** LV\_GS\_ENA = 0

**endif**

*Torque decrease intervention:*

**IF(1)** (C\_GS\_ENA\_INC\_DEC = 1H or 3H) **and**  
 LV\_GS\_ENA = 1 **and**  
 LV\_TQ\_GS\_DEC\_REQ = 1 **and**  
 ((T\_TQR\_GS\_INTV < C\_T\_MAX\_TQR\_GS\_INTV) **OR** LV\_AT = 0)

**Then(1) IF(2)** LV\_VAR\_BN = 1

**Then(2) IF(3)** TQ\_GS\_SLOW\_BN <> 8000H **and** TQ\_  
 GS\_FAST\_BN <> 8000H

**Then (3)** LV\_GS\_ENA\_DEC = 1

**Else(3)** LV\_GS\_ENA\_DEC = 0

**Endif (3)**

**Else(2) IF(4)** TQI\_GS\_SLOW\_REQ\_CAN ≠ FFH **and**  
 TQI\_GS\_FAST\_REQ\_CAN ≠ FFH

**Then(4)** LV\_GS\_ENA\_DEC = 1

**Else(4)** LV\_GS\_ENA\_DEC = 0

**Endif(4)**

**Endif(2)**

**Else(1)** LV\_GS\_ENA\_DEC = 0

**Endif**

*Torque increase intervention:*

**IF(1)** C\_GS\_ENA\_INC\_DEC = 2H or 3H **and**  
 LV\_GS\_ENA = 1 **and**  
 LV\_TQ\_GS\_INC\_REQ = 1

**Then(1) IF(2)** LV\_VAR\_BN = 1

**Then(2) IF(3)** TQ\_GS\_SLOW\_BN <> 8000H **and**  
 TQ\_GS\_FAST\_BN <> 8000H

**Then (3)** LV\_GS\_ENA\_INC = 1

**Else(3)** LV\_GS\_ENA\_INC = 0

**Endif(3)**

**Else(2) IF(5)** TQI\_GS\_SLOW\_REQ\_CAN ≠ FFH **and**  
 TQI\_GS\_FAST\_REQ\_CAN ≠ FFH

**Then(5)** LV\_GS\_ENA\_INC = 1

**Else(5)** LV\_GS\_ENA\_INC = 0

**Endif(5)**

**Endif(2)**

**Else(1)** LV\_GS\_ENA\_INC = 0

**Endif(1)**

STATE\_TQ\_ETCU\_PLAUS:

**if** LV\_GS\_ENA = 0 **and** BIT [0] is set

**IF** LV\_TQ\_GS\_DEC\_REQ = 1 **and**  
 T\_TQR\_GS\_INTV > = C\_T\_MAX\_TQR\_GS\_INTV **and** BIT [2] is set

```

IF(1)      LV_TQ_GS_DEC_REQ = 1
Then(1) IF(2)    LV_VAR_BN = 1
      Then(2) IF(3)      TQ_GS_SLOW_BN == 8000H or      BIT [3] is set
      GS_FAST_BN == 8000H
      Else(2) IF(4)    TQI_GS_SLOW_REQ_CAN == FFH or      BIT [3] is set
      TQI_GS_FAST_REQ_CAN ==FFH
      Endif(2)
Else(1)      BIT [01] set
Endif
IF      LV_TQ_GS_INC_REQ = =1
Then IF(2)    LV_VAR_BN = 1
      Then(2) IF(3)      TQ_GS_SLOW_BN == 8000H      BIT [3] is set
      TQ_GS_FAST_BN == 8000H
      Else(2) IF(4)    TQI_GS_SLOW_REQ_CAN == FFH or      BIT [3] is set
      TQI_GS_FAST_REQ_CAN ==FFH
      Endif(2)
Else      BIT [4] is set
Endif
  
```

### D.21.2 Torque request CAN selection

#### FUNCTION DESCRIPTION:

If one of the GS interventions enabled (LV\_GS\_ENA\_DEC/INC = 1), the torque request is received from CAN and copied into TQI\_GS\_FAST\_DEC/INC. At CAN 11H the requested torque is adjusted by ignition retardation. Only if ignition retardation is not sufficient for the requested torque reduction, TQI\_GS\_SLOW\_DEC is set to TQI\_GS\_REQ. So the throttle is used too. At BN the slow and fast path are different messages.

After LV\_GS\_ACT\_DEC/INC changes back to 0, both TQI\_GS\_FAST\_DEC/INC and TQI\_GS\_SLOW\_DEC/INC become their maximum/minimum value again.

#### Application conditions

**Initialisation:**                    **at reset**                    TQI\_GS\_FAST\_DEC\_REQ                    = 1023,97Nm  
    TQI\_GS\_SLOW\_DEC\_REQ                    = 1023,97Nm  
    TQI\_GS\_FAST\_INC\_REQ                    = 0 Nm  
    TQI\_GS\_SLOW\_INC\_REQ                    = 0 Nm

**Recurrence:**                                10 ms

**Activation:**                                (LV\_AT = 1 **or** LV\_VAR\_TCT = 1) **and** at LV\_IGK = 1

**Deactivation:**                                -

#### Formula section:

```

if      LV_VAR_BN = 1
then    TQI_GS_SLOW_DEC_REQ_1 = TQ_GS_SLOW_DEC_BN - TQ_LOSS
          TQI_GS_FAST_DEC_REQ_1 = TQ_GS_FAST_DEC_BN - TQ_LOSS
          TQI_GS_SLOW_INC_REQ_1 = TQ_GS_SLOW_INC_BN - TQ_LOSS
          TQI_GS_FAST_INC_REQ_1 = TQ_GS_FAST_INC_BN - TQ_LOSS
Else    TQI_GS_SLOW_INC_REQ_1 = TQI_GS_SLOW_REQ
          TQI_GS_FAST_INC_REQ_1 = TQI_GS_FAST_REQ
          TQI_GS_SLOW_DEC_REQ_1 = TQI_GS_SLOW_REQ
  
```

```

    TQI_GS_FAST_DEC_REQ_1 = TQI_GS_FAST_REQ
endif

IF      LV_GS_ENA_DEC = 1
Then    TQI_GS_SLOW_DEC_REQ = TQI_GS_SLOW_DEC_REQ_1
        TQI_GS_FAST_DEC_REQ = TQI_GS_FAST_DEC_REQ_1
Else    TQI_GS_SLOW_DEC_REQ = 7FFFH
        TQI_GS_FAST_DEC_REQ = 7FFFH
endif


IF      LV_GS_ENA_INC = 1
Then    TQI_GS_SLOW_INC_REQ = TQI_GS_SLOW_INC_REQ_1
        TQI_GS_FAST_INC_REQ = TQI_GS_FAST_INC_REQ_1
Else    TQI_GS_SLOW_INC_REQ = 0 Nm
        TQI_GS_FAST_INC_REQ = 0 Nm
endif

```

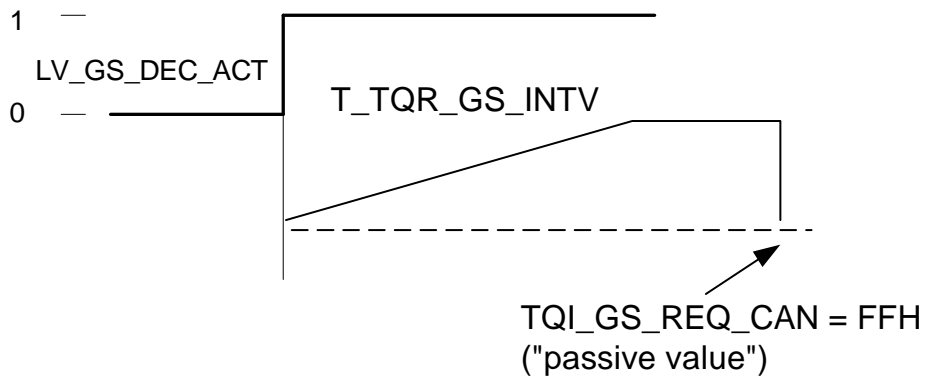
### D.21.3 Determination of gear shift torque intervention duration (CAN11H only)

#### FUNCTION DESCRIPTION:

The duration of decreased gear shift torque intervention  $T_{TQR\_GS\_INTV}$  is measured beginning at transition of  $LV\_GS\_DEC\_ACT$  from 0 to 1.  $T_{TQR\_GS\_INTV}$  is needed for limitation of gear shift intervention duration during enable conditions.  $T_{TQR\_GS\_INTV}$  is reseted to 0 if  $TQI\_GS\_SLOW\_REQ\_CAN$  or  $TQI\_GS\_FAST\_REQ\_CAN = FFH$ .


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**Signal flow diagram:**

**Application conditions**

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**Initialisation:**  $T_{TQR\_GS\_INTV} = 0$  at reset **or** at transition LV\_IGK 0 - -> 1

**Recurrence:** 10 ms

**Activation:** at LV\_IGK = 1 and LV\_VAR\_BN = 0

**Deactivation:** -

## D.21.4 GS intervention

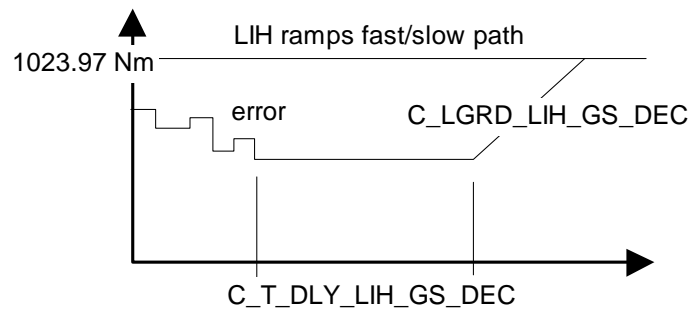
### D.21.4.1 GS decreased intervention and emergency operation

#### FUNCTION DESCRIPTION:

If during an active GS intervention an GS error or an EMS error occurs, the current torque reduction is continued for the time C\_T\_DLY\_LIH\_GS\_DEC and then subsequently increased to TQI\_GS\_FAST\_DEC = TQI\_GS\_SLOW\_DEC = 1023,97 Nm using C\_LGRD\_LIH\_GS\_DEC.

At transition from Limp home condition active to passive after torque increase to TQI\_GS\_FAST\_DEC = TQI\_GS\_SLOW\_DEC = 1023,97 Nm at limp home operation the counter T\_GS\_LIH\_CTR is stopped and set to 0.

#### Signal flow diagram:



#### Application conditions


**Initialisation:** at reset **or** at transition LV\_IGK 0 - -> 1  
 $LV\_GS\_DEC\_LIH = 0$   
 $LV\_GS\_DEC\_ACT = 0$   
 $TQI\_GS\_FAST\_DEC = TQI\_GS\_SLOW\_DEC = 1023.97$  Nm  
 $T\_GS\_DEC\_LIH\_CTR = 0$

**Recurrence:** 10 ms

**Activation:** (LV\_AT = 1 **or** LV\_VAR\_TCT = 1) **and** LV\_IGK = 1

**Deactivation:**

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**Formula section:**

GS\_DEC intervention and detection of GS\_DEC limp home operation :

```

if (1a)          LV_ETCU_DISABLE_CAN = 1
then (1a)
  if (1b)          TQI_GS_FAST_DEC < 1023.97 Nm      or
                    TQI_GS_SLOW_DEC < 1023.97 Nm
  Then (1b)       LV_GS_DEC_LIH = 1
                    T_GS_DEC_LIH_CTRN = T_GS_DEC_LIH_CTRN-1 + 10 ms
                    ( till T_DEC_GS_LIH_CTR = C_T_DLY_LIH_GS_DEC
                      )
  if (2)          T_GS_DEC_LIH_CTR <= C_T_DLY_LIH_GS_DEC      (time
  delay)
  then (2)       TQI_GS_FAST_DECN = TQI_GS_FAST_DECN-1      (last valid value)
                    TQI_GS_SLOW_DECN = TQI_GS_SLOW_DECN-1      (last valid value)
  else (2)       TQI_GS_FAST_DECN = TQI_GS_FAST_DECN-1 +
                    C_LGRD_LIH_GS_DEC
                    (till TQI_GS_FAST_DEC = 1023.97 Nm )
                    TQI_GS_SLOW_DECN = TQI_GS_FAST_DECN
  Endif (2)
  Else (1b)       LV_GS_DEC_LIH = 0
                    T_GS_LIH_CTR = 0
  Endif (1b)
else (1a)       LV_GS_DEC_LIH = 0
                    T_GS_LIH_CTR = 0
                    TQI_GS_FAST_DEC = TQI_GS_FAST_DEC_REQ
                    TQI_GS_SLOW_DEC = TQI_GS_SLOW_DEC_REQ
Endif(1a)
GS intervention active (LV_GS_DEC_ACT) :
if          TQI_GS_FAST_DEC < 1023.97 Nm
then       LV_GS_DEC_ACT = 1
else       LV_GS_DEC_ACT = 0
endif

```

**D.21.4.2 GS increased intervention and emergency operation**


**FUNCTION DESCRIPTION:**

If during an active GS intervention an GS error or an EMS error occurs, the current torque offset is continued for the time C\_T\_DLY\_LIH\_GS\_INC and then subsequently decreased to TQI\_GS\_FAST\_INC = TQI\_GS\_SLOW\_INC = 0 Nm using C\_LGRD\_LIH\_GS\_INC.

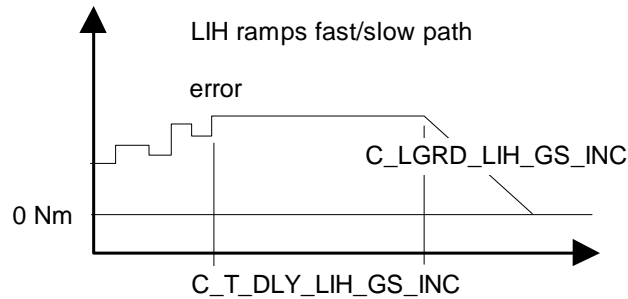
At transition from Limp home condition active to passive after torque decrease to TQI\_GS\_FAST\_INC = TQI\_GS\_SLOW\_INC = 0 Nm at limp home operation the counter T\_GS\_LIH\_CTR is stopped and set to 0.

**Signal flow diagram:**

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## Application conditions

**Initialisation:** at reset **or** at transition LV\_IGK 0 -> 1  
 LV\_GS\_LIH\_INC = 0  
 LV\_GS\_INC\_ACT = 0  
 TQI\_GS\_FAST\_INC = TQI\_GS\_SLOW\_INC = 0 Nm  
 T\_GS\_INC\_LIH\_CTR = 0

**Recurrence:** 10 ms

**Activation:** (LV\_AT = 1 **or** LV\_VAR\_TCT = 1) **and** LV\_IGK = 1

## Formula section:

GS\_INC intervention and detection of GS\_INC limp home operation :

**if (1a)** LV\_ETCU\_DISABLE\_CAN = 1

**then (1a)**

**if(1b)** TQI\_GS\_FAST\_INC > 0 **or**  
 TQI\_GS\_SLOW\_INC > 0

**Then(1b)** LV\_GS\_INC\_LIH = 1

T\_GS\_INC\_LIH\_CTR<sub>N</sub> = T\_GS\_INC\_LIH\_CTR<sub>N-1</sub> + 10 ms  
 (till T\_GS\_INC\_LIH\_CTR = C\_T\_DLY\_LIH\_GS\_INC)

**if (2)** T\_GS\_INC\_LIH\_CTR <= C\_T\_DLY\_LIH\_GS\_INC (time de-

lay)

**then (2)** TQI\_GS\_FAST\_INC<sub>N</sub> = TQI\_GS\_FAST\_INC<sub>N-1</sub> (last valid value)

**and** TQI\_GS\_SLOW\_INC<sub>N</sub> = TQI\_GS\_SLOW\_INC<sub>N-1</sub> (last valid value)

**else (2)** TQI\_GS\_FAST\_INC<sub>N</sub> = TQI\_GS\_FAST\_INC<sub>N-1</sub> -  
 C\_LGRD\_LIH\_GS\_INC  
 (till TQI\_GS\_FAST\_INC = 0Nm)

TQI\_GS\_SLOW\_INC<sub>N</sub> = TQI\_GS\_SLOW\_INC<sub>N-1</sub>

**endif (2)**

**Else(1b)** LV\_GS\_INC\_LIH = 0

T\_GS\_LIH\_CTR = 0

**Endif(1b)**

**else (1a)** LV\_GS\_INC\_LIH = 0

T\_GS\_LIH\_CTR = 0


TQI\_GS\_FAST\_INC = TQI\_GS\_FAST\_INC\_REQ

TQI\_GS\_SLOW\_INC = TQI\_GS\_SLOW\_INC\_REQ

**endif (1a)**

GS intervention active (LV\_GS\_INC\_ACT) :

**if** TQI\_GS\_FAST\_INC > 0 Nm

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```

then    LV_GS_INC_ACT    = 1
else    LV_GS_INC_ACT    = 0
endif

```

### D.21.4.3 Inhibiting fuel cut off during TCT-intervention

#### FUNCTION DESCRIPTION:

In order to avoid an increasing emission for very low emission vehicles the fuel cut off is inhibited. As result during TCT-intervention the SCC is suppressed in order to meet ULEV2 limits. In that case the reduction of the moment should only be done via spark retard.

#### Application conditions

**Initialisation:** at reset **or** at transition LV\_IGK 0 -> 1  
LV\_INH\_FCUT\_GS = 0

**Recurrence:** 10 ms

**Activation:** LV\_IGK = 1 **and** LV\_VAR\_TCT = 1


**Deactivation:** -

FCUT inhibition during TCT intervention active:

```

if    TQ_GS_FAST_BN >
      TQ_LOSS - C_TQ_TCT_FAST_INH_FCUT          AND
      TQ_GS_SLOW_BN >
      TQ_LOSS + C_TQ_TCT_SLOW_INH_FCUT
then  LV_INH_FCUT_GS = 1
else  LV_INH_FCUT_GS = 0
endif

```

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## D.22 Torque request for distance cruise control

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DCC_DISABLE_CAN	O/V	0... 1H	0 ...1	1	-
Logical variable for disabling DCC intervention due to CAN error					
LV_DCC_ENA_INC	O/V	0... 1H	0 ...1	1	-
Logical variable for increased torque intervention due to DCC					
LV_DCC_INC_ACT	O/V	0... 1H	0 ...1	1	-
Logical variable for torque intervention due to DCC or LDM					
LV_DCC_INC_LIH	O/V	0... 1H	0 ...1	1	-
Logical variable for torque intervention LIH due to DCC					
STATE_TQ_DCC_PLAUS	O/V	0... FFH	0... 255	1	-
Bitwise coded State for DCC intervention state					
T_DCC_LIH_CTR	V	0... FFH	0... 2.55	0.01	s
Time counter delay time					
TQI_DCC_FAST_INC	O/V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for fast torque intervention during DCC					
TQI_DCC_FAST_INC_REQ	V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for fast torque intervention during DCC					
TQI_DCC_FAST_INC_REQ_1	V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for fast torque intervention during DCC					
TQI_DCC_SLOW_INC	O/V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for slow torque intervention during DCC					
TQI_DCC_SLOW_INC_REQ	V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for slow torque intervention during DCC					
TQI_DCC_SLOW_INC_REQ_1	V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for slow torque intervention during DCC					


### Input data:

LV_CDN_VB_CAN_TQ_DIAG {p. 1185}	LV_DCC_ENA_INC {p. 6731}	LV_DCC_LIH_CAN {p. 1565}	LV_DCC_OFF_ECU {p. 5051}
LV_ERR_BN_TQ_DCC {p. 4870}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_DCC_INH_MON {p. 6983}	LV_IGK {p. 906}
LV_TQ_DCC_INC_REQ {p. 1568}	LV_VAR_DCC {p. 655}	STATE_DCC_OFF_REQ {p. 1572}	STATE_DCC_PUC_INH {p. 1572}
TQ_DCC_FAST_BN {p. 1581}	TQ_DCC_FAST_INC_BN {p. 1710}	TQ_DCC_SLOW_BN {p. 1581}	TQ_DCC_SLOW_INC_BN {p. 1710}
TQ_LOSS {p. 8385}			

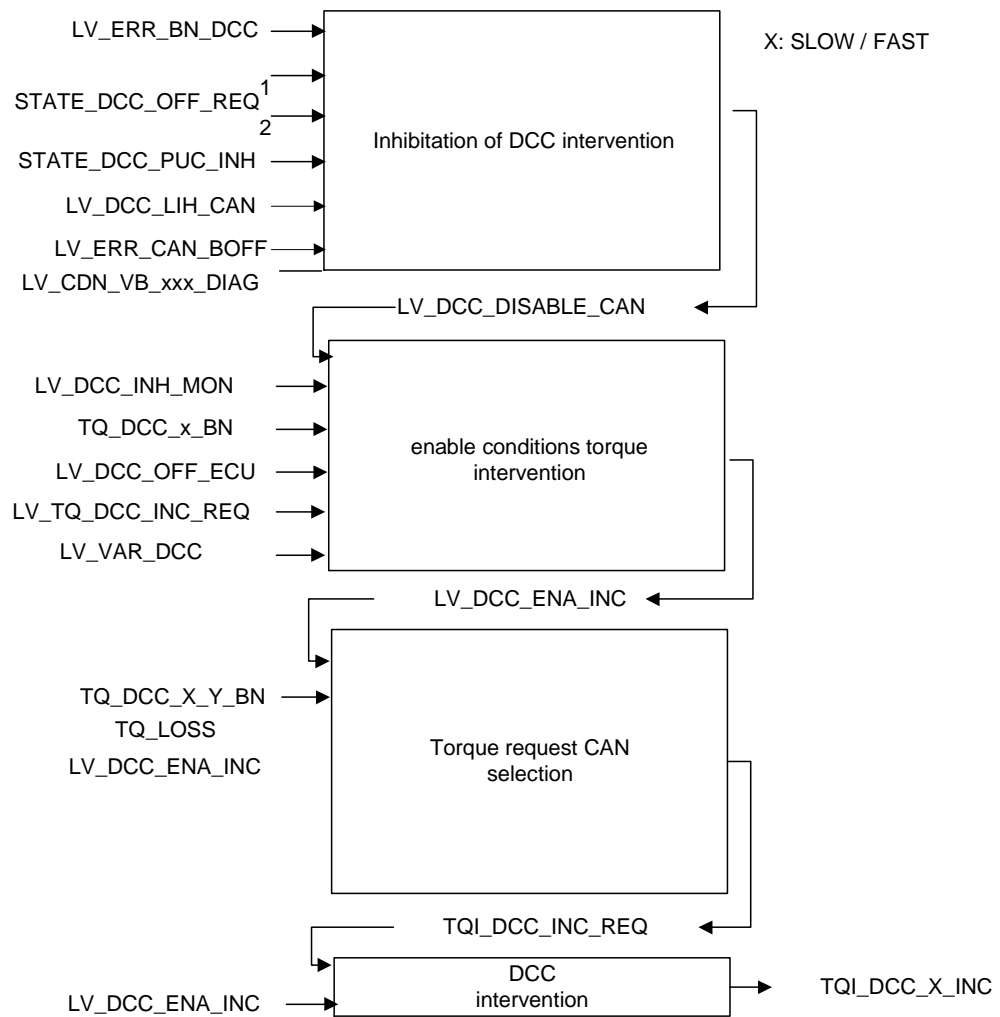
### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LGRD_LIH_DCC_INC	-	0... 7FFFH	0... 1023.96875	0.03125	Nm/10ms
Limiting gradient for DCC emergency ramp function (default 0.6 Nm/10ms)					
C_T_DLY_LIH_DCC_INC	-	0... FFH	0... 2.55	0.01	s
Delay time for activation of DCC emergency ramp function (default 0s)					

### General information:

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The DCC unit delivers a torque request via BN this module serves the enable conditions and the torque request witch will used in the torque request selection.



### Signal flow diagram:

## D.22.1 Enable conditions

### D.22.1.1 Inhibition DCC intervention

#### FUNCTION DESCRIPTION:

If the EMS detects an error on the CAN messages, the logical variable LV\_DCC\_DISABLE\_CAN is set to 1.

#### Application conditions

**Initialisation:** at reset and at transition LV\_IGK off - -> on  
LV\_DCC\_DISABLE\_CAN = 0

**Recurrence:** 10 ms

**Activation:**  $LV\_IGK = 1$  and  $LV\_VAR\_DCC = 1$

**Deactivation:** -

### Formula section:

#### CAN enviroment DCC inhibition:

```

if      LV_ERR_BN_TQ_DCC          = 1          or
        LV_ERR_CAN_BOFF          = 1          or
        LV_DCC_LIH_CAN           = 1          or
STATE_DCC_PUC_INH                = 03H        or
STATE_DCC_OFF_REQ                = 02H        or
LV_CDN_VB_CAN_TQ_DIAG = 0

then    LV_DCC_DISABLE_CAN       = 1
else    LV_DCC_DISABLE_CAN       = 0
endif

```

### D.22.1.2 enable conditions torque intervention

#### FUNCTION DESCRIPTION:

Depending on the configuration and plausible torque interfaces an increased torque intervention is possible.

#### Application conditions

**Initialisation:** at reset and at transition LV\_IGK off - -> on  
LV\_DCC\_ENA\_INC = 0

**Recurrence:** 10 ms

**Activation:**  $LV\_IGK = 1$  and  $LV\_VAR\_DCC = 1$

#### Formula section:

#### Torque increase intervention:

```

if      LV_DCC_OFF_ECU = 0          and
        LV_TQ_DCC_INC_REQ = 1      and
        LV_DCC_DISABLE_CAN = 0    and
TQ_DCC_SLOW_BN <> 8000H and
        TQ_DCC_FAST_BN <> 8000H and
        LV_ERR_DCC_INH_MON = 0
then    LV_DCC_ENA_INC = 1
else    LV_DCC_ENA_INC = 0
endif

```

#### STATE\_TQ\_DCC\_PLAUS

```

if      LV_DCC_LIH_CAN          = 1          or      BIT [00] set
STATE_DCC_PUC_INH                = 03H        or      BIT [01] set
STATE_DCC_OFF_REQ                = 02H        or      BIT [02] set

```

```

if      LV_DCC_OFF_ECU = 1                                BIT [03] set
if      LV_TQ_DCC_INC_REQ = 1
Then IF  TQ_DCC_SLOW_BN == 8000H                        BIT [05] set
           TQ_DCC_FAST_BN == 8000H
else
endif                                BIT [04] set

```

## D.22.2 Torque request CAN selection

### FUNCTION DESCRIPTION:

If the DCC interventions enabled (LV\_DCC\_ENA\_INC = 1), the torque request is received from CAN and copied into TQI\_DCC\_FAST/SLOW\_INC. The slow and fast path are different messages. After LV\_DCC\_INC\_ACT changes back to 0, both TQI\_DCC\_FAST\_INC and TQI\_DCC\_SLOW\_INC becomes their minimum values again.

### Application conditions

**Initialisation:** at reset and at transition LV\_IGK off - -> on  
 TQI\_DCC\_FAST\_INC\_REQ / \_1 = 0 Nm  
 TQI\_DCC\_SLOW\_INC\_REQ / \_1 = 0 Nm

**Recurrence:** 10 ms

**Activation:** at LV\_IGK = 1 and LV\_VAR\_DCC = 1

**Deactivation:** -

### Formula section:

TQI\_DCC\_SLOW\_INC\_REQ\_1 = TQ\_DCC\_SLOW\_INC\_BN - TQ\_LOSS

TQI\_DCC\_FAST\_INC\_REQ\_1 = TQ\_DCC\_FAST\_INC\_BN - TQ\_LOSS

**IF** LV\_DCC\_ENA\_INC = 1

**Then** TQI\_DCC\_SLOW\_INC\_REQ = TQI\_DCC\_SLOW\_INC\_REQ\_1

TQI\_DCC\_FAST\_INC\_REQ = TQI\_DCC\_FAST\_INC\_REQ\_1

**Else** TQI\_DCC\_SLOW\_INC\_REQ = 0 Nm

TQI\_DCC\_FAST\_INC\_REQ = 0 Nm

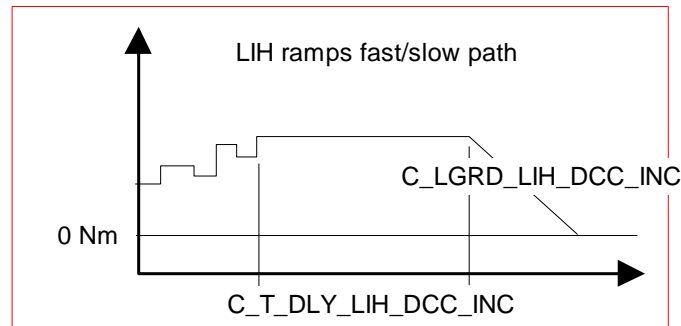
**Endif**

### D.22.2.1 DCC increased intervention and emergency operation

### FUNCTION DESCRIPTION:

If during an active DCC intervention a DCC or an EMS error occurs, the current torque offset is continued for the time C\_T\_DLY\_LIH\_DCC\_INC and then subsequently decreased to TQI\_DCC\_FAST\_INC = TQI\_DCC\_SLOW\_INC = 0 Nm using C\_LGRD\_LIH\_DCC\_INC. The DCC unit itself controls the torque leading during active LV\_TQ\_DCC\_INC\_REQ. therefore you will haven't a plausible Torque request without LV\_DCC\_ENA\_INC.

### Signal flow diagram:



### Application conditions

**Initialisation:** at reset and at transition LV\_IGK off - -> on

```

LV_DCC_INC_LIH = 0
LV_DCC_INC_ACT = 0
TQI_DCC_FAST_INC = TQI_DCC_SLOW_INC = 0Nm
T_DCC_LIH_CTR = 0

```

**Recurrence:** 10 ms

**Activation:** LV\_IGK = 1 and LV\_VAR\_DCC = 1

### Formula section:

*DCC\_INC intervention and detection of DCC\_INC limp home operation :*

```

if(1)      TQI_DCC_FAST_INC_REQ_1 0 Nm      and
            TQI_DCC_SLOW_INC_REQ_1 0 Nm      and
            LV_DCC_ENA_INC = 0
then(1)
    if(2)      TQI_DCC_FAST_INC > 0 Nm  or  TQI_DCC_SLOW_INC > 0 Nm
    then(2)    LV_DCC_INC_LIH = 1
              T_DCC_LIH_CTR_N = T_DCC_LIH_CTR_{N-1} + 10 ms
              (till T_DCC_LIH_CTR = C_T_DLY_LIH_DCC_INC)
    if(3)      T_DCC_LIH_CTR < C_T_DLY_LIH_DCC_INC                                     (time
    delay)
    then(3)    TQI_DCC_FAST_INC_N = TQI_DCC_FAST_INC_{N-1}                               (last
    valid value)
              TQI_DCC_SLOW_INC_N = TQI_DCC_SLOW_INC_{N-1}                               (last valid
    value)
    else(3)    TQI_DCC_FAST_INC_N = TQI_DCC_FAST_INC_{N-1} -
              C_LGRD_LIH_DCC_INC
              (till TQI_DCC_FAST_INC =
              0Nm)
              TQI_DCC_SLOW_INC_N = TQI_DCC_FAST_INC_N
    endif(3)
else(2)      LV_DCC_INC_LIH = 0
              T_DCC_LIH_CTR = 0
endif(2)
else(1)      LV_DCC_INC_LIH = 0
              T_DCC_LIH_CTR = 0


```

```
TQI_DCC_FAST_INC = TQI_DCC_FAST_INC_REQ
TQI_DCC_SLOW_INC = TQI_DCC_SLOW_INC_REQ
```

```
endif(1)
```

```
DCCT intervention active (LV_DCC_ACT_INC) :
```

```
if          TQI_DCC_SLOW_INC > 0 Nm          or
TQI_DCC_FAST_INC > 0 Nm
then      LV_DCC_INC_ACT = 1
else      LV_DCC_INC_ACT = 0
endif
```

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## D.23 Torque request for cruise control

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_REQ_CRU	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Scaling factor for requested torque at clutch from cruise control					
FAC_TQ_REQ_DCC	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Scaling factor of inverse DCC model					
LV_TQ_DCC_ACT	V	0... 1H	0 ...1	1	-
Torque structure led by driver but DCC intervention overtaking					
STATE_TQ_DCC	O/V	0H	0	-	-
		1H	1		
		8H	2		
		9H	3		
		AH	4		
		BH	5		
State of DCC torque intervention					
STATE_TQ_LDM	O/V	0H	0	-	-
		1H	1		
		8H	2		
		9H	3		
		AH	4		
		BH	5		
State of LDM torque intervention					
TQ_DELTA_MAX_CLU	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Difference between TQ_MAX_CLU and TQ_MIN_CLU					

### Input data:

FAC_TQ_CRU {p. 7237}	FAC_TQ_CRU_INI {p. 7237}	FAC_TQ_REQ_DRIV {p. 6570}	GR_DT {p. 8285}
LV_CRU_ACT {p. 7227}	LV_DCC_ENA_INC {p. 6731}	LV_IGK {p. 906}	LV_KD {p. 1269}
LV_LDM_DRIV_ACT {p. 8286}	LV_LDM_ENA {p. 6615}	LV_TQ_WHEEL_LDM_BN_ ERR {p. 1568}	LV_VAR_BN_LDM {p. 655}
LV_VAR_DCC {p. 655}	PV_AV {p. 1269}	TQ_LOSS {p. 8385}	TQ_MAX_CLU {p. 8380}
TQ_MIN_CLU {p. 8380}	TQ_WHEEL_LDM_BN {p. 1582}	TQI_DCC_FAST_INC {p. 6731}	TQI_REQ_TRA {p. 8192}
VS_FIL {p. 1176}	VS_SP_DRIV_CRU {p. 7237}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_DCC_FL	-	0... 8000H	0 ...1	30.5e-6	-
Full load detection of DCC					
C_LGRD_TQ_CRU_INC_1	-	0... FFFFH	0... 1.99996	30.5e-6	-
Change limitation for cruise control request out of lower vehicle speed					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LGRD_TQ_CRU_INC_2	-	0... FFFFH	0... 1.99996	30.5e-6	-
Change limitation for cruise control request out of higher vehicle speed					

## D.23.1 Torque request of DME internal Cruise control

### General information:

Depending on the cruise controller manipulated variable FAC\_TQ\_CRU the interpretation of torque request is calculated. Regarding the different resolutions the output of cruise control is converted to resolutions at the torque structure interface.

### Application conditions

**Activation:** every engine state and LV\_VAR\_DCC = 0 and LV\_VAR\_BN\_LDM = 0

**Recurrence:** 100 ms

**Initialization:** FAC\_TQ\_REQ\_CRU = 0 at reset

### Formula section:

*General calculation after initialisation:*

$$\text{FAC\_TQ\_REQ\_CRU} = \frac{\text{FAC\_TQ\_CRU}}{99,6\%}$$

*At initialisation of Cruise control:*

To get a smoothing transition into cruise controlled drive the initialisation ramp is depends on vehicle speed in relation the vehicle speed demand by driver:

**This query once :**

**IF (1)** LV\_CRU\_ACT = 0 to 1

FAC\_TQ\_CRU /99,6% > FAC\_TQ\_REQ\_DRIV

**Then (1.1)** at the first time FAC\_TQ\_REQ\_CRU = FAC\_TQ\_REQ\_DRIV

***This query until the end condition (until (1)) is fulfilled:***

**IF (2)** VS\_FIL ≤ VS\_SP\_DRIV\_CRU

**Then (2)**

FAC\_TQ\_REQ\_CRU = FAC\_TQ\_REQ\_CRU + C\_LGRD\_TQ\_CRU\_INC\_1

**Else (2)**

FAC\_TQ\_REQ\_CRU = FAC\_TQ\_REQ\_CRU + C\_LGRD\_TQ\_CRU\_INC\_2

**Until (1.1)** FAC\_TQ\_REQ\_CRU FAC\_TQ\_CRU /99,6%

**Else (1)**

$$\text{FAC\_TQ\_REQ\_CRU} = \frac{\text{FAC\_TQ\_CRU}}{99,6\%}$$

**Endif**

## D.23.2 Torque request an STATE of DCC and STATE of LDM

### FUNCTION DESCRIPTION:

#### General information:

The distance cruise control, the LDM and the transmission unit needs an information witch system (driver, DCC, LDM or CRU) leads the torque system. Therefore the compare between driver which and DCC/LDM is done.

#### Application conditions

**Initialisation:** STATE\_TQ\_DCC = 08H  
STATE\_TQ\_LDM = 08H  
FAC\_TQ\_REQ\_DCC = 0

**Recurrence:** 10 ms


**Activation:** LV\_VAR\_DCC = 1 **or** LV\_VAR\_BN\_LDM = 1 (and LV\_IGK = 1)

#### Formula section:

##### State of DCC/LDM in DME:

```

IF(1) LV_VAR_DCC = 1
Then(1) IF (2a) LV_KD = 0
    Then(2a) IF(3) LV_DCC_ENA_INC = 1 // "active"
        Then (3) IF (4) PV_AV > 0 %
            Then(4) IF(5) (TQI_REQ_TRA > TQI_DCC_FAST_INC )or
                (FAC_TQ_REQ_DRIV > C_FAC_DCC_FL)
                Then(5) STATE_TQ_DCC = 0AH
                    " DCC active overtaking by driver"
                Else (5) STATE_TQ_DCC = 01H
                    " DCC and Driver active"
            Endif(5)
        Else(4) STATE_TQ_DCC = 00H
            " driver passive DCC active"
        Endif(4)
    Else (3) If(6) PV_AV = 0 %
        Then(6) STATE_TQ_DCC = 08H
            " driver DCC passive"
        Else(6) STATE_TQ_DCC = 09H
            " active driver no DCC"
        Endif(6)
    Endif(3)
    Else(2a) STATE_TQ_DCC = 0BH "Kickdown active"
Endif(2a)
IF(2b) STATE_TQ_DCC = 0AH
Then(2b) LV_TQ_DCC_ACT = 1
Else(2b) LV_TQ_DCC_ACT = 0
Endif(2b)
Else (1) if(7) LV_VAR_BN_LDM = 1
    Then(7) IF (8) LV_KD = 0
  
```

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```

Then(8) IF(9) LV_LDM_ENA = 1 // "active"
  Then (9) IF (10) PV_AV > 0 %
    Then(10) IF(11) LV_LDM_DRIV_ACT = 0
      Then(11) STATE_TQ_LDM = 0AH
        " LDM active overtaking by driver"
      Else (11) STATE_TQ_LDM = 01H
        " LDM and Driver active"
      Endif(11)
    Else(10) STATE_TQ_LDM = 00H
      " driver passive LDM active"
    Endif(10)
  Else (9) If(12) IF PV_AV = 0 %
    Then(12) STATE_TQ_LDM = 08H
      " driver LDM passive"
    Else(12) STATE_TQ_LDM = 09H
      " active driver no LDM"
    Endif(12)
  Endif(9)
Else(8) STATE_TQ_LDM = 0BH "Kickdown active"
Endif(8)
Endif(7)
Endif(1)

```

*Inverse DCC Torque request model:*

```

TQ_REQ_DCC = TQI_DCC_FAST_INC + TQ_LOSS
TQ_DELTA_MAX_CLU = TQ_MAX_CLU - TQ_MIN_CLU
TQ_LDM_BN_CLU = TQ_WHEEL_LDM_BN /GR_DT

```

```

If(1) (LV_VAR_BN_LDM = 1 and LV_TQ_WHEEL_LDM_BN_ERR = 0)
Then(1) FAC_TQ_REQ_DCC =
  MIN(1;((TQ_LDM_BN_CLU -TQ_MIN_CLU) /TQ_DELTA_MAX_CLU))
Else(1)
  If(2) (LV_VAR_DCC = 1 and LV_DCC_ENA_INC = 1)
  Then(2) FAC_TQ_REQ_DCC =
    MIN(1;((TQ_REQ_DCC-TQ_MIN_CLU) /TQ_DELTA_MAX_CLU))
  Else(2) FAC_TQ_REQ_DCC = 0
  Endif(2)
Endif(1)

```

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## D.24 Torque request for traction control

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ASR_ACT	O/V	0... 1H	0 ...1	1	-
Logical variable for torque intervention due to TCS					
LV_ASR_ENA	V	0... 1H	0 ...1	1	-
Logical variable for ASR intervention enabling					
LV_ASR_LIH	V	0... 1H	0 ...1	1	-
Logical variable for torque intervention LIH due to TCS					
LV_MSR_ACT	O/V	0... 1H	0 ...1	1	-
Logical variable for torque intervention due to MSR					
LV_MSR_ENA	V	0... 1H	0 ...1	1	-
Logical variable for MSR intervention enabling					
LV_MSR_LIH	O/V	0... 1H	0 ...1	1	-
Logical variable for torque intervention LIH due to MSR					
LV_TCS_DISABLE	O/V	0... 1H	0 ...1	1	-
Logical variable for disabling TCS intervention due to EMS error					
LV_TCS_DISABLE_CAN	O/V	0... 1H	0 ...1	1	-
Logical variable for disabling TCS intervention due to EMS CAN error					
LV_TCS_ENA	V	0... 1H	0 ...1	1	-
Logical variable for basically TCS intervention enabling					
SF_TQD	O/V	0... 3H	0 ...3	1	-
Status flag driving torque at clutch					
STATE_TQ_TCS_PLAUS	O/V	0... FFH	0... 255	1	-
Bitwise coded State for TCS intervention state					
T_ASR_LIH_CTR	V	0... FFH	0... 2.55	0.01	s
Delay time					
T_MSR_LIH_CTR	V	0... FFH	0... 2.55	0.01	s
Delay time					
TQI_ASR_FAST	O/V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque decrement for fast torque intervention during TCS					
TQI_ASR_FAST_REQ	V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque decrement for fast torque intervention during TCS					
TQI_ASR_FAST_REQ_1	O	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque decrement for fast torque intervention during TCS					
TQI_ASR_SLOW	O/V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque decrement for slow torque intervention during TCS					
TQI_ASR_SLOW_REQ	V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque decrement for slow torque intervention during TCS					
TQI_ASR_SLOW_REQ_1	O	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque decrement for slow torque intervention during TCS					
TQI_MSR_FAST	O/V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for fast torque intervention during MSR					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQI_MSR_FAST_REQ	V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for fast torque intervention during TCS					
TQI_MSR_FAST_REQ_1	O	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for fast torque intervention during TCS					
TQI_MSR_SLOW	O/V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for slow torque intervention during MSR					
TQI_MSR_SLOW_REQ	V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for slow torque intervention during TCS					
TQI_MSR_SLOW_REQ_1	O	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for slow torque intervention during gear shift					

**Input data:**

IGA_MIN_H_RNG {p. 1828}	IGA_SP_H_RNG {p. 1948}	LV_ASR_PLAUS {p. 799}	LV_CDN_VB_CAN_TQ_DIAG {p. 1185}
LV_DI_TQ_REQ_CAN_MPI_GDI {p. 800}	LV_DT {p. 1310}	LV_ERR_BN_TCS {p. 4870}	LV_ERR_BN_TQ_TCS {p. 4871}
LV_ERR_BN_VS_TCS {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_MSR_INH_MON {p. 6983}	LV_ERR_TOUT_ASR_1 {p. 802}
LV_ERR_TOUT_ASR_3 {p. 802}	LV_ES {p. 1720}	LV_IGK {p. 906}	LV_MSR_PLAUS {p. 804}
LV_MTC_CUR_OFF {p. 6565}	LV_OFF_MTC_MON {p. 6877}	LV_PL {p. 1720}	LV_PU {p. 1720}
LV_SF_TQD_MON {p. 6791}	LV_ST {p. 1720}	LV_TCS_LIH_CAN {p. 1567}	LV_TQ_ASR_REQ {p. 1568}
LV_TQ_LIM_INTV {p. 6692}	LV_TQ_MSR_REQ {p. 1568}	LV_TQI_REQ_CAN_INH {p. 6687}	LV_VAR_ASR {p. 655}
LV_VAR_BN {p. 655}	STATE_ETC_LIH {p. 4982}	TQ_ASR_FAST_DEC_BN {p. 1710}	TQ_ASR_SLOW_DEC_BN {p. 1710}
TQ_LOSS {p. 8385}	TQ_MSR_FAST_INC_BN {p. 1711}	TQ_MSR_SLOW_INC_BN {p. 1711}	TQ_TCS_FAST_BN {p. 1582}
TQ_TCS_SLOW_BN {p. 1582}	TQI_ASR_FAST_REQ_CAN {p. 810}	TQI_ASR_SLOW_REQ_CAN {p. 810}	TQI_MSR_REQ_CAN {p. 811}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LGRD_LIH_ASR	-	0... 7FFFH	0... 1023.96875	0.03125	Nm/10ms
Limiting gradient for ASR emergency ramp function (default 0.6 Nm/10ms)					
C_LGRD_LIH_MSR	-	0... 7FFFH	0... 1023.96875	0.03125	Nm/10ms
Limiting gradient for MSR emergency ramp function (default 0.6 Nm/10ms)					
C_T_DLY_LIH_ASR	-	0... FFH	0... 2.55	0.01	s
Delay time for activation of ASR emergency ramp function (default 0s)					
C_T_DLY_LIH_MSR	-	0... FFH	0... 2.55	0.01	s
Delay time for activation of MSR emergency ramp function (default 0s)					
C_TQ_MAX_MSR	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Limiting torque for MSR					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------


**Configuration data:**

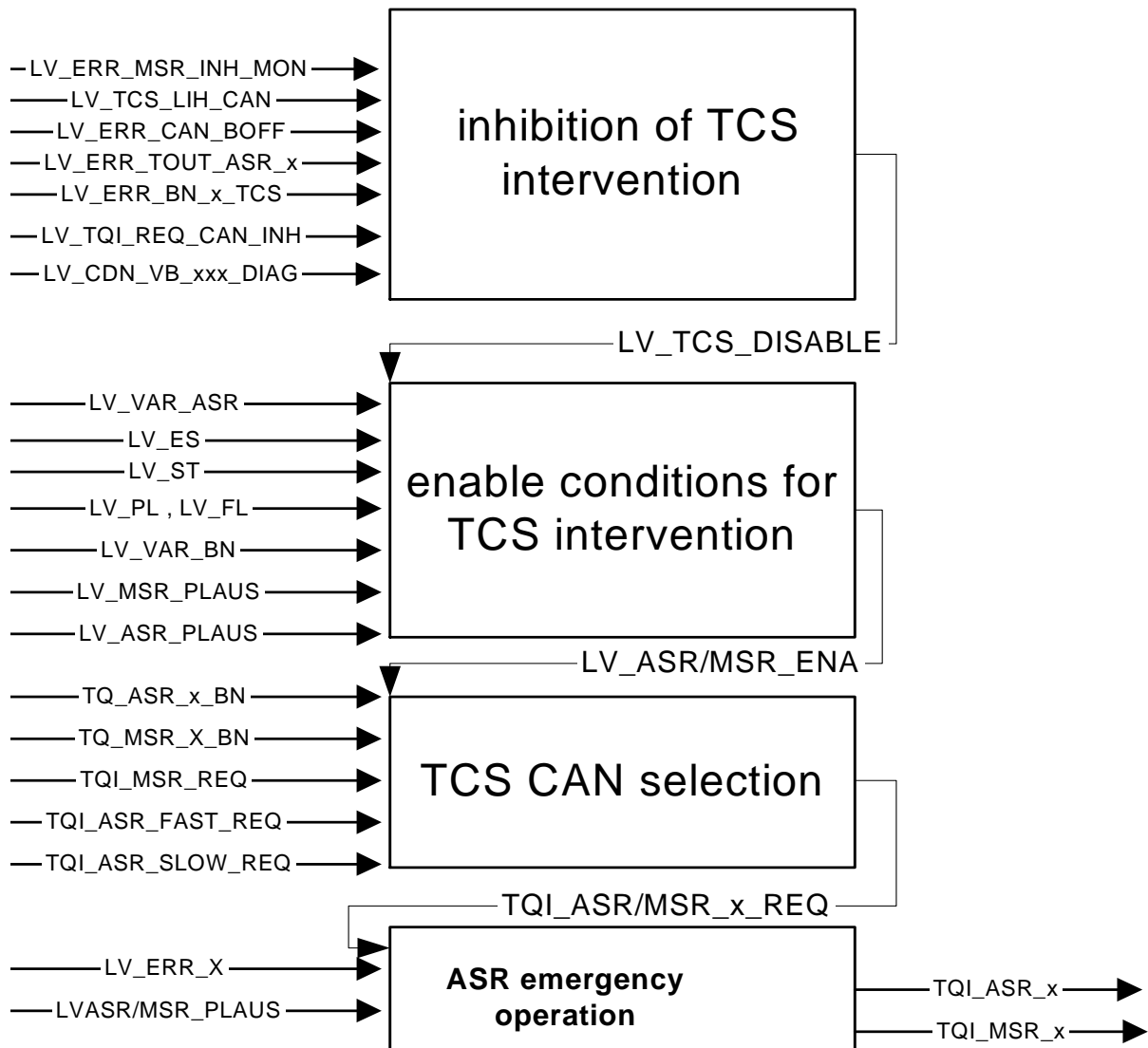
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_ASR_DISABLE	-	0... 1H	0 ...1	1	-
Logical constant to disable ASR interventions					
LC_MSR_DISABLE	-	0... 1H	0 ...1	1	-
Logical constant to disable MSR interventions					

**FUNCTION DESCRIPTION:**

Traction control function avoids wheel spinning on e.g. icy surfaces by reducing the engine torque in addition to brake the wheel. The ECU permanently checks, if a probable traction control torque intervention request can be executed, by checking, if an error at one or several of the relevant components for torque intervention occurred (LV\_TCS\_DISABLE). If no error is recognized and an actual traction control request is received, a check is done, if at actual engine operating condition a torque intervention allowed (LV\_ASR\_ENA or LV\_MSR\_ENA). Both torque request values, for fast and slow torque intervention are handed over to relevant torque coordination functions to adjust the engine torque.

MSR function avoids the vehicle from skidding on e.g. icy surfaces by reducing the drag torque of the engine at trailing throttle and trailing throttle fuel cut off. For to reach a higher lateral stability of the wheels the indicated engine torque is increased to reduce wheel slip.

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### Signal flow diagram:

## D.24.1 inhibition TCS intervention

### FUNCTION DESCRIPTION:

If the EMS detects a safety relevant error at throttle the logical variable LV\_TCS\_DISABLE is set to 1 in order to indicate a static EMS error.

### Application conditions

**Initialisation:**  $LV\_TCS\_DISABLE = 0 ; LV\_TCS\_DISABLE\_CAN = 0$  at reset

**Recurrence:** 10 ms

**Activation:** every engine operating state



**Deactivation:** –

**Formula section:**

```

if          LV_ERR_CAN_BOFF          = 1
or          LV_ERR_TOUT_ASR_1        = 1
or          LV_ERR_TOUT_ASR_3        = 1
or          LV_ERR_BN_TQ_TCS         = 1
or          LV_ERR_BN_VS_TCS         = 1
or          LV_ERR_BN_TCS            = 1
or          LV_CDN_VB_CAN_TQ_DIAG = 0
then        LV_TCS_DISABLE_CAN       = 1
else        LV_TCS_DISABLE_CAN       = 0
endif

```

```

if          LV_TQI_REQ_CAN_INH        = 1
or          LV_DI_TQ_REQ_CAN_MPI_GDI = 1
or          LV_ERR_MSR_INH_MON        = 1
or          LV_TCS_LIH_CAN            = 1
or          LV_TCS_DISABLE_CAN        = 1
then        LV_TCS_DISABLE            = 1
else        LV_TCS_DISABLE            = 0
endif

```

## D.24.2 Enable conditions for TCS torque intervention

### FUNCTION DESCRIPTION:

#### General information:

Depending on the configuration and plausible torque interfaces an inc (MSR). or decreased (ASR) torque intervention is possible.

The State STATE\_TQ\_TCS\_PLAUS indicates the interrupted condition witch is responsible for enable Bit = 0. The [ x ] Value shows the HEX address inside the Bitwise coded State.

#### Application conditions

**Initialisation:** *LV\_ASR/ TCS/ MSR\_ENA = 0; STATE\_TQ\_TCS\_PLAUS = 0 at reset*

**Recurrence:** *10 ms*


**Activation:** *every engine operating state*

#### Formula section:

```

if          LV_VAR_ASR = 1          and
              LV_TCS_DISABLE = 0    and
              LV_ES=0              and
              LV_ST = 0              and
Then        LV_TCS_ENA = 1
Else        LV_TCS_ENA = 0

```

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**Endif**

**IF(1)** LV\_VAR\_BN = 0

```

Then(1)if(2)      LC_ASR_DISABLE = 0
                   and      LV_TCS_ENA = 1
                   and      [ LV_PL = 1 or LV_PU = 1 ]
                   and      LV_ASR_PLAUS = 1
                   and      LV_TQ_ASR_REQ = 1
then(2)          LV_ASR_ENA = 1
else(2)          LV_ASR_ENA = 0

else(1) if(3)     LC_ASR_DISABLE = 0
                   and      LV_TCS_ENA = 1
                   and      [ LV_PL = 1 or LV_PU = 1 ]
                   and      TQ_TCS_FAST_BN <> 8000 H
                   and      TQ_TCS_SLOW_BN <> 8000 H
                   and      LV_TQ_ASR_REQ = 1
then(3)          LV_ASR_ENA = 1
else(3)          LV_ASR_ENA = 0
endif

```

**IF(1)** LV\_VAR\_BN = 0

```

Then(1) if      (2)      LC_MSR_DISABLE = 0
                   and      LV_TCS_ENA = 1
                   and      LV_MSR_PLAUS = 1
                   and      LV_TQ_MSR_REQ = 1
then (2)       LV_MSR_ENA = 1
else (2)       LV_MSR_ENA = 0

else(1) if(3)     LC_MSR_DISABLE = 0
                   and      LV_TCS_ENA = 1
                   and      TQ_TCS_FAST_BN <> 8000 H
                   and      TQ_TCS_SLOW_BN <> 8000 H
                   and      LV_TQ_MSR_REQ = 1
then (3)       LV_MSR_ENA = 1
else (3)       LV_MSR_ENA = 0
endif

```

**endif**

-----  
STATE TQ\_TCS\_PLAUS:

```

If      LV_TCS_ENA = 0                                BIT [00] set
IF[ LV_PL = 0 and LV_PU = 0 ]                        BIT [01] set
IF LV_TQ_ASR_REQ = 1
Then IF  LV_VAR_BN = 0
           Then      IF LV_ASR_PLAUS = 0                BIT [02] set
           elseif TQ_TCS_FAST_BN == 8000 H or          BIT [02] set
                   TQ_TCS_SLOW_BN == 8000 H
else                                          BIT [03] set
endif

If      LV_TCS_ENA = 0                                BIT [00] set
IF[ LV_PL = 0 and LV_PU = 0 ]                        BIT [01] set
IF LV_TQ_MSR_REQ = 1

```

```

Then IF LV_VAR_BN = 0
    Then IF LV_MSR_PLAUS = 0 BIT [02] set
    elseif TQ_TCS_FAST_BN == 8000 H or BIT [02] set
           TQ_TCS_SLOW_BN == 8000 H
else BIT [04] set
endif
-----

```

### D.24.3 Torque request CAN selection

#### FUNCTION DESCRIPTION:

If one of the TCS interventions enabled ( $LV\_ASR/MSR\_ENA = 1$ ), the torque request is received from CAN and copied into  $TQI\_ASR/MSR\_FAST$ . The slow and fast path are different messages. After  $LV\_ASR/MSR\_ACT$  changes back to 0, both  $TQI\_ASR/MSR\_FAST$  and  $TQI\_ASR/MSR\_SLOW$  become their maximum/minimum value again.

#### Application conditions

**Initialisation:** at reset  $TQI\_ASR\_FAST\_REQ = 1023.97 \text{ Nm}$   
 $TQI\_ASR\_SLOW\_REQ = 1023.97 \text{ Nm}$   
 $TQI\_MSR\_FAST\_REQ = 0 \text{ Nm}$   
 $TQI\_MSR\_SLOW\_REQ = 0 \text{ Nm}$

**Recurrence:** 10 ms

**Activation:** at  $LV\_IGK = 1$

**Deactivation:** -

#### Formula section:

```

if LV_VAR_BN = 1
then TQI_ASR_SLOW_REQ_1 = TQ_ASR_SLOW_DEC_BN - TQ_LOSS
     TQI_ASR_FAST_REQ_1 = TQ_ASR_FAST_DEC_BN - TQ_LOSS
     TQI_MSR_SLOW_REQ_1 = TQ_MSR_SLOW_INC_BN - TQ_LOSS
     TQI_MSR_FAST_REQ_1 = TQ_MSR_FAST_INC_BN - TQ_LOSS
Else TQI_MSR_SLOW_REQ_1 = TQI_MSR_REQ_CAN
     TQI_MSR_FAST_REQ_1 = TQI_MSR_REQ_CAN
     TQI_ASR_FAST_REQ_1 = TQI_ASR_FAST_REQ_CAN
     TQI_ASR_SLOW_REQ_1 = TQI_ASR_SLOW_REQ_CAN
endif
IF LV_ASR_ENA= 1
Then TQI_ASR_SLOW_REQ = TQI_ASR_SLOW_REQ_1
     TQI_ASR_FAST_REQ = TQI_ASR_FAST_REQ_1
Else TQI_ASR_SLOW_REQ = 1023.97 Nm
     TQI_ASR_FAST_REQ = 1023.97 Nm
endif
IF LV_MSR_ENA = 1
Then TQI_MSR_SLOW_REQ = TQI_MSR_SLOW_REQ_1
     TQI_MSR_FAST_REQ = TQI_MSR_FAST_REQ_1
Else TQI_MSR_SLOW_REQ = 0 Nm
     TQI_MSR_FAST_REQ = 0 Nm
endif

```

## D.24.4 TCS intervention

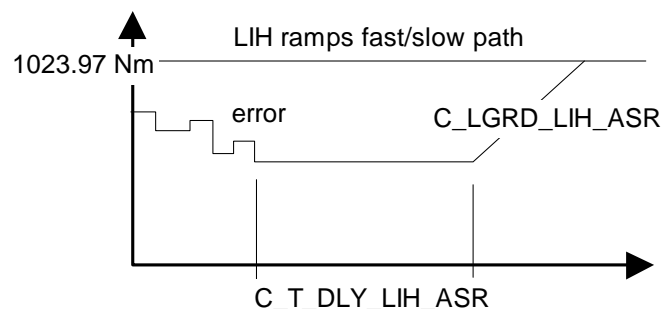
### D.24.4.1 ASR intervention and emergency operation

#### FUNCTION DESCRIPTION:

If during an active TCS intervention an TCS error or an EMS error occurs, the current torque reduction is continued for the time  $C\_T\_DLY\_LIH\_ASR$  and then subsequently increased to  $TQI\_ASR\_FAST = TQI\_ASR\_SLOW = 1023,97$  Nm using  $C\_LGRD\_LIH\_ASR$ .

At transition from limp home condition active to passive after torque increase to  $TQI\_ASR\_FAST = TQI\_ASR\_SLOW = 1023,97$  Nm at limp home operation the counter  $T\_TCS\_LIH\_CTR$  is stopped and set to 0.

#### Signal flow diagram:



#### Application conditions

##### Initialisation:

at reset **or** at transition LV\_IGK 0 -> 1  
 $LV\_ASR\_LIH = 0$   
 $LV\_ASR\_ACT = 0$   
 $TQI\_ASR\_FAST = TQI\_ASR\_SLOW = 1023.97$  Nm  
 $T\_ASR\_LIH\_CTR = 0$

##### Recurrence:

10 ms

##### Activation:


$LV\_IGK = 1$

#### Formula section:

ASR intervention and detection of ASR limp home operation :

**if (1)**  $LV\_TCS\_DISABLE\_CAN = 1$  **or**  
 $(LV\_VAR\_BN = 0 \text{ and } LV\_ASR\_PLAUS = 0 \text{ and } LV\_TQ\_ASR\_REQ = 1)$  **or**  
 $(LV\_VAR\_BN = 1 \text{ and } LV\_TQ\_ASR\_REQ = 0 \text{ and } LV\_TQ\_MSR\_REQ = 0 \text{ and } TQ\_TCS\_FAST\_BN <> 8000 \text{ H and } TQ\_TCS\_SLOW\_BN <> 8000 \text{ H})$

**then (1)** **if(1b)**  $TQI\_ASR\_FAST < 7FFFH$  **or**  
 $TQI\_ASR\_SLOW < 7FFFH$   
**Then(1b)**  $LV\_ASR\_LIH = 1$   
**if(1c)**  $T\_ASR\_LIH\_CTR < C\_T\_DLY\_LIH\_ASR$  (time delay)  
**Then(1c)**  $TQI\_ASR\_FAST_N = TQI\_ASR\_FAST_{N-1}$  (last valid value)

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```

value)
    TQI_ASR_SLOWN = TQI_ASR_SLOWN-1 (last valid
value)
    T_ASR_LIH_CTRN = T_ASR_LIH_CTRN-1 + 10 ms
    ( till T_TCS_LIH_CTR = C_T_DLY_LIH_ASR )
Else(1c)
    TQI_ASR_FASTN = TQI_ASR_FASTN-1 +
    C_LGRD_LIH_ASR
    (till TQI_TCS_FAST = 1023.97 Nm)
    TQI_ASR_SLOWN = TQI_ASR_FASTN
Endif(1c)
else(1b) LV_ASR_LIH = 0
    T_TCS_LIH_CTR = 0
Endif(1b)
Else(1)
    LV_ASR_LIH = 0
    T_TCS_LIH_CTR = 0
    TQI_ASR_FAST = TQI_ASR_FAST_REQ
    TQI_ASR_SLOW = TQI_ASR_SLOW_REQ
endif (1)

```

ASR intervention active (LV\_ASR\_ACT) :

```

if
    TQI_ASR_SLOW < 1023.97 Nm
    or
    TQI_ASR_FAST < 1023.97 Nm
then
    LV_ASR_ACT = 1
else
    LV_ASR_ACT = 0
endif

```

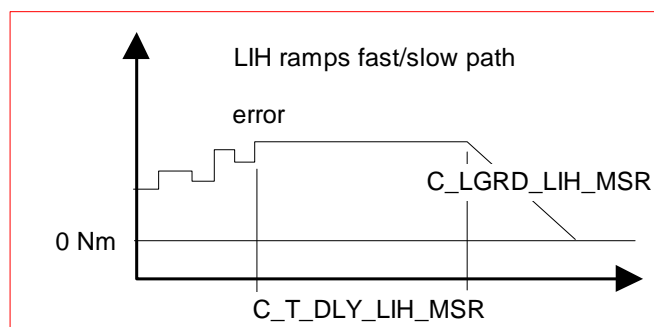
#### D.24.4.2 MSR intervention and emergency operation

##### FUNCTION DESCRIPTION:

If during an active MSR intervention an TCS error or an EMS error occurs, the current torque offset is continued for the time C\_T\_DLY\_LIH\_MSR and then subsequently decreased to TQI\_MSR\_FAST = TQI\_MSR\_SLOW = 0 Nm using C\_LGRD\_LIH\_MSR.

At transition from limp home condition active to passive after torque decrease to TQI\_MSR\_FAST = TQI\_MSR\_SLOW = 0 Nm at limp home operation the counter T\_TCS\_LIH\_CTR is stopped and set to 0.

##### Signal flow diagram:



## Application conditions

**Initialisation:** at reset **or** at transition LV\_IGK 0 - -> 1  
 LV\_MSR\_LIH = 0  
 LV\_MSR\_ACT = 0  
 TQI\_MSR\_FAST = TQI\_MSR\_SLOW = 0 Nm  
 T\_MSR\_LIH\_CTR = 0

**Recurrence:** 10 ms

**Activation:** LV\_IGK = 1

## Formula section:

MSR intervention and detection of MSR limp home operation :

**if (1)** LV\_TCS\_DISABLE\_CAN = 1 **or**  
 (LV\_VAR\_BN = 0 and LV\_MSR\_PLAUS = 0 and LV\_TQ\_MSR\_REQ = 1) **or**  
 (LV\_VAR\_BN = 1 and LV\_TQ\_MSR\_REQ = 0 and LV\_TQ\_ASX\_REQ = 0 and  
 TQ\_TCS\_FAST\_BN <> 8000 H and TQ\_TCS\_SLOW\_BN <> 8000 H)

**then (1)**

**if (1b)** TQI\_MSR\_FAST > 0 **or**  
 TQI\_MSR\_SLOW > 0

**Then (1b)** LV\_MSR\_LIH = 1

*delay)*

**if (2)** T\_MSR\_LIH\_CTR ≤ C\_T\_DLY\_LIH\_MSR (*time*

*value)*

**then (2)** TQI\_MSR\_FAST<sub>N</sub> = TQI\_MSR\_FAST<sub>N-1</sub> (*last valid*

*value)*

TQI\_MSR\_SLOW<sub>N</sub> = TQI\_MSR\_SLOW<sub>N-1</sub> (*last valid*

T\_MSR\_LIH\_CTR<sub>N</sub> = T\_MSR\_LIH\_CTR<sub>N-1</sub> + 10 ms

( *till T\_MSR\_LIH\_CTR = C\_T\_DLY\_LIH\_MSR*  
 )

**else (2)** TQI\_MSR\_FAST<sub>N</sub> = TQI\_MSR\_FAST<sub>N-1</sub> -

C\_LGRD\_LIH\_MSR

(*till TQI\_MSR\_FAST = 0Nm*)

TQI\_MSR\_SLOW<sub>N</sub> = TQI\_MSR\_FAST<sub>N</sub>

**endif (2)**

**Endif (1b)**

**else (1)**

LV\_MSR\_LIH = 0

T\_TCS\_LIH\_CTR = 0

TQI\_MSR\_FAST = min( (C\_TQ\_MAX\_MSR -  
 TQ\_LOSS); TQI\_MSR\_FAST\_REQ)

TQI\_MSR\_SLOW = min( (C\_TQ\_MAX\_MSR -  
 TQ\_LOSS); TQI\_MSR\_SLOW\_REQ)

**endif (1)**

MSR intervention active (LV\_MSR\_ACT) :

**if** TQI\_MSR\_SLOW > 0 Nm **or**  
 TQI\_MSR\_FAST > 0 Nm

**then** LV\_MSR\_ACT = 1

**else** LV\_MSR\_ACT = 0

**endif**

## D.24.5 Status flag driving torque at clutch SF\_TQD

### Application conditions

**Initialisation:**  $SF\_TQD = 0$  **at reset**

**Recurrence:**  $10\ ms$

**Activation:**  $at\ LV\_IGK = 1$

**Deactivation:**  $-$

### Formula section:

```

If (1)      STATE_ETC_LIH      = ETC_LIH_1      or
              STATE_ETC_LIH      = ETC_LIH_2_REV   or
              STATE_ETC_LIH      = ETC_LIH_2      or
              LV_OFF_MTC_MON      = 1
              (see Chapter: "Appl. Inc of process monitoring" and
              "Fault reaction of Process monitoring") or
              LV_SF_TQD_MON = 1

then (1)    SF_TQD = 03H
else(1)If(2)  IGA_SP_H_RNG <= IGA_MIN_H_RNG      or
                LV_TQ_LIM_INTV = 1


                Then (2)    SF_TQD = 01H
                Else (2)    SF_TQD = 00H
                Endif(2)

Endif(1)

```

# E - Monitoring Concept

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# E.1 Actual efficiencies

**Data definition:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_IGA_HOM_MON	V	0... FFH	0... 1.9921875	7.8125e-3	-
ignition efficiency in homogeneous (process monitoring)					
EFF_IGA_HOMS_MON	V	0... FFH	0... 1.9921875	7.8125e-3	-
ignition efficiency in multiple homogeneous-stratified (process monitoring)					
EFF_IGA_S_MON	V	0... FFH	0... 1.9921875	7.8125e-3	-
ignition efficiency in stratified (process monitoring)					
EFF_LAMB_HOM_MON	V	0... FFH	0... 1.9921875	7.8125e-3	-
lambda efficiency in homogeneous (process monitoring)					
EFF_LAMB_HOMS_MON	V	0... FFH	0... 1.9921875	7.8125e-3	-
lambda efficiency in homogeneous-stratified (process monitoring)					
EFF_LAMB_S_MON	V	0... FFH	0... 1.9921875	7.8125e-3	-
lambda efficiency in stratified homogeneous (process monitoring)					
EFF_TOT_MON	O/V	0... FFH	0... 1.9921875	7.8125e-3	-
total actual efficiencies					
IGA_DIF_AV_H_RNG_HOM_MON	V	0... B40H	0... -180	-0.0625	°CRK
difference from reference to actual ignition angle in homogeneous (process monitoring)					
IGA_DIF_AV_H_RNG_HOMS_MON	V	0... B40H	0... -180	-0.0625	°CRK
difference from reference to actual ignition angle in homogeneous_stratified (process monitoring)					
IGA_DIF_AV_HOM_MON	-	0... B40H	0... -180	-0.0625	°CRK
difference from reference to actual ignition angle in homogeneous (process monitoring)					

**Input data:**

IGA_IGC_H_RNG [NC_CYL_NR] {p. 1876}	IGA_REF_HOM_COR_Ext_MON {p. 6789}	IGA_REF_HOMS_COR_Ext_MON {p. 6789}	LAMB_MON {p. 6777}
LV_TQI_MON_ACT_MON {p. 6791}	MFF_LAMB_REF_IGA_MON {p. 6791}	MFF_TQ_MON {p. 6760}	N_32_MON {p. 7002}
OPM_AV_MON {p. 6792}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_EFF_IGA_HOM_MON	-	0... FFH	0... 99.609375	0.390625	%
LDPM_IGA_DIF_AV_MON_IP_EFF_MON	8	0... B40H	0... -180	-0.0625	°CRK
actual ignition efficiency in homogeneous (process monitoring)					
IP_EFF_IGA_HOMS_MON	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDPM_IGA_DIF_AV_MON_IP_EFF_MON	8	0... B40H	0... -180	-0.0625	°CRK
actual ignition efficiency in homogeneous_stratified (process monitoring)					
IP_EFF_LAMB_HOM_MON	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_LAMB_HOM_MON_IP_EFF_MON	8	0... 7FFFH	0... 31.9990234375	976.563e-6	-
lambda efficiency in homogeneous (process monitoring)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_EFF_LAMB_HOMS_MON	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_LAMB_HOMS_MON_IP_EFF_MON	8	0... 7FFFH	0... 31.9990234375	976.563e-6	-
lambda efficiency in homogeneous-stratified (process monitoring)					
IP_EFF_LAMB_S_MON	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_LAMB_S_MON_IP_EFF_MON	8	0... 7FFFH	0... 31.9990234375	976.563e-6	-
lambda efficiency in stratified (process monitoring)					
IP_FAC_EFF_IGA_MON	V	0... FFH	0... 15.9375	0.0625	-
LDP_N_32_MON_IP_FAC_EFF_IGA_MON	6	0... FFH	0... 8160	32	rpm
LDP_MFF_MON_IP_FAC_EFF_IGA_MON	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Factor ignition efficiency (process monitoring)					
IP_IGA_REF_HOM_MON	V	0... B40H	-90 ...90	0.0625	°CRK
LDPM_N_32_MON_IP_IGA_REF_MON	8	0... FFH	0... 8160	32	rpm
LDP_MFF_MON_IP_IGA_REF_HOM_MON	8	0... FFFFH	0... 1389	0.0211948	mg/stk
reference ignition angle in homogeneous (process monitoring)					
IP_IGA_REF_HOMS_MON	V	0... B40H	-90 ...90	0.0625	°CRK
LDPM_N_32_MON_IP_IGA_REF_MON	8	0... FFH	0... 8160	32	rpm
LDP_MFF_MON_IP_IGA_REF_HOMS_MON	8	0... FFFFH	0... 1389	0.0211948	mg/stk
reference ignition angle in homogeneous_stratified (process monitoring)					

## General Information

ACTION\_ECM3\_Service15TaskPfm(IN<>)

ACTION\_ECM3\_Service16TaskPfm(IN<>)

ACTION\_ECM3\_Service17TaskPfm(IN<>)

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 3.

ACTION\_ECM3\_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION\_ECM3\_Service15TaskPfm() and ACTION\_ECM3\_Service16TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN <>, IN <>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

Note: These actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode O and history variables in modules of the Process Monitoring have to be checked by the cyclical RAM test.

Hint Application Conditions Initialisation: for condition see 'Application incidences of process monitoring'

**Application Conditions**

Initialization: RST  
 Recurrence: 40MS  
 Activation: LV\_TQI\_MON\_ACT\_MON  
 Deactivation: !LV\_TQI\_MON\_ACT\_MON

**Function description**

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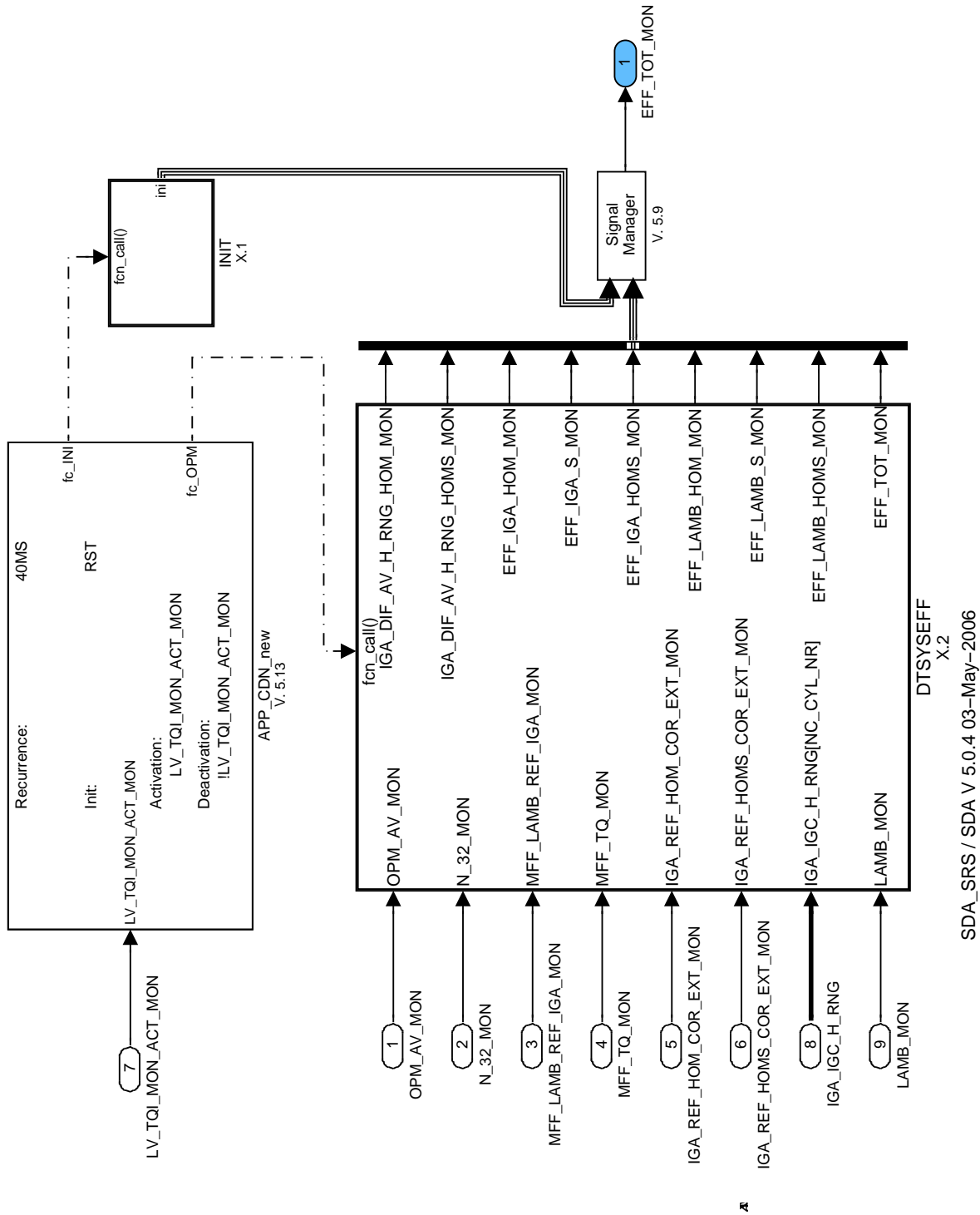


Figure E.1.1: : Path: ECM2\_DTSYSEFF

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### E.1.1 ECM2\_DTSYSEFF/INIT

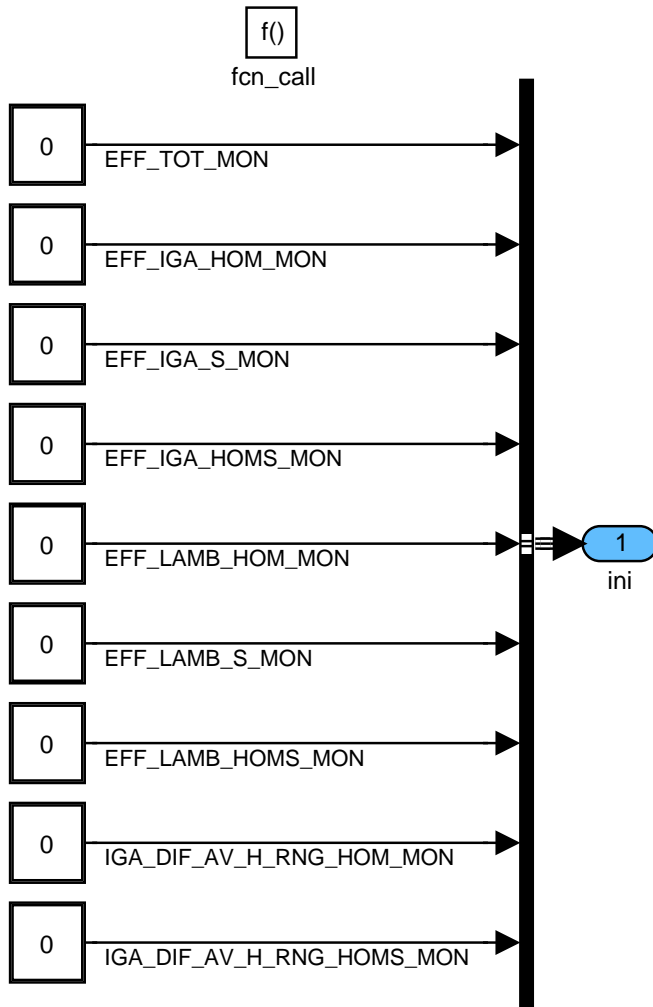


Figure E.1.2: : Path: ECM2\_DTSYSEFF/INIT

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### E.1.2 ECM2\_DTSYSEFF/DTSYSEFF

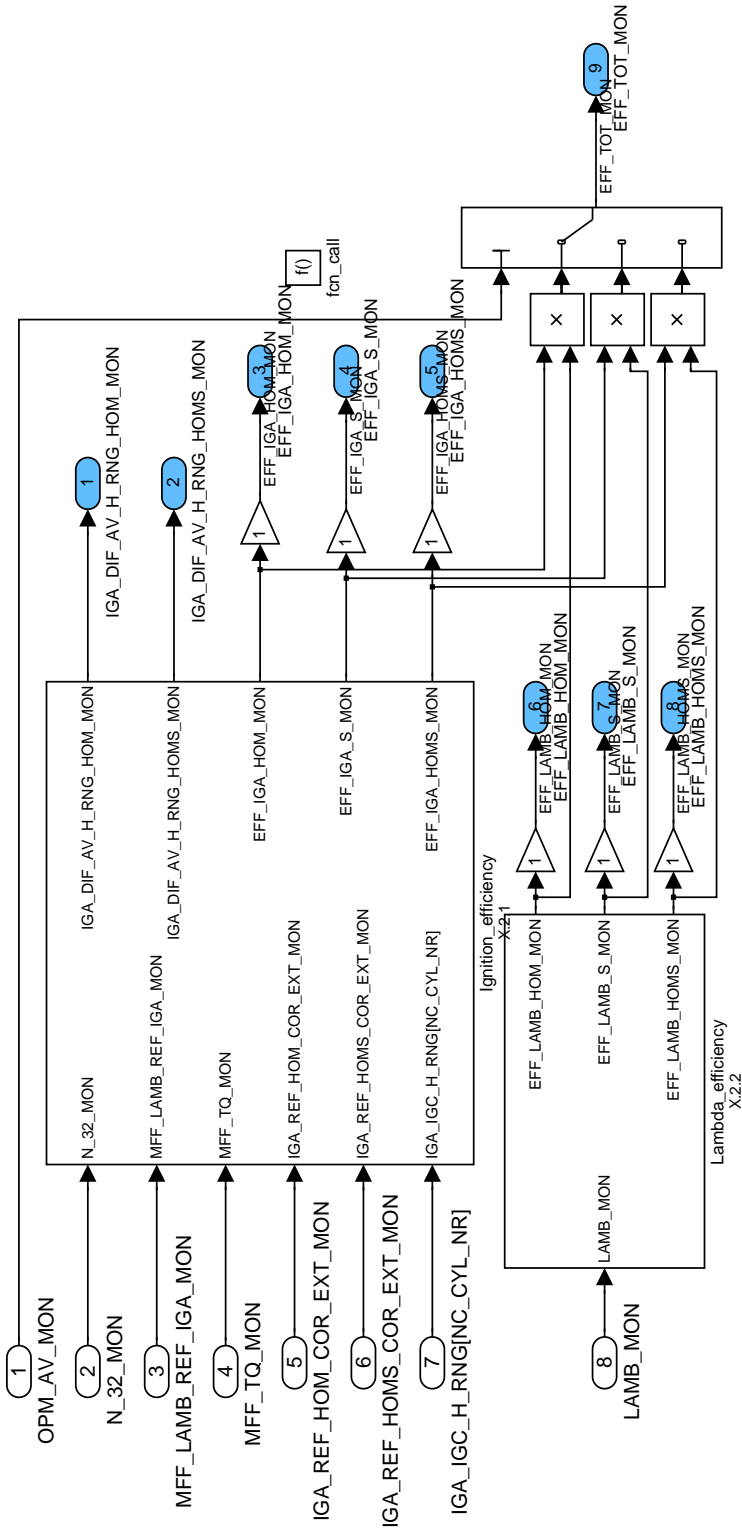



Figure E.1.3: : Path: ECM2\_DTSYSEFF/DTSYSEFF

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### E.1.2.1 ECM2\_DTSYSEFF/DTSYSEFF/IGNITION\_EFFICIENCY

<CONTENT VIEW="ANY">

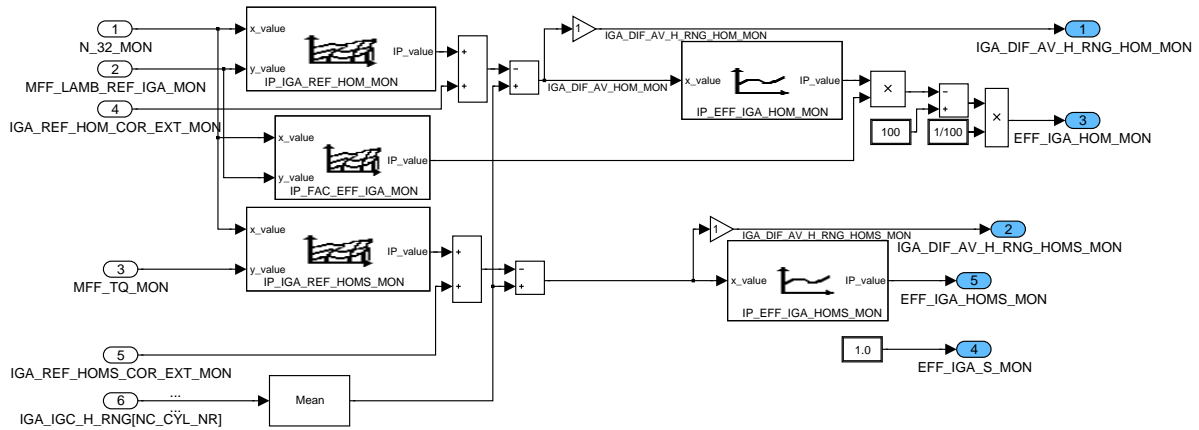


Figure E.1.4: : Path: ECM2\_DTSYSEFF/DTSYSEFF/ignition\_efficiency

### E.1.2.2 ECM2\_DTSYSEFF/DTSYSEFF/LAMBDA\_EFFICIENCY

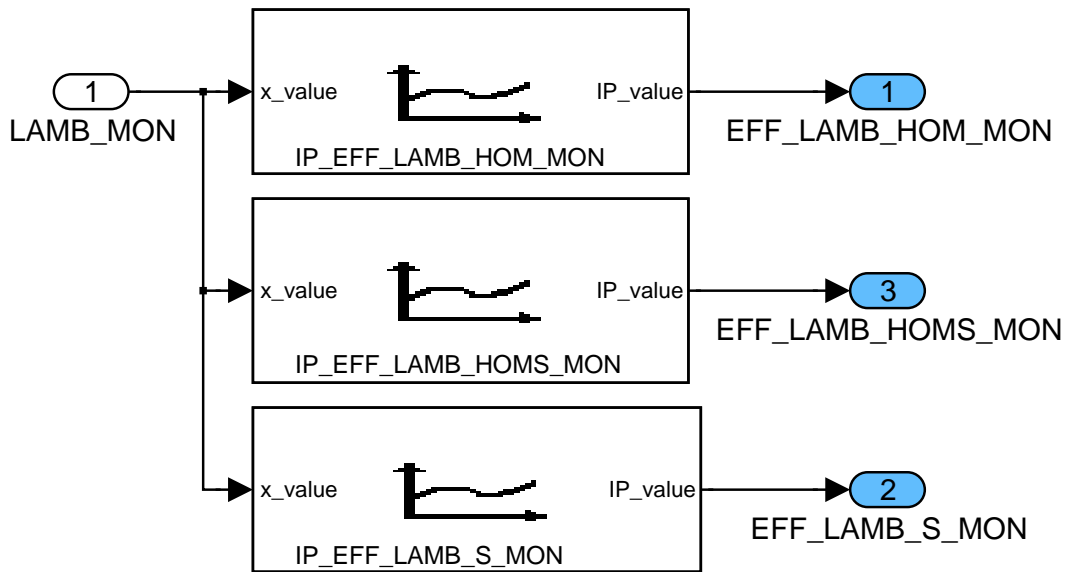


Figure E.1.5: : Path: ECM2\_DTSYSEFF/DTSYSEFF/Lambda\_efficiency


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## E.2 Actual fuel mass flow

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_SCC_MON	O/V	0... FFH	0... 1.99218	0.0078125	-
Actual efficiency of cylinder cut-off for torque monitoring					
FAC_PREV_STATE_IV_MON	V	0... FFH	0... 1.99218	0.0078125	-
Actual efficiency of cylinder cut-off from previous state					
LV_ENA_GRD_TI_IDX_MON	V	0... 1H	0 ...1	1	-
flag indicating stable dynamic conditions					
LV_IDX_TI_PLAUS_MON	O/V	0... 1H	0 ...1	1	-
Flag for unplausible injection index					
LV_IV_EGY_POST_MON	V	0... 1H	0 ...1	1	-
determination of energy level for post pulse					
MFF_IV_1_MON	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass Fuel Flow, first Pulse					
MFF_IV_2_MON	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass Fuel Flow, second Pulse					
MFF_IV_POST_MON	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass Fuel Flow, post pulse					
MFF_LAMB_MON	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Lambda relevant mass fuel flow					
MFF_LAMB_REF_MON	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Lambda relevant Mass Fuel Flow for stoichiometric conditions					
MFF_TQ_MON	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Torque relevant Mass Fuel Flow					
NR_CTR_IDX_MON	V	0... FFH	0... 255	1	-
counter for maximal transient jitter					
PRS_DIF_IV_1_MON	V	0... FFFFH	0... 347776	5.3067216	hPa
pressure difference at injector for first pulse					
PRS_DIF_IV_2_MON	V	0... FFFFH	0... 347776	5.3067216	hPa
pressure difference at injector for second pulse					
PRS_DIF_IV_POST_MON	V	0... FFFFH	0... 347776	5.3067216	hPa
pressure difference at injector for post pulse					
TI_1_MES_IDX_MON	V	0... FFFFH	0... 65.535	0.001	ms
Actual performed injection time for first pulse, based on IDX_TI					
TI_DIF_MES_IDX_MON	V	0... FFFFH	0... 65.535	0.001	ms
difference between measured and indexed signal					
TI_IDX_1_MON	V	0... FFFFH	0... 65.535	0.001	ms
IDX- based, virtual injection time, first pulse					
TI_IDX_2_MON	V	0... FFFFH	0... 65.535	0.001	ms
IDX- based, virtual injection time, second pulse					
TI_IDX_POST_MON	V	0... FFFFH	0... 65.535	0.001	ms
IDX- based, virtual injection time, post injection pulse					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TI_IV_1_COR_MON	V	0... FFFFH	0... 65.535	0.001	ms
standardized injection time for first pulse					
TI_IV_2_COR_MON	V	0... FFFFH	0... 65.535	0.001	ms
standardized injection time for second pulse					
TI_IV_POST_COR_MON	V	0... FFFFH	0... 65.535	0.001	ms
standardized injection time for post pulse					

**Input data:**

CHA_IV_1_MES [NC_CYL_NR] {p. 2035}	CHA_IV_2_MES [NC_CYL_NR] {p. 2035}	CHA_IV_POST_MES [NC_CYL_NR] {p. 2035}	EFF_SCC_AV {p. 6665}
EOI_1_MES [NC_CYL_NR] {p. 2036}	EOI_2_MES [NC_CYL_NR] {p. 2036}	EOI_POST_MES [NC_CYL_NR] {p. 2037}	FAC_LAM_AD_BAL [NC_CBK_EX_NR] {p. 1014}
FAC_LAM_LIM_FIL [NC_CBK_EX_NR] {p. 1014}	FAC_LAM_PCTL [NC_CBK_EX_NR] {p. 2462}	FAC_MFF_COR_INJ_MOD {p. 8241}	FAC_MFF_DIF_MV {p. 2260}
FAC_MFF_TFU {p. 2224}	FAC_MFF_WUP_CUS_ MON {p. 6789}	FAC_TI_L_PRS {p. 3327}	FAC_TI_PRS_COR_1 {p. 1999}
FAC_TI_PRS_COR_2 {p. 1999}	FAC_TI_PRS_COR_3 {p. 2000}	FUP {p. 1283}	IDX_TI_1_MON [NC_CYL_NR] {p. 6789}
IDX_TI_2_MON [NC_CYL_NR] {p. 6789}	IDX_TI_POST_MON [NC_CYL_NR] {p. 6789}	IGA_IGC_H_RNG [NC_CYL_NR] {p. 1876}	LC_CUR_SHP_INJ_ENA_ MON {p. 6803}
LV_IV_EGY_RNG_1 {p. 2261}	LV_IV_EGY_RNG_2 {p. 2261}	LV_IV_EGY_RNG_3 {p. 2261}	LV_TQI_MON_ACT_MON {p. 6791}
MAP_MES {p. 1198}	MFF_ADD_CYL_CP {p. 3692}	MFF_ADD_LAM_AD_OUT [NC_CBK_EX_NR] {p. 2464}	MFF_ADD_WF {p. 8242}
MFF_SP_1_EXT_COR [NC_CYL_NR] {p. 8242}	MFF_SP_2_EXT_COR [NC_CYL_NR] {p. 8242}	MFF_SP_3_EXT_COR [NC_CYL_NR] {p. 8242}	N_32_MON {p. 7002}
NC_CRK_INJ_BAS_REF {p. 626}	NC_CRK_INJ_REF_TDC {p. 626}	NC_CYL_NR {p. 1526}	PREV_STATE_IV {p. 2039}
SOI_1_MES [NC_CYL_NR] {p. 2039}	SOI_2_MES [NC_CYL_NR] {p. 2039}	SOI_POST_MES [NC_CYL_NR] {p. 2039}	TI_1_MES [NC_CYL_NR] {p. 2040}
TI_1_MON [NC_CYL_NR] {p. 6793}	TI_2_MES [NC_CYL_NR] {p. 2040}	TI_2_MON [NC_CYL_NR] {p. 6793}	TI_CAST {p. 2100}
TI_POST_MES [NC_CYL_NR] {p. 2041}	TI_POST_MON [NC_CYL_NR] {p. 6793}	TI_TUN_ADD_IV [NC_CYL_NR] {p. 2233}	TI_TUN_IV [NC_CYL_NR] {p. 2233}
TI_WUP {p. 2109}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_THD_FUP_DLY_1_MON	-	0... FFH	0... 8160	32	rpm
engine speed threshold for delay of FUP					
C_N_THD_FUP_DLY_2_MON	-	0... FFH	0... 8160	32	rpm
engine speed threshold for delay of FUP					
C_THD_GRD_TI_IDX_MON	-	8000... 7FFFH	-32.768 ...32.767	0.001	ms
gradient limit for stable dynamic conditions					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_THD_MFF_AD_ADD_MAX_MON	-	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
Threshold for offset from Lambda adaptation					
C_THD_MFF_AD_FAC_MAX_MON	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Threshold for offset from Lambda adaptation					
C_THD_MIN_CHA_IV_MON	-	0... 3FFFH	0... 2272.6968	2.2216	μAs
Threshold for minimal injector charge					
C_THD_MIN_N_IDX_MON	-	0... FFFH	0... 8160	32	rpm
engine speed threshold for index plausibilisation					
C_THD_MIN_TI_MES_MON	-	0... FFFFH	0... 65.535	0.001	ms
boundary for minimal injector opening					
C_THD_NR_CTR_IDX_MON	-	0... FFFH	0... 255	1	-
threshold for maximal transient jitter					
C_THD_SOI_POST_MON	-	FC40... 3C0H	-360 ...360	0.375	°CRK
Threshold for torque participation of post pulse					
C_TI_MES_OFS_MON	-	8000... 7FFFH	-32.768 ...32.767	0.001	ms
Injection time offset for low needle lift pulses that exceed special timing parameter calculation.					
IP_FAC_TI_PRS_CYL_L_MON	-	0... FFFFH	0... 15.99975	244.1e-6	-
LDPM_PRS_IP_FAC_TI_PRS_CYL_MON	12	0... FFFFH	0... 347776	5.3067216	hPa
correction of counter pressure on low needle lift					
IP_FAC_TI_PRS_CYL_MON	-	0... FFFFH	0... 15.99975	244.1e-6	-
LDPM_PRS_IP_FAC_TI_PRS_CYL_MON	12	0... FFFFH	0... 347776	5.3067216	hPa
correction of counter pressure on needle lift					
IP_MFF_TI_PRS_EGY_H_MON	V	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_TI_IP_MFF_EGY_H_MON	18	0... FFFFH	0... 65.535	0.001	ms
LDPM_PRS_DEC_INJ_MON	12	0... FFFFH	0... 347776	5.3067216	hPa
injector characteristic at high energy level					
IP_MFF_TI_PRS_EGY_L_MON	V	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_TI_IP_MFF_EGY_L_MON	18	0... FFFFH	0... 65.535	0.001	ms
LDPM_PRS_DEC_INJ_MON	12	0... FFFFH	0... 347776	5.3067216	hPa
injector characteristic at low energy level					
IP_PRS_INC_CMP_MON	V	0... FFFFH	0... 31.99951	488.299e-6	-
LDP_EOI_IP_PRS_INC_CMP_MON	12	0... 780H	0... 720	0.375	°CRK
LDP_CRK_INJ_IP_PRS_INC_CMP_MON	16	0... 780H	0... 720	0.375	°CRK
influence of the varying pressure increase inside the cylinder					
IP_THD_IDX_TI_MES_MON	-	0... FFFFH	0... 65.535	0.001	ms
LDP_TI_MES_IP_THD_IDX_MON	6	0... FFFFH	0... 65.535	0.001	ms
treshold for deviation between TI_MES and TI_IDX					
IP_TI_H_MON	-	0... FFFFH	0... 65.535	0.001	ms
LDP_IDX_TI_1_INJR_MON	8	0... FFFFH	0... 65535	1	-
Injection time for high injector needle lift.					
IP_TI_L_MON	-	0... FFFFH	0... 65.535	0.001	ms
LDP_IDX_TI_2_INJR_MON	8	0... FFFFH	0... 65535	1	-
Injection time for low injector needle lift.					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_IV_POST_EGY_RNG_MON	-	0... 1H	0 ...1	1	-
Logical constant for high or low energy post pulse					
LC_THD_SOI_POST_MON	-	0... 1H	0 ...1	1	-
Selection of the reference angle for post pulse recognition					

### Import actions:

ACTION_ECM3_Service15TaskPfm (IN<No Name available>)
ACTION_ECM3_Service16TaskPfm (IN<No Name available>)
ACTION_ECM3_Service17TaskPfm (IN<No Name available>)

## E.2.1 ECM2\_DTSYSMFFAC

This specification has to be coded according to the following method description: "M730204: Coding rules for process monitoring SW - ECM2.

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 1.

ACTION_ECM3_McChkStack()
--------------------------

Note: These actions are defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION\_ECM3\_Service15TaskPfm() and ACTION\_ECM3\_Service16TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN <>, IN <>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)


Note: These actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode "O" and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

### General information:

The ETC safety concept uses the mass-fuel-flow signal as a basis for the generation of a actual indicated engine torque. Therefore not the complete injection is seen as torque relevant. The post- pulse especially becomes weighted with a factor, which depends on its phasing. The sum of first, second and the weighted post- pulse (MFF\_TQ\_MON) is input for the determination of the actual engine torque. The un-weighted sum of all pulses (MFF\_LAMB\_MON) becomes corrected by elimination of all enrichments (e.g. WUP, CAST, etc.) with the aim to create a Lambda signal, which is comparable against the reference Lambda (see also 'Actual lambda deviation').

### Description:

The fuel mass flow is determined by a summation of all injection pulses for every cylinder with an arithmetic mean- value calculation afterwards. From I/O- Software the feedback- signal for the opening duration of the injectors (TI\_X\_MES) is supplied to the monitoring level as well as the the charge CHA\_IV\_X\_MES. The energy which was put into the injector's piezo- stack is taken as representative for the

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needle lift. After correction of these signals to standard conditions, a characteristic curve for a dedicated energy level, delivers the correspondence between injection time and mass-fuel-flow.

Hint!! Application Conditions - Initialisation: for condition see 'Application incidences of process monitoring'

### Application Condition

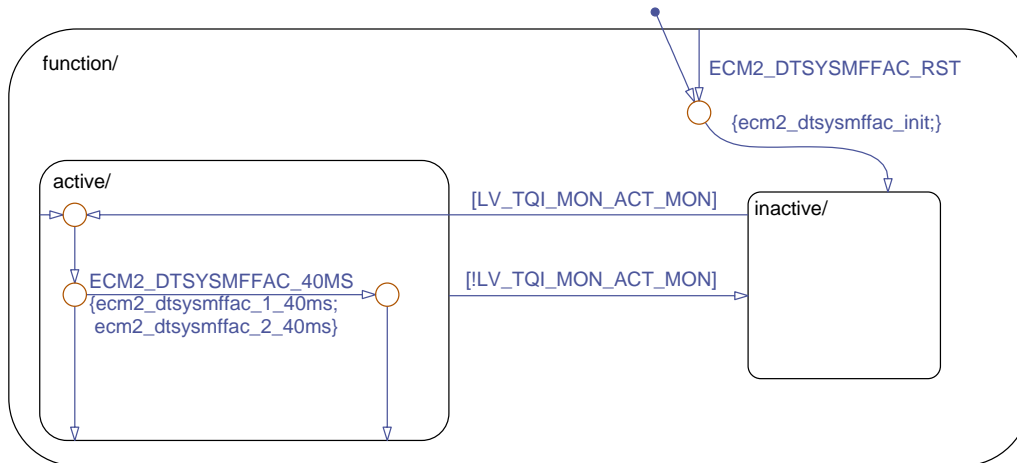
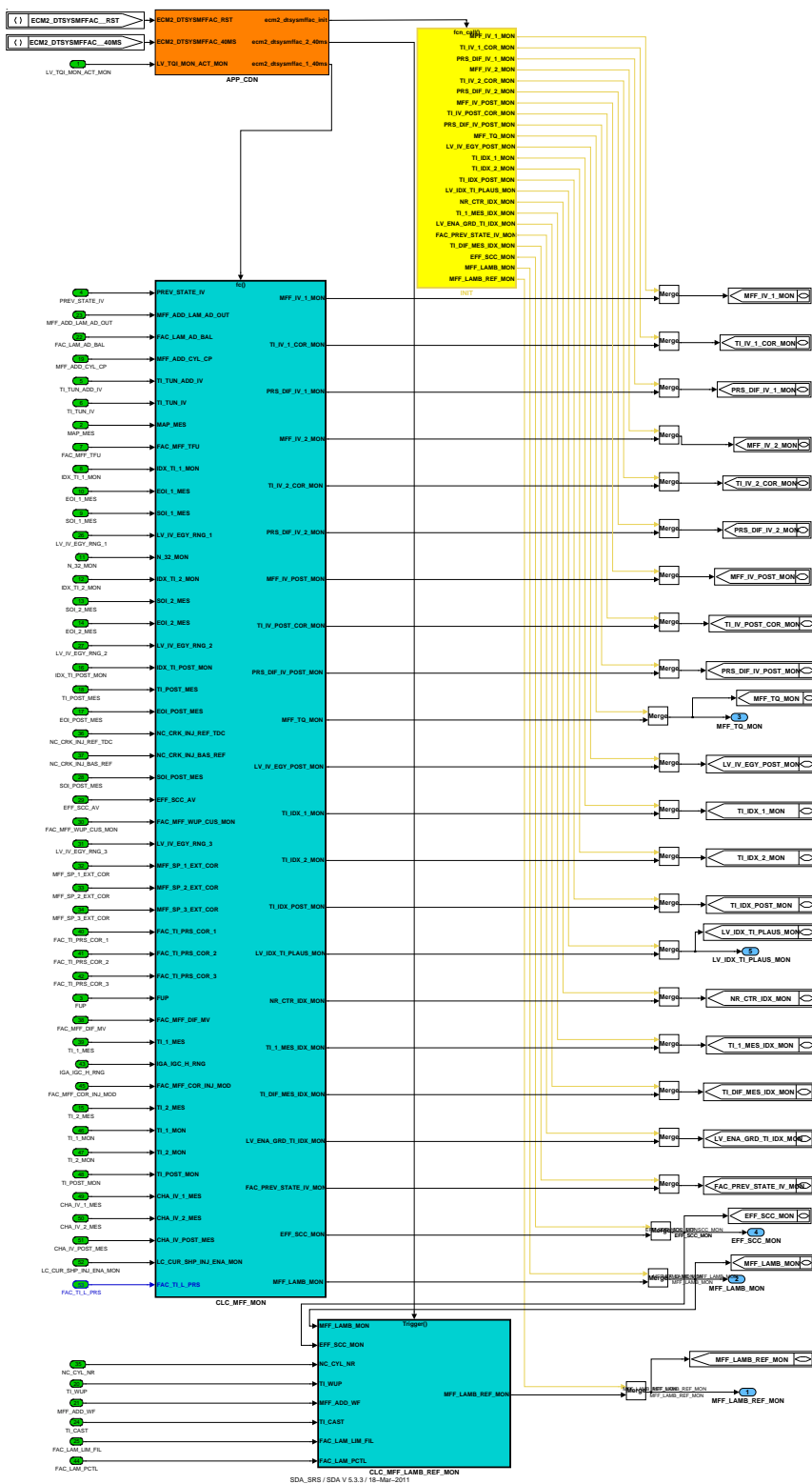


Figure E.2.1: ECM2\_DTSYSMFFAC/APP\_CDN/Chart1

### Function Description



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Figure E.2.2: ECM2\_DTSYSMFFAC

### E.2.1.1 SUBFUNCTION: INIT

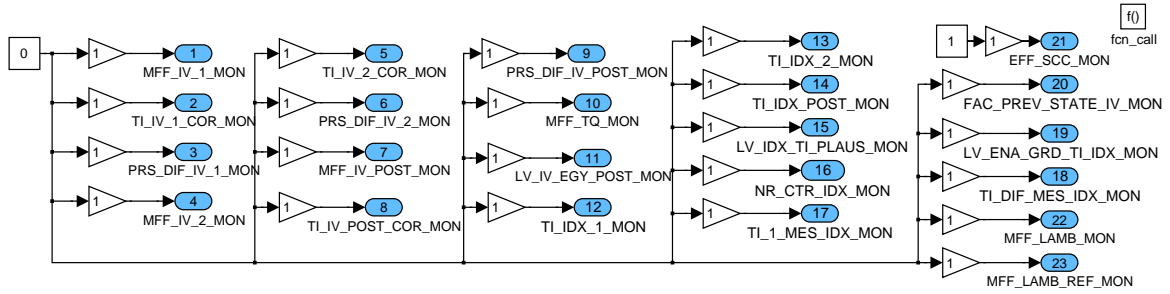


Figure E.2.3: ECM2\_DTSYSMFFAC/INIT

### E.2.1.2 SUBFUNCTION: CLC\_MFF\_LAMB\_REF\_MON

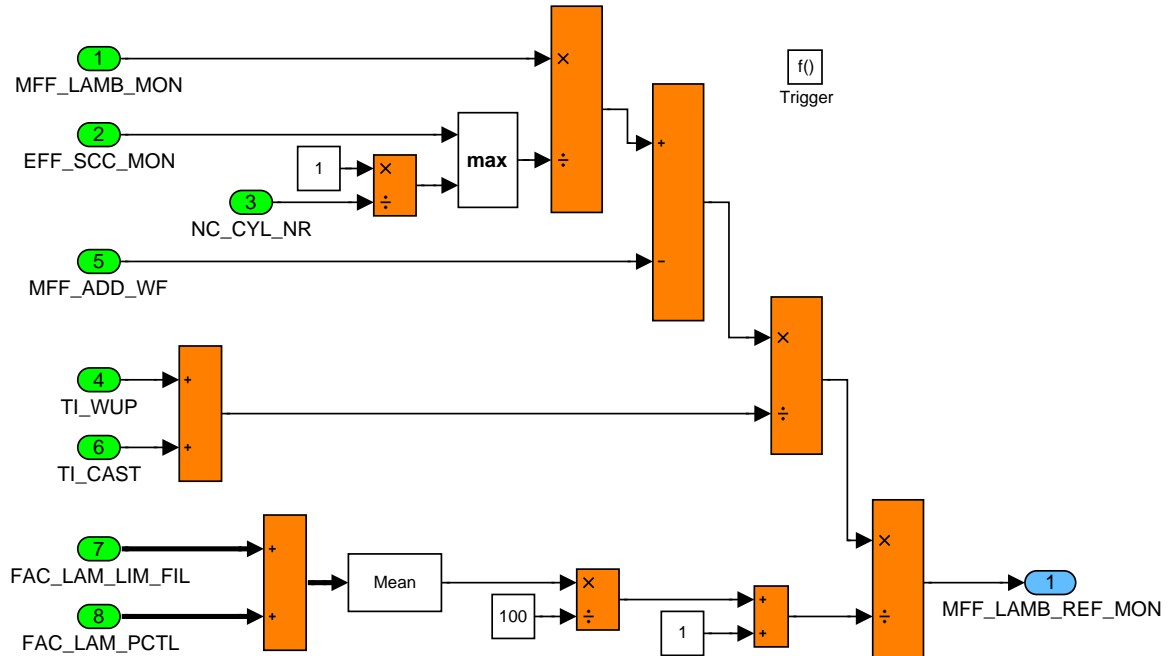
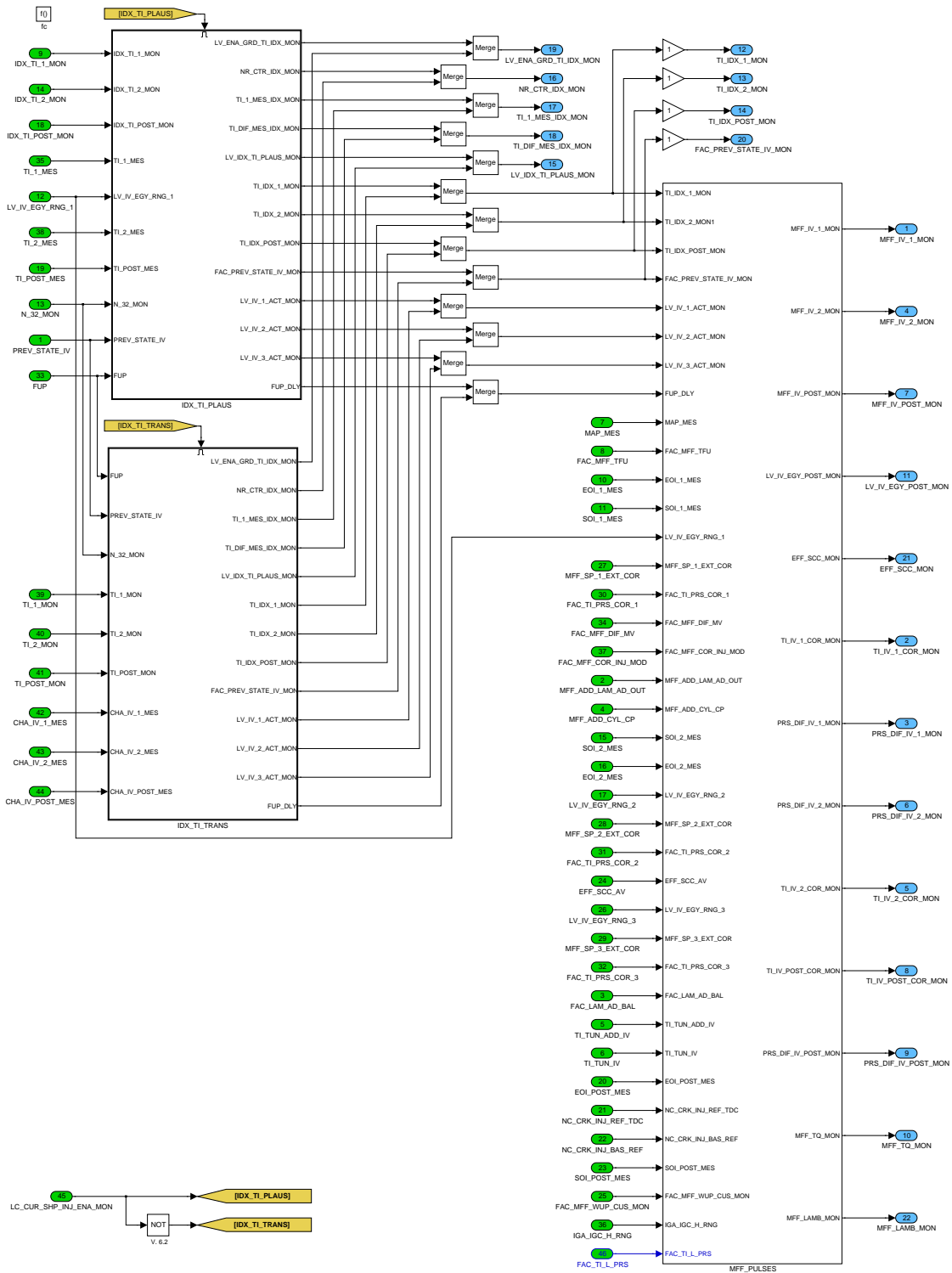


Figure E.2.4: ECM2\_DTSYSMFFAC/CLC\_MFF\_LAMB\_REF\_MON

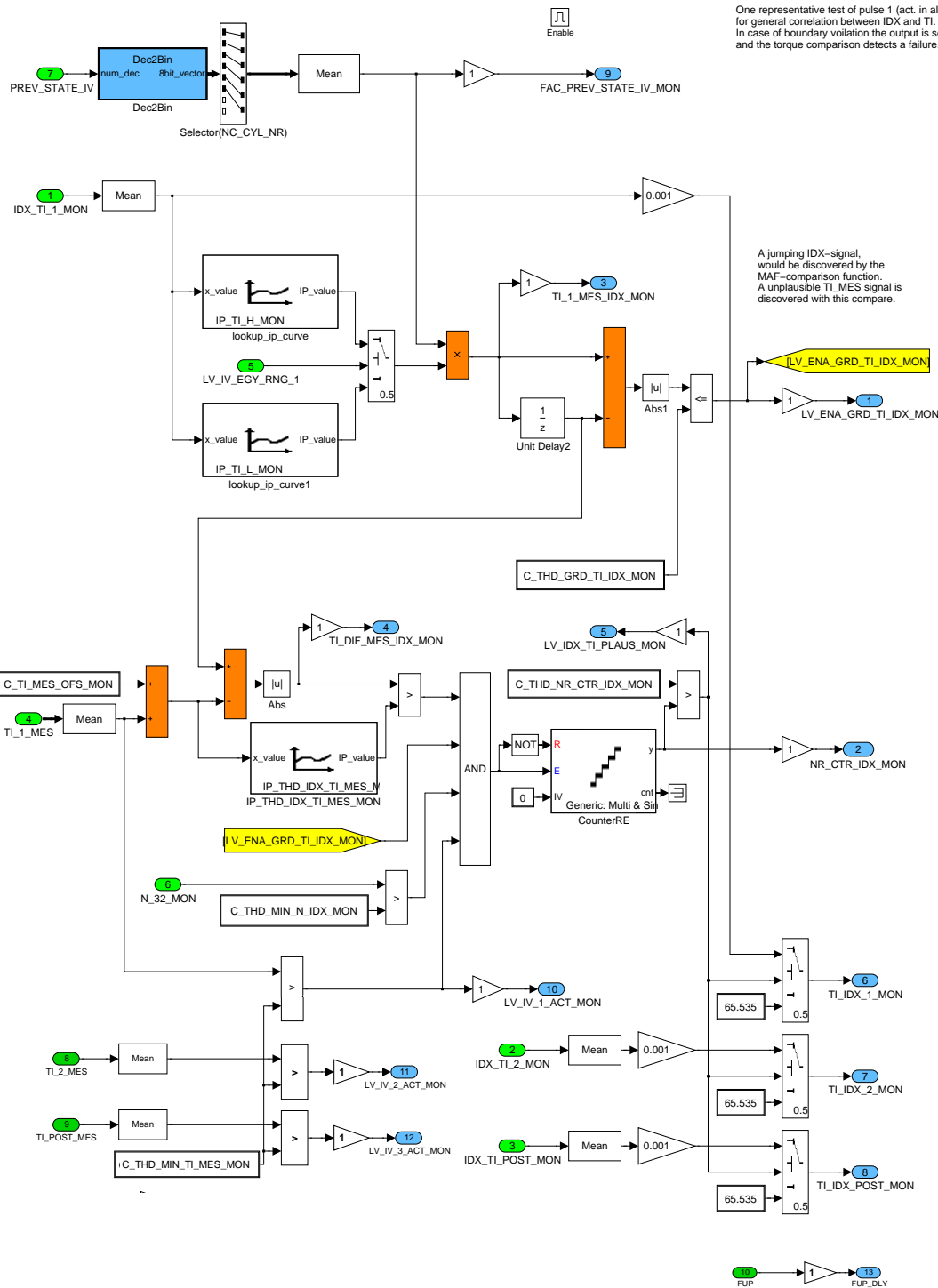
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### E.2.1.3 SUBFUNCTION: CLC\_MFF\_MON



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Figure E.2.5: ECM2\_DTSYSMFFAC/CLC\_MFF\_MON

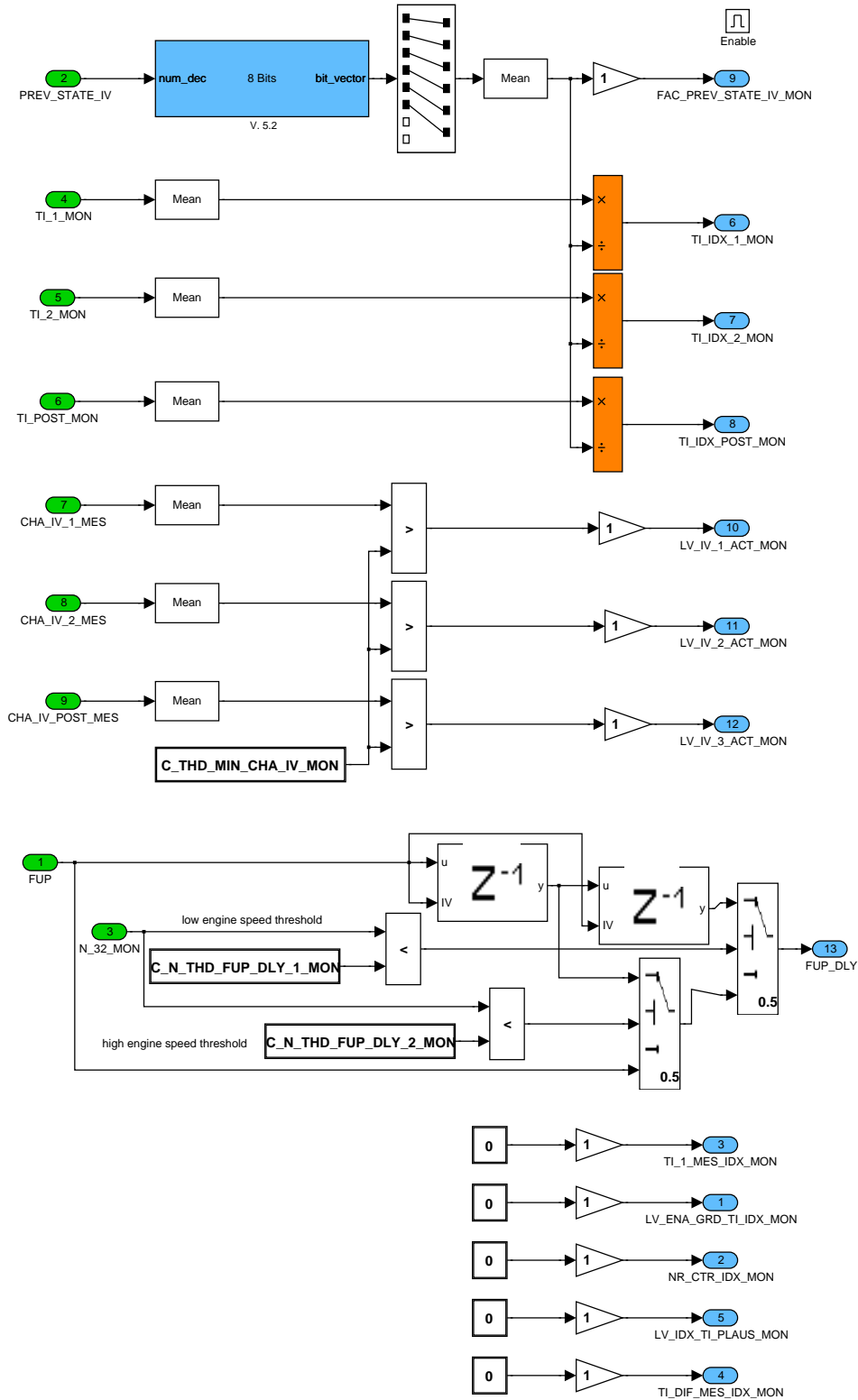


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Figure E.2.6: ECM2\_DTSYSMFFAC/CLC\_MFF\_MON/IDX\_TI\_PLAUS

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Figure 7 ECM2\_DTSYSMFFAC/ CLC\_MFF\_MON/ IDX\_TI\_TRANS

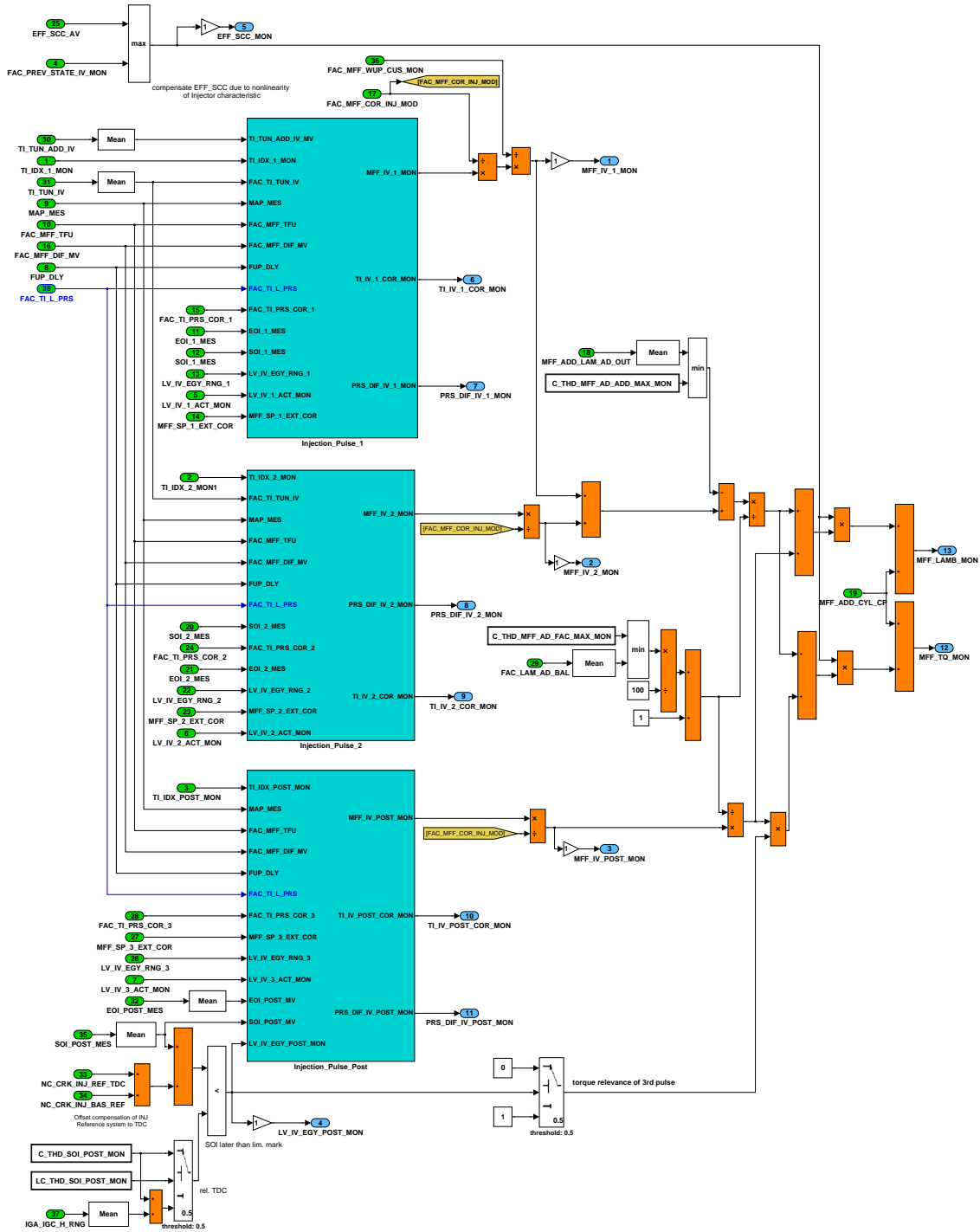


Figure E.2.7: ECM2\_DTSYSMFFAC/CLC\_MFF\_MON/MFF\_PULSES

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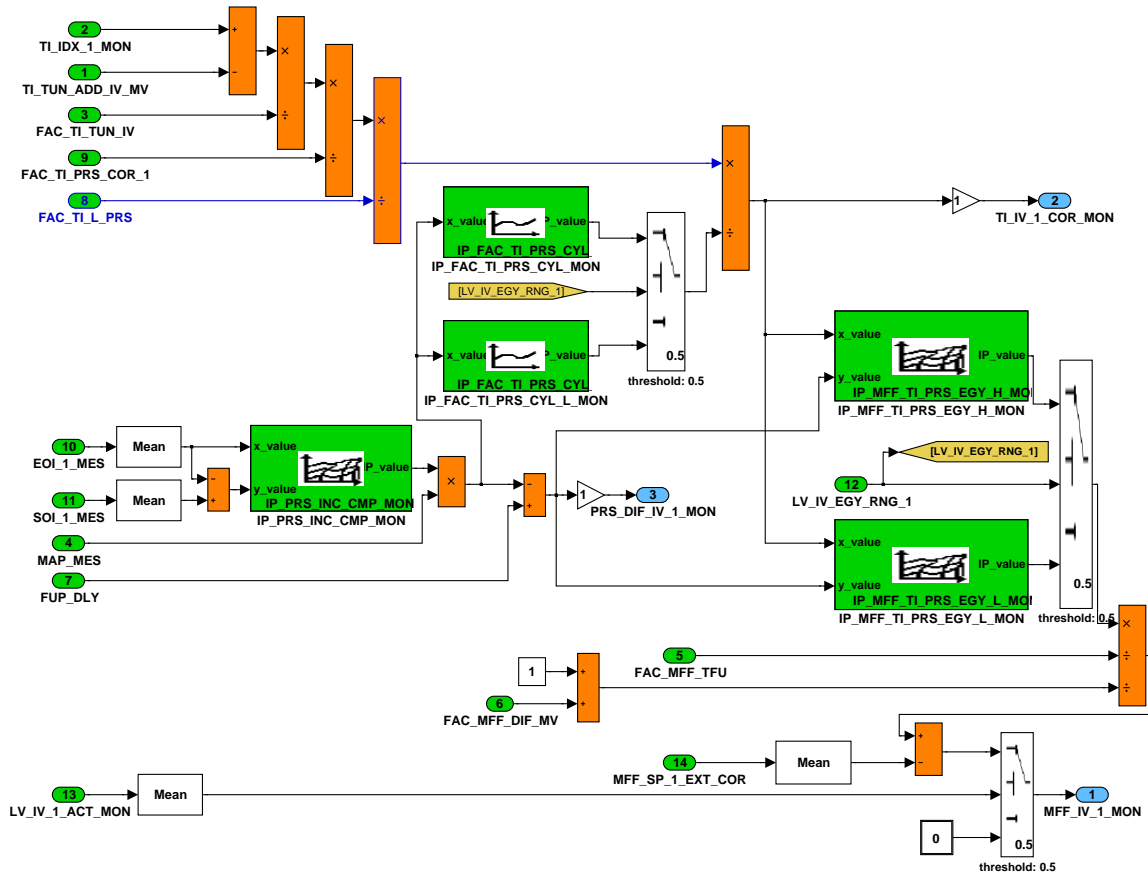


Figure E.2.8: ECM2\_DTSYSMFFAC/CLC\_MFF\_MON/MFF\_PULSES/Injection\_Pulse\_1

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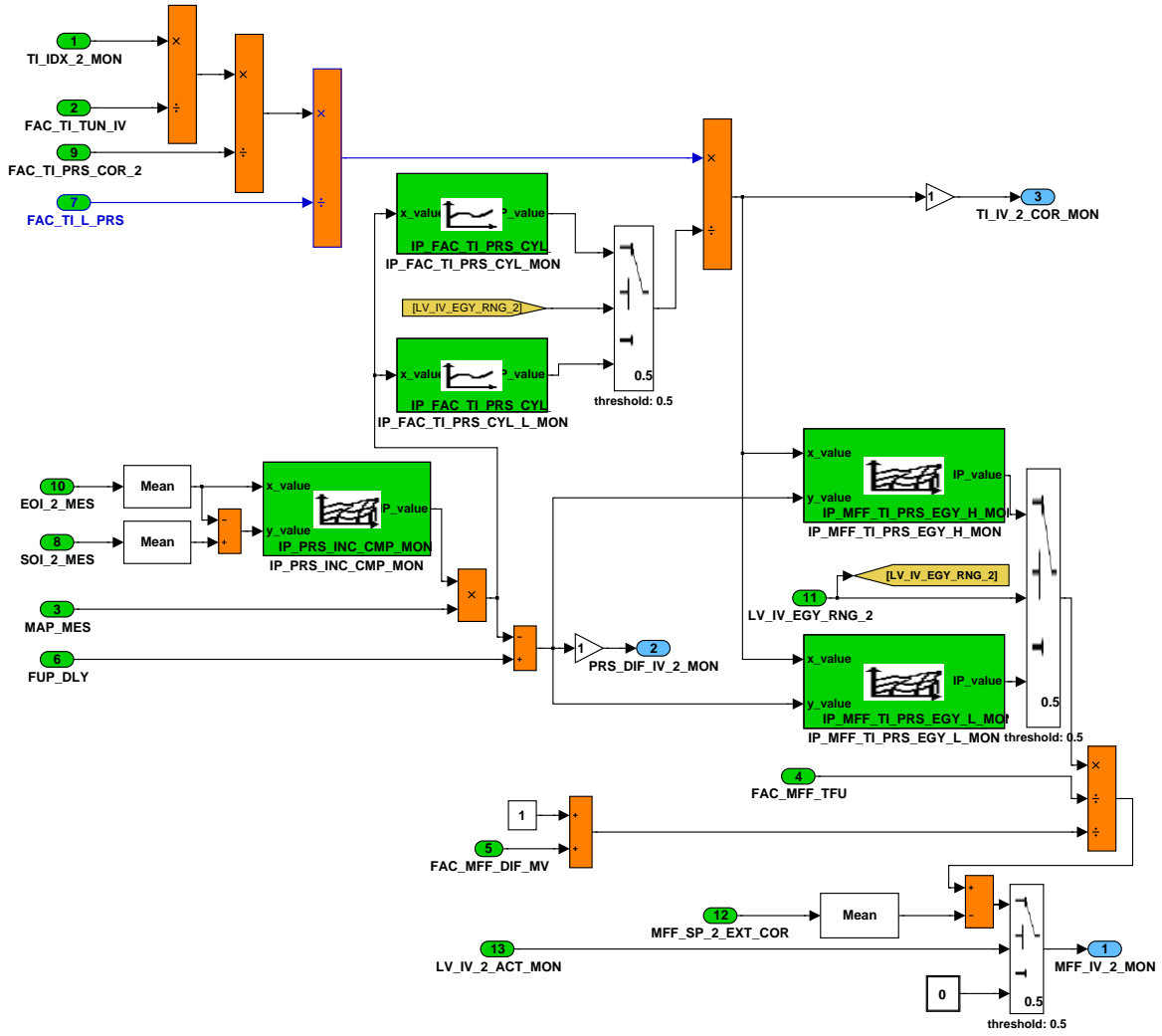


Figure E.2.9: ECM2\_DTSYSMFFAC/CLC\_MFF\_MON/MFF\_PULSES/Injection\_Pulse\_2

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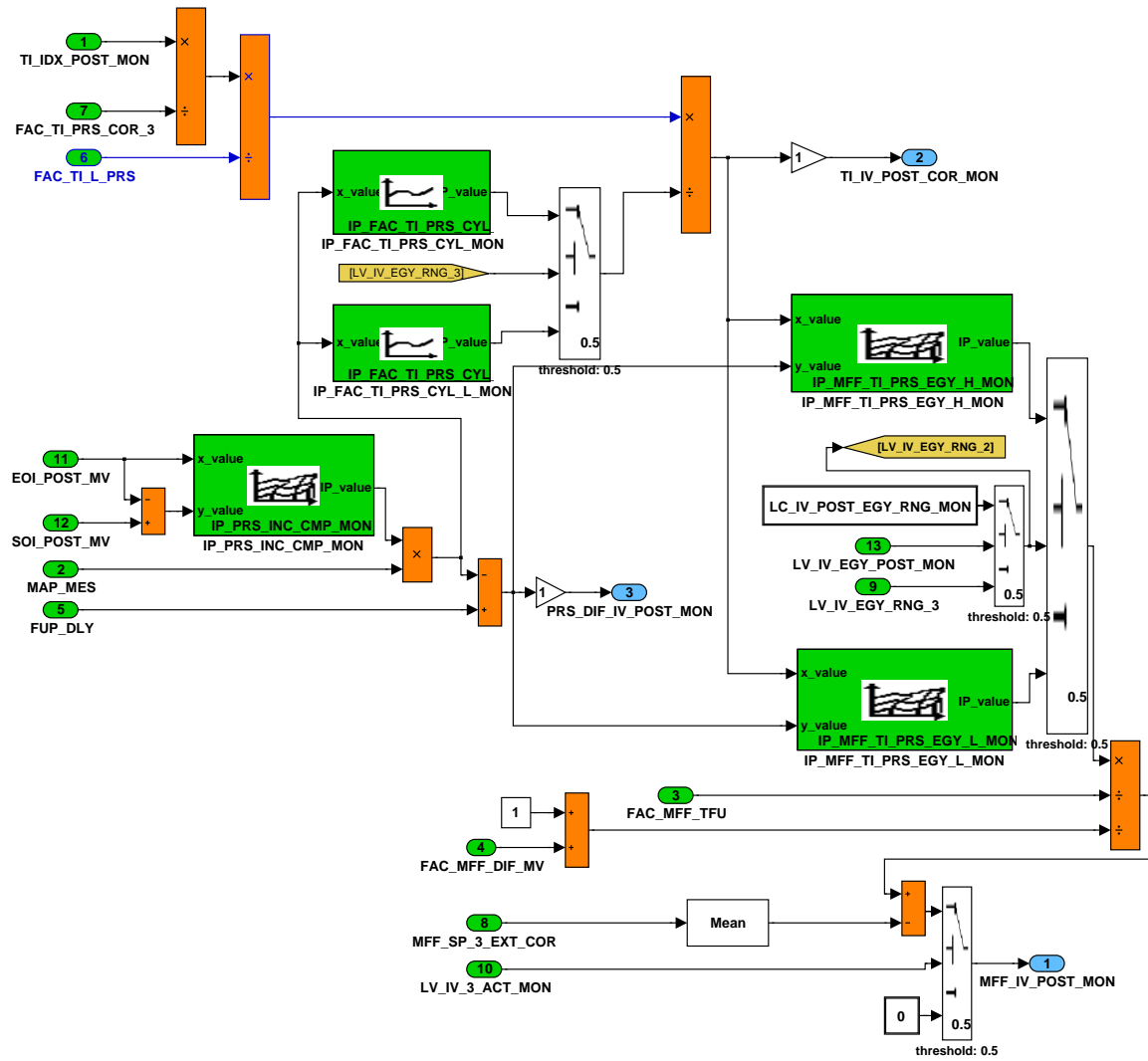


Figure E.2.10: ECM2\_DTSYSMFFAC/CLC\_MFF\_MON/MFF\_PULSES/Injection\_Pulse\_Post

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## E.3 Actual indicated engine torque

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQI_AV_MON	O/V	0... FFH	0... 510	2	Nm
Actual indicated engine torque (process monitoring)					

### Input data:

EFF_MFF_TQ_COR_MON {p. 6789}	EFF_TOT_MON {p. 6753}	LV_TQI_MON_ACT_MON {p. 6791}	MFF_TQ_MON {p. 6760}
N_32_MON {p. 7002}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TQI_CUS_MON	V	0... FFH	0... 510	2	Nm
LDP_N_32_MON_IP_TQI_CUS_MON	6	0... FFH	0... 8160	32	rpm
LDP_MFF_MON_IP_TQI_CUS_MON	8	0... FFFFH	0... 1389	0.02119478	mg/stk
Customer specific engine torque (process monitoring)					

### Import actions:

<b>ACTION_ECM3_ChkCpl</b> (IN<PRM_VAR>,IN<PRM_VAR_CPL>)
<b>ACTION_ECM3_McChkStack</b> ()
<b>ACTION_ECM3_ReadChkCpl</b> (OUT<PRM_RESULT>,IN<PRM_VAR>,IN<PRM_VAR_CPL>)
<b>ACTION_ECM3_Service3TaskPfm</b> (IN<PRM_K>)
<b>ACTION_ECM3_Service4TaskPfm</b> (IN<PRM_K>)
<b>ACTION_ECM3_Service5TaskPfm</b> (IN<PRM_K>)
<b>ACTION_ECM3_WriteChkCpl</b> (INOUT<PRM_VAR>,OUT<PRM_VAR_CPL>,IN<PRM_VALUE>)

### General information

ACTION_ECM3_Service3TaskPfm(IN<>)
ACTION_ECM3_Service4TaskPfm(IN<>)
ACTION_ECM3_Service5TaskPfm(IN<>)

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 4.

ACTION_ECM3_McChkStack()
--------------------------

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION\_ECM3\_Service3TaskPfm() and ACTION\_ECM3\_Service4TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN <>, IN <>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

Note: These actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode "O" and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test. This module calculates the actual indicated engine torque TQI\_AV\_MON. The map represents a simplified versions of the original map of the corresponding functions in the control level.

**Application conditions:**

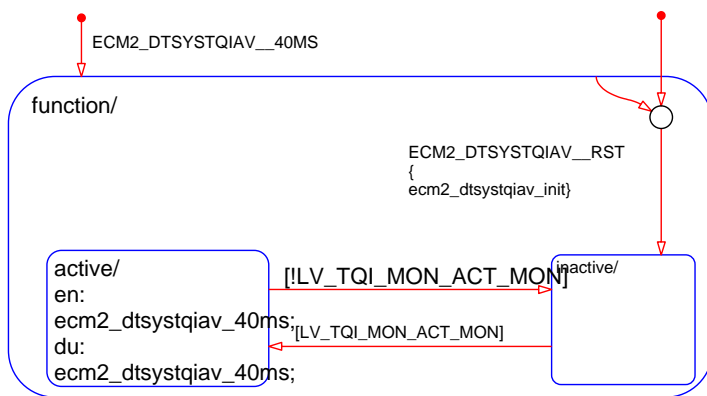


Figure E.3.1: ECM2\_DTSYSTQIAV/APP\_CDN/Chart

**Function description:**

**Signal flow diagram:**

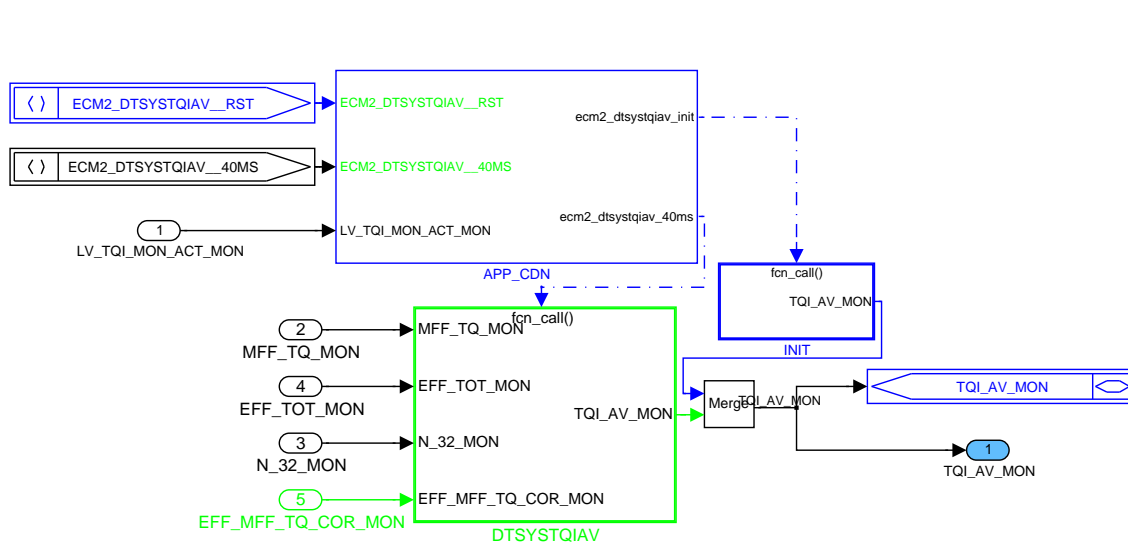


Figure E.3.2: ECM2\_DTSYSTQIAV

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**Formula section:**

**E.3.1 INIT**

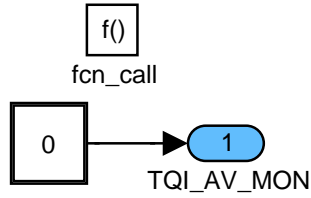


Figure E.3.3: ECM2\_DTSYSTQIAV/INIT

**E.3.2 DTSYSTQIAV**

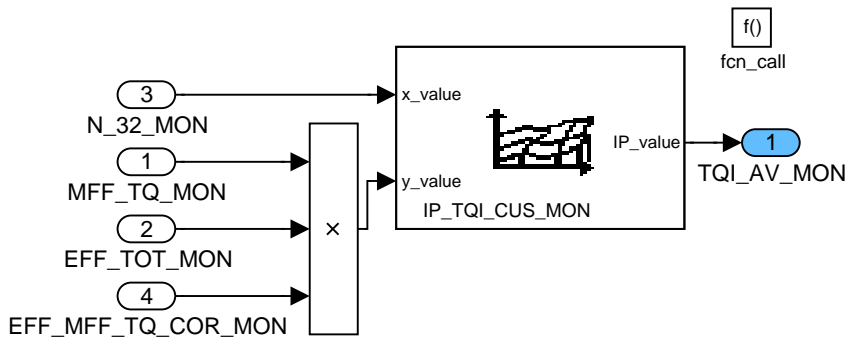


Figure E.3.4: ECM2\_DTSYSTQIAV/DTSYSTQIAV

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## E.4 Actual lambda deviation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_DIF_MON	O/V	8000... 7FFFH	-32... 31.99902	976.599e-6	-
Deviation between actual and modeled Lambda					
LAMB_DLY_MON	V	0... 7FFFH	0... 31.99902	976.599e-6	-
delayed LAMB_MON signal					
LAMB_MDL_MON	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
modeled lambda					
LAMB_MDL_REF_MON	V	0... 7FFFH	0... 31.99902	976.599e-6	-
Modeled lambda at reference conditions					
LAMB_MON	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Modeled Lambda					
MAF_DLY_MON	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Phase shifted MAF signal					
MAF_MON	O/V	0... FFH	0... 1389	5.4470588	mg/stk
Mass air flow signal used monitoring level					
MFF_TI_MON	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass flow, derived from fuel path					

### Input data:

EFF_SCC_MON {p. 6760}	FAC_COR_MFF_EXT_ADJ [NC_CYL_NR] {p. 798}	FAC_COR_MFF_EXT_ADJ_NVMY [NC_CYL_NR] {p. 798}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}
LV_FAC_COR_MFF_EXT_ADJ {p. 803}	LV_LAMB_LS_UP_VLD_MON [NC_CBK_EX_NR] {p. 6790}	LV_TQI_MON_ACT_MON {p. 6791}	MAF {p. 8277}
MAF_EGR_NEUT_GAS {p. 8278}	MAF_SCAV_EXT {p. 8278}	MFF_LAMB_MON {p. 6760}	MFF_LAMB_REF_MON {p. 6760}
OPM_AV_MON {p. 6792}	T_DLY_SOI_LSL_POS [NC_CBK_EX_NR] {p. 2464}	T_SEG_SW_MON {p. 7002}	T1_LSL_UP_OPT [NC_CBK_EX_NR] {p. 2464}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DIF_LS_UP_LAMB_MON	-	8000... 7FFFH	-32... 31.99902	976.599e-6	-
offset added on LAMB_MON					
C_FAC_MFF_MAF_MON	-	0... FFFFH	0... 15.99975	244.1e-6	-
Stoichiometric Constant for Lambda calculation					
C_FAC_T_SEG_MON	-	0... FFH	0... 15.9375	0.0625	-
Factor for multiple segment delay					
C_FAC_T1_LSL_UP_MON	-	0... 7FFFH	0... 31.99902	976.599e-6	-
adaptation factor for first order time lag of sensor					
C_LAMB_REF_MON	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Adjustable lambda reference					
C_T_INJ_REAC_HOM_MON	-	0... FFH	0... 10.2	0.04	s
maximal delay after reactivation at HOM					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_INJ_REAC_MON	-	0... FFH	0... 10.2	0.04	s
maximal delay after reactivation from PUC					
C_T_MIN_PUC_MON	-	0... FFH	0... 10.2	0.04	s
Time for minimal PUC duration					
C_THD_EFF_SCC_MIN_MON	-	0... FFH	0... 1.99218	0.0078125	-
Threshold for minimal pattern efficiency					
C_THD_MAX_LAMB_MON	-	8000... 7FFFH	-32... 31.99902	976.599e-6	-
Maximum treshold for modeled lambda					
C_THD_MAX_LAMB_SENS_MON	-	8000... 7FFFH	-32... 31.99902	976.599e-6	-
Maximum treshold for sensor synchronisation					
LC_FAC_COR_MFF_EXT_MON	-	0... 1H	0 ...1	1	-
Switch to disable correction factor for OBD-demo					
LC_LAMB_DLY_INI_MON	-	0... 1H	0 ...1	1	-
Initialisation switch of Pade filter					
LC_PUC_LAMB_MON	-	0... 1H	0 ...1	1	-
enable check of sensor signal during PUC					
LC_T_MIN_PUC_MON	-	0... 1H	0 ...1	1	-
Selector for minimal PUC duration					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_T_SAMPLE_MON	-	0... FFH	0... 255	1	ms
monitoring sample time					

**Import actions:**

<b>ACTION_ECM3_Service15TaskPfm</b> (IN<No Name available>)
<b>ACTION_ECM3_Service16TaskPfm</b> (IN<No Name available>)
<b>ACTION_ECM3_Service17TaskPfm</b> (IN<No Name available>)

**E.4.1 ECM2\_DTSYSLADIF**

This specification has to be coded according to the following method description: "M730204: Coding rules for process monitoring SW ECM2.

**Note:** These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 2.

**ACTION\_ECM3\_McChkStack()**

Note: These actions are defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION\_ECM3\_Service15TaskPfm() and ACTION\_ECM3\_Service16TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN <>, IN <>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

**Note:** These actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

General information:

The objective of this module is the determination of the deviation between the modelled Lambda and the sensor signal during stratified combustion or the deviation between the modelled Lambda and the reference Lambda during homogeneous combustion.


Description:

Homogeneous combustion: The MFF\_LAMB\_MON signal has to be corrected by subtracting all enrichments (e.g. WUP, CAST, etc.) because after modelling the resulting Lambda by using MAF from Level1, a compare against the reference Lambda (normally 1) takes place. For this injection mode no Lambda sensor is necessary then.

Stratified combustion: The MFF\_LAMB\_MON signal has not to be corrected by enrichments, because the sensor signal is used here directly for the plausibility check. Due to physical transport delay of the exhaust gas the modelled Lambda signal has also to be delayed. This is done with a 'PADE Filter'. Further the sensor behaviour itself has to be modelled by using a PT1 Filter. The resulting signal is compared with a mean value of both sensors or with the remaining, if one sensor is defect (in case of 2bank engine).

Hint!! Application Conditions Initialisation: for condition see 'Application incidences of process monitoring'

### Application Condition

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	Document key 10171571 SPE 000 AO	Pages Page 6779 of 8404	
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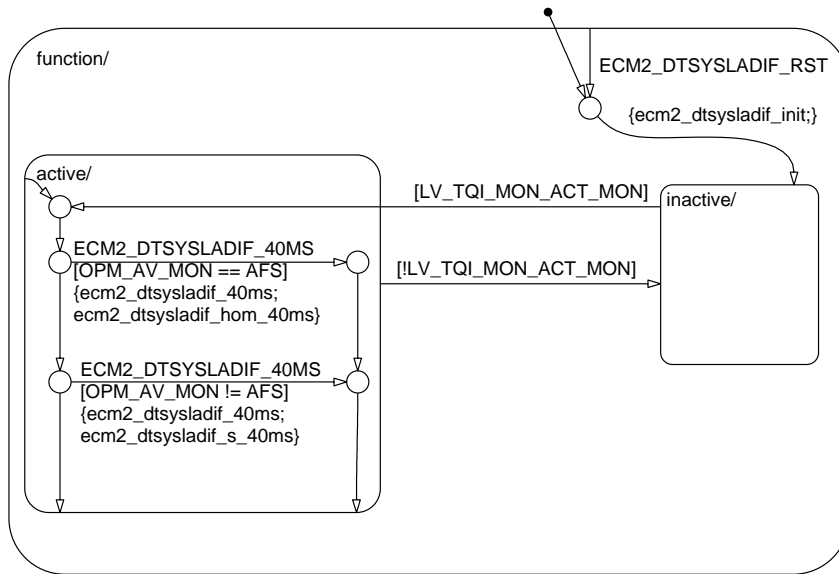



Figure E.4.1: ECM2\_DTSYSLADIF/APP\_CDN/Chart

**Function Description**

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 6780 of 8404</b>	
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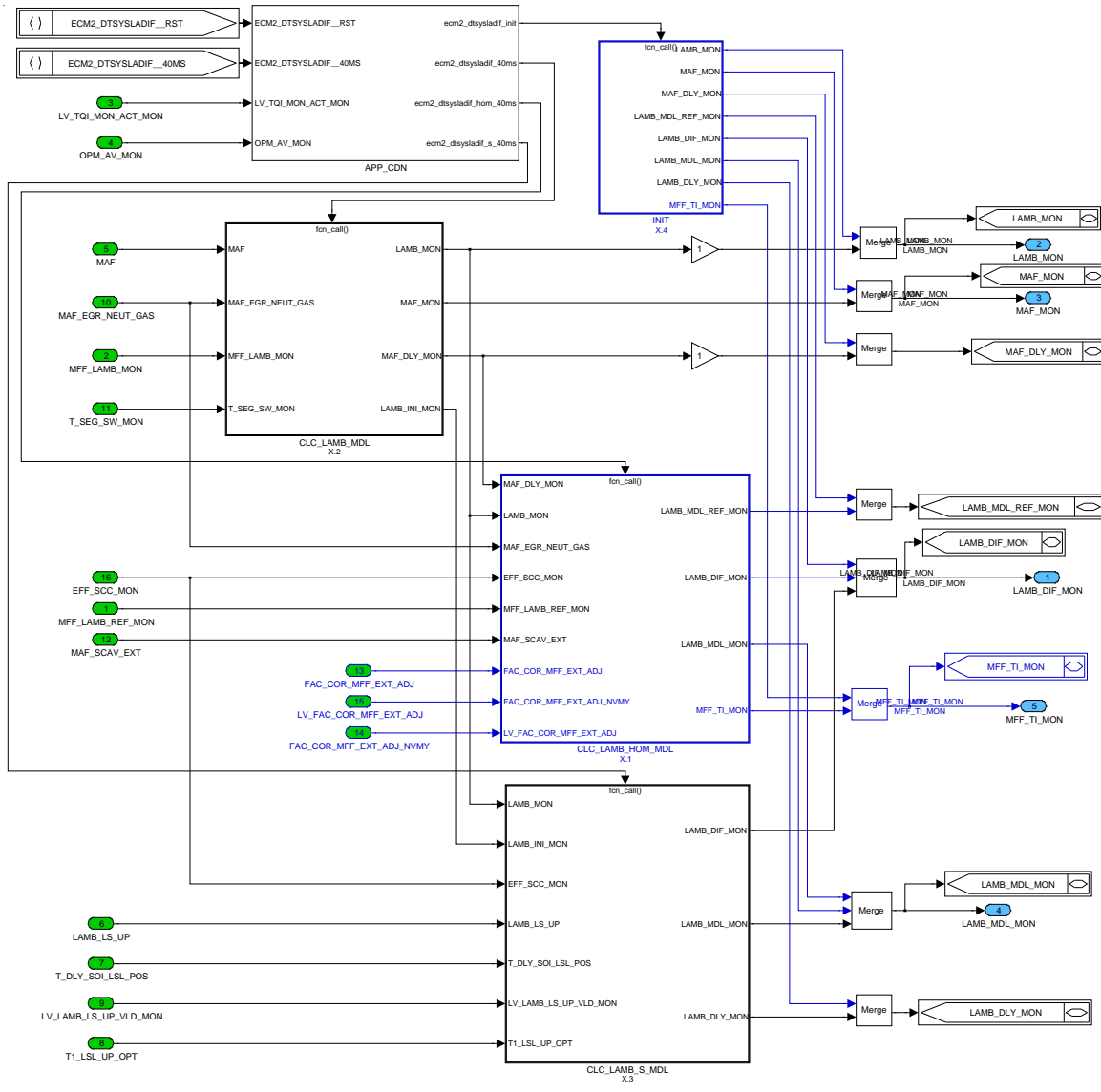


Figure E.4.2: ECM2\_DTSYSLADIF

E.4.1.1 SUBFUNCTION: INIT

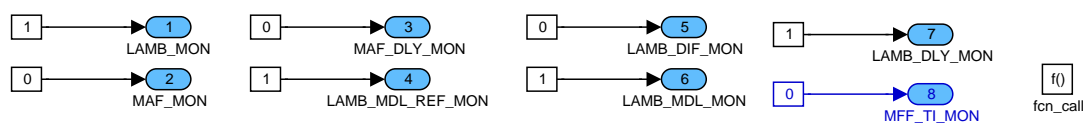


Figure E.4.3: ECM2\_DTSYSLADIF/INIT

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### E.4.1.2 ECM2\_DTSYSLADIF/CLC\_LAMB\_MDL

The Z-Block for the LAMB\_MON delay should be initialized with 1 at every function activation.

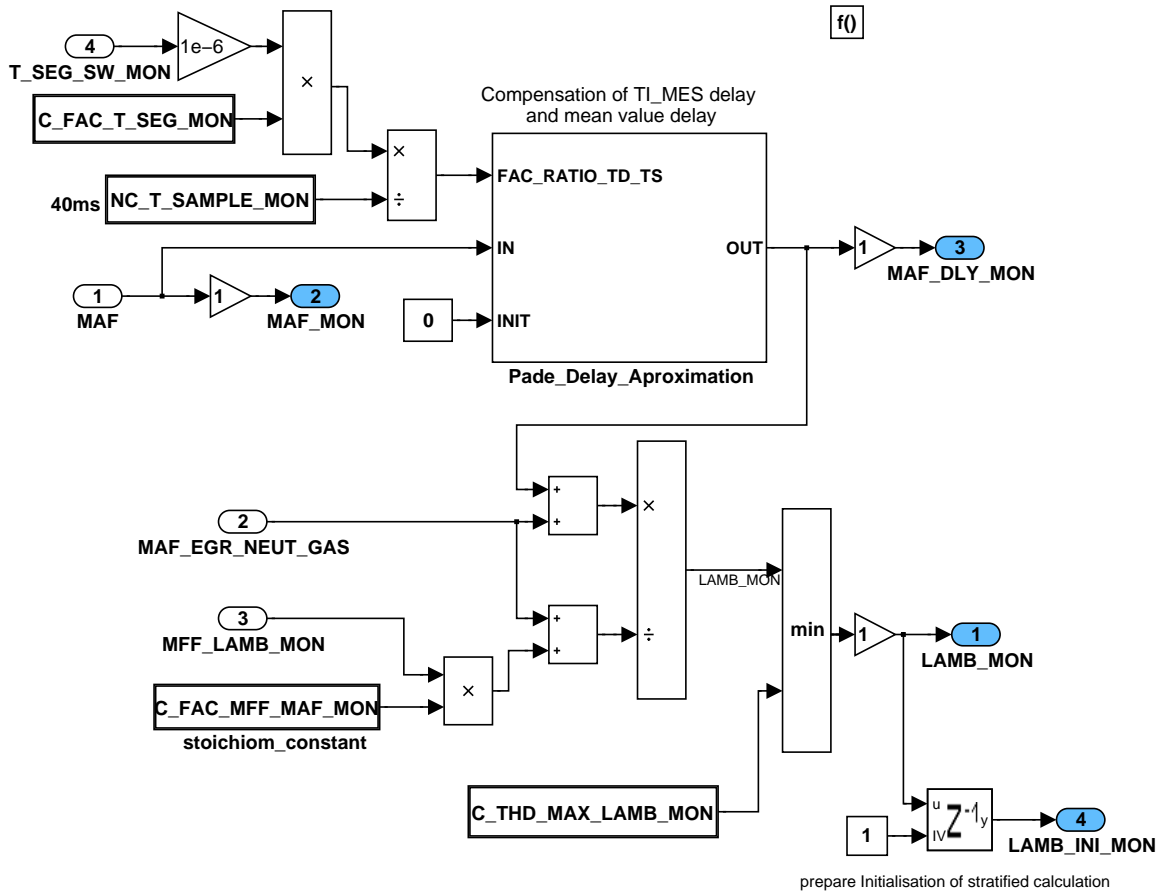


Figure E.4.4: ECM2\_DTSYSLADIF/CLC\_LAMB\_MDL

### E.4.1.3 ECM2\_DTSYSLADIF/CLC\_LAMB\_HOM\_MDL

**Note:** Once at every activation of CLC\_LAMB\_HOM\_MDL the T\_INJ\_REAC\_MON timer should be initialized with C\_T\_INJ\_REAC\_HOM\_MON.

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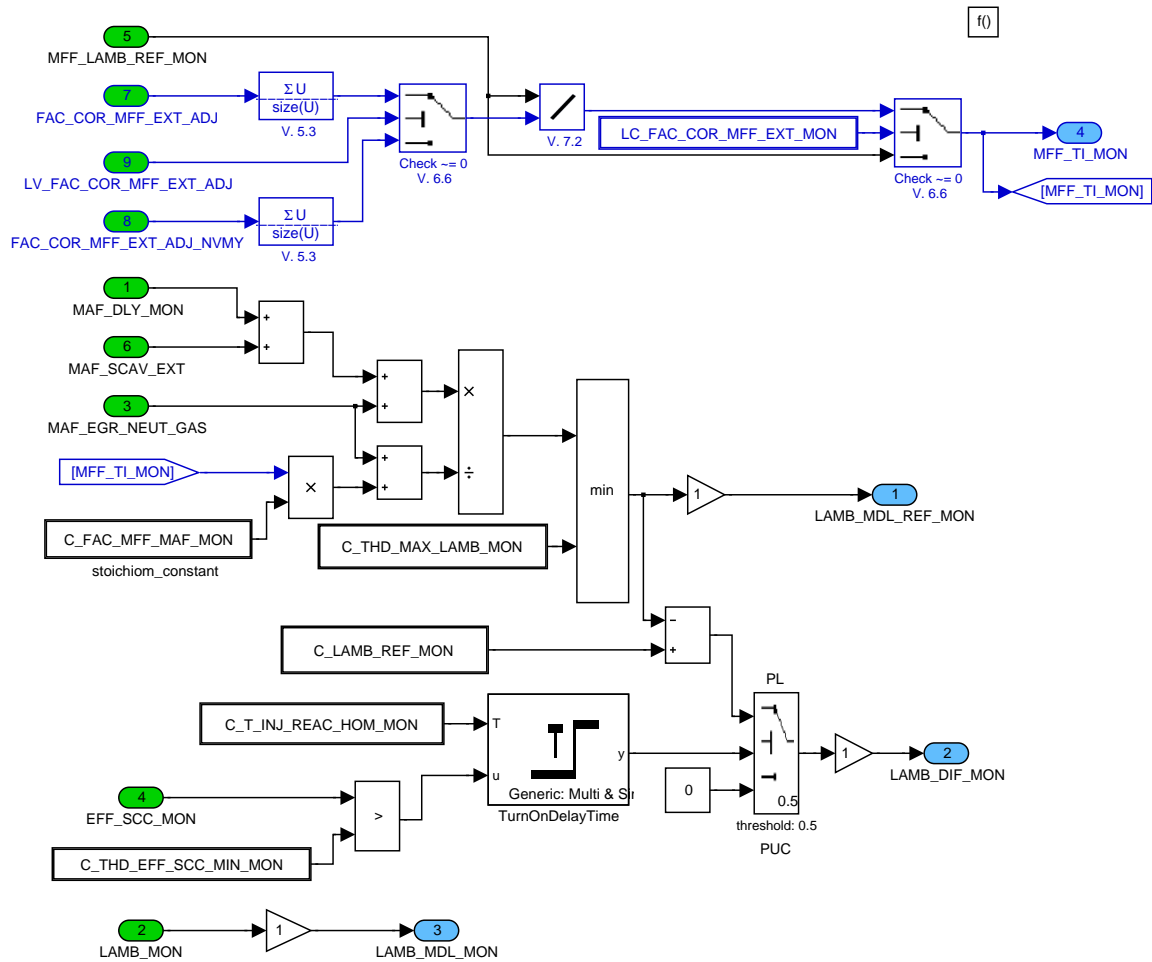


Figure E.4.5: ECM2\_DTSYSLADIF/CLC\_LAMB\_HOM\_MDL

### E.4.1.4 ECM2\_DTSYSLADIF/CLC\_LAMB\_S\_MDL

**Note:** All internal values of the Padefilter and the digital lowpass filter, shall be set to Init value, once at every activation of CLC\_LAMB\_S\_MDL. Also the T\_INJ\_REAC\_MON timer should be initialized with C\_T\_INJ\_REAC\_MON. Also the T\_MIN\_PUC\_MON timer should be set to 0, its output Y to 1. Further the Q output should be set to 1 at this time. The Reset input of the RSFlipFlop should have higher priority than the Set input.

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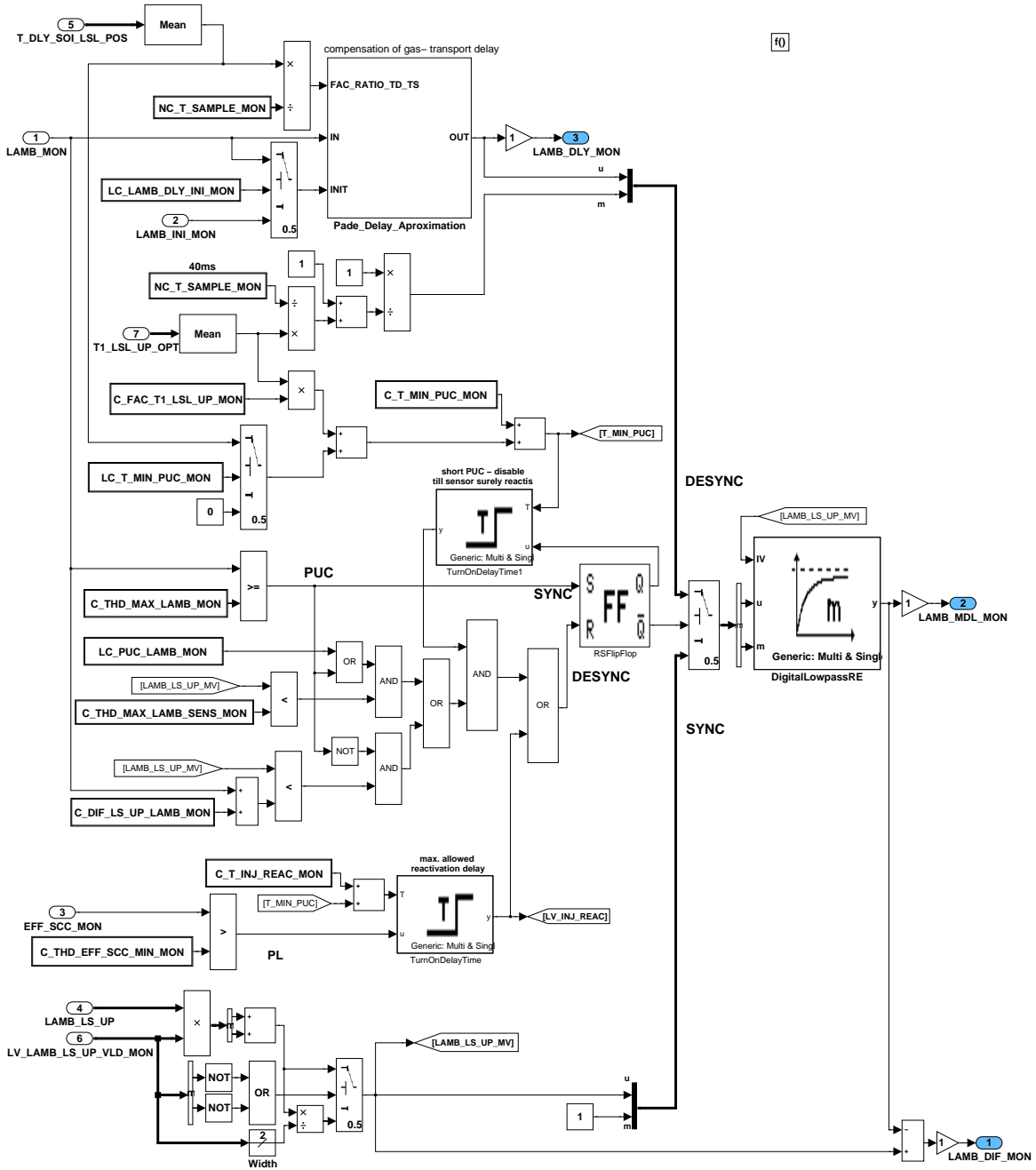


Figure E.4.6: ECM2\_DTSYSLADIF/CLC\_LAMB\_S\_MDL

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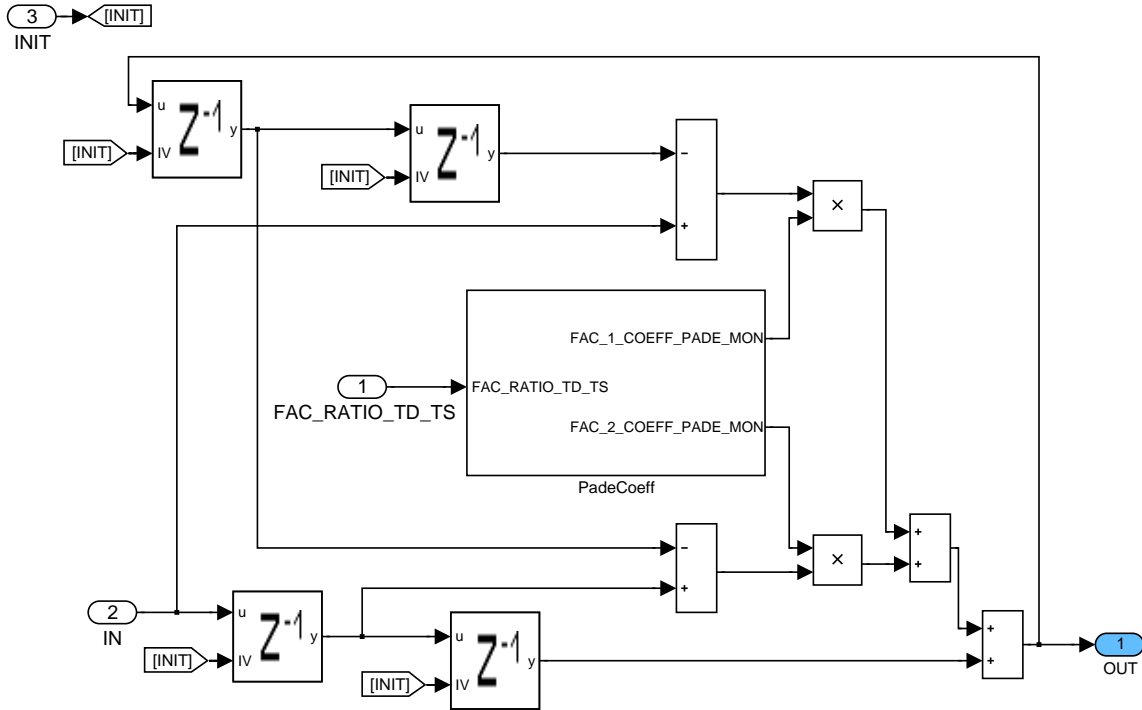


Figure E.4.7: ECM2\_DTSYSLADIF/CLC\_LAMB\_S\_MDL/Pade\_Delay\_Aproximation

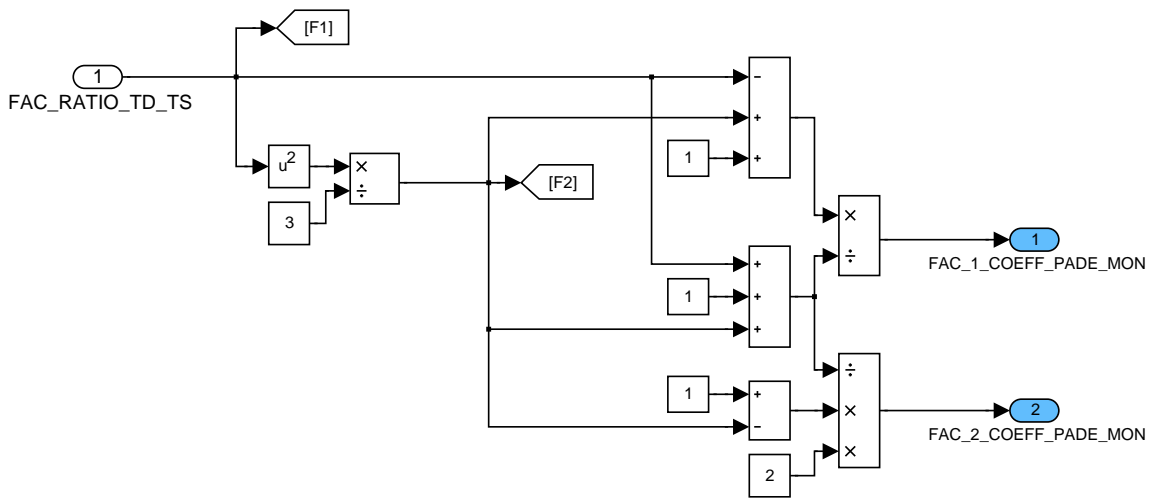


Figure E.4.8: ECM2\_DTSYSLADIF/CLC\_LAMB\_S\_MDL/Pade\_Delay\_Aproximation/PadeCoeff

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## E.5 Combustion mode switch requests

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_SWI_AFS_MON	O/V	0... 1H	0 ...1	1	-
Flag for switching to HOM_AFS due to non-HOM_AFS					

### Input data:

LV_SWI_AFS_LAMB_MON {p. 6791}	LV_SWI_AFS_MFF_MON {p. 6943}	LV_SWI_AFS_POST_INJ_ MON {p. 6791}	LV_SWI_AFS_TQI_MON {p. 6899}
LV_TQI_MON_ACT_MON {p. 6791}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_SWI_AFS_MON	-	0... 1H	0 ...1	1	-
Switch to force engine into AFS mode (process monitoring)					

### Import actions:

ACTION_ECM3_Service15TaskPfm (IN<No Name available>)
ACTION_ECM3_Service16TaskPfm (IN<No Name available>)
ACTION_ECM3_Service17TaskPfm (IN<No Name available>)

### E.5.1 ECM2\_DTSYSCMB

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 4.

ACTION_ECM3_McChkStack()
--------------------------

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION\_ECM3\_Service15TaskPfm() and ACTION\_ECM3\_Service16TaskPfm().


ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
--

ACTION_ECM3_ChkCpl(IN <>, IN <>)
----------------------------------

ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)
--

Note: These actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

### General information:

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This module combines all combustion mode switch requests from level 2 to switch to homogeneous stoichiometric mode in case of faults, which occurred in non HOM\_AFS mode.

### E.5.2 FUNCTION PART: ECM2\_DTSYSCMB

#### Application Condition

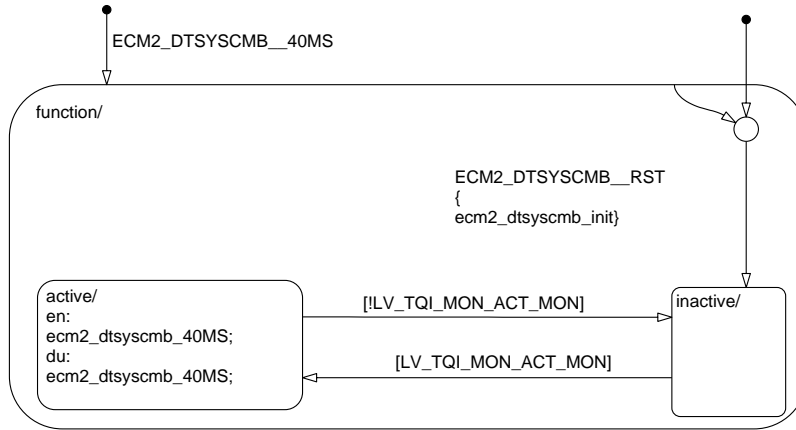


Figure E.5.1: ECM2\_DTSYSCMB/APP\_CDN/CHART

#### Function Description

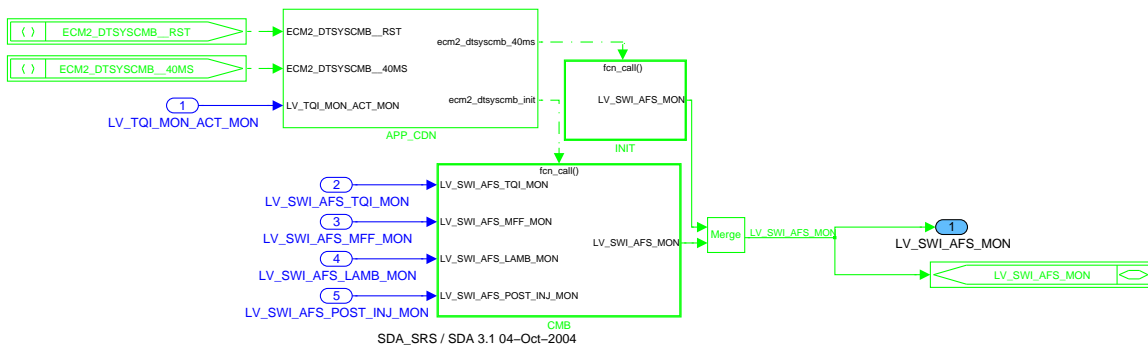


Figure E.5.2: ECM2\_DTSYSCMB

#### E.5.2.1 SUBFUNCTION: INIT

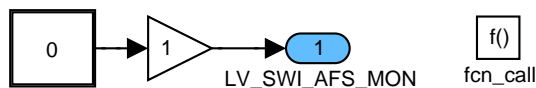


Figure E.5.3: ECM2\_DTSYSCMB/INIT

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### E.5.2.2 SUBFUNCTION: CMB

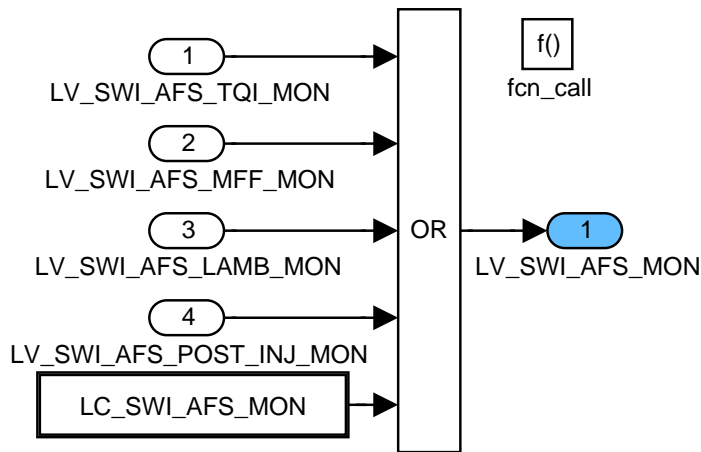



Figure E.5.4: ECM2\_DTSYSCMB/CMB

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## E.6 Configuration of process monitoring (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_SOF_INH_MON	V	0... FFH	0... 255	1	-
error flag sport-mode switch request monitoring					
CTR_N_SP_IS_EXT_REQ_DEC_MON	V	0... FFH	0... 255	1	-
Counter of iteration to allow N_SP_IS_EXT_REQ_MON decrementation					
CTR_OPM_AV_PLAUS_MON	V	0... FFH	0... 255	1	-
Debounce counter for error detection of OPM_AV					
CUR_ALTER_MON	V	0... FFH	0... 255	1	A
currency torque losses monitoring					
DFFGEN_FIL_MON	V	0... FFH	0... 99.60937	0.390625	%
currency torque losses monitoring					
EFF_MFF_TQ_COR_MON	O/V	0... FFH	0... 1.99218	0.0078125	-
efficiency on torque relevant mass fuel flow					
FAC_MFF_WUP_CUS_MON	O/V	0... FFH	0... 1.99218	0.0078125	-
OPM dependent mass fuel flow correction in warm-up phase (Monitoring level)					
FAC_PV_BAS_COR_MON	V	0... FFFFH	0... 1.99996	30.5e-6	-
basic correction - monitoring level					
FAC_PV_COR_MON	V	0... FFFFH	0... 1.99996	30.5e-6	-
Summation of corrections - monitoring level					
FAC_RAMP_NEG_P_D_IS_MON	O/V	0... FA0H	0... 0.5	0.000125	-
Factor for monitoring negative PD deactivation-ramp operations					
GR_DT_MDL_MON	V	0... FFFFH	0... 63.99902	976.599e-6	-
Modelled gear ratio for monitoring					
GR_DT_MON	O/V	0... FFFFH	0... 63.99902	976.599e-6	-
Gear ratio factor for monitoring					
GR_MT_MON	V	0... FFH	0... 255	1	-
Monitored value of manual transmission gear					
IDX_TI_1_MON [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Counting factor index for first pulse (monitoring)					
IDX_TI_2_MON [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Counting factor index for second pulse (monitoring)					
IDX_TI_POST_MON [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Counting factor index for post pulse (monitoring)					
IGA_REF_HOM_COR_EXT_MON	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Correction of reference ignition angle in homogeneous (for external functions e.g. VVT, EGR...)					
IGA_REF_HOMS_COR_EXT_MON	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Correction of reference ignition angle in homogeneous-stratified (for external functions e.g. VVT, EGR...)					
INT_TQI_N_CTL_TCT_MON	O/V	0... FFFFH	0... 204.79687	0.003125	Nm*s
Integrated torque request from TCT					
LV_ACT_N_SP_IS_EXT_ADJ_MON	V	0... 1H	0 ...1	1	-
LV for the displace of N_SP_IS_MON by tester demand					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ACT_N_SP_IS_POIL_EXT_MON	V	0... 1H	0 ...1	1	-
Condition for enabling oil pressure diagnosis by external request (monitoring)					
LV_AT_MON	O/V	0... 1H	0 ...1	1	-
Monitoring bit for AT coded					
LV_BRAKE_MON	O/V	0... 1H	0 ...1	1	-
Brake active or brake fault present					
LV_CDN_RNG_L_REQ_MON	V	0... 1H	0 ...1	1	-
Condition for transition to low-range-mode in monitoring level					
LV_CS_MON	V	0... 1H	0 ...1	1	-
clutch switch level 2					
LV_CT_MON	O/V	0... 1H	0 ...1	1	-
Logical bit for detection of driver request passive					
LV_ERR_CRU_INH_MON	O/V	0... 1H	0 ...1	1	-
Logival variable for inhibition of cruise control					
LV_ERR_OPM_AV_MON	O/V	0... 1H	0 ...1	1	-
Error in engine operation mode					
LV_ERR_SOF_INH_MON	O/V	0... 1H	0 ...1	1	-
error flag sport-mode switch request monitoring					
LV_ERR_VCC_PVS_1_MON	O/V	0... 1H	0 ...1	1	-
Fault in power supply for PVS_1 present					
LV_ERR_VCC_PVS_2_MON	O/V	0... 1H	0 ...1	1	-
Fault in power supply for PVS_2 present					
LV_ERR_VCC_PVS_MON	O/V	0... 1H	0 ...1	1	-
Fault in power supply for PVS present					
LV_IGK_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for ignition key on					
LV_INH_TQI_N_CTL_TCT_MON	V	0... 1H	0 ...1	1	-
General Inhibition bit of external torque request from TCT					
LV_INT_TQI_N_CTL_TCT_MON	V	0... 1H	0 ...1	1	-
Inhibition of external torque request from TCT due to integral check					
LV_LAMB_LS_UP_VLD_MON [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that lambda signal from WRAF system is reliable and up-to-date (process monitoring)					
LV_MSR_ACT_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for torque intervention due to MSR for monitoring use					
LV_N_LIM_ETC_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for activation of engine speed limitation monitoring					
LV_NT_SO2P_EXT_ADJ_ENA_MON	V	0... 1H	0 ...1	1	-
Condition for enabling desulfation by external request (monitoring)					
LV_OFF_IV_N_LIM_ETC_MON	O/V	0... 1H	0 ...1	1	-
Reversible fuel Cut Off Switch for all cylinders					
LV_PAS_RAMP_ACT_I_CHG_MON	O/V	0... 1H	0 ...1	1	-
Activation bit for initialisation of I-ramp					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_PAS_RAMP_ACT_P_D_CHG_MON	O/V	0... 1H	0 ...1	1	-
Activation bit for initialisation of PD-ramp					
LV_RNG_L_AT_MON	O/V	0... 1H	0 ...1	1	-
logical variable for engaged low range AT monitoring					
LV_RNG_L_MON	O/V	0... 1H	0 ...1	1	-
logical variable for engaged low range monitoring					
LV_SF_TQD_MON	O/V	0... 1H	0 ...1	1	-
Flag indicating level 2/3 error					
LV_SOF_SWI_MON	V	0... 1H	0 ...1	1	-
Sport-mode switch acting					
LV_SOF_SWI_REQ_MON	O/V	0... 1H	0 ...1	1	-
Sport-mode required by switch					
LV_SWI_AFS_LAMB_MON	O/V	0... 1H	0 ...1	1	-
Flag for switching to AFS mode					
LV_SWI_AFS_POST_INJ_MON	O/V	0... 1H	0 ...1	1	-
Flag for switching to AFS mode					
LV_SWI_FAC_TQ_REQ_MON	O/V	0... 1H	0 ...1	1	-
logical variable for switching to other factors for requested torque at clutch					
LV_SWI_TQ_MIN_CLU_MON	O/V	0... 1H	0 ...1	1	-
Idle speed setpoint from external influences					
LV_T_MAX_TQI_N_CTL_TCT_MON	V	0... 1H	0 ...1	1	-
Inhibition of external torque request from TCT due to maximal time check					
LV_TCHA_DIAG_REQ_MON	V	0... 1H	0 ...1	1	-
Condition for enabling charger diagnosis by external request (monitoring)					
LV_TQ_DROF_ACT_MON	V	0... 1H	0 ...1	1	-
function active					
LV_TQ_MAX_TQI_N_CTL_TCT_MON	V	0... 1H	0 ...1	1	-
Inhibition of external torque request from TCT due to maximal torque check					
LV_TQI_MON_ACT_MON	O/V	0... 1H	0 ...1	1	-
Activation condition for fuel cut off monitoring fulfilled - generic interface					
LV_VAR_TCT_MON	O/V	0... 1H	0 ...1	1	-
TCT-transmission recognized					
MFF_LAMB_REF_IGA_MON	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Lambda relevant Mass Fuel Flow for stoichiometric conditions (corrected by scavaging effect)					
N_ALTER_MON	V	0... FFFFH	0... 65535	1	rpm
currency torque losses monitoring					
N_DIF_COR_MON	V	0... FFH	-4096 ...4064	32	rpm
Idle speed control variable					
N_DIF_DROF_MON	V	0... FFH	-4096 ...4064	32	rpm
Engine speed difference effective for TQ_DROF					
N_DIF_MMV_MON	V	0... FFH	-4096 ...4064	32	rpm
N_DIF moving mean value					
N_DIF_MON	O/V	80... 7FH	-4096 ...4064	32	rpm
Engine speed deviation N_SP_IS - N					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
N_DIF_SP_IS_MON	O/V	80... 7FH	-4096 ...4064	32	rpm
Deviation of actual engine speed from idle speed setpoint					
N_SP_IS_BAS_MON	V	0... FFH	0... 8160	32	rpm
Monitored basis idle-speed setpoint					
N_SP_IS_CS_MON	V	0... FFH	0... 8160	32	rpm
Idle-speed setpoint given by DROF					
N_SP_IS_EXT_ADJ_MON	V	0... FFH	0... 8160	32	rpm
Idle speed setpoint from external influences					
N_SP_IS_EXT_REQ_MON	V	0... FFH	0... 8160	32	rpm
Plausible basis idle-speed setpoint while DROF or external tester demand active					
N_SP_IS_MON	O/V	0... FFH	0... 8160	32	rpm
Monitored value of idle speed setpoint					
N_SP_IS_RATIO_MON	O/V	0... FFFFH	0... 7.99987	122.1e-6	-
Ratio between actual engine speed and idle speed setpoint					
N_VS_RATIO_MON	V	0... FFH	0... 255	1	rpm/(km/h)
Monitored engine speed /vehicle speed ratio					
OPM_AV_MON	O/V	0H	-	-	-
		1H	S		
		2H	AFS		
		3H	AFL		
		8H	LIH		
actual engine operation mode (process monitoring)					
PV_AV_AD_MON	O/V	0... FFH	0... 99.60937	0.390625	%
Modified pedal value signal					
STATE_ERR_DET_TQ_MIN_MON	O/V	0H	PU	-	-
		1H	NON_PU		
		2H	PASSIVE		
Error-detection-state for monitoring of minimum torque at clutch					
STATE_PAS_RAMP_ACT_I_IS_MON	O/V	0... FFH	0... 255	1	-
Circular buffer indicating status of I-part deactivation ramp					
STATE_PAS_RAMP_ACT_P_D_IS_MON	O/V	0... FFH	0... 255	1	-
Circular buffer indicating status of PD-part deactivation ramp					
STATE_REQ_ISC_MON	O/V	0H	NOT_ACTIVE	-	-
		1H	IDLE		
		2H	TRAILING_THR		
		3H	PART_LOAD		
State of idle speed controller monitoring					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_TQI_N_CTL_TCT_MAX_MON	V	0... FFH	0... 10.2	0.04	s
Duration of external torque request from TCT over the maximum allowed					
T_TQI_N_CTL_TCT_MON	V	0... FFH	0... 10.2	0.04	s
Duration of external torque request from TCT					
T_TQI_OFS_ST_MON	V	0... FFH	0... 10.2	0.04	s
Timer for start offset					
TI_1_MON [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Actual performed cylinder individual injection time, first pulse (monitoring level)					
TI_2_MON [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Actual performed cylinder individual injection time, second pulse or additional pulse (monitoring level)					
TI_POST_MON [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Actual performed cylinder individual injection time, post injection pulse (monitoring level)					
TQ_ADD_MIN_CLU_MON	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Additional torque request from external sources					
TQ_AV_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
effective torque					
TQ_CONV_MAX_MDL_MON	V	0... FFH	0... 510	2	Nm
Maximum converter torque losses					
TQ_CONV_MAX_MON	O/V	0... FFH	0... 510	2	Nm
Monitored value of converter torque losses					
TQ_DIF_P_D_IS_MAX_2_MON	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Temporary variable					
TQ_DIF_P_D_IS_MAX_MON	O/V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Maximum value of PD-part					
TQ_DIF_P_D_IS_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Monitored PD-part of the idle speed controller					
TQ_DROF_MDL_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
drive off model value					
TQ_DROF_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
TQ request for drive off assistance					
TQ_LOSS_ACC_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Air conditioning compressor torque losses					
TQ_LOSS_ADD_FIL_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Filtered additional torque losses					
TQ_LOSS_ADD_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Additional torque losses					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_LOSS_ALTER_MDL_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Modelled alternator torque losses					
TQ_LOSS_ALTER_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Alternator torque losses					
TQ_LOSS_ARS_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Anti roll stabilisation torque losses					
TQ_LOSS_FIL_MMV_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Filtered additional torque losses (monitoring)					
TQ_LOSS_PSTE_1_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
steering wheel compressor torque losses					
TQ_LOSS_PSTE_2_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
steering wheel compressor torque losses					
TQ_LOSS_PSTE_3_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
power steering torque losses pste_3					
TQ_LOSS_PSTE_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
steering wheel compressor torque losses					
TQ_LOSS_SA_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
secondary air torque losses					
TQ_REQ_CLU_GRD_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Gradient of driver requested torque at clutch (monitoring)					
TQ_REQ_CLU_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Monitored driver requested torque at clutch*					
TQI_INC_CAN_MON	O/V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque demand from external CAN signals					
TQI_INC_EXT_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Monitored external torque demands					
TQI_MIN_PU_MAX_MON	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Monitoring threshold for minimum indicated torque in PU phase					
TQI_MIN_PU_MON	O/V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Plausibilised L2 value of Minimum indicated torque in PU phase					
TQI_N_CTL_TCT_MON	O/V	0... FFH	0... 510	2	Nm
Monitored external torque request from TCT					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQI_OFS_ST_MON	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Start offset for TQI_MIN_PU					
V_TPS_1_MON	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Adapted TPS signal channel 1					
V_TPS_2_MON	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Adapted TPS signal channel 2					
VS_MON	O/V	0... FFFFH	0... 511.99218	0.0078125	km/h
vehicle speed for monitoring PSTE_2					

**Input data:**

ANG_PSTE_STND {p. 1420}	C_FAC_MFF_MAF_MON {p. 6777}	C_N_DIF_HYS_IS_PU_ MON {p. 6799}	C_N_DIF_MAX_IS_MON {p. 6799}
C_THD_MAX_LAMB_MON {p. 6778}	CONF_SOF_SWI {p. 654}	EFF_SCC_MON {p. 6760}	FAC_MFF_TQ_COR_SCAV {p. 8193}
FAC_MFF_WUP_HOMS {p. 8241}	FAC_MFF_WUP_S {p. 8241}	FAC_TQ_REQ_DRIV_MON {p. 6851}	FAC_TQ_REQ_MON {p. 6851}
GEAR {p. 1302}	GEAR_INFO {p. 1564}	GR_DT {p. 8285}	GR_DT_MON {p. 6789}
IDX_TI_1_HOM_CLC [NC_CYL_NR] {p. 2000}	IDX_TI_1_S_CLC [NC_CYL_NR] {p. 2000}	IDX_TI_2_HOM_CLC [NC_CYL_NR] {p. 2000}	IDX_TI_2_S_CLC [NC_CYL_NR] {p. 2000}
IDX_TI_3_HOM_CLC [NC_CYL_NR] {p. 2000}	IDX_TI_3_S_CLC [NC_CYL_NR] {p. 2000}	IGA_REF_EGR_HOM_ COR {p. 8266}	IGA_REF_EGR_HOMS_ COR {p. 8266}
IGA_REF_LAMB_COR {p. 8266}	IGA_REF_TEMP_COR {p. 8266}	LAMB_MON {p. 6777}	LC_VAR_SPT_SWI {p. 659}
LV_ACT_N_SP_IS_EXT_ ADJ {p. 7763}	LV_ARS_ENA {p. 6650}	LV_AT {p. 654}	LV_CITY {p. 799}
LV_CLU_SWI {p. 996}	LV_CS_MON {p. 6790}	LV_CT {p. 1442}	LV_CT_MON {p. 6790}
LV_ERR_ALTER_COM {p. 4834}	LV_ERR_AMT_INH_MON {p. 6983}	LV_ERR_BLS_PLAUS {p. 4209}	LV_ERR_BN_ETCU {p. 4870}
LV_ERR_BN_GEAR_REV {p. 4870}	LV_ERR_BN_VEH_MOD {p. 4871}	LV_ERR_BN_VS_TCS {p. 4871}	LV_ERR_BSD {p. 4834}
LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_CONV_MON {p. 6894}	LV_ERR_CRK {p. 4455}	LV_ERR_CRU_INH_MON {p. 6790}
LV_ERR_CRU_MON {p. 6912}	LV_ERR_DCC_INH_MON {p. 6983}	LV_ERR_GEN {p. 1061}	LV_ERR_GEN_DIAG {p. 4924}
LV_ERR_GS_INH_MON {p. 6983}	LV_ERR_LDM_INH_MON {p. 6983}	LV_ERR_MFF_MON {p. 6943}	LV_ERR_MSR_INH_MON {p. 6983}
LV_ERR_MU_MC {p. 7072}	LV_ERR_N_32_MON {p. 7002}	LV_ERR_PVS {p. 4216}	LV_ERR_PVS_MON {p. 6961}
LV_ERR_PVS_RATIO_ MON {p. 6961}	LV_ERR_SOF_REQ {p. 4911}	LV_ERR_TQI_AV_MON {p. 6899}	LV_ERR_TQI_N_MAX_ MON {p. 6917}

LV_ERR_V_REF_1 {p. 4216}	LV_ERR_V_REF_2 {p. 4216}	LV_ERR_VS {p. 5021}	LV_ERR_VS_CAN {p. 1565}
LV_ETCU_SPT_SWI {p. 1565}	LV_IGK {p. 906}	LV_IM_BLS_MON {p. 852}	LV_IM_BTS_MON {p. 852}
LV_ISC_OFF_DROF {p. 1112}	LV_LAMB_LS_UP_VLD [NC_CBK_EX_NR] {p. 2352}	LV_MPL_INJ_ACT [NC_CBK_EX_NR] {p. 3379}	LV_MSR_ACT {p. 6741}
LV_MTC_CUR_OFF {p. 6565}	LV_N_LIM_ETC_LIH {p. 4982}	LV_N_LIM_ETC_LIH_REV {p. 4982}	LV_N_LIM_REQ_MON {p. 6877}
LV_N_LIM_REQ_RST_ CHK {p. 4230}	LV_N_SP_IS_LIH_ACT {p. 4216}	LV_NT_SO2P_EXT_ADJ_ ACT {p. 3144}	LV_POIL_EXT_ADJ_ACT {p. 7763}
LV_POST_INJ_ACT {p. 2179}	LV_PSTE_2_ENA {p. 6621}	LV_PSTE_3_ENA {p. 6621}	LV_PSTE_ENA {p. 6621}
LV_PUC {p. 1720}	LV_REQ_ISC {p. 3501}	LV_RNG_L_REQ {p. 6570}	LV_SAP {p. 804}
LV_TCHA_DIAG_REQ {p. 8233}	LV_TQ_DROF_ACT_MON {p. 6791}	LV_TQI_MON_ACT_MON {p. 6791}	LV_VAR_AMT {p. 655}
LV_VAR_BN {p. 655}	LV_VAR_ETCU_SPT {p. 656}	LV_VAR_PSTE_2 {p. 656}	LV_VAR_PSTE_3 {p. 656}
LV_VAR_TCT {p. 656}	MAF_SCAV_EXT {p. 8278}	MFF_ADD_CYL_CP {p. 3692}	MFF_ADD_TQ_CP {p. 8229}
MFF_LAMB_REF_MON {p. 6760}	MFF_TQ_MON {p. 6760}	N_32_MON {p. 7002}	N_SP_IS {p. 1122}
N_SP_IS_BRAKE {p. 8212}	N_SP_IS_CS {p. 1122}	N_SP_IS_EXT_ADJ {p. 7763}	N_SP_IS_POIL_CTL {p. 8212}
OPM_AV {p. 8137}	POW_REL_ALTER_CLC {p. 8368}	PV_AV_GRD {p. 1269}	PV_AV_MON {p. 6961}
STATE_EOL_KWP_N_SP_ IS {p. 7764}	STATE_ETCU_PROG_ INFO {p. 1574}	STATE_GEAR_REV_AT_ AMT {p. 1302}	STATE_GEAR_REV_CAN {p. 1574}
STATE_PAS_RAMP_ACT_ I_IS {p. 3441}	STATE_PAS_RAMP_ACT_ P_D_IS {p. 3441}	STATE_SPT_DISP_CAN {p. 8289}	STATE_VEH_MOD {p. 1578}
T_CTR_PU_ISC_ACT {p. 3501}	TCO_MON {p. 6903}	TI_1_MES [NC_CYL_NR] {p. 2040}	TI_2_MES [NC_CYL_NR] {p. 2040}
TI_POST_INJ [NC_CYL_NR] {p. 2179}	TI_POST_MES [NC_CYL_NR] {p. 2041}	TQ_AMT_MON {p. 6984}	TQ_CONV {p. 6710}
TQ_DCC_MON {p. 6984}	TQ_DIF_P_D_FAST_IS {p. 3441}	TQ_DIF_P_D_SLOW_IS {p. 3442}	TQ_DROF_FAST {p. 1112}
TQ_DROF_SLOW {p. 1112}	TQ_GS_MON {p. 6984}	TQ_LOSS_ACC {p. 6602}	TQ_LOSS_ADD_FIL {p. 8193}
TQ_LOSS_ALTER {p. 8369}	TQ_LOSS_ARS {p. 6650}	TQ_LOSS_MON {p. 6975}	TQ_LOSS_PSTE_1 {p. 6622}
TQ_LOSS_PSTE_2 {p. 6622}	TQ_LOSS_PSTE_3 {p. 6622}	TQ_MSR_MON {p. 6984}	TQ_REQ_CLU {p. 8390}

TQ_REQ_CLU_GB {p. 8193}	TQ_WHEEL_LDM_MON {p. 6984}	TQI_AMT_MON {p. 6984}	TQI_AV_MON {p. 6774}
TQI_GS_MON {p. 6984}	TQI_INC_CAN_MON {p. 6794}	TQI_MSR_MON {p. 6984}	TQI_N_CTL_TCT_FAST {p. 8193}
TQI_N_CTL_TCT_SLOW {p. 8193}	V_SOF_SWI_MON {p. 831}	VS {p. 1176}	VS_CAN {p. 1582}
VS_FIL {p. 1176}	VS_MON {p. 6795}	VS_SENS {p. 1176}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_SOF_INH_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_MAX_SOF_INH_MON	-	1... FFH	1... 255	1	-
Anti bounce counter max value					
C_CRLC_ALTER_MON	-	0... FFH	0... 0.99609	3.9063e-3	-
Alternator torque losses low pass					
C_CRLC_TQI_N_CTL_TCT_PLAUS_MON	-	0... FFH	0 ...1	3.9216e-3	-
Correlation factor for calculation of integrated torque request from TCT					
C_CTR_N_SP_IS_REQ_DEC_MAX_MON	-	0... FFH	0... 255	1	-
Maximum for counter of iteration to allow N_SP_IS_EXT_REQ_MON decrementation					
C_DEC_INT_TQI_N_CTL_TCT_MON	-	0... FFFFH	0... 204.79687	0.003125	Nm*s
Decrement of integrated torque request from TCT					
C_DEC_OPM_AV_PLAUS_MON	-	0... FFH	0... 255	1	-
Debounce decrement for plausibilisation of OPM_AV error					
C_DEC_T_TQI_N_CTL_TCT_MAX_MON	-	0... FFH	0... 10.2	0.04	s
Decrement of time for torque request from TCT over the maximum allowed					
C_DEC_T_TQI_N_CTL_TCT_MON	-	0... FFH	0... 10.2	0.04	s
Decrement of time for torque request from TCT					
C_DLY_LAMB_LS_UP_NOT_VLD_MON	-	0... FFH	0... 255	1	-
Delay (in samples) for switching LV_LS_UP_VLD_MON from 1 to 0					
C_FAC_EFF_ALTER_MON	-	0... FFH	0... 7.96875	0.03125	-
Alternator torque losses low pass					
C_FAC_GR_DIF_MON	-	0... FFH	0... 1.99218	0.0078125	-
Max. permitted difference in gear ratio					
C_FAC_GR_MAX_MON	-	0... FFH	0... 31.875	0.125	-
Max. value for gear ratio (shortest gear step)					
C_FAC_GR_MIN_MON	-	0... FFH	0... 31.875	0.125	-
Min. value for gear ratio (longest gear step)					
C_FAC_GR_MON	-	0... FFH	0... 2.55	0.01	-
1 /Wheel circumference					
C_FAC_MFF_ADD_CP_MIN_MON	-	0... FFH	0... 1.99218	0.0078125	-
weighting factor to limit torque relevant MFF_CP in stratified					
C_FAC_MFF_TQ_COR_SCAV_MIN_MON	-	0... FFH	0... 199.21875	0.78125	%
Minimal efficiency correction factor for scavenging					
C_FAC_N_ALTER_MON	-	0... FFH	0... 7.96875	0.03125	-

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_RAMP_P_D_MON	-	0... FA0H	0... 0.5	0.000125	-
Factor for monitoring negative DROF deactivation-ramp operation					
C_FAC_RAX_MON	-	0... FFH	0... 7.96875	0.03125	-
Gear ratio rear axle					
C_FAC_TQ_REQ_DRIV_SOF_MAX_MON	-	0... FFH	0... 1.99218	0.0078125	-
scaling factor treshold for activation IP_FAC_TQ_REQ_DRIV_RNG_L_MON					
C_FIL_TQ_P_D_IS_MAX_MON	-	0... FFFFH	0... 0.99998	15.3e-6	-
Filter correlation constant for PD-part torque threshold					
C_H_RNG_THD_OPM_AV_PLAUS_MON	-	0... 7FFFH	0... 31.99902	976.599e-6	-
High threshold to detect unplausable OPM_AV					
C_IGA_REF_EGR_HOM_COR_LIM_MON	-	0... B40H	-90 ...90	0.0625	°CRK
Correction of reference ignition angle limitation EGR in HOM					
C_IGA_REF_EGR_HOMS_COR_LIM_MON	-	0... B40H	-90 ...90	0.0625	°CRK
Correction of reference ignition angle limitation EGR in HOMS					
C_IGA_REF_LAMB_COR_LIM_MON	-	0... B40H	-90 ...90	0.0625	°CRK
Correction of reference ignition angle limitation LAMB_SP					
C_IGA_REF_TEMP_COR_LIM_MON	-	0... B40H	-90 ...90	0.0625	°CRK
Correction of reference ignition angle limitation TEMP					
C_INC_OPM_AV_PLAUS_MON	-	0... FFH	0... 255	1	-
Debounce increment for plausibilisation of OPM_AV error					
C_INT_MAX_TQI_N_CTL_TCT_MON	-	0... FFFFH	0... 204.79687	0.003125	Nm*s
Maximum value of integrated torque request from TCT					
C_INT_MIN_TQI_N_CTL_TCT_MON	-	0... FFFFH	0... 204.79687	0.003125	Nm*s
Minimum value of integrated torque request from TCT					
C_L_RNG_THD_OPM_AV_PLAUS_MON	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Low threshold to detect unplausable OPM_AV					
C_MIN_TQI_N_CTL_TCT_MON	-	0... FFH	0... 510	2	Nm
Threshold for monitoring of external torque request from TCT					
C_MIN_VS_RATIO_MON	-	0... FFH	0... 255	1	km/h
Minimum engine speed for the calculation of the monitored engine speed /vehicle speed ratio					
C_N_32_TQ_DROF_MAX_MON	-	0... FFH	0... 8160	32	rpm
min threshold N_DIF_DROF_MON					
C_N_DIF_ADD_DROF_MON	-	0... FFH	-4096 ...4064	32	rpm
offset threshold N_DIF_DROF_MON					
C_N_DIF_CRLC_HIGH_MON	-	0... FFH	0... 0.99609	3.9063e-3	-
Correlation factor for N_DIF_MMV calculation					
C_N_DIF_CRLC_LOW_MON	-	0... FFH	0... 0.99609	3.9063e-3	-
Correlation factor for N_DIF_MMV calculation					
C_N_DIF_DROF_MAX_MON	-	0... FFH	-4096 ...4064	32	rpm
max threshold N_DIF_DROF_MON					
C_N_DIF_DROF_MIN_MON	-	0... FFH	-4096 ...4064	32	rpm
min threshold N_DIF_DROF_MON					
C_N_DIF_FAC_MON	-	0... FFH	0... 0.99609	3.9063e-3	-
Multiplicative factor for N_DIF_COR calculation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_DIF_HYS_IS_PU_MON	-	80... 7FH	-4096 ...4064	32	rpm
N_DIF_MON hysteresis before state PU					
C_N_DIF_MAX_IS_MON	-	80... 7FH	-4096 ...4064	32	rpm
Maximum idle speed setpoint deviation for active PD-part					
C_N_DIF_MAX_PL_ACT_MON	-	80... 7FH	-4096 ...4064	32	rpm
Maximum idle-speed deviation allowed for active ISC in PL					
C_N_IS_SO2P_MIN_MON	-	0... FFH	0... 8160	32	rpm
Threshold for detecting running engine (Monitoring)					
C_N_MAX_KWP_MON	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for accepting the EOL- N_SP_IS_MON displace service					
C_N_NT_SO2P_EXT_ADJ_ACT_MON	-	0... FFH	0... 8160	32	rpm
Idle speed setpoint for SO2P in service (monitoring)					
C_N_POIL_EXT_ADJ_MAX_MON	-	0... FFH	0... 8160	32	rpm
Maximum idle speed setpoint for oil pressure diagnosis in service (monitoring)					
C_N_SP_IS_BAS_DIF_MAX_MON	-	0... 7FH	0... 4064	32	rpm
Idle speed gradient limitation					
C_N_SP_IS_CS_MAX_MON	-	0... FFH	0... 8160	32	rpm
Max. selection of Idle speed setpoint for drive-off-support					
C_N_SP_IS_LIH_MAX_MON	-	0... FFH	0... 8160	32	rpm
Maximum idle-speed setpoint when error with acclerator pedal module detected					
C_N_SP_IS_MAX_EXT_ADJ_MON	-	0... FFH	0... 8160	32	rpm
Maximum idle-speed setpoint when external Tester demand is active					
C_N_SP_IS_MAX_PL_ACT_MON	-	0... FFH	0... 8160	32	rpm
Maximum allowed idle-speed for active ISC in PL					
C_N_SP_LGRD_IS_EXT_REQ_DEC_MON	-	0... FFH	0... 8160	32	rpm
Decrement for idle speed SP for external request (Monitoring)					
C_N_SP_LGRD_IS_EXT_REQ_INC_MON	-	0... FFH	0... 8160	32	rpm
Increment for idle speed SP for external request (Monitoring)					
C_N_ST_MIN_MON	-	0... FFH	0... 8160	32	rpm
Enginespeed to activate startoffset for TQI_MIN_PU					
C_N_TCHA_DIAG_REQ_MAX_MON	-	0... FFH	0... 8160	32	rpm
Maximum idle speed setpoint for charger diagnosis in service (monitoring)					
C_N_THD_Fcut_N_LIM_ETC_MON	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for forced injection cut off in SAS mode					
C_OPM_AV_PLAUS_MAX_MON	-	1... FFH	1... 255	1	-
Threshold for detection of OPM_AV error					
C_PV_AV_GRD_SOF_MAX_MON	-	0... FFH	-1250... 1240.23437	9.765625	%/s
Pedal value gradient threshold for recognition of LV_RNG_L_MON					
C_PV_AV_SOF_MIN_MON	-	0... FFH	0... 99.60937	0.390625	%
PV_AV threshold for activation IP_FAC_TQ_REQ_DRIV_RNG_L_MON					
C_PV_POIL_EXT_ADJ_MAX_MON	-	0... FFH	0... 99.60937	0.390625	%
Accelerator pedal threshold for disabling external request for oil pressure diagnosis (Monitoring)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_PV_SO2P_EXT_MAX_MON	-	0... FFH	0... 99.60937	0.390625	%
Accelerator pedal threshold for disabling external request for desulfation (Monitoring)					
C_PV_TCHA_DIAG_EXT_MAX_MON	-	0... FFH	0... 99.60937	0.390625	%
Accelerator pedal threshold for disabling external request for charger diagnosis (Monitoring)					
C_STATE_ETCU_PROG_INFO_MON	-	0... FFH	0... 255	1	-
Manual activation of low range mode AT					
C_SWI_OPM_AV_MON	-	0... 3H	0 ...3	1	-
manual demand OPM_AV_MON					
C_T_MAX_TQI_N_CTL_TCT_MAX_MON	-	0... FFH	0... 10.2	0.04	s
Maximum time for torque request from TCT over the maximum allowed					
C_T_MAX_TQI_N_CTL_TCT_MON	-	0... FFH	0... 10.2	0.04	s
Maximum time for torque request from TCT					
C_T_PV_AV_GRD_SOF_MAX_MON	-	0... FFH	0... 10.2	0.04	s
Minimum time for pedal value gradient for recognition of LV_RNG_L_MON					
C_T_TQI_OFS_ST_MON	-	0... FFH	0... 10.2	0.04	s
Timer for TQI_MIN_PU startoffset					
C_THD_MIN_FAC_TQ_REQ_MON	-	0... FFH	0... 1.99218	0.0078125	-
Minimum threshold for driver request in order to detect PL					
C_TQ_DIF_IS_AD_CONV_MAX_MON	-	0... FFH	0... 510	2	Nm
Max. limitation for converter torque adaptation					
C_TQ_LOSS_ADD_ACC_MIN_MON	-	8000... 0H	-1024 ...0	0.03125	Nm
Minimum additional torque loss for ACC active					
C_TQ_LOSS_ADD_FIL_DIF_MAX_MON	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Maximum allowed difference between L2 and L1 filtered additional torque losses					
C_TQ_LOSS_ALTER_MIN_MON	-	8000... 0H	-1024 ...0	0.03125	Nm
Minimum additional torque loss for alternator					
C_TQ_LOSS_ARS_MIN_MON	-	8000... 0H	-1024 ...0	0.03125	Nm
Minimum additional torque loss for ARS active					
C_TQ_LOSS_FIL_MMV_INI_MIN_MON	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Minimum filtered additional torque losses used for initialisation of filtering function					
C_TQ_LOSS_PSTE_1_MIN_MON	-	8000... 0H	-1024 ...0	0.03125	Nm
Minimum additional torque loss for PSTE_1 active					
C_TQ_LOSS_PSTE_LIH_MON	-	8000... 0H	-1024 ...0	0.03125	Nm
Default value torque losses if no PSTE enabled					
C_TQ_LOSS_SA_MIN_MON	-	8000... 0H	-1024 ...0	0.03125	Nm
Minimum additional torque loss for SA active					
C_TQ_REQ_CLU_GB_MAX_MON	-	0... FFH	0... 510	2	Nm
Max. limitation for torque request from gearbox					
C_TQI_OFS_ST_MON	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
TQI_MIN_PU startoffset					
C_V_SOF_SWI_MAX_MON	-	0... 3FFH	0... 4.99511	4.88e-3	V
input voltage threshold max					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_V_SOF_SWI_MIN_MON	-	0... 3FFH	0... 4.99511	4.88e-3	V
input voltage threshold min					
C_V_SOF_SWI_ON_BOL_MON	-	0... 3FFH	0... 4.99511	4.88e-3	V
Voltage-Threshold bottom limit for sport mode ON					
C_V_SOF_SWI_ON_TOL_MON	-	0... 3FFH	0... 4.99511	4.88e-3	V
Voltage-Threshold top limit for sport mode ON					
C_V_TPS_1_LIH_MON	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Threshold for detection of throttle position 1 outside limp home position					
C_V_TPS_2_LIH_MON	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Threshold for detection of throttle position 2 outside limp home position					
C_V_TQ_ALTER_MON	-	0... FFH	0... 25.89843	0.1015625	V
Voltage range of monitoring					
C_VS_DIF_MAX_MON	-	0... FFFFH	0... 511.99218	0.0078125	km/h
minimum additional torque loss for SA active					
C_VS_LIH_MON	-	0... FFFFH	0... 511.99218	0.0078125	km/h
minimum additional torque loss for SA active					
C_VS_MAX_KWP_MON	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed for accepting the EOL- N_SP_IS_MON displace service					
C_VS_POIL_EXT_ADJ_MAX_MON	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed threshold for disabling external request for oil pressure diagnosis (Monitoring)					
C_VS_SO2P_EXT_MAX_MON	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for disabling external request for desulfation (Monitoring)					
C_VS_TCHA_DIAG_EXT_MAX_MON	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed threshold for disabling external request for charger diagnosis (Monitoring)					
ID_GR_MT_MON	-	0... FFH	0... 255	1	-
LDP_N_VS_RATIO_MON_GR_MT_MON	13	0... FFH	0... 255	1	rpm/(km/h)
Index table for Gear Ratio detection in the monitoring level					
ID_TQ_DROF_ENA_MON	-	0... 1H	0 ...1	1	-
LDP_N_DIF_DROF_MON_ID_TQ_DROF	3	0... FFH	-4096 ...4064	32	rpm
table for activation/deactivation of DROF					
IP_CUR_ALTER_MON	V	0... FFH	0... 255	1	A
LDP_DFFGEN_FIL_MON_LOSS_MON	6	0... FFH	0... 99.60937	0.390625	%
LDPM_N_ALTER_MON_TQ_LOSS_MON	6	0... FFFFH	0... 65535	1	rpm
Alternator torque losses					
IP_EFF_ALTER_MON	V	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_N_ALTER_MON_TQ_LOSS_MON	6	0... FFFFH	0... 65535	1	rpm
LDP_CUR_ALTER_MON_TQ_LOSS_MON	6	0... FFH	0... 255	1	A
Alternator torque losses					
IP_FAC_CONV_MON	-	0... FFFFH	0... 0.00048	7.4464e-9	Nm/rpm**2
LDP_TCO_MON_IP_FAC_CONV_MON	6	0... FEH	-48... 142.5	0.75	°C
Converter torque characteristics					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_N_GRD_TQ_AV_MON	-	0... FFH	0... 1.99218	0.0078125	-
LDP_TQ_AV_MON__TQ_DROF	4	0... FFFFH	-1024... 1023.96875	0.03125	Nm
N_DIF correction					
IP_FAC_PV_BAS_COR_MON	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_N_32_MON__FAC_PV_COR_MON	6	0... FFH	0... 8160	32	rpm
LDPM_PV_AV_MON__FAC_PV_COR_MON	6	0... FFH	0... 99.60937	0.390625	%
Basic correction for PV_AV_MON					
IP_FAC_TQ_DIF_P_D_IS_MON	-	0... FFH	0... 1.99218	0.0078125	-
LDP_TCO_MON_IP_FAC_TQ_P_D_MON	5	0... FEH	-48... 142.5	0.75	°C
Maximum scaling factor due to separation of PD-part					
IP_FAC_TQ_DROF_FAC_TQ_REQ_MON	-	0... FFH	0... 1.99218	0.0078125	-
LDP_FAC_TQ_REQ_MON__TQ_DROF	6	0... FFH	0... 1.99218	0.0078125	-
correction FAC_TQ_REQ_MON					
IP_FAC_TQ_DROF_VS_MON	V	0... FFH	0... 1.99218	0.0078125	-
LDP_VS_MON__TQ_DROF	6	0... FFFFH	0... 511.99218	0.0078125	km/h
LDP_N_32_MON__TQ_DROF	6	0... FFH	0... 8160	32	rpm
correction depending on VS and N_32					
IP_FAC_TQ_LOSS_ADD_FIL_MON	V	0... FFH	0... 0.99609	3.9062e-3	-
LDP_TQ_REQ_CLU__ADD_FIL_MON	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_TQ_REQ_CLU_GRD__ADD_FIL_MON	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Filter constant determination					
IP_FAC_VS_PV_BAS_COR_MON	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_VS_MON__FAC_PV_COR_MON	8	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed correction for PV_AV_MON					
IP_N_SP_IS_BAS_MAX_MON	-	0... FFH	0... 8160	32	rpm
LDP_TCO_MON_IP_N_SP_IS_MON	5	0... FEH	-48... 142.5	0.75	°C
Maximum basis idle speed setpoint depending on coolant temperature					
IP_TQ_DIF_P_D_IS_MAX_MON	-	0... FFH	0... 510	2	Nm
LDP_N_DIF_SP_IS_MON_IP_TQ_MON	6	0... FFH	-4096 ...4064	32	rpm
Maximum PD-part depending on speed deviation to idle speed setpoint					
IP_TQ_DROF_GRD_DEAC_MON	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDP_TQ_DROF_MDL_MON_1	3	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Decrement for the termination ramp of TQ_DROF_MDL_MON					
IP_TQ_DROF_MON	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_DIF_DROF_MON__TQ_DROF	6	0... FFH	-4096 ...4064	32	rpm
drive off torque request					
IP_TQ_LOSS_PSTE_2_MIN_MON	V	0... 8000H	-1024 ...0	0.03125	Nm
LDP_VS_MON__TQ_LOSS_MON	6	0... FFFFH	0... 511.99218	0.0078125	km/h


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_ANG_PSTE_STND_TQ_LOSS_MON	6	0... FFFFH	-100... 99.99694	3.0518e-3	%
minimum additional torque loss for PSTE_2 active					
IP_TQ_LOSS_PSTE_3_MIN_MON	V	0... 8000H	-1024 ...0	0.03125	Nm
LDP_VS_MON_TQ_LOSS_PSTE3_MON	6	0... FFFFH	0... 511.99218	0.0078125	km/h
LDP_ANG_PSTE_STND_TQ_PSTE3_MON	6	0... FFFFH	-100... 99.99694	3.0518e-3	%
minimum additional torque loss for PSTE_3 active					
IP_TQ_MAX_TQI_N_CTL_TCT_MON	-	0... FFH	0... 510	2	Nm
LDP_N_32_TQI_N_CTL_TCT_MON	6	0... FFH	0... 8160	32	rpm
Threshold for activation of maximal torque check for torque request from TCT					
IP_TQI_MIN_PU_MAX_MON	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDP_N_32_MON_IP_TQI_PU_MAX_MON	6	0... FFH	0... 8160	32	rpm
LDP_TCO_MON_IP_TQI_PU_MAX_MON	3	0... FEH	-48... 142.5	0.75	°C
Monitoring threshold for minimum indicated torque in PU phase					
LC_CONF_CITY_ENA_MON	-	0... 1H	0 ...1	1	-
Enable City mode off condition (1 on /0 off, 2 AMT on)					
LC_CUR_SHP_INJ_ENA_MON	-	0... 1H	0 ...1	1	-
Switch to enable injection current shaping via IDX_TI calculation.					
LC_INH_PU_REQ_MON	-	0... 1H	0 ...1	1	-
Logical bit to inhibit LV_PU in calculation of TQ_MIN_CLU_MDL_MON					
LC_N_SP_IS_CLC_INH_MON	-	0... 1H	0 ...1	1	-
Logical bit for switching between two engine-speed-deviation calculation paths(N_DIF_COR_x_MON)					
LC_OPM_AV_PLAUS_ENA_MON	-	0... 1H	0 ...1	1	-
Enable plausibilisation of OPM_AV					
LC_RNG_L_MAN_AS_MON	-	0... 1H	0 ...1	1	-
Calibration constant for to activate IP_FAC_TQ_REQ_DRIV_RNG_L (low range mode) in case if LV_RNG_L = 0 (default value = 0)					
LC_RNG_L_MON	-	0... 1H	0 ...1	1	-
Manual switch for low range detection monitoring					
LC_SWI_OPM_AV_MON	-	0... 1H	0 ...1	1	-
switch between OPM_AV (level 1) and predetermined state					
LC_TQ_DROF_ISC_OFF_MON	-	0... 1H	0 ...1	1	-
Boolean to enable/disable idle speed controller activation during drive off; 1=disabled (monitoring)					
LC_TQ_LOSS_ADD_FIL_MON	-	0... 1H	0 ...1	1	-
Switch for TQ_LOSS_ADD_FIL_MON calculation					
LC_VAR_SOF_SWI_MON	-	0... 1H	0 ...1	1	-
Calibration sport Switch (1 on /0 off, 2 AMT on)					

### Import actions:

<b>ACTION_ECM3_Service0TaskPfm</b> (IN<No Name available>)
<b>ACTION_ECM3_Service1TaskPfm</b> (IN<No Name available>)
<b>ACTION_ECM3_Service2TaskPfm</b> (IN<No Name available>)

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The input arguments have the values 1, 2, 3 and 4.

For further information concerning the order of action calls compared to the specified functions, please have a look on the following page.

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ACTION\_ECM3\_McChkStack()

**Note:** This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION\_ECM3\_Service0TaskPfm() and ACTION\_ECM3\_Service1TaskPfm().

ACTION\_ECM3\_WriteChkCpl(INOUT <>, OUT <>, IN <>)

ACTION\_ECM3\_ChkCpl(IN <>, IN <>)

ACTION\_ECM3\_ReadChkCpl(OUT <>, IN <>, IN <>)

**Note:** All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

ACTION\_INFR\_GetVTPSMON(OUT <V\_tps\_1\_mon>, OUT<V\_tps\_2\_mon>)

**Note:** This action is defined in chapter "ECM2 - Requirements to infrastructure interface".

### **Order of action calls:**

Application Incidences and Configuration or Process Monitoring

Initialization conditions

ACTION\_ECM3\_Service0TaskPfm(1)

ACTION\_ECM3\_McChkStack()

ACTION\_ECM3\_Service1TaskPfm(1)

Application incidences for the activation conditions of process monitoring

Application incidences for monitoring of torque demand from idle speed controller

1.16.1 Acquisition of sport-mode-switch for monitoring

1.20 Application incidences for actual fuel mass flow

ACTION\_ECM3\_Service2TaskPfm(1)

ACTION\_ECM3\_Service0TaskPfm(2)

ACTION\_ECM3\_McChkStack()

ACTION\_ECM3\_Service1TaskPfm(2)

Application incidences for monitoring of pedal value signals

1.5 Adaptation of OPM\_AV to OPM\_AV\_MON

Application incidences for the monitoring of torque losses

Appl. Inc. for actual lambda deviation

1.16.1 Acquisition of sport-mode-switch for monitoring

ACTION\_ECM3\_Service2TaskPfm(2)

ACTION\_ECM3\_Service0TaskPfm(3)

ACTION\_ECM3\_McChkStack()

ACTION\_ECM3\_Service1TaskPfm(3)

Forced injection shut off for Level 2 - engine speed limitation

State of torque intervention when level 2/3 error is detected

Application incidences for cruise control input

Application incidences for IPM monitoring

Application incidences for monitoring of CAN signals

Application incidences for monitoring of minimum torque at clutch  
 Application incidences for the actual efficiencies  
 Application incidences for the actual indicated engine torque  
 1.16.1 Acquisition of sport-mode-switch for monitoring  
 ACTION\_ECM3\_Service2TaskPfm(3)

ACTION\_ECM3\_Service0TaskPfm(4)  
 ACTION\_ECM3\_McChkStack()  
 ACTION\_ECM3\_Service1TaskPfm(4)  
 Sport switch monitoring  
 Driving off assistance  
 Application incidences for desired indicated engine torque  
 Application incidences for the combustion mode switch request  
 ACTION\_ECM3\_Service2TaskPfm(4)

## E.6.1 Initialization conditions

### FUNCTION DESCRIPTION:

#### General information:

The application condition for the initialization of e.g. the error bits, the anti-bounce-counters and other variables of the process monitoring is commonly defined here for all modules of the process monitoring. There is only a reference to the following definition of the application conditions in the different modules.

The error bits, anti-bounce-counters and other variables are initialized

1. at reset
2. at transition from LV\_IGK = 0 to 1
3. at clearing of the failure memory
4. with physical "0" if not defined differently!

There is one exception from the rule above. If the reset counter at the monitoring unit increased up to 7 resets, the fault reaction of the monitoring unit will be continued until the power supply of the monitoring unit is switched off.


## E.6.2 Application incidences for the activation conditions of process monitoring

### FUNCTION DESCRIPTION:

#### General information:

The logical variable LV\_N\_LIM\_ETC\_MON indicates, that any etc-safety-function of level 1, 2 or 3 has requested engine speed limitation or ignition key is switched off. The monitoring of the engine speed limitation is also active, when

1. any fault of the ETC-system (pedal value sensor, throttle position sensor, throttle actuator, power stage, idle speed actuator) is present and the driver demand is zero
2. throttle is disabled and at least one throttle position signal is outside the specified limp home position

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3. after a warm reset in case any etc-safety-function of level 1, 2 or 3 had requested engine speed limitation before the warm reset

The torque monitoring can only be active, when the ignition key is on and the throttle is not disabled and no mechanical/electrical error of the idle speed actuator is detected. Otherwise the control of the torque is not possible and torque monitoring is forbidden. This is not a risk, because engine is switched off or in limp home mode then, and the monitoring of the engine speed limitation is active in most cases (at least when the driver releases the pedal).

The logical variable LV\_IGK is copied to level 2 in the variable LV\_IGK\_MON, because it is used as a deactivation condition for the monitoring of PVS in level 2. In order to ensure the safety, the variable LV\_IGK\_MON is also used for the calculation of the global activation conditions LV\_N\_LIM\_ETC\_MON and LV\_TQI\_MON\_ACT\_MON.

### Application conditions

**Activation:** at every engine state

**Update Rate:** 40ms

### Formula section:

LV\_IGK\_MON = LV\_IGK

```

If      LV_IGK_MON          =      0      Or
          LV_N_LIM_REQ_MON    =      1      Or      (request from level 2, 3)
          LV_N_LIM_ETC_LIH    =      1      Or      (requests from level 1)
          LV_N_LIM_ETC_LIH_REV =      1      Or      (rev. SAS active, level
1)
          LV_N_LIM_REQ_RST_CHK =      1      Or      (reset resisting LIH)

          (LV_MTC_CUR_OFF     =      1      And
          PV_AV_MON           =      0)      Or

          (LV_MTC_CUR_OFF     =      1      And
          (V_TPS_1_MON > C_V_TPS_1_LIH_MON  Or
          V_TPS_2_MON < C_V_TPS_2_LIH_MON))

Then
          LV_N_LIM_ETC_MON    =      1

Else
          LV_N_LIM_ETC_MON    =      0

Endif

If      LV_IGK_MON          =      1      And      (ignition key on)
          LV_MTC_CUR_OFF     =      0      And      (MTC NOT switched off)
          LV_N_LIM_ETC_LIH_REV =      0

Then
          LV_TQI_MON_ACT_MON  =      1

Else
          LV_TQI_MON_ACT_MON  =      0

Endif

```

## E.6.3 Application incidences for monitoring of torque demand from idle speed controller

### E.6.3.1 Application incidences for monitoring driver request passive

#### FUNCTION DESCRIPTION:

The aim of this chapter is the monitoring of the variable LV\_CT which indicates whether a driver request is present or not where the request can be not only from the driver but also from other sources like cruise control or vehicle speed limitation functionality.

As long as the impact between LV\_CT = 0 and LV\_CT = 1 can be tolerated in terms of torque thresholds, the value can be copied to L2 without plausibility check.

#### Application conditions

<b>Activation:</b>	LV_TQI_MON_ACT_MON = 1
<b>Deactivation:</b>	otherwise
<b>Initialisation:</b>	for condition see Application Incidences of Process Monitoring LV_CT_MON = 1
<b>Update Rate:</b>	40 ms

#### Formula section:

LV\_CT\_MON = LV\_CT

### E.6.3.2 Application incidences for monitoring of idle speed setpoint


#### General information:

The objective of this function is the monitoring of the idle speed setpoint (N\_SP\_IS) and the corrected idle speed setpoint. Both of these values have to be monitored because they are important inputs for the torque monitoring functionalities. This function consists of two sections.

The first section involves the monitoring of the basis idle-speed setpoint and external offsets (driving-off assistance, CVT etc.) that might be added depending on certain activation conditions. In the second part of this functionality, the Level 2 model value for the idle-speed setpoint and other torque monitoring relevant variables (engine speed deviation, engine speed ratio etc.) are calculated.

#### Application conditions

<b>Activation:</b>	LV_TQI_MON_ACT_MON = 1
<b>Deactivation:</b>	otherwise
<b>Initialisation:</b>	(for condition see Application Incidences of Process Monitoring <b>OR</b> LV_TQI_MON_ACT_MON = 0 1) N_DIF_SP_IS_MON = 0 rpm N_SP_IS_RATIO_MON = 0 rpm N_SP_IS_MON = 0 rpm N_DIF_MON = 0 rpm N_DIF_MMV_MON = 0 rpm N_SP_IS_BAS_MON= <b>min</b> (N_SP_IS, IP_N_SP_IS_BAS_MAX_MON) FAC_RAMP_NEG_P_D_IS_MON = 0 LV_AT_MON = LV_AT LV_VAR_TCT_MON = LV_VAR_TCT

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```

N_SP_IS_EXT_ADJ_MON = min(N_SP_IS, C_N_SP_IS_MAX_EXT_ADJ_
MON)
LV_ACT_N_SP_IS_EXT_ADJ_MON = 0
GR_MT_MON = 0 at [ LV_ES = 1 or LV_ST = 1 or LV_CS
= 1 ]
N_VS_RATIO_MON = 0
N_SP_IS_CS_MON = min(N_SP_IS, C_N_SP_IS_CS_MAX_MON)
N_SP_IS_EXT_REQ_MON_K = min(N_SP_IS, IP_N_SP_IS_BAS_MAX_
MON)
N_SP_IS_EXT_REQ_MON_{K-1} = min(N_SP_IS, IP_N_SP_IS_BAS_MAX_
MON)
N_DIF_COR_MON = 0
LV_NT_SO2P_EXT_ADJ_ENA_MON = 0
CTR_N_SP_IS_EXT_REQ_DEC_MON_K = 0
CTR_N_SP_IS_EXT_REQ_DEC_MON_{K-1} = 0
LV_TCHA_DIAG_REQ_MON = 0
LV_ACT_N_SP_IS_POIL_EXT_MON = 0

```

Update rate: 40 ms

### E.6.3.2.1 Plausibilisation of basis idle-speed setpoint and external-influences

#### General information:

The basis idle speed setpoint is limited by a coolant temperature dependent maximum value, IP\_N\_SP\_IS\_BAS\_MAX\_MON. Under certain circumstances (for e.g. driving off situation i.e. the driver is slightly on the gas pedal and releases the clutch abruptly -> can lead to engine stalling), to assist the driver in this situation, N\_SP\_IS\_MON is raised to achieve a torque increasing demand from ISC. In case of an error, such external influences can lead to relatively large unwanted acceleration which makes the monitoring of the relevant activation conditions imperative.

#### Formula section:

{N\_SP\_IS\_LIM\_MON represents the basis idle-speed setpoint plus any offsets (for e.g. catalyst heating or low battery voltage) that might be added in L1 based on certain activation conditions.}

$$N\_SP\_IS\_LIM\_MON = N\_SP\_IS$$

**{Model value of maximum basis setpoint}**

$$N\_SP\_IS\_BAS\_MAX\_MON = IP\_N\_SP\_IS\_BAS\_MAX\_MON(TCO\_MON)$$


**{Idle speed setpoint plausibilisation through gradient limitation}**

```

IF|N_SP_IS_LIM_MON_k - N_SP_IS_BAS_MON_{k-1}| > C_N_SP_IS_BAS_DIF_MAX_MON
THEN
    N_SP_IS_BAS_MON_k = min(N_SP_IS_BAS_MON_{k-1}, N_SP_IS_BAS_
MAX_MON)
ELSE
    N_SP_IS_BAS_MON_k = min(N_SP_IS_LIM_MON_k, N_SP_IS_BAS_MAX_MON)
ENDIF

```

$$FAC\_RAMP\_NEG\_P\_D\_IS\_MON = C\_FAC\_RAMP\_P\_D\_MON$$

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### E.6.3.2.2 Calculation of idle-speed setpoint model value

The outputs of the function are:

- ratio between idle speed setpoint and actual engine speed - **N\_SP\_IS\_RATIO\_MON**
- deviation of actual engine speed from idle speed setpoint - **N\_DIF\_SP\_IS\_MON**
- deviation of actual engine speed from N\_SP\_IS - **N\_DIF\_MON**

#### Formula section:

#### Plausibility check for IS\_SP request from external tester (KWP-Service)

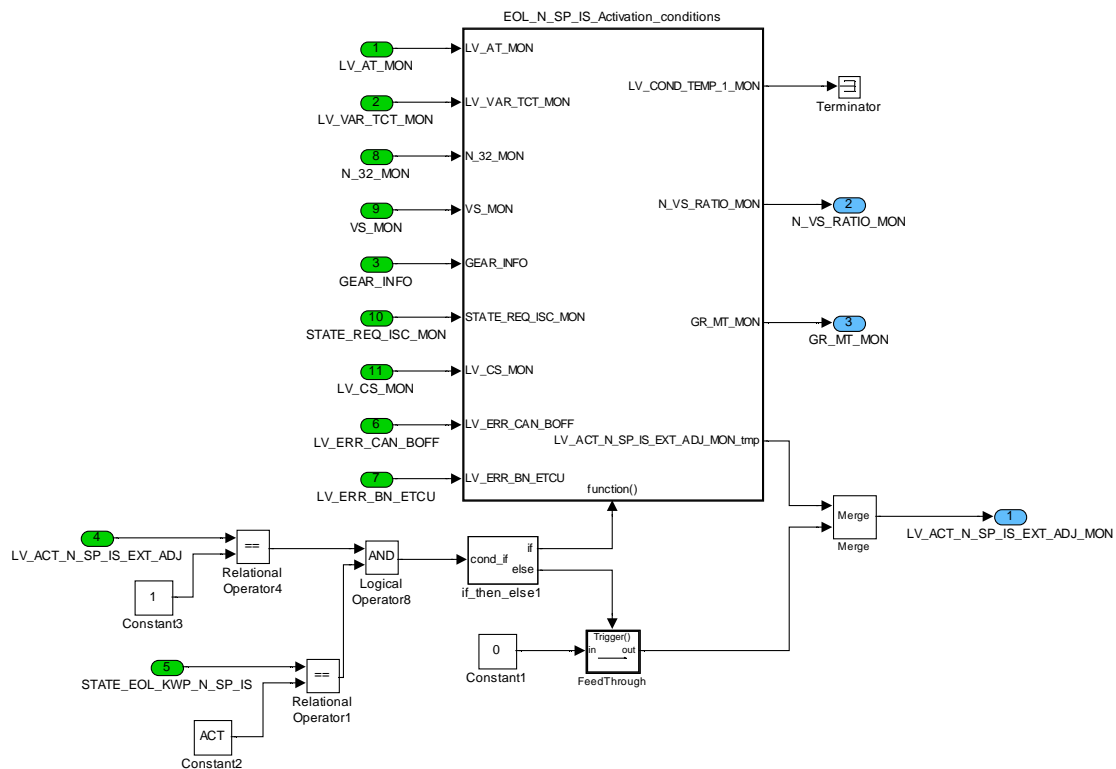


Figure E.6.1: :: ECM2\_CONFIACPR/EOLService\_N\_SP\_IS\_Displace

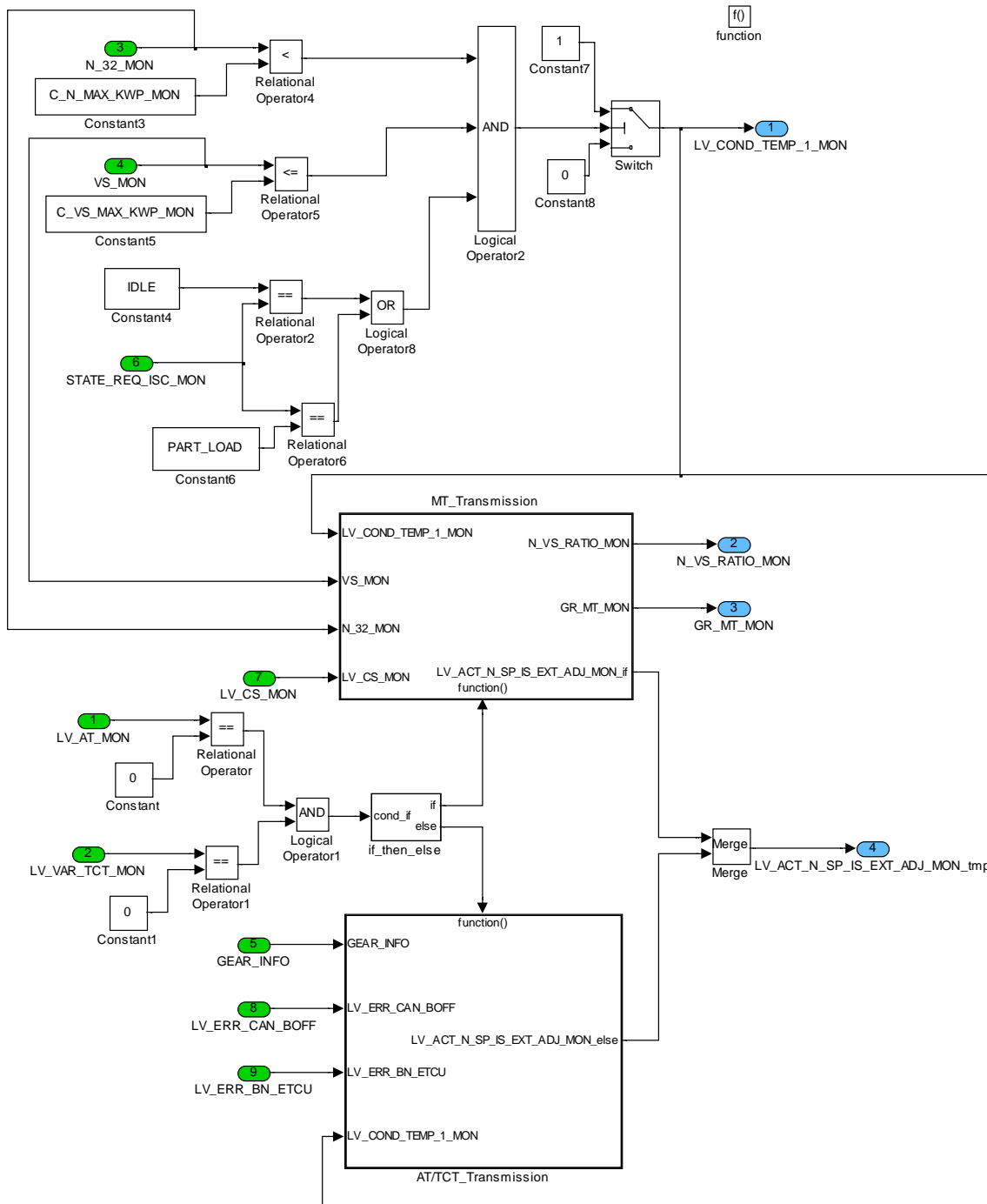


Figure E.6.2: .: ECM2\_CONFIACPR/EOLService\_N\_SP\_IS\_Displace/EOL\_N\_SP\_IS\_Activation\_conditions

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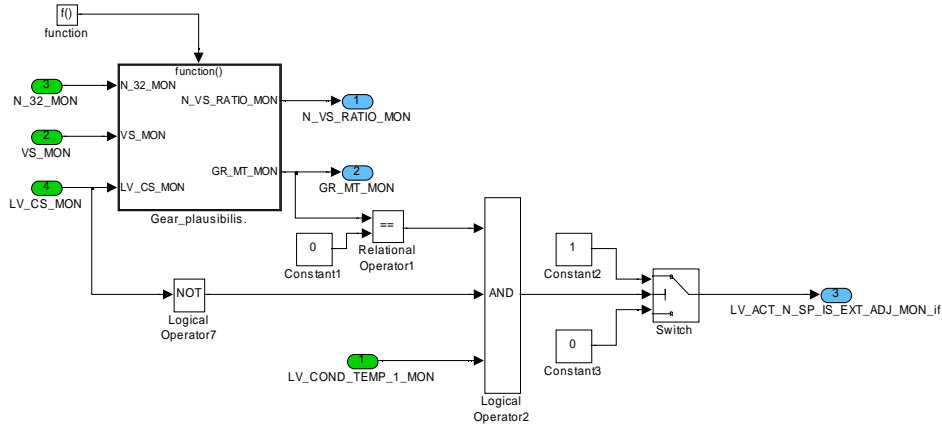


Figure E.6.3: :: ECM2\_CONFIACPR/EOLService\_N\_SP\_IS\_Displace/  
EOL\_N\_SP\_IS\_Activation\_conditions/MT\_Transmission

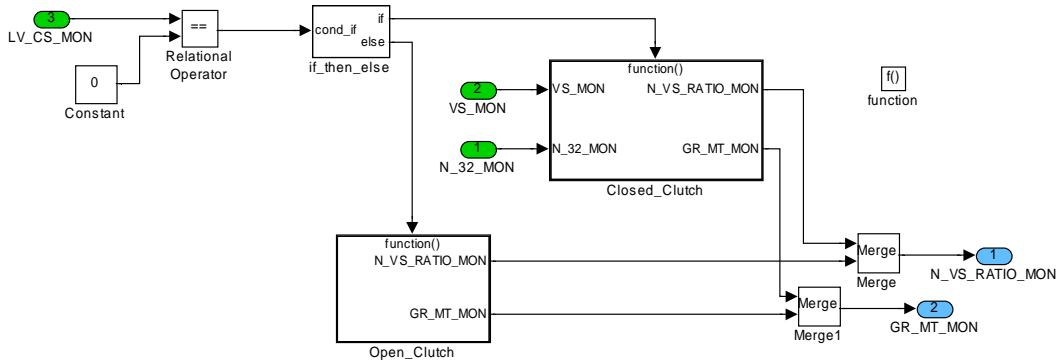


Figure E.6.4: :: ECM2\_CONFIACPR/EOLService\_N\_SP\_IS\_Displace/  
EOL\_N\_SP\_IS\_Activation\_conditions/MT\_Transmission/Gear\_plausibilis.

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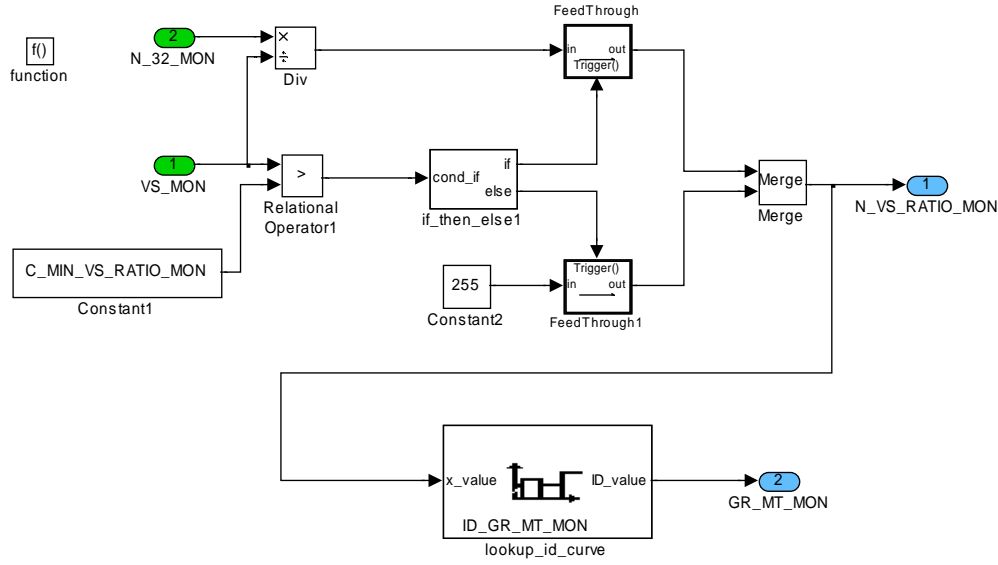


Figure E.6.5: :: ECM2\_CONFIA CPR/EOLService\_N\_SP\_IS\_Displace/  
EOL\_N\_SP\_IS\_Activation\_conditions/MT\_Transmission/Gear\_plausibilis./Closed\_Clutch

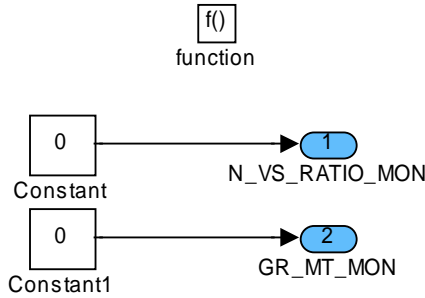


Figure E.6.6: :: ECM2\_CONFIA CPR/EOLService\_N\_SP\_IS\_Displace/  
EOL\_N\_SP\_IS\_Activation\_conditions/MT\_Transmission/Gear\_plausibilis./Open\_Clutch

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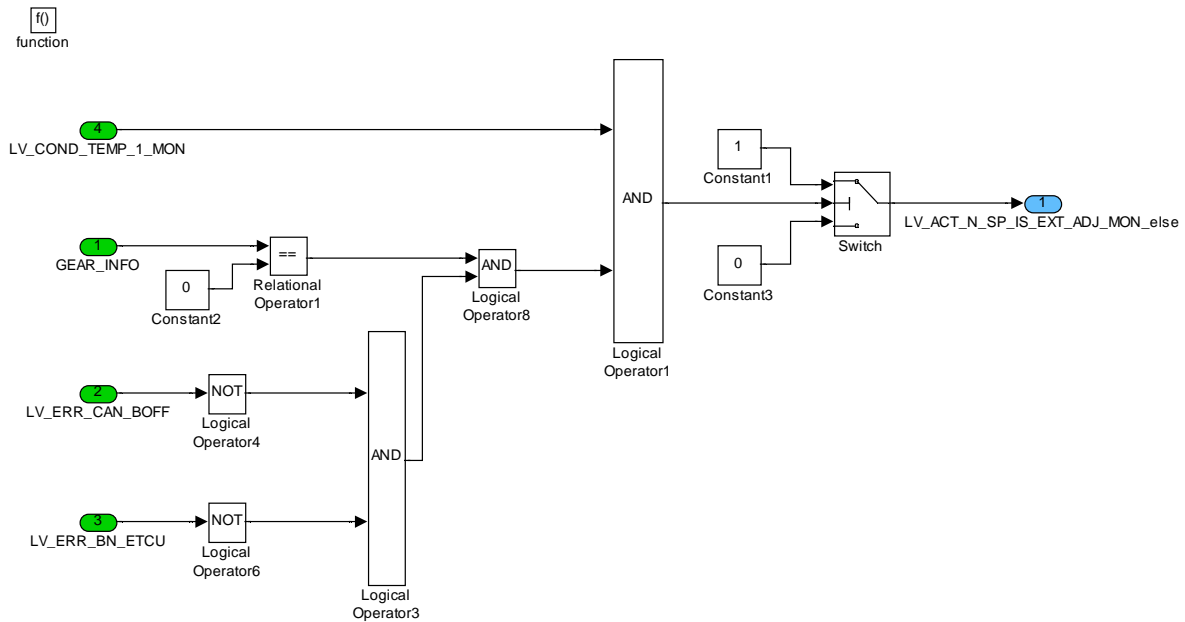


Figure E.6.7: :: ECM2\_CONFIA CPR/EOLService\_N\_SP\_IS\_Displace/  
EOL\_N\_SP\_IS\_Activation\_conditions/AT/TCT\_Transmission

### Calculation of LV\_NT\_SO2P\_EXT\_ADJ\_ENA\_MON

(raised idle speed SP due to external demand for desulfation)

```

If      LV_NT_SO2P_EXT_ADJ_ACT = 1                AND
          N_32_MON >= C_N_IS_SO2P_MIN_MON          AND
          GEAR = 0                                AND
          STATE_GEAR_REV_AT_AMT = 0                AND
          LV_CLU_SWI = 0                           AND
          VS_MON <= C_VS_SO2P_EXT_MAX_MON          AND
          PV_AV_MON <= C_PV_SO2P_EXT_MAX_MON
  
```

**Then**

```
LV_NT_SO2P_EXT_ADJ_ENA_MON = 1
```

**Else**

```
LV_NT_SO2P_EXT_ADJ_ENA_MON = 0
```

**Endif**

### Calculation of LV\_TCHA\_DIAG\_REQ\_MON

(raised idle speed SP due to external demand for charger diagnosis)

```

If      LV_TCHA_DIAG_REQ = 1                AND
          LV_CLU_SWI = 0                       AND
          VS_MON < C_VS_TCHA_DIAG_EXT_MAX_MON  AND
          PV_AV_MON < C_PV_TCHA_DIAG_EXT_MAX_MON
  
```

**Then**

```
LV_TCHA_DIAG_REQ_MON = 1
```

**Else**

```
LV_TCHA_DIAG_REQ_MON = 0
```

**Endif**

### Calculation of LV\_ACT\_N\_SP\_IS\_POIL\_EXT\_MON

(raised idle speed SP due to external demand for oil pressure diagnosis)

```

If      LV_POIL_EXT_ADJ_ACT = 1                AND
          GEAR = 0                            AND
          STATE_GEAR_REV_AT_AMT = 0           AND
          LV_CLU_SWI = 0                      AND
          VS_MON < C_VS_POIL_EXT_ADJ_MAX_MON AND
          PV_AV_MON < C_PV_POIL_EXT_ADJ_MAX_MON AND
Then
          LV_ACT_N_SP_IS_POIL_EXT_MON = 1
Else
          LV_ACT_N_SP_IS_POIL_EXT_MON = 0
Endif

```

**Calculation of N\_SP\_IS\_CS\_MON** (only if LV\_TQ\_DROF\_ACT\_MON = 1)  
(raised idle speed SP due to DROF active)

{MAX-limitation}  
 $N\_SP\_IS\_CS\_MON = \min(N\_SP\_IS\_CS, C\_N\_SP\_IS\_CS\_MAX\_MON)$

**Calculation of N\_SP\_IS\_EXT\_ADJ\_MON**  
(only if LV\_ACT\_N\_SP\_IS\_EXT\_ADJ\_MON = 1)

(raised idle speed SP due to external tester demand via K-line active)

{MAX-limitation}  
 $N\_SP\_IS\_EXT\_ADJ\_MON = \min(N\_SP\_IS\_EXT\_ADJ, C\_N\_SP\_IS\_MAX\_EXT\_ADJ\_MON)$

**Calculation of N\_SP\_IS\_EXT\_REQ\_MON**  
(idle speed SP due to active DROF or external tester demand)

```

IF          LV_ACT_N_SP_IS_EXT_ADJ_MON = 1

THEN        N_SP_IS_EXT_REQ_MON = N_SP_IS_EXT_ADJ_MON

ELSE IF    LV_TQ_DROF_ACT_MON = 1

THEN        N_SP_IS_EXT_REQ_MON = N_SP_IS_CS_MON


ELSE IF    LV_NT_SO2P_EXT_ADJ_ENA_MON = 1

THEN        N_SP_IS_EXT_REQ_MON = C_N_NT_SO2P_EXT_ADJ_ACT_MON

ELSE IF    LV_TCHA_DIAG_REQ_MON = 1

THEN        N_SP_IS_EXT_REQ_MON = min(N_SP_IS_BRAKE,
                                         C_N_TCHA_DIAG_REQ_MAX_MON)

```

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```

ELSE IF      LV_ACT_N_SP_IS_POIL_EXT_MON = 1

THEN        N_SP_IS_EXT_REQ_MON      = min(N_SP_IS_POIL_CTL,
                                           C_N_POIL_EXT_ADJ_MAX_MON)

ELSE        N_SP_IS_EXT_REQ_MON = N_SP_IS_BAS_MON

END IF

{gradient limitation}
IF(1)      N_SP_IS_EXT_REQ_MONK < N_SP_IS_EXT_REQ_MONK-1

THEN(1)

      IF(2)      CTR_N_SP_IS_EXT_REQ_DEC_MONK-1 >=
                  C_CTR_N_SP_IS_REQ_DEC_MAX_MON

      THEN(2)

            CTR_N_SP_IS_EXT_REQ_DEC_MONK = 0
            N_SP_IS_EXT_REQ_MONK =
                  min(N_SP_IS, N_SP_IS_EXT_REQ_MONK-1 -
                     C_N_SP_LGRD_IS_EXT_REQ_DEC_MON)

      ELSE(2)

            CTR_N_SP_IS_EXT_REQ_DEC_MONK =
                  CTR_N_SP_IS_EXT_REQ_DEC_MONK-1 + 1
            N_SP_IS_EXT_REQ_MONK = N_SP_IS_EXT_REQ_MONK-1

      END IF(2)

ELSE IF(1)  N_SP_IS_EXT_REQ_MONK > N_SP_IS_EXT_REQ_MONK-1

THEN(1)

      CTR_N_SP_IS_EXT_REQ_DEC_MONK = 0
      N_SP_IS_EXT_REQ_MONK = min(N_SP_IS, N_SP_IS_EXT_REQ_MONK-1 +
                                  C_N_SP_LGRD_IS_EXT_REQ_INC_MON)

ELSE(1)

      CTR_N_SP_IS_EXT_REQ_DEC_MONK = 0

END IF(1)

{Calculation of final L2 idle-speed setpoint model value}


IF (LV_N_SP_IS_LIH_ACT==1) AND (LV_ERR_PVS_RATIO_MON==1)

THEN N_SP_IS_MON = min(N_SP_IS, C_N_SP_IS_LIH_MAX_MON)

ELSE N_SP_IS_MON      =      max(N_SP_IS_BAS_MON,
                                  N_SP_IS_EXT_REQ_MON)

ENDIF

```

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```

N_SP_IS_RATIO_MON = N_32_MON / N_SP_IS_MON      {Idle-speed setpoint ratio}

{Deviation between engine speed idle-speed setpoint}

N_DIF_MON = N_SP_IS_MON - N_32_MON
{Calculation of engine speed deviation - N_DIF_COR_MON}
IF LC_N_SP_IS_CLC_INH_MON == 1
THEN {Calculation of engine speed deviation from idle setpoint}
  N_DIF_COR_MON = N_SP_IS_MON - N_32_MON
ELSE {Limitation of corrected idle speed setpoint between min& max thresholds}
  IF N_32_MON > N_SP_IS_MON
  THEN N_DIF_CRLC_MON = C_N_DIF_CRLC_HIGH_MON
  ELSE N_DIF_CRLC_MON = C_N_DIF_CRLC_LOW_MON
  ENDIF
  N_DIF_MMV_MON (n) = N_DIF_MMV_MON (n-1) + (N_DIF_MON -
  N_DIF_MMV_MON(n-1)) * N_DIF_CRLC_MON
{Calculation of engine speed deviation from corrected idle setpoint}

  N_DIF_COR_MON = N_DIF_MON - N_DIF_MMV_MON * C_N_DIF_FAC_MON
ENDIF
{Deviation between engine speed and corrected idle-speed setpoint - input for ISC}
N_DIF_SP_IS_MON = N_DIF_COR_MON

```

### E.6.3.3 Monitoring of Idle-speed controller activation conditions

#### Application conditions

**Activation:** LV\_TQI\_MON\_ACT\_MON = 1


**Deactivation:** otherwise

**Initialisation:** (for condition see Application Incidences of Process Monitoring  
**OR** LV\_TQI\_MON\_ACT\_MON = 0 1)  
**STATE\_REQ\_ISC\_MON = NOT\_ACTIVE**  
 TQ\_DIF\_P\_D\_IS\_MAX\_2\_MON = **max**(TQ\_DIF\_P\_D\_SLOW\_IS<sub>k</sub>,  
 TQ\_DIF\_P\_D\_FAST\_IS<sub>k</sub>)  
 TQ\_DIF\_P\_D\_IS\_MON = 0 Nm  
 TQ\_DIF\_P\_D\_IS\_MAX\_MON = **max**(TQ\_DIF\_P\_D\_SLOW\_IS<sub>k</sub>,  
 TQ\_DIF\_P\_D\_FAST\_IS<sub>k</sub>)  
 STATE\_PAS\_RAMP\_ACT\_P\_D\_IS\_MON = 0  
 STATE\_PAS\_RAMP\_ACT\_I\_IS\_MON = 0  
 LV\_PAS\_RAMP\_ACT\_P\_D\_CHG\_MON = 0  
 LV\_PAS\_RAMP\_ACT\_I\_CHG\_MON = 0

**Update Rate:** 40 ms

#### General information:

The ISC can be active either when the engine state idle is requested (LV\_REQ\_ISC = 1) or when the DROF functionality is active or under certain conditions in trailing-throttle state (LV\_PU=1) and part-load state (LV\_PL=1) and. So all of these possible ISC-active phases have to be monitored. The activation conditions are based on the L1 ISC activation conditions as described in the module Application incidences for the idle speed controller. In addition to the normal activation states, a NOT\_ACTIVE state is generated in order to be able to monitor the ISC if the activation information from the function level is faulty.

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**Formula section:**

**{The L1 ISC-Torque demand signal is copied to the process monitoring (L2) RAM}**      TQ\_DIF\_P\_D\_IS\_MON<sub>k</sub> = max(TQ\_DIF\_P\_D\_SLOW\_IS<sub>k</sub>, TQ\_DIF\_P\_D\_FAST\_IS<sub>k</sub>)

**{L2 threshold of normal PD-part torque request}**

TQ\_DIF\_P\_D\_IS\_MAX\_1\_MON = IP\_TQ\_DIF\_P\_D\_IS\_MAX\_MON(N\_DIF\_SP\_IS\_MON<sub>k</sub>)

**{Calculation of monitoring threshold for PD-part and corresponding filter parameters. Filtering only in falling direction.}**

**IF** TQ\_DIF\_P\_D\_IS\_MAX\_1\_MON<sub>k</sub> < TQ\_DIF\_P\_D\_IS\_MAX\_2\_MON<sub>k-1</sub>

**THEN** TQ\_DIF\_P\_D\_IS\_MAX\_2\_MON<sub>k</sub> =

    [C\_FIL\_TQ\_P\_D\_IS\_MAX\_MON \* TQ\_DIF\_P\_D\_IS\_MAX\_1\_MON<sub>k</sub>  
    + (1- C\_FIL\_TQ\_P\_D\_IS\_MAX\_MON) \* TQ\_DIF\_P\_D\_IS\_MAX\_2\_MON<sub>k-1</sub>]

**ELSE** TQ\_DIF\_P\_D\_IS\_MAX\_2\_MON<sub>k</sub> = TQ\_DIF\_P\_D\_IS\_MAX\_1\_MON<sub>k</sub>

**ENDIF**

TQ\_DIF\_P\_D\_IS\_MAX\_MON<sub>k</sub> = TQ\_DIF\_P\_D\_IS\_MAX\_2\_MON<sub>k</sub>

    \* IP\_FAC\_TQ\_DIF\_P\_D\_IS\_MON(TCO\_MON)

**{Evaluation of ISC-deactivation-ramp status in L1 to check for activation during current recurrence or between two L2 recurrences. To simplify the usage of individual Bit positions in the formula section, the following representation will be used:**

STATE\_PAS\_RAMP\_ACT\_P\_D\_IS\_MON(i) = STATE\_PAS\_RAMP\_ACT\_P\_D\_IS\_MON : Bit i where i=0 ... 4

STATE\_PAS\_RAMP\_ACT\_I\_IS\_MON (j) = STATE\_PAS\_RAMP\_ACT\_I\_IS\_MON : Bit j where j=0 ... 2}

STATE\_PAS\_RAMP\_ACT\_P\_D\_IS\_MON = STATE\_PAS\_RAMP\_ACT\_P\_D\_IS

**IF** {(STATE\_PAS\_RAMP\_ACT\_P\_D\_IS\_MON (0) == 1

**AND** STATE\_PAS\_RAMP\_ACT\_P\_D\_IS\_MON (4) == 0)

**OR** [ ( STATE\_PAS\_RAMP\_ACT\_P\_D\_IS\_MON (0) == 1

**AND** STATE\_PAS\_RAMP\_ACT\_P\_D\_IS\_MON (4) == 1 )

**AND** (STATE\_PAS\_RAMP\_ACT\_P\_D\_IS\_MON (1) == 0

**OR** STATE\_PAS\_RAMP\_ACT\_P\_D\_IS\_MON (2) == 0

**OR** STATE\_PAS\_RAMP\_ACT\_P\_D\_IS\_MON (3) == 0 ) ]

**OR** (LV\_TQI\_MON\_ACT\_MON = 0 1 **AND** STATE\_PAS\_RAMP\_ACT\_P\_D\_IS\_MON (0) ==

1))

**THEN** LV\_PAS\_RAMP\_ACT\_P\_D\_CHG\_MON = 1

**ELSE** LV\_PAS\_RAMP\_ACT\_P\_D\_CHG\_MON = 0

**ENDIF**

STATE\_PAS\_RAMP\_ACT\_I\_IS\_MON = STATE\_PAS\_RAMP\_ACT\_I\_IS

**IF** (STATE\_PAS\_RAMP\_ACT\_I\_IS\_MON (0) == 1

**AND** STATE\_PAS\_RAMP\_ACT\_I\_IS\_MON(2) == 0)

**OR** [STATE\_PAS\_RAMP\_ACT\_I\_IS\_MON (0) == 1

**AND** STATE\_PAS\_RAMP\_ACT\_I\_IS\_MON (2) == 1

**AND** STATE\_PAS\_RAMP\_ACT\_I\_IS\_MON (1) == 0 ]

**OR** (LV\_TQI\_MON\_ACT\_MON = 0 1 **AND** STATE\_PAS\_RAMP\_ACT\_I\_IS\_MON (0) == 1)

**THEN** LV\_PAS\_RAMP\_ACT\_I\_CHG\_MON = 1


**ELSE** LV\_PAS\_RAMP\_ACT\_I\_CHG\_MON = 0

**ENDIF**

**{Plausibilisation of ISC activation conditions}**

**IF**[(N\_DIF\_MON C\_N\_DIF\_MAX\_IS\_MON) **AND** (LV\_CT\_MON == 1)

**AND** (LV\_REQ\_ISC == 1)]

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```

THENSTATE_REQ_ISC_MON = IDLE
ELSE IF[ (N_DIF_MON < C_N_DIF_MAX_IS_MON - C_N_DIF_HYS_IS_PU_MON)
        AND (LV_CT_MON = 1) AND (T_CTR_PU_ISC_ACT == 0)]
    THEN STATE_REQ_ISC_MON = TRAILING_THR
    ELSE IF (LV_TQ_DROF_ACT_MON == 1 AND LC_TQ_DROF_ISC_OFF_MON == 0)
        OR ((N_SP_IS_MON < C_N_SP_IS_MAX_PL_ACT_MON) AND (LV_CT_MON
        == 0) AND (N_DIF_MON > C_N_DIF_MAX_PL_ACT_MON))
        OR LV_MSR_ACT_MON = 1
        THENSTATE_REQ_ISC_MON = PART_LOAD
        ELSE STATE_REQ_ISC_MON = NOT_ACTIVE
        ENDIF
    ENDIF
ENDIF
ENDIF

```

## E.6.4 Application incidences for monitoring of pedal value signals

### FUNCTION DESCRIPTION:

#### General information:

In order to be able to use the generic module for the monitoring of the pedal value signals in level 2, different information about the state of the brake are combined to one resulting information LV\_BRAKE\_MON. It is set, when at least one sensor (brake light switch or brake test switch) indicates an activated brake or a fault of a brake switch has been detected. The switch signals are read directly from port.

#### Application conditions

**Activation:** at every engine state

**Deactivation:** otherwise

**Initialisation:** for condition see Application Incidences of Process Monitoring

**Update Rate:** 40 ms

#### Formula section:

```

If          (LV_IM_BLS_MON = 1)           Or
            (LV_IM_BTS_MON = 1)           Or
            (LV_ERR_BLS_PLAUS = 1)
Then       LV_BRAKE_MON = 1
Else       LV_BRAKE_MON = 0
Endif

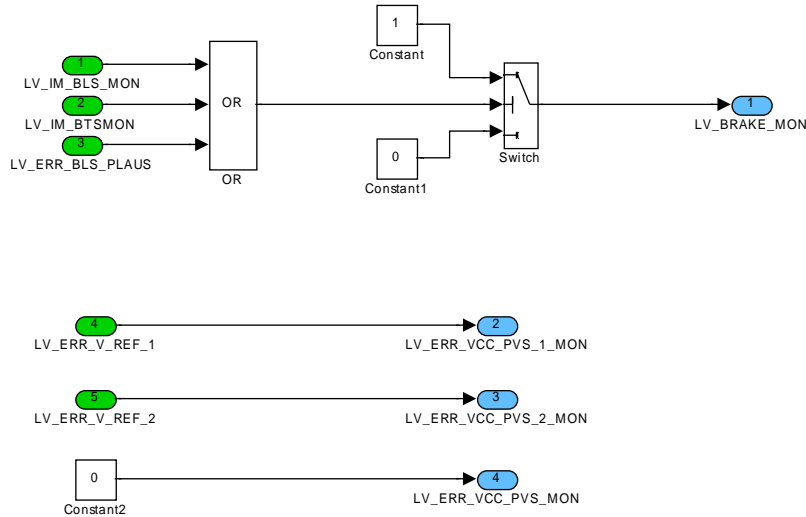
```

#### Supply voltage error bits:

```

LV_ERR_VCC_PVS_1_MON      = LV_ERR_V_REF_1
LV_ERR_VCC_PVS_2_MON      = LV_ERR_V_REF_2
LV_ERR_VCC_PVS_MON        = 0

```



## E.6.5 Adaptation of OPM\_AV to OPM\_AV\_MON

### General information:

### Application conditions

**Activation:** LV\_TQI\_MON\_ACT\_MON = 1

**Deactivation:** otherwise

**Initialisation:** for condition see Application Incidences of Process Monitoring  
And at LV\_TQI\_MON\_ACT\_MON 1 -> 0 OPM\_AV\_MON is set to  
AFS

**Update Rate:** 40 ms

### FUNCTION DESCRIPTION:

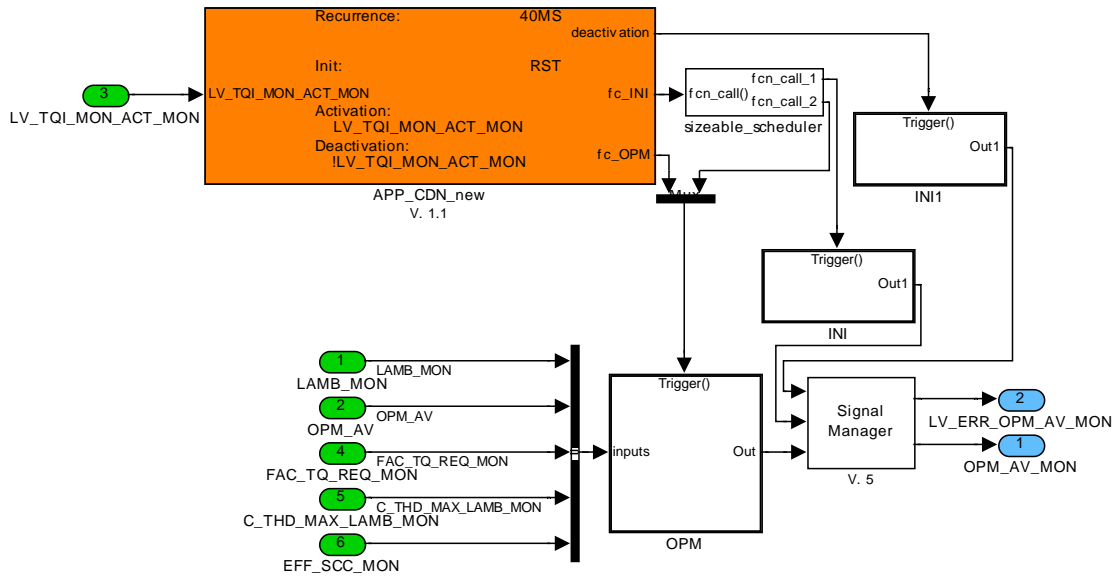


Figure 1: ECM2\_DTSYSMODULE

E.6.5.1 SUBFUNCTION: INIT

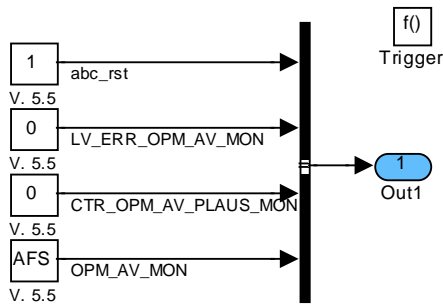


Figure E.6.8: : ECM2\_DTSYSMODULE/INIT

E.6.5.2 SUBFUNCTION: INIT1

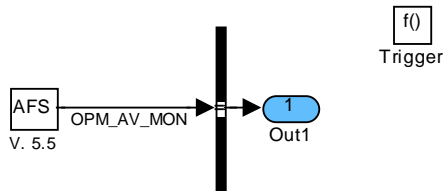


Figure E.6.9: : ECM2\_DTSYSMODULE/INIT1

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### E.6.5.3 SUBFUNCTION: OPM

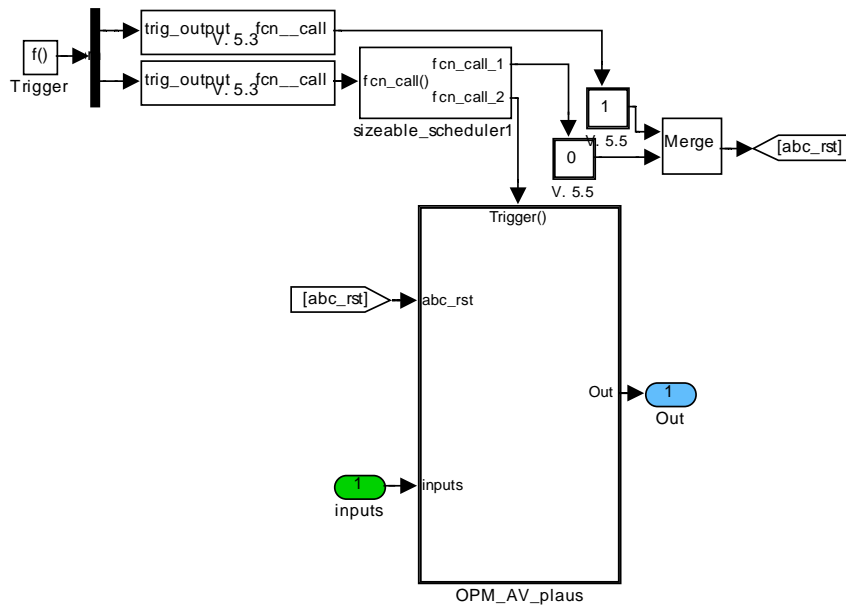



Figure E.6.10: : ECM2\_DTSYSMODULE /OPM

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### E.6.5.4 SUBFUNCTION: OPM\_AV\_plaus

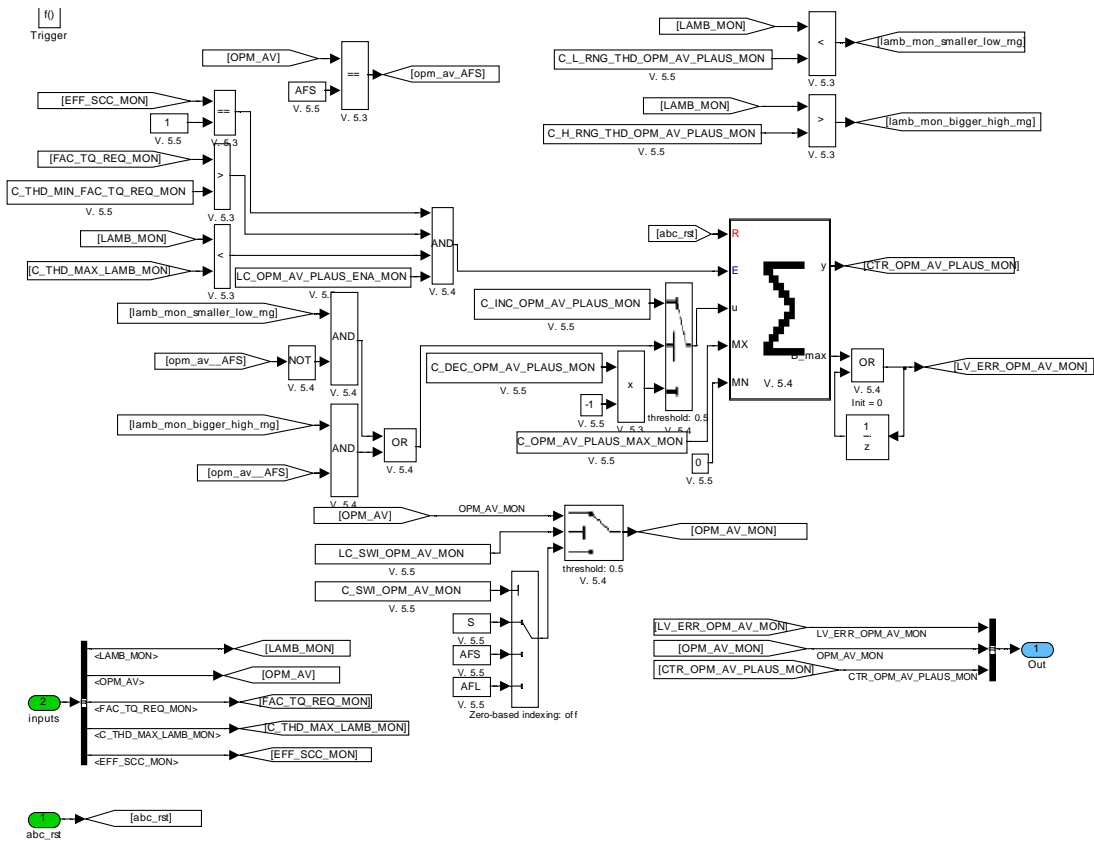


Figure E.6.11: : ECM2\_DTSYSMODULE /OPM/OPM\_AV\_PLAUS

## E.6.6 Application incidences for the monitoring of torque losses

### FUNCTION DESCRIPTION:

#### General information:

In order to be able to use module for the monitoring of torque losses in level 2 the not engine related additional torque losses are calculated here.

The level 1 value of each additional torque loss will be compared with a modelled one. The larger value (minimum absolute Torque value) of the two is added to the sum TQ\_LOSS\_ADD\_MON.


#### Application conditions

**Activation:** LV\_TQI\_MON\_ACT\_MON = 1

**Deactivation:** otherwise

**Initialisation:** for condition see Application Incidences of Process Monitoring  
 TQ\_LOSS\_ADD\_MON = 0  
 VS\_MON = 0 km/ h  
 TQ\_LOSS\_ADD\_FIL\_MON = 0  
 TQ\_REQ\_CLU\_MON = 0

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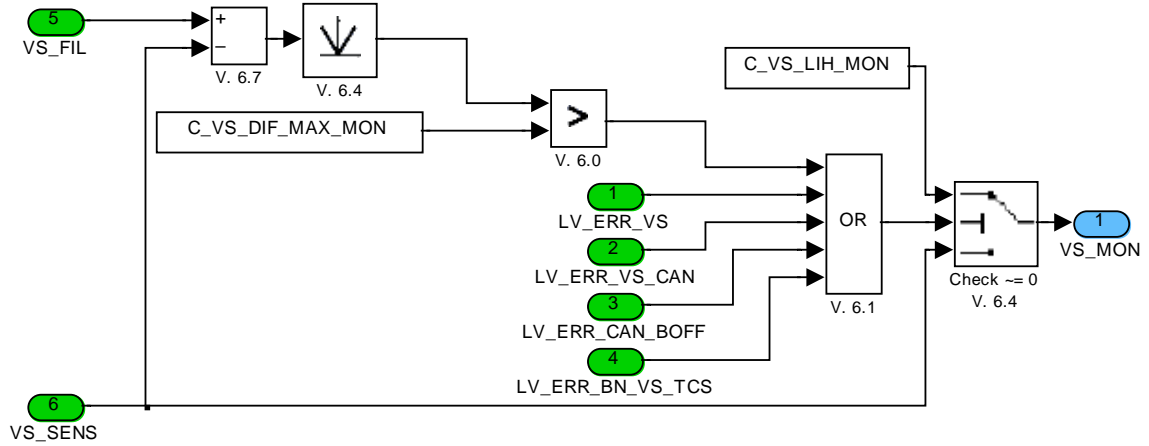
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```
TQ_REQ_CLU_GRD_MON = 0
TQ_LOSS_FIL_MMV_MON =
max(TQ_LOSS_ADD_FIL , C_TQ_LOSS_FIL_MMV_INI_MIN_MON)
```


**Recurrence:** 40 ms

**Signal flow diagram:**

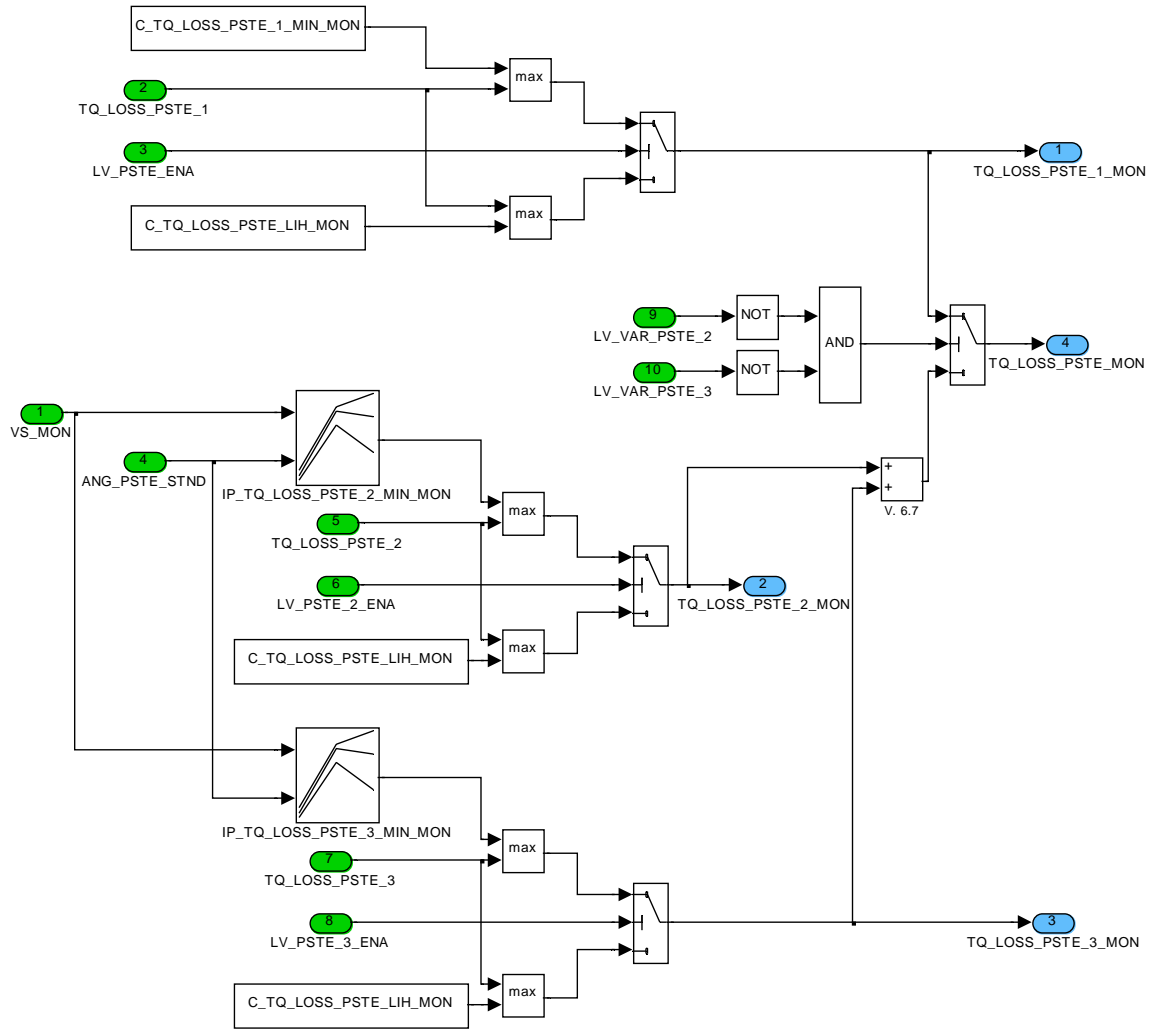
**E.6.6.1 Monitoring of vehicle speed**



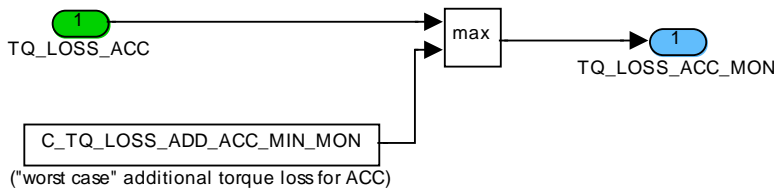
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### E.6.6.2 Monitoring of torque losses for powersteering



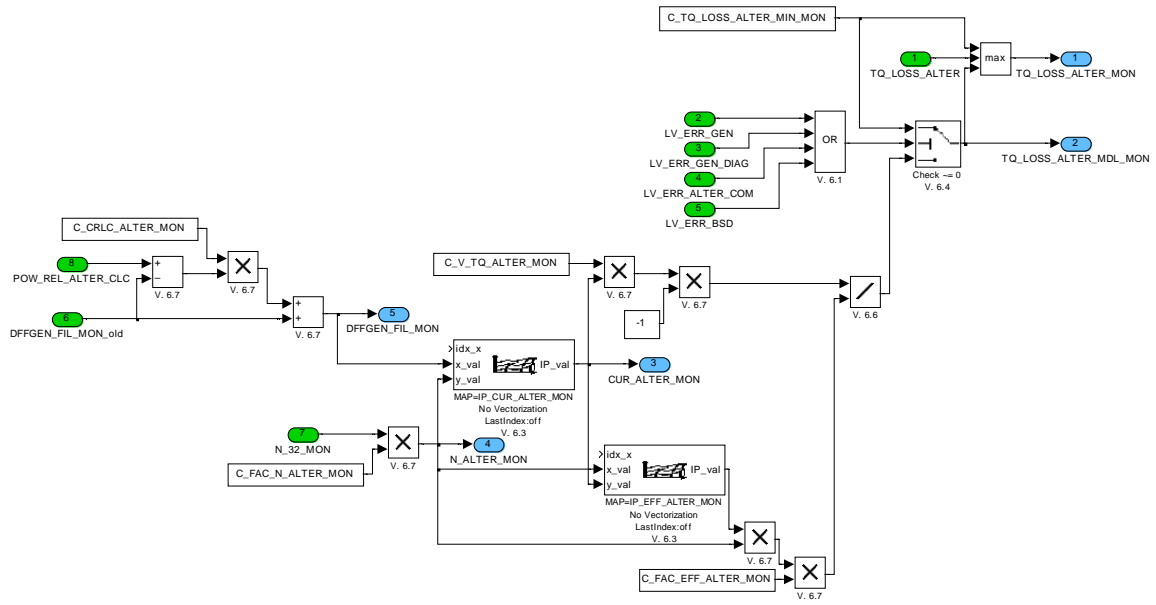
### E.6.6.3 Monitoring of torque losses for ACC



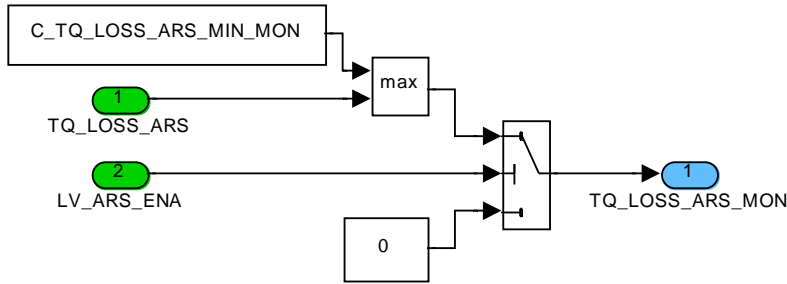
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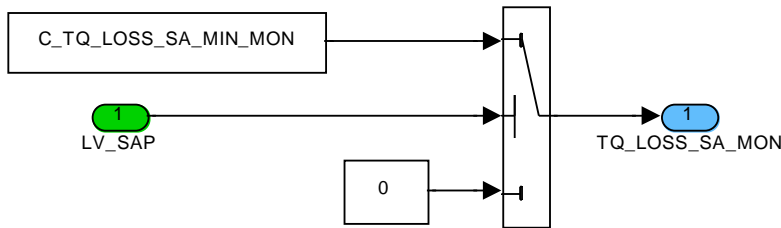
### E.6.6.4 Monitoring of torque losses for alternator



### E.6.6.5 Monitoring of torque losses for anti roll stabilisation

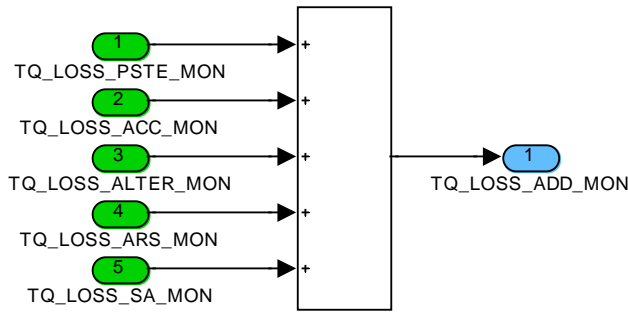


### E.6.6.6 Monitoring of torque losses for secondary air

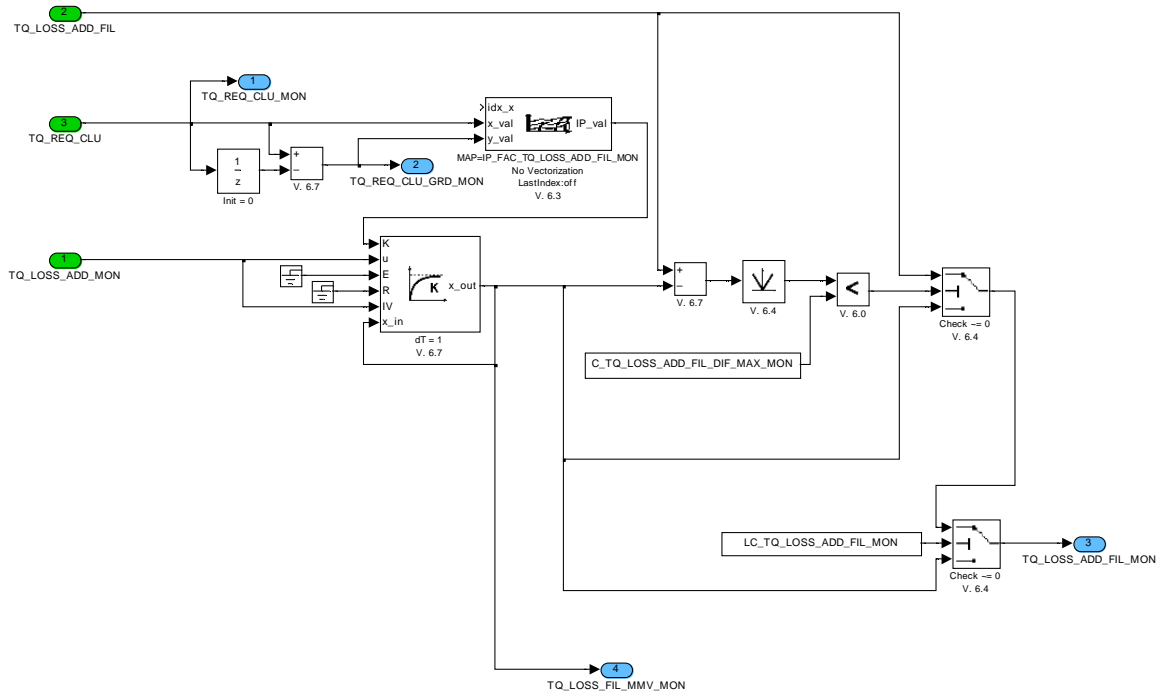


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### E.6.6.7 Calculation of the additional torque losses



### E.6.6.8 Calculation of the filtered additional torque losses



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## E.6.7 Application incidences for the actual lambda deviation


### E.6.7.1 ECM2\_DTSYSLADIF

#### General information:

#### Application conditions

**Activation:** LV\_TQI\_MON\_ACT\_MON = 1

**Deactivation:** otherwise

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**Initialisation:** for condition see Application Incidences of Process Monitoring

**Update Rate:** 40 ms

**FUNCTION DESCRIPTION:**

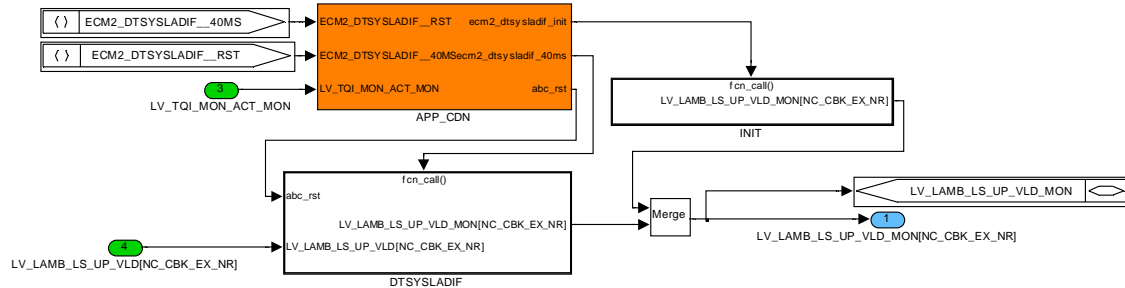


Figure E.6.12: : ECM2\_DTSYSLADIF

**E.6.7.1.1 SUBFUNCTION: INIT**

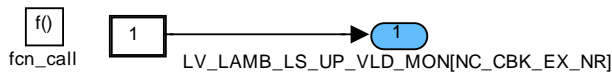


Figure E.6.13: : ECM2\_DTSYSLADIF/INIT

**E.6.7.1.2 SUBFUNCTION: determination\_of\_act\_lamb\_dev\_value**

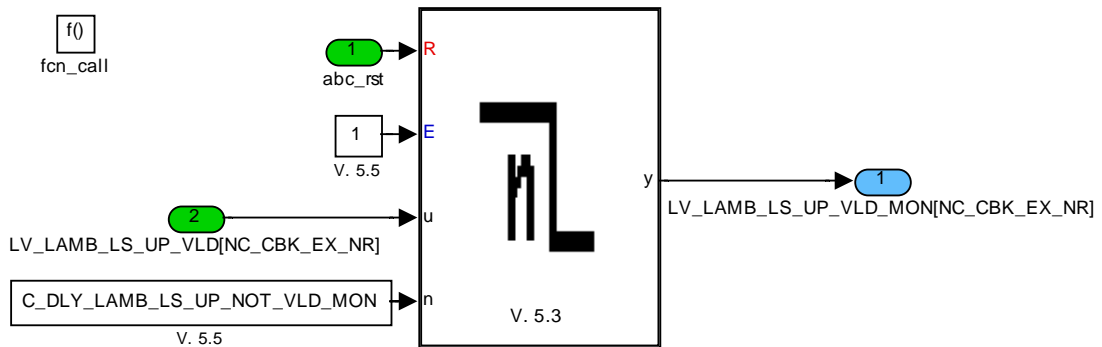



Figure E.6.14: : ECM2\_DTSYSLADIF/determination\_of\_act\_lamb\_dev\_value

**E.6.8 Forced injection shut-off for Level 2 - engine speed limitation**

**FUNCTION DESCRIPTION:**

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**General information:**

In order to ensure a safe injection cut off while engine speed limitation is active (LV\_N\_LIM\_ETC\_MON == 1) and engine speed is above the threshold C\_N\_THD\_FCUT\_N\_LIM\_ETC\_MON, the resulting logical variable LV\_OFF\_IV\_N\_LIM\_ETC\_MON is used at individual cylinder shut off functionality (same use and priority as LV\_OFF\_IV\_MON).

**Application conditions**

**Activation:** at every engine state

**Deactivation:** otherwise

**Initialisation:** for condition see Application Incidences of Process Monitoring  
LV\_OFF\_IV\_N\_LIM\_ETC\_MON = 0

**Update Rate:** 40 ms

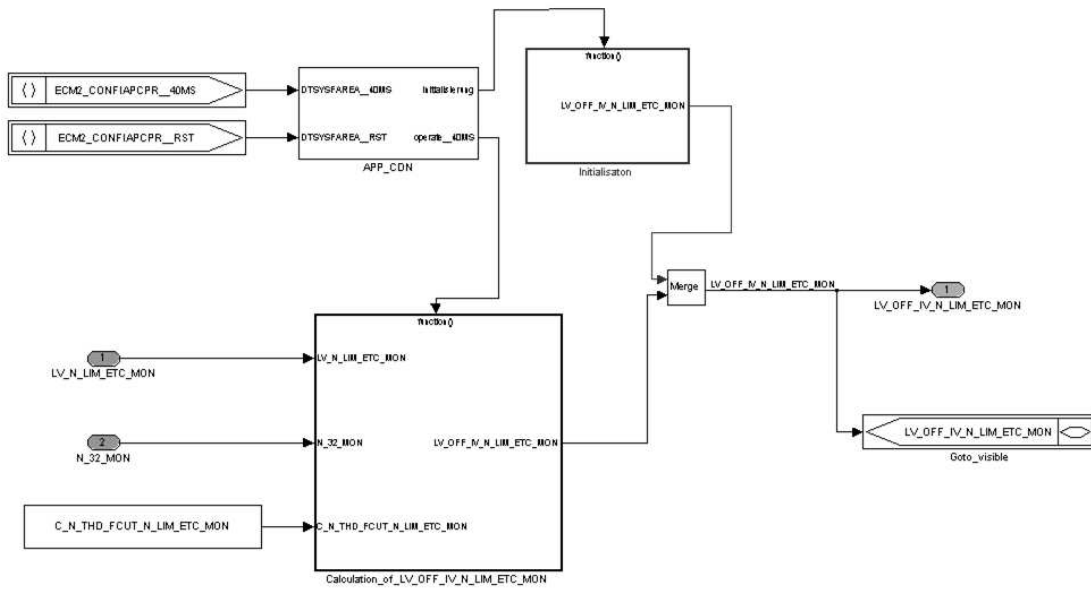


Figure E.6.15: : CONFIAPCPR

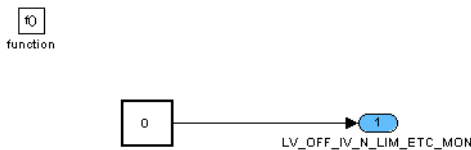


Figure E.6.16: : CONFIAPCPR /Initialisation

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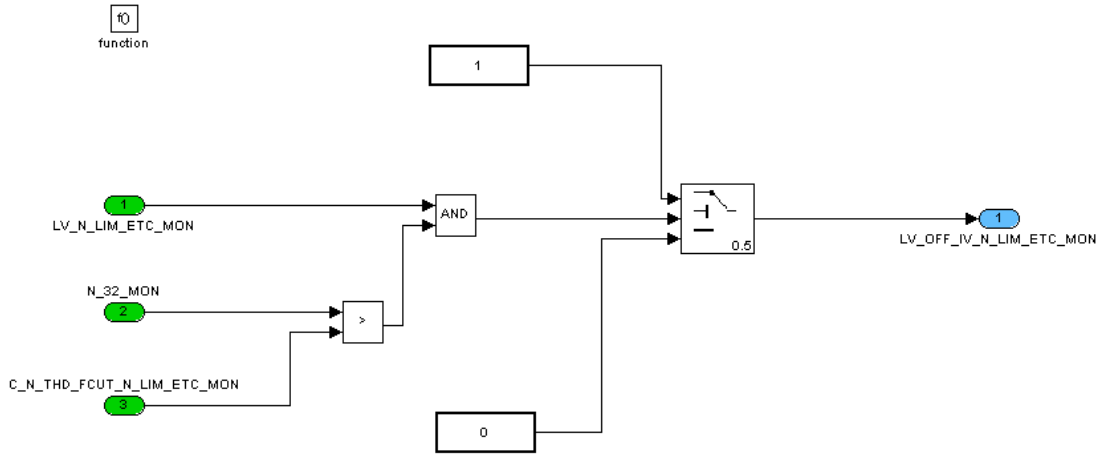


Figure E.6.17: : CONFIAPCPR/Calculation\_of\_LV\_OFF\_IV\_N\_LIM\_ETC\_MON

### E.6.9 State of torque intervention when level 2/3 error is detected

**General information:**

When a level 2/3 error is present except monitoring of cruise control the CAN status flag SF\_TQD = 3 is set via LV\_SF\_TQD\_MON = 1:

**Formula section:**

Error bit	SF_TQD
LV_ERR_CONV_MON	LV_SF_TQD_MON = 1
LV_ERR_MSR_INH_MON	LV_SF_TQD_MON = 1
LV_ERR_N_32_MON	LV_SF_TQD_MON = 1
LV_ERR_PVS_MON	LV_SF_TQD_MON = 1
LV_ERR_MFF_MON	LV_SF_TQD_MON = 1
LV_ERR_CRU_INH_MON	LV_SF_TQD_MON = 0
LV_ERR_TQI_AV_MON	LV_SF_TQD_MON = 1
LV_ERR_TQI_N_MAX_MON	LV_SF_TQD_MON = 1
LV_ERR_MU_MC	LV_SF_TQD_MON = 1
LV_ERR_DCC_INH_MON	LV_SF_TQD_MON = 1
LV_ERR_AMT_INH_MON	LV_SF_TQD_MON = 1
LV_ERR_GS_INH_MON	LV_SF_TQD_MON = 1
LV_ERR_LDM_INH_MON	LV_SF_TQD_MON = 1

### E.6.10 Application incidences for the cruise control input

**Formula section:**

$$LV\_ERR\_CRU\_INH\_MON = LV\_ERR\_CRU\_MON$$

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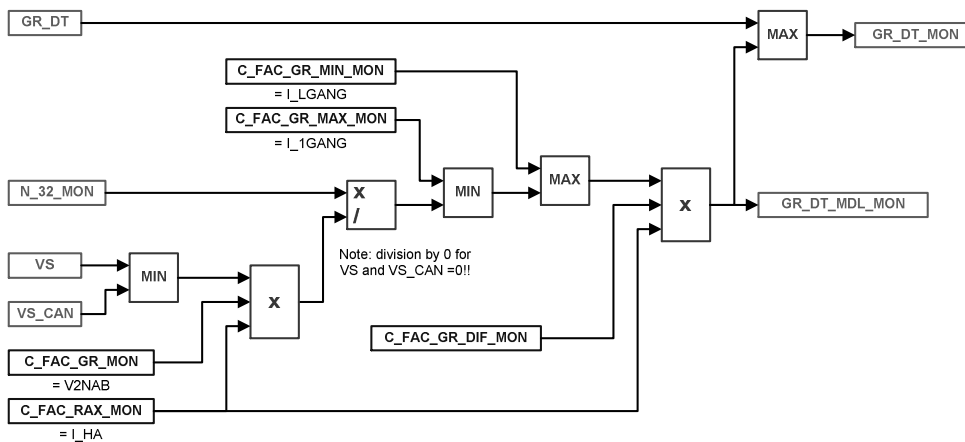
## E.6.11 Application incidences for the IPM-monitoring

### FUNCTION DESCRIPTION:

#### General information:

For the monitoring of the torque request from IPM (intelligent powertrain management) it is necessary to determine the gear ratio factor GR\_DT\_MON.

#### Signal flow diagram:



#### Application conditions

**Activation:** LV\_TQI\_MON\_ACT\_MON = 1

**Deactivation:** otherwise

**Initialisation:** for condition see Application Incidences of Process Monitoring  
 GR\_DT\_MON = 1  
 GR\_DT\_MDL\_MON = 1

**Update Rate:** 40 ms


#### Formula section:

##### Gear ratio of gear box:

$$GR\_DT\_MDL\_MON\_1 = \frac{(N\_32\_MON / 60) / ((\text{MIN}(VS; VS\_CAN) / 3.6) * C\_FAC\_GR\_MON * C\_FAC\_RAX\_MON)}{N\_32 \text{ in } [1/\text{sec}] \cdot VS \text{ in } [m/\text{sec}] \cdot 1/\text{wheelcircumference} \cdot \text{gear ratio rear axle}}$$

Note: for VS and VS\_CAN = 0 there is a division by zero!

##### Limitation of gear ratio of gear box:

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$$\text{GR\_DT\_MDL\_MON\_2} = \text{MAX}(\text{C\_FAC\_GR\_MIN\_MON}; \text{limit longest gear})$$

$$\text{GR\_DT\_MDL\_MON\_1} = \text{MIN}(\text{C\_FAC\_GR\_MAX\_MON}; \text{limit shortest gear})$$

Modelled total gear ratio of powertrain

$$\text{GR\_DT\_MDL\_MON} = \frac{\text{GR\_DT\_MDL\_MON\_2} * \text{C\_FAC\_GR\_DIF\_MON} * \text{C\_FAC\_RAX\_MON}}{\text{C\_FAC\_RAX\_MON}}$$

Powertrain gear ratio used for monitoring:

$$\text{GR\_DT\_MON} = \text{MAX}(\text{GR\_DT}; \text{GR\_DT\_MDL\_MON})$$

## E.6.12 Application incidences for the monitoring of CAN signals

### Application conditions

**Activation:** LV\_TQI\_MON\_ACT\_MON = 1

**Deactivation:** otherwise

**Initialisation:** for condition see Application Incidences of Process Monitoring

**Recurrence:** 40ms

### Formula section:

#### Plausibilisation of active MSR

```
IF          LV_MSR_ACT = 1 AND(TQI_MSR_MON > 0 OR TQ_MSR_MON > 0)
THEN       LV_MSR_ACT_MON = 1
ELSE       LV_MSR_ACT_MON = 0
ENDIF
```

#### Torque demand from external CAN signals

```
IF(1)      LV_VAR_BN = 0
THEN(1)    TQI_INC_CAN_MON = max      (TQI_MSR_MON, TQI_AMT_MON, TQI_GS_MON)
ELSEIF(1)  (LV_VAR_BN = 1)
            IF(2)      TQ_MSR_MON = 0                AND
                       TQ_DCC_MON = 0                AND
                       TQ_WHEEL_LDM_MON = 0          AND
                       TQ_AMT_MON = 0                AND
                       TQ_GS_MON = 0
            THEN(2)    TQI_INC_CAN_MON = 0
            ELSE(2)    TQI_INC_CAN_MON =
                       [max      (TQ_MSR_MON, TQ_DCC_MON,
                       TQ_WHEEL_LDM_MON /GR_DT_MON, TQ_AMT_MON,
                       TQ_GS_MON)] - TQ_LOSS_MON
            ENDIF(2)
ENDIF(1)
```

## E.6.13 Application incidences for the monitoring of minimum torque at clutch

## FUNCTION DESCRIPTION:

### General information:

The objective of this function is the determination of the error-detection paths of the minimum torque at clutch. The error-detection is divided into PU state and non-PU state. This separation is done because the biggest influence on the value of the minimum torque that is available at the clutch is the self-stabilising factor FAC\_N\_SP\_IS\_RATIO\_MON and this has a parabolic trajectory where the transition point from the positive values to TQ\_LOSS\_MON is around the idle-speed setpoint (N\_SP\_IS\_MON). STATE\_ERR\_DET\_TQ\_MIN\_MON is an input into the module Monitoring of minimum torque at clutch

### Application conditions

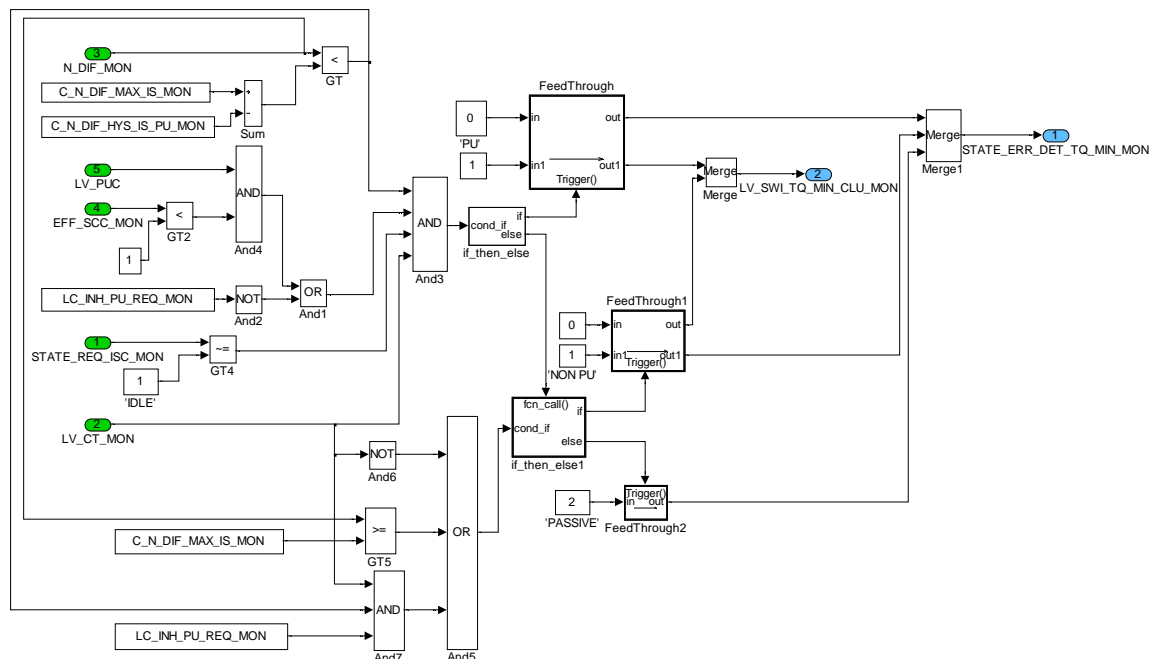
**Activation:** LV\_TQI\_MON\_ACT\_MON = 1

**Deactivation:** otherwise

**Initialisation:** for condition see Application Incidences of Process Monitoring  
 STATE\_ERR\_DET\_TQ\_MIN\_MON = PASSIVE  
 TQ\_ADD\_MIN\_CLU\_MON = 0 Nm  
 TQ\_CONV\_MAX\_MON = 0 Nm  
 TQ\_CONV\_MAX\_MDL\_MON = 0 Nm  
 LV\_SWI\_TQ\_MIN\_CLU\_MON = 0

**Update Rate:** 40 ms

### Formula section:

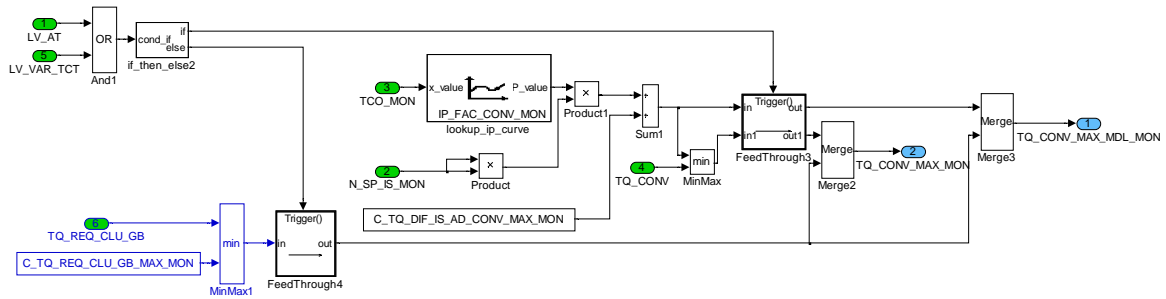


{Calculation of Maximum Converter Torque

If a CVT system is used, then the torque demand/engine load resulting from the transmission has to be considered here. If this value is transmitted from the TCU via CAN, then it has to be checked first in the module Monitoring of CAN-signals and only then used here. If a normal automatic transmission is



used, then the torque losses resulting from the converter can be calculated as given below. The torque request of the manual gearbox is considered here. }



Application incidences for the actual efficiencies

### E.6.13.1 CONFIAPCPR

#### General information:

The calculation of IGA\_REF\_HOM\_COR\_EXT\_MON and IGA\_REF\_HOMS\_COR\_EXT\_MON is an additive combination of limited values of level 1. The limitation of each single value allows having a close tolerance range for monitoring.

Furthermore, MFF\_LAMB\_REF\_IGA\_MON has to be provided for the "Actual Efficiencies" as scavaging corrected MFF-value.

#### Application conditions:

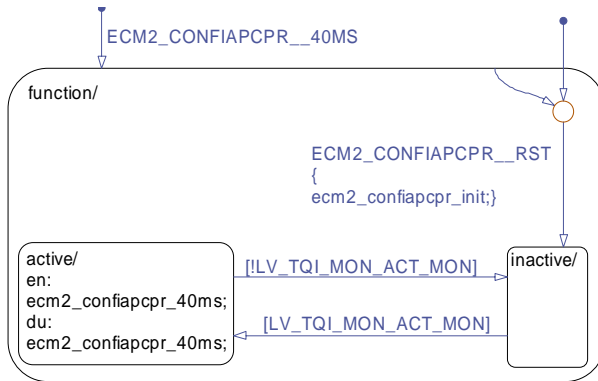



Figure E.6.18: : ECM2\_CONFIAPCPR/APP\_CDN\_Chart

#### FUNCTION DESCRIPTION:

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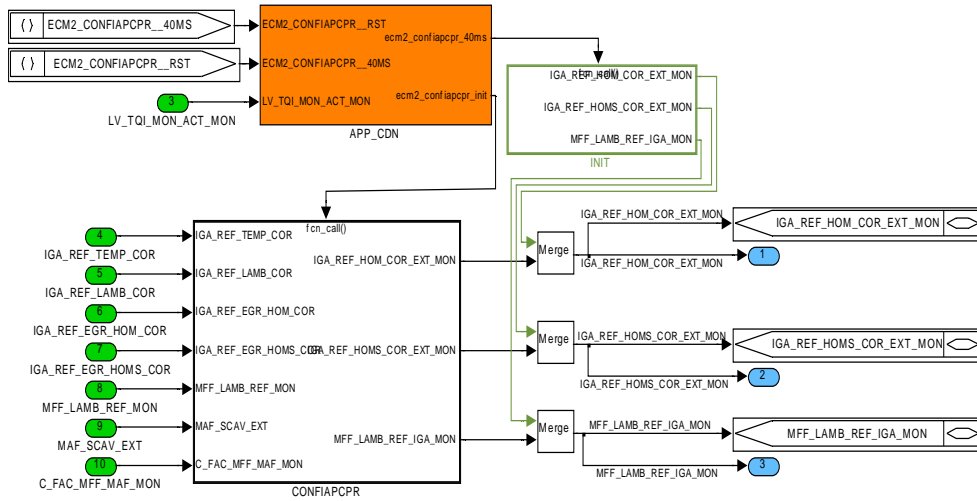


Figure E.6.19: : ECM2\_CONFIAPCPR

E.6.13.1.1 SUBFUNCTION: INIT

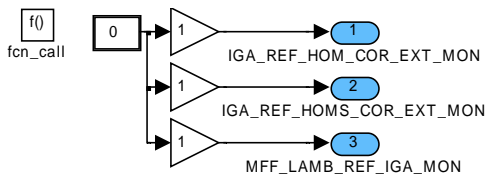


Figure E.6.20: : ECM2\_CONFIAPCPR/INIT

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### E.6.13.1.2 SUBFUNCTION: CONFIAPCPR

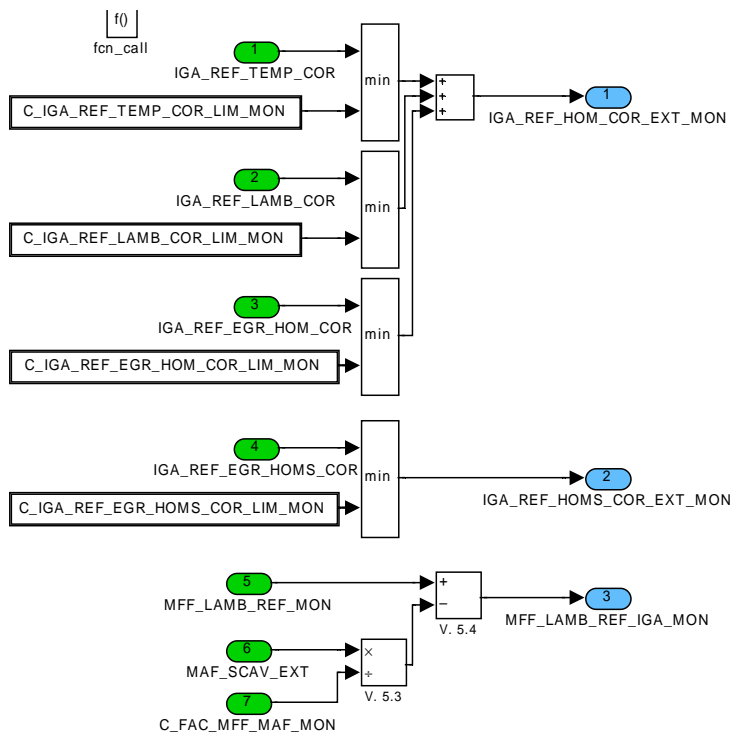


Figure E.6.21: : ECM2\_CONFIAPCPR/CONFIAPCPR

## E.6.14 Application incidences for the actual indicated engine torque

### E.6.14.1 CONFIAPCPR

#### General information:

#### Application conditions:

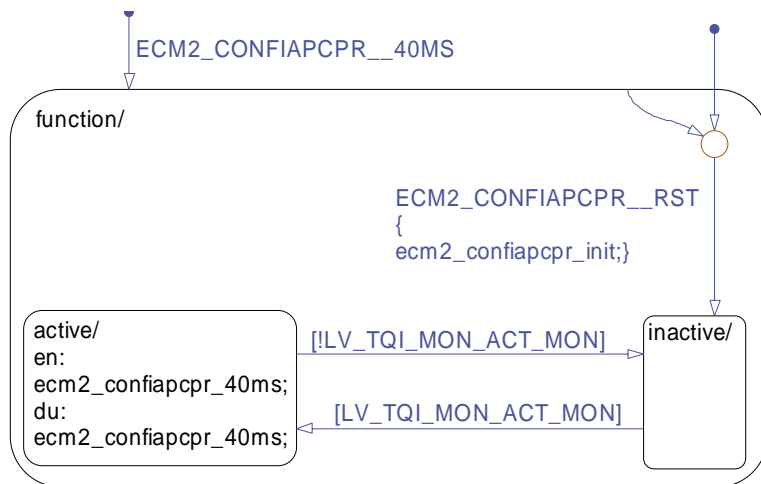


Figure E.6.22: : ECM2\_CONFIAPCPR/APP\_CDN\_Chart

**FUNCTION DESCRIPTION:**

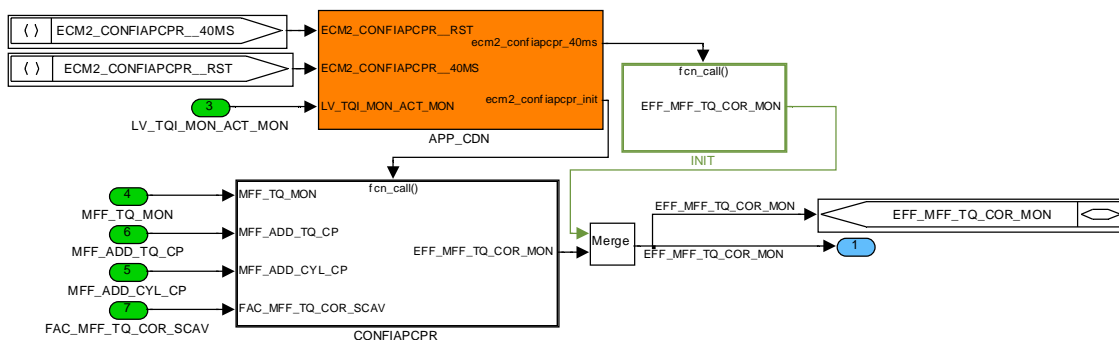


Figure E.6.23: : ECM2\_CONFIAPCPR

**E.6.14.1.1 SUBFUNCTION: INIT**

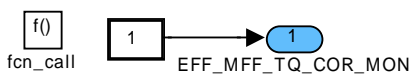


Figure E.6.24: : ECM2\_CONFIAPCPR/INIT

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### E.6.14.1.2 SUBFUNCTION: CONFIAPCPR

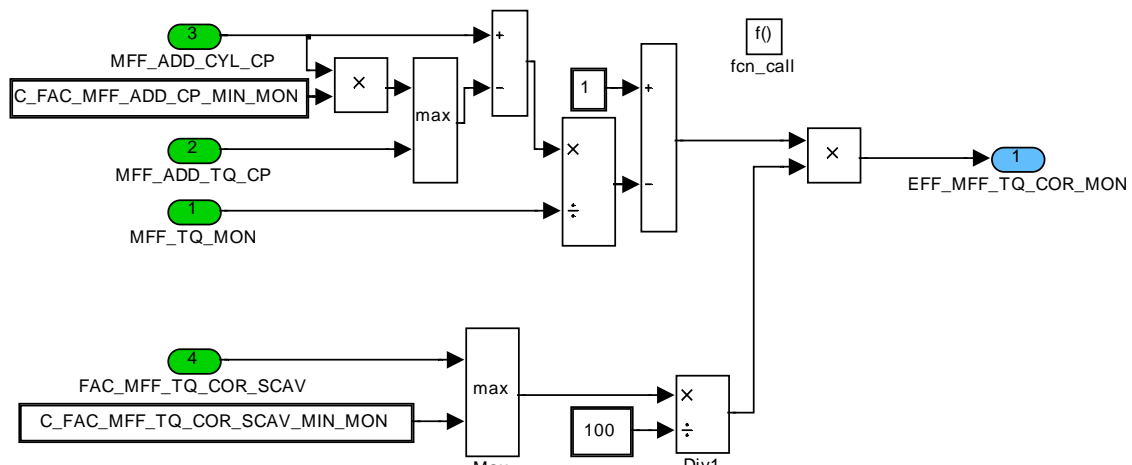


Figure E.6.25: : ECM2\_CONFIAPCPR/CONFIAPCPR

## E.6.15 Sport switch monitoring

### E.6.15.1 Acquisition of sport-mode-switch for monitoring

#### General information:

Calculation of the sport-mode request by taking the voltage of the sport-mode-switch and at BN 2000 variants on CAN message.

The request acts according to the rising edge of the voltage signal. This monitoring function connects to the level 1 function Chapter 9.

#### Application conditions

**Activation:** LV\_TQI\_MON\_ACT\_MON ==1

**Deactivation:** otherwise

**Initialisation:** for condition see Application Incidences of Process Monitoring  
In case of switch off the engine LV\_ES = 0 to 1 or reset:  
LV...MON = 0

**Update Rate:** 40 ms in general, exception voltage switch detection in 10 ms (this is realised by calling chapter 1.16.1 Acquisition of sport-mode-switch for monitoring" within each service task (see "Order of actions calls" at the beginning of this document)

#### Formula section:

Detection of tip switch position:

**Application conditions:**

Update rate: 10ms this is necessary to connect to level 1 because of monitoring 3 evaluation Cycles.

```

if (1)      LV_VAR_BN = 0
then (1)
  if (2)      LV_ERR_SOF_REQ = 0
  then (2)
    if (3)      (V_SOF_SWI_MONn-1 > C_V_SOF_SWI_ON_TOL_MON) changes to
                (C_V_SOF_SWI_ON_BOL_MON ≤ V_SOF_SWI_MONn ≤
                C_V_SOF_SWI_ON_TOL_MON)
                (equal to 0 ->1)
                and this result is valid for 3 evaluations
    then (3)      LV_SOF_SWI_MON = ! LV_SOF_SWI_MON
    endif (3)
  else (2)      LV_SOF_SWI_MON = 0
  endif (2)
else (1)
  if (4)      LV_ERR_BN_VEH_MOD = 0      and
                LV_ERR_CAN_BOFF = 0      and
                LV_ERR_BN_GEAR_REV = 0    and
                (STATE_VEH_MOD = 2H      OR ((LC_VAR_SPT_SWI=1) AND      (STATE_SPT_DISP_
CAN=1H)))
  then (4)      LV_SOF_SWI_MON = 1
  else (4)      LV_SOF_SWI_MON = 0
  endif (4)
endif (1)

```

**Calculation of LV\_SOF\_SWI\_REQ\_MON:**

```

if      (LV_CITY = 0 or LC_CONF_CITY_ENA_MON = 1)      and
          CONF_SOF_SWI      2      and
          LC_VAR_SOF_SWI_MON = 1      and
          LV_ERR_SOF_INH_MON = 0      and
          LV_SOF_SWI_MON      = 1
then      LV_SOF_SWI_REQ_MON      = 1
else      LV_SOF_SWI_REQ_MON      = 0
endif

```

**E.6.15.2 Low range detection ( LV\_RNG\_L )****Description:**

Depending on LC\_RNG\_L\_MON, the sport-switch and the LV\_RNG\_L\_AT\_MON -request from EGS the bit LV\_RNG\_L\_MON will be activated.

**Meaning of C\_STATE\_ETCU\_PROG\_INFO\_MON:**

Bit	LV_RNG_L_AT_MON will be set at condition:
0	AT / TCT in "S" / "DS" ("comfort transmission"; LV_VAR_ETCU_SPT=0)
1	AT / TCT in manual mode "M1 ... 6" ("comfort transmission"; LV_VAR_ETCU_SPT=0)
2	AT- / TCT-sport-switch in "S" / "DS" ("sport transmission"; LV_VAR_ETCU_SPT=1)
3	AT- / TCT-sport-switch in manual mode "M1 ... 6" ("sport transmission"; LV_VAR_ETCU_SPT=1)
4	Gearbox-sportswitch active and AT / TCT ("comfort transmission"; LV_VAR_ETCU_SPT=0)
5	Gearbox-sportswitch active and AT / TCT ("sport transmission"; LV_VAR_ETCU_SPT=1)
6	always with MT
7	not used

### Formula section:

If

AT / TCT "comfort" in "S-mode"

[STATE\_ETCU\_PROG\_INFO = 1H  
LV\_VAR\_ETCU\_SPT = 0  
Bit 0 of C\_STATE\_ETCU\_PROG\_INFO\_MON is set] **and** **or**

AT / TCT "comfort" in "M-mode"

[STATE\_ETCU\_PROG\_INFO = 2H  
LV\_VAR\_ETCU\_SPT = 0  
Bit 1 of C\_STATE\_ETCU\_PROG\_INFO\_MON is set] **and** **or**

AT / TCT "sport" in "S-mode"

[STATE\_ETCU\_PROG\_INFO = 1H  
LV\_VAR\_ETCU\_SPT = 1  
Bit 2 of C\_STATE\_ETCU\_PROG\_INFO\_MON is set] **and** **or**

AT / TCT "sport" in "M-mode"

[STATE\_ETCU\_PROG\_INFO = 2H  
LV\_VAR\_ETCU\_SPT = 1  
Bit 3 of C\_STATE\_ETCU\_PROG\_INFO\_MON is set] **and** **or**

AT / TCT "comfort" in "sport-mode-gearbox"

[LV\_VAR\_ETCU\_SPT = 0  
LV\_ETCU\_SPT\_SWI = 1  
Bit 4 of C\_STATE\_ETCU\_PROG\_INFO\_MON is set] **and** **or**

AT / TCT "sport" in "sport-mode-gearbox"

[LV\_VAR\_ETCU\_SPT = 1  
LV\_ETCU\_SPT\_SWI = 1  
Bit 5 of C\_STATE\_ETCU\_PROG\_INFO\_MON is set] **and** **or**

MT continious in "sport"-mode

[LV\_AT = 0 **and** LV\_VAR\_AMT = 0 **and** LV\_VAR\_TCT = 0 **and**  
Bit 6 of C\_STATE\_ETCU\_PROG\_INFO\_MON is set]

**Then** LV\_RNG\_L\_AT\_MON = 1

**Else** LV\_RNG\_L\_AT\_MON = 0

**Endif**

```

IF          LC_RNG_L_MON = 1                or          // request from application system
              LV_SOF_SWI_REQ_MON = 1 or // request from sport switch
              LV_RNG_L_AT_MON = 1 // request from gearbox
Then       LV_RNG_L_MON = 1
Else      LV_RNG_L_MON = 0
Endif

```

### E.6.15.3 Pedal value interpretation for monitoring

#### FUNCTION DESCRIPTION:

#### General information:

Depending on gear mode LV\_RNG\_L\_MON (LV\_RNG\_L\_MON =1) two maps can be calibrated with different pedal value interpretation for normal and low range mode. For this the switch condition LV\_SWI\_FAC\_TQ\_REQ\_MON is triggered.

Because of the different recurrences of level 1 (10ms) and level 2 (40 ms) and the not regarded driver progression correction of level 1, the switch to the RNG\_L\_MON progression of monitoring follows by fulfilled conditions after switch of level 1 LV\_RNG\_L\_REQ.

#### Application conditions

**Activation:** LV\_TQI\_MON\_ACT\_MON = 1

**Deactivation:** otherwise

**Initialisation:** for condition see Application Incidences of Process Monitoring  
LV\_SWI\_FAC\_TQ\_REQ\_MON = 0

**Update Rate:** 40 ms

#### Formula section:

```


IF          PV_AV_MON < C_PV_AV_SOF_MIN_MON                or
              FAC_TQ_REQ_DRIV_MON > C_FAC_TQ_REQ_DRIV_SOF_MAX_MON or
              PV_AV_GRD > C_PV_AV_GRD_SOF_MAX_MON
              for at least C_T_PV_AV_GRD_SOF_MAX_MON
THEN       LV_CDN_RNG_L_REQ_MON = 1
ELSE      LV_CDN_RNG_L_REQ_MON = 0
ENDIF

```

```

IF          (LV_RNG_L_MON = 1 or LC_RNG_L_MAN_AS_MON = 1)
              and
              (STATE_GEAR_REV_CAN = 0
              and
              STATE_GEAR_REV_AT_AMT = 0 (no reverse gear active))
              and
              LV_RNG_L_REQ = 1 (Level 1 has switched))
              and
              {
                To activate IP_FAC_TQ_REQ_DRIV_1_MON following conditions
                has to be checked. After activating this conditions are not used any more.
                LV_SWI_FAC_TQ_REQ_MON = 0
              }
              and

```

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## E.6.16 Driving off assistance monitoring

### FUNCTION DESCRIPTION:

The function Driving off assistance shall prevent the engine from stalling at driving off. This is shown by LV\_N\_SP\_IS\_CS = 1.

An extra torque request is calculated under individual conditions. While this extra torque is effective. Using the handshake to level 1 Please verify that LV\_ISC\_OFF\_DROF in Level one is calibrated to 1.

### Application conditions

**Activation:** LV\_TQI\_MON\_ACT\_MON = 1 **and** LV\_ERR\_CRK = 0 **and** LV\_AT = 0  
**and** LV\_ERR\_VS = 0 **and** LV\_ERR\_PVS = 0 **and** LV\_VAR\_AMT = 0  
**and** LV\_VAR\_TCT = 0 **and** N\_32\_MON < C\_N\_32\_TQ\_DROF\_MAX\_MON

**Deactivation:** LV\_TQI\_MON\_ACT\_MON = 0 **or** LV\_ERR\_CRK = 1 **or** LV\_AT = 1 **or**  
LV\_ERR\_VS = 1 **or** LV\_ERR\_PVS = 1 **or** LV\_VAR\_AMT = 1 **or**  
LV\_VAR\_TCT = 1 **or** N\_32\_MON > C\_N\_32\_TQ\_DROF\_MAX\_MON

**Initialisation:** at ECU-reset **or** at function deactivation:  
all = 0 (phy)

**Recurrence:** 40 ms

### Formula section:

LV\_CS\_MON is read direct on the clutch switch pinning input.

TQ\_AV\_MON = TQI\_AV\_MON + TQ\_LOSS\_MON

N\_DIF\_DROF\_MON = IP\_FAC\_N\_GRD\_TQ\_AV\_MON \* C\_N\_DIF\_ADD\_DROF\_MON +  
N\_DIF\_SP\_IS\_MON

**If** N\_DIF\_DROF\_MON <= C\_N\_DIF\_DROF\_MAX\_MON **and**  
N\_DIF\_DROF\_MON >= C\_N\_DIF\_DROF\_MIN\_MON **and**  
LV\_CS\_MON == 1 **and**  
ID\_TQ\_DROF\_ENA\_MON == 1 **and**  
LV\_ISC\_OFF\_DROF == 1 /\*check if level 1 is active\*/

**Then** LV\_TQ\_DROF\_ACT\_MON == 1

**Else** LV\_TQ\_DROF\_ACT\_MON == 0

**Endif**

**If** LV\_TQ\_DROF\_ACT\_MON == 1

**Then** TQ\_DROF\_MDL\_MON = IP\_TQ\_DROF\_MON \*  
IP\_FAC\_TQ\_DROF\_FAC\_TQ\_REQ\_MON \*  
IP\_FAC\_TQ\_DROF\_VS\_MON

**Else** TQ\_DROF\_MDL\_MON<sub>n</sub> = TQ\_DROF\_MDL\_MON<sub>n-1</sub> -  
IP\_TQ\_DROF\_GRD\_DEAC\_MON

**Endif**

TQ\_DROF\_MON =  
MIN(MAX(TQ\_DROF\_FAST;TQ\_DROF\_SLOW);TQ\_DROF\_MDL\_MON)

## E.6.17 Application incidences for the desired indicated engine torque

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**FUNCTION DESCRIPTION:****General information:**

The torque demands from cruise control, electronic gear shift control and the electronic stability program are set to zero, if these functions are not available. Otherwise, the torque demands have to be copied to the corresponding variable of level 2 and these variables have to be checked for plausibility (e.g. CAN monitoring, CRU monitoring, control units [ESP, EGS] with internal plausibility check).

For torque request at trailing throttle (TQI\_MIN\_PU\_MON) the map output TQI\_MIN\_PU\_MAX\_MON (monitoring threshold) will be taken into account. For consideration of the torque setpoint offset at engine start the corresponding torque value is added to TQI\_MIN\_PU\_MAX\_MON. After engine start this value is set to "0".

**Application conditions**

**Activation:** LV\_TQI\_MON\_ACT\_MON = 1

**Deactivation:** otherwise

**Initialisation:** All 0 for condition see Application Incidences of Process Monitoring

**Update Rate:** 40 ms

**Formula section:****E.6.17.1 Calculation of PV\_AV\_AD\_MON**

$$\text{FAC\_PV\_BAS\_COR\_MON} = \text{IP\_FAC\_PV\_BAS\_COR\_MON (N32\_MON; PV\_AV\_MON)} \\ * \text{IP\_FAC\_VS\_PV\_BAS\_COR\_MON (VS\_MON)}$$

$$\text{FAC\_PV\_COR\_MON} = \min(1; \max(0; \text{FAC\_PV\_BAS\_COR\_MON}))$$

$$\text{PV\_AV\_AD\_MON} = \text{PV\_AV\_MON} * (1 - \text{FAC\_PV\_COR\_MON})$$
**E.6.17.2 Calculation of external torque demand from TCT**

$$\text{TQI\_N\_CTL\_TCT\_MON} = \max(\text{TQI\_N\_CTL\_TCT\_FAST}; \text{TQI\_N\_CTL\_TCT\_SLOW})$$
**E.6.17.2.1 Integrated torque request monitoring**

**If** TQI\_N\_CTL\_TCT\_MON >= C\_MIN\_TQI\_N\_CTL\_TCT\_MON

**Then** INT\_TQI\_N\_CTL\_TCT\_MON = **MIN**{C\_INT\_MAX\_TQI\_N\_CTL\_TCT\_MON;  
**MAX**(C\_INT\_MIN\_TQI\_N\_CTL\_TCT\_MON;  
INT\_TQI\_N\_CTL\_TCT\_MON<sub>k-1</sub> + (TQI\_N\_CTL\_TCT\_MON \*  
(C\_CRLC\_TQI\_N\_CTL\_TCT\_PLAUS\_MON \* 0,04s))}

**Else** INT\_TQI\_N\_CTL\_TCT\_MON = **MIN**{ C\_INT\_MAX\_TQI\_N\_CTL\_TCT\_MON;  
**MAX**(C\_INT\_MIN\_TQI\_N\_CTL\_TCT\_MON;  
INT\_TQI\_N\_CTL\_TCT\_MON<sub>k-1</sub> -  
C\_DEC\_INT\_TQI\_N\_CTL\_TCT\_MON)}


**Endif**

**If** INT\_TQI\_N\_CTL\_TCT\_MON = C\_INT\_MAX\_TQI\_N\_CTL\_TCT\_MON

**Then** LV\_INT\_TQI\_N\_CTL\_TCT\_MON = 1

**Else** LV\_INT\_TQI\_N\_CTL\_TCT\_MON = 0

**Endif**

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**E.6.17.2.2 Maximum request time monitoring**

```

If          TQI_N_CTL_TCT_MON >= C_MIN_TQI_N_CTL_TCT_MON
Then       T_TQI_N_CTL_TCT_MONk =
              MIN(T_TQI_N_CTL_TCT_MONk-1 + 40 ms ;
                  C_T_MAX_TQI_N_CTL_TCT_MON)
Else       T_TQI_N_CTL_TCT_MONk = T_TQI_N_CTL_TCT_MONk-1 -
              C_DEC_T_TQI_N_CTL_TCT_MON
Endif

```

```

If          T_TQI_N_CTL_TCT_MON = C_T_MAX_TQI_N_CTL_TCT_MON
Then       LV_T_MAX_TQI_N_CTL_TCT_MON = 1
Else       LV_T_MAX_TQI_N_CTL_TCT_MON = 0
Endif

```

**E.6.17.2.3 Maximum torque request monitoring**

```

IF          TQI_N_CTL_TCT_MON > IP_TQ_MAX_TQI_N_CTL_TCT_MON
Then       T_TQI_N_CTL_TCT_MAX_MONk =
              MIN(T_TQI_N_CTL_TCT_MAX_MONk-1 + 40 ms ;
                  C_T_MAX_TQI_N_CTL_TCT_MAX_MON)
Else       T_TQI_N_CTL_TCT_MAX_MONk = T_TQI_N_CTL_TCT_MAX_MONk-1 -
              C_DEC_T_TQI_N_CTL_TCT_MAX_MON
Endif

```

```

IF          T_TQI_N_CTL_TCT_MAX_MON = C_T_MAX_TQI_N_CTL_TCT_MAX_MON
Then       LV_TQ_MAX_TQI_N_CTL_TCT_MON = 1
Else       LV_TQ_MAX_TQI_N_CTL_TCT_MON = 0
Endif

```

**E.6.17.2.4 Inhibition of external torque demand from TCT**

```

IF          LV_INT_TQI_N_CTL_TCT_MON = 1           or
              LV_T_MAX_TQI_N_CTL_TCT_MON = 1       or
              LV_TQ_MAX_TQI_N_CTL_TCT_MON = 1
Then       LV_INH_TQI_N_CTL_TCT_MON = 1
              TQI_N_CTL_TCT_MON = 0 Nm
Endif

```

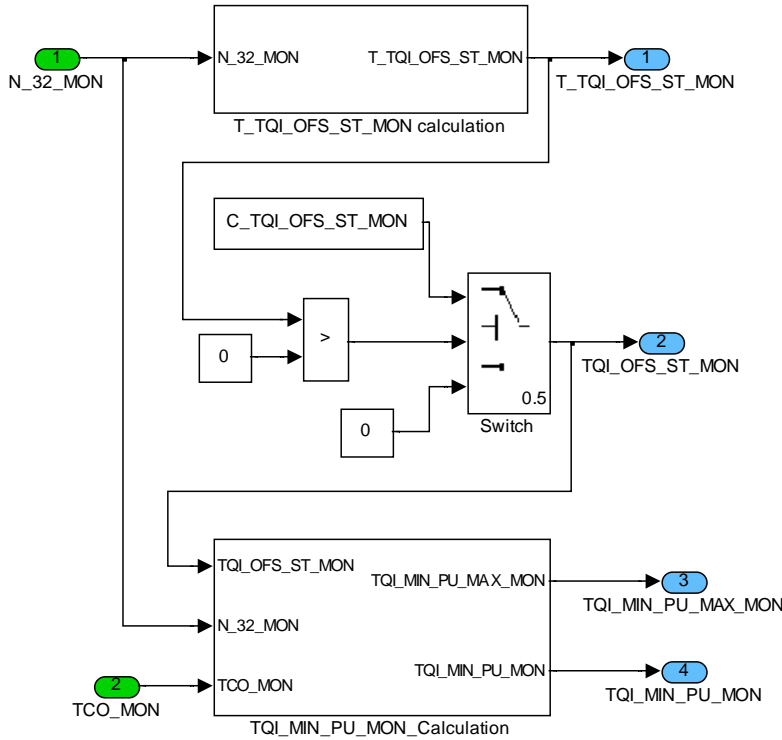
**E.6.17.3 Calculation of external torque demands**

```

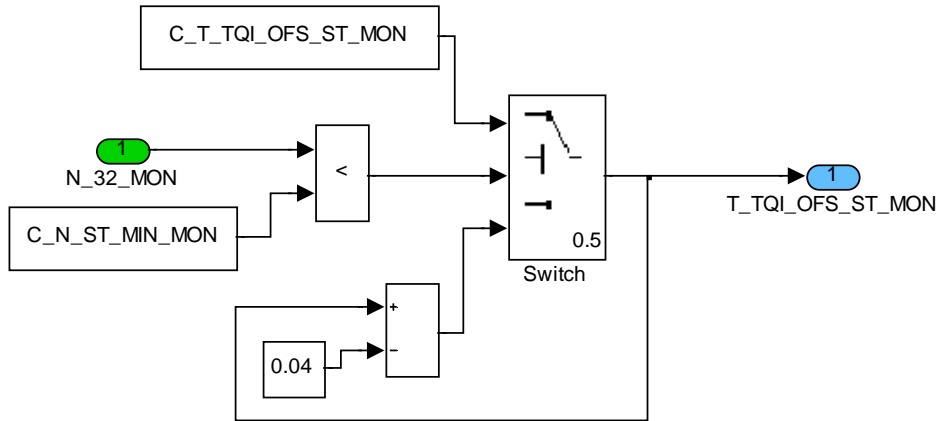
TQI_INC_EXT_MON = MAX(TQI_INC_CAN_MON ; TQI_N_CTL_TCT_MON)

```

### E.6.17.4 Minimum indicated engine torque in trailing throttle with consideration of torque setpoint offset at engine start

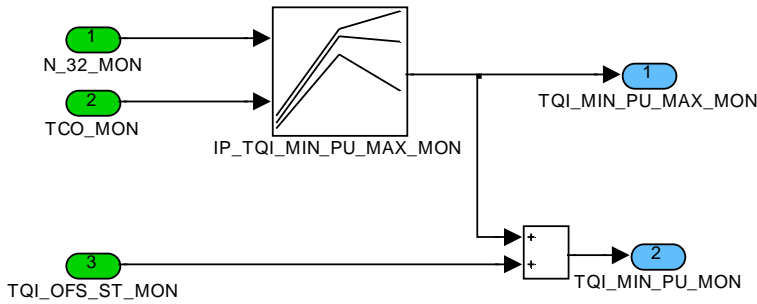


Appl.INC\_Desired\_indicated\_torque/Plausibilis. of minimum indicated torque in PU



Appl.INC\_Desired\_indicated\_torque/Plausibilis. of minimum indicated torque in PU/T\_TQI\_OFS\_ST\_MON calculation

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Appl.INC\_Desired\_indicated\_torque/Plausibilis. of minimum indicated torque in PU/TQI\_MIN\_PU\_MON\_Calculation

### E.6.18 Application incidences for the combustion mode switch request

#### General information:

#### FUNCTION DESCRIPTION:

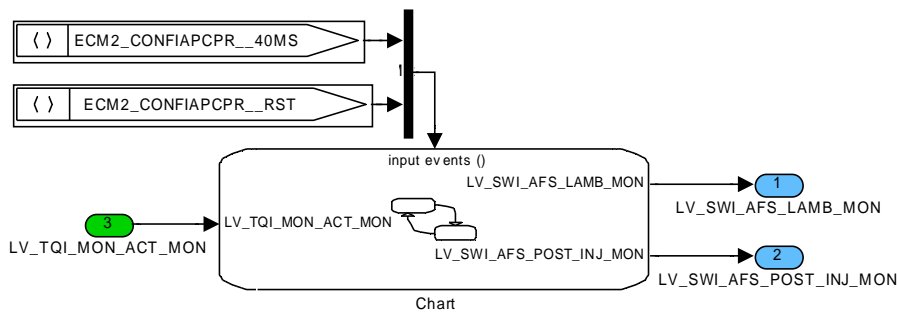


Figure E.6.26: : ECM2\_CONFIAPCPR

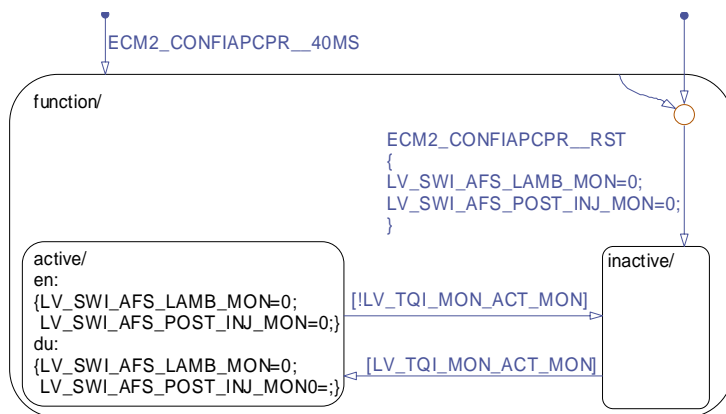


Figure E.6.27: : ECM2\_CONFIAPCPR/Chart

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## E.6.19 Application incidences for the actual fuel mass flow

### Application conditions

**Activation:** LV\_TQI\_MON\_ACT\_MON = 1

**Deactivation:** LV\_TQI\_MON\_ACT\_MON = 0

**Initialisation:** for condition see Application Incidences of Process Monitoring  
 FAC\_MFF\_WUP\_CUS\_MON = 1  
 IDX\_TI\_1\_MON = 0  
 IDX\_TI\_2\_MON = 0  
 IDX\_TI\_POST\_MON = 0  
 TI\_1\_MON = 0  
 TI\_2\_MON = 0  
 TI\_POST\_MON = 0

**Recurrence:** 40ms

### FUNCTION DESCRIPTION:

#### General information:

Dependent from OPM\_AV\_MON different fuel mass flow corrections for the warm-up phase are considered in FAC\_MFF\_WUP\_CUS\_MON.

According to LC\_CUR\_SHP\_INJ\_ENA\_MON either IDX\_TI\_x\_MON or TI\_x\_MON are used for the module actual fuel mass flow.

When MFMA is activated, is:

Either

IDX\_TI\_1\_MON the total monitored injection index

Or

TI\_1\_MON the total monitored injection time.

#### Signal flow diagram:

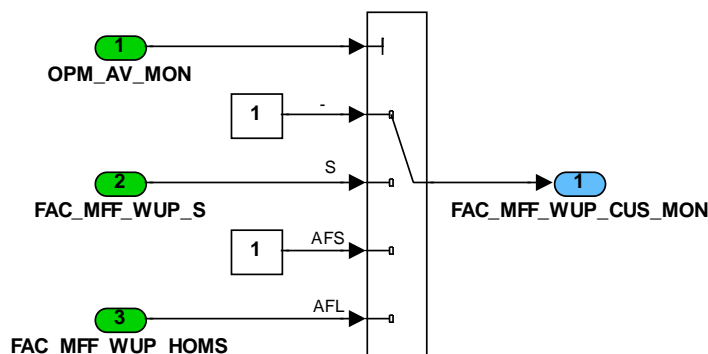


Figure E.6.28: : FAC\_MFF\_WUP\_CUS\_MON

IDX\_TI\_x\_MON/TI\_x\_MON calculation:

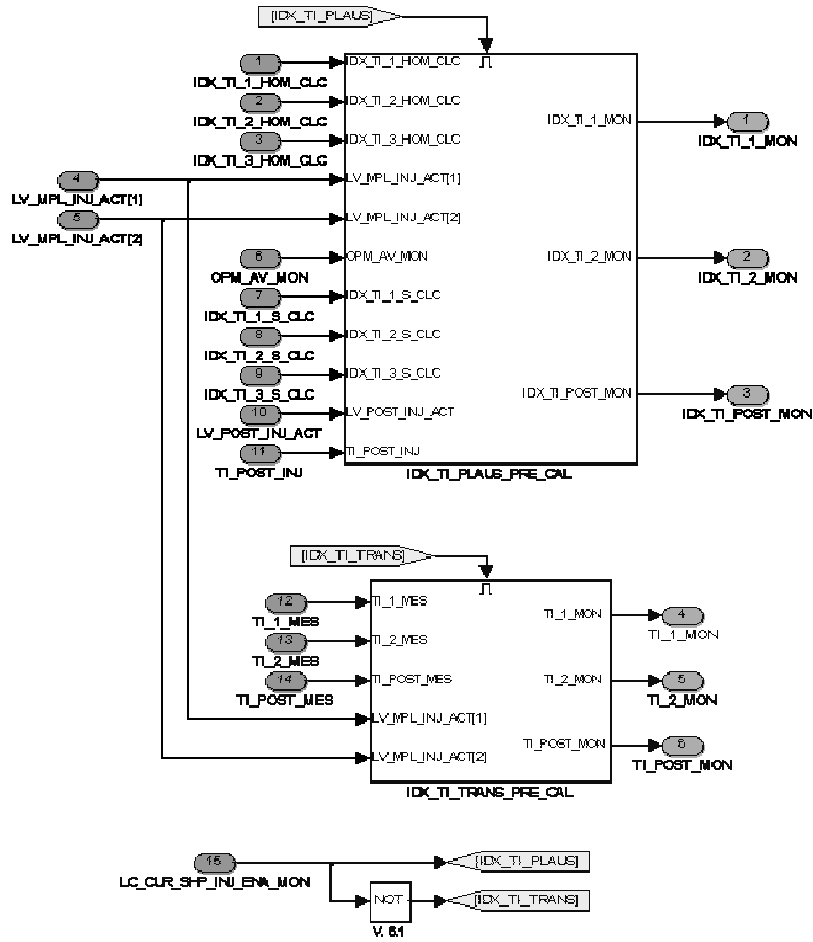


Figure E.6.29: : IDX\_INDEX\_CALCULATION

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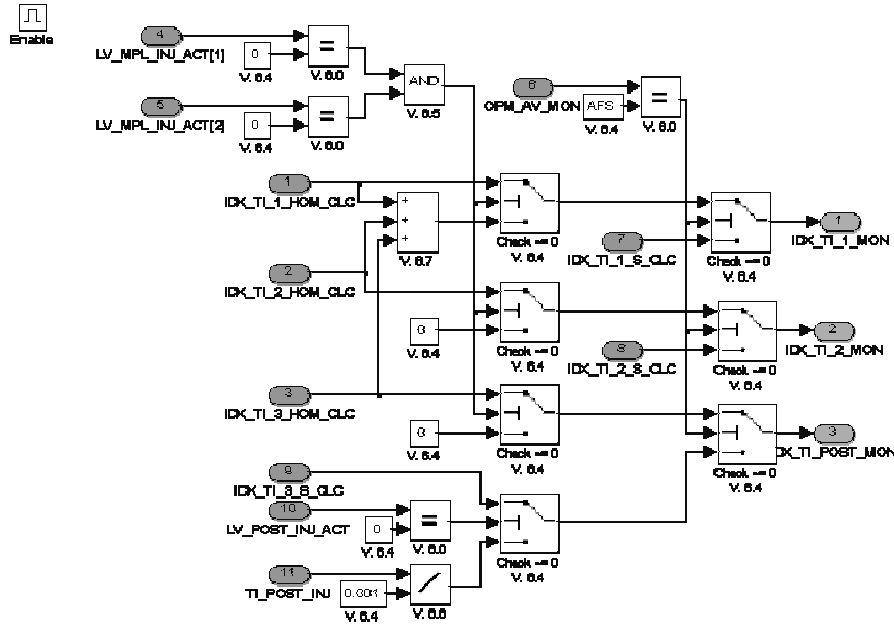


Figure E.6.30: : IDX\_TI\_PLAUS\_PRE\_CAL

In the Figure 3. the determination of LV\_POST\_INJ\_ACT is only done for stratified mode, because in the active homogenous mode it is not active. The Lambda adaption is only carried out in the homogenous state, then the part of LV\_MPL\_INJ\_ACT for stratified mode is deleted in compare to the earlier version

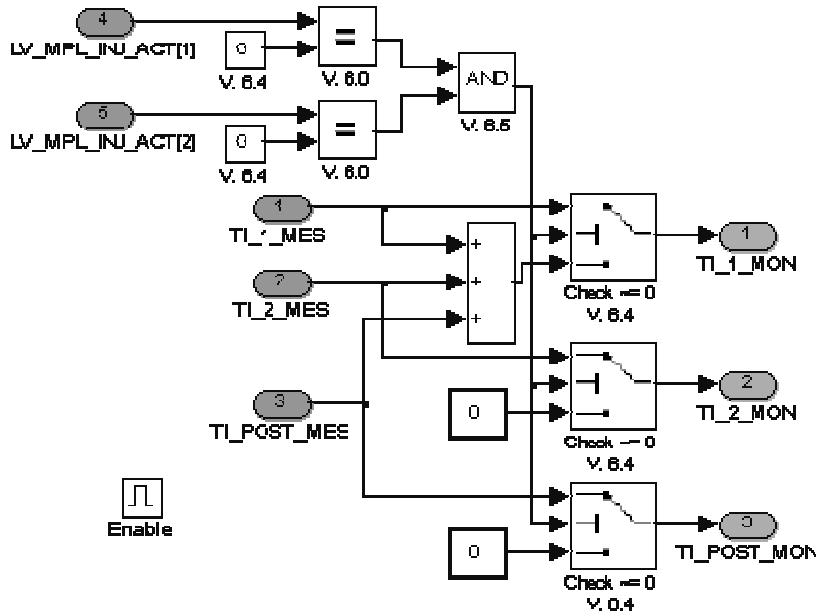


Figure E.6.31: : IDX\_TI\_TRANS\_PRE\_CAL

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## E.7 Debounce mechanism

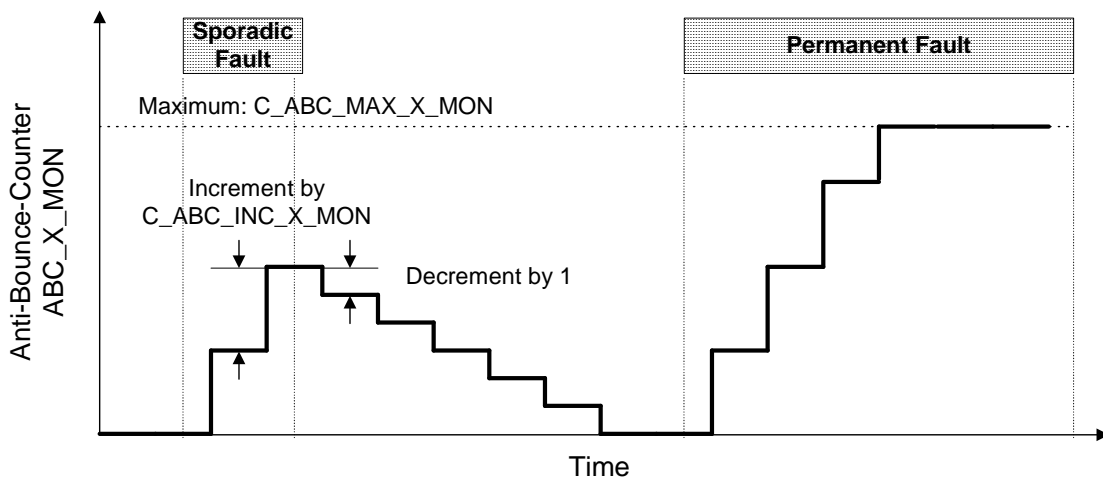
### FUNCTION DESCRIPTION:

#### General information:

Many diagnosis algorithms need a debounce mechanism in order to avoid a faulty diagnosis caused by normal disturbances. Since the process monitoring is intended to represent redundancy to the functions of level 1, there is also a redundant debounce mechanism required. That means an algorithm with separate code, ROM- and RAM data. The debounce algorithm is used for the functions of level 2 and 2 (copy of process monitoring).

#### Description:

The anti-bounce-counter ABC\_X\_MON is increased by C\_ABC\_INC\_X\_MON, if the conditions for fault detection are fulfilled. Otherwise, the anti-bounce counter is decremented by 1. If the anti-bounce-counter ABC\_X\_MON exceeds its threshold C\_ABC\_MAX\_X\_MON the first time during this engine running, the relating error-flag is set and a fault can be stored in the customer error memory.



#### Application conditions:

The activation, deactivation and recurrency of this module depends on the data of the related diagnosis function.

#### Formula section:

```

IF      (Fault detection condition fulfilled)
THEN
    Increment ABC_X_MON by C_ABC_INC_X_MON
    (limited to C_ABC_MAX_X_MON)
ELSE
    Decrement ABC_X_MON by 1    (limited to 0)
    
```

## E.8 Desired indicated engine torque

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_REQ_DRIV_MON	O/V	0... FFH	0... 1.99218	0.0078125	-
Scaling factor for requested torque at clutch from driver					
FAC_TQ_REQ_MON	O/V	0... FFH	0... 1.99218	0.0078125	-
Scaling factor for requested torque at clutch from driver and cruise control					
T_TQI_MON	V	0... FFH	0... 10.2	0.04	s
dead time counter for torque decrease					
TQI_REQ_TOT_MON	V	0... FFH	0... 510	2	Nm
Desired non-filtered indicated engine torque					
TQI_SP_MON	O/V	0... FFH	0... 510	2	Nm
Desired indicated engine torque					

### Input data:

FAC_TQ_REQ_CRU_MON {p. 6912}	LV_SWI_FAC_TQ_REQ_MON {p. 6791}	LV_TQI_MON_ACT_MON {p. 6791}	N_32_MON {p. 7002}
PV_AV_AD_MON {p. 6792}	TQ_DIF_P_D_IS_MON {p. 6793}	TQ_DROF_MON {p. 6793}	TQ_LOSS_MON {p. 6975}
TQ_MAX_CLU_MON {p. 6938}	TQ_MIN_CLU_MON {p. 6952}	TQI_INC_EXT_MON {p. 6794}	TQI_MIN_PU_MON {p. 6794}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_TQI_SP_MON	-	0... FFH	0... 0.99609	3.9063e-3	-
filter constant for realization of first order filter					
C_T_TQI_MON	-	0... FFH	0... 10.2	0.04	s
Dead time for torque decrease					
IP_FAC_TQ_REQ_DRIV_1_MON	V	0... FFH	0... 1.99218	0.0078125	-
LDPM_N_32_MON_IP_FAC_TQ_MON	8	0... FFH	0... 8160	32	rpm
LDPM_PV_AV_AD_MON_IP_FAC_MON	8	0... FFH	0... 99.60937	0.390625	%
Scaling factor for requested torque at clutch from driver in other mode					
IP_FAC_TQ_REQ_DRIV_MON	V	0... FFH	0... 1.99218	0.0078125	-
LDPM_N_32_MON_IP_FAC_TQ_MON	8	0... FFH	0... 8160	32	rpm
LDPM_PV_AV_AD_MON_IP_FAC_MON	8	0... FFH	0... 99.60937	0.390625	%
Scaling factor for requested torque at clutch from driver					

### Import actions:

<b>ACTION_ECM3_Service6TaskPfm</b> (IN<No Name available>)
<b>ACTION_ECM3_Service7TaskPfm</b> (IN<No Name available>)
<b>ACTION_ECM3_Service8TaskPfm</b> (IN<No Name available>)

## E.8.1 ECM2\_DTSYSTQISP

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The argument has the value 4.

ACTION_ECM3_McChkStack()
--------------------------

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION\_ECM3\_Service6TaskPfm() and ACTION\_ECM3\_Service7TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT<>,OUT<>,IN<>)
---

ACTION_ECM3_ChkCpl(IN<>, IN<>)
--------------------------------

ACTION_ECM3_ReadChkCpl(OUT<>,IN<>, IN<>)
--

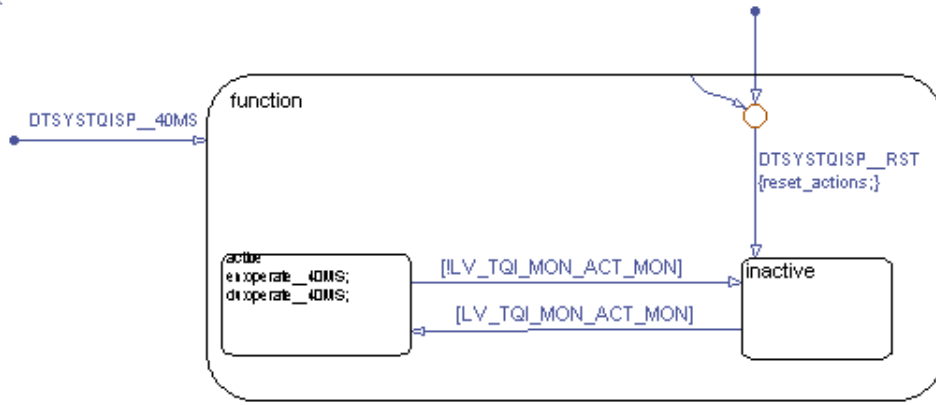
**Note:** These actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

### General information:

The objective of this module is to calculate the desired indicated engine torque which derives from the function level (level 1). All torque increasing demands are taken into account. The different parts are:

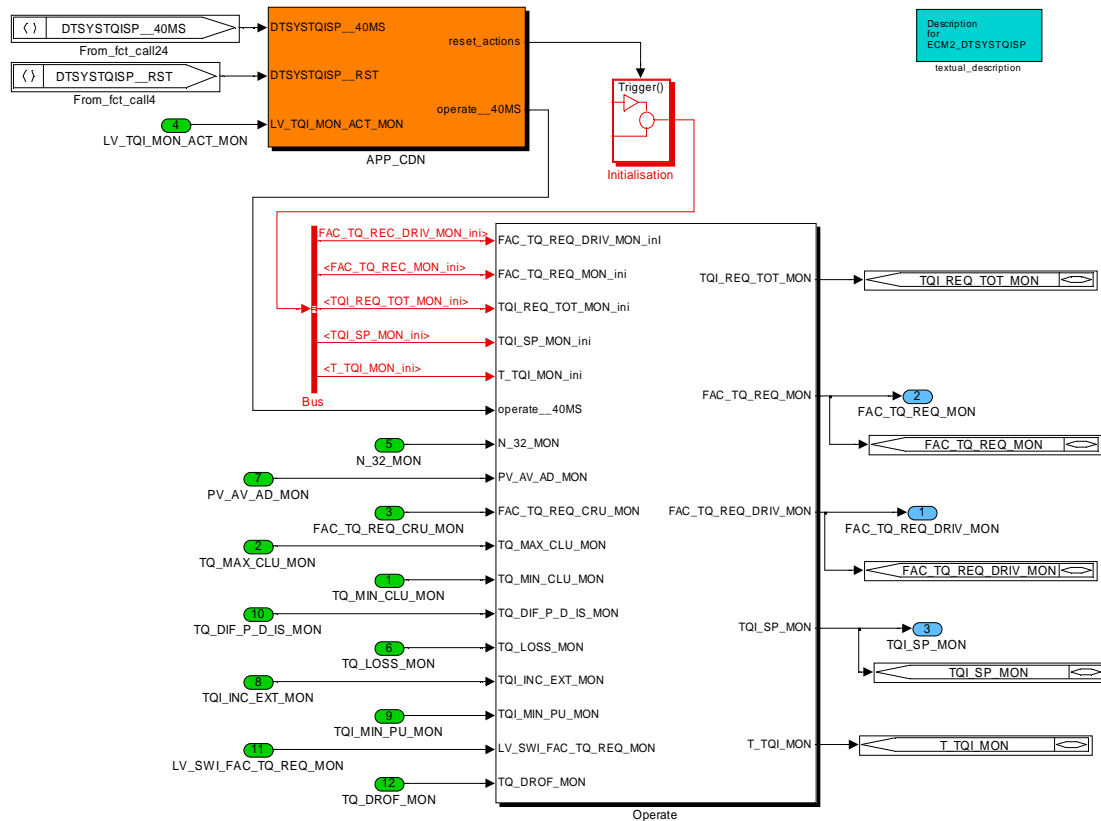
- calculation of scaling factor for requested torque at clutch from driver (FAC\_TQ\_REQ\_MON) in different operation modes, depending on engine speed (N\_32\_MON) and adapted accelerator pedal activation degree (PV\_AV\_AD\_MON)
- calculation of requested torque at clutch from driver
- switch from brake torque to indicated torque demands
- adding the torque request for drive off assistance
- filtering the raw torque demand in falling direction to take into account the system response time
- maximum choice between internal and external torque demands
- If the engine is in the trailing throttle state i.e. no driver demand but limitation on indicated engine torque to ensure a safe combustion at low load conditions, then the torque setpoint in L2 is limited by TQI\_MIN\_PU\_MON.
- adding internal increasing torque demands (TQ\_DIF\_P\_D\_IS\_MON)

### Application Condition



**Initialisation(DTSYSTQISP\_RST):** for condition see Application Incidences of Process Monitoring .

**Function Description**



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Figure E.8.1: ECM2\_DTSYSTQISP

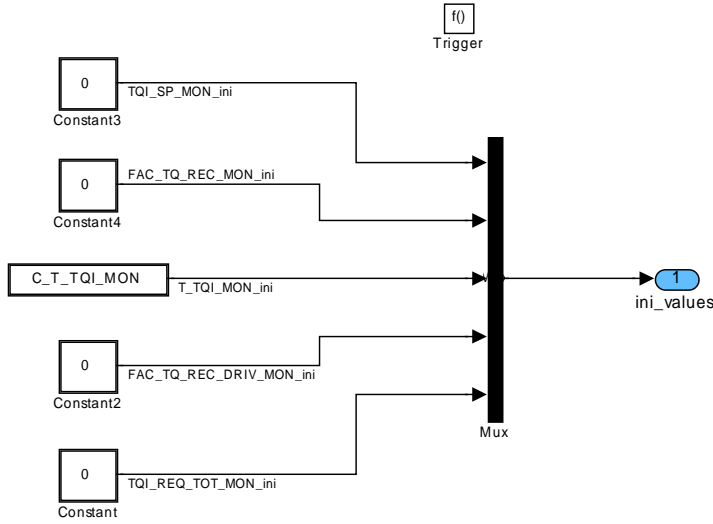


Figure E.8.2: ECM2\_DTSYSTQISP/Initialisation

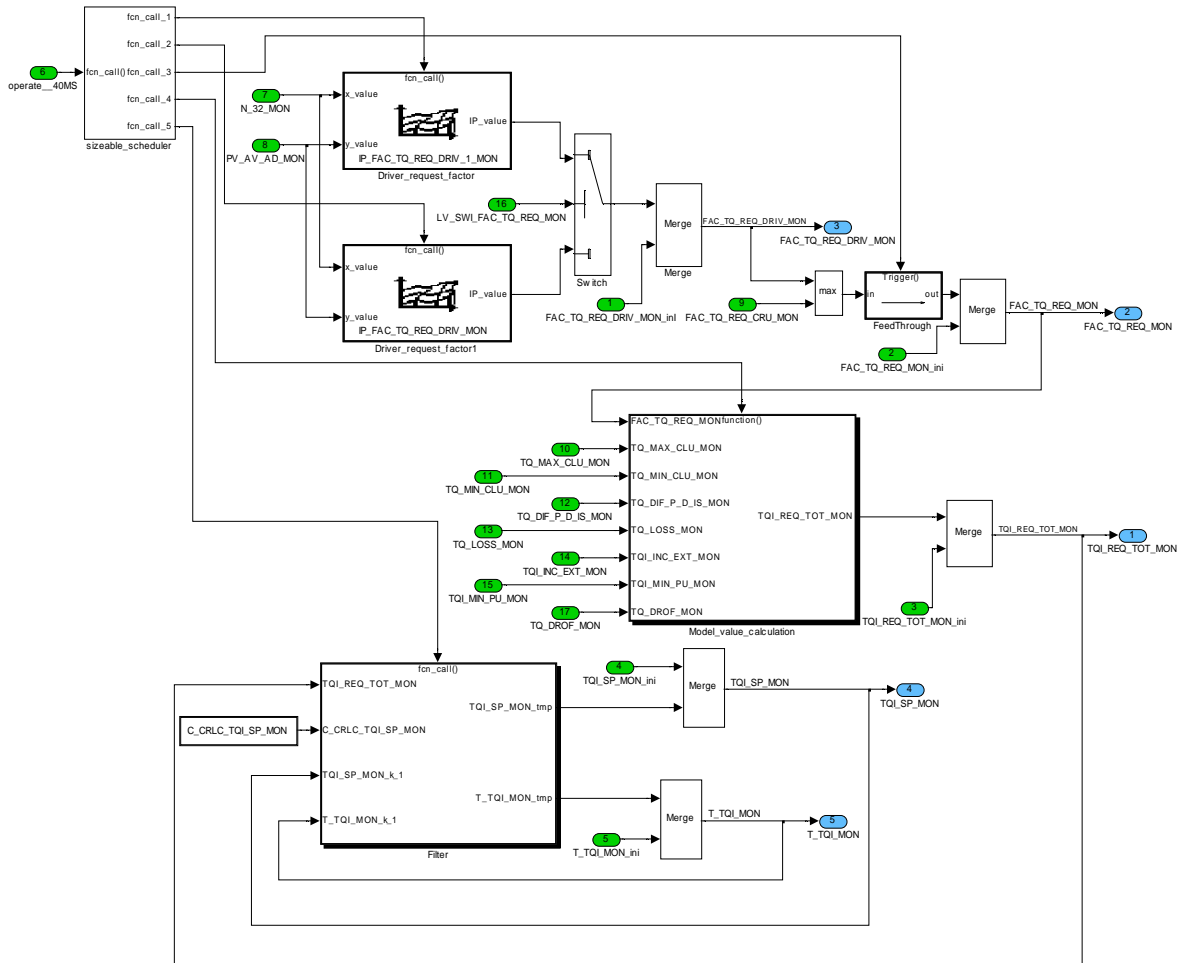



Figure E.8.3: ECM2\_DTSYSTQISP/Operate

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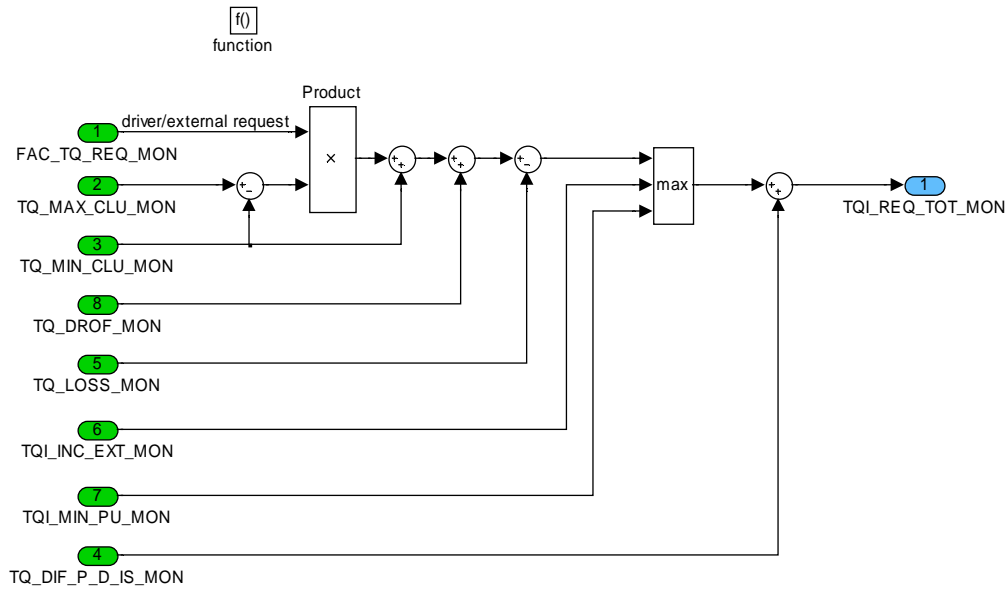


Figure E.8.4: ECM2\_DTSYSTQISP/Operate/Model\_value\_calculation

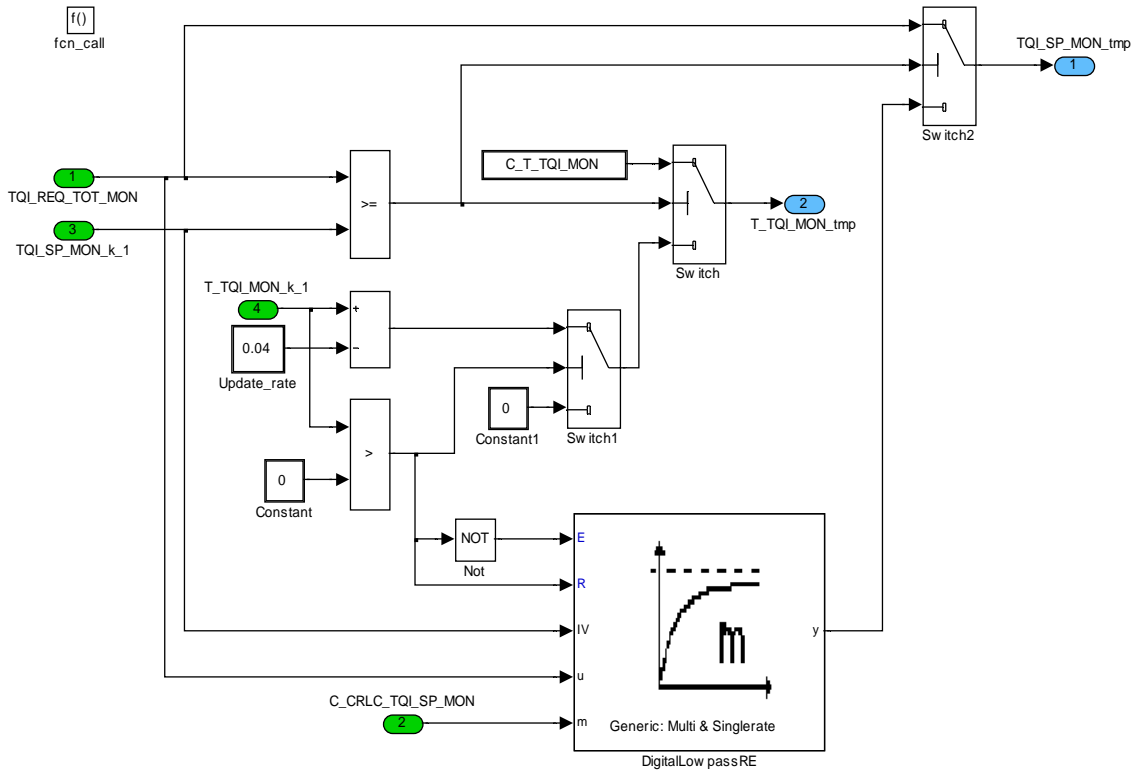


Figure E.8.5: ECM2\_DTSYSTQISP/Operate/Filter

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## E.9 Error memory management of process monitoring

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_SWI_AFS_MON	O/V/S	0... FFH	0... 255	1	-
Reset resistant counter for number of AFS requests by monitoring					
ERR_SYM_CONV_MON_1	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom A/D conversion Monitoring error reflect to level 1					
ERR_SYM_CRU_INH_MON_1	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom CRU Monitoring error reflect to level 1					
ERR_SYM_MFF_MON_1	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for mass fuel flow monitoring error					
ERR_SYM_N_32_MON_1	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom Engine speed Monitoring error reflect to level 1					
ERR_SYM_PVS_MON_1	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom PVS Monitoring error reflect to level 1					
ERR_SYM_SWI_AFS_MON	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
For each symptom : status of failure (set to 1 when failure symptom detected)					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TPS_MON_1	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom TPS Monitoring error reflect to level 1					
ERR_SYM_TQ_DIF_ISC_MON_1	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom ISC Monitoring error reflect to level 1					
ERR_SYM_TQ_EXT_MON_1	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom Max Torque at Clutch Monitoring error reflect to external torque level 1					
ERR_SYM_TQ_REQ_MON_1	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom Min torque at Clutch Monitoring error reflect to level 1					
ERR_SYM_TQI_AV_MON_1	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom Actual indicated engine torque Monitoring error reflect to level 1					
ERR_SYM_TQI_N_MAX_MON_1	V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
Error symptom Torque limitation Monitoring error reflect to level 1					
LV_CDN_DIAG_CONV_MON_1	V	0... 1H	0 ...1	1	-
Diagnosis condition A/D conversion Monitoring error reflect to level 1					
LV_CDN_DIAG_CRU_INH_MON_1	V	0... 1H	0 ...1	1	-
Diagnosis condition CRU Monitoring error reflect to level 1					
LV_CDN_DIAG_MFF_MON_1	V	0... 1H	0 ...1	1	-
Diagnosis condition mass fuel flow monitoring error reflect to level 1					
LV_CDN_DIAG_N_32_MON_1	V	0... 1H	0 ...1	1	-
Diagnosis condition Engine speed Monitoring error reflect to level 1					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_PVS_MON_1	V	0... 1H	0 ...1	1	-
Diagnosis condition PVS Monitoring error reflect to level 1					
LV_CDN_DIAG_SWI_AFS_MON	O/V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled)					
LV_CDN_DIAG_TPS_MON_1	O/V	0... 1H	0 ...1	1	-
Diagnosis condition TPS Monitoring error reflect to level 1					
LV_CDN_DIAG_TQ_DIF_ISC_MON_1	V	0... 1H	0 ...1	1	-
Diagnosis condition ISC Monitoring error reflect to level 1					
LV_CDN_DIAG_TQ_EXT_MON_1	V	0... 1H	0 ...1	1	-
Diagnosis condition Max Torque at Clutch Monitoring error reflect to external torque level 1					
LV_CDN_DIAG_TQ_REQ_MON_1	V	0... 1H	0 ...1	1	-
Diagnosis condition Min torque at Clutch Monitoring error reflect to level 1					
LV_CDN_DIAG_TQI_AV_MON_1	V	0... 1H	0 ...1	1	-
Diagnosis condition Actual indicated engine torque Monitoring error reflect to level 1					
LV_CDN_DIAG_TQI_N_MAX_MON_1	V	0... 1H	0 ...1	1	-
Diagnosis condition Torque limitation Monitoring error reflect to level 1					
LV_END_DIAG_CONV_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis 1 A/D conversion Monitoring error reflect to level 1					
LV_END_DIAG_CRU_INH_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis CRU Monitoring error reflect to level 1					
LV_END_DIAG_MFF_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis of mass fuel flow monitoring error reflect to level 1					
LV_END_DIAG_N_32_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis Engine speed Monitoring error reflect to level 1					
LV_END_DIAG_PVS_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis PVS Monitoring error reflect to level 1					
LV_END_DIAG_SWI_AFS_MON	O/V	0... 1H	0 ...1	1	-
Diagnostic of AFS request by monitoring performed at least one time					
LV_END_DIAG_TPS_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis TPS Monitoring error reflect to level 1					
LV_END_DIAG_TQ_DIF_ISC_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis ISC Monitoring error reflect to level 1					
LV_END_DIAG_TQ_EXT_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis Max Torque at Clutch Monitoring error reflect to external torque level 1					
LV_END_DIAG_TQ_REQ_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis Min torque at Clutch Monitoring error reflect to level 1					
LV_END_DIAG_TQI_AV_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis Actual indicated engine torque Monitoring error reflect to level 1					
LV_END_DIAG_TQI_N_MAX_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis Torque limitation Monitoring error reflect to level 1					
LV_ERR_CONV_MON_1	O/V	0... 1H	0 ...1	1	-
A/D conversion Monitoring error reflect to level 1					
LV_ERR_CRU_INH_MON_1	O/V	0... 1H	0 ...1	1	-
CRU Monitoring error reflect to level 1					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_MFF_MON_1	O/V	0... 1H	0 ...1	1	-
Mass fuel flow monitoring error reflect to level 1					
LV_ERR_N_32_MON_1	O/V	0... 1H	0 ...1	1	-
Engine speed Monitoring error reflect to level 1					
LV_ERR_PVS_MON_1	O/V	0... 1H	0 ...1	1	-
PVS Monitoring error reflect to level 1					
LV_ERR_SWI_AFS_MON	O/V	0... 1H	0 ...1	1	-
Indicator: maximum number of AFS request by MFF-monitoring has been reached					
LV_ERR_TPS_MON_1	O/V	0... 1H	0 ...1	1	-
TPS Monitoring error reflect to level 1					
LV_ERR_TQ_DIF_ISC_MON_1	O/V	0... 1H	0 ...1	1	-
ISC Monitoring error reflect to level 1					
LV_ERR_TQ_EXT_MON_1	O/V	0... 1H	0 ...1	1	-
Max Torque at Clutch Monitoring error reflect to external torque level 1					
LV_ERR_TQ_REQ_MON_1	O/V	0... 1H	0 ...1	1	-
Min torque at Clutch Monitoring error reflect to level 1					
LV_ERR_TQI_AV_MON_1	O/V	0... 1H	0 ...1	1	-
Actual indicated engine torque Monitoring error reflect to level 1					
LV_ERR_TQI_N_MAX_MON_1	O/V	0... 1H	0 ...1	1	-
Torque limitation Monitoring error reflect to level 1					
LV_ERR_TQI_N_MAX_MON_1_SAVE	R2	0... 1H	0 ...1	1	-
N_LIM monitoring error saved reset resistant					

**Input data:**

LV_ERR_AMT_INH_MON {p. 6983}	LV_ERR_CONV_MON {p. 6894}	LV_ERR_CRU_MON {p. 6912}	LV_ERR_DCC_INH_MON {p. 6983}
LV_ERR_GS_INH_MON {p. 6983}	LV_ERR_LDM_INH_MON {p. 6983}	LV_ERR_MFF_MON {p. 6943}	LV_ERR_MSR_INH_MON {p. 6983}
LV_ERR_N_32_MON {p. 7002}	LV_ERR_OPM_AV_MON {p. 6790}	LV_ERR_PVS_MON {p. 6961}	LV_ERR_SOF_INH_MON {p. 6790}
LV_ERR_TPS_MON {p. 6943}	LV_ERR_TQ_DIF_I_IS_ MON {p. 6921}	LV_ERR_TQ_DIF_P_D_IS_ MON {p. 6921}	LV_ERR_TQ_LOSS_MON {p. 6975}
LV_ERR_TQ_MAX_CLU_ MON {p. 6938}	LV_ERR_TQ_MIN_CLU_ MON {p. 6952}	LV_ERR_TQI_AV_MON {p. 6899}	LV_ERR_TQI_N_MAX_ MON {p. 6917}
LV_SWI_AFS_MFF_MAX_ MON {p. 6943}	LV_TQI_MON_ACT_MON {p. 6791}	VB {p. 1185}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_SWI_AFS_MON	V	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_SWI_AFS_MON	V	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_VB_MIN_MON_DIAG	V	0... FFH	0... 25.8984375	0.1015625	V
VB Threshold for activation of monitoring diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

### Import actions:

<b>ACTION_ERRM_NoFilterReset</b> (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_NoFilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_LV_ERR_SET>,IN<PRM_LV_ERR_RST>,IN<PRM_LV_END_DIAG>,OUT<PRM_LV_ERR>)

### General information

#### FUNCTION DESCRIPTION:

##### General information:

When a fault is detected by the level 2 of the ETC-Monitoring concept and the reaction is released in the module 'fault reaction of process monitoring', the fault is transferred to the error memory management. The memory area of all output data variables of this module is not permanently RAM tested, the memory area of this module is not cyclic ROM tested.

##### Description:

Since the different faults can occur in a successive way, they are stored in different locations of the error memory.

All faults LV\_ERR\_XX\_MON\_1 are stored in separate locations, in order to be able to analyze a scenario of successive faults. If more than one errors stored in one location, then it will be detected by different error symptoms.

The information whether a warning lamp (ETC MIL) is switched on in case of an error can be found in the general OBD error code table.

### Application conditions:

#### Initialisation:

- for condition see 'Application Incidences of Process Monitoring chapter 1.1'

-ACTION\_ERRM\_NoFilterReset (IN<CONV\_MON>, OUT<LV\_ERR\_CONV\_MON\_1>)

-ACTION\_ERRM\_NoFilterReset (IN<N\_32\_MON>, OUT<LV\_ERR\_N\_32\_MON\_1>)

-ACTION\_ERRM\_NoFilterReset (IN<TPS\_MON>, OUT<LV\_ERR\_TPS\_MON\_1>)

-ACTION\_ERRM\_NoFilterReset (IN<PVS\_MON>, OUT<LV\_ERR\_PVS\_MON\_1>)

-ACTION\_ERRM\_NoFilterReset (IN<CRU\_INH\_MON>, OUT<LV\_ERR\_CRU\_INH\_MON\_1>)


-ACTION\_ERRM\_NoFilterReset (IN<MFF\_MON>, OUT<LV\_ERR\_MFF\_MON\_1>)

-ACTION\_ERRM\_NoFilterReset (IN<TQ\_DIF\_ISC\_MON>, OUT<LV\_ERR\_TQ\_DIF\_ISC\_MON\_1>)

-ACTION\_ERRM\_NoFilterReset (IN<TQ\_REQ\_MON>, OUT<LV\_ERR\_TQ\_REQ\_MON\_1>)

-ACTION\_ERRM\_NoFilterReset (IN<TQ\_EXT\_MON>, OUT<LV\_ERR\_TQ\_EXT\_MON\_1>)

-ACTION\_ERRM\_NoFilterReset (IN<TQI\_AV\_MON>, OUT<LV\_ERR\_TQI\_AV\_MON\_1>)

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```
-ACTION_ERRM_NoFilterReset (IN<TQI_N_MAX_MON>, OUT<LV_ERR_
TQI_N_MAX_MON_1>)
```

```
(these actions erases filter data (LV_CDN_DIAG_xx = 0, LV_
ERR_xx = 0, ERR_SYM_xx = NO_SYM
- For LV_ERR_N_MAX_MON_SAVE = 0, if a power up is recognized.
A power up is detected, if the variables in the reset safe
RAM are not consistent.
```

**Activation:** at every engine state

**Deactivation:** -

**Recurrence:** 40 ms

### Function description:

### Formula section:

## E.9.1 Environmental data Calculation

### Formula section:

Set Environment Data for status bytes according to

*Chapter 1.1 Definition of Statusbytes of Error Memory Management of Process Monitoring (Appl.Inc.)*

## E.9.2 Error memory management of LV\_ERR\_CONV\_MON\_1

### **Formula section:**

```
LV_CDN_DIAG_CONV_MON_1 = 1
```

```
If LV_ERR_CONV_MON = 1
```

```
Then
```

```
lv_err_reset_CONV_MON_1 = 0;
lv_err_set_CONV_MON_1 = 1;      {failure detected}
ERR_SYM_CONV_MON_1 = SYM_3;
LV_END_DIAG_CONV_MON_1 = 1;
```

```
Else
```

```
lv_err_set_CONV_MON_1 = 0;
lv_err_reset_CONV_MON_1 = 1;  {no failure detected}
ERR_SYM_CONV_MON_1 = NO_SYM;
If { delay 520ms } then
```

```
/* After the level2 fault reaction time of 500ms the errors are updated
```

```
*/
```


```
LV_END_DIAG_CONV_MON_1 = 1;
```

```
Endif
```

```
Endif
```

For error management treatment the following action is called:

```
ACTION_ERRM_NoFilterSymptom(IN<CONV_MON>, IN<LV_CDN_DIAG_CONV_MON_1>, IN<ERR_
SYM_CONV_MON_1>, IN<lv_err_set_CONV_MON_1>, IN<lv_err_reset_CONV_MON_1>, IN<LV_
END_DIAG_CONV_MON_1>, OUT<LV_ERR_CONV_MON_1>)
```

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### E.9.3 Error memory management of LV\_ERR\_N\_32\_MON\_1

#### Formula section:

```
LV_CDN_DIAG_N_32_MON_1 = 1
```

```
If LV_ERR_N_32_MON = 1
```

```
Then
```

```
lv_err_reset_N_32_MON_1 = 0;
lv_err_set_N_32_MON_1 = 1;           {failure detected}
ERR_SYM_N_32_MON_1 = SYM_3;
LV_END_DIAG_N_32_MON_1 = 1;
```

```
Else
```

```
lv_err_set_N_32_MON_1 = 0;
lv_err_reset_N_32_MON_1 = 1;       {no failure detected}
ERR_SYM_N_32_MON_1 = NO_SYM;
```

```
If { delay 520ms } then
```

```
 / * After the level2 fault reaction time of 500ms the errors are updated
```

```
*/
```

```
LV_END_DIAG_N_32_MON_1 = 1;
```

```
Endif
```

```
Endif
```

For error management treatment the following action is called:

```
ACTION_ERRM_NoFilterSymptom(IN<N_32_MON>, IN<LV_CDN_DIAG_N_32_MON_1>, IN<ERR_SYM_N_32_MON_1>, IN<lv_err_set_N_32_MON_1>, IN<lv_err_reset_N_32_MON_1>, IN<LV_END_DIAG_N_32_MON_1>, OUT<LV_ERR_N_32_MON_1>)
```

### E.9.4 Error memory management of LV\_ERR\_TPS\_MON\_1

#### Formula section:

```
If LV_TQI_MON_ACT_MON = 1
```

```
Then LV_CDN_DIAG_TPS_MON_1 = 1
```

```
If LV_ERR_TPS_MON = 1
```

```
Then
```

```
lv_err_reset_TPS_MON_1 = 0;
lv_err_set_TPS_MON_1 = 1;           {failure detected}
ERR_SYM_TPS_MON_1 = SYM_3;
LV_END_DIAG_TPS_MON_1 = 1;
```

```
Else
```

```
lv_err_set_TPS_MON_1 = 0;
lv_err_reset_TPS_MON_1 = 1;       {no failure detected}
ERR_SYM_TPS_MON_1 = NO_SYM;
```

```
If { delay 520ms } then
```

```
 / * After the level2 fault reaction time of 500ms the errors are updated
```

```
*/
```


```
LV_END_DIAG_TPS_MON_1 = 1;
```

```
Endif
```

```
Endif
```

For error management treatment the following action is called:

```
ACTION_ERRM_NoFilterSymptom(IN<TPS_MON>, IN<LV_CDN_DIAG_TPS_MON_1>, IN<ERR_SYM_TPS_MON_1>, IN<lv_err_set_TPS_MON_1>, IN<lv_err_reset_TPS_MON_1>, IN<LV_END_DIAG_TPS_MON_1>, OUT<LV_ERR_TPS_MON_1>)
```

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## E.9.5 Error memory management of LV\_ERR\_PVS\_MON\_1

### Formula section:

```

LV_CDN_DIAG_PVS_MON_1 = 1

If    LV_ERR_PVS_MON = 1
Then
    lv_err_reset_PVS_MON_1 = 0;
    lv_err_set_PVS_MON_1 = 1;           {failure detected}
    ERR_SYM_PVS_MON_1 = SYM_3;
    LV_END_DIAG_PVS_MON_1 = 1;

Else
    lv_err_set_PVS_MON_1 = 0;
    lv_err_reset_PVS_MON_1 = 1;       {no failure detected}
    ERR_SYM_PVS_MON_1 = NO_SYM;
    If { delay 520ms } then
        / * After the level2 fault reaction time of 500ms the errors are updated
    */
        LV_END_DIAG_PVS_MON_1 = 1;
    Endif
Endif

```

For error management treatment the following action is called:

```

ACTION_ERRM_NoFilterSymptom(IN<PVS_MON>, IN<LV_CDN_DIAG_PVS_MON_1>, IN<ERR_SYM_
PVS_MON_1>, IN<lv_err_set_PVS_MON_1>, IN<lv_err_reset_PVS_MON_1>, IN<LV_END_DIAG_
PVS_MON_1>, OUT<LV_ERR_PVS_MON_1>)

```

## E.9.6 Error memory management of LV\_ERR\_CRU\_INH\_MON\_1

### Formula section:

```

If    LV_TQI_MON_ACT_MON = 1
Then  LV_CDN_DIAG_CRU_INH_MON_1 = 1;

If    (LV_ERR_CRU_MON = 1)
Then
    lv_err_reset_CRU_INH_MON_1 = 0;
    lv_err_set_CRU_INH_MON_1 = 1;       {failure detected}
    ERR_SYM_CRU_INH_MON_1 = SYM_0;
    LV_END_DIAG_CRU_INH_MON_1 = 1;

Elseif (LV_ERR_DCC_INH_MON = 1)
Then
    lv_err_reset_CRU_INH_MON_1 = 0;
    lv_err_set_CRU_INH_MON_1 = 1;       {failure detected}
    ERR_SYM_CRU_INH_MON_1 = SYM_1;
    LV_END_DIAG_CRU_INH_MON_1 = 1;

Elseif (LV_ERR_LDM_INH_MON = 1)
Then
    lv_err_reset_CRU_INH_MON_1 = 0;
    lv_err_set_CRU_INH_MON_1 = 1;       {failure detected}
    ERR_SYM_CRU_INH_MON_1 = SYM_2;
    LV_END_DIAG_CRU_INH_MON_1 = 1;

Else
    lv_err_set_CRU_INH_MON_1 = 0;
    lv_err_reset_CRU_INH_MON_1 = 1;     {no failure detected}
    ERR_SYM_CRU_INH_MON_1 = NO_SYM;
    If { delay 520ms } then
        / * After the level2 fault reaction time of 500ms the errors are updated
    */
        LV_END_DIAG_CRU_INH_MON_1 = 1;
    Endif
Endif


```

For error management treatment the following action is called:

```

ACTION_ERRM_NoFilterSymptom(IN<CRU_INH_MON>, IN<LV_CDN_DIAG_CRU_INH_MON_1>, IN<ERR_
SYM_CRU_INH_MON_1>, IN<lv_err_set_CRU_INH_MON_1>, IN<lv_err_reset_CRU_INH_MON_1>,
IN<LV_END_DIAG_CRU_INH_MON_1>, OUT<LV_ERR_CRU_INH_MON_1>)

```

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## E.9.7 Error memory management of LV\_ERR\_TQI\_AV\_MON\_1

### Formula section:

```

If    LV_TQI_MON_ACT_MON = 1
Then  LV_CDN_DIAG_TQI_AV_MON_1 = 1;

If    (LV_ERR_TQI_AV_MON = 1)
Then
    lv_err_reset_TQI_AV_MON_1 = 0;
    lv_err_set_TQI_AV_MON_1 = 1;           {failure detected}
    ERR_SYM_TQI_AV_MON_1 = SYM_3;
    LV_END_DIAG_TQI_AV_MON_1 = 1;

Else
    lv_err_set_TQI_AV_MON_1 = 0;
    lv_err_reset_TQI_AV_MON_1 = 1;       {no failure detected}
    ERR_SYM_TQI_AV_MON_1 = NO_SYM;
    If { delay 520ms } then
        / * After the level2 fault reaction time of 500ms the errors are updated
    */
        LV_END_DIAG_TQI_AV_MON_1 = 1;
    Endif
Endif

```

For error management treatment the following action is called:

```

ACTION_ERRM_NoFilterSymptom(IN<TQI_AV_MON>, IN<LV_CDN_DIAG_TQI_AV_MON_1>, IN<ERR_
SYM_TQI_AV_MON_1>, IN<lv_err_set_TQI_AV_MON_1>, IN<lv_err_reset_TQI_AV_MON_1>, IN<LV_
END_DIAG_TQI_AV_MON_1>, OUT<LV_ERR_TQI_AV_MON_1>)

```

## E.9.8 Error memory management of LV\_ERR\_TQI\_N\_MAX\_MON\_1

The error LV\_ERR\_TQI\_N\_MAX\_MON\_1 triggers the redundant switch off path (see "Fault Reaction of Process Monitoring") during the actual duty cycle. This finally leads to a reset after debouncing (see "Processor Monitoring"). The entry into the error memory has to be performed past reset. Therefore it is needful to store the error information reset safe; LV\_ERR\_TQI\_N\_MAX\_MON\_1\_SAVE is located in the reset safe RAM area. The entry into the error memory is done past reset by evaluation of the information stored before reset.

### Application conditions:

*Initialisation:* LV\_ERR\_TQI\_N\_MAX\_MON\_1\_SAVE = 0  
only after power up, no initialization after reset

### Formula section:

```


If    LV_IGK = 1 and VB > C_VB_MIN_MON_DIAG
Then  LV_CDN_DIAG_TQI_N_MAX_MON_1 = 1;

If (1) (LV_ERR_TQI_N_MAX_MON_1_SAVE = 1) / * error detected last duty cycle */

Then (1)
    / * error not jet passed to ERRM => transfer error information to ERRM*/

    lv_err_reset_TQI_N_MAX_MON_1 = 0;
    lv_err_set_TQI_N_MAX_MON_1 = 1;
    ERR_SYM_TQI_N_MAX_MON_1 = SYM_3;
    / * environment data are already reset safe stored before reset */
    LV_END_DIAG_TQI_N_MAX_MON_1 = 1;
    / * avoid more than one entry into error memory */

```

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```

If (2) {delay 120ms}
Then (2)
    / * this delay time period depends on Processor Monitoring */
    / * After this time period the reset has to be carried out */
    LV_ERR_TQI_N_MAX_MON_1_SAVE = 0;
Endif (2)
Else (1) / * error not detected last duty cycle */
If (3) (LV_ERR_TQI_N_MAX_MON_1 = 1)
Then (3) / * error was stored last recurrence */
    lv_err_reset_TQI_N_MAX_MON_1 = 0;
    lv_err_set_TQI_N_MAX_MON_1 = 1;
    ERR_SYM_TQI_N_MAX_MON_1 = SYM_3;
    LV_END_DIAG_TQI_N_MAX_MON_1 = 1;

Else (3)
    lv_err_set_TQI_N_MAX_MON_1 = 0;
    lv_err_reset_TQI_N_MAX_MON_1 = 1;      {no failure detected}
    ERR_SYM_TQI_N_MAX_MON_1 = NO_SYM;
If (4){ delay 520ms }
Then (4)
    / * After the level2 fault reaction time of 500ms the errors
are updated */
        LV_END_DIAG_TQI_N_MAX_MON_1 = 1;
Endif (4)
Endif (3)
Endif (1)
If (5) (LV_ERR_TQI_N_MAX_MON = 1)
Then (5) / * error detected in actual duty cycle */
If (6) (LV_ERR_TQI_N_MAX_MON_1_SAVE = 0)
Then (6)
    Set Environment Data for status bytes LV_ERR_TQI_N_MAX_MON_1
according to chapter 1.2 of Error Memory Management of Process Monitoring (Appl.Inc.)
Endif (6)
/ * store information reset save and avoid saving environment data next recurrence
*/
LV_ERR_TQI_N_MAX_MON_1_SAVE =1;
Endif (5)


```

For error management treatment the following action is called:

```

ACTION_ERRM_NoFilterSymptom(IN<TQI_N_MAX_MON>, IN<LV_CDN_DIAG_TQI_N_MAX_MON_
1>, IN<ERR_SYM_TQI_N_MAX_MON_1>, IN<lv_err_set_TQI_N_MAX_MON_1>, IN<lv_err_reset_
TQI_N_MAX_MON_1>, IN<LV_END_DIAG_TQI_N_MAX_MON_1>, OUT<LV_ERR_TQI_N_MAX_MON_
1>)

```

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## E.9.9 Error memory management of LV\_ERR\_MFF\_MON\_1

### Formula section:

```

If      LV_TQI_MON_ACT_MON = 1
Then    LV_CDN_DIAG_MFF_MON_1 = 1;

If      (LV_ERR_MFF_MON = 1)
Then
    lv_err_reset_MFF_MON_1 = 0;
    lv_err_set_MFF_MON_1 = 1;           {failure detected}
    ERR_SYM_MFF_MON_1 = SYM_3;
    LV_END_DIAG_MFF_MON_1 = 1;
Elseif (LV_ERR_OPM_AV_MON = 1)
Then
    lv_err_reset_MFF_MON_1 = 0;
    lv_err_set_MFF_MON_1 = 1;           {failure detected}
    ERR_SYM_MFF_MON_1 = SYM_2;
    LV_END_DIAG_MFF_MON_1 = 1;

Else
    lv_err_set_MFF_MON_1 = 0;
    lv_err_reset_MFF_MON_1 = 1;       {no failure detected}
    ERR_SYM_MFF_MON_1 = NO_SYM;
    If { delay 520ms }
    Then
        / * After the level2 fault reaction time of 500ms the errors are updated
    */
        LV_END_DIAG_MFF_MON_1 = 1;
    Endif
Endif

```

For error management treatment the following action is called:

```

ACTION_ERRM_NoFilterSymptom(IN<MFF_MON>, IN<LV_CDN_DIAG_MFF_MON_1>, IN<ERR_SYM_
MFF_MON_1>, IN<lv_err_set_MFF_MON_1>, IN<lv_err_reset_MFF_MON_1>, IN<LV_END_DIAG_
MFF_MON_1>, OUT<LV_ERR_MFF_MON_1>)

```

## E.9.10 Error memory management of LV\_ERR\_TQ\_DIF\_ISC\_MON\_1

### Formula section:


```

If      LV_TQI_MON_ACT_MON = 1
Then    LV_CDN_DIAG_TQ_DIF_ISC_MON_1 = 1;

If      (LV_ERR_TQ_DIF_I_IS_MON = 1)
Then
    lv_err_reset_TQ_DIF_ISC_MON_1 = 0;
    lv_err_set_TQ_DIF_ISC_MON_1 = 1;       {failure detected}
    ERR_SYM_TQ_DIF_ISC_MON_1 = SYM_2;
    LV_END_DIAG_TQ_DIF_ISC_MON_1 = 1;
Elseif (LV_ERR_TQ_DIF_P_D_IS_MON = 1)
then
    lv_err_reset_TQ_DIF_ISC_MON_1 = 0;
    lv_err_set_TQ_DIF_ISC_MON_1 = 1;       {failure detected}
    ERR_SYM_TQ_DIF_ISC_MON_1 = SYM_3;
    LV_END_DIAG_TQ_DIF_ISC_MON_1 = 1;

Else
    lv_err_set_TQ_DIF_ISC_MON_1 = 0;
    lv_err_reset_TQ_DIF_ISC_MON_1 = 1;    {no failure detected}
    ERR_SYM_TQ_DIF_ISC_MON_1 = NO_SYM;
    If { delay 520ms }
    then

```

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```

    / * After the level2 fault reaction time of 500ms the errors are updated
*/
    LV_END_DIAG_TQ_DIF_ISC_MON_1 = 1;
Endif
Endif

```

For error management treatment the following action is called:

```

ACTION_ERRM_NoFilterSymptom(IN<TQ_DIF_ISC_MON>, IN<LV_CDN_DIAG_TQ_DIF_ISC_MON_
1>, IN<ERR_SYM_TQ_DIF_ISC_MON_1>, IN<lv_err_set_TQ_DIF_ISC_MON_1>, IN<lv_err_reset_
TQ_DIF_ISC_MON_1>, IN<LV_END_DIAG_TQ_DIF_ISC_MON_1>, OUT<LV_ERR_TQ_DIF_ISC_MON_
1>)

```

## E.9.11 Error memory management of LV\_ERR\_TQ\_REQ\_MON\_1

**Formula section:**

```

If      LV_TQI_MON_ACT_MON = 1
Then    LV_CDN_DIAG_TQ_REQ_MON_1 = 1;

If      (LV_ERR_TQ_MAX_CLU_MON = 1)
Then
    lv_err_reset_TQ_REQ_MON_1 = 0;
    lv_err_set_TQ_REQ_MON_1 = 1;           {failure detected}
    ERR_SYM_TQ_REQ_MON_1 = SYM_0;
    LV_END_DIAG_TQ_REQ_MON_1 = 1;
Elseif (LV_ERR_TQ_MIN_CLU_MON = 1)
then
    lv_err_reset_TQ_REQ_MON_1 = 0;
    lv_err_set_TQ_REQ_MON_1 = 1;           {failure detected}
    ERR_SYM_TQ_REQ_MON_1 = SYM_1;
    LV_END_DIAG_TQ_REQ_MON_1 = 1;
Elseif (LV_ERR_TQ_LOSS_MON = 1)
then
    lv_err_reset_TQ_REQ_MON_1 = 0;
    lv_err_set_TQ_REQ_MON_1 = 1;           {failure detected}
    ERR_SYM_TQ_REQ_MON_1 = SYM_2;
    LV_END_DIAG_TQ_REQ_MON_1 = 1;
Elseif (LV_ERR_SOF_INH_MON = 1)
then
    lv_err_reset_TQ_REQ_MON_1 = 0;
    lv_err_set_TQ_REQ_MON_1 = 1;           {failure detected}
    ERR_SYM_TQ_REQ_MON_1 = SYM_3;
    LV_END_DIAG_TQ_REQ_MON_1 = 1;
Else
    lv_err_set_TQ_REQ_MON_1 = 0;
    lv_err_reset_TQ_REQ_MON_1 = 1;         {no failure detected}
    ERR_SYM_TQ_REQ_MON_1 = NO_SYM;
    If { delay 520ms }
    then
        / * After the level2 fault reaction time of 500ms the errors are updated
*/
        LV_END_DIAG_TQ_REQ_MON_1 = 1;
    Endif
Endif


```

For error management treatment the following action is called:

```

ACTION_ERRM_NoFilterSymptom(IN<TQ_REQ_MON>, IN<LV_CDN_DIAG_TQ_REQ_MON_1>, IN<ERR_
SYM_TQ_REQ_MON_1>, IN<lv_err_set_TQ_REQ_MON_1>, IN<lv_err_reset_TQ_REQ_MON_1>,
IN<LV_END_DIAG_TQ_REQ_MON_1>, OUT<LV_ERR_TQ_REQ_MON_1>)

```

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## E.9.12 Error memory management of LV\_ERR\_TQ\_EXT\_MON\_1

### Formula section:

```

If      LV_TQI_MON_ACT_MON = 1
Then    LV_CDN_DIAG_TQ_EXT_MON_1 = 1;

If      (LV_ERR_MSR_INH_MON = 1)
Then
    lv_err_reset_TQ_EXT_MON_1 = 0;
    lv_err_set_TQ_EXT_MON_1 = 1;           {failure detected}
    ERR_SYM_TQ_EXT_MON_1 = SYM_0;
    LV_END_DIAG_TQ_EXT_MON_1 = 1;
Elseif (LV_ERR_AMT_INH_MON = 1)
then
    lv_err_reset_TQ_EXT_MON_1 = 0;
    lv_err_set_TQ_EXT_MON_1 = 1;           {failure detected}
    ERR_SYM_TQ_EXT_MON_1 = SYM_2;
    LV_END_DIAG_TQ_EXT_MON_1 = 1;
Elseif (LV_ERR_GS_INH_MON = 1)
then
    lv_err_reset_TQ_EXT_MON_1 = 0;
    lv_err_set_TQ_EXT_MON_1 = 1;           {failure detected}
    ERR_SYM_TQ_EXT_MON_1 = SYM_3;
    LV_END_DIAG_TQ_EXT_MON_1 = 1;

Else
    lv_err_set_TQ_EXT_MON_1 = 0;
    lv_err_reset_TQ_EXT_MON_1 = 1;        {no failure detected}
    ERR_SYM_TQ_EXT_MON_1 = NO_SYM;
    If { delay 520ms }
    then
        / * After the level2 fault reaction time of 500ms the errors are updated
    */
        LV_END_DIAG_TQ_EXT_MON_1 = 1;
Endif

Endif

```

For error management treatment the following action is called:

ACTION\_ERRM\_NoFilterSymptom(IN<TQ\_EXT\_MON>, IN<LV\_CDN\_DIAG\_TQ\_EXT\_MON\_1>, IN<ERR\_SYM\_TQ\_EXT\_MON\_1>, IN<lv\_err\_set\_TQ\_EXT\_MON\_1>, IN<lv\_err\_reset\_TQ\_EXT\_MON\_1>, IN<LV\_END\_DIAG\_TQ\_EXT\_MON\_1>, OUT<LV\_ERR\_TQ\_EXT\_MON\_1>)

## E.9.13 Diagnosis for AFS request by monitoring (Diagnostic file – STD\_INI filter)

### FUNCTION DESCRIPTION:

#### General information:

CTR\_SWI\_AFS\_MON needs to be saved reset resistant AND in NVMY !

#### Description:

The MFF-monitoring-functionality is able to send requests for switching the engine to AFS-mode in case of detected unplausibilities in non-AFS-modes.

In order to gain information about the number of interventions of the MFF-monitoring- functionality during vehicle/ECU-lifetime, this diagnosis has been introduced.

The flag LV\_SWI\_AFS\_MFF\_MAX\_MON represents that the maximum allowed number of requests by MFF-monitoring to switch to AFS-mode has been reached.

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CTR\_SWI\_AFS\_MON is used to count these events.

Additionally, the indicator flag LV\_ERR\_SWI\_AFS\_MON is set. It is used to call the ERRM and store the indicator with environmental data (e.g. with the value of CTR\_SWI\_AFS\_MON) for further examination.

**Error-symptoms and conditions:** are defined to this diagnosis function as following

```
┌-┐-┐-┐-┐-
```

```
┌-┐-┐-┐-┐-
```

```

| | |┌-> LV_SWI_AFS_MFF_MAX_MON detected  (= SYM_0)
| |┌----> not used                      (= SYM_1)
|┌-----> not used                      (= SYM_2)
┌-----> not used                       (= SYM_3)

```

### Application conditions:

```

Activation:  If   LV_TQI_MON_ACT_MON = 1
              Then LV_CDN_DIAG_SWI_AFS_MON = 1
              Endif

```

Deactivation: When the activation condition is not fulfilled then LV\_CDN\_DIAG\_SWI\_AFS\_MON = 0.

Initialisation: LV\_CDN\_DIAG\_SWI\_AFS\_MON = STD\_INI

LV\_END\_DIAG\_SWI\_AFS\_MON = STD\_INI

LV\_ERR\_SWI\_AFS\_MON = STD\_INI

ERR\_SYM\_SWI\_AFS\_MON = STD\_INI

at first power up/on saved RAM lost (or reprogramming): CTR\_SWI\_AFS\_MON = 0

at reset: CTR\_SWI\_AFS\_MON = restored from NVMY

Recurrence: 40ms

### Formula section:

Symptoms calculation :

```
If   LV_SWI_AFS_MFF_MAX_MON changes from 0 - ->1
```

```
Then
```

```
ERR_SYM_SWI_AFS_MON = SYM_0
```

```
CTR_SWI_AFS_MON = CTR_SWI_AFS_MON +1
```

```
Else
```

```
ERR_SYM_SWI_AFS_MON = NO_SYM      { No failure has been detected }
```

```
Endif
```

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

### Configuration for diagnostic symptoms:

Diagnostic SWI_AFS_MON	Symptom description	Symptom	Filter type
AFS request by monitoring diagnosis	LV_SWI_AFS_MFF_MAX_MON	SYM_0	STD_INI
	not used	SYM_1	
	not used	SYM_2	
	not used	SYM_3	

## E.10 Error memory management of process monitoring (Appl. Inc.)

### Data definition:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
N_32_MON_SAVE	O/V/S	0... FFH	0... 8160	32	rpm
Engine speed (monitoring level, reset save)					
PREV_STATE_IV_SAVE	O/V/S	0... FFH	0... 255	1	-
status word disable injectors (reset save)					
STATE_LV_ERR_CRU_INH_MON_1	O/V	0... FFH	0... 255	1	-
Statusbyte of LV_ERR_CRU_INH_MON_1 (monitoring level)					
STATE_LV_ERR_MFF_MON_1	O/V	0... FFH	0... 255	1	-
Statusbyte of LV_ERR_MFF_MON_1 (monitoring level)					
STATE_LV_ERR_TQ_DIF_ISC_MON_1	O/V	0... FFH	0... 255	1	-
Statusbyte of LV_ERR_TQ_DIF_ISC_MON_1 (monitoring level)					
STATE_TQI_N_MAX_MON_1_1_SAVE	O/V/S	0... FFH	0... 255	1	-
Statusbyte1 of LV_ERR_TQI_N_MAX_MON_1 (monitoring level, reset save)					
STATE_TQI_N_MAX_MON_1_2_SAVE	O/V/S	0... FFH	0... 255	1	-
Statusbyte2 of LV_ERR_TQI_N_MAX_MON_1 (monitoring level, reset save)					

### Input data:

Ba_ist {p. 8154}	LV_BRAKE_MON {p. 6790}	LV_CRU_ACT {p. 7227}	LV_CRU_MAIN_SWI {p. 7220}
LV_ERR_CONV_MON {p. 6894}	LV_ERR_MFF_MON {p. 6943}	LV_ERR_MSR_INH_MON {p. 6983}	LV_ERR_N_32_MON {p. 7002}
LV_ERR_OPM_AV_MON {p. 6790}	LV_ERR_PVS {p. 4216}	LV_ERR_PVS_MON {p. 6961}	LV_ERR_TPS {p. 4982}
LV_ERR_TPS_MON {p. 6943}	LV_ERR_TQ_DIF_I_IS_MON {p. 6921}	LV_ERR_TQ_DIF_P_D_IS_MON {p. 6921}	LV_ERR_TQ_LOSS_MON {p. 6975}
LV_ERR_TQ_MAX_CLU_MON {p. 6938}	LV_ERR_TQ_MIN_CLU_MON {p. 6952}	LV_ERR_TQI_AV_MON {p. 6899}	LV_IGK_MON {p. 6790}
LV_IS {p. 1720}	LV_LAMB_LS_UP_VLD_MON [NC_CBK_EX_NR] {p. 6790}	LV_MTC_CUR_OFF {p. 6565}	LV_N_LIM_ETC_LIH {p. 4982}
LV_PAS_RAMP_ACT_I_CHG_MON {p. 6790}	LV_PAS_RAMP_ACT_P_D_CHG_MON {p. 6791}	LV_REQ_ISC {p. 3501}	LV_TQ_DCC_INC_REQ {p. 1568}
LV_TQ_WHEEL_LDM_REQ {p. 1568}	LV_TQI_MON_ACT_MON {p. 6791}	N_32_MON {p. 7002}	PREV_STATE_IV {p. 2039}
PV_AV_MON {p. 6961}			

### FUNCTION DESCRIPTION:

### General information:

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For every fault, the environmental conditions are stored in the environmental data variables. The error symptom is used for encoding the type of the fault if more than one level 2 error could lead to the error. The variables are chosen such that the fault scenario can be analyzed.

The memory area of all output data variables of this module is not cyclical RAM tested, the memory area of this module is not cyclic ROM tested.

### Application conditions

**Initialization:** –

**Activation:** according to "Error Memory management of Process Monitoring"

**Update Rate:** according to "Error Memory management of Process Monitoring"


### Formula section:

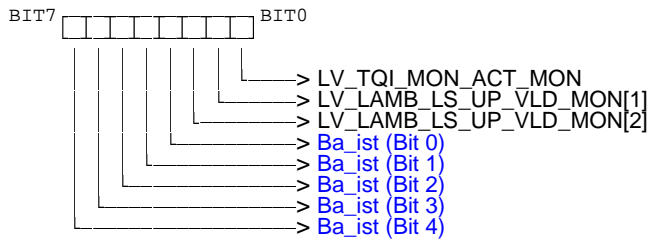
Since the different faults can occur in a successive way, they are stored in different locations of the failure memory.

## E.10.1 Definition of Statusbytes

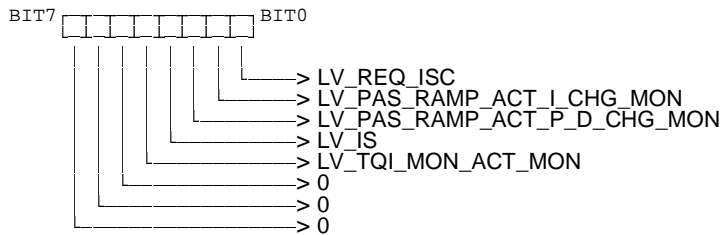
The bit values for the ENVD of each error (that actually uses bit values within its ENVD) are represented by a statusbyte. The definition of these statusbytes is listed below.

STATE\_LV\_ERR\_MFF\_MON\_1 :

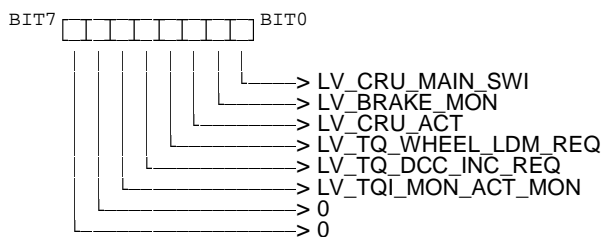
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STATE\_LV\_ERR\_TQ\_DIF\_ISC\_MON\_1 :



STATE\_LV\_ERR\_CRU\_INH\_MON\_1 :



## E.10.2 Definition of non volatile ENVD for LV\_ERR\_TQI\_N\_MAX\_MON\_1

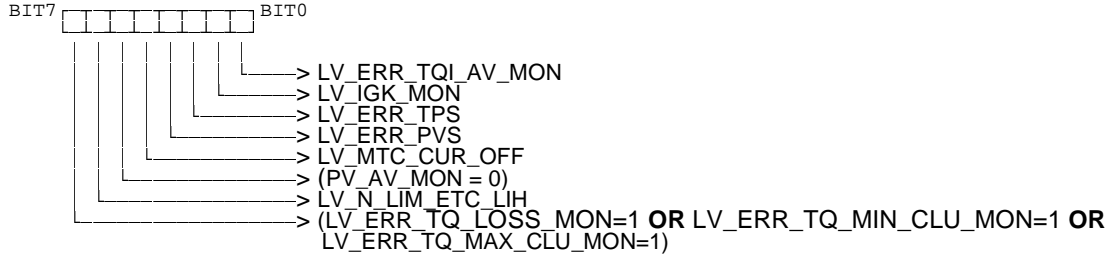
As the error LV\_ERR\_TQI\_N\_MAX\_MON leads to a reset of the ECU, its environmental data need to be stored reset save before the reset. Therefore the ENVD of this error is copied to reset save labels. This is only done one time when the error occurs (refer to "ERRM of process monitoring": ERRM of LV\_ERR\_TQI\_N\_MAX\_MON\_1).

N\_32\_MON\_SAVE = N\_32\_MON

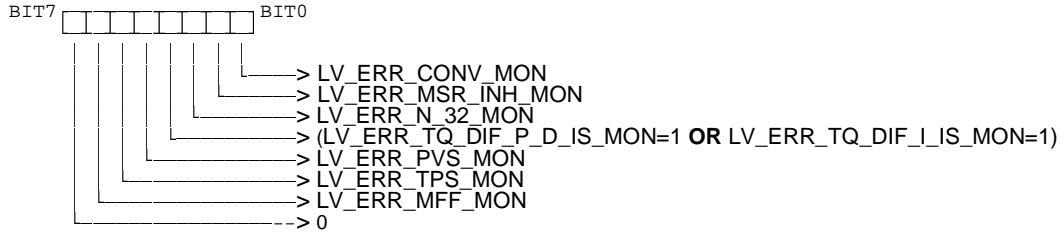
PREV\_STATE\_IV\_SAVE = PREV\_STATE\_IV

STATE\_TQI\_N\_MAX\_MON\_1\_1\_SAVE :






STATE\_TQI\_N\_MAX\_MON\_1\_2\_SAVE :



To save some locations in failure memory some of the level 2 errors collect in one error ,location as different symtoms, this is shown in the next table. In addition to the information above, for every fault environmental data is stored. This datas are tuneable. The following table is only a recommendation of enviromental datas.

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Error	SYM	Error Cause	Recommendation of environmental data			
Error bit level1		Error bit level2	First byte	Second Byte	Third byte	Fourth byte
LV_ERR_CONV_MON_1	3	LV_ERR_CONV_MON	N_32_MON	VP_MC_AN_DIG_MON_KWP	VP_MU_AN_DIG_MON_KWP	VB
LV_ERR_N_32_MON_1	3	LV_ERR_N_32_MON	N_32	N_32_MON	N_32_SUB_MON	T_SEG_SW_MON
LV_ERR_TPS_MON_1	3	LV_ERR_TPS_MON	TPS_AV	TPS_AV_MON	V_TPS_1_MON	V_TPS_2_MON
LV_ERR_PVS_MON_1	3	LV_ERR_PVS_MON	STATE_LV_ERR_CRU_INH_MON_1	PV_AV_MON	V_PVS_1_MON_KWP	V_PVS_2_MON_KWP
LV_ERR_CRU_INH_MON_1	0 or 1 or 2	LV_ERR_CRU_MON or LV_ERR_DCC_INH_MON or LV_ERR_LDM_INH_MON	STATE_LV_ERR_CRU_INH_MON_1	TQ_WHEEL_LDM_MON	FAC_TQ_REQ_CRU	TQ_DCC_MON
LV_ERR_TQI_AV_MON_1	3	LV_ERR_TQI_AV_MON	N_32_MON	TQI_SP_MON	TQI_AV_MON	TQI_SP_KWP
LV_ERR_TQI_N_MAX_MON_1	3	LV_ERR_TQI_N_MAX_MON	N_32_MON_SAVE	PREV_STATE_IV_SAVE	STATE_TQI_N_MAX_MON_1_1_SAVE	STATE_TQI_N_MAX_MON_1_2_SAVE
LV_ERR_MFF_MON_1	2 or 3	LV_ERR_OPM_AV_MON or LV_ERR_MFF_MON	STATE_LV_ERR_MFF_MON_1	MAF	MFF_SP_MV_KWP	LAMB_LS_UP_MV_KWP
LV_ERR_TQ_DIF_ISC_MON_1	2 or 3	LV_ERR_TQ_DIF_IS_MON or LV_ERR_TQ_DIF_P_D_IS_MON	STATE_LV_ERR_TQ_DIF_ISC_MON_1	N_DIF_SP_IS_MON	TQ_DIF_IS_MON	TQ_DIF_P_D_IS_MON
LV_ERR_TQ_REQ_MON_1	0 or 1 or 2 or 3	LV_ERR_TQ_MAX_CLU_MON or LV_ERR_TQ_MIN_CLU_MON or LV_ERR_TQ_LOSS_MON or LV_ERR_SOF_INH_MON	TQ_MAX_CLU_DIF_MON	TQ_MIN_CLU_DIF_MON	TQ_LOSS_DIF_MON	STATE_ENG
LV_ERR_TQ_EXT_MON_1	0 or 2 or 3	LV_ERR_MSR_INH_MON or LV_ERR_AMT_INH_MON or LV_ERR_GS_INH_MON	BIT 0: LV_MSR_PLAUS BIT 2: LV_TQ_AMT_INC_REQ BIT 3: LV_TQ_GS_INC_REQ	TQI_MSR_CAN	TQ_GS_MON	STATE_ERR_AMT_MON

The information whether a warning lamp (ETC MIL) is switched on in case of an error can be found in the general OBD error code table.

In case of more than one error cause occurs, always the first error (according to the table above; see BIT 0...4 of first Byte for the order) is taken into account.

### E.10.3 List of error codes and symptoms

The list of error codes and the list of error symptoms can be found in the chapter "Table of failures".

#### Configuration diagnostic symptoms:

Diagnosis XX	Symptom	Nr	ABC type
<i>Diagnosis description:</i> A/D monitoring error	no error	NO_ SYM	NO
CONV_MON	A/D monitoring error	SYM _3	
<i>Diagnosis description:</i> Engine speed monitoring error	no error	NO_ SYM	NO
N_32_MON	Engine speed monitoring error	SYM _3	
<i>Diagnosis description:</i> TPS monitoring error	no error	NO_ SYM	NO
TPS_MON	TPS monitoring error	SYM _3	
<i>Diagnosis description:</i> PVS monitoring error	no error	NO_ SYM	NO
PVS_MON	PVS monitoring error	SYM _3	
<i>Diagnosis description:</i> Cruise control monitoring error	no error	NO_ SYM	NO
CRU_INH_MON	Cruise control monitoring error	SYM _0	
	Distance cruise control monitoring error	SYM _1	
	LDM monitoring error	SYM _2	
<i>Diagnosis description:</i> Torque monitoring error	no error	NO_ SYM	NO
TQI_AV_MON	Torque monitoring error	SYM _3	
<i>Diagnosis description:</i> N_LIM monitoring error	no error	NO_ SYM	NO
TQI_N_MAX_MON	N_LIM monitoring error	SYM _3	
<i>Diagnosis description:</i> Mass fuel flow monitoring error	no error	NO_ SYM	NO
MFF_MON	Error in engine operation mode	SYM _2	
	Mass fuel flow monitoring error	SYM _3	
<i>Diagnosis description:</i> ISC monitoring error	no error	NO_ SYM	NO
ISC_MON	ISC I part monitoring error	SYM _2	
	ISC P-D part monitoring error	SYM _3	
<i>Diagnosis description:</i> Torque req. monitoring error	no error	NO_ SYM	NO
TQ_REQ_MON	TQ_MAX_CLU monitoring error	SYM _0	
	TQ_MIN_CLU monitoring error	SYM _1	

	<i>Torque loss monitoring error</i>	<i>SYM</i> <i>_2</i>	
	<i>Sound flap monitoring error</i>	<i>SYM</i> <i>_3</i>	
<i>Diagnosis description:</i> <i>External torque req. control monitoring error</i>	<i>no error</i>	<i>NO_</i> <i>SYM</i>	NO
<i>TQ_EXT_MON</i>	<i>Deceleration slip control monitoring error</i>	<i>SYM</i> <i>_0</i>	
	<i>Automated manual transmission monitoring error</i>	<i>SYM</i> <i>_2</i>	
	<i>Gear shift monitoring error</i>	<i>SYM</i> <i>_3</i>	

## E.11 Fault reaction of process monitoring

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_TRAN_1_MON	V	0... 1H	0 ...1	1	-
Flag for temporary fault 1 (exclusive fault of L3) during last recurrency					
LV_ERR_TRAN_2_MON	V	0... 1H	0 ...1	1	-
Flag for temporary fault 2 (together with fault of L2) during last recurrency					
LV_N_LIM_REQ_MON	O/V	0... 1H	0 ...1	1	-
Request for engine speed limitation					
LV_OFF_IV_MON	O/V	0... 1H	0 ...1	1	-
Request for disable of IV power stage by main controller					
LV_OFF_IV_N_LIM_ETC_TMP_MON	V	0... 1H	0 ...1	1	-
Flag for temporary injection cut off during last recurrency					
LV_OFF_MTC_MON	O/V	0... 1H	0 ...1	1	-
Request for disable of MTC power stage by main controller					

### Input data:

LV_ERR_CONV_MON {p. 6894}	LV_ERR_MFF_MON {p. 6943}	LV_ERR_MU_MC {p. 7072}	LV_ERR_N_32_MON {p. 7002}
LV_ERR_OPM_AV_MON {p. 6790}	LV_ERR_PVS_MON {p. 6961}	LV_ERR_TMP_MU_MC {p. 7072}	LV_ERR_TPS_MON {p. 6943}
LV_ERR_TQ_DIF_I_IS_MON {p. 6921}	LV_ERR_TQ_DIF_P_D_IS_MON {p. 6921}	LV_ERR_TQ_LOSS_MON {p. 6975}	LV_ERR_TQ_MAX_CLU_MON {p. 6938}
LV_ERR_TQ_MIN_CLU_MON {p. 6952}	LV_ERR_TQI_AV_MON {p. 6899}	LV_ERR_TQI_N_MAX_MON {p. 6917}	LV_OFF_IV_N_LIM_ETC_MON {p. 6790}

### Action definition

<b>ACTION_ECM2_LockPws ()</b>	Mode: O
Disable power stages by process monitoring (used when no ECM2 tasks executed).	

<b>ACTION_ECM2_ResetErrorFlags ()</b>	Mode: O
Enable power stages unless fault reaction already active.	

<b>ACTION_ECM2_UnlockPws ()</b>	Mode: O
Enable power stages by process monitoring for exactly one time (used when ECM2 tasks executed)	

### Import actions:

<b>ACTION_ECM3_Service12TaskPfm (IN&lt;No Name available&gt;)</b>
<b>ACTION_ECM3_Service13TaskPfm (IN&lt;No Name available&gt;)</b>
<b>ACTION_ECM3_Service14TaskPfm (IN&lt;No Name available&gt;)</b>

**Note:** These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 4.

```
ACTION_ECM3_McChkStack()
```

**Note:** This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION\_ECM3\_Service12TaskPfm() and ACTION\_ECM3\_Service13TaskPfm().

```
ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
```

```
ACTION_ECM3_ChkCpl(IN <>, IN <>)
```

```
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)
```

**Note:** All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

```
ACTION_ECM3_RedSwitchOffPath()
```

**Note:** This action is defined in chapter "Processor Monitoring", subsection "The redundant switch off path".

### Description for ACTION\_ECM2\_LockPws():

#### Description:

**Syntax:** ACTION\_ECM2\_LockPws()

#### Formula section:

```
LV_OFF_IV_MON = 1;
LV_OFF_MTC_MON = 1;
/* Disable injection and H-bridge */
```

### Description for ACTION\_ECM2\_UnlockPws():

#### Description:

**Syntax:** ACTION\_ECM2\_UnlockPws()

#### Formula section:

```
LV_OFF_IV_MON = 0;
LV_OFF_MTC_MON = 0;
/* Enable injection and H-bridge for exactly one time */
```

### Description for ACTION\_ECM2\_ResetErrorFlags():

#### Description:

**Syntax:** ACTION\_ECM2\_ResetErrorFlags()

**Formula section:**

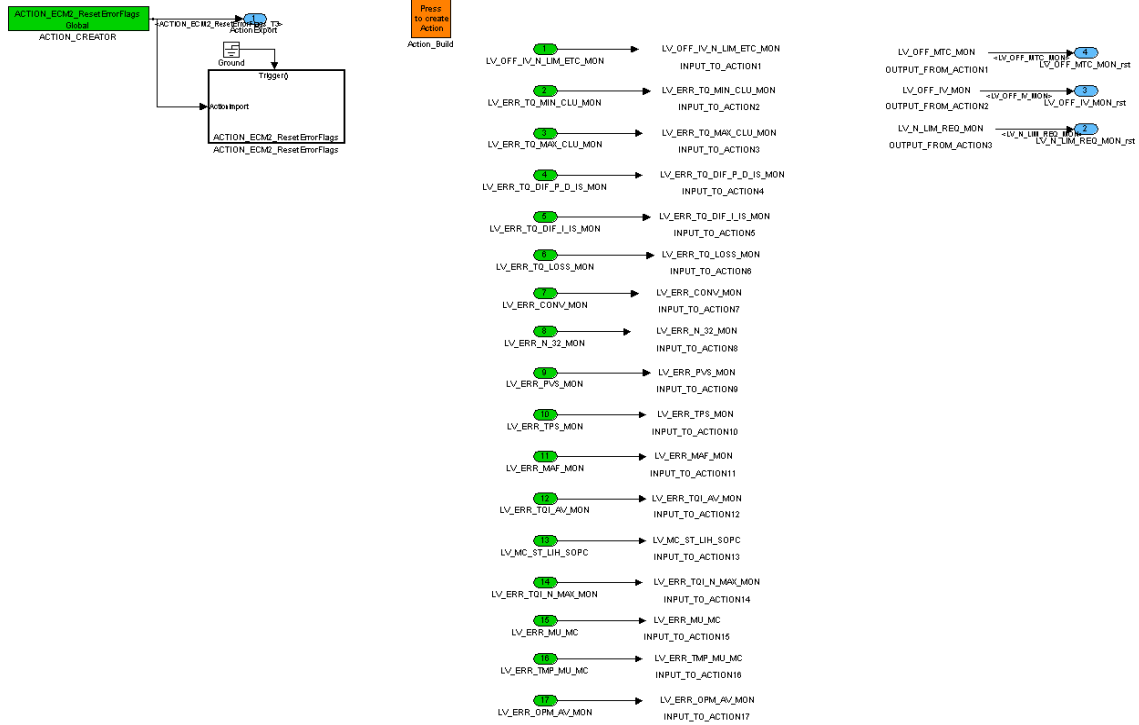


Figure E.11.1: ECM2\_DTSYSFAREA /ACTIONDEF\_ECM2\_ResetErrorFlags

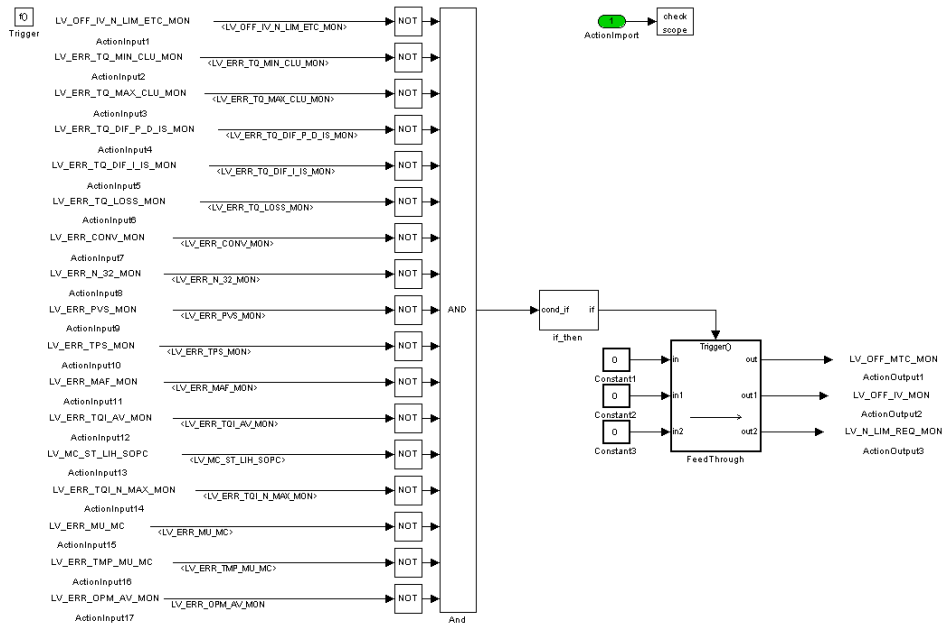


Figure E.11.2: ECM2\_DTSYSFAREA /ACTIONDEF\_ECM2\_ResetErrorFlags/ACTION\_ECM2\_ResetErrorFlags

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/\* Reset of ECM2 error flags to enable power stages unless fault reaction already active \*/

### **General description:**

The objective of this module is to react on faults detected by the process and processor monitoring of the etcmonitoringconcept. The following actions are introduced depending on the error level and the degree of degradation.

disable of throttle power stage (LV\_OFF\_MTC\_MON)

disable of injection power stage (LV\_OFF\_IV\_MON)

transmission of wrong answers from level 2 to the monitoring processor in order to force the monitoring unit to reset the main controller and switch off the throttle and the injection power stages (ACTION\_ECM3\_RedSwitchOffPath())

The faults taken into account are listed in the following:

monitoring of A/Dconverter (LV\_ERR\_CONV\_MON)

monitoring of engine speed (LV\_ERR\_N\_32\_MON)

monitoring of the PDshare of the idle speed controller (LV\_ERR\_TQ\_DIF\_P\_D\_IS\_MON)

monitoring of the Ishare of the idle speed controller (LV\_ERR\_TQ\_DIF\_I\_IS\_MON)

monitoring of torque losses (LV\_ERR\_TQ\_LOSS\_MON)

monitoring of minimum torque at clutch (LV\_ERR\_TQ\_MIN\_CLU\_MON)

monitoring of maximum torque at clutch (LV\_ERR\_TQ\_MAX\_CLU\_MON)

monitoring of pedal value signal (LV\_ERR\_PVS\_MON)

monitoring of mass fuel flow signal (LV\_ERR\_MFF\_MON)

torque monitoring (LV\_ERR\_TQI\_AV\_MON)

monitoring of engine speed limitation (LV\_ERR\_TQI\_N\_MAX\_MON)

processor monitoring on the main controller, continuous fault (LV\_ERR\_MU\_MC)

processor monitoring on the main controller, temporary fault (LV\_ERR\_TMP\_MU\_MC)

Additionally the engine speed limitation is carried out by forced fuel cutoff function (see appl. inc. of process monitoring) where the LV\_OFF\_IV\_MON is reversibly set, if LV\_OFF\_IV\_N\_LIM\_ETC\_MON is active.


Most of the faults lead to a request for the engine speed limitation and a disable of the throttle power stage. The engine speed limitation is carried out inside the application incidences and returns a bit LV\_OFF\_IV\_N\_LIM\_ETC\_MON, if injection has to be cut off..

A fault in the engine speed limitation detected by the etc safety concept and a fault detected by the processor monitoring of the main controller (after several unsuccessful resets) will lead to an immediate disable of the throttle and injection power stages. In addition, for a fault in the engine speed limitation, the transmission of wrong answers from level 2 to the monitoring unit will be forced in order to achieve the injection cutoff by the redundant disable path of the monitoring unit.

The error flags except LV\_ERR\_TMP\_MU\_MC are not reset until next ignition key on (transition from LV\_IGK = 0 to 1).

If the temporary error bit LV\_ERR\_TMP\_MU\_MC was exclusively set in the last sampling instant (represented by LV\_ERR\_TRAN\_1\_MON = 1) and LV\_ERR\_TMP\_MU\_MC is reset (=0) in the actual sampling instant and no other fault request for the same fault reactions, the request for a disable of the main throttle control (MTC) and the injection valves (IV) is reset (LV\_OFF\_MTC\_MON = 0 and LV\_OFF\_IV\_MON = 0). If LV\_ERR\_TMP\_MU\_MC was set in the last sampling instant with one or more other faults excepting LV\_ERR\_MU\_MON and LV\_ERR\_N\_MAX\_MON (represented by LV\_ERR\_TRAN\_2\_MON = 1) and LV\_ERR\_TMP\_MU\_MC is reset (=0) in the actual sampling instant the request for a disable the injection valves (IV) is reset (LV\_OFF\_IV\_MON = 0)

The following table shows the fault reactions corresponding to the underlying faults. No fault reaction is reset until next ignition key on (transition from LV\_IGK = 0 to 1). There are only two exceptions, 1.) for

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a temporary fault detected by the processor monitoring on the main controller (LV\_ERR\_TMP\_MU\_MC) and 2.) for injection cut off (LV\_OFF\_IV\_MON) during engine speed limitation.

Fault reaction				
Disable of MTC and IV via monitoring unit (ACTION_ECM3_RedSwitchOffPath())				
Disable of IV via main controller (LV_OFF_IV_MON = 1)				
Request engine speed limitation (LV_N_LIM_REQ_MON = 1)				
Disable of MTC via main controller (LV_OFF_MTC_MON = 1)				
Faults				
LV_ERR_CONV_MON	X	X	Z	Z
LV_ERR_N_32_MON	X	X	Z	Z
LV_ERR_TQ_DIF_P_D_IS_MON	X	X	Z	Z
LV_ERR_TQ_DIF_I_IS_MON	X	X	Z	Z
LV_ERR_TQ_LOSS_MON	X	X	Z	Z
LV_ERR_TQ_MIN_CLU_MON	X	X	Z	Z
LV_ERR_TQ_MAX_CLU_MON	X	X	Z	Z
LV_ERR_OPM_AV_MON	X	X	Z	Z
LV_ERR_PVS_MON	X	X	Z	Z
LV_ERR_TPS_MON	X	X	Z	Z
LV_ERR_MFF_MON	X	X	Z	Z
LV_ERR_TQI_AV_MON	X	X	Z	Z
LV_OFF_IV_N_LIM_ETC_MON*	Z	Z	X/0	Z
LV_ERR_TQI_N_MAX_MON	X	Z	X	X
LV_ERR_MU_MC	X	Z	X	Z
LV_ERR_TMP_MU_MC*	X	Z	X	Z

\* reversible during present driving cycle, for actions after reset see formulas or model description

The map shows resulting states of output bits. The proceeding is topdown, e.g. the undermost set fault bit of a column defines the resulting state. Symbol x means the related bit is set, z the former result of present recurrence will not be changed and 0 resets the related bit, if the fault is not set.

LV\_OFF\_IV\_MON must be calculated first by LV\_OFF\_IV\_N\_LIM\_ETC\_MON and than by non reversible fault reactions to be sure that a wrong write operation with LV\_OFF\_IV\_MON = 0 is less prior than fault reactions with permanent fuel cutoff.

### Application Condition

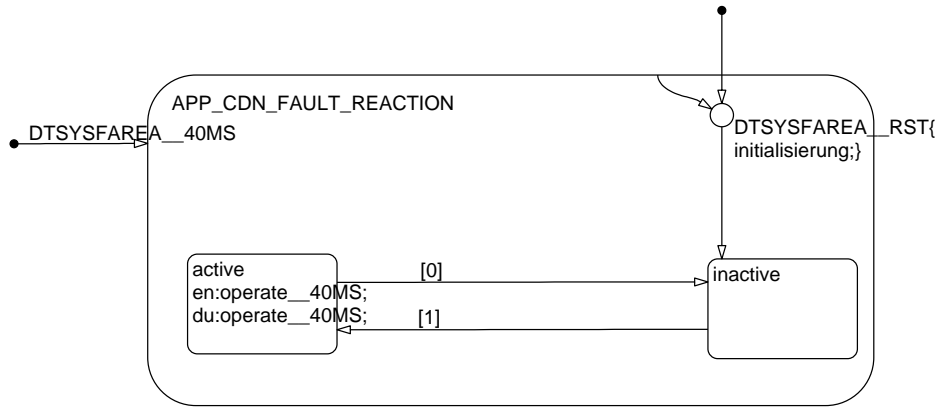



Figure E.11.3: FAREA/APP\_CDN/STATEFLOW\_CHART

**Function Description**

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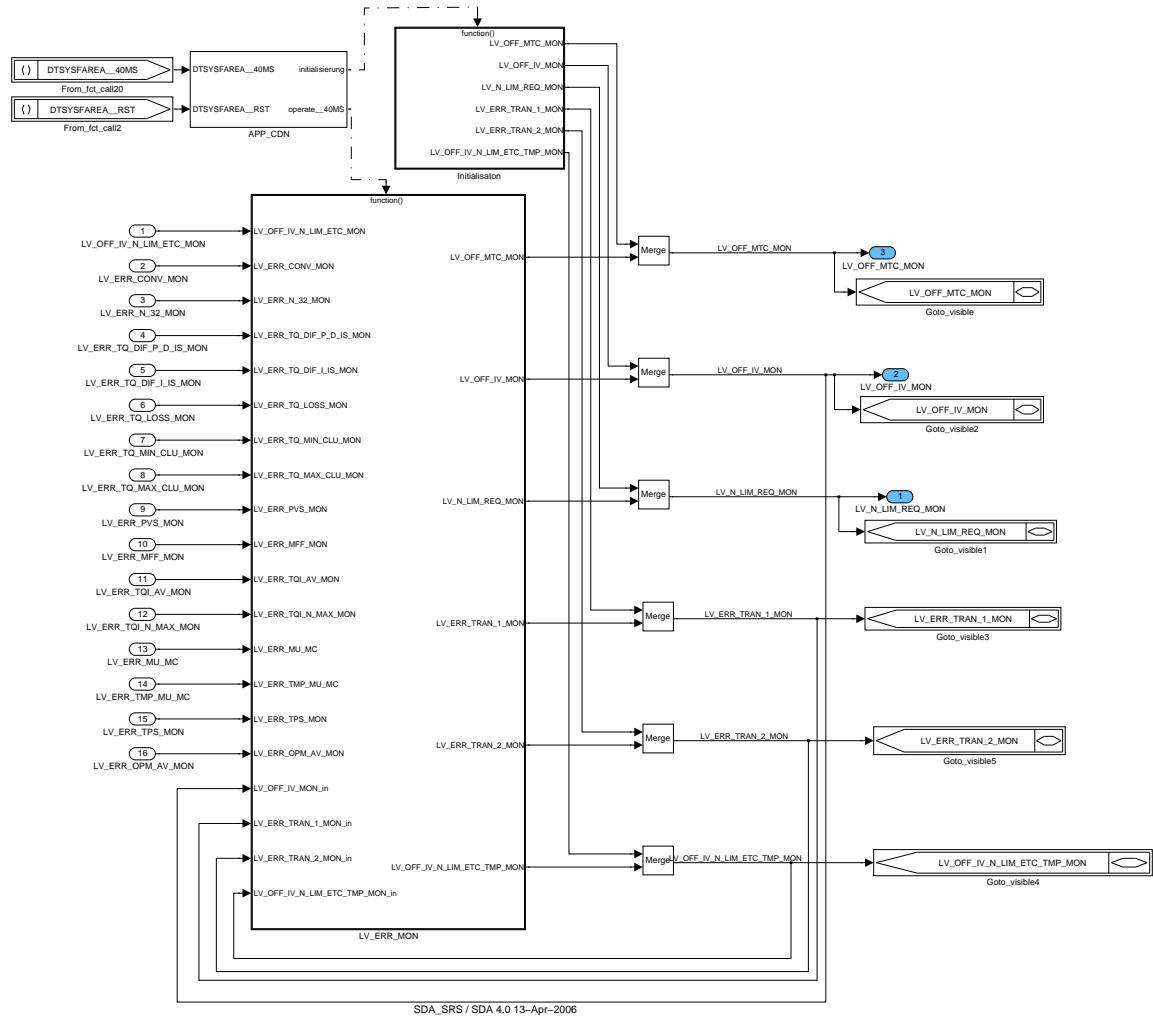



Figure E.11.4: FAREA

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### E.11.1 SUBFUNCTION: Initialisaton

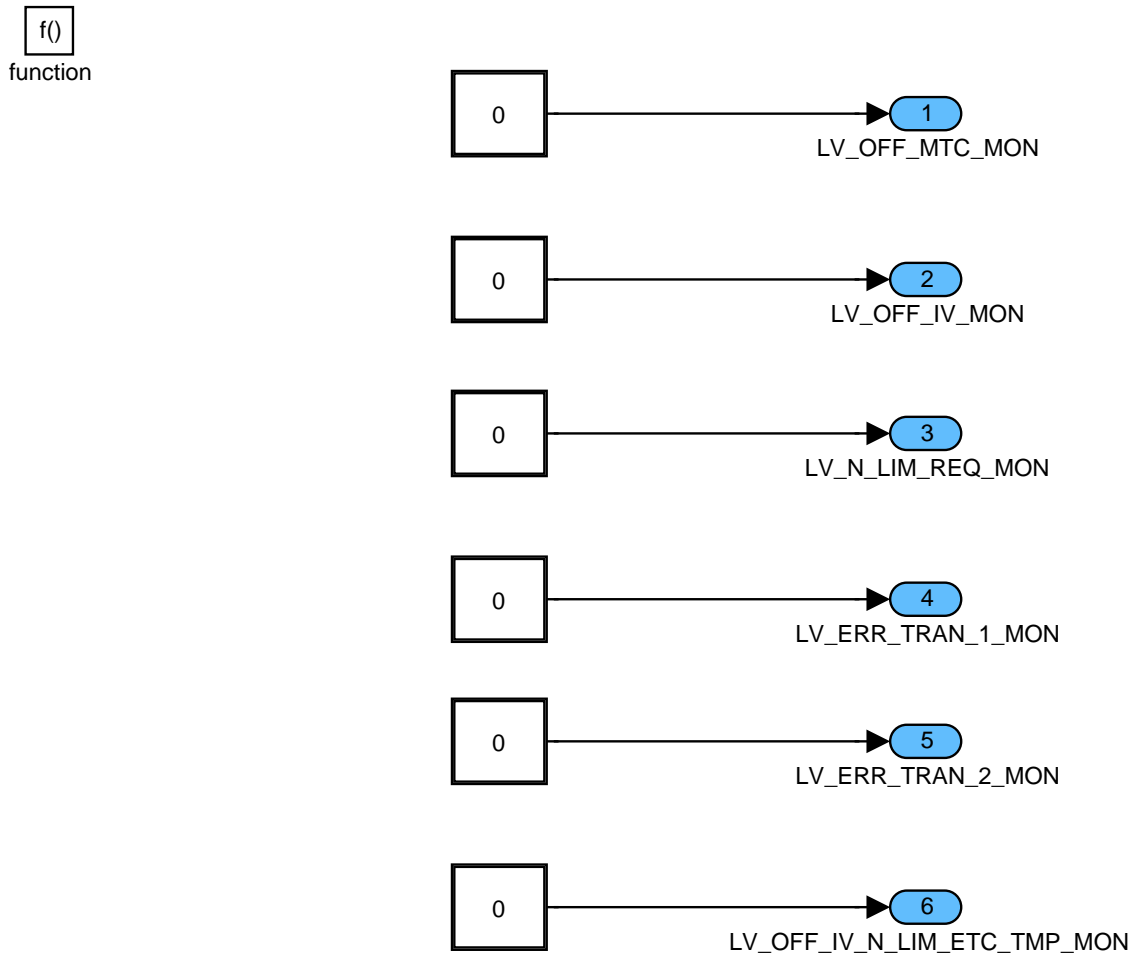


Figure E.11.5: FAREA/INITIALISATON

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### E.11.2 SUBFUNCTION: LV\_ERR\_MON

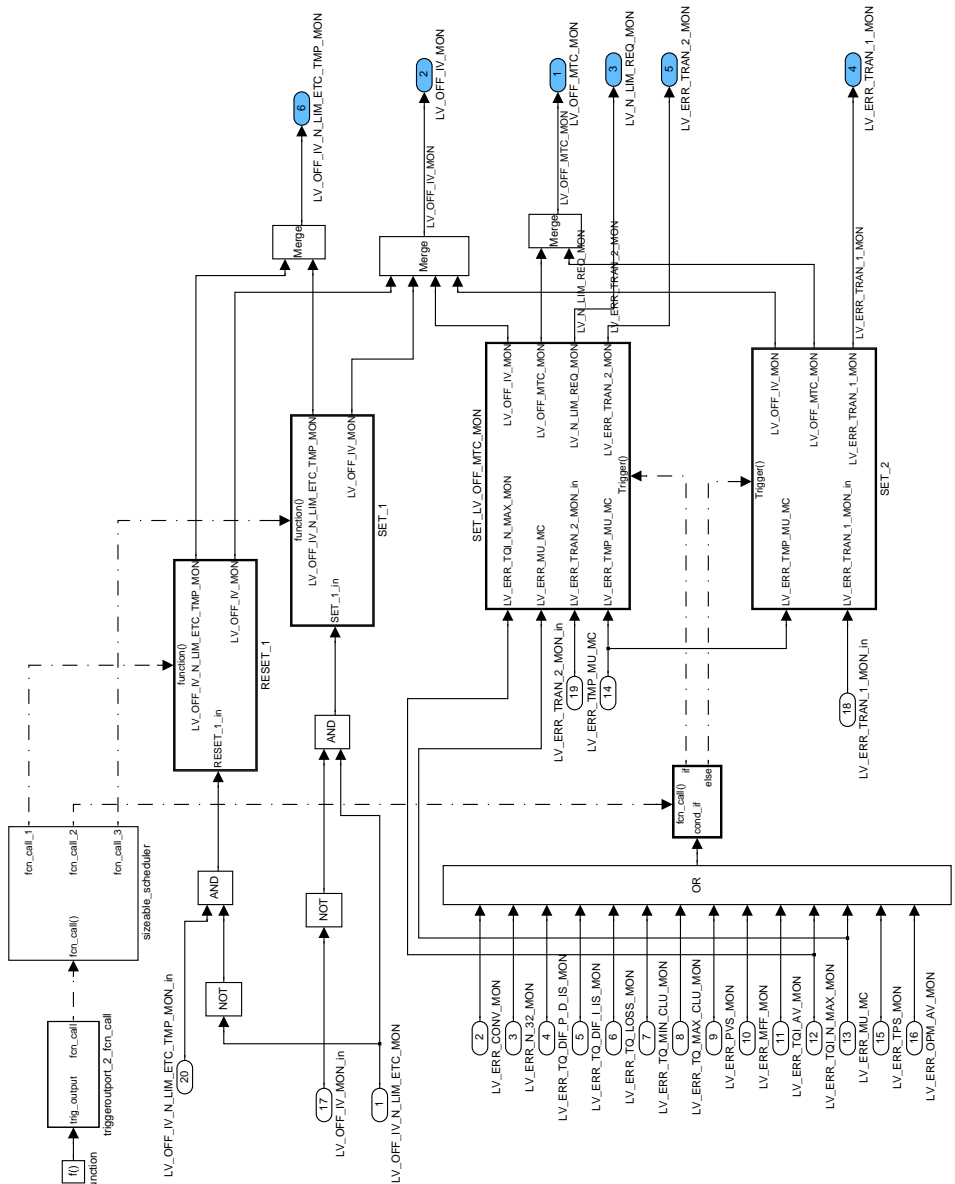


Figure E.11.6: FAREA/LV\_ERR\_MON

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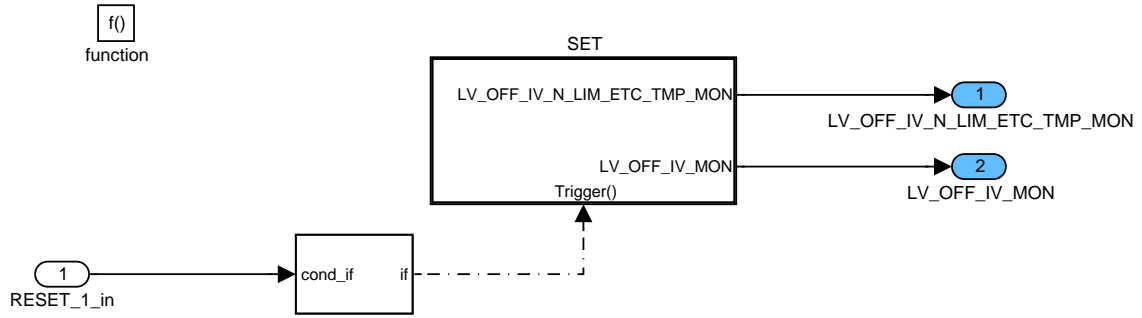


Figure E.11.7: FAREA/LV\_ERR\_MON/RESET\_1

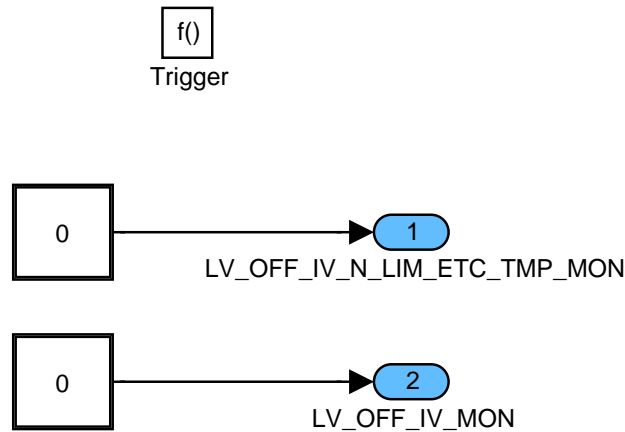


Figure E.11.8: FAREA/LV\_ERR\_MON/RESET\_1/SET

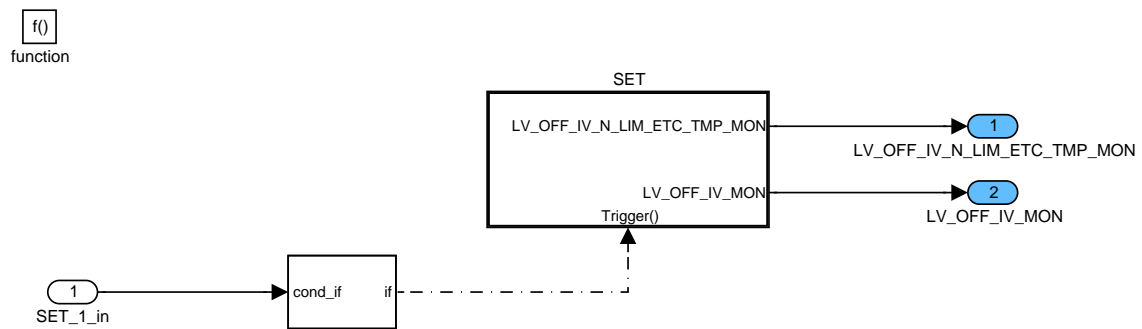


Figure E.11.9: FAREA/LV\_ERR\_MON/SET\_1

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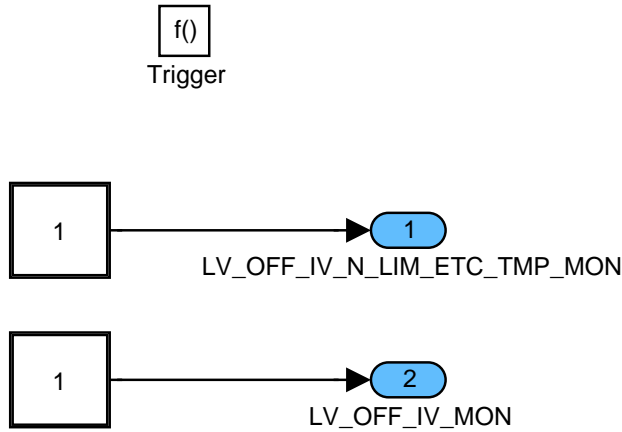


Figure E.11.10: FAREA/LV\_ERR\_MON/SET\_1/SET

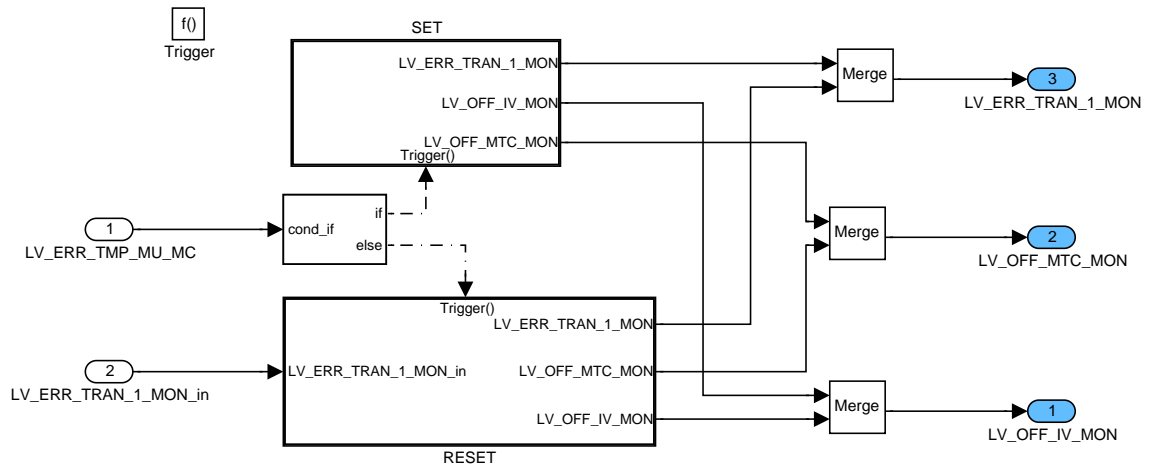


Figure E.11.11: FAREA/LV\_ERR\_MON/SET\_2

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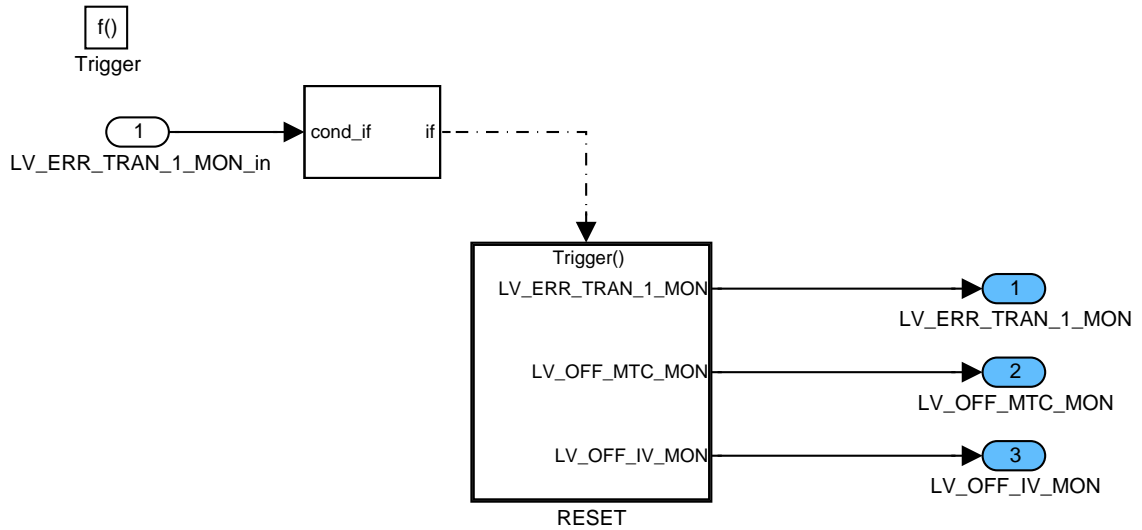


Figure E.11.12: FAREA/LV\_ERR\_MON/SET\_2/RESET

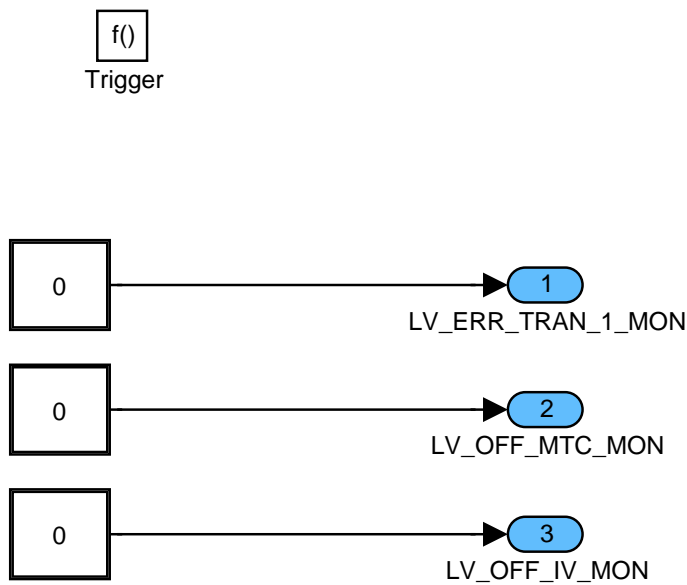


Figure E.11.13: FAREA/LV\_ERR\_MON/SET\_2/RESET/RESET

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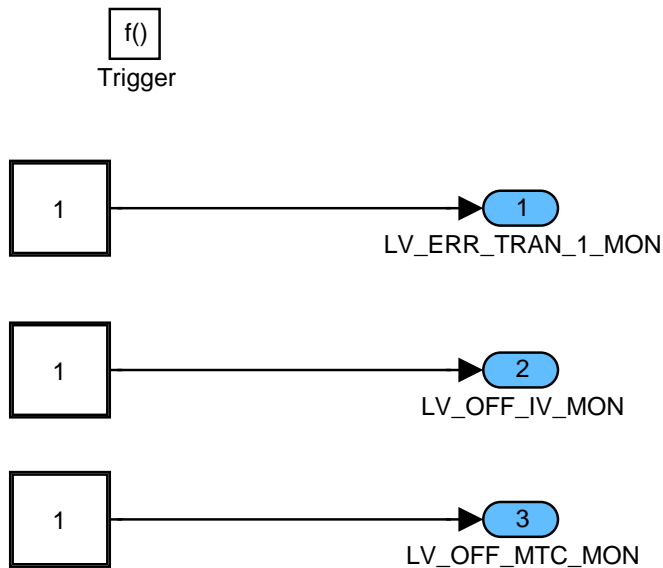


Figure E.11.14: FAREA/LV\_ERR\_MON/SET\_2/SET

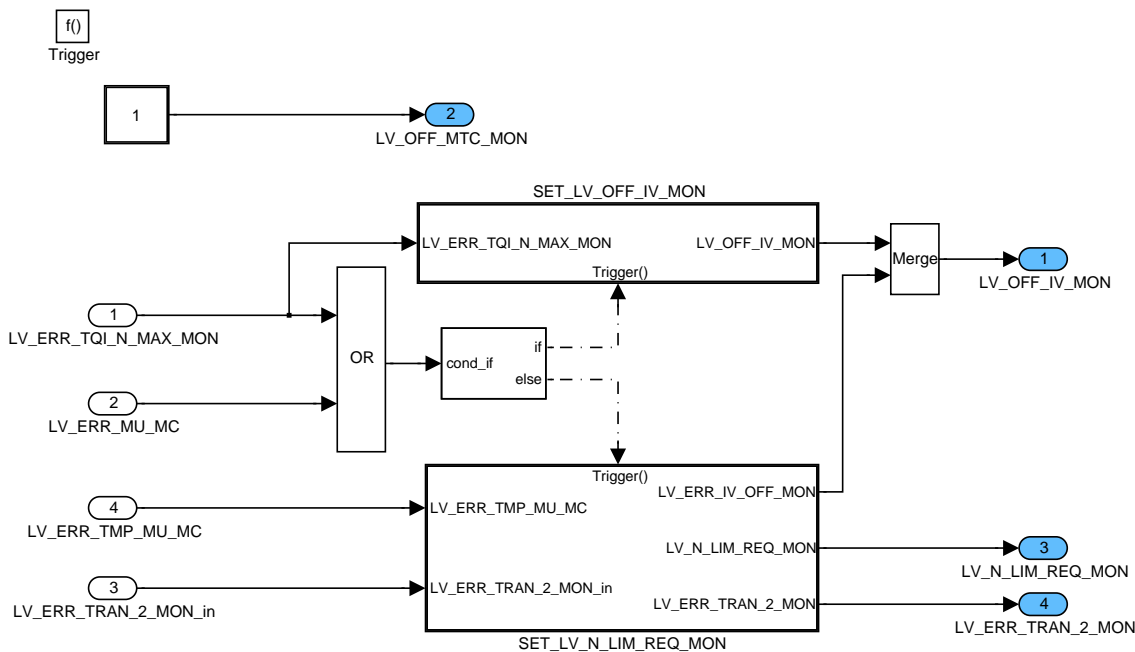


Figure E.11.15: FAREA/LV\_ERR\_MON/SET\_LV\_OFF\_MTC\_MON

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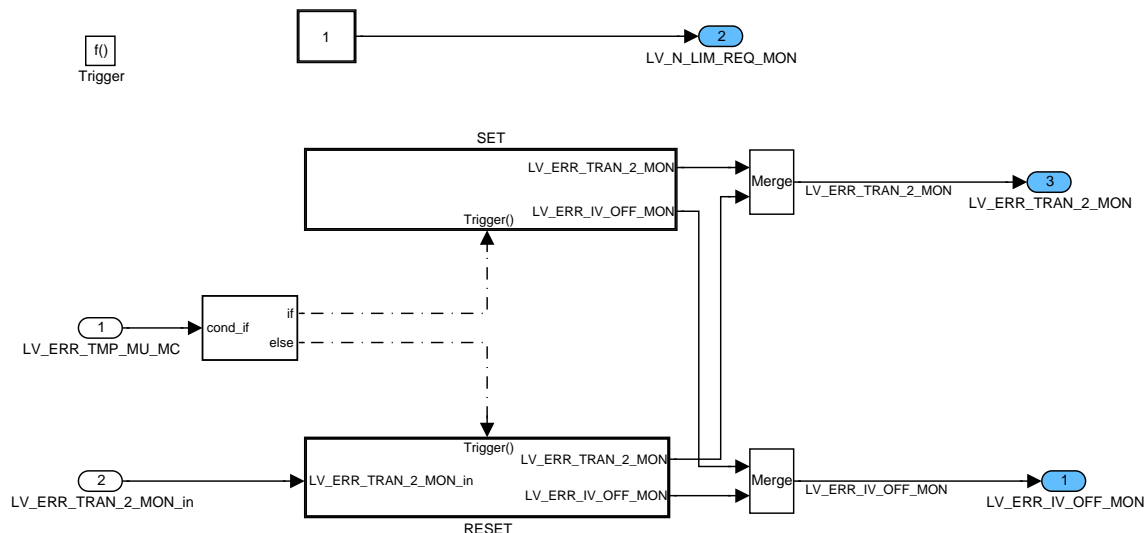


Figure E.11.16: FAREA/LV\_ERR\_MON/SET\_LV\_OFF\_MTC\_MON/SET\_LV\_N\_LIM\_REQ\_MON

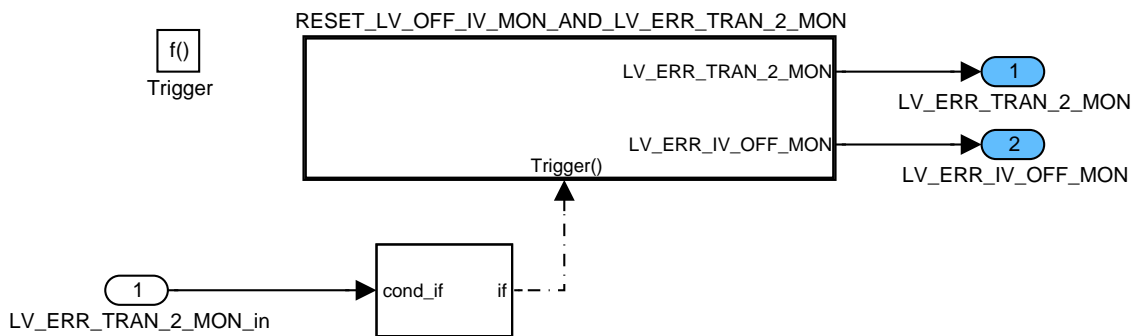


Figure E.11.17: FAREA/LV\_ERR\_MON/SET\_LV\_OFF\_MTC\_MON/SET\_LV\_N\_LIM\_REQ\_MON/RESET

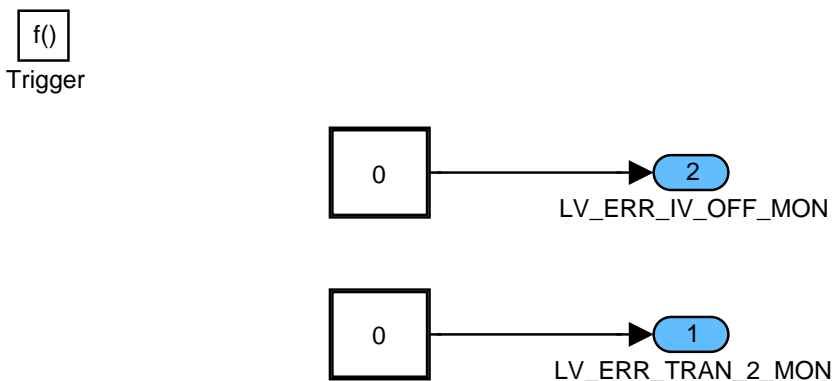


Figure E.11.18: FAREA/LV\_ERR\_MON/SET\_LV\_OFF\_MTC\_MON/SET\_LV\_N\_LIM\_REQ\_MON/RESET/RESET\_LV\_OFF\_IV\_MON\_AND\_LV\_ERR\_TRAN\_2\_MON

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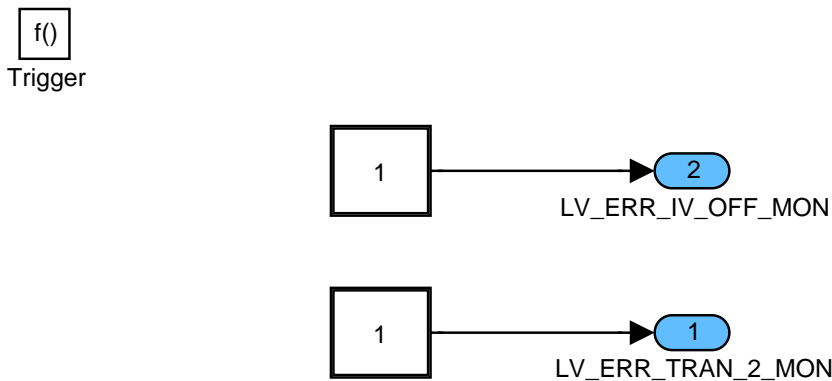


Figure E.11.19: FAREA/LV\_ERR\_MON/SET\_LV\_OFF\_MTC\_MON/SET\_LV\_N\_LIM\_REQ\_MON/SET

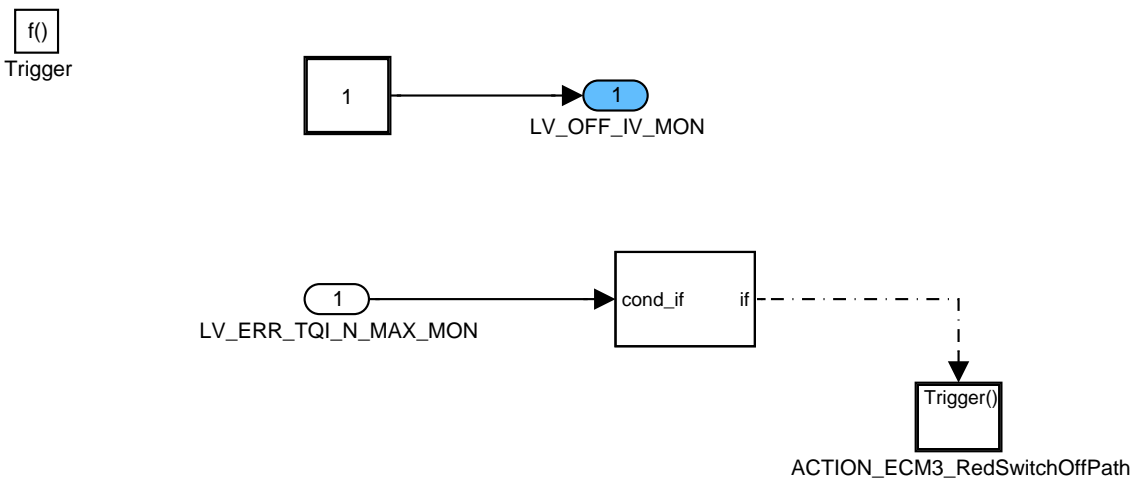


Figure E.11.20: FAREA/LV\_ERR\_MON/SET\_LV\_OFF\_MTC\_MON/SET\_LV\_OFF\_IV\_MON

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## E.12 General

### E.12.1 Basic Idea

The Monitoring Concept has to prevent an ETC system from dangerous behaviour like sudden acceleration against the driver's intent. At first faults, this must be without intervention of the driver. To avoid immobile cars at first faults, a limited limp home function is activated. This means the dynamic behaviour of the car is limited, and so in case of another (second) fault, the driver must possibly react (activation of brake pedal). The accepted fault reaction time is 500 ms. Minor deviations in the order of about 5% are possible due to run time fluctuations, aging effects and temperature influences. No or low engine power is seen as a safe state.

The Siemens ETC-Monitoring-Concept is based on the ETC-Safety-Concept of VDA Arbeitskreis E-Gas using the following main modification:

Additional, diverse AD-converter in monitoring unit (MU) for monitoring of A/D conversion. The used analog voltage must be non-constant, the frequency of the voltage changes must match to the synchronisation constraints given in the Processor Monitoring.

The monitoring concept consists of three levels, as shown in the following figure:

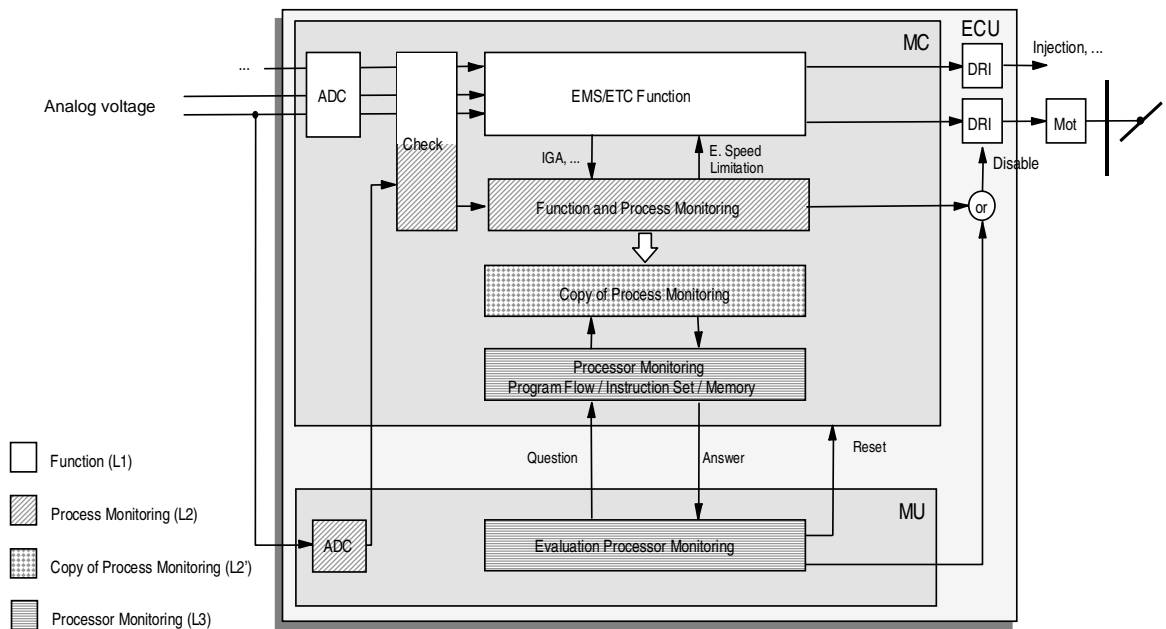


Figure E.12.1: : The three levels of the monitoring concept.

1. The function level is located on the main processor (MC).
2. The function/process monitoring level is also located on the main processor.
3. The processor monitoring level is located on the main processor and on the monitoring processor (MU).

#### E.12.1.1 Function Level (VDA-name: Level 1)

The function level performs standard EMS functions including ETC functionality (description *not* to be found in this chapter):

1. Determination of the drivers demand (via PVS) including standard diagnosis (signal range check, ...)
2. Determination of throttle position (via TPS) including standard diagnosis (signal range check, ...)

3. Receiving external torque requests (e.g. ASR, MSR, ...) including standard diagnosis (e.g. monitoring CAN by parity bit, ...). External modules must generate correct torque requests (safety requirement!) the ECU can only check, whether the transmission of this request was without faults.
  4. Internal calculation of torque requests (ISC, Cruise Control)
  5. Co-ordination and realisation of requested torque
- output: throttle position, ignition angle, injection time and cylinder cut off

### E.12.1.2 Process Monitoring Level (VDA-name: Level 2)

The process monitoring performs monitoring of sensors, actuators, torque effective functions, torque co-ordination, and torque realization as a check of the function level.

The description can be found in the modules:

1. Process Monitoring
2. Monitoring Sensor Signals (e.g. PVS, TCO, ...)
3. Monitoring Internal Signals (e.g. MAF, N\_32, ...)
4. Monitoring CAN Signals
5. Torque Monitoring
6. Fault Reaction

### E.12.1.3 Processor Monitoring Level (VDA-name: Level 3)

The processor monitoring monitors proper processor function: memory, operations of the processor, program flow, analog digital conversion

The description can be found in the modules:

1. Processor Monitoring
2. Communication between MC and MU
3. Fault Reaction

There are additional port extensions located on the monitoring unit. Note that this functionality is not a core functionality of level 3:

1. Input /Output (Description of port extension facility of the monitoring unit)

## E.12.2 Hardware Safety Module


The main-processor (MC) and the monitoring processor (MU, incl. port extensions) are connected via an internal communication. MU has its own oscillator (ceramic resonator).

When resetting, MC gives a reset signal to MU so it will also reset. This enables synchronisation between them.

Via the internal communication informations are exchanged. This informations belongs to: test calculations (level 2'), program flow of MC, monitoring of ADC, port extensions.

For the purpose of test calculations answers are compared to known results on MU. In case of faults, the power stages of the throttle and the injectors are disabled.

One analog voltage is connected with the first AD-channel of MU and the dedicated channel on MC. The MU value is transmitted to MC only to check the ADCs. Remaining AD-channels and digital outputs can be used as port extension (no monitoring function, but it has to be assured, that no damaging voltage is fed to the ports in case of any fault).

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## E.13 Monitoring of A/D conversion

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_CONV_MON	O/V	0... FFH	0... 255	1	-
Anti-bounce counter for ADC error					
LV_ERR_CONV_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for ADC error					

### Input data:

VP_MC_AN_DIG_MON {p. 7135}	VP_MU_AN_DIG_MON {p. 7135}		
-------------------------------	-------------------------------	--	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_CONV_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment (additive value in case of ADC error)					
C_ABC_MAX_CONV_MON	-	1... FFH	1... 255	1	-
Value at which ADC error is recognised when reached					
C_STATE_AN_DIG_ERR_ACT_MON	-	0... FFH	0... 255	1	-
Calibratable value used for provoking an error of the A/D conversion: if C_STATE_AN_DIG_ERR_ACT_MON has value F8H (=248) then the constant value 0, instead of ACQ_MU_0_MON is used as input for the comparison, resulting in an error.					
C_VP_ACQ_CONV_HYS_MON	-	0... 7FFFH	0... 4.999847	152.588e-6	V
Maximal allowed difference between the voltages on main controller and monitoring unit					

### Import actions:

ACTION_ECM3_Service3TaskPfm (IN<PRM_K>)
ACTION_ECM3_Service4TaskPfm (IN<PRM_K>)
ACTION_ECM3_Service5TaskPfm (IN<PRM_K>)

**Note:** These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 1.


ACTION_ECM3_McChkStack()
--------------------------

**Note:** This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION\_ECM3\_Service3TaskPfm() and ACTION\_ECM3\_Service4TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN <>, IN <>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

**Note:** All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

### General information:

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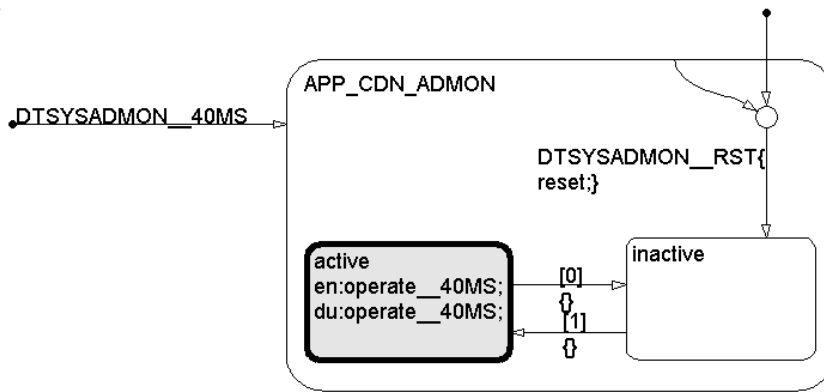
The analogue-digital-converter (ADC) diagnosis is performed by comparing two digital signals. The according analog signal is the same, it is converted once on the main controller (VP\_MC\_AN\_DIG\_MON) and also on the monitoring unit (VP\_MU\_AN\_DIG\_MON).

On an error free system, both values are not allowed to differ more than the hysteresis C\_VP\_ACQ\_CONV\_HYS\_MON.

This hysteresis also covers differences caused by the different sampling times.

There is the possibility to test whether the A/D monitoring works; this can be achieved by setting C\_STATE\_AN\_DIG\_ERR\_ACT\_MON to the value 248 (=F8H), resulting in the fact that the constant 0 (instead of VP\_MU\_AN\_DIG\_MON) is used as one of the inputs for the comparison, provoking a fault reaction of the ADC monitoring.


**Application Condition**

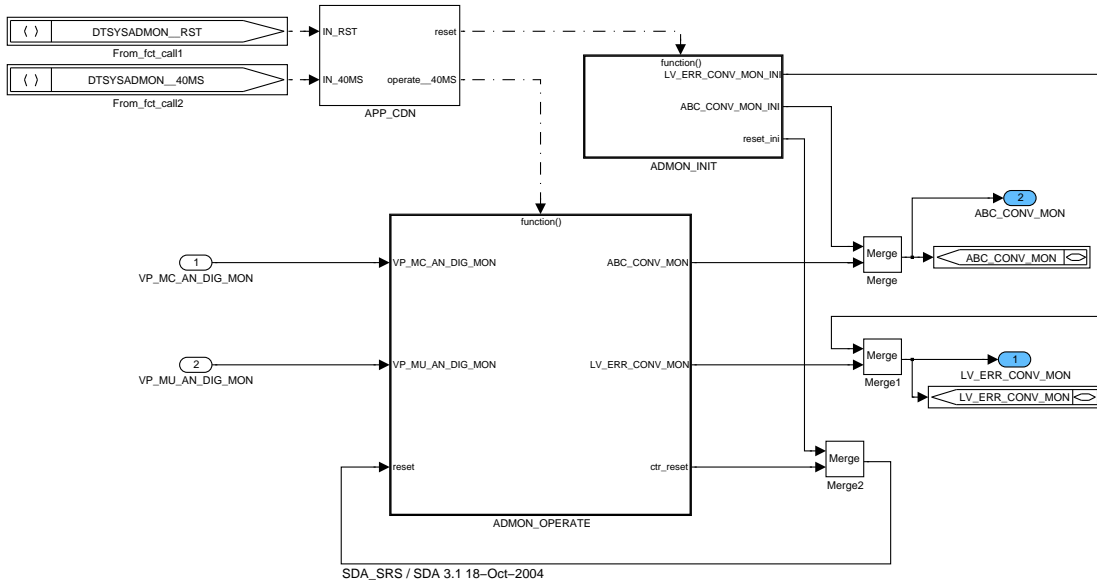


Module\_ECM2\_DTSYSADMON/APP\_CDN/Chart

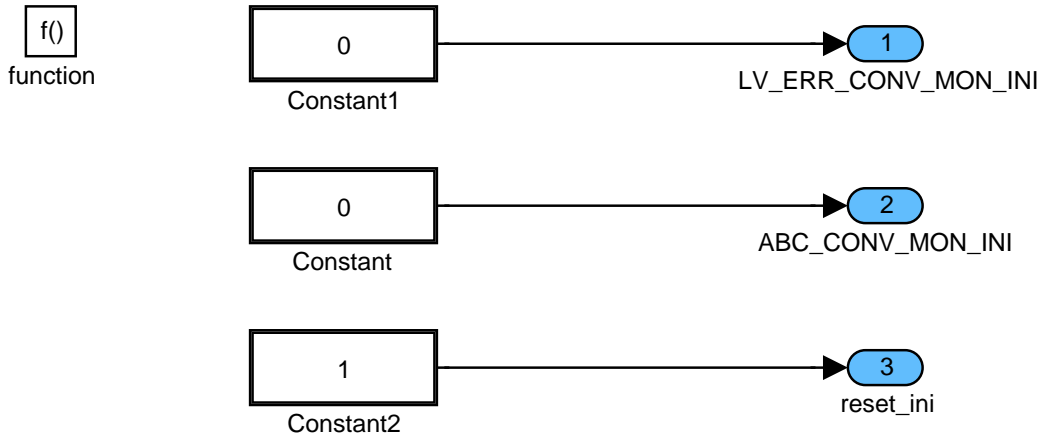
**Function Description**

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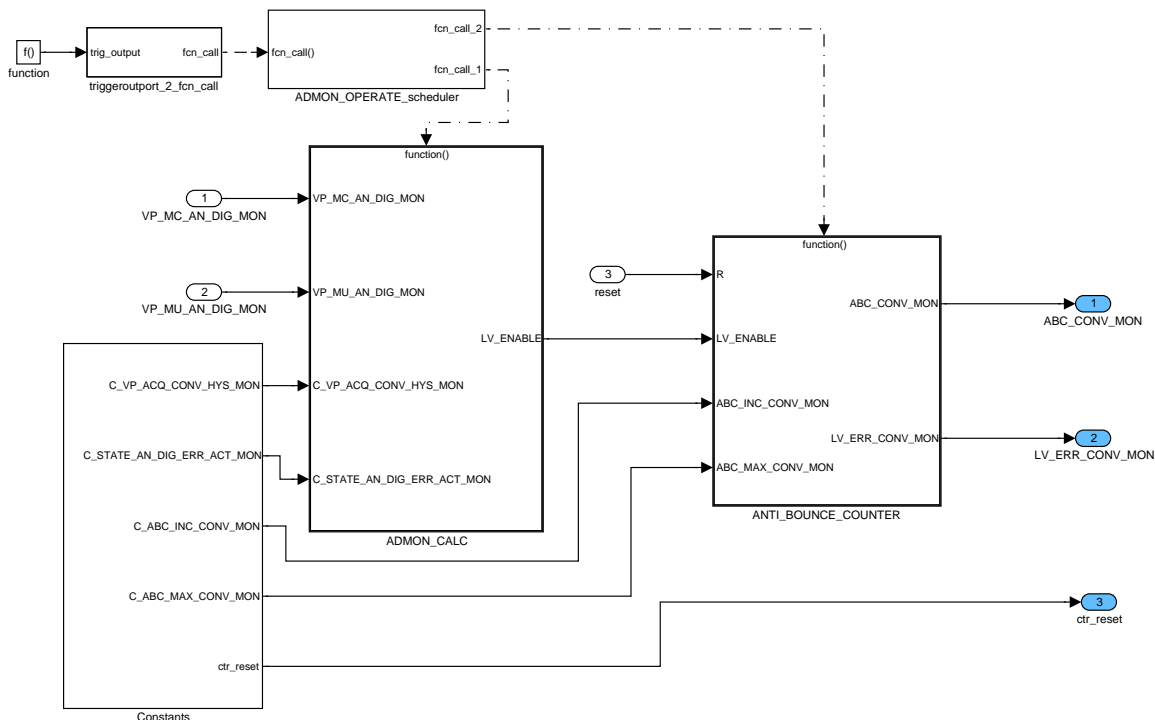
ECM2\_DTSYSADMN



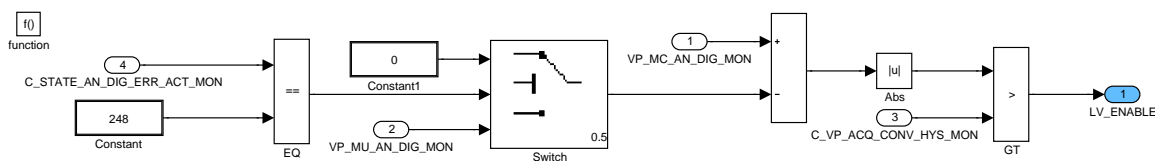
ECM2\_DTSYSADMN/ADMN\_INIT

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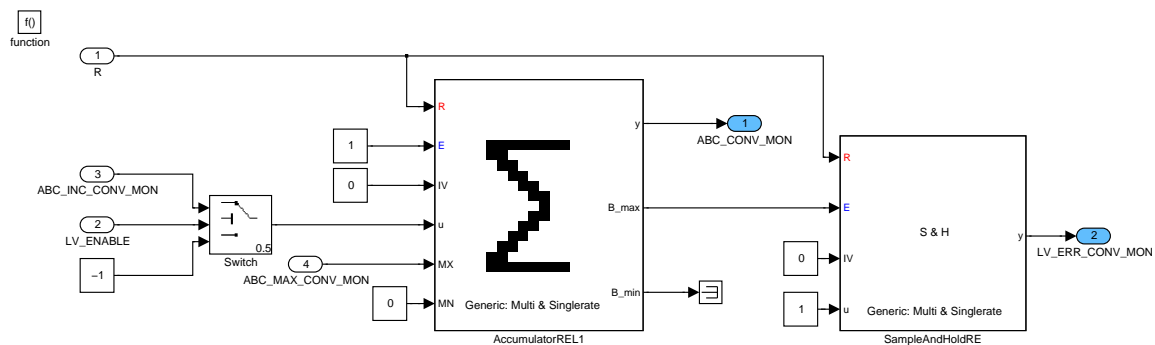




ECM2\_DTSYSADMON/ADMON\_OPERATE

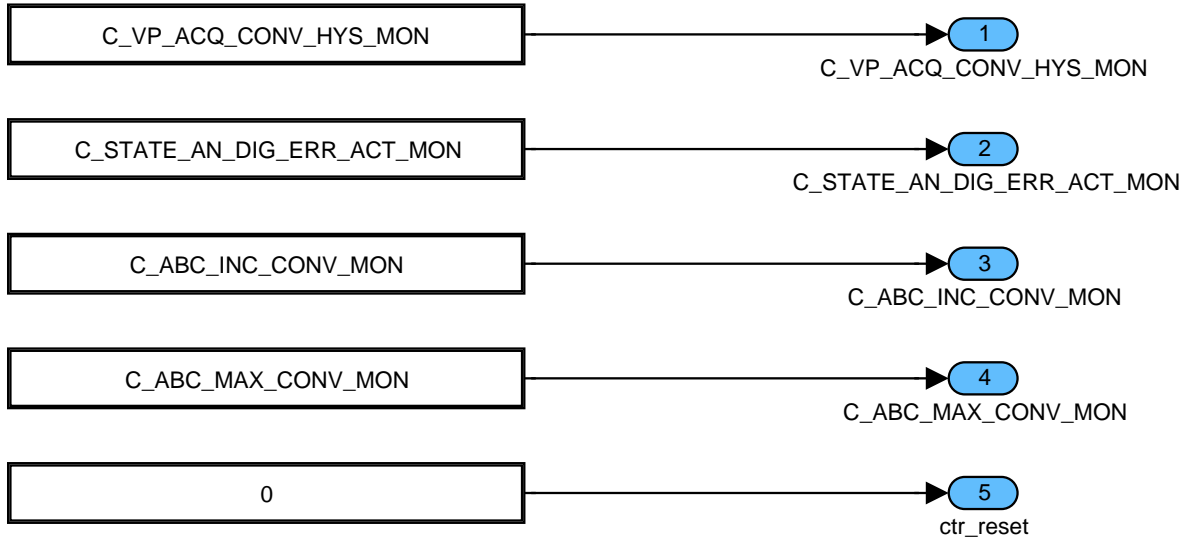


ECM2\_DTSYSADMON/ADMON\_OPERATE/ADMON\_CALC




ECM2\_DTSYSADMON/ADMON\_OPERATE/ANTI\_BOUNCE\_COUNTER

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ECM2\_DTSYSADMON/ADMON\_OPERATE/Constants

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## E.14 Monitoring of actual indicated engine torque

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_SWI_AFS_TQI_MON	V	0... FFH	0... 255	1	-
Anit-bounce-counter for request to AFS (TQI_DIF above allowed threshold)					
ABC_TQI_AV_AFS_MON	V	0... FFH	0... 255	1	-
Anti-bounce-counter for fault in torque generation (AFS-mode)					
LV_ERR_TQI_AV_MON	O/V	0... 1H	0 ...1	1	-
Fault currently present in torque generation					
LV_SWI_AFS_TQI_MON	O/V	0... 1H	0 ...1	1	-
Switch to AFS (TQI_DIF above allowed threshold)					
TQI_DIF_AV_MON	V	0... FFH	0... 510	2	Nm
deviation between actual and desired indicated engine torque					
TQI_DIF_MAX_MON	V	0... FFH	0... 510	2	Nm
permitted deviation between actual and desired indicated engine torque					
TQI_DIF_SP_MON	V	0... FFH	0... 510	2	Nm
deviation between torque setpoint and desired indicated engine torque					

### Input data:

LV_TQI_MON_ACT_MON {p. 6791}	N_32_MON {p. 7002}	OPM_AV_MON {p. 6792}	TQI_AV_MON {p. 6774}
TQI_SP {p. 8391}	TQI_SP_MON {p. 6851}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_SWI_AFS_TQI_MON	-	0... FFH	0... 255	1	-
ABC increment for request to AFS (TQI_DIF above allowed threshold)					
C_ABC_INC_TQI_AV_AFS_MON	-	0... FFH	0... 255	1	-
ABC increment at TQI_DIF above allowed threshold (AFS-mode)					
C_ABC_MAX_SWI_AFS_TQI_MON	-	1... FFH	1... 255	1	-
Value at which OPM will be switched to AFS at TQI_DIF above allowed threshold					
C_ABC_MAX_TQI_AV_AFS_MON	-	1... FFH	1... 255	1	-
Value at which TQI_AV_MON error is recognized. when reached (AFS-mode)					
C_GAIN_TQI_DIF_MAX_MON	-	0... FFH	0... 63.75	0.25	-
Factor for threshold diagnosis with TQI_SP					
IP_TQI_DIF_MAX_MON	V	0... FFH	0... 510	2	Nm
LDP_N_32_IP_TQI_DIF_MAX_MON	4	0... FFH	0... 8160	32	rpm
LDP_TQI_SP_IP_TQI_DIF_MAX_MON	4	0... FFH	0... 510	2	Nm
Threshold for diagnosis of engine torque overflow					

### Import actions:

<b>ACTION_ECM3_Service10TaskPfm</b> (IN<No Name available>)
<b>ACTION_ECM3_Service11TaskPfm</b> (IN<No Name available>)
<b>ACTION_ECM3_Service9TaskPfm</b> (IN<No Name available>)

## E.14.1 DTSYSTQMON

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 4.

ACTION_ECM3_McChkStack()
--------------------------

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION\_ECM3\_Service9TaskPfm() and ACTION\_ECM3\_Service10TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
--

ACTION_ECM3_ChkCpl(IN <>, IN <>)
----------------------------------

ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)
--

Note: These actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode 0 and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

### General information:

The objective of this module is the comparison of the desired indicated engine torque TQI\_SP\_MON (feedforward path) and the actual indicated engine torque TQI\_AV\_MON (feedback path). In the fault free case, the actual indicated engine torque should not exceed the desired indicated engine torque. A fault is detected after debouncing, when the actual indicated engine torque exceeds the setpoint value by more than a threshold value TQI\_DIF\_MAX\_MON depending on engine speed and the desired torque. If the operation mode is not equal to AFS a request for AFS will be debounced.

TQI\_AV\_MON depends on the dynamics of the intake manifold and on the dynamics of the lambda sensor which means that a possible fault cannot be detected before a certain time. Hence for a fast diagnosis TQI\_AV\_MON is not suitable but can be replaced by TQI\_SP which is compared to TQI\_SP\_MON. In case that TQI\_SP\_MON differs from TQI\_SP by more than a certain value, the error bit LV\_ERR\_TQI\_AV\_MON is set.

### Application Condition

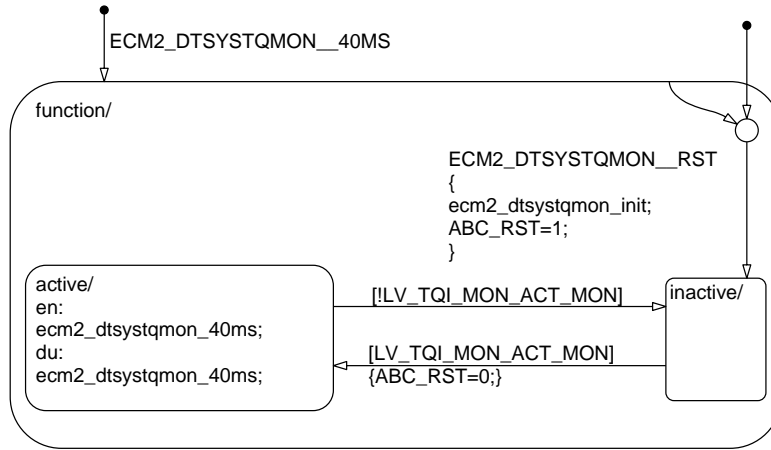


Figure E.14.1: ECM2\_DTSYSTQMON/APP\_CDN/CHART

**Function Description**

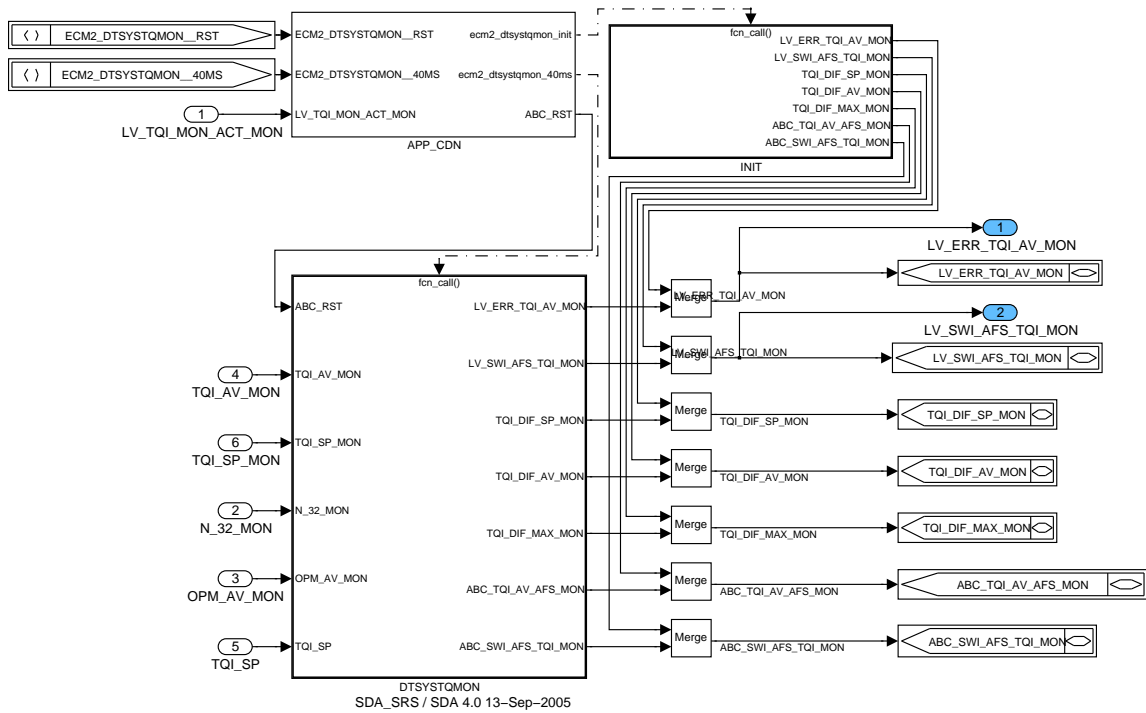


Figure E.14.2: ECM2\_DTSYSTQMON

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### E.14.1.1 SUBFUNCTION: INIT

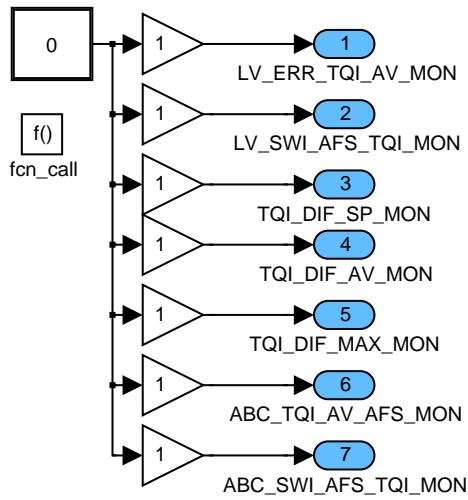


Figure E.14.3: ECM2\_DTSYSTQMON/INIT

### E.14.1.2 SUBFUNCTION: DTSYSTQMON

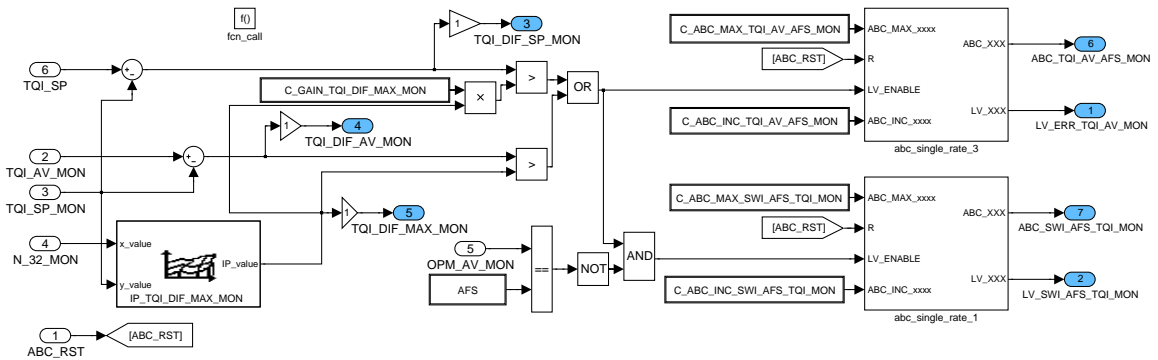


Figure E.14.4: ECM2\_DTSYSTQMON/DTSYSTQMON

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## E.15 Monitoring of coolant temperature

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_TCO_GRD_MON	V	0... FFH	0... 10.2	0.04	s
Timer for negative TCO gradient limitation					
TCO_MON	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature (monitoring level)					

### Input data:

LV_TQI_MON_ACT_MON {p. 6791}	TCO {p. 1100}	TCO_SUB {p. 1105}	
---------------------------------	---------------	-------------------	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_TCO_GRD_MAX_MON	-	0... FFH	0... 10.2	0.04	s
Minimum time before a new change of TCO_MON is allowed					
C_TCO_GRD_MAX_MON	-	0... FEH	0... 190.5	0.75	°C
Maximum negative gradient for the coolant temperature					
C_TCO_SUB_THD_MAX_MON	-	0... FE00H	-48... 142.5	2.9297e-3	°C
Threshold for the max. TCO_SUB temperature while TCO is lower than C_TCO_THD_MIN_MON					
C_TCO_THD_MIN_MON	-	0... FEH	-48... 142.5	0.75	°C
Threshold for the min. TCO temperature while TCO_SUB is higher than C_TCO_SUB_THD_MAX_MON					

### Import actions:

ACTION_ECM3_Service6TaskPfm (IN<No Name available>)
ACTION_ECM3_Service7TaskPfm (IN<No Name available>)
ACTION_ECM3_Service8TaskPfm (IN<No Name available>)

**Note:** These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 1.

**ACTION\_ECM3\_McChkStack()**

**Note:** This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION\_ECM3\_Service6TaskPfm() and ACTION\_ECM3\_Service7TaskPfm().

**ACTION\_ECM3\_WriteChkCpl(INOUT <>, OUT <>, IN <>)**

**ACTION\_ECM3\_ChkCpl(IN <>, IN <>)**

**ACTION\_ECM3\_ReadChkCpl(OUT <>, IN <>, IN <>)**

**Note:** All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

### E.15.1 FUNCTION PART: ECM2\_DTSYSTCO

**General information:**

A sudden decrease in the coolant temperature TCO caused by a fault can lead to an undesired increase of the torque demand and thus to an undesired acceleration of the car because of the temperature dependent friction compensation. Therefore the negative temperature gradient of TCO shall be limited in the function level. In order to detect process faults, the gradient of the coolant temperature which is copied to the process monitoring level is also limited, i.e. to C\_TCO\_GRD\_MAX\_MON. Also the diagnosis for a too low TCO-sensor temperature is monitored. The resulting value TCO\_MON is then used within the monitoring level. If a fault in TCO leads to an increased engine torque in the idle speed controller the module Monitoring of idle speed controller detects this fault as an increased torque demand from the idle speed controller.

In case of an error free system the temperature TCO\_MON used in the monitoring level should be the same as the temperature TCO used in the function level.

An additional timer is needed to compensate the different recurrences of level 1 and level 2. The maximum counter threshold C\_T\_TCO\_GRD\_MAX\_MON and the maximum negative temperature gradient C\_TCO\_GRD\_MAX\_MON need to be adapted in regard to the function recurrency and to C\_TCO\_GRD\_MAX of level 1.

The resolution of T\_TCO\_GRD\_MON and C\_T\_TCO\_GRD\_MAX\_MON depend on the update rate of the module.


**Application conditions:**

Activation:  $LV\_TQI\_MON\_ACT\_MON = 1$   
 Deactivation: otherwise  
 Initialization: for condition see *Application Incidences of Process Monitoring* ;  
 moreover, at deactivation:  

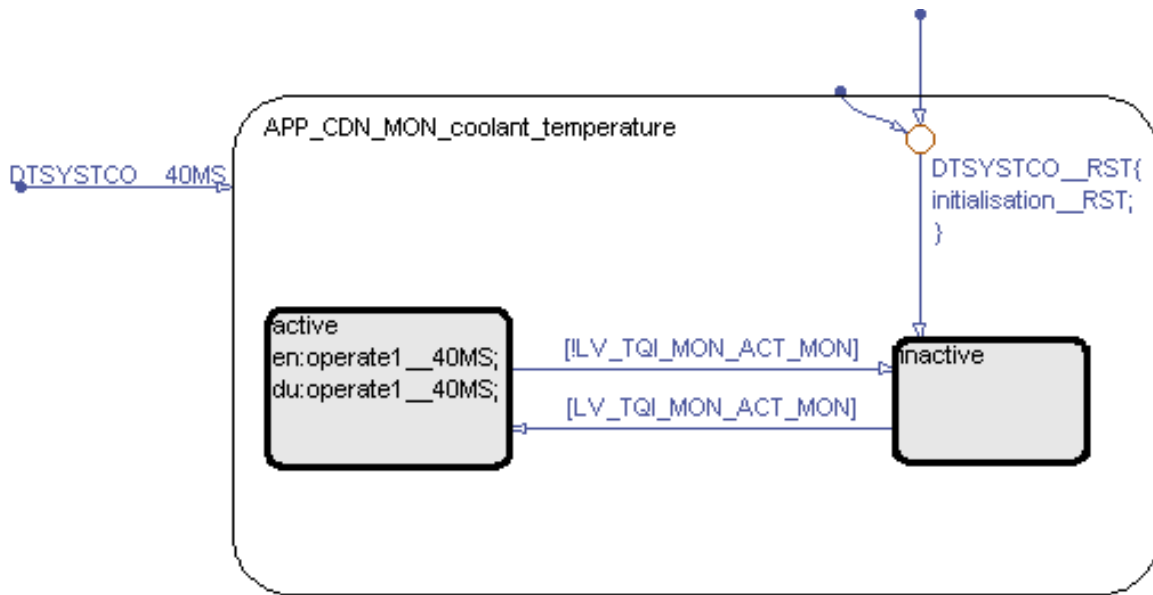
$$\frac{TCO\_MON(k)}{T\_TCO\_GRD\_MON} = \frac{TCO}{0.0}$$
  
 Update Rate: 40 msec

**Application Condition**

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**Note:**DTSYSTCO\_\_RST includes the function calls as defined in application incidences.

**Function Description**

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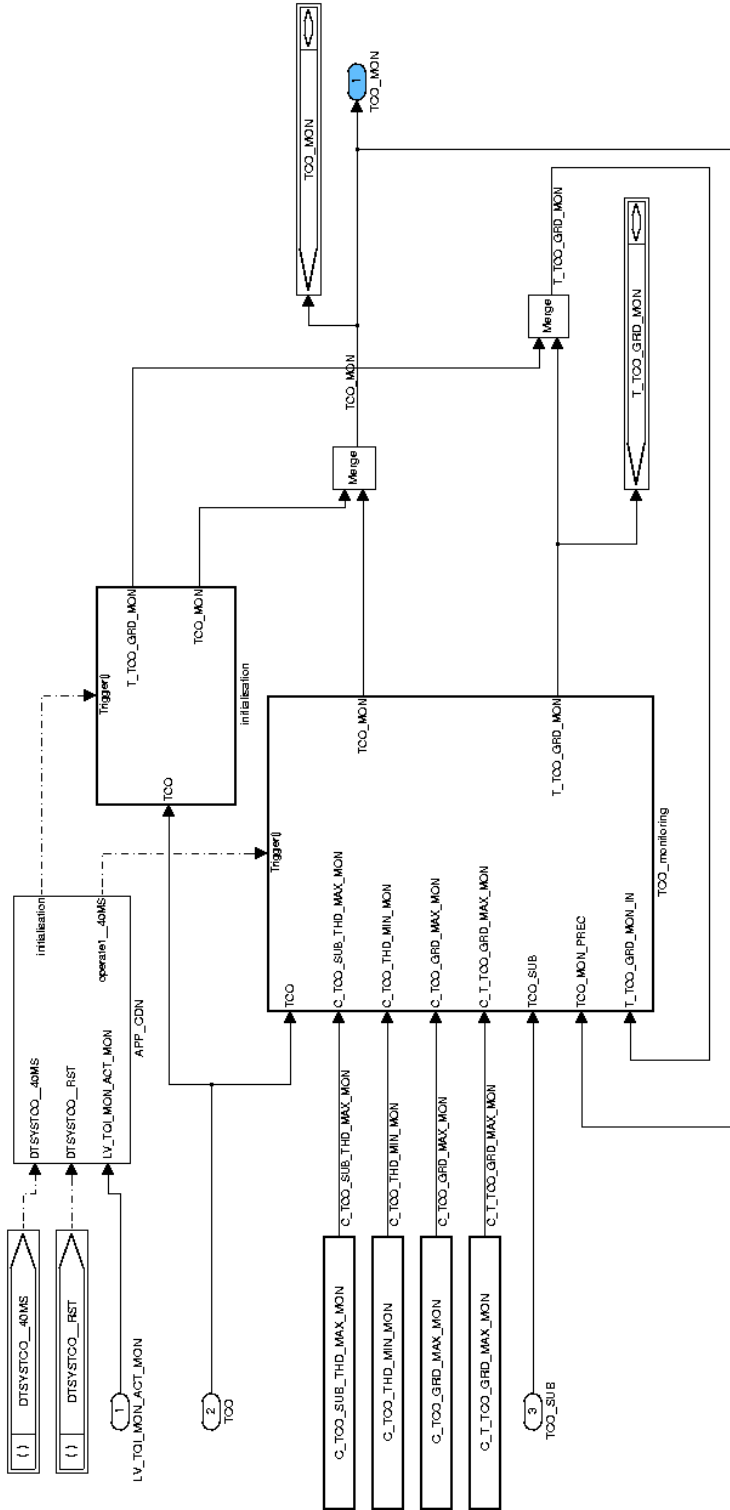


Figure E.15.1: ECM2\_DTSYSTCO

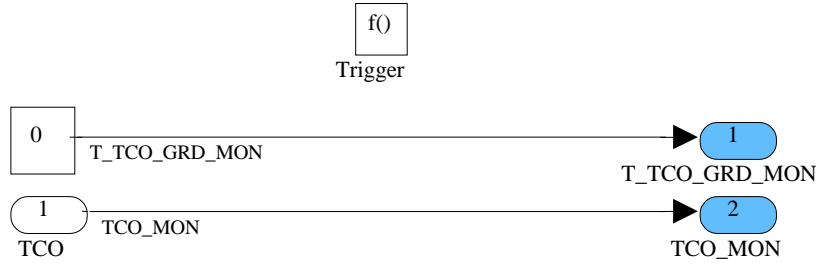


Figure E.15.2: ECM2\_DTSYSTCO/INITIALISATION

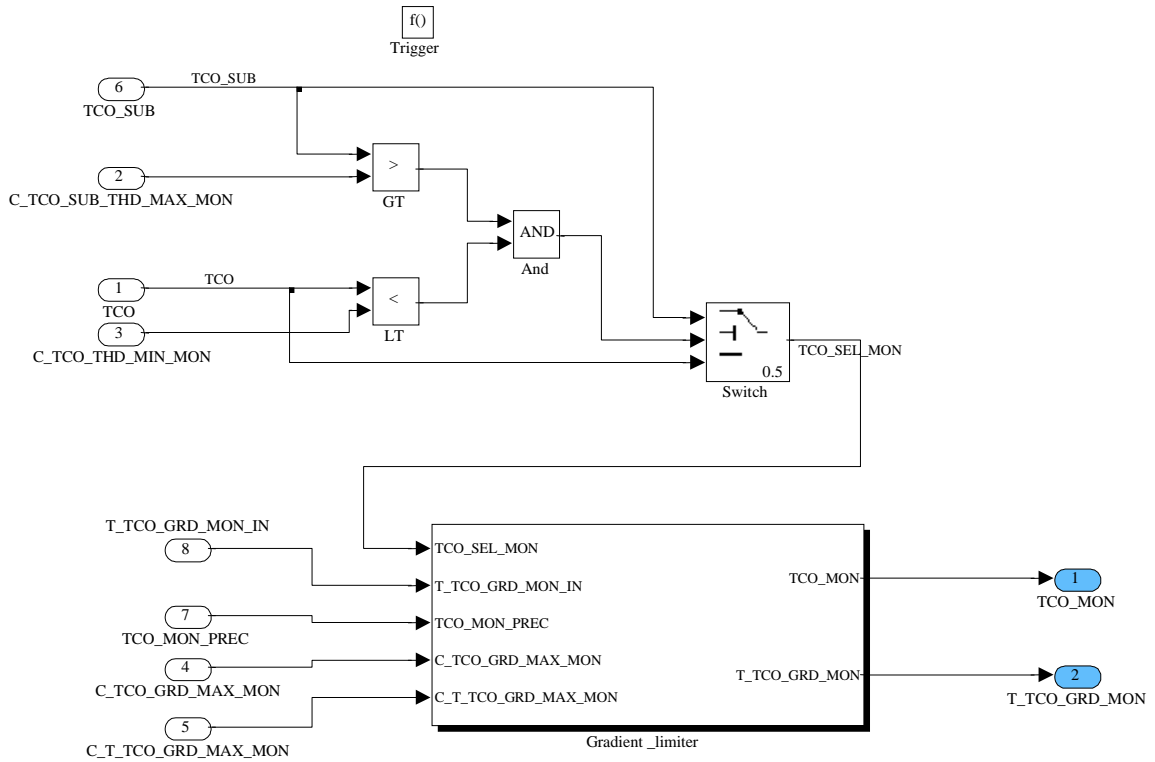


Figure E.15.3: ECM2\_DTSYSTCO/TCO\_MONITORING

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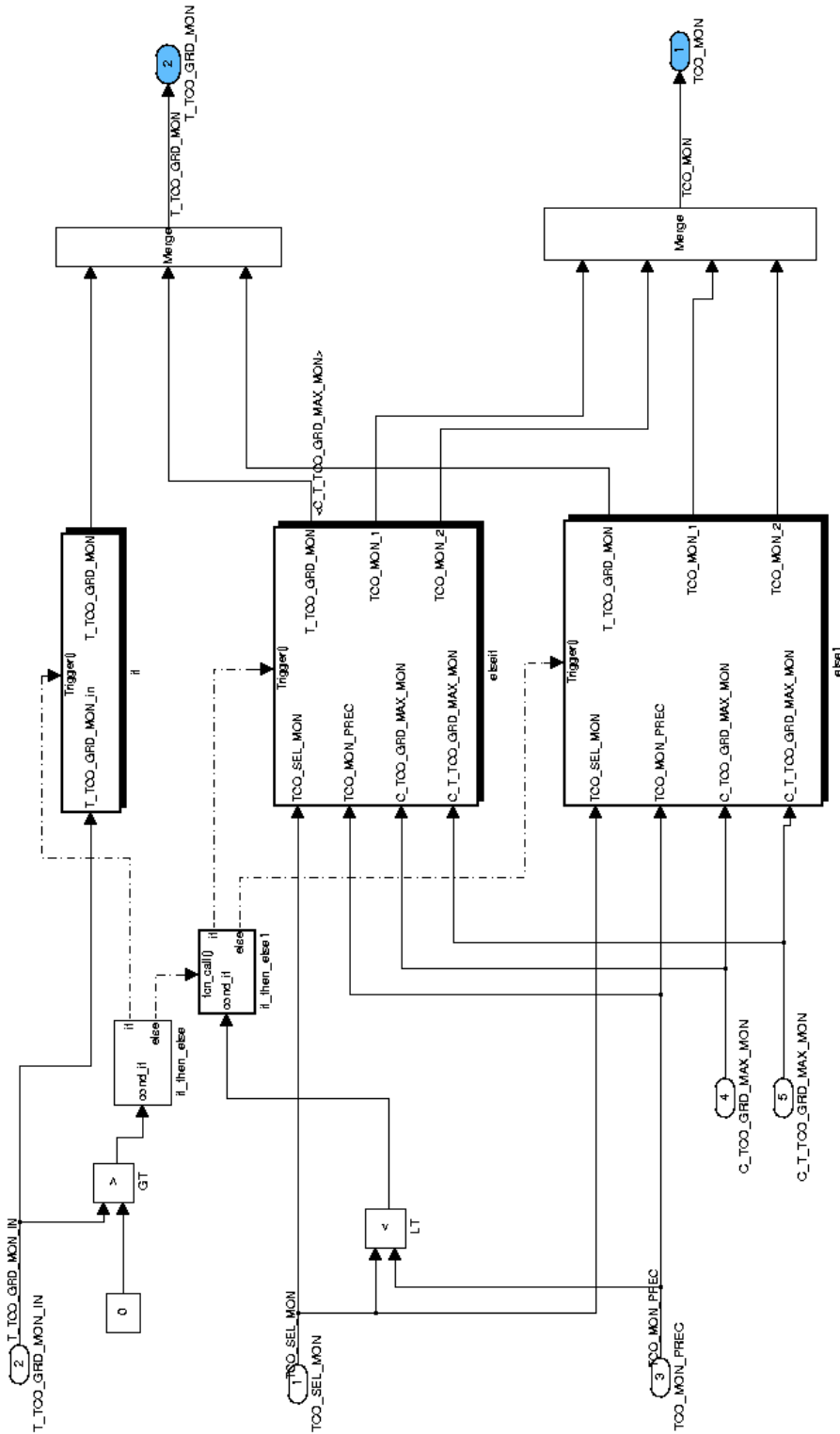


Figure E.15.4: ECM2\_DTSYSTCO/TCO\_MONITORING/GRADIENT\_LIMITER

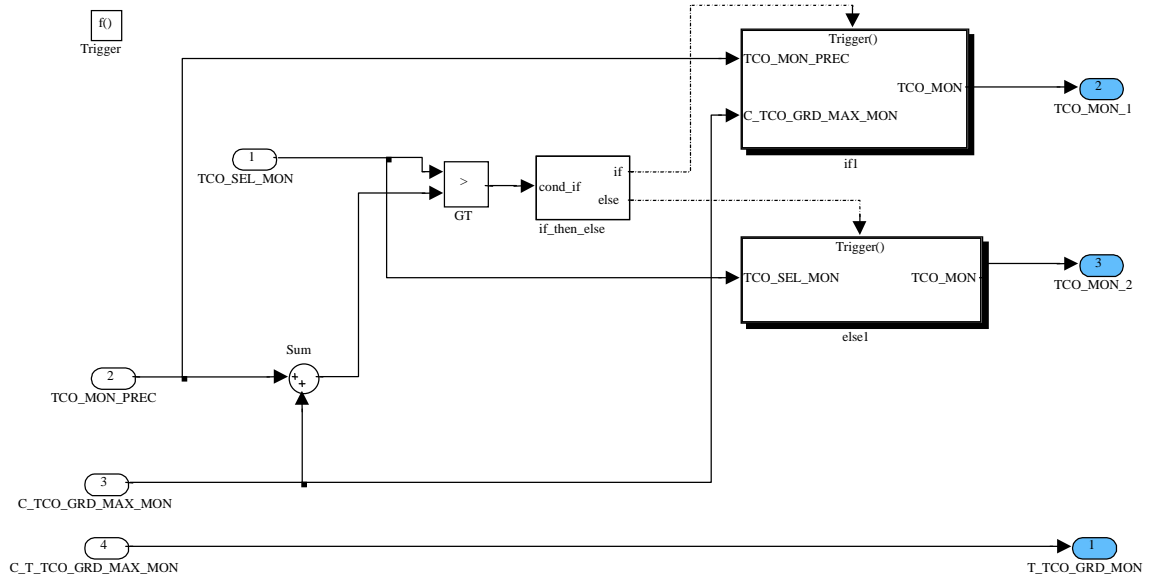


Figure 5 ECM2\_DTSYSTCO/ TCO\_monitoring/ Gradient\_limiter/ else1

Figure E.15.5: ECM2\_DTSYSTCO/TCO\_monitoring/Gradient\_limiter/else1/else1

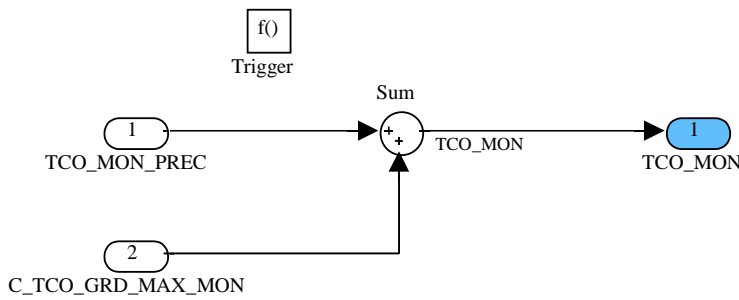


Figure E.15.6: ECM2\_DTSYSTCO/TCO\_monitoring/Gradient\_limiter/else1/if1

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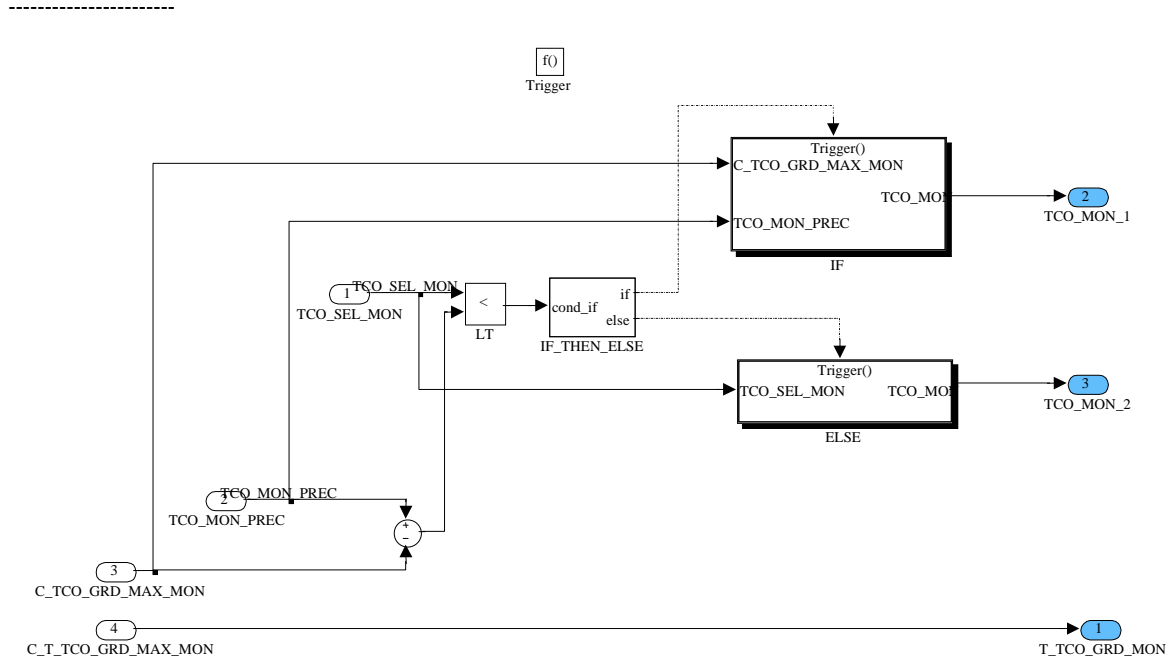


Figure E.15.7: ECM2\_DTSYSTCO/TCO\_monitoring/Gradient\_limiter/elseif

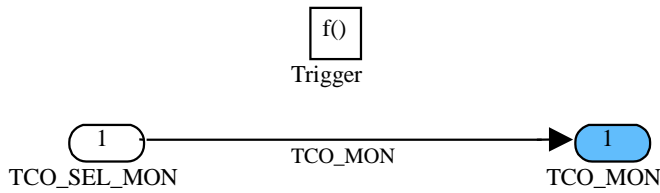


Figure E.15.8: ECM2\_DTSYSTCO/TCO\_monitoring/Gradient\_limiter/elseif/ELSE

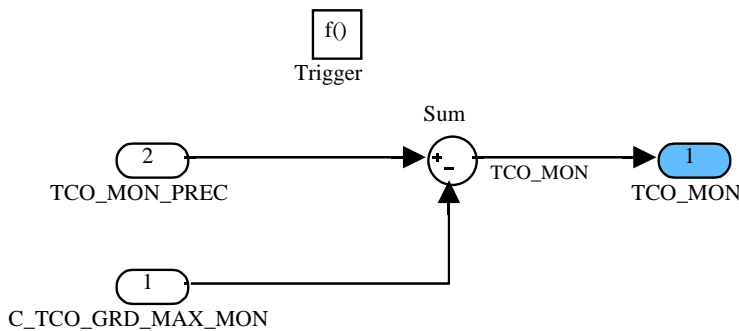


Figure E.15.9: ECM2\_DTSYSTCO/TCO\_monitoring/Gradient\_limiter/elseif/IF

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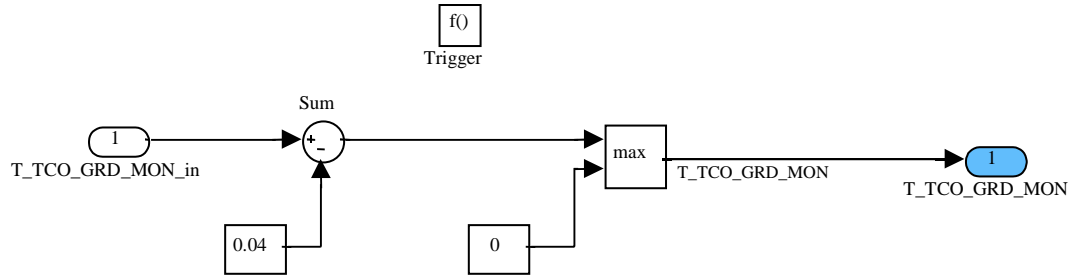



Figure E.15.10: ECM2\_DTSYSTCO/TCO\_monitoring/Gradient\_limiter/if

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## E.16 Monitoring of cruise control conditions

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_CRU_TQ_MON	V	0... FFH	0... 255	1	-
Anti bounce counter for monitoring of cruise control conditions					
FAC_TQ_REQ_CRU_MON	O/V	0... FFH	0... 1.99218	0.0078125	-
Scaling factor of cruise control torque demand in monitoring level					
LV_CRU_INH_MON	O/V	0... 1H	0 ...1	1	-
logical variable for inhibition of cruise control					
LV_ERR_CRU_MON	O/V	0... 1H	0 ...1	1	-
Fault in Cruise Control present					
T_CRU_INH_MON	V	0... FFH	0... 10.2	0.04	s
Timer for inhibition of cruise control torque demand in monitoring level					

### Input data:

FAC_TQ_REQ_CRU {p. 6737}	LV_BRAKE_MON {p. 6790}	LV_CRU_ACT {p. 7227}	LV_CRU_MAIN_SWI {p. 7220}
LV_ERR_MSW_2 {p. 5058}	LV_ERR_MSW_3 {p. 5058}	LV_ERR_MSW_TOG {p. 5058}	LV_TQI_MON_ACT_MON {p. 6791}
VS_FIL {p. 1176}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_CRU_TQ_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment for cruise torque request					
C_ABC_MAX_CRU_TQ_MON	-	1... FFH	1... 255	1	-
Maximum value of the anti - bounce counter					
C_T_CRU_INH_MON	-	0... FFH	0... 10.2	0.04	s
Delay time for disable of cruise control in monitoring level					
C_VS_MIN_CRU_MON	-	0... FFH	0... 510	2	km/h
Minimum threshold for vehicle speed control active					

### Import actions:

<b>ACTION_ECM3_Service10TaskPfm</b> (IN<No Name available>)
<b>ACTION_ECM3_Service11TaskPfm</b> (IN<No Name available>)
<b>ACTION_ECM3_Service9TaskPfm</b> (IN<No Name available>)

**Note:** These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 3.

**ACTION\_ECM3\_McChkStack()**

**Note:** This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION\_ECM3\_Service9TaskPfm() and ACTION\_ECM3\_Service10TaskPfm().



```
ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
```

```
ACTION_ECM3_ChkCpl(IN <>, IN <>)
```

```
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)
```

**Note:** All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

### ECM2\_DTSYSCRU: General information:

The cruise control function is able to request a lot of torque and to accelerate the car up to high speed. In order to avoid dangerous situations caused by a fault of the cruise control function, the main activation/deactivation conditions are monitored within the etc safety concept. Therefore the basic signals from the master control (Hauptschalter) and the brake are evaluated.

In a cruise control function including active deceleration also the conditions for deceleration enabling have to be monitored.

### Application Condition

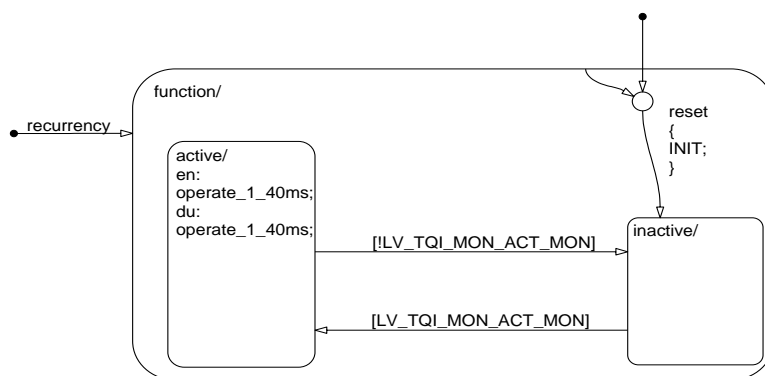


Figure E.16.1: ECM2\_DTSYSCRU/APP\_CDN/Chart

### **E.16.1 SUBFUNCTION: INIT**

For condition see 'Application Incidences of Process Monitoring'

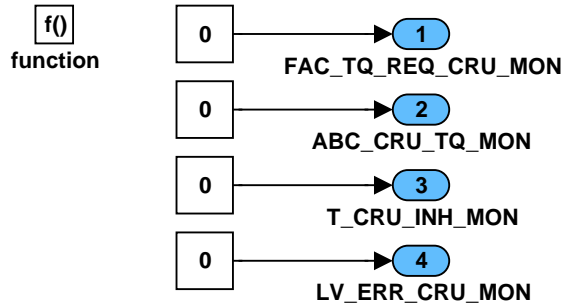
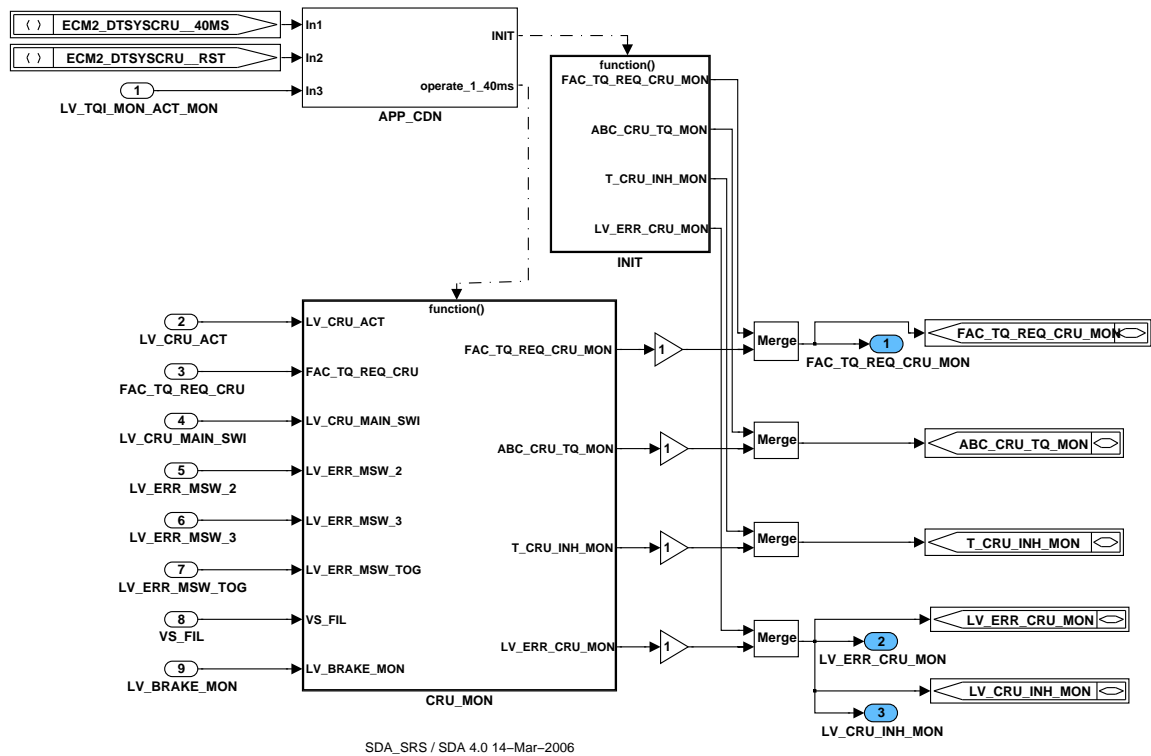


Figure E.16.2: ECM2\_DTSYSCRU /INIT

**Function Description**



SDA\_SRS / SDA 4.0 14-Mar-2006

Figure E.16.3: ECM2\_DTSYSCRU

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### E.16.2 SUBFUNCTION: ME00B\_CRU\_MON

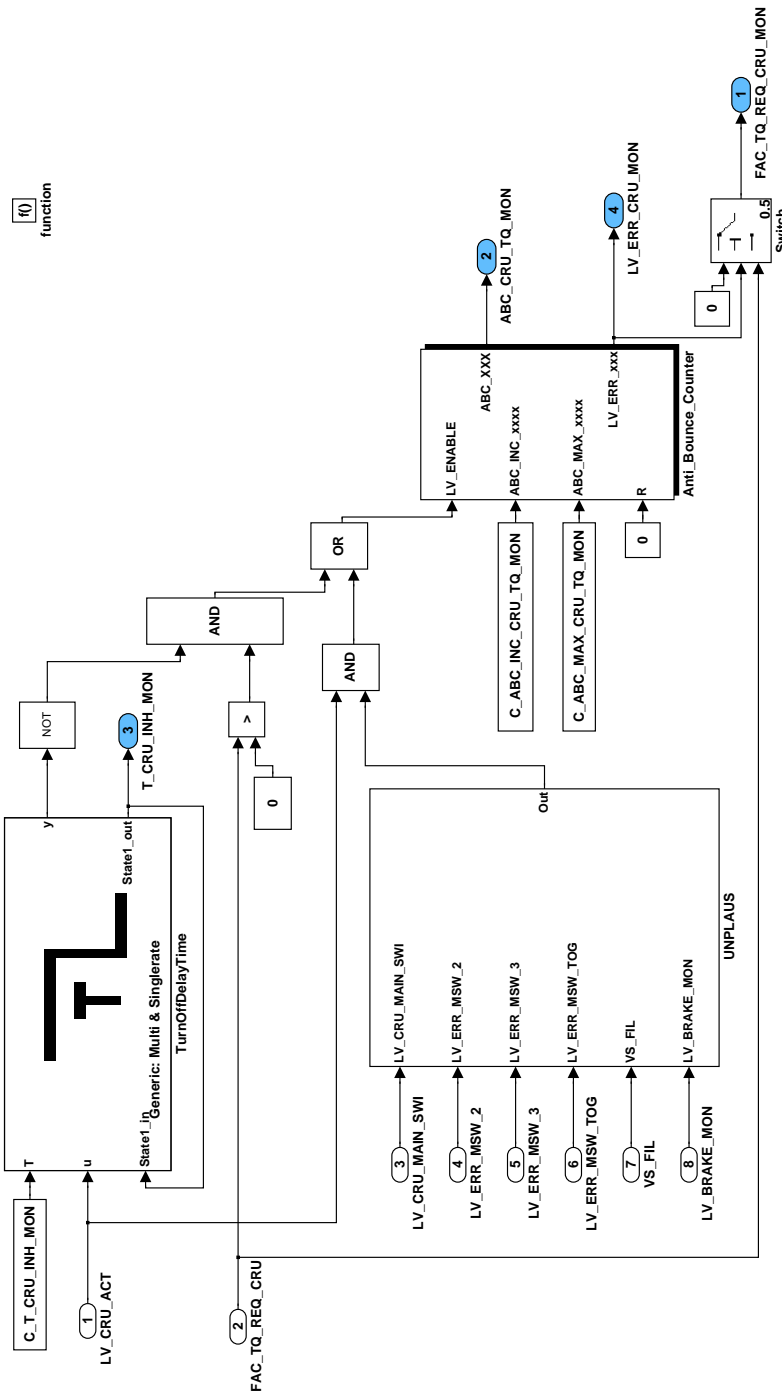



Figure E.16.4: ECM2\_DTSYSCRU /ME00B\_CRU\_MON

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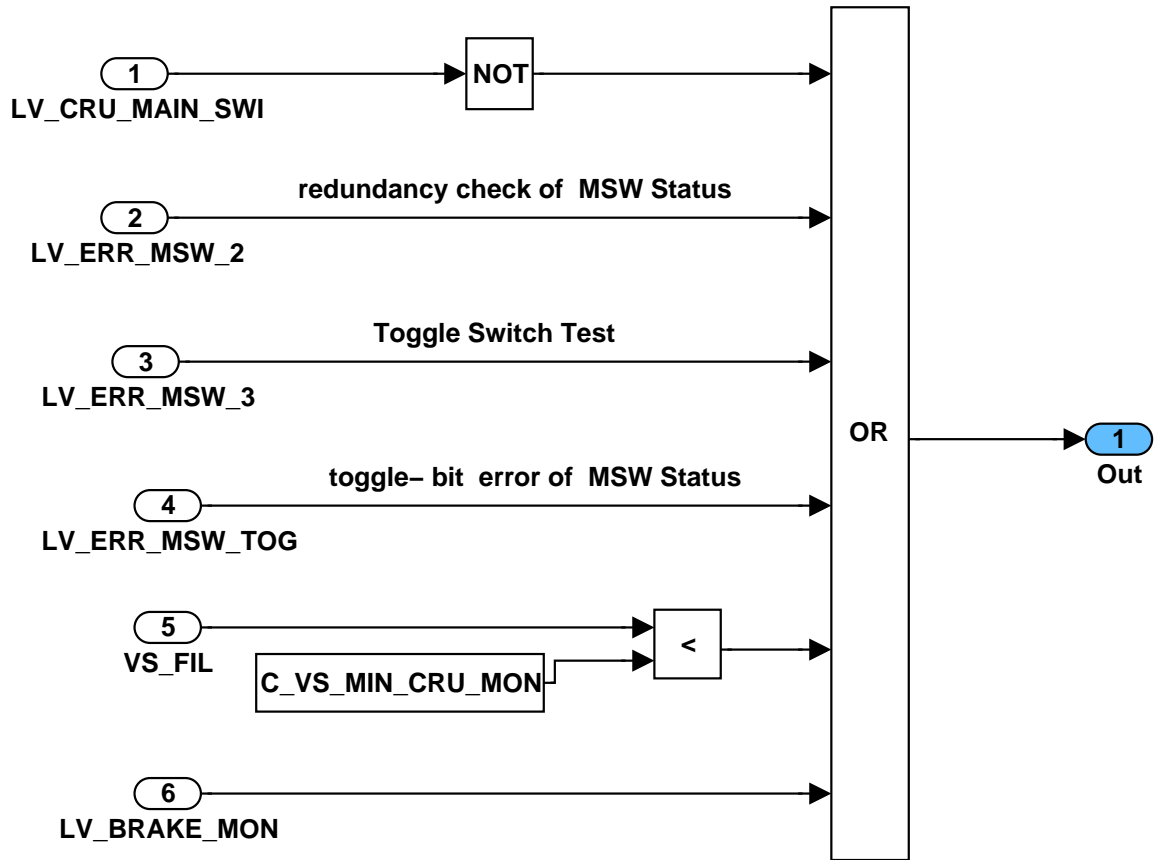


Figure E.16.5: ECM2\_DTSYSCRU /ME00B\_CRU\_MON/UNPLAUS

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## E.17 Monitoring of engine speed limitation

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_TQI_N_MAX_MON	O/V	0... FFH	0... 255	1	-
Anti-bounce-counter for fault in engine speed limitation					
LV_ERR_TQI_N_MAX_MON	O/V	0... 1H	0 ...1	1	-
Fault currently present in engine speed limitation					

### Input data:

LV_N_LIM_ETC_MON {p. 6790}	N_32_MON {p. 7002}	PREV_STATE_IV {p. 2039}	
-------------------------------	--------------------	-------------------------	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TQI_N_MAX_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_MAX_TQI_N_MAX_MON	-	1... FFH	1... 255	1	-
Maximum value of anti-bounce counter					
C_N_MAX_MTC_LIH_THD_MON	-	0... FFH	0... 8160	32	rpm
Speed threshold for the detection of a fault in the engine speed limitation					

### Import actions:

ACTION_ECM3_Service3TaskPfm (IN<PRM_K>)
ACTION_ECM3_Service4TaskPfm (IN<PRM_K>)
ACTION_ECM3_Service5TaskPfm (IN<PRM_K>)

**Note:** These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 3.

**ACTION\_ECM3\_McChkStack()**

**Note:** This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION\_ECM3\_Service3TaskPfm() and ACTION\_ECM3\_Service4TaskPfm().

**ACTION\_ECM3\_WriteChkCpl(INOUT <>, OUT <>, IN <>)**

**ACTION\_ECM3\_ChkCpl(IN <>, IN <>)**


**ACTION\_ECM3\_ReadChkCpl(OUT <>, IN <>, IN <>)**

**Note:** All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

### FUNCTION DESCRIPTION:

#### General information:

The objective of this module is to verify that the related level 1 function 'Engine speed limitation' works correctly. In case that the engine speed exceeds a certain speed level, the level 1 function activates ETC limp home mode (safety fuel cut-off) to protect the engine.

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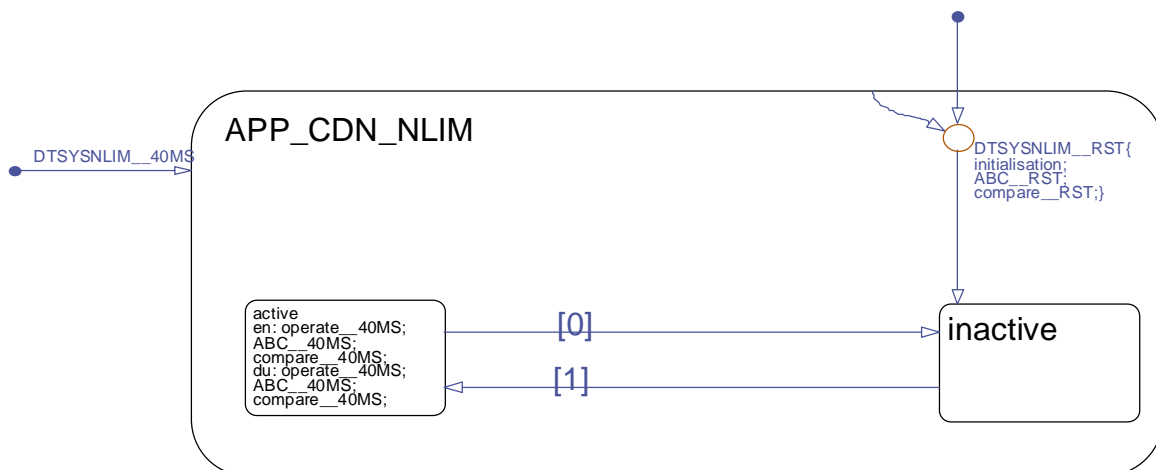
The level 2 function 'Monitoring of engine speed limitation' considers the status of the injection of all cylinders and the engine speed value and the ETC request flag (LV\_N\_LIM\_ETC\_MON). This flag is set to 1 if any function requests limp home activation.

In case that the engine speed exceeds the defined level 2 value C\_N\_MAX\_MTC\_LIH\_THD\_MON and limp home mode is requested (LV\_N\_LIM\_ETC\_MON = 1) and injection is active in at least one cylinder (PREV\_STATE\_IV = 0; fuel cut-off is not active!), the related error bit LV\_ERR\_TQI\_N\_MAX\_MON is set after having waited a certain debounce time defined by C\_ABC\_MAX\_TQI\_N\_MAX\_MON and C\_ABC\_INC\_TQI\_N\_MAX\_MON.

The injection status has to be checked to avoid that level 2 detects a failure in case that the engine speed exceeds the threshold although fuel cut-off has been put into action. This could happen if the vehicle is running down a hill and the engine speed increases because of the engine directly linked to the transmission.

## E.17.1 FUNCTION PART: NLIM

### Application Condition



**Note:** DTSYSNLIM\_\_RST includes the function calls as defined in application incidences.

### Function Description

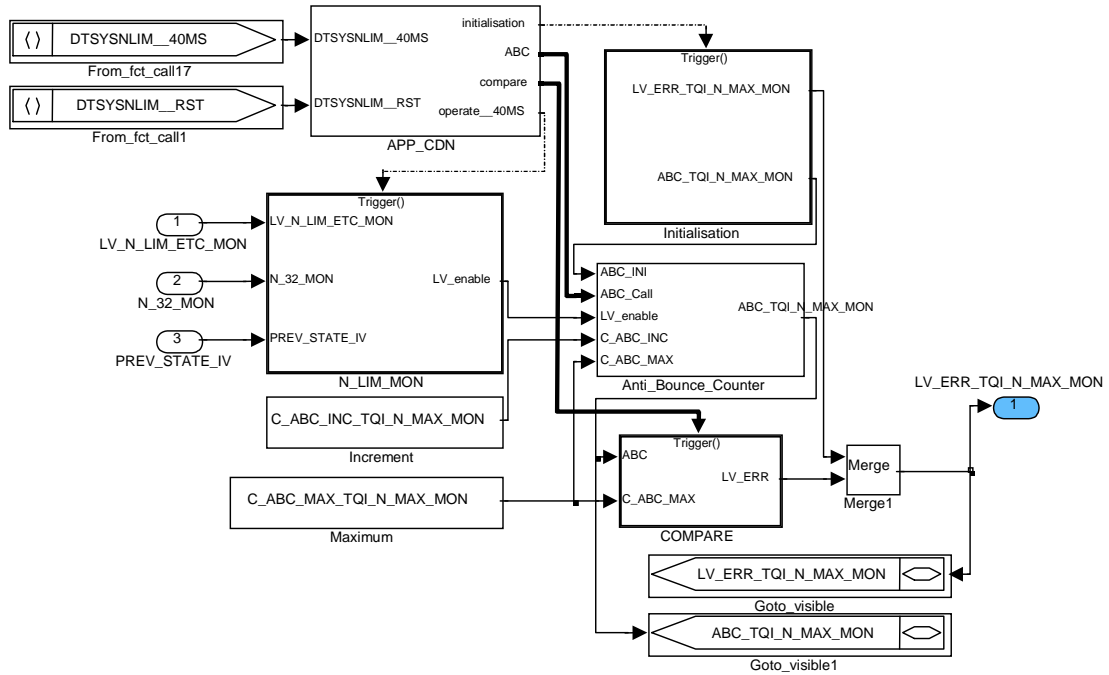


Figure E.17.1: NLIM

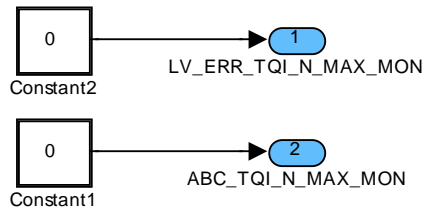


Figure E.17.2: NLIM/INITIALISATION

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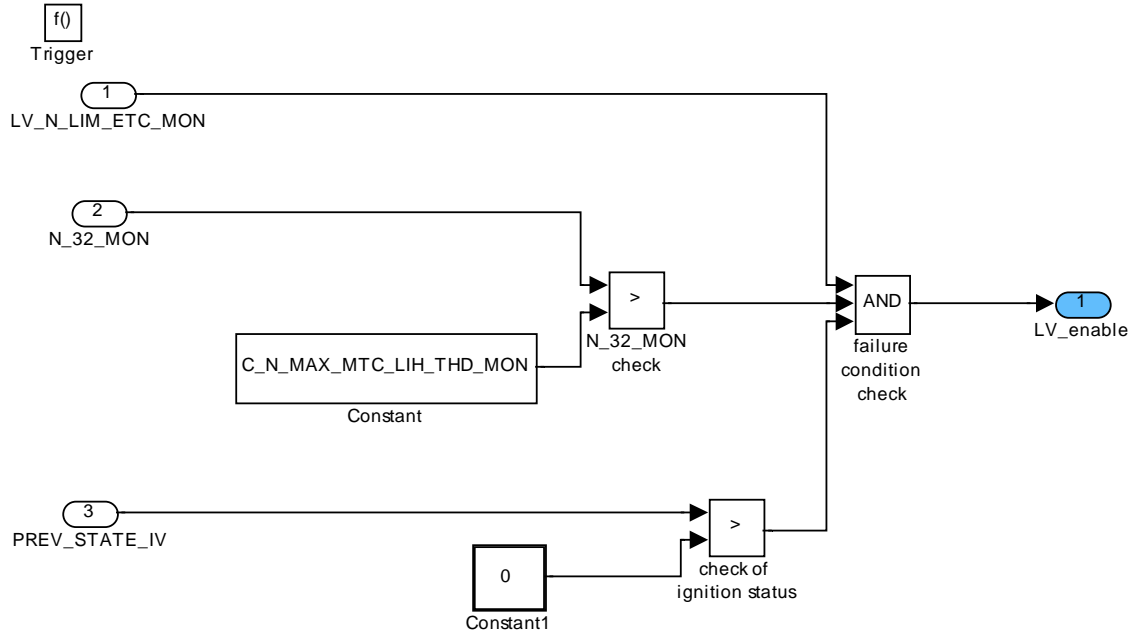



Figure E.17.3: NLIM/N\_LIM\_MON

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## E.18 Monitoring of idle speed controller

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_TQ_DIF_I_IS_MON	V	0... FFH	0... 255	1	-
Anti bounce counter for monitoring of I_PART of idle speed controller					
ABC_TQ_DIF_P_D_IS_MON	V	0... FFH	0... 255	1	-
Anti bounce counter for monitoring of idle speed controller - PD-part					
LV_ERR_TQ_DIF_I_IS_MON	O/V	0... 1H	0 ...1	1	-
Fault currently present in torque generation, symptom "idle speed controller - I-part"					
LV_ERR_TQ_DIF_P_D_IS_MON	O/V	0... 1H	0 ...1	1	-
Fault currently present in torque generation, symptom "idle speed controller - PD-part"					
LV_RAMP_P_D_BEG_VALUE_WRG_MON	V	0... 1H	0 ...1	1	-
Logical bit indicating wrong start value of PD-ramp					
STATE_ERR_TQ_DIF_I_IS_MON	O/V	0H	NO_ERROR	-	-
		1H	ERROR_PATH1		
		2H	ERROR_PATH2		
		3H	ERROR_PATH3		
		4H	ERROR_PATH4		
State variable for fault detection in torque generation, symptom idle speed controller - I-part					
STATE_ERR_TQ_DIF_P_D_IS_MON	O/V	0H	NO_ERROR	-	-
		1H	ERROR_PATH1		
		2H	ERROR_PATH2		
		3H	ERROR_PATH3		
		4H	ERROR_PATH4		
State variable for fault detection in torque generation, symptom idle speed controller - PD-part					
TQ_ADD_I_IS_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Decrement for modelled I-part during ramp function					
TQ_ADD_P_D_IS_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Decrement for modelled PD-part during ramp function					
TQ_DIF_I_IS_DIF_MON	V	80... 7FH	-256 ...254	2	Nm
Difference between monitored and modelled I-part					
TQ_DIF_I_IS_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Monitored I-part of the idle speed controller					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_DIF_I_IS_RAMP_MON	V	8000... 7FFFH	-256... 255.99218	0.0078125	Nm
Modelled I-part during ramp function					
TQ_DIF_P_D_IS_DIF_MON	V	80... 7FH	-256 ...254	2	Nm
Difference between monitored and modelled PD-part					
TQ_DIF_P_D_IS_RAMP_MON	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Modelled PD-part during ramp function					

**Input data:**

FAC_RAMP_NEG_P_D_IS_MON {p. 6789}	LV_PAS_RAMP_ACT_I_CHG_MON {p. 6790}	LV_PAS_RAMP_ACT_P_D_CHG_MON {p. 6791}	LV_REQ_ISC {p. 3501}
LV_TQ_I_MON_ACT_MON {p. 6791}	STATE_PAS_RAMP_ACT_I_IS_MON {p. 6792}	STATE_PAS_RAMP_ACT_P_D_IS_MON {p. 6792}	STATE_REQ_ISC_MON {p. 6792}
TQ_DIF_I_IS {p. 3441}	TQ_DIF_P_D_IS_MAX_MON {p. 6793}	TQ_DIF_P_D_IS_MON {p. 6793}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TQ_DIF_I_IS_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_INC_TQ_DIF_P_D_IS_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_MAX_TQ_DIF_I_IS_MON	-	1... FFH	1... 255	1	-
Maximum of anti bounce counter					
C_ABC_MAX_TQ_DIF_P_D_IS_MON	-	1... FFH	1... 255	1	-
Maximum of anti bounce counter					
C_FAC_RAMP_NEG_I_IS_MON	-	0... FA0H	0... 0.5	0.000125	-
Factor for monitoring negative ISC deactivation-ramp of I-part					
C_TQ_DIF_I_IS_ADD_MON	-	0... FFH	0... 255	1	Nm
Additive constant for I-part model value					
C_TQ_DIF_I_IS_MAX_MON	-	0... FFH	0... 255	1	Nm
Maximum I-part					
C_TQ_DIF_P_D_IS_ADD_MON	-	0... FFH	0... 255	1	Nm
Additive constant for PD-part model value					
C_TQ_DIF_P_D_RAMP_CHK_OFS_MON	-	0... FFH	0... 255	1	Nm
Offset for monitoring ramp start value					
C_TQ_I_ISC_NOT_ACT_MAX_MON	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum I-Part allowed when ISC not active					
C_TQ_P_D_ISC_NOT_ACT_MAX_MON	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum PD-part allowed when ISC not active					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TQ_PAS_I_IS_MON	-	0... FFH	0... 255	1	Nm
Target value for monitoring ISC deactivation-ramp operation					

### Import actions:

ACTION_ECM3_Service12TaskPfm (IN<No Name available>)
ACTION_ECM3_Service13TaskPfm (IN<No Name available>)
ACTION_ECM3_Service14TaskPfm (IN<No Name available>)

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 1.


### ACTION\_ECM3\_McChkStack()

**Note:** This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION\_ECM3\_Service12TaskPfm() and ACTION\_ECM3\_Service13TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN <>, IN <>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

**Note:** These actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode 0 and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

### Function Description

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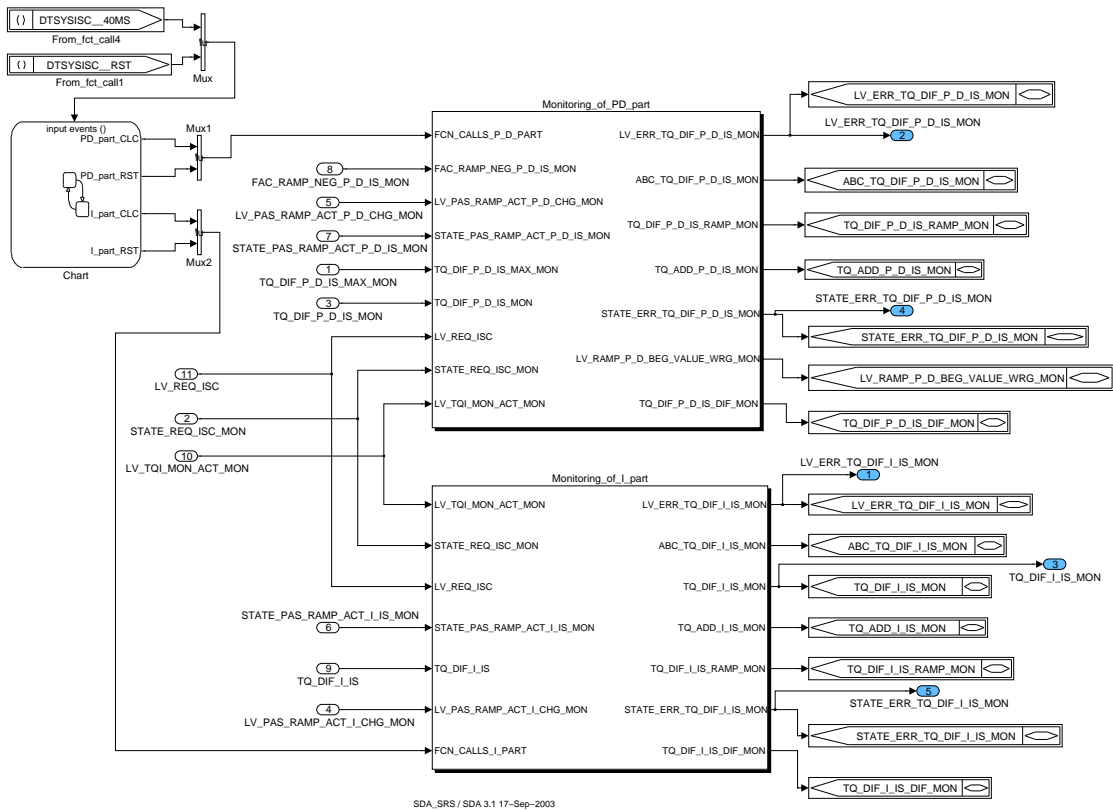


Figure E.18.1: ECM2\_DTSYSISC

### E.18.1 Monitoring of PD controller

#### General information:


The objective of this function is the monitoring of the torque demand from the PDpart of the idle speed controller function. Depending on the speed deviation to the idle speed setpoint and the coolant temperature a maximum PDpart is generated (the worst case values for the PDpart in the function level, i.e. great PDpart values are allowed for the most negative speed gradients => for  $N < N\_SP\_IS\_MON$  and for  $N > N\_SP\_IS\_MON$  small PDpart values are allowed). To additionally monitor the activation of the idle-speed controller in L1, a model value `STATE_REQ_ISC_MON`) of the activation status is calculated in the module `Application incidences of process monitoring`. To effectively plausibilise the values of `TQ_DIF_P_D_IS` and `TQ_DIF_I_IS` from the function level, both the monitoring thresholds as well as the activation condition model value are used.

The functionality that is depicted in the following pages consists of two fault scenarios:

Error Path - ISC not active:

Case 1: If the ISC is in the ramp limit operation due to deactivation of ISC, this ramp function is monitored. If `LV_PAS_RAMP_ACT_P_D_CHG_MON` is 1(i.e. indicates a change of `STATE_PAS_RAMP_ACT_P_D_IS(0)` from 0 to 1 or a flank change between two L2 sample times), the ramp calculation is triggered. It is first checked if the L1 ramp start-value is below the maximum PD-part. If this is the case, a ramp decrement `TQ_ADD_P_D_IS_MON` is calculated and the L1 start-value, `TQ_DIF_P_D_IS_MON`, plus a calibratable additive constant is copied to `TQ_DIF_P_D_IS_RAMP_MON`. During the ramp operation, the ramp model value is calculated by adding the model value (`TQ_DIF_P_D_IS_RAMP_MONk-1`) from the previous recurrency. If however the ramp start-value is greater than the threshold, `TQ_DIF_P_D_IS_MAX_MON`, then `LV_RAMP_P_D_BEG_VALUE_WRG_`

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MON is set to one. The difference between monitored and modelled PDpart is set as a visible variable for application work.

In the error detection part of this functionality, either  $TQ\_DIF\_P\_D\_IS\_MON_k > TQ\_DIF\_P\_D\_IS\_RAMP\_MON$  or  $LV\_RAMP\_P\_D\_BEG\_VALUE\_WRG\_MON == 1$  will lead to the error flag  $STATE\_ERR\_TQ\_DIF\_P\_D\_IS\_MON$  being set.

## Function Description

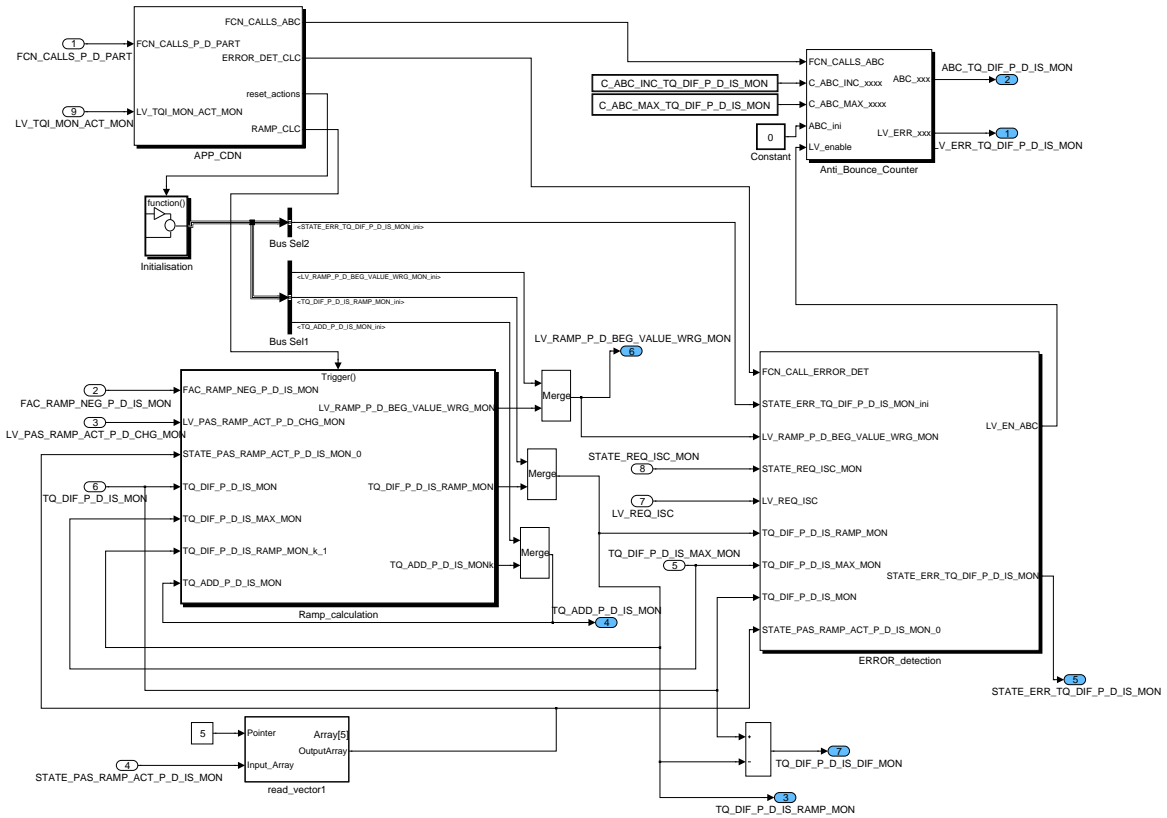


Figure E.18.2: ECM2\_DTSYSISC/Monitoring\_of\_PD\_part

Case 2: If the deactivation ramp is over, a torque demand from the PDpart of the controller greater than the passive value of zero indicates an error in the function level.


Error Path - ISC active:

Case 1: The ISC is when the engine is in idle state ( $LV\_IS=1$ ) or under certain conditions also in trailingthrottle ( $LV\_PU=1$ ) or partload ( $LV\_PL=1$ ). So all of these possible ISC active phases have to be monitored. A fault is set, if L1 declares the ISC be active and if L2 also detects the same based on plausible activation conditions ( $STATE\_REQ\_ISC\_MON = IDLE$  or  $TRAILING\_THR$  or  $PART\_LOAD$ ) and if the monitored PDpart  $TQ\_DIF\_P\_D\_IS\_MON$  exceeds the maximum PDpart  $TQ\_DIF\_P\_D\_IS\_MAX\_MON$ .

Case 2: If in L1 the ISC is active ( $LV\_REQ\_ISC=1$ ) but the activation conditions in L2 are not fulfilled i.e.  $STATE\_REQ\_ISC\_MON = IDLE$  or  $TRAILING\_THR$  or  $PART\_LOAD$ , then if  $TQ\_DIF\_P\_D\_IS\_MON$  is greater than a threshold value ( $C\_TQ\_P\_D\_ISC\_NOT\_ACT\_MAX\_MON$ ), the error-flag  $STATE\_ERR\_TQ\_DIF\_P\_D\_IS\_MON$  is set.

If one of the errors above is detected, a fault is declared after debouncing by the idle speed controller monitoring.

## Application Conditions

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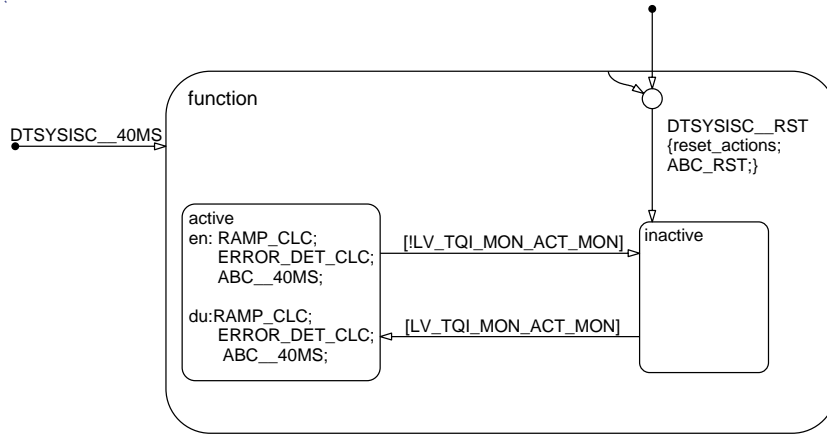


Figure E.18.3: Initialisation (DTSYSISC\_\_RST): for condition see Application Incidences of Process Monitoring .

Figure 3 ECM2\_DTSYSISC/Monitoring\_of\_PD\_part/APP\_CDN/Chart

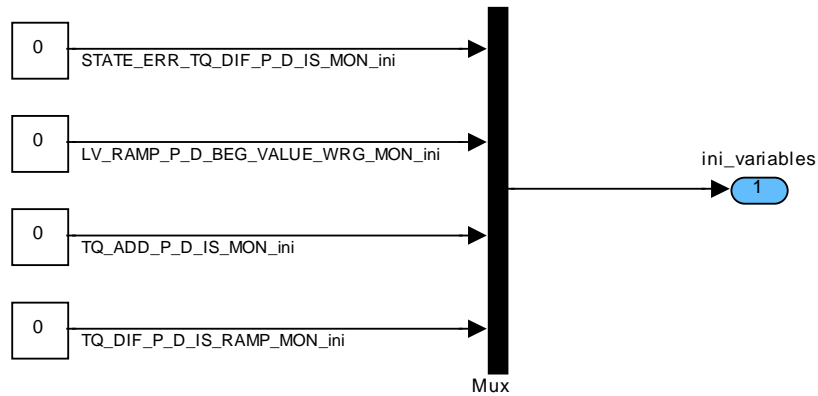


Figure E.18.4: ECM2\_DTSYSISC/Monitoring\_of\_PD\_part/Initialisation

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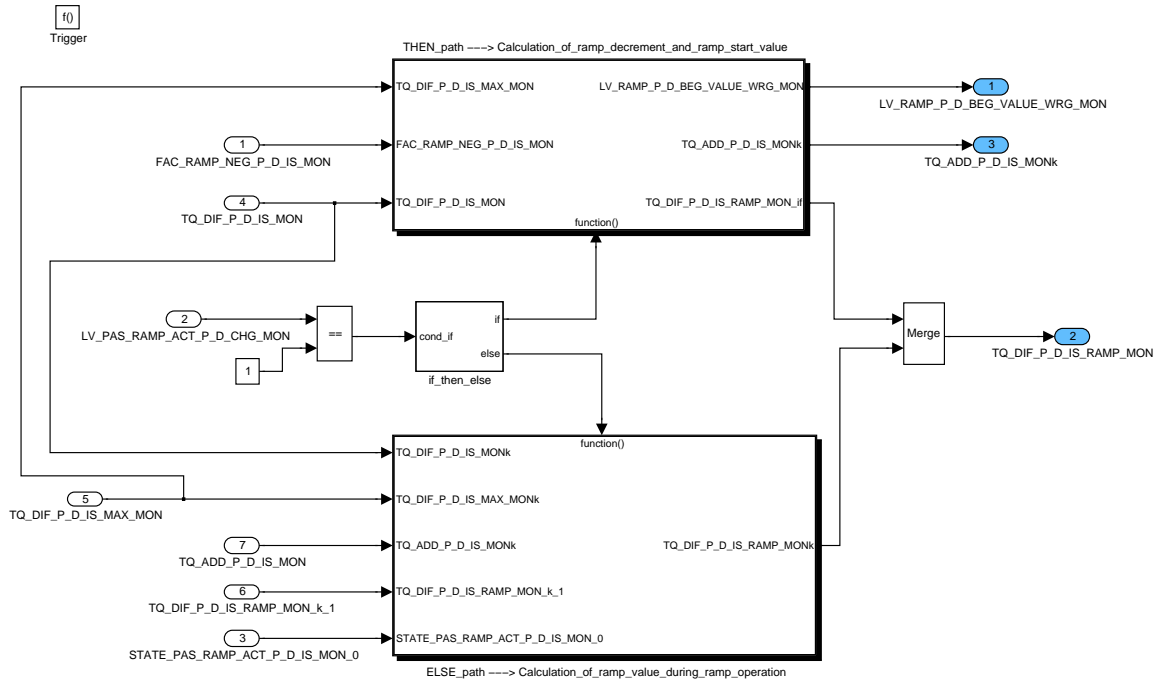


Figure E.18.5: ECM2\_DTSYSISC/Monitoring\_of\_PD\_part/Ramp\_calculation

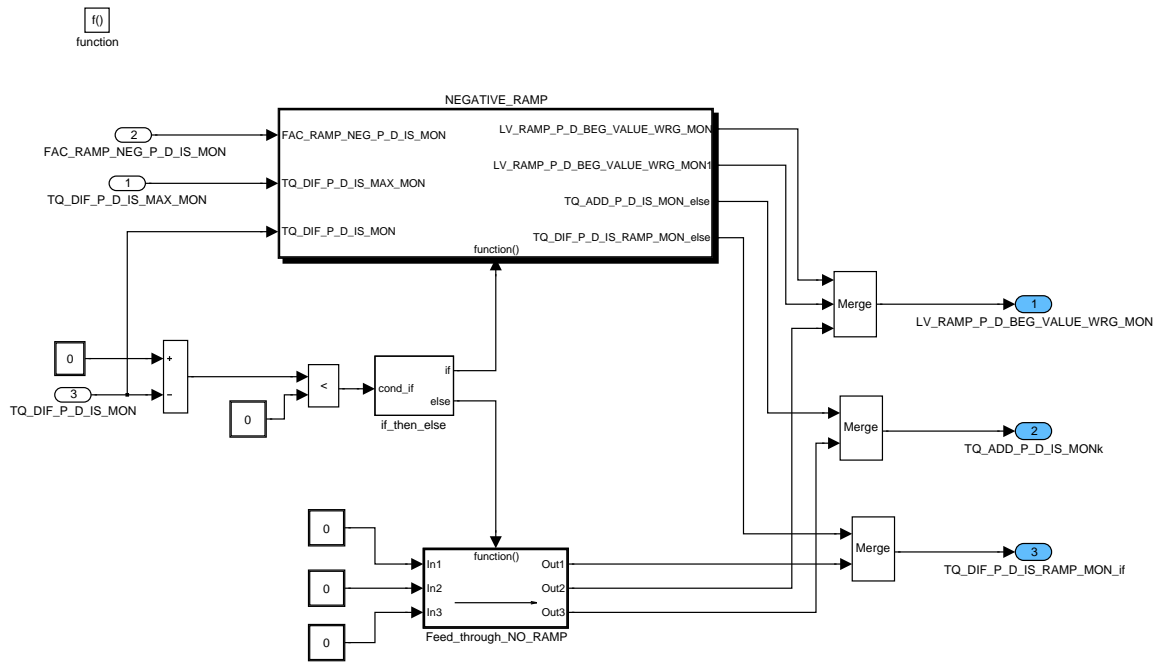


Figure E.18.6: ECM2\_DTSYSISC/Monitoring\_of\_PD\_part/Ramp\_calculation/THEN\_path

**NOTE:** The minimum PDramp increment/decrement is equal to the resolution of TQ\_ADD\_P\_D\_IS\_MON. If the theoretically calculated *absolute value* of TQ\_ADD\_P\_D\_IS\_MON is **smaller than the resolution and not equal to zero**, then is to be limited to the resolution. This would lead to a slower/faster descent of the deactivation ramp i.e. a shorterramp time. If the theoretical value of TQ\_ADD\_P\_D\_IS\_MON is equal to zero, this value is then maintained.

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UNSUPPORTED IMAGE FORMAT

For e.g: theoretical value = 0.04 Nm > Limited value = 0.03125 Nm  
 theoretical value = 0.01 Nm > Limited value = 0.03125 Nm

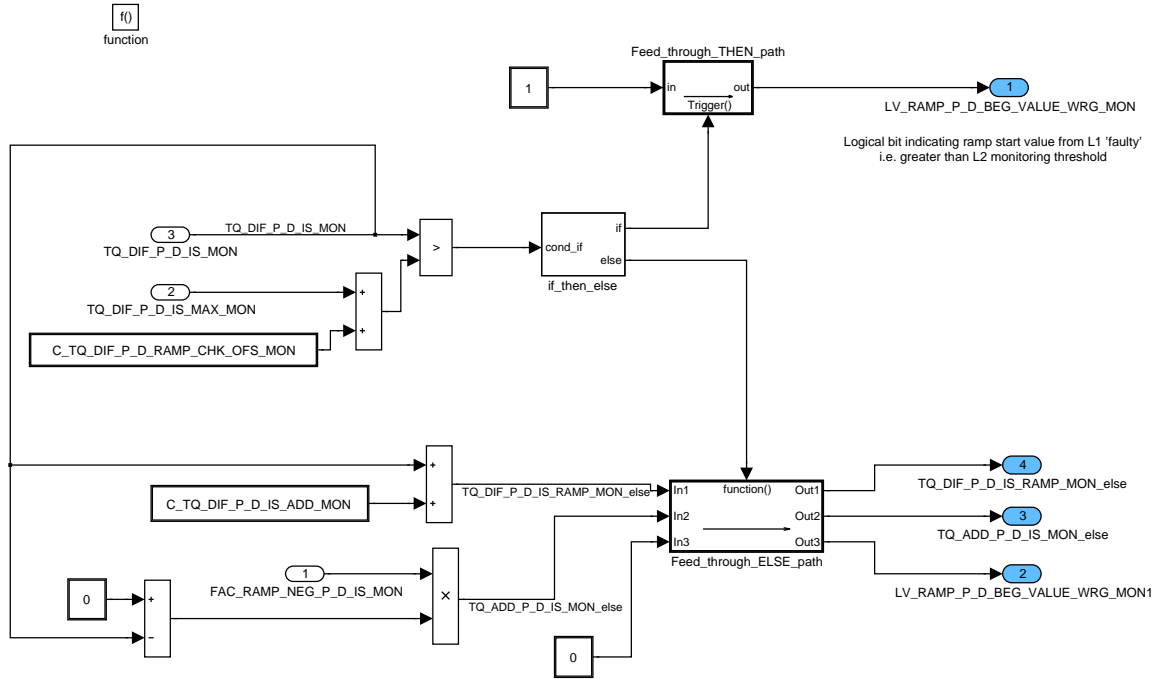


Figure E.18.7: ECM2\_DTSYSISC/Monitoring\_of\_PD\_part/Ramp\_calculation/THEN\_path/NEGATIVE\_RAMP

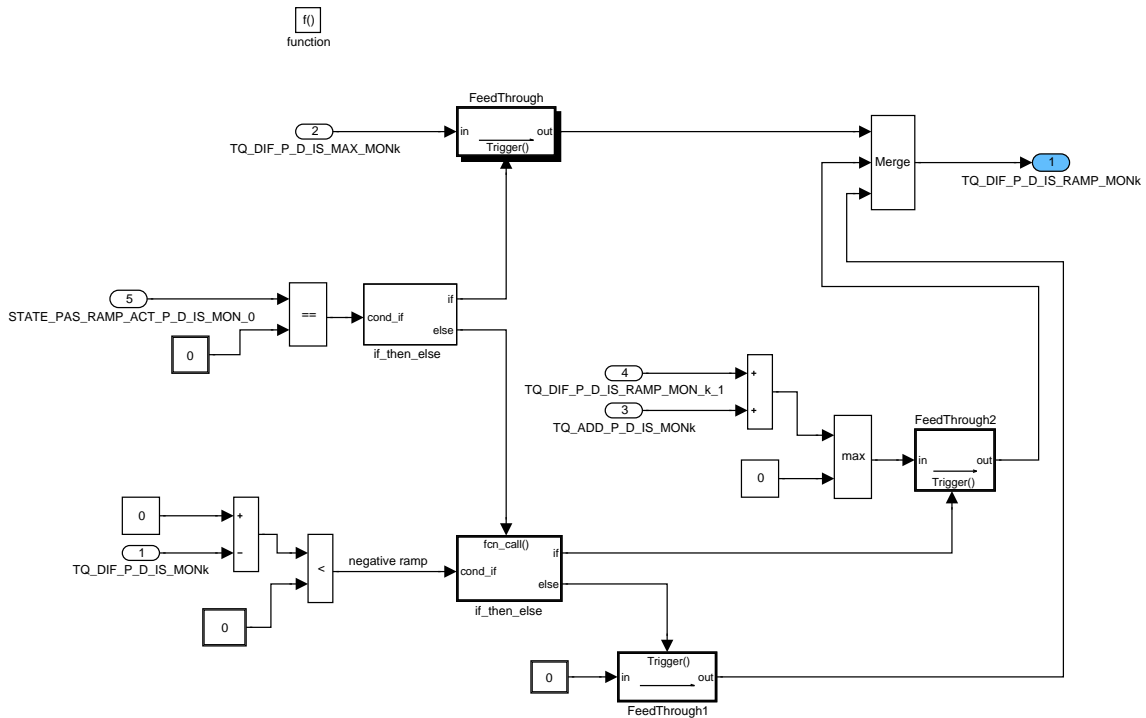


Figure E.18.8: ECM2\_DTSYSISC/Monitoring\_of\_PD\_part/Ramp\_calculation/ELSE\_path

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Released by Tetenborn Frank		Date 2013-02-13	File 30E00U01.00J
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 6928 of 8404	
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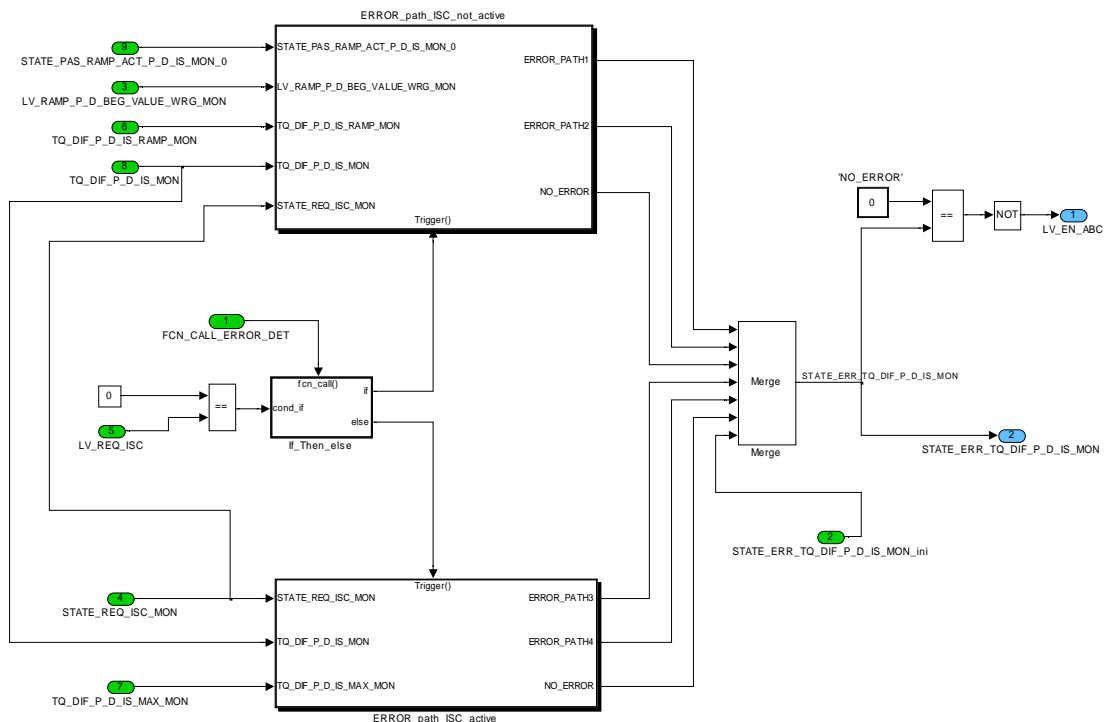


Figure E.18.9: ECM2\_DTSYISIC/Monitoring\_of\_PD\_part/ERROR\_detection

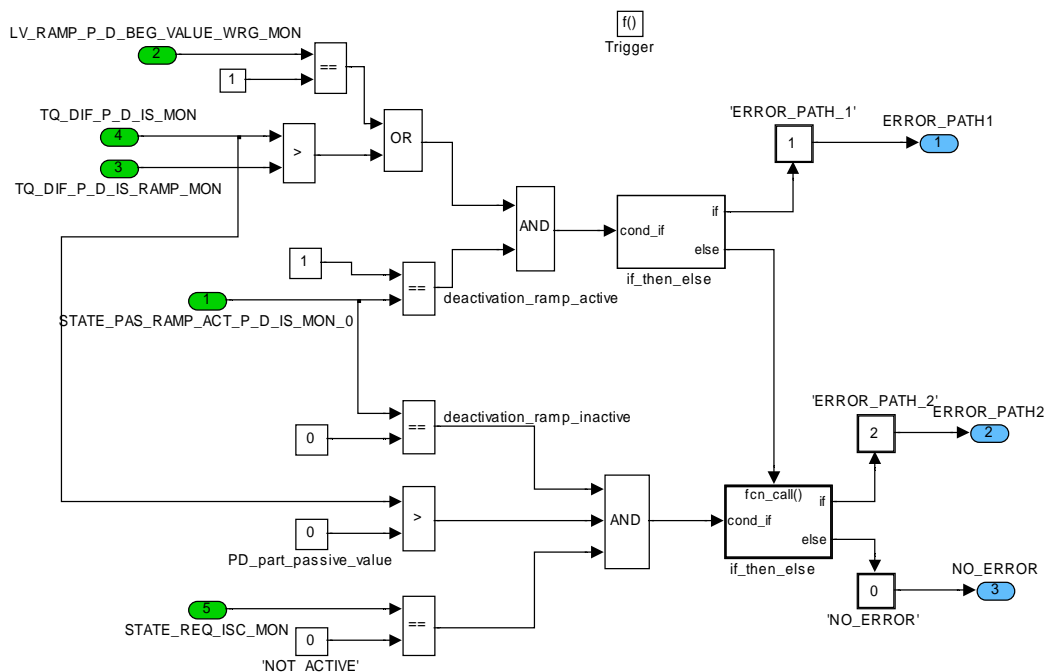


Figure E.18.10:  
ECM2\_DTSYISIC/Monitoring\_of\_PD\_part/ERROR\_detection/ERROR\_path\_ISC\_not\_active

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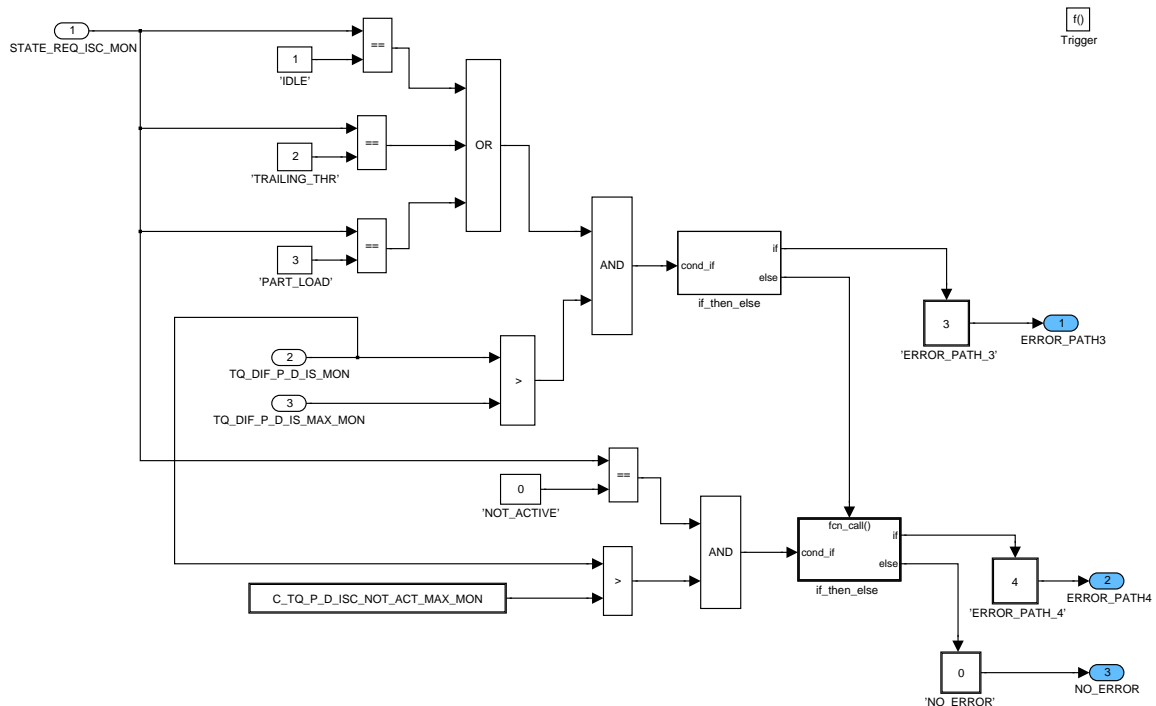


Figure E.18.11:  
ECM2\_DTSYSISC/Monitoring\_of\_PD\_part/ERROR\_detection/ERROR\_path\_ISC\_active

## E.18.2 Monitoring of I controller

### General information:

The objective of this function is the monitoring of the torque demand from the Ipart of the idle speed controller function. Two different faults scenarios are considered:

Error Path - ISC not active:

**Case 1:** If the ISC is actually in the ramp limit operation due to deactivation of ISC, this ramp function is monitored. If LV\_PAS\_RAMP\_ACT\_I\_CHG\_MON is 1 (i.e. indicates a change of STATE\_PAS\_RAMP\_ACT\_I\_IS(0) from 0 to 1 or a flank change between two L2 sample times), a ramp decrement (TQ\_ADD\_I\_IS\_MON) is calculated and the actual Ipart (TQ\_DIF\_I\_IS\_MON) plus a calibratable additive constant is copied to TQ\_DIF\_I\_IS\_RAMP\_MON. Further on, TQ\_DIF\_I\_IS\_RAMP\_MON is calculated by adding the calculated ramp decrement to the last delayed value. A fault is set, if  $TQ\_DIF\_I\_IS\_MON > TQ\_DIF\_I\_IS\_RAMP\_MON$  or greater than the monitoring threshold C\_TQ\_DIF\_I\_IS\_MAX\_MON. If one of the errors is detected, a fault is declared after debouncing. The difference between monitored and modelled value is declared as a visible variable for application purposes.

**Case 2:** If in L2 idle speed controller is not active i.e. STATE\_REQ\_ISC\_MON = NOT\_ACTIVE but the Ipart in the function level has not reached the passive value C\_TQ\_PAS\_I\_IS\_MON at the end of the deactivation ramp, then an error is declared.

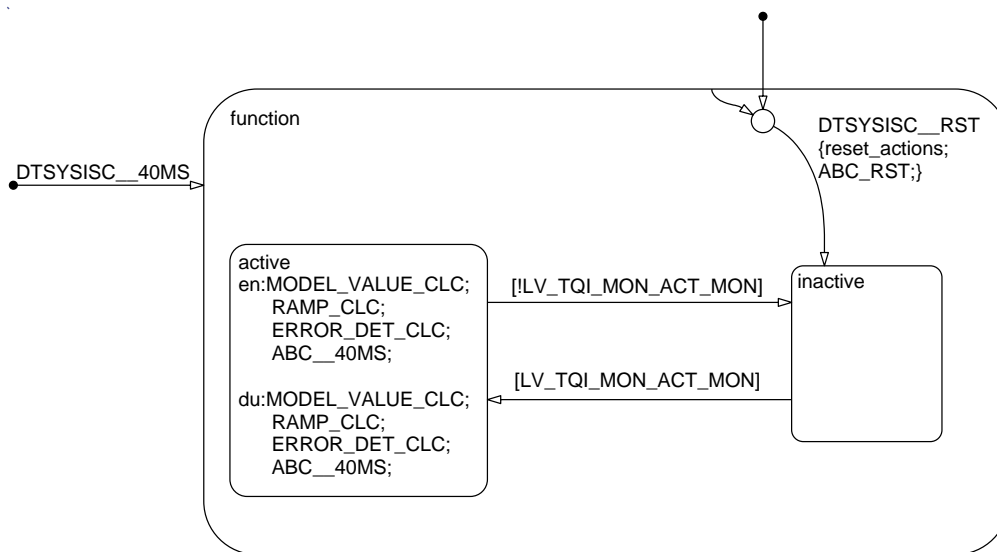
Error Path - ISC active:

**Case 1:** The ISC can be active either when the engine is in idle state (LV\_IS=1) or under certain conditions in trailingthrottle state (LV\_PU=1) and partload state (LV\_PL=1). So all of these possible ISC active phases have to be monitored. A fault is set, if L1 declares the ISC be active and if L2 also detects the same based on plausible activation conditions (STATE\_REQ\_ISC\_MON = IDLE or TRAILING\_THR or PART\_LOAD) and if torque demand from L1, TQ\_DIF\_I\_IS\_MON, exceeds a threshold value C\_TQ\_DIF\_I\_IS\_MAX\_MON.

Case 2: If in L1 the ISC is active (LV\_REQ\_ISC=1) but the monitoring functionality detects this activation to be faulty i.e. (STATE\_REQ\_ISC\_MON IDLE or TRAILING\_THR or PART\_LOAD), then an lpart torque demand from L1 greater than a threshold value (C\_TQ\_I\_ISC\_NOT\_ACT\_MAX\_MON) will lead to an error detection.

If one of the errors above is detected, a fault is declared after debouncing by the idle speed controller monitoring.

**Note:** The value of STATE\_PAS\_RAMP\_ACT\_I\_IS (bit coded byte) and STATE\_PAS\_RAMP\_ACT\_P\_D\_IS (bit coded byte) for the current recurrency (represented by STATE\_PAS\_RAMP\_ACT\_I\_IS\_0 and STATE\_PAS\_RAMP\_ACT\_P\_D\_IS\_0 respectively in the signal flow diagrams) are stored in the bit position 1.



**Initialisation (DTSYSISC\_RST):** for condition see Application Incidences of Process Monitoring .

Figure 12 ECM2\_DTSYSISC/Monitoring\_of\_I\_part/APP\_CDN/Chart

### Function Description

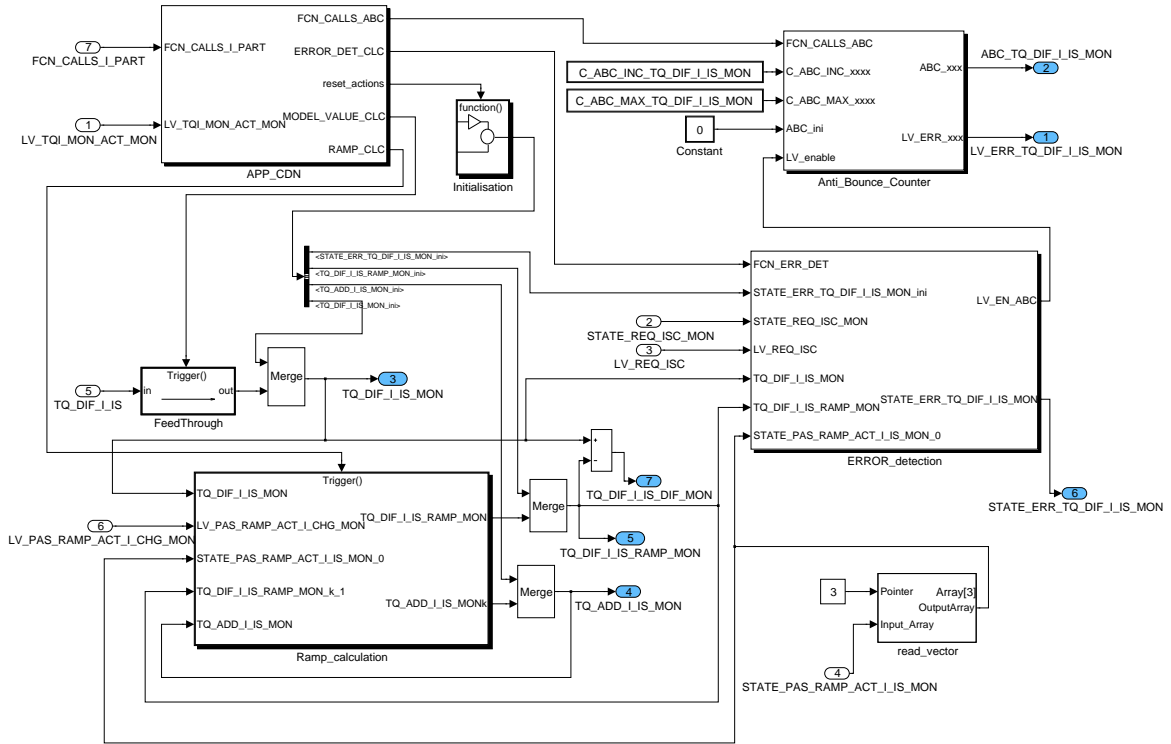


Figure E.18.12: ECM2\_DTSYSISC/Monitoring\_of\_I\_part

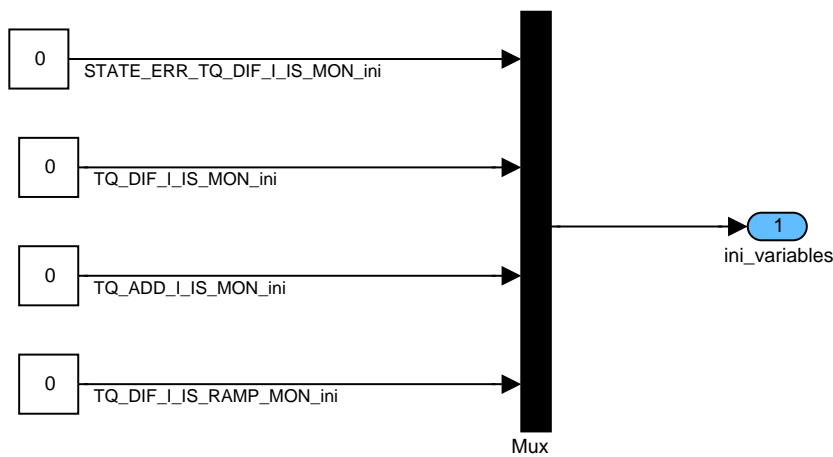


Figure E.18.13: ECM2\_DTSYSISC/Monitoring\_of\_I\_part/Initialisation

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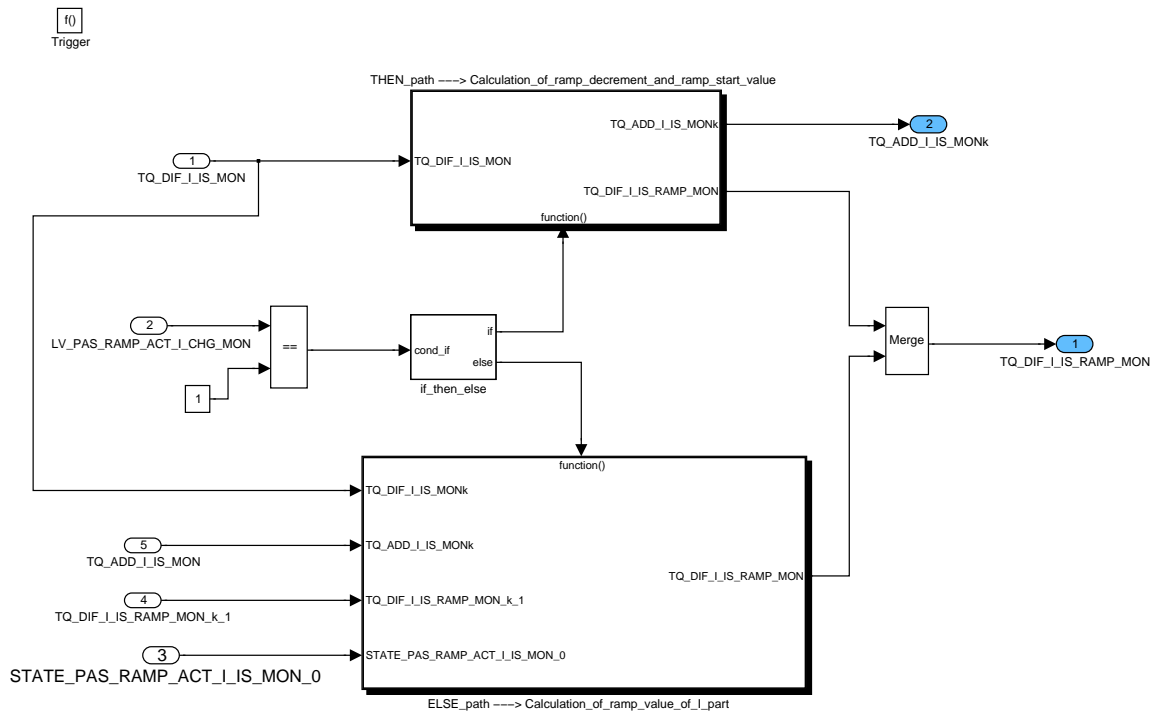


Figure E.18.14: ECM2\_DTSYSISC/Monitoring\_of\_I\_part/Ramp\_calculation

**Note:** The minimum Iramp increment/decrement is equal to the resolution of TQ\_ADD\_I\_IS\_MON (0.03125Nm). If the theoretically calculated **absolute value** of TQ\_ADD\_I\_IS\_MON is **smaller than the resolution and not equal to zero**, then is to be limited to the resolution. This would lead to a faster ascent/descent of the deactivation ramp i.e. shorterramp time. If the theoretical value of TQ\_ADD\_I\_IS\_MON is equal to zero, this value is then maintained.

For e.g:

theoretical value = 0.04 Nm	>	Limited value = 0.03125 Nm
theoretical value = 0.01 Nm	>	Limited value = 0.03125 Nm
theoretical value = 0.04 Nm	>	Limited value = 0.0625 Nm
theoretical value = 0.01 Nm	>	Limited value = 0.03125 Nm

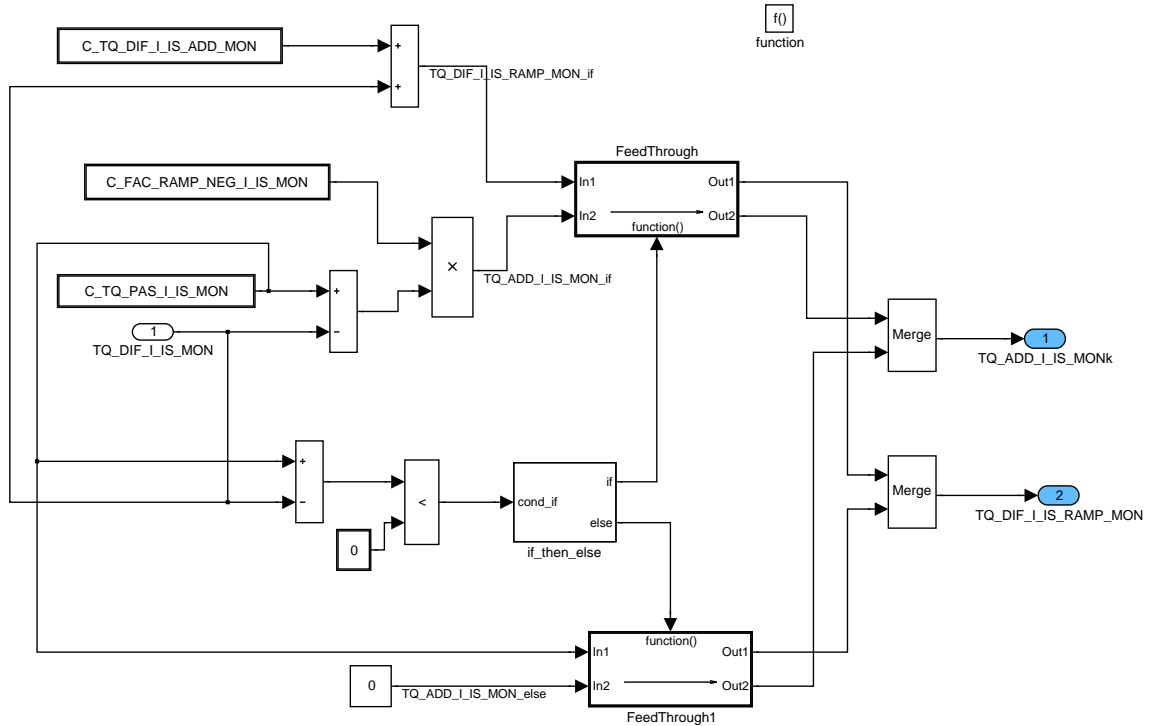


Figure E.18.15: ECM2\_DTSYSISC/Monitoring\_of\_I\_part/Ramp\_calculation/THEN\_path

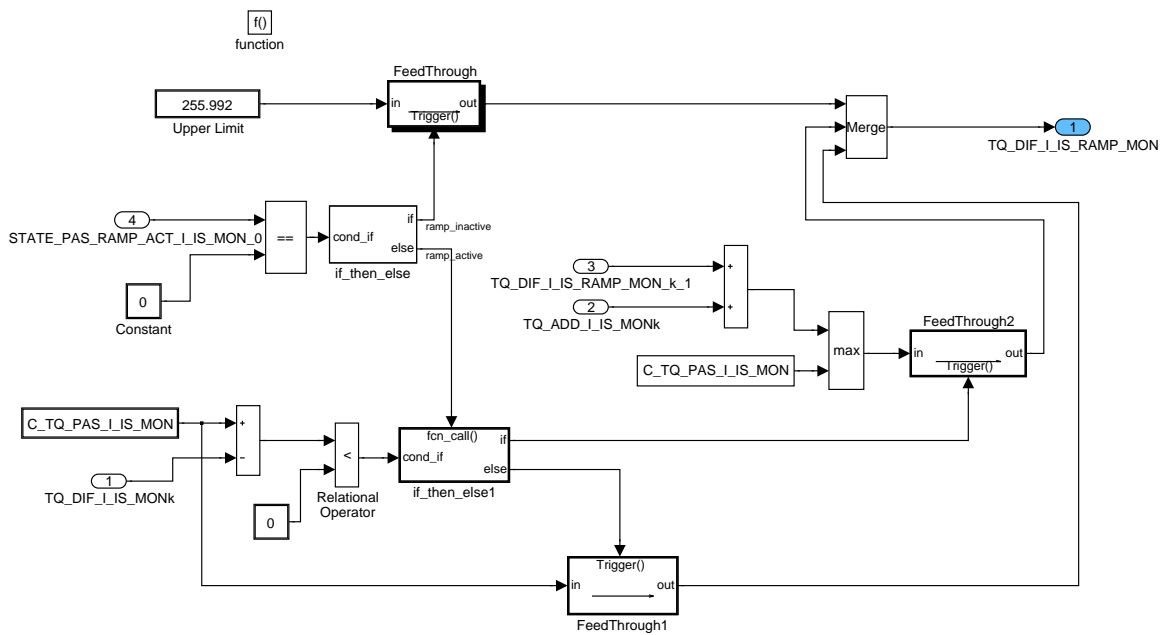
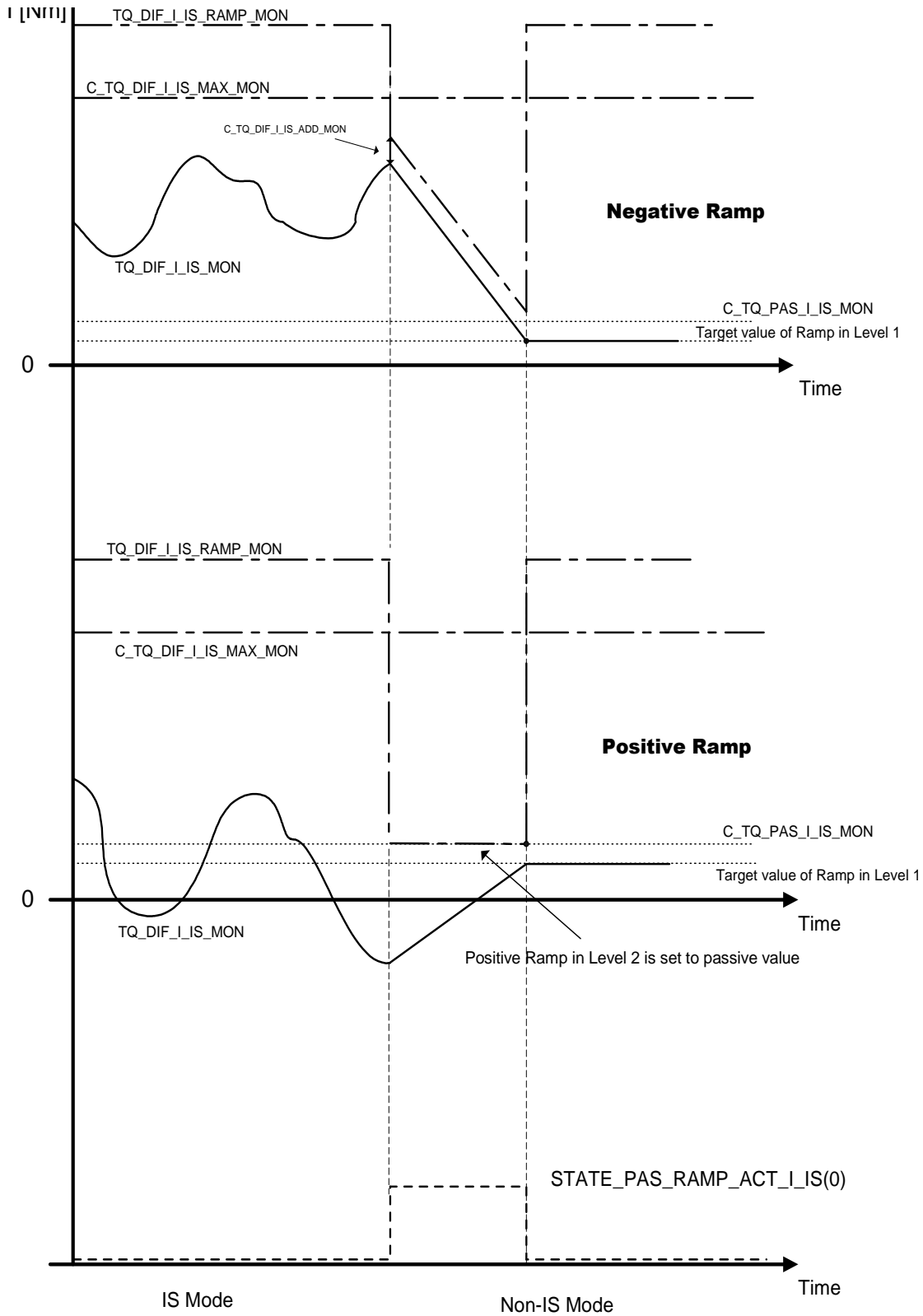


Figure E.18.16: ECM2\_DTSYSISC/Monitoring\_of\_I\_part/Ramp\_calculation/ELSE\_path

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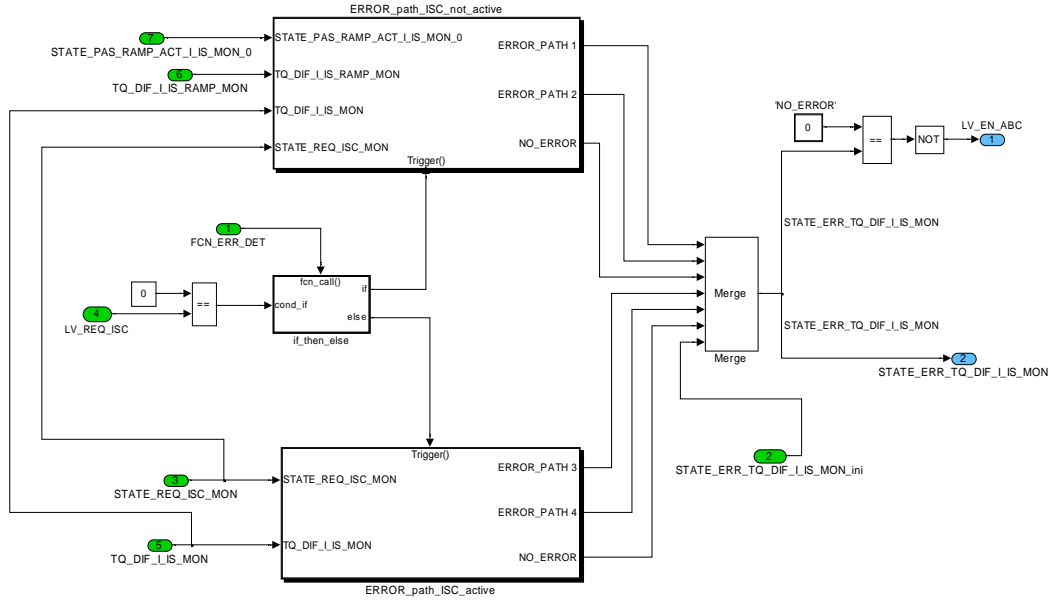


Figure E.18.17: ECM2\_DTSYSISISC/Monitoring\_of\_I\_part/ERROR\_detection

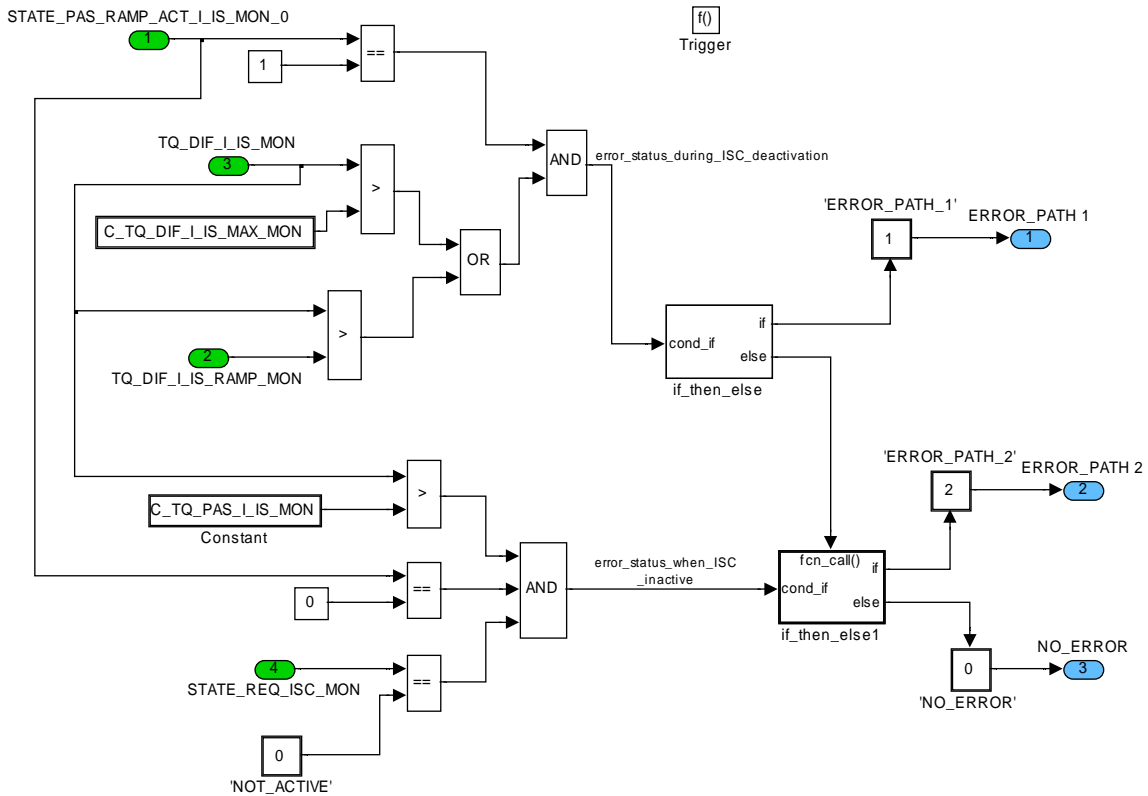


Figure E.18.18: ECM2\_DTSYSISISC/Monitoring\_of\_I\_part/ERROR\_detection/ERROR\_path\_ISC\_not\_active

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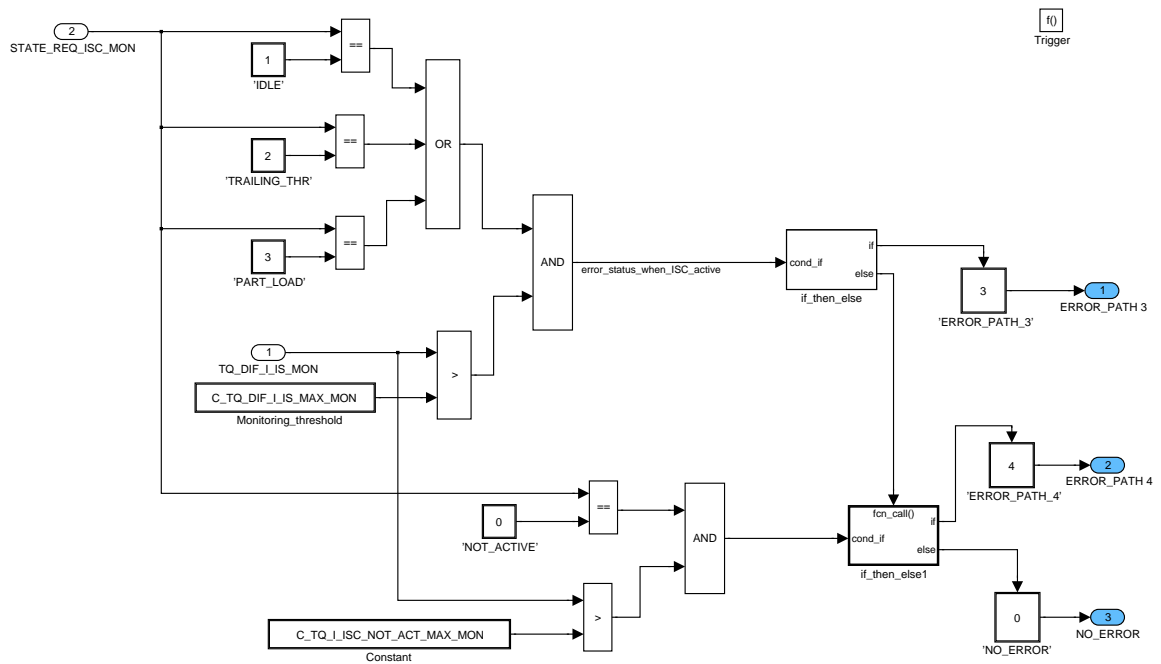


Figure E.18.19: ECM2\_DTSYISISC/Monitoring\_of\_I\_part/ERROR\_detection/ERROR\_path\_ISC\_active

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## E.19 Monitoring of maximum torque at clutch

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_TQ_MAX_CLU_MON	V	0... FFH	0... 255	1	-
Anti bounce counter for monitoring of maximum torque at clutch					
FAC_CHA_MAX_MON	V	0... FFFFH	0... 1.99996	30.5e-6	-
Ratio between the optimal and real air efficiency					
FAC_CUS_TQ_MAX_MON	V	0... FFFFH	0... 1.99996	30.5e-6	-
Model value of the output factor from the crossfade calculation					
LV_ERR_TQ_MAX_CLU_MON	O/V	0... 1H	0 ...1	1	-
Fault currently present in torque generation, symptom "maximum torque at clutch"					
TQ_MAX_CLU_DIF_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Difference between monitored and modelled maximum torque at clutch					
TQ_MAX_CLU_MAX_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Model value for maximum torque at clutch					
TQ_MAX_CLU_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
monitored maximum torque at clutch					

### Input data:

FAC_TQ_REQ_MON {p. 6851}	LV_TQI_MON_ACT_MON {p. 6791}	N_32_MON {p. 7002}	TQ_LOSS_REQ_CLU_MON {p. 6975}
TQ_MAX_CLU {p. 8380}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TQ_MAX_CLU_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_MAX_TQ_MAX_CLU_MON	-	1... FFH	1... 255	1	-
Maximum of anti bounce counter					
C_OFS_TIA_MON	-	0... FFFFH	0... 1.99996	30.5e-6	-
Offset reflecting the sound velocity influence					
IP_FAC_CHA_MAX_1_MON	-	0... FFFFH	-327.68 ...327.67	0.01	%
LDPM_N_32_MON__FAC_CHA_MON	11	0... FFH	0... 8160	32	rpm
Maximum relative cylinder filling by full load under normal conditions					
IP_FAC_CHA_MAX_2_MON	-	0... FFFFH	-327.68 ...327.67	0.01	%
LDPM_N_32_MON__FAC_CHA_MON	11	0... FFH	0... 8160	32	rpm
Maximum relative cylinder filling					
IP_FAC_CHA_MAX_FAC_TQ_REQ_MON	-	0... FFH	0... 0.99609	3.9063e-3	-
LDP_FAC_TQ_REQ_MON__TQ_MAX_MON	6	0... FFH	0... 1.99218	0.0078125	-
Weighting factor for TQ_MAX_MON correction					
IP_TQI_REF_MAX_MON	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDP_N_32_MON_IP_TQI_MAX_MON	7	0... FFH	0... 8160	32	rpm
Maximum reference indicated engine torque					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**Import actions:**

ACTION_ECM3_Service12TaskPfm (IN<No Name available>)
ACTION_ECM3_Service13TaskPfm (IN<No Name available>)
ACTION_ECM3_Service14TaskPfm (IN<No Name available>)

**E.19.1 ECM2\_DTSYSTQMAX**

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The argument has the value 2.

ACTION_ECM3_McChkStack()
--------------------------

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION\_ECM3\_Service12TaskPfm() and ACTION\_ECM3\_Service13TaskPfm().

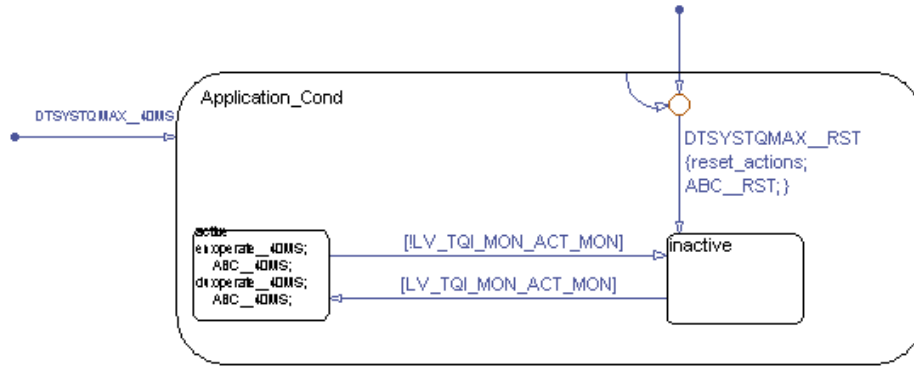
ACTION_ECM3_WriteChkCpl (INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN<>, IN<>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

**Note:** These actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode 0 and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

**General information:**

The objective of this function is the monitoring of the maximum torque at clutch. The maximum torque at clutch is compared to a model threshold value (TQ\_MAX\_CLU\_MAX\_MON). The factors influencing this threshold are: IP\_TQI\_REF\_MAX\_MON (the worst case condition i.e. maximum possible fresh air entering in the cylinder is taken into account inside this map), TQ\_LOSS\_REQ\_CLU\_MON and driver request influence as a weighting factor in a crossfade calculation. A fault is detected after debouncing, if the maximum torque at clutch exceeds this threshold.

**Application Condition**



**Initialisation(DTSYSTQMAX\_RST):** for condition see Application Incidences of Process Monitoring

**Function Description**

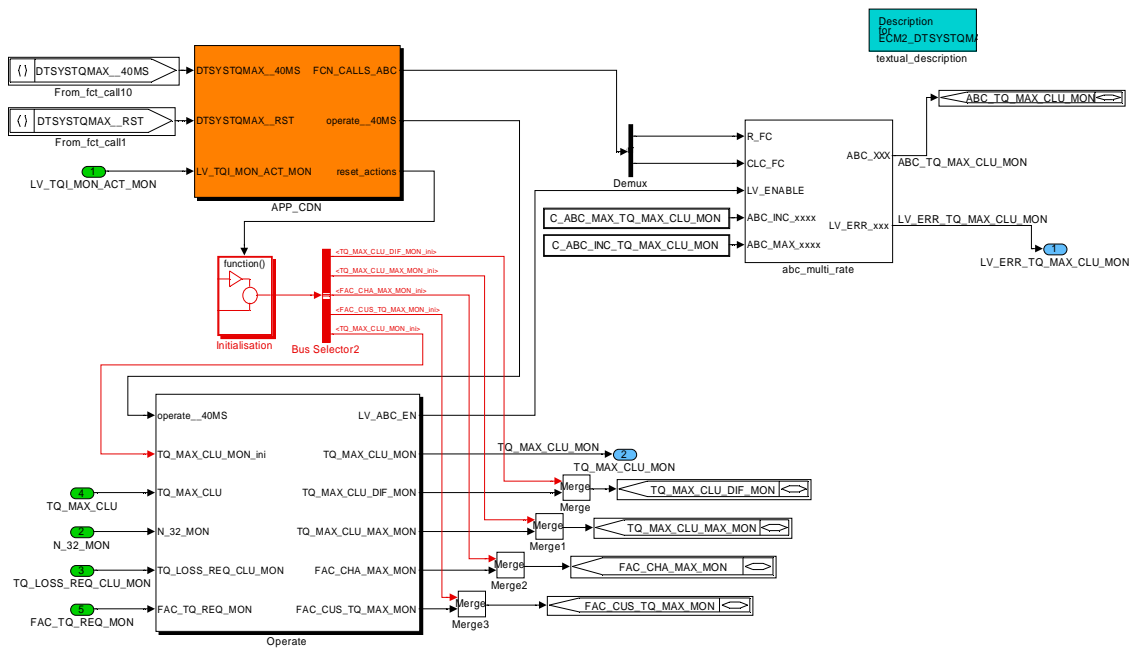


Figure E.19.1: ECM2\_DTSYSTQMAX

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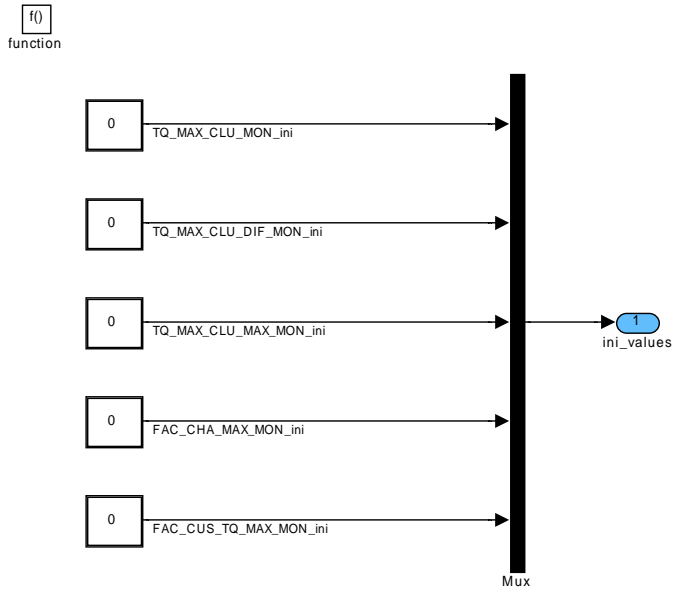


Figure E.19.2: ECM2\_DTSYSTQMAX/Initialisation

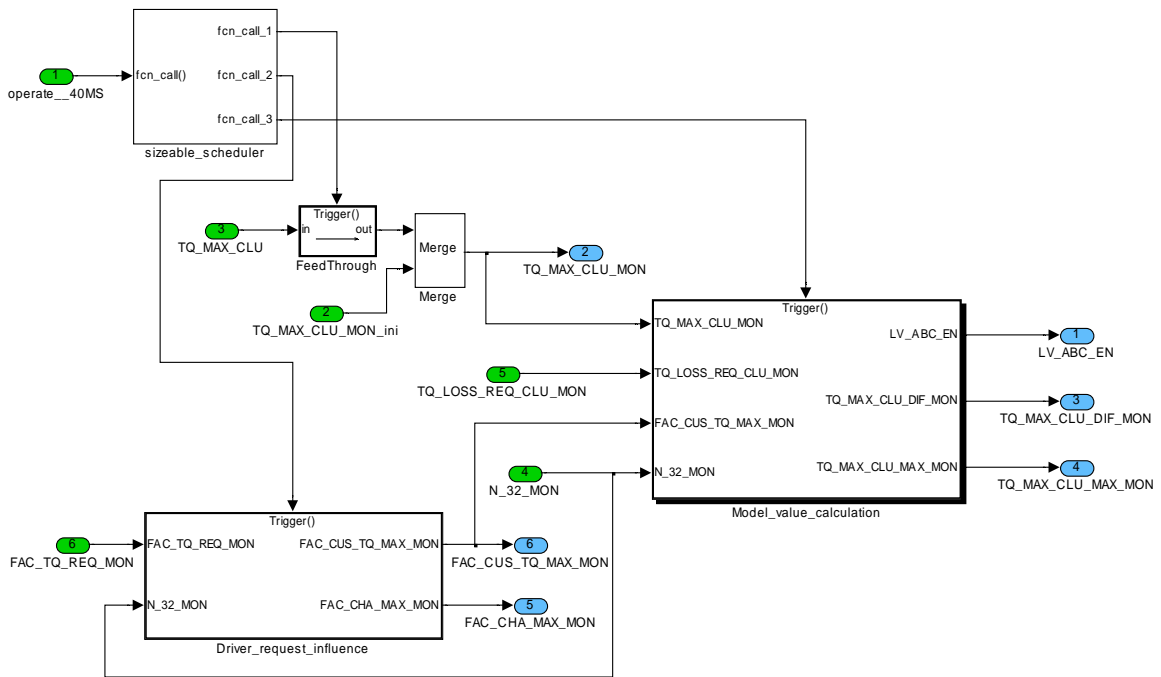


Figure E.19.3: ECM2\_DTSYSTQMAX/Operate

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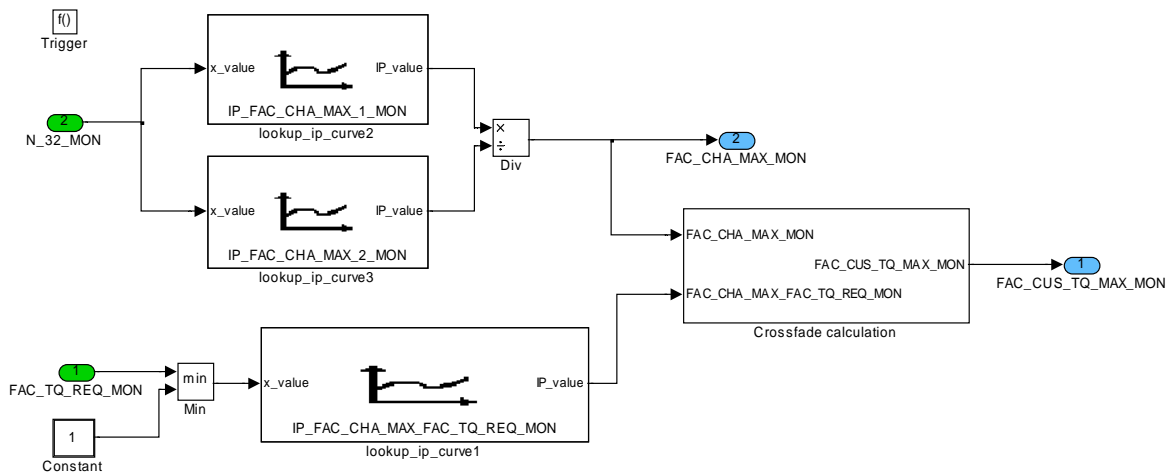


Figure E.19.4: ECM2\_DTSYSTQMAX/Operate/Driver\_request\_influence

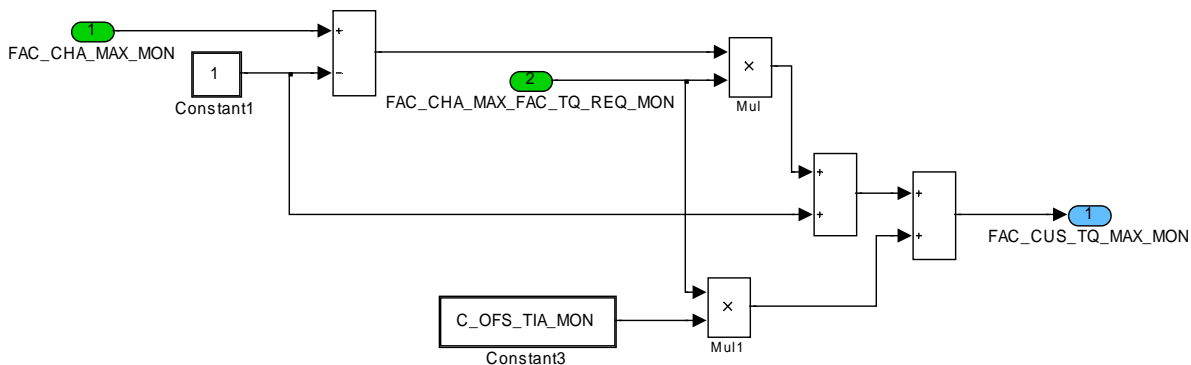


Figure E.19.5: ECM2\_DTSYSTQMAX/Operate/Driver\_request\_influence/Crossfade calculation

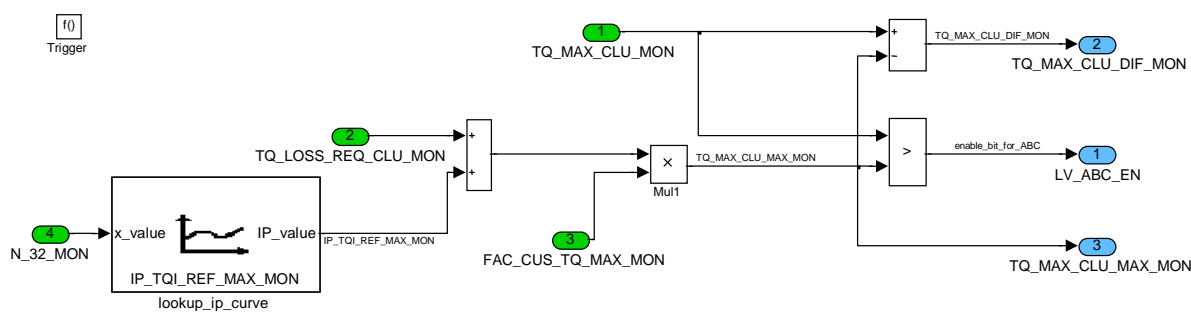


Figure E.19.6: ECM2\_DTSYSTQMAX/Operate/Model\_value\_calculation

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## E.20 Monitoring of mass fuel flow signal

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_LAMB_DIF_NEG_MON	V	0... FFH	0... 255	1	-
Anti bounce counter LAMB_DIF too small					
ABC_LAMB_DIF_POS_MON	V	0... FFH	0... 255	1	-
Anti bounce counter LAMB_DIF too high					
ABC_MFF_NOT_AFS_MON	V	0... FFH	0... 255	1	-
Anti bounce for fault in MFF signal (not AFS-mode)					
ABC_TPS_RATIO_MON	V	0... FFH	0... 255	1	-
Anti bounce counter TPS ratio diagnosis error					
LAMB_DIF_FIL_MON	V	8000... 7FFFH	-32... 31.9990234375	976.563e-6	-
Deviation between actual and modeled Lambda (low pass filtered)					
LAMB_DIF_NEG_MON	V	8000... 7FFFH	-32... 31.9990234375	976.563e-6	-
allowed negative LAMB_DIF threshold					
LAMB_DIF_POS_MON	V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
allowed positive LAMB_DIF threshold					
LV_ERR_MFF_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for error in mass fuel flow signal					
LV_ERR_TPS_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for different TPS diagnosis between L1 and L2					
LV_SWI_AFS_MFF_MAX_MON	V	0... 1H	0 ...1	1	-
allowed maximum number of transitions to AFS mode exceeded					
LV_SWI_AFS_MFF_MON	O/V	0... 1H	0 ...1	1	-
Flag for switching to AFS mode					
T_ACT_SWI_AFS_MFF_MON	V	0... FFFFH	0... 2621.4	0.04	s
active time for switch to AFS mode					
V_TPS_AD_1_MON	V	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Adapted TPS signal channel 1					
V_TPS_AD_2_MON	V	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Adapted TPS signal channel 2					

### Input data:

C_FAC_MFF_MAF_MON {p. 6777}	LAMB_DIF_MON {p. 6777}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_MDL_MON {p. 6777}
LV_ERR_FUP {p. 4717}	LV_ERR_MAP {p. 982}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}
LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}	LV_LAMB_LS_UP_VLD_ MON [NC_CBK_EX_NR] {p. 6790}
LV_TQI_MON_ACT_MON {p. 6791}	MAF_MON {p. 6777}	MFF_LAMB_MON {p. 6760}	N_32_MON {p. 7002}

OPM_AV_MON {p. 6792}	STATE_ERR_IV {p. 4803}	TQI_SP_MON {p. 6851}	V_TPS_1_MON {p. 6795}
V_TPS_2_MON {p. 6795}	V_TPS_AD_EL_BOL_1 {p. 4952}	V_TPS_AD_EL_BOL_2 {p. 4952}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_LAMB_DIF_NEG_MON	-	0... FFH	0... 255	1	-
ABC increment in case of act. Lambda smaller than reference Lambda					
C_ABC_INC_LAMB_DIF_POS_MON	-	0... FFH	0... 255	1	-
ABC increment in case of act. Lambda greater than reference Lambda					
C_ABC_INC_MFF_NOT_AFS_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment in case of MFF error (not AFS-mode)					
C_ABC_INC_TPS_RATIO_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment (additive value in case of ratio diagnosis error)					
C_ABC_MAX_LAMB_DIF_NEG_AFS_MON	-	1... FFH	1... 255	1	-
Value at which negative LAMB_DIF error is recognised, when reached (AFS-mode)					
C_ABC_MAX_LAMB_DIF_NEG_S_MON	-	1... FFH	1... 255	1	-
Value at which negative LAMB_DIF error is recognised, when reached (not AFS-mode)					
C_ABC_MAX_LAMB_DIF_POS_MON	-	1... FFH	1... 255	1	-
Value at which positive LAMB_DIF error is recognised, when reached					
C_ABC_MAX_MFF_NOT_AFS_MON	-	1... FFH	1... 255	1	-
Value at which MFF error is recognised. when reached (not AFS-mode)					
C_ABC_MAX_TPS_RATIO_MON	-	1... FFH	1... 255	1	-
Value at which ratio diagnosis error is recognized. when reached					
C_CRLC_LAMB_DIF_MON	-	0... FFH	0... 0.99609375	3.90625e-3	-
correlation constant for LAMB_DIF filter					
C_CTR_MAX_SWI_AFS_MFF_MON	-	0... FFH	0... 255	1	-
maximum number of transitions to AFS mode					
C_N_MIN_TPS_DIAG_MON	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for diagnosis of TPS ratio error					
C_T_ACT_SWI_AFS_MFF_MON	-	0... FFFFH	0... 2621.4	0.04	s
time out threshold for canceling AFS mode					
C_V_TPS_RATIO_HYS_MON	-	0... FFH	0... 4.98046875	0.0195313	V
Maximum TPS ratio error allowed					
IP_LAMB_DIF_ADD_1_MON	V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDP_N_32_MON_IP_LAMB_DIF_MON	4	0... FFH	0... 8160	32	rpm
LDP_TQI_SP_MON_IP_LAMB_DIF_MON	4	0... FFH	0... 510	2	Nm
map for expanding the allowed LAMB_DIF threshold based on TQI_SP_MON and N_32_MON					
IP_LAMB_DIF_ADD_2_MON	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDP_MFF_MON_IP_LAMB_DIF_ADD_MON	4	0... FFFFH	0... 1389	0.0211948	mg/stk
map for expanding the allowed LAMB_DIF threshold based on MFF					
IP_LAMB_DIF_NEG_MON	-	0... FFFFH	-32... 31.9990234375	976.563e-6	-



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_LAMB_MON_IP_LAMB_DIF_MON	8	0... 7FFFH	0... 31.9990234375	976.563e-6	-
map for allowed negative LAMB_DIF threshold					
IP_LAMB_DIF_POS_MON	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDPM_LAMB_MON_IP_LAMB_DIF_MON	8	0... 7FFFH	0... 31.9990234375	976.563e-6	-
map for allowed positive LAMB_DIF threshold					
LC_LAMB_SEL_MON	-	0... 1H	0 ...1	1	-
logical constant for selection of lambda value					
LC_RST_SWI_AFS_MFF_MON	-	0... 1H	0 ...1	1	-
Switch to disable LV_SWI_AFS_MFF_MON					

## General Information

ACTION\_ECM3\_Service18TaskPfm(IN<>)

ACTION\_ECM3\_Service19TaskPfm(IN<>)

ACTION\_ECM3\_Service20TaskPfm(IN<>)

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 2.

ACTION\_ECM3\_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION\_ECM3\_Service18TaskPfm() and ACTION\_ECM3\_Service19TaskPfm().

ACTION\_ECM3\_WriteChkCpl(INOUT <>, OUT <>, IN <>)


ACTION\_ECM3\_ChkCpl(IN <>, IN <>)

ACTION\_ECM3\_ReadChkCpl(OUT <>, IN <>, IN <>)

Note: These actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode 0 and history variables in modules of the Process Monitoring have to be checked by the cyclical RAM test.

General information:

The variable MFF\_TQ\_MON (represented via LAMB\_DIF\_MON) is needed for calculation of TQI\_AV\_MON. The modul checks the plausibility of MFF\_TQ\_MON (calculated in "Actual fuel mass flow"). Therefore LAMB\_DIF\_MON (actual Lambda reference Lambda) is checked against borders dependent on

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actual Lambda. The critical case will be, if LAMB\_DIF\_MON gets to small in nonAFS\_mode (equivalent to acceleration). Additionally, LV\_ERR\_... coming from Level 1 are considered. If there is an implausible state during non AFSmode, OPM will be switched to AFS first.

An additional TPS ratio check is performed. This function checks if any TPS failure has been detected in level 1 when a TPS ratio error is recognized in level 2.

Hint!! Application Conditions - Initialisation: for condition see 'Application incidences of process monitoring'

### Application Conditions


Initialization: RST

Recurrence: 40MS

Activation: LV\_TQI\_MON\_ACT\_MON

Deactivation: !LV\_TQI\_MON\_ACT\_MON

### Function description

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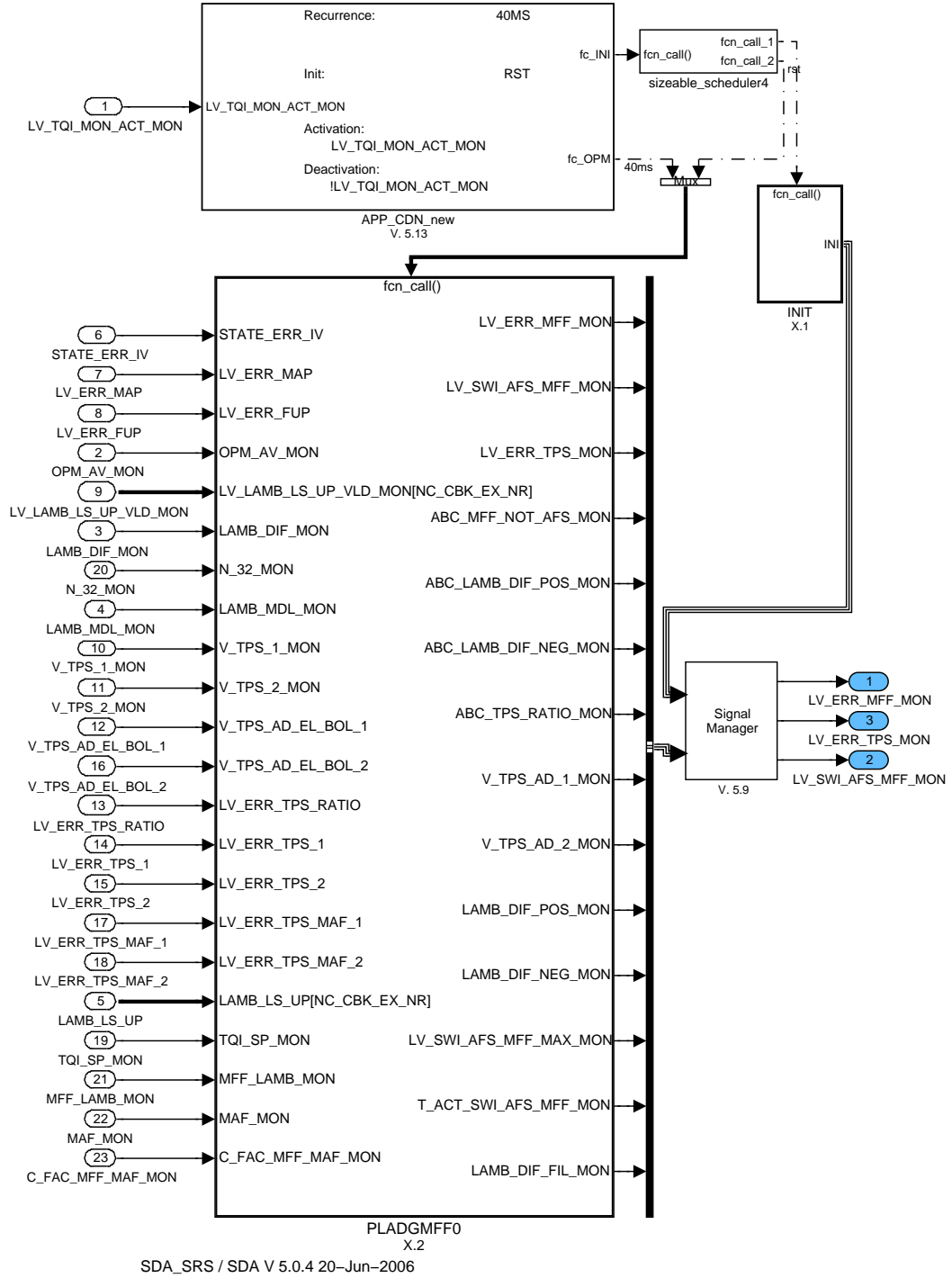


Figure E.20.1: : Path: ECM2\_PLADGMFF0

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## E.20.1 ECM2\_PLADGMFF0/INIT

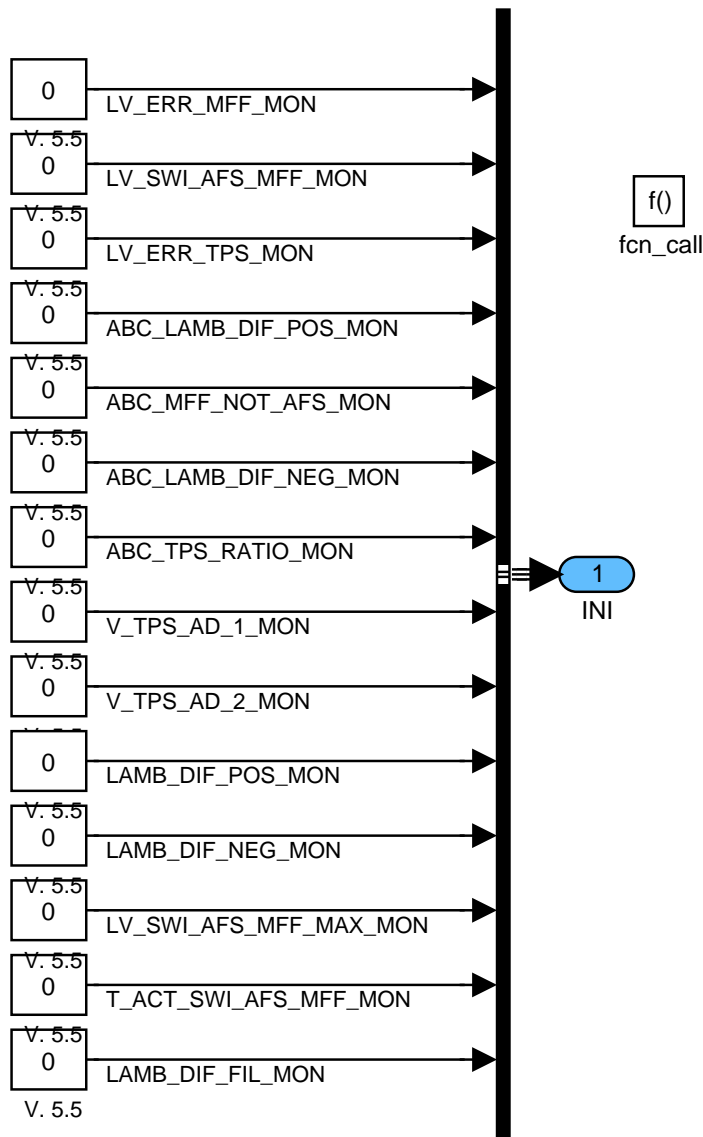


Figure E.20.2: : Path: ECM2\_PLADGMFF0/INIT

### E.20.2 ECM2\_PLADGMFF0/PLADGMFF0

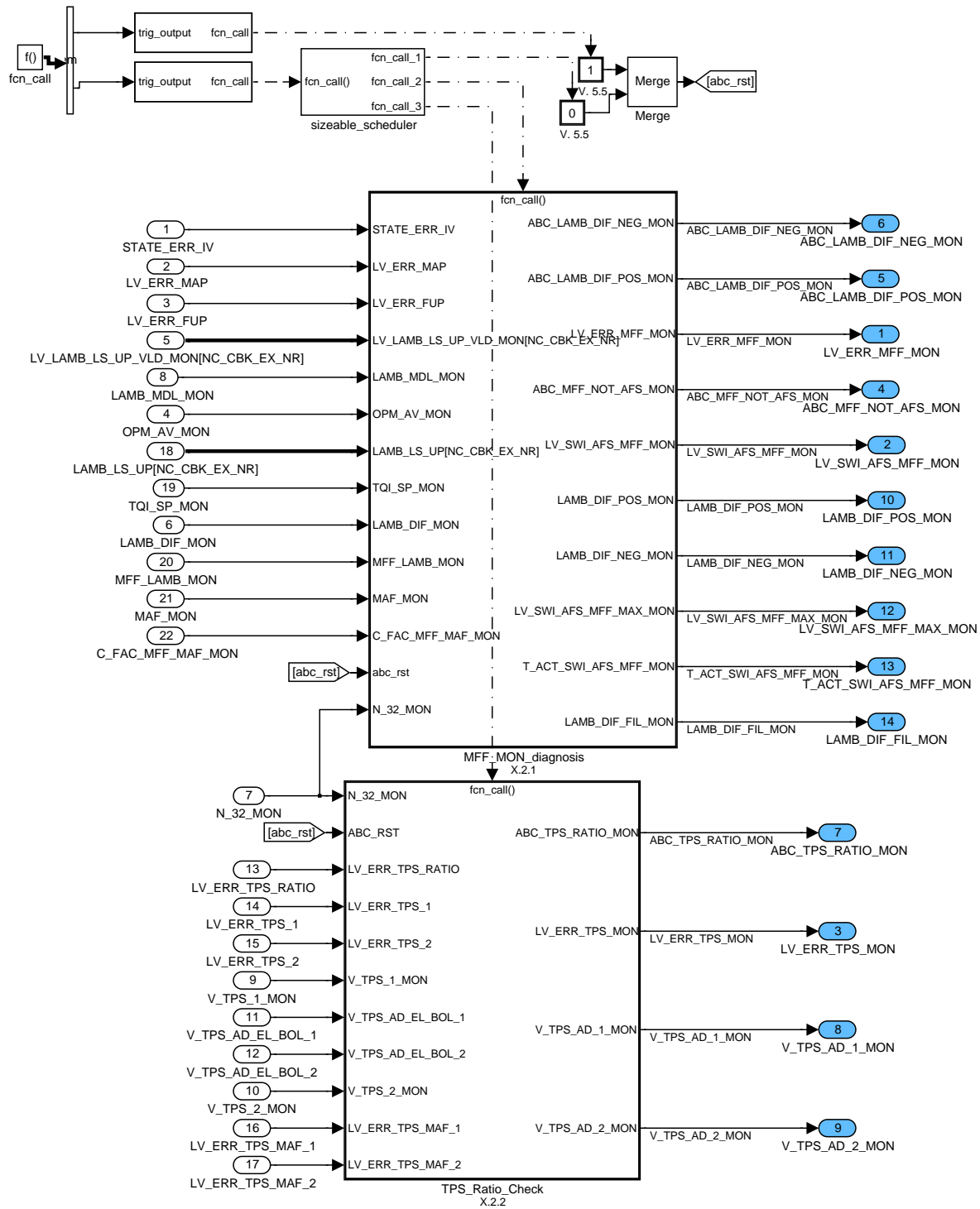
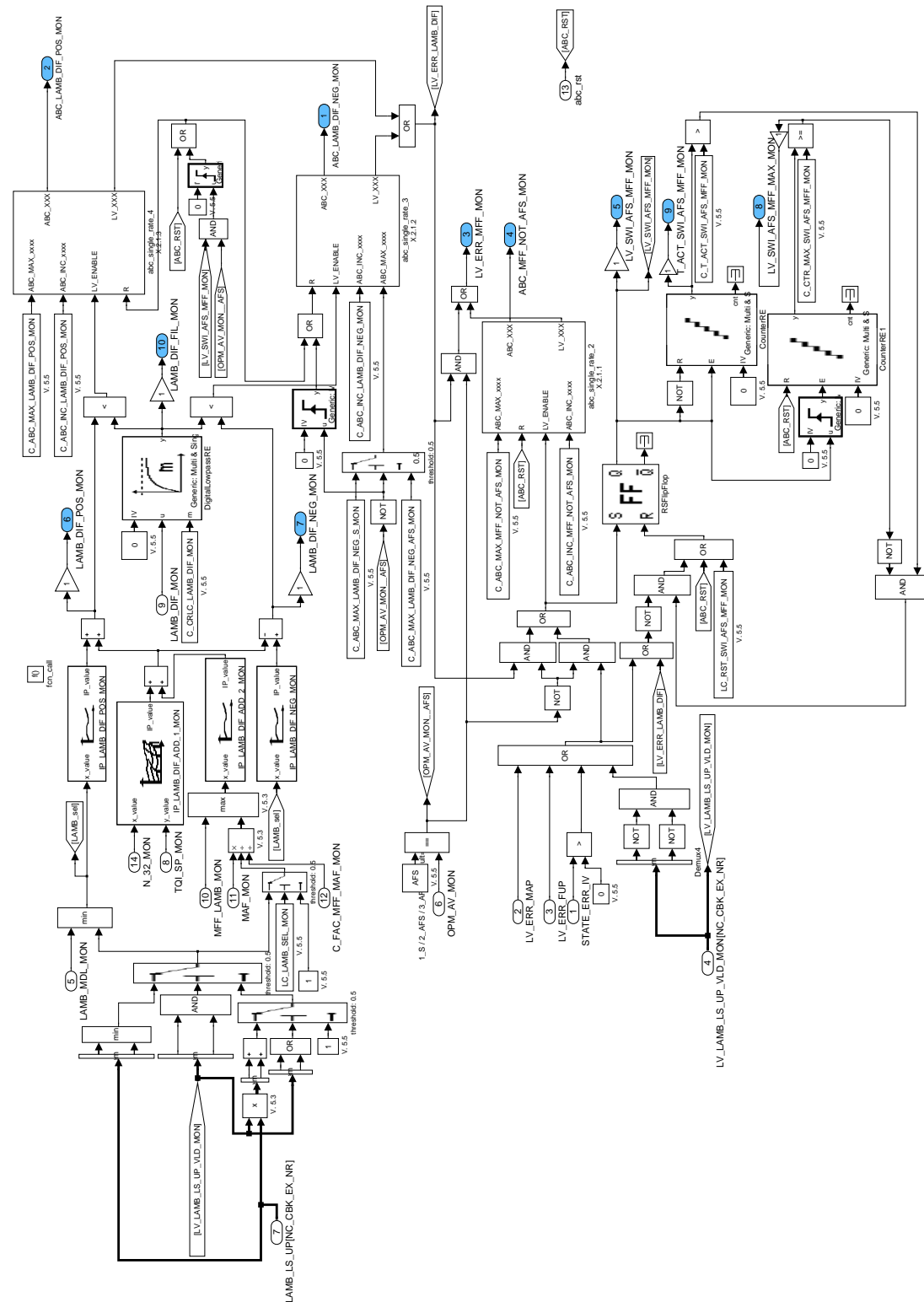


Figure E.20.3: : Path: ECM2\_PLADGMFF0/PLADGMFF0


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E.20.2.1 ECM2\_PLADGMFF0/PLADGMFF0/MFF\_MON\_DIAGNOSIS



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Figure E.20.4: : Path: ECM2\_PLADGMFF0/PLADGMFF0/MFF\_MON\_diagnosis

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### E.20.2.2 ECM2\_PLADGMFF0/PLADGMFF0/TPS\_RATIO\_CHECK

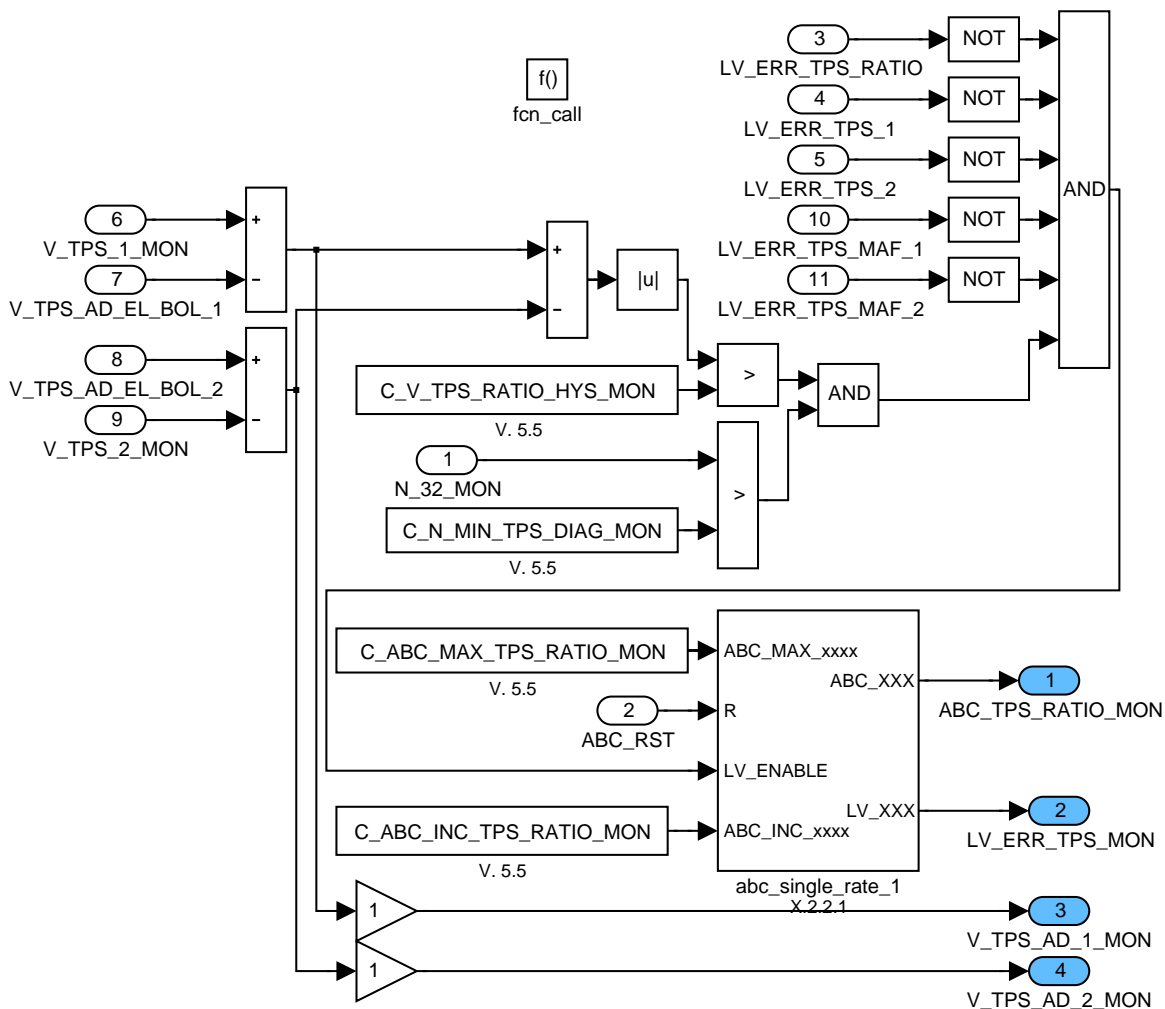


Figure E.20.5: : Path: ECM2\_PLADGMFF0/PLADGMFF0/TPS\_Ratio\_Check

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## E.21 Monitoring of minimum torque at clutch

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_TQ_MIN_CLU_MON	V	0... FFH	0... 255	1	-
Anti bounce counter for monitoring of minimum torque at clutch					
CTR_DLY_TQ_ST_MON	V	0... FFH	0... 10.2	0.04	s
Delay time counter for holding start torque influence					
FAC_N_SP_IS_RATIO_MON	V	8000... 7FFFH	-8... 7.99975	244.1e-6	-
Model of control factor for engine self-stabilising effect					
LV_ERR_TQ_MIN_CLU_MON	O/V	0... 1H	0 ...1	1	-
Fault currently present in torque generation, symptom "minimum torque at clutch"					
STATE_ERR_TQ_MIN_CLU_MON	O/V	0H 1H 2H	NO_ERROR ERROR_ PATH1 ERROR_ PATH2	-	-
State variable indicating origin of error resulting from monitoring of L1 torque value					
TQ_MIN_CLU_DIF_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
difference of monitored and modelled minimum torque at clutch					
TQ_MIN_CLU_MDL_2_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Temporary variable 2 for calculation of modelled minimum torque at clutch					
TQ_MIN_CLU_MDL_5_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Temporary variable 4 for calculation of modelled minimum torque at clutch					
TQ_MIN_CLU_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
monitored minimum torque at clutch					
TQ_ST_MON	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
modelled value of start torque					

### Input data:

LV_SWI_TQ_MIN_CLU_MON {p. 6791}	LV_TQ_MIN_CLU {p. 8379}	LV_TQI_MON_ACT_MON {p. 6791}	N_32_MON {p. 7002}
N_SP_IS_RATIO_MON {p. 6792}	STATE_ERR_DET_TQ_MIN_MON {p. 6792}	TCO_MON {p. 6903}	TQ_ADD_MIN_CLU_MON {p. 6793}
TQ_CONV_MAX_MON {p. 6793}	TQ_DIF_I_IS_MON {p. 6921}	TQ_LOSS_MON {p. 6975}	TQ_LOSS_REQ_CLU_MON {p. 6975}
TQ_MIN_CLU {p. 8380}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TQ_MIN_CLU_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_TQ_MIN_CLU_MON	-	1... FFH	1... 255	1	-
Maximum of anti bounce counter					
C_DLY_TQ_ST_MON	-	0... FFH	0... 10.2	0.04	s
Time delay to hold influence of start torque on TQ_MIN_CLU model value					
C_N_ST_MAX_MON	-	0... FFH	0... 8160	32	rpm
maximum start end speed					
C_TQ_MIN_CLU_MDL_OFS_MON	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Offset for L2 model value of minimum torque at clutch					
IP_FAC_N_SP_IS_RATIO_MON	-	0... FFFFH	-8... 7.99975	244.1e-6	-
LDP_N_SP_IS_RATIO_MON_IP_MON	5	0... FFFFH	0... 7.99987	122.1e-6	-
Idle self stabilising factor					
IP_TQI_MIN_REQ_PU_MON	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDP_N_32_MON_IP_TQI_MIN_MON	6	0... FFH	0... 8160	32	rpm
LDP_TCO_MON_IP_TQI_MIN_PU_MON	4	0... FEH	-48... 142.5	0.75	°C
Minimum requested indicated torque in PU phase					

### Import actions:

ACTION_ECM3_Service12TaskPfm (IN<No Name available>)
ACTION_ECM3_Service13TaskPfm (IN<No Name available>)
ACTION_ECM3_Service14TaskPfm (IN<No Name available>)

## E.21.1 FUNCTION PART: ECM2\_DTSYSTQMIN

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The argument has the value 3.

ACTION\_ECM3\_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION\_ECM3\_Service12TaskPfm() and ACTION\_ECM3\_Service13TaskPfm().

ACTION\_ECM3\_WriteChkCpl(INOUT<>, OUT<>, IN <>)


ACTION\_ECM3\_ChkCpl(IN<>, IN<>)

ACTION\_ECM3\_ReadChkCpl(OUT <>, IN<>, IN<>)

Note: These actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode 0 and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

### General information:

The objective of this function is the monitoring of the minimum torque at clutch. The model takes into account that a great part of the minimum torque at clutch could be the integral part of the ISC. Therefore the difference of monitored minimum torque at clutch and lpart of ISC is compared to a torque *threshold*

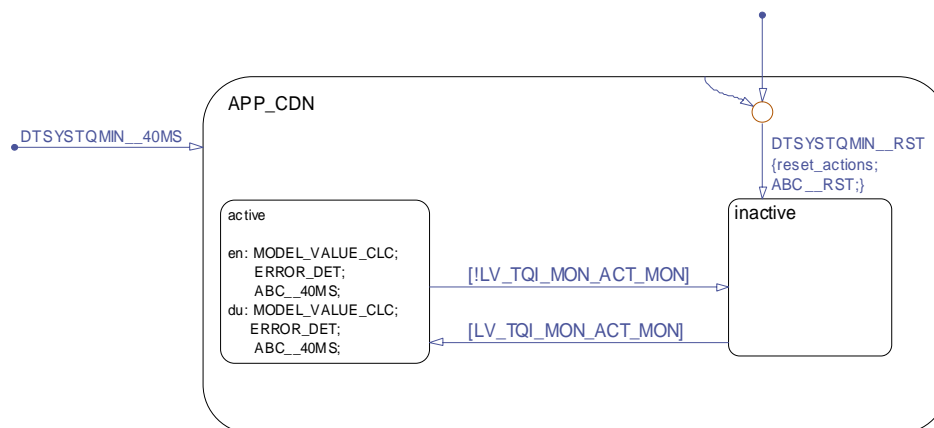
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which is dependent on: **1)** the engine self stabilising factor (function of ratio between engine speed and idle speed setpoint) **2)** TQ\_LOSS\_REQ\_CLU\_MON and **3)** TQ\_CONV\_MAX\_MON. For engine speeds above idle speed setpoint this difference must be negative. For speeds below idle speed setpoint great values for minimum torque at clutch are allowed.

One exception of the above mentioned rule is at engine start. If the engine is in start phase, an constant additive term is taken into account for the threshold (see also "Chapter D - Minimum Torque at Clutch"). To monitor this start torque term, the actual engine speed is compared to an upper threshold for the engine start endspeed. In addition to the lpart of ISC, the two other factors influencing the minimum torque at clutch are hydraulic torque losses inside the converter of an automatic gearbox TQ\_CONV\_MAX\_MON (which depends on coolant temperature and idle speed setpoint) and the minimum requested indicated torque in the PU phase TQI\_MIN\_REQ\_PU\_MON. However, if the engine is in PU or PUC mode TQ\_MIN\_CLU\_MDL is set to minimum possible torque that the driver can request i.e. TQ\_LOSS\_MON.

The plausibilisation of the L1 value, TQ\_MIN\_CLU, against a L2 model value is done based on current engine state. The variable STATE\_ERR\_DET\_TQ\_MIN\_MON (calculated in the module Application incidences of process monitoring ) is used to switch between the different error detection paths. If the engine is in PU or PUC and the L1 minimum torque at clutch value is greater than TQ\_LOSS\_MON, then an error state is set. If however the engine is neither in PU or PUC, then the L1 value is compared to the L2 model value TQ\_MIN\_CLU\_MDL\_4\_MON. If any of the error states are set, a fault is detected after debouncing.

## Application Conditions



**Initialisation(DTSYSTQMIN\_RST):** for condition see Application Incidences of Process Monitoring

## Function Description

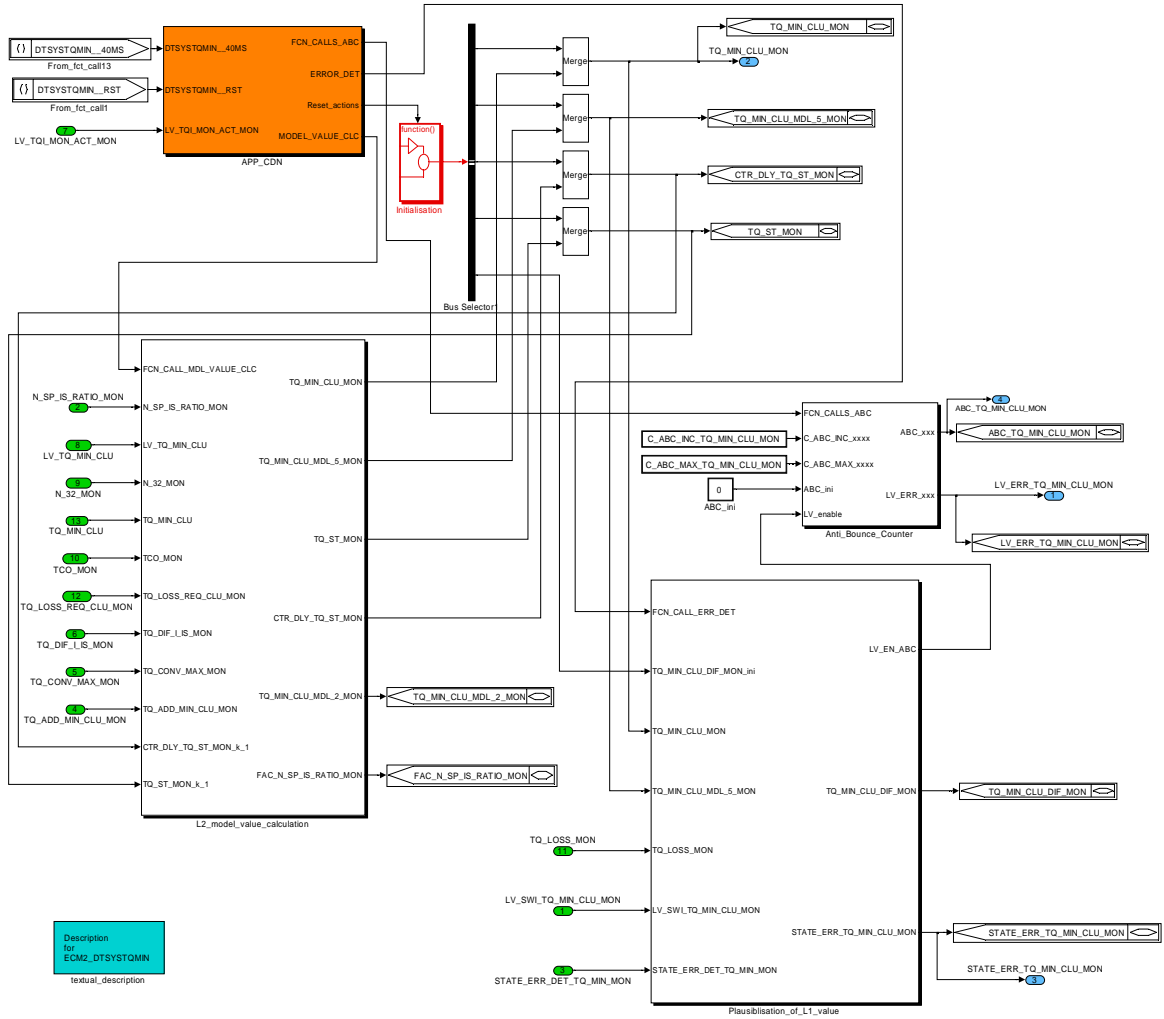


Figure E.21.1: ECM2\_DTSYSTQMIN

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f()  
function

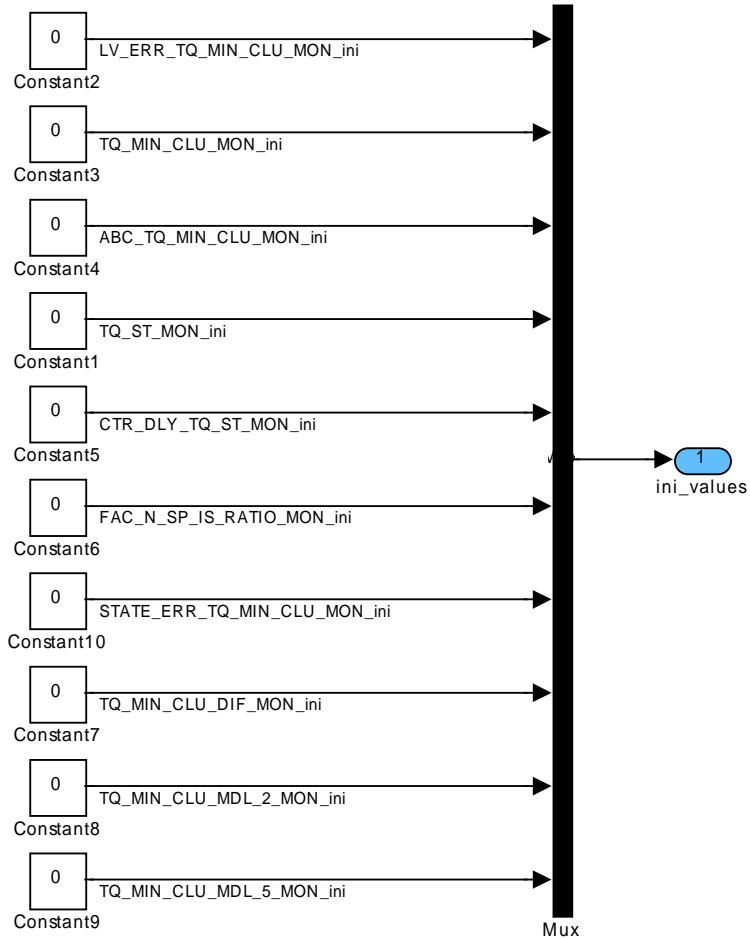


Figure E.21.2: ECM2\_DTSYSTQMIN/Initialisation

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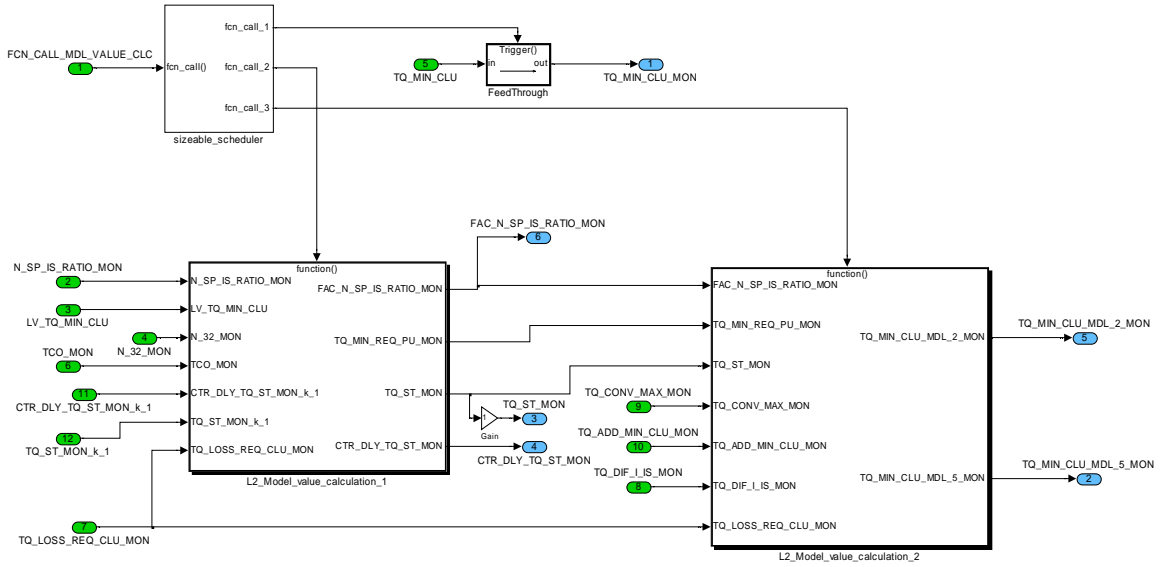


Figure E.21.3: ECM2\_DTSYSTQMIN/L2\_model\_value\_calculation

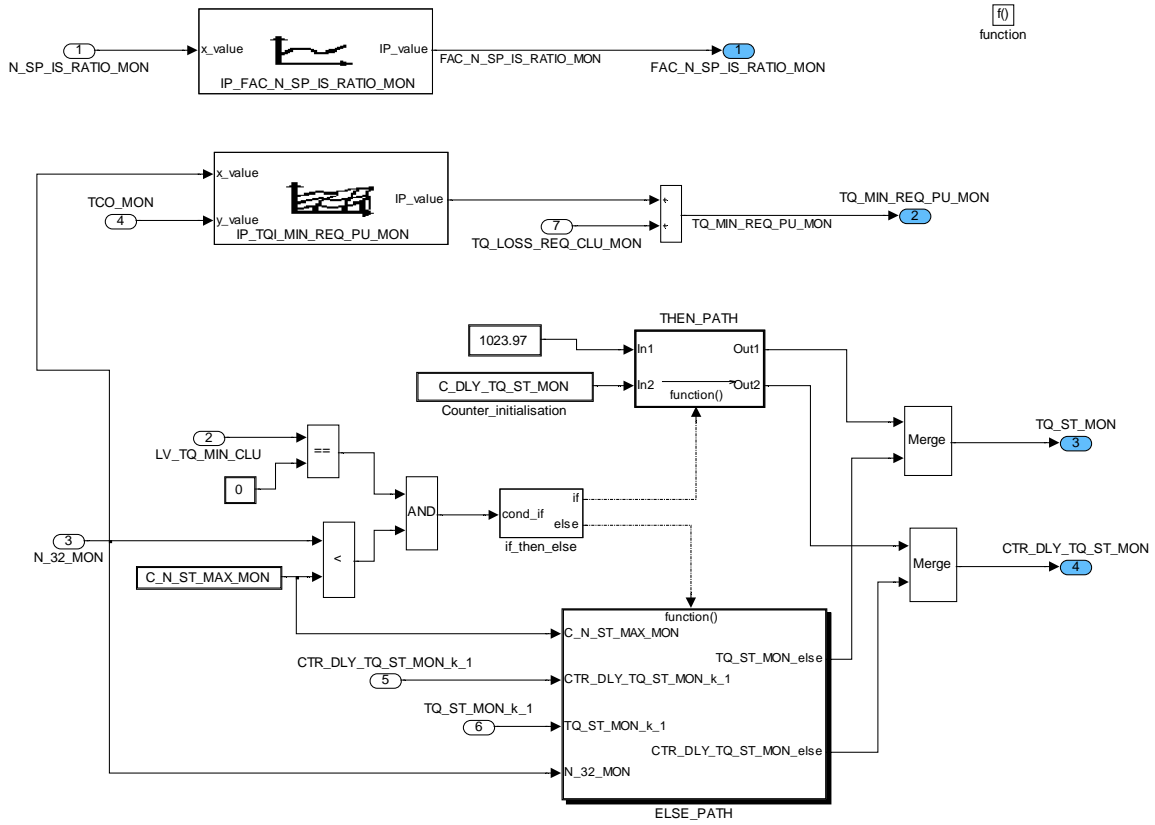


Figure E.21.4: ECM2\_DTSYSTQMIN/L2\_Model\_value\_calculation /L2\_Model\_value\_calculation\_1

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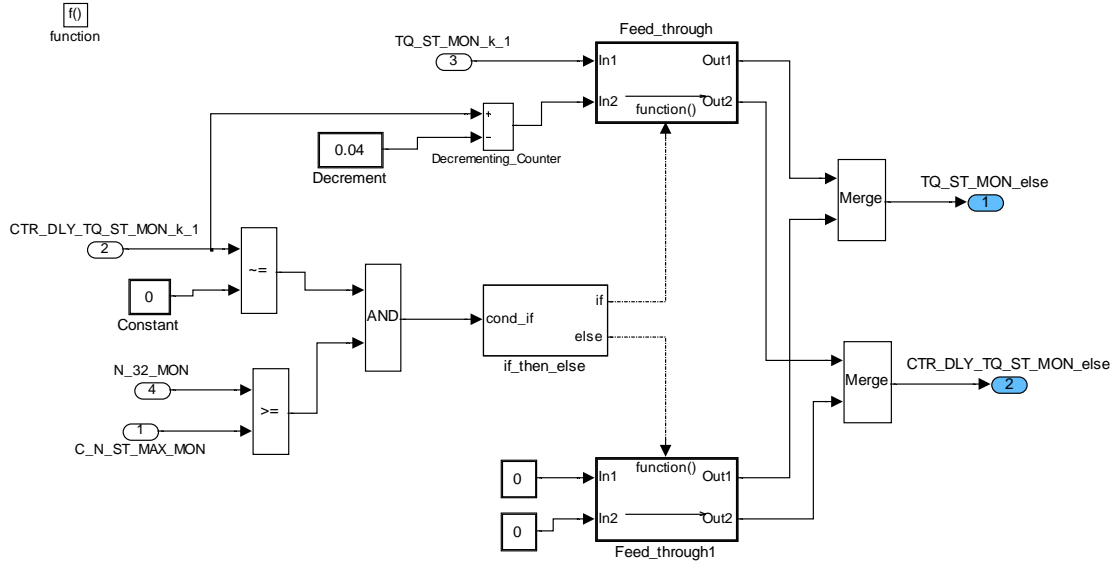


Figure E.21.5: ECM2\_DTSYSTQMIN/L2\_Model\_value\_calculation\_1/ELSE\_path

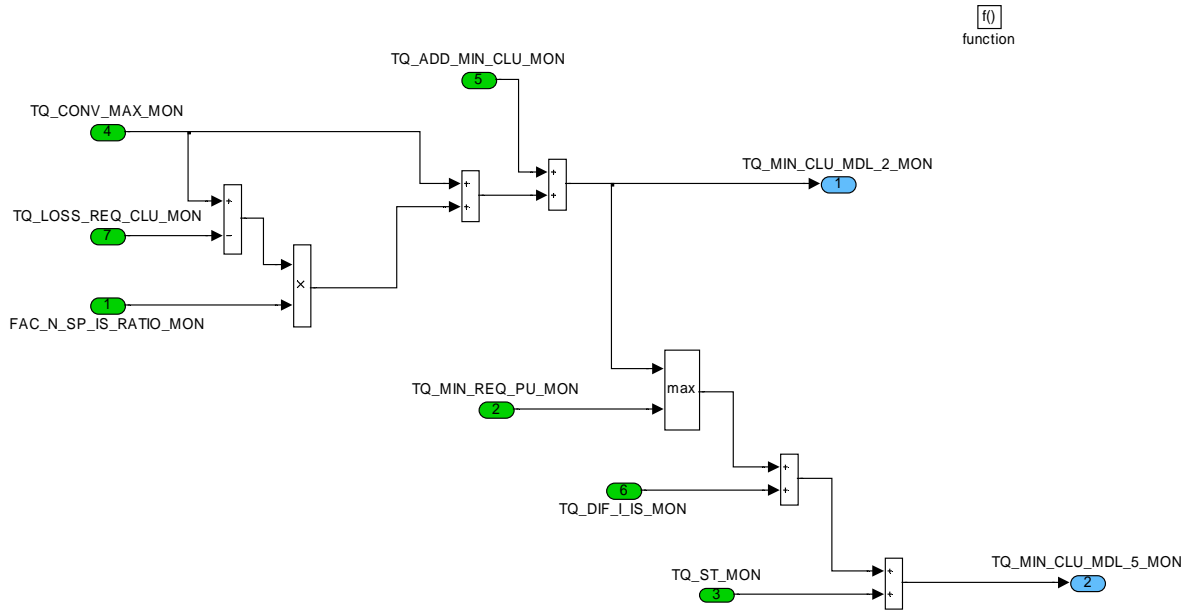


Figure E.21.6: ECM2\_DTSYSTQMIN/L2\_model\_value\_calculation/L2\_Model\_value\_calculation\_2

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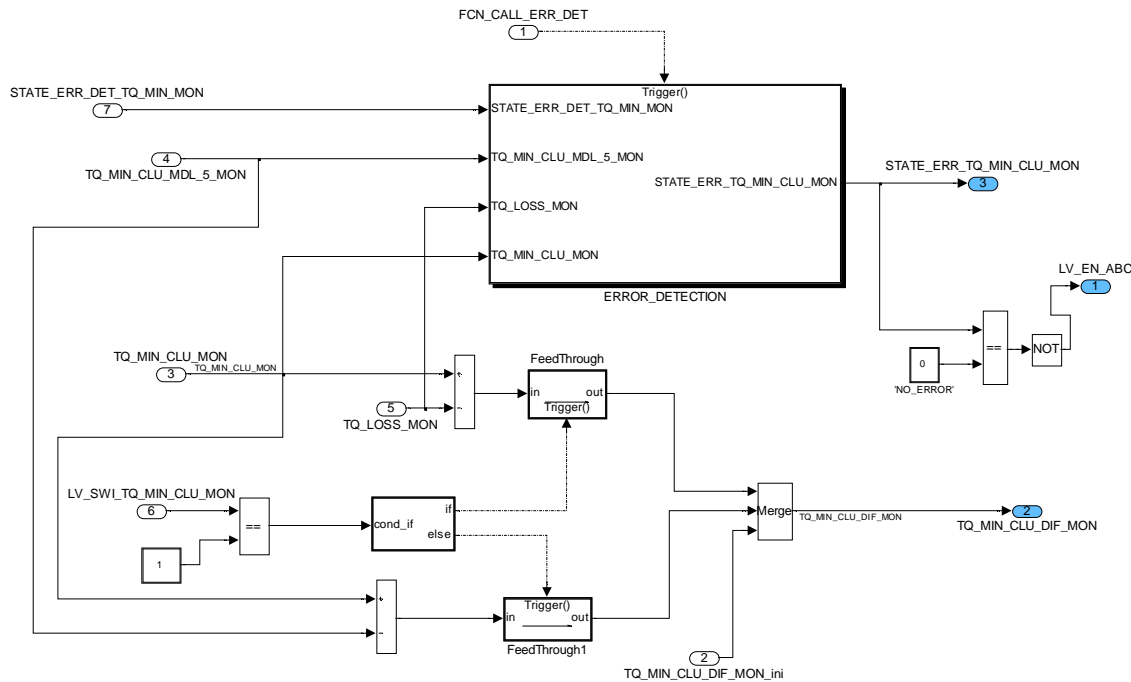


Figure E.21.7: ECM2\_DTSYSTQMIN/Plausibilisation\_of\_L1\_value

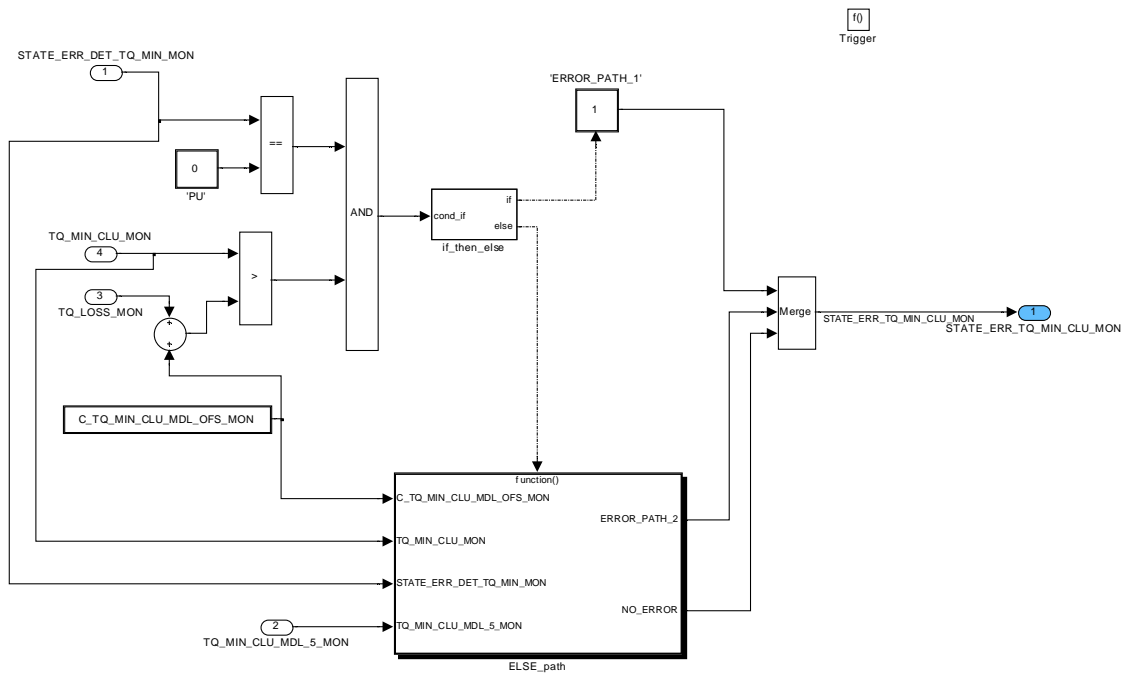


Figure E.21.8: ECM2\_DTSYSTQMIN/Plausibilisation\_of\_L1\_value /ERROR\_DETECTION

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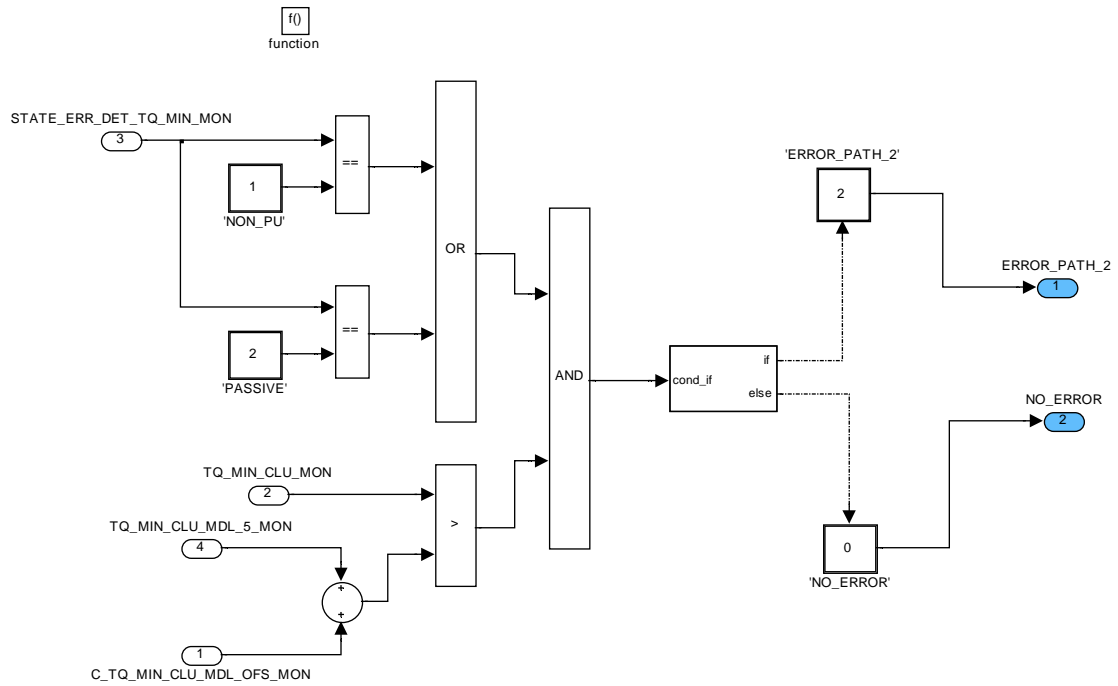


Figure E.21.9: ECM2\_DTSYSTQMIN/Plausibilisation\_of\_L1\_value/ERROR\_DETECTION/ELSE\_path

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## E.22 Monitoring of pedal value signal

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_PVS_RATIO_MON	O/V	0... FFH	0... 255	1	-
Anti bounce counter PVS ratio error					
FAC_V_SLOP_PVS_MON	V	0... FFH	0... 3.984375	0.015625	-
Factor for correction of slop of channel 2 in ratio check					
LV_ERR_PVS_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for different PVS diagnosis between L1 and L2					
LV_ERR_PVS_RATIO_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for ratio error between PVS channel 1 and 2					
PV_AV_1_MON	V	0... FFH	0... 99.609375	0.390625	%
Degree of activation of the accelerator pedal (channel 1)					
PV_AV_2_MON	V	0... FFH	0... 99.609375	0.390625	%
Degree of activation of the accelerator pedal (channel 2)					
PV_AV_MON	O/V	0... FFH	0... 99.609375	0.390625	%
Level 2 degree of activation of the accelerator pedal					
V_PVS_1_MON	O/V	0... 3FFH	0... 4.995117	0.00488281	V
Pedal value sensor 1 raw acquisition					
V_PVS_2_MON	O/V	0... 3FFH	0... 4.995117	0.00488281	V
Pedal value sensor 1 raw acquisition					

### Input data:

LV_BRAKE_MON {p. 6790}	LV_ERR_PVS_1 {p. 4216}	LV_ERR_PVS_2 {p. 4216}	LV_ERR_PVS_RATIO {p. 4216}
LV_ERR_VCC_PVS_1_MON {p. 6790}	LV_ERR_VCC_PVS_2_MON {p. 6790}	LV_ERR_VCC_PVS_MON {p. 6790}	LV_IGK_MON {p. 6790}
N_32_MON {p. 7002}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_PVS_RATIO_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment (additive value in case of error)					
C_ABC_MAX_PVS_RATIO_MON	-	1... FFH	1... 255	1	-
Value at which ratio error is recognized, when reached					
C_N_MIN_PVS_DIAG_MON	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for PVS diagnosis					
C_PV_LIH_MAX_MON	-	0... FFH	0... 99.609375	0.390625	%
Max. pedal position on case of any PVS error					
C_V_PVS_IS_THD_1_MON	-	0... 3FFH	0... 4.995117	0.00488281	V
Threshold for idle speed PVS channel 1					
C_V_PVS_IS_THD_2_MON	-	0... 3FFH	0... 4.995117	0.00488281	V
Threshold for idle speed PVS channel 2					
C_V_PVS_SLOP_1_MON	-	0... FFH	0... 79.6875	0.3125	%/V
Slope of the PVS channel 1					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_V_PVS_SLOP_2_MON	-	0... FFH	0... 159.375	0.625	%/V
Slope of the PVS channel 2					
IP_V_THD_RATIO_CHK_PVS_MON	-	0... FFH	0... 4.98046875	0.01953125	V
LDP_V_MIN_PV_MON_IP_V_PVS_MON	6	0... FFH	0... 4.98046875	0.01953125	V
Maximum PV ratio error allowed					

### Import actions:

ACTION_ECM3_Service3TaskPfm (IN<PRM_K>)
ACTION_ECM3_Service4TaskPfm (IN<PRM_K>)
ACTION_ECM3_Service5TaskPfm (IN<PRM_K>)

## E.22.1 ECM2\_DTSYSPVS

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 2.

ACTION\_ECM3\_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION\_ECM3\_Service3TaskPfm() and ACTION\_ECM3\_Service4TaskPfm().

ACTION\_ECM3\_WriteChkCpl(INOUT <>, OUT <>, IN <>)

ACTION\_ECM3\_ChkCpl(IN <>, IN <>)

ACTION\_ECM3\_ReadChkCpl(OUT <>, IN <>, IN <>)

Note: All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

ACTION\_INFR\_GetVPVSMON(OUT<V\_PVS\_1\_MON>, OUT<V\_PVS\_2\_MON>)

Note: These actions is defined in IRS, it is responsible for providing voltages from PVS channel 1 & 2

### General information:


The pedal value diagnosis is made in the monitoring level in order to check the V\_PVS input value of the torque monitoring function (level 2).

After the diagnosis, a resulting pedal value PV\_AV\_MON is used as input for the torque monitoring function.

A malfunction of level 1 will be assumed, if a ratio error of the two redundant pedal values is diagnosed after debouncing, yet no PVS failure was detected previously by the PVS diagnosis function of level 1.

The following errors were detected:

The difference between the values V\_PVS\_1\_MON and V\_PVS\_2\_MON is too large.

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The diagnosis system of level 2 detects a PVS ratio fault and no fault is detected by the diagnosis of level 1.

Any PVS errorBIT of the PVS diagnosis in level 1 has been reset without permission.

To ensure that the PVS diagnosis of level 1 detects a fault earlier than the PVS ratio diagnosis of level 2, the fault detection time of the diagnosis function in level 2 has to be adjusted that it exceeds the fault detection time of level 1. Therefore, all level 1 PVS diagnosis thresholds, all constants of the debounce counters and the cycle time have to be taken into account.

### Application Condition

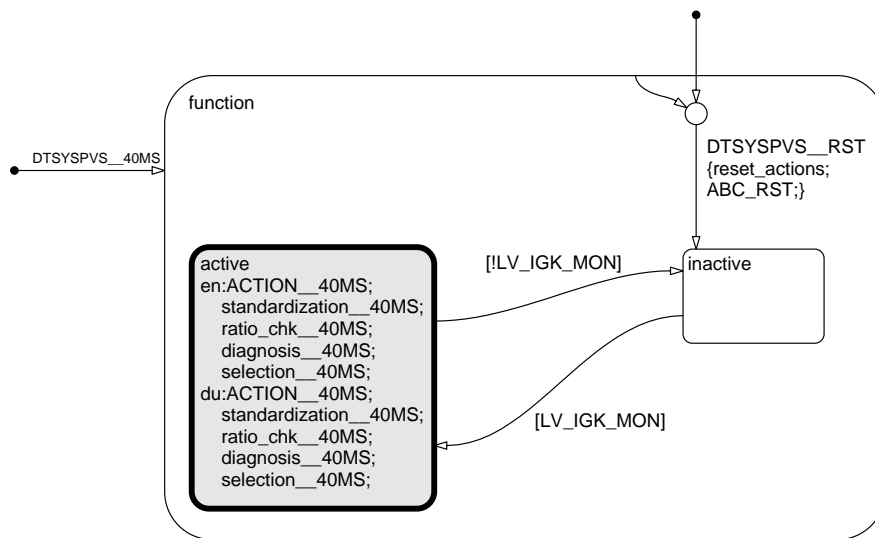


Figure E.22.1: ECM2\_DTSYSPVS/APP\_CDN/Chart

### Function Description

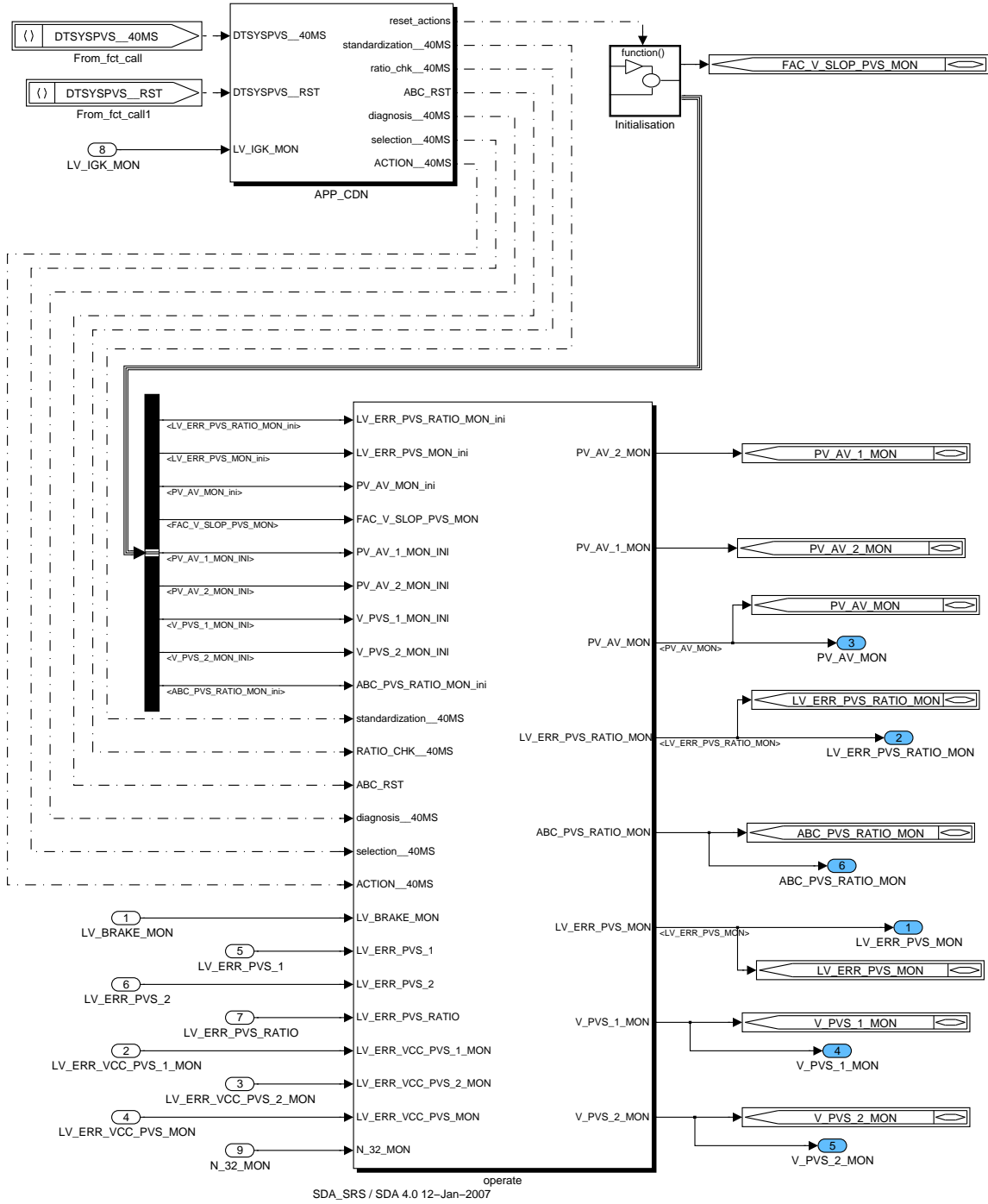


Figure E.22.2: ECM2\_DTSYSPVS

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### E.22.1.1 SUBFUNCTION: Initialisation

f()  
function

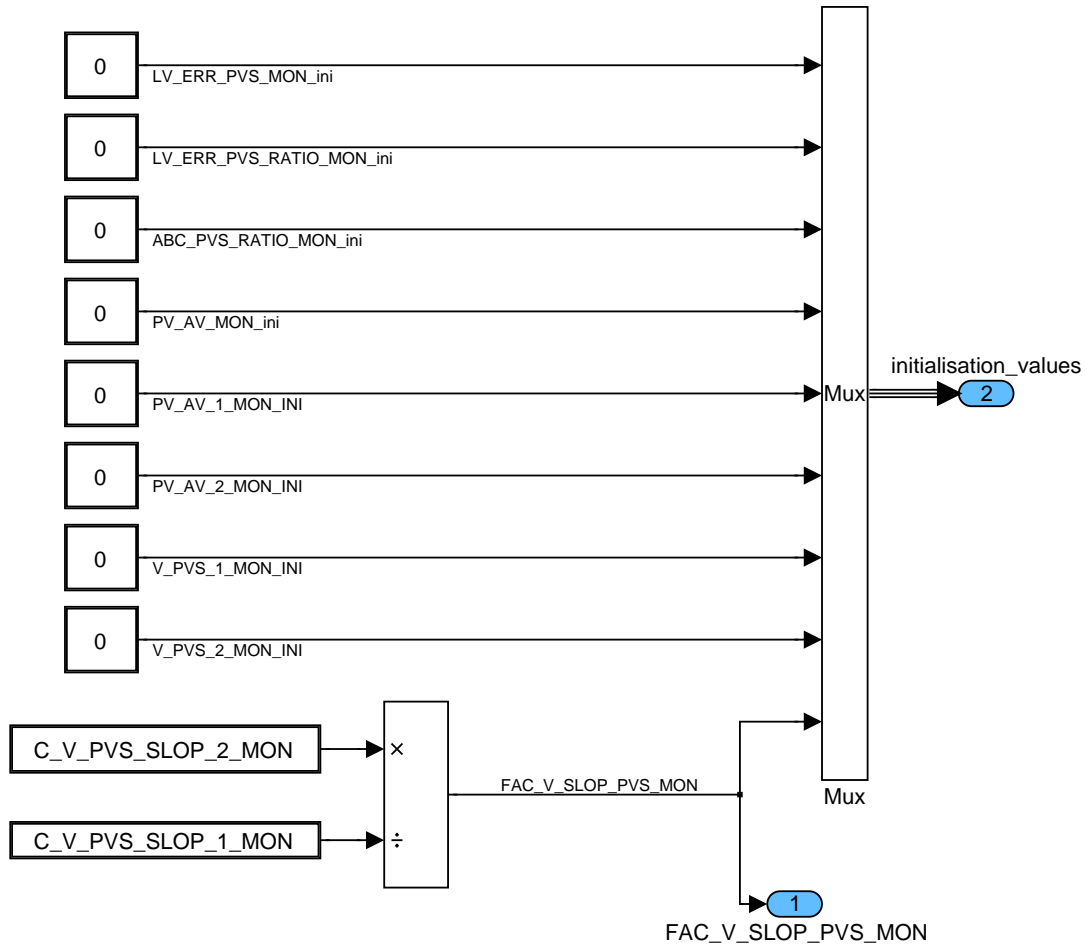


Figure E.22.3: ECM2\_DTSYSPVS/Initialisation

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### E.22.1.2 SUBFUNCTION: operate

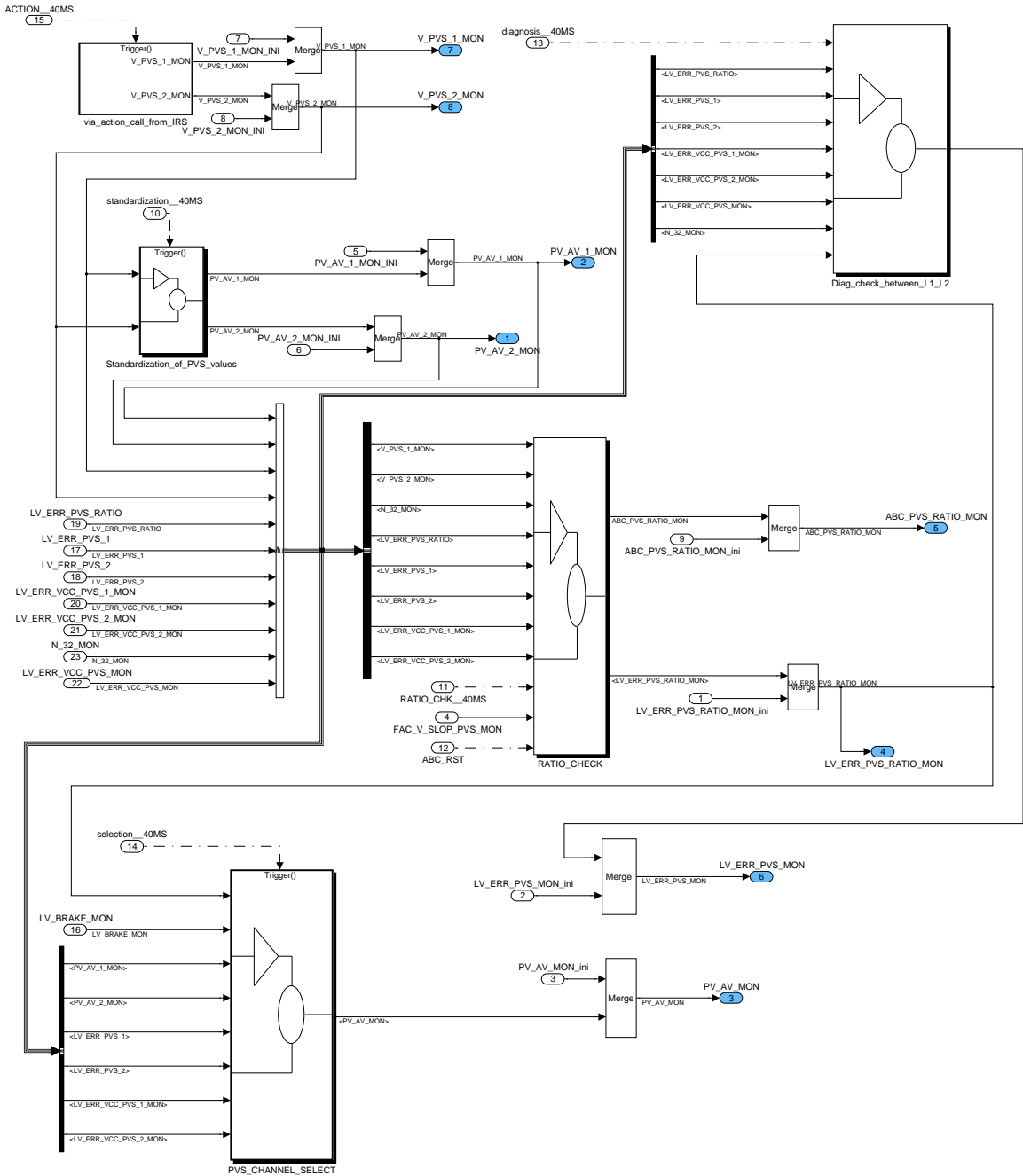


Figure E.22.4: ECM2\_DTSYSPVS/operate

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f() Trigger

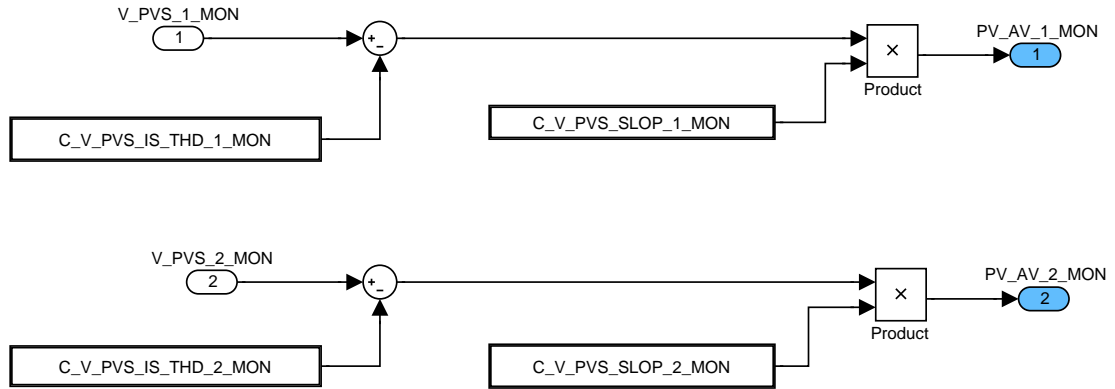



Figure E.22.5: ECM2\_DTSYSPVS/operate/Standardization\_of\_PVS\_values

**ECM2\_DTSYSPVS/OPERATE/RATIO\_CHECK**

In case of an error free system (no signal range error detected), the difference between V\_PVS\_1\_MON and V\_PVS\_2\_MON is not allowed to be greater than IP\_V\_THD\_RATIO\_CHK\_PVS\_MON.

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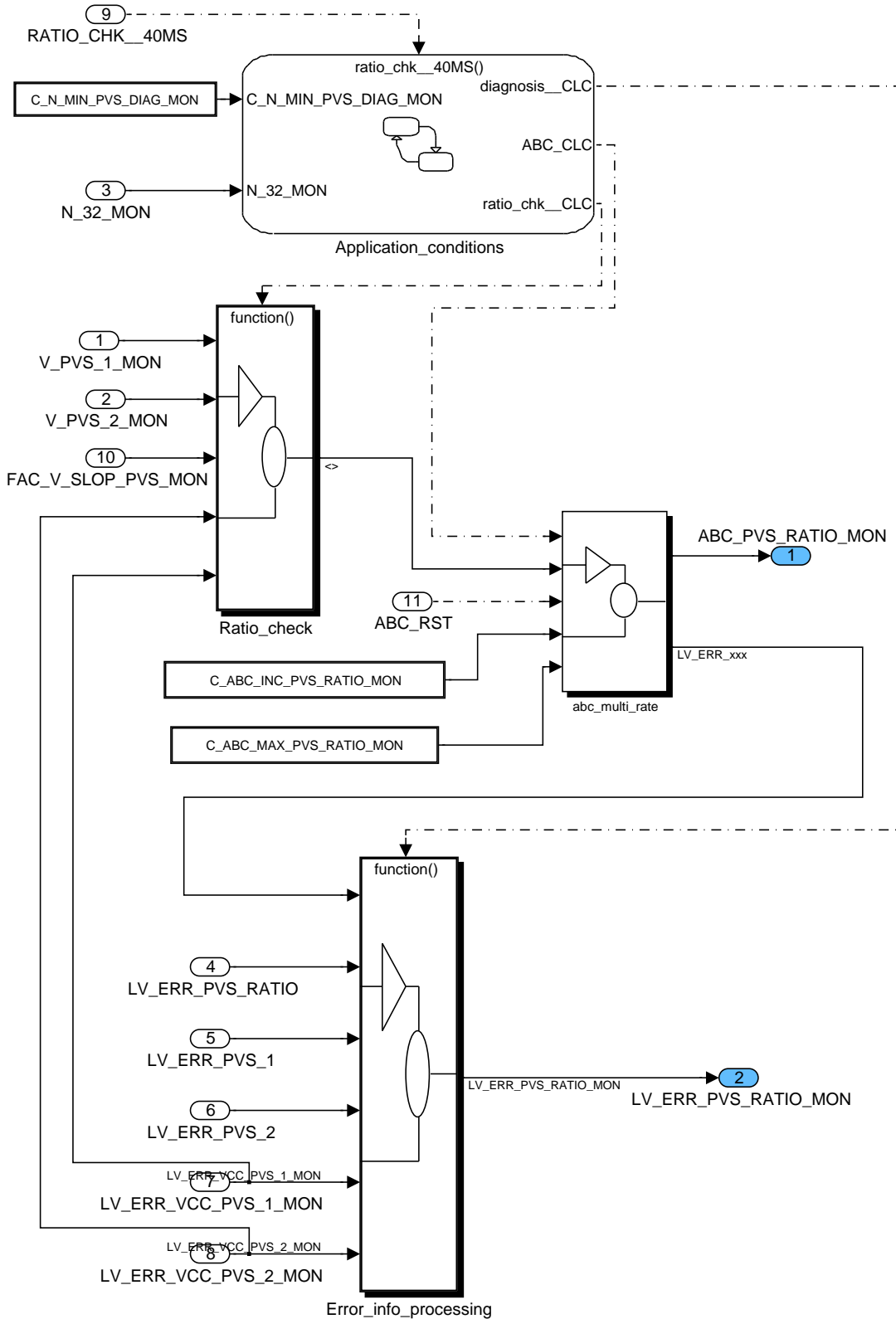


Figure E.22.6: ECM2\_DTSYSPVS/operate/RATIO\_CHECK

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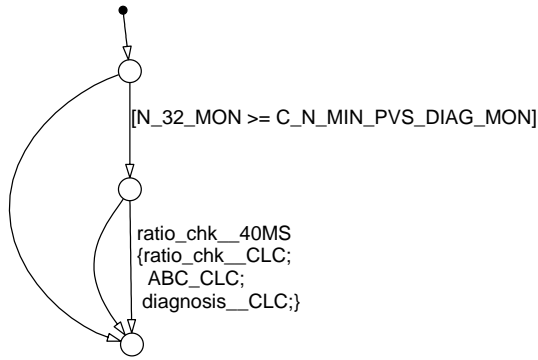


Figure E.22.7: ECM2\_DTSYSPVS/operate/RATIO\_CHECK/Application\_conditions

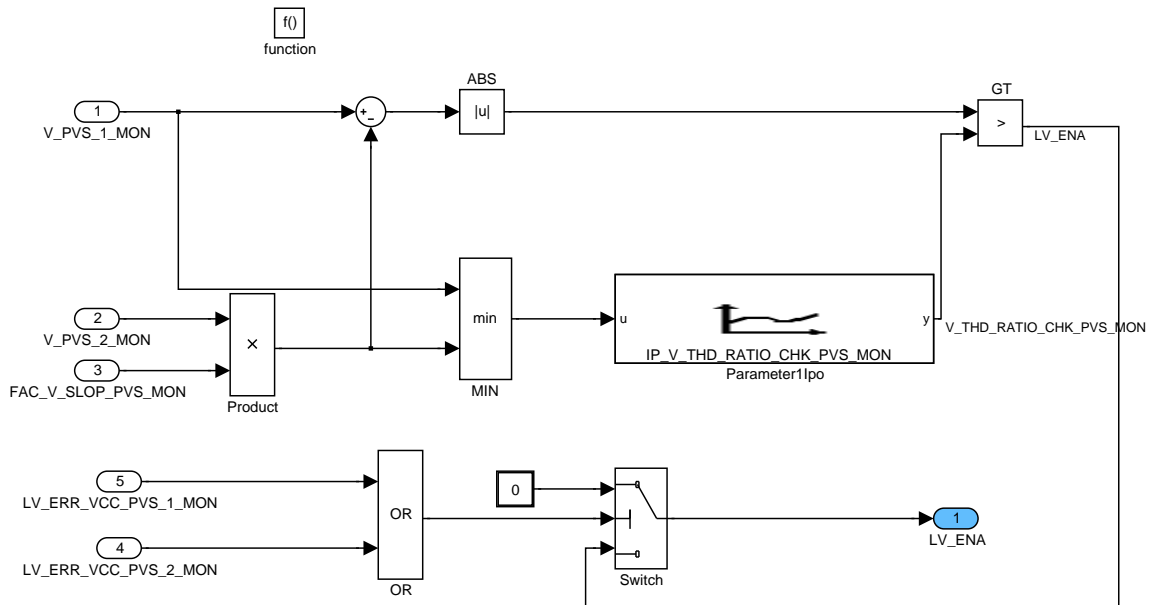


Figure E.22.8: ECM2\_DTSYSPVS/operate/RATIO\_CHECK/Ratio\_check

**ECM2\_DTSYSPVS/OPERATE/RATIO\_CHECK/ERROR\_INFO\_PROCESSING**

The Bits LV\_ERR\_VCC\_PVS\_1\_MON and LV\_ERR\_VCC\_PVS\_2\_MON are reversible like the correspondent failure bits from level 1. That means, the output LV\_ERR\_PVS\_RATIO\_MON has to be reversible also depending of these two error bits.

All PVS error information of the function level is considered. This allows the different process levels to be based on the same error information:

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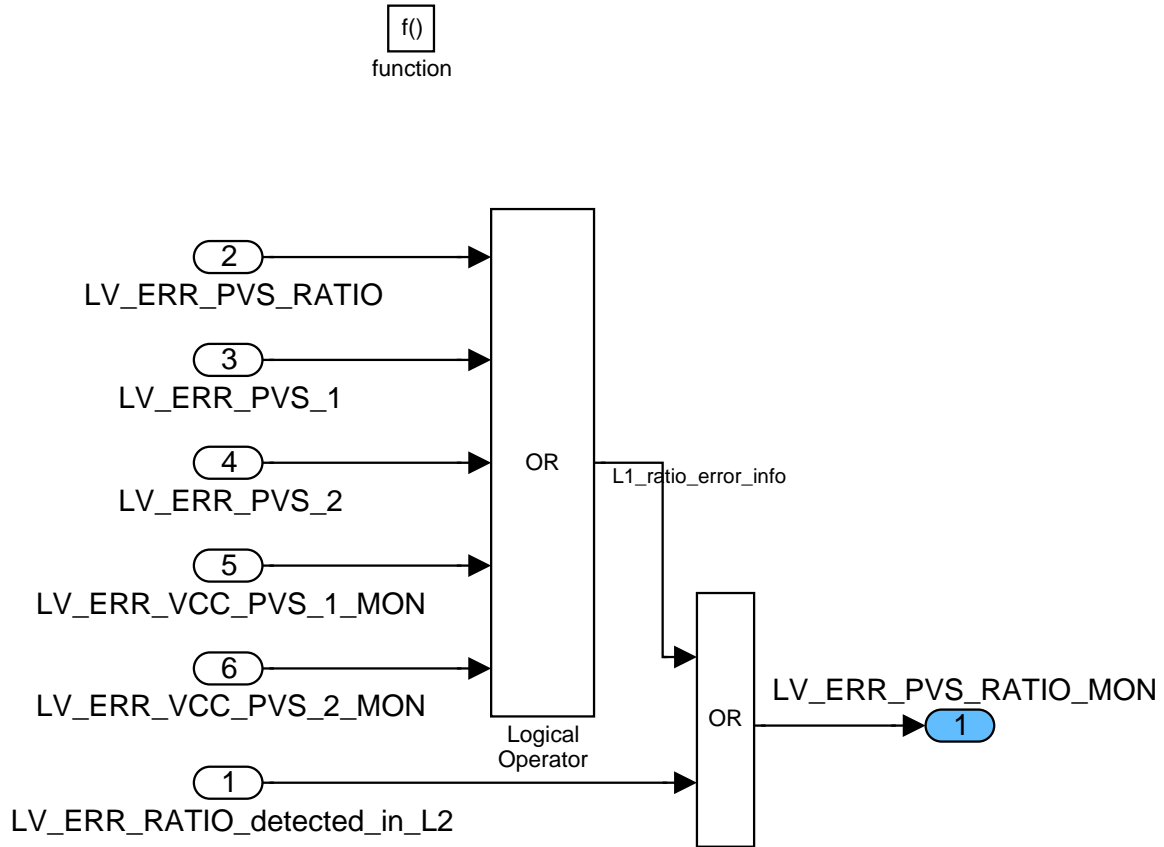


Figure E.22.9: ECM2\_DTSYSPVS/operate/RATIO\_CHECK/Error\_info\_processing

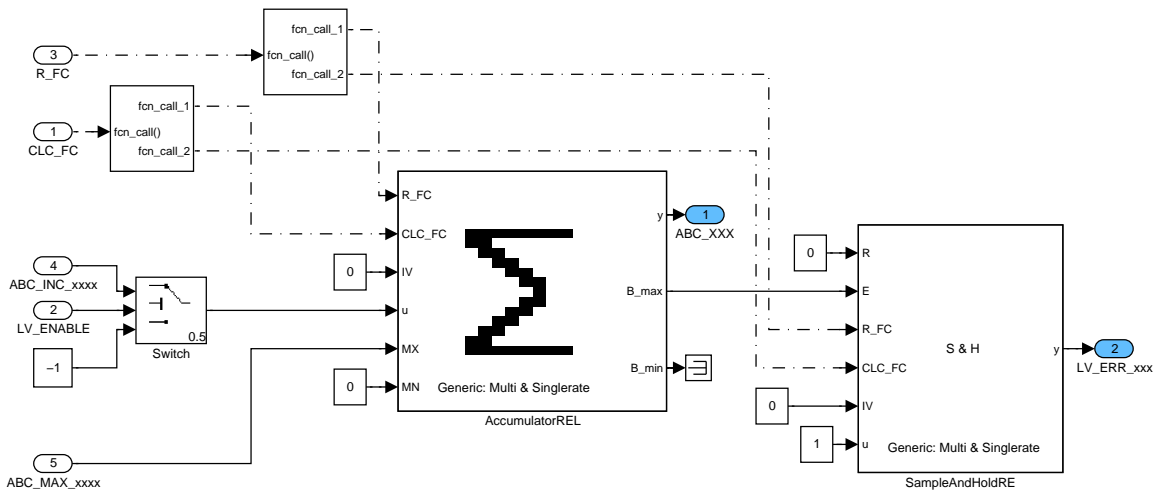


Figure E.22.10: ECM2\_DTSYSPVS/operate/RATIO\_CHECK/abc\_multi\_rate

**ECM2\_DTSYSPVS/OPERATE/DIAG\_CHECK\_BETWEEN\_L1\_L2**

If any PVS ratio error is detected in level 2 and no PVS error is detected in level 1, a fault of the PVS diagnosis in level 1 will be assumed.

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There is also a check, whether an errorBIT of the PVS diagnosis in level 1 was reset without permission. This is done by using the result of LV\_ERR\_PVS\_RATIO\_MON of the last recurrence.

LV\_ERR\_VCC\_PVS\_MON is assumed to be a PVS supply voltage error flag of a level 2 diagnosis in case of any PVS supply voltage error.

LV\_ERR\_VCC\_PVS\_1\_MON and LV\_ERR\_VCC\_PVS\_2\_MON are error flags that result from Level 1 diagnosis of PVS1 and PVS2 supply voltage and are assigned to the LV\_ERR\_VCC\_PVS\_1\_MON and LV\_ERR\_VCC\_PVS\_1\_MON respectively in the application incidences of process monitoring.

If an PVS?monitoring error is detected and the error bit LV\_ERR\_PVS\_MON is set, then this bit muts not be reversible.

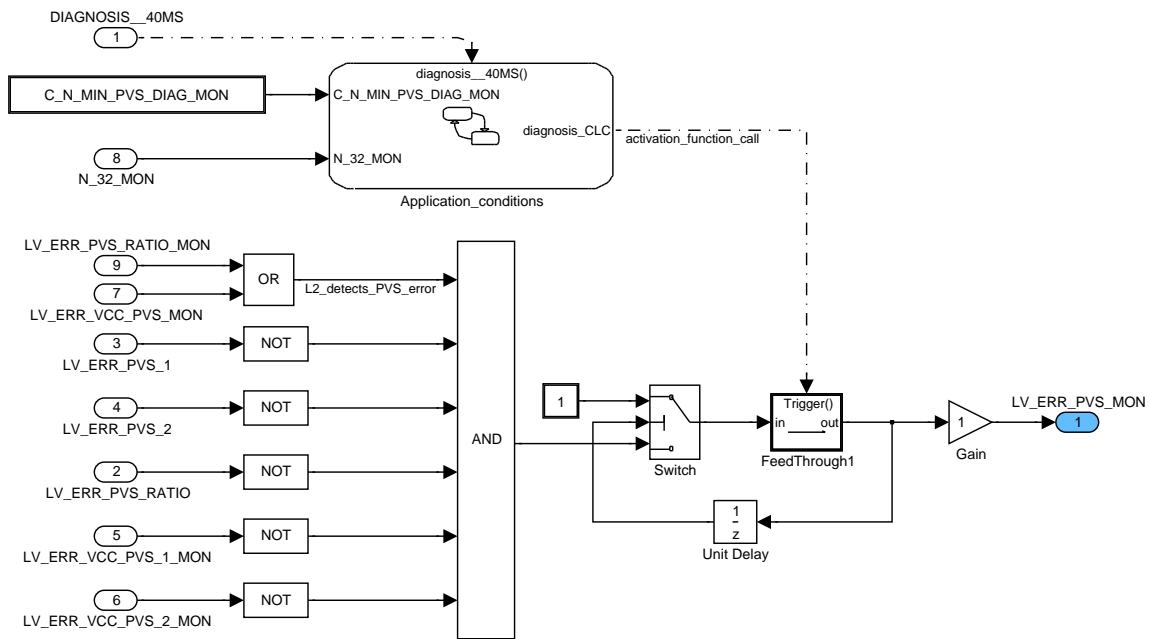


Figure E.22.11: ECM2\_DTSYSPVS/operate/Diag\_check\_between\_L1\_L2

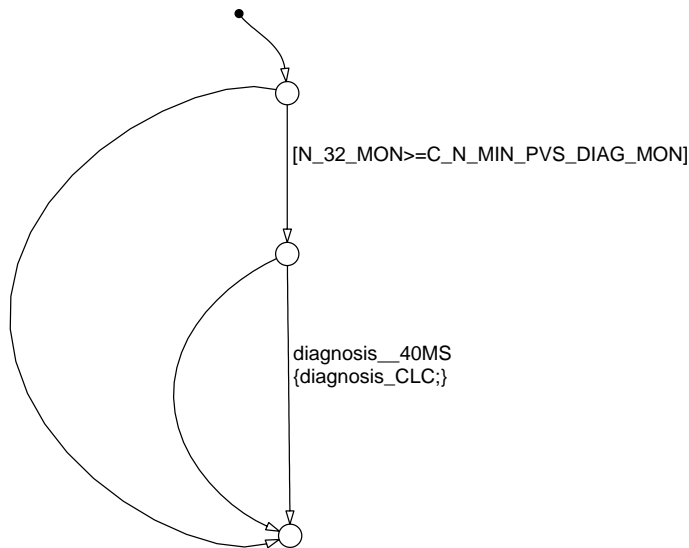


Figure E.22.12: ECM2\_DTSYSPVS/operate/Diag\_check\_between\_L1\_L2/Application\_conditions

### ECM2\_DTSYSPVS/OPERATE/PVS\_CHANNEL\_SELECT

Depending on the plausibility, the degree of pedal activation PV\_AV\_MON is defined by the signals PV\_AV\_1\_MON and PV\_AV\_2\_MON, as follows:

Error Level	Error bits set	Analysis, error handling
0	-	PV_AV_MON = MIN(PV_AV_1_MON, PV_AV_2_MON)
1	LV_ERR_PVS_RATIO_MON	PV_AV_MON = MIN(PV_AV_1_MON, PV_AV_2_MON) (minimum)
2	LV_ERR_PVS_1 OR LV_ERR_VCC_PVS_1_MON	PV_AV_MON = PV_AV_2_MON (selection)
3	LV_ERR_PVS_2 OR LV_ERR_VCC_PVS_2_MON	PV_AV_MON = PV_AV_1_MON (selection)
4	(LV_ERR_PVS_1 OR LV_ERR_VCC_PVS_1_MON) AND (LV_ERR_PVS_2 OR LV_ERR_VCC_PVS_2_MON)	PV_AV_MON = 0 driver demand not recognizable

If any PVS errorBIT is set:

PV\_AV\_MON will be limited to C\_PV\_LIH\_MAX\_MON.

Use of the brake as a redundant driver demand:

IF (LV\_BRAKE\_MON = 1)  
 THEN  
 PV\_AV\_MON = 0 (same as Error level 4)

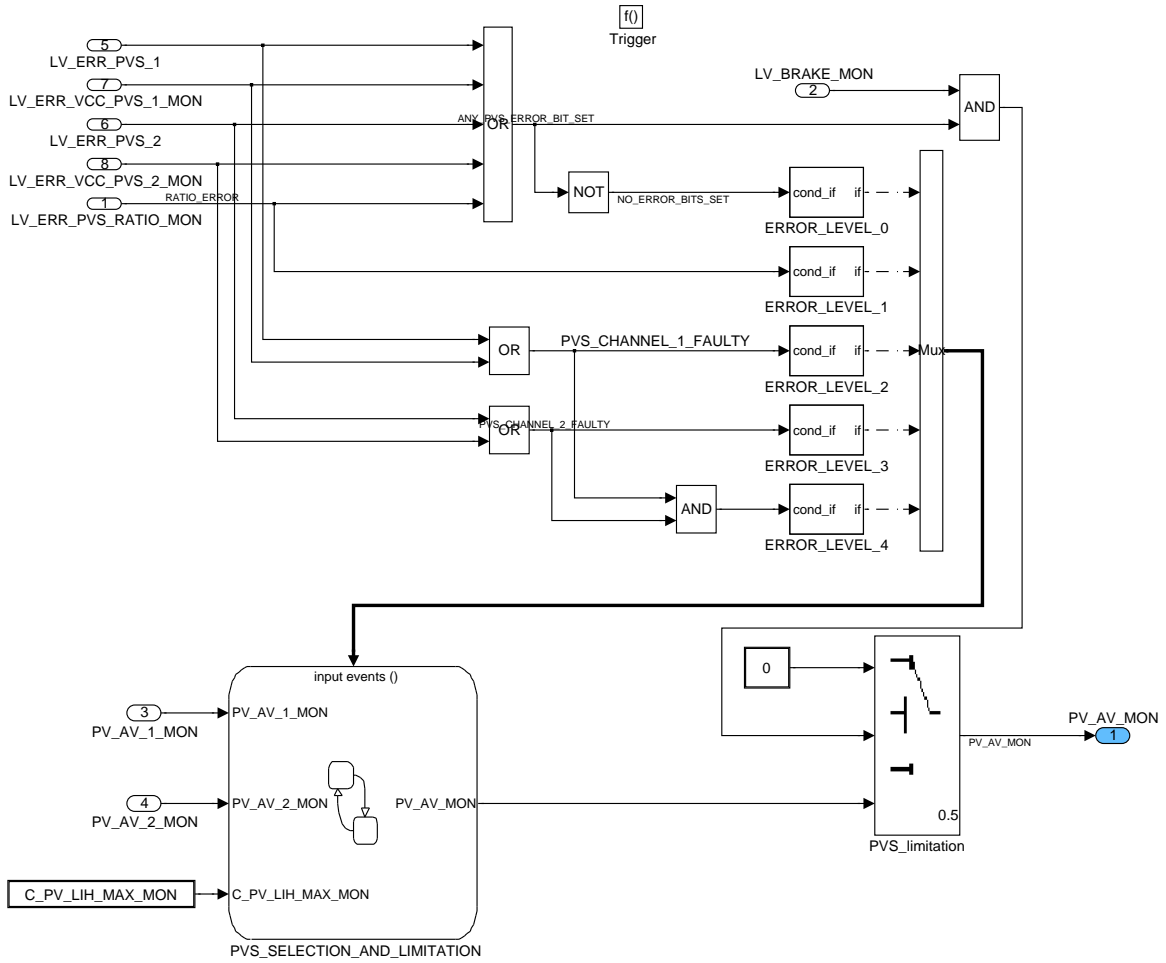


Figure E.22.13: ECM2\_DTSYSPVS/operate/PVS\_CHANNEL\_SELECT

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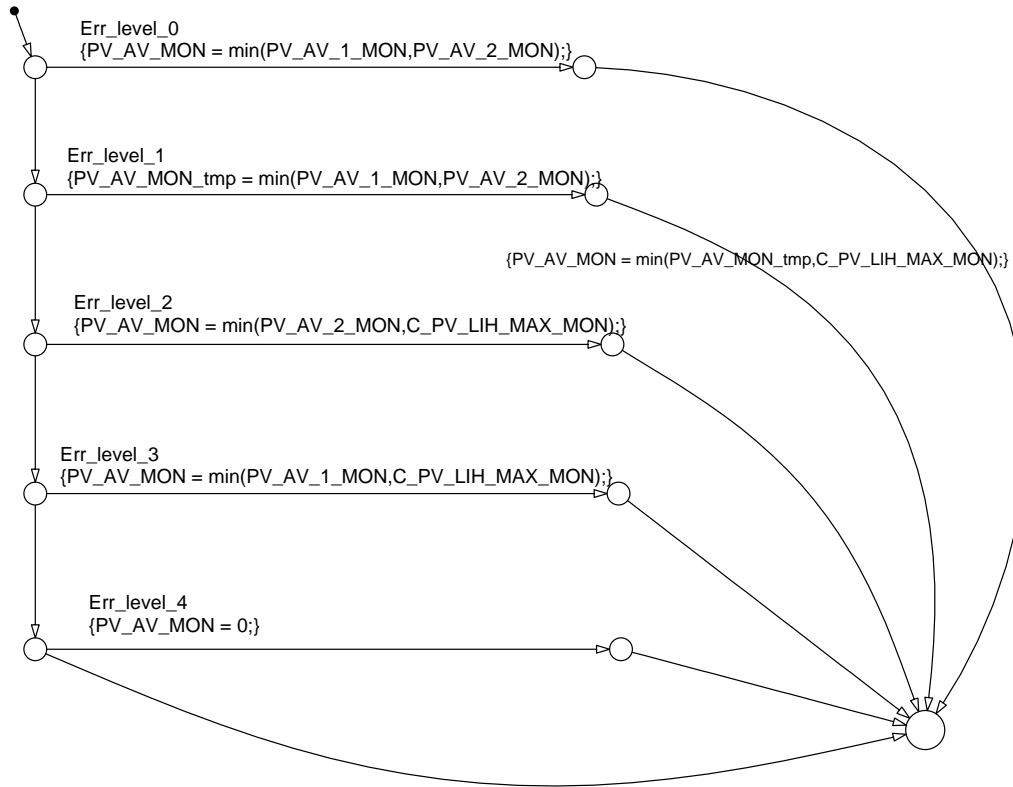



Figure E.22.14:  
ECM2\_DTSYSPVS/operate/PVS\_CHANNEL\_SELECT/PVS\_SELECTION\_AND\_LIMITATION

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## E.23 Monitoring of torque losses

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_TQ_LOSS_MON	O/V	0... FFH	0... 255	1	-
Anti bounce counter for monitoring of torque losses					
LV_ERR_TQ_LOSS_MON	O/V	0... 1H	0 ...1	1	-
Fault currently present in torque generation, symptom "torque losses"					
TQ_LOSS_MDL_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Modelled torque losses					
TQ_LOSS_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque losses					
TQ_LOSS_REQ_CLU_MDL_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Modelled filtered torque losses					
TQ_LOSS_REQ_CLU_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque losses without pumping losses					


### Input data:

LV_TQI_MON_ACT_MON {p. 6791}	MAF_MON {p. 6777}	N_32_MON {p. 7002}	TCO_MON {p. 6903}
TQ_DIF_IS_AD {p. 3518}	TQ_LOSS {p. 8385}	TQ_LOSS_ADD_FIL_MON {p. 6793}	TQ_LOSS_ADD_MON {p. 6793}
TQ_LOSS_REQ_CLU {p. 8385}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TQ_LOSS_MON	-	0... FFH	0... 255	1	-
anti bounce counter increment					
C_ABC_MAX_TQ_LOSS_MON	-	1... FFH	1... 255	1	-
maximum of anti bounce counter					
C_MAF_STK_CYL_REF_MON	-	0... FFH	0... 1389	5.4470588	mg/stk
Constant for the determination of the monitored engine friction losses					
C_TQ_IS_AD_MIN_MON	-	80... 7FH	-256 ...254	2	Nm
Min. limitation of engine torque losses adaptation					
IP_TQFR_ADD_MON	-	0... FFH	0... 510	2	Nm
LDP_TCO_MON_IP_TQFR_ADD_MON	5	0... FEH	-48... 142.5	0.75	°C
Coolant temperature correction of friction torque					
IP_TQFR_MON	V	0... FFH	0... 510	2	Nm
LDP_N_32_MON_IP_TQFR_MON	5	0... FFH	0... 8160	32	rpm
LDP_MAF_MON_IP_TQFR_MON	5	0... FFH	0... 1389	5.4470588	mg/stk
Base friction torque and pumping losses					

### Import actions:

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<b>ACTION_ECM3_ChkCpl</b> (IN<PRM_VAR>,IN<PRM_VAR_CPL>)
<b>ACTION_ECM3_McChkStack</b> ()
<b>ACTION_ECM3_ReadChkCpl</b> (OUT<PRM_RESULT>,IN<PRM_VAR>,IN<PRM_VAR_CPL>)
<b>ACTION_ECM3_Service10TaskPfm</b> (IN<No Name available>)
<b>ACTION_ECM3_Service11TaskPfm</b> (IN<No Name available>)
<b>ACTION_ECM3_Service9TaskPfm</b> (IN<No Name available>)
<b>ACTION_ECM3_WriteChkCpl</b> (INOUT<PRM_VAR>,OUT<PRM_VAR_CPL>,IN<PRM_VALUE>)

## General Information

ACTION_ECM3_Service9TaskPfm(IN< >)
ACTION_ECM3_Service10TaskPfm(IN< >)
ACTION_ECM3_Service11TaskPfm(IN< >)

Note: These actions are defined in chapter "Processor Monitoring", subsection "Program Flow Monitoring services for Process Monitoring". The first action has to be executed as first instruction in this module, the second action has to be executed as last instruction of this module. The argument n has the value 2.

ACTION_ECM3_McChkStack()
--------------------------

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION\_ECM3\_Service9TaskPfm() and ACTION\_ECM3\_Service10TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT < >, OUT < >, IN < >)
ACTION_ECM3_ChkCpl(IN < >, IN < >)
ACTION_ECM3_ReadChkCpl(OUT < >, IN < >, IN < >)

Note: These actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode 0 and history variables in modules of the Process Monitoring have to be checked by the cyclical RAM test.

### General information:

The objective of this function is the monitoring of the torque losses. It observes both level 1 values, TQ\_LOSS and TQ\_LOSS\_REQ\_CLU (filtered TQ\_LOSS without pumping losses), that is exclusively used for the determination of TQ\_MIN\_CLU and TQ\_MAX\_CLU.



It has to be distinguished between engine immanent torque losses (e.g. TQFR) and not engine immanent torque losses (e.g. TQ\_LOSS\_ACC), that are determined in the module "Appl. Inc. and configuration of process monitoring".

A fault is detected after debouncing, if the monitored TQ\_LOSS is smaller than the modelled one (TQ\_LOSS\_MDL\_MON) or if the monitored TQ\_LOSS\_REQ\_CLU is smaller than the modelled one (TQ\_LOSS\_REQ\_CLU\_MDL\_MON).

### Application Conditions

Initialization: RST

Recurrence: 40MS

Activation: LV\_TQI\_MON\_ACT\_MON

Deactivation: !LV\_TQI\_MON\_ACT\_MON

### Function description

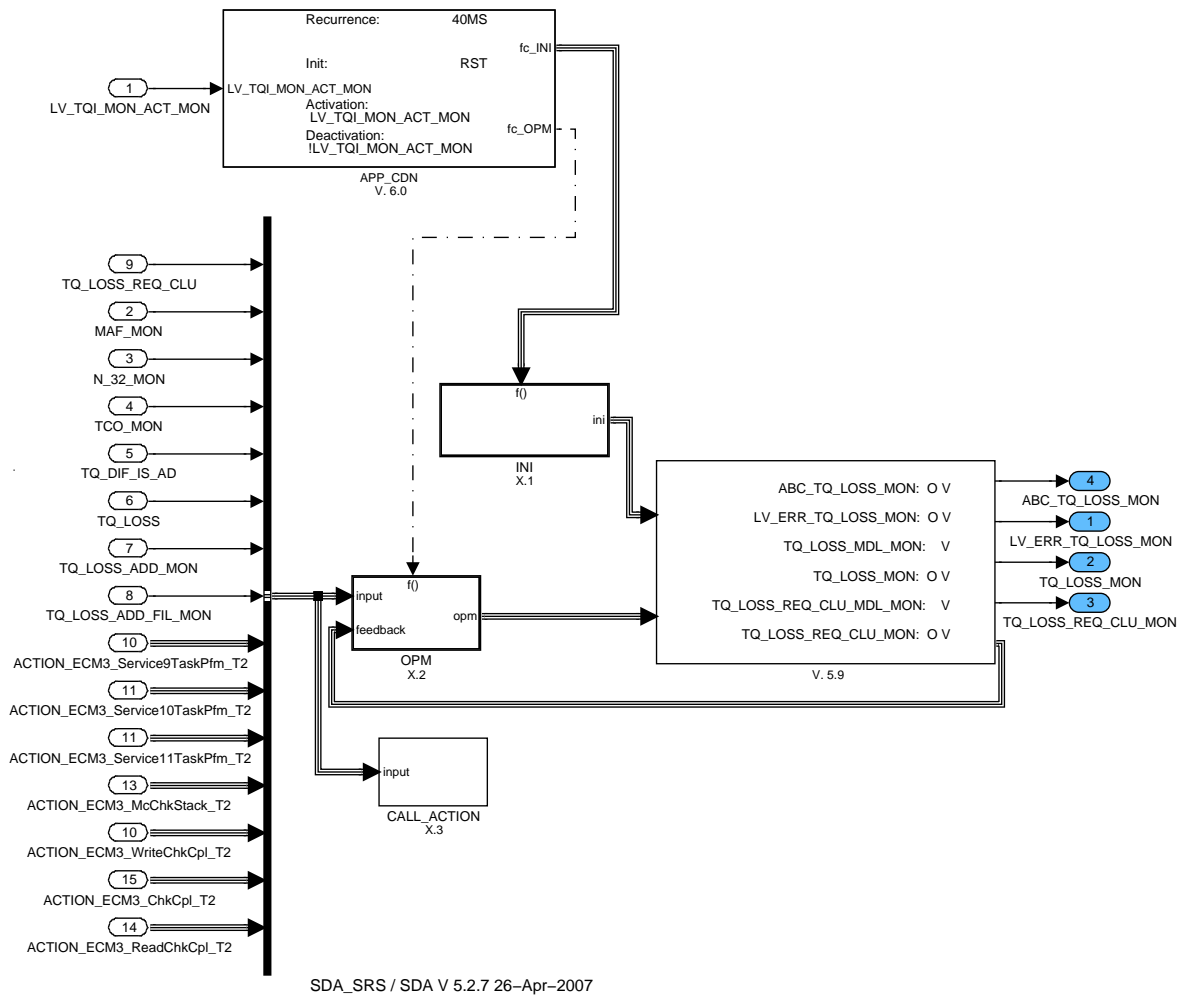



Figure E.23.1: :

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### E.23.1 Initialization

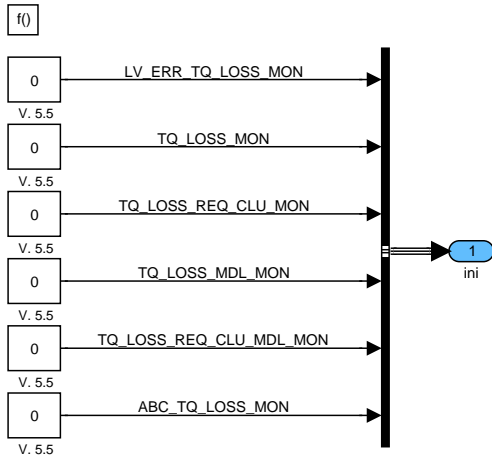


Figure E.23.2: :

### E.23.2 Formula section

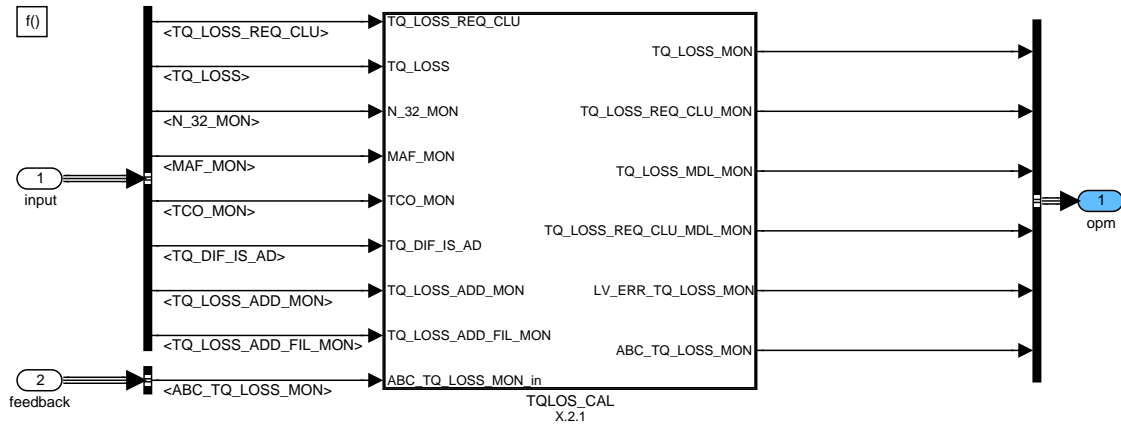


Figure E.23.3: :

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### E.23.2.1 Torque Loss calculation

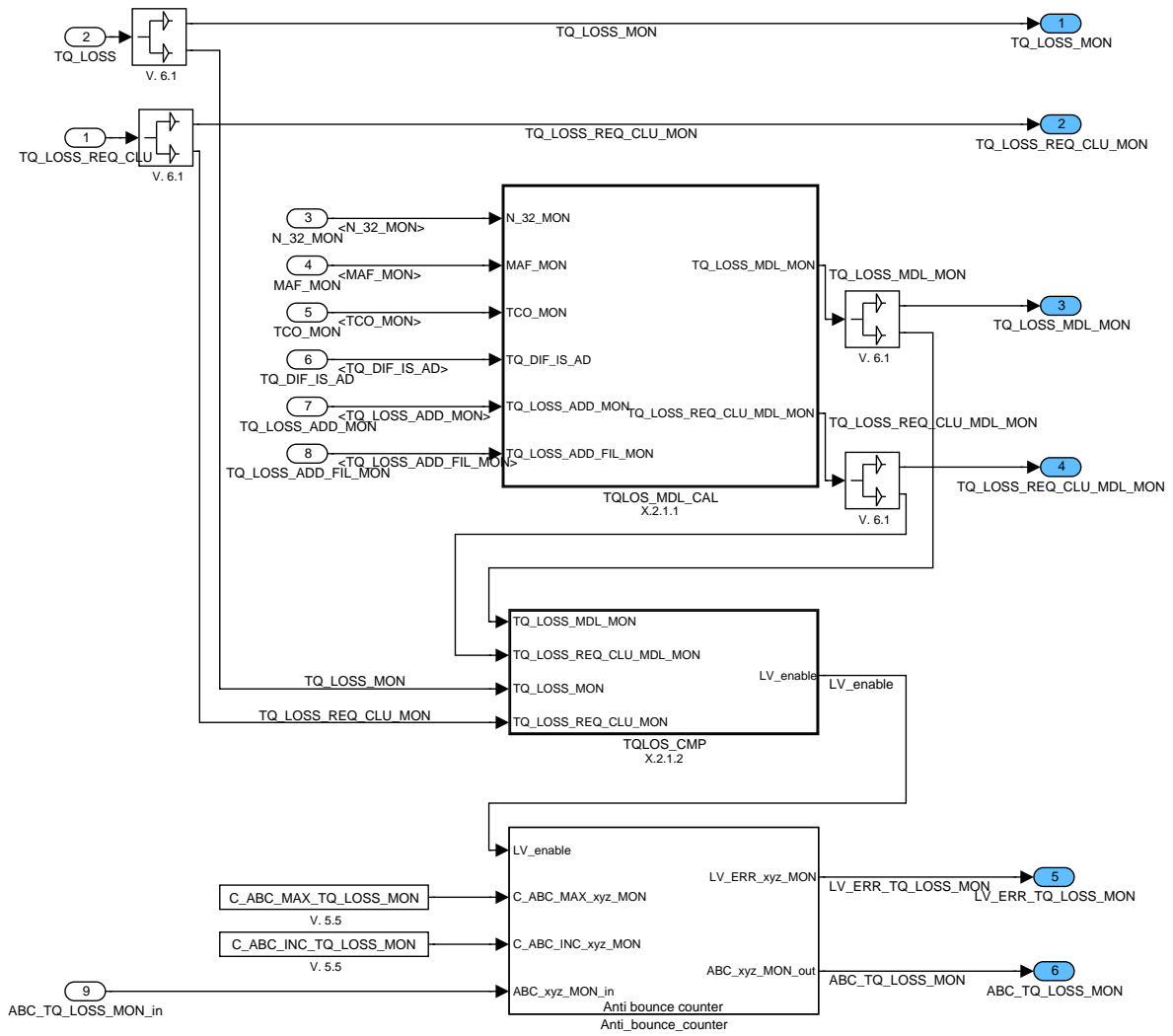


Figure E.23.4: :

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### E.23.2.1.1 Torque Loss - Modeled

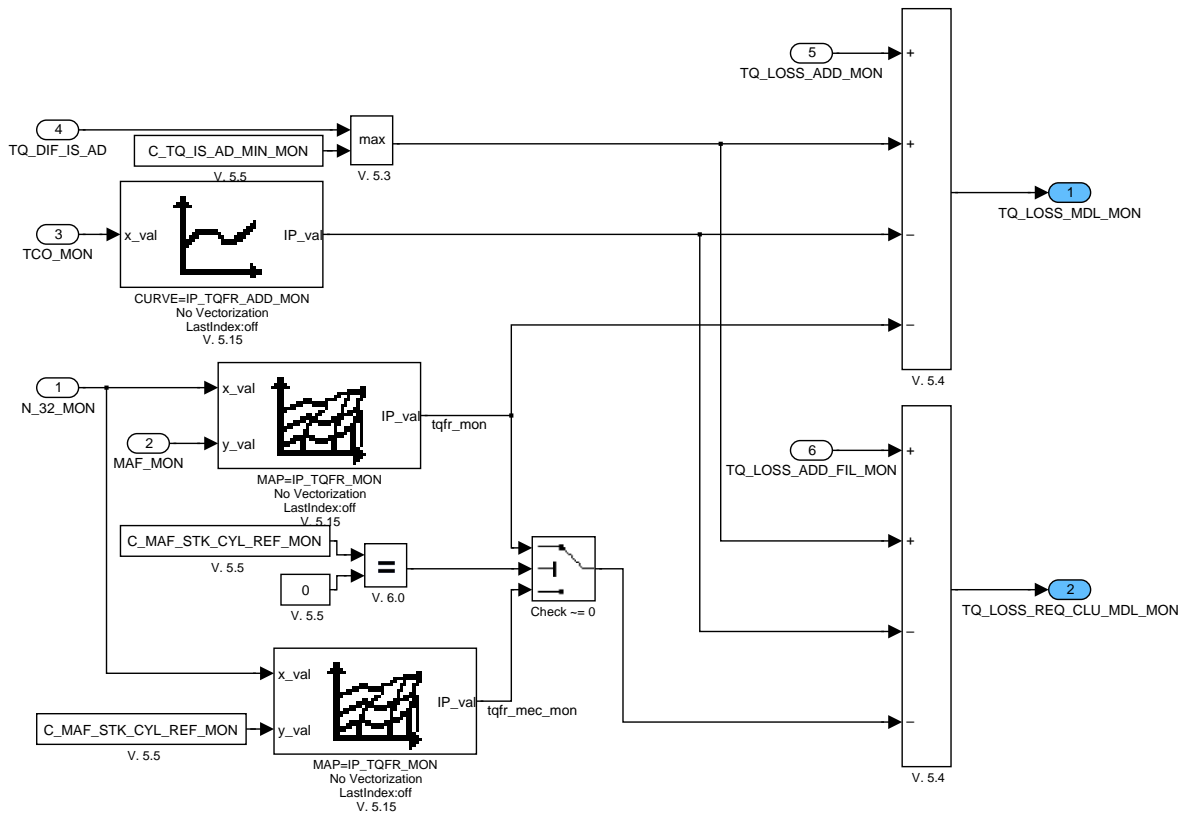


Figure E.23.5: :

### E.23.2.1.2 Torque Loss detection flag

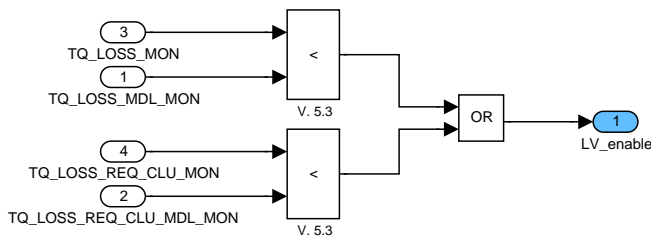


Figure E.23.6: :

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### E.23.3 Call Action

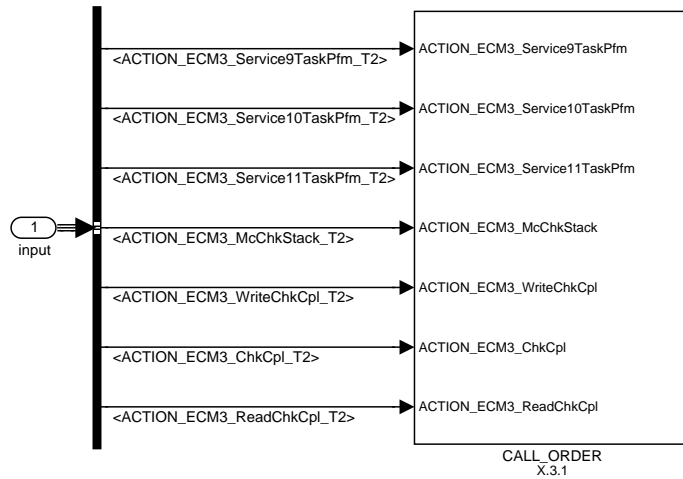



Figure E.23.7: :

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### E.23.3.1 Call order

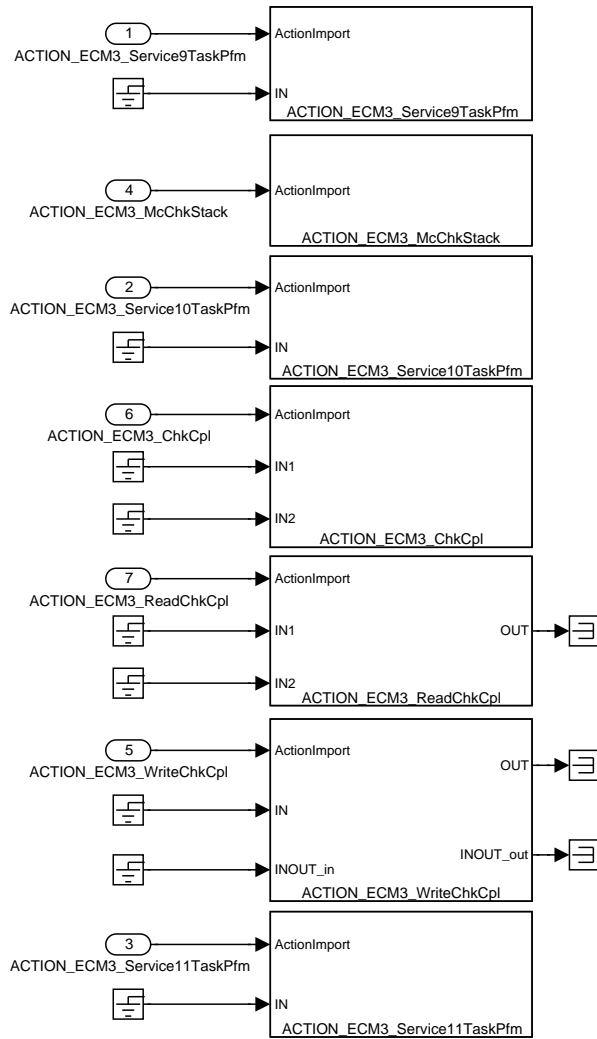


Figure E.23.8: :

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## E.24 Monitoring CAN signals

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_AMT_INH_MON	V	0... FFH	0... 255	1	-
Anti bounce counter for fault in AMT present					
ABC_DCC_INH_MON	V	0... FFH	0... 255	1	-
Anti bounce counter for fault in DCC present					
ABC_GS_INH_MON	V	0... FFH	0... 255	1	-
Anti bounce counter for fault in GS present					
ABC_LDM_INH_MON	V	0... FFH	0... 255	1	-
Anti bounce counter for fault in LDM present					
ABC_MSR_INH_MON	V	0... FFH	0... 255	1	-
Anti bounce counter for fault in MSR present					
LV_DCC_OFF_ECU_MON	V	0... 1H	0 ...1	1	-
Irreversible DCC error mon					
LV_ERR_AMT_INH_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for fault in MSR present					
LV_ERR_DCC_INH_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for fault in DCC present					
LV_ERR_DCC_IRREV_MON	V	0... 1H	0 ...1	1	-
Irreversible DCC error mon					
LV_ERR_DCC_REV_MON	V	0... 1H	0 ...1	1	-
Reversible DCC error mon					
LV_ERR_GS_INH_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for fault in GS present					
LV_ERR_LDM_INH_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for fault in LDM present					
LV_ERR_LDM_MON	V	0... 1H	0 ...1	1	-
LDM error mon					
LV_ERR_MSR_INH_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for fault in MSR present					
LV_LDM_OFF_ECU_1_MON	V	0... 1H	0 ...1	1	-
LDM Irreversible off mon					
LV_LDM_OFF_ECU_2_MON	V	0... 1H	0 ...1	1	-
LDM reversible off mon					
LV_LDM_OFF_ECU_MON	V	0... 1H	0 ...1	1	-
LDM off mon					
STATE_AMT_OLD_MON	V	0... 3H	0 ...3	1	-
Previos shift phase3					
STATE_ERR_AMT_MON	V	0... FFH	0... 255	1	-
State of AMT Error intervention					
T_AMT_INH_MON	O/V	0... FFH	0... 10.2	0.04	s
Timer for inhibition of AMT torque demand in monitoring level					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_DCC_BRAKE_DET_MON	V	0... FFH	0... 10.2	0.04	s
Brake delay timer mon					
T_DCC_INH_MON	V	0... FFH	0... 10.2	0.04	s
Timer for inhibition of DCC torque demand in monitoring level					
T_GS_INH_MON	O/V	0... FFH	0... 10.2	0.04	s
Timer for inhibition of GS torque demand in monitoring level					
T_LDM_BRAKE_DET_MON	V	0... FFH	0... 10.2	0.04	s
Brake delay timer mon					
T_LDM_INH_MON	V	0... FFH	0... 10.2	0.04	s
Timer for inhibition of LDM torque demand in monitoring level					
T_MSR_INH_MON	O/V	0... FFH	0... 10.2	0.04	s
Timer for inhibition of MSR torque demand in monitoring level					
T_STATE_AMT_1_DIAG_MON	V	0... FFH	0... 10.2	0.04	s
Intervention in shift phase 1					
T_STATE_AMT_2_DIAG_MON	V	0... FFH	0... 10.2	0.04	s
Intervention in shift phase 2					
T_STATE_AMT_3_DIAG_MON	V	0... FFH	0... 10.2	0.04	s
Intervention in shift phase 2					
T_STATE_CLU_AMT_DIAG_MON	V	0... FFH	0... 10.2	0.04	s
Timer clutch state 3					
T_TQI_AMT_DIAG_MON	V	0... FFH	0... 10.2	0.04	s
Intervention timer 1 or 3					
TQ_AMT_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque demand from drag control BN 2000					
TQ_DCC_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
DCC torque request for monitoring					
TQ_GS_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque demand from drag control BN 2000					
TQ_MSR_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque demand from drag control BN 2000					
TQ_WHEEL_LDM_MON	O/V	8000... 7FFFH	-32768 ...32767	1	Nm
LDM torque request for monitoring					
TQI_AMT_MON	O/V	0... FFH	0... 510	2	Nm
Torque demand from AMT control CAN 11H					
TQI_AMT_PLAUS_MON	V	0... FFH	0... 510	2	Nm
Plausibility torque					
TQI_GS_MON	O/V	0... FFH	0... 510	2	Nm
Torque demand from drag control CAN 11H					
TQI_MSR_MON	O/V	0... FFH	0... 510	2	Nm
Torque demand from drag control CAN 11H					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**Input data:**

ERR_SYM_BN_ETCU {p. 4861}	ERR_SYM_BN_LDM {p. 4862}	ERR_SYM_BN_TQ_AMT {p. 4864}	ERR_SYM_BN_TQ_DCC {p. 4864}
ERR_SYM_TOUT_AMT_1	GR_DT {p. 8285}	LV_AMT_ES {p. 1564}	LV_AMT_INC_ACT {p. 799}
LV_AT {p. 654}	LV_BRAKE_MON {p. 6790}	LV_CDN_VB_CAN_TQ_ DIAG {p. 1185}	LV_DCC_INC_ACT {p. 6731}
LV_DCC_LIH_CAN {p. 1565}	LV_DCC_OFF_ACK {p. 1565}	LV_DCC_OFF_ECU {p. 5051}	LV_DI_TQ_REQ_CAN_ MPI_GDI {p. 800}
LV_ERR_BLS_PLAUS {p. 4209}	LV_ERR_BN_ETCU {p. 4870}	LV_ERR_BN_LDM {p. 4870}	LV_ERR_BN_TCS {p. 4870}
LV_ERR_BN_TQ_AMT {p. 4870}	LV_ERR_BN_TQ_DCC {p. 4870}	LV_ERR_BN_TQ_ETCU {p. 4871}	LV_ERR_BN_TQ_TCS {p. 4871}
LV_ERR_BN_VS_TCS {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_CRK {p. 4455}	LV_ERR_CS {p. 5015}
LV_ERR_PVS {p. 4216}	LV_ERR_TOUT_AMT_1 {p. 802}	LV_ERR_TOUT_ASR_1 {p. 802}	LV_ERR_TOUT_ASR_3 {p. 802}
LV_ERR_TOUT_ETCU_1 {p. 802}	LV_ERR_TOUT_ETCU_2 {p. 802}	LV_ES {p. 1720}	LV_ETCU_DISABLE_CAN {p. 6718}
LV_ETCU_LIH_CAN {p. 1565}	LV_GS {p. 1565}	LV_GS_ENA_INC {p. 6718}	LV_GS_INC_ACT {p. 6718}
LV_IGK_MON {p. 6790}	LV_LDM_ACT {p. 6615}	LV_LDM_CAN_INI {p. 1566}	LV_LDM_ENA_PLAUS_ ERR {p. 5054}
LV_LDM_LIH_CAN {p. 1566}	LV_LDM_OFF_ECU {p. 5054}	LV_MSR_ACT {p. 6741}	LV_TCS_LIH_CAN {p. 1567}
LV_TCT_LIH_CAN {p. 1568}	LV_TQ_AMT_DEC_REQ {p. 1568}	LV_TQ_AMT_INC_REQ {p. 1568}	LV_TQ_ASR_REQ {p. 1568}
LV_TQ_GS_INC_REQ {p. 1568}	LV_TQ_MSR_REQ {p. 1568}	LV_TQ_WHEEL_LDM_BN_ ERR {p. 1568}	LV_TQ_WHEEL_LDM_ REQ {p. 1568}
LV_TQI_MON_ACT_MON {p. 6791}	LV_TQI_REQ_CAN_INH {p. 6687}	LV_VAR_BN {p. 655}	LV_VAR_DCC {p. 655}
LV_VAR_TCT {p. 656}	STATE_AMT {p. 1570}	STATE_DCC_INTV {p. 1572}	STATE_DCC_OFF_REQ {p. 1572}
STATE_DCC_PUC_INH {p. 1572}	TQ_AMT_FAST_BN {p. 1580}	TQ_AMT_SLOW_BN {p. 1581}	TQ_DCC_FAST_BN {p. 1581}
TQ_DCC_SLOW_BN {p. 1581}	TQ_GS_FAST_BN {p. 1581}	TQ_GS_FAST_INC_BN {p. 1710}	TQ_GS_SLOW_BN {p. 1581}
TQ_LOSS_MON {p. 6975}	TQ_SP_WHEEL {p. 6615}	TQ_TCS_FAST_BN {p. 1582}	TQ_TCS_SLOW_BN {p. 1582}

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TQ_WHEEL_LDM_BN {p. 1582}	TQI_AMT_FAST_DEC {p. 810}	TQI_AMT_FAST_INC {p. 810}	TQI_AMT_REQ_CAN {p. 810}
TQI_ASR_FAST_CAN {p. 810}	TQI_DCC_FAST_INC {p. 6731}	TQI_GS_FAST_INC {p. 6718}	TQI_GS_FAST_REQ_CAN {p. 810}
TQI_MSR_CAN {p. 811}	TQI_MSR_FAST {p. 6741}	TQI_REQ_FAST_SEL {p. 8391}	TQI_REQ_TRA_FAST {p. 8391}
VB {p. 1185}	VS_FIL {p. 1176}		

**Calibration data:**


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_AMT_INH_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_INC_DCC_INH_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_INC_DCC_IRREV_MON	-	0... FFH	0... 255	1	-
Increment counter					
C_ABC_INC_DCC_REV_MON	-	0... FFH	0... 255	1	-
Increment counter					
C_ABC_INC_GS_INH_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_INC_LDM_INH_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_INC_LDM_MON	-	0... FFH	0... 255	1	-
Increment counter					
C_ABC_INC_MSR_INH_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_MAX_AMT_INH_MON	-	1... FFH	1... 255	1	-
Maximum value of anti-bounce counter					
C_ABC_MAX_DCC_INH_MON	-	1... FFH	1... 255	1	-
Maximum value of anti-bounce counter					
C_ABC_MAX_DCC_IRREV_MON	-	1... FFH	1... 255	1	-
Maximum counter					
C_ABC_MAX_DCC_REV_MON	-	1... FFH	1... 255	1	-
Maximum counter					
C_ABC_MAX_GS_INH_MON	-	1... FFH	1... 255	1	-
Maximum value of anti-bounce counter					
C_ABC_MAX_LDM_INH_MON	-	1... FFH	1... 255	1	-
Maximum value of anti-bounce counter					
C_ABC_MAX_LDM_MON	-	1... FFH	1... 255	1	-
Maximum counter					
C_ABC_MAX_MSR_INH_MON	-	1... FFH	1... 255	1	-
Maximum value of anti-bounce counter					
C_CAN_VB_MIN_DIAG_MON	-	0... FFH	0... 25.89843	0.1015625	V
Threshold of battery voltage for CAN diagnosis					
C_T_AMT_INH_MON	-	0... FFH	0... 10.2	0.04	s
Delay time for disable of AMT torque demand in monitoring level					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DCC_INH_MON	-	0... FFH	0... 10.2	0.04	s
Delay time for disable of DCC torque demand in monitoring level					
C_T_DLY_AMT_INH_MON	-	0... FFH	0... 10.2	0.04	s
Delay time for incrementing ABC-counter - AMT monitoring level					
C_T_DLY_GS_INH_MON	-	0... FFH	0... 10.2	0.04	s
Delay time for incrementing ABC-counter - GS monitoring level					
C_T_GS_INH_MON	-	0... FFH	0... 10.2	0.04	s
Delay time for disable of GS torque demand in monitoring level					
C_T_LDM_INH_MON	-	0... FFH	0... 10.2	0.04	s
Delay time for disable of LDM torque demand in monitoring level					
C_T_MAX_BRAKE_DET_DCC_MON	-	0... FFH	0... 10.2	0.04	s
Maximum Brake delay timer					
C_T_MAX_BRAKE_DET_LDM_MON	-	0... FFH	0... 10.2	0.04	s
Maximum Brake delay timer					
C_T_MAX_STATE_AMT_1_DIAG_MON	-	0... FFH	0... 10.2	0.04	s
Max Intervention in shift phase 1					
C_T_MAX_STATE_AMT_2_DIAG_MON	-	0... FFH	0... 10.2	0.04	s
Max Intervention in shift phase 2					
C_T_MAX_STATE_AMT_3_DIAG_MON	-	0... FFH	0... 10.2	0.04	s
Max Intervention in shift phase 3					
C_T_MAX_STATE_CLU_AMT_DIAG_MON	-	0... FFH	0... 10.2	0.04	s
Max. time at clutch					
C_T_MAX_TQI_AMT_DIAG_MON	-	0... FFH	0... 10.2	0.04	s
Max. timer shift intervention phase 1 or 3					
C_T_MSR_INH_MON	-	0... FFH	0... 10.2	0.04	s
Delay time for disable of MSR torque demand in monitoring level					
C_TQI_AMT_CAN_ES_MON	-	0... FFH	0... 510	2	Nm
Torque at engine stop					
C_TQI_AMT_COND_DIAG_MON	-	0... FFH	0... 510	2	Nm
Torque at shift phase 0					
C_TQI_AMT_DIAG_MON	-	0... FFH	0... 510	2	Nm
Plausibility torque intervention hysteresis					
C_TQI_STND_MON	-	0... FFH	0... 510	2	Nm
Maximum indicated engine torque (scaling factor for torque demands from CAN)					
C_VS_FIL_AMT_MON	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed threshold engine stop					

### Import actions:

<b>ACTION_ECM3_ChkCpl</b> (IN<PRM_VAR>,IN<PRM_VAR_CPL>)
<b>ACTION_ECM3_ReadChkCpl</b> (OUT<PRM_RESULT>,IN<PRM_VAR>,IN<PRM_VAR_CPL>)
<b>ACTION_ECM3_Service6TaskPfm</b> (IN<No Name available>)
<b>ACTION_ECM3_Service7TaskPfm</b> (IN<No Name available>)
<b>ACTION_ECM3_Service8TaskPfm</b> (IN<No Name available>)
<b>ACTION_ECM3_WriteChkCpl</b> (INOUT<PRM_VAR>,OUT<PRM_VAR_CPL>,IN<PRM_VALUE>)

**Note:** These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The argument n has the value 3.

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**ACTION\_ECM3\_McChkStack()**

**Note:** This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION\_ECM3\_Service6TaskPfm() and ACTION\_ECM3\_Service7TaskPfm().

**Note:** All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

**E.24.1 MSR monitoring**

**FUNCTION DESCRIPTION:**

General information:  
The torque demands received by the CAN-bus are monitored.  
The input signals are read direct from CAN.

**Application conditions**

**Activation:** LV\_TQI\_MON\_ACT\_MON = 1  
**Deactivation:** otherwise  
**Initialization:** TQI\_MSR\_MON = 0  
 LV\_ERR\_MSR\_INH\_MON = 0  
 T\_MSR\_INH\_MON = 0  
 ABC\_MSR\_INH\_MON = 0  
 TQ\_MSR\_MON = -1024 Nm  
**Update Rate:** 40 msec

**Formula section:**


LV\_VAR\_BN = 0:

```

IF LV_ERR_MSR_INH_MON = 0
THEN
    TQI_MSR_MON = C_TQI_STND_MON * TQI_MSR_CAN
    IF LV_MSR_ACT = 1 and
        LV_ERR_TOUT_ASR_1 = 0 and
        LV_ERR_TOUT_ASR_3 = 0 and
        LV_DI_TQ_REQ_CAN_MPI_GDI = 0 and
        LV_TQI_REQ_CAN_INH = 0 and
        LV_TCS_LIH_CAN = 0 and
        LV_CDN_VB_CAN_TQ_DIAG = 1

    THEN
        Initialize Timer: T_MSR_INH_MON = C_T_MSR_INH_MON
        IF (LV_TQ_ASR_REQ = 1) OR
            (LV_TQ_MSR_REQ = 0) OR
            (TQI_MSR_CAN = 0) OR
            ((TQI_ASR_FAST_CAN + TQI_MSR_CAN) ≠ FFH) OR
            ((VB > C_CAN_VB_MIN_DIAG_MON) AND (LV_ERR_CAN_BOFF=1))
        THEN after debouncing with ABC_MSR_INH_MON
            Inhibit MSR non reversible until the initialization conditions for error bits are fulfilled
            (see application incidences for process monitoring);
    
```

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```

        LV_ERR_MSR_INH_MON = 1
        TQI_MSR_MON = 0
        T_MSR_INH_MON = 0
    ENDIF
ELSE
    IF      T_MSR_INH_MON = 0
    THEN TQI_MSR_MON = 0
    ELSE Decrement Timer T_MSR_INH_MON
    ENDIF
ENDIF

ELSE
    TQI_MSR_MON = 0
    T_MSR_INH_MON = 0
ENDIF

```


LV\_VAR\_BN = 1:

```

IF  LV_ERR_MSR_INH_MON = 0
THEN
    TQ_MSR_MON = TQ_TCS_FAST_BN
    IF      LV_MSR_ACT = 1
            LV_DI_TQ_REQ_CAN_MPI_GDI = 0
            LV_TQI_REQ_CAN_INH = 0
            LV_TCS_LIH_CAN = 0
            LV_ERR_BN_TQ_TCS = 0
            LV_ERR_BN_VS_TCS = 0
            LV_ERR_BN_TCS = 0
            LV_CDN_VB_CAN_TQ_DIAG      = 1
            and
            and
            and
            and
            and
            and
    THEN
        Initialize Timer: T_MSR_INH_MON = C_T_MSR_INH_MON
        IF      (LV_TQ_ASR_REQ = 1)
                (LV_TQ_MSR_REQ = 0)
                (TQ_TCS_FAST_BN = 8000H)
                (TQ_TCS_SLOW_BN = 8000H)
                ((VB > C_CAN_VB_MIN_DIAG_MON) AND (LV_ERR_CAN_BOFF = 1))
        THEN after debouncing with ABC_MSR_INH_MON
            Inhibit MSR non reversible until the initialization conditions for error bits are fulfilled
            (see application incidences for process monitoring):
            LV_ERR_MSR_INH_MON = 1
            TQ_MSR_MON = -1024 Nm
            T_MSR_INH_MON = 0
        ENDIF
    ELSE
        IF      (T_MSR_INH_MON = 0)
        THEN TQ_MSR_MON = -1024 Nm
        ELSE Decrement Timer T_MSR_INH_MON
        ENDIF
    ELSE
        TQ_MSR_MON = -1024 Nm

```

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```
T_MSR_INH_MON = 0
ENDIF
```

Explanation of some MSR inhibit conditions listed above:

On an error free CAN 11H transmission: TQI\_ASR\_FAST\_CAN is the same, but bitinverse value of TQI\_MSR\_CAN

The CAN-interface is directly checked for the CAN-Bus OFF fault

```
Anti-bounce counter:          ABC_MSR_INH_MON
Anti-bounce counter increment: C_ABC_INC_MSR_INH_MON
Anti-bounce counter maximum:  C_ABC_MAX_MSR_INH_MON
```

## E.24.2 DCC monitoring

### E.24.2.1 DCCTorque monitoring

#### FUNCTION DESCRIPTION:

##### General information:

The torque demands received by the CAN-bus are monitored.  
The input signals are read direct from CAN.

##### Application conditions

```
Activation:          LV_TQI_MON_ACT_MON = 1
Deactivation:        otherwise
Initialization:      TQ_DCC_MON = -1024Nm
                    LV_ERR_DCC_INH_MON = 0
                    T_DCC_INH_MON = 0
                    ABC_DCC_INH_MON = 0
Update Rate:         40 msec
```

##### Formula section:

LV\_VAR\_DCC = 1:

```
IF LV_ERR_DCC_INH_MON = 0
THEN
    TQ_DCC_MON = TQ_DCC_FAST_BN    (physical converted)
    IF LV_DCC_INC_ACT = 1
        LV_ERR_BN_TQ_DCC = 0
        LV_DCC_LIH_CAN = 0
        LV_ERR_CAN_BOFF = 0
        STATE_DCC_PUC_INH < 03H
        STATE_DCC_OFF_REQ = 02 H
        LV_DCC_OFF_ECU = 0
        LV_CDN_VB_CAN_TQ_DIAG = 1
    THEN
        Initialize Timer: T_DCC_INH_MON = C_T_DCC_INH_MON
        IF (LV_TQ_DCC_INC_REQ= 0)
            (TQ_DCC_FAST_BN = 8000H)
            (TQ_DCC_SLOW_BN = 8000H)
            OR
            OR
            OR
```

```

        LV_DCC_OFF_ECU_MON = 1                                OR
        ((VB > C_CAN_VB_MIN_DIAG_MON) AND (LV_ERR_CAN_BOFF = 1))
    THEN after debouncing with ABC_DCC_INH_MON
        Inhibit DCC non reversible until the initialization conditions for error bits are fulfilled
        (see application incidences for process monitoring):
        LV_ERR_DCC_INH_MON = 1
        TQ_DCC_MON = -1024 Nm
        T_DCC_INH_MON = 0
    ENDIF
ELSE
    IF T_DCC_INH_MON = 0
    THEN TQ_DCC_MON = -1024 Nm
    ELSE Decrement Timer T_DCC_INH_MON
    ENDIF
ENDIF
ELSE
    TQ_DCC_MON = -1024 Nm
    T_DCC_INH_MON = 0
ENDIF

```

### E.24.2.2 DCC Plausibility Monitoring

#### FUNCTION DESCRIPTION:

#### Description:

The Conditions for DCC in the function level are divided in reversible and irreversible conditions. This function is monitored in the DCC torque monitoring.

#### Application conditions

**Initialisation:** *all 0 at reset or LV\_IGK 0 - -> 1 or clear FMY*

**Recurrence:** *40 ms*

**Activation:** *LV\_TQI\_MON\_ACT\_MON = 1; LV\_VAR\_DCC = 1*

**Deactivation:** *-*

#### Formula section:

```

IF ( LV_ERR_BN_TQ_DCC = 1 AND ERR_SYM_BN_TQ_DCC = SYM_2 ) or
                                     "only timeout"
    LV_ERR_BLS_PLAUS = 1                                or
    LV_ERR_CS = 1                                       or
    LV_DI_TQ_REQ_CAN_MPI_GDI = 1                        or
    LV_ERR_CRK = 1

```

**Then** LV\_ERR\_DCC\_REV\_MON = 1 after debounce

**Else IF** LV\_ERR\_DCC\_REV\_MON = 0 ("not debounced yet")


**Then** reset counter to 0 // reset counter to 0, no rebounding!

**Else IF** LV\_DCC\_OFF\_ACK = 1

**then** LV\_ERR\_DCC\_REV\_MON = 0 // reset error and counter to 0, no rebounding!

ing!

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```

                reset counter to 0
            else unchanged
        endif

    IF      LV_BRAKE_MON = 1
    Then    T_DCC_BRAKE_DET_MONn = T_DCC_BRAKE_DET_MONn-1 + 40 ms
    else    T_DCC_BRAKE_DET_MONn = 0 ms
    endif

IF ( LV_ERR_BN_TQ_DCC = 1 AND ERR_SYM_BN_TQ_DCC = SYM_1 or SYM_3 ) or
  "ONLY ALIVE AND CHECKSUM ERRORS"
  LV_TQI_REQ_CAN_INH      = 1
  LV_ERR_PVS              = 1
  [ (T_DCC_BRAKE_DET_MON > C_T_MAX_BRAKE_DET_DCC_MON) and
    STATE_DCC_INTV == 01H ]
Then LV_ERR_DCC_IRREV_MON = 1 after debounce
Endif

IF      LV_ERR_DCC_IRREV_MON = 1 or LV_ERR_DCC_REV_MON = 1
Then    LV_DCC_OFF_ECU_MON = 1
Else IF LV_DCC_OFF_ACK = 1
  Then  LV_DCC_OFF_ECU_MON = 0
  Else  unchanged
Endif

```

## E.24.3 LDM monitoring

### E.24.3.1 LDM Torque monitoring

#### FUNCTION DESCRIPTION:

##### General information:

The torque demands received by the CAN-bus are monitored.  
The input signals are read direct from CAN.

#### Application conditions

**Activation:** LV\_TQI\_MON\_ACT\_MON = 1  
**Deactivation:** otherwise  
**Initialization:** TQ\_WHEEL\_LDM\_MON = -32000 Nm  
 LV\_ERR\_LDM\_INH\_MON = 0  
 T\_LDM\_INH\_MON = 0  
 ABC\_LDM\_INH\_MON = 0  
**Update Rate:** 40 msec


#### Formula section:

LV\_VAR\_BN\_LDM = 1:

```

IF LV_ERR_LDM_INH_MON = 0
THEN

```

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```

TQ_WHEEL_LDM_MON = TQ_WHEEL_LDM_BN
IF    LV_LDM_ACT = 1                                and
      LV_ERR_BN_LDM = 0                            and
      LV_LDM_LIH_CAN = 0                          and
      LV_ERR_CAN_BOFF = 0                         and
      LV_LDM_OFF_ECU = 0                          and
      LV_CDN_VB_CAN_TQ_DIAG = 1

THEN
  Initialize Timer: T_LDM_INH_MON = C_T_LDM_INH_MON
  IF    (LV_TQ_WHEEL_LDM_REQ= 0)                    OR
        (LV_TQ_WHEEL_LDM_BN_ERR = 1)              OR
        LV_LDM_OFF_ECU_MON = 1                    OR
        ((VB > C_CAN_VB_MIN_DIAG_MON) AND (LV_ERR_CAN_BOFF = 1))
  THEN after debouncing with ABC_LDM_INH_MON
        Inhibit LDM non reversible until the initialization conditions for error bits are fulfilled
        (see application incidences for process monitoring):
        LV_ERR_LDM_INH_MON = 1
        TQ_WHEEL_LDM_MON = -32000Nm
        T_LDM_INH_MON = 0
  ENDIF

ELSE
  IF    T_LDM_INH_MON = 0
  THEN TQ_WHEEL_LDM_MON = -32000Nm
  ELSE Decrement Timer T_LDM_INH_MON
  ENDIF
ENDIF

ELSE
  TQ_WHEEL_LDM_MON = -32000Nm
  T_LDM_INH_MON = 0
ENDIF

```

### E.24.3.2 LDM Plausibility Monitoring

#### FUNCTION DESCRIPTION:

#### Description:

The Conditions for LDM in the function level are divided in reversible and irreversible conditions. This function is monitored in the LDM torque monitoring.


#### Application conditions

**Initialisation:** *all 0 at reset or LV\_IGK 0 - -> 1 or clear FMY*

**Recurrence:** *40 ms*

**Activation:** LV\_TQI\_MON\_ACT\_MON = 1 and  
 LV\_VAR\_BN\_LDM = 1 and  
 LV\_LDM\_CAN\_INI = 0

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**Deactivation:** -

**Formula section:**

```

IF          LV_BRAKE_MON = 1
Then       T_LDM_BRAKE_DET_MONn = T_LDM_BRAKE_DET_MONn-1 + 40 ms
else       T_LDM_BRAKE_DET_MONn = 0 ms
endif
    
```

```

IF          [(T_LDM_BRAKE_DET_MON > C_T_MAX_BRAKE_DET_LDM_MON)
and        STATE_LDM_INTV == 01H ] or
              (LV_LDM_ENA_PLAUS_ERR = 1
and        LC_LDM_ENA_PLAUS_ERR = 1)
Then       LV_ERR_LDM_MON = 1 after debounce
Else       If          LV_ERR_LDM_MON = 0 ("not debounced yet")
Then       rebound counter to 0
Else       LV_ERR_LDM_MON = 0
              after rebound
endif
Endif
    
```

Calculation of LDM irreversible off

```

IF ( LV_ERR_BN_LDM = 1 AND ERR_SYM_BN_LDM = SYM_1 or SYM_3 ) or
      "ONLY ALIVE AND CHECKSUM ERRORS"
      LV_TQI_REQ_CAN_INH = 1 or
      LV_ERR_PVS = 1 or
      LV_ERR_LDM_MON = 1
Then LV_LDM_OFF_ECU_1_MON = 1 //LDM irreversible off
Endif
    
```

Calculation of reversible off

```

IF ( LV_ERR_BN_LDM = 1 AND ERR_SYM_BN_LDM = SYM_2 ) or
      "only timeout"
      LV_ERR_BLS_PLAUS = 1 or
      LV_ERR_CS = 1 or
      LV_ERR_CRK = 1 or
      LV_DI_TQ_REQ_CAN_MPI_GDI = 1 or
      LV_ETCU_DISABLE_CAN = 1
Then LV_LDM_OFF_ECU_2_MON = 1 //LDM reversible LDM off
Else LV_LDM_OFF_ECU_2_MON = 0
Endif
    
```

**IF** LV\_LDM\_OFF\_ECU\_1\_MON = 1 **or** LV\_LDM\_OFF\_ECU\_2\_MON = 1

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```

Then    LV_LDM_OFF_ECU_MON = 1
Else    LV_LDM_OFF_ECU_MON = 0
Endif
    
```

## E.24.4 AMT monitoring

### E.24.4.1 AMT torque monitoring

#### Application conditions

```

Activation:          LV_TQI_MON_ACT_MON = 1
Deactivation:       otherwise
Initialization:    TQI_AMT_MON = 0
                        LV_ERR_AMT_INH_MON = 0
                        T_AMT_INH_MON = 0
                        ABC_AMT_INH_MON = 0
                        TQ_AMT_MON = -1024 Nm
    
```

**Update Rate:** 40 msec

LV\_VAR\_BN = 0:

```

IF LV_ERR_AMT_INH_MON = 0
THEN
    TQI_AMT_MON = C_TQI_STND_MON * TQI_AMT_REQ_CAN
    IF LV_AMT_INC_ACT = 1 and
        LV_TQI_REQ_CAN_INH = 0 and
        LV_ERR_TOUT_AMT_1 = 0 and
        LV_AMT_LIH_CAN = 0 and
        LV_DI_TQ_REQ_CAN_MPI_GDI = 0 and
        LV_CDN_VB_CAN_TQ_DIAG = 1

    THEN
        Initialize Timer: T_AMT_INH_MON = C_T_AMT_INH_MON
        IF (LV_TQ_AMT_INC_REQ = 0) OR
            TQI_AMT_REQ_CAN = FFH OR
            (STATE_ERR_AMT_MON > 00H) OR
            for C_T_DLY_AMT_INH_MON) OR
            ((VB > C_CAN_VB_MIN_DIAG_MON) AND (LV_ERR_CAN_BOFF=1))
        THEN after debouncing with ABC_AMT_INH_MON
            Inhibit AMT non reversible until the initialization conditions for error bits are fulfilled
            (see application incidences for process monitoring):
            LV_ERR_AMT_INH_MON = 1
            TQI_AMT_MON = 0
            T_AMT_INH_MON = 0
        ENDIF

    ELSE
        IF (T_AMT_INH_MON = 0)
        THEN TQI_AMT_MON = 0
        ELSE Decrement Timer T_AMT_INH_MON
        ENDIF

ENDIF
    
```

```

ELSE
    TQI_AMT_MON = 0
    T_AMT_INH_MON = 0
ENDIF

```

LV\_VAR\_BN = 1:

```


IF LV_ERR_AMT_INH_MON = 0
THEN
    TQ_AMT_MON = TQ_AMT_FAST_BN
    IF LV_AMT_INC_ACT = 1                                and
        LV_ERR_BN_TQ_AMT = 0                            and
        LV_ERR_BN_ETCU = 0                              and
        LV_TQI_REQ_CAN_INH = 0                          and
        LV_AMT_LIH_CAN = 0                              and
        LV_DI_TQ_REQ_CAN_MPI_GDI = 0                    and
        LV_CDN_VB_CAN_TQ_DIAG = 1
    THEN
        Initialize Timer: T_AMT_INH_MON = C_T_AMT_INH_MON
        IF (LV_TQ_AMT_INC_REQ = 0)                       OR
            (TQ_AMT_FAST_BN = 8000H)                   OR
            (TQ_AMT_SLOW_BN = 8000H)                   OR
            (STATE_ERR_AMT_MON > 00H)                   OR
            for C_T_DLY_AMT_INH_MON                     OR
            ((VB > C_CAN_VB_MIN_DIAG_MON) AND (LV_ERR_CAN_BOFF = 1))
        THEN after debouncing with ABC_AMT_INH_MON
            Inhibit AMT non reversible until the initialization conditions for error bits are fulfilled
            (see application incidences for process monitoring):
            LV_ERR_AMT_INH_MON = 1
            TQ_AMT_MON = -1024 Nm
            T_AMT_INH_MON = 0
        ENDIF
    ELSE
        IF (T_AMT_INH_MON = 0)
        THEN TQ_AMT_MON = -1024 Nm
        ELSE Decrement Timer T_AMT_INH_MON
        ENDIF
    ENDIF
ELSE
    TQ_AMT_MON = -1024 Nm
    T_AMT_INH_MON = 0
ENDIF

```

The CAN-interface is directly checked for the CAN-Bus OFF fault

Anti-bounce counter: ABC\_AMT\_INH\_MON  
 Anti-bounce counter increment: C\_ABC\_INC\_AMT\_INH\_MON  
 Anti-bounce counter maximum: C\_ABC\_MAX\_AMT\_INH\_MON

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## E.24.4.2 AMT plausibility monitoring

### FUNCTION DESCRIPTION:

#### General information:

To suppress incorrect Torque request of transmission unit a monitoring of messages is done.

#### Application conditions

**Initialization:** 0  
**Recurrence:** 40 ms  
**Activation:** LV\_TQI\_MON\_ACT\_MON = 1 and LV\_IGK\_MON = 1

#### Signal flow diagram:

The structure is like the Level 1 function "AMT intervention plausibility"

#### Formula section:

```

if LV_VAR_BN = 0
Then TQI_AMT_PLAUS_MON = TQI_AMT_MON
Else IF LV_TQ_AMT_DEC_REQ = 1
    Then TQI_AMT_PLAUS_MON = TQI_AMT_FAST_DEC
else TQI_AMT_PLAUS_MON = TQI_AMT_FAST_INC
endif
    
```

#### Plausibility of shift phase:

```

if LV_GS = 0
Then if STATE_AMT = 0 and (TQI_AMT_PLAUS_MON <
    C_TQI_AMT_COND_DIAG_MON)
    Then STATE_ERR_AMT_MON = 00H
    Else STATE_ERR_AMT_MON = 01H
End if
Else if STATE_AMT = 0
    Then if LV_AMT_ES > 0
        Then if TQI_AMT_PLAUS_MON < C_TQI_AMT_CAN_ES_MON and
            VS_FIL < C_VS_FIL_AMT
            Then STATE_ERR_AMT_MON = 00H ; LV_AMT_ES_REQ = 1
            Else STATE_ERR_AMT_MON = 10H
            End if
        Else STATE_ERR_AMT_MON = 11H
        End if
    Else if STATE_AMT = 1
        Then if STATE_AMT_OLD_MON = 1
            Then T_STATE_AMT_1_DIAG_MON = T_STATE_AMT_1_DIAG_MON + 40 ms

        Else T_STATE_AMT_1_DIAG_MON = 0
            T_TQI_AMT_DIAG_MON = 0
        End if
    
```


```

Else if STATE_AMT = 2
  Then if STATE_AMT_OLD_MON = 2
    Then T_STATE_AMT_2_DIAG_MON = T_STATE_AMT_2_DIAG_MON
        +
                                                40 ms
    Else T_STATE_AMT_2_DIAG_MON = 0
        T_STATE_CLU_AMT_DIAG_MON = 0
    End if
  Else if STATE_AMT_OLD_MON = 3
    Then T_STATE_AMT_3_DIAG_MON = T_STATE_AMT_3_DIAG_MON
        +
                                                40 ms
    Else T_STATE_AMT_3_DIAG_MON = 0
        T_TQI_AMT_DIAG_MON = 0
    End if

If T_STATE_AMT_1_DIAG_MON > C_T_MAX_STATE_AMT_1_DIAG_MON OR
  T_STATE_AMT_2_DIAG_MON > C_T_MAX_STATE_AMT_2_DIAG_MON OR
  T_STATE_AMT_3_DIAG_MON > C_T_MAX_STATE_AMT_3_DIAG_MON
Then STATE_ERR_AMT_MON = 20H
Else if STATE_AMT = 1 or 3
  Then if TQI_AMT_PLAUS_MON >
        MAX(TQI_REQ_TRA_FAST; -1* TQ_LOSS_MON; TQI_MSR_FAST;
            TQI_DCC_FAST_INC; (TQ_SP_WHEEL/GR_DT)) +
        C_TQI_AMT_DIAG_MON
    Then T_TQI_AMT_PLAUS_MON_DIAG =
        T_TQI_AMT_DIAG_MON + 40 ms
    else T_TQI_AMT_PLAUS_MON_DIAG =
        T_TQI_AMT_DIAG_MON
    End if

    If T_TQI_AMT_PLAUS_MON_DIAG >
        C_T_MAX_TQI_AMT_DIAG_MON
    Then STATE_ERR_AMT_MON = 21H
    Else STATE_ERR_AMT_MON = 00H
    End if
  Else if STATE_CLU_AMT = 3
    Then T_STATE_CLU_AMT_DIAG_MON =
        T_STATE_CLU_AMT_DIAG_MON + 40
        ms
    Else T_STATE_CLU_AMT_DIAG_MON =
        T_STATE_CLU_AMT_DIAG_MON
    End if
    if T_STATE_CLU_AMT_DIAG_MON >
        C_T_MAX_STATE_CLU_AMT_DIAG_MON
    Then STATE_ERR_AMT_MON = 22H
    Else STATE_ERR_AMT_MON = 00H
    End if
  End if
End if
End if
End if

```

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**End if**

```

-----
STATE_AMT_OLD_MON = STATE_AMT
The flag LV_AMT_ES_REQ will be set until the end of driving cycle
IF LV_ES = 1 and LV_IGK_MON = 0 to 1
Then LV_AMT_ES_REQ = 0
Endif
    
```

Plausibility of Torque intervention about message counter:

```

IF ERR_SYM_TOUT_AMT_1 or BN_TQ_AMT or BN_ETCU = "SYM_2"
Then STATE_ERR_AMT_MON = 40H (timeout CAN)
Else if ERR_SYM_TOUT_AMT_1 or BN_TQ_AMT or BN_ETCU = "SYM_1"
    Then STATE_ERR_AMT_MON = 50H (timeout CAN)
    Else if ERR_SYM_TOUT_AMT_1 or BN_TQ_AMT or BN_ETCU = "SYM_3"
        then STATE_ERR_AMT_MON = 30H (timeout CAN)
        else STATE_ERR_AMT_MON remains
    
```

**endif**

**E.24.5 GS monitoring**

**E.24.5.1 GS torque monitoring**

**FUNCTION DESCRIPTION:**

General information:

The torque demands received by the CAN-bus are monitored.  
The input signals are read direct from CAN.

**Application conditions**

**Activation:** LV\_TQI\_MON\_ACT\_MON = 1 **and** (LV\_AT = 1 **or** LV\_VAR\_TCT = 1)

**Deactivation:** otherwise

**Initialization:** TQI\_GS\_MON = 0  
 LV\_ERR\_GS\_INH\_MON = 0  
 T\_GS\_INH\_MON = 0  
 ABC\_GS\_INH\_MON = 0  
 TQ\_GS\_MON = -1024 Nm

**Update Rate:** 40 msec


**Formula section:**

LV\_VAR\_BN = 0:

```

IF LV_ERR_GS_INH_MON = 0
THEN
    TQI_GS_MON = C_TQI_STND_MON * TQI_GS_FAST_REQ_CAN
    IF LV_GS_INC_ACT = 1 and
        LV_DI_TQ_REQ_CAN_MPI_GDI = 0 and
        LV_ETCU_LIH_CAN = 0 and
        LV_ERR_TOUT_ETCU_1 = 0 and
        LV_ERR_TOUT_ETCU_2 = 0
    
```

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```

LV_TQI_REQ_CAN_INH      = 0          and
LV_CDN_VB_CAN_TQ_DIAG  = 1

```

**THEN**

```

Initialize Timer: T_GS_INH_MON = C_T_GS_INH_MON

```

```

IF      (LV_TQ_GS_INC_REQ = 0)          OR
          (TQI_GS_FAST_REQ_CAN = FFH)    OR
          [(VB > C_CAN_VB_MIN_DIAG_MON) AND (LV_ERR_CAN_BOFF=1)]
          for C_T_DLY_GS_INH_MON}

```

```

THEN after debouncing with ABC_GS_INH_MON

```

```

Inhibit GS non reversible until the initialization conditions for error bits are fulfilled
(see application incidences for process monitoring):

```

```

LV_ERR_GS_INH_MON = 1
TQI_GS_MON = 0
T_GS_INH_MON = 0

```

**ENDIF**

**ELSE**

```

IF      T_GS_INH_MON = 0
THEN TQI_GS_MON = 0
ELSE Decrement Timer T_GS_INH_MON
ENDIF

```

**ENDIF**

**ELSE**

```

TQI_GS_MON = 0
T_GS_INH_MON = 0

```

**ENDIF**

LV\_VAR\_BN = 1:

```

IF LV_ERR_GS_INH_MON = 0

```

**THEN**

```

TQ_GS_MON = TQ_GS_FAST_BN

```

```

IF      LV_GS_INC_ACT          = 1          and
          LV_ERR_BN_TQ_ETCU      = 0          and
          LV_ERR_BN_ETCU         = 0          and
          LV_ETCU_LIH_CAN        = 0          and
          LV_TCT_LIH_CAN         = 0          and
          LV_TQI_REQ_CAN_INH     = 0          and
          LV_DI_TQ_REQ_CAN_MPI_GDI = 0          and
          LV_CDN_VB_CAN_TQ_DIAG  = 1

```

**THEN**

```


Initialize Timer: T_GS_INH_MON = C_T_GS_INH_MON

```

```

IF      (LV_TQ_GS_INC_REQ = 0)          OR
          (TQ_GS_FAST_BN = 8000H)        OR
          (TQ_GS_SLOW_BN = 8000H)        OR
          [(VB > C_CAN_VB_MIN_DIAG_MON) AND (LV_ERR_CAN_BOFF=1)]
          for C_T_DLY_GS_INH_MON}

```

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```

THEN after debouncing with ABC_GS_INH_MON
        Inhibit GS non reversible until the initialization conditions for error bits are fulfilled
        (see application incidences for process monitoring):
        LV_ERR_GS_INH_MON = 1
        TQ_GS_MON = -1024 Nm
        T_GS_INH_MON = 0
ENDIF

ELSE
        IF T_GS_INH_MON = 0
        THEN TQ_GS_MON = -1024 Nm
        ELSE Decrement Timer T_GS_INH_MON
        ENDIF
ENDIF

ELSE
        TQ_GS_MON = -1024 Nm
        T_GS_INH_MON = 0
ENDIF

```

The CAN-interface is directly checked for the CAN-Bus OFF fault

```

Anti-bounce counter:          ABC_GS_INH_MON
Anti-bounce counter increment: C_ABC_INC_GS_INH_MON
Anti-bounce counter maximum:  C_ABC_MAX_GS_INH_MON

```

## E.25 Monitoring of engine speed

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_N_32_MON	V	0... FFH	0... 255	1	-
Anti bounce counter N_32 ratio error					
LV_ERR_N_32_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for ratio error between N_32 and N_32_SUB_MON					
N_32_DIF_REL_MON	V	0... FFFFH	0... 255	3.8911e-3	-
Relative engine speed deviation monitoring level					
N_32_MON	O/V	0... FFH	0... 8160	32	rpm
Engine speed (monitoring level)					
N_32_SUB_MON	V	0... FFH	0... 8160	32	rpm
Engine speed substitute monitoring level					
T_SEG_SW_MON	O/V	0... FFFFFFFFH	0... 268435	1	µs
Timer for engine speed monitoring					

### Input data:

N_32 {p. 1525}			
----------------	--	--	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_N_32_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment (additive value in case of N_32 ratio error)					
C_ABC_MAX_N_32_MON	-	1... FFH	1... 255	1	-
Value at which N_32 ratio error is recognized, when reached					
C_N_32_DIF_REL_MAX_MON	-	0... FFFFH	0... 255	3.8911e-3	-
Maximum relative difference between N_32 and N_32_SUB_MON					
C_N_32_LIM_MON	-	1... FFH	32... 8160	32	rpm
Lower limit of denominator for relative error calculation (initial value: 32)					
C_N_32_MIN_MON	-	0... FFH	0... 8160	32	rpm
Lower limit for using the relative error concept					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_T_SEG_N_32_CLC	-	0... FFFFFFFFH	0 ...0	32	rpm*µs
Non calibratable data for N_32_SUB_MON calculation					

### Import actions:

<b>ACTION_ECM3_Service10TaskPfm</b> (IN<No Name available>)
<b>ACTION_ECM3_Service11TaskPfm</b> (IN<No Name available>)
<b>ACTION_ECM3_Service9TaskPfm</b> (IN<No Name available>)

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 1.

ACTION\_ECM3\_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION\_ECM3\_Service9TaskPfm() and ACTION\_ECM3\_Service10TaskPfm().

ACTION\_ECM3\_WriteChkCpl(INOUT <>, OUT <>, IN <>)  
 ACTION\_ECM3\_ChkCpl(IN <>, IN <>)  
 ACTION\_ECM3\_ReadChkCpl(OUT <>, IN <>, IN <>)

Note: All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

ACTION\_INFR\_GetTSEGSWMON(OUT <>)

**Note:** This action is defined in chapter "Basic SW Inputs and Outputs " (IRS).

### E.25.1 FUNCTION PART: ECM2\_DTSYSN

#### General information:

The comparison of the engine speed N\_32 to an engine speed substitute N\_32\_SUB\_MON, calculated in the monitoring level, performs the monitoring of the engine speed used in the monitoring level.

N\_32\_SUB\_MON is calculated from a segment timing information that is generated by a software timer solution in the BSW (T\_SEG\_SW\_MON). The software timer is triggered by crankshaft segments and produces time stamps for the trigger events. From these timing informations the signal T\_SEG\_SW\_MON is determined (resolution: 1µs).

The engine speed signals N\_32 and N\_32\_SUB\_MON are compared to each other by means of a relative deviation. The ratio of the difference of N\_32 and N\_32\_SUB\_MON related to the minimum of the two values is not allowed to deviate more than the maximum difference C\_N\_32\_DIF\_REL\_MAX\_MON. Otherwise a process fault is assumed. Since for a small engine speed the relative error concept is leading to a rather small permitted absolute difference between N\_32 and N\_32\_SUB\_MON, the monitoring could be too tight here. Therefore, as soon as both engine speed signals are smaller than a limit C\_N\_32\_MIN\_MON, the relative error is calculated by relating the absolute difference to the constant C\_N\_32\_LIM\_MON.


On an error free system N\_32 is copied to N\_32\_MON. If an engine speed error is detected, the maximum value of N\_32 and N\_32\_SUB\_MON is copied to N\_32\_MON to prevent from a sleeping fault in the module Monitoring of engine speed limitation .

**Note:** This version of engine speed monitoring is for systems where a second hardware timer, which in other versions was delivering the signal SEG\_T\_MES, is not available on the ECU and where the missing timer is substituted by a software timer solution in the BSW.

For configuration data:

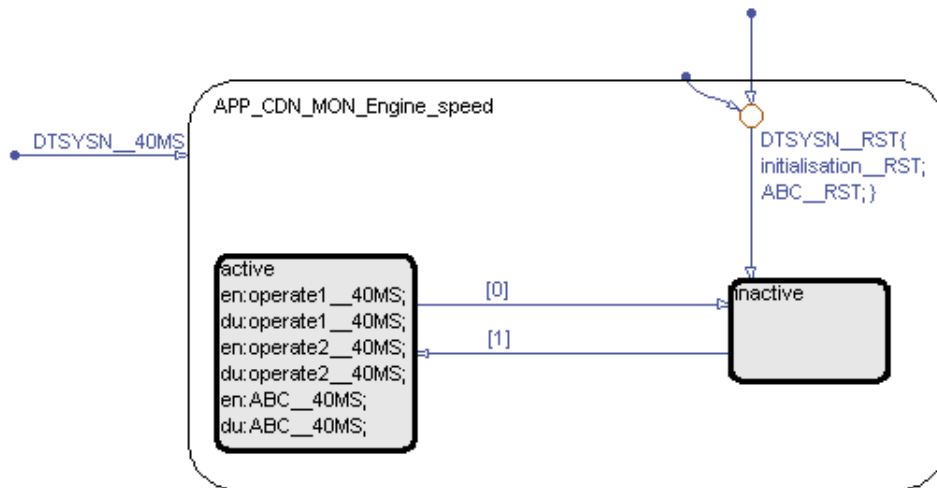
NC\_T\_SEG\_N\_32\_CLC is a constant for the calculation of N\_32\_SUB\_MON from T\_SEG\_SW:  
 UNSUPPORTED IMAGE FORMAT

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with `NC_CYL_NR` : number of cylinders

**Application Condition**



**Note:** DTSYSN\_\_RST includes the function calls as defined in application incidences.

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## Function Description

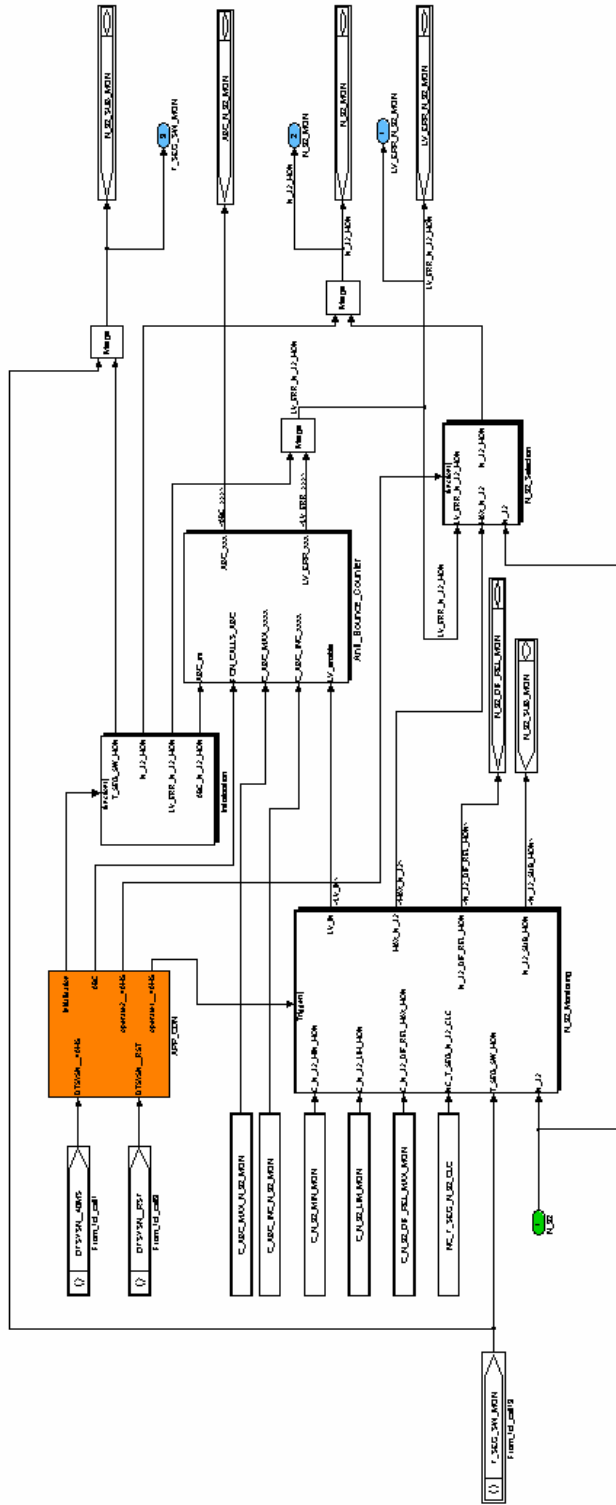


Figure E.25.1: ECM2\_DTSYSN

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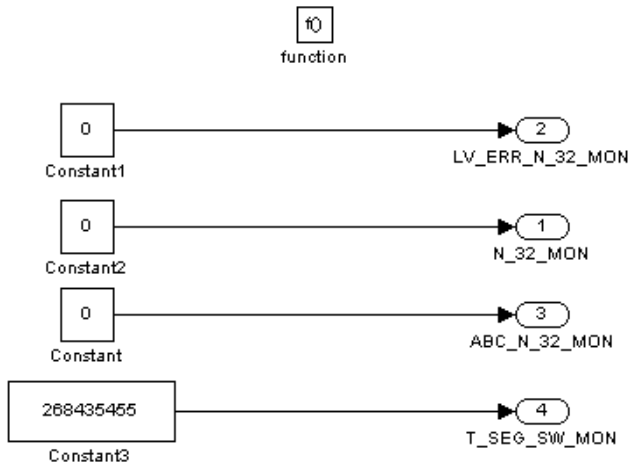


Figure E.25.2: ECM2\_DTSYSN/INITIALISATION

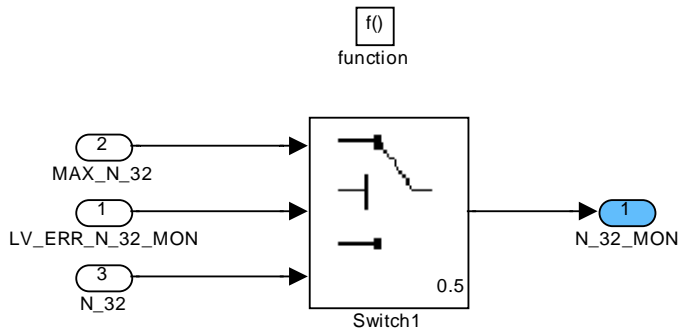


Figure E.25.3: ECM2\_DTSYSN/N\_32\_MON\_Selection

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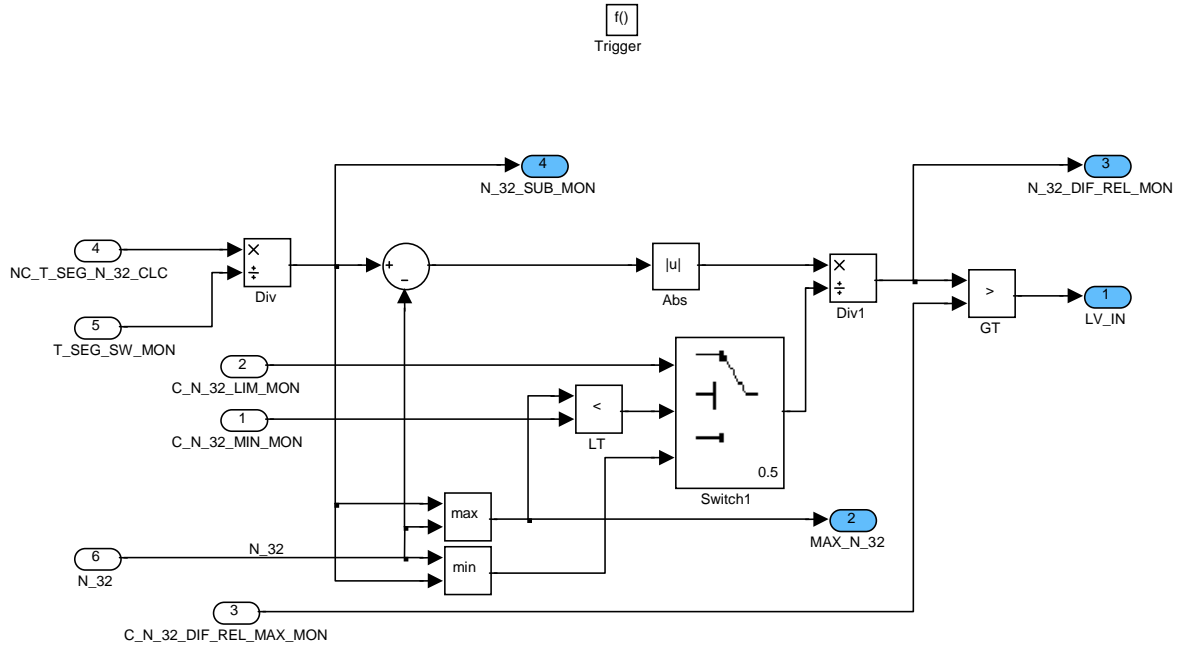


Figure E.25.4: ECM2\_DTSYSN/N\_32\_MONITORING

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## E.26 Process monitoring

### Input data:

LV_DIAG_END_RLY_ MAIN_DLY {p. 4933}	LV_RLY_MAIN_DLY_ERR {p. 4933}		
---	----------------------------------	--	--

### Import actions:

ACTION_ECM3_ServicePfm (IN<No Name available>)
--

**Note:** This action is defined in chapter "Processor Monitoring", subsection "Program Flow Monitoring services for Process Monitoring". This action has to be executed as last instruction after all tasks have been executed. After the first block of tasks, the action has to be called with argument 1, after the second with 2, after the third with 3 and after the fourth with 4. At the very end of the scheduler finally the action has to be called with argument 0, 6, and 7.

ACTION_ECM2_LockPws()
ACTION_ECM2_UnlockPws()

**Note:** These two actions are defined in module "Fault Reaction of process monitoring".

### General information:

The task of process monitoring is to check whether ETC /torque functions (located in function level) work properly and to take a fault reaction, if not. This is described in the following modules:

#### 1. Limitation of Negative Temperature Gradient

Engine Losses depend on engine temperature (indicated by TOIL or TCO). Cold temperature means big losses. These losses are compensated by the torque structure. This means faults like a temperature step from hot to cold within permitted signal range lead to miscompensation of losses (undesired torque increase). To avoid this, the max. negative temperature gradient is limited to (small) values, given by physics.

#### 1. Monitoring Sensor Signals

Sensor Signals (PVS, TPS) are checked a second time in process monitoring. This is done by using bigger tolerances and longer debouncing times. Having detected a fault in process monitoring, but not in function level, means a faulty function level. Fault reaction is done as described below. A fault, detected in function level earlier than in process monitoring or at the same time, means normal working of function level, therefore standard reaction of function level is done.

#### 1. Monitoring CAN Signals

CAN signals are only checked against protocol (parity bit, message counter, ...). No plausibilisation of values is possible. CAN monitoring performed in process monitoring is a subset of CAN monitoring performed in function level.

#### 1. Monitoring Internal Signals

Internal signals (engine speed, torque demand of idle speed controller, torque demand of Cruise Control, cylinder-cut-off efficiency, ...) are partly moved from function level to process monitoring as value and its complement (engine speed); partly a plausibility check of the values is done (Cruise Control request) or the values are computed a second time (idle speed controller). Fault reaction is done as described below.

#### 1. Torque Monitoring

The desired maximum indicated engine torque is calculated from individual torque requests and compared to the actual indicated engine torque, calculated from MFF, engine speed, ignition angle- and



other efficiencies. If the actual torque exceeds the desired torque by more than a certain threshold, a fault reaction is done as described below.

1. Fault Reaction

Standard fault reaction of process monitoring is disabling of throttle actuator and engine speed limitation, commanded to function level. As function level is detected to be faulty, the commanded limitation is monitored and if it is not realized properly, a command is given to send wrong answers to the monitoring processor. This means, the monitoring processor will cut off throttle actuator and injector valves directly.

In case of faults detected when transmitting values and their complement (fault in memory or in instruction set), powerstages are disabled and a reset is performed.

**Formula Section:**

```

IF          LV_DIAG_END_RLY_MAIN_DLY == 1  AND  LV_RLY_MAIN_DLY_ERR == 0
THEN
    ACTION_ECM2_UnlockPws();
    /* Hasto be executed exactly once! */
    Tasks/ECM2-functions activated according to table 1 starting with task "1";
ELSE
    ACTION_ECM2_LockPws();
ENDIF
    
```

**E.26.1 Task scheduler**

The process monitoring functionality is executed with an update rate of 40 ms. In order to achieve a balanced computational load of the controller, the functionality of the process monitoring is divided into 4 tasks (see following Table 1). For each task the first called module is the related part of Application Incidences of process monitoring.

**Table 1:** Distribution of the process monitoring functionality over four tasks. The task scheduler is executed every 10 ms. Within one task, the different functions are executed in the order according to the rows of the table.

Task 1 (k)	Task 2 (k+10 ms)	Task 3 (k+20 ms)	Task 4 (k+30 ms)
Application incidences of process monitoring(k)	Application incidences of process monitoring(k+10ms)	Application incidences of process monitoring(k+20ms)	Application incidences of process monitoring(k+30ms)
Monitoring of A/D-conversion	Monitoring of pedal value signals	Monitoring of engine speed limitation	Actual indicated engine torque
Monitoring of TCO		Monitoring of CAN signals	Desired indicated engine torque
Monitoring of engine speed	Monitoring of torque losses	Monitoring of cruise control conditions	Monitoring of actual indicated engine torque
Monitoring of idle speed controller	Monitoring of maximum torque at clutch	Monitoring of minimum torque at clutch	Fault reaction of process monitoring
Actual Fuel Mass Flow	Actual lambda deviation	Actual efficiencies	Combustion mode switch request
ACTION_ECM3_ServicePfm(1)	Monitoring of Mass Fuel Flow		ACTION_ECM3_ServicePfm(4)
ACTION_ECM3_ServicePfm(0)	ACTION_ECM3_ServicePfm(2)	ACTION_ECM3_ServicePfm(3)	Error memory management of process monitoring
	ACTION_ECM3_ServicePfm(0)	ACTION_ECM3_ServicePfm(0)	ACTION_ECM3_ServicePfm(0)

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## E.27 Processor monitoring by copy of process monitoring

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_SWI_AFS_TQI_MON2	V	0... FFH	0... 255	1	-
Anit bounce counter for request to AFS (TQI_DIF above allowed threshold)					
ABC_TQI_AV_AFS_MON2	V	0... FFH	0... 255	1	-
Anti bounce counter for fault in torque generation (AFS mode)					
ABC_TQI_N_MAX_MON2	V	0... FFH	0... 255	1	-
Anti bounce counter for fault in engine speed limitation					
EFF_IGA_HOM_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
ignition efficiency in homogeneous (process monitoring)					
EFF_IGA_HOMS_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
ignition efficiency in multiple homogeneous stratified (process monitoring)					
EFF_IGA_S_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
ignition efficiency in stratified (process monitoring)					
EFF_LAMB_HOM_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
lambda efficiency in homogeneous (process monitoring)					
EFF_LAMB_HOMS_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
lambda efficiency in homogeneous stratified (process monitoring)					
EFF_LAMB_S_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
lambda efficiency in stratified homogeneous (process monitoring)					
EFF_MFF_TQ_COR_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
efficiency on torque relevant mass fuel flow					
EFF_TOT_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
total actual efficiencies					
FAC_TQ_REQ_CRU_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
Torque demand from cruise control					
FAC_TQ_REQ_DRIV_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
Scaling factor for requested torque at clutch from driver					
FAC_TQ_REQ_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
Scaling factor for requested torque at clutch from driver and cruise control					
IGA_DIF_AV_H_RNG_HOM_MON2	V	0... B40H	0 ...0	0.0625	°CRK
difference from reference to actual ignition angle in homogeneous (process monitoring)					
IGA_DIF_AV_H_RNG_HOMS_MON2	V	0... B40H	0 ...0	0.0625	°CRK
difference from reference to actual ignition angle in homogeneous stratified (process monitoring)					
IGA_IGC_H_RNG_MON2 [NC_CYL_NR]	V	FA60... 5A0H	0... 90	0.0625	°CRK
Actual ignition angle high range					
IGA_REF_HOM_COR_EXT_MON2	V	FA60... 5A0H	0... 90	0.0625	°CRK
Correction of reference ignition angle in homogeneous (for external functions e.g. VVT, EGR...)					
IGA_REF_HOMS_COR_EXT_MON2	V	FA60... 5A0H	0... 90	0.0625	°CRK
Correction of reference ignition angle in homogeneous stratified (for external functions e.g. VVT, EGR...)					
LAMB_MON2	V	0... 7FFFH	0... 31.9990234	97.6563e3	-
Modeled Lambda					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LF_4_MON2	V	0... FFH	0... 255	1	-
Byte of logical starting values 4					
LV_DR_OFF_MU_MON2	V	0... 1H	0 ...1	1	-
Request for wrong answers of the level 2 test calculations to the monitoring unit in order to disable MTC and IV					
LV_ERR_CONV_MON2	V	0... 1H	0 ...1	1	-
Fault in A/D conversion present					
LV_ERR_MFF_MON2	V	0... 1H	0 ...1	1	-
Logical variable for error in mass fuel flow signal					
LV_ERR_MU_MC_MON2	V	0... 1H	0 ...1	1	-
Fault detected by processor monitoring (continuous)					
LV_ERR_N_32_MON2	V	0... 1H	0 ...1	1	-
Fault in engine speed present					
LV_ERR_OPM_AV_MON2	V	0... 1H	0 ...1	1	-
Level2 error for wrong plausibilisation of engine operation mode					
LV_ERR_PVS_MON2	V	0... 1H	0 ...1	1	-
Fault in pedal value signal present					
LV_ERR_TMP_MU_MC_MON2	V	0... 1H	0 ...1	1	-
Fault detected by processor monitoring (temporary)					
LV_ERR_TPS_MON2	V	0... 1H	0 ...1	1	-
Fault in TPS present					
LV_ERR_TQ_DIF_I_IS_MON2	V	0... 1H	0 ...1	1	-
Fault currently present in torque generation, symptom "idle speed controller I part"					
LV_ERR_TQ_DIF_P_D_IS_MON2	V	0... 1H	0 ...1	1	-
Fault currently present in torque generation, symptom "idle speed controller PD part"					
LV_ERR_TQ_LOSS_MON2	V	0... 1H	0 ...1	1	-
Fault in torque losses present					
LV_ERR_TQ_MAX_CLU_MON2	V	0... 1H	0 ...1	1	-
Fault currently present in torque generation, symptom "maximum torque at clutch"					
LV_ERR_TQ_MIN_CLU_MON2	V	0... 1H	0 ...1	1	-
Fault currently present in torque generation, symptom 'minimum torque at clutch					
LV_ERR_TQI_AV_MON2	V	0... 1H	0 ...1	1	-
Fault currently present in torque generation					
LV_ERR_TQI_N_MAX_MON2	V	0... 1H	0 ...1	1	-
Fault currently present in engine speed limitation					
LV_ERR_TRAN_1_MON2	V	0... 1H	0 ...1	1	-
Flag for temporary fault 1 (exclusive fault of L3) during last recurrency					
LV_ERR_TRAN_2_MON2	V	0... 1H	0 ...1	1	-
Flag for temporary fault 2 (together with fault of L2) during last recurrency					
LV_N_LIM_ETC_MON2	V	0... 1H	0 ...1	1	-
Engine speed limitation request					
LV_N_LIM_REQ_MON2	V	0... 1H	0 ...1	1	-
Request for engine speed limitation					
LV_OFF_IV_MON2	V	0... 1H	0 ...1	1	-
Request for disable of IV power stage by main controller					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_OFF_IV_N_LIM_ETC_MON2	V	0... 1H	0 ...1	1	-
Reversible fuel Cut Off Switch for all cylinders					
LV_OFF_IV_N_LIM_ETC_TMP_MON2	V	0... 1H	0 ...1	1	-
Flag for temporary injection cut off during last recurrency					
LV_OFF_MTC_MON2	V	0... 1H	0 ...1	1	-
Request for disable of MTC power stage by main controller					
LV_SWI_AFS_TQI_MON2	V	0... 1H	0 ...1	1	-
Switch to AFS (TQI_DIF above allowed threshold)					
LV_SWI_FAC_TQ_REQ_MON2	V	0... 1H	0 ...1	1	-
logical variable for switching to other factors for requested torque at clutch					
LV_TQI_MON_ACT_MON2	V	0... 1H	0 ...1	1	-
Logical variable for torque monitoring active					
MFF_LAMB_REF_IGA_MON2	V	0... FFFFH	0... 1389	0.02119478	mg/stk
Lambda relevant Mass Fuel Flow for stoichiometric conditions corrected by SCAV for EFF_IGA_MON					
MFF_TQ_MON2	V	0... FFFFH	0... 1389	0.02119478	mg/stk
Torque relevant Mass Fuel Flow					
N_32_MON2	V	0... FFH	0... 8160	32	rpm
Engine speed					
OPM_AV_MON2	V	1H 2H 3H 8H	S AFS AFL LIH	-	-
actual engine operation mode (process monitoring)					
PREV_STATE_IV_MON2	V	0... FFH	0... 255	1	-
State of injection valves at previous cycle					
PV_AV_AD_MON2	V	0... FFH	0... 99.609375	0.390625	%
Pedal value adaptation					
RESP_MON2	O/V	0... FFFFH	0... 65535	1	-
Answer of copy of process monitoring (Level 2)					
T_TQI_MON2	V	0... FFH	0... 10.2	0.04	s
Dead time for delay of desired indicated engine torque					
TQ_DIF_P_D_IS_MON2	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
P and D controller output for idle speed control					
TQ_DROF_MON2	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Torque demand from drive off assistant					
TQ_LOSS_MON2	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Torque losses					
TQ_MAX_CLU_MON2	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Monitored maximum torque at clutch					
TQ_MIN_CLU_MON2	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Monitored minimum torque at clutch					
TQI_AV_MON2	V	0... FFH	0... 510	2	Nm
Actual indicated engine torque (process monitoring)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQI_DIF_AV_MON2	V	0... FFH	0... 510	2	Nm
deviation between actual and desired indicated engine torque					
TQI_DIF_MAX_MON2	V	0... FFH	0... 510	2	Nm
Permitted deviation between actual and desired indicated engine torque					
TQI_DIF_SP_MON2	V	0... FFH	0... 510	2	Nm
deviation between torque setpoint and desired indicated engine torque					
TQI_INC_EXT_MON2	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
External torque request					
TQI_MIN_PU_MON2	V	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque for trailing throttle					
TQI_REQ_TOT_MON2	V	0... FFH	0... 510	2	Nm
Desired non delayed indicated engine torque					
TQI_SP_MON_MON2	V	0... FFH	0... 510	2	Nm
Desired indicated engine torque					
TQI_SP_MON2	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Setpoint indicated engine torque (function level)					

**Input data:**


NC_CYL_NR {p. 1526}	NC_TEST_REC_IDX_MAX_MON2 {p. 7101}	TEST_REC_IDX_MON2 {p. 7100}	
---------------------	---------------------------------------	--------------------------------	--

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_SWI_AFS_TQI_MON2	-	0... FFH	0... 255	1	-
ABC increment for request to AFS (TQI_DIF above allowed threshold)					
C_ABC_INC_TQI_AV_AFS_MON2	-	0... FFH	0... 255	1	-
ABC increment at TQI_DIF above allowed threshold (AFS mode)					
C_ABC_INC_TQI_N_MAX_MON2	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_MAX_SWI_AFS_TQI_MON2	-	1... FFH	1... 255	1	-
Value at which OPM will be switched to AFS at TQI_DIF above allowed threshold					
C_ABC_MAX_TQI_AV_AFS_MON2	-	1... FFH	1... 255	1	-
Value at which TQI_AV_MON error is recognized. when reached (AFS mode)					
C_ABC_MAX_TQI_N_MAX_MON2	-	1... FFH	1... 255	1	-
Maximum value of anti bounce counter					
C_CRLC_TQI_SP_MON2	-	0... FFH	0... 0.99609375	0.00390625	-
filter constant for realization of first order filter					
C_GAIN_TQI_DIF_MAX_MON2	-	0... FFH	0... 63.75	0.25	-
Factor for threshold diagnosis with TQI_SP					
C_N_MAX_MTC_LIH_THD_MON2	-	0... FFH	0... 8160	32	rpm
Speed threshold for the detection of a fault in the engine speed limitation					
C_STATE_RESP_MON2_RST_ACT_MON2	-	0... FFH	0... 255	1	-
Constant for reset activation via L2					
C_T_TQI_MON2	-	0... FFH	0... 10.2	0.04	s
Dead time for torque decrease					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_ABC_SWI_AFS_TQI_MON2	O/S	0... FFH	0... 255	1	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Anit bounce counter for request to AFS (TQI_DIF above allowed threshold)					
ID_ABC_TQI_AV_AFS_MON2	O/S	0... FFH	0... 255	1	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Anti bounce counter for fault in torque generation (AFS mode)					
ID_ABC_TQI_N_MAX_MON2	O/S	0... FFH	0... 255	1	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Anti bounce counter for monitoring of engine speed limitation					
ID_EFF_MFF_TQ_COR_MON2	O/S	0... FFH	0... 1.9921875	0.0078125	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
efficiency on torque relevant mass fuel flow					
ID_FAC_TQ_REQ_CRU_MON2	O/S	0... FFH	0... 1.9921875	0.0078125	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Torque demand from cruise control					
ID_IGA_IGC_H_RNG_MON2	O/S	FA60... 5A0H	0... 90	0.0625	°CRK
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Actual ignition angle					

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	Document key 10171571 SPE 000 AO	Pages Page 7014 of 8404	
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_IGA_REF_HOM_COR_EXT_MON2	O/S	FA60... 5A0H	0... 90	0.0625	°CRK
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Correction of reference ignition angle in homogeneous (for external functions e.g. VVT, EGR...)					
ID_IGA_REF_HOMS_COR_EXT_MON2	O/S	FA60... 5A0H	0... 90	0.0625	°CRK
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Correction of reference ignition angle in homogeneous stratified (for external functions e.g. VVT, EGR...)					
ID_LAMB_MON2	O/S	0... 7FFFH	0... 31.9990234	97.6563e3	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Modeled Lambda					
ID_LF_1_MON2	O/S	0... FFH	0... 255	1	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Table of logical starting values 1					
ID_LF_2_MON2	O/S	0... FFH	0... 255	1	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Table of logical starting values 2					
ID_LF_3_MON2	O/S	0... FFH	0... 255	1	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Table of logical starting values 3					

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_LF_4_MON2	O/S	0... FFH	0... 255	1	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Table of logical starting values 4					
ID_MFF_LAMB_REF_IGA_MON2	O/S	0... FFFFH	0... 1389	0.02119478	mg/stk
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Lambda relevant Mass Fuel Flow for stoichiometric conditions corrected by SCAV for EFF_IGA_MON					
ID_MFF_TQ_MON2	O/S	0... FFFFH	0... 1389	0.02119478	mg/stk
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Torque relevant Mass Fuel Flow					
ID_N_32_MON2	O/S	0... FFH	0... 8160	32	rpm
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Engine speed (monitoring level)					
ID_OPM_AV_MON2	O/S	1H 2H 3H 8H	S AFS AFL LIH	-	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
actual engine operation mode (process monitoring)					




Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_PREV_STATE_IV_MON2	O/S	0... FFH	0... 255	1	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
State of injection valves at previous cycle					
ID_PV_AV_AD_MON2	O/S	0... FFH	0... 99.609375	0.390625	%
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Pedal value adaptation					
ID_RESP_MON2	O/S	0... FFFFH	0... 65535	1	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Assignment table for answer decoder of copy of process monitoring					
ID_T_TQI_MON2	O/S	0... FFH	0... 10.2	0.04	s
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Dead time for delay of desired indicated engine torque, old value					
ID_TQ_DIF_P_D_IS_MON2	O/S	8000... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
P and D controller output for idle speed control					
ID_TQ_DROF_MON2	O/S	8000... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
TQ request for drive off assistance					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_TQ_LOSS_MON2	O/S	8000... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Torque losses					
ID_TQ_MAX_CLU_MON2	O/S	8000... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Monitored maximum torque at clutch					
ID_TQ_MIN_CLU_MON2	O/S	8000... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Monitored minimum torque at clutch					
ID_TQI_INC_EXT_MON2	O/S	8000... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
External torque request					
ID_TQI_MIN_PU_MON2	O/S	0... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Torque for trailing throttle					
ID_TQI_SP_MON_MON2	O/S	0... FFH	0... 510	2	Nm
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Resulting desired indicated engine torque, old value					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_TQI_SP_MON2	O/S	8000... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Setpoint indicated engine torque					
IP_EFF_IGA_HOM_MON2	-	0... FFH	0... 99.609375	0.390625	%
LDPM_IGA_DIF_AV_MON2_IP_MON2	8	0... B40H	0 ...0	0.0625	°CRK
actual ignition efficiency in homogeneous (process monitoring)					
IP_EFF_IGA_HOMS_MON2	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_IGA_DIF_AV_MON2_IP_MON2	8	0... B40H	0 ...0	0.0625	°CRK
actual ignition efficiency in homogeneous stratified (process monitoring)					
IP_EFF_LAMB_HOM_MON2	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_LAMB_HOM_MON2_IP_EFF_MON2	8	0... 7FFFH	0... 31.9990234	97.6563e3	-
lambda efficiency in homogeneous (process monitoring)					
IP_EFF_LAMB_HOMS_MON2	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_LAMB_HOMS_MON2_IP_EFF_MON2	8	0... 7FFFH	0... 31.9990234	97.6563e3	-
lambda efficiency in homogeneous stratified (process monitoring)					
IP_EFF_LAMB_S_MON2	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_LAMB_S_MON2_IP_EFF_MON2	8	0... 7FFFH	0... 31.9990234	97.6563e3	-
lambda efficiency in stratified (process monitoring)					
IP_FAC_EFF_IGA_MON2	-	0... FFH	0... 15.9375	0.0625	-
LDP_N_32_MON2_IP_FAC_EFF_MON2	6	0... FFH	0... 8160	32	rpm
LDP_MFF_MON2_IP_FAC_EFF_MON2	6	0... FFFFH	0... 1389	0.02119478	mg/stk
Factor ignition efficiency (process monitoring)					
IP_FAC_TQ_REQ_DRIV_1_MON2	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_N_32_MON2_IP_FAC_TQ_MON2	8	0... FFH	0... 8160	32	rpm
LDPM_PV_AV_AD_MON2_IP_FAC_MON2	8	0... FFH	0... 99.609375	0.390625	%
Scaling factor for requested torque at clutch from driver in other mode					
IP_FAC_TQ_REQ_DRIV_MON2	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_N_32_MON2_IP_FAC_TQ_MON2	8	0... FFH	0... 8160	32	rpm
LDPM_PV_AV_AD_MON2_IP_FAC_MON2	8	0... FFH	0... 99.609375	0.390625	%
Scaling factor for requested torque at clutch from driver					
IP_IGA_REF_HOM_MON2	-	0... B40H	0... 90	0.0625	°CRK
LDPM_N_32_MON2_IP_IGA_REF_MON2	8	0... FFH	0... 8160	32	rpm
LDP_MFF_MON2_IP_IGA_HOM_MON2	8	0... FFFFH	0... 1389	0.02119478	mg/stk
reference ignition angle in homogeneous (process monitoring)					
IP_IGA_REF_HOMS_MON2	-	0... B40H	0... 90	0.0625	°CRK
LDPM_N_32_MON2_IP_IGA_REF_MON2	8	0... FFH	0... 8160	32	rpm
LDP_MFF_MON2_IP_IGA_HOMS_MON2	8	0... FFFFH	0... 1389	0.02119478	mg/stk
reference ignition angle in homogeneous stratified (process monitoring)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TQI_CUS_MON2	-	0... FFH	0... 510	2	Nm
LDP_N_32_MON2_IP_TQI_CUS_MON2	6	0... FFH	0... 8160	32	rpm
LDP_MFF_MON2_IP_TQI_CUS_MON2	8	0... FFFFH	0... 1389	0.02119478	mg/stk
Customer specific engine torque (process monitoring)					
IP_TQI_DIF_MAX_MON2	-	0... FFH	0... 510	2	Nm
LDP_N_32_MON2_IP_TQI_DIF_MON2	4	0... FFH	0... 8160	32	rpm
LDP_TQI_SP_MON2_IP_MON2	4	0... FFH	0... 510	2	Nm
Threshold for diagnosis of engine torque overflow					

### E.27.1 ECM2\_DTSYSCOPPRHPDI

Attention: All Level 2' calibration data are set to INVISIBLE and NOT TUNABLE expect for C\_STATE\_RESP\_MON2\_RST\_ACT\_MON2. This is necessary in order to get a more robust calibration process in case of software or calibration data updates. C\_STATE\_RESP\_MON2\_RST\_ACT\_MON2 has to be visible and tunable in the calibration system in order to generate an L2' reset for test cases.

General information:

A copy of the main part of the process monitoring (level 2) is built (called level 2) and used as a set of test calculations. The target is to verify the correct behaviour of the process monitoring at any time using predefined test data and comparing the resulting answer to the expected answer stored in a predefined table. Moreover there is a special calculation routine responsible for checking the correct data transfer between registers and stack in case of interrupts during the calculation.

This processor monitoring function includes the monitoring functions described in the table below. However, no real fault reaction like disabling of throttle etc. is released.

Since the answers of these test calculations will be compared to the predefined table ID\_RESP\_MON2 (see processor monitoring), it is important to generate a different answer for every index of starting values (NC\_TEST\_REC\_IDX\_MAX\_MON2 different answers overall). The list of data points for the starting values must contain the indices 0...NC\_TEST\_REC\_IDX\_MAX\_MON21 in ascending order. For details see also "Processor Monitoring" and "Processor Monitoring (Appl.Inc.)".

Table of softwarecode of level 2 modules that is included in level 2 :

Module:	Specification:
Desired indicated engine torque	30E00K01.00I
Actual efficiencies	30E01401.00J
Actual indicated engine torque	30E00L01.00E
Monitoring of actual indicated engine torque	30E00M01.00E
Monitoring of engine speed limitation	30E00I01.00F
Fault reaction of process monitoring	30E00G01.00J

The softwarecode of the level 2 submodules is an exact copy of softwarecode of the level 2 modules listed in the table above, with exceptions described in the following sub chapters.

The following Application Condition takes into consideration that the level 2' module is triggered by Processor Monitoring (level 3).

### Application Condition

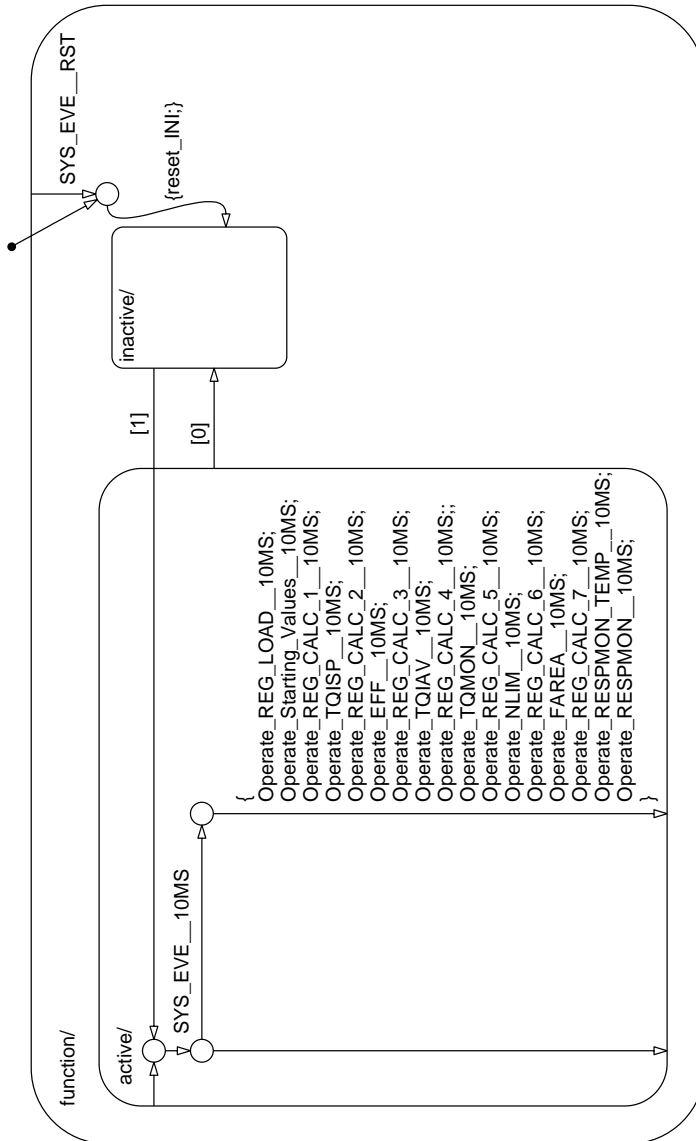

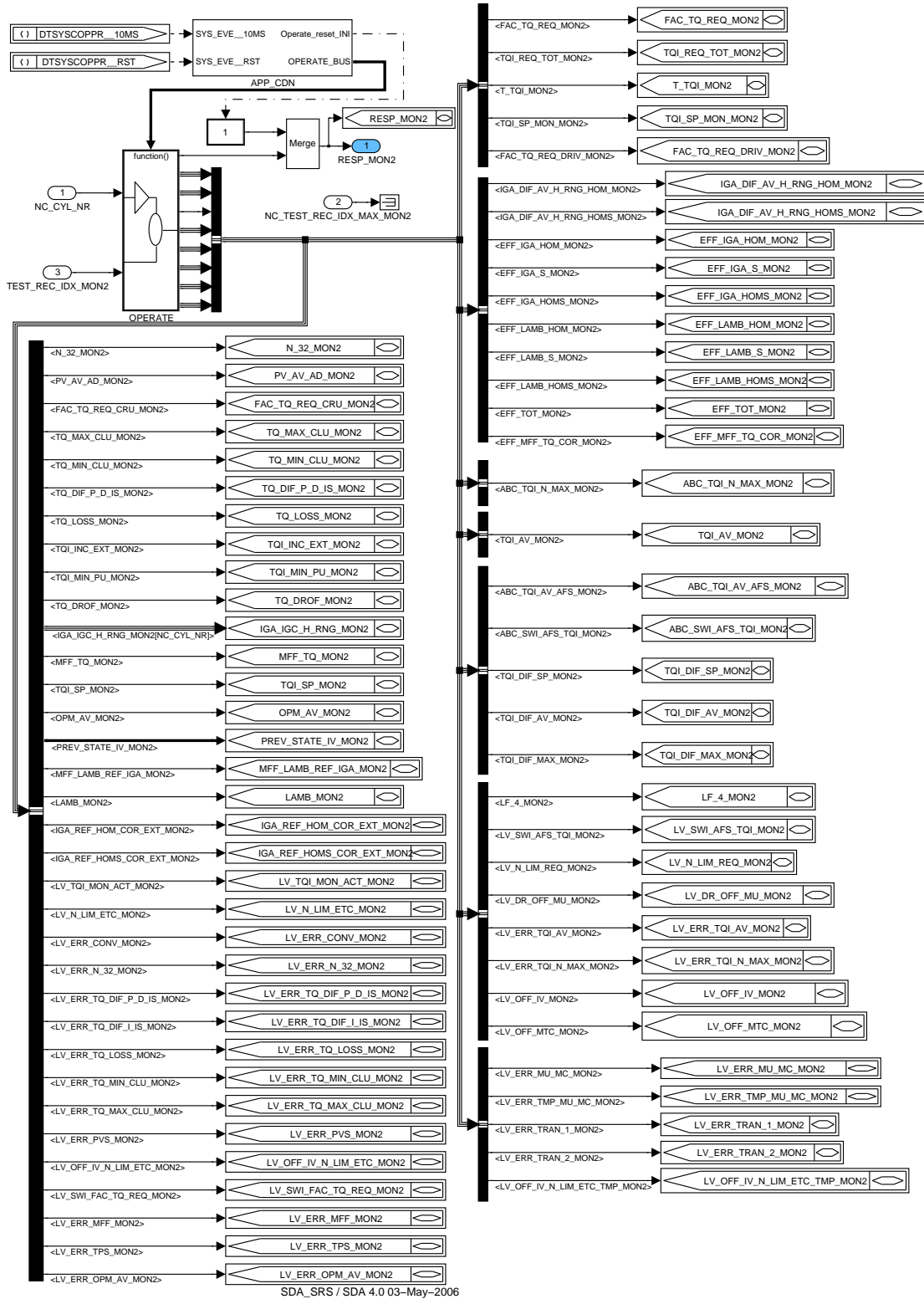


Figure E.27.1: ECM2\_DTSYSCOPPRHPDI/APP\_CDN/Chart

**Function Description**

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Figure E.27.2: ECM2\_DTSYSCOPPRHPDI

### E.27.1.1 OPERATE

General information:

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Based on the number of the question asked by the monitoring unit a corresponding set of starting values for the test calculation is selected from the lists of starting values.

The values of LDPM\_TEST\_REC\_IDX\_MON2 are fixed. They depend on the maximum NC\_TEST\_REC\_IDX\_MAX\_MON2 of the generated index TEST\_REC\_IDX\_MON2. The hex and physical limits are defined with static values which depend on the possible number of questions in the HW.

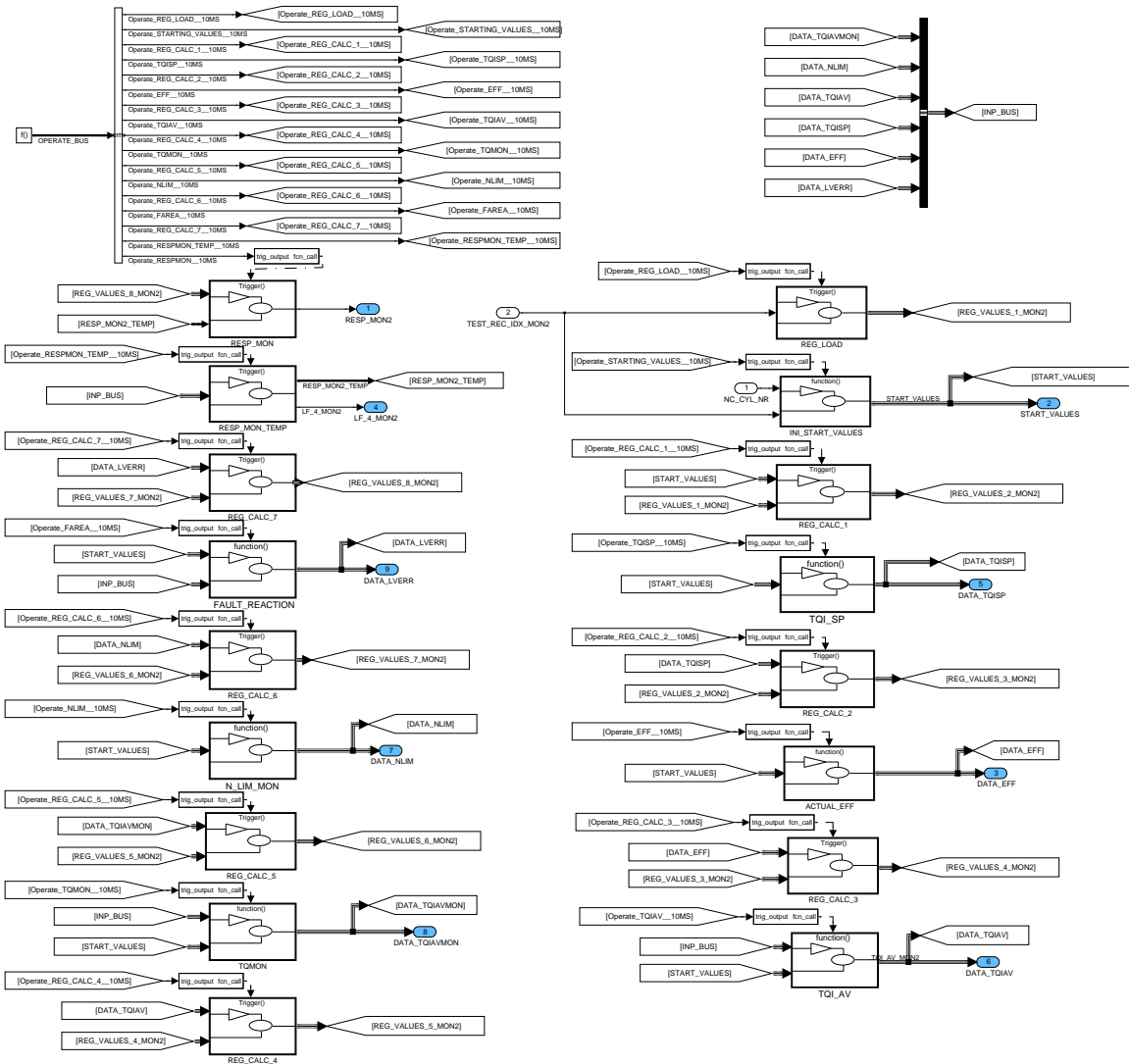


Figure E.27.3: ECM2\_DTSYSCOPRHPDI/OPERATE

### Register LOAD for checking Interrupt routine

In order to simulate an interrupt at first all registers and some cells of the user stack (if available) will be loaded with some defined initial values (see figure below).

The data type for these values has to be signed 32 bit. It is not allowed to use arrays for the load values: after the first calculation every register or user stack value has to be stored separately.

After the calculation, the function call of the first module out of the L2 copied functions shall be carried out; thereby, the current register values will be copied onto the stack.

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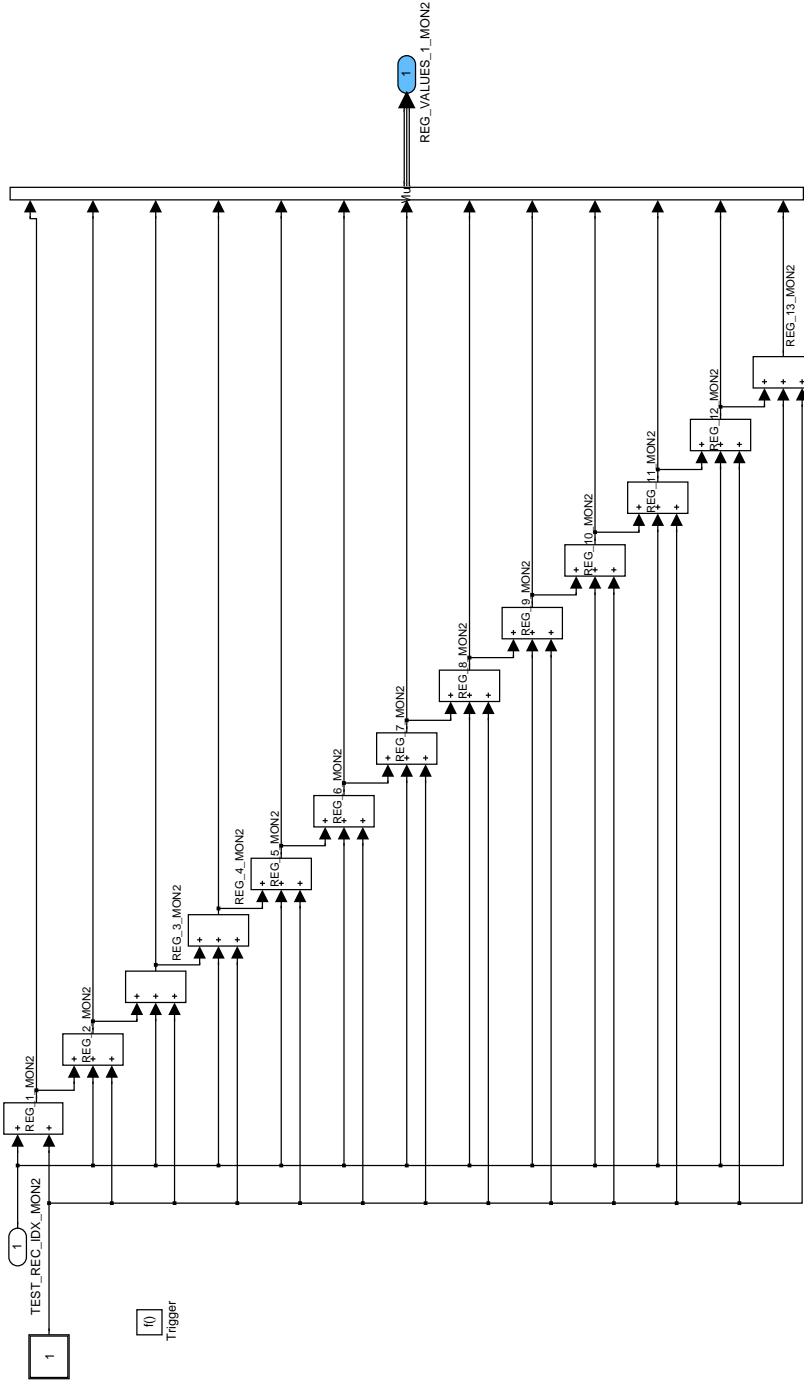



Figure E.27.4: ECM2\_DTSYSCOPPRHPDI/OPERATE/REG\_LOAD

**ECM2\_DTSYSCOPPRHPDI/OPERATE/INI\_START\_VALUES**

Initialization of variables from the lists of starting values

In order to ensure an unambiguous final result for RESP\_MON2 the values TQI\_AV\_MON2, TQI\_REQ\_TOT\_MON2, EFF\_TOT\_MON2 and FAC\_TQ\_REQ\_MON2 have to be initialized with zero.

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All logical variables are stored in tables of status bytes. In every recurrence, the information is copied from the table into the status bytes LF\_1\_MON2, LF\_2\_MON2, LF\_3\_MON2 and LF\_4\_MON2 respectively.

The position of the logical variables LV\_xyz\_MON2 within the status bytes are shown in the figures before:

**HINT:** The curve ID\_RESP\_MON2 is calibrated in this module. But the values depending on TEST\_REC\_IDX\_MON2 are used in L3 (processor monitoring). Therefore, the output of this ID is terminated in this simulation.

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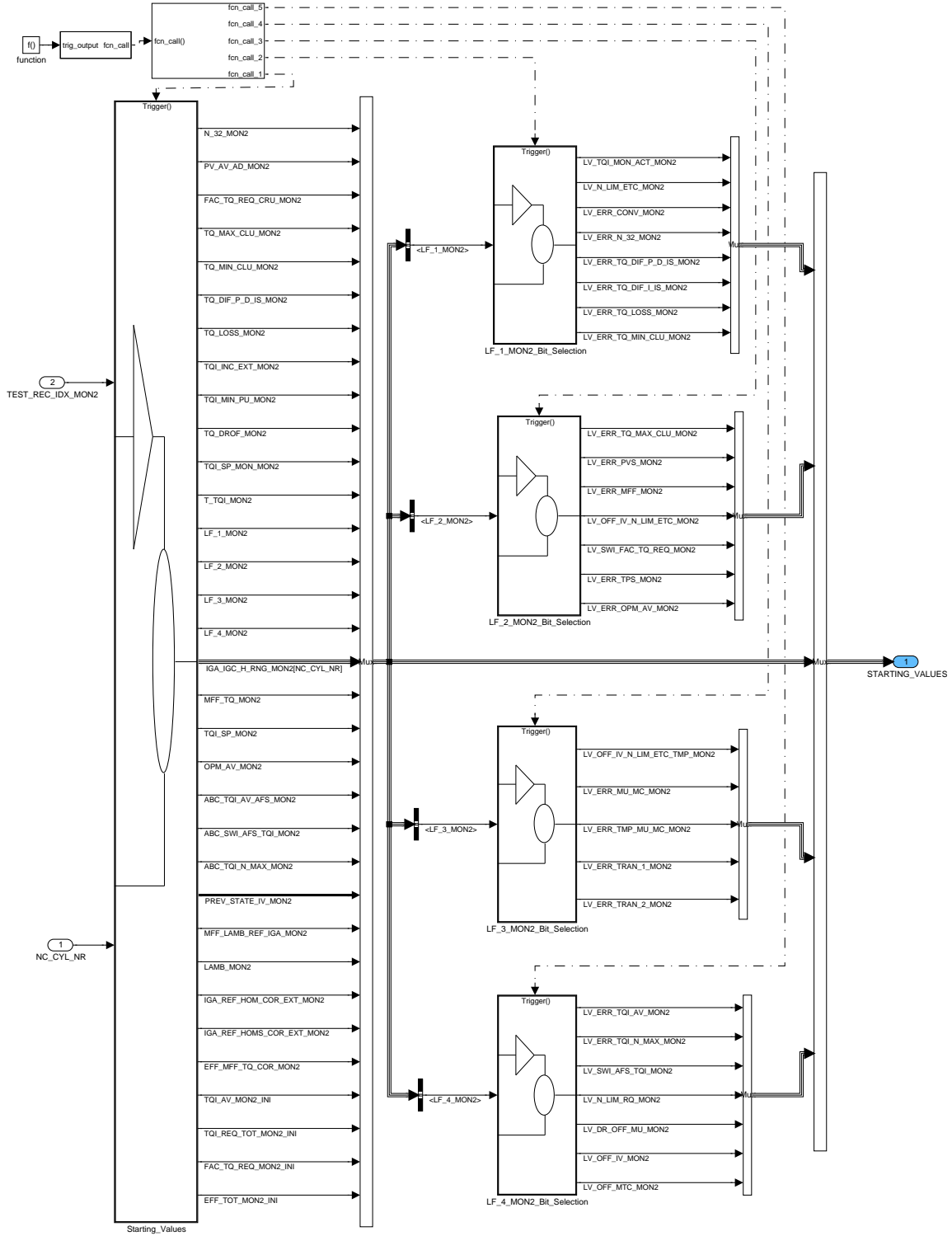


Figure E.27.5: ECM2\_DTSYSCOPPRHPDI/OPERATE/INI\_START\_VALUES

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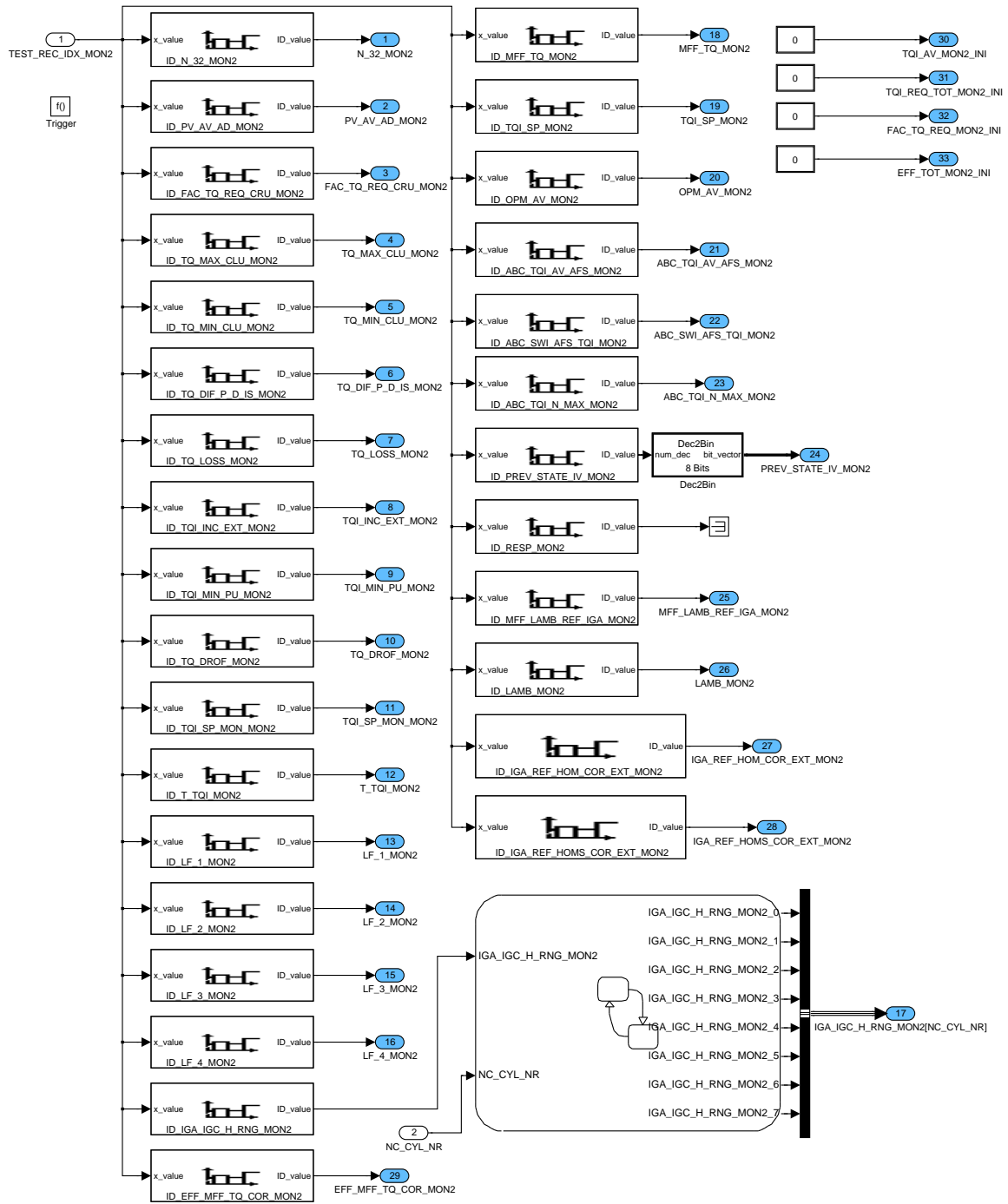


Figure E.27.6: ECM2\_DTSYSCOPPRHPDI/OPERATE/INI\_START\_VALUES/Starting Values

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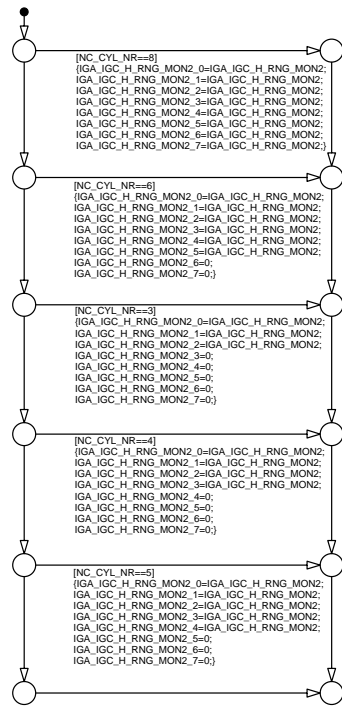
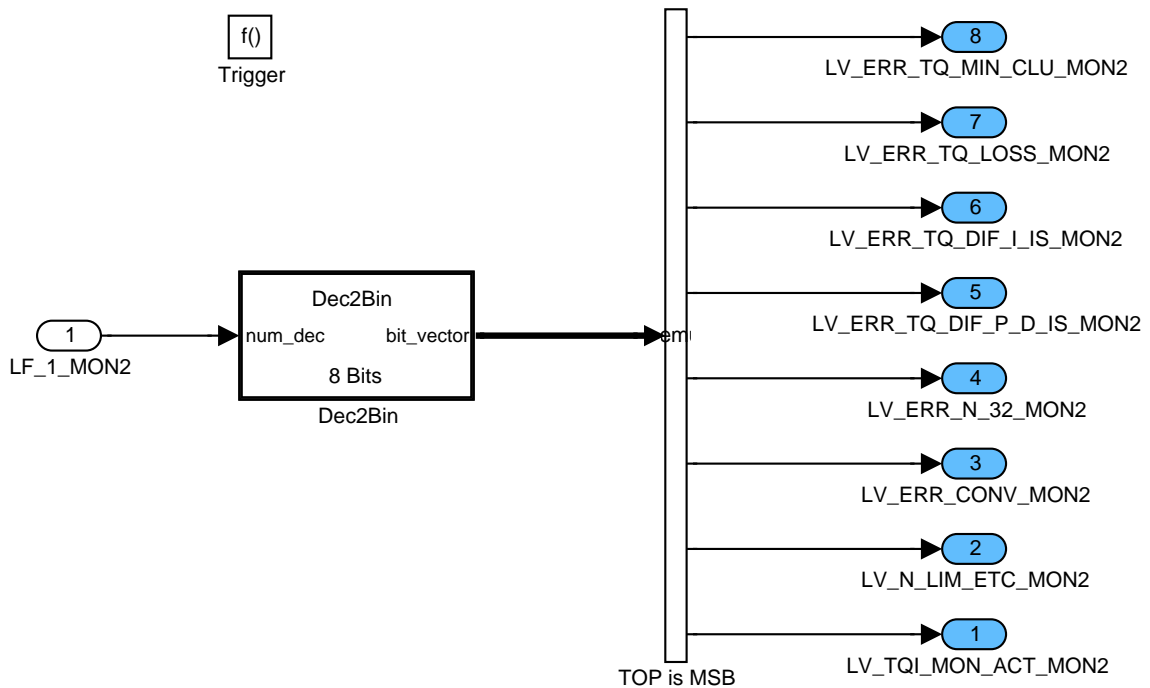


Figure E.27.7: ECM2\_DTSYSCOPPRHPDI/OPERATE/INI\_START\_VALUES/Starting\_Values/Chart1



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Figure E.27.8: ECM2\_DTSYSCOPPRHPDI/OPERATE/INI\_START\_VALUES/LF\_1\_MON2\_Bit\_Selection

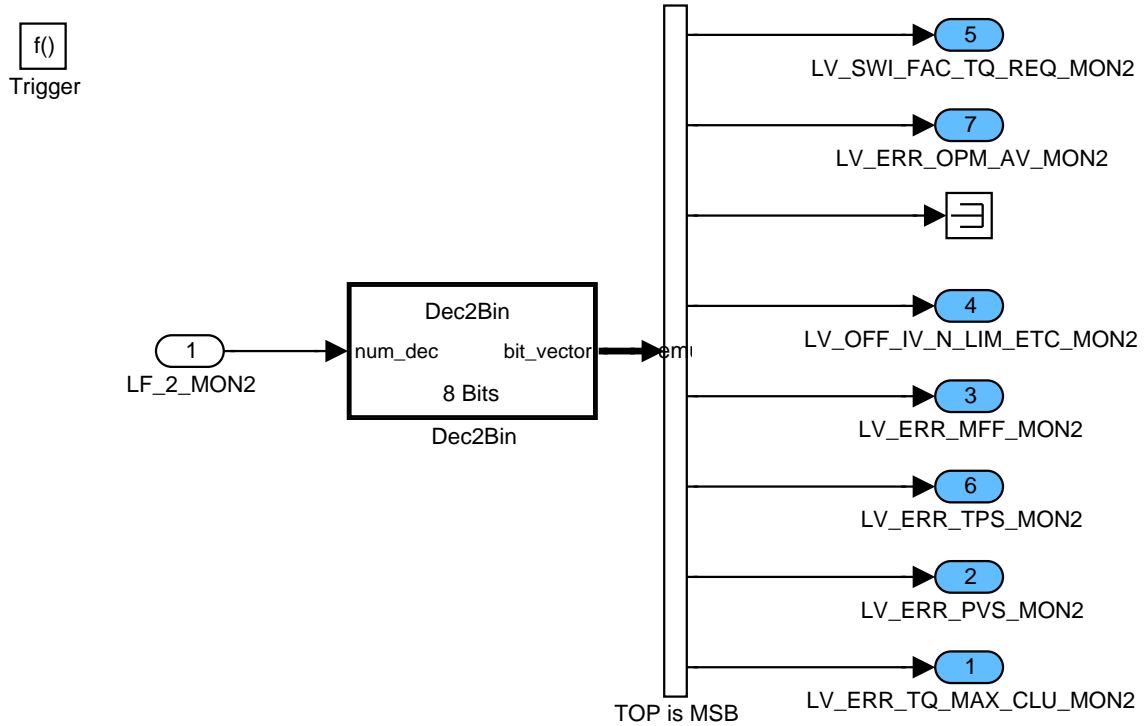


Figure E.27.9:  
ECM2\_DTSYSCOPPRHPDI/OPERATE/INI\_START\_VALUES/LF\_2\_MON2\_Bit\_Selection

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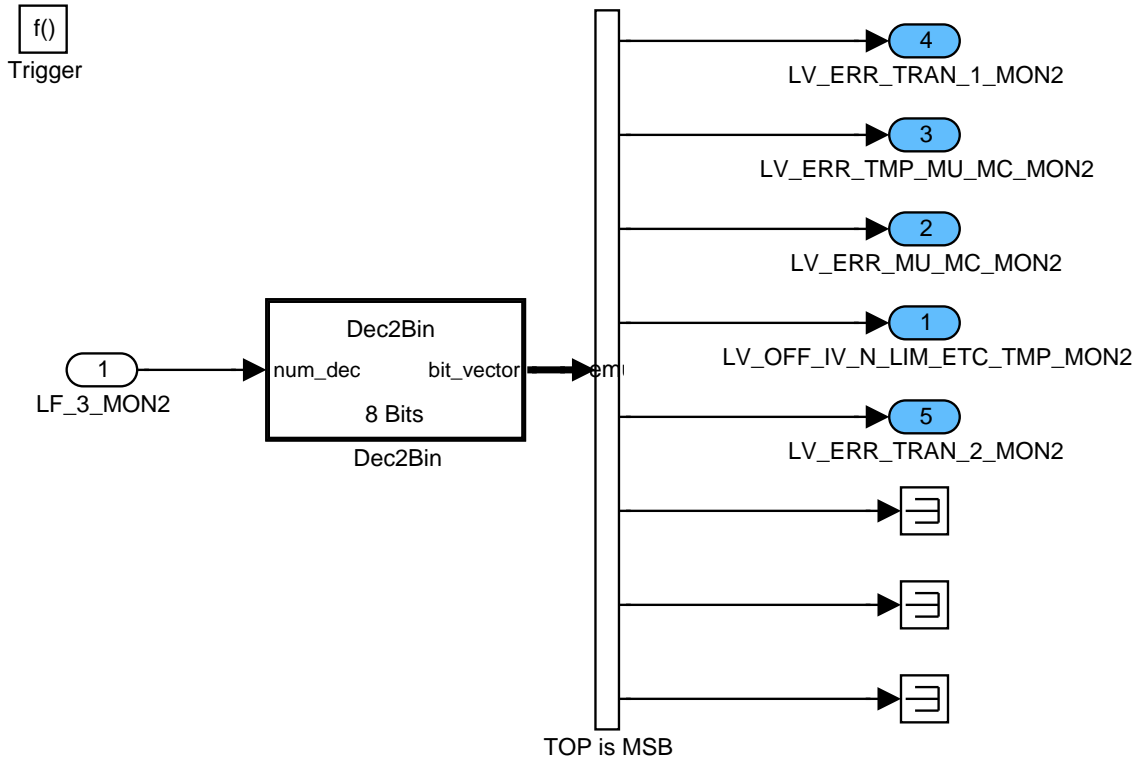


Figure E.27.10:  
ECM2\_DTSYSCOPRHPDI/OPERATE/INI\_START\_VALUES/LF\_3\_MON2\_Bit\_Selection

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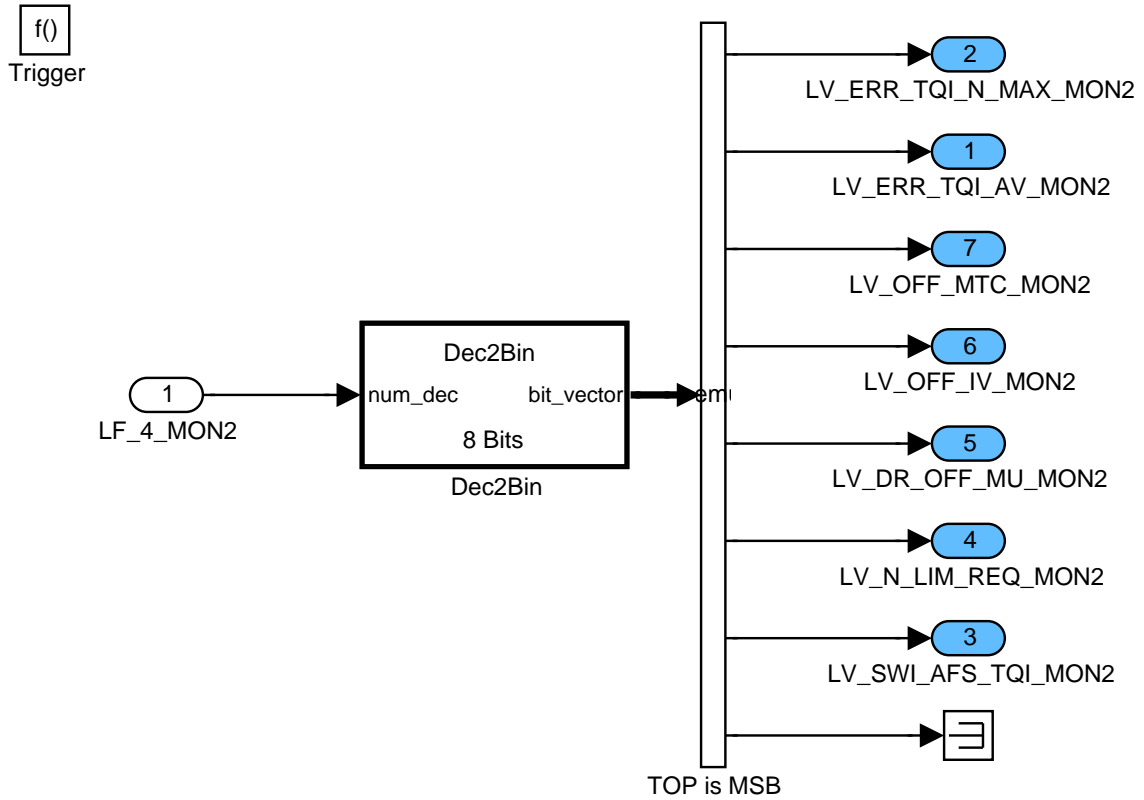



Figure E.27.11:  
ECM2\_DTSYSCOPRHPDI/OPERATE/INI\_START\_VALUES/LF\_4\_MON2\_Bit\_Selection

**Register calculation 1 for checking Interrupt routine**

After reloading the register values REG\_x\_MON2 from the stack, N\_32\_MON2 from the submodule INI\_START\_VALUE shall be added to every REG\_x\_MON2.

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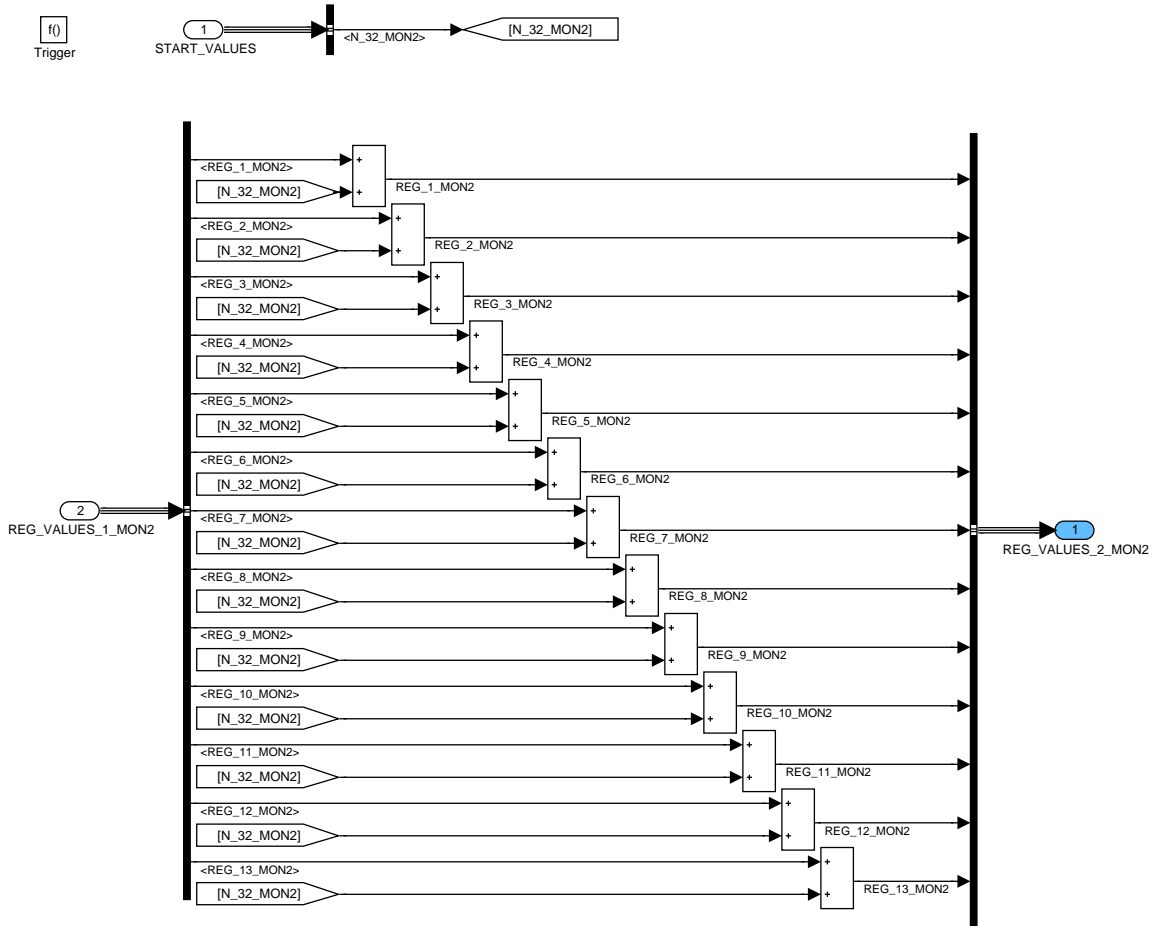


Figure E.27.12: ECM2\_DTSYSCOPPRHPDI/OPERATE/REG\_CALC\_1

**ECM2\_DTSYSCOPPRHPDI/OPERATE/TQI\_SP**

General information:

The module has exactly the same functionality than the corresponding module Desired indicated engine torque of level 2 (30E00K01.00I) except:

No RAM test of output data performed

No initialisation section included

TQI\_SP\_MON (output) renamed to TQI\_SP\_MON\_MON2

All input data, output data and calibration data renamed to level 2 naming

Example: xyz\_MON renamed to xyz\_MON2

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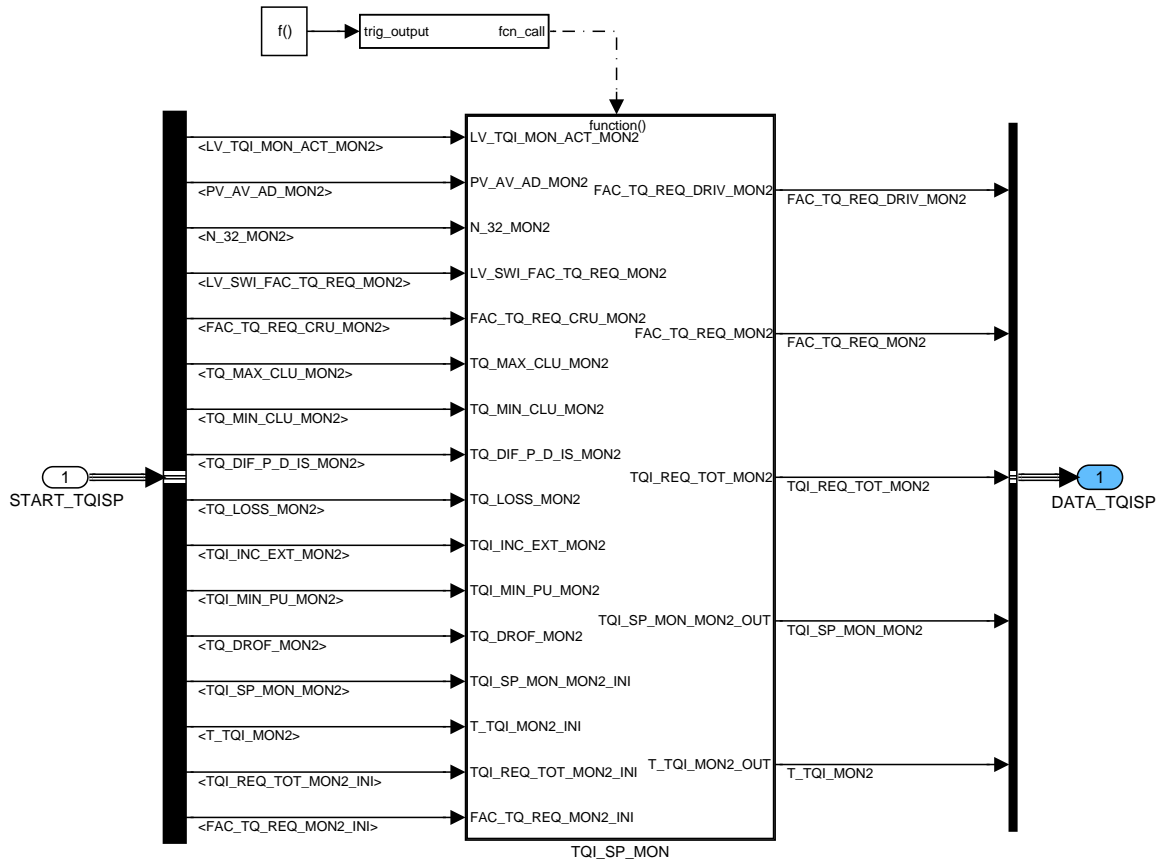


Figure E.27.13: ECM2\_DTSYSCOPPRHPDI/OPERATE/TQI\_SP

**Register calculation 2 for checking Interrupt routine**

After reloading the register values REG\_x\_MON2 from the stack, TQI\_SP\_MON\_MON2 from the sub-module TQI\_SP shall be added to every REG\_x\_MON2.

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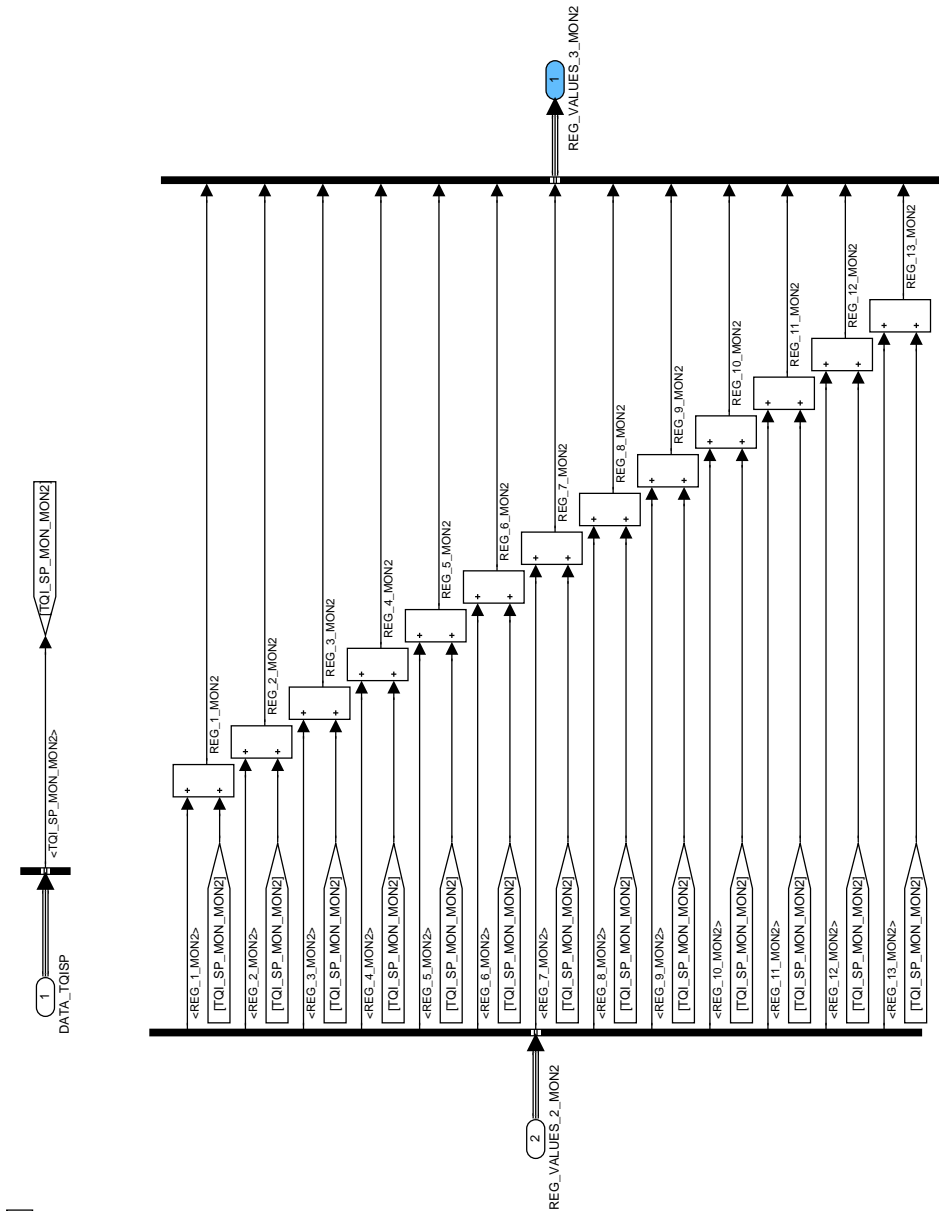



Figure E.27.14: ECM2\_DTSYSCOPPRHPDI/OPERATE/REG\_CALC\_2

**ECM2\_DTSYSCOPPRHPDI/OPERATE/ACTUAL\_EFF**

General information:

The module has exactly the same functionality than the corresponding module Actual efficiencies of level 2 (30E01401.00J) except:  
 No RAM test of output data performed  
 No initialisation section included  
 All input data, output data and calibration data renamed to level 2 naming  
 Example: xyz\_MON renamed to xyz\_MON2

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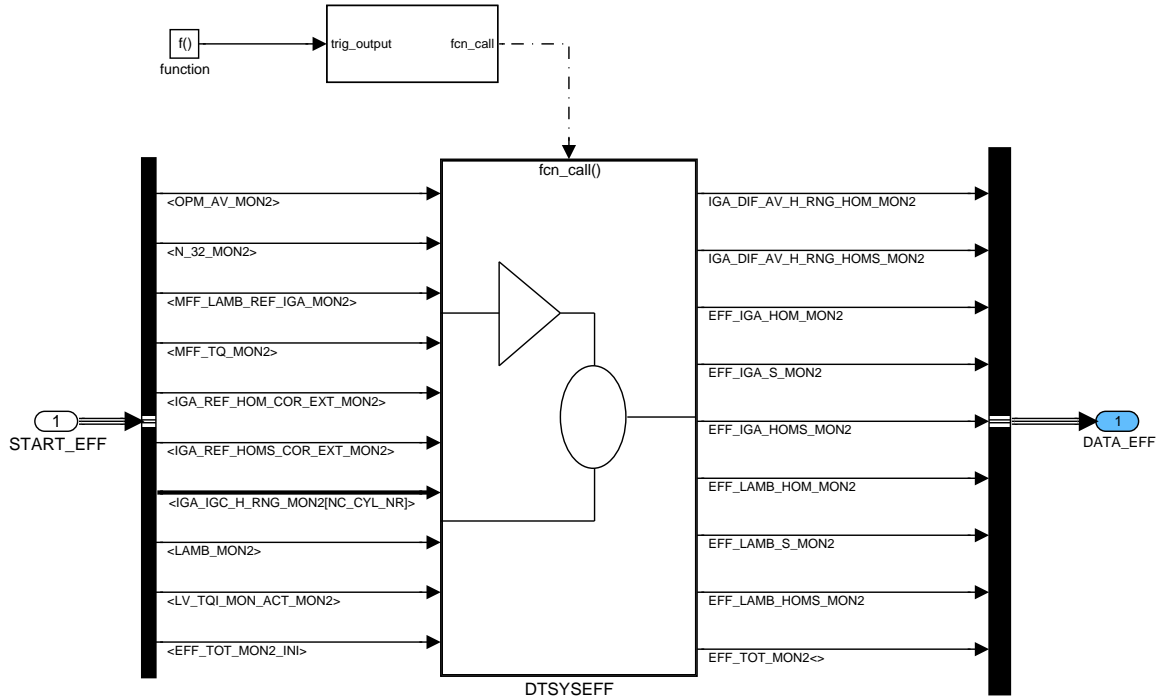


Figure E.27.15: ECM2\_DTSYSCOPPRHPDI/OPERATE/ACTUAL\_EFF

**Register calculation 3 for checking Interrupt routine**

After reloading the register values REG\_x\_MON2 from the stack, EFF\_TOT\_MON2 from the submodule ACTUAL\_EFF shall be added to every REG\_x\_MON2.

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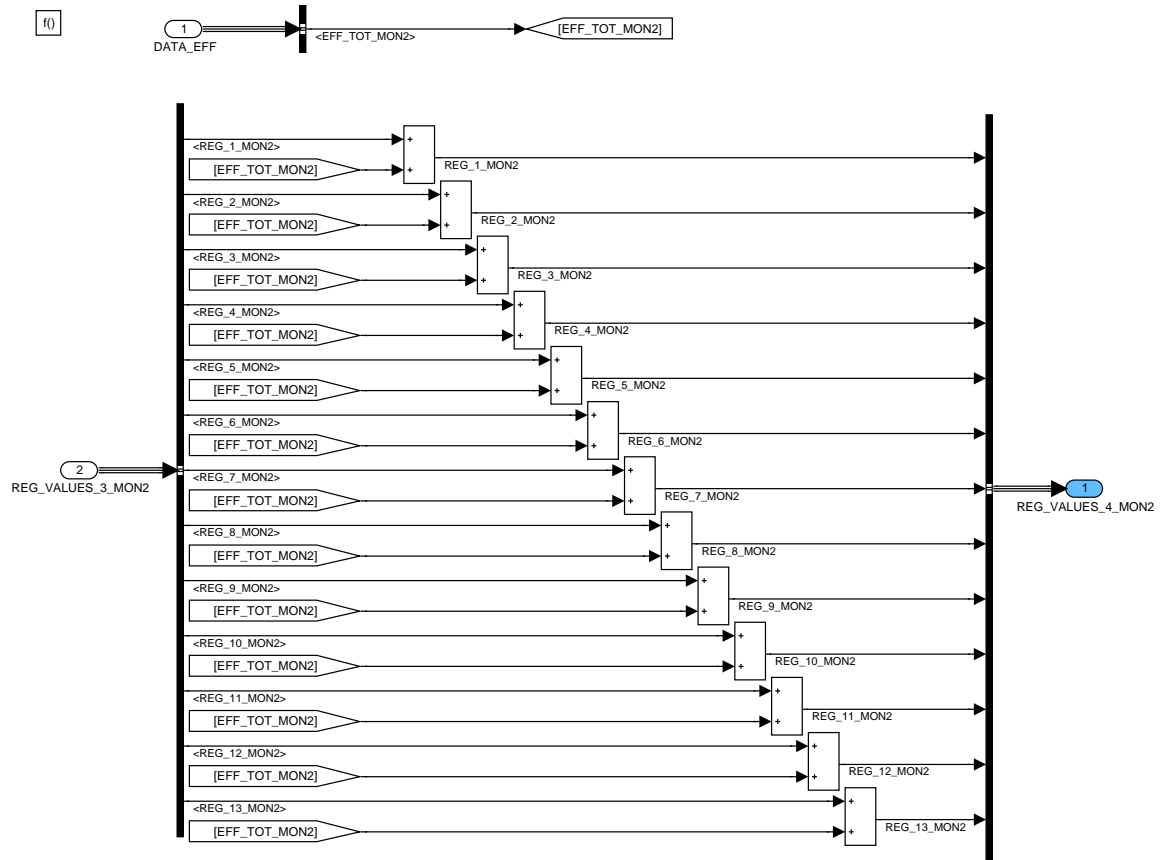


Figure E.27.16: ECM2\_DTSYSCOPPRHPDI/OPERATE/REG\_CALC\_3

**ECM2\_DTSYSCOPPRHPDI/OPERATE/TQI\_AV**

General information:

The module has exactly the same functionality than the corresponding module Actual indicated engine torque of level 2 (30E00L01.00E) except:


No RAM test of output data performed

No initialisation section included

All input data, output data and calibration data renamed to level 2 naming

Example: xyz\_MON renamed to xyz\_MON2

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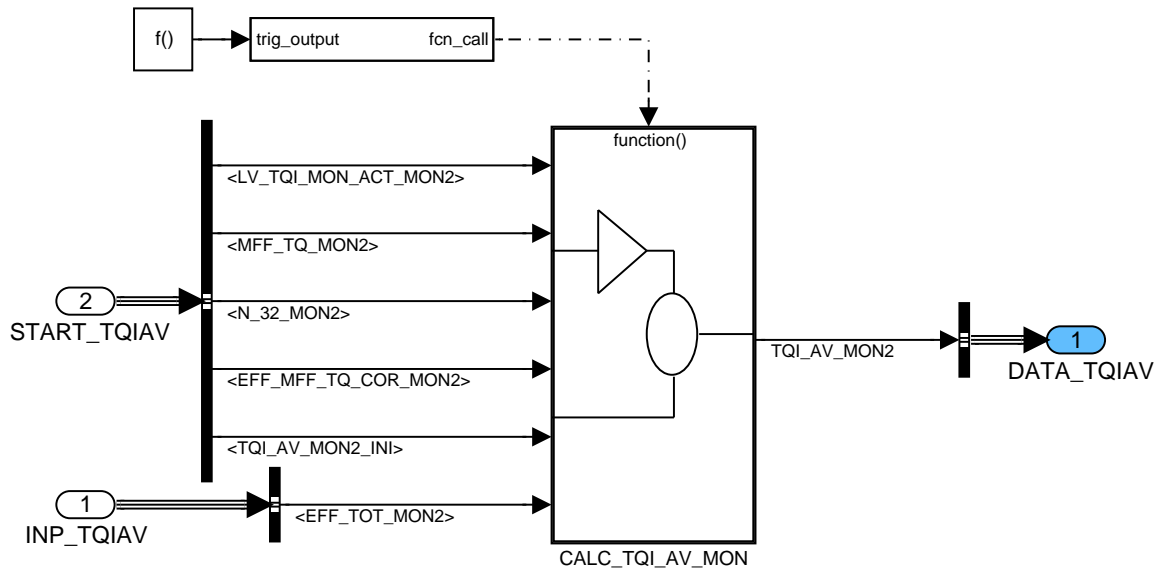



Figure E.27.17: ECM2\_DTSYSCOPPRHPDI/OPERATE/TQI\_AV

**Register calculation 4 for checking Interrupt routine**

After reloading the register values REG\_x\_MON2 from the stack, TQI\_AV\_MON2 from the submodule TQI\_AV shall be added to every REG\_x\_MON2.

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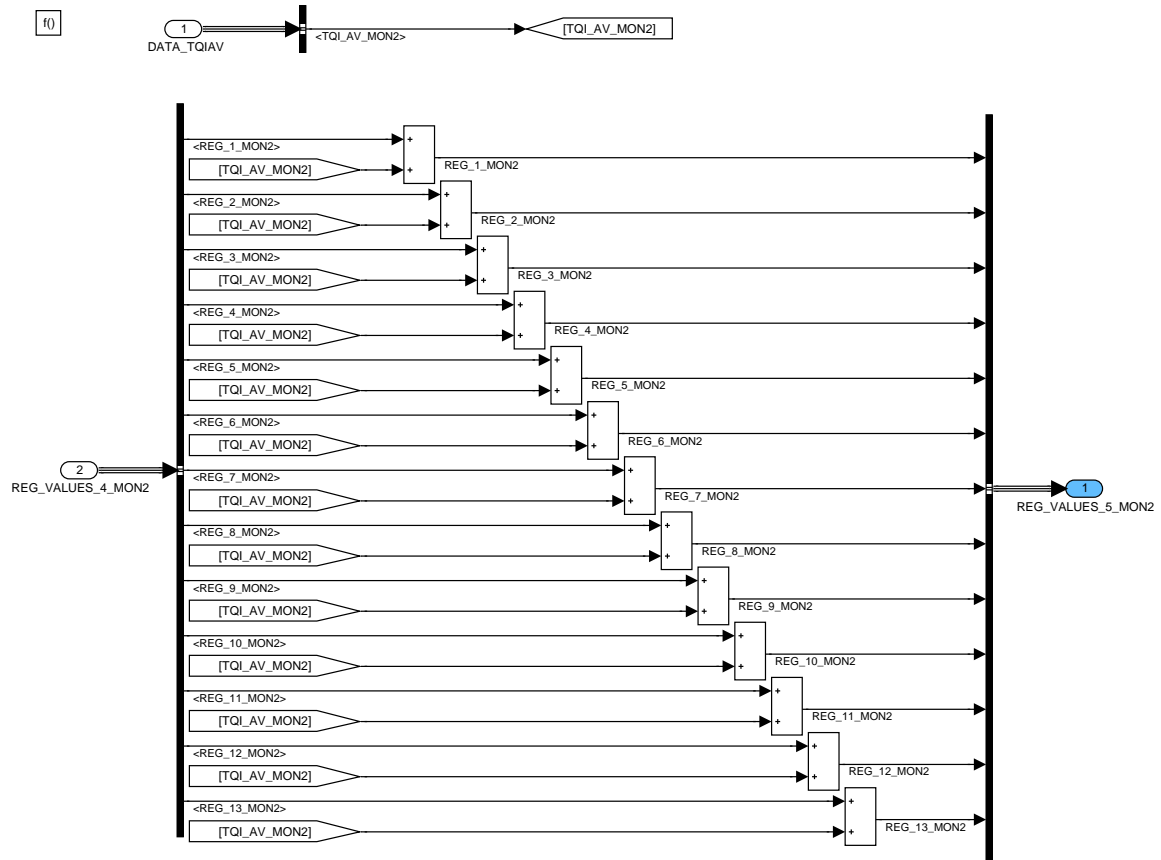


Figure E.27.18: ECM2\_DTSYSCOPPRHPDI/OPERATE/REG\_CALC\_4

**ECM2\_DTSYSCOPPRHPDI/OPERATE/TQMON**

General information:

The module has exactly the same functionality than the corresponding module Monitoring of actual indicated engine torque of level 2 (30E00M01.00E) except:

No RAM test of output data performed


No initialisation section included

TQI\_SP\_MON (input) renamed to TQI\_SP\_MON\_MON2

All input data, output data and calibration data renamed to level 2 naming

Example: xyz\_MON renamed to xyz\_MON2

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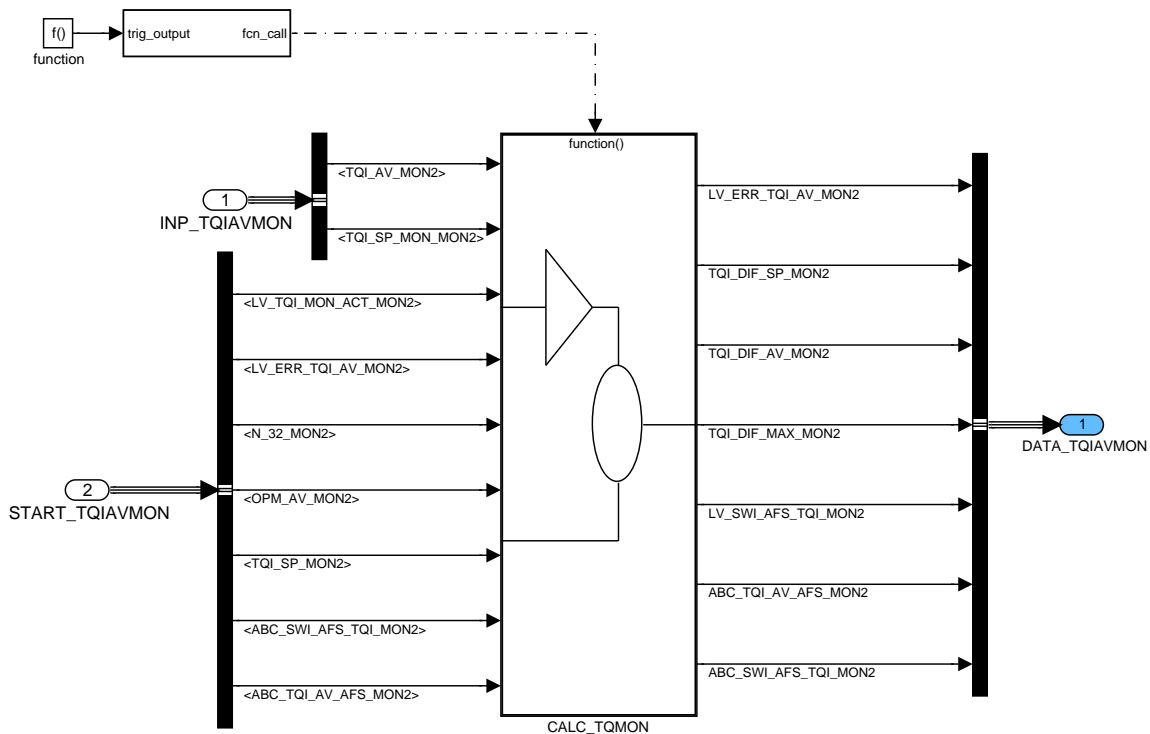


Figure E.27.19: ECM2\_DTSYSCOPPRHPDI/OPERATE/TQMON

**Register calculation 5 for checking Interrupt routine**

After reloading the register values REG\_x\_MON2 from the stack, ABC\_TQI\_AV\_AFS\_MON2 from the submodule TQMON shall be added to every REG\_x\_MON2.

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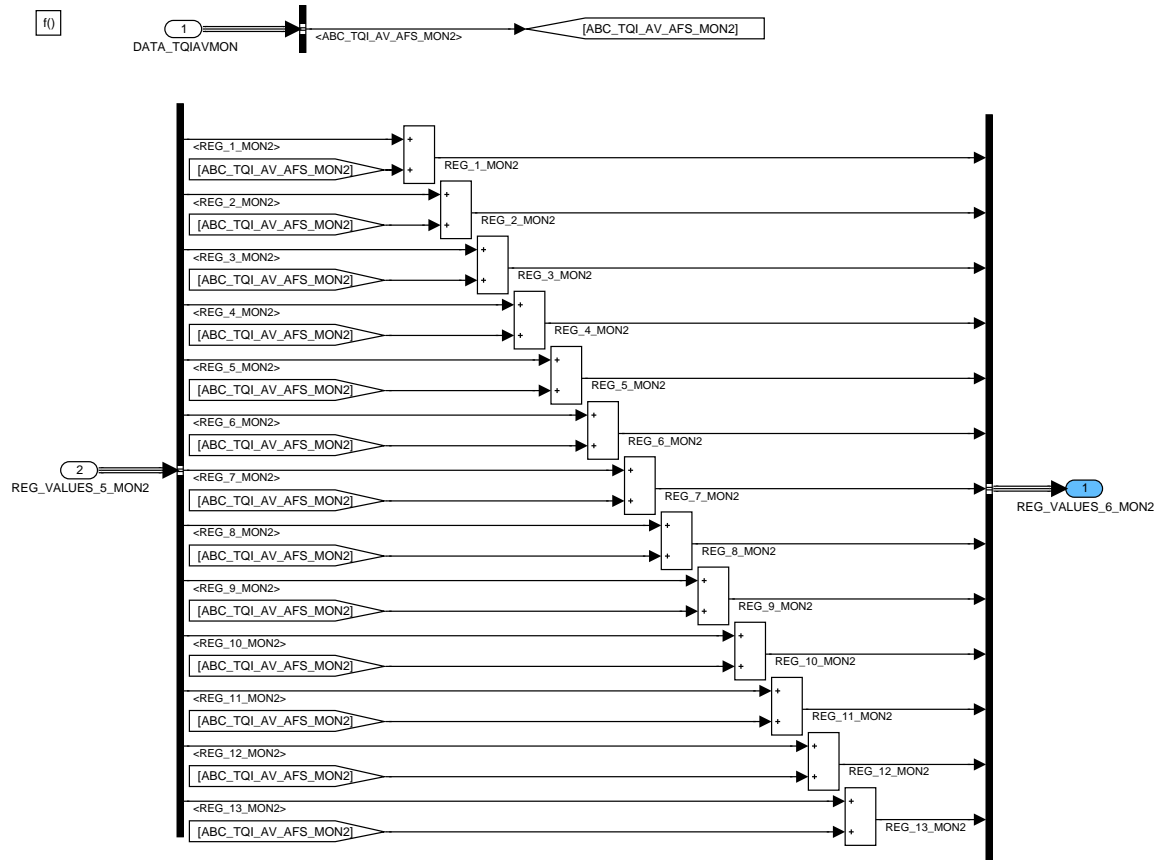


Figure E.27.20: ECM2\_DTSYSCOPPRHPDI/OPERATE/REG\_CALC\_5

**ECM2\_DTSYSCOPPRHPDI/OPERATE/N\_LIM\_MON**

General information:

The module has exactly the same functionality than the corresponding module Monitoring of engine speed limitation of level 2 (30E00101.00F) except:


No RAM test of output data performed

No initialisation section included

All input data, output data and calibration data renamed to level 2 naming

Example: xyz\_MON renamed to xyz\_MON2

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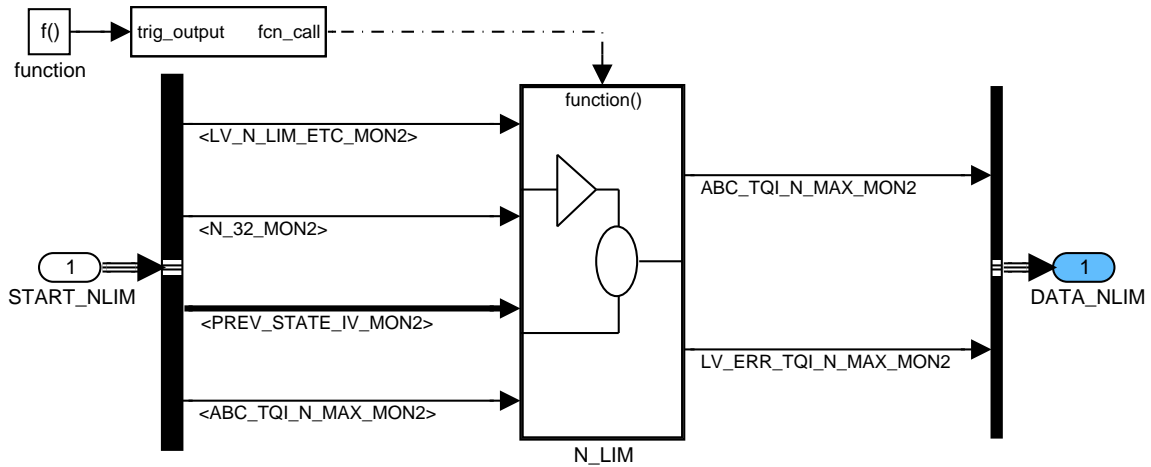


Figure E.27.21: ECM2\_DTSYSCOPPRHPDI/OPERATE/N\_LIM\_MON

**Register calculation 6 for checking Interrupt routine**

After reloading the register values REG\_x\_MON2 from the stack, ABC\_TQI\_N\_MAX\_MON2 from the submodule N\_LIM\_MON shall be added to every REG\_x\_MON2.

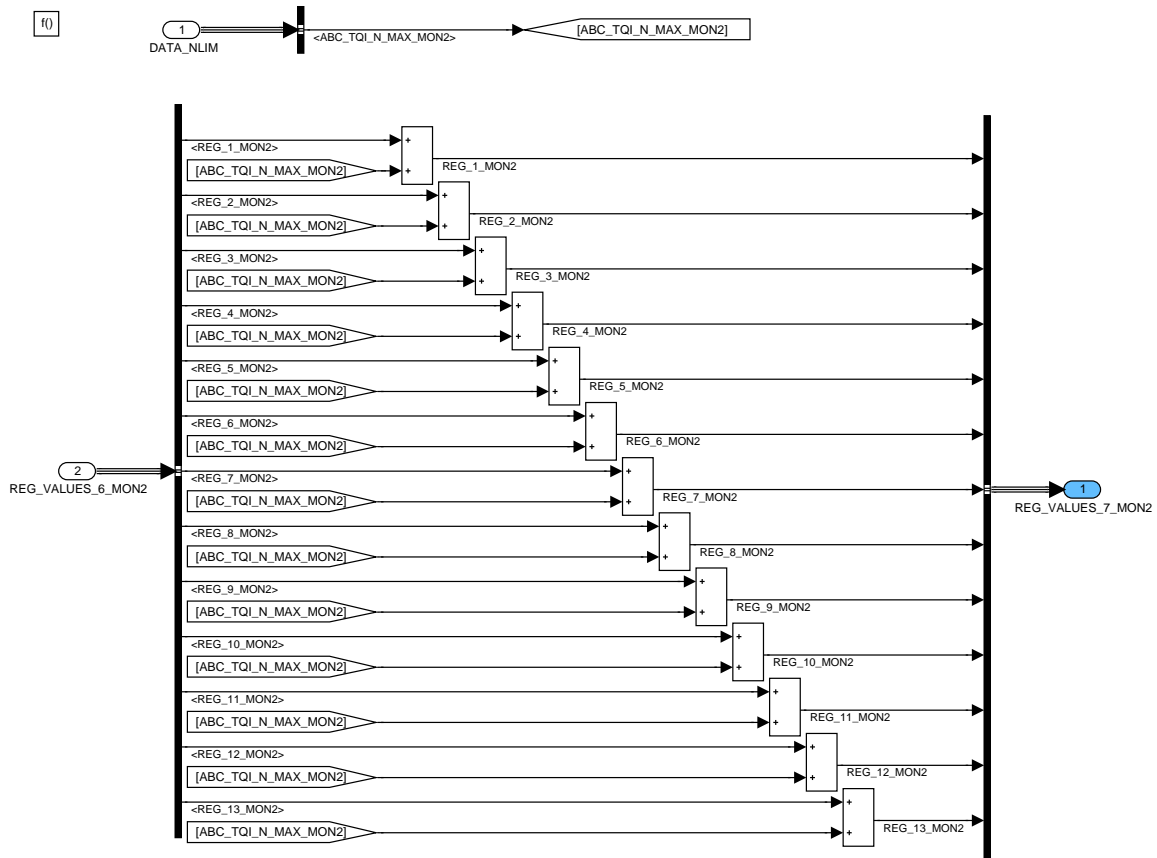


Figure E.27.22: ECM2\_DTSYSCOPPRHPDI/OPERATE/REG\_CALC\_6

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## ECM2\_DTSYSCOPPRHPDI/OPERATE/FAULT\_REACTION

General information:

The module has exactly the same functionality than the corresponding module Fault reaction of process monitoring of level 2 (30E00G01.00J) except:

No RAM test of output data performed

No initialisation section included

All input data, output data and calibration data renamed to level 2 naming

Example: xyz\_MON renamed to xyz\_MON2

The ACTION\_ECM3\_RedSwitchOffPath() is replaced, instead of the original action call LV\_DR\_OFF\_MU\_MON2 is set to 1.

The byte LF\_4\_MON2 is updated with the output flags after execution.

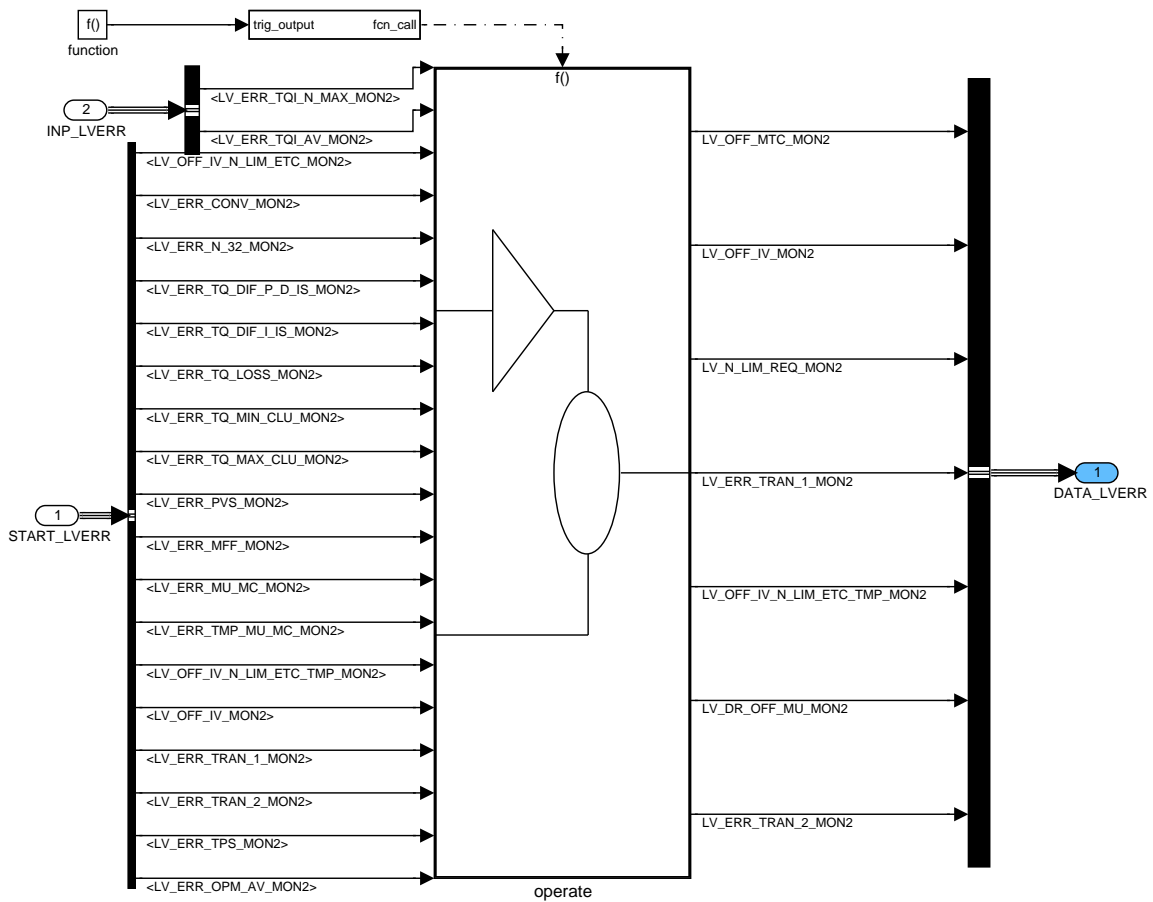


Figure E.27.23: ECM2\_DTSYSCOPPRHPDI/OPERATE/FAULT\_REACTION

### Register calculation 7 for checking Interrupt routine

After reloading the register values REG\_x\_MON2 from the stack, LV\_OFF\_IV\_MON2 from the submodule FAREA shall be added to every REG\_x\_MON2.

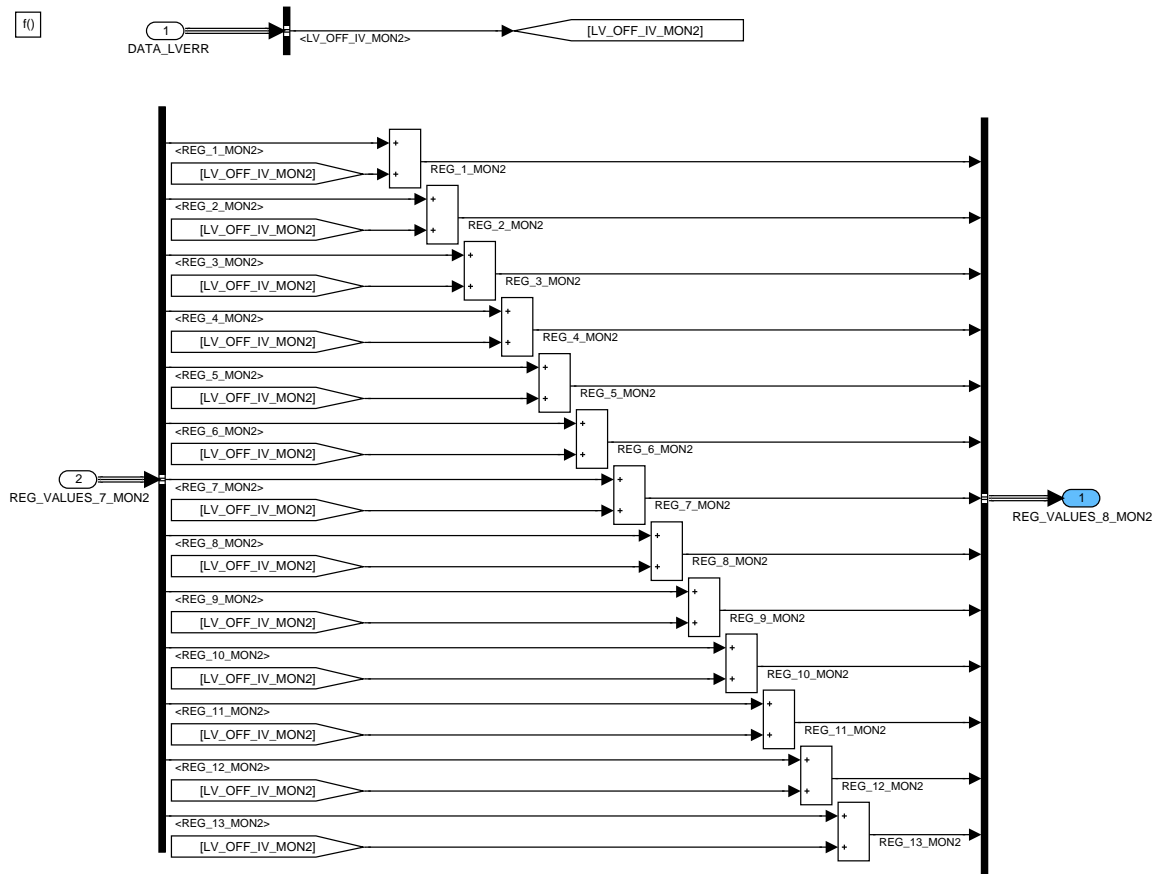


Figure E.27.24: ECM2\_DTSYSCOPPRHPDI/OPERATE/REG\_CALC\_7

### ECM2\_DTSYSCOPPRHPDI/OPERATE/RESP\_MON\_TEMP

#### General information:

The byte LF\_4\_MON2 is updated with the output flags after execution.

There is a possibility for faults, which leads to wrong interim results but to a correct final result of the test calculation. In order to ensure that such a kind of fault is detectable, the final result is composed of several intermediate ones coming out of different parts of the test calculation.

#### Formula section:

$$\begin{aligned}
 \text{RESP\_MON2\_TEMP} &= (\text{TQI\_SP\_MON\_MON2} \\
 &\quad \text{TQI\_AV\_MON2} \\
 &+ \quad \text{TQI\_REQ\_TOT\_MON2} \\
 &+ \quad \text{FAC\_TQ\_REQ\_MON2} \\
 &+ \quad \text{ABC\_TQI\_AV\_AFS\_MON2} \\
 &+ \quad 256 * \text{ABC\_TQI\_N\_MAX\_MON2}) \\
 \text{XOR} &\quad (256 * \text{LF\_4\_MON2})
 \end{aligned}$$

All operations are performed with hexadecimal values only. The different units are not taken into account. The result of the operations and all intermediate results are 32 Bit word size.

ID\_RESP\_MON2 [TEST\_REC\_IDX\_MON2] must fit to RESP\_MON2 if the test calculation with index TEST\_REC\_IDX\_MON2 has been executed correctly.

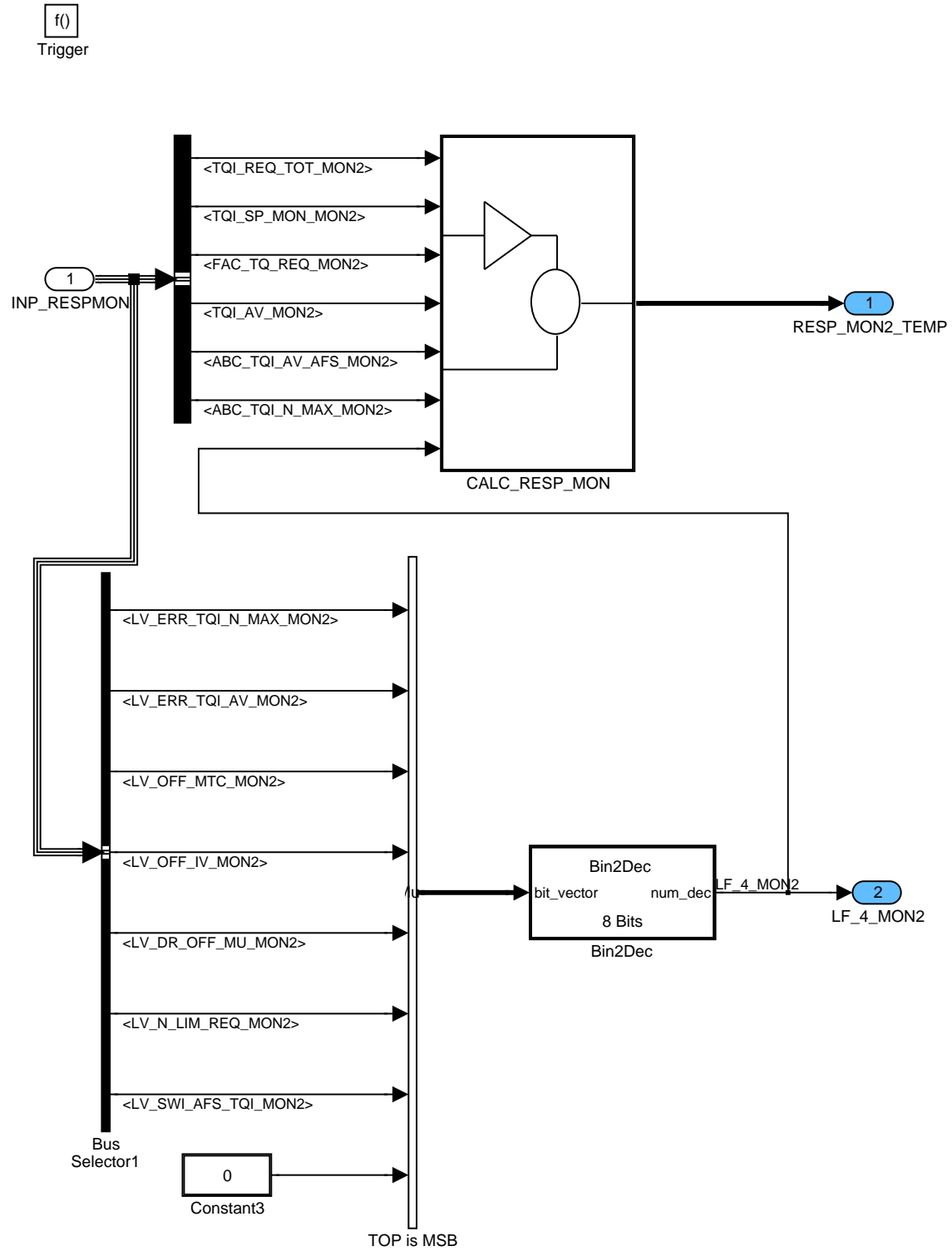


Figure E.27.25: ECM2\_DTSYSCOPRHPDI/OPERATE/RESP\_MON\_TEMP

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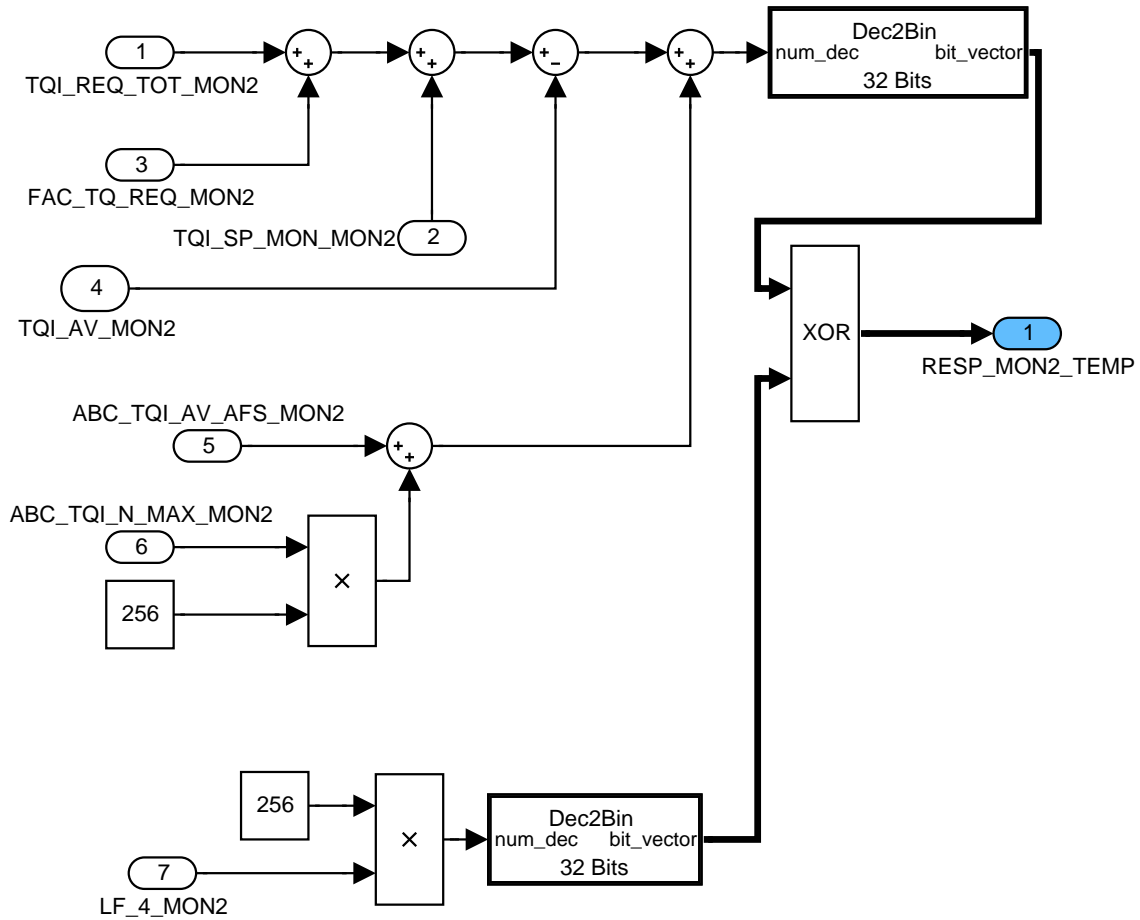


Figure E.27.26: ECM2\_DTSYSCOPPRHPDI/OPERATE/RESP\_MON\_TEMP/CALC\_RESP\_MON

### ECM2\_DTSYSCOPPRHPDI/OPERATE/RESP\_MON

For the final calculation of RESP\_MON2, the 32 bit values used so far have to be encoded into a 16 bit value. Therefore, after adding the register values, the high and the low 16 bit values of the resulting sum shall be combined by an XOR. The same procedure shall be applied to the temporary result RESP\_MON2\_TEMP which shall the additionally also be XORed with the final result of the register operations.

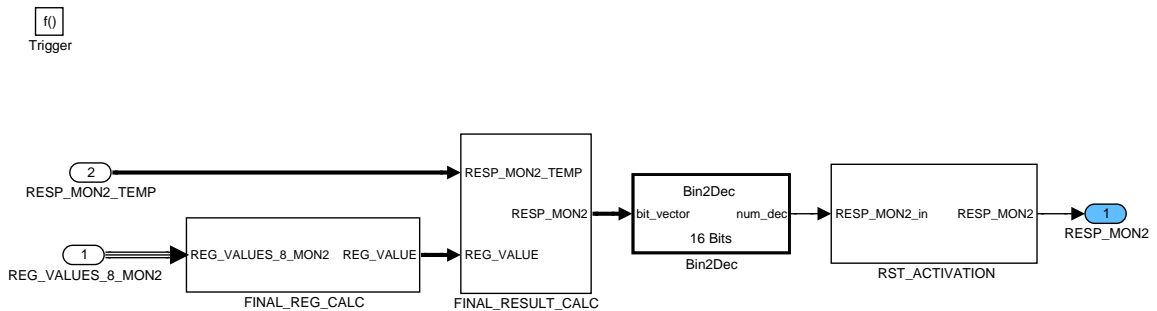


Figure E.27.27: ECM2\_DTSYSCOPPRHPDI/OPERATE/RESP\_MON

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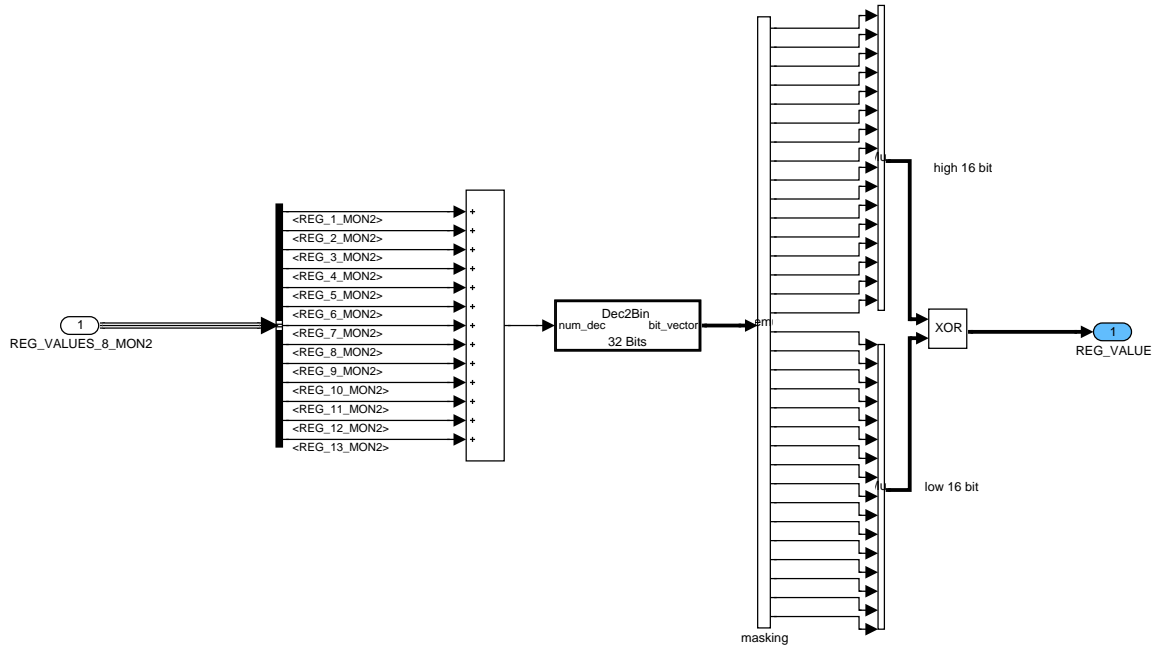


Figure E.27.28: ECM2\_DTSYSCOPPRHPDI/OPERATE/RESP\_MON/FINAL\_REG\_CALC

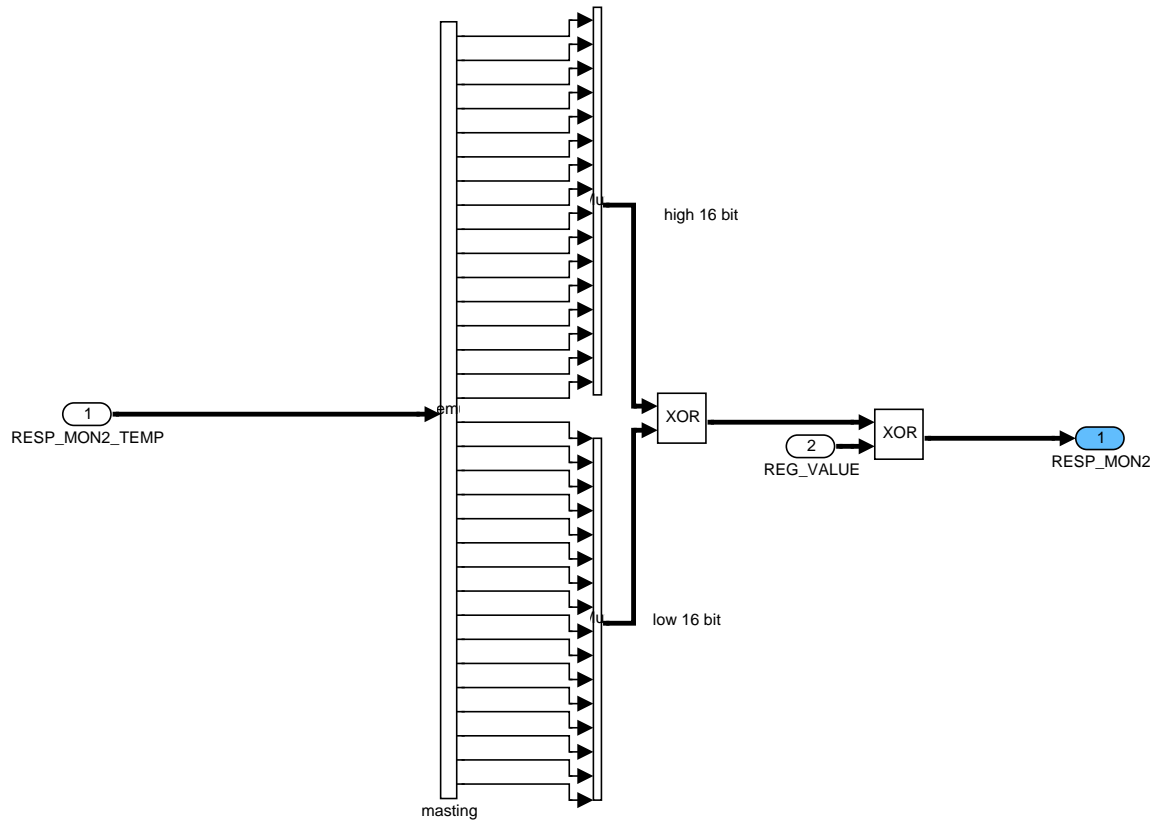


Figure E.27.29: ECM2\_DTSYSCOPPRHPDI/OPERATE/RESP\_MON/FINAL\_RESULT\_CALC

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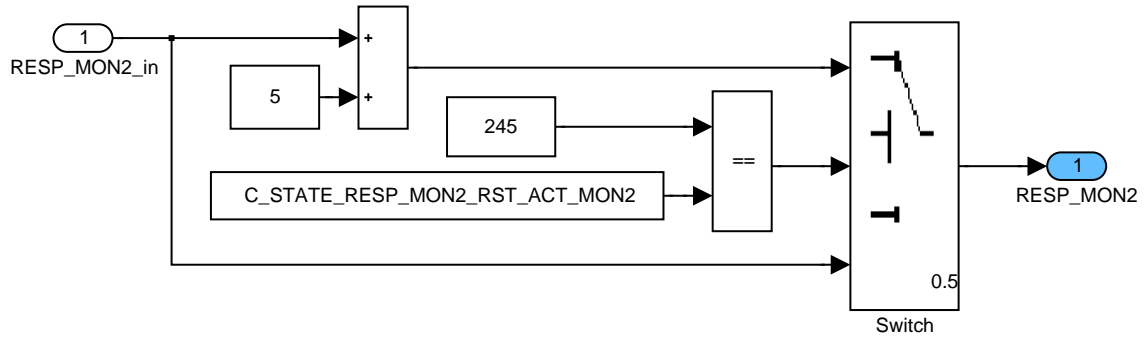


Figure E.27.30: ECM2\_DTSYSCOPPRHPDI/OPERATE/RESP\_MON/RST\_ACTIVATION

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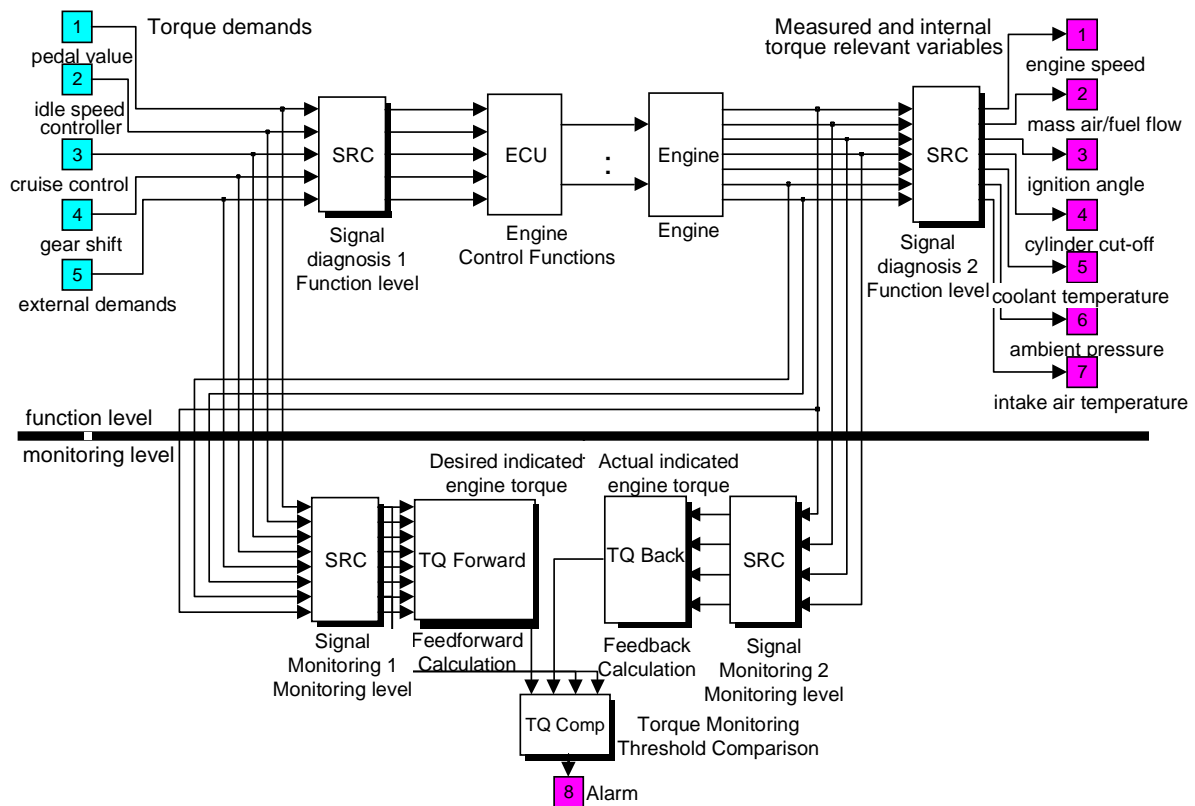
## E.28 Torque monitoring overview

In the function level the various torque demands coming from the driver, the idle speed controller etc. are co-ordinated to a resulting quantified charge setpoint. At the same time the actual indicated engine torque is calculated based on several measured and internal torque relevant variables.

The aim of the torque monitoring is to detect an increased actual indicated engine torque compared to the desired indicated engine torque. Therefore the co-ordination of the various torque demands and the calculation of the actual indicated engine torque done in the function level (level 1) is performed once again in the monitoring level (level 2), however with a simplified structure. Then the deviation between the actual (TQI\_AV\_MON) and the desired indicated engine torque (TQI\_SP\_MON) is checked for exceeding a threshold.

Signal flow diagram:

### Overview





## E.29 Communication MC - MU

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_MU_READY	-	0... FFH	0... 255	1	-
Local variable: counter for attempts of check of MU readiness					
LV_MC_CKS_OK	-	0... 1H	0 ...1	1	-
Local variable: flag indicating whether the (XOR) checksum of the data received from the MU is correct					
LV_MC_CKS_OK_CPL	-	0... 1H	0 ...1	1	-
Local variable: complement of LV_MC_CKS_OK					
LV_MC_COM_ERR	O/V	0... 1H	0 ...1	1	-
Error flag indicating any communication error (checksum, header, or parity)					
LV_MC_COM_ERR_CPL	O/V	0... 1H	0 ...1	1	-
Complement of LV_MC_COM_ERR					
LV_MC_HD_OK	-	0... 1H	0 ...1	1	-
Local variable: flag indicating whether the received header was correct or not					
LV_MC_HD_OK_CPL	-	0... 1H	0 ...1	1	-
Local variable: complement of LV_MC_HD_OK					
LV_MC_PAR_OK	-	0... 1H	0 ...1	1	-
Local variable: flag indicating whether the data received from the MU had the correct (even) parity					
LV_MC_PAR_OK_CPL	-	0... 1H	0 ...1	1	-
Local variable: complement of LV_MC_PAR_OK					
LV_MU_READY	O/V	0... 1H	0 ...1	1	-
Flag indicating whether MU is ready (=1) or not (=0)					
STATE_MU_TMP	O/V/S	0... FFH	0... 255	1	-
Header byte of MU as sent to MC (stored in reset-safe manner)					
STATE_MU_TMP_CPL	O/S	0... FFH	0... 255	1	-
Complement of STATE_MU_TMP (stored in reset-safe manner)					

### Input data:

NC_ABC_MC_CKS {p. 7073}	NC_ABC_MC_HD {p. 7074}	NC_ERR_COD_MC_CKS {p. 7077}	NC_ERR_COD_MC_HD {p. 7077}
NC_ERR_COD_MC_MU_READY {p. 7077}	NC_ERR_COD_MC_PAR {p. 7077}	NC_STATE_MC_CONF {p. 7136}	NC_STATE_MC_DI {p. 7136}
NC_STATE_MC_INI {p. 7136}	NC_STATE_MC_NORM {p. 7136}	NC_STATE_MC_NOT_VLD {p. 7136}	NC_STATE_MC_PRDR {p. 7136}
STATE_MC {p. 7135}			

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CTR_MU_READY_MAX	-	0... FFH	0... 255	1	-
Maximal number how often the check for MU readiness shall be performed before triggering a fault reaction					
NC_T_MC_COM_CYC	-	0... FFH	0... 255	1	-
Time between triggering two communications					

### Import actions:

<b>ACTION_ECM3_ChkCpl</b> (IN<PRM_VAR>,IN<PRM_VAR_CPL>)
<b>ACTION_ECM3_McDecAbc</b> (IN<PRM_ABC_ID>)
<b>ACTION_ECM3_McFaultReaction</b> (IN<PRM_ERR_COD>)
<b>ACTION_ECM3_McIncAbc</b> (IN<PRM_ABC_ID>,IN<PRM_ERR_COD>)
<b>ACTION_ECM3_McReadChkCpl</b> (OUT<PRM_RESULT>,IN<PRM_VAR>,IN<PRM_VAR_CPL>,IN<PRM_DFT_VALUE>)
<b>ACTION_ECM3_McReadChkState</b> (OUT<PRM_STATE_MC_TMP>)
<b>ACTION_ECM3_ReadChkCpl</b> (OUT<PRM_RESULT>,IN<PRM_VAR>,IN<PRM_VAR_CPL>)
<b>ACTION_ECM3_WriteChkCpl</b> (INOUT<PRM_VAR>,OUT<PRM_VAR_CPL>,IN<PRM_VALUE>)
<b>ACTION_INFR_McChkCks</b> (OUT<No Name available>)
<b>ACTION_INFR_McChkPar</b> (OUT<No Name available>)
<b>ACTION_INFR_McGetHd</b> (OUT<PRM_STATE_MU>)
<b>ACTION_INFR_McStartCom</b> (IN<No Name available>)
<b>ACTION_INFR_MuReady</b> (OUT<No Name available>)
<b>ACTION_INFR_StartMuReadyChk</b> ()

## FUNCTION DESCRIPTION:

### General information:

This module describes all functions related to monitoring of communications on the MC.

The complete function is split according to the states where the communication occurs, and also there is a second split between triggering a communication, and monitoring the data from a preceding communication; functions for communication monitoring are triggered after the communication between MC and MU is finished.

Note that header-byte monitoring, in case a DISABLE header is received from the MU, only performs the consecutive parity-bit checking; the transition to DISABLE, which is also a consequence of the received header, is specified in the function "G5.1 Disable request by MU" (cf. R5.1\_1.1).

A noteworthy point for communications in the states NORMAL and DISABLE is that the preparation of the next communication needs to be performed at a certain point *when all the necessary other functions have been executed and completed* as they prepare the data to be sent in the next communication; this can be contrasted to the two functions for CONFIG and PREDRIVE which are essentially triggered by state changes (with the additional point that certain data have to be sent to the infrastructure so that the correct values are transmitted to the MU).

### E.29.1 Check of MU readiness

## FUNCTION DESCRIPTION:

### General information:

The start-up on MC and MU is done asynchronously, so potentially the MC could already be willing to trigger the first communication while the MU has not yet completed its start-up. A communication error would be the consequence, even if the communication itself was performed without any problem - the MU simply was not yet ready and had, e.g., not yet properly prepared the data for the first communication.

In order to avoid such situations, the MC - as the master of the communication - shall first check whether the MU is ready. If the MU is ready, the first communication shall be triggered. Otherwise, the MU readiness check shall be repeated for a certain number of times, and if the MU is still not ready after a configurable number of attempts, a fault reaction shall be performed.

The configuration can be adjusted in such a way that the readiness check shall be performed forever without ever becoming actually ready; this is intended for such situations where no MU is available in the HW.

**Description:**

The function shall incorporate the following requirements:

**G57 Check of MU readiness**

R57\_1: The MC shall trigger the readiness check by calling the action ACTION\_INFR\_StartMuReady-Chk().

R57\_2: In the next recurrence, the MC shall fetch the result of the MU readiness check by calling the action ACTION\_INFR\_MuReady() with argument LV\_MU\_READY.

R57\_3: If LV\_MU\_READY = 1, the MU is ready; this information is used as one of the conditions for enabling the transition from INIT to CONFIG (where the first communication will then be triggered, cf. G12).

R57\_4: If LV\_MU\_READY = 0, CTR\_MU\_READY shall be increased by 1.

R57\_5: If CTR\_MU\_READY > NC\_CTR\_MU\_READY\_MAX, the central fault reaction shall be triggered by calling ACTION\_ECM3\_McFaultReaction() with argument NC\_ERR\_COD\_MC\_MU\_READY.

R57\_6: If CTR\_MU\_READY <= NC\_CTR\_MU\_READY\_MAX, the sequence shall be started again from R57\_1 onwards, i.e., calling ACTION\_INFR\_StartMuReadyChk() still in the same recurrence.


**Application conditions**

- Initialisation:** LV\_MU\_READY = 0;  
CTR\_MU\_READY = 0;
- Recurrence:** The **initialisation** shall be performed **after each power-up or reset**.  
The **function itself** shall be executed **every NC\_T\_MC\_COM\_CYC ms**.
- Activation:** (STATE\_MC = NC\_STATE\_MC\_INI) **AND** (LV\_MU\_READY <> 1)  
(only active in INIT state and when the check has not yet been finished)
- Deactivation:** *Otherwise*

**E.29.2 Trigger CONFIG communication**

**FUNCTION DESCRIPTION:**

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**General information:**

This function describes the triggering of the CONFIG communication by the MC.

**Description:**

The function incorporates the following requirements:

**G12 Trigger CONFIG communication**

R12\_1: In the CONFIG communication, the following data are sent from the MC to the MU:

- error code;
- error indication;
- reset counter;
- configuration data for MU (plus their complements).

(See the description of the communication protocol; further note that these data are *not* imported here because sending them to the infrastructure so that they are available for the communication is the task of the corresponding modules where the data are exported)

R12\_2: The communication is triggered by the MC once these data have been sent to the infrastructure by the responsible modules ("Central fault reaction", "State of fault reaction and up-to-dateness of error code", "Configuration of MU"); this shall be achieved by calling the action ACTION\_INFR\_McStartCom() with argument STATE\_MC.

**Application conditions**

- Initialisation:** -
- Recurrence:** *The **function** shall be **activated after the relevant data** (see R12\_1 above) **have been transported to the infrastructure.***
- Activation:** *STATE\_MC = NC\_STATE\_MC\_CONF (only active in CONFIG state)*
- Deactivation:** *Otherwise*

**E.29.3 Communication monitoring in CONFIG state**

**FUNCTION DESCRIPTION:**

**General information:**


This function describes how the CONFIG communication is monitored on the MC in the CONFIG state. Note that this really only refers to communication monitoring but not to evaluation of the received data: in case an error was encountered, an error flag (LV\_MC\_COM\_ERR) shall be set which is subsequently exported to other processor monitoring functions so that those do not get activated in case of a communication error.

**Description:**

The function incorporates the following requirements:

**G13 Communication monitoring in CONFIG state**

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R13\_1: The sequence of checks shall be communication checksum monitoring, followed by communication header-byte monitoring, and finally parity-bit checking.

R13\_2: For communication checksum monitoring:

R13\_2.1: the action ACTION\_INFR\_McChkCks() shall be called returning the flag LV\_MC\_CKS\_OK (which is set if the checksum was correct);

R13\_2.2: the variable LV\_MC\_CKS\_OK shall be stored together with its complement LV\_MC\_CKS\_OK\_CPL and it shall be accessed using the actions from section "RAM check service actions of Processor Monitoring" ACTION\_ECM3\_WriteChkCpl(), ACTION\_ECM3\_ChkCpl(), ACTION\_ECM3\_ReadChkCpl(), and ACTION\_ECM3\_McReadChkCpl(); its default value shall be 0;

R13\_2.3: in case of a checksum error:

R13\_2.3.1: an immediate fault reaction shall be carried out by calling ACTION\_ECM3\_McFaultReaction() with error code NC\_ERR\_COD\_MC\_CKS;

R13\_2.3.2: LV\_MC\_COM\_ERR shall be set;

R13\_2.3.3: no further communication monitoring shall be performed.

R13\_3: For communication header-byte monitoring:

R13\_3.1: the action ACTION\_INFR\_McGetHd() shall be called returning the header byte STATE\_MU\_TMP sent by the MU in the preceding communication; STATE\_MU\_TMP shall be stored together with its complement STATE\_MU\_TMP\_CPL; both variables shall be stored in a reset-safe manner;

R13\_3.2: the only acceptable header bytes are CONFIG and DISABLE;

R13\_3.3: in case a CONFIG header is received, LV\_MC\_HD\_OK shall be set and the communication monitoring shall continue (with parity-bit checking);

R13\_3.4: in case a DISABLE header is received, the flag LV\_MC\_HD\_OK shall be set and parity-bit checking shall be performed as for DISABLE communications (see section "Communication monitoring in DISABLE state" R4);

R13\_3.5: in case of receiving a header-byte other than CONFIG or DISABLE:

R13\_3.5.1: an immediate fault reaction shall be triggered by calling ACTION\_ECM3\_McFaultReaction with error code NC\_ERR\_COD\_MC\_HD;

R13\_3.5.2: the flag LV\_MC\_HD\_OK shall be reset;

R13\_3.5.3: LV\_MC\_COM\_ERR shall be set;

R13\_3.5.4: no further communication monitoring shall be performed;

R13\_3.6: the variable LV\_MC\_HD\_OK shall be stored together with its complement LV\_MC\_HD\_OK\_CPL and it shall be accessed using the actions from section "RAM check service actions of Processor Monitoring" ACTION\_ECM3\_WriteChkCpl(), ACTION\_ECM3\_ChkCpl(), ACTION\_ECM3\_ReadChkCpl(), and ACTION\_ECM3\_McReadChkCpl(); its default value shall be 0.

R13\_4: For parity-bit checking:

R13\_4.1: the action ACTION\_INFR\_McChkPar() shall be used which returns the flag LV\_MC\_PAR\_OK (which is set if the parity was correct);

R13\_4.2: the variable LV\_MC\_PAR\_OK shall be stored together with its complement LV\_MC\_PAR\_OK\_CPL and it shall be accessed using the actions from section "RAM check service actions of Processor Monitoring" ACTION\_ECM3\_WriteChkCpl(), ACTION\_ECM3\_ChkCpl(), ACTION\_ECM3\_ReadChkCpl(), and ACTION\_ECM3\_McReadChkCpl(); its default value shall be 0;


R13\_4.3 in case of a parity error:

R13\_4.3.1: an immediate fault reaction shall be triggered by calling ACTION\_ECM3\_McFaultReaction with error code NC\_ERR\_COD\_MC\_PAR;

R13\_4.3.2: LV\_MC\_COM\_ERR shall be set.

R13\_5: The variable LV\_MC\_COM\_ERR shall be stored together with its complement LV\_MC\_COM\_ERR\_CPL and accessed using the actions ACTION\_ECM3\_WriteChkCpl(), ACTION\_ECM3\_ChkCpl(), ACTION\_ECM3\_ReadChkCpl(), and ACTION\_ECM3\_McReadChkCpl() from section "RAM check service actions of processor monitoring on MC"; its default value shall be 1.

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## Application conditions

**Initialisation:**             */ \* After each power-up \*/*  
                                       STATE\_MU\_TMP = NC\_STATE\_MC\_INI;  
                                        */ \* After each power-up or reset, using the RAM check service*  
                                        *actions \*/*  
                                       LV\_MC\_CKS\_OK = 0;  
                                       LV\_MC\_HD\_OK = 0;  
                                       LV\_MC\_PAR\_OK = 0;  
                                       LV\_MC\_COM\_ERR = 0;

**Recurrence:**                The **initialisation** shall be performed **after each power-up or reset (as indicated above)**.  
 The **function itself** shall be triggered **after the communication between MC and MU is finished**.

**Activation:**                 STATE\_MC = NC\_STATE\_MC\_CONF (only active in CONFIG state)

**Deactivation:**               *Otherwise*

## E.29.4 Trigger PREDRIVE communication

### FUNCTION DESCRIPTION:

#### General information:

This function describes the triggering of the PREDRIVE communication by the MC.

#### Description:

The function incorporates the following requirements:

#### G14 Trigger PREDRIVE communication

R14\_1: In the PREDRIVE communication, the following data are sent from the MC to the MU:

- compatibility number;
- configuration data for MU (plus their complements).


(See the description of the communication protocol; further note that these data are *not* imported here because sending them to the infrastructure so that they are available for the communication is the task of the corresponding modules where the data are exported)

R14\_2: The communication is triggered by the MC once these data have been sent to the infrastructure by the responsible modules ("Version compatibility check", "Configuration of MU"); this shall be achieved by calling the action ACTION\_INFR\_McStartCom() with argument STATE\_MC.

## Application conditions

**Initialisation:**                –

**Recurrence:**                 *The function shall be activated after the relevant data (see R1 above) have been transported to the infrastructure and if NC\_T\_MC\_COM\_CYC ms have passed since the last communication.*

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**Activation:** `STATE_MC = NC_STATE_MC_PRDR` (only active in PREDRIVE state)

**Deactivation:** `Otherwise`

## E.29.5 Communication monitoring in PREDRIVE state

### FUNCTION DESCRIPTION:

#### General information:

This function describes how the PREDRIVE communication is monitored on the MC in the PREDRIVE state. Note that this really only refers to communication monitoring but not to evaluation of the received data: in case an error was encountered, an error flag (LV\_MC\_COM\_ERR) shall be set which is subsequently exported to other processor monitoring functions so that those do not get activated in case of a communication error.

#### Description:

The function incorporates the following requirements:

#### **G15 Communication monitoring in PREDRIVE state**

R15\_1: The sequence of checks shall be communication checksum monitoring, followed by communication header-byte monitoring.

R15\_2: For communication checksum monitoring:

R15\_2.1: the action ACTION\_INFR\_McChkCks() shall be called returning the flag LV\_MC\_CKS\_OK (which is set if the checksum was correct);

R15\_2.2: the variable LV\_MC\_CKS\_OK shall be stored together with its complement LV\_MC\_CKS\_OK\_CPL and it shall be accessed using the actions from section "RAM check service actions of Processor Monitoring" ACTION\_ECM3\_WriteChkCpl(), ACTION\_ECM3\_ChkCpl(), ACTION\_ECM3\_ReadChkCpl(), and ACTION\_ECM3\_McReadChkCpl(); its default value shall be 0;

R15\_2.3: in case of a checksum error:

R15\_2.3.1: an immediate fault reaction shall be carried out by calling ACTION\_ECM3\_McFaultReaction with error code NC\_ERR\_COD\_MC\_CKS;

R15\_2.3.2: LV\_MC\_COM\_ERR shall be set;

R15\_2.3.3: no further communication monitoring shall be performed.

R15\_3: For communication header-byte monitoring:

R15\_3.1: the action ACTION\_INFR\_McGetHd() shall be called returning the header byte STATE\_MU\_TMP sent by the MU in the preceding communication; STATE\_MU\_TMP shall be stored together with its complement STATE\_MU\_TMP\_CPL; both variables shall be stored in a reset-safe manner;

R15\_3.2: the only acceptable header bytes are PREDRIVE and DISABLE;


R15\_3.3: in case a PREDRIVE header is received, LV\_MC\_HD\_OK shall be set and communication monitoring is finished;

R15\_3.4: in case a DISABLE header is received, LV\_MC\_HD\_OK shall be set and parity-bit checking shall be performed as for DISABLE communications (see section "Communication monitoring in DISABLE state" R19\_4);

R15\_3.5: in case of receiving a header-byte other than PREDRIVE or DISABLE:

R15\_3.5.1: an immediate fault reaction shall be triggered by calling ACTION\_ECM3\_McFaultReaction with error code NC\_ERR\_COD\_MC\_HD;

R15\_3.5.2: the flag LV\_MC\_HD\_OK shall be reset;

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R15\_3.5.3: LV\_MC\_COM\_ERR shall be set;  
 R15\_3.5.4: no further communication monitoring shall be performed;  
 R15\_3.5.5: the variable LV\_MC\_HD\_OK shall be stored together with its complement LV\_MC\_HD\_OK\_CPL and it shall be accessed using the actions from section "RAM check service actions of Processor Monitoring" ACTION\_ECM3\_WriteChkCpl(), ACTION\_ECM3\_ChkCpl(), ACTION\_ECM3\_ReadChkCpl(), and ACTION\_ECM3\_McReadChkCpl(); its default value shall be 0.

R15\_4: The variable LV\_MC\_COM\_ERR shall be stored together with its complement LV\_MC\_COM\_ERR\_CPL and accessed using the actions ACTION\_ECM3\_WriteChkCpl(), ACTION\_ECM3\_ChkCpl(), ACTION\_ECM3\_ReadChkCpl(), and ACTION\_ECM3\_McReadChkCpl() from section "RAM check service actions of processor monitoring on MC."

**Application conditions**

**Initialisation:** / \* Using the RAM check actions \*/  
 LV\_MC\_COM\_ERR = 0;

**Recurrence:** The **initialisation** shall be performed **before the PREDRIVE communication is triggered**.  
 The **function itself** shall be triggered **after the communication between MC and MU is finished**.

**Activation:** STATE\_MC = NC\_STATE\_MC\_PRDR (only active in PREDRIVE state)

**Deactivation:** Otherwise

**E.29.6 Trigger NORMAL communication**

**FUNCTION DESCRIPTION:**

**General information:**

This function describes the triggering of the NORMAL communication by the MC.

**Description:**

The function incorporates the following requirements:

**G16 Trigger NORMAL communication**


R16\_1: In the NORMAL communication, the following data are sent from the MC to the MU:

- the PFM response;
- the FS-IST response;
- the value of the ignition key;
- the flag for the redundant switch-off path.

(See the description of the communication protocol; further note that these data are *not* imported here because sending them to the infrastructure so that they are available for the communication is the task of the corresponding modules where the data are exported)

R16\_2: The communication is triggered by the MC once these data have been sent to the infrastructure by the responsible modules ("Post-processing of PFM response before communications", "Post-processing of the FS-IST data on MC for transmission to MU", "Exporting the value of the ignition key",

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"The redundant switch-off path"); this shall be achieved by calling the action ACTION\_INFR\_McStart-Com() with argument STATE\_MC (note that the function can be called either shortly after the transition PREDRIVE→NORMAL, or after all other functions in NORMAL have been executed in case the NORMAL state is not left).

**Application conditions**

- Initialisation:** -
- Recurrence:** *The function shall be activated after the relevant data (see R16\_1 above) have been transported to the infrastructure and if NC\_T\_MC\_COM\_CYC ms have passed since the last communication.*
- Activation:** STATE\_MC = NC\_STATE\_MC\_NORM (only active in NORMAL state)
- Deactivation:** *Otherwise*

**E.29.7 Communication monitoring in NORMAL state**

**FUNCTION DESCRIPTION:**

**General information:**

This function describes how the NORMAL communications are monitored on the MC in the NORMAL state. Note that this really only refers to communication monitoring but not to evaluation of the received data: in case an error was encountered, an error flag (LV\_MC\_COM\_ERR) shall be set which is subsequently exported to other processor monitoring functions so that those do not get activated in case of a communication error.

**Description:**

The function incorporates the following requirements:

**G17 Communication monitoring in NORMAL state**

R17\_1: The sequence of checks shall be communication checksum monitoring, followed by communication header-byte monitoring.

R17\_2: For communication checksum monitoring:

R17\_2.1: the action ACTION\_INFR\_McChkCks() shall be called which returns the flag LV\_MC\_CKS\_OK (which is set if the checksum was correct);

R17\_2.2: the variable LV\_MC\_CKS\_OK shall be stored together with its complement LV\_MC\_CKS\_OK\_CPL and it shall be accessed using the actions from section "RAM check service actions of Processor Monitoring" ACTION\_ECM3\_WriteChkCpl(), ACTION\_ECM3\_ChkCpl(), ACTION\_ECM3\_ReadChkCpl(), and ACTION\_ECM3\_McReadChkCpl(); its default value shall be 0;

R17\_2.3: in case of a checksum error, a debounced fault reaction shall be carried out:


R17\_2.3.1: in case the checksum is wrong, the corresponding anti-bounce counter shall be increased (potentially triggering a fault reaction) by calling ACTION\_ECM3\_McIncAbc() with anti-bounce counter identifier NC\_ABC\_MC\_CKS and error code NC\_ERR\_COD\_MC\_CKS;

R17\_2.3.2: LV\_MC\_COM\_ERR shall be set;

R17\_2.3.3: no further communication monitoring shall be performed;

R17\_2.4: in case the checksum is correct, the corresponding anti-bounce counter shall be decreased by calling ACTION\_ECM3\_McDecAbc() with anti-bounce counter identifier NC\_ABC\_MC\_CKS.

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R17\_3: For communication header-byte monitoring:

R17\_3.1: the action ACTION\_INFR\_McGetHd() shall be called returning the header byte STATE\_MU\_TMP sent by the MU in the preceding communication; STATE\_MU\_TMP shall be stored together with its complement STATE\_MU\_TMP\_CPL; both variables shall be stored in a reset-safe manner;

R17\_3.2: the only acceptable header bytes are NORMAL and DISABLE;

R17\_3.3: in case a NORMAL header is received, LV\_MC\_HD\_OK shall be set and communication monitoring is finished;

R17\_3.4: in case a DISABLE header is received, LV\_MC\_HD\_OK shall be set and parity bit checking shall be performed as for DISABLE communications (see section "Communication monitoring in DISABLE state" R19\_4);

R17\_3.5: in case of receiving a header-byte different from NORMAL or DISABLE, a debounced fault reaction shall be carried out:

R17\_3.5.1: in case the header-byte is wrong, the corresponding anti-bounce counter shall be increased (potentially triggering a fault reaction) by calling ACTION\_ECM3\_McIncAbc() with anti-bounce counter identifier NC\_ABC\_MC\_HD and error code NC\_ERR\_COD\_MC\_HD;

R17\_3.5.2: the flag LV\_MC\_COM\_ERR shall be set;

R17\_3.5.3: no further communication monitoring shall be performed;

R17\_3.5.4: the flag LV\_MC\_HD\_OK shall be reset (in case the fault reaction is not correctly performed);

R17\_3.6: in case the header-byte is NORMAL, the corresponding anti-bounce counter shall be decreased by calling ACTION\_ECM3\_McDecAbc() with anti-bounce counter identifier NC\_ABC\_MC\_HD;

R17\_3.7: the variable LV\_MC\_HD\_OK shall be stored together with its complement LV\_MC\_HD\_OK\_CPL and it shall be accessed using the actions from section "RAM check service actions of Processor Monitoring" ACTION\_ECM3\_WriteChkCpl(), ACTION\_ECM3\_ChkCpl(), ACTION\_ECM3\_ReadChkCpl(), and ACTION\_ECM3\_McReadChkCpl(); its default value shall be 0.

R17\_4: The variable LV\_MC\_COM\_ERR shall be stored together with its complement LV\_MC\_COM\_ERR\_CPL and accessed using the actions ACTION\_ECM3\_WriteChkCpl(), ACTION\_ECM3\_ChkCpl(), ACTION\_ECM3\_ReadChkCpl(), and ACTION\_ECM3\_McReadChkCpl() from section "RAM check service actions of processor monitoring on MC."

### Application conditions

**Initialisation:** / \* Initialise LV\_MC\_COM\_ERR using the RAM check actions \*/

LV\_MC\_COM\_ERR = 0;

**Recurrence:** The **initialisation** shall be performed **before a NORMAL communication is triggered**.


The **function itself** shall be triggered **after the communication between MC and MU is finished**.

**Activation:** STATE\_MU = NC\_STATE\_MU\_NORM (only active in NORMAL state)

**Deactivation:** Otherwise

## E.29.8 Trigger DISABLE communication

### FUNCTION DESCRIPTION:

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**General information:**

This function describes the triggering of the DISABLE communication by the MC.

**Description:**

The function incorporates the following requirements:

**G18 Trigger DISABLE communication**

R18\_1: In the DISABLE communication, the following data are sent from the MC to the MU:

- error code;
- error indication;
- reset counter;
- the value of the ignition key;

(See the description of the communication protocol; further note that these data are *not* imported here because sending them to the infrastructure so that they are available for the communication is the task of the corresponding modules where the data are exported)

R18\_2: The communication is triggered by the MC once these data have been sent to the infrastructure by the responsible modules ("Exporting the value of the ignition key", "The redundant switch-off path"); this shall be achieved by calling the action ACTION\_INFR\_McStartCom() with argument STATE\_MC (note that the function can be called either shortly after the transition into DISABLE from a different state, or after all other functions in DISABLE have been executed in case the DISABLE state is not left).

**Application conditions**

**Initialisation:** -

**Recurrence:** *The function shall be activated after the relevant data (see R18\_1 above) have been transported to the infrastructure and if NC\_T\_MC\_COM\_CYC ms have passed since the last communication.*

**Activation:** *STATE\_MC = NC\_STATE\_MC\_DI (only active in DISABLE state)*

**Deactivation:** *Otherwise*

**E.29.9 Communication monitoring in DISABLE state**

**FUNCTION DESCRIPTION:**


**General information:**

This function describes how the DISABLE communication is monitored on the MC in the DISABLE state. Note that this really only refers to communication monitoring but not to evaluation of the received data: in case an error was encountered, an error flag (LV\_MC\_COM\_ERR) shall be set which is subsequently exported to other processor monitoring functions so that those do not get activated in case of a communication error.

**Description:**

The function incorporates the following requirements:

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## G19 Communication monitoring in DISABLE state

R19\_1: The sequence of checks shall be communication checksum monitoring, followed by communication header-byte monitoring, and finally parity-bit checking.

R19\_2: For communication checksum monitoring:

R19\_2.1: the action ACTION\_INFR\_McChkCks() shall be called which returns the flag LV\_MC\_CKS\_OK (which is set if the checksum was correct);

R19\_2.2: the variable LV\_MC\_CKS\_OK shall be stored together with its complement LV\_MC\_CKS\_OK\_CPL and it shall be accessed using the actions from section "RAM check service actions of Processor Monitoring" ACTION\_ECM3\_WriteChkCpl(), ACTION\_ECM3\_ChkCpl(), ACTION\_ECM3\_ReadChkCpl(), and ACTION\_ECM3\_McReadChkCpl(); its default value shall be 0;

R19\_2.3: in case of a checksum error, no fault reaction shall be carried out, only LV\_MC\_COM\_ERR shall be set and no further communication monitoring shall be performed.

R19\_3: For communication header-byte monitoring:

R19\_3.1: the action ACTION\_INFR\_McGetHd() shall be called returning the header byte STATE\_MU\_TMP sent by the MU in the preceding communication; STATE\_MU\_TMP shall be stored together with its complement STATE\_MU\_TMP\_CPL; both variables shall be stored in a reset-safe manner;

R19\_3.2: the only acceptable header bytes is DISABLE;

R19\_3.3: in case a DISABLE header is received, LV\_MC\_HD\_OK shall be set and the communication monitoring shall continue (with parity-bit checking);

R19\_3.4: in case of receiving a header-byte different from DISABLE, no fault reaction shall be carried out, only LV\_MC\_COM\_ERR shall be set and no further communication monitoring shall be performed; furthermore, also the flag LV\_MC\_HD\_OK shall be reset;

R19\_3.5: the variable LV\_MC\_HD\_OK shall be stored together with its complement LV\_MC\_HD\_OK\_CPL and it shall be accessed using the actions from section "RAM check service actions of Processor Monitoring" ACTION\_ECM3\_WriteChkCpl(), ACTION\_ECM3\_ChkCpl(), ACTION\_ECM3\_ReadChkCpl(), and ACTION\_ECM3\_McReadChkCpl(); its default value shall be 0.

R19\_4: For parity-bit checking:

R19\_4.1: the action ACTION\_INFR\_McChkPar() shall be used which returns the flag LV\_MC\_PAR\_OK (which is set if the parity was correct);

R19\_4.2: the variable LV\_MC\_PAR\_OK shall be stored together with its complement LV\_MC\_PAR\_OK\_CPL and it shall be accessed using the actions from section "RAM check service actions of Processor Monitoring"; its default value shall be 0 ACTION\_ECM3\_WriteChkCpl(), ACTION\_ECM3\_ChkCpl(), ACTION\_ECM3\_ReadChkCpl(), and ACTION\_ECM3\_McReadChkCpl());

R19\_4.3: in case of a parity error, no fault reaction shall be triggered, only LV\_MC\_COM\_ERR shall be set, and no further communication monitoring shall be performed.

R19\_5: The variable LV\_MC\_COM\_ERR shall be stored together with its complement LV\_MC\_COM\_ERR\_CPL and accessed using the actions ACTION\_ECM3\_WriteChkCpl(), ACTION\_ECM3\_ChkCpl(), ACTION\_ECM3\_ReadChkCpl(), and ACTION\_ECM3\_McReadChkCpl() from section "RAM check service actions of processor monitoring on MC."


### Application conditions

**Initialisation:** / \* Initialise LV\_MC\_COM\_ERR using the RAM check actions \*/

```
LV_MC_COM_ERR = 0;
```

**Recurrence:** The **initialisation** shall be performed **before a DISABLE communication is triggered.**


The **function itself** shall be triggered **after the communication between MC and MU is finished.**

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**Activation:** `STATE_MU = NC_STATE_MU_DI` (only active in DISABLE state)

**Deactivation:** `Otherwise`

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## E.30 Error memory management of processor monitoring

### Data definition:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_RST_ERR_MEM_ACT	V/S	0... FFH	0... 255	1	-
Local variable: current value of reset counter for error memory management, plus potentially additional information					
CTR_RST_ERR_MEM_OLD	V/S	0... FFH	0... 255	1	-
Local variable: old value of reset counter for error memory management, plus potentially additional information					
ERR_COD_ERR_MEM_ACT	V/S	0... 1FH	0... 31	1	-
Local variable: current value of error code for error memory management					
ERR_COD_ERR_MEM_OLD	V/S	0... 1FH	0... 31	1	-
Local variable: old value of error code for error memory management					
LV_MC_CPT_ERR_MEM_ACT	V/S	0... 1H	0 ...1	1	-
Local variable: flag indicating whether the current error code for error memory management belongs to MC (=1) or MU(=0)					
LV_MC_CPT_ERR_MEM_OLD	V/S	0... 1H	0 ...1	1	-
Local variable: flag indicating whether the old error code for error memory management belongs to MC (=1) or MU(=0)					
LV_MC_UPD_ERR_MEM_MC	-	0... 1H	0 ...1	1	-
Local variable: update flag for MC entries into error history (used as activation condition)					
LV_MC_UPD_ERR_MEM_MU	-	0... 1H	0 ...1	1	-
Local variable: update flag for MU entries into error history (used as activation condition)					
STATE_ERR_IDC_ERR_MEM_ACT	V/S	0... 3H	0 ...3	1	-
Local variable: current error indication for error memory management					
STATE_ERR_IDC_ERR_MEM_OLD	V/S	0... 3H	0 ...3	1	-
Local variable: old error indication for error memory management					

### Input data:

CTR_RST_MC {p. 7072}	CTR_RST_MC_CPL {p. 7072}	CTR_RST_MU {p. 7072}	ERR_COD_MC {p. 7072}
ERR_COD_MU {p. 7072}	IDX_STATE_SOPC {p. 7186}	IDX_STATE_SOPC_CPL {p. 7186}	LV_ABC_MC_ERR_COM {p. 7072}
LV_ABC_MC_ERR_FCT_SPC_IST {p. 7072}	LV_ABC_MC_ERR_PFM {p. 7072}	LV_ABC_MC_ERR_PFM_6 {p. 7072}	LV_V_H_DET_MU {p. 7073}
LV_V_L_DET_MU {p. 7073}	NC_CTR_RST_MC_THD {p. 7077}	NC_ERR_COD_MC_HD {p. 7077}	NC_ERR_COD_MC_NOT_ERR {p. 7077}
NC_ERR_COD_MC_SOPC {p. 7078}	NC_ERR_COD_MU_V_H {p. 7079}	NC_ERR_COD_MU_V_L {p. 7079}	NC_ERR_COD_MU_V_L_H {p. 7079}
NC_STATE_ERR_IDC_MC_NOT_PRES {p. 7079}	NC_STATE_MC_CONF {p. 7136}	NC_STATE_MC_DI {p. 7136}	NC_STATE_MC_NORM {p. 7136}
NC_STATE_MC_NOT_VLD {p. 7136}	NC_STATE_MC_PRDR {p. 7136}	STATE_ERR_IDC_MC {p. 7073}	STATE_ERR_IDC_MU {p. 7073}
STATE_MC {p. 7135}	STATE_MU_TMP {p. 7049}	STATE_MU_TMP_CPL {p. 7049}	

### Action definition

<b>ACTION_ECM3_McSetErrmUpdateFlag (IN&lt;PRM_CPT&gt;)</b>	Mode: O
This action sets the update flag LV_MC_UPD_ERR_MEM_cpt (=0 means MU, =1 means MC) for error memory information.	

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Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_CPT	in	0... 1H	0 ...1	1	-
This action sets the update flag LV_MC_UPD_ERR_MEM_cpt (=0 means MU, =1 means MC) for error memory information.					

### Import actions:

<b>ACTION_ECM3_ChkCpl</b> (IN<PRM_VAR>,IN<PRM_VAR_CPL>)
<b>ACTION_ECM3_McErrmService</b> (IN<No Name available>,IN<No Name available>,IN<No Name available>,IN<No Name available>,IN<No Name available>,IN<No Name available>,IN<No Name available>,IN<No Name available>)
<b>ACTION_ECM3_McReadChkCpl</b> (OUT<PRM_RESULT>,IN<PRM_VAR>,IN<PRM_VAR_CPL>,IN<PRM_DFT_VALUE>)
<b>ACTION_ECM3_McReadChkState</b> (OUT<PRM_STATE_MC_TMP>)
<b>ACTION_ECM3_ReadChkCpl</b> (OUT<PRM_RESULT>,IN<PRM_VAR>,IN<PRM_VAR_CPL>)
<b>ACTION_ECM3_WriteChkCpl</b> (INOUT<PRM_VAR>,OUT<PRM_VAR_CPL>,IN<PRM_VALUE>)

**Note:** data with mode "S" shall only be stored in a reset-safe manner, not in NVMY!

**Note:** the last action is defined in the application incidences and hence its functional content can be adjusted to project-specific needs/requirements.

### FUNCTION DESCRIPTION:

#### General information:

This module serves as the interface between the processor monitoring and the error memory management: as such, it provides an action call by which the current error information (error code, error indication, reset counter, and whether the data stem from MC or MU) get stored in a history-like fashion; furthermore, an action is imported (from the application incidences of processor monitoring to allow project-specific adaptations to different error memory concepts) and called after the saved values have been updated; this imported action performs the actual triggering of the error memory management with the current failure state.

#### Description:


The module provides the action ACTION\_ECM3\_McSetErrmUpdateFlag() which sets one of the update flags LV\_MC\_UPD\_ERR\_MEM\_MC and LV\_MC\_UPD\_ERR\_MEM\_MU, depending on the value of its argument.

This flag then, in turn, serves as (one of) the activation condition(s) for the functions described here, which then create/continue an error history using the variables in the output table.

The error history records which component has triggered the update of error memory information: the MC in INIT and after a fault reaction leading to permanent disabling of the power stages; the MU after a successful CONFIG communication and after receiving a DISABLE header from the MU in a state different from DISABLE.

The history stores the current value of reset counter, error code, error indication, and component (MC or MU), plus the corresponding old values (the length of the history is only two).

After the history is potentially updated, the project-specific function ACTION\_ECM3\_McErrmService(), which is imported from the application incidences (where it is defined), shall be called; this is taken

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care of by another sub-function, since the action shall be called *a/ways* even when none of the update functions is actually executed due to unsatisfied activation conditions: this is necessary to inform the error memory management not only in the case that an error is present but also in the case that no error is present.

### Description of ACTION\_ECM3\_McSetErrmUpdateFlag

#### Description:

Syntax: ACTION\_ECM3\_McSetErrmUpdateFlag (IN <cpt>)

Parameter (IN): cpt Component: 0 means MU, 1 means MC

Short description: This action sets one of the two flags LV\_MC\_UPD\_ERR\_MEM\_MU (if cpt = 0) or LV\_MC\_UPD\_ERR\_MEM\_MC (if cpt = 1); note that only setting the flag is prompted by other modules, the actual update of the data is done in this module (using the flags as activation conditions).

#### Application conditions

##### Initialisation:

After power-up:

```

/ * Initialise the information for error memory management
*/

```

```

CTR_RST_ERR_MEM_ACT = 0;
CTR_RST_ERR_MEM_OLD = 0;
ERR_COD_ERR_MEM_ACT = NC_ERR_COD_MC_NOT_ERR;
ERR_COD_ERR_MEM_OLD = NC_ERR_COD_MC_NOT_ERR;
STATE_ERR_IDC_ERR_MEM_ACT =
    NC_STATE_IDC_MC_NOT_PRES;
STATE_ERR_IDC_ERR_MEM_OLD =
    NC_STATE_IDC_MC_NOT_PRES;
LV_MC_CPT_ERR_MEM = 0;
LV_MC_CPT_ERR_MEM_OLD = 0;
LV_MC_UPD_ERR_MEM_MC = 0;
LV_MC_UPD_ERR_MEM_MU = 0;

```

After reset:

```

/ * No initialisation of error memory data necessary, update
will be performed, if necessary, by means of an action call
*/

```

```

LV_MC_UPD_ERR_MEM_MC = 0;
LV_MC_UPD_ERR_MEM_MU = 0;

```


**Recurrence:** *The **initialisation** shall be **performed after each power-up or reset.***

**Activation:** -

**Deactivation:** -

## E.30.1 Update of error memory information with MU data

### FUNCTION DESCRIPTION:

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**General information:**

This sub-function describes when and how the error history for the error memory gets updated with new data from the MU.

There are two cases for this:

1. after a successful CONFIG communication, when the error information sent from the MU have been evaluated on the MC (including the treatment of under- and over-voltage having been detected on the MU);
2. after a successful communication in which the MU sent a DISABLE header while the MC was (prior to the communication) not yet in DISABLE, and the error information sent from the MU has been evaluated on the MC.

Since the subsequent actions are slightly different and would only lead to complicated case distinctions, the two cases will be represented by two sub-functions.

**E.30.1.1 Update of error memory information with MU data after CONFIG communication**

**FUNCTION DESCRIPTION:**

**General information:**

This sub-function describes how the error memory gets updated with new data from the MU after a successful CONFIG communication, taking into account potentially set under-/over-voltage flags.

**Description:**

The function incorporates the following requirements:

**G39 Update of error memory information with MU data after CONFIG communication**

R39\_1: If

- **LV\_MC\_V\_L\_DET\_MU =1** or **LV\_MC\_V\_L\_DET\_MU =1** (i.e., a voltage monitoring error has been detected by the MU before the previous reset), and
- the **\_ACT**-variables (describing the most recently stored error) indicate an error which is **different from the same (combination of) voltage monitoring error(s) as currently detected by the MU** (i.e., **LV\_MC\_CPT\_ERR\_MEM\_ACT <> 0** or **ERR\_COD\_ERR\_MEM\_ACT** not equal to **NC\_ERR\_COD\_MU\_V\_L**, **NC\_ERR\_COD\_MU\_V\_H**, or **NC\_ERR\_COD\_MU\_V\_L\_H**, respectively, depending on the three possible combinations where at least one of the two flags is set):

R39\_1.1: the values of the **\_ACT**-variables of error memory information shall be saved in the corresponding **\_OLD**-variables;

R39\_1.2: **ERR\_COD\_ERR\_MEM\_ACT** shall be set to **NC\_ERR\_COD\_MU\_V\_L**, **NC\_ERR\_COD\_MU\_V\_H**, or **NC\_ERR\_COD\_MU\_V\_L\_H**, respectively, depending on the three possible combinations where at least one of the two flags is set;

R39\_1.3: **CTR\_RST\_ERR\_MEM\_ACT** shall be set to 0;


R39\_1.4: **STATE\_ERR\_IDC\_ERR\_MEM\_ACT** shall be set to **NC\_STATE\_IDC\_MC\_NOT\_PRES**;

R39\_1.5: **LV\_MC\_CPT\_ERR\_MEM\_ACT** shall be set to 0, i.e., the active component shall be set to MU.

R39\_2: If R39\_1 does not apply but:

- **LV\_MC\_CPT\_ERR\_MEM\_ACT <> 0** (most recently stored error not an MU error), or

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- **ERR\_COD\_ERR\_MEM\_ACT** <> **ERR\_COD\_MU** (most recently stored error has different error code), or
- **CTR\_RST\_ERR\_MEM\_ACT (four LSBs)** > **CTR\_RST\_MU** (most recently stored reset counter greater than current reset counter on MU, i.e., even though potentially the same error has occurred again, the decreased actual value of the reset counter indicates that the reset counter must have healed in between):

R39\_2.1: the values of the **\_ACT**-variables of error memory information shall be saved in the corresponding **\_OLD**-variables;

R39\_2.2: the values of **ERR\_COD\_MU**, **STATE\_ERR\_IDC\_MU**, and **CTR\_RST\_MU** shall be saved to the **\_ACT**-variables, and the active component shall be set to **MU**, i.e., **LV\_MC\_CPT\_ERR\_MEM\_ACT** shall be set to 0.

R39\_3: If R39\_1 and R39\_2 both do not apply but **CTR\_RST\_ERR\_MEM\_ACT (four LSBs)** < **CTR\_RST\_MU** (i.e., the same MU error has occurred at least one more time which led to the increment of the reset counter since the storage), then the **\_ACT**-variables shall be updated with the values of **ERR\_COD\_MU**, **STATE\_ERR\_IDC\_MU**, and **CTR\_RST\_MU**, and **LV\_MC\_CPT\_ERR\_MEM\_ACT** shall be set to 0, i.e., the active component shall be set to **MU**.

R39\_4: The update flag **LV\_MC\_UPD\_ERR\_MEM\_MU** shall be reset.

### Application conditions

**Initialisation:** –

**Recurrence:** *The function shall be executed after the function "Evaluation of error information from MU on MC" (when potentially new data from the MU are available on the MC).*

**Activation:** *(STATE\_MC = NC\_STATE\_MC\_CONF) AND (LV\_MC\_UPD\_ERR\_MEM\_MU = 1) AND ((STATE\_ERR\_IDC\_MU <> NC\_STATE\_ERR\_IDC\_MC\_NOT\_PRES) OR (LV\_V\_L\_DET\_MU = 1) OR (LV\_V\_H\_DET\_MU = 1)) (only active in CONFIG if update flag for MU is set and if any of the following conditions is true: the error indication of the MU is different from "no error present"; the UVD flag is set; the OVD flag is set)*

**Deactivation:** *Otherwise*

### **E.30.1.2 Update of error memory information with MU data after DISABLE communication**


#### FUNCTION DESCRIPTION:

#### General information:

This sub-function describes how the error memory gets updated with new data from the MU after a successful communication in which the MU sent a **DISABLE** header but the MC was, prior to the communication, not in **DISABLE** state (meanwhile, it is also in **DISABLE**).

#### Description:

The function incorporates the following requirements:

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## G40 Update of error memory information with MU data after DISABLE communication

R40\_1: If

- **LV\_MC\_CPT\_ERR\_MEM\_ACT**  $\langle \rangle$  0 (most recently stored error not an MU error), or
- **ERR\_COD\_ERR\_MEM\_ACT**  $\langle \rangle$  **ERR\_COD\_MU** (most recently stored error has different error code), or
- **CTR\_RST\_ERR\_MEM\_ACT** (four LSBs)  $>$  **CTR\_RST\_MU** (most recently stored reset counter greater than counter on MU, i.e., even though potentially the same error has occurred again, the decreased actual value of the reset counter indicates that the reset counter must have healed in between)

R40\_1.1: the values of the \_ACT-variables of error memory information shall be saved in the corresponding \_OLD-variables;

R40\_1.2: the values of **ERR\_COD\_MU**, **STATE\_ERR\_IDC\_MU**, and **CTR\_RST\_MU** shall be saved to the \_ACT-variables, and the active component shall be set to MU, i.e., **LV\_MC\_CPT\_ERR\_MEM\_ACT** shall be set to 0.

R40\_2: If R40\_1 does not apply, but **CTR\_RST\_ERR\_MEM\_ACT** (four LSBs)  $<$  **CTR\_RST\_MU** (i.e., the same MU error has occurred at least one more time which led to the increment of the reset counter since the storage), then the \_ACT-variables shall be updated with the values of **ERR\_COD\_MU**, **STATE\_ERR\_IDC\_MU**, and **CTR\_RST\_MU**, and **LV\_MC\_CPT\_ERR\_MEM\_ACT** shall be set to 0, i.e., the active component shall be set to MU.

R40\_3: The update flag **LV\_MC\_UPD\_ERR\_MEM\_MU** shall be reset.

### Application conditions

**Initialisation:** –

**Recurrence:** *The function shall be executed after the function "Evaluation of error information from MU on MC" (when potentially new data from the MU are available on the MC).*

**Activation:** *(STATE\_MC = NC\_STATE\_MC\_DI) AND  
(LV\_MC\_UPD\_ERR\_MEM\_MU = 1) AND  
(STATE\_ERR\_IDC\_MU  $\langle \rangle$  NC\_STATE\_ERR\_IDC\_MC\_NOT\_PRES)  
(only active in DISABLE if update flag for MU is set and error indication different from "no error present")*

**Deactivation:** *Otherwise*

## E.30.2 Update of error memory information with MC data


### FUNCTION DESCRIPTION:

#### General information:

This sub-function describes when and how the error history for the error memory gets updated with new data from the MC.

There are two cases for this:

1. in INIT (potentially after the error indication has been changed from "ECU restart request" to "ECU restart was requested");
2. after a fault reaction on the MC leading to permanent disabling (i.e., **CTR\_RST\_MC** = **NC\_CTR\_RST\_MC\_THD** + 1, error indication "disable request").

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In the first case, the update function is only called if the error indication is different from "no error present". Note that this condition is also satisfied in the second case, and in both cases, the update flag LV\_MC\_UPD\_ERR\_MEM\_MC has been set by the corresponding modules ("State of fault reaction and up-to-dateness of error code" and "Central fault reaction", respective).

Consequently, the activation conditions for the function are that LV\_MC\_UPD\_ERR\_MEM\_MC is set and that the error indication is different from "no error present."

### Description:

The function incorporates the following requirements:

#### **G41 Update of error memory information with MC data**

R41\_1: If

- **LV\_MC\_CPT\_ERR\_MEM\_ACT**  $\langle \rangle$  1 (most recently stored error not an MC error), or
- **ERR\_COD\_ERR\_MEM\_ACT**  $\langle \rangle$  **ERR\_COD\_MC** (most recently stored error has different error code), or
- **CTR\_RST\_ERR\_MEM\_ACT (four LSBs)**  $>$  **CTR\_RST\_MC** (most recently stored reset counter greater than counter on MC, i.e., even though potentially the same error has occurred again, the decreased actual value of the reset counter indicates that the reset counter must have healed in between):

R41\_1.1: the values of the \_ACT-variables of error memory information shall be saved in the corresponding \_OLD-variables;

R41\_1.2: the values of ERR\_COD\_MC, STATE\_ERR\_IDC\_MC, and CTR\_RST\_MC (after a consistency check with its complement CTR\_RST\_MC\_CPL using ACTION\_ECM3\_ReadChkCpl()) shall be saved to the \_ACT-variables, and the active component shall be set to MC, i.e., LV\_MC\_CPT\_ERR\_MEM\_ACT shall be set to 1;

R41\_1.3: if ERR\_COD\_MC = NC\_ERR\_COD\_MC\_SOPC (i.e., an error in the switch-off path check was detected), IDX\_STATE\_SOPC shall be encoded into the four MSBs of CTR\_RST\_ERR\_MEM\_ACT (CTR\_RST\_MC uses only the four LSBs); IDX\_STATE\_SOPC shall be accessed using the RAM check service actions (complement check with IDX\_STATE\_SOPC\_CPL);

R41\_1.4: if ERR\_COD\_MC = NC\_ERR\_COD\_MC\_HD (i.e., an invalid header-byte has been sent by the MU), the value of STATE\_MU\_TMP shall be encoded into the four MSBs of CTR\_RST\_ERR\_MEM\_ACT (CTR\_RST\_MC uses only the four LSBs); the value encoded in CTR\_RST\_ERR\_MEM\_ACT shall be as shown in the following table:

Value of STATE_MU_TMP	Encoded value (dec.)
NC_STATE_MC_CONF	1
NC_STATE_MC_PRDR	2
NC_STATE_MC_NORM	3
NC_STATE_MC_DI	4
NC_STATE_MC_NOT_VLD	5
00H	6
FFH	7
Otherwise	15

R41\_1.5: if ERR\_COD\_MC  $\langle \rangle$  NC\_ERR\_COD\_MC\_SOPC and ERR\_COD\_MC  $\langle \rangle$  NC\_ERR\_COD\_MC\_HD (i.e., neither an SOPC nor a header error has occurred), the flags LV\_ABC\_MC\_ERR\_COM, LV\_ABC\_MC\_ERR\_PFM, LV\_ABC\_MC\_ERR\_PFM\_6 and LV\_ABC\_MC\_ERR\_FCT\_SPC\_IST shall be encoded into the four MSBs of CTR\_RST\_ERR\_MEM\_ACT (CTR\_RST\_MC uses only the four LSBs) as follows:

Bit 3	Bit 2	Bit 1	Bit 0
LV_ABC_MC_ERR_FCT_SPC_IST	LV_ABC_MC_ERR_PFM_6	LV_ABC_MC_ERR_PFM	LV_ABC_MC_ERR_COM

R41\_2: If R41\_1 does not apply but **CTR\_RST\_ERR\_MEM\_ACT (four LSBs) < CTR\_RST\_MC** (i.e., the same MC error has occurred at least one more time which led to the increment of the reset counter since the storage):

R41\_2.1: the \_ACT-variables shall be updated with the values of ERR\_COD\_MC, STATE\_ERR\_IDC\_MC, and CTR\_RST\_MC (after a consistency check with its complement CTR\_RST\_MC\_CPL using ACTION\_ECM3\_ReadChkCpl()), and LV\_MC\_CPT\_ERR\_MEM\_ACT shall be set to 1, i.e., the active component shall be set to 1;

R41\_2.2: if ERR\_COD\_MC = NC\_ERR\_COD\_MC\_SOPC (i.e., an error in the switch-off path check was detected), IDX\_STATE\_SOPC shall be encoded into the four MSBs of CTR\_RST\_ERR\_MEM\_ACT (CTR\_RST\_MC uses only the four LSBs); IDX\_STATE\_SOPC shall be accessed using the RAM check service actions (complement check with IDX\_STATE\_SOPC\_CPL);

R41\_2.3: if ERR\_COD\_MC = NC\_ERR\_COD\_MC\_HD (i.e., an invalid header-byte has been sent by the MU), the value of STATE\_MU\_TMP shall be encoded into the four MSBs of CTR\_RST\_ERR\_MEM\_ACT (CTR\_RST\_MC uses only the four LSBs); the value encoded in CTR\_RST\_ERR\_MEM\_ACT shall be as shown in above table;

R41\_2.4: if ERR\_COD\_MC <> NC\_ERR\_COD\_MC\_SOPC and ERR\_COD\_MC <> NC\_ERR\_COD\_MC\_HD (i.e., neither an SOPC nor a header error has occurred), the flags LV\_ABC\_MC\_ERR\_COM, LV\_ABC\_MC\_ERR\_PFM, LV\_ABC\_MC\_ERR\_PFM\_6 and LV\_ABC\_MC\_ERR\_FCT\_SPC\_IST shall be encoded into the four MSBs of CTR\_RST\_ERR\_MEM\_ACT (CTR\_RST\_MC uses only the four LSBs) as shown in the table above.

R41\_3: The update flag LV\_MC\_UPD\_ERR\_MEM\_MC shall be reset.

### Application conditions

**Initialisation:** –

**Recurrence:** After the functions "State of fault reaction and up-to-dateness of error code" and "Central fault reaction"

**Activation:** (LV\_MC\_UPD\_ERR\_MEM\_MC = 1) **AND**  
(STATE\_ERR\_IDC\_MC <> NC\_STATE\_ERR\_IDC\_NOT\_PRES)

**Deactivation:** Otherwise


## E.30.3 Activation of project-specific function calling the error memory management

### FUNCTION DESCRIPTION:

#### General information:

This sub-function simply calls the project-specific function ACTION\_ECM3\_McErrmService() which uses hands error history to the error memory management and sets the necessary diagnosis flags.

The action shall be called every time when potentially an update of the error history could have been performed, regardless of an actual update; this is done because the error memory also needs to be informed of the case where *no* error is present/detected.

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**Description:**

The sub-function incorporates the following requirements:

**G42 Activation of project-specific function calling the error memory management**

R42\_1: The project-specific action ACTION\_ECM3\_McErrmService() shall be called in CONFIG or DISABLE with the complete error history after any of the update functions above has been called **regardless of whether the update function actually was activated**.

R42\_2: In DISABLE, ACTION\_ECM3\_McErrmService() shall only be called once.


**Application conditions**

**Initialisation:** –

**Recurrence:** *The function shall be called each time after one of the update functions could be have been activated, regardless of the actual activation of the update function.*

**Activation:** *(STATE\_MC = NC\_STATE\_MC\_CONF) OR  
(STATE\_MC = NC\_STATE\_MC\_DI) OR  
("LV\_MC\_UPD\_ERR\_MEM\_MC or LV\_MC\_UPD\_ERR\_MEM\_MU were previously set")  
(activated only in CONFIG and DISABLE after an update function could have been called)*

**Deactivation:** –

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## E.31 Fault reaction of processor monitoring

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_MC_CKS	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for checksum monitoring					
ABC_MC_CONF_DIF	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for receiving wrong configuration data from MU in NORMAL state					
ABC_MC_HD	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for header-byte monitoring					
ABC_MC_NOT_DEC	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not decreasing the anti-bounce counter for FS-IST answers correctly					
ABC_MC_PFM_0_RESP	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not reacting to wrongly transmitted PFM bit of task 0					
ABC_MC_PFM_0_TOG	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not toggling the PFM bit of task 0 in time					
ABC_MC_PFM_1_RESP	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not reacting to wrongly transmitted PFM bit of task 1					
ABC_MC_PFM_1_TOG	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not toggling the PFM bit of task 1 in time					
ABC_MC_PFM_2_RESP	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not reacting to wrongly transmitted PFM bit of task 2					
ABC_MC_PFM_2_TOG	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not toggling the PFM bit of task 2 in time					
ABC_MC_PFM_3_RESP	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not reacting to wrongly transmitted PFM bit of task 3					
ABC_MC_PFM_3_TOG	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not toggling the PFM bit of task 3 in time					
ABC_MC_PFM_4_RESP	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not reacting to wrongly transmitted PFM bit of task 4					
ABC_MC_PFM_4_TOG	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not toggling the PFM bit of task 4 in time					
ABC_MC_PFM_5_RESP	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not reacting to wrongly transmitted PFM bit of task 5					
ABC_MC_PFM_5_TOG	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not toggling the PFM bit of task 5 in time					
ABC_MC_PFM_6_RESP	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not reacting to wrongly transmitted PFM bit of task 6					
ABC_MC_PFM_6_TOG	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not toggling the PFM bit of task 6 in time					
ABC_MC_WRG_IDX	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not sending expected FS-IST test index (question)					
ABC_MC_WRG_RESP	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not reacting correctly to wrong FS-IST answers					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_COM_CYC_MC_DEC_RST	-	0... 3FFH	0... 1023	1	-
Local variable: communication cycle counter for healing of reset counter and error information					
CTR_COM_CYC_MC_DR_DI_TMP	V	0... FFH	0... 255	1	-
Communication cycle counter used for temporary disabling of power stages by Processor Monitoring					
CTR_MU_DI	-	0... FH	0... 15	1	-
Local variable: counter for time-out of disable request (counts number of communications since the DISABLE header was sent to the MU)					
CTR_RST_MC	O/V/S	0... FH	0... 15	1	-
Reset counter on MC					
CTR_RST_MC_CPL	O/S	0... FH	0... 15	1	-
Complement of CTR_RST_MC					
CTR_RST_MU	O/V/S	0... FH	0... 15	1	-
Value of reset counter of MU					
ERR_COD_MC	O/V/S	0... 1FH	0... 31	1	-
Error code of the MC					
ERR_COD_MU	O/V/S	0... 1FH	0... 31	1	-
Error code of the MU					
LV_ABC_MC_ERR_COM	O/V	0... 1H	0 ...1	1	-
Flag indicating that an anti-bounce counter for communication monitoring is greater than 0 after reset					
LV_ABC_MC_ERR_FCT_SPC_IST	O/V	0... 1H	0 ...1	1	-
Flag indicating that an anti-bounce counter for FS-IST is greater than 0 after reset					
LV_ABC_MC_ERR_PFM	O/V	0... 1H	0 ...1	1	-
Flag indicating that an anti-bounce counter for PFM tasks 0...5 (not for task 6!) is greater than 0 after reset					
LV_ABC_MC_ERR_PFM_6	O/V	0... 1H	0 ...1	1	-
Flag indicating that an anti-bounce counter for PFM task 6 is greater than 0 after reset					
LV_ERR_MU_MC	O/V	0... 1H	0 ...1	1	-
Error flag requesting and indicating permanent disabling of power stages by Processor Monitoring (MU and MC)					
LV_ERR_MU_MC_CPL	O	0... 1H	0 ...1	1	-
Complement of LV_ERR_MU_MC					
LV_ERR_TMP_MU_MC	O/V	0... 1H	0 ...1	1	-
Error flag requesting and indicating temporary disabling of power stages by Processor Monitoring (MU and MC)					
LV_ERR_TMP_MU_MC_CPL	O	0... 1H	0 ...1	1	-
Complement of LV_ERR_TMP_MU_MC					
LV_INJ_OFF_TMR_INJ_ENA_TMP	O/V	0... 1H	0 ...1	1	-
Temporary flag indicating enabling of injection by the injection off timer of MU					
LV_MC_DR_OFF	O/V	0... 1H	0 ...1	1	-
Flag indicating whether the redundant switch-off path was triggered					
LV_MC_DR_OFF_CPL	O	0... 1H	0 ...1	1	-
Complement of LV_MC_DR_OFF					
LV_MC_INH_SOPC	O/V	0... 1H	0 ...1	1	-
Flag indicating that the MC-part of the SOPC has to be delayed since the MU is still disabling					
LV_MU_DI_ACT	-	0... 1H	0 ...1	1	-
Local variable: flag indicating whether the DISABLE request is active (prompting a manipulated value for the reset counter to be sent to MU)					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_MU_DI_OUT_0	O/V	0... 1H	0 ...1	1	-
Flag indicating (in inverse logic!) whether the MU disables power stage 0 or not					
LV_MU_DI_OUT_1	O/V	0... 1H	0 ...1	1	-
Flag indicating (in inverse logic!) whether the MU disables power stage 1 or not					
LV_V_H_DET_MU	O/V	0... 1H	0 ...1	1	-
Flag indicating that over-voltage was detected by the MU					
LV_V_L_DET_MU	O/V	0... 1H	0 ...1	1	-
Flag indicating that under-voltage was detected by the MU					
MU_DI_STATE	O/V	0H	MU_DI_NOT_REQ	-	-
		1H	MU_DI_BUSY		
		2H	MU_DI_ERR		
		3H	MU_DI_OK		
State of MU Disable request					
STATE_ERR_IDC_MC	O/V/S	0... 3H	0 ...3	1	-
Error indication on MC					
STATE_ERR_IDC_MU	O/V/S	0... 3H	0 ...3	1	-
Error indication of MU					

**Input data:**

LV_MC_COM_ERR {p. 7049}	LV_MC_COM_ERR_CPL {p. 7049}	LV_MC_PFM_WRG_RESP_ACT_6 {p. 7117}	LV_MC_ROM_CHK_READY {p. 7135}
LV_MC_ROM_CHK_READY_CPL {p. 7135}	LV_MC_SOPC_ACT {p. 7186}	LV_MU_IGN_KEY {p. 7135}	NC_STATE_MC_CONF {p. 7136}
NC_STATE_MC_DI {p. 7136}	NC_STATE_MC_INI {p. 7136}	NC_STATE_MC_NORM {p. 7136}	NC_STATE_MC_PRDR {p. 7136}
NLC_MU_INJ_OFF_TMR_ENA {p. 7136}	STATE_MC {p. 7135}		

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ABC_MC_CKS	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to checksum monitoring					
NC_ABC_MC_CKS_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to checksum monitoring					
NC_ABC_MC_CKS_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to checksum monitoring					
NC_ABC_MC_CKS_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to checksum monitoring					
NC_ABC_MC_CONF_DIF	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to receiving different configuration data from MU					
NC_ABC_MC_CONF_DIF_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to receiving different configuration data from MU					
NC_ABC_MC_CONF_DIF_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to receiving different configuration data from MU					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ABC_MC_CONF_DIF_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to receiving different configuration data from MU					
NC_ABC_MC_HD	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to header-byte monitoring					
NC_ABC_MC_HD_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to header-byte monitoring					
NC_ABC_MC_HD_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to header-byte monitoring					
NC_ABC_MC_HD_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to header-byte monitoring					
NC_ABC_MC_NOT_DEC	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter for MU not decreasing the anti-bounce counter for FS-IST answers correctly					
NC_ABC_MC_NOT_DEC_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter for MU not decreasing the anti-bounce counter for FS-IST answers correctly					
NC_ABC_MC_NOT_DEC_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter for MU not decreasing the anti-bounce counter for FS-IST answers correctly					
NC_ABC_MC_NOT_DEC_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter for MU not decreasing the anti-bounce counter for FS-IST answers correctly					
NC_ABC_MC_PFM_0_RESP	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 0					
NC_ABC_MC_PFM_0_RESP_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 0					
NC_ABC_MC_PFM_0_RESP_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 0					
NC_ABC_MC_PFM_0_RESP_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 0					
NC_ABC_MC_PFM_0_TOG	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not toggling the PFM bit of task 0 in time					
NC_ABC_MC_PFM_0_TOG_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not toggling the PFM bit of task 0 in time					
NC_ABC_MC_PFM_0_TOG_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 0 in time					
NC_ABC_MC_PFM_0_TOG_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 0 in time					
NC_ABC_MC_PFM_1_RESP	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 1					
NC_ABC_MC_PFM_1_RESP_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 1					
NC_ABC_MC_PFM_1_RESP_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 1					
NC_ABC_MC_PFM_1_RESP_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 1					
NC_ABC_MC_PFM_1_TOG	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not toggling the PFM bit of task 1 in time					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ABC_MC_PFM_1_TOG_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not toggling the PFM bit of task 1 in time					
NC_ABC_MC_PFM_1_TOG_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 1 in time					
NC_ABC_MC_PFM_1_TOG_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 1 in time					
NC_ABC_MC_PFM_2_RESP	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 2					
NC_ABC_MC_PFM_2_RESP_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 2					
NC_ABC_MC_PFM_2_RESP_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 2					
NC_ABC_MC_PFM_2_RESP_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 2					
NC_ABC_MC_PFM_2_TOG	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not toggling the PFM bit of task 2 in time					
NC_ABC_MC_PFM_2_TOG_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not toggling the PFM bit of task 2 in time					
NC_ABC_MC_PFM_2_TOG_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 2 in time					
NC_ABC_MC_PFM_2_TOG_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 2 in time					
NC_ABC_MC_PFM_3_RESP	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 3					
NC_ABC_MC_PFM_3_RESP_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 3					
NC_ABC_MC_PFM_3_RESP_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 3					
NC_ABC_MC_PFM_3_RESP_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 3					
NC_ABC_MC_PFM_3_TOG	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not toggling the PFM bit of task 3 in time					
NC_ABC_MC_PFM_3_TOG_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not toggling the PFM bit of task 3 in time					
NC_ABC_MC_PFM_3_TOG_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 3 in time					
NC_ABC_MC_PFM_3_TOG_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 3 in time					
NC_ABC_MC_PFM_4_RESP	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 4					
NC_ABC_MC_PFM_4_RESP_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 4					
NC_ABC_MC_PFM_4_RESP_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 4					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ABC_MC_PFM_4_RESP_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 4					
NC_ABC_MC_PFM_4_TOG	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not toggling the PFM bit of task 4 in time					
NC_ABC_MC_PFM_4_TOG_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not toggling the PFM bit of task 4 in time					
NC_ABC_MC_PFM_4_TOG_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 4 in time					
NC_ABC_MC_PFM_4_TOG_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 4 in time					
NC_ABC_MC_PFM_5_RESP	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 5					
NC_ABC_MC_PFM_5_RESP_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 5					
NC_ABC_MC_PFM_5_RESP_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 5					
NC_ABC_MC_PFM_5_RESP_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 5					
NC_ABC_MC_PFM_5_TOG	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not toggling the PFM bit of task 5 in time					
NC_ABC_MC_PFM_5_TOG_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not toggling the PFM bit of task 5 in time					
NC_ABC_MC_PFM_5_TOG_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 5 in time					
NC_ABC_MC_PFM_5_TOG_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 5 in time					
NC_ABC_MC_PFM_6_RESP	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 6					
NC_ABC_MC_PFM_6_RESP_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 6					
NC_ABC_MC_PFM_6_RESP_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 6					
NC_ABC_MC_PFM_6_RESP_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 6					
NC_ABC_MC_PFM_6_TOG	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not toggling the PFM bit of task 6 in time					
NC_ABC_MC_PFM_6_TOG_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not toggling the PFM bit of task 6 in time					
NC_ABC_MC_PFM_6_TOG_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 6 in time					
NC_ABC_MC_PFM_6_TOG_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 6 in time					
NC_ABC_MC_WRG_IDX	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not sending the expected FS-IST test index (question)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ABC_MC_WRG_IDX_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not sending the expected FS-IST test index (question)					
NC_ABC_MC_WRG_IDX_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not sending the expected FS-IST test index (question)					
NC_ABC_MC_WRG_IDX_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not sending the expected FS-IST test index (question)					
NC_ABC_MC_WRG_RESP	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter for MU not reacting correctly to wrong FS-IST answers					
NC_ABC_MC_WRG_RESP_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter for MU not reacting correctly to wrong FS-IST answers					
NC_ABC_MC_WRG_RESP_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter for MU not reacting correctly to wrong FS-IST answers					
NC_ABC_MC_WRG_RESP_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter for MU not reacting correctly to wrong FS-IST answers					
NC_CTR_COM_CYC_MC_DEC_RST_INI	-	0... 3FFH	0... 1023	1	-
Initial value for communication cycle counter for healing of reset counter and error information					
NC_CTR_MU_DI_MAX	-	0... FH	0... 15	1	-
Maximal value for counter for disable request					
NC_CTR_RST_MC_DI	-	0... FH	0... 15	1	-
Value of reset counter to be sent to MU in case of a disable request					
NC_CTR_RST_MC_THD	-	0... FH	0... 15	1	-
Threshold for reset counter on MU, RST_CTR_MC, the reaching of which shall prompt the MU to irreversibly (for the current driving cycle) disable the power stages					
NC_CYCNR_MC_DR_DI_TMP	-	1... FFH	1... 255	1	-
Number of communication cycles (<>0) for temporary disabling after the PREDRIVE communication					
NC_ERR_COD_MC_CKS	-	0... 1FH	0... 31	1	-
Error code for "checksum of received data is wrong"					
NC_ERR_COD_MC_COMP_NR	-	0... 1FH	0... 31	1	-
Error code for "MU is incompatible to MC software"					
NC_ERR_COD_MC_CONF_DIF	-	0... 1FH	0... 31	1	-
Error code for "configuration data different from previously sent data"					
NC_ERR_COD_MC_HD	-	0... 1FH	0... 31	1	-
Error code for "header byte invalid or disallowed transition"					
NC_ERR_COD_MC_MU_READY	-	0... 1FH	0... 31	1	-
Error code for "MU not ready"					
NC_ERR_COD_MC_NOT_DEC	-	0... 1FH	0... 31	1	-
Error code for "MU does not decrease the anti-bounce counter for FS-IST correctly"					
NC_ERR_COD_MC_NOT_ERR	-	0... 1FH	0... 31	1	-
Error code for "no error"					
NC_ERR_COD_MC_NOT_VLD_TRAN	-	0... 1FH	0... 31	1	-
Error code for "invalid or more than one state active (invalid transition) on MC"					
NC_ERR_COD_MC_PAR	-	0... 1FH	0... 31	1	-
Error code for "parity error in received data"					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ERR_COD_MC_PFM_0_RESP	-	0... 1FH	0... 31	1	-
Error code for "MU does not respond to wrongly toggled bit 0 in PFM response"					
NC_ERR_COD_MC_PFM_0_TOG	-	0... 1FH	0... 31	1	-
Error code for "MU does not toggle bit 0 in the PFM synchronisation byte with the correct recurrence"					
NC_ERR_COD_MC_PFM_1_RESP	-	0... 1FH	0... 31	1	-
Error code for "MU does not respond to wrongly toggled bit 1 in PFM response"					
NC_ERR_COD_MC_PFM_1_TOG	-	0... 1FH	0... 31	1	-
Error code for "MU does not toggle bit 1 in the PFM synchronisation byte with the correct recurrence"					
NC_ERR_COD_MC_PFM_2_RESP	-	0... 1FH	0... 31	1	-
Error code for "MU does not respond to wrongly toggled bit 2 in PFM response"					
NC_ERR_COD_MC_PFM_2_TOG	-	0... 1FH	0... 31	1	-
Error code for "MU does not toggle bit 2 in the PFM synchronisation byte with the correct recurrence"					
NC_ERR_COD_MC_PFM_3_RESP	-	0... 1FH	0... 31	1	-
Error code for "MU does not respond to wrongly toggled bit 3 in PFM response"					
NC_ERR_COD_MC_PFM_3_TOG	-	0... 1FH	0... 31	1	-
Error code for "MU does not toggle bit 3 in the PFM synchronisation byte with the correct recurrence"					
NC_ERR_COD_MC_PFM_4_RESP	-	0... 1FH	0... 31	1	-
Error code for "MU does not respond to wrongly toggled bit 4 in PFM response"					
NC_ERR_COD_MC_PFM_4_TOG	-	0... 1FH	0... 31	1	-
Error code for "MU does not toggle bit 4 in the PFM synchronisation byte with the correct recurrence"					
NC_ERR_COD_MC_PFM_5_RESP	-	0... 1FH	0... 31	1	-
Error code for "MU does not respond to wrongly toggled bit 5 in PFM response"					
NC_ERR_COD_MC_PFM_5_TOG	-	0... 1FH	0... 31	1	-
Error code for "MU does not toggle bit 5 in the PFM synchronisation byte with the correct recurrence"					
NC_ERR_COD_MC_PFM_6_RESP	-	0... 1FH	0... 31	1	-
Error code for "MU does not respond to wrongly toggled bit 6 in PFM response"					
NC_ERR_COD_MC_PFM_6_TOG	-	0... 1FH	0... 31	1	-
Error code for "MU does not toggle bit 6 in the PFM synchronisation byte with the correct recurrence"					
NC_ERR_COD_MC_RAM_LEVEL_1	-	0... 1FH	0... 31	1	-
Error code for "error in standard RAM check (for level 1)"					
NC_ERR_COD_MC_RAM_LEVEL_2	-	0... 1FH	0... 31	1	-
Error code for "error in cyclic RAM check for level 2"					
NC_ERR_COD_MC_ROM_LEVEL_1	-	0... 1FH	0... 31	1	-
Error code for "error in standard ROM check (for level 1)"					
NC_ERR_COD_MC_ROM_LEVEL_2	-	0... 1FH	0... 31	1	-
Error code for "error in cyclic ROM check for level 2"					
NC_ERR_COD_MC_SOPC	-	0... 1FH	0... 31	1	-
Error code for "error in switch-off path check"					
NC_ERR_COD_MC_WRG_IDX	-	0... 1FH	0... 31	1	-
Error code for "MU does not send expected test index (question)"					
NC_ERR_COD_MC_WRG_RESP	-	0... 1FH	0... 31	1	-
Error code for "MU does not react to wrong FS-IST answers"					
NC_ERR_COD_MU_FCT_SPC_IST	-	0... 1FH	0... 31	1	-
Error code for "MU has detected a wrong FS-IST answer"					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ERR_COD_MU_V_H	-	0... 1FH	0... 31	1	-
Error code for "MU has detected over-voltage"					
NC_ERR_COD_MU_V_L	-	0... 1FH	0... 31	1	-
Error code for "MU has detected under-voltage"					
NC_ERR_COD_MU_V_L_H	-	0... 1FH	0... 31	1	-
Error code for "MU has detected both under- and over-voltage"					
NC_STATE_ERR_IDC_MC_DI_REQ	-	0... 3H	0 ...3	1	-
Error indication "DISABLE request"					
NC_STATE_ERR_IDC_MC_NOT_PRES	-	0... 3H	0 ...3	1	-
Error indication "no error present"					
NC_STATE_ERR_IDC_MC_PREV_REST	-	0... 3H	0 ...3	1	-
Error indication "ECU restart was requested"					
NC_STATE_ERR_IDC_MC_REST_REQ	-	0... 3H	0 ...3	1	-
Error indication "ECU restart request"					

## Action definition

<b>ACTION_ECM3_DisableReq (IN&lt;PRM_DI_OK&gt;)</b>	Mode: O
This action changes the state of processor monitoring on both MC and MU into DISABLE state	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_DI_OK	in	0... 1H	0 ...1	1	-
Parameter indication whether Disable request is completed by MU and MC. 1: Disable oK 0: Disable not finished					

<b>ACTION_ECM3_McDecAbc (IN&lt;PRM_ABC_ID&gt;)</b>	Mode: O
This action decreases the value of the indicated anti-bounce counter by 1.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_ABC_ID	in	0... FFH	0... 255	1	-
Identifier for index of anti-bounce counter					

<b>ACTION_ECM3_McFaultReaction (IN&lt;PRM_ERR_COD&gt;)</b>	Mode: O
This action immediately performs the central fault reaction storing the given error code.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_ERR_COD	in	0... FFH	0... 255	1	-
Error code to be stored in case of debouncing finished					

<b>ACTION_ECM3_McIncAbc (IN&lt;PRM_ABC_ID&gt;,IN&lt;PRM_ERR_COD&gt;)</b>	Mode: O
This action increases the value of the indicated anti-bounce counter by its corresponding increment; if the	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_ABC_ID	in	0... FFH	0... 255	1	-
Identifier for index of anti-bounce counter					
PRM_ERR_COD	in	0... FFH	0... 255	1	-
Error code to be stored in case of debouncing finished					

<b>ACTION_ECM3_RedSwitchOffPath ()</b>	Mode: O
This action sets the flag LV_MC_DR_OFF and, in doing so, activates the redundant switch-off path.	

<b>ACTION_ECM3_ShutDown (IN&lt;PRM_DI_OK&gt;)</b>	Mode: O
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This action changes the state of processor monitoring on both MC and MU into DISABLE state, eventually triggering a restart of the ECU (exported to ASW) ; the flag returns "false" in case the request has not been completed (with or without error).					
Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_DI_OK	in	0... 1H	0 ...1	1	-
Parameter indication whether Disable request is completed by MU and MC. 1: Disable oK 0: Disable not finished					

### Import actions:

ACTION_ECM2_LockPws ()
ACTION_ECM2_ResetErrorFlags ()
ACTION_ECM3_ChkCpl (IN<PRM_VAR>,IN<PRM_VAR_CPL>)
ACTION_ECM3_McCancelSopc ()
ACTION_ECM3_McChangeState (IN<PRM_STATE_MC_NEW>)
ACTION_ECM3_McReadChkCpl (OUT<PRM_RESULT>,IN<PRM_VAR>,IN<PRM_VAR_CPL>,IN<PRM_DFT_VALUE>)
ACTION_ECM3_McReadChkState (OUT<PRM_STATE_MC_TMP>)
ACTION_ECM3_McResetRomChkFlags ()
ACTION_ECM3_McSetErrmUpdateFlag (IN<PRM_CPT>)
ACTION_ECM3_McUnlockPwlResource ()
ACTION_ECM3_ReadChkCpl (OUT<PRM_RESULT>,IN<PRM_VAR>,IN<PRM_VAR_CPL>)
ACTION_ECM3_WriteChkCpl (INOUT<PRM_VAR>,OUT<PRM_VAR_CPL>,IN<PRM_VALUE>)
ACTION_INFR_McGetErrByte (OUT<PRM_IF_MU_ERR_BYTE>)
ACTION_INFR_McGetHd (OUT<PRM_STATE_MU>)
ACTION_INFR_McGetNdis0 (OUT<PRM_LV_MU_DI_OUT_0>)
ACTION_INFR_McGetNdis1 (OUT<PRM_LV_MU_DI_OUT_1>)
ACTION_INFR_McGetOvdFlag (OUT<PRM_LV_V_H_DET_MU>)
ACTION_INFR_McGetRstCtr (OUT<PRM_CTR_RST_MU>)
ACTION_INFR_McGetUvdFlag (OUT<PRM_LV_V_L_DET_MU>)
ACTION_INFR_McRestart ()
ACTION_INFR_McSendErrInfo (IN<PRM_ERR_COD_MC>,IN<PRM_STATE_ERR_IDC_MC>,IN<PRM_CTR_RST_MC>)


### General information

This module contains several functions related to the fault reaction of processor monitoring on the MC. Note that several functions might change the value of several of the output variables (e.g., the value of the reset counter of the MC, CTR\_RST\_MC, is changed by both the central fault reaction and the healing of reset counter and error information) but that always, at any given time, only **one** of the sub-functions is active so the variables simply have the value of the last update that they received (thereby acting as a kind of "merge" block).

**Note:** The four error codes (NC\_ERR\_COD\_MU\_V\_L, NC\_ERR\_COD\_MU\_V\_H, NC\_ERR\_COD\_MU\_V\_L\_H and NC\_ERR\_COD\_MU\_FCT\_SPC\_IST) are MU error codes and are only used in connection with error memory and the under-/over-voltage flags sent from the MU (see section "Acquisition of under-/over-voltage flags").

### E.31.1 Central fault reaction

#### General information:

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This function contains the central fault reaction of processor monitoring on the MC. Since this function is not activated with a fixed recurrence but only called when an error has actually occurred, the complete functionality is encapsulated in the action ACTION\_ECM3\_McFaultReaction() which can be imported and called by other functions, should they require to trigger an immediate fault reaction (debounced fault reactions are handled via G21 "Debounce mechanism").

#### In order to avoid recursive calls of the fault reaction:

- no monitoring of state machine shall be performed
- no complement checks shall be performed, only the complements shall be written
- for all calls of external functions (e.g. for disabling power stages), it has to be ensured that they cannot lead to recursive calls of the fault reaction

#### Description:

The function, via the action ACTION\_ECM3\_McFaultReaction(), incorporates the following requirements:

#### G1 Central fault reaction

R1\_1: Concerning the activation of the fault reaction:

- a fault reaction shall only be performed in a state different from DISABLE (i.e., STATE\_MC <> NC\_STATE\_MC\_DI);
- if STATE\_MC = NC\_STATE\_MC\_DI when the fault reaction is triggered, nothing shall be done;
- therefore, the following requirements only refer to the case that the fault reaction is actually performed (i.e., STATE\_MC <> NC\_STATE\_MC\_DI).


R1\_2: The action ACTION\_ECM3\_McCancelSopc() shall be called in order to ensure that the power stages can be disabled.

R1\_3: The power stages shall be disabled, see G22 "Disabling of power stages"; **this shall only be done if the fault reaction was activated in a state different from DISABLE (i.e., STATE\_MC <> NC\_STATE\_MC\_DI) to avoid recursive calls to the fault reaction (via ACTION\_ECM2\_LockPws()).**

R1\_4: A transition into the DISABLE state shall be performed, using ACTION\_ECM3\_McChangeState(); this shall be done before the power stages are disabled (due to R22\_8, the power stages will anyway be disabled in DISABLE, even if there is a problem during the execution of the fault reaction).

R1\_5: If the reset counter CTR\_RST\_MC on the MC is strictly less than the threshold NC\_CTR\_RST\_MC\_THD:

R1\_5.1: the reset counter shall be incremented by 1; this value shall be stored with complement CTR\_RST\_MC\_CPL in a reset-safe area; the default value for CTR\_RST\_MC shall be NC\_CTR\_RST\_MC\_THD + 1 (in case of data corruption, assume permanent disabling).

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R1\_5.2: an MC error code which corresponds to the error location shall be stored, together with the indicator "ECU restart request"; this value shall be stored in a reset-safe area.

R1\_5.3: There shall be an attempt to restart the ECU, using the action ACTION\_INFR\_McRestart().

R1\_6: If the reset counter is greater than or equal to the threshold NC\_CTR\_RST\_MC\_THD:

R1\_6.1: the reset counter shall be set to NC\_CTR\_RST\_MC\_THD + 1; this value shall be stored with complement CTR\_RST\_MC\_CPL in a reset-safe area; the default value for CTR\_RST\_MC shall be NC\_CTR\_RST\_MC\_THD + 1 (in case of data corruption, assume permanent disabling).

R1\_6.2: an MC error code which corresponds to the error location shall be stored, together with the indicator "DISABLE request"; this value shall be stored in a reset-safe area.

R1\_6.3: the update flag for MC error memory information shall be set by calling ACTION\_ECM3\_McSetErrmUpdateFlag(1).

R1\_6.4: there shall be no attempt to restart the MC.

R1\_7: No monitoring of state machine or complement checks using the RAM check service actions shall

be performed in order to avoid recursive calls of the fault reaction; for complements, the check shall be performed manually and in case of inconsistency, the default value shall be used.

R1\_8: The power latch resource for the Standard ROM check shall be unlocked by calling ACTION\_ECM3\_McUnlockPwlResource().

### Application conditions:

**Initialisation:** / \* Using the RAM check actions (where applicable) \*/

```
CTR_RST_MC = 0;
ERR_COD_MC = NC_ERR_COD_MC_NOT_ERR;
```

**Activation:** -

**Deactivation:** -

**Recurrence:** The **initialisation** shall be **performed after each power-up**.  
The **function** itself is **called when required**.

### Function description:

#### Formula section:


## E.31.2 Healing of reset counter and error information

### General information:

If the MC is in NORMAL state (which indicates that there is no error present) for a certain time (4s), then the reset counter is decreased by 1 since the system has been stable long enough to assume that there is currently no problem present; if this decreasing results in a reset counter of 0, also the error code and the error indication shall be cleared.

### Description:

This function incorporates the following requirements:

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## G2 Healing of reset counter and error code

R2\_1: The reset counter shall be decreased by 1 after 4000ms have passed.

R2\_2: If the reset counter is decremented to 0, the error code shall be cleared, i.e., set to 0, and the error indication shall be changed to "no error present."

R2\_3: The function shall only be active in NORMAL state, and if LV\_MC\_ROM\_CHK\_READY is set (i.e., after the standard ROM check has been completed and no reset or transition to DISABLE has occurred, hence the ROM check must have been successful); LV\_MC\_ROM\_CHK\_READY has to be accessed together with its complement LV\_MC\_ROM\_CHK\_READY\_CPL, using the actions from "RAM check service actions of processor monitoring on MC."

R2\_4: The time measurement shall be performed by counting communication cycles, rather than actually measuring elapsed time, counting backwards starting from NC\_CTR\_COM\_CYC\_MC\_DEC\_RST\_INI (see initialisation below).

R2\_5: Additionally, the healing shall only take place if LV\_MC\_PFM\_WRG\_RESP\_ACT\_6 is set to one indicating that the wrong response test for PFM task 6 has been performed at least once (to avoid endless resets due to wrong PFM in task 6).

R2\_6: While LV\_MC\_SOPC\_ACT = 1, no healing shall take place (to prohibit healing while the SOPC has not yet been completed).

### Application conditions:

#### Initialisation:

```
 / * Initialise communication cycle counter */
```

```
CTR_COM_CYC_MC_DEC_RST =
NC_CTR_COM_CYC_MC_DEC_RST_INI;
```

#### Activation:

```
(STATE_MC = NC_STATE_MC_NORM) AND
(LV_MC_ROM_CHK_READY = 1) AND
(LV_MC_PFM_WRG_RESP_ACT_6 = 1) AND
(LV_MC_SOPC_ACT = 0)
(only active in NORMAL AND after standard ROM check was completed
AND
wrong response test for PFM task 6 has been performed once
AND SOPC has
been completed)
```

#### Deactivation:


Otherwise

#### Recurrence:

The **initialisation** shall be performed **after each power-up or reset.**

The **function itself** shall be **activated after the data from NORMAL communications have been evaluated successfully.**

### Function description:

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**Formula section:****E.31.3 State of fault reaction and up-to-dateness of error code****General information:**

The error indication describes the current state of the fault reaction in the sense that, if the fault reaction is triggered and it is decided that the ECU should be restarted, the error indication is set to “ECU restart request”, while an (irreversible for the current driving cycle) DISABLE request leads to the error indication “DISABLE request” (the decision between these two choices depends of the value of the reset counter CTR\_RST\_MC, see section “Central fault reaction”).

**Description:**

This function incorporates the following requirements.

**G3 State of fault reaction and up-to-dateness of error code**

R3\_1: In addition to the error code, there shall be the error indication STATE\_ERR\_IDC\_MC which indicates the state of the fault reaction and the up-to-dateness of the error code:

- “No error present” shall be indicated while no error is present (including the case that the reset counter is being decremented);
- “ECU restart request” shall be indicated if fault reaction currently requests ECU restart (i.e., the reset counter has not yet reached a certain defined value);
- “DISABLE request” shall be indicated if fault reaction requests DISABLE instead of ECU restart (i.e., the reset counter has reached the defined value);
- “ECU restart was requested” (“previous restart request”) shall be indicated after ECU has been restarted due to an ECU restart request from the fault reaction.

R3\_2: The error indication shall be stored in a reset-safe RAM area.

R3\_3: After a reset but not after power-up, if the current error indication is “ECU restart request,” this shall


be changed to “ECU restart was requested”: a restart must have actually been performed because otherwise the INIT state could not have been reached (see initialisation below).

R3\_4: In INIT (i.e., STATE\_MC = NC\_STATE\_MC\_INI), the update flag for MC error memory information

shall always be set by calling ACTION\_ECM3\_McSetErrmUpdateFlag(1); this shall be done after the potential change of the error indication described by R3\_3.

R3\_5: Once the CONFIG communication has been prepared, i.e., after ACTION\_INFR\_McSendErrInfo() has been called, if the state of the fault reaction on the MC indicated “ECU restart was requested”, it shall be changed to “No error present” by setting STATE\_ERR\_IDC\_MC to NC\_STATE\_ERR\_IDC\_MC\_NOT\_PRES.

**Application conditions:**

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**Initialisation:**

After power-up:

```

/ * After power-up, initialise the error indication to
   "no error present" */
STATE_ERR_IDC_MC =
    NC_STATE_ERR_IDC_MC_NOT_PRES;

```

After reset:

```

/ * After reset, if "ECU restart request" is indicated, this
shall be
changed to "restart was requested": the restart request has
been
carried out successfully, see R3_3 above */

```

```

IF (STATE_ERR_IDC_MC =
      NC_STATE_ERR_IDC_MC_REST_REQ)
THEN
    STATE_ERR_IDC_MC =
      NC_STATE_ERR_IDC_MC_PREV_REST;
FI

```

**Activation:**

-

**Deactivation:**

-

**Recurrence:**

The **initialisation** shall be performed **after each power-up or reset**.

The **function itself** shall be **called**.

**Function description:****Formula section:****E.31.4 Transmission of error information from MC to MU****General information:**


This function describes how the error information (reset counter, error code, and error indication) are sent from MC to MU.

**Description:**

This function incorporates the following requirements:

**G4.1 Transmission of error information from MC to MU**

R4.1\_1: The MC shall send reset counter, error code, and error indication to the MU in the communications in the states CONFIG and DISABLE using the action call ACTION\_INFR\_McSendErrInfo(), before the respective communications are triggered, with arguments ERR\_COD\_MC, STATE\_ERR\_IDC\_MC, and CTR\_RST\_MC.

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R4.1\_2: When preparing the data for a DISABLE communication, i.e., if STATE\_MC = NC\_STATE\_MC\_DI, and LV\_MU\_DI\_ACT is set (i.e., if a disable request for the MU is still active, see "Disable request by external software"), the value NC\_CTR\_RST\_MU\_DI shall be used as one argument to ACTION\_INFR\_McSendErrInfo(), instead of CTR\_RST\_MC; NC\_CTR\_RST\_MU\_DI must be different from 0.

### Application conditions:

**Initialisation:** –

**Activation:** (STATE\_MC = NC\_STATE\_MC\_CONF) **OR**  
(STATE\_MC = NC\_STATE\_MC\_DI)  
(only active in CONFIG and DISABLE state)

**Deactivation:** Otherwise

**Recurrence:** The **function** shall be **executed before a communication is triggered**.

### Function description:

### Formula section:

## E.31.5 Evaluation of error information from MU on MC

### General information:

This function describes when and how the error information (reset counter, error code, and error indication) sent from the MU is evaluated on the MC.

### Description:

This function incorporates the following requirements:

### G4.2 Evaluation of error information from MU on MC


R4.2\_1: In CONFIG and DISABLE, if communication monitoring indicates no error, i.e., LV\_MC\_COM\_ERR = 0 (and its complement LV\_MC\_COM\_ERR\_CPL=1):

R4.2\_1.1: the MC shall obtain the reset counter CTR\_RST\_MU of the MU using the action ACTION\_INFR\_McGetRstCtr();

R4.2\_1.2: the MC shall obtain the error code ERR\_COD\_MU of the MU using the action ACTION\_INFR\_McGetErrCode();

R4.2\_1.3: the MC shall obtain the error indication STATE\_ERR\_IDC\_MU of the MU using the action ACTION\_INFR\_McGetErrIdc().

R4.2\_2: The update flag for MU error memory information shall be set by calling ACTION EMC3\_McSetErrmUpdateFlag(0).

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**Application conditions:**

**Initialisation:**            / \* Initialise MU error information \*/

```
CTR_RST_MU = 0;
ERR_COD_MU = NC_ERR_COD_MC_NOT_ERR;
STATE_ERR_IDC_MU = NC_STATE_ERR_IDC_MC_NOT_PRES;
```

**Activation:**               ((STATE\_MC = NC\_STATE\_MC\_CONF) **OR**  
                              (STATE\_MC = NC\_STATE\_MC\_DI)) **AND**  
                              (LV\_MC\_COM\_ERR = 0)  
                              *(only active after CONFIG or DISABLE communications, and if  
                              no  
                              communication error was detected)*

**Deactivation:**           Otherwise

**Recurrence:**            The **initialisation** shall be performed **after each power-up  
                              or reset.**

                              The **function itself** shall be executed **after the communication  
                              monitoring functions** and **after G5.1 "Disable request by MU."**

**Function description:****Formula section:****E.31.6 Disable request by MU****General information:**

This function deals with the case when the MU sends a DISABLE header. Receiving a DISABLE header from the MU always causes a transition to DISABLE and disabling of power stages.

**Description:**

This function incorporates the following requirements:

**G5.1 Disable request by MU**


R5.1\_1: If the MC is in a state different from DISABLE (i.e., STATE\_MC <> NC\_STATE\_MC\_DI) and a DISABLE header is received from the MU (i.e., ACTION\_ECM3\_McGetHd() returns NC\_STATE\_MC\_DI):

R5.1\_1.1: a transition into DISABLE shall be performed, using ACTION\_ECM3\_McChangeState();

R5.1\_1.2: the power-latch resource for the Standard ROM check shall be unlocked by calling ACTION\_ECM3\_McUnlockPwlResource();

R5.1\_1.3: **for production SW**, if the MU sends the error indication "ECU restart request" (i.e., if ACTION\_ECM3\_McGetErrIdc() returns NC\_STATE\_ERR\_IDC\_MC\_REST\_REQ), the MC shall attempt to restart the ECU by calling the action ACTION\_INFR\_McRestart() (the error indication expresses that the MU has performed a fault reaction which should have triggered a reset but the reset was not performed);  
**for**

**development SW**, no restart shall be attempted.

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R5.1\_2: If the value of MU\_DI\_STATE is different from "MU\_DI\_ERR", it shall be set to "MU\_DI\_OK" (if a corresponding disable request had already timed out, this shall not be masked by the MU finally responding with a DISABLE header).

R5.1\_3: No monitoring of state machine shall be performed (since anyway a change into DISABLE is the consequence).

### Application conditions:

**Initialisation:** -

**Activation:** always

**Deactivation:** -

**Recurrence:** The function shall be executed after the communication monitoring functions.

### Function description:

#### Formula section:

## E.31.7 Disable request by external software

### General information:

This function provides an interface for the application software in order to force both MC and MU into DISABLE state (in particular to be able to re-program the ECU without having to worry about time-out monitoring, PFM, FS-IST etc.).

### Description:

This function incorporates the following requirements:


### **G5.2 Disable request by external software**

R5.2\_1: Processor monitoring shall export an interface to the application software in order to force a transition of the processor monitoring on the MC into DISABLE state using ACTION\_ECM3\_McChangeState(); if already in DISABLE, the MC shall stay there.

R5.2\_2: The MC shall clear its error information, i.e., CTR\_RST\_MC, ERR\_COD\_MC, and STATE\_ERR\_IDC\_MC.

R5.2\_3: The disable request has four different states, recorded in MU\_DI\_STATE:

- "MU\_DI\_NOT\_REQ" meaning "no disable request"
- "MU\_DI\_BUSY" meaning "MU has not yet responded, the request is still busy"

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- "MU\_DI\_ERR" meaning "MU response has timed out"
- "MU\_DI\_OK" meaning "MU has responded in time"

R5.2\_4: The interface shall be provided in the form of the action call ACTION\_ECM3\_DisableReq()

R5.2\_4.1: when ACTION\_ECM3\_DisableReq() is called, and MU\_DI\_STATE is equal to "MU\_DI\_NOT\_REQ", it shall be set to "MU\_DI\_BUSY"; hence, if MU\_DI\_STATE is different from "MU\_DI\_NOT\_REQ", it shall remain unchanged;

R5.2\_4.2: the flag LV\_MU\_DI\_ACT shall be set (prompting sending NC\_CTR\_RST\_MU\_DI instead of the value of CTR\_RST\_MC (which is 0, see R2) to the MU in subsequent DISABLE communications, see "Transmission of error information from MC to MU" R3);

R5.2\_4.3: ACTION\_ECM3\_DisableReq() shall return "false" in case MU\_DI\_STATE is equal to "MU\_DI\_BUSY" and true otherwise.

R5.2\_5: After each subsequent communication, in case the MU has not responded with a DISABLE header (which leads to MU\_DI\_STATE being set to "MU\_DI\_OK", see "Disable request by MU" R2), i.e., if MU\_DI\_STATE is equal to "MU\_DI\_BUSY", the counter CTR\_MU\_DI shall be increased by one.

R5.2\_6: When the counter CTR\_MU\_DI reaches the value NC\_CTR\_MU\_DI\_MAX, this shall be considered as a time-out, i.e., STATE\_MU\_DI shall be set to "MU\_DI\_ERR" (which also counts as the disable request being finished, however unsuccessfully).

R5.2\_7: The action ACTION\_ECM3\_McResetRomChkFlags() shall be called (resetting the flags for the Standard ROM check).

R5.2\_8: In CONFIG, just before triggering the CONFIG communication, MU\_DI\_STATE shall be changed from "MU\_DI\_OK" (the initialisation value) to "MU\_DI\_NOT\_REQ"; in this way, as long as the transition from INIT to CONFIG has not yet been performed, the return value of ACTION\_ECM3\_DisableReq() will be 1 (instead of 0, cf. R5.2\_4.1 and R5.2\_4.3).

R5.2\_9: In case ACTION\_ECM3\_DisableReq() is called, the power-latch resource for the Standard ROM check shall be unlocked by calling ACTION\_ECM3\_McUnlockPwlResource().

### Application conditions:

**Initialisation:**           MU\_DI\_STATE = "MU\_DI\_OK";  
CTR\_MU\_DI = 0;  
LV\_MU\_DI\_ACT = 0;


**Activation:**               –

**Deactivation:**           –

**Recurrence:**           The **initialisation** shall be performed after each power-up or reset.

The **function itself** shall be called via ACTION\_ECM3\_DisableReq().

### Function description:

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**Formula section:**

### E.31.8 Shutdown request by external software

**General information:**

This function provides an interface for the application software in order to restart the ECU.

**Description:**

This function incorporates the following requirements:

#### G5.3 Shutdown request by external software

R5.3\_1: Processor monitoring shall export an interface to the application software in order to force restart of the ECU via the MU.

R5.3\_2: The interface shall be provided in the form of the action call ACTION\_ECM3\_ShutDown().

R5.3\_3: It behaves exactly like ACTION\_ECM3\_DisableReq() with the one exception that the flag LV\_MU\_DI\_ACT is not set, i.e., in subsequent DISABLE communications, the real value of CTR\_RST\_MC (which is 0 since it has been reset by the shutdown/disable request) is sent; this will first force the MU into DISABLE, clearing its error information in the process, and eventually to restart the ECU (unless the MU has not detected an error on its own, and also the state of the ignition key plays a role in how the MU reacts to the request).

**Application conditions:**

- Initialisation:** -
- Activation:** -
- Deactivation:** -
- Recurrence:** The **function itself** shall be called via **ACTION\_ECM3\_ShutDown()**.

**Function description:**


**Formula section:**

### E.31.9 The redundant switch-off path

**General information:**

In case process or processor monitoring on the MC detect a fatal error and attempt to disable the safety-relevant power stages, they can also use the switch-off paths on the monitoring unit to redundantly perform the switching-off. This is done via an action call (from within process monitoring) which sets a flag in the processor monitoring that forces the MC to deliberately send wrong FS-IST answers to the

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MU which in turn, potentially after some debouncing, leads to a fault reaction on the MU and in particular to disabling the safety-relevant power stages (hence the name “redundant switch-off path” as the MU is eventually prompted to also disable the power stages).

### Description:

This function incorporates the following requirements:

#### **G20 Redundant switch-off path**

R20\_1: There shall be an interface between process and processor monitoring which, when used, causes the processor monitoring on the MC to permanently send wrong FS-IST answers to the MU, in this way eventually (after debouncing) resulting in a fault reaction of the MU.

R20\_2: This interface shall be realised by providing the action call ACTION\_ECM3\_RedSwitchOffPath() to process monitoring which shall set the flag LV\_MC\_DR\_OFF; LV\_MC\_DR\_OFF shall be stored as together with its complement LV\_MC\_DR\_OFF\_CPL and shall only be accessed via the actions ACTION\_ECM3\_WriteChkCpl(), ACTION\_ECM3\_ChkCpl(), ACTION\_ECM3\_ReadChkCpl(), and ACTION\_ECM3\_McReadChkCpl() from "RAM check service actions of processor monitoring on MC"; its default value in case of a RAM error shall be 1, indicating that the redundant switch-off path has been triggered.

### Application conditions:

**Initialisation:**            / \* Using the RAM check service actions \*/  
LV\_MC\_DR\_OFF = 0;

**Activation:**                -

**Deactivation:**             -

**Recurrence:**              The **initialisation** shall be performed **after each power-up or reset**.

The **function itself** shall be called via ACTION\_ECM3\_RedSwitchOffPath().


### Function description:

#### Formula section:

## **E.31.10 Debounce mechanism**

### General information:

Debouncing is a very common task for many functions of processor monitoring. Hence this module exports actions which perform the two necessary tasks to do with debouncing: increasing one of these anti-bounce counters by a predefined increment, and decreasing such a counter with a predefined decrement. Note that increasing an anti-bounce counter can trigger a fault reaction (viz., if its maximal value is reached).

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## Note that values of anti-bounce counters are not exported directly!

### Description:

In the following, let xxx range over all possible identifiers for anti-bounce counters which are used on the MC (e.g., one possible value is HD for header-byte monitoring). The function incorporates the following requirements:

#### G21 Debounce mechanism

R21\_1: If an error has been detected the anti-bounce counter of the corresponding error location shall be increased by the corresponding increment NC\_ABC\_MC\_xxx\_INC without creating an overflow; this shall be achieved by calling ACTION\_ECM3\_McIncAbc().

R21\_2: If the anti-bounce counter reaches a corresponding maximum value NC\_ABC\_MC\_xxx\_MAX a fault reaction shall be triggered.

R21\_3: If no error is detected and the anti-bounce counter of the corresponding error location is greater than 0, the anti-bounce counter shall be decreased by the corresponding decrement NC\_ABC\_MC\_xxx\_DEC without creating an underflow; this shall be achieved by calling ACTION\_ECM3\_McDecAbc().

R21\_4: In general, if not specified otherwise, the following configuration shall be used: NC\_ABC\_MC\_xxx\_INI = 0, NC\_ABC\_MC\_xxx\_INC = 2, NC\_ABC\_MC\_xxx\_DEC = 1, NC\_ABC\_MC\_xxx\_MAX = 6.

R21\_5: After a reset, in INIT state, i.e., STATE\_MC = NC\_STATE\_MC\_INI:

R21\_5.1: if any anti-bounce counter of communication monitoring (xxx=HD, CKS, CONF\_DIF) is greater than 0, the flag LV\_ABC\_MC\_ERR\_COM shall be set to 1, otherwise it shall be set to 0;

R21\_5.2: if any anti-bounce counter of PFM **except for task 6** (xxx=PFM\_k\_TOG, PFM\_k\_RESP for 0 <=k<= 5) is greater than 0, the flag LV\_ABC\_MC\_ERR\_PFM shall be set to 1, otherwise it shall be set to 0;

R21\_5.3: if one of the two anti-bounce counters PFM\_6\_TOG or PFM\_6\_RESP **for task 6** is greater than 0, the flag LV\_ABC\_MC\_ERR\_PFM\_6 shall be set to 1, otherwise it shall be set to 0;

R21\_5.4: if any anti-bounce counter of FS-IST is greater than 0 (xxx=WRG\_IDX, WRG\_RESP) or greater

than 2 (in case of xxx=NOT\_DEC), the flag LV\_ABC\_MC\_ERR\_FCT\_SPC\_IST shall be set to 1, otherwise it shall be set to 0;

R21\_5.5: after evaluation, the anti-bounce counters shall be initialised to their corresponding INI values NC\_ABC\_MC\_xxx\_INI.

### Application conditions:


#### Initialisation:

After each power-up:

All anti-bounce counters are initialised to their corresponding INI values.

After each power-up and reset:

```
LV_ ABC_MC_ERR_COM = 0;
LV_ ABC_MC_ERR_PFM = 0;
LV_ ABC_MC_ERR_PFM_6 = 0;
LV_ ABC_MC_ERR_FCT_SPC_IST = 0;
```

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**Activation:** in all states (*in particular in in INIT state!*)

**Deactivation:** -

**Recurrence:** The **initialisation** shall be performed **after each power-up and reset** (see above).

Afterwards, **increasing** or **decreasing** of anti-bounce counters shall be done **via action calls**.

### Function description:

### Formula section:

## E.31.11 Disabling of power stages

### General information:

This function describes how and when the MC disables the power stages it is connected to, separately for each state.

The phrase "enabling of power stages" shall be used to denote the fact that the MC no longer *disables*; however, this does not imply anything regarding *actively using* the power stages.

Note that on the MC, there are two ways of disabling: one is by SW done via flags which lead to no active signals being generated (e.g., no injection patterns); the second one is via HW where dedicated HW lines are used to disable power stages (the MU only has such HW disable lines).

### Description:

The complete function satisfies the following requirements:

### G22 Disabling of power stages


R22\_1: The MC shall:

R22\_1.1: permanently disable the power stages by setting LV\_ERR\_MU\_MC = 1 (it has to be ensured that LV\_ERR\_MU\_MC, after being set once, is not reset again), plus additionally calling ACTION\_ECM2\_LockPws() (in order to ensure that process monitoring also disables the power stages);

R22\_1.2: temporarily disable the power stages by setting LV\_ERR\_TMP\_MU\_MC = 1, plus additionally calling ACTION\_ECM2\_LockPws() (in order to ensure that process monitoring also disables the power stages);

R22\_1.3: enable the power stages by setting LV\_ERR\_TMP\_MU\_MC = 0 and LV\_ERR\_MU\_MC = 0 (cf. remark above!), plus additionally calling the action ACTION\_ECM2\_ResetErrorFlags() (in order to ensure that process monitoring also stops disabling the power stages if appropriate).

R22\_2: Both error flags shall be stored together with their respective complements, LV\_ERR\_MU\_MC\_CPL and LV\_ERR\_TMP\_MU\_MC\_CPL, and shall be accessed using the imported RAM check service actions ACTION\_ECM3\_WriteChkCpl(), ACTION\_ECM3\_ChkCpl(), ACTION\_ECM3\_ReadChkCpl(), and ACTION\_ECM3\_McReadChkCpl() (see "RAM check service actions of processor monitoring on MC");

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their default values in case of a RAM error shall be 1, i.e., indicating that the power stages shall be disabled.

R22\_3: The power stages shall be disabled depending on the reset counters of both MC and MU, and the current state of the monitoring concept.

R22\_4: In INIT, the MC shall temporarily disable the power stages.

R22\_5: In CONFIG, the MC shall temporarily disable the power stages.

R22\_6: In PREDRIVE:

R22\_6.1: the MC shall temporarily disable the power stages;

R22\_6.2: before the PREDRIVE communication, if any of the two reset counters (CTR\_RST\_MC, or CTR\_RST\_MU) is  $> 1$ , the MC shall set CTR\_COM\_CYC\_MC\_DR\_DI\_TMP to NC\_CYCNR\_MC\_DR\_DI\_TMP (this counter shall be used to temporarily disable the power stages until in total NC\_CYCNR\_MC\_DR\_DI\_TMP + 2 communication cycles have been performed).

R22\_7: In NORMAL:

R22\_7.1: if CTR\_COM\_CYC\_MC\_DR\_DI\_TMP is not active (i.e., = 0), the MC shall enable the power stages (see signal flow diagram); this only holds if no pre-condition of any other requirement is satisfied (cf. in particular R22\_9 and R22\_10).

R22\_7.2.: if CTR\_COM\_CYC\_MC\_DR\_DI\_TMP is active (i.e.,  $<> 0$ ):

R22\_7.2.1: the MC shall temporarily disable the power stages;

R22\_7.2.2: CTR\_COM\_CYC\_MC\_DR\_DI\_TMP shall be decreased by one without creating an under-flow.

R22\_8: In DISABLE, the MC shall permanently and temporarily disable the power stages.

R22\_9: In PREDRIVE and NORMAL, the MC shall consider the status of the disable outputs of the MU regarding disabling the power stages:

R22\_9.1: the MC shall call the actions ACTION\_INFR\_McGetNdisOut0() and ACTION\_INFR\_McGetNdisOut1() to obtain the status information and store the results in LV\_MU\_DI\_OUT\_0 and LV\_MU\_DI\_OUT\_1 (note that disabling means status = 0, enabling means status = 1);

R22\_9.2: the information about the status of the MU disable outputs shall be used as follows:

R22\_9.2.1: if LV\_MU\_DI\_OUT\_0 = 0 and LV\_MU\_DI\_OUT\_1 = 1 and LV\_MU\_IGN\_KEY = 0 and NLC\_MU\_INJ\_OFF\_TMR\_ENA = 1, the injection-off timer (IOT) in the MU shall be assumed to be active; hence, the following assignment shall be performed:

- LV\_INJ\_OFF\_TMR\_INJ\_ENA\_TMP = 0 (*IOT active, no enabling of injection*);

R22\_9.2.2: if LV\_MU\_DI\_OUT\_0 = 0 and LV\_MU\_DI\_OUT\_1 = 0, the MU disables both its disable outputs; hence, the following assignment shall be performed:

- LV\_ERR\_TMP\_MU\_MC = 1 (*temporary disabling*)


R22\_9.2.3: if LV\_MU\_DI\_OUT\_0 = 1 and LV\_MU\_DI\_OUT\_1 = 1, the MU enables its disable outputs; hence, the IOT must be inactive and the following assignment shall be performed:

- LV\_INJ\_OFF\_TMR\_INJ\_ENA\_TMP = 1 (*IOT inactive, enabling of injection*);

R22\_9.2.4: otherwise, the following assignment shall be performed:

- LV\_ERR\_TMP\_MU\_MC = 1 (*temporary disabling*)

R22\_10: In NORMAL, while LV\_MC\_SOPC\_ACT = 1 (i.e., the MC-part of the SOPC has not yet been finished), the MC shall temporarily disable the power stages.

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R22\_11: In PREDRIVE and NORMAL, if the MU indicates disabling any of its power stages (i.e., LV\_MU\_DI\_OUT\_0 or LV\_MU\_DI\_OUT\_1 = 0), the flag LV\_MC\_INH\_SOPC shall be set to 1; otherwise, it shall be set to 0; the flag being set consequently indicates that the MU still disables the power stages (and therefore prompts a delay the MC-part of the SOPC).

### Application conditions:

**Initialisation:**             */ \* Initialise communication cycle counter for temporary disabling to "no temporary disabling" \*/*

```
CTR_COM_CYC_MC_DR_DI_TMP = 0;
```

```
 / * Delay of MC-part of SOPC (not yet) necessary */
```

```
LV_MC_INH_SOPC = 0;
```

```
 / * Using the RAM check service actions: temp. disabling */
```

```
LV_ERR_MU_MC = 0;
```

```
LV_ERR_TMP_MU_MC = 1;
```

```
LV_MU_DI_OUT_0 = 0;
```

```
LV_MU_DI_OUT_1 = 0;
```

```
 / * Power stages disabled after reset */
```

```
LV_INJ_OFF_TMR_ENA_INJ_TMP = 0;
```


**Activation:**                always

**Deactivation:**             -

**Recurrence:**              The **initialisation** shall be performed **after each power-up or reset**.

The **function itself** is **active in all states**.

### Function description:

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**Signal flow diagram:**

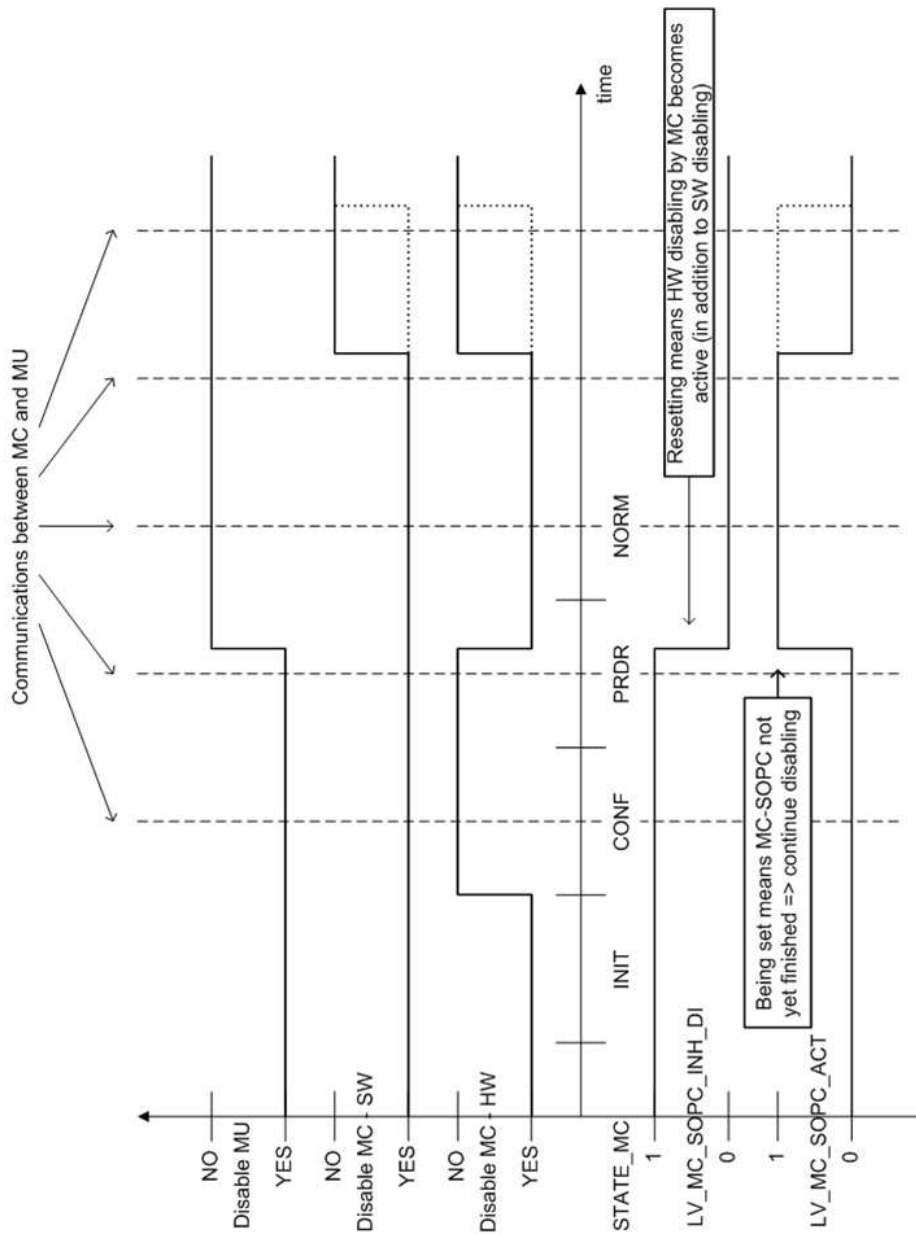


Figure E.31.1:


Note that the diagram only shows the case when no temporary disabling is performed; the distinction between SW and HW disabling on the MC is managed by the switch-off path check.

**Formula section:**

**E.31.12 Acquisition of under-/over-voltage flags**

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The MU contains detection mechanisms for both under- and over-voltage conditions in case its voltage leaves its operating range.

This is, amongst others, prompts a reset (which is held for as long as either condition persists) of MC and MU.

If the under- or over-voltage condition is present long enough, one of the flags LV\_V\_L\_DET\_MU or LV\_V\_H\_DET\_MU (as appropriate) is set. Once the voltage returns to its normal range, the system starts up and the two flags (which have been stored in a reset-safe area) are sent to the MC.

### Description:

The function incorporates the following requirement:

#### **G24 Acquisition of under-/over-voltage flags**

R24\_1: If no errors were detected in the CONFIG communication, i.e., if LV\_MC\_COM\_ERR = 0 (and its complement LV\_MC\_COM\_ERR\_CPL = 1), the flags LV\_V\_L\_DET\_MU and LV\_V\_H\_DET\_MU shall be assigned the values sent by the MU, using the actions ACTION\_INFR\_McGetUvdFlag() and ACTION\_INFR\_McGetOvdFlag(), respectively.

### Application conditions:

**Initialisation:** LV\_V\_H\_DET\_MU = 0;  
LV\_V\_L\_DET\_MU = 0;

**Activation:** (STATE\_MC = NC\_STATE\_MC\_CONF) **AND**  
(LV\_MC\_COM\_ERR = 0)  
*(only active in CONFIG and if no communication error was detected)*

**Deactivation:** Otherwise

**Recurrence:** The **initialisation** shall be performed **after each power-up or reset**.

The **function itself** shall be executed **after the communication monitoring functions**.

### Function description:

#### Formula section:


## **E.31.13 ACTION\_ECM3\_McFaultReaction**

### Description:

**Syntax:** ACTION\_ECM3\_McFaultReaction(IN <err\_cod>)

**Parameter (IN):** err\_cod error code indicating the cause of the fault reaction

**Short description:** This action performs the central fault reaction of processor monitoring on MC (as specified in "G1 Central fault reaction" above).

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### E.31.14 ACTION\_ECM3\_DisableReq

#### Description:

Syntax: ACTION\_ECM3\_DisableReq()

Parameter (OUT): flag Indication whether the disable request has been completed (perhaps with error, cf. R5.2\_4.3 above)

Short description: This action implements the disable request as specified above in "G5.2 Disable request by external software."

### E.31.15 ACTION\_ECM3\_ShutDown

#### Description:

Syntax: ACTION\_ECM3\_ShutDown()

Parameter (OUT): flag Indication whether the shutdown request has been finished (with or without error, cf. R5.2\_4.3 above)

Short description: This action requests a restart of the ECU via the MU as specified above in "G5.3 Shutdown request by external software" (whether this is actually done depends on the internal state of the MU).

### E.31.16 ACTION\_ECM3\_RedSwitchOffPath

#### Description:

Syntax: ACTION\_ECM3\_RedSwitchOffPath()

Short description: This action triggers the redundant switch-off path by setting the flag LV\_MC\_DR\_OFF using the action ACTION\_ECM3\_WriteChkCpl() (see "RAM check service actions of processor monitoring on MC").

### E.31.17 ACTION\_ECM3\_McIncAbc

#### Description:

Syntax: ACTION\_ECM3\_McIncAbc(  
IN <abc\_id>,  
IN <err\_cod>)

Parameter (IN): abc\_id identifier for the anti-bounce counter to be increased

Parameter (IN):    err\_cod    error code for a potential fault reaction

Short description:    This action increases the value of the specified anti-bounce counter by the corresponding increment without creating an overflow; if the corresponding maximal value is reached, a fault reaction shall be triggered by calling ACTION\_ECM3\_McFaultReaction().

### E.31.18 ACTION\_ECM3\_McDecAbc

#### Description:

Syntax:                ACTION\_ECM3\_McDecAbc(IN <abc\_id>)

Parameter (IN):    abc\_id                identifier for the anti-bounce counter to be increased

Short description:    This action decreases the value of the specified anti-bounce counter by 1 without creating an underflow.

## E.32 Function specific instruction set test

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_LID_MC_FCT_SPC_IST	V	0... FH	0... 15	1	-
Local variable: value of MU anti-bounce counter for FS-IST (obtained from ABC_RCV_MC_FCT_SPC_IST)					
ABC_LID_MC_FCT_SPC_IST_OLD	-	0... FH	0... 15	1	-
Local variable: saved value of MU anti-bounce counter for FS-IST from preceding communication cycle					
ABC_RCV_MC_FCT_SPC_IST	-	0... FH	0... 15	1	-
Local variable: value of FS-IST anti-bounce counter on MU (obtained via infrastructure)					
IDX_NR	-	0... 1FH	0... 31	1	-
Local variable: index for decoding of MU question					
IDX_NR_ERR_MC_FCT_SPC_IST	V	0... FFH	0... 255	1	-
Local variable: "marker" of index for which second calculation of copy of process monitoring failed					
IDX_NR_LID_MC_FCT_SPC_IST	-	0... 1FH	0... 31	1	-
Local variable: question number corresponding to MU question (IDX_TEST_RCV_MC_FCT_SPC_IST)					
IDX_NR_LID_MC_FCT_SPC_IST_OLD	-	0... 1FH	0... 31	1	-
Local variable: saved question number from previous communication cycle					
IDX_NR_LID_MC_FCT_SPC_IST_PRED	-	0... 1FH	0... 31	1	-
Local variable: predicted question number (for monitoring of question sent by MU)					
IDX_NR_RESP_MC_FCT_SPC_IST	-	0... 1FH	0... 31	1	-
Local variable: answer number of answer from level 2'					
IDX_TEST_RCV_MC_FCT_SPC_IST	-	0... 1FH	0... 31	1	-
Local variable: question sent by MU (obtained via infrastructure; to be decoded into question number)					
LV_MC_FCT_SPC_IST_ACT	-	0... 1H	0...1	1	-
Local variable: flag indicating whether FS-IST is active in current communication cycle					
LV_MC_FCT_SPC_IST_WRG_RESP_ACT	V	0... 1H	0...1	1	-
Local variable: flag indicating whether sending of wrong FS-IST answers is active or not					
TCC_MC_FCT_SPC_IST_WRG_RESP	-	0... 1FH	0... 31	1	-
Local variable: test cycle counter for sending wrong FS-IST answers to MU					
TEST_REC_IDX_MON2	O/V	0... 1FH	0... 31	1	-
Question number ("test index") exported to the copy of process monitoring					

### Input data:

ID_RESP_MON2 {p. 7017}	LDPM_TEST_REC_IDX_MON2	LV_MC_DR_OFF {p. 7072}	LV_MC_DR_OFF_CPL {p. 7072}
NC_ABC_MC_NOT_DEC {p. 7074}	NC_ABC_MC_WRG_IDX {p. 7076}	NC_ABC_MC_WRG_RESP {p. 7077}	NC_ERR_COD_MC_NOT_DEC {p. 7077}
NC_ERR_COD_MC_WRG_IDX {p. 7078}	NC_ERR_COD_MC_WRG_RESP {p. 7078}	NC_STATE_MC_NORM {p. 7136}	NC_STATE_MC_PRDR {p. 7136}
RESP_MON2 {p. 7012}	STATE_MC {p. 7135}		

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_NR_WRG_MC_FCT_SPC_IST	-	0... 1FH	0... 31	1	-
Constant for invalid question number (used in the decoding processes)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_RESP_MC_FCT_SPC_IST [NC_TEST_REC_IDX_MAX_MON2]	-	0... 3FH	0... 63	1	-
Array of answers to be sent to MU					
NC_IDX_RESP_WRG_MC_FCT_SPC_IST	-	0... 3FH	0... 63	1	-
Constant for invalid answer					
NC_IDX_TEST_MC_FCT_SPC_IST [NC_TEST_REC_IDX_MAX_MON2]	-	0... 3FH	0... 63	1	-
Array of valid questions; compared to actual questions sent from MU					
NC_TCC_MC_IST_WRG_RESP_CHK	-	0... 1FH	0... 31	1	-
Value of test cycle counter when MU reaction to sending of wrong answer should be checked					
NC_TCC_MC_IST_WRG_RESP_REQ	-	0... 1FH	0... 31	1	-
Value of test cycle counter when sending of wrong answer should be requested					
NC_TEST_REC_IDX_MAX_MON2	-	0... 1FH	0... 31	1	-
(NC_TEST_REC_IDX_MAX_MON2-1) is the maximal value for the question number exported to the test calculations in level 2'					

### Import actions:


<b>ACTION_ECM3_ChkCpl</b> (IN<PRM_VAR>,IN<PRM_VAR_CPL>)
<b>ACTION_ECM3_McDecAbc</b> (IN<PRM_ABC_ID>)
<b>ACTION_ECM3_McIncAbc</b> (IN<PRM_ABC_ID>,IN<PRM_ERR_COD>)
<b>ACTION_ECM3_McReadChkCpl</b> (OUT<PRM_RESULT>,IN<PRM_VAR>,IN<PRM_VAR_CPL>,IN<PRM_DFT_VALUE>)
<b>ACTION_ECM3_McReadChkState</b> (OUT<PRM_STATE_MC_TMP>)
<b>ACTION_ECM3_ReadChkCpl</b> (OUT<PRM_RESULT>,IN<PRM_VAR>,IN<PRM_VAR_CPL>)
<b>ACTION_ECM3_WriteChkCpl</b> (INOUT<PRM_VAR>,OUT<PRM_VAR_CPL>,IN<PRM_VALUE>)
<b>ACTION_INFR_McGetFsistAbcVal</b> (OUT<abc_rcv_mc_fct_spc_ist>)
<b>ACTION_INFR_McGetFsistIdx</b> (OUT<idx_test_rcv_mc_fct_spc_ist>)
<b>ACTION_INFR_McSendDrOff</b> (IN<lv_mc_dr_off>)
<b>ACTION_INFR_McSendFsistResp</b> (IN<idx_resp_trm_mc_fct_spc_ist>)

## FUNCTION DESCRIPTION:

### General information:

The function-specific instruction set test (FS-IST) complements the program flow monitoring (PFM) functionality in an effort to obtain as complete a monitoring of the proper functioning of the main controller (MC) as possible. The goal of the FS-IST is to check whether the MC is capable of correctly performing the calculations necessary for the most important safety-relevant functions in the *process monitoring* ("VDA level 2") - hence the name *function-specific* instruction-set test: only computations with relevance for the monitoring concept (the 'function' under consideration) are tested, as opposed to a complete instruction-set test.

As already stated, the FS-IST checks whether certain safety-relevant calculations are performed correctly. These so-called test calculations are performed by a copy of the relevant modules of process monitoring (so as not to 'disturb' the action process monitoring by the test calculations); these copied level 2 modules constitute the so-called copy of process monitoring, or level 2'. Although conceptually part of processor monitoring, the level 2' are in practise more closely associated to process monitoring than to processor monitoring: each change of a process monitoring module a copy of which is part of level 2' has to be carried out also for the corresponding level 2' module.

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Since the test calculations are also performed on the MC, i.e., by the same processor that performs the actual (level 2) calculations, the monitoring unit (MU) is used to initiate the FS-IST and check whether the calculations arrive at the correct results (otherwise no reasonable way of detecting faults is possible).

Concretely, the FS-IST is performed in the following way (there are some points to note about the timing which will be explained after the description of the basic algorithm):

- on the MU, there exists an array of test indices, or questions; these questions are simply bit patterns which are cyclically sent to the MC, i.e., at the beginning, the first entry of the array is sent, then the second, and so on (in the error-free case, the case of errors will be described later); for these question, there are corresponding answers, or responses, which are also stored in an array on the MU
- these test indices, once they have been received by the MC-part of processor monitoring, are then sent to the level 2' via an interface which, depending on the question from the MU, determines the starting values (i.e., values of inputs, etc.) for the level 2' modules;
- using this chosen starting values, level 2' calculates according to the modules, depending on the ability of the processor, yielding a specific actual output value that is then forwarded to the MC-part of processor monitoring, again via the interface, together with the expected result for this particular test index;
- the MC-part of processor monitoring then determines (by comparing the actual with the expected output value) whether the test calculation was performed successfully before sending a response, or answer, back to the MU; note that this answer is also influenced by other factors (e.g., if a fault by the MC-side of processor monitoring was detected, this answer is forced to be false from the expected answer on the MU)
- the MU receives the answer of the MC-part of processor monitoring and compares that to the entry in its array of expected results at the position corresponding to the sent test index;
- if this comparison has a positive result, and anti-bounce counter shall be decreased (without creating an underflow, i.e., if its value is already 0 nothing shall happen, see "G21 Debounce mechanism") and the procedure shall continue as described before;
- if the comparison shows that a wrong answer has been received, an anti-bounce counter shall be increased; upon reaching its maximal value, the central fault reaction ("G1 central fault reaction") shall be triggered; if the maximal value is not reached when increasing the anti-bounce counter, the particular question that was wrongly answered shall be re-sent to the MC for as long as the anti-bounce has not reached 0, i.e., if a question was answered wrongly and the value of the anti-bounce counter has value 4, the same question is sent (at least) 4 times before the next question is sent.

Note the possibility to distinguish between questions and question numbers: in this way, the algorithm for obtaining the new test index can be very simple, viz., the question number simply needs to be increased by 1 with every correct answer (or set to 1 if all possible numbers have been run through), while the actual bit patterns denoting the questions (to be found in a predefined array) can be chosen in such a way as to decrease (if not completely eliminate) the probability of corruption during the communication and also to be able to distinguish between question and answers in EMS and TCU mode of the MU. As stated before, some words regarding timing are necessary at this point:

- when the MU is used for monitoring of EMSs, the level 2' answers are only checked every second communication cycle;
- when the MU is used for monitoring of TCUs, the level 2' answers are checked every communication cycle;
- in NORMAL state, whenever the MU sends any question to the MC, the response received in that very communication (regardless of the chosen variant, EMS or TCU) is the answer corresponding to a previous question, i.e., in order to find out whether a question has been answered wrongly, the freshly received answer must be compared to the stored answer corresponding to the previous question;
- if an answer was wrong, the previously described timing situation leads to the fact that, before repeating the wrongly answered question, there will be one transmission of a new question (viz., in the communication where the wrong answer was received); for instance, assuming that both questions and question numbers are simply 0,1,2,... and question 3 is permanently answered wrongly by the MC, the following sequence of questions arises: 0,1,2,3,4,3,3,3... trigger "G1


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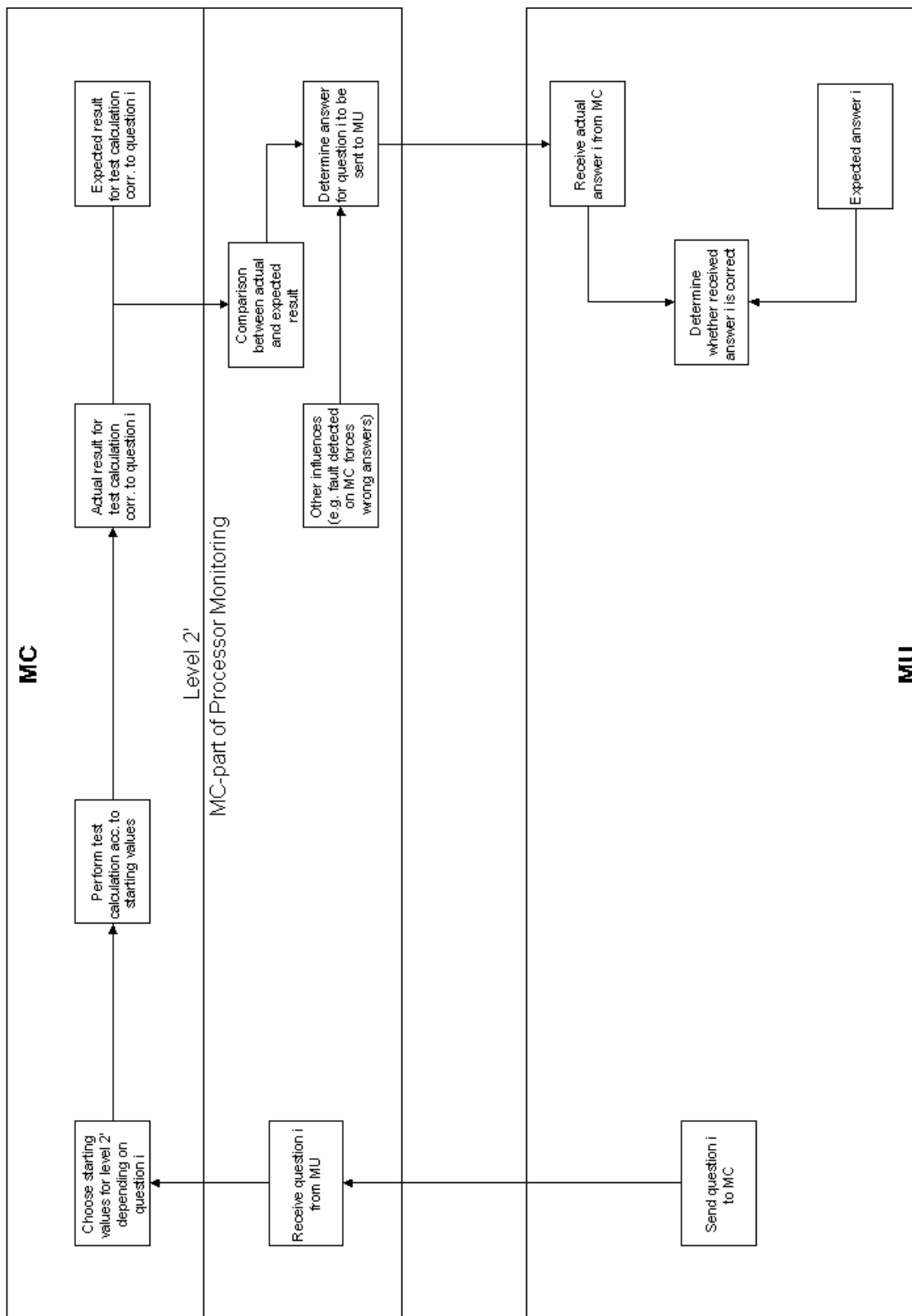
Central fault reaction", i.e., question 3 repeated until increasing the anti-bounce counter triggers a fault reaction; the answer to question 4 is simply ignored because the fact that the answer to question 3 was wrong only becomes apparent after question 4 has already been transmitted to the MC.

On the MC, for sending the response, there is a similar split into "answer" and "answer number" in order to facilitate the distinction between the responses from level 2' and for the MU.

### **Signal flow diagram:**

A schematic overview of the FS-IST functionality is given in the following diagram (note that the picture only depicts the control flow, one should not forget that time passes when the communications are performed, the level 2' calculations are performed etc.):


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### E.32.1 Pre-processing of the FS-IST data received from MU

#### FUNCTION DESCRIPTION:

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## General information:

This function pre-processes the data sent by the MU.

In PREDRIVE and NORMAL communications, the MU sends an FS-IST question and, only in NORMAL communications, additionally also the value of the anti-bounce counter for wrong FS-IST answers on the MU (it is not necessary to send that value in PREDRIVE because then its value is 0).

## Description:

The function incorporates the following requirements:

### **G33 Pre-processing of the FS-IST data received from MU**

The inputs to this function are `IDX_TEST_RCV_MC_FCT_SPC_IST`, the question as it was sent from the MU (via the infrastructure) and, in NORMAL communications, `ABC_RCV_MC_FCT_SPC_IST`, the value of the anti-bounce counter on the MU used for debouncing wrongly answered FS-IST questions.

Since the first MU anti-bounce counter value is only sent in NORMAL communications but the initial value of 0 is already known and used in PREDRIVE, it is necessary to use the local identifier `ABC_LID_MC_FCT_SPC_IST` to be used in all other MC FS-IST functions both in PREDRIVE and NORMAL; this variable is initialised to 0 before the PREDRIVE communication and then updated with the actual value sent by the MU after NORMAL communications.

As for the question sent by the MU, it is more efficient to instead use the corresponding *question number* (which is nothing but the appropriate index into the array `NC_IDX_TEST_MC_FCT_SPC_IST[]` of questions on the MC), in particular to simplify handing data to level 2'. Therefore, a decode step has to be taken after received the question on the MC: the received question `IDX_TEST_RCV_MC_FCT_SPC_IST` is simply compared to all entries in the array `NC_IDX_TEST_MC_FCT_SPC_IST[]` in order to find whether the transmitted question does indeed correspond to a known index on the MC, which is then stored in `IDX_NR_LID_MC_FCT_SPC_IST`; in order to detect when this decoding step fails, `IDX_NR_LID_MC_FCT_SPC_IST` is initialised to a specific value, `NC_IDX_NR_WRG_MC_FCT_SPC_IST`, indicating an invalid question number, and if no corresponding question number is found, this remains the value of `IDX_NR_LID_MC_FCT_SPC_IST`.

In this way, after both PREDRIVE and NORMAL communication(s), all data are always present for the other FS-IST functions.


## Application conditions

### **Initialisation:**

```

/ * Initialise the value of the MU anti-bounce counter sent
by the MU */
ABC_RCV_MC_FCT_SPC_IST = 0;
/ * Initialise the value of the MU anti-bounce counter on
the MC */
ABC_LID_MC_FCT_SPC_IST = 0;
/ * Initialise question number for question sent by MU to
wrong number */
IDX_NR_LID_MC_FCT_SPC_IST =
NC_IDX_NR_WRG_MC_FCT_SPC_IST;
/ * Initialise index number */
IDX_NR = 0;
/ * Initialise question sent by MU */
IDX_TEST_RCV_MC_FCT_SPC_IST = 0;

```

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**Recurrence:** The **initialisation** shall be performed **after each power-up or reset**.  
The **formula section** shall be **executed after the functions "Communication monitoring and evaluation of received data in PREDRIVE state" and "Communication monitoring and evaluation of received data in NORMAL state" have been finished**.

**Activation:** *((STATE\_MC = NC\_STATE\_MC\_PRDR) OR  
(STATE\_MC = NC\_STATE\_MC\_NORM)) AND  
"no errors during the evaluation following the communications"*

**Deactivation:** *Otherwise*

### Formula section:

```

/* Get question sent by MU from infrastructure */
ACTION_INFR_McGetFsistIdx(OUT    IDX_TEST_RCV_MC_FCT_SPC_IST);
/* Initialise local identifier for question number */
IDX_NR_LID_MC_FCT_SPC_IST = NC_IDX_NR_WRG_MC_FCT_SPC_IST;
/* In NORMAL, change the value of the MU anti-bounce counter to the received value */
IF (STATE_MC = NC_STATE_MC_NORM)
THEN /* In PREDRIVE, MC value of MU anti-bounce counter is set in initialisation*/
    /* Get value of anti-bounce counter on MU from infrastructure */
    ACTION_INFR_McGetFsistAbcVal(OUT    ABC_RCV_MC_FCT_SPC_IST);
    ABC_LID_MC_FCT_SPC_IST = ABC_RCV_MC_FCT_SPC_IST;
FI
/* Check whether received question corresponds to a question number; if yes, set local identifier to the
decoded question number */
FOR IDX_NR = 0 TO NC_TEST_REC_IDX_MAX_MON2 - 1
DO /* Check all defined questions */
    IF (NC_IDX_TEST_MC_FCT_SPC_IST[IDX_NR] = IDX_TEST_LID_MC_FST_SPC_IST)
    THEN /* Found the corresponding question number */
        IDX_NR_LID_MC_FCT_SPC_IST = IDX_NR;
    FI
FI
OD
/* If no matching question number is found, IDX_NR_LID_MC_FCT_SPC_IST will have value NC_IDX_
NR_WRG_MC_FCT_SPC_IST */
/* Has the number of the received question changed with this communication? */
IF (IDX_NR_LID_MC_FCT_SPC_IST <> TEST_REC_IDX_MON2)
THEN
    LV_MC_FCT_SPC_IST_ACT = 1;
FI /* Otherwise, LV_MC_FCT_SPC_IST_ACT remains unchanged */


```

## E.32.2 Test of MU reaction to wrong FS-IST answers

### FUNCTION DESCRIPTION:

#### General information:

This sub-function, under certain conditions, indicates (to the post-processing sub-function) a deliberate sending of wrong FS-IST answers to the MU, similar to PFM, with the goal to test whether the MU, after

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an appropriate delay, reacts to the received wrong answer by sending an increased anti-bounce counter and repeating the wrongly answered question.

This sub-function is executed after the pre-processing function.

### Description:

The function incorporates the following requirements:

#### **G34 Test of MU reaction to wrong FS-IST answers**

After the data received from the MU have been decoded and pre-processed, the newly received information (in particular about the value of the FS-IST anti-bounce counter on the MU) is used to determine whether it is possible to send a deliberately wrong FS-IST answer in the current system state.

In addition to the anti-bounce counter information from the MU, this system state includes the value of a test cycle counter `TCC_MC_FCT_SPC_IST_WRG_RESP` counting the number of times the function gets activated. There are two significant values of this counter, viz., `NC_TCC_MC_IST_WRG_RESP_REQ` and `NC_TCC_MC_IST_WRG_RESP_CHK`: the former means that sending a wrong answer is requested (this will eventually prompt setting a flag influencing the post-processing sub-function to export a bad answer); the latter value means that it is time to check whether the MU has reacted to a previously sent deliberately wrong answer (one has to allow for some delay because the MU only sends a new question every second communication cycle; consequently, the two values must necessarily be different). If the counter reaches a certain number then it is re-started, eventually triggering a new cycle of another wrong answer, check MU reaction to that and so on.

The sub-function consists of several sequential sub-tasks:

1. find out whether the MU anti-bounce counter sticks to a non-zero value (deploying a saved copy of its previous value);
2. test whether the MU has reacted (i.e., increased the anti-bounce counter accordingly) if the test cycle counter has reached value `NC_TCC_MC_IST_WRG_RESP_CHK`; this test also checks whether the MU anti-bounce counter sticks to 0 (complementing the previous test);
3. initiate sending a deliberately wrong FS-IST answer if the test cycle counter has reached value `NC_TCC_MC_IST_WRG_RESP_REQ`;
4. increase the value of the test cycle counter (including re-starting the counter when it is has reached its end value).


These sub-tasks shall be performed in this order; note that the second and third task cannot be activated at the same time anyway because their activation conditions are that the test cycle counter reaches two distinct values. As a consequence, they will be specified in one common formula section.

Note that for sub-task 3, (potentially) initiating the sending of a wrong FS-IST answer to the MU, is only performed if the MU anti-bounce counter is equal to 0, much like in the corresponding PFM functionality: sending a deliberately wrong answer must not trigger fault reaction. As a consequence, if the test cycle counter indicates that the MU should have reacted to a wrong answer (sub-task 2), it is tested whether the MU anti-bounce counter has value 2 which corresponds to exactly one increase of the MU anti-bounce counter (caused by the *deliberately* wrong answer).

It should furthermore be noted that, if during sub-task 2, it is found that the anti-bounce counter does not have the expected value, a wrong answer shall again be sent (this is achieved by setting the flag `LV_MC_FCT_SPC_IST_WRG_RESP_ACT`) and the test cycle counter shall be decrease by 1; the latter action is done because in sub-task 4, the test cycle counter is *unconditionally* increase by 1 so in the mentioned error case, the counter will, after the increase, still have value `NC_TCC_MC_IST_WRG_RESP_CHK`, i.e., after the next activation of the FS-IST, it will again be checked whether the MU has reacted to the wrong answer.

### Application conditions

**Initialisation:**                    `/* FS-IST to be activated */`  
     `LV_MC_FCT_SPC_IST_ACT = 1;`

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```

/ * Initialise saved value of MU anti-bounce counter */
ABC_LID_MC_FCT_SPC_IST_OLD = 0;
/ * Initially deactivate sending of wrong responses */
LV_MC_FCT_SPC_IST_WRG_RESP_ACT = 0;
/ * Initially set test cycle counter to requesting a wrong
response */
TCC_MC_FCT_SPC_IST_WRG_RESP = NC_TCC_MC_IST_WRG_RESP_REQ

```

**Recurrence:** The **initialisation** shall be **performed after each power-up or reset**.  
The **formula section** shall be **executed after the FS-IST sub-function "Pre-processing of FS-IST data received from MU" has been finished**.

**Activation:** (LV\_MC\_FCT\_SPC\_IST\_ACT = 1) **OR** ("MU configured for TCU mode")

**Deactivation:** Otherwise

### Formula section:

*/\* Sub-task 1: checking whether the MU anti-bounce counter sticks to a non-zero value \*/*

**IF** (ABC\_LID\_MC\_FCT\_SPC\_IST > 0)

**THEN** */\* Does the MU anti-bounce counter stick to a non-zero value? \*/*

**IF** (ABC\_LID\_MC\_FCT\_SPC\_IST = ABC\_LID\_MC\_FCT\_SPC\_IST\_OLD)

**THEN** */\* Yes: increase MC anti-bounce counter \*/*

ACTION\_ECM3\_McIncAbc( IN NC\_ABC\_MC\_NOT\_DEC,  
IN NC\_ERR\_COD\_MC\_NOT\_DEC);

**ELSE** */\* Has the anti-bounce counter been decreased? \*/*

**IF** (ABC\_LID\_MC\_FCT\_SPC\_IST < ABC\_LID\_MC\_FCT\_SPC\_IST\_OLD)

**THEN** */\* Yes: decrease MC anti-bounce counter \*/*

ACTION\_ECM3\_McDecAbc(IN NC\_ABC\_MC\_NOT\_DEC);

**FI** */\* Otherwise: no action as this behaviour of the MU anti-bounce counter might be caused by a (really, as opposed to deliberately) wrong level 2' response \*/*

**FI** */\* Note that sticking to 0 is tested later \*/*

**ELSE** */\* No, MU anti-bounce counter is equal to 0: decrease MC anti-bounce counter \*/*

ACTION\_ECM3\_McDecAbc(IN NC\_ABC\_MC\_NOT\_DEC);

**FI**

*/\* Sub-task 2: does the test cycle counter indicate checking the MU reaction? \*/*

**IF** (TCC\_MC\_FCT\_SPC\_IST\_WRG\_RESP = NC\_TCC\_MC\_IST\_WRG\_RESP\_CHK)

**THEN** */\* Yes: check value of MU anti-bounce counter (should be equal to 2)\*/*

**IF** (ABC\_LID\_MC\_FCT\_SPC\_IST = 2)

**THEN** */\* MU anti-bounce counter has the expected value: decrease corresponding MC anti-bounce counter \*/*

ACTION\_ECM3\_McDecAbc(IN NC\_ABC\_MC\_WRG\_RESP);

**ELSE** */\* MU anti-bounce counter does not have expected value: increase corresponding MC anti-bounce counter \*/*

ACTION\_ECM3\_McIncAbc(IN NC\_ABC\_MC\_WRG\_RESP,  
IN NC\_ERR\_COD\_MC\_WRG\_RESP);


*/\* Does the MU anti-bounce counter stick to 0? \*/*

**IF** (ABC\_LID\_MC\_FCT\_SPC\_IST = 0)

**THEN** */\* Yes: re-activate sending of wrong answer, decrease test cycle counter \*/*

LV\_MC\_FCT\_SPC\_IST\_WRG\_RESP\_ACT = 1;

TCC\_MC\_FCT\_SPC\_IST\_WRG\_RESP =  
TCC\_MC\_FCT\_SPC\_IST\_WRG\_RESP - 1;

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FI

FI

FI

```

/* Sub-task 3: request sending a wrong answer? */
IF ((TCC_MC_FCT_SPC_IST_WRG_RESP = NC_TCC_MC_IST_WRG_RESP_REQ)
THEN /* Yes: can we actually send a wrong answer (MU anti-bounce counter = 0)?*/
  IF (ABC_LID_MC_FCT_SPC_IST = 0)
  THEN /* Yes: set flag */
    LV_MC_FCT_SPC_IST_WRG_RESP_ACT = 1;
  ELSE /* No: try again in the next communication cycle */
    TCC_MC_FCT_SPC_IST_WRG_RESP =
      TCC_MC_FCT_SPC_IST_WRG_RESP - 1;

```

FI

FI

```

/* Sub-task 4: increase test cycle counter (including re-starting the counter) */
TCC_MC_FCT_SPC_IST_WRG_RESP =
  (TCC_MC_FCT_SPC_IST_WRG_RESP + 1)
  MOD NC_TEST_REC_IDX_MAX_MON2 + 4;
/* Note that still LV_MC_FCT_SPC_IST_ACT = 1, i.e., the FS-IST is still active! */

```

### E.32.3 Monitoring of FS-IST questions sent by MU

#### FUNCTION DESCRIPTION:

##### General information:

This sub-function monitors the sending of questions by the MU by comparing the question number corresponding to the actually sent question (in case it could be decoded) with a *predicted* question number (obtained as a function of the previous question number, plus the current and the saved state of the MU anti-bounce counter). In case of a discrepancy, a debounced fault reaction will be the result.

##### Description:


The function incorporates the following requirements:

#### **G35 Monitoring of FS-IST questions sent by MU**

After the data received from the MU have been pre-processed, in particular the newly sent question has been translated (if possible) into the matching question number on the MC, this function first predicts the expected question number; inputs for this are the previous, saved question number `IDX_NR_LID_MC_FCT_SPC_IST_OLD`, the current state of the MU anti-bounce counter `ABC_LID_MC_FCT_SPC_IST`, and the saved value `ABC_LID_MC_FCT_SPC_IST_OLD` of the MU anti-bounce counter, and the result of the prediction is stored in `IDX_NR_LID_MC_FCT_SPC_IST_PRED`.

Once the predicted question number has been obtained, a range check is performed for this decoded question number; in case it is found to be out of range (which means that the decode process detected an invalid question to which no matching question number could be found), a debounced fault reaction shall be performed and the *predicted* question number shall be saved (it is no use to save the invalid question number because the next prediction has to be based on a valid question number; moreover, the predicted question number is the one that should have been sent in the first place).

If the range check was successful, the predicted question number is compared with the decoded question number. If the two numbers disagree, a debounced fault reaction shall be performed, using the actions `ACTION_ECM3_McIncAbc` and `ACTION_ECM3_McDecAbc`, the anti-bounce counter `NC_ABC_`

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MC\_WRG\_IDX and (potentially) the error code NC\_ERR\_COD\_MC\_WRG\_IDX. The difference to the previous case with the failed range check is the fact that in this case, the decoded question number will, despite not being the expected one, still be used as the basis for the next prediction: after all, it is a valid question number sent by the MU and it reflects the internal state of the MU (at least from the point of view of FS-IST). If the prediction for the next question number is to have any chance of being accurate, the decoded value has to be used because also the MU bases its internal calculation on it.

Note that the saved question number is initialised to the maximal question number because then it is only necessary to increase it by 1 (modulo the maximal question number, i.e., 0) to obtain the predicted question number in case the MU anti-bounce counter has current value 0 - as is the case in PREDRIVE when the function is active for the first time, and so the initial case does not require special treatment but can be handled just like any other case.

Now back to the calculation of the predicted question number. There are several cases, all distinguished by the interplay between saved value (ABC\_LID\_MC\_FCT\_SPC\_IST\_OLD) and newly transmitted value (ABC\_LID\_MC\_FCT\_SPC\_IST) of the MU anti-bounce counter:

#### 1. ABC\_LID\_MC\_FCT\_SPC\_IST ≤ 1:

Then no error is present on the MU, hence the MU should send the next question, i.e.,

$$\begin{aligned} \text{IDX\_NR\_LID\_MC\_FCT\_SPC\_IST\_PRED} = \\ (\text{IDX\_NR\_LID\_MC\_FCT\_SPC\_IST\_OLD} + 1) \\ \text{MOD} \quad \quad \quad \text{NC\_TEST\_REC\_IDX\_MAX\_MON2}, \end{aligned}$$

as always during normal operation (the modulo-operation is necessary to avoid overflows of the predicted question number); the fact that less than or equal to 1 is tested is connected to the fact that the MU repeats a wrongly answered question until this condition for its FS-IST anti-bounce counter is satisfied;

#### 1. (ABC\_LID\_MC\_FCT\_SPC\_IST\_OLD = 0) AND (ABC\_LID\_MC\_FCT\_SPC\_IST = 2):

This case expresses the fact that an error was detected on the MU between the last and the current activation of the FS-IST on the MC; consequently, it is expected that the MU simply repeats the wrongly answered question number, i.e.,

$$\begin{aligned} \text{IDX\_NR\_LID\_MC\_FCT\_SPC\_IST\_PRED} = \\ (\text{IDX\_NR\_LID\_MC\_FCT\_SPC\_IST\_OLD} - 1) \\ (\text{for } \text{IDX\_NR\_LID\_MC\_FCT\_SPC\_IST\_OLD} > 0) \end{aligned}$$


and

$$\begin{aligned} \text{IDX\_NR\_LID\_MC\_FCT\_SPC\_IST\_PRED} = \text{NC\_TEST\_REC\_IDX\_MAX\_MON2} - \\ 1; \\ (\text{for } \text{IDX\_NR\_LID\_MC\_FCT\_SPC\_IST\_OLD} = 0) \end{aligned}$$

repeating the wrongly answered question means expecting the predecessor of the current question number because of the timing of fault detection in the FS-IST: in a certain communication, the MU receives an FS-IST answer  $A(i)$  from the MC to a question  $Q(i)$  with number  $i$  and, due to the bidirectional nature of the communication interface between MC and MU, in the very same communication it sends out the next question  $Q(i+1)$  (as the MU must assume that the received answer is correct because of system robustness issues); consequently, after the next activation of the FS-IST functions on the MC after this communication,  $i+1$  is stored in IDX\_NR\_LID\_MC\_FCT\_SPC\_IST\_OLD; in the meantime, the MU has detected that  $A(i)$  was wrong: a debounced fault reaction is the consequence (responsible for the checked increase of the MU anti-bounce counter from 0 to 2), and in the next communication, the MU will repeat the question  $Q(i)$ , i.e., exactly as expressed in the formula for the predicted question number above;

#### 1. Otherwise (meaning that the current value is >1 and the saved value is >0):

This means that the MU will repeat the same question number as the saved one, i.e.,  $\text{IDX\_NR\_LID\_MC\_FCT\_SPC\_IST\_PRED} = \text{IDX\_NR\_LID\_MC\_FCT\_SPC\_IST\_OLD}$ , and the explanation is similar to the previous case: the constellation of saved and current value for the MU anti-bounce counter can only be present if there has been an error on the MU but not in the last communication because otherwise, the save value of the MU anti-bounce counter would be 0 (the previous case); consequently, the MU has already started to repeat a wrongly answered question, and *will continue to do so* until its anti-bounce counter reaches 1 (cf. the first case); hence it is expected to receive the same question number as in the communication before.

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**Application conditions**

**Initialisation:**            / \* Initialise exported question number to invalid value \*/  
  
                                  TEST\_REC\_IDX\_MON2 = NC\_IDX\_NR\_WRG\_MC\_FCT\_SPC\_IST;

**Recurrence:**            The **initialisation** shall be performed **after each power-up or reset**  
                                  . The **function itself** shall be performed **after both FS-IST functions "Test of MU reaction to wrong FS-IST answers" and "Monitoring of FS-IST questions sent by MU" have been finished.**

**Activation:**             (LV\_MC\_FCT\_SPC\_IST\_ACT = 1) **OR** ("MU configured for TCU mode")

**Deactivation:**         Otherwise

**E.32.5 Export of the question number to level 2' (second calculation)**

**FUNCTION DESCRIPTION:**

**General information:**

This sub-function provides the question number to level 2' after all the required sub-functions have been activated; before calling level 2', a range check for the to-be-exported data is performed, and level 2' is not called in case the range check fails.

**Description:**

This sub-function incorporates the following requirements:

**G62 Export of the question number to level 2' (second calculation)**

R62\_1: The current question number IDX\_NR\_LID\_MC\_FCT\_SPC\_IST shall be assigned to the variable TEST\_REC\_IDX\_MON2 to be exported to level 2'.

R62\_2: A range check on the latter value shall be performed (in order to avoid an invalid value to be exported to level 2', in particular if it was not possible to decode the question sent by the MU; cf. G33).


R62\_3: If the range check was successful, TEST\_REC\_IDX\_MON2 shall be handed over to level 2', otherwise nothing is done: level 2' need not be activated with an invalid value (unnecessary computations), and there is no default value for it either (it is not clear what the MU expects in answer to a corrupted question).

**Application conditions**

**Initialisation:**         –

**Recurrence:**         The **function** shall be executed **after both FS-IST functions "Test of MU reaction to wrong FS-IST answers" and "Monitoring of FS-IST questions sent by MU" have been finished (even if they were not activated).**

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**Activation:** `(LV_MC_FCT_SPC_IST_ACT = 0) AND ("MU not configured for TCU mode") / * note that this function is executed in those recurrences of Processor Monitoring where G36 is not executed */`

**Deactivation:** `Otherwise`

## E.32.6 Decoding of the result of the level 2' test calculation

### FUNCTION DESCRIPTION:

#### General information:

This sub-function decodes the result of the test calculation from level 2' (a 16bit value) into an answer number that can then be used for generating the actual FS-IST answer sent to the MU (a 6bit value).

#### Description:

The sub-function incorporates the following requirements:

#### **G37 Decoding of the result of the level 2' test calculation**

R37\_1: After finishing, the test calculation of level 2' shall export its result in the 16bit value RESP\_MON2 (note: this is an *answer*, not an *answer number*, similar to the distinction between question and question number; RESP\_MON2 cannot be sent to the MU directly: the 16bit value would not fit into the 6bit reserved in the communication protocol for the FS-IST answer from the MC; consequently, a decoding process, like the decoding of the MU question, has to be performed before the actual FS-IST answer can be obtained).

R37\_2: The decoding process is performed utilising the 'conversion table' ID\_RESP\_MON2 and its axis LDPM\_TEST\_REC\_IDX\_MON2:

R37\_2.1: the answer number IDX\_NR\_RESP\_MC\_FCT\_SPC\_IST shall be initialised to the invalid number NC\_IDX\_NR\_WRG\_MC\_FCT\_SPC\_IST;

R37\_2.2: then IDX\_NR\_RESP\_MC\_FCT\_SPC\_IST runs through the table ID\_RESP\_MON2 (using LDPM\_TEST\_REC\_IDX\_MON2) and an index is sought such that a lookup at that index in the conversion table ID\_RESP\_MON2 yields RESP\_MON2 as the result;


R37\_2.3: in this way, if an index into ID\_RESP\_MON2 corresponding to RESP\_MON2 is found, IDX\_NR\_RESP\_MC\_FCT\_SPC\_IST is assigned this value or, if the level 2' response could not be decoded (i.e., if there is no matching table entry), IDX\_NR\_RESP\_MC\_FCT\_SPC\_IST is not updated and keeps the invalid number NC\_IDX\_NR\_WRG\_MC\_FCT\_SPC\_IST as value (this information can then be used in the subsequent post-processing sub-function).

#### Application conditions

**Initialisation:**  `/ * Initialise answer number to wrong number */  
IDX_NR_RESP_MC_FCT_SPC_IST =  
NC_IDX_NR_WRG_MC_FCT_SPC_IST;`

**Recurrence:** The **initialisation** shall be performed **after each power-up or reset**.  
The **function itself** shall be executed **after the FS-IST sub-function "Export of the question number to level 2'" has been finished**.

**Activation:** `(LV_MC_FCT_SPC_IST_ACT = 1) OR ("MU configured for TCU mode")`

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**Deactivation:** *Otherwise*

## E.32.7 Decoding of the result of the level 2' test calculation (second calculation)

### FUNCTION DESCRIPTION:

#### General information:

This sub-function decodes the result of the test calculation from level 2' (a 16bit value) into an answer number that can then be used for generating the actual FS-IST answer sent to the MU (a 6bit value).

This is done for the "second calculation" with the same question number. It is necessary to store whether the result was correct or not; for this, we have to ensure that TEST\_REC\_IDX\_MON2 is valid since otherwise level2' would not have been activated (hence we have to perform a range check on TEST\_REC\_IDX\_MON2).

#### Description:

The sub-function incorporates the following requirements:

#### **G63 Decoding of the result of the level 2' test calculation (second calculation)**

R63\_1: After finishing, the test calculation of level 2' shall export its result in the 16bit value RESP\_MON2 (note: this is an *answer*, not an *answer number*, similar to the distinction between question and question number; RESP\_MON2 cannot be sent to the MU directly: the 16bit value would not fit into the 6bit reserved in the communication protocol for the FS-IST answer from the MC; consequently, a decoding process, like the decoding of the MU question, has to be performed before the actual FS-IST answer can be obtained).

R63\_2: The decoding process is performed utilising the 'conversion table' ID\_RESP\_MON2 and its axis LDPM\_TEST\_REC\_IDX\_MON2:


R63\_2.1: the answer number IDX\_NR\_RESP\_MC\_FCT\_SPC\_IST shall be initialised to the invalid number NC\_IDX\_NR\_WRG\_MC\_FCT\_SPC\_IST;

R63\_2.2: then IDX\_NR\_RESP\_MC\_FCT\_SPC\_IST runs through the table ID\_RESP\_MON2 (using LDPM\_TEST\_REC\_IDX\_MON2) and an index is sought such that a lookup at that index in the conversion table ID\_RESP\_MON2 yields RESP\_MON2 as the result;

R63\_2.3: in this way, if an index into ID\_RESP\_MON2 corresponding to RESP\_MON2 is found, IDX\_NR\_RESP\_MC\_FCT\_SPC\_IST is assigned this value or, if the level 2' response could not be decoded (i.e., if there is no matching table entry), IDX\_NR\_RESP\_MC\_FCT\_SPC\_IST is not updated and keeps the invalid number NC\_IDX\_NR\_WRG\_MC\_FCT\_SPC\_IST as value (this information can then be used in the subsequent post-processing sub-function).

R63\_3: After the decoding, if

- TEST\_REC\_IDX\_MON2 is in range (*level 2' has in fact been activated with a defined question number*), **AND**
- IDX\_NR\_RESP\_MC\_FCT\_SPC\_IST <> TEST\_REC\_IDX\_MON2 (*the answer number from level 2' does not correspond to current (valid!) question, e.g., if the level2' answer RESP\_MON2 could not be found in ID\_RESP\_MON2*), **AND**
- IDX\_NR\_ERR\_MC\_FCT\_SPC\_IST is out of range, i.e., it has a value not between 0 and NC\_TEST\_REC\_IDX\_MAX\_MON2-1 (*no "second calculation" has failed previously; this is done to repeat the first wrongly answered "second calculation"*),

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IDX\_NR\_ERR\_MC\_FCT\_SPC\_IST shall be set to TEST\_REC\_IDX\_MON2 (storing the (valid!) question number for which the second calculation failed for later reference; by the previous conditions, this is the smallest/earliest question number for which the "second calculation" failed); otherwise, nothing shall be done (in particular, if IDX\_NR\_ERR\_MC\_FCT\_SPC\_IST is in range, it shall stay unchanged in order to remember the first question number for which the "second calculation" failed)

### Application conditions

**Initialisation:** / \* Initialise index for wrong second calculation to invalid number \*/

```

IDX_NR_ERR_MC_FCT_SPC_IST =
    NC_IDX_NR_WRG_MC_FCT_SPC_IST;

```

**Recurrence:** The **initialisation** shall be performed **after each power-up or reset**.

The **function itself** shall be executed **after the FS-IST sub-function "Export of the question number to level 2' (second calculation)" has been finished**.

**Activation:** (LV\_MC\_FCT\_SPC\_IST\_ACT = 0) **AND** ("MU not configured for TCU mode") / \* note that this function is executed in those recurrences of Processor Monitoring where G37 is **not** executed \*/

**Deactivation:** *Otherwise*

## E.32.8 Post-processing of the FS-IST data on MC for transmission to MU

### FUNCTION DESCRIPTION:

#### General information:

This sub-function performs the necessary post-processing steps regarding the FS-IST on the MC, most importantly sending of a wrong answer if this has previously been requested (whether deliberately, because the redundant switch-off path was triggered, or because any of the decoding steps has failed), and toggling the activation condition for the FS-IST (which is only activated every second communication cycle).


#### Description:

The sub-function incorporates the following requirements:

#### G38 Post-processing of the FS-IST data on MC for transmission to MU

R38\_1: If any of the following errors is active:

- the redundant switch-off path has been triggered (LV\_MC\_DR\_OFF = 1, LV\_MC\_DR\_OFF\_CPL = 0, checked using the RAM check service actions), or
- a deliberately wrong answer shall be sent to the MU (LV\_MC\_FCT\_SPC\_IST\_WRG\_RESP\_ACT = 1), or
- the current MU question could not be decoded properly (TEST\_REC\_IDX\_MON2 = NC\_IDX\_NR\_WRG\_MC\_FCT\_SPC\_IST), or
- the current level 2' answer could not be decoded properly (IDX\_NR\_RESP\_MC\_FCT\_SPC\_IST = NC\_IDX\_NR\_WRG\_MC\_FCT\_SPC\_IST), or
- the current question has been answered wrongly during the last "second calculation" (IDX\_NR\_RESP\_MC\_FCT\_SPC\_IST = IDX\_NR\_ERR\_MC\_FCT\_SPC\_IST),

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then a wrong answer shall be sent to the MU, calling the infrastructure action ACTION\_INFR\_McSendF-sistResp() with NC\_IDX\_RESP\_WRG\_MC\_FCT\_SPC\_IST as parameter.

R38\_2: Otherwise, in case no error has been detected, the corresponding entry in the "answer array" NC\_IDX\_RESP\_MC\_FCT\_SPC\_IST[] shall be sent to the MU, calling the infrastructure action ACTION\_INFR\_McSendF-sistResp() with NC\_IDX\_RESP\_MC\_FCT\_SPC\_IST[IDX\_NR\_RESP\_MC\_FCT\_SPC\_IST] as parameter.

R38\_3: Finally, the active flag LV\_MC\_FCT\_SPC\_IST\_ACT shall be toggled so that a new answer is only sent in the communication after the next communication cycle.

R38\_4: The value of LV\_MC\_DR\_OFF shall be written to the infrastructure using the action ACTION\_INFR\_McSendDrOff() so that it can be transmitted to the MU in NORMAL communications.

R38\_5: The flag LV\_MC\_FCT\_SPC\_IST\_WRG\_RESP\_ACT shall be reset to stop deliberately sending a wrong response.

R38\_6: If IDX\_NR\_ERR\_MC\_FCT\_SPC\_IST = IDX\_NR\_RESP\_MC\_FCT\_SPC\_IST, IDX\_NR\_ERR\_MC\_FCT\_SPC\_IST shall be re-set to NC\_IDX\_NR\_WRG\_MC\_FCT\_SPC\_IST (a wrong answer for the previously "remembered" question number where the "second calculation" failed shall be sent to MU so the question will be repeated by the MU and hence the "marker" can be re-set to its initial value).


### Application conditions

**Initialisation:** -

**Recurrence:** *The function shall be executed after all other FS-IST sub-functions have been finished.*

**Activation:** *(LV\_MC\_FCT\_SPC\_IST\_ACT = 1) OR ("MU configured for TCU mode")*

**Deactivation:** *Otherwise*

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## E.33 Program flow monitoring

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR	-	0... 7H	0 ...7	1	-
Local variable: counter for PFM tasks					
LF_MC_PFM_SYN_BYTE_CHG	-	0... 7FH	0... 127	1	-
Local variable: "change marker" recording the differences between a newly received synchronisation bytes and the previously received one (precisely those bits are set where the two synchronisation bytes differ)					
LF_MC_PFM_SYN_BYTE_CHG_OLD	-	0... 7FH	0... 127	1	-
Local variable: saved value of the previous "change marker"					
LF_MC_PFM_SYN_BYTE_MON	V	0... 7FH	0... 127	1	-
Local variable: PFM synchronisation byte which is updated synchronously to communications and used for monitoring the PFM data sent by the MU (timely updates, wrong response test)					
LF_MC_PFM_SYN_BYTE_TOG	V	0... 7FH	0... 127	1	-
Local variable: PFM synchronisation byte which is updated synchronously with monitored functionality (modified by PFM service actions)					
LF_MC_RCV_PFM_BYTE_MON	-	0... FFH	0... 255	1	-
Local variable: "raw" data sent by MU obtained via infrastructure (used for monitoring of MU)					
LF_MC_RCV_PFM_BYTE_TOG	-	0... FFH	0... 255	1	-
Local variable: "raw" data sent by MU obtained via infrastructure (used for PFM service actions)					
LF_MC_RESP_PFM	-	0... 7FH	0... 127	1	-
The PFM response of the MC (to be sent to the MU via the infrastructure)					
LF_MC_WRG_RESP_PFM_ACT	-	0... 7FH	0... 127	1	-
Local variable: bit field where a set bit k means that a wrong PFM response shall be sent out for task k					
LF_STATE_ABC_PFM_MU	-	0... 7FH	0... 127	1	-
Local variable: "status byte" recording, for each PFM anti-bounce counter on the MU, whether the counter has currently value 0 or not (updated using LF_MC_RCV_PFM_BYTE received from MU)					
LV_MC_CKS_OK_PFM	-	0... 1H	0 ...1	1	-
Local variable: flag indicating whether the (XOR) checksum of the data received from the MU is correct					
LV_MC_PFM_WRG_RESP_ACT_6	O/V	0... 1H	0 ...1	1	-
Flag indicating that the wrong response test for PFM task 6 has been performed at least once (needed for healing of reset counter and error information on the MC)					
STATE_MC_PFM_CTL_BYTE [NC_NR_MC_PFM]	-	0... FFH	0... 255	1	-
Local variable: array of PFM control bytes					
STATE_MU_TMP_PFM	-	0... FFH	0... 255	1	-
Local variable: header byte of MU as sent to MC					
TCC_MC_PFM_TOG [NC_NR_MC_PFM_TCC]	-	0... FFH	0... 255	1	-
Local variable: array of test cycle counters for monitoring the timely toggling of bits in the synchronisation byte by the MU for tasks 0 to 5					
TCC_MC_PFM_TOG_6	-	0... FFFFH	0... 65535	1	-
Local variable: test cycle counter for PFM task 6 (requires higher resolution than the others)					

### Input data:

LV_MC_COM_ERR {p. 7049}	LV_MC_COM_ERR_CPL {p. 7049}	NC_ABC_MC_PFM_0_ RESP {p. 7074}	NC_ABC_MC_PFM_0_ TOG {p. 7074}
----------------------------	--------------------------------	---------------------------------------	--------------------------------------

NC_ABC_MC_PFM_1_RESP {p. 7074}	NC_ABC_MC_PFM_1_TOG {p. 7074}	NC_ABC_MC_PFM_2_RESP {p. 7075}	NC_ABC_MC_PFM_2_TOG {p. 7075}
NC_ABC_MC_PFM_3_RESP {p. 7075}	NC_ABC_MC_PFM_3_TOG {p. 7075}	NC_ABC_MC_PFM_4_RESP {p. 7075}	NC_ABC_MC_PFM_4_TOG {p. 7076}
NC_ABC_MC_PFM_5_RESP {p. 7076}	NC_ABC_MC_PFM_5_TOG {p. 7076}	NC_ABC_MC_PFM_6_RESP {p. 7076}	NC_ABC_MC_PFM_6_TOG {p. 7076}
NC_ERR_COD_MC_PFM_0_RESP {p. 7078}	NC_ERR_COD_MC_PFM_0_TOG {p. 7078}	NC_ERR_COD_MC_PFM_1_RESP {p. 7078}	NC_ERR_COD_MC_PFM_1_TOG {p. 7078}
NC_ERR_COD_MC_PFM_2_RESP {p. 7078}	NC_ERR_COD_MC_PFM_2_TOG {p. 7078}	NC_ERR_COD_MC_PFM_3_RESP {p. 7078}	NC_ERR_COD_MC_PFM_3_TOG {p. 7078}
NC_ERR_COD_MC_PFM_4_RESP {p. 7078}	NC_ERR_COD_MC_PFM_4_TOG {p. 7078}	NC_ERR_COD_MC_PFM_5_RESP {p. 7078}	NC_ERR_COD_MC_PFM_5_TOG {p. 7078}
NC_ERR_COD_MC_PFM_6_RESP {p. 7078}	NC_ERR_COD_MC_PFM_6_TOG {p. 7078}	NC_STATE_MC_NORM {p. 7136}	NC_STATE_MC_PRDR {p. 7136}
STATE_MC {p. 7135}			

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_MC_PFM	-	0... FFH	0... 255	1	-
Number of PFM tasks					
NC_NR_MC_PFM_TCC	-	0... FFH	0... 255	1	-
Size of arrays TCC_MC_PFM_TOG[] and NC_TCC_MC_PFM_TOG_MAX[]					
NC_TCC_MC_PFM_TOG_6_MAX	-	0... FFFFH	0... 65535	1	-
Maximal number of communication cycles for the MU to perform the toggling of the PFM bit for task 6					
NC_TCC_MC_PFM_TOG_MAX [NC_NR_MC_PFM_TCC]	-	0... FFH	0... 255	1	-
Array containing the maximal number of communication cycles for the MU to perform the timely toggling of PFM bits for PFM tasks 0...NC_NR_MC_PFM_TCC					
NLF_MC_PFM_SYN_BYTE_INI	-	0... 7FH	0... 127	1	-
Initial value for the PFM synchronisation byte used for toggling by the service actions					

**Action definition**

<b>ACTION_ECM3_Service0TaskPfm</b> (IN<No Name available>)	Mode: O
--	---------

<b>ACTION_ECM3_Service10TaskPfm</b> (IN<No Name available>)	Mode: O
---	---------

<b>ACTION_ECM3_Service11TaskPfm</b> (IN<No Name available>)	Mode: O
---	---------

<b>ACTION_ECM3_Service12TaskPfm</b> (IN<No Name available>)	Mode: O
---	---------

<b>ACTION_ECM3_Service13TaskPfm</b> (IN<No Name available>)	Mode: O
<b>ACTION_ECM3_Service14TaskPfm</b> (IN<No Name available>)	Mode: O
<b>ACTION_ECM3_Service15TaskPfm</b> (IN<No Name available>)	Mode: O
<b>ACTION_ECM3_Service16TaskPfm</b> (IN<No Name available>)	Mode: O
<b>ACTION_ECM3_Service17TaskPfm</b> (IN<No Name available>)	Mode: O
<b>ACTION_ECM3_Service18TaskPfm</b> (IN<k>)	Mode: O
Service action for "inspection point" 18 in task k.	
<b>ACTION_ECM3_Service19TaskPfm</b> (IN<k>)	Mode: O
Service action for "inspection point" 19 in task k.	
<b>ACTION_ECM3_Service1TaskPfm</b> (IN<No Name available>)	Mode: O
<b>ACTION_ECM3_Service20TaskPfm</b> (IN<k>)	Mode: O
Service action for "inspection point" 20 in task k.	
<b>ACTION_ECM3_Service21TaskPfm</b> (IN<k>)	Mode: O
Service action for "inspection point" 21 in task k.	
<b>ACTION_ECM3_Service22TaskPfm</b> (IN<k>)	Mode: O
Service action for "inspection point" 22 in task k.	
<b>ACTION_ECM3_Service23TaskPfm</b> (IN<k>)	Mode: O
Service action for "inspection point" 23 in task k.	
<b>ACTION_ECM3_Service24TaskPfm</b> (IN<k>)	Mode: O
Service action for "inspection point" 24 in task k.	
<b>ACTION_ECM3_Service25TaskPfm</b> (IN<k>)	Mode: O
Service action for "inspection point" 25 in task k.	
<b>ACTION_ECM3_Service26TaskPfm</b> (IN<k>)	Mode: O
Service action for "inspection point" 26 in task k.	
<b>ACTION_ECM3_Service27TaskPfm</b> (IN<k>)	Mode: O
Service action for "inspection point" 27 in task k.	
<b>ACTION_ECM3_Service28TaskPfm</b> (IN<k>)	Mode: O
Service action for "inspection point" 28 in task k.	

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<b>ACTION_ECM3_Service29TaskPfm (IN&lt;k&gt;)</b>	Mode: O
Service action for "inspection point" 29 in task k.	

<b>ACTION_ECM3_Service2TaskPfm (IN&lt;No Name available&gt;)</b>	Mode: O

<b>ACTION_ECM3_Service3TaskPfm (IN&lt;PRM_K&gt;)</b>	Mode: O
Service action for "inspection point" 3 in task k.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_K	in	0... FFH	0... 255	1	-
task number					

<b>ACTION_ECM3_Service4TaskPfm (IN&lt;PRM_K&gt;)</b>	Mode: O
Service action for "inspection point" 4 in task k.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_K	in	0... FFH	0... 255	1	-
task number					

<b>ACTION_ECM3_Service5TaskPfm (IN&lt;PRM_K&gt;)</b>	Mode: O
Service action for "inspection point" 5 in task k.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_K	in	0... FFH	0... 255	1	-
task number					

<b>ACTION_ECM3_Service6TaskPfm (IN&lt;No Name available&gt;)</b>	Mode: O

<b>ACTION_ECM3_Service7TaskPfm (IN&lt;No Name available&gt;)</b>	Mode: O

<b>ACTION_ECM3_Service8TaskPfm (IN&lt;No Name available&gt;)</b>	Mode: O

<b>ACTION_ECM3_Service9TaskPfm (IN&lt;No Name available&gt;)</b>	Mode: O

<b>ACTION_ECM3_ServicePfm (IN&lt;No Name available&gt;)</b>	Mode: O

**Import actions:**

<b>ACTION_ECM3_ChkCpl (IN&lt;PRM_VAR&gt;,IN&lt;PRM_VAR_CPL&gt;)</b>
<b>ACTION_ECM3_McDecAbc (IN&lt;PRM_ABC_ID&gt;)</b>
<b>ACTION_ECM3_McIncAbc (IN&lt;PRM_ABC_ID&gt;,IN&lt;PRM_ERR_COD&gt;)</b>
<b>ACTION_ECM3_McReadChkState (OUT&lt;PRM_STATE_MC_TMP&gt;)</b>
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<b>ACTION_ECM3_ReadChkCpl</b> (OUT<PRM_RESULT>,IN<PRM_VAR>,IN<PRM_VAR_CPL>)
<b>ACTION_ECM3_WriteChkCpl</b> (INOUT<PRM_VAR>,OUT<PRM_VAR_CPL>,IN<PRM_VALUE>)
<b>ACTION_INFR_McChkCks</b> (OUT<No Name available>)
<b>ACTION_INFR_McGetHd</b> (OUT<PRM_STATE_MU>)
<b>ACTION_INFR_McGetPfmByte</b> (OUT<If_mc_rcv_pfm_byte>)
<b>ACTION_INFR_McSendPfmResp</b> (IN<If_mc_resp_pfm>)

## FUNCTION DESCRIPTION:

### General information:

Program flow monitoring (PFM) is one of the ways in which the processor monitoring functionality monitors whether the MC-SW, most importantly the process monitoring, is still executed “properly.” From the perspective of PFM, “properly” means that the safety-relevant functions of process monitoring are executed with the correct recurrence and in the correct sequence. The basic algorithm of PFM works as follows.


The MU sends a bit pattern, the so-called *PFM synchronisation byte*, to the MC: this synchronisation byte contains one bit for each of 7 *PFM tasks* (numbered from 0 to 6) to be monitored. Here, “PFM task” denotes a collection of software modules (=functions), in particular of process monitoring, which have to be executed in a defined order and which have to be executed in the same time grid. There can be up to 30 “inspection points” in each of the monitored tasks (e.g., if 3 inspections per module are performed, this means up to 10 modules per task).

Having been received by the MC, the synchronisation byte is used to obtain the so-called *PFM response byte*: if the monitored modules (of process monitoring or others) from one task *are executed* and, furthermore, if they are *executed in the correct order* (note that these are two different constraints!), they manipulate the bit in the response byte corresponding to ‘their’ task in such a way that it is finally toggled. The (thus potentially updated) response byte is sent back to the MU. In how far the sent response byte (MC → MU) differs from the originally transmitted synchronisation byte (MU → MC) depends solely on which monitored modules were executed until the communication where the response byte was transmitted.

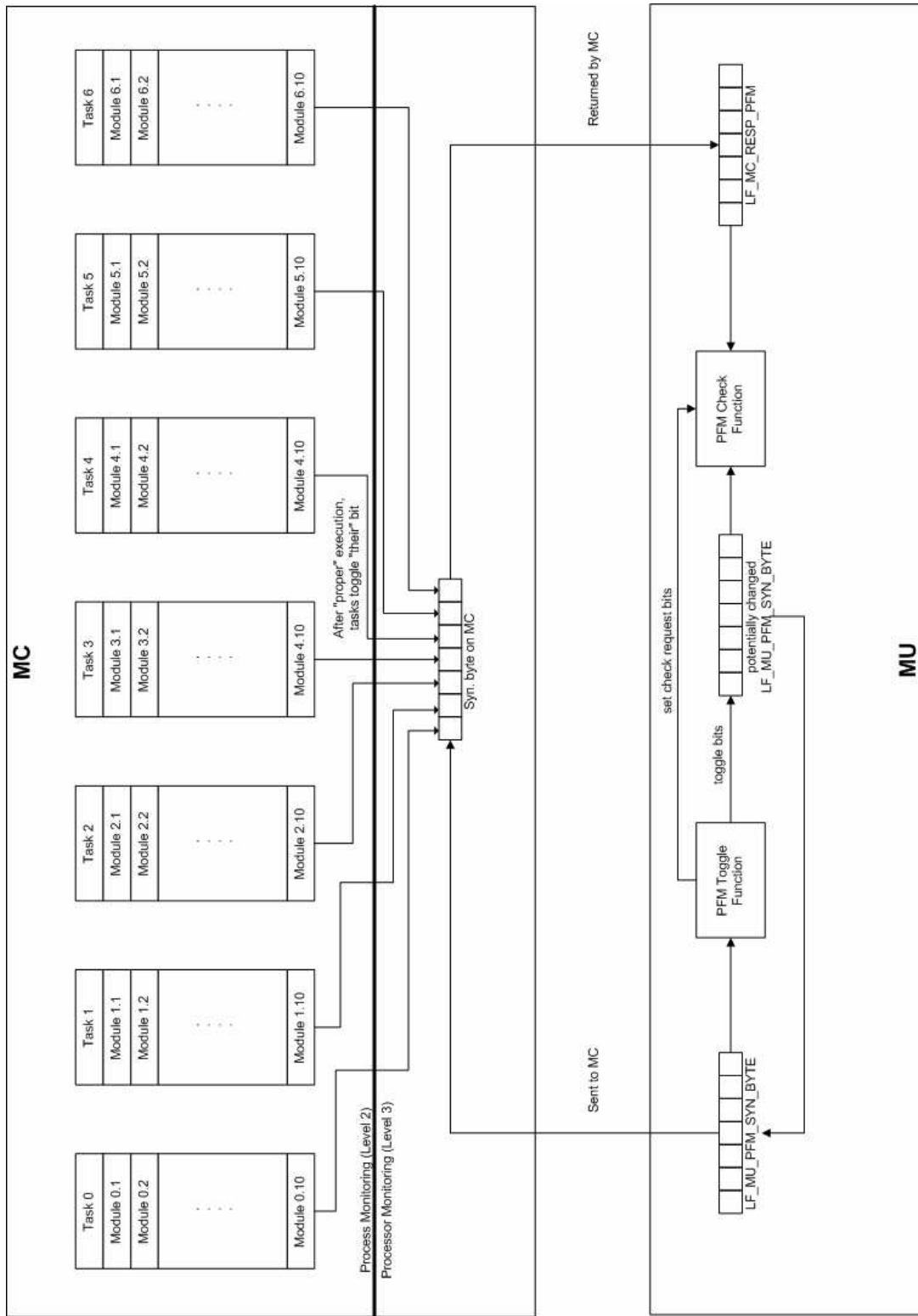
It should be noted that the MU sends two kinds of information: synchronisation bytes and status bytes, and that there is at least one status byte sent between two synchronisation bytes because of the toggle frequency on the MU. Such a status byte contains information about PFM anti-bounce counters on the MU: a set bit indicates that the corresponding counter has value > 0.

Meanwhile, on the MU, the synchronisation byte that was previously sent to the MC, is also manipulated: specific bits are toggled in a way in line with what is expected from the MC in terms of toggling the bits, assuming that the process monitoring tasks are executed “properly” in the sense explained above. When the PFM response of the MC (= a potential update by the MC of the original synchronisation byte) is received, it can thus be compared with the (now also on the MU manipulated) synchronisation byte on the MU.

Since the way the MU manipulates the synchronisation byte is the reference for how the MC should do the same task, a mismatch between the synchronisation byte and the PFM response of the MC indicates that the program execution on the MC is not performed in the prescribed way; as a consequence, a debounced fault reaction will be performed, using separate anti-bounce counters for each of the 7 tasks.


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**Signal flow diagram:**



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**Description:**

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The PFM on the MC has the following main tasks:

1. decoding of PFM byte sent by the MU;
2. PFM service actions;
3. monitoring of timely updates of the synchronisation byte by the MU;
4. test MU reaction to wrong PFM responses;
5. post-processing of PFM response before communications.

These sub-tasks of PFM shall, in the following, be represented as the sub-functions of this module.

A special case arises for the first sub-function. It is possible that the monitored functionality (e.g., process monitoring) is running asynchronously to the communications between MC and MU. Therefore, the sub-function must be split in two: one function running synchronously with the communications dealing with testing the MU responses (timely updates and reaction to deliberately wrong responses); another one running synchronously with the fastest monitored task acquiring the synchronisation byte for toggling by the PFM service actions in the same time grid as the modules under PFM inspection.

The last sub-function which is responsible for preparing the PFM response sent to the MU only takes into account that synchronisation byte which used for the service actions since only this can provide the information which modules of the monitored tasks have been executed.

The sequencing of these sub-functions shall also be described (which is basically in the order in which they are presented above with the exception of the service actions which are independently executed by the modules/tasks which are put under the supervision of PFM).

### E.33.1 Decoding of PFM byte sent by the MU used for monitoring of MU

#### FUNCTION DESCRIPTION:

##### General information:

This sub-function describes how the "raw" data received from the MU (via the infrastructure interface) are pre-processed for PFM on the MC.

Note that this sub-function deals with that instance of the synchronisation byte which is only evaluated to detect whether the MU is still processing its PFM functions properly.

##### Description:


The function incorporates the following requirements:

#### **G28 Decoding of PFM byte sent by the MU used for monitoring of MU**

R28\_1: In PREDRIVE, i.e., STATE\_MC = NC\_STATE\_MC\_PRDR, in case no communication error was detected (i.e., LV\_MC\_COM\_ERR = 0 and its complement LV\_MC\_COM\_ERR\_CPL = 1, checked using the RAM check service actions):

R28\_1.1: the "raw" PFM data sent by the MU are obtained by calling the action ACTION\_INFR\_McGetPfmByte() and the return value shall be stored in the variable LF\_MC\_RCV\_PFM\_BYTE\_MON;

R28\_1.2: since the MU always sends a synchronisation byte as the first PFM byte, bits 0...6 of LF\_MC\_RCV\_PFM\_BYTE\_MON shall be copied to the synchronisation byte on the MC, LF\_MC\_PFM\_SYN\_BYTE\_MON.

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R28\_2: In NORMAL, i.e., STATE\_MC = NC\_STATE\_MC\_NORM, in case no communication error was detected (i.e., LV\_MC\_COM\_ERR = 0 and its complement LV\_MC\_COM\_ERR\_CPL = 1, checked using the RAM check service actions):

R28\_2.1: the "raw" PFM data sent by the MU are obtained by calling the action ACTION\_INFR\_McGetPfmByte() and stored in the variable LF\_MC\_RCV\_PFM\_BYTE\_MON.

R28\_2.2: the change marker LF\_MC\_PFM\_SYN\_BYTE\_CHG is saved in LF\_MC\_PFM\_SYN\_BYTE\_CHG\_OLD.

R28\_2.3: depending on the value of the MSB (Most Significant Bit) of LF\_MC\_RCV\_PFM\_BYTE\_MON, two cases arise:

R28\_2.3.1: **MSB = 0** means the MU has sent an (updated) *synchronisation byte* as bits 0..6 of LF\_MC\_RCV\_PFM\_BYTE\_MON.

R28\_2.3.1.1: the change marker LF\_MC\_PFM\_SYN\_BYTE\_CHG is updated, setting bit *k* if bit *k* in LF\_MC\_PFM\_SYN\_BYTE\_MON <> bit *k* in LF\_MC\_RCV\_PFM\_BYTE\_MON, and clearing bit *k* otherwise;

R28\_2.3.1.2: bits 0..6 of LF\_MC\_RCV\_PFM\_BYTE\_MON shall be copied to LF\_MC\_PFM\_SYN\_BYTE\_MON;

R28\_2.3.1.3: LF\_STATE\_ABC\_PFM\_MU shall not be updated.

R28\_2.3.2: **MSB = 1** means the MU has sent a *status byte* of the PFM anti-bounce counters on the MU: bit  $0 \leq k \leq 6$  in LF\_MC\_RCV\_PFM\_BYTE\_MON being set indicates that the value of the anti-bounce counter for PFM task *k* on the MU is strictly greater than 0.

R28\_2.3.2.1: the change marker LF\_MC\_PFM\_SYN\_BYTE\_CHG shall be reset to 0;

R28\_2.3.2.2: bits 0..6 of LF\_MC\_RCV\_PFM\_BYTE\_MON shall be copied to LF\_STATE\_ABC\_PFM\_MU.

R28\_2.3.2.3: LF\_MC\_PFM\_SYN\_BYTE\_MON shall not be updated.

**Note:**

Requirement R28\_2.3.2.1 is based on the following equivalence:

*any of the two "change markers" LF\_MC\_PFM\_SYN\_BYTE\_CHG and LF\_MC\_PFM\_SYN\_BYTE\_CHG\_OLD is equal to 0*

*if and only if*

*the PFM byte from the corresponding communication (either the current one or the one before that) was a status byte.*

This holds because the MU sends a PFM synchronisation byte *only if* it was actually updated, compared to the previously sent synchronisation byte: at least one bit must have changed and hence, in turn, at least one set bit in the corresponding change marker would have to be set on the MC.

**Application conditions**

**Initialisation:**


LF\_MC\_RCV\_PFM\_BYTE\_MON = 0;  
 LF\_MC\_PFM\_SYN\_BYTE\_MON = 0;  
 LF\_STATE\_ABC\_PFM\_MU = 0;  
 LF\_MC\_PFM\_SYN\_BYTE\_CHG = 0;  
 LF\_MC\_PFM\_SYN\_BYTE\_CHG\_OLD = 0;  
 CTR = 0;

**Recurrence:**

The **initialisation** shall be **executed after each power-up or reset.**

The **function itself** shall be **executed after the modules** "Communication monitoring in PREDRIVE state" or "Communication monitoring in NORMAL state", depending on the current state (*i.e., synchronously to the communications between MC and MU*).

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**Activation:** `((STATE_MC = NC_STATE_MC_PRDR) OR  
(STATE_MC = NC_STATE_MC_NORM) ) AND  
(LV_MC_COM_ERR = 0)`  
(active in both PREDRIVE and NORMAL, but only if no communication error was detected)

**Deactivation:** `Otherwise`

### E.33.2 Decoding of PFM byte sent by the MU used for toggling by the PFM service actions

#### FUNCTION DESCRIPTION:

##### General information:

This sub-function describes how the "raw" data received from the MU (via the infrastructure interface) are pre-processed for PFM on the MC when used for the PFM service actions.

The function shall be executed **synchronously to, but before** the fastest monitored task: in case there has been an update of the synchronisation byte just before the execution of the monitored task, the PFM service actions will use the updated value of the synchronisation byte when determining the relevant bits in the PFM response LF\_MC\_RESP\_PFM sent to the MU.

Since this function potentially runs asynchronously to the communications between MC and MU, it is necessary to perform the necessary communication monitoring (checksum, header-byte) specifically inside this function. In case an error is detected, no fault reaction shall be carried out, only the received data shall be ignored: eventually the "standard" communication monitoring will be performed and will detect the error and perform the defined reaction.

##### Description:

The function incorporates the following requirements:

#### **G60 Decoding of PFM byte sent by the MU used for toggling by the PFM service actions**

R60\_1: In NORMAL, i.e., if MC\_STATE = NC\_STATE\_MC\_NORM:

R60\_1.1: for **communication checksum monitoring**, the action ACTION\_INFR\_McChkCks() shall be called returning the flag LV\_MC\_CKS\_OK\_PFM (which is set if the checksum was correct);

R60\_1.2: in case of a checksum error:

R60\_1.2.1: no further communication monitoring shall be performed;

R60\_1.2.2: no update of LF\_MC\_RCV\_PFM\_BYTE\_TOG shall be performed;


R60\_1.3: in case of correct checksum, for **communication header-byte monitoring**, the action ACTION\_INFR\_McGetHd() shall be called returning the header byte STATE\_MU\_TMP\_PFM sent by the MU in the latest communication.

R60\_1.4: If STATE\_MU\_TMP\_PFM <> NC\_STATE\_MC\_NORM, no update of LF\_MC\_RCV\_PFM\_BYTE\_TOG shall be performed.

R60\_1.5: If STATE\_MU\_TMP\_PFM = NC\_STATE\_MC\_NORM, the action ACTION\_INFR\_McGetPfm-Byte() shall be called and the return value shall be stored in the variable LF\_MC\_RCV\_PFM\_BYTE\_TOG.

R60\_1.6: Depending on the value of the MSB (Most Significant Bit) of LF\_MC\_RCV\_PFM\_BYTE\_TOG, two cases arise:

R60\_1.6.1: **MSB = 0** means the MU has sent an (updated) *synchronisation byte* as bits 0...6 of LF\_MC\_RCV\_PFM\_BYTE\_TOG, which shall hence be copied to LF\_MC\_PFM\_SYN\_BYTE\_TOG;

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R60\_1.6.2: **MSB = 1** means the MU has sent a *status byte* of the PFM anti-bounce counters on the MU, hence no update of LF\_MC\_PFM\_SYN\_BYTE\_TOG shall be performed.

**Application conditions**

**Initialisation:**            *LF\_MC\_PFM\_SYN\_BYTE\_TOG = NLF\_MC\_PFM\_SYN\_BYTE\_INI;*  
                                  *LF\_MC\_RCV\_PFM\_BYTE\_TOG = 0;*  
                                  *STATE\_MU\_TMP\_PFM = 0;*  
                                  *LV\_MC\_CKS\_OK\_PFM = 0;*

**Recurrence:**            The **initialisation** shall be **executed after each power-up or reset**.  
                                  The **function itself** shall be **executed synchronously to but before the fastest monitored task** (i.e., potentially asynchronously to the communications between MC and MU).

**Activation:**            (*STATE\_MC = NC\_STATE\_MC\_NORM*)    (only active in NORMAL)

**Deactivation:**        *Otherwise*

**E.33.3 PFM service actions**

**FUNCTION DESCRIPTION:**

**General information:**

This sub-function describes the services to supervise the program flow in relevant modules/tasks (in particular those of process monitoring).

**Description:**

The function incorporates the following requirements:

**G29 PFM service actions**

In general, PFM works by providing "markers" in the form of actions to be called at certain points in the supervised modules/tasks, thus enabling the PFM function to analyse the correctness of the program flow inside those modules/tasks.

In the following, let *k* always range over 0 to 6, with the intended meaning that *k* corresponds to one of the 7 different PFM tasks, and let *j* range over 0 to 29, for maximally 30 "inspection points" spread over (the modules in any of) the 7 tasks.


The PFM inspection for a fixed task *k* works as follows.

There is a *PFM control byte* STATE\_MC\_PFM\_CTL\_BYTE[*k*] which, before the first PFM synchronisation byte is transmitted from the MU to the MC (in the PREDRIVE communication), is initialised to *nc\_ctl\_ini* (one initial value for the control bytes of all tasks).

The PFM service actions ACTION\_ECM3\_ServicejTaskPfm(*k*) and ACTION\_ECM3\_ServicePfm(*k*) subsequently manipulate STATE\_MC\_PFM\_CTL\_BYTE[*k*], allowing the PFM function to track the program flow in the supervised tasks.

The idea behind the actions ACTION\_ECM3\_ServicejTaskPfm(*k*) is to record the correct sequencing inside a task: STATE\_MC\_PFM\_CTL\_BYTE[*k*] is manipulated such that

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**STATE\_MC\_PFM\_CTL\_BYTE[k] = nc\_ctl\_end\_k**

**if and only if**

**all "inspection points" in the task were reached in their correct sequence  $j = 0,1,2,\dots,max$**

( $max \leq 29$  and depends on the supervised task)

This yields the following error cases:

- "inspection points" were reached in an incorrect order (e.g., 0,1,3,2,...),
- "inspection points" were skipped (e.g., 0,2,3,...),
- "inspection points" were reached repeatedly (e.g., 0,1,1,2,...),
- or arbitrary combinations thereof.

In all of these cases, the control byte shall have a value different from *nc\_ctl\_end\_k*, indicating an incorrect program flow in task *k*.

The action ACTION\_ECM3\_ServicePfm(*k*) shall implement a "end of task" marker by checking the current value of STATE\_MC\_PFM\_CTL\_BYTE[*k*] for equality with the expected end value *nc\_ctl\_end\_k*.

This implies that this action must be executed *after all "inspection point" actions of task k have been executed*, i.e., it must be *the last PFM-relevant activity of the task k* under supervision; usually, it really is the last activity before the end of the task.

If the test is positive, i.e., all "inspection points" inside task *k* have been reached exactly once and in the correct sequence, bit *k* in the PFM response LF\_MC\_RESP\_PFM shall be set to the negated value of bit *k* in the current synchronisation byte LF\_MC\_PFM\_SYN\_BYTE\_TOG. Consequently, since the PFM response will eventually be transmitted to the MU, the MU will receive a bit which is toggled when compared to its original value in the synchronisation byte as sent from the MU.

If the test is negative, bit *k* in the synchronisation byte LF\_MC\_PFM\_SYN\_BYTE\_TOG shall simply be copied to bit *k* in the PFM response (since the MU expects to receive this bit in its toggled state, this will eventually prompt a reaction by the MU).

Regardless of the test result, the control byte for task *k* shall be re-initialised to its start value *nc\_ctl\_ini* in order to prepare a new execution of task *k*.

**Note:** the common start value *nc\_ctl\_ini* and the individual end values *nc\_ctl\_end\_k* for each of the control bytes are configurable so that they can be adapted to project-specific needs and NOT declared here.

**Note:** the PFM response is exclusively determined from the instance of the PFM synchronisation byte LF\_MC\_PFM\_SYN\_BYTE\_TOG acquired synchronously with the fastest monitored task since only this instance should record the effect of any monitored modules being executed.


### Description of ACTION\_ECM3\_Service(j)TaskPfm

#### Description:

**Syntax:** ACTION\_ECM3\_Service(j)TaskPfm(IN <k>)

**Parameter (IN):** k task number

**Short description:** This action manipulates the control byte STATE\_MC\_PFM\_CTL\_BYTE[*k*] of task *k* in order to indicate the fact that the *j*-th "inspection point" in the task has been reached

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## Description of ACTION\_ECM3\_ServicePfm

### Description:

**Syntax:** ACTION\_ECM3\_ServicePfm(IN <k>)  
**Parameter (IN):** k task number  
**Short description:** This action provides an "end of task" marker, see formula section.

### Formula section:

```
IF (STATE_MC_PFM_CTL_BYTE[k] = nc_ctl_end_k)
THEN /* all "inspection points" reached correctly, stored inverted bit in PFM response */
    LF_MC_RESP_PFM.k = invert(LF_MC_PFM_SYN_BYTE_TOG.k)
ELSE /* wrong program flow, store un-inverted bit in PFM response */
    LF_MC_RESP_PFM.k = LF_MC_PFM_SYN_BYTE_TOG.k
FI
/* Reset control byte for task k */
STATE_MC_PFM_CTL_BYTE[k] = nc_ctl_ini;
```

### Application conditions

**Initialisation:** / \* Set control bytes to their common start value \*/  
**FOR** k = 0 **TO** NC\_NR\_MC\_PFM  
**DO**  
 STATE\_MC\_PFM\_CTL\_BYTE[k] = nc\_ctl\_ini;  
**OD**

**Recurrence:** The **initialisation** shall be performed after each power-up or reset.  
 The **actions** shall be called from inside the supervised modules.

**Activation:** -

**Deactivation:** -

## E.33.4 Monitoring of timely updates of the synchronisation byte by the MU

### FUNCTION DESCRIPTION:

#### General information:

This sub-function describes the mechanism by which the MC monitors whether the MU sends, in the corresponding intervals of time, synchronisation bytes where specific bits have been toggled at the right rate.

In this way it is possible to detect whether the MU is still running in "real-time" compared to the MC (in some ways, this is the dual of PFM which serves the purpose to detect whether the modules/tasks of process monitoring still run in "real-time").



**Description:**

The function incorporates the following requirements:

**G30 Monitoring of timely updates of the synchronisation byte by the MU**

R30\_1: From the point of view of the MC, the MU is supposed to send updated synchronisation bytes at certain rates; the rate is determined by the bit toggling function on the MU, additionally influenced by the communication recurrence.

R30\_2: In order to check whether this toggling process on the MU still works correctly, there is the array TCC\_MC\_PFM\_TOG[] (of size 6) plus TCC\_MC\_PFM\_TOG\_6 (for PFM task 6 which, due to its low recurrence, needs higher resolution), on the MC, for counting communication cycles between two updates of the corresponding bit in the synchronisation bytes sent by the MU.

R30\_3: For each of the counters, there is a corresponding maximal value contained in the array NC\_TCC\_MC\_PFM\_TOG\_MAX[], plus NC\_TCC\_MC\_PFM\_TOG\_6\_MAX, which is used for detecting whether an update of the synchronisation byte by the MU was performed too late.

**Application conditions**

```

Initialisation:      / * Initialise the required data */
                        FOR CTR = 0 TO NC_NR_MC_PFM_TCC
                        DO
                            TCC_MC_PFM_TOG[CTR] = 0;
                        OD
                        TCC_MC_PFM_TOG_6 = 0;
    
```

**Recurrence:** The **initialisation** shall be performed after each power-up or reset.  
The **formula section** shall be executed after the PFM sub-function "Decoding of PFM byte sent by MU used for monitoring of MU."

**Activation:** (STATE\_MC = NC\_STATE\_MC\_NORM) (only performed in NORMAL after the PFM byte sent from the MU has been decoded; in PREDRIVE, the check does not make sense since there, the MU sends a synchronisation byte for the first time)


**Deactivation:** -

**Formula section:**

```

FOR CTR = 0 TO 5
DO
    /* Has the bit in the synchronisation byte been updated? */
    IF (LF_MC_PFM_SYN_BYTE_CHG.CTR = 1)
    THEN /* Yes: check value of test cycle counter */
        IF (TCC_MC_PFM_TOG[CTR] <
            NC_TCC_MC_PFM_TOG_MAX[CTR])
        THEN /* Bit toggled in time: decrease corresponding anti-bounce counter; reset test cycle counter*/
            ACTION_ECM3_McDecAbc(
                IN NC_ABC_MC_PFM_[CTR]_TOG);
            TCC_MC_PFM_TOG[CTR] = 0;
        ELSE /* Bit not toggled in time: debounced fault reaction; reset test cycle counter */
    
```

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```

ACTION_ECM3_McIncAbc(
    IN    NC_ABC_MC_PFM_[CTR]_TOG,
    IN    NC_ERR_COD_MC_PFM_[CTR]_TOG);
TCC_MC_PFM_TOG[CTR] = 0;

FI
/* Bit not updated; has the test cycle counter reached its maximal value? */
ELSEIF (TCC_MC_PFM_TOG[CTR] ≥
        NC_TCC_MC_PFM_TOG_MAX[CTR])
THEN /* Yes: debounced fault reaction; reset test cycle counter */
    ACTION_ECM3_McIncAbc(
        IN    NC_ABC_MC_PFM_[CTR]_TOG,
        IN    NC_ERR_COD_MC_PFM_[CTR]_TOG);
    TCC_MC_PFM_TOG[CTR] = 0;
ELSE /* No: increase test cycle counter */
    TCC_MC_PFM_TOG[CTR] = TCC_MC_PFM_TOG[CTR] + 1;

FI
OD
/* Perform the same algorithm for task 6, using TCC_MC_PFM_TOG_6 and NC_TCC_MC_PFM_TOG_6_MAX */

```

### E.33.5 Test MU reaction to wrong PFM responses

#### General information:

If a correctly working MU receives a wrong PFM response (i.e., at least one bit in the PFM response sent by the MC is different from the corresponding bit in the synchronisation byte kept on the MU), it performs a debounced fault reaction: it increases its corresponding anti-bounce counter and, if the maximal value for that counter is reached, triggers a fault reaction. This sub-function aims at testing this mechanism by, under the appropriate circumstances, *deliberately* sending a wrong PFM response to the MU and the checking the eventual reaction to the wrong response.

This presupposes the presence of a mechanism on the MC to "notice" the fact that the MU has increased a PFM anti-bounce counter after a wrong PFM response. Furthermore, the robustness of the system must not be affected by a deliberately wrong PFM response, in particular such a wrong answer must not trigger a fault reaction.

For implementing this mechanism, it is crucial that the MU, whenever its synchronisation byte has not changed, sends status bytes establishing which of its PFM anti-bounce counters have value 0 and which do not. It follows that those with value 0 can be tested because (very importantly) there, a wrong answer is *guaranteed* not to trigger a fault reaction (for the others, this need not be true) and, equally important, the next time a status byte is sent, it can be checked whether the anti-bounce counter is still equal to 0 (meaning that the MU has *not* reacted to the wrong response) or not (meaning that the MU has increased the corresponding anti-bounce counter and hence reacted to the wrong response).

Note that this check cannot detect an anti-bounce counter on the MU which is stuck to a value between 0 and the maximal value: the status byte will always indicate that the anti-bounce counter is different from 0 so that there will never be a deliberately wrong PFM response for the corresponding task.

#### Description:


The function incorporates the following requirements:

#### G31 Test MU reaction to wrong PFM responses

The algorithm is described in the formula section the following points should be pointed out (note that these considerations do not take into account the presence of communication errors).

When activated for the first time (after the first NORMAL communication), the initial status byte of the MU anti-bounce counters has just been received: in the PREDRIVE communication, the MU always

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sends the initial synchronisation byte; consequently, in the first NORMAL communication, the current status of the PFM anti-bounce counters on the MU is transmitted to the MC.

Moreover, LF\_MC\_PFM\_SYN\_BYTE\_CHG\_OLD currently has value 0 since, after the PREDRIVE communication, LF\_MC\_PFM\_SYN\_BYTE\_CHG is initialised to 0 and this value is stored in LF\_MC\_PFM\_SYN\_BYTE\_CHG\_OLD after the first NORMAL communication.

Consequently, the first condition is false for every  $k$ , and nothing happens until the test of LF\_STATE\_ABC\_PFM\_MU. If bit  $k$  of LF\_STATE\_ABC\_PFM\_MU is set, we do nothing (anti-bounce counter on MU not equal to 0, cannot risk sending a wrong response as this might trigger a fault reaction). If bit  $k$  is not set, this means that the anti-bounce counter on the MU for task  $k$  has value 0 so we activate sending wrong responses; this will result in a wrong bit in the PFM response in the next communication (in this case: the second NORMAL communication) sent out after the post-processing function has been executed. So a set bit in LF\_MC\_WRG\_RESP\_PFM\_ACT indicates that a wrong response was sent or will be sent, depending on when the value is observed.

Now assume that normal operation has continued for some time. When the function gets activated, the same test as described above is performed, viz., it is checked whether the corresponding bit in LF\_MC\_WRG\_RESP\_PFM\_ACT is set, which implies that in the previous communication, a wrong response has been sent out, and whether in the previous communication an updated synchronisation byte was transmitted by the MU; so the status of an MU anti-bounce counter is only checked after a bit was toggled on the MU and sent to the MC.

This test being successful implies that in the current communication, a status byte was sent and so it can be checked whether the status of the MU anti-bounce counter for a task  $k$  is not equal to 0.

If this is the case the previously sent wrong response was detected by the MU (since a wrong response is only sent out if the anti-bounce counter is equal to 0) and the corresponding anti-bounce counter on the MC can be decreased. However, if the value of the MU anti-bounce counter is equal to 0, this means that the previously sent wrong response was not detected and consequently, the corresponding anti-bounce counter on the MC must be increased, eventually leading to a debounced fault reaction.

If this increase of the MC anti-bounce counter has not yet triggered a fault reaction, it is then checked whether the MU anti-bounce counter status indicates a value of 0. If that is the case (i.e., either when really no error is present on the MU or when previously a wrong answer was sent out but the MU has not (yet) reacted to the wrong response), the flag corresponding bit in LF\_MC\_WRG\_RESP\_PFM\_ACT is set in order to send a wrong PFM response.

Note that this implies sending a wrong PFM response until one communication after the MU next updates its synchronisation byte and sends it to the MC because before that it is not possible to de-activate sending of wrong responses, unless the MU anti-bounce counter is no longer equal to 0 which also implies that the MC must have updated its synchronisation byte.


Sending a wrong response for any task is done for the first time as soon as the corresponding status byte received from the MU indicates that the MU anti-bounce counter has value 0. Due to its slow recurrence and the described algorithmic pre-condition, a long time has to elapse before the wrong response test for task 6 can be performed (also due to the fact that the corresponding anti-bounce counter is initialised to a non-zero value to speed up fault detection for this task). On the other hand, the reset counter on the MC heals after a certain time period which should last longer than the duration all possible diagnostic tests inside Processor Monitoring. Consequently, the healing can only be performed after the wrong response test for PFM task 6 has been performed at least once. This is fact shall be indicated to the function "Healing of reset counter and error code" (G2) by the flag LV\_MC\_PFM\_WRG\_RESP\_ACT\_6: it shall be set when sending a wrong PFM response for task 6 is activated.

## Application conditions

**Initialisation:** / \* Deactivate sending wrong PFM responses for all tasks \*/

```
LF_MC_WRG_RESP_PFM_ACT = 0;
LV_MC_PFM_WRG_RESP_ACT_6 = 0;
```

**Recurrence:** The **initialisation** shall be **performed after each power-up or reset**.

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The **formula section** shall be **executed after the PFM sub-function "Decoding of PFM byte sent by MU used for monitoring of MU."**

**Activation:** (STATE\_MC = NC\_STATE\_MC\_NORM) (only performed in NORMAL after the PFM byte sent from the MU has been decoded)

**Deactivation:** Otherwise

**Formula section:**

```

FOR CTR = 0 TO NC_NR_MC_PFM
DO /* Check whether sending of wrong responses for task k is active and whether the last communication, the bit for task k was toggled (=in the last communication, a synchronisation byte was sent so that now a status byte must have been received) */
  IF ((LF_MC_WRG_RESP_PFM_ACT.CTR = 1) AND (LF_MC_PFM_SYN_BYTE_CHG_OLD.CTR = 1))
  THEN /* Has MU-anti-bounce counter reacted to wrong response? */
    IF (LF_STATE_ABC_PFM_MU.CTR = 1)
    THEN /* Yes: decrease MC anti-bounce counter */
      ACTION_ECM3_McDecAbc(
        IN NC_ABC_MC_PFM_[CTR]_RESP);
      IF (CTR = 6)
      THEN /* Sending of wrong responses for task 6 has been performed at least once: indicate this to the function "Healing of reset counter and error code" (G2) */
        LV_MC_PFM_WRG_RESP_ACT_6 = 1;
      FI
    ELSE /* No: increase MC anti-bounce counter */
      ACTION_ECM3_McIncAbc(
        IN NC_ABC_MC_PFM_[CTR]_RESP,
        IN NC_ERR_COD_MC_PFM_[CTR]_RESP);
    FI
  FI
  /* Check if sending of wrong responses can be activated/stay active: is the MU anti-bounce counter equal to 0? */
  IF (LF_STATE_ABC_PFM_MU.CTR = 0)
  THEN /* Yes: activate sending of wrong responses */
    LF_MC_WRG_RESP_PFM_ACT.CTR = 1;
  ELSE /* No: deactivate sending of wrong responses; this also applies if previously a deliberately wrong answer was sent */
    LF_MC_WRG_RESP_PFM_ACT.CTR = 0;
  FI
OD

```

**E.33.6 Post-processing of PFM response before communications**


**General information:**

This sub-functions sets the value of the PFM response to be sent to the MU in the following (NORMAL) communication.

**Description:**

The function incorporates the following requirements:

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### G32 Post-processing of PFM response before communications

Before the new PFM response can be sent to the MU, some post-processing of its current value might be necessary, viz., if sending of wrong PFM responses is active for a certain task, it must be ensured that the effect of the service actions (which, if executed properly, would result in a correct PFM response for the corresponding task) is overridden and explicitly a wrong bit in the PFM response is set.

By the way the checking mechanism on the MU works, this means that the bit in the PFM response has to be *equal* to the value of the respective in the current synchronisation byte on the MC (as the MU expects this bit to be sent back with its value *toggled*).

Finally, the (potentially modified) PFM response LF\_MC\_PFM\_RESP has to be sent to the infrastructure so that it can be transmitted to the MU when the next communication is triggered.

To ensure this behaviour is precisely the task of this sub-function.

The function incorporates the following requirements:

R32\_1: assuming the value CTR ranges from 0..6 (for 7 monitored tasks)

R32\_2: the default PFM response bit **tmp\_LF\_MC\_RESP\_PFM.CTR** shall be exactly the received synchronization bit **LF\_MC\_PFM\_SYN\_BYTE\_TOG.CTR** except the corresponding monitored level2 task was executed.

R32\_3.1: refining R32\_2, if a new synchronization bit was received (i.e. LF\_MC\_PFM\_SYN\_BYTE\_CHG.CTR = 1), then

R32\_3.2: if level2 was executed (i.e. LF\_MC\_RESP\_PFM.CTR has changed since last function activation) then the value LF\_MC\_PFM\_SYN\_BYTE\_TOG.CTR has to be sent back

R32\_3.3: otherwise the value of LF\_MC\_RESP\_PFM.CTR has to be sent back.

R32\_4.1: refining R32\_2, if no new synchronization bit was received (i.e. LF\_MC\_PFM\_SYN\_BYTE\_CHG.CTR = 0), then the value of LF\_MC\_RESP\_PFM.CTR has to be sent back.

R32\_5: in case if sending of deliberately wrong answer is not active (i.e. LF\_MC\_WRG\_RESP\_PFM\_ACT.CTR = 0), the PFM response byte needs no further modifications.

R32\_6: in case if sending of deliberately wrong answer is active (i.e. LF\_MC\_WRG\_RESP\_PFM\_ACT.CTR = 1)

R32\_6.1 if a new synchronization bit was received (i.e. LF\_MC\_PFM\_SYN\_BYTE\_CHG.CTR = 1), then the inverted value of LF\_MC\_PFM\_SYN\_BYTE\_TOG.CTR has to be sent back

R32\_6.2 if no new synchronization bit was received (i.e. LF\_MC\_PFM\_SYN\_BYTE\_CHG.CTR = 0), then the value of LF\_MC\_PFM\_SYN\_BYTE\_TOG.CTR has to be sent back.

R32\_5: the sending of the final response byte **tmp\_LF\_MC\_RESP\_PFM** shall be initiated by calling `ACTION_INFR_McSendPfmResp(IN tmp_LF_MC_RESP_PFM);`

### Application conditions

**Initialisation:** `LF_MC_RESP_PFM = 0;`

**Recurrence:** The **initialisation** shall be performed after each power-up or reset.  
The **formula section** shall be executed just before the next communication is triggered.

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**Activation:** (STATE\_MC = NC\_STATE\_MC\_NORM) (active in NORMAL state)

**Deactivation:** Otherwise

**Formula section:**

*/\*set locally, temporary calculated PFM response to default response tog\*/*

tmp\_lf\_mc\_resp\_pfm = LF\_MC\_PFM\_SYN\_BYTE\_TOG;

**FOR** CTR = 0 **TO** 6

**DO**

**IF** LF\_MC\_PFM\_SYN\_BYTE\_CHG.CTR

**THEN** */\*synch. byte has changed\*/*

**IF** LF\_MC\_WRG\_RESP\_PFM\_ACT.CTR

**THEN** */\*response test is active, send inverted synch. byte\*/*

tmp\_lf\_mc\_resp\_pfm.CTR = !LF\_MC\_PFM\_SYN\_BYTE\_TOG.CTR;

**ELSE**

*/\*check if level 2 was executed\*/*

**IF** ecm3\_lf\_mc\_resp\_pfm\_old.CTR != LF\_MC\_RESP\_PFM.CTR

**THEN** */\* do nothing, send default response - -> tog \*/*

**ELSE** */\*send level 2 response\*/*

tmp\_lf\_mc\_resp\_pfm.CTR = LF\_MC\_RESP\_PFM.CTR;

**FI**

**FI**

**ELSE** */\*synch. byte has not changed\*/*

**IF** LF\_MC\_WRG\_RESP\_PFM\_ACT.CTR

**THEN** */\* response test is active, do nothing, send default response - -> tog \*/*

**ELSE** */\*send level 2 response\*/*

tmp\_lf\_mc\_resp\_pfm.CTR = LF\_MC\_RESP\_PFM.CTR;

**FI**

**FI**

**OD**

ecm3\_lf\_mc\_resp\_pfm\_old = LF\_MC\_RESP\_PFM;

ACTION\_INFR\_McSendPfmResp(IN tmp\_lf\_mc\_resp\_pfm);



## E.34 Processor monitoring

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LF_MU_CONF_BYTE	V	0... FFH	0... 255	1	-
Local variable: configuration data sent by MU (in PREDRIVE and NORMAL communications)					
LV_MC_ROM_CHK_OK	-	0... 1H	0 ...1	1	-
Flag indicating whether the level 1 ROM check was successful					
LV_MC_ROM_CHK_READY	O/V/S	0... 1H	0 ...1	1	-
Flag indicating whether the level 1 ROM check is ready					
LV_MC_ROM_CHK_READY_CPL	O/S	0... 1H	0 ...1	1	-
Complement of LV_MC_ROM_CHK_READY					
LV_MU_IGN_KEY	O/V	0... 1H	0 ...1	1	-
Ignition key signal redundantly acquired on MU (only useful in HW acquisition mode)					
NR_MU_COMP	O/V	0... 7H	0 ...7	1	-
Compatibility number sent by MU					
NR_MU_HW_VERS	O/V	0... 1FH	0... 31	1	-
Hardware version sent by MU					
STATE_MC	O/V	0... FFH	0... 255	1	-
Internal state of the MC (also used as header byte in communications)					
VP_MC_AN_DIG_MON	O/V	0... 7FFFH	0... 4.99984	152.6e-6	V
Result of A/D conversion on the MC (exported to process monitoring)					
VP_MC_AN_DIG_MON_CPL	O/V	0... 7FFFH	0... 4.99984	152.6e-6	V
Complement of V_MC_AN_DIG_MON (exported to process monitoring)					
VP_MC_AN_DIG_MON_TMP	-	8000... 7FFFH	-5... 4.99984	152.6e-6	V
Local variable: result of A/D conversion as fetched from infrastructure					
VP_MC_AN_DIG_MON_TMP_CPL	-	8000... 7FFFH	-5... 4.99984	152.6e-6	V
Local variable: complement of VP_MC_AN_DIG_MON_TMP					
VP_MU_AN_DIG_MON	O/V	0... 7FFFH	0... 4.99984	152.6e-6	V
Result of A/D conversion on the MU (exported to process monitoring)					
VP_MU_AN_DIG_MON_CPL	O/V	0... 7FFFH	0... 4.99984	152.6e-6	V
Complement of V_MU_AN_DIG_MON (exported to process monitoring)					

### Input data:

CTR_RST_MC {p. 7072}	CTR_RST_MC_CPL {p. 7072}	LV_MC_COM_ERR {p. 7049}	LV_MC_COM_ERR_CPL {p. 7049}
LV_MC_IGN_KEY {p. 7158}	LV_MU_READY {p. 7049}	NC_ABC_MC_CONF_DIF {p. 7073}	NC_CTR_RST_MC_THD {p. 7077}
NC_ERR_COD_MC_ COMP_NR {p. 7077}	NC_ERR_COD_MC_ CONF_DIF {p. 7077}	NC_ERR_COD_MC_NOT_ VLD_TRAN {p. 7077}	NC_ERR_COD_MC_RAM_ LEVEL_1 {p. 7078}
NC_ERR_COD_MC_RAM_ LEVEL_2 {p. 7078}	NC_ERR_COD_MC_ROM_ LEVEL_1 {p. 7078}	NC_ERR_COD_MC_ROM_ LEVEL_2 {p. 7078}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ERR_SWI_MC_LEVEL_2_CAL	-	0... FFH	0... 255	1	-
Switch to disregard ROM errors in the level 2 calibration data (when set to NC_ERR_SWI_MC_LEVEL_2_CAL)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ERR_SWI_MC_LEVEL_2_COD	-	0... FFH	0... 255	1	-
Switch to disregard ROM errors in the level 2 code (when set to NC_ERR_SWI_MC_LEVEL_2_COD)					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ERR_SWI_MC_LEVEL_2_CAL	-	0... FFH	0... 255	1	-
Value for the switch which allows to disregard ROM errors in the level 2 calibration area					
NC_ERR_SWI_MC_LEVEL_2_COD	-	0... FFH	0... 255	1	-
Value for the switch which allows to disregard ROM errors in the level 2 code					
NC_NR_MC_COMP	-	0... 7H	0 ...7	1	-
Compatibility information of MC					
NC_STATE_MC_CONF	-	0... FFH	0... 255	1	-
Internal representation (and header byte) for CONFIG state					
NC_STATE_MC_DI	-	0... FFH	0... 255	1	-
Internal representation (and header byte) for DISABLE state					
NC_STATE_MC_INI	-	0... FFH	0... 255	1	-
Internal representation for INIT state					
NC_STATE_MC_NORM	-	0... FFH	0... 255	1	-
Internal representation (and header byte) for NORMAL state					
NC_STATE_MC_NOT_VLD	-	0... FFH	0... 255	1	-
Internal representation for invalid state					
NC_STATE_MC_PRDR	-	0... FFH	0... 255	1	-
Internal representation (and header byte) for PREDRIVE state					
NC_VP_MC_AN_DIG_MON_CPL_ERR	-	8000... 7FFFH	-5... 4.99984	152.6e-6	V
Constant indicating a complement error of the value of the A/D conversion on the MC acquired in the infrastructure					
NLC_MU_IGN_KEY_ACQ	-	0... 1H	0 ...1	1	-
Configuration for acquisition of IGK signal on the MU (by software=0 or hardware=1)					
NLC_MU_INJ_OFF_TMR_ENA	-	0... 1H	0 ...1	1	-
Configuration of MU for enabling/disabling the injection-off timer					
NLC_MU_MOD	-	0... 1H	0 ...1	1	-
Configuration of MU mode (monitoring of EMS=0 or TCU=1)					
NLC_MU_POW_OFF_TMR_ENA	-	0... 1H	0 ...1	1	-
Configuration of MU for enabling/disabling the power-off timer					

**Action definition**

<b>ACTION_ECM3_ChkCpl</b> (IN<PRM_VAR>,IN<PRM_VAR_CPL>)	Mode: O
This action compares the value of var with its complement var_CPL.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_VAR	in	0... FFFFH	0... 65535	1	-
Variable					
PRM_VAR_CPL	in	0... FFFFH	0... 65535	1	-
Complement of variable					

<b>ACTION_ECM3_McChangeState</b> (IN<PRM_STATE_MC_NEW>)	Mode: O
This action changes the state of the MC to the given new state; when already in DISABLE, nothing is done.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_STATE_MC_NEW	in	0... FFH	0... 255	1	-
Representation of state to be entered					



<b>ACTION_ECM3_McChkStack ()</b>	Mode: O
This action triggers a check of the appropriate stack area by the infrastructure and evaluates its result.	

<b>ACTION_ECM3_McReadChkCpl (OUT&lt;PRM_RESULT&gt;,IN&lt;PRM_VAR&gt;,IN&lt;PRM_VAR_CPL&gt;,IN&lt;PRM_DFT_VALUE&gt;)</b>	Mode: O
This action checks that var and var_cpl are a valid value/complement pair; if no returns the supplied default value and triggers a fault reaction.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_RESULT	out	0... FFFFH	0... 65535	1	-
Variable to be checked					
PRM_VAR	in	0... FFFFH	0... 65535	1	-
Variable for the complement of PRM_VAR					
PRM_VAR_CPL	in	0... FFFFH	0... 65535	1	-
Value to be stored					
PRM_DFT_VALUE	in	0... FFFFH	0... 65535	1	-
Default value for PRM_VAR in case an inconsistency is detected					

<b>ACTION_ECM3_McReadChkState (OUT&lt;PRM_STATE_MC_TMP&gt;)</b>	Mode: O
This action checks the current state for being valid.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_STATE_MC_TMP	out	0... FFH	0... 255	1	-
Short description of the given parameter					

<b>ACTION_ECM3_McResetRomChkFlags ()</b>	Mode: O
This action resets the flags for the Standard ROM check in case this becomes necessary.	

<b>ACTION_ECM3_ReadChkCpl (OUT&lt;PRM_RESULT&gt;,IN&lt;PRM_VAR&gt;,IN&lt;PRM_VAR_CPL&gt;)</b>	Mode: O
This action checks that var and var_cpl are a valid value-complement pair, and if yes, stores the value in result so that the value can be used in successive calculations.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_RESULT	out	0... FFFFH	0... 65535	1	-
Result					
PRM_VAR	in	0... FFFFH	0... 65535	1	-
Variable					
PRM_VAR_CPL	in	0... FFFFH	0... 65535	1	-
Complement of variable					

<b>ACTION_ECM3_WriteChkCpl (INOUT&lt;PRM_VAR&gt;,OUT&lt;PRM_VAR_CPL&gt;,IN&lt;PRM_VALUE&gt;)</b>	Mode: O
This action writes the value into the RAM and cross-checks the written value; the complement is generated, stored, and the corresponding variable is returned.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_VAR	inout	0... FFFFH	0... 65535	1	-
Variable					
PRM_VAR_CPL	out	0... FFFFH	0... 65535	1	-
Complement of variable					
PRM_VALUE	in	0... FFFFH	0... 65535	1	-
Value					

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**Import actions:**

<b>ACTION_ECM3_McDecAbc</b> (IN<PRM_ABC_ID>)
<b>ACTION_ECM3_McFaultReaction</b> (IN<PRM_ERR_COD>)
<b>ACTION_ECM3_McIncAbc</b> (IN<PRM_ABC_ID>,IN<PRM_ERR_COD>)
<b>ACTION_ECM3_McLockPwlResource</b> ()
<b>ACTION_ECM3_McUnlockPwlResource</b> ()
<b>ACTION_ECM3_RedSwitchOffPath</b> ()
<b>ACTION_INFR_GetAnDigMonValMc</b> (OUT<vp_mc_an_dig_mon>)
<b>ACTION_INFR_GetAnDigMonValMu</b> (OUT<vp_mu_an_dig_mon>)
<b>ACTION_INFR_McChkStack</b> (OUT<PRM_LV_CHK_OK>)
<b>ACTION_INFR_McGetCompNr</b> (OUT<nr_mu_comp>)
<b>ACTION_INFR_McGetConfData</b> (OUT<lf_mu_conf_byte>)
<b>ACTION_INFR_McGetIlgkMu</b> (OUT<lv_mu_ign_key>)
<b>ACTION_INFR_McGetVersNr</b> (OUT<nr_mu_hw_vers>)
<b>ACTION_INFR_McRomChkOk</b> (OUT<lv_mc_rom_chk_ok>)
<b>ACTION_INFR_McRomChkReady</b> (OUT<lv_mc_rom_chk_ready>)
<b>ACTION_INFR_McSendCompNr</b> (IN<nr_mc_comp>)
<b>ACTION_INFR_McSendConfData</b> (IN<lv_mu_mod>,IN<lv_mu_ign_key_acq>,IN<lv_mu_pow_off_trm_ena>,IN<lv_mu_inj_off_trm_ena>)
<b>ACTION_INFR_McSendIlgk</b> (IN<lv_igk>)

**Description for actions:**

<b>ACTION_ECM3_McChangeState</b> (PRM_STATE_MC_NEW)					
Change STATE_MC to new state.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_STATE_MC_NEW	IN	0...FFH	0...255	1	[-]
Representation of state to be entered					

<b>ACTION_ECM3_WriteChkCpl</b> (PRM_VAR, PRM_VAR_CPL, PRM_VALUE)					
see description in section "RAM check service actions of Processor Monitoring on MC"					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_VAR	INOUT	any	any	any	any
Variable to be checked					
PRM_VAR_CPL	OUT	any		any	any
Variable for the complement of PRM_VAR					
PRM_VALUE	IN	any	any	any	any
Value to be stored					

<b>ACTION_ECM3_ChkCpl</b> (PRM_VAR, PRM_VAR_CPL)					
see description in section "RAM check service actions of Processor Monitoring on MC"					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_VAR	IN	any	any	any	any
Variable to be checked					
PRM_VAR_CPL	IN	any		any	any
Variable for the complement of PRM_VAR					

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<b>ACTION_ECM3_ReadChkCpl(PRM_RESULT, PRM_VAR, PRM_VAR_CPL)</b>					
see description in section "RAM check service actions of Processor Monitoring on MC"					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_RESULT	OUT	any	any	any	any
Variable to be checked					
PRM_VAR	IN	any		any	any
Variable for the complement of PRM_VAR					
PRM_VAR_CPL	IN	any	any	any	any
Value to be stored					

<b>ACTION_ECM3_McReadChkCpl(PRM_RESULT, PRM_VAR, PRM_VAR_CPL, PRM_DFT_VALUE)</b>					
see description in section "RAM check service actions of Processor Monitoring on MC"					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_RESULT	OUT	any	any	any	any
Variable to be checked					
PRM_VAR	IN	any		any	any
Variable for the complement of PRM_VAR					
PRM_VAR_CPL	IN	any	any	any	any
Value to be stored					
PRM_DFT_VALUE	IN	any	any	any	any
Default value for PRM_VAR in case an inconsistency is detected					

<b>ACTION_ECM3_McChkStack()</b>					
The action triggers a stack check via an infrastructure action and evaluates the result of the check.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit

<b>ACTION_ECM3_McReadChkState(&lt;PRM_STATE_MC_TMP&gt;)</b>					
The action reads the internal representation of the current state (STATE_MC) and checks it for validity; in case of an inconsistency, the return value shall be NC_STATE_MU_DI (the representation for DISABLE state) and a fault reaction shall be triggered.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_STATE_MC_TMP	OUT	0..FFH	0..255	1	[-]
Short description of the given parameter					

<b>ACTION_ECM3_McResetRomChkFlags()</b>					
This action resets the flags LV_MC_ROM_CHK_READY and LV_MC_ROM_CHK_OK; this is used by DISABLE requests.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit

**FUNCTION DESCRIPTION:**

**General information:**

This module describes the main function of processor monitoring on the MC, in particular the state machine.

**E.34.1 State machine on MC**

**FUNCTION DESCRIPTION:**

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**General information:**

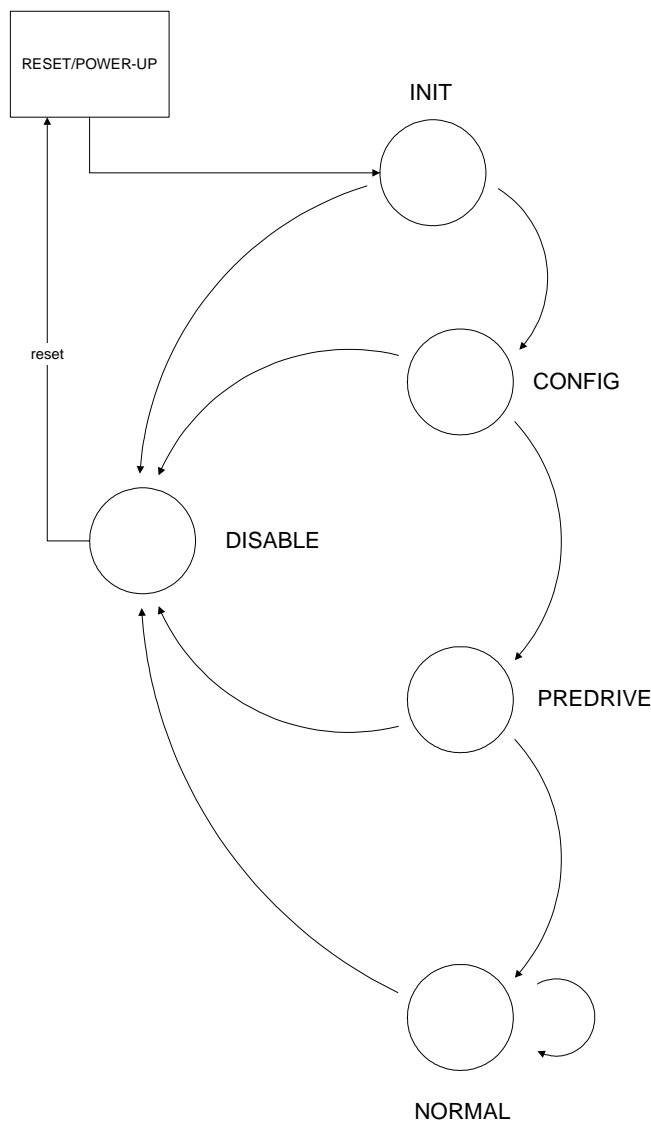
This function represents the main control flow in the MC; based on the current state of the MC, other modules/functions are activated or deactivated. The internal state machine of the MC governs which actions on the MC shall be performed, e.g.:

- which data are sent to the MU;
- which actions should be taken upon receiving data, in particular, whether the received data are acceptable and the MU is still in sync with the MC;
- whether the power stages should be disabled or enabled.

As described schematically in the signal flow diagram, given a state, there are only a certain number of other states reachable.


**Signal flow diagram:**

The following diagram shows the state machine of the MC with all the possible transitions.



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Figure E.34.1: State machine of the MC

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**Description:**

This function shall incorporate the following requirements:

**G51 State machine on MC**

R51\_1: All state changes shall be performed using the action ACTION\_ECM3\_McChangeState().

R51\_2: The possible state changes are described in the signal flow diagram above; no other transition between the states shall be performed.

R51\_3: A valid transition from one state to the other (according to the signal flow diagram) shall be performed when all tasks of the given state are finished; an exception is the transition to DISABLE state: this shall be performed immediately when a transition condition is given (e.g., when a fault reaction on the MC is carried out, or when the MU sends a DISABLE header).

Note: a rough sequencing of tasks and state transitions can be given as follows

- evaluation of data from previous communication
- state transition (if necessary)
- preparation of new communication
- triggering of new communication

R51\_4: The internal representations of states/header bytes shall be chosen in such a way that the minimum of the pair-wise hamming distances is as high as possible, i.e., in order to change from one valid representation of a state into another valid representation of a different state, several bits have to toggle at once.

R51\_5: The same bit patterns shall be used for internal representation of states and for the corresponding header bytes sent to the MU.

R51\_6: Concerning the transition from INIT to CONFIG:

R51\_6.1: there shall be a project-specific transition condition (cf. G52);

R51\_6.2: the transition shall only be performed if all tasks in INIT have been completed (cf. activation conditions) AND LV\_MU\_READY = 1 AND the project-specific condition is satisfied.

Note: the actual state change from INIT to CONFIG can be performed by the function G52 evaluating the project-specific transition condition; however, R51\_6.2 then has to be ensured by the control flow (e.g., the project-specific condition is only evaluated if all other conditions like LV\_MU\_READY = 1 are already satisfied).

**Description for ACTION\_ECM3\_McChangeState:**

ACTION_ECM3_McChangeState(PRM_STATE_MC_NEW)					
Change STATE_MC to new state.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_STATE_MC_NEW	IN	0...FFH	0...255	1	[-]
Representation of state to be entered					

**Formula section:**

*/\* When already in DISABLE, no transition shall be possible: see signal flow diagram \*/*


**IF** (STATE\_MC <> NC\_STATE\_MC\_DI)

**THEN**

STATE\_MC = PRM\_STATE\_MC\_NEW;

**FI**

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## Application conditions

**Initialisation:**     / \* Has the reset counter exceeded its threshold: if so, perform start-up in DISABLE; otherwise in INIT (note: also CTR\_RST\_MC\_CPL has to be checked, using the actions from "RAM check service actions of processor monitoring on MC") \*/  
                           STATE\_MC = NC\_STATE\_MC\_INI;  
                           **IF** (CTR\_RST\_MC > NC\_CTR\_RST\_MC\_THD)  
                           **THEN**  
                               STATE\_MC = NC\_STATE\_MC\_DI;  
                           **ELSE**

**Recurrence:**        The **initialisation** performed **after each power-up or reset**. **Afterwards**, the function is **called**.

**Activation:**         -

**Deactivation:**      -

## E.34.2 Monitoring of state machine

### FUNCTION DESCRIPTION:

#### Description:

This function shall incorporate the following requirements:

#### G9 Monitoring of state machine

R9\_1: The state machine on the MC shall be monitored in by testing whether STATE\_MC is still valid (i.e., that it is equal to one of NC\_STATE\_MC\_INI, NC\_STATE\_MC\_CONF, NC\_STATE\_MC\_PRDR, NC\_STATE\_MC\_NORM, NC\_STATE\_MC\_DI).

R9\_2: If it is detected that the MC is an undefined state:

R9\_2.1: it shall be assumed to be in DISABLE state;

R9\_2.2: an immediate fault reaction shall be performed by calling ACTION\_ECM3\_McFaultReaction() with error location NC\_ERR\_COD\_MC\_NOT\_VLD\_TRAN.

R9\_3: The function shall be incorporated into the action ACTION\_ECM3\_McReadChkState() as described in the formula section below.

#### Description for ACTION\_ECM3\_McReadChkState:

<b>ACTION_ECM3_McReadChkState(&lt;PRM_STATE_MC_TMP&gt;)</b>					
The action reads the internal representation of the current state (STATE_MC) and checks it for validity; in case of an inconsistency, the return value shall be NC_STATE_MU_DI (the representation for DISABLE state) and a fault reaction shall be triggered.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_STATE_MC_TMP	OUT	0...FFH	0...255	1	[-]
Short description of the given parameter					

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**Formula section:**

```

IF ("STATE_MC is valid") /* see R9_1 */
THEN
    PRM_STATE_MC_TMP = STATE_MC
ELSE /* invalid state */
    PRM_STATE_MC_TMP = NC_STATE_MC_DI;
    ACTION_ECM3_McFaultReaction (IN      NC_ERR_COD_MC_NOT_VLD_TRAN);
FI
    
```

**Application conditions**

- Initialisation:** -
- Recurrence:** *The function is called via ACTION\_ECM3\_McReadChkState().*
- Activation:** -
- Deactivation:** -

**E.34.3 ROM checks of processor monitoring on MC**

**FUNCTION DESCRIPTION:**

**General information:**

On the MC, there are two different ROM checks:

- the *standard ROM check* which checks the *whole* ROM (code, constants, calibration data with the exception of areas which can be changed during runtime like FLASH or EEPROM);
- the *cyclic ROM check for process monitoring* which checks the ROM of process monitoring (consisting of the code, constants, and calibration data of process monitoring, plus the code of all library functions called in the code of process monitoring).

The difference between the two ROM checks is the fact that the standard ROM check is performed only *once* after power-up (after reset only if the reset occurred before its successful completion) while the ROM check for process monitoring is *cyclic*, i.e., it is re-started after completion.

**E.34.3.1 Standard ROM check on MC**

**FUNCTION DESCRIPTION:**

**General information:**


This sub-function describes the standard ROM check (a.k.a. "level 1 ROM check") on the MC which is performed once per driving cycle directly after power-up or reset.

The two actions ACTION\_ECM3\_McLockPwIResource() and ACTION\_ECM3\_McUnlockPwIResource() are used to ensure that the ECU is not powered down before the ROM check has been completed at least once in the corresponding driving cycle.

**Description:**

The function incorporates the following requirements:

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## G8.1 Standard ROM check on MC

R8.1\_1: Every 1000ms:

R8.1\_1.1: the action ACTION\_INFR\_McRomChkReady() shall be called;

R8.1\_1.2: its return value shall be stored in the flag LV\_MC\_ROM\_CHK\_READY (indicating whether the Standard ROM check has been finished or not); the flag shall be stored in a reset-safe manner and together with a complement, LV\_MC\_ROM\_CHK\_READY\_CPL which shall also be stored in a reset-safe manner; LV\_MC\_ROM\_CHK\_READY shall be accessed (read/write) using the actions ACTION\_ECM3\_WriteChkCpl(), ACTION\_ECM3\_ChkCpl(), ACTION\_ECM3\_ReadChkCpl(), and ACTION\_ECM3\_McReadChkCpl() defined in the section "RAM check service actions of processor monitoring on MC"; its default value in case of a RAM error shall be 0;

R8.1\_1.3: if LV\_MC\_ROM\_CHK\_READY = 1:

R8.1\_1.3.1: the corresponding power-latch resource shall be unlocked by calling ACTION\_ECM3\_McUnlockPwlResource();

R8.1\_1.3.2: the action ACTION\_INFR\_McRomChkOk() shall be called;

R8.1\_1.3.3: its return value shall be stored in the flag LV\_MC\_ROM\_CHK\_OK (indicating whether the checksum calculated by the standard ROM check is equal to the expected one);

R8.1\_1.3.4: if LV\_MC\_ROM\_CHK\_OK = 0:

R8.1\_1.3.4.1: LV\_MC\_ROM\_CHK\_READY shall be reset to 0 using the RAM check service actions;

R8.1\_1.3.4.2: an immediate fault reaction shall be performed by calling ACTION\_ECM3\_McFaultReaction() with error code NC\_ERR\_COD\_MC\_ROM\_LEVEL\_1.

R8.1\_2: This function shall be under PFM control using the 1000ms PFM task (note that this does only refer to the processor monitoring function which only evaluates the result of the standard ROM check; the actual checksum calculation itself is part of the infrastructure and as such cannot be controlled by PFM).

### Description for ACTION\_ECM3\_McResetRomChkFlags:

ACTION_ECM3_McResetRomChkFlags()					
This action resets the flags LV_MC_ROM_CHK_READY and LV_MC_ROM_CHK_OK; this is used by DISABLE requests.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit

### Formula section:

LV\_MC\_ROM\_CHK\_OK = 0;

*/\* Using the RAM check service actions \*/*

LV\_MC\_ROM\_CHK\_READY = 0;

### Application conditions

#### Initialisation:

After power-up:

*/\* Using the RAM check service actions \*/*

LV\_MC\_ROM\_CHK\_READY = 0;

*/\* Lock power-latch resource \*/*

ACTION\_ECM3\_McLockPwlResource();

After power-up or reset:

LV\_MC\_ROM\_CHK\_OK = 0;

*/\* Lock power-latch resource \*/*

ACTION\_ECM3\_McLockPwlResource();



**Recurrence:** *Every 1000ms*

**Activation:** *(STATE\_MC <> NC\_STATE\_MC\_DI) AND (LV\_MC\_ROM\_CHK\_READY = 0)*

*/ \* using the RAM check service actions \*/*  
*(not in DISABLE state and not yet completed)*

**Deactivation:** *otherwise;*  
*at deactivation, call ACTION\_ECM3\_McUnlockPwlResource()*  
*/ \* after transition to DISABLE or after completion of ROM*  
*check: unlock power-latch resource \*/*

### E.34.3.2 Cyclic ROM check on MC for process monitoring

#### FUNCTION DESCRIPTION:

##### General information:

The cyclic ROM check for process monitoring ("level 2 ROM check") checks all level 2 ROM areas, which are different from the level 1 ROM areas, as well as the corresponding constant and calibration data, very much like the standard ROM check for the level 1 ROM areas. However, there are two differences between the two ROM checks.

First of all, while the level 1 ROM check is only executed *once* per driving cycle, the level 2 ROM check is performed cyclically, i.e., once it is finished, it starts again.

Secondly, the level 2 ROM check also takes into account all library functions (e.g., from the mathematics library) which might potentially called from within any level 2 function.

This can be achieved, e.g., by performing a *complete* check of those external libraries or by the use of so-called *inline functions* where only the code of those functions *which are actually called* is tested: the code of inline functions is directly copied to the place where the function is called, instead of performing a function call; concretely, the code of an inline function from the mathematics library called from a level 2 function thus becomes part of the level 2 code and is consequently tested by the level 2 code ROM check.

Note that the two mentioned ways to check external library functions were just chosen as examples: there might very well be other ways to include such libraries in the level 2 ROM check, it just has to be ensured that **each function called inside a level 2 function is included in the level 2 ROM check** (one way or another).

##### Description:

The function incorporates the following requirements:

#### **G8.2 Cyclic ROM Check on MC for Process Monitoring**

R8.2\_1: The checksum shall be calculated by an addition checksum.

R8.2\_2: Both the calculated checksum and its expected value shall be unsigned values obtained by adding unsigned values.

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R8.2\_3: The areas to be checked are comprised of the **level 2 code** area, the **level 2 constant data**, the **level 2 calibration data**, and the **code of all functions from external libraries contained in the level 2 code**.

R8.2\_4: For the level 2 code area, the following special mechanism shall be used:

R8.2\_4.1: there shall be two sections of level 2 code;

R8.2\_4.2: for one of the sections, there shall be a calibration switch C\_ERR\_SWI\_MC\_LEVEL\_2\_COD which, **for application software only**, allows ignoring errors in the level 2 code area if its value is set to NC\_ERR\_SWI\_MC\_LEVEL\_2\_COD; **for production software, this switch must be ignored!**

R8.2\_4.3: for the second section of the code area, C\_ERR\_SWI\_MC\_LEVEL\_2\_COD must not have any effect: a checksum error in this section shall always lead to a fault reaction;

R8.2\_4.4: the ROM areas where C\_ERR\_SWI\_MC\_LEVEL\_2\_COD and the expected checksum for the code area are stored shall not be part of the level 2 ROM check.

R8.2\_5: For the level 2 calibration area, the following special mechanism shall be used:

R8.2\_5.1: there shall be a calibration switch C\_ERR\_SWI\_MC\_LEVEL\_2\_CAL which, **for application software only**, allows ignoring errors in the level 2 calibration ROM area if its value is set to NC\_ERR\_SWI\_MC\_LEVEL\_2\_CAL; **for production software, this switch must be ignored!**

R8.2\_5.2: the ROM areas where C\_ERR\_SWI\_MC\_LEVEL\_2\_CAL and the expected checksum for the calibration data area are stored shall not be part of the level 2 ROM check.

R8.2\_6: In case a level 2 ROM error is detected, i.e., in case the calculated checksum does not agree with the expected one:

R8.2\_6.1: the redundant switch-off path shall be triggered by calling the action ACTION\_ECM3\_RedSwitchOff-Path();

R8.2\_6.2: an immediate fault reaction shall be performed by calling the action ACTION\_ECM3\_Mc-FaultReaction() with the error code NC\_ERR\_COD\_MC\_ROM\_LEVEL\_2;

R8.2\_6.3: the flag LV\_MC\_ROM\_CHK\_READY shall be reset (using the RAM check service actions).

R8.2\_7: The level 2 ROM check shall run in a fixed time grid and shall be called every **10ms**; the meaning of "running in a fixed time grid" is that the level 2 ROM check is activated with a fixed recurrence; when activated, it continues where it left off when called the time before, i.e., this does not mean that it has to be finished between two calls but simply that it is continued when called for the next time.

R8.2\_8: One level 2 ROM check cycle shall be finished:

R8.2\_8.1: in **EMS** mode, within the time for temporary disabling of power stages (see "G22 Disabling of power stages");

R8.2\_8.2: in **TCU** mode, within 500ms.

R8.2\_9: The cyclic ROM check for process monitoring shall be under PFM control (viz., the 40ms PFM task with task number 5)


### Application conditions

**Initialisation:** *The checksum shall be set to a configurable initial value.*

**Recurrence:** The **initialisation** shall be performed **after each power-up or reset** and **after one cycle has been completed**.  
The **function itself** shall be calculated **every 10ms**.

**Activation:** -

**Deactivation:** -

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## E.34.4 RAM checks of processor monitoring on MC

### FUNCTION DESCRIPTION:

#### General information:

Several RAM checks have to be performed on the MC to test the integrity of the RAM:

- there shall be a non-destructive RAM check for those data that have to be stored in a reset-safe way, and those RAM areas that are shared between BOOT and ECU software;
- for all remaining RAM areas, there shall be a destructive RAM check which also performs an initialisation to 0;
- additionally, there shall be a cyclic RAM check for the level 2 RAM areas and for some of the RAM areas of the processor monitoring: this is done by storing those variables as pair of value and complement and performing consistency checks when accessing the variables;
- in order to prevent faults due to interrupt handling while level 2 is active, also a stack check is implemented which checks the relevant memory area on the stack where the level 2 register content will be stored in case of an interrupt.

The first two kinds of RAM checks have to be performed in such a way as to be able to detect static errors like stuck bits/cells. The last two kinds of RAM check are used to detect dynamic errors like a bit toggling during runtime or one (process/processor monitoring) module corrupting the memory area of another one, or problems with the stack memory.

### E.34.4.1 Standard RAM check on MC

#### FUNCTION DESCRIPTION:

#### General information:

Those variables which are to be stored in the reset-safe RAM area have to be checked without destroying their contents.

#### Description:


The function incorporates the following requirements:

#### **G6 Standard RAM check on MC (destructive/non-destructive)**

R6\_1: In case an error has been detected during the Standard RAM check, an immediate fault reaction shall be performed; however, the Standard RAM check is active at a time when calling ACTION\_ECM3\_McFaultReaction() with the error code NC\_ERR\_COD\_MC\_RAM\_LEVEL\_1 is not possible; therefore, the effect of the action shall be mimicked as much as possible (increase reset counter, set error code, trigger reset if reset counter has not yet passed a certain threshold etc.).

#### Application conditions

- Initialisation:** –
- Recurrence:** *Once before all other functions are started*
- Activation:** *activated by the Standard RAM check*
- Deactivation:** –

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### E.34.4.2 RAM check service actions of processor monitoring on MC

#### FUNCTION DESCRIPTION:

##### General information:

In addition to the RAM checks described above which are only executed after power-up/reset, the processor monitoring on the MC also provides RAM check functionality which is used to protect data which is repeatedly used in both process and processor monitoring.

The functionality of the process monitoring (level 2) is calculated cyclically. The calculation and the storage of intermediate results of the process monitoring functions is performed using the registers of the processor as far as possible. The registers are tested by the function-specific instruction set test (see "MC function-specific instruction set test").

##### Description:

The function, via the exported actions, incorporates the following requirements:

#### **G7 RAM check service actions of processor monitoring on MC**

R7\_1: All variables of the process monitoring which are located in the RAM and used in the next recurrence of a task (e.g. anti-bounce-counters) or in a different successive task are stored as pairs consisting of the value and its complement.


R7\_2: After execution of a level 2 module, its results have to be copied from registers into variables located in the RAM. After storing a value from an internal register in the RAM, together with its complement in a variable of the name var\_CPL if the original variable was named var (example: LV\_OFF\_IV\_MON\_CPL contains the complement of LV\_OFF\_IV\_MON), the value is read back from the RAM and compared with the original value of the register. This procedure is performed by the action ACTION\_ECM3\_WriteChkCpl() described below.

R7\_3: At the beginning of the following recurrence of the task, the two complementary variables are checked for plausibility. Also intermediate results, which cannot be completely handled by the internal registers, are stored in value-complement pairs and checked for plausibility. This is done at the beginning of a level 2 module using the action ACTION\_ECM3\_ChkCpl() or ACTION\_ECM3\_ReadChkCpl(); the difference between these two actions is that the action ACTION\_ECM3\_ChkCpl() only performs a plausibility check for a variable and its complement variable without loading the actual value into a register, while ACTION\_ECM3\_ReadChkCpl() also loads a register with the value of the given variable.

R7\_4: If a RAM fault is detected by these functions, an immediate fault reaction shall be performed via ACTION\_ECM3\_McFaultReaction(), using the error code NC\_ERR\_COD\_MC\_RAM\_LEVEL\_2.

R7\_5: Additionally, there is also a variant of the level 2 RAM check service action ACTION\_ECM3\_ReadChkCpl() named ACTION\_ECM3\_McReadChkCpl() used for variables of processor monitoring; the difference to the level 2 service action is the presence of a default return value which shall be returned in case an inconsistency is detected (this is only meaningful for those variables which are stored in the reset-safe area, the others are initialised by the reset following the fault reaction).

R7\_6: All RAM check service actions have to be implemented as macros to avoid function calls in the code of level 2 and processor monitoring.

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R7\_7: All RAM check service actions have to be implemented in such a way that they are universally usable, in particular regardless of the type of their parameters.

**Description for ACTION\_ECM3\_WriteChkCpl**

<b>ACTION_ECM3_WriteChkCpl(PRM_VAR, PRM_VAR_CPL, PRM_VALUE)</b>					
see description in section "RAM check service actions of Processor Monitoring on MC"					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_VAR	INOUT	any	any	any	any
Variable to be checked					
PRM_VAR_CPL	OUT	any		any	any
Variable for the complement of PRM_VAR					
PRM_VALUE	IN	any	any	any	any
Value to be stored					

**Formula section:**

```

PRM_VAR = PRM_VALUE;
PRM_VAR_CPL = complement(PRM_VALUE);
IF (PRM_VAR != PRM_VALUE)
THEN
    ACTION_ECM3_McFaultReaction(
        IN    NC_ERR_COD_MC_RAM_LEVEL_2);
FI
    
```

**Description for ACTION\_ECM3\_ChkCpl**

<b>ACTION_ECM3_ChkCpl(PRM_VAR, PRM_VAR_CPL)</b>					
see description in section "RAM check service actions of Processor Monitoring on MC"					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_VAR	IN	any	any	any	any
Variable to be checked					
PRM_VAR_CPL	IN	any		any	any
Variable for the complement of PRM_VAR					

**Formula section:**

```

IF (PRM_VAR != complement(PRM_VAR_CPL))
THEN
    ACTION_ECM3_McFaultReaction(
        IN    NC_ERR_COD_MC_RAM_LEVEL_2);
FI
    
```

**Description for ACTION\_ECM3\_ReadChkCpl**

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<b>ACTION_ECM3_ReadChkCpl(PRM_RESULT, PRM_VAR, PRM_VAR_CPL)</b>					
see description in section "RAM check service actions of Processor Monitoring on MC"					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_RESULT	OUT	any	any	any	any
Variable to be checked					
PRM_VAR	IN	any		any	any
Variable for the complement of PRM_VAR					
PRM_VAR_CPL	IN	any	any	any	any
Value to be stored					

**Formula section**

```

PRM_RESULT = PRM_VAR;
IF (PRM_VAR != complement(PRM_VAR_CPL))
THEN
    ACTION_ECM3_McFaultReaction(
        IN    NC_ERR_COD_MC_RAM_LEVEL_2);
FI
    
```

**Description for ACTION\_ECM3\_McReadChkCpl**

<b>ACTION_ECM3_McReadChkCpl(PRM_RESULT, PRM_VAR, PRM_VAR_CPL, PRM_DFT_VALUE)</b>					
see description in section "RAM check service actions of Processor Monitoring on MC"					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_RESULT	OUT	any	any	any	any
Variable to be checked					
PRM_VAR	IN	any		any	any
Variable for the complement of PRM_VAR					
PRM_VAR_CPL	IN	any	any	any	any
Value to be stored					
PRM_DFT_VALUE	IN	any	any	any	any
Default value for PRM_VAR in case an inconsistency is detected					

**Formula section:**

```

IF (PRM_VAR != complement(PRM_VAR_CPL))
THEN
    PRM_RESULT = PRM_DFT_VALUE;
    ACTION_ECM3_McFaultReaction(
        IN    NC_ERR_COD_MC_RAM_LEVEL_2);
ELSE
    PRM_RESULT = PRM_VAR;
FI
    
```

**Application conditions**

**Initialisation:** *Before the first test of the complementary variables, all appropriate variables must be initialized properly using the action ACTION\_ECM3\_WriteChkCpl().*

**Recurrence:** *All the actions in this function are called.*

**Activation:** -

**Deactivation:** -

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### E.34.4.3 Stack check service action of processor monitoring on MC

#### FUNCTION DESCRIPTION:

##### General information:

In addition to the RAM checks described above (the start-up checks described in G6 and the cyclic level 2 RAM check described in G7), there is another memory test to ensure the integrity of memory areas used by the stack. The motivation for the function is as follows.

While a process monitoring (level 2) module is executed, an interrupt might occur. Prompted by the interrupt, the current content of the registers, plus "logistic" data like a return address, are stored on the stack. Once the interrupt handling is finished, the register content is restored from the stack and program execution continues where it left off before the interrupt (the address is also determined from the data saved on the stack).

However, if the used stack memory is corrupted, the level 2 register content might be corrupted without being detected; this could either lead to a dormant fault (level 2 might not catch an existing error) or reduce the availability of the vehicle (a level 2 fault reaction might get triggered unnecessarily).

Finally, if the return address is corrupted by being stored on the stack, the level 2 module might not be completed (leading to a problem with program flow monitoring (PFM), again reducing availability), or some code passages of the level 2 module might be omitted (again leading to a dormant fault).

Consequently, at the beginning of each level 2 module, the relevant stack areas have to be checked so that in case of an interrupt during the execution of the module, the necessary data can be correctly stored and recovered.

##### Description:

The function incorporates the following requirements:

#### **G49 Stack check service action of processor monitoring on MC**

R49\_1: The interface to level 2 shall be provided via the exported action ACTION\_ECM3\_McChkStack().

##### Remark:

- the action shall be called at the very beginning of each level 2 module in order to ensure that the relevant stack area is OK in case the level 2 module is interrupted;
- the action shall be "sandwiched" in between two PFM actions in order to ensure that the stack check action is entered and left properly since its code might not be completely ROM-checked.

R49\_2: When ACTION\_ECM3\_McChkStack() is called, the infrastructure action ACTION\_INFR\_McChkStack() shall be called in order to perform the stack check; the requirements to this action shall be described in the IRS of Processor Monitoring.


R49\_3: ACTION\_INFR\_McChkStack() shall return a flag indicating whether the stack check was successful or not.

R49\_4: If ACTION\_INFR\_McChkStack() indicates that the stack check was unsuccessful, an immediate fault reaction shall be performed via ACTION\_ECM3\_McFaultReaction(), using the error code NC\_ERR\_COD\_MC\_RAM\_LEVEL\_2.

R49\_5: The call and the execution of ACTION\_ECM3\_McChkStack() shall use no stack.

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**Initialisation:** -  
**Recurrence:** *The function is called via ACTION\_ECM3\_McChkStack().*  
**Activation:** -  
**Deactivation:** -

### E.34.5 Configuration of MU

#### FUNCTION DESCRIPTION:

##### General information:

The MU can be configured in various ways, e.g., whether it is used for monitoring of EMS or TCU application (a choice which has implications on timing etc.). The act of configuring is one of the tasks of the MC which sends these data in the first communication to the MU (and re-sends them in the second so that the data can be rendered plausible on the MU).

Since the configuration has far-reaching influences on the behaviour of the MU and the whole system (e.g., by enabling or disabling the injection-off timer) and each configuration information is simply a bit information, the MU keeps on sending its configuration to the MC in NORMAL communications so that a change in the configuration of the MU can be detected as quickly as possible.

##### Description:

The function incorporates the following requirements:

#### **G10 Configuration of MU by MC**


R10\_1: In the CONFIG communication, the MC sends configuration information to the MU; the MU can be configured with respect to:

- general mode (EMS or TCU, NLC\_MU\_MOD)
- hardware (via the dedicated input pin) or software (only via information received from the MC) acquisition of ignition key signal (NLC\_MU\_IGN\_KEY\_ACQ)
- power-off timer enabled or disabled (NLC\_MU\_POW\_OFF\_TMR\_ENA)
- injection-off timer enabled or disabled (NLC\_MU\_POW\_OFF\_TMR\_ENA)
- end-of-line test enabled or not (always disabled)

This is achieved by calling the action ACTION\_INFR\_McSendConfData() with the above arguments; note that the end-of-line test configuration is not part of the argument list since it is always disabled.

R10\_2: In the PREDRIVE communication, the MC shall re-send these data in order to confirm the previously sent data (note that, in case a discrepancy between the two sets of configuration data is detected, an immediate fault reaction on the MU shall be the consequence); since the arguments have already been sent to the infrastructure, there is no need to re-send them.

R10\_3: The MC shall obtain the complete set of configuration information (including the end-of-line test configuration) from the MU after the PREDRIVE communication so that the MC knows what the MU believes to be configured for; the information shall be stored in LF\_MU\_CONF\_BYTE acquired by calling the action ACTION\_INFR\_McGetConfData(), and compared to the data from R10\_1 and R10\_2; note that LF\_MU\_CONF\_BYTE is a compressed representation where the bit values for the configuration data have to be extracted from.

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R10\_4: The MC shall obtain the configuration information (excluding the end-of-line test configuration) from the MU after NORMAL communications; the information shall again be stored in LF\_MU\_CONF\_BYTE acquired by calling the action ACTION\_INFR\_McGetConfData(), and compared to the data from R10\_1 and R10\_2.

R10\_5: In case a configuration mismatch is detected on the MC:

R10\_5.1: in PREDRIVE, there shall be an immediate fault reaction by calling ACTION\_ECM3\_McFaultReaction() with error code NC\_ERR\_COD\_MC\_CONF\_DIF;

R10\_5.2: in NORMAL, there shall be a debounced fault reaction, using the anti-bounce counter NC\_ABC\_MC\_CONF\_DIF, the error code NC\_ERR\_COD\_MC\_CONF\_DIF, and the two actions ACTION\_ECM3\_McIncAbc() and ACTION\_ECM3\_McDecAbc().

**Application conditions**

**Initialisation:** LF\_MU\_CONF\_BYTE = 0;

**Recurrence:** The **initialisation** shall be performed **after each power-up or reset**.  
R10\_1 shall be executed before the CONFIG communication is triggered; R10\_2 does not require any activity; R10\_3 shall be executed after the PREDRIVE communication and the corresponding communication monitoring function; R10\_4 shall be executed after NORMAL communications and the corresponding communication monitoring function; R10\_5 shall be executed after R10\_3 and R10\_4, as appropriate.

**Activation:** For R10\_3 and R10\_4, LV\_MC\_COM\_ERR = 0 must hold (they are only executed if no communication error was detected; note that a consistency check with LV\_MC\_COM\_ERR\_CPL is necessary)

**Deactivation:** Otherwise

**E.34.6 Version compatibility check**

**FUNCTION DESCRIPTION:**

**General information:**

This functions describes when and how compatibility information is exchanged between MC and MU.


**Description:**

This function incorporates the following requirements:

**G11 Version compatibility check**

R11\_1: After the CONFIG communication, if communication monitoring has not found an error, i.e., if LV\_MC\_COM\_ERR = 0 (note that a consistency check with LV\_MC\_COM\_ERR\_CPL is necessary), the MC shall obtain the compatibility information sent by the MU (NR\_COMP\_MU; the hardware version NR\_MU\_HW\_VERS is only sent for information purposes) by calling the actions ACTION\_INFR\_McGetCompNr() and ACTION\_INFR\_McGetVersNr().

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R11\_2: If the compatibility information from the MU does not match the information on the MC (NC\_NR\_MC\_COMP), an immediate fault reaction shall be triggered by calling ACTION\_ECM3\_McFaultReaction with error code NC\_ERR\_COD\_MC\_COMP\_NR.

R11\_3: In the PREDRIVE communication, the MC shall send compatibility information the MU (NC\_NR\_MC\_COMP) by calling the action ACTION\_INFR\_McSendCompNr() before the PREDRIVE communication is triggered.

**Application conditions**

**Initialisation:** *NR\_MU\_COMP = 0;*

*NR\_MU\_HW\_VERS = 0;*

**Recurrence:** The **initialisation** shall be performed **after each power-up or reset**.  
R1 shall be executed after the CONFIG communication is completed and no communication error was detected; R2 shall be executed after R1, if necessary; R3 shall be executed before the PREDRIVE communication is triggered.

**Activation:** *For R1, LV\_MC\_COM\_ERR = 0 must hold (only executed if no communication error was no detected; note that a consistency check with LV\_MC\_COM\_ERR\_CPL is necessary)*

**Deactivation:** *Otherwise*

**E.34.7 Acquisition of values of A/D conversions**

**FUNCTION DESCRIPTION:**

**General information:**

This functions describes when and how the result of the A/D conversions (both on MC and MU) shall be acquired and how it is exported to process monitoring.


A/D conversions are performed on both MC and MU, in both cases after a communication, starting with the end of the CONFIG communication.

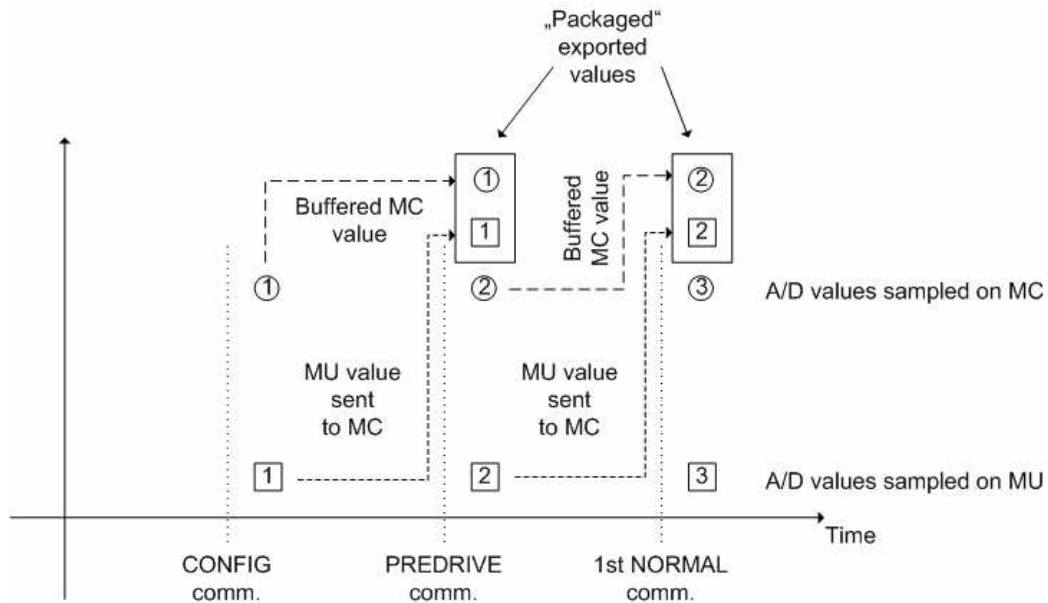
However, since the value acquired on the MU can only be transmitted to the MC in the next communication, the data have to be synchronised: for example, the value acquired on the MU after the CONFIG communication is only transmitted to the MC in the PREDRIVE communication and hence only available on the MC after the end of the PREDRIVE communication; in the meantime, the MC also has acquired A/D values after the CONFIG and PREDRIVE communications; so it has to be ensured that the value from the MU sampled after the CONFIG communication is exported ("packaged") together with the value sampled on the MC after the CONFIG communication.

This can easily be achieved by simply buffering the value sampled on the MC until after the next communication (see signal flow diagram).

**Signal flow diagram:**

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**Description:**

This function incorporates the following requirements:

**G23 Acquisition of values of A/D conversions**

R23\_1: After each communication:

R23\_1.1: the buffered A/D value VP\_MC\_AN\_DIG\_MON\_TMP shall be copied into VP\_MC\_AN\_DIG\_MON;

R23\_1.2: VP\_MC\_AN\_DIG\_MON\_TMP and VP\_MC\_AN\_DIG\_MON shall be stored together with their complements VP\_MC\_AN\_DIG\_MON\_TMP\_CPL and VP\_MC\_AN\_DIG\_MON\_CPL and only be accessed using the actions ACTION\_ECM3\_WriteChkCpl(), ACTION\_ECM3\_ChkCpl(), ACTION\_ECM3\_ReadChkCpl(), and ACTION\_ECM3\_McReadChkCpl() from section "RAM check service actions of processor monitoring on MC";

R23\_1.3: their default values in case of a RAM error shall be 0.

R23\_2: After storing the buffered value into the actual interface, the new value of the A/D conversion on the MC shall be fetched from the infrastructure by calling the action ACTION\_INFR\_GetAnDigMonValMc(), storing the result in VP\_MC\_AN\_DIG\_MON\_TMP.

R23\_3: If VP\_MC\_AN\_DIG\_MON\_TMP is equal to NC\_VP\_MC\_AN\_DIG\_MON\_CPL\_ERR:

R23\_3.1: VP\_MC\_AN\_DIG\_MON\_TMP shall be reset to 0 (using the RAM check actions);

R23\_3.2: an immediate fault reaction shall be performed via ACTION\_ECM3\_McFaultReaction(), using the error code NC\_ERR\_COD\_MC\_RAM\_LEVEL\_2;


R23\_3.3: otherwise, no action shall be performed.

R23\_4: After each successful PREDRIVE, NORMAL, and DISABLE communication (i.e., LV\_MC\_ERR\_COM = 0):

R23\_4.1: the freshly transmitted value of the A/D conversion on the MU shall be fetched from the infrastructure via the action ACTION\_INFR\_GetAnDigMonValMu(), storing the result in VP\_MU\_AN\_DIG\_MON;

R23\_4.2: VP\_MU\_AN\_DIG\_MON shall be stored together with its complement VP\_MU\_AN\_DIG\_MON\_CPL and only be accessed using the actions ACTION\_ECM3\_WriteChkCpl(), ACTION\_ECM3\_ChkCpl(),

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ACTION\_ECM3\_ReadChkCpl(), and ACTION\_ECM3\_McReadChkCpl() from section "RAM check service actions of processor monitoring on MC";

R23\_4.3: its default value in case of a RAM error shall be 0.

**Note:** the MU value VP\_MU\_AN\_DIG\_MON is only updated after a *successful* communication while the MC value is acquired after *each* communication; in the extreme case of no successful communications, the MU value will therefore freeze to the value obtained after the last correct communication, eventually leading to a fault reaction (of process monitoring, where the MC and MU values are compared); however, unsuccessful communications will (much faster) lead to a fault reaction of processor monitoring (by the communication monitoring functions).

### Application conditions

**Initialisation:**                    / \* Using the RAM check service actions \*/  
     VP\_MC\_AN\_DIG\_MON = 0;  
     VP\_MU\_AN\_DIG\_MON = 0;  
     VP\_MC\_AN\_DIG\_MON\_TMP = 0;

**Recurrence:**                    The **initialisation** shall be performed **after each power-up or reset**.  
     The **function itself** shall be executed **after the communication monitoring functions**.

**Activation:**                    For R23\_1, R23\_2, R23\_3:  
     Always.  
     For R23\_4:  
     ((STATE\_MC = NC\_STATE\_MC\_PRDR) **OR** (STATE\_MC = NC\_STATE\_MC\_NORM) **OR** (STATE\_MC = NC\_STATE\_MC\_DI)) **AND**  
     (LV\_MC\_COM\_ERR = 0)  
     (active in *PREDRIVE*, *NORMAL*, and *DISABLE* state but only if the preceding communication was successful; note that a consistency check with LV\_MC\_COM\_ERR\_CPL is necessary)

**Deactivation:**                    *Otherwise*

## E.34.8 Exchange of ignition key information between MC and MU

### FUNCTION DESCRIPTION:

#### General information:

This function describes when and how information regarding the state of the ignition key is exchanged between MC and MU.

#### Description:

This function incorporates the following requirements:

#### **G25 Exchange of ignition key information between MC and MU**


R25\_1: In each NORMAL and DISABLE communication, the MC sends the value of LV\_MC\_IGN\_KEY to the MU; this is achieved by calling ACTION\_INFR\_McSendIgk() with argument LV\_MC\_IGN\_KEY before the corresponding communications are triggered.

R25\_2: If the MU is configured for hardware acquisition of the ignition key signal, after each PREDRIVE, NORMAL, and DISABLE communication, the value of the ignition key input IGK\_IN on the MU shall be acquired by calling the action ACTION\_INFR\_McGetIlgkMu(), storing the result in LV\_MU\_IGN\_KEY, but only if no communication error was detected, i.e., LV\_MC\_COM\_ERR = 0 (note that a consistency check with LV\_MC\_COM\_ERR\_CPL is necessary).

**Application conditions**

- Initialisation:** `LV_MU_IGN_KEY = 0;`
- Recurrence:** The **initialisation** shall be performed **after each reset or power-up**. The **function** shall be **executed after the communication monitoring functions**.
- Activation:** `((STATE_MC = NC_STATE_MC_PRDR) OR (STATE_MC = NC_STATE_MC_NORM) OR (STATE_MC = NC_STATE_MC_DI))`  
(only active in PREDRIVE, NORMAL, and DISABLE state)
- Deactivation:** `Otherwise`

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## E.35 Processor Monitoring (Appl. Inc.)

### Data definition:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ENV_D_0_MON_3	O/V/S	0... FFH	0... 255	1	-
Environmental data 0 for general processor monitoring error					
ENV_D_1_MON_3	O/V/S	0... FFH	0... 255	1	-
Environmental data 1 for general processor monitoring error					
ENV_D_2_MON_3	O/V/S	0... FFH	0... 255	1	-
Environmental data 2 for general processor monitoring error					
ENV_D_3_MON_3	O/V/S	0... FFH	0... 255	1	-
Environmental data 3 for general processor monitoring error					
ERR_SYM_MON_3	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom extracted from ERR_COD_MC and ERR_COD_MU					
LV_CDN_DIAG_MON_3	V	0... 1H	0 ...1	1	-
Diagnosis condition for processor monitoring error					
LV_END_DIAG_MON_3	V	0... 1H	0 ...1	1	-
Indicates that diagnosis has been finished					
LV_ERR_MON_3	O/V	0... 1H	0 ...1	1	-
Error detected by processor monitoring					
LV_ERR_RAM_MON_3	O/V	0... 1H	0 ...1	1	-
RAM test error detected by processor monitoring					
LV_INJ_OFF_TMR_INJ_ENA	O/V	0... 1H	0 ...1	1	-
Indicates enabling of injection by injection off timer of MU					
LV_MC_IGN_KEY	O/V	0... 1H	0 ...1	1	-
Ignition key information to be sent from MC to MU					
LV_MC_ST_LIH_SOPC	O/V	0... 1H	0 ...1	1	-
Request to start in limp-home mode based on result of the switch-off path check					
LV_MC_ST_LIH_SOPC_CPL	O	0... 1H	0 ...1	1	-
Complement of LV_MC_ST_LIH_SOPC_CPL					
LV_MU_IGN_KEY_OLD	V	0... 1H	0 ...1	1	-
Flag used for storing value of ignition key signal on MU from last recurrence (needed for IOT handling)					

### Input data:

ERR_COD_MC {p. 7072}	ERR_COD_MU {p. 7072}	IDX_STATE_SOPC {p. 7186}	LV_DIAG_END_RLY_ MAIN_DLY {p. 4933}
LV_ERR_TMP_MU_MC {p. 7072}	LV_INJ_OFF_TMR_INJ_ ENA_TMP {p. 7072}	LV_MU_IGN_KEY {p. 7135}	LV_RLY_MAIN_DLY_ERR {p. 4933}
NC_ABC_MC_CKS {p. 7073}	NC_ABC_MC_CKS_INC {p. 7073}	NC_ABC_MC_CKS_INI {p. 7073}	NC_ABC_MC_CKS_MAX {p. 7073}
NC_ABC_MC_CONF_DIF {p. 7073}	NC_ABC_MC_CONF_DIF_ INC {p. 7073}	NC_ABC_MC_CONF_DIF_ INI {p. 7073}	NC_ABC_MC_CONF_DIF_ MAX {p. 7074}

NC_ABC_MC_HD {p. 7074}	NC_ABC_MC_HD_INC {p. 7074}	NC_ABC_MC_HD_INI {p. 7074}	NC_ABC_MC_HD_MAX {p. 7074}
NC_ABC_MC_NOT_DEC {p. 7074}	NC_ABC_MC_NOT_DEC_ INC {p. 7074}	NC_ABC_MC_NOT_DEC_ INI {p. 7074}	NC_ABC_MC_NOT_DEC_ MAX {p. 7074}
NC_ABC_MC_PFM_0_ RESP {p. 7074}	NC_ABC_MC_PFM_0_ RESP_INC {p. 7074}	NC_ABC_MC_PFM_0_ RESP_INI {p. 7074}	NC_ABC_MC_PFM_0_ RESP_MAX {p. 7074}
NC_ABC_MC_PFM_0_ TOG {p. 7074}	NC_ABC_MC_PFM_0_ TOG_INC {p. 7074}	NC_ABC_MC_PFM_0_ TOG_INI {p. 7074}	NC_ABC_MC_PFM_0_ TOG_MAX {p. 7074}
NC_ABC_MC_PFM_1_ RESP {p. 7074}	NC_ABC_MC_PFM_1_ RESP_INC {p. 7074}	NC_ABC_MC_PFM_1_ RESP_INI {p. 7074}	NC_ABC_MC_PFM_1_ RESP_MAX {p. 7074}
NC_ABC_MC_PFM_1_ TOG {p. 7074}	NC_ABC_MC_PFM_1_ TOG_INC {p. 7075}	NC_ABC_MC_PFM_1_ TOG_INI {p. 7075}	NC_ABC_MC_PFM_1_ TOG_MAX {p. 7075}
NC_ABC_MC_PFM_2_ RESP {p. 7075}	NC_ABC_MC_PFM_2_ RESP_INC {p. 7075}	NC_ABC_MC_PFM_2_ RESP_INI {p. 7075}	NC_ABC_MC_PFM_2_ RESP_MAX {p. 7075}
NC_ABC_MC_PFM_2_ TOG {p. 7075}	NC_ABC_MC_PFM_2_ TOG_INC {p. 7075}	NC_ABC_MC_PFM_2_ TOG_INI {p. 7075}	NC_ABC_MC_PFM_2_ TOG_MAX {p. 7075}
NC_ABC_MC_PFM_3_ RESP {p. 7075}	NC_ABC_MC_PFM_3_ RESP_INC {p. 7075}	NC_ABC_MC_PFM_3_ RESP_INI {p. 7075}	NC_ABC_MC_PFM_3_ RESP_MAX {p. 7075}
NC_ABC_MC_PFM_3_ TOG {p. 7075}	NC_ABC_MC_PFM_3_ TOG_INC {p. 7075}	NC_ABC_MC_PFM_3_ TOG_INI {p. 7075}	NC_ABC_MC_PFM_3_ TOG_MAX {p. 7075}
NC_ABC_MC_PFM_4_ RESP {p. 7075}	NC_ABC_MC_PFM_4_ RESP_INC {p. 7075}	NC_ABC_MC_PFM_4_ RESP_INI {p. 7075}	NC_ABC_MC_PFM_4_ RESP_MAX {p. 7076}
NC_ABC_MC_PFM_4_ TOG {p. 7076}	NC_ABC_MC_PFM_4_ TOG_INC {p. 7076}	NC_ABC_MC_PFM_4_ TOG_INI {p. 7076}	NC_ABC_MC_PFM_4_ TOG_MAX {p. 7076}
NC_ABC_MC_PFM_5_ RESP {p. 7076}	NC_ABC_MC_PFM_5_ RESP_INC {p. 7076}	NC_ABC_MC_PFM_5_ RESP_INI {p. 7076}	NC_ABC_MC_PFM_5_ RESP_MAX {p. 7076}
NC_ABC_MC_PFM_5_ TOG {p. 7076}	NC_ABC_MC_PFM_5_ TOG_INC {p. 7076}	NC_ABC_MC_PFM_5_ TOG_INI {p. 7076}	NC_ABC_MC_PFM_5_ TOG_MAX {p. 7076}
NC_ABC_MC_PFM_6_ RESP {p. 7076}	NC_ABC_MC_PFM_6_ RESP_INC {p. 7076}	NC_ABC_MC_PFM_6_ RESP_INI {p. 7076}	NC_ABC_MC_PFM_6_ RESP_MAX {p. 7076}
NC_ABC_MC_PFM_6_ TOG {p. 7076}	NC_ABC_MC_PFM_6_ TOG_INC {p. 7076}	NC_ABC_MC_PFM_6_ TOG_INI {p. 7076}	NC_ABC_MC_PFM_6_ TOG_MAX {p. 7076}

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NC_ABC_MC_WRG_IDX {p. 7076}	NC_ABC_MC_WRG_IDX_ INC {p. 7077}	NC_ABC_MC_WRG_IDX_ INI {p. 7077}	NC_ABC_MC_WRG_IDX_ MAX {p. 7077}
NC_ABC_MC_WRG_RESP {p. 7077}	NC_ABC_MC_WRG_ RESP_INC {p. 7077}	NC_ABC_MC_WRG_ RESP_INI {p. 7077}	NC_ABC_MC_WRG_ RESP_MAX {p. 7077}
NC_CTR_COM_CYC_MC_ DEC_RST_INI {p. 7077}	NC_CTR_MU_DI_MAX {p. 7077}	NC_CTR_MU_READY_ MAX {p. 7049}	NC_CTR_RST_MC_DI {p. 7077}
NC_CTR_RST_MC_THD {p. 7077}	NC_CTR_RST_MC_THD_ SOPC {p. 7186}	NC_CYCNR_MC_DR_DI_ TMP {p. 7077}	NC_ERR_COD_MC_CKS {p. 7077}
NC_ERR_COD_MC_ COMP_NR {p. 7077}	NC_ERR_COD_MC_ CONF_DIF {p. 7077}	NC_ERR_COD_MC_HD {p. 7077}	NC_ERR_COD_MC_MU_ READY {p. 7077}
NC_ERR_COD_MC_NOT_ DEC {p. 7077}	NC_ERR_COD_MC_NOT_ ERR {p. 7077}	NC_ERR_COD_MC_NOT_ VLD_TRAN {p. 7077}	NC_ERR_COD_MC_PAR {p. 7077}
NC_ERR_COD_MC_PFM_ 0_RESP {p. 7078}	NC_ERR_COD_MC_PFM_ 0_TOG {p. 7078}	NC_ERR_COD_MC_PFM_ 1_RESP {p. 7078}	NC_ERR_COD_MC_PFM_ 1_TOG {p. 7078}
NC_ERR_COD_MC_PFM_ 2_RESP {p. 7078}	NC_ERR_COD_MC_PFM_ 2_TOG {p. 7078}	NC_ERR_COD_MC_PFM_ 3_RESP {p. 7078}	NC_ERR_COD_MC_PFM_ 3_TOG {p. 7078}
NC_ERR_COD_MC_PFM_ 4_RESP {p. 7078}	NC_ERR_COD_MC_PFM_ 4_TOG {p. 7078}	NC_ERR_COD_MC_PFM_ 5_RESP {p. 7078}	NC_ERR_COD_MC_PFM_ 5_TOG {p. 7078}
NC_ERR_COD_MC_PFM_ 6_RESP {p. 7078}	NC_ERR_COD_MC_PFM_ 6_TOG {p. 7078}	NC_ERR_COD_MC_RAM_ LEVEL_1 {p. 7078}	NC_ERR_COD_MC_RAM_ LEVEL_2 {p. 7078}
NC_ERR_COD_MC_ROM_ LEVEL_1 {p. 7078}	NC_ERR_COD_MC_ROM_ LEVEL_2 {p. 7078}	NC_ERR_COD_MC_SOPC {p. 7078}	NC_ERR_COD_MC_ WRG_IDX {p. 7078}
NC_ERR_COD_MC_ WRG_RESP {p. 7078}	NC_ERR_COD_MU_FCT_ SPC_IST {p. 7078}	NC_ERR_COD_MU_V_H {p. 7079}	NC_ERR_COD_MU_V_L {p. 7079}
NC_ERR_COD_MU_V_L_ H {p. 7079}	NC_ERR_SWI_MC_ LEVEL_2_CAL {p. 7136}	NC_ERR_SWI_MC_ LEVEL_2_COD {p. 7136}	NC_IDX_NR_WRG_MC_ FCT_SPC_IST {p. 7100}
NC_IDX_RESP_MC_FCT_ SPC_IST [NC_TEST_REC_IDX_ MAX_MON2] {p. 7101}	NC_IDX_RESP_WRG_ MC_FCT_SPC_IST {p. 7101}	NC_IDX_STATE_SOPC_ DFCT {p. 7186}	NC_IDX_TEST_MC_FCT_ SPC_IST [NC_TEST_REC_IDX_ MAX_MON2] {p. 7101}



NC_NR_MC_COMP {p. 7136}	NC_NR_MC_PFM {p. 7118}	NC_NR_MC_PFM_TCC {p. 7118}	NC_NR_RESP_SOPC {p. 7186}
NC_PWL_LOCK_CDN_ ROM_CHK {p. 3778}	NC_RESP_SOPC_1 [NC_NR_RESP_SOPC] {p. 7186}	NC_RESP_SOPC_2 [NC_NR_RESP_SOPC] {p. 7186}	NC_STATE_ERR_IDC_ MC_DI_REQ {p. 7079}
NC_STATE_ERR_IDC_ MC_NOT_PRES {p. 7079}	NC_STATE_ERR_IDC_ MC_PREV_REST {p. 7079}	NC_STATE_ERR_IDC_ MC_REST_REQ {p. 7079}	NC_STATE_MC_CONF {p. 7136}
NC_STATE_MC_DI {p. 7136}	NC_STATE_MC_INI {p. 7136}	NC_STATE_MC_NORM {p. 7136}	NC_STATE_MC_NOT_VLD {p. 7136}
NC_STATE_MC_PRDR {p. 7136}	NC_STATE_RESP_DR_ DFT {p. 7186}	NC_STATE_RESP_DR_DI {p. 7186}	NC_STATE_RESP_DR_ ENA {p. 7186}
NC_STATE_RESP_SOPC_ DFCT {p. 7186}	NC_STATE_RESP_SOPC_ OK {p. 7186}	NC_T_MC_COM_CYC {p. 7049}	NC_TCC_MC_IST_WRG_ RESP_CHK {p. 7101}
NC_TCC_MC_IST_WRG_ RESP_REQ {p. 7101}	NC_TCC_MC_PFM_TOG_ 6_MAX {p. 7118}	NC_TCC_MC_PFM_TOG_ MAX [NC_NR_MC_PFM_TCC] {p. 7118}	NC_TEST_REC_IDX_ MAX_MON2 {p. 7101}
NC_VP_MC_AN_DIG_ MON_CPL_ERR {p. 7136}	NLC_MU_IGN_KEY_ACQ {p. 7136}	NLC_MU_INJ_OFF_TMR_ ENA {p. 7136}	NLC_MU_MOD {p. 7136}
NLC_MU_POW_OFF_ TMR_ENA {p. 7136}	NLF_MC_PFM_SYN_ BYTE_INI {p. 7118}	PWL_LOCK_CDN {p. 3776}	STATE_MC {p. 7135}

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CTR_RST_THD_ERR_MEM	-	0... FH	0... 15	1	-
Threshold for reset counter of MC and MU when error memory entries shall be generated					

**Action definition**

<b>ACTION_CM3_McLockPwlResource</b> ()	Mode: O
This action shall lock the power latch resource for the Standard ROM check to extend the power latch phase at least until the Standard ROM check has been completed.	

<b>ACTION_ECM3_McErrmService</b> (IN<No Name available>,IN<No Name available>,IN<No Name available>,IN<No Name available>,IN<No Name available>,IN<No Name available>,IN<No Name available>,IN<No Name available>)	Mode: O

<b>ACTION_ECM3_McUnlockPwlResource</b> ()	Mode: O

**Import actions:**

<b>ACTION_ECM3_ChkCpl</b> (IN<PRM_VAR>,IN<PRM_VAR_CPL>)
Continued on next page

<b>ACTION_ECM3_McChangeState</b> (IN<PRM_STATE_MC_NEW>)
<b>ACTION_ECM3_McFaultReaction</b> (IN<PRM_ERR_COD>)
<b>ACTION_ECM3_McReadChkCpl</b> (OUT<PRM_RESULT>,IN<PRM_VAR>,IN<PRM_VAR_CPL>,IN<PRM_DFT_VALUE>)
<b>ACTION_ECM3_McReadChkState</b> (OUT<PRM_STATE_MC_TMP>)
<b>ACTION_ECM3_ReadChkCpl</b> (OUT<PRM_RESULT>,IN<PRM_VAR>,IN<PRM_VAR_CPL>)
<b>ACTION_ECM3_WriteChkCpl</b> (INOUT<PRM_VAR>,OUT<PRM_VAR_CPL>,IN<PRM_VALUE>)
<b>ACTION_SetRstInfo_Ecm3</b> ()

**Error treatment:**

Diagnostic	Symptom description	Symptom	Filter type
<b>MON_3</b>			
<i>Diagnoses of Processor Monitoring</i>	ROM error on MC	SYM_0	NO
	RAM error on MC	SYM_1	
	SOPC or unspecific error	SYM_2	
	FS-IST error on MU	SYM_3	

Note: it is recommended to configure MON\_3 to "CARB CC"

Note: it is recommended to calibrate ENVD\_x\_MON\_3 to be stored in the error memory when a MON\_3 error occurs (ID\_ERR\_ENVD\_MON\_3).

Note: storage ENVD\_x\_MON\_3 as non-volatile shall be ensured via the Error Memory Management.

**E.35.1 Generic configuration - Value assignment for configuration data**

**FUNCTION DESCRIPTION:**

**General information:**

This section describes the value assignment for the generic (i.e., project-independent) configuration data of Processor Monitoring (e.g., header-bytes, error codes etc.) for engine management systems (EMSs).

**THESE ASSIGNMENTS CANNOT BE CHANGED BY PROJECTS!**

**Value assignment for configuration data of processor monitoring on MC:**

```

/* State machine */
NC_STATE_MC_INI = 241;      /* F1H */
NC_STATE_MC_CONF = 146;   /* 92H */
NC_STATE_MC_PRDR = 199;   /* C7 */
NC_STATE_MC_NORM = 173;   /* ADH */
NC_STATE_MC_DI = 59;      /* 3BH */
NC_STATE_MC_NOT_VLD = 2;  /* 02H */
/* Compatibility information of MC */
NC_NR_MC_COMP = 0;
/* Value for calibration switch so that no fault reaction will be performed after a ROM error for level 2 calibration data (NOT TAKEN INTO ACCOUNT IN PRODUCTION SOWFTARE!) */
NC_ERR_SWI_MC_LEVEL_2_CAL = 165 /* A5H */
    
```

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*/\* Value for calibration switch so that no fault reaction will be performed after a ROM error for level 2 code (NOT TAKEN INTO ACCOUNT IN PRODUCTION SOWFTARE!) \*/*

NC\_ERR\_SWI\_MC\_LEVEL\_2\_COD = 165 */\* A5H \*/*

*/\* Threshold for reset counter for irreversibly disabling of power stages \*/*

NC\_CTR\_RST\_MC\_THD = 7;

*/\* Error codes on MC\*/*

NC\_ERR\_COD\_MC\_NOT\_ERR = 0;

NC\_ERR\_COD\_MC\_HD = 1;

NC\_ERR\_COD\_MC\_CKS = 2;

NC\_ERR\_COD\_MC\_PAR = 3;

NC\_ERR\_COD\_MC\_CONF\_DIF = 4;

NC\_ERR\_COD\_MC\_SOPC = 5;

NC\_ERR\_COD\_MC\_COMP\_NR = 6;

NC\_ERR\_COD\_MC\_ROM\_LEVEL\_1 = 7;

NC\_ERR\_COD\_MC\_RAM\_LEVEL\_1 = 8;

NC\_ERR\_COD\_MC\_ROM\_LEVEL\_2 = 9;

NC\_ERR\_COD\_MC\_RAM\_LEVEL\_2 = 10;

NC\_ERR\_COD\_MC\_WRG\_IDX = 11;

NC\_ERR\_COD\_MC\_WRG\_RESP = 12;

NC\_ERR\_COD\_MC\_NOT\_DEC = 13;

NC\_ERR\_COD\_MC\_MU\_READY = 14;

NC\_ERR\_COD\_MC\_PFM\_0\_TOG = 16;

NC\_ERR\_COD\_MC\_PFM\_1\_TOG = 17;

NC\_ERR\_COD\_MC\_PFM\_2\_TOG = 18;

NC\_ERR\_COD\_MC\_PFM\_3\_TOG = 19;

NC\_ERR\_COD\_MC\_PFM\_4\_TOG = 20;

NC\_ERR\_COD\_MC\_PFM\_5\_TOG = 21;

NC\_ERR\_COD\_MC\_PFM\_6\_TOG = 22;

NC\_ERR\_COD\_MC\_NOT\_VLD\_TRAN = 23;

NC\_ERR\_COD\_MC\_PFM\_0\_RESP = 24;

NC\_ERR\_COD\_MC\_PFM\_1\_RESP = 25;

NC\_ERR\_COD\_MC\_PFM\_2\_RESP = 26;

NC\_ERR\_COD\_MC\_PFM\_3\_RESP = 27;

NC\_ERR\_COD\_MC\_PFM\_4\_RESP = 28;

NC\_ERR\_COD\_MC\_PFM\_5\_RESP = 29;

NC\_ERR\_COD\_MC\_PFM\_6\_RESP = 30;

*/\* Error codes on MU (for evaluation of error information: only used for error memory management) \*/*

NC\_ERR\_COD\_MU\_FCT\_SPC\_IST = 11; */\* Wrong FS-IST answer \*/*

NC\_ERR\_COD\_MU\_V\_L = 13; */\* Under-voltage detected on MU \*/*

NC\_ERR\_COD\_MU\_V\_H = 14; */\* Over-voltage detected on MU \*/*

NC\_ERR\_COD\_MU\_V\_L\_H = 15; */\* Under- and over-voltage detected on MU \*/*

*/\* Error indications \*/*

NC\_STATE\_ERR\_IDC\_MC\_NOT\_PRES = 0;

NC\_STATE\_ERR\_IDC\_MC\_REST\_REQ = 1;

NC\_STATE\_ERR\_IDC\_MC\_DI\_REQ = 2;


NC\_STATE\_ERR\_IDC\_MC\_PREV\_REST= 3;

*/\* Debounce mechanism: indicators for anti-bounce counters \*/*

NC\_ABC\_MC\_HD = 0;


NC\_ABC\_MC\_CKS = 1;

NC\_ABC\_MC\_CONF\_DIF = 2;

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```
NC_ABC_MC_WRG_IDX = 3;
NC_ABC_MC_WRG_RESP = 4;
NC_ABC_MC_NOT_DEC = 5;
NC_ABC_MC_PFM_0_TOG = 6;
NC_ABC_MC_PFM_1_TOG = 7;
NC_ABC_MC_PFM_2_TOG = 8;
NC_ABC_MC_PFM_3_TOG = 9;
NC_ABC_MC_PFM_4_TOG = 10;
NC_ABC_MC_PFM_5_TOG = 11;
NC_ABC_MC_PFM_6_TOG = 12;
NC_ABC_MC_PFM_0_RESP = 13;
NC_ABC_MC_PFM_1_RESP = 14;
NC_ABC_MC_PFM_2_RESP = 15;
NC_ABC_MC_PFM_3_RESP = 16;
NC_ABC_MC_PFM_4_RESP = 17;
NC_ABC_MC_PFM_5_RESP = 18;
NC_ABC_MC_PFM_6_RESP = 19;
/* Debounce mechanism: initial values for anti-bounce counters */
NC_ABC_MC_HD_INI = 0;
NC_ABC_MC_CKS_INI = 0;
NC_ABC_MC_CONF_DIF_INI = 0;
NC_ABC_MC_WRG_IDX_INI = 0;
NC_ABC_MC_WRG_RESP_INI = 0;
NC_ABC_MC_NOT_DEC_INI = 0;
NC_ABC_MC_PFM_0_TOG_INI = 0;
NC_ABC_MC_PFM_1_TOG_INI = 0;
NC_ABC_MC_PFM_2_TOG_INI = 0;
NC_ABC_MC_PFM_3_TOG_INI = 0;
NC_ABC_MC_PFM_4_TOG_INI = 0;
NC_ABC_MC_PFM_5_TOG_INI = 0;
NC_ABC_MC_PFM_6_TOG_INI = 4;
NC_ABC_MC_PFM_0_RESP_INI = 0;
NC_ABC_MC_PFM_1_RESP_INI = 0;
NC_ABC_MC_PFM_2_RESP_INI = 0;
NC_ABC_MC_PFM_3_RESP_INI = 0;
NC_ABC_MC_PFM_4_RESP_INI = 0;
NC_ABC_MC_PFM_5_RESP_INI = 0;
NC_ABC_MC_PFM_6_RESP_INI = 0;
/* Debounce mechanism: increments for anti-bounce counters */
NC_ABC_MC_HD_INC = 2;
NC_ABC_MC_CKS_INC = 2;
NC_ABC_MC_CONF_DIF_INC = 2;
NC_ABC_MC_WRG_IDX_INC = 2;
NC_ABC_MC_WRG_RESP_INC = 2;
NC_ABC_MC_NOT_DEC_INC = 2;
NC_ABC_MC_PFM_0_TOG_INC = 2;
NC_ABC_MC_PFM_1_TOG_INC = 2;
NC_ABC_MC_PFM_2_TOG_INC = 2;
NC_ABC_MC_PFM_3_TOG_INC = 2;
NC_ABC_MC_PFM_4_TOG_INC = 2;
NC_ABC_MC_PFM_5_TOG_INC = 2;
NC_ABC_MC_PFM_6_TOG_INC = 2;
```

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```

NC_ABC_MC_PFM_0_RESP_INC = 2;
NC_ABC_MC_PFM_1_RESP_INC = 2;
NC_ABC_MC_PFM_2_RESP_INC = 2;
NC_ABC_MC_PFM_3_RESP_INC = 2;
NC_ABC_MC_PFM_4_RESP_INC = 2;
NC_ABC_MC_PFM_5_RESP_INC = 2;
NC_ABC_MC_PFM_6_RESP_INC = 2;
/* Debounce mechanism: maximal values for anti-bounce counters */
NC_ABC_MC_HD_MAX = 6;
NC_ABC_MC_CKS_MAX = 6;
NC_ABC_MC_CONF_DIF_MAX = 6;
NC_ABC_MC_WRG_IDX_MAX = 6;
NC_ABC_MC_WRG_RESP_MAX = 6;
NC_ABC_MC_NOT_DEC_MAX = 6;
NC_ABC_MC_PFM_0_TOG_MAX = 6;
NC_ABC_MC_PFM_1_TOG_MAX = 6;
NC_ABC_MC_PFM_2_TOG_MAX = 6;
NC_ABC_MC_PFM_3_TOG_MAX = 6;
NC_ABC_MC_PFM_4_TOG_MAX = 6;
NC_ABC_MC_PFM_5_TOG_MAX = 6;
NC_ABC_MC_PFM_6_TOG_MAX = 6;
NC_ABC_MC_PFM_0_RESP_MAX = 6;
NC_ABC_MC_PFM_1_RESP_MAX = 6;
NC_ABC_MC_PFM_2_RESP_MAX = 6;
NC_ABC_MC_PFM_3_RESP_MAX = 6;
NC_ABC_MC_PFM_4_RESP_MAX = 6;
NC_ABC_MC_PFM_5_RESP_MAX = 6;
NC_ABC_MC_PFM_6_RESP_MAX = 6;
/* Initial value for communication cycle counter for healing of reset counter */
NC_CTR_COM_CYC_MC_DEC_RST_INI = 400; /* 190H */
/* Maximal value for counter for disable request */
NC_CTR_MU_DI_MAX = 6;
/* Value of reset counter to be sent to MU in case of a disable request */
NC_CTR_RST_MC_DI = 15;
/* Number of communication cycles for temporary disabling after PREDRIVE communication */
NC_CYCNR_MC_DR_DI_TMP = 50; /* 520ms of disabling in total */
/* 10ms time between two communications */
NC_T_MC_COM_CYC = 10;
/* Number of PFM tasks */
NC_NR_MC_PFM = 7;
/* Number of PFM test cycle counters */
NC_NR_MC_PFM_TCC = NC_NR_MC_PFM - 1;

/* Array containing the maximal number of communication cycles after which toggling of bits by the MU
for the corresponding PFM tasks must have happened */
NC_TCC_MC_PFM_TOG_MAX[NC_NR_MC_PFM_TCC] = [4, 8, 8, 8, 8, 8];
NC_TCC_MC_PFM_TOG_6_MAX = 428;
/* Initialisation value for the PFM synchronisation byte used for toggling by PFM service actions */
NLF_MC_PFM_SYN_BYTE_INI = 37; /* 25H */
/* FS-IST: maximal question/answer number */
NC_TEST_REC_IDX_MAX_MON2 = 15;
/* FS-IST: array of expected questions */

```

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```

NC_IDX_TEST_MC_FCT_SPC_IST[NC_TEST_REC_IDX_MAX_MON2] = [0, 33, 34, 3, 36, 5, 6, 39,
40, 9, 10, 43, 12, 45, 46];
/* FS-IST: array of corresponding answers */
NC_IDX_RESP_MC_FCT_SPC_IST[NC_TEST_REC_IDX_MAX_MON2] = [19, 4, 21, 22, 7, 8, 25, 26,
11, 28, 13, 14, 31, 32, 49];
/* FS-IST: constant for invalid answer */
NC_IDX_RESP_WRG_MC_FCT_SPC_IST = 62;          /* 3EH */
/* FS-IST: constant for invalid question number */
NC_IDX_NR_WRG_MC_FCT_SPC_IST = 31;
/* FS-IST: value of test cycle counter when sending a wrong response shall be requested */
NC_TCC_MC_IST_WRG_RESP_REQ = 1;
/* FS-IST: value of test cycle counter when reaction to wrong response shall be checked */
NC_TCC_MC_IST_WRG_RESP_CHK = 3;
/* constant indicating a complement error of the value of the A/D conversion on the MC acquired in the
infrastructure */
NC_VP_MC_AN_DIG_MON_CPL_ERR = -0,000152587890625;      /* FFFFH */

```

## E.35.2 Project-specific configuration - Value assignment for configuration data

### FUNCTION DESCRIPTION:

#### General information:

This section describes the value assignment for the project-specific configuration data of Processor Monitoring (e.g., configuration information for MU, etc.).

#### Value assignment for configuration data of Processor Monitoring:

```

/* Configuration */
NLC_MU_MOD = 0;                          /* EMS */
NLC_MU_IGN_KEY_ACQ = 1;                   /* HW acquisition */
NLC_MU_POW_OFF_TMR_ENA = 0;              /* POT inactive */
NLC_MU_INJ_OFF_TMR_ENA = 1;              /* IOT active */
/* Common threshold for reset counter of MU and MC determining when error memory information shall
be updated */
NC_CTR_RST_THD_ERR_MEM = 1;
/* Maximal value for counter in check of MU readiness */
NC_CTR_MU_READY_MAX = 3;

```

## E.35.3 Project-specific configuration - Configuration of switch-off path check


### FUNCTION DESCRIPTION:

#### General information:

This "sub-function" describes the configuration of the switch-off path check.

#### Description:

The function incorporates the following requirements:

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## G27 Configuration of switch-off path check

R27\_1: The following system configuration is assumed:

- the **MC is only connected to power stage 1 (H-bridge)**; the check result for its switch-off path to power stage 0 (injection) shall always be 0;
- the **MU is connected to both power stages 0 and 1**.

R27\_2: There are two final results:

- **"no engine start"** with representation NC\_STATE\_RESP\_SOPC\_DFCT (00H = 0) which shall simply trigger a fault reaction of processor monitoring by calling ACTION\_ECM3\_McFaultReaction() with error code NC\_ERR\_COD\_MC\_SOPC
- **"engine start"** with representation NC\_STATE\_RESP\_SOPC\_OK (FFH = 255) which shall prompt no reaction, i.e., the system starts up as usual.

R27\_3 : The SOPC threshold NC\_CTR\_RST\_MC\_THD\_SOPC for the reset counter is set to 0: the lookup for the final result shall always be performed in NC\_RESP\_SOPC\_2[].

R27\_4: The values in the array NC\_RESP\_SOPC\_2[] shall correspond to the following start-up behaviour:

Index	MC		MU		Result
	PWS0	PWS1	PWS0	PWS1	
0	0	0	0	0	no start
1	0	0	0	1	no start
2	0	0	1	0	no start
3	0	0	1	1	no start
4	0	1	0	0	no start
5	0	1	0	1	no start
6	0	1	1	0	start
7	0	1	1	1	start
8	1	0	0	0	no start
9	1	0	0	1	no start
10	1	0	1	0	no start
11	1	0	1	1	no start
12	1	1	0	0	no start
13	1	1	0	1	no start
14	1	1	1	0	no start
15	1	1	1	1	no start

In the above table, the first column represents the index IDX\_STATE\_SOPC, while the next 4 columns represent the feedback from the two power stages (in the way that they are used to obtain IDX\_STATE\_SOPC), and the last column described the entry in NC\_RESP\_SOPC\_2[] at index IDX\_STATE\_SOPC.


**R27\_5: The MU-SPOC result for power stage 0 obtained before triggering the PREDRIVE communication has to be re-checked before triggering the first NORMAL communication: the status of this particular disable line can only be determined unequivocally if tested when disabled and enabled; this does not cause any conflict with the MC-part of the SOPC since the MC is not connected to power stage 0. The final check result of power stage 0 for the MU has to take into account both checks: only if the first result was "disabled" and the second was "enabled", the complete check was successful.**

### Value assignment for configuration data of SOPC:

*/\* Size of arrays for switch-off path check \*/*

NC\_NR\_RESP\_SOPC = 16;

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```

/* always use NC_RESP_SOPC_2, never NC_RESP_SOPC_1 for lookup of the final result */
NC_CTR_RST_MC_THD_SOPC = 0;
/* SOPC result: no engine start possible */
NC_STATE_RESP_SOPC_DFCT = 0;
/* SOPC result regular engine start possible */
NC_STATE_RESP_SOPC_OK= 255;
/* not used: all entries are equal to NC_STATE_RESP_SOPC_DFCT */
NC_RESP_SOPC_1[NC_NR_RESP_SOPC] = [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]
/* see table and NCs for results above */
NC_RESP_SOPC_2[NC_NR_RESP_SOPC] = [0, 0, 0, 0, 0, 0, 255, 255, 0, 0, 0, 0, 0, 0, 0, 0]
/* Default value for IDX_STATE_SOPC: no switch-off path working */
NC_IDX_STATE_SOPC_DFCT = 0;
/* Diagnostic result from power stage "driver disabled" */
NC_STATE_RESP_DR_DI = 0;
/* Diagnostic result from power stage "driver enabled" */
NC_STATE_RESP_DR_ENA = 1;
/* Default diagnostic result from power stage ("status undefined") */
NC_STATE_RESP_DR_DFT = 3;

```

**Application conditions**

**Initialisation:** / \* Using the RAM check service actions \*/  
LV\_MC\_ST\_LIH\_SOPC = 0;

**Recurrence:** The **initialisation** shall be **executed after each power-up or reset**.

**E.35.4 Project-specific configuration - Error memory service function**

**General information:**

The function incorporates the following requirements:

**G43 Error memory service function**

The action ACTION\_ECM3\_McErrmService() shall be called when all the necessary information is available. When the action is called, it is first tested whether an update of the error history was performed right before the action was called. Since this is only done in case there currently is an error present, this means if no update was done the error symptom ERR\_SYM\_MON\_3 can be set to "NO\_SYM"; ERR\_SYM\_MON\_3 consists of four bits:

Bit3 (SYM_3)	Bit2 (SYM_2)	Bit1 (SYM_1)	Bit0 (SYM_0, LSB)
8	4	2	1
FS-IST error on MU	SOPC error/ unspecific level 3 error	RAM error on MC	ROM error on MC

For every fault, environmental conditions are stored in the environmental data variables ENVD\_x\_MON\_3; the stored content is chosen to help analysing the fault scenario afterwards; more information can be found in the formula section below.

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**Initialisation:**             */ \* Initialise the interfaces to ERRM \*/*  
LV\_ERR\_MON\_3 = 0;  
LV\_CDN\_DIAG\_MON\_3 = 0;  
LV\_END\_DIAG\_MON\_3 = 0;  
ERR\_SYM\_MON\_3 = NO\_SYM / \* No symptom \*/ ;  
ENV\_D\_0\_MON\_3 = 0;  
ENV\_D\_1\_MON\_3 = 0;  
ENV\_D\_2\_MON\_3 = 0;  
ENV\_D\_3\_MON\_3 = 0;

**Recurrence:**             *The initialisation shall be performed after each power-up and reset and at FMY reset.*

**Activation:**             *This sub-function is called.*

**Description of ACTION\_ECM3\_McErrmService**

**Description:**

**Syntax:**                    ACTION\_ECM3\_McErrmService(  
                                  IN <cpt\_act>,  
                                  IN <err\_cod\_act>,  
                                  IN <err\_idc\_act>,  
                                  IN <ctr\_rst\_act>,  
                                  IN <cpt\_old>,  
                                  IN <err\_cod\_old>,  
                                  IN <err\_idc\_old>,  
                                  IN <ctr\_rst\_old>  
                                  )

- Parameter (IN):    cpt\_act            component for current error information (1=MC, 0=MU)
- Parameter (IN):    err\_cod\_act      current error code
- Parameter (IN):    err\_idc\_act      current error indication
- Parameter (IN):    ctr\_rst\_act      current value of reset counter
- Parameter (IN):    cpt\_old           component for previous error information (1=MC, 0=MU)
- Parameter (IN):    err\_cod\_old      previous error code
- Parameter (IN):    err\_idc\_old      previous error indication
- Parameter (IN):    ctr\_rst\_old      previous value of reset counter

**Short description:**    This action receives the current error history and provides the interface to the error memory management.

**Formula section:**

**IF** ( (ctr\_rst\_act > 0) **OR** ((cpt\_act = 0) **AND** ("err\_cod\_act indicates voltage monitoring error"))) */\* reset counter of current error greater than 0 OR current error is an MU error and the current error is a voltage monitoring error \*/*

**THEN**

                          ACTION\_SetRstInfo\_Ecm3;                                    */\* set reset-cause -> RST\_DET \*/*


**FI**

**IF** (LV\_ERR\_MON\_3 = 1)                    */\* previously detected an error \*/*

**THEN** */\* Initialise data to be able to potentially update the error symptom \*/*

                          LV\_ERR\_MON\_3 = 0;  
                          ERR\_SYM\_MON\_3 = NO\_SYM;  
                          LV\_CDN\_DIAG\_MON\_3 = 1;  
                          LV\_END\_DIAG\_MON\_3 = 1;

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```

    Deliver the result to Error Management;
FI
IF ("no update of the error history has been performed before this call")
    /* can be checked by comparing env. data to actual parameters */
THEN
    ERR_SYM_MON_3 = NO_SYM;
    /* Otherwise attempt to set filtered error information ERR_SYM_MON_3 according evaluation of the
    given parameters */
ELSEIF ((cpt_act = 1) AND (ctr_rst_act > NC_CTR_RST_THD_ERR_MEM ))
    /* current error is an MC error and reset counter above threshold */
THEN
    IF ("err_cod_act indicates a ROM error (level 1 or level 2)")
    THEN
        ERR_SYM_MON_3 = SYM_0;          /* ROM error on MC */
    ELSEIF ("err_cod_act indicates a RAM error (level 1 or level 2)")
    THEN
        ERR_SYM_MON_3 = SYM_1;          /* RAM error on MC */
        LV_ERR_RAM_MON_3 = 1;
    ELSE /* Unspecific error */
        ERR_SYM_MON_3 = SYM_2
    FI
ELSEIF ((cpt_act = 0) AND ((ctr_rst_act > NC_CTR_RST_THD_ERR_MEM) OR ("err_cod_act indi-
cates over-voltage ")) /* current error is an MU error and reset counter above threshold OR over-
voltage was detected */
THEN
    IF ("err_cod_act indicates FS-IST error detected by the MU")
    THEN
        ERR_SYM_MON_3 = SYM_3;          /* FS-IST error on MU */
    ELSE
        ERR_SYM_MON_3 = SYM_2;          /* unspecific error */
    FI
FI
/* Now flags for error memory management can be set */
IF (ERR_SYM_MON_3 = NO_SYM)
    LV_ERR_MON_3 = 0; /* no error is present */
ELSE
    LV_ERR_MON_3 = 1; /* error signaled by ERR_SYM_MON_3 is present */
    /* Set environmental data, see table for exact bit positions */
    ENVD_0_MON_3 = "combine cpt_act, err_idc_act and err_cod_act into one byte";
    ENVD_1_MON_3 = ctr_rst_act; /* this could include encoded additional information */
    ENVD_2_MON_3 = "combine cpt_old, err_idc_old and err_cod_old into one byte";
    ENVD_3_MON_3 = ctr_rst_old; /* this could include encoded additional information */

```



This function incorporates the following requirements:

**G52 Project-specific transition condition for the transition from INIT to CONFIG state**

R52\_1: If LV\_DIAG\_END\_RLY\_MAIN\_DLY = 1 AND LV\_RLY\_MAIN\_DLY\_ERR = 0, the transition from INIT to CONFIG shall be possible.

R52\_2: Otherwise, the transition shall not be possible.

**Application conditions**

**Initialisation:** -

**Recurrence:** *The function shall be called by G51 "State machine on MC" for deciding if the transition from INIT to CONFIG can be performed.*

**Activation:** STATE\_MC = NC\_STATE\_MC\_INI (only active in INIT state)

**Deactivation:** Otherwise

**E.35.7 Project-specific configuration - Acquisition of ignition key information on MC**

**FUNCTION DESCRIPTION:**

**General information:**

In each NORMAL and DISABLE communication, the MC sends information about the status of the ignition key signal to the MU.

Usually, the ignition key information on the MC is available in LV\_IGK; however, in some instances, a pre-processing step could possible/necessary (e.g., if the signal is available redundantly, it can be checked for plausibility and then the monitored value can be sent to the MU; another application could be to return the MU value in HW acquisition mode back to the MU so that only the pin value on the MU will determine the MU-internal ignition key information).

To support any such pre-processing, this project-specific function allows to freely define the value of LV\_MC\_IGN\_KEY before it is sent to the MU.

**Description:**

This function incorporates the following requirements:

**G54 Acquisition of ignition key information on MC**


R54\_1: The value of LV\_MC\_IGN\_KEY shall be obtained by copying LV\_MU\_IGN\_KEY.

**Application conditions**

**Initialisation:** LV\_MC\_IGN\_KEY = 0

**Recurrence:** The **initialisation** shall be **performed after each power-up and reset.**

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The **function itself** shall be activated before G25 in NORMAL and DISABLE.

**Activation:** `(STATE_MC = NC_STATE_MC_NORM) OR (STATE_MC = NC_STATE_MC_DI)`  
  
(active in NORMAL and DISABLE state)

**Deactivation:** Otherwise

**Formula section:**

*/\* send back MU value to MU to avoid problems with wrong detection thresholds \*/*  
LV\_MC\_IGN\_KEY = LV\_MU\_IGN\_KEY

**E.35.8 Project-specific configuration - Extension of power-latch phase for Standard ROM check**

**FUNCTION DESCRIPTION:**

**General information:**

Since the Standard ROM check (G8.1) is calculated in the background, it is not pre-determined how long it will take to complete; however, there is the requirement that the ROM check has to be completed at least once per driving cycle. Consequently, in order to fulfil the mentioned requirement, the power latch phase (the phase after the ignition has been switched off, KL15 = 0, but before the ECU is switched off) shall be extended variably for (at least) as long the duration of one complete checksum calculation.

**Description:**

This function incorporates the following requirements:

**G64 Extension of power-latch phase for Standard ROM check**

**Application conditions**

**Initialisation:** -

**Recurrence:** *The function itself shall be activated via the action exported calls ACTION\_ECM3\_McLockPwlResources() and ACTION\_ECM3\_McUnlockPwlRes*

**Description of ACTION\_ECM3\_McLockPwlResource**


**Description:**

**Syntax:** ACTION\_ECM3\_McLockPwResource()

**Formula section:**

"set power-latch lock condition corresponding to NC\_PWL\_LOCK\_CDN\_ROM\_CHK in PWL\_LOCK\_CDN"

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**Description of ACTION\_ECM3\_McUnlockPwResource**

**Description:**

**Syntax:** ACTION\_ECM3\_McUnlockPwResource()

**Formula section:**

"reset power-latch lock condition corresponding to NC\_PWL\_LOCK\_CDN\_ROM\_CHK in PWL\_LOCK\_CDN"

**E.35.9 Project-specific configuration - Handling of injection-off timer functionality**

**FUNCTION DESCRIPTION:**

**General information:**

The injection-off timer inside the MU can disable the injection power stage. This fact shall be indicated to other SW parts via the flag LV\_INJ\_OFF\_TMR\_INJ\_ENA.

**Description:**

This function incorporates the following requirements:

**G65 Handling of injection-off timer functionality**

R65\_1: The value of LV\_INJ\_OFF\_TMR\_INJ\_ENA shall be obtained by checking a 0->1 transition of LV\_MU\_IGN\_KEY between the last two recurrences, see formula section below (*due to unreliable disable information from the MU, the only reliable decision base is the ignition key information*).

**NOTE:** the ignition key signal is already low while the timer is active but not yet disabling the injection so the injection will be disabled immediately after the 1->0 transition of the ignition key signal!

**NOTE:** this is only a temporary solution and should be changed once the latest version of the MU is consistently used in the HW; then it will be sufficient to copy the value of LV\_INJ\_OFF\_TMR\_ENA\_INJ\_TMP to LV\_INJ\_OFF\_TMR\_ENA\_INJ!

**Application conditions**


**Initialisation:** LV\_INJ\_OFF\_TMR\_ENA\_INJ = 0  
LV\_MU\_IGN\_KEY\_OLD = 0

**Recurrence:** The **initialisation** shall be performed after each power-up and reset.  
The **function itself** shall be activated after G22.

**Activation:** (STATE\_MC = NC\_STATE\_MC\_CONF)  
**OR** (STATE\_MC = NC\_STATE\_MC\_PRDR)  
**OR** (STATE\_MC = NC\_STATE\_MC\_NORM)  
/ \* only active in CONFIG; PREDRIVE, or NORMAL state \*/

**Deactivation:** otherwise / \* inactive in INIT and DISABLE state: here, LV\_ERR\_TMP\_MU\_MC is set anyway and so the power stages are disabled regardless of the IOT \*/

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**Formula section:**


*/\* Enable injection if value of ignition key signal on MU, LV\_MU\_IGN\_KEY, of current and last recurrence is high because then the IOT has been reliably reset inside the MU (wait-state needed due to delay stemming from SPI communication) \*/*

LV\_INJ\_OFF\_TMR\_INJ\_ENA = LV\_MU\_IGN\_KEY\_OLD **AND** LV\_MU\_IGN\_KEY;

*/\* Save current value for next recurrence \*/*

LV\_MU\_IGN\_KEY\_OLD = LV\_MU\_IGN\_KEY;

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## E.36 Processor monitoring general

### E.36.1 System Overview

Based on the recommendations of the VDA (as expressed in the version 2.0 of the paper of the VDA ETC working group "Arbeitskreis EGAS"), the monitoring concept for electronic control units (ECUs) uses three levels; this document provides a more detailed description of the *processor monitoring* level (level 3 in VDA terms).

Based on the VDA guidelines, the processor monitoring level consists of two *separate* hardware components: the main controller (MC) and the monitoring unit (MU). The former is generally realised by a micro controller ( $\mu$ C), while the latter might just as well be realised by an application-specific integrated circuit (ASIC), i.e., some specifically designed piece of hardware; this MU is almost exclusively used for processor monitoring functionality (the only exception is the A/D converter on the MU which is used for the monitoring of the A/D conversion on the MC; this functionality is as such not part of the processor monitoring but of the process monitoring, or "level 2" in VDA terms).

The monitoring concept described here is *generic* in the sense that it works regardless of how the MU is realised in terms of actual hardware ( $\mu$ C vs. ASIC), and for both engine management systems (EMSs) for gasoline/diesel engines and transmission control units (TCUs).

The two system components, MC and MU, *mutually* monitor each other (just to be clear about the fact that not only the MU monitors the MC). For instance, assume that there is a failure in the calculations of the ALU (arithmetic logic unit) of the MC. This could produce potentially dangerous results: e.g., due to a faulty calculation, the ECU might increase the engine speed too much for the driver to control the car. Additionally, the MC itself might not be able to detect such a fault and react appropriately (e.g., perform a reset, or switch off the engine): after all, it cannot even be guaranteed that the processor notices the fault, a (from the external point of view) faulty processor might internally believe that the system, including itself, is functioning correctly.


In order to be able to detect such a case, the MU provides an *independent* (hardware) instance which can judge (as far as it is safety-relevant) whether the behaviour of the MC is appropriate according to actual environment conditions and demands (like the driver's wish expressed, e.g., in terms of pushing the accelerator pedal); the behaviour of the MU, in turn, is then monitored by the MC in order to ascertain that the MU is still able to perform its monitoring duties.

All of these mutual monitoring activities are achieved by means of a repeated *question and answer* (Q& A) game: the MU sends questions to the MC, and the MC sends back the respective answers. Based on the quality of the sent questions and received answers, *both* components can tell whether the respective other component is still working correctly.

If there are faults detected while the ECU is running (by whatever means available), appropriate fault reactions are carried out, either by the MC or by the MU, whichever detects the error. As most of the monitored functionalities are safety-critical, such fault reactions or processor monitoring necessitate (at least temporarily) disabling of the safety-relevant power stages in order to reach the so-called *safe state*. In order to be able to perform this type of fault reaction, there have to be corresponding connections (*switch-off paths*) on the hardware level between MC/MU and the relevant power stages (e.g., H-bridge and injectors for gasoline engines). Note that, if the MU detects a fault on the MC, disables the power stages, and triggers a reset of the MC (the standard fault reaction), this reset is then fed back from the MC to the MU so that the *complete* system is restarted (potentially utilising external components like, e.g., power supply).

It should be stressed at this point that, as far as safety is concerned, the **primary goal** of the **fault reaction** is to **disable the power stages**: this prevents an error to result in an undesired acceleration

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of the car (or, correspondingly, unwanted shifting of gears or erroneous opening/closing of the clutch in TCU applications). The fact that (up to a certain maximal number) a reset is triggered after this disabling is only done in order to increase the **availability** of the car (i.e., to potentially enable the driver to continue his driving relatively undisturbed without having to use the ignition key)!

Coming back to the main task of processor monitoring, in order to set up the aforementioned Q&A game, the two components need to exchange data: this *communication interface* is usually implemented in the form of the *Serial Peripheral Interface* (SPI). In this way, MC and MU *synchronise* their progress and, in doing so, can monitor the performed actions.

As an immediate consequence of the separation on the hardware level, since each component has its own parameter memory for variables and is running its own algorithms (in case the MU is realised by an ASIC, this refers to the circuitry that is hard-wired into the chip), variables on the MU are, a priori, not visible (i.e., available) on the MC, and vice versa, unless they are specifically transferred to the other component via the communication interface: variables are *local* to the MU or the MC. Moreover, even after being transmitted from one component to the other, variables on the MC and the MU will usually have different names since the communication is based on *values*, not *names* (despite containing the same values!), and variable names reflect the content of the variables, which can very well be different on MC and MU.


It should furthermore be noted that any value exchanged between MC and MU can always only be a *snapshot* of a variable since it can only contain the actual value of the variable *at the time of the transmission*: consider the case a variable X is sent from the MU to the MC at a certain time t; if the variable is changed on the MU at time t+1, this update stays *local to the MU* in the sense that the MC only notices it if the changed X is re-transmitted to the MC after the update.

From a functional point of view, the main purpose of the processor monitoring is to monitor the proper functioning of the MC, thereby, continuing the layer-approach of the over-all system design (level 1 contains engine control functions and their diagnoses, level 2 monitors these functions and diagnoses by re-calculating the necessary values in an independent way to provide a means of judging their plausibility), in particular and most importantly, ensuring the proper functioning of the process monitoring. From this approach, the following main objectives of processor monitoring are derived:

- *memory checks on MC* (both RAM and ROM);
- *memory checks on MU* (RAM and ROM); this depends on the hardware realisation of the MU; on an ASIC, a RAM check shall be performed as usual; however, in place of a ROM check, there shall be a built-in self test (BIST) which tests the proper functioning of certain parts of the circuitry (mostly those parts responsible for triggering a fault reaction);
- *switch-off path check*: after each (re-)initialisation of the system, it must be checked whether the switch-off paths of the system work properly, viz., whether they can actually switch off the safety-relevant power stages should there be the need to do so later on;
- *program flow monitoring (PFM)*: it shall be checked that (monitoring-relevant) tasks (of level 2) on the MC are performed in the correct order and with the correct timing; here, task refers to a given and fixed sequence of modules running in the same nominal time grid (i.e., functionally connected parts of processor monitoring);
- *function-specific instruction set test (FS-IST)*: it shall be tested whether the processor correctly performs the (monitoring-relevant) calculations needed for the process monitoring on the MC; this shall be achieved by performing a number of *test calculations*; in order to avoid any effects of these (additional) test calculations on the actual monitoring functionality (and in line with VDA requirements), these test calculations are performed by a *copy* of some of the (monitoring-relevant) parts of the process monitoring located in separate memory on the MC which (being a copy of level 2 functionality) is also known as *level 2 (L2)*.

Note that PFM and the FS-IST complement each other to achieve as complete a monitoring of the processor functionality as possible: while PFM checks whether the necessary tasks are executed in the *correct order* and with the *correct timing*, the FS-IST additionally checks that the required *calculations are performed correctly* (so that the tasks can properly execute and calculate the *right result*

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- provided the employed algorithm is correct and correctly implemented: both PFM and L2 can only achieve formal or syntactic correctness, semantic correctness lies in the hands of the developer and cannot be tested (in this way)!).

A schematic overview of the system is presented in the following figure Sketch of processor monitoring with two power stages, including the required disable lines from the MC and the MU to the power stages; note that this picture does not include the redundant analogue input signal based on which the A/D conversion on the MU is performed and then sent to the MC in order to determine proper functioning of the A/D converter on the MC (by comparing the conversion result sent by the MU with the result obtained on the MC).

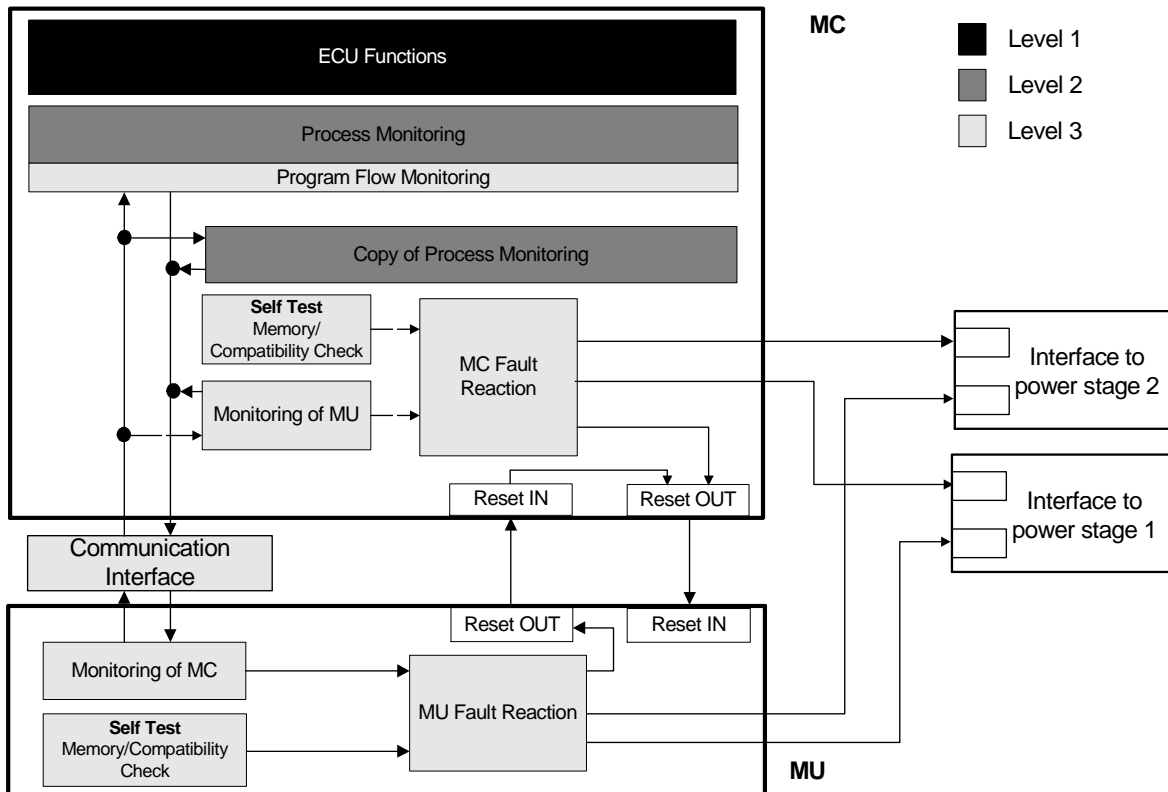


Figure 1: Sketch of processor monitoring with two power stages

### E.36.2 States of the Components

The behavior of both components of the processor monitoring (i.e., MC and MU) is described by two *autonomous* state machines, reflecting the fact that both constitute separate components of a distributed system and as such should really have a separate state space.

Even so, the structure of the two state machines is basically identical, mostly because the two components have a common task, viz., perform the processor monitoring. Nevertheless, as the two parts run independently of each other, both could be in mismatching states; it is the task of the communication interface to prohibit such cases by ensuring that the components *synchronously* progress through their states in the correct order. The exception to this rule is the DISABLE state which is entered after a fault was detected (on the component which detected the fault); this knowledge can then only be propagated to the other component by means of a communication, e.g., it can be the case that, for one communication cycle, the MU is in DISABLE while the MC is still in NORMAL (after the next communication, the MC will also go to DISABLE).

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The basic layout of the two state machines is described the figure State machine layout. The figure contains the basic transitions sequence through the different states. We shall now describe the actions which are performed in each of the states (for the time being without distinguishing between which actions are performed on MC and MU, respectively). Communications between MC and MU are an integral part of the system s functionality and, in any case, information about the current state of a component is always part of the data exchanged by the communications.

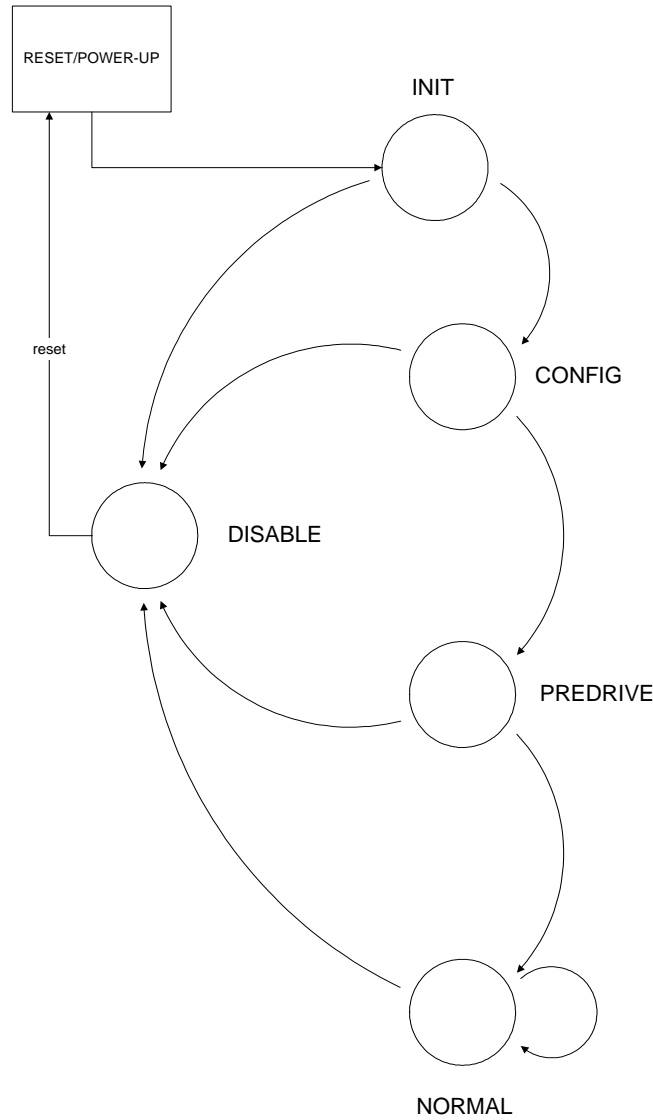



Figure E.36.1: : State machine layout

### E.36.2.1 The INIT state

As indicated by its name, the INIT state is the initial state of the state machine, i.e., always after power-up or a reset, start-up tasks like data initialisation and several self tests on both MC and MU are performed in INIT. Note that there is *no* communication performed while the two components are in their respective INIT states.

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### E.36.2.2 The CONFIG state

In the error free case, the next state is the CONFIG state which is mainly used to prepare and perform the first communication between MC and MU; consequently, the tasks carried out in this state are to prepare the communication, wait for it, and afterwards evaluate the received data. The exchanged data include error codes and reset counters, together with configuration and compatibility data; this communication is usually referred to as the CONFIG communication because if everything is working normally, both components will be in their respective CONFIG states.

### E.36.2.3 The PREDRIVE state

In the PREDRIVE state, another communication (the PREDRIVE communication) is performed which serves the purpose to initialise the PFM (see section Program Flow Monitoring for both MC and MU) and the FS-IST (see module Function-Specific Instruction Set Test on both MC and MU) with the necessary data; also the configuration data transferred in the previous communication is sent back in order to double-check correct reception; additionally, from this state onwards, the monitored A/D conversion values are transferred from the MU to the MC so that the value obtained on the MC can be checked against the conversion values (of the same signal!) from the MU.

### E.36.2.4 The NORMAL state

The NORMAL state is the state which is reached when all the previous actions (including communications) were performed successfully; it represents a properly functioning system. Since there are several tasks which have to be continuously performed (e.g., PFM, FS-IST), there are ongoing communications (NORMAL communication) in the NORMAL state which continue the exchange of the necessary data for such continuous tasks.

### E.36.2.5 The DISABLE state

The DISABLE state is reached if an error occurs during any the actions in the other states, see Figure 2; such errors include communication errors or errors detected during the Switch-off Path Check (see section Switch-Off Path Check). Consequently, since the system is malfunctioning, the power stages are disabled, by the component that enters its respective DISABLE state. In a corresponding communication (DISABLE communication), error information (like reset counters and error codes) are then exchanged.

## E.36.3 Communication protocol between MC and MU

In the following, the communication protocol between MC and MU shall be described where the communications in each state are described one after the other.

The description for each communication is given in such a way that always the data flow in both directions (MC to MU, and MU to MC) is depicted in a separate column.


Note that in following description of the communication protocol, all variables are named as they are known on the MC, the MU is regarded as a black-box.

A row in the tables corresponds to one byte, and where more than one data is sent in one byte together this indicated accordingly (e.g., in the CONFIG state communication, ERR\_COD\_MC and STATE\_ERR\_IDC\_MC are sent in a combined form as byte1 of the data sent from the MC to the MU).

The first byte of each communication in both directions is always a header byte reflecting the internal state of the sending component.

The last byte of each communication in both directions is always the (XOR) checksum of the previous 5 bytes (incl. header-byte) to detect communication errors.

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### E.36.3.1 CONFIG state communication

MC → MU	MU → MC
NC_STATE_MC_CONF	NC_STATE_MC_CONF
STATE_ERR_IDC_MC, ERR_COD_MC (P)	ERR_COD_MU, STATE_ERR_IDC_MU (P)
CTR_RST_MC (P)	LV_V_L_DET_MU, LV_V_H_DET_MU CTR_RST_MU (P),
<u>Configuration data 1:</u> NLC_MU_MOD NLC_MU_IGN_ACQ NLC_MU_INJ_OFF_TRM_ENA NLC_MU_POW_OFF_TRM_ENA <u>Configuration data 2:</u> 0 (P)	NR_MU_COMP, NR_MU_HW_VERS
Complement of configuration data 1 and 2 (P)	Empty (0x00)
Checksum	Checksum

(P) = Due to the high importance of the information, these data bytes are protected by a parity bit. A parity error (odd instead of even parity) is regarded as a communication error, see "G- Parity-bit checking."

- MC and MU exchange error codes, error indications, and reset counters (the error code and error indication of the MU are sent as LF\_MU\_ERR\_BYTE and then "decoded" to ERR\_COD\_MU and STATE\_ERR\_IDC\_MU).
- The flags LV\_V\_L\_DET\_MU and LV\_V\_H\_DET\_MU are set if under- or over-voltage, respectively, has been detected on the MU.
- Based on the compatibility information NC\_MU\_COMP and HW version NC\_MU\_HW\_VERS which is sent by the MU, the MC can check whether its software is compatible to the MU.
- By sending configuration data 1 and 2 during the CONFIG communication, the MU is configured by the MC: monitoring an EMS or a TCU; the acquisition of the ignition key signal can be configured to HW or SW mode; the IOT and POT functionality can be enabled; the 0 in Configuration data 2 stands for not performing EOLT.

### E.36.3.2 PREDRIVE state communication

MC → MU	MU → MC
NC_STATE_MC_PRDR	NC_STATE_MC_PRDR
NR_MC_COMP	LF_MC_RCV_PFM_BYTE
Empty (0x00)	LV_MU_DI_OUT_0, LV_MU_DI_OUT_1, IDX_TEST_RCV_MC_FCT_SPC_IST
<u>Configuration data 1:</u> NLC_MU_MOD, NLC_MU_IGN_ACQ, NLC_MU_INJ_OFF_TRM_ENA, NLC_MU_POW_OFF_TRM_ENA <u>Configuration data 2:</u> 0 (P)	LV_MU_IGN_KEY, LF_MU_CONF_BYTE_PRDR (combining Configuration data 1 and Configuration data 2)
Complement of configuration data 1 and 2 (P)	VP_MU_AN_DIG_MON
Checksum	Checksum

**(P)** = Due to the high importance of the information, these data bytes are protected by a parity bit. A parity error (odd instead of even parity) is regarded as a communication error, see "G- Parity-bit checking."

- The MU sends the first PFM synchronisation byte LF\_MC\_RCV\_PFM\_BYTE, the first FS-IST question IDX\_TEST\_RCV\_MC\_FCT\_SPC\_IST, and the converted analogue value VP\_MU\_AN\_DIG\_MON.
- The configuration data 1 and 2 are confirmed by the MC: now the MU is completely configured.
- To ensure that the MU is always working in the correct mode, it reads back all of its internally stored configuration data and sends it back to the MC as LF\_MU\_CONF\_BYTE\_PRDR.
- Based on the compatibility information NR\_MC\_COMP sent by the MC, the MU can check whether it is compatible to the MC.
- The MU shall send the status of its disable outputs in LV\_MU\_DI\_OUT\_0 and LV\_MU\_DI\_OUT\_1.
- The MU sends the latched valued of its input for the ignition key signal as LV\_MU\_IGN\_KEY (regardless of whether it was configured for SW or HW acquisition of said signal).

### E.36.3.3 NORMAL state communication

MC → MU	MU → MC
NC_STATE_MC_NORM	NC_STATE_MC_NORM
LF_MC_RESP_PFM	LF_MC_RCV_PFM_BYTE
LV_MC_DR_OFF, LV_IGK, IDX_RESP_TRM_FCT_SPC_IST	LV_MU_DI_OUT_0, LV_MU_DI_OUT_1, IDX_TEST_RCV_MC_FCT_SPC_IST
Empty (0x00)	LV_MU_IGN_KEY, LF_MU_CONF_BYTE_NORM, ABC_RCV_MC_FCT_SPC_IST
Empty (0x00)	VP_MU_AN_DIG_MON
Checksum	Checksum

- The MU keeps on sending FS-IST questions IDX\_TEST\_RCV\_MC\_FCT\_SPC\_IST, and additionally the FS-IST anti-bounce counter ABC\_RCV\_MC\_FCT\_SPC\_IST, and the monitored analogue value VP\_MU\_AN\_DIG\_MON.
- LF\_MC\_RCV\_PFM\_BYTE is either an updated PFM synchronisation byte or a status byte where a set bit indicates that the corresponding PFM anti-bounce counter on the MU has value >0.
- The MC sends the PFM answer byte LF\_MC\_RESP\_PFM and the FS-IST answer IDX\_RESP\_TRM\_FCT\_SPC\_IST.
- Additionally, it is indicated whether wrong FS-IST answers are sent because the redundant switch off path is activated via the flag LV\_MC\_DR\_OFF.
- As the information whether the ignition key is switched on or off is important information, as it is used to determine whether the injection will be switched off (via the IOT), the MC sends its information LV\_IGK to the MU.
- If the ignition key is connected to the CAN bus, the state of the ignition key cannot be acquired by the MU. In this case the IGK acquisition of the MU must be configured to software acquisition, i.e., LV\_IGK is used to determine whether the IOT or the POT has to be started.
- To ensure that the MU is always working in the correct mode, it reads back its internally stored configuration data 1 and sends it back to the MC in the form of LF\_MU\_CONF\_BYTE\_NORM.
- The MU shall send the status of its disable outputs in LV\_MU\_DI\_OUT\_0 and LV\_MU\_DI\_OUT\_1.
- The MU sends the latched valued of its input for the ignition key signal as LV\_MU\_IGN\_KEY (regardless of whether it was configured for SW or HW acquisition of said signal).

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### E.36.3.4 DISABLE state communication

MC → MU	MU → MC
NC_STATE_MC_DI	NC_STATE_MC_DI
STATE_ERR_IDC_MC ERR_COD_MC (P)	LF_MU_ERR_BYTE (P) (Combining ERR_COD_MU and STATE_ERR_IDC_MU)
LV_IGK CTR_RST_MC (P)	CTR_RST_MU (P)
Empty (0x00)	LV_MU_IGN_KEY
Empty (0x00)	VP_MU_AN_DIG_MON
Checksum	Checksum

(P) = Due to the high importance of the information, these data bytes are protected by a parity bit. A parity error (odd instead of even parity) is regarded as a communication error, see "G- Parity-bit checking."

- MC and MU exchange error codes, error indications, and reset counters (the error code and error indication of the MU are sent as LF\_MU\_ERR\_BYTE and then "decoded" to ERR\_COD\_MU and STATE\_ERR\_IDC\_MU).
- The MC sends its value of the ignition key signal, so does the MU.
- The MU sends the monitored analogue value VP\_MU\_AN\_DIG\_MON.

### E.36.4 Table of error codes of MC and MU

The following table shows the meanings of the different error codes of MC in order to make it easier to analyse them in case of an error detected by Processor Monitoring.



Value	ERR_COD_MC	ERR_COD_MU
0	No error	No error
1	Header-byte error detected on MC	Header-byte error detected on MU
2	Checksum error detected on MC	Checksum error detected on MU
3	Parity error detected on MC	Parity error detected on MU
4	Wrong configuration data sent by MU	Wrong configuration data sent by MC
5	Error in switch-off path check	Error in complement check of configuration data
6	Error in compatibility check on MC	Error in compatibility check on MU
7	Error in Standard ROM check	Communication maximum time-out monitoring
8	Error in Standard RAM check	Communication minimum time-out monitoring
9	Error in Level 2 ROM check	Error detected by ignition key monitoring on MU
10	Error in Level 2 RAM check	NORMAL instead of EOLT header received
11	FS-IST: MU sent wrong question	FS-IST: MC sent wrong answer
12	FS-IST: MU does not react to deliberately wrong answer	Redundant switch-off path has been triggered
13	FS-IST: MU does not decrease its FS-IST anti-bounce counter	MU has detected under-voltage
14	Error in check of MU readiness	MU has detected over-voltage
15	- ( <i>not used</i> )	MU has detected under- and over-voltage
16	PFM: MU does not toggle PFM bit 0 in time	PFM task 0 executed to slowly on MC
17	PFM: MU does not toggle PFM bit 1 in time	PFM task 1 executed to slowly on MC
18	PFM: MU does not toggle PFM bit 2 in time	PFM task 2 executed to slowly on MC
19	PFM: MU does not toggle PFM bit 3 in time	PFM task 3 executed to slowly on MC
20	PFM: MU does not toggle PFM bit 4 in time	PFM task 4 executed to slowly on MC
21	PFM: MU does not toggle PFM bit 5 in time	PFM task 5 executed to slowly on MC
22	PFM: MU does not toggle PFM bit 6 in time	PFM task 6 executed to slowly on MC
23	Invalid state transition or undefined state on MC	Invalid state transition or undefined state on MU
24	PFM: MU does not react to deliberately wrong PFM bit 0	- ( <i>not used</i> )
25	PFM: MU does not react to deliberately wrong PFM bit 1	- ( <i>not used</i> )
26	PFM: MU does not react to	- ( <i>not used</i> )



	deliberately wrong PFM bit 2	
27	PFM: MU does not react to deliberately wrong PFM bit 3	- (not used)
28	PFM: MU does not react to deliberately wrong PFM bit 4	- (not used)
29	PFM: MU does not react to deliberately wrong PFM bit 5	- (not used)
30	PFM: MU does not react to deliberately wrong PFM bit 6	- (not used)
31	- (not used)	- (not used)

## E.37 Switch off path check

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IDX_STATE_SOPC	O/V/S	0... FH	0... 15	1	-
Index into lookup table to determine the final result of the SOPC (stored in reset-safe manner)					
IDX_STATE_SOPC_CPL	O/S	0... FH	0... 15	1	-
Complement of IDX_STATE_SOPC (stored in reset-safe manner)					
LV_MC_SOPC_ACT	O/V	0... 1H	0 ...1	1	-
Flag indicating whether MC SOPC is still active (=1, i.e., not finished) or not (=0)					
LV_MC_SOPC_INH_DI	O/V	0... 1H	0 ...1	1	-
Flag indicating to other functions not to disable the power stages via HW disable lines because the MU-part of the SOPC is active					
LV_MC_SOPC_INH_DI_CPL	O	0... 1H	0 ...1	1	-
Complement of LV_MC_SOPC_INH_DI					
STATE_MC_RESP_SOPC	V	0... FFH	0... 255	1	-
Local variable: final result of the SOPC					

### Input data:

CTR_RST_MC {p. 7072}	CTR_RST_MC_CPL {p. 7072}	LV_MC_INH_SOPC {p. 7072}	NC_STATE_MC_CONF {p. 7136}
NC_STATE_MC_DI {p. 7136}	NC_STATE_MC_INI {p. 7136}	NC_STATE_MC_NORM {p. 7136}	NC_STATE_MC_PRDR {p. 7136}
STATE_MC {p. 7135}			

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CTR_RST_MC_THD_SOPC	-	0... FH	0... 15	1	-
SOPC threshold for reset counter determining from which lookup table the final result shall be obtained					
NC_IDX_STATE_SOPC_DFCT	-	0... FH	0... 15	1	-
Constant for lookup index indicating that no corresponding switch-off path is working (all defective)					
NC_NR_RESP_SOPC	-	0... FFH	0... 255	1	-
Size of arrays for switch-off path check					
NC_RESP_SOPC_1 [NC_NR_RESP_SOPC]	-	0... FFH	0... 255	1	-
Lookup table for final result if reset counter < SOPC threshold					
NC_RESP_SOPC_2 [NC_NR_RESP_SOPC]	-	0... FFH	0... 255	1	-
Lookup table for final result if reset counter >= SOPC threshold NC_CTR_RST_MC_THD_SOPC					
NC_STATE_RESP_DR_DFT	-	0... 3H	0 ...3	1	-
Diagnostic result of power stage (driver): default value "undefined" (i.e., no check could be performed)					
NC_STATE_RESP_DR_DI	-	0... 3H	0 ...3	1	-
Diagnostic result of power stage (driver): driver disabled (i.e., switch-off path is working)					
NC_STATE_RESP_DR_ENA	-	0... 3H	0 ...3	1	-
Diagnostic result of power stage (driver): driver enabled (i.e., switch-off path is not working)					
NC_STATE_RESP_SOPC_DFCT	-	0... FFH	0... 255	1	-
Constant indicating that the SOPC completely failed					
NC_STATE_RESP_SOPC_OK	-	0... FFH	0... 255	1	-
Constant indicating that the SOPC was completely successful					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

### Action definition

ACTION_ECM3_McCancelSopc ()	Mode: O
This action cancels the SOPC.	

### Import actions:

ACTION_ECM3_ChkCpl (IN<PRM_VAR>,IN<PRM_VAR_CPL>)
ACTION_ECM3_McReadChkCpl (OUT<PRM_RESULT>,IN<PRM_VAR>,IN<PRM_VAR_CPL>,IN<PRM_DFT_VALUE>)
ACTION_ECM3_McReadChkState (OUT<PRM_STATE_MC_TMP>)
ACTION_ECM3_ReadChkCpl (OUT<PRM_RESULT>,IN<PRM_VAR>,IN<PRM_VAR_CPL>)
ACTION_ECM3_WriteChkCpl (INOUT<PRM_VAR>,OUT<PRM_VAR_CPL>,IN<PRM_VALUE>)
ACTION_INFR_McGetDiagPws0 (OUT<state_mc_sopc_dr_0>)
ACTION_INFR_McGetDiagPws1 (OUT<state_mc_sopc_dr_1>)

Note: mode "S" shall mean storage in reset-safe, but not necessarily non-volatile memory.

### Description for actions:

<b>ACTION_ECM3_McCancelSopc()</b>					
When called, this action resets LV_MC_SOPC_INH_DI in order to ensure that the power stages can be properly disabled by the MC; this is used inside G1 "Central Fault Reaction" which could be activated while the SOPC is not yet finished.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit

### FUNCTION DESCRIPTION:

#### General information:

The switch-off path check (SOPC, previously also known as "Predrive Check") is part of the standard monitoring duties performed by the processor monitoring functions.

Its objective is to determine whether the system's *switch-off paths*, i.e., dedicated physical connections with the purpose to disable the safety-relevant power stages are fully functional, in case an error should necessitate this action,.


Both MC and MU can have up to two such switch-off paths each connected to MC and MU.

The check itself is performed during the system's start-up (see signal flow diagram below).

The principle idea of the check is that one of the two system components (MC or MU) attempts to disable the power stages it is connected to and then, after obtaining status information from the power stages, it is judged whether they are indeed disabled.

The status of the power stages during the SOPC shall be collected on the MC, simply because the MU cannot read back the status of the power stages.

It is clear that the SOPC has to be synchronised between the MC and the MU in order to avoid conflicts stemming from the need to unequivocally decide whether a given switch-off path works or not (e.g., the

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MC and MU paths must not be tested at the same time because it might not be possible to determine which component is actually responsible for the disabling or, should the disabling fail, which switch-off path to which component is broken).

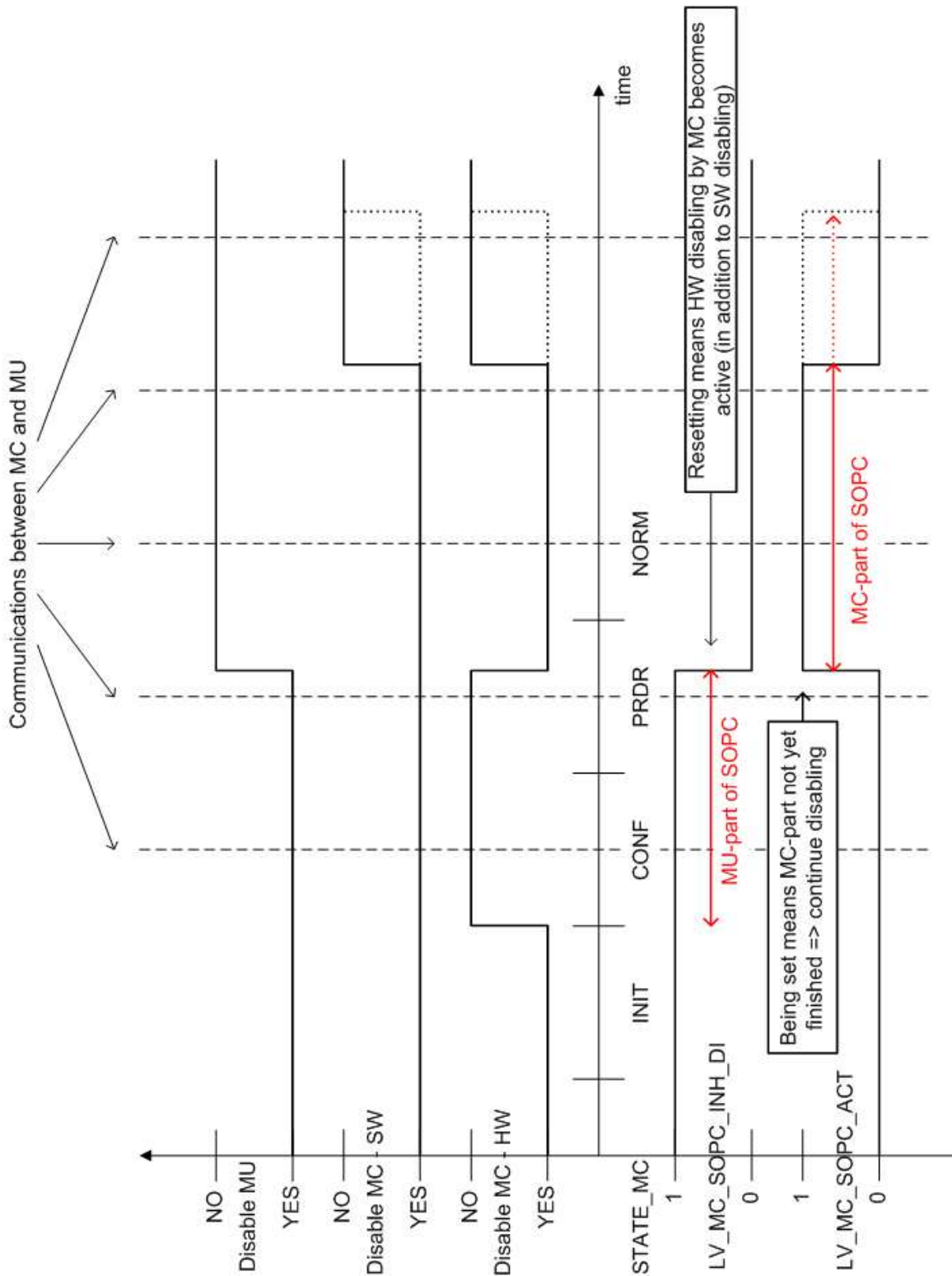
Since communications constitute the main synchronisation mechanism between MC and MU, the SOPC is synchronised according to different communications between MC and MU.

**This specification describes the generic procedure; any project-specific deviation or extension shall be specified in the application incidences, function "G27 Configuration for switch-off path check."**

### Signal flow diagram:

The sequencing of the switch-off path check with respect to the different communications is shown in the following diagram (note that the diagram only shows the case when no temporary disabling is performed):


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**Description:**

The function shall incorporate the following requirements (always refer to the signal flow diagram):

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## G26 Switch-off path check

R26\_1: The status information of a power stage shall be retrieved using the actions ACTION\_INFR\_McGetDiagPws0() and ACTION\_INFR\_McGetDiagPws1(); the requirements to these actions are described in the section "ECM3 - MC requirements to infrastructure interface."

R26\_2: For the check of the MU switch-off paths:

R26\_2.1: it shall be performed after the transition from INIT to CONFIG but before triggering the PREDRIVE communication (since, under regular circumstances, the MU stops disabling the power stages after the PREDRIVE communication, see signal flow diagram);

R26\_2.2: if any of the two actions returns "undefined" as status information from a power stage, it shall be assumed that the corresponding switch-off path is not working;

R26\_2.3: the result of the SOPC for the MU paths shall be stored as the two lower bits in the 4-bit vector IDX\_STATE\_SOPC, which shall be stored together with its complement IDX\_STATE\_SOPC\_CPL (see "RAM check service actions of processor monitoring on MC"), its default value being NC\_IDX\_STATE\_SOPC\_DFCT (= no switch-off path working);

R26\_2.4: the diagnostic result for power stage 0 shall be the MSB of the two bits reserved for the MU results;

R26\_2.5: a set bit shall indicate that the switch-off path is working;

R26\_2.6: when storing the two MU results, the upper two bits shall be reset (since IDX\_STATE\_SOPC is stored in reset-safe memory, these might still contain old data from a previous SOPC).

R26\_3: The flag LV\_MC\_SOPC\_INH\_DI shall be handled as follows:

R26\_3.1: it shall be set for the duration of the MU-part of the SOPC (from initialisation to shortly before the PREDRIVE communication);

R26\_3.2: it shall be reset after the MU-part of the SOPC **but before the PREDRIVE communication**;

R26\_3.3: it shall be stored together with its complement LV\_MC\_SOPC\_INH\_DI\_CPL pair and accessed using the actions from "RAM check service actions of processor monitoring on the MC", with default value 0, indicating inactive SOPC.

R26\_4: For the check of the MC switch-off paths:

R26\_4.1: it shall be performed at some point after triggering the PREDRIVE communication (under regular circumstances, the MU then no longer disables the power stages);

R26\_4.2: if any of the two actions returns "undefined" as status information from a power stage, it shall be assumed that the corresponding switch-off path is not working;

R26\_4.3: the result of the SOPC for the MC paths shall be stored as the two upper bits in the 4-bit vector IDX\_STATE\_SOPC, which shall be stored together with its complement IDX\_STATE\_SOPC\_CPL (see "RAM check service actions of processor monitoring on MC"), its default value being NC\_IDX\_STATE\_SOPC\_DFCT (= no switch-off path working);

R26\_4.4: the diagnostic result for power stage 0 shall be the MSB of the two bits reserved for the MC results;


R26\_4.5: a set bit shall indicate that the switch-off path is working.

R26\_5: As for the exact timing of the MC-part of the SOPC:

R26\_5.1: after the MU-part of the SOPC **but before the PREDRIVE communication**, LV\_MC\_SOPC\_ACT shall be set to 1 in order to indicate that the MC-part of the SOPC has not yet been completed (this prompts disabling of power stages by the MC, cf. R22\_10);

R26\_5.2: the MC-part of the SOPC can only be performed if LV\_MC\_INH\_SOPC = 0 (this indicates that the power stages are no longer temporarily disabled and that the MU no longer disables the power stages); under regular circumstances, this leaves time between after the PREDRIVE communication and before triggering the second NORMAL communication (cf. R22\_7.1 and R22\_9) to perform the check;

R26\_5.3: otherwise, if LV\_MC\_INH\_SOPC = 1, the MC-part of the SOPC has to be postponed until R26\_5.2 becomes applicable (note that LV\_MC\_SOPC\_ACT remains set!);

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R26\_5.4: after the MC-part of the SOPC has been finished, LV\_MC\_SOPC\_ACT shall be reset (allowing the power stages to be enabled, cf. R22\_10).

R26\_6: By the previous requirements R26\_2 and R26\_4, the index IDX\_STATE\_SOPC for the lookup in one of the result tables is generated by concatenating the results of MC and MU paths as depicted below:

Bit 3	Bit 2	Bit 1	Bit 0
MC result PSW0	MC result PWS1	MU result PWS0	MU result PWS1

R26\_7: For determining the final result of the SOPC, depending on the value of CTR\_RST\_MC (for which a consistency check with its complement CTR\_RST\_MC\_CPL using ACTION\_ECM3\_Read-ChkCpl() has to be performed), the following cases shall be distinguished:

R26\_7.1: if  $CTR\_RST\_MC < NC\_CTR\_RST\_MC\_THD\_SOPC$ , the final result of the switch-off path check STATE\_MC\_RESP\_SOPC shall be obtained by a lookup in the table NC\_RESP\_SOPC\_1[] at index IDX\_STATE\_SOPC;

R26\_7.2: if  $CTR\_RST\_MC = NC\_CTR\_RST\_MC\_THD\_SOPC$ , the final result of the switch-off path check STATE\_MC\_RESP\_SOPC shall be obtained by a lookup in the table NC\_RESP\_SOPC\_2[] at index IDX\_STATE\_SOPC;

R26\_7.3: the configuration of the lookup tables shall be described in the application incidences; in this way, the number of switch-off paths are connected to each component can be taken into account by putting dummy values into the lookup tables at appropriate positions.

R26\_8: For the final result STATE\_MC\_RESP\_SOPC:

R26\_8.1: it shall be obtained by a lookup in one of the two tables NC\_RESP\_SOPC\_x as described in R26\_7;

then shall determine the behaviour of the system as a reaction to the SOPC results; it shall be stored as a value/complement pair and be accessed by the actions from "RAM check service actions of processor monitoring on MC", its default value being NC\_STATE\_RESP\_SOPC\_DFCT (indicating a complete failure of the SOPC); the two simple cases are: allowing the engine to start-up as usual in case the result is NC\_STATE\_RESP\_SOPC\_OK (the switch-off path check was completely successful); performing the central fault reaction of processor monitoring in case NC\_STATE\_RESP\_SOPC\_DFCT (in case the status of the switch-off paths would not permit reaching the safe state of the system in case of a safety-critical error); since other reactions might be desired, there can be up to 256 different values which (potentially) could correspond to 256 different engine start-up behaviours (but it should be noted that there are only up to 16 different configurations of the status information of the power stages); the considered values (in addition to the default cases NC\_STATE\_RESP\_SOPC\_DFCT and NC\_STATE\_RESP\_SOPC\_OK), plus the corresponding reactions, are also described in the application incidences.

R26\_9: In DISABLE, the SOPC shall be cancelled; this means that LV\_MC\_SOPC\_INH\_DI shall be reset to 0 (and its complement set to 1) to indicate the end of the MU-part, and that LV\_MC\_SOPC\_ACT shall be reset to 0 to indicate the end of the MC-part.

R26\_10: If LV\_MC\_INH\_SOPC performs a transition from 0 to 1 during the MC-part of the SOPC (including the determination of the result), the MC-part has to be restarted (see R26\_5; the MC-part can only start anew when LV\_MC\_INH\_SOPC = 0).

**Description for action ACTION\_ECM3\_McCancelSopc:**

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<b>ACTION_ECM3_McCancelSopc()</b>					
When called, this action resets LV_MC_SOPC_INH_DI in order to ensure that the power stages can be properly disabled by the MC; this is used inside G1 "Central Fault Reaction" which could be activated while the SOPC is not yet finished.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit

### Formula section:

***/\* NOT using the RAM check service actions (to avoid recursion in fault reaction)! \*/***

LV\_MC\_SOPC\_INH\_DI = 0;

LV\_MC\_SOPC\_INH\_DI\_CPL = complement(0);

### Application conditions

#### Initialisation:

**After each power-up:**

*/ \* Using the RAM check service actions \*/*

IDX\_STATE\_SOPC = NC\_IDX\_STATE\_SOPC\_DFCT;

#### After each power-up or reset:

*/\* Using the RAM check service actions \*/*

LV\_MC\_SOPC\_INH\_DI = 1;

STATE\_MC\_RESP\_SOPC = NC\_STATE\_RESP\_SOPC\_DFCT;

*/\* MC-part of the SOPC not yet active, cf. R26\_5.1\*/*

LV\_MC\_SOPC\_ACT = 0;

#### Recurrence:

The **initialisation** shall be performed **after each power-up or reset (see above)**.

The **function itself** is **spread over the states INIT, CONFIG, PREDRIVE, and NORMAL**, as depicted in the signal flow diagram.

#### Activation:

STATE\_MC <> NC\_STATE\_MC\_DI (*inactive in DISABLE state*)

#### Deactivation:


STATE\_MC = NC\_STATE\_MC\_DI (*inactive in DISABLE state*)

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# F - Tuning functions

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## F.1 Misfire tuning functions

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INH_IGC_MIS_GEN	O/V	0... FFH	0... 255	1	-
Identification of cylinders shut off by ignition misfire generator					
INH_IV_MIS_GEN	O/V	0... FFH	0... 255	1	-
Identification of cylinders shut off by injection misfire generator					
LV_MIS_GEN	V	0... 1H	0 ...1	1	-
Flag to indicate the missing ignition and/or injection (current segment)					
LV_MIS_GEN_DET	V	0... 1H	0 ...1	1	-
Flag to indicate the missing ignition and/or injection, delayed to be synchronised with misfire detection flags					

### Input data:

EOI_LIM [NC_CYL_NR] {p. 797}	IGA_AV [NC_CYL_NR] {p. 1005}	N {p. 1525}	SEG_NR {p. 1525}
SOI_MAX {p. 807}	TD_IGC [NC_CYL_NR] {p. 1876}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MIS_RATE	-	0... FFH	0... 255	1	-
Misfire rate for regular misfire generator mode					
C_MIS_RATE_CYL [NC_CYL_NR]	-	0... FFH	0... 255	1	-
Misfire rate for cylinder regular misfire generator mode					
C_MOD_MIS_GEN	-	0... 2H	0 ...2	1	-
Misfire software generator function mode					
C_NR_TDC_DLY_MIS_GEN	-	0... FH	0... 15	1	-
Delay to synchronise LV_MIS_GEN_DET with misfire detection flags					
C_SEG_ST_MIS_GEN	-	0... 7H	0 ...7	1	-
Start segment for misfire software generator triggering					
ID_RND_PAT_MIS_GEN	V	0... 1H	0 ...1	1	-
LDP_X_ID_RND_PAT_MIS_GEN	16	0... FFH	0... 255	1	-
LDP_Y_ID_RND_PAT_MIS_GEN	16	0... FH	0... 15	1	-
Table of Boolean to define the pseudo random misfire sequence					
LC_IGN_OFF_MIS_GEN	-	0... 1H	0 ...1	1	-
Boolean for misfire generation with ignition cut-off (=1)					
LC_INJ_OFF_MIS_GEN	-	0... 1H	0 ...1	1	-
Boolean for misfire generation with injection cut-off (=1)					
LC_MIS_RATE_ENA_CYL [NC_CYL_NR]	-	0... 1H	0 ...1	1	-
Booleans to activate cylinder regular misfire generator mode per cylinder					
LC_REQ_MIS_GEN	-	0... 1H	0 ...1	1	-
Misfire software generator request					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_USE_MIS_GEN	-	0... 1H	0 ...1	1	-
Misfire software generator integration					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
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## F.1.1 Misfire software generator

### FUNCTION DESCRIPTION:

According the project SI integration plan and/or customer requirements/wishes, a software misfire generator can be included on EMS softwares and used during integration validation and calibration stages. It is strongly recommended to remove this functionality on serial product software: integration choice via NLC\_USE\_MIS\_GEN compilation switch.

### Application conditions

**Initialisation:** at reset & engine stalling  
LV\_MIS\_GEN = 0  
LV\_MIS\_GEN\_DET = 0  
INH\_IV\_MIS\_GEN = 0  
INH\_IGC\_MIS\_GEN = 0  
No function calls to INJR & IGR

**Recurrence:** *Segment*

### **Activation:**

The regular or random misfiring generation is applied on ignition and/or injection sequences.

**If** LC\_IGN\_OFF\_MIS\_GEN = 1

**Then** Ignition cut-off mode  
*(using INH\_IGC\_MIS\_GEN carrier, see Ignition misfire realisation)*  
LV\_MIS\_GEN is set to 1 according misfiring generation mode selected  
*(pseudo random or regular mode, see dedicated chapters below)*

**EndIf**

**If** LC\_INJ\_OFF\_MIS\_GEN = 1

**Then** Injection cut-off mode  
*(using INH\_IV\_MIS\_GEN carrier, see Injection misfire realisation)*  
LV\_MIS\_GEN is set to 1 according misfiring generation mode selected  
*(pseudo random or regular mode, see dedicated chapters below)*

**EndIf**

**If** LC\_IGN\_OFF\_MIS\_GEN = 1

**And** LC\_INJ\_OFF\_MIS\_GEN = 1

**Then** Ignition and injection off modes (for the same TDC)  
*(using INH\_IGC\_MIS\_GEN & INH\_IV\_MIS\_GEN carrier)*  
LV\_MIS\_GEN is set to 1 according misfiring generation mode selected  
*(pseudo random or regular mode, see dedicated chapters below)*

**EndIf**

**If** LC\_IGN\_OFF\_MIS\_GEN = 0

**And** LC\_INJ\_OFF\_MIS\_GEN = 0

**Then** No misfire generation allowed

LV\_MIS\_GEN = 0


INH\_IV\_MIS\_GEN = 0

INH\_IGC\_MIS\_GEN = 0

No function calls to INJR & IGR

**EndIf**

LV\_MIS\_GEN\_DET = LV\_MIS\_GEN delayed with C\_NR\_TDC\_DLY\_MIS\_GEN tdc's

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### F.1.1.1 Pseudo random misfiring generation mode

#### Application conditions:

The misfiring generation mode is authorised when the misfiring tuning function and the pseudo random misfiring tuning function are active.

This misfiring generation mode is global to all cylinders.

*Recurrence:* Segment

*Activation:*

```

If                LC_REQ_MIS_GEN = 1
    And            C_MOD_MIS_GEN = 0
    And            SEG_NR = C_SEG_ST_MIS_GEN
Then              Pseudo random misfiring generation is triggered
EndIf
    
```

*Deactivation:*

```

If                LC_REQ_MIS_GEN = 0
    Or              C_MOD_MIS_GEN ? 0
Then              Pseudo random misfiring generation mode is disabled
EndIf
    
```

#### Formula section:

A random ignition and/or injection is missing following the bitfield sequence ID\_RND\_PAT\_MIS\_GEN, where each bit corresponds to a TDC.

If the current bit value is 0 then the ignition and/or injection are missing; else ignition and injection are realised.

During the TDC where the ignition and/or injection are missing **And** if at least one of the cut-off mode is allowed (LC\_IGN\_OFF\_MIS\_GEN = 1 **Or** LC\_INJ\_OFF\_MIS\_GEN = 1), the flag LV\_MIS\_GEN is set to 1 else the flag LV\_MIS\_GEN is set to 0.

### F.1.1.2 Regular misfiring generation mode

#### Application conditions:

This generation mode is authorised when the misfiring tuning function and the regular misfiring tuning function are active.

This misfiring generation mode is global to all cylinders.

*Recurrence:* Segment

*Activation:*

```


If                LC_REQ_MIS_GEN = 1
    And            C_MOD_MIS_GEN = 1
    And            SEG_NR = C_SEG_ST_MIS_GEN
Then              Regular misfiring generation mode is triggered
EndIf
    
```

*Deactivation:*

```

If                LC_REQ_MIS_GEN = 0
    Or              C_MOD_MIS_GEN ? 1
Then              Regular misfiring generation mode is disabled
EndIf
    
```

#### Formula section:

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Regular ignition and/or injection are missing every C\_MIS\_RATE tdc.  
During the TDC where the ignition and/or injection are missing **And** if at least one of the cut-off mode is allowed (LC\_IGN\_OFF\_MIS\_GEN = 1 **Or** LC\_INJ\_OFF\_MIS\_GEN = 1), the flag LV\_MIS\_GEN is set to 1 else the flag LV\_MIS\_GEN is set to 0.

### F.1.1.3 Cylinder regular misfiring generation mode

#### Application conditions:

This generation mode is authorised when the misfiring tuning function and the regular misfiring tuning function are active.

This misfiring mode is dedicated to specific cylinder generation.

*Recurrence:* Segment

*Activation:*

```

If      LC_REQ_MIS_GEN = 1
          And      C_MOD_MIS_GEN = 2
          And      SEG_NR = C_SEG_ST_MIS_GEN
Then    Cylinder regular misfiring generation mode is triggered
EndIf
    
```

*Deactivation:*

```

If      LC_REQ_MIS_GEN = 0
          Or      C_MOD_MIS_GEN ? 2
Then    Cylinder regular misfiring generation mode is disabled
EndIf
    
```

#### Formula section:

```

If(1)    LC_MIS_RATE_ENA_CYL[SEG_NR] = 1
Then(1)  Ignition and/or injection are missing on cylinder SEG_NR every C_RATE_MIS_CYL[SEG_
NR] tdc's.
          If(2)    During the TDC where the ignition And/Or injection are missing
          And at least one of the cut-off mode is allowed (LC_IGN_OFF_MIS_GEN = 1 Or LC_INJ_
OFF_MIS_GEN = 1),
          Then(2)    LV_MIS_GEN = 1
          Else(2)    LV_MIS_GEN = 0
          EndIf(2)
Else(1)    No Ignition and/or injection are missing on cylinder SEG_NR
          LV_MIS_GEN is set to 0
EndIf(1)
    
```

### F.1.1.4 Injection misfire realisation

*Recurrence:* Every engine cycle, phased with required cylinder injection


#### Formula section:

The injection misfire realisation is realised via the INH\_IV\_MIS\_GEN carrier. This is an input for the Injection Cylinder Shut-Off Application Incidences file.

Cylinder switched off by injection software misfire generator is set to 1 within INH\_IV\_MIS\_GEN carrier.

All others cylinder bits are reset to 0 only if not set by the misfire pattern defined for the current engine cycle

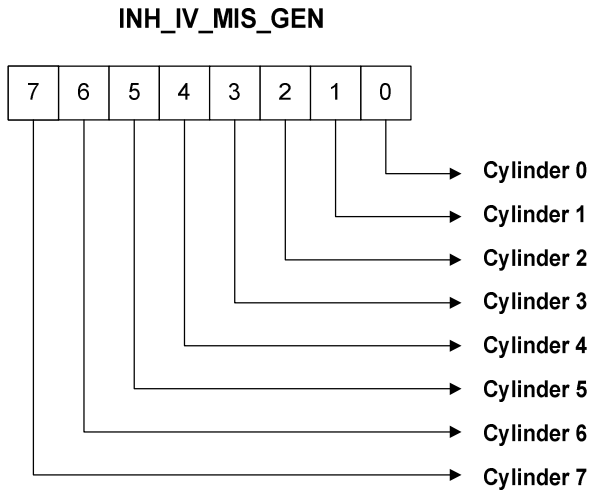
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**Important note on injection shut-off triggering:**

To be effective, the injection shut-off on Cylinder x must be triggered before the injection time starts on this cylinder. To evaluate the correct phasing for the injection shut-off, the maximum SOI (*start of injection angle*) is evaluated.

INH\_IV\_MIS\_GEN carrier must be updated at the segment just before the maximum start of injection ( SOI\_MAX + EOI\_LIM[0] ) to be strictly taken in account on this injection phase.



**F.1.1.5 Ignition misfire realisation**

*Recurrence: Every engine cycle, phased with required cylinder /coil ignition*

**Formula section:**

The ignition misfire realisation is realised via the INH\_IGC\_MIS\_GEN carrier. This is an input for the Ignition Cylinder Shut-Off Application Incidences file.

Cylinder switched off by ignition software misfire generator is set to 1 within INH\_IGC\_MIS\_GEN carrier.

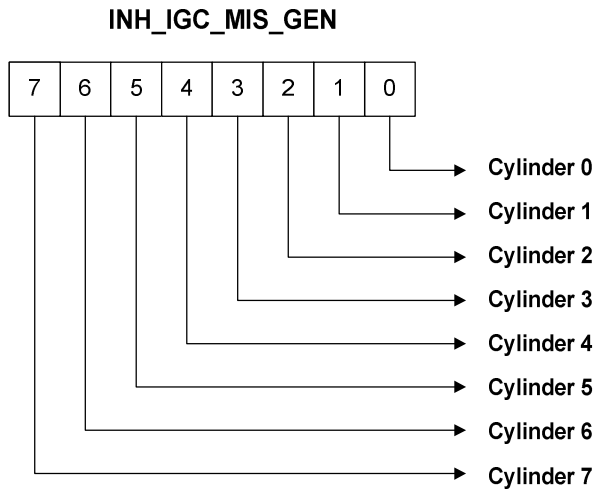
All others cylinder bits are reset to 0 only if not set by the misfire pattern defined for the current engine cycle

**Important note on ignition shut-off triggering:**

To be effective, the ignition shut-off on cylinder x must be triggered on the segment before the dwell time on the coil y starts for this cylinder x.

To evaluate the correct phasing for the ignition shut-off, the period TD\_IGC[x] must be converted in angle and added to the IGA\_AV[x] angle to defined the correct segment for triggering.


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# G - Vehicle speed control

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# G.1 Application conditions for cruise control

## Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
COUNT_VS_STEP	V	0... FFH	0... 255	1	-
Number of used Vehicle speed steps					
CTR_CRU_FLASH_LIGHT	-	0... FH	0... 15	1	-
Number of flash lights					
LV_CRU_DISP_HUD	O/V	0... 1H	0 ...1	1	-
Display on for HUD					
LV_PROG_STEP_1	O/V	0... 1H	0 ...1	1	-
Standing programming on					
LV_PROG_STEP_IF_ACT	V	0... 1H	0 ...1	1	-
Step Display on					
LV_STEP_ON	O/V	0... 1H	0 ...1	1	-
Step Display on					
LV_STEP_ON_ACT	O	0... 1H	0 ...1	1	-
Step Display on activation of resume					
LV_STEP_ON_ICL	O/V	0... 1H	0 ...1	1	-
Step Display on for instrument cluster					
NR_CRU_DIF_STEP	-	0... FFH	0... 255	1	-
Number of steps between VS_SP_DRIV_CRU_CAN and VS_MIN_CRU					
NR_STEP_ON	V	0... FFH	0... 255	1	-
Current vehicle speed step					
NR_VS_CRU	O/V	0... FFH	0... 255	1	-
Cycle numer of message IDX_NO					
VS_DIF_STEP_PROG	V	0... FFFFH	0... 511.99218	0.0078125	km/h
Differences between steps					
VS_IF_STEP_m	-	0... FFFFH	0... 511.9922	0.0078	km/h
Array of the vehicle speed steps depending on VEH_KEY_NR and Step number					
VS_SP_DRIV_CRU_CAN	O/V	0... FFFFH	0... 511.99218	0.0078125	km/h
Driver demand cruise control for INSTR					
VS_SP_DRIV_STEP	O/V	0... FFFFH	0... 511.99218	0.0078125	km/h
Active vehicle speed step for the controller					
VS_STEP_CAN_1	O/V	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed Step to the CAN i ( 1-3)					
VS_STEP_CAN_2	O/V	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed Step to the CAN i ( 1-3)					
VS_STEP_CAN_3	O/V	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed Step to the CAN i ( 1-3)					
VS_STEP_m	O/S	0... FFFFH	0... 511.9922	0.0078	km/h
Array of the vehicle speed steps depending on VEH_KEY_NR and Step number					

## Input data:

C_T_CRUS_OFF {p. 7220}	LC_CRUS_OFF_SWI {p. 7221}	LV_CRU_ACT {p. 7227}	LV_CRU_MAIN_SWI {p. 7220}
LV_IGK {p. 906}	LV_MSG_PROG_STEP_ CRU {p. 1566}	LV_ST {p. 1720}	LV_VAR_BN {p. 655}

LV_VAR_BN_LDM {p. 655}	LV_VAR_DCC {p. 655}	NR_VS_CRU_IF {p. 1569}	REQ_MSW {p. 7220}
STATE_CRU {p. 7227}	STATE_VS_ICL_DISP {p. 1578}	VEH_KEY_NR {p. 1582}	VS_CRU {p. 7215}
VS_MIN_CRU {p. 7227}	VS_SP_CRU_MAX {p. 7237}	VS_SP_DRIV_CRU {p. 7237}	VS_STEP_IF_1 {p. 1582}
VS_STEP_IF_2 {p. 1582}	VS_STEP_IF_3 {p. 1582}		

**Calibration data:**


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_CRU_FLASH_LIGHT	-	1... FFH	1... 255	1	-
Counter flash lights					
C_MAX_STEP	-	0... FFH	0... 255	1	-
Maximum number of steps					
C_T_CRU_FLASH_LIGHT	-	0... FFH	0... 2.55	0.01	s
Flash light duration time					
C_T_DLY_CRU_TIP	-	0... FFH	0... 2.55	0.01	s
Time delay for display vehicle speed pointer					
C_T_MIN_CRU_CHG	-	0... FFH	0... 2.55	0.01	s
Look time for events					
C_T_MIN_PROG	-	0... FFH	0... 5.1	0.02	s
Time for programming detection					
C_T_PROG_STEP_IF_ACT	-	0... FFH	0... 2.55	0.01	s
Time out for programming mode					
C_VS_DIF_STEP_MIN_HYS	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Minimum between steps hysteresis					
C_VS_DIF_STEP_MIN_K	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Minimum between steps in case of Km ICL					
C_VS_DIF_STEP_MIN_M	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Minimum between steps in case of mile ICL					
C_VS_DIF_STEP_PROG_K	-	0... FFFFH	0... 511.99218	0.0078125	km/h
km.p.h step calibration					
C_VS_DIF_STEP_PROG_M	-	0... FFFFH	0... 511.99218	0.0078125	km/h
m.p.h step calibration					
C_VS_DIF_TIP_PROG_K	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Difference between tip steps of Km ICL					
C_VS_DIF_TIP_PROG_M	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Difference between tip steps in case of mile ICL					
C_VS_MIN_PROG	-	0... FFFFH	0... 511.99218	0.0078125	km/h
VS_CRU threshold stand programming detection					
LC_CRU_DISP_SWI	-	0... 1H	0 ...1	1	-
Configuration switch to switch off CRU display for HUD and ICL due to driver request					

**General information:**

The stage cruise control is an add-on function of the cruise control. If is available then it's possible to program steps of vehicle speed witch are shown in the speedometer. The driver can used this function for jumps between fixed Steps during cruise control. The requirement is a steering lever with additional options MARK\_UP and MARK\_DOWN or the I drive functionality.

Basically there are two different ways of programming during drive or at standing vehicle.

The following assumptions of message from the CCC\_MASK are done:

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- receiving only at different data's
- the message to the instrument will sent after a complete receive of CCC\_MASK message
- depending on the calibration of C\_MAX\_STEP the quantity of evaluated NR\_VS\_CRU\_IF is limited

### Application conditions

#### Initialisation:

```

NR_STEP_ON = 0; COUNT_VS_STEP out of NVMY
VS_SP_DRIV_CRU_CAN = VS_MIN_CRU
LV_PROG_STEP_1 = 0
LV_STEP_ON = 0
  LV_CRU_DISP_HUD = 0
  LV_STEP_ON_ICL = 0
CTR_T_REQ_MSW_CON_MSG = 0
  VS_SP_DRIV_STEP = VS_MIN_CRU
  VS_STEP_m out of NVMY sorted depending on VEH_KEY_NR (if key
available)
  T_PROG_STEP_IF_ACT = 0

```

The vehicle key number is only read once at Initialisation, at the moment only one array for the first Key is available.

Recurrence: 10 ms

Recurrence: of NR\_VS\_CRU , VS\_STEP\_CAN\_i 100 ms to be Synchron with CAN Message

Activation: LV\_VAR\_BN = 1 and LV\_VAR\_DCC = 0 and LV\_VAR\_BN\_LDM = 0

#### Signal flow diagram:

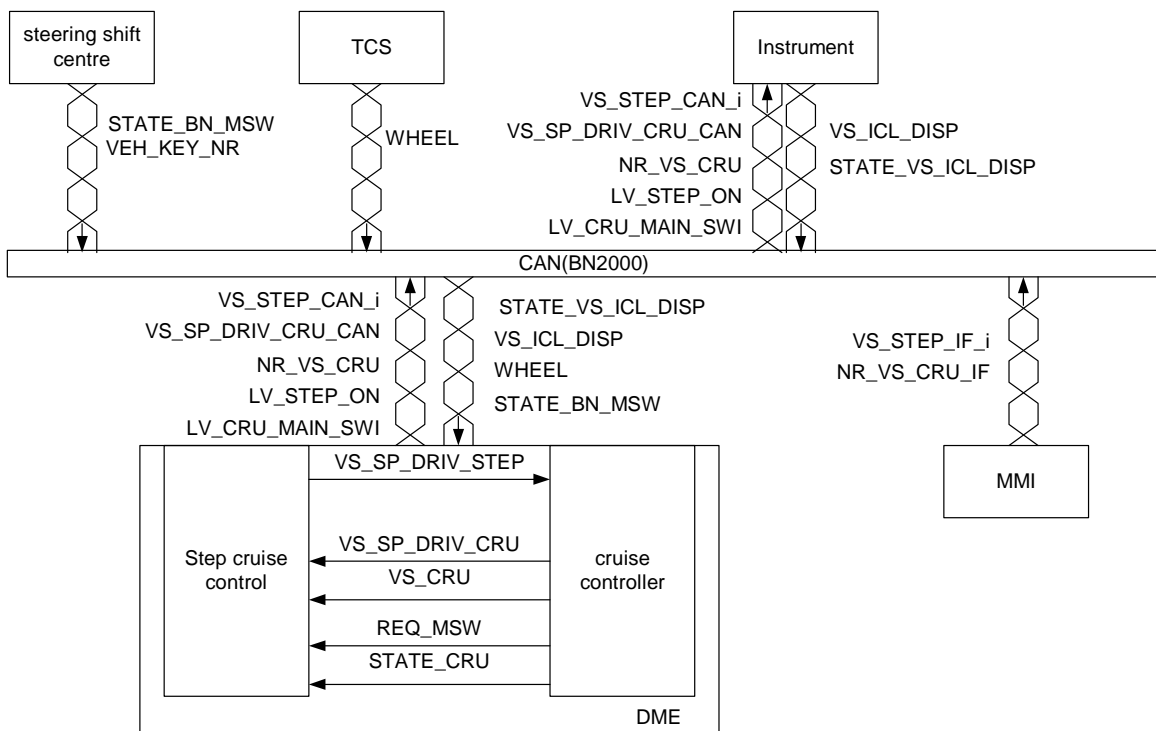


Figure G.1.1: : CAN structure for stage cruise control

**FUNCTION DESCRIPTION:****Description:**

The different states at the step control are triggered only at transitions of respective REQ\_MSW state at ramp to active. After detection of an event the respective REQ\_MSW State (TIP\_UP, DOWN; MARK\_UP, DOWN) is looked. MARK\_UP, DOWN for C\_T\_MIN\_CRU\_CHG or until idle is detected again, the exception is LV\_PROG\_STEP = 0 to 1

**Formula section:**

Counter:

```

IF          REQ_MSW = SOFT_OFF
THEN       increment CTR_T_REQ_MSW_CON_MSG
ELSE       CTR_T_REQ_MSW_CON_MSG = 0
ENDIF

```

Evaluation of CCC MASK message information for programming:

Vehicle speed steps of CCC\_MASK:

$$VS\_IF\_STEP\_m: m = \sum_{14}^0$$

m: Step number (0...14)

```

IF          LV_MSG_PROG_STEP_CRU == 1 ( new data available)
LV_MSG_PROG_STEP_CRU needs to be acknowledged after taking data over.

```

```

Then       LV_PROG_STEP_IF_ACT = 1
if         LV_PROG_STEP_IF_ACT = 0 1
Then       VS_IF_STEP_m(0...14) = 0
Else
Endif
VS_IF_STEP_m(0...14) = VS_STEP_IF_1
                    m = NR_VS_CRU_IF * 3           ; positions(0,3,6, 9,12)
VS_IF_STEP_m(0...14) = VS_STEP_IF_2
                    m = NR_VS_CRU_IF * 3+1         ; positions(1,4,7, 10,13)
VS_IF_STEP_m(0...14) = VS_STEP_IF_3
                    m = NR_VS_CRU_IF * 3+2         ; positions(2,5,8, 11,14)
else VS_STEP_m calculation of
endif
IF         LV_PROG_STEP_IF_ACT = 1
Then       T_PROG_STEP_IF_ACT ++
Endif
if         receiving C_MAX_STEP /3 blocks or
T_PROG_STEP_IF_ACT C_T_PROG_STEP_IF_ACT
Then       LV_PROG_STEP_IF_ACT = 0
T_PROG_STEP_IF_ACT = 0

```

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VS\_STEP\_m = VS\_IF\_STEP\_m (update count\_vs\_step, note: receive data  
can be unsorted)

[nr\_step\_on = 0]

**Endif**

Evaluation of key and stage information for programming:

Vehicle speed steps:

$$VS\_STEP\_m: \quad m = \sum_{14}^0$$

m: Step number (0...14)

	NR_VS_CRU				
	0	1	2	3	4
VS_STEP_CAN_1 =	VS_STEP_0	VS_STEP_3	VS_STEP_6	VS_STEP_9	VS_STEP_12
VS_STEP_CAN_2 =	VS_STEP_1	VS_STEP_4	VS_STEP_7	VS_STEP_10	VS_STEP_13
VS_STEP_CAN_3 =	VS_STEP_2	VS_STEP_5	VS_STEP_8	VS_STEP_11	VS_STEP_14

VS\_STEP\_m; m 0-14

VS\_STEP\_CAN\_i (i = 1,2,3) = VS\_STEP\_m

Programed vehicle speed steps:

$$VS\_STEP\_k: \quad k = \sum VS\_STEP\_m; \text{ for } VS\_STEP > 0 \text{ km. p. h.}$$

"0 = kmph means there is no programed VS\_CRU at this n\_m step"

COUNT\_VS\_STEP = number of VS\_STEP\_k

NR\_VS\_CRU : If a VS\_STEP\_m is changed the NR\_VS\_CRU is updated to the respective column number. In other cases and at first activation of Steps the Numbers is cycling updated. Additional the instrument unit itself saves the steps internal.

NR\_STEP\_ON : current step number of sorted Vehicle speed steps.

Concerning some programming rules of the steps, it is necessary to vary some variables in dependency on the equipped ICL. The difference is, whether the vehicle speed is announced in miles or kilometers.

**IF** STATE\_VS\_ICL\_DISP = 1 "km/h; mph"

**Then** VS\_DIF\_STEP\_MIN = C\_VS\_DIF\_STEP\_MIN\_M

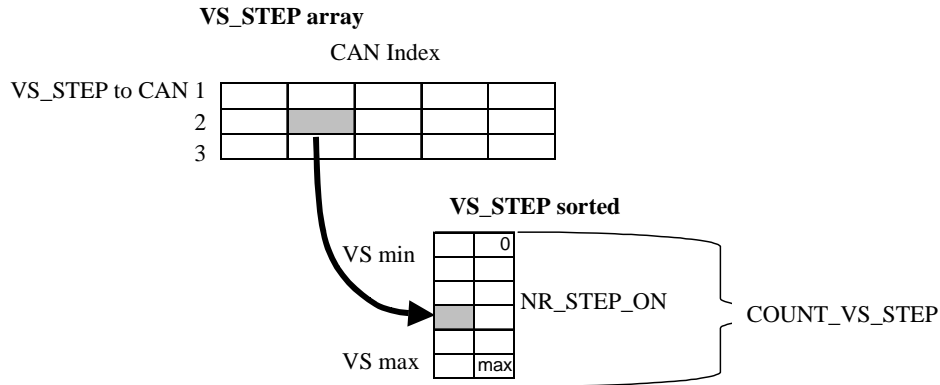
VS\_DIF\_TIP\_PROG = C\_VS\_DIF\_TIP\_PROG\_M

**Else** VS\_DIF\_STEP\_MIN = C\_VS\_DIF\_STEP\_MIN\_K

VS\_DIF\_TIP\_PROG = C\_VS\_DIF\_TIP\_PROG\_K

**Endif**

Signal flow diagram:



**REQ\_MSW = MARK UP:**

**IF** STATE\_VS\_ICL\_DISP = 1 "km/h; mph"  
**Then** NR\_CRU\_DIF\_STEP =  

$$\text{round down} ( \text{VS\_SP\_DRIV\_CRU\_CAN} / \text{C\_VS\_DIF\_STEP\_PROG\_M} )$$

$$\text{VS\_DIF\_STEP\_PROG} = \frac{\text{C\_VS\_DIF\_STEP\_PROG\_M} * (1 + \text{NR\_CRU\_DIF\_STEP}) - \text{VS\_SP\_DRIV\_CRU\_CAN}}{\text{VS\_DIF\_STEP\_PROG}}$$

$$\text{VS\_DIF\_STEP\_PROG} = \text{MAX} ( \text{VS\_DIF\_STEP\_MIN}; \text{VS\_CRU\_DIF\_STEP} )$$

**Else**

NR\_CRU\_DIF\_STEP =  

$$\text{round down} ( \text{VS\_SP\_DRIV\_CRU\_CAN} / \text{C\_VS\_DIF\_STEP\_PROG\_K} )$$

$$\text{VS\_DIF\_STEP\_PROG} = \frac{\text{C\_VS\_DIF\_STEP\_PROG\_K} * (1 + \text{NR\_CRU\_DIF\_STEP}) - \text{VS\_SP\_DRIV\_CRU\_CAN}}{\text{VS\_DIF\_STEP\_PROG}}$$

$$\text{VS\_DIF\_STEP\_PROG} = \text{MAX} ( \text{VS\_DIF\_STEP\_MIN}; \text{VS\_CRU\_DIF\_STEP} )$$

**End**

**REQ\_MSW = MARK DOWN:**

**IF** STATE\_VS\_ICL\_DISP = 1 "km/h; mph"  
**Then** NR\_CRU\_DIF\_STEP =  

$$\text{round down} ( \text{VS\_SP\_DRIV\_CRU\_CAN} / \text{C\_VS\_DIF\_STEP\_PROG\_M} )$$

$$\text{VS\_CRU\_DIF\_STEP} = \frac{-1 * ( \text{C\_VS\_DIF\_STEP\_PROG\_M} * \text{NR\_CRU\_DIF\_STEP} - \text{VS\_SP\_DRIV\_CRU\_CAN} )}{\text{VS\_DIF\_STEP\_PROG}}$$

**IF** VS\_CRU\_DIF\_STEP = =0 km/h  
**Then** VS\_DIF\_STEP\_PROG = C\_VS\_DIF\_STEP\_PROG\_M  
**else** VS\_DIF\_STEP\_PROG = MAX ( VS\_DIF\_STEP\_MIN; VS\_CRU\_DIF\_STEP )

**Else** NR\_CRU\_DIF\_STEP =

$$\text{round down} ( \text{VS\_SP\_DRIV\_CRU\_CAN} / \text{C\_VS\_DIF\_STEP\_PROG\_K} )$$

$$\text{VS\_CRU\_DIF\_STEP} = \frac{-1 * ( \text{C\_VS\_DIF\_STEP\_PROG\_K} * \text{NR\_CRU\_DIF\_STEP} - \text{VS\_SP\_DRIV\_CRU\_CAN} )}{\text{VS\_DIF\_STEP\_PROG}}$$

**IF** VS\_CRU\_DIF\_STEP = =0 km/h  
**Then** VS\_DIF\_STEP\_PROG = C\_VS\_DIF\_STEP\_PROG\_K  
**Else** VS\_DIF\_STEP\_PROG = MAX ( VS\_DIF\_STEP\_MIN; VS\_CRU\_DIF\_STEP )

**End**

**Standing vehicle programming detection LV\_PROG\_STEP\_1:**

Hysteresis of PROG\_STEP\_1:

```

IF      VS_CRU < C_VS_MIN_PROG          and
(REQ_MSW = MARK_UP or DOWN)              and
LV_IGK = 1                                and
LV_PROG_STEP_1 = 0
Then    LV_PROG_STEP_1 = 1
          LV_STEP_ON_PREV = LV_STEP_ON
          After first cycle of NR_VS_CRU; then LV_STEP_ON = 1      "display on"
ElseIf  LV_PROG_STEP_1 = 1              and
          (VS_CRU > C_VS_MIN_PROG or LV_IGK = 0 or LV_ST = 1 or
(CTR_T_REQ_MSW_CON_MSG > C_T_CRUS_OFF and
LC_CRUS_OFF_SWI = 0)
Then    LV_PROG_STEP_1 = 0
          LV_STEP_ON = LV_STEP_ON_PREV
          LV_STEP_ON_PREV = 0

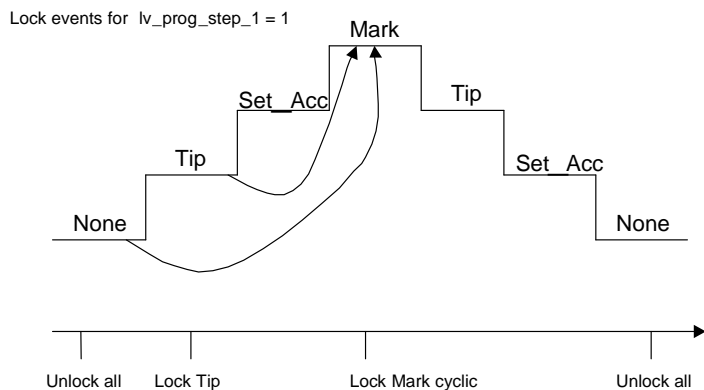
Endif

```

**G.1.1 Program conditions at Standing vehicle**

Activation: LV\_PROG\_STEP\_1 = 1

MSW detection:



**VS\_SP\_DRIV\_CRU\_CAN:**

First initialisation of VS\_SP\_DRIV\_CRU\_CAN:

```

IF      LV_PROG_STEP_1n-1 = 0 LV_PROG_STEP_1n = 1
Then    VS_SP_DRIV_CRU_CAN = VS_MIN_CRU
Else    "no action"
Endif

```

Calculation of VS\_SP\_DRIV\_CRU\_CAN:

**REQ\_MSW = MARK\_UP**

#-----


No step available:

```

IF      COUNT_VS_STEP = 0
Then    VS_SP_DRIV_CRU_CAN = min((VS_SP_DRIV_CRU_CAN(n-1)) +

```

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VS\_DIF\_STEP\_PROG); VS\_SP\_CRU\_MAX )

-----  
*step available (goto next higher step):*

**ElseIf** VS\_SP\_DRIV\_CRU\_CAN < max (VS\_STEP\_m)

**then** VS\_SP\_DRIV\_CRU\_CAN = VS\_STEP\_m

[for m = m =  $\sum_k^0$  ; min(abs(VS\_SP\_DRIV\_CRU\_CAN- VS\_STEP\_m)) **and**

VS\_SP\_DRIV\_CRU\_CAN < VS\_STEP\_m]

**Else IF** COUNT\_VS\_STEP < C\_MAX\_STEP

**then** VS\_SP\_DRIV\_CRU\_CAN = min((VS\_SP\_DRIV\_CRU\_CAN<sub>(n-1)</sub> +  
 VS\_DIF\_STEP\_PROG); VS\_SP\_CRU\_MAX)

**Else "NR\_STEP\_ON = C\_MAX\_STEP"**

VS\_SP\_DRIV\_CRU\_CAN<sub>n</sub> = VS\_SP\_DRIV\_CRU\_CAN<sub>(n-1)</sub>

**Endif**

-----#  
**REQ\_MSW = MARK\_DOWN:**

#-----

*No step available:*

**IF** COUNT\_VS\_STEP = 0

**Then** VS\_SP\_DRIV\_CRU\_CAN = max ((VS\_SP\_DRIV\_CRU\_CAN<sub>(n-1)</sub> -  
 VS\_DIF\_STEP\_PROG); VS\_MIN\_CRU)

-----  
*step available (goto next lower step):*

**ElseIf** VS\_SP\_DRIV\_CRU\_CAN > min (VS\_STEP\_m; m= 0 to k)

**then** VS\_SP\_DRIV\_CRU\_CAN = VS\_STEP\_m

[for m = m =  $\sum_k^0$  ; min(abs(VS\_SP\_DRIV\_CRU\_CAN- VS\_STEP\_m)) **and**

VS\_SP\_DRIV\_CRU\_CAN > VS\_STEP\_m]

**Else IF** COUNT\_VS\_STEP < C\_MAX\_STEP

**Then** VS\_SP\_DRIV\_CRU\_CAN = max ((VS\_SP\_DRIV\_CRU\_CAN<sub>(n-1)</sub> -  
 VS\_DIF\_STEP\_PROG); VS\_MIN\_CRU)

**Else** VS\_SP\_DRIV\_CRU\_CAN<sub>n</sub> = VS\_SP\_DRIV\_CRU\_CAN<sub>(n-1)</sub>

**Endif**

-----#  
**REQ\_MSW = TIP\_UP**


#-----

*No step available:*

**IF** COUNT\_VS\_STEP = 0

**Then** VS\_SP\_DRIV\_CRU\_CAN = (VS\_SP\_DRIV\_CRU\_CAN<sub>(n-1)</sub> +  
 VS\_DIF\_TIP\_PROG)

-----

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*"step available ":*

**ElseIf** COUNT\_VS\_STEP < C\_MAX\_STEP

**Then** *"tip up"*

VS\_SP\_DRIV\_CRU\_CAN = VS\_SP\_DRIV\_CRU\_CAN<sub>(n-1)</sub> +  
VS\_DIF\_TIP\_PROG

*"Proofing of Step range catch function"*

**IF** VS\_SP\_DRIV\_CRU\_CAN - VS\_STEP\_m < VS\_DIF\_STEP\_MIN

[for m = m =  $\sum_k^0$  ; min(abs(VS\_SP\_DRIV\_CRU\_CAN- VS\_STEP\_m)) ]

**Then** **IF** VS\_SP\_DRIV\_CRU\_CAN <= VS\_STEP\_m

**Then** VS\_SP\_DRIV\_CRU\_CAN = VS\_STEP\_m

**else** VS\_SP\_DRIV\_CRU\_CAN =

VS\_STEP\_m + VS\_DIF\_STEP\_MIN

**IF** VS\_SP\_DRIV\_CRU\_CAN >

VS\_STEP\_m (+1) - VS\_DIF\_STEP\_MIN

**Then** VS\_SP\_DRIV\_CRU\_CAN = VS\_STEP\_m (m+1)

**else** **remains**

**endif**

**else** *"goto next higher step or stay on highest step"*

min (VS\_SP\_DRIV\_CRU\_CAN = VS\_STEP\_m ; max (VS\_STEP\_k))

[for m = m =  $\sum_k^0$  ; min(abs(VS\_SP\_DRIV\_CRU\_CAN- VS\_STEP\_m)) and

VS\_SP\_DRIV\_CRU\_CAN < VS\_STEP\_m]

**endif**

**endif**

VS\_SP\_DRIV\_CRU\_CAN = min (VS\_SP\_DRIV\_CRU\_CAN; VS\_SP\_CRU\_MAX)

-----#

**REQ\_MSW = SET/ACC:**

Calculation like "REQ\_MSW = TIP\_UP", but in a recurrency of the time delay C\_T\_DLY\_CRU\_TIP.

T = C\_T\_DLY\_CRU\_TIP

**IF** T = 0 ms

**Then** next cycle calculation

**else** T = T -10 ms

**endif**

**REQ\_MSW = TIP\_DOWN:**

#-----

*No step available:*

**IF** COUNT\_VS\_STEP = 0

**Then** VS\_SP\_DRIV\_CRU\_CAN = (VS\_SP\_DRIV\_CRU\_CAN<sub>(n-1)</sub> - VS\_DIF\_TIP\_PROG)

*"step available tip down":*

**ElseIf** COUNT\_VS\_STEP < C\_MAX\_STEP

**Then** *"tip down"*

$$VS\_SP\_DRIV\_CRU\_CAN = VS\_SP\_DRIV\_CRU\_CAN_{(n-1)} - VS\_DIF\_TIP\_PROG$$

"Proofing of Step range catch function"

**IF** VS\_SP\_DRIV\_CRU\_CAN - VS\_STEP\_m < VS\_DIF\_STEP\_MIN

[for m = m =  $\sum_k^0$  ; min(abs(VS\_SP\_DRIV\_CRU\_CAN- VS\_STEP\_m)) ]

**Then IF** VS\_SP\_DRIV\_CRU\_CAN => VS\_STEP\_m

**Then** VS\_SP\_DRIV\_CRU\_CAN = VS\_STEP\_m

**else** VS\_SP\_DRIV\_CRU\_CAN = VS\_STEP\_m - VS\_DIF\_STEP\_MIN

**IF** VS\_SP\_DRIV\_CRU\_CAN < = VS\_STEP\_m (-1) + VS\_DIF\_STEP\_MIN

**Then** VS\_SP\_DRIV\_CRU\_CAN = VS\_STEP\_m (m-1)

**else remains**

**endif**

**else** "goto next lower step or stay on lowest step"

max (VS\_SP\_DRIV\_CRU\_CAN = VS\_STEP\_m ; MIN(VS\_STEP\_k))

[for m = m =  $\sum_k^0$  ; min(abs(VS\_SP\_DRIV\_CRU\_CAN- VS\_STEP\_m)) **and**

VS\_SP\_DRIV\_CRU\_CAN > VS\_STEP\_m]

**endif**

**endif**

VS\_SP\_DRIV\_CRU\_CAN = max (VS\_SP\_DRIV\_CRU\_CAN ; VS\_MIN\_CRU)

-----#

#### REQ\_MSW = DECC:

Calculaion like "REQ\_MSW = TIP\_DOWN", but in a recurrency of the time delay C\_T\_DLY\_CRU\_TIP.

T= C\_T\_DLY\_CRU\_TIP

**IF** T = 0 ms

**Then** next cycle calculation

**else** T = T -10 ms

**endif**


VS\_SP\_DRIV\_CRU\_CAN is allways limited in the range between VS\_MIN\_CRU and C\_VS\_SP\_MAX\_CRU.

#### Saving current Step VS\_STEP\_m:

(REQ\_MSW = RES and LV\_PROG\_STEP\_IF\_ACT== 0)

for T > C\_T\_MIN\_PROG

-----  
Set:

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**IF(3)** VS\_SP\_DRIV\_CRU\_CAN =><= VS\_STEP\_m ; (m =  $\sum_k^0$ ) ± VS\_DIF\_STEP\_MIN

**Then(3)** VS\_STEP\_m; m=k+1= VS\_SP\_DRIV\_CRU\_CAN  
For index m : VS\_STEP\_m<sub>(n-1)</sub> = 0 km.p.h.

-----  
erase:

**Else(3)** VS\_STEP\_m; m=k = 0 km.p.h (erase step)

**Endif**

### G.1.2 Conditions at driving

Activation: LV\_PROG\_STEP\_1 = 0:

Recurrence: 10 ms

#### Calculation of VS\_SP\_DRIV\_CRU\_CAN:

Depending on the State of cruise controller:

```

If LV_CRU_MAIN_SWI = 1
Then If LV_CRU_MAIN_SWI = 0 1 or STATE_CRU = Passiv active
Then VS_SP_DRIV_CRU_CAN = VS_SP_DRIV_CRU
Else if STATE_CRU = "SET_ACC / RETARD"
Then if REQ_MSW = ACC active
Then if VS_CRU VS_SP_DRIV_CRU_CAN
Then VS_SP_DRIV_CRU_CAN = MIN(VS_CRU; VS_SP_CRU_
MAX)
Endif
Else if VS_CRU VS_SP_DRIV_CRU_CAN // DEC ac-
tive
Then VS_SP_DRIV_CRU_CAN = MAX(VS_CRU; VS_MIN_CRU)
Endif
Endif
Else VS_SP_DRIV_CRU_CAN = VS_SP_DRIV_CRU
Endif
Endif

```

-----  
Recurrence: 10 ms:

#### Calculation of vehicle speed steps:

(REQ\_MSW = RES and LV\_PROG\_STEP\_IF\_ACT == 0 and VS\_CRU VS\_MIN\_CRU )  
for T > C\_T\_MIN\_PROG

Activation: LV\_STEP\_ON = 1 AND  
LV\_CRU\_MAIN\_SWI = 1 AND

NOT (LV\_CRU\_ACT = 0 -> 1 )

-----  
Set:

IF VS\_SP\_DRIV\_CRU\_CAN >< VS\_STEP\_m ; (m =  $\sum_k^0$ ) ± VS\_DIF\_STEP\_MIN

**Then IF** COUNT\_VS\_STEP < C\_MAX\_STEP  
**Then** VS\_STEP\_m; m=k+1= VS\_SP\_DRIV\_CRU\_CAN  
 For index m : VS\_STEP\_m(n-1) = 0 km.p.h.  
**Else**  
**repeat**  
 ignore of request, " number of steps are full"  
 " flashlight message triggered for "  
 LV\_STEP\_ON = 0 for C\_T\_CRU\_FLASH\_LIGHT then  
 LV\_STEP\_ON = 1 for C\_T\_CRU\_FLASH\_LIGHT then  
 CTR\_CRU\_FLASH\_LIGHT + 1  
**until** CTR\_CRU\_FLASH\_LIGHT = C\_CTR\_CRU\_FLASH\_LIGHT  
 reset counter CTR\_CRU\_FLASH\_LIGHT to 0  
**Else IF** VS\_SP\_DRIV\_CRU\_CAN >< VS\_STEP\_m ; (m =  $\sum_k^0$ ) ± (VS\_DIF\_STEP\_MIN -  
 C\_VS\_DIF\_STEP\_MIN\_HYS)  
**Then** erase: -----  
 VS\_STEP\_m; m=k = 0 km.p.h (errase step)  
 -----  
**else repeat**  
 ignore of request, " flashlight message triggered for "  
 LV\_STEP\_ON = 0 for C\_T\_CRU\_FLASH\_LIGHT then  
 LV\_STEP\_ON = 1 for C\_T\_CRU\_FLASH\_LIGHT then  
 CTR\_CRU\_FLASH\_LIGHT + 1  
**until** CTR\_CRU\_FLASH\_LIGHT = C\_CTR\_CRU\_FLASH\_LIGHT  
 reset counter CTR\_CRU\_FLASH\_LIGHT to 0  
**endif**  
**Endif**

**REQ\_MSW = MARK\_UP:**

**If** LV\_CRU\_MAIN\_SWI = 0 1 **or**  
 LV\_CRU\_ACT = 0 1  
**Then** lock key permanent  
**If** LV\_STEP\_ON = 0 **and**  
 Flashlight is not active  
**Then** LV\_STEP\_ON = 1  
**Endif**  
**Else** lock key cyclic  
**IF** LV\_CRU\_ACT = 1  
**Then IF** COUNT\_VS\_STEP = 0  
**Then If** LV\_STEP\_ON = 0 **and**  
 Flashlight is not active

```

        Then          LV_STEP_ON = 1
        Endif
VS_SP_DRIV_STEP = min((VS_SP_DRIV_CRU_CAN +
                        VS_DIF_STEP_PROG);
                        VS_SP_CRU_MAX)
        LV_STEP_ON_ACT = 1
Else          If          LV_STEP_ON = 0          and
                Flashlight is not active
        Then          LV_STEP_ON = 1
                Lock key permanent
        Else          IF          VS_SP_DRIV_CRU_CAN < max (VS_STEP_m)
        Then          VS_SP_DRIV_STEP = VS_STEP_m "next higher step"

[for m = m =  $\sum_k^0$  ; min(abs(VS_SP_DRIV_CRU_CAN- VS_STEP_m)) and

                VS_SP_DRIV_CRU_CAN < VS_STEP_m]
                LV_STEP_ON_ACT = 1
        Else no reaction          LV_STEP_ON_ACT = 0
        Endif
        Endif
        Endif
Else no reaction
        Endif
Endif

```

**REQ\_MSW = MARK\_DOWN:**

```

If          LV_CRU_MAIN_SWI = 0  1          or
LV_CRU_ACT = 0  1
Then          lock key permanent
                If          LV_STEP_ON = 0          and
                        Flashlight is not active
                Then          LV_STEP_ON = 1
                Endif
Else          lock key cyclic
        IF          LV_CRU_ACT = 1
        Then          IF          COUNT_VS_STEP = 0
                Then          If          LV_STEP_ON = 0          and
                        Flashlight is not active
                        Then          LV_STEP_ON = 1
                        Endif
                VS_SP_DRIV_STEP = max((VS_SP_DRIV_CRU_CAN -
                        VS_DIF_STEP_PROG); VS_MIN_CRU)
                LV_STEP_ON_ACT = 1
        Else          If          LV_STEP_ON = 0          and
                        Flashlight is not active
                Then          LV_STEP_ON = 1
                        Lock key permanent

```


```

0 to k)
    Else IF VS_SP_DRIV_CRU_CAN > min (VS_STEP_m; m=
    Then VS_SP_DRIV_STEP = VS_STEP_m "next lower step"
    [for m = m =  $\sum_k^0$  ; min(abs(VS_SP_DRIV_CRU_CAN - VS_STEP_m)) and
    VS_SP_DRIV_CRU_CAN > VS_STEP_m]
    LV_STEP_ON_ACT = 1
    Else IF VS_SP_DRIV_CRU_CAN > VS_MIN_CRU
    Then VS_SP_DRIV_STEP = VS_MIN_CRU
    LV_STEP_ON_ACT = 1
    else no reaction LV_STEP_ON_ACT = 0
    Endif
    Endif
    Endif
    Endif
    Else no reaction
    Endif
Endif
"regards physical conversion of veh. Speeds"
reset of LV_STEP_ON during drive:
IF LV_CRU_MAIN_SWI = 0 and LV_PROG_STEP_1 = 0
Then LV_STEP_ON = 0; LV_STEP_ON_ACT = 0; stop flashlight
Endif

reset of LV_STEP_ON_ACT during drive:
If LV_STEP_ON_ACT = 1
Then CTR_STEP_ON_ACT ++
Else CTR_STEP_ON_ACT = 0
Endif
If CTR_STEP_ON_ACT > 100 ms
Then LV_STEP_ON_ACT = 0
CTR_STEP_ON_ACT = 0
Endif

setting of LV_CRU_DISP_HUD and LV_STEP_ON_ICL :
If LC_CRU_DISP_SWI = 1
Then If CTR_T_REQ_MSW_CON_MSG > C_T_CRUS_OFF or
LV_CRU_OFF_IRR = 1
Then LV_CRU_DISP_HUD = 0
LV_STEP_ON_ICL = 0
Elseif LV_CRU_ACT = 1 or LV_PROG_STEP_1 = 1 or ( REQ_MSW > 1H
and
REQ_MSW != 7H )
Then LV_CRU_DISP_HUD = 1
LV_STEP_ON_ICL = LV_STEP_ON
Endif
Else
LV_STEP_ON_ICL = LV_STEP_ON
Endif

```

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## G.2 Cruise control auxiliary functions

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
AC_CRU	O/V	8000... 7FFFH	-15.72864 ...15.72816	0.00048	m/s <sup>2</sup>
Vehicle acceleration in CRU					
FAC_TQ_REQ_DRIV_MMV	O/V	0... FFFFH	0... 1.999969	30.5175e-6	-
Mean moving value of driver torque demand					
LV_CRU_OFF_BY_ASR_ESP_CTL	O/V	0... 1H	0 ...1	1	-
Soft off condition depending on ASC interventions					
LV_VS_DIAG_NOT_PLAUS	O/V	0... 1H	0 ...1	1	-
VS_CRU not plausible					
N_VS_CRU	O/V	0... 1FE0H	0... 16320	2	rpm/(km/h)
Ratio between engine speed and vehicle speed					
VS_CRU	O/V	0... FFFFH	0... 511.9921875	0.0078125	km/h
Filtered vehicle speed					
VS_DIF_ICL_TCS	V	0... 1H	0 ...1	1	-
Difference of vehicle speed INSTR and TCS					

### Input data:

FAC_TQ_REQ_DRIV {p. 6570}	LV_AT {p. 654}	LV_ERR_BN_ICL {p. 4870}	LV_ERR_BN_VS_TCS {p. 4871}
LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_VS {p. 5021}	LV_ERR_VS_CAN {p. 1565}	LV_PLAUS_ASR_CTL {p. 1567}
LV_PLAUS_ESP_CTL {p. 1567}	LV_TQ_ASR_REQ {p. 1568}	LV_VAR_AMT {p. 655}	LV_VAR_ASR {p. 655}
LV_VAR_BN_MSW {p. 655}	LV_VAR_TCT {p. 656}	N {p. 1525}	VS {p. 1176}
VS_FIL {p. 1176}	VS_ICL_DISP {p. 1582}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_VS_CRU_MMV	V	0... FFFFH	0... 0.9999847412109	15.2587e-6	km/h
Filter factor					
C_FAC_AC_CRU_MMV	V	0... FFFFH	0... 0.999985	15.3186e-6	-
Filtering AC_CRU					
C_FAC_TQ_REQ_DRIV_MMV	V	0... FFFFH	0... 0.999985	15.3186e-6	-
Filtering of driver demand					
C_FAC_VS_FIL	V	0... FFH	0... 255	1	-
Filter factor					
C_T_CRU_ASR_OFF	V	0... FFH	0... 25.5	0.1	s
Minimum time before cut-off CRU in case of ASR intervention					
C_T_CRU_ESP_BRAKE_OFF	V	0... FFH	0... 25.5	0.1	s
Minimum time before cut-off CRU in case of ESP intervention only with brake					
C_T_CRU_ESP_OFF	V	0... FFH	0... 25.5	0.1	s
Minimum time before cut-off CRU in case of ESP intervention					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_VS_DIAG_NOT_PLAUS	V	0... FFH	0... 25.5	0.1	s
debounce time for setting VS_CRU not plausible					
C_VS_MAX_DIAG	V	0... FFH	0... 255	1	km/h
Max. allowed deviation between VS_CRU and VS					
LC_VS_CRU_FIL	V	0... 1H	0 ...1	1	-
Filter factor activation					

## General information

### G.2.1 Runup lock

#### General information:

#### Application conditions:

**Initialisation:** 0 at reset

**Activation:** LV\_AT = 0 and LV\_VAR\_AMT = 0 and LV\_VAR\_TCT = 0

**Deactivation:** LV\_AT = 1 **or** LV\_VAR\_AMT = 1 **or** LV\_VAR\_TCT = 1

**Recurrence:** 100 ms

#### Function description:

#### Formula section:

In vehicles with manual transmission, the ratio between engine speed and vehicle speed is monitored on activating a function of the cruise control. At the start of a function, the ratio

$$N\_VS\_CRU = N / VS\_FIL \text{ is stored.}$$

The instantaneous ratio between engine speed and vehicle speed is formed in each cycle

$$N\_VS\_CRU_n = N_n / VS\_FIL_n$$

#### Remark:

If the percentage ratio exceeds the threshold value C\_N\_VS\_MAX\_CRU, hard cut-off has to occur.

### G.2.2 Filter of Vehicle Speed for Cruise control

#### General information:

With integration of stage cruise control the vehicle speed of instrument message is used. There is a deviation of DSC vehicle speed to the vehicle Speed of ICL therefore the visible signal has to be used to suppress a shown deviation to the driver.

#### Application conditions:

**Initialisation:** 0 at reset



**Activation:** LV\_VAR\_ASR = 1  
**Deactivation:** -  
**Recurrence:** 100 ms

**Function description:**

**Formula section:**

**If** LV\_VAR\_BN\_MSW = 1 **and**  
 LC\_VS\_CRU\_FIL = 1 **and**  
 LV\_ERR\_CAN\_BOFF = 0 **and**  
 LV\_ERR\_BN\_VS\_TCS = 0 **and**  
 LV\_ERR\_BN\_ICL = 0  
**Then** VS\_DIF\_ICL\_TCS = VS\_DIF\_ICL\_TCS<sub>n-1</sub> - C\_CRLC\_VS\_CRU\_MMV \*  
 (VS\_DIF\_ICL\_TCS<sub>(n-1)</sub> - VS\_ICL\_DISP + VS\_FIL)  
 VS\_CRU = VS\_FIL + VS\_DIF\_ICL\_TCS  
 (a physical conversion VS\_ICL\_DISP has be done)  
**Else** VS\_CRU = VS\_FIL  
**Endif**

**G.2.3 Acceleration monitoring for the CRU mode**

**General information:**

To monitor the vehicle dynamics in cruise control mode, the instantaneous acceleration of the vehicle is calculated in each computing cycle. The acceleration calculation is performed independently of the CRU mode with a 10 ms time pattern.

**Application conditions:**

**Initialisation:** AC\_CRU = 0 at reset  
**Activation:** -  
**Deactivation:** -  
**Recurrence:** 10ms

**Function description:**

**Formula section:**

AC\_CRU = AC\_CRU + (VS\_FIL<sub>n</sub> - VS\_FIL<sub>n-1</sub>) / 10ms \* C\_FAC\_AC\_CRU\_MMV

**Remark:**

If the instantaneous acceleration exceeds the adjustable value C\_AC\_MAX\_CRU, hard cut-off is performed, see chapter hard off conditions.

**G.2.4 Plausibility check of the speed signal VS\_FIL**

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**General information:**

The vehicle speed is acquired through the CAN signal WHEEL. To detect possible errors - if WHEEL is currently received and identified as correct by the ASR control unit a plausibility check is performed. The filtered external vehicle speed VS\_CRU is compared with the vehicle speed sensor signal. If a maximum allowed absolute deviation C\_VS\_MAX\_DIAG is exceeded, there is an error entry.

**Application conditions:**

**Initialisation:**                    0 at reset or LV\_IGK = 0 → 1  
**Activation:**                        LV\_VAR\_ASR = 1  
**Deactivation:**                      -  
**Recurrence:**                        100ms

**Function description:**

**Formula section:**

```

IF LV_ERR_VS      = 1      or
   LV_ERR_CAN_BOFF = 1      or
   LV_ERR_BN_VS_TCS = 1      or
   LV_ERR_BN_ICL   = 1      or
   LV_ERR_VS_CAN   = 1
THEN LV_VS_DIAG_NOT_PLAUS = 0
     T_VS_DIAG_NOT_PLAUS = 0
ELSE
  IF |VS_CRU - VS| >= C_VS_MAX_DIAG
  THEN T_VS_DIAG_NOT_PLAUS ++
       IF T_VS_DIAG_NOT_PLAUS > C_T_VS_DIAG_NOT_PLAUS
       THEN LV_VS_DIAG_NOT_PLAUS = 1
       ENDIF
  ELSE LV_VS_DIAG_NOT_PLAUS = 0
       T_VS_DIAG_NOT_PLAUS = 0
  ENDIF
ENDIF

```

**G.2.5 Recognition ASR/ESP-control and valid minimum time**


**General information:**

Recognition ASR/ESP-control and valid minimum time :

LV\_CRU\_OFF\_BY\_ASR\_ESP\_CTL = active:

Recognition due to the combination of the signals LV\_PLAUS\_ASR\_CTL, LV\_ASR\_REQ and LV\_PLAUS\_ESP\_CTL of the CAN-message ASC3

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LV_PLAUS_ASR_CTL	LV_TQ_ASR_REQ	LV_PLAUS_ESP_CTL	function	minimum time before cut-off CRU
1	1	0	ASR-control	C_T_CRU_ASR_OFF
1	1	1	ESP-control	C_T_CRU_ESP_OFF
1	0	1	ESP-control only brake	C_T_CRU_ESP_ BRAKE_OFF

### Application conditions:

**Initialisation:** 0 at reset

**Activation:** -

**Deactivation:** -

**Recurrence:** 100ms

### Function description:

### Formula section:

## G.2.6 Mean moving value calculation of Driver demand:

### General information:

For initialisation of I share of the cruise control function it is necessary to calculate a very slow driver demand

### Application conditions:

**Initialisation:** 0 at reset

**Activation:** -

**Deactivation:** -

**Recurrence:** 10ms

### Function description:

### Formula section:

$$\begin{aligned} \text{FAC\_TQ\_REQ\_DRIV\_MMV} = & \text{FAC\_TQ\_REQ\_DRIV\_MMV}_{n-1} + \\ & (\text{FAC\_TQ\_REQ\_DRIV} - \text{FAC\_TQ\_REQ\_DRIV\_MMV}_{n-1}) * \\ & \text{C\_FAC\_TQ\_REQ\_DRIV\_MMV} \end{aligned}$$

## G.3 Cruise control general

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CRU_MAIN_SWI	O/V	0... 1H	0 ...1	1	-
Indicate CRU readiness					
REQ_MSW	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H	HARD_OFF SOFT_OFF TIP_UP TIP_DOWN SET_AC- CELLERATE RESUME DECELERATE NONE MARK_HIGH MARK_DOWN	-	-
Evaluated Status of MSW request module					
STATE_MSW_CAN	O/V	0H 1H 2H 4H 7H	NONE SET_ACCEL- ERATE__TIP_ UP DECELERATE_ _TIP_DOWN OFF ERROR	-	-
Status of MSW to the CAN Message					

### Input data:

C_VB_MIN_MSW_DIAG {p. 5059}	C_VS_MIN_PROG {p. 7202}	LV_CRU_ACT {p. 7227}	LV_CRU_MAIN_SWI {p. 7220}
LV_CRU_OFF_IRR {p. 7227}	LV_ERR_BN_MSW {p. 4870}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_MSW_2 {p. 5058}
LV_ERR_MSW_3 {p. 5058}	LV_ERR_MSW_TOG {p. 5058}	LV_IGK {p. 906}	LV_MSW_MSG_VLD {p. 5058}
LV_PROG_STEP_1 {p. 7201}	LV_VAR_BN_LDM {p. 655}	LV_VAR_BN_MSW {p. 655}	LV_VAR_DCC {p. 655}
LV_VAR_MSW {p. 656}	STATE_BN_MSW {p. 1571}	STATE_MSW_DATA {p. 5059}	V_IGK {p. 1185}
VS_CRU {p. 7215}	VS_MIN_CRU {p. 7227}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_CRUS	-	0... FFH	0... 2550	10	ms
Minimum time between switch on ready and switch off ready					
C_T_CRUS_OFF	-	0... FFH	0... 5100	20	ms
Minimum recognition time on actuating the OFF button to switch off the display at BN 2000					
C_T_CRUS_ON	-	0... FFH	0... 2550	10	ms
Minimum recognition time on actuating the OFF button					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MIN_MSW	-	1... FFH	0.01 ...2.55	0.01	s
Time delay of REQ_MSW					
C_T_MIN_TIP_MSW	-	0... FFH	0... 2.55	0.01	s
Time delay of REQ_MSW TIP detection					
C_T_READY_CRU	-	64... FFH	1000 ...2550	10	ms
Delay time after control unit initialization					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_CRU_REQ_SWI	-	0... 1H	0 ...1	1	-
Configuration switch between MSW and steering lever					
LC_CRUS_OFF_SWI	-	0... 1H	0 ...1	1	-
Configuration switch to switch off the cruise control via MSW					

### G.3.1 Summary

**General information:**

The cruise control (CRU) controls the vehicle speed by a P/I controller to the required target speed. The CRU button in the multifunction steering wheel activates the control functions, if no cut-off conditions or switch-on prohibitions are present. The WHEEL signal of the ASC 1 message is evaluated as controlled variable. Corresponding to the existing control deviation, the value PV\_CRU is calculated for controlling the charge intervention.

Using the system, the driver can activate a control for maintaining the desired speed set by him. The desired speed can be approached comfortably in positive and negative direction by setting the instantaneous speed or by additional functions. Controlled approach to a stored desired speed is also possible. The driver then can store or change his desired speed using the following functions:

- Setting/acceleration (SET/ACC)
- Deceleration (DEC)
- Resume (RES)
- Tip-up (TP\_UP)
- Tip-down (TP\_DOWN)
- OFF (OFF)

#### G.3.1.1 Constant drive

**General information:**

After reaching the desired speed, the vehicle speed is kept constant independent of driving resistance changes which act on the vehicle, e.g. rising and falling gradient or headwind, if there are no abnormal termination conditions and the engine power or the braking effect is sufficient.

#### G.3.1.2 Setting/acceleration (SET/ACC)

**General information:**

By activating the SET/ACC function, the driver can store the instantaneous speed as desired speed and thus switch on the CRU system. Also the speed can be changed with a defined acceleration from the

controlled constant drive. After reaching the desired speed, the constant drive function of the control is active.

### G.3.1.3 Deceleration (DEC)

#### General information:

If the controlled constant drive function is active, the speed reduction takes place in the DEC function by the driver. In this case the desired speed is reduced. If the driver ends the function, the achieved instantaneous speed is stored as new desired speed and the controlled constant drive function is adopted. It is not possible to switch the system on through the recognised DEC function.

### G.3.1.4 Resume (RES)

#### General information:

When the driver activates the RES function, the vehicle is accelerated from the instantaneous speed with a defined acceleration to the stored desired speed. This applies both for larger and for smaller desired speeds compared with the instantaneous speed.

### G.3.1.5 Tip-up

#### General information:

Proceeding from controlled constant drive, the driver can increase his desired speed in steps of 1 k.p.h. by activating the TP\_UP function. This function can be selected several times consecutively, thus the vehicle can be brought to a new higher desired speed with a defined acceleration using the TP\_UP function.

### G.3.1.6 Tip-down

#### General information:

Proceeding from controlled constant drive, the driver can reduce his desired speed in steps of 1 k.p.h. by activating the TP\_DOWN function. This function can be selected several times consecutively, thus the vehicle can be brought to a new lower desired speed with a defined deceleration using the TP\_DOWN function.


### G.3.1.7 Off

#### General information:

To switch the system off, the driver can select the OFF function of the multifunction steering wheel. In this way the cruise control system is switched off softly, whereby the achieved desired speed remains stored for later activation by RES. If the engine running is stopped (LV\_IGK = 0, ES), then the readiness of CRU and the speed-setpoint are reduced to their initial values.

## G.3.2 Ready state and display

#### General information:

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A prerequisite for activating the CRU functions is the CRU ready state. After ECU initialization, the CRU state is initially passive. C\_T\_READY\_CRU after ignition key on LV\_IGK = 1 can be transformed into the ready state by pressing the OFF button once. To indicate CRU readiness to the driver, the CAN signal LV\_CRU\_MAIN\_SWI is set from 0 to 1. In this way the CRU ready lamp is activated in the CAN combination device.

The transition into the passive state occurs by pressing the OFF button once from the CRU ready state without controlled drive. The CRU ready lamp goes out.

For this functionality, the OFF button must be recognized for the minimum time of C\_T\_CRUS\_ON on actuation; the OFF button must not be actuated for at least C\_T\_CRUS between switch on ready and switch off ready.

The ready state is then also ended (-> passive) if the MSW diagnosis is momentarily not possible or a MSW error is momentarily present, see "Diagnosis and limp home" chapter.

Depending on the vehicle configuration LC\_CRU\_REQ\_SWI is switched between Multifunction steering wheel and Switch pack. The reason is, in a variant with switch pack is the main switch of cruise control on with LV\_IGK = 1.

### Application conditions

**Initialisation:** LV\_CRU\_MAIN\_SWI = 0

**Recurrence:** 10ms

### Formula section:

```

If (1) LV_IGK = 1 and T > C_T_READY_CRU and
(LC_CRU_REQ_SWI = 0 and LV_VAR_BN_MSW = 0) and LV_CRU_OFF_IRR = 0
Then(1) If(2) LV_CRU_MAIN_SWI = 0
Then(2) If(3) REQ_MSW = SOFT_OFF (for T > C_T_CRUS_ON) and
Time between transition LV_CRU_MAIN_SWI = 0/1
(and vice versa) > C_T_CRUS
Then(3) LV_CRU_MAIN_SWI = 1
Else (2) If(4) REQ_MSW = SOFT_OFF (for T > C_T_CRUS_ON) and
Time between transition LV_CRU_MAIN_SWI = 0/1
(and vice versa) > C_T_CRUS
Then(4) If(5) LV_CRU_ACT = 0
Then (5) LV_CRU_MAIN_SWI = 0
Else (5) LV_CRU_MAIN_SWI = 1 (remains )
Else (1) If(6)(LC_CRU_REQ_SWI = 0 and LV_VAR_BN_MSW = 1 and
LV_CRU_OFF_IRR = 0
Then(6) If(7) (VS_CRU VS_MIN_CRU and
REQ_MSW = TIP_UP/_DOWN) or
(VS_CRU > C_VS_MIN_PROG and
REQ_MSW = MARK_UP/_DOWN)
Then(7) LV_CRU_MAIN_SWI = 1
Else(7) If (REQ_MSW = SOFT_OFF (for T > C_T_CRUS_OFF) and
LC_CRUS_OFF_SWI = 0)
Then LV_CRU_MAIN_SWI = 0
Else LV_CRU_MAIN_SWI remains
Else (6) If LC_CRU_REQ_SWI = 1
then LV_CRU_MAIN_SWI = 1
else "LV_CRU_OFF_IRR = =1"
LV_CRU_MAIN_SWI = 0
    
```

**Endif**

**G.3.3 Evaluation serial data line from the MSW**

**General information:**

The buttons position of multifunction steering wheel (MSW) which is transferred digitally through a serial data line serves as interface between the driver and the CRU system (look at "Basic SW Inputs /Outputs"). The system interfaces are evaluated with a 10 ms time pattern.

A additional condition to the reception of a transfer pulse (see MSW interface in the Basic SW chapter) for reading the Output of the MSW-IC memory is further the MSW Diagnosis conditions.

**Description:**

The debounced and recognised function of the driver interface is evaluated only after the conditions for the CRU mode have been fulfilled. If no CRU mode is possible in the current driving cycle or at the moment, then "Hard cut-off" (FAC\_TQ\_CRU = 0) must be triggered.

According to the current status of the CRU and the recognised function of the driver interface, the functions OFF ("Soft cut-off"), resume, setting/acceleration, Tip-Up, Tip-Down, deceleration and the transition into the controlled constant drive can be triggered.

The function setting/acceleration (SET/ACC) is triggered if the CRU is ready, is in constant drive or another active function.

The deceleration function (DEC) is triggered accordingly, but requires that the CRU is in controlled drive, i.e. there is no setting mode in this case.

The tip functions Tip Up and Tip Down are triggered if the controlled constant drive or one of the two tip functions is active. Furthermore, a Tip-Up in CRU ready or with running resume triggers the setting function.

The Tip-Down function in active resume mode triggers only the abnormal termination of the running function and sets VS\_SP\_DRIV\_CRU to the actual speed VS\_FIL, but allows no setting in the above sense.


Precondition for a renewed activation of CRU-functions after cut-off or abnormal terminations are generally that the CRU mode is possible in principle and at least 'Rest' (None) was recognised once. As soon as 'None' or still no new function has be recognised after 'Setting/acceleration' or 'Deceleration', 'Transition into constant drive' is triggered. This applies especially for the resume function (RES) which is interlocked until rest is recognised again.

Resume is triggered only at CRU ready without controlled drive.

The following applies in an overtaking process: The triggering for hard and soft cut-off comes through. The same applies for functions which increase the value FAC\_TQ\_CRU, such as acceleration and TIP UP, in order to is able to "overdrive" in this way PV\_AV with the CRU. For all other functions, especially for "Deceleration" and "TIP DOWN", which reduce the FAC\_TQ\_CRU, the trigger is prevented, since the instantaneous driver wish via pedal is viewed as higher priority. With recognised RES position, triggering would make no sense.

For a possibly multiple actuation of buttons and superimposed CRU functions, priority must be given to the function recognition according to the following significance:

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Significance	Button/function
1	Brake light switch
1	Clutch switch
1	Transmission switch runup lock
2	OFF
3	Deceleration
4	Setting/acceleration
5	Resume

Significance 1 has highest priority

The function selection is made according to priority (see above). The tip functions are executed immediately after recognition. In this way the vehicle response should be improved for the driver, if he requests the SET/ACC or DEC function. In a pure tip request, rest (None) must be recognised between the individual tips.

**Application conditions**

**Initialization:**                    *STATE\_MSW\_CAN = "None"                    at reset and deactivation*  
     *REQ\_MSW /    = "Hard\_off"*

**Recurrence:**                    *10ms*

**Activation:**                    *LV\_IGK = 1 and V\_IGK > C\_VB\_MIN\_MSW\_DIAG*  
     *Time (since V\_IGK > C\_VB\_MIN\_MSW\_DIAG) > C\_T\_READY\_CRU*  
     *(Diagnosis conditions)*  
     *(LV\_VAR\_MSW = 1 or (LV\_VAR\_BN\_MSW = 1 and LV\_VAR\_DCC =*  
     *0 and LV\_VAR\_BN\_LDM = 0))*

Deactivation: otherwise

**Formula section:**

The evaluation of MSW is only done by CAN 11H variants. In BN 2000 the MSW requests are done by instument message.

**IF** LV\_VAR\_BN\_MSW = 0

**Then**

The Signal of STATE\_MSW\_DATA has to be received multiple (LV\_MSW\_MSG\_VLD = 1) before it is considered in the REQ\_MSW evaluation. The following distinctions are made because of the evaluation of STATE\_MSW\_DATA and an additional time condition:

REQ_MSW	STATE_MSW_DATA
0. HARD OFF:	MSW not allowed, ready or available
1. SOFT OFF:	OFF pressed.
2. TP_UP:	SET/ACC and no DEC pressed for C_T_MIN_MSW.
3. TP_DOWN:	DEC and no SET/ACC pressed for C_T_MIN_MSW.
4. SET/ACC:	SET/ACC and no DEC pressed for C_T_MIN_MSW.
5. RES:	RES pressed.
6. DEC:	DEC and no SET/ACC pressed for C_T_MIN_MSW .
7. NONE:	SET/ACC and DEC and RES and OFF not pressed.

STATE_MSW_CAN	STATE_MSW_DATA
0. None:	
1. SET/ACC /TP_UP:	SET/ACC pressed.
2. DEC /TP_DOWN:	DEC pressed.
3. RES:	RES pressed.

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4. OFF: OFF pressed  
 5. not used  
 6. not used  
 7. Error: LV\_ERR\_MSW\_2 = 1; LV\_ERR\_MSW\_3 = 1  
 LV\_ERR\_MSW\_TOG = 1

**else**

- REQ\_MSW                      STATE\_BN\_MSW
0. HARD OFF: MSW message not valid (7FH or LV\_ERR\_BN\_MSW ==1 or  
 LV\_ERR\_CAN\_BOFF == 1)
1. SOFT OFF: TIP UP or DOWN "OFF pressed"  
 2. TIP\_UP: TIP\_PRE pressed for ( C\_T\_MIN\_TIP\_MSW.  
 and C\_T\_MIN\_MSW.)
3. TIP\_DOWN: TIP\_POST pressed for ( C\_T\_MIN\_TIP\_  
 MSW.  
 and C\_T\_MIN\_MSW.)
4. SET/ACC: TIP\_PRE pressed for C\_T\_MIN\_MSW.  
 5. RES: TIP\_AXIAL.  
 6. DEC: TIP\_POST pressed for C\_T\_MIN\_MSW.  
 1. NONE: NONE  
 2. MARK\_UP PRESS\_PRE  
 3. MARK\_DOWN PRESS\_POST

The state REQ\_MSW = TIP\_UP/TIP\_DOWN is held for minimum C\_T\_MIN\_TIP\_MSW.

**endif**

## G.4 Cruise control input

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CRU_ACT	O/V	0... 1H	0 ...1	1	-
Intervention of cruise control					
LV_CRU_ACT_INH	O/V	0... 1H	0 ...1	1	-
Intervention of cruise control inhibited due to environmental conditions					
LV_CRU_ACT_VLD	V	0... 1H	0 ...1	1	-
Indicating if driver wanted to activate CRU in DC at least once (BN2000), in 11hex always =1					
LV_CRU_OFF_IRR	O/V	0... 1H	0 ...1	1	-
Irreversible cut off conditions for cruise control					
LV_CRU_OVER_ACT	V	0... 1H	0 ...1	1	-
Overtaking function active					
REQ_CRU	V	0H 1H 2H 3H 4H 5H 6H 7H	HARD_OFF SOFT_OFF TIP_UP TIP_DOWN SET_ ACCELERATE RESUME DECELERATE NONE	-	-
Request of cruise control functionality					
STATE_CRU	V	0H 1H 3H 5H 7H 9H	PASSIVE CONST_DRIVE RESUME SET_ACC RETARD TIP	-	-
Status of current cruise control functionality					
STATE_CRU_CAN	O/V	1H 2H 3H 4H 7H	CONST_TIP - RES - DEC	-	-
Status of cruise control to the CAN- Message					
STATE_CRU_OFF_IRR	O/V/S	0... FFFFH	0... 65535	1	-
Status switch off condition irreversible					
STATE_CRU_OFF_REV	O/V/S	0... FFFFH	0... 65535	1	-
Status switch off condition reversible					
T_DLY_CRU	V	0... FFFFH	0... 655.35	0.01	s
Time counter overtaking					
VS_MIN_CRU	O/V	0... FFFFH	0... 511.99218	0.0078125	km/h
Minimal Vehicle speed condition for VS_CRU					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**Input data:**

AC_CRU {p. 7215}	C_FAC_TQ_REQ_CLU_IS_HYS {p. 1442}	FAC_TQ_REQ_CRU {p. 6737}	FAC_TQ_REQ_DRIV {p. 6570}
GEAR_INFO {p. 1564}	IP_FAC_TQ_REQ_CLU_IS_N_32 {p. 1442}	LC_N_MAX_VS_MAX_ACT {p. 1151}	LV_ACT_CRU_MEM_EXT_ADJ {p. 7482}
LV_AT {p. 654}	LV_BRAKE_DET {p. 4209}	LV_CRU_MAIN_SWI {p. 7220}	LV_CRU_OFF_BY_ASR_ESP_CTL {p. 7215}
LV_CRU_OVER_ACT_ACK {p. 7237}	LV_ERR_BLS_PLAUS {p. 4209}	LV_ERR_BN_ETCU {p. 4870}	LV_ERR_BN_ICL {p. 4870}
LV_ERR_BN_MSW {p. 4870}	LV_ERR_BN_TCS {p. 4870}	LV_ERR_BN_TQ_AMT {p. 4870}	LV_ERR_BN_TQ_ETCU {p. 4871}
LV_ERR_BN_TQ_TCS {p. 4871}	LV_ERR_BN_VS_TCS {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_CRIT_OVL_ECU_VVL {p. 801}
LV_ERR_CRU_INH_MON {p. 6790}	LV_ERR_CS {p. 5015}	LV_ERR_CUR_H_VVL {p. 801}	LV_ERR_DR_SC_VVL {p. 801}
LV_ERR_MSW_2 {p. 5058}	LV_ERR_MSW_3 {p. 5058}	LV_ERR_MSW_TOG {p. 5058}	LV_ERR_OVL_ECU_VVL {p. 801}
LV_ERR_PVS {p. 4216}	LV_ERR_RLY_VVL {p. 801}	LV_ERR_TOUT_AMT_1 {p. 802}	LV_ERR_TOUT_ASR_1 {p. 802}
LV_ERR_TOUT_ASR_3 {p. 802}	LV_ERR_TOUT_ETCU_1 {p. 802}	LV_ERR_TOUT_ETCU_2 {p. 802}	LV_ERR_TQI_N_MAX_MON {p. 6917}
LV_ERR_VS {p. 5021}	LV_ERR_VS_CAN {p. 1565}	LV_ERR_VVL_ROT {p. 802}	LV_ES {p. 1720}
LV_IM_CS_PN {p. 852}	LV_N_LIM_REQ_MON {p. 6877}	LV_N_MAX {p. 3779}	LV_TQI_REQ_CAN_INH {p. 6687}
LV_VAR_AMT {p. 655}	LV_VAR_BN {p. 655}	LV_VAR_BN_LDM {p. 655}	LV_VAR_DCC {p. 655}
LV_VAR_TCT {p. 656}	LV_VS_DIAG_NOT_PLAUS {p. 7215}	LV_VS_MAX {p. 1148}	LV_VS_MAX_VSL {p. 7267}
N_VS_CRU {p. 7215}	REQ_MSW {p. 7220}	STATE_BN_MSW {p. 1571}	STATE_DHL_CTL {p. 1572}
STATE_IF_ICL_BN_MSW {p. 1574}	STATE_TCS_DECE {p. 1578}	STATE_VS_ICL_DISP {p. 1578}	T_ERR_VS_CAN {p. 1176}
VS_CRU {p. 7215}	VS_DIF_CRU {p. 7237}	VS_SP_CRU {p. 7237}	VS_SP_CRU_MAX {p. 7237}
VS_SP_DRIV_CRU {p. 7237}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AC_MAX_CRU	-	0... 7FFFH	0... 15.71952	479.7e-6	m/s**2
Max. acceleration					
C_FAC_TQ_REQ_HYS_CRU	-	0... FFFFH	0... 1.99996	30.5e-6	-
FAC_TQ_REQ hysteresis for start of the restart function					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_VS_MAX_CRU	-	0... FFH	0... 99.60937	0.390625	%
Threshold value for hard cut-off					
C_T_DLY_MAX_CRU	-	0... FFFFH	0... 655.35	0.01	s
Delay threshold for start of the restart function					
C_T_DLY_VS_SP_CRU_MAX	-	0... FFH	0... 255	1	s
Max .time for VS more than VS max at CRU					
C_VS_DIF_DLY_CRU_NEG	-	0... 7FFFH	0... 255.99218	0.0078125	km/h
Max. difference from VS_SP_DRIV_CRU and C_VS_DIF_DLY_CRU					
C_VS_DIF_DLY_CRU_POS	-	8000... 0H	-256 ...0	0.0078125	km/h
Max. difference from VS_SP_DRIV_CRU and C_VS_DIF_DLY_CRU					
C_VS_DIF_MIN_CRU_OVER	-	8000... 0H	-256 ...0	0.0078125	km/h
VS_DIF_CRU min value for finish overtaking function					
C_VS_MIN_CRU_K	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed condition for VS_CRU in case of Km - ICL					
C_VS_MIN_CRU_M	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed condition for VS_CRU in case of mile - ICL					
C_VS_MIN_PLAUS_CRU	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed condition for VS_CRU					
C_VS_SP_DIF_MAX_CRU	-	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Max. vehicle speed deviation					
C_VS_SP_DIF_MIN_CRU	-	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Min. vehicle speed deviation					

## G.4.1 Terminology

CRU manipulated variable:

FAC\_TQ\_CRU

Reference input variable:

VS\_SP\_CRU

Target variable:

VS\_SP\_DRIV\_CRU

Control deviation:

$VS\_DIF\_CRU = VS\_SP\_CRU - VS$

Reference input/target variable difference:

$VS\_SP\_DIF\_CRU = VS\_SP\_CRU - VS\_SP\_DRIV\_CRU$

## G.4.2 Conditions for cruise control

### FUNCTION DESCRIPTION:

The State of cruise control is the evaluation of the request and the cruise conditions.

If one of the following conditions is detected, no controller can be activated or an activated controller function is switched off. In this case a distinction is made between hard (FAC\_TQ\_CRU = 0) and soft cut-off (FAC\_TQ\_CRU through ramp function to zero).

### Application conditions:

## Application conditions

**Initialisation:** *STATE\_CRU\_OFF\_IRR, STATE\_CRU\_OFF\_REV out of NVMY  
LV\_CRU\_ACT\_VLD = 0 at LV\_IGK 0->1 **or** at reset  
all other outputs = 0*

**Recurrence:** *10 ms*

**Activation:** *LV\_VAR\_DCC = 0 and LV\_VAR\_BN\_LDM = 0*

**Deactivation:** *LV\_VAR\_DCC = 1 or LV\_VAR\_BN\_LDM = 1 then  
Initialisation: STATE\_CRU\_OFF\_IRR, STATE\_CRU\_OFF\_REV =00H*

### Formula section:

STATE_CRU_CAN	STATE_CRU
0. None:	PASSIVE
1. CONST	CONST_DRIVE or TIP
2.	not used
3. RES:	RES
4.	not used
5. SET/ACC	SET/ACC
6.	not used
7. DEC	DEC

**If** FAC\_TQ\_REQ\_DRIV > FAC\_TQ\_REQ\_CRU and STATE\_CRU not "passive"  
**Then** STATE\_CRU\_CAN = "None"  
**Endif**

### G.4.2.1 Conditions for hard cut-off

The control functions of the cruise control can be activated only if:

- CRU ready state present LV\_CRU\_MAIN\_SWI = 1

#### Irreversible cut-off due to diagnosis failures

With the following diagnosis errors the CRU is irreversible hard cut off for this engine run. The CRU-readiness and the CRU readiness light are reseted. The CRU function can be activated by LV\_IGK=0/1 change, as long as no running diagnosis errors are present. A distinction is done between the irreversible failures because of an error output for CAN message.

### Formula section:

**If** STATE\_VS\_ICL\_DISP = 1 "km/h; mph"  
**Then** VS\_MIN\_CRU = C\_VS\_MIN\_CRU\_M  
**Else** VS\_MIN\_CRU = C\_VS\_MIN\_CRU\_K  
**Endif**

// Recognition if cruise control is really configuration of car (in Case of E90 LV\_VAR\_BN = 1 instead of no build in cruise control)

**IF** LV\_VAR\_BN = 1  
**THEN IF** STATE\_BN\_MSW != No\_action (0h) **and**

```

STATE_BN_MSW != Invalid_signal (7h)
THEN //set bit for recognising desired usage of cruise control by driver for first time in
driving cycle:
    LV_CRU_ACT_VLD = 1
ENDIF
ELSE in case of 11hex bit is always set:
    LV_CRU_ACT_VLD = 1
ENDIF
if [7] LV_ERR_BLS_PLAUS = 1 or /* Error in break light system */
    [12] LV_ERR_VS = 1 or /* Error in speed signal (sensor) */
        [11] LV_VS_DIAG_NOT_PLAUS = 1 or /* Implausible speed signal VS_CRU */
        [10] LV_ERR_TQI_N_MAX_MON = 1 or /* Error Level 2 Monitoring */
        [10] LV_ERR_CRU_INH_MON = 1 or /* Error Level 2 Monitoring */
        [10] LV_N_LIM_REQ_MON = 1 or /* Error Level 2 Monitoring */
        [3] LV_ERR_CS = 1 or /* Error in clutch switch */
        [4] LV_ERR_MSW_2 = 1 or /* Multi-function steering wheel Error */
        [4] LV_ERR_MSW_3 = 1 or /* Multi-function steering wheel Error */
        [4] LV_ERR_MSW_TOG = 1 or /* Multi-function steering wheel Error */
        [4] LV_ERR_BN_MSW = 1 or /* Multi-function steering wheel Error */
            [9] LV_ERR_BN_ICL = 1 or /* CAN bus fault ICL */
                [8] LV_ERR_CAN_BOFF = 1 or /* CAN bus off */
                    [13] LV_ERR_TOUT_ASR_1 = 1 or /* CAN bus fault ASR */
                    [13] LV_ERR_TOUT_ASR_3 = 1 or /* CAN bus fault ASR */
                    [14] LV_ERR_BN_TCS = 1 or /* CAN bus fault TCS */
                    [14] LV_ERR_BN_TQ_TCS = 1 or /* CAN bus fault TCS */
                    [14] LV_ERR_BN_VS_TCS = 1 or /* CAN bus fault TCS */
                    [5] LV_ERR_TOUT_AMT_1 = 1 or /* CAN bus fault AMT */
                    [5] LV_ERR_BN_TQ_AMT = 1 or /* CAN bus fault AMT */
                    [6] LV_ERR_TOUT_ETCU_1 = 1 or /* CAN bus fault ETCU */
                    [6] LV_ERR_TOUT_ETCU_2 = 1 or /* CAN bus fault ETCU */
                    [6] LV_ERR_BN_ETCU = 1 or /* CAN bus fault ETCU */
                    [6] LV_ERR_BN_TQ_ETCU = 1 or /* CAN bus fault ETCU */
                    [2] LV_ERR_PVS = 1 or /* PVS-Error */
            [1] LV_ERR_CRIT_OVL_ECU_VVL = 1 or /* critical VVL driver overload */
            [1] LV_ERR_DR_SC_VVL = 1 or /* short circuit on VVL driver */
            [1] LV_ERR_OVL_ECU_VVL = 1 or /* VVL driver overload */
            [1] LV_ERR_RLY_VVL = 1 or /* VVL relay error */
            [1] LV_ERR_VVL_ROT = 1 or /* VVL rotation sense error */
            [1] LV_ERR_CUR_H_VVL = 1 /* VVL motor current critical high */
Then IF LV_CRU_ACT_VLD = 1
    THEN LV_CRU_OFF_IRR = 1
    ELSE LV_CRU_OFF_IRR = 0
    ENDIF
    REQ_CRU = Hard off
    (The cru readiness lamp is switched off.)
Endif

STATE_CRU_OFF_IRR :

```

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High Byte								Low Byte							
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		13	12			11	10	9	8	7	5	4	3	2	1
		14									6				
-----	-----	ASR/TCS-Error	Error VS	-----	-----	VS plausibility	Monitoring level 2	error instrument message	CAN Bus off	Brake error	AMT/ETCU-Error	MSW error	Error clutch switch	PVS-Error	VVL-Error

External adjustment:

```

If          LV_ACT_CRU_MEM_EXT_ADJ = 1
Then       STATE_CRU_OFF_IRR  = 00H
              STATE_CRU_OFF_REV  = 00H
Endif
    
```

```

If          LC_N_MAX_VS_MAX_ACT = 1
Then       LV_VS_MAX_VSL_1   = LV_VS_MAX
Else       LV_VS_MAX_VSL_1   = LV_VS_MAX_VSL
Endif
    
```

If one of the following conditions is current in active CRU function, CRU is transferred by hard cut-off (FAC\_TQ\_CRU = 0) into the ready state without controlled drive:

```

If          LV_CRU_MAIN_SWI = 0                or /* main switch off */
[1]          VS_CRU < C_VS_MIN_PLAUS_CRU        or /* speed under min. threshold */
              LV_ES = 1                          or /* Engine stop */
[2]          LV_BRAKE_DET = 1                    or /* Brake switch */
[3]          LV_N_MAX = 1                        or /* active engine speed limitation */
[4]          (LV_AT = 0 and LV_VAR_AMT = 0 and LV_VAR_TCT = 0 and
              |(N_VS_CRUn - N_VS_CRUn-1) / N_VS_CRUn-1 | * 100 > C_N_VS_MAX_CRU)
or /* implausible N/Vs-ratio with MT*/
[5]          (LV_CRU_OVER_ACT = 0 and |AC_CRU| > C_AC_MAX_CRU)
              or /* maximum acceleration exceeded
                                                    (not during overtaking function) */

              (LV_AT = 0 and LV_VAR_AMT = 0 and LV_VAR_TCT = 0) and
              LV_IM_CS_PN = 1)                    or /* clutch actuation with MT */
[6]          (LV_ERR_VS_CAN = 1 and
    
```

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```

T_ERR_VS_CAN = 0)                                or      /* Error on CAN signal VS_CAN
*/
((LV_AT = 1 or LV_VAR_AMT = 1 or LV_VAR_TCT = 1) and
GEAR_INFO = 0 or AH)                             or /*illegal gear info with AT or AMT/TCT*/
[7] REQ_MSW = "HARD_OFF"                          or      /* MSW-request */
[8] (LV_CRU_OVER_ACT = 1 and LV_VS_MAX_VSL_1 = 1)
                                           or
(LV_VAR_BN = 1 and
STATE_TCS_DECE = 02H or
STATE_IF_ICL_BN_MSW = 001))                      or
[15] LV_TQI_REQ_CAN_INH = 1                      or      /* Error in TPS/ETC */
[16] (STATE_DHL_CTL > 0H and STATE_DHL_CTL < FH) /* hill descent control active
*/

```

```

Then      REQ_CRU = Hard off
Endif

```

#### G.4.2.2 Conditions for soft cut-off:

##### General information:

If one of the following conditions is detected, the controller function is switched off. In this FAC\_TQ\_CRU is set through ramp function to zero.

##### Formula section:

```

If
[9] REQ_MSW = SOFT_OFF                          or      /* MSW-request */
[10] [LV_CRU_OVER_ACT = 0 and
(VS_DIF_CRU > C_VS_SP_DIF_MAX_CRU or
VS_DIF_CRU < C_VS_SP_DIF_MIN_CRU)]
                                           or      /* control deviation too large */
[11] [LV_CRU_OVER_ACT = 1 and
((T_DLY_CRU C_T_DLY_MAX_CRU) or
(VS_SP_DRIV_CRU - VS_CRU C_VS_DIF_DLY_CRU_POS) or
(VS_SP_DRIV_CRU - VS_CRU < C_VS_DIF_DLY_CRU_NEG))]
                                           or
[12] (VS_CRU VS_SP_CRU_MAX for longer than C_T_DLY_VS_SP_CRU_MAX)
if this condition is interrupted than time-counter is reset to 0
                                           or
[13] ASR- or ESP-control for minimum time active
(LV_CRU_OFF_BY_ASR_ESP_CTL = 1)

```


Remark:

```

Then      REQ_CRU = Soft off
Endif

```

STATE\_CRU\_OFF\_REV :

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High Byte								Low Byte							
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
7	2	3	1	8	4	5	6		16	15	9	13	12	11	10
MSW request HARD_OFF	Brake detection	Engine speed limitation	VS_CRU to low	Overtaking and VS_MAX active	Runup lock	Acceleration monitoring	Error VS_CAN to long	-----	Hill descent control (HDC) active	TPS/ETC-Error	MSW request "off"	External TQ intervention	VS_SP_MAX to long	Overtaking Funct. To long or to high VS_DIF	To high VS deviation

### G.4.2.3 Overtaking function

#### Description:

If the throttle wish  $FAC\_TQ\_REQ\_DRIV > FAC\_TQ\_REQ\_CRU$  and  $\geq IP\_FAC\_TQ\_REQ\_CLU\_IS\_N\_32$ , then the controlled detects overtaking and the value  $VS\_DIF\_I\_CRU$  remains stored as threshold value. The time for the overtaking function  $T\_DLY\_CRU$  is started. The adjustable time  $C\_T\_DLY\_MAX\_CRU$  states whether starting controlled constant drive is possible after ending the overtaking function.

During the overtaking function, 'Overdriving'  $FAC\_TQ\_REQ\_DRIV$  by the acceleration (ACC) and Tip-up functions is possible.

If the time  $C\_T\_DLY\_MAX\_CRU$  or the max. Deviation from the stored target speed is exceeded, no automatic start of controlled constant drive is possible any more. The CRU mode is ended. The functions of the cruise control can be activated again exclusively by the multifunction steering wheel. At resume the after overtaking function is finished the resume function is activated with the initialisation calculation of  $VS\_DIF\_I\_CRU$ .

During the overtaking function the calculation of  $FAC\_TQ\_CRU$  is calculated normal with freedzed I - share and calculated P-Share.

#### Application conditions

**Initialisation:**  $LV\_CRU\_OVER\_ACT = 0$

#### Formula section:

If  $LV\_CRU\_OVER\_ACT = 0$   
 Then If  $(STATE\_CRU = \text{constant drive or tip})$  and  
 $REQ\_MSW \neq TIP\_UP$  and  
 $REQ\_MSW \neq SET\_ACC$  and  
 $(REQ\_MSW \neq TIP\_DOWN)$  and  
 $REQ\_MSW \neq DECE$  or  
 $LV\_VAR\_BN = 0$  and  
 $TQ\_REQ\_DRIV > FAC\_TQ\_REQ\_CRU$  and  
 $FAC\_TQ\_REQ\_DRIV > IP\_FAC\_TQ\_REQ\_CLU\_IS\_N\_32$   
 Then  $T\_DLY\_CRUn = T\_DLY\_CRUn-1 + 10 \text{ ms}$

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```

        LV_CRU_OVER_ACT = 1
        // "VS_DIF_I_CRU stored see calculation of I-Share"
    Endif
Endif

If LV_CRU_OVER_ACT = 1
Then
    If (FAC_TQ_REQ_DRIV < FAC_TQ_REQ_CRU - C_FAC_TQ_REQ_HYS_CRU
        FAC_TQ_REQ_DRIV < IP_FAC_TQ_REQ_CLU_IS__N_32 - C_FAC_TQ_REQ_
        CLU_IS_HYS)
                and
        VS_DIF_CRU > C_VS_DIF_MIN_CRU_OVER
    Then LV_CRU_OVER_ACT = 0
    Else If REQ_MSW = TIP_UP or
        (REQ_MSW = TIP_DOWN and
        LV_VAR_BN = 1)
    Then If LV_CRU_OVER_ACT_ACK == 1
        Then LV_CRU_OVER_ACT = 0
        Endif
        REQ_CRU = REQ_MSW
    Endif
    Endif
Endif

If LV_CRU_ACT = 0 → 1 and VS_CRU ≤ VS_SP_CRU_MAX
Then
    If LV_VAR_BN = 1 and
        (REQ_MSW = TIP_DOWN or
        REQ_MSW = DECE or
        REQ_MSW = MARK_UP or
        REQ_MSW = MARK_DOWN)
    Then REQ_CRU = SET_ACC
    Endif
Endif

If LV_CRU_ACT = 1 and LV_CRU_OVER_ACT = 0
Then
    If REQ_MSW = MARK_UP or REQ_MSW = MARK_DOWN
    Then REQ_CRU = NONE
    Else REQ_CRU = REQ_MSW
    Endif
Endif

```


#### G.4.2.4 Condition for cruise control intervention

##### Description:

The cruise control intervention is active if the vehicle is in operation depending of FAC\_TQ\_CRU. The Status is needed in the Cruise control monitoring of ETC Safety Unit.

If an MSW request is active but LV\_CRU\_ACT stays 0 due to environmental conditions (VS\_CRU < VS\_MIN\_CRU, "Soft off", "Hard off" etc.) LV\_CRU\_ACT\_INH is set.

##### Formula section:

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```

If   LV_CRU_ACT = 0                                and
      (LV_MSW_IDLE = 1                                or
      (LV_CRU_MAIN_SWI = 0 → 1                        and
      LV_VAR_BN = 1))                                and
      VS_CRU >= VS_MIN_CRU                          and
      ((REQ_MSW = TIP_UP or SET/ACC)                or
      (LV_VAR_BN = 1                                and
      (REQ_MSW = TIP_DOWN or DECE or MARK_UP or MARK_DOWN)) or
      (REQ_MSW = RES                                and
      Triggering the RES function for plausible VS_SP_DRIV_CRU
      (VS_MIN_CRU <= VS_SP_DRIV_CRU <= VS_SP_CRU_MAX)))
Then   LV_CRU_ACT = 1
Endif

```

LV\_CRU\_ACT is reseted to 0 if an off condition is present.

```

If       LV_CRU_ACT = 1    and    REQ_CRU = "Soft off" or "Hard off"
Then     LV_CRU_ACT = 0
Endif

```

```

If       LV_CRU_ACT = 0 and REQ_MSW > 1H and REQ_MSW != 7H
          and LV_CRU_OFF_IRR = 0
Then     LV_CRU_ACT_INH = 1
Else     LV_CRU_ACT_INH = 0
Endif

```

## G.5 Cruise control basic functions

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_CRU	O/V	0... FFFFH	0... 99.99847	1.53e-3	%
CRU control variable					
FAC_TQ_CRU_INI	V	0... FFFFH	0... 99.99847	1.53e-3	%
CRU control variable initialisation value					
FAC_VS_CTL_CRU	V	0... FFH	0... 1.99218	0.0078125	-
Correction factor for actuating the reference input variable					
FAC_VS_LGRD_CRU	V	0... FFH	0... 0.99609	3.91e-3	-
Factor for intercepting the reference input variable					
LV_CRU_OVER_ACT_ACK	O/V	0... 1H	0 ...1	1	-
Hand shake overtaking function					
STATE_I_CRU	V	1H 2H 3H	LIM FREEZE NORM	-	-
Condition of I Share VS_DIF_I_CRU					
T_CTL_CRU	V	0... FFH	0... 25.5	0.1	s
Time of the controlled acceleration					
VS_DIF_CRU	O/V	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Control deviation					
VS_DIF_I_CRU	V	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Sum of the control deviations					
VS_SP_CRU	O/V	0... FFFFH	0... 511.99218	0.0078125	km/h
Reference input variable of the controller					
VS_SP_CRU_MAX	O/V	0... FFFFH	0... 511.99218	0.0078125	km/h
maximum limitation of cruise control					
VS_SP_DEC_CRU	V	0... FFFFH	0... 511.99218	0.0078125	km/h
Decrement for VS_SP_CRU					
VS_SP_DIF_CRU	V	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Target variable/reference input variable difference					
VS_SP_DRIV_CRU	V	0... FFFFH	0... 511.99218	0.0078125	km/h
Driver wish target variable					
VS_SP_INC_CRU	V	0... FFFFH	0... 511.99218	0.0078125	km/h
Increment for VS_SP_CRU					

### Input data:

AC_CRU {p. 7215}	C_FAC_TQ_REQ_CLU_IS_ HYS {p. 1442}	FAC_TQ_REQ_CRU {p. 6737}	FAC_TQ_REQ_DRIV {p. 6570}
FAC_TQ_REQ_DRIV_MMV {p. 7215}	GEAR {p. 1302}	IP_FAC_TQ_REQ_CLU_ IS_N_32 {p. 1442}	LV_AT {p. 654}

LV_CRU_MAIN_SWI {p. 7220}	LV_CRU_OVER_ACT {p. 7227}	LV_IGK {p. 906}	LV_RNG_L_REQ {p. 6570}
LV_STEP_ON_ACT {p. 7201}	LV_VAR_BN {p. 655}	N {p. 1525}	N_32 {p. 1525}
REQ_CRU {p. 7227}	REQ_MSW {p. 7220}	STATE_CC {p. 1571}	STATE_CRU {p. 7227}
STATE_VS_ICL_DISP {p. 1578}	T_CTL_CRU {p. 7237}	VS_CRU {p. 7215}	VS_MIN_CRU {p. 7227}
VS_SP_DRIV_STEP {p. 7201}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AC_NEG_CRU_DEACC	-	0... 5C28H	0... 511.9789	21.7e-3	m/s**2
Negative acceleration in deceleration					
C_AC_NEG_CRU_TIP	-	0... 5C28H	0... 511.9789	21.7e-3	m/s**2
Positive acceleration for Tip-up					
C_AC_POS_CRU_DEACC	-	0... 5C28H	0... 511.9789	21.7e-3	m/s**2
Positive acceleration					
C_AC_POS_CRU_TIP	-	0... 5C28H	0... 511.9789	21.7e-3	m/s**2
Positive acceleration for Tip-up					
C_FAC_AC_POS_CRU	-	0... FFH	0... 0.99609	3.91e-3	-
Maximum reduction of FAC_VS_LGRD_CRU					
C_FAC_AC_POS_CRU_RNG_L	-	0... FFH	0... 0.99609	3.91e-3	-
Maximum reduction of FAC_VS_LGRD_CRU at RNG_L					
C_FAC_TQ_CRU_LGRD	-	0... FFFFH	0... 99.99847	1.53e-3	%/100ms
Control variable limitation gradient					
C_FAC_TQ_CRU_MAX	-	0... FFFFH	0... 99.99847	1.53e-3	%
Maximum request of Cruise Control					
C_FAC_TQ_CRU_OFS	-	0... FFFFH	0... 99.99847	1.53e-3	%
Offset for cruise control variable					
C_FAC_VS_DIF_RNG_CRU	-	0... FFH	0... 0.99609	3.91e-3	-
Reduction factor for the control deviation VS_DIF_CRU					
C_T_MIN_CRU_CON	-	0... FFH	0... 25.5	0.1	s
Time condition for controlled acceleration					
C_T_MIN_PUC_CRU	-	0... FFH	0... 25.5	0.1	s
Time after entry into controlled constant drive					
C_VS_AC_MAX_CRU	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for acceleration valuation					
C_VS_AC_MIN_CRU	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for acceleration valuation					
C_VS_DIF_DELTA_I	-	0... FFH	0... 63.75	0.25	km/h
Positive acceleration					
C_VS_DIF_MAX_AC_CRU	-	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Condition for interrupting the incrementation or decrementation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VS_DIF_MAX_CRU	-	0... FFH	0... 31.875	0.125	km/h
Control difference threshold for incrementing VS_SP_CRU					
C_VS_DIF_MAX_IS_CRU	-	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Threshold of the control deviation for PUC end					
C_VS_DIF_MIN_AC_CRU	-	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Condition for interrupting the incrementation or decrementation					
C_VS_DIF_MIN_IS_CRU	-	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Threshold of the control deviation for zero setting of FAC_TQ_CRU					
C_VS_DIF_RNG_CRU	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Bandwidth for reducing the control deviation					
C_VS_DIF_TIP_K	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Km per tip in case of km - icl					
C_VS_DIF_TIP_M	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Km per tip in case of mile - icl					
C_VS_SP_CRU_MAX_K	-	0... FFFFH	0... 511.99218	0.0078125	km/h
maximum limitation of cruise control in case of KM - ICL					
C_VS_SP_CRU_MAX_M	-	0... FFFFH	0... 511.99218	0.0078125	km/h
maximum limitation of cruise control in case of Mile - ICL					
ID_AC_POS_CRU_AC	-	0... 5C28H	0... 511.9789	0.0217014	m/s**2
LDPM_GEAR_CRU	8	0... FFH	0... 255	1	-
Positive acceleration in setting/acceleration depending on GEAR					
ID_AC_POS_CRU_AC_RNG_L	-	0... 5C28H	0... 511.9789	0.0217014	m/s**2
LDPM_GEAR_CRU	8	0... FFH	0... 255	1	-
Positive acceleration in setting/acceleration at RNG_L depending on GEAR					
ID_AC_POS_CRU_RESU	-	0... 5C28H	0... 511.9789	0.0217014	m/s**2
LDPM_GEAR_CRU	8	0... FFH	0... 255	1	-
Positive acceleration at CRU resume depending on GEAR					
ID_AC_POS_CRU_RESU_RNG_L	-	0... 5C28H	0... 511.9789	0.0217014	m/s**2
LDPM_GEAR_CRU	8	0... FFH	0... 255	1	-
Positive acceleration at CRU resume at RNG_L depending on GEAR					
IP_AC_NEG_CRU_AC_N_FAC_TQ_CRU	V	0... 5C28H	0... 511.9789	21.7e-3	m/s**2
LDPM_N_21	3	0... FFH	0... 8160	32	rpm
LDPM_FAC_TQ_CRU_1	3	0... FFFFH	0... 99.99847	1.53e-3	%
Negative acceleration in setting/acceleration					
IP_AC_NEG_CRU_RESU	V	0... 5C28H	0... 511.9789	21.7e-3	m/s**2
LDPM_N_21	3	0... FFH	0... 8160	32	rpm
LDPM_FAC_TQ_CRU_1	3	0... FFFFH	0... 99.99847	1.53e-3	%
Negative acceleration at CRU resume					
IP_FAC_CC_CRU_AC_T_CTL_CRU	-	0... FFH	0... 1.99218	0.0078125	-
LDPM_T_CTL_CRU_1	5	0... FFH	0... 25.5	0.1	s
Correction factor of in/decrementing					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_CC_CRU_DECE_T_CTL_CRU	-	0... FFH	0... 1.99218	0.0078125	-
LDPM_T_CTL_CRU_1	5	0... FFH	0... 25.5	0.1	s
Correction factor of in/decrementing					
IP_FAC_CRU_AC_T_CTL_CRU	-	0... FFH	0... 1.99218	0.0078125	-
LDPM_T_CTL_CRU_1	5	0... FFH	0... 25.5	0.1	s
Correction factor of in/decrementing					
IP_FAC_CRU_DECE_T_CTL_CRU	-	0... FFH	0... 1.99218	0.0078125	-
LDPM_T_CTL_CRU_1	5	0... FFH	0... 25.5	0.1	s
Correction factor of in/decrementing					
IP_FAC_CRU_REST_T_CTL_CRU	-	0... FFH	0... 1.99218	0.0078125	-
LDPM_T_CTL_CRU_1	5	0... FFH	0... 25.5	0.1	s
Correction factor of in/decrementing					
IP_FAC_LGRD_CRU_REST_VS_SP_DIF	-	0... FFH	0... 0.99609	3.91e-3	-
LDPM_VS_SP_DIF_CRU_1	5	0... FFFFH	-256... 255.99218	0.0078125	km/h
Interception factor of the in/decrementing (xx = REST, TIP)					
IP_FAC_LGRD_CRU_TIP_VS_SP_DIF	-	0... FFH	0... 0.99609	3.91e-3	-
LDPM_VS_SP_DIF_CRU_1	5	0... FFFFH	-256... 255.99218	0.0078125	km/h
Interception factor of the in/decrementing (xx = REST, TIP)					
IP_FAC_PROP_CRU	V	0... FFFFH	0... 49.99923	763e-6	%(km/h)
LDPM_VS_SP_CRU_1	5	0... FFFFH	0... 511.99218	0.0078125	km/h
LDP_VS_DIF_CRU_FAC_PROP_CRU	4	0... FFFFH	-256... 255.99218	0.0078125	km/h
Proportional coefficient of the PI controller					
IP_FAC_TQ_CRU_DEC_N_32	-	0... FFFFH	0... 99.99847	1.53e-3	%
LDP_N_32_FAC_TQ_CRU	5	0... FFH	0... 8160	32	rpm
Decrement of the FAC_TQ_CRU					
IP_FAC_TQ_CRU_INI_ADD_AT	V	0... FFFFH	-200... 199.99389	6.1035e-3	%(m/s**2)
LDP_AC_CRU_FAC_TQ_CRU	6	0... FFFFH	-15.72... 15.71952	479.7e-6	%
LDP_GEAR_FAC_TQ_CRU	12	0... FFH	0... 255	1	-
Additive torque based on gear and acceleration					
IP_FAC_TQ_CRU_INI_ADD_MT	V	0... FFFFH	-200... 199.99389	6.1035e-3	%(m/s**2)
LDP_AC_CRU_FAC_TQ_CRU	6	0... FFFFH	-15.72... 15.71952	479.7e-6	%
LDP_GEAR_FAC_TQ_CRU	12	0... FFH	0... 255	1	-
Additive torque based on gear and acceleration					
IP_FAC_VS_DIF_I_CRU	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_VS_SP_CRU_1	5	0... FFFFH	0... 511.99218	0.0078125	km/h
LDP_VS_DIF_CRU_FAC_PROP_CRU	4	0... FFFFH	-256... 255.99218	0.0078125	km/h
Proportional coefficient of the PI controller					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_VS_SP_DIF_I_CRU	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_VS_SP_CRU__1	5	0... FFFFH	0... 511.99218	0.0078125	km/h
Delta VS_SP_CRU correction					

### G.5.1 General calculation of cruise control and constant drive

Application conditions:

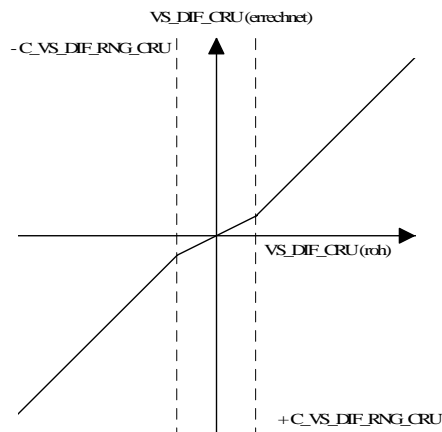
*Recurrence:* 100 ms

*Initialisation:* FAC\_TQ\_CRU = FAC\_TQ\_CRU\_INI based on setting conditions

#### FUNCTION DESCRIPTION:

Description:

On setting in PU/PUC or with very small FAC\_TQ\_REQ\_DRIV (driver gets off the pedal before setting Cruise Control), a very small I component setpoint (or 0) would be the results and it follows an undershooting below the required target speed. To prevent this, the I share set value is calculated depending on AC\_CRU so that a minimum FAC\_TQ\_CRU results.



#### Formula section:

Basically calculation for all cruise states:

*Total formula:*

$$FAC\_TQ\_CRU = (VS\_DIF\_CRU + VS\_DIF\_I\_CRU) * IP\_FAC\_PROP\_CRU$$

#### Conditions for change limitations of FAC\_TQ\_CRU:

$$FAC\_TQ\_CRU_{n-1} - FAC\_TQ\_CRU_n \leq C\_FAC\_TQ\_CRU\_LGRD$$

At driving by cruise control it should not be possible to request the maximum torque as well outside cruise control.

$$FAC\_TQ\_CRU \leq C\_FAC\_TQ\_CRU\_MAX$$

The non-linearized value of the control deviation from the reference input variable VS\_SP\_CRU and the control variable VS\_CRU is calculated as

$$VS\_DIF\_CRU \text{ (rough)} = VS\_SP\_CRU - VS\_CRU$$

To achieve a quiet control in the range of the target variable, the internal control deviation VS\_DIF\_CRU can be reduced in the adjustable bandwidth | C\_VS\_DIF\_RNG\_CRU | by an applicable factor C\_FAC\_VS\_DIF\_RNG\_CRU.

```

IF(1)          |VS_SP_CRU - VS_CRU| C_VS_DIF_RNG_CRU
Then(1)      VS_DIF_CRU = (VS_SP_CRU - VS_CRU) * C_FAC_VS_DIF_RNG_CRU
Else(1) If(2) (VS_SP_CRU - VS_CRU) > C_VS_DIF_RNG_CRU
    Then(2)    VS_DIF_CRU = (VS_SP_CRU - VS_CRU) - C_VS_DIF_RNG_CRU
    + C_VS_DIF_RNG_CRU * C_FAC_VS_DIF_RNG_CRU.
    Else(2)    VS_DIF_CRU = (VS_SP_CRU - VS_CRU)
    + C_VS_DIF_RNG_CRU * C_FAC_VS_DIF_RNG_CRU.

Endif (2)
Endif(1)
    
```

**I share calculation:**

Basically there are 3 states of STATE\_I\_CRU: NORM, LIM and FREEZE (for detailed information see formula section below)

If the FAC\_TQ\_CRU is on limitation (max, min value or freeze at PUC) then the I share is frozen **STATE\_I\_CRU = LIM** until a normal calculation of FAC\_TQ\_CRU is possible again. At constant driving or LV\_CRU\_OVER\_ACT = 1 the I share is frozen **STATE\_I\_CRU = LIM** but in the calculation of FAC\_TQ\_CRU there is no interrupt.

**Calculation in case of controller active:**

```


If          REQ_CRU = SOFT_OFF
Then       STATE_I_CRU = LIM
Else       If      [ STATE_CRU = DEC          AND
                    (VS_DIF_I_CRU + C_VS_DIF_DELTA_I - IVS_DIF_CRUI >= 0)] OR
                    [STATE_CRU = CONST_DRIVE AND
                    LV_CRU_OVER_ACT = 0 AND
                    FAC_TQ_CRU > (IP_FAC_TQ_REQ_CLU_IS_N_32 -
                                   C_FAC_TQ_REQ_CLU_IS_HYS) * 99,998%)
                                   + C_FAC_TQ_CRU_OFS AND
                    FAC_TQ_CRU < C_FAC_TQ_CRU_MAX]
Then       // General calculation

              STATE_I_CRU = NORM
              VS_DIF_I_CRU_N = VS_DIF_I_CRU_N-1 + VS_DIF_CRU *
                                   IP_FAC_VS_DIF_I_CRU

              VS_SP_CRU_START = VS_SP_CRU
              VS_DIF_I_CRU_START = VS_DIF_I_CRU

Else       If      STATE_CRU = SET_ACC          OR
              STATE_CRU = RESUME
Then       // Calculation during freeze of I share at SET/ACC, RES
    
```

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```

STATE_I_CRU = FREEZE
VS_SP_CRU_STAT = VS_SP_CRUn - VS_SP_CRUSTART
VS_DIF_I_CRU = VS_DIF_I_CRUSTART +
IP_FAC_VS_SP_DIF_I_CRU * VS_SP_CRU_STAT
Else // Calculation during limitation of I share

STATE_I_CRU = LIM
VS_SP_CRUSTART = VS_SP_CRU
VS_DIF_I_CRUSTART = VS_DIF_I_CRU
Endif
Endif
Endif

```

### Calculation in case of controller passive:

Initialisation value calculated once on transition passive to active:

```

IF LV_AT = 0
Then FAC_TQ_CRU_INI = FAC_TQ_REQ_DRIV_MMV * 99,998 % +
IP_FAC_TQ_CRU_INI_ADD_MT * AC_CRU
Else FAC_TQ_CRU_INI = FAC_TQ_REQ_DRIV_MMV * 99,998 % +
IP_FAC_TQ_CRU_INI_ADD_AT * AC_CRU
endif
VS_DIF_I_CRU = FAC_TQ_CRU_INI / IP_FAC_PROP_CRU

VS_SP_CRUSTART = VS_SP_CRU
VS_DIF_I_CRUSTART = VS_DIF_I_CRU
Disable gradient limitation for FAC_TQ_CRU once

```

#### G.5.1.1 Controlled constant drive (CONST\_DRIVE)

For controlled constant drive, the reference input variable VS\_SP\_CRU corresponds to the last target speed value reached, i.e. VS\_SP\_DRIV\_CRU. No control of the reference input variable is performed in this range.

With the basic function of control, the vehicle speed is controlled corresponding to the required reference input variable VS\_SP\_CRU. This occurs until a cut-off condition arises or a condition for cruise control is infringed. The resume function is locked in the controlled constant drive. On recognition of other CRU functions, the reference input variable is controlled. To be able to trigger trailing throttle cut-off expediently, the value FAC\_TQ\_CRU is initially limited downwards to the value ((IP\_FAC\_TQ\_REQ\_CLU\_IS\_N\_32 - C\_FAC\_TQ\_REQ\_CLU\_IS\_HYS)\*99,998%). Thus there can be no IS output. Only if the control deviation VS\_DIF\_CRU drops below the applicable value C\_VS\_DIF\_MIN\_IS\_CRU is FAC\_TQ\_CRU set equal to zero. However, this zero setting takes place at the earliest C\_T\_MIN\_PUC\_CRU seconds after entry into controlled constant drive. The trailing throttle cut-off is retained until the control deviation exceeds the applicable value C\_VS\_DIF\_MAX\_IS\_CRU.

#### Formula section:

FAC\_TQ\_CRU conditions:

```

IF T_CONST_DRIVE < C_T_MIN_PUC_CRU
Then If FAC_TQ_CRU < ((IP_FAC_TQ_REQ_CLU_IS_N_32 -
C_FAC_TQ_REQ_CLU_IS_HYS) * 99,998%)
+ C_FAC_TQ_CRU_OFS

```

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```

    then      FAC_TQ_CRU = ((IP_FAC_TQ_REQ_CLU_IS__N_32-
                          C_FAC_TQ_REQ_CLU_IS_HYS) * 99,998%)
                          + C_FAC_TQ_CRU_OFS
    endif
ElseIF      VS_DIF_CRU < C_VS_DIF_MIN_IS_CRU & &
    FAC_TQ_CRU < ((IP_FAC_TQ_REQ_CLU_IS__N_32-
                  C_FAC_TQ_REQ_CLU_IS_HYS) * 99,998%)
                  + C_FAC_TQ_CRU_OFS

    Then     FAC_TQ_CRU = 0
    Else     IF      VS_DIF_CRU > C_VS_DIF_MAX_IS_CRU
            Then     If      FAC_TQ_CRU < ((IP_FAC_TQ_REQ_CLU_IS__N_32-
                  C_FAC_TQ_REQ_CLU_IS_HYS) * 99,998%)
                  + C_FAC_TQ_CRU_OFS

                    Then     FAC_TQ_CRU = ((IP_FAC_TQ_REQ_CLU_IS__N_32-
                  C_FAC_TQ_REQ_CLU_IS_HYS) * 99,998%)
                  + C_FAC_TQ_CRU_OFS

                    Endif
            Else     calculation FAC_TQ_CRUn = calculation FAC_TQ_CRUn-1
    Endif
Endif

```

### G.5.1.2 Cut-off of the CRU function

#### General information:

##### Soft cut-off

In the soft cut-off of the cruise control, the cruise control wish FAC\_TQ\_REQ\_CRU is reduced to the driver wish FAC\_TQ\_REQ\_DRIV with the adjustable decrement IP\_FAC\_TQ\_CRU\_DEC \_\_N\_32 for FAC\_TQ\_REQ\_DRIV < FAC\_TQ\_REQ\_CRU until the pedal driver demand is reached. FAC\_TQ\_CRU is then set to zero.

##### Hard cut-off

In the hard cut-off mode of the cruise control, the charge wish FAC\_TQ\_CRU is set equal to zero. There is no limitation gradient. The CRU State is readiness.

Application conditions:

*Activation:* see Chapter: Cut-off Conditions and switch-on prohibitions

#### Formula section:

##### Soft cut-off

For FAC\_TQ\_REQ\_DRIV < FAC\_TQ\_REQ\_CRU there results:

FAC\_TQ\_CRU = FAC\_TQ\_CRU<sub>n-1</sub> - IP\_FAC\_TQ\_CRU\_DEC \_\_N\_32      until


FAC\_TQ\_REQ\_DRIV = FAC\_TQ\_REQ\_CRU

##### Hard cut-off

FAC\_TQ\_CRU = 0

Then, the CRU ready status is reached. Only now can the CRU mode be activated again.

### G.5.2 Controlled acceleration

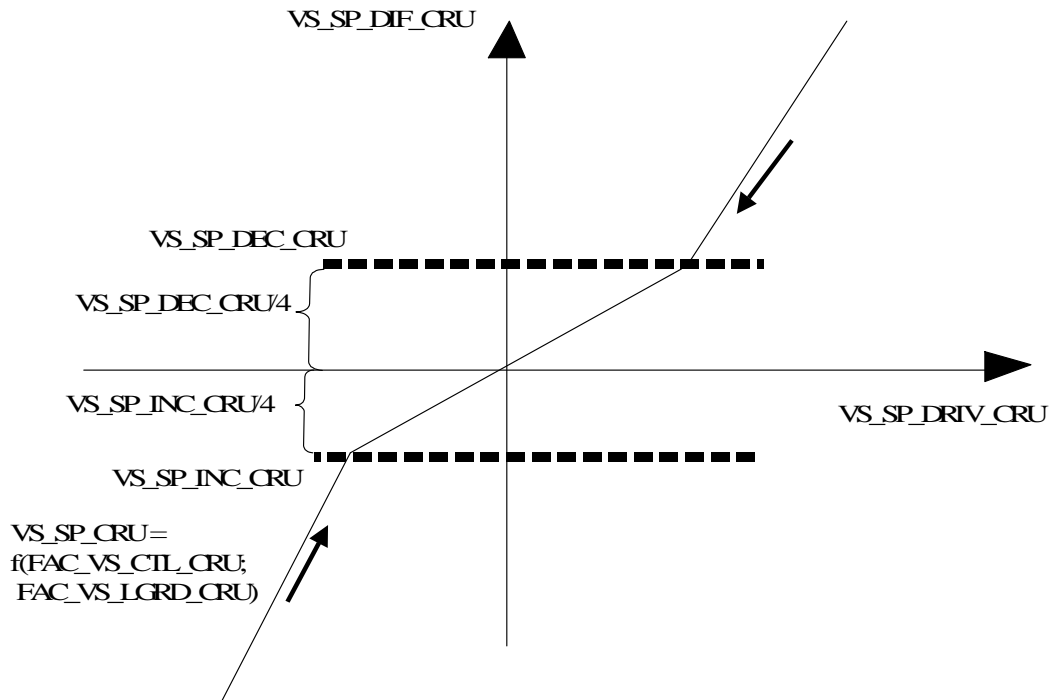
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**FUNCTION DESCRIPTION:**

Application conditions:

Initialisation: VS\_SP\_CRU = VS\_CRU

**Description:**



The reference input variable VS\_SP\_CRU is set equal to the instantaneous speed of the vehicle VS\_CRU at the start of the function.

The controlled acceleration of the vehicle is performed by controlled in/decrementation of the reference input variable of the cruise control. On start of the function, the time T\_CTL\_CRU is started and incremented in each computing cycle.

Is VS\_SP\_CRU is brought close to VS\_SP\_DRIV\_CRU with fixed increment (VS\_SP\_DEC\_CRU/4 or VS\_SP\_INC\_CRU/4).

A distinction is made between positive and negative acceleration.

FAC\_VS\_CTL\_CRU and FAC\_VS\_LGRD\_CRU are set by the momentarily active function of the cruise control, see following subchapter.

Formula section:

```

T_CTL_CRUn = T_CTL_CRUn-1 + 100 ms
VS_SP_DIF_CRU = VS_SP_CRU - VS_SP_DRIV_CRU
IF(1)      0 < VS_SP_DIF_CRU  VS_SP_DEC_CRU
Then(1)   VS_SP_CRUn = VS_SP_CRUn-1 - VS_SP_DEC_CRU /4
Else(1)
IF(2) VS_SP_DIF_CRU > VS_SP_DEC_CRU > 0
Then(2)   VS_SP_CRUn = VS_SP_CRUn-1
                - VS_SP_DEC_CRU           :Decrement
                * FAC_VS_CTL_CRU           :Factor for controlling
                * FAC_VS_LGRD_CRU         :Factor for intercepting
Else(2)
if(3)     (-1 * VS_SP_INC_CRU)  VS_SP_DIF_CRU < 0
    
```

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```

Then(3)      VS_SP_CRUn = VS_SP_CRUn-1+ VS_SP_INC_CRU/4
Else(3)
If(4)       VS_SP_DIF_CRU < (-1 * VS_SP_INC_CRU)
Then(4) VS_SP_CRUn = VS_SP_CRUn-1
                + VS_SP_INC_CRU           :Increment
                * FAC_VS_CTL_CRU          :Factor for controlling
                * FAC_VS_LGRD_CRU         :Factor for intercepting
Endif
Set of VS_SP_CRU in case of driver intervention:
If          (STATE_CRU = Set_acc or Retard)
                LV_VAR_BN = 1
                FAC_TQ_REQ_DRIV > FAC_TQ_REQ_CRU
                FAC_TQ_REQ_DRIV > IP_FAC_TQ_REQ_CLU_IS__N_32
                VS_CRU > VS_SP_CRU
Then       VS_SP_CRU = Min(VS_CRU, VS_SP_CRU_MAX)
Endif
    
```

Dec /Incrementation is interrupted if  
 VS\_DIF\_CRU > C\_VS\_DIF\_MAX\_AC\_CRU or  
 VS\_DIF\_CRU < C\_VS\_DIF\_MIN\_AC\_CRU

Dec /Incrementation is continued if  
 VS\_DIF\_CRU > C\_VS\_DIF\_MAX\_AC\_CRU or  
 VS\_DIF\_CRU < C\_VS\_DIF\_MIN\_AC\_CRU

### G.5.3 Actuating the reference input variable

General information:

The multiplicative correction factor FAC\_VS\_CTL\_CRU for in/decrementation the reference input variable in the controlled acceleration is calculated in each case for the individual functions of the cruise control. Also for automatic transmission, a distinction is made partially whether the converter clutch is just open or closed. The correction factor depends upon the time T\_CTL\_CRU. While the actuation of this function is active, the calculation of the I component is interrupted. The sum of the I component thus remains constant.

#### Formula section:

FAC\_VS\_CTL\_CRU = IP\_FAC\_XX\_CRU\_yy\_\_T\_CTL\_CRU

A distinction is made between the following CRU functions:

Resume: IP\_FAC\_CRU\_REST\_\_T\_CTL\_CRU

Setting/acceleration: **IF** LV\_AT = 0 or (LV\_AT = 1 and STATE\_CC != open)  
 Manual gear or automatic **Then** IP\_FAC\_CRU\_AC\_\_T\_CTL\_CRU  
 with closed converter clutch  
 Automatic with open converter **Else** IP\_FAC\_CC\_CRU\_AC\_\_T\_CTL\_CRU  
 Clutch **Endif**

Deceleration: **IF** LV\_AT = 0 or (LV\_AT = 1 and STATE\_CC != open)  
 Manual gear or automatic **Then** IP\_FAC\_CRU\_DECE\_\_T\_CTL\_CRU  
 with closed converter clutch  
 Automatic with open converter **Else** IP\_FAC\_CC\_CRU\_DECE\_\_T\_CTL\_CRU

Clutch Endif

## G.5.4 Intercepting the reference input variable target acceleration

General information:

To take account of the vehicle dynamics, the positive accelerations for high speeds as from approx. 80 k.p.h. must be reduced in the setting/acceleration and resume functions. For this purpose, the accelerations must be valued with a factor FAC\_VS\_LGRD\_CRU for in/decrementing the reference input variable. The acceleration is valued with 1 below the threshold C\_VS\_AC\_MIN\_CRU. If VS\_SP\_CRU exceeds this threshold, then the factor FAC\_VS\_LGRD\_CRU is reduced linearly by a ramp function up to the upper threshold C\_VS\_AC\_MAX\_CRU. The maximum reduction can be set through the value C\_FAC\_AC\_POS\_CRU.

To achieve comfortable interception of the reference input variable, the multiplicative correction factor, which is limited dependent on speed, must be calculated when in/decrementing the reference input variable in each case for the individual functions of the cruise control. While the interception of the reference input variable function is active, the calculation of the I component is interrupted. The sum of the I component remains constant. The correction factor depends upon the difference between reference input variable and target variable.

### Formula section:

```

IF      VS_SP_CRU < C_VS_AC_MIN_CRU
Then    FAC_VS_LGRD_CRU = 1
Else If VS_SP_CRU > C_VS_AC_MAX_CRU
Then    IF LV_RNG_L_REQ = 1
Then    FAC_VS_LGRD_CRU = C_FAC_AC_POS_CRU_RNG_L
Else    FAC_VS_LGRD_CRU = C_FAC_AC_POS_CRU
Else    FAC_VS_LGRD_CRU = FAC_VS_LGRD_CRUvehicle-speed-dependent
        * IP_FAC_LGRD_CRU_xx_VS_SP_DIF
    
```

During the acceleration  $IP\_FAC\_LGRD\_CRU\_xx\_VS\_SP\_DIF = 1$

$(FAC\_VS\_LGRD\_CRU = FAC\_VS\_LGRD\_CRU_{vehicle-speed-dependent})$

- Resume (RES):  $IP\_FAC\_LGRD\_CRU\_REST\_VS\_SP\_DIF$
- Tip Up and Tip down:  $IP\_FAC\_LGRD\_CRU\_TIP\_VS\_SP\_DIF$   
(TP\_UP, TP\_DOWN)

## G.5.5 Interventions

Application conditions:

Initialisation:  $VS\_SP\_DRIV\_CRU = VS\_MIN\_CRU$  at LV\_IGK 0 to1

### Formula section:

```

IF      STATE_VS_ICL_DISP = 1                "km/h; mph"
Then    VS_SP_CRU_MAX = C_VS_SP_CRU_MAX_M
Else    VS_SP_CRU_MAX = C_VS_SP_CRU_MAX_K
Endif
    
```

### G.5.5.1 Resume (RES)

Description:

When the resume function is activated, the vehicle is brought to the last target speed with the adjustable positive or negative acceleration. In this case the control basic function is activated and the reference input variable is controlled. When controlling the reference input variable VS\_SP\_CRU, a distinction is made between a resume to high speeds and a resume to the low speeds.

In a resume to a target speed, the reference input variable is in /decremented per computing cycle (100 ms).

To achieve a comfortable transition from the CRU status of ready to CRU mode on start of the restart function, the I component of the P/I controller is preallocated depending upon the recognised acceleration of the vehicle. To achieve comfortable acceleration on activating the resume function and on reaching the stored target speed, the control and interception of the reference input variable functions are series connected with the controlled acceleration function. In these functions a multiplicative correction factor is calculated in each case for in/decrementing the reference input variable.

At resume the after overtaking function is finished the resume function is activated with the initialisation calculation of FAC\_TQ\_CRU.

The algorithm for Step request is like the State resume. Only VS\_SP\_DRIV\_CRU is set to the current select mark VS\_SP\_DRIV\_STEP. Inside the controller a step request triggers the resume Function.

**Formula section:**

$$VS\_SP\_CRU = VS\_CRU$$

```

IF VS_CRU < VS_SP_DRIV_CRU
Then IF LV_RNG_L_REQ = 1
    Then VS_SP_INC_CRU = 3.6 * ID_AC_POS_CRU_RESU_RNG_L * 100 ms
    Else VS_SP_INC_CRU = 3.6 * ID_AC_POS_CRU_RESU * 100 ms
    VS_SP_CRU = capter "calculation of controlled acceleration"
Else
If VS_CRU > VS_SP_DRIV_CRU
Then VS_SP_DEC_CRU = 3.6 * IP_AC_NEG_CRU_RESU * 100 ms
    VS_SP_CRU = capter "calculation of controlled acceleration"
Endif
    
```

**G.5.5.2 CRU Step intervention**

**Formula section:**


Normal operation

```

If LV_STEP_ON_ACT = 1
Then if STATE_CRU != Passiv
    Then VS_SP_DRIV_CRU = VS_SP_DRIV_STEP
        If VS_SP_DRIV_CRU > VS_SP_CRU
            Then if VS_SP_CRU > VS_CRU
                Then VS_SP_CRU remains unchanged
                Else VS_SP_CRU = VS_CRU
            Endif
        Else if VS_SP_CRU > VS_CRU
            Then VS_SP_CRU = VS_CRU
            Else VS_SP_CRU remains unchanged
            Endif
        Endif
        STATE_CRU = Resume
    Endif
Endif
    
```

Additional for Overtaking

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```

If      STATE_CRU = Resume                                and
          LV_VAR_BN                                        and
          VS_SP_DRIV_CRU > VS_SP_CRU                      and
          VS_SP_CRU(n) VS_SP_CRU(n-1)                  and
          FAC_TQ_REQ_DRIV > FAC_TQ_REQ_CRU                and
          FAC_TQ_REQ_DRIV > IP_FAC_TQ_REQ_CLU_IS__N_32    and
          VS_CRU > VS_SP_CRU
Then      VS_SP_CRU = VS_CRU
Endif
    
```

### G.5.5.3 Setting/acceleration (SET/ACC)

Description:

On activating the setting/acceleration function from the CRU State of ready, the transition to controlled constant drive takes place. Reference input variable VS\_SP\_CRU and target variable VS\_SP\_DRIV\_CRU are set to the current speed VS\_CRU.

On activating the setting/acceleration function from readiness, a timer T\_CTL\_CRU is started. As long as SET/ACC recognizes that this timer reaches the value C\_T\_MIN\_CRU\_CON, the CRU state changes from controlled constant drive to controlled acceleration. The vehicle is brought to the required target speed with the adjustable positive ID\_AC\_POS\_CRU\_AC/RNG\_L or negative acceleration IP\_AC\_NEG\_CRU\_AC\_N\_FAC\_TQ\_CRU. In this case the control basic function is activated and the reference input variable VS\_SP\_CRU is controlled.

**As long as the setting/acceleration function is detected, the incrementation of the reference input variable takes place per computing cycle (100 ms) with the controlled acceleration function.**

On ending the setting/acceleration function, the target speed VS\_SP\_DRIV\_CRU is set equal to the achieved vehicle speed VS\_CRU. If the target speed VS\_SP\_DRIV\_CRU stored in this way is greater than the instantaneous reference input variable VS\_SP\_CRU, then the value VS\_SP\_CRU is incremented further by the value VS\_SP\_INC\_CRU through the controlled acceleration function. If the instantaneous reference input variable VS\_SP\_CRU is larger than the stored target speed VS\_SP\_DRIV\_CRU, then the reference input variable is decremented with the controlled acceleration function.

#### Formula section:

REQ\_MSW = ACC active:

```

IF          LV_RNG_L_REQ = 1
Then      VS_SP_INC_CRU = 3.6 * ID_AC_POS_CRU_AC_RNG_L * 100 ms
Else      VS_SP_INC_CRU = 3.6 * ID_AC_POS_CRU_AC * 100 ms
Endif
    
```

```

VS_SP_CRUn = VS_SP_CRUn-1
             + VS_SP_INC_CRU           :Increment
             * FAC_VS_CTL_CRU          :Factor for controlling
             * FAC_VS_LGRD_CRU        :Factor for intercepting
    
```

REQ\_MSW = ACC passive:

VS\_SP\_DRIV\_CRU = Min(VS\_CRU, VS\_SP\_CRU\_MAX)

```

IF          T_CONST_DRIVE C_T_MIN_CRU_CON
Then IF     VS_SP_CRU < VS_SP_DRIV_CRU
             Then IF LV_RNG_L_REQ = 1
                 Then      VS_SP_INC_CRU = 3.6 * ID_AC_POS_CRU_AC_RNG_L * 100
                 ms
                 Else VS_SP_INC_CRU = 3.6 * ID_AC_POS_CRU_AC * 100 ms
    
```

```

VS_SP_CRU = capter "calculation of controlled acceleration"
Else
  If      VS_SP_CRU > VS_SP_DRIV_CRU
  Then    VS_SP_DEC_CRU = 3.6 * IP_AC_NEG_CRU_AC__N__FAC_TQ_CRU* 100
  ms
  VS_SP_CRU = capter "calculation of controlled acceleration"
Endif
Endif

```

### G.5.5.4 Tip-up

Description:

On activating the TIP\_UP function, the vehicle is brought to the last target speed reached, i.e. VS\_SP\_DRIV\_CRU plus C\_VS\_DIF\_TIP\_M/K [km/h] with the adjustable positive acceleration C\_AC\_POS\_CRU\_TIP. In this case the control basic function is activated and the reference input variable VS\_SP\_CRU is controlled. By each detection of the TIP\_UP function, the target speed VS\_SP\_DRIV\_CRU is increased by C\_VS\_DIF\_TIP\_M/K [km/h].

If the absolute amount of the difference VS\_DIF\_CRU is greater than or equal to C\_VS\_DIF\_MAX\_CRU, the reference input variable VS\_SP\_CRU is incremented per computing cycle (100 ms) with the controlled acceleration function by the value:

#### Formula section:

```

IF      LV_CRU_OVER_ACT = 1      and      REQ_CRU = "TIP_UP"
Then    VS_SP_CRU = VS_SP_DRIV_CRU = MIN(VS_CRU, VS_SP_CRU_MAX)
        LV_CRU_OVER_ACT_ACK = 1
else    LV_CRU_OVER_ACT_ACK = 0
endif

```

```

IF      VS_SP_DRIV_CRU > VS_SP_CRU_MAX
Then    VS_SP_DRIV_CRU = VS_SP_CRU_MAX
Else if STATE_VS_ICL_DISP = 1
  Then  VS_SP_DRIV_CRU = VS_SP_DRIV_CRU + C_VS_DIF_TIP_M [km/h]
  Else  VS_SP_DRIV_CRU = VS_SP_DRIV_CRU + C_VS_DIF_TIP_K [km/h]
Endif
Endif

```

```

IF      VS_DIF_CRU > C_VS_DIF_MAX_CRU
Then    VS_SP_INC_CRU = 3.6 * C_AC_POS_CRU_TIP * 100 ms
        VS_SP_CRUn = VS_SP_CRUn-1
          + VS_SP_INC_CRU           :Increment
          * FAC_VS_CTL_CRU          :Factor for controlling
          * FAC_VS_LGRD_CRU         :Factor for intercepting

```

```

Else if STATE_VS_ICL_DISP = 1
  Then  VS_SP_CRU = VS_SP_CRU + C_VS_DIF_TIP_M [km/h]
  Else  VS_SP_CRU = VS_SP_CRU + C_VS_DIF_TIP_K [km/h]
Endif
Endif

```

### G.5.5.5 Tip-down

Description:

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On activating the TIP\_DOWN function, the vehicle is brought to the last target speed reached, i.e. VS\_SP\_DRIV\_CRU minus C\_VS\_DIF\_TIP\_M/K [km/h] by the adjustable negative acceleration C\_AC\_NEG\_CRU\_TIP. In this case the control basic function is activated and the reference input variable VS\_SP\_CRU is controlled. At each detection of the TIP\_DOWN function, the target speed VS\_SP\_DRIV\_CRU is reduced by C\_VS\_DIF\_TIP\_M/K [km/h].

VS\_SP\_CRU and VS\_SP\_DRIV\_CRU cannot be less than VS\_MIN\_CRU.

If the absolute amount of the difference VS\_DIF\_CRU is greater than or equal to C\_VS\_DIF\_MAX\_CRU, the reference input variable VS\_SP\_CRU is decrements per computing cycle (100 ms) with the controlled acceleration function. The charge wish FAC\_TQ\_CRU is limited to the value (IP\_FAC\_TQ\_REQ\_CLU\_IS\_N\_32\*99,998%). so that no trailing throttle cut-off is triggered (except for: PUC was already active before TIP\_DOWN).

#### Formula section:

```

IF                LV_CRU_OVER_ACT = 1      and      REQ_CRU = "TIP_DOWN"
Then             VS_SP_CRU = VS_SP_DRIV_CRU = MIN(VS_CRU; VS_SP_CRU_MAX)
                  LV_CRU_OVER_ACT_ACK = 1
else             LV_CRU_OVER_ACT_ACK = 0
endif

IF                VS_SP_DRIV_CRU < VS_MIN_CRU
Then             VS_SP_DRIV_CRU = C_VS_SP_CRU_MIN
Else if         STATE_VS_ICL_DISP = 1
  Then           VS_SP_DRIV_CRU = VS_SP_DRIV_CRU - C_VS_DIF_TIP_M [km/h]
  Else           VS_SP_DRIV_CRU = VS_SP_DRIV_CRU - C_VS_DIF_TIP_K [km/h]
Endif
Endif

IF                VS_DIF_CRU > C_VS_DIF_MAX_CRU
Then             VS_SP_DEC_CRU = 3.6 * C_AC_NEG_CRU_TIP * 100 ms
                  VS_SP_CRUn = VS_SP_CRUn-1
                              - VS_SP_DEC_CRU           :Decrement
                              * FAC_VS_CTL_CRU           :Factor for controlling
                              * FAC_VS_LGRD_CRU          :Factor for intercepting

Else if         STATE_VS_ICL_DISP = 1
  Then           VS_SP_CRU = VS_SP_CRU - C_VS_DIF_TIP_M [km/h]
  Else           VS_SP_CRU = VS_SP_CRU - C_VS_DIF_TIP_K [km/h]
Endif
Endif
FAC_TQ_CRU ((IP_FAC_TQ_REQ_CLU_IS_N_32 - C_FAC_TQ_REQ_CLU_IS_HYS) *
            99,998%)

```

#### G.5.5.6 Deceleration

##### Description:

On activating the deceleration function, the vehicle is brought to the required target speed with the adjustable negative C\_AC\_NEG\_CRU\_DEACC or positive acceleration C\_AC\_POS\_CRU\_DEACC (for the steady state). In this case the control basic function is activated and the reference input variable VS\_SP\_CRU is controlled.

As long as the deceleration function is detected, the decrementation of the reference input variable takes place per computing cycle (100 ms) with the controlled acceleration function

On ending the deceleration function, the target speed VS\_SP\_DRIV\_CRU is set equal with the reached vehicle speed VS\_CRU. If the target speed VS\_SP\_DRIV\_CRU thus stored is smaller than the instant-

neous reference input variable VS\_SP\_CRU, then the value VS\_SP\_CRU is decremented by the value VS\_SP\_DEC\_CRU further via the controlled acceleration function. VS\_SP\_CRU and VS\_SP\_DRIV\_CRU cannot be smaller than VS\_MIN\_CRU. If the instantaneous reference input variable VS\_SP\_CRU is smaller than the stored target speed VS\_SP\_DRIV\_CRU, then the reference input variable is incremented with the controlled acceleration function.

### Formula section:

REQ\_MSW = DEC active:

VS\_SP\_DEC\_CRU =  $3.6 * C\_AC\_NEG\_CRU\_DEACC * 100 \text{ ms}$

VS\_SP\_CRUn = VS\_SP\_CRUn-1  
 - VS\_SP\_DEC\_CRU : Decrement  
 \* FAC\_VS\_CTL\_CRU : Factor for controlling  
 \* FAC\_VS\_LGRD\_CRU : Factor for intercepting

REQ\_MSW = DEC passive:

VS\_SP\_DRIV\_CRU = Min(VS\_CRU, VS\_SP\_CRU\_MAX)

**IF** VS\_SP\_DRIV\_CRU < VS\_SP\_CRU

**Then** VS\_SP\_DEC\_CRU =  $3.6 * C\_AC\_NEG\_CRU\_DEACC * 100 \text{ ms}$

VS\_SP\_CRU = capter "calculation of controlled acceleration"

**Else** VS\_SP\_INC\_CRU =  $3.6 * C\_AC\_POS\_CRU\_DEACC * 100 \text{ ms}$

VS\_SP\_CRU = capter "calculation of controlled acceleration"

**Endif**


As long as decrementing the reference input variable VS\_SP\_CRU is active, the calculation of the I component is released.

Calculation of VS\_DIF\_I\_CRU until

VS\_DIF\_I\_CRU + C\_VS\_DIF\_DELTA\_I < VS\_DIF\_CRU

### G.5.5.7 OFF

In the OFF function, the last setpoint VS\_SP\_DRIV\_CRU remains stored and soft cut-off is activated. If the engine running is stopped (LV\_IGK, LV\_ES) the CRU - readiness and the last speed-setpoint are to reset to their initial values.

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## G.6 Vehicle speed limitation controller

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_VS_MAX_DIF_I	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Torque output of VS_MAX I Controller					
TQ_VS_MAX_DIF_P	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Torque output of VS_MAX P Controller					

### Input data:

AC_VEH_MMV {p. 1158}	FAC_VS_LIM_I_DYN_VSL {p. 7259}	FAC_VS_LIM_P_DYN_VSL {p. 7259}	LV_IGK {p. 906}
LV_VS_MAX_VSL {p. 7267}	N_VS {p. 806}	TQI_REQ_TRA {p. 8192}	TQI_VS_MAX {p. 6659}
VS_DIF_LIM {p. 1158}			

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LGRD_TQ_VS_MAX_I	-	0... 7FFFH	0... 1023.97	0.03125	Nm
Negative Gradient Limiter for VS_MAX I term					
C_MASS_VEH	-	0... FFH	0... 2550	10	kg
Equivalent Vehicle Mass for acceleration calculation					

### G.6.1 VHSL\_MG009

This module aims to limit the vehicle speed to C\_VS\_MAX. A PI controller is used to define the engine torque limitation. In order to minimise speed overshoot, a predicted vehicle speed is calculated and the I controller is initialised with a calculated torque reduction.

### Application Condition

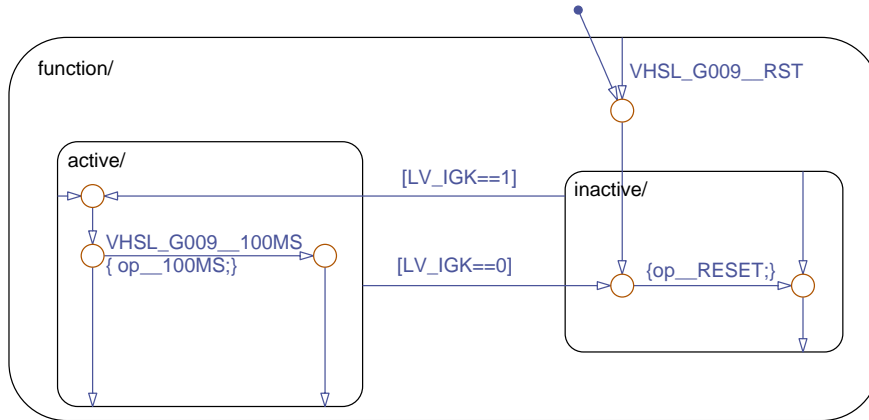



Figure G.6.1: VHSL\_MG009/APP\_CDN/Chart

**Function Description**

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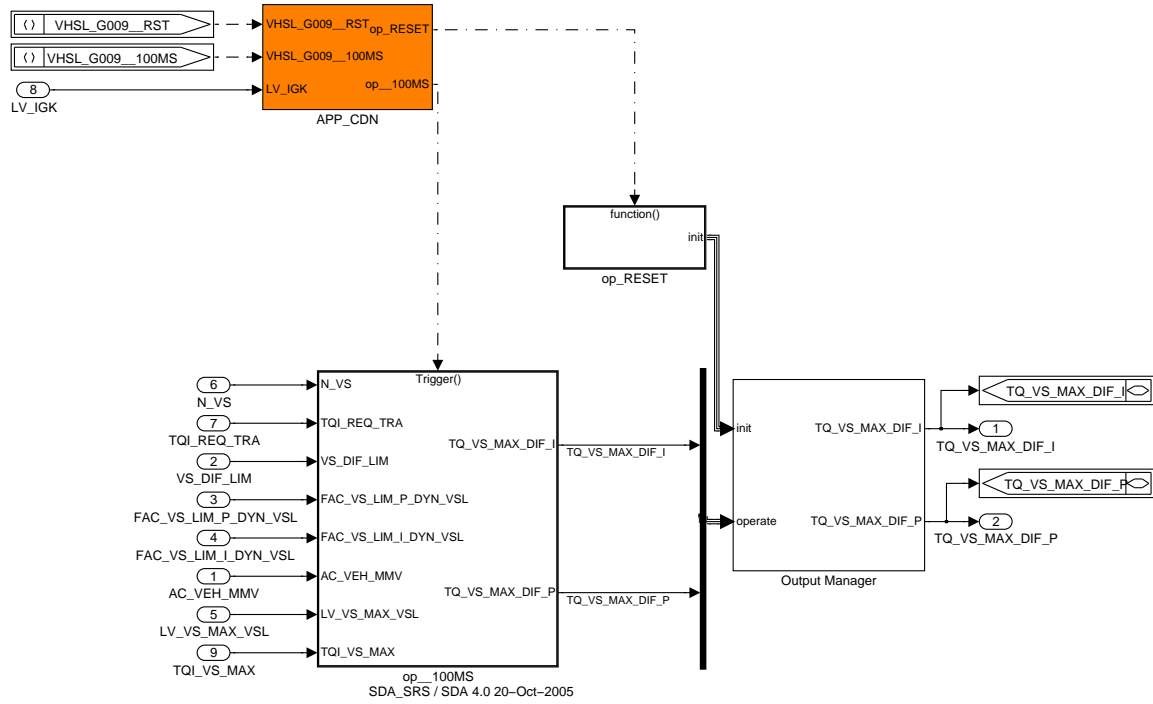


Figure G.6.2: VHS�\_MG009

**G.6.1.1 SUBFUNCTION: Output Manager**

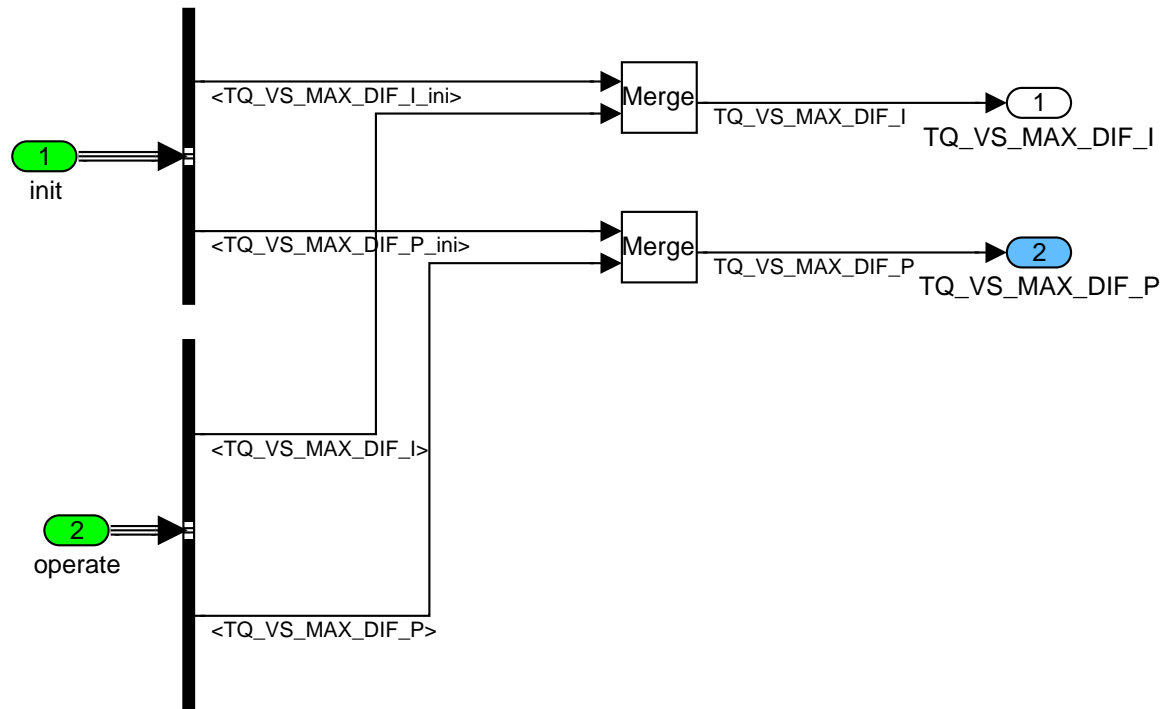
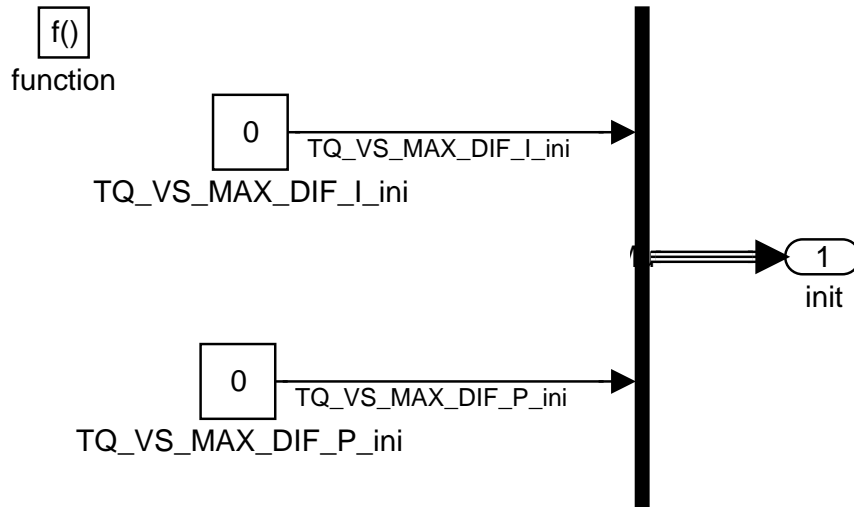


Figure G.6.3: VHS�\_MG009/Output Manager

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### G.6.1.2 SUBFUNCTION: op\_RESET



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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 7256 of 8404</b>	
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Figure 4 VHSL\_MG009/  
op\_RESET

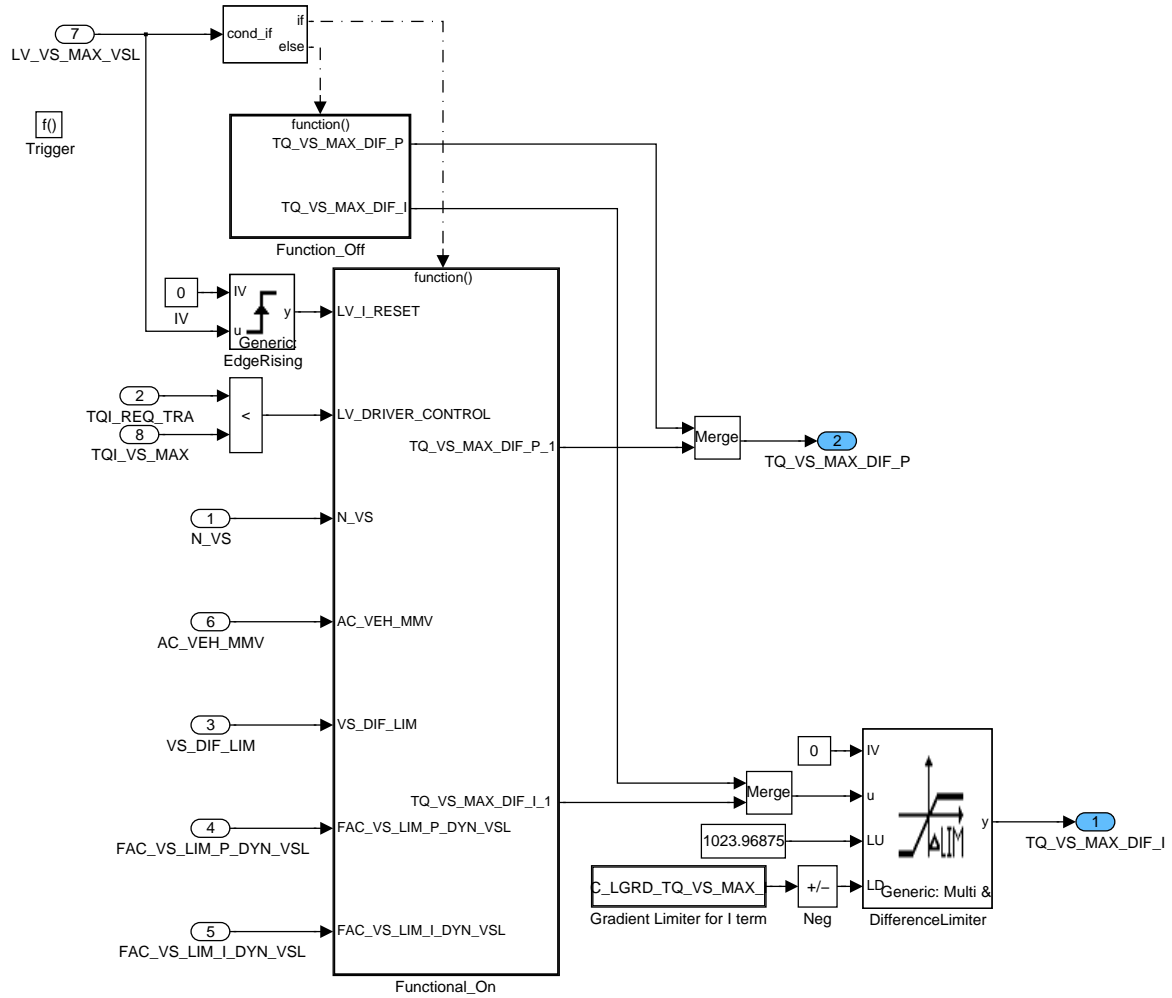
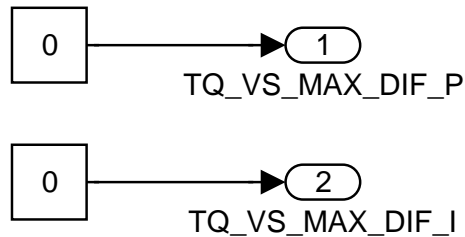


Figure G.6.4: VHSL\_MG009/op\_\_100MS

f()  
function



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Figure 6 VHSL\_MG009/ op\_\_100MS/  
Function\_Off

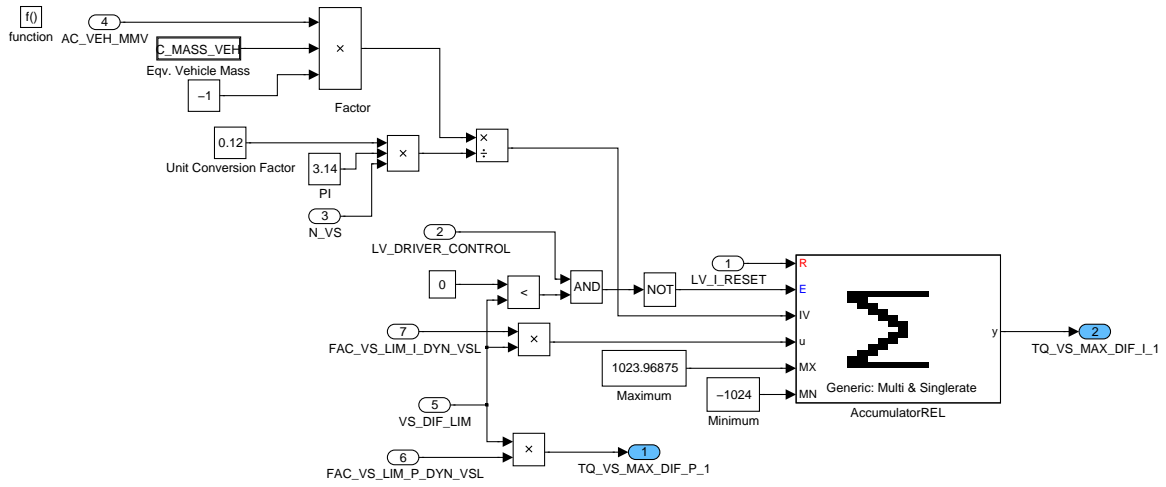


Figure G.6.5: VHSL\_MG009/op\_\_100MS/Functional\_On

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## G.7 Vehicle speed limitation controller (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_VS_LIM_I_DYN_VSL	O/V	0... 7FFFH	0... 255.992188	0.0078125	Nm/(km/h)
I control parameter for VS limitation					
FAC_VS_LIM_P_DYN_VSL	O/V	0... FFH	0... 127.5	0.5	Nm/(km/h)
P control parameter for VS limitation					
LV_FAC_CTL_DYN_CHG_VSL	V	0... 1H	0 ...1	1	-
flag indicating a change in the control dynamics					

### Input data:

LV_IGK {p. 906}	LV_VS_MAX_VSL {p. 7267}	N_VS {p. 806}	VS_DIF_LIM {p. 1158}
-----------------	-------------------------	---------------	----------------------

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_RAMP_VS_DEC_VSL	-	0... 400H	0 ...1	97.6563e3	-
ramp down constant (decrement)					
C_FAC_RAMP_VS_INC_VSL	-	0... 400H	0 ...1	97.6563e3	-
ramp up constant (increment)					
C_VS_THD_H_VSL	-	0... FFFFH	0... 655.35	0.01	km/h
upper limit of hysteresis for the vehicle speed					
C_VS_THD_L_VSL	-	0... FFFFH	0... 655.35	0.01	km/h
lower limit of hysteresis for the vehicle speed					
IP_FAC_VS_LIM_I_H_DYN_VSL	-	0... 7FFFH	0... 255.992188	0.0078125	Nm/(km/h)
LDPM_N_VS_LIM_VSL	8	0... FFH	0... 255	1	rpm/(km/h)
Gain for the integral term in high dynamics					
IP_FAC_VS_LIM_I_L_DYN_VSL	-	0... 7FFFH	0... 255.992188	0.0078125	Nm/(km/h)
LDPM_N_VS_LIM_VSL	8	0... FFH	0... 255	1	rpm/(km/h)
Gain for the integral term in low dynamics					
IP_FAC_VS_LIM_P_H_DYN_VSL	-	0... FFH	0... 127.5	0.5	Nm/(km/h)
LDPM_N_VS_LIM_VSL	8	0... FFH	0... 255	1	rpm/(km/h)
Gain for the proportional term in high dynamics					
IP_FAC_VS_LIM_P_L_DYN_VSL	-	0... FFH	0... 127.5	0.5	Nm/(km/h)
LDPM_N_VS_LIM_VSL	8	0... FFH	0... 255	1	rpm/(km/h)
Gain for the proportional term in low dynamics					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

### G.7.1 VHSL\_MG000

The control dynamic is determined by LV\_FAC\_CTL\_DYN\_CHG\_VSL. The I and PD control parameters are calculated based on the dynamic behaviour of the controller.

#### Application Condition

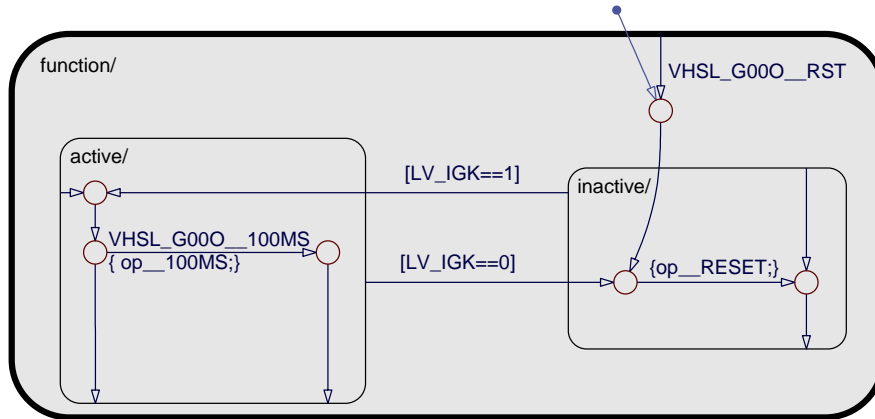
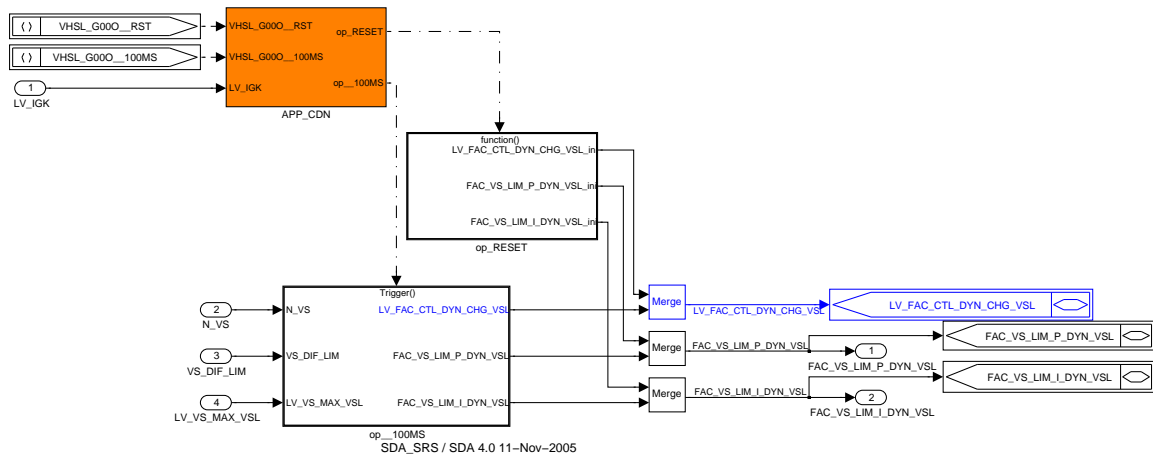


Figure G.7.1: VHSL\_MG000/APP\_CDN/Chart

#### Function Description



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Figure G.7.2: VHSL\_MG000

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### G.7.1.1 SUBFUNCTION: op\_RESET

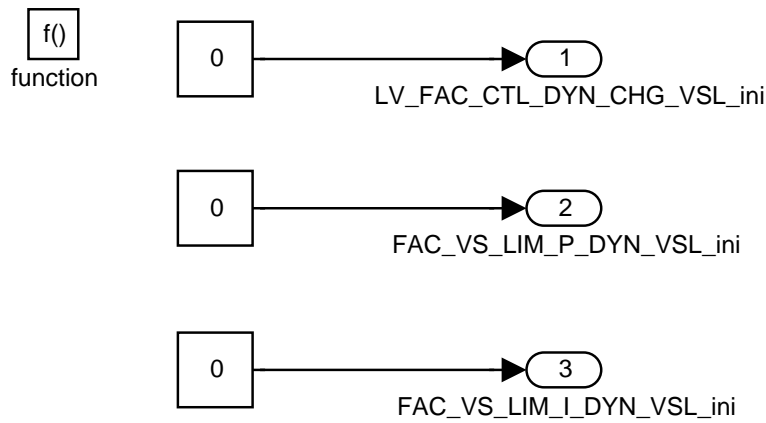


Figure G.7.3: VHSL\_MG00O/op\_RESET

### G.7.1.2 SUBFUNCTION: op\_\_100MS

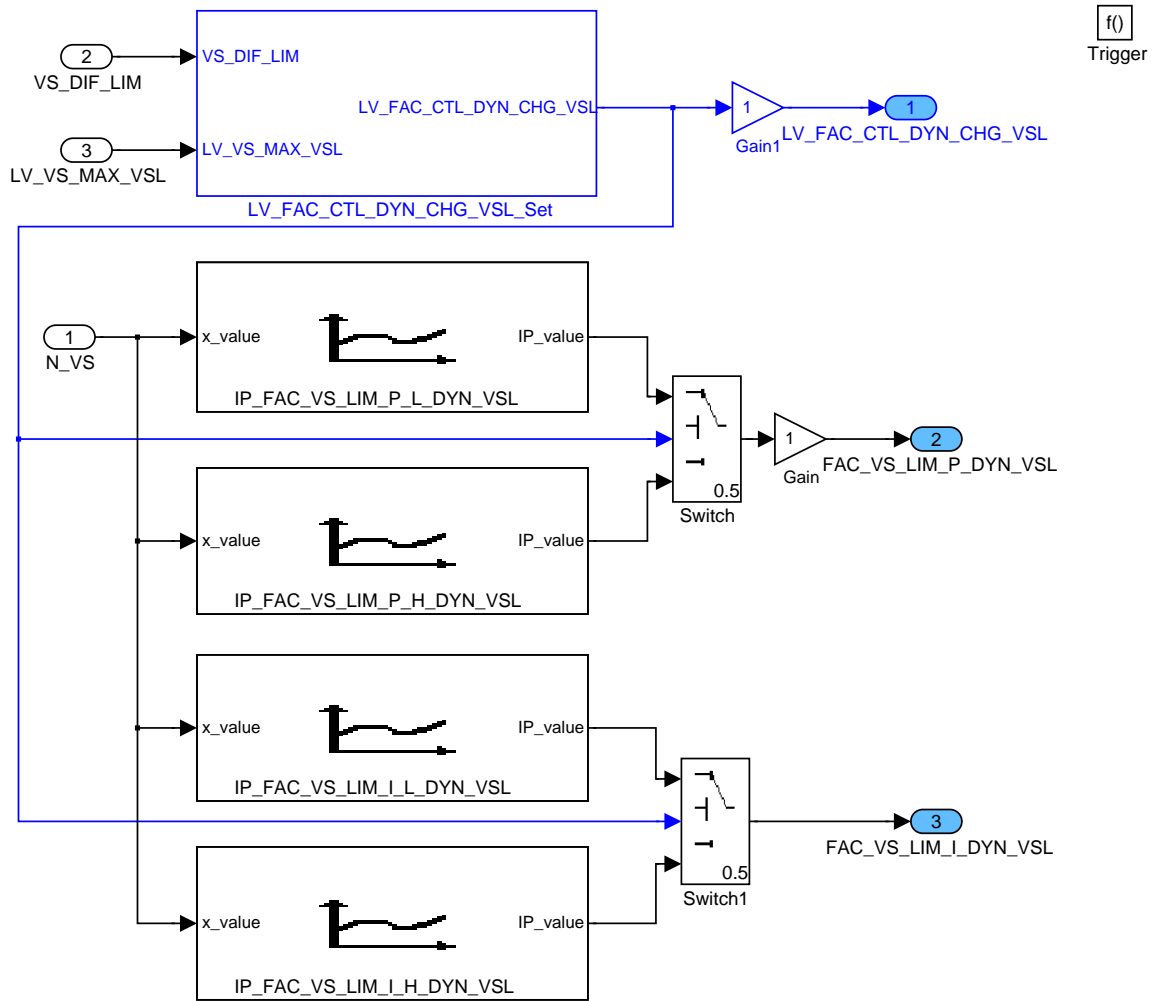


Figure G.7.4: VHS�\_MG000/op\_\_100MS

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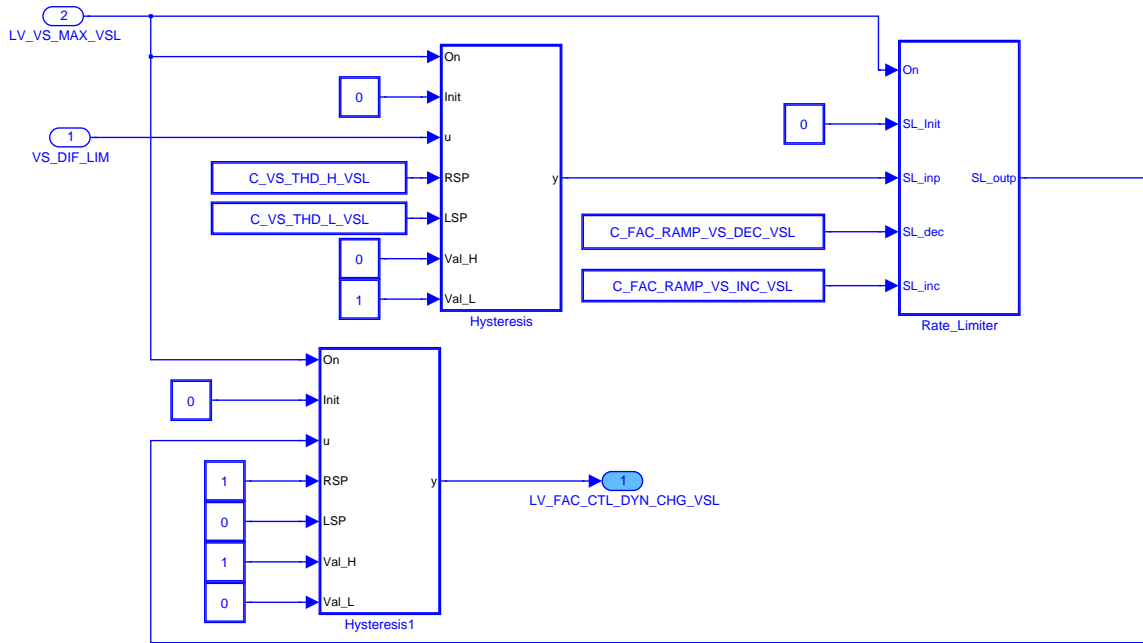


Figure G.7.5: VHSL\_MG00O/op\_\_100MS/LV\_FAC\_CTL\_DYN\_CHG\_VSL\_Set

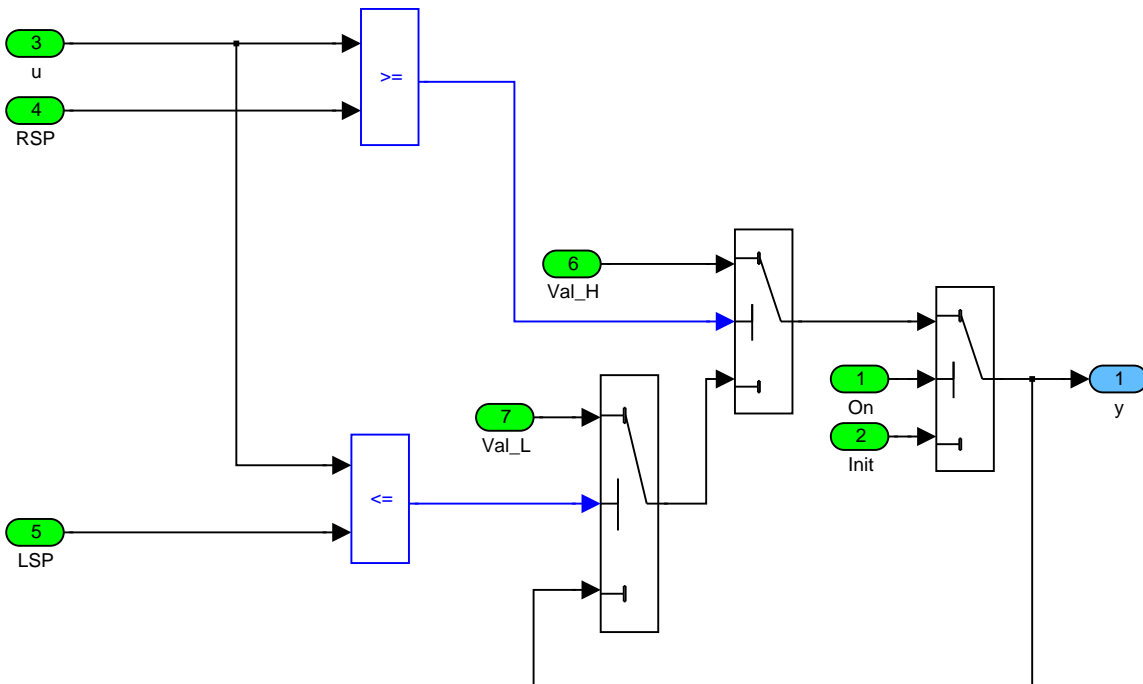


Figure G.7.6: VHSL\_MG00O/op\_\_100MS/LV\_FAC\_CTL\_DYN\_CHG\_VSL\_Set/Hysteresis

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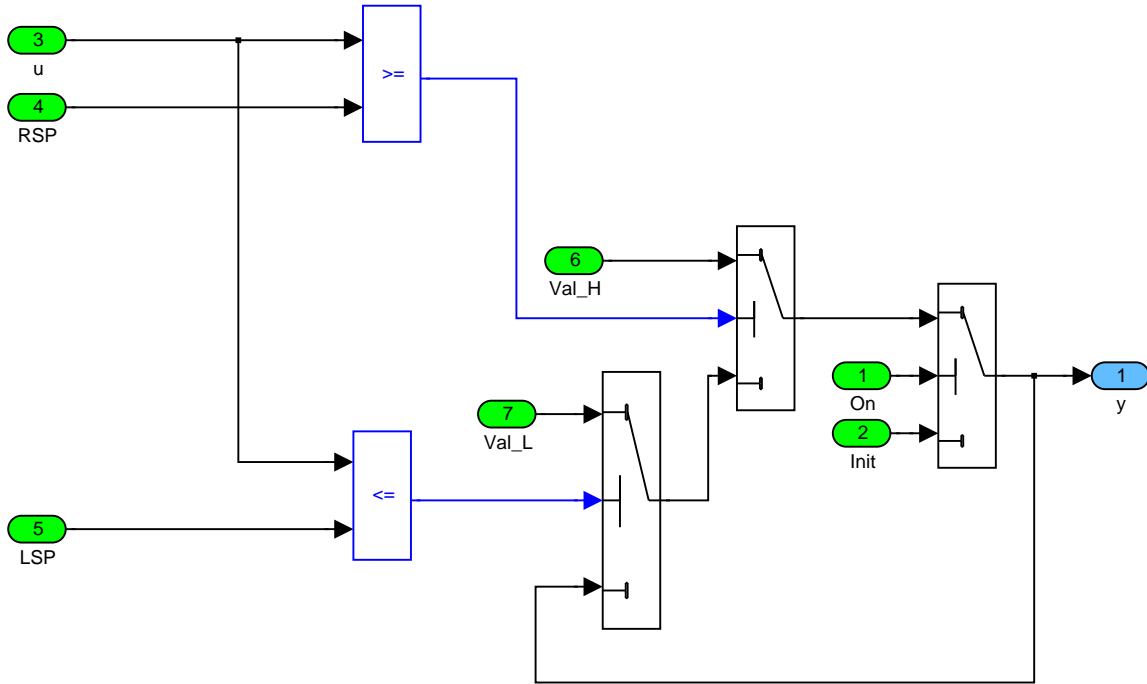


Figure G.7.7: VHSL\_MG000/op\_\_100MS/LV\_FAC\_CTL\_DYN\_CHG\_VSL\_Set/Hysteresis1

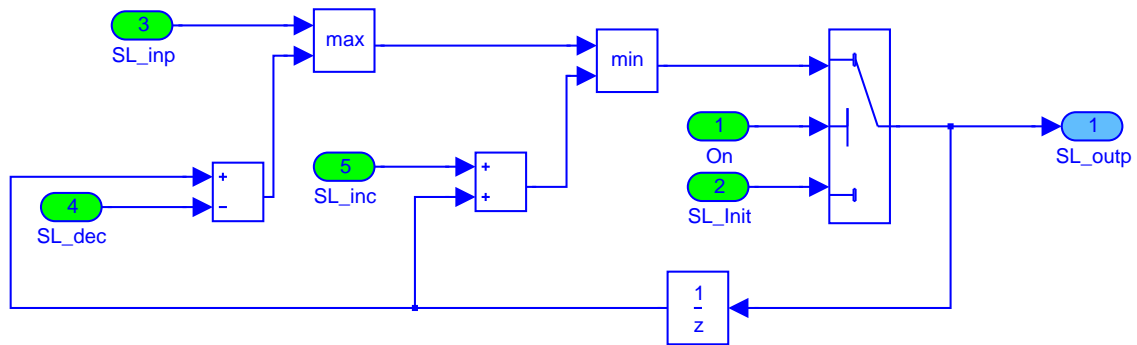


Figure G.7.8: VHSL\_MG000/op\_\_100MS/LV\_FAC\_CTL\_DYN\_CHG\_VSL\_Set/Rate\_Limiter

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# G.8 Vehicle speed limitation manager

**Data definition:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_VSL	O	0... 4H	0 ...4	1	-
states of the vehicle limitation manager					

**Input data:**

LV_IGK {p. 906}	LV_VS_MAX_VSL {p. 7267}		
-----------------	-------------------------	--	--

## G.8.1 FUNCTION PART: VHSL\_MG00D

**Application Condition**

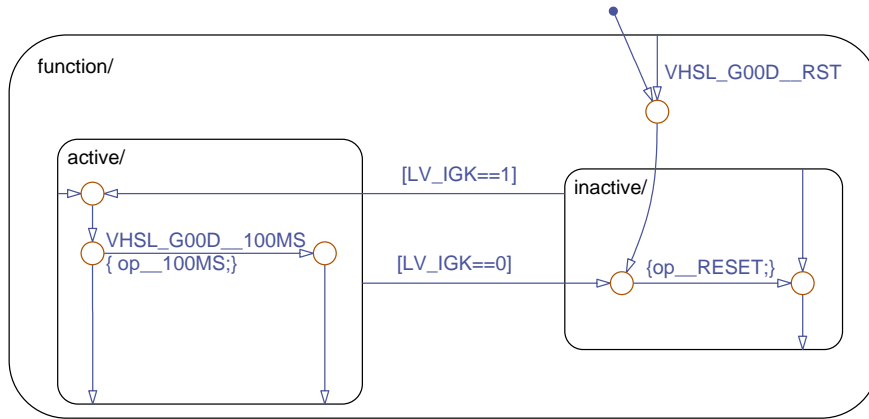


Figure G.8.1: VHSL\_MG00D/APP\_CDN/Chart

**Function Description**

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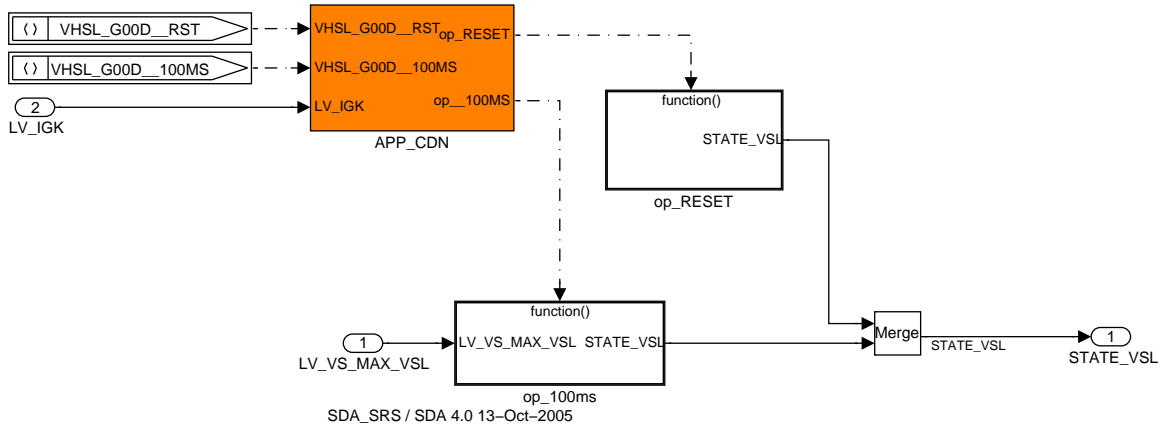


Figure G.8.2: VHS�\_MG00D

**G.8.1.1 SUBFUNCTION: op\_100ms**

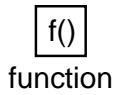


Figure G.8.3: VHS�\_MG00D/OP\_100MS

**G.8.1.2 SUBFUNCTION: op\_RESET**

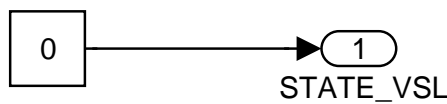
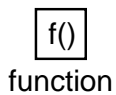


Figure G.8.4: VHS�\_MG00D/OP\_RESET

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## G.9 Vehicle speed limitation manager (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_VS_MAX_VSL	O/V	0... 1H	0 ...1	1	-
Boolean for vehicle speed limitation active					

### Input data:

LV_IGK {p. 906}	N_32 {p. 1525}	VS_MAX {p. 1158}	VS_PRED {p. 1158}
-----------------	----------------	------------------	-------------------

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_MIN_VS_MAX	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for VS_MAX function					
C_VS_MAX_HYS_OFF	-	0... 7FFFH	0... 327.67	0.01	km/h
Offset to turn off VS MAX limiter					
C_VS_MAX_HYS_ON	-	0... 7FFFH	0... 327.67	0.01	km/h
VS Offset to turn on VS MAX limiter					
LC_VS_MAX_VSL_MAN	-	0... 1H	0 ...1	1	-
Logical calibratable for the manually activation/deactivation of the vehicle speed limitation functionality					
LC_VSL_ACT_MAN	-	0... 1H	0 ...1	1	-
Manual switch to enable vehicle speed limiter					

### General Information

This module deals with the activation of the fix vehicle speed limitation functionality. The function is switched on, LV\_VS\_MAX is set, when the predicted vehicle speed, VS\_PRED exceeds the set point minus an offset, VS\_MAX - C\_VS\_MAX\_HYS\_ON. On the other hand the function is reset, and turned off, when the predicted vehicle speed, VS\_PRED drops below the set point minus a hysteresis VS\_MAX - C\_VS\_MAX\_HYS\_OFF. An additional activation condition is that engine speed should be below of a threshold, C\_N\_MIN\_VS\_MAX. This threshold must be set to a low value away from the VS\_MAX engine speed area. Application Condition

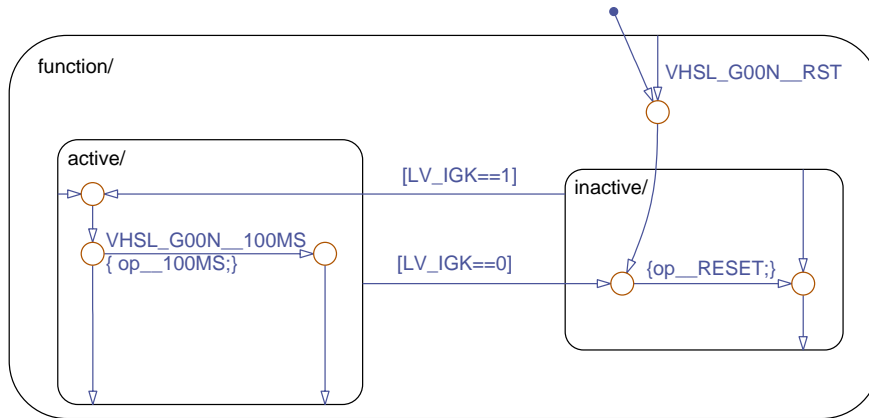


Figure G.9.1: VHSL\_MG00N/APP\_CDN/Chart

**Function Description**

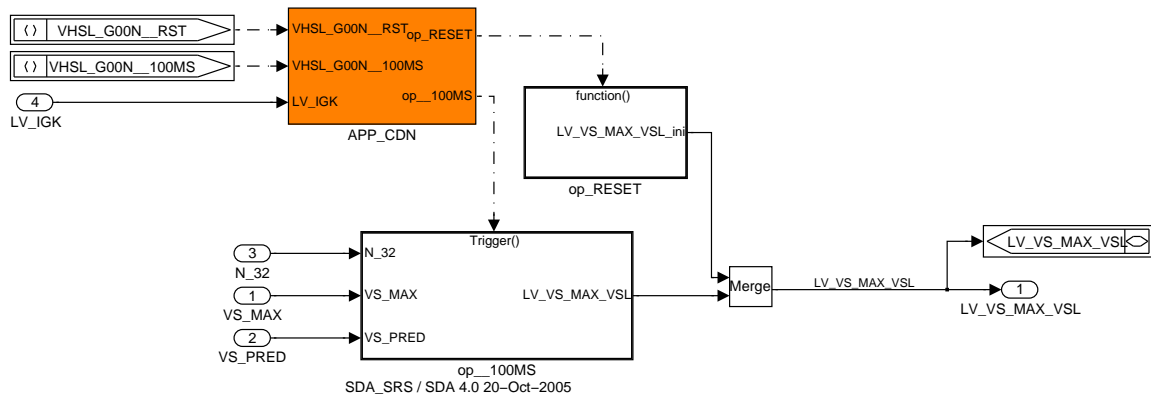


Figure G.9.2: VHSL\_MG00N

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### G.9.1 SUBFUNCTION: op\_RESET

f()  
function



Figure G.9.3: VHSL\_MG00N/op\_RESET

### G.9.2 VHSL\_MG00N/OP\_\_100MS

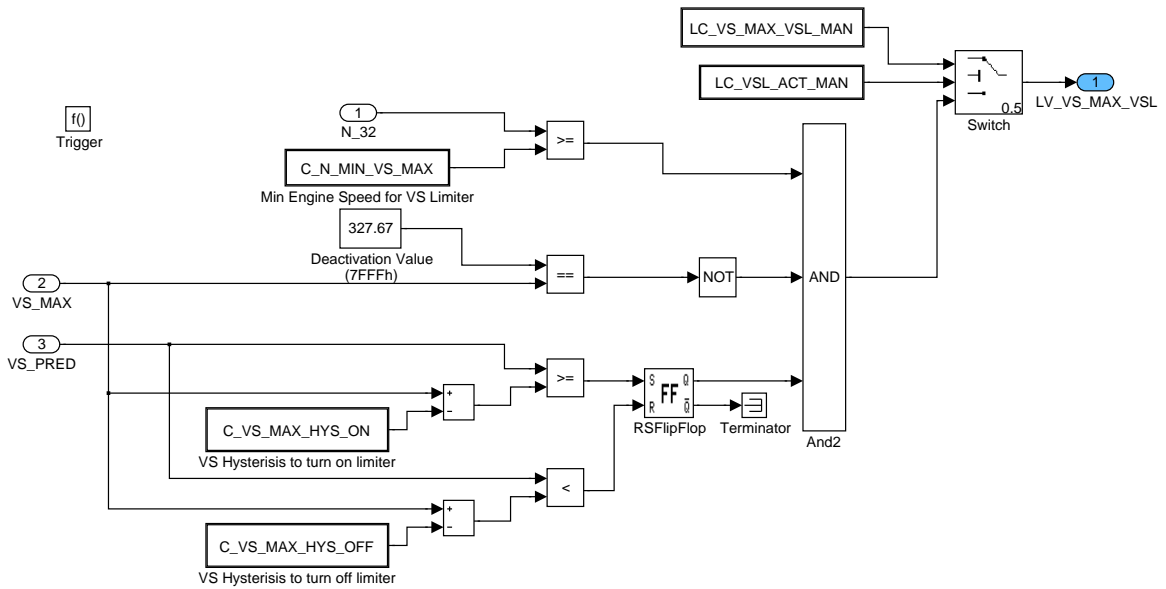


Figure G.9.4: VHSL\_MG00N/op\_\_100MS

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	Document key 10171571 SPE 000 AO	Pages Page 7269 of 8404	
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## G.10 Vehicle speed limitation output

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQI_VS_MAX	O/V	0... 7FFFH	0... 1023.97	0.03125004	Nm
Torque request for vehicle speed limitation					

### Input data:

LV_IGK {p. 906}	LV_VS_MAX_VSL {p. 7267}	TQ_VS_MAX_DIF_I {p. 7253}	TQ_VS_MAX_DIF_P {p. 7253}
TQI_AV {p. 981}	TQI_BAS_MAX {p. 810}	TQI_REQ_TRA {p. 8192}	

### G.10.1 VHSL\_MG00P

This functionality limits the engine torque output by TQI\_VS\_MAX. The value of TQI\_VS\_MAX is initialised with the current engine output torque requirement. This will be calculated as the maximum of TQI\_AV and minimum of TQI\_BAS\_MAX, TQI\_REQ\_TRA. This starting value of TQI\_VS\_MAX is then stored.

### Application Condition

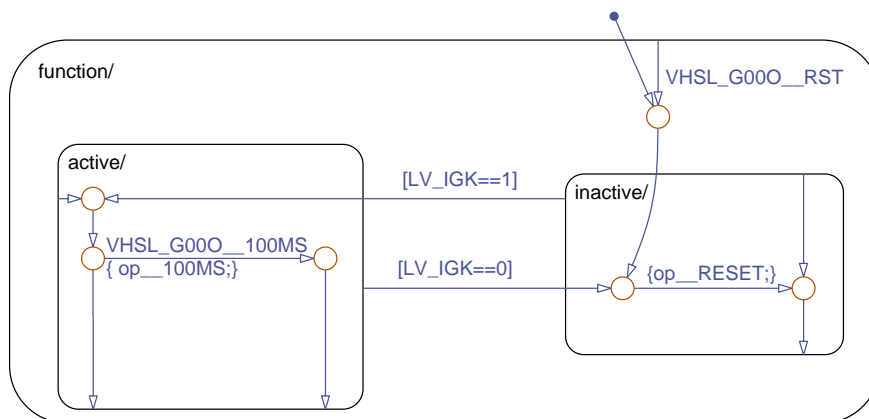


Figure G.10.1: VHSL\_MG00P/APP\_CDN/Chart

**Function Description**

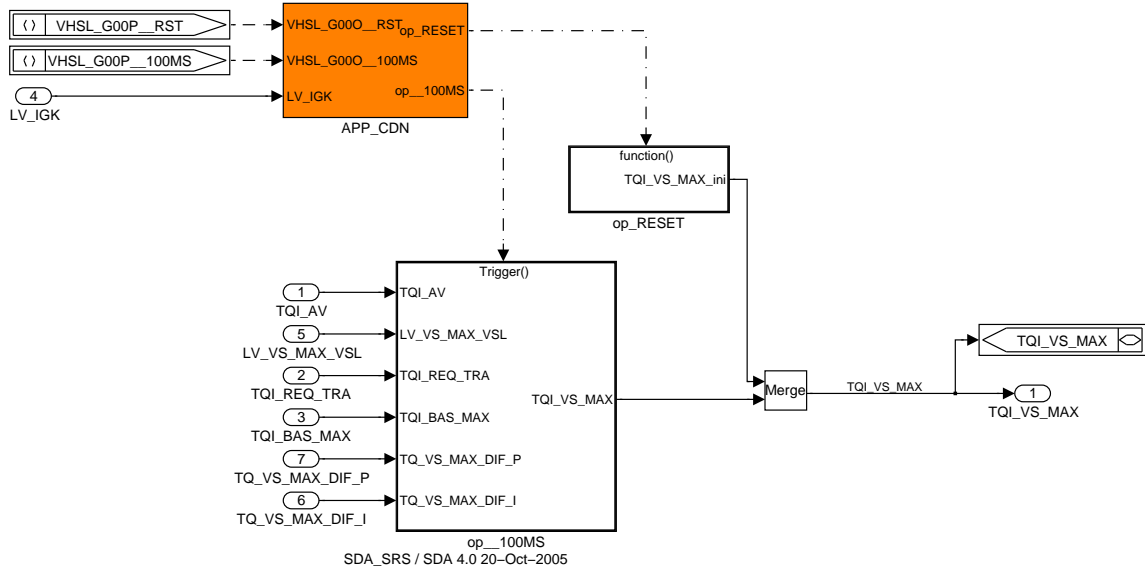


Figure G.10.2: VHS�\_MG00P

**G.10.1.1 SUBFUNCTION: op\_RESET**

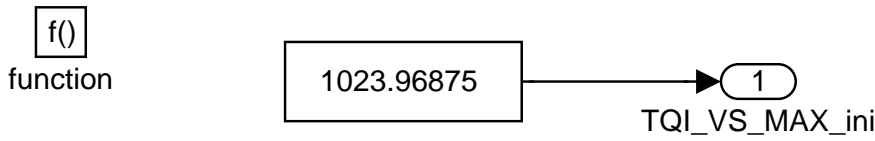


Figure 3 VHS�\_MG00P/  
op\_RESET

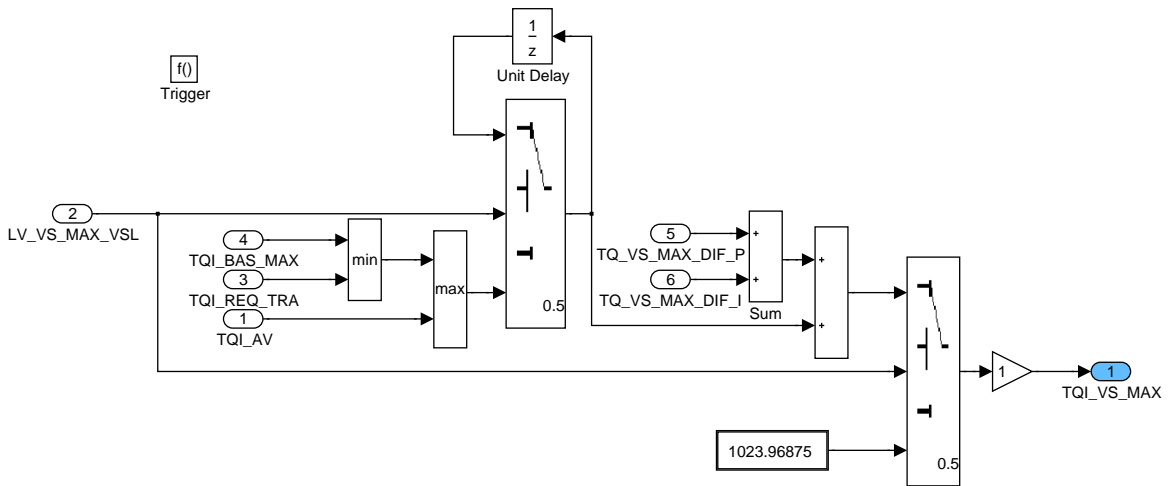



Figure G.10.3: VHS�\_MG00P/op\_100MS

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# I - Serial Communication

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# I.1 Error codes

Hex Value	Response Code	Mnemonic
10	generalReject	GR
11	serviceNotSupported	SNS
12	subFunctionNotSupported-invalidFormat	SFNS_IF
21	busy-repeatRequest	B_RR
22	conditionsNotCorrect /requestSequenceError	CNCORSE
23	routineNotComplete	RNC
31	requestOutOfRange	ROOR
33	securityAccessDenied/Required	SAD
35	invalidKey	IK
36	exceedNumberOfAttempts	ENOA
37	requiredTimeDelayNotExpired	RTDNE
40	downloadNotAccepted	DNA
41	improperDownloadType	IDT
42	can'tDownloadToSpecifiedAddress	CNDTSA
43	can'tDownloadNumberOfBytesRequested	CNDNOBR
50	uploadNotAccepted	UNA
51	improperUploadType	IUT
52	can'tUploadFromSpecifiedAddress	CNUFSA
53	can'tUploadNumberOfBytesRequested	CNUNOBR
71	transferSuspended	TS
72	transferAborted	TA
74	illegalAddressInBlockTransfer	IAIB
75	illegalByteCountInBlockTransfer	IBCBT
76	illegalBlockTransferType	IBTT
78	requestCorrectlyReceived-ResponsePending	RCRRP
79	incorrectByteCountDuringBlockTransfer	IBCDBT
80	serviceNotSupportedInActiveDiagnosticMode	SNSIADM

## I.1.1 General negative Responses

NegativeResponseCode	Cause of Occurrence
generalReject	selected diagnosticService is longer than the current receive buffer
serviceNotSupported	selected diagnosticService is not supported by the ECU
serviceNotSupportedInActiveDiagnosticMode	selected diagnosticService is not supported in the current diagnostic mode
securityAccessDenied/Required	selected diagnosticService is not supported in the current securityLevel
incorrectByteCountDuringBlockTransfer	Number of bytes of the telegram does not match to the given length
requestCorrectlyReceived-ResponsePending	the action to be performed by the selected diagnosticService may not be completed yet

1. These negative response codes are possible for all diagnostic services. The occurrence is depending on the system configuration.

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## I.2 Error handling

### I.2.1 Error handling during physical/functional Fast Initialization

#### I.2.1.1 Client(tester) Error handling during physical/functional Fast Initialization

<i>Client(tester) detects an...</i>	<i>Action</i>
<b>... error in T<sub>idle</sub> (W5 or P3min)</b>	The client(tester) is responsible to keep to the idle time The server(ECU) is responsible to keep to the time P1min. In case of an error the client(tester) must wait for T <sub>idle</sub> again.
<b>... error in P1min</b>	No observation necessary. P1min is always 0 ms.
<b>... error in P1max (P1max timeout)</b>	The client(tester) shall ignore the response and shall open a new timing window P2 to receive a directly repeated response from the same server(ECU) or a response from another server(ECU). If the server(ECU) doesn't repeat the response, the client(tester) shall wait for P3max timeout and afterwards the client(tester) may start a new Initialization beginning with a wake-up-pattern (T <sub>idle</sub> = 0 ms).
<b>... error in P2min</b>	No observation necessary. P2min is always 0 ms during Initialization.
<b>... error in P2max (no valid response from any server (ECU))</b>	If the client(tester) doesn't receive any response, the client(tester) shall wait for P3max timeout and afterwards may start a new Initialization beginning with a wake-up-pattern (T <sub>idle</sub> = 0 ms).
<b>... error in StartCommunication Positive Response (Byte collision) (Response contents) (Response checksum)</b>	The client(tester) shall ignore the response and shall open a new timing window P2 to receive a directly repeated response from the same server(ECU) or a response from another server(ECU). If the server(ECU) doesn't repeat the response, the client(tester) shall wait for P3max timeout and afterwards the client(tester) may start a new Initialization beginning with a wake-up-pattern (T <sub>idle</sub> = 0 ms).

Figure I.2.1: Client(tester) Error Handling during physical/functional Fast Initialization

#### I.2.1.2 Server(ECU) Error Handling during physical/functional Fast Initialization (normal timing only)

<i>Server(ECU) detects an ...</i>	<i>Action</i>
<b>... error in T<sub>idle</sub> (W5 or P3min)</b>	No observation necessary. The client(tester) is responsible to keep to the idle time T <sub>idle</sub> .
<b>... error in wake-up-pattern</b>	The server(ECU) shall not respond and shall be able to detect immediately a new wake-up-pattern sequence.
<b>... error in P4min</b>	No observation necessary. The client(tester) is responsible to keep to the time P4min
<b>... error in P4max (P4max timeout)</b>	The server(ECU) shall not respond and shall be able to detect immediately a new wake-up-pattern sequence.
<b>... error in StartCommunication Request (checksum) (contents)</b>	The server(ECU) shall not respond and shall be able to detect immediately a new wake-up-pattern sequence.
<b>... error in StartCommunication Positive Response (Byte collision)</b>	The server (ECU) shall repeat the response within a new timing window P2 considering arbitration.
<b>... unknown tester(client) target address or server(ECU) source address</b>	The server(ECU) shall not respond and shall be able to detect immediately a new wake-up-pattern sequence.

Figure I.2.2: Server(ECU) Error Handling during physical/functional Initialization

## I.2.2 Error handling after physical/functional Initialization

### I.2.2.1 Client(tester) Error handling after physical/functional Initialization

<i>Client(tester) detects an ...</i>	<i>Action</i>
... error in P1min	No observation necessary P1min is always 0 ms.
... error in P1max (P1max timeout)	The client(tester) shall ignore the response and shall open a new timing window P2 to receive a directly repeated response from the same server(ECU) or a response from another server(ECU). If the server(ECU) doesn't repeat the response, the client(tester) may repeat the same request in a new timing window P3.
... error in P2min	No observation necessary. The server(ECU) is responsible to keep to the time P2min.
... error in P2max (no valid response from any server (ECU) or missing responses)	The client(tester) may repeat the last request twice, each within in a new timing window P3. (i.e. three transmission total) any following appropriate action is client(tester) dependent if the client(tester) doesn't receive a response.
... error in server(ECU) Response (checksum) (contents)	The client(tester) may repeat the last request twice, each within in a new timing window P3. (i.e. three transmission total) any following appropriate action is client(tester) dependent if the client(tester) doesn't receive a response.

Figure I.2.3: Client(tester) communication Error Handling after physical/functional Initialization

### I.2.2.2 Server(ECU) Error Handling after physical/functional Initialization

<i>Server(ECU) detects an ...</i>	<i>Action</i>
... error in P3min	No observation necessary. The client(tester) is responsible to keep to the time P3min.
... error in P3max (P3max timeout)	The server(ECU) shall reset communication and shall be able to detect immediately a new wake-up-pattern sequence.
... error in P4min	No observation necessary. The client(tester) is responsible to keep to the time P4min.
... error in P4max (P4max timeout)	The server(ECU) shall ignore the request and shall open a new timing window P3 to receive a new request from the client(tester).
... error in client(tester) request (contents) (checksum)	The server(ECU) shall ignore the request and shall open a new timing window P3 to receive a new request from the client(tester).
... unknown source or target address	The server(ECU) shall ignore the request and shall open a new timing window P3 to receive a new request from the client(tester).
... error in its own Response (byte collision)	If the server(ECU) detects a byte collision within its own response, it must repeat the response within a new timing window P2 considering the arbitration.

Figure I.2.4: Server(ECU) Error Handling after physical/functional Initialization

## I.3 Implemented Diagnostic services

### Verwendete Abkürzungen:

<b>CDI</b>	ClearDiagnosticInformation	<b>RRRBLI</b>	RequestRoutineResultsByLocalIdentifier
<b>DDLI</b>	DynamicallyDefineLocalIdentifier	<b>STDS</b>	StartDiagnosticSession
<b>DNMT</b>	DisableNormalMessageTransmission	<b>STRBLI</b>	StartRoutineByLocalIdentifier
<b>IOCBLI</b>	InputOutputControlByLocalIdentifier	<b>SPRBLI</b>	StopRoutineByLocalIdentifier
<b>RDBC</b>	ReadDataByCommonIdentifier	<b>WDBC</b>	WriteDataByCommonIdentifier
<b>RDBLI</b>	ReadDataByLocalIdentifier		
<b>REI</b>	ReadEculdentification		

### I.3.1 Overview for SID 10h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
10_81	Wechsel Diagnosemode Mode 81	STDS	ENA	DI	L5	DI	BOO T	X	X	X	X	X	X
10_82	Wechsel Diagnosemode Mode 82	STDS	ENA	DI	L5	DI	BOO T	X	X	X	X	X	X
10_85	Wechsel Diagnosemode Mode 85	STDS	DI	L3	L5	DI	BOO T	X	X	X	X	X	X
10_86	Wechsel Diagnosemode Mode 86	STDS	DI	DI	L5	DI	BOO T	X	X	X	X	X	X
10_89	Wechsel Diagnosemode Mode 89	STDS	DI	DI	L5	L4	BOO T	X	X	X	X	X	X

### I.3.2 Overview for SID 11h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
11_01	EcuReset	EcuReset	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X

### I.3.3 Overview for SID 14h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
14_FF_FF	Fehlerspeicher löschen alle Gruppen	CDI	ENA	DI	L5	DI	ECU	X	X	X	X	X	X
14_FF_FB	Fehlerspeicher löschen Powertrain	CDI	ENA	DI	L5	DI	ECU	X	X	X	X	X	X

### I.3.4 Overview for SID 17h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
17	Fsp. lesen, lang	readStatusOfDTC	ENA	DI	L5	DI	ECU	X	X	X	X	X	X

### I.3.5 Overview for SID 18h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
18	Fehlerspeicher lesen, kurz	read DTCBy Status	ENA	DI	L5	DI	ECU	X	X	X	X	X	X

### I.3.6 Overview for SID 1Ah

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
1A_80	Identifikation lesen ECUIDT	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X
1A_86	Identifikation lesen CUIFDI	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X
1A_87	Identifikation lesen PECUHN	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X
1A_89	Identifikation lesen SSECUSEN	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X
1A_8A	Identifikation lesen CRSCOTSN	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X
1A_8B	Identifikation lesen CPD	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X
1A_8C	Identifikation lesen SSBSN	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X
1A_8D	Identifikation lesen SSESN	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X
1A_8E	Identifikation lesen SSCN	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X
1A_8F	Identifikation lesen LDSA	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X
1A_90	Identifikation lesen VIN short	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X
1A_91	Identifikation lesen VMECUHN	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X
1A_92	supplierBootLogisticField lesen	REI	ENA	L3	L5	DI	BOO T	-	-	-	X	X	-
1A_96	Identifikation lesen EROTAN	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X
1A_97	Identifikation lesen SNOET	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X
1A_98	Identifikation lesen RSCOTSN	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X
1A_99	Identifikation lesen PD	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X
1A_9A	Identifikation lesen VMECUHVN	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X
1A_9B	Identifikation lesen VMCI	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X
1A_9C	Identifikation lesen VMDI	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X
1A_9D	Identifikation lesen DOECUM	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X

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SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
1A_9E	Identifikation lesen SSI	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X
1A_9F	Identifikation lesen VMECUSLVN	REI	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X

### I.3.7 Overview for SID 20h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
20	Diagnosemode beenden	StopDiagnosticSession	ENA	L3	L5	L4	BOO T	X	X	X	X	X	X


### I.3.8 Overview for SID 21h

Hint: overview for EOL-services taken from 17I03901.000



SID number	service	type		Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
21_01	read system specific address	RDBLI	ENA	DI	L5	DI	BOO T		X	-	-	-	-	-
21_02	read overtemperature protection	RDBLI	ENA	DI	L5	DI	ECU		X	-	-	-	-	-
21_03	read engine overspeed detection	RDBLI	ENA	DI	L5	DI	ECU		X	-	-	-	-	-
21_05	read readiness flags	RDBLI	ENA	DI	L5	DI	ECU		X	X	X	X	X	X
21_06	receiving status of immobilizer	RDBLI	ENA	DI	L5	DI	ECU		-	-	-	-	-	-
21_07	read cruise control status	RDBLI	ENA	DI	L5	DI	ECU		X	-	-	-	-	-
21_08	release of multiple start value programming	RDBLI	ENA	DI	L5	DI	ECU		-	-	-	-	-	-
21_09	read DIT_ACT_MIL	RDBLI	ENA	DI	L5	DI	ECU		X	-	-	-	-	-
21_0A	read Error Memory with freeze frame data extra long	RDBLI	ENA	DI	L5	DI	ECU		X	X	X	X	X	X
21_20	Read Status EOL: Secondary air system	RDBLI	ENA	DI	L5	DI	ECU		X	-	-	-	-	-
21_22	Read Status EOL: CPS	RDBLI	ENA	DI	L5	DI	ECU		X	-	-	-	-	-
21_25	read INH_IV_KWP	RDBLI	ENA	DI	L5	DI	ECU		X	-	-	-	-	-
21_26	Read Status EOL: Idle speed setpoint displace	RDBLI	ENA	DI	L5	DI	ECU		X	-	-	-	-	-
21_27	Read Status EOL: VVL adaption	RDBLI	ENA	DI	L5	DI	ECU		X	-	-	-	-	-
21_36	read air-conditioner status	RDBLI	ENA	DI	L5	DI	ECU		X	-	-	-	-	-
21_3F	read idle speed status	RDBLI	ENA	DI	L5	DI	ECU		X	-	-	-	-	-
21_41	read LSH 4 status	RDBLI	ENA	DI	L5	DI	ECU		X	-	-	-	-	-
21_42	read LSH 3 status	RDBLI	ENA	DI	L5	DI	ECU		X	-	-	-	-	-
21_43	read LSH 2 status	RDBLI	ENA	DI	L5	DI	ECU		X	-	-	-	-	-
21_44	read LSH 1 status	RDBLI	ENA	DI	L5	DI	ECU		X	-	-	-	-	-
21_49	read Immobilizer status	RDBLI	ENA	DI	L5	DI	ECU		-	-	-	-	-	-

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SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
21_4C	read basic injection time cylinder 1	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_50	read engine speed	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_54	read intake air temperature	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_55	read coolant temperature	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_56	read ignition angle cylinder 1	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_57	read opening angle of the throttle valve (TPS_AV)	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_58	read mass air flow per segment measured (MAF_KGH_MES)	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_5B	read Pedal value sensor 1 raw acquisition (V_PVS_1_KWP)	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_71	read LV_KNK	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_A3	read VB	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_C0	read SAFM status	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_C1	read kva-factor	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_C3	read TRT	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_D5	Read Status EOL: ECRAS system test	RDBLI	ENA	DI	L5	DI	ECU	X	X	X	X	X	X
21_DA	Read Status EOL: DMTL	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_DF	Read Status EOL: Lambda sensors confused / wrong wired	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_F0	DDLl handling	RDBLI	ENA	DI	L5	DI	ECU	X	X	X	X	X	X

### I.3.9 Overview for SID 22h

Hint: overview taken from 17I00VOL.00R


Overview for SID number	service	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
22_10_00	Read check stamp	ECU	X	X	X	X	X	X
22_10_01	Read value BOS	ECU	X	X	X	X	X	X
22_10_0A	Read Energy saving status	ECU	X	X	X	X	X	X
22_16_00	Read Anzahl Subbusteilnehmer	ECU	X	X	X	X	X	X
22_16_01	Read Identifikation Subbusteilnehmer 1 (normaly: Batteriesensensor )	ECU	X	X	X	X	X	X
22_16_02	Read Identifikation Subbusteilnehmer 2 (normaly:elktr. Wasserpumpe)	ECU	X	X	X	X	X	X
22_16_03	Read Identifikation Subbusteilnehmer 3 (normaly:Generator 1)	ECU	X	X	X	X	X	X
22_20_00	read failure memory short	ECU	X	X	X	X	X	X
22_21_00	Read History Memory	ECU	X	X	X	X	X	X
22_25_00	Programm Reference Backup	BOOT	X	X	X	X	X	X
22_25_01	Erasing time	BOOT	X	X	X	X	X	X
22_25_02	Hardware reference	BOOT	X	X	X	X	X	X
22_25_03	Programm reference	BOOT	X	X	X	X	X	X
22_25_04	Data reference	BOOT	X	X	X	X	X	X
22_25_06	Maximum of block length	Boot-ECU	X	X	X	X	X	X
22_30_00	MIL Codierung lesen	ECU	X	X	X	X	X	X
22_30_01	Kat Codierung lesen	ECU	X	X	X	X	X	X
22_30_10	VMAX-Codierdaten lesen	ECU	X	X	X	X	X	X
22_30_20	OL/UL Codierung lesen	ECU	X	X	X	X	X	X
22_30_30	Status-Codierung-Protokoll lesen	ECU	X	X	X	X	X	X
22_32_00	Oelwechselintervall- Codierdaten lesen	ECU	X	X	X	X	X	X
22_32_10	IGR-Codierdaten lesen	ECU	X	X	X	X	X	X
22_32_11	Xenonverbau-Codierdaten lesen	ECU	X	X	X	X	X	X
22_32_20	SPA-Codierdaten lesen	ECU	X	X	X	X	X	X
22_32_30	BZE-Codierdaten lesen	ECU	X	X	X	X	X	X
22_32_40	Abgasklappe Codierdaten lesen	ECU	X	X	X	X	X	X
22_32_50	Codierung MSA lesen	ECU	-	X	-	X	-	-
22_32_60	Read CDASMOT	ECU	X	X	X	X	X	X
22_3F_FF	Aenderungsindex Codierdaten lesen	ECU	X	X	X	X	X	X
22_40_00	Read values 4000	ECU	X	X	X	X	X	X
22_40_01	Read values "batterie generator"	ECU	X	X	X	X	X	X
22_40_02	Read Switch Position	ECU	X	X	X	X	X	X
22_40_03	Read values of engine roughness	ECU	X	X	X	X	X	X

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Overview for SID number	service	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
22_40_06	Read CAMSHAFT-Sensor Adaption	ECU	X	X	X	X	X	X
22_40_07	Read State of Functions	ECU	X	X	X	X	X	X
22_40_08	Read Throttle and MAF-Adjustment Value	ECU	X	X	X	X	X	X
22_40_0A	Read mixture values	ECU	X	X	X	X	X	X
22_40_0B	VVT Messwerte auslesen	ECU	X	-	-	-	-	-
22_40_15	Read FASTA_Messwertblock 10	ECU	X	X	X	X	X	X
22_40_16	READ IGR-values	ECU	X	X	X	X	X	X
22_40_17	READ LEM-values	ECU	X	X	X	X	X	X
22_40_18	READ MSA-values	ECU	X	X	X	X	X	X
22_40_19	Fsp. Lesen mit Freeze Frame	ECU	X	X	X	X	X	X
22_40_1A	READ BZE-values	ECU	X	X	X	X	X	X
22_40_1B	Read: Results of intelligent alternator diagnosis	ECU	X	X	X	X	X	X
22_40_1C	Ringspeicher MSA lesen	ECU	X	X	X	X	X	X
22_40_1D	Read Verbredinfo	ECU	-	-	-	-	-	X
22_40_1E	Read CBS-Zündkerzen	ECU	-	X	X	X	X	-
22_40_1F	Read BMW-PST (BMW-Programmstandsinformation)	ECU	-	-	-	-	-	X
22_40_21	READ IBS-values	ECU	X	X	X	X	X	X
22_40_22	READ PM1 Status	ECU	X	X	X	X	X	X
22_40_23	READ PM2 Status	ECU	X	X	X	X	X	X
22_40_26	Rate Based Monitoring Mode 9 auslesen	ECU	X	X	X	X	X	X
22_40_27	Rate Based Monitoring Motorsteuerung MSV80 Block 1 auslesen	ECU	X	-	-	-	-	-
22_40_27	Rate Based Monitoring Motorsteuerung MSD8x Block 1 auslesen	ECU	-	X	X	X	X	X
22_40_28	Rate Based Monitoring Motorsteuerung MSV80 Block 2 auslesen	ECU	X	-	-	-	-	-
22_40_28	Rate Based Monitoring Motorsteuerung MSD8x Block 2 auslesen	ECU	-	X	X	X	X	X
22_40_2D	Messwerte Laufruhepruefung auslesen	ECU	X	X	X	X	X	X
22_40_2E	Nulfgang-Erkennung lesen	ECU	X	X	X	X	X	X
22_40_2F	MSA lesen	ECU	X	X	X	X	X	X
22_40_30	FASTA_LVS_lesen	ECU	-	X	X	X	X	-
22_40_31	Laufruhe Verbesserungssystem Zylinderstatistik auslesen	ECU	-	X	X	X	X	-
22_40_32	MFMA (Kleinstmengenadaption)	ECU	-	X	X	X	X	X
22_5F_88	Adrecovery lesen	ECU	-	X	X	X	X	-

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Overview for SID number	service	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
22_5F_8B	read PM recovery	ECU	X	X	X	X	X	X
22_5F_8E	MSA deactivation lesen	ECU	X	X	X	X	X	X
22_5F_8F	MSA Abschaltverhinderer lesen	ECU	X	X	X	X	X	X
22_5F_90	IMAALE lesen	ECU	-	X	X	X	X	X
22_5F_DE	VVT- Minhub lesen	ECU	X	-	-	-	-	-
22_5F_F0	Abgleichswert LL lesen	ECU	X	X	X	X	X	X
22_5F_F1	CO Abgleichswert lesen	ECU	X	-	-	-	-	-
22_5F_F2	Varianten lesen	ECU	X	X	X	X	X	X
22_5F_F3	Uebertemperatursicherung lesen	ECU	X	X	X	X	X	X
22_5F_F4	Fusshebelwerk Fehlbedienung lesen	ECU	X	X	X	X	X	-
22_5F_F6	Ueberdrehzahlsicherung lesen	ECU	X	X	X	X	X	X
22_5F_F7	Laufruhepruefung auslesen	ECU	X	X	X	X	X	-
22_5F_F8	Status Homogenbetrieb auslesen	ECU	-	X	X	X	X	-
22_C0_00	Read imob status (STATUS_EWS)	Boot- /ECU	X	X	X	X	X	X
22_C0_02	Read imob k_ews(tmp) (STATUS_EWS_SK)	Boot- /ECU	X	X	X	X	X	X

### I.3.10 Overview for SID 23h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
23	Speicher lesen	ReadMemoryByAddress	ENA	L3	L5	DI	BOO T	X	X	X	X	X	X

### I.3.11 Overview for SID 28h

SID number	service	type												
			Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)	
28_01	Enable positive or negative response	DNMT	ENA	DI	L5	DI	Boot-/ECU	X	X	X	X	X	X	X
28_02	Disable positive response	DNMT	ENA	DI	L5	DI	Boot-/ECU	X	X	X	X	X	X	X

### I.3.12 Overview for SID 29h

SID number	service	type												
			Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)	
29	Enable positive response	DNMT	ENA	DI	L5	DI	Boot-/ECU	X	X	X	X	X	X	X
29_01	Enable positive response	DNMT	ENA	DI	L5	DI	Boot-/ECU	X	X	X	X	X	X	X
29_02	Disable positive response	DNMT	ENA	DI	L5	DI	Boot-/ECU	X	X	X	X	X	X	X

### I.3.13 Overview for SID 2Ch

SID number	service	type												
			Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)	
2C_F0_02	DefineByCommonIdentifier	DDL	ENA	DI	L5	DI	ECU	X	X	X	X	X	X	X
2C_F0_03	DefineByMemoryAddress	DDL	ENA	DI	L5	DI	ECU	X	X	X	X	X	X	X
2C_F0_04	ClearDynamicallyDefinedLocalIdentifier	DDL	ENA	DI	L5	DI	ECU	X	X	X	X	X	X	X


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### I.3.14 Overview for SID 2Eh

Hint: overview taken from 17I00W03.0AA

SID number	service	MSV_80	MSD_80 (6cyl)	MSD_80 (4cyl)	MSD_81 (6cyl)	MSD_81 (4cyl)	MSD85(L4)
2E_10_00	Prüfstempel schreiben	X	-	-	-	-	-
2E_10_01	BOS löschen via Tester	X	X	X	X	X	X
2E_30_00	MIL-OFF Codierung schreiben	X	X	X	X	X	X
2E_30_01	Kat Codierung schreiben	X	X	X	X	X	X
2E_30_10	VMAX Codierung schreiben	X	X	X	X	X	X
2E_30_20	OL/UL Codierung schreiben	X	X	X	X	X	X
2E_30_30	Codierung-Protokoll schreiben	X	X	X	X	X	X
2E_32_00	Oelwechselintervall- Codierdaten schreiben	X	X	X	X	X	X
2E_32_10	IGR-Codierdaten schreiben	X	X	X	X	X	X
2E_32_11	Xenonverbau - Codierdaten schreiben	X	X	X	X	X	X
2E_32_20	Codierung SPA schreiben	X	X	X	X	X	X
2E_32_30	Codierung BZE schreiben	X	X	X	X	X	X
2E_32_40	Abgasklappe Codierung schreiben	X	X	X	X	X	X
2E_32_50	Codierung MSA schreiben	-	-	X	-	X	-
2E_32_60	Codierung CDASMOT schreiben	X	X	X	X	X	X
2E_3F_FF	Aenderungsindex der Codierdaten schreiben	X	X	X	X	X	X
2E_5F_87	Laufruheverbesserungssystem Zaehler Reset	-	X	X	X	X	-
2E_5F_88	Schreiben NOx-Adaptationswerte	-	X	X	X	X	-
2E_5F_89	Request Reset MSA-Tabellenspeicher	-	-	X	-	X	-
2E_5F_8A	Schreiben Nullgang-Lernwert	-	-	X	-	X	-
2E_5F_8B	PMB vorgeben	X	X	X	X	X	X
2E_5F_8E	MSA_DEAK schreiben	-	-	X	-	X	-
2E_5F_8F	MSA_DEAK_AV schreiben	-	-	X	-	X	-
2E_5F_90	IMAALLE schreiben	-	X	X	X	X	X
2E_5F_9x	IMA für Zylinder x schreiben	-	X	X	X	X	X
2E_5F_DE_00	VVT- Minhub Ansteuerung beenden	X	-	-	-	-	-
2E_5F_DE_07	VVT- Minhub ansteuern	X	-	-	-	-	-
2E_5F_DE_08	VVT- Minhub programmieren	X	-	-	-	-	-
2E_5F_F0_07	Abgleichswert LL ansteuern	X	X	X	X	X	X

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2E_5F_F0_08	Abgleichswert LL programmieren	X	X	X	X	X	X
2E_5F_F1_00	CO- Abgleich beenden	X	-	-	-	-	-
2E_5F_F1_04	CO- Abgleich Reset	X	-	-	-	-	-
2E_5F_F1_07	CO- Abgleich ansteuern	X	-	-	-	-	-
2E_5F_F1_08	CO- Abgleich programmieren	X	-	-	-	-	-
2E_5F_F2_04	Varianten loeschen	X	X	X	X	X	X
2E_5F_F3_04	Uebertemperatursicherung loeschen	X	X	X	X	X	X
2E_5F_F4_04	Fusshebelwerk Fehlbedienung loeschen	X	X	X	X	X	-
2E_5F_F5_04	Powermanagement Histogramm loeschen	X	X	X	X	X	X
2E_5F_F6_04	Ueberdrehzahlsicherung loeschen	X	X	X	X	X	X
2E_5F_F7_00	Laufruheprüfung Vorgeben beenden	X	-	-	-	-	-
2E_5F_F7_07	Laufruheprüfung vorgeben	X	-	-	-	-	-
2E_5F_F7_08	Laufruheprüfung programmieren	X	-	-	-	-	-
2E_5F_F8_00	Homogenbetrieb vorgeben beenden	-	X	X	X	X	-
2E_5F_F8_07	Homogenbetrieb vorgeben	-	X	X	X	X	-
2E_C0_01	Write k_ews4	X	X	X	X	X	X


### I.3.15 Overview for SID 30h

Hint: overview taken from 17I00M21.000



Overview for SID number	service	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
30_02_01	Bremslichtschalter auslesen	X	X	X	X	X	X
30_03_01	Bremslichttestschalter auslesen	X	X	X	X	X	X
30_04_01	Kupplungsschalter auslesen	X	X	X	X	X	X
30_05_01	Oeldruckschalter auslesen	X	X	X	X	X	X
30_06_01	Sporttaster auslesen	X	X	X	X	X	-
30_07_01	Nullgangssensor auslesen	-	X	-	X	-	-
30_0A_01	Ansauglufttemperatur 1 auslesen	X	X	X	X	X	X
30_0B_01	Ansauglufttemperatur 2 auslesen	-	-	-	-	-	X
30_0C_01	Motortemperatur auslesen	X	X	X	X	X	X
30_0D_01	Kuehlerauslasstemperatur auslesen	X	X	X	X	X	X
30_0E_01	Oelsensor auslesen	X	X	X	X	X	X
30_10_01	Steuergeraete-Innentemperatur auslesen	X	X	X	X	X	X
30_12_01	Abgastemperatur auslesen	-	X	X	X	X	X
30_13_01	Abgastemperatur 2 auslesen	-	-	-	-	-	X
30_17_01	Umgebungsdruck auslesen	X	X	X	X	X	X
30_18_01	Saugrohrdruck1 / Ladedruck1 auslesen	X	X	X	X	X	X
30_19_01	Saugrohrdruck2 / Ladedruck2 auslesen	-	X	X	X	X	X
30_1A_01	Raildrucksenor auslesen	-	X	X	X	X	X
30_1B_01	Kl.15 Spannung auslesen	X	X	X	X	X	X
30_1C_01	Kl.87 Spannung / Versorgung DME auslesen	X	X	X	X	X	X
30_1C_00/07	Kl.87 Spannung / Versorgung DME ansteuern	X	X	X	X	X	X
30_1E_01	Fahrerwunschversorgung 1 auslesen	X	X	X	X	X	X
30_1F_01	Fahrerwunschversorgung 2 auslesen	X	X	X	X	X	X
30_20_01	Versorgungsspannung VVL Sensor auslesen	X	-	-	-	-	-
30_20_01	Versorgung HPD5-Ventil auslesen	-	X	-	X	-	X
30_20_00/07	Versorgung HPD5-Ventil ansteuern	-	X	-	X	-	X
30_21_01	Lambdasonde vor Kat Bank 1 auslesen	X	X	X	X	X	X
30_22_01	Lambdasonde hinter Kat Bank 1 auslesen	X	X	X	X	X	X
30_23_01	Lambdasonde vor Kat Bank 2 auslesen	X	X	X	X	X	X
30_24_01	Lambdasonde hinter Kat Bank 2 auslesen	X	X	X	X	X	X
30_25_01	Luftmassenmesser 1 auslesen	X	X	X	X	X	X
30_27_01	Batteriesensor auslesen	X	X	X	X	X	X
30_28_01	Fahrerwunsch1 auslesen	X	X	X	X	X	X
30_29_01	Fahrerwunsch 2 auslesen	X	X	X	X	X	X


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Overview for SID number	service	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
30_2A_01	Drosselklappe auslesen	X	X	X	X	X	X
30_2A_00/07	Drosselklappe ansteuern	X	X	X	X	X	X
30_2E_01	Sekundaerluft HFM auslesen	X	-	-	-	-	X
30_2F_01	Taster Tempomat	X	X	X	X	X	-
30_30_01	Klopfbaustein1 auslesen	X	X	X	X	X	X
30_31_01	Klopfbaustein 2 auslesen	X	X	X	X	X	X
30_32_01	Generator Sollspannung BSD auslesen	X	X	X	X	X	X
30_32_00/07	Generator Sollspannung BSD ansteuern	X	X	X	X	X	X
30_37_01	Oeldrucksensor auslesen	X	X	X	X	X	-
30_3B_01	NOx-Sensor auslesen	X	X	X	X	X	-
30_3F_01	Kraftstoffniederdrucksensor auslesen	-	X	X	X	X	X
30_40_01	Bremsunterdrucksensor auslesen	X	X	-	X	-	-
30_43_01	Raildrucksenor 2 auslesen	-	-	-	-	-	X
30_44_01	Klopfbaustein 3 auslesen	-	-	-	-	-	X
30_-_01	Klopfbaustein 4 auslesen	-	-	-	-	-	X
30_46_01	Luftmassenmesser 2 auslesen	-	-	-	-	-	X
30_80_01	Radiator shutter auslesen	-	-	X	-	X	-
30_80_00/07	Radiator shutter ansteuern	-	-	X	-	X	-
30_82_01	HPD-Relais auslesen	-	X	-	X	-	X
30_82_00/07	HPD-Relais ansteuern	-	X	-	X	-	X
30_83_01	Wasserpumpe Turbolader auslesen	-	-	-	-	-	X
30_83_00/07	Wasserpumpe Turbolader ansteuern	-	-	-	-	-	X
30_84_01	Drosselklappenstellergehäuseheizung 2 auslesen	-	-	-	-	-	X
30_84_00/07	Drosselklappenstellergehäuseheizung 2 ansteuern	-	-	-	-	-	X
30_85_01	Drosselklappe 2 auslesen	-	-	-	-	-	X
30_85_00/07	Drosselklappe 2 ansteuern	-	-	-	-	-	X
30_86_01	(second) HPD5-Mengensteuerventil auslesen	-	X	-	X	-	X
30_86_00/07	(second) HPD5-Mengensteuerventil ansteuern	-	X	-	X	-	X
30_87_01	Abgasklappe 2 auslesen	-	-	-	-	-	X
30_87_00/07	Abgasklappe 2 ansteuern	-	-	-	-	-	X
30_88_01	Vanos Einlass Ventil Bank2 auslesen	-	-	-	-	-	X
30_88_00/07	Vanos Einlass Ventil Bank2 ansteuern	-	-	-	-	-	X
30_89_01	Vanos Auslass Ventil Bank2 auslesen	-	-	-	-	-	X


Overview for SID number	service	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
30_89_00/07	Vanos Auslass Ventil Bank2 ansteuern	-	-	-	-	-	X
30_8A_01	Umluftventil Bank 2 auslesen	-	-	-	-	-	X
30_8A_00/07	Umluftventil Bank 2 ansteuern	-	-	-	-	-	X
30_8B_01	Sekundaerluftventil 2 auslesen	-	-	-	-	-	X
30_8B_00/07	Sekundaerluftventil 2 ansteuern	-	-	-	-	-	X
30_9E_01	Drosselklappenstellergehaeuseheizung auslesen	-	X	X	X	X	X
30_9E_00/07	Drosselklappenstellergehaeuseheizung ansteuern	-	X	X	X	X	X
30_A4_01	Gesteuerte Luftfuehrung (untere Klappe) auslesen	X	X	X	X	X	X
30_A4_00/07	Gesteuerte Luftfuehrung (untere Klappe) ansteuern	X	X	X	X	X	X
30_AB_01	Oel Druck Regelung auslesen	X	X	X	X	X	-
30_AB_00/07	Oel Druck Regelung ansteuern	X	X	X	X	X	-
30_AC_01	Oeldruckventil auslesen	X	X	X	X	X	-
30_AC_00/07	Oeldruckventil ansteuern	X	X	X	X	X	-
30_AD_01	Kurbelgehaeuseentlueftungsheizung auslesen	-	X	X	X	X	X
30_AD_00/07	Kurbelgehaeuseentlueftungsheizung ansteuern	-	X	X	X	X	X
30_AE_01	Variable Sauganlage (DISA) Klappe2 auslesen	X	X	X	X	X	-
30_AE_00/07	Variable Sauganlage (DISA) Klappe2 ansteuern	X	X	X	X	X	-
30_B2_01	Motorlagersteuerung auslesen	-	X	X	X	X	-
30_B2_00/07	Motorlagersteuerung ansteuern	-	X	X	X	X	-
30_B5_01	Umluftventil Bank 1 auslesen	-	-	-	-	-	X
30_B5_00/07	Umluftventil Bank 1 ansteuern	-	-	-	-	-	X
30_B6_01	Ladedrucksteller 1 auslesen	-	X	X	X	X	X
30_B6_00/07	Ladedrucksteller 1 ansteuern	-	X	X	X	X	X
30_B7_01	Ladedrucksteller 2 auslesen	-	X	X	X	X	X
30_B7_00/07	Ladedrucksteller 2 ansteuern	-	X	X	X	X	X
30_BD_01	Mengensteuerventil auslesen	-	X	X	X	X	X
30_BD_00/07	Mengensteuerventil ansteuern	-	X	X	X	X	X
30_BE_01	Abgasrückführungsventil auslesen	X	X	X	X	X	-
30_BE_00/07	Abgasrückführungsventil ansteuern	X	X	X	X	X	-
30_BF_01	elektr. Wasserpumpe ueber BSD auslesen	X	X	X	X	X	-
30_BF_00/07	elektr. Wasserpumpe ueber BSD ansteuern	X	X	X	X	X	-
30_C1_01	Abgasklappe auslesen	X	X	X	X	X	X
30_C1_00/07	Abgasklappe ansteuern	X	X	X	X	X	X
30_C2_01	Soundklappeauslesen	X	X	X	X	X	X

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Overview for SID number	service	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
30_C2_00/07	Soundklappe ansteuern	X	X	X	X	X	X
30_C3_01	Gesteuerte Luftfuehrung auslesen	X	X	X	X	X	X
30_C3_00/07	Gesteuerte Luftfuehrung ansteuern	X	X	X	X	X	X
30_C4_01	Startrelais auslesen	X	X	X	X	X	X
30_C4_00/07	Startrelais ansteuern	X	X	X	X	X	X
30_C6_01	Variable Sauganlage (DISA) Klappe auslesen	X	X	X	X	X	-
30_C6_00/07	Variable Sauganlage (DISA) Klappe ansteuern	X	X	X	X	X	-
30_C7_01	Klimakompressor-Relais auslesen	X	X	X	X	X	-
30_C7_00/07	Klimakompressor-Relais ansteuern	X	X	X	X	X	-
30_C8_01	EBOX_Controlled_Fan auslesen	X	X	X	X	X	X
30_C8_00/07	EBOX_Controlled_Fan ansteuern	X	X	X	X	X	X
30_C9_01	Electr_Controlled_Thermostat auslesen	X	X	X	X	X	X
30_C9_00/07	Electr_Controlled_Thermostat ansteuern	X	X	X	X	X	X
30_CA_01	Sekundaerluftventil auslesen	X	-	-	-	-	X
30_CA_00/07	Sekundareluftventil ansteuern	X	-	-	-	-	X
30_CB_01	Sekundaerluftpumpe auslesen	X	-	-	-	-	X
30_CB_00/07	Sekundaerluftpumpe ansteuern	X	-	-	-	-	X
30_CC_01	Diagnosemodul-Tank Leakage Pumpe auslesen	X	-	X	-	X	X
30_CC_00/07	Diagnosemodul-Tank Leakage Pumpe ansteuern	X	-	X	-	X	X
30_CD_01	Diagnosemodul-Tank Leakage Ventil auslesen	X	-	X	-	X	X
30_CD_00/07	Diagnosemodul-Tank Leakage Ventil ansteuern	X	-	X	-	X	X
30_CE_01	Diagnosemodul-Tank Leakage Heizung auslesen	X	-	X	-	X	X
30_CE_00/07	Diagnosemodul-Tank Leakage Heizung ansteuern	X	-	X	-	X	X
30_CF_01	Canister_Purge_Solenoid auslesen	X	X	X	X	X	X
30_CF_00/07	Canister_Purge_Solenoid ansteuern	X	X	X	X	X	X
30_D0_01	Lambda_Sensor_Heating_Up_1 auslesen	X	X	X	X	X	X
30_D0_00/07	Lambda_Sensor_Heating_Up_1 ansteuern	X	X	X	X	X	X
30_D1_01	Lambda_Sensor_Heating_Down_1 auslesen	X	X	X	X	X	X
30_D1_00/07	Lambda_Sensor_Heating_Down_1 ansteuern	X	X	X	X	X	X
30_D2_01	Lambda_Sensor_Heating_Up_2 auslesen	X	X	X	X	X	X
30_D2_00/07	Lambda_Sensor_Heating_Up_2 ansteuern	X	X	X	X	X	X
30_D3_01	Lambda_Sensor_Heating_Down_2 auslesen	X	X	X	X	X	X
30_D3_00/07	Lambda_Sensor_Heating_Down_2 ansteuern	X	X	X	X	X	X
30_D4_01	Malfunction_Indicator_Lamp auslesen	X	X	X	X	X	X

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Overview for SID number	service	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
30_D4_00/07	Malfunction_Indicator_Lamp ansteuern	X	X	X	X	X	X
30_D5_01	Fahrgeschwindigkeitsregler-Lampe auslesen	X	X	X	X	X	X
30_D5_00/07	Fahrgeschwindigkeitsregler-Lampe ansteuern	X	X	X	X	X	X
30_D6_01	EML_Lamp auslesen	X	X	X	X	X	X
30_D6_00/07	EML_Lamp ansteuern	X	X	X	X	X	X
30_D8_01	Electrical_Fuel_Pump auslesen	X	X	X	X	X	X
30_D8_00/07	Electrical_Fuel_Pump ansteuern	X	X	X	X	X	X
30_DA_01	E-Box-Luefter auslesen	X	X	X	X	X	X
30_DA_00/07	E-Box-Luefter ansteuern	X	X	X	X	X	X
30_DC_01	VVT-Entlastungsrelais auslesen	X	-	-	-	-	X
30_DC_00/07	VVT-Entlastungsrelais ansteuern	X	-	-	-	-	X
30_DD_01	ValveTronic Lift auslesen	X	-	-	-	-	X
30_DD_00/07	ValveTronic Lift ansteuern	X	-	-	-	-	X
30_E1_01	Einspritzventil 1 auslesen	X	X	X	X	X	X
30_E1_00/07	Einspritzventil 1 ansteuern	X	-	-	-	-	-
30_E2_01	Einspritzventil 2 auslesen	X	X	X	X	X	X
30_E2_00/07	Einspritzventil 2 ansteuern	X	-	-	-	-	-
30_E3_01	Einspritzventil 3 auslesen	X	X	X	X	X	X
30_E3_00/07	Einspritzventil 3 ansteuern	X	-	-	-	-	-
30_E4_01	Einspritzventil 4 auslesen	X	X	X	X	X	X
30_E4_00/07	Einspritzventil 4 ansteuern	X	-	-	-	-	-
30_E5_01	Einspritzventil 5 auslesen	X	-	X	-	X	X
30_E5_00/07	Einspritzventil 5 ansteuern	X	-	-	-	-	-
30_E6_01	Einspritzventil 6 auslesen	X	-	X	-	X	X
30_E6_00/07	Einspritzventil 6 ansteuern	X	-	-	-	-	-
30_E7_01	Einspritzventil 7 auslesen	-	-	-	-	-	X
30_E8_01	Einspritzventil 8 auslesen	-	-	-	-	-	X
30_ED_01	Vanos Einlass Ventil auslesen	X	X	X	X	X	X
30_ED_00/07	Vanos Einlass Ventil ansteuern	X	X	X	X	X	X
30_EE_01	Vanos Auslass Ventil auslesen	X	X	X	X	X	X
30_EE_00/07	Vanos Auslass Ventil ansteuern	X	X	X	X	X	X
30_EF_01	HPD5-Mengensteuerventil 1 auslesen	-	-	-	-	-	X
30_EF_00/07	HPD5-Mengensteuerventil 1 ansteuern	-	-	-	-	-	X

### I.3.16 Overview for SID 31h

Hint: overview taken from 17I00N0D.0AB and 17I03901.000

SID number	service	Service Location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
31_01	ask checksums after reprogramming	BOOT	X	X	X	X	X	X
31_02	erase Memory	BOOT	X	X	X	X	X	X
31_03	erase History Memory	ECU	X	X	X	X	X	X
31_05	power down	ECU	X	X	X	X	X	X
31_07	start authentication	BOOT	X	X	X	X	X	X
31_08	check authentication	BOOT	X	X	X	X	X	X
31_09	check signature	BOOT	X	X	X	X	X	X
31_0A	report reprogramming status	BOOT	X	X	X	X	X	X
31_0C	energy spare mode	ECU	X	X	X	X	X	X
31_1F_EE	EWS4: Start calculation and storage	ECU	X	X	X	X	X	X
31_1F_E3	EWS4: Read out GXMODN data	ECU	X	X	X	X	X	X
31_1F_E4	EWS4: Read out length of GXMODN	ECU	X	X	X	X	X	X
31_1F_F1	EWS4: Transfer data of FSC to ECU	ECU	X	X	X	X	X	X
31_1F_F2	EWS4: Transfer length of ESC (FreiSchaltCode) to ECU	ECU	X	X	X	X	X	X
31_20	EOL Test ON: Secondary air system	ECU	X	X	X	X	X	X
31_22	EOL Test ON: CPS	ECU	X	X	X	X	X	X
31_25	switch off Injection valves	ECU	X	X	X	X	X	X
31_26	EOL Test ON: Idle speed setpoint displace	ECU	X	X	X	X	X	X
31_27	start VVL Adaptation	ECU	X	-	-	-	-	
31_2A	Start intelligent alternator test	ECU	X	X	X	X	X	X
31_2B	Start Ruhestrom test	ECU	X	X	X	X	X	X
31_2C	Start EOL test: Oil Pressure Regulation Diagnosis	ECU	X	X	X	X	X	-
31_2D	Start EOL test: Desulfatisierung	ECU	-	X	X	X	X	-
31_2E	Start Nullgang-Lernen	ECU	-	X	-	X	-	-
31_2F	Start Desulfatisierung Fahrbetrieb	ECU	-	X	X	X	X	-
31_30	delete selective adaption values	ECU	X	X	X	X	X	X
31_31	delete selective adaption values 2	ECU	-	X	X	X	X	X
31_CF	Start : Sperre Tankentlueftung	ECU	-	X	X	X	X	
31_D0	Start: Werkstattdiagnose ATL	ECU	-	X	X	X	X	X
31_D5	EOL Test ON: ECRAS system test	X	X	X	X	X	X	
31_D9	switch off Lambda controller	ECU	X	X	X	X	X	X
31_DA	EOL Test ON: DMTL	ECU	X	X	X	X	X	X
31_DF	EOL Test ON: Lambda sensors confused /	ECU	X	X	X	X	X	X

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SID number	service	Service Location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
	wrong wired							
31_E0	Ansteuern Eisy- Adaptionwerte (ungedrosselt)	ECU	X	-	-	-	-	-
31_E1	Ansteuern Eisy- Adaptionwerte (gedrosselt)	ECU	X	X	X	X	X	X
31_E2	Ansteuern Eisy- Adaptionwerte (gedrosselt mit Abgasrueckfuehrung)	ECU	-	X	X	X	X	X
31_E3	Ansteuern Krann- Adaptionwerte	ECU	X	X	X	X	X	X
31_E4	Ansteuern Klann-Adaptionwerte	ECU	X	X	X	X	X	X
31_E5	Ansteuern AGR-Adaptionwerte	ECU	-	X	-	X	-	-
31_F0	Calculate checksum for IncaPC	ECU	X	-	-	-	-	-
31_F1	Programming of calibration data for IncaPC	ECU	X	-	-	-	-	-
31_F4	cruise control delete switch off conditions	ECU	X	X	X	X	X	X
31_F5	switch off Idle speed uplift	ECU	X	X	X	X	X	X
31_F6	set default values PM for BN-SS	ECU	X	X	X	X	X	X
31_F7	Intelligente Generatorregelung	ECU	X	X	X	X	X	
31_FA	supplier interner Service	ECU / BOOT	X	X	X	X	X	X
31_FB	supplier interner Service	ECU / BOOT	X	X	X	X	X	X
31_FC	supplier interner Service	ECU / BOOT	X	X	X	X	X	X
31_FE	Message using CAN message	ECU	X	-	-	-	-	-

### I.3.17 Overview for SID 32h

Hint: overview taken from 17I00Z02.00F and 17I03901.000

SID number	service	Service Location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
32_20	EOL Test OFF: Secondary air system	ECU	X	-	-	-	-	X
32_22	EOL Test OFF: CPS	ECU	X	X	X	X	X	X
32_26	EOL Test OFF: Idle speed setpoint displace	ECU	X	X	X	X	X	X
32_27	Stop EOL - VVL Adaptation	ECU	X	-	-	-	-	-
32_2A	Stop intelligent alternator test	ECU	X	X	X	X	X	X
32_2C	Stop EOL test: Oil Pressure Regulation Diagnosis	ECU	X	X	X	X	X	-
32_2D	Stop EOL test: Desulfatisierung	ECU	-	X	X	X	X	-
32_2F	Stop Desulfatisierung Fahrbetrieb	ECU	-	X	X	X	X	-
32_CF	Stop : Sperre Tankentlueftung	ECU	-	X	X	X	X	-
32_D0	Stop: Werkstattdiagnose ATL	ECU	-	X	X	X	X	X
32_D5	Stop EOL: ECRAS system test	ECU	X	X	X	X	X	X
32_D9	stop switch off Lambda controller	ECU	-	X	X	X	X	X
32_DA	EOL Test OFF: DMTL	ECU	X	X	X	X	X	X
32_DF	EOL Test OFF: Lambda sensors confused / wrong wired	ECU	X	X	X	X	X	X
32_F0	stop checksum calculation for Inca PC	ECU	X	-	-	-	-	-
32_F1	stop programming of calibration data for IncaPC	ECU	X	-	-	-	-	-
32_F6	stop default values PM for BN-SS	ECU	-	X	X	X	X	X
32_F7	switch Intelligente Generatorregelung active	ECU	X	X	X	X	X	X

### I.3.18 Overview for SID 33h

Hint: overview taken from 17101101.00F and 17103901.00O



SID number	service	Service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85(8cyl)
33_20	Report EOL results: Secondary air system	ECU	X	-	-	-	-	X
33_22	Report EOL results: CPS	ECU	X	X	X	X	X	X
33_25	read INH_IV_KWP - Diagnos Status EV-Ausblendung	ECU	-	X	X	X	X	X
33_26	Report EOL results: Idle speed setpoint displace	ECU	X	X	X	X	X	X
33_27	Read Status EOL: VVL adaptation	ECU	X	-	-	-	-	-
33_2A	Read Status: intelligent alternator test	ECU	X	X	X	X	X	X
33_2B	Read result Ruhestrom Test	ECU	X	X	X	X	X	X
33_2F	Auslesen Desulfatisierung Fahrbetrieb	ECU	-	X	X	X	X	-
33_2C	Read Status EOL test: Oil Pressure Regulation Diagnosis	ECU	X	X	X	X	X	-
33_2D	Read status EOL test: Desulfatisierung	ECU	-	X	X	X	X	-
33_CF	Read Statrus : Sperre Tankentlueftung	ECU	-	X	X	X	X	-
33_D0	Read Status: Werkstattdiagnose ATL	ECU	-	X	X	X	X	X
33_D5	Read Status EOL: ECRAS system test	ECU	X	X	X	X	X	X
33_D9	Read Status: switch off lambda controller	ECU	-	X	X	X	X	X
33_DA	Report EOL results: DMTL	ECU	X	X	X	X	X	X
33_DF	Report EOL results: Lambda sensors confused / wrong wired	ECU	X	X	X	X	X	X
33_E0	Auslesen Eisy- Adaptionswerte (ungedrosselt)	ECU	X	-	-	-	-	-
33_E1	Auslesen Eisy- Adaptionswerte (gedrosselt)	ECU	X	X	X	X	X	X
33_E2	Auslesen Eisy- Adaptionswerte (gedrosselt mit Abgasrueckfuehrung)	ECU	-	X	X	X	X	X
33_E3	Auslesen Krann- Adaptionswerte	ECU	X	X	X	X	X	X
33_E4	Auslesen Klann-Adaptionswerte	ECU	X	X	X	X	X	X
33_E5	Auslesen AGR-Adaptionswerte	ECU	-	X	X	X	-	-
33_F0	Report results of checksum calculation for INCA PC	ECU	X	-	-	-	-	-
33_F1	Report results of programming the calibration data for INCA PC in the power latch phase	ECU	X	-	-	-	-	-
33_F6	Report Status: Steuern Messsemode stop default value	ECU	-	X	X	X	X	X
33_F7	report results of Intelligente Generatorregelung	ECU	X	X	X	X	X	X

### I.3.19 Overview for SID 34h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
34	Flash Programmierung	RequestDownload	DI	L3	L5	DI	BOO T	X	X	X	X	X	X

### I.3.20 Overview for SID 35h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
35	Request upload	UploadRequest	DI	L3	L5	DI	BOO T	X	X	X	X	X	X

### I.3.21 Overview for SID 36h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
36	Daten austauschen	TransferData	DI	L3	L5	DI	BOO T	X	X	X	X	X	X

### I.3.22 Overview for SID 37h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
37	Flash-Programmierung beenden	RequestTransferExit	DI	L3	L5	DI	BOO T	X	X	X	X	X	X

### I.3.23 Overview for SID 3Bh

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
3B_90	Kurze Fahrgestellnummer schreiben	WriteDataByLocalIdentifier	ENA	DI	L5	DI	ECU	X	X	X	X	X	X
3B_C1	KVA-Faktor schreiben	WriteDataByLocalIdentifier	ENA	DI	L5	DI	ECU	X	X	X	X	X	X

### I.3.24 Overview for SID 3Dh

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
3D	Speicher schreiben	WriteMemoryByAddress	DI	L3	L5	DI	BOO T	X	X	X	X	X	X

### I.3.25 Overview for SID 3Eh

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
3E	Enable positive response	TesterPresent	ENA	L3	L5	L4	Boot-/ECU	X	X	X	X	X	X
3E_01	Enable positive response	TesterPresent	ENA	ENA	ENA	ENA	BOO T	X	X	X	X	X	X
3E_02	Disable positive response	TesterPresent	ENA	ENA	ENA	ENA	BOO T	X	X	X	X	X	X

### I.3.26 Overview for SID 80h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
80_90_00	K-Linie- Applikation-Tool Reference page	EscapeCode	ENA	DI	L5	DI	BOO T	X	-	-	-	-	-
80_90_01	K-Linie- Applikation-Tool Working page RAM	EscapeCode	ENA	DI	L5	DI	BOO T	X	-	-	-	-	-

### I.3.27 Overview for SID 81h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
81	Aufbau Testerverbindung	StartCommunication	ENA	DI	L5	DI	BOO T	X	-	-	-	-	-

### I.3.28 Overview for SID 82h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
82	Abbau Testerverbindung	StopCommunication	ENA	L3	L5	L4	BOO T	X	-	-	-	-	-

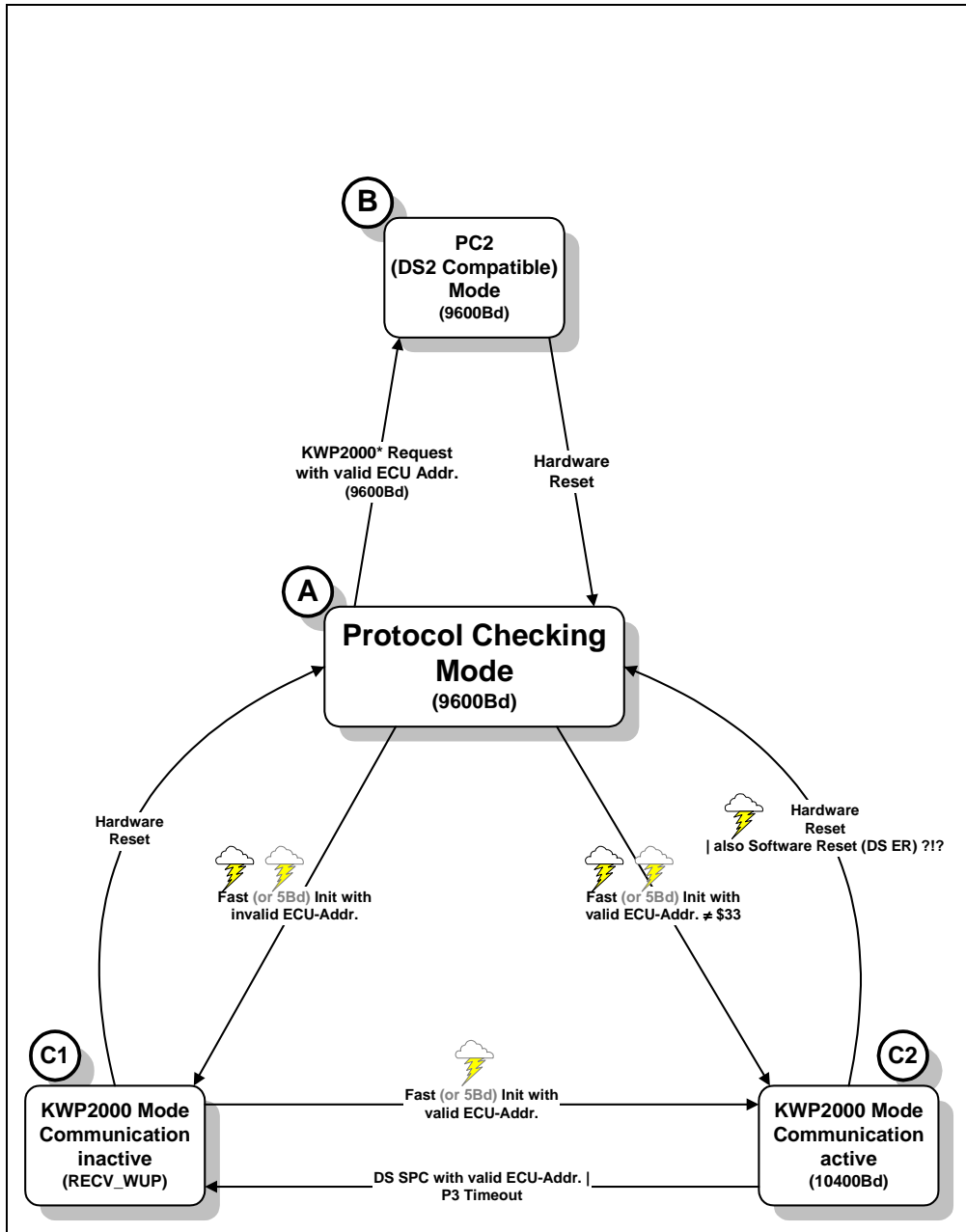
### I.3.29 Overview for SID 83h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
83_00	Read limits	AccessTimingParameter	ENA	L3	L5	DI	BOO T	X	-	-	-	-	-
83_01	Set parameter to default	AccessTimingParameter	ENA	L3	L5	DI	BOO T	X	-	-	-	-	-
83_02	Read activ parameters	AccessTimingParameter	ENA	L3	L5	DI	BOO T	X	-	-	-	-	-
83_03	Set parameter	AccessTimingParameter	ENA	L3	L5	DI	BOO T	X	-	-	-	-	-

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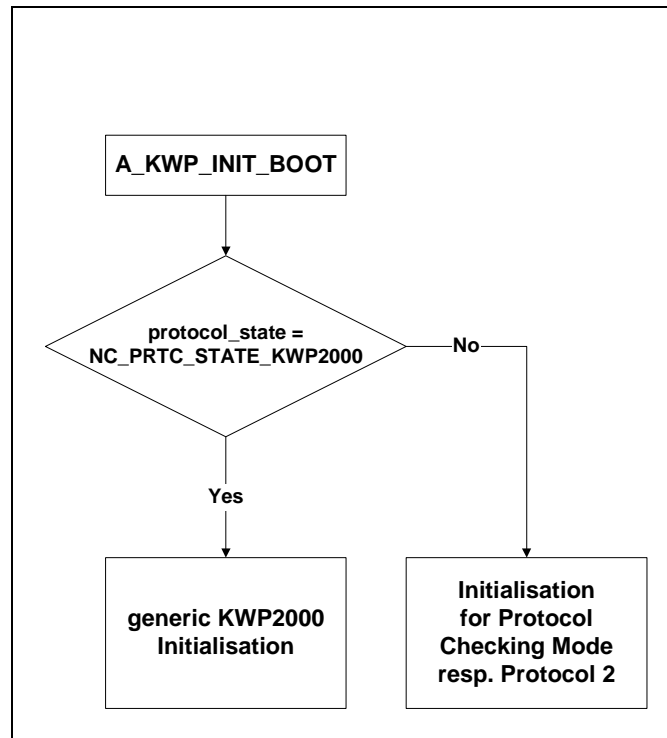
# I.4 Initialisation and timing

## I.4.1 Protocol Switching




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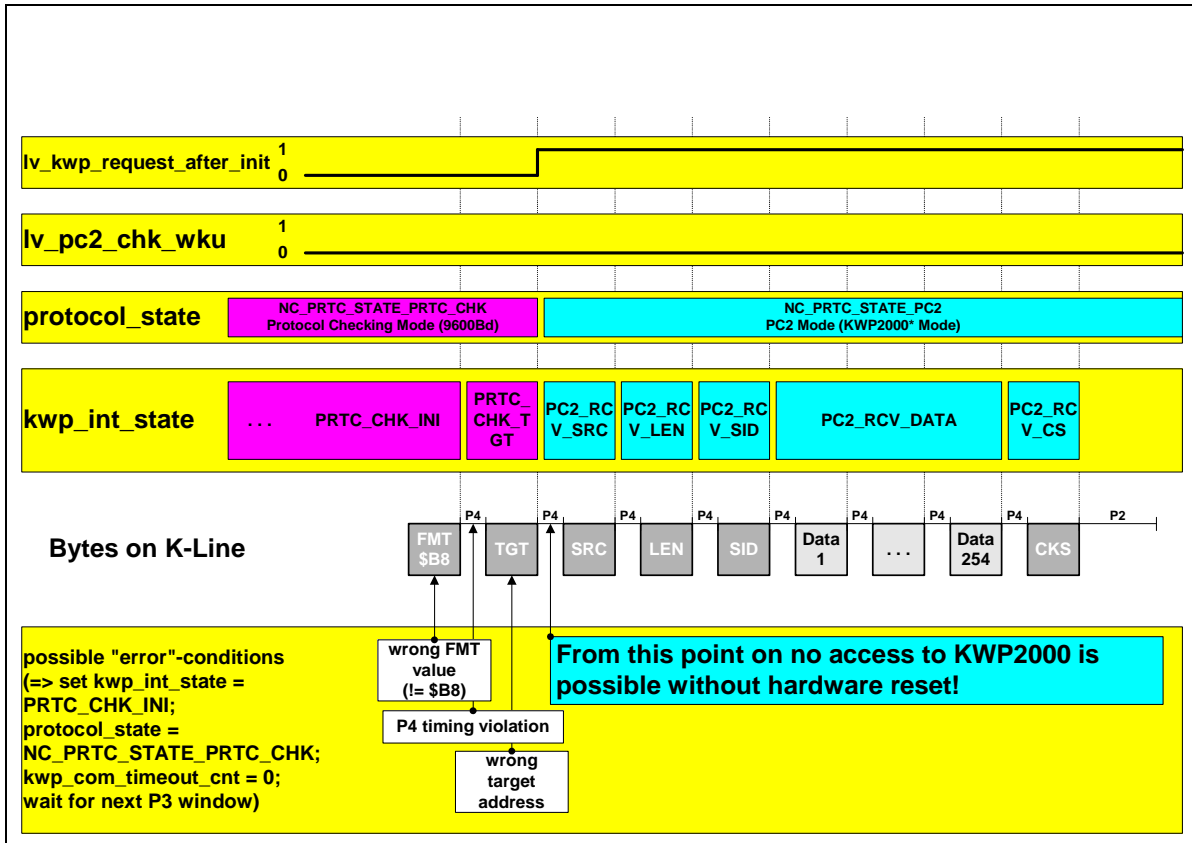
## I.4.2 Initialisation of different protocols



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### I.4.3 KWP\* Detection



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### I.4.4 WUP Detection for KWP

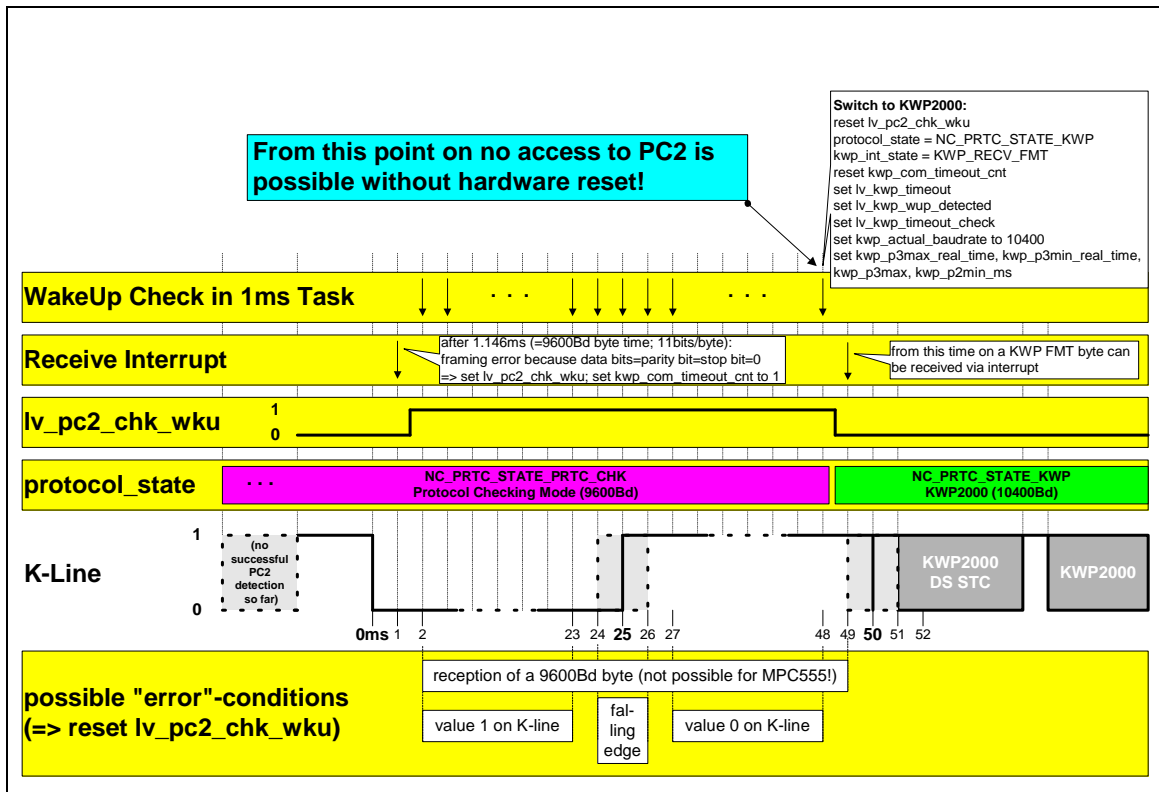


Figure I.4.1: Table Fast Initialization

1. The tester may use a baudrate of 10400 baud for initialization (stc) and communication. For KWP2000\* the baudrate is 9600 baud.
2. It is possible to change the baudrate with the service startDiagnosticSession.

### I.4.5 Timing

Timing Parameter	lower limit values / ms			upper limit values / ms		
	min.	default	Resolution	default	max.	Resolution
P1	0	0	-	20	20	-
P2	0	25	0,5	50 200ms for KWP*	6375	#25d; #FFh=6375ms
P3	0	55 25ms for KWP*	0.5	5000 infinity for KWP*	63750	#250d; #FFh=63750ms
P4	0	5	0.5	20	20	-
TWuP	49	50	-	-	51	-
TinL	24	25	-	-	26	-
Tidle	-	300	-	-	-	-

Figure I.4.2: Table - Normal Timing Parameter Set (for functional and physical addressing)

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<b>Value</b>	<b>Description</b>
<b>P1</b>	Inter byte time for ECU response
<b>P2</b>	Time between tester request and ECU response
<b>P3</b>	Time between end of ECU responses and start of new tester request
<b>P4</b>	Inter byte time for tester request
<b>TWuP</b>	High Low sequenz of the Wake-Up-Pattern
<b>TiniL</b>	Low sequenz of the Wake-Up-Pattern
<b>Tidle (W5)</b>	Idle Time

# I.5 Introduction

**Data definition:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
AMP_MES_KWP	V	0... FFH	0... 1353.19335	5.3066406	hPa
valid ambient pressure converted for DGNC					
CAM_IN_KWP	O/V	0... FFH	60... 155.625	0.375	°CRK
Actual position inlet CAM VVTI converted for KWP					
CAM_SP_IVVT_IN_KWP	O/V	0... FFH	60... 155.625	0.375	°CRK
Inlet CAM setpoint for VVTI converted for KWP					
CPU_LOAD_RST_DET_KWP	O/V	0... FFH	0... 99.60937	0.390625	%
CPU_LOAD_RST_DET[0] converted to KWP					
CTR_KM_CAN_KWP	O/V	0... FFH	0... 652800	2560	km
Vehicle kilometer reading from CAN message INSTR2, converted for KWP					
CUR_DMTL_COR_FIL_KWP	O/V	0... FFH	0... 49.80468	0.1953125	mA
Corrected and filtered pump current converted for KWP					
CUR_DMTL_REF_LEAK_KWP	O/V	0... FFH	0... 49.80468	0.1953125	mA
Pump current reference leakage converted for KWP					
CUR_DMTL_ROUGH_LEAK_MIN_KWP	O/V	0... FFH	0... 49.80468	0.1953125	mA
Min. pump current in case of rough leak measurement converted for KWP					
DIST_SO2P_END_KWP	O/V	0... FFH	0... 10200	40	km
Km - counter since last end of desulfation converted for KWP					
EFPPWM_KWP	O/V	0... FFH	0... 99.60937	0.390625	%
Pump speed of the electrical fuel pump as PWM signal converted for KWP					
FAC_MV_DIAG_DYN_LSL_UP_KWP [NC_CBK_EX_NR]	O/V	0... FFH	0... 1.02	0.004	-
Mean value of normalised single sensor signal amplitude converted for KWP					
FUP_EFP_KWP	O/V	0... FFH	0... 10825.7088	42.-376	hPa
Fuel pressure EFP converted for KWP					
FUP_KWP [NC_CBK_HPP_NR]	O/V	0... FFH	0... 346422	1358.5176	hPa
Fuel pressure converted for KWP					
LAMB_DELTA_I_LAM_ADJ_KWP [NC_CBK_EX_NR]	O/V	80... 7FH	-0.125... 0.12402	976.599e-6	-
LAMB_DELTA_I_LAM_ADJ converted for KWP					
LAMB_DIF_MON_KWP	O/V	80... 7FH	-2... 1.98437	0.015625	-
Deviation between actual and modeled Lambda for KWP					
LAMB_KWP [NC_CBK_EX_NR]	O/V	0... FFH	0... 1.99218	0.0078125	-
Signal value of lambda sensor					
LAMB_LS_UP_MV_KWP	O/V	0... FFH	0... 3.98437	0.015625	-
Mean value of lambda in multiple-branched exhaust gas lines converted for KWP					
LAMB_NOX_SENS_KWP	O/V	0... FFH	0... 3.98437	0.015625	-
Lambda value, measured by NOx sensor converted for KWP					
LAMB_SP_KWP [NC_CBK_EX_NR]	O/V	0... FFH	0... 1.99218	0.0078125	-
Lambda setpoint low byte value					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LOAD_MIN_MIS_KWP	O/V	0... FFH	0... 99.60937	0.390625	%
Nulllastwert für Aussetzererkennung					
LOAD_MIS_KWP	O/V	0... FFH	0... 99.60937	0.390625	%
Lastwert für Aussetzererkennung					
MAF_KGH_MES_BAS_KWP	V	0... FFH	0... 2040	8	kg/h
Raw air-mass flow measured (without correction, to be used for diagnosis only), converted for DGNC					
MAF_KWP	V	0... FFH	0... 1389	5.4470588	mg/stk
MAF converted to DGNC					
MFF_SP_MV_KWP	O/V	0... FFH	0... 1389	5.4470588	mg/stk
Mass fuel flow setpoint after combustion selection converted for KWP					
N_RST_DET_KWP	O/V	0... FFH	0... 8160	32	rpm
N_RST_DET[0] converted to KWP					
N_SAE_BYTE_KWP	O/V	0... FFH	0... 16320	64	rpm
Engine speed byte SAE J1979					
NOX_NS_KWP	O/V	FA... 5DH	-96... 1488	16	ppm
NOx concentration value, measured by NOx-Sensor for KWP					
NT_AGI_KWP	O/V	0... FFH	0 ...1	3.9216e-3	-
NOx trap aging factor converted for KWP					
NT_AGI_SUL_KWP	O/V	0... FFH	0... 0.99609	3.9062e-3	-
NOx trap aging factor due to sulphur load converted for KWP					
NT_SUL_KWP	O/V	0... FFH	0... 10444.8	40.96	mg
NOx trap sulphur loading					
OBD_AMP	O/V	0... FFH	0... 255	1	kPA
Barometric pressure SAE J1979					
OBD_FUP_RNG_H	O/V	0... FFFFH	0... 655350	10	kPA
High range Fuel pressure SAE J1979					
OBD_FUP_RNG_H_H	O/V	0... FFH	0... 652800	2560	kPA
High byte of OBD_FUP_RNG_H					
OBD_FUP_RNG_H_L	O/V	0... FFH	0... 2550	10	kPA
Low byte of OBD_FUP_RNG_H					
OBD_IGA_IGC	O/V	0... FFH	-64... 63.5	0.5	°CRK
Ignition time cylinder 1 SAE J1979					
OBD_LAM_COR [NC_CBK_EX_NR]	O/V	0... FFH	-100... 99.21875	0.78125	%
Lambda control factor SAE J1979					
OBD_LAMB_SP	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Lambda setpoint for display in mode 01 (PID \$44)					
OBD_MAF	O/V	0... FFFFH	0... 655.35	0.01	g/s
Air mass SAE J1979					
OBD_N	O/V	0... 7F80H	0... 8160	0.25	rpm
Engine speed SAE J1979					
OBD_TCO	O/V	0... FFH	-40 ...215	1	°C
Engine coolant temperature SAE J1979					
OBD_TIA	O/V	0... FFH	-40 ...215	1	°C
Intake air temperature 1 SAE J1979					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
OBD_VB	O/V	0... FFFFH	0... 65.535	0.001	V
Control module voltage SAE J1979					
OPG_ACR_KWP	O/V	0... FFH	0... 99.60937	0.390625	%
Measured opening of the actuator valve converted for KWP					
OPG_SP_ACR_KWP	O/V	0... FFH	0... 99.60937	0.390625	%
Setpoint request after limitation for actuator position control converted for KWP					
P_OEL_IST_KWP	O/V	0... FFH	0... 8160	32	hPa
Oil pressure IST-value converted to KWP					
P_OEL_SOLL_KWP	O/V	0... FFH	0... 8160	32	hPa
Oil pressure soll-value converted to KWP					
PBSU_KWP	O/V	0... FFH	0... 1353.19335	5.3066406	hPa
Absolute pressure in the brake servo, converted for KWP					
PUT_KWP [NC_MAP_SENS_NR]	O/V	0... FFH	0... 255	1	kPa
Pressure upstream the throttle (Turbo) converted for KWP					
PWM_ACR_KWP	O/V	80... 7FH	-100... 99.21875	0.78125	%
Finally duty cycle of digital actuator control converted to KWP					
PWM_ETC_KWP [NC_ETC_NR]	O/V	80... 7FH	-100... 99.21875	0.78125	%
Duty cycle for ETC actuator control converted for KWP					
PWM_NEUT_PSN_GB_KWP	O/V	0... FFH	0... 99.60937	0.390625	%
Tastverhältnis Nullgangsensor converted for KWP					
Q_iruhe2_kwp	V	0... FFH	0... 127	0.4980392	Ah
Entladung während Ruhestromverletzung converted and limited for DGNC					
R_IT_LS_DOWN_KWP_H [NC_CBK_EX_NR]	O/V	0... FFH	0... 65280	256	Ohm
Internal resistance of downstream oxygen sensor (measured) - high byte					
R_IT_LS_DOWN_KWP_L [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	Ohm
Internal resistance of downstream oxygen sensor (measured) - low byte					
R_IT_LS_UP_KWP_H [NC_CBK_EX_NR]	O/V	0... FFH	0... 16320	64	Ohm
Internal resistance of upstream oxygen sensor (measured) - high byte					
R_IT_LS_UP_KWP_L [NC_CBK_EX_NR]	O/V	0... FFH	0... 63.75	0.25	Ohm
Internal resistance of upstream oxygen sensor (measured) - low byte					
RATIO_NS_SHIFT_DIAG_KWP [NC_NOX_SENS_CONF]	V	80... 7FH	-1... 0.99218	0.0078125	-
NOx signal shift diagnosis value converted for diagnostic communication					
SEG_T_MES_KWP	O/V	0... FFFFH	0... 1999777	30.514648	µs
Laufunruhe Segmentzeit, converted for KWP					
SEG_T_MES_KWP_H	O/V	0... FFH	0... 1992115.794	7812.2188	µs
Laufunruhe Segmentzeit, converted for KWP, high byte					
SEG_T_MES_KWP_L	O/V	0... FFH	0... 7781.7024	30.51648	µs
Laufunruhe Segmentzeit, converted for KWP, low byte					
STATE_BYTE_SWI_KWP	O/V	0... FFH	0... 255	1	-
Carrierbyte switch states for KWP					
STATE_ECRAS_SYS_KWP_H	O/V	0... FFH	0... 255	1	-
Status Luftklappensystem High Byte					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_ECRAS_SYS_KWP_L	O/V	0... FFH	0... 255	1	-
Status Luftklappensystem Low Byte					
STATE_LRN_ECU_KWP	O/V	0H 11H 3DH 5AH 79H 97H A5H AEH BCH CBH D3H EAH FFHH	ROM_PLAUS LEARNING_ FAILED LOT8 LOT1 LOT5 LOT9 LOT2 LOT4 SERIAL_ECU LOT6 LOT7 LOT3 NOT_ LEARNED	-	-
Variant ECU for DGNC					
T_AST_SAE_KWP	V	0... FFH	0... 255	1	s
T_AST_SAE converted for DGNC ( and limited to 255s if T_AST_SAE > 255s )					
T_batt_kwp	V	CE... 64H	-50 ...100	1	°C
Battery temperature converted and limited for DGNC					
T_CH_SO2P_ACT_KWP	O/V	0... FFH	0... 6528	25.6	s
Time with active catalyst heating for desulfation without active desulfation converted for KWP					
T_ES_CUS_KWP	O/V	0... FFH	0... 1020	4	min
Engine shut-off duration, not deleted at ST_END					
T_ES_KWP	O/V	0... FFH	0... 1020	4	min
Engine shut-off duration					
T_PER_MAF_FRQ_KWP	O/V	0... FFH	0... 8160	32	µs
arithmetic average of the period time converted for KWP					
T_PER_MAF_KWP	O/V	0... FFH	0... 1.02	0.004	ms
period time of air mass converted for KWP					
TCHIP_KWP	O/V	0... FFH	-48 ...207	1	°C
chip temperature of alternator converted for KWP					
TIA_TCHA_KWP	O/V	0... FFH	-48 ...207	1	°C
Air temperature up turbo charger converted for KWP					
Tn_abstellm_kwp	V	0... FFH	0... 255	1	min
Engine off duration time (resolution min) converted and limited for DGNC					
TPS_AD_STEP_KWP [NC_ETC_NR]	O/V	0... FFH	0... 255	1	-
TPS_AD_STEP shifted to BYTE from DWORD					
TPS_AV_KWP [NC_ETC_NR]	O/V	0... FFH	0... 119.04046	0.4668254	°TPS
Throttle flap opening angle with high resolution converted for KWP					
TQ_AX_MAX_KWP	V	80... 7FH	-1024 ...1016	8	Nm
Maximum torque converted for DGNC					
TQ_AX_MIN_KWP	V	80... 7FH	-1024 ...1016	8	Nm
minimum torque converted for DGNC					
TQI_AV_H_RNG_MON_KWP	O/V	0... FFH	0... 1020	4	Nm
TQI_AV_H_RNG_MON converted for KWP					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQI_SP_H_RNG_MON_KWP	O/V	0... FFH	0... 1020	4	Nm
Desired indicated engine torque converted for DGNC					
TQI_SP_KWP	O/V	80... 7FH	-256 ...254	2	Nm
Torque setpoint fast path for KWP					
U_gen_kwp	V	0... FFH	0... 25.5	0.1	V
Generatorspannung converted with limitation for DGNC					
V_ALTER_SP_KWP	O/V	0... FFH	0... 25.5	0.1	V
setpoint alternator 1 voltage converted for KWP					
V_AMP_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
Voltage V_AMP shifted to FFC0H					
V_DMTL_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
Voltage V_DMTL shifted to KWP					
V_DUR_IGC_KWP [NC_CYL_NR]	O/V	0... FFH	0... 261.12	1.024	ms
Burn time duration for diagnosis validation, converted for KWP					
V_FUP_EFP_MV_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
mean value of low fuel pressure EFP sensor converted for KWP					
V_FUP_MV_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
Mean value of the acquired sensor voltage converted for KWP					
V_IGK_BAS_KWP	O/V	0... FFH	0... 28.8	0.1129412	V
Voltage V_IGK_BAS converted to KWP					
V_PBSU_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
Spannung Bremsunterdrucksensor converted to KWP					
V_PUT_KWP [NC_MAP_SENS_NR]	O/V	0... FFH	0... 4.98046	0.0195312	V
Voltage of the intake manifold pressure sensor up throttle (for diagnosis) converted for KWP					
V_PVS_1_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
Pedal value sensor 1 raw acquisition converted for KWP					
V_PVS_1_MON_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
Pedal value sensor 1 raw acquisition monitoring value converted for KWP					
V_PVS_2_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
Pedal value sensor 2 raw acquisition converted for KWP					
V_PVS_2_MON_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
Pedal value sensor 2 raw acquisition monitoring value converted for KWP					
V_SOF_SWI_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
Voltage V_SOF_SWI_KWP - ADC-value					
V_TPS_1_KWP [NC_ETC_NR]	O/V	0... FFH	0... 4.98046	0.0195312	V
Throttle position sensor 1 raw acquisition converted for KWP					
V_TPS_2_KWP [NC_ETC_NR]	O/V	0... FFH	0... 4.98046	0.0195312	V
Throttle position sensor 2 raw acquisition converted for KWP					
VB_BAS_KWP	O/V	0... FFH	0... 28.8	0.1129412	V
Voltage VB_BAS converted for KWP					
VCC_PVS_1_KWP	O/V	0... FFH	0... 9.96093	0.0390625	V
Voltage supply for pedal value sensor 1 raw acquisition converted for KWP					
VCC_PVS_2_KWP	O/V	0... FFH	0... 9.96093	0.0390625	V
Voltage supply for pedal value sensor 2 raw acquisition converted for KWP					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VFF_MFF_SP_FUP_CTL_KWP	O/V	0... FFH	0... 255	1	l/h
Volume fuel flow through the injectors converted for KWP					
VLS_DIF_LAM_ADJ_KWP [NC_CBK_EX_NR]	O/V	80... 7FH	-0.625... 0.62011	4.8828e-3	V
difference between set point and actual downstream LS signal converted for KWP					
VLS_DOWN_KWP [NC_CBK_EX_NR]	O/V	0... FFH	0... 4.98046	0.0195312	V
Downstream oxygen sensor voltage converted for KWP					
VLS_NOX_SENS_KWP [NC_NOX_SENS_CONF]	O/V	0... 578H	-200 ...1200	1	mV
Binary O2 signal voltage, raw value, measured by NOx-Sensor for KWP					
VLS_OFS_LSL_KWP [NC_CBK_EX_NR]	O/V	80... 7FH	-0.625... 0.62011	4.8828e-3	V
Output signal offset of linear lambda sensor for Ip gain16 converted for KWP					
VLS_UP_KWP [NC_CBK_EX_NR]	O/V	0... FFH	0... 4.98046	0.0195312	V
Upstream Oxygen sensor voltage converted for KWP					
VP_TCO_2_KWP [NC_NR_TCO_SENS]	O/V	0... FFH	0... 4.98046	0.0195312	V
Voltage of coolant temperature sensor (radiator outlet) converted for KWP					
VP_TCO_KWP [NC_NR_TCO_SENS]	O/V	0... FFH	0... 4.98046	0.0195312	V
Voltage of coolant temperature sensor shifted to FFC0H					
VP_TECU_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
Voltage VP_TECU shifted to FFC0H					
VP_TEG_PCAT_DOWN_KWP	O/V	0... FFH	0... 3.3	0.0129412	V
Catalyst temperature sensor raw acquisition converted for KWP					
VP_TIA_KWP [NC_SENS_NR_TIA_THR]	O/V	0... FFH	0... 4.98046	0.0195312	V
VP_TIA converted for KWP					
VP_TIA_TCHA_KWP	O/V	0... FFH	0... 3.3	0.0129412	V
Voltage for temperatur sensor up turbocharger converted for KWP					
VP_TPS_1_KWP [NC_ETC_NR]	O/V	80... 7FH	-5... 4.96	0.0390588	V
Signal voltage throttle position sensor 1, converted for KWP					
VP_TPS_2_KWP [NC_ETC_NR]	O/V	80... 7FH	-5... 4.96	0.0390588	V
Signal voltage throttle position sensor 1, converted for KWP					

**Input data:**

Absch_korr {p. 8154}	AMP_MES {p. 1163}	Atr {p. 8154}	Atlvst {p. 8154}
B_bsdprot2 {p. 8366}	B_lrffoff {p. 8367}	B_vsean_loc {p. 8347}	Ba_ist {p. 8154}
Ba_wm_ist {p. 8155}	BRAKE_PRS {p. 1561}	Bsdgencv {p. 8367}	Bsdgenregv {p. 8367}
CAM_EX [NC_NR_CBK_IVVT] {p. 8399}	CAM_IN [NC_NR_CBK_IVVT] {p. 8399}	CAM_IN_H [NC_NR_CBK_IVVT]	CAM_SP_IVVT_EX {p. 8399}
CAM_SP_IVVT_IN {p. 8399}	CAM_SP_REF_EX {p. 8399}	CAM_SP_REF_IN {p. 8399}	CAN_ERR_NOX_SENS [NC_NOX_SENS_CONF] {p. 1398}
CAN_STATE_NOX_SENS [NC_NOX_SENS_CONF] {p. 1398}	CHA_IV_1_MES [NC_CYL_NR] {p. 2035}	CL_MMV_SAE {p. 5926}	CPPWM_ADD_AD_MEM {p. 3756}
CPPWM_CPS {p. 3749}	CPU_LOAD_MAX_RST_ DET [NC_RST_DBG_LIST_ SIZE] {p. 560}	CPU_LOAD_RST_DET [NC_RST_DBG_LIST_ SIZE] {p. 560}	CTR_AD_COLD_LAM_AD_ INJ {p. 3348}

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CTR_AD_HOT_LAM_AD_INJ {p. 3348}	CTR_CH_SO2P {p. 1789}	CTR_ERR_LSL_IF_SPI_WR [NC_CBK_EX_NR] {p. 955}	CTR_GB_NEUT_NOT_PLAUS_SUM {p. 797}
CTR_KM_BN {p. 1563}	CTR_KM_CAN {p. 1563}	CTR_MIS_DET_CYL [NC_CYL_NR] {p. 6263}	CTR_NR_DIAG_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5168}
CTR_NS_AD_CYC [NC_NOX_SENS_CONF] {p. 3189}	CTR_NS_SHIFT_CYC [NC_NOX_SENS_CONF] {p. 6425}	CTR_STC_TECU_1 {p. 1256}	CTR_STC_TECU_2 {p. 1256}
CTR_STC_TECU_3 {p. 1256}	CTR_STC_TECU_4 {p. 1256}	CTR_STC_TECU_5 {p. 1256}	CTR_STC_TECU_6 {p. 1256}
CTR_STC_TECU_7 {p. 1256}	CTR_STC_TECU_8 {p. 1256}	CTR_SWI_AFS_MON {p. 6856}	CTR_WRST
CUR_CNS_CWP {p. 4093}	CUR_CNS_CWP_2_1	CUR_CNS_CWP_2_2	CUR_DMTL_COR_FIL {p. 5960}
CUR_DMTL_DMTLS_TEST {p. 5960}	CUR_DMTL_REF_LEAK {p. 5960}	CUR_DMTL_ROUGH_LEAK_MIN {p. 5960}	D_soc {p. 8156}
DELTA_CRK_CYL_LAM [NC_CBK_EX_NR] {p. 2838}	Dffgen {p. 8156}	Dfsiggen {p. 8368}	DIST_ACT_MIL {p. 5899}
DIST_LAM_AD_INJ_COLD {p. 3348}	DIST_LAM_AD_INJ_HOT {p. 3348}	DIST_NT_NS_AD [NC_NOX_SENS_CONF] {p. 3189}	DIST_NT_NS_SHIFT [NC_NOX_SENS_CONF] {p. 6425}
DIST_RST_DET [NC_RST_DBG_LIST_SIZE] {p. 560}	DIST_SO2P_END {p. 1789}	ECFPWM [NC_ECF_NR] {p. 3596}	ECFPWM_REQ
ECTPWM {p. 3858}	ECU_STATE {p. 1091}	EFF_CAT_DIAG_OBD [NC_CBK_EX_NR] {p. 5515}	EFF_IGA_CST_QUO_IS_MAX {p. 6493}
EFF_IGA_CST_QUO_PL_MAX {p. 6493}	EFPPWM {p. 3796}	EFPPWM_I {p. 3796}	EFPPWM_I_AD {p. 3796}
EFPPWM_MIN_AD {p. 3796}	EGY_STEP_INJ_CHA_GRD [NC_CYL_NR] {p. 2277}	Eisyagr_korfak_b {p. 8156}	ENVD_0_MON_3 {p. 7158}
ENVD_1_MON_3 {p. 7158}	ENVD_2_MON_3 {p. 7158}	ENVD_3_MON_3 {p. 7158}	ER_CYL [NC_CYL_NR] {p. 1454}
F_atlad {p. 8157}	FAC_COR_AD_RNG_H_ER_BAL_HOM [NC_CYL_NR]	FAC_COR_AD_RNG_IS_ER_BAL_HOM [NC_CYL_NR]	FAC_COR_AD_RNG_L_ER_BAL_HOM [NC_CYL_NR]
FAC_CYL_LAM_COR [NC_CYL_NR] {p. 2731}	FAC_DIAG_DYN_LSL_UP [NC_CBK_EX_NR] {p. 5345}	FAC_EGY_PWM_AD [NC_CYL_NR] {p. 2277}	FAC_FCO_KWP {p. 7541}

FAC_H_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	FAC_L_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	FAC_LAM_AD_BAL [NC_CBK_EX_NR] {p. 1014}	FAC_LAM_AD_CUS [NC_CBK_EX_NR] {p. 8308}
FAC_LAM_AD_OUT [NC_CBK_EX_NR] {p. 2461}	FAC_LAM_AD_SAE [NC_CBK_EX_NR] {p. 1014}	FAC_LAM_ADJ_COR_ LAM_AD_CUS [NC_CBK_EX_NR] {p. 8309}	FAC_LAM_CYL_SEL_ ADJ_CST [NC_CYL_NR] {p. 2731}
FAC_LAM_CYL_SEL_ ADJ_H_RNG [NC_CYL_NR] {p. 2731}	FAC_LAM_CYL_SEL_ ADJ_L_RNG [NC_CYL_NR] {p. 2731}	FAC_LAM_LIM [NC_CBK_EX_NR] {p. 2461}	FAC_LAM_MV_MMV [NC_CBK_EX_NR] {p. 2462}
FAC_LAM_TCO_A [NC_CBK_EX_NR] {p. 2677}	FAC_LAM_TCO_B [NC_CBK_EX_NR] {p. 2677}	FAC_LAM_TCO_C [NC_CBK_EX_NR] {p. 2677}	FAC_LAM_TCO_D [NC_CBK_EX_NR] {p. 2677}
FAC_LAM_TCO_E [NC_CBK_EX_NR] {p. 2677}	FAC_LSL_GAIN_AD [NC_CBK_EX_NR] {p. 2371}	FAC_MFF_ADD_FAC_ LAM_AD [NC_CBK_EX_NR] {p. 2641}	FAC_NOX_NS_AD [NC_NOX_SENS_CONF] {p. 3189}
FAC_TI_AD_ER_BAL [NC_CYL_NR] {p. 3298}	FAC_TI_ER_BAL [NC_CYL_NR] {p. 3298}	FLOW_COR_CPS {p. 3635}	FTL {p. 1564}
FUP {p. 1283}	FUP_EFP {p. 1290}	FUP_EFP_SP {p. 3792}	FUP_MPL [NC_CBK_HPP_NR]
FUP_RNG_H_MES {p. 1283}	FUP_SP_MPL [NC_CBK_HPP_NR]	GEAR {p. 1302}	Gen_manufak {p. 8368}
Gen_typkenn {p. 8368}	l_gen {p. 8158}	lerr {p. 8368}	lerrfgrenz {p. 8368}
IGA_IGC [NC_CYL_NR] {p. 1005}	IVVTPWM_EX [NC_NR_CBK_IVVT]	IVVTPWM_IN [NC_NR_CBK_IVVT]	KNKS [NC_CYL_NR] {p. 849}
KNKS_REL_NL [NC_CYL_NR] {p. 849}	LAMB_BAS [NC_CBK_EX_NR] {p. 8340}	LAMB_DELTA_AD_LAM_ ADJ [NC_CBK_EX_NR] {p. 2622}	LAMB_DELTA_I_LAM_ADJ [NC_CBK_EX_NR] {p. 2589}
LAMB_DIF_MON {p. 6777}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_LS_UP_MV {p. 2313}	LAMB_NOX_SENS [NC_NOX_SENS_CONF] {p. 1380}
LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LAMB_SP_SAE {p. 1015}	LC_SWI_AEB_TYP {p. 4136}	LF_ERR_PLAUS_IV_EGY_ CAL {p. 4790}
LF_ERR_PLAUS_IV_MFF_ CAL {p. 4790}	LOAD_BAT {p. 8368}	LOAD_CLC {p. 5801}	LOAD_MIN_MIS {p. 6283}
LOAD_MIS {p. 6213}	LSHPWM_DOWN [NC_CBK_EX_NR] {p. 2421}	LSHPWM_UP [NC_CBK_EX_NR] {p. 2385}	LV_ACCOUT_RLY {p. 3589}
LV_CAN_TEMP_MIN_THD [NC_NOX_SENS_CONF] {p. 1399}	LV_CDN_DIAG_TCHA_ LEAK {p. 1057}	LV_CRU_MAIN_SWI {p. 7220}	LV_CS {p. 8394}

LV_CS_CUS {p. 1419}	LV_CYL_BAL_AD_HOM_REQ_DC {p. 4066}	LV_CYL_BAL_AD_WG_OPEN_REQ [NC_CBK_EX_NR] {p. 4066}	LV_CYL_BAL_ER_AD_ADD_EOL {p. 4043}
LV_CYL_BAL_ER_AD_FAC_EOL {p. 4043}	LV_CYL_BAL_LAM_AD_DC {p. 4066}	LV_CYL_BAL_LAM_AD_EOL {p. 4043}	LV_CYL_BAL_LAM_SEL_AD_COLD_EOL {p. 4043}
LV_CYL_BAL_LAM_SEL_AD_HOT_DC {p. 4066}	LV_CYL_BAL_LAM_SEL_AD_HOT_EOL {p. 4043}	LV_DBG_INFO_VLD [NC_NR_DBG_NVMY]	LV_DMTL_PUMP {p. 5963}
LV_DMTLS {p. 5963}	LV_EBOX_CFA {p. 4133}	LV_ECF_RLY_ACT	LV_ECRAS_DOWN_1 {p. 3863}
LV_EF {p. 3614}	LV_END_DIAG_TCHA_LEAK {p. 1060}	LV_END_DIAG_TCHA_PRS_HIGH {p. 1060}	LV_END_DIAG_TCHA_PRS_LOW {p. 1060}
LV_ERR_ECFPWM_FB_3 [NC_ECF_NR]	LV_ERR_ECFPWM_FB_4 [NC_ECF_NR]	LV_HDMTL_ON {p. 5966}	LV_IM_BLS {p. 852}
LV_IM_BTS {p. 852}	LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}	LV_IS {p. 1720}	LV_KNK {p. 1961}
LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_MIL_CAN {p. 1566}	LV_PAS_RAMP_ACT_I_IS {p. 3440}	LV_POIL_SWI {p. 903}
LV_PWL_CWP	LV_RAS_OUT {p. 3594}	LV_RLY_CRCV_HEAT {p. 4142}	LV_RLY_HPDI
LV_RLY_ST {p. 3844}	LV_RLY_ST_CAN {p. 1567}	LV_SEG_AD_AVL_ER {p. 1473}	LV_SO2P_REQ_2 {p. 3073}
LV_SOF {p. 3851}	LV_SOF_SWI {p. 3851}	LV_SOF_SWI_REQ {p. 3851}	LV_VAR_MAF_LEARNT {p. 656}
LV_WAL_1_CAN {p. 1568}	LV_WUP {p. 1775}	MAF {p. 8277}	MAF_KGH_MES {p. 1192}
MAF_KGH_MES_BAS {p. 1192}	MAF_MON {p. 6777}	MAP {p. 8278}	MAP_DIP_MES_BAS {p. 1198}
MAP_MES {p. 1198}	MAP_SAE {p. 1198}	Md_gennm_na {p. 8160}	MFF_ADD_AD_ER_BAL [NC_CYL_NR] {p. 3269}
MFF_ADD_COLD_LAM_AD_INJ [NC_CYL_NR] {p. 3405}	MFF_ADD_HOT_LAM_AD_INJ [NC_CYL_NR] {p. 3405}	MFF_ADD_LAM_AD [NC_CBK_EX_NR] {p. 2642}	MFF_ADD_LAM_AD_OUT [NC_CBK_EX_NR] {p. 2464}
MFF_SP_MV {p. 2151}	Msnlgofts_tmp {p. 8163}	N {p. 1525}	N_32 {p. 1525}
N_32_MON {p. 7002}	N_32_SUB_MON {p. 7002}	N_CPU_LOAD_MAX_RST_DET [NC_RST_DBG_LIST_SIZE] {p. 560}	N_DIF_SP_IS_MON {p. 6792}

N_EFP_AV {p. 1569}	N_GRD {p. 1525}	N_PERC_ECF {p. 8225}	N_REL_CWP {p. 4095}
N_REL_CWP_2_1	N_REL_CWP_2_1_DIF	N_REL_CWP_2_2	N_REL_CWP_2_2_DIF
N_REL_CWP_DIF {p. 4537}	N_REL_CWP_SP {p. 8225}	N_REL_CWP_SP_2	N_RST_DET [NC_RST_ DBG_LIST_SIZE] {p. 560}
N_SP_IS {p. 1122}	NC_CBK_EX_NR {p. 1829}	NC_CBK_HPP_NR [1] {p. 812}	NC_CBK_IN_NR {p. 604}
NC_CYL_NR {p. 1526}	NC_ECF_NR {p. 576}	NC_MAP_SENS_NR	NC_NOX_SENS_CONF {p. 643}
NC_NR_CAM_CBK {p. 1507}	NC_NR_CBK_IVVT {p. 604}	NC_NR_CPS_CP	NC_NR_DBG_NVMY
NC_NR_STACK_ADR_RST	NC_NR_TCHA	NC_NR_TCO_SENS {p. 576}	NC_RST_DBG_ BACKTRACE_SIZE {p. 561}
NC_RST_DBG_LIST_SIZE {p. 561}	NC_SENS_NR_TIA_THR	NL [NC_CYL_NR] {p. 1962}	NOX_NS [NC_NOX_SENS_CONF] {p. 992}
NOX_OFS_LOAD [NC_NOX_SENS_CONF] {p. 3193}	NOX_OFS_PUC [NC_NOX_SENS_CONF] {p. 3193}	NT_AGI {p. 3073}	NT_AGI_SUL {p. 3073}
NT_AGI_THERMO {p. 3073}	NT_SUL {p. 3113}	OBD_TAM {p. 1569}	OPG_ACR {p. 1097}
OPG_SP_ACR {p. 3573}	Oz_krzcnt {p. 8164}	Oz_krzor	Oz_kvbog {p. 8164}
Oz_kvbsm_ul {p. 8164}	Oz_if1c {p. 8203}	Oz_if1t {p. 8164}	Oz_if2c {p. 8203}
Oz_if2t {p. 8164}	Oz_lgmwcnt {p. 8164}	Oz_lp {p. 8164}	Oz_lv {p. 8164}
Oz_nivakt {p. 8164}	Oz_nivkrzt {p. 8164}	Oz_nivlangt {p. 8164}	Oz_nivr {p. 8203}
Oz_oelkm {p. 8164}	Oz_oelzeit {p. 8164}	Oz_oricnt {p. 8164}	Oz_permakt {p. 8164}
Oz_permbog {p. 8164}	Oz_permex {p. 8164}	Oz_permlow {p. 8165}	Oz_permoff {p. 8165}
Oz_permr {p. 8203}	Oz_rwkvb {p. 8165}	Oz_rwperm {p. 8165}	Oz_tempakt {p. 8165}
Oz_tempr {p. 8203}	Oz_vormw {p. 8165}	Oz_vormwcnt {p. 8165}	P_oel_ist {p. 8203}
P_oel_soll {p. 8165}	PBSU {p. 807}	Pldr_soll {p. 8165}	POIL_PWM {p. 8203}
prdr_w_rb [NC_CBK_HPP_NR]	Ps_ist {p. 8165}	PSN_AD_CAM_EX [NC_NR_CAM_CBK] {p. 1533}	PSN_AD_CAM_IN [NC_NR_CAM_CBK] {p. 1533}
PSN_CAM_EX [NC_NR_CAM_CBK] {p. 1533}	PSN_CAM_IN [NC_NR_CAM_CBK] {p. 1533}	PUT {p. 1209}	PV_AV {p. 1269}
PV_AV_1 {p. 1269}	PV_AV_2 {p. 1269}	PV_AV_MON {p. 6961}	PV_AV_RAW {p. 1269}
Pvdkds {p. 8279}	PWM_ACR {p. 3580}	PWM_ETC [NC_ETC_NR]	Q_iruhe2
R_IT_LS_UP [NC_CBK_EX_NR] {p. 1320}	RATIO_MMV_NS_SHIFT_ DIAG [NC_NOX_SENS_CONF] {p. 6412}	RATIO_NS_SHIFT_DIAG [NC_NOX_SENS_CONF] {p. 6412}	REL_CWP_2_1_PWR

REL_CWP_2_2_PWR	REL_CWP_PWR {p. 4537}	RFPPWM {p. 8140}	RST_CLAS_SEC [NC_RST_DBG_LIST_SIZE] {p. 560}
RST_CLAS_TYP [NC_RST_DBG_LIST_SIZE] {p. 560}	RST_DBG_BACK_INFO_VLD [NC_RST_DBG_LIST_SIZE] {p. 560}	RST_INFO_ADD [NC_RST_DBG_LIST_SIZE] {p. 561}	RST_INFO_CTR {p. 561}
RST_SEC {p. 561}	RST_TYP {p. 561}	Rt_bastatg_hs {p. 8168}	Rt_bastatg_sa {p. 8168}
SEG_AD_MMV_ER [NC_CYL_NR] {p. 1474}	SEG_T_MES {p. 1447}	St_gen {p. 8171}	St_ngang {p. 8173}
STACK_ADR_RST [NC_NR_DBG_NVMY][NC_NR_STACK_ADR_RST]	Stat_sv_reg1 {p. 8175}	Stat_sv_reg2 {p. 8175}	STATE_ACIN_CAN {p. 1569}
STATE_ACR_AD {p. 4320}	STATE_CRU {p. 7227}	STATE_CRU_OFF_IRR {p. 7227}	STATE_CRU_OFF_REV {p. 7227}
STATE_ECRAS_SYS {p. 3863}	STATE_ENG {p. 1720}	STATE_EOL_KWP_CPS {p. 7763}	STATE_EOL_KWP_DMTL {p. 7764}
STATE_EOL_KWP_N_SP_IS {p. 7764}	STATE_EOL_KWP_SA {p. 7765}	STATE_EOL_KWP_VLS {p. 7765}	STATE_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4294}
STATE_LRN_ECU {p. 657}	STATE_LS_SAE [NC_CBK_EX_NR] {p. 2448}	STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}	STATE_LSH_UP [NC_CBK_EX_NR] {p. 2385}
STATE_MSW_CAN {p. 7220}	STATE_N_LIM_ETC_REQ	STATE_RST_INFO_ADD [NC_NR_DBG_NVMY]	STATE_RST_TYP [NC_NR_DBG_NVMY]
STATE_RST_TYP_ACT	STATE_SYM_DIAG_PUC_LSL_UP [NC_CBK_EX_NR] {p. 5297}	STATE_SYM_OBD_LSL_LSH_UP [NC_CBK_EX_NR] {p. 5439}	STATE_TPS_DIAG {p. 4982}
STATE_TQ_CAN_PLAUS {p. 4851}	SUM_DIAG_DIAGCPS_SAE {p. 5928}	SUM_RR {p. 6301}	SY_ANZ_EISY
T_ACT_LEAK_MES {p. 5971}	T_AST_SAE {p. 1766}	T_batt {p. 8175}	T_CH_SO2P_ACT {p. 1789}
T_ES {p. 1444}	T_ES_CUS {p. 1444}	T_PER_MAF_FRQ [NC_MAF_NR] {p. 834}	T2histshort {p. 8175}
T3histshort {p. 8175}	T4histshort {p. 8175}	TAM {p. 1579}	TAM_ST {p. 1214}
Tans {p. 8135}	Tchip {p. 8369}	TCO {p. 1100}	TCO_2 {p. 1218}
TCO_2_MES {p. 1218}	TCO_MES {p. 1100}	TCO_ST {p. 1100}	TECU {p. 1256}
TEG_CAT_DOWN_MDL {p. 8236}	TEG_PCAT_DOWN [NC_CBK_EX_NR] {p. 1253}	TEMP_EL_CWP {p. 4096}	TEMP_EL_CWP_2_1

TEMP_EL_CWP_2_2	Tget_b1 {p. 8177}	Tget_b2 {p. 8177}	Tget_b3 {p. 8177}
Tget_b4 {p. 8177}	Tget_b5 {p. 8177}	TI_1_MES [NC_CYL_NR] {p. 2040}	TIA {p. 1226}
TIA_MES {p. 1226}	TIA_ST {p. 1226}	TIA_TCHA {p. 1226}	Tlrigen {p. 8369}
Tmot_b1 {p. 8177}	Tmot_b2 {p. 8177}	Tmot_b3 {p. 8177}	Tmot_b4 {p. 8177}
Tmot_b5 {p. 8177}	Tn_abstellm {p. 8221}	Toel {p. 8177}	Toel_b1 {p. 8177}
Toel_b2 {p. 8177}	Toel_b3 {p. 8177}	Toel_b4 {p. 8177}	Toel_b5 {p. 8178}
TOIL_MES {p. 8204}	TPS_AD_STEP {p. 4951}	TPS_AV {p. 1169}	TPS_AV_1 {p. 1169}
TPS_AV_2 {p. 1169}	TPS_SP {p. 6555}	TPS_SP_MDL {p. 8377}	TQ_AX_MAX
TQ_AX_MIN	TQ_DIF_I_IS_MON {p. 6921}	TQ_DIF_P_D_FAST_IS {p. 3441}	TQ_DIF_P_D_SLOW_IS {p. 3442}
TQ_LOSS_MON {p. 6975}	TQ_MAX_CLU_DIF_MON {p. 6938}	TQ_MIN_CLU_DIF_MON {p. 6952}	TQ_REQ_CLU {p. 8390}
TQI_AV {p. 981}	TQI_AV_H_RNG_MON	TQI_AV_MON {p. 6774}	TQI_GS_FAST_DEC {p. 6718}
TQI_MSR_CAN {p. 811}	TQI_SP {p. 8391}	TQI_SP_H_RNG_MON	TQI_SP_MON {p. 6851}
TRT {p. 1504}	TRT_RST_DET [NC_RST_ DBG_LIST_SIZE] {p. 561}	TTIP_MES_LS_UP [NC_CBK_EX_NR] {p. 1321}	Tumg_b1 {p. 8178}
Tumg_b2 {p. 8178}	Tumg_b3 {p. 8178}	Tumg_b4 {p. 8178}	Tumg_b5 {p. 8178}
Tvngang {p. 8291}	U_batt {p. 8178}	U_fgen {p. 8369}	U_gen {p. 8178}
Ubt {p. 8179}	Uregnom {p. 8369}	V_ACR {p. 1097}	V_ACR_AD_BOL {p. 4320}
V_ACR_AD_BOL_0 {p. 4320}	V_ACR_AD_TOL {p. 4320}	V_ALTER_SP {p. 8369}	V_AMP {p. 831}
V_CWP {p. 4096}	V_CWP_2_1	V_CWP_2_2	V_DMTL
V_FUP_EFP {p. 1290}	V_FUP_EFP_MV {p. 1290}	V_FUP_MV {p. 1283}	V_IGK_BAS {p. 831}
V_IGK_MES {p. 847}	V_IV_1_MES [NC_CYL_NR] {p. 2041}	V_MAF {p. 811}	V_MAP {p. 1198}
V_PBSU	V_PUT {p. 1198}	V_PVS_1 {p. 831}	V_PVS_1_MON {p. 6961}
V_PVS_2 {p. 831}	V_PVS_2_MON {p. 6961}	V_SOF_SWI {p. 831}	V_TPS_1 {p. 831}
V_TPS_2 {p. 831}	VB {p. 1185}	VB_BAS {p. 831}	VB_RLY_HPDI
VCC_PVS_1 {p. 831}	VCC_PVS_2 {p. 832}	VFF_EFP {p. 989}	VFF_MFF_SP_FUP_CTL {p. 3881}
VIM_AV {p. 3622}	VIMPWM_1 {p. 3622}	VIMPWM_2 {p. 3622}	VLS_DIF_LAM_ADJ [NC_CBK_EX_NR] {p. 2590}
VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_DOWN_PUE_MMV [NC_CBK_EX_NR] {p. 5170}	VLS_DOWN_PUE_SAVE_ MAX [NC_CBK_EX_NR] {p. 5170}	VLS_DOWN_PUE_SAVE_ MIN [NC_CBK_EX_NR] {p. 5170}
VLS_DOWN_PUE_STD [NC_CBK_EX_NR] {p. 5170}	VLS_NOX_SENS [NC_NOX_SENS_CONF] {p. 1382}	VLS_OFS_LSL [NC_CBK_EX_NR] {p. 2315}	VLS_UP [NC_CBK_EX_NR] {p. 1341}

VP_TCO [NC_NR_TCO_SENS] {p. 1100}	VP_TECU {p. 1256}	VP_TEG_PCAT_DOWN {p. 1253}	VP_TIA {p. 1226}
VP_TIA_TCHA {p. 1226}	VP_TPS_1 [NC_ETC_NR]	VP_TPS_2 [NC_ETC_NR]	VS {p. 1176}
WGPWM [NC_CBK_EX_NR] {p. 8140}			

**General information:**

This specification is based on the on actual program version of Basic-Software.

All project specific implemented services and parameter of diagnostic communication protocol are listed below.

In the attached chapters, the displayed telegram structure is without the header for e.g. KWP2000, KWP2000\* or BMW-FAST Protocol.

The structure from the service ID is the same in all cases.

Below the differences between KWP2000, KWP2000\* and BMW-FAST Protocol are described.

**KWP2000:**

Baudrate: 10 400

Header:

Data Byte	Byte #	Parameter Name	CVT	Value	Mnemonic
	#1d	Format byte	M	#AALLLLLb	FMT
	#2d	Target address byte	C	#12h/#EAh/#EDh/#EFh /#33h	TGT
	#3d	Source address byte	C	#F1h	SRC
	#4d	Additional length byte	C	#01h-#FFh	LEN
#1d	#5d	Service ID Byte	M	#XXh	SID
•	#6d	Data Byte #02h	C	#XXh	DATA
•	•	•	•	•	
•	•	•	•	•	
•	•	•	•	•	
#255d	#259d	Data Byte #255d	C	#XXh	
	#260d	addition Checksum	M	#00h-#FFh	CS

**KWP2000\*:**

Baudrate: 9 600

Header:

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Data Byte	Byte #	Parameter Name	CVT	Value	Mnemonic
	#1d	Format byte	M	#B8h	FMT
	#2d	Target address byte	C	#12h	TGT
	#3d	Source address byte	C	#F1h	SRC
	#4d	length byte calculated by the tool	C	#01h-#FFh	LEN
#1d	#5d	Service ID Byte	M	#XXh	SID
•	#6d	Data Byte #02h	C	#XXh	DATA
•	•	•	•	•	
•	•	•	•	•	
•	•	•	•	•	
#255d	#259d	Data Byte #255d	C	#XXh	
	#260d	exor Checksum	M	#00h-#FFh	CS

**BMW-FAST:**

Baudrate: 115 200

Header:

Data Byte	Byte #	Parameter Name	CVT	Value	Mnemonic
	#1d	Format byte	M	#AALLLLLLb	FMT
	#2d	Target address byte	C	#12h/#EAh/#EDh/#EFh /#33h	TGT
	#3d	Source address byte	C	#F1h	SRC
	#4d	Additional length byte	C	#01h-#FFh	LEN
#1d	#5d	Service ID Byte	M	#XXh	SID
•	#6d	Data Byte #02h	C	#XXh	DATA
•	•	•	•	•	
•	•	•	•	•	
•	•	•	•	•	
#255d	#259d	Data Byte #255d	C	#XXh	
	#260d	addition Checksum	M	#00h-#FFh	CS

BMW-FAST is identical to KWP2000 except baudrate.

**I.5.1 Normative reference**

This implementation and the description of diagnostic communication protocol KWP2000 is based on the following standards:

ISO /FDIS 14229: 1996 Road Vehicles-Diagnostic systems - DiagnosticServices Specification

ISO /FDIS 14230-1:1996 Road Vehicles - Diagnostic systems -Keyword Protocol 2000 - Part 1:  
Physical Layer

ISO/FDIS 14230-2:1996 Road Vehicles - Diagnostic systems-Keyword Protocol 2000 - Part 2:  
Data Link Layer

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ISO /FDIS 14230-3:1996 Road Vehicles - Diagnostic systems -Keyword Protocol 2000 - Part 3:  
Implementation

ISO/DIS 14230-4 Road Vehicles - Diagnostic Systems Keyword Protocol 2000 - Part  
4  
KWP 2000 Requirements for emission-related systems

VDA /WD 14230-2: 1997 Keyword Protocol 2000 - Part 2 Data Link Layer  
**VDA - Recommended Practice**

VDA /WD 14230-3: 1997 Keyword Protocol 2000 - Part 3 Implementation  
**VDA - Recommended Practice**

Diagnosekommunikation mit KWP 2000(\*) in Motorsteuerungen Revision 1.2  
Ident.Nummer **1 430 227** Index d NÄL.-Nr.: **E2263.N**

## I.5.2 Convention

M: Mandatory

C: Conditional; the presence of the parameter depend on other parameters within the service

CVT: Conventions

#XXh: hexadecimal number

#XXd: decimal number

#XXb: binary number

These values are necessary for the services - read failure memory extra long (21\_0A and 17h) and DDLI and for the freeze frame.

When system values (Word) are used for DDLI output as a Byte, then the lowbyte is cut off, so only the high byte is the output. In this case a selection for the environmental value (FMY) is necessary, only the high Byte from the Word is the output.

When system values (Byte) are used for DDLI output as a Word, the Byte is shifted to the high Byte and the low Byte is filled with 00h.

Analog values e.g. 0...3FFh = 0...5V, are shifted 4 Bits to FFC0h.

When these analog values (FFC0h) are used for DDLI output as a Byte, then the lowbyte is cut off, so only the high byte is the output. In this case a selection for the environmental value (FMY) is necessary, only the high Byte from the Word is the output.

List for selection of the environmental datas for each failure also for DDLI service 2C  
cross out ist not supportet yet!

## I.5.3 Actuator Diagnosis - Timeouts

### I.5.3.1 Diagnostic Timeout

The standard timeout of KWP2000 is defined by P3 max.

In KWP2000(\*) is no timeout requested.

	P3 max
Default	5000ms infinity for KWP*
Extended	250ms
Programming	16s
Periodic transmission	250ms

After a diagnostic timeout occurs all actual actuator services are stopped.

### I.5.3.2 TIMEOUT\_TIME\_XX\_KWP

This timeout is sent by the protocol from the tester to the ECU. It can be different for each actuator service.

After the timeout TIMEOUT\_TIME\_XX\_KWP occurs the corresponding actuator services is stopped.

If TIMEOUT\_TIME\_XX\_KWP is greater than the diagnostic timeout, the tester has to take special care to sent tester present service.

### I.5.4 Definitions for EOL Tests

The status STATE\_EOL\_KWP\_XXX should be defined with the single Bits from the table below. Only supported (necessary) states can be described as followed:

<b>Definitions for EOL Tests: see BMW LH 7 507 660</b>	<b>values of the status if the function supported the singel one</b>	
<b>SIEMENS_VDO_SW_NAME</b>	<b>remark</b>	<b>hex value</b>
EOL_TEST_ACT	test currently running -function active	00h (other) 05H (MSD8x)
EOL_TEST_ST_INH	start of test not allowed - start-/control - conditions not correct	01h
EOL_TEST_PAR_NOT_PLAUS	hand over parameter not plausible- parameter not correct	02h
EOL_TEST_WAIT_REL	function waiting for release	03h
not used	not used	04h
EOL_TEST_NOT ST	test not yet started (default state) - function not started yet	00h (MSD8x) 05h (other)
EOL_TEST_END_WOUT_RESU LT	function finished - without failures otherwise see 08h or 09h	06h
EOL_TEST_ABORTED	test aborted - function stopped	07h
EOL_TEST_END_WOUT_ERR	test finished without errors - function complete, no errors	08h
EOL_TEST_END_WITH_ERR	test finished with errors - function complete, with errors	09h

Example (this is not a output section!):

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_EOL_KWP_XXX	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H	<b>MSD8x:</b> EOL_TEST_NOT_ST Other : EOL_TEST_ACT EOL_TEST_ST_INH EOL_TEST_PAR_NOT_PLAUS EOL_TEST_WAIT_REL not used <b>MSD8x:</b> EOL_TEST_ACT Other : EOL_TEST_NOT_ST EOL_TEST_END_WOUT_RESULT EOL_TEST_ABORTED EOL_TEST_END_WOUT_ERR EOL_TEST_END_WITH_ERR	1	-
State variable for end of line test XXX					

### I.5.5 Variable conversion for KWP2000 /KWP2000(\*)

#### Description of Basic Equations for conversion:

The general equation for conversion from Siemens internal Range to Customer Range is

<b>General Equation:</b>	
$Var_{cus-hex} = m(Var_{int-hex} - C)$	-----(1)
<b>Calculation of m and C:</b>	
$m = \frac{\text{resolution of Customer}}{\text{resolution of Siemens}}$	-----(2)
$C = 0_{int-hex} - 0_{cus-hex} / m$	-----(3)

$Var_{int-hex}$  = the hex value of the variable in Siemens internal Range

$Var_{cus-hex}$  = the hex value of the variable in customer Range

m = the slope of conversion from  $Var_{int-hex}$  to  $Var_{cus-hex}$ .

C = the offset of conversion from  $Var_{int-hex}$  to  $Var_{cus-hex}$ .

$0_{int-hex}$  = the hex. value for a phys. value 0 in Siemens Range.

$0_{cus-hex}$  = the hex. value for a phys. value 0 in Customer Range.

#### Derivation of Equations

To derive the above equations, consider two instances(a1 and a2) of the equation(1),

$$a1_{cus-hex} = m(a1_{int-hex} - C) \quad \text{-----(4)}$$

$$a2_{cus-hex} = m(a2_{int-hex} - C) \quad \text{-----(5)}$$

Subtracting (4) from (5) and rearranging, we get

$$m = \frac{(a1_{cus-hex} - a2_{cus-hex})}{(a1_{int-hex} - a2_{int-hex})}$$

$$= \frac{(a1_{cus-hex} - a2_{cus-hex}) / (a1_{phy} - a2_{phy})}{(a1_{int-hex} - a2_{int-hex}) / (a1_{phy} - a2_{phy})}$$

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resolution of Customer  
= ----- , Hence (2) is proved.  
resolution of Siemens


From (4), we get  
 $C = \frac{a1_{int-hex} - a1_{cus-hex}}{m}$   
The equation (3) is obtained when  $a1=0$ . Hence (3) is proved.

- where
- $a1_{int-hex}$  = the hex. value of the instance  $a1$  in Siemens Range.
  - $a1_{cus-hex}$  = the hex. value of the instance  $a1$  in Customer Range.
  - $a2_{int-hex}$  = the hex. value of the instance  $a2$  in Siemens Range.
  - $a2_{cus-hex}$  = the hex. value of the instance  $a2$  in Customer Range.
  - $a1_{phy}$  = the phys. value of the instance  $a1$  .
  - $a2_{phy}$  = the phys. value of the instance  $a2$  .

### I.5.6 DDLI- List for environmental data and ERRM

**!!! Attention !!!**  
**!!! The output variables above are only calculated at tester request. They are present in the a2I-file and visible in INCA, but no reasonable values will be displayed. !!!**

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### I.5.6.1 DDLI basic List

ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
5800	00	Zeit nach Start	T_AST_SAE		X	X	X	X	-	-	-
			T_AST_SAE_KWP	T_AST_SAE converted for DGNC ( and limited to 255s if T_AST_SAE > 255s )	-	-	-	-	X	X	X
5801	01	Umgebungsdruck	OBD_AMP	AMP_MES converted for KWP	X	X	X	X	X	X	X
5802	02	Zustand Lambdaregelung Bank 1	STATE_LS_SAE[1]		X	X	X	X	X	X	X
5803	03	Zustand Lambdaregelung Bank 2	STATE_LS_SAE[2]		X	X	X	X	X	X	X
5804	04	Berechneter Lastwert	LOAD_CLC		X	X	X	X	X	X	X
5805	05	Kühlmitteltemperatur	OBD_TCO	TCO_MES converted for KWP	X	X	X	X	X	X	X
5806	06	Lambda Integrator Gruppe 1	OBD_LAM_COR[1]	FAC_LAM_LIM_SAE[1] converted for KWP	X	X	X	X	X	X	X
5807	07	Lambda Adaption multiplikativ Gruppe 1	FAC_LAM_AD_SAE[1]		X	X	X	X	X	X	X
5808	08	Lambda Integrator Gruppe 2	OBD_LAM_COR[2]	FAC_LAM_LIM_SAE[2] converted for KWP	X	X	X	X	X	X	X
5809	09	Lambda Adaption multiplikativ Gruppe 2	FAC_LAM_AD_SAE[2]		X	X	X	X	X	X	X
580A	0A	Mass fuel flow setpoint after combustion selection	MFF_SP_MV_KWP	MFF_SP_MV converted for KWP	X	X	X	X	-	-	-
		Wasserpumpe Spannung; CWP_2_2	V_CWP_2_2		-	-	-	-	X	X	-
580B	0B	Saugrohrdruck	MAP_SAE		X	X	X	X	X	X	X
580C	0C	Drehzahl	OBD_N	N converted for KWP	X	X	X	X	X	X	X
580D	0D	Geschwindigkeit	VS		X	X	X	X	X	X	X
580E	0E	Zündzeitpunkt Zylinder 1	OBD_IGA_IGC	IGA_IGC[0] converted for KWP	X	X	X	X	X	X	X
580F	0F	Ansauglufttemperatur	OBD_TIA	TIA_MES converted for KWP	X	X	X	X	-	-	-
				TIA_MES[1] converted for KWP	-	-	-	-	X	X	X
5810	10	Luftdurchsatz OBD	OBD_MAF	MAF_KGH_MES converted for KWP	X	X	X	X	-	-	-
		Luftdurchsatz OBD	OBD_MAF	MAF_KGH_MES[0] converted for KWP	-	-	-	-	X	X	X
5811	11	Motordrehzahl	N_32		X	X	X	X	X	X	X
5812	12	Luftmasse gemessen	MAF_KGH_MES_BAS		X	X	X	X	-	-	-
			MAF_KGH_MES_BAS_KWP[1]	MAF_KGH_MES_BAS[1] converted to DGNC	-	-	-	-	X	X	X
5813	13	Relative Last	Rf		X	X	X	X	X	X	X
5814	14	Fahrpedalwert	PV_AV_RAW		X	X	X	X	X	X	X
5815	15	Batteriespannung	OBD_VB	VB converted for KWP	X	X	X	X	X	X	X
5816	16	Lambda Setpoint	OBD_LAMB_SP	LAMB_SP_SAE converted for KWP	X	X	X	X	X	X	X
5817	17	Umgebungstemperat	OBD_TAM		X	X	X	X	X	X	X

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ID_long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
		ur									
5818	18	Luftmasse gerechnet	MAF		X	X	X	X	-	-	-
			MAF_KWP	MAF converted for DGNC	-	-	-	-	X	X	X
5819	19	Drehzahl OBD Byte	N_SAE_BYTE_KWP	N converted for KWP	X	X	X	X	X	X	X
581A	1A	Nockenwelle Einlass	CAM_IN_KWP	CAM_IN[1] converted for KWP	X	X	X	X	-	-	-
		Spannung Drosselklappe Poti 1, Bank1	VP_TPS_1_KWP[1]	VP_TPS_1[1] converted for KWP	-	-	-	-	X	X	X
581B	1B	Nockenwelle Einlass Sollwert	CAM_SP_IVVT_IN_KWP	CAM_SP_IVVT_IN converted for KWP	X	X	X	X	-	-	-
		Spannung Drosselklappe Poti 2, Bank1	VP_TPS_2_KWP[1]	VP_TPS_2[1] converted for KWP	-	-	-	-	X	X	X
581C	1C	Nockenwelle Auslass	CAM_EX[1]		X	X	X	X	-	-	-
		Spannung Drosselklappe Poti 1, Bank2	VP_TPS_1_KWP[2]	VP_TPS_1[2] converted for KWP	-	-	-	-	X	X	X
581D	1D	Nockenwelle Auslass Sollwert	CAM_SP_IVVT_EX		X	X	X	X	-	-	-
		Wasserpumpe Stromaufnahme, CWP_2_1	CUR_CNS_CWP_2_1		-	-	-	-	X	X	-
581E	1E	Ansauglufttemperatur	TIA_MES		X	X	X	X	-	-	-
		Spannung Drosselklappe Poti 2, Bank2	VP_TPS_2_KWP[2]	VP_TPS_2[2] converted for KWP	-	-	-	-	X	X	X
581F	1F	Motortemperatur	TCO_MES		X	X	X	X	X	X	X
5820	20	Kühlmitteltemperatur Kühlerausgang	TCO_2_MES		X	X	X	X	X	X	X
5821	21	Steuergerät Innentemperatur	TECU		X	X	X	X	X	X	X
5822	22	( Motor ) - Öltemperatur	TOIL_MES		X	X	X	X	X	X	X
5823	23	Zeit Motor steht	T_ES		X	X	X	X	-	-	-
			T_ES_KWP	T_ES converted for DGNC	-	-	-	-	X	X	X
5824	24	Umgebungstemperatur	TAM		X	X	X	X	X	X	X
5825	25	Zeit Motor steht	T_ES_CUS_KWP	T_ES_CUS converted for KWP	X	X	X	X	X	X	X
5826	26	Drosselklappe Sensor 1	TPS_AV_1		X	X	X	X	-	-	-
		Drosselklappe 2 Sollwert	TPS_SP[2]		-	-	-	-	X	X	X
5827	27	Lambdasonden Heizung Vorkat 1	LSHPWM_UP[1]		X	X	X	X	X	X	X
5828	28	Lambdasonden Heizung Vorkat 2	LSHPWM_UP[2]		X	X	X	X	X	X	X
5829	29	Lambdasonden Heizung Hinterkat 1	LSHPWM_DOWN[1]		X	X	X	X	X	X	X

ID_long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
582A	2A	Lambdasonden Heizung Hinterkat 2	LSHPWM_DOWN[2]		X	X	X	X	X	X	X
582B	2B	Drehmomenteingriff über CAN	STATE_TQ_CAN_PLAUS		X	X	X	X	X	X	X
582C	2C	number of invalid INIT_REG_x write validation cycles	CTR_ERR_LSL_IF_S PI_WR[1]		X	X	X	X	X	X	X
582D	2D	number of invalid INIT_REG_x write validation cycles	CTR_ERR_LSL_IF_S PI_WR[2]		X	X	X	X	X	X	X
582E	2E	Adaptionsfaktor Sensor Zeitkonstante vor Kat Bank 1	FAC_DIAG_DYN_LSL_UP[1]		X	X	X	X	X	X	X
582F	2F	Adaptionsfaktor Sensor Zeitkonstante vor Kat Bank 2	FAC_DIAG_DYN_LSL_UP[2]		X	X	X	X	X	X	X
5830	30	Mean value of normalised single sensor signal amplitude	FAC_MV_DIAG_DYN_LSL_UP_KWP[1]	FAC_MV_DIAG_DYN_LSL_UP[1] converted for KWP	X	X	X	X	X	X	X
5831	31	Mean value of normalised single sensor signal amplitude	FAC_MV_DIAG_DYN_LSL_UP_KWP[2]	FAC_MV_DIAG_DYN_LSL_UP[2] converted for KWP	X	X	X	X	X	X	X
5832	32	Motor Status	STATE_ENG		X	X	X	X	X	X	X
5833	33	Umgebungstemperatur beim Start	TAM_ST		X	X	X	X	X	X	X
5834	34	Umgebungsdruck	AMP_MES		X	X	X	X			
			AMP_MES_KWP	AMP_MES converted for DGNC	-	-	-	-	X	X	X
5835	35	manufacturer identifier alternator	Gen_manufak		X	X	X	X	X	X	X
5836	36	Drehzahlgradient	N_GRD		X	X	X	X	X	X	X
5837	37	Status OBD-I Fehler vor Kat Bank 1	STATE_ERR_EL_LSL_UP[1]		X	X	X	X	X	X	X
5838	38	Status OBD-I Fehler vor Kat Bank 2	STATE_ERR_EL_LSL_UP[2]		X	X	X	X	X	X	X
5839	39	Status Drosselklappe Notlauf	STATE_N_LIM_ETC_REQ		X	X	X	X	X	X	X
583A	3A	Ansauglufttemperatur beim Start	TIA_ST		X	X	X	X	X	X	X
583B	3B	Kraftstofftank Füllstand	FTL		X	X	X	X	X	X	X
583C	3C	Spannung Kl. 87	VB		X	X	X	X	X	X	X
583D	3D	Reset type	RST_CLAS_TYP[0]		X	X	X	X	-	-	-
		Reset typ / RESET SAFE	STATE_RST_TYPE[0]		-	-	-	-	X	X	X
583E	3E	Motordrehzahl bei Reset	N_RST_DET_KWP	N_RST_DET[0] converted to KWP	X	X	X	X	X	X	X
583F	3F	Drosselklappe Sollwert	TPS_SP		X	X	X	X	-	-	-
		Drosselklappe	TPS_SP[1]		-	-	-	-	X	X	X

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ID_long	ID	Description	Label	Conversion		MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
		Sollwert										
5840	40	CPU Last bei Reset	CPU_LOAD_RST_DE T_KWP			X	X	X	X	X	X	X
5841	41	SG-Innentemperatur Rohwert	VP_TECU_KWP	VP_TECU converted for KWP		X	X	X	X	X	X	X
5842	42	type identifier alternator	Gen_typkenn			X	X	X	X	X	X	X
5843	43	Versorgung FWG 1	VCC_PVS_1_KWP	VCC_PVS_1 converted for KWP		X	X	X	X	X	X	X
5844	44	chip temperature alternator	TCHIP_KWP	Tchip converted for KWP		X	X	X	X	X	X	X
58-	-	Spannung Lambdasonde VorKat 1	VLS_UP_KWP[1]	VLS_UP[1] converted for KWP		X	X	X	X	X	X	X
5846	46	Spannung Pedalwertgeber 1	V_PVS_1_KWP	V_PVS_1 converted for KWP		X	X	X	X	X	X	X
5847	47	Spannung Pedalwertgeber 2	V_PVS_2_KWP	V_PVS_2 converted for KWP		X	X	X	X	X	X	X
5848	48	Spannung Lambdasonde VorKat 2	VLS_UP_KWP[2]	VLS_UP[2] converted for KWP		X	X	X	X	X	X	X
5849	49	Spannung Lambdasonde HinterKat 1	VLS_DOWN_KWP[1]	VLS_DOWN[1] converted for KWP		X	X	X	X	X	X	X
584A	4A	Spannung Kl. 15 Rohwert	V_IGK_BAS_KWP	V_IGK_BAS converted for KWP		X	X	X	X	X	X	X
584B	4B	Spannung Lambdasonde HinterKat 2	VLS_DOWN_KWP[2]	VLS_DOWN[2] converted for KWP		X	X	X	X	X	X	X
584C	4C	Spannung Drosselklappe Poti 2	V_TPS_2_KWP	V_TPS_2 converted for KWP		X	X	X	X	-	-	-
		DK-Adaptionsschritt Drosselklappe 2	TPS_AD_STEP_KWP[2]	TPS_AD_STEP[2] converted for KWP		-	-	-	-	X	X	X
584D	4D	korrigierter Sollwert Durchfluss Tankentlüftung	FLOW_COR_CPS			X	X	X	X	X	X	X
584E	4E	Spannung Drosselklappe Poti 1	V_TPS_1_KWP	V_TPS_1 converted for KWP		X	X	X	X	-	-	-
		Throttle flap opening angle with high resolution	TPS_AV_KWP[2]	TPS_AV[2] converted for KWP		-	-	-	-	X	X	X
584F	4F	Spannung Luftmasse	V_MAF			X	X	X	-	-	-	-
		Spannung Ansauglufttemperatur , Sensor 2	VP_TIA_KWP[2]	VP_TIA[2] converted for KWP		-	-	-	-	X	X	X
5850	50	Spannung Motortemperatur	VP_TCO_KWP	VP_TCO[0] converted for KWP		X	X	X	X	X	X	X
5851	51	Spannung Ansauglufttemperatur	VP_TIA_KWP	VP_TIA converted for KWP		X	X	X	X	-	-	-
		Spannung Ansauglufttemperatur , Sensor 1	VP_TIA_KWP[1]	VP_TIA[1] converted for KWP		-	-	-	-	X	X	X




ID_long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
5852	52	Kühlmitteltemperatur Kühlerausgang Rohwert	V_TCO_2_KWP	VP_TCO[1] converted for KWP	X	X	X	X	X	X	X
5853	53	Spannung Kl.87 Rohwert	VB_BAS_KWP	VB_BAS converted for KWP	X	X	X	X	X	X	X
5854	54	Versorgung FWG 2	VCC_PVS_2_KWP	VCC_PVS_2 converted for KWP	X	X	X	X	X	X	X
5855	55	Mittelwert Bank 1	FAC_LAM_MV_MMV[1]		X	X	X	X	X	X	X
5856	56	Mittelwert Bank 2	FAC_LAM_MV_MMV[2]		X	X	X	X	X	X	X
5857	57	exciting current alternator	Ierr		X	X	X	X	X	X	X
5858	58	Drosselklappe aktueller Wert	TPS_AV		X	X	X	X	-	-	-
		Throttle flap opening angle with high resolution, bank 1	TPS_AV_KWP[1]	TPS_AV[1] converted for KWP	-	-	-	-	X	X	X
5859	59	DMTL Strom Referenzleck	CUR_DMTL_REF_LEAK_KWP	CUR_DMTL_REF_LEAK converted for KWP	X	X	X	X	X	X	X
585A	5A	DMTL Strom Grobleck	CUR_DMTL_ROUGH_LEAK_MIN_KWP	CUR_DMTL_ROUGH_LEAK_MIN converted for KWP	X	X	X	X	X	X	X
585B	5B	DMTL Strom Diagnoseende	CUR_DMTL_COR_FIL_KWP	CUR_DMTL_COR_FIL converted for KWP	X	X	X	X	X	X	X
585C	5C	Widerstand Lambdasonde NK 1	R_IT_LS_DOWN_KWP_H[1]	HIGH BYTE (R_IT_LS_DOWN[1])	X	X	X	X	X	X	X
585D	5D	Widerstand Lambdasonde NK 2	R_IT_LS_DOWN_KWP_H[2]	HIGH BYTE (R_IT_LS_DOWN[2])	X	X	X	X	X	X	X
585E	5E	unteres Byte Widerstand Lambdasonde NK 1	R_IT_LS_DOWN_KWP_L[1]	LOW BYTE (R_IT_LS_DOWN[1])	X	X	X	X	X	X	X
585F	5F	unteres Byte Widerstand Lambdasonde NK 2	R_IT_LS_DOWN_KWP_L[2]	LOW BYTE (R_IT_LS_DOWN[2])	X	X	X	X	X	X	X
5860	60	Widerstand Lambdasonde VK 1	R_IT_LS_UP_KWP_H[1]	HIGH BYTE (R_IT_LS_UP[1])	X	X	X	X	X	X	X
5861	61	Widerstand Lambdasonde VK 2	R_IT_LS_UP_KWP_H[2]	HIGH BYTE (R_IT_LS_UP[2])	X	X	X	X	X	X	X
5862	62	Öldruck Sollwert	P_OEL_SOLL_KWP	P_oel_soll converted to KWP	X	X	X	X	-	-	-
5863	63	untere Byte Widerstand Lambdasonde VK 1	R_IT_LS_UP_KWP_L[1]	LOW BYTE (R_IT_LS_UP[1])	X	X	X	X	X	X	X
5864	64	untere Byte Widerstand Lambdasonde VK 2	R_IT_LS_UP_KWP_L[2]	LOW BYTE (R_IT_LS_UP[2])	X	X	X	X	X	X	X
5865	65	Oelstand Mittelwert Langzeit	Oz_nivlangt		X	X	X	X	X	X	X
5866	66	Füllstand Motoröl	Oz_lp		X	X	X	X	X	X	X
5867	67	Kilometerstand	CTR_KM_CAN_KWP	CTR_KM_CAN (high byte)	X	X	X	X	X	X	X
5868	68	Status Standverbraucher registriert Teil 1	Stat_sv_reg1		X	X	X	X	X	X	X
5869	69	Status	Stat_sv_reg2		X	X	X	X	X	X	X

ID_long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
		Standverbraucher registriert Teil 2									
586A	6A	Batteriespannung von IBS gemessen	U_batt		X	X	X	X	X	X	X
586B	6B	Zeit mit Ruhestrom 80 - 200 mA	T2histshort		X	X	X	X	X	X	X
586C	6C	Zeit mit Ruhestrom 200 - 1000 mA	T3histshort		X	X	X	X	X	X	X
586D	6D	Zähler Erkennung schlechte Strasse	SUM_RR		X	X	X	X	X	X	X
586E	6E	Zeit mit Ruhestrom >1000 mA	T4histshort		X	X	X	X	X	X	X
586F	6F	Ist-Öldruck	P_OEL_IST_KWP	P_oeI_ist converted to KWP	X	X	X	X	X	X	X
5870	70	Spannung DME Umgebungsdruck	V_AMP_KWP	V_AMP converted for KWP	X	X	X	X	X	X	X
5871	71	Lambda-Sollwert Gruppe 1	LAMB_SP_KWP[1]	LAMB_SP[1] converted for KWP	X	X	X	X	X	X	X
5872	72	controller version alternator	Bsdgenregv		X	X	X	X	X	X	X
5873	73	Lambda-Sollwert Gruppe 2	LAMB_SP_KWP[2]	LAMB_SP[2] converted for KWP	X	X	X	X	X	X	X
5874	74	Spannung Strommessung DMTL	V_DMTL_KWP	V_DMTL converted for KWP	X	X	X	X	X	X	X
5875	75	Sollwert Motormoment	TQI_SP_KWP	TQI_SP converted to TQI_SP_KWP	X	X	X	X	X	X	X
5876	76	OBD high range fuel pressure ( high byte )	OBD_FUP_RNG_H_H (high byte of OBD_FUP_RNG_H)	FUP_RNG_H_MES converted to OBD_FUP_RNG_H	X	X	X	X	X	X	X
5877	77	OBD high range fuel pressure ( low byte )	OBD_FUP_RNG_H_L (low byte of OBD_FUP_RNG_H)	FUP_RNG_H_MES converted to OBD_FUP_RNG_H	X	X	X	X	X	X	X
5878	78	Lambdaverschiebung Rückführregler 1	LAMB_DELTA_I_LAM_ADJ_KWP[1]	LAMB_DELTA_I_LAM_ADJ_[1] converted for KWP	X	X	X	X	X	X	X
5879	79	Lambdaverschiebung Rückführregler 2	LAMB_DELTA_I_LAM_ADJ_KWP[2]	LAMB_DELTA_I_LAM_ADJ_[2] converted for KWP	X	X	X	X	X	X	X
587A	7A	Status FGR	STATE_CRU		X	X	X	X	X	X	X
587B	7B	Abgleich AGR-Modell (Faktor)	Eisyagr_korfak_b		X	X	X	X	-	-	-
		Wasserpumpe Leistung, relativ CWP_2_2	REL_CWP_2_2_PWR		-	-	-	-	X	X	-
587C	7C	Status Motorsteuerung	ECU_STATE		X	X	X	X	X	X	X
587D	7D	Symptom bei Schubabschaltung Sonde vor Kat Bank1	STATE_SYM_DIAG_UC_LSL_UP[1]		X	X	X	X	X	X	X
587E	7E	Symptom bei Schubabschaltung	STATE_SYM_DIAG_UC_LSL_UP[2]		X	X	X	X	X	X	X

ID_long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
		Sonde vor Kat Bank2									
587F	7F	Tastverhaeltnis E-Lüfter	ECFPWM[0]		X	X	X	X	X	X	X
5880	80	Tastverhältnis: Luftklappe	ECRAPWM		X	X	X	X			
		Ansteuerung Luftklappe unten	LV_ECRAS_DOWN_1		-	-	-	-	X	X	X
5881	81	berechneter Gang	GEAR		X	X	X	X	X	X	X
5882	82	Motortemperatur beim Start	TCO_ST		X	X	X	X	X	X	X
5883	83	Spannung Klopfwerte Zylinder 1	NL[0]		X	X	X	X	X	X	X
5884	84	Actual value exciting current limitation alternator	Ierrfgrenz		X	X	X	X	X	X	X
5885	85	Spannung Klopfwerte Zylinder 3	NL[2]		X	X	X	X	X	X	X
5886	86	Spannung Klopfwerte Zylinder 6	NL[3]		X	X	X	X	X	X	X
5887	87	occupancy of alternator	Dfsiggen		X	X	X	X	X	X	X
5888	88	Spannung Klopfwerte Zylinder 4	NL[5]		X	X	X	X	X	X	X
5889	89	Lambda-Istwert Gruppe 1	LAMB_KWP[1]	LAMB_LS_UP[1] converted to KWP	X	X	X	X	X	X	X
588A	8A	Lambda-Istwert Gruppe 2	LAMB_KWP[2]	LAMB_LS_UP[2] converted to KWP	X	X	X	X	X	X	X
588B	8B	Zeit seit Startende	T_AST		X	X	X	X	X	X	X
588C	8C	Keramiktemperatur Lambdasonde VK 1	TTIP_MES_LS_UP[1]		X	X	X	X	X	X	X
588D	8D	aktuelle Zeit DMTL Leckmessung	T_ACT_LEAK_MES		X	X	X	X	X	X	X
588E	8E	Pumpenstrom bei DMTL Pumpenprüfung	CUR_DMTL_DMTLS_ TEST		X	X	X	X	X	X	X
588F	8F	Keramiktemperatur Lambdasonde VK 2	TTIP_MES_LS_UP[2]		X	X	X	X	X	X	X
5890	90	Spannung Bremsunterdrucksens or Wasserpumpe Elektronik Temperatur, CWP_2_2	V_PBSU_KWP  TEMP_EL_CWP_2_ 2	V_PBSU converted for KWP	X	X	X	X	-	-	-
5891	91	Momentanforderung an der Kupplung	TQ_REQ_CLU		X	X	X	X	X	X	X
5892	92	Bremsunterdruck	PBSU_KWP	For 4cyl:PBSU converted for KWP For 6cyl: stub with 0 hPa	X	X	X	X	-	-	-
		Wasserpumpe Stromaufnahme,	CUR_CNS_CWP_2_2		-	-	-	-	X	X	-


ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
		CWP_2_2									
5893	93	Drehmomentabfall schnell bei Gangwechsel	TQI_GS_FAST_DEC		X	X	X	X	X	X	X
5894	94	Symptom Lambdasondenheizung vor Kat Bank 1	STATE_SYM_OBD_LSL_LSH_UP[1]		X	X	X	X	X	X	X
5895	95	Symptom Lambdasondenheizung vor Kat Bank 2	STATE_SYM_OBD_LSL_LSH_UP[2]		X	X	X	X	X	X	X
5896	96	Abgastemperatur nach Kat Bank 1	TEG_CAT_DOWN_MDL[1]		X	X	X	X	X	X	X
5897	97	Abgastemperatur nach Kat Bank 2	TEG_CAT_DOWN_MDL[2]		X	X	X	X	X	X	X
5898	98	Generator Sollspannung	V_ALTER_SP_KWP	V_ALTER_SP converted for KWP	X	X	X	X	X	X	X
5899	99	DISA Position	VIM_AV		X	X	X	X	-	-	-
		Wasserpumpe Ist-Drehzahl, CWP_2_2	N_REL_CWP_2_2		-	-	-	-	X	X	-
589A	9A	Tastverhältnis Nullgangsensor	PWM_NEUT_PSN_GB_KWP	PWM_NEUT_PSN_GB converted for KWP	X	X	X	X	-	-	-
		Wasserpumpe Soll-Drehzahl CWP_2_1/2	N_REL_CWP_SP_2		-	-	-	-	X	X	-
589B	9B	Spannungsoffset Signalpfad CJ120 1	VLS_OFS_LSL_KWP[1]	VLS_OFS_LSL[1] converted for KWP	X	X	X	X	X	X	X
589C	9C	Spannungsoffset Signalpfad CJ120 2	VLS_OFS_LSL_KWP[2]	VLS_OFS_LSL[2] converted for KWP	X	X	X	X	X	X	X
589D	9D	Abweichung Lambdasonde zu Modellwert: Überwachung	LAMB_DIF_MON_KWP	LAMB_DIF_MON converted to LAMB_DIF_MON_KWP	X	X	X	X	X	X	X
589E	9E	NOx trap aging factor due to sulphur load	NTA_GI_SUL_KWP	NT_AGI_SUL converted for KWP	X	X	X	X	-	-	-
		State variable of the TPS diagnoses	STATE_TPS_DIAG[1]		-	-	-	-	X	X	X
589F	9F	Time with active catalyst heating for desulfation without active desulfation	T_CH_SO2P_ACT_KWP	T_CH_SO2P_ACT converted for KWP	X	X	X	X	-	-	-
		State variable of the TPS diagnoses	STATE_TPS_DIAG[2]		-	-	-	-	X	X	X
58A0	A0	Km - counter since last end of desulfation	DIST_SO2P_END_KWP	DIST_SO2P_END converted for KWP	X	X	X	X	-	-	-
		Duty cycle for ETC actuator control	PWM_ETC_KWP[0]	PWM_ETC[0] converted for KWP	-	-	-	-	X	X	X

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ID_long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
58A1	A1	NOx-Konzentration	NOX_NS_KWP	NOX_NS[1] converted for KWP	X	X	X	X	-	-	-
		Duty cycle for ETC actuator control	PWM_ETC_KWP[1]	PWM_ETC[1] converted for KWP	-	-	-	-	X	X	X
58A2	A2	Lineares Lambdasignal NOx-Sensor	LAMB_NOX_SENS_KWP	LAMB_NOX_SENS[1] converted for KWP	X	X	X	X	-	-	-
		required current of the electrical water pump	CUR_CNS_CWP		-	-	-	-	-	-	X
58A3	A3	binäres Spannungssignal NOx-Sensor	VLS_NOX_SENS_KWP	VLS_NOX_SENS[1] converted for KWÜ	X	X	X	X	-	-	-
		relative CWP power	REL_CWP_PWR		-	-	-	-	-	-	X
58A4	A4	Status NOx-Sensor	CAN_STATE_NOX_SENS_KWP[1]		X	X	X	X	-	-	-
		Status Generator	St_gen		-	-	-	-	X	X	X
58A5	A5	NOx trap sulphur loading	NT_SUL_KWP	NT_SUL converted for KWP	X	X	X	X	-	-	-
		calculated DF-signal from alternator	Dffgen		-	-	-	-	X	X	X
58A6	A6	NOx trap aging factor	NT_AGI_KWP	NT_AGI converted for KWP	X	X	X	X	-	-	-
			U_gen_kwp	U_gen converted with limitation for DGNC	-	-	-	-	X	X	X
58A7	A7	Mean value of lambda in multiple-branched exhaust gas lines	LAMB_LS_UP_MV_KWP	LAMB_LS_UP_MV converted for KWP	X	X	X	X	-	-	-
		Engine off duration time (resolution min)	Tn_abstellm_kwp	Tn_abstellm converted with limitation for DGNC	-	-	-	-	X	X	X
58A8	A8	Motorabstellzeit	T_ES_KWP	T_ES converted for KWP	X	X	X	X	X	X	X
58A9	A9	Resetzähler Überwachungsrechner: alter Wert	ENVD_3_MON_3		X	X	X	X	X	X	X
58AA	AA	Resetzähler Hauptrechner: alter Wert	ENVD_2_MON_3		X	X	X	X	X	X	X
58AB	AB	Engine speed	N_32		-	-	-	-	X	X	X
		Abweichung gemessener DK-Poti1 und modellierter DK-Poti	TPS_DIF_DIAG_COR_1_KWP	TPS_DIF_DIAG_COR_1 converted for KWP	X	X	X	X	-	-	-
58AC	AC	Batterietemperatur	T_batt_kwp	T_batt converted and limited for DGNC	-	-	-	-	X	X	X
		Abweichung gemessener DK-Poti2 und modellierter DK-Poti	TPS_DIF_DIAG_COR_2_KWP	TPS_DIF_DIAG_COR_2 converted for KWP	X	X	X	X	-	-	-

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ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
58AD	AD	Pedalwertgeber 1	PV_AV_1		X	X	X	X	X	X	X
58AE	AE	Periodendauer Luftmasse	T_PER_MAF_FRQ_K WP	T_PER_MAF_FRQ_AV[0] converted for KWP	X	X	X	X	-	-	-
		Periodendauer Luftmasse	T_PER_MAF_FRQ_K WP	T_PER_MAF_FRQ_AV[0]	-	-	-	-	X	X	X
58AF	AF	Kraftstoff Anforderung an Pumpe	VFF_EFP		X	X	X	X	X	X	X
58B0	B0	DK-Adaptionsschritt	TPS_AD_STEP_KWP	TPS_AD_STEP converted for KWP	X	X	X	X	-	-	-
		DK-Adaptionsschritt, Drosselklappe 1	TPS_AD_STEP_KWP[ 1]	TPS_AD_STEP[1] converted for KWP	-	-	-	-	X	X	X
58B1	B1	Funkenbrenndauer logical Zylinder 1	V_DUR_IGC_KWP[0]	V_DUR_IGC[0] converted for KWP	X	X	X	X	X	X	X
58B2	B2	Funkenbrenndauer logical Zylinder 2	V_DUR_IGC_KWP[1]	V_DUR_IGC[1] converted for KWP	X	X	X	X	X	X	X
58B3	B3	Funkenbrenndauer logical Zylinder 3	V_DUR_IGC_KWP[2]	V_DUR_IGC[2] converted for KWP	X	X	X	X	X	X	X
58B4	B4	Funkenbrenndauer logical Zylinder 4	V_DUR_IGC_KWP[3]	V_DUR_IGC[3] converted for KWP	X	X	X	X	X	X	X
58B5	B5	Funkenbrenndauer logical Zylinder 5	V_DUR_IGC_KWP[4]	V_DUR_IGC[4] converted for KWP	-	-	X	X	X	X	X
58B6	B6	Funkenbrenndauer logical Zylinder 6	V_DUR_IGC_KWP[5]	V_DUR_IGC[5] converted for KWP	-	-	X	X	X	X	X
58B7	B7	Bremsdruck	BRAKE_PRS		X	X	X	X	X	X	X
58B8	B8	Drehzahl Überwachung	N_32_MON		X	X	X	X	X	X	X
58B9	B9	Pedalwert Überwachung	PV_AV_MON		X	X	X	X	X	X	X
58BA	BA	Volume fuel flow through the injectors	VFF_MFF_SP_FUP_C TL_KWP	VFF_MFF_SP_FUP_CTL (high byte)	X	X	X	X	X	X	X
58BB	BB	Pump speed of the electrical fuel pump as PWM signal	EFPPWM_KWP	EFPPWM converted for KWP	X	X	X	X	X	X	X
58BC	BC	Luftmasse Überwachung	MAF_MON		X	X	X	X	X	X	X
58BD	BD	Zähler für Eisdetection in der Drosselklappe (high byte)	CTR_TPS_JAM_DET_ ACT_KWP_H	CTR_TPS_JAM_DET_ACT (high byte)	X	X	X	X	-	-	-
		Funkenbrenndauer logical Zylinder 7	V_DUR_IGC_KWP[6]	V_DUR_IGC[6] converted for KWP	-	-	-	-	X	X	X
58BE	BE	Funkenbrenndauer logical Zylinder 8	V_DUR_IGC_KWP[7]	V_DUR_IGC[7] converted for KWP	-	-	-	-	X	X	X

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ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
		Zähler für Eisdetection in der Drosselklappe (low byte)	CTR_TPS_JAM_DET_ ACT_KWP_L	CTR_TPS_JAM_DET_ACT (low byte)	X	X	X	X	-	-	-
58BF	BF	relative Momentenforderung von MSR über CAN	TQI_MSR_CAN		X	X	X	X	X	X	X
58C0	C0	Motordrehzahl Eratzwert Überwachung	N_32_SUB_MON		X	X	X	X	X	X	X
58C1	C1	Lafunruhe Segmentzeit	SEG_T_MES (high Byte)		X	X	X	X	-	-	-
			SEG_T_MES_KWP_H	SEG_T_MES converted to SEG_T_MES_KWP, high byte	-	-	-	-	X	X	X
58C2	C2	Statusbyte MFF- Monitoring	STATE_LV_ERR_MFF_ MON_1		X	X	X	X	X	X	X
58C3	C3	Statusbyte ISC- Monitoring	STATE_LV_ERR_TQ_ DIF_ISC_MON_1		X	X	X	X	X	X	X
58C4	C4	Statusbyte CRU- Monitoring	STATE_LV_ERR_CR U_INH_MON_1		X	X	X	X	X	X	X
58C5	C5	Drehzahl Überwachung (resetsicher)	N_32_MON_SAVE		X	X	X	X	X	X	X
58C6	C6	Status Einspritzventile (resetsicher)	PREV_STATE_IV_SA VE		X	X	X	X	X	X	X
58C7	C7	LL- Soll Drehzahlabweichu ng Überwachung	N_DIF_SP_IS_MON		X	X	X	X	X	X	X
58C8	C8	I-Anteil Momentdifferenz Überwachung und Modell	TQ_DIF_I_IS_MON		X	X	X	X	X	X	X
58C9	C9	I-Anteil LL passive Rampe aktiv	LV_PAS_RAMP_ACT _I_IS		X	X	X	X	X	X	X
58CA	CA	PD-Anteil langsam Leerlaufregelung	TQ_DIF_P_D_SLOW_ IS		X	X	X	X	X	X	X
58CB	CB	PD-Anteil schnell Leerlaufregelung	TQ_DIF_P_D_FAST_ IS		X	X	X	X	X	X	X
58CC	CC	Verlustmoment Überwachung	TQ_LOSS_MON		X	X	X	X	X	X	X
58CD	CD	Entladung während Ruhestromverletz ung	Q_iruhe2_kwp	Q_iruhe2 converted and limited for DGNC	-	-	-	-	X	X	X
58CE	CE	Carrierbyte Schalterstati	STATE_BYTE_SWI_K WP	0x01 LV_IM_BLS 0x02 LV_IM_BTS 0x10 LV_SOF_SWI_REQ 0x80 LV_PAS_RAMP_ACT_I_IS	X	X	X	X	X	X	X
58CF	CF	Motormoment Sollwert	TQI_SP_MON		X	X	X	X	-	-	-

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Released by <b>Tettenborn Frank</b>		Date <b>2013-02-13</b>	File <b>17100101.0AV</b>
	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 7335 of 8404</b>	
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ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
		Überwachung									
58CF	CF	Motormoment Sollwert Überwachung	TQI_SP_H_RNG_MO N_KWP	TQI_SP_H_RNG_MON converted for KWP	-	-	-	-	X	X	X
58D0	D0	Motormoment Istwert Überwachung	TQI_AV_MON		X	X	X	X	-	-	-
58D0	D0	Motormoment Istwert Überwachung	TQI_AV_H_RNG_MO N_KWP	TQI_AV_H_RNG_MON converted for KWP	-	-	-	-	X	X	X
58D1	D1	Moment aktueller Wert	TQI_AV		X	X	X	X	X	X	X
58D2	D2	Status Luftklappensystem High Byte	STATE_ECRAS_SYS _KWP_H	high byte of STATE_ECRAS_SYS	X	X	X	X	X	X	X
58D3	D3	Status Luftklappensystem Low Byte	STATE_ECRAS_SYS _KWP_L	low byte of STATE_ECRAS_SYS	X	X	X	X	X	X	X
58D4	D4	Abweichung maximales Moment an Kupplung Überwachung	TQ_MAX_CLU_DIF_M ON		X	X	X	X	X	-	X
		maximum torque	TQ_AX_MAX_KWP	TQ_AX_MAX converted for DGNC	-	-	-	-	-	X	-
58D5	D5	Air temperature up turbo charger	TIA_TCHA_KWP	TIA_TCHA converted for KWP	X	X	X	X	-	-	-
58D6	D6	Abweichung minimales Moment an Kupplung Überwachung	TQ_MIN_CLU_DIF_M ON		X	X	X	X	X	-	X
		minimum torque	TQ_AX_MIN_KWP	TQ_AX_MIN converted for DGNC	-	-	-	-	-	X	-
58D7	D7	Voltage for temperatur sensor up turbocharger	VP_TIA_TCHA_KWP	VP_TIA_TCHA converted for KWP	X	X	X	X	-	-	-
		Pressure upstream the throttle (Turbo)	PUT_KWP[2]	PUT_MES_BAS[2] converted for KWP	-	-	-	-	X	X	X
58D8	D8	Catalyst temperature sensor raw acquisition	VP_TEG_PCAT_DOW N_KWP	VP_TEG_PCAT_DOWN converted for KWP	X	X	X	X	-	-	-
		Voltage of the intake manifold pressure sensor up throttle (for diagnosis)	V_PUT_KWP[2]	V_PUT[2] converted for KWP	-	-	-	-	X	X	X
58D9	D9	Fehlercode Rechnerüberwachung : aktueller Wert	ENVD_0_MON_3		X	X	X	X	X	X	X
58DA	DA	Resetzähler Rechnerüberwachung : aktueller Wert	ENVD_1_MON_3		X	X	X	X	X	X	X




ID_long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
58DB	DB	Inhalt Statusbyte1 Drehzahlüberwachung (resetsicher)	STATE_TQI_N_MAX_MON_1_1_SAVE		X	X	X	X	X	X	X
58DC	DC	Inhalt Statusbyte2 Drehzahlüberwachung (resetsicher)	STATE_TQI_N_MAX_MON_1_2_SAVE		X	X	X	X	X	X	X
58DD	DD	Pressure upstream the throttle (Turbo)	PUT_KWP	PUT converted for KWP	X	X	X	X	-	-	-
		Pressure upstream the throttle (Turbo)	PUT_KWP[1]	PUT_MES_BAS[1] converted for KWP	-	-	-	-	X	X	X
58DE	DE	Voltage of the intake manifold pressure sensor up throttle (for diagnosis)	V_PUT_KWP	V_PUT converted for KWP	X	X	X	X	-	-	-
		Voltage of the intake manifold pressure sensor up throttle (for diagnosis)	V_PUT_KWP[1]	V_PUT[1] converted for KWP	-	-	-	-	X	X	X
58DF	DF	Spannung Sportschalter	V_SOF_SWI_KWP	V_SOF_SWI converted for KWP	X	X	X	X	-	-	-
		Wasserpumpe Leistung, relativ CWP_2_1	REL_CWP_2_1_PWR		-	-	-	-	X	X	-
58E0	E0	Abgleich Drosselklappenmodell (Faktor)	Eisydk_korfak_b		X	X	X	X	X	X	X
58E1	E1	Abgleich Drosselklappenmodell (Offset)	Eisydk_koroff_b		-	-	X	X	X	X	X
		Status Nullgangerkennung	St_ngang		X	X	-	-	-	-	-
58E2	E2	Abgleich Einlassventilmodell (Faktor)	Eisyev_korfak_b		X	X	X	X	X	X	X
58E3	E3	NOx signal shift diagnosis value	RATIO_NS_SHIFT_DIAG_KWP[1]	RATIO_NS_SHIFT_DIAG[1] converted for KWP	X	X	X	X	-	-	-
		Abgleich Einlassventilmodell (Offset)	Eisyev_koroff_b		-	-	-	-	X	X	X
58E4	E4	Betriebsart Istwert	Ba_ist		X	X	X	X	X	X	X
58E5	E5	Lastwert für Aussetzererkennung	LOAD_MIS_KWP	LOAD_MIS converted for KWP	X	X	X	X	X	X	X
58E6	E6	Nulllastwert für Aussetzererkennung	LOAD_MIN_MIS_KWP	LOAD_MIN_MIS converted for KWP	X	X	X	X	X	X	X
58E7	E7	Spannung Pedalwertgeber 1: Überwachung	V_PVS_1_MON_KWP	V_PVS_1_MON converted to V_PVS_1_MON_KWP	X	X	X	X	X	X	X
58E8	E8	Spannung Pedalwertgeber 2: Überwachung	V_PVS_2_MON_KWP	V_PVS_2_MON converted to V_PVS_2_MON_KWP	X	X	X	X	X	X	X
58E9	E9	Wasserpumpe Spannung	V_CWP		X	X	X	X	-	-	X

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7337 of 8404	
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ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
		Wasserpumpe Spannung; CWP_2_1	V_CWP_2_1		-	-	-	-	X	X	-
58EA	EA	Wasserpumpe Drehzahl	N_REL_CWP		X	X	X	X	-	-	X
		Wasserpumpe Ist- Drehzahl, CWP_2_1	N_REL_CWP_2_1		-	-	-	-	X	X	-
58EB	EB	Wasserpumpe Drehzahl Soll-Ist- Differenz	N_REL_CWP_DIF		X	X	X	X	-	-	X
		Wasserpumpe Drehzahl Soll-Ist- Differenz, CWP_2_1	N_REL_CWP_2_1_DIF		-	-	-	-	X	X	-
58EC	EC	Wasserpumpe Temperatur Elektronik	TEMP_EL_CWP		X	X	X	X	-	-	X
		Wasserpumpe Elektronik Temperatur, CWP_2_1	TEMP_EL_CWP_2_1		-	-	-	-	X	X	-
58ED	ED	Wasserpumpe Stromaufnahme	CUR_CNS_CWP		X	X	X	X	-	-	-
		gemittelter Raildruck Bank 1	V_FUP_MV_0_KWP	V_FUP_MV[0] converted for KWP	-	-	-	-	X	X	X
58EE	EE	Wasserpumpe leistungsreduziert	REL_CWP_PWR		X	X	X	X	-	-	-
		gemittelter Raildruck Bank 2	V_FUP_MV_1_KWP	V_FUP_MV[1] converted for KWP	-	-	-	-	X	X	X
58EF	EF	Mean value of the acquired sensor voltage	V_FUP_MV_KWP	V_FUP_MV converted for KWP	X	X	X	X	-	-	-
		gemittelter Raildruck Bank 2	FUP_KWP[1]	FUP_MPL[1] converted for KWP	-	-	-	-	X	X	X
58F0	F0	Fuel pressure	FUP_KWP	FUP (high byte)	X	X	X	X	-	-	-
		gemittelter Raildruck Bank 1	FUP_KWP[0]	FUP_MPL[0] converted for KWP	-	-	-	-	X	X	X
58F1	F1	DME - Losnummer	STATE_LRN_ECU_KWP	STATE_LRN_ECU (high byte)	X	X	X	X	X	X	X
58F2	F2	PWM signal for the VCV	PWM_VCV_KWP	PWM_VCV (high byte)	X	X	X	X	-	-	-
		Wasserpumpe Drehzahl Soll-Ist- Differenz, CWP_2_2	N_REL_CWP_2_2_DIF		-	-	-	-	X	X	-
58F3	F3	Fuel pressure EFP	FUP_EFP_KWP	FUP_EFP converted for KWP	X	X	X	X	X	X	X
58F4	F4	mean value of low fuel pressure EFP sensor	V_FUP_EFP_MV_KWP	V_FUP_EFP_MV converted for KWP	X	X	X	X	X	X	X
58F5	F5	Eingangssignal Rückführregler 1	VLS_DIF_LAM_ADJ_KWP[1]	VLS_DIF_LAM_ADJ[1] converted for KWP	X	X	X	X	X	X	X
58F6	F6	Eingangssignal Rückführregler 2	VLS_DIF_LAM_ADJ_KWP[2]	VLS_DIF_LAM_ADJ[2] converted for KWP	X	X	X	X	X	X	X

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 7338 of 8404</b>	
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ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
58F7	F7	Measured opening of the actuator valve	OPG_ACR_KWP	OPG_ACR converted for KWP	X	X	X	X	-	-	-
		Laufunruhe Segmentzeit	SEG_T_MES_KWP_L	SEG_T_MES converted to SEG_T_MES_KWP, low byte	-	-	-	-	X	X	X
58F8	F8	Segmentadaption Laufunruhe Zyl. 5	SEG_AD_MMV_ER[1]		X	X	X	X	X	X	X
58F9	F9	Segmentadaption Laufunruhe Zyl. 3	SEG_AD_MMV_ER[2]		X	X	X	X	X	X	X
58FA	FA	canister load fc cps	CL_MMV_SAE		X	X	X	X	X	X	X
58FB	FB	counter of N-events fc cps (step 2)	SUM_DIAG_DIAGCPS_SAE		X	X	X	X	X	X	X
58FC	FC	Setpoint request after limitation for actuator position control	OPG_SP_ACR_KWP	OPG_SP_ACR converted for KWP	X	X	X	X	-	-	-
		Warm up functions active	LV_WUP		-	-	-	-	X	X	X
58FD	FD	Finally duty cycle of digital actuator control	PWM_ACR_KWP	PWM_ACR converted for KWP	X	X	X	X	-	-	-
58FE	FE	Zähler für Umschaltungen nach HOM durch Monitoring	CTR_SWI_AFS_MON		X	X	X	X	-	-	-
58FF	FF	-	-	-	-	-	-	-	-	-	-


### I.5.6.2 Further DDLI- Lists (not for ERM)

ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
<b>200</b>	<b>Luft / Air</b>			-	-	-	-	-	-	-
4200	00	TIA	Ansauglufttemperatur 1	X	X	X	X	X	X	X
4201	01	AMP_MES	Umgebungsdruck	X	X	X	X	X	X	X
4202	02	MAP_MES	Saugrohrdruck	X	X	X	X	X	X	X
4203	03	MAF_KGH_MES	Massenstrom vom HFM	X	X	X	X	-	-	-
4204	04	TAM	Umgebungstemperatur	X	X	X	X	X	X	X
4205	05	MAP_DIP_MES_BAS	Saugrohrdruck1 / Ladedruck1	X	X	X	X	-	-	-
4206	06	MAF_KGH_MES_BAS[1]	Saugrohrdruck 1 / Ladedruck 1	-	-	-	-	X	X	X
4207	07	MAF_KGH_MES_BAS[2]	Saugrohrdruck 2 / Ladedruck 2	-	-	-	-	X	X	X
4208	08	MAF_KGH_MES[1]	Massenstrom vom HFM Bank 1	-	-	-	-	X	X	X
4209	09	MAF_KGH_MES[2]	Massenstrom vom HFM Bank 2	-	-	-	-	X	X	X
				-	-	-	-	-	-	-
<b>300</b>	<b>Wasser / Water</b>			-	-	-	-	-	-	-
4300	00	TCO	Kühlwassertemperatur	X	X	X	X	X	X	X
4301	01	TCO_2	Kuehlerauslassttemperatur	X	X	X	X	X	X	X
4302	02	REL_CWP_PWR	Wasserpumpe Leistung ueber BSD (Bit Serielle Datenschnittstelle)	X	X	X	X	-	-	X
4303	03	TEMP_EL_CWP	Wasserpumpe Elektronik Temperatur	X	X	X	X	-	-	X
4304	04	CUR_CNS_CWP	Wasserpumpe Strom	X	X	X	X	-	-	X
4305	05	N_REL_CWP	Wasserpumpe Drehzahl Ist	X	X	X	X	-	-	X
4306	06	N_REL_CWP_SP	Wasserpumpe Drehzahl Soll	X	X	X	X	-	-	X
4307	07	Ba_wm_ist	Betriebsart Wasserpumpe	X	X	X	X	X	X	X
4308	08			-	-	-	-	-	-	-
4309	09			-	-	-	-	-	-	-
430A	0A			-	-	-	-	-	-	-
430B	0B			-	-	-	-	-	-	-
430C	0C			-	-	-	-	-	-	-
430D	0D			-	-	-	-	-	-	-
430E	0E			-	-	-	-	-	-	-
430F	0F			-	-	-	-	-	-	-
4310	10	REL_CWP_2_1_PWR	Wasserpumpe Leistung, relativ CWP_2_1	-	-	-	-	X	X	-
4311	11	REL_CWP_2_2_PWR	Wasserpumpe Leistung, relativ CWP_2_2	-	-	-	-	X	X	-
4312	12	TEMP_EL_CWP_2_1	Wasserpumpe Elektronik Temperatur, CWP_2_1	-	-	-	-	X	X	-
4313	13	TEMP_EL_CWP_2_2	Wasserpumpe Elektronik Temperatur, CWP_2_2	-	-	-	-	X	X	-
4314	14	CUR_CNS_CWP_2_1	Wasserpumpe Stromaufnahme, CWP_2_1	-	-	-	-	X	X	-
4315	15	CUR_CNS_CWP_2_2	Wasserpumpe Stromaufnahme, CWP_2_2	-	-	-	-	X	X	-
4316	16	N_REL_CWP_2_1	Wasserpumpe Ist-Drehzahl, CWP_2_1	-	-	-	-	X	X	-

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
4317	17	N_REL_CWP_2_2	Wasserpumpe Ist-Drehzahl, CWP_2_2	-	-	-	-	X	X	-
4318	18	N_REL_CWP_SP_2	Wasserpumpe Soll-Drehzahl, CWP_2_1	-	-	-	-	X	X	-
4319	19	N_REL_CWP_SP_2	Wasserpumpe Soll-Drehzahl, CWP_2_2	-	-	-	-	X	X	-
431A	1A	V_CWP_2_1	Wasserpumpe Spannung; CWP_2_1	-	-	-	-	X	X	-
431B	1B	V_CWP_2_2	Wasserpumpe Spannung; CWP_2_2	-	-	-	-	X	X	-
431C	1C	N_REL_CWP_2_1_DIF	Wasserpumpe Drehzahl Soll-Ist-Differenz, CWP_2_1	-	-	-	-	X	X	-
431D	1D	N_REL_CWP_2_2_DIF	Wasserpumpe Drehzahl Soll-Ist-Differenz, CWP_2_2	-	-	-	-	X	X	-
				-	-	-	-	-	-	-
<b>400</b>		<b>Öl / Oil</b>		-	-	-	-	-	-	-
4400	00	Oz_nivlangt	Ölstand Mittelwert Langzeit	X	X	X	X	X	X	X
4401	01	Oz_lp	Füllstand Motoröl	X	X	X	X	X	X	X
4402	02	Toel	Öltemperatur	X	X	X	X	X	X	X
4403	03	Oz_kvbsm_ul	Kraftstoff-Verbrauch seit letztem Service	X	X	X	X	X	X	X
4404	04	Oz_oeikm	km seit letztem Service	X	X	X	X	X	X	X
4405	05	Oz_nivr	Oelsensor Niveau Rohwert	X	X	X	X	X	X	X
4406	06	Oz_permr	Oelsensor Qualität Rohwert	X	X	X	X	X	X	X
4407	07	Oz_tempr	Oelsensor Temperatur Rohwert	X	X	X	X	X	X	X
4408	08	Oz_tempakt	Oelsensor Temperatur	X	X	X	X	X	X	X
4409	09	Oz_nivakt	Oelsensor Niveau	X	X	X	X	X	X	X
440A	0A	Oz_permakt	Oelsensor Qualität	X	X	X	X	X	X	X
440B	0B	Oz_lf1c	Länderfaktor 1 codiert	X	X	X	X	X	X	X
440C	0C	Oz_lf2c	Länderfaktor 2 codiert	X	X	X	X	X	X	X
440D	0D	Oz_lf1t	Länderfaktor 1	X	X	X	X	X	X	X
440E	0E	Oz_lf2t	Länderfaktor 2	X	X	X	X	X	X	X
440F	0F	Oz_nivkrzt	Kurzmittelwert-Niveau für den Tester	X	X	X	X	X	X	X
4410	10	Oz_rwperm	Restweg aus Permittivität abgeleitet	X	X	X	X	X	X	X
4411	11	Oz_rwkvb	Restweg aus Kraftstoffverbrauch abgeleitet	X	X	X	X	X	X	X
4412	12	Oz_oeizeit	Oel-Alter in Monate	X	X	X	X	X	X	X
4413	13	Oz_permlow	aufbereitete Permittivität bei letztem Ölwechsel	X	X	X	X	X	X	X
4414	14	Oz_permex	Permittivität für Bewertung aufbereitet (extrapoliert)	X	X	X	X	X	X	X
4415	15	Oz_permoff	Offset für Permittivitätskorrektur	X	X	X	X	X	X	X
4416	16	Oz_kvbog	zugeteilte Bonuskraftstoffmenge	X	X	X	X	X	X	X
4417	17	Oz_permbog	zugeteilter Permittivitätsbonus	X	X	X	X	X	X	X
4418	18	Oz_iv	Status Peilstabanzeige	X	X	X	X	X	X	X
4419	19	-	-	-	-	-	-	-	-	-
441A	1A	-	-	-	-	-	-	-	-	-
441B	1B	-	-	-	-	-	-	-	-	-


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Released by <b>Tettenborn Frank</b>		Date <b>2013-02-13</b>	File <b>17100101.0AV</b>
	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 7341 of 8404</b>	
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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
441C	1C			-	-	-	-	-	-	-
441D	1D			-	-	-	-	-	-	-
441E	1E	Oz_krзор	Kurzzeitmittelwert	-	-	-	-	X	X	X
441F	1F	Oz_vormw	Vormittelwert	-	-	-	-	X	X	X
4420	20			-	-	-	-	-	-	-
4421	21	Oz_oricnt	Orientierungswert Counter	-	-	-	-	X	X	X
4422	22	Oz_vormwcnt	Vormittelwert Counter	-	-	-	-	X	X	X
4423	23	Oz_krzcnt	Kurzzeitmittelwert Counter	-	-	-	-	X	X	X
4424	24	Oz_lgmwcnt	Langzeitmittelwert Counter	-	-	-	-	X	X	X
4425	25			-	-	-	-	-	-	-
<b>500</b>		<b>MotorBauteile intern / Engine parts intern</b>		-	-	-	-	-	-	-
-00	00			-	-	-	-	-	-	-
-01	01			-	-	-	-	-	-	-
-02	02			-	-	-	-	-	-	-
-03	03			-	-	-	-	-	-	-
-04	04			-	-	-	-	-	-	-
-05	05	CAM_SP_IVVT_IN	Sollwert Einlassspreizung	X	X	X	X	-	-	-
-06	06	PSN_CAM_IN[1]	Nockenwellenposition Einlass	X	X	X	X	X	X	X
-07	07	PSN_CAM_EX[1]	Nockenwellenposition Auslass	X	X	X	X	X	X	X
-08	08	CAM_IN[1]	Istwert Einlassspreizung	X	X	X	X	-	-	-
-09	09	CAM_EX[1]	Istwert Auslassspreizung	X	X	X	X	X	X	X
-0A	0A	CAM_SP_REF_EX	Normspreizung Auslass	X	X	X	X	-	-	-
-0B	0B	CAM_SP_REF_IN	Normspreizung Einlass	X	X	X	X	-	-	-
-0C		IVVTPWM_IN[0]	VANOS PWM Wert Einlass Bank 1	-	-	-	-	X	X	X
-0D		IVVTPWM_IN[1]	VANOS PWM Wert Einlass Bank 2	-	-	-	-	X	X	X
-0E		IVVTPWM_EX[0]	VANOS PWM Wert Auslass Bank 1	-	-	-	-	X	X	X
-0F		IVVTPWM_EX[1]	VANOS PWM Wert Auslass Bank 2	-	-	-	-	X	X	X
-10		CAM_IN_H[1]	Istwert Einlassspreizung Bank 1	-	-	-	-	X	X	X
-11		CAM_IN_H[2]	Istwert Einlassspreizung Bank 2	-	-	-	-	X	X	X
-12		CAM_EX[2]	Istwert Auslassspreizung Bank 2	-	-	-	-	X	X	X
-13		CAM_SP_IVVT_IN	Sollwert Einlassspreizung Bank 1	-	-	-	-	X	X	X
-14		CAM_SP_IVVT_IN	Sollwert Einlassspreizung Bank 2	-	-	-	-	X	X	X
-15		CAM_SP_IVVT_EX	Sollwert Auslassspreizung Bank 1	-	-	-	-	X	X	X
-16		CAM_SP_IVVT_EX	Sollwert Auslassspreizung Bank 2	-	-	-	-	X	X	X
-17		CAM_SP_REF_IN	Normspreizung Einlass Bank 1	-	-	-	-	X	X	X
-18		CAM_SP_REF_IN	Normspreizung Einlass Bank 2	-	-	-	-	X	X	X
-19		CAM_SP_REF_EX	Normspreizung Auslass Bank 1	-	-	-	-	X	X	X
-1A		CAM_SP_REF_EX	Normspreizung auslass Bank 2	-	-	-	-	X	X	X
-1B		PSN_CAM_IN[2]	Nockenwellenposition Einlass Bank 2	-	-	-	-	X	X	X
-1C		PSN_CAM_EX[2]	Nockenwellenposition Auslass Bank 2	-	-	-	-	X	X	X
-1D		PSN_AD_CAM_EX[2]	Adaptionswert Nockenwelle Auslass Bank 2	-	-	-	-	X	X	X

ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
-1E		PSN_AD_CAM_IN[2]	Adaptionswert Nockenwelle Einlass Bank 2	-	-	-	-	X	X	X
				-	-	-	-	-	-	-
<b>600</b>	<b>MotorBauteile extern / Engine parts extern</b>			-	-	-	-	-	-	-
4600	00	TPS_AV	aktueller Drosselklappenwinkel	X	X	X	X	-	-	-
4601	01	TPS_SP_MDL	Drosselklappe Sollwert	X	X	X	X	-	-	-
4602	02	V_ALTER_SP	Generator Sollspannung BSD (Bit Serielle Datenschnittstelle)	X	X	X	X	X	X	X
4603	03	Tchip	Chiptemperatur Generator1	X	X	X	X	X	X	X
4604	04	I_gen	Generator Strom	X	X	X	X	X	X	X
4605	05	Bsdgencv	Chipversion Generator1	X	X	X	X	X	X	X
4606	06	Bsdgenregv	Reglerversion Generator1	X	X	X	X	X	X	X
4607	07	Gen_manufak	Herstellercode Generator1	X	X	X	X	X	X	X
4608	08	Gen_typkenn	Kennung Generatortyp Generator1	X	X	X	X	X	X	X
4609	09	VB	KI.87 Spannung / Versorgung DME (Digitale Motor Elektronik)	X	X	X	X	X	X	X
460A	0A	Ubt	Batteriespannung aktuell	X	X	X	X	X	X	X
460B	0B	U_batt	Batteriespannung von IBS gemessen	X	X	X	X	X	X	X
460C	0C	VB_BAS	Batteriespannung vom AD-Wandler DME	X	X	X	X	X	X	X
460D	0D	Absch_korr	Korrekturwert Abschaltung	X	X	X	X	X	X	X
460E	0E	D_soc	Abstand zur Startfähigkeitsgrenze	X	X	X	X	X	X	X
460F	0F	LOAD_BAT	Batterielast	X	X	X	X	X	X	X
4610	10	VIM_AV	aktuelle Position Disaklappen	X	X	X	X	-	-	-
4611	11	N_PERC_ECF	Sollwert E-Lüfter als PWM Wert	X	X	X	X	X	X	X
4612	12	Ierr	Erregerstrom Generator1	X	X	X	X	X	X	X
4613	13	U_fgen	Kopierter Wert von zum Generator gesendete Sollspannung Generator 1	X	X	X	X	X	X	X
4614	14	Dfsiggen	Auslastungsgrad Generator 1	X	X	X	X	X	X	X
4615	15	Ierrfgrenz	Kopie begrenzter Erregerstrom Generator 1	X	X	X	X	X	X	X
4616	16	TIrfgen	Kopier Generator1 LR Vorgabe auf Bus gelegt	X	X	X	X	X	X	X
4617	17	Md_gennm_na	gefiltertes Generatormoment absolut Ausgang	X	X	X	X	X	X	X
4618	18	B_Irffoff	Kopie Drehzahlschwelle für LR-Funktion Generator 1 aktiv	X	X	X	X	X	X	X
4619	19	B_bsdprot2	condition for BSD protocol controller type 2	X	X	X	X	X	X	X
461A	1A	Uregnom	nominal voltage alternator	X	X	X	X	X	X	X
				-	-	-	-	-	-	-
<b>700</b>	<b>Lambda</b>			-	-	-	-	-	-	-
4700	00	LV_IPLSL_VLD[1]	WRAF sensor pump current is valid Bank1	X	X	X	X	X	X	X
4701	01	LV_IPLSL_VLD[2]	WRAF sensor pump current is valid Bank2	X	X	X	X	X	X	X

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 7343 of 8404</b>	
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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
4702	02	VLS_UP_COR[1]	Spannung Lambdasonde Vorkat Bank 1 mit Offsetkorrektur	X	X	X	X	X	X	X
4703	03	VLS_UP_COR[2]	Spannung Lambdasonde Vorkat Bank 2 mit Offsetkorrektur	X	X	X	X	X	X	X
4704	04	LAMB_BAS[1]	Lambda Sollwert Bank1	X	X	X	X	X	X	X
4705	05	LAMB_BAS[2]	Lambda Sollwert Bank2	X	X	X	X	X	X	X
4706	06			-	-	-	-	-	-	-
4707	07	RFPWM[1]	PWM output recirculation flap, Bank 1	-	-	-	-	X	X	X
4708	08	RFPWM[2]	PWM output recirculation flap, Bank 2	-	-	-	-	X	X	X
4709	09	LV_RLY_HPDI	HPDI relay control command state	-	-	-	-	X	X	X
470A	0A	VB_RLY_HPDI	Voltage HPDI relay	-	-	-	-	X	X	X
				-	-	-	-	-	-	-
4710	10	MFF_ADD_COLD_LAM_AD_INJ[0]		X	X	X	X	-	-	-
4711	11	MFF_ADD_COLD_LAM_AD_INJ[1]		X	X	X	X	-	-	-
4712	12	MFF_ADD_COLD_LAM_AD_INJ[2]		X	X	X	X	-	-	-
4713	13	MFF_ADD_COLD_LAM_AD_INJ[3]		X	X	X	X	-	-	-
4714	14	MFF_ADD_COLD_LAM_AD_INJ[4]		-	-	X	X	-	-	-
4715	15	MFF_ADD_COLD_LAM_AD_INJ[5]		-	-	X	X	-	-	-
4716	16	MFF_ADD_HOT_LAM_AD_INJ[0]		X	X	X	X	-	-	-
4717	17	MFF_ADD_HOT_LAM_AD_INJ[1]		X	X	X	X	-	-	-
4718	18	MFF_ADD_HOT_LAM_AD_INJ[2]		X	X	X	X	-	-	-
4719	19	MFF_ADD_HOT_LAM_AD_INJ[3]		X	X	X	X	-	-	-
471A	1A	MFF_ADD_HOT_LAM_AD_INJ[4]		-	-	X	X	-	-	-
471B	1B	MFF_ADD_HOT_LAM_AD_INJ[5]		-	-	X	X	-	-	-
471C	1C	DIST_LAM_AD_INJ_COLD		X	X	X	X	-	-	-
471D	1D	DIST_LAM_AD_INJ_HOT		X	X	X	X	-	-	-
471E	1E	CTR_AD_COLD_LAM_AD_INJ		X	X	X	X	-	-	-
471F	1F	CTR_AD_HOT_LAM_AD_INJ		X	X	X	X	-	-	-
4720	20	RATIO_MMV_NS_SHIFT_DIAG[1]	NOx signal shift diagnosis mean value	X	X	X	X	-	-	-
4721	21	CTR_NS_SHIFT_CYC[1]	Counter of finished NOx signal shift diagnosis	X	X	X	X	-	-	-
4721	22	DIST_NT_NS_SHIFT[1]	Distance saved at last successful NOx signal shift diagnosis	X	X	X	X	-	-	-
				-	-	-	-	-	-	-
<b>800</b>		<b>Sonstiges / Other</b>								
4800	00	LV_CS	Kupplungsschalter Status	X	X	X	X	X	X	X
4801	01	LV_CS_CUS	Kupplungsschalter vorhanden	X	X	X	X	X	X	X
4802	02	LV_SOF_SWI	Sporttaster aktiv	X	X	X	X	X	X	X
4803	03	STATE_ACIN_CAN	Status Klima ein	X	X	X	X	X	X	X
4804	04			-	-	-	-	-	-	-
4805	05	LV_RLY_ST_CAN	Startrelais über CAN aktiv	X	X	X	X	X	X	X
4806	06	TECU	Steuergeraete-Innentemperatur	X	X	X	X	X	X	X
4807	07	N	Motor Drehzahl	X	X	X	X	X	X	X




ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
4808	08	N_SP_IS	Leerlauf Solldrehzahl	X	X	X	X	X	X	X
4809	09	LV_IS	Status LL	X	X	X	X	X	X	X
480A	0A	CTR_KM_BN	Kilometerstand Auflösung 1 km	X	X	X	X	X	X	X
480B	0B	PV_AV	Pedalwert Fahrerwunsch in %	X	X	X	X	X	X	X
480C	0C	VP_TIA[1]	Spannung Ansauglufttemperatur 1	-	-	-	-	X	X	X
480D	0D	VP_TIA[2]	Spannung Ansauglufttemperatur 2	-	-	-	-	X	X	X
480E	0E	TIA_MES[1]	Rohwert Ansauglufttemperatur 1	-	-	-	-	X	X	X
480F	0F	TIA_MES[2]	Rohwert Ansauglufttemperatur 2	-	-	-	-	X	X	X
4810	10	-	-	-	-	-	-	-	-	-
4811	11	-	-	-	-	-	-	-	-	-
4812	12	-	-	-	-	-	-	-	-	-
4813	13	-	-	-	-	-	-	-	-	-
4814	14	Pvdkds_i[0]	Druck vor Drosselklappe Bank 1	-	-	-	-	X	X	X
4815	15	Ps_ist_i[0]	Druck nach Drosselklappe Bank 1	-	-	-	-	X	X	X
4816	16	Tans_i[0]	Temperatur vor Drosselklappe Bank 1	-	-	-	-	X	X	X
4817	17	Pvdksd_i[1]	Druck vor Drosselklappe Bank 2	-	-	-	-	X	X	X
4818	18	Ps_ist_i[1]	Druck nach Drosselklappe Bank 2	-	-	-	-	X	X	X
4819	19	Tans_i[1]	Temperatur vor Drosselklappe Bank 2	-	-	-	-	X	X	X
481A	1A	FUP_H_MPL[0]	Raildruck Bank 1	-	-	-	-	X	X	X
481B	1B	FUP_H_MPL[1]	Raildruck Bank 2	-	-	-	-	X	X	X
481C	1C	VP_TPS_1[1]	ADC-Wert1 Drosselklappe Bank 1	-	-	-	-	X	X	X
481D	1D	VP_TPS_2[1]	ADC-Wert2 Drosselklappe Bank 1	-	-	-	-	X	X	X
481E	1E	VP_TPS_1[2]	ADC-Wert1 Drosselklappe Bank 2	-	-	-	-	X	X	X
481F	1F	VP_TPS_2[2]	ADC-Wert2 Drosselklappe Bank 2	-	-	-	-	X	X	X
4820	20	TPS_AV[1]	Drosselklappenwinkel Bank 1	-	-	-	-	X	X	X
4821	21	TPS_AV[2]	Drosselklappenwinkel Bank 2	-	-	-	-	X	X	X
4822	22	TPS_SP_MDL[1]	Drosselklappe Sollwert Bank 1	-	-	-	-	X	X	X
4823	23	TPS_SP_MDL[2]	Drosselklappe Sollwert Bank 2	-	-	-	-	X	X	X
4824	24			-	-	-	-	-	-	-
4825	25			-	-	-	-	-	-	-
4826	26			-	-	-	-	-	-	-
4827	27			-	-	-	-	-	-	-
4828	28			-	-	-	-	-	-	-
4829	29			-	-	-	-	-	-	-
482A	2A			-	-	-	-	-	-	-
482B	2B			-	-	-	-	-	-	-
482C	2C	TPS_SP[1]	Drosselklappe Sollwert Bank 1	-	-	-	-	X	X	X
482D	2D	TPS_SP[2]	Drosselklappe Sollwert Bank 2	-	-	-	-	X	X	X
482E	2E	LV_PWL_CWP	HPDI relay control command state	-	-	-	-	X	X	X
482F				-	-	-	-	-	-	-
4830	30	CTR_NR_DIAG_PUE_LS_DOWN[1]	Counter for completed gradient monitoring diagnosis, Bank 1	X	X	X	X	X	X	X
4831	31	CTR_NR_DIAG_PUE_LS_DOWN[2]	Counter for completed gradient	X	X	X	X	X	X	X

ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
			monitoring diagnosis, Bank2							
4832	32	VLS_DOWN_PUE_MMV[1]	Moving mean value of gradient monitoring, Bank1	X	X	X	X	X	X	X
4833	33	VLS_DOWN_PUE_MMV[2]	Moving mean value of gradient monitoring, Bank2	X	X	X	X	X	X	X
4834	34	VLS_DOWN_PUE_SAVE_MAX[1]	Saved maximum gradient of oxygen sensor downstream of all driving cycles , Bank1	X	X	X	X	X	X	X
4835	35	VLS_DOWN_PUE_SAVE_MAX[2]	Saved maximum gradient of oxygen sensor downstream of all driving cycles , Bank2	X	X	X	X	X	X	X
4836	36	VLS_DOWN_PUE_SAVE_MIN[1]	Saved minimum gradient of oxygen sensor downstream of all driving cycles , Bank1	X	X	X	X	X	X	X
4837	37	VLS_DOWN_PUE_SAVE_MIN[2]	Saved minimum gradient of oxygen sensor downstream of all driving cycles , Bank1	X	X	X	X	X	X	X
4838	38	VLS_DOWN_PUE_STD[1]	Squared standard deviation of gradient monitoring, Bank1	X	X	X	X	X	X	X
4839	39	VLS_DOWN_PUE_STD[2]	Squared standard deviation of gradient monitoring, Bank2	X	X	X	X	X	X	X
483A	3A			-	-	-	-	-	-	-
483B	3B			-	-	-	-	-	-	-
483C	3C			-	-	-	-	-	-	-
483D	3D			-	-	-	-	-	-	-
483E	3E			-	-	-	-	-	-	-
483F	3F			-	-	-	-	-	-	-
4840	40	FUP_SP_MPL[0]	berechneter Hochdrucksollwert, Bank 1	-	-	-	-	X	X	X
4841	41	FUP_SP_MPL[1]	berechneter Hochdrucksollwert, Bank 2	-	-	-	-	X	X	X
4841	42	N_EFP_AV	Drehzahl Kraftstoffpumpe	-	-	-	-	X	X	X
4843	43	prdr_w_rb[0]	Hochdruckreglerwert Ausgang, Bank 1	-	-	-	-	X	X	X
4844	44	prdr_w_rb[1]	Hochdruckreglerwert Ausgang, Bank 2	-	-	-	-	X	X	X
48-	-			-	-	-	-	-	-	-
4846	46			-	-	-	-	-	-	-
4847	47			-	-	-	-	-	-	-
4848	48			-	-	-	-	-	-	-
4849	49			-	-	-	-	-	-	-
484A	4A			-	-	-	-	-	-	-
484B	4B			-	-	-	-	-	-	-
484C	4C			-	-	-	-	-	-	-
484D	4D			-	-	-	-	-	-	-

ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
484E	4E			-	-	-	-	-	-	-
484F	4F			-	-	-	-	-	-	-
4850	50	CTR_MIS_DET_CYL[1]	Number of lifetime misfire events for logical cylinder 1	X	X	X	X	X	X	X
4851	51	CTR_MIS_DET_CYL[2]	Number of lifetime misfire events for logical cylinder 2	X	X	X	X	X	X	X
4852	52	CTR_MIS_DET_CYL[3]	Number of lifetime misfire events for logical cylinder 3	X	X	X	X	X	X	X
4853	53	CTR_MIS_DET_CYL[4]	Number of lifetime misfire events for logical cylinder 4	X	X	X	X	X	X	X
4854	54	CTR_MIS_DET_CYL[5]	Number of lifetime misfire events for logical cylinder 5	-	-	X	X	X	X	X
4855	55	CTR_MIS_DET_CYL[6]	Number of lifetime misfire events for logical cylinder 6	-	-	X	X	X	X	X
4856	56	CTR_MIS_DET_CYL[7]	Number of lifetime misfire events for logical cylinder 7	-	-	-	-	X	X	X
4857	57	CTR_MIS_DET_CYL[8]	Number of lifetime misfire events for logical cylinder 8	-	-	-	-	X	X	X
				-	-	-	-	-	-	-
4880	80	EFF_IGA_CST_QUO_IS_MAX	Maximum quotient of ignition angle efficiency integral and time at idle speed (relative to the maximum threshold in percent)	X	X	X	X	X	X	X
4881	81	EFF_IGA_CST_QUO_PL_MAX	Maximum quotient of ignition angle efficiency integral and time at part load (relative to the maximum threshold in percent)	X	X	X	X	X	X	X
<b>5A</b>		<b>MSx specific</b>			-	-	-	-	-	-
5A00	00	VCC_PVS_1	Versorgung FWG 1	X	X	X	X	X	X	X
5A01	01	VCC_PVS_2	Versorgung FWG 2	X	X	X	X	X	X	X
5A02	02	LV_CDN_DIAG_TCHA_LEAK	Boolean for diagnosis condition present on charger leakage diagnosis	X	X	X	X	-	-	-
		LV_CDN_DIAG_TCHA_LEAK[1]	Boolean for diagnosis condition present on charger leakage diagnosis, Bank1	-	-	-	-	X	X	X
5A03	03	LV_END_DIAG_TCHA_LEAK	End of diagnosis charger leakage diagnosis	X	X	X	X	-	-	-
		LV_END_DIAG_TCHA_LEAK[1]	End of diagnosis charger leakage diagnosis, Bank 1	-	-	-	-	X	X	X
5A04	04	V_PVS_1	Spannung Pedalwertgeber 1	X	X	X	X	X	X	X
5A05	05	V_PVS_2	Spannung Pedalwertgeber 2	X	X	X	X	X	X	X
5A06	06	V_TPS_1	Spannung Drosselklappe Poti 1	X	X	X	X	-	-	-
		LV_CDN_DIAG_TCHA_LEAK[2]	Boolean for diagnosis condition present on charger leakage diagnosis, Bank 2	-	-	-	-	X	X	X
5A07	07	V_TPS_2	Spannung Drosselklappe Poti 2	X	X	X	X	-	-	-
		LV_END_DIAG_TCHA_LEAK[2]	End of diagnosis charger leakage diagnosis, Bank2	-	-	-	-	X	X	X
5A08	08	V_TIA	Spannung Ansauglufttemperatur	X	X	X	X	-	-	-

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5A09	09	V_TCO	Spannung Motortemperatur	X	X	X	X	-	-	-
		VP_TCO[1]	Spannung Motortemperatur	-	-	-	-	X	X	X
5A0A	0A	V_TCO_2	Spannung Kühlmitteltemperatur Kühlerausgang	X	X	X	X	-	-	-
		VP_TCO[2]	Spannung Kühlmitteltemperatur Kühlerausgang	-	-	-	-	X	X	X
5A0B	0B	V_AMP	Spannung DME Umgebungsdruck	X	X	X	X	X	X	X
5A0C	0C	V_MAF	Spannung Luftmasse	X	X	X	-	-	-	-
5A0D	0D	V_SAF	Spannung Sekundärluft	X	X	X	X	-	-	-
5A0E	0E	VP_TECU	Spannung SG-Innentemperatur	X	X	X	X	X	X	X
5A0F	0F	V_IGK_BAS	Spannung KI.15	X	X	X	X	X	X	X
5A10	10	V_IGK_MES	Spannung KI15	X	X	X	X	X	X	X
5A11	11	VLS_UP[1]	Spannung Lambdasonde VorKat 1	X	X	X	X	X	X	X
5A12	12	VLS_UP[2]	Spannung Lambdasonde VorKat 2	X	X	X	X	X	X	X
5A13	13	VLS_DOWN[1]	Spannung Lambdasonde HinterKat 1	X	X	X	X	X	X	X
5A14	14	VLS_DOWN[2]	Spannung Lambdasonde HinterKat 2	X	X	X	X	X	X	X
5A15	15	LV_END_DIAG_TCHA_PRS_LOW	End of diagnosis charger pressure to low diagnosis	-	-	X	X	-	-	-
		LV_END_DIAG_TCHA_PRS_LOW[1]	End of diagnosis charger pressure to low diagnosis, Bank 1	-	-	-	-	X	X	X
5A16	16	V_PBSU	Spannung Bremsunterdrucksensor	X	X	-	-	-	-	-
		LV_END_DIAG_TCHA_PRS_HIGH	End of diagnosis charger pressure to high diagnosis	-	-	X	X	-	-	-
		LV_END_DIAG_TCHA_PRS_HIGH[1]	End of diagnosis charger pressure to high diagnosis, Bank 1	-	-	-	-	X	X	X
5A17	17	V_DMTL	Spannung Strommessung DMTL	X	X	X	X	X	X	X
5A18	18	VP_TEG_PCAT_DOWN	Spannung Katalysator-Temperatursensor	X	X	X	X	-	-	-
		LV_END_DIAG_TCHA_PRS_LOW[2]	End of diagnosis charger pressure to low diagnosis, Bank 2	-	-	-	-	X	X	X
5A19	19	LV_END_DIAG_TCHA_PRS_HIGH[2]	End of diagnosis charger pressure to high diagnosis, Bank 2	-	-	-	-	X	X	X
5A1A	1A			-	-	-	-	-	-	-
5A1B	1B			-	-	-	-	-	-	-
5A1C	1C			-	-	-	-	-	-	-
5A1D	1D			-	-	-	-	-	-	-
5A1E	1E	PBSU	Bremsunterdruck	X	X	X	X	-	-	-
5A1F	1F	TEG_PCAT_DOWN_1	Abgastemperatur	X	X	X	X	-	-	-
5A20	20	PWM_NEUT_PSN_GB	Tastverhältnis Nullgangssensor	X	X	X	X	-	-	-
5A21	21	TCO_2_MES	Kühlmitteltemperatur Kühlerausgang	X	X	X	X	X	X	X
5A22	22	TECU	Steuergerät Innentemperatur	X	X	X	X	X	X	X
5A23	23	P_oeI_soll	Sollwert Öldruck	X	X	X	X	-	-	-
5A24	24	TPS_SP	Drosselklappe Sollwert	X	X	X	X	-	-	-
5A25	25	P_oeI_ist	Istwert Öldruck	X	X	X	X	-	-	-
5A26	26	MAP	Umgebungsdruck	X	X	X	X	X	X	X
5A27	27	PV_AV_1	Pedalwertgeber Poti1	X	X	X	X	X	X	X

ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5A28	28	PV_AV_2	Pedalwertgeber Poti2	X	X	X	X	X	X	X
5A29	29	PV_AV_RAW	Fahrpedalwert	X	X	X	X	X	X	X
5A2A	2A	FUP_EFP_SP	Sollwert Kraftstoffpumpe	-	-	-	-	X	X	X
5A2B	2B	Tans	Temperatur vor Drosselklappe	X	X	X	X	-	-	-
5A2C	2C	Pvdkds	Druck vor Drosselklappe	X	X	X	X	-	-	-
5A2D	2D	Ps_ist	Druck nach Drosselklappe	X	X	X	X	-	-	-
5A2E	2E	FUP_EFP	Kraftstoffniederdrucksensor	X	X	X	X	X	X	X
5A2F	2F	FUP	Raildruck	X	X	X	X	-	-	-
		FUP_RNG_H_MES	measured fuel pressure	-	-	-	-	X	X	X
5A30	30	ER_CYL[0]	Laufunruhe IZylinder 1	X	X	X	X	X	X	X
5A31	31	ER_CYL[4]	Laufunruhe Zylinder 2 (only 6cyl)	X	X	X	X	X	X	X
5A32	32	ER_CYL[2]	Laufunruhe Zylinder 3 (6cyl) Laufunruhe Zylinder 4 (4cyl)	X	X	X	X	X	X	X
5A33	33	ER_CYL[5]	Laufunruhe Zylinder 4 (only 6cyl)	X	X	X	X	X	X	X
5A34	34	ER_CYL[1]	Laufunruhe Zylinder 5 (6cyl) Laufunruhe Zylinder 3 (4cyl)	X	X	X	X	X	X	X
5A35	35	ER_CYL[3]	Laufunruhe Zylinder 6 (6cyl) Laufunruhe Zylinder 2 (4cyl)	X	X	X	X	X	X	X
5A36	36	LV_KNK	Status Klopfen	X	X	X	X	X	X	X
5A37	37	NL[0]	Spannung Klopfwerte Zylinder 1	X	X	X	X	X	X	X
5A38	38	NL[4]	Spannung Klopfwerte Zylinder 2 (only 6cyl)	X	X	X	X	X	X	X
5A39	39	NL[2]	Spannung Klopfwerte Zylinder 3 (6cyl) Spannung Klopfwerte Zylinder 4 (4cyl)	X	X	X	X	X	X	X
5A3A	3A	NL[5]	Spannung Klopfwerte Zylinder 4 (only 6cyl)	X	X	X	X	X	X	X
5A3B	3B	NL[1]	Spannung Klopfwerte Zylinder 5 (6cyl) Spannung Klopfwerte Zylinder 3 (4cyl)	X	X	X	X	X	X	X
5A3C	3C	NL[3]	Spannung Klopfwerte Zylinder 6 (6cyl) Spannung Klopfwerte Zylinder 2(4cyl)	X	X	X	X	X	X	X
5A3D	3D	KNKS[0]	Klopfsignal Zylinder 1	X	X	X	X	X	X	X
5A3E	3E	KNKS_REL_NL[0]	Klopfsignal Zylinder 1 relativ	X	X	X	X	-	-	-
		KNKS[1]	Klopfsignal Zylinder 5	-	-	-	-	X	X	X
5A3F	3F	KNKS[5]	Klopfsignal Zylinder 3 ( for 4cyl. machine: Offh -not relevant)	X	X	X	X	X	X	X
5A40	40	KNKS_REL_NL[5]	Klopfsignal Zylinder 6 relativ ( for 4cyl. machine: Offh -not relevant)	X	X	X	X	-	-	-
		KNKS[2]	Klopfsignal Zylinder 4	-	-	-	-	X	X	X
5A41	41	NT_AGI_SUL	NOx trap aging factor due to sulphur load	X	X	X	X	-	-	-
		KNKS[3]		-	-	-	-	X	X	X
5A42	42	NT_AGI	NOx trap aging factor	X	X	X	X	-	-	-
		KNKS[4]	Klopfsignal Zylinder	-	-	-	-	X	X	X
5A43	43	NT_AGI_THERMO	NOx trap aging factor due to thermal aging	X	X	X	X	-	-	-
		KNKS[6]	Klopfsignal Zylinder 7	-	-	-	-	X	X	X
5A44	44	LV_SO2P_REQ_2	Request of a desulfation (forces catalyst heating)	X	X	X	X	-	-	-

ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
		KNKS[7]	Klopfsignal Zylinder 2	-	-	-	-	X	X	X
5A-	-	CTR_CH_SO2P	Counter of not effectual trials to heat the NOx - Trap for desulfation	X	X	X	X	-	-	-
		ER_CYL[6]	Laufunruhe Zylinder 7	-	-	-	-	X	X	X
5A46	46	DIST_SO2P_END	Km - counter since last end of desulfation	X	X	X	X	-	-	-
		ER_CYL[7]	Laufunruhe Zylinder 8	-	-	-	-	X	X	X
5A47	47	T_CH_SO2P_ACT	Time with active catalyst heating for desulfation without active desulfation	X	X	X	X	-	-	-
		NL[6]	Spannung Klopfwerte Zylinder 7	-	-	-	-	X	X	X
5A48	48	NL[7]	Spannung Klopfwerte Zylinder 2	-	-	-	-	X	X	X
		LC_SWI_AEB_TYP	Active engine brackets switch for different engine type	X	X	X	X	-	-	-
5A49	49	IGA_IGC[0]	Zündwinkel Zylinder1	X	X	X	X	X	X	X
5A4A	4A			-	-	-	-	-	-	-
5A4B	4B	LOAD_CLC	Berechneter Lastwert	X	X	X	X	X	X	X
5A4C	4C	STATE_MTC_HEAT	Status Drosselklappenheizungsrelais	X	X	X	X	-	-	-
5A4D	4D	LV_RLY_MTC_HEAT	Drosselklappenheizung EIN	X	X	X	X	-	-	-
5A4E	4E	LV_ACCOUT_RLY	Klimakompressorrelais Ein	X	X	X	X	X	X	X
5A4F	4F			-	-	-	-	-	-	-
5A50	50	LAMB_LS_UP[1]	Lambdawert vor Kat Bank1	X	X	X	X	X	X	X
5A51	51	LAMB_LS_UP[2]	Lambdawert vor Kat Bank2	X	X	X	X	X	X	X
5A52	52	LV_LS_DOWN_READY[1]	Status LS nach Kat Bank1	X	X	X	X	X	X	X
5A53	53	LV_LS_DOWN_READY[2]	Status LS nach Kat Bank2	X	X	X	X	X	X	X
5A54	54	STATE_LSH_DOWN[1]	Status LS Heizung nach Kat Bank1	X	X	X	X	X	X	X
5A55	55	STATE_LSH_DOWN[2]	Status LS Heizung nach Kat Bank2	X	X	X	X	X	X	X
5A56	56	STATE_LSH_UP[1]	Status LS Heizung vor Kat Bank1	X	X	X	X	X	X	X
5A57	57	STATE_LSH_UP[2]	Status LS Heizung vor Kat Bank2	X	X	X	X	X	X	X
5A58	58	LSHPWM_UP[1]	Lambdasondenheizung PWM vor Kat Bank 1	X	X	X	X	X	X	X
5A59	59	LSHPWM_DOWN[1]	Lambdasondenheizung PWM nach Kat Bank 1	X	X	X	X	X	X	X
5A5A	5A	LSHPWM_UP[2]	Lambdasondenheizung PWM vor Kat Bank 2	X	X	X	X	X	X	X
5A5B	5B	LSHPWM_DOWN[2]	Lambdasondenheizung PWM nach Kat Bank 2	X	X	X	X	X	X	X
5A5C	5C	ERR_VIMPWM_1_FB	Aktive Fehlerrückmeldung DISA-Klappe 1	X	X	X	X	-	-	-
5A5D	5D	CTR_VIMPWM_1_EDGE	Schalhäufigkeitszähler DISA-Klappe 1	X	X	X	X	-	-	-
5A5E	5E	ERR_VIMPWM_2_FB	Aktive Fehlerrückmeldung DISA-Klappe 2	X	X	X	X	-	-	-
5A5F	5F	CTR_VIMPWM_2_EDGE	Schalhäufigkeitszähler DISA-Klappe 2	X	X	X	X	-	-	-
5A60	60	LV_IM_BLS	Bremslichtschalter Ein	X	X	X	X	X	X	X
5A61	61	LV_IM_BTS	Bremslichttestschalter Ein	X	X	X	X	X	X	X

ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5A62	62	LV_POIL_SWI	Öldruck erreicht, Schalter o. Sensor (4Zyl)	X	X	X	X	X	X	X
5A63	63	LV_EBOX_CFA	E-Boxlüfter Ein	X	X	X	X	X	X	X
5A64	64	LV_SWI_AEB	Motorlager weiche Dämpfung	X	X	X	X	-	-	-
5A65	65	LV_EF	Abgasklappe Ein	X	X	X	X	-	-	-
5A66	66	LV_DMTL_PUMP	DMTL Pumpe Ein	X	X	X	X	X	X	X
5A67	67	LV_DMTLS	DMTL Ventil Ein	X	X	X	X	X	X	X
5A68	68	LV_HDMTL_ON	DMTL Heizung Ein	X	X	X	X	X	X	X
5A69	69	LV_MIL_CAN	MIL Lampe Ein	X	X	X	X	X	X	X
5A6A	6A	LV_CRU_MAIN_SWI	Lampe FGR Ein	X	X	X	X	X	X	X
5A6B	6B	LV_WAL_1_CAN	Lampe Check Engine Ein	X	X	X	X	X	X	X
5A6C	6C	FAC_FCO_KWP	Verbrauchskorrekturfktor	X	X	X	X	X	X	X
5A6D	6D	STATE_MSW_CAN	Status Taste FGR	X	X	X	X	X	X	X
5A6E	6E	STATE_CRU_OFF_IRR	Status für irreversible Abschaltbedingung	X	X	X	X	X	X	X
5A6F	6F	STATE_CRU_OFF_REV	Status für reversible Abschaltbedingung	X	X	X	X	X	X	X
5A70	70	LV_SOF	Soundklappe Zustand	X	X	X	X	-	-	-
5A71	71	VIMPWM_1	DISA1 PWM (große/obere Klappe)	X	X	X	X	-	-	-
5A72	72	VIMPWM_2	DISA2 PWM (kleine/untere Klappe)	X	X	X	X	-	-	-
5A73	73	LV_RLY_CRCV_HEAT	Kurbelgehäuseentlüftungsheizung	X	X	X	X	X	X	X
5A74	74	ECPWM	Beheizter Thermostat PWM	X	X	X	X	X	X	X
5A75	75			-	-	-	-	-	-	-
5A76	76	CPPWM_ADD_AD_MEM	Adaption Öffnungspunkt Tankentlüftungsventil	X	X	X	X	-	X	X
		CPPWM_ADD_AD_MEM[0]	Adaption Öffnungspunkt Tankentlüftungsventil	-	-	-	-	X	-	-
5A77	77	CPPWM_CPS	TankEntlüftungsVentil TEV PWM	X	X	X	X	X	X	X
5A78	78	LV_EF	Abgasklappe Ansteuerung	X	X	X	X	-	-	-
5A79	79	ECFPWM[0]	E-Lüfter PWM	X	X	X	X	X	X	X
5A7A	7A	IVVTPWM_IN[0]	VANOS PWM Wert Einlass	X	X	X	X	-	-	-
		ECFPWM_REQ	Requested pulse width modulated for ECF	-	-	-	-	X	X	X
5A7B	7B	IVVTPWM_EX[1]	VANOS PWM Wert Auslass	X	X	X	X	-	-	-
		LV_ECF_RLY_ACT	Boolean for activation ECF relais	-	-	-	-	X	X	X
5A7C	7C	FAC_NOX_NS_AD[1]	Adaptation of the NOx sensor characteristic shift	X	X	X	X	-	-	-
		LV_ERR_ECFPWM_FB_3	Error currently present, indicated by failure feedback from ECF control unit	-	-	-	-	X	X	X
5A7D	7D	CTR_NS_AD_CYC[1]	Counter of NOx signal gain adaptations	X	X	X	X	-	-	-
		LV_ERR_ECFPWM_FB_4	Error currently present, indicated by failure feedback from ECF control uni	-	-	-	-	X	X	X
5A7E	7E	DIST_NT_NS_AD[1]	Current distance from last NOx signal gain adaptation	X	X	X	X	-	-	-
5A7F	7F	DELTA_CRK_CYL_LAM[1]	adapted phase displacement, bank1	X	X	X	X	X	X	X
5A80	80	DELTA_CRK_CYL_LAM[2]	adapted phase displacement, bank 2	X	X	X	X	X	X	X



ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5A81	81	FAC_LAM_LIM[1]	Integrator Bank1	X	X	X	X	X	X	X
5A82	82	FAC_LAM_LIM[2]	Integrator Bank2	X	X	X	X	X	X	X
5A83	83	MFF_ADD_LAM_AD_OUT[1]	Adaption Offset Lambda Bank1	X	X	X	X	X	X	X
5A84	84	MFF_ADD_LAM_AD_OUT[2]	Adaption Offset Lambda Bank2	X	X	X	X	X	X	X
5A85	85	FAC_LAM_AD_CUS[1]	Adaption Multiplikation Lambda Bank1	X	X	X	X	X	X	X
5A86	86	FAC_LAM_AD_CUS[2]	Adaption Multiplikation Lambda Bank2	X	X	X	X	X	X	X
5A87	87	LAMB_DELTA_AD_LAM_ADJ[1]	Adaptionswert Trimregelung Bank1	X	X	X	X	X	X	X
5A88	88	LAMB_DELTA_AD_LAM_ADJ[2]	Adaptionswert Trimregelung Bank2	X	X	X	X	X	X	X
5A89	89	FAC_H_RNG_LAM_AD[1]	multiplikative Gemischadaption hohe Last Bank1	X	X	X	X	X	X	X
5A8A	8A	FAC_H_RNG_LAM_AD[2]	multiplikative Gemischadaption hohe Last Bank2	X	X	X	X	X	X	X
5A8B	8B	FAC_L_RNG_LAM_AD[1]	multiplikative Gemischadaption niedrige Last Bank1	X	X	X	X	X	X	X
5A8C	8C	FAC_L_RNG_LAM_AD[2]	multiplikative Gemischadaption niedrige Last Bank2	X	X	X	X	X	X	X
5A8D	8D	MFF_ADD_LAM_AD[1]	additive Gemischadaption Leerlauf Bank1	X	X	X	X	X	X	X
5A8E	8E	MFF_ADD_LAM_AD[2]	additive Gemischadaption Leerlauf Bank2	X	X	X	X	X	X	X
5A8F	8F	FAC_LSL_GAIN_AD[1]	Adaption Schubabgleich Bank 1	X	X	X	X	X	X	X
5A90	90	FAC_LSL_GAIN_AD[2]	Adaption Schubabgleich Bank 2	X	X	X	X	X	X	X
5A91	91	EFF_CAT_DIAG_OBD[1]	Katalysatordiagnosewert Bank1	X	X	X	X	X	X	X
5A92	92	EFF_CAT_DIAG_OBD[2]	Katalysatordiagnosewert Bank2	X	X	X	X	X	X	X
5A93	93	CTR_GB_NEUT_NOT_PLAUS_SUM		X	X	X	X	-	-	-
5A94	94	CAM_SP_IVVT_EX	Nockenwelle Auslass Sollwert	X	X	X	X	-	-	-
5A95	95	PSN_AD_CAM_EX[1]	Adaptionswert Nockenwelle Auslaß	X	X	X	X	X	X	X
5A96	96	PSN_AD_CAM_IN[1]	Adaptionswert Nockenwelle Einlaß	X	X	X	X	X	X	X
5A97	97	B_vsean_loc	E-VANOS im Anschlag bei letztem Abstellen	X	X	X	X	X	X	X
5A98	98			-	-	-	-	-	-	-
5A99	99	LV_SEG_AD_AVL_ER	Kurbelwellen Adaption beendet	X	X	X	X	X	X	X
5A9A	9A	LV_VAR_MAF_LEARNT	HFM learning function has been carried out	X	X	X	X	-	-	-
5A9B	9B	FAC_LAM_AD_BAL[1]	Lambda adaption output to be used in the MFF correction, bank1	X	X	X	X	-	-	-
5A9C	9C	FAC_LAM_AD_BAL[2]	Lambda adaption output to be used in the MFF correction, bank2	X	X	X	X	-	-	-
5A9D	9D	FAC_LAM_AD_OUT[1]	fuel mass set point factor, output from lambda adaptation, bank 1	X	X	X	X	-	-	-
5A9E	9E	FAC_LAM_AD_OUT[2]	fuel mass set point factor, output from lambda adaptation, bank 2	X	X	X	X	-	-	-
5A9F	9F	FAC_LAM_ADJ_COR_LAM_AD_CUS[1]	Corrected value of the Long term	X	X	X	X	-	-	-




ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
		]	customer Lambda Adaption (multiplicative share), bank1							
5AA0	A0	FAC_LAM_ADJ_COR_LAM_AD_CUS[2 ]	Corrected value of the Long term customer Lambda Adaption (multiplicative share), bank2	X	X	X	X	-	-	-
5AA1	A1	STATE_EOL_KWP_CPS	Status Diagnose TEV	X	X	X	X	-	-	-
5AA2	A2	STATE_EOL_KWP_DMTL	Status Diagnose DMTL	X	X	X	X	-	-	-
5AA3	A3	STATE_EOL_KWP_VLS	Status Diagnose Lambdasonden	X	X	X	X	-	-	-
5AA4	A4	STATE_EOL_KWP_N_SP_IS	Status Diagnose Leerlaufdrehzahlverstellung	X	X	X	X	-	-	-
5AA5	A5	STATE_EOL_KWP_SA	Status Diagnose Sekundärluft	X	X	X	X	-	-	-
5AA6	A6			-	-	-	-	-	-	-
5AA7	A7	Msnlgofts_tmp	Leckluftadaptation Istwert	X	X	X	X	X	X	X
5AA8	A8	STATE_ECRAS_SYS	Status Luftklappensystem	X	X	X	X	X	X	X
5AA9	A9	ECRASPWM	Tastverhältnis Luftklappe	X	X	X	X	X	X	X
5AAA	AA	POIL_PWM	Oilpressure PWM	X	X	X	X	-	-	-
5AAB	AB	WGPWM[0]	Wastegate 1 PWM	X	X	X	X	X	X	X
5AAC	A C	WGPWM[1]	Wastegate 2 PWM	X	X	X	X	X	X	X
5AAD	A D	Atlvst	Vorsteuerung Ladedruckregelung	X	X	X	X	X	X	X
5AAE	AE	Atlr	Reglerausgang und Vorsteuerung	X	X	X	X	X	X	X
5AAF	AF	F_atlad	Adaptionswert von der Ladedruckregelung	X	X	X	X	X	X	X
5AB0	B0	Pldr_soll	Solladedruck	X	X	X	X	X	X	X
5AB1	B1	VS	Geschwindigkeit	X	X	X	X	X	X	X
5AB2	B2	T_PER_MAF_FRQ[0]	Periodendauer Luftmasse	X	X	X	X	X	X	X
5AB3	B3	DIST_ACT_MIL	Fahrstreck mit MIL an	X	X	X	X	X	X	X
5AB4	B4	TRT	Betriebsstundenzähler	X	X	X	X	X	X	X
5AB5	B5	T_PER_MAF_FRQ[1]	Periodendauer Luftmasse 2	-	-	-	-	X	X	X
5AB6	B6	TIA_MES	Rohwert Ansauglufttemperatur 1	X	X	X	X	-	-	-
5AB7	B7	TCO_MES	Rohwert Kühlwassertemperatur	X	X	X	X	X	X	X
5AB8	B8	V_MAP	Spannung Saugrohrdruck	X	X	X	X	-	-	-
		V_MAP[0]	Spannung Saugrohrdruck 1	-	-	-	-	X	X	X
5AB9	B9	V_SOF_SWI	Spannung Sportschalter	X	X	X	X	-	-	-
5ABA	BA			-	-	-	-	-	-	-
5ABB	BB	V_MAP[1]	Spannung Saugrohrdruck 2	-	-	-	-	X	X	X
5ABC	B C	MAF_KGH_MES_BAS	Luftmasse	X	X	X	X	-	-	-
5ABD	B D	LV_RLY_ST	Starterrelais aktiv	X	X	X	X	X	X	X
5ABE	BE	EFPPWM_I	I-Anteil Kraftstoffpumpen-PWM	-	-	-	-	X	X	X
5ABF	BF			-	-	-	-	-	-	-
5AC0	C0			-	-	-	-	-	-	-
5AC1	C1			-	-	-	-	-	-	-

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5AC2	C2	RST_DBG_BACKTRACE_ADDRESS[0] [0]	Info last available caller address (default 0)	X	X	X	X	-	-	-
		STACK_ADR_RST[0][0]	Info last available caller addresses (default 0) / RESET SAFE	-	-	-	-	X	X	X
5AC3	C3	CTR_TPS_JAM_DET_ACT	Zähler für Eisdetection in der Drosselklappe	X	X	X	X	-	-	-
5AC4	C4	EFPPWM_MIN_AD	Minimum pump speed of the electrical fuel pump as PWM signal	X	X	X	X	X	X	X
5AC5	C5	EFPPWM_I_AD	Adaptive I-Part of the controller	X	X	X	X	X	X	X
5AC6	C6	V_ACR	Sensorspannung AGR	X	X	X	X	-	-	-
5AC7	C7	OPG_ACR	Hub des AGR-Tellerventils	X	X	X	X	-	-	-
5AC8	C8	V_ACR_AD_TOL	Adaptionswert oberer Anschlag (einmalig gelernt)	X	X	X	X	-	-	-
5AC9	C9	V_ACR_AD_BOL	Adaptionswert unterer Anschlag (immer wieder neu gelernt)	X	X	X	X	-	-	-
5ACA	C A	V_ACR_AD_BOL_0	Adaptionswert unterer Anschlag (einmalig am Anfang gelernt, Uradaptation)	X	X	X	X	-	-	-
5ACB	C B	STATE_ACR_AD	Status des Erlernens der AGR-Adaption	X	X	X	X	-	-	-
5AC	C C	CTR_STC_TECU_1	DME-Temperaturstatistik, Zähler 1	X	X	X	X	-	-	-
5AC	C D	CTR_STC_TECU_2	DME-Temperaturstatistik, Zähler 2	X	X	X	X	-	-	-
5ACE	C E	CTR_STC_TECU_3	DME-Temperaturstatistik, Zähler 3	X	X	X	X	-	-	-
5ACF	C F	CTR_STC_TECU_4	DME-Temperaturstatistik, Zähler 4	X	X	X	X	-	-	-
5AD0	D0	CTR_STC_TECU_5	DME-Temperaturstatistik, Zähler 5	X	X	X	X	-	-	-
5AD1	D1	CTR_STC_TECU_6	DME-Temperaturstatistik, Zähler 6	X	X	X	X	-	-	-
5AD2	D2	CTR_STC_TECU_7	DME-Temperaturstatistik, Zähler 7	X	X	X	X	-	-	-
5AD3	D3	CTR_STC_TECU_8	DME-Temperaturstatistik, Zähler 8	X	X	X	X	-	-	-
5AD4	D4			-	-	-	-	-	-	-
5AD5	D5	LV_RAS_OUT		-	-	X	X	-	-	-
		CTR_STC_TECU_1	DME-Temperaturstatistik, Zähler 1	-	-	-	-	X	X	X
5AD6	D6	NOX_OFS_PUC[1]	Fuel Cut Off = Schubabschaltung	X	X	X	X	-	-	-
		CTR_STC_TECU_2	DME-Temperaturstatistik, Zähler 2	-	-	-	-	X	X	X
5AD7	D7	NOX_OFS_LOAD[1]	Beladungsbetrieb NOx-Kat.	X	X	X	X	-	-	-
		CTR_STC_TECU_3	DME-Temperaturstatistik, Zähler 3	-	-	-	-	X	X	X
5AD8	D8	NOX_NS[1]	NOx-Konzentration	X	X	X	X	-	-	-
		CTR_STC_TECU_4	DME-Temperaturstatistik, Zähler 4	-	-	-	-	X	X	X
5AD9	D9	LAMB_NOX_SENS[1]	Lineares Lambdasignal NOx-Sensor	X	X	X	X	-	-	-
		CTR_STC_TECU_5	DME-Temperaturstatistik, Zähler 5	-	-	-	-	X	X	X
5ADA	D A	VLS_NOX_SENS[1]	binäres Spannungssignal NOx-Sensor	X	X	X	X	-	-	-
		CTR_STC_TECU_6	DME-Temperaturstatistik, Zähler 6	-	-	-	-	X	X	X
5ADB	D B	CAN_STATE_NOX_SENS[1]	Status NOx-Sensor	X	X	X	X	-	-	-
		CTR_STC_TECU_7	DME-Temperaturstatistik, Zähler 7	-	-	-	-	X	X	X

ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5AD C	D	CAN_ERR_NOX_SENS[1]	NOx-Sensor Error Byte	X	X	X	X	-	-	-
	C	CTR_STC_TECU_8	DME-Temperaturstatistik, Zähler 8	-	-	-	-	X	X	X
5AD D	D			-	-	-	-	-	-	-
5ADE	D			-	-	-	-	-	-	-
	E			-	-	-	-	-	-	-
5ADF	DF	LV_CAN_TEMP_MIN_THD[1]	Taupunkterkennung für NOx-Sensor	X	X	X	X	-	-	-
5AE0	E0	RST_SEC	Status-byte: security info for atypical reset (reset-save memory)	X	X	X	X	-	-	-
5AE1	E1	RST_CTR	For ECU without generic DBG driver: Number of atypical warm-resets since last power-up (reset-save memory)	X	X	X	X	-	-	-
5AE2	E2	RST_TYP	reset type of last reset	X	X	X	X	-	-	-
		STATE_RST_TYP_ACT	reset type of last reset	-	-	-	-	X	X	X
5AE3	E3	RST_DBG_BACK_INFO_VLD[0]	background info for last reset valid	X	X	X	X	-	-	-
		LV_DBG_INFO_VLD[0]	background info for last reset valid / RESET SAFE	-	-	-	-	X	X	X
5AE4	E4	RST_INFO_ADD[0]	Additional reset info (cause)	X	X	X	X	-	-	-
		STATE_RST_INFO_ADD[0]	Additional reset info (cause) / RESET SAFE	-	-	-	-	X	X	X
5AE5	E5	DIST_RST_DET[0]	Mileage counter at reset	X	X	X	X	X	X	X
5AE6	E6	TRT_RST_DET[0]	Total runtime at reset	X	X	X	X	X	X	X
5AE7	E7	CPU_LOAD_MAX_RST_DET[0]	Max. CPU load from reset detection	X	X	X	X	X	X	X
5AE8	E8	N_CPU_LOAD_MAX_RST_DET[0]	Engine speed at max. cpu load from reset detection	X	X	X	X	X	X	X
5AE9	E9	RST_CLAS_SEC[0]	Security info	X	X	X	X	-	-	-
5AEA	EA	RST_INFO_CTR	Number of atypical warm-resets since last power-up (BSW)	X	X	X	X	-	-	-
		CTR_WRST	Number of atypical warm-resets since last power-up (from BSW) / RESET SAFE	-	-	-	-	X	X	X
5AEB	EB	Tmot_b1	Kühlmitteltemperatur < 98°C	X	X	X	X	-	-	-
5AEC	E	Tmot_b2	98°C =< Kühlmitteltemperatur =< 112°C	X	X	X	X	-	-	-
5AED	E	Tmot_b3	113°C =< Kühlmitteltemperatur =< 120°C	X	X	X	X	-	-	-
5AEE	EE	Tmot_b4	121°C =< Kühlmitteltemperatur =< 125°C	X	X	X	X	-	-	-
5AEF	EF	Tmot_b5	Kühlmitteltemperatur > 125°C	X	X	X	X	-	-	-
5AF0	F0	Toel_b1	Motoröltemperatur < 80°C	X	X	X	X	-	-	-
5AF1	F1	Toel_b2	80°C =< Motoröltemperatur =< 110°C	X	X	X	X	-	-	-
5AF2	F2	Toel_b3	110°C =< Motoröltemperatur =< 135°C	X	X	X	X	-	-	-
5AF3	F3	Toel_b4	135°C =< Motoröltemperatur =< 150°C	X	X	X	X	-	-	-
5AF4	F4	Toel_b5	Motoröltemperatur > 150°C	X	X	X	X	-	-	-
5AF5	F5	Tget_b1	Getriebeöltemperatur < 80°C	X	X	X	X	-	-	-
5AF6	F6	Tget_b2	80°C =< Getriebeöltemperatur =< 109°C	X	X	X	X	-	-	-


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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5AF7	F7	Tget_b3	110°C =< Getriebeöltemperatur =< 124°C	X	X	X	X	-	-	-
5AF8	F8	Tget_b4	125°C =< Getriebeöltemperatur =< 129°C	X	X	X	X	-	-	-
5AF9	F9	Tget_b5	Getriebeöltemperatur > 129°C	X	X	X	X	-	-	-
5AFA	FA	Tumg_b1	Umgebungstemperatur < 3°C	X	X	X	X	-	-	-
5AFB	FB	Tumg_b2	3°C <= Umgebungstemperatur =< 19°C	X	X	X	X	-	-	-
5AFC	FC	Tumg_b3	20°C <= Umgebungstemperatur =< 29°C	X	X	X	X	-	-	-
5AFD	FD	Tumg_b4	30°C <= Umgebungstemperatur =< 39°C	X	X	X	X	-	-	-
5AFE	FE	Tumg_b5	Umgebungstemperatur > 39°C	X	X	X	X	-	-	-
				-	-	-	-	-	-	-
<b>5B MSD8x spezifisch</b>				-	-	-	-	-	-	-
5B00	00	TI_1_MES[0]	Einspritzzeit Zylinder 1 von der Endstufe rückgemessen	X	X	X	X	X	X	X
5B01	01	TI_1_MES[4]	Einspritzzeit Zylinder 2 von der Endstufe rückgemessen (for 4cyl and 6cyl) Einspritzzeit Zylinder 6 von der Endstufe rückgemessen (for 8cyl)	X	X	X	X	X	X	X
5B02	02	TI_1_MES[2]	Einspritzzeit Zylinder 3 von der Endstufe rückgemessen (for 6cyl) Einspritzzeit Zylinder 4 von der Endstufe rückgemessen (for 4cyl and 8cyl)	X	X	X	X	X	X	X
5B03	03	TI_1_MES[5]	Einspritzzeit Zylinder 4 von der Endstufe rückgemessen (for 4cyl and 6cyl) Einspritzzeit Zylinder 3 von der Endstufe rückgemessen (for 8cyl)	X	X	X	X	X	X	X
5B04	04	TI_1_MES[1]	Einspritzzeit Zylinder 5 von der Endstufe rückgemessen (for 6cyl and 8cyl) Einspritzzeit Zylinder 3 von der Endstufe rückgemessen (for 4cyl)	X	X	X	X	X	X	X
5B05	05	TI_1_MES[3]	Einspritzzeit Zylinder 6 von der Endstufe rückgemessen (for 6cyl) Einspritzzeit Zylinder 2 von der Endstufe rückgemessen (for 4cyl) Einspritzzeit Zylinder 8 von der Endstufe rückgemessen (for 8cyl)	X	X	X	X	X	X	X
5B06	06	TI_1_MES[6]	Einspritzzeit Zylinder 7 von der Endstufe rückgemessen	-	-	-	-	X	X	X
5B07	07	TI_1_MES[7]	Einspritzzeit Zylinder 2 von der Endstufe rückgemessen (for 8cyl)	-	-	-	-	X	X	X
5B08	08			-	-	-	-	-	-	-
5B09	09			-	-	-	-	-	-	-
5B0A	0A			-	-	-	-	-	-	-
5B0B	0B			-	-	-	-	-	-	-

ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5B0C	0C			-	-	-	-	-	-	-
5B0D	0D			-	-	-	-	-	-	-
5B0E	0E			-	-	-	-	-	-	-
5B0F	0F			-	-	-	-	-	-	-
5B10	10	EGY_STEP_INJ_CHA_GRD[0]	Tastverhältnis Injektor 1 von der Endstufe rückgemessen	X	X	X	X	X	X	X
5B11	11	EGY_STEP_INJ_CHA_GRD[4]	Tastverhältnis Injektor 2 von der Endstufe rückgemessen (for 6cyl) Tastverhältnis Injektor 6 von der Endstufe rückgemessen (for 8cyl)	-	-	X	X	X	X	X
5B12	12	EGY_STEP_INJ_CHA_GRD[2]	Tastverhältnis Injektor 3 von der Endstufe rückgemessen (for 6cyl) Tastverhältnis Injektor 4 von der Endstufe rückgemessen (for 4cyl and 8cyl)	X	X	X	X	X	X	X
5B13	13	EGY_STEP_INJ_CHA_GRD[5]	Tastverhältnis Injektor 4 von der Endstufe rückgemessen (for 6cyl) Tastverhältnis Injektor 3 von der Endstufe rückgemessen (for 8cyl)	-	-	X	X	X	X	X
5B14	14	EGY_STEP_INJ_CHA_GRD[1]	Tastverhältnis Injektor 5 von der Endstufe rückgemessen (for 4cyl and 8cyl) Tastverhältnis Injektor 3 von der Endstufe rückgemessen (for 4cyl)	X	X	X	X	X	X	X
5B15	15	EGY_STEP_INJ_CHA_GRD[3]	Tastverhältnis Injektor 6 von der Endstufe rückgemessen (for 6cyl) Tastverhältnis Injektor 2 von der Endstufe rückgemessen (for 4cyl) Tastverhältnis Injektor 8 von der Endstufe rückgemessen (for 8cyl)	X	X	X	X	X	X	X
5B16	16	EGY_STEP_INJ_CHA_GRD[6]	Tastverhältnis Injektor 7 von der Endstufe rückgemessen	-	-	-	-	X	X	X
5B17	17	EGY_STEP_INJ_CHA_GRD[7]	Tastverhältnis Injektor 2 von der Endstufe rückgemessen (for 8cyl)	-	-	-	-	X	X	X
5B18	18			-	-	-	-	-	-	-
5B19	19			-	-	-	-	-	-	-
5B1A	1A			-	-	-	-	-	-	-
5B1B	1B			-	-	-	-	-	-	-
5B1C	1C			-	-	-	-	-	-	-
5B1D	1D			-	-	-	-	-	-	-
5B1E	1E			-	-	-	-	-	-	-
5B1F	1F			-	-	-	-	-	-	-
5B20	20	CHA_IV_1_MES[0]	Elektrische Ladung Injektor 1	X	X	X	X	X	X	X
5B21	21	CHA_IV_1_MES[4]	Elektrische Ladung Injektor 2 (for 6cyl) Elektrische Ladung Injektor 6 (for 8cyl)	-	-	X	X	X	X	X
5B22	22	CHA_IV_1_MES[2]	Elektrische Ladung Injektor 3 (for 6cyl) Elektrische Ladung Injektor 4 (for 4cyl)	X	X	X	X	X	X	X

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
			and 8cyl)							
5B23	23	CHA_IV_1_MES[5]	Elektrische Ladung Injektor 4 (for 6cyl) Elektrische Ladung Injektor 3 (for 8cyl)	-	-	X	X	X	X	X
5B24	24	CHA_IV_1_MES[1]	Elektrische Ladung Injektor 5 (for 6cyl and 8cyl) Elektrische Ladung Injektor 3 (for 4cyl)	X	X	X	X	X	X	X
5B25	25	CHA_IV_1_MES[3]	Elektrische Ladung Injektor 6 (for 6cyl) Elektrische Ladung Injektor 2 (for 4cyl) Elektrische Ladung Injektor 8 (for 8cyl)	X	X	X	X	X	X	X
5B26	26	CHA_IV_1_MES[6]	Elektrische Ladung Injektor 7	-	-	-	-	X	X	X
5B27	27	CHA_IV_1_MES[7]	Elektrische Ladung Injektor 2 (for 8cyl)	-	-	-	-	X	X	X
5B28	28			-	-	-	-	-	-	-
5B29	29			-	-	-	-	-	-	-
5B2A	2A			-	-	-	-	-	-	-
5B2B	2B			-	-	-	-	-	-	-
5B2C	2C			-	-	-	-	-	-	-
5B2D	2D			-	-	-	-	-	-	-
5B2E	2E			-	-	-	-	-	-	-
5B2F	2F			-	-	-	-	-	-	-
5B30	30	V_IV_1_MES[0]	Spannung Injektor 1	X	X	X	X	X	X	X
5B31	31	V_IV_1_MES[4]	Spannung Injektor 2 (for 6cyl) Spannung Injektor 6 (for 8cyl)	-	-	X	X	X	X	X
5B32	32	V_IV_1_MES[2]	Spannung Injektor 3 (for 6cyl) Spannung Injektor 4 (for 4cyl and 8cyl)	X	X	X	X	X	X	X
5B33	33	V_IV_1_MES[5]	Spannung Injektor 4 (for 6cyl) Spannung Injektor 3 (for 8cyl)	-	-	X	X	X	X	X
5B34	34	V_IV_1_MES[1]	Spannung Injektor 5 (for 6cyl and 8cyl) Spannung Injektor 3 (for 4cyl)	X	X	X	X	X	X	X
5B35	35	V_IV_1_MES[3]	Spannung Injektor 6 (for 6cyl) Spannung Injektor 2 (for 4cyl) Spannung Injektor 8 (for 8cyl)	X	X	X	X	X	X	X
5B36	36	V_IV_1_MES[6]	Spannung Injektor 7 (for 8cyl)	-	-	-	-	X	X	X
5B37	37	V_IV_1_MES[7]	Spannung Injektor 2 (for 8cyl)	-	-	-	-	X	X	X
5B38	38			-	-	-	-	-	-	-
5B39	39			-	-	-	-	-	-	-
5B3A	3A			-	-	-	-	-	-	-
5B3B	3B			-	-	-	-	-	-	-
5B3C	3C			-	-	-	-	-	-	-
5B3D	3D			-	-	-	-	-	-	-

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5B3E	3E			-	-	-	-	-	-	-
5B3F	3F			-	-	-	-	-	-	-
5B40	40	FAC_EGY_PWM_AD[0]	Adaptationswert der Endstufe 1	X	X	X	X	X	X	X
5B41	41	FAC_EGY_PWM_AD[4]	Adaptationswert der Endstufe 2 (for 6cyl) Adaptationswert der Endstufe 6 (for 8cyl)	-	-	X	X	X	X	X
5B42	42	FAC_EGY_PWM_AD[2]	Adaptationswert der Endstufe 3 (for 6cyl) Adaptationswert der Endstufe 4 (for 4cyl and 8cyl)	X	X	X	X	X	X	X
5B43	43	FAC_EGY_PWM_AD[5]	Adaptationswert der Endstufe 4 (for 6cyl) Adaptationswert der Endstufe 3 (for 8cyl)	-	-	X	X	X	X	X
5B44	44	FAC_EGY_PWM_AD[1]	Adaptationswert der Endstufe 5 von der Endstufe rückgemessen (for 4cyl and 8cyl) Adaptationswert der Endstufe 3 (for 4cyl)	X	X	X	X	X	X	X
5B-	-	FAC_EGY_PWM_AD[3]	Adaptationswert der Endstufe 6 (for 6cyl) Adaptationswert der Endstufe 2 (for 4cyl) Adaptationswert der Endstufe 8 (for 8cyl)	X	X	X	X	X	X	X
5B46	46	FAC_EGY_PWM_AD[6]	Adaptationswert der Endstufe 7 (for 8cyl)	-	-	-	-	X	X	X
5B47	47	FAC_EGY_PWM_AD[7]	Adaptationswert der Endstufe 2 (for 8cyl)	-	-	-	-	X	X	X
5B48	48			-	-	-	-	-	-	-
5B49	49			-	-	-	-	-	-	-
5B4A	4A			-	-	-	-	-	-	-
5B4B	4B			-	-	-	-	-	-	-
5B4C	4C			-	-	-	-	-	-	-
5B4D	4D			-	-	-	-	-	-	-
5B4E	4E			-	-	-	-	-	-	-
5B4F	4F			-	-	-	-	-	-	-
5B50	50	FAC_CYL_LAM_COR[0]	Momentan eingerechnete CILC-Werte Injektor 1	X	X	X	X	-	-	-
5B51	51	FAC_CYL_LAM_COR[4]	Momentan eingerechnete CILC-Werte Injektor 2 (for 6cyl) Momentan eingerechnete CILC-Werte Injektor 6 (for 8cyl)	-	-	X	X	-	-	-
5B52	52	FAC_CYL_LAM_COR[2]	Momentan eingerechnete CILC-Werte Injektor 3 (for 6cyl) Momentan eingerechnete CILC-Werte Injektor 4 (for 4cyl and 8cyl)	X	X	X	X	-	-	-
5B53	53	FAC_CYL_LAM_COR[5]	Momentan eingerechnete CILC-Werte Injektor 4 (for 6cyl) Momentan eingerechnete CILC-Werte	-	-	X	X	-	-	-

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
			Injektor 3 (for 8cyl)							
5B54	54	FAC_CYL_LAM_COR[1]	Momentan eingerechnete CILC-Werte Injektor 5 (for 6cyl and 8cyl) Momentan eingerechnete CILC-Werte Injektor 3 (for 4cyl)	X	X	X	X	-	-	-
5B55	55	FAC_CYL_LAM_COR[3]	Momentan eingerechnete CILC-Werte Injektor 6 (for 6cyl) Momentan eingerechnete CILC-Werte Injektor 2 (for 4cyl) Momentan eingerechnete CILC-Werte Injektor 8 (for 8cyl)	X	X	X	X	-	-	-
5B56	56			-	-	-	-	-	-	-
5B57	57			-	-	-	-	-	-	-
5B58	58			-	-	-	-	-	-	-
5B59	59			-	-	-	-	-	-	-
5B5A	5A			-	-	-	-	-	-	-
5B5B	5B			-	-	-	-	-	-	-
5B5C	5C			-	-	-	-	-	-	-
5B5D	5D			-	-	-	-	-	-	-
5B5E	5E			-	-	-	-	-	-	-
5B5F	5F			-	-	-	-	-	-	-
5B60	60	FAC_LAM_CYL_SEL_ADJ_CST[0]	CILC-Adaption kalt Injektor 1	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_IS_ER_BAL_HO M[0]	Extended idle speed range correction factor adaptation value for cylinder balancing homogenous, injector 1	-	-	-	-	X	X	X
5B61	61	FAC_LAM_CYL_SEL_ADJ_CST[4]	CILC-Adaption kalt Injektor 2 (for 6cyl) CILC-Adaption kalt Injektor 6 (for 8cyl)	-	-	X	X	-	-	-
		FAC_COR_AD_RNG_IS_ER_BAL_HO M[1]	Extended idle speed range correction factor adaptation value for cylinder balancing homogenous, injector 2	-	-	-	-	X	X	X
5B62	62	FAC_LAM_CYL_SEL_ADJ_CST[2]	CILC-Adaption kalt Injektor 3 (for 6cyl) CILC-Adaption kalt Injektor 4 (for 4cyl and 8cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_IS_ER_BAL_HO M[2]	Extended idle speed range correction factor adaptation value for cylinder balancing homogenous, injector 3	-	-	-	-	X	X	X
5B63	63	FAC_LAM_CYL_SEL_ADJ_CST[5]	CILC-Adaption kalt Injektor 4 (for 6cyl) CILC-Adaption kalt Injektor 3 (for 8cyl)	-	-	X	X	-	-	-
		FAC_COR_AD_RNG_IS_ER_BAL_HO M[3]	Extended idle speed range correction factor adaptation value for cylinder balancing homogenous, injector 4	-	-	-	-	X	X	X


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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5B64	64	FAC_LAM_CYL_SEL_ADJ_CST[1]	CILC-Adaption kalt Injektor 5 (for 6cyl and 8cyl) CILC-Adaption kalt Injektor 3 (for 4cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_IS_ER_BAL_HOM[4]	Extended idle speed range correction factor adaptation value for cylinder balancing homogenous, injector 5	-	-	-	-	X	X	X
5B65	65	FAC_LAM_CYL_SEL_ADJ_CST[3]	CILC-Adaption kalt Injektor 6 (for 6cyl) CILC-Adaption kalt Injektor 2 (for 4cyl) CILC-Adaption kalt Injektor 8 (for 8cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_IS_ER_BAL_HOM[5]	Extended idle speed range correction factor adaptation value for cylinder balancing homogenous, injector 6	-	-	-	-	X	X	X
5B66	66	FAC_COR_AD_RNG_IS_ER_BAL_HOM[6]	Extended idle speed range correction factor adaptation value for cylinder balancing homogenous, injector 7	-	-	-	-	X	X	X
5B67	67	FAC_COR_AD_RNG_IS_ER_BAL_HOM[7]	Extended idle speed range correction factor adaptation value for cylinder balancing homogenous, injector 8	-	-	-	-	X	X	X
5B68	68			-	-	-	-	-	-	-
5B69	69			-	-	-	-	-	-	-
5B6A	6A			-	-	-	-	-	-	-
5B6B	6B			-	-	-	-	-	-	-
5B6C	6C			-	-	-	-	-	-	-
5B6D	6D			-	-	-	-	-	-	-
5B6E	6E			-	-	-	-	-	-	-
5B6F	6F			-	-	-	-	-	-	-
5B70	70	MFF_ADD_AD_ER_BAL[0]	ER-Adaption TI-additiv im LL Schicht für Injektor 1	X	X	X	X	-	-	-
5B71	71	MFF_ADD_AD_ER_BAL[4]	ER-Adaption TI-additiv im LL Schicht für Injektor 2(for 6cyl)	-	-	X	X	-	-	-
5B72	72	MFF_ADD_AD_ER_BAL[2]	ER-Adaption TI-additiv im LL Schicht für Injektor 3 ER-Adaption TI-additiv im LL Schicht für Injektor 4(for 4cyl )	X	X	X	X	-	-	-
5B73	73	MFF_ADD_AD_ER_BAL[5]	ER-Adaption TI-additiv im LL Schicht für Injektor 4(for 6cyl)	-	-	X	X	-	-	-
5B74	74	MFF_ADD_AD_ER_BAL[1]	ER-Adaption TI-additiv im LL Schicht für Injektor 5  ER-Adaption TI-additiv im LL Schicht für Injektor 3 (for 4cyl N43)	X	X	X	X	-	-	-


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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5B75	75	MFF_ADD_AD_ER_BAL[3]	ER-Adaption TI-additiv im LL Schicht für Injektor 6  ER-Adaption TI-additiv im LL Schicht für Injektor 2 (for 4cyl N43)	X	X	X	X	-	-	-
5B76	76			-	-	-	-	-	-	-
5B77	77			-	-	-	-	-	-	-
5B78	78			-	-	-	-	-	-	-
5B79	79			-	-	-	-	-	-	-
5B7A	7A			-	-	-	-	-	-	-
5B7B	7B			-	-	-	-	-	-	-
5B7C	7C			-	-	-	-	-	-	-
5B7D	7D			-	-	-	-	-	-	-
5B7E	7E			-	-	-	-	-	-	-
5B7F	7F			-	-	-	-	-	-	-
5B80	80	MFF_ADD_ER_BAL[0]	ER_MFF_additiv im LL-Schicht (momentan eingerechnetr Wert ) für Injektor 1	X	X	X	X	-	-	-
5B81	81	MFF_ADD_ER_BAL[4]	ER_MFF_additiv im LL-Schicht (momentan eingerechnetr Wert ) für Injektor 2 (for 6cyl)	-	-	X	X	-	-	-
5B82	82	MFF_ADD_ER_BAL[2]	ER_MFF_additiv im LL-Schicht (momentan eingerechnetr Wert ) für Injektor 3(for 6cyl) ER_MFF_additiv im LL-Schicht (momentan eingerechnetr Wert ) für Injektor 4 (for 4cyl)	X	X	X	X	-	-	-
5B83	83	MFF_ADD_ER_BAL[5]	ER_MFF_additiv im LL-Schicht (momentan eingerechnetr Wert ) für Injektor 4 (for 6cyl)	-	-	X	X	-	-	-
5B84	84	MFF_ADD_ER_BAL[1]	ER_MFF_additiv im LL-Schicht (momentan eingerechnetr Wert ) für Injektor 5 (for 6cyl) ER_MFF_additiv im LL-Schicht (momentan eingerechnetr Wert ) für Injektor 3 (for 4cyl)	X	X	X	X	-	-	-
5B85	85	MFF_ADD_ER_BAL[3]	ER_MFF_additiv im LL-Schicht (momentan eingerechnetr Wert ) für Injektor 6 (for 6cyl) ER_MFF_additiv im LL-Schicht (momentan eingerechnetr Wert ) für Injektor 2 (for 4cyl )	X	X	X	X	-	-	-
5B86	86			-	-	-	-	-	-	-
5B87	87			-	-	-	-	-	-	-
5B88	88			-	-	-	-	-	-	-
5B89	89			-	-	-	-	-	-	-
5B8A	8A			-	-	-	-	-	-	-
5B8B	8B			-	-	-	-	-	-	-


ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5B8C	8C			-	-	-	-	-	-	-
5B8D	8D			-	-	-	-	-	-	-
5B8E	8E			-	-	-	-	-	-	-
5B8F	8F			-	-	-	-	-	-	-
5B90	90	FAC_TI_AD_ER_BAL[0]	ER-Adaptionsfaktor in Schicht Teillast für Injektor 1	X	X	X	X	-	-	-
5B91	91	FAC_TI_AD_ER_BAL[4]	ER-Adaptionsfaktor in Schicht Teillast für Injektor 2 (for 6cyl)	-	-	X	X	-	-	-
5B92	92	FAC_TI_AD_ER_BAL[2]	ER-Adaptionsfaktor in Schicht Teillast für Injektor 3 (for 6cyl) ER-Adaptionsfaktor in Schicht Teillast für Injektor 4 (for 4cyl )	X	X	X	X	-	-	-
5B93	93	FAC_TI_AD_ER_BAL[5]	ER-Adaptionsfaktor in Schicht Teillast für Injektor 4 (for 6cyl)	-	-	X	X	-	-	-
5B94	94	FAC_TI_AD_ER_BAL[1]	ER-Adaptionsfaktor in Schicht Teillast für Injektor 5 (for 6cyl) ER-Adaptionsfaktor in Schicht Teillast für Injektor 3 (for 4cyl)	X	X	X	X	-	-	-
5B95	95	FAC_TI_AD_ER_BAL[3]	ER-Adaptionsfaktor in Schicht Teillast für Injektor 6 (for 6cyl) ER-Adaptionsfaktor in Schicht Teillast für Injektor 2 (for 4cyl )	X	X	X	X	-	-	-
5B96	96			-	-	-	-	-	-	-
5B97	97			-	-	-	-	-	-	-
5B98	98			-	-	-	-	-	-	-
5B99	99			-	-	-	-	-	-	-
5B9A	9A			-	-	-	-	-	-	-
5B9B	9B			-	-	-	-	-	-	-
5B9C	9C			-	-	-	-	-	-	-
5B9D	9D			-	-	-	-	-	-	-
5B9E	9E			-	-	-	-	-	-	-
5B9F	9F			-	-	-	-	-	-	-
5BA0	A0	FAC_TI_ER_BAL[0]	ER-Faktor in Schicht Teillast momentan eingerechnet für Injektor 1	X	X	X	X	-	-	-
5BA1	A1	FAC_TI_ER_BAL[4]	ER-Faktor in Schicht Teillast momentan eingerechnet für Injektor 2 (for 6cyl)	-	-	X	X	-	-	-
5BA2	A2	FAC_TI_ER_BAL[2]	ER-Faktor in Schicht Teillast momentan eingerechnet für Injektor 3 (for 6cyl) ER-Faktor in Schicht Teillast momentan eingerechnet für Injektor 4 (for 4cyl N43)	X	X	X	X	-	-	-
5BA3	A3	FAC_TI_ER_BAL[5]	ER-Faktor in Schicht Teillast momentan eingerechnet für Injektor 4 (for 6cyl)	-	-	X	X	-	-	-
5BA4	A4	FAC_TI_ER_BAL[1]	ER-Faktor in Schicht Teillast momentan eingerechnet für Injektor 5 (for 6cyl)	X	X	X	X	-	-	-

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
			ER-Faktor in Schicht Teillast momentan eingerechnet für Injektor 3 (for 4cyl)							
5BA5	A5	FAC_TI_ER_BAL[3]	ER-Faktor in Schicht Teillast momentan eingerechnet für Injektor 6 (for 6cyl) ER-Faktor in Schicht Teillast momentan eingerechnet für Injektor 2 (for 4cyl)	X	X	X	X	-	-	-
5BA6	A6			-	-	-	-	-	-	-
5BA7	A7			-	-	-	-	-	-	-
5BA8	A8			-	-	-	-	-	-	-
5BA9	A9			-	-	-	-	-	-	-
5BAA	AA			-	-	-	-	-	-	-
5BAB	AB			-	-	-	-	-	-	-
5BAC	A C			-	-	-	-	-	-	-
5BAD	A D			-	-	-	-	-	-	-
5BAE	AE			-	-	-	-	-	-	-
5BAF	AF			-	-	-	-	-	-	-
5BB0	B0	LV_CYL_BAL_LAM_AD_EOL	Lambdaadaption am Bandende hat fertig gelernt	X	X	X	X	-	-	-
5BB1	B1	LV_CYL_BAL_ER_AD_ADD_EOL	ER-Balancing am Bandende hat additiv adaptiert	X	X	X	X	-	-	-
5BB2	B2	LV_CYL_BAL_LAM_AD_DC	Lambdaadaption ist nötig, zyklisch während Motorbetrieb zu 1 gesetzt	X	X	X	X	-	-	-
5BB3	B3	LV_CYL_BAL_ER_AD_FAC_EOL	ER-Balancing am Bandende hat den Faktor adaptiert	X	X	X	X	-	-	-
5BB4	B4	LV_CYL_BAL_AD_HOM_REQ_DC	Zylindersel. Lambdaregelung fordert homogen an, zyklisch während dem Motorbetrieb zu 1 gesetzt	X	X	X	X	-	-	-
5BB5	B5	LV_CYL_BAL_LAM_SEL_AD_COLD_EOL	Zylindersel. Lambdaregelung kalt am Bandende hat fertig adaptiert	X	X	X	X	-	-	-
5BB6	B6	LV_CYL_BAL_LAM_SEL_AD_HOT_EOL	Zylindersel. Lambdaregelung warm am Bandende hat fertig adaptiert	X	X	X	X	-	-	-
5BB7	B7	LV_CYL_BAL_LAM_SEL_AD_HOT_DC	Zylindersel. Lambdaregelung warm ist nötig, zyklisch während Motorbetrieb zu 1 gesetzt	X	X	X	X	-	-	-
5BB8	B8	LV_CYL_BAL_AD_WG_OPEN_REQ[1]	Zylindersel. Lambdaregelung fordert offene WG an, zyklisch während dem Motorbetrieb zu 1 gesetzt	X	X	X	X	-	-	-
5BB9	B9	LV_CYL_BAL_AD_WG_OPEN_REQ[2]	Zylindersel. Lambdaregelung fordert öffnen WG2 an, zyklisch während dem Motorbetrieb zu 1 gesetzt	X	X	X	X	-	-	-
5BBA	BA	Rt_bastatg_h	Relative Zeit Homogen-Betrieb gesamter Motorlauf	X	X	X	X	-	-	-
5BBB	BB	Rt_bastatg_hs	Relative Zeit Homogen-Schicht-Betrieb gesamter Motorlauf	X	X	X	X	-	-	-
5BBC	B C	Rt_bastatg_s	Relative Zeit Schicht-Betrieb gesamter Motorlauf	X	X	X	X	-	-	-

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7364 of 8404	
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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5BBD	B D	Rt_bastatg_sa	Relative Zeit Homogen-Betrieb gesamter Motorlauf	X	X	X	X	-	-	-
5BBE	BE	LF_ERR_PLAUS_IV_EGY_CAL	cylinder individuell bit coded not plausible injector valve coding values "Energie" (1 - not plausible, 0 - plausible )	X	X	X	X	X	X	X
5BBF	BF	LF_ERR_PLAUS_IV_MFF_CAL	cylinder individuell bit coded not plausible injector valve coding values "Kleinmenge" (1 - not plausible, 0 - plausible )	X	X	X	X	X	X	X
5BC0	C0			-	-	-	-	-	-	-
5BC1	C1			-	-	-	-	-	-	-
5BC2	C2			-	-	-	-	-	-	-
5BC3	C3			-	-	-	-	-	-	-
5BC4	C4			-	-	-	-	-	-	-
5BC5	C5			-	-	-	-	-	-	-
5BC6	C6			-	-	-	-	-	-	-
5BC7	C7			-	-	-	-	-	-	-
5BC8	C8			-	-	-	-	-	-	-
5BC9	C9			-	-	-	-	-	-	-
5BCA	C A	FAC_LAM_TCO_A[1]	Lambda-Teillastadaption Bank 1 im Kühlmitteltemperaturmesspunkt A	X	X	X	X	X	X	X
5BCB	C B	FAC_LAM_TCO_A[2]	Lambda-Teillastadaption Bank 2 im Kühlmitteltemperaturmesspunkt A	X	X	X	X	X	X	X
5BC	C C	FAC_LAM_TCO_B[1]	Lambda-Teillastadaption Bank 1 im Kühlmitteltemperaturmesspunkt B	X	X	X	X	X	X	X
5BC	C D	FAC_LAM_TCO_B[2]	Lambda-Teillastadaption Bank 2 im Kühlmitteltemperaturmesspunkt B	X	X	X	X	X	X	X
5BCE	C E	FAC_LAM_TCO_C[1]	Lambda-Teillastadaption Bank 1 im Kühlmitteltemperaturmesspunkt C	X	X	X	X	X	X	X
5BCF	CF	FAC_LAM_TCO_C[2]	Lambda-Teillastadaption Bank 2 im Kühlmitteltemperaturmesspunkt C	X	X	X	X	X	X	X
5BD0	D0	FAC_LAM_TCO_D[1]	Lambda-Teillastadaption Bank 1 im Kühlmitteltemperaturmesspunkt D	X	X	X	X	X	X	X
5BD1	D1	FAC_LAM_TCO_D[2]	Lambda-Teillastadaption Bank 2 im Kühlmitteltemperaturmesspunkt D	X	X	X	X	X	X	X
5BD2	D2	FAC_LAM_TCO_E[1]	Lambda-Teillastadaption Bank 1 im Kühlmitteltemperaturmesspunkt E	X	X	X	X	X	X	X
5BD3	D3	FAC_LAM_TCO_E[2]	Lambda-Teillastadaption Bank 2 im Kühlmitteltemperaturmesspunkt E	X	X	X	X	X	X	X
5BD4	D4			-	-	-	-	-	-	-
5BD5	D5			-	-	-	-	-	-	-
5BD6	D6			-	-	-	-	-	-	-
5BD7	D7			-	-	-	-	-	-	-
5BD8	D8			-	-	-	-	-	-	-
5BD9	D9			-	-	-	-	-	-	-
5BDA	D A			-	-	-	-	-	-	-
5BDB	D D			-	-	-	-	-	-	-

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 7365 of 8404</b>	
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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
	B									
5BD C	D C			-	-	-	-	-	-	-
5BD D	D D			-	-	-	-	-	-	-
5BDE	D E			-	-	-	-	-	-	-
5BDF	DF			-	-	-	-	-	-	-
5BE0	E0	FAC_LAM_CYL_SEL_ADJ_H_RNG[0]	CILC-Adaptionswert warm High-Range Injektor 1	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_H_ER_BAL_HOM[0]	Extended high range correction factor adaptation value for cylinder balancing homogenous, logical injektor 1	-	-	-	-	X	X	X
5BE1	E1	FAC_LAM_CYL_SEL_ADJ_H_RNG[4]	CILC-Adaptionswert warm High-Range Injektor 2 (for 6cyl) CILC-Adaptionswert warm High-Range Injektor 6 (for 8cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_H_ER_BAL_HOM[1]	Extended high range correction factor adaptation value for cylinder balancing homogenous, logical injektor 2	-	-	-	-	X	X	X
5BE2	E2	FAC_LAM_CYL_SEL_ADJ_H_RNG[2]	CILC-Adaptionswert warm High-Range Injektor 3 (for 6cyl) CILC-Adaptionswert warm High-Range Injektor 4 (for 4cyl and 8cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_H_ER_BAL_HOM[2]	Extended high range correction factor adaptation value for cylinder balancing homogenous, logical injektor 3	-	-	-	-	X	X	X
5BE3	E3	FAC_LAM_CYL_SEL_ADJ_H_RNG[5]	CILC-Adaptionswert warm High-Range Injektor 4 (for 6cyl) CILC-Adaptionswert warm High-Range Injektor 3 (for 8cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_H_ER_BAL_HOM[3]	Extended high range correction factor adaptation value for cylinder balancing homogenous, logical injektor 4	-	-	-	-	X	X	X
5BE4	E4	FAC_LAM_CYL_SEL_ADJ_H_RNG[1]	CILC-Adaptionswert warm High-Range Injektor 5 (for 6cyl and 8cyl) CILC-Adaptionswert warm High-Range Injektor 3 (for 4cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_H_ER_BAL_HOM[4]	Extended high range correction factor adaptation value for cylinder balancing homogenous, logical injektor 5	-	-	-	-	X	X	X

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5BE5	E5	FAC_LAM_CYL_SEL_ADJ_H_RNG[3]	CILC-Adaptionswert warm High-Range Injektor 6 (for 6cyl) CILC-Adaptionswert warm High-Range Injektor 2 (for 4cyl) CILC-Adaptionswert warm High-Range Injektor 8 (for 8cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_H_ER_BAL_HOM [5]	Extended high range correction factor adaptation value for cylinder balancing homogenous, logical injektor 6	-	-	-	-	X	X	X
5BE6	E6	FAC_COR_AD_RNG_H_ER_BAL_HOM [6]	Extended high range correction factor adaptation value for cylinder balancing homogenous, logical injektor 7	-	-	-	-	X	X	X
5BE7	E7	FAC_COR_AD_RNG_H_ER_BAL_HOM [7]	Extended high range correction factor adaptation value for cylinder balancing homogenous, logical injektor 8	-	-	-	-	X	X	X
5BE8	E8			-	-	-	-	-	-	-
5BE9	E9			-	-	-	-	-	-	-
5BEA	EA			-	-	-	-	-	-	-
5BEB	EB			-	-	-	-	-	-	-
5BEC	E C			-	-	-	-	-	-	-
5BED	E D			-	-	-	-	-	-	-
5BEE	EE			-	-	-	-	-	-	-
5BEF	EF			-	-	-	-	-	-	-
5BF0	F0	FAC_LAM_CYL_SEL_ADJ_L_RNG[0]	CILC-Adaptionswert warm Low-Range Injektor 1	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_L_ER_BAL_HOM [0]	Extended low range correction factor adaptation value for cylinder balancing homogenous, logical injektor 1	-	-	-	-	X	X	X
5BF1	F1	FAC_LAM_CYL_SEL_ADJ_L_RNG[4]	CILC-Adaptionswert warm Low-Range Injektor 2 (for 6cyl) CILC-Adaptionswert warm Low-Range Injektor 6 (for 8cyl)	-	-	X	X	-	-	-
		FAC_COR_AD_RNG_L_ER_BAL_HOM [1]	Extended low range correction factor adaptation value for cylinder balancing homogenous, logical injektor 2	-	-	-	-	X	X	X
5BF2	F2	FAC_LAM_CYL_SEL_ADJ_L_RNG[2]	CILC-Adaptionswert warm Low-Range Injektor 3 (for 6cyl) CILC-Adaptionswert warm Low-Range Injektor 4 (for 4cyl and 8cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_L_ER_BAL_HOM [2]	Extended low range correction factor adaptation value for cylinder balancing homogenous, logical	-	-	-	-	X	X	X


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	Document key 10171571 SPE 000 AO	Pages Page 7367 of 8404	
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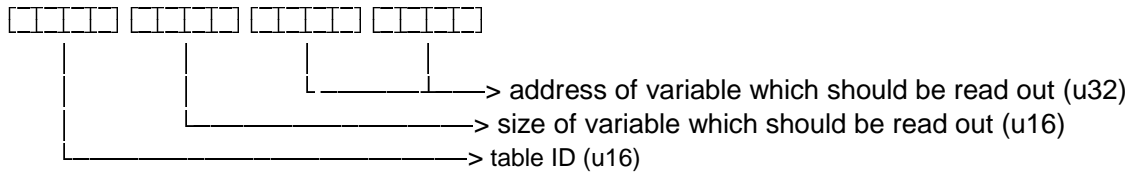
ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
			injektor 3							
5BF3	F3	FAC_LAM_CYL_SEL_ADJ_L_RNG[5]	CILC-Adaptionswert warm Low-Range Injektor 4 (for 6cyl) CILC-Adaptionswert warm Low-Range Injektor 3 (for 8cyl)	-	-	X	X	-	-	-
		FAC_COR_AD_RNG_L_ER_BAL_HOM [3]	Extended low range correction factor adaptation value for cylinder balancing homogenous, logical injektor 4	-	-	-	-	X	X	X
5BF4	F4	FAC_LAM_CYL_SEL_ADJ_L_RNG[1]	CILC-Adaptionswert warm Low-Range Injektor 5 (for 6cyl and 8cyl) CILC-Adaptionswert warm Low-Range Injektor 3 (for 4cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_L_ER_BAL_HOM [4]	Extended low range correction factor adaptation value for cylinder balancing homogenous, logical injektor 5	-	-	-	-	X	X	X
5BF5	F5	FAC_LAM_CYL_SEL_ADJ_L_RNG[3]	CILC-Adaptionswert warm Low-Range Injektor 6 (for 6cyl) CILC-Adaptionswert warm Low-Range Injektor 2 (for 4cyl) CILC-Adaptionswert warm Low-Range Injektor 8 (for 8cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_L_ER_BAL_HOM [5]	Extended low range correction factor adaptation value for cylinder balancing homogenous, logical injektor 6	-	-	-	-	X	X	X
5BF6	F6	FAC_COR_AD_RNG_L_ER_BAL_HOM [6]	Extended low range correction factor adaptation value for cylinder balancing homogenous, logical injektor 7	-	-	-	-	X	X	X
5BF7	F7	FAC_COR_AD_RNG_L_ER_BAL_HOM [7]	Extended low range correction factor adaptation value for cylinder balancing homogenous, logical injektor 8	-	-	-	-	X	X	X
5BF8	F8			-	-	-	-	-	-	-
5BF9	F9			-	-	-	-	-	-	-
5BFA	FA			-	-	-	-	-	-	-
5BFB	FB			-	-	-	-	-	-	-
5BFC	FC			-	-	-	-	-	-	-
5BFD	FD			-	-	-	-	-	-	-
5BFE	FE			-	-	-	-	-	-	-
5BFF	FF			-	-	-	-	-	-	-

### I.5.6.3 Further manual definable DDLI- List (not for ERRM)

In the dataset one more DDLI- list is implemented. In this list further variables for DDLI- read can be inserted without a software change. The insertion must be done with help of a hex editor. It is necessary to get the start address of the table DDLI\_table\_cal from the map- file, open the dataset (\*.s19- file) and edit it from the start address on. In the hex- file is always the same character string behind the table identifier. It contains the following information:

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	Document key 10171571 SPE 000 AO	Pages Page 7368 of 8404	
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On third position (byte 5 - 8) you have to insert the address of the wanted variable. The address can be taken from the map- file of the corresponding software and must be changed at every software change, too. On second position the correct size of the variable has to be inserted (e.g. 8 for a byte- variable).

5Fxx	DDL- List in dataset for auxiliary variables		
5FE0	E0	nn	nn
5FE1	E1	nn	nn
5FE2	E2	nn	nn
5FE3	E3	nn	nn
5FE4	E4	nn	nn
5FE5	E5	nn	nn
5FE6	E6	nn	nn
5FE7	E7	nn	nn
5FE8	E8	nn	nn
5FE9	E9	nn	nn
5FEA	EA	nn	nn
5FEB	EB	nn	nn
5FEC	EC	nn	nn
5FED	ED	nn	nn
5FEE	EE	nn	nn
5FEF	EF	nn	nn
5FF0	F0	nn	nn
5FF1	F1	nn	nn
5FF2	F2	nn	nn
5FF3	F3	nn	nn
5FF4	F4	nn	nn
5FF5	F5	nn	nn
5FF6	F6	nn	nn
5FF7	F7	nn	nn
5FF8	F8	nn	nn
5FF9	F9	nn	nn
5FFA	FA	nn	nn
5FFB	FB	nn	nn
5FFC	FC	nn	nn
5FFD	FD	nn	nn
5FFE	FE	nn	nn
5FFF	FF	nn	nn

## I.6 KWP2000 - SID 10h: startDiagnosticSession Service

### Input data:

LV_IGK {p. 906}		
-----------------	--	--

### General information:

This function is the first function when a diagnostic session starts.

Changing the diagnostic mode or switch over to another baudrate is possible after the command stop or reset KWP2000 inactive mode is set.

### StartDiagnosticSession Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startDiagnosticSessionRequest Service Id	M	#10h	STDS
#2d	diagnosticMode= [ Standard Diag.Mode Periodic Transmission Mode ECU Programming Mode Development Mode safty mode ]	M	#XXh= [ #81h #82h #85h #86h #89h ]	DCM
#3d	baudrateIdentifier (#XXh) = [ 9600 Baud 19200 Baud 38400 Baud 57600 Baud 115200 Baud (113636 Baud) (*) by tester ]	C	#XXh= [ #01h #02h #03h #04h #05h #06h ]	BI
#4d	Baud rate high byte (if baudrateIdentifier = 6)	C	#XXh	#XX
#5d	Baud rate middle byte (if baudrateIdentifier = 6)	C	#XXh	#XX
#6d	Baud rate low byte (if baudrateIdentifier = 6)	C	#XXh	#XX

Figure I.6.1: Table startDiagnosticSession Request Message

(\*) : With the MPC555 controller and a frequency of 40 MHz it is not possible to generate 115200baud with the desired tolerance range of +-1%.

The baudrate, which can be generated exactly by MPC555 and 40MHz, is 113636Baud.

1. Is the current DiagnosticSession different from StandardDiagnosticSession, it is not possible to get a positive response with the request stopCommunication. To stop the communication the ECU has to be turned back in the StandardDiagnosticSession with stopDiagnosticSession (SPDS) or the startDiagnosticSession (STDS [DCM #81h]) request.
2. Is the startDiagnosticSession request used without a baudrateMode or is the current request answered by negative response, the last selected baudrate and mode are still active.

### StartDiagnosticSession positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startDiagnosticSession Positive response	M	#50h	STDSPR
#2d	diagnosticMode= [ Std.Diagnostic Mode Periodic Transmission Mode ECU Programming Mode Development mode safty mode ]	M	#XXh= [ #81h #82h #85h #86h #89h ]	DCM
#3d	BaudrateIdentifier (#XXh) = [ f <sub>CPU</sub> =16MHz      f <sub>CPU</sub> =20 MHz      f <sub>CPU</sub> =24 MHz 9600 Baud          + 0,2%    + 0,2%    + 0,2% 19200 Baud         + 0,2%    + 1,7%    + 0,2% 38400 Baud         + 0,2%    + 1,7%    + 2,8% 57600 Baud         + 8,5%    + 8,5%    + 0,2% 115200 Baud        + 8,5%    + 8,5%    + 8,5% by tester ]	C	#XXh= [ #01h #02h #03h #04h #05h #06h ]	BI
#4d	Baud rate high byte	C	#XXh	#XX
#5d	Baud rate middle byte	C	#XXh	#XX
#6d	Baud rate low byte	C	#XXh	#XX

Figure I.6.2: Table startDiagnosticSession Positive Response Message

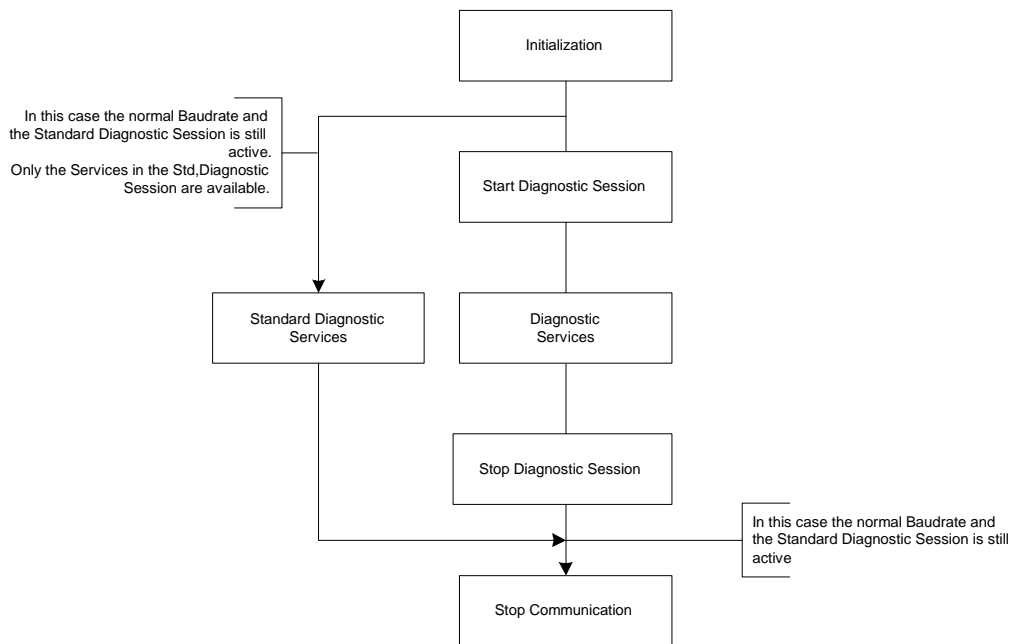
**StartDiagnosticSession negative Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	startDiagnosticSessionRequest Service Id	M	#10h	STDS
#3d	responseCode= [ conditionsNotCorrect, requestOutOfRange, wrong baud rate ]	M	#XXh= [ #22h, #31h, ]	RC

Figure I.6.3: Table startDiagnosticSession Negative Response Message

NegativeResponseCode	Cause of Occurrence
conditionsNotCorrect	selected diagnosticMode is not supported
requestOutOfRange	selected baudrate is not supported

**Message flow Diagnostic Session**



### StartDiagnosticSession (Periodic Transmission mode #82h)

Is only supported for KWP

### KWP2000 Periodic Transmission Mode Message Flow

This section specifies the conditions to enable the **Periodic Transmission** mode (#82) in the client (tester) and the server (ECU).

It also specifies the use of the service **accessTimingParameter** within this mode to modify the **PeriodicTransmission mode** default timing.

### Periodic Transmission Mode Message Flow

time	Client (tester) Request Message	Hex
	startCommunication Request Service ID	#81h

time	Server (ECU) PosResponse Message #2	Hex
P2	startCommunication PosRspSid [ Key byte 1 Key byte 2 ]	#C1h #XXh #XXh
	goto STEP#1 or STEP#2	

### STEP#1 dynamicallyDefineLocalIdentifier Request Service() (optinal)

time	Client (tester) Request Message	Hex
P3*	dynamicallyDefineLocalIdentifier Request Service ID [ possible parameter see service description ] <i>define the DDLI #F0h</i>	#2Ch #XXh

<i>time</i>	<i>Server (ECU) PosResponse Message #2</i>	<i>Hex</i>	<i>Server (ECU) NegResponse Message</i>	<i>Hex</i>
P2	dynamicallyDefineLocalIdentifier PosRspSId= [ ... ] goto STEP#2	#C3h   #XXh	negRespSId dynamicallyDefineLocalIdentifier ReqSId [ responseCode { see service description } ] ]	#7Fh #2Ch  #XXh
:	:	:	:	:

### STEP#2 startDiagnosticSession(DM\_PeriodicTransmission)

<i>time</i>	<i>Client (tester) Request Message</i>	<i>Hex</i>
P3	startDiagnosticSession Request Service ID= [ diagnosticMode = PeriodicTransmission SDMWPT ] ]	#10h  #82h

<i>time</i>	<i>Server (ECU) PosResponse Message #1</i>	<i>Hex</i>	<i>Server (ECU) NegResponse Message</i>	<i>Hex</i>
P2	startDiagnosticSession PosRspSId= [ diagnosticMode = SDMWPT PeriodicTransmission Mode ] ]	#50h  #82h	negResponseSId startDiagnosticSession ReqSId= [ responseCode { see service description } ] ]	#7Fh #21h  #XXh

### \*\*\* PeriodicTransmission mode with default timing enabled \*\*\*

<i>time</i>	<i>Server (ECU) PosResponse Message #2</i>	<i>Hex</i>
P2	startDiagnosticSession PosRspSId= [ diagnosticMode = SDMWPT ] ]	#50h  #82h

:

<i>time</i>	<i>Server (ECU) PosResponse Message #n</i>	<i>Hex</i>
P2	startDiagnosticSession PosRspSId= [ diagnosticMode = SDMWPT ] ]	#50h  #82h
	goto STEP#2 or STEP #3	

:

### STEP#2 accessTimingParameters(readLimitsOfPossibleValues) (optional)

<i>time</i>	<i>Client (tester) Request Message</i>	<i>Hex</i>
P3*	accessTimingParameters Request Service ID = [ TPI = readLimitsOfPossibleValues ] ]	#83h  #00h

time	Server (ECU) PosResponse Message #1	Hex
P2	accessTimingParameters PosRspSId= [ ... ]	#C3h  #XXh
	goto STEP#3 or to STEP#4	

:

:

time	Server (ECU) PosResponse Message #n	Hex
P2	accessTimingParameters PosRspSId= [ ... ]	#C3h  #XXh
	goto STEP#3 or to STEP#4	

:

:

Server (ECU) NegResponse Message	Hex
negRespSId	#7Fh
accessTimingParameters ReqSId= [ responseCode { see service description } ]	#83h  #XXh

### STEP#3 accessTimingParameters(setParameters) (optional)

time	Client (tester) Request Message	Hex
P3*	accessTimingParameters Request Service ID = [ TPI = setParameters ...: ]	#83h  #03h #XXh

time	Server (ECU) PosResponse Message #1	Hex
P2	accessTimingParameters PosRspSId= [ TPI = setParameters ]	#C3h  #03h
	goto STEP#5	

Server (ECU) NegResponse Message	Hex
negRespSId	#7Fh
accessTimingParameters ReqSId [ responseCode { see service description } ]	#83h  #XXh

\*\*\* modified standardDiagnosticMode timing parameter active \*\*\*

:

:

time	Server (ECU) PosResponse Message #n	Hex
P2	accessTimingParameters PosRspSId= [ TPI = setParameters ]	#C3h  #03h
	goto STEP#4	

### STEP#4 periodic transmission diagnostic service s(possible services refer to chapter )

time	Client (tester) Request Message	Hex
P3*	periodic transmission diagnostic service	#XXh

time	Server (ECU) PosResponse Message #1	Hex
P2	periodic transmission diagnostic service PosRspSId= [ record values ]	#XXh ...
	to STEP#5	

:

:

time	Server (ECU) PosResponse Message #1	Hex
P2	periodic transmission diagnostic service PosRspSId= [ record values ]	#XXh ...
	to STEP#5	

:

:

Server (ECU) NegResponse Message	Hex
negRespSId periodic transmission diagnostic service [ responseCode { see service description } ]	#7Fh #XXh #XXh

### STEP#5 stopDiagnosticSession(DM\_PeriodicTransmission)

time	Client (tester) Request Message	Hex
P3	stopDiagnosticSession Request Service Id	#20h

time	Server (ECU) PosResponse Message #1	Hex
P2	stopDiagnosticSession PosRspSId	#60h
	to STEP#6	

Server (ECU) NegResponse Message	Hex
negRespSId stopDiagnosticSession.ReqSId= [ responseCode { see service description } ]	#7Fh #20h #XXh

\*\*\* *standardDiagnosticModeWithPeriodicTransmission* disabled \*\*\*

default diagnostic session enabled and normal timing default values active

### STEP#6 stopCommunication

time	Client (tester) Request Message	Hex
P3*	stopCommunication Request Service Id	#82h

time	Server (ECU) PosResponse Message	Hex
P2	stopCommunication PosRspSId	#C2h

Server (ECU) NegResponse Message	Hex
negativeResponse Service Identifier stopCommunication.ReqSId= [ responseCode { see service description } ]	#7Fh #82h #XXh

### Possible Periodic Transmission Services

<b>Possible services in the Periodic Transmission mode</b>	<b>Mnemonic</b>	<b>SID</b>	<b>Description</b>
ReadDataByLocalIdentifier	RDBLI	#21h	Read of previous defined „dynamically defined local id“ (#F0h) or snapshot information.
ReadMemoryByAdress	RMBA	#23h	Read of memory contents
ReadStatusOfDiagnosticTroubleCodes	RSODTC	#17h	Read all Diagnostic Trounble Codes
ReadDiagnosticTroubleCodesByStatus	RDTCBS	#18h	Read one Diagnostic Trounble Codes with System Supplier Data
TesterPresent	TP	#3Eh	Tester Present without contents

**NOTE:** In case the Tester has defined a DynamicallyDefinedLocal ID (#F0h) all other services in the periodic transmission mode are blocked except the ReadDataByLocalID (#F0). With the service DDLI (sub identifier clear DDLI) in the Standart Diagnostic Mode the Tester can release all other services for the periodic transmission mode again.

### Periodic Transmission Message Flow Examples

**NOTE:** In the column Activity marks with the black row the Tester request messages and with the shaded row the ECU responses.



<b>Periodic Transmission with ATP and 3 Byte Header</b>			
<b>Time in ms</b>	<b>Hex values</b>	<b>Mnemonic</b>	<b>Activity</b>
49.2	81		[Black]
5.1	11		
5.1	F1		
5.1	81	STC	
5.1	04		
28.5	83		[Grey]
0.0	F1		
0.0	11		
0.0	C1	STC_PR	
0.0	EF		
0.0	8F		
0.0	C4		
194.9	82		[Black]
5.1	11		
5.1	F1		
5.1	10	STDS	
5.1	82		
5.1	16		
24.7	82		[Grey]
0.0	F1		
0.0	11		
0.0	50	STDS_PR	
0.0	82		
0.0	56		
14.0	82		[Black]
5.1	11		
5.1	F1		
5.1	83	ATP	
5.1	00		
29.1	89		[Grey]
0.0	F1		
0.0	11		
0.0	C3	ATP_PR	
0.0	00		
0.0	08		
0.0	01		
0.0	00		
0.0	14		
0.0	00		
0.0	69		
29.5	87		[Grey]
0.0	F1		
0.0	11		
0.0	C3	ATP_PR	
0.0	00		
0.0	08		
0.0	01		
0.0	00		
0.0	14		
0.0	00		
0.0	69		

Figure I.6.4: Periodic Transmission with DDLI and 1 Byte Header

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<b>Periodic Transmission with DDLI and 1 Byte Header</b>			
<b>Time in ms</b>	<b>Hex values</b>	<b>Mnemonic</b>	<b>Activity</b>
49.2	01		[Black Box]
5.1	81	STC	
5.1	82		
27.0	03		[Grey Box]
0.0	C1	STC_PR	
0.0	EF		
0.0	8F		
0.0	42		
192.9	08		[Black Box]
5.1	2C	DDLI	
5.1	F0		
5.1	03		
5.1	01		
5.1	01		
5.1	00		
5.1	00		
5.1	00		
5.1	29		
27.0	02		[Grey Box]
0.0	6C	DDLI_PR	
0.0	F0		
0.0	5E		
118.4	02		[Black Box]
5.1	10	STDS	
5.1	82		
5.1	94		
28.8	02		[Grey Box]
0.0	50	STDS_PR #1	
0.0	82		
0.0	D4		
:			
26.0	02		[Grey Box]
0.0	50	STDS_PR #n	
0.0	82		
0.0	D4		
:			

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Time in ms	Hex value	Mnemonic	Activity
5.1	11		
5.1	F1		
5.1	83	ATP	
5.1	03		
5.1	08		
5.1	01		
5.1	00		
5.1	14		
5.1	00		
5.1	2C		
:			
32.5	82		
0.0	F1		
0.0	11		
0.0	C3	ATP_PR #1	
0.0	03		
0.0	4A		
:			
4.0	82		
0.0	F1		
0.0	11		
0.0	C3	ATP_PR #n	
0.0	03		
0.0	4A		
:			
1.0	82		
0.2	11		
0.2	F1		
0.2	83	ATP	
0.2	01		
0.2	08		
:			
6.4	82		
0.0	F1		
0.0	11		
0.0	C3	ATP_PR #1	
0.0	01		
0.0	48		
:			
34.3	82		
0.0	F1		
0.0	11		
0.0	C3	ATP_PR #2	
0.0	01		
0.0	48		
:			

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<i>Time in ms</i>	<i>Hex value</i>	<i>Mnemonic</i>	<i>Activity</i>
14.4	02		
5.1	21	RDBLI	
5.1	F0		
5.1	13		
:			
32.8	03		
0.0	61	RDBLI_PR #1	
0.0	F0		
0.0	FA		
0.0	4E		
:			
25.0	03		
0.0	61	RDBLI_PR #2	
0.0	F0		
0.0	FB		
0.0	4F		
:			
25.4	03		
0.0	61	RDBLI_PR #n	
0.0	F0		
0.0	FC		
0.0	50		
:			
6.0	01		
5.1	20	SPDS	
5.1	21		
:			
26.1	01		
0.0	60	SPDS_PR	
0.0	61		
:			
88.9	01		
5.1	82	SPC	
5.1	83		
:			
25.3	01		
0.0	C2	SPC_PR	
0.0	C3		

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## I.7 KWP2000 - SID 17h: readStatusOfDTC Service

### Input data:

CTR_ERR_DYN_NR {p. 5767}	CTR_FRC [NC_NR_ERR_DYN] {p. 5767}	CTR_WUP_CYC [NC_NR_ERR_DYN] {p. 5767}	ENVD_CUS_SET_CMN [NC_NR_ENVD_CUS_ SET_CMN][NC_NR_FRF_ SET][NC_NR_ERR_DYN] {p. 5792}
ENVD_CUS_SET_SPC [NC_NR_ENVD_CUS_ SET_SPC][NC_NR_FRF_ SET][NC_NR_ERR_DYN] {p. 5792}	ERR_DTC [NC_NR_ERR_DYN] {p. 5756}	ERR_TYPE_BYTE [NC_NR_ERR_DYN] {p. 5744}	ERR_TYPE_EXT_BYTE [NC_NR_ERR_DYN] {p. 5744}
LV_IGK {p. 906}			

### I.7.1 17h - Read Error Memory long version - ReadStatusOfDiagnosticTroubleCodes service

#### General information:

This function allows to read out the numbers of CDK s , list of CDK s, the CDK status and the index of the environmental values. The index [x] represents the actual requested CDK (customer diagnostic key).

#### Application conditions

**Initialisation:** *at reset*  
**Activation:** LV\_IGK = 1  
**Deactivation:** LV\_IGK = 0  
 Diagnostic timeout  
 Service location: ECU-SW


#### Formula section:

**IF** ERR\_DTC[x] =0000h **or**  
 ERR\_DTC[x] =FFFFh  
**THEN** RESPONSE=NEGATIVE RESPONSE  
**ELSE** RESPONSE=POSITIVE RESPONSE

#### readStatusOfDTC Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	ReadStatusOfDiagnosticTroubleCodes Request SId	M	#17h	RSODTC
#2d	DiagnosticTroubleCode		#XXh,#XXh=	GODTC
#3d	[ CDK HighByte CDK LowByte ]	M M	[ #00h - #39h #01h - #99h ]	

Figure I.7.1: Table ReadStatusOfDiagnosticTroubleCodes Request Message

Released by Tettenborn Frank		Date 2013-02-13	File 17I00F01.00B
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7381 of 8404	
Regensburg (RGB)		Copyright ( C ) Continental AG,2007	A4: 2007-11

## readStatusOfDTC positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	ReadStatusOfDiagnosticTroubleCodes Pos. Response SId	M	#57h	RSODTCPR
#2d	numberOfDTC CTR_ERR_DYN_NR	M	#XXh	NRODTC
	listOfDTCAndStatus= [		[	LODTCAS
#3d	Error code CDK (high byte) ERR_DTC[x]	M	#XXh	
#4d	Error code CDK (low byte) ERR_DTC[x]	M	#XXh	
#5d	statusOfDTC ERR_TYPE_BYTE[x]	M	#XXh	
#6d	extended StatusOfDTC ERR_TYPE_EXT_BYTE[x]	M	#XXh	
#7d	P - code DTC (high byte) ACTION_ERRM_ReadDTCLevelByDTCLevel	M	#XXh	
#8d	P - code DTC (low byte) ACTION_ERRM_ReadDTCLevelByDTCLevel	M	#XXh	
#9d	frequency counter CTR_FRC[x]	M	#XXh	
#10d	warmup counter CTR_WUP_CYC[x]	M	#XXh	
#11d	km value by first occur (high byte) ENVD_CUS_SET_CMN[2][1]	M	#XXh	
#12d	km value by first occur (low byte) ENVD_CUS_SET_CMN[3][1]	M	#XXh	
#13d	1 environmental value first occur ENVD_CUS_SET_SPC[1][1]	M	#XXh	
#14d	2 environmental value first occur ENVD_CUS_SET_SPC[2][1]	M	#XXh	
#15d	3 environmental value first occur ENVD_CUS_SET_SPC[3][1]	M	#XXh	
#16d	4 environmental value first occur ENVD_CUS_SET_SPC[4][1]	M	#XXh	
#17d	km value by second occur (high byte) ENVD_CUS_SET_CMN[2][2]	M	#XXh	
#18d	km value by second occur (low byte) ENVD_CUS_SET_CMN[3][2]	M	#XXh	
#19d	1 environmental value second occur ENVD_CUS_SET_SPC[1][2]	M	#XXh	
#20d	2 environmental value second occur ENVD_CUS_SET_SPC[2][2]	M	#XXh	
#21d	3 environmental value second occur ENVD_CUS_SET_SPC[3][2]	M	#XXh	
#22d	4 environmental value second occur ENVD_CUS_SET_SPC[4][2]	M	#XXh	
#23d	km value by third occur (high byte) ENVD_CUS_SET_CMN[2][3]	M	#XXh	
#24d	km value by third occur (low byte) ENVD_CUS_SET_CMN[3][3]	M	#XXh	
#25d	1 environmental value third occur ENVD_CUS_SET_SPC[1][3]	M	#XXh	
#26d	2 environmental value third occur ENVD_CUS_SET_SPC[2][3]	M	#XXh	
#27d	3 environmental value third occur ENVD_CUS_SET_SPC[3][3]	M	#XXh	
#28d	4 environmental value third occur ENVD_CUS_SET_SPC[4][3]	M	#XXh	
	]		]	

Figure I.7.2: Table ReadStatusOfDiagnosticTroubleCodes Positive Response Message if the error is entered in error memory

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	ReadStatusOfDiagnosticTroubleCodes Pos. Response SId	M	#57h	RSODTCPR
#2d	numberOfDTC CTR_ERR_DYN_NR	M	#01h	NRODTC
	listOfDTCAndStatus= [		[	LODTCAS
#3d	Error code CDK (high byte)	M	#XXh	
#4d	Error code CDK (low byte)	M	#XXh	
#5d	CDK not entered or not defined	M	#00h	
	]		]	

Table ReadStatusOfDiagnosticTroubleCodes Positive Response Message Message if the error is not entered in error memory

## readStatusOfDTC negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	S	#7Fh	NR
#2d	ReadStatusOfDiagnosticTroubleCodes Request SId	M	#17h	RSODTC
#3d	responseCode= [ subFunctionNotSupported-invalidFormat, incorrectByteCountDuringBlockTransfer ]	M	#XXh= [ #12h, #79h ]	RC

Figure I.7.3: Table ReadStatusOfDiagnosticTroubleCodes Negative Response Message

**Request and Response (Example)**

This table lists the possible responses depending on the requestByFunction or requestByDTC. The CDK values 0xFFFF & 0x0000 are reserved for special purposes(not yet defined now).

Tester Request	ECU response
CDK value = 0x0000 or 0xFFFF	<ul style="list-style-type: none"> <li>Negative response: Sub-Function Not Supported Or Invalid Format</li> </ul>
CDK of a failure which is entered in dynamic layer	<ul style="list-style-type: none"> <li>Positive response</li> <li>number of CDKs entered in fsp_sequ and with matching CDK, i.e. 1</li> <li>CDK high</li> <li>CDK low</li> <li>statusOfCDK</li> <li>extended StatusOfDTC</li> <li>frequency counter</li> <li>warmup counter</li> <li>....</li> </ul>
CDK which doesn't fall under any of the previous cases	<ul style="list-style-type: none"> <li>Positive Response</li> <li>number of CDKs</li> <li>CDK high</li> <li>CDK low</li> <li>CDK low</li> <li>0</li> </ul>

## I.8 KWP2000 - SID 18h: readDTCByStatus Service

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ERR_DYN_NR_OBD	V	0... FFH	0... 255	1	-
Number of failures stored in dynamic memory (2 nd layer) with error class >=10h					

### Input data:

C_ERR_CLAS_XX {p. 5811}	CTR_ERR_DYN_NR {p. 5767}	ERR_DTC [NC_NR_ERR_DYN] {p. 5756}	ERR_TYPE_BYTE [NC_NR_ERR_DYN] {p. 5744}
LV_IGK {p. 906}	NC_NR_ERR_DYN {p. 5768}		

### I.8.1 18h - read failure memory short - ReadDiagnosticTroubleCodesByStatus service

#### General information:

This function is to read out the numbers of faults in the error memory and the status of CDK (see also "Fault-type-byte and fault-type extension byte" (chapter OBDII functions)). Only failures with error class of **>= 10h** are considered.

#### Application conditions

**Initialisation:** at reset

**Activation:** LV\_IGK = 1

**Deactivation:** LV\_IGK = 0  
Diagnostic timeout

**Service location:** see "list of implemented diagnostic services"

#### Formula section:

$CTR\_ERR\_DYN\_NR\_OBD = CTR\_ERR\_DYN\_NR - \text{errors with } C\_ERR\_CLAS\_XX < 10h$

#### Example:

$CTR\_ERR\_DYN\_NR = 3$

1.  $DIAG\_INST[0] = TCO\_EL$        $C\_ERR\_CLAS\_TCO\_EL = 11H$
2.  $DIAG\_INST[1] = VS$        $C\_ERR\_CLAS\_VS = 5H$
3.  $DIAG\_INST[2] = CAT\_DIAG\_1$        $C\_ERR\_CLAS\_CAT\_DIAG\_1 = 33H$

$\Rightarrow CTR\_ERR\_DYN\_NR\_OBD = 3 - 1 = 2$

**If** C\_ERR\_CLAS\_XX from error [NC\_NR\_ERR\_DYN] is calibrated with **>= 10h**  
**Then** error is considered for SID18  
**Else** error is not considered for SID18  
**Endif**



## ReadDiagnosticTroubleCodesByStatus Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	ReadDiagnosticTroubleCodesByStatus Request SId	M	#18h	RCDKBS
#2d	statusOfCDK - If the value in the telegram is not 02h, a value "00H" is given out on the reading of memory long;	M	#02h	SOCDK
#3d,#4d #3d,#4d	groupOfDiagnosticInformation (HighByte,LowByte) [ Read CDK's in all Group's Read CDK's only powertrain faults ]	M,M	#XXh,#XXh= [ #FFh,#FFh #FFh,#FBh ]	GOCDK

Figure I.8.1: Table ReadDiagnosticTroubleCodesByStatus Request Message

## ReadDiagnosticTroubleCodesByStatus positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	ReadDiagnosticTroubleCodesByStatus Pos. Response SId	M	#58h	RCDKBSPR
#2d	numberOfCDK - CTR_ERR_DYN_NR_OBD	M	#01h-#XXh	#NROCDK
#3d #4d #5d #6d #7d #8d . . . #22d #23d #24d	ListOfCDKAndStatus= [ CDK#0 high byte ERR_DTC[0] CDK#0 low byte ERR_DTC[0] statusOfCDK #1 ERR_TYPE_BYTE[0] CDK#1 high byte ERR_DTC[1] CDK#1 low byte ERR_DTC[1] statusOfCDK #2 ERR_TYPE_BYTE[1] . . . CDK#(NC_NR_ERR_DYN - 1) CDK#(NC_NR_ERR_DYN - 1) statusOfCDK #n ERR_TYPE_BYTE[NC_NR_ERR_DYN - 1] ]	C C C C C C . . . C C C	#XXh #XXh #XXh #XXh #XXh #XXh . . . #XXh #XXh #XXh	LOCDKAS

Figure I.8.2: Table ReadDiagnosticTroubleCodesByStatus Positive Response Message

## ReadDiagnosticTroubleCodesByStatus negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	S	#7Fh	NR
#2d	ReadDiagnosticTroubleCodesByStatus Request SId	M	#18h	RCDKBS
#3d	responseCode= [ subFunctionNotSupported-invalidFormat, requestOutOfRange, general response codes ]	M	#XXh= [ #12h, #31h, #XXh ]	RC

Figure I.8.3: Table ReadDiagnosticTroubleCodesByStatus Negative Response Message

## I.9 KWP2000 - SID 1Ah: readECUidentification Service

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ecu_type [16]	O	0	ASCII	1	-
first customer-specific part of SiemensBootLogisticInformationField					
sample_details [16]	O	0	ASCII	1	-
second customer-specific part of SiemensBootLogisticInformationField					
tester_control [16]	O	0	ASCII	1	-
third customer-specific part of SiemensBootLogisticInformationField					

### Input data:

C_IDX_COD_CONV {p. 4946}	LV_IGK {p. 906}	VIN_SHO [7] {p. 7541}	
-----------------------------	-----------------	-----------------------	--

### General information:

This function reads out from the ECU specific logistic values.

### Application conditions

**Initialisation:** *at reset*

**Activation:** LV\_IGK = 1

**Deactivation:** LV\_IGK = 0  
Diagnostic timeout  
Service location: see "list of implemented diagnostic services"

### Formula section:

#### ReadEcuIdentification Request


Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readEcuIdentification Request Service Id	M	#1Ah	REI
#2d	identificationOption	M	#XXh	IO

Figure I.9.1: Table readEcuIdentification Request Message

#### ReadEcuIdentification positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readEcuIdentification Request Service Id	M	#5Ah	REI
#2d	identificationOption	M	#XXh	IO
#3d	Data 1 for identification option	M	#XXh	
#3d + 1	Data 2 for identification option			
#3d + n	Data n for identification option	M	#XXh	

Figure I.9.2: Table ReadEcuIdentification Positive Response Message

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7386 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

### ReadEcuIdentification negative Response


Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	readEcuIdentification Request Service Id	M	#1Ah	REI
#3d	responseCode= [ general response code ECU ID not supported ]	M	#XXh= [ #XXh #12 ]	RC

Figure I.9.3: Table ReadEcuIdentification Negative Response Message


## I.9.1 Supported identification options

Identification Option nr.	SW name	Size / byte
ECUIDT 80 h Ecu Identification Data Table Info: 91h: VMCEUHN only 1x output	Reading of the Identification options: 91h,9Ah,9Bh,9Ch,97h,9Dh,9Eh,9FH exactly in this order	Compare the single identification options
CUIFDT 86 h actual BMW user information field	bmw_uif	32 blocks a 64 byte
PECUHN 87 h BMW physical HW number	kwp_io_pecuhn	18
SSECUSEN 89 h systemSupplierECUSerialNumber	serial_number	9
CRSCOTSN 8A h Calib.RepairShopCodeOrTesterSerialNr	NC_KWP_IO_CRSCOTSN	10
CPD 8B h Calib.ProgrammingDate	NC_KWP_IO_CPD	4
SSBSN 8C h SubSystemBootSoftwareNumber	sub_sys_boot_sw_nr	12
SSESN 8D h SubSystemECUSoftwareNumber	sub_sys_ecu_sw_nr	12
SSCN 8E h SubSystemCalibrationNumber	cal_customer_if	12
LDSA 8F h reportLogisticDataStartAddress	NC_KWP_IO_LDSA	8
VIN short 90 h short VehicleIdentificationNumber	VIN_SHO[7]	7
VMCEUHN 91 h VehicleManufactureECUHWnumber VMCEUHN 3 x output	bmw_hw_nr	18
SBLIF 92h customer specific part of supplierBootLogisticInformationField	in this order: ecu_type[16] sample_details[16] tester_control[16]	48
EROTAN 96 h exhaustRegulationOrTypeApprovalnumber	kwp_io_erotan	6
SNOET 97 h systemNameOrEngineType	kwp_io_snoet  kwp_io_snoet_cal (if ECU SW is active )	2
RSCOTSN 98 h RepairShopCodeOrTesterSerialNumber	kwp_io_rscatsn	8
PD 99 h ProgrammingDate	kwp_io_pd	4
VMCEUHVN 9A h vehicleManufacturerECUHWversionNo.	kwp_io_vmecuhvn	1
VMDI 9B h vehicleManufacturerCodingIndex	C_IDX_COD_CONV	1
VMDI 9C h vehicleManufacturerDiagnosticIndex	kwp_io_vmdi	2
DOECUM 9D h	date_of_final_test	4

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
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dateOfECUManufacturing		
SSI 9E h systemSupplierIndex	supplier_index	1
VMECUSLVN 9F h VMECUSoftwareLayerVersionNumber	bmw_sw_nr	12

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 7389 of 8404</b>	
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## I.10 KWP2000 - SID 20h: stopDiagnosticSession Service

### General information:

This function is for ending a diagnostic session.

#### stopDiagnostic Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	stopDiagnosticSessionRequest Service Id	M	#20h	SPDS

Figure I.10.1: Table stopDiagnostic Request Message

#### StopDiagnosticSession positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	stopDiagnosticSession Positive response	M	#60h	SPDSPR

Figure I.10.2: Table ecuReset Positive Response Message

1. After positive response, the Standard Diagnostic Session, the default timing and baudrate(10400 baud for KWP and 9600baud for KWP\*) are active !

#### StopDiagnosticSession negative Response

1. A negative response after StopDiagnosticSession is not possible!

## I.11 KWP2000 - SID 21h: readDataByLocalIdentifier Service

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
RLS_MPL_VALUE_PROG	O/V	0... 5H	0 ...5	1	-
release of multiple start value programming - only updated when service ist requested					
STATE_IMOB	O/V	0... FFH	0... 255	1	-
State of the immobilizer - only updated when service ist requested					

### Input data:

C_ERR_CLAS_XX {p. 5811}	C_STATE_READY_OBD_2 {p. 5695}	CTR_DC [NC_NR_ERR_DYN] {p. 5767}	CTR_ERR_DYN_NR {p. 5767}
CTR_FRC [NC_NR_ERR_DYN] {p. 5767}	CTR_KM_N_MAX {p. 4462}	CTR_N_MAX {p. 4462}	CTR_TOIL_MAX {p. 1223}
CTR_WUP_CYC [NC_NR_ERR_DYN] {p. 5767}	DIST_ACT_MIL {p. 5899}	DIST_TOIL_MAX {p. 1223}	ENVD_CUS_CMN [NC_NR_ENVD_CUS_] CMN][NC_NR_ERR_DYN] {p. 5792}
ENVD_CUS_SET_CMN [NC_NR_ENVD_CUS_] SET_CMN][NC_NR_FRF_] SET][NC_NR_ERR_DYN] {p. 5792}	ENVD_CUS_SET_SPC [NC_NR_ENVD_CUS_] SET_SPC][NC_NR_FRF_] SET][NC_NR_ERR_DYN] {p. 5792}	ENVD_OBD [NC_NR_ENVD_OBD][NC_] NR_ERR_DYN] {p. 5792}	ERR_DTC [NC_NR_ERR_DYN] {p. 5756}
ERR_TYPE_BYTE [NC_NR_ERR_DYN] {p. 5744}	ERR_TYPE_EXT_BYTE [NC_NR_ERR_DYN] {p. 5744}	FAC_FCO_KWP {p. 7541}	GEAR_EF_N_MAX {p. 4462}
GEAR_TOIL_MAX {p. 1223}	IGA_IGC [NC_CYL_NR] {p. 1005}	INH_IV_KWP {p. 7482}	LV_ACCOUT_RLY {p. 3589}
LV_CS_N_MAX {p. 4462}	LV_CS_TOIL_MAX {p. 1223}	LV_IGK {p. 906}	LV_IS {p. 1720}
LV_KNK {p. 1961}	LV_LOCK_IMOB	MAF_KGH_MES {p. 1192}	N {p. 1525}
N_GRD_N_MAX {p. 4462}	N_MAX {p. 4462}	N_TOIL_MAX {p. 1223}	NR_PAT_SCC_N_MAX {p. 4462}
PV_AV_N_MAX {p. 4462}	PV_AV_TOIL_MAX {p. 1223}	STATE_CRU_OFF_IRR {p. 7227}	STATE_CRU_OFF_REV {p. 7227}
STATE_DIAG_SA_SAFM {p. 808}	STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}	STATE_LSH_UP [NC_CBK_EX_NR] {p. 2385}	STATE_MSW_CAN {p. 7220}
T_N_MAX {p. 4462}	T_SUM_N_MAX {p. 4462}	TAM_TOIL_MAX {p. 1223}	TCO_MES {p. 1100}
TCO_TOIL_MAX {p. 1223}	TI_1_HOM [NC_CYL_NR] {p. 2002}	TIA_MES {p. 1226}	TOIL_MAX_WARN {p. 1223}
TOIL_THD_TOIL_MAX {p. 1223}	TPS_AV {p. 1169}	TQI_AV_TOIL_MAX {p. 1223}	TRT {p. 1504}

TRT_N_MAX {p. 4462}	V_PVS_1_KWP {p. 7311}	VB {p. 1185}	VS_N_MAX {p. 4462}
VS_TOIL_MAX {p. 1223}			

**Import actions:**

<b>ACTION_ERRM_ReadReadinessCode</b> (INOUT<PRM_READINESSCODE>,OUT<PRM_RESULTREADINESSCODE>)
--

**General information:**

All implemented SID 21h services are described below.

**Formula section:****I.11.1 Global negative Responses**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLID
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.11.1: Table: readDataByLocalIdentifier Negative Response Message

**Remark:**

The detailed message of the negative response code is described in chapter "Introduction".

**I.11.2 21\_01 - read system specific adress - ReadDataByLocalIdentifier service****General information:**

This function allows to read out the system specific addresses. They are necessary e.g. reprogramming the ECU with the NPS.


**Application conditions**

**Initialisation:** at reset  
**Activation:** Kl.15 on  
**Deactivation:** Kl.15 off  
 Diagnostic timeout  
 Service location: see list of implemented diagnostic services

**ReadDataByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = read system specific adress	M	#01h	RLI_

Figure I.11.2: Table readDataByLocalIdentifier Request Message

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## ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier= system specific adress	M	#01h	RLI_UEB
#3d	RecordValue #1high byte = Programming voltage 0V	M	#XXh	Not supported
#4d	RecordValue #2 middle byte= Programming voltage 0V	M	#XXh	Not supported
#5d	RecordValue #3 low byte = Programming voltage 0V	M	#XXh	Not supported
#6d	RecordValue #4high byte = Dummy for DP1	M	#FFh	
#7d	RecordValue #5 middle byte = Dummy for DP1	M	#FFh	
#8d	RecordValue #6 low byte = Dummy for DP1	M	#FFh	
#9d	RecordValue #7high byte = Dummy for DP2	M	#FFh	
#10d	RecordValue #8 middle byte = Dummy for DP2	M	#FFh	
#11d	RecordValue #9 low byte = Dummy for DP2	M	#FFh	
#12d	RecordValue #10 high byte = Dummy for DP3	M	#FFh	
#13d	RecordValue #11 middle byte = Dummy for DP3	M	#FFh	
#14d	RecordValue #12 low byte = Dummy for DP3	M	#FFh	
#15d	RecordValue #13 high byte = Dummy for DP4	M	#FFh	
#16d	RecordValue #14 middle byte = Dummy for DP4	M	#FFh	
#17d	RecordValue #15 low byte = Dummy for DP4	M	#FFh	
#18d	RecordValue #16 high byte = Dummy for DP5	M	#FFh	
#19d	RecordValue #17 middle byte = Dummy for DP5	M	#FFh	
#20d	RecordValue #18 low byte = Dummy for DP5	M	#FFh	
#21d	RecordValue #19 high byte = Dummy for DP6	M	#FFh	
#22d	RecordValue #20 middle byte = Dummy for DP6	M	#FFh	
#23d	RecordValue #21 low byte = Dummy for DP6	M	#FFh	
#24d	RecordValue #22 high byte = Dummy for DP7	M	#FFh	
#25d	RecordValue #23 middle byte = Dummy for DP7	M	#FFh	
#26d	RecordValue #24 low byte = Dummy for DP7	M	#FFh	
#27d	RecordValue #25 high byte = Dummy for DP8	M	#FFh	
#28d	RecordValue #26 middle byte = Dummy for DP8	M	#FFh	
#29d	RecordValue #27 low byte = Dummy for DP8	M	#FFh	
#30d	RecordValue #28 high byte = Dummy for DP9	M	#FFh	
#31d	RecordValue #29 middle byte = Dummy for DP9	M	#FFh	
#32d	RecordValue #30 low byte = Dummy for DP9	M	#FFh	
#33d	RecordValue #31 high byte = Dummy for DP10	M	#FFh	
#34d	RecordValue #32 middle byte = Dummy for DP10	M	#FFh	
#35d	RecordValue #33 low byte = Dummy for DP10	M	#FFh	
#36d	RecordValue #34 high byte = Dummy for DP11	M	#FFh	
#37d	RecordValue #35 middle byte = Dummy for DP11	M	#FFh	
#38d	RecordValue #36 low byte = Dummy for DP11	M	#FFh	
#39d	RecordValue #37 high byte = Dummy for DP12	M	#FFh	
#40d	RecordValue #38 middle byte = Dummy for DP12	M	#FFh	
#41d	RecordValue #39 low byte = Dummy for DP12	M	#FFh	
#42d	RecordValue #40 high byte = Dummy for DSK	M	#FFh	
#43d	RecordValue #41 middle byte = Dummy for DSK	M	#FFh	
#44d	RecordValue #42 low byte = Dummy for DSK	M	#FFh	
#-d	RecordValue #43 high byte = Dummy for WCODE	M	#FFh	
#46d	RecordValue #44 middle byte = Dummy for WCODE	M	#FFh	
#47d	RecordValue #- low byte = Dummy for WCODE	M	#FFh	
#48d	RecordValue #46 high byte = cal_ref_nr data reference	M	#XXh	
#49d	RecordValue #47 middle byte = cal_ref_nr data reference	M	#XXh	

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#50d	RecordValue #48 low byte = cal_ref_nr data reference	M	#XXh	
#51d	RecordValue #49 high byte = cif_backup	M	#XXh	
#52d	RecordValue #50 middle byte = cif_backup	M	#XXh	
#53d	RecordValue #51 low byte = cif_backup	M	#XXh	
#54d	RecordValue #52 high byte = del_time_max erasing time	M	#XXh	
#55d	RecordValue #53 middle byte = del_time_max erasing time	M	#XXh	
#56d	RecordValue #54 low byte = del_time_max erasing time	M	#XXh	
#57d	RecordValue #55 high byte = hw_reference	M	#XXh	
#58d	RecordValue #56 middle byte = hw_reference	M	#XXh	
#59d	RecordValue #57 low byte = hw_reference	M	#XXh	
#60d	RecordValue #58 high byte = ecu_sw_reference programm-reference	M	#XXh	
#61d	RecordValue #59 middle byte = ecu_sw_reference programm-reference	M	#XXh	
#62d	RecordValue #60 low byte = ecu_sw_reference programm-reference	M	#XXh	
#63d	RecordValue #61 high byte = bmw_uif user info field	M	#XXh	
#64d	RecordValue #62 middle byte = bmw_uif user info field	M	#XXh	
#65d	RecordValue #63 low byte = bmw_uif user info field	M	#XXh	
#66d	RecordValue #64 high byte = kwp_buf_len_max max. length of data	M	#XXh	
#67d	RecordValue #65 middle byte = kwp_buf_len_max max. length of data	M	#XXh	
#68d	RecordValue #66 low byte = kwp_buf_len_max max. length of data	M	#XXh	
#69d	RecordValue #67 high byte = date_of_final_test	M	#XXh	
#70d	RecordValue #68 middle byte = date_of_final_test	M	#XXh	
#71d	RecordValue #69 low byte = date_of_final_test	M	#XXh	
#72d	RecordValue #70 high byte = Dummy for the Baud rate table	M	#FFh	
#73d	RecordValue #71 middle byte = Dummy for the Baud rate table	M	#FFh	
#74d	RecordValue #72 low byte = Dummy for the Baud rate table	M	#FFh	

**Table readDataByLocalIdentifier Positive Response Message**  
**ReadDataByLocalIdentifier negative Response**  
Global Negative Responses

### I.11.3 21\_02 - read overtemperature protection - ReadDataByLocalIdentifier service

#### General information:

Exact description of the Function see file 14400S02.

#### Application conditions

**Initialisation:** *at reset the values from the NVMY*

**Activation:** LV\_IGK=1

**Deactivation:** LV\_IGK=0

Diagnostic timeout

Service location: see list of implemented diagnostic services

#### **ReadDataByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = read overtemperature protection	M	#02h	RLI_UET

Figure I.11.3: Table readDataByLocalIdentifier Request Message

### ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier= read overtemperature protection	M	#02h	RLI_UEB
#3d	RecordValue # = TOIL_MAX_WARN	M	#XXh	RV_
#4d	RecordValue # = VS_TOIL_MAX	M	#XXh	RV_
#5d	RecordValue # = N_TOIL_MAX high byte	M	#XXh	RV_
#6d	RecordValue # = N_TOIL_MAX low byte	M	#XXh	RV_
#7d	RecordValue # = GEAR_TOIL_MAX	M	#XXh	RV_
#8d	RecordValue # = TQI_AV_TOIL_MAX high byte	M	#XXh	RV_
#9d	RecordValue # = TQI_AV_TOIL_MAX low byte	M	#XXh	RV_
#10d	RecordValue # = TAM_TOIL_MAX	M	#XXh	RV_
#11d	RecordValue # = CTR_TOIL_MAX	M	#XXh	RV_
#12d	RecordValue # = TCO_TOIL_MAX	M	#XXh	RV_
#13d	RecordValue # = DIST_TOIL_MAX high byte	M	#XXh	RV_
#14d	RecordValue # = DIST_TOIL_MAX low byte	M	#XXh	RV_
#15d	RecordValue # = PV_AV_TOIL_MAX	M	#XXh	RV_
#16d	RecordValue # = LV_CS_TOIL_MAX	M	#XXh	RV_
#17d	RecordValue # = TOIL_THD_TOIL_MAX	M	#XXh	RV_

Figure I.11.4: Table readDataByLocalIdentifier Positive Response Message

### ReadDataByLocalIdentifier negative Response

Global Negative Responses

## I.11.4 21\_03 - read engine overspeed detection - ReadDataByLocalIdentifier service

### General information:

Exact description of the Function see file 14A06301.

Detection of an overrevving event and non-volatile storage of:

An overrevving event starts at exceeding the engine speed C\_N\_LIM\_MIN and active engine speed limitation (LV\_N\_MAX = 1).

At each overrevving event, the event frequency counter is incremented by 1. The highest engine speed reached N\_MAX and the associated total running time in case of highest engine speed reached TRT\_N\_MAX is only overwritten if a higher engine speed was reached.

### Application conditions

**Initialisation:** *at reset the values from the NVMY*

**Activation:** K1.15 on

**Deactivation:** K1.15 off  
Diagnostic timeout  
Service location: see list of implemented diagnostic services

## ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = read engine overspeed detection	M	#03h	RLI_UEB

Figure I.11.5: Table readDataByLocalIdentifier Request Message

## ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier= read engine overspeed detection	M	#03h	RLI_UEB
#3d	RecordValue # = N_MAX high byte	M	#XXh	RV_
#4d	RecordValue # = N_MAX low byte	M	#XXh	RV_
#5d	RecordValue # = TRT_N_MAX high word high byte	M	#XXh	RV_
#6d	RecordValue # = TRT_N_MAX high word low byte	M	#XXh	RV_
#7d	RecordValue # = TRT_N_MAX low word high byte	M	#XXh	RV_
#8d	RecordValue # = TRT_N_MAX low word low byte	M	#XXh	RV_
#9d	RecordValue # = CTR_N_MAX	M	#XXh	RV_
#10d	RecordValue # = CTR_KM_N_MAX high byte	M	#XXh	RV_
#11d	RecordValue # = CTR_KM_N_MAX low byte	M	#XXh	RV_
#12d	RecordValue # = N_GRD_N_MAX	M	#XXh	RV_
#13d	RecordValue # = VS_N_MAX	M	#XXh	RV_
#14d	RecordValue # = PV_AV_N_MAX	M	#XXh	RV_
#15d	RecordValue # = GEAR_EF_N_MAX	M	#XXh	RV_
#16d	RecordValue # = LV_CS_N_MAX	M	#XXh	RV_
#17d	RecordValue # = T_SUM_N_MAX high byte	M	#XXh	RV_
#18d	RecordValue # = T_SUM_N_MAX low byte	M	#XXh	RV_
#19d	RecordValue # = T_N_MAX high byte	M	#XXh	RV_
#20d	RecordValue # = T_N_MAX low byte	M	#XXh	RV_
#21d	RecordValue # = NR_PAT_SCC_N_MAX	M	#XXh	RV_

Figure I.11.6: Table readDataByLocalIdentifier Positive Response Message

## ReadDataByLocalIdentifier negative Response

### Global Negative Responses

## I.11.5 21\_05 - read readiness flags - ReadDataByLocalIdentifier service

### General information:

With this comand the readiness flags described in the chapter Readiness codes are shown. The flags (bit) are default 1 and when the diagnosis is done well, the flag is switched to 0.

### Description:

For reading readiness code see chapter OBD Error management - Communication interface .

### Application conditions

**Initialisation:** *at reset with 00h*

**Activation:** LV\_IGK=1 (K1.15 on)

**Deactivation:** LV\_IGK=0 (K1.15 off) or  
 Diagnostic timeout  
**Service location:** ECU-SW

### Formula section:

**IF** service 21\_05 is received.....

**THEN**

ACTION\_ERRM\_ReadReadinessCode(STATE\_READY\_OBD\_1, STATE\_READY\_OBD\_2)

The values

STATE\_READY\_OBD\_1 XXh

STATE\_READY\_OBD\_2 XXh

will be sent from the ECU to the tester

**ENDIF**

### ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = read readiness	M	#05h	RLI_REA

Figure I.11.7: Table readDataByLocalIdentifier Request Message

### ReadDataByLocalIdentifier positive Response on service with RLI = #05h

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier	M	#05h	RLI_REA
#3d	RecordValue # 1 STATE_READY_OBD_1	M	#XXh	RV_EVS
#4d	RecordValue # 2 STATE_READY_OBD_2	M	#XXh	RV_REA
#5d	RecordValue # 3 C_STATE_READY_OBD_2	M	#XXh	RV_REA

Figure I.11.8: Table readDataByLocalIdentifier Positive Response Message

Byte #	Name	Size	Conversion (hex/bin)	Conversion (physical)	Resol.
#3d	RecordValue # 1 = STATE_READY_OBD_1	1	xxxxxxxX b xxxxxxXx b xxxxXxx b  xxxxXxxx b xxxXxxxx b xxXxxxxx b xXxxxxxx b  Xxxxxxxx b	Missfire monitoring supported Fuel system monitoring supported Comprehensive component monitoring supported Not used Missfire monitoring status Fuel system monitoring status Comprehensive component monitoring status Not used	
Byte #	Name	Size	Conversion (hex/bin)	Conversion (physical)	Resol.
#4d	RecordValue # 2 = STATE_READY_OBD_2	1	xxxxxxxX b xxxxxxXx b xxxxXxx b xxxxXxxx b xxxXxxxx b xxXxxxxx b xXxxxxxx b Xxxxxxxx b	Catalyst monitoring Heated catalystComprehensive Evaporative system monitoring Secondary air system monitoring A/C system refrigerant monitoring Oxygen sensor monitoring Oxygen sensor heater monitoring EGR system monitoring	

Figure I.11.9: Table readDataByLocalIdentifier Positive Response Message Bit information

### ReadDataByLocalIdentifier negative Response

Global Negative Responses

## I.11.6 21\_06 - receiving status of immobilizer - ReadDataByLocalIdentifier service

### General information:

This function gives the actual status of the immobilizer back. The ecu reports to the tester whether the new start value is accepted or if the actual saved start value is identical with the one from the immobilizer. If there is a problem, the error information during synchronisation is also reported to the tester.

The ecu answers the question as long with the respective status until for the first time the answer is 01 or 02. When this answer is received, the ecu can activate this answer again after a Kl.15 change and the ecu power latch is over.

Parameter 04 process is running in the positive response switch after timeout occur to 03 Interface failure D\_EWS: frame or parity or no signal (timeout)

In case of an destroyed IMOB CODE STATUS the positive response should be 21h, the same as for -2-out-of-3 start values in the flash memory not OK;

### Application conditions

**Initialisation:** at reset

**Activation:** Kl.15 on

**Deactivation:** Kl.15 off  
Diagnostic timeout  
Service location: see list of implemented diagnostic services

### ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = read status of receiving immobilizer	M	#06h	RLI_

Figure I.11.10: Table readDataByLocalIdentifier Request Message

### ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier	M	#06h	RLI_
#3d	RecordValue # 1 = STATE_IMOB [ -start value programming or reset to start value was successful -wrong start value at reset attempt (Immob. and ECU do not match) -telegram contents was no start value (perhaps rolling code) -Interface failure D_EWS: frame or parity or no signal (timeout) -process is running " busy" -programming of start value or reset to start value doesn't happen in this Kl.15 cycle -same random number as by the last reset to start value despite of already done code switching -no start value programmed -2-out-of-3 start values in the flash memory not OK (only when UC is programmed e.g. after a power latch phase) or the IMOB_CODE_STATUS is destroyed ]	M	#XXh [ #00h, #01h, #02h, #03h, #04h, #05h,  #06h,  #07h, #21h, ]	RV_

Figure I.11.11: Table readDataByLocalIdentifier Positive Response Message

### ReadDataByLocalIdentifier negative Response

#### Global Negative Responses

## I.11.7 21\_07 - read cruise control status - ReadDataByLocalIdentifier service

### General information:

With this command the status described in the chapter Vehicle speed control are distributed.

### Application conditions

**Initialisation:** at reset

**Activation:** Kl.15 on (LV\_IGK=1)

**Deactivation:** Kl.15 off (LV\_IGK=0)


Diagnostic timeout

Service location: see list of implemented diagnostic services

### ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = read cruise control status	M	#07h	RLI_

Figure I.11.12: Table readDataByLocalIdentifier Request Message

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## ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier= cruise control status	M	#07h	RLI_
#3d	RecordValue # 1 = STATE_MSW_CAN	M	#XXh	RV_
#4d	RecordValue # 2 = STATE_CRU_OFF_IRR high byte	M	#XXh	RV_
#5d	RecordValue # 3 = STATE_CRU_OFF_IRR low byte	M	#XXh	RV_
#6d	RecordValue # 4 = STATE_CRU_OFF_REV high byte	M	#XXh	RV_
#7d	RecordValue # 5 = STATE_CRU_OFF_REV low byte	M	#XXh	RV_

Figure I.11.13: Table readDataByLocalIdentifier Positive Response Message

## ReadDataByLocalIdentifier negative Response

Global Negative Responses

### I.11.8 21\_08 - release of multiple start value programming - ReadDataByLocalIdentifier service

#### General information:

This function gives the actual status of release of multiple start value programming.  
This service should give always a response as well if the total running time  $t > 90\text{min}$ !

If the response is sent to the ECU by  $\text{TRT} > 90$  minutes then a negative response 7F\_21\_22- conditions not correct occur.

Meaning of RLS\_MPL\_VALUE\_PROG:

RLS\_MPL\_VALUE\_PROG=00h - release of multiple start value programming available

RLS\_MPL\_VALUE\_PROG=01h - release of multiple start value programming not available

RLS\_MPL\_VALUE\_PROG=04h - release process for start value programming is going on

RLS\_MPL\_VALUE\_PROG=05h - no release process for start value programming done in this cycle

#### Application conditions

**Initialisation:** *RLS\_MPL\_VALUE\_PROG=00h* at reset

**Activation:** LV\_IGK=1 (K1.15 on) and  
 Authenticity check and  
 TRT < 90min


**Deactivation:** LV\_IGK=0 (K1.15 off) or  
 Diagnostic timeout  
 Service location: see list of implemented diagnostic services

## ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = release of multiple start value programming	M	#08h	RLI_FEWS

Figure I.11.14: Table readDataByLocalIdentifier Request Message

## ReadDataByLocalIdentifier positive Response on service

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7400 of 8404	
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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	RecordLocalIdentifier= release of multiple start value programming	M	#08h	RLI_FEWS
#3d	RecordValue # 1 = RLS_MPL_VALUE_PROG [ - release of multiple start value programming available - release of multiple start value programming not available - release process for start value programming is going on - no release process for start value programming done in this cycle ]	M	#XXh [ #00h, #01h, #04h, #05h ]	RV_FEWS

Figure I.11.15: Table readDataByLocalIdentifier Positive Response Message

**ReadDataByLocalIdentifier negative Response**

Global Negative Responses

**I.11.9 21\_09 - read DIST\_ACT\_MIL - ReadDataByLocalIdentifier service****General information:**

This funktion reports the value of the distance MIL is active .

**Application conditions****Initialisation:** at reset**Activation:** LV\_IGK=1 (Kl.15 on)**Deactivation:** LV\_IGK=0 (Kl.15 off) or  
Diagnostic timeout

Service location: see list of implemented diagnostic services

**ReadDataByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier DIST_ACT_MIL	M	#09h	RLI_DIST_ACT_MIL

Figure I.11.16: Table readDataByLocalIdentifier Request Message

**ReadDataByLocalIdentifier positive Response on service**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier DIST_ACT_MIL	M	#09h	RLI_
#3d	RecordValue = DIST_ACT_MIL high byte high word	M	#XXh	RV_S_
#4d	RecordValue = DIST_ACT_MIL low byte high word	M	#XXh	RV_S_
#5d	RecordValue = DIST_ACT_MIL high byte low word	M	#XXh	RV_S_
#6d	RecordValue = DIST_ACT_MIL low byte low word	M	#XXh	RV_S_

Figure I.11.17: Table readDataByLocalIdentifier Positive Response Message

**ReadDataByLocalIdentifier negative Response**

Global Negative Responses

## I.11.10 21\_0A - read Error Memory with freeze frame data extra long - Read-DataByLocalIdentifier service

### General information:

This function is created to read out the failure memory with all the errors including the freeze frame data. The index of the environment values allows a classification to the list of the environment values from BMW.

Record Common Identifier table usage and reading:

- RCI usage as BYTE Values (Freeze Frame, Umweltbedingung, DDLI etc.) should support the full range 0x00 to 0xFF as VALID. A value that is not supported will be transmitted as 0xFF
- RCI usage as WORD Values (DDLI etc.) should support the range 0x0000 to 0xFFFFE as VALID. Invalid is shown with 0xFFFF.

This should enable the full range of internal Byte values to be used with no compromise, but still allow the diagnostic equipment to recognise if a value is available or not.

### Application conditions

**Initialisation:** *at reset with 00h*

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off) **or**  
*Diagnostic timeout*

**Service location:** *see list of implemented diagnostic services*

### Formula section:

**IF** ERR\_DTC[x] = 0000h **or**  
ERR\_DTC[x] = FFFFh  
**THEN** RESPONSE=NEGATIVE RESPONSE  
**ELSE** RESPONSE=POSITIVE RESPONSE

### ReadDataByLocalIdentifier Request


Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = Read Error Memory with freeze frame data	M	#0Ah	RLI_
#3d	Value = Error code ERR_DTC[x] high byte	M	#XXh	RV_
#4d	Value = Error code ERR_DTC[x] low byte	M	#XXh	RV_

Figure I.11.18: Table readDataByLocalIdentifier Request Message

### ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	<b>readDataByLocalIdentifier Positive Response Service Id</b>	<b>M</b>	<b>#61h</b>	<b>RDBLIDPR</b>
#2d	recordLocalIdentifier	M	#0Ah	RLI_
#3d	RecordValue # 1 = Error counter total CTR_ERR_DYN_NR	M	#XXh	RV_
#4d	RecordValue # 2 = Error code ERR_DTC[x] high byte	M	#XXh	RV_
#5d	RecordValue # 3 = Error code ERR_DTC[x] low byte	M	#XXh	RV_
#6d	RecordValue # 4 = status DTC#1 ERR_TYPE_BYTE[x]	M	#XXh	RV_
#7d	RecordValue # 5 = Cycle flag ERR_TYPE_EXT_BYTE[x]	M	#XXh	RV_
#8d	RecordValue # 8 = Frequency counter CTR_FRC[x]	M	#XXh	RV_
#9d	RecordValue # 9 = Error recover counter (HLC) CTR_DC[x]	M	#XXh	RV_
#10d	RecordValue # 10 = km-value by first occur high byte ENV_D_CUS_SET_CMN[2][1]	M	#XXh	RV_
#11d	RecordValue # 11 = km-value by first occur low byte ENV_D_CUS_SET_SPC[3][1]	M	#XXh	RV_
#12d	RecordValue # 12 = 1.environmental value first occur ENV_D_CUS_SET_SPC[1][1]	M	#XXh	RV_
#13d	RecordValue # 13 = Index for 1.environmental value	M	#XXh	RV_
#14d	RecordValue # 14 = 2.environmental value first occur ENV_D_CUS_SET_SPC[2][1]	M	#XXh	RV_
#15d	RecordValue # 15 = Index for 2.environmental value	M	#XXh	RV_
#16d	RecordValue # 16= 3.environmental value first occur ENV_D_CUS_SET_SPC[3][1]	M	#XXh	RV_
#17d	RecordValue # 17 = Index for 3.environmental value	M	#XXh	RV_
#18d	RecordValue # 18 = 4.environmental value first occur ENV_D_CUS_SET_SPC[4][1]	M	#XXh	RV_
#19d	RecordValue # 19 = Index for 4.environmental value	M	#XXh	RV_
#20d	RecordValue # 20 = km-value by second occur high byte ENV_D_CUS_SET_SPC[2][2]	M	#XXh	RV_
#21d	RecordValue # 21= km-value by second occur low byte ENV_D_CUS_SET_SPC[3][2]	M	#XXh	RV_
#22d	RecordValue # 22 = 1.environmental value second occur ENV_D_CUS_SET_SPC[1][2]	M	#XXh	RV_
#23d	RecordValue # 23 = 2.environmental value second occur ENV_D_CUS_SET_SPC[2][2]	M	#XXh	RV_
#24d	RecordValue # 24 = 3.environmental value second occur ENV_D_CUS_SET_SPC[3][2]	M	#XXh	RV_
#25d	RecordValue # 25 = 4.environmental value second occur ENV_D_CUS_SET_SPC[4][2]	M	#XXh	RV_
#26d	RecordValue # 26 = km-value by last occur high byte ENV_D_CUS_SET_SPC[2][3]	M	#XXh	RV_
#27d	RecordValue # 27 = km-value by last occur low byte ENV_D_CUS_SET_SPC[3][3]	M	#XXh	RV_
#28d	RecordValue # 28 = 1.environmental value last occur ENV_D_CUS_SET_SPC[1][3]	M	#XXh	RV_
#29d	RecordValue # 29= 2.environmental value last occur ENV_D_CUS_SET_SPC[2][3]	M	#XXh	RV_
#30d	RecordValue # 30= 3.environmental value last occur ENV_D_CUS_SET_SPC[3][3]	M	#XXh	RV_
#31d	RecordValue # 31 = 4.environmental value last occur ENV_D_CUS_SET_SPC[4][3]	M	#XXh	RV_
#32d	RecordValue # 32= Error class C_ERR_CLAS_XX	M	#00h	RV_
#33d	RecordValue # 33 = Importance counter TSF (not def. yet)	M	#00h	RV_
#34d	RecordValue # 34 = Debounce counter (MIL on) FLC FLC = DC_MAX_XX - CTR_DC[x]	M	#XXh	RV_

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
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#35d	RecordValue # 35= Deleting counter DLC CTR_WUP_CYC[x]	M	#XXh	RV_
#36d	RecordValue # 36 = Freeze frame data 0 - lambda control state bench 1 ENV_D_OBD[1][NC_NR_ERR_DYN]	M	#XXh	RV_
#37d	RecordValue # 37 = Freeze frame data 1 - lambda control state bench 2 ENV_D_OBD[2][NC_NR_ERR_DYN]	M	#XXh	RV_
#38d	RecordValue # 38 = Freeze frame data 2 - relative air mass ENV_D_OBD[3][NC_NR_ERR_DYN]	M	#XXh	RV_
#39d	RecordValue # 39 = Freeze frame data 3 - engine coolant temperature ENV_D_OBD[4][NC_NR_ERR_DYN]	M	#XXh	RV_
#40d	RecordValue # 40 = Freeze frame data 4 - variable factor bench 1 ENV_D_OBD[5][NC_NR_ERR_DYN]	M	#XXh	RV_
#41d	RecordValue # 41 = Freeze frame data 5 - adaptations factor bench 1 ENV_D_OBD[6][NC_NR_ERR_DYN]	M	#XXh	RV_
#42d	RecordValue # 40 = Freeze frame data 6 - variable factor bench 2 ENV_D_OBD[7][NC_NR_ERR_DYN]	M	#XXh	RV_
#43d	RecordValue # 43 = Freeze frame data 7 - adaptations factor bench 2 ENV_D_OBD[8][NC_NR_ERR_DYN]	M	#XXh	RV_
#44d	RecordValue # 44= Freeze frame data 8 - intake air pressure ENV_D_OBD[10][NC_NR_ERR_DYN]	M	#XXh	RV_
#-d	RecordValue # - = Freeze frame data 9 - engine speed ENV_D_CUS_CMN[1][NC_NR_ERR_DYN]	M	#XXh	RV_
#46d	RecordValue # 46 = Freeze frame data 10 - vehicle speed ENV_D_CUS_CMN[13][NC_NR_ERR_DYN]	M	#XXh	RV_
#47d	RecordValue # 6 = P code DTC " high byte ACTION_ERRM_ReadDTCLevelByDTCLevel	M	#XXh	RV_
#48d	RecordValue # 7 = P code DTC " low byte ACTION_ERRM_ReadDTCLevelByDTCLevel	M	#XXh	RV_
#49d	RecordValue # 49 = Checksum for each error	M	#00h	RV_

### Table readDataByLocalIdentifier Positive Response Message ReadDataByLocalIdentifier negative Response Global Negative Responses

## I.11.11 21\_25 - read INH\_IV\_KWP - ReadDataByLocalIdentifier service

### General information:

This funktion reports the value of the switch off pattern of the injection valves .

### Application conditions

#### Initialisation:

at reset

#### Activation:

LV\_IGK=1 (Kl.15 on)

#### Deactivation:

LV\_IGK=0 (Kl.15 off) or  
Diagnostic timeout

#### Service location:


services

see list of implemented diagnostic

### ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier INH_IV_KWP	M	#25h	RLL_INH_IV_KWP

Figure I.11.19: Table readDataByLocalIdentifier Request Message

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### ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier INH_IV_KWP	M	#25h	RLI_
#3d	RecordValue = INH_IV_KWP	M	#XXh	RV_S_

Figure I.11.20: Table readDataByLocalIdentifier Positive Response Message

### ReadDataByLocalIdentifier negative Response

Global Negative Responses

## I.11.12 21\_36 - read air-conditioner status - ReadDataByLocalIdentifier service

### General information:

With this comand the LV to activate the ACC-relay is distributed.

### Application conditions

**Initialisation:** *at reset*

**Activation:** Kl.15 on (LV\_IGK=1)

**Deactivation:** Kl.15 off (LV\_IGK=0) or  
Diagnostic timeout

Service location: see list of implemented diagnostic services

### ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = read air-conditioner status	M	#36h	RLI_

Figure I.11.21: Table readDataByLocalIdentifier Request Message

### ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier= read air-conditioner status	M	#36h	RLI_
#3d	RecordValue # 1 = LV_ACCOUT_RLY	M	#XXh	RV_

Figure I.11.22: Table readDataByLocalIdentifier Positive Response Message

### ReadDataByLocalIdentifier negative Response

Global Negative Responses

## I.11.13 21\_3F - read idle speed status - ReadDataByLocalIdentifier service

**General information:**

With this comand the status of the Idle Speed is hand over.

**Application conditions**

**Initialisation:** at reset  
**Activation:** LV\_IGK=1  
**Deactivation:** LV\_IGK=0  
 Diagnostic timeout  
**Service location:** see list of implemented diagnostic services

**ReadDataByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = read Idle Speed "Switch" status - LV_IS	M	#3Fh	RLI_IS

Figure I.11.23: Table readDataByLocalIdentifier Request Message

**ReadDataByLocalIdentifier positive Response on service**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier	M	#3Fh	RLI_
#3d	RecordValue = LV_IS	M	#XXh	RV_IS

Figure I.11.24: Table readDataByLocalIdentifier Positive Response Message

**ReadDataByLocalIdentifier negative Response**

Global Negative Responses

**I.11.14 21\_41 - read LSH 4 status - ReadDataByLocalIdentifier service**

**General information:**

With this comand the status of the lambda sensor heating 4 is distributed.

**Application conditions**

**Initialisation:** at reset  
**Activation:** LV\_IGK=1 (K1.15 on)  
**Deactivation:** LV\_IGK=0 (K1.15 off)  
 Diagnostic timeout  
**Service location:** see list of implemented diagnostic services

**ReadDataByLocalIdentifier Request**

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = read LSH 4 status	M	#41h	RLI_

Figure I.11.25: Table readDataByLocalIdentifier Request Message

**ReadDataByLocalIdentifier positive Response on service**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier= read LSH 4 status	M	#41h	RLI_
#3d	RecordValue # 1 = STATE_LSH_DOWN[2]	M	#XXh	RV_
#4d	RecordValue # 2 = dummy value fix	M	#FFh	RV_
#5d	RecordValue # 3 = dummy value fix	M	#FFh	RV_
#6d	RecordValue # 4 = dummy value fix	M	#FFh	RV_

Figure I.11.26: Table readDataByLocalIdentifier Positive Response Message

**ReadDataByLocalIdentifier negative Response**

Global Negative Responses

**I.11.15 21\_42 - read LSH 3 status - ReadDataByLocalIdentifier service****General information:**

With this comand the status of the lambda sensor heating 3 is distributed.

**Application conditions**

**Initialisation:** *at reset*

**Activation:** LV\_IGK=1 (K1.15 on)

**Deactivation:** LV\_IGK=0 (K1.15 off)  
Diagnostic timeout

Service location: see list of implemented diagnostic services

**ReadDataByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = read LSH 3 status	M	#42h	RLI_

Figure I.11.27: Table readDataByLocalIdentifier Request Message

**ReadDataByLocalIdentifier positive Response on service**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier= read LSH 3 status	M	#42h	RLI_
#3d	RecordValue # 1 = STATE_LSH_DOWN[1]	M	#XXh	RV_
#4d	RecordValue # 2 = dummy value fix	M	#FFh	RV_
#5d	RecordValue # 3 = dummy value fix	M	#FFh	RV_
#6d	RecordValue # 4 = dummy value fix	M	#FFh	RV_

Figure I.11.28: Table readDataByLocalIdentifier Positive Response Message

### ReadDataByLocalIdentifier negative Response

Global Negative Responses

### I.11.16 21\_43 - read LSH 2 status - ReadDataByLocalIdentifier service

#### General information:

With this comand the status of the lambda sensor heating 2 is distributed.

#### Application conditions

**Initialisation:** *at reset*

**Activation:** LV\_IGK=1 (K1.15 on)

**Deactivation:** LV\_IGK=0 (K1.15 off)

Diagnostic timeout

Service location: see list of implemented diagnostic services

#### ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = read LSH 2 status	M	#43h	RLI_

Figure I.11.29: Table readDataByLocalIdentifier Request Message

### ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier= read LSH 2 status	M	#43h	RLI_
#3d	RecordValue # 1 = STATE_LSH_UP[2]	M	#XXh	RV_
#4d	RecordValue # 2 = dummy value fix	M	#FFh	RV_
#5d	RecordValue # 3 = dummy value fix	M	#FFh	RV_
#6d	RecordValue # 4 = dummy value fix	M	#FFh	RV_

Figure I.11.30: Table readDataByLocalIdentifier Positive Response Message

### ReadDataByLocalIdentifier negative Response

Global Negative Responses



## I.11.17 21\_44 - read LSH 1 status - ReadDataByLocalIdentifier service

### General information:

With this comand the status of the lambda sensor heating 1 is distributed.

### Application conditions

**Initialisation:** *at reset*  
**Activation:** LV\_IGK=1 (Kl.15 on)  
**Deactivation:** LV\_IGK=0 (Kl.15 off)  
 Diagnostic timeout  
 Service location: see list of implemented diagnostic services

### ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = read LSH 1 status	M	#44h	RLI_

Figure I.11.31: Table readDataByLocalIdentifier Request Message

### ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier= read LSH 1 status	M	#44h	RLI_
#3d	RecordValue # 1 = STATE_LSH_UP[1]	M	#XXh	RV_
#4d	RecordValue # 2 = dummy value fix	M	#FFh	RV_
#5d	RecordValue # 3 = dummy value fix	M	#FFh	RV_
#6d	RecordValue # 4 = dummy value fix	M	#FFh	RV_

Figure I.11.32: Table readDataByLocalIdentifier Positive Response Message

### ReadDataByLocalIdentifier negative Response

Global Negative Responses

## I.11.18 21\_49 - read Immobilizer status - ReadDataByLocalIdentifier service

### General information:

With this comand the status of the Immobilizer is distributed.

### Application conditions

**Initialisation:** *at reset*  
**Activation:** Kl.15 on (LV\_IGK=1)  
**Deactivation:** Kl.15 off (LV\_IGK=0)  
 Diagnostic timeout  
 Service location: see list of implemented diagnostic services

### ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = read Immobilizer status	M	#49h	RLI_

Figure I.11.33: Table readDataByLocalIdentifier Request Message

### ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier= read Immobilizer status	M	#49h	RLI_
#3d	RecordValue # 1 =LV_LOCK_IMOB	M	#XXh	RV_

Figure I.11.34: Table readDataByLocalIdentifier Positive Response Message

### ReadDataByLocalIdentifier negative Response

Global Negative Responses

## I.11.19 21\_4C - Read basic injection time cylinder 1 - ReadDataByLocalIdentifier service

#### General information:

This funktion reports the value of the injection time cylinder logical .

#### Application conditions

**Initialisation:** at reset

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off) or  
Diagnostic timeout

Service location: see list of implemented diagnostic services

### ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier TI_1_HOM[0]	M	#4Ch	RLI_BIOS_TI_0

Figure I.11.35: Table readDataByLocalIdentifier Request Message

### ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier TI_1_HOM[0]	M	#4Ch	RLI_
#3d	RecordValue = TI_1_HOM[0] high byte	M	#XXh	RV_S_
#4d	RecordValue = TI_1_HOM[0] low byte	M	#XXh	RV_S_

Figure I.11.36: Table readDataByLocalIdentifier Positive Response Message

### ReadDataByLocalIdentifier negative Response

Global Negative Responses

## I.11.20 21\_50 - read engine speed - ReadDataByLocalIdentifier service

### General information:

This service reports the actual value of the engine speed.

### Application conditions

**Initialisation:** *at reset with 00h*

**Activation:** Kl.15 on

**Deactivation:** Kl.15 off  
Diagnostic timeout

Service location: see list of implemented diagnostic services

### ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = read engine speed	M	#50h	RLI_

Figure I.11.37: Table readDataByLocalIdentifier Request Message

### ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier= engine speed	M	#50h	RLI_
#3d	RecordValue # = N high byte	M	#XXh	RV_
#4d	RecordValue # = N low byte	M	#XXh	RV_

Figure I.11.38: Table readDataByLocalIdentifier Positive Response Message

### ReadDataByLocalIdentifier negative Response

Global Negative Responses

## I.11.21 21\_54 - read intake air temperature - ReadDataByLocalIdentifier service

**General information:**

This service reports the actual value of the intake air temperature.

**Application conditions**

**Initialisation:** *at reset with 00h*  
**Activation:** Kl.15 on  
**Deactivation:** Kl.15 off  
 Diagnostic timeout  
 Service location: see list of implemented diagnostic services

**readDataByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = read intake air temperature	M	#54h	RLI_

Figure I.11.39: Table readDataByLocalIdentifier Request Message

**readDataByLocalIdentifier positive Response on service**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier= intake air temperature	M	#54h	RLI_
#3d	RecordValue = TIA_MES	M	#XXh	RV_

Figure I.11.40: Table readDataByLocalIdentifier Positive Response Message

**readDataByLocalIdentifier negative Response**

Global Negative Responses

**I.11.22 21\_55 - read coolant temperature - ReadDataByLocalIdentifier service**

**General information:**

This service reports the actual value of the coolant temperature.

**Application conditions**

**Initialisation:** *at reset with 00h*  
**Activation:** Kl.15 on  
**Deactivation:** Kl.15 off  
 Diagnostic timeout  
 Service location: see list of implemented diagnostic services

**readDataByLocalIdentifier Request**

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = read coolant temperature	M	#55h	RLI_

Figure I.11.41: Table readDataByLocalIdentifier Request Message

**ReadDataByLocalIdentifier positive Response on service**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier= coolant temperature	M	#55h	RLI_
#3d	RecordValue = TCO_MES	M	#XXh	RV_

Figure I.11.42: Table readDataByLocalIdentifier Positive Response Message

**ReadDataByLocalIdentifier negative Response**

Global Negative Responses

**I.11.23 21\_56 - Read ignition angle cylinder 1 - ReadDataByLocalIdentifier service****General information:**

This funktion reports the value of the Ignition angle applied on cylinder log.0 (phys1) .

**Application conditions****Initialisation:** *at reset***Activation:** LV\_IGK=1 (Kl.15 on)**Deactivation:** LV\_IGK=0 (Kl.15 off) or  
Diagnostic timeout

Service location: see list of implemented diagnostic services

**ReadDataByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier IGA_IGC[0]	M	#56h	RLI_IGA_IGC_0

Figure I.11.43: Table readDataByLocalIdentifier Request Message

**ReadDataByLocalIdentifier positive Response on service**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier IGA_IGC[0]	M	#56h	RLI_
#3d	RecordValue = IGA_IGC[0]	M	#XXh	RV_S_

Figure I.11.44: Table readDataByLocalIdentifier Positive Response Message

**ReadDataByLocalIdentifier negative Response**  
Global Negative Responses

**I.11.24 21\_57 - read opening angle of the throttle valve (TPS\_AV) - ReadDataBy-LocalIdentifier service**

**General information:**

This service reports the actual value of the opening angle of the throttle valve (TPS\_AV).

**Application conditions**

**Initialisation:** *at reset with 00h*  
**Activation:** Kl.15 on  
**Deactivation:** Kl.15 off  
 Diagnostic timeout  
 Service location: see list of implemented diagnostic services

**ReadDataByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = read opening angle of the throttle valve (TPS_AV)	M	#57h	RLI_

Figure I.11.45: Table readDataByLocalIdentifier Request Message

**ReadDataByLocalIdentifier positive Response on service**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier= opening angle of the throttle valve (TPS_AV)	M	#57h	RLI_
#3d	RecordValue # = TPS_AV high Byte	M	#XXh	RV_
#4d	RecordValue # = TPS_AV low Byte	M	#XXh	RV_

Figure I.11.46: Table readDataByLocalIdentifier Positive Response Message

**ReadDataByLocalIdentifier negative Response**  
Global Negative Responses

**I.11.25 21\_58 - read mass air flow per segment measured (MAF\_KGH\_MES) - ReadDataByLocalIdentifier service**

**General information:**

This service reports the actual value of the mass air flow per segment measured (MAF\_KGH\_MES)

**Application conditions**

**Initialisation:** *at reset with 00h*  
**Activation:** LV\_IGK=1 (Kl.15 on)

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**Deactivation:** LV\_IGK=0 (Kl.15 off)  
Diagnostic timeout  
Service location: see list of implemented diagnostic services

### ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = read mass air flow per segment measured (MAF_KGH_MES)	M	#58h	RLI_

Figure I.11.47: Table readDataByLocalIdentifier Request Message

### ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier= mass air flow per segment measured (MAF_KGH_MES)	M	#58h	RLI_
#3d	RecordValue # = MAF_KGH_MES high Byte	M	#XXh	RV_
#4d	RecordValue # = MAF_KGH_MES low Byte	M	#XXh	RV_

Figure I.11.48: Table readDataByLocalIdentifier Positive Response Message

### ReadDataByLocalIdentifier negative Response

Global Negative Responses

## I.11.26 21\_5B - read Pedal value sensor 1 raw acquisition (V\_PVS\_1\_KWP) - ReadDataByLocalIdentifier service

### General information:

This service reports the actual value of the Pedal value sensor 1 raw acquisition of the accelerator pedal (V\_PVS\_1\_KWP).

V\_PVS\_1\_KWP is defined within the DDLI values.

### Application conditions

**Initialisation:** at reset with 00h


**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off)  
Diagnostic timeout  
Service location: see list of implemented diagnostic services

### ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = V_PVS_1_KWP	M	#5Bh	RLI_

Figure I.11.49: Table readDataByLocalIdentifier Request Message

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7415 of 8404	
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### ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier= V_PVS_1_KWP	M	#5Bh	RLI_
#3d	RecordValue # = V_PVS_1_KWP	M	#XXh	RV_

Figure I.11.50: Table readDataByLocalIdentifier Positive Response Message

### ReadDataByLocalIdentifier negative Response Global Negative Responses

### I.11.27 21\_71 - read LV\_KNK - ReadDataByLocalIdentifier service

#### General information:

This funktion reports the value of the Ignition angle applied on cylinder log.0 (phys1) .

#### Application conditions

**Initialisation:** *at reset*

**Activation:** LV\_IGK=1 (K1.15 on)

**Deactivation:** LV\_IGK=0 (K1.15 off) or  
Diagnostic timeout

Service location: see list of implemented diagnostic services

### ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier LV_KNK	M	#71h	RLI_LV_KNK

Figure I.11.51: Table readDataByLocalIdentifier Request Message

### ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier LV_KNK	M	#71h	RLI_
#3d	RecordValue = LV_KNK	M	#XXh	RV_S_

Figure I.11.52: Table readDataByLocalIdentifier Positive Response Message

### ReadDataByLocalIdentifier negative Response Global Negative Responses

### I.11.28 21\_A3 - read VB - ReadDataByLocalIdentifier service



**General information:**

This funktion reports the value of the battery voltage .

**Application conditions**

**Initialisation:** *at reset*

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off) or  
Diagnostic timeout

Service location: see list of implemented diagnostic services

**ReadDataByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier VB	M	#A3h	RLL_VB

Figure I.11.53: Table readDataByLocalIdentifier Request Message

**ReadDataByLocalIdentifier positive Response on service**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier VB	M	#A3h	RLL_VB
#3d	RecordValue = VB	M	#XXh	RV_S_

Figure I.11.54: Table readDataByLocalIdentifier Positive Response Message

**ReadDataByLocalIdentifier negative Response**

Global Negative Responses

**I.11.29 21\_C0 - read SAFM status - ReadDataByLocalIdentifier service**

**General information:**

With this comand the status of the secondary air mass sensor is distributed.

**Application conditions**

**Initialisation:** *at reset*

**Activation:** Kl.15 on (LV\_IGK=1)

**Deactivation:** Kl.15 off (LV\_IGK=0)  
Diagnostic timeout

Service location: see list of implemented diagnostic services

**ReadDataByLocalIdentifier Request**

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = read SAFM status	M	#C0h	RLI_

Figure I.11.55: Table readDataByLocalIdentifier Request Message

**ReadDataByLocalIdentifier positive Response on service**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier= read SAFM status	M	#C0h	RLI_
#3d	RecordValue # 1 = STATE_DIAG_SA_SAFM	M	#XXh	RV_

Figure I.11.56: Table readDataByLocalIdentifier Positive Response Message

**ReadDataByLocalIdentifier negative Response**

Global Negative Responses

**I.11.30 21\_C1 - read kva-factor - ReadDataByLocalIdentifier service****General information:**

This funktion shows the additive part of the correctionfactor for the consumption - displayed in the combi - for the customer service.

**Application conditions**

**Initialisation:** *at reset*

**Activation:** K1.15 on

**Deactivation:** K1.15 off  
Diagnostic timeout

Service location: see list of implemented diagnostic services

**ReadDataByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = KVA-factor	M	#C1h	RLI_KVA

Figure I.11.57: Table readDataByLocalIdentifier Request Message

**ReadDataByLocalIdentifier positive Response on service**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier	M	#C1h	RLI_KVA
#3d	RecordValue = FAC_FCO_KWP [ remain the same negative displace max.12.8% positive displace max.12.7% (1h=0.001/bit) ]	M	#XXh [ #00h, #80h-FFh #01h-7Fh ]	RV_

Figure I.11.58: Table readDataByLocalIdentifier Positive Response Message

**ReadDataByLocalIdentifier negative Response**

Global Negative Responses

**I.11.31 21\_C3 - read TRT - ReadDataByLocalIdentifier service****General information:**

This funktion reports the value of the Total running time .

**Application conditions****Initialisation:** *at reset***Activation:** LV\_IGK=1 (Kl.15 on)**Deactivation:** LV\_IGK=0 (Kl.15 off) or  
Diagnostic timeout

Service location: see list of implemented diagnostic services

**ReadDataByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier TRT	M	#C3h	RLI_TRT

Figure I.11.59: Table readDataByLocalIdentifier Request Message

**ReadDataByLocalIdentifier positive Response on service**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier TRT	M	#C3h	RLI_
#3d	RecordValue = TRT high byte high word	M	#XXh	RV_S_
#4d	RecordValue = TRT low byte high word	M	#XXh	RV_S_
#5d	RecordValue = TRT high byte low word	M	#XXh	RV_S_
#6d	RecordValue = TRT low byte low word	M	#XXh	RV_S_

Figure I.11.60: Table readDataByLocalIdentifier Positive Response Message

**ReadDataByLocalIdentifier negative Response**

Global Negative Responses

## I.11.32 21\_F0 - DDLI handling - ReadDataByLocalIdentifier service

### General information:

This function is created to read the DDLI, which has to be defined before with the service 2Ch.

### Application conditions

**Initialisation:** *at reset*  
**Activation:** Kl.15 on  
**Deactivation:** Kl.15 off  
 Diagnostic timeout  
 Service location: see list of implemented diagnostic services

### ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = DDLI	M	#F0h	DDLI

Figure I.11.61: Table readDataByLocalIdentifier Request Message

### ReadDataByLocalIdentifier positive Response

#### Example 1: DDLIDefinitonMode=DefineByCommonIdentifier and MemorySize=01

Information, which is given by the DDLI service (compare specification DynamicallyDefineLocalIdentifier service - 2Ch ).

MemorySize: fixed to 01  
 PIDDDLI\_x : PositionInDynamicallyDefinedLocalIdentifier x  
 RCI\_x : RecordCommonID (according to IO-data list) x

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	ReadDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier = DDLI	M	#F0h	RLI_
..	..	..	..	..
..	..	..	..	..
#2d+ PIDDDLI_1	Contents of IO-data given by the number in RCI_1 (compare IO-data list) in byte format	M	#XXh	
..	..	..	..	..
..	..	..	..	..
..	..	..	..	..
#2d+ PIDDDLI_x	Contents of IO-data given by the number in RCI_x (compare IO-data list) in byte format	M	#XXh	

Figure I.11.62: Table readDataByLocalIdentifier Positive Response Message

#### Example 2: DDLIDefinitonMode=DefineByCommonIdentifier and MemorySize=02

Information, which is given by the DDLI service (compare specification DynamicallyDefineLocalIdentifier service - 2Ch ).

MemorySize: fixed to 02  
 PIDDDLI\_x : PositionInDynamicallyDefinedLocalIdentifier x

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RCI\_x : RecordCommonID (according to IO-data list) x

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	ReadDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier = DDLI	M	#F0h	RLI_
..	..	..	..	..
..	..	..	..	..
#2d+ PIDDDLI_1	Contents of IO-data given by the number in RCI_1 (compare IO-data list) high byte	M	#XXh	
#2d+ 1+ PIDDDLI_1	Contents of IO-data given by the number in RCI_1 (compare IO-data list) low byte	M	#XXh	
..	..	..	..	..
..	..	..	..	..
#2d+ PIDDDLI_x	Contents of IO-data given by the number in RCI_x (compare IO-data list) high byte	M	#XXh	
#2d+ 1+ PIDDDLI_x	Contents of IO-data given by the number in RCI_x (compare IO-data list) low byte	M	#XXh	

Figure I.11.63: Table readDataByLocalIdentifier Positive Response Message

### Example 3: DDLIDefinitionMode= DefineByMemoryAddress

Information, which is given by the DDLI service (compare specification DynamicallyDefineLocalIdentifier service - 2Ch ).

MemorySize\_x


PIDDDLI\_x : PositionInDynamicallyDefinedLocalIdentifier x

MemoryAddress\_x

MemoryTypeIdentifier\_x

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	ReadDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	RecordLocalIdentifier = DDLI	M	#F0h	RLI_
..	..	..	..	..
..	..	..	..	..
#2d+ PIDDDLI_1	Contents of MemoryAddress_1 in MemoryTypeIdentifier_1 section	M	#XXh	
#2d+ 1+ PIDDDLI_1	Contents of MemoryAddress_1+1 in MemoryTypeIdentifier_1 section	M	#XXh	
#2d+ MemorySize_ 1+ PIDDDLI_1	Contents of MemoryAddress_1+MemorySize_1 in MemoryTypeIdentifier_1 section	M	#XXh	
..	..	..	..	..
..	..	..	..	..
#2d+ PIDDDLI_x	Contents of MemoryAddress_x in MemoryTypeIdentifier_x section	M	#XXh	
#2d+ 1+ PIDDDLI_x	Contents of MemoryAddress_x+1 in MemoryTypeIdentifier_x section	M	#XXh	
#2d+ MemorySize_ x+ PIDDDLI_x	Contents of MemoryAddress_x+MemorySize_x in MemoryTypeIdentifier_x section	M	#XXh	

Figure I.11.64: Table readDataByLocalIdentifier Positive Response Message

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7421 of 8404	
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## ReadDataByLocalIdentifier negative Response

### Global Negative Responses

<b>NegativeResponseCode</b>	<b>Cause of Occurrence</b>
SubFunctionNotSupported-invalidFormat	- selected RCI is not supported - selected DDDL is not supported

## I.12 KWP2000 - SID 28h: disableNormalMessageTrm Services

### Input data:

LV_IGK {p. 906}		
-----------------	--	--

### I.12.1 28h - DisableNormalMessageTransmission service

#### General information:

This command is used to inhibit J1850 normal message transmission from PCM (intersystem) while still performing other functions normally. That means, that PCM should still receive all its J1850 messages and process them as required.

#### Description:

The parameter **responseRequired** is used in the DisableNormalMessageTransmission request message. It indicates to the server(s) whether a positive response message is required or not.

A negative response shall even be sent if responseRequired is set to no

If the responseRequired parameter in the DisableNormalMessageTransmission request message is missing, the server(s) shall sent a response message.

The DisableNormalMessageTransmission service shall be used by a client to stop the normal (non diagnostic) and network management message transmission from the vehicle server(s).

#### Fault detection and storage is also disabled by this service.

The DisableNormalMessageTransmission request message can be used with both physical and functional addressing to stop the message transmission from an individual server or a group of servers. The server(s) being addressed shall respond with a DisableNormalMessageTransmission positive response message if the response option is set so or, if unable to stop the message transmission, respond with a DisableNormalMessageTransmission negative response message.

#### Application conditions

**Initialisation:** *at reset*

**Activation:** LV\_IGK=1 (K1.15 on)

**Deactivation:** LV\_IGK=0 (K1.15 off)  
Diagnostic timeout

**Service location:** see "list of implemented diagnostic services"

#### DisableNormalMessageTransmission service

<i>Data Byte</i>	<i>Parameter Name</i>	<i>Cvt</i>	<i>Hex Value</i>	<i>Mnemonic</i>
#1d	DisableNormalMessageTransmission service	M	#28h	DNMT
#2d	DisableNormalMessageTransmission [ <b>yes</b> - server shall send a positive or negative response to the request message <b>no</b> - server shall not send a positive response to the request ] ]	M	#XXh [ #01h,  #02h ] ]	

Figure I.12.1: Table ReadDataByCommonIdentifier Request Message

**DisableNormalMessageTransmission positive Response on service**

<i>Data Byte</i>	<i>Parameter Name</i>	<i>Cvt</i>	<i>Hex Value</i>	<i>Mnemonic</i>
#1d	DisableNormalMessageTransmission service Response Service Id	M	#68h	

Figure I.12.2: Table ReadDataByCommonIdentifier Positive Response Message

**DisableNormalMessageTransmission negative Response**

<i>Data Byte</i>	<i>Parameter Name</i>	<i>Cvt</i>	<i>Hex Value</i>	<i>Mnemonic</i>
#1d	<b>negativeResponse Service Id</b>	M	#7Fh	NR
#2d	ReadDataByCommonIdentifier Request Service Id	M	#28h	
#3d	responseCode=only general response code	M	#XXh	

Figure I.12.3: Table: ReadDataByCommonIdentifier Negative Response Message



# I.13 KWP2000 - SID 29h: enableNormalMessageTrm Services

**Input data:**

LV_IGK {p. 906}		
-----------------	--	--

## I.13.1 29h - EnableNormalMessageTransmission service

**General information:**

This command is used to cancel a mode 28h DisableNormalMessageTransmission request. The parameter responseRequired is used in the EnableNormalMessageTransmission request message. It indicates to the server(s) whether a positive response message is required or not. A negative response shall even be sent if responseRequired is set to no.

**Description:**

The EnableNormalMessageTransmission request message shall be used to indicate to the server that normal transmission shall be resumed. The service is used in combination with the DisableNormalMessageTransmission service to once again start the normal and network management message transmission from the server.

**Fault detection and storage is also Enabled by this service.**

The EnableNormalMessageTransmission request message can be used with both physical and functional addressing to resume normal messages transmission from an individual server or a group of servers.

The server(s) being addressed shall respond with a EnableNormalMessageTransmission negative response message.

**Application conditions**

**Initialisation:** at reset

**Activation:** LV\_IGK=1 (Kl.15 on)


**Deactivation:** LV\_IGK=0 (Kl.15 off)  
Diagnostic timeout

**Service location:** see "list of implemented diagnostic services"

**EnableNormalMessageTransmission service**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	EnableNormalMessageTransmission service	M	#29h	DNMT
#2d	EnableNormalMessageTransmission [ no_parameter or #01h: ECU shall send a positive response #02h: ECU shall not send a positive response ]  <b>Remark:</b> A negative response shall be sent in any case if an error occurs	M	#XXh [ -- / #01h, #02h ]	

Figure I.13.1: Table ReadDataByCommonIdentifier Request Message

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7425 of 8404	
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### EnableNormalMessageTransmission positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	EnableNormalMessageTransmission service Response Service Id	M	#69h	

Figure I.13.2: Table ReadDataByCommonIdentifier Positive Response Message

### EnableNormalMessageTransmission negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	ReadDataByCommonIdentifier Request Service Id	M	#29h	
#3d	responseCode=only general response code	M	#XXh	

Figure I.13.3: Table: ReadDataByCommonIdentifier Negative Response Message

## I.14 KWP2000 - SID 2Ch: dynamicallyDefineLocalIdentifier Service

see introduction  
see introduction

### General information:

This function is used to define /clear single or multiple data that can be read as one complete block by ReadDataByLocalId service 21\_F0 after block definition.

Data definition can be made either directly by address or by common identifier RCI from DDLI table (see specification 17I00101, "Introduction") defined inside ECU-SW.

### Application conditions

**Initialisation:** `at reset`

**Activation:** `LV_IGK = 1`

**Deactivation:** `LV_IGK = 0`  
`Diagnostic timeout`  
`Service location: see "list of implemented diagnostic services"`

### I.14.1 DynamicallyDefineLocalIdentifier Request - DefineByCommonIdentifier - 2C\_02

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	DynamicallyDefineLocalIdentifier Request Service Id	M	#2Ch	DDLI
#2d	DynamicallyDefinedLocalIdentifier	M	#F0h	DDDLI
#3d	DefinitionMode=XX	M	#XXh=	DNM
	[ DefineByCommonID ]		[ #02h ]	DBLI
#4d	PositionInDynamicallyDefinedLocalIdentifier	M	#XXh	PIDDDLI
#5d	MemorySize	M	#XXh	MS
#6d	RecordCommonID (high byte) <i>(Index according to DDLI data list)</i>	M	#XXh	RCI_HB
#7d	RecordCommonID (low byte) <i>(Index according to DDLI data list)</i>	M	#XXh	RCI_LB
#8d	PositionInRecordCommonIdentifier	M	#01h	PIRCI
...	...	C	...	
#n-5d	DefinitionMode=XX	C	#XXh=	DNM
	[ DefineByCommonID ]		[ #02h ]	
#n-4d	PositionInDynamicallyDefinedLocalIdentifier	C	#XXh	PIDDDLI
#n-3d	MemorySize	C	#XXh	MS
#n-1d	RecordCommonID (high byte) <i>(Index according to DDLI data list)</i>	C	#XXh	RCI_HB
#n-1d	RecordCommonID (low byte) <i>(Index according to DDLI data list)</i>	C	#XXh	RCI_LB
#nd	PositionInRecordCommonIdentifier	C	#01h	PICLI

Figure I.14.1: Table DynamicallyDefineLocalIdentifier Request Message - 2C\_02

## I.14.2 DynamicallyDefineLocalIdentifier Request - DefineByMemoryAddress - 2C\_03

(3-byte addressing)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	DynamicallyDefineLocalIdentifier Request Service Id	M	#2Ch	DDLI
#2d	DynamicallyDefinedLocalIdentifier	M	#F0h	DDDLI
#3d	DefinitionMode=XX [ DefineByMemoryAddress ]	M	#XXh= [ #03h ]	DNM  DBMA
#4d	PositionInDynamicallyDefinedLocalIdentifier	M	#XXh	PIDDLII
#5d	MemorySize	M	#XXh	MS
#6d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#7d	MemoryAddress (Middle Byte)	M	#XXh	MA_MB
#8d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
#9d	MemoryTypeIdIdentifier (optional) [ linear type external FLASH external RAM internal FLASH user information field UIF ]	U	#XXh [ #00h #02h #05h #06h #07h ]	MTI
...	...	C	...	
#n-6d	DefinitionMode=XX [ DefineByMemoryAddress ]	C	#XXh= [ #03h ]	DNM  DBMA
#n-5d	PositionInDynamicallyDefinedLocalIdentifier	C	#XXh	PIDDLII
#n-4d	MemorySize	C	#XXh	MS
#n-3d	MemoryAddress (High Byte)	C	#XXh	MA_HB
#n-2d	MemoryAddress (Middle Byte)	C	#XXh	MA_MB
#n-1d	MemoryAddress (Low Byte)	C	#XXh	MA_LB
#nd	MemoryTypeIdIdentifier (optional) [ linear type external FLASH external RAM internal FLASH user information field UIF ]	U	#XXh [ #00h #02h #05h #06h #07h ]	MTI

Figure I.14.2: Table DynamicallyDefineLocalIdentifier Request Message - 2C\_03 (3-byte addressing)

## I.14.3 DynamicallyDefineLocalIdentifier Request - DefineByMemoryAddress - 2C\_03

(4-byte addressing)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	DynamicallyDefineLocalIdentifier Request Service Id	M	#2Ch	DDLI
#2d	DynamicallyDefinedLocalIdentifier	M	#F0h	DDDLI
#3d	DefinitionMode=XX [ DefineByMemoryAddress ]	M	#XXh= [ #03h ]	DNM
				DBMA
#4d	PositionInDynamicallyDefinedLocalIdentifier	M	#XXh	PIDDLII
#5d	MemorySize	M	#XXh	MS
#6d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#7d	MemoryAddress (MiddleHigh Byte)	M	#XXh	MA_MHB
#8d	MemoryAddress (MiddleLow Byte)	M	#XXh	MA_MLB
#9d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
#10d	MemoryTypeIdIdentifier ( <b>mandatory, but not evaluated</b> ) [ 00h ... FFh ]	M	#XXh [ #XXh ]	MTI
...	...	C	...	
#n-7d	DefinitionMode=XX [ DefineByMemoryAddress ]	C	#XXh= [ #03h ]	DNM
				DBMA
#n-6d	PositionInDynamicallyDefinedLocalIdentifier	C	#XXh	PIDDLII
#n-5d	MemorySize	C	#XXh	MS
#n-4d	MemoryAddress (High Byte)	C	#XXh	MA_HB
#n-3d	MemoryAddress (MiddleHigh Byte)	M	#XXh	MA_MHB
#n-2d	MemoryAddress (MiddleLow Byte)	M	#XXh	MA_MLB
#n-1d	MemoryAddress (Low Byte)	C	#XXh	MA_LB
#nd	MemoryTypeIdIdentifier ( <b>mandatory, but not evaluated</b> ) [ 00h ... FFh ]	M	#XXh [ #XXh ]	MTI

Figure I.14.3: Table DynamicallyDefineLocalIdentifier Request Message - 2C\_03 (4-byte addressing)

**Remark:**

For **3-byte addressing** independent from delivery of a MemoryTypeIdIdentifier (byte 9) by the tester's request, the ECU automatically adds an offset to the requested memory address.

If no MemoryTypeIdIdentifier is delivered, the same offset as for MemoryTypeIdIdentifier 00h (linear addressing) is used.

This base memory offset must be subtracted from any memory address taken from the MAP- /A2L- file if 3-byte addressing is not sufficient for the address range!

For **4-byte addressing** a MemoryTypeIdIdentifier (byte 10) must be delivered by the tester's request. Though it is not evaluated or used within the ECU for this absolute addressing mode, it is necessary to decide between 3- /4-byte addressing mode.

In this 4-byte mode the absolute address delivered by the tester is used by the ECU without any memory offset.

For MSx80 (TriCore) the base memory offsets for **3-byte addressing** are:

MemoryTypeIdIdentifier:	Memory offset:
none (linear)	C000 0000h
00h (linear)	C000 0000h
02h (ext. FLASH)	8000 0000h (the same as for int. FLASH)
05h (ext. RAM)	D000 0000h

06h (int. FLASH) 8000 0000h  
 07h (UIF) 8000 xxxh not fixed yet, address might still change !!!

The DDLI Service with the definitionMode "defineByMemoryAddress" can only read memory areas, which are also readable by RMBA-service (for details about allowed memory areas see specification 17100J02, "SID23h: ReadMemoryByAddress").

#### I.14.4 DynamicallyDefineLocalIdentifier Request - ClearDDLI - 2C\_04

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	DynamicallyDefineLocalIdentifier Request Service Id	M	#2Ch	DDLI
#2d	DynamicallyDefinedLocalIdentifier	M	#F0h	DDDLI
#3d	DefinitionMode=XX [	M	#XXh= [	DNM
	ClearDynamicallyDefinedLocalIdentifier ]		#04h ]	CDDDLI

Figure I.14.4: Table DynamicallyDefineLocalIdentifier Request Message - 2C\_04

#### I.14.5 DynamicallyDefineLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	DynamicallyDefineLocalIdentifier Positive Response Id	M	#6Ch	DDLIPR
#2d	DynamicallyDefinedLocalIdentifier	M	#F0h	DDDLI

Figure I.14.5: Table DynamicallyDefineLocalIdentifier Positive Response Message

#### I.14.6 DynamicallyDefineLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	DynamicallyDefineLocalIdentifier Request Service Id	M	#2Ch	DDLI
#3d	responseCode= [	M	#XXh= [	RC
	subFunctionNotSupported-invalidFormat, conditionNotCorrect, requestOutOfRange, uploadNotAccepted, can'tUploadNumberOfBytesRequested, general response codes ]		#12h, #22h, #31h, #50h, #53h, #XXh ]	

Figure I.14.6: Table DynamicallyDefineLocalIdentifier Negative Response Message

NegativeResponseCode	Cause of Occurrence
SubFunctionNotSupported-invalidFormat	- selected RCI is not supported - selected DDDLI is not supported
ConditionNotCorrect	selected DNM is not supported
RequestOutOfRange	selected PIRCI does not exist
UploadNotAccepted	error in PIDDDLI information (outside DDLI area)
can'tUploadNumberOfBytesRequested	the requested information is bigger than the reserved buffer

## I.15 KWP2000 - SID 30h: inputOutputControlByLocalID Service

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ANG_SP_EXT_ADJ_VVL	O/V	0... FFH	0... 179.29687	0.703125	°
Valvtronic lift setpoint from the tester to valveronic controller					
arqtmsv_w_rb	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°CRK
Control value of VCV via tester					
arqtmsv_w_rb [NC_CBK_HPP_NR]	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°CRK
Control value of VCV via tester					
B_rqtmsv_rb	O/V	0... 1H	0 ...1	1	-
Condition VCV control via tester request					
B_rqtmsv_rb [NC_CBK_HPP_NR]	O/V	0... 1H	0 ...1	1	-
Condition VCV control via tester request					
CAM_SP_2_EX_EXT_ADJ	O/V	0... FFFFH	-128... 52300	0.8	°CRK
Output signal from the module actuator diagnosis to the function					
CAM_SP_2_IN_EXT_ADJ	O/V	0... FFFFH	-128... 52300	0.8	°CRK
Output signal from the module actuator diagnosis to the function					
CAM_SP_EX_EXT_ADJ	O/V	0... FFFFH	-128... 52300	0.8	°CRK
Output signal from the module actuator diagnosis to the function					
CAM_SP_IN_EXT_ADJ	O/V	0... FFFFH	-128... 52300	0.8	°CRK
Output signal from the module actuator diagnosis to the function					
CPPWM_EXT_ADJ	O/V	0... FFH	0... 99.60937	0.390625	%
CPPWM requested by service tool					
ECFPWM_ECF_EXT_ADJ	O/V	0... FFH	0... 99.60937	0.390625	%
Electric fan control pulse width modulation-signal for the function InputOutputControl					
ECPWM_EXT_ADJ	O/V	0... FFH	0... 99.60937	0.390625	%
PWM output signal for the electronic controlled thermostat in case of external adjustment					
EFPPWM_EXT_ADJ	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
EFPPWM while external controlling by service tool					
FUP_SP_EXT_ADJ	O/V	0... FFFFH	0... 347776	5.3067216	hPa
fuel pressure setpoint requested via KWP					
IV_EXT_ADJ [NC_CYL_NR]	O/V	0... FFH	0... 20.4	0.08	ms
Injection time cylinder individual at external adjustment					
IV_PER_EXT_ADJ [NC_CYL_NR]	O/V	0... FFH	0... 2550	10	ms
Injection period cylinder individual at external adjustment					
LSHPWM_DOWN_EXT_ADJ [NC_CBK_EX_NR]	O/V	0... FFH	0... 99.60937	0.390625	%
PWM-signal for the function InputOutputControl					
LSHPWM_UP_EXT_ADJ [NC_CBK_EX_NR]	O/V	0... FFH	0... 99.60937	0.390625	%
PWM-signal for the function InputOutputControl					
LV_ACCOUT_RLY_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ACT_ACCOUT_RLY_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for ACC-Relay 0=off, 1=on					
LV_ACT_CRU_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
switch for the function InputOutputControl 1 = active 0 = deactivate					
LV_ACT_DMTL_PUMP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for DMTL pump 0 = off, 1 = on					
LV_ACT_DMTLH_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for DMTL heater 0 = off, 1 = on					
LV_ACT_DMTLS_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for DMTL solenoid 0 = off, 1 = on					
LV_ACT_EBOX_CFA_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for ebox cooling fan 0 = off, 1 = on					
LV_ACT_ECRAS_DOWN_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Bit used to determine ECRASPWM by external adjustment					
LV_ACT_ECRAS_UP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Bit used to determine ECRASPWM by external adjustment					
LV_ACT_EF_2_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for second Exhaust Flap 0=off, 1=on					
LV_ACT_EF_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for Exhaust Flap 0=off, 1=on					
LV_ACT_MIL_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for MIL 1 = active 0 = inactive					
LV_ACT_RAS_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for the radiator shutter ( 0 = off, 1 = on )					
LV_ACT_RLY_CRCV_HEAT_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for crankcase ventilation heater relay 0 = closed, 1 = open					
LV_ACT_RLY_HPDI_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Command from tester for switching Piezo relay (0=off, 1=on)					
LV_ACT_RLY_MAIN_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Command from tester for switching main relay (0 = off, 1 = on)					
LV_ACT_RLY_MTC_2_HEAT_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for second throttle housing heater relay 0 = closed, 1 = open					
LV_ACT_RLY_MTC_HEAT_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for throttle housing heater relay 0 = closed, 1 = open					
LV_ACT_RLY_ST_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for starter relay 0 = off, 1 = on					
LV_ACT_RLY_VCV_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for VCV relay 0 = off, 1 = on					
LV_ACT_RLY_VVL_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for VVL relay 0 = off, 1 = on					
LV_ACT_SAP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Logical variable for SAP actuator test, set if request from service tool is accepted					
LV_ACT_SAV_2_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Logical variable for second SAV actuator test, set if request from service tool is accepted					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ACT_SAV_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Logical variable for SAV actuator test, set if request from service tool is accepted					
LV_ACT_SOF_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for sound flap 0=off, 1=on					
LV_ACT_VIM_1_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for DISA1 0 = closed, 1 = open					
LV_ACT_VIM_2_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for DISA2 0 = closed, 1 = open					
LV_ACT_WAL_1_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for SAP 0 = off, 1 = on					
LV_AD_DIS_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
boolean for disable adaptions while active external adjust					
LV_ANG_SP_EXT_ADJ_VVL	O/V	0... 1H	0 ...1	1	-
Valvtronic lift setpoint from the tester to valveronic controller active					
LV_CAM_SP_2_EX_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_CAM_SP_2_IN_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_CAM_SP_EX_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_CAM_SP_IN_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_CPPWM_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Activation of external adjustment of CPPWM by InputOutputControl					
LV_CRU_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of readiness of the function InputOutputControl					
LV_DMTL_PUMP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_DMTLH_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_DMTLS_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_EBOX_CFA_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_ECFPWM_ECF_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_ECRAS_DOWN_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Bit indicating that external adjustment of ECRAS_DOWN is active					
LV_ECRAS_UP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Bit indicating that external adjustment of ECRAS_UP is active					
LV_ECTPWM_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of the external adjustment by InputOutputControl					
LV_EF_2_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Activation of external adjustment by InputOutputControl					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_EF_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Activation of external adjustment by InputOutputControl					
LV_EFP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Status of electrical fuel pump requested by service tool					
LV_FUP_SP_REQ_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
request of external adjustment of fuel pressure					
LV_IV_EXT_ADJ [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_LSHPWM_DOWN_EXT_ADJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_LSHPWM_UP_EXT_ADJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_N_REL_CWP_SP_2_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_N_REL_CWP_SP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_OPG_SP_ACR_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Logical variable to activate the actuator setpoint adjustment by service tester					
LV_POIL_PWM_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_POIL_SP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_RAS_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for the radiator shutter ( 0 = off, 1 = on )					
LV_RFPPWM_EXT_ADJ [NC_NR_TCHA]	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_RLY_CRCV_HEAT_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_RLY_HPDI_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
HPDI relay control command state (0H = relay shall be switched off, 1H = relay shall be switched on)					
LV_RLY_MAIN_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Request of tester for main relay adjustment					
LV_RLY_MTC_2_HEAT_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_RLY_MTC_HEAT_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_RLY_ST_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_RLY_VCV_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Request of tester for VCV-relay adjustment					
LV_RLY_VVL_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_SAP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Status of SAP requested by service tool					
LV_SAV_2_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Status of second SAV requested by service tool					
LV_SAV_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Status of SAV requested by service tool					
LV_SOF_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_SWI_AEB_ACT_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Adjustment value for the activation of AEB (0= Off, 1 = On)					
LV_SWI_AEB_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Adjustment value for active engine bracket (0= Off, 1 = On)					
LV_TPS_SP_2_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Logical variable indicates an second ETC setpoint request by external device					
LV_TPS_SP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Logical variable indicates an ETC setpoint request by external device					
LV_V_ALTER_SP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_VIM_1_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_VIM_2_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_WAL_1_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_WGPWM_EXT_ADJ [NC_NR_TCHA]	O/V	0... 1H	0 ...1	1	-
activation of external adjustment "Ladedrucksteller ansteuern"					
N_REL_CWP_SP_2_EXT_ADJ	O/V	0... FFH	0... 99.60937	0.390625	%
adjustment value for speed of electrical water pump					
N_REL_CWP_SP_EXT_ADJ	O/V	0... FFH	0... 99.60937	0.390625	%
adjustment value for speed of electrical water pump					
OPG_SP_ACR_EXT_ADJ	O/V	0... FFFH	0... 99.97558	0.0244141	%
Actuator setpoint requested by service tester					
POIL_PWM_EXT_ADJ	O/V	0... FFH	0... 99.60937	0.390625	%
adjustment value for Oilpressure solenoid setpoint					
POIL_SP_EXT_ADJ	O/V	0... FFH	0... 8160	32	hPa
adjustment value for Oilpressure setpoint					
RFPPWM_EXT_ADJ [NC_NR_TCHA]	O/V	0... FFH	0... 99.60937	0.390625	%
adjustment value for RFP setpoint					
TIMEOUT_TIME_1C_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_20_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_2A_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TIMEOUT_TIME_32_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_80_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_82_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_83_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_84_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_85_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_87_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_88_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_89_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_8A_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_8B_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_9E_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_A4_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_AB_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_AC_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_AD_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_AE_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_B2_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_B5_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_B6_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_B7_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_BF_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TIMEOUT_TIME_C1_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_C2_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_C3_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_C4_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_C6_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_C7_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_C8_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_C9_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_CA_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_CB_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_CC_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_CD_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_CE_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_CF_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_D0_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_D1_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_D2_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_D3_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_D4_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_D5_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_D6_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_D8_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TIMEOUT_TIME_DA_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_DC_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_DD_KWP	O	0... FFH	0... 510	2	s
Timeout for tester request for valvetronic					
TIMEOUT_TIME_E1_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_E2_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_E3_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_E4_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_E5_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_E6_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_E7_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_E8_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_ED_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_EE_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_EF_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TPS_SP_2_EXT_ADJ	O/V	0... FFH	0... 99.60937	0.390625	%
second throttle position setpoint from tester					
TPS_SP_EXT_ADJ	O/V	0... FFH	0... 99.60937	0.390625	%
Throttle position setpoint from tester					
V_ALTER_SP_EXT_ADJ	O/V	0... FFFFH	0... 6553.5	0.1	V
adjustment value for alternator voltage setpoint					
WGPWM_EXT_ADJ [NC_NR_TCHA]	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
PWM output wastegate[NC_CBK_EX_NR]					

**Input data:**


Ba_ist {p. 8154}	FUP {p. 1283}	GEAR_INFO {p. 1564}	LV_AT {p. 654}
LV_BRAKE_DET {p. 4209}	LV_CS {p. 8394}	LV_ES {p. 1720}	LV_IGK {p. 906}
LV_IS {p. 1720}	LV_TEMP_MAX_SAP_COIL {p. 805}	LV_VAR_AMT {p. 655}	LV_VAR_TCT {p. 656}
N {p. 1525}	N_EFP_AV {p. 1569}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}
NC_NR_TCHA	POIL {p. 903}	STATE_MTC_HEAT {p. 6532}	STATE_SA {p. 808}
TCO {p. 1100}	VB {p. 1185}	VS {p. 1176}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUP_MAX_KWP	-	0... FFFFH	0... 347776	5.3067216	hPa
maximum fuel pressure for external adjustment					
C_FUP_MIN_KWP	-	0... FFFFH	0... 347776	5.3067216	hPa
minimum fuel pressure for external adjustment					
C_N_MAX_KWP	-	0... 1FE0H	0... 8160	1	rpm
max engine speed for accepting a KWP2000(*) service					
C_N_MAX_KWP_POIL	-	0... 1FE0H	0... 8160	1	rpm
maximum engine speed for external adjustment with poil dependence					
C_N_MIN_KWP	-	0... 1FE0H	0... 8160	1	rpm
minimum engine speed for external adjustment					
C_N_MIN_KWP_POIL	-	0... 1FE0H	0... 8160	1	rpm
minimum engine speed for external adjustment with poil dependence					
C_POIL_MAX_KWP	-	0... FFFFH	0... 10868	0.165835	hPa
Maximum threshold for oil pressure KWP					
C_POIL_MIN_KWP	-	0... FFFFH	0... 10868	0.165835	hPa
Maximum threshold for oil pressure KWP					
C_TCO_MAX_KWP	-	0... FEH	-48... 142.5	0.75	°C
maximum TCO threshold for activation of external adjustment					
C_TCO_MIN_KWP	-	0... FEH	-48... 142.5	0.75	°C
minimum TCO threshold for activation of external adjustment					
C_VB_MIN_KWP	-	0... FFH	0... 25.89843	0.1015625	V
minimum battery voltage for external adjustment					
C_VS_MAX_KWP	-	0... FFH	0... 255	1	km/h
maximum vehicle speed for accepting the service					
ID_IDX_ACT_DS_CONF	V	0... FFFFH	0... 65535	1	-
LDP_IDX_DS_ID_IDX_ACT_DS_CONF	70	0... FFH	0... 255	1	-
LDP_IDX_ENVD_ID_IDX_ACT_DS_CONF	6	0... FFH	0... 255	1	-
calibratable index of activation conditions and output variables for SID 30h services					

**General information:**

All implemented SID 30h services are described below.

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## I.15.1 Overview of implemented subservices

SID number	service	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
30_02_01	Bremslichtschalter auslesen	X	X	X	X	X	X
30_03_01	Bremslichttestschalter auslesen	X	X	X	X	X	X
30_04_01	Kupplungsschalter auslesen	X	X	X	X	X	X
30_05_01	Oeldruckschalter auslesen	X	X	X	X	X	X
30_06_01	Sporttaster auslesen	X	X	X	X	X	-
30_07_01	Nullgangssensor auslesen	-	X	-	X	-	-
30_0A_01	Ansauglufttemperatur 1 auslesen	X	X	X	X	X	X
30_0B_01	Ansauglufttemperatur 2 auslesen	-	-	-	-	-	X
30_0C_01	Motortemperatur auslesen	X	X	X	X	X	X
30_0D_01	Kuehlerauslasstemperatur auslesen	X	X	X	X	X	X
30_0E_01	Oelsensor auslesen	X	X	X	X	X	X
30_10_01	Steuergeraete-Innentemperatur auslesen	X	X	X	X	X	X
30_12_01	Abgastemperatur auslesen	-	X	X	X	X	X
30_13_01	Abgastemperatur 2 auslesen	-	-	-	-	-	X
30_17_01	Umgebungsdruck auslesen	X	X	X	X	X	X
30_18_01	Saugrohrdruck1 / Ladedruck1 auslesen	X	X	X	X	X	X
30_19_01	Saugrohrdruck2 / Ladedruck2 auslesen	-	X	X	X	X	X
30_1A_01	Raildrucksenor auslesen	-	X	X	X	X	X
30_1B_01	Kl.15 Spannung auslesen	X	X	X	X	X	X
30_1C_01	Kl.87 Spannung / Versorgung DME auslesen	X	X	X	X	X	X
30_1C_00/07	Kl.87 Spannung / Versorgung DME ansteuern	X	X	X	X	X	X
30_1E_01	Fahrerwunschversorgung 1 auslesen	X	X	X	X	X	X
30_1F_01	Fahrerwunschversorgung 2 auslesen	X	X	X	X	X	X
30_20_01	Versorgungsspannung VVL Sensor auslesen	X	-	-	-	-	-
30_20_01	Versorgung HPD5-Ventil auslesen	-	X	-	X	-	X
30_20_00/07	Versorgung HPD5-Ventil ansteuern	-	X	-	X	-	X
30_21_01	Lambdasonde vor Kat Bank 1 auslesen	X	X	X	X	X	X
30_22_01	Lambdasonde hinter Kat Bank 1 auslesen	X	X	X	X	X	X
30_23_01	Lambdasonde vor Kat Bank 2 auslesen	X	X	X	X	X	X
30_24_01	Lambdasonde hinter Kat Bank 2 auslesen	X	X	X	X	X	X
30_25_01	Luftmassenmesser 1 auslesen	X	X	X	X	X	X
30_27_01	Batteriesensor auslesen	X	X	X	X	X	X
30_28_01	Fahrerwunsch1 auslesen	X	X	X	X	X	X
30_29_01	Fahrerwunsch 2 auslesen	X	X	X	X	X	X
30_2A_01	Drosselklappe auslesen	X	X	X	X	X	X



SID number	service	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
30_2A_00/07	Drosselklappe ansteuern	X	X	X	X	X	X
30_2E_01	Sekundaerluft HFM auslesen	X	-	-	-	-	X
30_2F_01	Taster Tempomat	X	X	X	X	X	-
30_30_01	Klopfbaustein1 auslesen	X	X	X	X	X	X
30_31_01	Klopfbaustein 2 auslesen	X	X	X	X	X	X
30_32_01	Generator Sollspannung BSD auslesen	X	X	X	X	X	X
30_32_00/07	Generator Sollspannung BSD ansteuern	X	X	X	X	X	X
30_37_01	Oeldrucksensor auslesen	X	X	X	X	X	-
30_3B_01	NOx-Sensor auslesen	X	X	X	X	X	-
30_3F_01	Kraftoffniederdrucksensor auslesen	-	X	X	X	X	X
30_40_01	Bremsunterdrucksensor auslesen	X	X	-	X	-	-
30_43_01	Raildrucksenor 2 auslesen	-	-	-	-	-	X
30_44_01	Klopfbaustein 3 auslesen	-	-	-	-	-	X
30_45_01	Klopfbaustein 4 auslesen	-	-	-	-	-	X
30_46_01	Luftmassenmesser 2 auslesen	-	-	-	-	-	X
30_80_01	Radiator shutter auslesen	-	-	X	-	X	-
30_80_00/07	Radiator shutter ansteuern	-	-	X	-	X	-
30_82_01	HPD-Relais auslesen	-	X	-	X	-	X
30_82_00/07	HPD-Relais ansteuern	-	X	-	X	-	X
30_83_01	Wasserpumpe Turbolader auslesen	-	-	-	-	-	X
30_83_00/07	Wasserpumpe Turbolader ansteuern	-	-	-	-	-	X
30_84_01	Drosselklappenstellergehäuseheizung 2 auslesen	-	-	-	-	-	X
30_84_00/07	Drosselklappenstellergehäuseheizung 2 ansteuern	-	-	-	-	-	X
30_85_01	Drosselklappe 2 auslesen	-	-	-	-	-	X
30_85_00/07	Drosselklappe 2 ansteuern	-	-	-	-	-	X
30_86_01	(second) HPD5-Mengensteuerventil auslesen	-	X	-	X	-	X
30_86_00/07	(second) HPD5-Mengensteuerventil ansteuern	-	X	-	X	-	X
30_87_01	Abgasklappe 2 auslesen	-	-	-	-	-	X
30_87_00/07	Abgasklappe 2 ansteuern	-	-	-	-	-	X
30_88_01	Vanos Einlass Ventil Bank2 auslesen	-	-	-	-	-	X
30_88_00/07	Vanos Einlass Ventil Bank2 ansteuern	-	-	-	-	-	X
30_89_01	Vanos Auslass Ventil Bank2 auslesen	-	-	-	-	-	X
30_89_00/07	Vanos Auslass Ventil Bank2 ansteuern	-	-	-	-	-	X
30_8A_01	Umluftventil Bank 2 auslesen	-	-	-	-	-	X
30_8A_00/07	Umluftventil Bank 2 ansteuern	-	-	-	-	-	X

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SID number	service	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
30_8B_01	Sekundaerluftventil 2 auslesen	-	-	-	-	-	X
30_8B_00/07	Sekundaerluftventil 2 ansteuern	-	-	-	-	-	X
30_9E_01	Drosselklappenstellergehaueseheizung auslesen	-	X	X	X	X	X
30_9E_00/07	Drosselklappenstellergehaueseheizung ansteuern	-	X	X	X	X	X
30_A4_01	Gesteuerte Luftfuehrung (untere Klappe) auslesen	X	X	X	X	X	X
30_A4_00/07	Gesteuerte Luftfuehrung (untere Klappe) ansteuern	X	X	X	X	X	X
30_AB_01	Oel Druck Regelung auslesen	X	X	X	X	X	-
30_AB_00/07	Oel Druck Regelung ansteuern	X	X	X	X	X	-
30_AC_01	Oeldruckventil auslesen	X	X	X	X	X	-
30_AC_00/07	Oeldruckventil ansteuern	X	X	X	X	X	-
30_AD_01	Kurbelgehaeuseentlueftungsheizung auslesen	-	X	X	X	X	X
30_AD_00/07	Kurbelgehaeuseentlueftungsheizung ansteuern	-	X	X	X	X	X
30_AE_01	Variable Sauganlage (DISA) Klappe2 auslesen	X	X	X	X	X	-
30_AE_00/07	Variable Sauganlage (DISA) Klappe2 ansteuern	X	X	X	X	X	-
30_B2_01	Motorlagersteuerung auslesen	-	X	X	X	X	-
30_B2_00/07	Motorlagersteuerung ansteuern	-	X	X	X	X	-
30_B5_01	Umluftventil Bank 1 auslesen	-	-	-	-	X	X
30_B5_00/07	Umluftventil Bank 1 ansteuern	-	-	-	-	X	X
30_B6_01	Ladedrucksteller 1 auslesen	-	X	X	X	X	X
30_B6_00/07	Ladedrucksteller 1 ansteuern	-	X	X	X	X	X
30_B7_01	Ladedrucksteller 2 auslesen	-	X	X	X	X	X
30_B7_00/07	Ladedrucksteller 2 ansteuern	-	X	X	X	X	X
30_BD_01	Mengensteuerventil auslesen	-	X	X	X	X	X
30_BD_00/07	Mengensteuerventil ansteuern	-	X	X	X	X	X
30_BE_01	Abgasrückführungsventil auslesen	X	X	X	X	X	-
30_BE_00/07	Abgasrückführungsventil ansteuern	X	X	X	X	X	-
30_BF_01	elektr. Wasserpumpe ueber BSD auslesen	X	X	X	X	X	-
30_BF_00/07	elektr. Wasserpumpe ueber BSD ansteuern	X	X	X	X	X	-
30_C1_01	Abgasklappe auslesen	X	X	X	X	X	X
30_C1_00/07	Abgasklappe ansteuern	X	X	X	X	X	X
30_C2_01	Soundklappeauslesen	X	X	X	X	X	X
30_C2_00/07	Soundklappe ansteuern	X	X	X	X	X	X
30_C3_01	Gesteuerte Luftfuehrung auslesen	X	X	X	X	X	X
30_C3_00/07	Gesteuerte Luftfuehrung ansteuern	X	X	X	X	X	X

SID number	service	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
30_C4_01	Startrelais auslesen	X	X	X	X	X	X
30_C4_00/07	Startrelais ansteuern	X	X	X	X	X	X
30_C6_01	Variable Sauganlage (DISA) Klappe auslesen	X	X	X	X	X	-
30_C6_00/07	Variable Sauganlage (DISA) Klappe ansteuern	X	X	X	X	X	-
30_C7_01	Klimakompressor-Relais auslesen	X	X	X	X	X	-
30_C7_00/07	Klimakompressor-Relais ansteuern	X	X	X	X	X	-
30_C8_01	EBOX_Controlled_Fan auslesen	X	X	X	X	X	X
30_C8_00/07	EBOX_Controlled_Fan ansteuern	X	X	X	X	X	X
30_C9_01	Electr_Controlled_Thermostat auslesen	X	X	X	X	X	X
30_C9_00/07	Electr_Controlled_Thermostat ansteuern	X	X	X	X	X	X
30_CA_01	Sekundaerluftventil auslesen	X	-	-	-	-	X
30_CA_00/07	Sekundaerluftventil ansteuern	X	-	-	-	-	X
30_CB_01	Sekundaerluftpumpe auslesen	X	-	-	-	-	X
30_CB_00/07	Sekundaerluftpumpe ansteuern	X	-	-	-	-	X
30_CC_01	Diagnosemodul-Tank Leckage Pumpe auslesen	X	-	X	-	X	X
30_CC_00/07	Diagnosemodul-Tank Leckage Pumpe ansteuern	X	-	X	-	X	X
30_CD_01	Diagnosemodul-Tank Leckage Ventil auslesen	X	-	X	-	X	X
30_CD_00/07	Diagnosemodul-Tank Leckage Ventil ansteuern	X	-	X	-	X	X
30_CE_01	Diagnosemodul-Tank Leckage Heizung auslesen	X	-	X	-	X	X
30_CE_00/07	Diagnosemodul-Tank Leckage Heizung ansteuern	X	-	X	-	X	X
30_CF_01	Canister_Purge_Solenoid auslesen	X	X	X	X	X	X
30_CF_00/07	Canister_Purge_Solenoid ansteuern	X	X	X	X	X	X
30_D0_01	Lambda_Sensor_Heating_Up_1 auslesen	X	X	X	X	X	X
30_D0_00/07	Lambda_Sensor_Heating_Up_1 ansteuern	X	X	X	X	X	X
30_D1_01	Lambda_Sensor_Heating_Down_1 auslesen	X	X	X	X	X	X
30_D1_00/07	Lambda_Sensor_Heating_Down_1 ansteuern	X	X	X	X	X	X
30_D2_01	Lambda_Sensor_Heating_Up_2 auslesen	X	X	X	X	X	X
30_D2_00/07	Lambda_Sensor_Heating_Up_2 ansteuern	X	X	X	X	X	X
30_D3_01	Lambda_Sensor_Heating_Down_2 auslesen	X	X	X	X	X	X
30_D3_00/07	Lambda_Sensor_Heating_Down_2 ansteuern	X	X	X	X	X	X
30_D4_01	Malfunction_Indicator_Lamp auslesen	X	X	X	X	X	X
30_D4_00/07	Malfunction_Indicator_Lamp ansteuern	X	X	X	X	X	X


SID number	service	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
30_D5_01	Fahrgeschwindigkeitsregler-Lampe auslesen	X	X	X	X	X	X
30_D5_00/07	Fahrgeschwindigkeitsregler-Lampe ansteuern	X	X	X	X	X	X
30_D6_01	EML_Lamp auslesen	X	X	X	X	X	X
30_D6_00/07	EML_Lamp ansteuern	X	X	X	X	X	X
30_D8_01	Electrical_Fuel_Pump auslesen	X	X	X	X	X	X
30_D8_00/07	Electrical_Fuel_Pump ansteuern	X	X	X	X	X	X
30_DA_01	E-Box-Luefter auslesen	X	X	X	X	X	X
30_DA_00/07	E-Box-Luefter ansteuern	X	X	X	X	X	X
30_DC_01	VVT-Entlastungsrelais auslesen	X	-	-	-	-	X
30_DC_00/07	VVT-Entlastungsrelais ansteuern	X	-	-	-	-	X
30_DD_01	ValveTronic Lift auslesen	X	-	-	-	-	X
30_DD_00/07	ValveTronic Lift ansteuern	X	-	-	-	-	X
30_E1_01	Einspritzventil 1 auslesen	X	X	X	X	X	X
30_E1_00/07	Einspritzventil 1 ansteuern	X	-	-	-	-	-
30_E2_01	Einspritzventil 2 auslesen	X	X	X	X	X	X
30_E2_00/07	Einspritzventil 2 ansteuern	X	-	-	-	-	-
30_E3_01	Einspritzventil 3 auslesen	X	X	X	X	X	X
30_E3_00/07	Einspritzventil 3 ansteuern	X	-	-	-	-	-
30_E4_01	Einspritzventil 4 auslesen	X	X	X	X	X	X
30_E4_00/07	Einspritzventil 4 ansteuern	X	-	-	-	-	-
30_E5_01	Einspritzventil 5 auslesen	X	-	X	-	X	X
30_E5_00/07	Einspritzventil 5 ansteuern	X	-	-	-	-	-
30_E6_01	Einspritzventil 6 auslesen	X	-	X	-	X	X
30_E6_00/07	Einspritzventil 6 ansteuern	X	-	-	-	-	-
30_E7_01	Einspritzventil 7 auslesen	-	-	-	-	-	X
30_E8_01	Einspritzventil 8 auslesen	-	-	-	-	-	X
30_ED_01	Vanos Einlass Ventil auslesen	X	X	X	X	X	X
30_ED_00/07	Vanos Einlass Ventil ansteuern	X	X	X	X	X	X
30_EE_01	Vanos Auslass Ventil auslesen	X	X	X	X	X	X
30_EE_00/07	Vanos Auslass Ventil ansteuern	X	X	X	X	X	X
30_EF_01	HPD5-Mengensteuerventil 1 auslesen	-	-	-	-	-	X
30_EF_00/07	HPD5-Mengensteuerventil 1 ansteuern	-	-	-	-	-	X

### Application conditions (expect services 30\_xx\_00/01, 30\_BD\_07, 30\_CB\_07):

**Initialisation:** 0 at reset

**Activation:** depending on calibratable conditions  
see chapter "Activation conditions for SID 30\_xx\_07h services"

**Deactivation:** not activation

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**Service location:** for each project depending on calibration data ID\_IDX\_ACT\_DS\_CONF

**Global negative Responses**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	negativeResponse Service Id	M	7Fh	NR
2d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOBLID
3d	responseCode= only general response code	M	XXh	RC

The detailed message of the negative response code is described in chapter "Error-Codes".

**I.15.2 Flag for disable adaptions while external adjust with SID 30\_xx\_07h services**

**General information:**

The flag LV\_AD\_DIS\_EXT\_ADJ is set when an external adustment is done. The flag is set back to zero at ECU reset.

**Application conditions**

**Initialisation:** *0 at reset*  
**Activation:** *if a SID 30,xx,07 job is received*

**Formula section:**

LV\_AD\_DIS\_EXT\_ADJ = 1 *// if a SID 30,xx,07 job is received*

**I.15.3 Activation conditions for SID 30\_xx\_07h services**

**General information:**

All SID 30\_xx\_07 services (external adjust of actuators) are only allowed if several activation conditions are fulfilled. The activation condition(s), which has/have to be fulfilled, can be chosen for every adjustment service via a calibratable bitmask in the table ID\_IDX\_ACT\_DS\_CONF. In this table one axis is the identifier of the service. On the other axis on position 0 a word can be calibrated for every service (positions 1...5 in the table are reserved for maximal 5 variables from the DDLI- lists for the read- services, see chapter "actuator diagnosis read value " below). The activation- condition- word must be calibrated in the following way: In the bitmask every activation condition, which has to be checked, must be set to "1". The possible conditions with their positions are listed in the table below. The combination of the conditions gives the hex- value of the word, which has to be written to ID\_IDX\_ACT\_DS\_CONF (on position 0 and position with service identifier).

Example: On Position (A1;0) in the table ID\_IDX\_ACT\_DS\_CONF 1h (= 0000 0000 0000 0001 bin) is calibrated. So the service 30\_A1\_07 is only activated if LV\_IGK = 1.

If position (A1;0) is calibrated with 81h (0000 0000 1000 0001 bin), service 30\_A1\_07 is only activated if LV\_IGK = 1 and VB > C\_VB\_MIN\_KWP.

**Formula section:**

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Condition name	BitValue	Conditions that have to be fulfilled
Diagnosis (always checked)	00 00	$N < C\_N\_MAX\_KWP$
K15 ON	00 01	$LV\_IGK = 1$
$N = 0$	00 02	$LV\_ES = 1$
Idle speed	00 04	$LV\_IS = 1$
$N > N\_MIN$	00 08	$N > C\_N\_MIN\_KWP$
$v = 0$	00 10	$VS < C\_VS\_MAX\_KWP$
Engine warm	00 20	$TCO > C\_TCO\_MIN\_KWP$
Engine temperature normal	00 40	$TCO < C\_TCO\_MAX\_KWP$
Batt normal	00 80	$VB > C\_VB\_MIN\_KWP$
NEUTRAL	01 00	<pre> <b>If(1)</b>   GEAR_INFO = 0 <b>Then(1)</b>     <b>If(2)</b> LV_AT = 0 and LV_VAR_AMT = 0 and               LV_VAR_TCT = 0     <b>Then(2)</b>       <b>If(3)</b>   LV_CS = 0       <b>Then(3)</b> activation       <b>Endif(3)</b>     <b>Else(2)</b>       <b>If(3)</b> LV_VAR_AMT = 1 or LV_VAR_TCT = 1       <b>Then(3)</b>         <b>If(4)</b> LV_BRAKE_DET = 0         <b>Then(4)</b> activation         <b>Endif(4)</b>       <b>Else(3)</b>         <b>If(4)</b> LV_AT = 1         <b>Then(4)</b> activation         <b>Endif(4)</b>       <b>Endif(3)</b>     <b>Endif(2)</b>   <b>Endif(1)</b> </pre>
Fuel pump OFF	02 00	$LV\_ES = 1 \text{ AND } N\_EFP\_AV = 0$
Minimum oil pressure	04 00	$POIL > C\_POIL\_MIN\_KWP$ and $N > C\_N\_MIN\_KWP\_POIL$
Maximum oil pressure	08 00	$POIL < C\_POIL\_MAX\_KWP$ and $N < C\_N\_MAX\_KWP\_POIL$
Minimum fuel pressure	10 00	$FUP > C\_FUP\_MIN\_KWP$
Maximum fuel pressure	20 00	$FUP < C\_FUP\_MAX\_KWP$
nn	40 00	0
nn	80 00	0


### I.15.4 30\_xx\_01h - actuator diagnosis read value -

#### General information:

With this service actual actuator values can be read. The variable(s), which has to be read, can be chosen out of several tables in software (DDL- lists) via a calibratable identifier. The DDL- lists are described in the chapter "Introduction." The identifier is a word value which represents the place in the DDL- list. The calibration can be done within the table ID\_IDX\_ACT\_DS\_CONF. In this table one axis is the identifier of the service. On the other axis on positions 1...3 maximal 3 variables from the DDL- lists can be chosen via the DDL- identifier. (Position 0 in the table is reserved for activation conditions of adjustment jobs 30\_xx\_07; see chapter "activation conditions" above.)

The telegram length is variable and depends on the number and length (byte, word) of the chosen variable(s). If an illegal identifier is calibrated on position 1...3 in the table ID\_IDX\_ACT\_DS\_CONF (e.g. not defined identifiers) the service does not give back an error message! Instead of this the next valid calibrated variable is given on the next position in telegram.

Example: If the first variable is calibrated valid, it becomes the first position in the telegram (depending on the length of the variable (byte or word) this can be the first one or the first two data bytes of the telegram.) The second position is not calibrated valid, but the third is. So the variable, calibrated on third position is given back on second position in telegram.

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## Application conditions

**Initialisation:** 0 at reset

**Activation:** LV\_IGK =1

**Deactivation:** not activation

**Service location:** see list of "implemented diagnostic services"

## InputOutputControlByLocalIdentifier Request


Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2	InputOutputLocalIdentifier - [	M	XXh	IOLI_
	Bremslichtschalter		02h	
	Bremslichttestschalter		03h	
	Kupplungsschalter		04h	
	Oeldruckschalter		05h	
	Sporttaster		06h	
	Nullgangssensor		07h	
	Ansauglufttemperatur 1		0Ah	
	Ansauglufttemperatur 2		0Bh	
	Motortemperatur		0Ch	
	Kuehlerauslasstemperatur		0Dh	
	Oelsensor		0Eh	
	Steuergeraete-Innentemperatur		10h	
	Abgastemperatur		12h	
	Abgastempertur 2		13h	
	Umgebungsdruck		17h	
	Saugrohrdruck1 / Ladedruck1		18h	
	Saugrohrdruck2 / Ladedruck2		19h	
	Raildrucksenor		1Ah	
	Kl.15 Spannung		1Bh	
	Kl.87 Spannung / Versorgung DME (Digitale Motor Elektronik)		1Ch	
	Fahrewunschversorgung 1		1Eh	
	Fahrewunschversorgung 2		1Fh	
	Versorgungsspannung VVL Sensor (not MSD85)		20h	
	Versorgung HPDI-Ventil (only MSD85)		20h	
	Lambdasonde vor Kat Bank1		21h	
	Lambdasonde hinter Kat Bank1		22h	
	Lambdasonde vor Kat Bank2		23h	
	Lambdasonde hinter Kat Bank2		24h	
	Luftmassenmesser 1		25h	
	Batteriesensor		27h	
	Fahrewunsch 1		28h	
	Fahrewunsch 2		29h	



Drosselklappe	2Ah			
Sekundaerluft HFM (Heissfilm Luftmassenmesser)	2Eh			
Taster Tempomat	2Fh			
Klopfbaustein 1	30h			
Klopfbaustein 2	31h			
Generator Sollspannung BSD (Bit Serielle Datenschnittstelle)	32h			
Oeldrucksensor	37h			
NOx-Sensor	3Bh			
Kraftstoffniederdrucksensor	3Fh			
Bremsunterdrucksensor	40h			
Raildrucksensor 2	43h			
Klopfbaustein 3	44h			
Klopfbaustein 4	45h			
Mass air flow 2	46h			
Radiator shutter	80h			
HPD-Relais	82h			
Wasserpumpe Turbolader	83h			
Drosselklappenstellergehäuseheizung 2	84h			
Drosselklappe 2	85h			
(second) HPD5-Mengensteuerventil	86h			
Abgasklappe 2	87h			
Vanos Einlass Ventil Bank2	88h			
Vanos Auslass Ventil Bank2	89h			
Umluftventil Bank2	8Ah			
second Sekundaerluftventil	8Bh			
Drosselklappenstellergehäuseheizung	9Eh			
Gesteuerte Luftfuehrung (untere Klappe)	A4h			
Oeldruck-Regelung	ABh			
Oeldruckventil	ACH			
Kurbelgehaeuseentlueftungsheizung	ADh			
Variable Sauganlage (DISA) Klappe2	Aeh			
Motorlager	B2h			
Umluftventil Bank1	B5h			
Mengensteuerventil	BDh			
Abgasrückführungsventil	BEh			
elektr. Wasserpumpe ueber BSD (Bit Serielle Datenschnittstelle)	BFh			
Abgasklappe	C1h			
Soundklappe	C2h			
Gesteuerte Luftfuehrung (obere Klappe)	C3h			
Startrelais	C4h			
Variable Sauganlage (DISA) Klappe	C6h			
Klimakompressor-Relais	C7h			
E-Box-Luefter	C8h			
Kennfeldthermostat	C9h			
Sekundaerluftventil	CAh			
Sekundaerluftpumpe	CBh			
Diagnosemodul-Tank Leakage Pumpe	CCh			
Diagnosemodul-Tank Leakage Ventil	CDh			
Diagnosemodul-Tank Leakage Heizung	CEh			
Tankentlueftungsventil	CFh			
Lambdasondenheizung vor Kat Bank1	D0h			
Lambdasondenheizung hinter Kat Bank1	D1h			
Lambdasondenheizung vor Kat Bank2	D2h			
Lambdasondenheizung hinter Kat Bank2	D3h			
MIL (Malfunction Indicator Lamp)	D4h			
Fahrgeschwindigkeitsregler-Lampe	D5h			
EML (Engine Malfunction Lamp)	D6h			
Elektrische Kraftstoffpumpe 1	D8h			
E-Box-Luefter	DAh			
VVT-Entlastungsrelais	DCh			
VVT	DDh			
Einspritzventil 1	E1h			
Einspritzventil 2	E2h			
Einspritzventil 3	E3h			
Einspritzventil 4	E4h			
Einspritzventil 5	E5h			
Einspritzventil 6	E6h			
Einspritzventil 7	E7h			
Einspritzventil 8	E8h			
Vanos Einlass Ventil	FDh			
3	inputOutputControlParameter	M	01h	IOCP_RCS

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### InputOutputControlByLocalIdentifier positive Response


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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Positive Response Sid	M	70h	IOCBIDPR

2	InputOutputLocalIdentifier - [ Bremslichtschalter Bremslichttestschalter Kupplungsschalter Oeldruckschalter Sporttaster Nullgangssensor Ansauglufttemperatur 1 Ansauglufttemperatur 2 Motortemperatur Kuehlerauslasstemperatur Oelsensor Steuergeraete-Innentemperatur Abgastemperatur Abgastempertatur 2 Umgebungsdruck Saugrohrdruck1 / Ladedruck1 Saugrohrdruck2 / Ladedruck2 Raildrucksenor Kl.15 Spannung Kl.87 Spannung / Versorgung DME (Digitale Motor Elektronik) Fahrerwunschversorgung 1 Fahrerwunschversorgung 2 Versorgungsspannung VVL Sensor (not MSD85) Versorgung HPDI-Ventil (only MSD85 ) Lambdasonde vor Kat Bank1 Lambdasonde hinter Kat Bank1 Lambdasonde vor Kat Bank2 Lambdasonde hinter Kat Bank2 Luftmassenmesser 1 Batteriesensor Fahrerwunsch 1 Fahrerwunsch 2 Drosselklappe Sekundaerluft HFM (Heissfilm Luftmassenmesser) Taster Tempomat Klopfbaustein 1 Klopfbaustein 2 Generator Sollspannung BSD (Bit Serielle Datenschnittstelle) Oeldrucksensor NOx-Sensor Kraftstoffniederdrucksensor Bremsunterdrucksensor Raildrucksensor 2 Klopfbaustein 3 Klopfbaustein 4 Mass air flow 2 Radiator shutter HPD-Relais Wasserpumpe Turbolader Drosselklappenstellergehaeuseheizung 2 Drosselklappe 2 ansteuern (second) HPD5-Mengensteuerventil Abgasklappe 2 Vanos Einlass Ventil Bank2 Vanos Auslass Ventil Bank2 Umluftventil Bank2 second Sekundaerluftventil Drosselklappenstellergehaeuseheizung Gesteuerte Luftfuehrung (untere Klappe) Oeldruck-Regelung Oeldruckventil Kurbelgehaeuseentlueftungsheizung Variable Sauganlage (DISA) Klappe2 Motorlager Umluftventil Bank1 Mengensteuerventil Abgasrueckfuehrungsventil elekt. Wasserpumpe ueber BSD (Bit Serielle Datenschnittstelle)	M	XXh  02h 03h 04h 05h 06h 07h 0Ah 0Bh 0Ch 0Dh 0Eh 10h 12h 13h 17h 18h 19h 1Ah 1Bh 1Ch 1Eh 1Fh 20h 20h 21h 22h 23h 24h 25h 27h 28h 29h 2Ah 2Eh 2Fh 30h 31h 32h 37h 3Bh 3Fh 40h 43h 44h 45h 46h 80h 82h 83h 84h 85h 86h 87h 88h 89h 8Ah 8Bh 9Eh A4h ABh ACh ADh AEh B2h B5h BDh BEh BFh	IOLID
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	Fahrgeschwindigkeitsregler-Lampe EML (Engine Malfunction Lamp) Elektrische Kraftstoffpumpe 1 E-Luefter VVT-Entlastungsrelais VVT Einspritzventil 1 Einspritzventil 2 Einspritzventil 3 Einspritzventil 4 Einspritzventil 5 Einspritzventil 6 Einspritzventil 7 Einspritzventil 8 Vanos Einlass Ventil Vanos Auslass Ventil HPD5-Mengensteuerventil 1 ]		D5h D6h D8h DAh DCh DDh E1h E2h E3h E4h E5h E6h E7h E8h EDh EEh EFh ]	
3	inputOutputControlParameter	M	01h	IOCP_RCS
4	Data Byte depending on calibration	M	XXh	xx
...	...	...	...	...
n	Data Byte depending on calibration	M	XXh	xx

**Table InputOutputControlByLocalIdentifier positive response message**

### InputOutputControlByLocalIdentifier negative Response

Global Negative Responses

### I.15.5 30\_xx\_00h - stop actuator diagnosis -

#### General information:

When this service is received, the actuator diagnosis function stops and control is given back to the ECU control.

xx in the headline represents the identifier (00 ... FFh) of the actuator diagnosis service.

#### Application conditions

**Initialisation:** 0 at reset

**Activation:** LV\_IGK =1

**Deactivation:** not activation

**Service location:** see list of "implemented diagnostic services"


#### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request Sid	M	30h	IOCBLID

2	InputOutputLocalIdentifier - [ KI.87 Spannung / Versorgung DME (Digitale Motor Elektronik) Versorgung HPDI-Ventil Drosselklappe Generator Sollspannung BSD (Bit Serielle Datenschnittstelle) Radiator shutter HPD-Relais Wasserpumpe Turbolader Drosselklappenstellergehäuseheizung 2 Drosselklappe 2 (second) HPD5-Mengensteuerventil Abgasklappe 2 Vanos Einlass Ventil Bank2 Vanos Auslass Ventil Bank2 Umluftventil Bank2 second Sekundaerluftventil Drosselklappenstellergehäuseheizung Gesteuerte Luftfuehrung (untere Klappe) Oeldruck-Regelung Oeldruckventil Kurbelgehaeuseentlueftungsheizung Variable Sauganlage (DISA) Klappe2 Motorlager Umluftventil Bank1 Ladedrucksteller 1 Ladedrucksteller 2 Mengensteuerventil Abgasrückführungsventil elektr. Wasserpumpe ueber BSD (Bit Serielle Datenschnittstelle) Abgasklappe Soundklappe Gesteuerte Luftfuehrung (obere Klappe) Startrelais Variable Sauganlage (DISA) Klappe Klimakompressor-Relais E-Box-Luefter Kennfeldthermostat Sekundaerluftventil Sekundaerluftpumpe Diagnosemodul-Tank Leakage Pumpe Diagnosemodul-Tank Leakage Ventil Diagnosemodul-Tank Leakage Heizung Tankentlueftungsventil Lambdasondenheizung vor Kat Bank1 Lambdasondenheizung hinter Kat Bank1 Lambdasondenheizung vor Kat Bank2 Lambdasondenheizung hinter Kat Bank2 MIL (Malfunction Indicator Lamp) Fahrgeschwindigkeitsregler-Lampe EML (Engine Malfunction Lamp) Elektrische Kraftstoffpumpe 1 E-Box-Luefter VVT-Entlastungsrelais VVT Einspritzventil 1 Einspritzventil 2 Einspritzventil 3 Einspritzventil 4 Einspritzventil 5 Einspritzventil 6 Vanos Einlass Ventil Vanos Auslass Ventil HPD5-Mengensteuerventil 1 ]	M	XXh [ 1Ch 20h 2Ah 32h 80h 82h 83h 84h 85h 86h 87h 88h 89h 8Ah 8Bh 9Eh A4h ABh ACh ADh AEh B2h B5h B6h B7h BDh BEh BFh C1h C2h C3h C4h C6h C7h C8h C9h CAh CBh CCh CDh CEh CFh D0h D1h D2h D3h D4h D5h D6h D8h DAh DCh DDh E1h E2h E3h E4h E5h E6h EDh EEh EFh ]	IOLI_XX
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3	inputOutputControlParameter	M	00h	IOCP_RCTE CU
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### InputOutputControlByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR

2	InputOutputLocalIdentifier - [ KI.87 Spannung / Versorgung DME (Digitale Motor Elektronik) Versorgung HPDI-Ventil Drosselklappe Generator Sollspannung BSD (Bit Serielle Datenschnittstelle) Radiator shutter HPD-Relais Wasserpumpe Turbolader Drosselklappenstellergehäuseheizung 2 Drosselklappe 2 (second) HPD5-Mengensteuerventil Abgasklappe 2 Vanos Einlass Ventil Bank2 Vanos Auslass Ventil Bank2 Umluftventil Bank2 second Sekundaerluftventil Drosselklappenstellergehäuseheizung Gesteuerte Luftfuehrung (untere Klappe) Oeldruck-Regelung Oeldruckventil Kurbelgehaeuseentlueftungsheizung Variable Sauganlage (DISA) Klappe2 Motorlager Umluftventil Bank1 Ladedrucksteller 1 Ladedrucksteller 2 Mengensteuerventil Abgasrückführungsventil elektr. Wasserpumpe ueber BSD (Bit Serielle Datenschnittstelle) Abgasklappe Soundklappe Gesteuerte Luftfuehrung (obere Klappe) Startrelais Variable Sauganlage (DISA) Klappe Klimakompressor-Relais E-Box-Luefter Kennfeldthermostat Sekundaerluftventil Sekundaerluftpumpe Diagnosemodul-Tank Leakage Pumpe Diagnosemodul-Tank Leakage Ventil Diagnosemodul-Tank Leakage Heizung Tankentlueftungsventil Lambdasondenheizung vor Kat Bank1 Lambdasondenheizung hinter Kat Bank1 Lambdasondenheizung vor Kat Bank2 Lambdasondenheizung hinter Kat Bank2 MIL (Malfunction Indicator Lamp) Fahrgeschwindigkeitsregler-Lampe EML (Engine Malfunction Lamp) Elektrische Kraftstoffpumpe 1 E-Luefter VVT-Entlastungsrelais VVT Einspritzventil 1 Einspritzventil 2 Einspritzventil 3 Einspritzventil 4 Einspritzventil 5 Einspritzventil 6 Vanos Einlass Ventil Vanos Auslass Ventil HPD5-Mengensteuerventil 1 ]	M	XXh [ 1Ch 20h 2Ah 32h 80h 82h 83h 84h 85h 86h 87h 88h 89h 8Ah 8Bh 9Eh A4h ABh ACh ADh AEh B2h B5h B6h B7h BDh BEh BFh C1h C2h C3h C4h C6h C7h C8h C9h CAh CBh CCh CDh CEh CFh D0h D1h D2h D3h D4h D5h D6h D8h DAh DCh DDh E1h E2h E3h E4h E5h E6h EDh EEh EFh ]	IOLI_
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3	inputOutputControlParameter	M	00h	IOCP_RCTE CU
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### InputOutputControlByLocalIdentifier negative Response

Global Negative Responses

## I.15.6 30\_1C07 - KI.87 Spannung /Versorgung DME (Digitale Motor Elektronik) ansteuern

### Formula section:

#### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - KI.87 Spannung / Versorgung	M	1Ch	IOLI_UVSG
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_UVSG
5d	InputOutputControlParameter - LV_RLY_MAIN_EXT_ADJ	M	XXh	CS_TV_UVSG
6d	InputOutputControlParameter - TIMEOUT_TIME_1C_KWP	M	XXh	CS_TO_UVSG

Figure I.15.1: Table InputOutputControlByLocalIdentifier request message

#### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	1Ch	IOLI_UVSG
3d	InputOutputControlParameter	M	07h	IOCP_UVSG

Figure I.15.2: Table InputOutputControlByLocalIdentifier positive response message

### InputOutputControlByLocalIdentifier negative Response

Global Negative Responses

## I.15.7 30\_2007 - Versorgung HPDI-Ventil steuern

#### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	20h	IOLI_UVLSS
3	inputOutputControlParameter	M	07h	IOCP_STA
4	InputOutputControlParameter -not used	M	FFh	CS_PD_UVLSS
5	InputOutputControlParameter - LV_RLY_HPDI_EXT_ADJ	M	xxh	CS_LV_RLY_HPDI_EXT_ADJ
6	InputOutputControlParameter - TIMEOUT_TIME_20_KWP	M	xxh	CS_TO_UVLSS

#### InputOutputControlByLocalIdentifier Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	InputOutputControlByLocalIdentifier Response SId	M	70h	IOCBLIDPR
2	InputOutputLocalIdentifier	M	20h	IOLI_UVLSS
3	InputOutputControlParameter	M	07h	IOCP_STA

### I.15.8 30\_2A07 - Drosselklappe ansteuern

#### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2d	InputOutputLocalIdentifier - Drosselklappe	M	2Ah	IOLI_DK
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_DK
5d	InputOutputControlParameter - TPS_SP_EXT_ADJ	M	XXh	CS_TV_DK
6d	InputOutputControlParameter - TIMEOUT_TIME_2A_KWP	M	XXh	CS_TO_DK

Figure I.15.3: Table InputOutputControlByLocalIdentifier request message

#### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	2Ah	IOLI_DK
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.4: Table InputOutputControlByLocalIdentifier positive response message

### I.15.9 30\_3207 - Generator Sollspannung BSD (Bit Serielle Datenschnittstelle) ansteuern

#### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Generator Sollspannung BSD	M	32h	IOLI_UGEN
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PHY_UGEN
5d	inputOutputControlParameter - V_ALTER_SP_EXT_ADJ high byte	M	XXh	CS_PHY_UGEN
6d	InputOutputControlParameter - V_ALTER_SP_EXT_ADJ low byte	M	XXh	CS_PHY_UGEN
7d	InputOutputControlParameter - TIMEOUT_TIME_32_KWP	M	XXh	CS_TO_UGEN

Figure I.15.5: Table InputOutputControlByLocalIdentifier request message

#### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	32h	IOLI_UGEN
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.6: Table InputOutputControlByLocalIdentifier positive response message

## I.15.10 30\_8007 - Radaitor shutter ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	80h	IOLI_HPDR
3	inputOutputControlParameter	M	07h	IOCP_STA
4	InputOutputControlParameter -not used	M	FFh	CS_PD_RAS
5	InputOutputControlParameter - LV_ACT_RAS_EXT_ADJ	M	xxh	CS_TV_RAS
6	InputOutputControlParameter - TIMEOUT_TIME_80_KWP	M	xxh	CS_TO_RAS

### InputOutputControlByLocalIdentifier Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	InputOutputControlByLocalIdentifier Response SId	M	70h	IOCBLIDPR
2	InputOutputLocalIdentifier	M	80h	IOLI_RAS
3	InputOutputControlParameter	M	07h	IOCP_RAS

### InputOutputControlByLocalIdentifier Negative Response

## I.15.11 30\_8207 - HPD-Relais steuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	82h	IOLI_HPDR
3	inputOutputControlParameter	M	07h	IOCP_STA
4	InputOutputControlParameter -not used	M	FFh	CS_PD_HPDR
5	InputOutputControlParameter - LV_ACT_RLY_VCV_EXT_ADJ	M	xxh	CS_TV_HPDR
6	InputOutputControlParameter - TIMEOUT_TIME_82_KWP	M	xxh	CS_TO_HPDR

### InputOutputControlByLocalIdentifier Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	InputOutputControlByLocalIdentifier Response SId	M	70h	IOCBLIDPR
2	InputOutputLocalIdentifier	M	82h	IOLI_HPDR
3	InputOutputControlParameter	M	07h	IOCP_HPDR

## I.15.12 30\_8307 - Wasserpumpe Turbolader steuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	83h	IOLI_WAPUT
3	inputOutputControlParameter	M	07	IOCP_STA
4	InputOutputControlParameter -not used	M	FFh	CS_PD_WAPUT
5	InputOutputControlParameter - N_REL_CWP_SP_2_EXT_ADJ	M	xxh	CS_TV_WAPUT
6	InputOutputControlParameter - TIMEOUT_TIME_83_KWP	M	xxh	CS_TO_WAPUT

### InputOutputControlByLocalIdentifier Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	InputOutputControlByLocalIdentifier Response SId	M	70h	IOCBLIDPR
2	InputOutputLocalIdentifier	M	83h	IOLI_WAPUT
3	InputOutputControlParameter	M	07h	IOCP_STA

## I.15.13 30\_8407 - Drosselklappenstellergehäuseheizung 2 ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Drosselklappenstellergehäuseheizung 2	M	84h	IOLI_DKH2
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_DKH2
5d	InputOutputControlParameter - LV_ACT_RLY_MTC_2_HEAT_EXT_ADJ	M	XXh	CS_TV_DKH2
6d	InputOutputControlParameter - TIMEOUT_TIME_84_KWP	M	XXh	CS_TO_DKH2

Figure I.15.7: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	84h	IOLI_DKH2
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.8: Table InputOutputControlByLocalIdentifier positive response message

## I.15.14 30\_8507 - Drosselklappe 2 steuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	85h	IOLI_DKP2
3	inputOutputControlParameter	M	07	IOCP_STA
4	InputOutputControlParameter - not used	M	FFh	CS_PD_DKP2
5	InputOutputControlParameter - TPS_SP_2_EXT_ADJ	M	xxh	CS_TPS_SP_EXT_ADJ[2]
6	InputOutputControlParameter -TIMEOUT_TIME_85_KWP	M	xxh	CS_TO_DKH2



## InputOutputControlByLocalIdentifier Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	InputOutputControlByLocalIdentifier Response SId	M	70h	IOCBLIDPR
2	InputOutputLocalIdentifier	M	85h	IOLI_DKP2
3	InputOutputControlParameter	M	07h	IOCP_STA

## I.15.15 30\_8607 - (second) HPD5-Mengensteuerventil steuern

### Second HPD5-Mengensteuerventil for MSD85 only:

#### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	85h	IOLI_MSV2
3	inputOutputControlParameter	M	07	IOCP_STA
4	InputOutputControlParameter - not used	M	FFh	CS_PD_MSV2
5	InputOutputControlParameter - arqtmsv_w_rb[2] (high byte)	M	xxh	CS_
6	InputOutputControlParameter - arqtmsv_w_rb[2] (low byte)	M	xxh	
7	InputOutputControlParameter -TIMEOUT_TIME_86_KWP	M	xxh	CS_TO_MSV2

Hint: activation with B\_rqtmsv\_rb[2]

#### InputOutputControlByLocalIdentifier Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	InputOutputControlByLocalIdentifier Response SId	M	70h	IOCBLIDPR
2	InputOutputLocalIdentifier	M	86h	IOLI_MSV2
3	InputOutputControlParameter	M	07h	IOCP_STA


### HPD5-Mengensteuerventil for MSD80 4cyl only:

#### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	85h	IOLI_MSV2
3	inputOutputControlParameter	M	07	IOCP_STA
4	InputOutputControlParameter - not used	M	FFh	CS_PD_MSV2
5	InputOutputControlParameter - arqtmsv_w_rb (high byte)	M	xxh	CS_
6	InputOutputControlParameter - arqtmsv_w_rb (low byte)	M	xxh	
7	InputOutputControlParameter -TIMEOUT_TIME_86_KWP	M	xxh	CS_TO_MSV2

Hint: activation with B\_rqtmsv\_rb

#### InputOutputControlByLocalIdentifier Positive Response

Released by Tettenborn Frank		Date 2013-02-13	File 17100M25.00A
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7457 of 8404	
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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	InputOutputControlByLocalIdentifier Response SId	M	70h	IOCBLIDPR
2	InputOutputLocalIdentifier	M	86h	IOLI_MSV2
3	InputOutputControlParameter	M	07h	IOCP_STA

### I.15.16 30\_8707 - Abgasklappe 2 steuern

#### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	87	IOLI_AGK2
3	inputOutputControlParameter	M	07	IOCP_STA
4	InputOutputControlParameter - not used	M	FFh	CS_PD_AGK2
5	InputOutputControlParameter - LV_ACT_EF_2_EXT_ADJ	M	xxh	CS_LV_ACT_EF_EXT_ADJ[2]
6	InputOutputControlParameter - TIMEOUT_TIME_87_KWP	M	xxh	CS_TO_AGK2

#### InputOutputControlByLocalIdentifier Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	InputOutputControlByLocalIdentifier Response SId	M	70h	IOCBLIDPR
2	InputOutputLocalIdentifier	M	87h	IOLI_AGK2
3	InputOutputControlParameter	M	07h	IOCP_STA

### I.15.17 30\_8807 - Vanos Einlass Ventil Bank2 steuern

#### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	88	IOLI_ENWS2
3	inputOutputControlParameter	M	07	IOCP_STA
4	InputOutputControlParameter -	M	FFh	CS_PD_ENWS2
5	InputOutputControlParameter - CAM_SP_2_IN_EXT_ADJ (high byte)	M	Xxh	CS_CAM_SP_2_IN_EXT_ADJ
6	InputOutputControlParameter - CAM_SP_2_IN_EXT_ADJ (low byte)	M	Xxh	
7	InputOutputControlParameter - TIMEOUT_TIME_88_KWP	M	Xxh	CS_TO_ENWS2

#### InputOutputControlByLocalIdentifier Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	InputOutputControlByLocalIdentifier Response SId	M	70h	IOCBLIDPR
2	InputOutputLocalIdentifier	M	88h	IOLI_ENWS2
3	InputOutputControlParameter	M	07h	IOCP_STA

### I.15.18 30\_8907 - Vanos Auslass Ventil Bank 2 steuern

#### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	89	IOLI_ANSW2
3	inputOutputControlParameter	M	07	IOCP_STA
4	InputOutputControlParameter - Periodendauer Bank 2	M	FFh	CS_PD_ANSW2
5	InputOutputControlParameter - CAM_SP_2_EX_EXT_ADJ (high byte)	M	xxh	CS_CAM_SP_2_EX_EXT_ADJ
6	InputOutputControlParameter - CAM_SP_2_EX_EXT_ADJ (low byte)	M	xxh	
7	InputOutputControlParameter - TIMEOUT_TIME_89_KWP	M	xxh	CS_TO_ANWS2

### InputOutputControlByLocalIdentifier Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	InputOutputControlByLocalIdentifier Response SId	M	70h	IOCBLIDPR
2	InputOutputLocalIdentifier	M	89h	IOLI_ANSW2
3	InputOutputControlParameter	M	07h	IOCP_STA

## I.15.19 30\_8A07 - Umluftventil Bank 2 steuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	8A	IOLI_ULV2
3	inputOutputControlParameter	M	07	IOCP_STA
4	InputOutputControlParameter - not used	M	FFh	CS_PD_ULV2
5	InputOutputControlParameter - RFPWM_EXT_ADJ[2]	M	xxh	CS_TS_ULV2
6	InputOutputControlParameter - TIMEOUT_TIME_8A_KWP	M	xxh	CS_TO_ULV2

### InputOutputControlByLocalIdentifier Positive Response


Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	InputOutputControlByLocalIdentifier Response SId	M	70h	IOCBLIDPR
2	InputOutputLocalIdentifier	M	8Ah	IOLI_ULV2
3	InputOutputControlParameter	M	07h	IOCP_STA

## I.15.20 30\_8B07 - Sekundearluftventil 2 ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Sekundearluftventil 2	M	8Bh	IOLI_SLV2
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_SLV2
5d	InputOutputControlParameter - LV_ACT_SAV_2_EXT_ADJ	M	XXh	CS_TV_SLV2
6d	InputOutputControlParameter - TIMEOUT_TIME_8B_KWP	M	XXh	CS_TO_SLV2

Figure I.15.9: Table InputOutputControlByLocalIdentifier request message

Released by Tetenborn Frank		Date 2013-02-13	File 17100M25.00A
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7459 of 8404	
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## InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	CAh	IOLI_SLV2
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.10: Table InputOutputControlByLocalIdentifier positive response message

## I.15.21 30\_9E07 - Drosselklappenstellergehäuseheizung ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Drosselklappenstellergehäuseheizung	M	9Eh	IOLI_DKH
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_DKH
5d	InputOutputControlParameter - LV_ACT_RLY_MTC_HEAT_EXT_ADJ	M	XXh	CS_TV_DKH
6d	InputOutputControlParameter - TIMEOUT_TIME_9E_KWP	M	XXh	CS_TO_DKH

Figure I.15.11: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	9Eh	IOLI_DKH
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.12: Table InputOutputControlByLocalIdentifier positive response message

## I.15.22 30\_A407 - Gesteuerte Luftfuehrung (untere Klappe) ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2d	InputOutputLocalIdentifier - Gesteuerte Luftfuehrung ansteuern	M	A4h	IOLI_GLF2
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_GLF2
5d	InputOutputControlParameter - LV_ACT_ECRAS_DOWN_EXT_ADJ	M	XXh	CS_TV_GLF2
6d	InputOutputControlParameter - TIMEOUT_TIME_A4_KWP	M	XXh	CS_TO_GLF2

Figure I.15.13: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIPR
2d	InputOutputLocalIdentifier	M	A4h	IOLI_GLF2
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.14: Table InputOutputControlByLocalIdentifier positive response message

## I.15.23 30\_AB07 - Oeldruck-Regelung (Geregeltes Oeldrucksystem) ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request Sid	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Ölsolldruck	M	ABh	IOLI_ODR
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_P_OELSOL_TST
5d	inputOutputControlParameter - POIL_SP_EXT_ADJ	M	XXh	CS_P_OELSOL_TST
7d	InputOutputControlParameter - TIMEOUT_TIME_AB_KWP	M	XXh	CS_TO_ODR

Figure I.15.15: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response Sid	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	ABh	IOLI_ODR
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.16: Table InputOutputControlByLocalIdentifier positive response message

## I.15.24 30\_AC07 - Oeldruckventil (Geregeltes Oeldrucksystem) ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request Sid	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Generator Sollspannung BSD	M	ACH	IOLI_ODV
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_ODV
5d	inputOutputControlParameter - POIL_PWM_EXT_ADJ	M	XXh	CS_PD_ODV
6d	InputOutputControlParameter - TIMEOUT_TIME_AC_KWP	M	XXh	CS_TO_ODV

Figure I.15.17: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response Sid	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	ACH	IOLI_ODV
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.18: Table InputOutputControlByLocalIdentifier positive response message

## I.15.25 30\_AD07 - Kurbelgehäuseentlüftungsheizung ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Kurbelgehäuseentlüftungsheizung	M	ADh	IOLI_KGEH
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_KGEH
5d	InputOutputControlParameter - LV_ACT_RLY_CRCV_HEAT_EXT_ADJ	M	XXh	CS_TV_KGEH
6d	InputOutputControlParameter - TIMEOUT_TIME_AD_KWP	M	XXh	CS_TO_KGEH

Figure I.15.19: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	ADh	IOLI_KGEH
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.20: Table InputOutputControlByLocalIdentifier positive response message

## I.15.26 30\_AE07 - Variable Sauganlage (DISA) Klappe2 ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Variable Sauganlage (DISA) Klappe2	M	A Eh	IOLI_DISA2
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_DISA2
5d	InputOutputControlParameter - LV_VIM_2_EXT_ADJ	M	XXh	CS_TV_DISA2
6d	InputOutputControlParameter - TIMEOUT_TIME_AE_KWP	M	XXh	CS_TO_DISA2

Figure I.15.21: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	A Eh	IOLI_DISA2
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.22: Table InputOutputControlByLocalIdentifier positive response message

## I.15.27 30\_B207 - Motorlager ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Kurbelgehäuseentlueftungsheizung	M	B2h	IOLI_
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_
5d	inputOutputControlParameter - LV_SWI_AEB_EXT_ADJ	M	XXh	CS_
6d	InputOutputControlParameter - TIMEOUT_TIME_B2_KWP	M	XXh	CS_TO_

Figure I.15.23: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	B2h	IOLI_KGEH
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.24: Table InputOutputControlByLocalIdentifier positive response message

## I.15.28 30\_B507 - Umluftventil Bank 1 steuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	B5	IOLI_ULV
3	inputOutputControlParameter	M	07	IOCP_STA
4	InputOutputControlParameter - not used	M	FFh	CS_PD_ULV
5	InputOutputControlParameter - - RFPPWM_EXT_ADJ[1]	M	xxh	CS_TV_ULV
6	InputOutputControlParameter - TIMEOUT_TIME_B5_KWP	M	xxh	CS_TO_ULV

### InputOutputControlByLocalIdentifier Positive Response


Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	InputOutputControlByLocalIdentifier Response SId	M	70h	IOCBLIDPR
2	InputOutputLocalIdentifier	M	xxh	IOLI_ULV
3	InputOutputControlParameter	M	07h	IOCP_STA

## I.15.29 30\_B607 - Ladedrucksteller 1 ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Kurbelgehäuseentlueftungsheizung	M	B6h	IOLI_
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_
5d	inputOutputControlParameter - WGPWM_EXT_ADJ[1] (high byte)	M	XXh	CS_
6d	InputOutputControlParameter - WGPWM_EXT_ADJ[1] ( low byte)	M	XXh	CS_
7d	InputOutputControlParameter - TIMEOUT_TIME_B6_KWP	M	XXh	CS_TO_

Figure I.15.25: Table InputOutputControlByLocalIdentifier request message

Released by Tettenborn Frank		Date 2013-02-13	File 17100M25.00A
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7463 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11



### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	B6h	IOLI_KGEH
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.26: Table InputOutputControlByLocalIdentifier positive response message

### I.15.30 30\_B707 - Ladedrucksteller 2 ansteuern

#### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Kurbelgehauseentlueftungsheizung	M	B7h	IOLI_
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_
5d	inputOutputControlParameter - WGPWM_EXT_ADJ[2] (high byte)	M	XXh	CS_
6d	InputOutputControlParameter - WGPWM_EXT_ADJ[2] ( low byte)	M	XXh	CS_
7d	InputOutputControlParameter - TIMEOUT_TIME_B7_KWP	M	XXh	CS_TO_

Figure I.15.27: Table InputOutputControlByLocalIdentifier request message

#### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	B7h	IOLI_KGEH
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.28: Table InputOutputControlByLocalIdentifier positive response message

### I.15.31 30\_BD07 - Mengensteuerventil ansteuern

#### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Kurbelgehauseentlueftungsheizung	M	BDh	IOLI_
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_
5d	inputOutputControlParameter - FUP_SP_EXT_ADJ (high byte)	M	XXh	CS_
6d	InputOutputControlParameter - FUP_SP_EXT_ADJ ( low byte)	M	XXh	CS_
7d	InputOutputControlParameter - TIMEOUT_TIME_AD_KWP	M	XXh	CS_TO_

Figure I.15.29: Table InputOutputControlByLocalIdentifier request message

#### InputOutputControlByLocalIdentifier positive Response



Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBIDPR
2d	InputOutputLocalIdentifier	M	BDh	IOLI_KGEH
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.30: Table InputOutputControlByLocalIdentifier positive response message

## I.15.32 30\_BE07 - Abgasrückführungsventil ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBID
2d	InputOutputLocalIdentifier - Kurbelgehäuseentlueftungsheizung	M	BDh	IOLI_
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_
5d	inputOutputControlParameter - OPG_SP_ACR_EXT_ADJ (high byte)	M	XXh	CS_
6d	InputOutputControlParameter - OPG_SP_ACR_EXT_ADJ ( low byte)	M	XXh	CS_
7d	InputOutputControlParameter - TIMEOUT_TIME_AD_KWP	M	XXh	CS_TO_

Figure I.15.31: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBIDPR
2d	InputOutputLocalIdentifier	M	BDh	IOLI_KGEH
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.32: Table InputOutputControlByLocalIdentifier positive response message

## I.15.33 30\_BF07 - elektr. Wasserpumpe ueber BSD (Bit Serielle Datenschnittstelle) ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBID
2d	InputOutputLocalIdentifier - elektr. Wasserpumpe ueber BSD	M	BFh	IOLI_EWAP
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_EWAP
5d	InputOutputControlParameter - N_REL_CWP_SP_EXT_ADJ	M	XXh	CS_TV_EWAP
6d	InputOutputControlParameter - TIMEOUT_TIME_BF_KWP	M	XXh	CS_TO_EWAP

Figure I.15.33: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBIDPR
2d	InputOutputLocalIdentifier	M	BFh	IOLI_EWAP
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.34: Table InputOutputControlByLocalIdentifier positive response message

## I.15.34 30\_C107 - Abgasklappe ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Abgasklappe ansteuern	M	C1h	IOLI_AGK
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_AGK
5d	InputOutputControlParameter - LV_ACT_EF_EXT_ADJ	M	XXh	CS_TV_AGK
6d	InputOutputControlParameter - TIMEOUT_TIME_C1_KWP	M	XXh	CS_TO_AGK

Figure I.15.35: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	C1h	IOLI_AGK
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.36: Table InputOutputControlByLocalIdentifier positive response message

## I.15.35 30\_C207 - Soundklappe ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Soundklappe ansteuern	M	C2h	IOLI_SOK
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_SOK
5d	InputOutputControlParameter - LV_ACT_SOF_EXT_ADJ	M	XXh	CS_TV_SOK
6d	InputOutputControlParameter - TIMEOUT_TIME_C2_KWP	M	XXh	CS_TO_SOK

Figure I.15.37: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	C2h	IOLI_SOK
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.38: Table InputOutputControlByLocalIdentifier positive response message

## I.15.36 30\_C307 - Gesteuerte Luftfuehrung ansteuern (obere Klappe)

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2d	InputOutputLocalIdentifier - Gesteuerte Luftfuehrung ansteuern	M	C3h	IOLI_GLF
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_GLF
5d	InputOutputControlParameter - LV_ACT_ECRAS_UP_EXT_ADJ	M	XXh	CS_TV_GLF
6d	InputOutputControlParameter - TIMEOUT_TIME_C3_KWP	M	XXh	CS_TO_GLF

Figure I.15.39: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIPR
2d	InputOutputLocalIdentifier	M	C3h	IOLI_GLF
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.40: Table InputOutputControlByLocalIdentifier positive response message

## I.15.37 30\_C407 - Startrelais ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Startrelais ansteuern	M	C4h	IOLI_SR
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_SR
5d	InputOutputControlParameter - LV_ACT_RLY_ST_EXT_ADJ	M	XXh	CS_TV_SR
6d	InputOutputControlParameter - TIMEOUT_TIME_C4_KWP	M	XXh	CS_TO_SR

Figure I.15.41: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	C4h	IOLI_SR
3d	InputOutputControlParameter	M	07h	IOCP_STA


Figure I.15.42: Table InputOutputControlByLocalIdentifier positive response message

## I.15.38 30\_C607 - Variable Sauganlage (DISA) Klappe ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Variable Sauganlage (DISA) Klappe	M	C6h	IOLI_DISA
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_DISA
5d	InputOutputControlParameter - LV_VIM_1_EXT_ADJ	M	XXh	CS_TV_DISA
6d	InputOutputControlParameter - TIMEOUT_TIME_C6_KWP	M	XXh	CS_TO_DISA

Figure I.15.43: Table InputOutputControlByLocalIdentifier request message

Released by Tettenborn Frank		Date 2013-02-13	File 17100M25.00A
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7467 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	C6h	IOLI_DISA
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.44: Table InputOutputControlByLocalIdentifier positive response message

## I.15.39 30\_C707 - Klimakompressor-Relais ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Klimakompressor-Relais ansteuern	M	C7h	IOLI_KOREL
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_KOREL
5d	InputOutputControlParameter - LV_ACT_ACCOUT_RLY_EXT_ADJ	M	XXh	CS_TV_KOREL
6d	InputOutputControlParameter - TIMEOUT_TIME_C7_KWP	M	XXh	CS_TO_KOREL

Figure I.15.45: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	C7h	IOLI_KOREL
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.46: Table InputOutputControlByLocalIdentifier positive response message

## I.15.40 30\_C807 - E-Box-Luefter ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - E-Box-Luefter	M	C8h	IOLI_EBL
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_EBL
5d	InputOutputControlParameter - LV_ACT_EBOX_CFA_EXT_ADJ	M	XXh	CS_TV_EBL
6d	InputOutputControlParameter - TIMEOUT_TIME_C8_KWP	M	XXh	CS_TO_EBL

Figure I.15.47: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	C8h	IOLI_EBL
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.48: Table InputOutputControlByLocalIdentifier positive response message

## I.15.41 30\_C907 - Kennfeldthermostat ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request Sid	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Kennfeldthermostat	M	C9h	IOLI_KFT
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_KFT
5d	InputOutputControlParameter - ECTPWM_EXT_ADJ	M	XXh	CS_TV_KFT
6d	InputOutputControlParameter - TIMEOUT_TIME_C9_KWP	M	XXh	CS_TO_KFT

Figure I.15.49: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response Sid	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	C9h	IOLI_KFT
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.50: Table InputOutputControlByLocalIdentifier positive response message

## I.15.42 30\_CA07 - Sekundarluftventil ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request Sid	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Sekundarluftventil	M	CAh	IOLI_SLV
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_SLV
5d	InputOutputControlParameter - LV_ACT_SAV_EXT_ADJ	M	XXh	CS_TV_SLV
6d	InputOutputControlParameter - TIMEOUT_TIME_1C_KWP	M	XXh	CS_TO_SLV

Figure I.15.51: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response Sid	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	CAh	IOLI_SLV
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.52: Table InputOutputControlByLocalIdentifier positive response message

## I.15.43 30\_CB07 - Sekundarluftpumpe ansteuern

### Additional Application conditions:

**Initialisation:** 0 at reset

**Activation:** depending on calibratable conditions  
see chapter "activation conditions" above

**IF** LV\_TEMP\_MAX\_SAP\_COIL = 0 **and**  
 [ STATE\_SA = INACTIVE **or**  
 STATE\_SA = FINISHED **or**  
 STATE\_SA = CANCELED **or**  
 STATE\_SA = EXT\_ADJ **or**  
 STATE\_SA = EXT\_ADJ\_FIN **or**  
 STATE\_SA = EOL\_SA\_FIN]

**Deactivation:** not activation

**Service location:** see list of "implemented diagnostic services"

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request Sid	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Sekundaerluftpumpe	M	CBh	IOLI_SLP
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_SLP
5d	InputOutputControlParameter - LV_ACT_SAP_EXT_ADJ	M	XXh	CS_TV_SLP
6d	InputOutputControlParameter - TIMEOUT_TIME_CB_KWP	M	XXh	CS_TO_SLP

Figure I.15.53: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response Sid	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	CBh	IOLI_SLP
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.54: Table InputOutputControlByLocalIdentifier positive response message

## I.15.44 30\_CC07 - Diagnosemodul-Tank Leakage Pumpe ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request Sid	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Diagnosemodul-Tank Leakage Pumpe	M	CCh	IOLI_DMTL_P
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_DMTL_P
5d	InputOutputControlParameter - LV_ACT_DMTL_PUMP_EXT_ADJ	M	XXh	CS_TV_DMTL_P
6d	InputOutputControlParameter - TIMEOUT_TIME_CC_KWP	M	XXh	CS_TO_DMTL_P

Figure I.15.55: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	CCh	IOLI_DMTL_P
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.56: Table InputOutputControlByLocalIdentifier positive response message

## I.15.45 30\_CD07 - Diagnosemodul-Tank Leakage Ventil ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - KI.87 Spannung / Versorgung	M	CDh	IOLI_DMTL_V
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_DMTL_V
5d	InputOutputControlParameter - LV_ACT_DMTLS_EXT_ADJ	M	XXh	CS_TV_DMTL_V
6d	InputOutputControlParameter - TIMEOUT_TIME_CD_KWP	M	XXh	CS_TO_DMTL_V

Figure I.15.57: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	CDh	IOLI_DMTL_V
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.58: Table InputOutputControlByLocalIdentifier positive response message

## I.15.46 30\_CE07 - Diagnosemodul-Tank Leakage Heizung ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Diagnosemodul-Tank Leakage Heizung	M	CEh	IOLI_DMTLH
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_DMTLH
5d	InputOutputControlParameter - LV_ACT_DMTLH_EXT_ADJ	M	XXh	CS_TV_DMTLH
6d	InputOutputControlParameter - TIMEOUT_TIME_CE_KWP	M	XXh	CS_TO_DMTLH

Figure I.15.59: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	CEh	IOLI_DMTLH
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.60: Table InputOutputControlByLocalIdentifier positive response message



## I.15.47 30\_CF07 - Tankentlueftungsventil ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier Tankentlueftungsventil ansteuern	M	CFh	IOLI_TEV
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_TEV
5d	InputOutputControlParameter - CPPWM_EXT_ADJ	M	XXh	CS_TV_TEV
6d	InputOutputControlParameter - TIMEOUT_TIME_CF_KWP	M	XXh	CS_TO_TEV

Figure I.15.61: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	CFh	IOLI_TEV
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.62: Table InputOutputControlByLocalIdentifier positive response message

## I.15.48 30\_D007 - Lambdasondenheizung vor Kat Bank1 ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Lambdasondenheizung vor Kat Bank1	M	D0h	IOLI_LSH1
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_LSH1
5d	InputOutputControlParameter - LSHPWM_UP_EXT_ADJ[1]	M	XXh	CS_TV_LSH1
6d	InputOutputControlParameter - TIMEOUT_TIME_D0_KWP	M	XXh	CS_TO_LSH1

Figure I.15.63: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	D0h	IOLI_LSH1
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.64: Table InputOutputControlByLocalIdentifier positive response message

## I.15.49 30\_D107 - Lambdasondenheizung hinter Kat Bank1 ansteuern

### InputOutputControlByLocalIdentifier Request



Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Lambdasondenheizung hinter Kat Bank1	M	D1h	IOLI_LSH2
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_LSH2
5d	InputOutputControlParameter - LSHPWM_DOWN_EXT_ADJ[1]	M	XXh	CS_TV_LSH2
6d	InputOutputControlParameter - TIMEOUT_TIME_D1_KWP	M	XXh	CS_TO_LSH2

Figure I.15.65: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	D1h	IOLI_LSH2
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.66: Table InputOutputControlByLocalIdentifier positive response message

## I.15.50 30\_D207 - Lambdasondenheizung vor Kat Bank2 ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Lambdasondenheizung vor Kat Bank2	M	D2h	IOLI_LSH3
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_LSH3
5d	InputOutputControlParameter - LSHPWM_UP_EXT_ADJ[2]	M	XXh	CS_TV_LSH3
6d	InputOutputControlParameter - TIMEOUT_TIME_D2_KWP	M	XXh	CS_TO_LSH3

Figure I.15.67: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	D2h	IOLI_LSH3
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.68: Table InputOutputControlByLocalIdentifier positive response message

## I.15.51 30\_D307 - Lambdasondenheizung hinter Kat Bank2 ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Lambdasondenheizung hinter Kat Bank2	M	D3h	IOLI_LSH4
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_LSH4
5d	InputOutputControlParameter - LSHPWM_DOWN_EXT_ADJ[2]	M	XXh	CS_TV_LSH4
6d	InputOutputControlParameter - TIMEOUT_TIME_D3_KWP	M	XXh	CS_TO_LSH4

Figure I.15.69: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	D3h	IOLI_LSH4
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.70: Table InputOutputControlByLocalIdentifier positive response message

## I.15.52 30\_D407 - MIL (Malfunction Indicator Lamp) ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - MIL (Malfunction Indicator Lamp)	M	D4h	IOLI_MIL
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_MIL
5d	InputOutputControlParameter - LV_ACT_MIL_EXT_ADJ	M	XXh	CS_TV_MIL
6d	InputOutputControlParameter - TIMEOUT_TIME_D4_KWP	M	XXh	CS_TO_MIL

Figure I.15.71: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	D4h	IOLI_MIL
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.72: Table InputOutputControlByLocalIdentifier positive response message

## I.15.53 30\_D507 - Fahrgeschwindigkeitsregler-Lampe ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier Fahrgeschwindigkeitsregler-Lampe	M	D5h	IOLI_FGRL
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_FGRL
5d	InputOutputControlParameter - LV_ACT_CRU_EXT_ADJ	M	XXh	CS_TV_FGRL
6d	InputOutputControlParameter - TIMEOUT_TIME_D5_KWP	M	XXh	CS_TO_FGRL

Figure I.15.73: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	D5h	IOLI_FGRL
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.74: Table InputOutputControlByLocalIdentifier positive response message

## I.15.54 30\_D607 - EML (Engine Malfunction Lamp) ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - EML (Engine Malfunction Lamp)	M	D6h	IOLI_EML
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_EML
5d	InputOutputControlParameter - LV_ACT_WAL_1_EXT_ADJ	M	XXh	CS_TV_EML
6d	InputOutputControlParameter - TIMEOUT_TIME_D6_KWP	M	XXh	CS_TO_EML

Figure I.15.75: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	D6h	IOLI_EML
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.76: Table InputOutputControlByLocalIdentifier positive response message

## I.15.55 30\_D807 - Elektrische Kraftstoffpumpe ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Elektrische Kraftstoffpumpe	M	D8h	IOLI_EKP1
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_EKP1
5d	InputOutputControlParameter - EFPPWM_EXT_ADJ	M	XXh	CS_TV_EKP1
6d	InputOutputControlParameter - TIMEOUT_TIME_D8_KWP	M	XXh	CS_TO_EKP1

Figure I.15.77: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	D8h	IOLI_EKP1
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.78: Table InputOutputControlByLocalIdentifier positive response message

## I.15.56 30\_DA07 - E-Luefter ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - E-Luefter	M	DAh	IOLI_ELUE
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_ELUE
5d	InputOutputControlParameter - ECFPWM_ECF_EXT_ADJ	M	XXh	CS_TV_ELUE
6d	InputOutputControlParameter - TIMEOUT_TIME_DA_KWP	M	XXh	CS_TO_ELUE

Figure I.15.79: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	DAh	IOLI_ELUE
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.80: Table InputOutputControlByLocalIdentifier positive response message

## I.15.57 30\_DC07 - VVT-Entlastungsrelais ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - VVT-Entlastungsrelais ansteuern	M	DCh	IOLI_VVTR
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_VVTR
5d	InputOutputControlParameter - LV_RLY_VVL_EXT_ADJ	M	XXh	CS_TV_VVTR
6d	InputOutputControlParameter - TIMEOUT_TIME_DC_KWP	M	XXh	CS_TO_VVTR

Figure I.15.81: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	DCh	IOLI_VVTR
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.82: Table InputOutputControlByLocalIdentifier positive response message

## I.15.58 30\_DD07 - VVT ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - VVT	M	DDh	IOLI_VVT
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_VVT
5d	inputOutputControlParameter - ANG_SP_EXT_ADJ_VVL	M	XXh	CS_PHY_VVT
6d	InputOutputControlParameter - TIMEOUT_TIME_DD_KWP	M	XXh	CS_TO_VVT

Figure I.15.83: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	DDh	IOLI_VVT
3d	InputOutputControlParameter	M	07h	IOCP_STA


Figure I.15.84: Table InputOutputControlByLocalIdentifier positive response message

## I.15.59 30\_E107 - Einspritzventil 1 ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Einspritzventil 1	M	E1h	IOLI_EV1
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - IV_PER_EXT_ADJ[0]	M	XXh	CS_PD_EV1
5d	InputOutputControlParameter - IV_EXT_ADJ[0]	M	XXh	CS_TV_EV1
6d	InputOutputControlParameter - TIMEOUT_TIME_E1_KWP	M	XXh	CS_TO_EV1

Figure I.15.85: Table InputOutputControlByLocalIdentifier request message

Released by Tettenborn Frank		Date 2013-02-13	File 17100M25.00A
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7477 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	E1h	IOLI_EV1
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.86: Table InputOutputControlByLocalIdentifier positive response message

### I.15.60 30\_E207 - Einspritzventil 2 ansteuern

#### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Einspritzventil 2	M	E2h	IOLI_EV1
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - IV_PER_EXT_ADJ[4]	M	XXh	CS_PD_EV2
5d	InputOutputControlParameter - IV_EXT_ADJ[4]	M	XXh	CS_TV_EV2
6d	InputOutputControlParameter - TIMEOUT_TIME_E2_KWP	M	XXh	CS_TO_EV2

Figure I.15.87: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	E2h	IOLI_EV2
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.88: Table InputOutputControlByLocalIdentifier positive response message

### I.15.61 30\_E307 - Einspritzventil 3 ansteuern

#### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Einspritzventil 3	M	E3h	IOLI_EV1
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - IV_PER_EXT_ADJ[2]	M	XXh	CS_PD_EV3
5d	InputOutputControlParameter - IV_EXT_ADJ[2]	M	XXh	CS_TV_EV3
6d	InputOutputControlParameter - TIMEOUT_TIME_E3_KWP	M	XXh	CS_TO_EV3

Figure I.15.89: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	E3h	IOLI_EV3
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.90: Table InputOutputControlByLocalIdentifier positive response message

## I.15.62 30\_E407 - Einspritzventil 4 ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Einspritzventil 4	M	E4h	IOLI_EV1
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - IV_PER_EXT_ADJ[5]	M	XXh	CS_PD_EV4
5d	InputOutputControlParameter - IV_EXT_ADJ[5]	M	XXh	CS_TV_EV4
6d	InputOutputControlParameter - TIMEOUT_TIME_E4_KWP	M	XXh	CS_TO_EV4

Figure I.15.91: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	E4h	IOLI_EV4
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.92: Table InputOutputControlByLocalIdentifier positive response message

## I.15.63 30\_E507 - Einspritzventil 5 ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Einspritzventil 5	M	E5h	IOLI_EV1
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - IV_PER_EXT_ADJ[1]	M	XXh	CS_PD_EV5
5d	InputOutputControlParameter - IV_EXT_ADJ[1]	M	XXh	CS_TV_EV5
6d	InputOutputControlParameter - TIMEOUT_TIME_E5_KWP	M	XXh	CS_TO_EV5

Figure I.15.93: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	E5h	IOLI_EV5
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.94: Table InputOutputControlByLocalIdentifier positive response message



## I.15.64 30\_E607 - Einspritzventil 6 ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Einspritzventil 6	M	E6h	IOLI_EV1
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - IV_PER_EXT_ADJ[3]	M	XXh	CS_PD_EV6
5d	InputOutputControlParameter - IV_EXT_ADJ[3]	M	XXh	CS_TV_EV6
6d	InputOutputControlParameter - TIMEOUT_TIME_E6_KWP	M	XXh	CS_TO_EV6

Figure I.15.95: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	E6h	IOLI_EV6
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.96: Table InputOutputControlByLocalIdentifier positive response message

## I.15.65 30\_ED07 - Vanos Einlass Ventil ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Vanos Einlass Ventil	M	EDh	IOLI_ENWS
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_ENWS
5d	inputOutputControlParameter - CAM_SP_IN_EXT_ADJ high byte	M	XXh	CS_PD_ENWS
6d	InputOutputControlParameter - CAM_SP_IN_EXT_ADJ low byte	M	XXh	CS_TV_ENWS
7d	InputOutputControlParameter - TIMEOUT_TIME_ED_KWP	M	XXh	CS_TO_ENWS

Figure I.15.97: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	EDh	IOLI_ENWS
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.98: Table InputOutputControlByLocalIdentifier positive response message

## I.15.66 30\_EE07 - Vanos Auslass Ventil ansteuern

### InputOutputControlByLocalIdentifier Request



Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID
2d	InputOutputLocalIdentifier - Vanos Auslass Ventil	M	EEh	IOLI_ANWS
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_ANWS
5d	inputOutputControlParameter - CAM_SP_EX_EXT_ADJ high byte	M	XXh	CS_PD_ANWS
6d	InputOutputControlParameter - CAM_SP_EX_EXT_ADJ low byte	M	XXh	CS_TV_ANWS
7d	InputOutputControlParameter - TIMEOUT_TIME_EE_KWP	M	XXh	CS_TO_ANWS

Figure I.15.99: Table InputOutputControlByLocalIdentifier request message

### InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	InputOutputControlByLocalIdentifier Positive Response SId	M	70h	IOCBLIDPR
2d	InputOutputLocalIdentifier	M	EEh	IOLI_ANWS
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.100: Table InputOutputControlByLocalIdentifier positive response message

## I.15.67 30\_EF07 - HPD5 Mengensteuerventil 1 ansteuern

### InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2d	inputOutputLocalID	M	EFh	IOLI_HDP5
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	InputOutputControlParameter -not used	M	FFh	CS_PD_HDP5
5d	InputOutputControlParameter - arqtmsv_w_rb[1] (high byte)	M	xxh	CS_TV_HDP5
6d	InputOutputControlParameter - arqtmsv_w_rb [1](low byte)	M	xxh	CS_TV_HDP5
7d	InputOutputControlParameter - TIMEOUT_TIME_EF_KWP	M	xxh	CS_TO_HDP5

Figure I.15.101: Hint: activation with B\_rqtmsv\_rb[1]

### InputOutputControlByLocalIdentifier Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	InputOutputControlByLocalIdentifier Response SId	M	70h	IOCBLIDPR
2	InputOutputLocalIdentifier	M	EFh	IOLI_HDP5
3	InputOutputControlParameter	M	07h	IOCP_STA

## I.16 KWP2000 - SID 31h: startRoutineByLocalIdentifier Service

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_ecojob1	O/V	0... 1H	0 ...1	1	-
Ecos Job1 aktiv					
B_ecojob2	O/V	0... 1H	0 ...1	1	-
Ecos Job2 aktiv					
B_lvs_neustart	O/V/S	0... 1H	0 ...1	1	-
Rücksetzen der LVS					
B_nglern	O/V	0... 1H	0 ...1	1	-
Learning of neutral gear sensor					
Eco_max [i]	O/V	0... FFH	0... 0.31875	0.00125	A
Max. Ruhestromschwelle					
Eco_msb	O/V	0... FFH	0... 12.75	0.05	s
Ecos Messtartbedingung					
Eco_mz	O/V	0... FFH	0... 12.75	0.05	s
Dauer Mittelwertmessung					
Eco_timo	O/V	0... FFH	0... 255	1	s
Ecos Messung Timeout					
EFF_IGA_CST_LIM_EXT_ADJ	O/V	0... FFFFH	0... 1.99996	0.0000305	-
External efficiency limitation adjusted by external device					
FAC_CH_DIAG_EXT_ADJ_IS	O/V	0... FFH	0... 1.99218	0.0078125	-
Manipulation factor of CH torque reserve for ignition angle efficiency monitoring - demo-mode IS					
FAC_CH_DIAG_EXT_ADJ_PL	O/V	0... FFH	0... 1.99218	0.0078125	-
Manipulation factor of CH torque reserve for ignition angle efficiency monitoring - demo-mode PL					
INH_IV_KWP	O/V	0... 3FH	0... 63	1	-
Shut off request for cylinder x - -- -1=enabled /0=disabledBit0=cylinder 0 (log) Bit1=cylinder 1 (log)Bit2=cylinder 2 (log)Bit3=cylinder 3 (log)Bit4=cylinder 4 (log)Bit5=cylinder 5 (log)					
LV_ACT_CRU_MEM_EXT_ADJ	O	0... 1H	0 ...1	1	-
deleting value for STATE_CRU_OFF_IRR and STATE_CRU_OFF_REV =01h					
LV_AD_CLR_LONG_LAM_EXT_ADJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
tester request for initializing Long Term Lambda Adaptation					
LV_ALTER_CTL_EXT_ADJ	O/V/S	0... 1H	0 ...1	1	-
Set alternator control passiv					
LV_AUTH_L3_ENA	O	0... 1H	0 ...1	1	-
Level 3 authorisation was sucessfull					
LV_CH_DIAG_EXT_REQ	O/V	0... 1H	0 ...1	1	-
External request for ignition angle efficiency monitoring - demo-mode					
LV_CTR_CYL_BAL_RST_EXT	O/V	0... 1H	0 ...1	1	-
Reset request by service tool intervention - used by cylinder balancing OBDII diagnosis					
LV_CTR_TPS_JAM_DET_ACT_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
boolean for reset of jam counter when throttle changed in service					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CYL_BAL_AD_DC_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
request to clear flags for cylinder balancing lambda adaptation at active driving cycle					
LV_CYL_BAL_AD_EOL_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
request to clear flags for cylinder balancing lambda adaptation at end of line					
LV_EFP_CTL_AD_CLR_EXT_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable indicating external request for deleting of EFP adaptation values					
LV_ER_BAL_HOM_RNG_IS_ENA_KWP	O/V	0... 1H	0 ...1	1	-
Request from KWP to enable cylinder balancing homogenous at range idle speed					
LV_FAC_ER_BAL_HOM_EXT_ADJ_KWP	O/V	0... 1H	0 ...1	1	-
Request from KWP to enable cylinder balancing homogenous external adjustment					
LV_HPP_CTL_AD_CLR_EXT_REQ	O/V	0... 1H	0 ...1	1	-
External adjustment to reset the adaptation values of high pressure fuel system					
LV_INH_LAM_KWP	O/V	0... 1H	0 ...1	1	-
Switch off condition for lambda control via KWP2000 /01= disabled 00=enabled					
LV_LAM_AD_INJ_CLR_AD_EXT	O/V	0... 1H	0 ...1	1	-
Clear non-volatile data of lambda adaption via injection mode with service tester					
LV_LAM_CYL_SEL_ADJ_RST_IV_EXT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
external adjustment to reset the injector specific lambda adaptation values					
LV_MFF_ADD_AD_ER_BAL_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
request to clear additive adaptation value for cylinder balancing via TI intervention					
LV_MFF_FAC_AD_ER_BAL_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
request to clear multiple adaptation value for cylinder balancing via TI intervention					
LV_POW_MNG_BAT_CHG	O/V	0... 1H	0 ...1	1	-
condition for function requested of powermanagement register					
LV_POW_MNG_MES_MOD	O/V/S	0... 1H	0 ...1	1	-
set default values PM for BN-SS - set default vaule=01h					
LV_PWL_LOCK_CDN_CUS_INH	O/V	0... 1H	0 ...1	1	-
PWL_LOCK_CDN for customer functions (IBS) disabled due to powerdown-service					
LV_RON_STC_CLR_KWP	O/V	0... 1H	0 ...1	1	-
Flag to reset RON statistical data via tester command.					
LV_TQ_LOSS_AD_CLR_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Request to clear the adaptation values for torque losses					
STATE_EGY_MIN_KWP	O/V/S	0H 1H 2H 3H	PASSIVE EGY_1 EGY_2 EGY_3	-	-
State of FeTraWe /01= Fertigung 02= Transport 03= Werkstatt					
STATE_KWP_IMOB_STORE_K_EWS_ENA	O	0... FFH	0... 255	1	-
State calculation and storage of K_EWS4					

**Input data:**

C_FAC_EGY_PWM_MAN [NC_CYL_NR] {p. 2279}	C_N_MAX_KWP {p. 7439}	CRK_CYL_LAM_DELTA_ INI [NC_CBK_EX_NR] {p. 2838}	CTR_ERR_OBD_DIAG_ CYL_BAL_ER {p. 5112}
CTR_ERR_OBD_DIAG_ CYL_BAL_LAM [NC_CBK_EX_NR] {p. 5112}	CTR_MIS_DET_CYL [NC_CYL_NR] {p. 6263}	CTR_PHA_SHIFT_AD_ TRIG [NC_CBK_EX_NR] {p. 2838}	DELTA_CRK_CYL_LAM [NC_CBK_EX_NR] {p. 2838}

FAC_COR_AD_RNG_H_ ER_BAL_HOM [NC_CYL_NR]	FAC_COR_AD_RNG_IS_ ER_BAL_HOM [NC_CYL_NR]	FAC_COR_AD_RNG_L_ ER_BAL_HOM [NC_CYL_NR]	FAC_LAM_CYL_SEL_ ADJ_CST [NC_CYL_NR] {p. 2731}
FAC_LAM_CYL_SEL_ ADJ_H_RNG [NC_CYL_NR] {p. 2731}	FAC_LAM_CYL_SEL_ ADJ_L_RNG [NC_CYL_NR] {p. 2731}	FAC_TI_AD_ER_BAL [NC_CYL_NR] {p. 3298}	LC_AD_CLR_CPS {p. 812}
LC_AD_CLR_EGCP {p. 526}	LC_AD_CLR_EGR {p. 526}	LC_AD_CLR_ENRD {p. 526}	LC_AD_CLR_ENSD {p. 526}
LC_AD_CLR_IDLE {p. 812}	LC_AD_CLR_IMM {p. 812}	LC_AD_CLR_INSY {p. 526}	LC_AD_CLR_LACO {p. 527}
LC_AD_CLR_LAM {p. 527}	LC_AD_CLR_N_SP_IS {p. 527}	LC_AD_CLR_RON {p. 527}	LC_AD_CLR_SA {p. 812}
LC_AD_CLR_THRO	LC_AD_CLR_TPS {p. 527}	LC_AD_CLR_VAR {p. 528}	LC_AD_CLR_VVL_STATE_ NVMY {p. 812}
LV_ACT_N_SP_IS_BAS_ EXT_ADJ {p. 7680}	LV_CYL_BAL_AD_HOM_ REQ_DC {p. 4066}	LV_CYL_BAL_AD_WG_ OPEN_REQ [NC_CBK_EX_NR] {p. 4066}	LV_CYL_BAL_ER_AD_ ADD_EOL {p. 4043}
LV_CYL_BAL_ER_AD_ FAC_EOL {p. 4043}	LV_CYL_BAL_LAM_AD_ DC {p. 4066}	LV_CYL_BAL_LAM_AD_ EOL {p. 4043}	LV_CYL_BAL_LAM_SEL_ AD_COLD_EOL {p. 4043}
LV_CYL_BAL_LAM_SEL_ AD_HOT_DC {p. 4066}	LV_CYL_BAL_LAM_SEL_ AD_HOT_EOL {p. 4043}	LV_ES {p. 1720}	LV_IGK {p. 906}
LV_LAM_AD_INJ_EXT_ ENA {p. 3349}	LV_LAM_CYL_SEL_ADJ_ H_RNG_VLD [NC_CBK_EX_NR] {p. 2732}	LV_LAM_CYL_SEL_ADJ_ L_RNG_VLD [NC_CBK_EX_NR] {p. 2732}	MFF_ADD_AD_ER_BAL [NC_CYL_NR] {p. 3269}
MFF_ADD_CYL_LAM_ COR [NC_CYL_NR] {p. 2732}	N {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_CONF_DGNC_31_1F
NC_CYL_NR {p. 1526}	STATE_ENG {p. 1720}	STATE_LAMB_CYL_SEL_ CQ_SLOP [NC_CBK_EX_NR] {p. 2733}	TRT {p. 1504}
TvneutrIn {p. 7683}	VS {p. 1176}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_EGY_MIN_KWP	-	0... 1H	0...1	1	-
Switch to enable the configuration of FeTraWe-Mode in ECU /enable = 1					


**General information:**

All implemented SID 31h services are described below.

## I.16.1 Overview of supported subservices

SID number	service	Service Location	MSD_81 (4cyl)	MSD_81 (6cyl)
31_01	ask checksums after reprogramming	BOOT	X	X
31_02	erase Memory	BOOT	X	X
31_03	erase History Memory	ECU	X	X
31_05	power down	ECU	X	X
31_07	start authentication	BOOT	X	X
31_08	check authentication	BOOT	X	X
31_09	check signature	BOOT	X	X
31_0A	report reprogramming status	BOOT	X	X
31_0C	energy spare mode	ECU	X	X
31_1F_E5	SWT: SetVin	ECU	-	X
31_1F_E6	SWT: GetVin	ECU	-	X
31_1F_EA	SWT: PeriodicalCheck	ECU	-	X
31_1F_EB	SWT: GetFSC	ECU	-	X
31_1F_EC	SWT: GetFSCLen	ECU	-	X
31_1F_ED	SWT: DisableFSC	ECU	-	X
31_1F_EE	SWT: Check FSC (Freischaltcode)	ECU	X	X
31_1F_F1	SWT: Transfer data of FSC to ECU	ECU	X	X
31_1F_F2	SWT: Transfer length of FSC to ECU	ECU	X	X
31_1F_F6	SWT: GetStatus	ECU	-	X
31_1F_F8	SWT: GetSoftwareId	ECU	-	X
31_1F_F9	SWT: GetSoftwareIdFunc	ECU	-	X
31_25	switch off Injection valves	ECU	X	X
31_2B	Start Ruhestrom test	ECU	X	X
31_2E	Start Nullgang-Lernen	ECU	X	-
31_2F	Start Desulfatisierung Fahrbetrieb	ECU	X	X
31_30	delete selective adaption values	ECU	X	X
31_31	delete selective adaption values 2	ECU	X	X
31_34	Ansteuern Zylinder Gleichstellung Homogen	ECU	-	-
31_3A	Start CSERS-Diagnose	ECU	-	X
31_D9	switch off Lambda controller	ECU	X	X
31_E1	Ansteuern Eisy- Adaptionswerte (gedrosselt)	ECU	X	X
31_E2	Ansteuern Eisy- Adaptionswerte (gedrosselt mit Abgasrueckfuehrung)	ECU	X	X
31_E3	Ansteuern Krann- Adaptionswerte	ECU	X	X

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31_E4	Ansteuern Klann-Adaptionswerte	ECU	X	X
31_E5	Ansteuern AGR-Adaptionswerte	ECU	X	-
31_F4	cruise control delete switch off conditions	ECU	X	X
31_F5	switch off Idle speed uplift	ECU	X	X
31_F6	set default values PM for BN-SS	ECU	X	X
31_F7	Intelligente Generatorregelung	ECU	X	X
31_FA	Siemens interner Service	ECU / BOOT	X	X
31_FB	Siemens interner Service	ECU / BOOT	X	X
31_FC	Siemens interner Service	ECU / BOOT	X	X

## I.16.2 Global negative Responses

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	NegativeResponse Service Id	M	#7Fh	NR
#2d	StartRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#3d	ResponseCode=only general response code	M	#XXh	RC

Figure I.16.1: Table StartRoutineByLocalIdentifier Negative Response Message

### Remark:

The detailed message of the negative response code is described in chapter "Introduction".

## I.16.3 Standard Application conditions

**Initialisation**            **at reset** : zero, expect: nonvolataile data read from non-volataile memory

**Activation:**            LV\_IGK = 1

**Deactivation:**            LV\_IGK = 0  
Diagnostic timeout

**Service location:**            see list of Overview of supported subservices

## I.16.4 31\_01 ask checksums after reprogramming

### General information:

This function is created to report the checksums after a reprogramming session in order to write the security keys

A negativ response is only possible by a wrong parameter.

### Application conditions

**Initialisation:**            *at reset*

**Activation:**            K1.15 on

**Deactivation:**            K1.15 off  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier = ask for reprogramming ckecksum	M	#01h	RELI

Figure I.16.2: Table StartRoutineByLocalIdentifier Request Message

### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = ask for reprogramming ckecksum	M	#01h	RELI_
#3d	routineLocalIdentifier = state of checksum ] OK Checksum failure within Boot-SW Checksum failure within ECU-SW Checksum failure within caklibration data ]	M	#XXh= [ #00h, #01h, #02h, #04h ]	RELI_

Figure I.16.3: Table StartRoutineByLocalIdentifier Positive Response Message

### StartRoutineByLocalIdentifier negative Response

Global Negative Responses

## I.16.5 31\_02 erase Memory (not for Tricore-ECU)

### General information:

This function is created to erase the memory for not Tricore-ECUs before a update is programmed.

### Application conditions

**Initialisation:** at reset

**Activation:** Kl.15 on

**Deactivation:** Kl.15 off  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier = Erase Memory 31_02	M	#02h	RELI
#3d	routineLocalIdentifier = Memory adress high byte	M	#XXh	RELI_
#4d	routineLocalIdentifier = Memory adress middle byte	M	#XXh	RELI_
#5d	routineLocalIdentifier = Memory adress low byte	M	#XXh	RELI_
#6d	routineLocalIdentifier = Memory type 00=linear address area 02= (external) Flash 06= (internal)Flash	M	#XXh	RELI_
#7d	routineLocalIdentifier = number of bytes - high byte	M	#XXh	RELI_
#8d	routineLocalIdentifier = number of bytes - middle byte	M	#XXh	RELI_
#9d	routineLocalIdentifier = number of bytes - low byte	M	#XXh	RELI_

Figure I.16.4: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = erase memory	M	#02h	RELI_
#3d	routineLocalIdentifier = [ deleting o.k. deleting not o.k. ]	M	#XXh= [ #01h, #02h, ]	RELI_

Figure I.16.5: Table StartRoutineByLocalIdentifier Positive Response Message

**StartRoutineByLocalIdentifier negative Response**

Global Negative Responses

**I.16.6 31\_02 erase memory (for TRICORE ECUs)****General information:**

This services is used to erase the FLASH memory of Tricore-ECUs for reprogramming.

**Application conditions**

**Initialisation:** *at reset*

**Activation:** Kl.15 on

**Deactivation:** Kl.15 off  
Diagnostic timeout  
Service location: see list of implemented diagnostic services

**StartRoutineByLocalIdentifier Request (3-byte addressing)**



Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StartRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	RoutineLocalIdentifier = erase memory	M	#02h	RELI
#3d	RoutineLocalIdentifier = MemoryAddress (High Byte)	M	#XXh	RELI_
#4d	RoutineLocalIdentifier = MemoryAddress (Middle Byte)	M	#XXh	RELI_
#5d	RoutineLocalIdentifier = MemoryAddress (Low Byte)	M	#XXh	RELI_
(#6d)	RoutineLocalIdentifier = MemoryTypeIdentifier [ 02 = external FLASH 06 = internal FLASH ]	U	#XXh= [ #02h, #06h ]	RELI_
#6d / (#7d)	RoutineLocalIdentifier = MemorySize (High Byte)	U	#XXh	RELI_
#7d / (#8d)	RoutineLocalIdentifier = MemorySize (Middle Byte)	U	#XXh	RELI_
#8d / (#9d)	RoutineLocalIdentifier = MemorySize (Low Byte)	U	#XXh	RELI_

Figure I.16.6: Table StartRoutineByLocalIdentifier Request Message  
StartRoutineByLocalIdentifier Request (4-byte addressing)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StartRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	RoutineLocalIdentifier = erase memory	M	#02h	RELI
#3d	RoutineLocalIdentifier = MemoryAddress (High Byte)	M	#XXh	RELI_
#4d	RoutineLocalIdentifier = MemoryAddress (MiddleHigh Byte)	M	#XXh	RELI_
#5d	RoutineLocalIdentifier = MemoryAddress (MiddleLow Byte)	M	#XXh	RELI_
#6d	RoutineLocalIdentifier = MemoryAddress (Low Byte)	M	#XXh	RELI_
#7d	MemoryTypeIdentifier ( <b>mandatory, but not evaluated</b> ) [ 00h ... FFh ]	M	#XXh= [ #XXh ]	RELI_
#8d	RoutineLocalIdentifier = MemorySize (High Byte)	U	#XXh	RELI_
#9d	RoutineLocalIdentifier = MemorySize (MiddleHigh Byte)	U	#XXh	RELI_
#10d	RoutineLocalIdentifier = MemorySize (MiddleLow Byte)	U	#XXh	RELI_
#11d	RoutineLocalIdentifier = MemorySize (Low Byte)	U	#XXh	RELI_

Figure I.16.7: Table StartRoutineByLocalIdentifier Request Message

### Remark:

For **3-byte addressing** independent from delivery of a MemoryTypeIdentifier (byte 6) by the tester s request, the ECU automatically adds an offset to the requested memory address.

If no MemoryTypeIdentifier is delivered, the same offset as for MemoryTypeIdentifier 02h (external FLASH) or 06h (internal FLASH) is used. For compatibility reasons both MemoryTypeIdentifiers are supported.

This base memory offset must be subtracted from any memory address taken from the MAP- /A2L- file if 3-byte addressing is used!

For **4-byte addressing** a MemoryTypeIdentifier (byte 7) must be delivered by the tester s request.

Though it is not evaluated or used within the ECU for this absolute addressing mode, it is necessary to decide between 3- /4-byte addressing mode.

In this 4-byte mode the absolute address delivered by the tester is used by the ECU without any memory offset.

For MSx80 (TriCore) the base memory offset for **3-byte addressing** mode of this service is independent from MemoryTypeIdentifier :

MemoryTypeIdentifier:	Memory offset:
none (short)	8000 0000h
02h (ext. FLASH)	8000 0000h
06h (int. FLASH)	8000 0000h

### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StartRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	RoutineLocalIdentifier = erase memory	M	#02h	RELI_
#3d	RoutineLocalIdentifier = [ erasing o.k. erasing not o.k. ]	M	#XXh= [ #01h, #02h ]	RELI_

Figure I.16.8: Table StartRoutineByLocalIdentifier Positive Response Message

### StartRoutineByLocalIdentifier negative Response

Global Negative Responses

## I.16.7 31\_03 erase History Memory

### General information:

This function is to erase the history memory (max. 10, see also History memory (chapter OBDII functions)), then the RAM-Memory is erased during the engine run.

If not, the content of the RAM is transferred to the non volatile memory at the end of the Power latch phase.

### Application conditions

**Initialisation:** at reset

**Activation:** Kl.15 on

**Deactivation:** Kl.15 off  
Diagnostic timeout


**Service location:** see list of implemented diagnostic services

### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= [ erase History Memory ]	M	#XXh= [ #03h, ]	RELI

Figure I.16.9: Table StartRoutineByLocalIdentifier Request Message

### StartRoutineByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier erase history memory	M	#03h	RELI_

Figure I.16.10: Table StartRoutineByLocalIdentifier Positive Response Message

**StartRoutineByLocalIdentifier negative Response**

Global Negative Responses

**I.16.8 31\_05 power down****General information:**

This function is created to switches the ECU to the power down mode..

**Special Application conditions:****Initialisation at reset or LV\_IGK 0 --> 1:**

LV\_PWL\_LOCK\_CDN\_CUS\_INH = 0

**Activation:** LV\_IGK=0 (KI.15 off)**Deactivation:** LV\_IGK=1 (KI.15 on)  
Diagnostic timeout**Formula section:**

```

IF          LV_IGK = 0          AND
VS = 0          AND
LV_ES = 01H ( engine stopped )
THEN       IF          service 31_05 is received
          THEN
            LV_PWL_LOCK_CDN_CUS_INH = 1
            (reset PWL-lock-condition for customer)
            set Sleep-Indication-Bit and
            wait for NM-Acknowledge-Bit
            to shut down operating system
          ENDIF
        ENDIF
  
```

**StartRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier = power down mode	M	#05h	RELI
#3d	routineLocalIdentifier [ \$00h=switch all ecu's into the power down mode \$01h= switch all ecu's except the power module into the power down mode ]	M	#XXh [ 00h, 01h ]	RELI_

Figure I.16.11: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = power down mode	M	#05h	RELI_
#3d	routineLocalIdentifier [ \$00h=switch all ecu's into the power down mode \$01h= switch all ecu's except the power module into the power down mode ]	M	#XXh [ 00h, 01h ]	RELI_

Figure I.16.12: Table StartRoutineByLocalIdentifier Positive Response Message

**StartRoutineByLocalIdentifier negative Response**

## Global Negative Responses

**Remark: regarding the BMW LH 8 385 774.4 chapter 10.1.1 table 10.1.1- if within 5s power**

**down is not fulfilled, a negative Response 22h is sent to the tester.**

**I.16.9 31\_07 start authentication****General information:**

With this command the authentication procedure is started and the ECU sends the challenge key to the tester.

**Application conditions**

**Initialisation:** at reset

**Activation:** LV\_IGK=1 (K1.15 on)

**Deactivation:** LV\_IGK=0 (K1.15 off)  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

**StartRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StartRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	RoutineLocalIdentifier = start authentication	M	#07h	RELI_SA
#3d	RoutineEntryOption (security level) = [ security level 3 security level 4 security level 5 ]	M	#XXh [ #03h, #04h, #05h ]	REYO_01
#4d	RoutineEntryOption (user-ID byte_1)	M	#XXh	REYO_02
#5d	RoutineEntryOption (user-ID byte_2)	M	#XXh	REYO_03
#6d	RoutineEntryOption (user-ID byte_3)	M	#XXh	REYO_04
#7d	RoutineEntryOption (user-ID byte_4)	M	#XXh	REYO_05

Figure I.16.13: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StartRoutineByLocalIdentifier Positive Response Sid	M	#71h	STRBLIPR
#2d	RoutineLocalIdentifier = start authentication	M	#07h	RELI_SA
#3d	RoutineEntryStatus (challenge-key byte_1)	M	#XXh	REYS_01
#4d	RoutineEntryStatus (challenge-key byte_2)	M	#XXh	REYS_02
#5d	RoutineEntryStatus (challenge-key byte_3)	M	#XXh	REYS_03
#6d	RoutineEntryStatus (challenge-key byte_4)	M	#XXh	REYS_04
#7d	RoutineEntryStatus (challenge-key byte_5)	M	#XXh	REYS_05
#8d	RoutineEntryStatus (challenge-key byte_6)	M	#XXh	REYS_06
#9d	RoutineEntryStatus (challenge-key byte_7)	M	#XXh	REYS_07
#10d	RoutineEntryStatus (challenge-key byte_8)	M	#XXh	REYS_08

Figure I.16.14: Table StartRoutineByLocalIdentifier Positive Response Message

**StartRoutineByLocalIdentifier negative Response**

Global Negative Responses

**I.16.10 31\_08 check authentication****General information:**

With this command the RSA 512 authentication key delivered by the tester is checked inside the ECU.

**Application conditions**


**Initialisation:** `at reset`

**Activation:** `LV_IGK=1 (K1.15 on)`

**Deactivation:** `LV_IGK=0 (K1.15 off)`  
`Diagnostic timeout`

**Service location:** `see list of implemented diagnostic services`

**StartRoutineByLocalIdentifier Request**

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StartRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	RoutineLocalIdentifier = check authentication	M	#08h	RELI_CA
#3d	RoutineEntryOption = authentication key length (high byte)	M	#00h	REYO_01
#4d	RoutineEntryOption = authentication key length (mid_high byte)	M	#00h	REYO_02
#5d	RoutineEntryOption = authentication key length (mid_low byte)	M	#00h	REYO_03
#6d	RoutineEntryOption = authentication key length (low byte)	M	#10h	REYO_04
#7d	RoutineEntryOption = authentication key_1 (high byte)	M	#XXh	REYO_05
#8d	RoutineEntryOption = authentication key_1 (mid_high byte)	M	#XXh	REYO_06
#9d	RoutineEntryOption = authentication key_1 (mid_low byte)	M	#XXh	REYO_07
#10d	RoutineEntryOption = authentication key_1 (low byte)	M	#XXh	REYO_08
#11d	RoutineEntryOption = authentication key_2 (high byte)	M	#XXh	REYO_09
#12d	RoutineEntryOption = authentication key_2 (mid_high byte)	M	#XXh	REYO_10
#13d	RoutineEntryOption = authentication key_2 (mid_low byte)	M	#XXh	REYO_11
#14d	RoutineEntryOption = authentication key_2 (low byte)	M	#XXh	REYO_12
#xxd	...	M	#XXh	REYO_xx
#xxd	...	M	#XXh	REYO_xx
#xxd	...	M	#XXh	REYO_xx
#xxd	...	M	#XXh	REYO_xx
#67d	RoutineEntryOption = authentication key_16 (high byte)	M	#XXh	REYO_65
#68d	RoutineEntryOption = authentication key_16 (mid_high byte)	M	#XXh	REYO_66
#69d	RoutineEntryOption = authentication key_16 (mid_low byte)	M	#XXh	REYO_67
#70d	RoutineEntryOption = authentication key_16 (low byte)	M	#XXh	REYO_68

Figure I.16.15: Table StartRoutineByLocalIdentifier Request Message

### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StartRoutineByLocalIdentifier Positive Response Sid	M	#71h	STRBLIPR
#2d	RoutineLocalIdentifier = check authentication	M	#08h	RELI_CA
#3d	RoutineEntryStatus = [ authentication denied authentication accepted ]	M	#XXh [ #00h, #01h ]	REYS_01

Figure I.16.16: Table StartRoutineByLocalIdentifier Positive Response Message

### StartRoutineByLocalIdentifier negative Response

#### Global Negative Responses

## I.16.11 31\_09 check signature

### General information:

With this command the signature check for ECU-SW or calibration data is started.

### Application conditions

**Initialisation:** *at reset*

**Activation:** LV\_IGK=1 (K1.15 on) AND  
ECU running in Boot-SW

**Deactivation:** LV\_IGK=0 (Kl.15 off)  
 Diagnostic timeout  
**Service location:** see list of implemented diagnostic services

### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StartRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	RoutineLocalIdentifier = check signature	M	#09h	RELI_CS
#3d	RoutineEntryOption = [ check signature for ECU-SW check signature for calibration data ]	M	#XXh [ #02h, #04h ]	REYO_01

Figure I.16.17: Table StartRoutineByLocalIdentifier Request Message

### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StartRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = check signature	M	#09h	RELI_CS
#3d	routineEntryStatus = [ signature wrong signature correct ]	M	#XXh [ #00h, #01h ]	REYS_01

Figure I.16.18: Table StartRoutineByLocalIdentifier Positive Response Message

### StartRoutineByLocalIdentifier negative Response

Global Negative Responses

## I.16.12 31\_0A report reprogramming status

### General information:

This funktion check the reprogramming status of the ecu.

### Application conditions

**Initialisation:** at reset  
**Activation:** Kl.15 on  
**Deactivation:** Kl.15 off  
 Diagnostic timeout  
**Service location:** see list of implemented diagnostic services

### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= [ report reprogramming status ]	M	#XXh= [ #0Ah, ]	RELI_CPSP ROGS

Figure I.16.19: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = PSL	M	#0Ah	
#3d	RoutineEntryStatus = reprogramming status: HW reference not ok = 09h Program not complete = 0Ch Program reference not ok = 0Ah Signature pattern PAF not ok = 05h HW reference does not fit to program reference = 0Bh No calibration data available at all = 00h Calibration data not complete = 0Fh Calibration data reference not ok = 0Dh Signature pattern DAF not ok = 06h Program reference does not fit to calibration data ref = 0Eh ECU is correct programmed = 01h	M	#XXh	CS_PS

Figure I.16.20: Table StartRoutineByLocalIdentifier Positive Response Message

**StartRoutineByLocalIdentifier negative Response**

Global Negative Responses

**I.16.13 31\_0C energy spare mode****FUNCTION DESCRIPTION:**

This module handles the activation of the energy spare mode "FeTraWe". The mode is controlled by external tester and combined with an engine speed limit. The mode is regarded in dynamic error management.

With the received command an engine speed setpoint can be activated. The general function is described in the chapter engine speed limit coordination. The set energy spare mode includes either the activated "Fertigungs- /Transport- or Werkstattmode".

The mode is kept in ECU after disconnection of the tester. The same is applied in case of lost power supply.


**Special Application conditions:**

**Initialisation at reset or at LV\_IGK 0-> 1:** read from non-volatile memory

**Activation:** LV\_IGK=1 and LC\_EGY\_MIN\_KWP = 1

**Deactivation:** LV\_IGK=0 or LC\_EGY\_MIN\_KWP = 0  
Diagnostic timeout

**Formula section:**

Released by Tettenborn Frank		Date 2013-02-13	File 6XI00N02.00C
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7496 of 8404	
Regensburg (RGB)		Copyright ( C ) Continental AG,2007	A4: 2007-11



```

IF          activation identifier of service $31_OC_01 is received ***FeTraWe***
THEN       STATE_EGY_MIN_KWP = 1h
              send positive response

ELSEIF     activation identifier of service $31_OC_02 is received ***FeTraWe***
THEN       STATE_EGY_MIN_KWP = 2h
              send positive response

ELSEIF     activation identifier of service $31_OC_04 is received ***FeTraWe***
THEN       STATE_EGY_MIN_KWP = 3h
              send positive response

ELSEIF     deactivation identifier of service $31_OC_00 is received
THEN       STATE_EGY_MIN_KWP = 0h
              send positive response

              Save          STATE_EGY_MIN_KWP          in non-volatile memory

ELSE       remains unchanged send negative response

ENDIF

```

### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier = energie spare mode	M	#0Ch	
#3d	routineLocalIdentifier = set STATE_EGY_MIN_KWP [ passive Fertigungsmodus Transportmodus Werkstattmodus ]	M	#XXh [ #00h #01h #02h #04h ]	RELI_

Figure I.16.21: Table StartRoutineByLocalIdentifier Request Message


### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	startRoutineByLocalIdentifier = enery spare mode	M	#0Ch	
#3d	Routine entry status = FeTraWe [ not used Fertigungsmodus Transportmodus Werkstattmodus ]	M	#XXh [ #00h #01h #02h #04h ]	RELI_

Figure I.16.22: Table StartRoutineByLocalIdentifier Positive Response Message

### StartRoutineByLocalIdentifier negative Response

#### Global Negative Responses

Released by Tettenborn Frank		Date 2013-02-13	File 6XI00N02.00C
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7497 of 8404	
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## I.16.14 31\_1F Sweeping Technology SWT

### Additional Application condition:

Activation: LV\_ES = 1  
Deactivation: LV\_ES = 0

### I.16.14.1 31\_1F\_E5 SWT: SetVin

#### General information:

Simulation of setting VIN to ECU. Returns Flash write error if the VIN is not the same as stored in ECU.

#### Formula Section:

```

If(1)          service 31_1F_E5 is received
Then(1)
    #If(2)      NC_CONF_DGNC_31_1F = 0
    #Then(2)
        send negative response "RequestOutOfRange"
    #Else(2)
        LOC_FSC_LEN = 0
        ACTION_SWT_SetVin(IN VIN short[], OUT Result status)
        Send positive response
    #Endif(2)
Endif(1)
    
```

#### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	SWT_SetVin	M	#E5h	RELI
#4d	VIN short[1]	M	#XXh	RELI
#5d	VIN short[2]	M	#XXh	RELI
#6d	VIN short[3]	M	#XXh	RELI
#7d	VIN short[4]	M	#XXh	RELI
#8d	VIN short[5]	M	#XXh	RELI
#9d	VIN short[6]	M	#XXh	RELI
#10d	VIN short[7]	M	#XXh	RELI

Figure I.16.23: Table StartRoutineByLocalIdentifier Request Message

#### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	SWT_SetVin	M	#E5h	RELI_
#4d	Result status ] Unknown error Flash write error No L3 authentication Wrong parameter ok ]	M	#XXh [ #FFh, #E0h, #D9h, #D6h, #00h, ]	RELI_

Figure I.16.24: Table StartRoutineByLocalIdentifier Positive Response Message

### I.16.14.2 31\_1F\_E6 SWT: GetVin

#### General information:

Get VIN from ECU

#### Formula Section:

```

If(1)          service 31_1F_E6  is received
Then(1)
    #If(2)      NC_CONF_DGNC_31_1F = 0
    #Then(2)
        send negative response "RequestOutOfRange"
    #Else(2)
        LOC_FSC_LEN = 0
        ACTION_SWT_GetVin( OUTVIN short[], OUT Result status)
        Send positive response
    #Endif(2)
Endif(1)

```

#### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	SWT_GetVin	M	#E6h	RELI

Figure I.16.25: Table StartRoutineByLocalIdentifier Request Message

#### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	SWT_GetFsc	M	#E6h	RELI_
#4d	routineLocalIdentifier = Result status ] Unknown error ok ]	M	#XXh [ #FFh, #00h, ]	RELI_
#5d	VIN short[1]	M	#XXh	RELI
#6d	VIN short[2]	M	#XXh	RELI
#7d	VIN short[3]	M	#XXh	RELI
#8d	VIN short[4]	M	#XXh	RELI
#9d	VIN short[5]	M	#XXh	RELI
#10d	VIN short[6]	M	#XXh	RELI
#11d	VIN short[7]	M	#XXh	RELI

Figure I.16.26: Table StartRoutineByLocalIdentifier Positive Response Message

### I.16.14.3 31\_1F\_EA SWT: PeriodicalCheck

#### General information:

Manual triggered check for testing requirements.

#### Formula Section:

/\* only on request \*/

```

If(1)           service 31_1F_EA is received
Then(1)
  #If(2)       NC_CONF_DGNC_31_1F = 0
  #Then(2)
    send negative response "RequestOutOfRange"
  #Else(2)
    LOC_FSC_LEN = 0
  If(3)       Level 3 authorisation was successfull
  Then(3)
    LV_AUTH_L3_ENA =      1
  Else(3)
    LV_AUTH_L3_ENA = 0
  Endif(3)
  ACTION_SWT_ChkFsc(IN SWID, OUT Result status);
  If(3)       Result status = "still in work"
  Then(3)
    Init 78h response every 10ms
  Else(3)
    send positive response
  Endif(3)
#Endif(2)
Endif(1)

```

*/\* at every 10ms if 78h response is active \*/*

```

#If(1)      NC_CONF_DGNC_31_1F <> 0
#Then(1)
    If(2) Level 3 authorisation was sucessfull
    Then(2)
        LV_AUTH_L3_ENA =          1
    Else(2)
        LV_AUTH_L3_ENA = 0
    Endif(2)
    ACTION_SWT_ChkFsc(IN SWID, OUT Result status);
    If(2) Result status = "still in work"
    Then(2)
        Do nothing
    Else(2)
        stop 78h response
        send positive response
    Endif(2)
#Endif(1)
    
```

### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	SWT_PeriodicalChecks	M	#EAh	RELI
#4d	SWID Highword Highbyte	M	#XXh	RELI_
#5d	SWID Highword Lowbyte	M	#XXh	RELI_
#6d	SWID Lowword Highbyte	M	#XXh	RELI_
#7d	SWID Lowword Lowbyte	M	#XXh	RELI_

Figure I.16.27: Table StartRoutineByLocalIdentifier Request Message

### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	SWT_PeriodicalChecks	M	#EAh	RELI_
#4d	routineLocalIdentifier = Result status ] Unknown error SWID not available SWID check faiure Signature invalid FSC not available FSC rejected FSC cancelled Flash read error VIN checked failed No L3 authentication VIN can not be found in ECU ok ]	M	#XXh [ #FFh, #FEh #FCh #F9h #F6h, #F5h, #F4h, #DFh, #DEh, #D9h, #D2h, #00h, ]	RELI_

Figure I.16.28: Table StartRoutineByLocalIdentifier Positive Response Message

#### I.16.14.4 31\_1F\_EB SWT: GetFSC

##### General information:

Returns a FSC indentified by its CALLID.

##### Formula Section:

**If(1)** service 31\_1F\_EB is received

**Then(1)**

**#If(2)** NC\_CONF\_DGNC\_31\_1F = 0

**#Then(2)**

send negative response "RequestOutOfRange"

**#Else(2)**

**ACTION\_SWT\_CallidToSwid**(IN CALL\_ID, OUT TMP\_SWID)

**ACTION\_SWT\_GetFsc**

(IN TMP\_SWID,OUT FSC or part of FSC, OUT Result status)

**If(3)** LOC\_FSC\_LEN = 0

**Then(3)** Result status =" Wrong parameter"

**Endif(3)**

Send positive response

**#Endif(2)**

**Endif(1)**

#### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	SWT_GetFsc	M	#EBh	RELI
#4d	Telegramm no	M	#XXh	RELI_
#5d	CALL_ID Highbyte	M	#XXh	RELI_
#6d	CALL_ID Lowbyte	M	#XXh	RELI_

Figure I.16.29: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	SWT_GetFsc	M	#EBh	RELI_
#4d	Result status ] Unknown Error Wrong parameter ok ]	M	#XXh [ #FFh, #D6h, #00h, ]	RELI_
#5d	Telegramm no	M	#XXh	RELI_
#6d..#XXd	FSC or part of FSC	M	#XXh	RELI_

Figure I.16.30: Table StartRoutineByLocalIdentifier Positive Response Message Hint: If FSCLen = 0 the length of positive response is #5d

**I.16.14.5 31\_1F\_EC SWT: GetFSCLen****General information:**

Returns the length of a FSC identified by its SWID and generates a CALLID.

**Formula Section:**

If(1) service 31\_1F\_EC is receive

Then(1)

#If(2) NC\_CONF\_DGNC\_31\_1F = 0

#Then(2)

send negative response "RequestOutOfRange"

#Else(2)

**ACTION\_SWT\_GetFscLen( INSWID, OUTFSCLen, OUTResult status)**

LOC\_FSC\_LEN = FSCLen

**ACTION\_SWT\_SwidToCallid(IN SWID, OUT CALL\_ID)**

Send positive response

#Endif(2)

Endif(1)

**StartRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	SWT_GetFscLen	M	#ECh	RELI
#4d	SWID Highword Highbyte	M	#XXh	RELI_
#5d	SWID Highword Lowbyte	M	#XXh	RELI_
#6d	SWID Lowword Highbyte	M	#XXh	RELI_
#7d	SWID Lowword Lowbyte	M	#XXh	RELI_

Figure I.16.31: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	SWT_GetFscLen	M	#ECh	RELI_
#4d	Result status ] Unknown error SWID not available FSC not available Flash read error ok ]	M	#XXh [ #FFh, #FEh, #F6h, #DFh, #00h, ]	RELI_
#5d	FSClen Highbyte		#XXh	
#6d	FSClen Lowbyte		#XXh	
#7d	MXBL Highbyte		#00h	
#8d	MXBL Lowbyte		#C8h	
#9d	CALL_ID Highbyte		#XXh	
#10d	CALL_ID Lowbyte		#XXh	

Figure I.16.32: Table StartRoutineByLocalIdentifier Positive Response Message

**I.16.14.6 31\_1F\_ED SWT: DisableFSC****General information:**

Disables a stored FSC (not IMOB)

**Formula Section:**

**If(1)** service 31\_1F\_ED is received

**Then(1)**

**#If(2)** NC\_CONF\_DGNC\_31\_1F = 0

**#Then(2)**

send negative response "RequestOutOfRange"

**#Else(2)**

LOC\_FSC\_LEN = 0

**If(3)** Level 3 authorisation was successful

**Then(3)**

LV\_AUTH\_L3\_ENA = 1

**Else(3)**

LV\_AUTH\_L3\_ENA = 0



```

    Endif(3)
    ACTION_SWT_DisableFsc( IN SWID, OUT Result status)
    Send positive response
  #Endif(2)
Endif(1)

```

### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	SWT_DisableFSC	M	#EDh	RELI
#4d	SWID Highword Highbyte	M	#XXh	RELI_
#5d	SWID Highword Lowbyte	M	#XXh	RELI_
#6d	SWID Lowword Highbyte	M	#XXh	RELI_
#7d	SWID Lowword Lowbyte	M	#XXh	RELI_

Figure I.16.33: Table StartRoutineByLocalIdentifier Request Message

### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	SWT_DisableFSC	M	#EDh	RELI_
#4d	Result status ] Unknown Error SWID not available FSC is not available FSC is already disabled No L3 authentication ok ]	M	#XXh [ #FFh, #FEh, #F6h, #F4h, #D9h #00h, ]	RELI_

Figure I.16.34: Table StartRoutineByLocalIdentifier Positive Response Message

### I.16.14.7 31\_1F\_EE SWT: ChkFsc

#### General information:

SWT: Checks the stored FSC (date, swid, Serialnumber(IMOB)/VIN(NON-IMOB), signature)  
A negativ response is only possible by a wrong parameter.

#### Formula Section:

```

If(1)          service 31_1F_EE  is received
Then(1)
  #If(2)          NC_COND_DGNC_31_1F <> 0
  #Then(2)        LOC_FSC_LEN = 0
  #Endif(2)

```

If(2) Level 3 authorisation was sucessfull

```

Then(2)
  LV_AUTH_L3_ENA =          1

```

```

Else(2)
    LV_AUTH_L3_ENA = 0
Endif(2)
ACTION_SWT_ChkFsc(IN SWID, OUT Result status);
If(2) Result status = "still in work"
Then(2)
    Init 78h response every 10ms
Else(2)
    If(3) Result status != "Message RcvFSC not received"
    Then(3)
        send positive response
    Else(3)
        send negative response "subfunction not supported" (0x12)
    Endif(3)
Endif(2)
Endif(1)

```

*/\* at every 10ms if 78h response is active \*/*

```

If(1)          78h response is active
Then(1)
    If(2)      Level 3 authorisation was sucessfull
    Then(2)
        LV_AUTH_L3_ENA =          1
    Else(2)
        LV_AUTH_L3_ENA = 0
    Endif(2)
    ACTION_SWT_ChkFsc(IN SWID, OUT Result status);
    If(2) Result status = "still in work"
    Then(2)
        Do nothing
    Else(2)
        stop 78h response
        If(3) Result status != "Message RcvFSC not received"
        Then(3)
            send positive response
        Else(3)
            send negative response "subfunction not supported" (0x12)
        Endif(3)
    Endif(2)
#Endif(1)

```

### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	routineLocalIdentifier = ask for check FSC	M	#EEh	RELI
#4d	routineLocalIdentifier = SWID high_word_high_byte (SWT)	M	#XXh	RELI
#5d	routineLocalIdentifier = SWID high_word_low_byte (SWT)	M	#XXh	RELI
#6d	routineLocalIdentifier = SWID low_word_high_byte (SWT)	M	#XXh	RELI
#7d	routineLocalIdentifier = SWID low_word_low_byte (SWT)	M	#XXh	RELI

Figure I.16.35: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	routineLocalIdentifier = ChkFCS	M	#EEh	RELI_
#4d	routineLocalIdentifier = result ] Unknown error SWID not available SWID check faisure Signature invalid FSC not available FSC rejected FSC cancelled Flash read error VIN checked failed No L3 authentication VIN can not be found in ECU ok ]	M	#XXh [ #FFh, #FEh #FCh #F9h #F6h, #F5h, #F4h, #DFh, #DEh, #D9h, #D2h, #00h, ]	RELI_

Figure I.16.36: Table StartRoutineByLocalIdentifier Positive Response Message

**I.16.14.8 31\_1F\_F1 SWT: RcvFsc****General information:**

SWT: Transfer data of FSC to ECU. FSC will be stored in EEPROM for all non-IMOB SWIDs.  
A negativ response is only possible by a wrong parameter.

**Formula Section:**

**If(1)** service 31\_1F\_F1 is received

**Then(1)**

**#If(2)** NC\_COND\_DGNC\_31\_1F <> 0

**#Then(2)** LOC\_FSC\_LEN = 0

**#Endif(2)**

**ACTION\_SWT\_CallidToSwid( INCALLID, OUT TMP\_SWID)**

**If(2)** Level 3 authorisation was sucessfull

**Then(2)**

LV\_AUTH\_L3\_ENA = 1

**Else(2)**

```

        LV_AUTH_L3_ENA = 0
    Endif(2)
    ACTION_SWT_RcvFsc
        (IN TMP_SWID,*FSC[x], IN received message length - 6, OUTResult status)
    If(2)      Result status= "SWID not available"
    Then(2)
        Result status="Wrong Parameter"
    Endif(2)
    If(2)      Result status = "still in work"
    Then(2)
        Init 78h response every 10ms
    Else(2)
        send positive response
    Endif(2)
Endif(1)

```

*/\* at every 10ms if 78h response is active \*/*

```

If(1)      78h response is active
Then(1)
    #If(2)      NC_COND_DGNC_31_1F <> 0
    #Then(2)      LOC_FSC_LEN = 0
    #Endif(2)
    ACTION_SWT_CallidToSwid( IN callid, OUT TMP_SWID)
    If(2)      Level 3 authorisation was sucessfull
    Then(2)
        LV_AUTH_L3_ENA = 1
    Else(2)
        LV_AUTH_L3_ENA = 0
    Endif(2)
    ACTION_SWT_RcvFsc
        (IN TMP_SWID,*FSC[x], IN received message length - 6, OUTResult status)
    If(2)      Result status= "SWID not available"
    Then(2)      Result status="Wrong Parameter"
    Endif(2)
    If(2)      Result status = "still in work"
    Then(2)
        Do nothing
    Else(2)
        stop 78h response
        send positive response
    Endif(2)
Endif(1)

```

## StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	routineLocalIdentifier = ask for store FSC to ECU	M	#F1h	RELI
#4d	routineLocalIdentifier = Telegramm number ] Telegramm 1 Telegramm xx ]	M	#XXh [ #01h, #xxh, ]	RELI
#5d	routineLocalIdentifier = CALLID high_byte (SWT)	M	#XXh	RELI
#6d	routineLocalIdentifier = CALLID low_byte (SWT)	M	#XXh	RELI
#7d-Xd	routineLocalIdentifier = FSC[X]	M	#XXh	RELI

Figure I.16.37: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	routineLocalIdentifier = ask for length of GXMODN	M	#F1h	RELI_
#4d	routineLocalIdentifier = Result status ] Unknown error Invalid FSC Date Flash write error No L3 authentication Wrong Parameter No free space storing FSC Parser structure wrong ok ]	M	#XXh [ #FFh, #F8h, #E0h, #D9h, #D6h, #D3h, #D1h, #00h, ]	RELI_
#5d	routineLocalIdentifier = Telegramm number ] Telegramm 1 Telegramm xx ]	M	#XXh [ #01h, #xxh, ]	RELI_

Figure I.16.38: Table StartRoutineByLocalIdentifier Positive Response Message

**I.16.14.9 31\_1F\_F2 SWT: SetFscLen****General information:**

IMMO: Transfer length of FSC (FreiSchaltCode) to ECU

A negativ response is only possible by a wrong parameter.

The Software ID (SWID) is a 32 bit data type which contains 4 8bit fields. The CALL ID is a 16 bit short format used by KWP which is generated by 2 of the 4 SWID 8bit fields.

	<i>FSC function</i>	<i>16 bit CALLID</i>	<i>32 bit SWID</i>
	CALLID_IMOB_DME1 / SWID_IMOB_DME1	Highbyte #1: 0x07 Lowbyte #0: 0x40	AppNr Highbyte #3: 0x00 AppNr Lowbyte #2: <b>0x07</b> Upgr Idx Highbyte #1: <b>0x40</b> Upgr idx DA #0 : 0x00
	CALLID_IMOB_DME2 / SWID_IMOB_DME2	Highbyte #1: 0x09 Lowbyte #0: 0x12	AppNr Highbyte #3: 0x00 AppNr Lowbyte #2: <b>0x09</b> Upgr Idx Highbyte #1: <b>0x12</b> Upgr idx DA#0 : 0x00

**Formula Section:**

**If(1)** service 31\_1F\_F2 is received

**Then(1)**

**#If(2)** NC\_COND\_DGNC\_31\_1F <> 0

**#Then(2)** LOC\_FSC\_LEN = 0

**#Endif(2)**

**If(2)** ((SWID == SWID\_IMOB\_DME1) or (SWID == SWID\_IMOB\_DME2))

**Then(2)** Disable Monitoring Unit /\* Disable MU only for Immobilizer FSC \*/

**Else(2)**

**Endif(2)**

**ACTION\_SWT\_SwidToCallid**( INSWID, OUT CALLID)

**ACTION\_SWT\_SetFscLen**(IN SWID,IN FSC length, OUT Result status)

max. Block length = 5Eh /\* so 3 segments will be delivered for a 268 byte FSC\*/

Send positive response

**Endif(1)**

**StartRoutineByLocalIdentifier Request**

<i>Data Byte</i>	<i>Parameter Name</i>	<i>Cvt</i>	<i>Hex Value</i>	<i>Mnemonic</i>
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	routineLocalIdentifier = ask for FSC length	M	#F2h	RELI
#4d	routineLocalIdentifier = SWID(highword, highbyte) 1)	M	#XXh	RELI
#5d	routineLocalIdentifier = SWID(highword, lowbyte) 1)	M	#XXh	RELI
#6d	routineLocalIdentifier = SWID(lowword, highbyte) 1)	M	#XXh	RELI
#7d	routineLocalIdentifier = SWID(lowword, lowbyte) 1)	M	#XXh	RELI
#8d	routineLocalIdentifier FSC length (high byte) 1)	M	#XXh	RELI
#9d	routineLocalIdentifier FSC length (low byte) 1)	M	#XXh	RELI

Figure I.16.39: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	SWT_SetFscLen	M	#F2h	RELI_
#4d	routineLocalIdentifier = result ] Unknown error SWID not available No L3 authentication Wrong parameter No free space for storing FSC ok ]	M	#XXh [ #FFh, #FEh, #D9h, #D6h, #D3h, #00h, ]	RELI_
#5d	routineLocalIdentifier = max. Block length (high byte)	M	#00h	RELI_
#6d	routineLocalIdentifier = max. Block length (low byte)	M	#5Eh	RELI_
#7d	routineLocalIdentifier = CALLID high_byte (SWT)	M	#XXh	RELI_
#8d	routineLocalIdentifier = CALLID low_byte (SWT)	M	#XXh	RELI_

Figure I.16.40: Table StartRoutineByLocalIdentifier Positive Response Message

### I.16.14.10 31\_1F\_F6 SWT: GetStatus

#### General information:

A request returns all known SWIDs and its status (stored,active,disabled,denied)

#### Formula Section:

**If(1)** service 31\_1F\_F6 is received

**Then(1)**

**#If(2)** NC\_CONF\_DGNC\_31\_1F = 0

**#Then(2)**

send negative response "RequestOutOfRange"

**#Else(2)**

LOC\_FSC\_LEN = 0

TMP\_FLAG = 0

**ACTION\_SWT\_GetSoftwareIdFunc**

( OUT tmp\_no\_of\_swids,OUT tmp\_swid\_buffer, OUT result status 1)

**If(3)** (result status 1 = " Processing successfully")

**Then(3)**

**For** TMP\_U8 =0 **to** TMP\_NO\_OF\_SWIDS, TMP\_U8++

**do**

**ACTION\_SWT\_GetStatus**

(IN TMP\_SWID /\* from tmp\_swid\_buffer[TMP\_U8] \*/,  
OUT TMP\_STATUS, OUT result status 2)

**If** (result status 2 = " Processing successfully")

**Then** TMP\_FLAG = 1

**Endif**

kwp message #8d+TMP\_U8\*6 .. #11d+TMP\_U8\*6= TMP\_SWID

kwp message #12d +TMP\_U8\*6= 0x00

kwp message #13d+TMP\_U8\*6 = TMP\_STATUS

**Endfor**

**Endif(3)**

**If(3)** (TMP\_FLAG = 1)

```

    Then(3) kwp message #4d = "ok"
    Else(3) kwp message #4d = "Unknown error"
    Endif(3)
    Send postive response
  #Endif(2)
Endif(1)

```

### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	SWT_GetStatus	M	#F6h	RELI

Figure I.16.41: Table StartRoutineByLocalIdentifier Request Message

### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	SWT_GetStatus	M	#F6h	RELI_
#4d	Result status ] Unknown error ok ]	M	#XXh [ #FFh, #00h, ]	RELI_
#5d	RootCertStatus	M	#00h	RELI_
#6d	SigSCertStatus	M	#00h	RELI_
#7d	SWSigStatus	M	#02h	RELI_
#8d	First SWID Highword Highbyte	M	#XXh	RELI_
#9d	First SWID Highword Lowbyte	M	#XXh	RELI_
#10d	First SWID Lowword Highbyte	M	#XXh	RELI_
#11d	First SWID Lowword Lowbyte	M	#XXh	RELI_
#12d	First FSCSCertStatus	M	#00h	RELI_
#13d	First FSC Status SWID	M	#XXh	RELI_
...	...	...	...	...
#xxd	Last FSC Status SWID	M	#XXh	RELI_

Figure I.16.42: Table StartRoutineByLocalIdentifier Positive Response Message Hint: If no SWID is known the length of positive response is #7d


### I.16.14.11 31\_1F\_F8 SWT: GetSoftwareId

#### General information:

The request returns all known SWIDs without adress of the ECU, independend if active, disabled, or inactive.

#### Formula Section:

If(1) service 31\_1F\_F8 is received

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**Then(1)****#If(2)** NC\_CONF\_DGNC\_31\_1F = 0**#Then(2)**

send negative response "RequestOutOfRange"

**#Else(2)**

LOC\_FSC\_LEN = 0

**ACTION\_SWT\_GetSwidFunc**

(OUTNUMBER\_OF\_SWID, OUT SWID[], OUT Result status)

Send positive response

**#Endif(2)****Endif(1)****StartRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	GetSoftwareId	M	#F8h	RELI

Figure I.16.43: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	GetSoftwareId	M	#F8h	RELI_
#4d	Result status ] Unknown error ok ]	M	#XXh [ #FFh, #00h, ]	RELI_
#5d	First SWID Highword Highbyte	M	#XXh	RELI_
#6d	First SWID Highword Lowbyte	M	#XXh	RELI_
#7d	First SWID Lowword Highbyte	M	#XXh	RELI_
#8d	First SWID Lowword Lowbyte	M	#XXh	RELI_
...	...	...	...	...
#xxd	Last SWID Lowword Lowbyte	M	#XXh	RELI_

Figure I.16.44: Table StartRoutineByLocalIdentifier Positive Response Message Hint: If NUMBER\_OF\_SWID = 0 then the length of positive response is only #4d

**I.16.14.12 31\_1F\_F9 SWT: GetSoftwareIdFunc****General information:**

A request returns all known SWIDs of the ECU, independent if active, disabled, or inactive. The ECU adress is also delivered.

**Formula Section:****If(1)** service 31\_1F\_F9 is received**Then(1)****#If(2)** NC\_CONF\_DGNC\_31\_1F = 0

```

#Then(2)
    send negative response "RequestOutOfRange"
#Else(2)
    LOC_FSC_LEN = 0
    ACTION_SWT_GetSwidFunc
        ( OUTNUMBER_OF_SWID, OUT SWID[], OUT Result status)
    send positive response
#Endif(2)
Endif(1)

```

### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	GetSoftwareIdFunc	M	#F9h	RELI

Figure I.16.45: Table StartRoutineByLocalIdentifier Request Message

### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	GetSoftwareIdFunc	M	#F9h	RELI_
#4d	Result status ] Unknown Error ok ]	M	#XXh [ #FFh, #00h, ]	RELI_
#5d	Address ECU	M	#12h	RELI_
#6d	First SWID Highword Highbyte	M	#XXh	RELI_
#7d	First SWID Highword Lowbyte	M	#XXh	RELI_
#8d	First SWID Lowword Highbyte	M	#XXh	RELI_
#9d	First SWID Lowword Lowbyte	M	#XXh	RELI_
...	...	...	...	...
#xxd	Last SWID Lowword Lowbyte	M	#XXh	RELI_

Figure I.16.46: Table StartRoutineByLocalIdentifier Positive Response Message Hint: If NUMBER\_OF\_SWID = 0 then the length of positive response is only #5d

## I.16.15 31\_25 switch off Injection valves

### General information:

With this command the Injection valves can be switched off. The general function is described in the chapter Injection - Cylinder shut off .

### Special Application conditions:

**Initialisation:** at reset with 00h

**Activation:** LV\_IGK=1 (Kl.15 on) and  
 STATE\_ENG=02h or 03h (IS or PL) and  
 N<C\_N\_MAX\_KWP

**Deactivation:** LV\_IGK=0 (Kl.15 off) or  
 STATE\_ENG<>02h or 03h (IS or PL) or  
 N>=C\_N\_MAX\_KWP or  
 Diagnostic timeout  
 set INH\_IV\_KWP=00h

**Service location:** see list of implemented diagnostic services

#### Formula section:

**IF** activation conditions are fulfilled and  
 service 31\_25 is received

**THEN** INH\_IV\_KWP = sent to the module Cylinder shut off  
 send positive response

**ELSE** INH\_IV\_KWP=00h  
 send negative response

**ENDIF**

#### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= shut off request for cylinder x	M	#25h	RELI_
#3d	routineEntryOption = active	M	#01h	REYO_
#4d	routineEntryOption = INH_IV_KWP	M	#XXh	REYO_

Figure I.16.47: Table StartRoutineByLocalIdentifier Request Message

#### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = shut off request for cylinder x	M	#25h	RELI_
#3d	routineEntryStatus = active	M	#01h	REYS_01


Figure I.16.48: Table StartRoutineByLocalIdentifier Positive Response Message

#### StartRoutineByLocalIdentifier negative Response

Global Negative Responses

### I.16.16 31\_2B Ruhestrom steuern

#### General information:

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With this command "Ansteuern Ruhestromprüfung mit IBS" is started.  
Hint: Reset of B\_ecojob1/2 is normally done in BMW-module.

### Additional Application conditions:

Set in case of Deactivation : B\_ecojob1=0, B\_ecojob2 = 0

### Formula section:

```

If          service 31_2B is received
Then       Eco_.. = received values
              B_ecojob1 = 1
              send positive response
Else
              send negative response
Endif

```

### **StartRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= Ruhestrom_steuern	M	#2Bh	RELI_RUHE STROM
#3d	routineLocalIdentifier = set Eco_max_i	M	#XXh	REYO_I_MA X
#4d	routineLocalIdentifier = set Eco_msb	M	#XXh	REYO_MSB
#5d	routineLocalIdentifier = set Eco_mz	M	#XXh	REYO_MZ
#6d	routineLocalIdentifier = set Eco_timo	M	#XXh	REYO_TO

Figure I.16.49: Table StartRoutineByLocalIdentifier Request Message

### **StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = Ruhestrom steuern x	M	#2Bh	RELI_RUHE STROM

Figure I.16.50: Table StartRoutineByLocalIdentifier Positive Response Message

### **StartRoutineByLocalIdentifier negative Response**

Global Negative Responses


## **I.16.17 31\_2E Starten Nullgang-Lernen**

### General information:

With this command "Nullgang-Lernen" is started.

### Application conditions

**Initialisation:** *at reset with 00h*

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**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off) **or** Diagnostic timeout  
set: B\_nglern=0

**Service location:** see list of implemented diagnostic services

### Formula section:

**If** service 31\_2E is received  
**Then** B\_nglern = 1 for 2 sec  
Tvneutrin = 0.0  
send positive response  
**Endif**

### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= Ruhestrom_steuern	M	#2Eh	RELI_NGL

Figure I.16.51: Table StartRoutineByLocalIdentifier Request Message

### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = Ruhestrom steuern x	M	#2Eh	RELI_NGL

Figure I.16.52: Table StartRoutineByLocalIdentifier Positive Response Message

### StartRoutineByLocalIdentifier negative Response

Global Negative Responses

## I.16.18 31\_2F Starten Desulfatisierung Fahrbetrieb

### General information:

With this command "Desulfatisierung Fahrbetrieb" is started.

### Application conditions

**Initialisation:** at reset with 00h

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off) **or** Diagnostic timeout

**Service location:** see list of implemented diagnostic services

**Formula section:**

```

If           service 31_2F is received
Then        call ACTION_NOXM_StartCatHeatDesu()
                send positive response
Endif

```

**StartRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= Start Desulfatisierung Fahrbetrieb	M	#2Eh	RELI_DESF AHR

Figure I.16.53: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = Start Desulfatisierung Fahrbetrieb	M	#2Eh	RELI_DESF AHR

Figure I.16.54: Table StartRoutineByLocalIdentifier Positive Response Message

**StartRoutineByLocalIdentifier negative Response**

Global Negative Responses

**I.16.19 31\_30 delete selective adaption values****General information:**

With this comand the adaption values described in the chapter basic sw general operation -initialize non volatile datas are deleted.

All adaption values are initialized with their default values (compare detailed specifications), single adaption values according to the bit position.

If bit #4 within byte 4d ist masked (set to 1) by the tester, bit LV\_POW\_MNG\_BAT\_CHG is set to 1; after 5s LV\_POW\_MNG\_BAT\_CHG is automatically reset by the ECU to 0 again.

Within the telegram some macros are called (named with small letter below). This macros call functions over BMW- layer (see also layer- specification).

**Special Application conditions:**

**Initialisation:** at reset init with 0

**Activation:** LV\_IGK = 1 and  
LV\_ES = 1

**Deactivation:** LV\_IGK= 0 and  
LV\_ES = 0  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

**Formula section:**

setting of LV\_POW\_MNG\_BAT\_CHG:

```

IF          bit position #4 in byte #4dset to 1 within tester s request
THEN       set LV_POW_MNG_BAT_CHG to 1 and start timer
ELSE       do nothing
ENDIF

```

```

IF          LV_POW_MNG_BAT_CHG is set to 1 and timer >= 5s
THEN       reset LV_POW_MNG_BAT_CHG to 0
ELSE       do nothing
ENDIF

```

only **MSD80/MSD81**: setting/resetting LV\_CYL\_BAL .../LV\_MFF . / LV\_HPP\_CTL\_AD\_CLR\_EXT\_REQ:

```

IF          bit position is set to 1 with tester s request
THEN       set request bit
ELSE       do nothing

```

```

IF          request bit is 1 and init of corresponding values is done
THEN       reset request bit 100..200ms later
ELSE       do nothing

```


request bit	corresponding values	init value:
LV_CRK_CYL_LAM_DELTA_RST_LS_EXT[NC_CBK_EX_NR]	DELTA_CRK_CYL_LAM[NC_CBK_EX_NR]	0.0
	CRK_CYL_LAM_DELTA_INI[NC_CBK_EX_NR]	0.0
	CTR_PHA_SHIFT_AD_TRIG[NC_CBK_EX_NR]	0
LV_CTR_CYL_BAL_RST_EXT	CTR_ERR_OBD_DIAG_CYL_BAL_LAM[NC_CBK_EX_NR]	0
	CTR_ERR_OBD_DIAG_CYL_BAL_ER	0
LV_CYL_BAL_AD_EOL_EXT_ADJ:	LV_CYL_BAL_LAM_AD_EOL	
	LV_CYL_BAL_ER_AD_ADD_EOL	0
	LV_CYL_BAL_ER_AD_FAC_EOL	0
	LV_CYL_BAL_LAM_SEL_AD_COLD_EOL	0
	LV_CYL_BAL_LAM_SEL_AD_HOT_EOL	0
LV_CYL_BAL_AD_DC_EXT_ADJ:	LV_CYL_BAL_LAM_AD_DC,	0
	LV_CYL_BAL_AD_HOM_REQ_DC	0
	LV_CYL_BAL_LAM_SEL_AD_HOT_DC	0
	LV_CYL_BAL_AD_WG_OPEN_REQ[NC_CBK_EX_NR]	0
LV_LAM_CYL_SEL_ADJ_RST_IV_EXT[NC_CBK_EX_NR]	FAC_LAM_CYL_SEL_ADJ_L_RNG[NC_CYL_NR]	0.0
	FAC_LAM_CYL_SEL_ADJ_H_RNG[NC_CYL_NR]	0.0
	FAC_LAM_CYL_SEL_ADJ_CST[NC_CYL_NR]	0.0
	MFF_ADD_CYL_LAM_COR[NC_CYL_NR]	0.0
	STATE_LAMB_CYL_SEL_CQ_SLOP[NC_CBK_EX_NR]	0
	LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[NC_CBK_EX_NR]	0
	LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[NC_CBK_EX_NR]	0
LV_MFF_FAC_AD_ER_BAL_EXT_ADJ:	FAC_TI_AD_ER_BAL[NC_CYL_NR]	1.00
LV_MFF_ADD_AD_ER_BAL_EXT_ADJ:	MFF_ADD_AD_ER_BAL [NC_CYL_NR]	0.00
LV_HPP_CTL_AD_CLR_EXT_REQ:	all adaptation values in like init	

"High pressure pump control"

for

NVRAM

( 02904B01.xxx )

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### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= erase adaptive values	M	#30h	RELI
#3d	RoutineEntryStatus#1	M	#XXh	REYO_01
#4d	RoutineEntryStatus#2	M	#XXh	REYO_02
#5d	RoutineEntryStatus#3	M	#XXh	REYO_03

Figure I.16.55: Table StartRoutineByLocalIdentifier Request Message

### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier	M	#30h	RELI_AD
#3d	RoutineEntryStatus#1	M	#XXh	REYO_01
#4d	RoutineEntryStatus#2	M	#XXh	REYO_02
#5d	RoutineEntryStatus#3	M	#XXh	REYO_03

Figure I.16.56: Table StartRoutineByLocalIdentifier Positive Response Message

### StartRoutineByLocalIdentifier negative Response

Global Negative Responses



Bit Position	Name RoutineEntryStatus#1	Mnemonic
#0	idle speed LC_AD_CLR_N_SP_IS and LC_AD_CLR_IDLE	REYO_01
#1	knock control kr_clrad()	REYO_01
#2	lambda LC_AD_CLR_EGCP and (not MSD8x) LC_AD_CLR_LAM	REYO_01
#3	canister purge LC_AD_CLR_CPS	REYO_01
#4	mass flows to intake manifold eisy_clrad() and LC_AD_CLR_INSY and LC_AD_CLR_IMM	REYO_01
#5	throttle position sensor (not MSD85) LC_AD_CLR_TPS (only MSD85) LC_AD_CLR_THRO	REYO_01
#6	LACO adaptation: klann_clrad() and (not MSV80) LC_AD_CLR_LACO:	REYO_01
#7	MSD8x: ACRC adaptation LC_AD_CLR_EGR	REYO_01
Bit Position	Name RoutineEntryStatus#2	Mnemonic
#0	load control ls_clrad()	REYO_01
#1	MSD80/81: new Nox-sensor ACTION_NOXD_CleanAdDataNS(OUT <trig_CLR_AD>) ACTION_NOXD_CleanNSAdapt() ACTION_NOXD_CleanNSShiftAdapt() ACTION_NOXD_CleanMMVNSAdapt()	REYO_02
#2	not MSD8x: secondary air LC_AD_CLR_SA	REYO_02
#3	MSD8x: VCV adaptation LV_HPP_CTL_AD_CLR_EXT_REQ	REYO_02
#4	battery change LV_POW_MNG_BAT_CHG	REYO_02
#5	RON-adaption LC_AD_CLR_RON	REYO_02
#6	adapted variants LC_AD_CLR_VAR	REYO_02
#7	not MSD8x: VVL-adaption LC_AD_CLR_VVL_STATE_NVMY	REYO_02
Bit Position	Name RoutineEntryStatus#3	Mnemonic
#0	IVVT LC_AD_CLR_ENSD and vns_clrad()	REYO_03
#1	missfire LC_AD_CLR_ENRD	REYO_03
#2	only MSV80: burn control vbr_clrad()	REYO_03
#3	only MSD8x: cyl. balancing for DC and EOL: LV_CYL_BAL_AD_EOL_EXT_ADJ and LV_CYL_BAL_AD_DC_EXT_ADJ	REYO_03
#4	only MSD8x: ER-adaptation (faktor / add) and cylinder individuel lambda adaption values LV_MFF_FAC_AD_ER_BAL_EXT_ADJ and LV_MFF_ADD_AD_ER_BAL_EXT_ADJ and LV_LAM_CYL_SEL_ADJ_RST_IV_EXT[NC_CBK_EX_NR] and LV_CTR_CYL_BAL_RST_EXT	REYO_03
#5	only MSD8x: phase shift adaptation, bank 1 LV_CRK_CYL_LAM_DELTA_RST_LS_EXT[1]	REYO_03
#6	only MSD8x: phase shift adaptation, bank 2 LV_CRK_CYL_LAM_DELTA_RST_LS_EXT[2]	REYO_03
#7	only MSD8x: injector needle lift control ACTION_INJR_SetFacEgyPwmAd (IN <Cyl>, IN <Fac>) for all <Cyl> with <Fac> = C_FAC_EGY_PWM_MAN[Cyl]	REYO_03


Figure I.16.57: Table StartRoutineByLocalIdentifier Bit meaning

Refer the spec.on Non Volatile Data latest spec. xx000501 for deleting the variants.

## I.16.20 31\_31 delete selective adaption values 2

### General information:

With this comand the adaption values 2 in BMW-software are initialized with their default values.

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7521 of 8404	
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**Special Application conditions:**

**Initialisation:** at reset or in case of deactivation init with 0

**Activation:** LV\_IGK = 1 (Kl.15 on) **and**  
LV\_ES = 1

**Deactivation:** LV\_IGK= 0 (Kl.15 off) **or**  
LV\_ES = 0  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

**Formula section:**

**IF** bit position#0 in byte#3d is set to 1 with tester s request  
**THEN** do nothing

**ENDIF**

**IF** bit position#1 in byte#3d is set to 1 with tester s request  
**THEN** LV\_AD\_CLR\_LONG\_LAM\_EXT\_ADJ[1] = 1 for 2sec.

**ENDIF**

**IF** bit position#2 in byte#3d is set to 1 with tester s request  
**THEN** LV\_AD\_CLR\_LONG\_LAM\_EXT\_ADJ[2] = 1 for 2sec.

**ENDIF**

**IF** bit position#3 in byte#3d is set to 1 with tester s request  
**THEN** LV\_EFP\_CTL\_AD\_CLR\_EXT\_REQ = 1 for 2sec.

**ENDIF**

**IF** bit position#4 in byte#3d is set to 1 with tester s request  
**THEN** LV\_CTR\_TPS\_JAM\_DET\_ACT\_EXT\_ADJ = 1 for 2sec.

**ENDIF**

**IF** bit position#5 in byte#3d is set to 1 with tester s request  
**THEN** LV\_LAM\_CYL\_SEL\_ADJ\_RST\_IV\_EXT[1]= 1 for 2sec.

**ENDIF**

**IF** bit position#6 in byte#3d is set to 1 with tester s request  
**THEN** LV\_LAM\_CYL\_SEL\_ADJ\_RST\_IV\_EXT[2]= 1 for 2sec.

**ENDIF**

**IF** bit position#7 in byte#3d is set to 1 with tester s request  
**THEN** call ACTION\_MFMA\_SetEnableCondition(1),  
LV\_LAM\_AD\_INJ\_CLR\_AD\_EXT = 1 for 2sec.

**ENDIF**

Hint: The result of call ACTION\_MFMA\_SetEnableCondition(1), is visible with LV\_LAM\_AD\_INJ\_EXT\_ENA

**IF** bit position#6 in byte#4d is set to 1 with tester s request  
**THEN** LV\_TQ\_LOSS\_AD\_CLR\_EXT\_ADJ = 1 for 2sec

**ENDIF**

**IF** bit position#7 in byte#4d is set to 1 with tester s request  
**THEN** B\_lvs\_neustart = 1 /\* Hint: reset of B\_lvs\_neustart to 0 is done in BMW-software \*/

**ENDIF**

**IF** bit position#5 in byte#4d is set to 1 with tester s request  
**THEN** call ACTION\_NOXM\_CleanNTAdaptSul ()  
call ACTION\_NOXM\_CleanNTAdaptAgi()  
call ACTION\_NOXM\_CleanNTAdaptAgiMdl()

**ENDIF**

```

IF          bit position#4 in byte#4d is set to 1 with tester s request
THEN       call ACTION_EXTD_InitNTEgyStop()
Hint:      After call of ACTION_EXTD_InitNTEgyStop() is
           EGY_DEW_NT_STOP = C_EGY_DEW_NT_STOP
ENDIF

```

```

IF          bit position#3 in byte#4d is set to 1 with tester s request
THEN       LV_FAC_ER_BAL_HOM_EXT_ADJ_KWP = 1 for 2 sec
ENDIF

```

```

IF          bit position#2 in byte#4d is set to 1 with tester s request
THEN       CTR_MIS_DET_CYL[NC_CYL_NR] = 0
ENDIF

```

```

IF          bit position #1 in byte #4d set to 1 within tester s request
THEN       set LV_RON_STC_CLR_KWP =1 for 5sec
ELSE       do nothing
ENDIF

```

```

For        other bits with value "1" in request byte#3d..#5d
do         nothing

```

#### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= erase adaptive values 2	M	#31h	RELI
#3d	RoutineEntryStatus#1	M	#XXh	REYO_01
#4d	RoutineEntryStatus#2	M	#XXh	REYO_02
#5d	RoutineEntryStatus#3	M	#XXh	REYO_03

Figure I.16.58: Table StartRoutineByLocalIdentifier Request Message

#### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier	M	#31h	RELI_AD
#3d	RoutineEntryStatus#1	M	#XXh	REYO_01
#4d	RoutineEntryStatus#2	M	#XXh	REYO_02
#5d	RoutineEntryStatus#3	M	#XXh	REYO_03

Figure I.16.59: Table StartRoutineByLocalIdentifier Positive Response Message

Bit Position	Name RoutineEntryStatus#1	Mnemonic
#0	not used	REYO_01
#1	Long Term Lambda Adaptation: LV_AD_CLR_LONG_LAM_EXT_ADJ[1]	REYO_01
#2	Long Term Lambda Adaptation: LV_AD_CLR_LONG_LAM_EXT_ADJ[2]	REYO_01
#3	EKP- AdaptationLV_EFP_CTL_AD_CLR_EXT_REQ	REYO_01
#4	Adaption Jitterfunktion Drosselklappe LV_CTR_TPS_JAM_DET_ACT_EXT_ADJ	REYO_01
#5	<b>only MSD80/MSD81:</b> LV_LAM_CYL_SEL_ADJ_RST_IV_EXT[1]	REYO_01
#6	<b>only MSD80/MSD81:</b> LV_LAM_CYL_SEL_ADJ_RST_IV_EXT[2]	REYO_01
#7	<b>only MSD80/MSD81:</b> Kleinstmengenadaptation: LV_LAM_AD_INJ_CLR_AD_EXT and call ACTION_MFMA_SetEnableCondition(1)	REYO_01
Bit Position	Name RoutineEntryStatus#2	Mnemonic
#0	not used	REYO_01
#1	Kraftstoffqualitätserfassung: LV_RON_STC_CLR_KWP	REYO_02
#2	Zähler der Verbrennungsaussetzenerkennung CTR_MIS_DET_CYL[NC_CYL_NR]	REYO_02
#3	<b>only MSD85:</b> Reset Zylinder Gleichstellung Homogen: LV_FAC_ER_BAL_HOM_EXT_ADJ_KWP	REYO_02
#4	<b>only MSD80/81 (6cyl):</b> Adaption Taupunkt NOX-Sensor zurücksetzen ACTION_EXTD_InitNTEgyStop()	REYO_02
#5	<b>MSD80/MSD81:</b> new NOx-Catalyst ACTION_NOXM_CleanNTAdaptSul(void) ACTION_NOXM_CleanNTAdaptAgi(void) ACTION_NOXM_CleanNTAdaptAgiMdl(void)	REYO_02
#6	Verlustmomentadaption löschen: LV_TQ_LOSS_AD_CLR_EXT_ADJ	REYO_02
#7	<b>only MSD80:</b> Restart Laufruheverbesserung: B_lvs_neustart	REYO_02
Bit Position	Name RoutineEntryStatus#3	Mnemonic
#0	not used	REYO_03
#1	not used	REYO_03
#2	not used	REYO_03
#3	not used	REYO_03
#4	not used	REYO_03
#5	not used	REYO_03
#6	not used	REYO_03
#7	not used	REYO_03

Figure I.16.60: Table StartRoutineByLocalIdentifier Bit meaning

**StartRoutineByLocalIdentifier negative Response**


## Global Negative Responses

**I.16.21 31\_34 Ansteuern Zylinder Gleichstellung Homogen****General information:**

With this service the function "Zylinder Gleichstellung Homogen" is started. The start is only possible in case of cleared adaptation values for cylinder balancing.

**Additional Application conditions:****Initialisation at reset or at LV\_IGK 1-> 0 :**

$$LV\_ER\_BAL\_HOM\_RNG\_IS\_ENA\_KWP = 0$$
**Formula section:**

Released by Tettenborn Frank		Date 2013-02-13	File 6XI00N02.00C
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7524 of 8404	
Regensburg (RGB)		Copyright ( C ) Continental AG,2007	A4: 2007-11

```

If(1)      service 31_34 is received

      Then(1)
        If(2)      whole array FAC_COR_AD_RNG_H_ER_BAL_HOM[NC_CYL_NR] =
0
          and
            whole array FAC_COR_AD_RNG_IS_ER_BAL_HOM[NC_CYL_NR] = 0
          and
            whole array FAC_COR_AD_RNG_L_ER_BAL_HOM[NC_CYL_NR] = 0

        Then(2)
          LV_ER_BAL_HOM_RNG_IS_ENA_KWP = 1
          send positive response
        Else(2)
          send negative response "conditions not correct"
        Endif(2)
      Endif(1)
    
```

### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= switch off Lambda controller	M	#34h	RELI_ZGH

Figure I.16.61: Table StartRoutineByLocalIdentifier Request Message

### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIDValues	M	#34h	RELI_ZGH

Figure I.16.62: Table StartRoutineByLocalIdentifier Positive Response Message

### StartRoutineByLocalIdentifier negative Response

Global Negative Responses

## I.16.22 31\_3A Start CSERS-Diagnose

### General information:

This Services handles the Cold Start Emission Reduction Strategy (CSERS) Diagnose

### Additional Application conditions:

#### **Initialisation at LV\_IGK= 0 and at diagnostic timeout:**

```

LV_CH_DIAG_EXT_REQ = 0
EFF_IGA_CST_LIM_EXT_ADJ = 0.0
FAC_CH_DIAG_EXT_ADJ_IS = 0.0
FAC_CH_DIAG_EXT_ADJ_PL = 0.0
    
```

**Formula section:**

```

If(1)           service 31_3A is received
Then(1)
    EFF_IGA_CST_LIM_EXT_ADJ = received value
    FAC_CH_DIAG_EXT_ADJ_IS = received value
    FAC_CH_DIAG_EXT_ADJ_PL = received value
    LV_CH_DIAG_EXT_REQ = 1
    send positive response
Endif(1)
    
```

**StartRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= Start CSERS-Diagnose	M	#3Ah	STRBLI_
#3d	RoutineControlOption #1 = set EFF_IGA_CST_LIM_EXT_ADJ (High Byte)	M	#XXh	RELI_
#4d	RoutineControlOption #2 = set EFF_IGA_CST_LIM_EXT_ADJ (Low Byte)	M	#XXh	RELI_
#5d	RoutineControlOption #3 = set FAC_CH_DIAG_EXT_ADJ_IS	M	#XXh	RELI_
#6d	RoutineControlOption #3 = set FAC_CH_DIAG_EXT_ADJ_PL	M	#XXh	RELI_

Figure I.16.63: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response Id	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = Start CSERS-Diagnose	M	#3Ah	STRBLI_

Figure I.16.64: Table StartRoutineByLocalIdentifier Positive Response Message

**StartRoutineByLocalIdentifier negative Response**

Global Negative Responses

**I.16.23 31\_D9 switch off Lambda controller ( not MSD80/MSD81)**

**General information:**

With this command the Lambda Controller (bench 1 and 2) can be switched off. The general function is described in the chapter Injection - Lambda Control . The command is available for binary and linear lambda sensor systems.

**Additional Application conditions:**

set LV\_INH\_LAM\_KWP=00h at LV\_IGK = 0 and at diagnostic timeout

**Formula section:**

```

IF           activation conditions are fulfilled           and
                service 31_D9 is received
    
```

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```

THEN          LV_INH_LAM_KWP = sent to the module Lambda Control
              send positive response

ELSE          LV_INH_LAM_KWP remains unchanged
              send negative response

ENDIF

```

### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= switch off Lambda controller	M	#D9h	RELI_
#3d	routineEntryOption = active	M	#01h	REYO_01
#4d	routineEntryOption = LV_INH_LAM_KWP	M	#XXh	

Figure I.16.65: Table StartRoutineByLocalIdentifier Request Message

### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = switch off Lambda controller	M	#D9h	RELI_
#3d	routineEntryStatus = active	M	#01h	REYS_01

Figure I.16.66: Table StartRoutineByLocalIdentifier Positive Response Message

### StartRoutineByLocalIdentifier negative Response

Global Negative Responses

## I.16.24 31\_D9 switch off Lambda controller ( only MSD80/MSD81)

### General information:

With this command the Lambda Controller (bench 1 and 2) can be switched off. The general function is described in the chapter Injection - Lambda Control . The command is available for binary and linear lambda sensor systems.

### Application conditions

**Initialisation:** *at reset with 00h*

**Activation:** LV\_IGK=1 (K1.15 on)

**Deactivation:** LV\_IGK=0 (K1.15 off)  
 Diagnostic timeout  
 set LV\_INH\_LAM\_KWP=00h

**Service location:** see list of implemented diagnostic services

**Formula section:**

```

IF          service 31_D9 is received
THEN       LV_INH_LAM_KWP = 1
ENDIF
    
```

**StartRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= switch off Lambda controller	M	#D9h	RELI_
#3d	routineEntryOption = active	M	#01h	REYO_01
#4d	routineEntryOption = LV_INH_LAM_KWP	M	#XXh	

Figure I.16.67: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = switch off Lambda controller	M	#D9h	RELI_
#3d	routineEntryStatus = active	M	#01h	REYS_01

Figure I.16.68: Table StartRoutineByLocalIdentifier Positive Response Message

**StartRoutineByLocalIdentifier negative Response**

Global Negative Responses

**I.16.25 31\_E1 Ansteuern Eisy- Adaptionswerte (gedrosselt)**

**General information:**

With this service a function in the BMW- object is called (over the layer). The parameters, given from the tester via the below listet telegram, were overgiven to the function.

**Application conditions**

```

Initialisation:          at reset with 00h
Activation:             LV_IGK=1 (Kl.15 on)
Deactivation:          LV_IGK=0 (Kl.15 off)
                               Diagnostic timeout
Service location:      see list of implemented diagnostic
                               services
    
```

**Formula section:**

```

IF          service 31_E1 is received

THEN       call BMW- function with the following parameters:
            void eisymr_read_addk(sint16 Nkw, uint16 Vse_spri, uint16 Vsa_spri,
            Wdk_ist)
    
```

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sint1



ENDIF

### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= switch off Lambda controller	M	#E1h	RELI_EISYGD
#3d	RecordValue#1 = NKW high byte	M	#XXh	REYO_ NKW
#4d	RecordValue#2 = NKW low byte	M	#XXh	REYO_ NKW
#5d	RecordValue#3 = VSE_SPRI high byte	M	#XXh	REYO_ VSE_SPRI
#6d	RecordValue#4 = VSE_SPRI low byte	M	#XXh	REYO_ VSE_SPRI
#7d	RecordValue#5 = VSA_SPRI high byte	M	#XXh	REYO_ VSA_SPRI
#8d	RecordValue#6 = VSA_SPRI low byte	M	#XXh	REYO_ VSA_SPRI
#9d	RecordValue#7 = WDK_IST high byte	M	#XXh	REYO_ WDK_IST
#10d	RecordValue#8 = WDK_IST low byte	M	#XXh	REYO_ WDK_IST

Figure I.16.69: Table StartRoutineByLocalIdentifier Request Message

### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIDValues	M	#E1h	RELI_EISYGD

Figure I.16.70: Table StartRoutineByLocalIdentifier Positive Response Message

### StartRoutineByLocalIdentifier negative Response

Global Negative Responses

## I.16.26 31\_E2 Ansteuern Eisy- Adaptionswerte (gedrosselt mit Abgasrueckfuehrung)

### General information:

With this service a function in the BMW- object is called (over the layer). The parameters, given from the tester via the below listet telegram, were overgiven to the function.

### Application conditions

**Initialisation:** *at reset with 00h*

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off)  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

### Formula section:

IF service 31\_E2 is received

**THEN** call BMW- function with the received parameters:  
**void eisypsr\_read\_ad**(sint16 Nkw, uint16, Vse\_spri, uint16 Vsa\_spri,  
sint16 Wdk\_ist)

**ENDIF**

### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= switch off Lambda controller	M	#E2h	RELI_EISYGDAGR
#3d	RecordValue#1 = NKW high byte	M	#XXh	REYO_NKW
#4d	RecordValue#2 = NKW low byte	M	#XXh	REYO_NKW
#5d	RecordValue#3 = VSE_SPRI high byte	M	#XXh	REYO_VSE_SPRI
#6d	RecordValue#4 = VSE_SPRI low byte	M	#XXh	REYO_VSE_SPRI
#7d	RecordValue#5 = VSA_SPRI high byte	M	#XXh	REYO_VSA_SPRI
#8d	RecordValue#6 = VSA_SPRI low byte	M	#XXh	REYO_VSA_SPRI
#9d	RecordValue#7 = WDK_IST high byte	M	#XXh	REYO_WDK_IST
#10d	RecordValue#7 = WDK_IST low byte	M	#XXh	REYO_WDK_IST

Figure I.16.71: Table StartRoutineByLocalIdentifier Request Message

### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIDValues	M	#E2h	RELI_EISYGDAGR

Figure I.16.72: Table StartRoutineByLocalIdentifier Positive Response Message

### StartRoutineByLocalIdentifier negative Response

Global Negative Responses

## I.16.27 31\_E3 Ansteuern Krann- Adaptionswerte

### General information:

With this service a function in the BMW- object is called (over the layer). The parameters, given from the tester via the below listet telegram, were overgiven to the function.

### Application conditions

**Initialisation:** at reset with 00h

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off)  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

**Formula section:**

```

IF          service 31_E3 is received

THEN       call BMW- function with the following parameters:
              void krann_read_ad (sint16 Nkw, sint16 Rk, sint16 Tans, sint16 Tmot, uint8 Ba)

ENDIF

```

**StartRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= switch off Lambda controller	M	#E3h	RELI_KRANN
#3d	RecordValue#1 = NKW high byte	M	#XXh	REYO_NKW
#4d	RecordValue#2 = NKW low byte	M	#XXh	REYO_NKW
#5d	RecordValue#3 = Rk high byte	M	#XXh	REYO_RK
#6d	RecordValue#4 = Rk low byte	M	#XXh	REYO_RK
#7d	RecordValue#5 = Tans high byte	M	#XXh	REYO_TANS
#8d	RecordValue#5 = Tans low byte	M	#XXh	REYO_TANS
#9d	RecordValue#5 = Tmot high byte	M	#XXh	REYO_TMOT
#10d	RecordValue#5 = Tmot high byte	M	#XXh	REYO_TMOT
#11d	RecordValue#5 = Ba	M	#XXh	REYO_BA

Figure I.16.73: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIDValues	M	#E3h	RELI_KRANN

Figure I.16.74: Table StartRoutineByLocalIdentifier Positive Response Message

**StartRoutineByLocalIdentifier negative Response**

Global Negative Responses

**I.16.28 31\_E4 Ansteuern Klann- Adaptionwerte****General information:**

With this service a function in the BMW- object is called (over the layer). The parameters, given from the tester via the below listet telegram, were overgiven to the function.

**Application conditions****Initialisation:** - -**Activation:** LV\_IGK=1 (Kl.15 on)**Deactivation:** LV\_IGK=0 (Kl.15 off)  
Diagnostic timeout**Service location:** see list of implemented diagnostic services

**Formula section:**

**IF** service 31\_E4 is received

**THEN** call BMW- function with the following parameters:  
**void klann\_read\_ad** (sint16 nkw\_loc, uint16 rk\_loc, sint16 tmot\_loc )

**ENDIF**

**StartRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= switch off Lambda controller	M	#E4h	RELI_KLANN
#3d	RecordValue#1 = nkw_loc high byte	M	#XXh	REYO_NKW_LOC
#4d	RecordValue#2 = nkw_loc low byte	M	#XXh	REYO_NKW_LOC
#5d	RecordValue#3 = rk_loc high byte	M	#XXh	REYO_RK_LOC
#6d	RecordValue#4 = rk_loc low byte	M	#XXh	REYO_RK_LOC
#7d	RecordValue#5 = tmot_loc high byte	M	#XXh	REYO_TMOT_LOC
#8d	RecordValue#5 = tmot_loc low byte	M	#XXh	REYO_TMOT_LOC

Figure I.16.75: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIDValues	M	#E4h	RELI_KLANN

Figure I.16.76: Table StartRoutineByLocalIdentifier Positive Response Message

**StartRoutineByLocalIdentifier negative Response**

Global Negative Responses

**I.16.29 31\_E5 Ansteuern AGR- Adaptionwerte****General information:**

With this service a function in the BMW- object is called (over the layer). The parameter, given from the tester via the below listet telegram, were overgiven to the function.

**Application conditions**

**Initialisation:** - -

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off)  
 Diagnostic timeout

**Service location:** see list of implemented diagnostic services

**Formula section:**

```

IF           service 31_E5 is received

           THEN       call BMW- function with the following parameters:
           void eisagr_read_ad(uint16 Agrpos)

           ENDIF
    
```

**StartRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= switch off Lambda controller	M	#E5h	RELI_EISYAGR
#3d	RecordValue#1 = Agrpos (high byte)	M	#XXh	REYO_AGRPOS
#4d	RecordValue#2 = Agrpos (low byte)	M	#XXh	REYO_AGRPOS

Figure I.16.77: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIDValues	M	#E4h	RELI_EISYAGR

Figure I.16.78: Table StartRoutineByLocalIdentifier Positive Response Message

**StartRoutineByLocalIdentifier negative Response**

Global Negative Responses

**I.16.30 31\_F4 cruise control - delete switch off conditions**

**General information:**

With this comand the values described in the chapter `cruise control` are deleted. All values are initialized with their default values (compare detailed specifications). The deleted values are saved after a powerlatch phase into the non volatile memory.

**Application conditions**

```

Initialisation:           at reset

Activation:              K1.15 on   (LV_IGK=1)

Deactivation:           K1.15 off  (LV_IGK=0)
                             Diagnostic timeout

Service location:       see list of implemented diagnostic
                             services
    
```

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**Formular section:**

service 31\_F4 is received

**IF** LV\_ACT\_CRU\_MEM\_EXT\_ADJ =01h (deleting of CRU-conditions)

**THEN** STATE\_CRU\_OFF\_IRR =00h and  
STATE\_CRU\_OFF\_REV =00h

**ELSE** LV\_ACT\_CRU\_MEM\_EXT\_ADJ =00h

**StartRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= erase adaptive values	M	#F4h	RELI
#3d	RecordValue # 1 = LV_ACT_CRU_MEM_EXT_ADJ	M	#XXh	RV_

Figure I.16.79: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier	M	#30h	RELI_AD
#3d	RecordValue # 1 = LV_ACT_CRU_MEM_EXT_ADJ	M	#XXh	RV_

Figure I.16.80: Table StartRoutineByLocalIdentifier Positive Response Message

**StartRoutineByLocalIdentifier negative Response**

Global Negative Responses

**I.16.31 31\_F5 switch off Idle speed uplift**

**General information:**

This function is for switch off the idle speed uplift via KWP2000(\*).

**Application conditions**

**Initialisation:** at reset with 0

**Activation:** Kl.15 on

**Deactivation:** Kl.15 off  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

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**Formula section:**

```

If           service 31_F5 is requested
Then        LV_ACT_N_SP_IS_BAS_EXT_ADJ = 1
End If
    
```

**StartRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= [ switch off Idle speed uplift ]	M	#XXh= [ #F5h, ]	RELI

Figure I.16.81: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier switch off Idle speed uplift	M	#F5h	RELI_

Figure I.16.82: Table StartRoutineByLocalIdentifier Positive Response Message

**StartRoutineByLocalIdentifier negative Response**

Global Negative Responses

**I.16.32 31\_F6 set default values PM for BN-SS**

**General information:**

With this comand the values described in the chapter Power Management are set to default values. All values are initialized with their default values (compare detailed specifications). The value LV\_POW\_MNG\_MES\_MOD is saved after a powerlatch phase into the non volatile memory.

**Application conditions**

```

Initialisation:           at reset with LV_POW_MNG_MES_MOD from NVMY
Activation:              LV_IGK=1
Deactivation:           LV_IGK=0
                               Diagnostic timeout
Service location:       see list of implemented diagnostic
                               services
    
```

**Formular section:**

```

IF           service 31_F6 is received
THEN        LV_POW_MNG_MES_MOD = 01h
ELSE        LV_POW_MNG_MES_MOD remains unchanged
ENDIF
    
```

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### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier	M	#F6h	RELI

Figure I.16.83: Table StartRoutineByLocalIdentifier Request Message

### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier	M	#F6h	RELI_AD

Figure I.16.84: Table StartRoutineByLocalIdentifier Positive Response Message

### StartRoutineByLocalIdentifier negative Response

Global Negative Responses

## I.16.33 31\_F7 Intelligente Generatorregelung

### General information:

With this comand the intelligent alternator control can be switched off.

### Application conditions

**Initialisation:** *from NVMY*

**Activation:** LV\_IGK=1

**Deactivation:** LV\_IGK=0  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

### Formular section:

```

IF                service 31_F7        is received
THEN              LV_ALTER_CTL_EXT_ADJ= 01h
ELSE              LV_ALTER_CTL_EXT_ADJ remains unchanged
ENDIF

```

### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier	M	#F7h	RELI_IGR_OFF

Figure I.16.85: Table StartRoutineByLocalIdentifier Request Message

### StartRoutineByLocalIdentifier positive Response



<i>Data Byte</i>	<i>Parameter Name</i>	<i>Cvt</i>	<i>Hex Value</i>	<i>Mnemonic</i>
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier	M	#F7h	RELI_IGR_OFF

Figure I.16.86: Table StartRoutineByLocalIdentifier Positive Response Message

**StartRoutineByLocalIdentifier negative Response**

Global Negative Responses

**I.16.34 31\_FA Siemens interner Service**

undokumentiert

**I.16.35 31\_FB Siemens interner Service**

undokumentiert

**I.16.36 31\_FC Siemens interner Service**

undokumentiert

## I.17 KWP2000 - SID 35h: requestUpload Service

### Input data:

LV_IGK {p. 906}			
-----------------	--	--	--

### General information:

This function allows to upload data from the ECU.

### Application conditions

**Initialisation:** *at reset*

**Activation:** Kl.15 on

**Deactivation:** Kl.15 off  
 Diagnostic timeout  
 Service location: see "list of implemented diagnostic services"

### I.17.1 RequestUpload Request (3-byte addressing)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestUpload Request Service Id	M	#35h	RU
#2d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#3d	MemoryAddress (Middle Byte)	M	#XXh	MA_MB
#4d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
(#5d)	MemoryTypeIdentifier ( <b>optional</b> ) [ linear type external FLASH external RAM internal FLASH user information field UIF ]	U	#XXh [ #00h #02h #05h #06h #07h ]	MTI
#5d / (#6d)	DataFormatIdentifier (only uncompressed memory supported)	M	#00h	DFI
#6d / (#7d)	UncompressedMemorySize [High Byte]	M	#00h...#FFh	UCMS
#7d / (#8d)	UncompressedMemorySize [Middle Byte]	M	#00h...#FFh	UCMS
#8d / (#9d)	UncompressedMemorySize [Low Byte]	M	#00h...#FFh	UCMS

Figure I.17.1: Table RequestUpload Request Message

## I.17.2 RequestUpload Request (4-byte addressing)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestUpload Request Service Id	M	#35h	RU
#2d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#3d	MemoryAddress (MiddleHigh Byte)	M	#XXh	MA_MHB
#4d	MemoryAddress (MiddleLow Byte)	M	#XXh	MA_MLB
#5d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
#6d	MemoryTypeldentifier ( <b>mandatory, but not evaluated</b> ) [ 00h ... FFh ]	M	#XXh [ #XXh ]	MTI
#7d	DataFormatldentifier (only uncompressed memory supported)	M	#00h	DFI
#8d	UncompressedMemorySize [High Byte]	M	#00h...#FFh	UCMS
#9d	UncompressedMemorySize [MiddleHigh Byte]	M	#00h...#FFh	UCMS
#10d	UncompressedMemorySize [MiddleLow Byte]	M	#00h...#FFh	UCMS
#11d	UncompressedMemorySize [Low Byte]	M	#00h...#FFh	UCMS

Figure I.17.2: Table RequestUpload Request Message

### Remark:

For **3-byte addressing** independent from delivery of a MemoryTypeldentifier (byte 5) by the tester's request, the ECU automatically adds an offset to the requested memory address.

If no MemoryTypeldentifier is delivered, the same offset as for MemoryTypeldentifier 00h (linear addressing) is used.

This base memory offset must be subtracted from any memory address taken from the MAP- /A2L- file if 3-byte addressing is not sufficient for the address range!

For **4-byte addressing** a MemoryTypeldentifier (byte 6) must be delivered by the tester's request.

Though it is not evaluated or used within the ECU for this absolute addressing mode, it is necessary to decide between 3- /4-byte addressing mode.

In this 4-byte mode the absolute address delivered by the tester is used by the ECU without any memory offset.

For MSx80 (TriCore) the base memory offsets for **3-byte addressing** are:

MemoryTypeldentifier:	Memory offset:
none (linear)	C000 0000h
00h (linear)	C000 0000h
02h (ext. FLASH)	8000 0000h (the same as for int. FLASH)
05h (ext. RAM)	D000 0000h
06h (int. FLASH)	8000 0000h
07h (UIF)	8000 xxxxh not fixed yet, address might still change !!!

The supported address ranges are identical to the areas defined for the service ReadMemoryByAd-dress.

### I.17.3 RequestUpload positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	requestUpload Positive Response Service Id	M	#75h	RUPR
#2d	TransferResponseParameter=[maxNumberOfBlockLength] = 239d	M	#EFh	TREP_ MNROBL

Figure I.17.3: Table RequestUpload Positive Response Message

### I.17.4 RequestUpload negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	RequestUpload Request Service Id	M	#35h	RU
#3d	responseCode= [ CanNotUpload-FromSpecificAdress ]	M	#XXh= [ #52h ]	RC_

Figure I.17.4: Table RequestUpload Negative Response Message

## I.18 KWP2000 - SID 3Bh: writeDataByLocalIdentifier Service

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_FCO_KWP	O/V/S	80... 7FH	-0.128 ...0.127	0.001	-
Correction factor for consumption					
VIN_SHO [7]	O/V/S	0... FFH	0... 255	1	-
short vehicle identification number					

### General information:

All implemented SID 30h services are described below.

### Formula section:

### I.18.1 Global negative Responses

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	writeDataByLocalIdentifier Request Service ID	M	#3Bh	WDBLI
#3d	responseCode= only general response code	M	#XXh	RC

Figure I.18.1: Table writeDataByLocalIdentifier Negative Response Message

### Remark:

The detailed message of the negative response code is described in chapter "Error-Codes".

### I.18.2 3B\_90 - Kurze Fahrgestellnummer schreiben - writeDataByLocalIdentifier Service

### General information:

With this service the short vehicle identification code is written to E2PROM. Furthermore the identification number of the dataset (Cal-ID) is written to E2PROM. The receiving of this command is interpreted as successful coding of BMW variants.

### Application conditions

**Initialisation:** *at reset*

**Activation:** LV\_IGK = 1 **and** LV\_ES = 1

**Deactivation:** LV\_IGK = 0 **or** LV\_ES = 0

Diagnostic timeout

Service location: see list of "implemented diagnostic services"

### writeDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByLocalID Request Service Id	M	#3Bh	WDBLI
#2d	recordLocalIdentifier = Kurze Fahrgestellnummer	M	#90h	RLI_
#3d	RecordValue = VIN_SHO[0]	M	#XXh	RV_
#4d	RecordValue = VIN_SHO[1]	M	#XXh	RV_
#5d	RecordValue = VIN_SHO[2]	M	#XXh	RV_
#6d	RecordValue = VIN_SHO[3]	M	#XXh	RV_
#7d	RecordValue = VIN_SHO[4]	M	#XXh	RV_
#8d	RecordValue = VIN_SHO[5]	M	#XXh	RV_
#9d	RecordValue = VIN_SHO[6]	M	#XXh	RV_

Figure I.18.2: Table writeDataByLocalIdentifier Request Message

**writeDataByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByLocal ID Positive Response SId	M	#7Bh	WDBLIPR
#2d	routineLocalIdentifier= Kurze Fahrgestellnummer	M	#90h	RLI_

Figure I.18.3: Table writeDataByLocalIdentifier Positive Response Message

**writeDataByLocalIdentifier negative Response**

Global Negative Responses

**I.18.3 3B\_C1 - write kva-factor - writeDataByLocalIdentifier Service****General information:**

With this service the additive part of the correction-factor is updated.

The ECU works after that with this new value.

The additive part of this correction-factor is between -0,128 and +0,127.

**Application conditions**

**Initialisation:** *at reset*


**Activation:** Kl.15 on

**Deactivation:** Kl.15 off  
Diagnostic timeout  
Service location: see list of "implemented diagnostic services"

**writeDataByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByLocalID Request Service Id	M	#3Bh	WDBLI
#2d	recordLocalIdentifier = KVA-factor	M	#C1h	RLI_KVA
#3d	RecordValue = FAC_FCO_KWP [ remain the same negative displace max.12.8% positive displace max.12.7% (1h=0.001/bit) ]	M	#XXh [ #00h, #80h-FFh #01h-7Fh ]	RV_KVA_KORR

Figure I.18.4: Table writeDataByLocalIdentifier Request Message

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**writeDataByLocalIdentifier positive Response**

<i>Data Byte</i>	<i>Parameter Name</i>	<i>Cvt</i>	<i>Hex Value</i>	<i>Mnemonic</i>
#1d	WriteDataByLocal ID Positive Response SId	M	#7Bh	WDBLIPR
#2d	routineLocalIdentifier=KVA	M	#C1h	RLI_KVA

Figure I.18.5: Table writeDataByLocalIdentifier Positive Response Message

**writeDataByLocalIdentifier negative Response**

## Global Negative Responses

## I.19 KWP2000 - SID 32h: stopRoutineByLocalIdentifier Service

### Input data:

EFF_IGA_CST_LIM_EXT_ ADJ {p. 7482}	FAC_CH_DIAG_EXT_ADJ_ IS {p. 7482}	FAC_CH_DIAG_EXT_ADJ_ PL {p. 7482}	LV_CH_DIAG_EXT_REQ {p. 7482}
LV_IGK {p. 906}	LV_INH_LAM_KWP {p. 7483}	LV_POW_MNG_MES_ MOD {p. 7483}	

### General information:

All implemented SID 32h services are described below.  
Overview of supported subservices

SID number	service	Service location	MSD_81 (4cyl)	MSD_81 (6cyl)
32_2F	Stop Desulfatisierung Fahrbetrieb	ECU	X	X
33_3A	Stop CSERS-Diagnose	ECU	X	X
32_D9	stop switch off Lambda controller	ECU	X	X
32_F0	stop checksum calculation for Inca PC	ECU	-	-
32_F1	stop programming of calibration data for IncaPC	ECU	-	-
32_F6	stop default values PM for BN-SS	ECU	X	X
32_F7	switch Intelligente Generatorregelung active	ECU	X	X

### I.19.1 Global negative Responses

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	stopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.19.1: Table StopRoutineByLocalIdentifier Negative Response Message

#### Remark:

The detailed message of the negative response code is described in chapter "Introduction".

### I.19.2 32\_2F stop Desulfatisierung Fahrbetrieb

#### General information:



With this command the "Desulfatisierung Fahrbetrieb" is switch off.

**Application conditions**

**Initialisation:** - -  
**Activation:** LV\_IGK=1 (Kl.15 on)  
**Deactivation:** LV\_IGK=0 (Kl.15 off)  
 Diagnostic timeout  
**Service location:** see list of implemented diagnostic services

**Formular section:**

**If** service 32\_2F is received  
**Then** call ACTION\_NOXM\_StopCatHeatDesu()  
 Send positive response  
**Endif**

**StopRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#2d	RoutineLocalIdentifier	M	#2Fh	RELI_DESF AHR

Figure I.19.2: Table StopRoutineByLocalIdentifier Request Message

**StopRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier	M	#2Fh	RELI_DESF AHR

Figure I.19.3: Table StopRoutineByLocalIdentifier Positive Response Message

**StopRoutineByLocalIdentifier negative Response**

Global Negative Responses

**I.19.3 32\_3A Stop CSERS-Diagnose**

**General information:**

This Services handles the Cold Start Emission Reduction Strategy (CSERS) Diagnose

**Formula section:**

**If(1)** service 32\_3A is received  
**Then(1)**  
 LV\_CH\_DIAG\_EXT\_REQ = 0  
 EFF\_IGA\_CST\_LIM\_EXT\_ADJ = 0.0

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```
FAC_CH_DIAG_EXT_ADJ_IS = 0.0
FAC_CH_DIAG_EXT_ADJ_PL = 0.0
send positive response
```

Endif(1)

### StopRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#2d	RoutineLocalIdentifier	M	#3Ah	RELI_ZGH

Figure I.19.4: Table StopRoutineByLocalIdentifier Request Message

### StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier	M	#3Ah	RELI_ZGH

Figure I.19.5: Table StopRoutineByLocalIdentifier Positive Response Message

### StopRoutineByLocalIdentifier negative Response

Global Negative Responses

## I.19.4 32\_D9 stop switch off Lambda controller

### General information:

With this command the switch off of lambda controller by KWP2000 is ended.

### Application conditions

#### Initialisation:

--

#### Activation:

LV\_IGK=1 (K1.15 on)

#### Deactivation:

LV\_IGK=0 (K1.15 off)  
Diagnostic timeout

#### Service location:

services

see list of implemented diagnostic

### Formular section:

IF service 32\_D9 is received

THEN LV\_INH\_LAM\_KWP = 00h

ELSE LV\_INH\_LAM\_KWP remains unchanged

### StopRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#2d	RoutineLocalIdentifier	M	#D9h	RELI_

Figure I.19.6: Table StopRoutineByLocalIdentifier Request Message

### StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier	M	#D9h	RELI_

Figure I.19.7: Table StopRoutineByLocalIdentifier Positive Response Message

### StopRoutineByLocalIdentifier negative Response

Global Negative Responses

## I.19.5 32\_F0 stop checksum calculation for Inca PC

### General information:

With this service the tester stops the checksum calculation, which is started with the service 31\_F0.

### Application conditions

**Initialisation:** *at reset*

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** Kl.15 off  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

### StopRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#2d	RoutineLocalIdentifier = checksum calculation for IncaPC	M	#F0h	RELI_

Figure I.19.8: Table StopRoutineByLocalIdentifier Request Message

### StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = checksum calculation for IncaPC	M	#F0h	RELI_

Figure I.19.9: Table StopRoutineByLocalIdentifier Positive Response Message

### StopRoutineByLocalIdentifier negative Response

Global Negative Responses

## I.19.6 32\_F1 stop programming of calibration data for IncaPC

### General information:

With this service the tester deletes the request for programming of calibration data after the power latch, which is started with the service 31\_F1.

Once the programming of calibration data is started after the power latch it can not be interrupted.

### Application conditions

**Initialisation:** *at reset*

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off)  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

### StopRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#2d	RoutineLocalIdentifier = checksum calculation for IncaPC	M	#F1h	RELI_

Figure I.19.10: Table StopRoutineByLocalIdentifier Request Message

### StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = checksum calculation for IncaPC	M	#F1h	RELI_

Figure I.19.11: Table StopRoutineByLocalIdentifier Positive Response Message

### StopRoutineByLocalIdentifier negative Response

Global Negative Responses

## I.19.7 32\_F6 stop default values PM for BN-SS

### General information:

With this comand the values described in the chapter Power Management are set to default values. The value LV\_POW\_MNG\_MES\_MOD is saved after a powerlatch phase into the non volatile memory.

### Application conditions

**Initialisation:** *at reset with B\_fapmness from NVM*

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off)  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

**Formular section:**

**IF** service 32\_F6 is received  
**THEN** LV\_POW\_MNG\_MES\_MOD = 00h  
**ELSE** LV\_POW\_MNG\_MES\_MOD remains unchanged

**StopRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#2d	RoutineLocalIdentifier	M	#F6h	RELI_

Figure I.19.12: Table StopRoutineByLocalIdentifier Request Message

**StopRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier	M	#F6h	RELI_

Figure I.19.13: Table StopRoutineByLocalIdentifier Positive Response Message

**StopRoutineByLocalIdentifier negative Response**

Global Negative Responses

**I.19.8 32\_F7 switch Intelligente Generatorregelung active**

**General information:**

With this comand the intelligent altenator control is switched active again.

**Application conditions**

**Initialisation:** from NVMY  
**Activation:** LV\_IGK=1 (Kl.15 on)  
**Deactivation:** LV\_IGK=0 (Kl.15 off)  
Diagnostic timeout  
**Service location:** see list of implemented diagnostic services

**Formular section:**

**IF** service 32\_F7 is received  
**THEN** LV\_ALTER\_CTL\_EXT\_ADJ = 00h  
**ELSE** LV\_ALTER\_CTL\_EXT\_ADJ remains unchanged

**StopRoutineByLocalIdentifier Request**

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<i>Data Byte</i>	<i>Parameter Name</i>	<i>Cvt</i>	<i>Hex Value</i>	<i>Mnemonic</i>
#1d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#2d	RoutineLocalIdentifier	M	#F7h	RELI_IGR_OFF

Figure I.19.14: Table StopRoutineByLocalIdentifier Request Message

**StopRoutineByLocalIdentifier positive Response**

<i>Data Byte</i>	<i>Parameter Name</i>	<i>Cvt</i>	<i>Hex Value</i>	<i>Mnemonic</i>
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier	M	#F7h	RELI_IGR_OFF

Figure I.19.15: Table StopRoutineByLocalIdentifier Positive Response Message

**StopRoutineByLocalIdentifier negative Response**

Global Negative Responses

## I.20 Message structure

### I.20.1 Request Message with Conditional Target, Source Address and length information

The following table shows a general service table structure and its syntax.

Data Byte	Byte #	Parameter Name	CVT	Value	Mnemonic
	#1d	Format byte	M	#AALLLLLLb	FMT
	#2d	Target address byte	C	#12h/#EAh/#EDh/ #EFh/ #33h	TGT
	#3d	Source address byte	C	#F1h	SRC
	#4d	Additional length byte	C	#01h-#FFh	LEN
#1d	#5d	Service ID Byte	M		SID
•	#6d	Data Byte #02h	C	#XXh	DATA
•	•	•	•	•	
•	•	•	•	•	
•	•	•	•	•	
#255d	#259d	Data Byte #255d	C	#XXh	
	#260d	Checksum	M	#00h-#FFh	CS

1. The input/output buffer of *BSW-KWP* is limited to 255 (#FFh) **Bytes** (SID included).
2. In the following description the table begins with the first data byte (see shaded part of the table above).The headers of the message-flow are always the same construction and therefore in all following diagnostic service descriptions unnecessary.

Header				Data bytes					Checksum
Fmt	Tgt	Src	Len	SID	Data	•	•	•	CS
max 4 byte				max. 255 byte					1 byte

### I.20.2 Method of addressing

1. The BSW-KWP supports the physical Addressing with the Keybytes #8FEFh (startCommunicationPositive Response; Keybyte1 = #EFh, Keybyte2 = #8Fh), header with conditional target and source address information, with length information in the formatbyte or additional length byte, depending on the response length.
2. The ECU-address for **physical** addressing is #12h.
3. The ECU-address for **functional** addressing is #EFh.
4. The ECU-address for **functional** addressing powertrain CAN is #EAh actual not supported
5. The ECU-address for **functional** addressing BOS-CAN is #EDh actual not supported
6. The ECU-address for **OBD services** is #33h (functional).

### I.20.3 Length byte

1. The ECU sends the response with an additional length byte, if the length is longer than 64 byte.
2. The ECU accepts the length information of the request in an additional length byte or in the formatbyte.

### I.20.4 Header with or without Length ,Target and Source Address Information

The following two different types of headers are supported the *BSW-KWP* depending of the two high bits in the Format Byte:

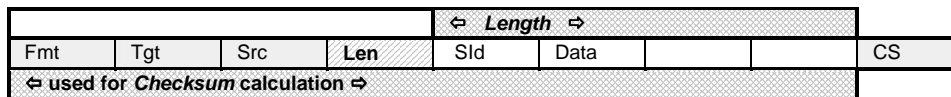


Figure I.20.1: Header with address information, with additional length byte

Possible Format Bytes:

<b>Physical Addressing</b>	A1=1	A0=0	L5=X	L4=X	L3=X	L2=X	L1=X	L0=X
<b>Functional Addressing</b>	A1=1	A0=1	L5=X	L4=X	L3=X	L2=X	L1=X	L0=X

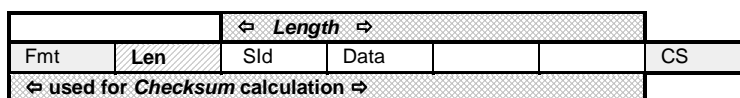


Figure I.20.2: Header without address information, with optional additional length byte

Possible Format Byte:

<b>Physical Addressing without Address Information</b>	A1=0	A0=0	L5=X	L4=X	L3=X	L2=X	L1=X	L0=X
--	------	------	------	------	------	------	------	------

## I.20.5 Checksum byte

1. The checksum is the sum of all bytes in the message (except the checksum byte itself) modulo 256 (i.e. 1 byte long):  
 (Checksum = Format + Target + Source + Length + Data[SID + DATA1 + + DATAn])  
 or (Checksum = Format + Target + Source + Data[SID + DATA1 + + DATAn])  
 or (Checksum = Format + Length + Data[SID + DATA1 + + DATAn])  
 or (Checksum = Format + Data[SID + DATA1 + + DATAn])



## I.21 SID 11h: ecuReset Service

### Input data:

LV_IGK {p. 906}	LV_LOCK_IMOB		
-----------------	--------------	--	--

### General information:

This function is for reset the ECU during a diagnostic session. Before the ECU is reset, the service writes down the EWS starting value to the E2PROM and once this is finished, the EWS starting value will be copied to flash memory. This happens only if no first code is detected in the flash memory and LV\_LOCK\_IMOB = 0 after service 31\_83\_00 has come up with response 00.

This function works only by engine speed=0rpm.

### ecuReset Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	ecuReset Request Service Id	M	#11h	ER
#2d	resetMode=[powerOn]	M	#01h	RM

Figure I.21.1: Table ecuReset Request Message

1. Attention, after the positive response the Communication is lost. A new Initialization is possible after the time W5(300ms).
2. This service is only possible in the reprogramming session. Only a session change to the ECU programmingMode is not sufficient to execute this service!!!

### EcuReset positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	ecuReset Positive Response Service Id	M	#51h	ERPR
#2d	resetMode=reset state	C	#01h	RS

Figure I.21.2: Table ecuReset Positive Response Message

### EcuReset negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	ecuReset Request Service Id	M	#11h	ER
#3d	responseCode= [ general response codes conditionsNotCorrect, ]	M	#XXh= [ #XX #22h, ]	RC

Figure I.21.3: Table ecuReset Negative Response Message

NegativeResponseCode	Cause of Occurrence
conditionsNotCorrect	engine is running or ignition is off

## I.22 SID 14h: clearDiagnosticInformation Service

### Input data:

LC_FMY_CLR	LV_IGK {p. 906}		
------------	-----------------	--	--

### I.22.1 14h - ClearDiagnosticInformation service

#### General information:

This function clears all diagnostic informations of the selected group.

#### Application conditions

**Initialisation:** *at reset*

**Activation:** LV\_IGK = 1

**Deactivation:** LV\_IGK = 0  
Diagnostic timeout  
Service location: see "list of implemented diagnostic services"

#### ClearDiagnosticInformation Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	clearDiagnosticInformation Request Service Id	M	#14h	CDI
#2d,#3d #2d,#3d	groupOfDiagnosticInformation (HighByte,LowByte) [ Clear DTC's in all Groups Clear Powertrain DTC ]	M,M	#XXh,#XXh= [ #FFh,#FFh #FFh,#FBh ]	GODIN

Figure I.22.1: Table ClearDiagnosticInformation Request Message

#### ClearDiagnosticInformation positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	clearDiagnosticInformation Positive Response SId	M	#54h	CDIPR
#2d,#3d #2d,#3d	groupOfDiagnosticInformation (HighByte,LowByte) [ Clear DTC's in all Groups Clear Powertrain DTC ]	M,M	#XXh,#XXh= [ #FFh,#FFh #FFh,#FBh ]	GODIN

Figure I.22.2: Table ClearDiagnosticInformation Positive Response Message

#### ClearDiagnosticInformation negative Response

<i>Data Byte</i>	<i>Parameter Name</i>	<i>Cvt</i>	<i>Hex Value</i>	<i>Mnemonic</i>
#1d	negativeResponse Service Id	M	#7Fh	NACK
#2d	clearDiagnosticInformation Request Service Id	M	#14h	CLRDTC
#3d	responseCode= [ requestOutOfRange incorrectByteCountDuringBlockTransfer ]	M	#XXh= [ #31h #79h ]	RC

Figure I.22.3: Table ClearDiagnosticInformation Negative Response Message

## I.23 SID 22h: readDataByCommonIdentifier Service

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Bosanfsqbd	O	0... FFH	0... 255	1	-
BOS-Lesen-Anforderung vom Tester					
CTR_BOS_READ	V	0... FFFFH	0... 65535	1	-
timeout counter for BOS read					
Ecu_sw_ref_bmw [9]	O	0	ASCII	1	-
BMW-ECU software reference					
LV_BOS_READ_REQ	V	0... 1H	0 ...1	1	-
flag indicating request BOS data for tester					

### Input data:

ALTER_COD_0 {p. 4093}	ALTER_COD_1 {p. 4093}	Amo_05 {p. 8154}	Amo_10 {p. 8154}
Amo_15 {p. 8154}	Amo_20 {p. 8154}	Amo_30 {p. 8154}	Amo_40 {p. 8154}
ANG_1_RAW_VVL {p. 797}	ANG_DE_ABSV_PLAUS_CHK_VVL {p. 797}	B_cd Xenonr {p. 8342}	B_dev0detec {p. 8366}
B_dev3detec {p. 8366}	B_dev6detec {p. 8366}	B_gangnull {p. 8343}	B_kupp_ext {p. 8394}
B_kwdreht {p. 8215}	B_msasw {p. 7679}	B_nggelermt {p. 8345}	B_ngimlf {p. 8345}
B_qvch2o {p. 8346}	B_spa_cist {p. 8347}	B_spa_csoll {p. 7679}	Ba_ist {p. 8154}
Ba_soll {p. 8154}	Bosbtvfbk {p. 8155}	Bosconf {p. 8155}	Bosmanip {p. 8155}
Bosmziel {p. 8155}	Bosprog2 {p. 8155}	Bosres {p. 8155}	Bosrlsm {p. 8155}
Bosrw2 {p. 8155}	Bosstate {p. 8155}	Bostoken {p. 8155}	Bszsi {p. 8155}
C_ERR_CLAS_XX {p. 5811}	CAM_EX [NC_NR_CBK_IVVT] {p. 8399}	CAM_IN [NC_NR_CBK_IVVT] {p. 8399}	CHK_STAMP {p. 7679}
CONF_EF {p. 7679}	CONF_SOF_SWI {p. 654}	CPPWM_CPS {p. 3749}	CTR_AD_COLD_LAM_AD_INJ {p. 3348}
CTR_AD_HOT_LAM_AD_INJ {p. 3348}	CTR_CDN_RBM [NC_NR_DIAG_RBM] {p. 5858}	CTR_COMP_RBM [NC_NR_DIAG_RBM] {p. 5858}	CTR_DC [NC_NR_ERR_DYN] {p. 5767}
CTR_ERR_DYN_NR {p. 5767}	CTR_ERR_HIS_NR {p. 5821}	CTR_FRC [NC_NR_ERR_DYN] {p. 5767}	CTR_KM_N_MAX {p. 4462}
CTR_N_MAX {p. 4462}	CTR_NS_AD_CYC [NC_NOX_SENS_CONF] {p. 3189}	CTR_NS_SHIFT_CYC [NC_NOX_SENS_CONF] {p. 6425}	CTR_NT_AGI_AD_CMPL_SUM {p. 3072}
CTR_NT_AGI_SO2P_FQ {p. 3072}	CTR_STC_RON_HIGH {p. 4145}	CTR_STC_RON_LOW {p. 4145}	CTR_STC_RON_MEDIUM {p. 4145}
CTR_TOIL_MAX {p. 1223}	CTR_WUP_CYC [NC_NR_ERR_DYN] {p. 5767}	DC_MAX_XX	Dfds [16] {p. 8156}

Dfmonitor {p. 8156}	DIST_LAM_AD_INJ_COLD {p. 3348}	DIST_LAM_AD_INJ_HOT {p. 3348}	DIST_NS_NEW {p. 3193}
DIST_NT_NS_AD [NC_NOX_SENS_CONF] {p. 3189}	DIST_NT_NS_SHIFT [NC_NOX_SENS_CONF] {p. 6425}	DIST_RON_STC [NC_NR_RON_KWP] {p. 4145}	DIST_TOIL_MAX {p. 1223}
EGY_SP_IV_EXT_ADJ [NC_CYL_NR] {p. 7679}	Eisydk_korfak_b {p. 8156}	Eisydk_koroff_b {p. 8157}	Eisyev_korfak_b {p. 8157}
Eisyev_koroff_b {p. 8157}	ENVD_CUS_SET_CMN [NC_NR_ENVD_CUS_] SET_CMN][NC_NR_FRF_] SET][NC_NR_ERR_DYN] {p. 5792}	ENVD_CUS_SET_SPC [NC_NR_ENVD_CUS_] SET_SPC][NC_NR_FRF_] SET][NC_NR_ERR_DYN] {p. 5792}	ENVD_OBD [NC_NR_ENVD_OBD][NC_] NR_ERR_DYN] {p. 5792}
ER_MMV_IS_DIAG [NC_CYL_NR] {p. 4375}	ERR_DTC [NC_NR_ERR_DYN] {p. 5756}	ERR_TYPE_BYTE [NC_NR_ERR_DYN] {p. 5744}	ERR_TYPE_EXT_BYTE [NC_NR_ERR_DYN] {p. 5744}
Exwink_ist {p. 798}	Exwinkkor {p. 798}	F_minhub {p. 798}	F_tikorrvr [8] {p. 798}
FAC_LAM_AD_CUS [NC_CBK_EX_NR] {p. 8308}	FAC_LAM_ADJ_COR_ LAM_AD_CUS [NC_CBK_EX_NR] {p. 8309}	FAC_LAM_ADJ_LAM_AD [NC_CBK_EX_NR] {p. 2641}	FAC_LAM_LIM [NC_CBK_EX_NR] {p. 2461}
FAC_MFF_ADD_EXT_ADJ {p. 7679}	FAC_NOX_NS_AD [NC_NOX_SENS_CONF] {p. 3189}	FAC_NT_AGI_LIM {p. 3072}	FAC_NT_AGI_MDL {p. 3437}
FAC_OIL_EXT_REQ_1 {p. 7680}	FAC_OIL_EXT_REQ_2 {p. 7680}	GEAR_EF_N_MAX {p. 4462}	GEAR_TOIL_MAX {p. 1223}
HIS [NC_NR_HIS][NC_NR_ ERR_HIS]	HIS_COD [NC_NR_ERR_HIS]	lbhwversi {p. 8159}	lbswbase {p. 8159}
lbswchang {p. 8159}	ld_bosmgt {p. 8159}	IGA_IGC [NC_CYL_NR] {p. 1005}	lgenk {p. 8159}
lgrinfo [30] {p. 8159}	IMOB_KWP_K_EWS4 [16] {p. 7680}	IMOB_KWP_K_EWS4_ TMP0 [16] {p. 7680}	IMOB_KWP_STATE_0
IMOB_KWP_STATE_15	IMOB_KWP_STATE_8	IMOB_NR_VLD_K_EWS4	lvvtmot [NC_CYL_NR] {p. 798}
K_EWS4 [16]	LC_RON_STC_ENA {p. 4145}	Leminfo [40] {p. 8160}	LF_BSD_CPT_AVL {p. 4093}
LF_CWP_INFO_COD {p. 4094}	LF_POW_CWP_COD {p. 4094}	LSHPWM_DOWN [NC_CBK_EX_NR] {p. 2421}	LSHPWM_UP [NC_CBK_EX_NR] {p. 2385}
Lurabs_f [NC_CYL_NR] {p. 8160}	Lurdif_f [NC_CYL_NR] {p. 8160}	LV_ACCOUT_RLY {p. 3589}	LV_ALTER_CTL_ENA {p. 7680}
LV_AT {p. 654}	LV_CAT_CONF_DIS_EXT_ REQ {p. 7680}	LV_CS {p. 8394}	LV_CS_N_MAX {p. 4462}

LV_CS_TOIL_MAX {p. 1223}	LV_DRI {p. 1302}	LV_ES {p. 1720}	LV_FAC_MFF_ADD_EXT_ ADJ_NVMY {p. 7680}
LV_FL {p. 1759}	LV_IGK {p. 906}	LV_IGK_OFF_ACK_ENA {p. 7680}	LV_IM_BLS {p. 852}
LV_IM_BTS {p. 852}	LV_IS {p. 1720}	LV_KD {p. 1269}	LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}
LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_LS_UP_READY [NC_CBK_EX_NR] {p. 2335}	LV_NT_AFS_REQ_AGI {p. 3072}	LV_NT_AFS_REQ_AGI_ TMP_3 {p. 3072}
LV_PUC {p. 1720}	LV_RST_MFF_ADD_EXT_ ADJ_NVMY {p. 7680}	LV_SEG_AD_AVL_ER {p. 1473}	LV_SENS_BAT_SMT_DET {p. 4095}
LV_SO2P_REQ_1 {p. 3073}	LV_SO2P_REQ_2 {p. 3073}	LV_SO2P_REQ_FQ {p. 3073}	LV_STST_VAR_COD {p. 7681}
LV_TPS_AD_REQ {p. 4951}	LV_VAR_ACIN {p. 655}	LV_VAR_AEB {p. 655}	LV_VAR_AMT {p. 655}
LV_VAR_ARS {p. 655}	LV_VAR_ASR_3 {p. 655}	LV_VAR_ASR_4 {p. 655}	LV_VAR_BN {p. 655}
LV_VAR_BN_EFP {p. 655}	LV_VAR_BN_GEAR_REV {p. 655}	LV_VAR_BN_LDM {p. 655}	LV_VAR_BN_LTG_HDLP_L {p. 655}
LV_VAR_BN_MSW {p. 655}	LV_VAR_BN_TRL {p. 655}	LV_VAR_DCC {p. 655}	LV_VAR_EAC {p. 805}
LV_VAR_EBOX_CFA {p. 655}	LV_VAR_ECRAS_DOWN {p. 4515}	LV_VAR_ECRAS_UP {p. 655}	LV_VAR_EF {p. 655}
LV_VAR_ETCU {p. 655}	LV_VAR_ETCU_SPT {p. 656}	LV_VAR_ICL {p. 656}	LV_VAR_LSH_DOWN {p. 656}
LV_VAR_LSH_UP {p. 656}	LV_VAR_MAF {p. 656}	LV_VAR_MSW {p. 656}	LV_VAR_NOX {p. 656}
LV_VAR_PSTE {p. 656}	LV_VAR_PSTE_2 {p. 656}	LV_VAR_PSTE_3 {p. 656}	LV_VAR_RLY_ACCOUT {p. 656}
LV_VAR_RLY_ST {p. 656}	LV_VAR_SAP {p. 805}	LV_VAR_SAV {p. 805}	LV_VAR_SOF {p. 656}
LV_VAR_STST {p. 805}	LV_VAR_TCT {p. 656}	LV_VAR_TQ_PBR {p. 656}	LV_VAR_VEH {p. 656}
MAF_KGH_MES_BAS {p. 1192}	MFF_ABSV_IV_EXT_ADJ [NC_CYL_NR] {p. 7681}	MFF_ADD_COLD_LAM_ AD_INJ [NC_CYL_NR] {p. 3405}	MFF_ADD_EXT_ADJ [NC_CBK_EX_NR] {p. 806}
MFF_ADD_EXT_ADJ_ NVMY {p. 806}	MFF_ADD_HOT_LAM_AD_ INJ [NC_CYL_NR] {p. 3405}	MFF_ADD_LAM_AD_OUT [NC_CBK_EX_NR] {p. 2464}	Minhub {p. 806}
Minhub_roh {p. 806}	Minhubvs {p. 806}	Minhubvs_ist {p. 806}	Minhubvsnv {p. 806}
Msa_arravrs [60] {p. 8163}	Msa_indexrs {p. 8163}	Msainfo [50] {p. 8163}	Msastz {p. 8163}
Msastzmsa {p. 8163}	N {p. 1525}	N_GRD_N_MAX {p. 4462}	N_KWP_OFS {p. 7681}
N_KWP_OFS_ACC {p. 7681}	N_KWP_OFS_ACC_DRI {p. 7681}	N_KWP_OFS_DRI {p. 7681}	N_KWP_OFS_VB {p. 7681}
N_MAX {p. 4462}	N_SP_IS {p. 1122}	N_TOIL_MAX {p. 1223}	NC_CBK_EX_NR {p. 1829}
NC_CYL_NR {p. 1526}	NC_K_EWS_MAX	NC_K_EWS_UNLOCKED	NC_NOX_SENS_CONF {p. 643}

NC_NR_CAM_CBK {p. 1507}	NC_NR_DIAG_RBM {p. 5871}	NC_NR_EDGE_CAM_EX {p. 874}	NC_NR_EDGE_CAM_IN {p. 874}
NC_NR_ERR_DYN {p. 5768}	NC_NR_ERR_HIS {p. 5821}	NC_NR_RON_KWP {p. 4145}	NC_NT_NR {p. 644}
NC_PSN_EDGE_CAM_EX [NC_NR_EDGE_CAM_EX][NC_NR_CAM_CBK] {p. 874}	NC_PSN_EDGE_CAM_IN [NC_NR_EDGE_CAM_IN][NC_NR_CAM_CBK] {p. 874}	NL [NC_CYL_NR] {p. 1962}	NR_PAT_SCC_N_MAX {p. 4462}
NT_AGI {p. 3073}	NT_AGI_SO2P_FQ_SUM {p. 3073}	NT_AGI_SUL {p. 3073}	NT_AGI_SUL_SNG [NC_NT_NR] {p. 3073}
NT_AGI_THERMO {p. 3073}	NT_AGI_THERMO_SNG [NC_NT_NR] {p. 3074}	NT_SUL_32 [NC_NT_NR] {p. 3113}	NT_SUL_H_32 [NC_NT_NR] {p. 3113}
OBD_FUP_RNG_H {p. 7308}	Oz_manip {p. 807}	Pmbbackup [7] {p. 8165}	Pminfo1 [37] {p. 8165}
Pminfo2 [29] {p. 8165}	POW_CONF_IDX_EXT_REQ {p. 7682}	PROT_CONF_IDX_EXT_REQ {p. 7682}	PSN_EDGE_AD_CAM_EX [NC_NR_EDGE_CAM_EX][NC_NR_CAM_CBK] {p. 1534}
PSN_EDGE_AD_CAM_IN [NC_NR_EDGE_CAM_IN][NC_NR_CAM_CBK] {p. 1534}	PV_AV_N_MAX {p. 4462}	PV_AV_TOIL_MAX {p. 1223}	Qv_cdherst_1 {p. 7682}
Qv_cdherst_2 {p. 7682}	Qv_cdherst_3 {p. 7682}	Qv_cdherst_4 {p. 7683}	Qv_cdherst_5 {p. 7683}
Qv_cdherst_6 {p. 7683}	Qv_cdherst_7 {p. 7683}	Qv_cdherst_8 {p. 7683}	Qv_h2o {p. 8166}
Qv_h2oquali {p. 8166}	Qv_h2ostatus {p. 8166}	Qv_nv_ezm {p. 8166}	Qv_nv_zh {p. 8166}
Qv_out_1 {p. 8166}	Qv_out_2 {p. 8166}	Qv_out_3 {p. 8166}	Qv_out_4 {p. 8166}
Qv_out_5 {p. 8166}	Qv_out_m {p. 8166}	Qv_quali_1 {p. 8166}	Qv_quali_2 {p. 8166}
Qv_quali_3 {p. 8166}	Qv_quali_4 {p. 8167}	Qv_quali_5 {p. 8167}	Qv_quali_m {p. 8167}
Qv_status {p. 8167}	Qv_td1 {p. 8167}	Qv_td2 {p. 8167}	Qv_td3 {p. 8167}
Qv_td4 {p. 8167}	Qv_td5 {p. 8167}	Qvc_status_1 {p. 8167}	Qvc_status_2 {p. 8167}
Qvc_status_3 {p. 8167}	Qvc_status_4 {p. 8167}	RATIO_MMV_NS_SHIFT_DIAG [NC_NOX_SENS_CONF] {p. 6412}	S_vsmnhb {p. 807}
S_vsmnhbnv {p. 807}	Snibs {p. 8168}	St_dgenerrst_md1 {p. 8169}	St_dgenerrst_md2 {p. 8169}
St_dgengrenz1 {p. 8169}	St_dgengrenz1_md1 {p. 8169}	St_dgengrenz1_md2 {p. 8169}	St_dgengrenz2 {p. 8169}
St_dgengrenz2_md1 {p. 8169}	St_dgengrenz2_md2 {p. 8169}	St_dgengrenzerr {p. 8169}	St_dgengrenzerr_md1 {p. 8170}
St_dgengrenzerr_md2 {p. 8170}	St_dgengrenznz {p. 8170}	St_dgengrenznz_md1 {p. 8170}	St_dgengrenznz_md2 {p. 8170}
St_dgenub1 {p. 8170}	St_dgenub1_md1 {p. 8170}	St_dgenub1_md2 {p. 8170}	St_dgenub2 {p. 8170}
St_dgenub2_md1 {p. 8170}	St_dgenub2_md2 {p. 8170}	St_dgenuberr {p. 8170}	St_dgenuberr_md1 {p. 8170}

St_dgenuberr_md2 {p. 8170}	St_dgenubnz {p. 8170}	St_dgenubnz_md1 {p. 8170}	St_dgenubnz_md2 {p. 8170}
St_dgenugen1 {p. 8170}	St_dgenugen1_md1 {p. 8170}	St_dgenugen1_md2 {p. 8170}	St_dgenugen2 {p. 8170}
St_dgenugen2_md1 {p. 8170}	St_dgenugen2_md2 {p. 8171}	St_dgenugenerr {p. 8171}	St_dgenugenerr_md1 {p. 8171}
St_dgenugenerr_md2 {p. 8171}	St_dgenugennz {p. 8171}	St_dgenugennz_md1 {p. 8171}	St_dgenugennz_md2 {p. 8171}
St_dvovrld {p. 807}	St_ngang0 {p. 8173}	St_vbrvs_aus {p. 807}	St_vbrvs_ein {p. 807}
St_vvt_err {p. 807}	STATE_CRU_OFF_IRR {p. 7227}	STATE_CRU_OFF_REV {p. 7227}	STATE_ECRAS_UP_VAR
STATE_EGY_MIN_KWP {p. 7483}	STATE_IMOB_K_EWS	STATE_MIL_ON_DIS_ EXT_REQ {p. 7683}	STATE_PSTE_3_SRC {p. 1576}
STATE_RON [NC_NR_RON_KWP] {p. 4145}	STATE_TBL_DRIV [8][6] {p. 809}	Stmsa {p. 8175}	Stmsaaa {p. 8175}
Stmsaav {p. 8175}	Stmsaea {p. 8175}	Stmsaev {p. 8175}	Swmsaav {p. 7683}
T_N_MAX {p. 4462}	T_prail_mon_xb_ypb [SY_PRAIL_MON_ANZ_ SCHWELLEN][SY_ANZ_ PRAILSENS] {p. 8175}	T_SUM_N_MAX {p. 4462}	TAM_TOIL_MAX {p. 1223}
TCO_2_MES {p. 1218}	TCO_MES {p. 1100}	TCO_TOIL_MAX {p. 1223}	Tget_b1 {p. 8177}
Tget_b2 {p. 8177}	Tget_b3 {p. 8177}	Tget_b4 {p. 8177}	Tget_b5 {p. 8177}
TI_1_HOM [NC_CYL_NR] {p. 2002}	TIA {p. 1226}	Tmot_b1 {p. 8177}	Tmot_b2 {p. 8177}
Tmot_b3 {p. 8177}	Tmot_b4 {p. 8177}	Tmot_b5 {p. 8177}	Toel_b1 {p. 8177}
Toel_b2 {p. 8177}	Toel_b3 {p. 8177}	Toel_b4 {p. 8177}	Toel_b5 {p. 8178}
TOIL_MAX_WARN {p. 1223}	TOIL_THD_TOIL_MAX {p. 1223}	TPS_AV_1 {p. 1169}	TQI_AV {p. 981}
TQI_AV_TOIL_MAX {p. 1223}	TRT_N_MAX {p. 4462}	Tumg_b1 {p. 8178}	Tumg_b2 {p. 8178}
Tumg_b3 {p. 8178}	Tumg_b4 {p. 8178}	Tumg_b5 {p. 8178}	Tvneutral {p. 8178}
Tvngang {p. 8291}	V_PVS_1 {p. 831}	VB {p. 1185}	VCC_DR_VVL {p. 811}
Verbredinfo [32]	VLS_UP [NC_CBK_EX_NR] {p. 1341}	VS {p. 1176}	VS_H_N_MAX {p. 811}
VS_MAX_SEL_EXT_REQ {p. 7683}	VS_N_MAX {p. 4462}	VS_TOIL_MAX {p. 1223}	Vvt_soll {p. 811}
Zbibs {p. 8180}	Zr_lvs_0 {p. 8180}	Zr_lvs_1 {p. 8180}	Zr_lvs_2 {p. 8180}
Zr_lvs_3 {p. 8180}	Zr_lvs_II_reakt {p. 8180}	Zr_lvssekt_0 {p. 8180}	Zr_lvssekt_1 {p. 8180}
Zr_lvssekt_2 {p. 8180}	Zr_lvssekt_3 {p. 8180}	Zr_lvssekt_4 {p. 8181}	Zr_lvssekt_5 {p. 8181}
Zr_lvssekt_6 {p. 8181}	Zr_lvssekt_7 {p. 8181}	Zr_lvssekt_8 {p. 8181}	Zr_lvszyl_0 {p. 8181}



Zr_lvszyl_1 {p. 8181}	Zr_lvszyl_2 {p. 8181}	Zr_lvszyl_3 {p. 8181}	Zr_lvszyl_4 {p. 8181}
Zr_lvszyl_5 {p. 8181}	Zrbosmld {p. 8181}	Zw_offkorrvr [NC_CYL_NR] {p. 8181}	Zylhubkor {p. 811}


**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_SENS_ZK	-	0... 1H	0 ...1	1	-
type of spark ( 1- sensierte Zündkerzen, 0- nicht sensierte Zündkerzen )					

**Hint: don t import variables which are not used due to with NC\_... suppressed services**

**General information:**


All implemented SID 22h services are described below.

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## I.23.1 Overview of implemented subservices

SID number	service	service location	MSD_81 (4cyl)	MSD_81 (6cyl)
22_10_00	Read check stamp	ECU	X	X
22_10_01	Read value BOS	ECU	X	X
22_10_0A	Read Energy saving status	ECU	X	X
22_16_00	Read Anzahl Subbusteilnehmer	ECU	X	X
22_16_01	Read Identifikation Subbusteilnehmer 1 (normaly: Batteriesensensor )	ECU	X	X
22_16_02	Read Identifikation Subbusteilnehmer 2 (normaly:elektr. Wasserpumpe)	ECU	X	X
22_16_03	Read Identifikation Subbusteilnehmer 3 (normaly:Generator 1)	ECU	X	X
22_16_04	Read Identifikation Subbusteilnehmer 34(normaly:ECRAS_UP)	ECU	-	-
22_20_00	read failure memory short	ECU	X	X
22_21_00	Read History Memory	ECU	X	X
22_25_00	Programm Reference Backup	BOOT	X	X
22_25_01	Erasing time	BOOT	X	X
22_25_02	Hardware reference	BOOT	X	X
22_25_03	Programm reference	BOOT	X	X
22_25_04	Data reference	BOOT	X	X
22_25_06	Maximum of block length	Boot- /ECU	X	X
22_30_00	MIL Codierung lesen	ECU	X	X
22_30_01	Kat Codierung lesen	ECU	X	X
22_30_10	VMAX-Codierdaten lesen	ECU	X	X
22_30_20	OL/UL Codierung lesen	ECU	X	X
22_30_30	Status-Codierung-Protokoll lesen	ECU	X	X
22_32_00	Oelwechselintervall- Codierdaten lesen	ECU	X	X
22_32_10	IQR-Codierdaten lesen	ECU	X	X
22_32_11	Xenonverbau-Codierdaten lesen	ECU	X	X
22_32_20	SPA-Codierdaten lesen	ECU	X	X
22_32_30	BZE-Codierdaten lesen	ECU	X	X
22_32_40	Abgasklappe Codierdaten lesen	ECU	X	X
22_32_50	Codierung MSA lesen	ECU	X	-
22_32_60	Read CDASMOT	ECU	X	X
22_3F_FF	Aenderungsindex Codierdaten lesen	ECU	X	X
22_40_00	Read values 4000	ECU	X	X
22_40_01	Read values "batterie generator"	ECU	X	X
22_40_02	Read Switch Position	ECU	X	X
22_40_03	Read values of engine roughness	ECU	X	X

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22_40_06	Read CAMSHAFT-Sensor Adaption	ECU	X	X
22_40_07	Read State of Functions	ECU	X	X
22_40_08	Read Throttle and MAF-Adjustment Value	ECU	X	X
22_40_0A	Read mixture values	ECU	X	X
22_40_0B	VVT Messwerte auslesen	ECU	-	-
22_40_15	Read FASTA_Messwertblock 10	ECU	X	X
22_40_16	READ IGR-values	ECU	X	X
22_40_17	READ LEM-values	ECU	X	X
22_40_18	READ MSA-values	ECU	X	X
22_40_19	Fsp. Lesen mit Freeze Frame	ECU	X	X
22_40_1A	READ BZE-values	ECU	X	X
22_40_1B	Read: Results of intelligent alternator diagnosis	ECU	X	X
22_40_1C	Ringspeicher MSA lesen	ECU	X	X
22_40_1D	Read Verbredinfo	ECU	-	-
22_40_1E	Read CBS-Zündkerzen	ECU	X	X
22_40_1F	Read BMW-PST (BMW-Programmstandsinformation)	ECU	-	-
22_40_21	READ IBS-values	ECU	X	X
22_40_22	READ PM1 Status	ECU	X	X
22_40_23	READ PM2 Status	ECU	X	X
22_40_26	Rate Based Monitoring Mode 9 auslesen	ECU	X	X
22_40_27	Rate Based Monitoring Motorsteuerung MSV80 Block 1 auslesen	ECU	-	-
22_40_27	Rate Based Monitoring Motorsteuerung MSD81 Block 1 auslesen	ECU	X	X
22_40_28	Rate Based Monitoring Motorsteuerung MSV80 Block 2 auslesen	ECU	-	-
22_40_28	Rate Based Monitoring Motorsteuerung MSD81 Block 2 auslesen	ECU	X	X
22_40_28	Rate Based Monitoring Motorsteuerung MSD85 Block 2 auslesen	ECU	-	-
22_40_2D	Messwerte Laufruhepruefung auslesen	ECU	X	X
22_40_2E	Nullgang-Erkennung lesen	ECU	X	X
22_40_2F	MSA lesen	ECU	X	X
22_40_30	FASTA_LVS_lesen	ECU	X	X
22_40_31	Laufruhe Verbesserungssystem Zylinderstatistik auslesen	ECU	X	X
22_40_32	MFMA (Kleinstmengenadaption)	ECU	X	X
22_40_35	Read: Kraftstoffqualitätsfassung	ECU	X	X

22_40_4C	Read "Zeitanteile der erreichten Druckbereiche (beim Tausch der Kraftstoffhochdruckpumpe)"	ECU	X	X
22_40_66	Rate Based Monitoring Motorsteuerung MSD85 Block 3 auslesen	ECU	X	X
22_5F_88	Adrecovery lesen	ECU	X	X
22_5F_8B	read PM recovery	ECU	X	X
22_5F_8E	MSA deactivation lesen	ECU	X	X
22_5F_8F	MSA Abschaltverhinderer lesen	ECU	X	X
22_5F_90	IMAALLE lesen	ECU	X	X
22_5F_DE	VVT- Minhub lesen	ECU	-	-
22_5F_F0	Abgleichswert LL lesen	ECU	X	X
22_5F_F1	CO Abgleichswert lesen	ECU	-	-
22_5F_F2	Varianten lesen	ECU	X	X
22_5F_F3	Uebertemperatursicherung lesen	ECU	X	X
22_5F_F4	Fusshebelwerk Fehlbedienung lesen	ECU	X	X
22_5F_F6	Ueberdrehzahlsicherung lesen	ECU	X	X
22_5F_F7	Laufruhepruefung auslesen	ECU	X	X
22_5F_F8	Status Homogenbetrieb auslesen	ECU	X	X
22_C0_00	Read imob status (STATUS_EWS)	Boot- /ECU	X	X
22_C0_02	Read imob k_ews(tmp) (STATUS_EWS_SK)	Boot- /ECU	X	X

## I.23.2 Global Application conditions (default)

If no Application conditions block is specified, use default


### Application conditions

<b>Initialisation:</b>	at reset	
<b>Activation:</b>	Kl.15 on	
<b>Deactivation:</b>	Kl.15 off	
	Diagnostic timeout	
<b>Service location:</b>	services	see list of implemented diagnostic

## I.23.3 Global negative Responses (default)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	negativeResponse Service ID	M	7Fh	NR
2	Request Service ID	M	22h	requestServiceID
3	responseCode ( 12h - subfunction not supported, 22h - conditionsNotCorrectOr RequestSequenceError )	M	XXh [ #12h, #22h ]	responseCode

### Remark:

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**If no negative response is specified, send Global negative Responses**

The detailed message of the negative response code is described in chapter "Error Codes".

### I.23.4 22\_1000 - Read check stamp

#### General information:

With this comand the 3 bytes of the check stamp was read out to the ecu. Those are actually in the volatile memory. In the latch off phase ( n = 0 rpm and KI.15 off) this values are written down into the non volatile memory. If the battery voltage is removed from the ECU, bevor the power latch phase ends, so the storage of the check stamp was cancelled and the value up to now was kept.

The writing of the check stamp was reserved for the customers production, that means that the check stamp can t be read by the ECU production factory.

The service only accept ram-reading.

#### **Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier	M	10h	RCL_TSP
3	RecordCommonIdentifier	M	00h	RCL_TSP

#### **Positive Response on service**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier	M	10h	RCL_TSP
3	RecordCommonIdentifier	M	00h	RCL_TSP
4	recordValue1 CHK_STAMP Byte 2	M	XXh	RV_PST
5	recordValue2 CHK_STAMP Byte 1	M	XXh	RV_PST
6	recordValue3 CHK_STAMP Byte 0 (LSB)	M	XXh	RV_PST

### I.23.5 22\_1001 - Read values BOS

#### General information:

This function is created to read out the described values from the ecu.

#### Formula section:

**If** service 22\_1001 is recieved

**then**

send 78 H

**endif**

**If(1)** 78H handling is activated for this function

**Then(1)**

increment CTR\_BOS\_READ

**if(2)** CTR\_BOS\_READ > 1C2H // timeout condition

**then(2)** send negative response

LV\_BOS\_READ\_REQ = 0

CTR\_BOS\_READ = 0

```

        Bosanfsgbd                = 0
        End data handling 78H
        // End data transmission to tester
    else(2)
        if(3)          LV_BOS_READ_REQ = 0
        then(3)
            if(4)      Bosconf = 1. bit
            then(4)    Bosanfsgbd = 1
                    LV_BOS_READ_REQ = 1
            else(4)    send negative response
                    LV_BOS_READ_REQ = 0
                    CTR_BOS_READ = 0
                    Bosanfsgbd = 0
                    End data handling 78H
                    // End data transmission to tester
            endif(4)
        else(3)
            if(4)      Bosanfsgbd = Bostoken           // data for tester are ready
            then(4) LV_BOS_READ_REQ = 0
                    send positive response
                    LV_BOS_READ_REQ = 0
                    CTR_BOS_READ = 0
                    Bosanfsgbd = 0
                    End data handling 78H
                    // End data transmission to tester
            endif(4)
        endif(3)
    endif(2)
endif(1)

```

## Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier read values	M	10h	RCI_
3	RecordCommonIdentifier	M	01h	RCI_

## Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Response Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier	M	10h	RCI_BOS
3	RecordCommonIdentifier	M	01h	RCI_BOS
4	recordValue1 = Id_bosmgt for first CBS-member	M	XXh	RV_Id_bosmgt
5	recordValue2 = Bosrlsm high byte for first CBS-member	M	XXh	RV_Bosrlsm
6	recordValue3 = Bosrlsm low byte for first CBS-member	M	XXh	RV_Bosrlsm
7	recordValue4 = Bosstate for first CBS-member	M	XXh	RV_Bosstate
8	recordValue5 = Zrbosmld for first CBS-member	M	XXh	RV_Zrbosmld
9	recordValue6 = Bosbtvfbk for first CBS-member	M	XXh	RV_Bosbtvfbk
10	recordValue7 = Bosrw2 for first CBS-member	M	XXh	RV_Bosrw2
11	recordValue8 = Bosmziel for first CBS-member	M	XXh	RV_Bosmziel
12	recordValue9 = Bosjziel for first CBS-member	M	XXh	RV_Bosjziel
13	recordValue10 = Bosprog2 for first CBS-member	M	XXh	RV_Bosprog2
14	recordValue11 = Bosmanip for first CBS-member	M	XXh	RV_Bosmanip
15	recordValue12 = Bosres for first CBS-member	M	XXh	RV_Bosres
16	recordValue13 = Bostoken for first CBS-member	M	XXh	RV_Bostoken

### I.23.6 22\_100A - RDBCIEGYlesen

#### General information:

#### Read energy saving status

This function is created to read out the described values from the ecu.

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Request Service ID</b>	<b>M</b>	<b>22h</b>	<b>RDBCIE</b>
2	RecordCommonIdentifier High Byte	M	10h	RCI_ESS
3	RecordCommonIdentifier Low Byte	M	0Ah	RCI_ESS

#### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Response Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier High Byte	M	10h	RDBCIEGYlesen
3	RecordCommonIdentifier Low Byte	M	0Ah	RDBCIEGYlesen
4	recordValue1 = STATE_EGY_MIN_KWP	M	XXh	RV_STATE_EGY_MIN_KWP

### I.23.7 22\_1600 - Read number of intelligente subbus members

#### General information:

This function is created to read out the number of intelligente sensors on Subbus.

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier read values	M	16h	RCI_
3	RecordCommonIdentifier	M	00h	RCI_

### Positive Response on service (not MSD85)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Response Service Id	M	62h	RDBCIPR
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	00h	RCI_BOS
4	RecordValue1= number of 1-bits from LF_BSD_CPT_AVL Bit0, Bit3 and Bit6 ( LF_BSD_CPT_AVL & 49h ) = number of sucessfully learnt intelligent sensors (possible components: Intelligent battery sensor,electrical coolant water pump and alternator ) on subbus	M	XXh [ 00h, 01h, 02h, 03h ]	RV_

### Positive Response on service ( only MSD85)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Response Service Id	M	62h	RDBCIPR
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	00h	RCI_BOS
4	RecordValue1= number of 1-bits from LF_BSD_CPT_AVL Bit0, Bit3 and Bit6 ( LF_BSD_CPT_AVL & 49h ) + LV_VAR_ECRAS_UP = number of sucessfully learnt intelligent sensors on BSD-BUS (possible components: Intelligent battery sensor,electrical coolant water pump and alternator ) plus number of sucessfully learnt intelligent sensors on LIN-BUS (possible component: ECRAS UP )	M	XXh [ 00h, 01h, 02h, 03h, 04h ]	RV_

## I.23.8 22\_1601 - Read detailed informations of the first intelligent subbus member

### General information:

This function is created to read out the detailed informations of the first intelligente subbus member.

### Request Service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Request Service Id	M	22h	RDBC1
2	RecordCommonIdentifier read values	M	16h	RCI_
3	RecordCommonIdentifier	M	01h	RCI_


### Formula section ( not for MSD85):

If(1) service 22\_16\_01 is received

Then(1)

If(2) B\_dev0detec = 1

Then(2) send Positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Response Service Id	M	62h	RDBCIPR
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	01h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	01h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = always zero	M	00h	RCI_
7	RecordValue 4 = always zero	M	00h	RCI_
8	RecordValue 5 = Zbibs (MSB)	M	XXh	RCI_
9	RecordValue 6 = Zbibs	M	XXh	RCI_
10	RecordValue 7 = Zbibs	M	XXh	RCI_
11	RecordValue 8 = Zbibs (LSB)	M	XXh	RCI_

**If (3)** B\_dev0detec = 0 and B\_dev3detec = 1  
**Then(3)** send Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Response Service Id	M	62h	RDBCIPR
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	01h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	02h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number ( always 0ffh )	M	FFh	RCI_
7	RecordValue 4 = BMW-part number ( always 0ffh )	M	FFh	RCI_
8	RecordValue 5 = BMW-part number ( always 0ffh )	M	FFh	RCI_
9	RecordValue 6 = BMW-part number ( always 0ffh )	M	FFh	RCI_
10	RecordValue 7 = BMW-part number ( always 0ffh )	M	FFh	RCI_
11	RecordValue 8 = BMW-part number ( always 0ffh )	M	FFh	RCI_
12	RecordValue 9 = LF_CWP_INFO_COD	M	XXh	RCI_
13	RecordValue 10 = LF_POW_CWP_COD	M	XXh	RCI_

**If (4)** B\_dev0detec = 0 and B\_dev3detec = 0 and B\_dev6detec = 1

**Then(4)** send Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Response Service Id	M	62h	RDBCIPR
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	01h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	03h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number ( always 0ffh )	M	FFh	RCI_
7	RecordValue 4 = BMW-part number ( always 0ffh )	M	FFh	RCI_
8	RecordValue 5 = BMW-part number ( always 0ffh )	M	FFh	RCI_
9	RecordValue 6 = BMW-part number ( always 0ffh )	M	FFh	RCI_
10	RecordValue 7 = BMW-part number ( always 0ffh )	M	FFh	RCI_
11	RecordValue 8 = BMW-part number ( always 0ffh )	M	FFh	RCI_
12	RecordValue 9 = ALTER_COD_0	M	XXh	RCI_
13	RecordValue 10 = ALTER_COD_1	M	XXh	RCI_

**Endif(4)**

**Endif(3)**

**Else(2)** send negative Response "Request out of range" ( 31h)

**Endif(2)**

**Endif(1)**

**Formula section ( only MSD85):**

**If(1)** service 22\_16\_01 is received

**Then(1)**

**If(2)** B\_dev0detec = 1

**Then(2)** send Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Response Service Id	M	62h	RDBCIPR
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	01h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	01h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = always zero	M	00h	RCI_
7	RecordValue 4 = always zero	M	00h	RCI_
8	RecordValue 5 = Zbibs (MSB)	M	XXh	RCI_
9	RecordValue 6 = Zbibs	M	XXh	RCI_
10	RecordValue 7 = Zbibs	M	XXh	RCI_
11	RecordValue 8 = Zbibs (LSB)	M	XXh	RCI_

**Else(2)**

**If (3)** B\_dev0detec = 0 and B\_dev3detec = 1

**Then(3)** send Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Response Service Id	M	62h	RDBCIPR
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	01h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	02h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number ( always 0ffh )	M	FFh	RCI_
7	RecordValue 4 = BMW-part number ( always 0ffh )	M	FFh	RCI_
8	RecordValue 5 = BMW-part number ( always 0ffh )	M	FFh	RCI_
9	RecordValue 6 = BMW-part number ( always 0ffh )	M	FFh	RCI_
10	RecordValue 7 = BMW-part number ( always 0ffh )	M	FFh	RCI_
11	RecordValue 8 = BMW-part number ( always 0ffh )	M	FFh	RCI_
12	RecordValue 9 = LF_CWP_INFO_COD	M	XXh	RCI_
13	RecordValue 10 = LF_POW_CWP_COD	M	XXh	RCI_

**Else(3)**

**If (4)** B\_dev0detec = 0 and B\_dev3detec = 0 and B\_dev6detec = 1

**Then(4)** send Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Response Service Id	M	62h	RDBCIPR
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	01h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	03h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number ( always Offh )	M	FFh	RCI_
7	RecordValue 4 = BMW-part number ( always Offh )	M	FFh	RCI_
8	RecordValue 5 = BMW-part number ( always Offh )	M	FFh	RCI_
9	RecordValue 6 = BMW-part number ( always Offh )	M	FFh	RCI_
10	RecordValue 7 = BMW-part number ( always Offh )	M	FFh	RCI_
11	RecordValue 8 = BMW-part number ( always Offh )	M	FFh	RCI_
12	RecordValue 9 = ALTER_COD_0	M	XXh	RCI_
13	RecordValue 10 = ALTER_COD_1	M	XXh	RCI_

```

Else(4)
  If (5)
    and LV_VAR_ECRAS_UP= 1
    and B_dev0detec = 0
    and B_dev3detec = 0
    And B_dev6detec = 0
  Then(5) send Positive Response

```

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Response Service Id	M	62h	RDBCIPR
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	01h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	3Dh	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number ( always Offh )	M	FFh	RCI_
7	RecordValue 4 = BMW-part number ( always Offh )	M	FFh	RCI_
8	RecordValue 5 = BMW-part number ( always Offh )	M	FFh	RCI_
9	RecordValue 6 = BMW-part number ( always Offh )	M	FFh	RCI_
10	RecordValue 7 = BMW-part number ( always Offh )	M	FFh	RCI_
11	RecordValue 8 = BMW-part number ( always Offh )	M	FFh	RCI_
12	RecordValue 9 = STATE_ECRAS_UP_VAR	M	XXh	RCI_

```

Else(5)
  send negative Response "Request out of range" ( 31h)
Endif(5)
Endif(4)
Endif(3)

```

```

Endif(2)
Endif(1)


```

## I.23.9 22\_1602 - Read detailed informations of second intelligent subbus member

### General information:

This function is created to read out the detailed informations of second intelligent subbus member

### Request Service

Released by Tettenborn Frank		Date 2013-02-13	File 43I00V01.00F
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7571 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Request Service Id	M	22h	RDBC1
2	RecordCommonIdentifier read values	M	16h	RCI_
3	RecordCommonIdentifier	M	02h	RCI_

**Formula section (not for MSD85):**

**If(1)** service 22\_16\_02 is received

**Then(1)**

**If(2)** B\_dev0detec = 1 and B\_dev3detec = 1

**Then(2)** send Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Response Service Id	M	62h	RDBCIPR
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	02h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	02h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number ( always Offh )	M	FFh	RCI_
7	RecordValue 4 = BMW-part number ( always Offh )	M	FFh	RCI_
8	RecordValue 5 = BMW-part number ( always Offh )	M	FFh	RCI_
9	RecordValue 6 = BMW-part number ( always Offh )	M	FFh	RCI_
10	RecordValue 7 = BMW-part number ( always Offh )	M	FFh	RCI_
11	RecordValue 8 = BMW-part number ( always Offh )	M	FFh	RCI_
12	RecordValue 9 = LF_CWP_INFO_COD	M	XXh	RCI_
13	RecordValue 10 = LF_POW_CWP_COD	M	XXh	RCI_

**Elseif(2)**

**If(3)** (B\_dev0detec = 1 and B\_dev3detec= 0 and B\_dev6detec = 1)

**or**

(B\_dev0detec = 0 and B\_dev3detec= 1 and B\_dev6detec = 1)

**Then(3)** send Positive Response

1	ReadDataByCommonIdentifier Response Service Id	M	62h	RDBCIPR
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	02h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	03h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number ( always Offh )	M	FFh	RCI_
7	RecordValue 4 = BMW-part number ( always Offh )	M	FFh	RCI_
8	RecordValue 5 = BMW-part number ( always Offh )	M	FFh	RCI_
9	RecordValue 6 = BMW-part number ( always Offh )	M	FFh	RCI_
10	RecordValue 7 = BMW-part number ( always Offh )	M	FFh	RCI_
11	RecordValue 8 = BMW-part number ( always Offh )	M	FFh	RCI_
12	RecordValue 9 = ALTER_COD_0	M	XXh	RCI_
13	RecordValue 10 = ALTER_COD_1	M	XXh	RCI_

**Else(3)** send negative Response "Request out of range" ( 31h)

**Endif(3)**

**Endif(2)**

**Endif(1)**

**Formula section (only for MSD85):**

**If(1)** service 22\_16\_02 is received  
**Then(1)**  
     **If(2)** B\_dev0detec = 1 and B\_dev3detec = 1  
     **Then(2)** send Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Response Service Id	M	62h	RDBCIPR
2	RecordCommonIdentifier	M	16h	RCL_BOS
3	RecordCommonIdentifier	M	02h	RCL_BOS
4	RecordValue 1 = Verbauort (high byte)	M	02h	RCL_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCL_
6	RecordValue 3 = BMW-part number ( always 0ffh )	M	FFh	RCL_
7	RecordValue 4 = BMW-part number ( always 0ffh )	M	FFh	RCL_
8	RecordValue 5 = BMW-part number ( always 0ffh )	M	FFh	RCL_
9	RecordValue 6 = BMW-part number ( always 0ffh )	M	FFh	RCL_
10	RecordValue 7 = BMW-part number ( always 0ffh )	M	FFh	RCL_
11	RecordValue 8 = BMW-part number ( always 0ffh )	M	FFh	RCL_
12	RecordValue 9 = LF_CWP_INFO_COD	M	XXh	RCL_
13	RecordValue 10 = LF_POW_CWP_COD	M	XXh	RCL_

**Elseif(2)**  
     **If(3)** (B\_dev0detec = 1 and B\_dev3detec= 0 and B\_dev6detec = 1)  
     **or**  
     (B\_dev0detec = 0 and B\_dev3detec= 1 and B\_dev6detec = 1)  
     **Then(3)** send Positive Response

1	ReadDataByCommonIdentifier Response Service Id	M	62h	RDBCIPR
2	RecordCommonIdentifier	M	16h	RCL_BOS
3	RecordCommonIdentifier	M	02h	RCL_BOS
4	RecordValue 1 = Verbauort (high byte)	M	03h	RCL_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCL_
6	RecordValue 3 = BMW-part number ( always 0ffh )	M	FFh	RCL_
7	RecordValue 4 = BMW-part number ( always 0ffh )	M	FFh	RCL_
8	RecordValue 5 = BMW-part number ( always 0ffh )	M	FFh	RCL_
9	RecordValue 6 = BMW-part number ( always 0ffh )	M	FFh	RCL_
10	RecordValue 7 = BMW-part number ( always 0ffh )	M	FFh	RCL_
11	RecordValue 8 = BMW-part number ( always 0ffh )	M	FFh	RCL_
12	RecordValue 9 = ALTER_COD_0	M	XXh	RCL_
13	RecordValue 10 = ALTER_COD_1	M	XXh	RCL_

**Else(3)**  
     **If(4)** LV\_VAR\_ECRAS\_UP = 1  
     **and**  
     ( (B\_dev0detec = 1 and B\_dev3detec= 0 and B\_dev6detec = 0)  
     **or**  
     (B\_dev0detec = 0 and B\_dev3detec= 1 and B\_dev6detec = 0)  
     **or**  
     (B\_dev0detec = 0 and B\_dev3detec= 0 and B\_dev6detec = 1)  
     )  
     **Then(4)** send Positive Response

1	ReadDataByCommonIdentifier Response Service Id	M	62h	RDBCIPR
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	02h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	3Dh	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number ( always Offh )	M	FFh	RCI_
7	RecordValue 4 = BMW-part number ( always Offh )	M	FFh	RCI_
8	RecordValue 5 = BMW-part number ( always Offh )	M	FFh	RCI_
9	RecordValue 6 = BMW-part number ( always Offh )	M	FFh	RCI_
10	RecordValue 7 = BMW-part number ( always Offh )	M	FFh	RCI_
11	RecordValue 8 = BMW-part number ( always Offh )	M	FFh	RCI_
12	RecordValue 9 = STATE_ECRAS_UP_VAR	M	XXh	RCI_

**Else(4)** send negative Response "Request out of range" ( 31h)  
**Endif(4)**

**Endif(3)**

**Endif(2)**

**Endif(1)**

### I.23.10 22\_1603 - Read detailed informations of third intelligent subbus member

#### General information:

This function is created to read out the detailed informations of third intelligente subbus member.

#### Request Service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Request Service Id	M	22h	RDBC
2	RecordCommonIdentifier read values	M	16h	RCI_
3	RecordCommonIdentifier	M	03h	RCI_

#### Formula section (not for MSD85):

**If(1)** service 22\_16\_03 is received

**Then(1)**

**If(2)** B\_dev0detec = 1 and B\_dev3detec= 1 and B\_dev6detec = 1

**Then(2)** send Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Response Service Id	M	62h	RDBCIPR
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	03h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	03h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number ( always Offh )	M	FFh	RCI_
7	RecordValue 4 = BMW-part number ( always Offh )	M	FFh	RCI_
8	RecordValue 5 = BMW-part number ( always Offh )	M	FFh	RCI_
9	RecordValue 6 = BMW-part number ( always Offh )	M	FFh	RCI_
10	RecordValue 7 = BMW-part number ( always Offh )	M	FFh	RCI_
11	RecordValue 8 = BMW-part number ( always Offh )	M	FFh	RCI_
12	RecordValue 9 = ALTER_COD_0	M	XXh	RCI_
13	RecordValue 10 = ALTER_COD_1	M	XXh	RCI_

**Else(2)** send negative Response "Request out of range" ( 31h)

**Endif(2)**

**Endif(1)**

**Formula section (only for MSD85):**

**If(1)** service 22\_16\_03 is received

**Then(1)**

**If(2)** B\_dev0detec = 1 and B\_dev3detec= 1 and B\_dev6detec = 1

**Then(2)** send Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Response Service Id	M	62h	RDBCIPR
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	03h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	03h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number ( always Offh )	M	FFh	RCI_
7	RecordValue 4 = BMW-part number ( always Offh )	M	FFh	RCI_
8	RecordValue 5 = BMW-part number ( always Offh )	M	FFh	RCI_
9	RecordValue 6 = BMW-part number ( always Offh )	M	FFh	RCI_
10	RecordValue 7 = BMW-part number ( always Offh )	M	FFh	RCI_
11	RecordValue 8 = BMW-part number ( always Offh )	M	FFh	RCI_
12	RecordValue 9 = ALTER_COD_0	M	XXh	RCI_
13	RecordValue 10 = ALTER_COD_1	M	XXh	RCI_

**Elseif(2)**

**If(3)** LV\_VAR\_ECRAS\_UP = 1

**and**

**(**

(B\_dev0detec = 1 and B\_dev3detec= 1 and B\_dev6detec = 0)

**or** (B\_dev0detec = 1 and B\_dev3detec= 0 and B\_dev6detec = 1)

**or** (B\_dev0detec = 0 and B\_dev3detec= 1 and B\_dev6detec = 1)

**)**

**Then(3)** send Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Response Service Id	M	62h	RDBCIPR
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	03h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	3Dh	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number ( always Offh )	M	FFh	RCI_
7	RecordValue 4 = BMW-part number ( always Offh )	M	FFh	RCI_
8	RecordValue 5 = BMW-part number ( always Offh )	M	FFh	RCI_
9	RecordValue 6 = BMW-part number ( always Offh )	M	FFh	RCI_
10	RecordValue 7 = BMW-part number ( always Offh )	M	FFh	RCI_
11	RecordValue 8 = BMW-part number ( always Offh )	M	FFh	RCI_
12	RecordValue 9 = STATE_ECRAS_UP_VAR	M	XXh	RCI_

**Else(3)** send negative Response "Request out of range" ( 31h)  
**Endif(3)**

**Endif(2)**

**Endif(1)**

### I.23.11 22\_1604 - Read detailed informations of fourth intelligent subbus member

#### General information:

This function is created to read out the detailed informations of fourth intelligente subbus member.

#### Request Service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Request Service Id	M	22h	RDBCII
2	RecordCommonIdentifier read values	M	16h	RCI_
3	RecordCommonIdentifier	M	04h	RCI_

#### Formula section (not for MSD85):

**If(1)** service 22\_16\_04 is received  
**Then(1)** send negative Response "Request out of range" (31h)  
**Endif(1)**

#### Formula section (only for MSD85):

**If(1)** service 22\_16\_04 is received  
**Then(1)**  
**If(2)** B\_dev0detec = 1  
**and** B\_dev3detec = 1  
**and** B\_dev6detec = 1  
**and** LV\_VAR\_ECRAS\_UP = 1  
**Then(2)** send Positive Response



Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Response Service Id	M	62h	RDBCIPR
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	04h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	3Dh	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number ( always Offh )	M	FFh	RCI_
7	RecordValue 4 = BMW-part number ( always Offh )	M	FFh	RCI_
8	RecordValue 5 = BMW-part number ( always Offh )	M	FFh	RCI_
9	RecordValue 6 = BMW-part number ( always Offh )	M	FFh	RCI_
10	RecordValue 7 = BMW-part number ( always Offh )	M	FFh	RCI_
11	RecordValue 8 = BMW-part number ( always Offh )	M	FFh	RCI_
12	RecordValue 9 = STATE_ECRAS_UP_VAR	M	XXh	RCI_

Else(2) send negative Response "Request out of range" ( 31h)  
 Endif(2)

Endif(1)

### I.23.12 22\_1605 ..22\_16FF Read detailed informations of other intelligent subbus member

#### General information:

This function is created to read out the detailed informations of other intelligente subbus members

#### Request Service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Request Service Id	M	22h	RDBCI
2	RecordCommonIdentifier read values	M	16h	RCI_
3	RecordCommonIdentifier	M	XXh [ 05h, .. FFh ]	RCI_

#### Formula section:

If(1) service 22\_16\_05..FF is received  
 Then(1) send negative Response "Request out of range" ( 31h)  
 Endif(1)

### I.23.13 22\_2000 - Read failure memory short

#### General information:

This function is to read out the numbers of faults in the error memory and the status of CDK (see also Fault-type-byte and fault-type extension byte (chapter OBDII functions)).

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier High Byte	M	20h	RCI_RDTCBS
3	RecordCommonIdentifier Low Byte	M	00h	RCI_RDTCBS

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	20h	RCI_RDTCBS
3	RecordCommonIdentifier Low Byte	M	00h	RCI_RDTCBS
4	numberOfCDK - CTR_ERR_DYN_NR	M	01h-XXh	NROCDK
5..24	ListOfCDKAndStatus= [ CDK0 high byte ERR_DTC[0] CDK0 low byte ERR_DTC[0] statusOfCDK 1 ERR_TYPE_BYTE[0] CDK1 high byte ERR_DTC[1] CDK1 low byte ERR_DTC[1] statusOfCDK 2 ERR_TYPE_BYTE[1] . . . CDK(NC_NR_ERR_DYN - 1) CDK(NC_NR_ERR_DYN - 1) statusOfCDK n ERR_TYPE_BYTE[NC_NR_ERR_DYN - 1] ]	C C C C C C . . . C C C	[ XXh XXh XXh XXh XXh XXh . . . XXh XXh XXh ]	LOCDKAS

## I.23.14 22\_2100 - Read History Memory

### General information:

This function is created to read out the history memory with all the errors (max. 10, see also History memory (chapter OBDII functions)). The checksum calculation for each error is a simple XOR of all the bytes belonging to that error.

### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier High Byte	M	21h	RCI_
3	RecordCommonIdentifier Low Byte	M	00h	RCI_

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Response Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier= Read History Memory	M	21h	RCI_TSP
3	RecordCommonIdentifier	M	00h	RCI_TSP
4	RecordValue 1 = Error counter total (supplier name: CTR_ERR_HIS_NR)	M	XXh	RV_
5	RecordValue 2 = Error code "CDK" high byte (supplier name: HIS_COD[x])	M	XXh	RV_
6	RecordValue 3 = Error code "CDK" low byte (supplier name: HIS_COD[x])	M	XXh	RV_
7	RecordValue 4 = status DTC1 (supplier name: HIS[1][x])	M	XXh	RV_
8	RecordValue 5 = Frequency counter (supplier name: HIS[2][x])	M	XXh	RV_
9	RecordValue 6 = km-value by first occur high byte (supplier name: HIS[3][x])	M	XXh	RV_
10	RecordValue 7 = km-value by first occur low byte (supplier name: HIS[4][x])	M	XXh	RV_
11	RecordValue 8 = km-value by second occur high byte (supplier name: HIS[5][x])	M	XXh	RV_
12	RecordValue 9 = km-value by second occur low byte (supplier name: HIS[6][x])	M	XXh	RV_
13	RecordValue 8 = km-value by last occur high byte (supplier name: HIS[7][x])	M	XXh	RV_
14	RecordValue 9 = km-value by last occur low byte (supplier name: HIS[8][x])	M	XXh	RV_
15	RecordValue 10 = Error class "CLA" (supplier name: HIS[9][x])	M	FFh	RV_
16	RecordValue 11= checksum for this DTC	M	FFh	RV_
17	next failure - convention see 5d as follows	M	XXh	RV_
18	:			RV_
19	:			RV_
5 +(n*9)	RecordValue 2 +(n*9)d 11= checksum for the last DTC (maximum is 10 DTC's)	M	FFh	RV_

## I.23.15 22\_2500 - Programm Reference Backup

### General information:

This function is for reading the Programmreference backup from the logistic data of the ecu.

### Application conditions


**Initialisation:** *at reset*

**Activation:** K1.15 on  
engine speed=0rpm

**Deactivation:** K1.15 off  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

### **Request**

Released by Tetenborn Frank		Date 2013-02-13	File 43I00V01.00F
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7579 of 8404	
Regensburg (RGB)		Copyright ( C ) Continental AG,2007	A4: 2007-11

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	25h	RCI_
3	RecordCommonIdentifier Low Byte	M	00h	RCI_

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	25h	RCI_TSP
3	RecordCommonIdentifier Low Byte	M	00h	RCI_TSP
4+ 3*(12+6)	recordValue1 backup of programm reference system - cif_backup	M	XXh	RV_

## I.23.16 22\_2501 - Erasing time

### General information:

This function ist for reading the erasing time of the flash memory of the ecu.

### Application conditions

**Initialisation:** at reset

**Activation:** Kl.15 on  
engine speed=0rpm

**Deactivation:** Kl.15 off  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	25h	RCI_
3	RecordCommonIdentifier Low Byte	M	01h	RCI_

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	25h	RCI_TSP
3	RecordCommonIdentifier Low Byte	M	01h	RCI_TSP
4	recordValue1 max. erasing time del_time_max	M	XXh	RV_
5	recordValue1 max. time for signature check kwp_sigt	M	XXh	RV_
6	recordValue1 max. time for ECU reset kwp_rst	M	XXh	RV_
7	recordValue1 max. time for authentication kwp_auth	M	XXh	RV_

## I.23.17 22\_2502 - Hardware reference

**General information:**

This function ist for reading the hardware reference of the ecu.

**Application conditions**

**Initialisation:** *at reset*

**Activation:** Kl.15 on  
engine speed=0rpm

**Deactivation:** Kl.15 off  
Diagnostic timeout  
Service location: see list of implemented diagnostic services

**Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier High Byte	M	25h	RCL_
3	RecordCommonIdentifier Low Byte	M	02h	RCL_

**Positive Response on service**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	25h	RCL_TSP
3	RecordCommonIdentifier Low Byte	M	02h	RCL_TSP
4	recordValue1 hardware reference hw_reference	M	XXh	RV_

**I.23.18 22\_2503 - Programm reference****General information:**

This function ist for reading the programm reference of the ecu.

**Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier High Byte	M	25h	RCL_
3	RecordCommonIdentifier Low Byte	M	03h	RCL_

**Positive Response on service**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	25h	RCL_TSP
3	RecordCommonIdentifier Low Byte	M	03h	RCL_TSP
4 6+3*12	recordValue1 ecu_sw_reference	M	XXh	RV_

## I.23.19 22\_2504 - Data reference

### General information:

This function ist for reading the data reference of the ecu.

### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier High Byte	M	25h	RCI_
3	RecordCommonIdentifier Low Byte	M	04h	RCI_

Figure I.23.1: Table Request Message

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	25h	RCI_TSP
3	RecordCommonIdentifier Low Byte	M	04h	RCI_TSP
4 6+3*17	RecordValue1 cal_ref_nr	M	XXh	RV_

## I.23.20 22\_2506 - Maximum of block length

### General information:

This function is for reading the maximum of block length, witch is possible for the ecu.

### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier High Byte	M	25h	RCI_
3	RecordCommonIdentifier Low Byte	M	06h	RCI_


### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	25h	RCI_TSP
3	RecordCommonIdentifier Low Byte	M	06h	RCI_TSP
4	RecordValue1 high byte = kwp_max_tel_len maximum block length	M	XXh	RV_
5	RecordValue1 low byte = kwp_max_tel_len maximum block length	M	XXh	RV_

## I.23.21 22\_3000 - RCI\_MIL\_lesen

### General information:

### MIL Codierung lesen

Released by Tettenborn Frank		Date 2013-02-13	File 43I00V01.00F
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7582 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

This function is created to read out the selected value of MIL (malfunction indication lamp) variant code.

### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier High Byte	M	30h	RCI_MIL_lesen
3	RecordCommonIdentifier Low Byte	M	00h	RCI_MIL_lesen

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	30h	RCI_MIL_lesen
3	RecordCommonIdentifier Low Byte	M	00h	RCI_MIL_lesen
4	recordValue = STATE_MIL_ON_DIS_EXT_REQ	M	XXh	RV_STATE_MIL_ON_DIS_EXT_REQ

## I.23.22 22\_3001 - RCI\_KAT\_lesen

### General information:

#### Kat Codierung lesen

This function is created to read out the selected value of catalyst variant code.

### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier High Byte	M	30h	RCI_KAT_lesen
3	RecordCommonIdentifier Low Byte	M	01h	RCI_KAT_lesen

### Positive Response on service


Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	30h	RCI_KAT_lesen
3	RecordCommonIdentifier Low Byte	M	01h	RCI_KAT_lesen
4	recordValue 1= LV_CAT_CONF_DIS_EXT_REQ	M	XXh	RV_LV_CAT_CONF_DIS_EXT_REQ

## I.23.23 22\_3010 - RCI\_VMAX\_lesen

### General information:

#### VMAX-Codierdaten lesen

This function is created to read out the selected value for maximum vehicle speed. The values 0 ... 3 represent one of four possible values for maximum vehicle speed.

Released by Tettenborn Frank		Date 2013-02-13	File 43I00V01.00F
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7583 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

## Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	30h	RCI_VMAX_lesen
3	RecordCommonIdentifier Low Byte	M	10h	RCI_VMAX_lesen

## Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	30h	RCI_VMAX_lesen
3	RecordCommonIdentifier Low Byte	M	10h	RCI_VMAX_lesen
4	recordValue 1 = VS_MAX_SEL_EXT_REQ	M	XXh	RV_VS_MAX_SEL_EXT_REQ

## I.23.24 22\_3020 - RCI\_CLS\_lesen

### General information:

#### STATUS\_CODIERUNG\_LEISTUNGSSTUFE

This function is created to read out the coding of power stage (Leistungsstufe)

## Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	30h	RCI_CLS_lesen
3	RecordCommonIdentifier Low Byte	M	20h	RCI_CLS_lesen

## Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	30h	RCI_CLS_lesen
3	RecordCommonIdentifier Low Byte	M	20h	RCI_CLS_lesen
4	recordValue 1 = POW_CONF_IDX_EXT_REQ	M	XXh	RV_POW_CONF_IDX_EXT_REQ

## I.23.25 22\_3030 - Status Codierung Protokoll lesen

### General information:

This function is created to read out the active communication protocol ( 14230 <-> 15765-4 ).

## Request



Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	30h	RCI_CDSP
3	RecordCommonIdentifier Low Byte	M	30h	RCI_CDSP

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	30h	RCI_CDSP
3	RecordCommonIdentifier Low Byte	M	30h	RCI_CDSP
4	recordValue = PROT_CONF_IDX_EXT_REQ	M	XXh	RV_CDSP

## I.23.26 22\_3200 - RCI\_OEL\_lesen

### General information:

#### Oelwechsel intervall- Codierdaten lesen

This function is created to read out the country dependant factors for oil change intervall.

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	32h	RCI_OEL_lesen
3	RecordCommonIdentifier Low Byte	M	00h	RCI_OEL_lesen

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	32h	RCI_OEL_lesen
3	RecordCommonIdentifier Low Byte	M	00h	RCI_OEL_lesen
4	recordValue 1 = FAC_OIL_EXT_REQ_1	M	XXh	RV_FAC_OIL_EXT_REQ_1
5	recordValue 2 = FAC_OIL_EXT_REQ_2	M	XXh	RV_FAC_OIL_EXT_REQ_2

## I.23.27 22\_3210 - RCI\_IGR\_lesen

### General information:

#### Read coding of IGR (Intelligente Generator-Regelung)

This function is created to read out the selected value intelligent alternator control variant code.

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	32h	RCI_IGR_lesen
3	RecordCommonIdentifier Low Byte	M	10h	RCI_IGR_lesen

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	32h	RCI_IGR_lesen
3	RecordCommonIdentifier Low Byte	M	10h	RCI_IGR_lesen
4	recordValue = LV_ALTER_CTL_ENA	M	XXh	RV_LV_ALTER_CTL_ENA

## I.23.28 22\_3211 - Xenonverbau-Codierdaten lesen

### General information:

This function is created to read out the selected value of "xenon-filled headlight mounted" variant code.

### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	32h	RCI_CDXEN
3	RecordCommonIdentifier Low Byte	M	11h	RCI_CDXEN

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	32h	RCI_CDXEN
3	RecordCommonIdentifier Low Byte	M	11h	RCI_CDXEN
4	recordValue = B_cd xenonr	M	XXh	RV_B_CDXENON

## I.23.29 22\_3220 - RCI\_SPA\_lesen

### General information:

### SPA-Codierdaten lesen

This function is created to read out the "Schaltpunktanzeige"

### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	32h	RCI_SPA_lesen
3	RecordCommonIdentifier Low Byte	M	20h	RCI_SPA_lesen

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	32h	RCI_SPA_lesen
3	RecordCommonIdentifier Low Byte	M	20h	RCI_SPA_lesen
4	recordValue1 = B_spa_csoll	M	XXh	RV_SPA_CSOLL
5	recordValue1 = B_spa_cist	M	XXh	RV_SPA_CIST

### I.23.30 22\_3230 - RCI\_BZE\_lesen

#### General information:

#### BZE-Codierdaten lesen

This function is created to read out the "Batteriezustands Erkennung"

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	32h	RCI_BZE_lesen
3	RecordCommonIdentifier Low Byte	M	30h	RCI_BZE_lesen

#### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	32h	RCI_BZE_lesen
3	RecordCommonIdentifier Low Byte	M	30h	RCI_BZE_lesen
4	recordValue1 = Qv_cdherst_1	M	XXh	RV_CD_HERST1
5	recordValue2 = Qv_cdherst_2	M	XXh	RV_CD_HERST2
6	recordValue3 = Qv_cdherst_3	M	XXh	RV_CD_HERST3
7	recordValue4 = Qv_cdherst_4	M	XXh	RV_CD_HERST4
8	recordValue5 = Qv_cdherst_5	M	XXh	RV_CD_HERST5
9	recordValue6 = Qv_cdherst_6	M	XXh	RV_CD_HERST6
10	recordValue7 = Qv_cdherst_7	M	XXh	RV_CD_HERST7
11	recordValue8 = Qv_cdherst_8	M	XXh	RV_CD_HESRT8

### I.23.31 22\_3240 - RCI\_AGK\_lesen

#### General information:

#### Read Coding Exhaust gas flap

This function is created to read out "Codierung fuer Abgasklappe auslesen"

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	32h	RCL_AGK_Iesen
3	RecordCommonIdentifier Low Byte	M	40h	RCL_AGK_Iesen

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	32h	RCL_AGK_Iesen
3	RecordCommonIdentifier Low Byte	M	40h	RCL_AGK_Iesen
4	recordValue1 = CONF_EF	M	XXh	RV_CODIERUNG_AGK

## I.23.32 22\_3250 - Read Coding of MSA

### General information:

With this comand the coding value of MSA is read out.

### Application conditions

**Initialisation:** - -

**Activation:** LV\_IGK = 1

**Deactivation:** LV\_IGK = 0  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

### Formula Section:

### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Request Service Id	M	22h	RDBCI
2	RecordCommonIdentifier	M	32h	RCL_CDMSA
3	RecordCommonIdentifier	M	50h	RCL_CDMSA

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Response Service Id	M	62h	RDBCIPR
2	RecordCommonIdentifier	M	32h	RCL_CDMSA
3	RecordCommonIdentifier	M	50h	RCL_CDMSA
4	recordValue1 = LV_STST_VAR_COD	M	XXh	RV_CODIERUNG_MSA

## I.23.33 22\_3260 - Read CDASMOT

**General information:**

This function is created to read out the "Codierung elektrische Diagnose der Funktion Abschaltung Klemme 15"

**Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	32h	RCI_CDASMOT
3	RecordCommonIdentifier Low Byte	M	60h	RCI_CDASMOT

**Positive Response on service**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	32h	RCI_CDASMOT
3	RecordCommonIdentifier Low Byte	M	60h	RCI_CDASMOT
5	recordValue1 = LV_IGK_OFF_ACK_ENA ( 0 - diagnosis off, 1 - diagnosis on )	M	XXh [0h, 1h]	RV_CODIERUNG _ASMOT

**I.23.34 22\_4000 - RCI\_MW\_lesen****General information:****STATUS\_MESSWERTE**

This function is created to read out the described values from the ecu.

**Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	40h	RCI_MW
3	RecordCommonIdentifier Low Byte	M	00h	RCI_MW

**Positive Response on service**

Data Byte	Parameter Name	Cv t	Hex Value	Mnemonic
1	<b>Response Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier High Byte	M	40h	RCI_MW
3	RecordCommonIdentifier Low Byte	M	00h	RCI_MW
4	recordValue1 = TI_1_HOM[0] high byte	M	XXh	RV_TI_1_HOM[0]
5	recordValue2 = TI_1_HOM[0] low byte	M	XXh	RV_TI_1_HOM[0]
6	recordValue3 = FAC_LAM_LIM[[1] high byte	M	XXh	RV_FAC_LAM_LIM[[1]
7	recordValue4 = FAC_LAM_LIM[[1] low byte	M	XXh	RV_FAC_LAM_LIM[[1]
8	recordValue5 = FAC_LAM_LIM[[2] high byte	M	XXh	RV_FAC_LAM_LIM[[2]
9	recordValue6 = FAC_LAM_LIM[[2] low byte	M	XXh	RV_FAC_LAM_LIM[[2]
10	recordValue7 = VS	M	XXh	RV_VS
11	recordValue8 = N high byte	M	XXh	RV_N
12	recordValue9 = N low byte	M	XXh	RV_N
13	recordValue10 = N_SP_IS high byte	M	XXh	RV_N_SP_IS
14	recordValue11 = N_SP_IS low byte	M	XXh	RV_N_SP_IS
15	recordValue12 = CAM_IN[1] high byte -if word <b>(not MSD85)</b> 0 - if byte <b>(not MSD85)</b> CAM_IN_H[1] high byte <b>(only MSD85)</b>	M	XXh	RV_CAM_IN_H[1]
16	recordValue13 = CAM_IN[1] low byte- if word <b>(not MSD85)</b> CAM_IN[1] - if byte <b>(not MSD85)</b> CAM_IN_H[1] low byte <b>(only MSD85)</b>	M	XXh	RV_CAM_IN_H[1]
17	recordValue14 = CAM_EX[1]	M	XXh	RV_CAM_EX[1]
18	recordValue15 = Dummy	M	FFh	RV_DUMMY_1
19	recordValue16 = TIA	M	XXh	RV_TIA
20	recordValue17 = TCO_MES	M	XXh	RV_TCO_MES
21	recordValue18 = IGA_IGC[0]	M	XXh	RV_IGA_IGC[0]
22	recordValue19 = TPS_AV_1 high byte <b>(not MS85)</b> TPS_AV_1[0] high byte <b>(only MSD85)</b>	M	XXh	RV_TPS_AV_1[1]
23	recordValue20 = TPS_AV_1 low byte <b>(not MSD85)</b> TPS_AV_1[0] low byte <b>(only MSD85)</b>	M	XXh	RV_TPS_AV_1[1]
24	recordValue21 = MAF_KGH_MES_BAS high byte <b>(not MSD85)</b> MAF_KGH_MES_BAS[0] high byte <b>(only MSD85)</b>	M	XXh	RV_MAF_KGH_MES_BAS[1]
25	recordValue22 = MAF_KGH_MES_BAS low byte <b>(not MSD85)</b> MAF_KGH_MES_BAS[0] high byte <b>(only MSD85)</b>	M	XXh	RV_MAF_KGH_MES_BAS[1]
26	recordValue23 = TQI_AV high byte	M	XXh	RV_TQI_AV
27	recordValue24 = TQI_AV low byte	M	XXh	RV_TQI_AV
28	recordValue25 = VB	M	XXh	RV_VB
29	recordValue26 = V_PVS_1 high byte	M	XXh	V_PVS_1
30	recordValue27 = V_PVS_1 low byte	M	XXh	RV_V_PVS_1
31	recordValue28 = TCO_2_MES	M	XXh	RV_TCO_2_MES
32	recordValue29 = NL[0] high byte	M	XXh	RV_NL[0]
33	recordValue30 = NL[0] low byte	M	XXh	RV_NL[0]
34	recordValue31 = NL[1] high byte	M	XXh	RV_NL[1]
35	recordValue32 = NL[1] low byte	M	XXh	RV_NL[1]
36	recordValue33 = NL[2] high byte	M	XXh	RV_NL[2]
37	recordValue34 = NL[2] low byte	M	XXh	RV_NL[2]
38	recordValue35 = NL[3] high byte	M	XXh	RV_NL[3]
39	recordValue36 = NL[3] high byte	M	XXh	RV_NL[3]
40	recordValue37 = NL[4] low byte	M	XXh	RV_NL[4]
41	recordValue38 = NL[4] low byte	M	XXh	RV_NL[4]
42	recordValue39 = NL[5] high byte	M	XXh	RV_NL[5]

43	recordValue40 = NL[5] low byte	M	XXh	RV_NL[5]
44	recordValue41 = NL[6] low byte	M	XXh	RV_NL[6]
-	recordValue42 = NL[6] low byte	M	XXh	RV_NL[6]
46	recordValue43 = NL[7] high byte	M	XXh	RV_NL[7]
47	recordValue44 = NL[7] low byte	M	XXh	RV_NL[7]

**Note: RecordValue data for not available components are FFh**

### I.23.35 22\_4001 - RCI\_BLZ\_lesen

#### General information:

#### Read values batterie generator

This function is created to read out the described values from the ecu.

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier High Byte	M	40h	RCI_BLZ_lesen
3	RecordCommonIdentifier Low Byte	M	01h	RCI_BLZ_lesen

#### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	40h	RCI_BLZ_lesen
3	RecordCommonIdentifier Low Byte	M	01h	RCI_BLZ_lesen
4	recordValue1 = Dfmonitor	M	XXh	Dfmonitor

### I.23.36 22\_4002 - RCI\_SSZ1\_lesen

#### General information:

#### Read Switch Position

This function is created to read the actual position of the car switches.

All switches are active 1 in the Bit position, as well as ground was switched.

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier High Byte	M	40h	RCI_SSZ1_lesen
3	RecordCommonIdentifier Low Byte	M	02h	RCI_SSZ1_lesen

#### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	40h	RCI_SSZ1_lesen
3	RecordCommonIdentifier Low Byte	M	02h	RCI_SSZ1_lesen
4	recordValue1 = Bitfield1	M	XXh	RV_SWITCH_POSITION

**Note:** For data, longer than one byte, the lowest byte is sent first

Byte #	Name	Size	Conversion (hex/bin)	Conversion (physical)	Mnemonic	Resol.
#4d	Bitfield 1	1	xxxxxx1 b xxxxx1x b xxxxx1xx b xxxx1xxx b xxx1xxxx b xx1xxxxx b x1xxxxxx b 1xxxxxxx b	LV_IGK LV_ES LV_CS LV_IM_BLS LV_IM_BTS not used not used LV_ACCOUT_RLY	RV_LV_IGK RV_LV_ES RV_LV_CS RV_LV_IM_BLS RV_LV_IM_BTS  RV_LV_ACCOUT_RLY	

### I.23.37 22\_4003 - RCI\_MLR\_lesen

#### General information:

#### Read values of engine roughness

This function is created to read out the values from the function-test engine roughness.

The calculation of the function is described in the chapter OBDII functions.

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	40h	RCI_MLR
3	RecordCommonIdentifier Low Byte	M	03h	RCI_MLR

#### Positive Response on service



Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	40h	RCI_MLR
3	RecordCommonIdentifier Low Byte	M	03h	RCI_MLR
4	recordValue1 high byte = ER_MMV_IS_DIAG[0]	M	XXh	RV_ER_MMV_IS_DIAG[0]
5	recordValue2 low byte = ER_MMV_IS_DIAG[0]	M	XXh	RV_ER_MMV_IS_DIAG[0]
6	recordValue3 high byte = ER_MMV_IS_DIAG[1]	M	XXh	RV_ER_MMV_IS_DIAG[1]
7	recordValue4 low byte = ER_MMV_IS_DIAG[1]	M	XXh	RV_ER_MMV_IS_DIAG[1]
8	recordValue5 high byte = ER_MMV_IS_DIAG[2]	M	XXh	RV_ER_MMV_IS_DIAG[2]
9	recordValue6 low byte = ER_MMV_IS_DIAG[2]	M	XXh	RV_ER_MMV_IS_DIAG[2]
10	recordValue7 high byte = ER_MMV_IS_DIAG[3]	M	XXh	RV_ER_MMV_IS_DIAG[3]
11	recordValue8 low byte = ER_MMV_IS_DIAG[3]	M	XXh	RV_ER_MMV_IS_DIAG[3]
12	recordValue9 high byte = ER_MMV_IS_DIAG[4]	M	XXh	RV_ER_MMV_IS_DIAG[4]
13	recordValue10 low byte = ER_MMV_IS_DIAG[4]	M	XXh	RV_ER_MMV_IS_DIAG[4]
14	recordValue11 high byte = ER_MMV_IS_DIAG[5]	M	XXh	RV_ER_MMV_IS_DIAG[5]
15	recordValue12 low byte = ER_MMV_IS_DIAG[5]	M	XXh	RV_ER_MMV_IS_DIAG[5]
16	recordValue13 Byte = LV_SEG_AD_AVL_ER	M	XXh	RV_LV_SEG_AD_AVL_ER
17	recordValue14 high byte = VLS_UP[1]	M	XXh	RV_VLS_UP[1]
18	recordValue15 low byte = VLS_UP[1]	M	XXh	RV_VLS_UP[1]
19	recordValue16 high byte = VLS_UP[2]	M	XXh	RV_VLS_UP[2]
20	recordValue17 low byte = VLS_UP[2]	M	XXh	RV_VLS_UP[2]
21	recordValue18 high byte = ER_MMV_IS_DIAG[6]	M	XXh	RV_ER_MMV_IS_DIAG[6]
22	recordValue19 low byte = ER_MMV_IS_DIAG[6]	M	XXh	RV_ER_MMV_IS_DIAG[6]
23	recordValue 20 high byte = ER_MMV_IS_DIAG[7]	M	XXh	RV_ER_MMV_IS_DIAG[7]
24	recordValue 21 low byte = ER_MMV_IS_DIAG[7]	M	XXh	RV_ER_MMV_IS_DIAG[7]

**Note: RecordValue data for not available components are FFh**

## I.23.38 22\_4006 - RCI\_NWA\_lesen

### General information:

#### Read CAMSHAFT-Sensor Adaption

This function is created to read the actual adaption data form the camshaft sensor of the engine. All switches are active 1 in the Bit position, as well as ground was switched.

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	40h	RCI_NWA_lesen
3	RecordCommonIdentifier Low Byte	M	06h	RCI_NWA_lesen

#### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Response Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier High Byte	M	40h	RCI_NWA_lesen
3	RecordCommonIdentifier Low Byte	M	06h	RCI_NWA_lesen
4	recordValue1 = NC_PSN_EDGE_CAM_EX[1][1] high Byte	M	XXh	RV_NC_PSN_EDGE_CAM_EX[1][1]
5	RecordValue 2 = NC_PSN_EDGE_CAM_EX[1][1] low Byte	M	XXh	RV_NC_PSN_EDGE_CAM_EX[1][1]
6	RecordValue 3= NC_PSN_EDGE_CAM_EX[6][1] high Byte	M	XXh	RV_NC_PSN_EDGE_CAM_EX[6][1]
7	RecordValue 4 = NC_PSN_EDGE_CAM_EX[6][1] low Byte	M	XXh	RV_NC_PSN_EDGE_CAM_EX[6][1]
8	RecordValue 5 = NC_PSN_EDGE_CAM_IN[1][1] high Byte	M	XXh	RV_NC_PSN_EDGE_CAM_IN[1][1]
9	RecordValue 6 = NC_PSN_EDGE_CAM_IN[1][1] low Byte	M	XXh	RV_NC_PSN_EDGE_CAM_IN[1][1]
10	RecordValue 7 = NC_PSN_EDGE_CAM_IN[6][1] high Byte	M	XXh	RV_NC_PSN_EDGE_CAM_IN[6][1]
11	RecordValue 8 = NC_PSN_EDGE_CAM_IN[6][1] low Byte	M	XXh	RV_NC_PSN_EDGE_CAM_IN[6][1]
12	RecordValue 9 = PSN_EDGE_AD_CAM_IN[1] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[1] [1]
13	RecordValue 10 = PSN_EDGE_AD_CAM_IN[1] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[1] [1]
14	RecordValue 11 = PSN_EDGE_AD_CAM_IN[2] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[2] [1]
15	RecordValue 12 = PSN_EDGE_AD_CAM_IN[2] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[2] [1]
16	RecordValue 13 = PSN_EDGE_AD_CAM_IN[3] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[3] [1]
17	RecordValue 14 = PSN_EDGE_AD_CAM_IN[3] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[3] [1]
18	RecordValue 15 = PSN_EDGE_AD_CAM_IN[4] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[4] [1]
19	RecordValue 16 = PSN_EDGE_AD_CAM_IN[4] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[4] [1]
20	RecordValue 17 = PSN_EDGE_AD_CAM_IN[5] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[5] [1]
21	RecordValue 18 = PSN_EDGE_AD_CAM_IN[5] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[5] [1]
22	RecordValue 19 = PSN_EDGE_AD_CAM_IN[6] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[6] [1]
23	RecordValue 20 = PSN_EDGE_AD_CAM_IN[6] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[6] [1]
24	RecordValue 21 = PSN_EDGE_AD_CAM_EX[1] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[1] [1]
25	RecordValue 22 = PSN_EDGE_AD_CAM_EX[1] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[1] [1]
26	RecordValue 23 = PSN_EDGE_AD_CAM_EX[2] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[2] [1]
27	RecordValue 23 = PSN_EDGE_AD_CAM_EX[2] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[2] [1]
28	RecordValue 25 = PSN_EDGE_AD_CAM_EX[3] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[3] [1]

29	RecordValue 26 = PSN_EDGE_AD_CAM_EX[3] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[3] [1]
30	RecordValue 27 = PSN_EDGE_AD_CAM_EX[4] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[4] [1]
31	RecordValue 28 = PSN_EDGE_AD_CAM_EX[4] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[4] [1]
32	RecordValue 29 = PSN_EDGE_AD_CAM_EX[5] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[5] [1]
33	RecordValue 30 = PSN_EDGE_AD_CAM_EX[5] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[5] [1]
34	RecordValue 31 = PSN_EDGE_AD_CAM_EX[6] [1] high Byte	M	XXh	RV_SN_EDGE_AD_CAM_EX[6] [1]
35	RecordValue 32 = PSN_EDGE_AD_CAM_EX[6] [1] low Byte	M	XXh	RV_SN_EDGE_AD_CAM_EX[6] [1]
36	RecordValue 33 = NC_PSN_EDGE_CAM_EX[1] [2] high Byte	M	XXh	RV_NC_PSN_EDGE_CAM_EX[1] [2]
37	RecordValue 34 = NC_PSN_EDGE_CAM_EX[1] [2] low Byte	M	XXh	RV_NC_PSN_EDGE_CAM_EX[1] [2]
38	RecordValue 35 = NC_PSN_EDGE_CAM_EX[6] [2] high Byte	M	XXh	RV_NC_PSN_EDGE_CAM_EX[6] [2]
39	RecordValue 36 = NC_PSN_EDGE_CAM_EX[6] [2] low Byte	M	XXh	RV_NC_PSN_EDGE_CAM_EX[6] [2]
40	RecordValue 37 = NC_PSN_EDGE_CAM_IN[1] [2] high Byte	M	XXh	RV_NC_PSN_EDGE_CAM_IN[1] [2]
41	RecordValue 38 = NC_PSN_EDGE_CAM_IN[1] [2] low Byte	M	XXh	RV_NC_PSN_EDGE_CAM_IN[1] [2]
42	RecordValue 38 = NC_PSN_EDGE_CAM_IN[6] [2] high Byte	M	XXh	RV_NC_PSN_EDGE_CAM_IN[6] [2]
43	RecordValue 39 = NC_PSN_EDGE_CAM_IN[6] [2] low Byte	M	XXh	RV_NC_PSN_EDGE_CAM_IN[6] [2]
44	RecordValue 40 = PSN_EDGE_AD_CAM_IN[1][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[1][2]
-	RecordValue 41 = PSN_EDGE_AD_CAM_IN[1][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[1][2]
46	RecordValue 42 = PSN_EDGE_AD_CAM_IN[2][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[2][2]
47	RecordValue 43 = PSN_EDGE_AD_CAM_IN[2][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[2][2]
48	RecordValue 44 = PSN_EDGE_AD_CAM_IN[3][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[3][2]
49	RecordValue - = PSN_EDGE_AD_CAM_IN[3][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[3][2]
50	RecordValue 46 = PSN_EDGE_AD_CAM_IN[4][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[4][2]
51	RecordValue 47 = PSN_EDGE_AD_CAM_IN[4][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[4][2]
52	RecordValue 48 = PSN_EDGE_AD_CAM_IN[5][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[5][2]
53	RecordValue 49 = PSN_EDGE_AD_CAM_IN[5][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[5][2]
54	RecordValue 50 = PSN_EDGE_AD_CAM_IN[6][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[6][2]
55	RecordValue 50 = PSN_EDGE_AD_CAM_IN[6][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[6][2]
56	RecordValue 40 = PSN_EDGE_AD_CAM_EX[1][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[1][2]

57	RecordValue 41 = PSN_EDGE_AD_CAM_EX[1][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[1][2]
58	RecordValue 42 = PSN_EDGE_AD_CAM_EX[2][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[2][2]
59	RecordValue 43 = PSN_EDGE_AD_CAM_EX[2][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[2][2]
60	RecordValue 44 = PSN_EDGE_AD_CAM_EX[3][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[3][2]
61	RecordValue - = PSN_EDGE_AD_CAM_EX[3][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[3][2]
62	RecordValue 46 = PSN_EDGE_AD_CAM_EX[4][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[4][2]
63	RecordValue 47 = PSN_EDGE_AD_CAM_EX[4][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[4][2]
64	RecordValue 48 = PSN_EDGE_AD_CAM_EX[5][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[5][2]
65	RecordValue 49 = PSN_EDGE_AD_CAM_EX[5][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[5][2]
66	RecordValue 50 = PSN_EDGE_AD_CAM_EX[6][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[6][2]
67	RecordValue 50 = PSN_EDGE_AD_CAM_EX[6][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[6][2]

**Note: RecordValue data for not available components are FFh**

## I.23.39 22\_4007 - RCI\_S SZ0\_lesen

### General information:

#### Read State of Functions

This function is created to read the actual condition of the engine.

All switches are active 1 in the Bit position, as well as ground was switched.

### I.23.39.1 MSD 85 only

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	40h	RCI_S SZ0_lesen
3	RecordCommonIdentifier Low Byte	M	07h	RCI_S SZ0_lesen

#### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	40h	RCI_S SZ0_lesen
3	RecordCommonIdentifier Low Byte	M	07h	RCI_S SZ0_lesen
4	RecordValue 1 Bitfield1	M	XXh	2_BYTE_SWITCH_POSITION
5	RecordValue 2 Bitfield2	M	XXh	2_BYTE_SWITCH_POSITION
6	Not used	M	FFh	RV_DUMMY_1
7	Not used	M	FFh	RV_DUMMY_2
8	Not used	M	FFh	RV_DUMMY_3
9	Not used	M	FFh	RV_DUMMY_4

Note: For data longer than one byte, the lowest byte is sent first

Byte	Name	Size	Conversion (hex/bin)	Conversion (physical)		Resol.
4	Bitfield 1	1	xxxxxxx1 b xxxxxx1x b xxxxx1xx b xxxx1xxx b xxx1xxxx b xx1xxxxx b x1xxxxxx b 1xxxxxxx b	LV_IS LV_FL LV_LS_DOWN_READY[1] LV_LS_DOWN_READY[2] LV_LS_UP_READY[2] LV_LS_UP_READY[1] LV_LAM_LSCL[2] LV_LAM_LSCL[1]	RV_LV_IS RV_LV_FL RV_LV_LS_DOWN_READY[1] RV_LV_LS_DOWN_READY[2] RV_LV_LS_UP_READY[2] RV_LV_LS_UP_READY[1] RV_LV_LAM_LSCL[2] RV_LV_LAM_LSCL[1]	
Byte	Name	Size	Conversion (hex/bin)	Conversion (physical)		Resol.
5	Bitfield 2	1	xxxxxxx1 b xxxxxx1x b xxxxx1xx b xxxx1xxx b xxx1xxxx b xx1xxxxx b x1xxxxxx b 1xxxxxxx b  1xxxxxxx b	not used not used LV_KD LV_DRI not used not used LV_PUC LV_TPS_AD_REQ	not used not used RV_LV_KD RV_LV_DRI not used not used RV_LV_PUC RV_LV_TPS_AD_REQ	

### I.23.39.2 All other projects

#### General information:

This function is created to read the actual condition of the engine.  
All switches are active 1 in the Bit position, as well as ground was switched.

#### Request


Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Request Service Id	M	22h	RDBC1
2	RecordCommonIdentifier = Read state of the functions	M	40h	RCI_FUN
3	RecordCommonIdentifier	M	07h	RCI_FUN

Figure I.23.2: Table ReadDataByCommonIdentifier Request Message

#### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Response Service Id	M	62h	RDBCIPR
2	RecordCommonIdentifier= Read state of the functions	M	40h	RCI_SCH
3	RecordCommonIdentifier	M	07h	RCI_SCH
4	RecordValue Bitfield1	M	XXh	RV_B1
5	RecordValue Bitfield2	M	XXh	RV_B2
6	RecordValue Bitfield3	M	XXh	RV_B3
7	RecordValue Bitfield4	M	XXh	RV_B4
8	RecordValue Bitfield5	M	XXh	RV_B5
9	RecordValue Bitfield6	M	XXh	RV_B6

Figure I.23.3: Table ReadDataByCommonIdentifier Positive Response Message


Released by Tettenborn Frank		Date 2013-02-13	File 43I00V01.00F
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7597 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

Note: For data longer than one byte, the lowest byte is sent first

Byte	Name	Size	Conversion (hex/bin)	Conversion (physical)	Resol.
4	Bitfield 1	1	xxxxxxx1 b xxxxxx1x b xxxxx1xx b xxxx1xxx b xxx1xxxx b xx1xxxxx b x1xxxxxx b 1xxxxxxx b	LV_IS LV_FL LV_LS_DOWN_READY[1] LV_LS_DOWN_READY[2] LV_LS_UP_READY[2] LV_LS_UP_READY[1] LV_LAM_LSCL[2] LV_LAM_LSCL[1]	
5	Bitfield 2	1	xxxxxxx1 b xxxxxx1x b xxxxx1xx b xxxx1xxx b xxx1xxxx b xx1xxxxx b x1xxxxxx b 1xxxxxxx b  1xxxxxxx b	not used not used LV_KD LV_DRI not used not used LV_PUC LV_TPS_AD_REQ	
6	Bitfield 3 STATE_CRU_OFF_IR R (low_byte)	1	xxxxxxx1 b xxxxxx1x b xxxxx1xx b xxxx1xxx b xxx1xxxx b xx1xxxxx b x1xxxxxx b 1xxxxxxx b	Limit dynamic 1 Limit dynamic 2 Error clutch switch MSW error Timeout ETCU 1 Brake error not used not used	
7	Bitfield 4 STATE_CRU_OFF_IR R (high_byte)	1	xxxxxxx1 b xxxxxx1x b xxxxx1xx b xxxx1xxx b xxx1xxxx b xx1xxxxx b x1xxxxxx b 1xxxxxxx b	Monitoring level 2 VS plausibility ISA limp home aktive TPS limp home Error VS Time out ASR ETC limp home not used	
8	Bitfield 5 STATE_CRU_OFF_R EV (low_byte)	1	xxxxxxx1 b xxxxxx1x b  xxxxx1xx b xxxx1xxx b xxx1xxxx b xx1xxxxx b x1xxxxxx b 1xxxxxxx b	To high VS deviation Overtaking funct. To long or to high VS_DIF VS_SP_MAX to long External TQ intervention MSW request "OFF" not used not used not used	
9	Bitfield 6 STATE_CRU_OFF_R EV (high_byte)	1	xxxxxxx1 b xxxxxx1x b xxxxx1xx b xxxx1xxx b xxx1xxxx b xx1xxxxx b x1xxxxxx b 1xxxxxxx b	Error VS_CAN to long Acceleration monitoring Run up lock Overtaking and VS_MAX active VS_FIL to low Engine speed limitation Brake detection MSW request HARD_OFF	

## I.23.40 22\_4008 - RDBCI\_DK\_lesen

### General information:

Released by Tettenborn Frank		Date 2013-02-13	File 43I00V01.00F
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7598 of 8404	
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## Read Throttle and MAF-Adjustment Value

## I.23.40.1 MSD 85 only

## Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	40h	RCI_DKHF
3	RecordCommonIdentifier Low Byte	M	08h	RCI_DKHF

## Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	40h	RCI_DKHF
3	RecordCommonIdentifier Low Byte	M	08h	RCI_DKHF
4	RecordValue 1 = EISYEV_KOROFF_B_I_[0]	M	XXh	RV_EISYEV_KOROFF_B_I_[0]
5	RecordValue 2 = EISYEV_KOROFF_B_I_[1]	M	XXh	RV_EISYEV_KOROFF_B_I_[1]
6	RecordValue 3 = EISYEV_KORFAC_B_I_[0]	M	XXh	RV_EISYEV_KORFAC_B_I_[0]
7	RecordValue 4 = EISYEV_KORFAC_B_I_[1]	M	XXh	RV_EISYEV_KORFAC_B_I_[1]
8	RecordValue 5 = EISYDK_KOROFF_B_I_[0]	M	XXh	RV_EISYDK_KOROFF_B_I_[0]
9	RecordValue 6 = EISYDK_KOROFF_B_I_[1]	M	XXh	RV_EISYDK_KOROFF_B_I_[1]
10	RecordValue 7 = EISYDK_KORFAC_B_I_[0]	M	XXh	RV_EISYDK_KORFAC_B_I_[0]
11	RecordValue 8 = EISYDK_KORFAC_B_I_[1]	M	XXh	RV_EISYDK_KORFAC_B_I_[1]

## I.23.40.2 All other projects

## Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier	M	40h	RCI_DKHF
3	RecordCommonIdentifier= Read Throttle and MAF- Adjustment Value	M	08h	RCI_DKHF

## Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier	M	40h	RCI_
3	RecordCommonIdentifier= Read Throttle and MAF- Adjustment Value	M	08h	RCI_
4	RecordValue 1 = dummy value fix	M	00h	RV_
5	RecordValue 2 = Eisyev_koroff_b	M	XXh	RV_
6	RecordValue 3 = dummy value fix	M	00h	RV_
7	RecordValue 4 = Eisyev_korfak_b	M	XXh	RV_
8	RecordValue 5 = dummy value fix	M	00h	RV_
9	RecordValue 6 = Eisydk_koroff_b	M	XXh	RV_
10	RecordValue 5 = dummy value fix	M	00h	RV_
11	RecordValue 6 = Eisydk_korfak_b	M	XXh	RV_

## I.23.41 22\_400A - RCI\_GAW\_lesen



**General information:****Read mixture values 'STATUS\_ADAPTION\_GEMISCH'**

This function is created to read the actual mixture values of the engine.

**Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier High Byte	M	40h	RCI_GAW_lesen
3	RecordCommonIdentifier Low Byte	M	0Ah	RCI_GAW_lesen

**Positive Response on service**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	40h	RCI_GAW_lesen
3	RecordCommonIdentifier Low Byte	M	0Ah	RCI_GAW_lesen
4	RecordValue 1 = MFF_ADD_LAM_AD_OUT[1] high Byte	M	XXh	RV_MFF_ADD_LAM_AD_OUT[1]
5	RecordValue 2 = MFF_ADD_LAM_AD_OUT[1] low Byte	M	XXh	RV_MFF_ADD_LAM_AD_OUT[1]
6	RecordValue 3 = MFF_ADD_LAM_AD_OUT[2] high Byte	M	XXh	RV_MFF_ADD_LAM_AD_OUT[2]
7	RecordValue 4 = MFF_ADD_LAM_AD_OUT[2] low Byte	M	XXh	RV_MFF_ADD_LAM_AD_OUT[2]
8	RecordValue 5 = FAC_LAM_AD_CUS[1] high Byte	M	XXh	RV_FAC_LAM_AD_CUS[1]
9	RecordValue 6 = FAC_LAM_AD_CUS[1] low Byte	M	XXh	RV_FAC_LAM_AD_CUS[1]
10	RecordValue 7 = FAC_LAM_AD_CUS[2] high Byte	M	XXh	RV_FAC_LAM_AD_CUS[2]
11	RecordValue 8 = FAC_LAM_AD_CUS[2] low Byte	M	XXh	RV_FAC_LAM_AD_CUS[2]
12	RecordValue 9 = LSHPWM_UP[1]	M	XXh	RV_LSHPWM_UP[1]
13	RecordValue 10 = LSHPWM_UP[2]	M	XXh	RV_LSHPWM_UP[2]
14	RecordValue 11 = LSHPWM_DOWN[1]	M	XXh	RV_LSHPWM_DOWN[1]
15	RecordValue 12 = LSHPWM_DOWN[2]	M	XXh	RV_LSHPWM_DOWN[2]

**I.23.42 22\_400B - VVT Messwerte auslesen****General information:**

This function is created to read out several values of the VVL- system

**Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier High Byte	M	40h	RCI_VVT
3	RecordCommonIdentifier Low Byte	M	0Bh	RCI_VVT

**Positive Response on service**



Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	40h	RCI_VVT
3	RecordCommonIdentifier Low Byte	M	0Bh	RCI_VVT
4	recordValue = Vvt_soll high byte	M	XXh	RV_SOLLW_VVT
5	recordValue = Vvt_soll low byte	M	XXh	RV_SOLLW_VVT
6	recordValue = Exwink_ist high byte	M	XXh	RV_ISTW_VVT
7	recordValue = Exwink_ist low byte	M	XXh	RV_ISTW_VVT
8	recordValue = lvvtmot[2] high byte	M	XXh	RV_I_VVT
9	recordValue = lvvtmot[2] low byte	M	XXh	RV_I_VVT
10	recordValue = VCC_DR_VVL high byte	M	XXh	RV_U_VVT
11	recordValue = VCC_DR_VVL low byte	M	XXh	RV_U_VVT
12	recordValue = ANG_1_RAW_VVL[2] high byte	M	XXh	RV_SRF_VVT
13	recordValue = ANG_1_RAW_VVL[2] low byte	M	XXh	RV_SRF_VVT
14	recordValue = St_vvt_err	M	XXh	RV_NOTL_VVT
15	recordValue = St_dvovrld	M	XXh	RV_SUEL_VVT
16	recordValue = ANG_DE_ABSV_PLAUS_CHK_VVL high byte	M	XXh	RV_DIFF_VVT
17	recordValue = ANG_DE_ABSV_PLAUS_CHK_VVL low byte	M	XXh	RV_DIFF_VVT

### I.23.43 22\_4015 - RCI\_FASTA10\_lesen

#### General information:

#### FASTA\_Messwerteblock\_10\_lesen

This function ist for reading the data of the FASTA (Fahrzeugnutzungsprofil).

#### I.23.43.1 MSD 85 only

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC I
2	RecordCommonIdentifier High Byte	M	40h	RCI_FAS10
3	RecordCommonIdentifier Low Byte	M	15h	RCI_FAS10

#### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Request Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier High Byte	M	40h	RCI_FAS10
3	RecordCommonIdentifier Low Byte	M	15h	RCI_FAS10
4	RecordValue1 = Bszsi ( high byte, high word)	M	XXh	RV_BSZS1
5	RecordValue2 = Bszsi ( low byte, high word)	M	XXh	RV_BSZS1
6	RecordValue3 = Bszsi ( high byte, low word)	M	XXh	RV_BSZS1
7	RecordValue4 = Bszsi ( low byte, low word)	M	XXh	RV_BSZS1
	<b>n/Md-Kennfeld</b>			
8	RecordValue5 = STATE_TBL_DRIV[0][0]	M	XXh	nmdsfnp
9	RecordValue6 = STATE_TBL_DRIV[1][0]	M	XXh	nmdsfnp
10	RecordValue7 = STATE_TBL_DRIV[2][0]	M	XXh	nmdsfnp
11	RecordValue8 = STATE_TBL_DRIV[3][0]	M	XXh	nmdsfnp
12	RecordValue9 = STATE_TBL_DRIV[4][0]	M	XXh	nmdsfnp
13	RecordValue10 = STATE_TBL_DRIV[5][0]	M	XXh	nmdsfnp
14	RecordValue11 = STATE_TBL_DRIV[6][0]	M	XXh	nmdsfnp
15	RecordValue12 = STATE_TBL_DRIV[7][0]	M	XXh	nmdsfnp
16	RecordValue13 = STATE_TBL_DRIV[0][1]	M	XXh	nmdsfnp
17	RecordValue14 = STATE_TBL_DRIV[1][1]	M	XXh	nmdsfnp
18	RecordValue15 = STATE_TBL_DRIV[2][1]	M	XXh	nmdsfnp
19	RecordValue16 = STATE_TBL_DRIV[3][1]	M	XXh	nmdsfnp
20	RecordValue17 = STATE_TBL_DRIV[4][1]	M	XXh	nmdsfnp
21	RecordValue18 = STATE_TBL_DRIV[5][1]	M	XXh	nmdsfnp
22	RecordValue19 = STATE_TBL_DRIV[6][1]	M	XXh	nmdsfnp
23	RecordValue20 = STATE_TBL_DRIV[7][1]	M	XXh	nmdsfnp
24	RecordValue21 = STATE_TBL_DRIV[0][2]	M	XXh	nmdsfnp
25	RecordValue22 = STATE_TBL_DRIV[1][2]	M	XXh	nmdsfnp
26	RecordValue23 = STATE_TBL_DRIV[2][2]	M	XXh	nmdsfnp
27	RecordValue24 = STATE_TBL_DRIV[3][2]	M	XXh	nmdsfnp
28	RecordValue25 = STATE_TBL_DRIV[4][2]	M	XXh	nmdsfnp
29	RecordValue26 = STATE_TBL_DRIV[5][2]	M	XXh	nmdsfnp
30	RecordValue27 = STATE_TBL_DRIV[6][2]	M	XXh	nmdsfnp
31	RecordValue28 = STATE_TBL_DRIV[7][2]	M	XXh	nmdsfnp
32	RecordValue29 = STATE_TBL_DRIV[0][3]	M	XXh	nmdsfnp
33	RecordValue30 = STATE_TBL_DRIV[1][3]	M	XXh	nmdsfnp
34	RecordValue31 = STATE_TBL_DRIV[2][3]	M	XXh	nmdsfnp
35	RecordValue32 = STATE_TBL_DRIV[3][3]	M	XXh	nmdsfnp
36	RecordValue33 = STATE_TBL_DRIV[4][3]	M	XXh	nmdsfnp
37	RecordValue34 = STATE_TBL_DRIV[5][3]	M	XXh	nmdsfnp
38	RecordValue35 = STATE_TBL_DRIV[6][3]	M	XXh	nmdsfnp
39	RecordValue36 = STATE_TBL_DRIV[7][3]	M	XXh	nmdsfnp
40	RecordValue37 = STATE_TBL_DRIV[0][4]	M	XXh	nmdsfnp
41	RecordValue38 = STATE_TBL_DRIV[1][4]	M	XXh	nmdsfnp
42	RecordValue39 = STATE_TBL_DRIV[2][4]	M	XXh	nmdsfnp
43	RecordValue40 = STATE_TBL_DRIV[3][4]	M	XXh	nmdsfnp
44	RecordValue41 = STATE_TBL_DRIV[4][4]	M	XXh	nmdsfnp
-	RecordValue42 = STATE_TBL_DRIV[5][4]	M	XXh	nmdsfnp
46	RecordValue43 = STATE_TBL_DRIV[6][4]	M	XXh	nmdsfnp
47	RecordValue44 = STATE_TBL_DRIV[7][4]	M	XXh	nmdsfnp


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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 7602 of 8404</b>	
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48	RecordValue- = STATE_TBL_DRIV[0][5]	M	XXh	nmdsfnp
49	RecordValue46 = STATE_TBL_DRIV[1][5]	M	XXh	nmdsfnp
50	RecordValue47 = STATE_TBL_DRIV[2][5]	M	XXh	nmdsfnp
51	RecordValue48 = STATE_TBL_DRIV[3][5]	M	XXh	nmdsfnp
52	RecordValue49 = STATE_TBL_DRIV[4][5]	M	XXh	nmdsfnp
53	RecordValue50 = STATE_TBL_DRIV[5][5]	M	XXh	nmdsfnp
54	RecordValue51 = STATE_TBL_DRIV[6][5]	M	XXh	nmdsfnp
55	RecordValue52 = STATE_TBL_DRIV[7][5]	M	XXh	nmdsfnp
	<b>Generatorauslastungsprofil</b>			
56	RecordValue53 = Dfds[0]	M	XXh	dfdsprofle
57	RecordValue54 = Dfds[1]	M	XXh	dfdsprofle
58	RecordValue55 = Dfds[2]	M	XXh	dfdsprofle
59	RecordValue56 = Dfds[3]	M	XXh	dfdsprofle
60	RecordValue57 = Dfds[4]	M	XXh	dfdsprofle
61	RecordValue58 = Dfds[5]	M	XXh	dfdsprofle
62	RecordValue59 = Dfds[6]	M	XXh	dfdsprofle
63	RecordValue60 = Dfds[7]	M	XXh	dfdsprofle
64	RecordValue61 = Dfds[8]	M	XXh	dfdsprofle
65	RecordValue62 = Dfds[9]	M	XXh	dfdsprofle
66	RecordValue63 = Dfds[10]	M	XXh	dfdsprofle
67	RecordValue64 = Dfds[11]	M	XXh	dfdsprofle
68	RecordValue65 = Dfds[12]	M	XXh	dfdsprofle
69	RecordValue66 = Dfds[13]	M	XXh	dfdsprofle
70	RecordValue67 = Dfds[14]	M	XXh	dfdsprofle
71	RecordValue68 = Dfds[15]	M	XXh	dfdsprofle
	<b>Energieaufnahme Bordnetz</b>			
72	RecordValue69 = Igenk (high byte, high word)	M	XXh	RV_IGENK
73	RecordValue70 = Igenk (low byte, high word)	M	XXh	RV_IGENK
74	RecordValue71 = Igenk (high byte, low word)	M	XXh	RV_IGENK
75	RecordValue72 = Igenk (low byte, low word)	M	XXh	RV_IGENK
	<b>Statistik Kühlsystemtemperaturen</b>			
76	RecordValue73 = Tmot_b1 (high byte)	M	XXh	TSTAT
77	RecordValue73 = Tmot_b1 (low byte)	M	XXh	TSTAT
78	RecordValue74 = Tmot_b2 (high byte)	M	XXh	TSTAT
79	RecordValue73 = Tmot_b2 (low byte)	M	XXh	TSTAT
80	RecordValue75 = Tmot_b3 (high byte)	M	XXh	TSTAT
81	RecordValue73 = Tmot_b3 (low byte)	M	XXh	TSTAT
82	RecordValue76 = Tmot_b4 (high byte)	M	XXh	TSTAT
83	RecordValue73 = Tmot_b4 (low byte)	M	XXh	TSTAT
84	RecordValue77 = Tmot_b5 (high byte)	M	XXh	TSTAT
85	RecordValue73 = Tmot_b5 (low byte)	M	XXh	TSTAT
86	RecordValue78 = Toel_b1 (high byte)	M	XXh	TSTAT
87	RecordValue78 = Toel_b1 (low byte)	M	XXh	TSTAT
88	RecordValue79 = Toel_b2 (high byte)	M	XXh	TSTAT
89	RecordValue78 = Toel_b2 (low byte)	M	XXh	TSTAT
90	RecordValue80 = Toel_b3 (high byte)	M	XXh	TSTAT
91	RecordValue78 = Toel_b3 (low byte)	M	XXh	TSTAT
92	RecordValue81 = Toel_b4 (high byte)	M	XXh	TSTAT
93	RecordValue78 = Toel_b4 (low byte)	M	XXh	TSTAT
94	RecordValue82 = Toel_b5 (high byte)	M	XXh	TSTAT

95	RecordValue78 = Toel_b5 (low byte)	M	XXh	TSTAT
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## I.23.43.2 All other projects

### Request


<i>Data Byte</i>	<i>Parameter Name</i>	<i>Cvt</i>	<i>Hex Value</i>	<i>Mnemonic</i>
1	ReaataByCommonIdentifier Request Service Id	M	22h	RDBCI
2	RecordCommonIdentifier	M	40h	RCI_FAS10
3	RecordCommonIdentifier	M	15h	RCI_FAS10

Figure I.23.4: Table ReadDataByCommonIdentifier Request Message

### Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>ReadDataByCommonIdentifier Response Service Id</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier	M	40h	RCI_FAS10
3	RecordCommonIdentifier	M	15h	RCI_FAS10
4	RecordValue1 = Bszsi ( high byte, high word)	M	XXh	RV_BSZSI
5	RecordValue2 = Bszsi ( low byte, high word)	M	XXh	RV_BSZSI
6	RecordValue3 = Bszsi ( high byte, low word)	M	XXh	RV_BSZSI
7	RecordValue4 = Bszsi ( low byte, low word)	M	XXh	RV_BSZSI
	<b>n/Md-Kennfeld</b>			
8	RecordValue5 = STATE_TBL_DRIV[0][0]	M	XXh	RV_NMDS
9	RecordValue6 = STATE_TBL_DRIV[1][0]	M	XXh	RV_NMDS
10	RecordValue7 = STATE_TBL_DRIV[2][0]	M	XXh	RV_NMDS
11	RecordValue8 = STATE_TBL_DRIV[3][0]	M	XXh	RV_NMDS
12	RecordValue9 = STATE_TBL_DRIV[4][0]	M	XXh	RV_NMDS
13	RecordValue10 = STATE_TBL_DRIV[5][0]	M	XXh	RV_NMDS
14	RecordValue11 = STATE_TBL_DRIV[6][0]	M	XXh	RV_NMDS
15	RecordValue12 = STATE_TBL_DRIV[7][0]	M	XXh	RV_NMDS
16	RecordValue13 = STATE_TBL_DRIV[0][1]	M	XXh	RV_NMDS
17	RecordValue14 = STATE_TBL_DRIV[1][1]	M	XXh	RV_NMDS
18	RecordValue15 = STATE_TBL_DRIV[2][1]	M	XXh	RV_NMDS
19	RecordValue16 = STATE_TBL_DRIV[3][1]	M	XXh	RV_NMDS
20	RecordValue17 = STATE_TBL_DRIV[4][1]	M	XXh	RV_NMDS
21	RecordValue18 = STATE_TBL_DRIV[5][1]	M	XXh	RV_NMDS
22	RecordValue19 = STATE_TBL_DRIV[6][1]	M	XXh	RV_NMDS
23	RecordValue20 = STATE_TBL_DRIV[7][1]	M	XXh	RV_NMDS
24	RecordValue21 = STATE_TBL_DRIV[0][2]	M	XXh	RV_NMDS
25	RecordValue22 = STATE_TBL_DRIV[1][2]	M	XXh	RV_NMDS
26	RecordValue23 = STATE_TBL_DRIV[2][2]	M	XXh	RV_NMDS
27	RecordValue24 = STATE_TBL_DRIV[3][2]	M	XXh	RV_NMDS
28	RecordValue25 = STATE_TBL_DRIV[4][2]	M	XXh	RV_NMDS
29	RecordValue26 = STATE_TBL_DRIV[5][2]	M	XXh	RV_NMDS
30	RecordValue27 = STATE_TBL_DRIV[6][2]	M	XXh	RV_NMDS
31	RecordValue28 = STATE_TBL_DRIV[7][2]	M	XXh	RV_NMDS
32	RecordValue29 = STATE_TBL_DRIV[0][3]	M	XXh	RV_NMDS
33	RecordValue30 = STATE_TBL_DRIV[1][3]	M	XXh	RV_NMDS
34	RecordValue31 = STATE_TBL_DRIV[2][3]	M	XXh	RV_NMDS
35	RecordValue32 = STATE_TBL_DRIV[3][3]	M	XXh	RV_NMDS
36	RecordValue33 = STATE_TBL_DRIV[4][3]	M	XXh	RV_NMDS
37	RecordValue34 = STATE_TBL_DRIV[5][3]	M	XXh	RV_NMDS
38	RecordValue35 = STATE_TBL_DRIV[6][3]	M	XXh	RV_NMDS
39	RecordValue36 = STATE_TBL_DRIV[7][3]	M	XXh	RV_NMDS
40	RecordValue37 = STATE_TBL_DRIV[0][4]	M	XXh	RV_NMDS
41	RecordValue38 = STATE_TBL_DRIV[1][4]	M	XXh	RV_NMDS
42	RecordValue39 = STATE_TBL_DRIV[2][4]	M	XXh	RV_NMDS
43	RecordValue40 = STATE_TBL_DRIV[3][4]	M	XXh	RV_NMDS
44	RecordValue41 = STATE_TBL_DRIV[4][4]	M	XXh	RV_NMDS
-	RecordValue42 = STATE_TBL_DRIV[5][4]	M	XXh	RV_NMDS
46	RecordValue43 = STATE_TBL_DRIV[6][4]	M	XXh	RV_NMDS
47	RecordValue44 = STATE_TBL_DRIV[7][4]	M	XXh	RV_NMDS

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48	RecordValue- = STATE_TBL_DRIV[0][5]	M	XXh	RV_NMDS
49	RecordValue46 = STATE_TBL_DRIV[1][5]	M	XXh	RV_NMDS
50	RecordValue47 = STATE_TBL_DRIV[2][5]	M	XXh	RV_NMDS
51	RecordValue48 = STATE_TBL_DRIV[3][5]	M	XXh	RV_NMDS
52	RecordValue49 = STATE_TBL_DRIV[4][5]	M	XXh	RV_NMDS
53	RecordValue50 = STATE_TBL_DRIV[5][5]	M	XXh	RV_NMDS
54	RecordValue51 = STATE_TBL_DRIV[6][5]	M	XXh	RV_NMDS
55	RecordValue52 = STATE_TBL_DRIV[7][5]	M	XXh	RV_NMDS
	<b>Generatorauslastungsprofil</b>			
56	RecordValue53 = Dfds[0]	M	XXh	RV_DFDS
57	RecordValue54 = Dfds[1]	M	XXh	RV_DFDS
58	RecordValue55 = Dfds[2]	M	XXh	RV_DFDS
59	RecordValue56 = Dfds[3]	M	XXh	RV_DFDS
60	RecordValue57 = Dfds[4]	M	XXh	RV_DFDS
61	RecordValue58 = Dfds[5]	M	XXh	RV_DFDS
62	RecordValue59 = Dfds[6]	M	XXh	RV_DFDS
63	RecordValue60 = Dfds[7]	M	XXh	RV_DFDS
64	RecordValue61 = Dfds[8]	M	XXh	RV_DFDS
65	RecordValue62 = Dfds[9]	M	XXh	RV_DFDS
66	RecordValue63 = Dfds[10]	M	XXh	RV_DFDS
67	RecordValue64 = Dfds[11]	M	XXh	RV_DFDS
68	RecordValue65 = Dfds[12]	M	XXh	RV_DFDS
69	RecordValue66 = Dfds[13]	M	XXh	RV_DFDS
70	RecordValue67 = Dfds[14]	M	XXh	RV_DFDS
71	RecordValue68 = Dfds[15]	M	XXh	RV_DFDS
	<b>Energieaufnahme Bordnetz</b>			
72	RecordValue69 = Igenk (high byte, high word)	M	XXh	RV_IGENK
73	RecordValue70 = Igenk (low byte, high word)	M	XXh	RV_IGENK
74	RecordValue71 = Igenk (high byte, low word)	M	XXh	RV_IGENK
75	RecordValue72 = Igenk (low byte, low word)	M	XXh	RV_IGENK
	<b>Statistik Kühlsystemtemperaturen</b>			
76	RecordValue73 = Tmot_b1 (high byte)	M	XXh	RV_TMOTB1
77	RecordValue73 = Tmot_b1 (low byte)	M	XXh	RV_TMOTB1
78	RecordValue74 = Tmot_b2 (high byte)	M	XXh	RV_TMOTB2
79	RecordValue73 = Tmot_b2 (low byte)	M	XXh	RV_TMOTB2
80	RecordValue75 = Tmot_b3 (high byte)	M	XXh	RV_TMOTB3
81	RecordValue73 = Tmot_b3 (low byte)	M	XXh	RV_TMOTB3
82	RecordValue76 = Tmot_b4 (high byte)	M	XXh	RV_TMOTB4
83	RecordValue73 = Tmot_b4 (low byte)	M	XXh	RV_TMOTB4
84	RecordValue77 = Tmot_b5 (high byte)	M	XXh	RV_TMOTB5
85	RecordValue73 = Tmot_b5 (low byte)	M	XXh	RV_TMOTB5
86	RecordValue78 = Toel_b1 (high byte)	M	XXh	RV_TOELB1
87	RecordValue78 = Toel_b1 (low byte)	M	XXh	RV_TOELB1
88	RecordValue79 = Toel_b2 (high byte)	M	XXh	RV_TOELB2
89	RecordValue78 = Toel_b2 (low byte)	M	XXh	RV_TOELB2
90	RecordValue80 = Toel_b3 (high byte)	M	XXh	RV_TOELB3
91	RecordValue78 = Toel_b3 (low byte)	M	XXh	RV_TOELB3
92	RecordValue81 = Toel_b4 (high byte)	M	XXh	RV_TOELB4
93	RecordValue78 = Toel_b4 (low byte)	M	XXh	RV_TOELB4
94	RecordValue82 = Toel_b5 (high byte)	M	XXh	RV_TOELB5

95	RecordValue78 = Toel_b5 (low byte)	M	XXh	RV_TOELB5
96	RecordValue83 = Tget_b1 (high byte)	M	XXh	RV_TGETB1
97	RecordValue83 = Tget_b1 (low byte)	M	XXh	RV_TGETB1
98	RecordValue84 = Tget_b2 (high byte)	M	XXh	RV_TGETB2
99	RecordValue83 = Tget_b2 (low byte)	M	XXh	RV_TGETB2
100	RecordValue85 = Tget_b3 (high byte)	M	XXh	RV_TGETB3
101	RecordValue83 = Tget_b3 (low byte)	M	XXh	RV_TGETB3
102	RecordValue86 = Tget_b4 (high byte)	M	XXh	RV_TGETB4
103	RecordValue83 = Tget_b4 (low byte)	M	XXh	RV_TGETB4
104	RecordValue87 = Tget_b5 (high byte)	M	XXh	RV_TGETB5
105	RecordValue83 = Tget_b5 (low byte)	M	XXh	RV_TGETB5
106	RecordValue88 = Tumg_b1 (high byte)	M	XXh	RV_TUMGB1
107	RecordValue88 = Tumg_b1 (low byte)	M	XXh	RV_TUMGB1
108	RecordValue89 = Tumg_b2 (high byte)	M	XXh	RV_TUMGB2
109	RecordValue88 = Tumg_b2 (low byte)	M	XXh	RV_TUMGB2
110	RecordValue90 = Tumg_b3 (high byte)	M	XXh	RV_TUMGB3
111	RecordValue88 = Tumg_b3 (low byte)	M	XXh	RV_TUMGB3
112	RecordValue91 = Tumg_b4 (high byte)	M	XXh	RV_TUMGB4
113	RecordValue88 = Tumg_b4 (low byte)	M	XXh	RV_TUMGB4
114	RecordValue92 = Tumg_b5 (high byte)	M	XXh	RV_TUMGB5
115	RecordValue88 = Tumg_b5 (low byte)	M	XXh	RV_TUMGB5

## I.23.44 22\_4016 - RCI\_IGRINFOlesen

### General information:

#### READ IGR-values

This function ist for reading the data of the IGR (Infospeicher Intelligente Genrator Regelung).

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier High Byte	M	40h	RCI_IGRINFO
3	RecordCommonIdentifier Low Byte	M	16h	RCI_IGRINFO

#### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	40h	RCI_IGRINFO
3	RecordCommonIdentifier Low Byte	M	16h	RCI_IGRINFO
4	RecordValue1 = Igrinfo[1]	M	XXh	RV_IGRINFO
5	RecordValue2 = Igrinfo[2]	M	XXh	RV_IGRINFO
6	RecordValue3 = Igrinfo[3]	M	XXh	RV_IGRINFO
7	RecordValue4 = Igrinfo[4]	M	XXh	RV_IGRINFO
8	RecordValue5 = Igrinfo[5]	M	XXh	RV_IGRINFO
9	RecordValue6 = Igrinfo[6]	M	XXh	RV_IGRINFO
10	RecordValue7 = Igrinfo[7]	M	XXh	RV_IGRINFO
11	RecordValue8 = Igrinfo[8]	M	XXh	RV_IGRINFO
12	RecordValue9 = Igrinfo[9]	M	XXh	RV_IGRINFO
13	RecordValue10 = Igrinfo[10]	M	XXh	RV_IGRINFO
14	RecordValue11 = Igrinfo[11]	M	XXh	RV_IGRINFO
15	RecordValue12 = Igrinfo[12]	M	XXh	RV_IGRINFO
16	RecordValue13 = Igrinfo[13]	M	XXh	RV_IGRINFO
17	RecordValue14 = Igrinfo[14]	M	XXh	RV_IGRINFO
18	RecordValue15 = Igrinfo[15]	M	XXh	RV_IGRINFO
19	RecordValue16 = Igrinfo[16]	M	XXh	RV_IGRINFO
20	RecordValue17 = Igrinfo[17]	M	XXh	RV_IGRINFO
21	RecordValue18 = Igrinfo[18]	M	XXh	RV_IGRINFO
22	RecordValue19 = Igrinfo[19]	M	XXh	RV_IGRINFO
23	RecordValue20 = Igrinfo[20]	M	XXh	RV_IGRINFO
24	RecordValue21 = Igrinfo[21]	M	XXh	RV_IGRINFO
25	RecordValue22 = Igrinfo[22]	M	XXh	RV_IGRINFO
26	RecordValue23 = Igrinfo[23]	M	XXh	RV_IGRINFO
27	RecordValue24 = Igrinfo[24]	M	XXh	RV_IGRINFO
28	RecordValue25 = Igrinfo[25]	M	XXh	RV_IGRINFO
29	RecordValue26 = Igrinfo[26]	M	XXh	RV_IGRINFO
30	RecordValue27 = Igrinfo[27]	M	XXh	RV_IGRINFO
31	RecordValue28 = Igrinfo[28]	M	XXh	RV_IGRINFO
32	RecordValue29 = Igrinfo[29]	M	XXh	RV_IGRINFO
33	RecordValue30 = Igrinfo[30]	M	XXh	RV_IGRINFO

## I.23.45 22\_4017 - RCI\_LEMINFO\_lesen

### General information:


#### READ LEM-values

This function ist for reading the data of the LEM (Infospeicher Leistungskoordination Elektrisch Mechanisch).

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	40h	RCI_LEMINFO
3	RecordCommonIdentifier Low Byte	M	17h	RCI_LEMINFO

#### Positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	40h	RCI_LEMINFO
3	RecordCommonIdentifier Low Byte	M	17h	RCI_LEMINFO
4	RecordValue1 = Leminfo[1]	M	XXh	RV_LEMINFO
5	RecordValue2 = Leminfo[2]	M	XXh	RV_LEMINFO
6	RecordValue3 = Leminfo[3]	M	XXh	RV_LEMINFO
7	RecordValue4 = Leminfo[4]	M	XXh	RV_LEMINFO
8	RecordValue5 = Leminfo[5]	M	XXh	RV_LEMINFO
9	RecordValue6 = Leminfo[6]	M	XXh	RV_LEMINFO
10	RecordValue7 = Leminfo[7]	M	XXh	RV_LEMINFO
11	RecordValue8 = Leminfo[8]	M	XXh	RV_LEMINFO
12	RecordValue9 = Leminfo[9]	M	XXh	RV_LEMINFO
13	RecordValue10 = Leminfo[10]	M	XXh	RV_LEMINFO
14	RecordValue11 = Leminfo[11]	M	XXh	RV_LEMINFO
15	RecordValue12 = Leminfo[12]	M	XXh	RV_LEMINFO
16	RecordValue13 = Leminfo[13]	M	XXh	RV_LEMINFO
17	RecordValue14 = Leminfo[14]	M	XXh	RV_LEMINFO
18	RecordValue15 = Leminfo[15]	M	XXh	RV_LEMINFO
19	RecordValue16 = Leminfo[16]	M	XXh	RV_LEMINFO
20	RecordValue17 = Leminfo[17]	M	XXh	RV_LEMINFO
21	RecordValue18 = Leminfo[18]	M	XXh	RV_LEMINFO
22	RecordValue19 = Leminfo[19]	M	XXh	RV_LEMINFO
23	RecordValue20 = Leminfo[20]	M	XXh	RV_LEMINFO
24	RecordValue21 = Leminfo[21]	M	XXh	RV_LEMINFO
25	RecordValue22 = Leminfo[22]	M	XXh	RV_LEMINFO
26	RecordValue23 = Leminfo[23]	M	XXh	RV_LEMINFO
27	RecordValue24 = Leminfo[24]	M	XXh	RV_LEMINFO
28	RecordValue25 = Leminfo[25]	M	XXh	RV_LEMINFO
29	RecordValue26 = Leminfo[26]	M	XXh	RV_LEMINFO
30	RecordValue27 = Leminfo[27]	M	XXh	RV_LEMINFO
31	RecordValue28 = Leminfo[28]	M	XXh	RV_LEMINFO
32	RecordValue29 = Leminfo[29]	M	XXh	RV_LEMINFO
33	RecordValue30 = Leminfo[30]	M	XXh	RV_LEMINFO
34	RecordValue31 = Leminfo[31]	M	XXh	RV_LEMINFO
35	RecordValue32 = Leminfo[32]	M	XXh	RV_LEMINFO
36	RecordValue33 = Leminfo[33]	M	XXh	RV_LEMINFO
37	RecordValue34 = Leminfo[34]	M	XXh	RV_LEMINFO
38	RecordValue35 = Leminfo[35]	M	XXh	RV_LEMINFO
39	RecordValue36 = Leminfo[36]	M	XXh	RV_LEMINFO
40	RecordValue37 = Leminfo[37]	M	XXh	RV_LEMINFO

## I.23.46 22\_4018 - READ MSA-values

### General information:

This function ist for reading the data of the MSA (Infospeicher Motor-Start/Stop Automatik).


### Request

<i>Data Byte</i>	<i>Parameter Name</i>	<i>Cvt</i>	<i>Hex Value</i>	<i>Mnemonic</i>
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier High Byte	M	40h	RCI_MSA
3	RecordCommonIdentifier Low Byte	M	18h	RCI_MSA

### Positive Response on service

<b>Data Byte</b>	<b>Parameter Name</b>	<b>Cvt</b>	<b>Hex Value</b>	<b>Mnemonic</b>
1	<b>Response Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier High Byte	M	40h	RCI_MSA
3	RecordCommonIdentifier Low Byte	M	18h	RCI_MSA
4	RecordValue1 = Msainfo[1]	M	XXh	RV_
5	RecordValue2 = Msainfo[2]	M	XXh	RV_
6	RecordValue3 = Msainfo[3]	M	XXh	RV_
7	RecordValue4 = Msainfo[4]	M	XXh	RV_
8	RecordValue5 = Msainfo[5]	M	XXh	RV_
9	RecordValue6 = Msainfo[6]	M	XXh	RV_
10	RecordValue7 = Msainfo[7]	M	XXh	RV_
11	RecordValue8 = Msainfo[8]	M	XXh	RV_
12	RecordValue9 = Msainfo[9]	M	XXh	RV_
13	RecordValue10 = Msainfo[10]	M	XXh	RV_
14	RecordValue11 = Msainfo[11]	M	XXh	RV_
15	RecordValue12 = Msainfo[12]	M	XXh	RV_
16	RecordValue13 = Msainfo[13]	M	XXh	RV_
17	RecordValue14 = Msainfo[14]	M	XXh	RV_
18	RecordValue15 = Msainfo[15]	M	XXh	RV_
19	RecordValue16 = Msainfo[16]	M	XXh	RV_
20	RecordValue17 = Msainfo[17]	M	XXh	RV_
21	RecordValue18 = Msainfo[18]	M	XXh	RV_
22	RecordValue19 = Msainfo[19]	M	XXh	RV_
23	RecordValue20 = Msainfo[20]	M	XXh	RV_
24	RecordValue21 = Msainfo[21]	M	XXh	RV_
25	RecordValue22 = Msainfo[22]	M	XXh	RV_
26	RecordValue23 = Msainfo[23]	M	XXh	RV_
27	RecordValue24 = Msainfo[24]	M	XXh	RV_
28	RecordValue25 = Msainfo[25]	M	XXh	RV_
29	RecordValue26 = Msainfo[26]	M	XXh	RV_
30	RecordValue27 = Msainfo[27]	M	XXh	RV_
31	RecordValue28 = Msainfo[28]	M	XXh	RV_
32	RecordValue29 = Msainfo[29]	M	XXh	RV_
33	RecordValue30 = Msainfo[30]	M	XXh	RV_
34	RecordValue31 = Msainfo[31]	M	XXh	RV_
35	RecordValue32 = Msainfo[32]	M	XXh	RV_
36	RecordValue33 = Msainfo[33]	M	XXh	RV_
37	RecordValue34 = Msainfo[34]	M	XXh	RV_
38	RecordValue35 = Msainfo[35]	M	XXh	RV_
39	RecordValue36 = Msainfo[36]	M	XXh	RV_
40	RecordValue37 = Msainfo[37]	M	XXh	RV_
41	RecordValue38 = Msainfo[38]	M	XXh	RV_
42	RecordValue39 = Msainfo[39]	M	XXh	RV_
43	RecordValue40 = Msainfo[40]	M	XXh	RV_
44	RecordValue41 = Msainfo[41]	M	XXh	RV_
-	RecordValue42 = Msainfo[42]	M	XXh	RV_
46	RecordValue43 = Msainfo[43]	M	XXh	RV_
47	RecordValue44 = Msainfo[44]	M	XXh	RV_
48	RecordValue- = Msainfo[-]	M	XXh	RV_
49	RecordValue46 = Msainfo[46]	M	XXh	RV_

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 7611 of 8404</b>	
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50	RecordValue47 = Msainfo[47]	M	XXh	RV_
51	RecordValue48 = Msainfo[48]	M	XXh	RV_
52	RecordValue49 = Msainfo[49]	M	XXh	RV_
53	RecordValue50 = Msainfo[50]	M	XXh	RV_

## I.23.47 22\_4019\_000 - RDBCI\_FSPFR

### General information:

#### read Error Memory with freeze frame data extra long, extended

This function is created to read out the failure memory with all the errors including the freeze frame data. The index of the environment values allows a classification to the list of the environment values from BMW.

Record Common Identifier table usage and reading:

- record values usage as BYTE Values (Freeze Frame, Umweltbedingung, DDLI etc.) should support the full range 0x00 to 0xFF as VALID. A value that is not supported will be transmitted as 0xFF
- record values usage as WORD Values (DDLI etc.) should support the range 0x0000 to 0xFFFFE as VALID. Invalid is shown with 0xFFFF.

This should enable the full range of internal Byte values to be used with no compromise, but still allow the diagnostic equipment to recognise if a value is available or not.

### Formula section:

IF ERR\_DTC[x] = 0000h or  
 ERR\_DTC[x] = FFFFh  
 THEN send **negative responses**  
 ELSE send **positive response**


### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	40h	RCI_FSPFR
3	RecordCommonIdentifier Low Byte	M	19h	RCI_FSPFR
4	Value = Error code ERR_DTC[x] high byte	M	XXh	RV_FSFF_F
5	Value = Error code ERR_DTC[x] low byte	M	XXh	RV_FSFF_F

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Positive Response Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier High Byte	M	40h	RCI_FSPFR
3	RecordCommonIdentifier Low Byte	M	19h	RCI_FSPFR
4	RecordValue 1 = Error counter total CTR_ERR_DYN_NR	M	XXh	RV_FSFF_FZG
5	RecordValue 2 = Error code ERR_DTC[x] high byte	M	XXh	RV_FSFF_FC
6	RecordValue 3 = Error code ERR_DTC[x] low byte	M	XXh	RV_FSFF_FC
7	RecordValue 4 = status DTC1 ERR_TYPE_BYTE[x]	M	XXh	RV_FSFF_FA
8	RecordValue 5 = Cycle flag ERR_TYPE_EXT_BYTE[x]	M	XXh	RV_FSFF_ERW
9	RecordValue 6 = Frequency counter CTR_FRC[x]	M	XXh	RV_FSFF_HZ
10	RecordValue 7 = Error recover counter (HLC) CTR_DC[x]	M	XXh	RV_FSFF_HLC
11	RecordValue 8 = km-value by first occur high byte ENV_D_CUS_SET_CMN[2][1]	M	XXh	RV_FSFF_KM1
12	RecordValue 9= km-value by first occur low byte ENV_D_CUS_SET_CMN[3][1]	M	XXh	RV_FSFF_KM1
13	RecordValue 10 = 1.environmental value first occur ENV_D_CUS_SET_SPC[1][1]	M	XXh	RV_FSFF_UW11
14	RecordValue 11 = Index for 1.environmental value	M	XXh	RV_FSFF_UW11
15	RecordValue 12 = 2.environmental value first occur ENV_D_CUS_SET_SPC[2][1]	M	XXh	RV_FSFF_UW21
16	RecordValue 13 = Index for 2.environmental value	M	XXh	RV_FSFF_UW21A
17	RecordValue 14= 3.environmental value first occur ENV_D_CUS_SET_SPC[3][1]	M	XXh	RV_FSFF_UW31
18	RecordValue 15 = Index for 3.environmental value	M	XXh	RV_FSFF_UW31A
19	RecordValue 16 = 4.environmental value first occur ENV_D_CUS_SET_SPC[4][1]	M	XXh	RV_FSFF_UW41
20	RecordValue 17 = Index for 4.environmental value	M	XXh	RV_FSFF_UW41A
21	RecordValue 18 = km-value by second occur high byte ENV_D_CUS_SET_CMN[2][2]	M	XXh	RV_FSFF_KM2
22	RecordValue 19= km-value by second occur low byte ENV_D_CUS_SET_CMN[3][2]	M	XXh	RV_FSFF_KM2
23	RecordValue 20 = 1.environmental value second occur ENV_D_CUS_SET_SPC[1][2]	M	XXh	RV_FSFF_UW12
24	RecordValue 21 = 2.environmental value second occur ENV_D_CUS_SET_SPC[2][2]	M	XXh	RV_FSFF_UW22
25	RecordValue 22 = 3.environmental value second occur ENV_D_CUS_SET_SPC[3][2]	M	XXh	RV_FSFF_UW23
26	RecordValue 23 = 4.environmental value second occur ENV_D_CUS_SET_SPC[4][2]	M	XXh	RV_FSFF_UW24
27	RecordValue 24 = km-value by last occur high byte ENV_D_CUS_SET_CMN[2][3]	M	XXh	RV_FSFF_KMX
28	RecordValue 25 = km-value by last occur low byte ENV_D_CUS_SET_CMN[3][3]	M	XXh	RV_FSFF_KMX
29	RecordValue 26 = 1.environmental value last occur ENV_D_CUS_SET_SPC[1][3]	M	XXh	RV_FSFF_UW1X
30	RecordValue 27= 2.environmental value last occur ENV_D_CUS_SET_SPC[2][3]	M	XXh	RV_FSFF_UW2X
31	RecordValue 28= 3.environmental value last occur ENV_D_CUS_SET_SPC[3][3]	M	XXh	RV_FSFF_UW3X
32	RecordValue 29 = 4.environmental value last occur ENV_D_CUS_SET_SPC[4][3]	M	XXh	RV_FSFF_UW4X
33	RecordValue 30= Error class C_ERR_CLAS_XX	M	00h	RV_FSFF_CLA
34	RecordValue 31 = Importance counter TSF (not def. yet)	M	FFh	RV_FSFF_TSF

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 7613 of 8404</b>	
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35	RecordValue 32 = Debounce counter (MIL on) FLC FLC = DC_MAX_XX - CTR_DC[x]	M	XXh	RV_FSFF_FLC
36	RecordValue 33= Deleting counter DLC CTR_WUP_CYC[x]	M	XXh	RV_FSFF_DLC
37	RecordValue 34 = P code DTC " high byte ACTION_ERRM_ReadDTCLLevelByDTCLLevel	M	XXh	RV_FSFF_PID02
38	RecordValue 35 = P code DTC " low byte ACTION_ERRM_ReadDTCLLevelByDTCLLevel	M	XXh	RV_FSFF_PID02
39	RecordValue 36 = Freeze frame data 0 - STATE_LS_1 (fuel system state bench 1) ENVD_OBD[1][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID03
40	RecordValue 37 = Freeze frame data 1 - STATE_LS_2 (fuel system state bench 2) ENVD_OBD[2][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID03
41	RecordValue 38 = Freeze frame data 2 - LOAD_CLC (calculated load value) ENVD_OBD[3][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID04
42	RecordValue 39 = Freeze frame data 3 - OBD_TCO (engine coolant temperature) ENVD_OBD[4][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID05
43	RecordValue 40 = Freeze frame data 4 - OBD_LAM_COR_1 (short term fuel trim bank 1) ENVD_OBD[5][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID06
44	RecordValue 41 = Freeze frame data 5 - OBD_LAM_AD_1 (long term fuel trim bank 1) ENVD_OBD[6][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID07
-	RecordValue 42 = Freeze frame data 6 - OBD_LAM_COR_2 (short term fuel trim bank 2) ENVD_OBD[7][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID08
46	RecordValue 43 = Freeze frame data 7 - OBD_LAM_AD_2 (long term fuel trim bank 2) ENVD_OBD[8][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID09
47	RecordValue 44 = Freeze frame data 8 - OBD_FUP (fuel pressure ENVD_OBD[9][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID0A
48	RecordValue - = Freeze frame data 9 - OBD_MAP (intake manifold absolutr pressure) ENVD_OBD[10][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID0B
49	RecordValue 46 = Freeze frame data 10 - OBD_N ( engine rpm, high byte) ENVD_OBD[11][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID0C
50	RecordValue 47 = Freeze frame data 11 - OBD_N ( engine rpm, low byte) ENVD_OBD[12][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID0C
51	RecordValue 48 = Freeze frame data 12 - VS (vehicle speed) ENVD_OBD[13][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID0D
52	RecordValue 49 = Freeze frame data 13 - OBD_IGA_IGC (ignition timing advance cylinder 1) ENVD_OBD[14][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID0E
53	RecordValue 50 = Freeze frame data 14 - OBD_TIA (intake air temperature) ENVD_OBD[15][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID0F
54	RecordValue 51 = Freeze frame data 15 - OBD_MAF ( air flow rate mass air flow sensor, high byte) ENVD_OBD[16][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID10
55	RecordValue 52 = Freeze frame data 16 - OBD_MAF ( air flow rate mass air flow sensor, high byte) ENVD_OBD[17][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID10

56	RecordValue 53 = Freeze frame data 17 - OBD_TPS_1 (absolute throttle position) ENVD_OBD[18][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID11
57	RecordValue 54 = Freeze frame data 18 - STATE_OBD_SA (commanded secondary air status) ENVD_OBD[19][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID12
58	RecordValue 55 = Freeze frame data 19 - not supported (auxiliary input)	M	FFh	RV_FSFF_PID1E
59	RecordValue 56 = Freeze frame data 20 - OBD_T_AST ( time since engine start, high byte) ENVD_OBD[20][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID1F
60	RecordValue 57 = Freeze frame data 21 - OBD_T_AST ( time since engine start, low byte) ENVD_OBD[21][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID1F
61	RecordValue 58 = Freeze frame data 22 - not supported (fuel rail pressure relative to manifold vacuum , high byte)	M	FFh	RV_FSFF_PID22
62	RecordValue 59 = Freeze frame data 23 - not supported (fuel rail pressure relative to manifold vacuum , low byte)	M	FFh	RV_FSFF_PID22
63	RecordValue 60 = Freeze frame data 24 - OBD_FUP_RNG_H (fuel rail pressure , high byte) ENVD_OBD[22][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID23
64	RecordValue 61 = Freeze frame data 25 - OBD_FUP_RNG_H (fuel rail pressure , low byte) ENVD_OBD[23][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID23
65	RecordValue 62 = Freeze frame data 26 - not supported (commanded EGR)	M	FFh	RV_FSFF_PID2C
66	RecordValue 63 = Freeze frame data 27 - not supported (EGR error)	M	FFh	RV_FSFF_PID2D
67	RecordValue 64 = Freeze frame data 28 -CPPWM_CPS (commanded evaporative purge) ENVD_OBD[24][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID2E
68	RecordValue 65 = Freeze frame data 29 - OBD_FTL (fuel level input) ENVD_OBD[25][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID2F
69	RecordValue 66 = Freeze frame data 30 - OBD_AMP (barometric pressure ) ENVD_OBD[26][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID33
70	RecordValue 67 = Freeze frame data 31 - OBD_VB (control module voltage, high byte) ENVD_OBD[27][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID42
71	RecordValue 68 = Freeze frame data 32 - OBD_VB (control module voltage, low byte) ENVD_OBD[28][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID42
72	RecordValue 69 = Freeze frame data 33 - LOAD_ABSV (absolute load value, high byte) ENVD_OBD[29][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID43
73	RecordValue 70 = Freeze frame data 34 - LOAD_ABSV (absolute load value, low byte) ENVD_OBD[30][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID43
74	RecordValue 71 = Freeze frame data 35 - OBD_LAMB_SP (commanded equivalence ratio, high byte) ENVD_OBD[31][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID44
75	RecordValue 72 = Freeze frame data 36 - OBD_LAMB_SP (commanded equivalence ratio, low byte) ENVD_OBD[32][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID44
76	RecordValue 73 = Freeze frame data 37 - OBD_TPS_REL (relative throttle position) ENVD_OBD[33][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID-

77	RecordValue 74 = Freeze frame data 38 - OBD_TAM (ambiente air temperature) ENVD_OBD[34][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID46
78	RecordValue 75 = Freeze frame data 39 - OBD_TPS_2 (absolute throttle position, sensor 2) ENVD_OBD[35][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID47
79	RecordValue 76 = Freeze frame data 40 - not supported (absolute throttle position C)	M	FFh	RV_FSFF_PID48
80	RecordValue 77 = Freeze frame data 41 - OBD_PV_1 (acceleration pedal position, sensor 1) ENVD_OBD[36][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID49
81	RecordValue 78 = Freeze frame data 42 - OBD_PV_2 (acceleration pedal position, sensor 2) ENVD_OBD[37][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID4A
82	RecordValue 79 = Freeze frame data 43 - not supported (acceleration pedal position F)	M	FFh	RV_FSFF_PID4B
83	RecordValue 80 = Freeze frame data 44 - OBD_TPS_SP (commanded throttle position) ENVD_OBD[38][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID4C

## I.23.48 22\_401A - RCI\_BZEINFOlesen

### General information:

#### READ BZE-values

This function is for reading the data of the BZE (Batterie Zustands Erkennung)

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier High Byte	M	40h	RCI_BZEINFO
3	RecordCommonIdentifier Low Byte	M	1A	RCI_BZEINFO

#### Positive Response on service



Data Byte	Parameter Name	Cv t	Hex Value	Mnemonic
1	<b>Response Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier High Byte	M	40h	RCI_BZEINFO
3	RecordCommonIdentifier Low Byte	M	1A	RCI_BZEINFO
4	RecordValue1 = Qv_out_m	M	XXh	RV_QV_OUT_M
5	RecordValue2 = Qv_quali_m	M	XXh	RV_QV_QUALI_M
6	RecordValue3 = Qv_status	M	XXh	RV_QV_STATUS
7	RecordValue4 = Qv_out_1	M	XXh	RV_QV_OUT_1
8	RecordValue5 = Qv_out_2	M	XXh	RV_QV_OUT_2
9	RecordValue6 = Qv_out_3	M	XXh	RV_QV_OUT_3
10	RecordValue7 = Qv_out_4	M	XXh	RV_QV_OUT_4
11	RecordValue8 = Qv_out_5	M	XXh	RV_QV_OUT_5
12	RecordValue9 = Qv_quali_1	M	XXh	RV_QV_QUALI_1
13	RecordValue10 = Qv_quali_2	M	XXh	RV_QV_QUALI_2
14	RecordValue11 = Qv_quali_3	M	XXh	RV_QV_QUALI_3
15	RecordValue12 = Qv_quali_4	M	XXh	RV_QV_QUALI_4
16	RecordValue13 = Qv_quali_5	M	XXh	RV_QV_QUALI_5
17	RecordValue14 = Qv_td1 (high byte)	M	XXh	RV_QV_TD1
18	RecordValue15 = Qv_td1 (low byte)	M	XXh	RV_QV_TD1
19	RecordValue16 = Qv_td2 (high byte)	M	XXh	RV_QV_TD2
20	RecordValue17 = Qv_td2 (low byte)	M	XXh	RV_QV_TD2
21	RecordValue18 = Qv_td3 (high byte)	M	XXh	RV_QV_TD3
22	RecordValue19 = Qv_td3 (low byte)	M	XXh	RV_QV_TD3
23	RecordValue20 = Qv_td4 (high byte)	M	XXh	RV_QV_TD4
24	RecordValue20 = Qv_td4 (low byte)	M	XXh	RV_QV_TD4
25	RecordValue18 = Qv_td5 (high byte)	M	XXh	RV_QV_TD5
26	RecordValue18 = Qv_td5 (low byte)	M	XXh	RV_QV_TD5
27	RecordValue24 = Qvc_status_1	M	XXh	RV_QVC_STATUS_1
28	RecordValue25 = Qvc_status_2	M	XXh	RV_QVC_STATUS_2
29	RecordValue26 = Qvc_status_3	M	XXh	RV_QVC_STATUS_3
30	RecordValue27 = Qvc_status_4	M	XXh	RV_QVC_STATUS_4
31	RecordValue28 = Qv_nv_zh ( high byte, high word )	M	XXh	RV_QV_NV_ZH
32	RecordValue29 = Qv_nv_zh ( low byte, high word)	M	XXh	RV_QV_NV_ZH
33	RecordValue30 = Qv_nv_zh ( ligh byte, low word )	M	XXh	RV_QV_NV_ZH
34	RecordValue31 = Qv_nv_zh ( low byte, low word)	M	XXh	RV_QV_NV_ZH
35	RecordValue32 = Qv_nv_ezm (high byte)	M	XXh	RV_QV_NV_EZM
36	RecordValue33 = Qv_nv_ezm (low byte)	M	XXh	RV_QV_NV_EZM
37	RecordValue34 = Qv_h2o ( high byte)	M	XXh	RV_QV_H2O
38	RecordValue35 = Qv_h2o ( low byte)	M	XXh	RV_QV_H2O
39	RecordValue36 = Qv_h2oquali	M	XXh	RV_QV_H2OQUALI
40	RecordValue37 = B_qvch2o	M	XXh [ 0, 1]	RV_ST_QVC1
41	RecordValue38 = Qv_h2ostatus	M	XXh	RV_QV_H2OSTATUS


## I.23.49 22\_401B - RCI\_GENINFO\_lesen

### General information:

### Generator Diagnoseerweiterung

This function is created to read out the values from the function-test of intelligent alternator.

### Request

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<i>Data Byte</i>	<i>Parameter Name</i>	<i>Cvt</i>	<i>Hex Value</i>	<i>Mnemonic</i>
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier High Byte	M	40h	RCL_GENINFO
3	RecordCommonIdentifier Low Byte	M	1Bh	RCL_GENINFO

Figure I.23.5: Table Request Message

**Positive Response on service**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Response Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier High Byte	M	40h	RCI_GENINFO
3	RecordCommonIdentifier Low Byte	M	1Bh	RCI_GENINFO
4	recordValue1 = St_dgenub1 (high byte)	M	XXh	RV_ST_DGENUB1
5	recordValue2 = St_dgenub1 (low byte)	M	XXh	RV_ST_DGENUB1
6	recordValue3 = St_dgenub2 (high byte)	M	XXh	RV_ST_DGENUB2
7	recordValue4 = St_dgenub2 (low byte)	M	XXh	RV_ST_DGENUB2
8	recordValue5 = St_dgenubnz (high byte)	M	XXh	RV_ST_DGENUBNZ
9	recordValue6 = St_dgenubnz (low byte)	M	XXh	RV_ST_DGENUBNZ
10	recordValue7 = St_dgenuberr	M	XXh	RV_ST_DGENUBERR
11	recordValue8 = St_dgenugen1 (high byte)	M	XXh	RV_ST_DGENUGEN1
12	recordValue9 = St_dgenugen1 (low byte)	M	XXh	RV_ST_DGENUGEN1
13	recordValue10 = St_dgenugen2 (high byte)	M	XXh	RV_ST_DGENUGEN2
14	recordValue11 = St_dgenugen2 (low byte)	M	XXh	RV_ST_DGENUGEN2
15	recordValue12 = St_dgenugennz (high byte)	M	XXh	RV_ST_DGENUGENNZ
16	recordValue13 = St_dgenugennz (low byte)	M	XXh	RV_ST_DGENUGENNZ
17	recordValue14 = St_dgenugenerr	M	XXh	RV_ST_DGENUGENERR
18	recordValue15 = St_dgengrenz1	M	XXh	RV_ST_DGENGRENZ1
19	recordValue16 = St_dgengrenz2	M	XXh	RV_ST_DGENGRENZ2
20	recordValue17 = St_dgengrenznz	M	XXh	RV_ST_DGENGRENZLNZ
21	recordValue18 = St_dgengrenzerr	M	XXh	RV_ST_DGENGRENZERR
22	recordValue19 = St_dgenub1_md1 (high byte)	M	XXh	RV_ST_DGENUB1_MD1
23	recordValue20 = St_dgenub1_md1 (low byte)	M	XXh	RV_ST_DGENUB1_MD1
24	recordValue21 = St_dgenub2_md1 (high byte)	M	XXh	RV_ST_DGENUB2_MD1
25	recordValue22 = St_dgenub2_md1 (low byte)	M	XXh	RV_ST_DGENUB2_MD1
26	recordValue23 = St_dgenubnz_md1 (high byte)	M	XXh	RV_ST_DGENUBNZ_MD1
27	recordValue24 = St_dgenubnz_md1 (low byte)	M	XXh	RV_ST_DGENUBNZ_MD1
28	recordValue25 = St_dgenuberr_md1	M	XXh	RV_ST_DGENUBERR_MD1
29	recordValue26 = St_dgenugen1_md1 (high byte)	M	XXh	RV_ST_DGENUGEN1_MD1
30	recordValue27 = St_dgenugen1_md1 (low byte)	M	XXh	RV_ST_DGENUGEN1_MD1
31	recordValue28 = St_dgenugen2_md1 (high byte)	M	XXh	RV_ST_DGENUGEN2_MD1
32	recordValue29 = St_dgenugen2_md1 (low byte)	M	XXh	RV_ST_DGENUGEN2_MD1
33	recordValue30 = St_dgenugennz_md1 (high byte)	M	XXh	RV_ST_DGENUGENNZ_MD1
34	recordValue31 = St_dgenugennz_md1 (low byte)	M	XXh	RV_ST_DGENUGENNZ_MD1
35	recordValue32 = St_dgenugenerr_md1	M	XXh	RV_ST_DGENUGENERR_MD1
36	recordValue33 = St_dgengrenz1_md1	M	XXh	RV_ST_DGENGRENZ1_MD1
37	recordValue34 = St_dgengrenz2_md1	M	XXh	RV_ST_DGENGRENZ2_MD1
38	recordValue35 = St_dgengrenznz_md1	M	XXh	RV_ST_DGENGRENZLNZ_MD1
39	recordValue36 = St_dgengrenzerr_md1	M	XXh	RV_ST_DGENGRENZERR_MD1
40	recordValue37 = St_dgenub1_md2 (high byte)	M	XXh	RV_ST_DGENUB1_MD2
41	recordValue38 = St_dgenub1_md2 (low byte)	M	XXh	RV_ST_DGENUB1_MD2
42	recordValue39 = St_dgenub2_md2 (high byte)	M	XXh	RV_ST_DGENUB2_MD2
43	recordValue40 = St_dgenub2_md2 (low byte)	M	XXh	RV_ST_DGENUB2_MD2
44	recordValue41 = St_dgenubnz_md2 (high byte)	M	XXh	RV_ST_DGENUBNZ_MD2
-	recordValue42 = St_dgenubnz_md2 (low byte)	M	XXh	RV_ST_DGENUBNZ_MD2
46	recordValue43 = St_dgenuberr_md2	M	XXh	RV_ST_DGENUBERR_MD2
47	recordValue44 = St_dgenugen1_md2 (high byte)	M	XXh	RV_ST_DGENUGEN1_MD2
48	recordValue- = St_dgenugen1_md2 (low byte)	M	XXh	RV_ST_DGENUGEN1_MD2
49	recordValue46 = St_dgenugen2_md2	M	XXh	RV_ST_DGENUGEN2_MD2

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50	recordValue47 = St_dgenugennz_md2 (high byte)	M	XXh	RV_ST_DGENUGENNZ_MD2
51	recordValue48 = St_dgenugennz_md2 (low byte)	M	XXh	RV_ST_DGENUGENNZ_MD2
52	recordValue49 = St_dgenugenerr_md2	M	XXh	RV_ST_DGENUGENERR_MD2
53	recordValue50 = St_dgengrenz1_md2	M	XXh	RV_ST_DGENGRENZ1_MD2
54	recordValue51 = St_dgengrenz2_md2	M	XXh	RV_ST_DGENGRENZ2_MD2
55	recordValue52 = St_dgengrenznz_md2	M	XXh	RV_ST_DGENGRENZNZ_MD2
56	recordValue53 = St_dgengrenzerr_md2	M	XXh	RV_ST_DGENGRENZERR_MD2
57	recordValue54 = St_dgenerrst_md1 (high byte)	M	XXh	RV_ST_DGENERRRST_MD1
58	recordValue55 = St_dgenerrst_md1 (low byte)	M	XXh	RV_ST_DGENERRRST_MD1
59	recordValue56 = St_dgenerrst_md2 (high byte)	M	XXh	RV_ST_DGENERRRST_MD2
60	recordValue57 = St_dgenerrst_md2 (low byte)	M	XXh	RV_ST_DGENERRRST_MD2

## I.23.50 22\_401C - Ringspeicher MSA lesen

### General information:

This function is created to read out the "Ringspeicher MSA"

### Request


Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier High Byte	M	40h	RCL_MSARING
3	RecordCommonIdentifier Low Byte	M	1Ch	RCL_MSARING

Figure I.23.6: Table Request Message

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Request Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier High Byte	M	40h	RCL_MSARING
3	RecordCommonIdentifier Low Byte	M	1Ch	RCL_MSARING
4	recordValue1 = Msastz (high byte)	M	XXh	RV_MSASTZ
5	recordValue2 = Msastz (low byte)	M	XXh	RV_MSASTZ
6	recordValue3 = Msastzmsa (high byte)	M	XXh	RV_MSASTZMSA
7	recordValue4 = Msastzmsa (low byte)	M	XXh	RV_MSASTZMSA
8	recordValue5 = Msa_indexrs	M	XXh	RV_MSA_INDEXRS
9	recordValue6 = Msa_arravrs[1]	M	XXh	RV_MSA_ARRAVRS
10	recordValue7 = Msa_arravrs[2]	M	XXh	RV_MSA_ARRAVRS
11	recordValue8 = Msa_arravrs[3]	M	XXh	RV_MSA_ARRAVRS
12	recordValue9 = Msa_arravrs[4]	M	XXh	RV_MSA_ARRAVRS
13	recordValue10 = Msa_arravrs[5]	M	XXh	RV_MSA_ARRAVRS
14	recordValue11 = Msa_arravrs[6]	M	XXh	RV_MSA_ARRAVRS
15	recordValue12 = Msa_arravrs[7]	M	XXh	RV_MSA_ARRAVRS
16	recordValue13 = Msa_arravrs[8]	M	XXh	RV_MSA_ARRAVRS
17	recordValue14 = Msa_arravrs[9]	M	XXh	RV_MSA_ARRAVRS
18	recordValue15 = Msa_arravrs[10]	M	XXh	RV_MSA_ARRAVRS
19	recordValue16 = Msa_arravrs[11]	M	XXh	RV_MSA_ARRAVRS
20	recordValue17 = Msa_arravrs[12]	M	XXh	RV_MSA_ARRAVRS
21	recordValue18 = Msa_arravrs[13]	M	XXh	RV_MSA_ARRAVRS
22	recordValue19 = Msa_arravrs[14]	M	XXh	RV_MSA_ARRAVRS
23	recordValue20 = Msa_arravrs[15]	M	XXh	RV_MSA_ARRAVRS
24	recordValue21 = Msa_arravrs[16]	M	XXh	RV_MSA_ARRAVRS
25	recordValue22 = Msa_arravrs[17]	M	XXh	RV_MSA_ARRAVRS
26	recordValue23 = Msa_arravrs[18]	M	XXh	RV_MSA_ARRAVRS
27	recordValue24 = Msa_arravrs[19]	M	XXh	RV_MSA_ARRAVRS
28	recordValue25 = Msa_arravrs[20]	M	XXh	RV_MSA_ARRAVRS
29	recordValue26 = Msa_arravrs[21]	M	XXh	RV_MSA_ARRAVRS
30	recordValue27 = Msa_arravrs[22]	M	XXh	RV_MSA_ARRAVRS
31	recordValue28 = Msa_arravrs[23]	M	XXh	RV_MSA_ARRAVRS
32	recordValue29 = Msa_arravrs[24]	M	XXh	RV_MSA_ARRAVRS
33	recordValue30 = Msa_arravrs[25]	M	XXh	RV_MSA_ARRAVRS
34	recordValue31 = Msa_arravrs[26]	M	XXh	RV_MSA_ARRAVRS
35	recordValue32 = Msa_arravrs[27]	M	XXh	RV_MSA_ARRAVRS
36	recordValue33 = Msa_arravrs[28]	M	XXh	RV_MSA_ARRAVRS
37	recordValue34 = Msa_arravrs[29]	M	XXh	RV_MSA_ARRAVRS
38	recordValue35 = Msa_arravrs[30]	M	XXh	RV_MSA_ARRAVRS
39	recordValue36 = Msa_arravrs[31]	M	XXh	RV_MSA_ARRAVRS
40	recordValue37 = Msa_arravrs[32]	M	XXh	RV_MSA_ARRAVRS
41	recordValue38 = Msa_arravrs[33]	M	XXh	RV_MSA_ARRAVRS
42	recordValue39 = Msa_arravrs[34]	M	XXh	RV_MSA_ARRAVRS
43	recordValue40 = Msa_arravrs[35]	M	XXh	RV_MSA_ARRAVRS
44	recordValue41 = Msa_arravrs[36]	M	XXh	RV_MSA_ARRAVRS
-	recordValue42 = Msa_arravrs[37]	M	XXh	RV_MSA_ARRAVRS
46	recordValue43 = Msa_arravrs[38]	M	XXh	RV_MSA_ARRAVRS
47	recordValue44 = Msa_arravrs[39]	M	XXh	RV_MSA_ARRAVRS
48	recordValue- = Msa_arravrs[40]	M	XXh	RV_MSA_ARRAVRS
49	recordValue46 = Msa_arravrs[41]	M	XXh	RV_MSA_ARRAVRS
50	recordValue47 = Msa_arravrs[42]	M	XXh	RV_MSA_ARRAVRS

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51	recordValue48 = Msa_arravrs[43]	M	XXh	RV_MSA_ARRAVRS
52	recordValue49 = Msa_arravrs[44]	M	XXh	RV_MSA_ARRAVRS
53	recordValue50 = Msa_arravrs[-]	M	XXh	RV_MSA_ARRAVRS
54	recordValue51 = Msa_arravrs[46]	M	XXh	RV_MSA_ARRAVRS
55	recordValue52 = Msa_arravrs[47]	M	XXh	RV_MSA_ARRAVRS
56	recordValue53 = Msa_arravrs[48]	M	XXh	RV_MSA_ARRAVRS
57	recordValue54 = Msa_arravrs[49]	M	XXh	RV_MSA_ARRAVRS
58	recordValue55 = Msa_arravrs[50]	M	XXh	RV_MSA_ARRAVRS
59	recordValue56 = Msa_arravrs[51]	M	XXh	RV_MSA_ARRAVRS
60	recordValue57 = Msa_arravrs[52]	M	XXh	RV_MSA_ARRAVRS
61	recordValue58 = Msa_arravrs[53]	M	XXh	RV_MSA_ARRAVRS
62	recordValue59 = Msa_arravrs[54]	M	XXh	RV_MSA_ARRAVRS
63	recordValue60 = Msa_arravrs[55]	M	XXh	RV_MSA_ARRAVRS
64	recordValue61 = Msa_arravrs[56]	M	XXh	RV_MSA_ARRAVRS
65	recordValue62 = Msa_arravrs[57]	M	XXh	RV_MSA_ARRAVRS
66	recordValue63 = Msa_arravrs[58]	M	XXh	RV_MSA_ARRAVRS
67	recordValue64 = Msa_arravrs[59]	M	XXh	RV_MSA_ARRAVRS
68	recordValue65 = Msa_arravrs[60]	M	XXh	RV_MSA_ARRAVRS

### I.23.51 22\_401D - RCI\_VERBREDINFO\_lesen

#### General information:

This function is created to read out the "Verbredinfo" - Array

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier High Byte	M	40h	RCI_VERBREDINFO
3	RecordCommonIdentifier Low Byte	M	1Dh	RCI_VERBREDINFO

#### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	40h	RCI_VERBREDINFO
3	RecordCommonIdentifier Low Byte	M	1Dh	RCI_VERBREDINFO
4	recordValue1 = Verbredinfo[1]	M	XXh	RV_VERBREDINFO
5	recordValue2 = Verbredinfo[2]	M	XXh	RV_VERBREDINFO
6	recordValue3 = Verbredinfo[3]	M	XXh	RV_VERBREDINFO
7	recordValue4 = Verbredinfo[4]	M	XXh	RV_VERBREDINFO
8	recordValue5 = Verbredinfo[5]	M	XXh	RV_VERBREDINFO
9	recordValue6 = Verbredinfo[6]	M	XXh	RV_VERBREDINFO
10	recordValue7 = Verbredinfo[7]	M	XXh	RV_VERBREDINFO
11	recordValue8 = Verbredinfo[8]	M	XXh	RV_VERBREDINFO
12	recordValue9= Verbredinfo[9]	M	XXh	RV_VERBREDINFO
13	recordValue10 = Verbredinfo[10]	M	XXh	RV_VERBREDINFO
14	recordValue11 = Verbredinfo[11]	M	XXh	RV_VERBREDINFO
15	recordValue12 = Verbredinfo[12]	M	XXh	RV_VERBREDINFO
16	recordValue13 = Verbredinfo[13]	M	XXh	RV_VERBREDINFO
17	recordValue14= Verbredinfo[14]	M	XXh	RV_VERBREDINFO
18	recordValue15 = Verbredinfo[15]	M	XXh	RV_VERBREDINFO
19	recordValue16 = Verbredinfo[16]	M	XXh	RV_VERBREDINFO
20	recordValue17 = Verbredinfo[17]	M	XXh	RV_VERBREDINFO
21	recordValue18 = Verbredinfo[18]	M	XXh	RV_VERBREDINFO
22	recordValue19 = Verbredinfo[19]	M	XXh	RV_VERBREDINFO
23	recordValue20 = Verbredinfo[20]	M	XXh	RV_VERBREDINFO
24	recordValue21 = Verbredinfo[21]	M	XXh	RV_VERBREDINFO
25	recordValue22 = Verbredinfo[22]	M	XXh	RV_VERBREDINFO
26	recordValue23 = Verbredinfo[23]	M	XXh	RV_VERBREDINFO
27	recordValue24 = Verbredinfo[44]	M	XXh	RV_VERBREDINFO
28	recordValue25 = Verbredinfo[25]	M	XXh	RV_VERBREDINFO
29	recordValue26 = Verbredinfo[26]	M	XXh	RV_VERBREDINFO
30	recordValue27 = Verbredinfo[27]	M	XXh	RV_VERBREDINFO
31	recordValue28 = Verbredinfo[28]	M	XXh	RV_VERBREDINFO
32	recordValue29= Verbredinfo[29]	M	XXh	RV_VERBREDINFO
33	recordValue30 = Verbredinfo[30]	M	XXh	RV_VERBREDINFO
34	recordValue31 = Verbredinfo[31]	M	XXh	RV_VERBREDINFO
35	recordValue32 = Verbredinfo[32]	M	XXh	RV_VERBREDINFO

## I.23.52 22\_401E - Read CBS-Daten Zündkerzen

### General information:

This function is created to read out the described values from the ecu.  
Input and Output data see at service 22\_10\_01 for MSx80.

### Formula section:

```


If service 22_40_1E is recieved
then
    send 78 H
endif

```

```

If(1)    78H handling is activated for this function
Then(1)

```

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```

increment CTR_BOS_READ
if(2)      CTR_BOS_READ > 1C2H           // timeout condition
then(2)    send negative response
              LV_BOS_READ_REQ      = 0
              CTR_BOS_READ         = 0
              Bosanfsgbd           = 0
              End data handling 78H
                                      // End data transmission to tester
else(2)
if(3)      LV_BOS_READ_REQ = 0
then(3)
if(4)      LC_SENS_ZK = 1
then(4)    Bosanfsgbd = 0AH
              LV_BOS_READ_REQ = 1
else(4)    send negative response
              LV_BOS_READ_REQ      = 0
              CTR_BOS_READ         = 0
              Bosanfsgbd           = 0
              End data handling 78H
                                      // End data transmission to tester
endif(4)
else(3)
if(4)      Bosanfsgbd = Bostoken       // data for tester are ready
then(4)    LV_BOS_READ_REQ = 0
              send positive response
              LV_BOS_READ_REQ      = 0
              CTR_BOS_READ         = 0
              Bosanfsgbd           = 0
              End data handling 78H
                                      // End data transmission to tester
endif(4)
endif(3)
endif(2)
endif(1)

```

## Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	40h	RCI_
3	RecordCommonIdentifier Low Byte	M	1Eh	RCI_

Figure I.23.7: Table Request Message

## Positive Response on service



Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Response Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier	M	40h	RCI_CBSZK_I esen
3	RecordCommonIdentifier	M	1Eh	RCI_CBSZK_I esen
4	recordValue1 = Id_bosmgt	M	XXh	RV_Id_bosmgt
5	recordValue2 = Bosrlsm (high byte)	M	XXh	RV_Bosrlsm
6	recordValue3 = Bosrlsm (low byte)	M	XXh	RV_Bosrlsm
7	recordValue4 = Bosstate	M	XXh	RV_Bosstate
8	recordValue5 = Zrbosmld	M	XXh	RV_Zrbosmld
9	recordValue6 = Bosbtvfbk	M	XXh	RV_Bosbtvfbk
10	recordValue7 = Bosrw2	M	XXh	RV_Bosrw2
11	recordValue8 = Bosmziel	M	XXh	RV_Bosmziel
12	recordValue9 = Bosjziel	M	XXh	RV_Bosjziel
13	recordValue10 = Bosprog2	M	XXh	RV_Bosprog2
14	recordValue11 = Bosmanip	M	XXh	RV_Bosmanip
15	recordValue12 = Bosres	M	XXh	RV_Bosres
16	recordValue13 = Bostoken	M	XXh	RV_Bostoken

### I.23.53 22\_401F - Read BMW-PST

#### General information:

This function is created to read out the "BMW-Programmstandsinformation"

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Request Service ID</b>	M	22h	RDBC I
2	RecordCommonIdentifier High Byte	M	40h	RCI_PST
3	RecordCommonIdentifier Low Byte	M	1Fh	RCI_PST

#### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Response Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier High Byte	M	40h	RCI_PST
3	RecordCommonIdentifier Low Byte	M	1Fh	RCI_PST
4	recordValue1 = Ecu_sw_ref_bmw[1]	M	XXh	RV_PST
5	recordValue2 = Ecu_sw_ref_bmw[2]	M	XXh	RV_PST
6	recordValue3 = Ecu_sw_ref_bmw[3]	M	XXh	RV_PST
7	recordValue4 = Ecu_sw_ref_bmw[4]	M	XXh	RV_PST
8	recordValue5 = Ecu_sw_ref_bmw[5]	M	XXh	RV_PST
9	recordValue6 = Ecu_sw_ref_bmw[6]	M	XXh	RV_PST
10	recordValue7 = Ecu_sw_ref_bmw[7]	M	XXh	RV_PST
11	recordValue8 = Ecu_sw_ref_bmw[8]	M	XXh	RV_PST
12	recordValue9 = Ecu_sw_ref_bmw[9]	M	XXh	RV_PST

### I.23.54 22\_4021 - RCI\_IBS\_lesen

#### Formula section:

Released by Tettenborn Frank		Date 2013-02-13	File 43I00V01.00F
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7625 of 8404	
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BMW part numbers ASCII byte 7-1 conversion from Hex to ASCII:

The value of Zbibs is limited to a valid range between 0d and 9 999 999d for converting and reporting the data as ASCII string.

**Note:** zbibs\_rest and temp\_byte are only help values for conversion, they are not accessible as online-values or RAM-cells.

```
IF                Zbibs < 9 999 999d
THEN             zbibs_rest = zbibs
ELSE             zbibs_rest = 9 999 999d
ENDIF
```

```
temp_byte = (zbibs_rest /1 000 000d)
BMW part numbers ASCII byte 7 = temp_byte + 30h
zbibs_rest = Zbibs - (temp_byte * 1 000 000d)
```

```
temp_byte = (zbibs_rest /100 000d)
BMW part numbers ASCII byte 6 = temp_byte + 30h
zbibs_rest = zbibs_rest - (temp_byte * 100 000d)
```

```
temp_byte = (zbibs_rest /10 000d)
BMW part numbers ASCII byte 5 = temp_byte + 30h
zbibs_rest = zbibs_rest - (temp_byte * 10 000d)
```

```
temp_byte = (zbibs_rest /1 000d)
BMW part numbers ASCII byte 4 = temp_byte + 30h
zbibs_rest = zbibs_rest - (temp_byte * 1 000d)
```

```
temp_byte = (zbibs_rest /100d)
BMW part numbers ASCII byte 3 = temp_byte + 30h
zbibs_rest = zbibs_rest - (temp_byte * 100d)
```

```
temp_byte = (zbibs_rest /10d)
BMW part numbers ASCII byte 2 = temp_byte + 30h
zbibs_rest = zbibs_rest - (temp_byte * 10d)
```

BMW part numbers ASCII byte 1 = zbibs\_rest + 30h

**Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	ReadDataByCommonIdentifier Request Service Id	M	22h	RDBC1
2	RecordCommonIdentifier	M	40h	RCL_IBS
3	RecordCommonIdentifier	M	21h	RCL_IBS

**Positive Response on service**

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>ReadDataByCommonIdentifier Response Service Id</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier	M	40h	RCI_IBS
3	RecordCommonIdentifier	M	21h	RCI_IBS
4	RecordValue1 BMW part numbers ASCII byte 7	M	XXh	RV_ZB_IBS
5	RecordValue2 BMW part numbers ASCII byte 6	M	XXh	RV_ZB_IBS
6	RecordValue3 BMW part numbers ASCII byte 5	M	XXh	RV_ZB_IBS
7	RecordValue4 BMW part numbers ASCII byte 4	M	XXh	RV_ZB_IBS
8	RecordValue5 BMW part numbers ASCII byte 3	M	XXh	RV_ZB_IBS
9	RecordValue6 BMW part numbers ASCII byte 2	M	XXh	RV_ZB_IBS
10	RecordValue7 BMW part numbers ASCII byte 1	M	XXh	RV_ZB_IBS
11	RecordValue8 Snibs byte 3	M	XXh	RV_SN_IBS
12	RecordValue9 Snibs byte 2	M	XXh	RV_SN_IBS
13	RecordValue10 Snibs byte 1	M	XXh	RV_SN_IBS
14	RecordValue11 Snibs byte 0	M	XXh	RV_SN_IBS
15	RecordValue12 SW-baseline IBS_DEZ byte = lbswbase	M	XXh	RV_SW_BL_IBS
16	RecordValue13 SW-index IBS_DEZ byte = lbswchang	M	XXh	RV_SWIDX_IBS
17	RecordValue14 HW-index IBS_DEZ byte = lbhwversi	M	XXh	RV_HWIDX_IBS
18	RecordValue15 reserved dummy byte not used	M	FFh	RV_
19	RecordValue16 reserved dummy byte not used	M	FFh	RV_
20	RecordValue17 reserved dummy byte not used	M	FFh	RV_
21	RecordValue18 reserved dummy byte not used	M	FFh	RV_
22	RecordValue19 reserved dummy byte not used	M	FFh	RV_
23	RecordValue20 reserved dummy byte not used	M	FFh	RV_

## I.23.55 22\_4022 - RCI\_PM1\_lesen

### General information:

#### READ PM1 Status

This function ist for reading the data (array Pminfo1)of the Powermanagement.


### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Request Service ID</b>	<b>M</b>	<b>22h</b>	<b>RDBCI</b>
2	RecordCommonIdentifier High Byte	M	40h	RCI_PM1_lesen
3	RecordCommonIdentifier Low Byte	M	22h	RCI_PM1_lesen

### Positive Response on service

<b>Data Byte</b>	<b>Parameter Name</b>	<b>Cvt</b>	<b>Hex Value</b>	<b>Mnemonic</b>
<b>1</b>	<b>Response Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier High Byte	M	40h	RCI_PM1_lesen
3	RecordCommonIdentifier Low Byte	M	22h	RCI_PM1_lesen
4	RecordValue1 = Pminfo1 Word 0 high byte	M	XXh	RV_PMINFO1
5	RecordValue2 = Pminfo1 Word 0 low byte	M	XXh	RV_PMINFO1
6	RecordValue3 = Pminfo1 Word 1 high byte	M	XXh	RV_PMINFO1
7	RecordValue4 = Pminfo1 Word 1 low byte	M	XXh	RV_PMINFO1
8	RecordValue5 = Pminfo1 Word 2 high byte	M	XXh	RV_PMINFO1
9	RecordValue6 = Pminfo1 Word 2 low byte	M	XXh	RV_PMINFO1
10	RecordValue7 = Pminfo1 Word 3 high byte	M	XXh	RV_PMINFO1
11	RecordValue8 = Pminfo1 Word 3 low byte	M	XXh	RV_PMINFO1
12	RecordValue9 = Pminfo1 Word 4 high byte	M	XXh	RV_PMINFO1
13	RecordValue10 = Pminfo1 Word 4 low byte	M	XXh	RV_PMINFO1
14	RecordValue11 = Pminfo1 Word 5 high byte	M	XXh	RV_PMINFO1
15	RecordValue12 = Pminfo1 Word 5 low byte	M	XXh	RV_PMINFO1
16	RecordValue13 = Pminfo1 Word 6 high byte	M	XXh	RV_PMINFO1
17	RecordValue14 = Pminfo1 Word 6 low byte	M	XXh	RV_PMINFO1
18	RecordValue15 = Pminfo1 Word 7 high byte	M	XXh	RV_PMINFO1
19	RecordValue16 = Pminfo1 Word 7 low byte	M	XXh	RV_PMINFO1
20	RecordValue17 = Pminfo1 Word 8 high byte	M	XXh	RV_PMINFO1
21	RecordValue18 = Pminfo1 Word 8 low byte	M	XXh	RV_PMINFO1
22	RecordValue19 = Pminfo1 Word 9 high byte	M	XXh	RV_PMINFO1
23	RecordValue20 = Pminfo1 Word 9 low byte	M	XXh	RV_PMINFO1
24	RecordValue21 = Pminfo1 Word 10 high byte	M	XXh	RV_PMINFO1
25	RecordValue22 = Pminfo1 Word 10 low byte	M	XXh	RV_PMINFO1
26	RecordValue23 = Pminfo1 Word 11 high byte	M	XXh	RV_PMINFO1
27	RecordValue24 = Pminfo1 Word 11 low byte	M	XXh	RV_PMINFO1
28	RecordValue25 = Pminfo1 Word 12 high byte	M	XXh	RV_PMINFO1
29	RecordValue26 = Pminfo1 Word 12 low byte	M	XXh	RV_PMINFO1
30	RecordValue27 = Pminfo1 Word 13 high byte	M	XXh	RV_PMINFO1
31	RecordValue28 = Pminfo1 Word 13 low byte	M	XXh	RV_PMINFO1
32	RecordValue29 = Pminfo1 Word 14 high byte	M	XXh	RV_PMINFO1
33	RecordValue30 = Pminfo1 Word 14 low byte	M	XXh	RV_PMINFO1
34	RecordValue31 = Pminfo1 Word 15 high byte	M	XXh	RV_PMINFO1
35	RecordValue32 = Pminfo1 Word 15 low byte	M	XXh	RV_PMINFO1
36	RecordValue33 = Pminfo1 Word 16 high byte	M	XXh	RV_PMINFO1
37	RecordValue34 = Pminfo1 Word 16 low byte	M	XXh	RV_PMINFO1
38	RecordValue35 = Pminfo1 Word 17 high byte	M	XXh	RV_PMINFO1
39	RecordValue36 = Pminfo1 Word 17 low byte	M	XXh	RV_PMINFO1
40	RecordValue37 = Pminfo1 Word 18 high byte	M	XXh	RV_PMINFO1
41	RecordValue38 = Pminfo1 Word 18 low byte	M	XXh	RV_PMINFO1
42	RecordValue39 = Pminfo1 Word 19 high byte	M	XXh	RV_PMINFO1
43	RecordValue40 = Pminfo1 Word 19 low byte	M	XXh	RV_PMINFO1
44	RecordValue41 = Pminfo1 Word 20 high byte	M	XXh	RV_PMINFO1
-	RecordValue42 = Pminfo1 Word 20 low byte	M	XXh	RV_PMINFO1
46	RecordValue43 = Pminfo1 Word 21 high byte	M	XXh	RV_PMINFO1
47	RecordValue44 = Pminfo1 Word 21 low byte	M	XXh	RV_PMINFO1
48	RecordValue- = Pminfo1 Word 22 high byte	M	XXh	RV_PMINFO1

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 7628 of 8404</b>	
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49	RecordValue46 = Pminfo1 Word 22 low byte	M	XXh	RV_PMINFO1
50	RecordValue47 = Pminfo1 Word 23 high byte	M	XXh	RV_PMINFO1
51	RecordValue48 = Pminfo1 Word 23 low byte	M	XXh	RV_PMINFO1
52	RecordValue49 = Pminfo1 Word 24 high byte	M	XXh	RV_PMINFO1
53	RecordValue50 = Pminfo1 Word 24 low byte	M	XXh	RV_PMINFO1
54	RecordValue51 = Pminfo1 Word 25 high byte	M	XXh	RV_PMINFO1
55	RecordValue52 = Pminfo1 Word 25 low byte	M	XXh	RV_PMINFO1
56	RecordValue53 = Pminfo1 Word 26 high byte	M	XXh	RV_PMINFO1
57	RecordValue54 = Pminfo1 Word 26 low byte	M	XXh	RV_PMINFO1
58	RecordValue55 = Pminfo1 Word 27 high byte	M	XXh	RV_PMINFO1
59	RecordValue56 = Pminfo1 Word 27 low byte	M	XXh	RV_PMINFO1
60	RecordValue57 = Pminfo1 Word 28 high byte	M	XXh	RV_PMINFO1
61	RecordValue58 = Pminfo1 Word 28 low byte	M	XXh	RV_PMINFO1
62	RecordValue59 = Pminfo1 Word 29 high byte	M	XXh	RV_PMINFO1
63	RecordValue60 = Pminfo1 Word 29 low byte	M	XXh	RV_PMINFO1
64	RecordValue61 = Pminfo1 Word 30 high byte	M	XXh	RV_PMINFO1
65	RecordValue62 = Pminfo1 Word 30 low byte	M	XXh	RV_PMINFO1
66	RecordValue63 = Pminfo1 Word 31 high byte	M	XXh	RV_PMINFO1
67	RecordValue64 = Pminfo1 Word 31 low byte	M	XXh	RV_PMINFO1
68	RecordValue65 = Pminfo1 Word 32 high byte	M	XXh	RV_PMINFO1
69	RecordValue66 = Pminfo1 Word 32 low byte	M	XXh	RV_PMINFO1
70	RecordValue67 = Pminfo1 Word 33 high byte	M	XXh	RV_PMINFO1
71	RecordValue68 = Pminfo1 Word 33 low byte	M	XXh	RV_PMINFO1
72	RecordValue69 = Pminfo1 Word 34 high byte	M	XXh	RV_PMINFO1
73	RecordValue70 = Pminfo1 Word 34 low byte	M	XXh	RV_PMINFO1
74	RecordValue71 = Pminfo1 Word 35 high byte	M	XXh	RV_PMINFO1
75	RecordValue72 = Pminfo1 Word 35 low byte	M	XXh	RV_PMINFO1
76	RecordValue73 = Pminfo1 Word 36 high byte	M	XXh	RV_PMINFO1
77	RecordValue74 = Pminfo1 Word 36 low byte	M	XXh	RV_PMINFO1

## I.23.56 22\_4023 - RCI\_PM2\_lesen

### General information:

#### READ PM2 Status

This function ist for reading the data (array Pminfo2)of the Powermanagement.

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier High Byte	M	40h	RCI_PM2_lesen
3	RecordCommonIdentifier Low Byte	M	23h	RCI_PM2_lesen

#### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	40h	RCI_PM2_lesen
3	RecordCommonIdentifier Low Byte	M	23h	RCI_PM2_lesen
4	RecordValue1 = Pminfo2 byte 0	M	XXh	RV_PMINFO2
5	RecordValue2 = Pminfo2 byte 1	M	XXh	RV_PMINFO2
6	RecordValue3 = Pminfo2 byte 2	M	XXh	RV_PMINFO2
7	RecordValue4 = Pminfo2 byte 3	M	XXh	RV_PMINFO2
8	RecordValue5 = Pminfo2 byte 4	M	XXh	RV_PMINFO2
9	RecordValue6 = Pminfo2 byte 5	M	XXh	RV_PMINFO2
10	RecordValue7 = Pminfo2 byte 6	M	XXh	RV_PMINFO2
11	RecordValue8 = Pminfo2 byte 7	M	XXh	RV_PMINFO2
12	RecordValue9 = Pminfo2 byte 8	M	XXh	RV_PMINFO2
13	RecordValue10 = Pminfo2 byte 9	M	XXh	RV_PMINFO2
14	RecordValue11 = Pminfo2 byte 10	M	XXh	RV_PMINFO2
15	RecordValue12 = Pminfo2 byte 11	M	XXh	RV_PMINFO2
16	RecordValue13 = Pminfo2 byte 12	M	XXh	RV_PMINFO2
17	RecordValue14 = Pminfo2 byte 13	M	XXh	RV_PMINFO2
18	RecordValue15 = Pminfo2 byte 14	M	XXh	RV_PMINFO2
19	RecordValue16 = Pminfo2 byte 15	M	XXh	RV_PMINFO2
20	RecordValue17 = Pminfo2 byte 16	M	XXh	RV_PMINFO2
21	RecordValue18 = Pminfo2 byte 17	M	XXh	RV_PMINFO2
22	RecordValue19 = Pminfo2 byte 18	M	XXh	RV_PMINFO2
23	RecordValue20 = Pminfo2 byte 19	M	XXh	RV_PMINFO2
24	RecordValue21 = Pminfo2 byte 20	M	XXh	RV_PMINFO2
25	RecordValue22 = Pminfo2 byte 21	M	XXh	RV_PMINFO2
26	RecordValue23 = Pminfo2 byte 22	M	XXh	RV_PMINFO2
27	RecordValue24 = Pminfo2 byte 23	M	XXh	RV_PMINFO2
28	RecordValue25 = Pminfo2 byte 24	M	XXh	RV_PMINFO2
29	RecordValue26 = Pminfo2 byte 25	M	XXh	RV_PMINFO2
30	RecordValue27 = Pminfo2 byte 26	M	XXh	RV_PMINFO2
31	RecordValue28 = Pminfo2 byte 27	M	XXh	RV_PMINFO2
32	RecordValue29 = Pminfo2 byte 28	M	XXh	RV_PMINFO2

### I.23.57 22\_4026 - RCI\_RBMMODE9\_lesen

#### General information:

#### Rate Based Monitoring Mode 9 auslesen

This function ist for reading the rate based monitoring data. It gives back the denminators and numerators of the RBM relevant diagnoses.

#### Description:

#### API to select Rate-Based Monitoring data to be transmitted via Mode \$09 based on spec 30B02601.00E

*This is only for information! This chapter will not be updated when the spec 30B02601 changes!*

The following paragraph describes the data selection algorithm to be executed only once (for CPU load saving reason), upon external tool request via Mode \$09, by calling an API.

Syntax : ACTION\_ERRM\_SelectRbmData ( INOUT < ListRbmData > ,  
OUT < ResultRbmData > )

Parameter (in) : No parameter

Parameter (out) : ResultRbmData

Parameter(inout) : ListRbmData

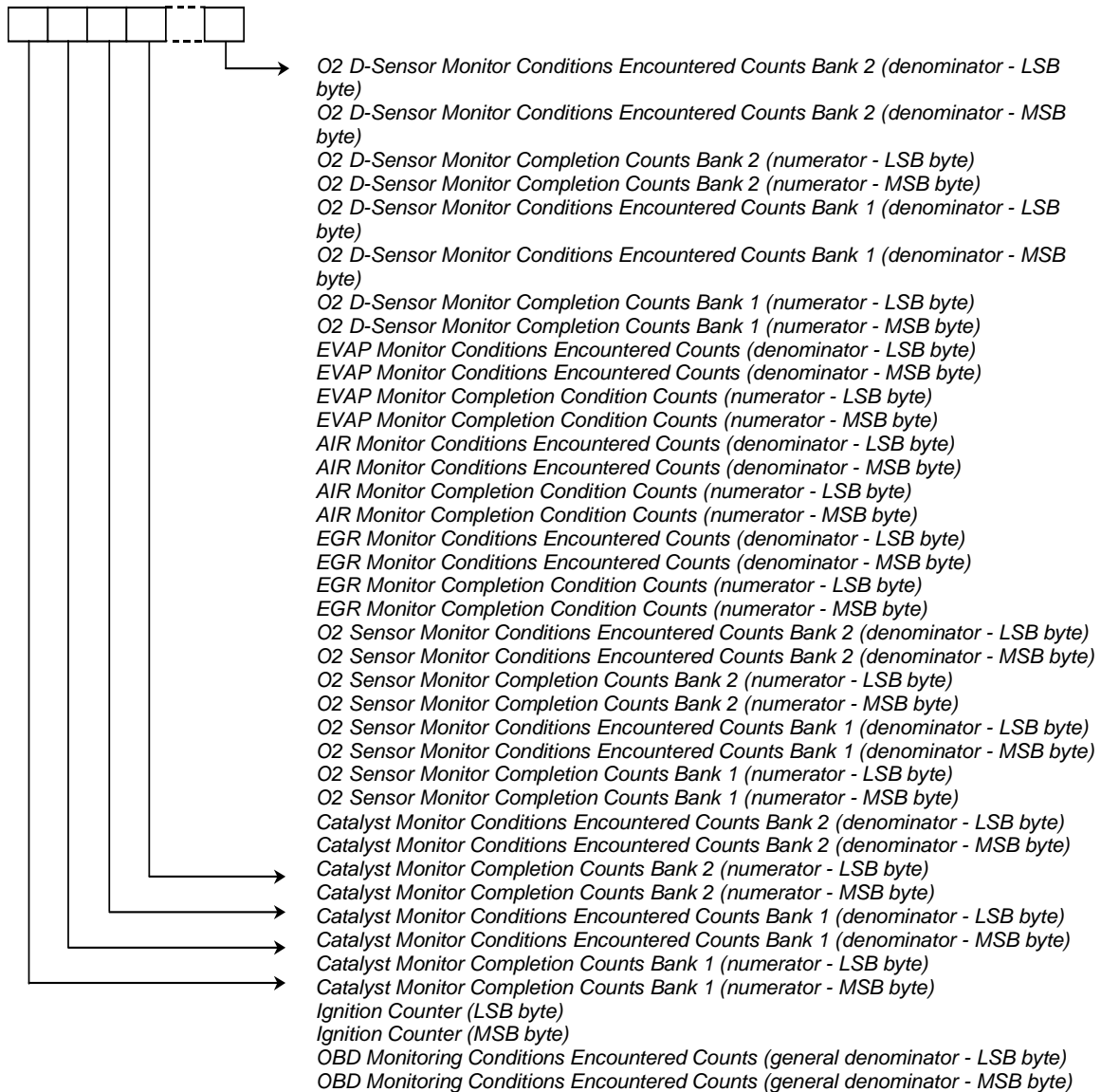
Short description : This API calculates and returns the Rate-Based Monitoring data to be transmitted to the Scan-Tool, when requested by the Mode 09\$ (InfoType \$08).

ResultRbmData : Indicates if the API has been executed or not.

Authorised values for ResultRbmDataSelection are :

- POSITIVE\_RESPONSE : the call of the API is successful
- NEGATIVE\_RESPONSE : the call of the API is unsuccessful

ListRbmData : Software structure filled-up with 20 counters of 2 bytes coming from Rate-Based Monitoring



The function described above is used to bring the RBM- values into KWP- buffer. The content of this KWP- buffer is given to tester with the telegram- layout described below.

## Request



<i>Data Byte</i>	<i>Parameter Name</i>	<i>Cvt</i>	<i>Hex Value</i>	<i>Mnemonic</i>
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier High Byte	M	40h	RCI_RBMMODE9
3	RecordCommonIdentifier Low Byte	M	26h	RCI_RBMMODE9

### Positive Response on service




Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	Response Service ID	M	#62	RDBCIPR
#2d	RecordCommonIdentifier	M	#40	RCI_RBMM S1
#3d	RecordCommonIdentifier = Rate Based Monitoring	M	#26	RCI_RBMM S1
#4d	RecordValue#1 = CTR_CDN_OBD_RBM (high byte)	M	#XXh	DREC_1
#5d	RecordValue#2 = CTR_CDN_OBD_RBM (low byte)	M	#XXh	DREC_2
#6d	RecordValue#3 = CTR_IGK_CYC_RBM (high byte)	M	#XXh	DREC_
#7d	RecordValue#4 = CTR_IGK_CYC_RBM (low byte)	M	#XXh	DREC_
#8d	RecordValue#5 = CTR_COMP_RBM_CLC_CAT_1 (high byte)	M	#XXh	DREC_
#9d	RecordValue#6 = CTR_COMP_RBM_CLC_CAT_1 (low byte)	M	#XXh	DREC_
#10d	RecordValue#7 = CTR_CDN_RBM_CLC_CAT_1 (high byte)	M	#XXh	DREC_
#11d	RecordValue#8 = CTR_CDN_RBM_CLC_CAT_1 (low byte)	M	#XXh	DREC_
#12d	RecordValue#9 = CTR_COMP_RBM_CLC_CAT_2 (high byte)	M	#XXh	DREC_
#13d	RecordValue#10 = CTR_COMP_RBM_CLC_CAT_2 (low byte)	M	#XXh	DREC_
#14d	RecordValue#11 = CTR_CDN_RBM_CLC_CAT_2 (high byte)	M	#XXh	DREC_
#15d	RecordValue#12 = CTR_CDN_RBM_CLC_CAT_2 (low byte)	M	#XXh	DREC_
#16d	RecordValue#13 = CTR_COMP_RBM_CLC_LS_UP_1 (high byte)	M	#XXh	DREC_
#17d	RecordValue#14 = CTR_COMP_RBM_CLC_LS_UP_1 (low byte)	M	#XXh	DREC_
#18d	RecordValue#15 = CTR_CDN_RBM_CLC_LS_UP_1 (high byte)	M	#XXh	DREC_
#19d	RecordValue#16 = CTR_CDN_RBM_CLC_LS_UP_1 (low byte)	M	#XXh	DREC_
#20d	RecordValue#17 = CTR_COMP_RBM_CLC_LS_UP_2 (high byte)	M	#XXh	DREC_
#21d	RecordValue#18 = CTR_COMP_RBM_CLC_LS_UP_2 (low byte)	M	#XXh	DREC_
#22d	RecordValue#19 = CTR_CDN_RBM_CLC_LS_UP_2 (high byte)	M	#XXh	DREC_
#23d	RecordValue#20 = CTR_CDN_RBM_CLC_LS_UP_2 (low byte)	M	#XXh	DREC_
#24d	RecordValue#21 = CTR_COMP_RBM_CLC_VVT (high byte)	M	#XXh	DREC_
#25d	RecordValue#22 = CTR_COMP_RBM_CLC_VVT (low byte)	M	#XXh	DREC_
#26d	RecordValue#23 = CTR_CDN_RBM_CLC_VVT (high byte)	M	#XXh	DREC_
#27d	RecordValue#24 = CTR_CDN_RBM_CLC_VVT (low byte)	M	#XXh	DREC_
#28d	RecordValue#25 = CTR_COMP_RBM_CLC_SA (high byte)	M	#XXh	DREC_
#29d	RecordValue#26 = CTR_COMP_RBM_CLC_SA (low byte)	M	#XXh	DREC_
#30d	RecordValue#27 = CTR_CDN_RBM_CLC_SA (high byte)	M	#XXh	DREC_
#31d	RecordValue#28 = CTR_CDN_RBM_CLC_SA (low byte)	M	#XXh	DREC_
#32d	RecordValue#29 = CTR_COMP_RBM_CLC_LEAK (high byte)	M	#XXh	DREC_
#33d	RecordValue#30 = CTR_COMP_RBM_CLC_LEAK (low byte)	M	#XXh	DREC_
#34d	RecordValue#31 = CTR_CDN_RBM_CLC_LEAK (high byte)	M	#XXh	DREC_
#35d	RecordValue#32 = CTR_CDN_RBM_CLC_LEAK (low byte)	M	#XXh	DREC_
#36d	RecordValue#33 = CTR_COMP_RBM_CLC_LS_DOWN_1 (high byte)	M	#XXh	DREC_
#37d	RecordValue#34 = CTR_COMP_RBM_CLC_LS_DOWN_1 (low byte)	M	#XXh	DREC_
#38d	RecordValue#35 = CTR_CDN_RBM_CLC_LS_DOWN_1 (high byte)	M	#XXh	DREC_
#39d	RecordValue#36 = CTR_CDN_RBM_CLC_LS_DOWN_1 (low byte)	M	#XXh	DREC_
#40d	RecordValue#37 = CTR_COMP_RBM_CLC_LS_DOWN_2 (high byte)	M	#XXh	DREC_
#41d	RecordValue#38 = CTR_COMP_RBM_CLC_LS_DOWN_2 (low byte)	M	#XXh	DREC_
#42d	RecordValue#39 = CTR_CDN_RBM_CLC_LS_DOWN_2 (high byte)	M	#XXh	DREC_
#43d	RecordValue#40 = CTR_CDN_RBM_CLC_LS_DOWN_2 (low byte)	M	#XXh	DREC_40

Figure I.23.8: Table ReadDataByIdentifier Positive Response Message

## I.23.58 22\_4027 - RCI\_RBMM S1\_lesen

### General information:

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7633 of 8404	
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## Rate Based Monitoring Motorsteuerung Block 1 auslesen

This function reads out RBM values block 1.


### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	40h	RCI_RBMS1
3	RecordCommonIdentifier Low Byte	M	27h	RCI_RBMS1

### Positive Response on service


Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	<b>ReadDataByIdentifier Response Service Id</b>	<b>M</b>	<b>#62h</b>	<b>RDBCIPR</b>
#2d	dataIdentifier #1 =	M	#40h	DID_
#3d	[ byte1(MSB)		#27h	B1
	byte2 ]			B2
#4d	RecordValue#1 = CTR_COMP_RBM_CAT_DIAG_1 high byte	M	#XXh	RV_1
#5d	RecordValue#2 = CTR_COMP_RBM_CAT_DIAG_1 low byte	M	#XXh	RV_2
#6d	RecordValue#3 = CTR_CDN_RBM_CAT_DIAG_1 high byte	M	#XXh	RV_
#7d	RecordValue#4 = CTR_CDN_RBM_CAT_DIAG_1 low byte	M	#XXh	RV_
#8d	RecordValue#5 = CTR_COMP_RBM_CAT_DIAG_2 high byte	M	#XXh	RV_
#9d	RecordValue#6 = CTR_COMP_RBM_CAT_DIAG_2 low byte	M	#XXh	RV_
#10d	RecordValue#7 = CTR_CDN_RBM_CAT_DIAG_2 high byte	M	#XXh	RV_
#11d	RecordValue#8 = CTR_CDN_RBM_CAT_DIAG_2 low byte	M	#XXh	RV_
#12d	RecordValue#9 = CTR_COMP_RBM_DYN_VLD_LS_UP_1 high byte	M	#XXh	RV_
#13d	RecordValue#10 = CTR_COMP_RBM_DYN_VLD_LS_UP_1 low byte	M	#XXh	RV_
#14d	RecordValue#11 = CTR_CDN_RBM_DYN_VLD_LS_UP_1 high byte	M	#XXh	RV_
#15d	RecordValue#12 = CTR_CDN_RBM_DYN_VLD_LS_UP_1 low byte	M	#XXh	RV_
#16d	RecordValue#13 = CTR_COMP_RBM_SHIFT_AFL_LSL_UP_1 high byte	M	#XXh	RV_
#17d	RecordValue#14 = CTR_COMP_RBM_SHIFT_AFL_LSL_UP_1 low byte	M	#XXh	RV_
#18d	RecordValue#15 = CTR_CDN_RBM_SHIFT_AFL_LSL_UP_1 high byte	M	#XXh	RV_
#19d	RecordValue#16 = CTR_CDN_RBM_SHIFT_AFL_LSL_UP_1 low byte	M	#XXh	RV_
#20d	RecordValue#17 = CTR_COMP_RBM_SHIFT_AFR_LSL_UP_1 high byte	M	#XXh	RV_
#21d	RecordValue#18 = CTR_COMP_RBM_SHIFT_AFR_LSL_UP_1 low byte	M	#XXh	RV_
#22d	RecordValue#19 = CTR_CDN_RBM_SHIFT_AFR_LSL_UP_1 high byte	M	#XXh	RV_
#23d	RecordValue#20 = CTR_CDN_RBM_SHIFT_AFR_LSL_UP_1 low byte	M	#XXh	RV_
#24d	RecordValue#21 = CTR_COMP_RBM_AIR_LSL_UP_1 high byte	M	#XXh	RV_
#25d	RecordValue#22 = CTR_COMP_RBM_AIR_LSL_UP_1 low byte	M	#XXh	RV_
#26d	RecordValue#23 = CTR_CDN_RBM_AIR_LSL_UP_1 high byte	M	#XXh	RV_
#27d	RecordValue#24 = CTR_CDN_RBM_AIR_LSL_UP_1 low byte	M	#XXh	RV_
#28d	RecordValue#25 = CTR_COMP_RBM_DYN_VLD_LS_UP_2 high byte	M	#XXh	RV_
#29d	RecordValue#26 = CTR_COMP_RBM_DYN_VLD_LS_UP_2 low byte	M	#XXh	RV_
#30d	RecordValue#27 = CTR_CDN_RBM_DYN_VLD_LS_UP_2 high byte	M	#XXh	RV_
#31d	RecordValue#28 = CTR_CDN_RBM_DYN_VLD_LS_UP_2 low byte	M	#XXh	RV_
#32d	RecordValue#29 = CTR_COMP_RBM_SHIFT_AFL_LSL_UP_2 high byte	M	#XXh	RV_
#33d	RecordValue#30 = CTR_COMP_RBM_SHIFT_AFL_LSL_UP_2 low byte	M	#XXh	RV_
#34d	RecordValue#31 = CTR_CDN_RBM_SHIFT_AFL_LSL_UP_2 high byte	M	#XXh	RV_
#35d	RecordValue#32 = CTR_CDN_RBM_SHIFT_AFL_LSL_UP_2 low byte	M	#XXh	RV_
#36d	RecordValue#33 = CTR_COMP_RBM_SHIFT_AFR_LSL_UP_2 high byte	M	#XXh	RV_
#37d	RecordValue#34 = CTR_COMP_RBM_SHIFT_AFR_LSL_UP_2 low byte	M	#XXh	RV_
#38d	RecordValue#35 = CTR_CDN_RBM_SHIFT_AFR_LSL_UP_2 high byte	M	#XXh	RV_
#39d	RecordValue#36 = CTR_CDN_RBM_SHIFT_AFR_LSL_UP_2 low byte	M	#XXh	RV_
#40d	RecordValue#37 = CTR_COMP_RBM_AIR_LSL_UP_2 high byte	M	#XXh	RV_
#41d	RecordValue#38 = CTR_COMP_RBM_AIR_LSL_UP_2 low byte	M	#XXh	RV_
#42d	RecordValue#39 = CTR_CDN_RBM_AIR_LSL_UP_2 high byte	M	#XXh	RV_
#43d	RecordValue#40 = CTR_CDN_RBM_AIR_LSL_UP_2 low byte	M	#XXh	RV_
#44d	RecordValue#41 = CTR_COMP_RBM_SMALL_LEAK high byte	M	#XXh	RV_
#-d	RecordValue#42 = CTR_COMP_RBM_SMALL_LEAK low byte	M	#XXh	RV_
#46d	RecordValue#43 = CTR_CDN_RBM_SMALL_LEAK high byte	M	#XXh	RV_
#47d	RecordValue#44 = CTR_CDN_RBM_SMALL_LEAK low byte	M	#XXh	RV_44
#48d	RecordValue#- = CTR_COMP_RBM_MEC_IVVT_IN high byte	M	#XXh	RV_

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#49d	RecordValue#46 = CTR_COMP_RBM_MEC_IVVT_IN low byte	M	#XXh	RV_
#50d	RecordValue#47 = CTR_CDN_RBM_MEC_IVVT_IN high byte	M	#XXh	RV_
#51d	RecordValue#48 = CTR_CDN_RBM_MEC_IVVT_IN low byte	M	#XXh	RV_
#52d	RecordValue#49 = CTR_COMP_RBM_MEC_IVVT_EX high byte	M	#XXh	RV_
#53d	RecordValue#50 = CTR_COMP_RBM_MEC_IVVT_EX low byte	M	#XXh	RV_
#54d	RecordValue#51 = CTR_CDN_RBM_MEC_IVVT_EX high byte	M	#XXh	RV_
#55d	RecordValue#52 = CTR_CDN_RBM_MEC_IVVT_EX low byte	M	#XXh	RV_
#56d	RecordValue#53 = NOT USED	M	#00h	RV_
#57d	RecordValue#54 = NOT USED	M	#00h	RV_
#58d	RecordValue#55 = NOT USED	M	#00h	RV_
#59d	RecordValue#56 = NOT USED	M	#00h	RV_
#60d	RecordValue#57 = NOT USED	M	#00h	RV_
#61d	RecordValue#58 = NOT USED	M	#00h	RV_
#62d	RecordValue#59 = NOT USED	M	#00h	RV_
#63d	RecordValue#60 = NOT USED	M	#00h	RV_
#64d	RecordValue#61 = NOT USED	M	#00h	RV_
#65d	RecordValue#62 = NOT USED	M	#00h	RV_
#66d	RecordValue#63 = NOT USED	M	#00h	RV_
#67d	RecordValue#64 = NOT USED	M	#00h	RV_
#68d	RecordValue#65 = NOT USED	M	#00h	RV_
#69d	RecordValue#66 = NOT USED	M	#00h	RV_
#70d	RecordValue#67 = NOT USED	M	#00h	RV_
#71d	RecordValue#68 = NOT USED	M	#00h	RV_
#72d	RecordValue#69 = CTR_COMP_RBM_TOOTH_OFF_IN_1 high byte	M	#XXh	RV_
#73d	RecordValue#70 = CTR_COMP_RBM_TOOTH_OFF_IN_1 low byte	M	#XXh	RV_
#74d	RecordValue#71 = CTR_CDN_RBM_TOOTH_OFF_IN_1 high byte	M	#XXh	RV_
#75d	RecordValue#72 = CTR_CDN_RBM_TOOTH_OFF_IN_1 low byte	M	#XXh	RV_
#76d	RecordValue#73 = CTR_COMP_RBM_TOOTH_OFF_EX_1 high byte	M	#XXh	RV_
#77d	RecordValue#74 = CTR_COMP_RBM_TOOTH_OFF_EX_1 low byte	M	#XXh	RV_
#78d	RecordValue#75 = CTR_CDN_RBM_TOOTH_OFF_EX_1 high byte	M	#XXh	RV_
#79d	RecordValue#76 = CTR_CDN_RBM_TOOTH_OFF_EX_1 low byte	M	#XXh	RV_
#80d	RecordValue#77 = NOT USED	M	#00h	RV_
#81d	RecordValue#78 = NOT USED	M	#00h	RV_
#82d	RecordValue#79 = NOT USED	M	#00h	RV_
#83d	RecordValue#80 = NOT USED	M	#00h	RV_
#84d	RecordValue#81 = NOT USED	M	#00h	RV_
#85d	RecordValue#82 = NOT USED	M	#00h	RV_
#86d	RecordValue#83 = NOT USED	M	#00h	RV_
#87d	RecordValue#84 = NOT USED	M	#00h	RV_
#88d	RecordValue#85 = NOT USED	M	#00h	RV_
#89d	RecordValue#86 = NOT USED	M	#00h	RV_
#90d	RecordValue#87 = NOT USED	M	#00h	RV_
#91d	RecordValue#88 = NOT USED	M	#00h	RV_
#92d	RecordValue#89 = NOT USED	M	#00h	RV_
#93d	RecordValue#90 = NOT USED	M	#00h	RV_
#94d	RecordValue#91 = NOT USED	M	#00h	RV_
#95d	RecordValue#92 = NOT USED	M	#00h	RV_
#96d	RecordValue#93 = NOT USED	M	#00h	RV_

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#97d	RecordValue#94= NOT USED	M	#00h	RV_
#98d	RecordValue#95= NOT USED	M	#00h	RV_
#99d	RecordValue#96= NOT USED	M	#00h	RV_
#100d	RecordValue#97= NOT USED	M	#00h	RV_
#101d	RecordValue#98= NOT USED	M	#00h	RV_
#102d	RecordValue#99= NOT USED	M	#00h	RV_
#103d	RecordValue#100= NOT USED	M	#00h	RV_
#104d	RecordValue#101= NOT USED	M	#00h	RV_
#105d	RecordValue#102 = NOT USED	M	#00h	RV_
#106d	RecordValue#103= NOT USED	M	#00h	RV_
#107d	RecordValue#104= NOT USED	M	#00h	RV_
#108d	RecordValue#105 = CTR_COMP_RBM_CHK_LS_DOWN_1 high byte	M	#XXh	RV_
#109d	RecordValue#106 = CTR_COMP_RBM_CHK_LS_DOWN_1 low byte	M	#XXh	RV_
#110d	RecordValue#107= CTR_CDN_RBM_CHK_LS_DOWN_1 high byte	M	#XXh	RV_
#111d	RecordValue#108 = CTR_CDN_RBM_CHK_LS_DOWN_1 low byte	M	#XXh	RV_
#112d	RecordValue#113 = CTR_COMP_RBM_SWT_LS_DOWN_1 high byte	M	#XXh	RV_
#113d	RecordValue#114 = CTR_COMP_RBM_SWT_LS_DOWN_1 low byte	M	#XXh	RV_
#114d	RecordValue#115 = CTR_CDN_RBM_SWT_LS_DOWN_1 high byte	M	#XXh	RV_
#115d	RecordValue#116 = CTR_CDN_RBM_SWT_LS_DOWN_1 low byte	M	#XXh	RV_
#116d	RecordValue#121 = CTR_COMP_RBM_PUC_LS_DOWN_1 high byte	M	#XXh	RV_
#117d	RecordValue#122 = CTR_COMP_RBM_PUC_LS_DOWN_1 low byte	M	#XXh	RV_
#118d	RecordValue#123 = CTR_CDN_RBM_PUC_LS_DOWN_1 high byte	M	#XXh	RV_
#119d	RecordValue#124 = CTR_CDN_RBM_PUC_LS_DOWN_1 low byte	M	#XXh	RV_
#120d	RecordValue#129 = CTR_COMP_RBM_PUE_LS_DOWN_1 high byte	M	#XXh	RV_
#121d	RecordValue#130 = CTR_COMP_RBM_PUE_LS_DOWN_1 low byte	M	#XXh	RV_
#122d	RecordValue#131= CTR_CDN_RBM_PUE_LS_DOWN_1 high byte	M	#XXh	RV_
#123d	RecordValue#132 = CTR_CDN_RBM_PUE_LS_DOWN_1 low byte	M	#XXh	RV_
#124d	RecordValue#109 = CTR_COMP_RBM_CHK_LS_DOWN_2 high byte	M	#XXh	RV_
#125d	RecordValue#110 = CTR_COMP_RBM_CHK_LS_DOWN_2 low byte	M	#XXh	RV_
#126d	RecordValue#111= CTR_CDN_RBM_CHK_LS_DOWN_2 high byte	M	#XXh	RV_
#127d	RecordValue#112 = CTR_CDN_RBM_CHK_LS_DOWN_2 low byte	M	#XXh	RV_
#128d	RecordValue#117 = CTR_COMP_RBM_SWT_LS_DOWN_2 high byte	M	#XXh	RV_
#129d	RecordValue#118 = CTR_COMP_RBM_SWT_LS_DOWN_2 low byte	M	#XXh	RV_
#130d	RecordValue#119 = CTR_CDN_RBM_SWT_LS_DOWN_2 high byte	M	#XXh	RV_
#131d	RecordValue#120 = CTR_CDN_RBM_SWT_LS_DOWN_2 low byte	M	#XXh	RV_
#132d	RecordValue#125 = CTR_COMP_RBM_PUC_LS_DOWN_2 high byte	M	#XXh	RV_
#133d	RecordValue#126 = CTR_COMP_RBM_PUC_LS_DOWN_2 low byte	M	#XXh	RV_
#134d	RecordValue#127 = CTR_CDN_RBM_PUC_LS_DOWN_2 high byte	M	#XXh	RV_
#135d	RecordValue#128 = CTR_CDN_RBM_PUC_LS_DOWN_2 low byte	M	#XXh	RV_
#136d	RecordValue#133 = CTR_COMP_RBM_PUE_LS_DOWN_2 high byte	M	#XXh	RV_
#&permi;d	RecordValue#134 = CTR_COMP_RBM_PUE_LS_DOWN_2 low byte	M	#XXh	RV_
#138d	RecordValue#135= CTR_CDN_RBM_PUE_LS_DOWN_2 high byte	M	#XXh	RV_
#139d	RecordValue#136 = CTR_CDN_RBM_PUE_LS_DOWN_2 low byte	M	#XXh	RV_136


## I.23.59 22\_4028 - RCI\_RBMMS2\_lesen

### General information:

### Rate Based Monitoring Motorsteuerung Block 2 auslesen

This function reads out RBM values block 2.

### Request


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<i>Data Byte</i>	<i>Parameter Name</i>	<i>Cvt</i>	<i>Hex Value</i>	<i>Mnemonic</i>
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	40h	RCI_RBMMMS2
3	RecordCommonIdentifier Low Byte	M	28h	RCI_RBMMMS2

### Positive Response on service

<i>D</i> ata Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	ReadDataByIdentifier Response Service Id	M	#62h	RDBCIPR
#2d #3d	dataIdentifier #1 = [       byte1(MSB) byte2 ]	M	#40h #28h	DID_ B1 B2
#4d	RecordValue#1 = CTR_COMP_RBM_DIAGCPS high byte	M	#XXh	RV_1
#5d	RecordValue#2 = CTR_COMP_RBM_DIAGCPS low byte	M	#XXh	RV_2
#6d	RecordValue#3 = CTR_CDN_RBM_DIAGCPS high byte	M	#XXh	RV_
#7d	RecordValue#4 = CTR_CDN_RBM_DIAGCPS low byte	M	#XXh	RV_
#8d	RecordValue#5 = CTR_COMP_RBM_ROUGH_LEAK high byte	M	#XXh	RV_
#9d	RecordValue#6 = CTR_COMP_RBM_ROUGH_LEAK low byte	M	#XXh	RV_
#10d	RecordValue#7 = CTR_CDN_RBM_ROUGH_LEAK high byte	M	#XXh	RV_
#11d	RecordValue#8 = CTR_CDN_RBM_ROUGH_LEAK low byte	M	#XXh	RV_
#12d	RecordValue#9 = CTR_COMP_RBM_DMTLM high byte	M	#XXh	RV_
#13d	RecordValue#10 = CTR_COMP_RBM_DMTLM low byte	M	#XXh	RV_
#14d	RecordValue#11 = CTR_CDN_RBM_DMTLM high byte	M	#XXh	RV_
#15d	RecordValue#12 = CTR_CDN_RBM_DMTLM low byte	M	#XXh	RV_
#16d	RecordValue#13 = CTR_COMP_RBM_TH high byte	M	#XXh	RV_
#17d	RecordValue#14 = CTR_COMP_RBM_TH low byte	M	#XXh	RV_
#18d	RecordValue#15 = CTR_CDN_RBM_TH high byte	M	#XXh	RV_
#19d	RecordValue#16 = CTR_CDN_RBM_TH low byte	M	#XXh	RV_
#20d	RecordValue#17 = CTR_COMP_RBM_TCO_PLAUS high byte	M	#XXh	RV_
#21d	RecordValue#18 = CTR_COMP_RBM_TCO_PLAUS low byte	M	#XXh	RV_
#22d	RecordValue#19 = CTR_CDN_RBM_TCO_PLAUS high byte	M	#XXh	RV_
#23d	RecordValue#20 = CTR_CDN_RBM_TCO_PLAUS low byte	M	#XXh	RV_
#24d	RecordValue#21 = CTR_COMP_RBM_TCO_STUCK high byte	M	#XXh	RV_
#25d	RecordValue#22 = CTR_COMP_RBM_TCO_STUCK low byte	M	#XXh	RV_
#26d	RecordValue#23 = CTR_CDN_RBM_TCO_STUCK high byte	M	#XXh	RV_
#27d	RecordValue#24 = CTR_CDN_RBM_TCO_STUCK low byte	M	#XXh	RV_
#28d	RecordValue#25 = CTR_COMP_RBM_TCO_2_PLAUS high byte	M	#XXh	RV_
#29d	RecordValue#26 = CTR_COMP_RBM_TCO_2_PLAUS low byte	M	#XXh	RV_
#30d	RecordValue#27 = CTR_CDN_RBM_TCO_2_PLAUS high byte	M	#XXh	RV_
#31d	RecordValue#28 = CTR_CDN_RBM_TCO_2_PLAUS low byte	M	#XXh	RV_
#32d	RecordValue#29 = CTR_COMP_RBM_TAM_PLAUS high byte	M	#XXh	RV_
#33d	RecordValue#30 = CTR_COMP_RBM_TAM_PLAUS low byte	M	#XXh	RV_
#34d	RecordValue#31 = CTR_CDN_RBM_TAM_PLAUS high byte	M	#XXh	RV_
#35d	RecordValue#32 = CTR_CDN_RBM_TAM_PLAUS low byte	M	#XXh	RV_
#36d	RecordValue#33 = CTR_COMP_RBM_VS_PLAUS high byte	M	#XXh	RV_
#37d	RecordValue#34 = CTR_COMP_RBM_VS_PLAUS low byte	M	#XXh	RV_
#38d	RecordValue#35 = CTR_CDN_RBM_VS_PLAUS high byte	M	#XXh	RV_
#39d	RecordValue#36 = CTR_CDN_RBM_VS_PLAUS low byte	M	#XXh	RV_
#40d	RecordValue#37 = CTR_COMP_RBM_FTL_OBD high byte	M	#XXh	RV_
#41d	RecordValue#38 = CTR_COMP_RBM_FTL_OBD low byte	M	#XXh	RV_
#42d	RecordValue#39 = CTR_CDN_RBM_FTL_OBD high byte	M	#XXh	RV_
#43d	RecordValue#40 = CTR_CDN_RBM_FTL_OBD low byte	M	#XXh	RV_
#44d	RecordValue#41 = CTR_COMP_RBM_OBD_LSH_DOWN_1 high byte	M	#XXh	RV_
#-d	RecordValue#42 = CTR_COMP_RBM_OBD_LSH_DOWN_1 low byte	M	#XXh	RV_
#46d	RecordValue#43 = CTR_CDN_RBM_OBD_LSH_DOWN_1 high byte	M	#XXh	RV_


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<b>D ata Byte</b>	<b>Parameter Name</b>	<b>Cvt</b>	<b>Hex Value</b>	<b>Mnemonic</b>
#47d	RecordValue#44 = CTR_CDN_RBM_OBD_LSH_DOWN_1 low byte	M	#XXh	RV_
#48d	RecordValue#45 = CTR_COMP_RBM_OBD_LSH_DOWN_2 high byte	M	#XXh	RV_
#49d	RecordValue#46 = CTR_COMP_RBM_OBD_LSH_DOWN_2 low byte	M	#XXh	RV_
#50d	RecordValue#47 = CTR_CDN_RBM_OBD_LSH_DOWN_2 high byte	M	#XXh	RV_
#51d	RecordValue#48 = CTR_CDN_RBM_OBD_LSH_DOWN_2 low byte	M	#XXh	RV_
#52d	RecordValue#49 = CTR_COMP_RBM_OBD_VLD_LSH_UP_1 high byte	M	#XXh	RV_
#53d	RecordValue#50 = CTR_COMP_RBM_OBD_VLD_LSH_UP_1 low byte	M	#XXh	RV_
#54d	RecordValue#51 = CTR_CDN_RBM_OBD_VLD_LSH_UP_1 high byte	M	#XXh	RV_
#55d	RecordValue#52 = CTR_CDN_RBM_OBD_VLD_LSH_UP_1 low byte	M	#XXh	RV_
#56d	RecordValue#53 = CTR_COMP_RBM_OBD_VLD_LSH_UP_2 high byte	M	#XXh	RV_
#57d	RecordValue#54 = CTR_COMP_RBM_OBD_VLD_LSH_UP_2 low byte	M	#XXh	RV_
#58d	RecordValue#55 = CTR_CDN_RBM_OBD_VLD_LSH_UP_2 high byte	M	#XXh	RV_
#59d	RecordValue#56 = CTR_CDN_RBM_OBD_VLD_LSH_UP_2 low byte	M	#XXh	RV_
#60d	RecordValue#57 = CTR_COMP_RBM_CS high byte	M	#XXh	RV_
#61d	RecordValue#58 = CTR_COMP_RBM_CS low byte	M	#XXh	RV_
#62d	RecordValue#59 = CTR_CDN_RBM_CS high byte	M	#XXh	RV_
#63d	RecordValue#60 = CTR_CDN_RBM_CS low byte	M	#XXh	RV_
#64d	RecordValue#61 = CTR_COMP_RBM_ISC high byte	M	#XXh	RV_
#65d	RecordValue#62 = CTR_COMP_RBM_ISC low byte	M	#XXh	RV_
#66d	RecordValue#63 = CTR_CDN_RBM_ISC high byte	M	#XXh	RV_
#67d	RecordValue#64 = CTR_CDN_RBM_ISC low byte	M	#XXh	RV_
#68d	RecordValue#65 = CTR_COMP_RBM_MAF high byte	M	#XXh	RV_
#69d	RecordValue#66 = CTR_COMP_RBM_MAF low byte	M	#XXh	RV_
#70d	RecordValue#67 = CTR_CDN_RBM_MAF high byte	M	#XXh	RV_
#71d	RecordValue#68 = CTR_CDN_RBM_MAF low byte	M	#XXh	RV_
#72d	RecordValue#69 = CTR_COMP_RBM_TIA_PLAUS high byte	M	#XXh	RV_
#73d	RecordValue#70 = CTR_COMP_RBM_TIA_PLAUS low byte	M	#XXh	RV_
#74d	RecordValue#71 = CTR_CDN_RBM_TIA_PLAUS high byte	M	#XXh	RV_
#75d	RecordValue#72 = CTR_CDN_RBM_TIA_PLAUS low byte	M	#XXh	RV_
#76d	RecordValue#73 = CTR_COMP_RBM_AMP_PLAUS high byte	M	#XXh	RV_
#77d	RecordValue#74 = CTR_COMP_RBM_AMP_PLAUS low byte	M	#XXh	RV_
#78d	RecordValue#75 = CTR_CDN_RBM_AMP_PLAUS high byte	M	#XXh	RV_
#79d	RecordValue#76 = CTR_CDN_RBM_AMP_PLAUS low byte	M	#XXh	RV_
#80d	RecordValue#77 = CTR_COMP_RBM_LOAD_TPS_PLAUS high byte	M	#XXh	RV_
#81d	RecordValue#78 = CTR_COMP_RBM_LOAD_TPS_PLAUS low byte	M	#XXh	RV_
#82d	RecordValue#79 = CTR_CDN_RBM_LOAD_TPS_PLAUS high byte	M	#XXh	RV_
#83d	RecordValue#80 = CTR_CDN_RBM_LOAD_TPS_PLAUS low byte	M	#XXh	RV_
#84d	RecordValue#81 = NOT USED	M	#00h	RV_
#85d	RecordValue#82 = NOT USED	M	#00h	RV_
#86d	RecordValue#83 = NOT USED	M	#00h	RV_
#87d	RecordValue#84 = NOT USED	M	#00h	RV_
#88d	RecordValue#85 = NOT USED	M	#00h	RV_
#89d	RecordValue#86 = NOT USED	M	#00h	RV_
#90d	RecordValue#87 = NOT USED	M	#00h	RV_
#91d	RecordValue#88 = NOT USED	M	#00h	RV_
#92d	RecordValue#89 = CTR_COMP_RBM_MAP_DIP_PLAUS high byte	M	#XXh	RV_


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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
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<b>D ata Byte</b>	<b>Parameter Name</b>	<b>Cvt</b>	<b>Hex Value</b>	<b>Mnemonic</b>
#93d	RecordValue#90 = CTR_COMP_RBM_MAP_DIP_PLAUS low byte	M	#XXh	RV_
#94d	RecordValue#91 = CTR_CDN_RBM_MAP_DIP_PLAUS high byte	M	#XXh	RV_
#95d	RecordValue#92 = CTR_CDN_RBM_MAP_DIP_PLAUS low byte	M	#XXh	RV_
#96d	RecordValue#93 = NOT USED	M	#00h	RV_
#97d	RecordValue#94 = NOT USED	M	#00h	RV_
#98d	RecordValue#95 = NOT USED	M	#00h	RV_
#99d	RecordValue#96 = NOT USED	M	#00h	RV_
#100d	RecordValue#97 = NOT USED	M	#00h	RV_
#101d	RecordValue#98 = NOT USED	M	#00h	RV_
#102d	RecordValue#99 = NOT USED	M	#00h	RV_
#103d	RecordValue#100 = NOT USED	M	#00h	RV_
#104d	RecordValue#101 = CTR_COMP_RBM_VLS_DOWN_DIF_1 high byte	M	#XXh	RV_
#105d	RecordValue#102 = CTR_COMP_RBM_VLS_DOWN_DIF_1 low byte	M	#XXh	RV_
#106d	RecordValue#103 = CTR_CDN_RBM_VLS_DOWN_DIF_1 high byte	M	#XXh	RV_
#107d	RecordValue#104 = CTR_CDN_RBM_VLS_DOWN_DIF_1 low byte	M	#XXh	RV_
#108d	RecordValue#105 = CTR_COMP_RBM_VLS_DOWN_DIF_2 high byte	M	#XXh	RV_
#109d	RecordValue#106 = CTR_COMP_RBM_VLS_DOWN_DIF_2 low byte	M	#XXh	RV_
#110d	RecordValue#107 = CTR_CDN_RBM_VLS_DOWN_DIF_2 high byte	M	#XXh	RV_
#111d	RecordValue#108 = CTR_CDN_RBM_VLS_DOWN_DIF_2 low byte	M	#XXh	RV_
#112d	RecordValue#109 = CTR_COMP_RBM_T_ES high byte	M	#XXh	RV_
#113d	RecordValue#110 = CTR_COMP_RBM_T_ES low byte	M	#XXh	RV_
#114d	RecordValue#111 = CTR_CDN_RBM_T_ES high byte	M	#XXh	RV_
#115d	RecordValue#112 = CTR_CDN_RBM_T_ES low byte	M	#XXh	RV_
#116d	RecordValue#113 = CTR_COMP_RBM_TPS high byte	M	#XXh	RV_
#117d	RecordValue#114 = CTR_COMP_RBM_TPS low byte	M	#XXh	RV_
#118d	RecordValue#115 = CTR_CDN_RBM_TPS high byte	M	#XXh	RV_
#119d	RecordValue#116 = CTR_CDN_RBM_TPS low byte	M	#XXh	RV_
#120d	RecordValue#117 = NOT USED	M	#00h	RV_
#121d	RecordValue#118 = NOT USED	M	#00h	RV_
#122d	RecordValue#119 = NOT USED	M	#00h	RV_
#123d	RecordValue#120 = NOT USED	M	#00h	RV_
#124d	RecordValue#121 = NOT USED	M	#00h	RV_
#125d	RecordValue#122 = NOT USED	M	#00h	RV_
#126d	RecordValue#123 = NOT USED	M	#00h	RV_
#127d	RecordValue#124 = NOT USED	M	#00h	RV_
#128d	RecordValue#125 = CTR_COMP_RBM_ISC_CST high byte	M	#XXh	RV_
#129d	RecordValue#126 = CTR_COMP_RBM_ISC_CST low byte	M	#XXh	RV_
#130d	RecordValue#127 = CTR_CDN_RBM_ISC_CST high byte	M	#XXh	RV_
#131d	RecordValue#128 = CTR_CDN_RBM_ISC_CST low byte	M	#XXh	RV_
#132d	RecordValue#129 = CTR_COMP_RBM_TQ_CST high byte	M	#XXh	RV_
#133d	RecordValue#130 = CTR_COMP_RBM_TQ_CST low byte	M	#XXh	RV_
#134d	RecordValue#131 = CTR_CDN_RBM_TQ_CST high byte	M	#XXh	RV_
#135d	RecordValue#132 = CTR_CDN_RBM_TQ_CST low byte	M	#XXh	RV_
#136d	RecordValue#133 = CTR_COMP_RBM_TCO_STUCK_RNG high byte	M	#XXh	RV_
#&permi;d	RecordValue#134 = CTR_COMP_RBM_TCO_STUCK_RNG low byte	M	#XXh	RV_
#138d	RecordValue#135 = CTR_CDN_RBM_TCO_STUCK_RNG high byte	M	#XXh	RV_

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<b>D ata Byte</b>	<b>Parameter Name</b>	<b>Cvt</b>	<b>Hex Value</b>	<b>Mnemonic</b>
#139d	RecordValue#136 = CTR_CDN_RBM_TCO_STUCK_RNG low byte	M	#XXh	RV_
#140d	RecordValue#&pernil; = NOT USED	M	#00h	RV_
#141d	RecordValue#138 = NOT USED	M	#00h	RV_
#142d	RecordValue#139 = NOT USED	M	#00h	RV_
#143d	RecordValue#140 = NOT USED	M	#00h	RV_
#144d	RecordValue#141 = NOT USED	M	#00h	RV_
#1-d	RecordValue#142 = NOT USED	M	#00h	RV_
#146d	RecordValue#143 = NOT USED	M	#00h	RV_
#147d	RecordValue#144 = NOT USED	M	#00h	RV_
#148d	RecordValue#1- = NOT USED	M	#00h	RV_
#149d	RecordValue#146 = NOT USED	M	#00h	RV_
#150d	RecordValue#147 = NOT USED	M	#00h	RV_
#151d	RecordValue#148 = NOT USED	M	#00h	RV_
#152d	RecordValue#149 = NOT USED	M	#00h	RV_
#153d	RecordValue#150 = NOT USED	M	#00h	RV_
#154d	RecordValue#151 = NOT USED	M	#00h	RV_
#155d	RecordValue#152 = NOT USED	M	#00h	RV_
#156d	RecordValue#153 = NOT USED	M	#00h	RV_
#157d	RecordValue#154 = NOT USED	M	#00h	RV_
#158d	RecordValue#155 = NOT USED	M	#00h	RV_
#159d	RecordValue#156 = NOT USED	M	#00h	RV_
#160d	RecordValue#157 = NOT USED	M	#00h	RV_
#161d	RecordValue#158 = NOT USED	M	#00h	RV_
#162d	RecordValue#159 = NOT USED	M	#00h	RV_
#163d	RecordValue#160 = NOT USED	M	#00h	RV_
#164d	RecordValue#161 = NOT USED	M	#00h	RV_
#165d	RecordValue#162 = NOT USED	M	#00h	RV_
#166d	RecordValue#163 = NOT USED	M	#00h	RV_
#167d	RecordValue#164 = NOT USED	M	#00h	RV_
#168d	RecordValue#165 = CTR_COMP_RBM_T_ES_TCO_FAST high byte	M	#XXh	RV_
#169d	RecordValue#166 = CTR_COMP_RBM_T_ES_TCO_FAST low byte	M	#XXh	RV_
#170d	RecordValue#167 = CTR_CDN_RBM_T_ES_TCO_FAST high byte	M	#XXh	RV_
#171d	RecordValue#168 = CTR_CDN_RBM_T_ES_TCO_FAST low byte	M	#XXh	RV_
#172d	RecordValue#169 = CTR_COMP_RBM_T_ES_TCO_SLOW high byte	M	#XXh	RV_
#173d	RecordValue#170 = CTR_COMP_RBM_T_ES_TCO_SLOW low byte	M	#XXh	RV_
#-→d	RecordValue#171 = CTR_CDN_RBM_T_ES_TCO_SLOW high byte	M	#XXh	RV_
#175d	RecordValue#172 = CTR_CDN_RBM_T_ES_TCO_SLOW low byte	M	#XXh	RV_
#176d	RecordValue#173 = CTR_COMP_RBM_FUP_CH_1 high byte	M	#XXh	RV_
#177d	RecordValue#-→ = CTR_COMP_RBM_FUP_CH_1 low byte	M	#XXh	RV_
#178d	RecordValue#175 = CTR_CDN_RBM_FUP_CH_1 high byte	M	#XXh	RV_
#179d	RecordValue#176 = CTR_CDN_RBM_FUP_CH_1 low byte	M	#XXh	RV_
#180d	RecordValue#177 = NOT USED	M	#00h	RV_
#181d	RecordValue#178 = NOT USED	M	#00h	RV_
#182d	RecordValue#179 = NOT USED	M	#00h	RV_
#183d	RecordValue#180 = NOT USED	M	#00h	RV_
#184d	RecordValue#181 = CTR_COMP_RBM_EFF_IGA_CST_IS high byte	M	#XXh	RV_

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<b>Data Byte</b>	<b>Parameter Name</b>	<b>Cvt</b>	<b>Hex Value</b>	<b>Mnemonic</b>
#185d	RecordValue#182 = CTR_COMP_RBM_EFF_IGA_CST_IS low byte	M	#XXh	RV_
#186d	RecordValue#183 = CTR_CDN_RBM_EFF_IGA_CST_IS high byte	M	#XXh	RV_
#187d	RecordValue#184 = CTR_CDN_RBM_EFF_IGA_CST_IS low byte	M	#XXh	RV_
#188d	RecordValue#185 = CTR_COMP_RBM_EFF_IGA_CST_PL high byte	M	#XXh	RV_
#189d	RecordValue#186 = CTR_COMP_RBM_EFF_IGA_CST_PL low byte	M	#XXh	RV_
#190d	RecordValue#187 = CTR_CDN_RBM_EFF_IGA_CST_PL high byte	M	#XXh	RV_
#191d	RecordValue#188 = CTR_CDN_RBM_EFF_IGA_CST_PL low byte	M	#XXh	RV_
#192d	RecordValue#189 = CTR_COMP_RBM_CAM_CST_IVVT_IN_1 high byte	M	#XXh	RV_
#193d	RecordValue#190 = CTR_COMP_RBM_CAM_CST_IVVT_IN_1 low byte	M	#XXh	RV_
#194d	RecordValue#191 = CTR_CDN_RBM_CAM_CST_IVVT_IN_1 high byte	M	#XXh	RV_
#195d	RecordValue#192 = CTR_CDN_RBM_CAM_CST_IVVT_IN_1 low byte	M	#XXh	RV_
#196d	RecordValue#193 = NOT USED	M	#00h	RV_
#197d	RecordValue#194 = NOT USED	M	#00h	RV_
#198d	RecordValue#195 = NOT USED	M	#00h	RV_
#199d	RecordValue#196 = NOT USED	M	#00h	RV_
#200d	RecordValue#197 = CTR_COMP_RBM_CAM_CST_IVVT_EX_1 high byte	M	#XXh	RV_
#201d	RecordValue#198 = CTR_COMP_RBM_CAM_CST_IVVT_EX_1 low byte	M	#XXh	RV_
#202d	RecordValue#199 = CTR_CDN_RBM_CAM_CST_IVVT_EX_1 high byte	M	#XXh	RV_
#203d	RecordValue#200 = CTR_CDN_RBM_CAM_CST_IVVT_EX_1 low byte	M	#XXh	RV_
#204d	RecordValue#201 = NOT USED	M	#00h	RV_
...	...	M	#00h	RV_
...	...	M	#00h	RV_
#231d	RecordValue#228 = NOT USED	M	#00h	RV_

## I.23.60 22\_402D - RCI\_MWLRP\_lesen

### General information:

#### Messwerte Laufruhepruefung auslesen

This function reads out values from the engine roughness check.

### I.23.60.1 MSD 85 only

#### Request

<b>Data Byte</b>	<b>Parameter Name</b>	<b>Cvt</b>	<b>Hex Value</b>	<b>Mnemonic</b>
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier High Byte	M	40h	RCI_MWLRP
3	RecordCommonIdentifier Low Byte	M	2Dh	RCI_MWLRP

#### Positive Response on service


Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Response Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIR</b>
2	RecordCommonIdentifier High Byte	M	40h	RCI_MWLRP
3	RecordCommonIdentifier Low Byte	M	2Dh	RCI_MWLRP
4	Not used	M	FFh	RV_DUMMY_1
5	Not used	M	FFh	RV_DUMMY_2
6	Not used	M	FFh	RV_DUMMY_3
7	Not used	M	FFh	RV_DUMMY_4
8	RecordValue5 = Amo_05 high byte	M	XXh	RV_AMO_05
9	RecordValue6 = Amo_05 low byte	M	XXh	RV_AMO_05
10	RecordValue7 = Amo_10high byte	M	XXh	RV_AMO_10
11	RecordValue8 = Amo_10low byte	M	XXh	RV_AMO_10
12	RecordValue9 = Amo_15 high byte	M	XXh	RV_AMO_15
13	RecordValue10 = Amo_15 low byte	M	XXh	RV_AMO_15
14	RecordValue11 = Amo_20 high byte	M	XXh	RV_AMO_20
15	RecordValue12 = Amo_20 low byte	M	XXh	RV_AMO_20
16	Not used	M	FFh	RV_DUMMY_5
17	Not used	M	FFh	RV_DUMMY_6
18	Not used	M	FFh	RV_DUMMY_7
19	Not used	M	FFh	RV_DUMMY_8
20	Not used	M	FFh	RV_DUMMY_9
21	Not used	M	FFh	RV_DUMMY_10
22	Not used	M	FFh	RV_DUMMY_11
23	Not used	M	FFh	RV_DUMMY_12
24	Not used	M	FFh	RV_DUMMY_13
25	Not used	M	FFh	RV_DUMMY_14
26	Not used	M	FFh	RV_DUMMY_15
27	Not used	M	FFh	RV_DUMMY_16
28	Not used	M	FFh	RV_DUMMY_17
29	Not used	M	FFh	RV_DUMMY_18
30	Not used	M	FFh	RV_DUMMY_19
31	Not used	M	FFh	RV_DUMMY_20
32	Not used	M	FFh	RV_DUMMY_21
33	Not used	M	FFh	RV_DUMMY_22
34	Not used	M	FFh	RV_DUMMY_23
35	RecordValue32 = Lurabs_f[0] high byte	M	XXh	RV_LURABS_F[0]
36	RecordValue33 = Lurabs_f[0] low byte	M	XXh	RV_LURABS_F[0]
37	RecordValue34 = Lurdif_f[0] high byte	M	XXh	RV_LURDIF_F[0]
38	RecordValue35 = Lurdif_f[0] low byte	M	XXh	RV_LURDIF_F[0]
39	RecordValue36 = Zw_offkorrvr[0] high byte	M	XXh	RV_ZW_OFFKORRVR[0]
40	RecordValue37 = Zw_offkorrvr[0] low byte	M	XXh	RV_ZW_OFFKORRVR[0]
41	Not used	M	FFh	RV_DUMMY_24
42	Not used	M	FFh	RV_DUMMY_25
43	RecordValue40 = Lurabs_f[1] high byte	M	XXh	RV_LURABS_F[1]
44	RecordValue41 = Lurabs_f[1] low byte	M	XXh	RV_LURABS_F[1]
-	RecordValue42 = Lurdif_f[1] high byte	M	XXh	RV_LURDIF_F[1]
46	RecordValue43 = Lurdif_f[1] low byte	M	XXh	RV_LURDIF_F[1]
47	RecordValue44 = Zw_offkorrvr[1] high byte	M	XXh	RV_ZW_OFFKORRVR[1]
48	RecordValue- = Zw_offkorrvr[1] low byte	M	XXh	RV_ZW_OFFKORRVR[1]

M

49	Not used	M	FFh	RV_DUMMY_26
50	Not used	M	FFh	RV_DUMMY_27
51	RecordValue48 = Lurabs_f[2] high byte	M	XXh	RV_LURABS_F[2]
52	RecordValue49 = Lurabs_f[2] low byte	M	XXh	RV_LURABS_F[2]
53	RecordValue50 = Lurdif_f[2] high byte	M	XXh	RV_LURDIF_F[2]
54	RecordValue51 = Lurdif_f[2] low byte	M	XXh	RV_LURDIF_F[2]
55	RecordValue52 = Zw_offkorrvr[2] high byte	M	XXh	RV_ZW_OFFKORRVR[2]
56	RecordValue53 = Zw_offkorrvr[2] low byte	M	XXh	RV_ZW_OFFKORRVR[2]
57	Not used	M	FFh	RV_DUMMY_28
58	Not used	M	FFh	RV_DUMMY_29
59	RecordValue56 = Lurabs_f[3] high byte	M	XXh	RV_LURABS_F[3]
60	RecordValue57 = Lurabs_f[3] low byte	M	XXh	RV_LURABS_F[3]
61	RecordValue58 = Lurdif_f[3] high byte	M	XXh	RV_LURDIF_F[3]
62	RecordValue59 = Lurdif_f[3] low byte	M	XXh	RV_LURDIF_F[3]
63	RecordValue60 = Zw_offkorrvr[3] high byte	M	XXh	RV_ZW_OFFKORRVR[3]
64	RecordValue61 = Zw_offkorrvr[3] low byte	M	XXh	RV_ZW_OFFKORRVR[3]
65	Not used	M	FFh	RV_DUMMY_30
66	Not used	M	FFh	RV_DUMMY_31
67	RecordValue64 = Lurabs_f[4] high byte	M	XXh	RV_LURABS_F[4]
68	RecordValue65 = Lurabs_f[4] low byte	M	XXh	RV_LURABS_F[4]
69	RecordValue66 = Lurdif_f[4] high byte	M	XXh	RV_LURDIF_F[4]
70	RecordValue67 = Lurdif_f[4] low byte	M	XXh	RV_LURDIF_F[4]
71	RecordValue68 = Zw_offkorrvr[4] high byte	M	XXh	RV_ZW_OFFKORRVR[4]
72	RecordValue69 = Zw_offkorrvr[4] low byte	M	XXh	RV_ZW_OFFKORRVR[4]
73	Not used	M	FFh	RV_DUMMY_32
74	Not used	M	FFh	RV_DUMMY_33
75	RecordValue72 = Lurabs_f[5] high byte	M	XXh	RV_LURABS_F[5]
76	RecordValue73 = Lurabs_f[5] low byte	M	XXh	RV_LURABS_F[5]
77	RecordValue74 = Lurdif_f[5] high byte	M	XXh	RV_LURDIF_F[5]
78	RecordValue75 = Lurdif_f[5] low byte	M	XXh	RV_LURDIF_F[5]
79	RecordValue76 = Zw_offkorrvr[5] high byte	M	XXh	RV_ZW_OFFKORRVR[5]
80	RecordValue77 = Zw_offkorrvr[5] low byte	M	XXh	RV_ZW_OFFKORRVR[5]
81	Not used	M	FFh	RV_DUMMY_34
82	Not used	M	FFh	RV_DUMMY_35
83	RecordValue80 = Lurabs_f[6] high byte	M	XXh	RV_LURABS_F[6]
84	RecordValue81 = Lurabs_f[6] low byte	M	XXh	RV_LURABS_F[6]
85	RecordValue82 = Lurdif_f[6] high byte	M	XXh	RV_LURDIF_F[6]
86	RecordValue83 = Lurdif_f[6] low byte	M	XXh	RV_LURDIF_F[6]
87	RecordValue84 = Zw_offkorrvr[6] high byte	M	XXh	RV_ZW_OFFKORRVR[6]
88	RecordValue85 = Zw_offkorrvr[6] low byte	M	XXh	RV_ZW_OFFKORRVR[6]
89	Not used	M	FFh	RV_DUMMY_36
90	Not used	M	FFh	RV_DUMMY_37
91	RecordValue88 = Lurabs_f[7] high byte	M	XXh	RV_LURABS_F[7]
92	RecordValue89 = Lurabs_f[7] low byte	M	XXh	RV_LURABS_F[7]
93	RecordValue90 = Lurdif_f[7] high byte	M	XXh	RV_LURDIF_F[7]
94	RecordValue91 = Lurdif_f[7] low byte	M	XXh	RV_LURDIF_F[7]
95	RecordValue92 = Zw_offkorrvr[7] high byte	M	XXh	RV_ZW_OFFKORRVR[7]
96	RecordValue93 = Zw_offkorrvr[7] low byte	M	XXh	RV_ZW_OFFKORRVR[7]
97	RecordValue94 = Amo_30 high byte	M	XXh	RV_AMO_30
98	RecordValue95 = Amo_30 low byte	M	XXh	RV_AMO_30

99	RecordValue96 = Amo_40 high byte	M	XXh	RV_AMO_40
100	RecordValue97 = Amo_40 low byte	M	XXh	RV_AMO_40

Hint: all record values which are not defined in BMW-layer.h are FFh,

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also RecordValue 65d ... 93d for 4cyl-machine,  
RecordValue 78d ... 93d for 6cyl-machine

### I.23.60.2 All other projects

#### General information:

#### Messwerte Laufruhepruefung auslesen

This function reads out values from the engine roughness check.

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	40h	RCI_MWLRP
3	RecordCommonIdentifier Low Byte	M	2Dh	RCI_MWLRP

#### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Response Service ID</b>	<b>M</b>	<b>62h</b>	RDBCIR
2	RecordCommonIdentifier High Byte	M	40h	RCI_MWLRP
3	RecordCommonIdentifier Low Byte	M	2Dh	RCI_MWLRP
4	RecordValue1 = St_vbrvs_ aus high byte	M	XXh	RV_ST_VBRVS_AUS
5	RecordValue2 = St_vbrvs_ aus low byte	M	XXh	RV_ST_VBRVS_AUS
6	RecordValue3 = St_vbrvs_ein	M	XXh	RV_ST_VBRVS_EIN
7	RecordValue4 = dummy value fix	M	FFh	RV_ST_VBRVS_EINNV
8	RecordValue5 = Amo_05 high byte	M	XXh	RV_AMO_05
9	RecordValue6 = Amo_05 low byte	M	XXh	RV_AMO_05
10	RecordValue7 = Amo_10high byte	M	XXh	RV_AMO_10
11	RecordValue8 = Amo_10low byte	M	XXh	RV_AMO_10
12	RecordValue9 = Amo_15 high byte	M	XXh	RV_AMO_15
13	RecordValue10 = Amo_15 low byte	M	XXh	RV_AMO_15
14	RecordValue11 = Amo_20 high byte	M	XXh	RV_AMO_20
15	RecordValue12 = Amo_20 low byte	M	XXh	RV_AMO_20
16	RecordValue13 = [ Exwinkkor high byte <b>(only MSV80),</b> FFh <b>(other) ]</b>	M	XXh	RV_EXWINKKOR
17	RecordValue14 = [ Exwinkkor low byte <b>(only MSV80),</b> FFh <b>(other) ]</b>	M	XXh	RV_EXWINKKOR
18	RecordValue15 = Zylhubkor	M	XXh	RV_ZYLHUBKOR
19	RecordValue16 = [ Minhub high byte <b>(only MSV80),</b> FFh <b>(other) ]</b>	M	XXh	RV_MINHUB
20	RecordValue17 = [ Minhub low byte <b>(only MSV80),</b> FFh <b>(other) ]</b>	M	XXh	RV_MINHUB
21	RecordValue18 = F_minhub high byte	M	XXh	RV_F_MINHUB
22	RecordValue19 = F_minhub low byte	M	XXh	RV_F_MINHUB
23	RecordValue20 = Minhub_ roh high byte	M	XXh	RV_MINHUB_ROH
24	RecordValue21 = Minhub_ roh low byte	M	XXh	RV_MINHUB_ROH
25	RecordValue22 = Minhubvs high byte	M	XXh	RV_MINHUBVS
26	RecordValue23 = Minhubvs low byte	M	XXh	RV_MINHUBVS
27	RecordValue24 = Minhubvs_ist high byte	M	XXh	RV_MINHUBVS_IST
28	RecordValue25 = Minhubvs_ist low byte	M	XXh	RV_MINHUBVS_IST
29	RecordValue26 = Minhubvsnv high byte	M	XXh	RV_MINHUBVSNV
30	RecordValue27 = Minhubvsnv low byte	M	XXh	RV_MINHUBVSNV
31	RecordValue28 = S_vsmnhb	M	XXh	RV_S_VSMNHBB
32	RecordValue29 = S_vsmnhbnv	M	XXh	RV_S_VSMNHBNV
33	RecordValue30 = F_tikorrvr[0] high byte	M	XXh	RV_F_TIKORRVR[0]
34	RecordValue31 = F_tikorrvr[0] low byte	M	XXh	RV_F_TIKORRVR[0]
35	RecordValue32 = Lurabs_f[0] high byte	M	XXh	RV_LURABS_F[0]
36	RecordValue33 = Lurabs_f[0] low byte	M	XXh	RV_LURABS_F[0]
37	RecordValue34 = Lurdif_f[0] high byte	M	XXh	RV_LURDIF_F[0]
38	RecordValue35 = Lurdif_f[0] low byte	M	XXh	RV_LURDIF_F[0]
39	RecordValue36 = Zw_offkorrvr[0] high byte	M	XXh	RV_ZW_OFFKORRVR[0]
40	RecordValue37 = Zw_offkorrvr[0] low byte	M	XXh	RV_ZW_OFFKORRVR[0]
41	RecordValue38 = F_tikorrvr[1] high byte	M	XXh	RV_F_TIKORRVR[1]
42	RecordValue39 = F_tikorrvr[1] low byte	M	XXh	RV_F_TIKORRVR[1]
43	RecordValue40 = Lurabs_f[1] high byte	M	XXh	RV_LURABS_F[1]
44	RecordValue41 = Lurabs_f[1] low byte	M	XXh	RV_LURABS_F[1]
-	RecordValue42 = Lurdif_f[1] high byte	M	XXh	RV_LURDIF_F[1]

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Released by <b>Tettenborn Frank</b>		Date <b>2013-02-13</b>	File <b>43I00V01.00F</b>
	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 7647 of 8404</b>	
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46	RecordValue43 = Lurdif_f[1] low byte	M	XXh	RV_LURDIF_F[1]
47	RecordValue44 = Zw_offkorrvr[1] high byte	M	XXh	RV_ZW_OFFKORRVR[1]
48	RecordValue- = Zw_offkorrvr[1] low byte	M	XXh	RV_ZW_OFFKORRVR[1]
49	RecordValue46 = F_tikorrvr[2] high byte	M	XXh	RV_F_TIKORRVR[2]
50	RecordValue47 = F_tikorrvr[2] low byte	M	XXh	RV_F_TIKORRVR[2]
51	RecordValue48 = Lurabs_f[2] high byte	M	XXh	RV_LURABS_F[2]
52	RecordValue49 = Lurabs_f[2] low byte	M	XXh	RV_LURABS_F[2]
53	RecordValue50 = Lurdif_f[2] high byte	M	XXh	RV_LURDIF_F[2]
54	RecordValue51 = Lurdif_f[2] low byte	M	XXh	RV_LURDIF_F[2]
55	RecordValue52 = Zw_offkorrvr[2] high byte	M	XXh	RV_ZW_OFFKORRVR[2]
56	RecordValue53 = Zw_offkorrvr[2] low byte	M	XXh	RV_ZW_OFFKORRVR[2]
57	RecordValue54 = F_tikorrvr[3] high byte	M	XXh	RV_F_TIKORRVR[3]
58	RecordValue55 = F_tikorrvr[3] low byte	M	XXh	RV_F_TIKORRVR[3]
59	RecordValue56 = Lurabs_f[3] high byte	M	XXh	RV_LURABS_F[3]
60	RecordValue57 = Lurabs_f[3] low byte	M	XXh	RV_LURABS_F[3]
61	RecordValue58 = Lurdif_f[3] high byte	M	XXh	RV_LURDIF_F[3]
62	RecordValue59 = Lurdif_f[3] low byte	M	XXh	RV_LURDIF_F[3]
63	RecordValue60 = Zw_offkorrvr[3] high byte	M	XXh	RV_ZW_OFFKORRVR[3]
64	RecordValue61 = Zw_offkorrvr[3] low byte	M	XXh	RV_ZW_OFFKORRVR[3]
65	RecordValue62 = F_tikorrvr[4] high byte	M	XXh	RV_F_TIKORRVR[4]
66	RecordValue63 = F_tikorrvr[4] low byte	M	XXh	RV_F_TIKORRVR[4]
67	RecordValue64 = Lurabs_f[4] high byte	M	XXh	RV_LURABS_F[4]
68	RecordValue65 = Lurabs_f[4] low byte	M	XXh	RV_LURABS_F[4]
69	RecordValue66 = Lurdif_f[4] high byte	M	XXh	RV_LURDIF_F[4]
70	RecordValue67 = Lurdif_f[4] low byte	M	XXh	RV_LURDIF_F[4]
71	RecordValue68 = Zw_offkorrvr[4] high byte	M	XXh	RV_ZW_OFFKORRVR[4]
72	RecordValue69 = Zw_offkorrvr[4] low byte	M	XXh	RV_ZW_OFFKORRVR[4]
73	RecordValue70 = F_tikorrvr[5] high byte	M	XXh	RV_F_TIKORRVR[5]
74	RecordValue71 = F_tikorrvr[5] low byte	M	XXh	RV_F_TIKORRVR[5]
75	RecordValue72 = Lurabs_f[5] high byte	M	XXh	RV_LURABS_F[5]
76	RecordValue73 = Lurabs_f[5] low byte	M	XXh	RV_LURABS_F[5]
77	RecordValue74 = Lurdif_f[5] high byte	M	XXh	RV_LURDIF_F[5]
78	RecordValue75 = Lurdif_f[5] low byte	M	XXh	RV_LURDIF_F[5]
79	RecordValue76 = Zw_offkorrvr[5] high byte	M	XXh	RV_ZW_OFFKORRVR[5]
80	RecordValue77 = Zw_offkorrvr[5] low byte	M	XXh	RV_ZW_OFFKORRVR[5]
81	RecordValue78 = F_tikorrvr[6] high byte	M	XXh	RV_F_TIKORRVR[6]
82	RecordValue79 = F_tikorrvr[6] low byte	M	XXh	RV_F_TIKORRVR[6]
83	RecordValue80 = Lurabs_f[6] high byte	M	XXh	RV_LURABS_F[6]
84	RecordValue81 = Lurabs_f[6] low byte	M	XXh	RV_LURABS_F[6]
85	RecordValue82 = Lurdif_f[6] high byte	M	XXh	RV_LURDIF_F[6]
86	RecordValue83 = Lurdif_f[6] low byte	M	XXh	RV_LURDIF_F[6]
87	RecordValue84 = Zw_offkorrvr[6] high byte	M	XXh	RV_ZW_OFFKORRVR[6]
88	RecordValue85 = Zw_offkorrvr[6] low byte	M	XXh	RV_ZW_OFFKORRVR[6]
89	RecordValue86 = F_tikorrvr[7] high byte	M	XXh	RV_F_TIKORRVR[7]
90	RecordValue87 = F_tikorrvr[7] low byte	M	XXh	RV_F_TIKORRVR[7]
91	RecordValue88 = Lurabs_f[7] high byte	M	XXh	RV_LURABS_F[7]
92	RecordValue89 = Lurabs_f[7] low byte	M	XXh	RV_LURABS_F[7]
93	RecordValue90 = Lurdif_f[7] high byte	M	XXh	RV_LURDIF_F[7]
94	RecordValue91 = Lurdif_f[7] low byte	M	XXh	RV_LURDIF_F[7]
95	RecordValue92 = Zw_offkorrvr[7] high byte	M	XXh	RV_ZW_OFFKORRVR[7]



96	RecordValue93 = Zw_offkorrvr[7] low byte	M	XXh	RV_ZW_OFFKORRV[7]
97	RecordValue94 = Amo_30 high byte	M	XXh	RV_AMO_30
98	RecordValue95 = Amo_30 low byte	M	XXh	RV_AMO_30
99	RecordValue96 = Amo_40 high byte	M	XXh	RV_AMO_40
100	RecordValue97 = Amo_40 low byte	M	XXh	RV_AMO_40

Hint: all record values which are not defined in BMW-layer.h are FFh,  
also RecordValue 65d ... 93d for 4cyl-machine,  
RecordValue 78d ... 93d for 6cyl-machine

### I.23.61 22\_402E - Nullgang-Erkennung lesen

#### General information:

This function is created to read out the info about "Nullgang Erkennung"

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCi
2	RecordCommonIdentifier High Byte	M	40h	RCI_NGE
3	RecordCommonIdentifier Low Byte	M	2Eh	RCI_NGE

Figure I.23.9: Table Request Message

#### Positive Response on service


Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Response Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier High Byte	M	40h	RCI_NGE
3	RecordCommonIdentifier Low Byte	M	2Eh	RCI_NGE
4	recordValue1 = Tvngang (high byte)	M	XXh	RV_PHY_NG_POSITION
5	recordValue2 = Tvngang (low byte)	M	XXh	RV_PHY_NG_POSITION
6	recordValue3 = Tvneutral (high byte)	M	XXh	RV_PHY_NG_LERN
7	recordValue4 = Tvneutral (low byte)	M	XXh	RV_PHY_NG_LERN
8	recordValue5 = 0 - if B_gangnull = FALSE 1 - if B_gangnull = TRUE	M	XXh	RV_STAT_NG_ERKANNT
9	recordValue6 = 0 - if B_nggelernt = 0 1 - if B_nggelernt = 1	M	XXh	RV_STAT_NG_GELERNT
10	recordValue7 = 0 - if B_kupp_ext = FALSE 1 - if B_kupp_ext = TRUE	M	XXh	RV_STATKUP_BETAETIGT
11	recordValue8 = 0 - if B_kwdreht = FALSE 1 - if B_kwdreht = TRUE	M	XXh	RV_STAT_MOT_DREHT
12	recordValue9 = 0 - if B_ngimlf = FALSE 1 - if B_ngimlf = TRUE	M	XXh	RV_STAT_NG_IM_LF

### I.23.62 22\_402F - MSA lesen

#### General information:

This function is created to read out the state of "MotorStopAutomatik"

#### Request

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	40h	RCI_MSA
3	RecordCommonIdentifier Low Byte	M	2Fh	RCI_MSA

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCI <sup>PR</sup>
2	RecordCommonIdentifier High Byte	M	40h	RCI_MSA
3	RecordCommonIdentifier Low Byte	M	2Fh	RCI_MSA
4	recordValue1 = Stmsa (high byte, high word)	M	XXh	RV_STAT_MSA
5	recordValue2 = Stmsa (low byte, high word)	M	XXh	RV_STAT_MSA
6	recordValue3 = Stmsa (high byte, low word)	M	XXh	RV_STAT_MSA
7	recordValue4 = Stmsa (low byte, low word)	M	XXh	RV_STAT_MSA
8	recordValue5 = Stmsaav (high byte, high word)	M	XXh	RV_STAT_MSAAV
9	recordValue6 = Stmsaav (low byte, high word)	M	XXh	RV_STAT_MSAAV
10	recordValue7 = Stmsaav (high byte, low word)	M	XXh	RV_STAT_MSAAV
11	recordValue8 = Stmsaav (low byte, low word)	M	XXh	RV_STAT_MSAAV
12	recordValue9 = Stmsaev (high byte, high word)	M	XXh	RV_STAT_MSAEVV
13	recordValue10 = Stmsaev (low byte, high word)	M	XXh	RV_STAT_MSAEVV
14	recordValue11 = Stmsaev (high byte, low word)	M	XXh	RV_STAT_MSAEVV
15	recordValue12 = Stmsaev (low byte, low word)	M	XXh	RV_STAT_MSAEVV
16	recordValue13 = Stmsaaa (high byte, high word)	M	XXh	RV_STAT_MSAAA
17	recordValue14 = Stmsaaa (low byte, high word)	M	XXh	RV_STAT_MSAAA
18	recordValue15 = Stmsaaa (high byte, low word)	M	XXh	RV_STAT_MSAAA
19	recordValue16 = Stmsaaa (low byte, low word)	M	XXh	RV_STAT_MSAAA
20	recordValue17 = Stmsaea (high byte, high word)	M	XXh	RV_STAT_MSAEA
21	recordValue18 = Stmsaea (low byte, high word)	M	XXh	RV_STAT_MSAEA
22	recordValue19 = Stmsaea (high byte, low word)	M	XXh	RV_STAT_MSAEA
23	recordValue20 = Stmsaea (low byte, low word)	M	XXh	RV_STAT_MSAEA

## I.23.63 22\_4030 - FASTA\_LVS\_lesen

### General information:

This function ist for reading the data of the FASTA\_LVS (Fahrzeugnutzungsprofil)

### Formula section:

### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier	M	40h	RCI_LVS
3	RecordCommonIdentifier	M	30h	RCI_LVS

### Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Response Service Id</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier	M	40h	RCI_LVS
3	RecordCommonIdentifier	M	30h	RCI_LVS
4	RecordValue1 = Zr_lvs_0 ( high byte)	M	XXh	RV_ZR_LVS_0
5	RecordValue2 = Zr_lvs_0 ( low byte)	M	XXh	RV_ZR_LVS_0
6	RecordValue3 = Zr_lvs_1 ( high byte)	M	XXh	RV_ZR_LVS_1
7	RecordValue4 = Zr_lvs_1 ( low byte)	M	XXh	RV_ZR_LVS_1
8	RecordValue5 = Zr_lvs_2( high byte)	M	XXh	RV_ZR_LVS_2
9	RecordValue6 = Zr_lvs_2( low byte)	M	XXh	RV_ZR_LVS_2
10	RecordValue7 = Zr_lvs_3 ( high byte)	M	XXh	RV_ZR_LVS_3
11	RecordValue8 = Zr_lvs_3 ( low byte)	M	XXh	RV_ZR_LVS_3
12	RecordValue9 = Zr_lvssekt_0 (high byte)	M	XXh	RV_ZR_LVSSEKT_0
13	RecordValue10 = Zr_lvssekt_0 ( low byte )	M	XXh	RV_ZR_LVSSEKT_0
14	RecordValue11 = Zr_lvssekt_1 (high byte)	M	XXh	RV_ZR_LVSSEKT_1
15	RecordValue12 = Zr_lvssekt_1 ( low byte )	M	XXh	RV_ZR_LVSSEKT_1
16	RecordValue13 = Zr_lvssekt_2 (high byte)	M	XXh	RV_ZR_LVSSEKT_2
17	RecordValue14 = Zr_lvssekt_2 ( low byte )	M	XXh	RV_ZR_LVSSEKT_2
18	RecordValue15 = Zr_lvssekt_3 (high byte)	M	XXh	RV_ZR_LVSSEKT_3
19	RecordValue16 = Zr_lvssekt_3 ( low byte )	M	XXh	RV_ZR_LVSSEKT_3
20	RecordValue17 = Zr_lvssekt_4 (high byte)	M	XXh	RV_ZR_LVSSEKT_4
21	RecordValue18 = Zr_lvssekt_4 ( low byte )	M	XXh	RV_ZR_LVSSEKT_4
22	RecordValue19 = Zr_lvssekt_5 (high byte)	M	XXh	RV_ZR_LVSSEKT_5
23	RecordValue20 = Zr_lvssekt_5 ( low byte )	M	XXh	RV_ZR_LVSSEKT_5
24	RecordValue21 = Zr_lvssekt_6 (high byte)	M	XXh	RV_ZR_LVSSEKT_6
25	RecordValue22 = Zr_lvssekt_6 ( low byte )	M	XXh	RV_ZR_LVSSEKT_6
26	RecordValue23 = Zr_lvssekt_7 (high byte)	M	XXh	RV_ZR_LVSSEKT_7
27	RecordValue24 = Zr_lvssekt_7 ( low byte )	M	XXh	RV_ZR_LVSSEKT_7
28	RecordValue25 = Zr_lvssekt_8 (high byte)	M	XXh	RV_ZR_LVSSEKT_8
29	RecordValue26 = Zr_lvssekt_8 ( low byte )	M	XXh	RV_ZR_LVSSEKT_8
30	RecordValue27 = Zr_lvs_ll_reakt	M	XXh	RV_ZR_LVS_LL_REAKT

## I.23.64 22\_4031 - LVSZYL\_lesen

### General information:

This function ist for reading the data of the LVSZYL (LaufruheVerbesserungssystem Zylinderstatistik)

### Formula section:

### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Request Service ID</b>	<b>M</b>	<b>22h</b>	<b>RDBC I</b>
2	RecordCommonIdentifier	M	40h	RCI_LVSZYL
3	RecordCommonIdentifier	M	31h	RCI_LVSZYL

### Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Response Service Id</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier	M	40h	RCL_LVSYL
3	RecordCommonIdentifier	M	31h	RCL_LVSYL
4	RecordValue1 = Zr_lvszyl_0 ( high byte)	M	XXh	RV_STAT_ZR_LVSZ YL_0
5	RecordValue2 = Zr_lvszyl_0 ( low byte)	M	XXh	RV_STAT_ZR_LVSZ YL_0
6	RecordValue3 = Zr_lvszyl_1 ( high byte)	M	XXh	RV_STAT_ZR_LVSZ YL_1
7	RecordValue4 = Zr_lvszyl_1 ( low byte)	M	XXh	RV_STAT_ZR_LVSZ YL_1
8	RecordValue5 = Zr_lvszyl_2( high byte)	M	XXh	RV_STAT_ZR_LVSZ YL_2
9	RecordValue6 = Zr_lvszyl_2( low byte)	M	XXh	RV_STAT_ZR_LVSZ YL_2
10	RecordValue7 = Zr_lvszyl_3 ( high byte)	M	XXh	RV_STAT_ZR_LVSZ YL_3
11	RecordValue8 = Zr_lvszyl_3 ( low byte)	M	XXh	RV_STAT_ZR_LVSZ YL_3
12	RecordValue9 = Zr_lvszyl_4( high byte)	M	XXh	RV_STAT_ZR_LVSZ YL_4
13	RecordValue10 = Zr_lvszyl_4( low byte)	M	XXh	RV_STAT_ZR_LVSZ YL_4
14	RecordValue11= Zr_lvszyl_5 ( high byte)	M	XXh	RV_STAT_ZR_LVSZ YL_5
15	RecordValue12 = Zr_lvszyl_5 ( low byte)	M	XXh	RV_STAT_ZR_LVSZ YL_5

## I.23.65 22\_4032 - MFMA\_lesen

### General information:

This function ist for reading the data of MFMA (Kleinstmengenadaption)

### Formula section:

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Request Service ID</b>	<b>M</b>	<b>22h</b>	<b>RDBCI</b>
2	RecordCommonIdentifier	M	40h	RCL_MFMA
3	RecordCommonIdentifier	M	32h	RCL_MFMA

#### Positive Response

Data Byte	Parameter Name	Cv t	Hex Value	Mnemonic
1	<b>Response Service Id</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier	M	40h	RCI_MFMA
3	RecordCommonIdentifier	M	32h	RCI_MFMA
4	RecordValue1 = CTR_AD_COLD_LAM_AD_INJ	M	XXh	RV_CTR_AD_COLD_LAM_AD_INJ
5	RecordValue2 = CTR_AD_HOT_LAM_AD_INJ	M	XXh	RV_CTR_AD_HOT_LAM_AD_INJ
6	RecordValue3 = DIST_LAM_AD_INJ_COLD ( high byte)	M	XXh	RV_DIST_LAM_AD_INJ_COLD
7	RecordValue4 = DIST_LAM_AD_INJ_COLD ( low byte)	M	XXh	RV_DIST_LAM_AD_INJ_COLD
8	RecordValue5 = DIST_LAM_AD_INJ_HOT ( high byte)	M	XXh	RV_DIST_LAM_AD_INJ_HOT
9	RecordValue6 = DIST_LAM_AD_INJ_HOT ( low byte)	M	XXh	RV_DIST_LAM_AD_INJ_HOT
10	RecordValue7 = FAC_LAM_ADJ_COR_LAM_AD_CUS[1] ( high byte)	M	XXh	RV_FAC_LAM_ADJ_COR_LAM_AD_CUS[1]
11	RecordValue8 = FAC_LAM_ADJ_COR_LAM_AD_CUS[1] ( low byte)	M	XXh	RV_FAC_LAM_ADJ_COR_LAM_AD_CUS[1]
12	RecordValue9 = FAC_LAM_ADJ_COR_LAM_AD_CUS[2] ( high byte)	M	XXh	RV_FAC_LAM_ADJ_COR_LAM_AD_CUS[2]
13	RecordValue10 =FAC_LAM_ADJ_COR_LAM_AD_CUS[2] ( high byte)	M	XXh	RV_FAC_LAM_ADJ_COR_LAM_AD_CUS[2]
14	RecordValue11 = FAC_LAM_ADJ_LAM_AD[1] (high byte)	M	XXh	RV_FAC_LAM_ADJ_LAM_AD[1]
15	RecordValue12 = FAC_LAM_ADJ_LAM_AD[1] ( low byte )	M	XXh	RV_FAC_LAM_ADJ_LAM_AD[1]
16	RecordValue13 = FAC_LAM_ADJ_LAM_AD[2] (high byte)	M	XXh	RV_FAC_LAM_ADJ_LAM_AD[2]
17	RecordValue14 = FAC_LAM_ADJ_LAM_AD[2] ( low byte )	M	XXh	RV_FAC_LAM_ADJ_LAM_AD[2]
18	RecordValue15 = MFF_ADD_COLD_LAM_AD_INJ[0] (high byte)	M	XXh	RV_MFF_ADD_COLD_LAM_AD_INJ[0]
19	RecordValue16 = MFF_ADD_COLD_LAM_AD_INJ[0] ( low byte )	M	XXh	RV_MFF_ADD_COLD_LAM_AD_INJ[0]
20	RecordValue17 = MFF_ADD_HOT_LAM_AD_INJ[0] (high byte)	M	XXh	RV_MFF_ADD_HOT_LAM_AD_INJ[0]
21	RecordValue18 = MFF_ADD_HOT_LAM_AD_INJ[0] ( low byte )	M	XXh	RV_MFF_ADD_HOT_LAM_AD_INJ[0]
22	RecordValue19 = MFF_ADD_COLD_LAM_AD_INJ[1] (high byte)	M	XXh	RV_MFF_ADD_COLD_LAM_AD_INJ[1]
23	RecordValue20 = MFF_ADD_COLD_LAM_AD_INJ[1] ( low byte )	M	XXh	RV_MFF_ADD_COLD_LAM_AD_INJ[1]
24	RecordValue 21 = MFF_ADD_HOT_LAM_AD_INJ[1] (high byte)	M	XXh	RV_MFF_ADD_HOT_LAM_AD_INJ[1]
25	RecordValue22 = MFF_ADD_HOT_LAM_AD_INJ[1] ( low byte )	M	XXh	RV_MFF_ADD_HOT_LAM_AD_INJ[1]
26	RecordValue23 = MFF_ADD_COLD_LAM_AD_INJ[2] (high byte)	M	XXh	RV_MFF_ADD_COLD_LAM_AD_INJ[2]
27	RecordValue24 = MFF_ADD_COLD_LAM_AD_INJ[2] ( low byte )	M	XXh	RV_MFF_ADD_COLD_LAM_AD_INJ[2]
28	RecordValue25 = MFF_ADD_HOT_LAM_AD_INJ[2] (high byte)	M	XXh	RV_MFF_ADD_HOT_LAM_AD_INJ[2]
29	RecordValue26 = MFF_ADD_HOT_LAM_AD_INJ[2] ( low byte )	M	XXh	RV_MFF_ADD_HOT_LAM_AD_INJ[2]
30	RecordValue27 = MFF_ADD_COLD_LAM_AD_INJ[3] (high byte)	M	XXh	RV_MFF_ADD_COLD_LAM_AD_INJ[3]
31	RecordValue28 = MFF_ADD_COLD_LAM_AD_INJ[3] ( low byte )	M	XXh	RV_MFF_ADD_COLD_LAM_AD_INJ[3]
32	RecordValue29 = MFF_ADD_HOT_LAM_AD_INJ[3] (high byte)	M	XXh	RV_MFF_ADD_HOT_LAM_AD_INJ[3]

33	RecordValue30 = MFF_ADD_HOT_LAM_AD_INJ[3] ( low byte )	M	XXh	RV_MFF_ADD_HOT_LAM_AD_INJ[3]
34	RecordValue31 = MFF_ADD_COLD_LAM_AD_INJ[4] (high byte)	M	XXh	RV_MFF_ADD_COLD_LAM_AD_INJ[4]
35	RecordValue32 = MFF_ADD_COLD_LAM_AD_INJ[4] ( low byte )	M	XXh	RV_MFF_ADD_COLD_LAM_AD_INJ[4]
36	RecordValue33 = MFF_ADD_HOT_LAM_AD_INJ[4] (high byte)	M	XXh	RV_MFF_ADD_HOT_LAM_AD_INJ[4]
37	RecordValue34 = MFF_ADD_HOT_LAM_AD_INJ[4] ( low byte )	M	XXh	RV_MFF_ADD_HOT_LAM_AD_INJ[4]
38	RecordValue35 = MFF_ADD_COLD_LAM_AD_INJ[5] (high byte)	M	XXh	RV_MFF_ADD_COLD_LAM_AD_INJ[5]
39	RecordValue36 = MFF_ADD_COLD_LAM_AD_INJ[5] ( low byte )	M	XXh	RV_MFF_ADD_COLD_LAM_AD_INJ[5]
40	RecordValue37 = MFF_ADD_HOT_LAM_AD_INJ[5] (high byte)	M	XXh	RV_MFF_ADD_HOT_LAM_AD_INJ[5]
41	RecordValue38 = MFF_ADD_HOT_LAM_AD_INJ[5] ( low byte )	M	XXh	RV_MFF_ADD_HOT_LAM_AD_INJ[5]
42	RecordValue39 = MFF_ADD_COLD_LAM_AD_INJ[6] (high byte)	M	XXh	RV_MFF_ADD_COLD_LAM_AD_INJ[6]
43	RecordValue40 = MFF_ADD_COLD_LAM_AD_INJ[6] ( low byte )	M	XXh	RV_MFF_ADD_COLD_LAM_AD_INJ[6]
44	RecordValue41 = MFF_ADD_HOT_LAM_AD_INJ[6] (high byte)	M	XXh	RV_MFF_ADD_HOT_LAM_AD_INJ[6]
-	RecordValue42 = MFF_ADD_HOT_LAM_AD_INJ[6] ( low byte )	M	XXh	RV_MFF_ADD_HOT_LAM_AD_INJ[6]
46	RecordValue43 = MFF_ADD_COLD_LAM_AD_INJ[7] (high byte)	M	XXh	RV_MFF_ADD_COLD_LAM_AD_INJ[7]
47	RecordValue44 = MFF_ADD_COLD_LAM_AD_INJ[7] ( low byte )	M	XXh	RV_MFF_ADD_COLD_LAM_AD_INJ[7]
48	RecordValue- = MFF_ADD_HOT_LAM_AD_INJ[7] (high byte)	M	XXh	RV_MFF_ADD_HOT_LAM_AD_INJ[7]
49	RecordValue46 = MFF_ADD_HOT_LAM_AD_INJ[7] ( low byte )	M	XXh	RV_MFF_ADD_HOT_LAM_AD_INJ[7]

**Hint: transmitt 0ffh for variables which are not exist in project**

## I.23.66 22\_4035 - Kraftstoffqualitätserfassung lesen

### General information:

With this service the values for fuel quality statistic can be read.

### Formula section:

```

If(1)          service 22_40_35 is received
Then(1)
    #If(2)          NC_NR_RON_KWP < 1
    #Then(2)
        send negative response "subfunction not supported"
    #Else(2)
        If(3)          LC_RON_STC_ENA = 0
        Then(3)       send negative response "subfunction not supported"
        Else(3)       send positive response
        Endif(3)
    #Endif(2)
Endif(1)

```

## Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier high byte	M	40h	RCI_RCI_KQE
3	RecordCommonIdentifier low byte	M	35h	RCI_RCI_KQE

## Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCI PR
2	RecordCommonIdentifier high byte	M	40h	RCI_RCI_KQE
3	RecordCommonIdentifier low byte	M	35h	RCI_RCI_KQE
4	RecordValue1 = CTR_STC_RON_LOW (high byte)	M	XXh	RV_KQE_
5	RecordValue2 = CTR_STC_RON_LOW (low byte)	M	XXh	RV_KQE_
6	RecordValue3 = CTR_STC_RON_MEDIUM (high byte)	M	XXh	RV_KQE_
7	RecordValue4 = CTR_STC_RON_MEDIUM (low byte)	M	XXh	RV_KQE_
8	RecordValue5 = CTR_STC_RON_HIGH (high byte)	M	XXh	RV_KQE_
9	RecordValue6 = CTR_STC_RON_HIGH (low byte)	M	XXh	RV_KQE_
10	RecordValue7 = DIST_RON_STC[1] (high byte)	M	XXh	RV_KQE_
11	RecordValue8 = DIST_RON_STC[1] (low byte)	M	XXh	RV_KQE_
12	RecordValue9 = STATE_RON[1]	M	XXh	RV_KQE_
...	...	...	...	...
3*NC_NR_RO N_KWP + 7	RecordValue(3* NC_NR_RON_KWP +4) = DIST_RON_STC[NC_NR_RON_KWP] (high byte)	M	XXh	RV_KQE_
3*NC_NR_RO N_KWP + 8	RecordValue(3* NC_NR_RON_KWP +5) = DIST_RON_STC[NC_NR_RON_KWP] (low byte)	M	XXh	RV_KQE_
3*NC_NR_RO N_KWP + 9	RecordValue(3* NC_NR_RON_KWP +6) = STATE_RON[NC_NR_RON_KWP]	M	XXh	RV_KQE_

## I.23.67 22\_404C - Read Zeitanteile der erreichten Druckbereiche (beim Tausch der Kraftstoffhochdruckpumpe)

### General information:

This function is created to read out the "Zeitanteile der erreichten Druckbereiche (beim Tausch der Kraftstoffhochdruckpumpe)"

### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	Request Service ID	M	22h	RDBCI
#2d	RecordCommonIdentifier High Byte	M	40h	RCI_RBMMS2
#3d	RecordCommonIdentifier Low Byte	M	4Ch	RCI_RBMMS2

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	ReadDataByIdentifier Response Service Id	M	62h	RDBCIPR
#2d #3d	dataIdentifier #1 =[            byte1(MSB) byte2 ]	M	40h 4Ch	DID_B1 B2
#4d	RecordValue#1 = T_prail_mon_xb_y pb[1][1] high byte, high word	M	XXh	RV_1
#5d	RecordValue#2= T_prail_mon_xb_y pb[1][1] low byte, high word	M	XXh	RV_2
#6d	RecordValue#3= T_prail_mon_xb_y pb[1][1] high byte, low word	M	XXh	RV_
#7d	RecordValue#4= T_prail_mon_xb_y pb[1][1] low byte, low word	M	XXh	RV_
#8d	RecordValue#5 = T_prail_mon_xb_y pb[2][1] high byte, high word	M	XXh	RV_
#9d	RecordValue#6 = T_prail_mon_xb_y pb[2][1] low byte, high word	M	XXh	RV_
#10d	RecordValue#7 = T_prail_mon_xb_y pb[2][1] high byte, low word	M	XXh	RV_
#11d	RecordValue#8 = T_prail_mon_xb_y pb[2][1] low byte, low word	M	XXh	RV_

Figure I.23.10: Table ReadDataByIdentifier Positive Response Message

### I.23.68 22\_4066 - RCI\_RBMMS3\_lesen

#### General information:

#### Rate Based Monitoring Motorsteuerung Block 3 auslesen

This function reads out RBM values block 3.

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	Request Service ID	M	22h	RDBC I
#2d	RecordCommonIdentifier High Byte	M	40h	RCI_RBMMS2
#3d	RecordCommonIdentifier Low Byte	M	66h	RCI_RBMMS2

#### Positive Response on service



Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	ReadDataByIdentifier Response Service Id	M	62h	RDBCIPR
#2d #3d	dataIdentifier #1 =[ byte1(MSB) byte2 ]	M	40h 66h	DID_B1 B2
#4d	RecordValue#1 = CTR_COMP_RBM_PUC_VLD_LS_UP_1 high byte	M	XXh	RV_1
#5d	RecordValue#2 = CTR_COMP_RBM_PUC_VLD_LS_UP_1 low byte	M	XXh	RV_2
#6d	RecordValue#3 = CTR_CDN_RBM_PUC_VLD_LS_UP_1 high byte	M	XXh	RV_
#7d	RecordValue#4 = CTR_CDN_RBM_PUC_VLD_LS_UP_1 low byte	M	XXh	RV_
#8d	RecordValue#5 = CTR_COMP_RBM_PUC_VLD_LS_UP_2 high byte	M	XXh	RV_
#9d	RecordValue#6 = CTR_COMP_RBM_PUC_VLD_LS_UP_2 low byte	M	XXh	RV_
#10d	RecordValue#7 = CTR_CDN_RBM_PUC_VLD_LS_UP_2 high byte	M	XXh	RV_
#11d	RecordValue#8 = CTR_CDN_RBM_PUC_VLD_LS_UP_2 low byte	M	XXh	RV_
#12d	RecordValue#9 = CTR_COMP_RBM_OC_LS_DOWN_1 high byte	M	XXh	RV_
#13d	RecordValue#10 = CTR_COMP_RBM_OC_LS_DOWN_1 low byte	M	XXh	RV_
#14d	RecordValue#11 = CTR_CDN_RBM_OC_LS_DOWN_1 high byte	M	XXh	RV_
#15d	RecordValue#12 = CTR_CDN_RBM_OC_LS_DOWN_1 low byte	M	XXh	RV_
#16d	RecordValue#13 = CTR_COMP_RBM_OC_LS_DOWN_2 high byte	M	XXh	RV_
#17d	RecordValue#14 = CTR_COMP_RBM_OC_LS_DOWN_2 low byte	M	XXh	RV_
#18d	RecordValue#15 = CTR_CDN_RBM_OC_LS_DOWN_2 high byte	M	XXh	RV_
#19d	RecordValue#16 = CTR_CDN_RBM_OC_LS_DOWN_2 low byte	M	XXh	RV_
#20d	RecordValue#17 = CTR_COMP_RBM_SCG_LS_DOWN_1 high byte	M	XXh	RV_
#21d	RecordValue#18 = CTR_COMP_RBM_SCG_LS_DOWN_1 low byte	M	XXh	RV_
#22d	RecordValue#19 = CTR_CDN_RBM_SCG_LS_DOWN_1 high byte	M	XXh	RV_
#23d	RecordValue#20 = CTR_CDN_RBM_SCG_LS_DOWN_1 low byte	M	XXh	RV_
#24d	RecordValue#21 = CTR_COMP_RBM_SCG_LS_DOWN_2 high byte	M	XXh	RV_
#25d	RecordValue#22 = CTR_COMP_RBM_SCG_LS_DOWN_2 low byte	M	XXh	RV_
#26d	RecordValue#23 = CTR_CDN_RBM_SCG_LS_DOWN_2 high byte	M	XXh	RV_
#27d	RecordValue#24 = CTR_CDN_RBM_SCG_LS_DOWN_2 low byte	M	XXh	RV_
#28d	RecordValue#25 = CTR_COMP_RBM_OC_LSL_UP_1 high byte	M	XXh	RV_
#29d	RecordValue#26 = CTR_COMP_RBM_OC_LSL_UP_1 low byte	M	XXh	RV_
#30d	RecordValue#27 = CTR_CDN_RBM_OC_LSL_UP_1 high byte	M	XXh	RV_
#31d	RecordValue#28 = CTR_CDN_RBM_OC_LSL_UP_1 low byte	M	XXh	RV_
#32d	RecordValue#29 = CTR_COMP_RBM_OC_LSL_UP_2 high byte	M	XXh	RV_
#33d	RecordValue#30 = CTR_COMP_RBM_OC_LSL_UP_2 low byte	M	XXh	RV_
#34d	RecordValue#31 = CTR_CDN_RBM_OC_LSL_UP_2 high byte	M	XXh	RV_
#35d	RecordValue#32 = CTR_CDN_RBM_OC_LSL_UP_2 low byte	M	XXh	RV_
#36d	RecordValue#33 = CTR_COMP_RBM_CSERS_INJ high byte	M	XXh	RV_
#37d	RecordValue#34 = CTR_COMP_RBM_CSERS_INJ low byte	M	XXh	RV_
#38d	RecordValue#35 = CTR_CDN_RBM_CSERS_INJ high byte	M	XXh	RV_
#39d	RecordValue#36 = CTR_CDN_RBM_CSERS_INJ low byte	M	XXh	RV_

Figure I.23.11: Table ReadDataByIdentifier Positive Response Message


## I.23.69 22\_5F88 - ADRECOVERY\_lesen

### General information:

This command read out the informations about the Nox-trap from ECU. This is necessary before re-programming or change of ECU.

### Formula section:

If service 22\_5F\_88 is received

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```

then
    send positive response
endif

```


### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCi
2	RecordCommonIdentifier	M	5Fh	RCI_ADRECOVERY
3	RecordCommonIdentifier	M	88h	RCI_ADRECOVERY

### Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Response Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier	M	5Fh	RCI_ADRECOVERY
3	recordCommonIdentifier	M	88h	RCI_ADRECOVERY
4	recordValue1 = NT_SUL_32[1] (high word, high byte )	M	XXh	RV_NT_SUL_32[1]
5	recordValue2 = NT_SUL_32[1] (high word, low byte )	M	XXh	RV_NT_SUL_32[1]
6	recordValue3 = NT_SUL_32[1] (low word, high byte )	M	XXh	RV_NT_SUL_32[1]
7	recordValue4 = NT_SUL_32[1] (low word, low byte )	M	XXh	RV_NT_SUL_32[1]
8	recordValue5 = NT_SUL_32[2] (high word, high byte )	M	XXh	RV_NT_SUL_32[2]
9	recordValue6 = NT_SUL_32[2] (high word, low byte )	M	XXh	RV_NT_SUL_32[2]
10	recordValue7 = NT_SUL_32[2] (low word, high byte )	M	XXh	RV_NT_SUL_32[2]
11	recordValue8 = NT_SUL_32[2] (low word, low byte )	M	XXh	RV_NT_SUL_32[2]
12	recordValue9 = NT_SUL_H_32[1] (high word, high byte )	M	XXh	RV_NT_SUL_H_32[1]
13	recordValue10 = NT_SUL_H_32[1] (high word, low byte )	M	XXh	RV_NT_SUL_H_32[1]
14	recordValue11 = NT_SUL_H_32[1] (low word, high byte )	M	XXh	RV_NT_SUL_H_32[1]
15	recordValue12 = NT_SUL_H_32[1] (low word, low byte )	M	XXh	RV_NT_SUL_H_32[1]
16	recordValue13 = NT_SUL_H_32[2] (high word, high byte )	M	XXh	RV_NT_SUL_H_32[2]
17	recordValue14 = NT_SUL_H_32[2] (high word, low byte )	M	XXh	RV_NT_SUL_H_32[2]
18	recordValue15 = NT_SUL_H_32[2] (low word, high byte )	M	XXh	RV_NT_SUL_H_32[2]
19	recordValue16 = NT_SUL_H_32[2] (low word, low byte )	M	XXh	RV_NT_SUL_H_32[2]
10	recordValue17 = NT_AGI (high byte)	M	XXh	RV_NT_AGI
21	recordValue18 = NT_AGI (low byte)	M	XXh	RV_NT_AGI
22	recordValue19 = NT_AGI_SO2P_FQ_SUM (high word, high byte )	M	XXh	RV_NT_AGI_SO2P_FQ_SUM
23	recordValue20 = NT_AGI_SO2P_FQ_SUM (high word, low byte )	M	XXh	RV_NT_AGI_SO2P_FQ_SUM
24	recordValue21 = NT_AGI_SO2P_FQ_SUM (low word, high byte )	M	XXh	RV_NT_AGI_SO2P_FQ_SUM
25	recordValue22 = NT_AGI_SO2P_FQ_SUM (low word, low byte )	M	XXh	RV_NT_AGI_SO2P_FQ_SUM
26	recordValue23 = NT_AGI_SUL (high byte)	M	XXh	RV_NT_AGI_SUL
27	recordValue24 = NT_AGI_SUL (low byte)	M	XXh	RV_NT_AGI_SUL
28	recordValue25 = NT_AGI_SUL_SNG[1] (high word, high byte )	M	XXh	RV_NT_AGI_SUL_SNG[1]
29	recordValue26 = NT_AGI_SUL_SNG[1] (high word, low byte )	M	XXh	RV_NT_AGI_SUL_SNG[1]
30	recordValue27 = NT_AGI_SUL_SNG[1] (low word, high byte )	M	XXh	RV_NT_AGI_SUL_SNG[1]
31	recordValue28 = NT_AGI_SUL_SNG[1] (low word, low byte )	M	XXh	RV_NT_AGI_SUL_SNG[1]
32	recordValue29 = NT_AGI_SUL_SNG[2] (high word, high byte )	M	XXh	RV_NT_AGI_SUL_SNG[2]
33	recordValue30 = NT_AGI_SUL_SNG[2] (high word, low byte )	M	XXh	RV_NT_AGI_SUL_SNG[2]
34	recordValue31 = NT_AGI_SUL_SNG[2] (low word, high byte )	M	XXh	RV_NT_AGI_SUL_SNG[2]
35	recordValue32 = NT_AGI_SUL_SNG[2] (low word, low byte )	M	XXh	RV_NT_AGI_SUL_SNG[2]
36	recordValue33 = NT_AGI_THERMO (high byte)	M	XXh	RV_NT_AGI_THERMO
37	recordValue34 = NT_AGI_THERMO (low byte)	M	XXh	RV_NT_AGI_THERMO
38	recordValue35 = NT_AGI_THERMO_SNG[1] (high byte)	M	XXh	RV_NT_AGI_THERMO_SNG[1]
39	recordValue36 = NT_AGI_THERMO_SNG[1] (high byte)	M	XXh	RV_NT_AGI_THERMO_SNG[1]
40	recordValue37 = NT_AGI_THERMO_SNG[2] (high byte)	M	XXh	RV_NT_AGI_THERMO_SNG[2]
41	recordValue38 = NT_AGI_THERMO_SNG[2] (low byte)	M	XXh	RV_NT_AGI_THERMO_SNG[2]
42	recordValue39 = CTR_NT_AGI_AD_CMPL_SUM (high byte)	M	XXh	RV_CTR_NT_AGI_AD_CMPL_SUM
43	recordValue40 = CTR_NT_AGI_AD_CMPL_SUM (low byte)	M	XXh	RV_CTR_NT_AGI_AD_CMPL_SUM
44	recordValue41 = CTR_NT_AGI_SO2P_FQ (high byte)	M	XXh	RV_CTR_NT_AGI_SO2P_FQ
-	recordValue42 = CTR_NT_AGI_SO2P_FQ (low byte)	M	XXh	RV_CTR_NT_AGI_SO2P_FQ
46	recordValue43 = LV_NT_AFS_REQ_AGI	M	XXh	RV_LV_NT_AFS_REQ_AGI

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47	recordValue44 = LV_NT_AFS_REQ_AGI_TMP_3	M	XXh	RV_LV_NT_AFS_REQ_AGI_TMP_3
48	recordValue45 = LV_SO2P_REQ_1	M	XXh	RV_LV_SO2P_REQ_1
49	recordValue46 = LV_SO2P_REQ_2	M	XXh	RV_LV_SO2P_REQ_2
50	recordValue47 = LV_SO2P_REQ_FQ	M	XXh	RV_LV_SO2P_REQ_FQ
51	recordValue48 = FAC_NT_AGI_LIM (high byte)	M	XXh	RV_FAC_NT_AGI_LIM
52	recordValue49 = FAC_NT_AGI_LIM (low byte)	M	XXh	RV_FAC_NT_AGI_LIM
53	recordValue50 = FAC_NT_AGI_MDL (high word, high byte)	M	XXh	RV_FAC_NT_AGI_MDL
54	recordValue51 = FAC_NT_AGI_MDL (high word, low byte)	M	XXh	RV_FAC_NT_AGI_MDL
55	recordValue52 = FAC_NT_AGI_MDL (low word, high byte)	M	XXh	RV_FAC_NT_AGI_MDL
56	recordValue53 = FAC_NT_AGI_MDL (low word, low byte)	M	XXh	RV_FAC_NT_AGI_MDL
57	recordValue54 = DIST_NS_NEW (high byte)	M	XXh	RV_DIST_NS_NEW
58	recordValue55 = DIST_NS_NEW (low byte)	M	XXh	RV_DIST_NS_NEW
59	recordValue56 = DIST_NT_NS_SHIFT[1] (high byte)	M	XXh	RV_DIST_NT_NS_SHIFT[1]
60	recordValue57 = DIST_NT_NS_SHIFT[1] (low byte)	M	XXh	RV_DIST_NT_NS_SHIFT[1]
61	recordValue58 = CTR_NS_AD_CYC[1] (high byte)	M	XXh	RV_CTR_NS_AD_CYC[1]
62	recordValue59 = CTR_NS_AD_CYC[1] (low byte)	M	XXh	RV_CTR_NS_AD_CYC[1]
63	recordValue60 = DIST_NT_NS_AD[1] (high byte)	M	XXh	RV_DIST_NT_NS_AD[1]
64	recordValue61 = DIST_NT_NS_AD[1] (low byte)	M	XXh	RV_DIST_NT_NS_AD[1]
65	recordValue62 = FAC_NOX_NS_AD[1] (high byte)	M	XXh	RV_FAC_NOX_NS_AD[1]
66	recordValue63 = FAC_NOX_NS_AD[1] (low byte)	M	XXh	RV_FAC_NOX_NS_AD[1]
67	recordValue64 = CTR_NS_SHIFT_CYC[1] (high byte)	M	XXh	RV_CTR_NS_SHIFT_CYC[1]
68	recordValue65 = CTR_NS_SHIFT_CYC[1] (low byte)	M	XXh	RV_CTR_NS_SHIFT_CYC[1]
69	recordValue66 = RATIO_MMV_NS_SHIFT_DIAG[1] (high byte)	M	XXh	RV_RATIO_MMV_NS_SHIFT_DIAG[1]
70	recordValue67 = RATIO_MMV_NS_SHIFT_DIAG[1] (low byte)	M	XXh	RV_RATIO_MMV_NS_SHIFT_DIAG[1]

Note: In case of NC\_NT\_NR = 1 must 0ffh transmitte for all "record Values " with array element[2]

## I.23.70 22\_5F8B - RCI\_PMB\_lesen

### General information:

#### STATUS\_PM\_BACKUP

This service reads out the battery status.

### Formula section:

```

if          service 22_5F8B received
then       send positive response
endif

```

### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier high byte	M	5Fh	RCI_PMB
3	RecordCommonIdentifier low byte	M	8Bh	RCI_PMB

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Response Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier high byte	M	5Fh	RCI_PMB
3	RecordCommonIdentifier low byte	M	8Bh	RCI_PMB
4	RecordValue1 = Pmbackup[0]	M	XXh	RV_PMBACKUP[0]
5	RecordValue2 = Pmbackup[1]	M	XXh	RV_PMBACKUP[1]
6	RecordValue3 = Pmbackup[2]	M	XXh	RV_PMBACKUP[2]
7	RecordValue4 = Pmbackup[3]	M	XXh	RV_PMBACKUP[3]
8	RecordValue5 = Pmbackup[4]	M	XXh	RV_PMBACKUP[4]
9	RecordValue6 = Pmbackup[5]	M	XXh	RV_PMBACKUP[5]
10	RecordValue7 = Pmbackup[6]	M	XXh	RV_PMBACKUP[6]

### I.23.71 22\_5F8E - MSA deactivation lesen

#### General information:

This function is created to read out the state of "MotorStopAutomatik deaktivieren"

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	Request Service ID	M	22h	RDBCI
2d	RecordCommonIdentifier High Byte	M	5Fh	RCI_MSA_D EAK
3d	RecordCommonIdentifier Low Byte	M	8Eh	RCI_MSA_D EAK

Figure I.23.12: Table Request Message

#### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	<b>Response Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2d	RecordCommonIdentifier High Byte	M	5Fh	RCI_MSA_DEAK
3d	RecordCommonIdentifier Low Byte	M	8Eh	RCI_MSA_DEAK
4d	recordValue1 = 0 -if B_msasw = FALSE 1 - if B_msasw = TRUE	M	XXh	RV_STAT_MSA_DEA K

### I.23.72 22\_5F8F - MSA Abschaltverhinderer lesen

#### General information:

This function is created to read out the state of "Selektive Deaktivierung Abschaltverhinderer MotorStopAutomatik "

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	Request Service ID	M	22h	RDBCI
2d	RecordCommonIdentifier High Byte	M	5Fh	RCI_MSA_D EAK_AV
3d	RecordCommonIdentifier Low Byte	M	8Fh	RCI_MSA_D EAK_AV

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	Response Service ID	M	62h	RDBCI PR
2d	RecordCommonIdentifier High Byte	M	5Fh	RCI_MSA_DEAK_AV
3d	RecordCommonIdentifier Low Byte	M	8Fh	RCI_MSA_DEAK_AV
4d	recordValue1 = Swmsaav (high byte, high word)	M	XXh	RV_STAT_MSA_DEA K_AV
5d	recordValue2 = Swmsaav (low byte, high word)	M	XXh	RV_STAT_MSA_DEA K_AV
6d	recordValue3 = Swmsaav (high byte, low word)	M	XXh	RV_STAT_MSA_DEA K_AV
7d	recordValue4 = Swmsaav (low byte, low word)	M	XXh	RV_STAT_MSA_DEA K_AV

## I.23.73 22\_5F90 - IMAALLE lesen

**General Information:** This function is created to read out the described values from the ECU.

### I.23.73.1 MSD 85 only

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	5Fh	RV_IMAALLE
3	RecordCommonIdentifier Low Byte	M	90h	RV_IMAALLE

#### Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	5Fh	RV_IMAALLE
3	RecordCommonIdentifier Low Byte	M	90h	RV_IMAALLE
4	recordValue1 = EGY_SP_IV_EXT_ADJ[0] high byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[0]
5	rcord value 2 = EGY_SP_IV_EXT_ADJ[0] low byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[0]
6	recordValue3 = MFF_ABSV_IV_EXT_ADJ[0] high byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[0]
7	recordValue4 = MFF_ABSV_IV_EXT_ADJ[0] low byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[0]
8	recordValue5 = EGY_SP_IV_EXT_ADJ[1] high byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[1]
9	rcord value6 = EGY_SP_IV_EXT_ADJ[1] low byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[1]
10	recordValue7 = MFF_ABSV_IV_EXT_ADJ[1] high byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[1]
11	recordValue8 = MFF_ABSV_IV_EXT_ADJ[1] low byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[1]
12	recordValue9 = EGY_SP_IV_EXT_ADJ[2] high byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[2]
13	rcord value10 = EGY_SP_IV_EXT_ADJ[2] low byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[2]
14	recordValue11 = MFF_ABSV_IV_EXT_ADJ[2] high byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[2]
15	recordValue12 = MFF_ABSV_IV_EXT_ADJ[2] low byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[2]
16	recordValue139 = EGY_SP_IV_EXT_ADJ[3] high byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[3]
17	rcord value14 = EGY_SP_IV_EXT_ADJ[3] low byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[3]
18	recordValue15 = MFF_ABSV_IV_EXT_ADJ[3] high byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[3]
19	recordValue16 = MFF_ABSV_IV_EXT_ADJ[3] low byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[3]
20	recordValue17 = EGY_SP_IV_EXT_ADJ[4] high byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[4]
21	rcord value18 = EGY_SP_IV_EXT_ADJ[4] low byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[4]
22	recordValue19 = MFF_ABSV_IV_EXT_ADJ[4] high byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[4]
23	recordValue20 = MFF_ABSV_IV_EXT_ADJ[4] low byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[4]
24	recordValue21 = EGY_SP_IV_EXT_ADJ[5] high byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[5]
25	rcord value22 = EGY_SP_IV_EXT_ADJ[5] low byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[5]
26	recordValue23 = MFF_ABSV_IV_EXT_ADJ[5] high byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[5]
27	recordValue24 = MFF_ABSV_IV_EXT_ADJ[5] low byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[5]
28	recordValue25 = EGY_SP_IV_EXT_ADJ[6] high byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[6]
29	rcord value26 = EGY_SP_IV_EXT_ADJ[6] low byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[6]
30	recordValue27 = MFF_ABSV_IV_EXT_ADJ[6] high byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[6]
31	recordValue28 = MFF_ABSV_IV_EXT_ADJ[6] low byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[6]
32	recordValue29 = EGY_SP_IV_EXT_ADJ[7] high byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[7]
33	rcord value30 = EGY_SP_IV_EXT_ADJ[7] low byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[7]
34	recordValue31 = MFF_ABSV_IV_EXT_ADJ[7] high byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[7]
35	recordValue32 = MFF_ABSV_IV_EXT_ADJ[7] low byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[7]

### I.23.73.2 All other projects

**Description:** This function is created to read out the described values from the ECU.

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	22h	RDBC I
2	RecordCommonIdentifier High Byte	M	5Fh	RV_IMAALLE
3	RecordCommonIdentifier Low Byte	M	90h	RV_IMAALLE

#### Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	5Fh	RV_IMAALLE
3	RecordCommonIdentifier Low Byte	M	90h	RV_IMAALLE
4	recordValue1 = EGY_SP_IV_EXT_ADJ[0] high byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[0]
5	rcord value 2 = EGY_SP_IV_EXT_ADJ[0] low byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[0]
6	recordValue3 = MFF_ABSV_IV_EXT_ADJ[0] high byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[0]
7	recordValue4 = MFF_ABSV_IV_EXT_ADJ[0] low byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[0]
...	...	...	...	...
...	...	...	...	...
...	...	...	...	...
4*NC_CYL_NR	recordValue4*NC_CYL_NR-3 = EGY_SP_IV_EXT_ADJ[NC_CYL_NR-1] high byte	M	XXh	RV_
4*NC_CYL_NR +1	recordValue4*NC_CYL_NR-2= EGY_SP_IV_EXT_ADJ[NC_CYL_NR-1] low byte	M	XXh	RV_
4*NC_CYL_NR +2	recordValue4*NC_CYL_NR-1= MFF_ABSV_IV_EXT_ADJ[NC_CYL_NR-1] high byte	M	XXh	RV_
4*NC_CYL_NR +3	recordValue4*NC_CYL_NR = MFF_ABSV_IV_EXT_ADJ[NC_CYL_NR-1] low byte	M	XXh	RV_

### I.23.74 22\_5FDE - VVT- Minhub lesen

#### General information:

This service reads out the specified value(s).

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier high byte	M	5Fh	RCI_
3	RecordCommonIdentifier low byte	M	DEh	RCI_


#### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier high byte	M	5Fh	RCI_
3	RecordCommonIdentifier low byte	M	DEh	RCI_
4	RecordValue1 = Minhub high byte	M	XXh	RV_
5	RecordValue2 = Minhub low byte	M	XXh	RV_

### I.23.75 22\_5FF0 - RCI\_LL\_ABGLEICH\_lesen

#### General information:

#### Abgleichswert LL lesen - ReadDataByCommonIdentifier

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7664 of 8404	
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With the tester via KWP telegram an idle speed offset for five different conditions can be read.

### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier high byte	M	5Fh	RCI_RCI_LL_ABGLEICH
3	RecordCommonIdentifier low byte	M	F0h	RCI_RCI_LL_ABGLEICH

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier high byte	M	5Fh	RCI_RCI_LL_ABGLEICH
3	RecordCommonIdentifier low byte	M	F0h	RCI_RCI_LL_ABGLEICH
4	RecordValue1 = N_KWP_OFS_ACC_DRI	M	XXh	RV_N_KWP_OFS_ACC_DRI
5	RecordValue2 = N_KWP_OFS_DRI	M	XXh	RV_N_KWP_OFS_DRI
6	RecordValue3 = N_KWP_OFS	M	XXh	RV_N_KWP_OFS
7	RecordValue4 = N_KWP_OFS_ACC	M	XXh	RV_N_KWP_OFS_ACC
8	RecordValue5 = N_KWP_OFS_VB	M	XXh	RV_N_KWP_OFS_VB

## I.23.76 22\_5FF1 - CO Abgleichswert lesen

### General information:

With the tester via KWP telegram the values for CO adjustment can be read.

### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier high byte	M	5Fh	RCI_
3	RecordCommonIdentifier low byte	M	F1h	RCI_

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier high byte	M	5Fh	RCI_
3	RecordCommonIdentifier low byte	M	F1h	RCI_
4	RecordValue1 = LV_FAC_MFF_ADD_EXT_ADJ_NVMY	M	XXh	RV_
5	RecordValue2 = LV_RST_MFF_ADD_EXT_ADJ_NVMY	M	XXh	RV_
6	RecordValue3 = FAC_MFF_ADD_EXT_ADJ	M	XXh	RV_
7	RecordValue4 = MFF_ADD_EXT_ADJ[1] high byte	M	XXh	RV_
8	RecordValue5 = MFF_ADD_EXT_ADJ[1] low byte	M	XXh	RV_
9	RecordValue6 = MFF_ADD_EXT_ADJ[2] high byte	M	XXh	RV_
10	RecordValue7 = MFF_ADD_EXT_ADJ[2] low byte	M	XXh	RV_
11	RecordValue8 = MFF_ADD_EXT_ADJ_NVMY high byte	M	XXh	RV_
12	RecordValue9 = MFF_ADD_EXT_ADJ_NVMY low byte	M	XXh	RV_

## I.23.77 22\_5FF2 - RCI\_ECU\_CONFIG\_lesen

### General information:

This service shows the actual recognized variants.

### Request

<i>Data Byte</i>	<i>Parameter Name</i>	<i>Cvt</i>	<i>Hex Value</i>	<i>Mnemonic</i>
1	Request Service ID	M	22h	RDBC1
2	RecordCommonIdentifier high byte	M	5Fh	RCI_ECU_CONFIG
3	RecordCommonIdentifier low byte	M	F2h	RCI_ECU_CONFIG

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Response Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier high byte	M	5Fh	RCI_ECU_CONFIG
3	RecordCommonIdentifier low byte	M	F2h	RCI_ECU_CONFIG
4	inputOutputControlParameter - LV_AT	M	XXh	RV_LV_AT
5	inputOutputControlParameter - LV_VAR_ACIN	M	XXh	RV_LV_VAR_ACIN
6	inputOutputControlParameter - LV_VAR_AMT	M	XXh	RV_LV_VAR_AMT
7	inputOutputControlParameter - LV_VAR_ARS	M	XXh	RV_LV_VAR_ARS
8	inputOutputControlParameter - LV_VAR_ASR	M	XXh	RV_LV_VAR_ASR
9	inputOutputControlParameter - LV_VAR_BN	M	XXh	RV_LV_VAR_BN
10	inputOutputControlParameter - LV_VAR_BN_MSW	M	XXh	RV_LV_VAR_BN_MSW
11	inputOutputControlParameter - LV_VAR_DCC	M	XXh	RV_LV_VAR_DCC
12	inputOutputControlParameter - LV_VAR_EBOX_CFA	M	XXh	RV_LV_VAR_EBOX_CFA
13	inputOutputControlParameter - LV_VAR_ETCU	M	XXh	RV_LV_VAR_ETCU
14	inputOutputControlParameter - LV_VAR_ICL	M	XXh	RV_LV_VAR_ETCU
15	inputOutputControlParameter - LV_VAR_MSW	M	XXh	RV_LV_VAR_MSW
16	inputOutputControlParameter - LV_VAR_PSTE	M	XXh	RV_LV_VAR_PSTE
17	inputOutputControlParameter - LV_VAR_SOF	M	XXh	RV_LV_VAR_SOF
18	inputOutputControlParameter - CONF_SOF_SWI (00h= no SOF_SWI, 01h=SOE_SWI, 02h=SOE_SWI_AMT)	M	XXh	RV_LV_VAR_SOF_SWI
19	inputOutputControlParameter - LV_VAR_BN_GEAR_REV	M	XXh	RV_LV_VAR_BN_GEAR_REV
20	inputOutputControlParameter - LV_VAR_EAC ( <b>only MSV80</b> ) not supported ( <b>other</b> )	M	[XXh, FFh]	
21	inputOutputControlParameter - LV_VAR_VEH	M	XXh	RV_LV_VAR_VEH
22	inputOutputControlParameter - LV_VAR_SAP	M	XXh	
23	inputOutputControlParameter - LV_VAR_EF	M	XXh	RV_LV_VAR_EF
24	inputOutputControlParameter - LV_VAR_ECRAS_UP	M	XXh	RV_LV_VAR_ECRAS_UP
25	inputOutputControlParameter - LV_VAR_RLY_ACCOUT ( not MSD85) not supported (MSD85)	M	[XXh, FFh]	RV_LV_VAR_RLY_ACCOUT
26	inputOutputControlParameter - LV_VAR_SAV	M	XXh	
27	inputOutputControlParameter - LV_VAR_RLY_ST	M	XXh	RV_LV_VAR_RLY_ST
28	inputOutputControlParameter - LV_VAR_ASR_3	M	XXh	RV_LV_VAR_ASR_3
29	inputOutputControlParameter - LV_VAR_BN_LDM	M	XXh	RV_LV_VAR_BN_LDM
30	inputOutputControlParameter - LV_VAR_BN_LTG_HDLP_L	M	XXh	RV_LV_VAR_BN_LTG_HDLP_L
31	inputOutputControlParameter - LV_VAR_LSH_DOWN	M	XXh	RV_LV_VAR_LSH_DOWN
32	inputOutputControlParameter - LV_VAR_LSH_UP	M	XXh	RV_LV_VAR_LSH_UP
33	inputOutputControlParameter - LV_VAR_ASR_4	M	XXh	RV_LV_VAR_ASR_4
34	inputOutputControlParameter - LV_VAR_MAF	M	XXh	RV_LV_VAR_MAF
35	inputOutputControlParameter - LV_VAR_PSTE_2 or (LV_VAR_PSTE_3 and STATE_PSTE_3_SRC = "AFS")	M	XXh	RV_LV_VAR_PSTE_2
36	inputOutputControlParameter - LV_VAR_BN_EFP	M	XXh	RV_LV_VAR_BN_EFP
37	inputOutputControlParameter - LV_SENS_BAT_SMT_DET	M	XXh	RV_LV_VAR_BN_EFP
38	inputOutputControlParameter - LV_VAR_BN_TRL	M	XXh	RV_LV_VAR_BN_TRL
39	inputOutputControlParameter - not supported	M	FFh	
40	inputOutputControlParameter - LV_VAR_ECRAS_DOWN	M	XXh	RV_LV_VAR_ECRAS_DOWN
41	inputOutputControlParameter - LV_VAR_NOX ( <b>only MSD80/MSD81</b> ) not supported ( <b>other</b> )	M	[XXh, FFh]	
42	inputOutputControlParameter - not supported	M	FFh	

43	inputOutputControlParameter - LV_VAR_ETCU_SPT ( <b>only MSV80</b> ) not supported ( <b>other</b> )	M	[XXh, FFh]	RV_LV_VAR_ETCU_SPT
44	inputOutputControlParameter - LV_VAR_TCT	M	XXh	RV_LV_VAR_TCT
-	inputOutputControlParameter - LV_VAR_AEB	M	XXh	RV_LV_VAR_AEB
46	inputOutputControlParameter - LV_VAR_TQ_PBR	M	XXh	RV_LV_VAR_TQ_PBR

## I.23.78 22\_5FF3 - RCI\_UET\_lesen

### General information:

This service reads out the specified value(s).

### Application conditions

**Initialisation:** *at reset the values from the NVMY*

**Activation:** LV\_IGK=1

**Deactivation:** LV\_IGK=0

Diagnostic timeout

Service location: see list of implemented diagnostic services

### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier high byte	M	5Fh	RCI_UET
3	RecordCommonIdentifier low byte	M	F3h	RCI_UET

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier high byte	M	5Fh	RCI_UET
3	RecordCommonIdentifier low byte	M	F3h	RCI_UET
4	RV_TOIL_MAX_WARN	M	XXh	RV_TOIL_MAX_WARN
5	RecordValue = VS_TOIL_MAX	M	XXh	RV_VS_TOIL_MAX
6	RecordValue = N_TOIL_MAX high byte	M	XXh	RV_N_TOIL_MAX
7	RecordValue = N_TOIL_MAX low byte	M	XXh	RV_N_TOIL_MAX
8	RecordValue = GEAR_TOIL_MAX	M	XXh	RV_GEAR_TOIL_MAX
9	RecordValue = TQI_AV_TOIL_MAX high byte	M	XXh	RV_TQI_AV_TOIL_MAX
10	RecordValue = TQI_AV_TOIL_MAX low byte	M	XXh	RV_TQI_AV_TOIL_MAX
11	RecordValue = TAM_TOIL_MAX	M	XXh	RV_TAM_TOIL_MAX
12	RecordValue = CTR_TOIL_MAX	M	XXh	RV_CTR_TOIL_MAX
13	RecordValue = TCO_TOIL_MAX	M	XXh	RV_TCO_TOIL_MAX
14	RecordValue = DIST_TOIL_MAX high byte	M	XXh	RV_DIST_TOIL_MAX
15	RecordValue = DIST_TOIL_MAX low byte	M	XXh	RV_DIST_TOIL_MAX
16	RecordValue = PV_AV_TOIL_MAX	M	XXh	RV_PV_AV_TOIL_MAX
17	RecordValue = LV_CS_TOIL_MAX	M	XXh	RV_LV_CS_TOIL_MAX
18	RecordValue = TOIL_THD_TOIL_MAX	M	XXh	RV_TOIL_THD_TOIL_MAX

## I.23.79 22\_5FF4 - Fusshebelwerk Fehlbedienung lesen

### General information:

This service reads out the specified value(s).

### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier high byte	M	5Fh	RCI_
3	RecordCommonIdentifier low byte	M	F4h	RCI_

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCI PR
2	RecordCommonIdentifier high byte	M	5Fh	RCI_
3	RecordCommonIdentifier low byte	M	F4h	RCI_
4	RecordValue1 = dummy fix	M	FFh	RV_

## I.23.80 22\_5FF6 - RCI\_UEN\_lesen

### General information:

Exact description of the Function see file 14A06301.

Detection of an overrevving event and non-volatile storage of:

An overrevving event starts at exceeding the engine speed C\_N\_LIM\_MIN and active engine speed limitation (LV\_N\_MAX = 1).

At each overrevving event, the event frequency counter is incremented by 1. The highest engine speed reached N\_MAX and the associated total running time in case of highest engine speed reached TRT\_N\_MAX is only overwritten if a higher engine speed was reached.

### Application conditions

**Initialisation:** *at reset the values from the NVMY*

**Activation:** Kl.15 on

**Deactivation:** Kl.15 off  
Diagnostic timeout  
Service location: see list of implemented diagnostic services

### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier high byte	M	5Fh	RCI_UEN
3	RecordCommonIdentifier low byte	M	F6h	RCI_UEN

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	<b>Response Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2	RecordCommonIdentifier high byte	M	5Fh	RCI_UEN
3	RecordCommonIdentifier low byte	M	F6h	RCI_UEN
4	RecordValue = N_MAX high byte	M	XXh	RV_N_MAX
5	RecordValue = N_MAX low byte	M	XXh	RV_N_MAX
6	RecordValue = TRT_N_MAX high word high byte	M	XXh	RV_TRT_N_MAX
7	RecordValue = TRT_N_MAX high word low byte	M	XXh	RV_TRT_N_MAX
8	RecordValue = TRT_N_MAX low word high byte	M	XXh	RV_TRT_N_MAX
9	RecordValue = TRT_N_MAX low word low byte	M	XXh	RV_TRT_N_MAX
10	RecordValue = CTR_N_MAX	M	XXh	RV_CTR_N_MAX
11	RecordValue = CTR_KM_N_MAX high byte	M	XXh	RV_CTR_KM_N_MAX
12	RecordValue = CTR_KM_N_MAX low byte	M	XXh	RV_CTR_KM_N_MAX
13	RecordValue = N_GRD_N_MAX	M	XXh	RV_N_GRD_N_MAX
14	RecordValue = VS_N_MAX ( <b>not for MSS70</b> ) = VS_H_N_MAX ( high byte, <b>only MSS70</b> )	M	XXh	RV_VS_N_MAX
15	RecordValue = PV_AV_N_MAX	M	XXh	RV_PV_AV_N_MAX
16	RecordValue = GEAR_EF_N_MAX	M	XXh	RV_GEAR_EF_N_MAX
17	RecordValue = LV_CS_N_MAX	M	XXh	RV_LV_CS_N_MAX
18	RecordValue = T_SUM_N_MAX high byte	M	XXh	RV_T_SUM_N_MAX
19	RecordValue = T_SUM_N_MAX low byte	M	XXh	RV_T_SUM_N_MAX
20	RecordValue = T_N_MAX high byte	M	XXh	RV_T_N_MAX
21	RecordValue = T_N_MAX low byte	M	XXh	RV_T_N_MAX
22	RecordValue = NR_PAT_SCC_N_MAX	M	XXh	RV_NR_PAT_SCC_N_MAX

Hint to Data Byte 14d: physical range is 0..510 km/h for MSS70, 0..255 km/h for all other

## I.23.81 22\_5FF7 - Laufruhepruefung auslesen

### General information:

This service reads out the specified value(s).

### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	<b>Request Service ID</b>	<b>M</b>	<b>22h</b>	<b>RDBC I</b>
2d	RecordCommonIdentifier high byte	M	5Fh	RCI_LRP
3d	RecordCommonIdentifier low byte	M	F7h	RCI_LRP

Figure I.23.13: Table Request Message

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	Response Service ID	M	62h	RDBCIPR
2d	RecordCommonIdentifier high byte	M	5Fh	RCI_LRP
3d	RecordCommonIdentifier low byte	M	F7h	RCI_LRP
4d	RecordValue1 = St_vbrvs_aus Bit 7	M	XXh	RV_STAT_L RP_BIT7
5d	RecordValue2 = St_vbrvs_aus Bit 6	M	XXh	RV_STAT_L RP_BIT6
6d	RecordValue3 = St_vbrvs_aus Bit 5	M	XXh	RV_STAT_L RP_BIT5
7d	RecordValue4 = St_vbrvs_aus Bit 4	M	XXh	RV_STAT_L RP_BIT4
8d	RecordValue5 = St_vbrvs_aus Bit 3	M	XXh	RV_STAT_ HUBEINGRI FF_INAKTIV
9d	RecordValue6 = St_vbrvs_aus Bit 2	M	XXh	RV_STAT_ MINHUBEIN GRIFF_INA KTIV
10d	RecordValue7 = St_vbrvs_aus Bit 1	M	XXh	RV_STAT_Z UENDWINK ELEINGRIF F_INAKTIV
11d	RecordValue8 = St_vbrvs_aus Bit 0	M	XXh	RV_STAT_ GEMISCHEI NGRIFF_IN AKTIV

Figure I.23.14: Table Positive Response Message

## I.23.82 22\_5FF8 - Status Homogenbetrieb auslesen

### General information:

This service reads out the engine operation mode.

### Application conditions

**Initialisation:** `at reset`

**Activation:** `LV_IGK=1 (K1.15 on)`

**Deactivation:** `LV_IGK=0 (K1.15 off)`  
`Diagnostic timeout`

**Service location:** `see list of implemented diagnostic services`

### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	Request Service ID	M	22h	RDBC
2d	RecordCommonIdentifier high byte	M	5Fh	RCI_LRP
3d	RecordCommonIdentifier low byte	M	F8h	RCI_LRP

Figure I.23.15: Table Request Message

### Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	Response Service ID	M	62h	RDBCIPR
2d	RecordCommonIdentifier high byte	M	5Fh	RCI_LRP
3d	RecordCommonIdentifier low byte	M	F8h	RCI_LRP
4d	RecordValue1 = Ba_soll	M	XXh	RV_BA_
5d	RecordValue2 = Ba_ist	M	XXh	RV_BA_

Figure I.23.16: Table Positive Response Message

### I.23.83 22\_C000 - Read imob status (STATUS\_EWS)

#### General information:

IMMO: RD\_IMOB\_STATUS

The service is different for boot-sw and ecu-sw.

A negativ response is possible by a wrong parameter.

#### Formula section:

##### Only for boot sw-version:

tmp\_k\_ews4\_locked = 0

0) **If(1)** (K\_EWS4[0..15] > 0x0) and (K\_EWS4[0..15] < 0xFF) (Blank Check Page)

**Then(1)** tmp\_k\_ews4\_locked = 1

**Else(1)** tmp\_k\_ews4\_locked unchanged

**Endif(1)**

#### Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	Request Service ID	M	22h	RDBC
2d	RecordCommonIdentifier	M	C0h	RCI_TSP
3d	RecordCommonIdentifier	M	00h	RCI_TSP

Figure I.23.17: Table Request Message

#### StartRoutineByLocalIdentifier positive Response



Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	Response Service ID	M	62h	RDBCIPR
2d	RecordCommonIdentifier	M	C0h	RCI_TSP
3d	RecordCommonIdentifier	M	00h	RCI_TSP
4d	RecordValue 1 = tmp_k_ews4_locked <<7   1 ( boot sw version ) = IMOB_KWP_STATE_0 ( ecu sw version )	M	XXh	RV_PST
5d	RecordValue 2 = xx	M	FFh	RV_PST
6d	RecordValue 3 = xx	M	FFh	RV_PST
7d	RecordValue 4 = xx	M	FFh	RV_PST
8d	RecordValue 5 = xx	M	FFh	RV_PST
9d	RecordValue 6 = xx	M	FFh	RV_PST
10d	RecordValue 7 = xx	M	FFh	RV_PST
11d	RecordValue 8 = xx	M	FFh	RV_PST
12d	RecordValue 9 = 8- tmp_k_ews4_locked ( boot sw version ) = IMOB_KWP_STATE_8 ( ecu sw version )	M	XXh	RV_PST
13d	RecordValue 10 = xx	M	FFh	RV_PST
14d	RecordValue 11 = xx	M	FFh	RV_PST
15d	RecordValue 12 = xx	M	FFh	RV_PST
16d	RecordValue 13 = xx	M	FFh	RV_PST
17d	RecordValue 14 = xx	M	FFh	RV_PST
18d	RecordValue 15 = xx	M	FFh	RV_PST
19d	RecordValue 16 = 1 ( boot sw version ) = IMOB_KWP_STATE_15 ( ecu sw version )	M	XXh	RV_PST

Figure I.23.18: Table Positive Response Message

### I.23.84 22\_C002 - Read imob k\_ews(tmp) (STATUS\_EWS\_SK)

#### General information:

IMMO: Read RD\_IMOB\_K\_EWS (Read "temporary secret key" from ECU-Ram)

The service is different for boot-sw and ecu-sw.

A negative response is possible by a wrong parameter

#### Formula section:

##### Only for boot sw-version:

**If(1)** (K\_EWS4[0..15] > 0x0) & & (K\_EWS4[0..15] < 0xFF) (Blank Check Page 0)

**Then(1)** IMOB\_KWP\_RESP[0..15] = 0 (whole array)

**Else(1)**

**If(2)** ( IMOB\_KWP\_K\_EWS4[0..15] !=  
IMOB\_KWP\_K\_EWS4\_TMP0[0..15] xor 0xFF )  
(short data consistence check)

**Then(2)** IMOB\_KWP\_RESP[0..15] = 0xFF (whole array)

**Else(2)** IMOB\_KWP\_RESP[0..15] = IMOB\_KWP\_K\_EWS4[0..15]

**Endif(2)**

**Endif(1)**

##### Only for ecu sw-version:

**If(1)** STATE\_IMOB\_K\_EWS != NC\_K\_EWS\_UNLOCKED  
and NC\_K\_EWS\_MAX = IMOB\_NR\_VLD\_K\_EWS4

```

Then(1)      IMOB_KWP_RESP[0-15] = 0 (whole array)
Else(1)
    If(2)          ( IMOB_KWP_K_EWS4[0..15] !=
                    IMOB_KWP_K_EWS4_TMP0[0..15] xor 0xFF )
                    (short data consistence check)
    Then(2)       IMOB_KWP_RESP[0..15] = 0xFF (whole array)
    Else(2)       IMOB_KWP_RESP[0..15] = IMOB_KWP_K_EWS4[0..15]
Endif(2)
Endif(1)

```

### StartRoutineByLocalIdentifier Request


Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	Request Service ID	M	22h	RDBC1
2d	RecordCommonIdentifier	M	C0h	RCI_TSP
3d	RecordCommonIdentifier	M	02h	RCI_TSP

Figure I.23.19: Table StartRoutineByLocalIdentifier Request Message

### StartRoutineByLocalIdentifier positive Response

<b>Data Byte</b>	<b>Parameter Name</b>	<b>Cvt</b>	<b>Hex Value</b>	<b>Mnemonic</b>
1d	<b>Response Service ID</b>	<b>M</b>	<b>62h</b>	<b>RDBCIPR</b>
2d	RecordCommonIdentifier	M	C0h	RCI_TSP
3d	RecordCommonIdentifier	M	02h	RCI_TSP
4d	RecordValue 1	M	FFh	RV_PST
5d	RecordValue 2	M	FFh	RV_PST
6d	RecordValue 3	M	FFh	RV_PST
7d	RecordValue 4	M	FFh	RV_PST
8d	RecordValue 5	M	FFh	RV_PST
9d	RecordValue 6	M	FFh	RV_PST
10d	RecordValue 7	M	FFh	RV_PST
11d	RecordValue 8	M	FFh	RV_PST
12d	RecordValue 9	M	FFh	RV_PST
13d	RecordValue 10	M	FFh	RV_PST
14d	RecordValue 11	M	FFh	RV_PST
15d	RecordValue 12	M	FFh	RV_PST
16d	RecordValue 13	M	FFh	RV_PST
17d	RecordValue 14	M	FFh	RV_PST
18d	RecordValue 15	M	FFh	RV_PST
19d	RecordValue 16	M	FFh	RV_PST
20d	RecordValue 17 = IMOB_KWP_RESP[0]	M	XXh	RV_PST
21d	RecordValue 18 = IMOB_KWP_RESP[1]	M	XXh	RV_PST
22d	RecordValue 19 = IMOB_KWP_RESP[2]	M	XXh	RV_PST
23d	RecordValue 20 = IMOB_KWP_RESP[3]	M	XXh	RV_PST
24d	RecordValue 21 = IMOB_KWP_RESP[4]	M	XXh	RV_PST
25d	RecordValue 22 = IMOB_KWP_RESP[5]	M	XXh	RV_PST
26d	RecordValue 23 = IMOB_KWP_RESP[6]	M	XXh	RV_PST
27d	RecordValue 24 = IMOB_KWP_RESP[7]	M	XXh	RV_PST
28d	RecordValue 25 = IMOB_KWP_RESP[8]	M	XXh	RV_PST
29d	RecordValue 26 = IMOB_KWP_RESP[9]	M	XXh	RV_PST
30d	RecordValue 27 = IMOB_KWP_RESP[10]	M	XXh	RV_PST
31d	RecordValue 28 = IMOB_KWP_RESP[11]	M	XXh	RV_PST
32d	RecordValue 29 = IMOB_KWP_RESP[12]	M	XXh	RV_PST
33d	RecordValue 30 = IMOB_KWP_RESP[13]	M	XXh	RV_PST
34d	RecordValue 31 = IMOB_KWP_RESP[14]	M	XXh	RV_PST
35d	RecordValue 32 = IMOB_KWP_RESP[15]	M	XXh	RV_PST

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## I.24 SID 23h: readMemoryByAddress Service

### Input data:

LV_IGK {p. 906}		
-----------------	--	--

### General information:

This function ist for reading values from the memory

### Application conditions

**Initialisation:** *at reset*

**Activation:** LV\_IGK = 1

**Deactivation:** LV\_IGK = 0

Diagnostic timeout

Service location: see "list of implemented diagnostic services"

### I.24.1 ReadMemoryByAddress Request (3-byte addressing)


Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	ReadMemoryByAddress Request	M	#23h	RMBA
#2d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#3d	MemoryAddress (Middle Byte)	M	#XXh	MA_MB
#4d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
(#5d)	MemoryTypeIdentifier (optional) [ linear type external FLASH external RAM internal FLASH user information field UIF ]	U	#XXh [ #00h #02h #05h #06h #07h ]	MTI
#5d / (#6d)	MemorySize	M	#1h...#FEh	MS

Figure I.24.1: Table ReadMemoryByAddress Request Message (3-byte addressing)

### I.24.2 ReadMemoryByAddress Request (4-byte addressing)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	ReadMemoryByAddress Request	M	#23h	RMBA
#2d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#3d	MemoryAddress (MiddleHigh Byte)	M	#XXh	MA_MHB
#4d	MemoryAddress (MiddleLow Byte)	M	#XXh	MA_MLB
#5d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
#6d	MemoryTypeIdentifier (mandatory, but not evaluated) [ 00h ... FFh ]	M	#XXh [ #XXh ]	MTI
#7d	MemorySize	M	#1h...#FEh	MS

Figure I.24.2: Table ReadMemoryByAddress Request Message (4-byte addressing)

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**Remark:**

For **3-byte addressing** independent from delivery of a MemoryTypewriter (byte 5) by the tester's request, the ECU automatically adds an offset to the requested memory address.

If no MemoryTypewriter is delivered, the same offset as for MemoryTypewriter 00h (linear addressing) is used.

This base memory offset must be subtracted from any memory address taken from the MAP- /A2L- file if 3-byte addressing is not sufficient for the address range!

For **4-byte addressing** a MemoryTypewriter (byte 6) must be delivered by the tester's request. Though it is not evaluated or used within the ECU for this absolute addressing mode, it is necessary to decide between 3- /4-byte addressing mode.

In this 4-byte mode the absolute address delivered by the tester is used by the ECU without any memory offset.

For MSx80 (TriCore) the base memory offsets for **3-byte addressing** are:

MemoryTypewriter:	Memory offset:
none (linear)	C000 0000h
00h (linear)	C000 0000h
02h (ext. FLASH)	8000 0000h (the same as for int. FLASH)
05h (ext. RAM)	D000 0000h
06h (int. FLASH)	8000 0000h
07h (UIF)	8000 xxxh not fixed yet, address might still change !!!

Boot Software Active			ECU Software Active		
Memory ID	Range (absolute addr.)	Security Level	Memory ID	Range (absolute addr.)	Security Level
00h (linear)	C000 0000h ...C000 FFFFh C03F C000h...C03F FFFFh	None	00h (linear)	C000 0000h ...C000 FFFFh C03F C000h...C03F FFFFh	None
02h (ext. FLASH)	8000 0000h ...801F FFFFh	None	02h (ext. FLASH)	8000 0000h ...801F FFFFh	None
05h (ext. RAM)	D000 0000h...D000 FFFFh	None	05h (ext. RAM)	D000 0000h...D000 FFFFh	None
06h (int. FLASH)	8000 0000h ...801F FFFFh	None	06h (int. FLASH)	8000 0000h ...801F FFFFh	None
07h (UIF)	8000 xxxh ... 8000 xxxh	None	07h (UIF)	8000 xxxh ... 8000 xxxh	None

Figure I.24.3: Table call conditions readMemoryByAddress (2)

**I.24.3 ReadMemoryByAddress positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	ReadMemoryByAddress Positive Response	M	#63h	RMBAPR
#2d	RecordValue#1 data 1	M	#XXh	RV
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
#nd	RecordValue#m	M	#XXh	

Figure I.24.4: Table ReadMemoryByAddress Positive Response Message

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## I.24.4 ReadMemoryByAddress negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	NegativeResponse Service Id	S	#7Fh	NR
#2d	ReadMemoryByAddressRequest Service Id	M	#23h	RMBA
#3d	ResponseCode= [ general response code ]	M	#XXh= [ #XXh ]	RC

Figure I.24.5: Table ReadMemoryByAddress Negative Response Message

## I.25 SID 2Eh: writeDataByCommonIdentifier Service

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_msahfkreset	O/V	0... 1H	0 ...1	1	-
Flag indicating request "Reset MSA-Tabellenspeicher"					
B_msasw	O/V	0... 1H	0 ...1	1	-
Bedingung MSA bis zum nächsten Zündungswechsel deaktivieren					
B_pmrestore	O/V	0... 1H	0 ...1	1	-
Bedingung Daten zurückgeschrieben					
B_prail_mon_clr	O/V	0... 1H	0 ...1	1	-
Raildruckmonitor zurücksetzen auf 0					
B_spa_csoll	O/V/S	0... 1H	0 ...1	1	-
Codierung SPA aus Tester					
B_zrlvs_clr	O/V	0... 1H	0 ...1	1	-
Zurücksetzen der internen Zähler des LVS					
CHK_STAMP	O/S	0... FFFFFFFFH	0... 4294967295	1	-
Check stamp written by the customers production					
CONF_EF	O/V/S	0... FFH	0... 255	1	-
Configuration of exhaust gas flap					
CTR_NS_AD_CYC_EXT_ADJ [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 65535	1	-
External Adjustment value for Counter of NOx signal gain adaptations					
CTR_NS_SHIFT_CYC_EXT_ADJ [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 65535	1	-
External values of CTR_NS_SHIFT_CYC					
CTR_NT_AGI_AD_CMPL_SUM_EXT_ADJ	O/V	0... FFFFH	0... 65535	1	-
External adjustment value for counter of completed aging adaptation					
CTR_NT_AGI_SO2P_FQ_EXT_ADJ	O/V	0... FFFFH	0... 65535	1	-
External adjustment value for counter of completed aging adaptation during FQ adaptation					
DIST_NS_NEW_EXT_ADJ	O/V	0... FFFFH	0... 524280	8	km
External adjust value for mileage counter value of last exchange of NOx sensor					
DIST_NT_NS_AD_EXT_ADJ [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 524280	8	km
External Adjustment for Current distance from last NOx signal gain adaptation					
DIST_NT_NS_SHIFT_EXT_ADJ [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 524280	8	km
External adjustment value for DIST_NT_NS_SHIFT					
EGY_SP_IV_EXT_ADJ [NC_CYL_NR]	O/V/S	0... FFFFH	0... 255	3.8911e-3	mJ
external adjusted injection valve EGY setpoint value (high flow)					
FAC_MFF_ADD_EXT_ADJ	O/V	0... FFH	-50... 49.60937	0.390625	%
Factor for CO correction in idling					
FAC_NOX_NS_AD_EXT_ADJ [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 127.99804	1.9531e-3	-
External Adjustment for Adaptation of the NOx sensor characteristic shift					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_NT_AGI_LIM_EXT_ADJ	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
External adjustment value for limited NOx trap aging factor					
FAC_NT_AGI_MDL_EXT_ADJ	O/V	0... FFFFFFFFH	0... 0.99999	232.8e-12	-
External value for modeled aging of NT					
FAC_OIL_EXT_REQ_1	O/V/S	0... FFH	0... 2.55	0.01	-
Country dependant factor for oil change intervall via tester					
FAC_OIL_EXT_REQ_2	O/V/S	0... FFH	0... 2.55	0.01	-
Country dependant factor for oil change intervall via tester					
IDX_VAR_COD [2]	O/V/S	0... FFH	0... 255	1	-
changing index of vehicle configuration code via tester					
IMOB_KWP_K_EWS4 [16]	O	0... FFH	0... 255	1	-
Received secret key					
IMOB_KWP_K_EWS4_1 [16]	O	0... FFH	0... 255	1	-
Received secret key, 1st backup					
IMOB_KWP_K_EWS4_2 [16]	O	0... FFH	0... 255	1	-
Received secret key, 2nd back up					
IMOB_KWP_K_EWS4_TMP0 [16]	O	0... FFH	0... 255	1	-
Received secret key, temporaery					
LV_ACT_N_SP_IS_BAS_EXT_ADJ	O	0... 1H	0 ...1	1	-
logical variable for switching off the max-selection					
LV_ALTER_CTL_ENA	O/V/S	0... 1H	0 ...1	1	-
Intelligent alternator control activated					
LV_CAT_CONF_DIS_EXT_REQ	O/V/S	0... 1H	0 ...1	1	-
disable of learnig cat variants and setting variant to "no cat" via tester					
LV_FAC_MFF_ADD_EXT_ADJ_NVMY	O/V	0... 1H	0 ...1	1	-
Logical value for storing CO correction in NVMY					
LV_FHW_RST	O/V	0... 1H	0 ...1	1	-
boolean for reset of wrong used pedal unit					
LV_IGK_OFF_ACK_ENA	O/V/S	0... 1H	0 ...1	1	-
Diagnosis acknowledge IGK off enabled via service tester job (1= enabled)					
LV_KWP_ENA	O/V	0... 1H	0 ...1	1	-
logical variable for idle speed setpoint offset by tester enabled					
LV_LTG_GAS_ENA	O/V/S	0... 1H	0 ...1	1	-
xenon-filled headlights mounted					
LV_NT_AFS_REQ_AGI_TMP_3_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
External adjustment value for logical value for the request of lambda =1 operation					
LV_POW_MNG_HIS_RST	O/V	0... 1H	0 ...1	1	-
conditions for function request parking power					
LV_RST_MFF_ADD_EXT_ADJ_NVMY	O/V	0... 1H	0 ...1	1	-
Flag to reset external MFF correction to 0					
LV_SO2P_REQ_2_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
External adjustment value for request of a desulfation (forces catalyst heating)					
LV_SO2P_REQ_FQ_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
External adjustment value for logical value for active FQ adaptation					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_STST_DEAC	O/V/S	0... 1H	0 ...1	1	-
Logical value for switch off the MSA permanently					
LV_STST_VAR_COD	O/V/S	0... 1H	0 ...1	1	-
logical value for MSA-coding ( 0 - without MSA. 1 - with MSA )					
LV_VAR_OBDC_CAN	O/V	0... 1H	0 ...1	1	-
Variable to activate OBD communication on CAN (=1)					
LV_VVL_MIN_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by tester					
LV_VVL_MIN_NVMY_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by tester					
MFF_ABSV_IV_EXT_ADJ [NC_CYL_NR]	O/V/S	0... FFFFH	0... 1389	0.0211948	mg/stk
External adjusted injection valve absolute MFF correction value (low flow)					
N_KWP_OFS	O/V	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 0 and LV_DRI = 0					
N_KWP_OFS_ACC	O/V	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 1 and LV_DRI = 0					
N_KWP_OFS_ACC_DRI	O/V	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 1 and LV_DRI = 1					
N_KWP_OFS_ACC_DRI_KWP	O	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 1 and LV_DRI = 1 /Byte 4 in the KWP telegramm					
N_KWP_OFS_ACC_DRI_NVMY	O/V/S	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 1 and LV_DRI = 1 stored in non volatile memory					
N_KWP_OFS_ACC_KWP	O	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 1 and LV_DRI = 0 /Byte 7 in the KWP telegramm					
N_KWP_OFS_ACC_NVMY	O/V/S	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 1 and LV_DRI = 0 stored in non volatile memory					
N_KWP_OFS_DRI	O/V	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 0 and LV_DRI = 1					
N_KWP_OFS_DRI_KWP	O	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 0 and LV_DRI = 1 /Byte 5 in the KWP telegramm					
N_KWP_OFS_DRI_NVMY	O/V/S	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 0 and LV_DRI = 1 stored in non volatile memory					
N_KWP_OFS_KWP	O	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 0 and LV_DRI = 0 /Byte 6 in the KWP telegramm					
N_KWP_OFS_NVMY	O/V/S	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 0 and LV_DRI = 0 stored in non volatile memory					
N_KWP_OFS_VB	O/V	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at battery charging is active					
N_KWP_OFS_VB_KWP	O	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at battery charging is active /Byte 8 in the KWP telegramm					
N_KWP_OFS_VB_NVMY	O/V/S	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at battery charging is active stored in non volatile memory					
N_SP_OFS_KWP	O/V	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset from the tester to idle speed module depend of the 5 conditions					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
N_SP_OFS_KWP_1	O	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset from the tester to idle speed module for calculation					
NT_AGI_SO2P_FQ_SUM_EXT_ADJ	O/V	0... FFFFFFFH	0... 255.99998	15.3e-6	-
External adjustment value for sum of NOx trap aging factor during FQ adaptation					
NT_AGI_SUL_SNG_EXT_ADJ [NC_NT_NR]	O/V	0... FFFFFFFFH	0... 0.99999	232.8e-12	-
External adjustment value for NOx trap aging factor due to sulphur load (bench selective)					
NT_AGI_THERMO_SNG_EXT_ADJ [NC_NT_NR]	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
External adjustment value for NOx trap aging factor due to thermal aging (bench selective)					
NT_SUL_32_EXT_ADJ [NC_NT_NR]	O/V	0... FFFFFFFFH	0... 10485.6	2.4414e-6	mg
External adjustment value for NOx trap sulphur loading					
NT_SUL_H_32_EXT_ADJ [NC_NT_NR]	O/V	0... FFFFFFFFH	0... 10485.6	2.4414e-6	mg
External adjustment value for NOx trap sulphur loading for high sulphured fuel					
Pmrestore [7]	O/V	0... FFH	0... 255	1	-
Restorespeicher					
POW_CONF_IDX_EXT_REQ	O/V/S	0... 3H	0 ...3	1	-
Selected power configuration code via tester					
PROT_CONF_IDX_EXT_REQ	O/V/S	0... 2H	0 ...2	1	-
Selected data transmission protocol via tester( 0/1 - 15765-4, 2 -14230 )					
QOIL_DS_RST_KWP_1	O/V	0... FFH	0... 255	1	-
Reset oil quality via tester					
QOIL_DS_RST_KWP_2	O/V	0... FFH	0... 255	1	-
Reset availability via tester					
QOIL_DS_RST_KWP_3	O/V	0... FFH	0... 255	1	-
Reset number of services via tester					
QOIL_DS_RST_KWP_4	O/V	8000... 7FFFH	-32768 ...32767	1	-
Reset rest distance via tester					
QOIL_DS_RST_KWP_5	O/V	0... FFH	0... 255000	1000	km
Reset forecast way clearance via tester					
QOIL_DS_RST_KWP_6	O/V	0... FFH	0... 255	1	-
Reset target month via tester					
QOIL_DS_RST_KWP_7	O/V	0... FFH	0... 255	1	-
Reset target year via tester					
QOIL_DS_RST_KWP_8	O/V	0... FFH	0... 255	1	-
Reset forecast time clearance via tester					
QOIL_DS_RST_KWP_9	O/V	0... FFH	0... 255	1	-
Unit base for service clear via tester					
Qv_cdherst_1	O/V/S	0... FFH	0... 255	1	-
Codierung Hersteller 1					
Qv_cdherst_2	O/V/S	0... FFH	0... 255	1	-
Codierung Hersteller 2					
Qv_cdherst_3	O/V/S	0... FFH	0... 255	1	-
Codierung Hersteller 3					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Qv_cdherst_4	O/V/S	0... FFH	0... 255	1	-
Codierung Hersteller 4					
Qv_cdherst_5	O/V/S	0... FFH	0... 255	1	-
Codierung Hersteller 5					
Qv_cdherst_6	O/V/S	0... FFH	0... 255	1	-
Codierung Hersteller 6					
Qv_cdherst_7	O/V/S	0... FFH	0... 255	1	-
Codierung Hersteller 7					
Qv_cdherst_8	O/V/S	0... FFH	0... 255	1	-
Codierung Hersteller 8					
RATIO_MMV_NS_SHIFT_DIAG_EXT_ADJ [NC_NOX_SENS_CONF]	O/V	8000... 7FFFH	-1... 0.99996	30.5e-6	-
External value of RATIO_MMV_NS_SHIFT_DIAG					
STATE_CMB_CTL_KWP	O/V	0... FFH	0... 255	1	-
carrier byte state combustion control					
STATE_CMB_CTL_NVMY_KWP	O/V/S	0... FFH	0... 255	1	-
carrier byte state combustion control non volatile saved					
STATE_HOM_AFS_REQ_EXT_ADJ	O/V	0... FFFFH	0... 65535	1	-
raw operation mode request from tester					
STATE_IV_CHG	O/V/S	0... FFFFH	0... 65535	1	-
Bit coded state indicating whether injection valve was changed - 1 on bit position x indicates injector change for logical cylinder x					
STATE_MIL_ON_DIS_EXT_REQ	O/V/S	0... 2H	0 ...2	1	-
request for variant "MIL_OFF" via tester					
Swmsaav	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Selektive temporäre Deaktivierung AVs bis zum nächsten Zündungswechsel					
Tvneutrin	O/V	0... FFFFH	0... 655.35	0.01	%
Tastverhältnis Nullgangsensor vorgeben					
VS_MAX_SEL_EXT_REQ	O/V/S	0... 3H	0 ...3	1	-
Selected maximum vehicle speed code via tester					
VVL_MIN_EXT_ADJ	O/V	0... FFFFH	0... 65.535	0.001	mm
adjustment value for minimum valve lift					
VVL_MIN_NVMY_EXT_ADJ	O/V	0... FFFFH	0... 65.535	0.001	mm
adjustment value for minimum valve lift					

**Input data:**


CHA_CDN_BAT {p. 797}	CONF_SOF_SWI {p. 654}	CTR_ERR_DYN_NR {p. 5767}	CTR_KM_CAN {p. 1563}
CTR_N_MAX {p. 4462}	CTR_TOIL_MAX {p. 1223}	DIST_TOIL_MAX {p. 1223}	GEAR_TOIL_MAX {p. 1223}
Id_bosrtak {p. 8159}	IMOB_CONFIG_EWS4 [4]	IMOB_NR_VLD_K_EWS4	K_EWS4 [16]
LC_N_OFS_KWP_DISABLE {p. 7685}	LV_ACIN {p. 1564}	LV_AT {p. 654}	LV_CS_TOIL_MAX {p. 1223}
LV_DRI {p. 1302}	LV_ERR_TCO {p. 4496}	LV_ES {p. 1720}	LV_IGK {p. 906}
LV_IS {p. 1720}	LV_REQ_ISC {p. 3501}	LV_SENS_BAT_SMT_DET {p. 4095}	LV_VAR_ACIN {p. 655}
LV_VAR_AEB {p. 655}	LV_VAR_AMT {p. 655}	LV_VAR_ARS {p. 655}	LV_VAR_ASR {p. 655}

LV_VAR_ASR_3 {p. 655}	LV_VAR_ASR_4 {p. 655}	LV_VAR_BN_EFP {p. 655}	LV_VAR_BN_GEAR_REV {p. 655}
LV_VAR_BN_LDM {p. 655}	LV_VAR_BN_LTG_HDLP_L {p. 655}	LV_VAR_BN_MSW {p. 655}	LV_VAR_BN_TRL {p. 655}
LV_VAR_CWP_LIN	LV_VAR_DCC {p. 655}	LV_VAR_EBOX_CFA {p. 655}	LV_VAR_ECRAS_DOWN {p. 4515}
LV_VAR_EF {p. 655}	LV_VAR_ETCU {p. 655}	LV_VAR_ETCU_SPT {p. 656}	LV_VAR_ICL {p. 656}
LV_VAR_LSH_DOWN {p. 656}	LV_VAR_LSH_UP {p. 656}	LV_VAR_MAF {p. 656}	LV_VAR_MAF_LEARNT {p. 656}
LV_VAR_MSW {p. 656}	LV_VAR_NOX {p. 656}	LV_VAR_PSTE {p. 656}	LV_VAR_PSTE_2 {p. 656}
LV_VAR_PSTE_3 {p. 656}	LV_VAR_RLY_ACCOUT {p. 656}	LV_VAR_RLY_ST {p. 656}	LV_VAR_SAP {p. 805}
LV_VAR_SAV {p. 805}	LV_VAR_SOF {p. 656}	LV_VAR_TCT {p. 656}	LV_VAR_TQ_PBR {p. 656}
N_MAX {p. 4462}	N_TOIL_MAX {p. 1223}	NC_CYL_NR {p. 1526}	NC_K_EWS_MAX
NC_NOX_SENS_CONF {p. 643}	NC_NT_NR {p. 644}	NT_AGI {p. 3073}	PV_AV_TOIL_MAX {p. 1223}
STATE_IMOB_K_EWS	STATE_PSTE_3_SRC {p. 1576}	TAM_TOIL_MAX {p. 1223}	TCO {p. 1100}
TCO_TOIL_MAX {p. 1223}	TOIL_MAX_WARN {p. 1223}	TOIL_THD_TOIL_MAX {p. 1223}	TQI_AV_TOIL_MAX {p. 1223}
TRT {p. 1504}	TRT_N_MAX {p. 4462}	VS_TOIL_MAX {p. 1223}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CHA_CDN_BAT_KWP_MIN	-	0... FFH	0... 127	0.4980392	Ah
minimum threshold for active battery charging due to enable conditions of idle speed offset by tester					
C_N_OFS_ACC_DRI_MAX	-	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset maximum threshold at LV_ACIN = 1 and LV_DRI = 1					
C_N_OFS_ACC_DRI_MIN	-	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset minimum threshold at LV_ACIN = 1 and LV_DRI = 1					
C_N_OFS_ACC_MAX	-	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset maximum threshold at LV_ACIN = 1 and LV_DRI = 0					
C_N_OFS_ACC_MIN	-	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset minimum threshold at LV_ACIN = 1 and LV_DRI = 0					
C_N_OFS_DRI_MAX	-	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset maximum threshold at LV_ACIN = 0 and LV_DRI = 1					
C_N_OFS_DRI_MIN	-	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset minimum threshold at LV_ACIN = 0 and LV_DRI = 1					
C_N_OFS_MAX	-	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset maximum threshold at LV_ACIN = 0 and LV_DRI = 0					
C_N_OFS_MIN	-	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset minimum threshold at LV_ACIN = 0 and LV_DRI = 0					
C_N_OFS_VB_MAX	-	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset maximum threshold at battery charging is active					
C_N_OFS_VB_MIN	-	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset minimum threshold at battery charging is active					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_PROT_CONF_IDX_EXT_REQ	-	0... 2H	0 ...2	1	-
init value for selected data transmission protocol via tester( 0- - 15765, change with tester allowed 1 -15765, change with tester not allowed 2 -14230, change with tester not allowed )					
C_TCO_MIN_MFF_ADD_EXT_ADJ	-	0... FEH	-48... 142.5	0.75	°C
Minimum TCO for CO- adjustment via tester					
C_TCO_MIN_N_OFS_KWP	-	0... FEH	-48... 142.5	0.75	°C
Minimum TCO threshold for activate idle speed offset					
C_VAR_STATE	-	0... FFH	0... 255	1	-
Country variant of the dataset					
LC_N_OFS_KWP_DISABLE	-	0... 1H	0 ...1	1	-
disable bit for idle speed setpoint offset by tester					
LC_STST_VAR_COD_ENA	-	0... 1H	0 ...1	1	-
enable STST-coding after TRT >= 10H ( 0- disable, 1 - enable)					

### General information:

All implemented SID 2Eh services are described below.


### I.25.1 Import Actions

ACTION_ECM3_DisableReq	ACTION_NOXM_WriteSulfurExtAdj(void)
ACTION_NOXM_WriteAgingExtAdj(void)	ACTION_NOXM_WriteAgIMExtAdj
ACTION_NOXD_WriteNSAdExtAdj	ACTION_NOXD_WriteNSGainDiagExtAdj
ACTION_NOXD_WriteNSShiftDiagExtAdj	ACTION_NOXD_WriteMMVNSExtAdj(void)

Overview of supported subservices

SID number	service	MSV_80	MSD_80 (6cyl)	MSD_80 (4cyl)	MSD_81 (6cyl)	MSD_81 (4cyl)	MSD85(L4)
2E_10_00	Prüfstempel schreiben	X	X	X	X	X	X
2E_10_01	BOS löschen via Tester	X	X	X	X	X	X
2E_30_00	MIL-OFF Codierung schreiben	X	X	X	X	X	X
2E_30_01	Kat Codierung schreiben	X	X	X	X	X	X
2E_30_10	VMAX Codierung schreiben	X	X	X	X	X	X
2E_30_20	OL/UL Codierung schreiben	X	X	X	X	X	X
2E_30_30	Codierung-Protokoll schreiben	X	X	X	X	X	-
2E_32_00	Oelwechselintervall-Codierdaten schreiben	X	X	X	X	X	X
2E_32_10	IGR-Codierdaten schreiben	X	X	X	X	X	X
2E_32_11	Xenonverbau - Codierdaten schreiben	X	X	X	X	X	X
2E_32_20	Codierung SPA schreiben	X	X	X	X	X	X
2E_32_30	Codierung BZE schreiben	X	X	X	X	X	X
2E_32_40	Abgasklappe Codierung schreiben	X	X	X	X	X	X
2E_32_50	Codierung MSA schreiben	-	-	X	-	X	-
2E_32_60	Codierung CDASMOT schreiben	X	X	X	X	X	X
2E_3F_FF	AenderungsindeX der Codierdaten schreiben	X	X	X	X	X	X
2E_5F_7F	Clear "Zeitanteile der erreichten Druckbereiche (beim Tausch der Kraftstoffhochdruckpumpe)"	X	X	X	X	X	X
2E_5F_87	Laufruheverbesserungssystem Zaehler Reset	-	X	X	X	X	-
2E_5F_88	Schreiben NOx-Adaptationswerte	-	X	X	X	X	-
2E_5F_89	Request Reset MSA-Tabellenspeicher	-	-	X	-	X	-
2E_5F_8A	Schreiben Nullgang-Lernwert	-	-	X	-	X	-
2E_5F_8B	PMB vorgeben	X	X	X	X	X	X
2E_5F_8E	MSA_DEAK schreiben	-	-	X	-	X	-
2E_5F_8F	MSA_DEAK_AV schreiben	-	-	X	-	X	-
2E_5F_90	IMAALLE schreiben	-	X	X	X	X	X

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2E_5F_9x	IMA für Zylinder x schreiben	-	X	X	X	X	X
2E_5F_DE_00	VVT- Minhub Ansteuerung beenden	X	-	-	-	-	-
2E_5F_DE_07	VVT- Minhub ansteuern	X	-	-	-	-	-
2E_5F_DE_08	VVT- Minhub programmieren	X	-	-	-	-	-
2E_5F_F0_07	Abgleichswert LL ansteuern	X	X	X	X	X	X
2E_5F_F0_08	Abgleichswert LL programmieren	X	X	X	X	X	X
2E_5F_F1_00	CO- Abgleich beenden	X	-	-	-	-	-
2E_5F_F1_04	CO- Abgleich Reset	X	-	-	-	-	-
2E_5F_F1_07	CO- Abgleich ansteuern	X	-	-	-	-	-
2E_5F_F1_08	CO- Abgleich programmieren	X	-	-	-	-	-
2E_5F_F2_04	Varianten loeschen	X	X	X	X	X	X
2E_5F_F3_04	Uebertemperatursicherung loeschen	X	X	X	X	X	X
2E_5F_F4_04	Fusshebelwerk Fehlbedienung loeschen	X	X	X	X	X	-
2E_5F_F5_04	Powermanagement Histogramm loeschen	X	X	X	X	X	X
2E_5F_F6_04	Ueberdrehzahlsicherung loeschen	X	X	X	X	X	X
2E_5F_F7_00	Laufruheprüfung Vorgeben beenden	X	-	-	-	-	-
2E_5F_F7_07	Laufruheprüfung vorgeben	X	-	-	-	-	-
2E_5F_F7_08	Laufruheprüfung programmieren	X	-	-	-	-	-
2E_5F_F8_00	Homogenbetrieb vorgeben beenden	-	X	X	X	X	-
2E_5F_F8_07	Homogenbetrieb vorgeben	-	X	X	X	X	-
2E_C0_01	Write k_ews4	X	X	X	X	X	X

## I.25.2 Standard application conditions

*Initialisation at reset:* 0, **except:** nonvolatile variables from NVRAM

*Activation:* LV\_IGK = 1

*Deactivation:* LV\_IGK = 0 or Diagnostic timeout

*Service location:* see "list of implemented diagnostic services"

### Standard Global negative Responses:

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCID
#3d	General response code	M	#XX	RC

Figure I.25.1: Table: WriteDataByCommonIdentifier Negative Response Message

**Remark:**

The detailed message of the negative response code is described in chapter "Error codes".

### I.25.3 2E\_10\_00 Write check stamp

#### General information:

With this comand the 3 bytes of the check stamp are written to the ECU (only lowest 3 byte of CHK\_STAMP are used in software). Those are actually in the volatile memory. In the latch off phase ( n = 0 rpm and KI.15 off) this values are written down into the non volatile memory. If the battery voltage is removed from the ECU, bevor the power latch phase ends, the storage of the check stamp is cancelled and the value up to now was kept.

The writing of the check stamp was reserved for the customers production, that means that the check stamp can t be written by the ECU production factory.

Because for writing CHK\_STAMP NVMY programing is necessary it is written to the EEPROM during the ECU power latch. During this time the value of CHK\_STAMP is buffered in RAM.

#### **WriteDataByCommonIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCID
#2d	RecordCommonIdentifier	M	#10h	RCL_TSP
#3d	RecordCommonIdentifier	M	#00h	RCL_TSP
#4d	recordValue#1 = CHK_STAMP Byte 2	M	#XXh	RV_PST
#5d	recordValue#2 = CHK_STAMP Byte 1	M	#XXh	RV_PST
#6d	recordValue#3 = CHK_STAMP Byte 0 (LSB)	M	#XXh	RV_PST

Figure I.25.2: Table WriteDataByCommonIdentifier Request Message

#### **WriteDataByCommonIdentifier positive Response on service with RLI = #F0h**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier	M	#10h	RCL_TSP
#3d	recordCommonIdentifier	M	#00h	RCL_TSP

Figure I.25.3: Table WriteDataByCommonIdentifier Positive Response Message

### I.25.4 2E\_10\_01 Reset BOS data

#### General information:



With this command the required service data (BOS-bedarfsorientierte Servicedaten löschen) can be reset.

The BMW module OZ/PM/.. makes a reset if the layervalue Id\_bosrtt (via QOIL\_DS\_RST\_KWP\_1) is not equal 00h.

### Additional Application conditions:

**Recurrence:** 100 ms

### Formula section:

```

If(1)      service 2E_10_01 is received
then(1)
              QOIL_DS_RST_KWP_i = corresponding record value
elseif(1)

```

*//this part has to be calculated with a recurrence of 100ms:*

```

if      Id_bosrtak = QOIL_DS_RST_KWP_1
then    QOIL_DS_RST_KWP_1 = 0
endif

```

### **WriteDataByCommonIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier high byte	M	#10h	RCI_BOS
#3d	RecordCommonIdentifier low byte	M	#01h	RCI_BOS
#4d	recordValue#1 = reset mode (fix)	M	#01h	RV_RES
#5d	recordValue#2 = QOIL_DS_RST_KWP_1	M	#XXh	RV_Id_bosrtt
#6d	recordValue#3 = QOIL_DS_RST_KWP_2	M	#XXh	RV_Bosbtvfbkt
#7d	recordValue#4 = QOIL_DS_RST_KWP_3	M	#XXh	RV_Zrbosrt
#8d	recordValue#5 = QOIL_DS_RST_KWP_4 high byte	M	#XXh	RV_Bosrlsmt
#9d	recordValue#6 = QOIL_DS_RST_KWP_4 low byte	M	#XXh	RV_Bosrlsmt
#10d	recordValue#7 = QOIL_DS_RST_KWP_9	M	#xxh	RV_Einheit
#11d	recordValue#8 = QOIL_DS_RST_KWP_5	M	#XXh	RV_Bosrw2t
#12d	recordValue#9 = QOIL_DS_RST_KWP_6	M	#XXh	RV_Bosmzielt
#13d	recordValue#10 = QOIL_DS_RST_KWP_7	M	#XXh	RV_Bosjzielt
#14d	recordValue#11 = QOIL_DS_RST_KWP_8	M	#XXh	RV_Bosprog2t
#15d	recordValue#12 = dummy value ( not used )	M	#xxh	RV_RESERVE

Figure I.25.4: Table WriteDataByCommonIdentifier Request Message

### **WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCI PR
#2d	RecordCommonIdentifier	M	#10h	RCI_BOS
#3d	RecordCommonIdentifier	M	#01h	RCI_BOS

Figure I.25.5: Table WriteDataByCommonIdentifier Positive Response Message

## I.25.5 2E\_30\_00 MIL-OFF Codierung schreiben

### General information:

With this command the MIL (malfunction indication lamp) can be switched off permanently. In case of a production ECU (active authentication/signature) the selection is only possible within the first 10 hours of ECU- runtime (TRT < 10 hours). The selection is stored in non volatile memory immediately during running time (because after coding the ECU is reset) and can not be changed after 10 hours. After 10 hours the ECU answers to the write- command with "subFunctionNotSupported."

### Additional Application conditions:

**Activation:** LV\_ES = 1 and  
( TRT <= 10 hours - only if authentication/signature is active)

**Deactivation:** Diagnostic timeout or  
(TRT > 10 hours - only if authentication/signature is active)  
*//send negative response code 12: subFunctionNotSupported*

### Formula section:

```
IF          C_VAR_STATE = 1
THEN       STATE_MIL_ON_DIS_EXT_REQ = 0
ELSE      IF          recordValue#1 > 2H
           THEN       send negative response code 31: requestOutOfRange
           ELSE       STATE_MIL_ON_DIS_EXT_REQ = recordValue#1
```

### WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#30h	RCI_CDSM
#3d	RecordCommonIdentifier Low Byte	M	#00h	RCI_CDSM
#4d	recordValue#1 = STATE_MIL_ON_DIS_EXT_REQ	M	#XXh	RV_MIL

Figure I.25.6: Table WriteDataByCommonIdentifier Request Message

### WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCI PR
#2d	RecordCommonIdentifier High Byte	M	#30h	RCI_CDSM
#3d	RecordCommonIdentifier Low Byte	M	#00h	RCI_CDSM

Figure I.25.7: Table WriteDataByCommonIdentifier Positive Response Message

### Meaning of C\_VAR\_STATE:

0 = ECE  
1 = US

## I.25.6 2E\_30\_01 Kat Codierung schreiben

### General information:

With this command automatically learning of catalyst variants can be disabled. Catalyst variant is set to "no cat." In case of a production ECU (active authentication/signature) the selection is only possible within the first 10 hours of ECU- runtime (TRT < 10 hours). The selection is stored in non volatile memory immediately during running time (because after coding the ECU is reset) and can not be changed after 10 hours. After 10 hours the ECU answers to the write- command with "subFunctionNotSupported."

### Additional Application conditions:

**Activation:** LV\_ES = 1 (Engine Stop) **and**  
(TRT <= 10 hours - only if authentication/signature is active)

**Deactivation:** Diagnostic timeout **or**  
(TRT > 10 hours - only if authentication/signature is active)  
*//send negative response code 12: subFunctionNotSupported*

### Formula section:

**IF** recordValue#1 > 1H  
**THEN** send negative response code 31: requestOutOfRange  
**ELSE** LV\_CAT\_CONF\_DIS\_EXT\_REQ = recordValue#1

### WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBC1
#2d	RecordCommonIdentifier High Byte	M	#30h	RCI_CDSO
#3d	RecordCommonIdentifier Low Byte	M	#01h	RCI_CDSO
#4d	recordValue#1 = LV_CAT_CONF_DIS_EXT_REQ	M	#XXh	RV_KATV

Figure I.25.8: Table WriteDataByCommonIdentifier Request Message

### WriteDataByCommonIdentifier positive Response


Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#30h	RCI_CDSO
#3d	RecordCommonIdentifier Low Byte	M	#01h	RCI_CDSO

Figure I.25.9: Table WriteDataByCommonIdentifier Positive Response Message

## I.25.7 2E\_30\_10 VMAX Codierung schreiben

### General information:

With this command one of four possible values for maximum vehicle speed is selected. In case of a production ECU (active authentication/signature) the selection is only possible within the first 10 hours

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of ECU- runtime (TRT < 10 hours). The selection is stored in non volatile memory immediately during running time (because after coding the ECU is reset) and can not be changed after 10 hours. After 10 hours the ECU answers to the write- command with "subFunctionNotSupported."

**Additional Application conditions:**

**Activation:** LV\_ES = 1 (Engine Stop) **and**  
(TRT <= 10 hours - only if authentication/signature is active)

**Deactivation:** Diagnostic timeout **or**  
(TRT > 10 hours - only if authentication/signature is active)  
*//send negative response code 12: subFunctionNotSupported*

**Formula section:**

**IF** recordValue#1 > 3H  
**THEN** send negative response code 31: requestOutOfRange  
**ELSE** VS\_MAX\_SEL\_EXT\_REQ = recordValue#1

**WriteDataByCommonIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#30h	RCL_CDSV MAX
#3d	RecordCommonIdentifier Low Byte	M	#10h	RCL_CDSV MAX
#4d	recordValue#1 = VS_MAX_SEL_EXT_REQ	M	#XXh	RV_VMAX

Figure I.25.10: Table WriteDataByCommonIdentifier Request Message

**WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCI PR
#2d	RecordCommonIdentifier High Byte	M	#30h	RCL_CDSV MAX
#3d	RecordCommonIdentifier Low Byte	M	#10h	RCL_CDSV MAX

Figure I.25.11: Table WriteDataByCommonIdentifier Positive Response Message

**I.25.8 2E\_30\_20 OL/UL Codierung schreiben**

**General information:**

With this command one of three power configuration codes is selected. This code is taken for the plausibility check of the two engine power variants OL ("obere Leistung") and UL ("untere Leistung"). In case of a production ECU (active authentication/signature) the selection is only possible within the first 10 hours of ECU- runtime (TRT < 10 hours). The selection is stored in non volatile memory immediately during running time (because after coding the ECU is reset) and can not be changed after 10 hours. After 10 hours the ECU answers to the write- command with "subFunctionNotSupported."

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**Additional Application conditions:**

**Activation:** LV\_ES = 1 (Engine Stop) **and**  
(TRT <= 10 hours - only if authentication/signature is active)

**Deactivation:** Diagnostic timeout **or**  
(TRT > 10 hours - only if authentication/signature is active)  
*//send negative response code 12: subFunctionNotSupported*

**Formula section:**

**IF** recordValue#1 > 3H  
**THEN** send negative response code 31: requestOutOfRange  
**ELSE** POW\_CONF\_IDX\_EXT\_REQ = recordValue#1

**WriteDataByCommonIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBC1
#2d	RecordCommonIdentifier High Byte	M	#30h	RCI_CDSL
#3d	RecordCommonIdentifier Low Byte	M	#20h	RCI_CDSL
#4d	recordValue#1 = POW_CONF_IDX_EXT_REQ	M	#XXh	RV_OLUL

Figure I.25.12: Table WriteDataByCommonIdentifier Request Message

**WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#30h	RCI_CDSL
#3d	RecordCommonIdentifier Low Byte	M	#20h	RCI_CDSL

Figure I.25.13: Table WriteDataByCommonIdentifier Positive Response Message

**I.25.9 2E\_30\_30 Codierung Protokoll schreiben****General information:**

With this command the ISO-protocol variant is selected. In case of a production ECU (active authentication/signature) the selection is only possible within the first 10 hours of ECU- runtime (TRT < 10 hours). The selection is stored in non volatile memory immediately during running time (because after coding the ECU is reset) and can not be changed after 10 hours. After 10 hours the ECU answers to the write- command with "subFunctionNotSupported."

**Additional Application conditions:****Initialisation at first run of ECU:**

PROT\_CONF\_IDX\_EXT\_REQ = C\_PROT\_CONF\_IDX\_EXT\_REQ

**Initialisation at reset or at first run of ECU:**

If PROT\_CONF\_IDX\_EXT\_REQ = 2 // 14230

**Then**

```

        LV_VAR_OBDC_CAN = 0
    Else
        LV_VAR_OBDC_CAN = 1
    Endif
    
```

**Activation:** LV\_ES = 1 and  
(TRT <= 10 hours - only if authentication/signature is active)

**Deactivation:** (TRT > 10 hours - only if authentication/signature is active)  
//send negative response code 12: subFunctionNotSupported

**Formula section:**

```

If(1)          recordValue#1 > 2H
Then(1)       send negative response code 31: requestOutOfRange
Else(1)
    If(2)      C_PROT_CONF_IDX_EXT_REQ = 0
    Then (2)  PROT_CONF_IDX_EXT_REQ = recordValue#1
    If(3)     PROT_CONF_IDX_EXT_REQ = 2 // 14230
    Then(3)   LV_VAR_OBDC_CAN = 0
    Else(3)   LV_VAR_OBDC_CAN = 1
    Endif(3)
    Else(2)   send negative response subFunctionNotSupported
    End(2)
End(1)
    
```

**WriteDataByCommonIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#30h	RCI_CDSL
#3d	RecordCommonIdentifier Low Byte	M	#30h	RCI_CDSL
#4d	recordValue#1 = PROT_CONF_IDX_EXT_REQ	M	#XXh	RV_OLUL

Figure I.25.14: Table WriteDataByCommonIdentifier Request Message


**WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCI PR
#2d	RecordCommonIdentifier High Byte	M	#30h	RCI_CDSL
#3d	RecordCommonIdentifier Low Byte	M	#30h	RCI_CDSL

Figure I.25.15: Table WriteDataByCommonIdentifier Positive Response Message

**I.25.10 2E\_32\_00 Oelwechselintervall- Codierdaten schreiben**

**General information:**

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With this command two country dependant factors for oil change intervall can be coded. The selection is stored in non volatile memory immediately during running time (because after coding the ECU is reset).

### Additional Application conditions:

**Activation:** LV\_ES = 1

**Deactivation:** LV\_ES = 0

### Formula section:

### WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#32h	RCI_CDSO
#3d	RecordCommonIdentifier Low Byte	M	#00h	RCI_CDSO
#4d	recordValue#1 = FAC_OIL_EXT_REQ_1	M	#XXh	RV_OZLF1C
#5d	recordValue#2 = FAC_OIL_EXT_REQ_2	M	#XXh	RV_OZLF2C

Figure I.25.16: Table WriteDataByCommonIdentifier Request Message

### WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCI PR
#2d	RecordCommonIdentifier High Byte	M	#32h	RCI_CDSO
#3d	RecordCommonIdentifier Low Byte	M	#00h	RCI_CDSO

Figure I.25.17: Table WriteDataByCommonIdentifier Positive Response Message

## I.25.11 2E\_32\_10 IGR-Codierdaten schreiben

### General information:

With this command the Intelligent alternator control can be coded.

### Additional Application conditions:

**Activation:** LV\_ES = 1

**Deactivation:** LV\_ES = 0

### Formula section:

### WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#32h	RCI_CDIGR
#3d	RecordCommonIdentifier Low Byte	M	#10h	RCI_CDIGR
#4d	recordValue#1 = LV_ALTER_CTL_ENA	M	#XXh	RV_B_CDIGRON

Figure I.25.18: Table WriteDataByCommonIdentifier Request Message

**WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCI PR
#2d	RecordCommonIdentifier High Byte	M	#32h	RCI_CDIGR
#3d	RecordCommonIdentifier Low Byte	M	#10h	RCI_CDIGR

Figure I.25.19: Table WriteDataByCommonIdentifier Positive Response Message

**I.25.12 2E\_32\_11 Xenonverbau Codierdaten schreiben****General information:**

With this command the mounting of xenon-filled headlights can be coded.

**Additional Application conditions:**

**Activation:** LV\_ES = 1

**Deactivation:** LV\_ES = 0

**Formula section:****WriteDataByCommonIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#32h	RCI_CDXEN
#3d	RecordCommonIdentifier Low Byte	M	#11h	RCI_CDXEN
#4d	recordValue#1 = LV_LTG_GAS_ENA	M	#XXh	RV_B_CDXENON

Figure I.25.20: Table WriteDataByCommonIdentifier Request Message

**WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCI PR
#2d	RecordCommonIdentifier High Byte	M	#32h	RCI_CDXEN
#3d	RecordCommonIdentifier Low Byte	M	#11h	RCI_CDXEN

Figure I.25.21: Table WriteDataByCommonIdentifier Positive Response Message



## I.25.13 2E\_32\_20 Codierung SPA

### General information:

With this command the "Schaltpunktanzeige" can be coded.

### Formula section:

#### WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#32h	WDBCI_SPA_vor geben
#3d	RecordCommonIdentifier Low Byte	M	#20h	WDBCI_SPA_vor geben
#4d	Record value #1 = B_spa_csoll	M	#XXh	RV_SPA_CSOLL
#5d	Record value #2 = Dummy	M	#XXh	RV_DUMMY

Figure I.25.22: Table WriteDataByCommonIdentifier Request Message

#### WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCI_PR
#2d	RecordCommonIdentifier High Byte	M	#32h	WDBCI_SP A_vorgeben
#3d	RecordCommonIdentifier Low Byte	M	#20h	WDBCI_SP A_vorgeben

Figure I.25.23: Table WriteDataByCommonIdentifier Positive Response Message

## I.25.14 2E\_32\_30 Codierung BZE schreiben

### General information:

With this command the Intelligent alternator control can be coded.

### Formula section:

#### WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#32h	WDBCI_BZE_vor geben
#3d	RecordCommonIdentifier Low Byte	M	#30h	WDBCI_BZE_vor geben
#4d	Record value #1 = Qv_cdherst_1	M	#XXh	RV_CD_HERST1
#5d	Record value #2 = Qv_cdherst_2	M	#XXh	RV_CD_HERST2
#6d	Record value #3 = Qv_cdherst_3	M	#XXh	RV_CD_HERST3
#7d	Record value #4 = Qv_cdherst_4	M	#XXh	RV_CD_HERST4
#8d	Record value #5 = Qv_cdherst_5	M	#XXh	RV_CD_HERST5
#9d	Record value #6 = Qv_cdherst_6	M	#XXh	RV_CD_HERST6
#10d	Record value #7 = Qv_cdherst_7	M	#XXh	RV_CD_HERST7
#11d	Record value #8 = Qv_cdherst_8	M	#XXh	RV_CD_HERST8

Figure I.25.24: Table WriteDataByCommonIdentifier Request Message

**WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCI PR
#2d	RecordCommonIdentifier High Byte	M	#32h	WDBCI_BZE _vorgeben
#3d	RecordCommonIdentifier Low Byte	M	#30h	WDBCI_BZE _vorgeben

Figure I.25.25: Table WriteDataByCommonIdentifier Positive Response Message

**I.25.15 2E\_32\_40 Abgasklappe Codierung schreiben****General information:**

With this command the used exhaust flap will be defined.

**Formula section:****WriteDataByCommonIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#32h	WDBCI_AG K_vorgeben
#3d	RecordCommonIdentifier Low Byte	M	#40h	WDBCI_AG K_vorgeben
#4d	recordValue#1 = CONF_EF	M	#XXh	RV_CODIER UNG_AGK

Figure I.25.26: Table WriteDataByCommonIdentifier Request Message

**WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#32h	WDBC_I_AG K_vorgeben
#3d	RecordCommonIdentifier Low Byte	M	#40h	WDBC_I_AG K_vorgeben

Figure I.25.27: Table WriteDataByCommonIdentifier Positive Response Message

## I.25.16 2E\_32\_50 MSA Codierung schreiben

### General information:

With this command the use of MSA will be defined.

The selection is only possible within the first 10 hours of ECU- runtime (TRT < 10 hours and LC\_STST\_VAR\_COD = 0 ) or LC\_STST\_VAR\_COD\_ENA = 1. The selection is stored in non volatile memory

In case of LC\_STST\_VAR\_CO\_ENA = 0.no change after 10 hours is possible and the ECU answers to the write- command with "subFunctionNotSupported."

### Additional Application conditions:

**Activation:** LV\_ES = 1 and  
(LC\_STST\_VAR\_COD\_ENA = 1  
or  
TRT <= 10 hours - if authentication/signature is active)

**Deactivation:** LV\_ES = 0 or  
(TRT > 10 hours - if authentication/signature is active  
and LC\_STST\_VAR\_COD\_ENA = 0,  
//send negative response code 12: subFunctionNotSupported  
)

### Formula section:

#### WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBC_I
#2d	RecordCommonIdentifier High Byte	M	#32h	WDBC_I_CD MSA
#3d	RecordCommonIdentifier Low Byte	M	#50h	WDBC_I_CD MSA
#4d	recordValue#1 = LV_STST_VAR_COD ( 0 - without MSA, 1 - with MSA )	M	#XXh	RV_CODIER UNG_MSA

Figure I.25.28: Table WriteDataByCommonIdentifier Request Message

#### WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#32h	WDBCI_CD MSA
#3d	RecordCommonIdentifier Low Byte	M	#50h	WDBCI_CD MSA

Figure I.25.29: Table WriteDataByCommonIdentifier Positive Response Message

### I.25.17 2E\_32\_60 Codierung CDASMOT schreiben

#### General information:

With this function the "Codierung elektrische Diagnose der Funktion Abschaltung Klemme 15" is written in NVRAM

#### Formula section:

#### WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	2Eh	WDBCI
2	RecordCommonIdentifier High Byte	M	32h	WDBCI_CDASMOT
3	RecordCommonIdentifier Low Byte	M	60h	WDBCI_CDASMOT
4	recordValue#1 = LV_IGK_OFF_ACK_ENA ( 0 - diagnosis off, 1 - diagnosis on )	M	XXh [ 0h, 1h]	RV_CODIERUNG_ASMOT

#### WriteDataByCommonIdentifier Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	6Eh	RDBCIPR
2	RecordCommonIdentifier High Byte	M	32h	WDBCI_CDASM OT
3	RecordCommonIdentifier Low Byte	M	60h	WDBCI_ CDASMOT

### I.25.18 2E\_3F\_FF Aenderungsindex der Codierdaten schreiben

#### General information:


With this command the changing index of the coding data is written. The value is stored in non volatile memory immediately during running time (because after coding the ECU is reset).

#### Additional Application conditions:

Activation: LV\_ES = 1

Deactivation: LV\_ES = 0

#### Formula section:

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## WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#3Fh	RCL_
#3d	RecordCommonIdentifier Low Byte	M	#FFh	RCL_
#4d	recordValue#1 = IDX_VAR_COD[2]	M	#XXh	RV_
#5d	recordValue#2 = IDX_VAR_COD[1]	M	#XXh	RV_

Figure I.25.30: Table WriteDataByCommonIdentifier Request Message

## WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCI PR
#2d	RecordCommonIdentifier High Byte	M	#3Fh	RCL_
#3d	RecordCommonIdentifier Low Byte	M	#FFh	RCL_

Figure I.25.31: Table WriteDataByCommonIdentifier Positive Response Message

## I.25.19 2E\_5F\_7F Clear "Zeitanteile der erreichten Druckbereiche (beim Tausch der Kraftstoffhochdruckpumpe)"

### General information:

This service clears the statistic "Zeitanteile der erreichten Druckbereiche (beim Tausch der Kraftstoffhochdruckpumpe)".

### Additional application conditions:

Initialisation at reset and in case of PWL:

B\_prail\_mon\_clr = 0

### Formula section:

**If(1)** service 2E,5F,7F is received

**Then(1)**

B\_prail\_mon\_clr = 1

**Endif(1)**

## WriteDataByIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value
#1d	WriteDataByIdentifier Request Service Id	M	#2Eh
#2d	RecordCommonIdentifier High Byte	M	#5Fh
#3d	RecordCommonIdentifier Low Byte	M	#7Fh

Figure I.25.32: Table WriteDataByIdentifier Request Message

## WriteDataByIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value
#1d	WriteDataByIdentifier Response Service Id	M	#6Eh
#2d	RecordCommonIdentifier High Byte	M	#5Fh
#3d	RecordCommonIdentifier Low Byte	M	#7Fh

Figure I.25.33: Table WriteDataByIdentifier Positive Response Message

## I.25.20 2E\_5F\_87 LaufruheVerbesserungssystem Zaehler Reset

### General information:

This command generate a request to reset the counter of "Laufruheverbesserungssystem" in BMW-software.

### Formula section:

```

If      service 2E_5F_87 is received
then
        set B_zrlvs_clr = 1 for 2 sec.
        send positive response
endif

```

### WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCi
#2d	RecordCommonIdentifier	M	#5Fh	WDCI_LVSZ YL_RESET
#3d	RecordCommonIdentifier	M	#87h	WDCI_LVSZ YL_RESET

Figure I.25.34: Table WriteDataByCommonIdentifier Request Message

### WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier	M	#5Fh	WDCI_LVSZ YL_RESET
#3d	recordCommonIdentifier	M	#87h	WDCI_LVSZ YL_RESET

Figure I.25.35: Table WriteDataByCommonIdentifier Positive Response Message

## I.25.21 2E\_5F\_88 ADRECOVERY vorgeben

### General information:

This command write informations about the Nox-trap into ECU. This is necessary after reprogramming or change of ECU.

### **Formula section:**


**If** service 2E\_5F\_88 is received

**Then**

store received values into corresponding variables  
 call ACTION\_NOXM\_WriteSulfurExtAdj(void)  
 call ACTION\_NOXM\_WriteAgingExtAdj(void)  
 call ACTION\_NOXM\_WriteAgiMExtAdj  
 call ACTION\_NOXD\_WriteNSAdExtAdj  
 call ACTION\_NOXD\_WriteNSShiftDiagExtAdj  
 call ACTION\_NOXD\_WriteNSGainDiagExtAdj  
 call ACTION\_NOXD\_WriteMMVNSExtAdj(void)  
 send positive response


**endif**

### **WriteDataByCommonIdentifier Request**

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	<b>WriteDataByCommonIdentifier Request Service Id</b>	<b>M</b>	<b>#2Eh</b>	<b>WDBCI</b>
#2d	RecordCommonIdentifier	M	#5Fh	WDCI_ADRESTORE
#3d	RecordCommonIdentifier	M	#88h	WDCI_ADRESTORE
#4d	recordValue#1 = NT_SUL_32_EXT_ADJ[1] (high word, high byte )	M	#XXh	RV_NT_SUL_32[1]
#5d	recordValue#2 = NT_SUL_32_EXT_ADJ [1] (high word, low byte )	M	#XXh	RV_NT_SUL_32[1]
#6d	recordValue#3 = NT_SUL_32_EXT_ADJ [1] (low word, high byte )	M	#XXh	RV_NT_SUL_32[1]
#7d	recordValue#4 = NT_SUL_32_EXT_ADJ [1] (low word, low byte )	M	#XXh	RV_NT_SUL_32[1]
#8d	recordValue#5 = NT_SUL_32_EXT_ADJ [2] (high word, high byte )	M	#XXh	RV_NT_SUL_32[2]
#9d	recordValue#6 = NT_SUL_32_EXT_ADJ [2] (high word, low byte )	M	#XXh	RV_NT_SUL_32[2]
#10d	recordValue#7 = NT_SUL_32_EXT_ADJ [2] (low word, high byte )	M	#XXh	RV_NT_SUL_32[2]
#11d	recordValue#8 = NT_SUL_32_EXT_ADJ [2] (low word, low byte )	M	#XXh	RV_NT_SUL_32[2]
#12d	recordValue#9 = NT_SUL_H_32_EXT_ADJ [1] (high word, high byte )	M	#XXh	RV_NT_SUL_H_32[1]
#13d	recordValue#10 = NT_SUL_H_32_EXT_ADJ [1] (high word, low byte )	M	#XXh	RV_NT_SUL_H_32[1]
#14d	recordValue#11 = NT_SUL_H_32_EXT_ADJ [1] (low word, high byte )	M	#XXh	RV_NT_SUL_H_32[1]
#15d	recordValue#12 = NT_SUL_H_32_EXT_ADJ [1] (low word, low byte )	M	#XXh	RV_NT_SUL_H_32[1]
#16d	recordValue#13 = NT_SUL_H_32_EXT_ADJ [2] (high word, high byte )	M	#XXh	RV_NT_SUL_H_32[2]
#17d	recordValue#14 = NT_SUL_H_32_EXT_ADJ [2] (high word, low byte )	M	#XXh	RV_NT_SUL_H_32[2]
#18d	recordValue#15 = NT_SUL_H_32_EXT_ADJ [2] (low word, high byte )	M	#XXh	RV_NT_SUL_H_32[2]
#19d	recordValue#16 = NT_SUL_H_32_EXT_ADJ [2] (low word, low byte )	M	#XXh	RV_NT_SUL_H_32[2]
#20d	recordValue#17 = not used	M	#XXh	RV_
#21d	recordValue#18 = not used	M	#XXh	RV_
#22d	recordValue#19 = NT_AGI_SO2P_FQ_SUM_EXT_ADJ (high word, high byte )	M	#XXh	RV_NT_AGI_SO2P_FQ_SUM
#23d	recordValue#20 = NT_AGI_SO2P_FQ_SUM_EXT_ADJ (high word, low byte )	M	#XXh	RV_NT_AGI_SO2P_FQ_SUM
#24d	recordValue#21 = NT_AGI_SO2P_FQ_SUM_EXT_ADJ (low word, high byte )	M	#XXh	RV_NT_AGI_SO2P_FQ_SUM
#25d	recordValue#22 = NT_AGI_SO2P_FQ_SUM_EXT_ADJ (low word, low byte )	M	#XXh	RV_NT_AGI_SO2P_FQ_SUM
#26d	recordValue#23 = not used	M	#XXh	RV_NT_AGI_SUL
#27d	recordValue#24 = not used	M	#XXh	RV_NT_AGI_SUL
#28d	recordValue#25 = NT_AGI_SUL_SNG_EXT_ADJ [1] high word, high byte )	M	#XXh	RV_NT_AGI_SUL_SNG[1]
#29d	recordValue#26 = NT_AGI_SUL_SNG_EXT_ADJ [1] (high word, low byte )	M	#XXh	RV_NT_AGI_SUL_SNG[1]
#30d	recordValue#27 = NT_AGI_SUL_SNG_EXT_ADJ [1] (low word, high byte )	M	#XXh	RV_NT_AGI_SUL_SNG[1]

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#31d	recordValue#28 = NT_AGI_SUL_SNG_EXT_ADJ [1] (low word, low byte )	M	#XXh	RV_NT_AGI_SUL_SNG[1]
#32d	recordValue#29 = NT_AGI_SUL_SNG_EXT_ADJ [2](high word, high byte )	M	#XXh	RV_NT_AGI_SUL_SNG[2]
#33d	recordValue#30 = NT_AGI_SUL_SNG_EXT_ADJ [2] (high word, low byte )	M	#XXh	RV_NT_AGI_SUL_SNG[2]
#34d	recordValue#31 = NT_AGI_SUL_SNG_EXT_ADJ [2] (low word, high byte )	M	#XXh	RV_NT_AGI_SUL_SNG[2]
#35d	recordValue#32 = NT_AGI_SUL_SNG_EXT_ADJ [2] (low word, low byte )	M	#XXh	RV_NT_AGI_SUL_SNG[2]
#36d	recordValue#33 = not used	M	#XXh	RV_
#37d	recordValue#34 = not used	M	#XXh	RV_
#38d	recordValue#35 = NT_AGI_THERMO_SNG_EXT_ADJ [1] (high byte)	M	#XXh	RV_NT_AGI_THERMO_SNG[1]
#39d	recordValue#36 = NT_AGI_THERMO_SNG_EXT_ADJ [1] (high byte)	M	#XXh	RV_NT_AGI_THERMO_SNG[1]
#40d	recordValue#37 = NT_AGI_THERMO_SNG_EXT_ADJ [2] (high byte)	M	#XXh	RV_NT_AGI_THERMO_SNG[2]
#41d	recordValue#38 = NT_AGI_THERMO_SNG_EXT_ADJ [2] (low byte)	M	#XXh	RV_NT_AGI_THERMO_SNG[2]
#42d	recordValue#39 = CTR_NT_AGI_AD_CMPL_SUM_EXT_ADJ (high byte)	M	#XXh	RV_CTR_NT_AGI_AD_CMPL_SUM
#43d	recordValue#40 = CTR_NT_AGI_AD_CMPL_SUM_EXT_ADJ (low byte)	M	#XXh	RV_CTR_NT_AGI_AD_CMPL_SUM
#44d	recordValue#41 = CTR_NT_AGI_SO2P_FQ_EXT_ADJ (high byte)	M	#XXh	RV_CTR_NT_AGI_SO2P_FQ
#-d	recordValue#42 = CTR_NT_AGI_SO2P_FQ_EXT_ADJ (low byte)	M	#XXh	RV_CTR_NT_AGI_SO2P_FQ
#46d	recordValue#43 = not used	M	#XXh	RV_
#47d	recordValue#44 = LV_NT_AFS_REQ_AGI_TMP_3_EXT_ADJ	M	#XXh	RV_LV_NT_AFS_REQ_AGI_TMP_3
#48d	recordValue#- = not used	M	#XXh	RV_
#49d	recordValue#46 = LV_SO2P_REQ_2_EXT_ADJ	M	#XXh	RV_LV_SO2P_REQ_2
#50d	recordValue#47 = LV_SO2P_REQ_FQ_EXT_ADJ	M	#XXh	RV_LV_SO2P_REQ_FQ
#51d	recordValue#48 = FAC_NT_AGI_LIM_EXT_ADJ (high byte)	M	#XXh	RV_FAC_NT_AGI_LIM
#52d	recordValue#49 = FAC_NT_AGI_LIM_EXT_ADJ (low byte)	M	#XXh	RV_FAC_NT_AGI_LIM
#53	recordValue50 = FAC_NT_AGI_MDL_EXT_ADJ (high word, high byte)	M	#XXh	RV_FAC_NT_AGI_MDL_EXT_ADJ
#54	recordValue51 = FAC_NT_AGI_MDL_EXT_ADJ (high word, low byte)	M	#XXh	RV_FAC_NT_AGI_MDL_EXT_ADJ
#55	recordValue52 = FAC_NT_AGI_MDL_EXT_ADJ (low word, high byte)	M	#XXh	RV_FAC_NT_AGI_MDL_EXT_ADJ
#56	recordValue53 = FAC_NT_AGI_MDL_EXT_ADJ (low word, low byte)	M	#XXh	RV_FAC_NT_AGI_MDL_EXT_ADJ
#57	recordValue54 = DIST_NS_NEW_EXT_ADJ (high byte)	M	#XXh	RV_DIST_NS_NEW_EXT_ADJ
#58	recordValue55 = DIST_NS_NEW_EXT_ADJ (low byte)	M	#XXh	RV_DIST_NS_NEW_EXT_ADJ
#59	recordValue56 = DIST_NT_NS_SHIFT_EXT_ADJ [1] (high byte)	M	#XXh	RV_DIST_NT_NS_SHIFT_EXT_ADJ[1]
#60	recordValue57 = DIST_NT_NS_SHIFT_EXT_ADJ [1] (low byte)	M	#XXh	RV_DIST_NT_NS_SHIFT_EXT_ADJ[1]
#61	recordValue58 = CTR_NS_AD_CYL_EXT_ADJ [1] (high byte)	M	#XXh	RV_CTR_NS_AD_CYL_EXT_ADJ[1]
#62	recordValue59 = CTR_NS_AD_CYL_EXT_ADJ [1] (low byte)	M	#XXh	RV_CTR_NS_AD_CYL_EXT_ADJ[1]
#63	recordValue60 = DIST_NT_NS_AD_EXT_ADJ [1] (high byte)	M	#XXh	RV_DIST_NT_NS_AD_EXT_ADJ[1]
#64	recordValue61 = DIST_NT_NS_AD_EXT_ADJ [1] (low byte)	M	#XXh	RV_DIST_NT_NS_AD_EXT_ADJ[1]
#65	recordValue62 = FAC_NOX_NS_AD_EXT_ADJ [1] (high byte)	M	#XXh	RV_FAC_NOX_NS_AD_EXT_ADJ[1]

#66	recordValue63 = FAC_NOX_NS_AD_EXT_ADJ [1] (low byte)	M	#XXh	RV_FAC_NOX_NS_AD_EXT_ADJ[1]
#67	recordValue64 = CTR_NS_SHIFT_CYC_EXT_ADJ[1] (high byte)	M	XXh	RV_CTR_NS_SHIFT_CYC_EXT_ADJ [1]
#68	recordValue65 = CTR_NS_SHIFT_CYC_EXT_ADJ[1] (low byte)	M	XXh	RV_CTR_NS_SHIFT_CYC_EXT_ADJ [1]
#69	recordValue66 = RATIO_MMV_NS_SHIFT_DIAG_EXT_ADJ[1] (high byte)	M	XXh	RV_RATIO_MMV_NS_SHIFT_DIAG_EXT_ADJ[1]
#70	recordValue67 = RATIO_MMV_NS_SHIFT_DIAG_EXT_ADJ[1] (low byte)	M	XXh	RV_RATIO_MMV_NS_SHIFT_DIAG_EXT_ADJ [1]

### Table WriteDataByCommonIdentifier Request Message

(Hint: In case of NC\_NT\_NR =1 must 0ffh transmittet for all "recorde values " with array element[2])

### WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier	M	#5Fh	WDCI_ADR ESTORE
#3d	recordCommonIdentifier	M	#88h	WDCI_ADR ESTORE

Figure I.25.36: Table WriteDataByCommonIdentifier Positive Response Message

## I.25.22 2E\_5F\_89 Request Reset MSA-Tabellenspeicher

### General information:

This command the request Reset MSA-Tabellenspeicher is send to BMW-software.

### Additional Application conditions:

Initialisation at reset and in case of LV\_IGK 1-> 0:  
B\_msahfkreset = 0

### Formula section:

```

If      service 2E_5F_89 is received
then
          B_msahfkreset = 1
          send positive response
endif

```

### Formula section:

### WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCi
#2d	RecordCommonIdentifier	M	#5Fh	WDCI_MSA RING_HFKR ESET
#3d	RecordCommonIdentifier	M	#89h	WDCI_MSA RING_HFKR ESET WDCI_NGS

Figure I.25.37: Table WriteDataByCommonIdentifier Request Message

**WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier	M	#5Fh	WDCI_MSA RING_HFKR ESET WDCI_NGS
#3d	recordCommonIdentifier	M	#89h	WDCI_MSA RING_HFKR ESET WDCI_NGS

Figure I.25.38: Table WriteDataByCommonIdentifier Positive Response Message

**I.25.23 2E\_5F\_8A Nullgang\_Lernwert\_vorgeben****General information:**

This command write the Nullgang\_Lernwert\_vorgeben to BMW-software.

**Additional Application conditions:**

Initialisation at reset and in case of LV\_IGK 1-> 0:

$$Tvneutrin = 0.0$$

**Formula section:**

```

if      service 2E_5F_8A is received
then
          Tvneutrin = corresponding received values
          send positive response
endif

```

**Formula section:****WriteDataByCommonIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCi
#2d	RecordCommonIdentifier	M	#5Fh	WDCI_NGS
#3d	RecordCommonIdentifier	M	#8Ah	WDCI_NGS
#4d	recordValue#1 = Tvneutrin (high byte)	M	#XXh	WDCI_NGS
#5d	recordValue#2 = Tvneutrin (low byte)	M	#XXh	WDCI_NGS

Figure I.25.39: Table WriteDataByCommonIdentifier Request Message

### WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier	M	#5Fh	WDCI_NGS
#3d	recordCommonIdentifier	M	#8Ah	WDCI_NGS

Figure I.25.40: Table WriteDataByCommonIdentifier Positive Response Message

## I.25.24 2E\_5F\_8B PMB\_vorgeben

### General information:

This command write informations about the state of battery into ECU. This is necessary after reprogramming or change of ECU.

### Formula section:

```

if          service 2E_5F_8B is received
then
    Pmrestore[7] = corresponding received values
    set B_pmrestore = 1 for 5 sec.
    send positive response
endif

```

### WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBC1
#2d	RecordCommonIdentifier	M	#5Fh	WDCI_PMB
#3d	RecordCommonIdentifier	M	#8Bh	WDCI_PMB
#4d	recordValue#1 = Pmrestore[0]	M	#XXh	RV_PMRES TORE[0]
#5d	recordValue#2 = Pmrestore[1]	M	#XXh	RV_PMRES TORE[1]
#6d	recordValue#3 = Pmrestore[2]	M	#XXh	RV_PMRES TORE[2]
#7d	recordValue#4 = Pmrestore[3]	M	#XXh	RV_PMRES TORE[3]
#8d	recordValue#5 = Pmrestore[4]	M	#XXh	RV_PMRES TORE[4]
#9d	recordValue#6 = Pmrestore[5]	M	#XXh	RV_PMRES TORE[5]
#10d	recordValue#7 = Pmrestore[6]	M	#XXh	RV_PMRES TORE[6]

Figure I.25.41: Table WriteDataByCommonIdentifier Request Message

**WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBC1PR
#2d	RecordCommonIdentifier	M	#5Fh	WDCI_PMB
#3d	recordCommonIdentifier	M	#8Bh	WDCI_PMB

Figure I.25.42: Table WriteDataByCommonIdentifier Positive Response Message

**I.25.25 2E\_5F\_8E MSA\_DEAK****General information:**

With this command the deactivation of MSA can be switched on /off.

In the first 250 km the MSA can be switched off permanently with service request 2E\_5F\_8E\_08. After more than 250km the ECU answers on this request with "subFunctionNotSupported" and the deactivation of MSA with 2E\_5F\_8E\_07 is only possible for the actual driving cycle.

**Additional Application conditions:**

Initialisation at reset or LV\_IGK 1 > 0:

```

If          CTR_KM_CAN > 249 km and LV_STST_DEAC = 1
Then       store LV_STST_DEAC = 0 in non volatile memory
Endif
B_msasw = LV_STST_DEAC

```

**Formula section:**

```

if(1)      record value#1 = 0
then(1)   LV_STST_DEAC      = 0

```

```

        B_msasw          = 0
        store LV_STST_DEAC = 0 in non volatile memory
        send positive responses
    endif(1)
    if(1)                record value#1 = 7
    then(1)
        B_msasw = 1
        send positive response
    endif(1)
    if(1)                record value#1 = 8
    then(1)
        if(2)            CTR_KM_CAN > 249 km
        then(2)          LV_STST_DEAC = 0
                        B_msasw = 0
                        send negative response
        else(2)          LV_STST_DEAC = 1
                        B_msasw = 1
                        send positive response
        endif(2)
        store LV_STST_DEAC in non volatile memory
    else(1)
        send negative response
    endif(1)
endif(1)

```

### WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_MSA_DEAK
#3d	RecordCommonIdentifier Low Byte	M	#8Eh	RCI_MSA_DEAK
#4d	Record value#1	M	#XXh	RV_RCTECU

Figure I.25.43: Table WriteDataByCommonIdentifier Request Message

### WriteDataByCommonIdentifier positive Response


Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCI PR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_MSA_D EAK
#3d	RecordCommonIdentifier Low Byte		#8Eh	RCI_MSA_D EAK

Figure I.25.44: Table WriteDataByCommonIdentifier Positive Response Message

## I.25.26 2E\_5F\_8F MSA\_DEAK\_AV

### General information:

With this command the selective deactivation of "Abschaltverhinderer MSA" can be coded.

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**Additional Application conditions:**

Initialisation at reset or LV\_IGK 1 -> 0: Swmsaav = 0

**Formula section:**

```

if      record value#1 = 0
then
    Swmsaav = 0
    send positive response
endif
if      record value#1 = 7
then
    Swmsaav = received value
    send positive response
elseif
    send negative response
endif

```

**WriteDataByCommonIdentifier Request ( only service 2E\_5F\_8F\_00 )**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_MSA_DEAK_AV
#3d	RecordCommonIdentifier Low Byte	M	#8Fh	RCI_MSA_DEAK_AV
#4d	Record value#1	M	#00h	RV_RCTECU

Figure I.25.45: Table WriteDataByCommonIdentifier Request Message

**WriteDataByCommonIdentifier Request ( only service 2E\_5F\_8F\_07 )**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_MSA_DEAK_AV
#3d	RecordCommonIdentifier Low Byte	M	#8Fh	RCI_MSA_DEAK_AV
#4d	Record value#1	M	#07h	RV_STA
#5d	Record value#2 = Swmsaav (high byte , high word)	M	#XXh	RV_MSA_DEAK_AV
#6d	Record value#3 = Swmsaav (low byte , high word)	M	#XXh	RV_MSA_DEAK_AV
#7d	Record value#4 = Swmsaav (high byte , low word)	M	#XXh	RV_MSA_DEAK_AV
#8d	Record value#5 = Swmsaav (low byte , low word)	M	#XXh	RV_MSA_DEAK_AV

Figure I.25.46: Table WriteDataByCommonIdentifier Request Message

**WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCL_MSA_D EAK_AV
#3d	RecordCommonIdentifier Low Byte		#8Fh	RCL_MSA_D EAK_AV

Figure I.25.47: Table WriteDataByCommonIdentifier Positive Response Message

## I.25.27 2E\_5F\_90 IMAALLE programmieren

### Description:

With this service all injection valve corrections are written individual for each cylinder. The values EGY\_SP\_IV\_EXT\_ADJ[NC\_CYL\_NR] and MFF\_ABSV\_IV\_EXT\_ADJ[NC\_CYL\_NR] must be stored in **reprogrammingresistant** non volatile memory. At first run of new ECU or in case of NVRAM error the output data must initialized with zero.

STATE\_IV\_CHG is used at engine stop to engine run.

### Additional Application conditions:

```

Initialisation:      at reset: from NVRAM and from reprogramming resistant NVRAM ,
                    at exit start:      if STATE_IV_CHG <> 0
                                           then      STATE_IV_CHG = 0
                                           write NVRAM "BMW coding"
                                           endif

```

Activation: LV\_ES = 1

Deactivation: LV\_ES = 0

### Formula Section:

```

If received service 2E_5F_90
then
    EGY_SP_IV_EXT_ADJ[NC_CYL_NR] = corresponding received values
    MFF_ABSV_IV_EXT_ADJ[NC_CYL_NR] = corresponding received values
    STATE_IV_CHG( bit 0 ).. STATE_IV_CHG(bit NC_CYL_NR-1) = 1
    send positive response
endif

```

### WriteDataByCommonIdentifier Request



Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_IMAALLE
#3d	RecordCommonIdentifier Low Byte	M	#90h	RCI_IMAALLE
#4d	RecordValue#1 = - EGY_SP_IV_EXT_ADJ[0] high byte	M	#XXh	RCI_
#5d	RecordValue#2 = - EGY_SP_IV_EXT_ADJ[0] low byte	M	#XXh	RCI_
#6d	RecordValue#3 = - MFF_ABSV_IV_EXT_ADJ[0] high byte	M	#XXh	RCI_
#7d	RecordValue#4 = - MFF_ABSV_IV_EXT_ADJ[0] low byte	M	#XXh	RCI_
...	...	...	...	...
...	...	...	...	...
...	...	...	...	...
#4*NC_CYL _NR	RecordValue#(4*NC_CYL_NR-3) = EGY_SP_IV_EXT_ADJ[NC_CYL_NR-1] high byte	M	#XXh	RCI_
#4*NC_CYL _NR +1	RecordValue#(4*NC_CYL_NR -2) = EGY_SP_IV_EXT_ADJ[NC_CYL_NR-1] low byte	M	#XXh	RCI_
#4*NC_CYL _NR +2	RecordValue#(4*NC_CYL_NR -1) = MFF_ABSV_IV_EXT_ADJ[NC_CYL_NR-1] high byte	M	#XXh	RCI_
#4*NC_CYL _NR +3	RecordValue#(4*NC_CYL_NR) = MFF_ABSV_IV_EXT_ADJ[NC_CYL_NR-1] low byte	M	#XXh	RCI_

Figure I.25.48: Table WriteDataByLocalIdentifier Request Message

**WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCI PR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_IMAALLE
#3d	RecordCommonIdentifier Low Byte	M	#90h	RCI_IMAALLE

Figure I.25.49: Table WriteDataByLocalIdentifier Positive Response Message

**I.25.28 2E\_5F\_9x IMA0x programmieren****Description:**

With this service cylinder balancing injection valve corrections is written only for cylinder x.

**Additional Application conditions:**

*Initialisation at exit start:* STATE\_IV\_CHG = 0

*Activation:* LV\_ES = 1

*Deactivation:* LV\_ES = 0

**Formula Section:**

```

if          received service 2E_5F_9x and x <= NC_CYL_NR    // x from 2E_5F_9x
then
    EGY_SP_IV_EXT_ADJ[x-1] = received value
    MFF_ABSV_IV_EXT_ADJ[x-1] = received value
    STATE_IV_CHG(bit x-1) = 1
    send positive response
endif

```

## WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_IMA0x
#3d	RecordCommonIdentifier Low Byte	M	#9xh	RCI_IMA0x
#4d	RecordValue#1 = - EGY_SP_IV_EXT_ADJ[x-1] high byte	M	#XXh	RCI_
#5d	RecordValue#2= - EGY_SP_IV_EXT_ADJ[x-1] low byte	M	#XXh	RCI_
#6d	RecordValue#3= - MFF_ABSV_IV_EXT_ADJ[x-1] high byte	M	#XXh	RCI_
#7d	RecordValue#4= - MFF_ABSV_IV_EXT_ADJ[x-1] low byte	M	#XXh	RCI_

Figure I.25.50: Table WriteDataByLocalIdentifier Request Message

## WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCI PR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_IMA0x
#3d	RecordCommonIdentifier Low Byte	M	#9xh	RCI_IMA0x

Figure I.25.51: Table WriteDataByLocalIdentifier Positive Response Message

## I.25.29 2E\_5F\_DE\_00 VVT- Minhub Ansteuerung beenden

### General information:

When this service is received, the actuator diagnosis function stops and control is given back to the ECU control.

### Formula section:

## WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_VH
#3d	RecordCommonIdentifier Low Byte	M	#DEh	RCI_VH
#4d	Inputoutputcontrolparameter	M	#00h	IOCP_RCTECU

Figure I.25.52: Table inputoutputcontrolByCommonIdentifier Request Message

## WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_VH
#3d	RecordCommonIdentifier Low Byte	M	#DEh	RCI_VH
#4d	Inputoutputcontrolparameter	M	#00h	IOCP_RCTECU

Figure I.25.53: Table inputoutputcontrolByCommonIdentifier Positive Response Message

### I.25.30 2E\_5F\_DE\_07 VVT- Minhub ansteuern

#### Description:

With this service the minimum valve lift can be adjusted.

#### Formula section:

#### WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_MINH
#3d	RecordCommonIdentifier Low Byte	M	#DEh	RCI_MINH
#4d	Inputoutputcontrolparameter	M	#07h	IOCP_STA
#5d	inputOutputControlParameter - VVL_MIN_EXT_ADJ high byte	M	#XXh	CS_MINH
#6d	InputOutputControlParameter - VVL_MIN_EXT_ADJ low byte	M	#XXh	CS_MINH

Figure I.25.54: Table inputoutputcontrolByLocalIdentifier Request Message

#### WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_MINH
#3d	RecordCommonIdentifier Low Byte	M	#DEh	RCI_MINH
#4d	Inputoutputcontrolparameter	M	#07h	IOCP_STA

Figure I.25.55: Table inputoutputcontrolByLocalIdentifier Positive Response Message


### I.25.31 2E\_5F\_DE\_08 VVT- Minhub programmieren

#### Description:

With this service the minimum valve lift can be programmed into non volatile memory after power latch phase.

#### Additional Application conditions:

Activation: LV\_ES = 1

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7715 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

Deactivation: LV\_ES = 0

### Formula section:

### WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_MINH
#3d	RecordCommonIdentifier Low Byte	M	#DEh	RCI_MINH
#4d	Inputoutputcontrolparameter	M	#08h	IOCP_LTA
#5d	inputOutputControlParameter - VVL_MIN_NVMY_EXT_ADJ high byte	M	#XXh	CS_MINH
#6d	InputOutputControlParameter - VVL_MIN_NVMY_EXT_ADJ low byte	M	#XXh	CS_MINH

Figure I.25.56: Table inputoutputcontrolByLocalIdentifier Request Message

### WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCI PR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_MINH
#3d	RecordCommonIdentifier Low Byte	M	#DEh	RCI_MINH
#4d	Inputoutputcontrolparameter	M	#08h	IOCP_LTA

Figure I.25.57: Table inputoutputcontrolByLocalIdentifier Positive Response Message

## I.25.32 2E\_5F\_F0\_07 Abgleichswert LL ansteuern

### General information:

With the tester via KWP telegram an idle speed offset for five different conditions can be calibrated. The idle speed setpoint offsets stored into the non volatile memory are initialized with 0 as default value. In case of a tester is connected via KWP N\_KWP\_OFS\_ACC\_DRI, N\_KWP\_OFS\_DRI, N\_KWP\_OFS\_ACC, N\_KWP\_OFS and N\_KWP\_OFS\_VB are sent and the bit store was sent the adjusted values are stored into non volatile memory.

In case of LV\_KWP\_ENA = 1 and a tester is connected via KWP the adjustment values N\_KWP\_OFS\_ACC\_DRI\_KWP, N\_KWP\_OFS\_DRI\_KWP, N\_KWP\_OFS\_KWP, N\_KWP\_OFS\_ACC\_KWP and N\_KWP\_OFS\_VB\_KWP from tester are used.


N\_SP\_OFS\_KWP is permanently used in the idle speed module, so the calculation within the KWP-module have to do permanently.

For the time, when the tester works on the car, the max. selection should be off for this KI.15 cycle. Now the new setting of the offsets can be made.

### Additional Application conditions:

#### Initialisation at reset:

$$\begin{aligned} \text{N\_KWP\_OFS\_ACC\_DRI} &= \text{N\_KWP\_OFS\_ACC\_DRI\_NVMY} \\ \text{N\_KWP\_OFS\_DRI} &= \text{N\_KWP\_OFS\_DRI\_NVMY} \end{aligned}$$

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7716 of 8404	
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```

        N_KWP_OFS           = N_KWP_OFS_NVMY
        N_KWP_OFS_ACC      = N_KWP_OFS_ACC_NVMY
N_KWP_OFS_VB           = N_KWP_OFS_VB_NVMY
        N_SP_OFS_KWP      = 0

```

**Activation:** LV\_KWP\_ENA = 1

**Deactivation:** LV\_KWP\_ENA = 0

**Recurrence:** 10 ms

### Formula section:

*switch off the max-selection in this Kl.15 cycle:*

```

IF          the service 2E_5F_F0_07 is received
  THEN      LV_ACT_N_SP_IS_BAS_EXT_ADJ=01h
  ELSE      LV_ACT_N_SP_IS_BAS_EXT_ADJ=00h
ENDIF

```

*idle speed setpoint offset at LV\_ACIN = 1 and LV\_DRI = 1 ( N\_KWP\_OFS\_ACC\_DRI\_KWP ) :*

```

IF          N_KWP_OFS_ACC_DRI_KWP           C_N_OFS_ACC_DRI_MAX
  THEN      N_KWP_OFS_ACC_DRI               = C_N_OFS_ACC_DRI_MAX
  ELSEIF    N_KWP_OFS_ACC_DRI_KWP           C_N_OFS_ACC_DRI_MIN
  THEN      N_KWP_OFS_ACC_DRI               = C_N_OFS_ACC_DRI_MIN
  ELSE      N_KWP_OFS_ACC_DRI               = N_KWP_OFS_ACC_DRI_KWP
ENDIF

```

*idle speed setpoint offset at LV\_ACIN = 0 and LV\_DRI = 1 ( N\_KWP\_OFS\_DRI\_KWP ) :*

```

IF          N_KWP_OFS_DRI_KWP               C_N_OFS_DRI_MAX
  THEN      N_KWP_OFS_DRI                   = C_N_OFS_DRI_MAX
  ELSEIF    N_KWP_OFS_DRI_KWP               C_N_OFS_DRI_MIN
  THEN      N_KWP_OFS_DRI                   = C_N_OFS_DRI_MIN
  ELSE      N_KWP_OFS_DRI                   = N_KWP_OFS_DRI_KWP
ENDIF

```

*idle speed setpoint offset at LV\_ACIN = 0 and LV\_DRI = 0 ( N\_KWP\_OFS\_KWP ) :*

```

IF          N_KWP_OFS_KWP                   C_N_OFS_MAX
  THEN      N_KWP_OFS                       = C_N_OFS_MAX
  ELSEIF    N_KWP_OFS_KWP                   C_N_OFS_MIN
  THEN      N_KWP_OFS                       = C_N_OFS_MIN
  ELSE      N_KWP_OFS                       = N_KWP_OFS_KWP
ENDIF

```

*idle speed setpoint offset at LV\_ACIN = 1 and LV\_DRI = 0 ( N\_KWP\_OFS\_ACC\_KWP ) :*

```

IF          N_KWP_OFS_ACC_KWP               C_N_OFS_ACC_MAX
  THEN      N_KWP_OFS_ACC                   = C_N_OFS_ACC_MAX
  ELSEIF    N_KWP_OFS_ACC_KWP               C_N_OFS_ACC_MIN
  THEN      N_KWP_OFS_ACC                   = C_N_OFS_ACC_MIN
  ELSE      N_KWP_OFS_ACC                   = N_KWP_OFS_ACC_KWP
ENDIF

```

*idle speed setpoint offset at battery charging is active ( N\_KWP\_OFS\_VB\_KWP ) :*

```

IF          N_KWP_OFS_VB_KWP               C_N_OFS_VB_MAX
  THEN      N_KWP_OFS_VB                   = C_N_OFS_VB_MAX
  ELSEIF    N_KWP_OFS_VB_KWP               C_N_OFS_VB_MIN
  THEN      N_KWP_OFS_VB                   = C_N_OFS_VB_MIN
  ELSE      N_KWP_OFS_VB                   = N_KWP_OFS_VB_KWP

```

**ENDIF***idle speed setpoint - LV\_KWP\_ENA :*

```

IF                TCO                > C_TCO_MIN_N_OFS_KWP
    and            LV_ERR_TCO                = 0
    and            LC_N_OFS_KWP_DISABLE = 0
    and            LV_REQ_ISC                = 1
THEN            LV_KWP_ENA                = 1
ELSE            LV_KWP_ENA                = 0
ENDIF

IF                LV_KWP_ENA = 0
THEN            no adjustment and no programming by tester is allowed
    and            the ECU send 'invalid parameter' response to the tester request
ELSE            adjustment and programming by tester is allowed
ENDIF

```

*Idle Speed Setpoint Offset by Tester (KWP):*

```

IF                LV_DRI = 1    and    LV_ACIN = 1    (AC is ready
and drive engaged)
THEN                N_SP_OFS_KWP_1    = N_KWP_OFS_ACC_DRI
    ELSEIF (1)        LV_DRI = 1    and    LV_ACIN = 0    (AC is not ready and drive
engaged)
        THEN (1)        N_SP_OFS_KWP_1    = N_KWP_OFS_DRI
        ELSEIF (2)        LV_DRI = 0    and    LV_ACIN = 0    (AC is not ready
and drive not engaged)
            THEN (2)        N_SP_OFS_KWP_1    = N_KWP_OFS
            ELSEIF (3)        LV_DRI = 0    and    LV_ACIN = 1    (AC is ready and
drive not engaged)
                THEN (3)        N_SP_OFS_KWP_1    = N_KWP_OFS_ACC
    ELSE                N_SP_OFS_KWP_1 = 0
ENDIF

IF                CHA_CDN_BAT > C_CHA_CDN_BAT_KWP_MIN    (battery charging
act.)
THEN                N_SP_OFS_KWP = N_SP_OFS_KWP_1 + N_KWP_OFS_VB
ELSE                N_SP_OFS_KWP = N_SP_OFS_KWP_1
ENDIF

```

**WriteDataByCommonIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCi
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_ABLl
#3d	RecordCommonIdentifier Low Byte	M	#F0h	RCI_ABLl
#4d	Inputoutputcontrolparameter	M	#07h	IOCP_STA
#5d	InputoutputLocalValue = N_KWP_OFS_ACC_DRI_KWP Value offset drive position and air condition	M	#XXh	IOLI_
#6d	InputoutputLocalValue = N_KWP_OFS_DRI_KWP Value offset drive position	M	#XXh	IOLI_
#7d	InputoutputLocalValue = N_KWP_OFS_KWP Value offset for idle speed	M	#XXh	IOLI_
#8d	InputoutputLocalValue N_KWP_OFS_ACC_KWP Value offset air condition	M	#XXh	IOLI_
#9d	InputoutputLocalValue = N_KWP_OFS_VB_KWP Value offset voltage battery	M	#XXh	IOLV

Figure I.25.58: Table inputoutputcontrolByLocalIdentifier Request Message

### WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_ABLl
#3d	RecordCommonIdentifier Low Byte	M	#F0h	RCI_ABLl
#4d	Inputoutputcontrolparameter	M	#07h	IOCP_STA
#5d	InputoutputLocalValue = N_KWP_OFS_ACC_DRI_KWP Value offset drive position and air condition	M	#XXh	IOLI_
#6d	InputoutputLocalValue = N_KWP_OFS_DRI_KWP Value offset drive position	M	#XXh	IOLI_
#7d	InputoutputLocalValue = N_KWP_OFS_KWP Value offset for idle speed	M	#XXh	IOLI_
#8d	InputoutputLocalValue N_KWP_OFS_ACC_KWP Value offset air condition	M	#XXh	IOLI_
#9d	InputoutputLocalValue = N_KWP_OFS_VB_KWP Value offset voltage battery	M	#XXh	IOLV

Figure I.25.59: Table inputoutputcontrolByLocalIdentifier Positive Response Message

## I.25.33 2E\_5F\_F0\_08 Abgleichswert LL programmieren

### General information:

In a tester is connected via KWP and the bit store is received, the adjustment values from tester N\_KWP\_OFS\_ACC\_DRI\_KWP, N\_KWP\_OFS, N\_KWP\_OFS\_DRI\_KWP, N\_KWP\_OFS\_ACC\_KWP and N\_KWP\_OFS\_VB\_KWP are stored into the non volatile memory. The non volatile stored values are used after reset as initialization values for idle speed setpoint offset.

### Additional Application conditions:

**Activation:** LV\_KWP\_ENA = 1

**Deactivation:** LV\_KWP\_ENA = 0

**Formula Section:****WriteDataByCommonIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCi
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_ABLl
#3d	RecordCommonIdentifier Low Byte	M	#F0h	RCI_ABLl
#4d	Inputoutputcontrolparameter	M	#08h	IOCP_LTA
#5d	InputoutputLocalValue = N_KWP_OFS_ACC_DRI_KWP Value offset drive position and air condition	M	#XXh	IOLI_
#6d	InputoutputLocalValue = N_KWP_OFS_DRI_KWP Value offset drive position	M	#XXh	IOLI_
#7d	InputoutputLocalValue = N_KWP_OFS_KWP Value offset for idle speed	M	#XXh	IOLI_
#8d	InputoutputLocalValue N_KWP_OFS_ACC_KWP Value offset air condition	M	#XXh	IOLI_
#9d	InputoutputLocalValue = N_KWP_OFS_VB_KWP Value offset voltage battery	M	#XXh	IOLV

Figure I.25.60: Table inputoutputcontrolByLocalIdentifier Request Message

**WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_ABLl
#3d	RecordCommonIdentifier Low Byte	M	#F0h	RCI_ABLl
#4d	Inputoutputcontrolparameter	M	#08h	IOCP_LTA
#5d	InputoutputLocalValue = N_KWP_OFS_ACC_DRI_KWP Value offset drive position and air condition	M	#XXh	IOLI_
#6d	InputoutputLocalValue = N_KWP_OFS_DRI_KWP Value offset drive position	M	#XXh	IOLI_
#7d	InputoutputLocalValue = N_KWP_OFS_KWP Value offset for idle speed	M	#XXh	IOLI_
#8d	InputoutputLocalValue N_KWP_OFS_ACC_KWP Value offset air condition	M	#XXh	IOLI_
#9d	InputoutputLocalValue = N_KWP_OFS_VB_KWP Value offset voltage battery	M	#XXh	IOLV

Figure I.25.61: Table inputoutputcontrolByLocalIdentifier Positive Response Message

**I.25.34 2E\_5F\_F1\_00 CO-Abgleich beenden****General information:**

When this service is received, the actuator diagnosis function stops and control is given back to the ECU control.

**Formula Section:****WriteDataByCommonIdentifier Request**



Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_VH
#3d	RecordCommonIdentifier Low Byte	M	#F1h	RCI_VH
#4d	Inputoutputcontrolparameter	M	#00h	IOCP_RCTECU

Figure I.25.62: Table inputoutputcontrolByCommonIdentifier Request Message

**WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCI PR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F1h	RCI_
#4d	Inputoutputcontrolparameter	M	#00h	IOCP_RCTECU

Figure I.25.63: Table inputoutputcontrolByCommonIdentifier Positive Response Message

**I.25.35 2E\_5F\_F1\_04 CO- Abgleich Reset****Description:**

With this service the MFF trim value for CO- Adjust can be reset.

**Additional Application conditions:**

Activation: LV\_VAR\_LSH\_UP = 0

Deactivation: LV\_VAR\_LSH\_UP = 1

**Formula section:**

```
IF          service 2E_5F_F1_04 is received
THEN      LV_RST_MFF_ADD_EXT_ADJ_NVMY = 1 for 2s
ENDIF
```

**WriteDataByCommonIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F1h	RCI_
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_

Figure I.25.64: Table inputoutputcontrolByLocalIdentifier Request Message

**WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F1h	RCI_
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_STA

Figure I.25.65: Table inputoutputcontrolByLocalIdentifier Positive Response Message

## I.25.36 2E\_5F\_F1\_07 CO- Abgleich ansteuern

### Description:

With this service the MFF trim value for CO- Adjust can be adjusted. This is necessary for cars without catalystr.

The value from tester is written in the variable FAC\_MFF\_ADD\_EXT\_ADJ for 1 second. Then the variable FAC\_MFF\_ADD\_EXT\_ADJ is set to 0 for 1s. After the 2 seconds, the next value can be sent. During this 2 seconds no new value from tester is accepted to avoid too fast trimming (= negative response).

### Additional Application conditions:

*Initialisation:* FAC\_MFF\_ADD\_EXT\_ADJ = 0 %  
TIMER\_1 = 0 s

*Activation:* LV\_VAR\_LSH\_UP = 0           **and**  
LV\_IS = 1                               **and**  
CTR\_ERR\_DYN\_NR = 0               **and**  
TCO > C\_TCO\_MIN\_MFF\_ADD\_EXT\_ADJ

*Deactivation:* not activation or timeout

### Formula section:

```

IF                Service 2E_5F_F1_07 is received and
                    TIMER_1 = 0 s
THEN             initialise TIMER_1 with 2 s                               and
                    FAC_MFF_ADD_EXT_ADJ = value from tester               and
                    send positive response
ELSEIF          TIMER_1 = 2 s or 1s
THEN             FAC_MFF_ADD_EXT_ADJ = 0
                    TIMER_1 = TIMER_1 - 1s
                    send negative response "conditions not correct" when Service 2E_5F_F1_07 is
                    ceived again
ENDIF

```

### WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F1h	RCI_
#4d	Inputoutputcontrolparameter	M	#07h	IOCP_STA
#5d	inputOutputControlParameter - FAC_MFF_ADD_EXT_ADJ	M	#XXh	CS_

Figure I.25.66: Table inputoutputcontrolByLocalIdentifier Request Message

#### WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCI PR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F1h	RCI_
#4d	Inputoutputcontrolparameter	M	#07h	IOCP_STA

Figure I.25.67: Table inputoutputcontrolByLocalIdentifier Positive Response Message

### I.25.37 2E\_5F\_F1\_08 CO- Abgleich programmieren

#### Description:

With this service the MFF trim value for CO- Adjust can be programmed into non volatile memory after power latch phase.

After receiving the service 2E\_5F\_F1\_08, the flag LV\_FAC\_MFF\_ADD\_EXT\_ADJ\_NVMY is set to 1 for 2 seconds. The flag LV\_FAC\_MFF\_ADD\_EXT\_ADJ\_NVMY triggers the CO- Adjust function to save the trim value into non volatile memory after power latch phase.

#### Additional Application conditions:

Activation: LV\_IS = 1 and  
LV\_VAR\_LSH\_UP = 0 and  
CTR\_ERR\_DYN\_NR = 0 and  
TCO > C\_TCO\_MIN\_MFF\_ADD\_EXT\_ADJ

Deactivation: not activation or timeout

#### Formula section:

IF service 2E\_5F\_F1\_08 is received  
THEN LV\_FAC\_MFF\_ADD\_EXT\_ADJ\_NVMY = 1 for 2s  
ENDIF

#### WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F1h	RCI_
#4d	Inputoutputcontrolparameter	M	#08h	IOCP_LTA

Figure I.25.68: Table inputoutputcontrolByLocalIdentifier Request Message

### WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCI PR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F1h	RCI_
#4d	Inputoutputcontrolparameter	M	#08h	IOCP_LTA

Figure I.25.69: Table inputoutputcontrolByLocalIdentifier Positive Response Message

## I.25.38 2E\_5F\_F2\_04 Varianten loeschen

### General information:

This service resets the bits of learned variants. Re-learning is possible depending on the learning conditions of every device (see chapter "variant coding"). If the byte on position x in the tester telegram is 01, the variant flag/variable which is dedicated to position x is set to 0 and so the variant is erased.

The variants LV\_VAR\_BN and LV\_VAR\_VEH are vehicle specific can not be reset via tester (safety reasons; see also chapter "variant coding").

### Additional Application conditions:

**Activation:** LV\_ES=1

**Deactivation:** LV\_ES=0


### Formular section:

### InputOutputControlByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	<b>WriteDataByCommonIdentifier Request Service Id</b>	<b>M</b>	<b>#2Eh</b>	<b>WDBCI</b>
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F2h	RCI_
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_RTD
#5d	inputOutputControlParameter - LV_AT	M	#XXh	
#6d	inputOutputControlParameter - LV_VAR_ACIN	M	#XXh	
#7d	inputOutputControlParameter - LV_VAR_AMT	M	#XXh	
#8d	inputOutputControlParameter - LV_VAR_ARS	M	#XXh	
#9d	inputOutputControlParameter - LV_VAR_ASR	M	#XXh	
#10d	inputOutputControlParameter - not used	M	#FFh	
#11d	inputOutputControlParameter - LV_VAR_BN_MSW	M	#XXh	
#12d	inputOutputControlParameter - LV_VAR_DCC	M	#XXh	
#13d	inputOutputControlParameter - LV_VAR_EBOX_CFA	M	#XXh	
#14d	inputOutputControlParameter - LV_VAR_ETCU	M	#XXh	
#15d	inputOutputControlParameter - LV_VAR_ICL	M	#XXh	
#16d	inputOutputControlParameter - LV_VAR_MSW	M	#XXh	
#17d	inputOutputControlParameter - LV_VAR_PSTE	M	#XXh	
#18d	inputOutputControlParameter - LV_VAR_SOF	M	#XXh	
#19d	inputOutputControlParameter - CONF_SOF_SWI	M	#XXh	
#20d	inputOutputControlParameter - LV_VAR_BN_GEAR_REV	M	#XXh	
#21d	inputOutputControlParameter - not used	M	#FFh	
#22d	inputOutputControlParameter - not used	M	#FFh	
#23d	inputOutputControlParameter - LV_VAR_SAP ( not MSD80/81), not used (MSD80/81)	M	[#XXh, #FFh]	
#24d	inputOutputControlParameter - LV_VAR_EF	M	#XXh	
#25d	inputOutputControlParameter - LV_VAR_CWP_LIN ( <b>only MSD85</b> ), not used ( <b>other</b> )	M	[#XXh, #FFh]	
#26d	inputOutputControlParameter - LV_VAR_RLY_ACCOUT (not MSD85) not supported (MSD85)	M	[#XXh, #FFh]	
#27d	inputOutputControlParameter - LV_VAR_SAV (not MSD80/81), not used (MSD80/81)	M	[#XXh, #FFh]	
#28d	inputOutputControlParameter - LV_VAR_RLY_ST	M	#XXh	
#29d	inputOutputControlParameter - LV_VAR_ASR_3	M	#XXh	
#30d	inputOutputControlParameter - LV_VAR_BN_LDM	M	#XXh	
#31d	inputOutputControlParameter - LV_VAR_BN_LTG_HDLP_L	M	#XXh	
#32d	inputOutputControlParameter - LV_VAR_LSH_DOWN	M	#XXh	
#33d	inputOutputControlParameter - LV_VAR_LSH_UP	M	#XXh	
#34d	inputOutputControlParameter - LV_VAR_ASR_4	M	#XXh	
#35d	inputOutputControlParameter - LV_VAR_MAF and LV_VAR_MAF_LEARNT	M	#XXh	
#36d	inputOutputControlParameter - LV_VAR_PSTE_2 and LV_VAR_PSTE_3 and STATE_PSTE_3_SRC	M	#XXh	
#37d	inputOutputControlParameter - LV_VAR_BN_EFP	M	#XXh	
#38d	inputOutputControlParameter - LV_SENS_BAT_SMT_DET	M	#XXh	
#39d	inputOutputControlParameter - LV_VAR_BN_TRL	M	#XXh	
#40d	inputOutputControlParameter - not supported	M	#FFh	
#41d	inputOutputControlParameter - not supported	M	#FFh	
#42d	inputOutputControlParameter - LV_VAR_NOX ( only MSD80/81) not supported ( other )	M	[#XXh, #FFh]	
#43d	inputOutputControlParameter - not supported	M	#FFh	
#44d	inputOutputControlParameter - LV_VAR_ETCU_SPT	M	#XXh	

#-d	inputOutputControlParameter - LV_VAR_TCT	M	#XXh	
#46d	inputOutputControlParameter - LV_VAR_AEB	M	#XXh	
#47d	inputOutputControlParameter - LV_VAR_TQ_PBR	M	#XXh	

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 7725 of 8404</b>	
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**Table InputOutputControlByCommonIdentifier request message  
InputOutputControlByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCL_
#3d	RecordCommonIdentifier Low Byte	M	#F2h	RCL_
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_RTD

Figure I.25.70: Table inputoutputcontrolByCommonIdentifier Positive Response Message

### I.25.39 2E\_5F\_F3\_04 Uebertemperatursicherung loeschen

#### General information:

The service sets the values for over temperature protection to default values.

#### Formula section:

**IF** service 2E\_5F\_F3\_04 is received

**THEN**

CTR_TOIL_MAX	=	00h
TOIL_MAX_WARN	=	00h
VS_TOIL_MAX	=	00h
N_TOIL_MAX	=	00h
GEAR_TOIL_MAX	=	00h
TQI_AV_TOIL_MAX	=	00h
TAM_TOIL_MAX	=	00h
TCO_TOIL_MAX	=	00h
DIST_TOIL_MAX	=	00h
PV_AV_TOIL_MAX	=	00h
LV_CS_TOIL_MAX	=	00h
TOIL_THD_TOIL_MAX	=	00h

**ELSE** the values keep unchanged

#### **WriteDataByCommonIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBC
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCL_UET
#3d	RecordCommonIdentifier Low Byte	M	#F3h	RCL_UET
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_RTD

Figure I.25.71: Table inputoutputcontrolByCommonIdentifier Request Message

#### **WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_UET
#3d	RecordCommonIdentifier Low Byte	M	#F3h	RCI_UET
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_RTD

Figure I.25.72: Table inputoutputcontrolByCommonIdentifier Positive Response Message

## I.25.40 2E\_5F\_F4\_04 Fusshebelwerk Fehlbedienung loeschen

### General information:

no description

### Additional Application conditions:

**Activation:** timeout time < 5s

**Deactivation:** timeout time >= 5s

### Formula section:

```

IF          service 2E_5F_F4_04 is received
THEN       timeout time = 0s
           LV_FHW_RST = 01h
ELSE
ENDIF     increment timeout time

```

```

IF          timeout time >= 5s
THEN       LV_FHW_RST = 00h
ELSE
ENDIF     LV_FHW_RST remains unchanged

```

### WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBC1
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_FHW
#3d	RecordCommonIdentifier Low Byte	M	#F4h	RCI_FHW
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_RTD

Figure I.25.73: Table inputoutputcontrolByCommonIdentifier Request Message

### WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCL_FHW
#3d	RecordCommonIdentifier Low Byte	M	#F4h	RCL_FHW
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_RTD

Figure I.25.74: Table inputoutputcontrolByCommonIdentifier Positive Response Message

## I.25.41 2E\_5F\_F5\_04 Powermanagement Histogramm loeschen

### General information:

With this comand the values described in the chapter Power Management are set to default values. All values are initialized with their default values (compare detailed specifications).

After the timeout time of 5s, the function ist stopped, and the value for LV\_POW\_MNG\_HIS\_RST is set to 00h;

### Additional Application conditions:

**Activation:** timeout ime < 5s

**Deactivation:** timeout time >= 5s

### Formula section:

**IF** service 2E\_5F\_F5\_04 is received

**THEN** timeout time = 0s

LV\_POW\_MNG\_HIS\_RST = 01h

**ELSE** increment timeout time

**ENDIF**

**IF** timeout time >= 5s

**THEN** LV\_POW\_MNG\_HIS\_RST = 00h

**ELSE** LV\_POW\_MNG\_HIS\_RST reains unchanged

**ENDIF**

### WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCL_HISR
#3d	RecordCommonIdentifier Low Byte	M	#F5h	RCL_HISR
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_RTD

Figure I.25.75: Table inputoutputcontrolByCommonIdentifier Request Message

### WriteDataByCommonIdentifier positive Response



Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_HISR
#3d	RecordCommonIdentifier Low Byte	M	#F5h	RCI_HISR
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_RTD

Figure I.25.76: Table inputoutputcontrolByCommonIdentifier Positive Response Message

## I.25.42 2E\_5F\_F6\_04 Ueberdrehzahlsicherung loeschen

### General information:

Detection of an overrevving event and non-volatile storage of:

- highest engine speed reached N\_MAX
- associated total running time in case of highest engine speed reached TRT\_N\_MAX
- event frequency counter CTR\_N\_MAX

An overrevving event starts at exceeding the engine speed C\_N\_LIM\_MIN and active engine speed limitation (LV\_N\_MAX = 1).

At each overrevving event, the event frequency counter is incremented by 1. The highest engine speed reached N\_MAX and the associated total running time in case of highest engine speed reached TRT\_N\_MAX is only overwritten if a higher engine speed was reached.

For this service authenticity is necessary.

### Additional Application conditions:

Activation: LV\_ES = 1 and  
authentication is necessary

Deactivation: LV\_ES= 0

### Formula section:

IF service 2E\_5F\_F6\_04 is received

THEN N\_MAX = 00h  
TRT\_N\_MAX = 00h  
CTR\_N\_MAX = 00h

ELSE the values keep unchanged

### WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_OVR
#3d	RecordCommonIdentifier Low Byte	M	#F6h	RCI_OVR
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_RTD

Figure I.25.77: Table inputoutputcontrolByCommonIdentifier Request Message

**WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCI PR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_OVR
#3d	RecordCommonIdentifier Low Byte	M	#F6h	RCI_OVR
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_RTD
#5d	Verify byte = 01h = ok Verify byte = 02h = not ok	M	#XXh	IOCP

Figure I.25.78: Table inputoutputcontrolByCommonIdentifier Positive Response Message

**I.25.43 2E\_5F\_F7\_00 Laufruheprüfung Vorgeben beenden****General information:**

no description

**Formula section:**

IF service 2E\_5F\_F7\_00 is received  
 THEN set STATE\_CMB\_CTL\_KWP = 00h  
 ELSE STATE\_CMB\_CTL\_KWP remains unchanged

**WriteDataByCommonIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_LRP
#3d	RecordCommonIdentifier Low Byte	M	#F7h	RCI_LRP
#4d	Inputoutputcontrolparameter	M	#00h	RV_RCTEC U

Figure I.25.79: Table inputoutputcontrolByCommonIdentifier Request Message

**WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_LRP
#3d	RecordCommonIdentifier Low Byte	M	#F7h	RCI_LRP

Figure I.25.80: Table inputoutputcontrolByCommonIdentifier Positive Response Message

## I.25.44 2E\_5F\_F7\_07 Laufruheprüfung vorgeben

### General information:

no description

### Formula section:

**IF** one of the bytes in the telegram is > 1h  
**THEN** send negative response code 31: requestOutOfRange  
**ELSE** built STATE\_CMB\_CTL\_NVMY\_KWP from telegram

### WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBC
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_LRP
#3d	RecordCommonIdentifier Low Byte	M	#F7h	RCI_LRP
#4d	Inputoutputcontrolparameter	M	#07h	RV_STA
#5d	recordValue#1 = STATE_CMB_CTL_KWP Bit 0	M	#XXh	STAT_GEMI SCHEINGRI FF_INAKTIV
#6d	recordValue#2 = STATE_CMB_CTL_KWP Bit 1	M	#XXh	STAT_ZUEN DWINKELEI NGRIFF_IN AKTIV
#7d	recordValue#3 = STATE_CMB_CTL_KWP Bit 2	M	#XXh	STAT_MINH UBEINGRIF F_INAKTIV
#8d	recordValue#4 = STATE_CMB_CTL_KWP Bit 3	M	#XXh	STAT_HUB EINGRIFF_I NAKTIV
#9d	recordValue#5 = dummy value fix	M	#00h	RV_LRP_BI T4
#10d	recordValue#6 = dummy value fix	M	#00h	RV_LRP_BI T5
#11d	recordValue#7 = dummy value fix	M	#00h	RV_LRP_BI T6
#12d	recordValue#8 = dummy value fix	M	#00h	RV_LRP_BI T7

Figure I.25.81: Table inputoutputcontrolByCommonIdentifier Request Message

### WriteDataByCommonIdentifier positive Response

<i>Data Byte</i>	<i>Parameter Name</i>	<i>Cvt</i>	<i>Hex Value</i>	<i>Mnemonic</i>
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_LRP
#3d	RecordCommonIdentifier Low Byte	M	#F7h	RCI_LRP

Figure I.25.82: Table inputoutputcontrolByCommonIdentifier Positive Response Message

## I.25.45 2E\_5F\_F7\_08 Laufruheprüfung programmieren

### General information:

no description

### Additional Application conditions:

**Initialisation:** STATE\_CMB\_CTL\_NVMY\_KWP at clearing NVMY with 00h else from NVMY

### Formula section:

**IF** one of the bytes in the telegram is > 1h  
**THEN** send negative response code 31: requestOutOfRange  
**ELSE** built STATE\_CMB\_CTL\_NVMY\_KWP from telegram

### WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBC1
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_LRP
#3d	RecordCommonIdentifier Low Byte	M	#F7h	RCI_LRP
#4d	Inputoutputcontrolparameter	M	#08h	RV_LTA
#5d	recordValue#1 = STATE_CMB_CTL_NVMY_KWP Bit 0	M	#XXh	STAT_GEMI SCHEINGRI FF_INAKTIV
#6d	recordValue#2 = STATE_CMB_CTL_NVMY_KWP Bit 1	M	#XXh	STAT_ZUEN DWINKELEI NGRIFF_IN AKTIV
#7d	recordValue#3 = STATE_CMB_CTL_NVMY_KWP Bit 2	M	#XXh	STAT_MINH UBEINGRIF F_INAKTIV
#8d	recordValue#4 = STATE_CMB_CTL_NVMY_KWP Bit 3	M	#XXh	STAT_HUB EINGRIFF_I NAKTIV
#9d	recordValue#5 = dummy value fix	M	#00h	RV_LRP_BI T4
#10d	recordValue#6 = dummy value fix	M	#00h	RV_LRP_BI T5
#11d	recordValue#7 = dummy value fix	M	#00h	RV_LRP_BI T6
#12d	recordValue#8 = dummy value fix	M	#00h	RV_LRP_BI T7

Figure I.25.83: Table inputoutputcontrolByCommonIdentifier Request Message

**WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBC1PR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_LRP
#3d	RecordCommonIdentifier Low Byte	M	#F7h	RCI_LRP

Figure I.25.84: Table inputoutputcontrolByCommonIdentifier Positive Response Message

**I.25.46 2E\_5F\_F8\_00 Homogenbetrieb vorgeben beenden****General information:**

When this service is received, the actuator diagnosis function stops and control is given back to the ECU control.


**Formula section:**

```

IF          service 2E_5F_F8_00 is received
THEN       STATE_HOM_AFS_REQ_EXT_ADJ = 00h
ELSE       STATE_HOM_AFS_REQ_EXT_ADJ remains unchanged
ENDIF

```

**WriteDataByCommonIdentifier Request**

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7733 of 8404	
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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_VH
#3d	RecordCommonIdentifier Low Byte	M	#F8h	RCI_VH
#4d	Inputoutputcontrolparameter	M	#00h	IOCP_RCTECU

Figure I.25.85: Table inputoutputcontrolByCommonIdentifier Request Message

**WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCI PR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F8h	RCI_
#4d	Inputoutputcontrolparameter	M	#00h	IOCP_RCTECU

Figure I.25.86: Table inputoutputcontrolByCommonIdentifier Positive Response Message

**I.25.47 2E\_5F\_F8\_07 Homogen vorgeben****General information:**

When this service is received, the request for operation mode is sent to the module "operation mode request from tester".

**Additional Application conditions:**

**Initialisation at reset or at LV\_IGK 1 -> 0:** STATE\_HOM\_AFS\_REQ\_EXT\_ADJ = 0

**Activation:** LV\_IS = 1

**Deactivation:** LV\_IS = 0

**Formula section:****WriteDataByCommonIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F8h	RCI_
#4d	Inputoutputcontrolparameter	M	#07h	IOCP_
#5d	recordValue #1 = STATE_HOM_AFS_REQ_EXT_ADJ (high byte)	M	#XXh	IOCP_
#6d	recordValue #2 = STATE_HOM_AFS_REQ_EXT_ADJ (low byte)	M	#XXh	IOCP_

Figure I.25.87: Table inputoutputcontrolByCommonIdentifier Request Message

**WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F8h	RCI_
#4d	Inputoutputcontrolparameter	M	#07h	IOCP_

Figure I.25.88: Table inputoutputcontrolByCommonIdentifier Positive Response Message

## I.25.48 2E\_C0\_01 Write k\_ews4 (STEUERN\_EWS)

### General information:

IMMO: Write STEUERN\_EWS4 (Save secret key to ECU)

A negativ response is possible by a wrong parameter and formula section.

### Formula section:

#### Only for boot sw-version:

```
If(1)      K_EWS4[0..255] > 0x0 and K_EWS4[0..255] < 0xFF (Blank Check Page 0)
Then(1)    "Negative Response: KWP_RC_CNCORSE"
           break
```

#### Else(1)

```
If(2)      "record value#1" = 0x3
```

```
Then(2)    IMOB_KWP_K_EWS4 [0..15] = "record value#2..#17"
```

```
If(2a) IMOB_KWP_K_EWS4 [0-15] != 0xFF or 0x0 (all data not 0 or max.)
```

```
Then(2a)   IMOB_KWP_K_EWS4_TMP0[0-15] =
            IMOB_KWP_K_EWS4[0-15] xor 0xFF
```

```
"Positive Response"
```

```
Else(2a)   "Negative Response"
```

```
Endif(2a)
```

#### Else(2)

```
If(3)      "record value#1" = 0x1
```

#### Then(3)

```
If(4)      IMOB_KWP_K_EWS4[0..15] !=
```

```
            IMOB_KWP_K_EWS4_TMP0[0..15] xor 0xFF
```

```
Then(4)    "Negative Response: KWP_RC_CNCORSE"
```

```
break
```

```
Else(4)    "Positive Response"
```

#### Flash:

```
IMOB_KWP_K_EWS4[0..15]
```

```
IMOB_KWP_K_EWS4_1[0..15] xor 0xFF
```

```
IMOB_KWP_K_EWS4_2[0..15] xor 0xAA
```

#### Endif(4)

```
Else(3)    "Negative Response: KWP_RC_SFNS_IF"
```

```
Endif(3)
```

```
Endif(2)
```

```
Endif(1)
```

Only for ECU sw-version:

```

If(1)     STATE_IMOB_K_EWS = NC_K_EWS_UNLOCKED
           and IMOB_NR_VLD_K_EWS4 < NC_K_EWS_MAX
Then(1)
           If(2)     "record value#1" = 0x3
           Then(2)
               IMOB_KWP_K_EWS4 [0..15] = "record value#2..#17"
               If(2a) IMOB_KWP_K_EWS4 [0-15] != 0xFF or 0x0 (all data not 0 or max.)
               Then(2a)     IMOB_KWP_K_EWS4_TMP0[0-15] =
                           IMOB_KWP_K_EWS4[0-15] xor 0xFF
                           send "Positive Response"
               Else(2a)     send "Negative Response"
               Endif(2a)
               ACTION_ECM3_DisableReq           (disable MU for storage)

           Else(2) If(3)     "record value#1" = 0x1
           Then(3)
               If(4)     IMOB_KWP_K_EWS4[0..15] !=
                           IMOB_KWP_K_EWS4_TMP0[0..15] xor 0xAA
           Then(4)     "Negative Response: KWP_RC_CNCORSE"
                       break
           Else(4)     send "Positive Response"
                       Flash: k_ews4[at next free block]
                           (storage place depending on
                               imob_nr_vld_k_ews4)
                           IMOB_KWP_K_EWS4[0-15]
                           IMOB_KWP_K_EWS4_1[0-15] xor 0xFF
                           IMOB_KWP_K_EWS4_2[0-15] xor 0xAA
                       Flash: imob_config_ews4[0-3]
                           imob_config_ews4_1[0-3] xor 0xFF
                           imob_config_ews4_2[0-3] xor 0xAA

           Endif(4)
           Else(3)     "Negative Response: KWP_RC_SFNS_IF"
           Endif(3)

       Endif(2)
Else(1)     "Negative Response: KWP_RC_CNCORSE"
Endif(1)

```

### WriteDataByCommonIdentifier Request



Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier	M	#C0h	RCI_TSP
#3d	RecordCommonIdentifier	M	#01h	RCI_TSP
#4d	recordValue#1 = IMOB_KWP_MODE_BYTE	M	#xxh	RV_PST
#5d	recordValue#2 = IMOB_KWP_K_EWS4[0]	M	#xxh	RV_PST
#6d	recordValue#3 = IMOB_KWP_K_EWS4[1]	M	#xxh	RV_PST
#7d	recordValue#4 = IMOB_KWP_K_EWS4[2]	M	#xxh	RV_PST
#8d	recordValue#5 = IMOB_KWP_K_EWS4[3]	M	#xxh	RV_PST
#9d	recordValue#6 = IMOB_KWP_K_EWS4[4]	M	#xxh	RV_PST
#10d	recordValue#7 = IMOB_KWP_K_EWS4[5]	M	#xxh	RV_PST
#11d	recordValue#8 = IMOB_KWP_K_EWS4[6]	M	#xxh	RV_PST
#12d	recordValue#9 = IMOB_KWP_K_EWS4[7]	M	#xxh	RV_PST
#13d	recordValue#10 = IMOB_KWP_K_EWS4[8]	M	#xxh	RV_PST
#14d	recordValue#11 = IMOB_KWP_K_EWS4[9]	M	#xxh	RV_PST
#15d	recordValue#12 = IMOB_KWP_K_EWS4[10]	M	#xxh	RV_PST
#16d	recordValue#13 = IMOB_KWP_K_EWS4[11]	M	#xxh	RV_PST
#17d	recordValue#14 = IMOB_KWP_K_EWS4[12]	M	#xxh	RV_PST
#18d	recordValue#15 = IMOB_KWP_K_EWS4[13]	M	#xxh	RV_PST
#19d	recordValue#16 = IMOB_KWP_K_EWS4[14]	M	#xxh	RV_PST
#20d	recordValue#17 = IMOB_KWP_K_EWS4[15]	M	#xxh	RV_PST

Figure I.25.89: WriteDataByCommonIdentifier positive Response

**WriteDataByCommonIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCI PR
#2d	RecordCommonIdentifier High Byte	M	#C0h	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#01h	RCI_

Figure I.25.90: Table inputoutputcontrolByCommonIdentifier Positive Response Message

## I.26 SID 33h: requestRoutineResultsByLocalIdentifier Service

### Input data:

B_diagigr {p. 8283}	B_maregdk_ad {p. 8344}	B_mareghub_ad {p. 797}	B_psragr_ad {p. 8346}
Eco_jobstat1 {p. 8156}	Eco_result1 {p. 8156}	INH_IV_KWP {p. 7482}	Klann_test1 {p. 8159}
Klann_test2 {p. 8159}	Krnn_test {p. 8159}	LV_CDN_DIAG_EFF_IGA_CST_IS {p. 6517}	LV_CDN_DIAG_EFF_IGA_CST_PL {p. 6517}
LV_CH_SO2P_WOUT_LIM {p. 3144}	LV_DIAG_CST_ACT {p. 6508}	LV_IGK {p. 906}	LV_INH_DIAG_EFF_IGA_CST {p. 6508}
LV_INH_LAM_KWP {p. 7483}	LV_KWP_PROG_DATA {p. 803}	LV_POW_MNG_MES_MOD {p. 7483}	LV_SO2P_REQ_2 {p. 3073}
Mrnn_test_dk {p. 8162}	Mrnn_test_pr {p. 8162}	Mrnn_test_vvt {p. 806}	NT_SUL {p. 3113}
Prnn_test_agr {p. 8165}	STATE_CH {p. 1777}	STATE_EOL_DGNC_CH_DIAG {p. 6508}	T_AST {p. 1766}
TCO_ST {p. 1100}			

### General information:

All implemented SID 33h services are described below.

## I.26.1 Overview of supported subservices:

SID number	service	Service location	MSD_81 (4cyl)	MSD_81 (6cyl)
33_25	read INH_IV_KWP - Diagnos Status EV-Ausblendung	ECU	X	X
33_2B	Read result Ruhestrom Test	ECU	X	X
33_2F	Auslesen Desulfatisierung Fahrbetrieb	ECU	X	X
33_3A	Read result CSERS-Diagnose	ECU	X	X
33_D9	Read Status: switch off lambda controller	ECU	X	X
33_E0	Auslesen Eisy- Adaptionswerte (ungedrosselt)	ECU	-	-
33_E1	Auslesen Eisy- Adaptionswerte (gedrosselt)	ECU	X	X
33_E2	Auslesen Eisy- Adaptionswerte (gedrosselt mit Abgasrueckfuehrung)	ECU	X	X
33_E3	Auslesen Krann- Adaptionswerte	ECU	X	X
33_E4	Auslesen Klann-Adaptionswerte	ECU	X	X
33_E5	Auslesen AGR-Adaptionswerte	ECU	X	-
33_F0	Report results of checksum calculation for INCA PC	ECU	-	-
33_F1	Report results of programming the calibration data for INCA PC in the power latch phase	ECU	-	-
33_F6	Report Status: Steuern Messemode stop default value	ECU	X	X
33_F7	report results of Intelligente Generatorregelung	ECU	X	X

## I.26.2 Global negative Responses

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	NegativeResponse Service Id	M	#7Fh	NR
#2d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.26.1: Table RequestRoutineResultsByLocalIdentifier Negative Response Message

### Remark:


The detailed message of the negative response code is described in chapter "Introduction".

## I.26.3 33\_25 Read INH\_IV\_KWP -diagnosis status EV-Ausblendung - requestRoutineResultsByLocalIdentifier

### General information:

With this service the tester can ask for the results of the -diagnosis status EV-Ausblendung

### Application conditions

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**Initialisation:** *at reset*

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off)  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

### RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLLI
#2d	RoutineLocalIdentifier	M	#25h	RELI_

Figure I.26.2: Table RequestRoutineResultsByLocalIdentifier Request Message

### RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLLIPR
#2d	RoutineLocalIdentifier	M	#25h	RELI_
#3d	RecordValue#3 = INH_IV_KWP	M	#XXh	RRS_

Figure I.26.3: Table RequestRoutineResultsLocalIdentifier Positive Response Message

### RequestRoutineResultsByLocalIdentifier negative Response

Global Negative Responses

## I.26.4 33\_2B Read result Ruhestrom Test

### General information:

With this service the tester can ask for the results of "Ruhestromprüfung mit IBS"

### Application conditions

**Initialisation:** *at reset*

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off)  
Diagnostic timeout


**Service location:** see list of implemented diagnostic services

### RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLLI
#2d	RoutineLocalIdentifier	M	#2Bh	RELI_RUHESTR OM

Figure I.26.4: Table RequestRoutineResultsByLocalIdentifier Request Message

### RequestRoutineResultsByLocalIdentifier positive Response

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7740 of 8404	
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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier	M	#2Bh	RELI_
#3d	RecordValue#1 = Eco_jobstat1	M	#XXh	RRS_FS_RU HESTROM
#4d	RecordValue#2 = Eco_result1 (high byte)	M	#XXh	RRS_RUHES TROM
#5d	RecordValue#3 = Eco_result1 (low byte)	M	#XXh	RRS_RUHES TROM

Figure I.26.5: Table RequestRoutineResultsLocalIdentifier Positive Response Message

**RequestRoutineResultsByLocalIdentifier negative Response**

Global Negative Responses

**I.26.5 33\_2F Read result Desulfatisierung Fahrbetrieb****General information:**

With this service the tester can ask for the results of "Desulfatisierung Fahrbetrieb"

**Application conditions****Initialisation:***at reset***Activation:**

LV\_IGK=1 (Kl.15 on)

**Deactivation:**LV\_IGK=0 (Kl.15 off)  
Diagnostic timeout**Service location:**

diagnostic services

see list of implemented

**RequestRoutineResultsByLocalIdentifier Request**


Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#2d	RoutineLocalIdentifier	M	#2Fh	RELI_DESFAHR

Figure I.26.6: Table RequestRoutineResultsByLocalIdentifier Request Message

**RequestRoutineResultsByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier	M	#2Fh	RELI_DESFA HR
#3d	RecordValue#1 = LV_CH_SO2P_WOUT_LIM	M	#XXh	RRS_ LV_CH_SO2P _WOUT_LIM
#4d	RecordValue#2 = NT_SUL (high byte)	M	#XXh	RRS_NT_SUL
#5d	RecordValue#3 = NT_SUL (low byte)	M	#XXh	RRS_NT_SUL
#6d	RecordValue#4 = LV_SO2P_REQ_2			

Figure I.26.7: Table RequestRoutineResultsLocalIdentifier Positive Response Message

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7741 of 8404	
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## RequestRoutineResultsByLocalIdentifier negative Response Global Negative Responses

### I.26.6 33\_3A Read result CSERS-Diagnose

#### Formula section:

```

If(1)           service 33,3A is received
Then(1)
                send positive response
Endif(1)
    
```

#### RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLLI
#2d	RoutineLocalIdentifier	M	#3Ah	RELI_ZGH

Figure I.26.8: Table RequestRoutineResultsByLocalIdentifier Request Message

#### RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLLIPR
#2d	RoutineLocalIdentifier	M	#3Ah	RELI_ZGH
#3d	RecordValue#1 = STATE_EOL_DGNC_CH_DIAG	M	#XXh	RRS_
#4d	RecordValue#2 = LV_DIAG_CST_ACT	M	#XXh	RRS_
#5d	RecordValue#3 = LV_INH_DIAG_EFF_IGA_CST	M	#XXh	RRS_
#6d	RecordValue#4 = STATE_CH	M	#XXh	RRS_
#7d	RecordValue#5 = T_AST (high byte)	M	#XXh	RRS_
#8d	RecordValue #6 = T_AST (low byte)	M	#XXh	RRS_
#9d	RecordValue #7 = TCO_ST	M	#XXh	RRS_
#10d	RecordValue #8 = LV_CDN_DIAG_EFF_IGA_CST_IS	M	#XXh	RRS_
#11d	RecordValue #9 = LV_CDN_DIAG_EFF_IGA_CST_PL	M	#XXh	RRS_

Figure I.26.9: Table RequestRoutineResultsLocalIdentifier Positive Response Message

## RequestRoutineResultsByLocalIdentifier negative Response Global Negative Responses

### I.26.7 33\_D9 Read status: switch off lambda controller- requestRoutineResults-ByLocalIdentifier


#### General information:

With this service the tester can ask for switch off lambda controller by KWP-service.

#### Application conditions

```

Initialisation:           at reset
Activation:              LV_IGK=1 (K1.15 on)
Deactivation:           LV_IGK=0 (K1.15 off)
    
```

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	Document key 10171571 SPE 000 AO	Pages Page 7742 of 8404	
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Diagnostic timeout  
**Service location:** see list of implemented  
diagnostic services

**RequestRoutineResultsByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#2d	RoutineLocalIdentifier	M	#D9h	RELI_

Figure I.26.10: Table RequestRoutineResultsByLocalIdentifier Request Message

**RequestRoutineResultsByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier	M	#D9h	RELI_
#3d	RecordValue#1 = LV_INH_LAM_KWP	M	#XXh	RRS_

Figure I.26.11: Table RequestRoutineResultsLocalIdentifier Positive Response Message

**RequestRoutineResultsByLocalIdentifier negative Response**

Global Negative Responses

**I.26.8 33\_E0 Auslesen Eisy- Adaptionswerte (ungedrosselt)**

**General information:**

With this service the tester can ask for the results of the Eisy- adaption.

**Application conditions**

**Initialisation:** at reset

**Activation:** LV\_IGK=1 (K1.15 on)

**Deactivation:** LV\_IGK=0 (K1.15 off)  
Diagnostic timeout

**Service location:** see list of implemented  
diagnostic services

**RequestRoutineResultsByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#2d	RoutineLocalIdentifier	M	#E0h	RELI_EISYUGD

Figure I.26.12: Table RequestRoutineResultsByLocalIdentifier Request Message

**RequestRoutineResultsByLocalIdentifier positive Response**

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier	M	#E0h	RELI_EISYUGD
#3d	RecordValue#1 = B_mareghub_ad	M	#XXh	RRS_FS_EISYUGD
#4d	RecordValue#2 = Mrnn_test_vvt high byte	M	#XXh	RRS_MRNN_TEST_VVT
#5d	RecordValue#3 = Mrnn_test_vvt low byte	M	#XXh	RRS_MRNN_TEST_VVT

Figure I.26.13: Table RequestRoutineResultsLocalIdentifier Positive Response Message

### RequestRoutineResultsByLocalIdentifier negative Response Global Negative Responses

## I.26.9 33\_E1 Auslesen Eisy- Adaptionswerte (gedrosselt)

### General information:

With this service the tester can ask for the results of the Eisy- adaption.

### Application conditions

**Initialisation:** *at reset*

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off)  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

### RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#2d	RoutineLocalIdentifier	M	#E1h	RELI_EISYGD

Figure I.26.14: Table RequestRoutineResultsByLocalIdentifier Request Message

### RequestRoutineResultsByLocalIdentifier positive Response



Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifierValue	M	#E1h	RELI_EISYGD
#3d	RecordValue#1 = B_maregdk_ad	M	#XXh	RRS_FS_EISYGD
#4d	RecordValue#2 = Mrnn_test_dk high byte	M	#XXh	RRS_MRNN_TEST_DK
#5d	RecordValue#3 = Mrnn_test_dk low byte	M	#XXh	RRS_MRNN_TEST_DK

Figure I.26.15: Table RequestRoutineResultsLocalIdentifier Positive Response Message

**RequestRoutineResultsByLocalIdentifier negative Response**

Global Negative Responses

**I.26.10 33\_E2 Auslesen Eisy- Adaptionswerte (gedrosselt mit Abgasrueckfuehrung)****General information:**

With this service the tester can ask for the results of the Eisy- adaption.

**Application conditions**

**Initialisation:** *at reset*

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off)  
Diagnostic timeout

**Service location:** *see list of implemented diagnostic services*

**RequestRoutineResultsByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLLI
#2d	RoutineLocalIdentifier	M	#E2h	RELI_EISYGDA GR

Figure I.26.16: Table RequestRoutineResultsByLocalIdentifier Request Message

**RequestRoutineResultsByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifierValue	M	#E2h	RELI_EISYGD AGR
#3d	RecordValue#1 = B_maregdk_ad	M	#XXh	RRS_FS_ EISYGD
#4d	RecordValue#2 = Mrnn_test_pr high byte	M	#XXh	RRS_ MRNN_TEST _PR
#5d	RecordValue#3 = Mrnn_test_pr low byte	M	#XXh	RRS_ MRNN_TEST _PR

Figure I.26.17: Table RequestRoutineResultsLocalIdentifier Positive Response Message

### RequestRoutineResultsByLocalIdentifier negative Response Global Negative Responses

## I.26.11 33\_E3 Auslesen Krann- Adaptionswerte

### General information:

With this service the tester can ask for the results of the KRANN- adaption.

### Application conditions

**Initialisation:** `at reset`

**Activation:** `LV_IGK=1 (Kl.15 on)`

**Deactivation:** `LV_IGK=0 (Kl.15 off)`  
`Diagnostic timeout`

**Service location:** `see list of implemented  
diagnostic services`

### RequestRoutineResultsByLocalIdentifier Request


Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#2d	RoutineLocalIdentifier	M	#E3h	RELI_KRANN

Figure I.26.18: Table RequestRoutineResultsByLocalIdentifier Request Message

### RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifierValue	M	#E3h	RELI_KRANN
#3d	RecordValue#1 = dummy value fix	M	#FFh	RRS_FS_KRA NN
#4d	RecordValue#2 = Krnn_test high byte	M	#XXh	RRS_KRNN_ TEST
#5d	RecordValue#3 = Krnn_test low byte	M	#XXh	RRS_ KRNN_TEST

Figure I.26.19: Table RequestRoutineResultsLocalIdentifier Positive Response Message

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## RequestRoutineResultsByLocalIdentifier negative Response

### Global Negative Responses

## I.26.12 33\_E4 Auslesen Klann- Adaptionswerte

### General information:

With this service the tester can ask for the results of the KLANN- adaption.

### Application conditions

**Initialisation:** *at reset*

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off)  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

### RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#2d	RoutineLocalIdentifier	M	#E4h	RELI_KLANN

Figure I.26.20: Table RequestRoutineResultsByLocalIdentifier Request Message

### RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifierValue	M	#E4h	RELI_KLANN
#3d	RecordValue#1 = dummy value fix	M	#FFh	RRS_FS_KLANN
#4d	RecordValue#2 = Klann_test1 high byte	M	#XXh	RRS_KLNN_READ_AD_1
#5d	RecordValue#3 = Klann_test1 low byte	M	#XXh	RRS_KLANN_READ_AD_1
#6d	RecordValue#2 = Klann_test2 high byte	M	#XXh	RRS_KLNN_READ_AD_2
#7d	RecordValue#3 = Klann_test2 low byte	M	#XXh	RRS_KLANN_READ_AD_2

Figure I.26.21: Table RequestRoutineResultsLocalIdentifier Positive Response Message

## RequestRoutineResultsByLocalIdentifier negative Response

### Global Negative Responses

## I.26.13 33\_E5 Auslesen AGR - Adaptionswerte

### General information:

With this service the tester can ask for the results of the AGR- adaption.

## Application conditions

**Initialisation:** *at reset*

**Activation:** LV\_IGK=1 (K1.15 on)

**Deactivation:** LV\_IGK=0 (K1.15 off)  
Diagnostic timeout

**Service location:** *see list of implemented diagnostic services*

## RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLLI
#2d	RoutineLocalIdentifier	M	#E5h	RELI_EISYAGR

Figure I.26.22: Table RequestRoutineResultsByLocalIdentifier Request Message

## RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLLIPR
#2d	RoutineLocalIdentifierValue	M	#E5h	RELI_EISYAGR
#3d	RecordValue#1 = B_psrgr_ad	M	#FFh	RRS_FS_EISYAGR
#4d	RecordValue#2 = Prnn_test_agr high byte	M	#XXh	RRS_PRNN_TEST_AGR
#5d	RecordValue#3 = Prnn_test_agr low byte	M	#XXh	RRS_PRNN_TEST_AGR

Figure I.26.23: Table RequestRoutineResultsLocalIdentifier Positive Response Message

## RequestRoutineResultsByLocalIdentifier negative Response

Global Negative Responses

## I.26.14 33\_F0 Report results of checksum calculation for IncaPC

### General information:

With this service the tester can ask for the results of the checksum calculation, which is started with the service 31\_F0.

If the checksum is equal to the checksum, which is given by 31\_F0, the ECU reports a positive response. Otherwise a negative response is sent.

### Application conditions

**Initialisation:** *at reset*

**Activation:** LV\_IGK=1 (K1.15 on)

**Deactivation:** LV\_IGK=0 (K1.15 off)  
Diagnostic timeout

**Service location:** *see list of implemented diagnostic services*

### RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#2d	RoutineLocalIdentifier = checksum calculation for IncaPC	M	#F0h	RELI_

Figure I.26.24: Table RequestRoutineResultsByLocalIdentifier Request Message

### RequestRoutineResultsByLocalIdentifier positive Response (= equal checksums)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = checksum calculation for IncaPC	M	#F0h	RELI_

Figure I.26.25: Table RequestRoutineResultsLocalIdentifier Positive Response Message

### RequestRoutineResultsByLocalIdentifier negative Response

Global Negative Responses

## I.26.15 33\_F1 Report results of programming the calibration data in the power latch of IncaPC

### General information:

With this service the tester can ask for the results of the programming process of the calibration data in the power latch, which is started with the service 31\_F1

Please consider that the calibration data are programmed at the end of the power latch phase. That means the ECU is not able to send the positive response for finishing the programming of the calibration data.

### Application conditions

**Initialisation:** *at reset*

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off)  
Diagnostic timeout

**Service location:** *see list of implemented diagnostic services*

### RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#2d	RoutineLocalIdentifier = programming of calibration data in the power latch phase for IncaPC	M	#F1h	RELI_

Figure I.26.26: Table RequestRoutineResultsByLocalIdentifier Request Message

### RequestRoutineResultsByLocalIdentifier positive Response (= equal checksums)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	<b>RequestRoutineResultsByLocalIdentifier Positive Response</b>	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = programming of calibration data in the power latch phase for IncaPC	M	#F1h	RELI_
#3d	Programming of calibration data not yet requested: If (lv_kwp_prog_data = 0) => status = #84h IGK is still on: If (lv_kwp_prog_data=1 AND lv_igk=1) => status = #80h ECU will start the programming in the power latch phase: If (lv_kwp_prog_data=1 AND lv_igk=0) => status = #82h	M	#XXh	

Figure I.26.27: Table RequestRoutineResultsLocalIdentifier Positive Response Message

**RequestRoutineResultsByLocalIdentifier negative Response**

Global Negative Responses

**I.26.16 33\_F6 Read status: PM-Messmode- requestRoutineResultsByLocalIdentifier****General information:**

With this service the tester can ask the state of PM-Messmode

**Application conditions****Initialisation:** at reset**Activation:** LV\_IGK=1 (Kl.15 on)**Deactivation:** LV\_IGK=0 (Kl.15 off)  
Diagnostic timeout**Service location:** see list of implemented  
diagnostic services**RequestRoutineResultsByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	<b>RequestRoutineResultsByLocalIdentifier Request Service Id</b>	M	#33h	RRRBLI
#2d	RoutineLocalIdentifier	M	#F6h	RELI_

Figure I.26.28: Table RequestRoutineResultsByLocalIdentifier Request Message

**RequestRoutineResultsByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	<b>RequestRoutineResultsByLocalIdentifier Positive Response</b>	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier	M	#F6h	RELI_
#3d	RecordValue#1 = LV_POW_MNG_MES_MOD	M	#XXh	RRS_

Figure I.26.29: Table RequestRoutineResultsLocalIdentifier Positive Response Message

**RequestRoutineResultsByLocalIdentifier negative Response**

Global Negative Responses

## I.26.17 33\_F7 Report results of Intelligente Generatorregelung

### General information:

With this service the tester can ask for the status Intelligente Generatorregelung , which is started with the service 31\_F7

### Application conditions

**Initialisation:** at reset

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off)  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

### RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#2d	RoutineLocalIdentifier = Intelligente Generatorregelung	M	#F7h	RELI_IGR_OFF

Figure I.26.30: Table RequestRoutineResultsByLocalIdentifier Request Message

### RequestRoutineResultsByLocalIdentifier positive Response (= equal checksums)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = Intelligente Generatorregelung	M	#F7h	RELI_IGR_OFF
#3d	RecordValue#1 = #05h if B_diagigr = 1 or #00h if B_diagigr = 0	M	#XXh	PRS_FS_IGR_OFF

Figure I.26.31: Table RequestRoutineResultsLocalIdentifier Positive Response Message

### RequestRoutineResultsByLocalIdentifier negative Response

#### Global Negative Responses

## I.27 SID 34h: requestDownload Service

### Input data:

LV_IGK {p. 906}			
-----------------	--	--	--

### General information:

This function is used for reprogramming the ECU.

Flash reprogramming is done with the following procedure:

RequestDownload, TransferData, ..., RequestTransferExit, RequestDownload, TransferData, ..., RequestTransferExit.

This means at memory address gaps during the programming session the transfer data service is finished with RequestTransferExit service. Resumption is done with a new RequestDownload-Service.

### Application conditions

**Initialisation:** *at reset*

**Activation:** K1.15 on

**Deactivation:** K1.15 off  
Diagnostic timeout

Service location: see "list of implemented diagnostic services"

### I.27.1 RequestDownload Request (3-byte addressing)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestDownload Request Service Id	M	#34h	RD
#2d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#3d	MemoryAddress (Middle Byte)	M	#XXh	MA_MB
#4d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
(#5d)	MemoryTypeIdentifier (optional) [ external FLASH internal FLASH ]	U	#XXh [ #02h #06h ]	MTI
#5d / (#6d)	DataFormatIdentifier [uncompresses]	M	#00h	DFI
#6d / (#7d)	UncompressedMemorySize [High Byte]	M	#00h...#FFh	UCMS
#7d / (#8d)	UncompressedMemorySize [Middle Byte]	M	#00h...#FFh	UCMS
#8d / (#9d)	UncompressedMemorySize [Low Byte]	M	#00h...#FFh	UCMS

Figure I.27.1: Table RequestDownload Request Message



## I.27.2 RequestDownload Request (4-byte addressing)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestDownload Request Service Id	M	#34h	RD
#2d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#3d	MemoryAddress (MiddleHigh Byte)	M	#XXh	MA_MHB
#4d	MemoryAddress (MiddleLow Byte)	M	#XXh	MA_MLB
#5d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
#6d	MemoryTypeIdentifier ( <b>mandatory, but not evaluated</b> ) [ 00h ... FFh ]	M	#XXh [ #XXh ]	MTI
#7d	DataFormatIdentifier [uncompresses]	M	#00h	DFI
#8d	UncompressedMemorySize [High Byte]	M	#00h...#FFh	UCMS
#9d	UncompressedMemorySize [MiddleHigh Byte]	M	#00h...#FFh	UCMS
#10d	UncompressedMemorySize [MiddleLow Byte]	M	#00h...#FFh	UCMS
#11d	UncompressedMemorySize [Low Byte]	M	#00h...#FFh	UCMS

Figure I.27.2: Table RequestDownload Request Message

### Remark:

For **3-byte addressing** independent from delivery of a MemoryTypeIdentifier (byte 5) by the tester s request, the ECU automatically adds an offset to the requested memory address.

If no MemoryTypeIdentifier is delivered, the same offset as for MemoryTypeIdentifier 00h (linear addressing) is used. Currently a download to this memory area is not allowed, it will be supported later on for supplier-Revival download within a restricted memory area and additional security check.

For compatibility reasons both MemoryTypeIdentifiers (02h ext. FLASH /06h int. FLASH) are supported and add the same memory offset.

This base memory offset must be subtracted from any memory address taken from the MAP- /A2L- file if 3-byte addressing is used!

For **4-byte addressing** a MemoryTypeIdentifier (byte 6) must be delivered by the tester s request.

Though it is not evaluated or used within the ECU for this absolute addressing mode, it is necessary to decide between 3- /4-byte addressing mode.

In this 4-byte mode the absolute address delivered by the tester is used by the ECU without any memory offset.

For MSx80 (TriCore) the base memory offsets for **3-byte addressing** mode of this service are:

MemoryTypeIdentifier:	Memory offset:	
none (linear)	C000 0000h	supported for supplier-Revival download later on
02h (ext. FLASH)	8000 0000h	
06h (int. FLASH)	8000 0000h	

### I.27.3 RequestDownload positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestDownload Positive Response Service Id	M	#74h	RDPR
#2d	TransferResponseParameter=[maxNumberOfBlockLength]	M	#XXh	TREP_ MNROBL

Figure I.27.3: Table RequestDownload Positive Response Message

### I.27.4 RequestDownload negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	RequestDownload Request Service Id	M	#34h	RD
#3d	responseCode= [ general response code, download not allowed, conditins for programming not fulfilled ]	M	#XXh= [ #XXh, #40h, #22h ]	RC

Figure I.27.4: Table RequestDownload Negative Response Message

## I.28 SID 36h: transferData Service

### General information:

This funktion is for exchanging data after a request upload or download service.

### Application conditions

**Initialisation:** `at reset`

**Activation:** `Kl.15 on`

**Deactivation:** `Kl.15 off`  
`Diagnostic timeout`  
`Service location: Boot-/ ECU-SW`  
**TransferData Request after a request upload service**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	transferData Request Service Id	M	#36h	TD

Figure I.28.1: Table TransferData Request Message after request upload

### TransferData positive Response after a request upload service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	transferData Positive Response Service Id	M	#76h	TDPR
#2d	Data 1	M	#XXh	
#3d	Data 2	M	#XXh	
#nd	Data n	M	#XXh	

Figure I.28.2: Table TransferData Positive Response Message after request upload

### TransferData negative Response after a request upload service


Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	TransferData Request Service Id	M	#36h	TD
#3d	responseCode= [ general response code all bytes are uploaded ]	M	#XXh= [ #XXh, #53h, ]	RC

Figure I.28.3: Table TransferData Negative Response Message after request upload

### TransferData Request after a request download service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	transferData Request Service Id	M	#36h	TD
#2d	Data 1	M	#XXh	
#3d	Data 2	M	#XXh	
#nd	Data n	M	#XXh	

Figure I.28.4: Table TransferData Request Message after request download

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7755 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

### TransferData positive Response after a request download service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	transferData Positive Response Service Id	M	#76h	TDPR
#2d	number of transfer commands since 1. request high_Byte	M	#XXh	TDPR
#3d	number of transfer commands since 1. request low_Byte	M	#XXh	TDPR
#4d	status byte [ reprogramming ok reprogramming not ok. ]	M	#XXh [ #01h, #02h ]	TDPR

Figure I.28.5: Table TransferData Positive Response Message after request download

### TransferData negative Response after a request download service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	<b>NegativeResponse Service Id</b>	<b>M</b>	<b>#7Fh</b>	<b>NR</b>
#2d	TransferData Request Service Id	M	#36h	TD
#3d	ResponseCode= [ general response code conditions not correct ]	M	#XXh= [ #XXh, #22h, ]	RC

Figure I.28.6: Table TransferData Negative Response Message after request download

Time	client (Tester)	server (ECU)
P3	transferData.Request#1[...]	
P2		transferData.PositiveResponse#1[...]
P3	transferData.Request#2[...]	
P2		transferData.PositiveResponse#2[...]
.	.	.
.	.	.
.	.	.
P3	transferData.Request#n[...]	
P2		transferData.PositiveResponse#n[...]

Figure I.28.7: Table transferData Message Flow

## I.29 SID 37h: requestTransferExit Service

### Input data:

LV_IGK {p. 906}			
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### General information:

This function is necessary to stop the RequestDownload /RequestUpload process.

**Remark:** Ending a reprogramming session. There are no new informations since the last transfer data available, therefore it is not necessary to transmit a verify byte.

### Application conditions

**Initialisation:** *at reset*

**Activation:** Kl.15 on

**Deactivation:** Kl.15 off  
Diagnostic timeout  
Service location: see "list of implemented diagnostic services"

### I.29.1 RequestTransferExit Request (short form)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestTransferExit	M	#37h	RTE

Figure I.29.1: Table RequestTransferExit Request Message

### I.29.2 RequestTransferExit Request (3-byte addressing)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestTransferExit	M	#37h	RTE
#2d	Download / Upload MemoryAddress (High Byte) <b>(not evaluated)</b>	U	#XXh	MA_HB
#3d	Download / Upload MemoryAddress (Middle Byte) <b>(not evaluated)</b>	U	#XXh	MA_MB
#4d	Download / Upload MemoryAddress (Low Byte) <b>(not evaluated)</b>	U	#XXh	MA_LB
(#5d)	Download / Upload MemoryAddress (Low Byte) <b>(not evaluated)</b>	U	#XXh	MTI
#5d / (#6d)	MemoryTypeIdentifier <b>(not evaluated)</b>	U	#00h	DFI
#6d / (#7d)	UncompressedMemorySize [High Byte] <b>(not evaluated)</b>	U	#00h...#FFh	UCMS
#7d / (#8d)	UncompressedMemorySize [Middle Byte] <b>(not evaluated)</b>	U	#00h...#FFh	UCMS
#8d / (#9d)	UncompressedMemorySize [Low Byte] <b>(not evaluated)</b>	U	#00h...#FFh	UCMS

Figure I.29.2: Table RequestTransferExit Request Message

### I.29.3 RequestTransferExit Request (4-byte addressing)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestTransferExit	M	#37h	RTE
#2d	Download / Upload MemoryAddress (High Byte) (not evaluated)	U	#XXh	MA_HB
#3d	Download / Upload MemoryAddress (MiddleHigh Byte) (not evaluated)	U	#XXh	MA_MHB
#4d	Download / Upload MemoryAddress (MiddleLow Byte) (not evaluated)	U	#XXh	MA_MLB
#5d	Download / Upload MemoryAddress (Low Byte) (not evaluated)	U	#XXh	MA_LB
#6d	MemoryTypeIdentifier (mandatory, but not evaluated)	U	#XXh	MTI
#7d	DataFormatIdentifier [uncompresses] (not evaluated)	U	#00h	DFI
#8d	UncompressedMemorySize [High Byte] (not evaluated)	U	#00h...#FFh	UCMS
#9d	UncompressedMemorySize [MiddleHigh Byte] (not evaluated)	U	#00h...#FFh	UCMS
#10d	UncompressedMemorySize [MiddleLow Byte] (not evaluated)	U	#00h...#FFh	UCMS
#11d	UncompressedMemorySize [Low Byte] (not evaluated)	U	#00h...#FFh	UCMS

Figure I.29.3: Table RequestTransferExit Request Message

#### Remark:

No additional formal parameters are evaluated. The only criteria checked is the request length.

Accepted request lengths and telegram formats are:

1 byte: SID

8 bytes: SID, Addr3, Addr2, Addr1, DFI, Size3, Size2, Size1

9 bytes: SID, Addr3, Addr2, Addr1, MTI, DFI, Size3, Size2, Size1

11 bytes: SID, Addr4, Addr3, Addr2, Addr1, MTI, DFI, Size4, Size3, Size2, Size1

This service is only accepted after all previously defined data transfer (by RequestDownload /RequestUpload) is done, i.e. no more data is left from TransferData service.

### I.29.4 RequestTransferExit positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestTransferExit PositiveResponse	M	#77h	PR

Figure I.29.4: Table RequestTransferExit Positive Response Message

### I.29.5 RequestTransferExit negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	NegativeResponse Service Id	M	#7Fh	NR
#2d	RequestTransferExit Service Id	M	#37h	RTE
#3d	ResponseCode=General response code Upload / Download not complete	M	#XXh #22h	RC

Figure I.29.5: Table RequestTransferExit Negative Response Message

## I.30 SID 3Dh: writeMemoryByAddress Service

### Input data:

LV_IGK {p. 906}			
-----------------	--	--	--

### General information:

This function is used for writing values into the ECU's memory

### Application conditions

**Initialisation:** *at reset*

**Activation:** Kl.15 on

**Deactivation:** Kl.15 off  
Diagnostic timeout  
Service location: see "list of implemented diagnostic services"

### I.30.1 WriteMemoryByAddress Request (3-byte addressing)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteMemoryByAddress Request	M	#3Dh	WMBA
#2d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#3d	MemoryAddress (Middle Byte)	M	#XXh	MA_MB
#4d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
(#5d)	MemoryTypeIdentifier (optional) [ external FLASH internal FLASH user information field UIF ]	U	#XXh [ #02h #06h #07h ]	MTI
#5d / (#6d)	MemorySize	M	#1h...#FAh	MS
#6d / (#7d)	RecordValue #1	M	#XXh	RV
...	...	...	...	
#nd	RecordValue #m	U	#XXh	

Figure I.30.1: Table WriteMemoryByAddress Request Message

## I.30.2 WriteMemoryByAddress Request (4-byte addressing)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	<b>WriteMemoryByAddress Request</b>	<b>M</b>	<b>#3Dh</b>	<b>WMBA</b>
#2d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#3d	MemoryAddress (MiddleHigh Byte)	M	#XXh	MA_MHB
#4d	MemoryAddress (MiddleLow Byte)	M	#XXh	MA_MLB
#5d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
#6d	MemoryTypeldentifier ( <b>mandatory, but not evaluated</b> ) [ 00h ... FFh ]	M	#XXh [ #XXh ]	MTI
#7d	MemorySize	M	#1h...#FAh	MS
#8d	RecordValue #1	M	#XXh	RV
...	...	...	...	
#nd	RecordValue #m	U	#XXh	

Figure I.30.2: Table WriteMemoryByAddress Request Message

### Remark:

For **3-byte addressing** independent from delivery of a MemoryTypeldentifier (byte 5) by the tester's request, the ECU automatically adds an offset to the requested memory address.

If no MemoryTypeldentifier is delivered, the same offset as for MemoryTypeldentifier 00h (linear addressing) is used.

This base memory offset must be subtracted from any memory address taken from the MAP- /A2L- file if 3-byte addressing is not sufficient for the address range!

For **4-byte addressing** a MemoryTypeldentifier (byte 6) must be delivered by the tester's request.

Though it is not evaluated or used within the ECU for this absolute addressing mode, it is necessary to decide between 3- /4-byte addressing mode.

In this 4-byte mode the absolute address delivered by the tester is used by the ECU without any memory offset.

For MSx80 (TriCore) the base memory offsets for **3-byte addressing** are:

**MemoryTypeldentifier:      Memory offset:**

02h (ext. FLASH)              8000 0000h (the same as for int. FLASH)

06h (int. FLASH)              8000 0000h

07h (UIF)                      8000 xxxxh not fixed yet, address might still change !!!

Boot Software Active			ECU Software Active		
Memory ID	Range (absolute addr.)	Security Level	Memory ID	Range (absolute addr.)	Security Level
02h (ext. FLASH)	8000 xxxxh ... 8000 xxxxh	None	02h (ext. FLASH)	8000 xxxxh ... 8000 xxxxh	None
06h (int. FLASH)	8000 xxxxh ... 8000 xxxxh	None	06h (int. FLASH)	8000 xxxxh ... 8000 xxxxh	None
07h (UIF)	8000 xxxxh ... 8000 xxxxh	None	07h (UIF)	8000 xxxxh ... 8000 xxxxh	None

Figure I.30.3: Table call conditions writeMemoryByAddress



### I.30.3 WriteMemoryByAddress positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	<b>WriteMemoryByAddress Positive Response</b>	<b>M</b>	<b>#7Dh</b>	<b>WMBAPR</b>
#2d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#3d	MemoryAddress (Middle Byte)	M	#XXh	MA_MB
#4d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
(#5d)	MemoryTypeIdentifier ( <b>optional</b> ) [ external FLASH internal FLASH user information field UIF ]	U	#XXh [ #02h #06h #07h ]	MTI

Figure I.30.4: Table WriteMemoryByAddress Positive Response Message

### I.30.4 WriteMemoryByAddress negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	<b>negativeResponse Service Id</b>	<b>S</b>	<b>#7Fh</b>	<b>NR</b>
#2d	writeMemoryByAddressRequest Service Id	M	#3Dh	WMBA
#3d	responseCode=general response code]	M	#XXh	RC

Figure I.30.5: Table WriteMemoryByAddress Negative Response Message

## I.31 SID 3Eh: testerPresent Service

### Input data:

LV_IGK {p. 906}		
-----------------	--	--

### General information:

This funktion is for keeping KWP2000 communication alive.

### Application conditions

**Initialisation:** *at reset*

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off)  
Diagnostic timeout

**Service location:** Boot-/ ECU-SW

**TesterPresent Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	<b>testerPresent Request Service Id</b>	M	#3Eh	TP
#2d	testerPresent Request Service Id [ no parameter or #01h: ECU shall send a positive response #02h: ECU shall not send a positive response ]  <b>Remark:</b> A negative response shall be sent in any case if an error occurs	M	#XXh [ -- / #01h, #02h ]	TP

Figure I.31.1: Table testerPresent Request Message

### TesterPresent positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	<b>testerPresent Positive Response Service Id</b>	M	#7Eh	TPPR

Figure I.31.2: Table testerPresent Positive Response Message

### TesterPresent negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	<b>negativeResponse Service Id</b>	M	#7Fh	NR
#2d	inputOutputControlByLocalIdentifier Request SId	M	#3Eh	IOBLID
#3d	responseCode=only general respons code	M	#XXh	RC

Figure I.31.3: Table InputOutputControlByLocalIdentifier negative response message

## I.32 Special test mode

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_gentestanf	O/V	0... 1H	0 ...1	1	-
Bedingung Testeransteuerung Generator					
B_testpoelsys	O/V	0... 1H	0 ...1	1	-
Flag indicating "Diagnosefunktion Oeldruckregelung"					
LAMB_SP_EXT_ADJ [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Bank selective external lambda-setpoint (EOL test)					
LV_ACT_ECRAS_EOL_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Bit indicating activated ECRAS System test					
LV_ACT_N_SP_IS_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
LV for displace N_SP_IS					
LV_ACT_SA_EOL	O/V	0... 1H	0 ...1	1	-
Activation bit for secondary air EOL test					
LV_ACT_VLS_EOL_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
LV for start EOL test: Lambda sensors confused /not wired					
LV_EOL_CPS	O/V	0... 1H	0 ...1	1	-
LV for the end of line test CPS					
LV_LAM_AD_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Request of "Sperr Tankentlueftung"					
LV_LAMB_SP_EXT_ADJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag to activate bank selective external lambda-setpoint (EOL test)					
LV_NT_SO2P_EXT_ADJ_REQ_NOT_STOP	O/V	0... 1H	0 ...1	1	-
request STOP desulfation by tester ( 0 -stop )					
LV_NT_SO2P_EXT_ADJ_REQ_ST	O/V	0... 1H	0 ...1	1	-
request START desulfation by tester ( 1-start )					
LV_POIL_EXT_ADJ_ACT	O/V	0... 1H	0 ...1	1	-
Flag indicating active oil pressure diagnosis function					
LV_TCHA_DIAG_EXT_REQ	O/V	0... 1H	0 ...1	1	-
external request by tester for diagnosis of ATL					
N_SP_IS_EXT_ADJ	O/V	0... 1FE0H	0... 8160	1	rpm
idle speed setpoint from the tester					
STATE_EOL_KWP_CPS	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9HH	NOT_START ST_INH PAR_ NOT_PLAUS WAIT_REL UNDEF ACT END_WOUT_ RESULT ABORTED END_WOUT_ ERR END_WITH_ ERR	-	-
State variable for EOL test: CPS					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_EOL_KWP_DMTL	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9HH	NOT_START ST_INH PAR_ NOT_PLAUS WAIT_REL UNDEF ACT END_WOUT_ RESULT ABORTED END_WOUT_ ERR END_WITH_ ERR	-	-
State variable for end of line test DMTL					
STATE_EOL_KWP_ECRAS	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9HH	NOT_START ST_INH PAR_ NOT_PLAUS WAIT_REL UNDEF ACT END_WOUT_ RESULT ABORTED END_WOUT_ ERR END_WITH_ ERR	-	-
State variable for EOL test: Ecras system test					
STATE_EOL_KWP_N_SP_IS	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9HH	NOT_START ST_INH PAR_ NOT_PLAUS WAIT_REL UNDEF ACT END_WOUT_ RESULT ABORTED END_WOUT_ ERR END_WITH_ ERR	-	-
State variable for displace N_SP_IS					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_EOL_KWP_SA	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9HH	NOT_START ST_INH PAR_ NOT_PLAUS WAIT_REL UNDEF ACT END_WOUT_ RESULT ABORTED END_WOUT_ ERR END_WITH_ ERR	-	-
Status of SA EOL diagnosis					
STATE_EOL_KWP_VLS	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9HH	NOT_START ST_INH PAR_ NOT_PLAUS WAIT_REL UNDEF ACT END_WOUT_ RESULT ABORTED END_WOUT_ ERR END_WITH_ ERR	-	-
State variable for EOL test: Lambda sensors confused /not wired					
STATE_EOL_KWP_VVL_AD	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9HH	NOT_START ST_INH PAR_ NOT_PLAUS WAIT_REL UNDEF ACT END_WOUT_ RESULT ABORTED END_WOUT_ ERR END_WITH_ ERR	-	-
State variable for EOL - VVL adaptation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_NT_SO2P_EXT_ADJ	O/V	0H 1H	FAST ALTERNATING	-	-
Additional information for desulfation mode by external request from tester					

**Input data:**

AMP {p. 982}	Atlsvc_dpvdk1 {p. 8154}	Atlsvc_dpvdk2 {p. 8154}	Atlsvc_dpvdk3 {p. 8154}
B_kupp {p. 8343}	C_N_MAX_KWP {p. 7439}	C_TCO_MIN_VLS_EOL {p. 8129}	C_TEG_CAT_DOWN_EOL {p. 8129}
C_VS_MAX_KWP {p. 7439}	CTL_SHIFT_LOCK_CAN {p. 1563}	CTR_NS_SHIFT_CYC_ NOT_VLD [NC_NOX_SENS_CONF] {p. 6425}	CTR_NS_SHIFT_CYC_ VLD [NC_NOX_SENS_CONF] {p. 6425}
CUR_DMTL_COR_FIL_ EOL {p. 5960}	CUR_DMTL_REF_LEAK_ EOL {p. 5960}	CUR_DMTL_ROUGH_ LEAK_MIN_EOL {p. 5960}	EGY_DEW_END_NT {p. 3181}
EGY_DEW_END_NT_INT {p. 3181}	Gangi {p. 8394}	Gangi_roh	GEAR {p. 1302}
GEAR_INFO {p. 1564}	Genitest_tol {p. 8158}	Geniutest_ab {p. 8158}	l_gentest {p. 8158}
LAMB_LS_UP_AFL_EOL [NC_CBK_EX_NR] {p. 8128}	LAMB_LS_UP_AFR_EOL [NC_CBK_EX_NR] {p. 8128}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LAMB_SP_SA_EOL
LAMB_SP_VLS_EOL [NC_CBK_EX_NR] {p. 8128}	LC_SA_SWI_ACQ {p. 1088}	LV_ACT_VLS_EOL {p. 8128}	LV_AT {p. 654}
LV_BRAKE_DET {p. 4209}	LV_CAN_TEMP_MIN_THD [NC_NOX_SENS_CONF] {p. 1399}	LV_CDN_VB_MIN_DIAG {p. 1185}	LV_CLU_SWI {p. 996}
LV_CONF_DMTL {p. 654}	LV_CS {p. 8394}	LV_CUR_DMTL_REF_DIF_ MAX {p. 5963}	LV_CUR_DMTL_THD_DIF_ MES {p. 5963}
LV_DET_FUC_OPEN {p. 5963}	LV_DET_REFU {p. 5963}	LV_DIAG_ACT_INH_LS_ UP_DOWN [NC_CBK_EX_NR] {p. 5407}	LV_ECRAS_DOWN_EXT_ ADJ {p. 7433}
LV_ECRAS_EOL_INH {p. 3863}	LV_ECRAS_UP_EXT_ADJ {p. 7433}	LV_ENA_LEAK_DMTL {p. 5964}	LV_END_DIAG_DIAGCPS {p. 5926}
LV_END_DIAG_SA_SAFM {p. 800}	LV_END_DIAG_SA_SAP {p. 800}	LV_END_DIAG_SA_SAV {p. 800}	LV_END_DIAG_SA_SYS {p. 800}
LV_EOL_CPS_ERR {p. 5926}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CHG_LS_UP {p. 5416}
LV_ERR_CRK {p. 4455}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_ECRAS_EOL {p. 3863}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}

LV_ERR_FTL_MIN {p. 4762}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_ERR_MAF {p. 4815}
LV_ERR_PUT_EL {p. 4828}	LV_ERR_SA_SAFM {p. 801}	LV_ERR_SA_SAP {p. 801}	LV_ERR_SA_SAV {p. 801}
LV_ERR_SA_SAV_LSL {p. 801}	LV_ERR_SA_SYS {p. 802}	LV_ERR_SAP {p. 802}	LV_ERR_SAV {p. 802}
LV_ERR_TCO {p. 4496}	LV_FCT_LIH_SA	LV_IGK {p. 906}	LV_INH_DIAGCPS {p. 5954}
LV_IS {p. 1720}	LV_LAM_AD_ENA {p. 3737}	LV_LAM_AD_END {p. 2642}	LV_LAMB_LS_UP_VLD [NC_CBK_EX_NR] {p. 2352}
LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_MAF_SP_TQI_DYW_ DIAGCPS {p. 5927}	LV_MIS_STATE_A {p. 6238}	LV_MIS_STATE_B {p. 6238}
LV_PL {p. 1720}	LV_ST_END {p. 1720}	LV_T_DMTL_MAX {p. 5967}	LV_TEMP_MAX_SAP_ COIL {p. 805}
LV_VAR_AMT {p. 655}	LV_VAR_TCT {p. 656}	LV_VB_DIF_MAX {p. 5967}	LV_VB_JUMP {p. 1185}
LV_VB_RANGE_DMTL {p. 5967}	MAF_INT_MIN_VLS_EOL {p. 8128}	N {p. 1525}	N_32 {p. 1525}
NC_MAP_SENS_NR	NC_NOX_SENS_CONF {p. 643}	Nkw {p. 8215}	Nkw_poel_soll {p. 8163}
NT_SUL {p. 3113}	OPM_AV {p. 8137}	OPM_AV_DIAGCPS {p. 5954}	P_oel_ist {p. 8203}
P_oel_soll {p. 8165}	Pu {p. 8278}	PV {p. 978}	Pwg_ist {p. 8190}
SAF_DIAG_MAX {p. 807}	SAF_DIAG_MIN {p. 807}	St_alsvc	St_atlsvc_pvdk {p. 8169}
St_gentest {p. 8171}	St_testpoelsys {p. 8174}	St_testpoelsys2 {p. 8174}	STATE_DIAG_SA_LS
STATE_DIAG_SA_SAFM {p. 808}	STATE_DIAGCPS {p. 5927}	STATE_DMTL {p. 5969}	STATE_DMTL_EOL {p. 5970}
STATE_ECRAS_SYS {p. 3863}	STATE_EOL_KWP_NS_ SHIFT_DIAG [NC_NOX_SENS_CONF] {p. 6427}	STATE_KWP_SO2P {p. 3144}	STATE_KWP_SRV_AD_ REQ_VVL
STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}	STATE_LSH_UP [NC_CBK_EX_NR] {p. 2385}	STATE_NS_SHIFT_DIAG [NC_NOX_SENS_CONF] {p. 6427}	STATE_NT_SO2P_EXT_ ADJ_ACT {p. 3144}
STATE_VLS_EOL {p. 8128}	SUM_AFL_VLS_DIAG_ SA_1	SUM_AFL_VLS_DIAG_ SA_2	SUM_DIAG_DIAGCPS_ EOL {p. 5928}
SUM_FLOW_SP_ DIAGCPS_EOL {p. 5928}	T_NS_SHIFT_DEAC_ TEMP [NC_NOX_SENS_CONF] {p. 6427}	T_NS_SHIFT_WAIT_REP [NC_NOX_SENS_CONF] {p. 6427}	T_NT_SO2P_EXT_ADJ_ ACT {p. 3144}

TAM {p. 1579}	TCO {p. 1100}	TEG_CAT_DOWN_MDL {p. 8236}	TEG_WALL_NT_DOWN_ MDL {p. 8237}
TIA {p. 1226}	Tmot {p. 8226}	Tn_abstell {p. 8221}	TNT_MDL_L {p. 8237}
TNT_MDL_MV {p. 8237}	Toel {p. 8177}	U_gentest {p. 8179}	V {p. 979}
VLS_DOWN_AFL_EOL [NC_CBK_EX_NR] {p. 8128}	VLS_DOWN_AFR_EOL [NC_CBK_EX_NR] {p. 8128}	VS {p. 1176}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_MIN_SA_EOL	-	0... FEH	-48... 142.5	0.75	°C
TCO Threshold for EOL activation					

**Hint for MSV80: In STATE\_EOL\_KWP\_... is 0H = ACT and 5H = NOT\_START**

ACTION_NOXD_StartNNShiftDiag()
ACTION_NOXD_EndNNShiftDiag()



### I.32.1 Overview of implemented subservices

SID number	service	MSV_80	MSD_80 (4-cyl)	MSD_80 (6-cyl)	MSD_81 (4-cyl)	MSD_81 (6-cyl)	MSD85 (L4)
21_20	Read Status EOL: Secondary air system	X	-	-	-	-	-
21_22	Read Status EOL: CPS	X	-	-	-	-	-
21_26	Read Status EOL: Idle speed setpoint displace	X	-	-	-	-	-
21_27	Read Status EOL: VVL adaption	X	-	-	-	-	-
21_D5	Read Status EOL: ECRAS system test	X	X	X	X	X	X
21_DA	Read Status EOL: DMTL	X	-	-	-	-	-
21_DF	Read Status EOL: Lambda sensors confused / wrong wired	X	-	-	-	-	-
31_20	EOL Test ON: Secondary air system						
31_22	EOL Test ON: CPS	X	X	X	X	X	X
31_26	EOL Test ON: Idle speed setpoint displace	X	X	X	X	X	X
31_27	start VVL Adaptation	X	-	-	-	-	-
31_2A	Start intelligent alternator test	X	X	X	X	X	X
31_2C	Start EOL test: Oil Pressure Regulation Diagnosis	X	X	X	X	X	-
31_2D	Start EOL test: Desulfatisierung	-	X	X	X	X	-
31_33	Start EOLtest: NOX-SensorShiftDiagnosis	-	X	X	X	X	-
31_CF	Start : Sperre Tankentlueftung	-	X	X	X	X	-
31_D0	Start: Werkstattdiagnose ATL	-	X	X	X	X	X
31_D5	EOL Test ON: ECRAS system test	X	X	X	X	X	X
31_DA	EOL Test ON: DMTL	X	-	X	-	X	X
31_DF	EOL Test ON: Lambda sensors confused / wrong wired	X	X	X	X	X	X
32_20	EOL Test OFF: Secondary air system	X	-	-	-	-	X
32_22	EOL Test OFF: CPS	X	X	X	X	X	X
32_26	EOL Test OFF: Idle speed setpoint displace	X	X	X	X	X	X
32_27	Stop EOL - VVL Adaptation	X	-	-	-	-	-
32_2A	Stop intelligent alternator test	X	X	X	X	X	X
32_2C	Stop EOL test: Oil Pressure Regulation Diagnosis	X	X	X	X	X	-
32_2D	Stop EOL test: Desulfatisierung	-	X	X	X	X	-
32_33	Stop EOLtest: NOX-SensorShiftDiagnosis	-	X	X	X	X	-
32_CF	Stop : Sperre Tankentlueftung	-	X	X	X	X	-
32_D0	Stop: Werkstattdiagnose ATL	-	X	X	X	X	X

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32_D5	Stop EOL: ECRAS system test	X	X	X	X	X	X
32_DA	EOL Test OFF: DMTL	X	-	X	-	X	X
32_DF	EOL Test OFF: Lambda sensors confused / wrong wired	X	X	X	X	X	X
33_20	Report EOL results: Secondary air system	X	-	-	-	-	X
33_22	Report EOL results: CPS	X	X	X	X	X	X
33_26	Report EOL results: Idle speed setpoint displace	X	X	X	X	X	X
33_27	Read Status EOL: VVL adaptation	X	-	-	-	-	-
33_2A	Read Status: intelligent alternator test	X	X	X	X	X	X
33_2C	Read Status EOL test: Oil Pressure Regulation Diagnosis	X	X	X	X	X	-
33_2D	Read status EOL test: Desulfatisierung	-	X	X	X	X	-
33_33	Read Status EOL-test: NOX-SensorShiftDiagnosis	-	X	X	X	X	-
33_CF	Read Status : Sperre Tankentlueftung	-	X	X	X	X	-
33_D0	Read Status: Werkstattdiagnose ATL	-	X	X	X	X	X
33_D5	Read Status EOL: ECRAS system test	X	X	X	X	X	X
33_DA	Report EOL results: DMTL	X	-	X	-	X	X
33_DF	Report EOL results: Lambda sensors confused / wrong wired	X	X	X	X	X	X

## I.32.2 Lambda- setpoint for external adjustment

### FUNCTION DESCRIPTION:

#### General information:

This function is for shifting the lambda-setpoint in the lambda coordination to fulfill requests of external adjustment /EOL diagnosis.

i=1 for cylinder bank 1 and i = 2 for cylinder bank 2

#### Description:

The lambda-setpoint LAMB\_SP\_EXT\_ADJ[i] is calculated as long as the activation bits:

- LV\_ACT\_VLS\_EOL //Lambda setpoint shifting for lambda sensor EOL test
- LV\_ACT\_SA\_EOL //Lambda setpoint shifting for secondary air EOL test


are active. The bit are set/reset by customer tool.

#### Application conditions

**Initialisation:** LV\_LAMB\_SP\_EXT\_ADJ[i] = 0  
LAMB\_SP\_EXT\_ADJ[i] = 1  
at LV\_IGK =1 **or** ECU reset

**Recurrence:** 20ms

**Activation:** LV\_IGK = 1

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**Formula section:**

Lambda setpoint shifting for lambda sensor EOL test

```

If                LV_ACT_VLS_EOL = 1
Then             LV_LAMB_SP_EXT_ADJ[i]= 1                //bank 1 and bank 2
                  LAMB_SP_EXT_ADJ[i] = LAMB_SP_VLS_EOL[i]
    
```

Lambda setpoint shifting for secondary air EOL test

```

Elseif          LV_ACT_SA_EOL = 1
Then            LV_LAMB_SP_EXT_ADJ_[i] = 1                //bank 1 and bank 2
                  LAMB_SP_EXT_ADJ[i] = LAMB_SP_SA_EOL
    
```

Lambda setpoint shifting passive

```

Else           LV_LAMB_SP_EXT_ADJ_[i] = 0                //bank 1 and bank 2
                  LAMB_SP_EXT_ADJ[i] = 1
Endif
    
```

**I.32.3 Services 21\_20 /31\_20 /32\_20 /33\_20 for end of line test: SA-system test**

**FUNCTION DESCRIPTION:**

**General information:**

The EOL test is performed in order to check the SA system in the factory or in the workshop. If EOL test is active (LV\_ACT\_EOL\_SA = 1) then secondary air function (Pump and Valve) and the configured diagnosis (depending of LC\_SA\_SWI\_ACQ) is activated as long as EOL is requested or diagnosis is finished.

**Description:**

The EOL test contain the services:

- **21\_20 - Read Status EOL- test**
- **31\_20 - EOL Test start**
- **32\_20 - EOL Test stop**
- **33\_20 - Report EOL test results**

**Application conditions**

**Initialisation:**                   at LV\_IGK 0->1 or reset  
   STATE\_EOL\_KWP\_SA = NOT\_START  
   LV\_ACT\_SA\_EOL = 0

**Recurrence:**                       *same as SA function*


**Activation:**                       see following chapter  
   *Service location:*                       ECU-SW

**I.32.3.1 Secondary air system diagnosis through SAF-meter (SAFM)**

**Description:**

This service is only performed if                   **LC\_SA\_SWI\_ACQ = 1**

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### I.32.3.1.1 21\_20 Read Status EOL- test - SA-system - ReadDataByLocalIdentifier service

#### ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = SA-system test	M	#20h	RELI_

Figure I.32.1: Table readDataByLocalIdentifier Request Message

#### ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier = SA-system test	M	#20h	RELI_
#3d	RecordValue = STATE_EOL_KWP_SA [ MSV70:function active , MSx80:function not started yet conditions not correct parameter not correct funciton waiting not used MSV70: function not started yet, MSx80: function active function finished, no result function stopped function finished, no error function finished, error present ]	M	#XXh [ #00h, #01h, #02h #03h #04h #05h, #06h #07h #08h #09h ]	RV_

Figure I.32.2: Table readDataByLocalIdentifier Positive Response Message

#### ReadDataByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLID
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.3: Table: readDataByLocalIdentifier Negative Response Message

#### Formula section:

The determination of STATE\_EOL\_KWP\_SA is stopped if EOL-test is stopped by tester request (service 32\_20). In this case STATE\_EOL\_KWP\_SA = NOT\_START).

```

If          LV_ACT_SA_EOL = 1
Then       If          LV_IS = 0                               or
                LV_FCT_LIH_SA = 1                             or
                LV_VB_JUMP = 1                               or
                LV_TEMP_MAX_SAP_COIL = 1                     or
                LV_ERR_MAF = 1                               or
                LV_ERR_AMP = 1                               or
                LV_ERR_AMP_PLAUS = 1                         or
                LV_ERR_TCO = 1                               or
                LV_ERR_CRK = 1                               or
                LV_ERR_FTL_MIN = 1                           or
    
```

```

                LV_MIS_STATE_A = 1           or
                LV_MIS_STATE_B = 1           or
                LV_ERR_SAV = 1               or
                LV_ERR_SAP = 1               or
                LV_ERR_LOAD_TPS_PLAUS = 1
    Then          LV_ACT_SA_EOL = 0
                STATE_EOL_KWP_SA = 1H       //conditions not correct
    Elseif        LV_ERR_SA_SAFM = 1
    Then          LV_ACT_SA_EOL = 0
                STATE_EOL_KWP_SA = 9H       //function finished, error present
    Elseif        LV_ERR_SA_SAV = 1           or
                LV_ERR_SA_SYS = 1
    Then          LV_ACT_SA_EOL = 0
                STATE_EOL_KWP_SA = 9H       //function finished, error present
    Elseif        LV_END_DIAG_SA_SAV = 1     and
                LV_END_DIAG_SA_SYS = 1     and
                LV_END_DIAG_SA_SAFM = 1    and
                LV_ERR_SA_SAV = 0         and
                LV_ERR_SA_SYS = 0         and
                LV_ERR_SA_SAFM = 0
    Then          LV_ACT_SA_EOL = 0
                STATE_EOL_KWP_SA = 8H       //function finished, no error
    Endif
Else            no change
Endif

```


### I.32.3.1.2 31\_20 EOL Test start - SA-system test - StartRoutineByLocalIdentifier service

#### Formula section:

```

If              request 31_20 is received   and
                LV_IS = 1                   and
                TCO > C_TCO_MIN_SA_EOL     and
                LV_VB_JUMP = 0              and
                LV_TEMP_MAX_SAP_COIL = 0    and
                LV_ERR_SA_SAFM = 0         and
                LV_ERR_SA_SYS = 0          and
                LV_ERR_SA_SAV = 0          and
                LV_ERR_MAF = 0              and
                LV_ERR_AMP = 0              and
                LV_ERR_AMP_PLAUS = 0        and
                LV_ERR_TCO = 0              and
                LV_ERR_CRK = 0              and
                LV_ERR_FTL_MIN = 0          and
                LV_MIS_STATE_A = 0         and
                LV_MIS_STATE_B = 0         and
                LV_ERR_SAV = 0              and
                LV_ERR_SAP = 0              and
                LV_ERR_LOAD_TPS_PLAUS = 0   and
                (STATE_DIAG_SA_SAFM = SAFM_DIAG_END or SAFM_DIAG_CNL)
Then           LV_ACT_SA_EOL = 1
                STATE_EOL_KWP_SA = ACT     //active

```

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```
Else      STATE_EOL_KWP_SA = 1H      //conditions not correct
Endif
```

### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= start EOL Test - SA-system test	M	#20h	RELI_

Figure I.32.4: Table StartRoutineByLocalIdentifier Request Message

### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = EOL Test SA-system test	M	#20h	RELI_
#3d	routineEntryStatus = EOL Test active	M	ACT	REYS_01

Figure I.32.5: Table StartRoutineByLocalIdentifier Positive Response Message

### StartRoutineByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.6: Table StartRoutineByLocalIdentifier Negative Response Message

### I.32.3.1.3 32\_20 EOL Test OFF - SA-system test - StopRoutineByLocalIdentifier service

#### Formula section:

```
If      request 32_20 is received
Then    LV_ACT_SA_EOL = 0
        STATE_EOL_KWP_SA = NOT_START      //function not started
Endif
```

### StopRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#2d	RoutineLocalIdentifier = stop EOL Test SA-system test	M	#20h	RELI_

Figure I.32.7: Table StopRoutineByLocalIdentifier Request Message

### StopRoutineByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = stop EOL Test SA-system test	M	#20h	RELI_
#3d	routineEntryStatus = EOL Test inactive	M	NOT_START	REYS_01

Figure I.32.8: Table StopRoutineByLocalIdentifier Positive Response Message

**StopRoutineByLocalIdentifier negative Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.32.9: Table StopRoutineByLocalIdentifier Negative Response Message

**I.32.3.1.4 33\_20 - Report EOL results - SA-system test - RequestRoutineResultsByLocalIdentifier service****RequestRoutineResultsByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#2d	RoutineLocalIdentifier = ask for results SA-system test	M	#20h	RELI_

Figure I.32.10: Table RequestRoutineResultsByLocalIdentifier Request Message

**Not for MSD80: RequestRoutineResultsByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = SA-system test	M	#20h	RELI_
#3d	RecordValue = STATE_DIAG_SA_SAFM	M	#XXh	RELI_
#4d	RecordValue = SAF_DIAG_MIN high byte	M	#XXh	RELI_
#5d	RecordValue = SAF_DIAG_MIN low byte	M	#XXh	RELI_
#4d	RecordValue = SAF_DIAG_MAX high byte	M	#XXh	RELI_
#5d	RecordValue = SAF_DIAG_MAX low byte	M	#XXh	RELI_

Figure I.32.11: Table RequestRoutineResultsLocalIdentifier Positive Response Message

**Only for MSD80: RequestRoutineResultsByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = SA-system test	M	#20h	RELI_
#3d	RecordValue = STATE_EOL_KWP_SA	M	#XXh	RELI_
#4d	RecordValue = STATE_DIAG_SA_SAFM	M	#XXh	RELI_
#5d	RecordValue = SAF_DIAG_MIN high byte	M	#XXh	RELI_
#6d	RecordValue = SAF_DIAG_MIN low byte	M	#XXh	RELI_
#7d	RecordValue = SAF_DIAG_MAX high byte	M	#XXh	RELI_
#8d	RecordValue = SAF_DIAG_MAX low byte	M	#XXh	RELI_

Figure I.32.12: Table RequestRoutineResultsLocalIdentifier Positive Response Message

**RequestRoutineResultsByLocalIdentifier negative Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	NegativeResponse Service Id	M	#7Fh	NR
#2d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.32.13: Table RequestRoutineResultsByLocalIdentifier Negative Response Message

**I.32.3.2 Secondary air system diagnosis through lambda sensor (LISL)**

**Description:**

This service is only performed if **LC\_SA\_SWI\_ACQ = 0**

**I.32.3.2.1 21\_20 Read Status EOL- test - SA-system - ReadDataByLocalIdentifier service**

**ReadDataByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = SA-system test	M	#20h	RELI_

Figure I.32.14: Table readDataByLocalIdentifier Request Message

**ReadDataByLocalIdentifier positive Response on service**

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier = SA-system test	M	#20h	RELI_
#3d	RecordValue = STATE_EOL_KWP_SA [ MSV70:function active , MSx80:function not started yet conditions not correct parameter not correct funciton waiting not used MSV70: function not started yet, MSx80: function active function finished, no result function stopped function finished, no error function finished, error present ]	M	#XXh [ #00h, #01h, #02h, #03h, #04h, #05h, #06h, #07h, #08h, #09h ]	RV_

Figure I.32.15: Table readDataByLocalIdentifier Positive Response Message

**ReadDataByLocalIdentifier negative Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLID
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.16: Table: readDataByLocalIdentifier Negative Response Message

**Formula section:**

The determination of STATE\_EOL\_KWP\_SA is stopped if EOL-test is stopped by tester request (service 32\_20). In this case STATE\_EOL\_KWP\_SA = NOT\_START.

```

If          LV_ACT_SA_EOL = 1
Then
  If          LV_IS = 0
    or
    LV_FCT_LIH_SA = 1
    or
    LV_VB_JUMP = 1
    or
    LV_TEMP_MAX_SAP_COIL = 1
    or
    LV_ERR_AMP = 1
    or
    LV_ERR_AMP_PLAUS = 1
    or
    LV_ERR_TCO = 1
    or
    LV_ERR_CRK = 1
    or
    LV_ERR_FTL_MIN = 1
    or
    LV_MIS_STATE_A = 1
    or
    LV_MIS_STATE_B = 1
    or
    LV_ERR_SAV = 1
    or
    LV_ERR_SAP = 1
    or
    LV_ERR_FSD[i] = 1
    or
    LV_ERR_LS_UP[i] = 1
    or
    LV_ERR_CHG_LS_UP = 1
    or
    LV_ERR_MAF = 1
  Then          LV_ACT_SA_EOL = 0
                STATE_EOL_KWP_SA = 1H
                //conditions not correct
  Elseif       LV_ERR_SA_SAV = 1
    or
    LV_ERR_SA_SAP = 1
  
```

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```

Then      LV_ACT_SA_EOL = 0
          STATE_EOL_KWP_SA = 9H           //function finished, error present
Elseif    LV_END_DIAG_SA_SAP = 1         and
          LV_ERR_SA_SAV = 0              and
          LV_ERR_SA_SAP = 0              and
Then      LV_ACT_SA_EOL = 0
          STATE_EOL_KWP_SA = 8H         //function finished, no error
Endif
Else      no change
Endif
    
```

### I.32.3.2.2 31\_20 EOL Test start - SA-system test - StartRoutineByLocalIdentifier service

#### Formula section:

```

If        request 31_20 is received      and
          LV_IS = 1                      and
          TCO > C_TCO_MIN_SA_EOL        and
          LV_VB_JUMP = 0                 and
          LV_TEMP_MAX_SAP_COIL = 0      and
          LV_ERR_AMP = 0                 and
          LV_ERR_AMP_PLAUS = 0          and
          LV_ERR_TCO = 0                 and
          LV_ERR_CRK = 0                 and
          LV_ERR_FTL_MIN = 0            and
          LV_MIS_STATE_A = 0            and
          LV_MIS_STATE_B = 0            and
          LV_ERR_SAV = 0                 and
          LV_ERR_SAP = 0                 and
          LV_ERR_FSD[i] = 0              and
          LV_ERR_LS_UP[i] = 0           and
          LV_ERR_CHG_LS_UP = 0          and
          LV_ERR_MAF = 0                 and
          (STATE_DIAG_SA_LS = SA_DIAG_END or SA_DIAG_CNL)
Then      LV_ACT_SA_EOL = 1
          STATE_EOL_KWP_SA = ACT         //active
Else      STATE_EOL_KWP_SA = 1H         //conditions not correct
Endif
    
```

#### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= start EOL Test - SA-system test	M	#20h	RELI_
#3d	routineEntryOption = EOL Test active	M	#00h	REYO_01

Figure I.32.17: Table StartRoutineByLocalIdentifier Request Message

#### StartRoutineByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = EOL Test SA-system test	M	#20h	RELI_
#3d	routineEntryStatus = EOL Test active	M	#00h	REYS_01

Figure I.32.18: Table StartRoutineByLocalIdentifier Positive Response Message

### StartRoutineByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.19: Table StartRoutineByLocalIdentifier Negative Response Message

### I.32.3.2.3 32\_20 EOL Test OFF - SA-system test - StopRoutineByLocalIdentifier service

#### Formula section:

```

If          request 32_20 is received
Then       LV_ACT_SA_EOL = 0
           STATE_EOL_KWP_SA = NOT_START           //function not started
Endif
    
```

### StopRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#2d	RoutineLocalIdentifier = stop EOL Test SA-system test	M	#20h	RELI_
#3d	routineEntryOption = EOL Test inactive	M	NOT_START	REYO_01

Figure I.32.20: Table StopRoutineByLocalIdentifier Request Message

### StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = stop EOL Test SA-system test	M	#20h	RELI_
#3d	routineEntryStatus = EOL Test inactive	M	NOT_START	REYS_01

Figure I.32.21: Table StopRoutineByLocalIdentifier Positive Response Message

### StopRoutineByLocalIdentifier negative Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.32.22: Table StopRoutineByLocalIdentifier Negative Response Message

### I.32.3.2.4 33\_20 - Report EOL results - SA-system test - RequestRoutineResultsByLocalIdentifier service

#### RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#2d	RoutineLocalIdentifier = ask for results SA-system test	M	#20h	RELI_

Figure I.32.23: Table RequestRoutineResultsByLocalIdentifier Request Message

#### Not for MSD80: RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = SA-system test	M	#20h	RELI_
#3d	RecordValue = STATE_DIAG_SA_LS	M	#XXh	RELI_
#4d	RecordValue = SUM_AFL_VLS_DIAG_SA_1 high byte	M	#XXh	RELI_
#5d	RecordValue = SUM_AFL_VLS_DIAG_SA_1 low byte	M	#XXh	RELI_
#6d	RecordValue = SUM_AFL_VLS_DIAG_SA_2 high byte	M	#XXh	RELI_
#7d	RecordValue = SUM_AFL_VLS_DIAG_SA_2 low byte	M	#XXh	RELI_

Figure I.32.24: Table RequestRoutineResultsLocalIdentifier Positive Response Message

#### Only for MSD80: RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = SA-system test	M	#20h	RELI_
#3d	RecordValue = STATE_EOL_KWP_SA	M	#XXh	RELI_
#4d	RecordValue = STATE_DIAG_SA_LS	M	#XXh	RELI_
#5d	RecordValue = SUM_AFL_VLS_DIAG_SA_1 high byte	M	#XXh	RELI_
#6d	RecordValue = SUM_AFL_VLS_DIAG_SA_1 low byte	M	#XXh	RELI_
#7d	RecordValue = SUM_AFL_VLS_DIAG_SA_2 high byte	M	#XXh	RELI_
#8d	RecordValue = SUM_AFL_VLS_DIAG_SA_2 low byte	M	#XXh	RELI_

Figure I.32.25: Table RequestRoutineResultsLocalIdentifier Positive Response Message

#### RequestRoutineResultsByLocalIdentifier negative Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	NegativeResponse Service Id	M	#7Fh	NR
#2d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.32.26: Table RequestRoutineResultsByLocalIdentifier Negative Response Message

### I.32.4 Services 21\_22 /31\_22 /32\_22 /33\_22 for end of line test: CPS-Check

#### I.32.4.1 31\_22 - Start EOL-Test CPS-Check - StartRoutineByLocalIdentifier service

##### General information:

This funktion handles the functional check CPS also end of line test CPS called.

##### Application conditions

**Initialisation:** LV\_EOL\_CPS =00h at reset  
STATE\_EOL\_KWP\_CPS= NOT\_START at reset

**Activation:** LV\_IGK=1 (Kl.15 on) and  
LV\_EOL\_CPS = 1

**Deactivation:** LV\_IGK=0 (Kl.15 off) or  
Diagnostic timeout

**Servicelocation:** see list of implemented diagnostic services

##### Formula section:

calculation of LV\_EOL\_CPS

```

IF          LV_IGK=1 (Kl.15 on)          and
            LV_ST_END = 1                and
            LV_INH_DIAGCPS = 0           and
            VS = 0                        and
            LV_MAF_SP_TQI_DYW_DIAGCPS = 1 and
            (OPM_AV_DIAGCPS = 1 or OPM_AV_DIAGCPS = 2) and
            LV_ERR_DIAGCPS = 0
THEN
            LV_EOL_CPS = 1
ELSE
            LV_EOL_CPS = 0
ENDIF
    
```

calculation of STATE\_EOL\_KWP\_CPS

```

IF          activation conditions are not fulfilled
THEN
            STATE_EOL_KWP_CPS =01H // EOL_TEST_ST_INH
ELSE IF     STATE_DIAGCPS >= 01H AND
            LV_END_DIAG_DIAGCPS = 00H
THEN
            STATE_EOL_KWP_CPS = ACT // EOL_TEST_
ACT
    
```

```

ELSEIF STATE_DIAGCPS >= 1H AND
        LV_END_DIAG_DIAGCPS = 1 AND
        LV_EOL_CPS_ERR = 1
THEN STATE_EOL_KWP_CPS = 09H // EOL_TEST_
END_WITH_ERR
ELSEIF STATE_DIAGCPS >= 1H AND
        LV_END_DIAG_DIAGCPS = 1 AND
        LV_EOL_CPS_ERR = 0
THEN STATE_EOL_KWP_CPS = 08H //EOL_TEST_
END_WOUT_ERR
ELSEIF STATE_DIAGCPS = 0H
THEN STATE_EOL_KWP_CPS = NOT_START
ENDIF
ENDIF

```

activation of EOL test

```

IF service 31_22 received and activation conditions for EOL test fulfilled
THEN STATE_EOL_KWP_CPS = ACT // EOL_TEST_
ACT
LV_EOL_CPS=01H //request to start EOL test
STATE_EOL_KWP_DMTL remains unchanged
ELSE
ENDIF

```

#### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= start EOL Test CPS	M	#22h	RELI_CPS

Figure I.32.27: Table StartRoutineByLocalIdentifier Request Message

#### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = start EOL Test CPS	M	#22h	RELI_CPS
#3d	routineEntryStatus = STATE_EOL_KWP_CPS	M	ACT	REYS_

Figure I.32.28: Table StartRoutineByLocalIdentifier Positive Response Message


#### StartRoutineByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.29: Table StartRoutineByLocalIdentifier Negative Response Message

### I.32.4.2 21\_22 - Read STATUS EOL - CPS-Check - ReadDataByLocalIdentifier service

#### Application conditions

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	Document key 10171571 SPE 000 AO	Pages Page 7782 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

**Initialisation:** 0 at reset  
**Activation:** LV\_IGK=1 (Kl.15 on)  
**Deactivation:** LV\_IGK=0 (Kl.15 off) **or**  
 Diagnostic timeout  
**ServiceLocation:** see list of implemented diagnostic services

### ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier - EOL read state CPS Check	M	#22h	RELI_CPS

Figure I.32.30: Table readDataByLocalIdentifier Request Message

### ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier - EOL read state CPS Check	M	#22h	RELI_CPS
#3d	RecordValue = STATE_EOL_KWP_CPS	M	#XXh	RV_S_CPS

Figure I.32.31: Table readDataByLocalIdentifier Positive Response Message

### ReadDataByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLID
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.32: Table: readDataByLocalIdentifier Negative Response Message

## I.32.4.3 32\_22 - Stop EOL-Test CPS-Check - StopRoutineByLocalIdentifier service

### Application conditions

**Initialisation:** 0 at reset  
**Activation:** LV\_IGK=1 (Kl.15 on)  
**Deactivation:** LV\_IGK=0 (Kl.15 off) **or**  
 Diagnostic timeout  
**ServiceLocation:** see list of implemented diagnostic services

### Formula section:

stop of EOL test  
**IF** service 32\_22 received  
**THEN** STATE\_EOL\_KWP\_CPS = NOT\_START //EOL\_TEST\_NOT\_ST  
 EOL\_CPS=00H //request to stop EOL test

**ELSE** STATE\_EOL\_KWP\_CPS remains unchanged  
**ENDIF**

**StopRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	stopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#2d	routineLocalIdentifier = stop EOL Test CPS	M	#22h	RELI_CPS

Figure I.32.33: Table StopRoutineByLocalIdentifier Request Message

**StopRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	stopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	routineLocalIdentifier = stop EOL Test CPS	M	#22h	RELI_CPS
#3d	routineEntryStatus = STATE_EOL_KWP_CPS	M	NOT_START	REYS_01

Figure I.32.34: Table StopRoutineByLocalIdentifier Positive Response Message

**StopRoutineByLocalIdentifier negative Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	stopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.32.35: Table StopRoutineByLocalIdentifier Negative Response Message

**I.32.4.4 33\_22 - Report results of - CPS EOL - RequestRoutineResultsByLocalIdentifier service**

**Application conditions**

**Initialisation:** 0 at reset  
**Activation:** LV\_IGK=1 (K1.15 on)  
**Deactivation:** LV\_IGK=0 (K1.15 off) **or**  
 Diagnostic timeout  
**Servicelocation:** see list of implemented diagnostic services

**RequestRoutineResultsByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#2d	RoutineLocalIdentifier = CPS EOL test values	M	#22h	RELI_CPS

Figure I.32.36: Table RequestRoutineResultsByLocalIdentifier Request Message

**Not for MSD80: RequestRoutineResultsByLocalIdentifier positive Response**

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = CPS EOL test values	M	#22h	RELI_CPS
#3d	RecordValue = STATE_DIAGCPS [ Step_INIT Step_1 Step_2 Step_3 CPS_RAMP LOCK_STEP ]	M	#XXh [ #00h, #01h, #02h, #03h, #04h, #05h, ]	RELI_
#4d	RecordValue = SUM_DIAG_DIAGCPS_EOL	M	#XXh	RELI_
#5d	RecordValue = SUM_FLOW_SP_DIAGCPS_EOL	M	#XXh	RELI_

Figure I.32.37: Table RequestRoutineResultsLocalIdentifier Positive Response Message

**Only for MSD80: RequestRoutineResultsByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = CPS EOL test values	M	#22h	RELI_CPS
#3d	RecordValue = STATE_EOL_KWP_CPS	M	#XXh	RELI_
#4d	RecordValue = STATE_DIAGCPS [ Step_INIT Step_1 Step_2 Step_3 CPS_RAMP LOCK_STEP ]	M	#XXh [ #00h, #01h, #02h, #03h, #04h, #05h, ]	RELI_
#5d	RecordValue = SUM_DIAG_DIAGCPS_EOL	M	#XXh	RELI_
#6d	RecordValue = SUM_FLOW_SP_DIAGCPS_EOL	M	#XXh	RELI_

Figure I.32.38: Table RequestRoutineResultsLocalIdentifier Positive Response Message

**RequestRoutineResultsByLocalIdentifier negative Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	NegativeResponse Service Id	M	#7Fh	NR
#2d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#3d	responseCode= general response codes	M	#XXh	RC

Figure I.32.39: Table RequestRoutineResultsByLocalIdentifier Negative Response Message

**I.32.5 Services 21\_26 /31\_26 /32\_26 /33\_26 for end of line test: EOL- N\_SP\_IS displace**

**General information:**

This EOL test is to calculate the N\_SP\_IS displace. The general function is described in the chapter System variables - Idle speed setpoint calculation .

**Application conditions:**

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**Initialisation at reset :**

STATE\_EOL\_KWP\_N\_SP\_IS = NOT\_START  
LV\_ACT\_N\_SP\_IS\_EXT\_ADJ = 0  
N\_SP\_IS\_EXT\_ADJ = 0

**Activation:**

LV\_IGK=1 (Kl.15 on) and  
LV\_IS=1 or LV\_PL=1 and  
N<C\_N\_MAX\_KWP and  
GEAR\_INFO=0h and  
VS<= C\_VS\_MAX\_KWP and  
LV\_CS=0

(for LV\_AT=0 and

LV\_VAR\_AMT=0 and  
LV\_VAR\_TCT = 0 ) and  
for LV\_VAR\_AMT=1

LV\_BRAKE\_DET=0

**Deactivation:**

LV\_IGK=0 (Kl.15 off) or  
Diagnostic timeout

**Service location:** ECU-SW

**I.32.5.1 31\_26 - ON EOL- N\_SP\_IS displace - StartRoutineByLocalIdentifier service**

**Formula section:**

```

IF          activation conditions are fulfilled          and
              service 31_26 is received

THEN        STATE_EOL_KWP_N_SP_IS = ACT (EOL test active)
              LV_ACT_N_SP_IS_EXT_ADJ=1
              CTL_SHIFT_LOCK_CAN=03h
              send positive response

ELSE        STATE_EOL_KWP_N_SP_IS =01h (EOL test inhibited)
              LV_ACT_N_SP_IS_EXT_ADJ remains unchanged
              CTL_SHIFT_LOCK_CAN remains unchanged
              send negative response

ENDIF
    
```

**StartRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StartRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	RoutineLocalIdentifier= start EOL Test N_SP_IS displace	M	#26h	RELI_
#3d	RoutineEntryOption = N_SP_IS_EXT_ADJ high byte	M	#XXh	
#4d	RoutineEntryOption = N_SP_IS_EXT_ADJ low byte	M	#XXh	

Figure I.32.40: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StartRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	RoutineLocalIdentifier = EOL Test N_SP_IS displace	M	#26h	RELI_
#3d	routineEntryStatus = EOL Test active	M	#00h	REYS_01

Figure I.32.41: Table StartRoutineByLocalIdentifier Positive Response Message

### StartRoutineByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	NegativeResponse Service Id	M	#7Fh	NR
#2d	StartRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#3d	ResponseCode=only general response code	M	#XXh	RC

Figure I.32.42: Table StartRoutineByLocalIdentifier Negative Response Message

### I.32.5.2 32\_26 - OFF EOL-Test N\_SP\_IS displace - StopRoutineByLocalIdentifier service

#### Formula section:

```

IF          service 32_26 received

THEN          STATE_EOL_KWP_N_SP_IS = NOT_START (EOL test not started)
              LV_ACT_N_SP_IS_EXT_ADJ =0

ELSE          STATE_EOL_KWP_N_SP_IS remains unchanged
              LV_ACT_N_SP_IS_EXT_ADJ remains unchanged

ENDIF
    
```

### StopRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#2d	RoutineLocalIdentifier = stop EOL Test N_SP_IS displace	M	#26h	RELI_

Figure I.32.43: Table StopRoutineByLocalIdentifier Request Message

### StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = stop EOL Test N_SP_IS displace	M	#26h	RELI_
#3d	routineEntryStatus = EOL Test inactive	M	NOT_START	REYS_01

Figure I.32.44: Table StopRoutineByLocalIdentifier Positive Response Message

### StopRoutineByLocalIdentifier negative Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	NegativeResponse Service Id	M	#7Fh	NR
#2d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#3d	ResponseCode=general response codes	M	#XXh	RC

Figure I.32.45: Table StopRoutineByLocalIdentifier Negative Response Message

### I.32.5.3 21\_26 - Read STATUS EOL- N\_SP\_IS displace - ReadDataByLocalIdentifier service

#### ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	ReadDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	RecordLocalIdentifier = N_SP_IS displace	M	#26h	RLI_

Figure I.32.46: Table readDataByLocalIdentifier Request Message

#### ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	ReadDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	RecordLocalIdentifier = N_SP_IS displace	M	#26h	RLI_
#3d	RecordValue = STATE_EOL_KWP_N_SP_IS [ MSV70: function active, MSX80: function not started yet function start inhibited function start parameter not plausible MSV70: function not started yet, MSx80: function active ]	M	#XXh [ #00h, #01h, #02h, #05h ]	RV_S_

Figure I.32.47: Table readDataByLocalIdentifier Positive Response Message

#### ReadDataByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	NegativeResponse Service Id	M	#7Fh	NR
#2d	ReadDataByLocalIdentifier Request Service Id	M	#21h	RDBLID
#3d	ResponseCode=only general response code	M	#XXh	RC


Figure I.32.48: Table: readDataByLocalIdentifier Negative Response Message

### I.32.5.4 33\_26 - Report results of - N\_SP\_IS displace - RequestRoutineResultsByLocalIdentifier service

#### RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#2d	RoutineLocalIdentifier = N_SP_IS displace EOL test values	M	#26h	RELI_

Figure I.32.49: Table RequestRoutineResultsByLocalIdentifier Request Message

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7788 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

**Not for MSD80: RequestRoutineResultsByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = N_SP_IS displace EOL test values	M	#26h	RELI_
#3d	RecordValue = N high byte	M	#XXh	RELI_
#4d	RecordValue = N low byte	M	#XXh	RELI_

Figure I.32.50: Table RequestRoutineResultsLocalIdentifier Positive Response Message

**Only for MSD80: RequestRoutineResultsByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = N_SP_IS displace EOL test values	M	#26h	RELI_
#3d	RecordValue = STATE_EOL_KWP_N_SP_IS	M	#XXh	RELI_
#4d	RecordValue = N high byte	M	#XXh	RELI_
#5d	RecordValue = N low byte	M	#XXh	RELI_RELI_

Figure I.32.51: Table RequestRoutineResultsLocalIdentifier Positive Response Message

**RequestRoutineResultsByLocalIdentifier negative Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	NegativeResponse Service Id	M	#7Fh	NR
#2d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#3d	ResponseCode= general response codes	M	#XXh	RC

Figure I.32.52: Table RequestRoutineResultsByLocalIdentifier Negative Response Message

**I.32.6 Services 21\_27 /31\_27 /32\_27 /33\_27 for end of line test: VVL adaption**

**I.32.6.1 31\_27 - start VVL Adaption - StartRoutineByLocalIdentifier service**

**General information:**

This function handles the tester adaption request. After receiving the Tester request the function sets the variables KWP\_B\_FA, KWP\_B\_FAVVTAL and VVT\_KWP\_EXT\_AD\_ERV\_REQ. Then it waits till the adaption process starts which can be detected testing the STATE\_AD\_RUN\_VVL variable. After finishing the adaption process the function returns the result of the adaption routine. The general function is described in the chapter VVL Position Sensor Adaptation .

**Application conditions:**

**Initialisation at reset state /at restart:**

STATE\_EOL\_KWP\_VVL\_AD = NOT\_START

Recurrence: 10ms - see Activation

Activation: started from the KW2000 request handler when the corresponding diagnose message is received

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Deactivation: response sent to the tester

**Service location:** see list of implemented diagnostic services

**Formula section:**

```

if (STATE_KWP_SRV_AD_REQ_VVL!= TERMINATE )
then
    Send negative response with ResponseCode=22h;
    //ConditionNotCorrectOrRequestSequenceError
else
    if(2) ((REYS_01==01h) || ( REYS_01==06h))
        then(2)
            Send positive response
            call function Set KWP adaption request state variable with parameter (REYS_01)
        else(2)
            Send negative response with ResponseCode=22h;
            //ConditionNotCorrectOrRequestSequenceError
    endif(2)
endif
    
```

**StartRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= start EOL Test VVL adaption	M	#27h	RELI_VVL
#3d	REYS_01= Adaption request command	M	#XXh	REYS_01

Figure I.32.53: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = EOL Test VVL adaption	M	#27h	RELI_VVL
#3d	routineEntryStatus = EOL Test active	M	ACT	REYS_01

Figure I.32.54: Table StartRoutineByLocalIdentifier Positive Response Message

**ReadDataByLocalIdentifier negative Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.55: Table StartRoutineByLocalIdentifier Negative Response Message

**I.32.6.2 21\_27 - Read Status EOL: VVL adaption - ReadDataByLocalIdentifier service**

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**General information:**

This funktion reports the state of the EOL VVL adaption.

**Application conditions**

**Initialisation:** *at reset*

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off) or  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

**ReadDataByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier STATE_EOL_KWP_VVL_AD	M	#27h	RLI_

Figure I.32.56: Table readDataByLocalIdentifier Request Message

**ReadDataByLocalIdentifier positive Response on service**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier STATE_EOL_KWP_VVL_AD	M	#27h	RLI_
#3d	RecordValue = STATE_EOL_KWP_VVL_AD	M	#XXh	RV_S_

Figure I.32.57: Table readDataByLocalIdentifier Positive Response Message

**ReadDataByLocalIdentifier negative Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLID
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.58: Table: readDataByLocalIdentifier Negative Response Message

**I.32.6.3 32\_27 - Stop EOL - VVL Adaptation - stopRoutineByLocalIdentifier**

**General information:**

With this comand the EOL-Test VVL adaptation is stopped. The general function is described in the chapter VVL Position Sensor Adaptation .

**Application conditions**

**Initialisation:** *at reset*

**Activation:** at receiving the corresponding KWP request

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**Deactivation:**

*Service location:* see list of implemented diagnostic services

**Formula section:**

```

if          (request 32_27 received)
then
    Send positive response
    call function Set KWP adaption request state variable with parameter (
        TERMINATE )
endif
    
```

**StopRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	stopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#2d	routineLocalIdentifier = stop EOL Test VVL adaptation	M	#27h	RELI_VVL

Figure I.32.59: Table StopRoutineByLocalIdentifier Request Message

**StopRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	stopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	routineLocalIdentifier = stop EOL Test VVL adaptation	M	#27h	RELI_VVL
#3d	routineEntryStatus = EOL Test inactive	M	NOT_STAR T	REYS_01

Figure I.32.60: Table StopRoutineByLocalIdentifier Positive Response Message

**StopRoutineByLocalIdentifier negative Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	stopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.32.61: Table StopRoutineByLocalIdentifier Negative Response Message

**I.32.6.4 33\_27 - Read Status EOL: VVL adaptation - RequestRoutineResultsByLocalIdentifier service**

**General information:**

This function reports the state of the EOL VVL adaption.

**Application conditions**

**Initialisation:** at reset

**Activation:** LV\_IGK=1 (K1.15 on)

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**Deactivation:** LV\_IGK=0 (K1.15 off) or  
Diagnostic timeout  
**Service location:** see list of implemented diagnostic services

### RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#2d	RoutineLocalIdentifier = VVL adaptation EOL test values	M	#27h	RELI_

Figure I.32.62: Table RequestRoutineResultsByLocalIdentifier Request Message

### RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = STATE_EOL_KWP_VVL_AD	M	#27h	RELI_
#4d	RecordValue = STATE_EOL_KWP_VVL_AD	M	#XXh	

Figure I.32.63: Table RequestRoutineResultsLocalIdentifier Positive Response Message

### RequestRoutineResultsByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	NegativeResponse Service Id	M	#7Fh	NR
#2d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#3d	ResponseCode= general response codes	M	#XXh	RC

Figure I.32.64: Table RequestRoutineResultsByLocalIdentifier Negative Response Message

## I.32.7 Services 31\_2A /32\_2A /33\_2A for EOL test: Generator

### Application conditions

**Initialisation at reset:** *B\_gentestanf = 0*

**Recurrence:** **if** B\_gentestanf =1 then 100ms  
**else** event triggered

**Activation:** LV\_IGK=1

**Deactivation:** LV\_IGK=0  
Diagnostic timeout  
**Service location:** see list of implemented diagnostic services

### I.32.7.1 31\_2A - start EOL Generator test - StartRoutineByLocalIdentifier service

#### General information:

With this command the test of generatortest is started.

**Formula section:**

```

IF          service 31_2A is received

THEN       B_gentestanf = 1
           send positive response

ENDIF
    
```

**StartRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= Generatortest	M	#2Ah	RELI_GENU ITEST

Figure I.32.65: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response Id	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = Generatortest	M	#2Ah	RELI_GENU ITEST
#3d	routineEntryStatus = EOL Generatortest activr	M	#05h	REYS_01

Figure I.32.66: Table StartRoutineByLocalIdentifier Positive Response Message

**StartRoutineByLocalIdentifier negative Response**

Global Negative Responses

**I.32.7.2 32\_2A - stop EOL Generatortest - stopRoutineByLocalIdentifier**

**General information:**

With this comand the test of generatortest is switched off.

**Formular section:**

```

/* event triggered:*/
If          service 32_2A is received

Then       B_gentestanf = 0
           send positive response

Endif

/* with 100ms recurrence: */
If          St_gentest = 6 /* test finished */
           or St_gentest = 7 /* test interrupted */
           or St_gentest = 8 /* test conditions not fulfilled */
    
```

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```
Then          B_gentestanf = 0
Endif
```

### StopRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#2d	RoutineLocalIdentifier = Generatorstest	M	#2Ah	RELI_

Figure I.32.67: Table StopRoutineByLocalIdentifier Request Message

### StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = Generatorstest	M	#2Ah	RELI_
#3d	routineEntryStatus = EOL Generatorstest inactiv	M	#00h	REYS_01

Figure I.32.68: Table StopRoutineByLocalIdentifier Positive Response Message

### StopRoutineByLocalIdentifier negative Response

Global Negative Responses

## I.32.7.3 33\_2A - read EOL Generatorstest results - requestRoutineResultsByLocalIdentifier

### General information:

With this service the tester can ask for the results of generatorstest.

### Formular section:

```
If          service 33_2A is received
```

```
Then          send positive response
```

```
Endif
```

### RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLLI
#2d	RoutineLocalIdentifier	M	#2Ah	RELI_GENUITE ST

Figure I.32.69: Table RequestRoutineResultsByLocalIdentifier Request Message

### RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier	M	#2Ah	RELI_GENUIT EST
#3d	RecordValue#1 = St_gentest	M	#XXh	RRS_FS_GE NUITEST
#4d	RecordValue#2 = Geniutest_err	M	#XXh	RRS_GENUIT EST_ERR
#5d	RecordValue#3 = Geniutest_ab	M	#XXh	RRS_GENUIT EST_AB
#6d	RecordValue#4 = Genitest_tol	M	#XXh	RRS_GENUIT EST_TOL
#7d	RecordValue#5 = Genutest_tol	M	#XXh	RRS_GENUIT EST_BOL
#8d	RecordValue#6 = I_gentest	M	#XXh	RRS_I_GENT EST
#9d	RecordValue#7 = U_gentest ( high byte )	M	#XXh	RRS_U_GEN TEST
#10d	RecordValue#8 = U_gentest ( low byte )	M	#XXh	RRS_U_GEN TEST

Figure I.32.70: Table RequestRoutineResultsLocalIdentifier Positive Response Message

### RequestRoutineResultsByLocalIdentifier negative Response

Global Negative Responses

## I.32.8 Services 31\_2C /32\_2C /33\_2C for EOL test: ODR (Oil Pressure Regulation Diagnosis)

### Application conditions

**Initialisation at reset:** B\_testpoelsys = 0  
LV\_POIL\_EXT\_ADJ\_ACT = 0

**Activation:** LV\_IGK=1

**Deactivation:** LV\_IGK=0

Diagnostic timeout  
**Service location:** see list of implemented diagnostic services

### I.32.8.1 31\_2C - start EOL ODR test - StartRoutineByLocalIdentifier service

#### General information:

With this command the test of ODR (Oil Pressure Regulation) is started.

#### Formula section:

**If** service 31\_2C is received

**Then** B\_testpoelsys = 1  
LV\_POIL\_EXT\_ADJ\_ACT = 1  
send positive response

**Endif**

### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= ODR	M	#2Ch	RELI_ODR

Figure I.32.71: Table StartRoutineByLocalIdentifier Request Message

### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response Id	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = Diagnosefunktion Oeldruckregelung	M	#2Ch	STRBLI_OD R_steuern
#3d	routineEntryStatus = EOL ODR test activ	M	#05h	REYS_01

Figure I.32.72: Table StartRoutineByLocalIdentifier Positive Response Message

### StartRoutineByLocalIdentifier negative Response

Global Negative Responses

## I.32.8.2 32\_2C - stop EOL ODR test - stopRoutineByLocalIdentifier service

#### General information:

With this command the test of ODR (Oil Pressure Regulation) is switched off.

#### Formula section:

**If** service 32\_2C is received

**Then** B\_testpoelsys = 0  
 LV\_POIL\_EXT\_ADJ\_ACT = 0  
 send positive response

**Endif**

### StopRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#2d	RoutineLocalIdentifier = ODR	M	#2Ch	RELI_ODR

Figure I.32.73: Table StopRoutineByLocalIdentifier Request Message

### StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = Diagnosefunktion Oeldruckregelung beenden	M	#2Ch	SPRBLI_ODR_ende
#3d	routineEntryStatus = EOL ODR test inactiv	M	#00h	REYS_01

Figure I.32.74: Table StopRoutineByLocalIdentifier Positive Response Message

**StopRoutineByLocalIdentifier negative Response**

Global Negative Responses

**I.32.8.3 33\_2C - Report EOL ODR results - requestRoutineResultsByLocalIdentifier service**

**General information:**

With this service the tester can ask for the results of the Oil Pressure Regulation diagnosis.

**Formula section:**

If service 33\_2C is received

Then send positive response

Endif

**RequestRoutineResultsByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#2d	RoutineLocalIdentifier = ODR	M	#2Ch	RELI_ODR

Figure I.32.75: Table RequestRoutineResultsByLocalIdentifier Request Message

**RequestRoutineResultsByLocalIdentifier positive Response**

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIIPR
#2d	RoutineLocalIdentifier = RRRBLI_ODR_lesen	M	#2Ch	RRRBLI_ODR_lesen
#3d	RecordValue#1 = St_testpoelsys	M	#XXh	RRS_ST_TES TPOELSYS
#4d	RecordValue#2 = St_testpoelsys2	M	#XXh	RRS_ST_TES TPOELSYS2
#5d	RecordValue#3 = Toel high byte	M	#XXh	RRS_TOEL
#6d	RecordValue#4 = Toel low byte	M	#XXh	RRS_TOEL
#7d	RecordValue#5 = P_oeI_soll high byte	M	#XXh	RRS_P_OEL_ SOLL
#8d	RecordValue#6 = P_oeI_soll low byte	M	#XXh	RRS_P_OEL_ SOLL
#9d	RecordValue#7 = P_oeI_ist high byte	M	#XXh	RRS_P_OEL_ IST
#10d	RecordValue#8 = P_oeI_ist low byte	M	#XXh	RRS_P_OEL_ IST
#11d	RecordValue#9 = Nkw_soll high byte	M	#XXh	RRS_NKW_S OLL
#12d	RecordValue#10 = Nkw_soll low byte	M	#XXh	RRS_NKW_S OLL
#13d	RecordValue#11 = Nkw high byte	M	#XXh	RRS_NKW
#14d	RecordValue#12 = Nkw low byte	M	#XXh	RRS_NKW

Figure I.32.76: Table RequestRoutineResultsLocalIdentifier Positive Response Message

### RequestRoutineResultsByLocalIdentifier negative Response

Global Negative Responses

## I.32.9 Services 31\_2D /32\_2D /33\_2D for EOL test: Steuern Desulfatisierung

### Application conditions

**Initialisation at reset and at LV\_IGK 1-> 0:** LV\_NT\_SO2P\_EXT\_ADJ\_REQ\_ST = 0  
 STATE\_NT\_SO2P\_EXT\_ADJ = NOT\_START  
 LV\_NT\_SO2P\_EXT\_ADJ\_REQ\_NOT\_STOP = 1

**Activation:** LV\_IGK=1

**Deactivation:** LV\_IGK=0

Diagnostic timeout

**Service location:** see list of implemented diagnostic services

### I.32.9.1 31\_2D - start EOL Steuern Desulfatisierung- StartRoutineByLocalIdentifier service

#### General information:

With this command the desulfation is started.

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**Formula section:**

**If** service 31\_2D is received

**Then** LV\_NT\_SO2P\_EXT\_ADJ\_REQ\_NOT\_STOP = 1  
STATE\_NT\_SO2P\_EXT\_ADJ = received value  
LV\_NT\_SO2P\_EXT\_ADJ\_REQ\_ST = 1 ( only for 2 sec )  
send positive response

**Endif**

**StartRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= Desulfation	M	#2Dh	RELI_DES
#3d	record value #1 = STATE_NT_SO2P_EXT_ADJ	M	#XXh	RV_STATE_NT_SO2P_EXT_ADJ

Figure I.32.77: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response Id	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = Desulfation	M	#2Dh	STRBLI_DES
#3d	routineEntryStatus = Desulfation is activ	M	#05h	REYS_01

Figure I.32.78: Table StartRoutineByLocalIdentifier Positive Response Message

**StartRoutineByLocalIdentifier negative Response**

Global Negative Responses

**I.32.9.2 32\_2D - stop EOL Steuern Desulfatisierung - stopRoutineByLocalIdentifier service**

**General information:**

With this command the desulfation is switched off.

**Formula section:**

**If** service 32\_2D is received

**Then** LV\_NT\_SO2P\_EXT\_ADJ\_REQ\_ST = 0  
LV\_NT\_SO2P\_EXT\_ADJ\_REQ\_NOT\_STOP = 0 ( only for 2 sec )  
send positive response

**Endif**

**StopRoutineByLocalIdentifier Request**

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#2d	RoutineLocalIdentifier = Desulfation	M	#2Dh	RELI_DES

Figure I.32.79: Table StopRoutineByLocalIdentifier Request Message

### StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = Diagnosefunktion Oeldruckregelung beenden	M	#2Dh	SPRBLI_DES_ende
#3d	routineEntryStatus = Desulfation is inactiv	M	#00h	REYS_01

Figure I.32.80: Table StopRoutineByLocalIdentifier Positive Response Message

### StopRoutineByLocalIdentifier negative Response

Global Negative Responses

## I.32.9.3 33\_2D - Report EOL desulfation result - requestRoutineResultsByLocalIdentifier service

### General information:

With this service the tester can ask for the results of the desulfation

### Formula section:

If service 33\_2D is received

Then send positive response

Endif

### RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#2d	RoutineLocalIdentifier = DES	M	#2Dh	RELI_DES

Figure I.32.81: Table RequestRoutineResultsByLocalIdentifier Request Message

### RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	<b>RequestRoutineResultsByLocalIdentifier Positive Response</b>	<b>M</b>	<b>#73h</b>	<b>RRRBLIPR</b>
#2d	RoutineLocalIdentifier = RRRBLI_DES_lesen	M	#2Dh	RRRBLI_DES_lesen
#3d	RecordValue#1 = STATE_KWP_SO2P	M	#XXh	RRS_STATE_KWP_SO2P
#4d	RecordValue#2 = STATE_NT_SO2P_EXT_ADJ_ACT	M	#XXh	RRS_STATE_NT_SO2P_EXT_ADJ_ACT
#5d	RecordValue#3 = TNT_MDL_L (high byte)	M	#XXh	RRS_TNT_MDL_L
#6d	RecordValue#4 = TNT_MDL_L (low byte)	M	#XXh	RRS_TNT_MDL_L
#7d	RecordValue#5 = TNT_MDL_MV (high byte)	M	#XXh	RRS_TNT_MDL_MV
#8d	RecordValue#6 = TNT_MDL_MV (low byte)	M	#XXh	RRS_TNT_MDL_MV
#9d	RecordValue#7 = T_NT_SO2P_EXT_ADJ_ACT (high byte)	M	#XXh	RRS_T_NT_SO2P_EXT_ADJ_ACT
#10d	RecordValue#8 = T_NT_SO2P_EXT_ADJ_ACT (low byte)	M	#XXh	RRS_T_NT_SO2P_EXT_ADJ_ACT
#11d	RecordValue#9 = NT_SUL (high byte)	M	#XXh	RRS_NT_SUL
#12d	RecordValue#10 = NT_SUL (low byte)	M	#XXh	RRS_NT_SUL
#13d	RecordValue#11 = LAMB_SP (high byte)	M	#XXh	RRS_LAMB_SP
#14d	RecordValue#12 = LAMB_SP (low byte)	M	#XXh	RRS_LAMB_SP
#15	RecordValue#13 = LAMB_SP[1] (high byte)	M	#XXh	RRS_LAMB_SP[1]
#16d	RecordValue#14 = LAMB_SP[1] (low byte)	M	#XXh	RRS_LAMB_SP[1]
#17d	RecordValue#15 = LAMB_SP[2] (high byte)	M	#XXh	RRS_LAMB_SP[2]
#18d	RecordValue#16 = LAMB_SP[2] (low byte)	M	#XXh	RRS_LAMB_SP[2]
#19d	RecordValue#17 =N_32	M	#XXh	RRS_N_32
#20d	RecordValue#18 =VS	M	#XXh	RRS_VS
#21d	RecordValue#19 =PV (high byte)	M	#XXh	RRS_PV
#22d	RecordValue#20 =PV (low byte)	M	#XXh	RRS_PV
#23d	RecordValue#21 =GEAR	M	#XXh	RRS_GEAR
#24d	RecordValue#22 =LV_CLU_SWI	M	#XXh	RRS_LV_CLU_SWI

Figure I.32.82: Table RequestRoutineResultsLocalIdentifier Positive Response Message

**RequestRoutineResultsByLocalIdentifier negative Response**

Global Negative Responses

**I.32.10 Services 31\_33 /32\_33 /33\_33 for NOx-SensorShift Diagnose**

**Application conditions:**

**Initialisation at reset and at LV\_IGK 0->1:Call ACTION\_NOXD\_EndNNShiftDiag()**

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**Activation:** LV\_IGK=1

**Deactivation:** LV\_IGK=0

Diagnostic timeout

**Service location:** see list of implemented diagnostic services

### I.32.10.1 31\_33 - Start Werkstattdiagnose NOx-SensorShift - StartRoutineByLocalIdentifier service

#### General information:

With this command the "Werkstattdiagnose NOx-SensorShift" is requested

#### Formula section:

```

If(1)           service 31_33 is received
                  Call ACTION_NOXD_StartNNShiftDiag()
                  send positive response
Endif(1)
    
```

#### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= Auftrag NOx-SensorShiftDiagnose	M	#33h	STRBLI_NO XS

Figure I.32.83: Table StartRoutineByLocalIdentifier Request Message

#### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response Id	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = Auftrag NOx-SensorShiftDiagnose	M	#33h	STRBLI_NO XS
#3d	routineEntryStatus = Status Auftrag NOx-SensorShiftDiagnose	M	#05h	STRBLI_AT L_steuern

Figure I.32.84: Table StartRoutineByLocalIdentifier Positive Response Message

#### StartRoutineByLocalIdentifier negative Response


Global Negative Responses

### I.32.10.2 32\_33 - Stop Werkstattdiagnose NOx-SensorShift -stopRoutineByLocalIdentifier

#### General information:

With this comand the "Werkstattdiagnose NOx-SensorShift" is deactivated

#### Formular section:

Released by Tettenborn Frank		Date 2013-02-13	File 17103901.00S
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7803 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

**If** service 32\_33 is received  
**Then** Call ACTION\_NOXD\_EndNNShiftDiag()  
 send positive response  
**Endif**

### StopRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#2d	RoutineLocalIdentifier = Auftrag Werkstattdiagnose NOx-SensorShift beenden	M	#33h	STRBLI_NOXS _beenden

Figure I.32.85: Table StopRoutineByLocalIdentifier Request Message

### StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = Auftrag Werkstattdiagnose NOx-SensorShift beenden	M	#33h	STRBLI_NOXS_been den
#3d	routineEntryStatus = Status Auftrag Werkstattdiagnose NOx-SensorShift is inactiv	M	#00h	STRBLI_NOXS_been den

Figure I.32.86: Table StopRoutineByLocalIdentifier Positive Response Message

### StopRoutineByLocalIdentifier negative Response

Global Negative Responses

## I.32.10.3 33\_33 - Read Status Auftrag Diagnosefunktion NOx-SensorShift - requestRoutineResultsByLocalIdentifier service

### General information:

With this service the tester can read out the state of "Werkstattdiagnose NOx-SensorShift".

### Formular section:

**If** service 33\_33 is received  
**Then** send positive response  
**Endif**

### RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLLI
#2d	RoutineLocalIdentifier - Status Werkstattdiagnose NOX-SensorShift lesen	M	#33h	RRRBLLI_NOXS_ lesen

Figure I.32.87: Table RequestRoutineResultsByLocalIdentifier Request Message

### RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	<b>RequestRoutineResultsByLocalIdentifier Positive Response</b>	<b>M</b>	<b>#73h</b>	<b>RRRBLIPR</b>
#2d	RoutineLocalIdentifier - Status Werkstattdiagnose NOX-SensorShift lesen	M	#33h	RRRBLI_NOX S_lesen
#3d	RecordValue#1 = STATE_EOL_KWP_NS_SHIFT_DIAG[1]	M	#XXh	RRS_
#4d	RecordValue#2 = STATE_NS_SHIFT_DIAG[1] (high byte	M	#XXh	RRS_
#5d	RecordValue#3 = STATE_NS_SHIFT_DIAG[1] (low byte)	M	#XXh	RRS_
#6d	RecordValue#4 = EGY_DEW_END_NT (high word, high byte)	M	#XXh	RRS_
#7d	RecordValue#5 = EGY_DEW_END_NT (high word, low byte)	M	#XXh	RRS_
#8d	RecordValue#6 = EGY_DEW_END_NT (low word, high byte)	M	#XXh	RRS_
#9d	RecordValue#7 = EGY_DEW_END_NT (low word, low byte)	M	#XXh	RRS_
#10d	RecordValue#8= EGY_DEW_END_NT_INT (high word, high byte)	M	#XXh	RRS_
#11d	RecordValue#9= EGY_DEW_END_NT_INT (high word, low byte)	M	#XXh	RRS_
#12d	RecordValue#10= EGY_DEW_END_NT_INT (low word, high byte)	M	#XXh	RRS_
#13d	RecordValue#11= EGY_DEW_END_NT_INT (low word, low byte)	M	#XXh	RRS_
#14d	RecordValue#12= TEG_WALL_NT_DOWN_MDL (high byte)	M	#XXh	RRS_
#15d	RecordValue#13 = TEG_WALL_NT_DOWN_MDL (low byte)	M	#XXh	RRS_
#16d	RecordValue#14 = T_NS_SHIFT_DEAC_TEMP[1] (high byte)	M	#XXh	RRS_
#17d	RecordValue#15 = T_NS_SHIFT_DEAC_TEMP[1] (low byte)	M	#XXh	RRS_
#18d	RecordValue#16 = T_NS_SHIFT_WAIT_REP[1] (high byte)	M	#XXh	RRS_
#19d	RecordValue#17 = T_NS_SHIFT_WAIT_REP[1] (low byte)	M	#XXh	RRS_
#20d	RecordValue#18 = LV_CAN_TEMP_MIN_THD[1]	M	#XXh	RRS_
#21d	RecordValue#19 = CTR_NS_SHIFT_CYC_NOT_VLD[1]	M	#XXh	RRS_
#22d	RecordValue#20 = CTR_NS_SHIFT_CYC_VLD[1]	M	#XXh	RRS_
#23d	RecordValue#21 = OPM_AV	M	#XXh	RRS_

Figure I.32.88: Table RequestRoutineResultsLocalIdentifier Positive Response Message  
**RequestRoutineResultsByLocalIdentifier negative Response**  
Global Negative Responses

### I.32.11 Services 31\_CF /32\_CF /33\_CF for : Sperre Tankentlueftung

#### Application conditions

Initialisation at reset and at LV\_IGK 0->1: LV\_LAM\_AD\_ENA = 0

**Activation:** LV\_IGK=1

**Deactivation:** LV\_IGK=0

Diagnostic timeout  
**Service location:** see list of implemented diagnostic services

#### I.32.11.1 31\_CF - Start Sperre Tankentlueftung - StartRoutineByLocalIdentifier service

##### General information:

With this command the "Sperre Tankentlueftung" is activated

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**Formula section:**

```

IF          service 31_CF is received

THEN       LV_LAM_AD_EXT_ADJ = 1
           send positive response

ENDIF
    
```

**StartRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= Auftrag Deaktivierung TEV-Regelung starten	M	#CFh	STRBLI_TE VR-steuern

Figure I.32.89: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response Id	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = Auftrag Deaktivierung TEV-Regelung starten	M	#CFh	STRBLI_TE VR-steuern
#3d	routineEntryStatus = Status Deaktivierung TEV-Regelung aktiv	M	#05h	STRBLI_TE VR-steuern

Figure I.32.90: Table StartRoutineByLocalIdentifier Positive Response Message

**StartRoutineByLocalIdentifier negative Response**

Global Negative Responses

**I.32.11.2 32\_CF - Stop Sperre Tankentlueftung -StopRoutineByLocalIdentifier service**

**General information:**

With this comand the "Sperre Tankentlueftung" is deactivated

**Formular section:**

```

If          service 32_CF is received

Then       LV_LAM_AD_EXT_ADJ = 0
           send positive response

Endif
    
```

**StopRoutineByLocalIdentifier Request**

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#2d	RoutineLocalIdentifier = Auftrag Deaktivierung TEV-Regelung beenden	M	#CFh	STRBLI_TEVR-steuern

Figure I.32.91: Table StopRoutineByLocalIdentifier Request Message

**StopRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = Auftrag Deaktivierung TEV-Regelung beenden	M	#CFh	STRBLI_TEVR-steuern
#3d	routineEntryStatus = Status Deaktivierung TEV-Regelung inaktiv	M	#00h	STRBLI_TEVR-steuern

Figure I.32.92: Table StopRoutineByLocalIdentifier Positive Response Message

**StopRoutineByLocalIdentifier negative Response**

Global Negative Responses

**I.32.11.3 33\_CF - read Status Sperre Tankentlueftung - RequestRoutineResultsByLocalIdentifier service**

General information:

With this service the tester can ask for the status of "Sperre Tankentlueftung".

Formular section:

If service 33\_CF is received

Then send positive response

Endif

**RequestRoutineResultsByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLLI
#2d	RoutineLocalIdentifier = Auftrag Deaktivierung TEV-Regelung Status auslesen	M	#CFh	RRRBLLI_TEVR_Iesen

Figure I.32.93: Table RequestRoutineResultsByLocalIdentifier Request Message

**RequestRoutineResultsByLocalIdentifier positive Response**

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRB LI PR
#2d	RoutineLocalIdentifier = Auftrag Deaktivierung TEV-Regelung Status auslesen	M	#CFh	RRRB LI TEV R_lesen
#3d	RecordValue#1 = LV_LAM_AD_ENA	M	#XXh	RRS_LV_LAM _AD_ENA
#4d	RecordValue#2 = LV_LAM_AD_END	M	#XXh	RRS_LV_LAM _AD_END

Figure I.32.94: Table RequestRoutineResultsLocalIdentifier Positive Response Message

**RequestRoutineResultsByLocalIdentifier negative Response**  
Global Negative Responses

**I.32.12 Services 31\_D0 /32\_D0 /33\_D0 for Werkstattdiagnose Abgas-Turbolader**

**Application conditions**

**Initialisation at reset and at LV\_IGK 0->1:** LV\_TCHA\_DIAG\_EXT\_REQ = 0

**Activation:** LV\_IGK=1

**Deactivation:** LV\_IGK=0

Diagnostic timeout  
**Service location:** see list of implemented diagnostic services

**I.32.12.1 31\_D0 - Start Werkstattdiagnose Abgas-Turbolader - StartRoutineByLocalIdentifier service**

**General information:**

With this command the "Werkstattdiagnose Abgas-Turbolader" is requested

**Formula section:**

```

If                service 31_D0 is received

Then              LV_TCHA_DIAG_EXT_REQ = 1
                    send positive response

Endif
    
```

**StartRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRB LI
#2d	routineLocalIdentifier= Auftrag Werkstattdiagnose Abgas-Turbolader starten	M	#D0h	STRB LI AT L_steuern

Figure I.32.95: Table StartRoutineByLocalIdentifier Request Message

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### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response Id	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = Auftrag Werkstattdiagnose Abgas-Turbolader starten	M	#D0h	STRBLI_ATL_steuern
#3d	routineEntryStatus = Status Auftrag Werkstattdiagnose Abgas-Turbolader starten active	M	#05h	STRBLI_ATL_steuern

Figure I.32.96: Table StartRoutineByLocalIdentifier Positive Response Message

### StartRoutineByLocalIdentifier negative Response

Global Negative Responses

### I.32.12.2 32\_D0 - Stop Werkstattdiagnose Abgas-Turbolader - stopRoutineByLocalIdentifier

#### General information:

With this command the "Sperrung Tankentlueftung" is deactivated

#### Formular section:

If service 32\_D0 is received

Then LV\_TCHA\_DIAG\_EXT\_REQ = 0  
send positive response

Endif

### StopRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#2d	RoutineLocalIdentifier = Auftrag Werkstattdiagnose Abgas-Turbolader beenden	M	#D0h	STRBLI_ATL_beenden

Figure I.32.97: Table StopRoutineByLocalIdentifier Request Message

### StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = Auftrag Werkstattdiagnose Abgas-Turbolader beenden	M	#D0h	STRBLI_ATL_beenden
#3d	routineEntryStatus = Status Auftrag Werkstattdiagnose Abgas-Turbolader inactive	M	#00h	STRBLI_ATL_beenden

Figure I.32.98: Table StopRoutineByLocalIdentifier Positive Response Message

### StopRoutineByLocalIdentifier negative Response

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Global Negative Responses

**I.32.12.3 33\_D0 - read Status Auftrag Diagnosefunktion Abgasturbolader - requestRoutineResultsByLocalIdentifier service**

**General information:**

With this service the tester can read out the state of "Werkstattdiagnose Abgasturbolader".

**Formular section:**

**If** service 33\_D0 is received

**Then** send positive response

**Endif**

**RequestRoutineResultsByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLLI
#2d	RoutineLocalIdentifier - Status Werkstattdiagnose Abgasturbolader lesen	M	#D0h	RRRBLLI_ATL_lesen

Figure I.32.99: Table RequestRoutineResultsByLocalIdentifier Request Message

**RequestRoutineResultsByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	<b>RequestRoutineResultsByLocalIdentifier Positive Response</b>	<b>M</b>	<b>#73h</b>	<b>RRRBLIPR</b>
#2d	RoutineLocalIdentifier - Status Werkstattdiagnose Abgasturbolader lesen	M	#D0h	RRRBLI_ATL_ lesen
#3d	RecordValue#1 = St_atlsvc	M	#XXh	RRS_ST_ATL SVC
#4d	RecordValue#2 = St_atlsvc_pvdk	M	#XXh	RRS_ST_ATL SVC_PVDK
#5d	RecordValue#3 = AMP (high byte)	M	#XXh	RRS_AMP
#6d	RecordValue#4 = AMP (low byte)	M	#XXh	RRS_AMP
#7d	RecordValue#5 = TAM	M	#XXh	RRS_TAM
#8d	RecordValue#6 = TIA	M	#XXh	RRS_TIA
#9d	RecordValue#7 = Atlsvc_dpvdK1 (high byte)	M	#XXh	RRS_ATLSVC _DPVDK1
#10d	RecordValue#8= Atlsvc_dpvdK1 (low byte)	M	#XXh	RRS_ATLSVC _DPVDK1
#11d	RecordValue#9= Atlsvc_dpvdK2 (high byte)	M	#XXh	RRS_ATLSVC _DPVDK2
#12d	RecordValue#10= Atlsvc_dpvdK2 (low byte)	M	#XXh	RRS_ATLSVC _DPVDK2
#13d	RecordValue#11= Atlsvc_dpvdK3 (high byte)	M	#XXh	RRS_ATLSVC _DPVDK3
#14d	RecordValue#12= Atlsvc_dpvdK3 (low byte)	M	#XXh	RRS_ATLSVC _DPVDK3
#15d	RecordValue#13 = Pwg_ist (high byte)	M	#XXh	RRS_PWG_IS T
#16d	RecordValue#14 = Pwg_ist (low byte)	M	#XXh	RRS_PWG_IS T
#17d	RecordValue#15 = Tn_abstell (high byte)	M	#XXh	RRS_TN_ABS TELL
#18d	RecordValue#16 = Tn_abstell (loe byte)	M	#XXh	RRS_TN_ABS TELL
#19d	RecordValue#17 = B_kupp	M	#XXh	RRS_B_KUPP
#20d	RecordValue#18 = Gangi_roh ( <b>MSD85</b> ) Gangi ( <b>not MSD85</b> )	M	#XXh	RRS_GANGL_ ROH
#21d	RecordValue#19 = V (high byte)	M	#XXh	RRS_V
#22d	RecordValue#20 = V (low byte)	M	#XXh	RRS_V
#23d	RecordValue#21 = Tmot (high byte)	M	#XXh	RRS_TMOT
#24d	RecordValue#22 = Tmot (low byte)	M	#XXh	RRS_TMOT
#25d	RecordValue#23 = Pu (high byte)	M	#XXh	RRS_PU
#26d	RecordValue#24 = Pu (low byte)	M	#XXh	RRS_PU
#27d	RecordValue#25 = LV_ERR_PUT_EL [1] ( <b>MSD85</b> ), LV_ERR_PUT_EL ( <b>not MSD85</b> )	M	#XXH	RRS_LV_ERR _PUT_EL
#28d	RecordValue#25 = LV_ERR_PUT_EL[2] ( <b>MSD85</b> ), #FFh ( <b>not MSD85</b> )	M	#XXH	RRS_LV_ERR _PUT_EL

Figure I.32.100: Table RequestRoutineResultsLocalIdentifier Positive Response Message

**RequestRoutineResultsByLocalIdentifier negative Response**  
Global Negative Responses

**I.32.13 Services 21\_DA /31\_DA /32\_DA /33\_DA for end of line test: Leakage de-  
tection**

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This function shows the diagnosis status of the end of line test (EOL) of the diagnostic module tank leakage (DMTL) detection.

### I.32.13.1 31\_DA - ON EOL-Test DMTL - StartRoutineByLocalIdentifier service

With the service request 31\_DA the EOL-DMTL-test can be started.

#### Application conditions

**Initialisation:** STATE\_EOL\_KWP\_DMTL = NOT\_START (EOL\_TEST\_NOT\_ST) at reset

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off) or  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

#### Formula section:

/\* activation of DMTL-EOL test \*/

IF(1) service request 31\_DA is received

THEN(1)

IF(2) LV\_CONF\_DMTL = 0

THEN(2) STATE\_EOL\_KWP\_DMTL remains unchanged  
send negative response

ELSE(2)

IF(3) conditions for EOL test are fulfilled

THEN(3) STATE\_EOL\_KWP\_DMTL = ACT (EOL test active)  
send positive response

ELSE(3) STATE\_EOL\_KWP\_DMTL = EOL\_TEST\_INH (EOL test inhibited=01H)  
send negative response

ENDIF(3)

ENDIF(2)

ENDIF(1)

#### StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier - start EOL Test DMTL	M	#DAh	RELI_DMTL

Figure I.32.101: Table StartRoutineByLocalIdentifier Request Message

#### StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = start EOL Test DMTL	M	#DAh	RELI_DMTL
#3d	routineEntryStatus = STATE_EOL_KWP_DMTL	M	ACT	REYS_01

Figure I.32.102: Table StartRoutineByLocalIdentifier Positive Response Message

### StartRoutineByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.103: Table StartRoutineByLocalIdentifier Negative Response Message

### I.32.13.2 21\_DA - read STATUS DMTL EOL - ReadDataByLocalIdentifier service

With the service 21\_DA the current status of the EOL (STATE\_EOL\_KWP\_DMTL) test can be displayed.

#### Application conditions

**Initialisation:** 0 at reset

**Activation:** LV\_IGK=1 (K1.15 on)

**Deactivation:** LV\_IGK=0 (K1.15 off) or  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

#### ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = DMTL EOL	M	#DAh	RLI_DMTL

Figure I.32.104: Table readDataByLocalIdentifier Request Message

#### ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier - DMTL EOL	M	#DAh	RLI_KVA
#3d	RecordValue = STATE_EOL_KWP_DMTL	M	#XXh	RV_S_DMTL

Figure I.32.105: Table readDataByLocalIdentifier Positive Response Message

#### ReadDataByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLID
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.106: Table: readDataByLocalIdentifier Negative Response Message

### I.32.13.3 32\_DA - OFF EOL-Test DMTL - StopRoutineByLocalIdentifier service

With the service request 32\_DA the EOL-DMTL-test can be stopped.

#### Application conditions

**Initialisation:** 0 at reset

**Activation:** LV\_IGK=1 (K1.15 on)

**Deactivation:** LV\_IGK=0 (K1.15 off) **or**  
Diagnostic timeout

**ServiceLocation:** see list of implemented diagnostic services

#### Formula section:

```

/*stop of EOL test*/
IF          service 32_DA received
THEN       STATE_EOL_KWP_DMTL      = NOT_START//EOL_TEST_NOT_
ST
ELSE       STATE_EOL_KWP_DMTL remains unchanged
ENDIF
    
```

#### StopRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	stopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#2d	routineLocalIdentifier = stop EOL Test DMTL	M	#Dah	RELI_DMTL

Figure I.32.107: Table StopRoutineByLocalIdentifier Request Message

#### StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	stopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	routineLocalIdentifier - stop EOL Test DMTL	M	#Dah	RELI_DMTL
#2d	routineEntryStatus = STATE_EOL_KWP_DMTL	M	NOT_START	REYS_01

Figure I.32.108: Table StopRoutineByLocalIdentifier Positive Response Message

#### StopRoutineByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	stopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.32.109: Table StopRoutineByLocalIdentifier Negative Response Message

### I.32.13.4 33\_DA - report results of - DMTL EOL - RequestRoutineResultsByLocalIdentifier service

#### General information:

With the service 33\_DA the tester can ask for the results of DMTL end of line test which is started with the service 31\_DA.

#### Application conditions

**Initialisation:** 0 at reset

**Activation:** LV\_IGK=1 (K1.15 on)

**Deactivation:** LV\_IGK=0 (K1.15 off) **or**  
Diagnostic timeout

**ServiceLocation:** see list of implemented diagnostic services

#### Formula section:

```

If(1)          service 33_DA is received
If(2)          LV_CONF_DMTL = 0
Then(2)       send negative response (serviceNotSupported)
Else(2)
    /* calculation of STATE_EOL_KWP_DMTL: Only for MSD80 */
If             11h <= STATE_DMTL_EOL <=26H (DMTL cancelled)
or             DMTL cancelled due to other conditions(in this case STATE_DMTL_
EOL reports last active state before cancellation)
Then           STATE_EOL_KWP_DMTL = EOL_TEST_ABORTED (=07H)

If(3)          STATE_DMTL_EOL=08h (DMTL function is finished, tank tight)
Then(3)       STATE_EOL_KWP_DMTL = EOL_TEST_END_WOUT_ERR (=08H)
Endif(3)

If(3)          STATE_DMTL_EOL=09h (DMTL function is finished, small leak)
or             STATE_DMTL_EOL=0Ah (DMTL function is finished, rough leak)
or             STATE_DMTL_EOL=0Bh (DMTL function is finished, module error)
Then(3)       STATE_EOL_KWP_DMTL = EOL_TEST_END_WITH_ERR (=09H)
Endif(3)

    send positive response

Endif(2)
Endif(1)
    
```

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### RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#2d	RoutineLocalIdentifier - DMTL EOL test values	M	#DAh	RELI_DMTL

Figure I.32.110: Table RequestRoutineResultsByLocalIdentifier Request Message

### Not for MSD80: RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = DMTL EOL test values	M	#DAh	RELI_DMTL
#3d	RecordValue = STATE_DMTL_EOL [ START REF_LEAK_MES ROUGH_LEAK_MES ROUGH_LEAK_MES_LEN ROUGH_LEAK_MES_END SMALL_LEAK_MES SMALL_LEAK_MES_LEN 2.REF_LEAK_MES TANK_PROOFED SMALL_LEAK ROUGH_LEAK MODULE_ERROR ! LV_VB_RANGE_DMTL (VB out of range) ! LV_ENA_LEAK_DMTL (electrical error) LV_DET_REFU (fuel refill detected) LV_DET_FUC_OPEN (fuel cap open) LV_VB_DIF_MAX (VB fluctuation too high) LV_T_DMTL_MAX (maximum duration of diagnosis reached) LV_CUR_DMTL_REF_DIF_MAX (fluctuation of ref. current too high) LV_CUR_DMTL_THD_DIF_MES (decr. pump current during measure) END ]	M	#XXh [ #00h, #01h, #02h, #03h, #04h, #05h, #06h, #07h, #08h, #09h, #0Ah, #0Bh, #11h, #12h, #21h, #22h, #23h, #24h, #25h, #26h, #0Ch ]	
#4d	RecordValue = CUR_DMTL_REF_LEAK_EOL high Byte	M	#XXh	
#5d	RecordValue = CUR_DMTL_REF_LEAK_EOL low Byte	M	#XXh	
#6d	RecordValue = CUR_DMTL_ROUGH_LEAK_MIN_EOL high Byte	M	#XXh	
#7d	RecordValue = CUR_DMTL_ROUGH_LEAK_MIN_EOL low Byte	M	#XXh	
#8d	RecordValue = CUR_DMTL_COR_FIL_EOL high Byte	M	#XXh	
#9d	RecordValue = CUR_DMTL_COR_FIL_EOL low Byte	M	#XXh	

Figure I.32.111: Table RequestRoutineResultsLocalIdentifier Positive Response Message

### Only for MSD80: RequestRoutineResultsByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = DMTL EOL test values	M	#DAh	RELI_DMTL
#3d	RecordValue = STATE_EOL_KWP_DMTL	M	#XXh	RELI_DMTL
#4d	RecordValue = STATE_DMTL_EOL [ START REF_LEAK_MES ROUGH_LEAK_MES ROUGH_LEAK_MES_LEN ROUGH_LEAK_MES_END SMALL_LEAK_MES SMALL_LEAK_MES_LEN 2.REF_LEAK_MES TANK_PROOFED SMALL_LEAK ROUGH_LEAK MODULE_ERROR ! LV_VB_RANGE_DMTL (VB out of range) ! LV_ENA_LEAK_DMTL (electrical error) LV_DET_REFU (fuel refill detected) LV_DET_FUC_OPEN (fuel cap open) LV_VB_DIF_MAX (VB fluctuation too high) LV_T_DMTL_MAX (maximum duration of diagnosis reached) LV_CUR_DMTL_REF_DIF_MAX (fluctuation of ref. current too high) LV_CUR_DMTL_THD_DIF_MES (decr. pump current during measure) END ]	M	#XXh [ #00h, #01h, #02h, #03h, #04h, #05h, #06h, #07h, #08h, #09h, #0Ah, #0Bh, #11h, #12h, #21h, #22h, #23h, #24h, #25h, #26h, #0Ch ]	
#5d	RecordValue = CUR_DMTL_REF_LEAK_EOL high Byte	M	#XXh	RELI_DMTL
#6d	RecordValue = CUR_DMTL_REF_LEAK_EOL low Byte	M	#XXh	RELI_DMTL
#7d	RecordValue = CUR_DMTL_ROUGH_LEAK_MIN_EOL high Byte	M	#XXh	RELI_DMTL
#8d	RecordValue = CUR_DMTL_ROUGH_LEAK_MIN_EOL low Byte	M	#XXh	RELI_DMTL
#9d	RecordValue = CUR_DMTL_COR_FIL_EOL high Byte	M	#XXh	RELI_DMTL
#10d	RecordValue = CUR_DMTL_COR_FIL_EOL low Byte	M	#XXh	RELI_DMTL

Figure I.32.112: Table RequestRoutineResultsLocalIdentifier Positive Response Message  
RequestRoutineResultsByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	NegativeResponse Service Id	M	#7Fh	NR
#2d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.32.113: Table RequestRoutineResultsByLocalIdentifier Negative Response Message

### I.32.14 Services 21\_DF /31\_DF /32\_DF /33\_DF for end of line test: Lambda sensors confused /wrong wired - linear sensors

#### I.32.14.1 31\_DF EOL Test ON - Lambda sensors confused /wrong wired - StartRoutineByLocalIdentifier service

#### FUNCTION DESCRIPTION:

#### General information:

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This EOL test is to detect confused or wrong wired linear lambda sensors in order to prevent bad emissions.

i = 1 for cylinder bank1 and i = 2 for cylinder bank 2

**Application conditions**

**Initialisation:** STATE\_EOL\_KWP\_VLS = NOT\_START at reset  
 LV\_ACT\_VLS\_EOL\_EXT\_ADJ = 00h at reset

**Activation:** LV\_IGK=1 (K1.15 on) **and**  
 LV\_IS = 1 **and**  
 TCO > C\_TCO\_MIN\_VLS\_EOL **and**  
 TEG\_CAT\_DOWN\_MDL[i] > C\_TEG\_CAT\_DOWN\_EOL **and** //for both exhaust banks  
 LV\_LAMB\_LS\_UP\_VLD[i] = 1 **and** //for both exhaust banks  
 LV\_LS\_DOWN\_READY[i] = 1 **and** //for both exhaust banks  
 STATE\_LSH\_UP[i] = LSH\_POW\_CTL **and** //for both exhaust banks  
 STATE\_LSH\_DOWN[i] = LSH\_POW\_CTL **and** //for both exhaust banks  
 LV\_DIAG\_ACT\_INH\_LS\_UP\_DOWN[i] = 0 //for both exhaust banks

**Deactivation:** LV\_IGK=0 (K1.15 off) **or**  
 conditions from activation not fulfilled **or**  
 Diagnostic timeout

**Service location:** see list of implemented diagnostic services

**Formula section:**

activation of EOL test

```

IF service 31_DF is received and
activation conditions for EOL test fulfilled (see above)
THEN STATE_EOL_KWP_VLS = ACT //ACT
LV_ACT_VLS_EOL_EXT_ADJ = 1 //request to start EOL test
ELSE STATE_EOL_KWP_VLS remains unchanged
LV_ACT_VLS_EOL_EXT_ADJ = 0
ENDIF
    
```

**StartRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= start EOL Test shifted lambdasensor check	M	#DFh	RELI_LSEOL

Figure I.32.114: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = EOL Test shifted lambdasensor check	M	#DFh	RELI_LSEOL
#3d	routineEntryStatus = STATE_EOL_KWP_VLS	M	ACT	REYS_01

Figure I.32.115: Table StartRoutineByLocalIdentifier Positive Response Message

### StartRoutineByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.116: Table StartRoutineByLocalIdentifier Negative Response Message

## I.32.14.2 21\_DF Read Status EOL - Lambda sensors confused /wrong wired - Read-DataByLocalIdentifier service

### Application conditions

**Initialisation:** 0 at reset

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off) or  
Diagnostic timeout

**Service location:** see list of implemented diagnostic services

### ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = shifted lambdasensor check	M	#DFh	RELI_LSEOL

Figure I.32.117: Table readDataByLocalIdentifier Request Message

### ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier = shifted lambdasensor check	M	#DFh	RELI_LSEOL
#3d	RecordValue = STATE_EOL_KWP_VLS	M	#XXh	RV_S_LSEOL

Figure I.32.118: Table readDataByLocalIdentifier Positive Response Message

### ReadDataByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLID
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.119: Table: readDataByLocalIdentifier Negative Response Message

### I.32.14.3 32\_DF EOL Test OFF - Lambda sensors confused /wrong wired - StopRoutineByLocalIdentifier service

#### Application conditions

**Initialisation:**                    0 at reset

**Activation:**                        LV\_IGK=1 (K1.15 on)

**Deactivation:**                    LV\_IGK=0 (K1.15 off)            or  
Diagnostic timeout

**Service location:**                see list of implemented diagnostic services

#### Formula section:

stop of EOL test

```

IF          service 32_DF received
THEN       STATE_EOL_KWP_VLS = NOT_START           //NOT_START
           LV_ACT_VLS_EOL_EXT_ADJ = 0               //request to stop EOL test
ELSE
           STATE_EOL_KWP_VLS remains unchanged
ENDIF
    
```

#### StopRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#2d	RoutineLocalIdentifier - stop EOL Test shifted lambdasensor check	M	#DFh	RELI_LSEOL

Figure I.32.120: Table StopRoutineByLocalIdentifier Request Message

#### StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = stop EOL Test shifted lambdasensor check	M	#DFh	RELI_LSEOL
#3d	routineEntryStatus = STATE_EOL_KWP_VLS	M	NOT_START	REYS_01

Figure I.32.121: Table StopRoutineByLocalIdentifier Positive Response Message

#### StopRoutineByLocalIdentifier negative Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#3d	responseCode=general response codes	M	#XX	RC

Figure I.32.122: Table StopRoutineByLocalIdentifier Negative Response Message

### I.32.14.4 33\_DF - Report EOL results - Lambda sensors confused /wrong wired - RequestRoutineResultsByLocalIdentifier service

#### Application conditions

**Initialisation:**                    0 at reset

**Activation:**                        LV\_IGK=1 (K1.15 on)

**Deactivation:**                    LV\_IGK=0 (K1.15 off)            or  
Diagnostic timeout

**Service location:**                see list of implemented diagnostic services

#### RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#2d	RoutineLocalIdentifier = ask for shifted lambdasensor check EOL test values	M	#DFh	RELI_LSEOL

Figure I.32.123: Table RequestRoutineResultsByLocalIdentifier Request Message

#### RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = shifted lambdasensor check EOL test values	M	#DFh	RELI_LSEOL
#3d	RecordValue#1 = STATE_EOL_KWP_VLS	M	#XXh	
#4d	RecordValue#2 = STATE_VLS_EOL [ diagnosis inactive diagnosis 1.step diagnosis 2.step diagnosis finished, sensor OK diagnosis finished, upstream oxygen sensor shifted diagnosis finished, downstream oxygen sensor shifted diagnosis finished, upstream and downstream oxygen sensor shifted diagnosis finished, upstream oxygen sensor bank 1 not plausible diagnosis finished, upstream oxygen sensor bank 2 not plausible diagnosis finished, downstream oxygen sensor bank 1 not plausible diagnosis finished, downstream oxygen sensor bank 2 not plausible diagnosis finished, no interpretable result ]	M	#XXh [ #00h, #01h, #02h, #10h, #11h, #12h, #13h, #14h, #15h, #16h, #17h, #18h ]	
#5d	RecordValue#3 = LAMB_LS_UP_AFR_EOL[1] high byte	M	#XXh	
#6d	RecordValue#4 = LAMB_LS_UP_AFR_EOL[1] low byte	M	#XXh	
#7d	RecordValue#5 = LAMB_LS_UP_AFR_EOL[2] high byte	M	#XXh	
#8d	RecordValue#6 = LAMB_LS_UP_AFR_EOL[2] low byte	M	#XXh	
#9d	RecordValue#7 = VLS_DOWN_AFR_EOL[1] high byte	M	#XXh	
#10d	RecordValue#8 = VLS_DOWN_AFR_EOL[1] low byte	M	#XXh	
#11d	RecordValue#9 = VLS_DOWN_AFR_EOL[2] high byte	M	#XXh	
#12d	RecordValue#10 = VLS_DOWN_AFR_EOL[2] low byte	M	#XXh	
#13d	RecordValue#11 = LAMB_LS_UP_AFL_EOL[1] high byte	M	#XXh	
#14d	RecordValue#12 = LAMB_LS_UP_AFL_EOL[1] low byte	M	#XXh	
#15d	RecordValue#13 = LAMB_LS_UP_AFL_EOL[2] high byte	M	#XXh	
#16d	RecordValue#14 = LAMB_LS_UP_AFL_EOL[2] low byte	M	#XXh	
#17d	RecordValue#15 = VLS_DOWN_AFL_EOL[1] high byte	M	#XXh	
#18d	RecordValue#16 = VLS_DOWN_AFL_EOL[1] low byte	M	#XXh	
#19d	RecordValue#17 = VLS_DOWN_AFL_EOL[2] high byte	M	#XXh	
#20d	RecordValue#18 = VLS_DOWN_AFL_EOL[2] low byte	M	#XXh	
#21d	RecordValue#19 = MAF_INT_MIN_VLS_EOL high Byte	M	#XXh	
#22d	RecordValue#20 = MAF_INT_MIN_VLS_EOL low Byte	M	#XXh	

Figure I.32.124: Table RequestRoutineResultsLocalIdentifier Positive Response Message  
**RequestRoutineResultsByLocalIdentifier negative Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	NegativeResponse Service Id	M	#7Fh	NR
#2d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.32.125: Table RequestRoutineResultsByLocalIdentifier Negative Response Message

### I.32.15 Services 21\_D5 /31\_D5 /32\_D5 /33\_D5 for end of line test: ECRAS system test

#### FUNCTION DESCRIPTION:

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**General information:**

This EOL test is to test the ECRAS System. The ECRAS diagnosis will be enabled.

**Application conditions**

**Initialisation:** at reset or LV\_IGK 0->1: STATE\_EOL\_KWP\_ECRAS = NOT\_START,  
LV\_ACT\_ECRAS\_EOL\_EXT\_ADJ = 00h

**Recurrence:** same as ECRAS diagnosis function (100ms)

**Activation:** LV\_IGK=1 (Kl.15 on)

**Deactivation:** LV\_IGK=0 (Kl.15 off) **or**  
Diagnostic timeout  
*Service location:* see list of implemented diagnostic services

**Formula section:**

**Calculation of STATE\_EOL\_KWP\_ECRAS:**

The calculation of the state STATE\_EOL\_KWP\_ECRAS is started with activation of LV\_ACT\_ECRAS\_EOL\_EXT\_ADJ (0->1). Depending on several conditions the state and LV\_ACT\_ECRAS\_EOL\_EXT\_ADJ will be set. The Determination of STATE\_EOL\_KWP\_ECRAS is stopped after deactivation of the EOL by tester. In this case STATE\_EOL\_KWP\_ECRAS = NOT\_START (function not started). Once the calculation of the STATE\_EOL\_KWP\_ECRAS is started, it has to be calculated with a recurrence of 100ms until deactivation.

```


If LV_ACT_ECRAS_EOL_EXT_ADJ = 1
Then If LV_ECRAS_UP_EXT_ADJ = 1 or
LV_ECRAS_DOWN_EXT_ADJ = 1 or
LV_CDN_VB_MIN_DIAG = 0
Then LV_ACT_ECRAS_EOL_EXT_ADJ = 0
STATE_EOL_KWP_ECRAS = 01H //conditions not correct
Elseif LV_ECRAS_EOL_INH = 1 and
LV_ERR_ECRAS_EOL = 1
Then LV_ACT_ECRAS_EOL_EXT_ADJ = 0
STATE_EOL_KWP_ECRAS = 9H //function finished, error present
Elseif LV_ECRAS_EOL_INH = 1
Then LV_ACT_ECRAS_EOL_EXT_ADJ = 0
STATE_EOL_KWP_ECRAS = 8H //function finished, without error
Endif
Else no change
Endif
    
```

**I.32.15.1 31\_D5 EOL Test ON - ECRAS system test - StartRoutineByLocalIdentifier service**

**Description:**

If the activation service is received and the activation conditions are fulfilled the ECRAS system test is started (LV\_ACT\_ECRAS\_EOL\_EXT\_ADJ 0-> 1)

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**Formula section:**

activation of EOL test

```

IF          service 31_D5  is received          and
              LV_ECRAS_UP_EXT_ADJ = 0           and
              LV_ECRAS_DOWN_EXT_ADJ = 0         and
              LV_CDN_VB_MIN_DIAG = 1           and
              LV_ECRAS_EOL_INH = 0
THEN       STATE_EOL_KWP_ECRAS = ACT           // ACT
              LV_ACT_ECRAS_EOL_EXT_ADJ = 1     //request to start EOL test
ELSE       STATE_EOL_KWP_ECRAS = 1H          //conditions not correct
              LV_ACT_ECRAS_EOL_EXT_ADJ remains unchanged
ENDIF
    
```

**StartRoutineByLocalIdentifier Request**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#2d	routineLocalIdentifier= start EOL ECRAS system test	M	#D5h	RELI_GLFS

Figure I.32.126: Table StartRoutineByLocalIdentifier Request Message

**StartRoutineByLocalIdentifier positive Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = EOL ECRAS system test	M	#D5h	RELI_GLFS
#3d	routineEntryStatus = STATE_EOL_KWP_ECRAS	M	ACT	RRR_FS_G LFS

Figure I.32.127: Table StartRoutineByLocalIdentifier Positive Response Message

**StartRoutineByLocalIdentifier negative Response**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.128: Table StartRoutineByLocalIdentifier Negative Response Message

**I.32.15.2 21\_D5 Read Status EOL - ECRAS system test - ReadDataByLocalIdentifier service**

**Application conditions**

**Initialisation:** 0 at reset

**Activation:** LV\_IGK=1 (K1.15 on)

**Deactivation:** LV\_IGK=0 (K1.15 off) or Diagnostic timeout

**Service location:** see list of implemented diagnostic services

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### ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLI
#2d	recordLocalIdentifier = ECRAS system test	M	#D5h	RELI_LSEOL

Figure I.32.129: Table readDataByLocalIdentifier Request Message

### ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	readDataByLocalIdentifier Positive Response Service Id	M	#61h	RDBLIDPR
#2d	recordLocalIdentifier = ECRAS system test	M	#D5h	RELI_LSEOL
#3d	RecordValue = STATE_EOL_KWP_ECRAS	M	#XXh	RV_S_LSEOL

Figure I.32.130: Table readDataByLocalIdentifier Positive Response Message

### ReadDataByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLID
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.131: Table: readDataByLocalIdentifier Negative Response Message

## I.32.15.3 32\_D5 EOL Test OFF - ECRAS system test - StopRoutineByLocalIdentifier service

### Description:

If this service is received the EOL test will be stopped.

### Formula section:

stop of EOL test

```

IF          service 32_D5 received
THEN       STATE_EOL_KWP_ECRAS = NOT_START           // NOT_START
           LV_ACT_ECRAS_EOL_EXT_ADJ = 0             //request to stop EOL test
ELSE       STATE_EOL_KWP_ECRAS remains unchanged
ENDIF
    
```

### StopRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#2d	RoutineLocalIdentifier - stop EOL ECRAS system test	M	#D5h	RELI_GLFS

Figure I.32.132: Table StopRoutineByLocalIdentifier Request Message

### StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = stop EOL ECRAS system test	M	#D5h	RELI_GLFS
#3d	routineEntryStatus = STATE_EOL_KWP_ECRAS	M	NOT_START	RRR_FS_GLFS

Figure I.32.133: Table StopRoutineByLocalIdentifier Positive Response Message

### StopRoutineByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#3d	responseCode=general response codes	M	#XX	RC

Figure I.32.134: Table StopRoutineByLocalIdentifier Negative Response Message

## I.32.15.4 33\_D5 - Report EOL results - ECRAS system test - RequestRoutineResultsByLocalIdentifier service

### Description:

The EOL state (STATE\_EOL\_KWP\_ECRAS) and the status of the ECRAS system (STATE\_ECRAS\_SYS) will send if this service is received.

### RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLLI
#2d	RoutineLocalIdentifier = ask EOL test state and values	M	#D5h	RELI_GLFS

Figure I.32.135: Table RequestRoutineResultsByLocalIdentifier Request Message

### RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLLIPR
#2d	RoutineLocalIdentifier = ECRAS system test EOL test values	M	#D5h	RELI_GLFS
#3d	RecordValue = STATE_EOL_KWP_ECRAS	M	#XXh	RRR_FS_GLFS
#4d	RecordValue = STATE_ECRAS_SYS high byte	M	#XXh	
#5d	RecordValue = STATE_ECRAS_SYS low byte	M	#XXh	

Figure I.32.136: Table RequestRoutineResultsLocalIdentifier Positive Response Message


### RequestRoutineResultsByLocalIdentifier negative Response

<i>Data Byte</i>	<i>Parameter Name</i>	<i>Cvt</i>	<i>Hex Value</i>	<i>Mnemonic</i>
#1d	NegativeResponse Service Id	M	#7Fh	NR
#2d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.32.137: Table RequestRoutineResultsByLocalIdentifier Negative Response Message

## I.33 Flash reprogramming procedure

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 7828 of 8404</b>
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### I.33.1 The message flow of flash-reprogramming with WinKFP Tool (customer reprog.)


Time	Client (DIAG-Tester)	Server (ECU)
P3 P2	ReadMemoryByAddress [UIF]	ReadMemoryByAddress Pos.Rsp [UIF data]
P3 P2	ReadDataByCommonIdentifier [MaxResponseTime]	ReadDataByCommonIdentifier Pos.Rsp [MaxResponseTime]
P3 P2	StartRoutineByLocalIdentifier [ProgrammingStatus]	StartRoutineByLocalIdentifier Pos.Rsp [ProgrammingStatus]
P3 P2	ReadDataByCommonIdentifier [MaxBlockLength]	ReadDataByCommonIdentifier Pos.Rsp [MaxBlockLength]
P3 P2	StartDiagnosticSession [ECUProgrammingMode]	If (StartDiagnosticSession Neg. Rsp SAD) go on at <b>Label_1</b> If (StartDiagnosticSession Pos.Rsp) go on at <b>Label_2</b>
P3 P2	<b>Label_1:</b> ReadEculdentification [SystemSupplierECUserialNumber]	ReadEculdentification Pos.Rsp [SystemSupplierECUserialNumber]
P3 P2	StartRoutineByLocalIdentifier [AuthRequestSeed]	StartRoutineByLocalIdentifier Pos.Rsp [AuthRequestSeed]
P3 P2	StartRoutineByLocalIdentifier [AuthSendKey]	StartRoutineByLocalIdentifier Pos.Rsp [AuthSendKey]
P3 P2	StartDiagnosticSession [ECUProgrammingMode]	StartDiagnosticSession Pos.Rsp
P3 P2	<b>Label_2:</b> StartRoutineByLocalIdentifier [EraseMemory, ECU_SW or CAL_DATA]	StartRoutineByLocalIdentifier Pos.Rsp [EraseMemory]
P3 P2	DisableNormalMessageTransmission [functional, SuppressPosResponse]	
P3 P2	EnableNormalMessageTransmission [physical (ECU), SuppressPosResponse]	
P3 P2	RequestDownload [ECU_SW or CAL_DATA, area #1]	RequestDownload Pos.Rsp.
P3 P2 P3 P2 : P3 P2	TransferData [#1] TransferData [#2] : TransferData [#n]	TransferData Pos.Rsp. [#1] TransferData Pos.Rsp. [#2] : TransferData Pos.Rsp. [#n]
P3 P2	RequestTransferExit [ECU_SW or CAL_DATA, area #1]	RequestTransferExit Pos.Rsp.
P3 P2	RequestDownload [ECU_SW or CAL_DATA, area #2 (optional)]	RequestDownload Pos.Rsp.
P3 P2 P3 P2 : P3 P2	TransferData [#1] TransferData [#2] : TransferData [#n]	TransferData Pos.Rsp. [#1] TransferData Pos.Rsp. [#2] : TransferData Pos.Rsp. [#n]

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P3	RequestTransferExit [ECU_SW or CAL_DATA, area #2 (optional)]	
P2		RequestTransferExit Pos.Rsp.
P3	RequestDownload [ECU_SW or CAL_DATA, area #n (optional)]	
P2		RequestDownload Pos.Rsp.
P3	TransferData [#1]	TransferData Pos.Rsp.[#1]
P2		
P3	TransferData [#2]	TransferData Pos.Rsp. [#2]
P2		
:	:	:
P3	TransferData [#n]	TransferData Pos.Rsp. [#n]
P2		
P3	RequestTransferExit [ECU_SW or CAL_DATA, area #n (optional)]	
P2		RequestTransferExit Pos.Rsp.
P3	EnableNormalMessageTransmission [functional, SuppressPosResponse]	
P3	StartRoutineByLocalIdentifier [ProgrammingStatus]	
P2		StartRoutineByLocalIdentifier Pos.Rsp [ProgrammingStatus]
P3	StartRoutineByLocalIdentifier [CheckSignature, ECU_SW or CAL_DATA]	
P2		StartRoutineByLocalIdentifier Pos.Rsp [CheckSignature]
P3	StartRoutineByLocalIdentifier [ProgrammingStatus]	
P2		StartRoutineByLocalIdentifier Pos.Rsp [ProgrammingStatus]
P3	StopDiagnosticSession (only for CAL_DATA programming)	
P2		StopDiagnosticSession Pos.Rsp
P3	EcuReset (only for CAL_DATA programming)	
P2		EcuReset Pos.Rsp
P3	StartRoutineByLocalIdentifier [ProgrammingStatus] (only for CAL_DATA programming)	
P2		StartRoutineByLocalIdentifier Pos.Rsp [ProgrammingStatus]

## Table Message FlowFlash programming

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	Document key 10171571 SPE 000 AO	Pages Page 7830 of 8404	
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## I.34 Emission related software and system configuration

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MOD_1_PID_1_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (01h - 08h)					
MOD_1_PID_2_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (09h - 10h)					
MOD_1_PID_3_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (11h - 18h)					
MOD_1_PID_4_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (19h - 20h)					
MOD_1_PID_5_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (21h - 28h)					
MOD_1_PID_6_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (29h - 30h)					
MOD_1_PID_7_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (31h - 38h)					
MOD_1_PID_8_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (39h - 40h)					
MOD_1_PID_9_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (41h - 48h)					
MOD_1_PID_A_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (49h - 50h)					
MOD_1_PID_B_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (51h - 58h)					
MOD_1_PID_C_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (59h - 60h)					
MOD_2_PID_1_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (01h - 09h)					
MOD_2_PID_2_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (09h - 10h)					
MOD_2_PID_3_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (11h - 18h)					
MOD_2_PID_4_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (19h - 20h)					
MOD_2_PID_5_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (21h - 28h)					
MOD_2_PID_6_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (29h - 30h)					
MOD_2_PID_7_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (31h - 38h)					
MOD_2_PID_8_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (39h - 40h)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MOD_2_PID_9_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (41h - 48h)					
MOD_2_PID_A_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (49h - 50h)					
MOD_2_PID_B_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (51h - 58h)					
MOD_2_PID_C_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (59h - 60h)					
MOD_5_TID_1_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (01h - 08h)					
MOD_5_TID_10_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05(49h - 50h)					
MOD_5_TID_11_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (51h - 58h)					
MOD_5_TID_12_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (59h - 60h)					
MOD_5_TID_13_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (61h - 68h)					
MOD_5_TID_14_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (69h - 70h)					
MOD_5_TID_15_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (71h - 78h)					
MOD_5_TID_16_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (79h - 80h)					
MOD_5_TID_17_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (81h - 88h)					
MOD_5_TID_18_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (89h - 90h)					
MOD_5_TID_19_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (91h - 98h)					
MOD_5_TID_2_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (09h - 10h)					
MOD_5_TID_20_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05(99h - A0h)					
MOD_5_TID_3_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (11h - 18h)					
MOD_5_TID_4_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (19h - 20h)					
MOD_5_TID_5_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (21h - 28h)					
MOD_5_TID_6_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (29h - 30h)					
MOD_5_TID_7_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (31h - 38h)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MOD_5_TID_8_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (39h - 40h)					
MOD_5_TID_9_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (41h - 48h)					
MOD_6_TID_1_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 06 (01h - 08h)					
MOD_6_TID_2_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 06 (09h - 10h)					
MOD_6_TID_3_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 06 (11h - 18h)					
MOD_6_TID_4_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 06 (19h - 20h)					
MOD_9_VIT_1_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 09 (01h - 09h) for ISO 15765-4					
MOD_9_VIT_2_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 09 (09h - 10h) for ISO 15765-4					
MOD_9_VIT_3_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 09 (11h - 18h) for ISO 15765-4					
MOD_9_VIT_4_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 09 (19h - 20h) for ISO 15765-4					

**Input data:**


LV_VAR_OBDC_CAN {p. 7681}			
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**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CLC_READY_OBD_1	-	0... FFH	0... 255	1	-
Calibration byte to force readiness to 0 without calculation					
C_MOD_1_PID_1_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (01h - 08h)					
C_MOD_1_PID_2_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (09h - 10h)					
C_MOD_1_PID_3_DIAG	-	0... FFH	0... 255	1	-
Byte which defines the PIDs supported by the mode 01 (11h - 18h)					
C_MOD_1_PID_4_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (19h - 20h)					
C_MOD_1_PID_5_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (21h - 28h)					
C_MOD_1_PID_6_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (29h - 30h)					
C_MOD_1_PID_7_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (31h - 38h)					
C_MOD_1_PID_8_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (39h - 40h)					
C_MOD_1_PID_9_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (41h - 48h)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MOD_1_PID_A_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (49h - 50h)					
C_MOD_1_PID_B_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (51h - 58h)					
C_MOD_1_PID_C_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (59h - 60h)					
C_MOD_2_PID_1_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (01h - 08h)					
C_MOD_2_PID_2_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (09h - 10h)					
C_MOD_2_PID_3_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (11h - 18h)					
C_MOD_2_PID_4_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (19h - 20h)					
C_MOD_2_PID_5_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (21h - 28h)					
C_MOD_2_PID_6_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (29h - 30h)					
C_MOD_2_PID_7_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (31h - 38h)					
C_MOD_2_PID_8_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (39h - 40h)					
C_MOD_2_PID_9_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (41h - 48h)					
C_MOD_2_PID_A_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (49h - 50h)					
C_MOD_2_PID_B_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (51h - 58h)					
C_MOD_2_PID_C_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (59h - 60h)					
C_MOD_5_TID_1_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (01h - 08h)					
C_MOD_5_TID_10_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (49h - 50h)					
C_MOD_5_TID_11_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (51h - 58h)					
C_MOD_5_TID_12_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (59h - 60h)					
C_MOD_5_TID_13_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (61h - 68h)					
C_MOD_5_TID_14_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (69h - 70h)					
C_MOD_5_TID_15_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (71h - 78h)					

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	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 7834 of 8404</b>	
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MOD_5_TID_16_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (79h - 80h)					
C_MOD_5_TID_17_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (81h - 88h)					
C_MOD_5_TID_18_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (89h - 90h)					
C_MOD_5_TID_19_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (91h - 98h)					
C_MOD_5_TID_2_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (09h - 10h)					
C_MOD_5_TID_20_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (99h - A0h)					
C_MOD_5_TID_3_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (11h - 18h)					
C_MOD_5_TID_4_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (19h - 20h)					
C_MOD_5_TID_5_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (21h - 28h)					
C_MOD_5_TID_6_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (29h - 30h)					
C_MOD_5_TID_7_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (31h - 38h)					
C_MOD_5_TID_8_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (39h - 40h)					
C_MOD_5_TID_9_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (41h - 48h)					
C_MOD_6_TID_1_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 06 (01h - 08h)					
C_MOD_6_TID_2_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 06 (09h - 10h)					
C_MOD_6_TID_3_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 06 (11h - 18h)					
C_MOD_6_TID_4_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 06 (19h - 20h)					
C_MOD_9_VIT_1_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the VITs supported by the mode 09 (01h - 08h) for ISO 15765-4					
C_MOD_9_VIT_2_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the VITs supported by the mode 09 (09h - 10h) for ISO 15765-4					
C_MOD_9_VIT_3_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the VITs supported by the mode 09 (11h - 18h) for ISO 15765-4					
C_MOD_9_VIT_4_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the VITs supported by the mode 09 (19h - 20h) for ISO 15765-4					
C_OBD_REQ	-	0... FFH	0... 255	1	-
Byte which indicates the OBD requirements					


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VLS_DOWN_AFL_AFR_SAE	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Lean to rich threshold for downstream lambda sensor for MODE 06h					
C_VLS_DOWN_AFR_AFL_SAE	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Rich to lean threshold for downstream lambda sensor for MODE 06h					
C_VLS_DOWN_CYC_MAX_SAE	-	0... FFH	0... 1.275	0.005	V
Maximum downstream sensor test cycle voltage, Mode 5					
C_VLS_DOWN_CYC_MIN_SAE	-	0... FFH	0... 1.275	0.005	V
Minimum downstream sensor test cycle voltage, Mode 5					
LC_VAR_OBDC_CAN	-	0... 1H	0 ...1	1	-
Logical switch to activate OBD communication on CAN (=1) /or K-line (=0)					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_MOD_1_PID_1_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (01h - 08h)					
NC_MOD_1_PID_2_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (09h - 10h)					
NC_MOD_1_PID_3_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (11h - 18h)					
NC_MOD_1_PID_4_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (19h - 20h)					
NC_MOD_1_PID_5_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (21h - 28h)					
NC_MOD_1_PID_6_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (29h - 30h)					
NC_MOD_1_PID_7_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (31h - 38h)					
NC_MOD_1_PID_8_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (39h - 40h)					
NC_MOD_1_PID_9_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (41h - 48h)					
NC_MOD_1_PID_A_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (49h - 50h)					
NC_MOD_1_PID_B_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (51h - 58h)					
NC_MOD_1_PID_C_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (59h - 60h)					
NC_MOD_2_PID_1_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (01h - 08h)					
NC_MOD_2_PID_2_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (09h - 10h)					
NC_MOD_2_PID_3_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (11h - 18h)					
NC_MOD_2_PID_4_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (19h - 20h)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_MOD_2_PID_5_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (21h - 28h)					
NC_MOD_2_PID_6_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (29h - 30h)					
NC_MOD_2_PID_7_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (31h - 38h)					
NC_MOD_2_PID_8_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (39h - 40h)					
NC_MOD_2_PID_9_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (41h - 48h)					
NC_MOD_2_PID_A_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (49h - 50h)					
NC_MOD_2_PID_B_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (51h - 58h)					
NC_MOD_2_PID_C_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (59h - 60h)					
NC_MOD_5_TID_1_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (01h - 08h)					
NC_MOD_5_TID_10_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05(49h - 50h)					
NC_MOD_5_TID_11_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (51h - 58h)					
NC_MOD_5_TID_12_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (59h - 60h)					
NC_MOD_5_TID_13_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (61h - 68h)					
NC_MOD_5_TID_14_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (69h - 70h)					
NC_MOD_5_TID_15_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (71h - 78h)					
NC_MOD_5_TID_16_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (79h - 80h)					
NC_MOD_5_TID_17_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (81h - 88h)					
NC_MOD_5_TID_18_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (89h - 90h)					
NC_MOD_5_TID_19_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (91h - 98h)					
NC_MOD_5_TID_2_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (09h - 10h)					
NC_MOD_5_TID_20_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (99h - A0h)					
NC_MOD_5_TID_3_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (11h - 18h)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_MOD_5_TID_4_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (19h - 20h)					
NC_MOD_5_TID_5_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (21h - 28h)					
NC_MOD_5_TID_6_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (29h - 30h)					
NC_MOD_5_TID_7_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (31h - 38h)					
NC_MOD_5_TID_8_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (39h - 40h)					
NC_MOD_5_TID_9_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (41h - 48h)					
NC_MOD_6_TID_1_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 06 (01h - 08h)					
NC_MOD_6_TID_2_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 06 (09h - 10h)					
NC_MOD_6_TID_3_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 06 (11h - 18h)					
NC_MOD_6_TID_4_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 06 (19h - 20h)					
NC_MOD_9_VIT_1_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the VITs supported by the mode 09 (01h - 08h) for ISO 15765-4					
NC_MOD_9_VIT_2_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the VITs supported by the mode 09 (09h - 10h) ) for ISO 15765-4					
NC_MOD_9_VIT_3_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the VITs supported by the mode 09 (11h - 18h) ) for ISO 15765-4					
NC_MOD_9_VIT_4_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the VITs supported by the mode 09 (19h - 20h) ) for ISO 15765-4					

## I.34.1 Activation of OBD communication on CAN /K-line

### FUNCTION DESCRIPTION:

#### General information:


Depending on calibration or coding, a different OBD communication can be applied.

#### Application conditions

**Activation:** *only once after ECU power-on reset*

#### Formula section:

**If** LC\_VAR\_OBDC\_CAN = 1  
**Then** OBD communication on CAN is active (ISO 15765 - 4)  
**Else** **If** LV\_VAR\_OBDC\_CAN = 1  
**Then** OBD communication on CAN is active (ISO 15765 - 4)  
**Else** OBD communication on K-line is active (ISO 9141-2, ISO 14230-4)

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**Endif**

**Endif**

### I.34.2 Configuration and calibration of OBD communication on K-line (ISO 9141-2, ISO 14230-4)

**Description:**

MOD\_i\_PID /TID /VIT\_j\_DIAG variable definition

MOD\_i\_PID /\_TID /\_VIT\_j\_DIAG defines supported PIDs list for mode i. This definition depends on software **configuration** (ie if it is implemented in the software) and depends on system. Indeed, for a same software, we can have different system corresponding.

To define the software configuration, we use constants (NC\_MOD\_i\_XXX\_j\_DIAG)

To define system, we use functions (F\_MOD\_i\_XXX\_j\_DIAG) depends on different **calibrations**.

System configuration ( calibration):

The definition of F\_MOD\_i\_XXX\_j\_DIAG is: C\_MOD\_i\_XXX\_j\_DIAG.

Software configuration:

The definition of all NC\_MOD\_x\_PID\_y\_DIAG are inside the concerning table:

e.g. in the table below NC\_MOD\_x\_PID\_y\_DIAG = **11100101 = E5h**

NC_MOD_x_PID_y_DIAG		C_MOD_x_PID_y_DIAG
BIT	Function	Supported
0	PID 10h : Function H	<b>Yes</b>
1	PID 0Fh : Function G	No
2	PID 0Eh : Function F	<b>Yes</b>
3	PID 0Dh : Function E	No
4	PID 0Ch : Function D	No
5	PID 0Bh : Function C	<b>Yes</b>
6	PID 0Ah : Function B	<b>Yes</b>
7	PID 09h : Function A	<b>Yes</b>

**Formula section:**

MOD\_i\_XXX\_j\_DIAG = NC\_MOD\_i\_XXX\_j\_DIAG & & F\_MOD\_i\_XXX\_j\_DIAG(calibration) with & & = bit per bit and.

#### I.34.2.1 Supported PIDs for Mode 01h

**Description:**

**No:** the PID is not supported

**Yes:** the PID is supported

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NC_MOD_1_PID_1_DIAG		C_MOD_1_PID_1_DIAG
BIT	Function	Supported
0	PID 08h : Short term fuel trim - Bank 2	Yes
1	PID 07h : Long term fuel trim - Bank 1	Yes
2	PID 06h : Short term fuel trim - Bank 1	Yes
3	PID 05h : Engine coolant temperature	Yes
4	PID 04h : Calculated load value	Yes
5	PID 03h : Fuel system status	Yes
6	PID 02h : Trouble code that caused required freeze frame	No
7	PID 01h : DTCs and supported tests	Yes

NC_MOD_1_PID_2_DIAG		C_MOD_1_PID_2_DIAG
BIT	Function	Supported
0	PID 10h : Air flow rate from MAF sensor	Yes
1	PID 0Fh : Intake air temperature	Yes
2	PID 0Eh : Ignition time advance	Yes
3	PID 0Dh : Vehicle speed	Yes
4	PID 0Ch : Engine RPM	Yes
5	PID 0Bh : Intake manifold absolute pressure	Yes
6	PID 0Ah : Fuel pressure (gauge)	Yes
7	PID 09h : Long term fuel trim - Bank 2	Yes

Figure I.34.1: NC\_MOD\_1\_PID\_3\_DIAG

NC_MOD_1_PID_3_DIAG		C_MOD_1_PID_3_DIAG
BIT	Function	Supported
0	PID 18h : Bank 2 Sensor 1(binary)	No
1	PID 17h : Bank 2 Sensor 2	No
2	PID 16h : Bank 2 Sensor 1	No
3	PID 15h : Bank 1 Sensor 2	Yes
4	PID 14h : Bank 1 Sensor 1(binary)	No
5	PID 13h : Location of oxygen sensors	Yes
6	PID 12h : Secondary air status	Yes
7	PID 11h : Absolute throttle position sensor	Yes

Figure I.34.2: NC\_MOD\_1\_PID\_4\_DIAG



NC_MOD_1_PID_4_DIAG		C_MOD_1_PID_4_DIAG
BIT	Function	Supported
0	PID 20h : PIDs supported (\$21 - \$40)	<b>Yes</b>
1	PID 1Fh : Time since engine start	<b>Yes</b>
2	PID 1Eh : Reserved	No
3	PID 1Dh : Reserved	No
4	PID 1Ch : OBD requirements	<b>Yes</b>
5	PID 1Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2	No
6	PID 1Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1	No
7	PID 19h : Bank 2 Sensor 2 or Bank 3 Sensor 2	<b>Yes</b>

Figure I.34.3: NC\_MOD\_1\_PID\_5\_DIAG

NC_MOD_1_PID_5_DIAG		C_MOD_1_PID_5_DIAG
BIT	Function	Supported
0	PID 28h : Bank 2 Sensor 1 (Wide range O2S)	<b>Yes</b>
1	PID 27h : Bank 2 Sensor 2 (Wide range O2S)	No
2	PID 26h : Bank 2 Sensor 1 (Wide range O2S)	No
3	PID 25h : Bank 1 Sensor 2 (Wide range O2S)	No
4	PID 24h : Bank 1 Sensor 1 (Wide range O2S)	<b>Yes</b>
5	PID 23h : Fuel pressure high range (gauge)	<b>Yes</b>
6	PID 22h : Relative fuel pressure	No
7	PID 21h : Distance travelled while MIL is activated	<b>Yes</b>

Figure I.34.4: NC\_MOD\_1\_PID\_6\_DIAG

NC_MOD_1_PID_6_DIAG		C_MOD_1_PID_6_DIAG
BIT	Function	Supported
0	PID 30h : Number of warm-ups since diagnostic trouble codes cleared	<b>Yes</b>
1	PID 2Fh : Fuel Level Input	<b>Yes</b>
2	PID 2Eh : Command Evaporative Purge	<b>Yes</b>
3	PID 2Dh : EGR Error	<b>Yes</b>
4	PID 2Ch : Command EGR	<b>Yes</b>
5	PID 2Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	No
6	PID 2Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	No
7	PID 29h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	No

Figure I.34.5: NC\_MOD\_1\_PID\_7\_DIAG

NC_MOD_1_PID_7_DIAG		C_MOD_1_PID_7_DIAG
BIT	Function	Supported
0	PID 38h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	<b>Yes</b>
1	PID 37h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	No
2	PID 36h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	No
3	PID 35h : Bank 1 Sensor 2 (Wide range O2S)	No
4	PID 34h : Bank 1 Sensor 1 (Wide range O2S)	<b>Yes</b>
5	PID 33h : Barometric Pressure	<b>Yes</b>
6	PID 32h : Evap System Vapor Pressure	No
7	PID 31h : Distance since diagnostic trouble codes cleared	<b>Yes</b>

Figure I.34.6: NC\_MOD\_1\_PID\_8\_DIAG

NC_MOD_1_PID_8_DIAG		C_MOD_1_PID_8_DIAG
BIT	Function	Supported
0	PID 40h : PIDs supported (\$41 - \$60)	<b>Yes</b>
1	PID 3Fh : Catalyst Temperature Bank 2, Sensor 2	<b>Yes</b>
2	PID 3Eh : Catalyst Temperature Bank 1, Sensor 2	<b>Yes</b>
3	PID 3Dh : Catalyst Temperature Bank 2, Sensor 1	<b>Yes</b>
4	PID 3Ch : Catalyst Temperature Bank 1, Sensor 1	<b>Yes</b>
5	PID 3Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	No
6	PID 3Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	No
7	PID 39h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	No

Figure I.34.7: NC\_MOD\_1\_PID\_9\_DIAG

NC_MOD_1_PID_9_DIAG		C_MOD_1_PID_9_DIAG
BIT	Function	Supported
0	PID 48h : Absolute Throttle Position C	No
1	PID 47h : Absolute Throttle Position B	<b>Yes</b>
2	PID 46h : Ambient air temperature	<b>Yes</b>
3	PID -h : Relative Throttle Position	<b>Yes</b>
4	PID 44h : Commanded Equivalence Ratio	<b>Yes</b>
5	PID 43h : Absolute Load Value	<b>Yes</b>
6	PID 42h : Control module voltage	<b>Yes</b>
7	PID 41h : Monitor status this driving cycle	<b>Yes</b>

Figure I.34.8: NC\_MOD\_1\_PID\_A\_DIAG

NC_MOD_1_PID_A_DIAG		C_MOD_1_PID_A_DIAG
BIT	Function	Supported
0	PID 50h : Reserved	No
1	PID 4Fh : Reserved	No
2	PID 4Eh : Time since diagnostic trouble codes cleared	<b>Yes</b>
3	PID 4Dh : Minutes run by the engine while MIL activated	<b>Yes</b>
4	PID 4Ch : Commanded Throttle Actuator Control	<b>Yes</b>
5	PID 4Bh : Accelerator Pedal Position F	No
6	PID 4Ah : Accelerator Pedal Position E	<b>Yes</b>
7	PID 49h : Accelerator Pedal Position D	<b>Yes</b>

Figure I.34.9: NC\_MOD\_1\_PID\_B\_DIAG

NC_MOD_1_PID_B_DIAG		C_MOD_1_PID_B_DIAG
BIT	Function	Supported
0	PID 58h : Reserved	No
1	PID 57h : Reserved	No
2	PID 56h : Reserved	No
3	PID 55h : Reserved	No
4	PID 54h : Reserved	No
5	PID 53h : Reserved	No
6	PID 52h : Reserved	No
7	PID 51h : Reserved	No

Figure I.34.10: NC\_MOD\_1\_PID\_C\_DIAG

NC_MOD_1_PID_C_DIAG		C_MOD_1_PID_C_DIAG
BIT	Function	Supported
0	PID 60h : Reserved	No
1	PID 5Fh : Reserved	No
2	PID 5Eh : Reserved	No
3	PID 5Dh : Reserved	No
4	PID 5Ch : Reserved	No
5	PID 5Bh : Reserved	No
6	PID 5Ah : Reserved	No
7	PID 59h : Reserved	No

### I.34.2.2 Supported PIDs for Mode 02h

#### Description:

**No:** the PID is not supported

**Yes:** the PID is supported

NC_MOD_2_PID_1_DIAG		C_MOD_2_PID_1_DIAG
BIT	Function	Supported
0	PID 08h : Short term fuel trim - Bank 2 and Bank 4	<b>Yes</b>
1	PID 07h : Long term fuel trim - Bank 1 and Bank 3	<b>Yes</b>
2	PID 06h : Short term fuel trim - Bank 1 and Bank 3	<b>Yes</b>
3	PID 05h : Engine coolant temperature	<b>Yes</b>
4	PID 04h : Calculated load value	<b>Yes</b>
5	PID 03h : Fuel system status	<b>Yes</b>
6	PID 02h : Trouble code that caused required freeze frame	<b>Yes</b>
7	PID 01h : DTCs and supported tests	No

Figure I.34.11: NC\_MOD\_2\_PID\_2\_DIAG

NC_MOD_2_PID_2_DIAG		C_MOD_2_PID_2_DIAG
BIT	Function	Supported
0	PID 10h : Air flow rate from MAF sensor	<b>Yes</b>
1	PID 0Fh : Intake air temperature	<b>Yes</b>
2	PID 0Eh : Ignition time advance	<b>Yes</b>
3	PID 0Dh : Vehicle speed	<b>Yes</b>
4	PID 0Ch : Engine RPM	<b>Yes</b>
5	PID 0Bh : Intake manifold absolute pressure	<b>Yes</b>
6	PID 0Ah : Fuel pressure (gauge)	<b>Yes</b>
7	PID 09h : Long term fuel trim - Bank 2 and Bank 4	<b>Yes</b>

Figure I.34.12: NC\_MOD\_2\_PID\_3\_DIAG

NC_MOD_2_PID_3_DIAG		C_MOD_2_PID_3_DIAG
BIT	Function	Supported
0	PID 18h : Not required	No
1	PID 17h : Not required	No
2	PID 16h : Not required	No
3	PID 15h : Not required	No
4	PID 14h : Not required	No
5	PID 13h : Not required	No
6	PID 12h : Secondary air status	<b>Yes</b>
7	PID 11h : Absolute throttle position sensor	<b>Yes</b>

Figure I.34.13: NC\_MOD\_2\_PID\_4\_DIAG

NC_MOD_2_PID_4_DIAG		C_MOD_2_PID_4_DIAG
BIT	Function	Supported
0	PID 20h : PIDs supported (\$21 - \$40)	<b>Yes</b>
1	PID 1Fh : Time since engine start	<b>Yes</b>
2	PID 1Eh : Not required	No
3	PID 1Dh : Not required	No
4	PID 1Ch : Not required	No
5	PID 1Bh : Not required	No
6	PID 1Ah : Not required	No
7	PID 19h : Not required	No

Figure I.34.14: NC\_MOD\_2\_PID\_5\_DIAG

NC_MOD_2_PID_5_DIAG		C_MOD_2_PID_5_DIAG
BIT	Function	Supported
0	PID 28h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	No
1	PID 27h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	No
2	PID 26h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	No
3	PID 25h : Bank 1 Sensor 2 (Wide range O2S)	No
4	PID 24h : Bank 1 Sensor 1 (Wide range O2S)	No
5	PID 23h : Diesel fuel pressure (gauge)	<b>Yes</b>
6	PID 22h : Relative fuel pressure	No
7	PID 21h : Distance travelled while MIL is activated	No

Figure I.34.15: NC\_MOD\_2\_PID\_6\_DIAG

NC_MOD_2_PID_6_DIAG		C_MOD_2_PID_6_DIAG
BIT	Function	Supported
0	PID 30h : Number of warm-ups since diagnostic trouble codes cleared	No
1	PID 2Fh : Fuel Level Input	<b>Yes</b>
2	PID 2Eh : Command Evaporative Purge	<b>Yes</b>
3	PID 2Dh : EGR Error	<b>Yes</b>
4	PID 2Ch : command EGR	<b>Yes</b>
5	PID 2Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	No
6	PID 2Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	No
7	PID 29h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	No

NC_MOD_2_PID_7_DIAG		C_MOD_2_PID_7_DIAG
BIT	Function	Supported
0	PID 38h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	No
1	PID 37h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	No
2	PID 36h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	No
3	PID 35h : Bank 1 Sensor 2 (Wide range O2S)	No
4	PID 34h : Bank 1 Sensor 1 (Wide range O2S)	No
5	PID 33h : Barometric Pressure	<b>Yes</b>
6	PID 32h : Evap System Vapor Pressure	No
7	PID 31h : Distance since diagnostic trouble codes cleared	No

Figure I.34.16: NC\_MOD\_2\_PID\_8\_DIAG

NC_MOD_2_PID_8_DIAG		C_MOD_2_PID_8_DIAG
BIT	Function	Supported
0	PID 40h : PIDs supported (\$41 - \$60)	<b>Yes</b>
1	PID 3Fh : Catalyst Temperature Bank 2, Sensor 2	No
2	PID 3Eh : Catalyst Temperature Bank 1, Sensor 2	No
3	PID 3Dh : Catalyst Temperature Bank 2, Sensor 1	No
4	PID 3Ch : Catalyst Temperature Bank 1, Sensor 1	No
5	PID 3Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	No
6	PID 3Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	No
7	PID 39h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	No

Figure I.34.17: NC\_MOD\_2\_PID\_9\_DIAG

NC_MOD_2_PID_9_DIAG		C_MOD_2_PID_9_DIAG
BIT	Function	Supported
0	PID 48h : Absolute Throttle Position C	No
1	PID 47h : Absolute Throttle Position B	<b>Yes</b>
2	PID 46h : Ambient air temperature	<b>Yes</b>
3	PID -h : Relative Throttle Position	<b>Yes</b>
4	PID 44h : Commanded Equivalence Ratio	<b>Yes</b>
5	PID 43h : Absolute Load Value	<b>Yes</b>
6	PID 42h : Control module voltage	<b>Yes</b>
7	PID 41h : Monitor status this driving cycle	No

Figure I.34.18: NC\_MOD\_2\_PID\_A\_DIAG

NC_MOD_2_PID_A_DIAG		C_MOD_2_PID_A_DIAG
BIT	Function	Supported
0	PID 50h : Reserved	No
1	PID 4Fh : Reserved	No
2	PID 4Eh : Time since diagnostic trouble codes cleared	No
3	PID 4Dh : Minutes run by the engine while MIL activated	No
4	PID 4Ch : Commanded Throttle Actuator Control	Yes
5	PID 4Bh : Accelerator Pedal Position F	No
6	PID 4Ah : Accelerator Pedal Position E	Yes
7	PID 49h : Accelerator Pedal Position D	Yes

Figure I.34.19: NC\_MOD\_2\_PID\_B\_DIAG

NC_MOD_2_PID_B_DIAG		C_MOD_2_PID_B_DIAG
BIT	Function	Supported
0	PID 58h : Reserved	No
1	PID 57h : Reserved	No
2	PID 56h : Reserved	No
3	PID 55h : Reserved	No
4	PID 54h : Reserved	No
5	PID 53h : Reserved	No
6	PID 52h : Reserved	No
7	PID 51h : Reserved	No

Figure I.34.20: NC\_MOD\_2\_PID\_C\_DIAG

NC_MOD_2_PID_C_DIAG		C_MOD_2_PID_C_DIAG
BIT	Function	Supported
0	PID 60h : Reserved	No
1	PID 5Fh : Reserved	No
2	PID 5Eh : Reserved	No
3	PID 5Dh : Reserved	No
4	PID 5Ch : Reserved	No
5	PID 5Bh : Reserved	No
6	PID 5Ah : Reserved	No
7	PID 59h : Reserved	No

### I.34.2.3 Supported TIDs for mode 05h

#### Description:

No: the TID is not supported,      Yes: the TID is supported

NC_MOD_5_TID_1_DIAG		C_MOD_5_TID_1_DIAG	
BIT	Function		Supported
0	TID 08h : Maximum sensor voltage for test cycle (binary) <b>B1S2 B2S2</b>		<b>Yes</b>
1	TID 07h : Minimum sensor voltage for test cycle (binary) <b>B1S2 B2S2</b>		<b>Yes</b>
2	TID 06h : Lean to rich sensor switch time (binary) B1S1 B2S1		No
3	TID 05h : Rich to lean sensor switch time (binary) B1S1 B2S1		No
4	TID 04h : High sensor voltage for switch time calculation (binary) B1S1 B2S1		No
5	TID 03h : Low sensor voltage for switch time calculation (binary) B1S1 B2S1		No
6	TID 02h : Lean to rich sensor threshold voltage (binary) <b>B1S2 B2S2</b>		<b>Yes</b>
7	TID 01h : Rich to lean sensor threshold voltage (binary) <b>B1S2 B2S2</b>		<b>Yes</b>

Figure I.34.21: NC\_MOD\_5\_TID\_2\_DIAG

NC_MOD_5_TID_2_DIAG		C_MOD_5_TID_2_DIAG	
BIT	Function		Supported
0	TID 10h : reserved		No
1	TID 0Fh : reserved		No
2	TID 0Eh : reserved		No
3	TID 0Dh : reserved		No
4	TID 0Ch : reserved		No
5	TID 0Bh : reserved		No
6	TID 0Ah : reserved		No
7	TID 09h : reserved		No

Figure I.34.22: NC\_MOD\_5\_TID\_3\_DIAG

NC_MOD_5_TID_3_DIAG		C_MOD_5_TID_3_DIAG	
BIT	Function		Supported
0	TID 18h : reserved		No
1	TID 17h : reserved		No
2	TID 16h : reserved		No
3	TID 15h : reserved		No
4	TID 14h : reserved		No
5	TID 13h : reserved		No
6	TID 12h : reserved		No
7	TID 11h : reserved		No

Figure I.34.23: NC\_MOD\_5\_TID\_4\_DIAG



NC_MOD_5_TID_4_DIAG		C_MOD_5_TID_4_DIAG
BIT	Function	Supported
0	TID 20h : TIDs supported (\$21 - \$40)	<b>Yes</b>
1	TID 1Fh : reserved	No
2	TID 1Eh : reserved	No
3	TID 1Dh : reserved	No
4	TID 1Ch : reserved	No
5	TID 1Bh : reserved	No
6	TID 1Ah : reserved	No
7	TID 19h : reserved	No

Figure I.34.24: NC\_MOD\_5\_TID\_5\_DIAG

NC_MOD_5_TID_5_DIAG		C_MOD_5_TID_5_DIAG
BIT	Function	Supported
0	TID 28h : reserved	No
1	TID 27h : reserved	No
2	TID 26h : reserved	No
3	TID 25h : reserved	No
4	TID 24h : reserved	No
5	TID 23h : reserved	No
6	TID 22h : reserved	No
7	TID 21h : reserved	No

Figure I.34.25: NC\_MOD\_5\_TID\_6\_DIAG

NC_MOD_5_TID_6_DIAG		C_MOD_5_TID_6_DIAG
BIT	Function	Supported
0	TID 30h : Reserved	No
1	TID 2Fh : Reserved	No
2	TID 2Eh : Reserved	No
3	TID 2Dh : Reserved	No
4	TID 2Ch : Reserved	No
5	TID 2Bh : Reserved	No
6	TID 2Ah : Reserved	No
7	TID 29h : Reserved	No

Figure I.34.26: NC\_MOD\_5\_TID\_7\_DIAG

NC_MOD_5_TID_7_DIAG		C_MOD_5_TID_7_DIAG
BIT	Function	Supported
0	TID 38h : Reserved	No
1	TID 37h : Reserved	No
2	TID 36h : Reserved	No
3	TID 35h : Reserved	No
4	TID 34h : Reserved	No
5	TID 33h : Reserved	No
6	TID 32h : Reserved	No
7	TID 31h : Reserved	No

Figure I.34.27: NC\_MOD\_5\_TID\_8\_DIAG

NC_MOD_5_TID_8_DIAG		C_MOD_5_TID_8_DIAG
BIT	Function	Supported
0	TID 40h : TIDs supported (\$41 - \$60)	<b>Yes</b>
1	TID 3Fh : Reserved	No
2	TID 3Eh : Reserved	No
3	TID 3Dh : Reserved	No
4	TID 3Ch : Reserved	No
5	TID 3Bh : Reserved	No
6	TID 3Ah : Reserved	No
7	TID 39h : Reserved	No

Figure I.34.28: NC\_MOD\_5\_TID\_9\_DIAG

NC_MOD_5_TID_9_DIAG		C_MOD_5_TID_9_DIAG
BIT	Function	Supported
0	TID 48h : Reserved	No
1	TID 47h : Reserved	No
2	TID 46h : Reserved	No
3	TID -h : Reserved	No
4	TID 44h : Reserved	No
5	TID 43h : Reserved	No
6	TID 42h : Reserved	No
7	TID 41h : Reserved	No

Figure I.34.29: NC\_MOD\_5\_TID\_10\_DIAG

NC_MOD_5_TID_10_DIAG		C_MOD_5_TID_10_DIAG
BIT	Function	Supported
0	TID 50h : Reserved	No
1	TID 4Fh : Reserved	No
2	TID 4Eh : Reserved	No
3	TID 4Dh : Reserved	No
4	TID 4Ch : Reserved	No
5	TID 4Bh : Reserved	No
6	TID 4Ah : Reserved	No
7	TID 49h : Reserved	No

Figure I.34.30: NC\_MOD\_5\_TID\_11\_DIAG

NC_MOD_5_TID_11_DIAG		C_MOD_5_TID_11_DIAG
BIT	Function	Supported
0	TID 58h : Reserved	No
1	TID 57h : Reserved	No
2	TID 56h : Reserved	No
3	TID 55h : Reserved	No
4	TID 54h : Reserved	No
5	TID 53h : Reserved	No
6	TID 52h : Reserved	No
7	TID 51h : Reserved	No

Figure I.34.31: NC\_MOD\_5\_TID\_12\_DIAG

NC_MOD_5_TID_12_DIAG		C_MOD_5_TID_12_DIAG
BIT	Function	Supported
0	TID 60h : TIDs supported (\$61 - \$80)	<b>Yes</b>
1	TID 5Fh : Reserved	No
2	TID 5Eh : Reserved	No
3	TID 5Dh : Reserved	No
4	TID 5Ch : Reserved	No
5	TID 5Bh : Reserved	No
6	TID 5Ah : Reserved	No
7	TID 59h : Reserved	No

Figure I.34.32: NC\_MOD\_5\_TID\_13\_DIAG

NC_MOD_5_TID_13_DIAG		C_MOD_5_TID_13_DIAG
BIT	Function	Supported
0	TID 68h : Reserved	No
1	TID 67h : Reserved	No
2	TID 66h : Reserved	No
3	TID 65h : Reserved	No
4	TID 64h : Reserved	No
5	TID 63h : Reserved	No
6	TID 62h : Reserved	No
7	TID 61h : Reserved	No

Figure I.34.33: NC\_MOD\_5\_TID\_14\_DIAG

NC_MOD_5_TID_14_DIAG		C_MOD_5_TID_14_DIAG
BIT	Function	Supported
0	TID 70h : Reserved	No
1	TID 6Fh : Reserved	No
2	TID 6Eh : Reserved	No
3	TID 6Dh : Reserved	No
4	TID 6Ch : Reserved	No
5	TID 6Bh : Reserved	No
6	TID 6Ah : Reserved	No
7	TID 69h : Reserved	No

Figure I.34.34: NC\_MOD\_5\_TID\_15\_DIAG

NC_MOD_5_TID_15_DIAG		C_MOD_5_TID_15_DIAG
BIT	Function	Supported
0	TID 78h : Reserved	No
1	TID 77h : Reserved	No
2	TID 76h : Reserved	No
3	TID 75h : Reserved	No
4	TID 74h : Reserved	No
5	TID 73h : Reserved	No
6	TID 72h : Reserved	No
7	TID 71h : Reserved	No

Figure I.34.35: NC\_MOD\_5\_TID\_16\_DIAG

NC_MOD_5_TID_16_DIAG		C_MOD_5_TID_16_DIAG
BIT	Function	Supported
0	TID 80h : TIDs supported (\$81 - \$A0)	<b>Yes</b>
1	TID 7Fh : Reserved	No
2	TID 7Eh : Reserved	No
3	TID 7Dh : Reserved	No
4	TID 7Ch : Reserved	No
5	TID 7Bh : Reserved	No
6	TID 7Ah : Reserved	No
7	TID 79h : Reserved	No

Figure I.34.36: NC\_MOD\_5\_TID\_17\_DIAG

NC_MOD_5_TID_17_DIAG		C_MOD_5_TID_17_DIAG
BIT	Function	Supported
0	TID 88h : not defined	No
1	TID 87h : not defined	No
2	TID 86h : not defined	No
3	TID 85h : not defined	No
4	TID 84h : Fuel trim diagnosis	<b>Yes</b>
5	TID 83h : Dynamic diagnosis	<b>Yes</b>
6	TID 82h : A/F setpoint linear	<b>Yes</b>
7	TID 81h : Measured A/F ratio linear	<b>Yes</b>

Figure I.34.37: NC\_MOD\_5\_TID\_18\_DIAG

NC_MOD_5_TID_18_DIAG		C_MOD_5_TID_18_DIAG
BIT	Function	Supported
0	TID 90h : Reserved	No
1	TID 8Fh : Reserved	No
2	TID 8Eh : Reserved	No
3	TID 8Dh : Reserved	No
4	TID 8Ch : Reserved	No
5	TID 8Bh : Reserved	No
6	TID 8Ah : Reserved	No
7	TID 89h : Reserved	No

Figure I.34.38: NC\_MOD\_5\_TID\_19\_DIAG

NC_MOD_5_TID_19_DIAG		C_MOD_5_TID_19_DIAG
BIT	Function	Supported
0	TID 98h : Reserved	No
1	TID 97h : Reserved	No
2	TID 96h : Reserved	No
3	TID 95h : Reserved	No
4	TID 94h : Reserved	No
5	TID 93h : Reserved	No
6	TID 92h : Reserved	No
7	TID 91h : Reserved	No

Figure I.34.39: NC\_MOD\_5\_TID\_20\_DIAG

NC_MOD_5_TID_20_DIAG		C_MOD_5_TID_20_DIAG
BIT	Function	Supported
0	TID A0h : TIDs supported (\$A1 - \$C0)	No
1	TID 9Fh : Reserved	No
2	TID 9Eh : Reserved	No
3	TID 9Dh : Reserved	No
4	TID 9Ch : Reserved	No
5	TID 9Bh : Reserved	No
6	TID 9Ah : Reserved	No
7	TID 99h : Reserved	No

### I.34.2.4 Supported TIDs for Mode 06h

#### Description:

No: the TID is not supported

Yes: the TID is supported

NC_MOD_6_TID_1_DIAG		C_MOD_6_TID_1_DIAG
BIT	Function	Supported
0	TID 08h : Reserved	No
1	TID 07h : Reserved	No
2	TID 06h : Oxygen sensor heater	Yes
3	TID 05h : Evaporative monitor	Yes
4	TID 04h : Reserved	No
5	TID 03h : Secondary air monitor	Yes
6	TID 02h : Oxygen sensor monitor	Yes
7	TID 01h : Catalyst monitor	Yes

Figure I.34.40: NC\_MOD\_6\_TID\_2\_DIAG

NC_MOD_6_TID_2_DIAG		C_MOD_6_TID_2_DIAG
BIT	Function	Supported
0	TID 10h : reserved	No
1	TID 0Fh : reserved	No
2	TID 0Eh : reserved	No
3	TID 0Dh : reserved	No
4	TID 0Ch : reserved	No
5	TID 0Bh : reserved	No
6	TID 0Ah : reserved	No
7	TID 09h : reserved	No

Figure I.34.41: NC\_MOD\_6\_TID\_3\_DIAG

NC_MOD_6_TID_3_DIAG		C_MOD_6_TID_3_DIAG
BIT	Function	Supported
0	TID 18h : reserved	No
1	TID 17h : reserved	No
2	TID 16h : reserved	No
3	TID 15h : reserved	No
4	TID 14h : reserved	No
5	TID 13h : reserved	No
6	TID 12h : reserved	No
7	TID 11h : reserved	No

Figure I.34.42: NC\_MOD\_6\_TID\_4\_DIAG

NC_MOD_6_TID_4_DIAG		C_MOD_6_TID_4_DIAG
BIT	Function	Supported
0	TID 20h : TIDs supported (\$21 - \$40)	No
1	TID 1Fh : reserved	No
2	TID 1Eh : reserved	No
3	TID 1Dh : reserved	No
4	TID 1Ch : reserved	No
5	TID 1Bh : reserved	No
6	TID 1Ah : reserved	No
7	TID 19h : reserved	No

### I.34.2.5 Supported TIDs for Mode 08h (not supported yet)

### I.34.2.6 Supported VITs for Mode 09h

#### Description:

No: the VIT is not supported, Yes: the VIT is supported

NC_MOD_9_VIT_1_DIAG		C_MOD_9_VIT_1_DIAG
BIT	Function	Supported
0	VIT 08h : In-Use Performance Tracking	Yes
1	VIT 07h : Message Count IPT	Yes
2	VIT 06h : Calibration Verification Numbers	Yes
3	VIT 05h : Number of response for Calibration Verification Numbers	Yes
4	VIT 04h : Calibration IDs	Yes
5	VIT 03h : Number of response for Calibration IDs	Yes
6	VIT 02h : Vehicle Identification Number	Yes
7	VIT 01h : Number of response for Vehicle Identification Number	Yes

Figure I.34.43: NC\_MOD\_9\_VIT\_2\_DIAG

NC_MOD_9_VIT_2_DIAG		C_MOD_9_VIT_2_DIAG
BIT	Function	Supported
0	VIT 10h : Reserved	No
1	VIT 0Fh : Reserved	No
2	VIT 0Eh : Reserved	No
3	VIT 0Dh : Reserved	No
4	VIT 0Ch : Reserved	No
5	VIT 0Bh : Reserved	No
6	VIT 0Ah : Reserved	No
7	VIT 09h : Reserved	No


Figure I.34.44: NC\_MOD\_9\_VIT\_3\_DIAG

NC_MOD_9_VIT_3_DIAG		C_MOD_9_VIT_3_DIAG
BIT	Function	Supported
0	VIT 18h : Reserved	No
1	VIT 17h : Reserved	No
2	VIT 16h : Reserved	No
3	VIT 15h : Reserved	No
4	VIT 14h : Reserved	No
5	VIT 13h : Reserved	No
6	VIT 12h : Reserved	No
7	VIT 11h : Reserved	No

Figure I.34.45: NC\_MOD\_9\_VIT\_4\_DIAG



NC_MOD_9_VIT_4_DIAG		C_MOD_9_VIT_4_DIAG
BIT	Function	Supported
0	VIT 20h : VITs supported (\$21 - \$40)	No
1	VIT 1Fh : Reserved	No
2	VIT 1Eh : Reserved	No
3	VIT 1Dh : Reserved	No
4	VIT 1Ch : Reserved	No
5	VIT 1Bh : Reserved	No
6	VIT 1Ah : Reserved	No
7	VIT 19h : Reserved	No

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## I.35 InfoType description for mode 09h

### Input data:

MOD_9_VIT_1_DIAG {p. 7833}	MOD_9_VIT_2_DIAG {p. 7833}	MOD_9_VIT_3_DIAG {p. 7833}	MOD_9_VIT_4_DIAG {p. 7833}
-------------------------------	-------------------------------	-------------------------------	-------------------------------

### I.35.1 Description of Mode 09h, VIT 00h - All supported VITs

VIT 00h - DATA A - Supported VIT 01h to 08h		
BIT	Function	name
0	VIT 08h : In-Use Performance Tracking	MOD_9_VIT_1_DIAG
1	VIT 07h : Message Count IPT	
2	VIT 06h : Calibration Verification Numbers	
3	VIT 05h : Number of response for Calibration Verification Numbers	
4	VIT 04h : Calibration IDs	
5	VIT 03h : Number of response for Calibration IDs	
6	VIT 02h : Vehicle Identification Number	
7	VIT 01h : Number of response for Vehicle Identification Number	
VIT 00h - DATA B - Supported VIT 09h to 10h		
BIT	Function	name
0	VIT 10h : reserved	MOD_9_VIT_2_DIAG
1	VIT 0Fh : reserved	
2	VIT 0Eh : reserved	
3	VIT 0Dh : reserved	
4	VIT 0Ch : reserved	
5	VIT 0Bh : reserved	
6	VIT 0Ah : reserved	
7	VIT 09h : reserved	
VIT 00h - DATA C - Supported VIT 11h to 18h		
BIT	Function	name
0	VIT 18h : reserved	MOD_9_VIT_3_DIAG
1	VIT 17h : reserved	
2	VIT 16h : reserved	
3	VIT 15h : reserved	
4	VIT 14h : reserved	
5	VIT 13h : reserved	
6	VIT 12h : reserved	
7	VIT 11h : reserved	
VIT 00h - DATA D - Supported VIT 19h to 20h		
BIT	Function	name
0	VIT 20h : VITs supported (\$21 - \$40)	MOD_9_VIT_4_DIAG
1	VIT 1Fh : reserved	
2	VIT 1Eh : reserved	
3	VIT 1Dh : reserved	
4	VIT 1Ch : reserved	
5	VIT 1Bh : reserved	
6	VIT 1Ah : reserved	
7	VIT 19h : reserved	

## I.35.2 Description of Mode 09h, VIT 01h - Messagecount VIN

### I.35.3 Request vehicle information request message

<b>Message direction:</b>		External test equipment → All ECUs	
<b>Message Type:</b>		Request	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType: MessageCount VIN	01	INFTYP

#### Positive responses (read InfoType value)

#### Request vehicle information response message

<b>Message direction:</b>		ECU → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: MessageCount VIN	01	INFTYP
#3	MessageCount VIN = 5 response messages	05	MC_CALID

## I.35.4 Description of Mode 09h, VIT 02h - VIN

### Request vehicle information request message

<b>Message direction:</b>		External test equipment → All ECUs	
<b>Message Type:</b>		Request	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType: VIN	02	INFTYP

## I.35.5 Response positive report VIN

### First positive response

#### Request vehicle information response message (1)

<b>Message direction:</b>		ECU#1 → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: VIN	02	INFTYP
#3	MessageCount VIN = 1 <sup>st</sup> response message	01	MC_CALID
#4	Data A: Pad-byte	00	byte always 0
#5	Data B: Pad-byte	00	byte always 0
#6	Data C: Pad-byte	00	byte always 0
#7	Data D:	XX*	VIN char 0

\* 30h, if there is no VIN.

### Second positive response

#### Request vehicle information response message (2)

<b>Message direction:</b>		ECU → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: VIN	02	INFTYP
#3	MessageCount VIN = 2 <sup>nd</sup> response message	02	MC_CALID
#4	Data A:	XX*	VIN char 1
#5	Data B:	XX*	VIN char 2
#6	Data C:	XX*	VIN char 3
#7	Data D:	XX*	VIN char 4

\* 30h, if there is no VIN.

### third positive response

#### Request vehicle information response message (3)

<b>Message direction:</b>		ECU → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: VIN	02	INFTYP
#3	MessageCount VIN = 3 <sup>rd</sup> response message	03	MC_CALID
#4	Data A:	XX*	VIN char 5
#5	Data B:	XX*	VIN char 6
#6	Data C:	XX*	VIN char 7
#7	Data D:	XX*	VIN char 8

\* 30h, if there is no VIN

### forth positive response

#### Request vehicle information response message (4)

<b>Message direction:</b>		ECU → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: VIN	02	INFTYP
#3	MessageCount VIN = 4 <sup>nd</sup> response message	04	MC_CALID
#4	Data A:	XX*	VIN char 9
#5	Data B:	XX*	VIN char 10
#6	Data C:	XX*	VIN char 11
#7	Data D:	XX*	VIN char 12

\* 30h, if there is no VIN

### fifth positive response

#### Request vehicle information response message (5)

<b>Message direction:</b>		ECU → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: VIN	02	INFTYP
#3	MessageCount VIN = 5 <sup>nd</sup> response message	05	MC_CALID
#4	Data A:	XX*	VIN char 13
#5	Data B:	XX*	VIN char 14
#6	Data C:	XX*	VIN char 15
#7	Data D:	XX*	VIN char 16

\* 30h, if there is no VIN

## I.35.6 Description of Mode 09h, VIT 03h - Messagecount Calibration IDs

### I.35.7 Request vehicle information request message

<b>Message direction:</b>		External test equipment → All ECUs	
<b>Message Type:</b>		Request	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType: MessageCount Calibration Id	03	INFTYP

#### Positive responses (read InfoType value)

#### Request vehicle information response message

<b>Message direction:</b>		ECU → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: MessageCount Calibration Id	03	INFTYP
#3	MessageCount Calibration Id = 8 response messages	08	MC_CALID

### I.35.8 Description of Mode 09h, VIT 04h - Calibration IDs

#### Request vehicle information request message

<b>Message direction:</b>		External test equipment → All ECUs	
<b>Message Type:</b>		Request	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType: Calibration Id	04	INFTYP

### I.35.9 Response positive report Calibration ID

#### First positive response

##### Request vehicle information response message (1)

<b>Message direction:</b>		ECU#1 → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Id	04	INFTYP
#3	MessageCount Calibration Id = 1 <sup>st</sup> response message	01	MC_CALID
#4	Data A: SW version number char 1	NC_BMW_HW_NR_3 *or 30	second digit in BCD
#5	Data B: SW version number char 2	NC_BMW_HW_NR_4 *or 30	first digit in BCD
#6	Data C: SW version number char 3	NC_BMW_HW_NR_4 *or 30	second digit in BCD
#7	Data D: SW version number char 4	NC_BMW_HW_NR_5 *or 30	first digit in BCD

\* 30h, if there is no HW\_NR.

#### Second positive response

##### Request vehicle information response message (2)

Message direction:		ECU → External test equipment	
Message Type:		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Id	04	INF TYP
#3	MessageCount Calibration Id = 2 <sup>nd</sup> response message	02	MC_CALID
#4	Data A: SW version number char 5	NC_BMW_HW_NR_5 *or 30	second digit in BCD
#5	Data B: SW version number char 6	NC_BMW_HW_NR_6 *or 30	first digit in BCD
#6	Data C: SW version number char 7	NC_BMW_HW_NR_6 *or 30	second digit in BCD
#7	Data D: Pad-Byte	00	byte always 0

\* 30h, if there is no HW\_NR.

### third positive response

#### Request vehicle information response message (3)

Message direction:		ECU → External test equipment	
Message Type:		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Id	04	INF TYP
#3	MessageCount Calibration Id = 3 <sup>rd</sup> response message	03	MC_CALID
#4	Data A: Pad-Byte	00	byte always 0
#5	Data B: Pad-Byte	00	byte always 0
#6	Data C: Pad-Byte	00	byte always 0
#7	Data D: Pad-Byte	00	byte always 0

### forth positive response


#### Request vehicle information response message (4)

Message direction:		ECU → External test equipment	
Message Type:		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Id	04	INF TYP
#3	MessageCount Calibration Id = 4 <sup>th</sup> response message	04	MC_CALID
#4	Data A: Pad-Byte	00	byte always 0
#5	Data B: Pad-Byte	00	byte always 0
#6	Data C: Pad-Byte	00	byte always 0
#7	Data D: Pad-Byte	00	byte always 0

### fifth positive response

#### Request vehicle information response message (5)

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<b>Message direction:</b>		ECU → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Id	04	INFTYP
#3	MessageCount Calibration Id = 5 <sup>nd</sup> response message	05	MC_CALID
#4	Data A: Calibration version number char 1	CAL_NR_3 or 30*	second digit in BCD
#5	Data B: Calibration version number char 2	CAL_NR_4 or 30*	first digit in BCD
#6	Data C: Calibration version number char 3	CAL_NR_4 or 30*	second digit in BCD
#7	Data D: Calibration version number char 4	CAL_NR_5 or 30*	first digit in BCD

\* if no CAL\_NR in software;

### sixth positive response

#### Request vehicle information response message (6)

<b>Message direction:</b>		ECU → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Id	04	INFTYP
#3	MessageCount Calibration Id = 6 <sup>nd</sup> response message	06	MC_CALID
#4	Data A: Calibration version number char 5	CAL_NR_5 or 30*	second digit in BCD
#5	Data B: Calibration version number char 6	CAL_NR_6 or 30*	first digits in BCD
#6	Data C: Calibration version number char 7	CAL_NR_6 or 30*	second digit in BCD
#7	Data D: Pad-Byte	00	byte always 0

\* if no CAL\_NR in software;

### seventh positive response

#### Request vehicle information response message (7)

<b>Message direction:</b>		ECU → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Id	04	INFTYP
#3	MessageCount Calibration Id = 7 <sup>nd</sup> response message	07	MC_CALID
#4	Data A: Pad-Byte	00	byte always 0
#5	Data B: Pad-Byte	00	byte always 0
#6	Data C: Pad-Byte	00	byte always 0
#7	Data D: Pad-Byte	00	byte always 0

### eight positive response



### Request vehicle information response message (8)

<b>Message direction:</b>		ECU → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Id	04	INFTYP
#3	MessageCount Calibration Id = 8 <sup>nd</sup> response message	08	MC_CALID
#4	Data A: Pad-Byte	00	byte always 0
#5	Data B: Pad-Byte	00	byte always 0
#6	Data C: Pad-Byte	00	byte always 0
#7	Data D: Pad-Byte	00	byte always 0

## I.35.10 Description of Mode 09h, VIT 05h - Messagecount Calibration verification numbers

### Request vehicle information request message

<b>Message direction:</b>		External test equipment → All ECUs	
<b>Message Type:</b>		Request	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType: MessageCount Calibration Verification Number	05	INFTYP

### Positive responses (read InfoType value)

### Request vehicle information response message

<b>Message direction:</b>		ECU → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: MessageCount Calibration Verification Number	05	INFTYP
#3	MessageCount Calibration Verification Number = 2 response messages	02	MC_CVN

## I.35.11 Description of Mode 09h, VIT 06h - Calibration verification numbers

The on-board software will calculate the CVN (CRC) based on memory content in a cyclic way. The result will be stored non volatile. That means the previous value will be available till a new one is calculated.

At first initialisation of ECU no CVN is available till first one is calculated (app. 1min).

### Request vehicle information request message (read InfoType values)

Data Byte	Parameter Name	Hex Value	Mnemonic
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType (read InfoType values)	06	INFTYP

### I.35.11.1 Response positive report calibration verification number

#### First positive response

#### Request vehicle information response message (1)

Message direction:		ECU → External test equipment	
Message Type:		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Verification Number	06	INFTYP
#3	MessageCount Calibration Verification Number = 1 <sup>st</sup> response message	01	MC_CVN
#4	Data A: MSB CRC-32 Application SW	MSB (CKS_CRC_ECU)	DATA_A
#5	Data B: ...	M_H (CKS_CRC_ECU)	DATA_B
#6	Data C: ...	M_L (CKS_CRC_ECU)	DATA_C
#7	Data D: LSB CRC-32 Application SW	LSB (CKS_CRC_ECU)	DATA_D

#### Second positive response

#### Request vehicle information response message (2)

Message direction:		ECU#1 → External test equipment	
Message Type:		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Verification Number	06	INFTYP
#3	MessageCount Calibration Verification Number = 2 <sup>nd</sup> response message	02	MC_CVN
#4	Data A: MSB CRC-32 Calibration data	MSB (CKS_CRC_CAL)	DATA_A
#5	Data B: ...	M_H (CKS_CRC_CAL)	DATA_B
#6	Data C: ...	M_L (CKS_CRC_CAL)	DATA_C
#7	Data D: LSB CRC-32 Calibration data	LSB (CKS_CRC_CAL)	DATA_D

## I.35.12 Description of Mode 09h, InfoType 07h - MessageCount IPT

#### Request vehicle information request message

Message direction:		External test equipment → All ECUs	
Message Type:		Request	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType: MessageCount IPT	07	INFTYP

## Positive responses (read InfoType value)

### Request vehicle information response message

<b>Message direction:</b>		ECU → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: MessageCount IPT	07	INFTYP
#3	Number of messages to report In-use Performance Tracking = 8 response messages	08	MC_IPT

## I.35.13 Description of Mode 09h, InfoType 08h

### Request vehicle information request message

<b>Message direction:</b>		External test equipment → All ECUs	
<b>Message Type:</b>		Request	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType: In-use Performance Tracking	08	INFTYP

## Response positive : In-use Performance Tracking

### First positive response

#### Request vehicle information response message (1)

<b>Message direction:</b>		ECU#1 → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: In-use Performance Tracking	08	INFTYP
#3	MessageCount Calibration Id = 1 <sup>st</sup> response message	01	MC_CALID
#4	Data A: MSB (OBD Monitoring Conditions Encountered Counts - general denominator)	XX	OBDCOND_A
#5	Data B: LSB (OBD Monitoring Conditions Encountered Counts Counts - general denominator)	XX	OBDCOND_B
#6	Data C: MSB (Ignition Counter)	XX	IGNCNTR_A
#7	Data D: LSB (Ignition Counter)	XX	IGNCNTR_B

### Second positive response

#### Request vehicle information response message (2)

<b>Message direction:</b>		ECU → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: In-use Performance Tracking	08	INFTYP
#3	MessageCount Calibration Id = 2 <sup>nd</sup> response message	02	MC_CALID
#4	Data A: MSB (Catalyst Monitor Completion Counts Bank 1 - numerator)	XX	CATCOMP1_A
#5	Data B: LSB (Catalyst Monitor Completion Counts Bank 1 - numerator)	XX	CATCOMP1_B
#6	Data C: MSB (Catalyst Monitor Conditions Encountered Counts Bank 1 - denominator)	XX	CATCOND1_A
#7	Data D: LSB (Catalyst Monitor Conditions Encountered Counts Bank 1 - denominator)	XX	CATCOND1_B

### Third positive response

#### Request vehicle information response message (3)

<b>Message direction:</b>		ECU → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: In-use Performance Tracking	08	INFTYP
#3	MessageCount Calibration Id = 3 <sup>rd</sup> response message	03	MC_CALID
#4	Data A: MSB (Catalyst Monitor Completion Counts Bank 2 - numerator)	XX	CATCOMP2_A
#5	Data B: LSB (Catalyst Monitor Completion Counts Bank 2 - numerator)	XX	CATCOMP2_B
#6	Data C: MSB (Catalyst Monitor Conditions Encountered Counts Bank 2 - denominator)	XX	CATCOND2_A
#7	Data D: LSB (Catalyst Monitor Conditions Encountered Counts Bank 2 - denominator)	XX	CATCOND2_B

### Fourth positive response

#### Request vehicle information response message (1)

<b>Message direction:</b>		ECU#1 → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: In-use Performance Tracking	08	INFTYP
#3	MessageCount Calibration Id = 4 <sup>th</sup> response message	04	MC_CALID
#4	Data A: MSB (O2 Sensor Monitor Completion Counts Bank 1 - numerator)	XX	O2SCOMP1_A
#5	Data B: LSB (O2 Sensor Monitor Completion Counts Bank 1 - numerator)	XX	O2SCOMP1_B
#6	Data C: MSB (O2 Sensor Monitor Conditions Encountered Counts Bank 1 - denominator)	XX	O2SCOND1_A
#7	Data D: LSB (O2 Sensor Monitor Conditions Encountered Counts Bank 1 - denominator)	XX	O2SCOND1_B

## Fifth positive response

### Request vehicle information response message (2)

<b>Message direction:</b>		ECU → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: In-use Performance Tracking	08	INFTYP
#3	MessageCount Calibration Id = 5 <sup>th</sup> response message	05	MC_CALID
#4	Data A: MSB (O2 Sensor Monitor Completion Counts Bank 2 - numerator)	XX	O2SCOMP2_A
#5	Data B: LSB (O2 Sensor Monitor Completion Counts Bank 2 - numerator)	XX	O2SCOMP2_B
#6	Data C: MSB (O2 Sensor Monitor Conditions Encountered Counts Bank 2 - denominator)	XX	O2SCOND2_A
#7	Data D: LSB (O2 Sensor Monitor Conditions Encountered Counts Bank 2 - denominator)	XX	O2SCOND2_B

## Sixth positive response

### Request vehicle information response message (3)

<b>Message direction:</b>		ECU → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: In-use Performance Tracking	08	INFTYP
#3	MessageCount Calibration Id = 6 <sup>th</sup> response message	06	MC_CALID
#4	Data A: MSB (EGR Monitor Completion Condition Counts - numerator)	XX	EGRCOMP_A
#5	Data B: LSB (EGR Monitor Completion Condition Counts - numerator)	XX	EGRCOMP_B
#6	Data C: MSB (EGR Monitor Conditions Encountered Counts - denominator)	XX	EGRCOND_A
#7	Data D: LSB (EGR Monitor Conditions Encountered Counts - denominator)	XX	EGRCOND_B

## Seventh positive response

### Request vehicle information response message (4)

<b>Message direction:</b>		ECU → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: In-use Performance Tracking	08	INFTYP
#3	MessageCount Calibration Id = 7 <sup>th</sup> response message	07	MC_CALID
#4	Data A: MSB (AIR Monitor Completion Condition Counts (Secondary Air) - numerator)	XX	AIRCOMP_A
#5	Data B: LSB (AIR Monitor Completion Condition Counts (Secondary Air) - numerator)	XX	AIRCOMP_B
#6	Data C: MSB (AIR Monitor Conditions Encountered Counts (Secondary Air) - denominator)	XX	AIRCOND_A
#7	Data D: LSB (AIR Monitor Conditions Encountered Counts (Secondary Air) - denominator)	XX	AIRCOND_B

### Eighth positive response

#### Request vehicle information response message (4)

<b>Message direction:</b>		ECU → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: In-use Performance Tracking	08	INFTYP
#3	MessageCount Calibration Id = 8 <sup>th</sup> response message	08	MC_CALID
#4	Data A: MSB (EVAP Monitor Completion Condition Counts - numerator)	XX	EVAPCOMP_A
#5	Data B: LSB (EVAP Monitor Completion Condition Counts - numerator)	XX	EVAPCOMP_B
#6	Data C: MSB (EVAP Monitor Conditions Encountered Counts - denominator)	XX	EVAPCOND_A
#7	Data D: LSB (EVAP Monitor Conditions Encountered Counts - denominator)	XX	EVAPCOND_B

### Formula section:

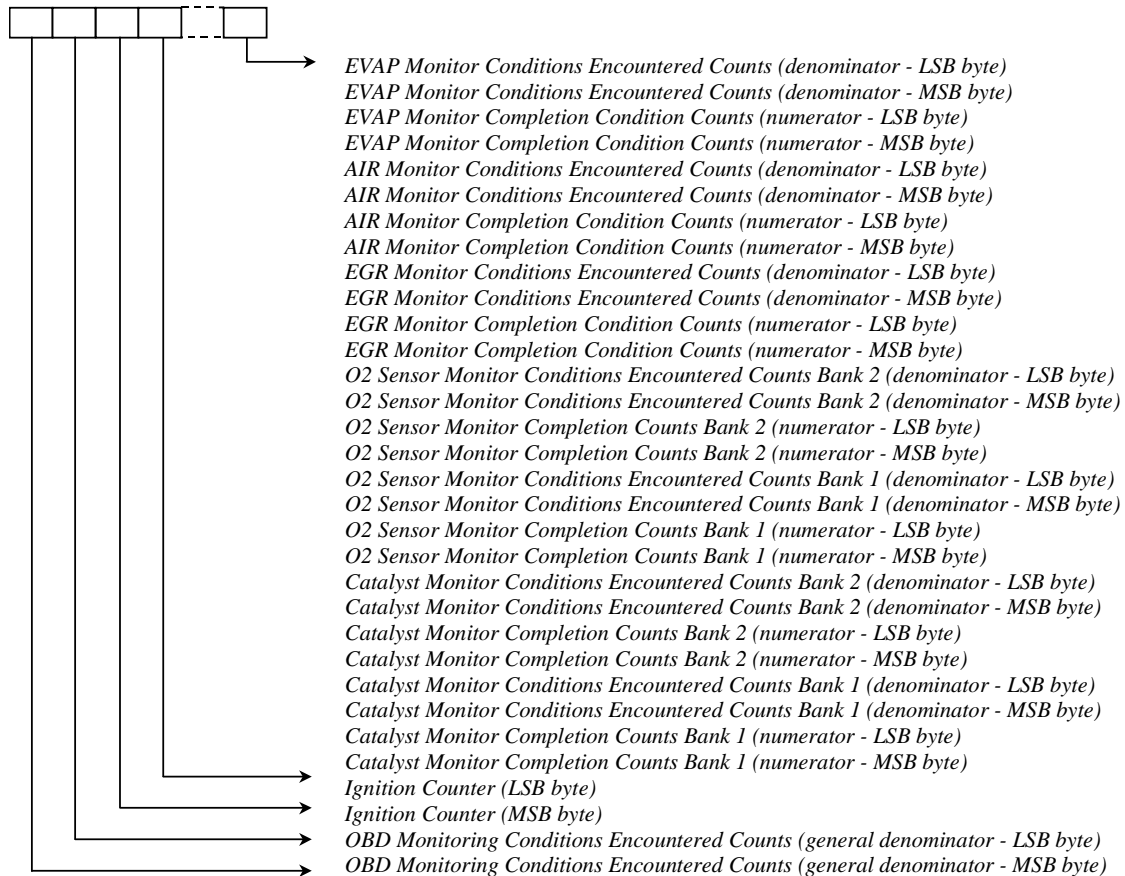
```

ACTION_ERRM_SelectRbmData    (
                               INOUT < ListRbmData >,
                               OUT < ResultRbmData >
                               )

```

Call **APIACTION\_ERRM\_SelectRbmData**  
Send positive(s) response(s)

ListRbmData : Software structure filled-up with 16 counters of 2 bytes coming from Rate-Based Monitoring



## I.36 Mode \$04 - Clear Reset Emission Related Diag Information

### I.36.1 Functional description

The purpose of this service is to provide a means for the diagnostic tool to command on-board ECM to clear the whole failure memory (all emission-related and non emission-related diagnostic information) (See Error Management specification).

#### Request message

Bytes	Parameter name	Hex value
#01	Request to clear/reset emission-related diagnostic information	04

The ECM shall respond to this service request with ignition ON and the engine not running and ECM not locked by immobilizer. ECUs that cannot perform this operation under other conditions, such as with the engine running, shall respond negatively with condition not correct.

#### Formula section

##### **ACTION\_ERRM\_ClrInfoByTypeOfDtc**

```
(
  IN <ALL>
  OUT <ResultClrInfo>
)
```

**IF** ResultClrInfo = INFO\_CLEARED **THEN**

Positive response

**ELSE**

Negative response with "Condition not correct"

**ENDIF**

Refer to Error Management module

Example :

1. Clear number of emission-related diagnostic trouble codes stored (Mode 01h, PID 01h)
2. Clear emission-related diagnostic trouble codes (Mode 03h)
3. Clear emission-related diagnostic trouble code for the freeze frame data (Mode 01h, PID 02h)
4. Clear freeze frame data of the failure (Mode 02h)
5. Reset status of system monitoring tests (Mode 01h, PID 01h - Readiness code)
6. Clear on board monitoring test results for continuously monitored systems (Mode 07h)
7. Clear distance travelled while MIL is activated (Mode 01h, PID 21h)
8. Clear on-board monitoring test results for non-continuously monitored systems (Mode 06h)
9. Clear the LV\_READY\_XXX (inhibition of the result)

#### Positive response message



Bytes	Parameter name	Hex value
#01	Request to clear/reset emission-related diagnostic information positive response	44

### Negative response message

Bytes	Parameter name	Hex value
#1	Negative response	7F
#2	Request to clear/reset emission-related diagnostic information	04
#3	Error code = Service not supported Sub function not supported - Invalid format Condition not correct	11 12 22

### Error code

Error code	Cause
Condition not correct	Engine running ECU locked by immobilizer
Service not supported	The requested mode is not supported (vehicle is not an EOBD or OBD2 system)
Sub function not supported - Invalid format	The length of the request is incorrect

## I.37 Mode \$05 - Request Oxygen Sensor Monitoring Test Results

### Input data:

LV_READY_XXX			
--------------	--	--	--

### I.37.1 Functional description

The purpose of this service is to allow access to the on-board oxygen sensor monitoring test results. The same information may be obtained by the use of service \$06.

The request message for test results includes a Test ID value that indicates the information requested.

Many methods may be used to calculate test results for this service by different manufacturers. If data values are to be reported using these messages that are different from those specified, ranges of test values have been assigned that can be used which have standard units of measure. The external test equipment can convert these values and display them in the standard units.

The ECU will respond to this message by transmitting the requested test data last determined by the system. The latest test results are to be retained, even over multiple ignition OFF cycles, until replaced by more recent test results. Test results are requested by Test ID.

Not all test values are applicable or supported by all vehicles. An optional feature of this service is for the ECU to indicate which Test IDs are supported. Test ID \$00 is a bit-encoded value that indicates support for Test IDs from \$01 to \$20. Test ID \$20 indicates support for Test IDs \$21 through \$40, etc. This is the same concept as used for PID support in services \$01 and \$02 as specified

If Test ID \$00 is not supported, then the ECU does not use this feature to indicate Test ID support.

### I.37.2 Message data bytes

#### I.37.2.1 Request oxygen sensor monitoring test results request message definition (read supported TIDs)

##### Request oxygen sensor monitoring test results request message (read supported TIDs)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request oxygen sensor monitoring test results request SID	M	05	SIDRQ
#2	Test ID	M	00-20-40-60-80-A0-C0-E0	TID
#3	O2 Sensor #	M	xx	O2SNO

#### I.37.2.2 Request oxygen sensor monitoring test results response message definition (report supported TIDs)

##### Request oxygen sensor monitoring test results response message (report supported TIDs)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request oxygen sensor monitoring test results response SID	M	-	SIDPR
#2	Test ID	M	00-20-40-60-80-A0-C0-E0	TID
#3	O2 Sensor #	M	xx	O2SNO
#4	data record of supported Test IDs = [ Data A: supported Test IDs, Data B: supported Test IDs, Data C: supported Test IDs, Data D: supported Test IDs ]	M	xx	DATA_A
#5		M	xx	DATA_B
#6		M	xx	DATA_C
#7		M	xx	DATA_D

### I.37.2.3 Request oxygen sensor monitoring test results request message definition (read TID values)

#### Request oxygen sensor monitoring test results request message (read TID values)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request oxygen sensor monitoring test results request SID	M	05	SIDRQ
#2	Test ID	M	xx	TID
#3	O2 Sensor #	M	xx	O2SNO

### I.37.2.4 Request oxygen sensor monitoring test results response message definition (report TID values)

#### Request oxygen sensor monitoring test results response message (report TID values)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request oxygen sensor monitoring test results response SID	M	-	SIDPR
#2	TEST ID	M	xx	TID
#3	O2 Sensor #	M	xx	O2SNO
#4	data record of Test ID = [ Test Value Minimum Limit Maximum Limit ]	M	xx	TESTVAL
#5		C	xx	MINLIMIT
#6		C	xx	MAXLIMIT
C = Conditional — if the supported Test ID is a constant (\$01 - \$04) the parameters Minimum and Maximum Limit shall not be included				

## I.37.3 Parameter definition

### I.37.3.1 Test ID and data byte descriptions

#### Test ID scaling description

Test ID	Description	Min. (\$00)	Max. (\$FF)	Scaling/bit
\$01	Rich to lean sensor threshold voltage (constant)	0 V	1.275 V	0.005 V
\$02	Lean to rich sensor threshold voltage (constant)	0 V	1.275 V	0.005 V
\$03	Low sensor voltage for switch time calculation (constant)	0 V	1.275 V	0.005 V
\$04	High sensor voltage for switch time calculation (constant)	0 V	1.275 V	0.005 V
\$05	Rich to lean sensor switch time (calculated)	0 s	1.02 s	0.004 s
\$06	Lean to rich sensor switch time (calculated)	0 s	1.02 s	0.004 s
\$07	Minimum sensor voltage for test cycle (calculated)	0 V	1.275 V	0.005 V
\$08	Maximum sensor voltage for test cycle (calculated)	0 V	1.275 V	0.005 V
\$09	Time between sensor transitions (calculated)	0 s	10.2 s	0.04 s
\$0A	Sensor period (calculated)	0 s	10.2 s	0.04 s
0B	EWMA (Exponential Weighted Moving Average) misfire counts for last 10 driving cycles (calculated) Calculation: $0.1 * (\text{current counts}) + 0.9 * (\text{previous average})$ Initial value for (previous average) = 0	0 count	65535 counts	1 count per bit
0C	Misfire counts for last/current driving cycles (calculated)	0 count	65535 counts	1 count per bit
\$0D-\$1F	reserved - to be specified by ISO			
\$21-\$2F	manufacturer Test ID description	0 s	1.02 s	0.004 s
\$30-\$3F	:	0 s	10.2 s	0.04 s
\$41-\$4F	:	0 V	1.275 V	0.005 V
\$50-\$5F	:	0 V	12.75 V	0.05 V
\$61-\$6F	:	0 Hz	25.5 Hz	0.1 Hz
\$70-\$7F	:	0 counts	255 counts	1 count
\$81-\$9F	manufacturer Test ID description	manufacturer specific values / units		
\$A1-\$BF	:	:	:	:
\$C1-\$DF	:	:	:	:
\$E1-\$FF	:	:	:	:

### I.37.3.2 Oxygen sensor location definition

The Oxygen sensor location value used in the request message shall indicate the Oxygen Sensor location as defined by PID \$13 or \$1D as specified in mode 1.

#### Oxygen sensor location description

Oxygen sensor location (one, and only one bit can be set to a 1)		
Bit	Sensor location <sup>1)</sup>	Alternative sensor location <sup>2)</sup>
0	Bank 1 - Sensor 1	Bank 1 - Sensor 1
1	Bank 1 - Sensor 2	Bank 1 - Sensor 2
2	Bank 1 - Sensor 3	Bank 2 - Sensor 1
3	Bank 1 - Sensor 4	Bank 2 - Sensor 2
4	Bank 2 - Sensor 1	Bank 3 - Sensor 1
5	Bank 2 - Sensor 2	Bank 3 - Sensor 2
6	Bank 2 - Sensor 3	Bank 4 - Sensor 1
7	Bank 2 - Sensor 4	Bank 4 - Sensor 2

<sup>1)</sup> If Service \$01 PID \$13 supported.  
<sup>2)</sup> If Service \$01 PID \$1D supported.

### I.37.3.3 Test result description

The following table defines the test result.

#### Test Result description

Hex	# of bytes	Description
00 - FF	1	The Test Result parameter includes either a constant or a calculated value depending on the Test ID.

### I.37.3.4 Minimum and Maximum Test Limit description

The following table defines Minimum and Maximum Test Limit.

#### Minimum and Maximum Test Limit description

Test Limit	# of bytes	Description
Minimum	1	The minimum test limit (only for calculated test result) is the minimum value to which the test result is compared. The Test Limit value is either a minimum or a maximum value to which the test results are compared. The Test Limit unsigned numeric value
Maximum	1	The maximum test limit (only for calculated test result) is the maximum value to which the test result is compared.

Results of latest mandated on-board oxygen sensor monitoring test, see figure below.

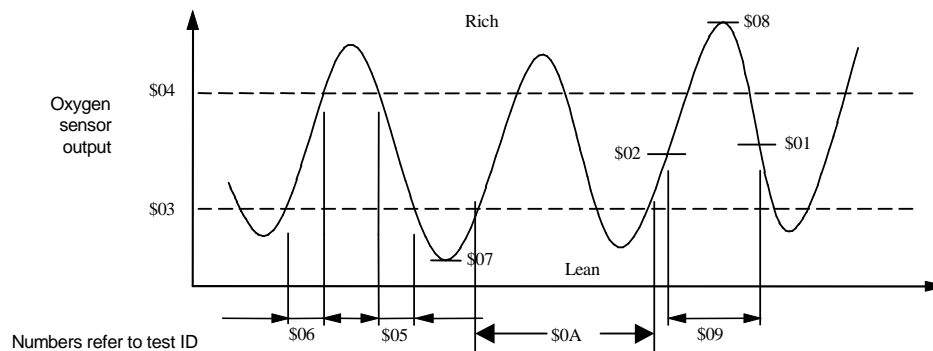


Figure I.37.1: Test ID value example

## I.38 Mode \$06 - Request On Board Monit Test Results For Non Cont.-...

### Input data:

LV_READY_XXX			
--------------	--	--	--

### I.38.1 Functional description

The purpose of this service is to allow access to the results (test value and test limit) for an on-board diagnostic monitoring tests of specific components/system that are not continuously monitored.

The latest test results are to be retained, even over multiple ignition 'off' cycles, until replaced by more recent test results.

Not all TIDs are applicable or supported by all systems. Then, all ECUs must at least answer to TID 00h by sending back the list of the PIDs used.

This service can be used as an alternative to service 05h to report oxygen sensor test results.

You can find the exhaustive list of generic TIDs definition in chapter TID description for mode 06h .

The specific list of supported TIDs for current project can be found in chapter Emission-related software and system configuration .

### Request message (read supported PIDs)

Bytes	Parameter name	Cvt	Hex value
#01	Request on-board monitoring test results for non-continuously monitored systems	M	06
#02	On-board diagnostic monitor ID	M	00-20-40-60-80-A0-C0-E0

### Positive response (read supported PIDs)

Bytes	Parameter name	Cvt	Hex value
#01	Request on-board monitoring test results for non-continuously monitored systems positive response	M	46
#02	Test ID	M	00-20-40-60-80-A0-C0-E0
#03	Test limit type and component ID	M	FF
#04	Data A	M	XX
#05	Data B	M	XX
#06	Data C	M	XX
#07	Data D	M	XX

### Request message (read test result)

Bytes	Parameter name	CVT	Hex value
#01	Request on-board monitoring test results for non-continuously monitored systems	M	06
#02	On-board diagnostic monitor ID	M	XX

### Response message (report test status)

Bytes	Parameter name		Hex value
#01	Request on-board monitoring test results for non-continuously monitored systems positive response	M	46
#02	Test ID	M	XX
#03	Test limit type and component ID	M	XX
#04	Test value (msb)	M	XX
#05	Test value (lsb)	M	XX
#06	Test limit (msb)	M	XX
#07	Test limit (lsb)	M	XX

### Formula section:

IF LV\_READY\_XXX = ON THEN

Negative response (No result since last reset/clear)

ELSE

Positive response with test result

END

### Test limit type and component ID definition

Byte #3	Value	Description
bit 0 to bit 6		Component ID - Manufacturer defined - necessary when multiple components or systems are present on the vehicle and have the same definition of test ID.
bit 7	0 1	Most significant bit indicates type of test limit, where: Test limit is maximum value - test fails if test value is greater than this value Test limit is minimum value - test fails if test value is less than this value  If the test result should be within a range of values, two messages will be returned, one with the minimum limit value and one with the maximum limit value.

### Negative response message

Bytes	Parameter name	Hex value
#1	Negative response	7F
#2	Request on-board monitoring test results for non-continuously monitored systems	06
#3	Error code = Service not supported Sub function not supported - Invalid format Condition not correct	11 12 22

### I.38.1.1 Error code

Error code	Cause
Service not supported	The requested mode is not supported (vehicle is not an EOBD or OBD2 system)
Sub function not supported - Invalid format	The requested TID is not supported or the length of the request is incorrect
Condition not correct	No result since last reset/clear or Test in progress



## I.39 Mode \$07 - Request On Board Monit Test Results For Cont.-...

### I.39.1 Functional description

The purpose of this service is to enable the off-board test device to obtain test results for emission-related powertrain components/systems that are continuously monitored during normal driving conditions.

The intended use of this data is to assist the service technician after a vehicle repair, and after clearing diagnostic information, by reporting test results after a single driving cycle. If the test failed during the driving cycle, the DTC associated with that test will be reported. Test results reported by this service do not necessarily indicate a faulty component/system. If test results indicate a failure after additional driving, then the MIL will be illuminated and a DTC will be set and reported with Mode 03, indicating a faulty component/system. Once Service \$03 indicates a faulty component/system, Service \$07 may or may not continue to report it as a one-trip failure also.

If an ECU does not have stored DTCs then it shall respond with a message indicating no codes are stored by setting the parameter "Number of DTC" to 00h.

#### Request message

Bytes	Parameter name	CVT	Hex value
#01	Request on-board monitoring test results for continuously monitored system	M	07

#### Formula section:

##### **ACTION\_ERRM\_ReadDtcByTypeOfDtc**

```
(
  IN <OBD& TEMPORARY>
  IN <LAW>
  INOUT <DTC1 to DTCm>
  OUT <ResultDtc>
)
```

```
IF ResultDtc != NO_BUFFER_FULL
    Positive response
ELSE
    Negative response general reject
ENDIF
```

#### First positive response message

Bytes	Parameter name	Hex value
#01	<b>Request on-board monitoring test results for continuously monitored system positive response</b>	47
#02	Code #1 (msb)	XX or 00
#03	Code #1 (lsb)	XX or 00
#04	Code #2 (msb)	XX or 00
#05	Code #2 (lsb)	XX or 00
#06	Code #3 (msb)	XX or 00
#07	Code #3 (lsb)	XX or 00

### Next positive response message

Bytes	Parameter name	Hex value
#01	<b>Request on-board monitoring test results for continuously monitored system positive response</b>	47
#02	Code #4 (msb)	XX or 00
#03	Code #4 (lsb)	XX or 00
#04	Code #5 (msb)	XX or 00
#05	Code #5 (lsb)	XX or 00
#06	Code #6 (msb)	XX or 00
#07	Code #6 (lsb)	XX or 00

If different failures have the same stored DTC number, only one DTC number shall be reported.

The standard does not request the order in which the diagnostic trouble codes shall be transmitted.

In the case of less than 3 codes have been stored, the answer shall be completed by 0000h in order to guarantee a fixed length.

### Negative response message

Bytes	Parameter name	Hex value
#1	<b>Negative response</b>	7F
#2	<b>Request emission-related powertrain diagnostic trouble codes</b>	07
#3	Error code =     Service not supported Sub function not supported - Invalid format General reject	11 12 10

### Error code

Error code	Cause
Service not supported	The requested mode is not supported (vehicle is not an EOBD or OBD2 system)
Sub function not supported - Invalid format	The length of the request is incorrect

## I.40 Mode \$03 - Request Emission Related Diagnostic Information

### I.40.1 Functional description for ISO 14 230-4

The purpose of this mode is to enable the off-board test device to obtain stored emission-related powertrain diagnostic trouble codes (DTCs).

This operation should be divided in two phases (not necessary) :

1st phase : the diagnostic tool requests the number of emission-related troubles codes (mode = 01h, PID = 01h).

If ECM does not have stored codes, then that module shall respond with a message indicating zero codes are stored.

2nd phase : the diagnostic tool requests the diagnostic troubles codes stored (mode = 03h).

If additional trouble codes are set between the time that the number of codes are reported by an ECM, and the stored codes are reported by an ECM, then the number of codes reported could exceed the number expected by the diagnostic tool. In this case the diagnostic tool should repeat this cycle until the number of codes reported equals the number expected based on the Mode 01 response.

If there is no emission-related diagnostic trouble code to report, no response is required, but for ISO 14230-4 interfaces, the module will respond with a report containing no codes. (all Codes = 00 for the response)

#### Request message

Bytes	Parameter name	CVT	Hex value
#01	Request emission-related powertrain diagnostic trouble codes	M	03


#### Formula section

##### **ACTION\_ERRM\_ReadDtcByTypeOfDtc**

```
(
  IN <OBD & CONFIRMED>
  IN <LAW>
  INOUT <DTC1 to DTCm>
  OUT <ResultDtc>
)
```

```
IF ResultDtc != BUFFER_FULL
    Positive response
ELSE
    Negative response general reject
ENDIF
```

#### First positive response message

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Bytes	Parameter name	Hex value
#01	<b>Request emission-related powertrain diagnostic trouble codes positive response</b>	43
#02	Code #1 (msb)	XX or 00
#03	Code #1 (lsb)	XX or 00
#04	Code #2 (msb)	XX or 00
#05	Code #2 (lsb)	XX or 00
#06	Code #3 (msb)	XX or 00
#07	Code #3 (lsb)	XX or 00

### Next positive response if more than 3 DTC

Bytes	Parameter name	Hex value
#01	<b>Request emission-related powertrain diagnostic trouble codes positive response</b>	43
#02	Code #4 (msb)	XX or 00
#03	Code #4 (lsb)	XX or 00
#04	Code #5 (msb)	XX or 00
#05	Code #5 (lsb)	XX or 00
#06	Code #6 (msb)	XX or 00
#07	Code #6 (lsb)	XX or 00

The standard does not request the order in which the diagnostic trouble codes shall be transmitted. In the case of less than 3 codes for a response have been stored, the answer shall be completed by 0000h in order to guarantee a fixed length.

### Negative response message

Bytes	Parameter name	Hex value
#1	<b>Negative response</b>	7F
#2	<b>Request emission-related powertrain diagnostic trouble codes</b>	03
#3	Error code = Service not supported Sub function not supported - Invalid format general reject	11 12 10

### Error code

Error code	Cause
Service not supported	The requested mode is not supported (vehicle is not an EOBD or OBD2 system)
Sub function not supported - Invalid format	The length of the request is incorrect

## I.41 Mode \$01 - Request Current Powertrain Diagnostic

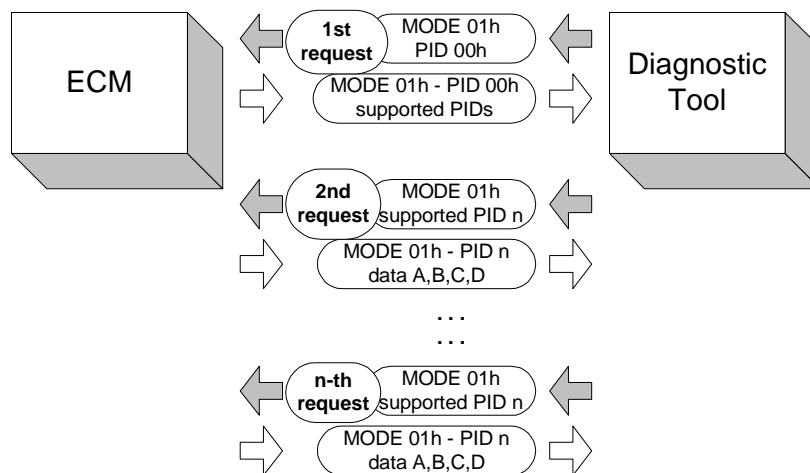
### I.41.1 Functional description for ISO 14230-4

The purpose of this mode is to allow access to current emission-related data values including analog inputs and outputs, digital inputs and outputs, system status information, and calculated parameter values.

Each request contains a Parameter Identification (PID) which indicates to the ECM the specific information to be transmitted. The information transmitted by the ECM must be the latest ones, all acquisitions shall correspond to actual measurements and not to values selected by the ECM for the limp home mode.

Not all PIDs are applicable or supported by all systems. Then, all ECUs must at least answer to PID 00h by sending back the list of the PIDs used.

You can find the exhaustive list of generic PIDs definition in chapter PID description for mode 01h . The specific list of supported PIDs can be found in chapter Emission-related software and system configuration .



#### Request message definition (read supported PIDs)

Byte s	Parameter name	Hex value
#01	Request current powertrain diagnostic data	01
#02	PID	00-20-40-60-80-A0-C0-E0

#### Positive response message definition (read supported PIDs)

Bytes	Parameter name	Cvt	Hex value
#01	<b>Request current powertrain diagnostic data positive response</b>	M	41
#02	PID	M	00-20-40-60-80-A0-C0-E0
#03	Data A	M	XX
#04	Data B	M	XX
#05	Data C	M	XX
#06	Data D	M	XX

### Request message definition (read PID value)

Bytes	Parameter name	Hex value
#01	<b>Request current powertrain diagnostic data</b>	01
#02	PID	XX

### Positive response message (read PID value)

Bytes	Parameter name	Cvt	Hex value
#01	<b>Request current powertrain diagnostic data positive response</b>	M	41
#02	PID	M	XX
#03	Data A	M	XX
#04	Data B (optional)	C	XX
#05	Data C (optional)	C	XX
#06	Data D (optional)	C	XX

C =Conditional - Data B -D depend on selected PID value


M = Mandatory

### Negative response message

Bytes	Parameter name	Hex value
#1	<b>Negative response</b>	7F
#2	<b>Request current powertrain diagnostic data</b>	01
#3	Error code =      Service not supported Sub function not supported - Invalid format	11 12

### Error code

Error code	Cause
Service not supported	The requested mode is not supported (vehicle is not an EOBD or OBD2 system)
Sub function not supported - Invalid format	The requested PID is not supported or the length of the request is incorrect

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## I.42 Mode \$02 - Request Powertrain Freeze Frame Data

### Import:

```

ACTION_ERRM_ReadFrfByDtc
(
    IN <TypeOfFF>
    IN <FFIdentifier>
    IN <DtcIdentifier>
    IN <LevelOfDTC>
    INOUT <Frf>
    OUT <ResultFrf>
)

```

This API returns a Freeze Frame related to the DTC given in parameter.

### I.42.1 Functional description for ISO 14230-4

The purpose of this mode is to allow access to emission-related data values which were stored during the freeze frame required by OBD-II regulations.

Each request contains a Parameter IDentification (PID) which indicates to the ECM the specific information to be transmitted.

The information to be transmitted is the freeze frame data which has been stored by the ECM at the failure occurrence. Like mode 01h, no limp home value shall be transmitted. The definition of the failure context is given by the frame number - in this case, we only select one failure context which is defined by the frame number 00h.

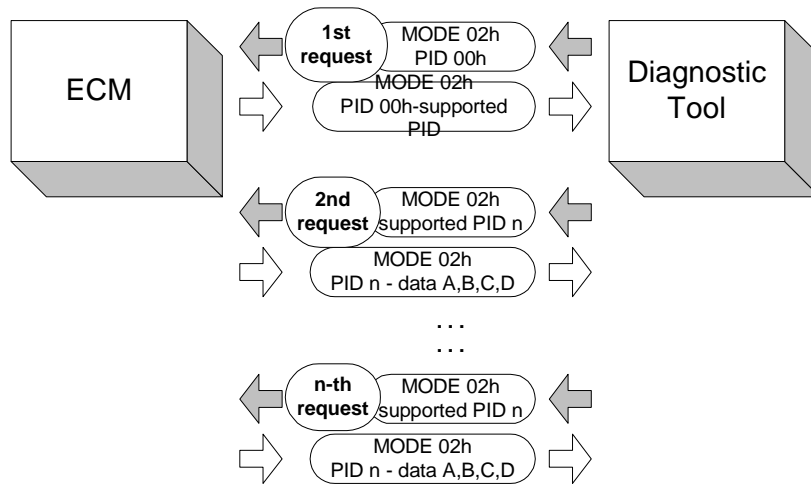
Not all PIDs are applicable or supported by all systems. Then, all ECUs must at least answer to PID 00h by sending back the list of the PIDs used.

PID 02h is the DTC that caused the freeze frame data to be stored. If freeze frame data is not stored in the ECM, the system should report 00 00h as the DTC. Any data reported when the stored DTC is 00 00h may not be valid.

You can find the exhaustive list of generic PIDs definition, scaling information, and display formats for the required freeze frame in chapter PID description for mode 02h .

The specific list of supported PIDs for current project can be found in chapter Emission-related software and system configuration .





## I.42.2 Message data bytes

### Request message (read supported PIDs)

Bytes	Parameter name	Cvt	Hex value
#01	Request powertrain freeze frame data	M	02
#02	PID	M	00-20-40-60-80-A0-C0-E0
#03	Frame number	M	00

### Positive response message (read supported PIDs)

Bytes	Parameter name	Cvt	Hex value
#01	Request powertrain freeze frame data positive response	M	42
#02	PID	M	00-20-40-60-80-A0-C0-E0
#03	Frame number	M	00
#04	Data A	M	XX
#05	Data B	M	XX
#06	Data C	M	XX
#07	Data D	M	XX

### Request message (read PID value)

Bytes	Parameter name	Cvt	Hex value
#01	<b>Request powertrain freeze frame data</b>	M	02
#02	PID	M	XX
#03	Frame number	M	00

### Positive response message (read PID value)

Bytes	Parameter name	Cvt	Hex value
#01	<b>Request powertrain freeze frame data positive response</b>	M	42
#02	PID	M	XX
#03	Frame number	M	00
#04	Data A	M	XX
#05	Data B	C	XX
#06	Data C	C	XX
#07	Data D	C	XX

C = Conditional Data B -D depend on selected PID value

M = Mandatory

### Negative response message


Bytes	Parameter name	Hex value
#1	<b>Negative response</b>	7F
#2	<b>Request current powertrain diagnostic data</b>	02
#3	Error code =	11
	Service not supported	12
	Sub function not supported - Invalid format	22
	Condition not correct	10
	General reject	

### Error code

Error code	Cause
Service not supported	The requested mode is not supported (vehicle is not an EOBD or OBD2 system)
Sub function not supported - Invalid format	The requested PID is not supported The length of the request is incorrect Freeze frame number is different of 00h
Condition not correct	no freeze frame stored
General reject	Software Problem

### Formula section

#### ACTION\_ERRM\_ReadFrFByDtc


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```

(
  IN <LAW>
  IN <FIRST>
  IN <NO_DTC>
  IN <LAW>
  INOUT <FrF>
  OUT <ResultFrF>
)

IF      ResultFrF = BUFFER_FULL
  Negative response with "General reject"
ELSE
  IF    ResultFrF = FRF_PRESENT THEN
    Positive response
  ELSE
    IF      PID = 02h THEN
      Positive response with DTC = 0000h
    ELSE
      Negative response with "Condition not correct"
    ENDIF
  ENDIF
ENDIF

```

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# I.43 OBD service interpreter

## Action definition

<b>ACTION_OBDC_ReqOBDServices</b> (<IN>,<PRM_STATE_BUF_INP>,<IN>,<PRM_STATE_LEN_INP>,<OUT>,<PRM_STATE_BUF_OUT>,<OUT>,<PRM_STATE_LEN_OUT>)	Mode: O
This action is the main interface to OBD functionality.	
<b>ACTION_OBDC_ReturnCode</b> (OUT<PRM_STATE_COD_OBD>)	Mode: O
This action return the response code to KWP/UDS.	
<b>ACTION_OBDC_SetMaxBuffOut</b> (IN<PRM_STATE_MAX_BUF_OUT>)	Mode: O
This action set the remaining number of available bytes.	

### I.43.1 ACTION\_OBDC\_ReqOBDServices

#### Description for actions:

<b>ACTION_OBDC_ReqOBDServices</b> ( IN < PRM_STATE_BUF_INP > , IN < PRM_STATE_LEN_INP > , OUT < PRM_STATE_BUF_OUT > , OUT < PRM_STATE_LEN_OUT > )					
This action is the main interface to OBD functionality.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_STATE_BUF_INP					
See description below					
PRM_STATE_LEN_INP	U16	0..FFFF	0..65535	-	-
Number of bytes contained by PRM_STATE_BUF_INP (request length)					
PRM_STATE_BUF_OUT					
See description below					
PRM_STATE_LEN_OUT	U8	0..FF	0..255	-	-
Number of bytes contained by PRM_STATE_LEN_OUT (response length)					

#### FUNCTION DESCRIPTION:

##### General information:


This action is the entry point of the OBD functionality.

##### Description:

This action will be called by the UDS/KWP.  
 Depending on the scan tool request, the UDS/KWP functionality calls the OBD service interpreter. The service interpreter checks certain general conditions which are common for all the configured services. If these general conditions are true, then only the corresponding service shall be called.

##### Description of parameters used by ACTION\_OBDC\_ReqOBDServices ():

**PRM\_STATE\_BUF\_INP:** Software structure filled up with the bytes of the OBD requested.

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	Document key 10171571 SPE 000 AO	Pages Page 7892 of 8404	
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PRM\_STATE\_BUF\_OUT: Software structure filled up with the bytes of the OBD response.

PRM\_STATE\_LEN\_INP: Number of bytes contained by PRM\_STATE\_BUF\_INP (request length).

PRM\_STATE\_LEN\_OUT: Number of bytes contained by PRM\_STATE\_LEN\_OUT (response length).

### **Application conditions**

**Initialisation:** -

**Recurrence:** *On scan tool request, called by KWP/ UDS*

**Activation:** -

### **Formula section:**

**SWITCH** PRM\_STATE\_BUF\_INP // Check the requested OBD service by the scan tool

**CASE** Service 01h:

**Call** Service 01h treatment

to fill PRM\_STATE\_BUF\_OUT and PRM\_STATE\_LEN\_OUT

**CASE** Service 02h:

**Call** Service 02h treatment

to fill PRM\_STATE\_BUF\_OUT and PRM\_STATE\_LEN\_OUT

**CASE** Service 03h:

**Call** Service 03h treatment

to fill PRM\_STATE\_BUF\_OUT and PRM\_STATE\_LEN\_OUT

**CASE** Service 04h:

**Call** Service 04h treatment

to fill PRM\_STATE\_BUF\_OUT and PRM\_STATE\_LEN\_OUT

**CASE** Service 06h:

**Call** Service 06h treatment

to fill PRM\_STATE\_BUF\_OUT and PRM\_STATE\_LEN\_OUT

**CASE** Service 07h:

**Call** Service 07h treatment

to fill PRM\_STATE\_BUF\_OUT and PRM\_STATE\_LEN\_OUT

**CASE** Service 08h:

**Call** Service 08h treatment

to fill PRM\_STATE\_BUF\_OUT and PRM\_STATE\_LEN\_OUT

**CASE** Service 09h:


**Call** Service 09h treatment

to fill PRM\_STATE\_BUF\_OUT and PRM\_STATE\_LEN\_OUT

**CASE** Service 0Ah:

**Call** Service 0Ah treatment

to fill PRM\_STATE\_BUF\_OUT and PRM\_STATE\_LEN\_OUT

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
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**OTHERWISE**

// Nothing to do

**Negative response handling:**

The only negative response allowed to be sent is CNCORSE 22h in case of conditions not fulfilled for service 04h request.

In all other cases of no positive response availability, NO RESPONSE will be sent on CAN.

**I.43.2 ACTION\_OBDC\_ReturnCode**

**Description for actions:**

ACTION_OBDC_ReturnCode ( OUT < PRM_STATE_COD_OBD > )					
This action return the response code to KWP/UDS.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_STATE_COD_OBD	U8	0..FF	0..255	-	-
response code returned to KWP/UDS					

**FUNCTION DESCRIPTION:**

**General information:**

This action return the response code to KWP/UDS.

**Description:**

This action will be called by the UDS/KWP.

Depending of the treatment of OBD services, a response code is necessary to be provided to KWP/UDS.

**Description of parameters used by ACTION\_OBDC\_ReturnCode ():**

PRM\_STATE\_COD\_OBD: Software structure filled up with the response code. This can have the values:

- 00h - Positive response
- 22h - Negative response with error code 22h

**Application conditions**

- Initialisation:** -
- Recurrence:** *On scan tool request, called by KWP/ UDS*
- Activation:** -

**Formula section:**

At each request set PRM\_STATE\_COD\_OBD to one of the values above.

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### I.43.3 ACTION\_OBDC\_SetMaxBuffOut

#### Description for actions:

ACTION_OBDC_SetMaxBuffOut ( IN < PRM_STATE_MAX_BUF_OUT > )					
This action set the remaining number of available bytes.					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_STATE_MAX_BUF_OUT	U16	0..FFFF	0..65535	-	-
Remaining length of buffer					

#### FUNCTION DESCRIPTION:

##### General information:

This action set the remaining number of available bytes.

##### Description:

This action will be called by the UDS/KWP which will set the remaining number of bytes for OBD output buffer

##### Description of parameters used by ACTION\_OBDC\_SetMaxBuffOut ():

PRM\_STATE\_MAX\_BUF\_OUT: Software structure filled with the remaining number of bytes for output buffer.


#### Application conditions

- Initialisation:** -
- Recurrence:** *On scan tool request, called by KWP/ UDS*
- Activation:** -

#### Formula section:

At each request PRM\_STATE\_MAX\_BUF\_OUT is set by the KWP/UDS with the remaining number of bytes for output buffer.

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## I.44 PID description for mode 01h

### Input data:

AMP_MES {p. 1163}	C_CLC_READY_OBD_1 {p. 7833}	C_OBD_REQ {p. 7835}	CPPWM_CPS {p. 3749}
CTR_WUP_DTC_CLR {p. 5899}	DIST_ACT_MIL {p. 5899}	DIST_DTC_CLR {p. 5899}	FAC_LAM_AD_SAE [NC_CBK_EX_NR] {p. 1014}
FAC_LAM_LIM_SAE [NC_CBK_EX_NR] {p. 1014}	FUP {p. 1283}	FUP_RNG_H_MES {p. 1283}	IGA_IGC [NC_CYL_NR] {p. 1005}
IPLSL_COR [NC_CBK_EX_NR] {p. 2313}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_SP_SAE {p. 1015}	LOAD_ABSV {p. 5801}
LOAD_CLC {p. 5801}	MAF_KGH_MES {p. 1192}	MAP_SAE {p. 1198}	MOD_1_PID_1_DIAG {p. 7831}
MOD_1_PID_2_DIAG {p. 7831}	MOD_1_PID_3_DIAG {p. 7831}	MOD_1_PID_4_DIAG {p. 7831}	MOD_1_PID_5_DIAG {p. 7831}
MOD_1_PID_6_DIAG {p. 7831}	MOD_1_PID_7_DIAG {p. 7831}	MOD_1_PID_8_DIAG {p. 7831}	MOD_1_PID_9_DIAG {p. 7831}
MOD_1_PID_A_DIAG {p. 7831}	MOD_1_PID_B_DIAG {p. 7831}	MOD_1_PID_C_DIAG {p. 7831}	N {p. 1525}
NC_INJ_CONF {p. 626}	OBD_EGR_DIF {p. 5801}	OBD_FTL {p. 5801}	OBD_PV_1 {p. 5801}
OBD_PV_2 {p. 5801}	OBD_TAM {p. 1569}	OBD_TPS_1 {p. 5801}	OBD_TPS_2 {p. 5801}
OBD_TPS_REL {p. 5801}	OBD_TPS_SP {p. 5801}	OPG_SP_ACR {p. 3573}	PSN_LS {p. 656}
STATE_CMPL_OBD {p. 5899}	STATE_ENA_OBD {p. 5899}	STATE_LS_SAE [NC_CBK_EX_NR] {p. 2448}	STATE_OBD_SA {p. 808}
T_ACT_MIL_SAE {p. 809}	T_AST_SAE {p. 1766}	T_DTC_CLR {p. 5899}	TCO_MES {p. 1100}
TEG_CAT_DOWN_MDL {p. 8236}	TEG_CAT_UP_MDL [ _i] {p. 8236}	TIA_MES {p. 1226}	VB {p. 1185}
VLS_COR_LSL [NC_CBK_EX_NR] {p. 1088}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VS {p. 1176}	

**Note:** This specification is according with the ISO 15031-5 issue 8.

### I.44.1 Description of PID 00h - Defines Supported PIDs 01h - 20h

0 : the PID is not used

1 : the PID is used

#### DATA A - Supported PIDs 01h to 08h



PID 00h - DATA A - Supported PID 01h to 08h		
BIT	Function	Name
0	PID 08h : Short term fuel trim - Bank 2	MOD_1_PID_1_DIAG
1	PID 07h : Long term fuel trim - Bank 1	
2	PID 06h : Short term fuel trim - Bank 1	
3	PID 05h : Engine coolant temperature	
4	PID 04h : Calculated load value	
5	PID 03h : Fuel system status	
6	PID 02h : Trouble code that caused required freeze frame	
7	PID 01h : DTCs and supported tests	

#### DATA B - Supported PIDs 09h to 10h

PID 00h - DATA B - Supported PID 09h to 10h		
BIT	Function	Name
0	PID 10h : Air flow rate from MAF sensor	MOD_1_PID_2_DIAG
1	PID 0Fh : Intake air temperature	
2	PID 0Eh : Ignition time advance	
3	PID 0Dh : Vehicle speed	
4	PID 0Ch : Engine RPM	
5	PID 0Bh : Intake manifold absolute pressure	
6	PID 0Ah : Fuel pressure (gauge)	
7	PID 09h : Long term fuel trim - Bank 2	

#### DATA C - Supported PIDs 11h to 18h

PID 00h - DATA C - Supported PID 11h to 18h		
BIT	Function	Name
0	PID 18h : Bank 2 Sensor 1 or Bank 3 Sensor 1	MOD_1_PID_3_DIAG
1	PID 17h : Bank 1 Sensor 4 or Bank 2 Sensor 2	
2	PID 16h : Bank 1 Sensor 3 or Bank 2 Sensor 1	
3	PID 15h : Bank 1 Sensor 2	
4	PID 14h : Bank 1 Sensor 1	
5	PID 13h : Location of oxygen sensors	
6	PID 12h : Secondary air status	
7	PID 11h : Absolute throttle position sensor	


#### DATA D - Supported PIDs 19h to 20h

PID 00h - DATA D - Supported PID 19h to 20h		
BIT	Function	Name
0	PID 20h : PIDs supported (\$21 - \$40)	MOD_1_PID_4_DIAG
1	PID 1Fh : Time Since Engine Start	
2	PID 1Eh : Auxiliary Input Status	
3	PID 1Dh : Location of oxygen sensors	
4	PID 1Ch : OBD requirements	
5	PID 1Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2	
6	PID 1Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1	
7	PID 19h : Bank 2 Sensor 2 or Bank 3 Sensor 2	

## I.44.2 Description of PID 01h - Monitor status since DTCs cleared

### PID \$01 definition

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PID (hex)	Description	Data byte	Scaling/bit	External test equipment SI (Metric) / English display
01	Monitor status since DTCs cleared			
	a) The bits in this PID shall report two pieces of information for each monitor: Monitor status since DTCs were last cleared, saved in NVRAM or KAM. Monitors supported on this vehicle.			
	Number of emission-related DTCs and MIL status	A (bit)	byte 1 of 4	DTC and MIL status:
	# of DTCs stored in this ECU	0-6	hex to decimal	DTC_CNT: xxxd
	Malfunction Indicator Light (MIL) Status	7	0 = MIL OFF; 1 = MIL ON	MIL: OFF or ON
	The MIL status shall indicate "OFF" during the key on, engine off bulb check unless the MIL has also been commanded "ON" for a detected malfunction.			
	Supported tests which are continuous	B (bit)	byte 2 of 4 (Low Nibble)	Support status of continuous monitors:
	Misfire monitoring	0	0 = monitor not supported (NO) 1 = monitor supported (YES)	MIS_SUP: NO or YES
	Misfire monitoring shall be supported on both, spark ignition and compression vehicles if the vehicle utilises a misfire monitor.			
	Fuel system monitoring	1	0 = monitor not supported (NO) 1 = monitor supported (YES)	FUEL_SUP: NO or YES
	Fuel system monitoring shall be supported on vehicles that utilise oxygen sensors for closed loop fuel feedback control, and utilise a fuel system monitor, typically spark ignition engines.			
	Comprehensive component monitoring	2	0 = monitor not supported (NO) 1 = monitor supported (YES)	CCM_SUP: NO or YES
	Comprehensive component monitoring shall be supported on spark ignition and compression ignition vehicles that utilise comprehensive component monitoring.			
	reserved (bit shall be reported as '0')	3		---

Figure I.44.1: PID \$01 definition (continued)

PID (hex)	Description	Data byte	Scaling/bit	External test equipment SI (Metric) / English display
	Status of continuous monitoring tests since DTC cleared:	B (bit)	byte 2 of 4 (High Nibble)	Completion status of continuous monitors since DTC cleared:
	Misfire monitoring	4	0 = monitor complete, or not applicable (YES) 1 = monitor not complete (NO)	MIS_RDY: YES or NO
	Misfire monitoring shall always indicate complete for spark ignition engines. Misfire monitoring shall indicate complete for compression ignition engines after the misfire evaluation is complete.			
	Fuel system monitoring	5	0 = monitor complete, or not applicable (YES) 1 = monitor not complete (NO)	FUEL_RDY: YES or NO
	Fuel system monitoring shall always indicate complete for both spark ignition and compression ignition engines.			
	Comprehensive component monitoring	6	0 = monitor complete, or not applicable (YES) 1 = monitor not complete (NO)	CCM_RDY: YES or NO
	Comprehensive component monitoring shall always indicate complete on both spark ignition and compression ignition engines. NOTE It can be assumed that by the time any non-continuous monitors are complete, continuous comprehensive component monitoring will also be complete. Bit 6 is allowed to always indicate "complete" on spark ignition vehicles that support other non-continuous monitors.			
	reserved (bit shall be reported as '0')	7		---
	Supported tests run at least once per trip	C (bit)	byte 3 of 4	Support status of non-continuous monitors:
	Catalyst monitoring	0	0 = monitor not supported (NO) 1 = monitor supported (YES)	CAT_SUP: NO or YES
	Heated catalyst monitoring	1		HCAT_SUP: NO or YES
	Evaporative system monitoring	2		EVAP_SUP: NO or YES
	Secondary air system monitoring	3		AIR_SUP: NO or YES
	A/C system refrigerant monitoring	4		ACRF_SUP: NO or YES
	Oxygen sensor monitoring	5		O2S_SUP: NO or YES
	Oxygen sensor heater monitoring	6		HTR_SUP: NO or YES
	EGR system monitoring	7	EGR_SUP: NO or YES	
	Status of tests run at least once per trip	D (bit)	byte 4 of 4	Completion status of non-continuous monitors since DTCs cleared:
	Catalyst monitoring	0	0 = monitor complete, or not applicable (YES) 1 = monitor not complete (NO)	CAT_RDY: YES or NO
	Heated catalyst monitoring	1		HCAT_RDY: YES or NO
	Evaporative system monitoring	2		EVAP_RDY: YES or NO
	Secondary air system monitoring	3		AIR_RDY: YES or NO
	A/C system refrigerant monitoring	4		ACRF_RDY: YES or NO
	Oxygen sensor monitoring	5		O2S_RDY: YES or NO
	Oxygen sensor heater monitoring	6		HTR_RDY: YES or NO
	EGR system monitoring	7	EGR_RDY: YES or NO	

Figure I.44.2: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	(bit 0 to 6) :	NR_DTC
	(bit 7) :	STATE_MIL
data B	STATE_READY_OBD_1 *	
data C	C_STATE_READY_OBD_2	
data D	STATE_READY_OBD_2	

- \*) The bit 0 up to 3 of this byte is calibration value C\_STATE\_READY\_OBD\_1.  
The bit 4 up to 6 of this byte indicate if the tests has been performed continuously since the reinitialization of the memorized information.

#### Formula section:

##### **ACTION\_ERRM\_ReadQuantityOfDtc**

```
(
  IN <OBD & CONFIRMED>
  IN <LAW>
  INOUT <NR_DTC>
  OUT <ResultQuantity>
)
```

##### **ACTION\_ERRM\_ReadReadinessCode**

```
(
  INOUT < C_STATE_READY_OBD_2, STATE_READY_OBD_
  1,
  STATE_READY_OBD_2>
  OUT <ResultReadinessCode>
)
```

```
IF (ResultQuantity = DTC_PRESENT OR
  ResultQuantity = NO_DTC_PRESENT) AND
  ResultReadinessCode = POSITIVE_RESPONSE
THEN
```

Positive response

**ELSE**

No answer

**ENDIF**

These actions should be sent at each time we use the mode 01h PID01.

Refer to Error management module.

### **I.44.3 Description of PID 03h - Status of fuel system**

#### **PID \$03 definition**

PID (hex)	Description	Data Byte	Scaling/bit	External test equipment SI (Metric) / English display	
03	Fuel system 1 status:	A (bit)	byte 1 of 2	FUELSYS1:	
	(unused bits shall be reported as '0'; no more than one bit at a time can be set to a '1' of that bank)	0	1 = Open loop - has not yet satisfied conditions to go closed loop	OL	
		1	1 = Closed loop - using oxygen sensor(s) as feedback for fuel control	CL	
		2	1 = Open loop due to driving conditions (e.g. power enrichment, deceleration enleanment)	OL-Drive	
		3	1 = Open loop - due to detected system fault	OL-Fault	
		4	1 = Closed loop, but fault with at least one oxygen sensor - may be using single oxygen sensor for fuel control	CL-Fault	
		5-7	reserved (bits shall be reported as '0')	---	
	NOTE Fuel systems do not refer to injector banks. Fuel systems are intended to represent completely different fuel systems that can independently enter and exit closed loop fuel. Banks of injectors on a V-engine are generally not independent and share the same closed-loop enablement criteria.				
	Fuel system 2 status:	B (bit)	byte 2 of 2	FUELSYS2:	
	(unused bits shall be reported as '0'; no more than one bit at a time can be set to a '1' of that bank)	0	1 = Open loop - has not yet satisfied conditions to go closed loop	OL	
1		1 = Closed loop - using oxygen sensor(s) as feedback for fuel control	CL		
2		1 = Open loop due to driving conditions (e.g. power enrichment, deceleration enleanment)	OL-Drive		
3		1 = Open loop - due to detected system fault	OL-Fault		
4		1 = Closed loop, but fault with at least one oxygen sensor - may be using single oxygen sensor for fuel control	CL-Fault		
5-7		reserved (bits shall be reported as '0')	---		

IF PSN\_LS = 11H or 33H  
THEN

Data Byte	Application data to use	Formating conversion used
data A	STATE_LS_SAE [1]	no
data B	STATE_LS_SAE [2]	no

ELSE

Data Byte	Application data to use	Formating conversion used
data A	None	no
data B	None	no

ENDIF

#### I.44.4 Description of PID 04h - Calculated load value

##### PID \$04 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
04	Calculated LOAD Value!	A	0 %	100 %	100/255 %	LOAD_PCT: xxx.x %
	<p>The OBD regulations previously defined CLV as:            (current airflow / peak airflow @ sea level) * (BARO @ sea level / BARO) * 100%            Various manufacturers have implemented this calculation in a variety of ways. The following definition, although a little more restrictive, will standardise and improve the accuracy the calculation.  <math>LOAD\_PCT = [current\ airflow] / [(peak\ airflow\ at\ WOT@STP\ as\ a\ function\ of\ rpm) * (BARO/29.92) * SQRT(298/(AAT+273))]</math>            Where: STP = Standard Temperature and Pressure = 25 °C, 29.92 in Hg BARO, SQRT = square root,            WOT = wide open throttle, AAT=Ambient Air Temperature and is in °C            Characteristics of LOAD_PCT are:            Reaches 1.0 at WOT at any altitude, temperature or rpm for both naturally aspirated and boosted engines.            Indicates percent of peak available torque.            Linearly correlated with engine vacuum            Often used to schedule power enrichment.            Compression ignition engines (diesels) shall support this PID using fuel flow in place of airflow for the above calculations.            NOTE Both spark ignition and compression ignition engines shall support PID \$04. See PID \$43 for an additional definition of engine LOAD.</p>					

Figure I.44.3: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	LOAD_CLC	no

## I.44.5 Description of PID 05h - Engine coolant temperature

### PID \$05 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
05	Engine Coolant Temperature	A	-40 °C	+215 °C	1 °C with -40 °C offset	ECT: xxx °C (xxx °F)
	ECT shall display engine coolant temperature derived from an engine coolant temperature sensor or a cylinder head temperature sensor. Many diesels do not use either sensor and may substitute Engine Oil Temperature instead.					

Figure I.44.4: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	TCO_MES	Shift to different range

## I.44.6 Description of PID 06h - Short term fuel trim - Bank 1 and Bank 3

### PID \$06 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
06	Short Term Fuel Trim - Bank 1 (use if only 1 fuel trim value)	A	-100 % (lean)	+99.22 % (rich)	100/128 % (0 % at 128)	SHRTFT1: xxx.x % SHRTFT3: xxx.x %
	Short Term Fuel Trim - Bank 3	B				
Short Term Fuel Trim Bank 1/3 shall indicate the correction being utilised by the closed loop fuel algorithm. If the fuel system is in open loop, SHRTFT1/3 shall report 0% correction. NOTE Data B shall only be included in the response message of a PID \$06 if supported by the vehicle. If PID \$1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 3 supported) of PID \$1D if Data B of PID \$06 is supported or not.						

IF PSN\_LS = 11H or 33H

THEN

Data Byte	Application data to use	Formating conversion used
data A	FAC_LAM_LIM_SAE [1]	Shift to different range

ELSE

Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	

ENDIF

## I.44.7 Description of PID 07h - Long term fuel trim - Bank 1 and Bank 3

### PID \$07 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
07	Long Term Fuel Trim - Bank 1 (use if only 1 fuel trim value)	A	-100 % (lean)	+99.22 % (rich)	100/128 % (0 % at 128)	LONGFT1: xxx.x % LONGFT3: xxx.x %
	Long Term Fuel Trim - Bank 3	B				
Fuel trim correction for Bank 1/3 stored in Non-volatile RAM or Keep-alive RAM. LONGFT shall indicate the correction being utilised by the fuel control algorithm at the time the data is requested, in both open loop and closed loop fuel control. If no correction is utilised in open loop fuel, LONGFT shall report 0% correction. If long-term fuel trim is not utilised at all by the fuel control algorithm, the PID shall not be supported. NOTE Data B shall only be included in the response message of a PID \$07 if supported by the vehicle. If PID \$1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 3 supported) of PID \$1D if Data B of PID \$07 is supported or not.						

IF PSN\_LS = 33H

THEN

Data Byte	Application data to use	Formating conversion used
data A	FAC_LAM_AD_SAE [1]	-

ELSE

Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	

ENDIF

### I.44.8 Description of PID 08h - Short term fuel trim - Bank 2 and Bank 4

#### PID \$08 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
08	Short Term Fuel Trim - Bank 2 (use if only 1 fuel trim value) Short Term Fuel Trim - Bank 4	A B	-100 % (lean)	+99.22 % (rich)	100/128 % (0 % at 128)	SHRTFT2: xxx.x % SHRTFT4: xxx.x %
<p>Short Term Fuel Trim Bank 2/4 shall indicate the correction being utilized by the closed loop fuel algorithm. If the fuel system is in open loop, SHRTFT24 shall report 0% correction.</p> <p>NOTE Data B shall only be included in the response message of a PID \$08 if supported by the vehicle. If PID \$1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 4 supported) of PID \$1D if Data B of PID \$08 is supported or not.</p>						

IF PSN\_LS = 11H or 33H  
THEN

Data Byte	Application data to use	Formating conversion used
data A	FAC_LAM_LIM_SAE [2]	Shift to different range

ELSE

Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	


ENDIF

### I.44.9 Description of PID 09h - Long term fuel trim - Bank 2 and Bank 4

#### PID \$09 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
09	Long Term Fuel Trim - Bank 2 (use if only 1 fuel trim value) Long Term Fuel Trim - Bank 4	A B	-100 % (lean)	+99.22 % (rich)	100/128 % (0 % at 128)	LONGFT2: xxx.x % LONGFT4: xxx.x %
<p>Fuel trim correction for Bank 2/4 stored in Non-volatile RAM or Keep-alive RAM. LONGFT shall indicate the correction being utilised by the fuel control algorithm at the time the data is requested, in both open loop and closed loop fuel control. If no correction is utilised in open loop fuel, LONGFT shall report 0% correction. If long-term fuel trim is not utilised at all by the fuel control algorithm, the PID shall not be supported.</p> <p>NOTE Data B shall only be included in the response message of a PID \$09 if supported by the vehicle. If PID \$1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 4 supported) of PID \$1D if Data B of PID \$09 is supported or not.</p>						

IF PSN\_LS = 33H  
THEN

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Data Byte	Application data to use	Formating conversion used
data A	FAC_LAM_AD_SAE [2]	-

ELSE

Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	

ENDIF

### I.44.10 Description of PID 0Ah - Fuel pressure (gauge)

#### PID \$0A definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
0A	Fuel Rail Pressure (gauge)	A	0 kPa (gauge)	765 kPa (gauge)	3 kPa per bit (gauge)	FRP: xxx kPa (xx.x psi)
	FRP shall display fuel rail pressure at the engine when the reading is referenced to atmosphere (gauge pressure).					

Figure I.44.5: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	FUP	Shift to different range

### I.44.11 Description of PID 0Bh - Intake manifold absolute pressure

#### PID \$0B definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
0B	Intake Manifold Absolute Pressure	A	0 kPa (absolute)	255 kPa (absolute)	1 kPa per bit (absolute)	MAP: xxx kPa (xx.x inHg)
	MAP shall display manifold pressure derived from a Manifold Absolute Pressure sensor, if a sensor is utilised. If a vehicle uses both a MAP and MAF sensor, both the MAP and MAF PIDs shall be supported.					

Figure I.44.6: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MAP_SAE	None

### I.44.12 Description of PID 0Ch - Engine speed

#### PID \$0C definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
0C	Engine RPM	A , B	0 min <sup>-1</sup>	16383.75 min <sup>-1</sup>	¼ rpm per bit	RPM: xxxxx min <sup>-1</sup>

Figure I.44.7: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB ( N )	Shift to different range
data B	LSB ( N )	Shift to different range

### I.44.13 Description of PID 0Dh - Vehicle speed

#### PID \$0D definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
0D	Vehicle Speed Sensor	A	0 km/h	255 km/h	1 km/h per bit	VSS: xxx km/h (xxx mph)
VSS shall display vehicle road speed, if utilised by the control module strategy. Vehicle speed may be derived from a vehicle speed sensor, calculated by the PCM using other speed sensors, or obtained from the vehicle serial data communication bus.						

Figure I.44.8: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	VS	no

### I.44.14 Description of PID 0Eh - Ignition timing advance

#### PID \$0E definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
0E	Ignition Timing Advance for #1 Cylinder	A	-64 °	63.5 °	½ ° with 0 ° at 128	SPARKADV: xx °
Ignition timing spark advance for #1 cylinder (not including mechanical advance)						

Figure I.44.9: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	IGA_IGC[0]	Shift to different range

### I.44.15 Description of PID 0Fh - Intake air temperature

#### PID \$0B definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
0F	Intake Air Temperature	A	-40 °C	+215 °C	1 °C with -40 °C offset	IAT: xxx °C (xxx °F)
IAT shall display intake manifold air temperature, if utilised by the control module strategy. IAT may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.						

Figure I.44.10: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	TIA_MES	Shift to different range

## I.44.16 Description of PID 10h - Air flow rate from MAF

### PID \$0B definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
10	Air Flow Rate from Mass Air Flow Sensor	A , B	0 g/s	655.35 g/s	0.01 g/s	MAF: xxx.xx g/s (xxxx.x lb/min)
MAF shall display the airflow rate as measured by the MAF sensor, if a sensor is utilised.						

Figure I.44.11: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB (MAF_KGH_MES )	Kg/h into g/s
data B	LSB (MAF_KGH_MES )	Kg/h into g/s

## I.44.17 Description of PID 11h - Absolute throttle position sensor

### PID \$0A - \$11 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
11	Absolute Throttle Position	A	0 %	100 %	100/255 %	TP: xxx.x %
<p>Absolute throttle position (not "relative" or "learned" throttle position) shall be displayed as a normalised value, scaled from 0 to 100%. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed throttle position is a 1.0 volts, TP shall display <math>(1.0 / 5.0) = 20\%</math> at closed throttle and 50% at 2.5 volts. Throttle position at idle will usually indicate greater than 0%, and throttle position at wide open throttle will usually indicate less than 100%.</p> <p>For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage.</p> <p>NOTE See PID \$- for a definition of Relative Throttle Position.</p>						

Figure I.44.12: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	OBD_TPS_1	no

### I.44.18 Description of PID 12h - Commanded secondary air status

With autolearning the value for the LV\_VAR\_SAP is defined to the value defined by the project

IF PID \$12 supported and LV\_VAR\_SAP <> 0

THEN

PID \$12 definition

PID (hex)	Description	Data byte	Scaling/bit	External test equipment SI (Metric) / English display
12	Commanded Secondary Air Status	A (bit)	byte 1 of 1	AIR_STAT:
	(if supported, one, and only one bit at a time can be set to a 1)	0	1 = upstream of first catalytic converter	AIR_STAT: UPS
		1	1 = downstream of first catalytic converter inlet	AIR_STAT: DNS
		2	1 = atmosphere / off	AIR_STAT: OFF
		3-7	reserved (bits shall be reported as '0')	---

Figure I.44.13: Data Byte

Data Byte	Calibration data to use	Formating conversion used
data A	STATE_OBD_SA	-


ENDIF

### I.44.19 Description of PID 13h - Location of oxygen sensors

PID \$13 definition

PID (hex)	Description	Data byte	Scaling/bit	External test equipment SI (Metric) / English display
13	Location of Oxygen Sensors	A (bit)	byte 1 of 4	O2SLOC:
	(where sensor 1 is closest to the engine. Each bit indicates the presence or absence of an oxygen sensor at the following location)	0	1 = Bank 1 - Sensor 1 present at that location	O2S11
		1	1 = Bank 1 - Sensor 2 present at that location	O2S12
		2	1 = Bank 1 - Sensor 3 present at that location	O2S13
		3	1 = Bank 1 - Sensor 4 present at that location	O2S14
		4	1 = Bank 2 - Sensor 1 present at that location	O2S21
		5	1 = Bank 2 - Sensor 2 present at that location	O2S22
		6	1 = Bank 2 - Sensor 3 present at that location	O2S23
		7	1 = Bank 2 - Sensor 4 present at that location	O2S24

With autolearning the value for the PSN\_LS is defined like this:

Released by Tetenborn Frank		Date 2013-02-13	File 17101G02.001
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7908 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

```

IF      PID 13h is supported
THEN    PSN_LS is defined to the value defined by the project
ELSE    PSN_LS is defined to 0
ENDIF

```

Data Byte	Calibration data to use	Formating conversion used
data A	PSN_LS	no

#### I.44.20 Description of PID 14h - Bank 1 Sensor 1 (not supported)

#### I.44.21 Description of PID 15h - Bank 1 Sensor 2

PID \$15 definition if PID \$13 is supported!

PID (hex)	Description Use if PID \$13 or PID \$1D are supported!	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
15	Oxygen Sensor Output Voltage Bank 1 - Sensor 2	A	0 V	1.275 V	0.005 V	O2Sxy: x.xxx V
	Short Term Fuel Trim (B1-S2) (associated with this sensor \$FF if this sensor is not used in the calculation)	B	-100.00 % (lean)	99.22 % (rich)	100/128 % (0 % at 128)	SHRTFTxy: xxx.x %
These PIDs shall be used for a conventional, 0 to 1 Volt oxygen sensor. Any sensor with a different full scale value shall be normalised to provide nominal full scale at \$C8 (200 decimal). Wide-range/linear oxygen sensors shall use PID \$25 or PID \$35.						

```

IF      PSN_LS = 33H
THEN

```

Data Byte	Application data to use	Formating conversion used
data A	VLS_DOWN[1]	-
data B	0xFF	

ELSE

Data Byte	Application data to use	Formating conversion used
data A	NONE	-
data B	NONE	

ENDIF

#### I.44.22 Description of PID 16h - Bank 1 Sensor 3 or Bank 2 Sensor 1 (not supported)

#### I.44.23 Description of PID 17h - Bank 1 Sensor 4 or Bank 2 Sensor 2 (not supported)

### I.44.24 Description of PID 18h - Bank 2 Sensor 1 or Bank 3 Sensor 1 (not supported)

### I.44.25 Description of PID 19h - Bank 2 Sensor 2 or Bank 3 Sensor 2

PID \$19 definition if PID \$13 is supported!

PID (hex)	Description Use if PID \$13 is supported!	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
19	Oxygen Sensor Output Voltage Bank 2 - Sensor 2	A	0 V	1.275 V	0.005 V	O2Sxy: x.xxx V
	Short Term Fuel Trim (B2-S2) (associated with this sensor \$FF if this sensor is not used in the calculation)	B	-100.00 % (lean)	99.22 % (rich)	100/128 % (0 % at 128)	SHRTFTxy: xxx.x %
These PIDs shall be used for a conventional, 0 to 1 Volt oxygen sensor. Any sensor with a different full scale value shall be normalised to provide nominal full scale at \$C8 (200 decimal). Wide-range/linear oxygen sensors shall use PID \$29 or PID \$39.						

IF PSN\_LS = 33H  
THEN

Data Byte	Application data to use	Formatting conversion used
Data A	VLS_DOWN[2]	-
Data B	0xFF	

ELSE

Data Byte	Application data to use	Formatting conversion used
Data A	NONE	-
Data B	NONE	

ENDIF

### I.44.26 Description of PID 1Ah - Bank 2 Sensor 3 or Bank 4 Sensor 1 (not supported)

### I.44.27 Description of PID 1Bh - Bank 2 Sensor 4 or Bank 4 Sensor 2 (not supported)

### I.44.28 Description of PID 1Ch - OBD requirements

PID \$1C definition

PID (hex)	Description	Data byte	Scaling	External test equipment SI (Metric) / English display
1C	OBD requirements to which vehicle is designed	A (hex)	byte 1 of 1 (State Encoded Variable)	OBDSUP:
		01	OBD II (California ARB)	OBD II
		02	OBD (Federal EPA)	OBD
		03	OBD and OBD II	OBD and OBD II
		04	OBD I	OBD I
		05	Not OBD compliant	NO OBD
		06	EOBD	EOBD
		07	EOBD and OBD II	EOBD and OBD II
		08	EOBD and OBD	EOBD and OBD
		09	EOBD, OBD and OBD II	EOBD, OBD and OBD II
0A - FF	reserved by document	---		

Figure I.44.14: Data Byte

Data Byte	Calibration data to use	Formating conversion used
data A	C_OBD_REQ	-

### I.44.29 Description of PID 1Dh - Location of oxygen sensors (not supported)

### I.44.30 Description of PID 1Eh - Auxiliary input status (not supported)

### I.44.31 Description of PID 1Fh - Time Since Engine Start

#### PID \$1F definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
1F	Time Since Engine Start	A , B	0 sec.	65,535 sec.	1 second per count	RUNTM: xxxxx sec.
	RUNTM shall increment while the engine is running. It shall freeze if the engine stalls. RUNTM shall be reset to zero during every control module power-up and when entering the key-on, engine off position. RUNTM is limited to 65,535 seconds and shall not wrap around to zero.					

Figure I.44.15: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB (T_AST_SAE)	-
data B	LSB (T_AST_SAE)	-

### I.44.32 Description of PID 20h - Supported PIDs 21h - 40h

0 : the PID is not used  
1 : the PID is used

#### DATA A - Supported PIDs 21h - 28h

PID 20h - DATA A - Supported PID 21h to 28h		
BIT	Function	Name
0	PID 28h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	MOD_1_PID_5_DIAG
1	PID 27h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	
2	PID 26h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	
3	PID 25h : Bank 1 Sensor 2 (Wide range O2S)	
4	PID 24h : Bank 1 Sensor 1 (Wide range O2S)	
5	PID 23h : Diesel fuel pressure (gauge)	
6	PID 22h : Relative fuel pressure	
7	PID 21h : Distance travelled while MIL is activated	

#### DATA B - Supported PIDs 29h to 30h

PID 20h - DATA B - Supported PID 29h to 30h		
BIT	Function	Name
0	PID 30h : Number of warm-ups since diagnostic trouble codes cleared	MOD_1_PID_6_DIAG
1	PID 2Fh : Fuel Level Input	
2	PID 2Eh : Commanded Evaporative Purge	
3	PID 2Dh : EGR Error	
4	PID 2Ch : Command EGR	
5	PID 2Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	
6	PID 2Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	
7	PID 29h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	

#### DATA C - Supported PIDs 31h to 38h

PID 20h - DATA C - Supported PID 31h to 38h		
BIT	Function	Name
0	PID 38h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	MOD_1_PID_7_DIAG
1	PID 37h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	
2	PID 36h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	
3	PID 35h : Bank 1 Sensor 2 (Wide range O2S)	
4	PID 34h : Bank 1 Sensor 1 (Wide range O2S)	
5	PID 33h : Barometric Pressure	
6	PID 32h : Evap System Vapor Pressure	
7	PID 31h : Distance since diagnostic trouble codes cleared	

#### DATA D - Supported PIDs 39h to 40h

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PID 20h - DATA D - Supported PID 39h to 40h		
BIT	Function	Name
0	PID 40h : PIDs supported (\$41 - \$60)	MOD_1_PID_8_DIAG
1	PID 3Fh : Catalyst Temperature Bank 2, Sensor 2	
2	PID 3Eh : Catalyst Temperature Bank 1, Sensor 2	
3	PID 3Dh : Catalyst Temperature Bank 2, Sensor 1	
4	PID 3Ch : Catalyst Temperature Bank 1, Sensor 1	
5	PID 3Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	
6	PID 3Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	
7	PID 39h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	

### I.44.33 Description of PID 21h - Distance travelled while MIL is activated

#### PID \$21 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
21	<b>Distance Travelled While MIL is Activated</b> <ul style="list-style-type: none"> <li>Conditions for "Distance travelled" counter:           <ul style="list-style-type: none"> <li>reset to \$0000 when MIL state changes from deactivated to activated by this ECU</li> <li>accumulate counts in km if MIL is activated (ON)</li> <li>do not change value while MIL is not activated (OFF)</li> <li>reset to \$0000 if diagnostic information is cleared either by service \$04 or 40 warm-up cycles without MIL activated</li> <li>do not wrap to \$0000 if value is \$FFFF</li> </ul> </li> </ul>	A , B	0 km	65535 km	1 km per count	MIL_DIST: xxxxx km (xxxxx miles)

Figure I.44.16: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB ( DIST_ACT_MIL )	-
data B	LSB ( DIST_ACT_MIL )	

### I.44.34 Description of PID 22h - Fuel Rail Pressure relative to manifold vacuum (not supported)

### I.44.35 Description of PID 23h - Fuel Rail Pressure

IF NC\_INF\_CONF <> 0 (only supported for MSD)  
THEN

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
23	Fuel rail pressure	A , B	0 kPa	655350 kPa	10 kPa per bit unsigned, 1 kPa = 0.1-0377 PSI	FRP: xxxxxx kPa (xxxxx.x PSI)
	FRP shall display fuel rail pressure at the engine when the reading is referenced to atmosphere (gauge pressure)					

Figure I.44.17: Data Byte

Data Byte	Application data to use	Formatting conversion used
data A	MSB (FUP_RNG_H_MES)	Shift to different range
data B	LSB (FUP_RNG_H_MES)	Shift to different range

ENDIF

### I.44.36 Description of PID 24h - Bank 1 Sensor 1 (Wide range)

PID \$24 definition

PID (hex)	Description Use if PID \$13 or PID \$1D is supported!	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
24	Equivalence Ratio (lambda) (B1-S1) Bank 1 - Sensor 1 (wide range O2S)	A , B	0	1.999	0.0000305	EQ_RATxy: x.xxx
	Oxygen Sensor Voltage (B1-S1)	C , D	0 V	7.999 V	0.000122 V	O2Sxy: x.xxx V
	PID \$24 shall be used for linear or wide-ratio Oxygen Sensors when equivalence ratio and voltage are displayed					

IF PSN\_LS = 11H or 33H  
THEN

Data Byte	Application data to use	Formating conversion used
data A	MSB (LAMB_LS_UP[1])	Shift to different range
data B	LSB (LAMB_LS_UP[1])	=
data C	MSB (VLS_COR_LSL[1])	=
data D	LSB (VLS_COR_LSL[1])	=

ELSE

Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	=
data C	NONE	=
data D	NONE	=

ENDIF

**I.44.37 Description of PID 25h - Bank 1 Sensor 2 (Wide range) (not supported)****I.44.38 Description of PID 26h - Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range) (not supported)****I.44.39 Description of PID 27h - Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range) (not supported)****I.44.40 Description of PID 28h - Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range)**

PID \$28 definition if PID \$13 is supported

PID (hex)	Description Use if PID \$13 is supported!	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
28	Equivalence Ratio (lambda) Bank 2 - Sensor 1 (wide range O2S)	A , B	0	1.999	0.0000305	EQ_RATxy: x.xxx
	Oxygen Sensor Voltage (B2-S1)	C , D	0 V	7.999 V	0.000122 V	O2Sxy: x.xxx V
	PIDs \$28 shall be used for linear or wide-ratio Oxygen Sensors when equivalence ratio and voltage are displayed					

**IF** PSN\_LS = 11H or 33H  
**THEN**

Data Byte	Application data to use	Formating conversion used
data A	MSB (LAMB_LS_UP[2])	Shift to different range
data B	LSB (LAMB_LS_UP[2])	=
data C	MSB (VLS_COR_LSL[2])	=
data D	LSB (VLS_COR_LSL[2])	=

**ELSE**

Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	=
data C	NONE	=
data D	NONE	=

**ENDIF****I.44.41 Description of PID 29h - Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range) (not supported)****I.44.42 Description of PID 2Ah - Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range) (not supported)**

### I.44.43 Description of PID 2Bh - Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range) (not supported)

### I.44.44 Description of PID 2C - Commanded EGR

IF NC\_INF\_CONF <> 0 (only supported for MSD)  
THEN

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
2C	Commanded EGR	A	0% (no flow)	100% (max. flow)	100/255 %	EGR_PCT: xxx.x%
<p>Commanded EGR displayed as a percent. EGR_PCT shall be normalised to the maximum EGR commanded output control parameter. EGR systems use a variety of methods to control the amount of EGR delivered to the engine.</p> <p>1) If an on/off solenoid is used - EGR_PCT shall display 0% when the EGR is commanded off, 100% when the EGR system is commanded on.</p> <p>2) If a vacuum solenoid is duty cycled, the EGR duty cycle from 0 to 100% shall be displayed.</p> <p>3) If a linear or stepper motor valve is used, the fully closed position shall be displayed as 0%, the fully open position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open position. For example, a stepper-motor EGR valve that moves from 0 to 128 counts shall display 0% at 0 counts, 100% at 128 counts and 50% at 64 counts.</p> <p>4) Any other actuation method shall be normalised to display 0% when no EGR is commanded and 100% at the maximum commanded EGR position.</p>						

Figure I.44.18: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	OPG_SP_ACR	-

ENDIF

### I.44.45 Description of PID 2D definition - EGR Error

IF NC\_INF\_CONF <> 0 (only supported for MSD)  
THEN

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PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
2D	EGR Error = (EGR actual - EGR commanded) / EGR commanded * 100%	A	-100 % (less than commanded)	+99.22 % (more than commanded)	100/128 % (0 % at 128)	EGR_ERR: xxx.x%
	<p>EGR error, as a percent of commanded EGR. Often, EGR valve control outputs are not in the same engineering units as the EGR feedback input sensors. For example, an EGR valve can be controlled using a duty-cycled vacuum solenoid, however, the feedback input sensor is a position sensor. This makes it impossible to display "actual" versus "commanded" in the same engineering units. EGR error solved this problem by displaying a normalised (non-dimensional) EGR system feedback parameter. EGR error is defined to be:</p> <p>(actual EGR - commanded EGR) / commanded EGR.</p> <p>For example if 10% EGR is commanded and 5% is delivered to the engine, the EGR_ERR is (5% - 10%) / 10 = -50% error.</p> <p>EGR_ERR may be computed using various control parameters such as position, steps, counts, etc. All EGR systems must react to quickly changing conditions in the engine; therefore, EGR_ERR will generally show errors during transient conditions. Under steady condition, the error will be minimized (no necessarily zero, however) if the EGR system is under control.</p> <p>If the control system does not use closed loop control, EGR_ERR shall not be supported.</p>					

Figure I.44.19: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	OBD_EGR_DIF	-

## ENDIF

### I.44.46 Description of PID 2Eh - Commanded Evaporative Purge

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
2E	Commanded Evaporative Purge	A	0% no flow	100% max. flow	100/255 %	EVAP_PCT: xxx.x %
	<p>Commanded evaporative purge control valve displayed as a percent. EVAP_PCT shall be normalised to the maximum EVAP purge commanded output control parameter.</p> <ol style="list-style-type: none"> <li>1) If an on/off solenoid is used - EVAP_PCT shall display 0% when purge is commanded off, 100% when purge is commanded on.</li> <li>2) If a vacuum solenoid is duty cycled, the EVAP purge valve duty cycle from 0 to 100% shall be displayed.</li> <li>3) If a linear or stepper motor valve is used, the fully closed position shall be displayed as 0%, the fully open position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open position. For example, a stepper-motor EVAP purge valve that moves from 0 to 128 counts shall display 0% at 0 counts, 100% at 128 counts and 50% at 64 counts.</li> <li>4) Any other actuation method shall be normalised to display 0% when no purge is commanded and 100% at the maximum commanded purge position/flow.</li> </ol>					

Figure I.44.20: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	CPPWM_CPS	-

### I.44.47 Description of PID 2Fh - Fuel Level Input

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
2F	Fuel Level Input	A	0% no fuel	100% max. fuel capacity	100/255 %	FLI: xxx.x %
<p>FLI shall indicate nominal fuel tank liquid fill capacity as a percent of maximum, if utilised by the control module for OBD monitoring. FLI may be obtained directly from a sensor, may be obtained indirectly via the vehicle serial data communication bus, or may be inferred by the control strategy using other sensor inputs. Vehicles that use gaseous fuels shall display the percent of useable fuel capacity.</p>						

Figure I.44.21: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	OBD_FTL	no

### I.44.48 Description of PID 30h - Number of warm-ups since diagnostic trouble codes cleared

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
30	Number of warm-ups since diagnostic trouble codes cleared	A	0	255	1 warm-up per count	WARM_UPS: xxx
<p>Number of OBD warm-up cycles since all DTCs were cleared (via an external test equipment or possibly, a battery disconnect). A warm-up is defined in the OBD regulations to be sufficient vehicle operation such that coolant temperature rises by at least 22 °C (40 °F) from engine starting and reaches a minimum temperature of 70 °C (160 deg °F) (60 °C (140 °F) for diesels). This PID is not associated with any particular DTC. It is simply an indication for I/M, of the last time an external test equipment was used to clear DTCs. If greater than 255 warm ups have occurred, WARM_UPS shall remain at 255 and not wrap to zero.</p>						

Figure I.44.22: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	CTR_WUP_DTC_CLR	-

### I.44.49 Description of PID 31h - Distance since diagnostic trouble codes cleared

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
31	Distance since diagnostic trouble codes cleared (same scaling as PID \$21)	A, B	0 km	65,535 km	1 km per count	CLR_DIST: xxxxx km (xxxxx miles)
	Distance accumulated since DTCs were cleared (via an external test equipment or possibly, a battery disconnect). This PID is not associated with any particular DTC. It is simply an indication for I/M (Inspection/Maintenance), of the last time an external test equipment was used to clear DTCs. If greater than 65,535 km have occurred, CLR_DIST shall remain at 65,535 km and not wrap to zero.					

Figure I.44.23: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB(DIST_DTC_CLR)	
data B	LSB(DIST_DTC_CLR)	

### I.44.50 Description of PID 32h - Evap System Vapor Pressure (not supported)

### I.44.51 Description of PID 33h - Barometric Pressure

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
33	Barometric Pressure	A	0 kPa (absolute)	255 kPa (absolute)	1 kPa per bit (absolute)	BARO: xxx kPa (xx.x inHg)
	Barometric pressure utilised by the control module. BARO is normally obtained from a dedicated BARO sensor, from a MAP sensor at key-on and during certain modes of driving, or inferred from a MAF sensor and other inputs during certain modes of driving. The control module shall report BARO from whatever source it is derived from. NOTE Some weather services report local BARO values adjusted to sea level. In these cases, the reported value may not match the displayed value on the external test equipment. NOTE If BARO is inferred while driving and stored in non-volatile RAM or Keep-alive RAM, BARO may not be accurate after a battery disconnect or total memory clear.					

Figure I.44.24: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	AMP_MES	Shift to different range

### I.44.52 Description of PID 34h - Bank 1 Sensor 1 (Wide range)

#### PID \$34 definition

PID (hex)	Description Use if PID \$13 or PID \$1D is supported!	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
34	Equivalence Ratio (lambda) Bank 1 - Sensor 1 (wide range O2S)	A , B	0	1.999	0.0000305	EQ_RATxy: x.xxx
	Oxygen Sensor Current (B1-S1)	C , D	-128 mA	127.996 mA	0.00390625 mA (\$8000 = 0 mA)	O2Sxy: x.xxx mA
	PID \$34 shall be used for linear or wide-ratio Oxygen Sensors when equivalence ratio and current are displayed					

**IF** PSN\_LS = 11H or 33H

**THEN**

Data Byte	Application data to use	Formating conversion used
data A	LAMB_LS_UP[1]	-
data B	LAMB_LS_UP[1]	
data C	IPLSL_COR[1]	-
data D	IPLSL_COR[1]	

**ELSE**

Data Byte	Application data to use	Formating conversion used
data A	NONE	-
data B	NONE	
data C	NONE	-
data D	NONE	

**ENDIF**

#### I.44.53 Description of PID 35h - Bank 1 Sensor 2 (Wide range) (not supported)

#### I.44.54 Description of PID 36h - Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range) (not supported)

#### I.44.55 Description of PID 37h - Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range) (not supported)

#### I.44.56 Description of PID 38h - Bank 2 Sensor 1 (Wide range)

**PID \$38 definition if PID \$13 is supported**



PID (hex)	Description Use if PID \$13 is supported!	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
38	Equivalence Ratio (lambda) Bank 2 - Sensor 1 (wide range O2S)	A , B	0	1.999	0.0000305	EQ_RATxy: x.xxx
	Oxygen Sensor Current (B2-S1)	C , D	-128 mA	127.996 mA	0.00390625 mA (\$8000 = 0 mA)	O2Sxy: x.xxx mA
PIDs \$38 shall be used for linear or wide-ratio Oxygen Sensors when equivalence ratio and current are displayed						

**IF** PSN\_LS = 11H or 33H

**THEN**

Data Byte	Application data to use	Formating conversion used
data A	LAMB_LS_UP[2]	-
data B	LAMB_LS_UP[2]	
data C	IPLSL_COR[2]	-
data D	IPLSL_COR[2]	

**ELSE**

Data Byte	Application data to use	Formating conversion used
data A	NONE	-
data B	NONE	
data C	NONE	-
data D	NONE	

**ENDIF**

#### I.44.57 Description of PID 39h - Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range) (not supported)

#### I.44.58 Description of PID 3Ah - Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range) (not supported)

#### I.44.59 Description of PID 3Bh - Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range) (not supported)

### I.44.60 Description of PID 3C - Catalyst Temperature Bank 1, Sensor 1

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
3C	Catalyst Temperature Bank 1, Sensor 1	A , B	-40 °C	+6513.5 °C	0.1 °C / bit with -40 °C offset	CATEMP11: xxxx.x °C (xxxx.x °F)
CATEMP11 shall display catalyst substrate temperature for a bank 1 catalyst, if utilised by the control module strategy for OBD monitoring, or the Bank 1, Sensor 1 catalyst temperature sensor. CATEMP11 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.						

Figure I.44.25: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB( TEG_CAT_UP_MDL[1])	Shift to different range
data B	LSB(TEG_CAT_UP_MDL[1])	=

### I.44.61 Description of PID 3D - Catalyst Temperature Bank 2, Sensor 1

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
3D	Catalyst Temperature Bank 2, Sensor 1	A , B	-40 °C	+6513.5 °C	0.1 °C / bit with -40 °C offset	CATEMP21: xxxx.x °C (xxxx.x °F)
CATEMP21 shall display catalyst substrate temperature for a bank 2 catalyst, if utilised by the control module strategy for OBD monitoring, or the Bank 2, Sensor 1 catalyst temperature sensor. CATEMP21 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.						

Figure I.44.26: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB( TEG_CAT_UP_MDL[2])	Shift to different range
data B	LSB(TEG_CAT_UP_MDL[2])	=

### I.44.62 Description of PID 3E - Catalyst Temperature Bank 1, Sensor 2

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
3E	Catalyst Temperature Bank 1, Sensor 2	A , B	-40 °C	+6513.5 °C	0.1 °C / bit with -40 °C offset	CATEMP12: xxxx.x °C (xxxx.x °F)
CATEMP12 shall display catalyst substrate temperature for an additional bank 1 catalyst, if utilised by the control module strategy for OBD monitoring, or the Bank 1, Sensor 2 catalyst temperature sensor. CATEMP12 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.						

Figure I.44.27: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB( TEG_CAT_DOWN_MDL[1])	Shift to different range
data B	LSB(TEG_CAT_DOWN_MDL[1])	=

### I.44.63 Description of PID 3F Catalyst Temperature Bank 2, Sensor 2

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
3F	Catalyst Temperature Bank 2, Sensor 2	A , B	-40 °C	+6513.5 °C	0.1 °C / bit with -40 °C offset	CATEMP22: xxxx.x °C (xxxx.x °F)
CATEMP22 shall display catalyst substrate temperature for an additional bank 2 catalyst, if utilised by the control module strategy for OBD monitoring, or the Bank 2, Sensor 2 catalyst temperature sensor. CATEMP22 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.						

Figure I.44.28: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB( TEG_CAT_DOWN_MDL[2])	Shift to different range
data B	LSB(TEG_CAT_DOWN_MDL[2])	=

### I.44.64 Description of PID 40h - Supported PIDs 41h - 60h

0 : the PID is not used

1 : the PID is used

#### DATA A - Supported PIDs 41h - 48h

PID 40h - DATA A - Supported PID 41h to 48h		
BIT	Function	Name
0	PID 48h : Absolute Throttle Position C	MOD_1_PID_9_DIAG
1	PID 47h : Absolute Throttle Position B	
2	PID 46h : Ambient air temperature	
3	PID -h : Relative Throttle Position	
4	PID 44h : Command Equivalence Ratio	
5	PID 43h : Absolue Load Value	
6	PID 42h : Control module voltage	
7	PID 41h : Monitor status this driving cycle	

PID 40h - DATA B - Supported PID 49h to 50h		
BIT	Function	Name
0	PID 50h : Reserved	MOD_1_PID_A_DIAG
1	PID 4Fh : Reserved	
2	PID 4Eh : Time since diagnostic trouble codes cleared	
3	PID 4Dh : Minutes run by the engine while MIL activated	
4	PID 4Ch : Commanded Throttle Actuator Control	
5	PID 4Bh : Accelerator Pedal Position F	
6	PID 4Ah : Accelerator Pedal Position E	
7	PID 49h : Accelerator Pedal Position D	

#### DATA C - Supported PIDs 51h to 58h

PID 40h - DATA C - Supported PID 51h to 58h		
BIT	Function	Name
0	PID 58h : Reserved	MOD_1_PID_B_DIAG
1	PID 57h : Reserved	
2	PID 56h : Reserved	
3	PID 55h : Reserved	
4	PID 54h : Reserved	
5	PID 53h : Reserved	
6	PID 52h : Reserved	
7	PID 51h : Reserved	

#### DATA D - Supported PIDs 59h to 60h

PID 40h - DATA D - Supported PID 59h to 60h		
BIT	Function	Name
0	PID 60h : Reserved	MOD_1_PID_C_DIAG
1	PID 5Fh : Reserved	
2	PID 5Eh : Reserved	
3	PID 5Dh : Reserved	
4	PID 5Ch : Reserved	
5	PID 5Bh : Reserved	
6	PID 5Ah : Reserved	
7	PID 59h : Reserved	

### I.44.65 Description of PID 41 - Monitor status this driving cycle

#### PID \$41 definition

PID (hex)	Description	Data Byte	Scaling/bit	External test equipment SI (Metric) / English display
41	Monitor status this driving cycle			
	<p>The bit in this PID shall report two pieces of information for each monitor:</p> <p>1) Monitor enable status for the current driving cycle. This bit shall indicate when a monitor is disabled in a manner such that there is no way for the driver to operate the vehicle for the remainder of the driving cycle and make the monitor run. Typical examples are:            Engine-off soak not long enough (e.g., cold start temperature conditions not satisfied)            Monitor maximum time limit or number of attempts/aborts exceeded            Ambient air temperature too low or too high            BARO too low (high altitude)            The monitor shall not indicate "disabled" for operator-controlled conditions such as rpm, load, throttle position, minimum time limit not exceeded, ECT, TP, etc.</p> <p>2) Monitor completion status for the current driving/monitoring cycle. Status shall be reset to "not complete" upon starting a new monitoring cycle. Note that some monitoring cycles can include various engine-operating conditions; other monitoring cycles begin after the ignition key is turned off. Some status bits on a given vehicle can utilise engine-running monitoring cycles while others can utilise engine-off monitoring cycles. Resetting the bits to "not complete" upon starting the engine will accommodate most engine-running and engine-off monitoring cycles, however, manufacturers are free to define their own monitoring cycles.            NOTE PID \$41 bits shall be utilised for all non-continuous monitors which are supported, and change completion status in PID \$01. If a non-continuous monitor is not supported or always shows "complete", the corresponding PID \$41 bits shall indicate disabled and complete. PID \$41 bits may be utilised at the vehicle manufacturer's discretion for all continuous monitors which are supported with the exception of bit 03 which shall always showed CCM as enabled for spark ignition and compression ignition engines.</p>			

Figure I.44.29: PID \$41 definition (continued)

PID (hex)	Description	Data Byte	Scaling/bit	External test equipment SI (Metric) / English display
41	Monitor status this driving cycle			
		<b>A (bit)</b>	<b>byte 1 of 4</b>	
	Reserved - shall be reported as \$00	0-7		---
	<b>Enable status of continuous monitors this monitoring cycle:</b>	<b>B (bit)</b>	byte 2 of 4 (Low Nibble)	Enable status of continuous monitors this monitoring cycle: NO means disabled for rest of this monitoring cycle or not supported in PID \$01, YES means enabled for this monitoring cycle.
	Misfire monitoring	0	0 = monitor disabled for rest of this monitoring cycle or not supported (NO)	MIS_ENA: NO or YES
	Fuel system monitoring	1	1 = monitor enabled for this monitoring cycle (YES)	FUEL_ENA: NO or YES
	Comprehensive component monitoring	2		CCM_ENA: YES
	reserved (bit shall be reported as '0')	3		

Figure I.44.30: PID \$41 definition (continued)

PID (hex)	Description	Data Byte	Scaling/bit	External test equipment SI (Metric) / English display
41	Monitor status this driving cycle			
	<b>Completion status of continuous monitors this monitoring cycle:</b>	<b>B (bit)</b>	<b>byte 2 of 4 (High Nibble)</b>	<b>Completion status of continuous monitors this monitoring cycle:</b>
	Misfire monitoring C_CLC_READY_OBD_1[0]	4	See PID \$01 to determine which monitors are supported 0 = monitor complete this monitoring cycle, or not supported (YES) 1 = monitor not complete this monitoring cycle (NO)	MIS_CMPL: YES or NO FUELCMPL: YES or NO CCM_CMPL: YES or NO
	Fuel system monitoring C_CLC_READY_OBD_1[1]	5		
	Comprehensive component monitoring C_CLC_READY_OBD_1[2]	6		
	reserved (bit shall be reported as '0') C_CLC_READY_OBD_1[3]	7		

Figure I.44.31: PID \$41 definition (continued)

PID (hex)	Description	Data Byte	Scaling/bit	External test equipment SI (Metric) / English display
41	Monitor status this driving cycle			
	<b>Enable status of non-continuous monitors this monitoring cycle:</b>	<b>C (bit)</b>	<b>byte 3 of 4</b>	<b>Enable status of non-continuous monitors this monitoring cycle:</b>
	Catalyst monitoring	0	0 = monitor disabled for rest of this monitoring cycle (NO) 1 = monitor enabled for this monitoring cycle (YES)	CAT_ENA: YES or NO HCAT_ENA: YES or NO EVAP_ENA: YES or NO AIR_ENA: YES or NO ACRF_ENA: YES or NO O2S_ENA: YES or NO HTR_ENA: YES or NO EGR_ENA: YES or NO
	Heated catalyst monitoring	1		
	Evaporative system monitoring	2		
	Secondary air system monitoring	3		
	A/C system refrigerant monitoring	4		
	Oxygen sensor monitoring	5		
	Oxygen sensor heater monitoring	6		
	EGR system monitoring	7		

Figure I.44.32: PID \$41 definition (continued)

PID (hex)	Description	Data Byte	Scaling/bit	External test equipment SI (Metric) / English display
41	Monitor status this driving cycle			
	<b>Completion status of non-continuous monitors this monitoring cycle:</b>	<b>D (bit)</b>	<b>byte 4 of 4</b>	<b>Completion status of non-continuous monitors this monitoring cycle:</b>
	Catalyst monitoring	0	See PID \$01 to determine which monitors are supported. 0 = monitor complete this monitoring cycle, or not supported (YES) 1 = monitor not complete this monitoring cycle (NO)	CAT_CMPL: YES or NO HCATCMPL: YES or NO EVAPCMPL: YES or NO AIR_CMPL: YES or NO ACRFCMPL: YES or NO O2S_CMPL: YES or NO HTR_CMPL: YES or NO EGR_CMPL: YES or NO
	Heated catalyst monitoring	1		
	Evaporative system monitoring	2		
	Secondary air system monitoring	3		
	A/C system refrigerant monitoring	4		
	Oxygen sensor monitoring	5		
	Oxygen sensor heater monitoring	6		
	EGR system monitoring	7		

Figure I.44.33: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	0x00	
data B	C_CLC_READY_OBD_1[0...3] + STATE_ENA_OBD[0...3]	
data C	STATE_ENA_OBD[8..15]	
data D	STATE_CMPL_OBD[8..15]	

## I.44.66 Description of PID 42 - Control module voltage

### PID \$42 definition


PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
42	Control module voltage	A , B	0 V	65.535 V	0.001 V per bit	VPWR: xx.xxx V
	VPWR - power input to the control module. VPWR is normally battery voltage, less any voltage drop in the circuit between the battery and the control module. NOTE 42-volt vehicles may utilise multiple voltages for different systems on the vehicle. VPWR represents the voltage at the control module; it may be significantly different than battery voltage.					

Figure I.44.34: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB (VB)	Shift to different range
data B	LSB (VB)	

## I.44.67 Description of PID 43 - Absolute Load Value

### PID \$43 definition

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 7927 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
43	Absolute Load Value	A , B	0 %	25700%	100/255 %	LOAD_ABS: xxx.x%
	<p>The absolute load value has some different characteristics than the LOAD_PCT defined in PID 04 This definition, although restrictive, will standardise the calculation. LOAD_ABS is the normalised value of air mass per intake stroke displayed as a percent.</p> $\text{LOAD\_ABS} = [\text{air mass (g/intake stroke)}] / [1.184 \text{ (g/intake stroke)} * \text{cylinder displacement in litres}]$ <p>Derivation:</p> $\text{air mass (g / intake stroke)} = [\text{total engine air mass (g/sec)}] / [\text{rpm (revs/min)} * (1 \text{ min} / 60 \text{ sec}) * (1/2 \# \text{ of cylinders (strokes /rev)}]$ $\text{LOAD\_ABS} = [\text{air mass (g)/intake stroke}] / [\text{maximum air mass (g)/intake stroke at WOT@STP at 100\% volumetric efficiency}] * 100\%$ <p>Where: STP = Standard Temperature and Pressure = 25 °C, 29.92 in Hg (1013 hPa) BARO, WOT = wide open throttle</p> <p>The quantity (maximum air mass (g)/intake stroke at WOT@STP at 100% volumetric efficiency) is a constant for a given cylinder swept volume. The constant is 1.184 (g/litre 3) * cylinder displacement (litre 3/intake stroke) based on air density at STP</p> <p>Characteristics of LOAD_ABS are:</p> <ul style="list-style-type: none"> <li>Ranges from 0 to approximately 0.95 for naturally aspirated engines, 0 - 4 for boosted engines</li> <li>Linearly correlated with engine indicated and brake torque</li> <li>Often used to schedule spark and EGR rates</li> <li>Peak value of LOAD_ABS correlates with volumetric efficiency at WOT.</li> <li>Indicates the pumping efficiency of the engine for diagnostic purposes.</li> <li>Spark ignition engine are required to support PID \$43. Compression ignition (diesel) engines are not required to support this PID.</li> </ul> <p>NOTE See PID \$04 for an additional definition of engine LOAD..</p>					

Figure I.44.35: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB (LOAD_ABSV)	no
data B	LSB (LOAD_ABSV)	no

## I.44.68 Description of PID 44 - Commanded Equivalence Ratio

Table .1 PID \$44 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
44	Commanded Equivalence Ratio	A , B	0	1.999	0.0000305	EQ_RAT: x.xxx
	<p>Fuel systems that utilise conventional oxygen sensor shall display the commanded open loop equivalence ratio while the fuel control system is in open loop. EQ_RAT shall indicate 1.0 while in closed loop fuel.</p> <p>Fuel systems that utilise wide-range/linear oxygen sensors shall display the commanded equivalence ratio in both open loop and closed loop operation.</p> <p>To obtain the actual A/F ratio being commanded, multiply the stoichiometric A/F ratio by the equivalence ratio. For example, for gasoline, stoichiometric is 14.64:1 ratio. If the fuel control system was commanding an 0.95 EQ_RAT, the commanded A/F ratio to the engine would be 14.64 * 0.95 = 13.9 A/F</p>					

Figure I.44.36: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB(LAMB_SP_SAE [1])	Shift to different resolution
data B	LSB(LAMB_SP_SAE [1])	=



## I.44.69 Description of PID - - Relative Throttle Position

### PID \$- definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
-	Relative Throttle Position	A	0 %	100 %	100/255 %	TP_R: xxx.x %
	<p>Relative or "learned" throttle position shall be displayed as a normalised value, scaled from 0 to 100%. TP_R should display a value of 0% at the "learned closed-throttle position. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed throttle position is a 1.0 volts, TP shall display <math>(1.0 - 1.0 / 5.0) = 0\%</math> at closed throttle and 30% at 2.5 volts. Because of the closed-throttle offset, wide open throttle will usually indicate substantially less than 100%.</p> <p>For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage. See PID \$11 for a definition of Absolute Throttle Position.</p>					

Figure I.44.37: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	OBD_TPS_REL	-

## I.44.70 Description of PID 46 - Ambient air temperature

### PID \$46 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
46	Ambient air temperature (same scaling as IAT - \$0F)	A	-40 °C	+215 °C	1 °C with -40 °C offset	AAT: xxx °C / xxx °F
	<p>AAT shall display ambient air temperature, if utilised by the control module strategy for OBD monitoring. AAT may be obtained directly from a sensor, may be obtained indirectly via the vehicle serial data communication bus, or may be inferred by the control strategy using other sensor inputs.</p>					

Figure I.44.38: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	OBD_TAM	-

## I.44.71 Description of PID 47 - Absolute Throttle Position B

### PID \$47 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
47	Absolute Throttle Position B	A	0 %	100 %	100/255 %	TP_B: xxx.x %
	<p>Absolute throttle position B, if utilised by the control module, (not "relative" or "learned" throttle position) shall be displayed as a normalised value, scaled from 0 to 100%. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed throttle position is a 1.0 volts, TP_B shall display <math>(1.0 / 5.0) = 20\%</math> at closed throttle and 50% at 2.5 volts. Throttle position at idle will usually indicate greater than 0%, and throttle position at wide open throttle will usually indicate less than 100%.</p> <p>For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage.</p>					

Figure I.44.39: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	OBD_TPS_2	-

### I.44.72 Description of PID 48 - Absolute Throttle Position C (not supported)

### I.44.73 Description of PID 49 - Accelerator Pedal Position D

#### PID \$49 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
49	Accelerator Pedal Position D	A	0 %	100 %	100/255 %	APP_D: xxx.x %
	<p>Accelerator Pedal Position D, if utilised by the control module, (not "relative" or "learned" pedal position) shall be displayed as a normalised value, scaled from 0 to 100%. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed pedal is 1.0 volt, APP_D shall display <math>(1.0 / 5.0) = 20\%</math> at closed pedal and 50% at 2.5 volts. Pedal position at idle will usually indicate greater than 0%, and pedal position at wide open pedal will usually indicate less than 100%.</p> <p>For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage.</p>					

Figure I.44.40: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	OBD_PV_1	-

### I.44.74 Description of PID 4A - Accelerator Pedal Position E

#### PID \$4A definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
4A	Accelerator Pedal Position E	A	0 %	100 %	100/255 %	APP_E: xxx.x %
	<p>Accelerator Pedal Position E, if utilised by the control module, (not "relative" or "learned" pedal position) shall be displayed as a normalised value, scaled from 0 to 100%. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed pedal is 1.0 volt, APP_E shall display <math>(1.0 / 5.0) = 20\%</math> at closed pedal and 50% at 2.5 volts. Pedal position at idle will usually indicate greater than 0%, and pedal position at wide open pedal will usually indicate less than 100%.</p> <p>For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage.</p>					

Figure I.44.41: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	OBD_PV_2	-

### I.44.75 Description of PID 4B - Accelerator Pedal Position F (not supported)

### I.44.76 Description of PID 4C - Commanded Throttle Actuator Control

#### PID \$4C definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
4C	Commanded Throttle Actuator Control	A	0% (closed throttle)	100% (wide open throttle)	100/255 %	TAC_PCT: xxx.x%
	<p>Commanded TAC displayed as a percent. TAC_PCT shall be normalised to the maximum TAC commanded output control parameter. TAC systems use a variety of methods to control the amount of throttle opening.</p> <ol style="list-style-type: none"> <li>1) If a linear or stepper motor is used, the fully closed throttle position shall be displayed as 0%, the fully open throttle position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open throttle position. For example, a stepper-motor TAC that moves the throttle from 0 to 128 counts shall display 0% at 0 counts, 100% at 128 counts and 50% at 64 counts.</li> <li>2) Any other actuation method shall be normalised to display 0% when the throttle is commanded closed and 100% when the throttle is commanded open.</li> </ol>					

Figure I.44.42: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	OBD_TPS_SP	-

### I.44.77 Description of PID 4D - Minutes run by the engine while MIL activated

#### PID \$4D definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) / English display
4D	Minutes run by the engine while MIL activated	A, B	0 min	65535 min 1092.25 hours	1 min per count	MIL_TIME: xxxx hrs, xx min
	<ul style="list-style-type: none"> <li>Conditions for "Minutes run by the engine while MIL activated" counter: reset to \$0000 when MIL state changes from deactivated to activated by this ECU accumulate counts in minutes if MIL is activated (ON) do not change value while MIL is not activated (OFF) reset to \$0000 if diagnostic information is cleared either by service \$04 or 40 warm-up cycles without MIL activated do not wrap to \$0000 if value is \$FFFF</li> </ul>					

Figure I.44.43: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB (T_ACT_MIL_SAE)	-
data B	LSB (T_ACT_MIL_SAE)	-

## I.44.78 Description of PID 4E - Time since diagnostic trouble codes cleared

### PID \$4E definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
4E	Time since diagnostic trouble codes cleared	A, B	0 min	65535 min 1092.25 hours	1 min per count	CLR_TIME: xxxx hrs, xx min
	Time accumulated since DTCs were cleared (via an external test equipment or possibly, a battery disconnect). This PID is not associated with any particular DTC. It is simply an indication for I/M (Inspection/Maintenance), of the last time an external test equipment was used to clear DTCs. If greater than 65,535 min have occurred, CLR_TIME shall remain at 65,535 min and not wrap to zero.					

Figure I.44.44: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB (T_DTC_CLR)	-
data B	LSB (T_DTC_CLR)	-

## I.44.79 Description of PID 4F up to FFh - Reserved

### PID \$4F - \$FF definition

PID (hex)	Description	Data Byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
4F - FF	Reserved by document	---	---	---	---	---

## I.45 PID description for mode 02h

### Input data:

MOD_2_PID_1_DIAG {p. 7831}	MOD_2_PID_2_DIAG {p. 7831}	MOD_2_PID_3_DIAG {p. 7831}	MOD_2_PID_4_DIAG {p. 7831}
MOD_2_PID_5_DIAG {p. 7831}	MOD_2_PID_6_DIAG {p. 7831}	MOD_2_PID_7_DIAG {p. 7831}	MOD_2_PID_8_DIAG {p. 7831}
MOD_2_PID_9_DIAG {p. 7832}	MOD_2_PID_A_DIAG {p. 7832}	MOD_2_PID_B_DIAG {p. 7832}	MOD_2_PID_C_DIAG {p. 7832}
NC_INJ_CONF {p. 626}	PSN_LS {p. 656}		

### General information:

This specification is according with the ISO 15031-5 issue 8.

"IDX" is used instead of the array definition [NC\_NR\_ERR\_DYN].

At PSN\_LS you can see the configuration of the oxygen-sensors:

PSN\_LS:

BIT	Function	Status
0	Bank 1 Sensor 1	1= available, 0 = not available
1	Bank 1 Sensor 2	1= available, 0 = not available
2	Bank 1 Sensor 3	1= available, 0 = not available
3	Bank 1 Sensor 4	1= available, 0 = not available
4	Bank 2 Sensor 1	1= available, 0 = not available
5	Bank 2 Sensor 2	1= available, 0 = not available
6	Bank 2 Sensor 3	1= available, 0 = not available
7	Bank 2 Sensor 4	1= available, 0 = not available

### I.45.1 Description of PID 00h - Supported PIDs 01h - 20h

0 : the PID is not used

1 : the PID is used

DATA A - Supported PIDs 01h to 08h

PID 00h - DATA A - Supported PID 01h to 08h		
BIT	Function	Name
0	PID 08h : Short term fuel trim - Bank 2 and Bank 4	MOD_2_PID_1_DIAG
1	PID 07h : Long term fuel trim - Bank 1 and Bank 3	
2	PID 06h : Short term fuel trim - Bank 1 and Bank 3	
3	PID 05h : Engine coolant temperature	
4	PID 04h : Calculated load value	
5	PID 03h : Fuel system status	
6	PID 02h : Trouble code that caused required freeze frame	
7	PID 01h : Monitor status since DTCs cleared	

DATA B - Supported PIDs 09h to 10h

PID 00h - DATA B - Supported PID 09h to 10h		
BIT	Function	Name
0	PID 10h : Air flow rate from MAF sensor	MOD_2_PID_2_DIAG
1	PID 0Fh : Intake air temperature	
2	PID 0Eh : Ignition time advance	
3	PID 0Dh : Vehicle speed	
4	PID 0Ch : Engine RPM	
5	PID 0Bh : Intake manifold absolute pressure	
6	PID 0Ah : Fuel pressure (gauge)	
7	PID 09h : Long term fuel trim - Bank 2	

## DATA C - Supported PIDs 11h to 18h

PID 00h - DATA C - Supported PID 11h to 18h		
BIT	Function	Name
0	PID 18h : Bank 2 Sensor 1 or Bank 3 Sensor 1	MOD_2_PID_3_DIAG
1	PID 17h : Bank 1 Sensor 4 or Bank 2 Sensor 2	
2	PID 16h : Bank 1 Sensor 3 or Bank 2 Sensor 1	
3	PID 15h : Bank 1 Sensor 2	
4	PID 14h : Bank 1 Sensor 1	
5	PID 13h : Location of Oxygen Sensors	
6	PID 12h : Secondary air status	
7	PID 11h : Absolute throttle position sensor	

## DATA D - Supported PIDs 19h to 20h

PID 00h - DATA D - Supported PID 19h to 20h		
BIT	Function	Name
0	PID 20h : PIDs supported (\$21 - \$40)	MOD_2_PID_4_DIAG
1	PID 1Fh : Time Since Engine Start	
2	PID 1Eh : Auxiliary Input Status	
3	PID 1Dh : Location of oxygen sensors	
4	PID 1Ch : OBD requirements to which vehicle is designed	
5	PID 1Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2	
6	PID 1Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1	
7	PID 19h : Bank 2 Sensor 2 or Bank 3 Sensor 2	

## I.45.1.1 Description of PID 02h - Diagnostic trouble codes

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling	External test equipment SI (Metric) / English display
02	DTC that caused required freeze frame data storage (\$0000 indicates no freeze frame data)	A, B	00 00	FF FF	Hexadecimal e.g. P01AB  (DTCs defined in ISO 15031-6)	DTCFRZF: Pxxxx, Cxxxx, Bxxxx, Uxxxx

**Formula section:****CALL API :**

ACTION\_ERRM\_ReadFrFByDtc ( IN <FRF\_LAW> ,

```

        IN <FIRST>,
        IN <NO_DTC>,
        IN <DTC_LAW>
        INOUT <Frf>
        OUT <ResultFrf>
    )

```

```

IF ResultFrf == NO_FRF_PRESENT
THEN

```

Data Byte	Application data to use	Formating conversion used
data A	0x00	-
data B	0x00	-

```

ELSE

```

Data Byte	Application data to use	Formating conversion used
data A	Frf[0]	-
data B	Frf[1]	-

```

ENDIF

```

#### I.45.1.2 Description of PID 03h - Status of fuel system

```

If      PSN_LS = 11H or 33H           // upstream sensors available
Then    DATA_A = ENVD_OBD_1_IDX      // FRF of STATE_LS_1
        DATA_B = ENVD_OBD_2_IDX      //FRF of STATE_LS_2

Else    PID 03h is not supported

Endif

Else

```

#### I.45.1.3 Description of PID 04h - Calculated load value

```

DATA_A = ENVD_OBD_3_IDX           // FRF of LOAD_CLC

```

#### I.45.1.4 Description of PID 05h - Engine coolant temperature

```

DATA_A = ENVD_OBD_4_IDX           // FRF of TCO_MES

```

#### I.45.1.5 Description of PID 06h - Short term fuel trim - Bank 1 and Bank 3

```

If      PSN_LS = 11H or 33H           // upstream sensors available
Then    PID 06h is supported
        DATA_A = ENVD_OBD_5_IDX      // FRF of OBD_LAM_COR_1
        DATA_B = NONE                //Bank 3 not supported

Else    PID 06h is not supported

Endif

```

#### I.45.1.6 Description of PID 07h - Long term fuel trim - Bank 1 and Bank 3

```

If      PSN_LS = 33H                 // upstream and downstream sensors available
Then    PID 07h is supported
        DATA_A = ENVD_OBD_6_IDX      // FRF of OBD_LAM_AD_1
        DATA_B = NONE                //Bank 3 not supported

Else    PID 07h is not supported

```

**Endif**

**I.45.1.7 Description of PID 08h - Short term fuel trim - Bank 2 and Bank 4**

```

If          PSN_LS = 11H or 33H          // upstream sensors available
Then       PID 08h is supported
              DATA_A = ENVD_OBD_7_IDX    // FRF of OBD_LAM_COR_2
              DATA_B = NONE              // Bank 3 not supported
Else       PID 08h is not supported
Endif
    
```

**I.45.1.8 Description of PID 09h - Long term fuel trim - Bank 2 and Bank 4**

```

If          PSN_LS = 33H                // upstream and downstream sensors available
Then       PID 09h is supported
              DATA_A = ENVD_OBD_8_IDX    // FRF of OBD_LAM_AD_2
              DATA_B = NONE              // Bank 3 not supported
Else       PID 07h is not supported
Endif
    
```

**I.45.1.9 Description of PID 0Ah - Fuel pressure (gage)**

DATA\_A = ENVD\_OBD\_9\_IDX // FRF of OBD\_FUP

**I.45.1.10 Description of PID 0Bh - Intake manifold absolute pressure**

DATA\_A = ENVD\_OBD\_10\_IDX // FRF of MAP\_SAE

**I.45.1.11 Description of PID 0Ch - Engine speed**

DATA\_A = ENVD\_OBD\_11\_IDX // FRF of OBD\_N (high byte)  
 DATA\_B = ENVD\_OBD\_12\_IDX // FRF of OBD\_N (low byte)

**I.45.1.12 Description of PID 0Dh - Vehicle speed**

DATA\_A = ENVD\_OBD\_13\_IDX // FRF of VS

**I.45.1.13 Description of PID 0Eh - Ignition timing advance**

DATA\_A = ENVD\_OBD\_14\_IDX // FRF of OBD\_IGA\_IGC, cylinder 1

**I.45.1.14 Description of PID 0Fh - Intake air temperature**

DATA\_A = ENVD\_OBD\_15\_IDX // FRF of OBD\_TIA

**I.45.1.15 Description of PID 10h - Air flow rate from MAF**

DATA\_A = ENVD\_OBD\_16\_IDX // FRF of OBD\_MAF (high byte)  
 DATA\_B = ENVD\_OBD\_17\_IDX // FRF of OBD\_MAF (low byte)


**I.45.1.16 Description of PID 11h - Absolute throttle position sensor**

DATA\_A = ENVD\_OBD\_18\_IDX // FRF of OBD\_TPS\_1

**I.45.1.17 Description of PID 12h - Commanded secondary air status**

DATA\_A = ENVD\_OBD\_19\_IDX // FRF of STATE\_OBD\_SA

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### I.45.1.18 Description of PID 1Fh - Time Since Engine Start

DATA\_A = ENVD\_OBD\_20\_IDX // FRF of T\_AST\_SAE (high byte)  
 DATA\_B = ENVD\_OBD\_21\_IDX // FRF of T\_AST\_SAE (low byte)

### I.45.2 Description of PID 20h - Supported PIDs 21h - 40h

0 : the PID is not used, 1 : the PID is used

DATA A - Supported PIDs 21h - 28h

PID 20h - DATA A - Supported PID 21h to 28h		
BIT	Function	Name
0	PID 28h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	MOD_2_PID_5_DIAG
1	PID 27h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	
2	PID 26h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	
3	PID 25h : Bank 1 Sensor 2 (Wide range O2S)	
4	PID 24h : Bank 1 Sensor 1 (Wide range O2S)	
5	PID 23h : Diesel fuel pressure (gauge)	
6	PID 22h : Relative fuel pressure	
7	PID 21h : Distance travelled while MIL is activated	

DATA B - Supported PIDs 29h to 30h

PID 20h - DATA B - Supported PID 29h to 30h		
BIT	Function	Name
0	PID 30h : Number of warm-ups since diagnostic trouble codes cleared	MOD_2_PID_6_DIAG
1	PID 2Fh : Fuel Level Input	
2	PID 2Eh : Commanded Evaporative Purge	
3	PID 2Dh : EGR Error	
4	PID 2Ch : Command EGR	
5	PID 2Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	
6	PID 2Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	
7	PID 29h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	

DATA C - Supported PIDs 31h to 38h

PID 20h - DATA C - Supported PID 31h to 38h		
BIT	Function	Name
0	PID 38h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	MOD_2_PID_7_DIAG
1	PID 37h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	
2	PID 36h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	
3	PID 35h : Bank 1 Sensor 2 (Wide range O2S)	
4	PID 34h : Bank 1 Sensor 1 (Wide range O2S)	
5	PID 33h : Barometric Pressure	
6	PID 32h : Evap System Vapor Pressure	
7	PID 31h : Distance since diagnostic trouble codes cleared	

DATA D - Supported PIDs 39h to 40h

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PID 20h - DATA D - Supported PID 39h to 40h		
BIT	Function	Name
0	PID 40h : PIDs supported (\$41 - \$60)	MOD_2_PID_8_DIAG
1	PID 3Fh : Catalyst Temperature Bank 2, Sensor 2	
2	PID 3Eh : Catalyst Temperature Bank 1, Sensor 2	
3	PID 3Dh : Catalyst Temperature Bank 2, Sensor 1	
4	PID 3Ch : Catalyst Temperature Bank 1, Sensor 1	
5	PID 3Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	
6	PID 3Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	
7	PID 39h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	

### I.45.2.1 Description of PID 23h - Fuel pressure

```

If          NC_INJ_CONF <> 0           //only supported for MSD
Then       DATA_A = ENVD_OBD_22_IDX   // FRF of OBD_FUP_RNG_H
              DATA_B = ENVD_OBD_23_IDX   // FRF of OBD_FUP_RNG_H
Endif

```

### I.45.2.2 Description of PID 2Eh - Commanded Evaporative purge

```
DATA_A = ENVD_OBD_24_IDX           // FRF of CPPWM_CPS
```

### I.45.2.3 Description of PID 2Fh - Fuel Level Input

```
DATA_A = ENVD_OBD_25_IDX           // FRF of OBD_FTL
```

### I.45.2.4 Description of PID 33h - Barometric Pressure

```
DATA_A = ENVD_OBD_26_IDX           // FRF of OBD_AMP
```

### I.45.3 Description of PID 40h - Supported PIDs 41h - 60h

0 : the PID is not used  
1 : the PID is used

DATA A - Supported PIDs 41h - 48h

PID 40h - DATA A - Supported PID 41h to 48h		
BIT	Function	Name
0	PID 48h : Absolute Throttle Position C	MOD_2_PID_9_DIAG
1	PID 47h : Absolute Throttle Position B	
2	PID 46h : Ambient air temperature	
3	PID -h : Relative Throttle Position	
4	PID 44h : Command Equivalence Ratio	
5	PID 43h : Absolute Load Value	
6	PID 42h : Control module voltage	
7	PID 41h : Monitor status this driving cycle	

DATA B - Supported PIDs 49h to 50h

PID 40h - DATA B - Supported PID 49h to 50h		
BIT	Function	Name
0	PID 50h : Reserved	MOD_2_PID_A_DIAG
1	PID 4Fh : Reserved	
2	PID 4Eh : Time since diagnostic trouble codes cleared	
3	PID 4Dh : Minutes run by the engine while MIL activated	
4	PID 4Ch : Commanded Throttle Actuator Control	
5	PID 4Bh : Accelerator Pedal Position F	
6	PID 4Ah : Accelerator Pedal Position E	
7	PID 49h : Accelerator Pedal Position D	

## DATA C - Supported PIDs 51h to 58h

PID 40h - DATA C - Supported PID 51h to 58h		
BIT	Function	Name
0	PID 58h : Reserved	MOD_2_PID_B_DIAG
1	PID 57h : Reserved	
2	PID 56h : Reserved	
3	PID 55h : Reserved	
4	PID 54h : Reserved	
5	PID 53h : Reserved	
6	PID 52h : Reserved	
7	PID 51h : Reserved	

## DATA D - Supported PIDs 59h to 60h

PID 40h - DATA D - Supported PID 59h to 60h		
BIT	Function	Name
0	PID 60h : Reserved	MOD_2_PID_C_DIAG
1	PID 5Fh : Reserved	
2	PID 5Eh : Reserved	
3	PID 5Dh : Reserved	
4	PID 5Ch : Reserved	
5	PID 5Bh : Reserved	
6	PID 5Ah : Reserved	
7	PID 59h : Reserved	

## I.45.3.1 Description of PID 42 - Control module voltage

DATA\_A = ENVD\_OBD\_27\_IDX // FRF of OBD\_VB (high byte)  
 DATA\_B = ENVD\_OBD\_28\_IDX // FRF of OBD\_VB (low byte)

## I.45.3.2 Description of PID 43 - Absolute Load Value

DATA\_A = ENVD\_OBD\_29\_IDX // FRF of LOAD\_ABSV (high byte)  
 DATA\_B = ENVD\_OBD\_30\_IDX // FRF of LOAD\_ABSV (low byte)

## I.45.3.3 Description of PID 44 - Commanded Equivalence Ratio

DATA\_A = ENVD\_OBD\_31\_IDX // FRF of OBD\_LAMP\_SP (high byte)  
 DATA\_B = ENVD\_OBD\_32\_IDX // FRF of OBD\_LAMP\_SP (low byte)

### I.45.3.4 Description of PID - - Relative Throttle Position

DATA\_A = ENVD\_OBD\_33\_IDX // FRF of OBD\_TPS\_REL

### I.45.3.5 Description of PID 46 - Ambient air temperature

DATA\_A = ENVD\_OBD\_34\_IDX // FRF of OBD\_TAM

### I.45.3.6 Description of PID 47 - Absolute Throttle Position B

DATA\_A = ENVD\_OBD\_35\_IDX // FRF of OBD\_TPS\_2

### I.45.3.7 Description of PID 49 - Accelerator Pedal Position D


DATA\_A = ENVD\_OBD\_36\_IDX // FRF of OBD\_PV\_1

### I.45.3.8 Description of PID 4A - Accelerator Pedal Position E

DATA\_A = ENVD\_OBD\_37\_IDX // FRF of OBD\_PV\_2

### I.45.3.9 Description of PID 4C - Commanded throttle actuator control

DATA\_A = ENVD\_OBD\_38\_IDX // FRF of OBD\_TPS\_SP

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## I.46 SID 01h: Request current powertrain diagnostic data

### I.46.1 Functional description

The purpose of this service is to allow access to current emission-related data values, including analogue inputs and outputs, digital inputs and outputs, and system status information. The request for information includes a parameter identification (PID) value that indicates to the on-board system the specific information requested. PID specifications, scaling information, and display formats are included in Annex B of ISO 15031-5.4.


The ECU(s) will respond to this message by transmitting the requested data value last determined by the system. All data values returned for sensor readings will be actual readings, not default or substitute values used by the system because of a fault with that sensor.

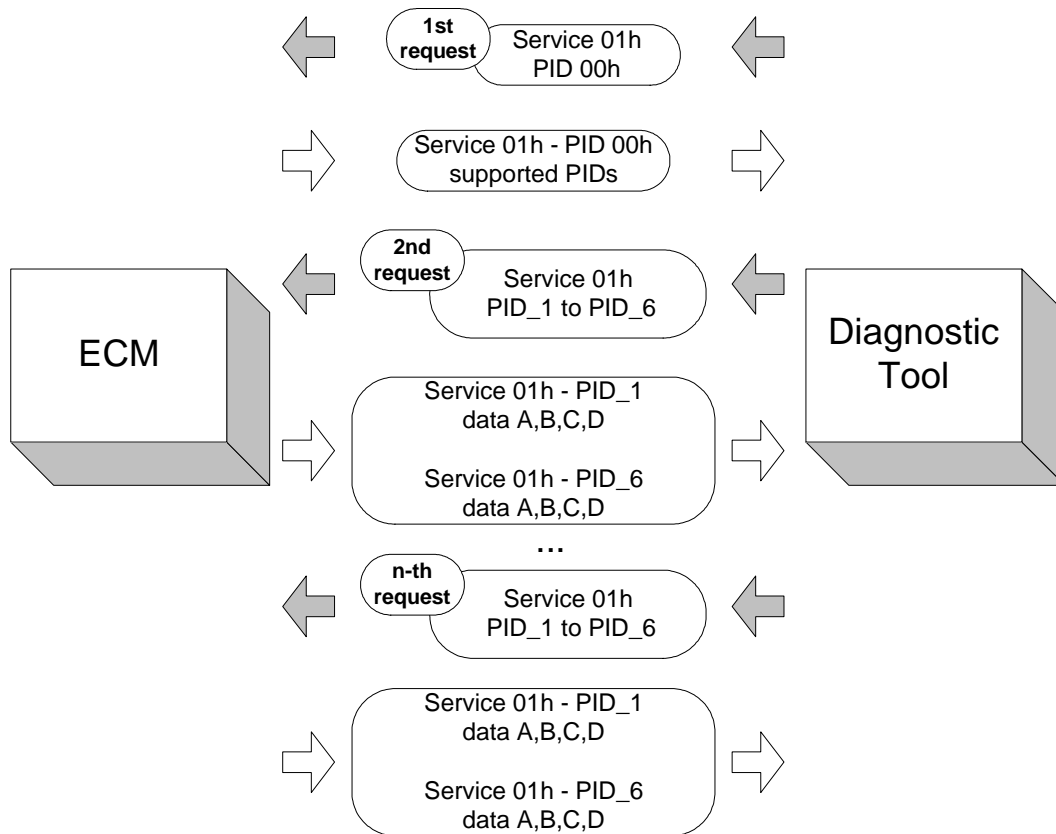
Not all PIDs are applicable or supported by all systems. PID 00h is a bit-encoded value that indicates for each ECU which PIDs are supported. PID 00h indicates support for PIDs from 01h to 20h. PID 20h indicates support for PIDs 21h through 40h, etc. PID 00h is required for those ECUs that respond to a corresponding service 01h request message as specified in Annex A of ISO 15031-5.4.

**IMPORTANT All emissions-related OBD ECUs shall support service 01h and PID 00h. Service 01h with PID 00h is defined as the universal "initialization/keep alive/ping" message for all emissions-related OBD ECUs.**

The request message may contain up to six (6) PIDs. An external test equipment is not allowed to request a combination of PIDs supported and PIDs, which report data values. The ECU shall support requests for up to six (6) PIDs. The request message may contain the same PID multiple times. The ECU shall treat each PID as a separate parameter and respond with data for each PID (data returned may be different for the same PID) as often as requested.

The order of the PIDs in the response message is not required to match the order in the request message.

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## I.46.2 Message data bytes

### I.46.2.1 Read supported PIDs

#### Request current powertrain diagnostic data request message (read supported PIDs)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request current powertrain diagnostic data request SID	M	01	SIDRQ
#2	PID#1 (PIDs supported: see Annex A of ISO 15031-5.4)	M	xx	PID
#3	PID#2 (PIDs supported: see Annex A of ISO 15031-5.4)	U	xx	PID
#4	PID#3 (PIDs supported: see Annex A of ISO 15031-5.4)	U	xx	PID
#5	PID#4 (PIDs supported: see Annex A of ISO 15031-5.4)	U	xx	PID
#6	PID#5 (PIDs supported: see Annex A of ISO 15031-5.4)	U	xx	PID
#7	PID#6 (PIDs supported: see Annex A of ISO 15031-5.4)	U	xx	PID
U = User Optional — PID may be included to avoid multiple PID supported request messages				

**NOTE** To request PIDs supported range from C1h - FFh another request message with PID#1 = C0h and PID#2 = E0h shall be sent to the vehicle.

### I.46.2.2 Report supported PIDs

ECU(s) must respond to all supported ranges if requested. A range is defined as a block of 32 PIDs (e.g. range #1: PID 01h-20h). The ECU shall not respond to unsupported PID ranges unless subsequent ranges have a supported PID(s).

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## Request current powertrain diagnostic data response message (report supported PIDs)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request current powertrain diagnostic data response SID	M	41	SIDPR
#2	data record of supported PIDs = [ 1 <sup>st</sup> supported PID Data A: supported PIDs, Data B: supported PIDs, Data C: supported PIDs, Data D: supported PIDs ]	M	xx	PIDREC_ PID
#3		M	xx	DATA_A
#4		M	xx	DATA_B
#5		M	xx	DATA_C
#6		M	xx	DATA_D
:	:	:	:	:
#n-4	data record of supported PIDs = [ m <sup>th</sup> supported PID Data A: supported PIDs, Data B: supported PIDs, Data C: supported PIDs, Data D: supported PIDs ]	C1	xx	PIDREC_ PID
#n-3		C2	xx	DATA_A
#n-2		C2	xx	DATA_B
#n-1		C2	xx	DATA_C
#n		C2	xx	DATA_D
C1 = Conditional — PID value shall be the same value as included in the request message if supported by the ECU C2 = Conditional — value indicates PIDs supported; range of supported PIDs depends on selected PID value (see C1)				

**NOTE** The response message shall only include the PID(s) and Data A - D which are supported by the ECU. If the request message includes (a) PID value(s) which are not supported by the ECU those shall not be included in the response message.

## I.46.2.3 Read PID values

## Request current powertrain diagnostic data request message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request current powertrain diagnostic data request SID	M	01	SIDRQ
#2	PID#1 (see Annex B of ISO 15031-5.4)	M	xx	PID
#3	PID#2 (see Annex B of ISO 15031-5.4)	U	xx	PID
#4	PID#3 (see Annex B of ISO 15031-5.4)	U	xx	PID
#5	PID#4 (see Annex B of ISO 15031-5.4)	U	xx	PID
#6	PID#5 (see Annex B of ISO 15031-5.4)	U	xx	PID
#7	PID#6 (see Annex B of ISO 15031-5.4)	U	xx	PID
U = User Optional — the parameter may be present or not				

## I.46.2.4 Report PID values

### Request current powertrain diagnostic data response message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request current powertrain diagnostic data response SID	M	41	SIDPR
#2	data record of 1 <sup>st</sup> supported PID = [	M	xx	PIDREC_ PID
#3	PID#1	M	xx	DATA_A
#4	data A,	C1	xx	DATA_B
#5	data B,	C1	xx	DATA_C
#6	data C,	C1	xx	DATA_D
#6	data D ]	C1	xx	DATA_D
:	:	:	:	:
#n-4	data record of m <sup>th</sup> supported PID = [	C2	xx	PIDREC_ PID
#n-3	PID#m	C2	xx	DATA_A
#n-2	data A,	C3	xx	DATA_B
#n-1	data B,	C3	xx	DATA_C
#n	data C,	C3	xx	DATA_D
#n	data D ]	C3	xx	DATA_D
C1 = Conditional — “data B - D” depend on selected PID value C2 = Conditional — parameter is only present if supported by the ECU C3 = Conditional — parameters and values for “data B - D” depend on selected PID number and are only included if PID is supported by the ECU				

**NOTE** Not all PIDs, which are included in the request message may be supported by all emission-related ECUs, which shall comply with this specification. Therefore, each vehicle ECU, which supports at least one (1) PID, shall send a response message including the PID(s) with data.

## I.46.2.5 Parameter definition

### I.46.2.5.1 PIDs supported

Annex A of ISO 15031-5.4 specifies the interpretation of the data record of supported PIDs.

### I.46.2.5.2 PID and data byte descriptions

Annex B of ISO 15031-5.4 specifies standardised emission-related parameters.



## I.47 SID 01h: Request current powertrain diagnostic data (Appl.Inc)

### Input data:

AMP_SAE {p. 1163}	C_CLC_READY_OBD_1 {p. 7833}	C_OBD_REQ {p. 7835}	CPPWM_CPS {p. 3749}
CTR_WUP_DTC_CLR {p. 5899}	DIST_ACT_MIL {p. 5899}	DIST_DTC_CLR {p. 5899}	FAC_LAM_AD_SAE [NC_CBK_EX_NR] {p. 1014}
FAC_LAM_LIM_SAE [NC_CBK_EX_NR] {p. 1014}	FUP {p. 1283}	FUP_H_SAE {p. 5801}	FUP_MES_SAE [NC_CBK_HPP_NR]
FUP_SP_SAE [NC_CBK_HPP_NR]	IGA_IGC [NC_CYL_NR] {p. 1005}	IPLSL_COR [NC_CBK_EX_NR] {p. 2313}	LAMB_DELTA_AD_LAM_ ADJ_SAE [NC_CBK_EX_NR] {p. 1014}
LAMB_DELTA_LAM_ADJ_ SAE [NC_CBK_EX_NR] {p. 1014}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_SP_SAE {p. 1015}	LOAD_ABSV {p. 5801}
LOAD_CLC {p. 5801}	MAF_KGH_MES {p. 1192}	MAF_KGH_MES_SAE [NC_MAF_NR]	MAP_SAE {p. 1198}
N {p. 1525}	NC_CYL_NR {p. 1526}	NC_INJ_CONF {p. 626}	OBD_EGR_DIF {p. 5801}
OBD_FTL {p. 5801}	OBD_PV_1 {p. 5801}	OBD_PV_2 {p. 5801}	OBD_TAM {p. 1569}
OBD_TPS_1 {p. 5801}	OBD_TPS_2 {p. 5801}	OBD_TPS_REL {p. 5801}	OBD_TPS_SP {p. 5801}
OPG_SP_ACR {p. 3573}	STATE_CMPL_OBD {p. 5899}	STATE_ENA_OBD {p. 5899}	STATE_LS_SAE [NC_CBK_EX_NR] {p. 2448}
STATE_MIL {p. 5827}	STATE_OBD_SA {p. 808}	STATE_PSN_FUP_SAE {p. 819}	STATE_PSN_LS_SAE {p. 819}
STATE_PSN_MAF_SAE {p. 819}	STATE_PSN_TIA_SAE {p. 819}	STATE_PSN_TPS_SAE {p. 819}	STATE_VAR_SAP_SAE {p. 819}
T_ACT_MIL {p. 5899}	T_AST_SAE {p. 1766}	T_DTC_CLR {p. 5899}	TCO_MES {p. 1100}
TEG_CAT_DOWN_MDL {p. 8236}	TEG_CAT_UP_MDL [i] {p. 8236}	TIA_MES {p. 1226}	TIA_MES_SAE [NC_SENS_NR_TIA]
TIA_THR_MES_SAE [NC_SENS_NR_TIA_THR]	TPS_REL_SAE [NC_ETC_NR]	TPS_SP_SAE [NC_ETC_NR]	VB {p. 1185}
VLS_COR_LSL [NC_CBK_EX_NR] {p. 1088}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VS_SAE {p. 1176}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_STATE_SRV_1_PID	V	0... FFH	0... 255	1	-
LDPM_STATE_PID_SRV_1_2_OBDC	20	0... 13H	0... 19	1	-

Table of bytes which defines the PID's supported by the service 01h (01h - A0h)

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_STATE_OBD_FUEL	V	0... FFH	0... 255	1	-

Define which type of fuel is currently being utilized by the vehicle

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_STATE_OBD_REQ_VEH	V	0... FFH	0... 255	1	-
Define which are the OBD requirements for Heavy Duty Vehicles					

### Import actions:

<b>ACTION_ERRM_ReadQuantityOfDtc</b> (IN<PRM_TYPEOFDTC>,IN<PRM_LEVELOFDTC>,INOUT<PRM_QUANTITY>,OUT<PRM_RESULTQUANTITY>)
<b>ACTION_ERRM_ReadReadinessCode</b> (INOUT<PRM_READINESSCODE>,OUT<PRM_RESULTREADINESSCODE>)

### General information

Depending on calibration of ID\_STATE\_SRV\_1\_PID the PID's are supported or not.

Each LDPM[0...19] of the table represents an 8 PIDs configuration:

0 => the PID is not supported

1 => the PID is supported

### Application conditions:

**Initialisation:** -

**Activation:** -

**Deactivation:** -

**Recurrence:** -

### Function description:

### Formula section:


## I.47.1 Configuration of Emission requirements to which vehicle is designed

### Description:

The vehicle is not Heavy Duty relevant, thus NC\_STATE\_OBD\_REQ\_VEH = 0h.

NC_STATE_OBD_REQ_VEH	
Function	Hex value
Heavy Duty Vehicles (EURO IV) B1	0E
Heavy Duty Vehicles (EURO V) B2	0F
Heavy Duty Vehicles (EURO EEC) C (gas engines)	10

### Formula section:

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NC\_STATE\_OBD\_REQ\_VEH = 0h

## I.47.2 Configuration of Type of fuel currently being utilized by the vehicle

### Description:

The vehicle is equipped only with gasoline engines.

NC_STATE_OBD_FUEL	
Function	Hex value
Gasoline/petrol	01
Methanol	02
Ethanol	03
Diesel	04
Liquefied Petroleum Gas (LPG)	05
Compressed Natural Gas (CNG)	06
Propane	07
Battery/electric	08
Bi-fuel vehicle using gasoline	09
Bi-fuel vehicle using methanol	0A
Bi-fuel vehicle using ethanol	0B
Bi-fuel vehicle using LPG	0C
Bi-fuel vehicle using CNG	0D
Bi-fuel vehicle using propane	0E
Bi-fuel vehicle using battery	0F
Bi-fuel vehicle using battery and combustion engine	10
Hybrid vehicle using gasoline engine	11
Hybrid vehicle using gasoline engine on ethanol	12
Hybrid vehicle using diesel engine	13
Hybrid vehicle using battery	14
Hybrid vehicle using battery and combustion engine	15
Hybrid vehicle in regeneration mode	16

### Formula section:

NC\_STATE\_OBD\_FUEL = 01h

## I.47.3 Description of PID 00h - Defines Supported PIDs 01h - 20h

### DATA A - Supported PIDs 01h to 08h

PID 00h – DATA A - Supported PID 01h to 08h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[0]
0	PID 08h : Short term fuel trim - Bank 2	1

Continued on next page

1	PID 07h : Long term fuel trim - Bank 1	1
2	PID 06h : Short term fuel trim - Bank 1	1
3	PID 05h : Engine coolant temperature	1
4	PID 04h : Calculated load value	1
5	PID 03h : Fuel system status	1
6	PID 02h : Trouble code that caused required freeze frame	0
7	PID 01h : DTCs and supported tests	1

### DATA B - Supported PIDs 09h to 10h

PID 00h – DATA B - Supported PID 09h to 10h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[1]
0	PID 10h : Air flow rate from MAF sensor	1
1	PID 0Fh : Intake air temperature	1
2	PID 0Eh : Ignition time advance	1
3	PID 0Dh : Vehicle speed	1
4	PID 0Ch : Engine RPM	1
5	PID 0Bh : Intake manifold absolute pressure	1
6	PID 0Ah : Fuel pressure (gauge)	1
7	PID 09h : Long term fuel trim - Bank 2	1

### DATA C - Supported PIDs 11h to 18h

PID 00h – DATA C - Supported PID 11h to 18h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[2]
0	PID 18h : Bank 2 Sensor 1 or Bank 3 Sensor 1	0
1	PID 17h : Bank 1 Sensor 4 or Bank 2 Sensor 2	0
2	PID 16h : Bank 1 Sensor 3 or Bank 2 Sensor 1	0
3	PID 15h : Bank 1 Sensor 2	1
4	PID 14h : Bank 1 Sensor 1	0
5	PID 13h : Location of oxygen sensors	1
6	PID 12h : Secondary air status	1
7	PID 11h : Absolute throttle position sensor	1

### DATA D - Supported PIDs 19h to 20h

Continued on next page

PID 00h - DATA D - Supported PID 19h to 20h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[3]
0	PID 20h : PIDs supported (\$21 - \$40)	1
1	PID 1Fh : Time Since Engine Start	1
2	PID 1Eh : Auxiliary Input Status	0
3	PID 1Dh : Location of oxygen sensors	0
4	PID 1Ch : OBD requirements	1
5	PID 1Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2	0
6	PID 1Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1	0
7	PID 19h : Bank 2 Sensor 2 or Bank 3 Sensor 2	1


## I.47.4 Description of PID 01h - Monitor status since DTCs cleared

### PID \$01 definition

PID (hex)	Description	Data byte	Scaling/bit	External test equipment SI (Metric) /English display
01	Monitor status since DTCs cleared			
	The bits in this PID shall report two pieces of information for each monitor: <ol style="list-style-type: none"> <li>Monitor status since DTCs were last cleared, saved in NVRAM or KAM.</li> <li>Monitors supported on this vehicle.</li> </ol>			
	Number of emission-related DTCs and MIL status	A (bit)	byte 1 of 4	DTC and MIL status:
	# of DTCs stored in this ECU	0-6	hex to decimal	DTC_CNT: xxxd
	Malfunction Indicator Light (MIL) Status	7	0 = MIL OFF; 1 = MIL ON	MIL: OFF or ON
	The MIL status shall indicate "OFF" during the key on, engine off bulb check unless the MIL has also been commanded "ON" for a detected malfunction.			
	Supported tests which are continuous	B (bit)	byte 2 of 4 (Low Nibble)	Support status of continuous monitors:
	Misfire monitoring	0	0 = monitor not supported (NO) 1 = monitor supported (YES)	MIS_SUP: NO or YES
	Misfire monitoring shall be supported on both, spark ignition and compression vehicles if the vehicle utilises a misfire monitor.			
	Fuel system monitoring	1	0 = monitor not supported (NO) 1 = monitor supported (YES)	FUEL_SUP: NO or YES
	Fuel system monitoring shall be supported on vehicles that utilise oxygen sensors for closed loop fuel feedback control, and utilise a fuel system monitor, typically spark ignition engines.			
	Comprehensive component monitoring	2	0 = monitor not supported (NO) 1 = monitor supported (YES)	CCM_SUP: NO or YES
	Comprehensive component monitoring shall be supported on spark ignition and compression ignition vehicles that utilise comprehensive component monitoring.			
	reserved (bit shall be reported as '0')	3		--

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### PID \$01 definition (continued)

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PID (hex)	Description	Data byte	Scaling/bit	External test equipment SI (Metric) /English display
	Status of continuous monitoring tests since DTC cleared:	B (bit)	byte 2 of 4 (High Nibble)	Completion status of continuous monitors since DTC cleared:
	Misfire monitoring	4	0 = monitor complete, or not applicable (YES) 1 = monitor not complete (NO)	MIS_RDY: YES or NO
	Misfire monitoring shall always indicate complete for spark ignition engines. Misfire monitoring shall indicate complete for compression ignition engines after the misfire evaluation is complete.			
	Fuel system monitoring	5	0 = monitor complete, or not applicable (YES) 1 = monitor not complete (NO)	FUEL_RDY: YES or NO
	Fuel system monitoring shall always indicate complete for both spark ignition and compression ignition engines.			
	Comprehensive component monitoring	6	0 = monitor complete, or not applicable (YES) 1 = monitor not complete (NO)	CCM_RDY: YES or NO
	Comprehensive component monitoring shall always indicate complete on both spark ignition and compression ignition engines. NOTE It can be assumed that by the time any non-continuous monitors are complete, continuous comprehensive component monitoring will also be complete. Bit 6 is allowed to always indicate "complete" on spark ignition vehicles that support other non-continuous monitors.			
	reserved (bit shall be reported as '0')	7		--
	Supported tests run at least once per trip	C (bit)	byte 3 of 4	Support status of non-continuous monitors:
	Catalyst monitoring	0	0 = monitor not supported (NO) 1 = monitor supported (YES)	CAT_SUP: NO or YES
	Heated catalyst monitoring	1		HCAT_SUP: NO or YES
	Evaporative system monitoring	2		EVAP_SUP: NO or YES
	Secondary air system monitoring	3		AIR_SUP: NO or YES
	A/C system refrigerant monitoring	4		ACRF_SUP: NO or YES
	Oxygen sensor monitoring	5		O2S_SUP: NO or YES
	Oxygen sensor heater monitoring	6		HTR_SUP: NO or YES
	EGR system monitoring	7		EGR_SUP: NO or YES
	Status of tests run at least once per trip	D (bit)	byte 4 of 4	Completion status of non-continuous monitors since DTCs cleared:
	Catalyst monitoring	0	0 = monitor complete, or not applicable (YES) 1 = monitor not complete (NO)	CAT_RDY: YES or NO
	Heated catalyst monitoring	1		HCAT_RDY: YES or NO
	Evaporative system monitoring	2		EVAP_RDY: YES or NO
	Secondary air system monitoring	3		AIR_RDY: YES or NO
	A/C system refrigerant monitoring	4		ACRF_RDY: YES or NO
	Oxygen sensor monitoring	5		O2S_RDY: YES or NO
	Oxygen sensor heater monitoring	6		HTR_RDY: YES or NO
	EGR system monitoring	7		EGR_RDY: YES or NO

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Data Byte	Application data to use		Formatting conversion used
data A	(bit 0 to 6) :	NR_DTC	-
	(bit 7) :	STATE_MIL	
Continued on next page			

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data B	STATE_READY_OBD_1*	
data C	C_STATE_READY_OBD_2	
data D	STATE_READY_OBD_2	

- \*) The bit 0 up to 3 of this byte is calibration value C\_STATE\_READY\_OBD\_1.  
The bit 4 up to 6 of this byte indicate if the tests has been performed continuously since the reinitialization of the memorized information.

### Formula section:

#### **ACTION\_ERRM\_ReadQuantityOfDtc**

```
(
IN <OBD & CONFIRMED>
IN <LAW>
INOUT <NR_DTC>
OUT <ResultQuantity>
)
```

#### **ACTION\_ERRM\_ReadReadinessCode**

```
(
INOUT < C_STATE_READY_OBD_2, STATE_READY_OBD_1,
STATE_READY_OBD_2>
OUT <ResultReadinessCode>
)
```

```
IF (ResultQuantity = DTC_PRESENT OR
ResultQuantity = NO_DTC_PRESENT) AND
ResultReadinessCode = POSITIVE_RESPONSE
```

#### **THEN**

Positive response

#### **ELSE**

No answer

#### **ENDIF**

These actions should be sent at each time we use the mode 01h PID01.  
Refer to "Error management" module.

## I.47.5 Description of PID 03h - Status of fuel system

```
IF (ID_STATE_SRV_1_PID[2] & 20h) // PID 13h is supported
THEN
IF (STATE_PSN_LS_SAE & 11h)
THEN
```

PID (hex)	Description	Data Byte	Scaling/bit	External test equipment
				SI (Metric) /English display
03	Fuel system 1 status:	A (bit)	byte 1 of 2	FUELSYS1:

Continued on next page

	(unused bits shall be reported as '0'; no more than one bit at a time can be set to a '1' of that bank)	0	1 = Open loop - has not yet satisfied conditions to go closed loop	OL
		1	1 = Closed loop - using oxygen sensor(s) as feedback for fuel control	CL
		2	1 = Open loop due to driving conditions (e.g. power enrichment, deceleration enrichment)	OL-Drive
		3	1 = Open loop - due to detected system fault	OL-Fault
		4	1 = Closed loop, but fault with at least one oxygen sensor - may be using single oxygen sensor for fuel control	CL-Fault
		5-7	reserved (bits shall be reported as '0')	--
NOTE Fuel systems do not refer to injector banks. Fuel systems are intended to represent completely different fuel systems that can independently enter and exit closed loop fuel. Banks of injectors on a V-engine are generally not independent and share the same closed-loop enablement criteria.				
	Fuel system 2 status:	B (bit)	byte 2 of 2	FUELSYS2:
	(unused bits shall be reported as '0'; no more than one bit at a time can be set to a '1' of that bank)	0	1 = Open loop - has not yet satisfied conditions to go closed loop	OL
		1	1 = Closed loop - using oxygen sensor(s) as feedback for fuel control	CL
		2	1 = Open loop due to driving conditions (e.g. power enrichment, deceleration enrichment)	OL-Drive
		3	1 = Open loop - due to detected system fault	OL-Fault
		4	1 = Closed loop, but fault with at least one oxygen sensor - may be using single oxygen sensor for fuel control	CL-Fault
		5-7	reserved (bits shall be reported as '0')	--

Data Byte	Application data to use	Formatting conversion used
data A	STATE_LS_SAE[1]	no
data B	STATE_LS_SAE[2]	no

**ENDIF**


## I.47.6 Description of PID 04h - Calculated load value

### PID \$04 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
04	Calculated LOAD Value!	A	0 %	100 %	100/255 %	LOAD_PCT: xxx.x %

Continued on next page

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	<p>The OBD regulations previously defined CLV as:  <math>(\text{current airflow} / \text{peak airflow @ sea level}) * (\text{BARO @ sea level} / \text{BARO}) * 100\%</math></p> <p>Various manufacturers have implemented this calculation in a variety of ways. The following definition, although a little more restrictive, will standardise and improve the accuracy the calculation.</p> <p><math>\text{LOAD\_PCT} = [\text{current airflow}] / [(\text{peak airflow at WOT@STP as a function of rpm}) * (\text{BARO}/29.92) * \text{SQRT}(298/(\text{AAT}+273))]</math></p> <ul style="list-style-type: none"> <li>- Where: STP = Standard Temperature and Pressure = 25°C, 29.92 in Hg BARO, SQRT = square root,</li> <li>- WOT = wide open throttle, AAT=Ambient Air Temperature and is in°C</li> </ul> <p style="padding-left: 40px;">Characteristics of LOAD_PCT are:</p> <ul style="list-style-type: none"> <li>- Reaches 1.0 at WOT at any altitude, temperature or rpm for both naturally aspirated and boosted engines.</li> </ul> <ul style="list-style-type: none"> <li>- Indicates percent of peak available torque.</li> <li>- Linearly correlated with engine vacuum</li> <li>- Often used to schedule power enrichment.</li> <li>- Compression ignition engines (diesels) shall support this PID using fuel flow in place of airflow for the above calculations.</li> </ul> <p>NOTE Both spark ignition and compression ignition engines shall support PID \$04. See PID \$43 for an additional definition of engine LOAD.</p>
--	---

Data Byte	Application data to use	Formating conversion used
data A	LOAD_CLC	no

## I.47.7 Description of PID 05h - Engine coolant temperature

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
05	Engine Coolant Temperature	A	-40 °C	+215 °C	1 °C with -40 °C off-set	ECT: xxx °C (xxx °F)
	ECT shall display engine coolant temperature derived from an engine coolant temperature sensor or a cylinder head temperature sensor. Many diesels do not use either sensor and may substitute Engine Oil Temperature instead.					

Data Byte	Application data to use	Formating conversion used
data A	TCO_MES	Shift to different range

### I.47.8 Description of PID 06h - Short term fuel trim - Bank 1 and Bank 3

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
06	Short Term Fuel Trim - Bank 1 (use if only 1 fuel trim value) Short Term Fuel Trim - Bank 3	A  B	-100 % (lean)	+99.22 % (rich)	100/128 % (0 % at 128)	SHRTFT1: xxx.x % SHRTFT3: xxx.x %
<p>Short Term Fuel Trim Bank 1/3 shall indicate the correction being utilised by the closed loop fuel algorithm. If the fuel system is in open loop, SHRTFT1/3 shall report 0% correction.</p> <p>NOTE Data B shall only be included in the response message of a PID \$06 if supported by the vehicle. If PID \$1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 3 supported) of PID \$1D if Data B of PID \$06 is supported or not.</p>						

**IF** (PID 13h is supported) **THEN**  
**IF** (Bank 1 is supported)  
**THEN**

Data Byte	Application data to use	Formating conversion used
data A	FAC_LAM_LIM_SAE[1]	Shift to different range

**ELSE**

Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	

**ENDIF**

**ENDIF**

## I.47.9 Description of PID 07h - Long term fuel trim - Bank 1 and Bank 3

### PID \$07 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
07	Long Term Fuel Trim - Bank 1 (use if only 1 fuel trim value) Long Term Fuel Trim - Bank 3	A  B	-100 % (lean)	+99.22 % (rich)	100/128 % (0 % at 128)	LONGFT1: xxx.x % LONGFT3: xxx.x %
	<p>Fuel trim correction for Bank 1/3 stored in Non-volatile RAM or Keep-alive RAM. LONGFT shall indicate the correction being utilised by the fuel control algorithm at the time the data is requested, in both open loop and closed loop fuel control. If no correction is utilised in open loop fuel, LONGFT shall report 0% correction. If long-term fuel trim is not utilised at all by the fuel control algorithm, the PID shall not be supported.</p> <p>NOTE Data B shall only be included in the response message of a PID \$07 if supported by the vehicle. If PID \$1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 3 supported) of PID \$1D if Data B of PID \$07 is supported or not.</p>					

**IF (PID 13h is supported) THEN**

**IF (Bank 1 is supported)**

**THEN**

Data Byte	Application data to use	Formating conversion used
data A	FAC_LAM_AD_SAE[1]	-

**ELSE**

Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	

**ENDIF**

**ENDIF**

## I.47.10 Description of PID 08h - Short term fuel trim - Bank 2 and Bank 4

### PID \$08 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
08	Short Term Fuel Trim - Bank 2 (use if only 1 fuel trim value) Short Term Fuel Trim - Bank 4	A  B	-100 % (lean)	+99.22 % (rich)	100/128 % (0 % at 128)	SHRTFT2: xxx.x % SHRTFT4: xxx.x %
<p>Short Term Fuel Trim Bank 2/4 shall indicate the correction being utilized by the closed loop fuel algorithm. If the fuel system is in open loop, SHRTFT24 shall report 0% correction.</p> <p>NOTE Data B shall only be included in the response message of a PID \$08 if supported by the vehicle. If PID \$1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 4 supported) of PID \$1D if Data B of PID \$08 is supported or not.</p>						

**IF** (PID 13h is supported) **THEN**  
**IF** (Bank 2 is supported)  
**THEN**

Data Byte	Application data to use	Formating conversion used
data A	FAC_LAM_LIM_SAE[2]	Shift to different range

**ELSE**

Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	

**ENDIF**  
**ENDIF**

## I.47.11 Description of PID 09h - Long term fuel trim - Bank 2 and Bank 4

### PID \$09 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
Continued on next page						

09	Long Term Fuel Trim – Bank 2 (use if only 1 fuel trim value) Long Term Fuel Trim – Bank 4	A  B	-100 % (lean)	+99.22 % (rich)	100/128 % (0 % at 128)	LONGFT2: xxx.x % LONGFT4: xxx.x %
<p>Fuel trim correction for Bank 2/4 stored in Non-volatile RAM or Keep-alive RAM. LONGFT shall indicate the correction being utilised by the fuel control algorithm at the time the data is requested, in both open loop and closed loop fuel control. If no correction is utilised in open loop fuel, LONGFT shall report 0% correction. If long-term fuel trim is not utilised at all by the fuel control algorithm, the PID shall not be supported.</p> <p>NOTE Data B shall only be included in the response message of a PID \$09 if supported by the vehicle. If PID \$1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 4 supported) of PID \$1D if Data B of PID \$09 is supported or not.</p>						

**IF** (PID 13h is supported) **THEN**  
**IF** (Bank 2 is supported)  
**THEN**

Data Byte	Application data to use	Formating conversion used
data A	FAC_LAM_AD_SAE[2]	-

**ELSE**  
**ENDIF**

**ENDIF**


## I.47.12 Description of PID 0Ah - Fuel pressure (gauge)

### PID \$0A definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
0A	Fuel Rail Pressure (gauge)	A	0 kPa(gauge)	765 kPa (gauge)	3 kPa per bit (gauge)	FRP: xxx kPa (xx.x psi)
FRP shall display fuel rail pressure at the engine when the reading is referenced to atmosphere (gauge pressure).						

Data Byte	Application data to use	Formating conversion used
data A	FUP	Shift to different range

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### I.47.13 Description of PID 0Bh - Intake manifold absolute pressure

#### PID \$0B definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equip- ment SI (Metric) /English dis- play
0B	Intake Manifold Absolute Pressure	A	0 kPa (absolute)	255 kPa (absolute)	1 kPa per bit (absolute)	MAP: xxx kPa (xx.x inHg)
MAP shall display manifold pressure derived from a Manifold Absolute Pressure sensor, if a sensor is utilised. If a vehicle uses both a MAP and MAF sensor, both the MAP and MAF PIDs shall be supported.						

Data Byte	Application data to use	Formating conversion used
data A	MAP_SAE	None

### I.47.14 Description of PID 0Ch - Engine speed

#### PID \$0C definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equip- ment SI (Metric) /English dis- play
0C	Engine RPM	A , B	0 min <sup>-1</sup>	16383.75 min <sup>-1</sup>	¼ rpm per bit	RPM: xxxxx min <sup>-1</sup>

Data Byte	Application data to use	Formating conversion used
data A	MSB ( N )	Shift to different range
data B	LSB ( N )	Shift to different range

### I.47.15 Description of PID 0Dh - Vehicle speed

#### PID \$0D definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
0D	Vehicle Speed Sensor	A	0 km/h	255 km/h	1 km/h per bit	VSS: xxx km/h (xxx mph)
VSS shall display vehicle road speed, if utilised by the control module strategy. Vehicle speed may be derived from a vehicle speed sensor, calculated by the PCM using other speed sensors, or obtained from the vehicle serial data communication bus.						

Data Byte	Application data to use	Formating conversion used
data A	VS_SAE	no

## I.47.16 Description of PID 0Eh - Ignition timing advance

### PID \$0E definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
0E	Ignition Timing Advance for #1 Cylinder	A	-64 °	63.5 °	½ ° with 0 ° at 128	SPARKADV: xx °
Ignition timing spark advance for #1 cylinder (not including mechanical advance)						

Data Byte	Application data to use	Formating conversion used
data A	IGA_IGC[0]	Shift to different range

## I.47.17 Description of PID 0Fh - Intake air temperature

### PID \$0B definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
Continued on next page						

0F	Intake Air Temperature	A	-40 °C	+215 °C	1 °C with -40 °C off- set	IAT: xxx °C (xxx °F)
IAT shall display intake manifold air temperature, if utilised by the control module strategy. IAT may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.						

Data Byte	Application data to use	Formating conversion used
data A	TIA_MES	Shift to different range

## I.47.18 Description of PID 10h - Air flow rate from MAF

### PID \$0B definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equip- ment SI (Metric) /English dis- play
10	Air Flow Rate from Mass Air Flow Sensor	A , B	0 g/s	655.35 g/ s	0.01 g/s	MAF: xxx.xx g/s (xxxx.x lb/min)
MAF shall display the airflow rate as measured by the MAF sensor, if a sensor is utilised.						


Data Byte	Application data to use	Formating conversion used
data A	MSB (MAF_KGH_MES )	Kg/h into g/s
data B	LSB (MAF_KGH_MES )	Kg/h into g/s

## I.47.19 Description of PID 11h - Absolute throttle position sensor

### PID \$0A - \$11 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equip- ment SI (Metric) /English dis- play
11	Absolute Throttle Position	A	0 %	100 %	100/255 %	TP: xxx.x %
Continued on next page						

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	<p>Absolute throttle position (not "relative" or "learned" throttle position) shall be displayed as a normalised value, scaled from 0 to 100%. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed throttle position is a 1.0 volts, TP shall display <math>(1.0 / 5.0) = 20\%</math> at closed throttle and 50% at 2.5 volts. Throttle position at idle will usually indicate greater than 0%, and throttle position at wide open throttle will usually indicate less than 100%.</p> <p>For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage.</p> <p>NOTE See PID \$45 for a definition of Relative Throttle Position.</p>
--	---

Data Byte	Application data to use	Formatting conversion used
data A	OBD_TPS_1	no

### I.47.20 Description of PID 12h - Commanded secondary air status

With autolearning the value for the STATE\_VAR\_SAP\_SAE is defined to the value defined by the project.

**IF** (ID\_STATE\_SRV\_1\_PID[2] & 40h) **AND** (STATE\_VAR\_SAP\_SAE <> 0)

**THEN**

**PID \$12 definition**


PID (hex)	Description	Data byte	Scaling/bit	External test equipment SI (Metric) /English display
12	Commanded Secondary Air Status	A (bit)	byte 1 of 1	AIR_STAT:
	(if supported, one, and only	0	1 = upstream of first catalytic converter	AIR_STAT: UPS
	one bit at a time can be set	1	1 = downstream of first catalytic converter inlet	AIR_STAT: DNS
	to a 1)	2	1 = atmosphere /off	AIR_STAT: OFF
		3-7	reserved (bits shall be reported as '0')	--

Data Byte	Calibration data to use	Formatting conversion used
data A	STATE_OBD_SA	-

**ENDIF**

### I.47.21 Description of PID 13h - Location of oxygen sensors

**PID \$13 definition**

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PID (hex)	Description	Data byte	Scaling/bit	External test equipment SI (Metric) /English display
13	Location of Oxygen Sensors	A (bit)	byte 1 of 4	O2SLOC:
	(where sensor 1 is closest to the engine. Each bit indicates the presence or absence of an oxygen sensor at the following location)	0	1 = Bank 1 - Sensor 1 present at that location	O2S11
		1	1 = Bank 1 - Sensor 2 present at that location	O2S12
		2	1 = Bank 1 - Sensor 3 present at that location	O2S13
		3	1 = Bank 1 - Sensor 4 present at that location	O2S14
		4	1 = Bank 2 - Sensor 1 present at that location	O2S21
		5	1 = Bank 2 - Sensor 2 present at that location	O2S22
		6	1 = Bank 2 - Sensor 3 present at that location	O2S23
		7	1 = Bank 2 - Sensor 4 present at that location	O2S24

```

IF (ID_STATE_SRV_1_PID[2] & 20h) // PID 13h is supported
THEN STATE_PSN_LS_SAE is defined to the value defined by the project
ELSE STATE_PSN_LS_SAE = 0
ENDIF

```

Data Byte	Calibration data to use	Formating conversion used
data A	STATE_PSN_LS_SAE	no

## I.47.22 Description of PID 15h - Bank 1 Sensor 2


### PID \$15 definition if PID \$13 is supported!

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
15	Oxygen Sensor Output Voltage Bank 1 – Sensor 2	A	0 V	1.275 V	0.005 V	O2Sxy: x.xxx V
	Short Term Fuel Trim (B1-S2) (associated with this sensor \$FF if this sensor is not used in the calculation)	B	-100.00 % (lean)	99.22 % (rich)	100/128 % (0 % at 128)	SHRTFTxy: xxx.x %
These PIDs shall be used for a conventional, 0 to 1 Volt oxygen sensor. Any sensor with a different full scale value shall be normalised to provide nominal full scale at \$C8 (200 decimal). Wide-range/linear oxygen sensors shall use PID \$25 or PID \$35.						

```

IF (PID 13h is supported) THEN
  IF (Bank 1 sensor 2 is supported) THEN

```

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Data Byte	Application data to use	Formating conversion used
data A	VLS_DOWN[1]	-
data B	0xFF	

**ELSE**

Data Byte	Application data to use	Formating conversion used
data A	NONE	-
data B	NONE	

**ENDIF**

**ENDIF**

### I.47.23 Description of PID 19h - Bank 2 Sensor 2 or Bank 3 Sensor 2

**PID \$19 definition if PID \$13 is supported!**

PID (hex)	Description Use if PID \$13 is supported!	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
19	Oxygen Sensor Output Voltage Bank 2 – Sensor 2	A	0 V	1.275 V	0.005 V	O2Sxy: x.xxx V
	Short Term Fuel Trim (B2-S2) (associated with this sensor \$FF if this sensor is not used in the calculation)	B	-100.00 % (lean)	99.22 % (rich)	100/128 % (0 % at 128)	SHRTFTxy: xxx.x %
These PIDs shall be used for a conventional, 0 to 1 Volt oxygen sensor. Any sensor with a different full scale value shall be normalised to provide nominal full scale at \$C8 (200 decimal). Wide-range/linear oxygen sensors shall use PID \$29 or PID \$39.						

**IF (PID 13h is supported) THEN**

**IF (Bank 2 sensor 2 is supported) THEN**

Data Byte	Application data to use	Formating conversion used
Data A	VLS_DOWN[2]	-
Data B	0xFF	

**ELSE**

Data Byte	Application data to use	Formating conversion used
Data A	NONE	-
Data B	NONE	

**ENDIF**

**ENDIF**

## I.47.24 Description of PID 1Ch - OBD requirements

### PID \$1C definition

PID (hex)	Description	Data byte	Scaling	External test equipment SI (Metric) /English display
1C	OBD requirements to which vehicle is designed	A (hex)	byte 1 of 1 (State Encoded Variable)	OBDSUP:
		01	OBD II (California ARB)	OBD II
		02	OBD (Federal EPA)	OBD
		03	OBD and OBD II	OBD and OBD II
		04	OBD I	OBD I
		05	Not OBD compliant	NO OBD
		06	EOBD	EOBD
		07	EOBD and OBD II	EOBD and OBD II
		08	EOBD and OBD	EOBD and OBD
		09	EOBD, OBD and OBD II	EOBD, OBD and OBD II
		0A - FF	reserved by document	--


Data Byte	Calibration data to use	Formating conversion used
data A	C_OBD_REQ	-

## I.47.25 Description of PID 1Fh - Time Since Engine Start

### PID \$1F definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
1F	Time Since Engine Start	A , B	0 sec.	65,535 sec.	1 second per count	RUNTM: xxxxx sec.
Continued on next page						

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RUNTM shall increment while the engine is running. It shall freeze if the engine stalls. RUNTM shall be reset to zero during every control module power-up and when entering the key-on, engine off position. RUNTM is limited to 65,535 seconds and shall not wrap around to zero.
---

Data Byte	Application data to use	Formating conversion used
data A	MSB (T_AST_SAE)	-
data B	LSB (T_AST_SAE)	-

### I.47.26 Description of PID 20h - Supported PIDs 21h - 40h

0 : the PID is not used

1 : the PID is used

#### DATA A - Supported PIDs 21h - 28h

PID 20h - DATA A - Supported PID 21h to 28h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[4]
0	PID 28h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	1
1	PID 27h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	0
2	PID 26h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	0
3	PID 25h : Bank 1 Sensor 2 (Wide range O2S)	0
4	PID 24h : Bank 1 Sensor 1 (Wide range O2S)	1
5	PID 23h : Fuel pressure high-range (gauge)	1
6	PID 22h : Relative fuel pressure	0
7	PID 21h : Distance travelled while MIL is activated	1

#### DATA B - Supported PIDs 29h to 30h

PID 20h - DATA B - Supported PID 29h to 30h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[5]
0	PID 30h : Number of warm-ups since diagnostic trouble codes cleared	1
1	PID 2Fh : Fuel Level Input	1
2	PID 2Eh : Commanded Evaporative Purge	1
3	PID 2Dh : EGR Error	1
4	PID 2Ch : Command EGR	1
5	PID 2Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	0

Continued on next page

6	PID 2Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	0
7	PID 29h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	0

### DATA C - Supported PIDs 31h to 38h

PID 20h - DATA C - Supported PID 31h to 38h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[6]
0	PID 38h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	1
1	PID 37h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	0
2	PID 36h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	0
3	PID 35h : Bank 1 Sensor 2 (Wide range O2S)	0
4	PID 34h : Bank 1 Sensor 1 (Wide range O2S)	1
5	PID 33h : Barometric Pressure	1
6	PID 32h : Evap System Vapor Pressure	0
7	PID 31h : Distance since diagnostic trouble codes cleared	1

### DATA D - Supported PIDs 39h to 40h

PID 20h - DATA D - Supported PID 39h to 40h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[7]
0	PID 40h : PIDs supported (\$41 - \$60)	1
1	PID 3Fh : Catalyst Temperature Bank 2, Sensor 2	1
2	PID 3Eh : Catalyst Temperature Bank 1, Sensor 2	1
3	PID 3Dh : Catalyst Temperature Bank 2, Sensor 1	1
4	PID 3Ch : Catalyst Temperature Bank 1, Sensor 1	1
5	PID 3Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	0
6	PID 3Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	0
7	PID 39h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	0

## I.47.27 Description of PID 21h - Distance travelled while MIL is activated

### PID \$21 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equip- ment SI (Metric) /English display
21	Distance Travelled While MIL is Activated	A , B	0 km	65535 km	1 km per count	MIL_DIST: xxxxx km (xxxxx miles)
Continued on next page						

	Conditions for "Distance travelled" counter: <ul style="list-style-type: none"> <li>• reset to \$0000 when MIL state changes from deactivated to activated by this ECU</li> <li>• accumulate counts in km if MIL is activated (ON)</li> <li>• do not change value while MIL is not activated (OFF)</li> <li>• reset to \$0000 if diagnostic information is cleared either by service \$04 or 40 warm-up cycles without MIL activated</li> <li>• do not wrap to \$0000 if value is \$FFFF</li> </ul>	
--	---	--

Data Byte	Application data to use	Formating conversion used
data A	MSB ( DIST_ACT_MIL )	-
data B	LSB ( DIST_ACT_MIL )	

### I.47.28 Description of PID 23h - Fuel Rail Pressure

**IF** NC\_INF\_CONF <> 0 (only supported for MSD)  
**THEN**


PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equip- ment SI (Metric) /English display
23	Fuel rail pressure	A , B	0 kPa	655350 kPa	10 kPa per bit unsigned, 1 kPA = 0.1450377 PSI	FRP: xxxxxx kPa (xxxxx.x PSI)
	FRP shall display fuel rail pressure at the engine when the reading is referenced to atmosphere (gauge pressure)					

Data Byte	Application data to use	Formatting conversion used
data A	MSB (FUP_H_SAE)	Shift to different range
data B	LSB (FUP_H_SAE)	Shift to different range

**ENDIF**

### I.47.29 Description of PID 24h - Bank 1 Sensor 1 (Wide range)

**PID \$24 definition**

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PID (hex)	Description Use if PID \$13 or PID \$1D is supported!	Data byte	Min. value	Max. value	Scaling/ bit	External test equip- ment SI (Metric) /English display
24	Equivalence Ratio (lambda) (B1-S1) Bank 1 – Sensor 1 (wide range O2S)	A , B	0	1.999	- 0.0000305	EQ_RATxy: x.xxx
	Oxygen Sensor Voltage (B1-S1)	C , D	0 V	7.999 V	0.000122 V	O2Sxy: x.xxx V
	PID \$24 shall be used for linear or wide-ratio Oxygen Sensors when equivalence ratio and voltage are displayed					

**IF** (PID 13h is supported) **THEN**  
**IF** (Bank 1 is supported) **THEN**

Data Byte	Application data to use	Formating conversion used
data A	MSB (LAMB_LS_UP[1])	Shift to different range
data B	LSB (LAMB_LS_UP[1])	=
data C	MSB (VLS_COR_LSL[1])	=
data D	LSB (VLS_COR_LSL[1])	=

**ELSE**

Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	=
data C	NONE	=
data D	NONE	=

**ENDIF**

**ENDIF**

### I.47.30 Description of PID 28h - Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range)

**PID \$28 definition if PID \$13 is supported**

PID	Description	Data	Min.	Max.	Scaling/ bit	External test equip- ment
Continued on next page						



(hex)	Use if PID \$13 is supported!	byte	value	value		SI (Metric) /English display
28	Equivalence Ratio (lambda) Bank 2 – Sensor 1 (wide range O2S)	A , B	0	1.999	-	EQ_RATxy: x.xxx 0.0000305
	Oxygen Sensor Voltage (B2-S1)	C , D	0 V	7.999 V	0.000122 V	O2Sxy: x.xxx V
PIDs \$28 shall be used for linear or wide-ratio Oxygen Sensors when equivalence ratio and voltage are displayed						

**IF** (PID 13h is supported) **THEN**  
**IF** (Bank 2 is supported) **THEN**

Data Byte	Application data to use	Formating conversion used
data A	MSB (LAMB_LS_UP[2])	Shift to different range
data B	LSB (LAMB_LS_UP[2])	=
data C	MSB (VLS_COR_LSL[2])	=
data D	LSB (VLS_COR_LSL[2])	=

**ELSE**

Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	=
data C	NONE	=
data D	NONE	=

**ENDIF**

**ENDIF**

### I.47.31 Description of PID 2C - Commanded EGR

**IF** NC\_INJ\_CONF <> 0 (only supported for MSD)  
**THEN**

PID	Description	Data	Min.	Max.	Scaling/ bit	External test equip- ment
(hex)		byte	value	value		SI (Metric) /English display
Continued on next page						

2C	Commanded EGR	A	0% (no flow)	100% (max. flow)	100/255 %	EGR_PCT: xxx.x%
<p>Commanded EGR displayed as a percent. EGR_PCT shall be normalised to the maximum EGR commanded output control parameter. EGR systems use a variety of methods to control the amount of EGR delivered to the engine.</p> <p>1) If an on/off solenoid is used – EGR_PCT shall display 0% when the EGR is commanded off, 100% when the EGR system is commanded on.</p> <p>2) If a vacuum solenoid is duty cycled, the EGR duty cycle from 0 to 100% shall be displayed.</p> <p>3) If a linear or stepper motor valve is used, the fully closed position shall be displayed as 0%, the fully open position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open position. For example, a stepper-motor EGR valve that moves from 0 to 128 counts shall display 0% at 0 counts, 100% at 128 counts and 50% at 64 counts.</p> <p>4) Any other actuation method shall be normalised to display 0% when no EGR is commanded and 100% at the maximum commanded EGR position.</p>						

Data Byte	Application data to use	Formating conversion used
data A	OPG_SP_ACR	Shift to different range

**ENDIF****I.47.32 Description of PID 2D definition - EGR Error**

**IF** NC\_INJ\_CONF <> 0 (only supported for MSD)

**THEN**

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equip- ment SI (Metric) /English dis- play
2D	EGR Error = (EGR actual – EGR commanded) /EGR commanded * 100%	A	-100 % (less than com- manded)	+99.22 % (more than com- manded)	100/128 % (0 % at 128)	EGR_ERR: xxx.x%
Continued on next page						


	<p>EGR error, as a percent of commanded EGR. Often, EGR valve control outputs are not in the same engineering units as the EGR feedback input sensors. For example, an EGR valve can be controlled using a duty-cycled vacuum solenoid, however, the feedback input sensor is a position sensor. This makes it impossible to display "actual" versus "commanded" in the same engineering units. EGR error solved this problem by displaying a normalised (non-dimensional) EGR system feedback parameter. EGR error is defined to be:</p> $(\text{actual EGR} - \text{commanded EGR}) / \text{commanded EGR}$ <p>For example if 10% EGR is commanded and 5% is delivered to the engine, the EGR_ERR is <math>(5\% - 10\%) / 10 = -50\%</math> error.</p> <p>EGR_ERR may be computed using various control parameters such as position, steps, counts, etc. All EGR systems must react to quickly changing conditions in the engine; therefore, EGR_ERR will generally show errors during transient conditions. Under steady condition, the error will be minimized (no necessarily zero, however) if the EGR system is under control.</p> <p>If the control system does not use closed loop control, EGR_ERR shall not be supported.</p>
--	--

Data Byte	Application data to use	Formating conversion used
data A	OBD_EGR_DIF	-

## ENDIF

### I.47.33 Description of PID 2Eh - Commanded Evaporative Purge

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display
2E	Commanded Evaporative Purge	A	0% no flow	100% max. flow	100/255 %	EVAP_PCT: xxx.x %
	<p>Commanded evaporative purge control valve displayed as a percent. EVAP_PCT shall be normalised to the maximum EVAP purge commanded output control parameter.</p> <ol style="list-style-type: none"> <li>1) If an on/off solenoid is used – EVAP_PCT shall display 0% when purge is commanded off, 100% when purge is commanded on.</li> <li>2) If a vacuum solenoid is duty cycled, the EVAP purge valve duty cycle from 0 to 100% shall be displayed.</li> <li>3) If a linear or stepper motor valve is used, the fully closed position shall be displayed as 0%, the fully open position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open position. For example, a stepper-motor EVAP purge valve that moves from 0 to 128 counts shall display 0% at 0 counts, 100% at 128 counts and 50% at 64 counts.</li> <li>4) Any other actuation method shall be normalised to display 0% when no purge is commanded and 100% at the maximum commanded purge position/flow.</li> </ol>					

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Data Byte	Application data to use	Formating conversion used
data A	CPPWM_CPS	-

### I.47.34 Description of PID 2Fh - Fuel Level Input


PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display
2F	Fuel Level Input	A	0% no fuel	100% max. fuel capacity	100/255 %	FLI: xxx.x %
<p>FLI shall indicate nominal fuel tank liquid fill capacity as a percent of maximum, if utilised by the control module for OBD monitoring . FLI may be obtained directly from a sensor, may be obtained indirectly via the vehicle serial data communication bus, or may be inferred by the control strategy using other sensor inputs. Vehicles that use gaseous fuels shall display the percent of useable fuel capacity.</p>						

Data Byte	Application data to use	Formating conversion used
data A	OBD_FTL	no

### I.47.35 Description of PID 30h - Number of warm-ups since diagnostic trouble codes cleared

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display
30	Number of warm-ups since diagnostic trouble codes cleared	A	0	255	1 warm-up per count	WARM_UPS: xxx
<p>Number of OBD warm-up cycles since all DTCs were cleared (via an external test equipment or possibly, a battery disconnect). A warm-up is defined in the OBD regulations to be sufficient vehicle operation such that coolant temperature rises by at least 22°C (40°F) from engine starting and reaches a minimum temperature of 70°C (160 deg°F) (60°C (140°F) for diesels). This PID is not associated with any particular DTC. It is simply an indication for I/M, of the last time an external test equipment was used to clear DTCs. If greater than 255 warm ups have occurred, WARM_UPS shall remain at 255 and not wrap to zero.</p>						

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Data Byte	Application data to use	Formating conversion used
data A	CTR_WUP_DTC_CLR	-

### I.47.36 Description of PID 31h - Distance since diagnostic trouble codes cleared


PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display
31	Distance since diagnostic trouble codes cleared (same scaling as PID \$21)	A , B	0 km	65,535 km	1 km per count	CLR_DIST: xxxxx km (xxxxx miles)
Distance accumulated since DTCs were cleared (via an external test equipment or possibly, a battery disconnect). This PID is not associated with any particular DTC. It is simply an indication for I/M (Inspection/ Maintenance), of the last time an external test equipment was used to clear DTCs. If greater than 65,535 km have occurred, CLR_DIST shall remain at 65,535 km and not wrap to zero.						

Data Byte	Application data to use	Formating conversion used
data A	MSB(DIST_DTC_CLR)	-
data B	LSB(DIST_DTC_CLR)	

### I.47.37 Description of PID 33h - Barometric Pressure

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display
33	Barometric Pressure	A	0 kPa (absolute)	255 kPa (absolute)	1 kPa per bit (absolute)	BARO: xxx kPa (xx.x inHg)
Continued on next page						

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<p>Barometric pressure utilised by the control module. BARO is normally obtained from a dedicated BARO sensor, from a MAP sensor at key-on and during certain modes of driving, or inferred from a MAF sensor and other inputs during certain modes of driving. The control module shall report BARO from whatever source it is derived from.</p> <p>NOTE Some weather services report local BARO values adjusted to sea level. In these cases, the reported value may not match the displayed value on the external test equipment.</p> <p>NOTE If BARO is inferred while driving and stored in non-volatile RAM or Keep-alive RAM, BARO may not be accurate after a battery disconnect or total memory clear.</p>
---

Data Byte	Application data to use	Formating conversion used
data A	AMP_SAE	Shift to different range

### I.47.38 Description of PID 34h - Bank 1 Sensor 1 (Wide range)

#### PID \$34 definition if PID \$13 is supported

PID (hex)	Description Use if PID \$13 or PID \$1D is supported!	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
34	Equivalence Ratio (lambda) Bank 1 - Sensor 1 (wide range O2S)	A , B	0	1.999	0.0000305	EQ_RATxy: x.xxx
	Oxygen Sensor Current (B1-S1)	C , D	-128 mA	- 127.996 mA	0.00390625 mA (\$8000 = 0 mA)	O2Sxy: x.xxx mA
	PID \$34 shall be used for linear or wide-ratio Oxygen Sensors when equivalence ratio and current are displayed					

**IF** (PID 13h is supported) **THEN**  
**IF** (Bank 1 is supported) **THEN**

Data Byte	Application data to use	Formating conversion used
data A	LAMB_LS_UP[1]	-
data B	LAMB_LS_UP[1]	
data C	IPLSL_COR[1]	-
data D	IPLSL_COR[1]	

**ELSE**

Data Byte	Application data to use	Formating conversion used
data A	NONE	-
data B	NONE	
data C	NONE	-
data D	NONE	

**ENDIF**

**ENDIF**

### I.47.39 Description of PID 38h - Bank 2 Sensor 1 (Wide range)

**PID \$38 definition if PID \$13 is supported**

PID	Description	Data	Min.	Max.	Scaling/bit	External test equipment
(hex)	Use if PID \$13 is supported!	byte	value	value		SI (Metric) / English display
38	Equivalence Ratio (lambda) Bank 2 - Sensor 1 (wide range O2S)	A , B	0	1.999	0.0000305	EQ_RATxy: x.xxx
	Oxygen Sensor Current (B2-S1)	C , D	-128 mA	- 127.996 mA	0.00390625 mA (\$8000 = 0 mA)	O2Sxy: x.xxx mA
PIDs \$38 shall be used for linear or wide-ratio Oxygen Sensors when equivalence ratio and current are displayed						

**IF (PID 13h is supported) THEN**


**IF (Bank 2 is supported) THEN**

Data Byte	Application data to use	Formating conversion used
data A	LAMB_LS_UP[2]	-
data B	LAMB_LS_UP[2]	
data C	IPLSL_COR[2]	-
data D	IPLSL_COR[2]	

**ELSE**

Data Byte	Application data to use	Formating conversion used
data A	NONE	-
data B	NONE	
data C	NONE	-
data D	NONE	

**ENDIF**

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**ENDIF****I.47.40 Description of PID 3C - Catalyst temperature Bank 1, Sensor 1**

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
3C	Catalyst Temperature Bank 1, Sensor 1	A , B	-40 °C	+6513.5 °C	0.1 °C /bit with -40 °C offset	CATEMP11: xxxx.x °C (xxxx.x °F)
CATEMP11 shall display catalyst substrate temperature for a bank 1 catalyst, if utilised by the control module strategy for OBD monitoring, or the Bank 1, Sensor 1 catalyst temperature sensor. CATEMP11 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.						


Data Byte	Application data to use	Formating conversion used
data A	MSB( TEG_CAT_UP_MDL[1])	Shift to different range
data B	LSB(TEG_CAT_UP_MDL[1])	=

**I.47.41 Description of PID 3D - Catalyst temperature Bank 2, Sensor 1**

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
3D	Catalyst Temperature Bank 2, Sensor 1	A , B	-40 °C	+6513.5 °C	0.1 °C /bit with -40 °C offset	CATEMP21: xxxx.x °C (xxxx.x °F)
CATEMP21 shall display catalyst substrate temperature for a bank 2 catalyst, if utilised by the control module strategy for OBD monitoring, or the Bank 2, Sensor 1 catalyst temperature sensor. CATEMP21 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.						

Data Byte	Application data to use	Formating conversion used
data A	MSB( TEG_CAT_UP_MDL[2])	Shift to different range
data B	LSB(TEG_CAT_UP_MDL[2])	=

**I.47.42 Description of PID 3E - Catalyst temperature Bank 1, Sensor 2**

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PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equip- ment SI (Metric) /English display
3E	Catalyst Temperature Bank 1, Sensor 2	A , B	-40 °C	+6513.5 °C	0.1 °C /bit with -40 °C offset	CATEMP12: xxxx.x °C (xxxx.x °F)
CATEMP12 shall display catalyst substrate temperature for an additional bank 1 catalyst, if utilised by the control module strategy for OBD monitoring, or the Bank 1, Sensor 2 catalyst temperature sensor. CATEMP12 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.						

Data Byte	Application data to use	Formating conversion used
data A	MSB( TEG_CAT_DOWN_MDL[1])	Shift to different range
data B	LSB(TEG_CAT_DOWN_MDL[1])	=

### I.47.43 Description of PID 3F - Catalyst temperature Bank 2, Sensor 2


PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equip- ment SI (Metric) /English display
3F	Catalyst Temperature Bank 2, Sensor 2	A , B	-40 °C	+6513.5 °C	0.1 °C /bit with -40 °C offset	CATEMP22: xxxx.x °C (xxxx.x °F)
CATEMP22 shall display catalyst substrate temperature for an additional bank 2 catalyst, if utilised by the control module strategy for OBD monitoring, or the Bank 2, Sensor 2 catalyst temperature sensor. CATEMP22 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.						

Data Byte	Application data to use	Formating conversion used
data A	MSB( TEG_CAT_DOWN_MDL[2])	Shift to different range
data B	LSB(TEG_CAT_DOWN_MDL[2])	=

### I.47.44 Description of PID 40h - Supported PIDs 41h - 60h

- 0 : the PID is not used
- 1 : the PID is used

#### DATA A - Supported PIDs 41h - 48h

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PID 40h - DATA A - Supported PID 41h to 48h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[8]
0	PID 48h : Absolute Throttle Position C	0
1	PID 47h : Absolute Throttle Position B	1
2	PID 46h : Ambient air temperature	1
3	PID 45h : Relative Throttle Position	1
4	PID 44h : Command Equivalence Ratio	1
5	PID 43h : Absolute Load Value	1
6	PID 42h : Control module voltage	1
7	PID 41h : Monitor status this driving cycle	1

### DATA A - Supported PIDs 49h - 50h


PID 40h - DATA B - Supported PID 49h to 50h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[9]
0	PID 50h : Max. value for Air Flow Rate	0
1	PID 4Fh : Max. value for Equivalence Ratio	0
2	PID 4Eh : Time since diagnostic trouble codes cleared	1
3	PID 4Dh : Minutes run by the engine while MIL activated	1
4	PID 4Ch : Commanded Throttle Actuator Control	1
5	PID 4Bh : Accelerator Pedal Position F	0
6	PID 4Ah : Accelerator Pedal Position E	1
7	PID 49h : Accelerator Pedal Position D	1

### DATA C - Supported PIDs 51h to 58h

PID 40h - DATA C - Supported PID 51h to 58h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[10]
0	PID 58h : Long term fuel trim Bank 2	1
1	PID 57h : Short term fuel trim Bank 2	1
2	PID 56h : Long term fuel trim Bank 1	1
3	PID 55h : Short term fuel trim Bank 1	1
4	PID 54h : Evap System Vapor Pressure	0
5	PID 53h : Absolute Evap System Vapor Pressure	0
6	PID 52h : Alcohol Fuel Percentage	0
7	PID 51h : Type of fuel used by the vehicle	0

### DATA D - Supported PIDs 59h to 60h

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PID 40h - DATA D - Supported PID 59h to 60h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[11]
0	PID 60h : PIDs supported (\$61 - \$80)	1 (If NC_CYL_NR = 8)
1	PID 5Fh : Emission requirements to which vehicle is designed	0
2	PID 5Eh : Engine Fuel Rate	0
3	PID 5Dh : Fuel Injection Timing	0
4	PID 5Ch : Engine Oil Temperature	0
5	PID 5Bh : Hybrid Battery Pack Remaining Life	0
6	PID 5Ah : Relative Accelerator Pedal Position	0
7	PID 59h : Fuel Rail Pressure (absolute)	0

## I.47.45 Description of PID 41 - Monitor status this driving cycle

### PID \$41 definition

PID (hex)	Description	Data Byte	Scaling/bit	External test equipment SI (Metric) /English display
41	Monitor status this driving cycle			
	<p>The bit in this PID shall report two pieces of information for each monitor:</p> <ol style="list-style-type: none"> <li>1) Monitor enable status for the current driving cycle. This bit shall indicate when a monitor is disabled in a manner such that there is no way for the driver to operate the vehicle for the remainder of the driving cycle and make the monitor run. Typical examples are:  Engine-off soak not long enough (e.g., cold start temperature conditions not satisfied)  Monitor maximum time limit or number of attempts/aborts exceeded  Ambient air temperature too low or too high  BARO too low (high altitude)  The monitor shall not indicate "disabled" for operator-controlled conditions such as rpm, load, throttle position, minimum time limit not exceeded, ECT, TP, etc.</li> <li>2) Monitor completion status for the current driving/monitoring cycle. Status shall be reset to "not complete" upon starting a new monitoring cycle. Note that some monitoring cycles can include various engine-operating conditions; other monitoring cycles begin after the ignition key is turned off. Some status bits on a given vehicle can utilise engine-running monitoring cycles while others can utilise engine-off monitoring cycles. Resetting the bits to "not complete" upon starting the engine will accommodate most engine-running and engine-off monitoring cycles, however, manufacturers are free to define their own monitoring cycles.</li> </ol> <p>NOTE PID \$41 bits shall be utilised for all non-continuous monitors which are supported, and change completion status in PID \$01. If a non-continuous monitor is not supported or always shows "complete", the corresponding PID \$41 bits shall indicate disabled and complete. PID \$41 bits may be utilised at the vehicle manufacturer's discretion for all continuous monitors which are supported with the exception of bit 03 which shall always showed CCM as enabled for spark ignition and compression ignition engines.</p>			

### PID \$41 definition (continued)

PID	Description	Data	Scaling/bit	External test equipment
Continued on next page				


(hex)		Byte		SI (Metric) /English display
41	Monitor status this driving cycle			
		<b>A</b> (bit)	byte 1 of 4	
	Reserved - shall be reported as \$00	0-7		--
	<b>Enable status of continuous monitors this monitoring cycle:</b>	<b>B</b> (bit)	byte 2 of 4 (Low Nibble)	<b>Enable status of continuous monitors this monitoring cycle: NO means disabled for rest of this monitoring cycle or not supported in PID \$01, YES means enabled for this monitoring cycle.</b>
	Misfire monitoring	0	0 = monitor disabled for rest of this monitoring cycle or not supported (NO) 1 = monitor enabled for this monitoring cycle (YES)	MIS_ENA: NO or YES FUEL_ENA: NO or YES CCM_ENA: YES
	Fuel system monitoring	1		
	Comprehensive component monitoring	2		
	reserved (bit shall be reported as '0')	3		

### PID \$41 definition (continued)

PID (hex)	Description	Data Byte	Scaling/bit	External test equipment SI (Metric) /English display
41	Monitor status this driving cycle			
	<b>Completion status of continuous monitors this monitoring cycle:</b>	<b>B</b> (bit)	byte 2 of 4 (High Nibble)	<b>Completion status of continuous monitors this monitoring cycle:</b>
	Misfire monitoring C_CLC_READY_OBD_1[0]	4	See PID \$01 to determine which monitors are supported 0 = monitor complete this monitoring cycle, or not supported (YES) 1 = monitor not complete this monitoring cycle (NO)	MIS_
	Fuel system monitoring C_CLC_READY_OBD_1[1]	5		CMPL:
	Comprehensive component monitoring C_CLC_READY_OBD_1[2]	6		YES
	reserved (bit shall be reported as '0') C_CLC_READY_OBD_1[3]	7		or
				NO
				FUELCMPL:
				YES
				or
				NO
				CCM_
				CMPL:
				YES

### PID \$41 definition (continued)

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PID (hex)	Description	Data Byte	Scaling/bit	External test equipment SI (Metric) /English display
41	Monitor status this driving cycle			
	<b>Enable status of non-continuous monitors this monitoring cycle:</b>	<b>C (bit)</b>	<b>byte 3 of 4</b>	<b>Enable status of non-continuous monitors this monitoring cycle:</b>
	Catalyst monitoring	0	0 = monitor disabled for rest of this monitoring cycle (NO) 1 = monitor enabled for this monitoring cycle (YES)	CAT_ENA: YES or NO HCAT_ENA: YES or NO EVAP_ENA: YES or NO AIR_ENA: YES or NO ACRF_ENA: YES or NO O2S_ENA: YES or NO HTR_ENA: YES or NO EGR_ENA: YES or NO
	Heated catalyst monitoring	1		
	Evaporative system monitoring	2		
	Secondary air system monitoring	3		
	A/C system refrigerant monitoring	4		
	Oxygen sensor monitoring	5		
	Oxygen sensor heater monitoring	6		
	EGR system monitoring	7		


### PID \$41 definition (continued)

PID (hex)	Description	Data Byte	Scaling/bit	External test equipment SI (Metric) /English display
41	Monitor status this driving cycle			
	<b>Completion status of non-continuous monitors this monitoring cycle:</b>	<b>D (bit)</b>	<b>byte 4 of 4</b>	<b>Completion status of non-continuous monitors this monitoring cycle:</b>
	Catalyst monitoring	0	See PID \$01 to determine which monitors are supported. 0 = monitor complete this monitoring cycle, or not supported (YES) 1 = monitor not complete this monitoring cycle (NO)	CAT_CMPL: YES or NO HCATCMPL: YES or NO EVAPCMPL: YES or NO AIR_CMPL: YES or NO ACRFCMPL: YES or NO O2S_CMPL: YES or NO HTR_CMPL: YES or NO EGR_CMPL: YES or NO
	Heated catalyst monitoring	1		
	Evaporative system monitoring	2		
	Secondary air system monitoring	3		
	A/C system refrigerant monitoring	4		
	Oxygen sensor monitoring	5		
	Oxygen sensor heater monitoring	6		
	EGR system monitoring	7		

Data Byte	Application data to use	Formatting conversion used
data A	0x00	-
data B	C_CLC_READY_OBD_1[0...3] + STATE_ENA_OBD[0...3]	
data C	STATE_ENA_OBD[8..15]	

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data D	STATE_CMPL_OBD[8..15]	
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## I.47.46 Description of PID 42 - Control module voltage

### PID \$42 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equip- ment SI (Metric) /English dis- play
42	Control module voltage	A , B	0 V	65.535 V	0.001 V per bit	VPWR: xx.xxx V
<p>VPWR – power input to the control module. VPWR is normally battery voltage, less any voltage drop in the circuit between the battery and the control module.</p> <p>NOTE 42-volt vehicles may utilise multiple voltages for different systems on the vehicle. VPWR represents the voltage at the control module; it may be significantly different than battery voltage.</p>						

Data Byte	Application data to use	Formating conversion used
data A	MSB (VB)	Shift to different range
data B	LSB (VB)	

## I.47.47 Description of PID 43 - Absolute Load Value

### PID \$43 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equip- ment SI (Metric) /English dis- play
43	Absolute Load Value	A , B	0 %	25700%	100/255 %	LOAD_ABS: xxx.x%
Continued on next page						

	<p>The absolute load value has some different characteristics than the LOAD_PCT defined in PID 04 This definition, although restrictive, will standardise the calculation. LOAD_ABS is the normalised value of air mass per intake stroke displayed as a percent.</p> <p><math>LOAD\_ABS = [air\ mass\ (g/intake\ stroke)] / [1.184\ (g/intake\ stroke) * cylinder\ displacement\ in\ litres]</math></p> <p>Derivation:</p> <p><math>air\ mass\ (g\ /intake\ stroke) = [total\ engine\ air\ mass\ (g/sec)] / [rpm\ (revs/min) * (1\ min /60\ sec) * (1/2\ \#\ of\ cylinders\ (strokes\ /rev)]</math></p> <p><math>LOAD\_ABS = [air\ mass\ (g)/intake\ stroke] / [maximum\ air\ mass\ (g)/intake\ stroke\ at\ WOT@STP\ at\ 100\% \ volumetric\ efficiency] * 100\%</math></p> <p>Where: STP = Standard Temperature and Pressure = 25°C, 29.92 in Hg (1013 hPa) BARO, WOT = wide open throttle</p> <p>The quantity (maximum air mass (g)/intake stroke at WOT@STP at 100% volumetric efficiency) is a constant for a given cylinder swept volume. The constant is 1.184 (g/litre 3) * cylinder displacement (litre 3/intake stroke) based on air density at STP</p> <p>Characteristics of LOAD_ABS are:</p> <p>Ranges from 0 to approximately 0.95 for naturally aspirated engines, 0 – 4 for boosted engines</p> <p>Linearly correlated with engine indicated and brake torque</p> <p>Often used to schedule spark and EGR rates</p> <p>Peak value of LOAD_ABS correlates with volumetric efficiency at WOT.</p> <p>Indicates the pumping efficiency of the engine for diagnostic purposes.</p> <p>Spark ignition engine are required to support PID \$43. Compression ignition (diesel) engines are not required to support this PID.</p> <p>NOTE See PID \$04 for an additional definition of engine LOAD..</p>
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Data Byte	Application data to use	Formating conversion used
data A	MSB (LOAD_ABSV)	no
data B	LSB (LOAD_ABSV)	no

## I.47.48 Description of PID 44 - Commanded Equivalence Ratio

Table .1 — PID \$44 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equip- ment SI (Metric) /English dis- play
44	Commanded Equivalence Ratio	A , B	0	1.999	0.0000305	EQ_RAT: x.xxx
Continued on next page						

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	<p>Fuel systems that utilise conventional oxygen sensor shall display the commanded open loop equivalence ratio while the fuel control system is in open loop. EQ_RAT shall indicate 1.0 while in closed loop fuel.</p> <p>Fuel systems that utilise wide-range/linear oxygen sensors shall display the commanded equivalence ratio in both open loop and closed loop operation.</p> <p>To obtain the actual A/F ratio being commanded, multiply the stoichiometric A/F ratio by the equivalence ratio. For example, for gasoline, stoichiometric is 14.64:1 ratio. If the fuel control system was commanding an 0.95 EQ_RAT, the commanded A/F ratio to the engine would be <math>14.64 * 0.95 = 13.9</math> A/F</p>
--	---

Data Byte	Application data to use	Formating conversion used
data A	MSB(LAMB_SP_SAE[1])	Shift to different resolution
data B	LSB(LAMB_SP_SAE[1])	=

## I.47.49 Description of PID 45 - Relative Throttle Position


### PID \$45 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equip- ment SI (Metric) /English display
45	Relative Throttle Position	A	0 %	100 %	100/255 %	TP_R: xxx.x %
	<p>Relative or "learned" throttle position shall be displayed as a normalised value, scaled from 0 to 100%. TP_R should display a value of 0% at the "learned closed-throttle position. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed throttle position is a 1.0 volts, TP shall display <math>(1.0 - 1.0 / 5.0) = 0\%</math> at closed throttle and 30% at 2.5 volts. Because of the closed-throttle offset, wide open throttle will usually indicate substantially less than 100%.</p> <p>For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage. See PID \$11 for a definition of Absolute Throttle Position.</p>					

Data Byte	Application data to use	Formating conversion used
data A	OBD_TPS_REL	-

## I.47.50 Description of PID 46 - Ambient air temperature

•

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## PID \$46 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equip- ment SI (Metric) /English display
46	Ambient air temperature (same scaling as IAT - \$0F)	A	-40 °C	+215 °C	1 °C with -40 °C offset	AAT: xxx °C /xxx °F
AAT shall display ambient air temperature, if utilised by the control module strategy for OBD monitoring. AAT may be obtained directly from a sensor, may be obtained indirectly via the vehicle serial data communication bus, or may be inferred by the control strategy using other sensor inputs.						

Data Byte	Application data to use	Formating conversion used
data A	OBD_TAM	-

## I.47.51 Description of PID 47 - Absolute Throttle Position B


### PID \$47 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equip- ment SI (Metric) /English display
47	Absolute Throttle Position B	A	0 %	100 %	100/255 %	TP_B: xxx.x %
<p>Absolute throttle position B, if utilised by the control module, (not "relative" or "learned" throttle position) shall be displayed as a normalised value, scaled from 0 to 100%. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed throttle position is a 1.0 volts, TP_B shall display <math>(1.0 / 5.0) = 20\%</math> at closed throttle and 50% at 2.5 volts. Throttle position at idle will usually indicate greater than 0%, and throttle position at wide open throttle will usually indicate less than 100%.</p> <p>For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage.</p>						

Data Byte	Application data to use	Formating conversion used
data A	OBD_TPS_2	-

## I.47.52 Description of PID 49 - Accelerator Pedal Position D

### PID \$49 definition

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PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equip- ment SI (Metric) /English display
49	Accelerator Pedal Position D	A	0 %	100 %	100/255 %	APP_D: xxx.x %
<p>Accelerator Pedal Position D, if utilised by the control module, (not "relative" or "learned" pedal position) shall be displayed as a normalised value, scaled from 0 to 100%. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed pedal is 1.0 volt, APP_D shall display <math>(1.0 / 5.0) = 20\%</math> at closed pedal and 50% at 2.5 volts. Pedal position at idle will usually indicate greater than 0%, and pedal position at wide open pedal will usually indicate less than 100%.</p> <p>For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage.</p>						

Data Byte	Application data to use	Formating conversion used
data A	OBD_PV_1	-

## I.47.53 Description of PID 4A - Accelerator Pedal Position E

### PID \$4A definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equip- ment SI (Metric) /English display
4A	Accelerator Pedal Position E	A	0 %	100 %	100/255 %	APP_E: xxx.x %
<p>Accelerator Pedal Position E, if utilised by the control module, (not "relative" or "learned" pedal position) shall be displayed as a normalised value, scaled from 0 to 100%. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed pedal is 1.0 volt, APP_E shall display <math>(1.0 / 5.0) = 20\%</math> at closed pedal and 50% at 2.5 volts. Pedal position at idle will usually indicate greater than 0%, and pedal position at wide open pedal will usually indicate less than 100%.</p> <p>For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage.</p>						

Data Byte	Application data to use	Formating conversion used
data A	OBD_PV_2	-

## I.47.54 Description of PID 4C - Commanded Throttle Actuator Control

### PID \$4C definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
4C	Commanded Throttle Actuator Control	A	0% (closed throttle)	100% (wide open throttle)	100/255 %	TAC_PCT: xxx.x%
<p>Commanded TAC displayed as a percent. TAC_PCT shall be normalised to the maximum TAC commanded output control parameter. TAC systems use a variety of methods to control the amount of throttle opening.</p> <p>1) If a linear or stepper motor is used, the fully closed throttle position shall be displayed as 0%, the fully open throttle position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open throttle position. For example, a stepper-motor TAC that moves the throttle from 0 to 128 counts shall display 0% at 0 counts, 100% at 128 counts and 50% at 64 counts.</p> <p>2) Any other actuation method shall be normalised to display 0% when the throttle is commanded closed and 100% when the throttle is commanded open.</p>						

Data Byte	Application data to use	Formatting conversion used
data A	OBD_TPS_SP	-

## I.47.55 Description of PID 4D - Minutes run by the engine while MIL activated

### PID \$4D definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display
4D	Minutes run by the engine while MIL activated	A, B	0 min	65535 min 1092.25 hours	1 min per count	MIL_TIME: xxxx hrs, xx min
Continued on next page						

	<p>Conditions for "Minutes run by the engine while MIL activated" counter:</p> <ul style="list-style-type: none"> <li>• reset to \$0000 when MIL state changes from deactivated to activated by this ECU</li> <li>• accumulate counts in minutes if MIL is activated (ON)</li> <li>• do not change value while MIL is not activated (OFF)</li> <li>• reset to \$0000 if diagnostic information is cleared either by service \$04 or 40 warm-up cycles without MIL activated</li> <li>• do not wrap to \$0000 if value is \$FFFF</li> </ul>	
--	--	--

Data Byte	Application data to use	Formating conversion used
data A	MSB (T_ACT_MIL)	-
data B	LSB (T_ACT_MIL)	

## I.47.56 Description of PID 4E - Time since diagnostic trouble codes cleared

### PID \$4E definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equip- ment SI (Metric) /English display
4E	Time since diagnostic trouble codes cleared	A, B	0 min	65535 min 1092.25 hours	1 min per count	CLR_TIME: xxxx hrs, xx min
	Time accumulated since DTCs were cleared (via an external test equipment or possibly, a battery disconnect). This PID is not associated with any particular DTC. It is simply an indication for I/M (Inspection/Maintenance), of the last time an external test equipment was used to clear DTCs. If greater than 65,535 min have occurred, CLR_TIME shall remain at 65,535 min and not wrap to zero.					

Data Byte	Application data to use	Formating conversion used
data A	MSB (T_DTC_CLR)	-
data B	LSB (T_DTC_CLR)	

## I.47.57 Description of PID 55 – Short term fuel trim Bank 1

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equip- ment SI (Metric) /English display
55	Short Term Secondary O2 Sensor Fuel Trim	A , B	-100 %	+99,22 %	100/128 %	
<p>Short Term Secondary O2 Sensor Fuel Trim Bank 1/3 shall indicate the correction being utilised by the closed loop fuel algorithm. If the fuel system is in open loop, STSO2FT shall report 0% correction.</p> <p>NOTE Data B shall only be included in the response message of a PID \$55 if supported by the vehicle.</p> <p>If PID \$1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 3 supported) of PID \$1D if Data B of PID \$55 is supported or not. If PID \$13 is supported, then DATA B of PID \$55 shall not be supported.</p>						

**IF** (PID 13h is supported) **THEN**  
     **IF** (Bank 1 is supported) **AND** (Bank 1 Sensor 2 is supported)  
     **THEN**

Data Byte	Application data to use	Formating conversion used
data A	LAMB_DELTA_LAM_ADJ_SAE[1]	-
data B	NONE	-

**ELSE**

Data Byte	Application data to use	Formating conversion used
data A	NONE	
data B	NONE	-

**ENDIF**

**ENDIF**

## I.47.58 Description of PID 56 – Long term fuel trim Bank 1

### PID \$56 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equip- ment SI (Metric) /English display
56	Long Term Secondary O2 Sensor Fuel Trim	A , B	-100 %	+99,22 %	100/128 %	
Continued on next page						

	<p>Secondary O2 Sensor Fuel trim correction for Bank 1/3 stored in Non-volatile RAM or Keep-alive RAM. LGSO2FT shall indicate the correction being utilised by the fuel control algorithm at the time the data is requested, in both open loop and closed loop fuel control. If no correction is utilised in open loop fuel, LGSO2FT shall report 0% correction. If secondary O2 sensor long-term fuel trim is not utilised at all by the fuel control algorithm, the PID shall not be supported.</p> <p>NOTE Data B shall only be included in the response message of a PID \$56 if supported by the vehicle. If PID \$1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 3 supported) of PID \$1D if Data B of PID \$56 is supported or not. If PID \$13 is supported, then DATA B of PID \$56 shall not be supported.</p>
--	--

**IF** (PID 13h is supported) **THEN**  
     **IF** (Bank 1 is supported) **AND** (Bank 1 Sensor 2 is supported)  
     **THEN**

Data Byte	Application data to use	Formating conversion used
data A	LAMB_DELTA_AD_LAM_ADJ_SAE[1]	-
data B	NONE	-

**ELSE**

Data Byte	Application data to use	Formating conversion used
data A	NONE	-
data B	NONE	-

**ENDIF**


**ENDIF**

## I.47.59 Description of PID 57 – Short term fuel trim Bank 2

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equip- ment SI (Metric) /English display
55	Short Term Secondary O2 Sensor Fuel Trim	A , B	-100 %	+99,22 %	100/128 %	
	<p>Short Term Secondary O2 Sensor Fuel Trim Bank 2/4 shall indicate the correction being utilised by the closed loop fuel algorithm. If the fuel system is in open loop, STSO2FT shall report 0% correction.</p> <p>NOTE Data B shall only be included in the response message of a PID \$57 if supported by the vehicle. If PID \$1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 4 supported) of PID \$1D if Data B of PID \$57 is supported or not. If PID \$13 is supported, then DATA B of PID \$57 shall not be supported.</p>					

**IF** (PID 13h is supported) **THEN**

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**IF** (Bank 2 is supported) **AND** (Bank 2 Sensor 2 is supported)  
**THEN**

Data Byte	Application data to use	Formating conversion used
data A	LAMB_DELTA_LAM_ADJ_SAE[2]	-
data B	NONE	-

**ELSE**

Data Byte	Application data to use	Formating conversion used
data A	NONE	
data B	NONE	-

**ENDIF**

**ENDIF**

## I.47.60 Description of PID 58 - Long term fuel trim Bank 2


### PID \$58 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equip- ment SI (Metric) /English display
58	Long Term Secondary O2 Sensor Fuel Trim	A , B	-100 %	+99,22 %	100/128 %	
<p>Secondary Sensor Fuel trim correction for Bank 2/4 stored in Non-volatile RAM or Keep-alive RAM. LGSO2FT shall indicate the correction being utilised by the fuel control algorithm at the time the data is requested, in both open loop and closed loop fuel control. If no correction is utilised in open loop fuel, LGSO2FT shall report 0% correction. If post O2 sensor long-term fuel trim is not utilised at all by the fuel control algorithm, the PID shall not be supported.</p> <p>NOTE Data B shall only be included in the response message of a PID \$58 if supported by the vehicle.If PID \$1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 4 supported) of PID \$1D if Data B of PID \$58 is supported or not. If PID \$13 is supported, then DATA B of PID \$58 shall not be supported.</p>						

**IF** (PID 13h is supported) **THEN**  
**IF** (Bank 2 is supported) **AND** (Bank 2 Sensor 2 is supported)  
**THEN**

Data Byte	Application data to use	Formating conversion used
data A	LAMB_DELTA_AD_LAM_ADJ_SAE[2]	-
data B	NONE	-

**ELSE**

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Data Byte	Application data to use	Formating conversion used
data A	NONE	-
data B	NONE	-

**ENDIF**

**ENDIF**

### I.47.61 Description of PID 60 - Supported PIDs 61h – 80h

0 : the PID is not used

1 : the PID is used

#### DATA A - Supported PIDs 61h - 68h


PID 60h - DATA A - Supported PID 61h to 68h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[12]
0	PID 68h : Intake Air Temperature Sensor	1 (If NC_CYL_NR = 8)
1	PID 67h : Engine Coolant Temperature	0
2	PID 66h : Mass Air Flow Sensor	1 (If NC_CYL_NR = 8)
3	PID 65h : Auxiliary Inputs /Outputs	0
4	PID 64h : Engine Percent Torque Data	0
5	PID 63h : Engine Reference Torque	0
6	PID 62h : Actual Engine -Percent Torque	0
7	PID 61h : Driver's Demand Engine - Percent Torque	0

#### DATA A - Supported PIDs 69h - 70h

PID 60h - DATA B - Supported PID 69h to 70h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[13]
0	PID 70h : Boost Pressure Control	0
1	PID 6Fh : Turbocharger Compressor Inlet Pressure	0
2	PID 6Eh : Injection Pressure Control System	0
3	PID 6Dh : Fuel Pressure Control System	1 (If NC_CYL_NR = 8)
4	PID 6Ch : Commanded Throttle Actuator Control and Relative Throttle Position	1 (If NC_CYL_NR = 8)
5	PID 6Bh : Exhaust Gas Recirculation Temperature	0
6	PID 6Ah : Commanded Diesel Intake Air Flow Control and Relative Intake Air Flow Position	0
7	PID 69h : Commanded EGR and EGR Error	0

#### DATA A - Supported PIDs 71h - 78h

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PID 60h - DATA C - Supported PID 71h to 78h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[14]
0	PID 78h : Exhaust Gas Temperature Bank 1	0
1	PID 77h : Charge Air Cooler Temperature	0
2	PID 76h : Turbocharger B Temperature	0
3	PID 75h : Turbocharger A Temperature	0
4	PID 74h : Turbocharger RPM	0
5	PID 73h : Exhaust Pressure	0
6	PID 72h : Wastegate Control	0
7	PID 71h : Variable Geometry Turbo Control	0

### DATA A - Supported PIDs 79h - 80h

PID 60h - DATA D - Supported PID 79h to 80h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[15]
0	PID 80h : PIDs supported (\$81 - \$A0)	0
1	PID 7Fh : Engine Run Time	0
2	PID 7Eh : PM NTE control area status	0
3	PID 7Dh : NOx NTE control area status	0
4	PID 7Ch : Diesel Particulate Filter Temperature	0
5	PID 7Bh : Diesel Particulate Filter Bank 2	0
6	PID 7Ah : Diesel Particulate Filter Bank 1	0
7	PID 79h : Exhaust Gas Temperature Bank 2	0

## I.47.62 Description of PID 66h – Mass air flow sensor (If NC\_CYL\_NR = 8)

### PID \$66 definition

Data Byte	Application data to use	Formating conversion used
data A	STATE_PSN_MAF_SAE	-
data B	MSB (MAF_KGH_MES_SAE[1])	-
data C	LSB (MAF_KGH_MES_SAE[1])	-
data D	MSB (MAF_KGH_MES_SAE[2])	-
data E	LSB (MAF_KGH_MES_SAE[2])	-

### I.47.63 Description of PID 68h – Intake Air Temperature Sensor (If NC\_CYL\_NR = 8)

TABLE B84 - PID \$68 DEFINITION

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display	
68	Intake Air Temperature Sensor						
	Support of Intake Air Temperature Sensor Data	A (bit)	Byte 1 of 7				
	IAT Bank 1, Sensor 1 supported	A, bit 0	0	1	1 = IAT Bank 1, Sensor 1 data supported		
	IAT Bank 1, Sensor 2 supported	A, bit 1	0	1	1 = IAT Bank 1, Sensor 2 data supported		
	IAT Bank 1, Sensor 3 supported	A, bit 2	0	1	1 = IAT Bank 1, Sensor 3 data supported		
	IAT Bank 2, Sensor 1 supported	A, bit 3	0	1	1 = IAT Bank 2, Sensor 1 data supported		
	IAT Bank 2, Sensor 2 supported	A, bit 4	0	1	1 = IAT Bank 2, Sensor 2 data supported		
	IAT Bank 2, Sensor 3 supported	A, bit 5	0	1	1 = IAT Bank 2, Sensor 3 data supported		
	reserved (bits shall be reported as '0')	A, bits 6 - 7	0	0			
	Intake Air Temperature Bank 1, Sensor 1	B	-40 °C	215 °C	1 °C with -40 °C offset	IAT 11: xxx °C (xxx °F)	
	IAT Bank 1, Sensor 1 shall display intake manifold air temperature, if utilised by the control module strategy. IAT may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.						
	Intake Air Temperature Bank 1, Sensor 2	C	-40 °C	215 °C	1 °C with -40 °C offset	IAT 12: xxx °C (xxx °F)	
	IAT Bank 1, Sensor 2 shall display intake manifold air temperature, if utilised by the control module strategy.						
	Intake Air Temperature Bank 1, Sensor 3	D	-40 °C	215 °C	1 °C with -40 °C offset	IAT 13: xxx °C (xxx °F)	
	IAT Bank 1, Sensor 3 shall display intake manifold air temperature, if utilised by the control module strategy.						
	Intake Air Temperature Bank 2, Sensor 1	E	-40 °C	215 °C	1 °C with -40 °C offset	IAT 21: xxx °C (xxx °F)	
	IAT Bank 2, Sensor 1 shall display intake manifold air temperature, if utilised by the control module strategy.						
	Intake Air Temperature Bank 2, Sensor 2	F	-40 °C	215 °C	1 °C with -40 °C offset	IAT 22: xxx °C (xxx °F)	
	IAT Bank 2, Sensor 2 shall display intake manifold air temperature, if utilised by the control module strategy.						
	Intake Air Temperature Bank 2, Sensor 3	G	-40 °C	215 °C	1 °C with -40 °C offset	IAT 23: xxx °C (xxx °F)	
IAT Bank 2, Sensor 3 shall display intake manifold air temperature, if utilised by the control module strategy.							

Figure I.47.1:

Data Byte	Application data to use	Formatting conversion used
data A	STATE_PSN_TIA_SAE	-
data B	TIA_MES_SAE[1]	-
data C	TIA_THR_MES_SAE[1]	-
data D	0 (not defined)	-
data E	TIA_MES_SAE[2]	-

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data F	TIA_THR_MES_SAE[2]	-
data G	0 (not defined)	-

### I.47.64 Description of PID 6Ch – Commanded Throttle Actuator Control and Relative Throttle Position (If NC\_CYL\_NR = 8)

#### PID \$6C definition

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
6C	Commanded Throttle Actuator Control and Relative Throttle Position					
	Support of Throttle Actuator Control System Data	A	Byte 1 of 5			
	Commanded Throttle Actuator A Control supported	A, bit 0	0	1	1 = Cmd Throttle Actuator A Control data supported	
	Relative Throttle A Position supported	A, bit 1	0	1	1 = Relative Throttle A Position data supported	
	Commanded Throttle Actuator B Control supported	A, bit 2	0	1	1 = Cmd Throttle Actuator B Control data supported	
	Relative Throttle B Position supported	A, bit 3	0	1	1 = Relative Throttle B Position data supported	
	reserved (bits shall be reported as '0')	A, bits 4 - 7	0	0		
	Commanded Throttle Actuator A Control	B	0 % (closed throttle)	100 % (wide open throttle)	100/255 %	TAC_A_CMD: xxx.x%
	<p>Commanded TAC displayed as a percent. TAC_A_CMD shall be normalised to the maximum TAC commanded output control parameter. TAC systems use a variety of methods to control the amount of throttle opening.</p> <p>1) If a linear or stepper motor is used, the fully closed throttle position shall be displayed as 0%, the fully open throttle position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open throttle position. For example, a stepper-motor TAC that moves the throttle 0 to 127 counts shall display 0% at 0 counts (report \$00), 100% at 127 counts (report \$FF) and 50.2% at 64 counts (report \$80).</p> <p>2) Any other actuation method shall be normalised to display 0% when the throttle is commanded closed and 100% when the throttle is commanded open.</p>					
	Relative Throttle A Position	C	0 %	100 %	100/255 %	TP_A_REL: xxx.x %
	<p>Relative or "learned" throttle position shall be displayed as a normalised value, scaled from 0 to 100%. TP_A_REL should display a value of 0% at the "learned closed-throttle position. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed throttle position is at 1.0 volts, TP_A_REL shall display <math>(1.0 - 1.0 / 5.0) = 0\%</math> at closed throttle and 30% at 2.5 volts. Because of the closed-throttle offset, wide open throttle will usually indicate substantially less than 100%.</p> <p>For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage. See PID \$11 for a definition of Absolute Throttle Position.</p>					
	Commanded Throttle Actuator B Control	D	0 % (closed throttle)	100 % (wide open throttle)	100/255 %	TAC_B_CMD: xxx.x%

Figure I.47.2:


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TABLE B88 - PID \$6C DEFINITION (CONTINUED)

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
6C	<p>Commanded TAC displayed as a percent. TAC_B_CMD shall be normalised to the maximum TAC commanded output control parameter. TAC systems use a variety of methods to control the amount of throttle opening.</p> <p>1) If a linear or stepper motor is used, the fully closed throttle position shall be displayed as 0%, the fully open throttle position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open throttle position. For example, a stepper-motor TAC that moves the throttle from 0 to 127 counts shall display 0% at 0 counts (report \$00), 100% at 127 counts (report \$\$F) and 50.2% at 64 counts (report \$80).</p> <p>2) Any other actuation method shall be normalised to display 0% when the throttle is commanded closed and 100% when the throttle is commanded open.</p>					
	<p>Relative Throttle B Position</p> <p>Relative or "learned" throttle position shall be displayed as a normalised value, scaled from 0 to 100%. TP_B_REL should display a value of 0% at the "learned closed-throttle position. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed throttle position is at 1.0 volts, TP_B_REL shall display <math>(1.0 - 1.0 / 5.0) = 0\%</math> at closed throttle and 30% at 2.5 volts. Because of the closed-throttle offset, wide open throttle will usually indicate substantially less than 100%.</p> <p>For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage. See PID \$11 for a definition of Absolute Throttle Position.</p>	E	0 %	100 %	100/255 %	TP_B_REL: xxx.x %

Figure I.47.3:

Data Byte	Application data to use	Formating conversion used
data A	STATE_PSN_TPS_SAE	-
data B	TPS_SP_SAE[1]	
data C	TPS_REL_SAE[1]	-
data D	TPS_SP_SAE[2]	
data E	TPS_REL_SAE[2]	-

### I.47.65 Description of PID 6Dh – Fuel Pressure Control System (If NC\_CYL\_NR = 8)

#### PID \$6D definition

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display	
6D	Fuel Pressure Control System						
	Support of Fuel Pressure Control System Data	A (bit)	Byte 1 of <u>611</u>				
	Commanded Fuel Rail Pressure <u>A</u> supported	A, bit 0	0	1	1 = Commanded Fuel Rail Pressure <u>A</u> data supported		
	Fuel Rail Pressure <u>A</u> supported	A, bit 1	0	1	1 = Fuel Rail Pressure <u>A</u> data supported		
	Fuel Temperature <u>A</u> supported	A, bit 2	0	1	1 = Fuel Temperature <u>A</u> data supported		
	<u>Commanded Fuel Rail Pressure B</u> supported	<u>A, bit 3</u>	<u>0</u>	<u>1</u>	<u>1 = Commanded Fuel Rail Pressure B data supported</u>		
	<u>Fuel Rail Pressure B</u> supported	<u>A, bit 4</u>	<u>0</u>	<u>1</u>	<u>1 = Fuel Rail Pressure B data supported</u>		
	<u>Fuel Temperature B</u> supported	<u>A, bit 5</u>	<u>0</u>	<u>1</u>	<u>1 = Fuel Temperature B data supported</u>		
	reserved (bits shall be reported as '0')	A, bits <u>3-6-7</u>	0	0			
	Commanded Fuel Rail Pressure <u>A</u>	B,C	0 kPa	655350 kPa	10 kPa per bit unsigned, 1 kPa = 0.1450377 PSI	FRP_ <u>A</u> _CMD: xxxxxx kPa (xxxxx.x PSI)	
	FRP_ <u>A</u> _CMD shall display commanded fuel rail pressure when the reading is referenced to atmosphere (gage pressure).						
	Fuel Rail Pressure <u>A</u>	D,E	0 kPa	655350 kPa	10 kPa per bit unsigned, 1 kPa = 0.1450377 PSI	FRP_ <u>A</u> : xxxxxx kPa (xxxxx.x PSI)	
	FRP_ <u>A</u> shall display fuel rail pressure when the reading is referenced to atmosphere (gage pressure).						
	Fuel Rail Temperature <u>A</u>	F	-40 °C	215 °C	1 °C with -40 °C offset	FRT_ <u>A</u> : xxx °C (xxx °F)	
	FRT_ <u>A</u> shall display fuel rail temperature.						
	<u>Commanded Fuel Rail Pressure B</u>	<u>G,H</u>	<u>0 kPa</u>	<u>655350 kPa</u>	<u>10 kPa per bit unsigned, 1 kPa = 0.1450377 PSI</u>	<u>FRP_ B _CMD: xxxxxx kPa (xxxxx.x PSI)</u>	
	<u>FRP_ B _CMD shall display commanded fuel rail pressure when the reading is referenced to atmosphere (gage pressure).</u>						
<u>Fuel Rail Pressure B</u>	<u>I,J</u>	<u>0 kPa</u>	<u>655350 kPa</u>	<u>10 kPa per bit unsigned, 1 kPa = 0.1450377 PSI</u>	<u>FRP_ B: xxxxxx kPa (xxxxx.x PSI)</u>		
<u>FRP_ B shall display fuel rail pressure when the reading is referenced to atmosphere (gage pressure).</u>							
<u>Fuel Rail Temperature B</u>	<u>K</u>	<u>-40 °C</u>	<u>215 °C</u>	<u>1 °C with -40 °C offset</u>	<u>FRT_ B: xxx °C (xxx °F)</u>		
<u>FRT_ B shall display fuel rail temperature.</u>							

Figure I.47.4:

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Data Byte	Application data to use	Formatting conversion used
data A	STATE_PSN_FUP_SAE	-
data B	MSB (FUP_SP_SAE[1])	-
data C	LSB (FUP_SP_SAE[1])	-
data D	MSB (FUP_MES_SAE[1])	-
data E	LSB (FUP_MES_SAE[1])	-
data F	0 (not defined)	-
data G	MSB (FUP_SP_SAE[2])	-
data H	LSB (FUP_SP_SAE[2])	-
data I	MSB (FUP_MES_SAE[2])	-
data J	LSB (FUP_MES_SAE[2])	-

Continued on next page

data K	0 (not defined)	-
--------	-----------------	---

### I.47.66 Description of PID 80h - Supported PIDs 81h - A0h (not supported)

0 : the PID is not used

1 : the PID is used

#### DATA A - Supported PIDs 81h - 88h

PID 80h - DATA A - Supported PID 81h to 88h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[16]
0	PID 88h : ISO/SAE reserved	0
1	PID 87h : Intake Manifold Absolute Pressure	0
2	PID 86h : Particulate Matter (PM) Sensor	0
3	PID 85h : NOx Control System	0
4	PID 84h : Manifold Surface Temperature	0
5	PID 83h : NOx Sensor	0
6	PID 82h : Engine Run Time for AECD #6 -#10	0
7	PID 81h : Engine Run Time for AECD #1 -#5	0

#### DATA A - Supported PIDs 89h - 90h

PID 80h - DATA B - Supported PID 89h to 90h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[17]
0	PID 90h : ISO/SAE reserved	0
1	PID 8Fh : ISO/SAE reserved	0
2	PID 8Eh : ISO/SAE reserved	0
3	PID 8Dh : ISO/SAE reserved	0
4	PID 8Ch : ISO/SAE reserved	0
5	PID 8Bh : ISO/SAE reserved	0
6	PID 8Ah : ISO/SAE reserved	0
7	PID 89h : ISO/SAE reserved	0

#### DATA A - Supported PIDs 91h - 98h

PID 80h - DATA C - Supported PID 91h to 98h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[18]
0	PID 98h : ISO/SAE reserved	0

Continued on next page

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1	PID 97h : ISO/SAE reserved	0
2	PID 96h : ISO/SAE reserved	0
3	PID 95h : ISO/SAE reserved	0
4	PID 94h : ISO/SAE reserved	0
5	PID 93h : ISO/SAE reserved	0
6	PID 92h : ISO/SAE reserved	0
7	PID 91h : ISO/SAE reserved	0

### DATA A - Supported PIDs 99h – A0h


PID 80h - DATA D - Supported PID 99h to A0h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[19]
0	PID A0h : ISO/SAE reserved	0
1	PID 9Fh : ISO/SAE reserved	0
2	PID 9Eh : ISO/SAE reserved	0
3	PID 9Dh : ISO/SAE reserved	0
4	PID 9Ch : ISO/SAE reserved	0
5	PID 9Bh : ISO/SAE reserved	0
6	PID 9Ah : ISO/SAE reserved	0
7	PID 99h : ISO/SAE reserved	0

## I.47.67 Description of PID 88h up to FFh - Reserved

### PID \$84 - \$FF definition

PID	Description	Data	Min.	Max.	Scaling/ bit	External test equip- ment
(hex)		Byte	value	value		SI (Metric) /English dis- play
88 - FF	ISO/SAE reserved	--	--	--	--	--

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## I.48 SID 02h: Request powertrain freeze frame data

### Import actions:

<b>ACTION_ERRM_ReadFrByDtc</b>	(IN<PRM_TYPEOFF>,IN<PRM_FFIDENTIFIER>,IN<PRM_DTCIDENTIFIER>,IN<PRM_LEVELOFDTC>,INOUT<PRM_FRF>,OUT<PRM_RESULTFRF>)
--------------------------------	---

### I.48.1 Functional description

The purpose of this service is to allow access to emission-related data values in a freeze frame. This allows expansion to meet manufacturer specific requirements not necessarily related to the required freeze frame, and not necessarily containing the same data values as the required freeze frame. The request message includes a parameter identification (PID) value that indicates to the on-board system the specific information requested. PID specifications, scaling information, and display formats for the freeze frame are included in Annex B of ISO 15031-5.4.

The ECU(s) will respond to this message by transmitting the requested data value stored by the system. All data values returned for sensor readings will be actual stored readings, not default or substitute values used by the system because of a fault with that sensor.

Service 02h PID 02h indicates the DTC that caused the freeze frame data to be stored. If freeze frame data is not stored in the ECU, the system shall report 00 00h as the DTC.

The frame number byte will indicate 00h for the freeze frame data. Manufacturers may optionally save additional freeze frames and use this service to obtain that data by specifying the freeze frame number in the request message. If a manufacturer uses these additional freeze frames, they will be stored under conditions specified by the manufacturer, and contain data specified by the manufacturer.

Not all PIDs are applicable or supported by all systems. PID 00h is a bit-encoded value that indicates for each ECU which PIDs are supported. PID 00h indicates support for PIDs from 01h to 20h. PID 20h indicates support for PIDs 21h through 40h, etc. PID 00h is required for those ECUs that respond to a corresponding service 02h request message as specified in Annex A of ISO 15031-5.4.

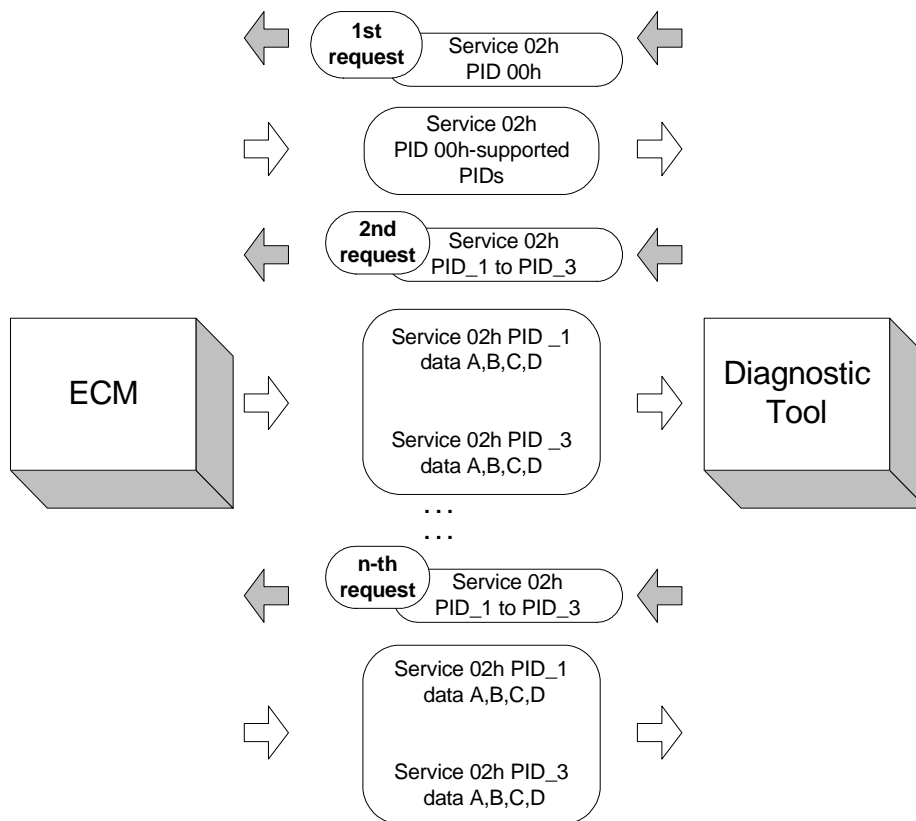
The order of the PIDs in the response message is not required to match the order in the request message.

The request message may contain up to three (3) PIDs. An external test equipment is not allowed to request a combination of PIDs supported and PIDs, which report data values. The ECU shall support requests for up to three (3) PIDs. The request message may contain the same PID multiple times. The ECU shall treat each PID as a separate parameter and respond with data for each PID as often as requested.

### Proper response from server/ECU for ISO 15765-4 protocol:



Service 02h not supported	The ECU shall not respond
Service 02h supported PID requested, no Freeze Frame stored	PID 02h indicates 0000h, but if PIDs are requested, ECU must not respond except if supported PIDs (00h, 20h, ...) have been requested, then the ECU shall send a response with the supported PID and data bytes
Service 02h unsupported PID requested, no Freeze Frame stored	PID 02h indicates 0000h, but if PIDs are requested, ECU must not respond except for support PIDs 00h, 20h, etc.
Service 02h supported PID requested, Freeze Frame stored	Respond within P2 timing
Service 02h unsupported PID requested, Freeze Frame stored	The ECU shall not respond



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## I.48.2 Message data bytes

### I.48.2.1 Read supported PIDs

#### Request powertrain freeze frame data request message (read supported PIDs)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request powertrain freeze frame data request SID	M	02	SIDRQ
#2	PID#1 (PIDs supported: Annex A of ISO 15031-5.4)	M	xx	PID
#3	frame #	M	xx	FRNO_
#4	PID#2 (PIDs supported: Annex A of ISO 15031-5.4)	U	xx	PID
#5	frame #	U/C	xx	FRNO_
#6	PID#3 (PIDs supported: Annex A of ISO 15031-5.4)	U	xx	PID
#7	frame #	U/C	xx	FRNO_
U = User Optional — PID may be included to reduce multiple PID supported request messages C = Conditional — parameter is only included if preceding PID# is included				

NOTE To request PIDs supported range from 61h - FFh, multiple request messages with PIDs = 60h, 80h, A0h, C0h and E0h shall be sent to the vehicle.

### I.48.2.2 Report supported PIDs

ECU(s) must respond to all supported ranges if requested. A range is defined as a block of 32 PIDs (e.g. range #1: PID 01h-20h). The ECU shall not respond to unsupported PID ranges unless subsequent ranges have a supported PID(s).

#### Request powertrain freeze frame data response message (report supported PIDs)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request powertrain freeze frame data response SID	M	42	SIDPR
#2	1 <sup>st</sup> supported PID	M	00	PID
#3	frame #	M	xx	FRNO_
#4	data record of supported PIDs = [ Data A: supported PIDs, Data B: supported PIDs, Data C: supported PIDs, Data D: supported PIDs ]	M	xx	DATA_REC
#5		M	xx	DATA_A
#6		M	xx	DATA_B
#7		M	xx	DATA_C
:	:	:	:	:
#n-5	m <sup>th</sup> supported PID	C1	xx	PID
#n-4	frame #	C1	xx	FRNO_
#n-3	data record of supported PIDs = [ Data A: supported PIDs, Data B: supported PIDs, Data C: supported PIDs, Data D: supported PIDs ]	C2	xx	DATA_REC
#n-2		C2	xx	DATA_A
#n-1		C2	xx	DATA_B
#n		C2	xx	DATA_C
C1 = Conditional — PID value shall be the same value as included in the request message if supported by the ECU C2 = Conditional — value indicates PIDs supported; range of supported PIDs depends on selected PID value (see C1)				

NOTE The response message shall only include the PID(s) and Data A - D which are supported by the ECU. If the request message includes (a) PID value(s) which are not supported by the ECU those shall not be included in the response message.

### I.48.2.3 Read freeze frame PID values

#### Request powertrain freeze frame data request message (read freeze frame PID values)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request powertrain freeze frame data request SID	M	02	SIDRQ
#2	PID#1 (see Annex B of ISO 15031-5.4)	M	xx	PID
#3	frame #	M	xx	FRNO
#4	PID#2 (see Annex B of ISO 15031-5.4)	U	xx	PID
#5	frame #	C1	xx	FRNO
#6	PID#3 (see Annex B of ISO 15031-5.4)	U	xx	PID
#7	frame #	C1	xx	FRNO

U = User Optional — the parameter may be present or not  
C1 = Conditional — parameter is only present if preceding PID# is present

### I.48.2.4 Report freeze frame PID values

#### Request powertrain freeze frame data response message (report freeze frame PID values)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request powertrain freeze frame data response SID	M	42	SIDPR
#2	1 <sup>st</sup> supported PID	M	xx	PID_
#3	frame #	M	xx	FRNO_
#4	data record of 1 <sup>st</sup> supported PID = [ data A, data B, data C, data D ]	M	xx	DATA_A
#5		C1	xx	DATA_B
#6		C1	xx	DATA_C
#7		C1	xx	DATA_D
:	:	:	:	:
#2	m <sup>th</sup> supported PID	C2	xx	PID_
#3	frame #	C2	xx	FRNO_
#4	data record of m <sup>th</sup> supported PID = [ data A, data B, data C, data D ]	C3	xx	DATA_A
#5		C4	xx	DATA_B
#6		C4	xx	DATA_C
#7		C4	xx	DATA_D

C1 = Conditional — "data B - D" depend on selected PID  
C2 = Conditional — parameter shall be the same value as included in the request message and only present if supported  
C3 = Conditional — data A shall be included if preceding PID is supported  
C4 = Conditional — parameters and values for "data B - D" depend on selected PID number

### I.48.2.5 Parameter definition

#### I.48.2.5.1 PIDs supported

Annex A of ISO 15031-5.4 specifies the interpretation of the data record of supported PIDs.

#### I.48.2.5.2 PID and data byte descriptions

Annex B of ISO 15031-5.4 specifies standardised emission-related parameters.

#### I.48.2.5.3 Frame # description

The frame number identifies the freeze frame, which includes emission-related data values in case an emission-related DTC is detected by the ECU.


### I.48.2.6 Formula section

#### ACTION\_ERRM\_ReadFrFByDtc

```
(
  IN <LAW>
  IN <FIRST>
  IN <NO_DTC>
  IN <LAW>
  INOUT <FrF>
  OUT <ResultFrF>
)
```

```

  IF (PID = X0h) where PID X0h means PID 00h, 20h, 40h, 60h, 80h, A0h, C0h, E0h
  THEN
    Positive response
  ELSE
    IF ResultFrF = FRF_PRESENT THEN
      Positive response
    ELSE
      IF PID = 02h THEN Positive response with DTC = 0000h
      ELSE No answer
    ENDIF
  ENDIF
ENDIF
ENDIF
```

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## I.49 SID 02h: Request powertrain freeze frame data (Appl. Inc.)

### Input data:

NC_CYL_NR {p. 1526}	NC_INJ_CONF {p. 626}	STATE_PSN_LS_SAE {p. 819}	STATE_VAR_SAP_SAE {p. 819}
---------------------	----------------------	------------------------------	-------------------------------

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_STATE_SRV_2_PID	V	0... FFH	0... 255	1	-
LDPM_STATE_PID_SRV_1_2_OBDC	20	0... 13H	0... 19	1	-
Table of bytes which defines the PID's supported by the service 02h (01h - A0h)					

### Action definition

<b>ACTION_ERRM_ReadFrByDtc</b> (IN<PRM_TYPEOFFF>,IN<PRM_FFIDENTIFIER>,IN<PRM_DTCIDENTIFIER>,IN<PRM_LEVELOFDTC>,<INOUT><PRM_FRF>,<OUT><PRM_RESULTFRF>)					Mode: O
This API returns a freeze frame or a part of freeze frame.					
Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_TYPEOFFF	in	0... FFFFH	0... 65535	1	-
Type of Freeze Frame					
PRM_FFIDENTIFIER	in	0... FFH	0... 255	1	-
Freeze frame number					
PRM_DTCIDENTIFIER	in	0... FFH	0... 255	1	-
DTC number					
PRM_LEVELOFDTC	in	01H 02H	LAW CUS	-	-
OBD or Customer DTC					
PRM_FRF	inout	0... FFH	0... 255	1	-
Pointer to buffer for Freeze frame					
PRM_RESULTFRF	out	0... FFH	0... 255	1	-
Result of Freeze frame reading					

### General information

Depending on calibration of ID\_STATE\_SRV\_2\_PID the PID's are supported or not.

Each LDPM[0...19] of the table represents an 8 PIDs configuration:

0 => the PID is not supported

1 => the PID is supported


"PID 13h is supported" means – (ID\_STATE\_SRV\_1\_PID[2] & 20h)

"PID 1Dh is supported" means – (ID\_STATE\_SRV\_1\_PID[3] & 08h)

"Bank 1 is supported" means – ((STATE\_PSN\_LS\_SAE & 0Fh) OR (STATE\_PSN\_LS\_1\_SAE & 03h))

"Bank 2 is supported" means – ((STATE\_PSN\_LS\_SAE & F0h) OR (STATE\_PSN\_LS\_1\_SAE & 0Ch))

"Bank 1 – Sensor 2 is supported" means – ((STATE\_PSN\_LS\_SAE & 02h) OR (STATE\_PSN\_LS\_1\_SAE & 02h))

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"Bank 2 – Sensor 2 is supported" means – ((STATE\_PSN\_LS\_SAE & 20h) OR (STATE\_PSN\_LS\_1\_SAE & 08h))

"IDX" is used instead of the array definition [NC\_NR\_ERR\_DYN].

At STATE\_PSN\_LS\_SAE you can see the configuration of the oxygen-sensors:

BIT	Function	Status
0	Bank 1 Sensor 1	1= available, 0 = not available
1	Bank 1 Sensor 2	1= available, 0 = not available
2	Bank 1 Sensor 3	1= available, 0 = not available
3	Bank 1 Sensor 4	1= available, 0 = not available
4	Bank 2 Sensor 1	1= available, 0 = not available
5	Bank 2 Sensor 2	1= available, 0 = not available
6	Bank 2 Sensor 3	1= available, 0 = not available
7	Bank 2 Sensor 4	1= available, 0 = not available

### Application conditions:

**Initialisation:** –  
**Activation:** –  
**Deactivation:** –  
**Recurrence:** –

### Function description:

### Formula section:

## I.49.1 Description of PID 00h - Supported PIDs 01h - 20h

DATA A - Supported PIDs 01h to 08h

PID 00h - DATA A - Supported PID 01h to 08h		
BIT	Function	Bitmask: ID_STATE_SRV_2_PID[0]
0	PID 08h : Short term fuel trim - Bank 2 and Bank 4	1
1	PID 07h : Long term fuel trim - Bank 1 and Bank 3	1
2	PID 06h : Short term fuel trim - Bank 1 and Bank 3	1
3	PID 05h : Engine coolant temperature	1
4	PID 04h : Calculated load value	1

Continued on next page

5	PID 03h : Fuel system status	1
6	PID 02h : Trouble code that caused required freeze frame	1
7	PID 01h : Monitor status since DTCs cleared	0

## DATA B - Supported PIDs 09h to 10h

PID 00h - DATA B - Supported PID 09h to 10h		
BIT	Function	Bitmask: ID_STATE_SRV_2_PID[1]
0	PID 10h : Air flow rate from MAF sensor	1
1	PID 0Fh : Intake air temperature	1
2	PID 0Eh : Ignition time advance	1
3	PID 0Dh : Vehicle speed	1
4	PID 0Ch : Engine RPM	1
5	PID 0Bh : Intake manifold absolute pressure	1
6	PID 0Ah : Fuel pressure (gauge)	1
7	PID 09h : Long term fuel trim - Bank 2	1

## DATA C - Supported PIDs 11h to 18h

PID 00h - DATA C - Supported PID 11h to 18h		
BIT	Function	Bitmask: ID_STATE_SRV_2_PID[2]
0	PID 18h : Bank 2 Sensor 1 or Bank 3 Sensor 1	0
1	PID 17h : Bank 1 Sensor 4 or Bank 2 Sensor 2	0
2	PID 16h : Bank 1 Sensor 3 or Bank 2 Sensor 1	0
3	PID 15h : Bank 1 Sensor 2	0
4	PID 14h : Bank 1 Sensor 1	0
5	PID 13h : Location of Oxygen Sensors	1
6	PID 12h : Secondary air status	1
7	PID 11h : Absolute throttle position sensor	1

## DATA D - Supported PIDs 19h to 20h

PID 00h - DATA D - Supported PID 19h to 20h		
BIT	Function	Bitmask: ID_STATE_SRV_2_PID[3]
0	PID 20h : PIDs supported (\$21 - \$40)	1

Continued on next page

1	PID 1Fh : Time Since Engine Start	1
2	PID 1Eh : Auxiliary Input Status	0
3	PID 1Dh : Location of oxygen sensors	0
4	PID 1Ch : OBD requirements to which vehicle is designed	0
5	PID 1Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2	0
6	PID 1Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1	0
7	PID 19h : Bank 2 Sensor 2 or Bank 3 Sensor 2	0

### I.49.1.1 Description of PID 02h - Diagnostic trouble codes

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling	External test equipment SI (Metric) /English display
02	DTC that caused required freeze frame data storage	A, B	00 00	FF FF	Hexadecimal e.g. P01AB	DTCFRZF: Pxxxx, Cxxxx, Bxxxx, Uxxxx
	(\$0000 indicates no freeze frame data)				(DTCs defined in ISO 15031-6)	

#### Formula section:

#### CALL API :

```
ACTION_ERRM_ReadFrfByDtc (
    IN <FRF_LAW>,
    IN <FIRST>,
    IN <NO_DTC>,
    IN <DTC_LAW>
    INOUT <Frf>
    OUT <ResultFrf>
)
```

```
IF ResultFrf == NO_FRF_PRESENT
```

#### THEN

Data Byte	Application data to use	Formating conversion used
data A	0x00	-
data B	0x00	

#### ELSE



Data Byte	Application data to use	Formating conversion used
data A	Frff[0]	-
data B	Frff[1]	

**ENDIF**

### I.49.1.2 Description of PID 03h - Status of fuel system

```

If          PID 13h is supported
Then
    If          (STATE_PSN_LS_SAE & 11h)           // upstream sensors available
    Then
        DATA_A = ENVD_OBD_1_IDX
        DATA_B = ENVD_OBD_2_IDX
    Endif
Endif

```

### I.49.1.3 Description of PID 04h - Calculated load value

DATA\_A = ENVD\_OBD\_3\_IDX

### I.49.1.4 Description of PID 05h - Engine coolant temperature

DATA\_A = ENVD\_OBD\_4\_IDX

### I.49.1.5 Description of PID 06h - Short term fuel trim - Bank 1 and Bank 3

```

If (PID 13h is supported) Then
    If (Bank 1 is supported) Then
        DATA_A = ENVD_OBD_5_IDX
        DATA_B = NONE           //Bank 3 not supported
    Endif
Endif

```

### I.49.1.6 Description of PID 07h - Long term fuel trim - Bank 1 and Bank 3

```

If (PID 13h is supported) Then
    If (Bank 1 is supported) Then
        DATA_A = ENVD_OBD_6_IDX
        DATA_B = NONE           //Bank 3 not supported
    Endif
Endif

```

### I.49.1.7 Description of PID 08h - Short term fuel trim - Bank 2 and Bank 4

```

If (PID 13h is supported) Then
    If (Bank 2 is supported) Then
        DATA_A = ENVD_OBD_7_IDX
        DATA_B = NONE           //Bank 3 not supported
    Endif
Endif

```

**I.49.1.8 Description of PID 09h - Long term fuel trim - Bank 2 and Bank 4**

```

If (PID 13h is supported) Then
    If (Bank 2 is supported) Then
        DATA_A = ENVD_OBD_8_IDX
        DATA_B = NONE //Bank 3 not supported
    Endif
Endif

```

**I.49.1.9 Description of PID 0Ah - Fuel pressure (gauge)**

DATA\_A = ENVD\_OBD\_9\_IDX

**I.49.1.10 Description of PID 0Bh - Intake manifold absolute pressure**

DATA\_A = ENVD\_OBD\_10\_IDX

**I.49.1.11 Description of PID 0Ch - Engine speed**

DATA\_A = ENVD\_OBD\_11\_IDX  
 DATA\_B = ENVD\_OBD\_12\_IDX

**I.49.1.12 Description of PID 0Dh - Vehicle speed**

DATA\_A = ENVD\_OBD\_13\_IDX

**I.49.1.13 Description of PID 0Eh - Ignition timing advance**

DATA\_A = ENVD\_OBD\_14\_IDX

**I.49.1.14 Description of PID 0Fh - Intake air temperature**

DATA\_A = ENVD\_OBD\_15\_IDX

**I.49.1.15 Description of PID 10h - Air flow rate from MAF**

DATA\_A = ENVD\_OBD\_16\_IDX  
 DATA\_B = ENVD\_OBD\_17\_IDX

**I.49.1.16 Description of PID 11h - Absolute throttle position sensor**

DATA\_A = ENVD\_OBD\_18\_IDX

**I.49.1.17 Description of PID 12h - Commanded secondary air status**

```

If (ID_STATE_SRV_2_PID[2] & 40h) and (STATE_VAR_SAP_SAE <> 0)
Then DATA_A = ENVD_OBD_19_IDX
Endif

```

**I.49.1.18 Description of PID 1Fh - Time Since Engine Start**

DATA\_A = ENVD\_OBD\_20\_IDX  
 DATA\_B = ENVD\_OBD\_21\_IDX

**I.49.2 Description of PID 20h - Supported PIDs 21h - 40h**

0 : the PID is not used, 1 : the PID is used

DATA A - Supported PIDs 21h - 28h

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PID 20h - DATA A - Supported PID 21h to 28h		
BIT	Function	Bitmask: ID_STATE_SRV_2_PID[4]
0	PID 28h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	0
1	PID 27h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	0
2	PID 26h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	0
3	PID 25h : Bank 1 Sensor 2 (Wide range O2S)	0
4	PID 24h : Bank 1 Sensor 1 (Wide range O2S)	0
5	PID 23h : High fuel pressure (gauge)	1
6	PID 22h : Relative fuel pressure	0
7	PID 21h : Distance travelled while MIL is activated	0

## DATA B - Supported PIDs 29h to 30h


PID 20h - DATA B - Supported PID 29h to 30h		
BIT	Function	Bitmask: ID_STATE_SRV_2_PID[5]
0	PID 30h : Number of warm-ups since diagnostic trouble codes cleared	0
1	PID 2Fh : Fuel Level Input	1
2	PID 2Eh : Commanded Evaporative Purge	1
3	PID 2Dh : EGR Error	0
4	PID 2Ch : Command EGR	0
5	PID 2Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	0
6	PID 2Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	0
7	PID 29h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	0

## DATA C - Supported PIDs 31h to 38h

PID 20h - DATA C - Supported PID 31h to 38h		
BIT	Function	Bitmask: ID_STATE_SRV_2_PID[6]
0	PID 38h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	0
1	PID 37h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	0
2	PID 36h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	0
3	PID 35h : Bank 1 Sensor 2 (Wide range O2S)	0
4	PID 34h : Bank 1 Sensor 1 (Wide range O2S)	0
5	PID 33h : Barometric Pressure	1
6	PID 32h : Evap System Vapor Pressure	0
7	PID 31h : Distance since diagnostic trouble codes cleared	0

## DATA D - Supported PIDs 39h to 40h

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PID 20h - DATA D - Supported PID 39h to 40h		
BIT	Function	Bitmask: ID_STATE_SRV_2_PID[7]
0	PID 40h : PIDs supported (\$41 - \$60)	1
1	PID 3Fh : Catalyst Temperature Bank 2, Sensor 2	0
2	PID 3Eh : Catalyst Temperature Bank 1, Sensor 2	0
3	PID 3Dh : Catalyst Temperature Bank 2, Sensor 1	0
4	PID 3Ch : Catalyst Temperature Bank 1, Sensor 1	0
5	PID 3Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	0
6	PID 3Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	0
7	PID 39h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	0

### I.49.2.1 Description of PID 23h – Fuel pressure

```

If          NC_INJ_CONF <> 0                               //only MSD
Then       DATA_A = ENVD_OBD_22_IDX
              DATA_B = ENVD_OBD_23_IDX
Endif

```

### I.49.2.2 Description of PID 2Eh – Commanded Evaporative purge

DATA\_A = ENVD\_OBD\_24\_IDX

### I.49.2.3 Description of PID 2Fh - Fuel Level Input

DATA\_A = ENVD\_OBD\_25\_IDX

### I.49.2.4 Description of PID 33h - Barometric Pressure

DATA\_A = ENVD\_OBD\_26\_IDX

### I.49.3 Description of PID 40h - Supported PIDs 41h - 60h

0 : the PID is not used

1 : the PID is used

DATA A - Supported PIDs 41h - 48h

PID 40h - DATA A - Supported PID 41h to 48h		
BIT	Function	Bitmask: ID_STATE_SRV_2_PID[8]
0	PID 48h : Absolute Throttle Position C	0
1	PID 47h : Absolute Throttle Position B	1
2	PID 46h : Ambient air temperature	1
3	PID 45h : Relative Throttle Position	1
4	PID 44h : Command Equivalence Ratio	1
5	PID 43h : Absolute Load Value	1
6	PID 42h : Control module voltage	1

Continued on next page

7	PID 41h : Monitor status this driving cycle	0
---	---	---

## DATA B - Supported PIDs 49h to 50h

PID 40h - DATA B - Supported PID 49h to 50h		
BIT	Function	Bitmask: ID_STATE_SRV_2_PID[9]
0	PID 50h : External test equipment config. information #2	0
1	PID 4Fh : External test equipment config. information #1	0
2	PID 4Eh : Time since diagnostic trouble codes cleared	0
3	PID 4Dh : Minutes run by the engine while MIL activated	0
4	PID 4Ch : Commanded Throttle Actuator Control	1
5	PID 4Bh : Accelerator Pedal Position F	0
6	PID 4Ah : Accelerator Pedal Position E	1
7	PID 49h : Accelerator Pedal Position D	1

## DATA C - Supported PIDs 51h to 58h

PID 40h - DATA C - Supported PID 51h to 58h		
BIT	Function	Bitmask: ID_STATE_SRV_2_PID[10]
0	PID 58h : Long term fuel trim Bank 2	1
1	PID 57h : Short term fuel trim Bank 2	0
2	PID 56h : Long term fuel trim Bank 1	1
3	PID 55h : Short term fuel trim Bank 1	0
4	PID 54h : Evap System Vapor Pressure	0
5	PID 53h : Absolute Evap System Vapor Pressure	0
6	PID 52h : Alcohol Fuel Percentage	0
7	PID 51h : Type of fuel used by the vehicle	0

## DATA D - Supported PIDs 59h to 60h

PID 40h - DATA D - Supported PID 59h to 60h		
BIT	Function	Bitmask: ID_STATE_SRV_2_PID[11]
0	PID 60h : PIDs supported (\$61 - \$80)	1 (If NC_CYL_NR = 8)
1	PID 5Fh : Emission requirements to which vehicle is designed	0
2	PID 5Eh : Engine Fuel Rate	0

Continued on next page

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3	PID 5Dh : Fuel Injection Timing	0
4	PID 5Ch : Engine Oil Temperature	0
5	PID 5Bh : Hybrid Battery Pack Remaining Life	0
6	PID 5Ah : Relative Accelerator Pedal Position	0
7	PID 59h : Fuel Rail Pressure (absolute)	0

### I.49.3.1 Description of PID 42 - Control module voltage

DATA\_A = ENVD\_OBD\_27\_IDX

DATA\_B = ENVD\_OBD\_28\_IDX

### I.49.3.2 Description of PID 43 - Absolute Load Value

DATA\_A = ENVD\_OBD\_29\_IDX

DATA\_B = ENVD\_OBD\_30\_IDX

### I.49.3.3 Description of PID 44 - Commanded Equivalence Ratio

DATA\_A = ENVD\_OBD\_31\_IDX

DATA\_B = ENVD\_OBD\_32\_IDX

### I.49.3.4 Description of PID 45 - Relative Throttle Position

DATA\_A = ENVD\_OBD\_33\_IDX

### I.49.3.5 Description of PID 46 - Ambient air temperature

DATA\_A = ENVD\_OBD\_34\_IDX

### I.49.3.6 Description of PID 47 - Absolute Throttle Position B

DATA\_A = ENVD\_OBD\_35\_IDX

### I.49.3.7 Description of PID 49 - Accelerator Pedal Position D

DATA\_A = ENVD\_OBD\_36\_IDX

### I.49.3.8 Description of PID 4A - Accelerator Pedal Position E

DATA\_A = ENVD\_OBD\_37\_IDX

### I.49.3.9 Description of PID 4C – Commanded throttle actuator control

DATA\_A = ENVD\_OBD\_38\_IDX

### I.49.3.10 Description of PID 56 – Long term fuel trim bank 1


**If** (PID 13h is supported) **Then**

**If** (Bank 1 is supported) **and** (Bank 1 Sensor 2 is supported) **Then**

DATA\_A = ENVD\_OBD\_39\_IDX

**Endif**

**Endif**

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### I.49.3.11 Description of PID 58 – Long term fuel trim bank 2

**If** (PID 13h is supported) **Then**

**If** (Bank 2 is supported) **and** (Bank 2 Sensor 2 is supported) **Then**

DATA\_A = ENV\_D\_OBD\_40\_IDX

**Endif**

**Endif**

### I.49.4 Description of PID 60h - Supported PIDs 61h – 80h

0 : the PID is not used

1 : the PID is used

#### DATA A - Supported PIDs 61h - 68h

PID 60h - DATA A - Supported PID 61h to 68h		
BIT	Function	Bitmask: ID_STATE_SRV_2_PID[12]
0	PID 68h : Intake Air Temperature Sensor	1(If NC_CYL_NR = 8)
1	PID 67h : Engine Coolant Temperature	0
2	PID 66h : Mass Air Flow Sensor	1(If NC_CYL_NR = 8)
3	PID 65h : Auxiliary Inputs /Outputs	0
4	PID 64h : Engine Percent Torque Data	0
5	PID 63h : Engine Reference Torque	0
6	PID 62h : Actual Engine -Percent Torque	0
7	PID 61h : Driver's Demand Engine - Percent Torque	0

#### DATA A - Supported PIDs 69h - 70h

PID 60h - DATA B - Supported PID 69h to 70h		
BIT	Function	Bitmask: ID_STATE_SRV_2_PID[13]
0	PID 70h : Boost Pressure Control	0
1	PID 6Fh : Turbocharger Compressor Inlet Pressure	0
2	PID 6Eh : Injection Pressure Control System	0
3	PID 6Dh : Fuel Pressure Control System	1(If NC_CYL_NR = 8)
4	PID 6Ch : Commanded Throttle Actuator Control and Relative Throttle Position	1(If NC_CYL_NR = 8)
5	PID 6Bh : Exhaust Gas Recirculation Temperature	0
6	PID 6Ah : Commanded Diesel Intake Air Flow Control and Relative Intake Air Flow Position	0
7	PID 69h : Commanded EGR and EGR Error	0

#### DATA A - Supported PIDs 71h - 78h

PID 60h - DATA C - Supported PID 71h to 78h		
BIT	Function	Bitmask: ID_STATE_SRV_2_PID[14]
0	PID 78h : Exhaust Gas Temperature Bank 1	0
1	PID 77h : Charge Air Cooler Temperature	0
2	PID 76h : Turbocharger B Temperature	0
3	PID 75h : Turbocharger A Temperature	0
4	PID 74h : Turbocharger RPM	0
5	PID 73h : Exhaust Pressure	0
6	PID 72h : Wastegate Control	0
7	PID 71h : Variable Geometry Turbo Control	0

### DATA A - Supported PIDs 79h - 80h

PID 60h - DATA D - Supported PID 79h to 80h		
BIT	Function	Bitmask: ID_STATE_SRV_2_PID[15]
0	PID 80h : PIDs supported (\$81 - \$A0)	0
1	PID 7Fh : Engine Run Time	0
2	PID 7Eh : PM NTE control area status	0
3	PID 7Dh : NOx NTE control area status	0
4	PID 7Ch : Diesel Particulate Filter Temperature	0
5	PID 7Bh : Diesel Particulate Filter Bank 2	0
6	PID 7Ah : Diesel Particulate Filter Bank 1	0
7	PID 79h : Exhaust Gas Temperature Bank 2	0

#### I.49.4.1 Description of PID 66h – Mass air flow sensor (If NC\_CYL\_NR = 8)

Data Byte	Application data to use	Remark
data A	DATA_A = ENVD_OBD_41_IDX	//Support status
data B	DATA_B = ENVD_OBD_42_IDX	//MSB – Measured S1
data C	DATA_C = ENVD_OBD_43_IDX	//LSB – Measured S1
data D	DATA_D = ENVD_OBD_44_IDX	//MSB – Measured S2
data E	DATA_E = ENVD_OBD_45_IDX	//LSB – Measured S2

#### I.49.4.2 Description of PID 68h – Intake Air Temperature Sensor (If NC\_CYL\_NR = 8)



Data Byte	Application data to use	Remark
data A	DATA_A = ENVD_OBD_46_IDX	//Support status
data B	DATA_B = ENVD_OBD_47_IDX	//IAT B1S1
data C	DATA_C = ENVD_OBD_48_IDX	//IAT B1S2
data D	DATA_D = 0 (not defined)	//IAT B1S3
data E	DATA_E = ENVD_OBD_49_IDX	//IAT B2S1
data F	DATA_F = ENVD_OBD_50_IDX	//IAT B2S2
data G	DATA_G = 0 (not defined)	//IAT B1S3

#### I.49.4.3 Description of PID 6Ch – Commanded Throttle Actuator Control and Relative Throttle Position (If NC\_CYL\_NR = 8)

Data Byte	Application data to use	Formating conversion used
data A	DATA_A = ENVD_OBD_51_IDX	//Support status
data B	DATA_B = ENVD_OBD_52_IDX	//Commanded 1
data C	DATA_C = ENVD_OBD_53_IDX	//Position 1
data D	DATA_D = ENVD_OBD_54_IDX	//Commanded 2
data E	DATA_E = ENVD_OBD_55_IDX	//Position 2

#### I.49.4.4 Description of PID 6Dh – Fuel Pressure Control System (If NC\_CYL\_NR = 8)

Data Byte	Application data to use	Remark
data A	DATA_A = ENVD_OBD_56_IDX	//Support status
data B	DATA_B = ENVD_OBD_57_IDX	//MSB – Commanded 1
data C	DATA_C = ENVD_OBD_58_IDX	//LSB – Commanded 1
data D	DATA_D = ENVD_OBD_59_IDX	//MSB – Measured 1
data E	DATA_E = ENVD_OBD_60_IDX	//LSB – Measured 1
data F	DATA_F = 0 (not defined)	//Temperature 1
data G	DATA_G = ENVD_OBD_61_IDX	//MSB – Commanded 2
data H	DATA_H = ENVD_OBD_62_IDX	//LSB – Commanded 2
data I	DATA_I = ENVD_OBD_63_IDX	//MSB – Measured 2
data J	DATA_J = ENVD_OBD_64_IDX	//LSB – Measured 2
data K	DATA_K = 0 (not defined)	//Temperature 2

#### I.49.5 Description of PID 80h - Supported PIDs 81h - A0h (not supported)

0 : the PID is not used

1 : the PID is used

#### DATA A - Supported PIDs 81h - 88h

PID 80h - DATA A - Supported PID 81h to 88h		
BIT	Function	Bitmask: ID_STATE_SRV_2_PID[16]
0	PID 88h : ISO/SAE reserved	0
1	PID 87h : Intake Manifold Absolute Pressure	0
2	PID 86h : Particulate Matter (PM) Sensor	0
3	PID 85h : NOx Control System	0
4	PID 84h : Manifold Surface Temperature	0
5	PID 83h : NOx Sensor	0
6	PID 82h : Engine Run Time for AECD #6 -#10	0
7	PID 81h : Engine Run Time for AECD #1 -#5	0

### DATA A - Supported PIDs 89h - 90h


PID 80h - DATA B - Supported PID 89h to 90h		
BIT	Function	Bitmask: ID_STATE_SRV_2_PID[17]
0	PID 90h : ISO/SAE reserved	0
1	PID 8Fh : ISO/SAE reserved	0
2	PID 8Eh : ISO/SAE reserved	0
3	PID 8Dh : ISO/SAE reserved	0
4	PID 8Ch : ISO/SAE reserved	0
5	PID 8Bh : ISO/SAE reserved	0
6	PID 8Ah : ISO/SAE reserved	0
7	PID 89h : ISO/SAE reserved	0

### DATA A - Supported PIDs 91h - 98h

PID 80h - DATA C - Supported PID 91h to 98h		
BIT	Function	Bitmask: ID_STATE_SRV_2_PID[18]
0	PID 98h : ISO/SAE reserved	0
1	PID 97h : ISO/SAE reserved	0
2	PID 96h : ISO/SAE reserved	0
3	PID 95h : ISO/SAE reserved	0
4	PID 94h : ISO/SAE reserved	0
5	PID 93h : ISO/SAE reserved	0
6	PID 92h : ISO/SAE reserved	0
7	PID 91h : ISO/SAE reserved	0

### DATA A - Supported PIDs 99h – A0h

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PID 80h - DATA D - Supported PID 99h to A0h		
BIT	Function	Bitmask: ID_STATE_SRV_2_PID[19]
0	PID A0h : ISO/SAE reserved	0
1	PID 9Fh : ISO/SAE reserved	0
2	PID 9Eh : ISO/SAE reserved	0
3	PID 9Dh : ISO/SAE reserved	0
4	PID 9Ch : ISO/SAE reserved	0
5	PID 9Bh : ISO/SAE reserved	0
6	PID 9Ah : ISO/SAE reserved	0
7	PID 99h : ISO/SAE reserved	0

## I.50 SID 03h: Request emission-related diagnostic trouble codes

### Import actions:

<b>ACTION_ERRM_ReadDtcByTypeOfDtc</b> (<IN>,<TypeOfDtc>,<IN>,<LevelOfDtc>,<INOUT>,<ListOfDtc>,<OUT>,<ResultDtc>)
<b>ACTION_ERRM_ReadQuantityOfDtc</b> (IN<PRM_TYPEOFDTC>,<IN>,<LevelOfDtc>,<INOUT>,<ListOfDtc>,<OUT>,<ResultDtc>,<PRM_QUANTITY>,<OUT>,<PRM_RESULTQUANTITY>)

### I.50.1 Functional description

The purpose of this service is to enable the external test equipment to obtain confirmed emission-related DTCs (diagnostic trouble codes).

Send a Service \$03 request for all emission-related DTCs. Each ECU that has DTCs will respond with one (1) message containing all emission-related DTCs. If an ECU does not have emission-related DTCs then it shall respond with a message indicating no DTCs are stored by setting the parameter # of DTC to 00h

DTCs are transmitted in two (2) bytes of information for each DTC. The first two (2) bits (high order) of the first (1) byte for each DTC indicate whether the DTC is a Powertrain, Chassis, Body, or Network DTC (refer to ISO 15031-6 for additional interpretation of this structure). The second two (2) bits will indicate the first digit of the DTC (0 through 3). The second (2) nibble of the first (1) byte and the entire second (2) byte are the next three (3) hexadecimal characters of the actual DTC reported as hexadecimal. A Powertrain DTC transmitted as 0143h shall be displayed as P0143.

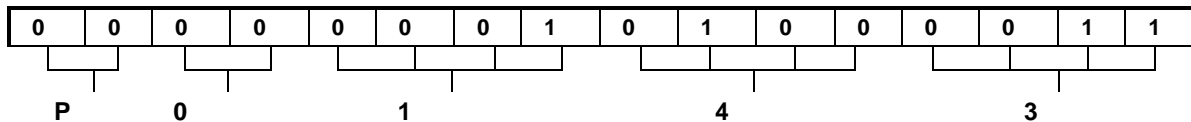


Figure I.50.1: Diagnostic trouble code encoding example DTC P0143

### I.50.2 Message data bytes

#### I.50.2.1 Request message definition

##### Request emission-related DTC request message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request emission-related DTC request SID	M	03	SIDRQ

## I.50.2.2 Response message definition

### Request emission-related DTC response message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request emission-related DTC response SID	M	43	SIDPR
#2	# of DTC = [ no emission-related DTCs stored emission-related DTCs stored ]	M	xx = [ 00, 01 - FF	#OFDTC
#3	DTC#1 (High Byte)	C	xx	DTC1HI
#4	DTC#1 (Low Byte)	C	xx	DTC1LO
:	:	:	xx	
#n-1	DTC#m (High Byte)	C	xx	DTCmHI
#n	DTC#m (Low Byte)	C	xx	DTCmLO

C = Conditional — DTC#1 - DTC#m are only included if # of DTC parameter value ≠ \$00

## I.50.2.3 Parameter definition

### I.50.2.3.1 # of DTC parameter description

The # of DTC parameter reports the emission-related DTC(s) currently (at the time of the request message processing) stored in the ECU(s).

### I.50.2.4 Formula section

#### ACTION\_ERRM\_ReadQuantityOfDtc

```
(
  IN <OBD& CONFIRMED>
  IN <LAW>
  INOUT <NR_DTC>
  OUT <ResultQuantity>
)
```

#### ACTION\_ERRM\_ReadDtcByTypeOfDtc

```
(
  IN <OBD& CONFIRMED>
  IN <LAW>
  INOUT <DTC1 to DTCm>
  OUT <ResultDtc>
)
```

```
IF ResultDtc != BUFFER_FULL THEN
    Positive response
ELSE
    No answer
ENDIF
```

## I.51 SID 04h: Clear/reset emission-related diagnostic inf.

### Input data:

LV_ES {p. 1720}	LV_IGK {p. 906}	NLC_ERR_CLR_ENG_ RUN_SAE {p. 8026}	
-----------------	-----------------	--	--

### Action definition

<b>ACTION_OBDC_Srv04Cnd</b> (OUT<PRM_STATE_SRV_4_RESP>)	Mode: O
This function permit to clear all failures in dynamic memory, or not	

### Import actions:

<b>ACTION_ERRM_ClrInfoByTypeOfDtc</b> (<IN>,<TypeOfDtc>,<OUT>,<ResultClrInfo>)
<b>ACTION_OBDC_Srv04CndSp</b> (OUT<PRM_STATE_SRV_4_SP_RESP>)
<b>ACTION_OBDC_Srv04SpActions</b> ()

### I.51.1 Functional description

The purpose of this service is to provide a means for the external test equipment to command ECUs to clear the whole failure memory (all emission-related and non emission-related diagnostic information) (refer to Error Management module)

This includes:

1. MIL and number of diagnostic trouble codes (can be read with Service 01h, PID 01h)
2. Clear the I/M (Inspection/Maintenance) readiness bits (Service 01h, PID 01h and 41h) (Ser-vice 01h, PID 01h and 41h)
3. Confirmed diagnostic trouble codes (can be read with Service 03h)
4. Pending diagnostic trouble codes (can be read with Service 07h)
5. Diagnostic trouble code for freeze frame data (can be read with Service 02h, PID 02h)
6. Freeze frame data (can be read with Service 02h)
7. Status of system monitoring tests (can be read with Service 01h, PID 01h)
8. On-board monitoring test results (can be read with Service 06h)
9. Distance travelled while MIL is activated with Service 01h, PID 21h (can be read with Service 01h, PID 21h)
10. Number of warm-ups since DTCs cleared with Service 01h, PID 30h (can be read with Service 01h, PID 30h)
11. Distance travelled since DTCs cleared (can be read with Service 01h, PID 31h)
12. Time run by the engine while MIL is activated (can be read with Service 01h, PID 4Dh)

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13. Time since diagnostic trouble codes cleared (can be read with Service 01h, PID 4Eh)
14. Reset misfire counts of standardized Test ID 0Bh to zero (can be read with Service 06h)

### Description of parameter OUT used by function ACTION\_OBDC\_Srv04Cnd ():

PRM\_STATE\_SRV\_4\_RESP: Result to say if the function is done or not.

Authorised values for PRM\_STATE\_SRV\_4\_RESP are:

- (1) The call of the function is successful  
 (0) The call of the function is not successful

### Description for actions:

ACTION_OBDC_Srv04Cnd (OUT < PRM_STATE_SRV_4_RESP >)					
This function permit to clear all failures in dynamic memory, or not. In this function the project should define their own conditions in order to permit or not the clearing performed with Service 04h					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_STATE_SRV_4_RESP	OUT	00H..FFH	0..255	1	-
Result to say if the function is done or not					

The purpose of this function is to define the conditions in order to permit to clear all failures in dynamic memory, or not.

All ECUs shall respond to this request message with ignition ON, with the engine not running.

### Formula section:

```

IF NLC_ERR_CLR_ENG_RUN_SAE THEN
  IF LV_IGK
  THEN
    PRM_STATE_SRV_4_RESP = 1
  ELSE
    PRM_STATE_SRV_4_RESP = 0
  ENDIF
ELSE
  IF LV_IGK AND LV_ES
  THEN
    PRM_STATE_SRV_4_RESP = 1
  ELSE
    PRM_STATE_SRV_4_RESP = 0
  ENDIF
ENDIF
  
```

## I.51.2 Message data bytes

### I.51.2.1 Request message

Bytes	Parameter name	Hex value
#01	Request to clear/reset emission-related diagnostic information	04

For safety and/or technical design reasons, ECUs that can not perform this operation under other conditions, such as with the engine running shall send a negative response message with response code 22h - conditionsNotCorrect.

#### I.51.2.1.1 Formula section

If there are used the generic conditions in order to check if the clearing of all failures in dynamic memory, can be performed or not, this is the sequence to be respected:

```

IFACTION_OBDC_Srv04Cnd()
THEN
    ACTION_ERRM_ClrInfoByTypeOfDtc
        (
            IN <ALL>
            OUT <ResultClrInfo>
        )
    CALL ACTION_OBDC_Srv04SpActions()
        Positive response;
ELSE
        Negative response with "Condition not correct";
ENDIF

```

If there are used the project specific conditions in order to check if the clearing of all failures in dynamic memory, can be performed or not, this is the sequence to be respected:

```

IFACTION_OBDC_Srv04CndSp()
THEN
    ACTION_ERRM_ClrInfoByTypeOfDtc
        (
            IN <ALL>
            OUT <ResultClrInfo>
        )
    CALL ACTION_OBDC_Srv04SpActions()
        Positive response;
ELSE
        Negative response with "Condition not correct";
ENDIF

```

#### I.51.2.2 Positive response message

Bytes	Parameter name	Hex value
#01	Request to clear/reset emission-related diagnostic information positive response	44

#### I.51.2.3 Negative response message

Bytes	Parameter name	Hex value
#1	Negative response	7F
#2	Request to clear/reset emission-related diagnostic information	04
#3	Error code = Condition not correct	22



### I.51.2.4 Error code

Error code	Cause
Condition not correct	In case of ECU can not perform the clearing

## I.52 SID 04h: Clear/reset emission-related diagnostic inf. (Appl. Inc.)

### Input data:

N_32 {p. 1525}	VS {p. 1176}		
----------------	--------------	--	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_32_MAX_CLR_FMY_SRV_4	V	0... FFH	0... 8160	32	rpm
Maximum engine speed threshold to erase error memory in service 04					

### Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_ERR_CLR_ENG_RUN_SAE	-	0... 1H	0 ...1	1	-
Byte which indicates if the erase will be done when engine is running or not					

### Action definition

<b>ACTION_OBDC_Srv04CndSp (OUT&lt;PRM_STATE_SRV_4_SP_RESP&gt;)</b>	Mode: O
This function permit to clear all failures in dynamic memory, or not	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_STATE_SRV_4_SP_RESP	out	0... FFH	0... 255	1	-
Result to say if the function is done or not					

<b>ACTION_OBDC_Srv04SpActions ()</b>	Mode: O
This function permit to project to add their own manufacturer specific "clearing/resetting" actions	

### General information

The purpose of this function is to define the conditions in order to permit to clear all failures in dynamic memory, or not.

### Application conditions:

**Initialisation:** —

**Activation:** —

**Deactivation:** —


**Recurrence:** —

### Function description:

### Formula section:

### I.52.1 Definition of NLC\_ERR\_CLR\_ENG\_RUN\_SAE

#### Description:

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Erase with or without engine running - NLC_ERR_CLR_ENG_RUN_SAE	
Value	Description
0	The clearing of failures is performed when engine is NOT running
1	The clearing of failures is performed when engine is running

**Formula section:**

NLC\_ERR\_CLR\_ENG\_RUN\_SAE = 1

**I.52.2 ACTION\_OBDC\_Srv04CndSp****I.52.2.1 Description of parameter OUT used by function ACTION\_OBDC\_Srv04CndSp():****Description:**

PRM\_STATE\_SRV\_4\_SP\_RESP: Result to say if the function is done or not.

Authorised values for PRM\_STATE\_SRV\_4\_SP\_RESP are:

- (1) The call of the function is successful
- (0) The call of the function is not successful

**Formula section:**

```

IF    VS = 0                AND
        N_32 < C_N_32_MAX_CLR_FMY_SRV_4
THEN
        PRM_STATE_SRV_4_SP_RESP = 1
ELSE
        PRM_STATE_SRV_4_SP_RESP = 0
ENDIF

```

**I.52.3 ACTION\_OBDC\_Srv04SpActions****I.52.3.1 Description of parameter OUT used by function ACTION\_OBDC\_Srv04SpActions():****Description:**

Other manufacturer specific "clearing/resetting" actions may also occur in response to the Service \$04 request.

**Formula section:**

ACTION not used yet

## I.53 SID 06h: Request on-board monitoring testS - specific syst

### I.53.1 Functional description

The purpose of this service is to allow access to the results for on-board diagnostic monitoring tests of specific components /systems that are continuously monitored (e.g. mis-fire monitoring) and non-continuously monitored (e.g. catalyst system).

The request message for test values includes an On-Board Diagnostic Monitor ID (see Annex D of ISO 15031-5.4) that indicates the information requested. Unit and Scaling information is included in Annex E of ISO 15031-5.4.

The vehicle manufacturer is responsible for assigning "Manufacturer Defined Test IDs" for different tests of a monitored system. The latest valid test values (results) are to be retained, even over multiple ignition OFF cycles, until replaced by more recent test values (results). Test values (results) are requested by On-Board Diagnostic Monitor ID. Test values (results) are always reported with the Minimum and Maximum Test Limits. The Unit and Scaling ID included in the response message defines the scaling and unit to be used by the external test equipment to display the test values (results), Minimum Test Limit, and Maximum Test Limit information.

If an On-Board Diagnostic Monitor has not been completed at least once since Clear/reset emission-related diagnostic information or battery disconnect, then the parameters Test Value (Results), Minimum Test Limit, and Maximum Test Limit shall be set to zero (0000h) values.


Not all On-Board Diagnostic Monitor IDs are applicable or supported by all systems. On-Board Diagnostic Monitor ID 00h is a bit-encoded value that indicates for each ECU which On-Board Diagnostic Monitor IDs are supported. On-Board Diagnostic Monitor ID 00h indicates support for On-Board Diagnostic Monitor IDs from 01h to 20h. On-Board Diagnostic Monitor ID 20h indicates support for On-Board Diagnostic Monitor IDs 21h through 40h, etc. This is the same concept for PIDs/TIDs/InfoTypes support in services 01h, 02h, 06h, 08h, and 09h. On-Board Diagnostic Monitor ID 00h is required for those ECUs that respond to a corresponding service 06h request message as specified in Annex A of ISO 15031-5.4.

The request message including supported On-Board Diagnostic Monitor IDs may contain up to six (6) OBDMIDs. A request message including an On-Board Diagnostic Monitor ID, which reports test values shall only contain one (1) OBDMID. An external test equipment is not allowed to request a combination of OBDMIDs supported and a single OBDMID, which report test values. The ECU shall support requests for up to six (6) supported OBDMIDs and only one (1) OBDMID which reports test values.

A unique method must be utilized for displaying data for monitors that have multiple tests. Many OBD monitors have multiple tests that that are done in either a serial or parallel manner. If a monitor uses multiple OBD Monitor ID/Test ID combinations that may not all complete at the same time, the following method shall be used to update the stored test results at the time of monitor completion:

After the monitor completes, update all Monitor ID/Test ID combinations (or test results ) that were utilized by the monitor with appropriate passing or failing results. If a test result (or Monitor ID/Test ID ) was not utilized during this monitoring event, set the Test Values and Minimum and Maximum Test Limits to their initial values (0000h, test not completed). Test results from the previously completed monitoring events shall not be mixed with test results from the current completed monitoring event.

In some cases, test results (or Monitor ID/Test ID combinations ) will be displayed as being incomplete even though the monitor (as indicated by PID 41h) was successfully completed and either passed or

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failed. In other cases, some Test IDs will show passing results while others will show failing results after the monitor (as indicated by PID 41h) was successfully completed and failed. Note that OBD-II regulations prohibit a passing monitor from showing any failing test results. If an initial, serial test indicates a failure and a subsequent re-test of the system indicates a passing result, the test that was utilized to make the passing determination should be displayed, while the failing test that was utilized to make the initial determination should be reset to its initial values (0000h, test not completed).

As an example of a serial monitor, an evaporative system monitor can fail for a large evaporative system leak and never continue to test for small leaks or very small leaks. In this case, the Test ID for the large leak would show a failing result, while the small leak test and the very small leak test would show incomplete. As an example of the parallel monitor, a purge valve flow monitor can pass by having a large rich lambda shift, a large lean lambda shift or a large engine rpm increase. If the purge valve is activated and a large rich lambda shift occurs, the Test ID for the rich lambda shift would show a passing result while the other two Test IDs would show incomplete. Since some Test IDs for a completed monitor will show incomplete, PID 41h must be used to determine monitor completion status.

## I.53.2 Message data bytes

### I.53.2.1 Read supported OBDMIDs

**Request on-board monitoring test results for specific monitored systems request message (read supported OBDMIDs)**

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request on-board monitoring test results for specific monitored systems request SID	M	06	SIDRQ
#2	On-Board Diagnostic Monitor ID (OBDMIDs supported: Annex A of ISO 15031-5.4)	M	xx	OBDMID
#3	On-Board Diagnostic Monitor ID (OBDMIDs supported: Annex A of ISO 15031-5.4)	U	xx	OBDMID
#4	On-Board Diagnostic Monitor ID (OBDMIDs supported: Annex A of ISO 15031-5.4)	U	xx	OBDMID
#5	On-Board Diagnostic Monitor ID (OBDMIDs supported: Annex A of ISO 15031-5.4)	U	xx	OBDMID
#6	On-Board Diagnostic Monitor ID (OBDMIDs supported: Annex A of ISO 15031-5.4)	U	xx	OBDMID
#7	On-Board Diagnostic Monitor ID (OBDMIDs supported: Annex A of ISO 15031-5.4)	U	xx	OBDMID
U = User Optional — OBDMID may be included to avoid multiple OBDMID supported request messages				

**NOTE** To request OBDMIDs supported range from C1h - FFh another request message with OBDMID#1 = C0h and OBDMID#2 = E0h shall be sent to the vehicle

### I.53.2.2 Report supported OBDMIDs

ECU(s) must respond to all supported ranges if requested. A range is defined as a block of 32 OBDMIDs (e.g. range #1: OBDMID 01h-20h). The ECU shall not respond to unsupported OBDMID ranges unless subsequent ranges have a supported OBDMID(s).

### Request on-board monitoring test results for specific monitored systems response message (report supported OBDMIDs)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request on-board monitoring test results for specific monitored systems response SID	M	46	SIDPR
#2	data record of supported OBDMID = [			OBDMIDREC
	1 <sup>st</sup> supported OBDMID	M	xx	OBDMID
#3	Data A: supported OBDMIDs,	M	xx	DATA_A
#4	Data B: supported OBDMIDs,	M	xx	DATA_B
#5	Data C: supported OBDMIDs,	M	xx	DATA_C
#6	Data D: supported OBDMIDs ]	M	xx	DATA_D
:	:	:	:	:
#n-4	data record of supported OBDMID = [			OBDMIDREC
	m <sup>th</sup> supported OBDMID	C1	xx	OBDMID
#n-3	Data A: supported OBDMIDs,	C2	xx	DATA_A
#n-2	Data B: supported OBDMIDs,	C2	xx	DATA_B
#n-1	Data C: supported OBDMIDs,	C2	xx	DATA_C
#n	Data D: supported OBDMIDs ]	C2	xx	DATA_D
C1 = Conditional — OBDMID value shall be the same value as included in the request message if supported by the ECU C2 = Conditional — value indicates OBDMIDs supported; range of supported OBDMIDs depends on selected OBDMID value (see C1)				

**NOTE** The response message shall only include the OBDMID(s) and Data A - D which are supported by the ECU. If the request message includes (a) OBDMID value(s) which are not supported by the ECU those shall not be included in the response message.

### I.53.2.3 Read OBDMID test values

#### Request on-board monitoring test results for specific monitored systems request message (read OBDMID test values)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request on-board monitoring test results for specific monitored systems request SID	M	06	SIDRQ
#2	On-Board Diagnostic Monitor ID	M	xx	OBDMID

### I.53.2.4 Report OBDMID test values

Request on-board monitoring test results for specific monitored systems response message (report OBDMID test values)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request on-board monitoring test results for specific monitored systems response SID	M	46	SIDPR
#2	data record of supported OBDMID = [ On-Board Diagnostic Monitor ID	M	xx	OBDMIDREC OBDMID
#3	Std./Manuf. Defined TID#1	M	xx	S/MDTID
#4	Unit And Scaling ID#1	M	xx	UASID
#5	Test Value (High Byte)#1	M	xx	TVHI
#6	Test Value (Low Byte)#1	M	xx	TVLO
#7	Min. Test Limit (High Byte)#1	M	xx	MINTLHI
#8	Min. Test Limit (Low Byte)#1	M	xx	MINTLLO
#9	Max. Test Limit (High Byte)#1	M	xx	MAXTLHI
#10	Max. Test Limit (Low Byte)#1 ]	M	xx	MAXTLLO
:	:	:	:	:
#n-8	data record of supported OBDMID = [ On-Board Diagnostic Monitor ID	C1	xx	OBDMIDREC OBDMID
#n-7	Std./Manuf. Defined TID#m	C2	xx	S/MDTID
#n-6	Unit And Scaling ID#m	C2	xx	UASID
#n-5	Test Value (High Byte)#m	C2	xx	TVHI
#n-4	Test Value (Low Byte)#m	C2	xx	TVLO
#n-3	Min. Test Limit (High Byte)#m	C2	xx	MINTLHI
#n-2	Min. Test Limit (Low Byte)#m	C2	xx	MINTLLO
#n-1	Max. Test Limit (High Byte)#m	C2	xx	MAXTLHI
#n	Max. Test Limit (Low Byte)#m ]	C2	xx	MAXTLLO
C1 = Conditional — parameter is only present if more than one (1) Manufacturer Defined TID is supported by the ECU for the requested Monitor ID. C2 = Conditional — parameter and value depends on selected Manufacturer Defined TID number and are only included if the Manufacturer Defined TID is supported by the ECU. The value shall be zero (00h) in case the On-Board Diagnostic Monitor has not been completed at least once since Clear/reset emission-related diagnostic information or battery disconnect.				

### I.53.2.5 Response code

**Note :** The response is given following the condition made by the project.  
Here is an example :

#### Formula section:

```

IF      Conditions from the specification XXI06Q01.XXX are fullfield
THEN
      Positive response with test result
ELSE
      Positive response with all data equal to 0000h
ENDIF
  
```

### I.53.3 Parameter definition

#### I.53.3.1 On-Board Diagnostic Monitor IDs supported

The On-Board Diagnostic Monitor IDs supported is the same concept as used for PID support in services 01h and 02h as specified in Annex A of ISO 15031-5.4.

#### I.53.3.2 On-Board Diagnostic Monitor ID description

The On-Board Diagnostic Monitor ID is a one (1) byte parameter and is defined in Annex D of ISO 15031-5.4. An On-Board Diagnostic Monitor may have more than one (1) monitor test (Test ID).

### I.53.3.3 Standardised and Manufacturer Defined Test ID description

The Standardised and Manufacturer Defined Test ID is a one (1) byte parameter. For example, the On-Board Diagnostic Monitor " Oxygen Sensor Monitor Bank 1 - Sensor 1" may have the following Standardised Test ID:

The table below specifies the range of identifiers.

#### Standardised Test ID description

Range (Hex)	Description
00	ISO/SAE reserved
01	Rich to lean sensor threshold voltage (constant)
02	Lean to rich sensor threshold voltage (constant)
03	Low sensor voltage for switch time calculation (constant)
04	High sensor voltage for switch time calculation (constant)
05	Rich to lean sensor switch time (calculated)
06	Lean to rich sensor switch time (calculated)
07	Minimum sensor voltage for test cycle (calculated)
08	Maximum sensor voltage for test cycle (calculated)
09	Time between sensor transitions (calculated)
0A	Sensor period (calculated)
0B	<p>EWMA (Exponential Weighted Moving Average) misfire counts for last ten (10) driving cycles (calculated, rounded to an integer value)</p> <p>General EWMA calculation: <math>0.1 * (\text{current misfire counts}) + 0.9 * (\text{previous misfire counts average})</math></p> <p>Initial value for (previous misfire counts average) = 0</p> <p>Note: Internal ECU calculation registers with precision higher than one count must be used and retained to calculate the contents of registers 0Bh and 0Ch to prevent rounding errors. If this is not done, these registers will never count back down to zero after misfire stops. The calculations must be done using the high precision registers, then rounded to the nearest integer value to be output as register 0Bh and 0Ch</p> <p><math>\text{High\_Precision\_EWMA\_Misfire\_Counts}_{\text{current}} = \text{Rounded} [(0.1) * \text{High\_Precision\_Misfire\_Counts}_{\text{current}} + (0.9) * \text{High\_Precision\_EWMA\_Misfire\_Counts}_{\text{previous}}]</math></p> <p>Where: Rounded means rounded to the nearest integer. The high precision values are never reported, they are only used for internal calculations.</p> <p>This TEST ID shall be reported with OBD Monitor IDs A2h - ADh and the Scaling ID 24h.</p>
0C	Misfire counts for last/current driving cycles (calculated, rounded to an integer value)
0D - 7F	Reserved for future standardisation

#### Manufacturer Defined Test ID description

Range (Hex)	Description
80 - FE	Manufacturer Defined Test ID range - this parameter is an identifier for the test performed within the On-Board Diagnostic Monitor.
FF	Reserved by document

Results of latest mandated on-board oxygen sensor monitoring tests, see figure below.



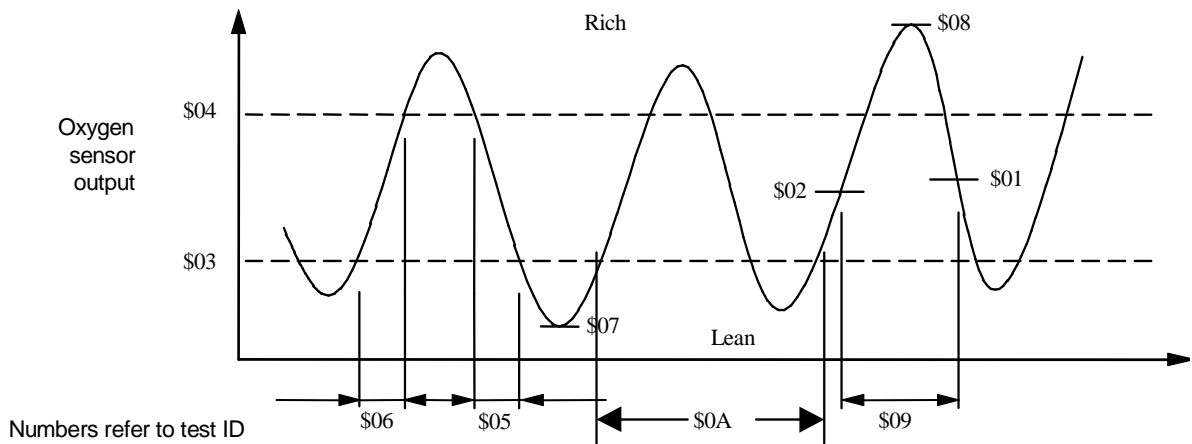


Figure I.53.1: 1 Standardised Test ID value example

### I.53.3.4 Unit and Scaling ID definition

The Unit and Scaling ID is a one (1) byte identifier to reference the scaling and unit to be used by the external test equipment to calculate and display the test values (results), Minimum Test Limit, and the Maximum Test Limit for the Standardised and Manufacturer Defined Test ID requested. All standardised Unit And Scaling IDs are specified in Annex E of ISO 15031-5.4.

### I.53.3.5 Test Value (result) description

The Test Value represents the test result and is defined in the table below.

#### Test Value description

Parameter name	# of bytes	Description
Test Value	2 (High and Low Byte)	Test Value (Result) - this value shall be calculated and displayed by the external test equipment based on the Unit and Scaling ID included in the response message. The Test Value shall be within the Minimum and Maximum Test Limit to indicate a "Pass" result.

### I.53.3.6 Minimum Test Limit description


The Minimum Test Limit parameter is defined in the table below.

#### Minimum Test Limit description

Parameter name	# of bytes	Description
Minimum Test Limit	2 (High and Low Byte)	The Minimum Test Limit shall be calculated and displayed by the external test equipment based on the Unit and Scaling ID included in the response message. The Unit and Scaling IDs are specified in Annex E of ISO 15031-5.4. The Minimum Test Limit shall be the minimum value for the monitor identified by the On-Board Diagnostic Monitor ID. For the Standardised Test IDs which are constant values the Minimum Test Limit shall be the same value as reported for the Test Value. It is the vehicle manufacturer's responsibility to provide information whether a Test Value which equals the Minimum Test Value results in a "Pass" or "Fail" condition.

### I.53.3.7 Maximum Test Limit description

The Maximum Test Limit parameter is defined in the table below.


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## Maximum Test Limit description

Parameter name	# of bytes	Description
Maximum Test Limit	2 (High and Low Byte)	The Maximum Test Limit shall be calculated and displayed by the external test equipment based on the Unit and Scaling ID included in the response message. The Unit and Scaling IDs are specified in Annex E of ISO 15031-5.4. The Maximum Test Limit shall be the maximum value for the monitor identified by the On-Board Diagnostic Monitor ID. For the Standardised Test IDs which are constant values the Maximum Test Limit shall be the same value as reported for the Test Value. It is the vehicle manufacturer's responsibility to provide information whether a Test Value which equals the Maximum Test Value results in a "Pass" or "Fail" condition.


## I.53.4 Standard definition Monitor

### Standard On-Board Diagnostic Monitor ID definition

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OBDMID (Hex)	On-Board Diagnostic Monitor ID name
00	OBD Monitor IDs supported (01h - 20h)
01	Exhaust Gas Sensor Monitor Bank 1 - Sensor 1
02	Exhaust Gas Sensor Monitor Bank 1 - Sensor 2
03	Exhaust Gas Sensor Monitor Bank 1 - Sensor 3
04	Exhaust Gas Sensor Monitor Bank 1 - Sensor 4
05	Exhaust Gas Sensor Monitor Bank 2 - Sensor 1
06	Exhaust Gas Sensor Monitor Bank 2 - Sensor 2
07	Exhaust Gas Sensor Monitor Bank 2 - Sensor 3
08	Exhaust Gas Sensor Monitor Bank 2 - Sensor 4
09	Exhaust Gas Sensor Monitor Bank 3 - Sensor 1
0A	Exhaust Gas Sensor Monitor Bank 3 - Sensor 2
0B	Exhaust Gas Sensor Monitor Bank 3 - Sensor 3
0C	Exhaust Gas Sensor Monitor Bank 3 - Sensor 4
0D	Exhaust Gas Sensor Monitor Bank 4 - Sensor 1
0E	Exhaust Gas Sensor Monitor Bank 4 - Sensor 2
0F	Exhaust Gas Sensor Monitor Bank 4 - Sensor 3
10	Exhaust Gas Sensor Monitor Bank 4 - Sensor 4
11 - 1F	Reserved by document for future standardisation
20	OBD Monitor IDs supported (21h - 40h)
21	Catalyst Monitor Bank 1
22	Catalyst Monitor Bank 2
23	Catalyst Monitor Bank 3
24	Catalyst Monitor Bank 4
25 - 30	Reserved by document for future standardisation
31	EGR Monitor Bank 1
32	EGR Monitor Bank 2
33	EGR Monitor Bank 3
34	EGR Monitor Bank 4
35	VVT Monitor Bank 1
36	VVT Monitor Bank 2
37	VVT Monitor Bank 3
38	VVT Monitor Bank 4
39	EVAP Monitor (Cap Off)
3A	EVAP Monitor (0.090")
3B	EVAP Monitor (0.040")
3C	EVAP Monitor (0.020")

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OBDMID (Hex)	On-Board Diagnostic Monitor ID name
3D	Purge Flow Monitor
3E - 3F	Reserved by document for future standardisation
40	OBD Monitor IDs supported (41h - 60h)
41	Exhaust Gas Sensor Heater Monitor Bank 1 - Sensor 1
42	Exhaust Gas Sensor Heater Monitor Bank 1 - Sensor 2
43	Exhaust Gas Sensor Heater Monitor Bank 1 - Sensor 3
44	Exhaust Gas Sensor Heater Monitor Bank 1 - Sensor 4
-	Exhaust Gas Sensor Heater Monitor Bank 2 - Sensor 1
46	Exhaust Gas Sensor Heater Monitor Bank 2 - Sensor 2
47	Exhaust Gas Sensor Heater Monitor Bank 2 - Sensor 3
48	Exhaust Gas Sensor Heater Monitor Bank 2 - Sensor 4
49	Exhaust Gas Sensor Heater Monitor Bank 3 - Sensor 1
4A	Exhaust Gas Sensor Heater Monitor Bank 3 - Sensor 2
4B	Exhaust Gas Sensor Heater Monitor Bank 3 - Sensor 3
4C	Exhaust Gas Sensor Heater Monitor Bank 3 - Sensor 4
4D	Exhaust Gas Sensor Heater Monitor Bank 4 - Sensor 1
4E	Exhaust Gas Sensor Heater Monitor Bank 4 - Sensor 2
4F	Exhaust Gas Sensor Heater Monitor Bank 4 - Sensor 3
50	Exhaust Gas Sensor Heater Monitor Bank 4 - Sensor 4
51 - 5F	Reserved by document for future standardisation
60	OBD Monitor IDs supported (61h - 80h)
61	Heated Catalyst Monitor Bank 1
62	Heated Catalyst Monitor Bank 2
63	Heated Catalyst Monitor Bank 3
64	Heated Catalyst Monitor Bank 4
65 - 70	Reserved by document for future standardisation
71	Secondary Air Monitor 1
72	Secondary Air Monitor 2
73	Secondary Air Monitor 3
74	Secondary Air Monitor 4
75 - 7F	Reserved by document for future standardisation
80	OBD Monitor IDs supported (81h - A0h)
81	Fuel System Monitor Bank 1
82	Fuel System Monitor Bank 2
83	Fuel System Monitor Bank 3
84	Fuel System Monitor Bank 4

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OBDMID (Hex)	On-Board Diagnostic Monitor ID name
85	Boost Pressure Control Monitor Bank 1
86	Boost Pressure Control Monitor Bank 2
87 - 8F	ISO/SAE reserved
90	NOx Adsorber Monitor Bank 1
91	NOx Adsorber Monitor Bank 2
92 - 97	ISO/SAE reserved
98	NOx Catalyst Monitor Bank 1
99	NOx Catalyst Monitor Bank 2
9A - 9F	ISO/SAE reserved
A0	OBD Monitor IDs supported (A1h - C0h)
A1	Mis-Fire Monitor General Data
A2	Mis-Fire Cylinder 1 Data
A3	Mis-Fire Cylinder 2 Data
A4	Mis-Fire Cylinder 3 Data
A5	Mis-Fire Cylinder 4 Data
A6	Mis-Fire Cylinder 5 Data
A7	Mis-Fire Cylinder 6 Data
A8	Mis-Fire Cylinder 7 Data
A9	Mis-Fire Cylinder 8 Data
AA	Mis-Fire Cylinder 9 Data
AB	Mis-Fire Cylinder 10 Data
AC	Mis-Fire Cylinder 11 Data
AD	Mis-Fire Cylinder 12 Data
AE	Mis-Fire Cylinder 13 Data
AF	Mis-Fire Cylinder 14 Data
B0	Mis-Fire Cylinder 15 Data
B1	Mis-Fire Cylinder 16 Data
B2	PM Filter Monitor Bank 1
B3	PM Filter Monitor Bank 2
B4 - BF	ISO/SAE reserved
C0	OBD Monitor IDs supported (C1h - E0h)
C1 - DF	Reserved by document for future standardisation
E0	OBD Monitor IDs supported (E1h - FFh)
E1 - FF	Vehicle Manufacturer defined OBDMIDs

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## I.54 SID 06h: Request on-board monitoring testS - specific syst (Appl.Inc)

### Input data:

C_CTR_SWT_LS_DOWN {p. 5153}	C_CUR_DMTL_REF_LEAK_MAX {p. 5972}	C_CUR_DMTL_REF_LEAK_MIN {p. 5972}	C_SAF_DIAG_MAX {p. 812}
C_SAF_DIAG_MIN {p. 812}	C_SUM_AFL_VLS_MIN_DIAG_SA_1 {p. 1088}	C_SUM_CNL_SMALL_LEAK_MES_MAX {p. 5973}	C_VLS_DOWN_AFL_AFR_SAE {p. 7836}
C_VLS_DOWN_AFR_AFL_SAE {p. 7836}	C_VLS_MIN_DIAG_PUC_LS_DOWN {p. 4277}	C_VLS_THD_DIAG_SCP_LS_DOWN {p. 4268}	CAM_DYN_IVVT_EX_SAE [NC_NR_CBK_IVVT] {p. 8399}
CAM_DYN_IVVT_EX_TOL_SAE [NC_NR_CBK_IVVT] {p. 8399}	CAM_DYN_IVVT_IN_SAE [NC_NR_CBK_IVVT] {p. 8399}	CAM_DYN_IVVT_IN_TOL_SAE [NC_NR_CBK_IVVT] {p. 8399}	CL_MMV_DIAGCPS_MAX_SAE {p. 5926}
CL_MMV_DIAGCPS_MIN_SAE {p. 5926}	CL_MMV_SAE {p. 5926}	CTR_MIS_DC_CYL [NC_CYL_NR] {p. 6237}	CTR_MIS_DC_MMV_CYL [NC_CYL_NR] {p. 6237}
CTR_MIS_TOT_DC {p. 6237}	CTR_SAVE_SWT_LS_DOWN [NC_CBK_EX_NR] {p. 5151}	EFF_CAT_DIAG_OBD [NC_CBK_EX_NR] {p. 5515}	EFF_CAT_MAX_DIAG_OBD [NC_CBK_EX_NR] {p. 5515}
FAC_DLY_LSL_UP_DIAG_SAE [NC_CBK_EX_NR] {p. 5346}	FAC_DLY_LSL_UP_DIAG_TOL_SAE [NC_CBK_EX_NR] {p. 5346}	FAC_DYN_LSL_UP_DIAG_SAE [NC_CBK_EX_NR] {p. 5346}	FAC_DYN_LSL_UP_DIAG_TOL_SAE [NC_CBK_EX_NR] {p. 5346}
LC_SA_SWI_ACQ {p. 1088}	LV_ERR_MEM_XX {p. 5767}	LV_READY_XX {p. 5881}	M6_CTR_CNL_SMALL_LEAK_MES {p. 5967}
M6_CUR_DMTL_COR_FIL_CID18 {p. 5968}	M6_CUR_DMTL_DMTLS_TEST {p. 5968}	M6_CUR_DMTL_REF_LEAK {p. 5968}	M6_CUR_DMTL_ROUGH_LEAK_END {p. 5968}
M6_CUR_DMTL_ROUGH_LEAK_LEN_END {p. 5968}	M6_CUR_DMTL_SMALL_LEAK_END {p. 5968}	M6_CUR_DMTL_THD_DMTLS_TEST {p. 5968}	M6_CUR_DMTL_THD_ROUGH_LEAK {p. 5968}
M6_CUR_DMTL_THD_ROUGH_LEAK_LEN {p. 5968}	MAF_DIAGCPS_SAE {p. 5927}	MAF_DIAGCPS_THD_SAE {p. 5927}	NC_CYL_NR {p. 1526}
NC_NR_CPS_CP	R_IT_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5198}	R_IT_THD_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5198}	SAF_DIAG_MAX_SAE {p. 1088}
SAF_DIAG_MIN_SAE {p. 1088}	STATE_EVAP_SAE {p. 819}	STATE_PSN_LS_1_SAE {p. 819}	STATE_PSN_LS_SAE {p. 819}
STATE_VAR_SAP_SAE {p. 819}	SUM_AFL_VLS_DIAG_SA_1_SAE {p. 1088}	SUM_AFL_VLS_DIAG_SA_2_SAE {p. 1088}	SUM_DIAG_DIAGCPS_SAE {p. 5928}

SUM_DIAG_DIAGCPS_SAE_1	SUM_DIAG_DIAGCPS_SAE_2	SUM_DIAGCPS_MAX_SAE {p. 5928}	TTIP_OBD_LSH_UP_MES_BOL_SAE [NC_CBK_EX_NR] {p. 5439}
TTIP_OBD_LSH_UP_MES_SAE [NC_CBK_EX_NR] {p. 5439}	TTIP_OBD_LSH_UP_MES_TOL_SAE [NC_CBK_EX_NR] {p. 5439}	VLS_DOWN_MAX_DC [NC_CBK_EX_NR] {p. 1503}	VLS_DOWN_MIN_DC [NC_CBK_EX_NR] {p. 1503}
VLS_DOWN_PUC_SAVE [NC_CBK_EX_NR] {p. 4276}	VLS_DOWN_PUE_BOL_SAE [NC_CBK_EX_NR] {p. 5169}	VLS_DOWN_PUE_SAE [NC_CBK_EX_NR] {p. 5170}	VLS_DOWN_PUE_TOL_SAE [NC_CBK_EX_NR] {p. 5170}

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_STATE_SRV_6_TID [NC_NR_TID]	-	0... FFH	0... 255	1	-
LDP_STATE_TID_ID_STATE_SRV_6	NC_ NR_ TID	0... FFH	0... 255	1	-

Table of bytes which defines the TIDs supported by the service 06h ISO 15765-4

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_TID	-	0... FFH	0... 255	1	-

Define how many TIDs are supported by the project

**FUNCTION DESCRIPTION:****General information:**


In the table **ID\_STATE\_SRV\_6\_TID** the configured OBDMID's and TID's can be calibrated.

**I.54.1 Configuration for supported OBDMID's****Description:**

If an OBDMID is supported, then in column "Supported" "1" is configured, if not "0" is configured.

OBDMID (HEX)	Function	Supported
01	Exhaust Gas Sensor Monitor Bank 1 - Sensor 1	1
02	Exhaust Gas Sensor Monitor Bank 1 - Sensor 2	1
03	Exhaust Gas Sensor Monitor Bank 1 - Sensor 3	0
04	Exhaust Gas Sensor Monitor Bank 1 - Sensor 4	0
05	Exhaust Gas Sensor Monitor Bank 2 - Sensor 1	1
06	Exhaust Gas Sensor Monitor Bank 2 - Sensor 2	1
07	Exhaust Gas Sensor Monitor Bank 2 - Sensor 3	0
08	Exhaust Gas Sensor Monitor Bank 2 - Sensor 4	0
09	Exhaust Gas Sensor Monitor Bank 3 - Sensor 1	0
0A	Exhaust Gas Sensor Monitor Bank 3 - Sensor 2	0
0B	Exhaust Gas Sensor Monitor Bank 3 - Sensor 3	0
0C	Exhaust Gas Sensor Monitor Bank 3 - Sensor 4	0
0D	Exhaust Gas Sensor Monitor Bank 4 - Sensor 1	0
0E	Exhaust Gas Sensor Monitor Bank 4 - Sensor 2	0
0F	Exhaust Gas Sensor Monitor Bank 4 - Sensor 3	0
10	Exhaust Gas Sensor Monitor Bank 4 - Sensor 4	0
<b>11 - 1F</b>	<b>ISO/SAE reserved</b>	0
<b>20</b>	<b>OBD Monitor IDs supported (\$21 - \$40)</b>	1
21	Catalyst Monitor Bank 1	1
22	Catalyst Monitor Bank 2	1
23	Catalyst Monitor Bank 3	0
24	Catalyst Monitor Bank 4	0
<b>25 - 30</b>	<b>ISO/SAE reserved</b>	0
31	EGR Monitor Bank 1	0
32	EGR Monitor Bank 2	0
33	EGR Monitor Bank 3	0
34	EGR Monitor Bank 4	0
35	VVT Monitor Bank 1	1
36	VVT Monitor Bank 2	1
37	VVT Monitor Bank 3 (IF NC_CYL_NR = 8)	1
38	VVT Monitor Bank 4 (IF NC_CYL_NR = 8)	1
39	EVAP Monitor (Cap Off)	0
3A	EVAP Monitor (0.090")	0
3B	EVAP Monitor (0.040")	1
3C	EVAP Monitor (0.020")	1
3D	Purge Flow Monitor	1
<b>3E - 3F</b>	<b>ISO/SAE reserved</b>	0
<b>40</b>	<b>OBD Monitor IDs supported (\$41 - \$60)</b>	1
41	Exhaust Gas Sensor Heater Monitor Bank 1 - Sensor 1	1


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OBDMID (HEX)	Function	Supported
42	Exhaust Gas Sensor Heater Monitor Bank 1 - Sensor 2	1
43	Exhaust Gas Sensor Heater Monitor Bank 1 - Sensor 3	0
44	Exhaust Gas Sensor Heater Monitor Bank 1 - Sensor 4	0
-	Exhaust Gas Sensor Heater Monitor Bank 2 - Sensor 1	1
46	Exhaust Gas Sensor Heater Monitor Bank 2 - Sensor 2	1
47	Exhaust Gas Sensor Heater Monitor Bank 2 - Sensor 3	0
48	Exhaust Gas Sensor Heater Monitor Bank 2 - Sensor 4	0
49	Exhaust Gas Sensor Heater Monitor Bank 3 - Sensor 1	0
4A	Exhaust Gas Sensor Heater Monitor Bank 3 - Sensor 2	0
4B	Exhaust Gas Sensor Heater Monitor Bank 3 - Sensor 3	0
4C	Exhaust Gas Sensor Heater Monitor Bank 3 - Sensor 4	0
4D	Exhaust Gas Sensor Heater Monitor Bank 4 - Sensor 1	0
4E	Exhaust Gas Sensor Heater Monitor Bank 4 - Sensor 2	0
4F	Exhaust Gas Sensor Heater Monitor Bank 4 - Sensor 3	0
50	Exhaust Gas Sensor Heater Monitor Bank 4 - Sensor 4	0
<b>51 - 5F</b>	<b>ISO/SAE reserved</b>	0
<b>60</b>	<b>OBD Monitor IDs supported (\$61 - \$80)</b>	<b>1</b>
61	Heated Catalyst Monitor Bank 1	0
62	Heated Catalyst Monitor Bank 2	0
63	Heated Catalyst Monitor Bank 3	0
64	Heated Catalyst Monitor Bank 4	0
<b>65 - 70</b>	<b>ISO/SAE reserved</b>	0
71	Secondary Air Monitor 1	1
72	Secondary Air Monitor 2	1
73	Secondary Air Monitor 3	0
74	Secondary Air Monitor 4	0
<b>75 - 7F</b>	<b>ISO/SAE reserved</b>	0
<b>80</b>	<b>OBD Monitor IDs supported (\$81 - \$A0)</b>	<b>1</b>
81	Fuel System Monitor Bank 1	0
82	Fuel System Monitor Bank 2	0
83	Fuel System Monitor Bank 3	0
84	Fuel System Monitor Bank 4	0
85	Boost Pressure Control Monitor Bank 1	0
86	Boost Pressure Control Monitor Bank 2	0
87 - 8F	ISO/SAE reserved	0
90	NOx Adsorber Monitor Bank 1	0
91	NOx Adsorber Monitor Bank 2	0
92 - 97	ISO/SAE reserved	0
98	NOx Catalyst Monitor Bank 1	0

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OBDMID (HEX)	Function	Supported
99	NOx Catalyst Monitor Bank 2	0
9A - 9F	ISO/SAE reserved	0
<b>A0</b>	<b>OBD Monitor IDs supported (\$A1 - \$C0)</b>	<b>1</b>
A1	Mis-Fire Monitor General Data	1
A2	Mis-Fire Cylinder 1 Data	1
A3	Mis-Fire Cylinder 2 Data	1
A4	Mis-Fire Cylinder 3 Data	1
A5	Mis-Fire Cylinder 4 Data	1
A6	Mis-Fire Cylinder 5 Data (IF NC_CYL_NR = 6 or 8)	1
A7	Mis-Fire Cylinder 6 Data (IF NC_CYL_NR = 6 or 8)	1
A8	Mis-Fire Cylinder 7 Data (IF NC_CYL_NR = 8)	1
A9	Mis-Fire Cylinder 8 Data (IF NC_CYL_NR = 8)	1
AA	Mis-Fire Cylinder 9 Data	0
AB	Mis-Fire Cylinder 10 Data	0
AC	Mis-Fire Cylinder 11 Data	0
AD	Mis-Fire Cylinder 12 Data	0
AE	Mis-Fire Cylinder 13 Data	0
AF	Mis-Fire Cylinder 14 Data	0
B0	Mis-Fire Cylinder 15 Data	0
B1	Mis-Fire Cylinder 16 Data	0
B2	PM Filter Monitor Bank 1	0
B3	PM Filter Monitor Bank 2	0
B4 - BF	ISO/SAE reserved	0
C0	OBD Monitor IDs supported (C1h - E0h)	0
C1 - DF	Reserved by document for future standardisation	0
E0	OBD Monitor IDs supported (E1h - FFh)	0
E1 - FF	Vehicle manufacturer defined OBDMIDs	0

## I.54.2 Configuration of calibratable TID's

### Description:

The table ID\_STATE\_SRV\_6\_TID will be filled with calibrated TID values. Each position in the table will have an associated TID and OBDMID.

- If the calibration of the TID = xy => TID is sended with xy
- If the calibration of the TID = 0 => TID is not supported
- If the calibration of all TID's of the OBDMID = 0 => OBDMID is not supported

### Example:

If for instance in a project will be supported the following TIDs:

TIDs 01h, 02h, 03h, 04h, 05h, 81h, 82h, 90h, 98h, C1h

- => configure NC\_NR\_TID = 10  
(LDP\_STATE\_TID\_ID\_STATE\_SRV\_6 automatically is set to 10)
- => ID\_STATE\_SRV\_6\_TID will have the dimension 10.

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### Configuration of the table ID\_STATE\_SRV\_6\_TID:

pos val	x[0]	x[1]	x[2]	x[3]	x[4]	x[5]	x[6]	x[7]	x[8]	x[9]
	01h	02h	03h	02h	05h	81h	82h	81h	98h	C1h
	OBDMID yy			OBDMID zz			OBDMID vv			

Each position in table will have an associated OBDMID:

Postion 0: TID 01h => for OBDMID yy

Postion 1: TID 02h => for OBDMID yy

Postion 2: TID 03h => for OBDMID yy

Postion 3: TID 02h => for OBDMID zz

Postion 4: TID 05h => for OBDMID zz

Postion 5: TID 81h => for OBDMID zz

Postion 6: TID 82h => for OBDMID zz

Postion 7: TID 81h => for OBDMID vv

Postion 8: TID 98h => for OBDMID vv

Postion 9: TID C1h => for OBDMID vv

Each OBDMID can be disabled separately:

e.g. if at position x[0], x[1], x[2] configure value 00h => OBDMID yy is **not supported**.

#### Formula section:

**IF** ALL configured TIDs for the same OBDMID have value **00h**  
**THEN** OBDMID **IS NOT SUPPORTED**  
**ELSE** OBDMID **IS SUPPORTED**  
**ENDIF**

### I.54.3 Configuration of table-size

#### Description:

The table-size of ID\_STATE\_SRV\_6\_TID depends on number of defined TID's (= NC\_NR\_TID), see Tables ff.

In order to have only one calibration for all BMW engines (4, 6, 8 cyl) the table is configured for the maximum number of OBDMID's /TID's (= 8 cyl). If one OBDMID is not supported due to configuration (e.g. OBDMID A9 in a 4 cyl engine) => Calibration data in the table on this position is not considered.

#### Formula section:

TID's are defined from position 0...59 => NC\_NR\_TID = 60

### I.54.4 Description of OBDMID 01h - 06h (Lambda sensor diagnosis)

#### General information:

Additional to the calibration the support of the OBDMID's can be learnt. Depending on the learning result (see STATE\_PSN\_LS\_SAE and STATE\_PSN\_LS\_1\_SAE) the OBDMID 01h - 06h are supported or not.

#### I.54.4.1 Description of OBDMID 01h - Oxygen Sensor Monitor Bank 1 - Sensor 1

##### Formula section:

```
IF (STATE_PSN_LS_SAE & 01h) OR (STATE_PSN_LS_1_SAE & 01h)
THEN OBDMID 01h IS SUPPORTED
ELSE OBDMID 01h IS NOT SUPPORTED
ENDIF
```

Dynamic diagnosis - TID 83	
Position in table	[0]
Unit and scaling	04h (Raw value 0...FFFFh / 0...65.535 )
Test value	FAC_DYN_LSL_UP_DIAG_SAE[1]
Min test limit	0 = 0000h
Max test limit	FAC_DYN_LSL_UP_DIAG_TOL_SAE[1] (e.g. 0.9)
Delay diagnosis - TID 84	
Position in table	[1]
Unit and scaling	04h (Raw value 0...FFFFh / 0...65.535 )
Test value	FAC_DLY_LSL_UP_DIAG_SAE[1]
Min test limit	0 = 0000h
Max test limit	FAC_DLY_LSL_UP_DIAG_TOL_SAE[1] (e.g. 0.9)

##### Formula section:

```
IF ID_STATE_SRV_6_TID[see Table above]<> 0
THEN TID is supported
IF LV_READY_DYN_VLD_LS_UP[1] = 0 OR
LV_ERR_MEM_DYN_VLD_LS_UP[1] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID is not supported
ENDIF
```

#### I.54.4.2 Description of OBDMID 02h - Oxygen Sensor Monitor Bank 1 - Sensor 2

##### Formula section:

```
IF (STATE_PSN_LS_SAE & 02h) OR (STATE_PSN_LS_1_SAE & 02h)
THEN OBDMID 02h IS SUPPORTED
ELSE OBDMID 02h IS NOT SUPPORTED
ENDIF
```

Rich to lean sensor threshold voltage - TID 01	
Position in table	[2]
Unit and scaling	0Ah (Voltage 0...FFFFH / 0...8V)
Test value	C_VLS_DOWN_AFR_AFL_SAE
Min test limit	0V = 0000h
Max test limit	C_VLS_THD_DIAG_SCP_LS_DOWN
Lean to rich sensor threshold voltage - TID 02	
Position in table	[3]
Unit and scaling	0Ah (Voltage 0...FFFFH / 0...8V)
Test value	C_VLS_DOWN_AFL_AFR_SAE
Min test limit	0V = 0000h
Max test limit	C_VLS_THD_DIAG_SCP_LS_DOWN
Low sensor voltage for switch time calculation - TID 07	
Position in table	[4]
Unit and scaling	0Ah (Voltage 0...FFFFH / 0...8V)
Test value	VLS_DOWN_MIN_DC[1]
Min test limit	0V = 0000h
Max test limit	C_VLS_THD_DIAG_SCP_LS_DOWN
High sensor voltage for switch time calculation - TID 08	
Position in table	[5]
Unit and scaling	0Ah (Voltage 0...FFFFH / 0...8V)
Test value	VLS_DOWN_MAX_DC[1]
Min test limit	0V = 0000h
Max test limit	C_VLS_THD_DIAG_SCP_LS_DOWN
Switching time diagnosis - TID 91	
Position in table	[6]
Unit and scaling	05h (Raw value 0...FFFFh / 0...2)
Test value	CTR_SAVE_SWT_LS_DOWN[1]
Min test limit	0 = 0000h
Max test limit	C_CTR_SWT_LS_DOWN (e.g. 1)

**Formula section:**

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0           //each separate
THEN       TID is supported
  IF       LV_READY_SWT_LS_DOWN[1] = 0                       OR
          LV_ERR_MEM_SWT_LS_DOWN[1] = 1
  THEN     Positive response with test result
  ELSE     Positive response with all data equal to 0000h
ENDIF
ELSE       TID is not supported
ENDIF

```


Lean to rich diagnosis - TID 92	
Position in table	[7]
Unit and scaling	B1h (Voltage per time 8000...7FFFh / -65536 ...65534)
Test value	VLS_DOWN_PUE_SAE[1]
Min test limit	VLS_DOWN_PUE_BOL_SAE[1]
Max test limit	VLS_DOWN_PUE_TOL_SAE[1]

**Formula section:**

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0
THEN       TID is supported

```

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```

IF          LV_READY_PUE_LS_DOWN[1] = 0          OR
            LV_ERR_MEM_PUE_LS_DOWN[1] = 1
THEN
ELSE       Positive response with test result
ENDIF
ELSE       Positive response with all data equal to 0000h
ENDIF
ELSE       TID is not supported
ENDIF

```

Rich to lean diagnosis - TID 93	
Position in table	[8]
Unit and scaling	0Ah (Voltage 0...FFFFH / 0...8V)
Test value	VLS_DOWN_PUC_SAVE[1]
Min test limit	0 = 0000h
Max test limit	C_VLS_MIN_DIAG_PUC_LS_DOWN

#### Formula section:

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0
THEN       TID is supported
  IF          LV_READY_PUC_LS_DOWN[1] = 0          OR
            LV_ERR_MEM_PUC_LS_DOWN[1] = 1
  THEN
  ELSE       Positive response with test result
  ENDIF
ELSE       Positive response with all data equal to 0000h
ENDIF
ELSE       TID is not supported
ENDIF

```

### I.54.4.3 Description of OBDMID 05h - Oxygen Sensor Monitor Bank 2 - Sensor 1

#### Formula section:

```

IF (STATE_PSN_LS_SAE & 10h) OR (STATE_PSN_LS_1_SAE & 04h)
THEN OBDMID 05h IS SUPPORTED
ELSE OBDMID 05h IS NOT SUPPORTED
ENDIF

```


Dynamic diagnosis - TID 83	
Position in table	[9]
Unit and scaling	04h (Raw value 0...FFFFh / 0...65.535 )
Test value	FAC_DYN_LSL_UP_DIAG_SAE[2]
Min test limit	0 = 0000h
Max test limit	FAC_DYN_LSL_UP_DIAG_TOL_SAE[2] (e.g. 0.9)
Delay diagnosis - TID 84	
Position in table	[10]
Unit and scaling	04h (Raw value 0...FFFFh / 0...65.535 )
Test value	FAC_DLY_LSL_UP_DIAG_SAE[2]
Min test limit	0 = 0000h
Max test limit	FAC_DLY_LSL_UP_DIAG_TOL_SAE[2] (e.g. 0.9)

#### Formula section:

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0

```

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```

THEN      TID is supported
IF        LV_READY_DYN_VLD_LS_UP[2] = 0          OR
          LV_ERR_MEM_DYN_VLD_LS_UP[2] = 1
THEN      Positive response with test result
ELSE      Positive response with all data equal to 0000h
ENDIF

ELSE      TID is not supported
ENDIF

```

#### I.54.4.4 Description of OBDMID 06h - Oxygen Sensor Monitor Bank 2 - Sensor 2

##### Formula section:

```

IF (STATE_PSN_LS_SAE & 20h) OR (STATE_PSN_LS_1_SAE & 08h)
THEN OBDMID 06h IS SUPPORTED
ELSE OBDMID 06h IS NOT SUPPORTED
ENDIF

```


Rich to lean sensor threshold voltage - TID 01	
Position in table	[11]
Unit and scaling	0Ah (Voltage 0...FFFFH / 0...8V)
Test value	C_VLS_DOWN_AFL_AFL_SAE
Min test limit	0V = 0000h
Max test limit	C_VLS_THD_DIAG_SCP_LS_DOWN
Lean to rich sensor threshold voltage - TID 02	
Position in table	[12]
Unit and scaling	0Ah (Voltage 0...FFFFH / 0...8V)
Test value	C_VLS_DOWN_AFL_AFR_SAE
Min test limit	0V = 0000h
Max test limit	C_VLS_THD_DIAG_SCP_LS_DOWN
Low sensor voltage for switch time calculation - TID 07	
Position in table	[13]
Unit and scaling	0Ah (Voltage 0...FFFFH / 0...8V)
Test value	VLS_DOWN_MIN_DC[2]
Min test limit	0V = 0000h
Max test limit	C_VLS_THD_DIAG_SCP_LS_DOWN
High sensor voltage for switch time calculation - TID 08	
Position in table	[14]
Unit and scaling	0Ah (Voltage 0...FFFFH / 0...8V)
Test value	VLS_DOWN_MAX_DC[2]
Min test limit	0V = 0000h
Max test limit	C_VLS_THD_DIAG_SCP_LS_DOWN
Switching time diagnosis - TID 91	
Position in table	[15]
Unit and scaling	05h (Raw value 0...FFFFh / 0...2)
Test value	CTR_SAVE_SWT_LS_DOWN[2]
Min test limit	0 = 0000h
Max test limit	C_CTR_SWT_LS_DOWN (e.g. 1)

##### Formula section:

```

IF        ID_STATE_SRV_6_TID[see Table above] <> 0          //each separate
THEN      TID is supported
IF        LV_READY_SWT_LS_DOWN[2] = 0                      OR
          LV_ERR_MEM_SWT_LS_DOWN[2] = 1

```

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```

THEN           Positive response with test result
ELSE           Positive response with all data equal to 0000h
ENDIF
ELSE           TID is not supported
ENDIF

```

Lean to rich diagnosis - TID 92	
Position in table	[16]
Unit and scaling	B1h (Voltage per time 8000...7FFFh / -65536 ...65534)
Test value	VLS_DOWN_PUE_SAE[2]
Min test limit	VLS_DOWN_PUE_BOL_SAE[2]
Max test limit	VLS_DOWN_PUE_TOL_SAE[2]

#### Formula section:

```

IF             ID_STATE_SRV_6_TID[see Table above] <> 0
THEN          TID is supported
  IF           LV_READY_PUE_LS_DOWN[2] = 0           OR
                LV_ERR_MEM_PUE_LS_DOWN[2] = 1
  THEN          Positive response with test result
  ELSE          Positive response with all data equal to 0000h
ENDIF
ELSE          TID is not supported
ENDIF

```

Rich to lean diagnosis - TID 93	
Position in table	[17]
Unit and scaling	0Ah (Voltage 0...FFFFH / 0...8V)
Test value	VLS_DOWN_PUC_SAVE[2]
Min test limit	0 = 0000h
Max test limit	C_VLS_MIN_DIAG_PUC_LS_DOWN

#### Formula section:

```


IF             ID_STATE_SRV_6_TID[see Table above] <> 0
THEN          TID is supported
  IF           LV_READY_PUC_LS_DOWN[2] = 0           OR
                LV_ERR_MEM_PUC_LS_DOWN[2] = 1
  THEN          Positive response with test result
  ELSE          Positive response with all data equal to 0000h
ENDIF
ELSE          TID is not supported
ENDIF

```

### I.54.5 Description of OBDMID 21 - 22h (Catalyst diagnosis)

#### General information:

Additional to the calibration the support of the OBDMID's can be learnt. Depending on the learning result (see STATE\_PSN\_LS\_SAE and STATE\_PSN\_LS\_1\_SAE) the OBDMID 21h - 22h are supported or not.

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### I.54.5.1 Description of OBDMID 21h - Catalyst Monitor Bank 1

#### Formula section:

```
IF (STATE_PSN_LS_SAE & 03h) OR (STATE_PSN_LS_1_SAE & 03h)
THEN OBDMID 21h IS SUPPORTED
ELSE OBDMID 21h IS NOT SUPPORTED
ENDIF
```

OSC method (linear system) - TID 81	
Position in table	[18]
Unit and scaling	05h (Raw value 0...FFFFh / 0...2)
Test value	EFF_CAT_DIAG_OBD[1]
Min test limit	0 = 0000h
Max test limit	EFF_CAT_MAX_DIAG_OBD[1]

#### Formula section:

```
IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
  IF LV_READY_CAT_DIAG[1] = 0 OR
     LV_ERR_MEM_CAT_DIAG[1] = 1
  THEN Positive response with test result
  ELSE Positive response with all data equal to 0000h
  ENDIF
ELSE TID is not supported
ENDIF
```

### I.54.5.2 Description of OBDMID 22h - Catalyst Monitor Bank 2


#### Formula section:

```
IF (STATE_PSN_LS_SAE & 30h) OR (STATE_PSN_LS_1_SAE & 0Ch)
THEN OBDMID 22h IS SUPPORTED
ELSE OBDMID 22h IS NOT SUPPORTED
ENDIF
```

OSC method (linear system) - TID 81	
Position in table	[19]
Unit and scaling	05h (Raw value 0...FFFFh / 0...2)
Test value	EFF_CAT_DIAG_OBD[2]
Min test limit	0 = 0000h
Max test limit	EFF_CAT_MAX_DIAG_OBD[2]

#### Formula section:

```
IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
  IF LV_READY_CAT_DIAG[2] = 0 OR
     LV_ERR_MEM_CAT_DIAG[2] = 1
  THEN Positive response with test result
```

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```

ELSE          Positive response with all data equal to 0000h
ENDIF
ELSE          TID is not supported
ENDIF

```

## I.54.6 Description of OBDMID 35h - VVT Monitor Bank 1

### I.54.6.1 Camshaft position deviation diagnosis - Inlet 1 (If NC\_CYL\_NR = 4 or 6)

Steady and dynamic deviation - TID 98	
Position in table	[20]
Unit and scaling	1Ch (Angle 0...FFFFh / 0...655.35°)
Test value	CAM_DYN_IVVT_IN_SAE[1]
Min test limit	0h
Max test limit	CAM_DYN_IVVT_IN_TOL_SAE[1]

#### Formula section:

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0
THEN       TID is supported
  IF       LV_READY_MEC_IVVT_IN = 0                OR
           LV_ERR_MEM_MEC_IVVT_IN = 1
  THEN     Positive response with test result
  ELSE     Positive response with all data equal to 0000h
ENDIF
ELSE       TID is not supported
ENDIF

```

### I.54.6.2 Camshaft position deviation diagnosis - Inlet 1 (If NC\_CYL\_NR = 8)

Steady and dynamic deviation - TID 98	
Position in table	[20]
Unit and scaling	1Ch (Angle 0...FFFFh / 0...655.35°)
Test value	CAM_DYN_IVVT_IN_SAE[1]
Min test limit	0h
Max test limit	CAM_DYN_IVVT_IN_TOL_SAE[1]

#### Formula section:

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0
THEN       TID is supported
  IF       LV_READY_MEC_IVVT_IN[1] = 0                OR
           LV_ERR_MEM_MEC_IVVT_IN[1] = 1
  THEN     Positive response with test result
  ELSE     Positive response with all data equal to 0000h
ENDIF
ELSE       TID is not supported
ENDIF

```

## I.54.7 Description of OBDMID 36h - VVT Monitor Bank 2

### I.54.7.1 Camshaft position deviation diagnosis - Exhaust 1 (If NC\_CYL\_NR = 4 or 6)

Steady and dynamic deviation - TID 98	
Position in table	[21]
Unit and scaling	1Ch (Angle 0...FFFFh / 0...655.35°)
Test value	CAM_DYN_IVVT_EX_SAE[1]
Min test limit	0h
Max test limit	CAM_DYN_IVVT_EX_TOL_SAE[1]

#### Formula section:

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0
THEN       TID is supported
  IF       LV_READY_MEC_IVVT_EX = 0                OR
           LV_ERR_MEM_MEC_IVVT_EX = 1
  THEN     Positive response with test result
  ELSE     Positive response with all data equal to 0000h
ENDIF

ELSE       TID is not supported
ENDIF

```

### I.54.7.2 Camshaft position deviation diagnosis - Exhaust 1 (If NC\_CYL\_NR = 8)

Steady and dynamic deviation - TID 98	
Position in table	[21]
Unit and scaling	1Ch (Angle 0...FFFFh / 0...655.35°)
Test value	CAM_DYN_IVVT_EX_SAE[1]
Min test limit	0h
Max test limit	CAM_DYN_IVVT_EX_TOL_SAE[1]

#### Formula section:

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0
THEN       TID is supported
  IF       LV_READY_MEC_IVVT_EX[1] = 0            OR
           LV_ERR_MEM_MEC_IVVT_EX[1] = 1
  THEN     Positive response with test result
  ELSE     Positive response with all data equal to 0000h
ENDIF

ELSE       TID is not supported
ENDIF

```

## I.54.8 Description of OBDMID 37h - VVT Monitor Bank 3

### I.54.8.1 Camshaft position deviation diagnosis - Inlet 2 (If NC\_CYL\_NR = 8)

Steady and dynamic deviation - TID 98	
Position in table	[22]
Unit and scaling	1Ch (Angle 0...FFFFh / 0...655.35°)
Test value	CAM_DYN_IVVT_IN_SAE[2]
Min test limit	0h
Max test limit	CAM_DYN_IVVT_IN_TOL_SAE[2]

#### Formula section:

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0
THEN       TID is supported
  IF       LV_READY_MEC_IVVT_IN[2] = 0                OR
           LV_ERR_MEM_MEC_IVVT_IN[2] = 1
  THEN     Positive response with test result
  ELSE     Positive response with all data equal to 0000h
ENDIF
ELSE       TID is not supported
ENDIF

```

## I.54.9 Description of OBDMID 38h - VVT Monitor Bank 4

### I.54.9.1 Camshaft position deviation diagnosis - Exhaust 2 (If NC\_CYL\_NR = 8)

Steady and dynamic deviation - TID 98	
Position in table	[23]
Unit and scaling	1Ch (Angle 0...FFFFh / 0...655.35°)
Test value	CAM_DYN_IVVT_EX_SAE[2]
Min test limit	0h
Max test limit	CAM_DYN_IVVT_EX_TOL_SAE[2]

#### Formula section:


```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0
THEN       TID is supported
  IF       LV_READY_MEC_IVVT_EX[2] = 0                OR
           LV_ERR_MEM_MEC_IVVT_EX[2] = 1
  THEN     Positive response with test result
  ELSE     Positive response with all data equal to 0000h
ENDIF
ELSE       TID is not supported
ENDIF

```

## I.54.10 Description of OBDMID 3Bh - 3Dh (EVAP diagnosis)

#### General information:

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Additional to the calibration the support of the OBDMID's can be learnt. OBDMID 3Bh - 3Ch are only supported if the vehicle is equipped with DMTL module.

#### Formula section:

```

IF          STATE_EVAP_SAE <> 0
THEN       OBDMID 3Bh - 3Ch are supported
ELSE       OBDMID 3Bh - 3Ch are not supported
ENDIF
  
```

#### I.54.10.1 Description of OBDMID 3B - EVAP Monitor Large (0.040" /1.0mm)

Leak detection DMTL - Long cycle - TID 81	
Position in table	[24]
Unit and scaling	0Dh (Current 0...FFFFh / 0...256 mA)
Test value	M6_CUR_DMTL_ROUGH_LEAK_LEN_END
Min test limit	M6_CUR_DMTL_THD_ROUGH_LEAK_LEN
Max test limit	FFFFh (256 mA)
Leak detection DMTL - Short cycle - TID 82	
Position in table	[25]
Unit and scaling	0Dh (Current)
Test value	M6_CUR_DMTL_ROUGH_LEAK_END
Min test limit	M6_CUR_DMTL_THD_ROUGH_LEAK
Max test limit	FFFFh (256 mA)

#### Formula section:

```


IF          ID_STATE_SRV_6_TID[see Table above] <> 0           //each seperate
THEN       TID's are supported
  IF          LV_READY_ROUGH_LEAK = 0                           OR
             LV_ERR_MEM_ROUGH_LEAK = 1
  THEN       Positive response with test result
  ELSE       Positive response with all data equal to 0000h
  ENDIF
ELSE       TID' s are not supported
ENDIF
  
```

DMTL module - Signal error - TID 8B	
Position in table	[26]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	M6_CTR_CNL_SMALL_LEAK_MES
Min test limit	0h
Max test limit	C_SUM_CNL_SMALL_LEAK_MES_MAX

#### Formula section:

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0           //each seperate
THEN       TID's are supported
  IF          LV_READY_DMTL_SIG = 0                             OR
             LV_ERR_DMTL_SIG = 1
  THEN       Positive response with test result
  ELSE       Positive response with all data equal to 0000h
  
```

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```

ENDIF
ELSE      TID's are not supported
ENDIF

```

<b>DMTL module - Plausibility error - TID 8C</b>	
Position in table	[27]
Unit and scaling	0Dh (Current 0...FFFFh / 0...256 mA)
Test value	M6_CUR_DMTL_DMTLS_TEST
Min test limit	0h
Max test limit	M6_CUR_DMTL_THD_DMTLS_TEST

#### Formula section:

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0           //each seperate
THEN       TID's are supported
  IF          LV_READY_DMTL_PLAUS = 0                OR
              LV_ERR_MEM_DMTL_PLAUS = 1
  THEN       Positive response with test result
  ELSE       Positive response with all data equal to 0000h
ENDIF

ELSE       TID's are not supported
ENDIF

```

<b>DMTL module - MIN error - TID 8D</b>	
Position in table	[28]
Unit and scaling	0Dh (Current 0...FFFFh / 0...256 mA)
Test value	M6_CUR_DMTL_COR_FIL_CID18
Min test limit	C_CUR_DMTL_REF_LEAK_MIN
Max test limit	FFFFh

#### Formula section:

```


IF          ID_STATE_SRV_6_TID[see Table above] <> 0           //each seperate
THEN       TID's are supported
  IF          LV_READY_DMTL_MIN = 0                OR
              LV_ERR_MEM_DMTL_MIN = 1
  THEN       Positive response with test result
  ELSE       Positive response with all data equal to 0000h
ENDIF

ELSE       TID's are not supported
ENDIF

```

<b>DMTL module - MAX error - TID 8E</b>	
Position in table	[29]
Unit and scaling	0Dh (Current 0...FFFFh / 0...256 mA)
Test value	M6_CUR_DMTL_COR_FIL_CID18
Min test limit	0h
Max test limit	C_CUR_DMTL_REF_LEAK_MAX

#### Formula section:

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```

IF                ID_STATE_SRV_6_TID[see Table above] <> 0           //each separate
THEN              TID's are supported
  IF                LV_READY_DMTL_MAX = 0                               OR
                    LV_ERR_MEM_MAX = 1
  THEN              Positive response with test result
  ELSE              Positive response with all data equal to 0000h
ENDIF
ELSE              TID's are not supported
ENDIF

```

### I.54.10.2 Description of OBDMID 3C - EVAP Monitor Small (0.020" /0.5 mm)

Leak detection DMTL - Short cycle - TID 3C	
Position in table	[30]
Unit and scaling	0Dh (Current 0...FFFFh / 0...256 mA)
Test value	M6_CUR_DMTL_SMALL_LEAK_END
Min test limit	M6_CUR_DMTL_REF_LEAK
Max test limit	FFFFh (256 mA)

#### Formula section:

```

IF                ID_STATE_SRV_6_TID[see Table above] <> 0
THEN              TID is supported
  IF                LV_READY_SMALL_LEAK = 0                               OR
                    LV_ERR_MEM_SMALL_LEAK = 1
  THEN              Positive response with test result
  ELSE              Positive response with all data equal to 0000h
ENDIF
ELSE              TID is not supported
ENDIF

```

### I.54.10.3 Description of OBDMID 3D - EVAP Purge Flow monitor (If NC\_NR\_CPS\_CP = 1)

Functional check TEV - Step 1 - TID 81	
Position in table	[31]
Unit and scaling	05h (Raw value 0...FFFFh / 0...2)
Test value	CL_MMV_SAE
Min test limit	CL_MMV_DIAGCPS_MIN_SAE
Max test limit	CL_MMV_DIAGCPS_MAX_SAE
Functional check TEV - Step 2 - TID 82	
Position in table	[32]
Unit and scaling	03h (Raw value 0...FFFFh / 0...655,35)
Test value	SUM_DIAG_DIAGCPS_SAE
Min test limit	0h(0)
Max test limit	SUM_DIAGCPS_MAX_SAE
Functional check TEV - Step 3 - TID 83	
Position in table	[33]
Unit and scaling	2Dh (Weight per stroke 0...FFFFh / 0...655,35 mg/stk)
Test value	MAF_DIAGCPS_SAE
Min test limit	0h (0 mg/stk)
Max test limit	MAF_DIAGCPS_THD_SAE

**Formula section:**

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0           //each separate
THEN       TID's are supported
  IF       LV_READY_DIAGCPS = 0                               OR
           LV_ERR_MEM_DIAGCPS = 1
  THEN     Positive response with test result
  ELSE     Positive response with all data equal to 0000h
ENDIF
ELSE       TID's are not supported
ENDIF

```

**I.54.10.4 Description of OBDMID 3D - EVAP Purge Flow monitor (If NC\_NR\_CPS\_CP = 2)**

Functional check TEV_1 - Step 2 - TID 82	
Position in table	[34]
Unit and scaling	24h (Raw value 0...FFFFh / 0...65535)
Test value	SUM_DIAG_DIAGCPS_SAE_1
Min test limit	0h(0)
Max test limit	SUM_DIAGCPS_MAX_SAE

**Formula section:**

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0
THEN       TIDs are supported
  IF       LV_READY_DIAGCPS_1 = 0                               OR
           LV_ERR_MEM_DIAGCPS_1 = 1
  THEN     Positive response with test result
  ELSE     Positive response with all data equal to 0000h
ENDIF
ELSE       TIDs are not supported
ENDIF

```


Functional check TEV_2 - Step 2 - TID 82	
Position in table	[35]
Unit and scaling	24h (Raw value 0...FFFFh / 0...65535)
Test value	SUM_DIAG_DIAGCPS_SAE_2
Min test limit	0h(0)
Max test limit	SUM_DIAGCPS_MAX_SAE

**Formula section:**

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0
THEN       TIDs are supported
  IF       LV_READY_DIAGCPS_2 = 0                               OR
           LV_ERR_MEM_DIAGCPS_2 = 1
  THEN     Positive response with test result
  ELSE     Positive response with all data equal to 0000h
ENDIF
ELSE       TIDs are not supported

```

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**ENDIF**

## I.54.11 Description of OBDMID 41h - 46h (Oxygen sensor heater diagnosis)

### General information:

Additional to the calibration the support of the OBDMID's can be learnt. Depending on the learning result (see STATE\_PSN\_LS\_SAE and STATE\_PSN\_LS\_1\_SAE) the OBDMID 41h - 46h are supported or not.

### I.54.11.1 Description of OBDMID 41h Oxygen Sensor Heater Monitor Bank 1 Sensor 1

#### Formula section:

```
IF (STATE_PSN_LS_SAE & 01h) OR (STATE_PSN_LS_1_SAE & 01h)
THEN OBDMID 41h IS SUPPORTED
ELSE OBDMID 41h IS NOT SUPPORTED
ENDIF
```

Sensor temperature - TID 85	
Position in table	[36]
Unit and scaling	16h (Temperature 0000...FFFF / -40...6513.5°C)
Test value	TTIP_OBD_LSH_UP_MES_SAE[1]
Min test limit	TTIP_OBD_LSH_UP_MES_BOL_SAE[1]
Max test limit	TTIP_OBD_LSH_UP_MES_TOL_SAE[1]

#### Formula section:

```
IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
  IF LV_READY_OBD_VLD_LSH_UP[1] = 0 OR
     LV_ERR_MEM_OBD_VLD_LSH_UP[1] = 1
  THEN Positive response with test result
  ELSE Positive response with all data equal to 0000h
  ENDIF
ELSE TID is not supported
ENDIF
```

### I.54.11.2 Description of OBDMID 42h Oxygen Sensor Heater Monitor Bank 1 Sensor 2

#### Formula section:

```
IF (STATE_PSN_LS_SAE & 02h) OR (STATE_PSN_LS_1_SAE & 02h)
THEN OBDMID 42h IS SUPPORTED
ELSE OBDMID 42h IS NOT SUPPORTED
ENDIF
```

Sensor resistance - TID 81	
Position in table	[37]
Unit and scaling	14h (Resistance 0...FFFFh / 0...65535 Ohm)
Test value	R_IT_OBD_LSH_DOWN[1]
Min test limit	0h
Max test limit	R_IT_THD_OBD_LSH_DOWN[1]

**Formula section:**

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0
THEN       TID is supported
  IF       LV_READY_OBD_LSH_DOWN[1] = 0                OR
           LV_ERR_MEM_OBD_LSH_DOWN[1] = 1
  THEN     Positive response with test result
  ELSE     Positive response with all data equal to 0000h
ENDIF
ELSE       TID is not supported
ENDIF

```

**I.54.11.3 Description of OBDMID -h Oxygen Sensor Heater Monitor Bank 2 Sensor 1****Formula section:**

```

IF (STATE_PSN_LS_SAE & 10h) OR (STATE_PSN_LS_1_SAE & 04h)
THEN OBDMID -h IS SUPPORTED
ELSE OBDMID -h IS NOT SUPPORTED
ENDIF

```

Sensor temperature - TID 85	
Position in table	[38]
Unit and scaling	16h (Temperature 0000...FFFF / -40...6513.5°C)
Test value	TTIP_OBD_LSH_UP_MES_SAE[2]
Min test limit	TTIP_OBD_LSH_UP_MES_BOL_SAE[2]
Max test limit	TTIP_OBD_LSH_UP_MES_TOL_SAE[2]


**Formula section:**

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0
THEN       TID is supported
  IF       LV_READY_OBD_VLD_LSH_UP[2] = 0                OR
           LV_ERR_MEM_OBD_VLD_LSH_UP[2] = 1
  THEN     Positive response with test result
  ELSE     Positive response with all data equal to 0000h
ENDIF
ELSE       TID is not supported
ENDIF

```

**I.54.11.4 Description of OBDMID 46h Oxygen Sensor Heater Monitor Bank 2 Sensor 2**

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**Formula section:**

```

IF (STATE_PSN_LS_SAE & 20h) OR (STATE_PSN_LS_1_SAE & 08h)
THEN OBDMID 46h IS SUPPORTED
ELSE OBDMID 46h IS NOT SUPPORTED
ENDIF

```

Sensor resistance - TID 81	
Position in table	[39]
Unit and scaling	14h (Resistance 0...FFFFh / 0...65535 Ohm)
Test value	R_IT_OBD_LSH_DOWN[2]
Min test limit	0h
Max test limit	R_IT_THD_OBD_LSH_DOWN[2]

**Formula section:**

```

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
  IF LV_READY_OBD_LSH_DOWN[2] = 0 OR
    LV_ERR_MEM_OBD_LSH_DOWN[2] = 1
  THEN Positive response with test result
  ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID is not supported
ENDIF

```

**I.54.12 Description of OBDMID 71h - 72h (Secondary air diagnosis)****General information:**

Additional to the calibration the support of the OBDMID's can be learnt. OBDMID 71h - 72h are only supported if the vehicle is equipped with SA pump. Depending on Hardware configuration only one monitor is active (via lambda-sensor **or** flow meter).

**Formula section:**

```

IF STATE_VAR_SAP_SAE <> 0
THEN OBDMID 71h - 72h are supported
  IF LC_SA_SWI_ACQ = 1
  THEN OBDMID 71h is not supported //SA flow meter equipped
  ELSE OBDMID 72h is not supported //SA flow meter not equipped
  ENDIF
ELSE OBDMID 71h - 72h are not supported
ENDIF

```

### I.54.12.1 Description of OBDMID 71h - Secondary air monitor with lambda sensor

Monitoring of minimum flow rate - TID 81	
Position in table	[40]
Unit and scaling	01h (Raw value 0...FFFFh / 0...65535)
Test value	MIN [SUM_AFL_VLS_DIAG_SA_1_SAE, SUM_AFL_VLS_DIAG_SA_2_SAE]
Min test limit	C_SUM_AFL_VLS_MIN_DIAG_SA_1
Max test limit	FFFFh (65535)

#### Formula section:

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0
THEN       TID is supported
  IF       LV_READY_SA_SAP = 0                OR
           LV_ERR_MEM_SA_SAP = 1
  THEN     Positive response with test result
  ELSE     Positive response with all data equal to 0000h
ENDIF

ELSE       TID is not supported
ENDIF
  
```

### I.54.12.2 Description of OBDMID 72h - Secondary air monitor with SA flow meter

Monitoring of minimum flow rate - TID 82	
Position in table	[41]
Unit and scaling	27h (Weight per time 0...FFFFh / 0...655,35 g/s)
Test value	SAF_DIAG_MIN_SAE
Min test limit	0h
Max test limit	C_SAF_DIAG_MIN
Monitoring of minimum flow rate - TID 83	
Position in table	[42]
Unit and scaling	27h (Weight per time 0...FFFFh / 0...655,35 g/s)
Test value	SAF_DIAG_MAX_SAE
Min test limit	0h
Max test limit	C_SAF_DIAG_MAX

#### Formula section:


```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0                //each seperate
THEN       TID are supported
  IF       LV_READY_SA_SYS = 0                OR
           LV_ERR_MEM_SA_SYS = 1
  THEN     Positive response with test result
  ELSE     Positive response with all data equal to 0000h
ENDIF

ELSE       TID are not supported
ENDIF
  
```

### I.54.13 Description of OBDMID A1h...A9h Misfire Clinder Data

#### Description:

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Depending on the number of cylinder (NC\_CYL\_NR) the following OBDMID's are supported or not and the corresponding variables are different:

Configuration for OBDMID's A2...A9				
OBDMID / Cylinder	NC_CYL_NR = 4	NC_CYL_NR = 6	NC_CYL_NR = 8	NC_CYL_NR = tbd
OBDMID A2 / Cylinder 1	0	0	0	
OBDMID A3 / Cylinder 2	3	4	7	
OBDMID A4 / Cylinder 3	1	2	5	
OBDMID A5 / Cylinder 4	2	5	2	
OBDMID A6 / Cylinder 5	Not supported	1	1	
OBDMID A7 / Cylinder 6	Not supported	3	4	
OBDMID A8 / Cylinder 7	Not supported	Not supported	6	
OBDMID A9 / Cylinder 8	Not supported	Not supported	3	

e.g. data from OBDMID A4 (If 8-cyl engine):

- CTR\_MIS\_DC\_CYL[5]
- CTR\_MIS\_DC\_MMV\_CYL[5]
- LV\_READY\_MIS[5]
- LV\_ERR\_MEM\_MIS[5]

#### I.54.14 Description of OBDMID A1h - Mis-fire Monitor General Data

Mis-Fire Monitor General Data - TID 0C	
Position in table	[43]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_TOT_DC
Min test limit	0
Max test limit	65535 = FFFFh

#### Formula section:

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0
THEN       TID is supported
  IF       LV_READY_MIS[0] = 0                OR
           LV_ERR_MEM_MIS[0] = 1
  THEN     Positive response with test result
  ELSE     Positive response with all data equal to 0000h
ENDIF
ELSE       TID is not supported
ENDIF

```

## I.54.15 Description of OBDMID A2h Mis-fire Clinder 1 Data

Mis-Fire Count for Last/Current driving cycle - TID 0C	
Position in table	[44]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh
EWMA Mis-Fire Count for Last 10 driving cycle - TID 0B	
Position in table	[45]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_MMV_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh

### Formula section:

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0           //each seperate
THEN       TID's are supported
  IF       LV_READY_MIS[see table] = 0                       OR
           LV_ERR_MEM_MIS[see table] = 1
  THEN     Positive response with test result
  ELSE     Positive response with all data equal to 0000h
ENDIF

ELSE       TID's are not supported
ENDIF

```

## I.54.16 Description of OBDMID A3h - Mis-fire Cylinder 2 Data

Mis-Fire Count for Last/Current driving cycle - TID 0C	
Position in table	[46]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh
EWMA Mis-Fire Count for Last 10 driving cycle - TID 0B	
Position in table	[47]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_MMV_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh

### Formula section:

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0           //each seperate
THEN       TID's are supported
  IF       LV_READY_MIS[see table] = 0                       OR
           LV_ERR_MEM_MIS[see table] = 1
  THEN     Positive response with test result
  ELSE     Positive response with all data equal to 0000h
ENDIF

ELSE       TID's are not supported

```

**ENDIF**

### I.54.17 Description of OBDMID A4h - Mis-fire Cylinder 3 Data

Mis-Fire Count for Last/Current driving cycle - TID 0C	
Position in table	[48]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh
EWMA Mis-Fire Count for Last 10 driving cycle - TID 0B	
Position in table	[49]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_MMV_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh

#### Formula section:

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0           //each separate
THEN       TID's are supported
  IF       LV_READY_MIS[see table] = 0                       OR
           LV_ERR_MEM_MIS[see table] = 1
  THEN     Positive response with test result
  ELSE     Positive response with all data equal to 0000h
ENDIF
ELSE       TID's are not supported
ENDIF

```

### I.54.18 Description of OBDMID A5h - Mis-fire Cylinder 4 Data


Mis-Fire Count for Last/Current driving cycle - TID 0C	
Position in table	[50]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh
EWMA Mis-Fire Count for Last 10 driving cycle - TID 0B	
Position in table	[51]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_MMV_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh

#### Formula section:

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0           //each separate
THEN       TID's are supported
  IF       LV_READY_MIS[see table] = 0                       OR
           LV_ERR_MEM_MIS[see table] = 1
  THEN     Positive response with test result
  ELSE     Positive response with all data equal to 0000h

```

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```

ENDIF
ELSE      TID's are not supported
ENDIF

```

### I.54.19 Description of OBDMID A6h - Mis-fire Cylinder 5 Data

Mis-Fire Count for Last/Current driving cycle - TID 0C	
Position in table	[52]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh
EWMA Mis-Fire Count for Last 10 driving cycle - TID 0B	
Position in table	[53]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_MMV_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh

#### Formula section:

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0           //each separate
THEN       TID's are supported
  IF          LV_READY_MIS[see table] = 0                       OR
              LV_ERR_MEM_MIS[see table] = 1
  THEN       Positive response with test result
  ELSE       Positive response with all data equal to 0000h
ENDIF

ELSE       TID's are not supported
ENDIF

```

### I.54.20 Description of OBDMID A7h - Mis-fire Cylinder 6 Data

Mis-Fire Count for Last/Current driving cycle - TID 0C	
Position in table	[54]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh
EWMA Mis-Fire Count for Last 10 driving cycle - TID 0B	
Position in table	[55]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_MMV_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh

#### Formula section:

```

IF          ID_STATE_SRV_6_TID[see Table above] <> 0           //each separate
THEN       TID's are supported
  IF          LV_READY_MIS[see table] = 0                       OR
              LV_ERR_MEM_MIS[see table] = 1

```



```

THEN           Positive response with test result
ELSE           Positive response with all data equal to 0000h
ENDIF
ELSE           TID's are not supported
ENDIF

```

### I.54.21 Description of OBDMID A8h - Mis-fire Cylinder 7 Data

Mis-Fire Count for Last/Current driving cycle - TID 0C	
Position in table	[56]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh
EWMA Mis-Fire Count for Last 10 driving cycle - TID 0B	
Position in table	[57]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_MMV_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh

#### Formula section:

```

IF             ID_STATE_SRV_6_TID[see Table above] <> 0           //each separate
THEN          TID's are supported
  IF             LV_READY_MIS[see table] = 0                       OR
                 LV_ERR_MEM_MIS[see table] = 1
  THEN          Positive response with test result
  ELSE          Positive response with all data equal to 0000h
ENDIF
ELSE          TID's are not supported
ENDIF

```

### I.54.22 Description of OBDMID A9h - Mis-fire Cylinder 8 Data


Mis-Fire Count for Last/Current driving cycle - TID 0C	
Position in table	[58]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh
EWMA Mis-Fire Count for Last 10 driving cycle - TID 0B	
Position in table	[59]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_MMV_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh

#### Formula section:

```

IF             ID_STATE_SRV_6_TID[see Table above] <> 0           //each separate
THEN          TID's are supported


```

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```

IF                LV_READY_MIS[see table] = 0                OR
                    LV_ERR_MEM_MIS[see table] = 1
THEN              Positive response with test result
ELSE              Positive response with all data equal to 0000h
ENDIF
ELSE              TID's are not supported
ENDIF

```

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## I.55 SID 07h: Request emission-related diagnostic trouble codes - pending

### Import actions:

<b>ACTION_ERRM_ReadDtcByTypeOfDtc</b> (<IN>,<TypeOfDtc>,<IN>,<LevelOfDtc>,<INOUT>,<ListOfDtc>,<OUT>,<ResultDtc>)
<b>ACTION_ERRM_ReadQuantityOfDtc</b> (IN<PRM_TYPEOFDTC>,IN<PRM_LEVELOFDTC>,INOUT<PRM_QUANTITY>,OUT<PRM_RESULTQUANTITY>)

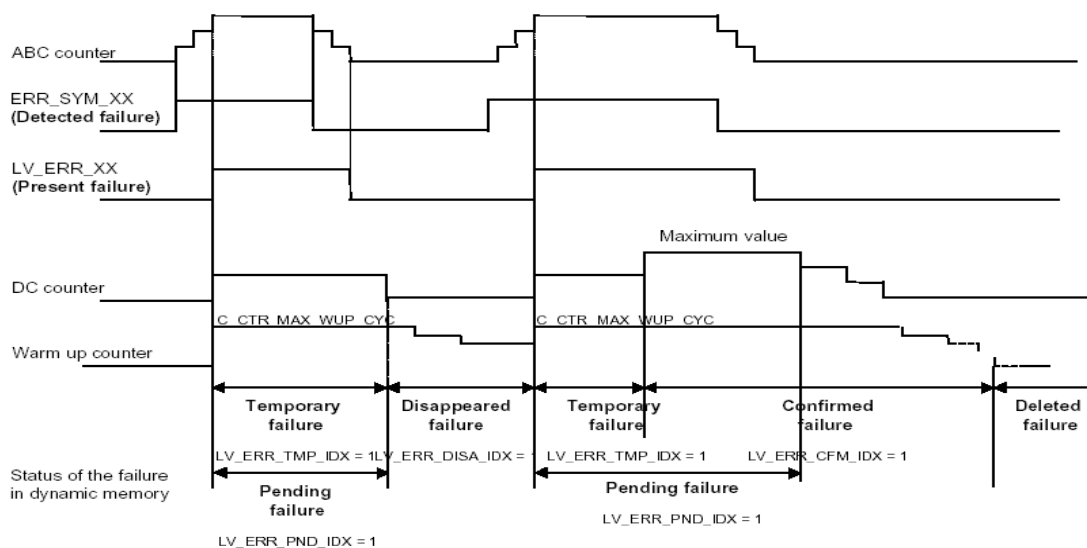
### I.55.1 Functional description for ISO 15765-4

The purpose of this service is to enable the external test equipment to obtain pending diagnostic trouble codes detected during current or last completed driving cycle for emission-related components /systems that are tested or continuously monitored during normal driving conditions. Service 07h is required for all DTCs and is independent of Service 03h.

The intended use of this data is to assist the service technician after a vehicle repair, and after clearing diagnostic information, by reporting test results after a single driving cycle. If the test failed during the driving cycle, the DTC associated with that test will be reported. Test results reported by this service do not necessarily indicate a faulty component /system. If test results indicate a failure after additional driving, then the MIL will be illuminated and a DTC will be set and reported with service 03h, indicating a faulty component /system. This service can always be used to request the results of the latest test, independent of the setting of a DTC.

Test results for these components /systems are reported in the same format as the DTCs in Service \$03 - refer to the functional description for service \$03.

If an ECU does not have stored DTCs then it shall respond with a message indicating no codes are stored by setting the parameter "Number of DTC" to 00h.



## I.55.2 Message data bytes

### I.55.2.1 Request message definition

Request emission-related diagnostic trouble codes detected during current or last completed driving cycle request message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request emission-related diagnostic trouble codes detected during current or last completed driving cycle request SID	M	07	SIDRQ

### I.55.2.2 Response message definition

Request emission-related diagnostic trouble codes detected during current or last completed driving cycle response message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request emission-related diagnostic trouble codes detected during current or last completed driving cycle response SID	M	47	SIDPR
#2	# of DTC = [ no emission-related DTCs # of emission-related DTCs ]	M	00 01 - FF	#OFDTC
#3	DTC#1 (High Byte)	C	xx	DTC1HI
#4	DTC#1 (Low Byte)	C	xx	DTC1LO
:	:	:	xx	
#n-1	DTC#m (High Byte)	C	xx	DTCmHI
#n	DTC#m (Low Byte)	C	xx	DTCmLO
C = Conditional — DTC#1 - DTC#m are only included if # of DTC parameter value ≠ \$00				

### I.55.2.3 Formula section

#### ACTION\_ERRM\_ReadQuantityOfDtc

```
(
  IN <OBD& PENDING>
  IN <LAW>
  INOUT <NR_DTC>
  OUT <ResultQuantity>
)
```

#### ACTION\_ERRM\_ReadDtcByTypeOfDtc

```
(
  IN <OBD& PENDING>
  IN <LAW>
  INOUT <DTC1 to DTCm>
  OUT <ResultDtc>
)
```

```
IF ResultDtc != BUFFER_FULL
  THEN
    Positive response
  ELSE
    No answer
ENDIF
```

## I.56 SID 08h: Request control of on-board system, test/component

### Import actions:

<b>ACTION_OBDC_Srv08EvapSysLeak</b> (OUT<No Name available>)
--

### I.56.1 Functional description

The purpose of this service is to enable the external test equipment to control the operation of an on-board system, test or component.

The data bytes will be specified, if necessary, for each Test ID in Annex F of ISO 15031-5.4, and will be unique for each Test ID.

Possible uses for these data bytes in the request message are:

1. Turn on-board system/test/component ON
2. Turn on-board system/test/component OFF
3. Cycle on-board system/test/component for  $n$  seconds.

Possible uses for these data bytes in the response message are:

1. Report system status
2. Report test results

Not all TIDs are applicable or supported by all systems. TID 00h is a bit-encoded value that indicates for each ECU which TIDs are supported. TID 00h indicates support for TIDs from 01h to 20h. TID 20h indicates support for TIDs 21h through 40h, etc. TID 00h is required for those ECUs that respond to a corresponding service \$08 request message as specified in Annex A of ISO 15031-5.4.

The order of the TIDs in the response message is not required to match the order in the request message.

The request message including supported Test IDs may contain up to six (6) Test IDs. A request message including a Test ID with optional data shall only contain one (1) Test ID. An external test equipment is not allowed to request a combination of Test IDs supported and a single Test ID with optional data. The ECU shall support requests for up to six (6) supported Test IDs and only one (1) Test ID with optional data.

### I.56.2 Message data bytes

#### I.56.2.1 Read supported TIDs

##### Request control of on-board device request message (read supported TIDs)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request control of on-board device request SID	M	08	SIDRQ
#2	TID#1 (Test IDs supported: Annex A of ISO 15031-5.4)	M	xx	TID
#3	TID#2 (Test IDs supported: Annex A of ISO 15031-5.4)	U	xx	TID
#4	TID#3 (Test IDs supported: Annex A of ISO 15031-5.4)	U	xx	TID
#5	TID#4 (Test IDs supported: Annex A of ISO 15031-5.4)	U	xx	TID
#6	TID#5 (Test IDs supported: Annex A of ISO 15031-5.4)	U	xx	TID
#7	TID#6 (Test IDs supported: Annex A of ISO 15031-5.4)	U	xx	TID

U = User Optional — TID may be included to avoid multiple TID supported request messages

**NOTE** To request TIDs supported range from C1h - FFh another request message with TID#1 = C0h and TID#2 = E0h shall be sent to the vehicle

### I.56.2.2 Report supported TIDs

ECU(s) must respond to all supported ranges if requested. A range is defined as a block of 32 TIDs (e.g. range #1: TID 01h-20h). The ECU shall not respond to unsupported TID ranges unless subsequent ranges have a supported TID(s).

#### Request control of on-board device response message (report supported TIDs)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request control of on-board device response message SID	M	48	SIDPR
#2	data record of supported TIDs = [ 1 <sup>st</sup> supported TID Data A: supported TIDs, Data B: supported TIDs, Data C: supported TIDs, Data D: supported TIDs ]	M	xx	TIDREC_ TID
#3		M	xx	DATA_A
#4		M	xx	DATA_B
#5		M	xx	DATA_C
#6		M	xx	DATA_D
:	:	:	:	:
#n-4	data record of supported TIDs = [ m <sup>th</sup> supported TID Data A: supported TIDs, Data B: supported TIDs, Data C: supported TIDs, Data D: supported TIDs ]	C1	xx	TIDREC_ TID
#n-3		C2	xx	DATA_A
#n-2		C2	xx	DATA_B
#n-1		C2	xx	DATA_C
#n		C2	xx	DATA_D
C1 = Conditional — TID value shall be the same value as included in the request message if supported by the ECU C2 = Conditional — value indicates TIDs supported; range of supported TIDs depends on selected TID value (see C1)				

**NOTE** The response message shall only include the TID(s) and Data A - D which are supported by the ECU. If the request message includes (a) TID value(s) which are not supported by the ECU those shall not be included in the response message.

### I.56.2.3 Read TID values

#### Request control of on-board device request message (read TID values)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request control of on-board device request SID	M	08	SIDRQ
#2	data record of Test ID = [ Test ID (request Test ID values) Data A, Data B, Data C, Data D, Data E ]	M/C1	xx	TIDREC TID
#3		C2	xx	DATA_A
#4		C2	xx	DATA_B
#5		C2	xx	DATA_C
#6		C2	xx	DATA_D
#7		C2	xx	DATA_E
C1 = Conditional — Test ID value shall be one of the supported Test IDs of previous response message C2 = Conditional — presence and values of Data A - E parameter depend on Test ID				

## I.56.2.4 Report TID values

### Request control of on-board device response message (report TID values)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request control of on-board device response SID	M	48	SIDPR
#2	data record of Test ID = [ Test ID (report Test ID values) Data A, Data B, Data C, Data D, Data E ]	M/C1	xx	TIDREC
#3		C2	xx	TID
#4		C2	xx	DATA_A
#5		C2	xx	DATA_B
#6		C2	xx	DATA_C
#7		C2	xx	DATA_D
C1 = Conditional — Test ID value shall be the same value as included in the request message C2 = Conditional — presence and values of Data A - E parameter depend on Test ID				

## I.56.2.5 Negative response message

Bytes	Parameter name	Hex value
#1	Negative response	7F
#2	Request current powertrain diagnostic data	08
#3	Error code = Condition not correct	22

### I.56.2.5.1 Error code

Error code	Cause
Condition not correct	system conditions are not proper to run evaporative system leak test

## I.56.2.6 Parameter definition

### I.56.2.6.1 Test IDs supported

Refer to Annex A of ISO 15031-5.4.

### I.56.2.6.2 Test ID description

Refer to Annex F of ISO 15031-5.4.

## I.56.3 Description of TID 01h - Evaporative system leak test

### I.56.3.1 Request message

Bytes	Parameter name	Hex value
#1	Request control of on-board system, test, or component	08
#2	Test ID = Evaporative system leak activation	01

### Formula section:

**I.56.3.2 IF ACTION\_OBDC\_Srv08EvapSysLeak()****THEN****I.56.3.3 Send Positive response message**

Bytes	Parameter name	Hex value
#1	Request control of on-board system, test, or component response	48
#2	Test ID = Evaporative system leak activation	01

**ELSE**

Send negative response message with response code 22h - conditionsNotCorrect

Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)
#1	Negative Response Service Identifier	7F
#2	Request control of on-board device request SID	08
#3	Negative Response Code: conditionsNotCorrect	22

**ENDIF**



## I.57 SID 09h: Request vehicle information

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_CKS_BOOT_1_SAE	O/S	0... FFFFFFFFH	0... 4294967295	1	-
CRC for CBOOT					
STATE_CKS_BOOT_2_SAE	O/S	0... FFFFFFFFH	0... 4294967295	1	-
CRC for SBOOT					
STATE_CKS_CAL_SAE	O/S	0... FFFFFFFFH	0... 4294967295	1	-
CRC for CALIB					
STATE_CKS_ECU_SAE	O/S	0... FFFFFFFFH	0... 4294967295	1	-
CRC for ECU					
STATE_CKS_SEL_SEG_SAE	O/S	0... FFFFFFFFH	0... 4294967295	1	-
CRC for several or all segments of memory					
STATE_CKS_SEL_SEG_SPC_SAE	O/S	0... FFFFFFFFH	0... 4294967295	1	-
CRC for a specific segment of memory					

### Input data:

NC_STATE_CKS_CONF_ CAN {p. 8090}	NC_STATE_COMP_TYP_ CAN {p. 8090}	NC_STATE_SRV_9_CAN_ VIT	
--	--	----------------------------	--

### Import actions:

<b>ACTION_ERRM_SelectRbmData</b> (<INOUT>,<PRM_CTR_MOD_9_RBM[36]>,<OUT>,<PRM_RES_MOD_9>)
<b>ACTION_INFR_GetChecksumCks</b> (IN<PRM_SW_COMPONENTS>,<OUT><PRM_CHECKSUM>,<OUT><PRM_STATUS>)
<b>ACTION_INFR_GetStatusCks</b> (IN<PRM_SW_COMPONENTS>,<IN><PRM_COMMOND>,<OUT><PRM_STATUS>)
<b>ACTION_INFR_StartCks</b> (IN<PRM_SW_COMPONENTS>,<OUT><PRM_STATUS>)
<b>ACTION_OBDC_GetCALIDCalib</b> (OUT<No Name available>)
<b>ACTION_OBDC_GetCALIDCBoot</b> (OUT<No Name available>)
<b>ACTION_OBDC_GetCALIDECU</b> (OUT<No Name available>)
<b>ACTION_OBDC_GetCALIDSBBoot</b> (OUT<No Name available>)
<b>ACTION_OBDC_GetCALIDSelSeg</b> (OUT<No Name available>)
<b>ACTION_OBDC_GetCALIDSelSegSpc</b> (OUT<No Name available>)
<b>ACTION_OBDC_GetECUNAME</b> (OUT<No Name available>)
<b>ACTION_OBDC_GetVIN</b> (OUT<No Name available>)

### I.57.1 Functional description

The purpose of this service is to enable the off-board test device to request vehicle specific information such as Vehicle Identification Number (VIN) and calibration IDs.

## I.57.1.1 Read supported Info Type

### I.57.1.1.1 Request message

Bytes	Parameter name	CVT	Hex value
#1	<b>Request vehicle information</b>	M	09
#2	Info Type#1 (VITs supported : 01h - 20h)	M	00
#3	Info Type#2 (VITs supported : 21h - 40h)	U	20
#4	Info Type#3 (VITs supported : 41h - 60h)	U	40
#5	Info Type#4 (VITs supported : 61h - 80h)	U	60
#6	Info Type#5 (VITs supported : 81h - A0h)	U	80
#7	Info Type#6 (VITs supported : A1h - C0h)	U	A0

U = User optional	Info Type may be included to avoid multiple Info Type supported request messages
-------------------	--

To request Info Types supported range from C1h to FFh another request message with Info Type1 = C0h and Info Type2 = E0h shall be sent to the vehicle.

### I.57.1.1.2 Positive response message

Bytes	Parameter name	CVT	Hex value
#1	<b>Request vehicle information</b>	M	49
#2	Info Type = 1 <sup>st</sup> supported Info Type	M	00
#4	Supported Info Type 01h - 08h	M	XX
#5	Supported Info Type 09h - 10h	M	XX
#6	Supported Info Type 11h - 18h	M	XX
#7	Supported Info Type 19h - 20h	M	XX
#n-4	Info Type = m <sup>th</sup> supported Info Type	C1	XX
#n-3	Supported Info Type m1h - m8h	C2	XX
#n-2	Supported Info Type m9h - (m+1)0h	C2	XX
#n-1	Supported Info Type (m+1)1h - (m+1)8h	C2	XX
#n	Supported Info Type (m+1)9h - (m+2)0h	C2	XX

C1 = Conditional	Info Type value shall be the same value as included in the request message if supported by the ECU
C2 = Conditional	Value indicates Info Type supported, the range of supported Info Type depends on selected Info Type value

The response message shall only include the Info Types and Data A - D which are supported by the ECU. If the request message includes (a) Info Type value(s) which are not supported by the ECU, those shall not be included in the response message.

## I.57.1.2 Read Info Type values

### I.57.1.2.1 Request message

Bytes	Parameter name	CVT	Hex value
#1	<b>Request vehicle information</b>	M	09
#2	Info Type (Read Info Type values)	M	02, 04, 06, 08, 0A, 0B

### I.57.1.2.2 Positive response message

Bytes	Parameter name	CVT	Hex value
#1	<b>Request vehicle information</b>	M	49
#2	Info Type (Report Info Type values)	M/C1	02, 04, 06, 08, 0A, 0B
#3	Number of data items	M/C1	XX
#4	Data #1	M/C2	XX
#5	Data #2	C2	XX
#n	Data #m	C2	XX

C1 = Conditional	Info Type value shall be the same value as included in the request message
C2 = Conditional	Data #2 to Data #m depend on selected Info Type value

### I.57.1.3 Negative response message

Bytes	Parameter name	CVT	Hex value
#1	<b>Negative response</b>	M	7F
#2	<b>Request emission-related powertrain diagnostic trouble codes</b>	M	09
#3	Error code = Request correctly received response pending	M	78

#### I.57.1.3.1 Error code

Error code	Cause
Request correctly received response pending	The on-board processor requires significant time to calculate the CRCs

## I.57.2 Description of Service 09h, INFOTYPE 00h

### DATA A - Supported INFOTYPES 01h to 08h

INFOTYPE 00h - DATA A - Supported INFOTYPE 01h to 08h		
BIT	Function	name
0	INFOTYPE 08h : In-use Performance Tracking data byte description for spark ignition engines	NC_STATE_SRV_9_CAN_VIT[0]
1	INFOTYPE 07h : Not supported	
2	INFOTYPE 06h : Calibration Verification Numbers	
3	INFOTYPE 05h : Not supported	
4	INFOTYPE 04h : Calibration IDs	
5	INFOTYPE 03h : Not supported	
6	INFOTYPE 02h : Vehicule Identification Number	
7	INFOTYPE 01h : Not supported	

### DATA B - Supported INFOTYPES 09h to 10h

INFOTYPE 00h - DATA B - Supported INFOTYPE 09h to 10h		
BIT	Function	name
0	INFOTYPE 10h : reserved	NC_STATE_SRV_9_CAN_VIT[1]
1	INFOTYPE 0Fh : reserved	
2	INFOTYPE 0Eh : reserved	
3	INFOTYPE 0Dh : reserved	
4	INFOTYPE 0Ch : reserved	
5	INFOTYPE 0Bh : In-use Performance Tracking data byte description for compression ignition engines	
6	INFOTYPE 0Ah : ECUNAME	
7	INFOTYPE 09h : Not supported	

#### DATA C - Supported INFOTYPES 11h to 18h

INFOTYPE 00h - DATA C - Supported INFOTYPE 11h to 18h		
BIT	Function	name
0	INFOTYPE 18h : reserved	NC_STATE_SRV_9_CAN_VIT[2]
1	INFOTYPE 17h : reserved	
2	INFOTYPE 16h : reserved	
3	INFOTYPE 15h : reserved	
4	INFOTYPE 14h : reserved	
5	INFOTYPE 13h : reserved	
6	INFOTYPE 12h : reserved	
7	INFOTYPE 11h : reserved	

#### DATA D - Supported INFOTYPES 19h to 20h

INFOTYPE 00h - DATA D - Supported INFOTYPE 19h to 20h		
BIT	Function	name
0	INFOTYPE 20h : INFOTYPES supported (\$21 - \$40)	NC_STATE_SRV_9_CAN_VIT[3]
1	INFOTYPE 1Fh : reserved	
2	INFOTYPE 1Eh : reserved	
3	INFOTYPE 1Dh : reserved	
4	INFOTYPE 1Ch : reserved	
5	INFOTYPE 1Bh : reserved	
6	INFOTYPE 1Ah : reserved	
7	INFOTYPE 19h : reserved	

### I.57.3 Description of Service 09h, INFOTYPE 02h - VIN


VIN = 17 characters and should be reported as ASCII values

#### Request vehicle information request message

<b>Message direction:</b>	External test equipment → All ECUs		
<b>Message Type:</b>	Request		
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType: 02 - VIN (Vehicle Identification Number)	02	INFOTYP

#### Formula section:

CALL ACTION\_OBDC\_GetVIN ()

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**CONSTRUCT** Positive response**I.57.3.1 Response positive report Vehicle Identification Number (VIN)****Request vehicle information response message**

<b>Message direction:</b>		ECU #1 → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: 02 - VIN (Vehicle Information Number)	02	INFTYP
#3	Number of data items: 01	01	NODI
#4	Data_A: VIN Character 1	XX	VIN
#5	Data_B: VIN Character 2	XX	VIN
#6	Data_C: VIN Character 3	XX	VIN
#7	Data_D: VIN Character 4	XX	VIN
#8	Data_E: VIN Character 5	XX	VIN
#9	Data_F: VIN Character 6	XX	VIN
#10	Data_G: VIN Character 7	XX	VIN
#11	Data_H: VIN Character 8	XX	VIN
#12	Data_I: VIN Character 9	XX	VIN
#13	Data_J: VIN Character 10	XX	VIN
#14	Data_K: VIN Character 11	XX	VIN
#15	Data_L: VIN Character 12	XX	VIN
#16	Data_M: VIN Character 13	XX	VIN
#17	Data_N: VIN Character 14	XX	VIN
#18	Data_O: VIN Character 15	XX	VIN
#19	Data_P: VIN Character 16	XX	VIN
#20	Data_Q: VIN Character 17	XX	VIN

**I.57.4 Description of Service 09h, INFOTYPE 04h - Calibration IDs**

A Calibration ID will be reported for the ECM, depending on the software architecture. Calibration ID can include a maximum of 16 ASCII characters. Calibration ID can contain only printable ASCII characters, and will be reported as ASCII values.

Calibration ID should uniquely identify the software installed in the ECM.

The amount of Calibration Id is included in the "Number of data items" parameter.

About Calibration coherence identifier definition sees the file: ECU reprogramming, coherence system (Chapter 0)

**Request vehicle information request message**

<b>Message direction:</b>		External test equipment → All ECUs	
<b>Message Type:</b>		Request	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType: Calibration Id	04	INFTYP

**Formula section:**

```

IF (NC_STATE_COMP_TYP_CAN AND 0x20) = 0x20      //requested only one CALID for ECM
THEN CALL ACTION_OBDC_GetCALIDSelSeg()
ELSE                                             //several CALID requested
  IF (NC_STATE_COMP_TYP_CAN AND 0x01) = 0x01
  THEN CALL ACTION_OBDC_GetCALIDCBoot()
  ENDIF

  IF (NC_STATE_COMP_TYP_CAN AND 0x02) = 0x02
  THEN CALL ACTION_OBDC_GetCALIDSBboot()
  ENDIF

  IF (NC_STATE_COMP_TYP_CAN AND 0x04) = 0x04
  THEN CALL ACTION_OBDC_GetCALIDCalib()
  ENDIF


  IF (NC_STATE_COMP_TYP_CAN AND 0x08) = 0x08
  THEN CALL ACTION_OBDC_GetCALIDECU()
  ENDIF

  IF (NC_STATE_COMP_TYP_CAN AND 0x10) = 0x10
  THEN CALL ACTION_OBDC_GetCALIDSelSegSpc()
  ENDIF
ENDIF
CONSTRUCT Positive response

```

#### I.57.4.1 Response positive report Calibration ID

##### Request vehicle information response message

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Message direction:		ECU#1 → External test equipment	
Message Type:		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Id	04	INFTYP
#3	Number of data items:	XX	NODI
#4	Data_A: Calibration ID for XXX: char 1	XXX	CALID
#5	Data_B: Calibration ID for XXX: char 2	XXX	CALID
#6	Data_C: Calibration ID for XXX: char 3	XXX	CALID
#7	Data_D: Calibration ID for XXX: char 4	XXX	CALID
#8	Data_E: Calibration ID for XXX: char 5	XXX	CALID
#9	Data_F: Calibration ID for XXX: char 6	XXX	CALID
#10	Data_G: Calibration ID for XXX: char 7	XXX	CALID
#11	Data_H: Calibration ID for XXX: char 8	XXX	CALID
#12	Data_I: Calibration ID for XXX: char 9	XXX	CALID
#13	Data_J: Calibration ID for XXX: char 10	XXX	CALID
#14	Data_K: Calibration ID for XXX: char 11	XXX	CALID
#15	Data_L: Calibration ID for XXX: char 12	XXX	CALID
#16	Data_M: Calibration ID for XXX: char 13	XXX	CALID
#17	Data_N: Calibration ID for XXX: char 14	XXX	CALID
#18	Data_O: Calibration ID for XXX: char 15	XXX	CALID
#19	Data_P: Calibration ID for XXX: char 16	XXX	CALID
----	-----	-----	-----
#n	Data_A: Calibration ID for YYY: char 1	YYY	CALID
#n+1	Data_B: Calibration ID for YYY: char 2	YYY	CALID
# n+2	Data_C: Calibration ID for YYY: char 3	YYY	CALID
# n+3	Data_D: Calibration ID for YYY: char 4	YYY	CALID
# n+4	Data_E: Calibration ID for YYY: char 5	YYY	CALID
# n+5	Data_F: Calibration ID for YYY: char 6	YYY	CALID
# n+6	Data_G: Calibration ID for YYY: char 7	YYY	CALID
# n+7	Data_H: Calibration ID for YYY: char 8	YYY	CALID
# n+8	Data_I: Calibration ID for YYY: char 9	YYY	CALID
# n+9	Data_J: Calibration ID for YYY: char 10	YYY	CALID
# n+10	Data_K: Calibration ID for YYY: char 11	YYY	CALID
# n+11	Data_L: Calibration ID for YYY: char 12	YYY	CALID
# n+12	Data_M: Calibration ID for YYY: char 13	YYY	CALID
# n+13	Data_N: Calibration ID for YYY: char 14	YYY	CALID
# n+14	Data_O: Calibration ID for YYY: char 15	YYY	CALID
# n+15	Data_P: Calibration ID for YYY: char 16	YYY	CALID

**Note:**

- The sequence of the 16 bytes (Data\_A - Data\_P) from #n to #n+15 is depending of the components number. This is depending of how many components are configured in the configuration byte NC\_STATE\_COMP\_TYP\_CAN.
- e.g. (if it is configured to 1 component we have only one sequence of 16 bytes, if it is configured to 2 components we have two sequences of 16 bytes, and so on).
- e.g. if it is configured to 1 component than the positive response will be constructed using only one data set for CALID and the length of response is 19 bytes.
- e.g. if it is configured to 2 components than the positive response will be constructed using two data sets for CALID XXX, and YYY and the length of response is 35 bytes.
- the order of the CALID in the response is the same like in the NC\_STATE\_COMP\_TYP\_CAN:

## Positive response

SID	InfoType	1 <sup>st</sup> group of 16 bytes	2 <sup>nd</sup> group of 16 bytes	3 <sup>rd</sup> group of 16 bytes	4 <sup>th</sup> group of 16 bytes	5 <sup>th</sup> group of 16 bytes
49	04	CALID for one area or a combination of several or all section areas of the ECU	ECU CALID	CALIB CALID	SBOOT CALID	CBOOT CALID

### I.57.5 Description of Service 09h, INFOTYPE 06h - Calibration verification numbers

The on-board software will calculate the CVN (CRC) based on memory content

If the calculation does not use all four bytes, the CVN shall be right justified and filled with 00h.

The amount of CVNs is included in the "Number of data items" parameter.

#### Request vehicle information request message (read InfoType values)

Data Byte	Parameter Name	Hex Value	Mnemonic
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType (read InfoType values)	06	INFOTYP

#### I.57.5.1 Response positive report calibration verification number

Request vehicle information response message

Message direction:		ECU#1 → External test equipment	
Message Type:		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Verification Number	06	INFOTYP
#3	Number of data items:	XX	NODI
#4	Data_A : 1 <sup>st</sup> byte of CRC for XXX calculation value	XXX	DATA_A
#5	Data_B : 2 <sup>nd</sup> byte of CRC for XXX calculation value	XXX	DATA_B
#6	Data_C : 3 <sup>rd</sup> byte of CRC for XXX calculation value	XXX	DATA_C
#7	Data_D : 4 <sup>th</sup> byte of CRC for XXX calculation value	XXX	DATA_D
----	----	----	----
#n	Data_A : 1 <sup>st</sup> byte of CRC for YYY calculation value	YYY	DATA_A
#n+1	Data_B : 2 <sup>nd</sup> byte of CRC for YYY calculation value	YYY	DATA_B
#n+2	Data_C : 3 <sup>rd</sup> byte of CRC for YYY calculation value	YYY	DATA_C
#n+3	Data_D : 4 <sup>th</sup> byte of CRC for YYY calculation value	YYY	DATA_D

#### Note:

- The sequence of the 4 bytes (Data\_A - Data\_D) from #n to #n+3 is depending of the components number. This is depending of how many components are configured in the configuration byte NC\_STATE\_COMP\_TYP\_CAN.
- e.g. (if it is configured to 1 component we have only one sequence of 4 bytes, if it is configured to 2 components we have two sequences of 4 bytes, and so on).
- the order of the CVNs in the response is the same like in the NC\_STATE\_COMP\_TYP\_CAN:



Positive response						
SID	InfoType	1 <sup>st</sup> group of 4 bytes	2 <sup>nd</sup> group of 4 bytes	3 <sup>rd</sup> group of 4 bytes	4 <sup>th</sup> group of 4 bytes	5 <sup>th</sup> group of 4 bytes
49	06	CRC for one area or a combination of several or all section areas of the ECU	ECU CRC	CALIB CRC	SBOOT CRC	CBOOT CRC

### Application conditions

#### Initialisation:

At NVMINI system event:

```
STATE_CKS_BOOT_1_SAE = 0
STATE_CKS_BOOT_2_SAE = 0
STATE_CKS_ECU_SAE = 0
STATE_CKS_CAL_SAE = 0
STATE_CKS_SEL_SEG_SAE = 0
STATE_CKS_SEL_SEG_SPC_SAE = 0
```

#### Recurrence:

-

#### Activation:

-

#### Formula section:

IF NC\_STATE\_CKS\_CONF\_CAN is 1

THEN

AT RESET:

Restore values for **STATE\_CKS\_SEL\_SEG\_SPC\_SAE**, **STATE\_CKS\_SEL\_SEG\_SAE**, **STATE\_CKS\_BOOT\_1\_SAE**, **STATE\_CKS\_BOOT\_2\_SAE**, **STATE\_CKS\_ECU\_SAE**, **STATE\_CKS\_CAL\_SAE** from NVMY

ENDIF

At reception of the request the correct flow is:

IF NC\_STATE\_CKS\_CONF\_CAN is 1

THEN (1)

IF for the first time after a reprogramming event of the ECU(s), the checksum computation is not ready

THEN (2)

A negative response message with response code 78h - RequestCorrectlyReceived-ResponsePending must be sent by the ECU(s) until the checksum computation is done and positive response message is available

ELSE (2)


Check if checksum is done

IF checksum for all COMPONENTs, depending of the configuration of the project is done

if (**ACTION\_INFR\_GetStatusCks** (component, NC\_CKSC\_CMD\_CHK\_READY) == component)

THEN (3)

Initialize **STATE\_CKS\_SEL\_SEG\_SPC\_SAE**, **STATE\_CKS\_SEL\_SEG\_SAE**, **STATE\_CKS\_BOOT\_1\_SAE**, **STATE\_CKS\_BOOT\_2\_SAE**, **STATE\_CKS\_ECU\_SAE**, **STATE\_CKS\_CAL\_SAE**, with CKS values:


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```

    IF (NC_STATE_COMP_TYP_CAN & 20h)    //Only one CKS requested for ECM
      THEN STATE_CKS_SEL_SEG_SAE = ACTION_INFR_GetChecksumCks (com-
        ponent for several sections)
    ENDIF
    IF (NC_STATE_COMP_TYP_CAN & 10h)    //Other specific area (e.g. Volcano)
      THEN STATE_CKS_SEL_SEG_SPC_SAE = ACTION_INFR_GetChecksumCks
        (component for several sections)
    ENDIF
    IF (NC_STATE_COMP_TYP_CAN & 08h)    //ECU area
      THEN STATE_CKS_ECU_SAE = ACTION_INFR_GetChecksumCks (component
        for ECU area)
    ENDIF
    IF (NC_STATE_COMP_TYP_CAN & 04h)    //CALIB area
      THEN STATE_CKS_CAL_SAE = ACTION_INFR_GetChecksumCks (component
        for CALIB area)
    ENDIF
    IF (NC_STATE_COMP_TYP_CAN & 02h)    //SBOOT area
      THEN STATE_CKS_BOOT_2_SAE = ACTION_INFR_GetChecksumCks (com-
        ponent for SBOOT area)
    ENDIF
    IF (NC_STATE_COMP_TYP_CAN & 01h)    //CBOOT area
      THEN STATE_CKS_BOOT_1_SAE = ACTION_INFR_GetChecksumCks (com-
        ponent for CBOOT area)
    ENDIF
    IF (NC_STATE_COMP_TYP_CAN & 20h)    //Only one CKS requested for ECM
      THEN Send positive(s) response(s) only for STATE_CKS_SEL_SEG_SAE
      ELSE Send positive(s) response(s) for configured areas
    ENDIF

  ELSE (3)
    Send positive(s) response(s) with the values for CKS restored at RESET
  ENDIF (3)
ENDIF (2)
ELSE (1)
IF NC_STATE_CKS_CONF_CAN is 2
  IF crc calculation not started (the negative response « 78 pending response » was not sent at
  all)
    THEN (4)
      Start crc calculation
      CALL ACTION_INFR_StartCks (component)
      Send negative response "78h pending response"
    ELSE (4)
      AT each recall before next response check if checksum is done
      IF checksum for all COMPONENTs, depending of the configuration of the project is done
      if (ACTION_INFR_GetStatusCks (component, NC_CKSC_CMD_CHK_READY) == com-
        ponent)
        THEN (5)
          Initialize STATE_CKS_SEL_SEG_SPC_SAE, STATE_CKS_SEL_SEG_SAE, STATE_
          CKS_BOOT_1_SAE, STATE_CKS_BOOT_2_SAE, STATE_CKS_ECU_SAE, STATE_
          CKS_CAL_SAE, with CKS values:
          IF (NC_STATE_COMP_TYP_CAN & 20h)    //Only one CKS requested for ECM
            THEN STATE_CKS_SEL_SEG_SAE = ACTION_INFR_GetChecksumCks (com-
              ponent for several sections)

```

Released by Tetenborn Frank		Date 2013-02-13	File 30I06U01.00D
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 8082 of 8404	
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```

ENDIF
IF (NC_STATE_COMP_TYP_CAN & 10h) //Other specific area (e.g. Volcano)
    THEN STATE_CKS_SEL_SEG_SPC_SAE = ACTION_INFR_GetChecksumCks
    (component for several sections)
ENDIF
IF (NC_STATE_COMP_TYP_CAN & 08h) //ECU area
    THEN STATE_CKS_ECU_SAE = ACTION_INFR_GetChecksumCks (component
    for ECU area)
ENDIF
IF (NC_STATE_COMP_TYP_CAN & 04h) //CALIB area
    THEN STATE_CKS_CAL_SAE = ACTION_INFR_GetChecksumCks (component
    for CALIB area)
ENDIF
IF (NC_STATE_COMP_TYP_CAN & 02h) //SBOOT area
    THEN STATE_CKS_BOOT_2_SAE = ACTION_INFR_GetChecksumCks (com-
    ponent for SBOOT area)
ENDIF
IF (NC_STATE_COMP_TYP_CAN & 01h) //CBOOT area
    THEN STATE_CKS_BOOT_1_SAE = ACTION_INFR_GetChecksumCks (com-
    ponent for CBOOT area)
ENDIF
IF (NC_STATE_COMP_TYP_CAN & 20h) //Only one CKS requested for ECM
    THEN Send positive(s) response(s) only for STATE_CKS_SEL_SEG_SAE
    ELSE Send positive(s) response(s) for configured areas
ENDIF
ENDIF (6)
ELSE (5)
    Send negative response "78h pending response"
ENDIF (5)
ENDIF (4)
ENDIF (1)

```

## I.57.6 Description of Service 09h, InfoType 08h

### Request vehicle information request message

<b>Message direction:</b>	External test equipment → All ECUs		
<b>Message Type:</b>	Request		
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information request SID	09	SIDRQ
#2	In-use Performance Tracking data byte description for spark ignition engines	08	INFTYP

#### Formula section:

**CALL** ACTION\_ERRM\_SelectRbmData(<PRM\_CTR\_MOD\_9\_RBM[36]>, <PRM\_RES\_MOD\_9>)  
**CONSTRUCT** positive response with PRM\_CTR\_MOD\_9\_RBM[0].. PRM\_CTR\_MOD\_9\_RBM[19]

### I.57.6.1 Response positive report In-Use Performance Tracking

#### Request vehicle information response message

Message direction:		ECU#1 → External test equipment	
Message Type:		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: In-use Performance Tracking	08	INFTYP
#3	Number of data items: 20	14	NODI
#4	Data A1: MSB (OBD Monitoring Conditions Encountered Counts - general denominator)	XX	OBDCOND_A
#5	Data A2: LSB (OBD Monitoring Conditions Encountered Counts - general denominator)	XX	OBDCOND_B
#6	Data B1: MSB (Ignition Cycle Counter)	XX	IGNCNTR_A
#7	Data B2: LSB (Ignition Cycle Counter)	XX	IGNCNTR_B
#8	Data C1: MSB (Catalyst Monitor Completion Counts Bank 1 - numerator)	XX	CATCOMP1_A
#9	Data C2: LSB (Catalyst Monitor Completion Counts Bank 1 - numerator)	XX	CATCOMP1_B
#10	Data D1: MSB (Catalyst Monitor Conditions Encountered Counts Bank 1 - denominator)	XX	CATCOND1_A
#11	Data D2: LSB (Catalyst Monitor Conditions Encountered Counts Bank 1 - denominator)	XX	CATCOND1_B
#12	Data E1: MSB (Catalyst Monitor Completion Counts Bank 2 - numerator)	XX	CATCOMP2_A
#13	Data E2: LSB (Catalyst Monitor Completion Counts Bank 2 - numerator)	XX	CATCOMP2_B
#14	Data F1: MSB (Catalyst Monitor Conditions Encountered Counts Bank 2 - denominator)	XX	CATCOND2_A
#15	Data F2: LSB (Catalyst Monitor Conditions Encountered Counts Bank 2 - denominator)	XX	CATCOND2_B
#16	Data G1: MSB (O2 Sensor Monitor Completion Counts Bank 1 - numerator)	XX	O2SCOMP1_A
#17	Data G2: LSB (O2 Sensor Monitor Completion Counts Bank 1 - numerator)	XX	O2SCOMP1_B
#18	Data H1: MSB (O2 Sensor Monitor Conditions Encountered Counts Bank 1 - denominator)	XX	O2SCOND1_A
#19	Data H2: LSB (O2 Sensor Monitor Conditions Encountered Counts Bank 1 - denominator)	XX	O2SCOND1_B
#20	Data I1: MSB (O2 Sensor Monitor Completion Counts Bank 2 - numerator)	XX	O2SCOMP2_A
#21	Data I1: LSB (O2 Sensor Monitor Completion Counts Bank 2 - numerator)	XX	O2SCOMP2_B
#22	Data J1: MSB (O2 Sensor Monitor Conditions Encountered Counts Bank 2 - denominator)	XX	O2SCOND2_A
#23	Data J2: LSB (O2 Sensor Monitor Conditions Encountered Counts Bank 2 - denominator)	XX	O2SCOND2_B
#24	Data K1 MSB (EGR/VVT Monitor Completion Condition Counts - numerator)	XX	EGRCOMP_A
#25	Data K2: LSB (EGR/VVT Monitor Completion Condition Counts - numerator)	XX	EGRCOMP_B
#26	Data L1: MSB (EGR/VVT Monitor Conditions Encountered Counts - denominator)	XX	EGRCOND_A
#27	Data L2: LSB (EGR/VVT Monitor Conditions Encountered Counts - denominator)	XX	EGRCOND_B
#28	Data M1: MSB (AIR Monitor Completion Condition Counts (Secondary Air) - numerator)	XX	AIRCOMP_A

Message direction:		ECU#1 → External test equipment	
Message Type:		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#29	Data M2: LSB (AIR Monitor Completion Condition Counts (Secondary Air) - numerator)	XX	AIRCOMP_B
#30	Data N1: MSB (AIR Monitor Conditions Encountered Counts (Secondary Air) - denominator)	XX	AIRCOND_A
#31	Data N2: LSB (AIR Monitor Conditions Encountered Counts (Secondary Air) - denominator)	XX	AIRCOND_B
#32	Data O1: MSB (EVAP Monitor Completion Condition Counts - numerator)	XX	EVAPCOMP_A
#33	Data O2: LSB (EVAP Monitor Completion Condition Counts - numerator)	XX	EVAPCOMP_B
#34	Data P1: MSB (EVAP Monitor Conditions Encountered Counts - denominator)	XX	EVAPCOND_A
#35	Data P2: LSB (EVAP Monitor Conditions Encountered Counts - denominator)	XX	EVAPCOND_B
#36	Data Q1: MSB (Secondary O2 Sensor Monitor Completion Counts Bank 1 - numerator)	XX	SO2SCOMP1_A
#37	Data Q2: LSB (Secondary O2 Sensor Monitor Completion Counts Bank 1 - numerator)	XX	SO2SCOMP1_B
#38	Data R1: MSB (Secondary O2 Sensor Monitor Conditions Encountered Counts Bank 1 - denominator)	XX	SO2SCOND1_A
#39	Data R2: LSB (Secondary O2 Sensor Monitor Conditions Encountered Counts Bank 1 - denominator)	XX	SO2SCOND1_B
#40	Data S1: MSB (Secondary O2 Sensor Monitor Completion Counts Bank 2 - numerator)	XX	SO2SCOMP2_A
#41	Data S2: LSB (Secondary O2 Sensor Monitor Completion Counts Bank 2 - numerator)	XX	SO2SCOMP2_B
#42	Data T1: MSB (Secondary O2 Sensor Monitor Conditions Encountered Counts Bank 2 - denominator)	XX	SO2SCOND2_A
#43	Data T2: LSB (Secondary O2 Sensor Monitor Conditions Encountered Counts Bank 2 - denominator)	XX	SO2SCOND2_B

### I.57.7 Description of Service 09h, INFOTYPE 0Ah - ECUNAME

The number of the data bytes reported to the scan tool for InfoType 0Ah must be 20 ASCII characters.

#### Request vehicle information request message

Message direction:		External test equipment → All ECUs	
Message Type:		Request	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType: 0A - ECUNAME	0A	INFotyp

#### Formula section:

**CALL** ACTION\_OBDC\_GetECUNAME()  
**CONSTRUCT** Positive response

### I.57.7.1 Response positive report ECUNAME

#### Request vehicle information response message

Message direction:		ECU #1 → External test equipment	
Message Type:		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: 0A - ECUNAME	0A	INFTYP
#3	Number of data items: 01	01	NODI
#4	Data_A: ECU Acronym Character 1	XX	ECU
#5	Data_B: ECU Acronym Character 2	XX	ECU
#6	Data_C: ECU Acronym Character 3	XX	ECU
#7	Data_D: ECU Acronym Character 4	XX	ECU
#8	Data_E: Delimiter	"_"	-
#9	Data_F: Reported text name Character 1	YY	ECUNAME
#10	Data_G: Reported text name Character 2	YY	ECUNAME
#11	Data_H: Reported text name Character 3	YY	ECUNAME
#12	Data_I: Reported text name Character 4	YY	ECUNAME
#13	Data_J: Reported text name Character 5	YY	ECUNAME
#14	Data_K: Reported text name Character 6	YY	ECUNAME
#15	Data_L: Reported text name Character 7	YY	ECUNAME
#16	Data_M: Reported text name Character 8	YY	ECUNAME
#17	Data_N: Reported text name Character 9	YY	ECUNAME
#18	Data_O: Reported text name Character 10	YY	ECUNAME
#19	Data_P: Reported text name Character 11	YY	ECUNAME
#20	Data_Q: Reported text name Character 12	YY	ECUNAME
#21	Data_R: Reported text name Character 13	YY	ECUNAME
#22	Data_S: Reported text name Character 14	YY	ECUNAME
#23	Data_T: Reported text name Character 15	YY	ECUNAME

## I.57.8 Description of Service 09h, InfoType 0Bh

### Request vehicle information request message

Message direction:		External test equipment → All ECUs	
Message Type:		Request	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information request SID	09	SIDRQ
#2	In-use Performance Tracking data byte description for compression ignition engines	0B	INFTYP

### Formula section:

**CALL ACTION\_ERRM\_SelectRbmData**(<PRM\_CTR\_MOD\_9\_RBM[36]>, <PRM\_RES\_MOD\_9>)  
**CONSTRUCT** positive response with PRM\_CTR\_MOD\_9\_RBM[20].. PRM\_CTR\_MOD\_9\_RBM[35]

## I.57.8.1 Response positive report In-Use Performance Tracking

### Request vehicle information response message

Message direction:		ECU#1 → External test equipment	
Message Type:		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	In-use Performance Tracking data byte description for compression ignition engines	0B	INFTYP
#3	Number of data items: 16	10	NODI
#4	Data A1: MSB (OBD Monitoring Conditions Encountered Counts - general denominator)	XX	OBDCOND_A
#5	Data A2: LSB (OBD Monitoring Conditions Encountered Counts - general denominator)	XX	OBDCOND_B
#6	Data B1: MSB (Ignition Cycle Counter)	XX	IGNCNTR_A
#7	Data B2: LSB (Ignition Cycle Counter)	XX	IGNCNTR_B
#8	Data C1: MSB (NMHC Catalyst Monitor Completion Condition Counts - numerator)	XX	HCCATCOMP_A
#9	Data C2: LSB (NMHC Catalyst Monitor Completion Condition Counts - numerator)	XX	HCCATCOMP_B
#10	Data D1: MSB (NMHC Catalyst Monitor Conditions Encountered Counts - denominator)	XX	HCCATCOND_A
#11	Data D2: LSB (NMHC Catalyst Monitor Conditions Encountered Counts - denominator)	XX	HCCATCOND_B
#12	Data E1: MSB (NOx Catalyst Monitor Completion Condition Counts - numerator)	XX	NCATCOMP_A
#13	Data E2: LSB (NOx Catalyst Monitor Completion Condition Counts - numerator)	XX	NCATCOMP_B
#14	Data F1: MSB (NOx Catalyst Monitor Conditions Encountered Counts - denominator)	XX	NCATCOND_A
#15	Data F2: LSB (NOx Catalyst Monitor Conditions Encountered Counts - denominator)	XX	NCATCOND_B
#16	Data G1: MSB (NOx Adsorber Monitor Completion Condition Counts - numerator)	XX	NADSCOMP_A
#17	Data G2: LSB (NOx Adsorber Monitor Completion Condition Counts - numerator)	XX	NADSCOMP_B
#18	Data H1: MSB (NOx Adsorber Monitor Conditions Encountered Counts - denominator)	XX	NADSCOND_A
#19	Data H2: LSB (NOx Adsorber Monitor Conditions Encountered Counts - denominator)	XX	NADSCOND_B
#20	Data G1: MSB (PM Filter Monitor Completion Condition Counts - numerator)	XX	PMCOMP_A
#21	Data G2: LSB (PM Filter Monitor Completion Condition Counts - numerator)	XX	PMCOMP_B
#22	Data H1: MSB (PM Filter Monitor Conditions Encountered Counts - denominator)	XX	PMCOND_A
#23	Data H2: LSB (PM Filter Monitor Conditions Encountered Counts - denominator)	XX	PMCOND_B
#24	Data I1: MSB (Exhaust Gas Sensor Monitor Completion Condition Counts - numerator)	XX	EGSCOMP_A
#25	Data I2: LSB (Exhaust Gas Sensor Monitor Completion Condition Counts - numerator)	XX	EGSCOMP_B
#26	Data J1: MSB (Exhaust Gas Sensor Monitor Conditions Encountered Counts- denominator)	XX	EGSCOND_A
#27	Data J2: LSB (Exhaust Gas Sensor Monitor Conditions Encountered Counts- denominator)	XX	EGSCOND_B
#28	Data K1: MSB (EGR/VVT Monitor Completion Condition Counts - numerator)	XX	EGRCOMP_A



<b>Message direction:</b>		ECU#1 → External test equipment	
<b>Message Type:</b>		Response	
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#29	Data K2: LSB (EGR/VVT Monitor Completion Condition Counts - numerator)	XX	EGRCOMP_B
#30	Data L1: MSB (EGR/VVT Monitor Conditions Encountered Counts - denominator)	XX	EGRCOND_A
#31	Data L2: LSB (EGR/VVT Monitor Conditions Encountered Counts - denominator)	XX	EGRCOND_B
#32	Data M1: MSB (Boost Pressure Monitor Completion Condition Counts - numerator)	XX	BPCOMP_A
#33	Data M2: LSB (Boost Pressure Monitor Completion Condition Counts - numerator)	XX	BPCOMP_B
#34	Data N1: MSB (Boost Pressure Monitor Conditions Encountered Counts - denominator)	XX	BPCOND_A
#35	Data N2: LSB (Boost Pressure Monitor Conditions Encountered Counts - denominator)	XX	BPCOND_B



## I.58 SID 09h: Request vehicle information (Appl. Inc.)

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CDN_RBM_CLC_CAT_1	V	0... FFFFH	0... 65535	1	-
Denominator of CAT_1 group					
CTR_CDN_RBM_CLC_CAT_2	V	0... FFFFH	0... 65535	1	-
Denominator of CAT_1 group					
CTR_CDN_RBM_CLC_LEAK	V	0... FFFFH	0... 65535	1	-
Denominator of LEAK group					
CTR_CDN_RBM_CLC_LS_DOWN_1	V	0... FFFFH	0... 65535	1	-
Denominator of LS_DOWN_1 group					
CTR_CDN_RBM_CLC_LS_DOWN_2	V	0... FFFFH	0... 65535	1	-
Denominator of LS_DOWN_2 group					
CTR_CDN_RBM_CLC_LS_UP_1	V	0... FFFFH	0... 65535	1	-
Denominator of LS_UP_1 group					
CTR_CDN_RBM_CLC_LS_UP_2	V	0... FFFFH	0... 65535	1	-
Denominator of LS_UP_2 group					
CTR_CDN_RBM_CLC_SA	V	0... FFFFH	0... 65535	1	-
Denominator of SA group					
CTR_CDN_RBM_CLC_VVT	V	0... FFFFH	0... 65535	1	-
Denominator of VVT group					
CTR_COMP_RBM_CLC_CAT_1	V	0... FFFFH	0... 65535	1	-
Numerator of CAT_1 group					
CTR_COMP_RBM_CLC_CAT_2	V	0... FFFFH	0... 65535	1	-
Numerator of CAT_1 group					
CTR_COMP_RBM_CLC_LEAK	V	0... FFFFH	0... 65535	1	-
Numerator of EVAM group					
CTR_COMP_RBM_CLC_LS_DOWN_1	V	0... FFFFH	0... 65535	1	-
Numerator of LS_DOWN_1 group					
CTR_COMP_RBM_CLC_LS_DOWN_2	V	0... FFFFH	0... 65535	1	-
Numerator of LS_DOWN_2 group					
CTR_COMP_RBM_CLC_LS_UP_1	V	0... FFFFH	0... 65535	1	-
Numerator of LS_UP_1 group					
CTR_COMP_RBM_CLC_LS_UP_2	V	0... FFFFH	0... 65535	1	-
Numerator of LS_UP_2 group					
CTR_COMP_RBM_CLC_SA	V	0... FFFFH	0... 65535	1	-
Numerator of SA group					
CTR_COMP_RBM_CLC_VVT	V	0... FFFFH	0... 65535	1	-
Numerator of VVT group					
ECU_CVN_CAL	V	0... FFFFFFFFH	0... 4294967295	1	-
Calibration verification Number from Calibration data					
ECU_CVN_PROG	V	0... FFFFFFFFH	0... 4294967295	1	-
Calibration verification Number from ECU Program					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ECU_ID_CAL [NC_NR_CAL_CHAR_LEN]	V	0	ASCII	1	-
Calibration identification number - Data - (16 byte - ASCII) for OBD communication					
ECU_ID_SW [NC_NR_CAL_CHAR_LEN]	V	0	ASCII	1	-
Calibration identification number - Program - (16 byte - ASCII) for OBD communication					
ECU_VIN [NC_NR_VIN_CHAR_LEN]	V	0	ASCII	1	-
Vehicle identification number (17 byte - ASCII) for OBD communication					

**Input data:**

STATE_CKS_CAL_SAE {p. 8073}	STATE_CKS_ECU_SAE {p. 8073}		
--------------------------------	--------------------------------	--	--

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_STATE_SRV_9_CAN_VIT	-	0... FFH	0... 255	1	-
LDP_STATE_VIT_ID_STATE_SRV_9	4	0... 03H	0 ...3	1	-
Table of bytes which defines the INFOTYPES supported by the service 09h (01h - 20h) - ISO 15765-4					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_CAL_CHAR_LEN	-	0... FFH	0... 255	1	-
Number of ASCII elements used for Calibration Identification (=16)					
NC_NR_VIN_CHAR_LEN	-	0... FFH	0... 255	1	-
Number of ASCII elements used for Vehicle Identification (=17)					
NC_STATE_CKS_CONF_CAN	-	0... FFH	0... 255	1	-
byte which defines the response method for service \$09 InfoType \$06					
NC_STATE_COMP_TYP_CAN	-	0... FFH	0... 255	1	-
byte which defines the components used in a ECU					
NC_STATE_SEL_SEG_CAN	-	0... FFH	0... 255	1	-
Configuration byte which defines area of an ECU					
NC_STATE_SEL_SEG_SPC_CAN	-	0... FFH	0... 255	1	-
Configuration byte which defines a specific area of an ECU					

**Action definition**

<b>ACTION_OBDC_GetCALIDCalib</b> (OUT<No Name available>)	Mode: O
This action fill the CALIB CALID with the correct values from the project	

<b>ACTION_OBDC_GetCALIDCBoot</b> (OUT<No Name available>)	Mode: O
This action fill the CBOOT CALID with the correct values from the project	

<b>ACTION_OBDC_GetCALIDECU</b> (OUT<No Name available>)	Mode: O
This action fill the ECU CALID with the correct values from the project	

<b>ACTION_OBDC_GetCALIDSBBoot</b> (OUT<No Name available>)	Mode: O
This action fill the SBOOT CALID with the correct values from the project	

<b>ACTION_OBDC_GetCALIDSelSeg</b> (OUT<No Name available>)	Mode: O
This action fill the several or all segments of memory CALID with the correct values from the project	

<b>ACTION_OBDC_GetCALIDSelSegSpc</b> (OUT<No Name available>)	Mode: O
This action fill the specific segment of memory CALID with the correct values from the project	

<b>ACTION_OBDC_GetECUNAME</b> (OUT<No Name available>)	Mode: O
This action fills the emission related ECU Name	

<b>ACTION_OBDC_GetVIN</b> (OUT<No Name available>)	Mode: O
This action fill the VIN with the correct values from the project	

**Import actions:**

<b>ACTION_ERRM_SelectRbmData</b> (<INOUT>,<PRM_CTR_MOD_9_RBM[36]>,<OUT>,<PRM_RES_MOD_9>)
--

**I.58.1 NC\_STATE\_CKS\_CONF\_CAN**

NC_STATE_CKS_CONF_CAN	
Value	Description
1	Method #1: The CVN(s) must not be computed on demand, but instead shall be computed at least once per trip. A trip shall be of reasonable length (e.g. 5 - 10 minutes). The computed CVN(s) shall be stored in NVM (Non Volatile Memory) for immediate access by the external test equipment. Once the computation is completed for the very first time after a reprogramming event of the ECU(s) or a battery disconnect, the results shall be made available to the external test equipment even if the engine is running. If the CVN(s) are requested before they have been computed a negative response message with response code \$78 - RequestCorrectlyReceived-ResponsePending shall be sent by the ECU(s) until the positive response message is available for the ISO 14230-4 and ISO 15765-4 protocols.
2	Method #2: If method #1 does not apply the ECU(s)' on-board software shall compute the CVN(s) on an external test equipment request message. If the ECU(s) are not able to send an immediate positive response message a negative response message with response code \$78 - RequestCorrectlyReceived-ResponsePending shall be sent by the ECU(s) until the positive response message is available for the ISO 14230-4 and ISO 15765-4 protocols.

**Formula section:**

NC\_STATE\_CKS\_CONF\_CAN = 1

**I.58.2 NC\_STATE\_COMP\_TYP\_CAN**

NC_STATE_COMP_TYP_CAN		
BIT	Function	Supported
0	Use CBOOT area	0
1	Use SBOOT area	0
2	Use CALIB area	1
3	Use ECU area	1
4	One area or a combination of several or all section areas of the ECU	0
5	Dummy value, always 0	0
6	Dummy value, always 0	0
7	Dummy value, always 0	0

**Formula section:**

see Table

**I.58.3 NC\_STATE\_SEL\_SEG\_CAN**

NC_STATE_SEL_SEG_CAN	
Value	Description
XX	The value of the define represent the area of one component or a a combination of several or all section areas of the ECU

NC\_STATE\_SEL\_SEG\_CAN = 0 (not used)

**I.58.4 NC\_STATE\_SEL\_SEG\_SPC\_CAN**

NC_STATE_SEL_SEG_SPC_CAN	
Value	Description
XX	The value of the define represent the area of one component of the ECM (e.g. Volcano)

NC\_STATE\_SEL\_SEG\_SPC\_CAN = 0 (not used)

**I.58.5 NC\_NR\_VIN\_CHAR\_LEN**

NC_NR_VIN_CHAR_LEN	
Value	Description
XX	Number of ASCII elements used for Vehicle Identification

NC\_NR\_VIN\_CHAR\_LEN = 17 dez

**I.58.6 NC\_NR\_CAL\_CHAR\_LEN**

NC_NR_CAL_CHAR_LEN	
Value	Description
XX	Number of ASCII elements used for Calibration Identification

NC\_NR\_CAL\_CHAR\_LEN = 16 dez

**I.58.7 Supported INFOTYPES for Service 09h - ISO 15765-4****Description:**In the table **ID\_STATE\_SRV\_9\_CAN\_VIT** each byte represents an 8 INFOTYPES configuration

ID_STATE_SRV_9_CAN_VIT[0]		Supported INFOTYPES from 01h - 08h
BIT	Function	Supported
0	INFOTYPE 08h : In-Use Performance Tracking	1
1	INFOTYPE 07h : Not used	0
2	INFOTYPE 06h : Calibration Verification Numbers	1
3	INFOTYPE 05h : Not used	0
4	INFOTYPE 04h : Calibration IDs	1
5	INFOTYPE 03h : Not used	0
6	INFOTYPE 02h : Vehicule Identification Number	1
7	INFOTYPE 01h : Not used	0

Figure I.58.1: ID\_STATE\_SRV\_9\_CAN\_VIT[1]

ID_STATE_SRV_9_CAN_VIT[1]		Supported INFOTYPES from 09h - 10h
BIT	Function	Supported
0	INFOTYPE 10h : Reserved	0
1	INFOTYPE 0Fh : Reserved	0
2	INFOTYPE 0Eh : Reserved	0
3	INFOTYPE 0Dh : Reserved	0
4	INFOTYPE 0Ch : Reserved	0
5	INFOTYPE 0Bh : Reserved	0
6	INFOTYPE 0Ah : ECUNAME	1
7	INFOTYPE 09h : Reserved	0

Figure I.58.2: ID\_STATE\_SRV\_9\_CAN\_VIT[2]

ID_STATE_SRV_9_CAN_VIT[2]		Supported INFOTYPES from 11h - 18h
BIT	Function	Supported
0	INFOTYPE 18h : Reserved	0
1	INFOTYPE 17h : Reserved	0
2	INFOTYPE 16h : Reserved	0
3	INFOTYPE 15h : Reserved	0
4	INFOTYPE 14h : Reserved	0
5	INFOTYPE 13h : Reserved	0
6	INFOTYPE 12h : Reserved	0
7	INFOTYPE 11h : Reserved	0

Figure I.58.3: ID\_STATE\_SRV\_9\_CAN\_VIT[3]

ID_STATE_SRV_9_CAN_VIT[3]		Supported INFOTYPES from 19h - 20h
BIT	Function	Supported
0	INFOTYPE 20h : INFOTYPES supported (\$21 - \$40)	0
1	INFOTYPE 1Fh : Reserved	0
2	INFOTYPE 1Eh : Reserved	0
3	INFOTYPE 1Dh : Reserved	0
4	INFOTYPE 1Ch : Reserved	0
5	INFOTYPE 1Bh : Reserved	0
6	INFOTYPE 1Ah : Reserved	0
7	INFOTYPE 19h : Reserved	0

## I.58.8 Description of Service 09h, INFOTYPE 02h - VIN

### Description:

Vehicle Identification Number (VIN) = 17 characters and should be reported as ASCII values

### Description for actions:

ACTION_OBDC_GetVIN (OUT < PRM_STATE_VIN >)					
This action fill the VIN with the correct values from the project					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_STATE_VIN[0..16]	IN	0...FFH	0...255	1	[-]
See description below					

### FUNCTION DESCRIPTION:

Description of parameter OUT used by action **ACTION\_OBDC\_GetVIN** ():

#### PRM\_STATE\_VIN:


Software structure of 17 ASCII elements filled up with VIN. This structure has to be filled byte by byte. For visualization the variables ECU\_VIN[0...16] are filled at ACTION request (ASCII format) or once after power up reset (after CVN calc. is finished).

PRM_STATE_VIN[0]	= kwp_io_vin[0]	// VIN Character 0
PRM_STATE_VIN[1]	= kwp_io_vin[1]	// VIN Character 1
PRM_STATE_VIN[2]	= kwp_io_vin[2]	// VIN Character 2
PRM_STATE_VIN[3]	= kwp_io_vin[3]	// VIN Character 3
PRM_STATE_VIN[4]	= kwp_io_vin[4]	// VIN Character 4
PRM_STATE_VIN[5]	= kwp_io_vin[5]	// VIN Character 5
PRM_STATE_VIN[6]	= kwp_io_vin[6]	// VIN Character 6
PRM_STATE_VIN[7]	= kwp_io_vin[7]	// VIN Character 7
PRM_STATE_VIN[8]	= kwp_io_vin[8]	// VIN Character 8
PRM_STATE_VIN[9]	= kwp_io_vin[9]	// VIN Character 9
PRM_STATE_VIN[10]	= kwp_io_vin[10]	// VIN Character 10
PRM_STATE_VIN[11]	= kwp_io_vin[11]	// VIN Character 11
PRM_STATE_VIN[12]	= kwp_io_vin[12]	// VIN Character 12
PRM_STATE_VIN[13]	= kwp_io_vin[13]	// VIN Character 13
PRM_STATE_VIN[14]	= kwp_io_vin[14]	// VIN Character 14
PRM_STATE_VIN[15]	= kwp_io_vin[15]	// VIN Character 15
PRM_STATE_VIN[16]	= kwp_io_vin[16]	// VIN Character 16

## I.58.9 Description of Service 09h, INFOTYPE 04h - Calibration IDs

### Description:

A Calibration ID will be reported for the ECM, depending on the software architecture. Calibration ID can include a maximum of 16 ASCII characters. Calibration ID can contain only printable ASCII characters, and will be reported as ASCII values. Calibration ID should uniquely identify the software installed in the ECM. The amount of Calibration Id is included in the "Number of data items" parameter. About Calibration coherence identifier definition see the file : ECU reprogramming, coherence system (Chapter 0)

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### I.58.9.1 API for configuration of Customer Boot CALID: ACTION\_OBDC\_GetCALIDCBoot (OUT < PRM\_STATE\_BOOT\_1 >)

#### Description for actions:

ACTION_OBDC_GetCALIDCBoot (OUT < PRM_STATE_BOOT_1 >)					
This action fill the CBOOT CALID with the correct values from the project					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_STATE_BOOT_1[0...15]	IN	0...FFH	0...255	1	[-]
Name of supplier CBOOT-ID					

#### FUNCTION DESCRIPTION:

Description of parameter OUT used by action ACTION\_OBDC\_GetCALIDCBoot ():

#### PRM\_STATE\_BOOT\_1:

Software structure of 16 ASCII elements filled up with CBOOT CALID(Calibration Identifications only for CBOOT area). This structure has to be filled byte by byte.

PRM_STATE_BOOT_1[0]	= not used	//CBOOT CALID Character 1
PRM_STATE_BOOT_1[1]	= not used	//CBOOT CALID Character 2
PRM_STATE_BOOT_1[2]	= not used	//CBOOT CALID Character 3
PRM_STATE_BOOT_1[3]	= not used	//CBOOT CALID Character 4
PRM_STATE_BOOT_1[4]	= not used	//CBOOT CALID Character 5
PRM_STATE_BOOT_1[5]	= not used	//CBOOT CALID Character 6
PRM_STATE_BOOT_1[6]	= not used	//CBOOT CALID Character 7
PRM_STATE_BOOT_1[7]	= not used	//CBOOT CALID Character 8
PRM_STATE_BOOT_1[8]	= not used	//CBOOT CALID Character 9
PRM_STATE_BOOT_1[9]	= not used	//CBOOT CALID Character 10
PRM_STATE_BOOT_1[10]	= not used	//CBOOT CALID Character 11
PRM_STATE_BOOT_1[11]	= not used	//CBOOT CALID Character 12
PRM_STATE_BOOT_1[12]	= not used	//CBOOT CALID Character 13
PRM_STATE_BOOT_1[13]	= not used	//CBOOT CALID Character 14
PRM_STATE_BOOT_1[14]	= not used	//CBOOT CALID Character 15
PRM_STATE_BOOT_1[15]	= not used	//CBOOT CALID Character 16

### I.58.9.2 API for configuration of supplier Boot CALID: ACTION\_OBDC\_GetCALIDSBoot (OUT < PRM\_STATE\_BOOT\_2 >)

#### Description for actions:

ACTION_OBDC_GetCALIDSBoot (OUT < PRM_STATE_BOOT_2 >)					
This action fill the SBOOT CALID with the correct values from the project					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_STATE_BOOT_2[0...15]	IN	0...FFH	0...255	1	[-]
Name of supplier SBOOT-ID					

#### FUNCTION DESCRIPTION:



Description of parameter OUT used by action **ACTION\_OBDC\_GetCALIDSBoot** ():

### PRM\_STATE\_BOOT\_2:

Software structure of 16 ASCII elements filled up with SBOOT CALID(Calibration Identifications only for SBOOT area). This structure has to be filled byte by byte.

<u>PRM_STATE_BOOT_2[0]</u>	= not used	//SBOOT CALID Character 1
<u>PRM_STATE_BOOT_2[1]</u>	= not used	//SBOOT CALID Character 2
<u>PRM_STATE_BOOT_2[2]</u>	= not used	//SBOOT CALID Character 3
<u>PRM_STATE_BOOT_2[3]</u>	= not used	//SBOOT CALID Character 4
<u>PRM_STATE_BOOT_2[4]</u>	= not used	//SBOOT CALID Character 5
<u>PRM_STATE_BOOT_2[5]</u>	= not used	//SBOOT CALID Character 6
<u>PRM_STATE_BOOT_2[6]</u>	= not used	//SBOOT CALID Character 7
<u>PRM_STATE_BOOT_2[7]</u>	= not used	//SBOOT CALID Character 8
<u>PRM_STATE_BOOT_2[8]</u>	= not used	//SBOOT CALID Character 9
<u>PRM_STATE_BOOT_2[9]</u>	= not used	//SBOOT CALID Character 10
<u>PRM_STATE_BOOT_2[10]</u>	= not used	//SBOOT CALID Character 11
<u>PRM_STATE_BOOT_2[11]</u>	= not used	//SBOOT CALID Character 12
<u>PRM_STATE_BOOT_2[12]</u>	= not used	//SBOOT CALID Character 13
<u>PRM_STATE_BOOT_2[13]</u>	= not used	//SBOOT CALID Character 14
<u>PRM_STATE_BOOT_2[14]</u>	= not used	//SBOOT CALID Character 15
<u>PRM_STATE_BOOT_2[15]</u>	= not used	//SBOOT CALID Character 16

### I.58.9.3 API for configuration of Calibration area CALID: ACTION\_OBDC\_GetCALIDECU (OUT < PRM\_STATE\_ECU >)

#### Description for actions:

ACTION_OBDC_GetCALIDECU (OUT < PRM_STATE_ECU >)					
This action fill the ECU CALID with the correct values from the project					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_STATE_ECU[0...15]	IN	0...FFH	0...255	1	[-]
See description bellow					


#### FUNCTION DESCRIPTION:

Description of parameter OUT used by action **ACTION\_OBDC\_GetCALIDECU** ():

### PRM\_STATE\_ECU:

Software structure of 16 ASCII elements filled up with ECU CALID(Calibration Identifications only for ECU area). This structure has to be filled byte by byte. For visualization the variable ECU\_ID\_SW[0...15] is filled at ACTION request or once after power up reset (after CVN calc. is finished).

<u>PRM_STATE_ECU[0]</u>	=	low nibble from bmw_hw_nr[2]	//ECU CALID Character 1
<u>PRM_STATE_ECU[1]</u>	=	high nibble from bmw_hw_nr[3]	//ECU CALID Character 2
<u>PRM_STATE_ECU[2]</u>	=	low nibble from bmw_hw_nr[3]	//ECU CALID Character 3
<u>PRM_STATE_ECU[3]</u>	=	high nibble from bmw_hw_nr[4]	//ECU CALID Character 4
<u>PRM_STATE_ECU[4]</u>	=	low nibble from bmw_hw_nr[4]	//ECU CALID Character 5
<u>PRM_STATE_ECU[5]</u>	=	high nibble from bmw_hw_nr[5]	//ECU CALID Character 6

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```

PRM_STATE_ECU[6] = low nibble from bmw_hw_nr[5] //ECU CALID Character 7
PRM_STATE_ECU[7] = 00h //ECU CALID Character 8
PRM_STATE_ECU[8] = 00h //ECU CALID Character 9
PRM_STATE_ECU[9] = 00h //ECU CALID Character 10
PRM_STATE_ECU[10] = 00h //ECU CALID Character 11
PRM_STATE_ECU[11] = 00h //ECU CALID Character 12
PRM_STATE_ECU[12] = 00h //ECU CALID Character 13
PRM_STATE_ECU[13] = 00h //ECU CALID Character 14
PRM_STATE_ECU[14] = 00h //ECU CALID Character 15
PRM_STATE_ECU[15] = 00h //ECU CALID Character 16

```

#### I.58.9.4 API for configuration of ECU SW CALID: ACTION\_OBDC\_GetCALIDCalib (OUT < PRM\_STATE\_CAL >)

##### Description for actions:

ACTION_OBDC_GetCALIDCalib (OUT < PRM_STATE_CAL >)					
This action fill the CALIB CALID with the correct values from the project					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_STATE_CAL[0...15]	IN	0...FFH	0...255	1	[-]
See description bellow					

##### FUNCTION DESCRIPTION:

Description of parameter OUT used by action **ACTION\_OBDC\_GetCALIDCalib** ():

##### PRM\_STATE\_CAL:

Software structure of 16 ASCII elements filled up with CALIB CALID(Calibration Identifications only for Calibration area). This structure has to be filled byte by byte.


##### Remark:

bmw\_cal\_nr[0..6] has to be defined inside the project as interface, because the actual CALIB CALID must be evaluated from the BMW\_UIF (reprog-history) table first. For visualization the variable ECU\_ID\_CAL[0...15] is filled at ACTION request or once after power up reset (after CVN calc. is finished).

```

PRM_STATE_CAL[0] = bmw_cal_nr[0] //CALIB CALID Character 1
PRM_STATE_CAL[1] = bmw_cal_nr[1] //CALIB CALID Character 2
PRM_STATE_CAL[2] = bmw_cal_nr[2] //CALIB CALID Character 3
PRM_STATE_CAL[3] = bmw_cal_nr[3] //CALIB CALID Character 4
PRM_STATE_CAL[4] = bmw_cal_nr[4] //CALIB CALID Character 5
PRM_STATE_CAL[5] = bmw_cal_nr[5] //CALIB CALID Character 6
PRM_STATE_CAL[6] = bmw_cal_nr[6] //CALIB CALID Character 7
PRM_STATE_CAL[7] = not used //CALIB CALID Character 8
PRM_STATE_CAL[8] = not used //CALIB CALID Character 9
PRM_STATE_CAL[9] = not used //CALIB CALID Character 10
PRM_STATE_CAL[10] = not used //CALIB CALID Character 11
PRM_STATE_CAL[11] = not used //CALIB CALID Character 12
PRM_STATE_CAL[12] = not used //CALIB CALID Character 13

```

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PRM\_STATE\_CAL[13] = not used //CALIB CALID Character 14  
 PRM\_STATE\_CAL[14] = not used //CALIB CALID Character 15  
 PRM\_STATE\_CAL[15] = not used //CALIB CALID Character 16

### I.58.9.5 API for configuration of a defined specific area CALID: ACTION\_OBDC\_GetCALIDSelSegSpc (OUT < PRM\_STATE\_SEL\_SEG\_SPC >)

#### Description for actions:

ACTION_OBDC_GetCALIDSelSeg (OUT < PRM_STATE_SEL_SEG >)					
This action fill the several or all segments of memory CALID with the correct values from the project					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_STATE_SEL_SEG[0...15]	IN	0...FFH	0...255	1	[-]
See description below					

#### FUNCTION DESCRIPTION:

Description of parameter OUT used by action ACTION\_OBDC\_GetCALIDSelSeg ():

#### PRM\_STATE\_SEL\_SEG:

Software structure of 16 ASCII elements filled up with SEGMENT CALID(Calibration Identifications only for several or all segments of memory). This structure has to be filled byte by byte.

PRM\_STATE\_SEL\_SEG[0] = not used //SEGMENT CALID Character 1  
 PRM\_STATE\_SEL\_SEG[1] = not used //SEGMENT CALID Character 2  
 PRM\_STATE\_SEL\_SEG[2] = not used //SEGMENT CALID Character 3  
 PRM\_STATE\_SEL\_SEG[3] = not used //SEGMENT CALID Character 4  
 PRM\_STATE\_SEL\_SEG[4] = not used //SEGMENT CALID Character 5  
 PRM\_STATE\_SEL\_SEG[5] = not used //SEGMENT CALID Character 6  
 PRM\_STATE\_SEL\_SEG[6] = not used //SEGMENT CALID Character 7  
 PRM\_STATE\_SEL\_SEG[7] = not used //SEGMENT CALID Character 8  
 PRM\_STATE\_SEL\_SEG[8] = not used //SEGMENT CALID Character 9  
 PRM\_STATE\_SEL\_SEG[9] = not used //SEGMENT CALID Character 10  
 PRM\_STATE\_SEL\_SEG[10] = not used //SEGMENT CALID Character 11  
 PRM\_STATE\_SEL\_SEG[11] = not used //SEGMENT CALID Character 12  
 PRM\_STATE\_SEL\_SEG[12] = not used //SEGMENT CALID Character 13  
 PRM\_STATE\_SEL\_SEG[13] = not used //SEGMENT CALID Character 14  
 PRM\_STATE\_SEL\_SEG[14] = not used //SEGMENT CALID Character 15  
 PRM\_STATE\_SEL\_SEG[15] = not used //SEGMENT CALID Character 16

### I.58.9.6 API for configuration of a defined area CALID: ACTION\_OBDC\_GetCALIDSelSeg (OUT < PRM\_STATE\_SEL\_SEG >)

#### Description for actions:

<b>ACTION_OBDC_GetCALIDSelSeg (OUT &lt; PRM_STATE_SEL_SEG &gt;)</b>					
This action fill the several or all segments of memory CALID with the correct values from the project					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_STATE_SEL_SEG[0...15]	IN	0...FFH	0...255	1	[-]
See description below					

### FUNCTION DESCRIPTION:

Description of parameter OUT used by action **ACTION\_OBDC\_GetCALIDSelSeg** ():


#### **PRM\_STATE\_SEL\_SEG:**

Software structure of 16 ASCII elements filled up with SEGMENT CALID(Calibration Identifications only for several or all segments of memory). This structure has to be filled byte by byte.

PRM_STATE_SEL_SEG[0] = not used	<i>//SEGMENT CALID Character</i>
1	
PRM_STATE_SEL_SEG[1] = not used	<i>//SEGMENT CALID Character</i>
2	
PRM_STATE_SEL_SEG[2] = not used	<i>//SEGMENT CALID Character</i>
3	
PRM_STATE_SEL_SEG[3] = not used	<i>//SEGMENT CALID Character</i>
4	
PRM_STATE_SEL_SEG[4] = not used	<i>//SEGMENT CALID Character</i>
5	
PRM_STATE_SEL_SEG[5] = not used	<i>//SEGMENT CALID Character</i>
6	
PRM_STATE_SEL_SEG[6] = not used	<i>//SEGMENT CALID Character</i>
7	
PRM_STATE_SEL_SEG[7] = not used	<i>//SEGMENT CALID Character</i>
8	
PRM_STATE_SEL_SEG[8] = not used	<i>//SEGMENT CALID Character</i>
9	
PRM_STATE_SEL_SEG[9] = not used	<i>//SEGMENT CALID Character</i>
10	
PRM_STATE_SEL_SEG[10] = not used	<i>//SEGMENT CALID Character</i>
11	
PRM_STATE_SEL_SEG[11]= not used	<i>//SEGMENT CALID Character</i>
12	
PRM_STATE_SEL_SEG[12] = not used	<i>//SEGMENT CALID Character</i>
13	
PRM_STATE_SEL_SEG[13] = not used	<i>//SEGMENT CALID Character</i>
14	
PRM_STATE_SEL_SEG[14] = not used	<i>//SEGMENT CALID Character</i>
15	
PRM_STATE_SEL_SEG[15] = not used	<i>//SEGMENT CALID Character</i>
16	

### **I.58.9.7 Description of Service 09h, INFOTYPE 0Ah - ECUNAME**

#### **Description for actions:**

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<b>ACTION_OBDC_GetECUNAME(OUT &lt;PRM_STATE_ECU_NAME&gt;)</b>					
This action fills the emission related ECU Name					
Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_STATE_ECU_NAME[0...19]	IN	0...FFH	0...255	1	[-]
See description below					

### FUNCTION DESCRIPTION:

Description of parameter OUT used by action ACTION\_OBDC\_GetECUNAME():

### PRM\_STATE\_ECU\_NAME:


Software structure of 20 ASCII characters filled up with ECU Name of an emission related ECU. This structure has to be field byte by byte.

Defined field assignment:

- Data bytes 1-4, XXXX , contains ECU acronym, and
- Data byte 5, - , contains delimiter, and
- Data bytes 6-20, YYYYYYYYYYYYYYYY , contains text name

### ECU acronyms:

The first 4 bytes from the response of InfoType 0Ah have to be one of the acronyms described in the table bellow.

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The emissions-related ECUs (control modules) have to report the external test equipment acronym and name as listed below. This table is not complete and emissions-related ECUs not listed in the table must be reported to ISO/SAE for definition.		
External test equipment reported acronym (max 1 - 4 chars.)	Full name of Control Module/ECU	External test equipment reported name (max 14 chars + 1 optional digit)
ABS, ABS1, ABS2	Anti-Lock Brake System (ABS) Control Module	AntiLockBrake
AFCM, AFC1, AFC2	Alternative Fuel Control Module	AltFuelCtrl
AHCM, AHC1, AHC2	Auxiliary Heater Control Module	AuxHeatCtrl
AWDC, AWD1, AWD2	All Wheel Drive Control Module	AllWhlDrvCtrl
BECM, BEC1, BEC2	Battery Energy Control Module	B+EnergyCtrl
BSCM, BSC1, BSC2	Brake System Control Module	BrakeSystem
CRCM, CRC1, CRC2	Cruise Control Module	CruiseControl
CTCM, CTC1, CTC2	Coolant Temperature Control Module	CoolTempCtrl
DMCM, DMC1, DMC2	Drive Motor Control Module	DriveMotorCtrl
ECCI, ECC1, ECC2	Emissions Critical Control Information	EmisCritInfo
ECM, ECM1, ECM2	Engine Control Module	EngineControl
FACM, FAC1, FAC2	Fuel Additive Control Module	FuelAddCtrl
FICM, FIC1, FIC2	Fuel Injector Control Module	FuelInjCtrl
FPCM, FPC1, FPC2	Fuel Pump Control Module	FuelPumpCtrl
4WDC, 4WD1, 4WD2	Four-Wheel Drive Clutch Control Module	4WhlDrvClCtrl
GPCM, GPC1, GPC2	Glow Plug Control Module	GlowPlugCtrl
GSM, GSM1, GSM2	Gear Shift Control Module	GearShiftCtrl
HPCM, HPC1, HPC2	Hybrid Powertrain Control Module	HybridPtrCtrl
IPC, IPC1, IPC2	Instrument Panel Cluster (IPC) Control Module	InstPanelClust
PCM, PCM1, PCM2	Powertrain Control Module	PowertrainCtrl
RDCM, RDC1, RDC2	Reductant Control Module	ReductantCtrl
SGCM, SGC1, SGC2	Starter / Generator Control Module	Start/GenCtrl
TACM, TAC1, TAC2	Throttle Actuator Control Module	ThrotActCtrl
TCCM, TCC1, TCC2	Transfer Case Control Module	TransfCaseCtrl
TCM, TCM1, TCM2	Transmission Control Module	TransmisCtrl

External test equipment reported name: **ECM -EngineControl**

```

PRM_STATE_ECU_NAME[0] = E
PRM_STATE_ECU_NAME[1] = C
PRM_STATE_ECU_NAME[2] = M
PRM_STATE_ECU_NAME[3] = $00
PRM_STATE_ECU_NAME[4] = "-" //delimiter
PRM_STATE_ECU_NAME[5] = E
PRM_STATE_ECU_NAME[6] = n
PRM_STATE_ECU_NAME[7] = g
PRM_STATE_ECU_NAME[8] = i
PRM_STATE_ECU_NAME[9] = n
PRM_STATE_ECU_NAME[10] = e
PRM_STATE_ECU_NAME[11] = C
PRM_STATE_ECU_NAME[12] = o

```

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```

PRM_STATE_ECU_NAME[13] = n
PRM_STATE_ECU_NAME[14] = t
PRM_STATE_ECU_NAME[15] = r
PRM_STATE_ECU_NAME[16] = o
PRM_STATE_ECU_NAME[17] = l
PRM_STATE_ECU_NAME[18] = $00
PRM_STATE_ECU_NAME[19] = $00

```

### I.58.9.8 Visualization for Service 09h - RBM data

#### Description:

This function is used to visualize the Service 09h data for measuring proposed. If the ACTION is called by SCAN-Tool, the variables are filled up.

#### Application conditions

**Initialisation:** *0 at reset*

**Recurrence:** *-*


**Activation:** *at ACTION request or once after power up reset (after CVN calc. is finished)*

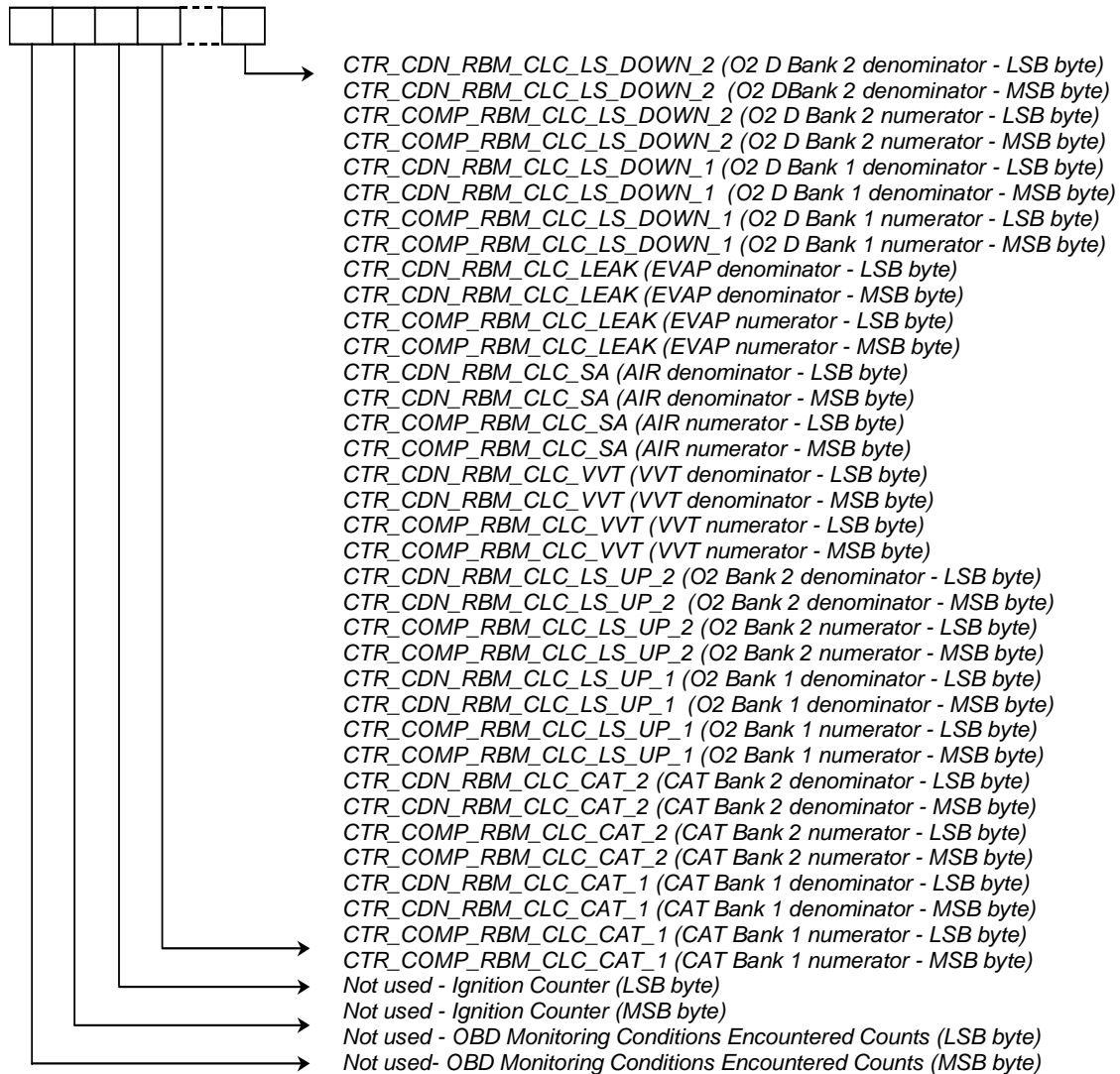
#### Formula section:

ACTION\_ERRM\_SelectRbmData()

ListRbmData : Software structure filled-up with 20 counters of 2 bytes coming from Rate-Based Monitoring. The first 4 bytes are not used for visualization.

First Byte.....Last Byte

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### I.58.9.9 Visualization for Service 09h - VIN data

#### Description:

This function is used to visualize the Service 09h data for measuring proposed. If the VIN is called by SCAN-Tool, the variables are filled up.

#### Application conditions


**Initialisation:** *0 at reset*

**Recurrence:** *-*

**Activation:** *at ACTION request or once after power up reset (after CVN calc. is finished)*


#### Formula section:

ECU\_CVN\_PROG = STATE\_CKS\_ECU\_SAE

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ECU\_CVN\_CAL = STATE\_CKS\_CAL\_SAE

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## I.59 SID 0Ah: Request emission related diagnostic trouble codes - permanent

### Import actions:

<b>ACTION_ERRM_ReadDtcByTypeOfDtc</b> (<IN>,<TypeOfDtc>,<IN>,<LevelOfDtc>,<INOUT>,<ListOfDtc>,<OUT>,<ResultDtc>)
<b>ACTION_ERRM_ReadQuantityOfDtc</b> (IN<PRM_TYPEOFDTC>,<IN>,<LevelOfDtc>,<INOUT>,<ListOfDtc>,<OUT>,<ResultDtc>)
<b>ACTION_ERRM_ReadQuantityOfDtc</b> (IN<PRM_TYPEOFDTC>,<IN>,<LevelOfDtc>,<INOUT>,<ListOfDtc>,<OUT>,<ResultDtc>)

### I.59.1 Functional description

The purpose of this service is to enable the external test equipment to obtain all DTCs with "permanent DTC" status. These are DTCs that are "confirmed" and are retained in the non-volatile memory of the server until the appropriate monitor for each DTC has determined that the malfunction is no longer present and is not commanding the MIL on.

Service \$0A is required for all emissions-related DTCs. The intended use of this data is to prevent vehicles from passing an in-use inspection simply by disconnecting the battery or clearing DTCs with a scan tool prior to the inspection. The presence of permanent DTCs at an inspection without the MIL illuminated is an indication that a proper repair was not verified by the on-board monitoring system.

Permanent DTCs shall be stored in non-volatile memory (NVRAM) and may not be erased by any diagnostic services (generic or enhanced) or by disconnecting power to the ECU.


A confirmed DTC shall be stored as a permanent DTC no later than the end of the ignition cycle and subsequently at all times that the confirmed DTC is commanding the MIL on (e.g., for currently failing systems but not during the 40 warm-up cycle self-healing process).

Permanent DTCs may be erased if:

- The OBD II system itself determines that the malfunction that caused the permanent fault code to be stored is no longer present and is not commanding the MIL on, e.g., three consecutive complete driving cycles with no malfunction, or as specified by the OBD regulations,
- After clearing fault information in the ECU (i.e., through the use of a diagnostic service or battery disconnect), the diagnostic monitor for the malfunction that caused the permanent DTC to be stored has fully executed (i.e., has executed the minimum number of checks necessary for MIL illumination) and determined the malfunction is no longer present, e.g., one complete driving cycle with no malfunction or as specified by the OBD regulations.

-Permanent fault codes may be erased when the ECU containing the permanent DTCs is reprogrammed if the readiness status for all monitored components and systems is set to not complete in conjunction with the reprogramming event.

Note that due to implementation timing differences during the phase-in of permanent DTCs, there may be cases where some ECUs support permanent DTCs while other ECUs do not.

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## I.59.2 Message data bytes

### I.59.2.1 Request message definition

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request emission-related diagnostic trouble codes with permanent status request SID	M	0A	SIDRQ

### I.59.2.2 Response message definition

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request emission-related diagnostic trouble codes with permanent status response SID	M	4A	SIDPR
#2	# of DTC = [ no emission-related DTCs with permanent status # of emission-related DTCs with permanent status ]	M	Xx = [ 00, 01 -FF]	#OFDTC
#3	DTC#1 (High Byte)	C	xx	DTC1HI
#4	DTC#1 (Low Byte)	C	xx	DTC1LO
:	:	:	xx	
#n-1	DTC#m (High Byte)	C	xx	DTCmHI
#n	DTC#m (Low Byte)	C	xx	DTCmLO

C = Conditional — DTC#1 - DTC#m are only included if # of DTC parameter value ≠ \$00.

### I.59.2.3 Parameter definition

This service does not support any parameters.

### I.59.2.4 Formula section

#### ACTION\_ERRM\_ReadQuantityOfDtc

```
(
  IN <PERMANENT>
  IN <LAW>
  INOUT <NR_DTC>
  OUT <ResultQuantity>
)
```

#### ACTION\_ERRM\_ReadDtcByTypeOfDtc

```
(
  IN <PERMANENT>
  IN <LAW>
  INOUT <DTC1 to DTCm>
  OUT <ResultDtc>
)
```

**IF** ResultDtc != BUFFER\_FULL **THEN**

Positive response

**ELSE**

No answer

**ENDIF**

## I.60 Test identification description for mode 05h

### Input data:

C_LAMB_BAS_COR_MIN {p. 812}	C_LAMB_DELTA_I_MAX_ DIAG {p. 5217}	C_LAMB_DELTA_I_MIN_ DIAG {p. 5217}	C_VLS_DOWN_CYC_ MAX_SAE {p. 7836}
C_VLS_DOWN_CYC_MIN_ SAE {p. 7836}	FAC_DYN_LSL_DIAG_ SAE [NC_CBK_EX_NR] {p. 1006}	FAC_DYN_LSL_DIAG_ TOL_SAE [NC_CBK_EX_NR] {p. 1006}	LAMB_DELTA_I_SAVE_ DIAG [NC_CBK_EX_NR] {p. 5215}
LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	MOD_5_TID_1_DIAG {p. 7832}	MOD_5_TID_10_DIAG {p. 7832}	MOD_5_TID_11_DIAG {p. 7832}
MOD_5_TID_12_DIAG {p. 7832}	MOD_5_TID_13_DIAG {p. 7832}	MOD_5_TID_14_DIAG {p. 7832}	MOD_5_TID_15_DIAG {p. 7832}
MOD_5_TID_16_DIAG {p. 7832}	MOD_5_TID_17_DIAG {p. 7832}	MOD_5_TID_18_DIAG {p. 7832}	MOD_5_TID_19_DIAG {p. 7832}
MOD_5_TID_2_DIAG {p. 7832}	MOD_5_TID_20_DIAG {p. 7832}	MOD_5_TID_3_DIAG {p. 7832}	MOD_5_TID_4_DIAG {p. 7832}
MOD_5_TID_5_DIAG {p. 7832}	MOD_5_TID_6_DIAG {p. 7832}	MOD_5_TID_7_DIAG {p. 7832}	MOD_5_TID_8_DIAG {p. 7833}
MOD_5_TID_9_DIAG {p. 7833}	PSN_LS {p. 656}	VLS_DOWN_MAX_DC [NC_CBK_EX_NR] {p. 1503}	VLS_DOWN_MIN_DC [NC_CBK_EX_NR] {p. 1503}

### FUNCTION DESCRIPTION:

#### General information:

Read on-board oxygen sensor monitoring test results by an external tester. The use of this mode is optional, depending on the method used by the vehicle manufacturer to comply with the requirement for oxygen sensor monitoring.


Mode05 is only supported if lambda sensors are mounted ( PSN\_LS = 11H or 33H, see below).

#### PSN\_LS:

BIT	Function	Status
0	Bank 1 Sensor 1	1= available, 0 = not available
1	Bank 1 Sensor 2	1= available, 0 = not available
2	Bank 1 Sensor 3	1= available, 0 = not available
3	Bank 1 Sensor 4	1= available, 0 = not available
4	Bank 2 Sensor 1	1= available, 0 = not available
5	Bank 2 Sensor 2	1= available, 0 = not available
6	Bank 2 Sensor 3	1= available, 0 = not available
7	Bank 2 Sensor 4	1= available, 0 = not available

#### Formula section:

If PSN\_LS = 33h //means, that  
Bank1 /Sensor 1 and

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*Bank2 /Sensor 1 and  
Bank1 /Sensor 2 and  
Bank2 /Sensor 2* are available.

**Then** all defined TID are supported  
**Elseif** PSN\_LS = 11h //means, that Bank1 /Sensor1 and Bank2 Sensor1 are available.  
**Then** only TID \$81, \$82, \$83, \$83 are supported  
**Else** Mode 5 is not supported  
**Endif**

## I.60.1 Supported Test ID of MODE \$05

### I.60.1.1 MODE \$05, Test ID \$00, DATA A Supported TIDs \$01 ... \$08

MODE \$05 — Request Oxygen Sensor Monitoring Test Results				
TID \$00 — DATA A — Supported TIDs \$01 ... \$08				
BIT	Function	Supported if	output available for	
0	TID \$08: Maximum sensor voltage for test cycle (calculated)	PSN_LS = 33H and MOD_5_TID_1_DIAG (bit 0)	upstream	No
			downstream	Yes
1	TID \$07: Minimum sensor voltage for test cycle (calculated)	PSN_LS = 33H and MOD_5_TID_1_DIAG (bit 1)	upstream	No
			downstream	Yes
2	TID \$06: Lean to rich sensor switch time (calculated)	Not supported	upstream	No
3	TID \$05: Rich to lean sensor switch time (calculated)	Not supported	upstream	No
4	TID \$04: High sensor voltage for switch time calculation (constant)	Not supported	upstream	No
5	TID \$03: Low sensor voltage for switch time calculation (constant)	Not supported	upstream	No
6	TID \$02: Lean to rich sensor threshold voltage (constant)	PSN_LS = 33H and MOD_5_TID_1_DIAG (bit 6)	upstream	No
			downstream	Yes
7	TID \$01: Rich to lean sensor threshold voltage (constant) ,	PSN_LS = 33H and MOD_5_TID_1_DIAG (bit 7)	upstream	No
			downstream	Yes

### I.60.1.2 MODE \$05, Test ID \$00, DATA B /C /D Supported TIDs \$09 ... \$20 (Reserved)

### I.60.1.3 MODE \$05, Test ID \$20, DATA A /B /C /D Supported TIDs \$21 ... \$40 (Reserved)

### I.60.1.4 MODE \$05, Test ID \$40, DATA A /B /C /D Supported TIDs \$41 ... \$60 (Reserved)

### I.60.1.5 MODE \$05, Test ID \$60, DATA A /B /C /D Supported TIDs \$61 ... \$80 (Reserved)

### I.60.1.6 MODE \$05, Test ID \$80, DATA A Supported TIDs \$81 ... \$88

MODE \$05 — Request Oxygen Sensor Monitoring Test Results				
TID \$80 — DATA A — Supported TIDs \$81 ... \$88				
BIT	Function	Supported if	output available	
0	TID \$88: reserved			
1	TID \$87: reserved			
2	TID \$86: reserved			
3	TID \$85: reserved			
4	TID \$84: fuel trim diagnosis	PSN_LS = 33H or 11H and MOD_5_TID_17_DIAG (bit 3)	upstream	<b>Yes</b>
5	TID \$83: sensor dynamics diagnosis	PSN_LS = 33H or 11H and MOD_5_TID_17_DIAG (bit 2)	upstream	<b>Yes</b>
6	TID \$82: actual a/f setpoint	PSN_LS = 33H or 11H and MOD_5_TID_17_DIAG (bit 1)	upstream	<b>Yes</b>
7	TID \$81: actual a/f-ratio linear	PSN_LS = 33H or 11H and MOD_5_TID_17_DIAG (bit 0)	upstream	<b>Yes</b>

### I.60.1.7 MODE \$05, Test ID \$80, DATA B Supported TIDs \$89 ... \$A0 (Reserved)

## I.60.2 PID definition for MODE 05

### I.60.2.1 MODE \$05, Test ID \$01 Downstream (B1S2 and B2S2) , Rich to lean threshold voltage

MODE \$05 — Request Oxygen Sensor Monitoring Test Results	
TID \$01 — Rich to lean sensor threshold voltage downstream B1S2 B2S2 (constant)	
Project System Variables	
test value	C_VLS_DOWN_CYC_MIN_SAE
min. value	<b>not required</b>
max. value	<b>not required</b>

TID \$01 — DATA A - Test value			
	SAE 1979		Project definitions
min. value	0[V]	min. value	0[V] (00H)
max. value	1.275[V]	max. value	1.275[V] (FFH)
scaling	0.005[V] (1 V @ C8h)	scaling	0.005[V]
display		test value	C_VLS_DOWN_CYC_MIN_SAE

### I.60.2.2 MODE \$05, Test ID \$02 Downstream (B1S2 and B2S2) , Lean to rich threshold voltage

MODE \$05 — Request Oxygen Sensor Monitoring Test Results	
TID \$02 — Lean to rich sensor threshold voltage downstream B1S2 B2S2 (constant)	
Project System Variables	
test value	C_VLS_DOWN_CYC_MAX_SAE
min. value	<b>not required</b>
max. value	<b>not required</b>

TID \$02 — DATA A - Test value			
	SAE 1979		Project definitions
min. value	0[V]	min. value	0[V] (00H)
max. value	1.275[V]	max. value	1.275[V] (FFH)
scaling	0.005[V] (1 V @ C8h)	scaling	0.005[V]
display		test value	C_VLS_DOWN_CYC_MAX_SAE

### I.60.2.3 MODE \$05, Test ID \$07 Downstream (B1S2 and B2S2), Minimum voltage for test cycle

MODE \$05 — Request Oxygen Sensor Monitoring Test Results	
TID \$07 — Minimum sensor voltage for test cycle downstream B1S2 B2S2	
	Project System Variables
test value	VLS_DOWN_MIN_DC[NC_CBK_EX_NR]
min. value	0[V] (00H)
max. value	1.275[V] (FFH)

TID \$07 — DATA A - Test value			
	SAE 1979		Project definitions
min. value	0[V] (00H)	min. value	0[V] (00H)
max. value	1.275[V] (FFH)	max. value	5[V] (3FFH)
scaling	0.005[V]	scaling	0.005[V]
display		test value	VLS_DOWN_MIN_DC[NC_CBK_EX_N R]
TID \$07 — DATA B - Minimum test limit			
	SAE 1979		Project definitions
min. value	0[V] (00H)	min. value	
max. value	1.275[V] (FFH)	max. value	
scaling	0.005[V]	scaling	
display		test value	0[V] (0H)
TID \$07 — DATA C - Maximum test limit			
	SAE 1979		Project definitions
min. value	0[V] (00H)	min. value	
max. value	1.275[V] (FFH)	max. value	
scaling	0.005[V]	scaling	
display		test value	1.275[V] (FFH)

### I.60.2.4 MODE \$05, Test ID \$08 Downstream (B1S2 and B2S2), Maximum voltage for test cycle

MODE \$05 — Request Oxygen Sensor Monitoring Test Results	
TID \$08 — Maximum sensor voltage for test cycle downstream B1S2 B2S2	
	Project System Variables
test value	VLS_DOWN_MAX_DC[NC_CBK_EX_NR]
min. value	0[V] (00H)
max. value	1.275[V] (FFH)


TID \$08 — DATA A - Test value			
	SAE 1979		Project definitions
<i>min. value</i>	0[V] (00H)	<i>min. value</i>	0[V] (00H)
<i>max. value</i>	1.275[V] (FFH)	<i>max. value</i>	5[V] (3FFH)
<i>scaling</i>	0.005[V]	<i>scaling</i>	0.005[V]
<i>display</i>		<i>test value</i>	VLS_DOWN_MAX_DC[NC_CBK_EX_N R]
TID \$08 — DATA B - Minimum test limit			
	SAE 1979		Project definitions
<i>min. value</i>	0[V] (00H)	<i>min. value</i>	
<i>max. value</i>	1.275[V] (FFH)	<i>max. value</i>	
<i>scaling</i>	0.005[V]	<i>scaling</i>	
<i>display</i>		<i>test value</i>	0[V] (0H)
TID \$08 — DATA C - Maximum test limit			
	SAE 1979		Project definitions
<i>min. value</i>	0[V] (00H)	<i>min. value</i>	
<i>max. value</i>	1.275[V] (FFH)	<i>max. value</i>	
<i>scaling</i>	0.005[V]	<i>scaling</i>	
<i>display</i>		<i>test value</i>	1.275[V] (FFH)

### I.60.2.5 MODE \$05, Test ID \$81 Upstream (B1S1 and B2S1) , Actual A/F-ratio

MODE \$05 — Request Oxygen Sensor Monitoring Test Results	
TID \$81 — Actual A/F-ratio WRAF sensor upstream B1S1 B2S1 (calculated)	
	Project System Variables
<i>test value</i>	LAMB_LS_UP[NC_CBK_EX_NR]
<i>min. value</i>	C_LAMB_BAS_COR_MIN
<i>max. value</i>	2 (FFH)

TID \$81 — DATA A - Test value			
	SAE 1979		Project definitions
<i>min. value</i>	0 (00H)	<i>min. value</i>	0s (00H)
<i>max. value</i>	2 (FFH)	<i>max. value</i>	32 (7FFFH)
<i>scaling</i>	0.00781	<i>scaling</i>	0.98e-3
<i>display</i>		<i>test value</i>	LAMB_LS_UP[NC_CBK_EX_NR]
TID \$81 — DATA B - Minimum test limit			
	SAE 1979		Project definitions
<i>min. value</i>	0 (00H)	<i>min. value</i>	0s (00H)
<i>max. value</i>	2 (FFH)	<i>max. value</i>	32 (7FFFH)
<i>scaling</i>	0.00781	<i>scaling</i>	0.98e-3
<i>display</i>		<i>min. limit</i>	C_LAMB_BAS_COR_MIN
TID \$81 — DATA C - Maximum test limit			
	SAE 1979		Project definitions
<i>min. value</i>	0 (00H)	<i>min. value</i>	
<i>max. value</i>	2 (FFH)	<i>max. value</i>	
<i>scaling</i>	0.00781	<i>scaling</i>	
<i>display</i>		<i>max. limit</i>	2 (FFH)

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### I.60.2.6 MODE \$05, Test ID \$82 Upstream (B1S1 and B2S1), Actual A/F-setpoint

MODE \$05 — Request Oxygen Sensor Monitoring Test Results	
TID \$82 — Actual A/F-setpoint WRAF sensor upstream B1S1 B2S1 (calculated)	
	Project System Variables
test value	LAMB_SP[NC_CBK_EX_NR]
min. value	C_LAMB_BAS_COR_MIN
max. value	2 (FFH)

TID \$82 — DATA A - Test value			
	SAE 1979		Project definitions
min. value	0 (00H)	min. value	0s (00H)
max. value	2 (FFH)	max. value	32 (7FFFH)
scaling	0.00781	scaling	0.98e-3
display		test value	LAMB_SP[NC_CBK_EX_NR]
TID \$82 — DATA B - Minimum test limit			
	SAE 1979		Project definitions
min. value	0 (00H)	min. value	0s (00H)
max. value	2 (FFH)	max. value	32 (7FFFH)
scaling	0.00781	scaling	0.98e-3
display		min. limit	C_LAMB_BAS_COR_MIN
TID \$82 — DATA C - Maximum test limit			
	SAE 1979		Project definitions
min. value	0 (00H)	min. value	
max. value	2 (FFH)	max. value	
scaling	0.00781	scaling	
display		max. limit	2 (FFH)

### I.60.2.7 MODE \$05, Test ID \$83 Upstream (B1S1 and B2S1), Dynamic diagnosis

MODE \$05 — Request Oxygen Sensor Monitoring Test Results	
TID \$83 — sensor dynamic upstream B1S1 B2S1 (calculated)	
	Project System Variables
test value	FAC_DYN_LSL_DIAG_SAE[NC_CBK_EX_NR]
min. value	0 (00H)
max. value	FAC_DYN_LSL_DIAG_TOL_SAE[NC_CBK_EX_NR]

TID \$83 — DATA A - Test value			
	SAE 1979		Project definitions
min. value	0 (00H)	min. value	-327.68 (8000H)
max. value	3.99998 (FFH)	max. value	327.67 (7FFFH)
scaling	0.0156	scaling	0.01 [-]
display		test value	FAC_DYN_LSL_DIAG_SAE[i]
TID \$83 — DATA B — Minimum test limit			
	SAE 1979		Project definitions
min. value	0 (00H)	min. value	
max. value	3.99998 (FFH)	max. value	
scaling	0.0156	scaling	
display		min. limit	0 (00H)
TID \$83 — DATA C — Maximum test limit			
	SAE 1979		Project definitions
min. value	0 (00H)	min. value	
max. value	3.99998 (FFH)	max. value	327.67 (7FFFH)
scaling	0.0156	scaling	0.01 [-]
display		max. limit	FAC_DYN_LSL_DIAG_TOL_SAE[i]



### I.60.2.8 MODE \$05, Test ID \$84 Upstream (B1S1 and B2S1), Fuel trim sensor diagnosis

MODE \$05 — Request Oxygen Sensor Monitoring Test Results	
TID \$84 — fuel trim sensor diagnosis upstream B1S1 B2S1 (calculated)	
	Project System Variables
test value	LAMB_DELTA_I_SAVE_DIAG[NC_CBK_EX_NR]
min. value	C_LAMB_DELTA_I_MIN_DIAG
max. value	C_LAMB_DELTA_I_MAX_DIAG

TID \$84 — DATA A - Test value			
	manuf. def.		Project definitions
min. value	-0.125 (00H)	min. value	-0.125 (F800H)
max. value	+0.125 (FFH)	max. value	+0.125 (800H)
scaling	9.80392e-4 (0.25/256)	scaling	6,1035E-5 [-]
display		test value	LAMB_DELTA_I_SAVE_DIAG[i]
TID \$84 — DATA B Minimum test limit			
	manuf. def.		Project definitions
min. value	-0.125 (00H)	min. value	-0.125 (F800H)
max. value	+0.125 (FFH)	max. value	+0.125 (800H)
scaling	9.80392e-4 (0.25/256)	scaling	6,1035E-5 [-]
display		min. limit	C_LAMB_DELTA_I_MIN_DIAG
TID \$84 — DATA C — Maximum test limit			
	manuf. def.		Project definitions
min. value	-0.125 (00H)	min. value	-0.125 (F800H)
max. value	+0.125 (FFH)	max. value	+0.125 (800H)
scaling	9.80392e-4 (0.25/256)	scaling	6,1035E-5 [-]
display		max. limit	C_LAMB_DELTA_I_MAX_DIAG

## I.61 Test identification description for mode 06h

### Input data:


C_CL_MMV_DIAGCPS {p. 5929}	C_CTR_SWT_LS_DOWN {p. 5153}	C_CUR_DMTL_REF_ LEAK_MAX {p. 5972}	C_CUR_DMTL_REF_ LEAK_MIN {p. 5972}
C_SAF_DIAG_MAX {p. 812}	C_SAF_DIAG_MIN {p. 812}	C_SUM_AFL_VLS_MIN_ DIAG_SA_1 {p. 1088}	C_SUM_CNL_SMALL_ LEAK_MES_MAX {p. 5973}
C_SUM_DIAGCPS_MAX {p. 5930}	CAT_DIAG_MOD_6 [NC_CBK_EX_NR] {p. 1037}	CAT_MAX_DIAG_MOD_6 [NC_CBK_EX_NR] {p. 1037}	CL_MMV_SAE {p. 5926}
CTR_SAVE_SWT_LS_ DOWN [NC_CBK_EX_NR] {p. 5151}	FAC_DYN_LSL_DIAG_ SAE [NC_CBK_EX_NR] {p. 1006}	FAC_DYN_LSL_DIAG_ TOL_SAE [NC_CBK_EX_NR] {p. 1006}	LC_SA_SWI_ACQ {p. 1088}
LV_CONF_DMTL {p. 654}	LV_ERR_MEM_XX {p. 5767}	LV_READY_XX {p. 5881}	M6_CTR_CNL_SMALL_ LEAK_MES {p. 5967}
M6_CUR_DMTL_COR_ FIL_CID18 {p. 5968}	M6_CUR_DMTL_COR_ FIL_CID19 {p. 5968}	M6_CUR_DMTL_DMTLS_ TEST {p. 5968}	M6_CUR_DMTL_REF_ LEAK {p. 5968}
M6_CUR_DMTL_ROUGH_ LEAK_END {p. 5968}	M6_CUR_DMTL_ROUGH_ LEAK_LEN_END {p. 5968}	M6_CUR_DMTL_SMALL_ LEAK_END {p. 5968}	M6_CUR_DMTL_THD_ DMTLS_TEST {p. 5968}
M6_CUR_DMTL_THD_ ROUGH_LEAK {p. 5968}	M6_CUR_DMTL_THD_ ROUGH_LEAK_LEN {p. 5968}	MAF_DIAGCPS_SAE {p. 5927}	MAF_DIAGCPS_THD_SAE {p. 5927}
MOD_6_TID_2_DIAG {p. 7833}	MOD_6_TID_3_DIAG {p. 7833}	MOD_6_TID_4_DIAG {p. 7833}	PSN_LS {p. 656}
R_IT_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5198}	R_IT_THD_OBD_LSH_ DOWN [NC_CBK_EX_NR] {p. 5198}	SAF_DIAG_MAX_SAE {p. 1088}	SAF_DIAG_MIN_SAE {p. 1088}
SUM_AFL_VLS_DIAG_ SA_1_SAE {p. 1088}	SUM_AFL_VLS_DIAG_ SA_2_SAE {p. 1088}	SUM_DIAG_DIAGCPS_ SAE {p. 5928}	TTIP_OBD_LSH_UP_ MES_BOL_SAE [NC_CBK_EX_NR] {p. 5439}
TTIP_OBD_LSH_UP_ MES_SAE [NC_CBK_EX_NR] {p. 5439}	TTIP_OBD_LSH_UP_ MES_TOL_SAE [NC_CBK_EX_NR] {p. 5439}		

### I.61.1 Overview of all implemented TID's

#### FUNCTION DESCRIPTION:

#### General information:

The CID is calculated depending if the Threshold is working as a "Maximum" or "Minimum" threshold. The "Minimum" CID is always the "Maximum" CID + 80h.

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For example:

TID 03h /CID 05/85h : Secondary Air Monitor 1 - LinLam Min flow bank 1/2

=> CID 05h is a "Maximum" Threshold

=> CID 85h is a "Minimum" Threshold (85h = 05h + 80h)

List of all TIDs
<b>Catalyst monitor</b>
TID 01h / CID 01h : Catalyst monitor Bank1
TID 01h / CID 02h : Catalyst monitor Bank2
<b>Oxygen sensor monitor</b>
TID 02h / CID 15h : Oxygen sensor monitor Bank1 - Sensor1 - Dynamic
TID 02h / CID 30h : Oxygen sensor monitor Bank1 - Sensor2 - Switchtime
TID 02h / CID 18 : Oxygen sensor monitor Bank2 - Sensor1 - Dynamic
TID 02h / CID 32h : Oxygen sensor monitor Bank2 - Sensor2 - Switchtime
<b>Secondary air monitor</b>
TID 03h / CID 20h : Secondary Air Monitor 2 - SA - meter Min flow, Step 1
TID 03h / CID 21h : Secondary Air Monitor 2 - SA - meter Min flow, Step 2
TID 03h / CID 05h(85h) : Secondary Air Monitor 1 - LinLam Min flow bank 1/2
<b>Evaporative monitor</b>
TID 05h / CID 07h(87h) : EVAP monitor - CPS check - Step 1
TID 05h / CID 08h : EVAP monitor - CPS check - Step 2
TID 05h / CID 09h : EVAP monitor - CPS check - Step 3
TID 05h / CID 13h : EVAP monitor - Module error - Max error
TID 05h / CID 14h : EVAP monitor - Module error - Plausibility error
TID 05h / CID 17h : EVAP monitor - Module error - Signal error
TID 05h / CID 12h(92h) : EVAP monitor - Module error - Min error
TID 05h / CID 15h(95h) : EVAP monitor - DMTL - Rough leak - Short cycle
TID 05h / CID 16h(96h) : EVAP monitor - DMTL - Small leak
TID 05h / CID 18h(98h) : EVAP monitor - DMTL - Rough leak - Long cycle
<b>Oxygen heater monitor</b>
TID 06h / CID 03h : Oxygen Sensor Heater Monitor Bank 1 - Sensor 2 - R
TID 06h / CID 04h : Oxygen Sensor Heater Monitor Bank 2 - Sensor 2 - R
TID 06h / CID 05h/85h: Oxygen Sensor Heater Monitor Bank 1-Sensor 1 - TTIP
TID 06h / CID 06h/86h: Oxygen Sensor Heater Monitor Bank 2-Sensor 1 - TTIP

## I.61.2 Supported TIDs 01h - C0h

### I.61.2.1 Description of TID 00h - Supported TIDs 01h - 20h

TID 00h - DATA A - Supported TID 01h to 08h		
BIT	Function	Name
0	TID 08h : Reserved	MOD_6_TID_1_DIAG
1	TID 07h : Reserved	
2	TID 06h : Oxygen sensor heater monitor	
3	TID 05h : Evaporative monitor	
4	TID 04h : Reserved	
5	TID 03h : Secondary air monitor	
6	TID 02h : Oxygen sensor monitor	
7	TID 01h : Catalyst monitor	
TID 00h - DATA B - Supported TID 09h to 10h		
BIT	Function	Name
0	TID 10h : reserved	MOD_6_TID_2_DIAG
1	TID 0Fh : reserved	
2	TID 0Eh : reserved	
3	TID 0Dh : reserved	
4	TID 0Ch : reserved	
5	TID 0Bh : reserved	
6	TID 0Ah : reserved	
7	TID 09h : reserved	
TID 00h - DATA C - Supported TID 11h to 18h		
BIT	Function	Name
0	TID 18h : reserved	MOD_6_TID_3_DIAG
1	TID 17h : reserved	
2	TID 16h : reserved	
3	TID 15h : reserved	
4	TID 14h : reserved	
5	TID 13h : reserved	
6	TID 12h : reserved	
7	TID 11h : reserved	
TID 00h - DATA D - Supported TID 19h to 20h		
BIT	Function	Name
0	TID 20h : TIDs supported (\$21 - \$40)	MOD_6_TID_4_DIAG
1	TID 1Fh : reserved	
2	TID 1Eh : reserved	
3	TID 1Dh : reserved	
4	TID 1Ch : reserved	
5	TID 1Bh : reserved	
6	TID 1Ah : reserved	
7	TID 19h : reserved	

## I.61.3 Description of TID 01 - Catalyst monitoring

### General information:

TID 01 is only supported if the vehicle is equipped with lambda sensors UP and DOWN

### Formula section:

```

If           PSN_LS = 33H
Then        TID 01 is supported
Else        TID 01 is not supported
Endif

```

### I.61.3.1 CID 01h - Bank 1

OSC method (linear system)	
Std/Manufacturer defined <b>CID</b>	01h
Unit and scaling	NONE
Test value	CAT_DIAG_MOD_6[1]
Min test limit	NONE
Max test limit	CAT_MAX_DIAG_MOD_6[1]

#### Formula section:

```

IF           LV_READY_CAT_DIAG[1] = 0           OR
                LV_ERR_MEM_CAT_DIAG[1] = 1
THEN        Positive response with test result
ELSE        Positive response with all data equal to 0000h
ENDIF

```

### I.61.3.2 CID 02h - Bank 2

OSC method (linear system)	
Std/Manufacturer defined <b>CID</b>	02h
Unit and scaling	NONE
Test value	CAT_DIAG_MOD_6[2]
Min test limit	NONE
Max test limit	CAT_MAX_DIAG_MOD_6[2]

#### Formula section:

```

IF           LV_READY_CAT_DIAG[2] = 0           OR
                LV_ERR_MEM_CAT_DIAG[2] = 1
THEN        Positive response with test result
ELSE        Positive response with all data equal to 0000h
ENDIF

```

## I.61.4 Description of TID 02h - Lambda sensor diagnosis

#### General information:


TID 02 is only supported if the vehicle is equipped with lambda sensors UP and DOWN or UP.

#### Formula section:

```

if           PSN_LS = 33H or 11H

```

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```

Then      TID 02 is supported
  If      PSN_LS = 11H
  Then    CID 30h /32h are not supported
          //no Downstream sensors
  Endif
Else      TID 02 is not supported
Endif

```

#### I.61.4.1 CID 15h - Dynamic diagnosis (linear), Bank 1

Sensor dynamic diagnosis	
Std/Manufacturer defined <b>CID</b>	15h (MAX)
Unit and scaling	NONE
Test value	FAC_DYN_LSL_DIAG_SAE[1]
Min test limit	0
Max test limit	FAC_DYN_LSL_DIAG_TOL_SAE[1]

#### Formula section:

```

IF      LV_READY_DYN_VLD_LS_UP[1] = 0      OR
        LV_ERR_MEM_DYN_VLD_LS_UP[1] = 1
THEN    Positive response with test result
ELSE    Positive response with all data equal to 0000h
ENDIF

```

#### I.61.4.2 CID 18h - Dynamic diagnosis (linear), Bank 2

Sensor dynamic diagnosis	
Std/Manufacturer defined <b>CID</b>	18h (MAX)
Unit and scaling	NONE
Test value	FAC_DYN_LSL_DIAG_SAE[2]
Min test limit	0
Max test limit	FAC_DYN_LSL_DIAG_TOL_SAE[2]

#### Formula section:

```

IF      LV_READY_DYN_VLD_LS_UP[2] = 0      OR
        LV_ERR_MEM_DYN_VLD_LS_UP[2] = 1
THEN    Positive response with test result
ELSE    Positive response with all data equal to 0000h
ENDIF

```

### I.61.4.3 CID 30h - Switchtime diagnosis (downstream binary), Bank 1

Switchtime diagnosis	
Std/Manufacturer defined CID	30h
Unit and scaling	NONE
Test value	CTR_SAVE_SWT_LS_DOWN[1]
Min test limit	NONE
Max test limit	C_CTR_SWT_LS_DOWN

#### Formula section:

```

IF          LV_READY_SWT_LS_DOWN[1] = 0          OR
           LV_ERR_MEM_SWT_LS_DOWN[1] = 1
THEN       Positive response with test result
ELSE       Positive response with all data equal to 0000h
ENDIF

```

### I.61.4.4 CID 32h - Switchtime diagnosis (downstream binary), Bank 2

Switchtime diagnosis	
Std/Manufacturer defined CID	32h
Unit and scaling	NONE
Test value	CTR_SAVE_SWT_LS_DOWN[2]
Min test limit	NONE
Max test limit	C_CTR_SWT_LS_DOWN

#### Formula section:

```

IF          LV_READY_SWT_LS_DOWN[2] = 0          OR
           LV_ERR_MEM_SWT_LS_DOWN[2] = 1
THEN       Positive response with test result
ELSE       Positive response with all data equal to 0000h
ENDIF

```

### I.61.5 Description of TID 03h - Secondary air monitoring

#### General information:


TID 03h is only supported if SA pump is learnt. Depending of hardware configuration in the car only one type of SA monitoring is active (via lambda-sensor **or** flow meter).

#### Formula section:

```

If          LV_VAR_SAP = 1
Then       TID 03 is supported
           If          LC_SA_SWI_ACQ = 1
           Then       CID 05h(=85h) are not supported           //no diagnosis via lambda
sensor

```

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```

Else          CID 20h and 21h are not supported          //no diagnosis via SAF
meter
Endif
Else          TID 03 is not supported
Endif

```

### I.61.5.1 CID 20h/21h - Secondary air monitor with flow meter (SAFM)

Monitoring of minimum flow rate	
Std/Manufacturer defined <b>CID</b>	20h
Unit and scaling	NONE
Test value	SAF_DIAG_MIN_SAE
Min test limit	NONE
Max test limit	C_SAF_DIAG_MIN
Monitoring of minimum flow rate	
Std/Manufacturer defined <b>CID</b>	21h
Unit and scaling	NONE
Test value	SAF_DIAG_MAX_SAE
Min test limit	NONE
Max test limit	C_SAF_DIAG_MAX

#### Formula section:

```

IF          LV_READY_SA_SYS = 0          OR
          LV_ERR_MEM_SA_SYS = 1
THEN       Positive response with test result
ELSE       Positive response with all data equal to 0000h
Endif

```

### I.61.5.2 CID 85h - Secondary air monitor with lambda sensor (LISL)

Monitoring of minimum flow rate, Bank 1 / Bank 2	
Std/Manufacturer defined <b>CID</b>	85h (identifier 05h + 80h)
Unit and scaling	NONE
Test value	<b>MIN</b> [ SUM_AFL_VLS_DIAG_SA_1_SAE; SUM_AFL_VLS_DIAG_SA_2_SAE ]
Min test limit	C_SUM_AFL_VLS_MIN_DIAG_SA_1
Max test limit	NONE

#### Formula section:

```

IF          LV_READY_SA_SAP = 0          OR
          LV_ERR_MEM_SA_SAP = 1
THEN       Positive response with test result
ELSE       Positive response with all data equal to 0000h
ENDIF

```

1.1

Description of TID 05h - Evaporative Monitor



**General information:**

All DMTL related CID's are only supported if the CAR is equipped with the DMTL module.

**Formula section:**

**If** LV\_CONF\_DMTL = 0  
**Then** CID's 13h/14h/17h/ 12h(=92h)/15h(=95h)/16h(=96h)/18h(=98h)  
 ... are not supported  
**Else** all CID's of TID 05h are supported  
**Endif**

**I.61.5.3 CID 09h/87h/88h - Purge Flow monitor (TEV check)**

<b>Functional check TEV - Step 1</b>	
Std/Manufacturer defined <b>CID</b>	87h (identifier 07h + 80h)
Unit and scaling	NONE
Test value	CL_MMV_SAE
Min test limit	C_CL_MMV_DIAGCPS
Max test limit	NONE
<b>Functional check TEV - Step 2</b>	
Std/Manufacturer defined <b>CID</b>	08h
Unit and scaling	NONE
Test value	SUM_DIAG_DIAGCPS_SAE
Min test limit	NONE
Max test limit	C_SUM_DIAGCPS_MAX
<b>Functional check TEV - Step 3</b>	
Std/Manufacturer defined <b>CID</b>	09h
Unit and scaling	NONE
Test value	MAF_DIAGCPS_SAE
Min test limit	NONE
Max test limit	MAF_DIAGCPS_THD_SAE

**Formula section:**

**IF** LV\_READY\_DIAGCPS = 0 **OR**  
 LV\_ERR\_MEM\_DIAGCPS = 1  
**THEN** Positive response with test result  
**ELSE** Positive response with all data equal to 0000h  
**ENDIF**

### I.61.5.4 CID 13h/14h/17h/92h - DMTL module diagnosis

DMTL module - MAX error	
Std/Manufacturer defined CID	13h
Unit and scaling	NONE
Test value	M6_CUR_DMTL_COR_FIL_CID19
Min test limit	NONE
Max test limit	C_CUR_DMTL_REF_LEAK_MAX

#### Formula section:

```

IF          LV_READY_DMTL_MAX = 0                OR
           LV_ERR_MEM_DMTL_MAX = 1
THEN       Positive response with test result
ELSE       Positive response with all data equal to 0000h
ENDIF

```

DMTL module - Plausibility error	
Std/Manufacturer defined CID	14h
Unit and scaling	NONE
Test value	M6_CUR_DMTL_DMTLS_TEST
Min test limit	NONE
Max test limit	M6_CUR_DMTL_THD_DMTLS_TEST

#### Formula section:

```

IF          LV_READY_DMTL_PLAUS = 0            OR
           LV_ERR_MEM_DMTL_PLAUS = 1
THEN       Positive response with test result
ELSE       Positive response with all data equal to 0000h
ENDIF

```


DMTL module - Signal error	
Std/Manufacturer defined CID	17h
Unit and scaling	NONE
Test value	M6_CTR_CNL_SMALL_LEAK_MES
Min test limit	NONE
Max test limit	C_SUM_CNL_SMALL_LEAK_MES_MAX

#### Formula section:

```

IF          LV_READY_DMTL_SIG = 0                OR
           LV_ERR_MEM_DMTL_SIG = 1
THEN       Positive response with test result
ELSE       Positive response with all data equal to 0000h
ENDIF

```

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<b>DMTL module - MIN error</b>	
Std/Manufacturer defined <b>CID</b>	92h (identifier 12h + 80h)
Unit and scaling	NONE
Test value	M6_CUR_DMTL_COR_FIL_CID18
Min test limit	C_CUR_DMTL_REF_LEAK_MIN
Max test limit	NONE

**Formula section:**

```

IF          LV_READY_DMTL_MIN = 0                OR
            LV_ERR_MEM_DMTL_MIN = 1
THEN       Positive response with test result
ELSE       Positive response with all data equal to 0000h
ENDIF

```

**I.61.5.5 CID 95h/98h - Rough-leak diagnosis**

<b>Leak detection DMTL - Long cycle</b>	
Std/Manufacturer defined <b>CID</b>	98h (identifier 18h + 80h)
Unit and scaling	NONE
Test value	M6_CUR_DMTL_ROUGH_LEAK_LEN_END
Min test limit	M6_CUR_DMTL_THD_ROUGH_LEAK_LEN
Max test limit	NONE
<b>Leak detection DMTL - Short cycle</b>	
Std/Manufacturer defined <b>CID</b>	95h (identifier 15h + 80h)
Unit and scaling	NONE
Test value	M6_CUR_DMTL_ROUGH_LEAK_END
Min test limit	M6_CUR_DMTL_THD_ROUGH_LEAK
Max test limit	NONE

**Formula section:**

```

IF          LV_READY_ROUGH_LEAK = 0              OR
            LV_ERR_MEM_ROUGH_LEAK = 1
THEN       Positive response with test result
ELSE       Positive response with all data equal to 0000h
ENDIF

```

### I.61.5.6 CID 96h - Small-leak diagnosis

Leak detection DMTL - Short cycle	
Std/Manufacturer defined <b>CID</b>	96h (identifier 16h + 80h)
Unit and scaling	NONE
Test value	M6_CUR_DMTL_SMALL_LEAK_END
Min test limit	M6_CUR_DMTL_REF_LEAK
Max test limit	NONE

#### Formula section:

```

IF          LV_READY_SMALL_LEAK = 0                OR
           LV_ERR_MEM_SMALL_LEAK = 1
THEN       Positive response with test result
ELSE       Positive response with all data equal to 0000h
ENDIF

```

### I.61.6 Description of TID 06h - Oxygen sensor heater monitoring

#### General information:

TID 06 is only supported if the vehicle is equipped with lambda sensors UP and DOWN or UP.

#### Formula section:

```

If          PSN_LS = 33H or 11H
Then       TID 06 is supported
           If          PSN_LS = 11H
           Then       CID 03h /04h are not supported      //no Downstream sensors
           Endif
Else       TID 06 is not supported
Endif

```

#### I.61.6.1 CID 05h /85h - Oxygen sensor heater monitor, Bank 1 Sensor 1 (linear)


Sensor temperature	
Std/Manufacturer defined <b>CID</b>	05h (MAX) 85h (MIN)
Unit and scaling	NONE
Test value	TTIP_OBD_LSH_UP_MES_SAE[1]
Min test limit	TTIP_OBD_LSH_UP_MES_BOL_SAE[1]
Max test limit	TTIP_OBD_LSH_UP_MES_TOL_SAE[1]

#### Formula section:

```

IF          LV_READY_OBD_VLD_LSH_UP[1] = 0                OR
           LV_ERR_MEM_OBD_VLD_LSH_UP[1] = 1
THEN       Positive response with test result
ELSE       Positive response with all data equal to 0000h

```

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**ENDIF****I.61.6.2 CID 03h - Oxygen sensor heater monitor, Bank 1 Sensor 2 (binary)**

Sensor resistance	
Std/Manufacturer defined <b>CID</b>	03h
Unit and scaling	NONE
Test value	R_IT_OBD_LSH_DOWN[1]
Min test limit	NONE
Max test limit	R_IT_THD_OBD_LSH_DOWN[1]

**Formula section:**

**IF** LV\_READY\_OBD\_LSH\_DOWN[1] = 0 **OR**  
 LV\_ERR\_MEM\_OBD\_LSH\_DOWN[1] = 1  
**THEN** Positive response with test result  
**ELSE** Positive response with all data equal to 0000h  
**ENDIF**

**I.61.6.3 CID 06h /86h - Oxygen sensor heater monitor, Bank 2 Sensor 1 (linear)**

Sensor temperature	
Std/Manufacturer defined <b>CID</b>	06h (MAX) 86h (MIN)
Unit and scaling	NONE
Test value	TTIP_OBD_LSH_UP_MES_SAE[2]
Min test limit	TTIP_OBD_LSH_UP_MES_BOL_SAE[2]
Max test limit	TTIP_OBD_LSH_UP_MES_TOL_SAE[2]


**Formula section:**

**IF** LV\_READY\_OBD\_VLD\_LSH\_UP[2] = 0 **OR**  
 LV\_ERR\_MEM\_OBD\_VLD\_LSH\_UP[2] = 1  
**THEN** Positive response with test result  
**ELSE** Positive response with all data equal to 0000h  
**ENDIF**

**I.61.6.4 CID 04h - Oxygen sensor heater monitor, Bank 2 Sensor 2 (binary)**

Sensor resistance	
Std/Manufacturer defined <b>CID</b>	04h
Unit and scaling	NONE
Test value	R_IT_OBD_LSH_DOWN[2]
Min test limit	NONE
Max test limit	R_IT_THD_OBD_LSH_DOWN[2]


**Formula section:**

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```


IF                LV_READY_OBD_LSH_DOWN[2] = 0                OR
                   LV_ERR_MEM_OBD_LSH_DOWN[2] = 1
THEN              Positive response with test result
ELSE              Positive response with all data equal to 0000h
ENDIF

```

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# J - EOL

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## J.1 Upstream lambda sensor test

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_LS_UP_AFL_EOL [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Frozen Lambda value for lambda sensor EOL diagnos confused wired					
LAMB_LS_UP_AFR_EOL [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Frozen Lambda value for lambda sensor EOL diagnos confused wired					
LAMB_SP_VLS_EOL [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Bank selective setpoint (LS mix EOL test)					
LV_ACT_VLS_EOL	O/V	0... 1H	0 ...1	1	-
Activation bit for lambda sensor EOL diagnos confused wired					
LV_VLS_EOL_SHIFT_REP_INH	V	0... 1H	0 ...1	1	-
Bit to prevent endless loop of lambda shifts					
MAF_INT_MIN_VLS_EOL	O/V	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral for lambda sensor EOL diagnos confused wired					
STATE_VLS_EOL	O/V	0H	OFF	-	-
		1H	STEP_1		
		2H	STEP_2		
		3H	WAIT		
		4H	TIMEOUT		
		10H	FINISHED		
		11H	ERR_UP		
		12H	ERR_DOWN		
		13H	ERR_UP_		
		14H	DOWN		
14H	ERR_UP_1				
15H	ERR_UP_2				
16H	ERR_DOWN_1				
17H	ERR_DOWN_2				
18H	NO_RESULT				
Status of lambda sensor EOL diagnos confused wired					
T_WAIT_VLS_EOL_OPM_SWI	V	0... FFFFH	0... 1310.7	0.02	s
Time waiting for operation mode switch					
VLS_DOWN_AFL_EOL [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Frozen VLS value for lambda sensor EOL diagnos confused wired					
VLS_DOWN_AFR_EOL [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Frozen VLS value for lambda sensor EOL diagnos confused wired					

### Input data:

C_OPM_EXT_REQ_VLS_EOL {p. 1763}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LV_ACT_VLS_EOL_EXT_ADJ {p. 7763}	LV_IGK {p. 906}
MAF_CYL {p. 8277}	NC_FAC_MAF_INT_20 {p. 651}	OPM_REQ_CUS {p. 8137}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_LS_UP_AFL_EOL	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lean Lambda threshold for lambda sensor EOL diagnosis					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_LS_UP_AFR_EOL	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Rich Lambda threshold for lambda sensor EOL diagnosis					
C_LAMB_SP_VLS_EOL_AFL	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda setpoint AFL for lambda sensor EOL diagnos confused wired					
C_LAMB_SP_VLS_EOL_AFR	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda setpoint AFR for lambda sensor EOL diagnos confused wired					
C_MAF_INT_MIN_VLS_EOL	-	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral threshold for lambda sensor EOL diagnos confused wired					
C_T_WAIT_VLS_EOL_OPM_SWI	-	0... FFFFH	0... 1310.7	0.02	s
Time threshold waiting for operation mode switch					
C_TCO_MIN_VLS_EOL	-	0... FEH	-48... 142.5	0.75	°C
TCO threshold for VLS EOL diagnosis					
C_TEG_CAT_DOWN_EOL	-	0... FFFFH	-48... 1459.305	0.023	°C
TEG_CAT_DOWN threshold for VLS EOL diagnosis					
C_VLS_AFL_EOL	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Lean VLS threshold for lambda sensor EOL diagnosis					
C_VLS_AFR_EOL	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Rich VLS threshold for lambda sensor EOL diagnosis					

## FUNCTION DESCRIPTION:

### General information:

This EOL test is to detect confused or wrong wired lambda sensors in order to prevent bad emissions for a two cylinder bank system, therefore:


$i = 1$  for cylinder bank 1 and  $i = 2$  for cylinder bank 2

### Description:

This EOL-test is activated by customer-tool by setting LV\_ACT\_VLS\_EOL\_EXT\_ADJ = 1. At the same time a switch to the correct engine operation mode (e.g. homogenous combustion mode) is triggered in another software module. The function goes to the state WAIT until the correct combustion mode is reached (indicated by OPM\_REQ\_CUS = C\_OPM\_EXT\_REQ\_VLS\_EOL). Meanwhile a timer T\_WAIT\_VLS\_EOL\_OPM\_SWI is incremented. If this timer exceeds the threshold C\_T\_WAIT\_VLS\_EOL\_OPM\_SWI, the switch to the correct engine operation mode failed. So the function goes to state TIMEOUT and the test is stopped. The test can only be restarted, when a stop command is sent from tester (LV\_ACT\_VLS\_EOL\_EXT\_ADJ = 0) and the start command is sent again (LV\_ACT\_VLS\_EOL\_EXT\_ADJ = 1).

When the engine is in correct operation mode, STEP-1 is started with shifting the Lambda-setpoint (bank 2 lean /bank 1 rich) for C\_MAF\_INT\_MIN\_VLS\_EOL. After reaching the MAF integral there is the first freezing of VLS values. After this STEP-2 is started inverse (bank 2 rich /bank 1 lean). After reaching the MAF integral there is the second freezing of VLS values.

In STEP-3 it is checked, if the frozen values are valid. If YES the EOL result is calculated (resuming with STEP\_4). If NO (the frozen values of the downstream sensors are in an undefined band between rich and lean), STEP\_1 and STEP\_2 are started again, to validate these values. The setting and checking of the flag LV\_VLS\_EOL\_SHIFT\_REP\_INH makes sure, that this validation is done only one time and the test can not enter an endless loop of STEP\_1 and STEP\_2.

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After this the EOL result STATE\_VLS\_EOL is calculated finally (STEP-4), by comparing the frozen values with calibratable thresholds.

The idea is, that at rich lambda setpoint LAMB\_LS\_UP and VLS\_DOWN of the corresponding exhaust bank must show "rich" values. Analogous the same at lean lambda setpoint. If the frozen values are confused for bank 1 and 2 (lean value at rich setpoint and vice versa), then the corresponding sensors (upstream and/or downstream) are confused wired. If the frozen values do not cross the thresholds, the corresponding sensor signal is sticking.

The test is also used for failure analysis by the mechanics at the garage in the field.

### Application conditions

**Initialisation:** LAMB\_SP\_VLS\_EOL[i] = 1 **and** remaining outputs = 0 at initialization routine of start EOL test **or**  
ECU reset **or**  
Clearing error memory **or**  
LV\_IGK 0->1

**Recurrence:** 20ms

**Activation:**

```

If          LV_ACT_VLS_EOL_EXT_ADJ 0 -> 1
Then       Start function with WAIT
Else       STATE_VLS_EOL = OFF
Endif
    
```

**Deactivation:** LV\_ACT\_VLS\_EOL\_EXT\_ADJ = 0  
Action at deactivation: set LAMB\_SP\_VLS\_EOL[i] = 1 **and** remaining outputs = 0

### Formula section:

WAIT

```

IF          OPM_REQ_CUS = C_OPM_EXT_REQ_VLS_EOL
THEN       Continue with STEP_1
ELSE       IF          T_WAIT_VLS_EOL_OPM_SWI > C_T_WAIT_VLS_EOL_OPM_SWI
THEN       STATE_VLS_EOL = TIMEOUT
                Stop calculation and deactivate function without reset of all variables
ELSE       increment timer T_WAIT_VLS_EOL_OPM_SWI
ENDIF
    
```

**ENDIF**

STEP-1, First bankwise lambdasetpoint shifting

**STATE\_VLS\_EOL = STEP\_1**

*Start calculation of MAF\_INT\_MIN\_VLS\_EOL*

MAF\_INT\_MIN\_VLS\_EOL = MAF\_INT\_MIN\_VLS\_EOL + MAF\_CYL\*NC\_FAC\_MAF\_INT\_20

LV\_ACT\_VLS\_EOL = 1 *for lambda coordination*

LAMB\_SP\_VLS\_EOL[1] = C\_LAMB\_SP\_VLS\_EOL\_AFR *bank1 = rich*

LAMB\_SP\_VLS\_EOL[2] = C\_LAMB\_SP\_VLS\_EOL\_AFL *bank2 = lean*

**If** MAF\_INT\_MIN\_VLS\_EOL >= C\_MAF\_INT\_MIN\_VLS\_EOL

**Then** LAMB\_LS\_UP\_AFR\_EOL[1] = LAMB\_LS\_UP[1]


LAMB\_LS\_UP\_AFL\_EOL[2] = LAMB\_LS\_UP[2]

VLS\_DOWN\_AFR\_EOL[1] = VLS\_DOWN[1]

VLS\_DOWN\_AFL\_EOL[2] = VLS\_DOWN[2]

LAMB\_SP\_VLS\_EOL[1] = 1 *reset*

LAMB\_SP\_VLS\_EOL[2] = 1 *reset*

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```

        MAF_INT_MIN_VLS_EOL = 0                reset
        Continue with STEP-2
Else      Integration is still active
Endif

```

STEP-2, Second bankwise lambdasetpoint shifting

**STATE\_VLS\_EOL = STEP\_2**

*Start calculation of MAF\_INT\_MIN\_VLS\_EOL*

MAF\_INT\_MIN\_VLS\_EOL = MAF\_INT\_MIN\_VLS\_EOL + MAF\_CYL\*NC\_FAC\_MAF\_INT\_20

LV\_ACT\_VLS\_EOL = 1 *for lambda coordination*

LAMB\_SP\_VLS\_EOL[1] = C\_LAMB\_SP\_VLS\_EOL\_AFL *bank1 = lean*

LAMB\_SP\_VLS\_EOL[2] = C\_LAMB\_SP\_VLS\_EOL\_AFR *bank2 = rich*

**If** MAF\_INT\_MIN\_VLS\_EOL >= C\_MAF\_INT\_MIN\_VLS\_EOL

**Then** LAMB\_LS\_UP\_AFL\_EOL[1] = LAMB\_LS\_UP[1]

LAMB\_LS\_UP\_AFR\_EOL[2] = LAMB\_LS\_UP[2]

VLS\_DOWN\_AFL\_EOL[1] = VLS\_DOWN[1]

VLS\_DOWN\_AFR\_EOL[2] = VLS\_DOWN[2]

LAMB\_SP\_VLS\_EOL[1] = 1 *reset*

LAMB\_SP\_VLS\_EOL[2] = 1 *reset*

MAF\_INT\_MIN\_VLS\_EOL = 0 *reset*

Continue with STEP-3, "Validation"

**Else** Integration is still active

**Endif**

STEP-3, Validation of frozen VLS values

**If** (C\_VLS\_AFL\_EOL < VLS\_DOWN\_AFR\_EOL[1] < C\_VLS\_AFR\_EOL **or**  
 C\_VLS\_AFL\_EOL < VLS\_DOWN\_AFR\_EOL[2] < C\_VLS\_AFR\_EOL **or**  
 C\_VLS\_AFL\_EOL < VLS\_DOWN\_AFL\_EOL[1] < C\_VLS\_AFR\_EOL **or**  
 C\_VLS\_AFL\_EOL < VLS\_DOWN\_AFL\_EOL[2] < C\_VLS\_AFR\_EOL) **and**

LV\_VLS\_EOL\_SHIFT\_REP\_INH = 0

**Then** Repeat STEP-1 for the second cycle

LV\_VLS\_EOL\_SHIFT\_REP\_INH = 1

**Else** Continue with STEP-4 "Calculation"

LV\_ACT\_VLS\_EOL = 0 *reset*

**Endif**

STEP-4, Calculation of test results STATE\_VLS\_EOL

**Remark:** After the first error status is detected the calculation is stopped

EOL test finished, all sensors O.K.

**If** LAMB\_LS\_UP\_AFR\_EOL[1] < C\_LAMB\_LS\_UP\_AFR\_EOL **and**  
 LAMB\_LS\_UP\_AFR\_EOL[2] < C\_LAMB\_LS\_UP\_AFR\_EOL **and**  
 VLS\_DOWN\_AFR\_EOL[1] > C\_VLS\_AFR\_EOL **and**  
 VLS\_DOWN\_AFR\_EOL[2] > C\_VLS\_AFR\_EOL **and**  
 LAMB\_LS\_UP\_AFL\_EOL[1] > C\_LAMB\_LS\_UP\_AFL\_EOL **and**  
 LAMB\_LS\_UP\_AFL\_EOL[2] > C\_LAMB\_LS\_UP\_AFL\_EOL **and**  
 VLS\_DOWN\_AFL\_EOL[1] < C\_VLS\_AFL\_EOL **and**  
 VLS\_DOWN\_AFL\_EOL[2] < C\_VLS\_AFL\_EOL

**Then** **STATE\_VLS\_EOL = FINISHED**

EOL test finished, UP sensors confused

**Elseif** LAMB\_LS\_UP\_AFR\_EOL[1] > C\_LAMB\_LS\_UP\_AFR\_EOL      **and**  
LAMB\_LS\_UP\_AFR\_EOL[2] > C\_LAMB\_LS\_UP\_AFR\_EOL      **and**  
VLS\_DOWN\_AFR\_EOL[1] > C\_VLS\_AFR\_EOL      **and**  
VLS\_DOWN\_AFR\_EOL[2] > C\_VLS\_AFR\_EOL      **and**  
LAMB\_LS\_UP\_AFL\_EOL[1] < C\_LAMB\_LS\_UP\_AFL\_EOL      **and**  
LAMB\_LS\_UP\_AFL\_EOL[2] < C\_LAMB\_LS\_UP\_AFL\_EOL      **and**  
VLS\_DOWN\_AFL\_EOL[1] < C\_VLS\_AFL\_EOL      **and**  
VLS\_DOWN\_AFL\_EOL[2] < C\_VLS\_AFL\_EOL

**Then**      **STATE\_VLS\_EOL = ERR\_UP**

EOL test finished, DOWN sensors confused

**Elseif** LAMB\_LS\_UP\_AFR\_EOL[1] < C\_LAMB\_LS\_UP\_AFR\_EOL      **and**  
LAMB\_LS\_UP\_AFR\_EOL[2] < C\_LAMB\_LS\_UP\_AFR\_EOL      **and**  
VLS\_DOWN\_AFR\_EOL[1] < C\_VLS\_AFR\_EOL      **and**  
VLS\_DOWN\_AFR\_EOL[2] < C\_VLS\_AFR\_EOL      **and**  
LAMB\_LS\_UP\_AFL\_EOL[1] > C\_LAMB\_LS\_UP\_AFL\_EOL      **and**  
LAMB\_LS\_UP\_AFL\_EOL[2] > C\_LAMB\_LS\_UP\_AFL\_EOL      **and**  
VLS\_DOWN\_AFL\_EOL[1] > C\_VLS\_AFL\_EOL      **and**  
VLS\_DOWN\_AFL\_EOL[2] > C\_VLS\_AFL\_EOL

**Then**      **STATE\_VLS\_EOL = ERR\_DOWN**

EOL test finished, UP& DOWN sensors confused

**Elseif** LAMB\_LS\_UP\_AFR\_EOL[1] > C\_LAMB\_LS\_UP\_AFR\_EOL      **and**  
LAMB\_LS\_UP\_AFR\_EOL[2] > C\_LAMB\_LS\_UP\_AFR\_EOL      **and**  
VLS\_DOWN\_AFR\_EOL[1] < C\_VLS\_AFR\_EOL      **and**  
VLS\_DOWN\_AFR\_EOL[2] < C\_VLS\_AFR\_EOL      **and**  
LAMB\_LS\_UP\_AFL\_EOL[1] < C\_LAMB\_LS\_UP\_AFL\_EOL      **and**  
LAMB\_LS\_UP\_AFL\_EOL[2] < C\_LAMB\_LS\_UP\_AFL\_EOL      **and**  
VLS\_DOWN\_AFL\_EOL[1] > C\_VLS\_AFL\_EOL      **and**  
VLS\_DOWN\_AFL\_EOL[2] > C\_VLS\_AFL\_EOL

**Then**      **STATE\_VLS\_EOL = ERR\_UP\_DOWN**

EOL test finished, UP1 not plausible

**Elseif** LAMB\_LS\_UP\_AFR\_EOL[1] > C\_LAMB\_LS\_UP\_AFR\_EOL      **or**  
LAMB\_LS\_UP\_AFL\_EOL[1] < C\_LAMB\_LS\_UP\_AFL\_EOL

**Then**      **STATE\_VLS\_EOL = ERR\_UP\_1**

EOL test finished, UP2 not plausible

**Elseif** LAMB\_LS\_UP\_AFR\_EOL[2] > C\_LAMB\_LS\_UP\_AFR\_EOL      **or**  
LAMB\_LS\_UP\_AFL\_EOL[2] < C\_LAMB\_LS\_UP\_AFL\_EOL

**Then**      **STATE\_VLS\_EOL = ERR\_UP\_2**

EOL test finished, DOWN1 not plausible

**Elseif** VLS\_DOWN\_AFR\_EOL[1] < C\_VLS\_AFR\_EOL      **or**  
VLS\_DOWN\_AFL\_EOL[1] > C\_VLS\_AFL\_EOL


**Then**      **STATE\_VLS\_EOL = ERR\_DOWN\_1**

EOL test finished, DOWN2 not plausible

**Elseif** VLS\_DOWN\_AFR\_EOL[2] < C\_VLS\_AFR\_EOL      **or**  
VLS\_DOWN\_AFL\_EOL[2] > C\_VLS\_AFL\_EOL

**Then**      **STATE\_VLS\_EOL = ERR\_DOWN\_2**


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EOL test finished, no result


**Else        STATE\_VLS\_EOL = NO\_RESULT**

**Endif**

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# R - Customer provided functions

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# R.1 Customer adaptation module: AIRT

## Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_tumers	O/V	0... 1H	0 ...1	1	-
Ambient temperature via CAN faulty, substitute value is taken					
Tans	O/V	FE0C... 5DCH	-50 ...150	0.1	°C
intake air temperature					
Tumg	O/V	FE0C... 5DCH	-50 ...150	0.1	°C
ambient temperature (modelled)					
Tumg_can	O/V	FE0C... 5DCH	-50 ...150	0.1	°C
ambient temperature					
Tvld	O/V	FE0C... 5DCH	-50 ...150	0.1	°C
Air temperature up turbo charger					

## Input data:

LV_TAM_CAN_ERR {p. 1567}	TAM {p. 1579}	TIA {p. 1226}	TIA_TCHA {p. 1226}
-----------------------------	---------------	---------------	--------------------

## FUNCTION DESCRIPTION:

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

## Application conditions

**Initialisation:**

```

at reset:          0:          Tumg_can,
B_tumers
                first measured value:  Tumg, Tans, Tvld
at PWL:          last measured value:  Tumg, Tans,
Tvld
                last valid value:    Tumg_can
0:              B_tumers

```

**Recurrence:** 100ms: Tumg, Tumg\_can, Tans, Tvld, B\_tumers

**Activation:** every engine state

**Deactivation:**

## Formula section:

*Remark:* all formulas are valid in a **physical** meaning

```

Tans      =  TIA
Tumg      =  TAM
Tumg_can  =  TAM
Tvld      =  TIA_TCHA
B_tumers  =  LV_TAM_CAN_ERR

```

## R.2 Customer adaptation module: CBMD

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_ase_abgas	O/V	0... 1H	0 ...1	1	-
Logical variable for CARB A misfire criterion confirmed					
B_ase_kat	O/V	0... 1H	0 ...1	1	-
Logical variable for CARB B misfire criterion confirmed					
B_hmm_clc	O/V	0... 1H	0 ...1	1	-
Logical variable for the deactivation of all AFL- mode relevant modules.					
B_sch_clc	O/V	0... 1H	0 ...1	1	-
Logical variable for the deactivation of all S- mode relevant modules.					
B_sk_homla1	O/V	0... 1H	0 ...1	1	-
flag for switching to HOM_AFS due to faults in non-HOM_AFS					
B_vb_hmm	O/V	0... 1H	0 ...1	1	-
Inhibit of AFL mode due to project specific requests.					
B_vb_sch	O/V	0... 1H	0 ...1	1	-
Inhibit of stratified mode due to project specific requests.					
LAMB_SP_S_EXT	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
lambda setpoint for stratified mode					
LV_FUP_SP_SWI	O/V	0... 1H	0 ...1	1	-
Flag for fuel pressure setpoint switch					
LV_HOM_ACT	O/V	0... 1H	0 ...1	1	-
Homogeneous ignition and injection parameters are applied to the engine					
LV_HOM_AFL_ACT	O/V	0... 1H	0 ...1	1	-
Homogeneous air fuel lean mode active					
LV_HOM_AFS_ACT	O/V	0... 1H	0 ...1	1	-
Logical variables indicates active homogeneous stoichiometric state					
LV_HOM_AFS_REQ	O/V	0... 1H	0 ...1	1	-
Request for AFS mode					
LV_HOM_ENA	O/V	0... 1H	0 ...1	1	-
catalyst heating home					
LV_HOM_RUN	O/V	0... 1H	0 ...1	1	-
Flag to activate homogeneous calculations					
LV_IGA_AND_INJ_SWI	O/V	0... 1H	0 ...1	1	-
Logical variable controlling igiton and injection mode (stratified or homogeneous).					
LV_IGA_AND_INJ_SWI_1	O/V	0... 1H	0 ...1	1	-
Logical variable controlling igiton and injection mode (stratified or homogeneous).					
LV_IGA_AND_INJ_SWI_2	O/V	0... 1H	0 ...1	1	-
Logical variable controlling igiton and injection mode (stratified or homogeneous).					
LV_IGA_AND_INJ_SWI_HOMS	O/V	0... 1H	0 ...1	1	-
Logical variable controlling igiton and injection mode (stratified or homogeneous-stratified).					
LV_IGA_AND_INJ_SWI_HOMS_1	O/V	0... 1H	0 ...1	1	-
Logical variable controlling igiton and injection mode (stratified or homogeneous-stratified), for bank 1					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_IGA_AND_INJ_SWI_HOMS_2	O/V	0... 1H	0 ...1	1	-
Logical variable controlling ignition and injection mode (stratified or homogeneous-stratified), for bank 2					
LV_S_ACT	O/V	0... 1H	0 ...1	1	-
Stratified ignition and injection parameters are applied to the engine					
LV_S_ENA	O/V	0... 1H	0 ...1	1	-
catalyst heating home					
LV_S_RUN	O/V	0... 1H	0 ...1	1	-
Flag to activate stratified calculations					
LV_SP_RATE_CYL_EGR_SWI	O/V	0... 1H	0 ...1	1	-
Flag for EGR setpoint rate					
OPM_AV	O/V	0H	-	-	-
		1H	S		
		2H	AFS		
		3H	AFL		
		8H	LIH		
actual engine operation mode					
OPM_REQ	O/V	0H	-	-	-
		1H	S		
		2H	AFS		
		3H	AFL		
		8H	LIH		
Requested engine operation mode (for operation switch manager)					
OPM_REQ_CUS	O/V	0... FFFFH	0... 65535	1	-
Actual engine operation mode ( 16bit )					
STATE_CMB_CTL	O/V	0H	HOM_AFS	-	-
		1H	AFS_TO_AFL		
		2H	HOM_AFL		
		3H	AFL_TO_AFS		
		4H	HOM_TO_S		
		5H	BACKS		
		6H	S		
		7H	S_TO_HOM		
		8H	BACKHOM		
States of the combustion management					

**Input data:**


B_esp_h1 {p. 8343}	B_esp_h2 {p. 8343}	B_esp_hs1 {p. 8343}	B_esp_hs2 {p. 8343}
B_hmm_akt {p. 8343}	B_hom_akt {p. 8343}	B_hstoech {p. 8343}	B_prsoll_h {p. 8346}
B_sch_akt {p. 8346}	B_schicht {p. 8346}	B_verb_h {p. 8347}	B_verb_s {p. 8347}
Ba_ist {p. 8154}	Ba_soll {p. 8154}	Baw_ist {p. 8155}	ECU_STATE {p. 1091}
La_abgas1 {p. 8160}	La_abgas2 {p. 8160}	LV_AFL_CLC {p. 1822}	LV_INH_AFL {p. 1822}
LV_INH_S {p. 1822}	LV_MIS_STATE_A {p. 6238}	LV_S_CLC {p. 1822}	LV_SWI_AFS_MON {p. 6786}

**Application conditions**

**Initialisation at reset:** 0, except LAMB\_SP\_S\_EXT = 1.00

**Recurrence :** 10 ms

**Activation:** at every engine state

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**Deactivation:**                    - - -

## R.2.1 Outputs for BMW which are defined as CBMD exported data

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

### Formula section:

**if** ECU\_STATE = "PWL"

**then**

```

B_ase_abgas = 0
B_ase_kat   = 0
B_vb_hmm   = 0
B_vb_sch   = 0
B_hmm_clc  = 0
B_sch_clc  = 0

```

**else**

```

B_ase_abgas           = LV_MIS_STATE_B
B_ase_kat             = LV_MIS_STATE_A
B_vb_hmm              = LV_INH_AFL
B_vb_sch              = LV_INH_S
B_hmm_clc             = LV_AFL_CLC
B_sch_clc             = LV_S_CLC
B_sk_homla1          = LV_SWI_AFS_MON

```

**Endif**

## R.2.2 Outputs for supplier aggregates

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs can be different from the specified values due to the input data attributes.


### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

```

LV_S_RUN              = B_sch_akt
LV_HOM_RUN           = B_hom_akt
LV_HOM_AFS_REQ       = B_hstoech
OPM_AV               = Ba_ist
OPM_REQ              = Ba_soll
OPM_REQ_CUS          = Baw_ist
LV_          S_ACT    = B_schicht
LV_HOM_ACT           = ! B_schicht
LV_IGA_AND_INJ_SWI_1 = B_esp_h1
LV_IGA_AND_INJ_SWI   = B_esp_h1
LV_IGA_AND_INJ_SWI_2 = B_esp_h2
LV_IGA_AND_INJ_SWI_HOMS_1 = B_esp_hs1

```

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```

LV_IGA_AND_INJ_SWI_HOMS          =      B_esp_hs1
LV_IGA_AND_INJ_SWI_HOMS_2        =      B_esp_hs2
LV_FUP_SP_SWI                    =      B_prsoll_h
LV_HOM_AFL_ACT                   =      B_hmm_akt
if Ba_ist=2 and LV_HOM_AFL_ACT=0
then      STATE_CMB_CTL=0Hex      HOM_AFS
else      if Ba_ist=2 and LV_HOM_AFL_ACT=1
then      STATE_CMB_CTL=2Hex      HOM_AFL
else      if Ba_ist=1 or Ba_ist=3
then      STATE_CMB_CTL=6Hex      S
endif
endif

endif

If      Ba_ist = 1
then    LV_SP_RATE_CYL_EGR_SWI = 0
else    LV_SP_RATE_CYL_EGR_SWI = 1
endif
If      STATE_CMB_CTL = 0Hex
Then    LV_HOM_AFS_ACT          =      1
Else    LV_HOM_AFS_ACT          =      0
Endif
LV_S_ENA      = ! B_verb_s
LV_HOM_ENA    = ! B_verb_h
LAMB_SP_S_EXT = 0,5*(La_abgas1 + La_abgas2)

```

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## R.3 Customer adaptation module: CHRГ

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
RFPPWM	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
PWM output recirculation flap					
WGPWM [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
PWM output wastegate[NC_CBK_EX_NR]					

### Input data:

LV_ERR_WG_DR [NC_CBK_EX_NR]	LV_RFPPWM_EXT_ADJ [NC_NR_TCHA] {p. 7434}	LV_VAR_TCHA {p. 656}	LV_WGPWM_EXT_ADJ [NC_NR_TCHA] {p. 7435}
NC_CBK_EX_NR {p. 1829}	NC_NR_TCHA	RFPPWM_EXT_ADJ [NC_NR_TCHA] {p. 7435}	Tvulv {p. 8178}
Tvwg {p. 8178}	Tvwg2 {p. 8178}		

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_WGPWM_SUB_DIAG	-	0... FFFFH	0... 99.99847	1.5259e-3	%
PWM output wastegate in case of electrical failure					

### R.3.1 Outputs for supplier Aggregates

#### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

#### Application conditions

**Initialisation:** 0 at reset

**Recurrence:** all 10 ms


**Activation:** every engine state if LV\_VAR\_TCHA = 1 // control of HW pins  
via WGPWM, RFPPWM  
only in case of turbo  
charger variant  
In power latch phase:  
WGPWM[NC\_CBK\_EX\_NR] = 0  
RFPPWM = last calculated  
value

#### Formula section:

```

If LV_WGPWM_EXT_ADJ[1] = 0
Then
  IF LV_ERR_WG_DR[1] = 0
  Then WGPWM[1] = Tvwg
  Else WGPWM[1] = C_WGPWM_SUB_DIAG
Else
  WGPWM[1] = WGPWM_EXT_ADJ[1]

```

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**Endif**

```


If          LV_WGPWM_EXT_ADJ[2] = 0
Then
    IF       LV_ERR_WG_DR[2] = 0
    Then     WGPWM[2] = Tvwg2
    Else     WGPWM[2] = C_WGPWM_SUB_DIAG
Else
    WGPWM[2] = WGPWM_EXT_ADJ[2]
Endif

```

```

If          LV_RFPPWM_EXT_ADJ[1] = 0
Then
    RFPPWM = Tvulv
Else
    RFPPWM = RFPPWM_EXT_ADJ[1]
Endif

```

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## R.4 CUSF - Requirements to infrastructure interface

### General Information:

#### **In-/Output for Functions**

A Function with the property INPUT is provided by the supplier

A Function with the property OUTPUT is provided by BMW

### Application Conditions:

*Initialisation:* -

*Recurrence:* At function request

*Activation:* every engine state

*Deactivation:* -

### Function description:

This functions must be provided by the supplier-SW to the BMW-SW at the Layerinterface.

### Formula section:

Name	Parameter	return value	In-/Output	Remark
Layer_DisableISR	void	void	Eingang	deactivation of all ISR
Layer_EnableISR	void	void	Eingang	activation of all ISR
Layer_GetSystemTime 1ms	void	uint32	Eingang	systemtime with 1ms resolution
Layer_GetSystemTime 1us	void	uint32	Eingang	systemtime with 1 us resolution


## R.5 Customer reference list

### FUNCTION DESCRIPTION:

#### General information:


This document is used to handle the configuration management of desired implementation of the customer OBJ files. For each SW release a fitting list of OBJ file references has to be created. The list is sorted in alphabetic order.

#### Description:

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atlad
atldiag
atlgls
atlob
atlout
atlpump
atreg
atlstat
atmnn
atmph
atmph_n53
atmph_svc
ausy_ak
ausy_kat
ausy_turb
bgcreng
bgkuppl
bgllgen
bls
blsagr
blsatl
blsdisa
blsdk
blshub
blstempk
bs
co2mng
deavanos
dgen
dibs
dqlt
eavanos
eavnst
eisy
eisy_diag
eisy_dk
eisy_ev
eisy_llk
eisy_mr
eisy_psreg
eisy_sr
eisy_verd
eisyagr


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gen_fasta
igr
igrdiag
igrsbcalc
imdgen
inv_ipol
ipmna_dynkor
ipmna_genkor
ipmna_genstoff
ipmna_loadresp
ipmna_md2ierr
ipmna_statmbilanz
ipmna_statmkor
kf_ipol
kl_ipol
krann
kt_ibs
lamko
layer
ldstgen
lemdiag
llpmctrl
llranh
lolimot
mdanman
mdar
mdbafak
mdbanl
mdbaprio
mdbaschalt
mddmk
mdfw
mdfzdyn
mdipmfw
mdist
mdla
mdmax
mdna
mdres
mdreskrll
mdrfmxatl
mdrk
mlp

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mslam
ozbg
ozgg
ozleit
oznivdl
ozperm
ozrestkm
oztemp
ozvisc
pgenllred
pgentred
pid_regler
pmbattmng
pmbattregen
pmcbsbatt
pmdiag
pmmsa
pmmsadiag
pmprsvcalc
pmsoccalc
pmsocfit
pmsockor
pmsocstart
pmspgw
pmubnkor
pmukomp
pmverbentl
pmverbmng
poel_reg
railko
restgas
services_msd80
ss_msv
sst
ulvout
ulvreg
wes
wese
wm_nl
wm_start
wmewapu
wmkft
wmprio

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wmschalt
wmzusta
zwaus
zwgrund
zwopt

No version numbers of OBJ-Files are available !

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## R.6 Dynamic requirements of customer provided functionality

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_N_MAX_CLC_AUSY_TURB_SEG	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call ausy_turb_seg					
LV_N_MAX_CLC_EISY_VERD_SEG	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call eisy_verd_seg					
LV_N_MAX_CLC_KLANN_20MS	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call klann_20ms					
LV_N_MAX_CLC_MDBAFK_10MS	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call mdbafak_10ms					
LV_N_MAX_CLC_MDBANL_10MS	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call mdanl_10ms					
LV_N_MAX_CLC_MDBAPRIO_10MS	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call mdbaprio_10ms					
LV_N_MAX_CLC_MDRK_SEG	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call mdrk_seg					
LV_N_MAX_CLC_RAILKO_10MS	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call railko_10ms					
LV_N_MAX_CLC_ULVOUT_10MS	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call ulvout_10ms					
LV_N_MAX_CLC_ULVREG_10MS	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call ulvreg_10ms					
LV_N_MAX_CLC_WESE_SEG	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call wese_seg					

### Input data:

LV_VAR_TCHA {p. 656}	N {p. 1525}		
----------------------	-------------	--	--

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_HYS_CLC_AUSY_TURB_SEG	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call ausy_turb_seg (default: 200 rpm)					
C_N_HYS_CLC_EISY_VERD_SEG	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call eisy_verd_seg (default: 200 rpm)					
C_N_HYS_CLC_KLANN_20MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call klann_20ms (default: 200 rpm)					
C_N_HYS_CLC_MDBAFK_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call mdbafak_10ms (default: 200 rpm)					
C_N_HYS_CLC_MDBANL_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call mdbanl_10ms (default: 200 rpm)					
C_N_HYS_CLC_MDBAPRIO_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call mdbaprio_10ms (default: 200 rpm)					
C_N_HYS_CLC_MDRK_SEG	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call mdrk_seg (default: 200 rpm)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_HYS_CLC_RAILKO_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call railko_10ms (default: 200 rpm)					
C_N_HYS_CLC_ULVOUT_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call ulvout_10ms (default: 200 rpm)					
C_N_HYS_CLC_ULVREG_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call ulvreg_10ms (default: 200 rpm)					
C_N_HYS_CLC_WESE_SEG	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call wese_seg (default: 200 rpm)					
C_N_MAX_CLC_AUSY_TURB_SEG	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call ausy_turb_seg (default: 4000 rpm)					
C_N_MAX_CLC_EISY_VERD_SEG	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call eisy_verd_seg (default: 4000 rpm)					
C_N_MAX_CLC_KLANN_20MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call klann_20ms (default: 4000 rpm)					
C_N_MAX_CLC_MDBAFK_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call mdbafk_10ms (default: 4000 rpm)					
C_N_MAX_CLC_MDBANL_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call mdbanl_10ms (default: 4000 rpm)					
C_N_MAX_CLC_MDBAPRIO_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call mdbaprio_10ms (default: 400rpm)					
C_N_MAX_CLC_MDRK_SEG	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call mdrk_seg (default: 4000 rpm)					
C_N_MAX_CLC_RAILKO_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call railko_10ms (default: 4000 rpm)					
C_N_MAX_CLC_ULVOUT_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call ulvout_10ms (default: 4000 rpm)					
C_N_MAX_CLC_ULVREG_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call ulvreg_10ms (default: 4000 rpm)					
C_N_MAX_CLC_WESE_SEG	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call wese_seg (default: 4000 rpm)					


### General information:

This module is a customer request out of the BMW-supplier Software Layer, where the scheduling of BMW tasks is defined. For detailed information on the scheduling of BMW tasks please refer to the corresponding layer specification.

To prevent the CPU from overload the scheduling of some BMW tasks may be halved via engine speed thresholds or switched of via LV\_VAR\_TCHA. In case engine speed exceeds the corresponding threshold only each 2<sup>nd</sup> function call will be conducted.

### Application conditions

<b>Initialisation:</b>	<i>all = 0 at reset</i>
<b>Recurrence:</b>	<i>seg and 10ms, 20ms</i>
<b>Activation:</b>	<i>always</i>
<b>Deactivation:</b>	<i>-</i>

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**Formula section:**Function call MDBAPRIO\_10MS:

**If**  $N > C\_N\_MAX\_CLC\_MDBAPRIO\_10MS$   
**Then**  $LV\_N\_MAX\_CLC\_MDBAPRIO\_10MS = 1$   
**Endif**

**If**  $N < C\_N\_MAX\_CLC\_MDBAPRIO\_10MS - C\_N\_HYS\_CLC\_MDBAPRIO\_10MS$   
**Then**  $LV\_N\_MAX\_CLC\_MDBAPRIO\_10MS = 0$   
**Endif**

**If**  $LV\_N\_MAX\_CLC\_MDBAPRIO\_10MS = 1$   
**Then** only each 2<sup>nd</sup> function call for MDBAPRIO\_10MS will be conducted  
**Else** each function call for MDBAPRIO\_10MS will be conducted  
**Endif**

Function call WESE\_SEG:

**If**  $N > C\_N\_MAX\_CLC\_WESE\_SEG$   
**Then**  $LV\_N\_MAX\_CLC\_WESE\_SEG = 1$   
**Endif**

**If**  $N < C\_N\_MAX\_CLC\_WESE\_SEG - C\_N\_HYS\_CLC\_WESE\_SEG$   
**Then**  $LV\_N\_MAX\_CLC\_WESE\_SEG = 0$   
**Endif**

**If**  $LV\_N\_MAX\_CLC\_WESE\_SEG = 1$   
**Then** only each 2<sup>nd</sup> function call for WESE\_SEG will be conducted  
**Else** each function call for WESE\_SEG will be conducted  
**Endif**

Function call MDRK\_SEG:


**If**  $N > C\_N\_MAX\_CLC\_MDRK\_SEG$   
**Then**  $LV\_N\_MAX\_CLC\_MDRK\_SEG = 1$   
**Endif**

**If**  $N < C\_N\_MAX\_CLC\_MDRK\_SEG - C\_N\_HYS\_CLC\_MDRK\_SEG$   
**Then**  $LV\_N\_MAX\_CLC\_MDRK\_SEG = 0$   
**Endif**

**If**  $LV\_N\_MAX\_CLC\_MDRK\_SEG = 1$   
**Then** only each 2<sup>nd</sup> function call for MDRK\_SEG will be conducted  
**Else** each function call for MDRK\_SEG will be conducted  
**Endif**

Function call KLANN\_20MS:

**If**  $N > C\_N\_MAX\_CLC\_KLANN\_20MS$   
**Then**  $LV\_N\_MAX\_CLC\_KLANN\_20MS = 1$   
**Endif**

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```

If          N < C_N_MAX_CLC_KLANN_20MS - C_N_HYS_CLC_KLANN_20MS
Then       LV_N_MAX_CLC_KLANN_20MS = 0
Endif

```

```

If          LV_N_MAX_CLC_KLANN_20MS = 1
Then       only each 2nd function call for KLANN_20MS will be conducted
Else       each function call for KLANN_20MS will be conducted
Endif

```

Function call EISY\_VERD\_SEG:

```

If          N > C_N_MAX_CLC_EISY_VERD_SEG
Then       LV_N_MAX_CLC_EISY_VERD_SEG = 1
Endif

```

```

If          N < C_N_MAX_CLC_EISY_VERD_SEG - C_N_HYS_CLC_EISY_VERD_SEG
Then       LV_N_MAX_CLC_EISY_VERD_SEG = 0
Endif

```

```

If          LV_N_MAX_CLC_EISY_VERD_SEG = 1
Then       only each 2nd function call for EISY_VERD_SEG will be conducted
Else       each function call for EISY_VERD_SEG will be conducted
Endif

```

Function call MDBAFAK\_10MS:

```

If          N > C_N_MAX_CLC_MDBAFAK_10MS
Then       LV_N_MAX_CLC_MDBAFAK_10MS = 1
Endif

```

```

If          N < C_N_MAX_CLC_MDBAFAK_10MS - C_N_HYS_CLC_MDBAFAK_10MS
Then       LV_N_MAX_CLC_MDBAFAK_10MS = 0
Endif

```

```

If          LV_N_MAX_CLC_MDBAFAK_10MS = 1
Then       only each 2nd function call for MDBAFAK_10MS will be conducted
Else       each function call for MDBAFAK_10MS will be conducted
Endif

```

Function call MDBANL\_10MS:

```

If          N > C_N_MAX_CLC_MDBANL_10MS
Then       LV_N_MAX_CLC_MDBANL_10MS = 1
Endif

```

```

If          N < C_N_MAX_CLC_MDBANL_10MS - C_N_HYS_CLC_MDBANL_10MS
Then       LV_N_MAX_CLC_MDBANL_10MS = 0
Else       do nothing
Endif

```

```

If          LV_N_MAX_CLC_MDBANL_10MS = 1

```

**Then**            only each 2<sup>nd</sup> function call for MDBANL\_10MS will be conducted  
**Else**            each function call for MDBANL\_10MS will be conducted  
**Endif**

Function call RAILKO\_10MS:

**If**                 $N > C\_N\_MAX\_CLC\_RAILKO\_10MS$   
**Then**             $LV\_N\_MAX\_CLC\_RAILKO\_10MS = 1$   
**Endif**

**If**                 $N < C\_N\_MAX\_CLC\_RAILKO\_10MS - C\_N\_HYS\_CLC\_RAILKO\_10MS$   
**Then**             $LV\_N\_MAX\_CLC\_RAILKO\_10MS = 0$   
**Else**            do nothing  
**Endif**

**If**                 $LV\_N\_MAX\_CLC\_RAILKO\_10MS = 1$   
**Then**            only each 2<sup>nd</sup> function call for RAILKO\_10MS will be conducted  
**Else**            each function call for RAILKO\_10MS will be conducted  
**Endif**

Function call AUSY\_TURB\_SEG

**If**                 $N > C\_N\_MAX\_CLC\_AUSY\_TURB\_SEG$   
**Then**             $LV\_N\_MAX\_CLC\_AUSY\_TURB\_SEG = 1$   
**Endif**

**If**                 $N < C\_N\_MAX\_CLC\_AUSY\_TURB\_SEG - C\_N\_HYS\_CLC\_AUSY\_TURB\_SEG$   
**Then**             $LV\_N\_MAX\_CLC\_AUSY\_TURB\_SEG = 0$   
**Endif**

**If**                 $LV\_N\_MAX\_CLC\_AUSY\_TURB\_SEG = 1$   
**Then**            only each 2<sup>nd</sup> function call for AUSY\_TURB\_SEG will be conducted  
**Else**            each function call for AUSY\_TURB\_SEG will be conducted

Functions, called depending on LV\_VAR\_TCHA:

**If(1)**             $LV\_VAR\_TCHA = 1$   
**Then(1)**  
     atlstat\_10ms,  
     atlad\_100ms,  
     atldiag\_100ms,  
     atldiag\_10ms,  
     atlgls\_10ms,  
     atlob\_20ms,  
     atlob\_50ms,  
     atlout\_10ms,  
     atlpump\_10ms,  
     atlreg\_10ms,  
     atlstat\_10ms,



blsatl\_10ms,  
 blsatl\_20ms,  
 blsatl\_50ms,  
 eisy\_diag\_n100ms,  
 mdrfmxatl\_50ms                                 will be conducted

Function call ULVOUT\_10MS:

**If**                  $N > C\_N\_MAX\_CLC\_ULVOUT\_10MS$   
**Then**                  $LV\_N\_MAX\_CLC\_ULVOUT\_10MS = 1$   
**Endif**

**If**                  $N < C\_N\_MAX\_CLC\_ULVOUT\_10MS - C\_N\_HYS\_CLC\_ULVOUT\_10MS$   
**Then**                  $LV\_N\_MAX\_CLC\_ULVOUT\_10MS = 0$   
**Endif**

**If**                  $LV\_N\_MAX\_CLC\_ULVOUT\_10MS = 1$   
**Then**                 only each 2<sup>nd</sup> function call for ULVOUT\_10MS will be conducted  
**Else**                 each function call for ULVOUT\_10MS will be conducted  
**Endif**

Function call ULVREG\_10MS:


**If**                  $N > C\_N\_MAX\_CLC\_ULVREG\_10MS$   
**Then**                  $LV\_N\_MAX\_CLC\_ULVREG\_10MS = 1$   
**Endif**

**If**                  $N < C\_N\_MAX\_CLC\_ULVREG\_10MS - C\_N\_HYS\_CLC\_ULVREG\_10MS$   
**Then**                  $LV\_N\_MAX\_CLC\_ULVREG\_10MS = 0$   
**Endif**

**If**                  $LV\_N\_MAX\_CLC\_ULVREG\_10MS = 1$   
**Then**                 only each 2<sup>nd</sup> function call for ULVREG\_10MS will be conducted  
**Else**                 each function call for ULVREG\_10MS will be conducted  
**Endif**

**Endif(1)**

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 8153 of 8404</b>	
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## R.7 Interface definitions of customer provided functionality

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Absch_korr	O/V/S	8000... 7FFFH	-50... 49.99847	1.5259e-3	-
Korrekturwert Abschaltung					
Agr_rate	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
EGR rate					
Agr_soll	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Exhausted gas setpoint					
Agrpos_soll	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
AGR-Ventil Sollposition					
Amo_05	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Amplitude 0,5 Motorordnung					
Amo_10	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Amplitude 1,0 Motorordnung					
Amo_15	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Amplitude 1,5 Motorordnung					
Amo_20	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Amplitude 2,0 Motorordnung					
Amo_30	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Amplitude 3. Motorordnung					
Amo_40	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Amplitude 4. Motorordnung					
Aspr	O/V	0... FFH	0... 204	0.8	°CRK
setpoint outlet camshaft					
Atlr	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Stellgröße Regler und Vorsteuerung					
Atlsvc_dpvd1	O/V	8000... 7FFFH	-1280... 1279.96093	0.0390625	hPa
Differenzdruck vor DK beider Turbolader					
Atlsvc_dpvd2	O/V	8000... 7FFFH	-1280... 1279.96093	0.0390625	hPa
Differenzdruck vor DK mit Turbolader 1					
Atlsvc_dpvd3	O/V	8000... 7FFFH	-1280... 1279.96093	0.0390625	hPa
Differenzdruck vor DK mit Turbolader 1					
Atlvst	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Stellgröße Anteil Vorsteuerung					
Ba_ist	O/V	0... FFH	0... 255	1	km/m
Actual engine operation mode					
Ba_soll	O/V	0... FFH	0... 255	1	-
requested engine operation mode					

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 8154 of 8404</b>	
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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Ba_subist	O/V	0... FFH	0... 255	1	-
Actual engine operation mode					
Ba_subsoll	O/V	0... FFH	0... 255	1	-
requested engine operation mode					
Ba_switch_uek	O/V	0... FFH	0... 255	1	-
Schalter für Wandfilmkompensation					
Ba_wm_ist	O/V	0... FFH	0... 255	1	-
Ist-Betriebsart Wärmemanagementkoordinator					
Baw_ist	O/V	0... FFFFH	0... 65535	1	-
Betriebsart und Subbetriebsart IST					
Baw_prio	O/V	0... FFFFH	0... 65535	1	-
priorisierte Betriebsart und Subbetriebsart					
Baw_soll	O/V	0... FFFFH	0... 65535	1	-
Betriebsart und Subbetriebsart SOLL					
Bosbtvfbk	O/V/S	0... FFH	0... 255	1	%
Verfügbarkeit Motoröl					
Bosconf	O/V/S	0... FFFFFFFFH	0... 4294967295	1	-
Bos-Teilnehmer: Bit 1 = OZ; Bit 8 = PM					
Bosfxid2	O/V/S	0... FFFFH	0... 65535	1	-
ID_Funktion_BOS_Meldung_2					
Bosid2	O/V/S	0... FFH	0... 255	1	-
ID2_BOS_Meldung_2					
Bosziel	O/V/S	0... FFH	0... 255	1	-
Zieltermin_Jahr_BOS_Meldung_2					
Bosmanip	O/V	0... FFH	0... 255	1	-
Manipulationsbyte					
Bosmziel	O/V/S	0... FFH	0... 255	1	month
Zieltermin_Monat_BOS_Meldung_2					
Bosprog2	O/V/S	0... FFH	0... 255	1	month
Prognose_Intervall_Zeit_BOS_Meldung_2					
Bosres	O/V/S	0... FFH	0... 255	1	-
BOS_Reserve					
Bosrlsm	O/V/S	8000... 7FFFH	-32768 ...32767	1	-
Remaining milage for oil (from combi)					
Bosrw2	O/V/S	0... FFH	0... 255000	1000	km
Prognose_Intervall_Weg_BOS_Meldung_2					
Bosstate	O/V	0... FFH	0... 255	1	-
Einheit für Restlaufstrecke					
Bostoken	O/V	0... FFH	0... 255	1	-
Teilen der BOS-Schnittstelle zwischen OZ und PM (0= frei, 1= besetzt vom OZ, 8= besetzt vom PM)					
Bszsi	O/V/S	0... FFFFFFFFH	0... 4294967295	1	-
Betriebsstundenzaehler					
Ctrcbr	O/V	0... FFH	0... 255	1	-
Steuerung Stromzweige					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Ctrpcos	O/V	0... FFH	0... 255	1	-
Steuerung Standverbraucher					
Ctrprio	O/V	0... FFH	0... 255	1	-
Steuerung Spitzenreduzierung Priorität					
Ctrprioef	O/V	0... FFH	0... 255	1	-
Steuerung Spitzenreduzierung Priorität Komfort					
Ctrpwrcos	O/V	0... FFFFH	0... 65535	1	-
Steuerung Leistung Sonderverbraucher					
Ctrpwspcos	O/V	0... FFH	0... 127.5	0.5	%
Steuerung Leistung Sonderverbraucher					
D_soc	O/V/S	0... 7FFFH	0... 99.99694	3.0518e-3	-
Abstand zur Starffähigkeitsgrenze					
Dfds [16]	O/V/S	0... FFH	0... 255	1	-
Generatorauslastungsprofil					
Dffgen	O/V	0... FFH	0... 100	0.3921569	%
calculated DF-signal from alternator					
Dfmonitor	O/V	0... FFH	0... 100	0.3921569	%
condition of battery load					
Dla_soll_puls [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-8... 7.99975	244.1e-6	-
Lambdadifferenzen aus Pulsation					
Drf_spuel	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	%
Delta RF das in der Überschneidung durchgespuelt wird					
Dwese2_h [NC_CYL_NR]	O/V	E200... 5A00H	-180 ...540	0.0234375	°CRK
Differenz zw. Einspritzende 2. Einspritzung Homogen und Zündung					
Dzw_agr_hs	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Deltazündwinkel AGR-Korrektur (homogen-schicht)					
Dzw_agr_kor	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
ignition angle correction for external exhaust gas recirculation					
Dzw_anm	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Referenzwert für B_kftkr, mittlerer adaptierter Spätziehwinkel					
Dzw_krkorll	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°CRK
Verschiebung ZW-Frühgrenze bei Klopfen im LL					
Dzwo_lam_kor	O/V	80... 7FH	-64... 63.5	0.5	°CRK
Grundreferenzzündwinkel Lambdakorrektur					
Dzwot	O/V	80... 7FH	-64... 63.5	0.5	°CRK
Grundreferenzzündwinkel Temperaturkorrektur					
Eco_jobstat1	O/V	0... FFH	0... 255	1	-
Eco Job 1 Rueckgabewer					
Eco_result1	O/V	0... FFFFH	0... 81.99874	1.2512e-3	A
ECOS Ruhestrom 1					
Eisyagr_korfak_b	O/V	0... FFH	0... 1.99218	0.0078125	-
Abgleich AGR-Modell (Faktor)					
Eisydk_korfak_b	O/V	0... FFH	0... 1.99218	0.0078125	-
Abgleich DK-Modell (Faktor)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Eisydk_koroff_b	O/V	80... 7FH	-1024 ...1016	8	kg/h
Abgleich DK-Modell (Offset)					
Eisyev_korfak_b	O/V	0... FFH	0... 1.99218	0.0078125	-
Abgleich EV-Modell (Faktor)					
Eisyev_koroff_b	O/V	80... 7FH	-1024 ...1016	8	kg/h
Abgleich EV-Modell (Offset)					
Espr	O/V	0... FFH	0... 204	0.8	°CRK
setpoint inlet camshaft					
Espr_mod_soll [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
Aktueller Einspritzmodus (Sollvorgabe)					
Eta_labas	O/V	8000... 7FFFH	-200... 199.99389	6.1035e-3	%
Lambdawirkungsgrad bei Lambda_bas_cor					
Eta_labas_soll	O/V	8000... 7FFFH	-200... 199.99389	6.1035e-3	%
Lambda-Wirkungsgrad					
Eta_lambda_1	O/V	8000... 7FFFH	-200... 199.99389	6.1035e-3	%
Lambda-Wirkungsgrad, Bank1					
Eta_lambda_2	O/V	8000... 7FFFH	-200... 199.99389	6.1035e-3	%
Lambda-Wirkungsgrad, Bank 2					
Eta_md_uesp	O/V	8000... 7FFFH	-200... 199.99389	6.1035e-3	%
Wirkungsgradkorrektur beim Überspülen					
Eta_mdkh	O/V	8000... 7FFFH	-200... 199.99389	6.1035e-3	%
Wirkungsgradkorrektur bei Katheizen					
Eta_zw_minres	O/V	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
Minimal möglicher Zündwinkelwirkungsgrad für Momentenreserve bezogen auf min. Zündwinkel					
F_atlad	O/V/S	0... FFFFH	0... 1.99996	30.5e-6	-
Atl-Regler Adaptionfaktor					
F_atldyn	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Überspülfaktor					
F_bsmdres	O/V/S	0... FFH	0... 0.99609	3.9063e-3	-
Faktor Bauteilschutz zur Begrenzung der Drehmomentreserve (bei Nox-Katheizen)					
F_llr_ba	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Factor for operation mode transition					
F_lradap1	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	-
Lambdaadaptionwert Bank1					
F_lradap2	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	-
Lambdaadaptionwert Bank2					
F_nst_ba	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Factor for operation mode transition for TI_CAST					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
F_rkkorwl_hs	O/V	0... FFFFH	0... 3.99993	61e-6	-
Warmlaufkorrektur Homogen-Schicht nur für 1. Einspritzung					
F_rkkorwl_s	O/V	0... FFFFH	0... 3.99993	61e-6	-
Warmlaufkorrektur Schicht nur für 1. Einspritzung					
F_sicher_zw	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Überblendfaktor aus Verbrennungsregelung für Zündwinkel					
F_st_ba	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Factor for operation mode transition for MFF_CST					
F_tikorzsk [NC_CYL_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Zylinderindividueller Einspritzkorrektur aus VBR					
F_vl_aus	O/V	0... FFFFH	0... 3.99993	61e-6	-
load factor for switching off full load					
F_vwi_ba	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Faktor zur Überblendung des Vorlagerungswinkels					
F_wl_ba	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Factor for operation mode transition for TI_WUP_1					
F_wnwkh	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Factor for fading ignition angle in case of catalyst heating					
F_wnwkhk	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Überblendfaktor (warm/kalt) für Spreizung und Zündhaken während Katheizen					
F_zw_hsplit	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Faktor zur Überblendung von Größen des Zündpfads					
Genitest_tol	O/V	0... FFH	0... 99.60937	0.390625	%
Toleranzbereich für Abweichung vom Sollwert Strom					
Geniutest_ab	O/V	0... FFH	0... 255	1	-
GENIUTEST Abbruchbedingung					
Geniutest_err	O/V	0... FFH	0... 255	1	-
GENIUTESTFehler					
Genutest_tol	O/V	0... FFH	0... 99.60937	0.390625	%
Def_f_ub_b100					
I_batt	O/V	0... FFFFH	-200... 5042.8	0.08	A
battery current					
I_craweng	O/V	8000... 7FFFH	-32768 ...32767	1	A
Strombedarf Motor					
I_gen	O/V	0... FFH	0... 255	1	A
Generatorstrom					
I_genmax	O/V	0... FFH	0... 255	1	A
Generatormaximalstrom					
I_gentest	O/V	0... FFH	0... 255	1	A
Modellierter Generatorstrom für Tester für Generatorstest					
I_ges	O/V	0... FFFFH	0... 63.99902	976.599e-6	-
Gesamtübersetzung					
I_ha	O/V	0... FFFFH	0... 63.99902	976.599e-6	-
Übersetzung Hinterachse					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
lbhwversi	O/V	0... FFH	0... 255	1	-
IBS Hardwareversion					
lbsderrs1	O/V/S	0... FFH	0... 255	1	-
Dibs Fehlerzähler BSD					
lbsderrs2	O/V/S	0... FFFFH	0... 65535	1	-
Dibs Fehlerzähler EBSD					
lbspreco2	O/V/S	0... FFH	0... 255	1	-
Vorteiler für lbsderrs2					
lbswbase	O/V	0... FFH	0... 255	1	-
IBS Softwarebaseline					
lbswchang	O/V	0... FFH	0... 255	1	-
IBS SW-Änderungsstatus					
Id_bosmg	O/V	0... FFFFH	0... 65535	1	-
Id für Motoröl (BOS Kombi)					
Id_bosmgt	O/V	0... FFH	0... 255	1	-
ID für Motoröl (BOS-Tester)					
Id_bosmsg	O/V	0... FFH	0... 255	1	-
Id für Motoröl (BOS Kombi)					
Id_bosrtak	O/V	0... FFH	0... 255	1	-
Acknowledge reset durchgeführt					
lerrgrenz	O/V	0... FFH	0... 31.875	0.125	A
Begrenzter Erregerstrom Generator 1					
lgenk	O/V/S	F32	-	F32	-
Generator aufintegriert					
lgrinfo [30]	O/V/S	0... FFH	0... 255	1	-
information storage for IGR ( intelligente Generatorreglung)					
Injekt_hub_h	O/V	0... FFH	0... 255	1	-
Injektorhub Homogen					
Injekt_hub_hs	O/V	0... FFH	0... 255	1	-
Injektorhub Homogen-Schicht					
Injekt_hub_s	O/V	0... FFH	0... 255	1	-
Injektorhub Schicht					
Klann_mw1	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	-
Lambdaadaptionmittelwert Bank1					
Klann_mw2	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	-
Lambdaadaptionmittelwert Bank2					
Klann_test1	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	-
Lambdaadaptionwert für Tester Bank1					
Klann_test2	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	-
Lambdaadaptionwert für Tester Bank2					
Krnn_test	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Testerwert NN KR-Adaption					
Ktupscstr	O/V/S	0... FFFFH	0... 65535	1	-
Fehlerzähler EBSD Checksumme					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
La_abgas1	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Berechnete Lambda in Abgas inklusiv Durchspülung in sch, hos und hom					
La_abgas2	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Berechnete Lambda in Abgas inklusiv Durchspülung in sch, hos und hom					
La_bas1	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Basis-Lambda soll Bank 1					
La_bas2	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Basis-Lambda soll Bank 2					
La_bs1	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
lambda for catalyst overheating prevention bank 1					
La_bs2	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
lambda for catalyst overheating prevention bank 2					
La_ref_hommm	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda Sollwert Homogen mager					
La_sollreg [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda setpoint for controller (with lambda pulsation)					
Leminfo [40]	O/V/S	0... FFH	0... 255	1	-
information storage for LEM ( Leistungskoordination Elektrisch Mechanisch )					
Lurabs_f [NC_CYL_NR]	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	-
gefilterte Laufruhedeltas eines Zylinders					
Lurdif_f [NC_CYL_NR]	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	-
gefilterte Laufruhedeltas eines Zylinders					
Md_can_dmee	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
theoretisches Moment für Getriebesteuerung					
Md_genm_na	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
filtered torque losses due to alternator					
Md_getriebe_hs	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
torque losses for manual gear					
Md_max_klima	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
air-conditioning-compressor limit torque					
Md_na_ges	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
total torque losses for additive engine devices					
Md_na_ges_f	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
filtered total torque losses for additive engine devices					
Md_rad_ist	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Ist-Moment an den Antriebsrädern					
Md_rad_istlm	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Ist-Radmoment aus Luftmasse ohne externe Eingriffe					
Md_rad_ksoll	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
koordiniertes Wunschradmoment					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Md_rad_max	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Max. Radmoment					
Md_rad_min	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Schleppmoment unbefeuert					
Md_reib_sa	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Reibmoment					
Md_res_atlsv	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Angeforderte Momentenreserve während der Turboladerdiagnose					
Md_res_max	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
max mögliche Momentenreserve					
Mdi_fzdyn	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
inneres Wunschkupplungsmoment nach Fahrdynamikfilterung					
Mdi_fzdyn_res	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
inneres Moment nach Fahrdynamikfilterung mit Momentenreserve					
Mdi_ist_m	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
Über alle Zylinder gemittelt inneres Motormoment					
Mdi_max	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
maximales inneres Moment					
Mdi_max_l1	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
Maximales inneres Moment					
Mdi_min_hs	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Minimal mögliche Moment in Schicht					
Mdi_min_s	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
inneres minimales Moment im Schicht					
Mdi_ml_soll	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
Max. torque at air					
Mdi_ml_sollvb	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Soll-Moment Luftpfad vor Sicherheitsbegrenzung					
Mdi_nregl_plus	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Inneres Moment Drehzahlregler langsamer Pfad (erhöhend)					
Mdi_nregs_plus	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Inneres Moment Drehzahlregler schneller Pfad (erhöhend)					
Mdi_opt_l1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
reference indicated engine torque					
Mdi_opt_s	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
Motormoment Schicht					
Mdi_reib	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
torque losses					
Mdi_res_max	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
inneres Moment incl. max mögliche Momentenreserve ohne Einfluss LL					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Mdi_res_maxll	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
inneres Moment incl. max mögliche Momentenreserve mit Einfluss LL					
Mdi_s_istm	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
Ist-Moment im Schichtbetrieb über alle Zylinder gemittelt					
Mdi_soll	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
inneres Sollmoment					
Mdi_soll [k]	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
inneres Sollmoment					
Mdi_soll_l	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
inneres Sollmoment					
Mdi_soll_lk	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
inneres Soll-Moment langsamer Pfad ohne Sicherheitseingriff					
Mdi_wunsch	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Inneres Fahrerwunschmoment mit Begrenzung ohne Eingriffe					
Mdi_zw_soll	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
torque setpoint from ignition path					
Mdi_zw_sollcan	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
inneres Sollmoment-über den Zw einzustellen					
Mdi_zw_sollvb	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Soll-Moment Zündpfad vor Sicherheitsbegrenzung					
Mdk_max	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
max. torque at clutch					
Mdk_min	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Minimales Kupplungsmoment					
Mdk_wunsch	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
torque setpoint at clutch before filter					
Mdk_wunsch_filt	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Gefiltertes Wunschmoment					
Mdk_wunsch_ipm	O	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Torque request for IPM					
Mk_soll_h [NC_CYL_NR][NC_NR_IV_PLS]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Kraftstoffmasse Homogen als Sollwert					
Mk_soll_s	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Kraftstoffmasse Schicht als Sollwert					
Mkzyl_soll_hs [NC_CYL_NR][NC_NR_IV_PLS]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Kraftstoffmasse Homogenschicht als Sollwert (zylinderindividuell, je Einspritzung)					
Mkzyl_soll_s [NC_CYL_NR][4]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Kraftstoffmasse Schicht als Sollwert (zylinderindividuell, je Einspritzung)					
Mrnn_test_dk	O/V	8000... 7FFFH	-1... 0.99996	30.5e-6	-
Testerwert NN DK-Adaption					
Mrnn_test_pr	O/V	8000... 7FFFH	-2... 1.99993	61e-6	-
Testerwert NN PR-Adaption					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Ms_res_max	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
max Luftmassenstrom der durch Momentenreserve angefordert werden kann					
Msa_arravrs [60]	O/V/S	0... FFH	0... 255	1	-
Ringspeicher Abschaltverhinderer					
Msa_indexrs	O/V/S	0... FFH	0... 255	1	-
Index fuer den Ringspeicher Abschaltverhinderer					
Msagr	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
AGR-Massenstrom					
Msainfo [50]	O/V/S	0... FFH	0... 255	1	-
information storage for MSA ( Motor-Start/Stop-Automatik)					
Msastz	O/V/S	0... FFFFH	0... 65535	1	-
Zaehler aller Startversuche					
Msastzmsa	O/V/S	0... FFFFH	0... 65535	1	-
Zaehler aller MSA-Startversuche					
Msdk	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
mass flow through throttle					
Msdk_f	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
mass flow through throttle					
Msnlgoofs_tmp	O/V/S	8000... 7FFFH	-1024... 1023.96875	0.03125	kg/h
Leckluft Adaptionwert					
Mszyl	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
mass flow to cylinder					
Mszyl_ges	O/V	0... FFFFH	0... 6553.5	0.1	kg/h
total inducted air mass, including EGR					
N_dzm	O/V	0... 7FFFH	0... 32767	1	rpm
Angezeigte Drehzahl					
N_gen	O/V	0... 7FFFH	0... 32767	1	rpm
Generatordrehzahl					
N_nstart	O/V	0... 7FFFH	0... 32767	1	rpm
Motordrehzahl nach Motorstart					
Nelueft_wm	O/V	0... FFH	0... 99.60937	0.390625	%
Solldrehzahl E-Lüfter Vorgabe WM					
Newp_soll	O/V	0... FFH	0... 255	1	-
Solldrehzahl elektrische Wasserpumpe					
Nkw_poel_notl	O/V	0... 7FFFH	0... 32767	1	rpm
Max. Drehzahl bei defektem Ösystem (Bauteilschutz)					
Nkw_poel_soll	O/V	0... 7FFFH	0... 32767	1	rpm
Soll LL-Drehzahl aus Öldruckregelung (für HLL, Testerbetrieb...)					
Nmax_ba	O/V	0... 7FFFH	0... 32767	1	rpm
Maximal-Drehzahl bei aktueller Betriebsart					
Nsl_koor	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
LL-Solldrehzahl, koordiniert					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Nslb	O/V	0... 7FFFH	0... 32767	1	rpm
engine speed correction due to battery load-bilanz					
Oz_krz2cnt	O/V	0... FFH	0... 255	1	-
Zähler 20er- Packet Niveaumessung					
Oz_krzcnt	O/V	0... FFH	0... 255	1	-
Zähler 10er- Packet Niveaumessung					
Oz_krzkor	O/V	0... FFH	0... 74.70703	0.2929688	-
Niveaumessung OrientierungsMw					
Oz_krzkor2k	O/V	0... FFH	0... 74.70703	0.2929688	-
Niveaumessung 20er- Packet					
Oz_kvbog	O/V/S	0... FFFFH	0... 65535	1	-
Zugeteilte Bonuskraftstoffmenge					
Oz_kvbsm_ul	O/V/S	0... FFFFFFFFH	0... 524288	122.1e-6	-
Kraftstoffverbrauch seit letztem Ölwechsel					
Oz_lf1t	O/V/S	0... FFH	0... 2.55	0.01	-
Länderfaktor 1 codiert					
Oz_lf2t	O/V/S	0... FFH	0... 2.55	0.01	-
Länderfaktor 2 codiert					
Oz_lgmwcnt	O/V	0... FFH	0... 255	1	-
Zähler LangzeitMw Niveaumessung					
Oz_lp	O/V	0... FFH	0... 255	1	-
Für "Ölkannenanzeige im Display"					
Oz_lv	O/V	0... FFH	0... 255	1	-
Erforderliche Nachfüllmenge Motoröl					
Oz_nivakt	O/V	0... FFH	0... 74.70703	0.2929688	-
Aktuelles Ölniveau für den DIS-Tester					
Oz_nivkor	O/V	0... FFH	0... 74.70703	0.2929688	-
Niveaumessung korrigiertes Ölniveau					
Oz_nivkrzt	O/V	0... FFH	0... 74.70703	0.2929688	-
Kurzzeit-Ölniveau-Mittelwert für den DIS-Tester					
Oz_nivlangt	O/V/S	0... FFH	0... 74.70703	0.2929688	-
Langzeit-Ölniveau-Mittelwert für den DIS-Tester					
Oz_oelkm	O/V/S	0... FFFFH	0... 655350	10	km
Oelkilometer					
Oz_oelzeit	O/V	0... FFFFH	0... 65535	1	-
Öllaufzeit					
Oz_oricnt	O/V	0... FFH	0... 255	1	-
Zähler OriMw Niveaumessung					
Oz_permakt	O/V	0... FFFFH	0... 5.9999	91.6e-6	-
Aktuelle Ölpermittivität für den DIS-Tester					
Oz_permbog	O/V/S	0... FFFFH	0... 5.9999	91.6e-6	-
Zugeteilter Permittivitätsbonus					
Oz_permex	O/V/S	0... FFFFH	0... 5.9999	91.6e-6	-
Permittivität für Bewertung aufgereitet (extrapoliert)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Oz_permlow	O/V/S	0... FFFFH	0... 5.9999	91.6e-6	-
Aufbereitete Permittivität bei letztem Ölwechsel					
Oz_permoff	O/V	0... FFFFH	0... 5.9999	91.6e-6	-
Offset für Permittivitätskorrektur					
Oz_reset	O/V	0... FFH	0... 255	1	-
Status der Reset-Art an Kombi					
Oz_rwkvb	O/V	8000... 7FFFH	-327680 ...327670	10	km
Restweg aus Kraftstoffverbrauch abgeleitet					
Oz_rwperm	O/V	8000... 7FFFH	-327680 ...327670	10	km
Restweg aus Permittivität abgeleitet					
Oz_tempakt	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Aktuelle Öltemperatur für den DIS-Tester					
Oz_vormw	O/V	0... FFH	0... 74.70703	0.2929688	-
Niveaumessung VorMw					
Oz_vormwcnt	O/V	0... FFH	0... 255	1	-
Zähler VorMw Niveaumessung					
P_oel_soll	O/V	0... FFFFH	0... 65535	1	hPa
Sollwert Öldruck					
Pldr_soll	O/V	0... FFFFH	0... 2559.96093	0.0390625	hPa
Ladedruck Sollwert					
Pm_klemmstat	O/V	0... FFH	0... 255	1	-
Klemmenstatus bei Tiefentladung					
Pmbackup [7]	O/V	0... FFH	0... 255	1	-
Backupspeicher					
Pminfo1 [37]	O/V/S	0... FFFFH	0... 65535	1	%
Infospeicher 1					
Pminfo2 [29]	O/V/S	0... FFH	0... 255	1	-
Infospeicher 2					
Poel_fpwm	O/V	0... FFH	0... 255	1	Hz
Frequenz PWM Ansteuerung Öldruck-Regelventi					
Prail_out_s	O/V	0... FFFFH	0... 39.99938	610.4e-6	MPa
Raildruckvorgabe von BMW, gültig nur wenn B_prailsw gesetzt ist.					
Prail_soll	O/V	0... FFFFH	0... 39.99938	610.4e-6	MPa
Raildruckvorgabe von BMW, gültig nur wenn B_prailsw gesetzt ist.					
Prrn_test	O/V	8000... 7FFFH	-2... 1.99993	61e-6	-
Testerwert NN PR-Adaption					
Prrn_test_agr	O/V	8000... 7FFFH	-2... 1.99993	61e-6	-
Testerwert NN AGR-Adaption					
Ps	O/V	0... FFFFH	0... 2559.96093	0.0390625	hPa
manifold pressure					
Ps_ist	O/V	0... FFFFH	0... 2559.96093	0.0390625	hPa
measured manifold pressure					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Pspvdk	O/V	0... FFFFH	0 ...1	15.3e-6	-
pressure quotient at throttle					
Pspvdk_soll	O/V	0... FFFFH	0... 3.99993	61e-6	-
Druckverhältnis über Drosselklappe Sollwert					
Psreg [_i]	O/V	8000... 7FFFH	-2... 1.99993	61e-6	-
Saugrohrdruckregler I-Anteil					
Pssol	O/V	0... FFFFH	0... 2559.96093	0.0390625	hPa
Soll-Saugrohrdruck					
Ptc_pwr	O/V	0... FFH	0... 127.5	0.5	%
Maximale Leistung, die der PTC einstellen darf					
Q_abgnox	O/V	8000... 7FFFH	-20480... 20479.375	0.625	W
Wärmestrom [W] von Abgas an Abgasanlage hinter Noxkat					
Qv_h2o	O/V/S	0... FFFFH	0... 63.99902	976.599e-6	-
bisheriger Wasserverlust					
Qv_h2oquali	O/V/S	0... FFH	0... 99.60937	0.390625	%
Qualitätswert für Wasserverlust					
Qv_h2ostatus	O/V/S	0... FFH	0... 255	1	Ah
Statuswert für Entwicklung Wasserverlust					
Qv_nv_ezm	O/V/S	8000... 7FFFH	-32... 31.99902	976.599e-6	-
mittlerer Fehler über alle Hystereseberechnungen					
Qv_nv_start	O/V/S	80... 7FH	-128 ...127	1	A
Aus Start berechneter Kapazitätsverlust					
Qv_nv_zh	O/V/S	0... FFFFFFFFH	0... 4294967295	1	-
Zahl der Hystereseberechnungen					
Qv_out_1	O/V/S	80... 7FH	-128 ...127	1	A
Kapazitätsverlust letzter Start					
Qv_out_2	O/V/S	80... 7FH	-128 ...127	1	A
Kapazitätsverlust 2. letzter Start					
Qv_out_3	O/V/S	80... 7FH	-128 ...127	1	A
Kapazitätsverlust 3. letzter Start					
Qv_out_4	O/V/S	80... 7FH	-128 ...127	1	A
Kapazitätsverlust 4. letzter Start					
Qv_out_5	O/V/S	80... 7FH	-128 ...127	1	A
Kapazitätsverlust 5. letzter Start					
Qv_out_m	O/V/S	0... FFH	0... 99.60937	0.390625	%
Gültiger gemittelter Kapazitätsverlust					
Qv_quali_1	O/V/S	0... FFH	0... 99.60937	0.390625	%
Qualitätsindex für letzten Qv-Wert					
Qv_quali_2	O/V/S	0... FFH	0... 99.60937	0.390625	%
Qualitätsindex für 2. letzten Qv-Wert					
Qv_quali_3	O/V/S	0... FFH	0... 99.60937	0.390625	%
Qualitätsindex für 3. letzten Qv-Wert					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Qv_quali_4	O/V/S	0... FFH	0... 99.60937	0.390625	%
Qualitätsindex für 4. letzten Qv-Wert					
Qv_quali_5	O/V/S	0... FFH	0... 99.60937	0.390625	%
Qualitätsindex für 5. letzten Qv-Wert					
Qv_quali_m	O/V/S	0... FFH	0... 99.60937	0.390625	%
Qualitätsindex für gemittelten Qv-Wert					
Qv_status	O/V/S	80... 7FH	-128 ...127	1	-
Prozessstatus /Trend für gemittelten Qv-Wert					
Qv_td1	O/V/S	0... FFFFH	0... 65535	1	h
Zeit seit Qv_out_1 - Berechnung					
Qv_td2	O/V/S	0... FFFFH	0... 65535	1	h
Zeitabstand zwischen Qv_out_1 und Qv_out_2					
Qv_td3	O/V/S	0... FFFFH	0... 65535	1	h
Zeitabstand zwischen Qv_out_2 und Qv_out_3					
Qv_td4	O/V/S	0... FFFFH	0... 65535	1	h
Zeitabstand zwischen Qv_out_3 und Qv_out_4					
Qv_td5	O/V/S	0... FFFFH	0... 65535	1	h
Zeitabstand zwischen Qv_out_4 und Qv_out_5					
Qvc_status_1	O/V/S	0... FFH	0... 99.60937	0.390625	%
Ausgang für Schlüsselgröße 1					
Qvc_status_2	O/V/S	0... FFH	0... 99.60937	0.390625	%
Ausgang für Schlüsselgröße 2					
Qvc_status_3	O/V/S	0... FFH	0... 255	1	Ah
Ausgang für Schlüsselgröße 3					
Qvc_status_4	O/V/S	80... 7FH	-128 ...127	1	-
Ausgang für Schlüsselgröße 4					
Rf	O/V	0... 7530H	0... 300	0.01	%
relative cylinder filling					
Rf_ig_ist	O/V	0... 7530H	0... 300	0.01	%
Inertgas-Anteil im Brennraum					
Rf_res_max	O/V	0... 7530H	0... 300	0.01	%
Maximale rel. Füllung aus MD-Reserve für Katheizen					
Rf_soll	O/V	0... 7530H	0... 300	0.01	%
setpoint relative cylinder filling					
Rf_vl	O/V	0... 7530H	0... 300	0.01	%
maximum setpoint relative cylinder filling					
Rfv_vns	O/V	0... 7530H	0... 300	0.01	%
Relative Füllung für Vanos					
Rk_add_wf	O/V	8000... 7FFFH	-1600... 1599.95117	0.0488281	%
Wandfilmkorrektur DI Homogen					
Rk_kor_h	O/V	8000... 7FFFH	-1600... 1599.95117	0.0488281	%
rel. Kraftstoffmasse homogen stationär					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Rk_kor_kva	O/V	8000... 7FFFH	-1600... 1599.95117	0.0488281	%
Korrigierte Kraftstoffmasse für Kraftstoffverbrauchsanzeige					
Rk_korres_hs	O/V	8000... 7FFFH	-1600... 1599.95117	0.0488281	%
Korrigiertes Rk_soll mit Momentenreserve (homogen-schicht)					
Rk_korres_s	O/V	8000... 7FFFH	-1600... 1599.95117	0.0488281	%
Korrigiertes Rk_soll mit Momentenreserve (schicht)					
Rk_vlo_hs	O/V	8000... 7FFFH	-1600... 1599.95117	0.0488281	%
Umschaltgrenze Homogenschicht					
Rk_vlo_s	O/V	8000... 7FFFH	-1600... 1599.95117	0.0488281	%
Umschaltgrenze Schicht					
Rkte_max	O/V	8000... 7FFFH	-1600... 1599.95117	0.0488281	%
Max zul. Menge Kraftstoff aus TE					
Rkte_md	O/V	8000... 7FFFH	-1600... 1599.95117	0.0488281	%
Momentenrelevanter Teil der Kraftstoffmasse					
Rqpcos	O/V	0... FFH	0... 255	1	-
Anforderung Standverbraucher					
Rt_bastatg_h	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Relative Zeit Homogen Betrieb gesamter Motorlauf					
Rt_bastatg_hs	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Relative Zeit Homogen-Schicht-Betrieb gesamter Motorlauf					
Rt_bastatg_s	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Relative Zeit Schicht-Betrieb gesamter Motorlauf					
Rt_bastatg_sa	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Relative Zeit Homogen Betrieb gesamter Motorlauf					
Selspcos	O/V	0... FFH	0... 255	1	-
Selection special consumers					
Snibs	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Seriennummer IBS					
Spa_art	O/V	0... FFH	0... 255	1	-
Anzeigeart für Schaltpunktanzeige					
Spa_art_2	O/V	0... FFH	0... 255	1	-
Anzeigeart für Schaltpunktanzeige 2					
Spa_gang	O/V	0... FFH	0... 255	1	-
Gang für die Schaltpunktanzeige					
St_aekh	O/V/S	0... FFH	0... 255	1	-
Carrier Byte "Aussetzererkennung Katheizen"					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_aekh_ae	O/V	0... FFH	0... 255	1	-
Statuswort Aussetzer erkannt zylinderselektiv					
St_ar1	O/V	0... FFH	0... 255	1	-
Statuswort Antiruckel					
St_atldiag2_out	O/V	0... FFH	0... 255	1	-
Statusbyte Interface Ausgang					
St_atlstat	O/V	0... FFH	0... 255	1	-
Statuswort Laderstatus					
St_atlsvc	O/V	0... FFH	0... 255	1	-
Status während der Diagnose der Abgasturbolader					
St_atlsvc_pvdk	O/V	0... FFH	0... 255	1	-
Ergebnis der Diagnosefunktion der Abgasturbolader					
St_atlsvc_start	O/V	0... FFH	0... 255	1	-
Status nach Aufruf der Diagnosefunktion der Abgasturbolader					
St_ba_agf	O/V	0... FFH	0... 255	1	-
Status Betriebsarten angefordert					
St_blsdisa2	O/V	0... FFH	0... 255	1	-
Statuswort BLSDISA Ausgang					
St_blshub	O/V	0... FFH	0... 255	1	-
Statuswort BLSHUB					
St_bns	O/V/S	0... FFH	0... 255	1	-
Statusbyte Bordnetzstabilität					
St_deavns2	O/V/S	0... FFH	0... 255	1	-
Status Bedingung Vanos im Anschlag					
St_dgen0	O/V	0... FFH	0... 255	1	-
Statusbyte DGEN					
St_dgenerrst_md1	O/V/S	0... FFFFH	0... 65535	1	-
Statusbyte Fehlerzuweisung zu Messdatensatz1					
St_dgenerrst_md2	O/V/S	0... FFFFH	0... 65535	1	-
Statusbyte Fehlerzuweisung zu Messdatensatz2					
St_dgengrenz1	O/V/S	0... FFH	0... 31.875	0.125	A
Mittelwert der Erregerstrombegrenzung über applizierbare Zeit X (z.B. 10min)					
St_dgengrenz1_md1	O/V/S	0... FFH	0... 31.875	0.125	A
Mittelwert der Erregerstrombegrenzung über applizierbare Zeit X (z.B. 10min) zu 1. Messdatensatz					
St_dgengrenz1_md2	O/V/S	0... FFH	0... 31.875	0.125	A
Mittelwert der Erregerstrombegrenzung über applizierbare Zeit X (z.B. 10min) zu 2. Messdatensatz					
St_dgengrenz2	O/V/S	0... FFH	0... 31.875	0.125	A
Mittelwert der Erregerstrombegrenzung über applizierbare Zeit Y (z.B. 30min)					
St_dgengrenz2_md1	O/V/S	0... FFH	0... 31.875	0.125	A
Mittelwert der Erregerstrombegrenzung über applizierbare Zeit Y (z.B. 30min) zu 1. Messdatensatz					
St_dgengrenz2_md2	O/V/S	0... FFH	0... 31.875	0.125	A
Mittelwert der Erregerstrombegrenzung über applizierbare Zeit Y (z.B. 30min) zu 2. Messdatensatz					
St_dgengrenzerr	O/V/S	0... FFH	0... 255	1	-
Fehlerstati zur Erregerstrombegrenzung					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_dgengrenzerr_md1	O/V/S	0... FFH	0... 255	1	-
Fehlerstati zur Erregerstrombegrenzung zu 1. Messdatensatz					
St_dgengrenzerr_md2	O/V/S	0... FFH	0... 255	1	-
Fehlerstati zur Erregerstrombegrenzung zu 2. Messdatensatz					
St_dgengrenznz	O/V/S	0... FFH	0... 31.875	0.125	A
Mittelwert der Erregerstrombegrenzung über applizierbare Zeit Z (z.B. 2min)					
St_dgengrenznz_md1	O/V/S	0... FFH	0... 31.875	0.125	A
Mittelwert der Erregerstrombegrenzung über applizierbare Zeit Z (z.B. 2min) zu 1. Messdatensatz					
St_dgengrenznz_md2	O/V/S	0... FFH	0... 31.875	0.125	A
Mittelwert der Erregerstrombegrenzung über applizierbare Zeit Z (z.B. 2min) zu 2. Messdatensatz					
St_dgenub1	O/V/S	0... FFFFH	0... 6173.397	0.0942	V
Mittelwert der Batteriespannung über applizierbare Zeit X (z.B. 10min)					
St_dgenub1_md1	O/V/S	0... FFFFH	0... 6173.397	0.0942	V
Mittelwert der Batteriespannung über applizierbare Zeit X (z.B. 10min) zu 1. Messdatensatz					
St_dgenub1_md2	O/V/S	0... FFFFH	0... 6173.397	0.0942	V
Mittelwert der Batteriespannung über applizierbare Zeit X (z.B. 10min) zu 2. Messdatensatz					
St_dgenub2	O/V/S	0... FFFFH	0... 6173.397	0.0942	V
Mittelwert der Batteriespannung über applizierbare Zeit X (z.B. 30min)					
St_dgenub2_md1	O/V/S	0... FFFFH	0... 6173.397	0.0942	V
Mittelwert der Batteriespannung über applizierbare Zeit X (z.B. 30min) zu 1. Messdatensatz					
St_dgenub2_md2	O/V/S	0... FFFFH	0... 6173.397	0.0942	V
Mittelwert der Batteriespannung über applizierbare Zeit X (z.B. 30min) zu 2. Messdatensatz					
St_dgenuberr	O/V/S	0... FFH	0... 255	1	-
Fehlerstati zur Batteriespannung					
St_dgenuberr_md1	O/V/S	0... FFH	0... 255	1	-
Fehlerstati zur Batteriespannung zu 1. Messdatensatz					
St_dgenuberr_md2	O/V/S	0... FFH	0... 255	1	-
Fehlerstati zur Batteriespannung zu 2. Messdatensatz					
St_dgenubnz	O/V/S	0... FFFFH	0... 6173.397	0.0942	V
Statuswort Messung Spannung Ub					
St_dgenubnz_md1	O/V/S	0... FFFFH	0... 6173.397	0.0942	V
Mittelwert der Batteriespannung über applizierbare Zeit Z (z.B. 2min) zu 1. Messdatensatz					
St_dgenubnz_md2	O/V/S	0... FFFFH	0... 6173.397	0.0942	V
Mittelwert der Batteriespannung über applizierbare Zeit Z (z.B. 2min) zu 2. Messdatensatz					
St_dgenugen1	O/V/S	0... FFFFH	0... 6553.5	0.1	V
Mittelwert der Generatorsollspannung über applizierbare Zeit X (z.B. 10min)					
St_dgenugen1_md1	O/V/S	0... FFFFH	0... 6553.5	0.1	V
Mittelwert der Generatorsollspannung über applizierbare Zeit X (z.B. 10min) zu 1. Messdatensatz					
St_dgenugen1_md2	O/V/S	0... FFFFH	0... 6553.5	0.1	V
Mittelwert der Generatorsollspannung über applizierbare Zeit X (z.B. 10min) zu 2. Messdatensatz					
St_dgenugen2	O/V/S	0... FFFFH	0... 6553.5	0.1	V
Mittelwert der Generatorsollspannung über applizierbare Zeit Y (z.B. 30min)					
St_dgenugen2_md1	O/V/S	0... FFFFH	0... 6553.5	0.1	V
Mittelwert der Generatorsollspannung über applizierbare Zeit X (z.B. 30min) zu 1. Messdatensatz					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_dgenugen2_md2	O/V/S	0... FFH	0... 25.5	0.1	V
Mittelwert der Generatorsollspannung über applizierbare Zeit X (z.B. 30min) zu 2. Messdatensatz					
St_dgenugenerr	O/V/S	0... FFH	0... 255	1	-
Fehlerstati zur Generatorsollspannung					
St_dgenugenerr_md1	O/V/S	0... FFH	0... 255	1	-
Fehlerstati zur Generatorsollspannung zu 1. Messdatensatz					
St_dgenugenerr_md2	O/V/S	0... FFH	0... 255	1	-
Fehlerstati zur Generatorsollspannung zu 2. Messdatensatz					
St_dgenugennz	O/V/S	0... FFFFH	0... 6553.5	0.1	V
Statuswort Messung Spannung Ugen					
St_dgenugennz_md1	O/V/S	0... FFFFH	0... 6553.5	0.1	V
Mittelwert der Generatorsollspannung über applizierbare Zeit Z (z.B. 2min) zu 1. Messdatensatz					
St_dgenugennz_md2	O/V/S	0... FFFFH	0... 6553.5	0.1	V
Mittelwert der Generatorsollspannung über applizierbare Zeit Z (z.B. 2min) zu 2. Messdatensatz					
St_dibs0	O/V/S	0... FFH	0... 255	1	-
Bitbasis dibs					
St_disa_bmw	O/V	0... FFH	0... 255	1	-
Status Disa					
St_dps	O/V	0... FFH	0... 255	1	-
Statuswort					
St_dsc_mradist	O/V	0... FFH	0... 255	1	-
Status Ist-Radmoment					
St_ecostat2	O/V/S	0... FFH	0... 255	1	-
Ecos Statusbyte 2					
St_eisy_hfm	O/V	0... FFH	0... 255	1	-
Status Eisy adaption					
St_eisyad_read	O/V/S	0... FFH	0... 255	1	-
Status Eisy adaption					
St_eisydiag1	O/V	0... FFH	0... 255	1	-
Diagnose Mslam					
St_eisydiag2	O/V	0... FFH	0... 255	1	-
Diagnose Mslam					
St_entlast_loc	O/V	0... FFH	0... 255	1	-
Status ENTLAST_LOC					
St_es_urstart	O/V	0... FFH	0... 255	1	-
Status Urstart					
St_fas_mradist	O/V	0... FFH	0... 255	1	-
Status Radmoment Ist					
St_fw	O/V	0... FFH	0... 255	1	-
Statuswort mdfw					
St_gen	O/V	0... FFH	0... 255	1	-
Status Generator					
St_gentest	O/V	0... FFH	0... 255	1	-
Status Generatorstest					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_gl_adapt	O/V	0... FFH	0... 255	1	-
Statusbyte adaption KH					
St_hhs	O/V	0... FFH	0... 255	1	-
carrierbyte HHS					
St_igroutnv	O/V/S	0... FFH	0... 255	1	-
Statusbyte St_igrout					
St_imdgen0	O/V	0... FFH	0... 255	1	-
Statuswort Imdgen					
St_injad_quit	O/V	0... FFH	0... 255	1	-
Quittung Adaptionanforderung d. Kleinstmengen					
St_kath_ena	O/V	0... FFH	0... 255	1	-
Statuswort erlaubte Katheizmassnahmen					
St_klann_ad1	O/V	0... FFH	0... 255	1	-
Statusbyte fuer klann_ad1					
St_klann_ad2	O/V	0... FFH	0... 255	1	-
Statusbyte fuer klann_ad2					
St_ldm_kupp	O/V	0... FFH	0... 255	1	-
Status_Kraftschluss					
St_ldstgen	O/V	0... FFH	0... 255	1	-
Lastzustand Generator					
St_llranh0	O/V	0... FFH	0... 255	1	-
Statusbyte Leerlaufdrehzahlanhebung					
St_mdar0	O/V	0... FFH	0... 255	1	-
Statuswort mdar 0					
St_mdar1	O/V	0... FFH	0... 255	1	-
Statuswort mdar 1					
St_mdar2	O/V	0... FFH	0... 255	1	-
Statuswort mdar2					
St_mdbafak	O/V	0... FFH	0... 255	1	-
Status MDBAFAK					
St_mdbafak2	O/V	0... FFH	0... 255	1	-
Status MDBAFAK					
St_mdbanl_pwgll	O/V	0... FFH	0... 255	1	-
Statuswort für Bits					
St_mdbanl2	O/V	0... FFH	0... 255	1	-
Statusbyte Notlaufmanager					
St_mdinfo_ges	O/V	0... FFH	0... 255	1	-
Status Momenteneingriffe					
St_mdk	O/V	0... FFH	0... 255	1	-
Status Momentenstruktur					
St_mdrk2	O/V	0... FFH	0... 255	1	-
Statusbyte					
St_mdrv_anz	O/V	0... FFH	0... 255	1	-
Über dieses Signal wird die MDrive- Anzeige im Kombi gesteuert.					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_mdrv_dsc	O/V	0... FFH	0... 255	1	-
Das Signal gibt an, welcher Modus für das System DSC im M-Drive voreingestellt ist.					
St_mdrv_eng	O/V	0... FFH	0... 255	1	-
Das Signal gibt an, welcher Modus für die Motorsteuerung im M-Drive voreingestellt ist.					
St_mdrv_mod_grb	O/V	0... FFH	0... 255	1	-
Das Signal gibt an, welcher Modus für das Getriebe im MDrive voreingestellt ist.					
St_mdrv_stg_grb	O/V	0... FFH	0... 255	1	-
Das Signal gibt an, welche Drive- Logic-Stufe für das Getriebe im M-Drive voreingestellt ist.					
St_mini	O/V	0... FFH	0... 255	1	-
Statuswort für Bits					
St_msaa	O/V	0... FFH	0... 255	1	-
Statusbyte msaa					
St_msanz	O/V	0... FFFFH	0... 65535	1	-
Statusword msanz					
St_msabs	O/V	0... FFH	0... 255	1	-
Statusbyte MSA-Betriebstrategie					
St_msdsms	O/V	0... FFH	0... 255	1	-
Statuswort mdssm					
St_ngang	O/V/S	0... FFH	0... 255	1	-
Status Nullgangerkennung					
St_ngang0	O/V	0... FFH	0... 255	1	-
Status Nullgangerkennung					
St_nmax_ba	O/V	0... FFH	0... 255	1	-
Statuswort für CC Meldung Drehzahlbegrenzung aus MDBA					
St_oz_o	O/V	0... FFH	0... 255	1	-
Statusbyte für Ausgänge OZ					
St_ozbg0	O/V	0... FFH	0... 255	1	-
Statuswort OZBG					
St_pmdiag0	O/V	0... FFH	0... 255	1	-
Statuswort PMDIAG					
St_pmdiag1	O/V	0... FFH	0... 255	1	-
Statuswort PMDIAG					
St_pmprsvcalc1	O/V	0... FFH	0... 255	1	-
Statuswort PMPRSVCALC					
St_poelreg2	O/V	0... FFH	0... 255	1	-
Status Öldruckregelung 2					
St_pr	O/V	0... FFH	0... 255	1	-
Status Raildruck					
St_prailpulsor	O/V	0... FFH	0... 255	1	-
Container für Bits					
St_prestoppmsa	O/V	0... FFH	0... 255	1	-
Statuswort f. MSA-Prestopp					
St_qvc1	O/V	0... FFH	0... 255	1	-
Status QVC					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_rail	O/V	0... FFH	0... 255	1	-
Statuswort Raildruckregler					
St_rf1	O/V	0... FFH	0... 255	1	-
Statusbyte					
St_rk_kva	O/V	0... FFH	0... 255	1	-
Container für Bits					
St_sa	O/V	0... FFH	0... 255	1	-
Statuswort Schubabschaltung					
St_sa_atmph	O/V	0... FFH	0... 255	1	-
Statusbyte Ausgang Schubabschaltung von ATMPH					
St_sleep	O/V	0... FFH	0... 255	1	-
Statusbyte Sleep					
St_sondenheiz	O/V	0... FFH	0... 255	1	-
Statusbyte St_sondenheiz					
St_statmkor1	O/V	0... FFH	0... 255	1	-
Statuswort					
St_testpoelsys	O/V	0... FFH	0... 255	1	-
Statuswort für Überprüfung Ölsystem im Testerbetrieb					
St_testpoelsys2	O/V	0... FFH	0... 255	1	-
Zusätzliche Info zu Überprüfung Öldrucksystem im Testerbetrieb					
St_ti_b	O/V	0... FFH	0... 255	1	-
Status "Begrenzung der Einspritzzeit"					
St_tiausgang	O/V	0... FFH	0... 255	1	-
Status Einspritzung					
St_ubw	O/V/S	0... FFH	0... 255	1	-
carrierbyte "Spannungswaechter"					
St_ugenkor0	O/V	0... FFH	0... 255	1	-
Status Ugenkor					
St_vbrzyl_aus	O/V	0... FFFFH	0... 65535	1	-
Status Zylindergleichstellung					
St_vsa	O/V	0... FFH	0... 255	1	-
Status Anschlagadaption Auslass					
St_vse	O/V	0... FFH	0... 255	1	-
Status Anschlagadaption Einlass					
St_wesb_s	O/V	0... FFH	0... 255	1	-
Status Einspritzwinkel 3. Einspritzung Schicht Wesb/Wese					
St_wese	O/V	0... FFH	0... 255	1	-
Status Einspritzwinkel					
St_wm1	O/V	0... FFH	0... 255	1	-
Statusbyte fuer Ausgang WM-Koordinator					
St_zwbts1	O/V	0... FFH	0... 255	1	-
Status Bauteilschutzfunktion					
St_zwgrund	O/V	0... FFH	0... 255	1	-
Statuswort ZWGRUND					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Stat_fofumx_anf	O/V	0... FFFFH	0... 65535	1	-
Anforderung maximale Folgefunkten (Zylinderselektiv)					
Stat_lvs	O/V	0... FFH	0... 255	1	-
Stufe Laufruheverbesserung in Schicht					
Stat_sv_reg1	O/V	0... FFH	0... 255	1	-
Status Standverbraucher registriert Teil 1					
Stat_sv_reg2	O/V	0... FFH	0... 255	1	-
Status Standverbraucher registriert Teil 2					
Stat_zyl_aus	O/V	0... FFH	0... 255	1	-
Zylinderausblendenanforderung					
Stmsa	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Status MSA und Funktionsabschalter					
Stmsaaa	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Status MSA Abschaltaufforderer					
Stmsaav	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Status MSA aktiv und bereit und Abschaltverhinderer					
Stmsaea	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Status MSA Einschaltaufforderer					
Stmsaev	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Status MSA Einschaltverhinderer					
Stpcos	O/V	0... FFH	0... 255	1	-
Status Standverbraucher					
T_batt	O/V	FE0C... 5DCH	-50 ...150	0.1	°C
battery temperature					
T_ikat1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Abgastemperatur im Kat, Bank1					
T_ikat1_stat	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
stationäre Abgastemperatur im Kat, Bank1					
T_ikat2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Abgastemperatur im Kat, Bank2					
T_ikat2_stat	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
stationäre Abgastemperatur im Kat, Bank2					
T_prail_mon_xb_y pb [SY_PRAIL_MON_ANZ_SCHWELLEN][SY_ANZ_PRAILSENS]	O/V/S	0... FFFFFFFFH	0... 42949672.95	0.01	s
Raildruckmonitor: aufintegrierte Zeit des Raildrucks Prail_ist_xpb von Rail ix zwischen Schwellen iy					
T2histshort	O/V	0... FFH	0... 3808	14.933333	min
Zeit, indem der Ruhestrom bei 80..200mA liegt					
T3histshort	O/V	0... FFH	0... 3808	14.933333	min
Zeit, indem der Ruhestrom bei 200..1000mA liegt					
T4histshort	O/V	0... FFH	0... 3808	14.933333	min
Zeit, indem der Ruhestrom größer als 1000mA liegt					
Tabg_asens	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Modellierte Abgastemperatur am Temperatursensor (Rohr 15)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Tabg_demax1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Max. Temperatur für Desulfatisierung Bank1					
Tabg_demax2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Max. Temperatur für Desulfatisierung Bank2					
Tabg_demaxav	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Gemittelte max. Temperatur für Desulfatisierung					
Tabg_desul	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
max. Temperatur im Unterbodenkat für Desulfatisierung					
Tabg_ikat_av	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Abgastemp. im Kat gemittelt					
Tabg_inok1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Temperatur im Noxkat 1.Mono Bank1					
Tabg_inok2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Temperatur im Noxkat 1.Mono Bank2					
Tabg_nk_av	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Gemittelte Temperatur nach Kat					
Tabg_nk1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Abgastemp. nach Kat Bank 1					
Tabg_nk2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Abgastemp. nach Kat Bank 2					
Tabg_nnok1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Temperatur im Noxkat 2.Mono Bank1					
Tabg_nnok2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Temperatur im Noxkat 2.Mono Bank2					
Tabg_nok_av	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Mittelwert der Temperaturen im Monolith Unterbodenkat					
Tabg_nok_av1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Mittelwert der Temperaturen im Monolith Unterbodenkat Bank1					
Tabg_nok_av2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Mittelwert der Temperaturen im Monolith Unterbodenkat Bank2					
Tabg_nokmax	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Maximum der Temperaturen im Monolith Unterbodenkat					
Tabg_nokmax1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Maximum der Temperaturen im Monolith Unterbodenkat Bank1					
Tabg_nokmax2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Maximum der Temperaturen im Monolith Unterbodenkat bank 2					
Tabg_nokmin	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Minimum der Temperaturen im Monolith Unterbodenkat					
Tabg_r10	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Abgastemperatur nach Rohr 10, nach Kat, Bank2					
Tabg_r9	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Abgastemperatur nach Rohr 9, nach Kat, Bank1					
Tabg_vk_av	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Gemittelte Temperatur vor Kat					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Tabg_vk1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Abgastemperatur vor Kat, Bank1					
Tabg_vk2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Abgastemperatur vor Kat, Bank2					
Td_wese [NC_CYL_NR][2]	O/V	0... FFFFH	0... 262.14	0.004	ms
Zeitabstände Einspritzung Schicht (Zylinder, 1-2)					
Td_wese23min_hs [NC_CYL_NR]	O/V	0... FFFFH	0... 262.14	0.004	ms
minimaler Zeitabstand Einspritzung zw. 2 und 3 in Homogen-Schicht					
Tvt_md1	O	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Temperatur am Einlassventil modelliert					
Tgen	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Generatortemperatur					
Tget_b1	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Temperatur < 80°C					
Tget_b2	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
80°C =< Temperatur =< 109°C					
Tget_b3	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
110°C =< Temperatur =< 124°C					
Tget_b4	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
125°C =< Temperatur =< 129°C					
Tget_b5	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Temperatur > 129°C					
Tlrgen	O/V	0... FFH	0... 25.5	0.1	s
physical input for load response time					
Tmot_b1	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Temperatur < 98°C					
Tmot_b2	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
98°C =< Temperatur =< 112°C					
Tmot_b3	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
113°C =< Temperatur =< 120°C					
Tmot_b4	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
121°C =< Temperatur =< 125°C					
Tmot_b5	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Temperatur > 125°C					
Toel	O/V	FE0C... 5DCH	-50 ...150	0.1	°C
Öltemperaturausgabe					
Toel_b1	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Temperatur < 80°C					
Toel_b2	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
80°C =< Temperatur =< 110°C					
Toel_b3	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
110°C =< Temperatur =< 135°C					
Toel_b4	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
135°C =< Temperatur =< 150°C					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Toel_b5	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Temperatur > 150°C					
Toel_oz	O/V	FE0C... 5DCH	-50 ...150	0.1	°C
Öltemperatursausgabe					
Tumg_abst	O/V	FE0C... 5DCH	-50 ...150	0.1	°C
Abstell-Aussentemperatur					
Tumg_b1	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Temperatur < 3°C					
Tumg_b2	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
3°C =< Temperatur =< 19°C					
Tumg_b3	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
20°C =< Temperatur =< 29°C					
Tumg_b4	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
30°C =< Temperatur =< 39°C					
Tumg_b5	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Temperatur > 39°C					
Tumg_battab	O/V	FE0C... 5DCH	-50 ...150	0.1	°C
Abstell-Umgebungstemperatur Batterie					
Tv_kft	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Ausgegebenes TV für KFT					
Tv_poel	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
Tastverhältnis Öldruck-Regelventil					
Tvneutral	O/V/S	0... FFFFH	0... 655.35	0.01	%
Tastverhältnis Nullgangsensor					
Tvulv	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Tastverhältnis Umluftventil					
Tvwg	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Wastegate 1 PWM Ausgang					
Tvwg2	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Wastegate 2 PWM Ausgang					
Tw_m1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Rohrwandtemperatur vor Kat, Bank 1					
Tw_m2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Rohrwandtemperatur vor Kat, Bank 2					
Tw_nk1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Rohrwandtemperatur nach Kat, Bank 1					
Tw_nk2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Rohrwandtemperatur nach Kat, Bank 2					
Tw_noxsens	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Rohrwandtemperatur am Noxsensor					
U_batt	O/V	0... FFFFH	6... 22.38375	0.00025	V
Batteriespannung von IBS gemessen					
U_gen	O/V	0... FFFFH	0... 6553.5	0.1	V
generator voltage					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
U_gentest	O/V	0... FFFFH	0... 6553.5	0.1	V
Sollspannung für Tester für Generatorstest					
Ubt	O/V	0... FFFFH	0... 61.425	0.015	V
voltage battery					
ulev	O	0... FFH	0... 255	1	-
Spannungsebene ( internal used )					
Ulev	O	0... FFH	0... 255	1	-
Spannungsebene ( internal used )					
Vsa_spri	O/V	0... FFFFH	0... 6553.5	0.1	°CRK
spread angle outlet camshaft					
Vsa_sprn	O/V	0... FFFFH	0... 6553.5	0.1	°CRK
spread angle outlet camshaft at reference conditions (warm engine)					
Vsadw_md6_mx	O/V	0... FFFFH	0... 655.35	0.01	°CRK
Testlimit Regelabweichung Vanos Auslass für Mode\$06					
Vsadw_md6_tst	O/V/S	0... FFFFH	0... 655.35	0.01	°CRK
Testergebnis Regelabweichung Vanos Auslass für Mode\$06					
Vse_spri	O/V	0... FFFFH	0... 6553.5	0.1	°CRK
spread angle inlet camshaft					
Vse_sprn	O/V	0... FFFFH	0... 6553.5	0.1	°CRK
spread angle intlet camshaft at reference conditions (warm engine)					
Vsedw_md6_mx	O/V	0... FFFFH	0... 655.35	0.01	°CRK
Testlimit Regelabweichung Vanos Einlass für Mode\$06					
Vsedw_md6_tst	O/V/S	0... FFFFH	0... 655.35	0.01	°CRK
Testergebnis Regelabweichung Vanos Einlass für Mode\$06					
Wdk_diag	O/V	0... 1000H	0... 100	0.0244141	%
Berechneter Winkel der Drosselklappe aus Hauptfüllungssignal					
Wdk_soll	O/V	0... 1000H	0... 100	0.0244141	%
setpoint throttle opening					
Wes_soll_h [NC_CYL_NR][NC_PLS_NR]	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Soll Einspritzwinkel homogen					
Wesb_s [NC_CYL_NR]	O/V	E200... 5A00H	-180 ...540	0.0234375	°CRK
Winkel Einspritzbeginn Haupteinspritzung schicht zylinderindividuell					
Wesb1_h [NC_CYL_NR]	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Einspritzbeginn 1. Einspritzung Homogen					
Wesb1_hs [NC_CYL_NR]	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Einspritzbeginn 1. Einspritzung Homogen-stratified					
Wesb2max_h	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Frühest möglicher Einspritzbeginnwinkel 2. Einspritzung Homogen					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Wesb3max	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Frühest möglicher Einspritzbeginnwinkel 3. Einspritzung Homogen					
Wesb4_s [NC_CYL_NR]	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Einspritzbeginn 3. Einspritzung Schicht					
Wesbkh_s [NC_CYL_NR]	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Einspritzbeginn Katheizeinspritzung Schicht					
Wese_s [NC_CYL_NR]	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Winkel Einspritzende Haupteinspritzung Schicht zylinderindividuell					
Wese2_h [NC_CYL_NR]	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Einspritzendewinkel 2. Einspritzung Homogen absolut zum ZOT					
Wese2_hs [NC_CYL_NR]	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Einspritzende 2. Einspritzung Homogen-stratified					
Wese3_h [NC_CYL_NR]	O/V	E200... 5A00H	-180 ...540	0.0234375	°CRK
Einspritzendewinkel 3. Einspritzung Homogen absolut zum ZOT					
Wese3_hs [NC_CYL_NR]	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Einspritzendewinkel 3. Einspritzung Homogen-Schicht					
Zbibs	O/V/S	0... FFFFFFFFH	0... 4294967295	1	-
Zusbaunummer					
Zr_lvs_0	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufe 0 LVS					
Zr_lvs_1	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufe 1 LVS					
Zr_lvs_2	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufe 2 LVS					
Zr_lvs_3	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufe 3 LVS					
Zr_lvs_ll_reakt	O/V/S	0... FFH	0... 255	1	-
Anzahl der schnellen LVS Reaktionen im Leerlauf					
Zr_lvssekt_0	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung in Sektor 0					
Zr_lvssekt_1	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung in Sektor 1					
Zr_lvssekt_2	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung in Sektor 2					
Zr_lvssekt_3	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung in Sektor 3					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Zr_lvssekt_4	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung in Sektor 4					
Zr_lvssekt_5	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung in Sektor 5					
Zr_lvssekt_6	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung in Sektor 6					
Zr_lvssekt_7	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung in Sektor 7					
Zr_lvssekt_8	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung in Sektor 8					
Zr_lvszyl_0	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung durch Zylinder 0					
Zr_lvszyl_1	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung durch Zylinder 1					
Zr_lvszyl_2	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung durch Zylinder 2					
Zr_lvszyl_3	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung durch Zylinder 3					
Zr_lvszyl_4	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung durch Zylinder 4					
Zr_lvszyl_5	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung durch Zylinder 5					
Zrbosmld	O/V/S	0... FFH	0... 255	1	-
Servicezähler für BOS-Meldung					
Zw_grund1	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Grundzündwinkel ohne Kr mit Kr- und ROZ-Adaption Bank 1					
Zw_grund2	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Grundzündwinkel ohne Kr mit Kr- und ROZ-Adaption Bank 2					
Zw_offkorrvr [NC_CYL_NR]	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Zündwinkelkorrektur durch Verbrennungsregelung					
Zw_opt1	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Optimaler Zündwinkel mit Tmot- und Lambdaeinfluss Bank 1					
Zw_opt2	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Optimaler Zündwinkel mit Tmot- und Lambdaeinfluss Bank 2					
Zw_soll_hs [NC_CYL_NR]	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°CRK
Zündwinkel der über die TPU ausgegeben wird. Dieser Zündwinkel ist für den Homogen- Schichtbetrieb gültig.					
Zw_soll_s [NC_CYL_NR]	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°CRK
Zündwinkel der über die TPU ausgegeben wird. Dieser Zündwinkel ist für den Homogen- und den Schichtbetrieb gültig.					

### General information:

Data description of BMW outputs. For more detailed information on datatypes and short description please refer to the BMW layer specification.


### Application conditions

#### Initialisation:

```

0
  except :
I_ha:           63
Bosconf :           from nonvolatile memory


```

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Eisyagr_korfak_b: 1
F_atlad: from nonvolatile memory
T_prail_mon_xb_y pb[i][j]: From NVMY
Vsdw_md6_tst, Vsedw_md6_tst: From NVMY
F_ffboost : 1
F_szboost : 1
La_bs1/ 2 : 2
Oz_kvbsm_ul : from nonvolatile memory
Ps : Pu
St_ldstgen : 2
Tumg_abst : from nonvolatile memory
Tumg_battab : from nonvolatile memory
Eta_labas, Eta_labas_sol: 100%
Eta_lambda_1, Eta_lambda_2: 100 %
Nmax_ba: 9000 rpm
Absch_korr: from nonvolatile memory
Bosfxid2: from nonvolatile memory
Bosid2: from nonvolatile memory
D_soc: from nonvolatile memory
Eta_md_uesp: 100%
Eta_mdkh: 100%
F_bsm dres: 1.0
Ibsderrsl: from nonvolatile memory
Ibsderrsl2: from nonvolatile memory
Ibspreco2: from nonvolatile memory
Ktupcsctr: from nonvolatile memory
La_sollreg[NC_CBK_EX_NR]: 1.0
Msa_arravrs[60] from nonvolatile memory
Msa_indexrs from nonvolatile memory
Msastz from nonvolatile memory
Msastzmsa from nonvolatile memory
Nmax_ba: 9000
Oz_nivlangt: from nonvolatile memory
Oz_oelkm: from nonvolatile memory
St_dibs0 from nonvolatile memory
Bosjziel from nonvolatile memory
Bosmziel from nonvolatile memory
Bosprog2 from nonvolatile memory
Bosres from nonvolatile memory
Bosrw2 from nonvolatile memory
Tabg_r10 first valid value
Tabg_r9 first valid value
Tabg_vk1 first valid value
Tabg_vk2 first valid value
Tw_m1 first valid value
Tw_m2 first valid value
Stat_sv_reg1 first valid value
Stat_sv_reg2 first valid value
Tabg_demax1 first calculated value
Tabg_demax2 first calculated value
Tabg_demaxav first calculated value
Tabg_ikat_av first calculated value
Tabg_nk1 first calculated value
Tabg_nk2 first calculated value
Tabg_nk_av first calculated value
Tabg_vk_av first calculated value
Bosbtvfbk: from nonvolatile memory

```

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Bosrlsm:                from nonvolatile memory
Oz_kvbog:                from nonvolatile memory
Pminfo1[37]:            from nonvolatile memory
Pminfo2[29]:            from nonvolatile memory
Zrbosmld:                from nonvolatile memory
St_bns                   from nonvolatile memory
St_ubw                   from nonvolatile memory
St_deavns2               last calculated value
St_sleep                 1
Tw_nk1                   first calculated value
Tw_nk2                   first calculated value
Oz_permbog               from non volatile memory
Oz_permex                from non volatile memory
Oz_permlow               from non volatile memory
Oz_lflt:                 from non volatile memory
Oz_lf2t:                 from non volatile memory
Igrinfo[30]:            from non volatile memory
Leminfo[40]:            from non volatile memory
Msainfo[50]:            from non volatile memory
St_igroutnv:            from non volatile memory
Pspvdk_soll:            1.00
Psreg_i:                 1.00
Prnn_test:              last calculated value
Prnn_test_agr:          last calculated value
Poel_fpwm:              244 Hz
Tabg_desul, Tabg_inok1, Tabg_inok2, Tabg_nnok1, Tabg_nnok2,
Tabg_nok_av, Tabg_nok_av1, Tabg_nok_av2, Tabg_nokmax, Tabg_
nokmax1, Tabg_nokmax2, Tabg_nokmin, Q_abgnox, Tw_noxsens:
first calculated value
Read from NVRAM:
  Bszi, Dfds[16], Igenk, Genitest_tol, Genitest_bol, Qv_h2o,
Qv_h2oquali, Qv_h2ostatus, St_ecostat2, St_spa2, Zr_lvs_ll_
reakt
Initialisation by BMW:
  Bosstate, Id_bosmg, Id_bosmsg, Oz_lp, Oz_lv, Ba_ist, Krn_
test, U_gen, Wdk_diag, Zbibs, Zw_grund1, Zw_grund2, Zw_opt1,
Zw_opt2, Mrnn_test_dk, Qv_nv_ezm, Qv_nv_ezm, Qv_nv_start,
Qv_nv_zh, Qv_out_1, Qv_out_2, Qv_out_3, Qv_out_4, Qv_out_5,
Qv_out_m, Qv_quali_1, Qv_quali_2, Qv_quali_3, Qv_quali_4, Qv_
quali_5, Qv_quali_m, Qv_status, Qv_tdl, Qv_tdl2, Qv_tdl3, Qv_
td4, Qv_tdl5, Qvc_status_1, Qvc_status_2, Qvc_status_3, Qvc_
status_4, Msnlgofs_tmp, Tvneutral, St_dgen.., Mdi_max, St_
ngang,
Calculated in PWL:
  Last valid value:      Dfds[16] (once), Lurabs_f/ Lurdif_
f, Rt_bastatg_sa


```

**Recurrence:**

```

10 ms
except :
segment :      Zw_md[NC_CYL_NR] , Ps, Ps_ist, Pspvdk, Rf,
Mk_soll_s, Mkzyl_soll_s[NC_CYL_NR] [NC_NR_INJ_PULSES+1], Msagr,
Msdk, Msdk_f, Mszyl, Mszyl_ges, Lurdif_f/ Lurabs_f, Wesbl_
h, Wesbl_hs, Wese2_hs, Wese_s, Wese2_h[NC_CYL_NR], Mkzyl_
soll_hs[NC_CYL_NR] [NC_NR_INJ_PULSES], Mk_soll_h[NC_CYL_NR]
[NC_NR_INJ_PULSES], F_rkkorwl_hs, F_rkkorwl_s, Msnlgofs_tmp,
Wese3_h[NC_CYL_NR], Amo_05, Amo_10, Amo_15, Amo_20, Amo_30,
Amo_40, Dla_soll_puls[NC_CBK_EX_NR], Td_wese[NC_CYL_NR] [2],

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Td\_wese23min\_hs[NC\_CYL\_NR], Wesb2max\_h, Wesb3max\_h Wesb4\_s[NC\_CYL\_NR], Wese3\_hs[NC\_CYL\_NR], Injekt\_hub\_h, Injekt\_hub\_hs, Injekt\_hub\_s, Stat\_fofumx\_anf, Stat\_lvs, Stat\_zyl\_aus, Wesbkh\_s[NC\_CYL\_NR], B\_aekh\_akt, St\_aekh, St\_aekh\_ae, St\_injad\_quit, St\_wesb\_s, Wesb\_s[NC\_CYL\_NR], Zw\_offkorrivr[NC\_CYL\_NR], Rk\_kor\_kva, St\_praillpulskor, St\_rk\_kva,

F\_tikorzsk[NC\_CYL\_NR], Espr\_mod\_soll[NC\_CYL\_NR], Wes\_soll\_h[NC\_CYL\_NR][NC\_PLS\_NR], Zr\_lvs\_ll\_reakt,

St\_es\_urstart


**5 ms** : Exwink\_soll, Tv\_vvtlr

**20 ms**: Wdk\_diag, F\_lradap1, F\_lradap2

**100 ms** : Nsl\_koor , I\_craweng , I\_gen , St\_dgen0 , St\_gen , St\_ldstgen, Tv\_kft, Ba\_subso11, Ba\_subist, Ibsderrsl, Ibsderrsl, Ibspreco2, Ktupcsc2tr, Ptc\_pwr, St\_dibs0, U\_batt, I\_batt, Pm\_klemmstat, Stat\_sv\_reg1, Stat\_sv\_reg2, T2histshort, T3histshort, T4histshort, St\_pmdiag0, St\_pmdiag1, Rt\_bastatg\_sa, Krn\_test, U\_gen, Mrnn\_test\_dk, Igrinfo[30], Leminfo[40], Msainfo[50], Prnn\_test, Prnn\_test\_agr, St\_entlast\_loc, St\_igroutnv, St\_eisydiag1, St\_eisydiag2, St\_imdgen0, F\_atlad, St\_hhs, Klann\_test1, Klann\_test2, I\_gentest, U\_gentest, St\_gentest, Eco\_jobstat1, Eco\_result1, St\_ecostat2, Pmbackup[7], St\_nmax\_ba, St\_vbrzyl\_aus, St\_atlsv, St\_atlsv\_pvd, St\_atlsv\_start, Zr\_lvs\_0, Zr\_lvs\_1, Zr\_lvs\_2, Zr\_lvs\_3, Zr\_lvssekt\_0, , Zr\_lvssekt\_1, Zr\_lvssekt\_2 , Zr\_lvssekt\_3, Zr\_lvssekt\_4, Zr\_lvssekt\_5, Zr\_lvssekt\_6, Zr\_lvssekt\_7, Zr\_lvssekt\_8, Zr\_lvszyl\_0, Zr\_lvszyl\_2 Zr\_lvszyl\_3, Zr\_lvszyl\_4, Zr\_lvszyl\_5, St\_sondenheiz, Atlsv\_dpvd1, Atlsv\_dpvd2, Atlsv\_dpvd3, St\_atldiag2\_out, Klann\_mw1, Klann\_mw2, St\_mdbanl\_pwg11, Mrnn\_test\_pr, Vsadw\_md6\_mx, Vsadw\_md6\_tst, Vsedw\_md6\_mx, Vsedw\_md6\_tst

**200 ms** : Newp\_soll , St\_egs1, Md\_max\_klima, ba\_wm\_ist, Tabg\_r10, Tabg\_r9, Tabg\_vk1, Tabg\_vk2, Tw\_m1, Tw\_m2, Tabg\_demax1, Tabg\_demax2, Tabg\_demaxav, Tabg\_ikat\_av, Tabg\_nk1, Tabg\_nk2, Tabg\_nk\_av, Tabg\_vk\_av, St\_wm1, Tw\_nk1, Tw\_nk2, Tabg\_desul, Tabg\_inok1, Tabg\_inok2, Tabg\_nnok1, Tabg\_nnok2, Tabg\_nok\_av, Tabg\_nok\_av1, Tabg\_nok\_av2, Tabg\_nokmax, Tabg\_nokmax1, Tabg\_nokmax2, Tabg\_nokmin, T\_ikat1\_stat, T\_ikat2\_stat, Tumg\_b1, Tumg\_b2, Tumg\_b3, Tumg\_b4, Tumg\_b5, Tget\_b1, Tget\_b2, Tget\_b3, Tget\_b4, Tget\_b5, Toel\_b1, Toel\_b2, Toel\_b3, Toel\_b4, Toel\_b5, Tmot\_b1, , Tmot\_b2, Tmot\_b3, Tmot\_b4, Tmot\_b5, T\_ikat1, T\_ikat2, F\_bsm\_dres, Q\_abgnox, Tw\_noxsens

**1000 ms** : Bosbtvfbk , Bosrlsm , Bosstate , Dfmonitor , Nslb , Id\_bosmg , Id\_bosmgt , Id\_bosmsg , Nelueft\_wm , Oz\_kvbog Oz\_kvbsm\_ul Oz\_lp , Oz\_lv , Oz\_oelzeit, Oz\_permbog, Oz\_permex, Oz\_permlow, Oz\_permoff, Oz\_rwkv, Oz\_rwperm, St\_ozbg0 , Toel , Toel\_oz , Tumg\_abst , Tumg\_battab , Zrbosmld , Absch\_korr, Bosfxid2, Bosid2, D\_soc, Oz\_nivakt, Oz\_nivkrzt, Oz\_nivlangt, Oz\_reset, Bosjziel, Bosmziel, Bosprog2, Bosres, Bosrw2, Oz\_permakt, Oz\_tempakt, Bszi, Igenk, Dzw\_anm, Ibhwersi, Ibswbase, Ibswchang, Snibs, Zbibs, Oz\_lfl1t, Oz\_lfl2t, Bosconf, Bostoken, Id\_bosrtak, St\_ubw, Oz\_krz2cnt, Oz\_krzcnt, Oz\_krzkor2k, Oz\_krzor, Oz\_lgmwcnt, Oz\_nivkor, Oz\_orient, Oz\_vormw, Oz\_vormwcn, Qv\_nv\_ezm, Qv\_nv\_start, Qv\_nv\_zh, Qv\_out\_1, Qv\_out\_2, Qv\_out\_3, Qv\_out\_4, Qv\_out\_5, Qv\_out\_m, Qv\_quali\_1, Qv\_quali\_2, Qv\_quali\_3, Qv\_quali\_4, Qv\_quali\_5, Qv\_quali\_m, Qv\_status, Qv\_td1, Qv\_td2, Qv\_td3, Qv\_td4, Qv\_td5, Qvc\_status\_1, Qvc\_status\_

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2, Qvc\_status\_3, Qvc\_status\_4, Oz\_oelkm, St\_dgen., Genitest\_tol, Geniutest\_ab, Geniutest\_err, Genutest\_tol, Qv\_h2o, Qv\_h2oquali, Qv\_h2ostatus, St\_qvc1

**background** : Rf\_vl, F\_wnwkh, F\_wnwkhk

**once per driving cycle** : Dfds[16]

**triggered by event** : St\_sleep

### Activation:

calculation activation is defined in BMW code with special values at power latch phase:

**0** : St\_mdinfo\_ges, St\_ldm\_kupp, F\_wnwkh, Md\_rad\_ist, Md\_rad\_max, Md\_rad\_min, St\_atlout, Dzw\_lam\_kor, Dzwot, I\_batt, Mdi\_ml\_sollvb, Mdi\_zw\_sollvb, Mdk\_wunsch\_filt, Tvwg, Tvwg2, St\_arl, St\_rail, St\_vsa, St\_vse, Tvulv, Mdk\_wunsch\_ipm, Mdk\_max, F\_wnwkh, I\_ges, Eta\_labas, Eta\_labas\_soll, Eta\_lambda\_1, Eta\_lambda\_2, Dzw\_anm, St\_entlast\_loc, St\_gl\_adapt, Bostoken, Id\_bosrtak, F\_zw\_hsplit, Mdi\_reib, Rk\_kor\_h, Dla\_soll\_puls[NC\_CBK\_EX\_NR], Md\_can\_dmee, St\_prestoppmsa, Espr\_mod\_soll[NC\_CYL\_NR],

Wes\_soll\_h[NC\_CYL\_NR][NC\_PLS\_NR], Md\_na\_ges\_f, St\_es\_urstart, Mrnn\_test\_pr

**1**: Eisyagr\_korfak\_b F\_rkkorwl\_hs, F\_rkkorwl\_s, La\_sollreg[NC\_CBK\_EX\_NR], F\_bsmdres

**63**: I\_ha


**100%**: Eta\_md\_uesp, Eta\_mdkh

9000: Nmax\_ba

**last calculated value:** Amo\_05, Amo\_10, Amo\_15, Amo\_20, Amo\_30, Amo\_40, St\_deavns2, Tw\_nk1, Tw\_nk2, Pssol, Mdi\_max\_l1, Krn\_test, Pspdvk\_soll, Mrnn\_test\_dk, Oz\_lf1t, Oz\_lf2t, St\_imdgen0, Rfv\_vns, Atlr, Atlvst, F\_atlad, Pldr\_soll, Klann\_test1, Klann\_test2, Oz\_krz2cnt, Oz\_krzcnt, Oz\_krzkor2k, Oz\_krzkor, Oz\_lgmwcnt, Oz\_nivkor, Oz\_oricnt, Oz\_vormw, Oz\_vormwcnt, Qv\_nv\_ezm, Qv\_nv\_ezm, Qv\_nv\_start, Qv\_nv\_zh, Qv\_out\_1, Qv\_out\_2, Qv\_out\_3, Qv\_out\_4, Qv\_out\_5, Qv\_out\_m, Qv\_quali\_1, Qv\_quali\_2, Qv\_quali\_3, Qv\_quali\_4, Qv\_quali\_5, Qv\_quali\_m, Qv\_status, Qv\_tdl, Qv\_td2, Qv\_td3, Qv\_td4, Qv\_td5, Qvc\_status\_1, Qvc\_status\_2, Qvc\_status\_3, Qvc\_status\_4, St\_ngang0, Stmsa, Stmsaaa, Stmsaav, Stmsaev, T\_ikat1\_stat, T\_ikat2\_stat, F\_lradap1, F\_lradap2, F\_sicher\_zw, Msnlgofs\_tmp, Stmsaaa, Stmsaea, Tvneutral, St\_blshub, Oz\_oelkm, St\_mdbafak2, St\_wese, St\_blstdisa2, Drf\_spuel, I\_gentest, U\_gentest, St\_dgen..., St\_gentest, St\_testpoelsys, St\_testpoelsys2, Eco\_jobstat1, Eco\_result1, Genitest\_tol, Genitest\_bol, Md\_reib\_sa, Qv\_h2o, Qv\_h2oquali, Qv\_h2ostatus, St\_ecostat2, St\_qvc1, St\_klann\_ad1, St\_klann\_ad2, Msa\_arravrs[60], Msa\_indexrs, Msastz, Msastzmsa, St\_msabs, St\_nmax\_ba, St\_vbrzyl\_aus, T\_ikat1, T\_ikat2, Dzw\_agr\_hs, Prnn\_test, Prnn\_test\_agr, Md\_res\_atlsv, St\_atlsv, St\_atlsv\_pvd, St\_atlsv\_start, St\_sondenheiz, Zw\_offkorrvr[NC\_CYL\_NR], Rk\_kor\_kva, St\_prailpulskor, St\_rk\_kva, St\_atldiag2\_out, F\_tikorzsk[NC\_CYL\_NR], Mdi\_max, Rk\_korres\_hs, Rk\_korres\_s, Klann\_mw1, Klann\_mw2, St\_mdbanl\_pwgll, St\_ngang, Md\_genm\_na, Zr\_lvs\_ll\_reakt, T\_prail\_mon\_xb\_ypb[i][j]

**last value** : St\_wm1, St\_ewp, St\_lklps1, Ba\_ist, Wdk\_diag, Bosconf, Bosmanip, St\_hhs, St\_msaa, St\_msaanz, St\_ubw, Stat\_zyl\_aus


**Last valid value:** Vsadw\_md6\_mx, Vsadw\_md6\_tst, Vsedw\_md6\_mx, Vsedw\_md6\_tst

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Non volatile Data handling

The following non volatile data must not be initialised but keep their value in case the ECU was newly flashed with a new software version ("flash resistant data")

T_prail_mon_xb_y pb[SY_PRAIL_MON_ANZ_SCHWELLEN][SY_ANZ_PRAILSENS]		

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## R.8 Customer adaptation module: CYBL

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_gl_ad	O/V	0... 1H	0 ...1	1	-
Lambdaadaption am Bandende hat fertig gelernt					
B_gl_adder	O/V	0... 1H	0 ...1	1	-
ER_Balancing am Bandende hat additiv adaptiert					
B_gl_adz	O/V	0... 1H	0 ...1	1	-
Lambdaadaption ist nötig, zyklisch während Motorbetrieb zu 1 gesetzt					
B_gl_adz_offset1	O/V	0... 1H	0 ...1	1	-
Zylinderselektive Adaption vom Lambda-Offset auf Bank1 ist erfolgt.					
B_gl_adz_offset2	O/V	0... 1H	0 ...1	1	-
Zylinderselektive Adaption vom Lambda-Offset auf Bank 2 ist erfolgt.					
B_gl_hz	O/V	0... 1H	0 ...1	1	-
Zylindersel. Lambdaeegelung fordert homogen an, zyklisch während dem Motorbetrieb zu 1 gesetzt					
B_gl_wg1	O/V	0... 1H	0 ...1	1	-
Zylindersel. Lambdaeegelung fordert öffne WG1 an, zyklisch während dem Motorbetrieb zu 1 gesetzt					
B_gl_wg2	O/V	0... 1H	0 ...1	1	-
Zylindersel. Lambdaeegelung fordert öffne WG2 an, zyklisch während dem Motorbetrieb zu 1 gesetzt					
B_gl_zsk	O/V	0... 1H	0 ...1	1	-
Zylindersel. Lambdaeegelung kalt am Bandende hat fertig adaptiert					
B_gl_zsw	O/V	0... 1H	0 ...1	1	-
Zylindersel. Lambdaeegelung warm am Bandende hat fertig adaptiert					
B_gl_zswz	O/V	0... 1H	0 ...1	1	-
Zylindersel. Lambdaeegelung warm ist nötig, zyklisch während Motorbetrieb zu 1 gesetzt					
B_injad_anf	O/V	0... 1H	0 ...1	1	-
Anforderung Kleinstmengenadaption					
B_lamzylact_1	O/V	0... 1H	0 ...1	1	-
Bedingung CILC aktiv (Bank 1)					
B_lamzylact_2	O/V	0... 1H	0 ...1	1	-
Bedingung CILC aktiv (Bank 2)					
B_lurzylact	O/V	0... 1H	0 ...1	1	-
Bedingung CYBL aktiv					
F_tizyl [NC_CYL_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	-
zylinderindividueller Einspritzfaktor					
FAC_MFF_COR_EXT_LAM_AD_INJ [NC_CYL_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
External fuel mass correction factor (combustion controller)					
Km_inj_tausch_zyl [NC_CYL_NR]	O/V/S	0... FFFFH	0... 655350	10	km
Km-Stand bei dem die letzte Injektorcodierung vorgenommen wurde					
LV_INH_BAL_CUS	O/V	0... 1H	0 ...1	1	-
CILC and CYBL inhibit by external request					

### Input data:

B_ext_zylstop {p. 8343}	DIST_IV_CHG [NC_CYL_NR] {p. 2289}	F_tikorzsk [NC_CYL_NR] {p. 8158}	FAC_TI_BAL [NC_CYL_NR] {p. 3215}
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LV_CYL_BAL_AD_HOM_ REQ_DC {p. 4066}	LV_CYL_BAL_AD_WG_ OPEN_REQ [NC_CBK_EX_NR] {p. 4066}	LV_CYL_BAL_ER_AD_ ADD_EOL {p. 4043}	LV_CYL_BAL_LAM_AD_ ADD_DC [NC_CBK_EX_NR] {p. 4066}
LV_CYL_BAL_LAM_AD_ DC {p. 4066}	LV_CYL_BAL_LAM_AD_ EOL {p. 4043}	LV_CYL_BAL_LAM_SEL_ AD_COLD_EOL {p. 4043}	LV_CYL_BAL_LAM_SEL_ AD_HOT_DC {p. 4066}
LV_CYL_BAL_LAM_SEL_ AD_HOT_EOL {p. 4043}	LV_LAM_CYL_ENA [NC_CBK_EX_NR] {p. 2864}	LV_TI_CYL_BAL_ER_ACT {p. 4022}	STATE_LAM_AD_INJ_ACT [NC_CBK_EX_NR] {p. 3379}

## R.8.1 Outputs for BMW which are not defined as CYBL exported data

### FUNCTION DESCRIPTION:

Adaption to BMW environment.

### Application conditions:

*Initialisation at reset or at exit power latch phase:*

**1:** B\_gl\_ad, B\_gl\_adder, B\_gl\_zsk, B\_gl\_zsw  
**0:** B\_gl\_adz, B\_gl\_hz, B\_gl\_zswz, B\_gl\_wg1, B\_gl\_wg2,  
 B\_lamzylact\_1, B\_lamzylact\_2, B\_lurzylact, B\_injad\_anf, B\_gl\_adz\_  
 offset1, B\_gl\_adz\_offset2  
**1.0:** F\_tizyl[NC\_CYL\_NR]  
**Last calculated value:** Km\_inj\_tausch\_zyl[ANZAHL\_ZYLINDER]

*Recurrence:* 10 ms: B\_gl\_ad, B\_gl\_adder, B\_gl\_adz, B\_gl\_hz  
 B\_gl\_zsk, B\_gl\_zsw, B\_gl\_zswz, B\_gl\_wg1, B\_gl\_wg2  
 20ms: B\_injad\_anf  
 100ms: F\_tizyl[NC\_CYL\_NR], B\_lamzylact\_1, B\_lamzylact\_2, B\_lurzylact,  
 B\_gl\_adz\_offset1, B\_gl\_adz\_offset2, Km\_inj\_tausch\_zyl[ANZAHL\_ZYLINDER]

*Special values at PWL:*

**Last calculated value:** Km\_inj\_tausch\_zyl[ANZAHL\_ZYLINDER]

*Activation:* every engine state

### Formula section:

**If** ECU\_STATE = "PWL"

**Then**

B\_gl\_ad = 1  
 B\_gl\_adder = 1  
 B\_gl\_zsk = 1  
 B\_gl\_zsw = 1  
 B\_gl\_adz = 0  
 B\_gl\_hz = 0  
 B\_gl\_zswz = 0  
 B\_gl\_wg1 = 0  
 B\_gl\_wg2 = 0  
 B\_injad\_anf = 0

Km\_inj\_tausch\_zyl[ANZAHL\_ZYLINDER] = Last calculated value

### Else

```

B_gl_ad = LV_CYL_BAL_LAM_AD_EOL
B_gl_adder = LV_CYL_BAL_ER_AD_ADD_EOL
B_gl_adz = LV_CYL_BAL_LAM_AD_DC
B_gl_adz_offset1 = LV_CYL_BAL_LAM_AD_ADD_DC[1]
B_gl_adz_offset2 = LV_CYL_BAL_LAM_AD_ADD_DC[2]
B_gl_hz = LV_CYL_BAL_AD_HOM_REQ_DC
B_gl_zsk = LV_CYL_BAL_LAM_SEL_AD_COLD_EOL
B_gl_zsw = LV_CYL_BAL_LAM_SEL_AD_HOT_EOL
B_gl_zswz = LV_CYL_BAL_LAM_SEL_AD_HOT_DC
B_gl_wg1 = LV_CYL_BAL_AD_WG_OPEN_REQ[1]
B_gl_wg2 = LV_CYL_BAL_AD_WG_OPEN_REQ[2]
B_lamzylact_1 = LV_LAM_CYL_ENA[1]
B_lamzylact_2 = LV_LAM_CYL_ENA[2]
B_lurzylact      = LV_TI_CYL_BAL_ER_ACT
F_tizyl[NC_CYL_NR] = FAC_TI_BAL[NC_CYL_NR]
Km_inj_tausch_zyl[ANZAHL_ZYLINDER] = DIST_IV_CHG[NC_CYL_NR]
if      STATE_LAM_AD_INJ_ACT[1] > 0
      or STATE_LAM_AD_INJ_ACT[2] > 0
then    B_injad_anf = 1
else    B_injad_anf = 0
endif

```

### Endif

## R.8.2 Outputs for supplier aggregates

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

### Application conditions

Initialisation at reset or exit "PWL": 0

**Recurrence :** 100 ms: LV\_INH\_BAL\_CUS  
Segment: FAC\_MFF\_COR\_EXT\_LAM\_AD\_INJ[NC\_CYL\_NR]


**Activation :** every engine state

### Formula section:

```

LV_INH_BAL_CUS      = B_ext_zylstop
FAC_MFF_COR_EXT_LAM_AD_INJ[NC_CYL_NR] = F_tikorzsk[NC_CYL_NR]

```

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## R.9 Customer adaptation module: DRRQ

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_bls	O/V	0... 1H	0 ...1	1	-
Driver request; pedal value					
Pwg_ist	O/V	8000... 7FFFH	-800... 799.97558	0.0244141	%
Pedalwert Fahrerwunsch in %					
Pwg_ist_roh	O/V	8000... 7FFFH	-800... 799.97558	0.0244141	%
Pedalwert Fahrerwunsch in %, Rohwert					
Pwg_max	O/V	8000... 7FFFH	-800... 799.97558	0.0244141	%
Maximum selection of Pwg_ist and virtual pedal value					

### Input data:

LV_BRAKE_DET {p. 4209}	LV_IGK {p. 906}	PV_CUS {p. 1269}	PV_CUS_RAW {p. 1269}
PV_MAX {p. 1269}			

### R.9.1 Outputs for BMW which are defined as DRRQ exported data

#### FUNCTION DESCRIPTION:

Adaption to BMW environment.

*Remark:* The really possible resolution and limits of the output are different to the specified values due to the input data attributes.

#### Application conditions

**Initialisation:** `0% at reset`

**Recurrence:** `10ms`

*Note:*

`Pwg_ist(_roh)` has to be updated directly after `PV_CUS(_RAW)` has been calculated.

`Pwg_max` has to be updated directly after `PV_MAX` has been calculated.

**Activation:** `after reset`

**Deactivation:** `after power latch phase`

#### Formula section:

*Remark:* all formulas are valid in a **physical** meaning


**If** `LV_IGK = 1`

**Then** `Pwg_ist = PV_CUS`

`Pwg_ist_roh = PV_CUS_RAW`

`Pwg_max = PV_MAX`

**Else** `Pwg_ist = 0%`

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Pwg\_ist\_roh = 0%

Pwg\_max = 0%

## R.9.2 Outputs for BMW which are not defined as DRRQ exported data

### FUNCTION DESCRIPTION:

Adaption to BMW environment.

### Application conditions

**Initialisation:** -


**Recurrence:** 100ms

**Activation:** after reset (always)

**Deactivation:** -

### Formula section:

B\_bls = LV\_BRAKE\_DET

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## R.10 Customer adaptation module: DRVB

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ACT_AJ	O/V	0... 1H	0 ...1	1	-
LV anti-jerk function active					
TQI_REQ_TRA	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Indicated torque request after transient torque function					

### Input data:

B_ar_akt {p. 8342}	Mdi_reib {p. 8161}	Mdk_wunsch_filt {p. 8162}	
--------------------	--------------------	---------------------------	--

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

### Application conditions

**Initialisation:** at reset and at each activation and deactivation:  
all outputs are initialised with 0

**Recurrence :** 10 ms

**Activation:**  $LV\_IGK = 1$

**Deactivation:**  $LV\_IGK = 0$

### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

$$\begin{aligned} LV\_ACT\_AJ &= B\_ar\_akt \\ TQI\_REQ\_TRA &= Mdk\_wunsch\_filt - Mdi\_reib \end{aligned}$$



## R.11 Customer adaptation module: ECM2

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_dkpu	O/V	0... 1H	0 ...1	1	-
LV for activation of engine speed limitation monitoring					
B_siko_rechnet	O/V	0... 1H	0 ...1	1	-
Activation condition for fuel cut off monitoring fulfilled					
FAC_MFF_TQ_COR_SCAV	O/V	8000... 7FFFH	-200... 199.99389	6.1035e-3	%
Efficiency correction factor for scavenging					
TQ_LOSS_ADD_FIL	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Filtered additional torque losses					
TQ_REQ_CLU_GB	O/V	0... FFH	0... 510	2	Nm
Torque request from manual gearbox (torque losses)					
TQI_N_CTL_TCT_FAST	O/V	0... FFH	0... 510	2	Nm
Fast torque request of n-controller for TCT					
TQI_N_CTL_TCT_SLOW	O/V	0... FFH	0... 510	2	Nm
Slow torque request of n-controller for TCT					

### Input data:

Eta_md_uesp {p. 8157}	LV_N_LIM_ETC_MON {p. 6790}	LV_TQI_MON_ACT_MON {p. 6791}	Md_getriebe_hs {p. 8160}
Md_na_ges_f {p. 8160}	Mdi_nregl_plus {p. 8161}	Mdi_nregs_plus {p. 8161}	

### R.11.1 Outputs for BMW functions which are not defined as ECM2 exported data

#### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

#### Application conditions

**Initialisation:** at reset all 0  
at PWL: B\_siko\_rechnet = 0


**Recurrence :** 40 ms

**Activation:** B\_dkpu: every engine state  
B\_siko\_rechnet: every engine state except PWL

#### Formula section:

B\_dkpu = LV\_N\_LIM\_ETC\_MON  
B\_siko\_rechnet = LV\_TQI\_MON\_ACT\_MON

### R.11.2 Outputs for supplier functions which are defined as BMW exported data

Released by Tettenborn Frank		Date 2013-02-13	File 43R01V01.00E
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 8193 of 8404	
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**FUNCTION DESCRIPTION:**

Adaptation to BMW environment.

**Application conditions****Initialisation:**

FAC\_MFF\_TQ\_COR\_SCAV = 100%  
 TQ\_REQ\_CLU\_GB = 0 Nm  
 TQI\_N\_CTL\_TCT\_FAST = 0 Nm  
 TQI\_N\_CTL\_TCT\_SLOW = 0 Nm  
 TQ\_LOSS\_ADD\_FIL = 0 Nm

**Recurrence :**

FAC\_MFF\_TQ\_COR\_SCAV: 10ms  
 TQ\_REQ\_CLU\_GB: 40ms  
 TQI\_N\_CTL\_TCT\_FAST: 40ms  
 TQI\_N\_CTL\_TCT\_SLOW: 40ms  
 TQ\_LOSS\_ADD\_FIL: 40ms

**Activation:**

*every engine state*

**Formula section:**

*Remark:* all formulas are valid in a **physical** meaning

FAC\_MFF\_TQ\_COR\_SCAV = Eta\_md\_uesp  
 TQ\_REQ\_CLU\_GB = Md\_getriebe\_hs  
 TQI\_N\_CTL\_TCT\_FAST = Mdi\_nregs\_plus  
 TQI\_N\_CTL\_TCT\_SLOW = Mdi\_nregl\_plus  
 TQ\_LOSS\_ADD\_FIL = Md\_na\_ges\_f

## R.12 Customer adaptation module: EGCP

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_lamson_ok1	O/V	0... 1H	0 ...1	1	-
Lambdasonde VK, Bank1, bereit					
B_lamson_ok2	O/V	0... 1H	0 ...1	1	-
Lambdasonde VK, Bank2, bereit					
B_pruef1	O/V	0... 1H	0 ...1	1	-
Lambda coordination request to change set point for active plausibility test					
B_pruef2	O/V	0... 1H	0 ...1	1	-
Lambda coordination request to change set point for active plausibility test					
B_sbblsu	O/V	0... 1H	0 ...1	1	-
operability status of the lambda sensor (delayed), exhaust cylinderbank 1					
B_sbblsu2	O/V	0... 1H	0 ...1	1	-
operability status of the lambda sensor (delayed), exhaust cylinderbank 2					
La_pruef1	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda set point for active plausibility test bank 1					
La_pruef2	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda set point for active plausibility test bank 2					
Lam_son1	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda signal value of the WRAF sensor					
Lam_son2	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda signal value of the WRAF sensor					
Ulams_1	O/V	0... 7FFH	0... 9.99511	4.8828e-3	V
corrected output signal of the lambda sensor, exhaust cylinderbank 1					
Ulams_2	O/V	0... 7FFH	0... 9.99511	4.8828e-3	V
corrected output signal of the lambda sensor, exhaust cylinderbank 2					

### Input data:

LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_SP_DIAG_LS_UP_ DOWN [NC_CBK_EX_NR] {p. 2437}	LV_INH_LSCL [NC_CBK_EX_NR] {p. 2544}	LV_LAMB_LS_UP_VLD [NC_CBK_EX_NR] {p. 2352}
LV_LAMB_SP_REQ_ DIAG_ACT [NC_CBK_EX_NR] {p. 2437}	NC_CBK_EX_NR {p. 1829}	VLS_UP_COR [NC_CBK_EX_NR] {p. 2315}	

### R.12.1 Outputs for BMW which are defined as EGCP exported data

#### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

i = 1 ... NC\_CBK\_EX\_NR

#### Application conditions:

*Initialisation at reset or at exit power latch state:*

B\_pruef1, B\_pruef2, B\_sbblsu, B\_sbblsu2

B\_lamson\_ok1, B\_lamson\_ok2 = 0  
 La\_pruef1 = La\_pruef2 = 1.00  
 Lam\_son1, Lam\_son2, Ulams\_1, Ulams\_2 : first calculation

*Activation:* every engine state, except power latch phase

*Deactivation :* at power latch phase

*Values at power latch phase :*

Lam\_son1 = Lam\_son2 = 1.0  
 La\_pruef1 = La\_pruef2 = 1.0  
 B\_pruef1 = B\_pruef2 = 0  
 B\_lamson\_ok1, B\_lamson\_ok2 = 0  
 B\_sbblsu = B\_sbblsu2 = 1  
 Ulams\_1 = Ulams\_2 = 0 V

*Recurrences:* 10 ms Lam\_son1/2, Ulams\_1/2, B\_lamson\_ok1, B\_lamson\_ok2

100 ms La\_pruef1/2, B\_pruef1/2, B\_sbblsu, B\_sbblsu2

### Formula section:

Lam\_son1 = LAMB\_LS\_UP[1]  
 Lam\_son2 = LAMB\_LS\_UP[2]  
 La\_pruef1 = LAMB\_SP\_DIAG\_LS\_UP\_DOWN[1]  
 La\_pruef2 = LAMB\_SP\_DIAG\_LS\_UP\_DOWN[2]  
 B\_pruef1 = LV\_LAMB\_SP\_REQ\_DIAG\_ACT[1]  
 B\_pruef2 = LV\_LAMB\_SP\_REQ\_DIAG\_ACT[2]  
 B\_sbblsu = not(LV\_INH\_LSCL[1])  
 B\_sbblsu2 = not(LV\_INH\_LSCL[2])  
 Ulams\_1 = VLS\_UP\_COR[1]  
 Ulams\_2 = VLS\_UP\_COR[2]  
 B\_lamson\_ok1 = LV\_LAMB\_LS\_UP\_VLD[1]  
 B\_lamson\_ok2 = LV\_LAMB\_LS\_UP\_VLD[2]

## R.13 Customer adaptation module: EGRC

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Agrpos	O/V	0... FFFFH	0... 99.9985	0.001526	%
Current EGR valve position delivered to BMW software					
B_agr_ktrl	O/V	0... 1H	0 ...1	1	-
EGR control active					
EGR_RATIO_SP	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
EGR-Ratio Setpoint					
OPG_SP_REQ_ACR	O/V	0... FFFFH	0... 99.97558	0.0244141	%
Actuator valve position setpoint request in normal operation					

### Input data:

Agr_soll {p. 8154}	Agrpos_soll {p. 8154}	LV_ACR_CTL_ENA {p. 3599}	OPG_ACR {p. 1097}
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### R.13.1 BMW software to ACRC adaptation

#### FUNCTION DESCRIPTION:

This function is used for the adaptation to BMW customer software. *Remark:* the really possible resolution and limits of the outputs can be different from the specified values due to the input data attributes. The variables has to be executed before the ACRC functionality is calculated.

#### Application conditions

**Initialization:** at RST all to zero  
**Recurrence:** 10 ms  
**Activation:** at all engine operating states  
**Deactivation:** no deactivation

#### Formula section:

```

EGR_RATIO_SP          = Agr_soll
if      LV_ACR_CTL_ENA == 1
then    OPG_SP_REQ_ACR = Agrpos_soll
else    OPG_SP_REQ_ACR = 0
endif

```

### R.13.2 ACRC to BMW software adaptation

#### FUNCTION DESCRIPTION:

This function is used for the adaptation to BMW customer software. *Remark:* the really possible resolution and limits of the outputs can be different from the specified values due to the input data attributes. The variable has to be executed after the ACRC functionality is calculated.

## Application conditions

**Initialization:** at RST set all to


**Recurrences:** 10 ms

**Activation:** *at all engine operating states*

**Deactivation:** *no deactivation*

## Formula section:

B\_agr\_ktrl = LV\_ACR\_CTL\_ENA  
Agrpos = OPG\_ACR

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 8198 of 8404</b>	
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## R.14 Customer adaptation module: EGTR

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_desu_fett	O	0... 1H	0 ...1	1	-
Request of a fast desulfation (instead of an alternating desulfation)					
B_desu_puls	O/V	0... 1H	0 ...1	1	-
Flag to be passed to the lambda stimulation coordination					
B_kathom	O/V	0... 1H	0 ...1	1	-
Request of lambda = 1 operation mode					
B_rgnkat	O/V	0... 1H	0 ...1	1	-
Logical value for regeneration phase request					
B_rgnkat_hla1	O/V	0... 1H	0 ...1	1	-
Request regeneration lambda = 1					
D_la_sa1	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
lambda controller set point shift					
D_la_sa2	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
lambda controller set point shift					
La_desu_kh1	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda setpoint during catalyst heating for desulfation bank 1					
La_desu_kh2	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda setpoint during catalyst heating for desulfation bank 2					
La_desu1	O	0... FFFFH	0... 15.99975	244.1e-6	-
Absolut lambda setpoint for lambda pulsation, desulfation bank1					
La_desu2	O	0... FFFFH	0... 15.99975	244.1e-6	-
Absolut lambda setpoint for lambda pulsation, desulfation bank2					
La_es	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda setpoint for desulfation					
La_puls1	O/V	80... 7FH	-0.125... 0.12402	976.599e-6	-
Lambda setpoint for forced stimulation					
La_puls2	O/V	80... 7FH	-0.125... 0.12402	976.599e-6	-
Lambda setpoint for forced stimulation					
La_rgn1	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
lambda setpoint for catalyst regeneration					
La_rgn2	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
lambda setpoint for catalyst regeneration					
LAMB_PLS_EXT_CUS [NC_CBK_EX_NR]	O/V	F800... 7FFH	-0.125... 0.12493	61e-6	-
lambda set point deviation from external source					
LV_PUC_LOCK_TNT	O/V	0... 1H	0 ...1	1	-
LV suppression of PUC due to high Nox trap temperature					

### Input data:

B_vb_sa_nk {p. 8347}	Dla_soll_puls [NC_CBK_EX_NR] {p. 8156}	ECU_STATE {p. 1091}	La_soll_stat1
La_soll_stat2	La_soll1	La_soll2	LAMB_PLS_O2L_OSC [NC_CBK_EX_NR] {p. 2563}

LAMB_PULS_SO2P [NC_CBK_EX_NR] {p. 3150}	LAMB_RGN [NC_CBK_EX_NR] {p. 2885}	LAMB_SO2P [NC_CBK_EX_NR] {p. 3129}	LAMB_SP_CH_SO2P [NC_CBK_EX_NR] {p. 2169}
LAMB_SP_DELTA_CAT_ PURGE [NC_CBK_EX_NR] {p. 2939}	LAMB_SP_DIAG_AFL [NC_CBK_EX_NR] {p. 5589}	LV_DIAG_AFL_REQ {p. 5589}	LV_NT_AFS_REQ {p. 2982}
LV_RGN_REQ_NTLD_AFS {p. 2983}	LV_SO2P_FAST_REQ {p. 3129}	LV_SO2P_LAMB_PULS {p. 3129}	LV_SO2P_REQ {p. 3129}
NC_CBK_EX_NR {p. 1829}	TQ_ADD_SO2P {p. 6582}		

## R.14.1 Outputs for BMW functions which are not defined as EGTR exported data

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

### Application conditions:

*Initialisation at reset or at exit power latch phase :*

0.0 : La\_puls1 /2, D\_la\_sa1/2, La\_desu1/2  
 0: B\_kathom, B\_rgnkat\_hla1, B\_desu\_fett,  
 B\_desu\_puls, B\_rgnkat  
 1.0: La\_rgn1/2, La\_desu\_kh1/2, La\_es

*Recurrence :*

100 ms	La_es
10 ms	B_rgnkat, La_rgn1, La_rgn2, B_kathom, B_rgnkat_hla1
20ms	D_la_sa1, D_la_sa2, B_desu_fett, B_desu_puls
seg	La_puls1 /2, La_desu1/2, La_desu_kh1/2

*Activation:* every engine state, except at power latch phase

*Deactivation:* at power latch phase

*Values at deactivation:* 0, except B\_rgnkat, B\_kathom, B\_rgnkat\_hla1=1

### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

B\_rgnkat = LV\_RGN\_NT\_REQ OR LV\_DIAG\_AFL\_REQ

IF (LV\_RGN\_NT\_REQ == 0 AND LV\_DIAG\_AFL\_REQ == 1)  
 THEN %lambda setpoint for TWC lean diagnosis after regeneration

La\_rgn1 = LAMB\_SP\_DIAG\_AFL[1]

La\_rgn2 = LAMB\_SP\_DIAG\_AFL[2]

ELSE %lambda setpoint for regeneration

La\_rgn1 = LAMB\_RGN[1]

La\_rgn2 = LAMB\_RGN[2]

ENDIF



```

La_es           = LAMB_SO2P[1]
D_la_sa1       = LAMB_SP_DELTA_CAT_PURGE[1]
D_la_sa2       = LAMB_SP_DELTA_CAT_PURGE[2]
La_puls1       = LAMB_PLS_O2L_OSC[1]
La_puls2       = LAMB_PLS_O2L_OSC[2]
B_kathom       = LV_NT_AFS_REQ
B_desu_fett    = LV_SO2P_FAST_REQ AND LV_SO2P_REQ
La_desu1       = 1 + LAMB_PULS_SO2P[1]
La_desu2       = 1 + LAMB_PULS_SO2P[2]
B_desu_puls    = LV_SO2P_LAMB_PULS
La_desu_kh1    = LAMB_SP_CH_SO2P[1]
La_desu_kh2    = LAMB_SP_CH_SO2P[2]
B_rgnkat_hla1 = LV_RGN_REQ_NTLD_AFS

```

## R.14.2 Outputs for supplier functions which are defined as BMW exported data

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

### Application conditions

**Initialisation:**                   LAMB\_PLS\_EXT\_CUS[NC\_CBK\_EX\_NR] = 0  
   LV\_PUC\_LOCK\_TNT                 = 0

**Recurrence :**                   **200ms:**                   LV\_PUC\_LOCK\_TNT  
   **Segment synchronous:** LAMB\_PLS\_EXT[NC\_CBK\_EX\_NR] (**synchronised with the update of Dla\_soll\_puls**):

**Activation:**                   *every engine state*

### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

```

LV_PUC_LOCK_TNT           = B_vb_sa_nk
LAMB_PLS_EXT_CUS[1]      = Dla_soll_puls[1] (synchronised with the update of Dla_soll_puls)
LAMB_PLS_EXT_CUS[2]      = Dla_soll_puls[2] (synchronised with the update of Dla_soll_puls)

```

## R.15 Customer adaptation module: ENLU

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_poel	O/V	0... 1H	0 ...1	1	-
Bedingung Öldrucksschalter					
B_poelsoltst	O/V	0... 1H	0 ...1	1	-
Bedingung Sollwert Öldruck über Tester					
B_td_og	O/V	0... 1H	0 ...1	1	-
Bedingung Abkühlzeit gültig					
B_td_ogok	O/V	0... 1H	0 ...1	1	-
condition state machine once valid calculated					
B_toel	O/V	0... 1H	0 ...1	1	-
Bedingung tr und tv gültig					
Bosbtvfbkt	O/V	0... FFH	0... 255	1	-
Verfügbarkeit vom Tester					
Boszielt	O/V	0... FFH	0... 255	1	-
Zieltermin Jahr vom Tester					
Bosmzielt	O/V	0... FFH	0... 255	1	-
Zieltermin_Monat vom Tester					
Bosprog2t	O/V	0... FFH	0... 255	1	-
Prognose Intervall Zeit vom Tester					
Bosrlsmt	O/V	8000... 7FFFH	-32768 ...32767	1	-
Restlaufstrecke Motoröl vom Tester					
Bosrw2t	O/V	0... FFH	0... 255000	1000	km
Prognose Intervall Weg vom Tester					
DIST_RESI_OIL	O/V	8000... 7FFFH	-32768 ...32767	1	-
Ausgabewert Restlaufstrecke Motoröl					
DIST_RESI_OIL_KM	O/V	0... FFH	0... 255	1	-
Einheit der BOS-Info (km)					
FRQ_POIL_PWM	V	0A... FFH	10... 255	1	Hz
Frequency of the oil pressure actuator PWM					
Id_bosrtt	O/V	0... FFH	0... 255	1	-
ID f BOS_Reset vom Tester					
idbosmsg	O	0... FFH	0... 255	1	-
Kennung für BOS-Meldung vom Kombi					
LV_LOIL_VLD_WR	O/V	0... 1H	0 ...1	1	-
Flag to set LV_SOIL_VLD_LOIL and LV_T_COOL_VLD_LOIL					
LV_POIL_SWI_CUS	O/V	0... 1H	0 ...1	1	-
Condition oil pressure display (from customer)					
LV_SOIL_VLD_LOIL_CUS	O/V	0... 1H	0 ...1	1	-
Oil temperature valid from customer					
LV_T_COOL_VLD_LOIL_CUS	O/V	0... 1H	0 ...1	1	-
Cool off time valid from customer					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Oz_lf1c	O/V	0... FFH	0... 2.55	0.01	-
Länderfaktor 1 codiert					
Oz_lf2c	O/V	0... FFH	0... 2.55	0.01	-
Länderfaktor 2 codiert					
Oz_nivr	O/V	0... FFH	0... 255	1	-
oil sensor raw value of oil level					
Oz_permr	O/V	0... FFFFH	0... 65535	1	-
ÖZS: oil sensor raw value of oil permittivity					
Oz_status	O/V	0... FFH	0... 255	1	-
ÖZS: status information of oil sensor					
Oz_tempr	O/V	0... FFH	0... 255	1	-
ÖZS: oil sensor raw value of oil temperature					
P_oe_ist	O/V	8000... 7FFFH	-32768 ...32767	1	hPa
Ist Öldruck					
P_oesol_tst	O/V	0... FFH	0... 8160	32	hPa
Sollwert Öldruck über Tester					
POIL_PWM	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Tastverhältnis Öldruck-Regelventil					
POIL_SP	O/V	0... 4E20H	0... 20	0.001	bar
setpoint of oil pressure					
QOIL_DS_CAN_2_1	O/V	0... FFH	0... 255	1	-
ID2 BOS message 2					
QOIL_DS_CAN_2_2	O/V	0... FFFFH	0... 65535	1	-
ID function BOS message 2					
QOIL_DS_CAN_2_3	O/V	0... FFH	0... 255000	1000	km
Forecast intermittent way BOS message 2					
QOIL_DS_CAN_2_4	O/V	0... FFH	0... 255	1	-
target-date year BOS message 2					
QOIL_DS_CAN_2_5	O/V	0... FFH	0... 255	1	-
target-date month BOS message 2					
QOIL_DS_CAN_2_6	O/V	0... FFH	0... 255	1	-
Forecast intermittent time BOS message 2					
STATE_LOIL	O/V	0... FFH	0... 255	1	-
fluid-level engine-oil					
STATE_OIL_AVL	O/V	0... FFH	0... 255	1	-
Rest-Verfügbarkeit Motoröl in Prozent					
STATE_OIL_REQ	O/V	0... FFH	0... 255	1	-
Recommended refill volume engine-oil					
Td_og_cnt	O/V	0... 64H	0... 100	1	-
Zähler für fallende Flanken im Töns Signal					
Td_og_icnt	O/V	0... FFFFH	0... 655.35	0.01	s
Time between flanks					
Td_og_tk	O/V	0... FFFFH	0... 6553.5	0.1	s
Abkühlzeit vom TÖNS					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Td_og_tr	O/V	0... FFFFH	0... 6553.5	0.1	s
Referenzzeit					
Td_og_tv	O/V	0... FFFFH	0... 6553.5	0.1	s
Abkühlzeit Vom TÖNS					
Td_og_uplcnt	O/V	0... 64H	0... 100	1	-
Zähler für unplausible Signale					
Tget	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	°C
gear box oil temperature					
Toel_getr	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	°C
gear box oil temperature					
Toel_mdl	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
oil temperature model					
TOIL	O/V	0... C8H	-40 ...160	1	°C
Oil temperature					
TOIL_MES	O/V	0... C8H	-40 ...160	1	°C
oil temperature					
TOIL_STOP	O/V	0... C8H	-40 ...160	1	°C
Oil temperature at transition to ES					
zrbosmld	O/V/S	0... FFH	0... 255	1	-
anzuweisender Zähler für durchgeführten Ölservice					
Zrbosrt	O/V	0... FFH	0... 255	1	-
Servicezählerwert vom Tester					

**Input data:**

B_poel_rot {p. 8346}	Bosbtvfbk {p. 8155}	Bosfxid2 {p. 8155}	Bosid2 {p. 8155}
Bosziel {p. 8155}	Bosmziel {p. 8155}	Bosprog2 {p. 8155}	Bosrlsm {p. 8155}
Bosrw2 {p. 8155}	Bosstate {p. 8155}	CTR_EDGE_FALL_LOIL {p. 797}	CTR_SIG_NOT_VLD_LOIL {p. 797}
FAC_OIL_EXT_REQ_1 {p. 7680}	FAC_OIL_EXT_REQ_2 {p. 7680}	ld_bosmsg {p. 8159}	ld_bosrtak {p. 8159}
LC_POIL_CTL_ENA {p. 903}	LV_BIOS_POIL_SWI {p. 903}	LV_ERR_POIL_DR {p. 4357}	LV_POIL_PWM_EXT_ADJ {p. 7434}
LV_POIL_SP_EXT_ADJ {p. 7434}	LV_SOIL_VLD_LOIL {p. 804}	LV_ST_END {p. 1720}	LV_STATE_RUN_LOIL {p. 804}
LV_T_COOL_VLD_LOIL {p. 805}	LV_T_ES_NOT_PLAUS {p. 4467}	N {p. 1525}	NC_CYL_NR {p. 1526}
Oz_kvbsm_ul {p. 8164}	Oz_lp {p. 8164}	Oz_lv {p. 8164}	oznivr {p. 4095}
ozpermr_w {p. 4095}	ozstatus	oztempr	P_oe_soll {p. 8165}
Poel_fpwm {p. 8165}	POIL {p. 903}	POIL_PWM_EXT_ADJ {p. 7435}	POIL_SP_EXT_ADJ {p. 7435}
QOIL_DS_RST_KWP_1 {p. 7682}	QOIL_DS_RST_KWP_2 {p. 7682}	QOIL_DS_RST_KWP_3 {p. 7682}	QOIL_DS_RST_KWP_5 {p. 7682}
QOIL_DS_RST_KWP_6 {p. 7682}	QOIL_DS_RST_KWP_7 {p. 7682}	QOIL_DS_RST_KWP_8 {p. 7682}	QOIL_DS_RST_KWP_9 {p. 7682}
T_COOL_LOIL {p. 809}	T_EDGE_FALL_LOIL {p. 809}	T_REF_SIG_LEN_LOIL {p. 809}	T_TEMP_SIG_LEN_LOIL {p. 809}

TEMP_GB {p. 1580}	Toel {p. 8177}	Tv_poel {p. 8178}	
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**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_POIL_PWM_ERR_SUB	-	0... FFH	0... 99.60937	0.390625	%
Substitute value of POIL_PWM in case of detected failure on oil pressure actuator					
C_T_TIA_TCO_DIAG	-	1... FFFFH	1... 65535	1	s
time condition for toil-, tco-, tecu- and tia diagnosis					
C_TOIL_SUB_DIAG	-	0... C8H	-40 ...160	1	°C
substitute oil temperature					

**Import actions:**

ACTION_INFR_SetFrqPwmPoilDr (IN<frq_poil_pwm>)
ACTION_INFR_SetPwmPoilDr (IN<poil_pwm>)

**R.15.1 Outputs for BMW functions which are defined as ENLU exported data****FUNCTION DESCRIPTION:**

Adaptation to BMW environment.

**Application conditions****Initialisation:**

0 at reset, *Td\_og\_icnt* = 0s  
first valid value: *Tget*

*Oz\_lf1c* = FAC\_OIL\_EXT\_REQ\_1

*Oz\_lf2c* = FAC\_OIL\_EXT\_REQ\_2

*P\_oel\_ist* = POIL

*Recurrence* : 1000ms: *Toel\_mdl*, *Oz\_permr*, *Oz\_status*,  
*Oz\_tempr*, *Oz\_nivr*,

*Zrbosrt*, *Id\_bosrtt*, *Bosbtvfbkt*,  
*Bosrlsmt*,

*Bosrw2t*, *Bosmzielt*, *Bosjzielt*, *Bosprog2t*  
100 ms: *Toel\_getr*, *B\_td\_ogok*, *B\_poel*, *Td\_og\_icnt*, *Td\_og\_cnt*,  
*Td\_og\_tk*, *Td\_og\_tr*, *Td\_og\_tv*, *Td\_og\_uplcnt*, *B\_toel*,  
*B\_td\_og*


10 ms: *Tget*, *P\_oelsol\_tst*, *P\_oel\_ist*, *B\_poelsoltst*

*Activation*: every engine state

*During power latch*:

*Tget*, *P\_oel\_ist*: last valid value

*P\_oelsol\_tst*, *B\_poelsoltst*, *Bosrlsmt* = 0

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**Formula section:**

*Remark:* all formulas are valid in a **physical** meaning

Toel\_getr = Tget = TEMP\_GB

Toel\_md1 = C\_TOIL\_SUB\_DIAG

Oz\_nivr = oznivr

Oz\_tempr = oztempr

Oz\_permr = ozpermr\_w

Oz\_status = ozstatus

Id\_bosrtt = QOIL\_DS\_RST\_KWP\_1

Bosbtvfbkt = QOIL\_DS\_RST\_KWP\_2

Zrbosrt = QOIL\_DS\_RST\_KWP\_3

IF QOIL\_DS\_RST\_KWP\_9 = 1

THEN Bosrlsmt = QOIL\_DS\_RST\_KWP\_4

ELSE Bosrlsmt = 8000h (*unplausibel*)

Bosrw2t = QOIL\_DS\_RST\_KWP\_5

Bosmzielt = QOIL\_DS\_RST\_KWP\_6

Bosjzielt = QOIL\_DS\_RST\_KWP\_7

Bosprog2t = QOIL\_DS\_RST\_KWP\_8

Oz\_if1c = FAC\_OIL\_EXT\_REQ\_1

Oz\_if2c = FAC\_OIL\_EXT\_REQ\_2

P\_oe1\_ist = POIL

B\_poelsoltst = LV\_POIL\_SP\_EXT\_ADJ

B\_poel = LV\_BIOS\_POIL\_SWI

**if** LV\_ST\_END = 1

**then** P\_oe1sol\_tst = POIL\_SP\_EXT\_ADJ

**else** P\_oe1sol\_tst = 0

**endif**

**if** NC\_CYL\_NR = 6

**then**

Td\_og\_cnt = 0

Td\_og\_icnt = 0

Td\_og\_tk = 0

Td\_og\_tr = 0

Td\_og\_tv = 0

Td\_og\_uplcnt = 0

B\_toel = 0

B\_td\_og = 0

B\_td\_ogok = !LV\_T\_ES\_NOT\_PLAUS

**else** Td\_og\_icnt = T\_EDGE\_FALL\_LOIL

Td\_og\_cnt = CTR\_EDGE\_FALL\_LOIL

Td\_og\_tk = T\_COOL\_LOIL

Td\_og\_tr = T\_REF\_SIG\_LEN\_LOIL

Td\_og\_tv = T\_TEMP\_SIG\_LEN\_LOIL

Td\_og\_uplcnt = CTR\_SIG\_NOT\_VLD\_LOIL

B\_toel = LV\_SOIL\_VLD\_LOIL


// before ozgg\_100ms()

B\_td\_og = LV\_T\_COOL\_VLD\_LOIL

// before ozgg\_100ms()

B\_td\_ogok = LV\_STATE\_RUN\_LOIL

**endif**

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## R.15.2 Outputs for supplier aggregates

### FUNCTION DESCRIPTION:

Adaptation to BMW environment

### Application conditions

#### **Initialisation:**

```
at reset:    DIST_RESI_OIL = Bosrlsm
             STATE_OIL_AVL = Bosbtvfbk
             FRQ_POIL_PWM = 244 Hz
             ACTION_INFR_SetFrqPwmPoilDr(IN <FRQ_POIL_PWM>).
after BMW-ini2 (calcualtion like in formula section):
idbosmsg, STATE_OIL_AVL, OIL_DS_CAN_2_1,
QOIL_DS_CAN_2_2, QOIL_DS_CAN_2_3,
OIL_DS_CAN_2_4, QOIL_DS_CAN_2_5, QOIL_DS_CAN_2_6,
DIST_RESI_OIL, zrbosmld
  at LV_ES 0->1 : TOIL_STOP
```

#### **Recurrence:**

```
10ms: POIL_SP, POIL_PWM, FRQ_POIL_PWM, LV_POIL_SWI_CUS
100 ms: LV_SOIL_VLD_LOIL_CUS, LV_T_COOL_VLD_LOIL_CUS, LV_
LOIL_VLD_WR
1000 ms: TOIL_MES, TOIL, DIST_RESI_OIL,
          DIST_RESI_OIL_KM, STATE_OIL_AVL,
          idbosmsg, QOIL_DS_CAN_2_1, QOIL_DS_CAN_2_2,
          QOIL_DS_CAN_2_3, QOIL_DS_CAN_2_4, QOIL_DS_CAN_2_5, QOIL_
DS_CAN_2_6, zrbosmld
```

#### **Activation:**

*every engine state*

### Formula section:

```
TOIL_MES           = Toel
TOIL               = Toel
DIST_RESI_OIL      = Bosrlsm
DIST_RESI_OIL_KM   = Bosstate
STATE_OIL_AVL      = Bosbtvfbk
zrbosmld           = Zrbosmld
idbosmsg           = Id_bosmsg
STATE_OIL_REQ      = Oz_lv
STATE_LOIL         = Oz_lp
QOIL_DS_CAN_2_1    = Bosid2
QOIL_DS_CAN_2_2    = Bosfxid2
QOIL_DS_CAN_2_3    = Bosrw2
QOIL_DS_CAN_2_4    = Bosjziel
QOIL_DS_CAN_2_5    = Bosmziel
QOIL_DS_CAN_2_6    = Bosprog2
LV_POIL_SWI_CUS    = B_poel_rot
POIL_SP            = P_oel_soll
FRQ_POIL_PWM       = Poel_fpwm
if LC_POIL_CTL_ENA = 1
then ACTION_INFR_SetFrqPwmPoilDr(IN <FRQ_POIL_PWM>)
      if N = 0 and LV_POIL_PWM_EXT_ADJ = 1
      then POIL_PWM = POIL_PWM_EXT_ADJ
```

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```

else          if      LV_ERR_POIL_DR = 0
              then    POIL_PWM = Tv_poel
              else    POIL_PWM = C_POIL_PWM_ERR_SUB
              endif

endif
ACTION_INFR_SetPwmPoilDr(IN <POIL_PWM>)
// Due to the used HW module CLK6 the specified resolution of POIL_PWM
// (1.5259e-3) can not be realised. The CLK6 is limited by following technical
// data: 4.47 Hz (0.2237ms) ... 292941.45 Hz (3.413µs)

```

```

else
    "no connection to I/O Software"

```

```

endif
LV_SOIL_VLD_LOIL_CUS = B_toel           // after ozgg_100ms()
LV_T_COOL_VLD_LOIL_CUS = B_td_og       // after ozgg_100ms()
if LV_LOIL_VLD_WR = 0
    then LV_LOIL_VLD_WR = 1             // after ozgg_100ms()
    else LV_LOIL_VLD_WR = 0             // after ozgg_100ms()
endif

```

### R.15.2.1 Oil Temperature at Engine Stopping TOIL\_STOP

TOIL\_STOP is determined at each transition to ES. TOIL\_STOP will be stored in the non-volatile memory during the ECU's self holding phase.

By occurring of EEPROM error TOIL\_STOP should be initialized with -40 °C (0x0h).

Initialisation:           with stored value

#### Formula section:

TOIL\_STOP = TOIL



## R.16 Customer adaptation module: ENOS

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_sa	-	0... 1H	0 ...1	1	-
1: pull fuel cut off					
B_sae	O/V	0... 1H	0 ...1	1	-
1: trailing throttle					
B_start	O/V	0... 1H	0 ...1	1	-
1: start condition					
B_startende	O/V	0... 1H	0 ...1	1	-
1: start left to running engine					
LV_ETCU_PUC_REQ	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Schubabschaltung nach Schubrückschaltung"					
LV_INH_PUC_CUS	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Schubabschaltung verboten"					
Nwe	O/V	0... 7FFFH	0... 32767	1	rpm
reactivation engine speed					

### Input data:

B_safast_egs {p. 8346}	B_ums_vbsa {p. 8347}	LV_PU {p. 1720}	LV_PUC {p. 1720}
LV_ST_END {p. 1720}	N_MIN_PUC {p. 1720}		

### R.16.1 Outputs for BMW which are defined as ENOS exported data

#### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

#### Application conditions

**Initialisation:** 0 , **except**  
                   B\_start = 1  
                   B\_startende = 0 at reset and at transition LV\_ES 0  
 -> 1

**Recurrences:** 10 ms: B\_startende, B\_start  
                   20 ms: B\_sa, B\_sae

**Activation:** every engine state

#### Formula section:

B\_sa = LV\_PUC  
 B\_sae = LV\_PU  
 B\_start = ! LV\_ST\_END

B\_startende = LV\_ST\_END

## R.16.2 Outputs for BMW which are not defined as ENOS exported data

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

### Application conditions

**Initialisation:** 0  
**Recurrences:** 20 ms  
**Activation:** *every engine state*

### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

```
if    LV_IGK = 1
then  Nwe = N_MIN_PUC
else  Nwe = 0
endif
```

## R.16.3 Outputs for supplier aggregates

### FUNCTION DESCRIPTION:

### Application conditions

**Initialisation:** *at reset : 0*  
*at power latch phase : 0*  
**Recurrence:** 100 ms  
 10 ms: LV\_ETCU\_PUC\_REQ  
**Activation:** *at every engine state*

### Formula section:

LV\_INH\_PUC\_CUS = B\_ums\_vbsa  
 LV\_ETCU\_PUC\_REQ = B\_safast\_egs

## R.17 Customer adaptation module: ENRD

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Fak_er_schw	O/V	0... FFH	0... 2.55	0.01	-
Quotient aus Engine Roughness und dem Schwellenwert der Aussetzererkennung					
Lur [NC_CYL_NR]	O/V	8000... 7FFFH	-32768 ...32767	1	1/s**2
engine roughness cylinder selektiv					
Lur_aus_quo	O/V	0... FFH	0... 1.99218	0.0078125	-
Quotient Laufunruhewert /Aussetzerschwelle					

### Input data:

ER_AV_QUO {p. 1469}	ER_CYL [NC_CYL_NR] {p. 1454}	NC_CYL_NR {p. 1526}	
---------------------	---------------------------------	---------------------	--

### R.17.1 Outputs for BMW functions which are defined as ENRD exported data

#### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

#### Application conditions

Initialisation at reset or at exit PWL: 0

Recurrence : every segment

Activation: every engine state

Special value at PWL: Lur\_aus\_quo = 0  
Fak\_er\_schw = 0

#### Formula section:

Remark: all formulas are valid in a **physical** meaning

Lur[NC\_CYL\_NR] = ER\_CYL[NC\_CYL\_NR]  
Lur\_aus\_quo = ER\_AV\_QUO  
Fak\_er\_schw = ER\_AV\_QUO

## R.18 Customer adaptation module: ENSC

### Data definition:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_llr_on	O/V	0... 1H	0 ...1	1	-
Logical variable for idle speed controller activation request					
FAC_TQ_ADD_IS_OPM_SEL	O/V	0... FFH	0... 0.99609	3.9062e-3	-
Torque reserve for idle speed interpolation factor for operation switch manager					
Md_anfhi	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Moment Anfahrhilfe					
Md_res_anfhi	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Moment Anfahrhilfe					
Mdi_llrad	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
Idle speed controller, adaptation					
Mdi_llri	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
idle speed controller, I-part					
Mdi_llrp	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
idle speed controller, P/D-part slow					
Mdi_llrzw	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
idle speed controller, P/D-part fast					
Mdi_res_llmn	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
torque reserve at idle, lower limit					
Mdi_res_llmx	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
torque reserve at idle, limitation for stabilizing the ISC at high torque reserves					
N_SP_IS_BRAKE	O/V	0... 7FFFH	0... 32767	1	rpm
idle speed correction due to accumulator charge					
N_SP_IS_POIL_CTL	O/V	0... 1FE0H	0... 8160	1	rpm
idle speed correction due to oil pressure regulator					
N_SP_IS_POW_1	O/V	0... 1FE0H	0... 8160	1	rpm
Idle speed correction due to accumulator charge					
Nkw_soll	O/V	0... 7FFFH	0... 32767	1	rpm
Soll Drehzahl					
Nsllm	O/V	0... 7FFFH	0... 32767	1	rpm
Idle speed setpoint without drivetrain engaged (LV_DRI = 0)					
Nstat	O/V	0... 7FFFH	0... 32767	1	rpm
Idle speed setpoint without guidance					

### Input data:

ECU_STATE {p. 1091}	F_llr_ba {p. 8157}	LV_REQ_ISC {p. 3501}	N_SP_IS {p. 1122}
N_SP_IS_2 {p. 1122}	Nkw_poel_soll {p. 8163}	Nsl_koor {p. 8163}	Nslb {p. 8164}
TQ_ADD_IS_BOL {p. 3544}	TQ_ADD_PL_DROF {p. 1112}	TQ_DIF_ADD_IS_TOL {p. 3544}	TQ_DIF_I_IS {p. 3441}
TQ_DIF_IS_AD {p. 3518}	TQ_DIF_P_D_FAST_IS {p. 3441}	TQ_DIF_P_D_SLOW_IS {p. 3442}	TQ_DROF_FAST {p. 1112}
TQ_DROF_SLOW {p. 1112}			

### R.18.1 Outputs for BMW which are defined as ENSC exported data

### FUNCTION DESCRIPTION:

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Adaptation to BMW environment.

*Remark:* The really possible physical limits of the outputs are different to the specified values due to the input data attributes.

### Application conditions

**Initialisation at reset or at exit power latch phase:** 0

**Recurrences:** Mdi\_llri, Nstat : 20 ms  
all others : 10 ms

**Activation:** every engine state

**Deactivation:** - -

### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

B\_llr\_on = LV\_REQ\_ISC

If ECU\_STATE = "PWL"

**Then**

Mdi\_llrad = 0

Mdi\_llri = 0

Mdi\_llrp = 0

Mdi\_llrzw = 0

Mdi\_res\_llmn = 0

Mdi\_res\_llmx = 0

Nstat = 0

Md\_anfhi = 0

Md\_res\_anfhi = 0

**Elseif**

Mdi\_llrad = TQ\_DIF\_IS\_AD

Mdi\_llri = TQ\_DIF\_I\_IS

Mdi\_llrp = TQ\_DIF\_P\_D\_SLOW\_IS

Mdi\_llrzw = TQ\_DIF\_P\_D\_FAST\_IS

Mdi\_res\_llmn = TQ\_ADD\_IS\_BOL

Mdi\_res\_llmx = TQ\_DIF\_ADD\_IS\_TOL

Nstat = N\_SP\_IS

Md\_anfhi = TQ\_DROF\_FAST

Md\_res\_anfhi = (TQ\_DROF\_SLOW - TQ\_DROF\_FAST) + TQ\_ADD\_PL\_DROF

**Endif**

## R.18.2 Outputs for BMW which are not defined as ENSC exported data

### FUNCTION DESCRIPTION:


Adaptation to BMW environment.

### Application conditions:

*Initialisation at reset or at exit power latch phase:* 0

*Recurrence:* 10 ms

*Activation:* every engine state

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**Formula section:**

*Remark:* all formulas are valid in a **physical** meaning

```

Nslm          = N_SP_IS_2
if   ECU_STATE = "PWL"
then
          Nkw_soll = 0
else
          Nkw_soll = N_SP_IS
endif

```

**R.18.3 Outputs for supplier Aggregates****FUNCTION DESCRIPTION:**

Adaptation to BMW environment.

**Application conditions**

**Initialisation:** all outputs = 0 at Reset

**Recurrence:** N\_SP\_IS\_POW\_1 is updated every 1000 ms  
 N\_SP\_IS\_BRAKE is updated every 100 ms  
 FAC\_TQ\_ADD\_IS\_OPM\_SEL, N\_SP\_IS\_POIL\_CTL is updated every  
 10 ms

**Activation:** every engine state


**Formula section:**

*Remark:* all formulas are valid in a **physical** meaning

```

N_SP_IS_BRAKE          = Nsl_koor
N_SP_IS_POW_1          = Nslb
FAC_TQ_ADD_IS_OPM_SEL = F_llr_ba
N_SP_IS_POIL_CTL       = Nkw_poel_soll

```

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## R.19 Customer adaptation module: ENSD

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_kwdreht	O/V	0... 1H	0 ...1	1	-
engine speed > 0 rpm					
B_kwnotl	O/V	0... 1H	0 ...1	1	-
error detected at crank engine position determination system					
Kw_pos	O/V	0... FFFFH	0... 1535.97656	0.0234375	°CRK
Engine position, absolute					
Nkw	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
engine speed					
Nkw_grad	O/V	80... 7FH	-4096 ...4064	32	rpm/s
engine speed gradient					
Nkw_zahn	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
Engine speed calculated from T_TOOTH					
Seg5z [24]	O/V	0... FFFFH	0... 65.535	0.001	ms
Segment time for 5 tooth					
Segakt	O/V	0... FFH	0... 255	1	-
segment number					
Vsa_adp_ext	O/V	0... FFFFH	0... 6553.5	0.1	°CRK
Theoretical engine position for exhaust camshaft i edge 6					
Vse_adp_ext	O/V	0... FFFFH	0... 6553.5	0.1	°CRK
Theoretical engine position for intake camshaft i edge 6					

### Input data:

LV_ERR_CRK {p. 4455}	LV_ES {p. 1720}	LV_FIRST_VLD_TOOTH {p. 1505}	LV_ST_END {p. 1720}
LV_SYN_VLD {p. 1506}	LV_T_SEG_5_TOOTH_VLD {p. 1042}	N {p. 1525}	N_GRD {p. 1525}
N_TOOTH_CUS {p. 1042}	NC_CYL_NR {p. 1526}	NC_NR_CAM_CBK {p. 1507}	NC_PSN_EDGE_CAM_EX [NC_NR_EDGE_CAM_EX][NC_NR_CAM_CBK] {p. 874}
NC_PSN_EDGE_CAM_IN [NC_NR_EDGE_CAM_IN][NC_NR_CAM_CBK] {p. 874}	PSN_ENG {p. 1525}	SEG_NR {p. 1525}	


### Import actions:

**ACTION\_INFR\_GetT5T** (IN<idx>, OUT<time>)

## R.19.1 Outputs for BMW functions

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

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*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

### Application conditions:

*Initialisation*

**at reset:**

```

If      NC_CYL_NR = 6
Vse_adp_ext = NC_PSN_EDGE_CAM_IN[6][1]
Vsa_adp_ext = NC_PSN_EDGE_CAM_EX[6][1]

Else
Vse_adp_ext = NC_PSN_EDGE_CAM_IN[1][1]
Vsa_adp_ext = NC_PSN_EDGE_CAM_EX[1][1]

```

**end**

0: B\_kwnotl, B\_kwdreht, Nkw, Segakt, Nkw\_grad, Nkw\_zahn,  
 Seg5z[24]  
 720°CRK: Kw\_pos

**at LV\_ES 0-> 1:** B\_kwdreht = 0, Nkw = 0

**at PWL :** 0: B\_kwnotl, Segakt, Nkw\_grad

*Recurrence :*

B\_kwnotl, Segakt:

segment

Kw\_pos, Nkw\_grad, Nkw\_zahn, B\_kwdreht: 10ms

Vse\_adp\_ext, Vsa\_adp\_ext: once at reset

Seg5z[24]: Segment,

after "Segment time acquisition for partial segments"

Nkw: If LV\_ST\_END = 0

Then recurrence is 10ms

Else recurrence is segment

Endif

*Activation:*

every engine state

### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

```

B_kwnotl = LV_ERR_CRK
B_kwdreht = LV_FIRST_VLD_TOOTH
Nkw = N
Segakt = SEG_NR
if(1) LV_T_SEG_5_TOOTH_VLD = 1
then(1) transfer of measured times from BSW to ASW
          Seg5z(idx) = ACTION_INFR_GetT5T(
                    IN      idx
                                OUT      time)

```

For idx derived from SEG\_NR as depicted in following table:



SEG_NR	0	1	2	3	4	5
idx	16...19	20...23	0...3	4...7	8...11	12...15

```

else(1)      For idx = 0...23
                Seg5z(idx) = FFFFH
endif(1)

If          LV_SYN_VLD = 1
                Kw_pos      =      PSN_ENG
Else
                Kw_pos      = 720 °CRK
end
Nkw_grad      =      N_GRD
Nkw_zahn      =      N_TOOTH_CUS

```

## R.20 Customer adaptation module: ENSL

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_nlf	O/V	0... 1H	0 ...1	1	-
Notluftfahren aktiv					
B_ska	O/V	0... 1H	0 ...1	1	-
SKA aktiv, ausgelöst über Ebene 1, 2 oder 3					
Mdi_nmax	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Maximum torque at engine speed limitation					
N_LIH_PRS_OIL	O/V	0... 1FE0H	0... 8160	1	rpm
Required engine speed limit by customer for oil pressure limp home mode					
N_MAX_LIH_STATE_CMB_S	O/V	0... 1FE0H	0... 8160	1	rpm
Engine speed limit for required stratified limp home mode					
Nmax_var	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
Actual engine speed limit depending on TOIL - red area (BN2000)					

### Input data:

LV_ERR_ECU_CKS {p. 4232}	LV_ERR_ECU_RAM {p. 4232}	LV_MAF_BLS_DIAG {p. 4820}	LV_MTC_LIH_ACT {p. 4216}
LV_MTC_LIH_CUR_OFF {p. 4982}	LV_N_LIM_REQ_MON {p. 6877}	LV_TPS_MTC_N_LIM {p. 4982}	N_MAX_THD_2 {p. 1148}
Nkw_poel_notl {p. 8163}	Nmax_ba {p. 8163}	TQI_N_MAX {p. 3779}	

### R.20.1 Outputs for BMW functions which are not defined as ENSL exported data

#### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

#### Application conditions

**Initialisation:** Mdi\_nmax = 1000 Nm  
 B\_nlf, B\_ska, Nmax\_var = 8000 rpm  
*Value at PWL:* last calculated value: B\_nlf, B\_ska

**Recurrence :** 10 ms

**Activation:** every engine state


#### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

Mdi\_nmax = TQI\_N\_MAX

Nmax\_var = N\_MAX\_THD\_2

**IF** LV\_N\_LIM\_REQ\_MON == 1 **OR** // Request from safty  
 LV\_TPS\_MTC\_N\_LIM == 1 **OR** // Request from ETC diagnosis  
 LV\_MTC\_LIH\_ACT == 1 **OR** // Request from PVS diagnosis

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```

LV_MAF_BLS_DIAG==1      OR // MAF error and brake active
LV_ERR_ECU_CKS ==1      OR // Request from Checksum calculation
LV_ERR_ECU_RAM == 1      // Request from RAM check

THEN      B_ska = 1
ELSE      B_ska = 0
END
B_nlf = LV_MTC_LIH_CUR_OFF

```

## R.20.2 Outputs for supplier functions

### FUNCTION DESCRIPTION:

#### General information:

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

#### Description:

Above a specific engine speed, the calculation of the stratified combustion mode is switched off. To enable a stratified limp home mode even when the stratified combustion mode calculation is switched off, the engine speed limitation N\_MAX\_LIH\_STATE\_CMB\_S is introduced to reactivate stratified mode calculation. The BMW-variable Nmax\_ba from the Layer is copied to the supplier-variable N\_MAX\_LIH\_STATE\_CMB\_S

#### Application conditions

**Initialisation:** N\_MAX\_LIH\_STATE\_CMB\_S = Nmax\_ba  
N\_LIH\_PRS\_OIL = Nkw\_poel\_notl

**Recurrence:** N\_MAX\_LIH\_STATE\_CMB\_S: 100 ms  
N\_LIH\_PRS\_OIL: 10ms

**Activation:** *at every engine operating state*

**Deactivation:** -

#### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

N\_MAX\_LIH\_STATE\_CMB\_S = Nmax\_ba

N\_LIH\_PRS\_OIL = Nkw\_poel\_notl

## R.21 Customer adaptation module: ENSS

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_abgewuert	O/V	0... 1H	0 ...1	1	-
Motor abgewürft					
B_dc_new	O/V	0... 1H	0 ...1	1	-
Neuer Fahrzyklus mit Klemmenwechsel					
B_motlaeuft	O/V	0... 1H	0 ...1	1	-
Running engine without starter, only through combustion					
B_msacanerr	O/V	0... 1H	0 ...1	1	-
CAN error of MSA relevant signals					
B_msadeakt	O/V	0... 1H	0 ...1	1	-
Bedingung MSADeaktivierung					
B_msaklimaav	O/V	0... 1H	0 ...1	1	-
Bedingung MSA-Abschaltverhinderer von KLIMA					
B_msaklimaea	O/V	0... 1H	0 ...1	1	-
Bedingung MSA-Einschaltaufforderer von KLIMA					
B_msastopt	O/V	0... 1H	0 ...1	1	-
Motor stop because MSA					
B_msavadapt	O/V	0... 1H	0 ...1	1	-
MSA inhibition due to adaption					
B_msaverh	-	0... 1H	0 ...1	1	-
Bedingung MSAVerhinderung					
B_schlok	O/V	0... 1H	0 ...1	1	-
Boolean for key detected					
LV_ERR_STST	O/V	0... 1H	0 ...1	1	-
MSA error					
LV_LSH_DOWN_OFF_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
request switch off heating of downstream lambda sonde, bank selektiv					
LV_LSH_NS_OFF_REQ	O/V	0... 1H	0 ...1	1	-
request switch off heating of NOx-sensor					
LV_LSH_UP_OFF_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
request switch off heating of upstream lambda sonde, bank selektiv					
LV_STST_ACT	O/V	0... 1H	0 ...1	1	-
MSA active					
LV_STST_ACT_READY	O/V	0... 1H	0 ...1	1	-
MSA active and ready					
LV_STST_PRE_STOP_REQ	O/V	0... 1H	0 ...1	1	-
Preliminary MSA engine stop request					
LV_STST_ST_REQ_CUS	O/V	0... 1H	0 ...1	1	-
MSA engine start request					
LV_STST_ST_RLS	O/V	0... 1H	0 ...1	1	-
MSA engine start release					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_STST_STOP_REQ_CUS	O/V	0... 1H	0 ...1	1	-
MSA engine stop request					
T_CTR_ES	V	0... FFH	0... 2550	10	ms
time until detection of delayed engine stop					
Tn_abstell	O	0... FFFFH	0... 65535	1	s
engine off duration time (resolution s)					
Tn_abstellm	O/S	0... FFFFH	0... 65535	1	min
Engine off duration time (resolution min)					
Tn_start_10	O/V	0... FFFFH	0... 655350	10	ms
time after engine start					
Tn_start_1s	O/V	0... FFFFH	0... 65535	1	s
Zeit nach Startende in 1s aufgelöst					
Zr_seg_nstart	O	0... FFFFH	0... 65535	1	-
Cycle counter at start and after start (reset at exit start to after start)					

**Input data:**

B_hlsh1_off {p. 8343}	B_hlsh2_off {p. 8343}	B_hlsu1_off {p. 8343}	B_hlsu2_off {p. 8343}
B_hnox_off {p. 8343}	B_msaakt {p. 8344}	B_msaaktber {p. 8344}	B_msaerr {p. 8345}
B_msaprestopp {p. 8345}	B_msastart {p. 8345}	B_msastartf {p. 8345}	B_msastopp {p. 8345}
C_NR_CBK_EX {p. 944}	CYC_CAST {p. 1766}	ECU_STATE {p. 1091}	LV_DC {p. 5746}
LV_ENG_RUN_CMB {p. 800}	LV_ERR_CAN_STST {p. 800}	LV_IGK {p. 906}	LV_KEY_VLD {p. 1566}
LV_ST_END {p. 1720}	LV_STALL {p. 1766}	LV_STST_DEAC_ACT {p. 804}	LV_STST_ES {p. 804}
LV_STST_INH_ACT {p. 804}	LV_STST_INH_CDN_AD {p. 804}	NC_CBK_EX_NR {p. 1829}	STATE_STST_REQ_CAN {p. 809}
T_AST {p. 1766}	T_ES_CUS {p. 1444}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_CTR_ES	-	0... FFH	0... 2550	10	ms
delay time for detection of engine stop					

**R.21.1 Outputs for BMW functions which are defined as ENSS exported data****FUNCTION DESCRIPTION:**

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.


**Application conditions**

**Initialisation:** 0

**Recurrence :** event triggered / 10ms: B\_abgewuergt, T\_CTR\_ES  
10 ms: Zr\_seg\_nstart, Tn\_start\_10, B\_motlauft,  
B\_msadeakt,

B\_msaverh, B\_schlok

*Remark:* the resolution of T\_AST is 100 ms

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1000ms: Tn\_start\_1s

**Activation:** every engine state

### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

```

if      ECU_STAT = "PWL"
then    B_motlaeuft = 0
        Tn_start_10 = 0
        Tn_start_1s = 0
else    Tn_start_10 = T_AST
        Tn_start_1s = T_AST
        B_motlaeuft = LV_ENG_RUN_CMB
        B_msadeakt  = LV_STST_DEAC_ACT
        B_msaverh   = LV_STST_INH_ACT
        B_schlok    = LV_KEY_VLD
endif

```

Zr\_seg\_nstart = CYC\_CAST

/\* at LV\_ES 0-> 1 \*/

T\_CTR\_ES = C\_T\_CTR\_ES

/\* every 10ms \*/

```

if(1)    LV_ES = 1
then(1)  decrement T_CTR_ES
        if(2)    transition T_CTR_ES->0 and LV_IGK = 1
        Then(2)
            if(3)    LV_STST_ES = 0
            Then(3)  B_abgewuert = 1
                    call abwuerg_ini()
            Else(3)  call msastopp_ini()
            Endif(3)
        Endif(2)
endif(1)

```

/\* at LV\_ST\_END 0 -> 1\*/

B\_abgewuert = 0

## R.21.2 Outputs for BMW functions which are not defined as ENSS exported data


### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

### Application conditions

**Initialisation:** 0

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**Recurrence :** 10 ms: Tn\_abstell Remark: the input data recurrence is 1000ms  
 B\_msacanerr, B\_msavadapt, B\_msastopt, B\_dc\_new  
 100ms: B\_msaklimaav, B\_msaklimaea  
 1000 ms: Tn\_abstellm

**Activation:** every ECU state, including WAKE\_UP  
 Except B\_msacanerr, B\_msavadapt  
 Value in power latch phase: last valid value  
 Except: B\_dc\_new = 0

### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

B\_dc\_new = LV\_DC

Tn\_abstell = T\_ES\_CUS \* 60

#### *Hint:*

T\_ES\_CUS only has a resolution of 1 minute, but Tn\_abstell must have a resolution of 1 second ! Thus Tn\_abstell jumps in 60 sec steps.

Tn\_abstellm = T\_ES\_CUS

B\_msacanerr = LV\_ERR\_CAN\_STST

B\_msavadapt = LV\_STST\_INH\_CDN\_AD

**If** ECU\_STATE = "PWL"

**Then** B\_msastopt = 0

**Else** B\_msastopt = LV\_STST\_ES

**If** STATE\_STST\_REQ\_CAN = "NO\_REQ"

**or** STATE\_STST\_REQ\_CAN = "INVALID\_SIGNAL"

**Then** B\_msaklimaav= 0,B\_msaklimaea= 0

**Endif**

**If** STATE\_STST\_REQ\_CAN = "START\_REQ"

**Then** B\_msaklimaav= 0,B\_msaklimaea= 1

**Endif**

**If** STATE\_STST\_REQ\_CAN = "STOP\_REQ"

**Then** B\_msaklimaav= 0,B\_msaklimaea= 0

**Endif**

**If** STATE\_STST\_REQ\_CAN = "START\_INH"

**Then** B\_msaklimaav= 0,B\_msaklimaea= 0

**Endif**

**If** STATE\_STST\_REQ\_CAN = "STOP\_INH"

**Then** B\_msaklimaav= 1,B\_msaklimaea= 0

**Endif**

**Endif**

## R.21.3 Outputs for supplier aggregates, customer ( supplier

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

**Application conditions**

**Initialisation:** 0  
**Recurrence :** 10 ms / 100ms  
**Activation:** *at every engine state*  
**Deactivation:** -


**Formula section:**

/\* recurrence 10ms \*/

```
LV_STST_ACT           = B_msaakt
LV_STST_ACT_READY    = B_msaaktber
LV_ERR_STST          = B_msaerr
LV_STST_ST_RLS       = B_msastartf
LV_STST_ST_REQ_CUS   = B_msastart
LV_STST_STOP_REQ_CUS = B_msastopp
LV_STST_PRE_STOP_REQ = B_msaprestopp
```

/\* recurrence 100ms \*/

```
LV_LSH_NS_OFF_REQ = B_hnox_off
if      C_NR_CBK_EX = 2           //OL configuration
then
    LV_LSH_DOWN_OFF_REQ[1] = B_hlsh1_off
    LV_LSH_DOWN_OFF_REQ[2] = B_hlsh2_off
    LV_LSH_UP_OFF_REQ[1]   = B_hlsu1_off
    LV_LSH_UP_OFF_REQ[2]   = B_hlsu2_off
Else    // C_NR_CBK_EX = 1 , UL configuration
    LV_LSH_DOWN_OFF_REQ[1] = B_hlsh1_off
    LV_LSH_DOWN_OFF_REQ[2] = B_hlsh1_off
    LV_LSH_UP_OFF_REQ[1]   = B_hlsu1_off
    LV_LSH_UP_OFF_REQ[2]   = B_hlsu1_off
Endif
```

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## R.22 Customer adaptation module: ENTE

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_elu600	O/V	0... 1H	0 ...1	1	-
Learnt cooling fan variant					
B_lklps_In	O/V	0... 1H	0 ...1	1	-
Boolean for learnt variant ECRAS_UP					
B_lklps_In1	O/V	0... 1H	0 ...1	1	-
Boolean for learnt variant ECRAS_DOWN					
B_nkmtmp	O/V	0... 1H	0 ...1	1	-
Boolean for low coolant temperature ( from IHKA)					
Ba_ist_ewp	O/V	0... AH	0... 10	1	-
internal operation state of the CWP					
ECPWM_CLC	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Calculated pulse width modulated signal for the electronic controlled thermostat					
L_pwmout	O/V	0... FFH	0... 99.60937	0.390625	%
Electric fan control pulse width modulation					
LV_ECRAS	O/V	0... 1H	0 ...1	1	-
Indication of air flaps being closed (1)/open (0)					
LV_ECRAS_DOWN	O/V	0... 1H	0 ...1	1	-
SV label for B_LKLPS1 (from layer)					
LV_ECRAS_UP	O/V	0... 1H	0 ...1	1	-
SV label for B_LKLPS (from layer)					
LV_LIH_COC_ON	O/V	0... 1H	0 ...1	1	-
Limp home cooling circuit - engine overtemperature - request to transmission					
LV_TEMP_ENG_WARN_1	O/V	0... 1H	0 ...1	1	-
1: activate yellow warning lamp for TCO overtemperature (Check-Control-Messages in BN vehicles)					
LV_TEMP_ENG_WARN_2	O/V	0... 1H	0 ...1	1	-
1: activate red warning lamp for TCO overtemperature (Check-Control-Messages in BN vehicles)					
LV_TEMP_ENG_WARN_3	O/V	0... 1H	0 ...1	1	-
1: activate gearshift up for TCO overtemperature (Check-Control-Messages in BN vehicles)					
Md_na_el	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Torque loss of the electronic controled cooling fan(s)					
Md_na_ewapu	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Torque losses electric water pump					
N_PERC_ECF	O/V	0... FFH	0... 99.60937	0.390625	%
percentage value of electronic fan speed setpoint					
N_REL_CWP_SP	O/V	0... FFH	0... 255	1	-
Setpoint of EWAPU sent via bsd-component driver					
STATE_COC	O/V	0... FFH	0... 255	1	-
State coolant circuit management					
Tka	O/V	EC78... 7FFFH	-50... 327.67	0.01	°C
Coolant temperature at radiator outlet					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Tmot	O/V	EC78... 7FFFH	-50... 327.67	0.01	°C
Coolant temperature					
Tmot_abstell	O/V	EC78... 7FFFH	-50... 327.67	0.01	°C
Coolant temperature at engine stop					
Tmot_start	O/V	EC78... 7FFFH	-50... 327.67	0.01	°C
Coolant temperature at engine start					
Tmot_start_dc	O/V	EC78... 7FFFH	-50... 327.67	0.01	°C
Coolant temperature at first start of driving cycle					
Tsg	O/V	EC78... 7FFFH	-50... 327.67	0.01	°C
Temperatur Steuergerät					

**Input data:**

B_lklps {p. 8344}	B_lklps1 {p. 8344}	B_ntlkws {p. 8346}	B_tmmi_warn1 {p. 8347}
B_tmmi_warn2 {p. 8347}	B_tmmi_warn3 {p. 8347}	Ba_wm_ist {p. 8155}	ECFPWM_ECF {p. 1045}
ECU_STATE {p. 1091}	LV_FAN_VAR_AD {p. 803}	LV_N_REL_CWP_SP_EXT_ADJ {p. 7434}	LV_REQ_TCO_L {p. 1567}
LV_VAR_ECRAS_DOWN {p. 4515}	LV_VAR_ECRAS_UP {p. 655}	N_REL_CWP_SP_EXT_ADJ {p. 7435}	Nelueft_wm {p. 8163}
Newp_soll {p. 8163}	STATE_CWP_INT {p. 4537}	STATE_ENG {p. 1720}	TCO {p. 1100}
TCO_2 {p. 1218}	TCO_ST {p. 1100}	TCO_ST_DC {p. 1100}	TCO_STOP {p. 1100}
TECU {p. 1256}	TQ_LOSS_CWP_EL {p. 6658}	TQ_LOSS_ECF {p. 6580}	Tv_kft {p. 8178}

**R.22.1 Outputs for BMW functions****FUNCTION DESCRIPTION:**

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the output are different from the specified values due to the input data attributes.

**Application conditions****Initialisation:**


all 0  
 except B\_lklps\_ln = true , Tmot\_start=TCO; Tmot=TCO; Tmot\_abstell = TCO\_STOP, Tsg = TECU  
 (this init has to be done after the init process of tco/ tecu-acquisition)

**Recurrence :**

10ms: Md\_na\_el, Md\_na\_ewapu  
 100 ms: Tmot, Tka, L\_pwmout, B\_elu600, Tsg, Tmot\_start\_dc  
 200 ms: B\_lklps\_ln, B\_lklps\_ln1  
 Ba\_ist\_ewp, B\_nkmtmp  
 1000 ms: Tmot\_start, Tmot\_abstell

**Activation:**

every engine state

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**Formula section:**

*Remark:* all formulas are valid in a **physical** meaning

```

Tmot                =          TCO
Tmot_start_dc      =          TCO_ST_DC
If          STATE_ENG          =          0
Then       Tmot_start          =          TCO
Else       Tmot_start          =          TCO_ST
Endif
If  ECU_STATE =          4  "power latch"
Then Tmot_abstell      =          TCO_STOP
Endif
Tka                =          TCO_2
L_pwmout           =          ECFPWM_ECF
Ba_ist_ewp         =          STATE_CWP_INT
Md_na_el           =          TQ_LOSS_ECF
Md_na_ewapu        =          TQ_LOSS_CWP_EL
B_nkmttemp         =          LV_REQ_TCO_L
B_elu600           =          LV_FAN_VAR_AD
B_iklps_In         =          LV_VAR_ECRAS_UP
B_iklps_In1        =          LV_VAR_ECRAS_DOWN
Tsg                =          TECU

```

**R.22.2 Outputs for supplier functions****FUNCTION DESCRIPTION:**

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the output are different from the specified values due to the input data attributes.

**Application conditions**

**Initialisation:** all 0 at reset

**Recurrence :** 100 ms: ECTPWM\_CLC  
 200 ms: N\_REL\_CWP\_SP, LV\_LIH\_COC\_ON, LV\_TEMP\_ENG\_WARN\_1,  
 LV\_TEMP\_ENG\_WARN\_2, LV\_TEMP\_ENG\_WARN\_3, STATE\_COC, LV\_ECRAS,  
 N\_PERC\_ECF, LV\_ECRAS\_UP, LV\_ECRAS\_DOWN

**Activation:** every engine state

**Formula section:**


```

ECTPWM_CLC          =          Tv_kft
N_PERC_ECF          =          Nelueft_wm
LV_LIH_COC_ON       =          B_ntlkws
LV_TEMP_ENG_WARN_1 =          B_tmmi_warn1
LV_TEMP_ENG_WARN_2 =          B_tmmi_warn2
LV_TEMP_ENG_WARN_3 =          B_tmmi_warn3
STATE_COC           =          Ba_wm_ist // up to now not used; planned to put on CAN

```

LV\_ECRAS = 0

LV\_ECRAS\_UP = B\_iklps


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LV\_ECRAS\_DOWN = B\_lkps1

```

IF                LV_N_REL_CWP_SP_EXT_ADJ = 1
THEN             N_REL_CWP_SP = N_REL_CWP_SP_EXT_ADJ * 2,55 [1/%]
ELSE             N_REL_CWP_SP = Newp_soll
ENDIF

```

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## R.23 Customer adaptation module: EVAC

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_dtev_aktiv	O/V	0... 1H	0 ...1	1	-
Inhibition of MAP-control requested by fc cps					
B_eol_tev	O/V	0... 1H	0 ...1	1	-
Bedingung BandendeTEV-Check aktiv					
B_te	O/V	0... 1H	0 ...1	1	-
1: canister purge valve is not closed					
B_te_la1	O/V	0... 1H	0 ...1	1	-
air fuel stochiometric for CP					
B_teblg	O/V	0... 1H	0 ...1	1	-
Bedingung Beladungsgrad wird gelernt					
B_tev_erf	O/V	0... 1H	0 ...1	1	-
Request to inhib Catalyst and O2 sensor diagnosis for allowing purge canister activation					
B_tev_zu	O/V	0... 1H	0 ...1	1	-
Logical value for CPS valve closed					
Fakf	O/V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Moving mean value of the canister load CL					
LV_CP_INH_CUS	O/V	0... 1H	0 ...1	1	-
CPS-INH request from customer					
Mdi_res_tev	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
torque reserve for canister purge at idle					
MFF_ADD_TQ_CP	O/V	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
TQ relevant mass flow					
MFF_MAX_CP_CUS	O/V	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
Maximum mass flow from canister purge					
MFF_MAX_HOMS_CUS	O/V	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
MFF threshold for engine operation mode change HOM <-> HOMS					
MFF_MAX_S_CUS	O/V	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
MFF threshold for engine operation mode change HOMS <-> S					
Mste	O/V	0... FFFFH	0... 25.5996	390.6e-6	kg/h
mass flow through canister purge valve					
Rktev	O/V	8000... 7FFFH	-16... 15.99951	488.299e-6	-
fuel correction due to canister purge					
Status_tev	O/V	0... FFH	0... 255	1	-
State canister purge					

### Input data:

B_tev_stopp {p. 8347}	C_MAF_REF {p. 8279}	C_MFF_FAC {p. 8245}	CL_MMV {p. 3698}
ECU_STATE {p. 1091}	LV_CP_ACT_REQ {p. 3636}	LV_CP_CLOSE_ACT {p. 3749}	LV_EOL_CPS {p. 7763}
LV_INH_MAP_CTL_ DIAGCPS {p. 5926}	LV_LAMB_AFS_CP {p. 3700}	MAF_CPS {p. 3636}	MFF_ADD_CYL_CP {p. 3692}

Rk_vlo_hs {p. 8168}	Rk_vlo_s {p. 8168}	Rkte_max {p. 8168}	Rkte_md {p. 8168}
STATE_CP {p. 3637}	TQ_ADD_CP {p. 3562}		

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_DIAGCPS_EOL_HOM_REQ	-	0... 1H	0 ...1	1	-
Homogeneous AFS request due to active EOL DIAGCPS					

**R.23.1 Outputs for BMW functions which are defined as EVAC exported data****FUNCTION DESCRIPTION:**

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

**Application conditions ( for BMW variables):**

*Initialisation:* 0 at reset

*Recurrence :* 10 ms  
                   Rktev, Mste 20 ms  
                   100ms: B\_dtev\_aktiv

*Activation:* every engine state, except power latch phase

*Deactivation:* power latch phase

Value at power latch phase: 0, Fakf: last valid value

**Formula section:**

*Remark:* all formulas are valid in a **physical** meaning


**If** ECU\_STATE = "PWL"

**Then**

```
Mdi_res_tev = 0
B_dtev_aktiv = 0
B_eol_tev = 0
B_tev_erv = 0
B_tev_zu = 0
Rktev = 0
Mste = 0
B_te_la1 = 0
B_te = 0
Status_tev = 0
B_teblg = 0
```

**Else**

```
Mdi_res_tev = TQ_ADD_CP
B_dtev_aktiv = LV_INH_MAP_CTL_DIAGCPS
B_eol_tev = LV_EOL_CPS
B_tev_erv = LV_CP_ACT_REQ
B_tev_zu = LV_CP_CLOSE_ACT
Rktev = MFF_ADD_CYL_CP / (C_MAF_REF * C_MFF_FAC)
Status_tev = STATE_CP
Mste = MAF_CPS
```

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```

B_te_la1 = LV_LAMB_AFS_CP or (LC_DIAGCPS_EOL_HOM_REQ and LV_EOL_CPS)
B_te     = ! LV_CP_CLOSE_ACT
Fakf    = CL_MMV

```

```

If STATE_CP = RAMP_OPEN (8H) or RAMP_OPEN_FAST (9H)
    or MAX_PURGE (AH)

```

```

    Then B_tebg = 1

```

```

    Else B_tebg = 0

```

```

Endif

```

```

Endif

```

## R.23.2 Outputs for supplier aggregates, customer ( supplier

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs can be different from the specified values due to the input data attributes.

### Application conditions (for supplier variables):

*Initialisation:* 0

*Recurrence :* 10 ms

*Activation:* at every engine state

### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

```

LV_CP_INH_CUS           = B_tev_stopp
MFF_MAX_CP_CUS         = Rkte_max * C_MAF_REF * C_MFF_FAC
MFF_ADD_TQ_CP          = Rkte_md * C_MAF_REF * C_MFF_FAC
MFF_MAX_S_CUS          = Rk_vlo_s * C_MAF_REF * C_MFF_FAC
MFF_MAX_HOMS_CUS       = Rk_vlo_hs * C_MAF_REF * C_MFF_FAC

```

## R.24 Customer adaptation module: EXTC

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_atlsv_c_if	O/V	0... 1H	0 ...1	1	-
Testeranforderung für Diagnosefunktion der Abgasturbolader					
B_bsakt_zuli1	O/V	0... 1H	0 ...1	1	-
Boolean for active catalyst overheating control bank 2					
B_bsakt_zuli2	O/V	0... 1H	0 ...1	1	-
Boolean for active catalyst overheating control bank 1					
B_kath	O	0... 1H	0 ...1	1	-
Catalyst heating function general					
Baw_katman1	O/V	0... FFFFH	0... 65535	1	-
Statuswort Katheizanforderung - "priorisierter" Wunsch					
Baw_katman2	O/V	0... FFFFH	0... 65535	1	-
Statuswort Katheizanforderung - "alternativ" Wunsch					
Drfkh_s	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	%
differences for S - CH					
Dwesb3_kh_s	O/V	E200... 5A00H	-180 ...540	0.0234375	°CRK
Delta Zündwinkel Einspritzbeginn 3.EinspritzungSchicht					
Dwese2_kh_h	O/V	E200... 5A00H	-180 ...540	0.0234375	°CRK
Delta Zündwinkel Einspritzende 2. Einspritzung homogen					
Dzw_kh_s	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Catalyst heating ignition angle difference (stratified)					
FAC_MAF_REL_EGR_COR	O/V	0... BB8H	0... 300	0.1	%
Relative filling, EGR-corrected					
FAC_TQ_ADD_SO2P_EXT	O/V	0... FFH	0... 0.99609	3.9063e-3	-
External factor reducing torque reserve for desulfation catalyst heating					
La_bsuzli1	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda for catalyst overheating prevention bank 1					
La_bsuzli2	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda for catalyst overheating prevention bank 2					
La_kh1	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda catalyst heating					
La_kh2	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda catalyst heating					
LAMB_COP [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda for catalyst overheating prevention bank 1+2					
LV_CH	O/V	0... 1H	0 ...1	1	-
Auxiliary Function " Catalyst Heating Spark"					
LV_CH_AST_REQ_TCHA_DIAG	O/V	0... 1H	0 ...1	1	-
Activation of catalyst heating function requested for turbo charger diagnosis					
LV_CH_INH	O/V	0... 1H	0 ...1	1	-
Inhibition of general catalyst heating					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAMB_COP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Lambda setpoint calculation for catalyst overheating prevention is active					
LV_PUC_INH_TEMP_CAT	O/V	0... 1H	0 ...1	1	-
Flag to inhibit PUC operation due to too high TEMP_CAT					
LV_TCHA_DIAG_REQ	O/V	0... 1H	0 ...1	1	-
Request of ATL-Diagnosis					
LV_TCHA_DIAG_REQ_OFF	V	0... 1H	0 ...1	1	-
request to switch off ATL-diagnosis					
Mdi_res_kh	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Torque reserve for catalyst heating					
P_rail_kh	O/V	0... FFFFH	0... 39.99938	610.4e-6	MPa
Rail pressure from catalyst heating manager					
Prio_katman1	O/V	80... 7FH	-128 ...127	1	-
Priority number (highest wish) of catalyst heating manager					
Prio_katman2	O/V	80... 7FH	-128 ...127	1	-
Priority number (second wish) of catalyst heating manager					
TQ_ADD_CH_TCHA_DIAG	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for turbocharger diagnosis - to be realized via catalyst heating					
Wesb1kh_h [NC_CYL_NR]	O/V	E200... 5A00H	-180 ...540	0.0234375	°CRK
Einspritzbegin 1. Einspritzung homogen					


**Input data:**

B_atlsvc {p. 8342}	B_atlsvc_khm {p. 8342}	B_bs1 {p. 8342}	B_bs2 {p. 8342}
B_vb_sa {p. 8347}	B_vbkhm_notl {p. 8347}	Baw_ist {p. 8155}	C_MAF_REF {p. 8279}
CRK_INJ_BAS [NC_CYL_NR] {p. 2122}	EOI_2_DELTA_MPLH_CH {p. 2159}	F_bsmadres {p. 8157}	FUP_SP_CH {p. 3611}
IGA_DIF_S_CH {p. 1943}	La_bs1 {p. 8160}	La_bs2 {p. 8160}	LAMB_COP_CUS [i] {p. 2195}
LAMB_SP_CH [NC_CBK_EX_NR] {p. 2169}	LV_TCHA_DIAG_EXT_ REQ {p. 7763}	MAF_DIF_S_CH {p. 6529}	Md_res_atlsvc {p. 8161}
NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NR_PRI_CH_MOD {p. 1796}	NR_PRI_CH_MOD_REQ {p. 1796}
Rfv_vns {p. 8167}	SOI_1_MPLH_CH [NC_CYL_NR] {p. 2154}	SOI_MPLP_DIF_CH {p. 2188}	STATE_CH {p. 1777}
STATE_CH_MOD_IVVT {p. 1040}	STATE_CH_MOD_IVVT_ REQ {p. 1040}	TQ_ADD_CH {p. 6582}	

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_TCHA_DIAG_EXT_REQ	-	0... 1H	0 ...1	1	-
switch for manual start of ATL-diagnosis (default: 0)					

**R.24.1 Outputs for BMW functions which are defined as EXTC exported data****FUNCTION DESCRIPTION:**

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl
	Document key 10171571 SPE 000 AO	Pages Page 8233 of 8404
Regensburg (RGB)	Copyright (C) Continental AG, 2007	A4: 2007-11

Adaptation to BMW environment.

### Application conditions:

*Initialisation at reset or at exit power latch phase:*

	0 ,except	La_bsuzli1/2	= 2.00, La_kh1/2 = 1.00
<i>Recurrence :</i>	seg	Dwesb3_kh_s, Dwese2_kh_h,	
		Wesb1kh_h[ANZAHL_ZYLINDER], P_rail_kh, Dzw_kh_s	
	10 ms	Mdi_res_kh, La_kh1/2,	
		La_bsuzli1, La_bsuzli2, Drfkh_s, Baw_katman1, Baw_katman2	
	100ms	Prio_katman1/2, B_kath, B_atlsvc_if	
	200ms	B_bsakt_zuli1, B_bsakt_zuli2	

Activation: every engine state, except power latch phase  
 Deactivation: at power latch phase, except B\_kath  
 Values at Deactivation: 0, except P\_rail\_kh: last calculated value

### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

Mdi_res_kh	=	TQ_ADD_CH
La_bsuzli1	=	LAMB_COP_CUS_1
La_bsuzli2	=	LAMB_COP_CUS_2
B_bsakt_zuli1	=	LV_LAMB_COP_CUS_1
B_bsakt_zuli2	=	LV_LAMB_COP_CUS_2
Dwesb3_kh_s	=	SOI_MPLP_DIF_CH
Dwese2_kh_h	=	EOI_2_DELTA_MPLH_CH
La_kh1	=	LAMB_SP_CH[1]
La_kh2	=	LAMB_SP_CH[2]
Baw_katman1	=	STATE_CH_MOD_IVVT_REQ
Baw_katman2	=	STATE_CH_MOD_IVVT
Dzw_kh_s	=	IGA_DIF_S_CH

Wesb1kh_h[ANZAHL_ZYLINDER]	=	SOI_1_MPLH_CH[NC_CYL_NR] + CRK_INJ_BAS[0]
Drfkh_s	=	MAF_DIF_S_CH / C_MAF_REF
Prio_katman1	=	NR_PRI_CH_MOD_REQ
Prio_katman2	=	NR_PRI_CH_MOD
P_rail_kh	=	FUP_SP_CH
B_kath	=	LV_CH
B_atlsvc_if	=	LV_TCHA_DIAG_REQ


## R.24.2 Outputs for supplier aggregates

### FUNCTION DESCRIPTION:

Adaptation to BMW environment

### Application conditions

**Initialisation at reset: 0, except** LAMB\_COP [NC\_CBK\_EX\_NR] = 2.00  
 FAC\_TQ\_ADD\_SO2P\_EXT = 1.00  
*Initialisation at LV\_IGK 0-> 1:* LV\_TCHA\_DIAG\_REQ\_OFF  
 = 0

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 8234 of 8404	
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**Recurrence:**

```

10ms:      LAMB_COP [NC_CBK_EX_NR],
           LV_LAMB_COP [NC_CBK_EX_NR],
           LV_LAMB_COP, FAC_MAF_REL_EGR_COR, LV_CH, LV_CH_INH, TQ_
           ADD_CH_TCHA_DIAG
           100ms:      LV_PUC_INH_TEMP_CAT,
                       LV_TCHA_DIAG_REQ, LV_TCHA_DIAG_REQ_OFF,

                       LV_CH_AST_REQ_TCHA_DIAG
           200ms:      FAC_TQ_ADD_SO2P_EXT

```

**Activation:** *every engine state*

### Formula section:

```

LAMB_COP[1]      = La_bs1
LAMB_COP[2]      = La_bs2
LV_LAMB_COP[1]   = B_bs1
LV_LAMB_COP[2]   = B_bs2
LV_LAMB_COP      = B_bs2 or B_bs1
LV_PUC_INH_TEMP_CAT = B_vb_sa
FAC_MAF_REL_EGR_COR = Rfv_vns

```

**if** one of the following combinations of the bit values (bit 4 to bit 11) of Baw\_ist is active

Bit															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
				0	0	0	0	0	1	0	0				
				0	0	0	0	0	1	0	1				
				0	0	0	0	0	1	1	1				
				0	0	0	0	1	0	1	0				
				0	0	0	0	1	0	1	1				
				0	0	0	0	1	1	0	0				
				0	0	0	0	1	1	0	1				
				0	0	0	0	1	1	1	0				

```

then          LV_CH = 1
else          LV_CH = 0
endif

```

```

LV_CH_INH = B_vbkhm_notl
FAC_TQ_ADD_SO2P_EXT = F_bsmadres
TQ_ADD_CH_TCHA_DIAG = Md_res_atlsvc
if          B_atlsvc switch 1 -> 0
then        LV_TCHA_DIAG_REQ_OFF = 1
endif
LV_TCHA_DIAG_REQ = (LC_TCHA_DIAG_EXT_REQ or LV_TCHA_DIAG_EXT_REQ)

and not(LV_TCHA_DIAG_REQ_OFF)
LV_CH_AST_REQ_TCHA_DIAG = B_atlsvc_khm

```

## R.25 Customer adaptation module: EXTD

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_atm_tpnk1	O/V	0... 1H	0 ...1	1	-
Dew point has been reached post cat. specific bank 1 downstream					
B_atm_tpnk2	O/V	0... 1H	0 ...1	1	-
Dew point has been reached post cat. specific bank 2 downstream					
B_atm_tpvk1	O/V	0... 1H	0 ...1	1	-
Bedingung Taupunktende erreicht Lambdasonde vor Kat1					
B_atm_tpvk2	O/V	0... 1H	0 ...1	1	-
Bedingung Taupunktende erreicht Lambdasonde vor Kat2					
EGY_DEW_NT_DOWN	O/V	8000... 7FFFH	-20480... 20479.375	0.625	W
amount of energy brought into exhaust system for nox trap dew point detection					
LV_CHECK_MDL_ST	O/V	0... 1H	0 ...1	1	-
Flag for modelling start					
Tabg_sens1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Signal exhaust gas temperature sensor 1					
Tabg_sens2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Signal exhaust gas temperature sensor 2					
TEG_CAT_DOWN_MDL	O/V	0... 7FF0H	0... 2047	0.0625	°C
Bank selektive modelled exhaust gas temperature downstream for interfaces					
TEG_CAT_DOWN_MDL [i]	O	0... 7FF0H	0... 2047	0.0625	°C
Exhaust gas temperature downstream Cat					
TEG_CAT_DOWN_MDL_BAS [NC_CBK_EX_NR]	O/V	0... FFFFH	-48 ...1	0.023	°C
Model of exhaust temperature post catalyst downstream					
TEG_CAT_UP_MDL [i]	O	0... 7FF0H	0... 2047	0.0625	°C
Bank selektive modelled exhaust gas temperature upstream for interfaces					
TEG_CAT_UP_MDL [NC_CBK_EX_NR]	O/V	0... 7FF0H	0... 2047	0.0625	°C
Modelled exhaust gas temperature; engine out (bank selective)					
TEG_DYN	O/V	0... 7FF0H	0... 2047	0.0625	°C
Modelled exhaust gas temperature upstream for interfaces					
TEG_STAT_MAX	O/V	0... 7FF0H	0... 2047	0.0625	°C
Gemittelte max. Temperatur für Desulfatisierung					
TEG_STAT_MAX_1	O/V	0... 7FF0H	0... 2047	0.0625	°C
Max. Temperatur für Desulfatisierung Bank 1					
TEG_STAT_MAX_2	O/V	0... 7FF0H	0... 2047	0.0625	°C
Max. Temperatur für Desulfatisierung Bank 2					
TEG_WALL_CAT_DOWN_MDL [NC_CBK_EX_NR]	O/V	0... FFFFH	-48 ...1	0.023	°C
Model of exhaust wall temperature post catalyst downstream					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TEG_WALL_CAT_UP_MDL [NC_CBK_EX_NR]	O/V	0... FFFFH	-48 ...1	0.023	°C
Model of exhaust wall temperature pre catalyst upstream					
TEG_WALL_NT_DOWN_MDL	O/V	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
exhaust manifold wall temperature at NOX-sensor					
TEG_WALL_NT_DOWN_MDL_ST	O/V	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
exhaust manifold wall temperature at NOX-sensor at start					
TEMP_CAT	O/V	0... FFFFH	-33... 990.98437	0.015625	°C
Modelled exhaust gas temperature downstream for interfaces					
TEMP_CAT_DYN_MDL [NC_CBK_EX_NR]	O/V	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Modelled catalyst temperature under dynamic conditions					
TEMP_CAT_STAT_MDL [NC_CBK_EX_NR]	O/V	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
modeled catalyst monolith temperature (bank selective)					
Tkat_mod	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
modelled catalyst temperature					
TNT_MDL_1 [NC_NT_NR]	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Modelled NOx catalyst temperature of the first monolith					
TNT_MDL_2 [NC_NT_NR]	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Modelled NOx catalyst temperature of the second monolith					
TNT_MDL_H	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Maximum of modelled NOx catalyst monolith temperatures					
TNT_MDL_H_1	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Maximum of modelled NOx catalyst monolith temperatures, bank 1					
TNT_MDL_H_2	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Maximum of modelled NOx catalyst monolith temperatures, bank 2					
TNT_MDL_L	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Minimum of modelled NOx catalyst monolith temperatures					
TNT_MDL_MAX_AVL	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Maximum attainable monolith temp. for active Nox cat. desulfation					
TNT_MDL_MV	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Temperature NoX-trap mean value					
TNT_MDL_MV_SNG [NC_NT_NR]	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Mean value of the two modelled NOx catalyst monolith temperatures for each exhaust branch					

**Input data:**

LV_ST_END {p. 1720}	LV_STST_STOP_CYC_ MEM {p. 805}	LV_TEG_CAT_DOWN_ MIN_THD [NC_CBK_EX_NR] {p. 2446}	LV_TEG_MIN_THD [NC_CBK_EX_NR] {p. 2446}
NC_CBK_EX_NR {p. 1829}	NC_NT_NR {p. 644}	Q_abgnox {p. 8166}	T_ikat1 {p. 8175}
T_ikat1_stat {p. 8175}	T_ikat2 {p. 8175}	T_ikat2_stat {p. 8175}	Tabg_demax1 {p. 8176}
Tabg_demax2 {p. 8176}	Tabg_demaxav {p. 8176}	Tabg_desul {p. 8176}	Tabg_ikat_av {p. 8176}
Tabg_inok1 {p. 8176}	Tabg_inok2 {p. 8176}	Tabg_nk_av {p. 8176}	Tabg_nk1 {p. 8176}
Tabg_nk2 {p. 8176}	Tabg_nnok1 {p. 8176}	Tabg_nnok2 {p. 8176}	Tabg_nok_av {p. 8176}

Tabg_nok_av1 {p. 8176}	Tabg_nok_av2 {p. 8176}	Tabg_nokmax {p. 8176}	Tabg_nokmax1 {p. 8176}
Tabg_nokmax2 {p. 8176}	Tabg_nokmin {p. 8176}	Tabg_r10 {p. 8176}	Tabg_r9 {p. 8176}
Tabg_vk_av {p. 8176}	Tabg_vk1 {p. 8177}	Tabg_vk2 {p. 8177}	TEG_PCAT_DOWN_COR [NC_CBK_EX_NR] {p. 3181}
Tw_m1 {p. 8178}	Tw_m2 {p. 8178}	Tw_nk1 {p. 8178}	Tw_nk2 {p. 8178}
Tw_noxsens {p. 8178}			

## R.25.1 Output for BMW functions which are not defined as EXT D exported data

### FUNCTION DESCRIPTION:

*Remark:* all formulas are valid in a **physical** meaning

### Application conditions:

Initialisation at reset or at exit power latch phase for variables with BMW-naming convention:

0 °C: Tkat\_mod  
0: B\_atm\_tpnk1, B\_atm\_tpnk2, B\_atm\_tpvk1, B\_atm\_tpvk2  
First valid value: Tabg\_sens1, Tabg\_sens2, Tabg\_sensturb1, Tabg\_sensturb2

Recurrence: 200ms  
Activation: at every engine state  
Deactivation: --

### Formula section:

B\_atm\_tpvk1 = LV\_TEG\_MIN\_THD[1]  
B\_atm\_tpvk2 = LV\_TEG\_MIN\_THD[2]  
B\_atm\_tpnk1 = LV\_TEG\_CAT\_DOWN\_MIN\_THD[1]  
B\_atm\_tpnk2 = LV\_TEG\_CAT\_DOWN\_MIN\_THD[2]

If ECU\_STATE is not "PWL"

**then**

Tkat\_mod = TEG\_CAT\_DOWN\_MDL  
Tabg\_sens1 = TEG\_PCAT\_DOWN\_COR[1]

If NC\_NT\_NR = 2

**then**

Tabg\_sens2 = TEG\_PCAT\_DOWN\_COR[2]

**else**

Tabg\_sens2 = TEG\_PCAT\_DOWN\_COR[1]

**Endif**

## R.25.2 Outputs for supplier aggregates

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs can be different from the specified values due to the input data attributes.

## Application conditions

### Initialisation for variables with supplier-naming convention: 0 °C

#### Except :


```

EGY_DEW_NT_DOWN      =      Q_abgnox
TEG_CAT_DOWN_MDL_BAS[1] = Tabg_r9
TEG_CAT_DOWN_MDL_BAS[2] = Tabg_r10
TEG_CAT_UP_MDL[1] = Tabg_vk1
TEG_CAT_UP_MDL[2] = Tabg_vk2
TEG_CAT_UP_MDL_1 = Tabg_vk1
TEG_CAT_UP_MDL_2 = Tabg_vk2
TEG_STAT_MAX_1 = Tabg_demax1
TEG_STAT_MAX_2 = Tabg_demax2
TEG_STAT_MAX = Tabg_demaxav
TEMP_CAT = Tabg_ikat_av
TEG_CAT_DOWN_MDL[1] = Tabg_nk1
TEG_CAT_DOWN_MDL[2] = Tabg_nk2
TEG_CAT_DOWN_MDL_1 = Tabg_nk1
TEG_CAT_DOWN_MDL_2 = Tabg_nk2
TEG_CAT_DOWN_MDL = Tabg_nk_av
TEG_WALL_NT_DOWN_MDL_ST      = Tw_noxsens
TEG_WALL_NT_DOWN_MDL      = Tw_noxsens
TEG_DYN = Tabg_vk_av
TEMP_CAT_DYN_MDL[1]      = T_ikat1
TEMP_CAT_DYN_MDL[2]      = T_ikat2
TEMP_CAT_STAT_MDL[1]      = T_ikat1_stat
TEMP_CAT_STAT_MDL[2]      = T_ikat2_stat
TNT_MDL_MAX_AVL      = Tabg_desul
TNT_MDL_1[1]      =Tabg_inok1
TNT_MDL_1[2]      =Tabg_inok2
TNT_MDL_2[1]      =Tabg_nnok1
TNT_MDL_2[2]      =Tabg_nnok2
TNT_MDL_MV      =Tabg_nok_av
TNT_MDL_MV_SNG[1]=Tabg_nok_av1
TNT_MDL_MV_SNG[2]=Tabg_nok_av2
TNT_MDL_H      =Tabg_nokmax
TNT_MDL_H_1      =Tabg_nokmax1
TNT_MDL_H_2      =Tabg_nokmax2
TNT_MDL_L      =Tabg_nokmin

```

**Recurrence :** 200 ms

**Activation:** *every engine state*

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 8239 of 8404</b>	
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**Formula section:**

*Remark:* all formulas are valid in a **physical** meaning

EGY\_DEW\_NT\_DOWN = Q\_abgnox  
 TEG\_WALL\_CAT\_UP\_MDL[1] = Tw\_m1  
 TEG\_WALL\_CAT\_UP\_MDL[2] = Tw\_m2  
 TEG\_WALL\_CAT\_DOWN\_MDL[1] = Tw\_nk1  
 TEG\_WALL\_CAT\_DOWN\_MDL[2] = Tw\_nk2  
 TEG\_CAT\_DOWN\_MDL\_BAS[1] = Tabg\_r9  
 TEG\_CAT\_DOWN\_MDL\_BAS[2] = Tabg\_r10  
 TEG\_CAT\_UP\_MDL[1] = Tabg\_vk1  
 TEG\_CAT\_UP\_MDL[2] = Tabg\_vk2  
 TEG\_STAT\_MAX\_1 = Tabg\_demax1  
 TEG\_STAT\_MAX\_2 = Tabg\_demax2  
 TEG\_STAT\_MAX = Tabg\_demaxav  
 TEMP\_CAT = Tabg\_ikat\_av  
 TEG\_CAT\_DOWN\_MDL[1] = Tabg\_nk1  
 TEG\_CAT\_DOWN\_MDL[2] = Tabg\_nk2  
 TEG\_CAT\_DOWN\_MDL = Tabg\_nk\_av  
 TEG\_WALL\_NT\_DOWN\_MDL = Tw\_noxsens  
 TEG\_DYN = Tabg\_vk\_av  
 TEMP\_CAT\_DYN\_MDL[1] = T\_ikat1  
 TEMP\_CAT\_DYN\_MDL[2] = T\_ikat2  
 TEMP\_CAT\_STAT\_MDL[1] = T\_ikat1\_stat  
 TEMP\_CAT\_STAT\_MDL[2] = T\_ikat2\_stat  
 TNT\_MDL\_MAX\_AVL = Tabg\_desul  
 TNT\_MDL\_1[1] = Tabg\_inok1  
 TNT\_MDL\_1[2] = Tabg\_inok2  
 TNT\_MDL\_2[1] = Tabg\_nnok1  
 TNT\_MDL\_2[2] = Tabg\_nnok2  
 TNT\_MDL\_MV = Tabg\_nok\_av  
 TNT\_MDL\_MV\_SNG[1] = Tabg\_nok\_av1  
 TNT\_MDL\_MV\_SNG[2] = Tabg\_nok\_av2  
 TNT\_MDL\_H = Tabg\_nokmax  
 TNT\_MDL\_H\_1 = Tabg\_nokmax1  
 TNT\_MDL\_H\_2 = Tabg\_nokmax2  
 TNT\_MDL\_L = Tabg\_nokmin

**If(1)** LV\_ES = 1

**Then(1)**

LV\_CHECK\_MDL\_ST = 0

**Else(1)**

**If(2)** LV\_CHECK\_MDL\_ST = 0

**And** TEG\_WALL\_NT\_DOWN\_MDL(n-1) <> TEG\_WALL\_NT\_DOWN\_MDL(n)

**Then(2)**

LV\_CHECK\_MDL\_ST = 1

**If** LV\_STST\_STOP\_CYC\_MEM = 0

**Then** TEG\_WALL\_NT\_DOWN\_MDL\_ST = TEG\_WALL\_NT\_DOWN\_MDL

**Endif**

**Endif(2)**

**Endif(1)**



## R.26 Customer adaptation module: FMSP

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_dosp_akt	O	0... FFH	0... 255	1	-
Injection mode requested					
B_wst	O	0... 1H	0 ...1	1	-
Auxiliary function "Re-start"					
CTR_MFF_SP_HOM_BAS_TMP [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for calculation of MFF_SP_HOM_BAS_TMP					
F_start	O	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
cold start enrichment					
F_vst	O	0... FFFFH	0... 63.99902	976.599e-6	-
mixture enrichment due to warm-up and cold after start enrichment					
FAC_1_HOM_COR [NC_CYL_NR]	V	0... FFFFH	0... 0.99998	15.3e-6	-
MFF additive correction on 1st. injection pulse (homogeneous modus)					
FAC_1_S_COR [NC_CYL_NR]	V	0... FFFFH	0... 0.99998	15.3e-6	-
MFF additive correction on 1st. injection pulse (stratified modus)					
FAC_2_HOM_COR [NC_CYL_NR]	V	0... FFFFH	0 ...1	15.3e-6	-
MFF additive correction on 2nd. injection pulse (homogeneous modus)					
FAC_2_S_COR [NC_CYL_NR]	V	0... FFFFH	0 ...1	15.3e-6	-
MFF additive correction on 2nd. injection pulse (stratified modus)					
FAC_3_HOM_COR [NC_CYL_NR]	V	0... FFFFH	0 ...1	15.3e-6	-
MFF additive correction on 3rd. injection pulse (homogeneous modus)					
FAC_3_S_COR [NC_CYL_NR]	V	0... FFFFH	0 ...1	15.3e-6	-
MFF additive correction on 3rd. injection pulse (stratified modus)					
FAC_MFF_COR_INJ_MOD	O/V	0... FFH	0... 1.99218	0.0078125	-
Mass fuel flow correction at different homogeneous injection mode					
FAC_MFF_COR_INJ_MOD_S	O/V	0... FFH	0... 1.99218	0.0078125	-
Mass fuel flow correction at different injection stratified mode					
FAC_MFF_CST_OPM_SEL	O/V	0... FFH	0... 0.99609	3.9062e-3	-
start fuel mass flow interpolation factor for operation switch manager					
FAC_MFF_WUP_HOMS	O/V	0... FFH	0... 1.99218	0.0078125	-
Mass fuel flow correction during homogeneous lean warm-up phase					
FAC_MFF_WUP_S	O/V	0... FFH	0... 1.99218	0.0078125	-
Mass fuel flow correction stratified warm-up phase					
FAC_MPLP_COR [NC_CYL_NR]	V	0... FFFFH	0... 0.99998	15.3e-6	-
MFF additive correction on post injection pulse (stratified modus)					
FAC_TI_CAST_OPM_SEL	O/V	0... FFH	0... 0.99609	3.9062e-3	-
post start injection time correction interpolation factor for operation switch manager					
FAC_TI_WUP_OPM_SEL	O/V	0... FFH	0... 0.99609	3.9062e-3	-
warm up injection time correction interpolation factor for operation switch manager					
INJ_MOD_HOM_REQ	O/V	0... FFH	0... 255	1	-
injection mode selection hom (single /multi)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INJ_MOD_S_REQ	O/V	0... FFH	0... 255	1	-
injection mode selection strat (single /multi)					
LF_MFF_HOM	O/V	0... FFH	0... 255	1	-
Bitfield to indicate homogeneous injection mapping and ignition coupling.					
LV_ADD_PULSE_ENA	O/V	0... 1H	0 ...1	1	-
Switch to enable additional injection pulse at homogeneous mode, single injection mode (injection update at transient operation)					
LV_EOI_ST_ENA	O/V	0... 1H	0 ...1	1	-
Indicates if an EOI based start is requested					
LV_FCO_COR_REQ	O/V	0... 1H	0 ...1	1	-
Anforderung Verbrauchsberechnung mit korrigierter Kraftstoffmasse					
LV_ST_H_PRS	-	0... 1H	0 ...1	1	-
Flag indicating high pressure start requested					
LV_ST_INJ_AUTH	O/V	0... 1H	0 ...1	1	-
Flag indicating injection authorized					
LV_TI_COR_WF_OPM_1_ACT	O/V	0... 1H	0 ...1	1	-
wall film operation mode switch					
MFF_ADD_WF	O/V	8000... 7FFFH	-694.5... 694.4788	0.02119-	mg/stk
Total fuel amount for wall film compensation					
MFF_SP_1_EXT_COR [NC_CYL_NR]	O/V	8000... 7FFFH	-694.5... 694.4788	0.02119-	mg/stk
Fuel mass setpoint external correction for the first pulse (aging and coding corr.)					
MFF_SP_1_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Cylinder individual mass fuel flow setpoint for homogeneous mode, first pulse					
MFF_SP_1_HOMS [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the first pulse at homogeneous-stratified mode					
MFF_SP_1_S [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the first pulse at stratified mode					
MFF_SP_1_S_TMP	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the third pulse at stratified mode, for temporary calculations					
MFF_SP_2_EXT_COR [NC_CYL_NR]	O/V	8000... 7FFFH	-694.5... 694.4788	0.02119-	mg/stk
Fuel mass setpoint external correction for the second pulse (aging and coding corr.)					
MFF_SP_2_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the second pulse at homogeneous mode					
MFF_SP_2_HOMS [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the second pulse at homogeneous-stratified mode					
MFF_SP_2_S [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the second pulse at stratified mode					
MFF_SP_2_S_TMP	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the second pulse at stratified mode, for temporary calculations					
MFF_SP_3_EXT_COR [NC_CYL_NR]	O/V	8000... 7FFFH	-694.5... 694.4788	0.02119-	mg/stk
Fuel mass setpoint external correction for the third pulse (aging and coding corr.)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MFF_SP_3_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the third pulse at homogeneous mode					
MFF_SP_3_HOMS [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the second pulse at homogeneous-stratified mode					
MFF_SP_3_S [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the third pulse at stratified mode					
MFF_SP_BAS	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Momentary fuel mass setpoint without adaptation					
MFF_SP_BAS_S	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Momentary stratified fuel mass setpoint without adaptation					
MFF_SP_FCO_COR	O/V	8000... 7FFFH	-694.5... 694.4788	0.02119-	mg/stk
Korrigierte Kraftstoffmasse für Kraftstoffverbrauchsanzeige					
MFF_SP_HOM_BAS [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow setpoint for homogeneous mode (exhaust gas bank specific)					
MFF_SP_HOM_BAS_TMP [NC_CBK_EX_NR]	V	0... FFFFFFFFH	0... 91030893	0.0211948	mg/stk
Temp. variable: Mass fuel flow setpoint for homogeneous mode (exhaust gas bank specific)					
MFF_SP_HOM_MPG_TMP [NC_NR_IV_PLS]	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow setpoint for homogeneous mode (temporary value) for FUMU.					
MFF_SP_HOM_TMP [NC_NR_IV_PLS]	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow setpoint for homogeneous mode (temporary value).					
MFF_SP_HOMS	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass flow setpoint at homogeneous-stratified combustion mode					
MFF_SP_HOMS_PRED	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass flow setpoint if homogeneous-stratified combustion mode would be active					
MFF_SP_MPLP [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the post pulse at stratified mode					
MFF_SP_MPLP_EXT_COR [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint external correction for the post pulse (aging and coding corr.)					
MFF_SP_S	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass in stratified combustion					
MFF_SP_S_PRED	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Predicted mass fuel flow setpoint if stratified combustion mode would be active					
MFF_SP_S_SWI_HOM	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow expected after switching from stratified to homogeneous mode					
NR_INJ_PLS_HOM_REQ	O/V	0... 3H	0 ...3	1	-
Number of requested injection pulses for homogeneous mode					
NR_INJ_PLS_HOM_REQ_TMP	-	0... FFH	0... 255	1	-
Number of requested injection pulses for homogeneous mode, for temporary calculations					
NR_INJ_PLS_S_REQ	O/V	0... 3H	0 ...3	1	-
Number of requested injection pulses for stratified or homogeneous-stratified mode					
Rk_1	O	0... FFFFH	0... 31.99951	488.299e-6	-
relative fuel mass cylinder bank i					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Rk_2	O	0... FFFFH	0... 31.99951	488.299e-6	-
relative fuel mass cylinder bank i					
Rk_kh_s	O/V	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
Mass fuel flow of the post injection during CH					
Rk2_kh_h	O/V	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
relative fuel mass cylinder bank i					

**Input data:**


B_espr_start {p. 8343}	B_hd_start {p. 8343}	B_rkkor_kva {p. 8346}	Ba_switch_uek {p. 8155}
C_INJ_MOD_SP_MAN {p. 3334}	C_MFF_REF	CTR_CYL_NR_ST_CLC {p. 1754}	CTR_CYL_NR_STOP_CLC {p. 1754}
ECU_STATE {p. 1091}	Espr_mod_soll [NC_CYL_NR] {p. 8157}	F_nst_ba {p. 8157}	F_rkkorwl_hs {p. 8158}
F_rkkorwl_s {p. 8158}	F_st_ba {p. 8158}	F_wl_ba {p. 8158}	FAC_LAM_AD_BAL [NC_CBK_EX_NR] {p. 1014}
FAC_LAM_ADJ_COR_ LAM_AD_CUS [NC_CBK_EX_NR] {p. 8309}	FAC_ST_AMP {p. 2099}	FAC_ST_REST {p. 2094}	INJ_MOD_GLOBAL {p. 3328}
LC_INJ_MOD_SP_MAN_ ENA {p. 3335}	LV_CH {p. 8232}	LV_HOM_AFL_ACT {p. 8136}	LV_IGA_AND_INJ_SWI_ HOMS {p. 8136}
LV_REST {p. 1766}	LV_S_ACT {p. 8137}	LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}
MFF_ADD_BAL [NC_CYL_NR] {p. 3215}	MFF_ADD_BAL_EXT [NC_CYL_NR] {p. 3261}	MFF_ADD_LAM_AD_INJ [NC_CYL_NR] {p. 3405}	MFF_LAM_ADD_LAM_AD_ OUT [NC_CBK_EX_NR] {p. 2642}
MFF_MPLP_CH {p. 2179}	MFF_SP_2_MPLH_CH {p. 2164}	MFF_SP_HOM [NC_CBK_EX_NR] {p. 2151}	MFF_SP_MV {p. 2151}
Mk_soll_h [NC_CYL_ NR][NC_NR_IV_PLS] {p. 8162}	Mk_soll_s {p. 8162}	Mkzyl_soll_hs [NC_CYL_ NR][NC_NR_IV_PLS] {p. 8162}	N {p. 1525}
NC_INJ_MOD_MASK_2 {p. 2045}	NC_INJ_MOD_MULTI {p. 2045}	NC_INJ_MOD_SINGLE {p. 2045}	NC_LAMB_REF [NC_CYL_NR] {p. 812}
NC_NR_IV_PLS {p. 627}	Rk_add_wf {p. 8167}	Rk_kor_h {p. 8167}	Rk_kor_kva {p. 8168}
Rk_korres_hs {p. 8168}	Rk_korres_s {p. 8168}	SEG_NR {p. 1525}	TI_CAST {p. 2100}
TI_WUP {p. 2109}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ADD_PULSE_ENA	-	0... 2H	0 ...2	1	-
Constant for enabling additional pulses in case of injection time update at transient conditions, homogeneous mode (0 = disable, 1 = enable, 2 = enable at start end)					
C_FAC_MPLP_COR	-	0... FFFFH	0... 0.99998	15.3e-6	-
Constant defining how quantitatively the additive adaptation value shall be used in the post injection pulse					
C_MAF_REF	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Reference air mass flow for the calculation of MAF and MAF_MAX_COR					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MFF_FAC	-	0... FFFFH	0... 0.12499	1.9073e-6	-
Constant for stoichiometric air/fuel ratio (=1/14.7)					
C_MFF_SP_1_HOM_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the first pulse in homogeneous mode (manual adjustment)					
C_MFF_SP_1_HOMS_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the first pulse in homogeneous-stratified mode (manual adjustment)					
C_MFF_SP_1_S_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the first pulse in stratified mode (manual adjustment)					
C_MFF_SP_2_HOM_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the second pulse in homogeneous mode (manual adjustment)					
C_MFF_SP_2_HOMS_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the second pulse in homogeneous-stratified mode (manual adjustment)					
C_MFF_SP_2_S_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the second pulse in stratified mode (manual adjustment)					
C_MFF_SP_3_HOM_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the third pulse in homogeneous mode (manual adjustment)					
C_MFF_SP_3_HOMS_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the third pulse in homogeneous-stratified mode (manual adjustment)					
C_MFF_SP_3_S_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the third pulse in stratified mode (manual adjustment)					
C_MFF_SP_MPLP_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the post pulse in stratified mode (manual adjustment)					
IP_FAC_MFF_ADD_BAL_EXT	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_MFF_IP_FAC_MFF_ADD_EXT	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Weighting factor for additive aging and coding corrections on MFF					
IP_FAC_MFF_ADD_LAM_AD_INJ	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_MFF_IP_FAC_MFF_LAM_AD_INJ	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Weighting factor for the additive corrections from the function Minimum Fuel Mass Adaptation					
IP_FAC_MFF_COR_HOMS	V	0... FFH	0... 1.99218	0.0078125	-
LDP_MFF_IP_FAC_MFF_COR_HOMS	12	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_IP_FAC_MFF_COR_HOMS	10	0... 1FE0H	0... 8160	1	rpm
Fuel mass correction factor for operation mode HOMS					
IP_FAC_MFF_COR_MPLH	V	0... FFH	0... 1.99218	0.0078125	-
LDP_MFF_IP_FAC_MFF_COR_MPLH	12	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_IP_FAC_MFF_COR_MPLH	10	0... 1FE0H	0... 8160	1	rpm
Fuel mass correction factor for injection mode double injection - homogenous					
IP_FAC_MFF_COR_MPLH_3	V	0... FFH	0... 1.99218	0.0078125	-
LDP_MFF_IP_FAC_MFF_COR_MPLH_3	12	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_IP_FAC_MFF_COR_MPLH_3	10	0... 1FE0H	0... 8160	1	rpm
Fuel mass correction factor for injection mode triple injection - homogenous					
IP_FAC_MFF_COR_MPLS	V	0... FFH	0... 1.99218	0.0078125	-
LDP_MFF_IP_FAC_MFF_COR_MPLS	12	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_IP_FAC_MFF_COR_MPLS	10	0... 1FE0H	0... 8160	1	rpm
Fuel mass correction factor for injection mode double injection - stratified					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_MFF_COR_MPLS_3	V	0... FFH	0... 1.99218	0.0078125	-
LDP_MFF_IP_FAC_MFF_COR_MPLS_3	12	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_IP_FAC_MFF_COR_MPLS_3	10	0... 1FE0H	0... 8160	1	rpm
Fuel mass correction factor for injection mode triple injection - stratified					
IP_FAC_MFF_COR_SNGH	V	0... FFH	0... 1.99218	0.0078125	-
LDP_MFF_IP_FAC_MFF_COR_SNGH	12	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_IP_FAC_MFF_COR_SNGH	10	0... 1FE0H	0... 8160	1	rpm
Fuel mass correction factor for injection single injection - homogenous					
LC_FAC_MFF_HOM_COR_ENA	-	0... 1H	0 ...1	1	-
Switch for activation of fuel mass correction in homogenous mode					
LC_FAC_MFF_HOMS_COR_ENA	-	0... 1H	0 ...1	1	-
Switch for activation of fuel mass correction in HOMS mode					
LC_FAC_MFF_S_COR_ENA	-	0... 1H	0 ...1	1	-
Switch for activation of fuel mass correction in stratified mode					
LC_FAC_S_COR_ENA	-	0... 1H	0 ...1	1	-
Enable additive compensation over all stratified injection pulses					
LC_FAC_S_COR_MAN	-	0... 1H	0 ...1	1	-
Manual switch to enable additive compensation of third injection pulse per calibration constant					
LC_MFF_ADD_AD_LAM_OUT_MAN	-	0... 1H	0 ...1	1	-
Manual switch to consider lambda adaptation values for MFF_SP_1_S calculation					
LC_MFF_COR_CH_ENA	-	0... 1H	0 ...1	1	-
Switch for activation of injection mode dependend fuel mass correction during catalyst heating					
LC_MFF_COR_ST_ENA	-	0... 1H	0 ...1	1	-
Switch for activation of injection mode dependend fuel mass correction during start					
LC_MFF_MPG_NEW	-	0... 1H	0 ...1	1	-
Switch to activate new fuel mass mapping within layer.					
LC_MFF_SP_HOM_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual homogeneous mode active					
LC_MFF_SP_HOMS_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual homogeneous-stratified mode active					
LC_MFF_SP_S_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual stratified mode active					

## R.26.1 Outputs for BMW functions which are defined as FMSP exported data

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

$i = 1, 2$  (index cylinder bank)


*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

### Application conditions:

Initialisation: at reset and at exit ECU\_STATE "PWL":

0, except  $F_{vst} = 1.00$

Recurrence : segment : (Mk\_hom\_ext\_1, Mk\_hom\_ext\_2)

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(Mk\_hom\_ext), B\_dosp\_akt, F\_vst, Rk\_i, Rk2\_kh\_h, Rk2\_kh\_s

10 ms: B\_wst, F\_start

At "First valid tooth" and before module M904B (High pressure pump control)

Activation: every engine state

Deactivation: -

### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

**if** ECU\_STATE "PWL"  
**then**

```

B_dosp_akt          = 0
B_wst               = 0
F_start            = 0
F_vst              = 1.00
Rk_1               = 0
Rk_2               = 0
Rk2_kh_h           = 0
Rk_kh_s            = 0
  
```

**else**

```

B_wst = LV_REST
  
```

```

If      ((INJ_MOD_GLOBAL & NC_INJ_MOD_MASK_2) == NC_INJ_MOD_SINGLE)
Then    B_dosp_akt = 0          (single injection activ)
Else    B_dosp_akt = 1          (multi injection activ)
Endif
  
```

```

F_vst = TI_WUP + TI_CAST
  
```

$$Rk_i = \frac{MFF\_SP\_HOM\_i}{C\_MAF\_REF * C\_MFF\_FAC}$$

Umrechnung von supplier [mg/str] in [%] mit:

Rk2\_kh\_h = MFF\_SP\_2\_MPLH\_CH / C\_MFF\_REF \* 100%

Rk\_kh\_s = MFF\_MPLP\_CH / C\_MFF\_REF \* 100%


F\_start = FAC\_ST\_REST \* FAC\_ST\_AMP \* 100%

**endif**

## R.26.2 Outputs for supplier-aggregates

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

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*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

### Application conditions:

Initialisation at reset: 0

#### **Expect:**

INJ\_MOD\_HOM\_REQ = NC\_INJ\_MOD\_SINGLE

INJ\_MOD\_S\_REQ = NC\_INJ\_MOD\_SINGLE

FAC\_MFF\_WUP\_S = 1

FAC\_MFF\_WUP\_HOMS = 1

FAC\_MFF\_COR\_INJ\_MOD = 1

FAC\_MFF\_COR\_INJ\_MOD\_S = 1

**For** x = CTR\_CYL\_NR\_ST\_CLC to CTR\_CYL\_NR\_STOP\_CLC

FAC\_1\_S\_COR[x] = 1

FAC\_2\_S\_COR[x] = 0

FAC\_3\_S\_COR[x] = 0

FAC\_MPLP\_COR[x] = C\_FAC\_MPLP\_COR

#### **Endfor**

Recurrence : LV\_ST\_END = 0: 10 ms  
LV\_ST\_END = 1: segment synchronous

**Note: Please pay attention before integrating this function in the SW. This function shall be calculated before the module 'Calculation of MFF setpoint'.**

**CTR\_CYL\_NR\_ST\_CLC , CTR\_CYL\_NR\_STOP\_CLC and LV\_S\_CLC must be calculated before calculation of this module**

**Any other order of calculation should not be changed**

FAC\_MFF\_CST\_OPM\_SEL,

FAC\_TI\_CAST\_OPM\_SEL,

FAC\_TI\_WUP\_OPM\_SEL

**Expect:** 10ms : MFF\_SP\_HOMS\_PRED, MFF\_SP\_S\_PRED

Activation: every engine state

Deactivation: -

### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

LV\_FCO\_COR\_REQ = B\_rkkor\_kva

MFF\_SP\_FCO\_COR = Rk\_kor\_kva \* C\_MAF\_REF \* C\_MFF\_FAC

MFF\_ADD\_WF = Rk\_add\_wf \* C\_MAF\_REF \* C\_MFF\_FAC

MFF\_SP\_S\_SWI\_HOM = Rk\_kor\_h \* C\_MAF\_REF \* C\_MFF\_FAC


FAC\_MFF\_WUP\_S = F\_rkkorwl\_s

FAC\_MFF\_WUP\_HOMS = F\_rkkorwl\_hs

**IF** LC\_MFF\_MPG\_NEW = 1

**THEN**

Only element 0 is used to indicate injection mode

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Bit 0 of LF\_MFF\_HOM = Bit 0 of Espr\_mod\_soll[0]  
 Bit 1 of LF\_MFF\_HOM = Bit 2 of Espr\_mod\_soll[0]  
 Bit 2 of LF\_MFF\_HOM = Bit 3 of Espr\_mod\_soll[0]  
 Bit 3 of LF\_MFF\_HOM = Bit 4 of Espr\_mod\_soll[0]  
 Bit 4 of LF\_MFF\_HOM = Bit 5 of Espr\_mod\_soll[0]

**Note:** Bits 0, 1 and 2 of LF\_MFF\_HOM[x] state that the fuel mass on the respective pulse is unequal to zero (=1) or equal to zero (=0), which means that this pulse shall not be carried out.

Bits 3 and 4 state that pulse 2 resp. pulse 3 are ignition coupled (=1) or not (=0).

**ENDIF**

NR\_INJ\_PLS\_HOM\_REQ\_TMP = 0

IF CTR\_CYL\_NR\_ST\_CLC  $\neq$  CTR\_CYL\_NR\_STOP\_CLC

THEN

// runtime reduction is inactive

MFF\_SP\_HOM\_BAS\_TMP[ ] = 0

// all NC\_CBK\_EX\_NR elements

CTR\_MFF\_SP\_HOM\_BAS\_TMP[ ] = 0

// all NC\_CBK\_EX\_NR elements

**ENDIF**

**If** LC\_MFF\_SP\_HOM\_MAN\_ACT = 1

**Then**

**For** x = CTR\_CYL\_NR\_ST\_CLC to CTR\_CYL\_NR\_STOP\_CLC

MFF\_SP\_1\_HOM[x] = C\_MFF\_SP\_1\_HOM\_MAN

MFF\_SP\_2\_HOM[x] = C\_MFF\_SP\_2\_HOM\_MAN

MFF\_SP\_3\_HOM[x] = C\_MFF\_SP\_3\_HOM\_MAN

**Endfor**

**IF** MFF\_SP\_1\_HOM[0] > 0

**THEN**

NR\_INJ\_PLS\_HOM\_REQ\_TMP = NR\_INJ\_PLS\_HOM\_REQ\_TMP **OR** 0x1 ...bitwise

**ENDIF**

**IF** MFF\_SP\_2\_HOM[0] > 0

**THEN**

NR\_INJ\_PLS\_HOM\_REQ\_TMP = NR\_INJ\_PLS\_HOM\_REQ\_TMP **OR** 0x2 ...bitwise

**ENDIF**

**IF** MFF\_SP\_3\_HOM[0] > 0

**THEN**

NR\_INJ\_PLS\_HOM\_REQ\_TMP = NR\_INJ\_PLS\_HOM\_REQ\_TMP **OR** 0x4 ...bitwise

**ENDIF**

**Else**

**For** x = CTR\_CYL\_NR\_ST\_CLC to CTR\_CYL\_NR\_STOP\_CLC

**IF** LC\_MFF\_MPG\_NEW = 1

**THEN**

**IF** LV\_ST\_END = 0 **AND** (LF\_MFF\_HOM **BitwiseAND** 7h = 4) // only third bit is set

**THEN** - high pressure start with fuel mass on pulse 3

MFF\_SP\_1\_HOM[x] = 0

MFF\_SP\_2\_HOM[x] = Mk\_soll\_h[x][2] // zero based indexing

MFF\_SP\_3\_HOM[x] = 0

**ELSE**

**IF** LV\_ST\_END = 0 **AND** (LF\_MFF\_HOM **BitwiseAND** 7h = 2)

// only second bit is set

**THEN** - high pressure start with fuel mass on pulse 2

MFF\_SP\_1\_HOM[x] = 0

```

MFF_SP_2_HOM[x]      = Mk_soll_h[x][1] // zero based indexing
MFF_SP_3_HOM[x]      = 0
ELSE
  tmp = 0           // Note: tmp is a temporary counter counting from 0 to 3.
  MFF_SP_HOM_MPG_TMP[ ] = 0           // all NC_NR_IV_PLS elements
  FOR i = 0 TO NC_NR_IV_PLS - 1 DO
    IF Bit i of LF_MFF_HOM = 1
      THEN
        MFF_SP_HOM_MPG_TMP [tmp] = Mk_soll_h[x][i]
        tmp = tmp + 1
      ENDIF
    ENDFOR
  MFF_SP_1_HOM[x]      = MFF_SP_HOM_MPG_TMP [0]
  MFF_SP_2_HOM[x]      = MFF_SP_HOM_MPG_TMP [1]
  MFF_SP_3_HOM[x]      = MFF_SP_HOM_MPG_TMP [2]
  ENDIF
ENDIF
ELSE

  MFF_SP_1_HOM[x]      = Mk_soll_h[x][0]
  MFF_SP_2_HOM[x]      = Mk_soll_h[x][1]
  MFF_SP_3_HOM[x]      = Mk_soll_h[x][2]
ENDIF

```

```

MFF_SP_HOM_BAS_TMP[[NC_LAMB_REF[bit x]]new =
  MFF_SP_HOM_BAS_TMP[[NC_LAMB_REF[bit x]] +
  (MFF_SP_1_HOM[x] + MFF_SP_2_HOM[x] + MFF_SP_3_HOM[x])

```

Increment CTR\_MFF\_SP\_HOM\_BAS\_TMP [NC\_LAMB\_REF[bit x]] by 1

```

IF MFF_SP_1_HOM[x] > 0
  THEN
    NR_INJ_PLS_HOM_REQ_TMP = NR_INJ_PLS_HOM_REQ_TMP OR 0x1   ...bitwise
  ENDIF
IF MFF_SP_2_HOM[x] > 0
  THEN
    NR_INJ_PLS_HOM_REQ_TMP = NR_INJ_PLS_HOM_REQ_TMP OR 0x2   ...bitwise
  ENDIF
IF MFF_SP_3_HOM[x] > 0
  THEN
    NR_INJ_PLS_HOM_REQ_TMP = NR_INJ_PLS_HOM_REQ_TMP OR 0x4   ...bitwise
  ENDIF
Endfor

```

**Endif**


% mean homogeneous mass fuel flow set point (sum over all pulses) assigned to each exhaust gas bank, without any correction. or adaptation

(Calculation of mean value while runtime optimization only once every 720° Crank, outside of runtime optimization every segment)

```

FOR i = 0 TO NC_CBK_EX_NR - 1 DO
  IF CTR_MFF_SP_HOM_BAS_TMP [i] >= (NC_CYL_NR / NC_CBK_EX_NR)
  THEN

```

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```


MFF_SP_HOM_BAS[i]new =
    MFF_SP_HOM_BAS_TMP[i]/(NC_CYL_NR /NC_CBK_EX_NR)
CTR_MFF_SP_HOM_BAS_TMP [i] = 0
MFF_SP_HOM_BAS_TMP[i] = 0
ENDIF
ENDFOR

% Fuel mass setpoint of current cylinder [x] without adaptation for the fuel consumption calculation
MFF_SP_BAS = MFF_SP_1_HOM[SEG_NR] + MFF_SP_2_HOM[SEG_NR] + MFF_
SP_3_HOM[SEG_NR]

IF NR_INJ_PLS_HOM_REQ_TMP > 3
THEN
    INJ_MOD_HOM_REQ = NC_INJ_MOD_MULTI
    NR_INJ_PLS_HOM_REQ = 3
    IF (LC_FAC_MFF_HOM_COR_ENA = 1)
        FAC_MFF_COR_INJ_MOD = IP_FAC_MFF_COR_MPLH_3(MFF_SP_BAS, N)
    ELSE
        FAC_MFF_COR_INJ_MOD = 1
    ENDIF
ELSE
    IF NR_INJ_PLS_HOM_REQ_TMP = 3
    THEN
        INJ_MOD_HOM_REQ = NC_INJ_MOD_MULTI
        NR_INJ_PLS_HOM_REQ = 2
        IF ( LC_FAC_MFF_HOM_COR_ENA = 1 AND
            ( LV_CH =0 OR LC_MFF_COR_CH_ENA =1) AND
            ( LV_ST_END=1 OR LC_MFF_COR_ST_ENA=1) )
            FAC_MFF_COR_INJ_MOD = IP_FAC_MFF_COR_MPLH(MFF_SP_BAS, N)
        ELSE
            FAC_MFF_COR_INJ_MOD = 1
        ENDIF
    ELSE
        INJ_MOD_HOM_REQ = NC_INJ_MOD_SINGLE
        NR_INJ_PLS_HOM_REQ = 1
        IF (LC_FAC_MFF_HOM_COR_ENA = 1 AND
            ( LV_ST_END=1 OR LC_MFF_COR_ST_ENA=1) )
        THEN
            FAC_MFF_COR_INJ_MOD = IP_FAC_MFF_COR_SNGH(MFF_SP_BAS, N)
        ELSE
            FAC_MFF_COR_INJ_MOD = 1
        ENDIF
    ENDIF
ENDIF
ENDIF

If(4) LV_S_CLC = 1
Then(4)
    IF LC_MFF_SP_HOMS_MAN_ACT = 1
    Then
        For x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC

```

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```

MFF_SP_1_HOMS[x]      =          C_MFF_SP_1_HOMS_MAN
MFF_SP_2_HOMS[x]      =          C_MFF_SP_2_HOMS_MAN
MFF_SP_3_HOMS[x]      =          C_MFF_SP_3_HOMS_MAN

```

**Endfor**

**Else**

**For** x = CTR\_CYL\_NR\_ST\_CLC to CTR\_CYL\_NR\_STOP\_CLC

```

MFF_SP_1_HOMS[x]      =          Mkzyl_soll_hs[x][0]
MFF_SP_2_HOMS[x]      =          Mkzyl_soll_hs[x][1]
MFF_SP_3_HOMS[x]      =          Mkzyl_soll_hs[x][2]

```

**Endfor**

```

MFF_SP_HOMS = MFF_SP_1_HOMS[x] + MFF_SP_2_HOMS[x] +
              MFF_SP_3_HOMS[x]

```

(x = latest segment)

**Endif**

**If** LC\_MFF\_SP\_S\_MAN\_ACT = 1

**Then**

**For** x = CTR\_CYL\_NR\_ST\_CLC to CTR\_CYL\_NR\_STOP\_CLC

```

MFF_SP_1_S[x]         = C_MFF_SP_1_S_MAN
MFF_SP_2_S[x]         = C_MFF_SP_2_S_MAN
MFF_SP_3_S[x]         = C_MFF_SP_3_S_MAN
MFF_SP_MPLP[x]        = C_MFF_SP_MPLP_MAN

```

**Endfor**

```

MFF_SP_S              = C_MFF_SP_1_S_MAN + C_MFF_SP_2_S_MAN + C_MFF_SP_3_
S_MAN + C_MFF_SP_MPLP_MAN

```

**Else**

**For** x = CTR\_CYL\_NR\_ST\_CLC to CTR\_CYL\_NR\_STOP\_CLC

```

MFF_SP_1_S[x]         =          Mkzyl_soll_s[x][0]
MFF_SP_2_S[x]         =          Mkzyl_soll_s[x][1]
MFF_SP_3_S[x]         =          Mkzyl_soll_s[x][2]
MFF_SP_MPLP[x]        =          Mkzyl_soll_s[x][3]

```

**Endfor**

```

MFF_SP_S              =          Mk_soll_s

```

**Endif**

**If** ((LC\_INJ\_MOD\_SP\_MAN\_ENA = 0) and (LV\_IGA\_AND\_INJ\_SWI\_HOMS = 1))

or

((LC\_INJ\_MOD\_SP\_MAN\_ENA = 1) and ( C\_INJ\_MOD\_SP\_MAN = 'HOMS' or  
C\_INJ\_MOD\_SP\_MAN = 'HOMS-SNG' or  
C\_INJ\_MOD\_SP\_MAN = 'HOMS+PLS3'))

**Then**

```

MFF_SP_S_TMP = 0

```

**For** x = CTR\_CYL\_NR\_ST\_CLC to CTR\_CYL\_NR\_STOP\_CLC

```

MFF_SP_1_S[x]         =          MFF_SP_1_HOMS[x]
MFF_SP_2_S[x]         =          MFF_SP_2_HOMS[x]
MFF_SP_3_S[x]         =          MFF_SP_3_HOMS[x]
MFF_SP_MPLP[x]        =          0

```

```

MFF_SP_S_TMP = MFF_SP_S_TMP + MFF_SP_1_HOMS[x] +
              MFF_SP_2_HOMS[x] + MFF_SP_3_HOMS[x]

```

```

Endfor
  MFF_SP_S = MFF_SP_S_TMP /
  (CTR_CYL_NR_STOP_CLC - CTR_CYL_NR_ST_CLC + 1)

```

**Endif**

% Fuel mass setpoint of current cylinder [x] without adaptation for the fuel consumption calculation

```

IF LV_S_ACT = 1 OR LV_HOM_AFL_ACT = 1
THEN
  MFF_SP_BAS = MFF_SP_1_S[SEG_NR] + MFF_SP_2_S[SEG_NR] +
  MFF_SP_3_S[SEG_NR]

```

**ENDIF**

```

  MFF_SP_BAS_S = MFF_SP_1_S[SEG_NR] + MFF_SP_2_S[SEG_NR] +
  MFF_SP_3_S[SEG_NR]

```

**Endif(4)**

Injection mode selection: at BMW the main pulse are the 2<sup>nd</sup> pulse if there is no 1<sup>st</sup> pulse the 2<sup>nd</sup> pulse will copied to the 1<sup>st</sup> puls:

```

If(1)      LV_ST_END = 1
Then(1)
  At start end:
  MFF_SP_1_S_TMP          = 0
  MFF_SP_2_S_TMP          = 0
  If (2)      LC_MFF_SP_HOM_MAN_ACT = 1
  Then(2)
    For      x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC
      Check, if all fuel masses for the first and the second pulse strat. Mode are zero
      MFF_SP_1_S_TMP      = MFF_SP_1_S_TMP OR MFF_SP_1_S[x]
      wise
      MFF_SP_2_S_TMP      = MFF_SP_2_S_TMP OR MFF_SP_2_S[x]
      wise
    Endfor
  Else(2)

```

```

For      x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC
  % distribution factors of MFF correction between the injection pulses
  MFF_SP_HOM_TMP = MFF_SP_1_HOM[x]+ MFF_SP_2_HOM[x]+
  MFF_SP_3_HOM[x]


```

```

  FAC_1_HOM_COR[x] = MFF_SP_1_HOM[x] /MFF_SP_HOM_TMP
  FAC_2_HOM_COR[x] = MFF_SP_2_HOM[x] /MFF_SP_HOM_TMP
  FAC_3_HOM_COR[x] = 1- (FAC_1_COR[x]+ FAC_2_COR[x])

```

% MFF correction of 1<sup>st</sup>. pulse due to Lambda Adaptation and Cylinder Balancing  
 MFF\_SP\_1\_HOM[x] =

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$$\begin{aligned} & (\text{MFF\_LAM\_ADD\_LAM\_AD\_OUT}[\text{NC\_LAMB\_REF}[\text{bit } x]] + \text{MFF\_ADD\_BAL}[x]) * \text{FAC\_1\_HOM\_COR}[x] + \\ & \text{MFF\_SP\_1\_HOM}[x] * (1 + (\text{FAC\_LAM\_AD\_BAL}[\text{NC\_LAMB\_REF}[\text{bit } x]] / 100\%)) \end{aligned}$$

% MFF correction of 1<sup>st</sup>. pulse due to injector coding , aging predictive correction and minimum fuel mass adaptation

$$\begin{aligned} \text{MFF\_SP\_1\_EXT\_COR}[x] = & \text{MFF\_ADD\_BAL\_EXT}[x] * \text{IP\_FAC\_MFF\_ADD\_BAL\_EXT}(\text{MFF\_SP\_1\_HOM}[x]) \\ & + \\ & \text{MFF\_ADD\_LAM\_AD\_INJ}[x] * \\ & \text{IP\_FAC\_MFF\_ADD\_LAM\_AD\_INJ}(\text{MFF\_SP\_1\_HOM}[x]) \end{aligned}$$

$$\text{MFF\_SP\_1\_HOM}[x] = \text{MFF\_SP\_1\_HOM}[x] * \text{FAC\_MFF\_COR\_INJ\_MOD} + \text{MFF\_SP\_1\_EXT\_COR}[x]$$

**If(3)** MFF\_SP\_2\_HOM[x] > 0  
**Then(3)**

% 2<sup>nd</sup>. pulse MFF correction

$$\begin{aligned} \text{MFF\_SP\_2\_HOM}[x] = & (\text{MFF\_LAM\_ADD\_LAM\_AD\_OUT}[\text{NC\_LAMB\_REF}[\text{bit } x]] + \text{MFF\_ADD\_BAL}[x]) * \text{FAC\_2\_HOM\_COR}[x] + \\ & \text{MFF\_SP\_2\_HOM}[x] * (1 + (\text{FAC\_LAM\_AD\_BAL}[\text{NC\_LAMB\_REF}[\text{bit } x]] / 100\%)) \end{aligned}$$

% MFF correction of 2<sup>nd</sup> pulse due to injector coding , aging predictive correction and minimum fuel mass adaptation

$$\begin{aligned} \text{MFF\_SP\_2\_EXT\_COR}[x] = & \text{MFF\_ADD\_BAL\_EXT}[x] * \text{IP\_FAC\_MFF\_ADD\_BAL\_EXT}(\text{MFF\_SP\_2\_HOM}[x]) \\ & + \\ & \text{MFF\_ADD\_LAM\_AD\_INJ}[x] * \\ & \text{IP\_FAC\_MFF\_ADD\_LAM\_AD\_INJ}(\text{MFF\_SP\_2\_HOM}[x]) \end{aligned}$$

$$\text{MFF\_SP\_2\_HOM}[x] = \text{MFF\_SP\_2\_HOM}[x] * \text{FAC\_MFF\_COR\_INJ\_MOD} + \text{MFF\_SP\_2\_EXT\_COR}[x]$$

**Endif(3)**


**If(4)** MFF\_SP\_3\_HOM[x] > 0  
**Then(4)**

% 3<sup>rd</sup>. pulse MFF correction

$$\begin{aligned} \text{MFF\_SP\_3\_HOM}[x] = & (\text{MFF\_LAM\_ADD\_LAM\_AD\_OUT}[\text{NC\_LAMB\_REF}[\text{bit } x]] + \text{MFF\_ADD\_BAL}[x]) * \\ & \text{FAC\_3\_HOM\_COR}[x] + \\ & \text{MFF\_SP\_3\_HOM}[x] * (1 + (\text{FAC\_LAM\_AD\_BAL}[\text{NC\_LAMB\_REF}[\text{bit } x]] / 100\%)) \end{aligned}$$

% MFF correction of 3<sup>rd</sup>. pulse due to injector coding, aging predictive correction and minimum fuel mass adaptation

$$\begin{aligned} \text{MFF\_SP\_3\_EXT\_COR}[x] = & \text{MFF\_ADD\_BAL\_EXT}[x] * \text{IP\_FAC\_MFF\_ADD\_BAL\_EXT}(\text{MFF\_SP\_3\_HOM}[x]) \\ & + \\ & \text{MFF\_ADD\_LAM\_AD\_INJ}[x] * \\ & \text{IP\_FAC\_MFF\_ADD\_LAM\_AD\_INJ}(\text{MFF\_SP\_3\_HOM}[x]) \end{aligned}$$

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```
MFF_SP_3_HOM[x] = MFF_SP_3_HOM[x] * FAC_MFF_COR_INJ_MOD +
                MFF_SP_3_EXT_COR[x]
```

**Endif(4)**

Check, if all fuel masses for the first and the second pulse strat. Mode are zero

```
MFF_SP_1_S_TMP      = MFF_SP_1_S_TMP OR MFF_SP_1_S[x]
```

wise

```
MFF_SP_2_S_TMP      = MFF_SP_2_S_TMP OR MFF_SP_2_S[x]
```

wise

**Endfor**

**Endif(2)**

**Else(1)**

At start:

```
MFF_SP_1_S_TMP      = 0
```

```
MFF_SP_2_S_TMP      = 0
```

```
LV_EOI_ST_ENA = 0
```

**For** x = CTR\_CYL\_NR\_ST\_CLC to CTR\_CYL\_NR\_STOP\_CLC

Check, if all fuel masses for the first and the second pulse strat. Mode are zero

```
MFF_SP_1_S_TMP      = MFF_SP_1_S_TMP OR MFF_SP_1_S[x]
```

wise

```
MFF_SP_2_S_TMP      = MFF_SP_2_S_TMP OR MFF_SP_2_S[x]
```

wise

**Endfor**

**If** NR\_INJ\_PLS\_HOM\_REQ\_TMP = 2

**Then** (high pressure start)

```
LV_EOI_ST_ENA = 1
```

**For** x = CTR\_CYL\_NR\_ST\_CLC to CTR\_CYL\_NR\_STOP\_CLC

```
MFF_SP_1_HOM[x]     = MFF_SP_2_HOM[x]*
                    (1+(FAC_LAM_ADJ_COR_LAM_AD_CUS[NC_LAMB_REF[bit x]] /100%))
```

```
MFF_SP_2_HOM[x]     = 0
```

**Endfor**

**Else** (low pressure start)

**For** x = CTR\_CYL\_NR\_ST\_CLC to CTR\_CYL\_NR\_STOP\_CLC

```
MFF_SP_1_HOM[x]     = MFF_SP_1_HOM[x]*
                    (1+ (FAC_LAM_ADJ_COR_LAM_AD_CUS [NC_LAMB_REF[bit x]] /100%))
```

```
MFF_SP_2_HOM[x]     = MFF_SP_2_HOM[x]*
                    (1+ (FAC_LAM_ADJ_COR_LAM_AD_CUS [NC_LAMB_REF[bit x]] /100%))
```


```
MFF_SP_3_HOM[x]     = MFF_SP_3_HOM[x]*
                    (1+ (FAC_LAM_ADJ_COR_LAM_AD_CUS [NC_LAMB_REF[bit x]] /100%))
```

**Endfor**

**Endif**

**Endif(1)**

**If(11)** LV\_S\_CLC = 1

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**Then(11)**

In case of homogeneous-stratified mode, copy the fuel masses for homs to the fuel masses for stratified mode (mapping):

```

IF(1a) ((LC_INJ_MOD_SP_MAN_ENA = 0) and (LV_IGA_AND_INJ_SWI_HOMS = 1))
  or
  ((LC_INJ_MOD_SP_MAN_ENA = 1) and (C_INJ_MOD_SP_MAN = 'HOMS' or
                                     C_INJ_MOD_SP_MAN = 'HOMS-SNG' or
                                     C_INJ_MOD_SP_MAN = 'HOMS+PLS3'))

```

**THEN**(1a) homs mode

```

  IF (LC_FAC_MFF_HOMS_COR_ENA = 1)
    FAC_MFF_COR_INJ_MOD_S =
      IP_FAC_MFF_COR_HOMS(MFF_SP_BAS_S, N)

```

**ELSE**

```

  FAC_MFF_COR_INJ_MOD_S = 1

```

**ENDIF**

```

IF MFF_SP_2_S_TMP > 0

```

**THEN** homs tripple injection - no pulse mapping

```

  INJ_MOD_S_REQ = NC_INJ_MOD_MULTI
  NR_INJ_PLS_S_REQ = 3

```

**ELSE**

```

  IF MFF_SP_1_S_TMP > 0

```

**THEN** homs double injection

```

  INJ_MOD_S_REQ = NC_INJ_MOD_MULTI
  NR_INJ_PLS_S_REQ = 2

```

```

  For          x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC

```

```

    MFF_SP_2_S[x] = MFF_SP_3_S[x]

```

```

    MFF_SP_3_S[x] =      0

```

**Endfor**

**ELSE** homs single injection

```

  INJ_MOD_S_REQ = NC_INJ_MOD_SINGLE

```

```

  NR_INJ_PLS_S_REQ = 1

```

```

  For          x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC

```

```

    MFF_SP_1_S[x] = MFF_SP_3_S[x]

```

```

  MFF_SP_2_S[x] =      0

```

```

  MFF_SP_3_S[x] =      0

```

**Endfor**

**ENDIF**

**ENDIF**

**ELSE**(1a) s mode has to be calculated

```

  IF          MFF_SP_1_S_TMP > 0

```

**THEN** s tripple injection - no pulse mapping

```

  INJ_MOD_S_REQ = NC_INJ_MOD_MULTI

```

```

  NR_INJ_PLS_S_REQ = 3

```

```

IF (LC_FAC_MFF_S_COR_ENA = 1)

```

```

  FAC_MFF_COR_INJ_MOD_S =

```

```

  IP_FAC_MFF_COR_MPLS_3(MFF_SP_BAS_S, N)

```

**ELSE**


```

  FAC_MFF_COR_INJ_MOD_S = 1

```

**ENDIF**

**ELSE**

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```

IF (LC_FAC_MFF_S_COR_ENA = 1)
  FAC_MFF_COR_INJ_MOD_S=
    IP_FAC_MFF_COR_MPLS(MFF_SP_BAS_S,N)
ELSE
  FAC_MFF_COR_INJ_MOD_S = 1
ENDIF
IF MFF_SP_2_S_TMP > 0
THEN s double injection
  INJ_MOD_S_REQ = NC_INJ_MOD_MULT
  NR_INJ_PLS_S_REQ = 2
  For x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC
    MFF_SP_1_S[x] = MFF_SP_2_S[x]
    MFF_SP_2_S[x] = MFF_SP_3_S[x]
    MFF_SP_3_S[x] = 0
  Endfor
ELSE s single injection
  INJ_MOD_S_REQ = NC_INJ_MOD_SINGLE
  NR_INJ_PLS_S_REQ = 1
  For x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC
    MFF_SP_1_S[x] = MFF_SP_3_S[x]
MFF_SP_2_S[x] = 0
MFF_SP_3_S[x] = 0

Endfor
ENDIF
ENDIF

```

**ENDIF**(1a) puls mapping

Statement usefull for ECM2

```

IF LV_IGA_AND_INJ_SWI = 0
THEN FAC_MFF_COR_INJ_MOD = FAC_MFF_COR_INJ_MOD_S
ENDIF

```

Corrections for fuel masses due to cylinder balancing

```

IF(3) LC_MFF_ADD_AD_LAM_BAL_MAN = 1 AND
      LV_ST_END = 1 AND
      LC_MFF_SP_S_MAN_ACT = 0
THEN(3) corrections have to be calculated

```

Calculation of correction factors

**For** x = CTR\_CYL\_NR\_ST\_CLC to CTR\_CYL\_NR\_STOP\_CLC

% MFF correction distribution factors

**IF**(5a) LC\_FAC\_S\_COR\_ENA = 1

**THEN**(5a)

% Calculation of the additive Lambda Adaption distribution factor over all pulses (default value: the additive adaptation considered only on the first pulse).

**IF**(5b) LC\_FAC\_S\_COR\_MAN = 0

**Then(5b)**

$$\text{FAC\_1\_S\_COR}[x] = \text{MFF\_SP\_1\_S}[x] / (\text{MFF\_SP\_1\_S}[x] + \text{MFF\_SP\_2\_S}[x] + \text{MFF\_SP\_3\_S}[x] + \text{MFF\_SP\_MPLP}[x])$$

$$\text{FAC\_2\_S\_COR}[x] = \text{MFF\_SP\_2\_S}[x] / (\text{MFF\_SP\_1\_S}[x] + \text{MFF\_SP\_2\_S}[x] + \text{MFF\_SP\_3\_S}[x] + \text{MFF\_SP\_MPLP}[x])$$

$$\text{FAC\_3\_S\_COR}[x] = \text{MFF\_SP\_3\_S}[x] / (\text{MFF\_SP\_1\_S}[x] + \text{MFF\_SP\_2\_S}[x] + \text{MFF\_SP\_3\_S}[x] + \text{MFF\_SP\_MPLP}[x])$$

$$\text{FAC\_MPLP\_COR}[x] = 1 - (\text{FAC\_1\_S\_COR}[x] + \text{FAC\_2\_S\_COR}[x] + \text{FAC\_3\_S\_COR}[x])$$

**Else(5b)**

$$\text{FAC\_1\_S\_COR}[x] = \text{MFF\_SP\_1\_S}[x] / (\text{MFF\_SP\_1\_S}[x] + \text{MFF\_SP\_2\_S}[x] + \text{MFF\_SP\_3\_S}[x])$$

$$\text{FAC\_2\_S\_COR}[x] = \text{MFF\_SP\_2\_S}[x] / (\text{MFF\_SP\_1\_S}[x] + \text{MFF\_SP\_2\_S}[x] + \text{MFF\_SP\_3\_S}[x])$$

$$\text{FAC\_3\_S\_COR}[x] = \text{MFF\_SP\_3\_S}[x] / (\text{MFF\_SP\_1\_S}[x] + \text{MFF\_SP\_2\_S}[x] + \text{MFF\_SP\_3\_S}[x])$$

$$\text{FAC\_MPLP\_COR}[x] = \text{C\_FAC\_MPLP\_COR}$$

**Endif(5b)****Endif(5a)**

Note: In case of a division by zero, the corresponding variable FAC\_SP\_... should be set to zero!

Calculation of corrected fuel masses due to cylinder balancing:

% 1<sup>st</sup>. pulse MFF correction - first pulse is always calculated

$$\text{MFF\_SP\_1\_S}[x] = (\text{MFF\_LAM\_ADD\_LAM\_AD\_OUT}[\text{NC\_LAMB\_REF}[\text{bit } x]] + \text{MFF\_ADD\_BAL}[x]) * \text{FAC\_1\_S\_COR}[x] +$$

$$\text{MFF\_SP\_1\_S}[x] * (1 + (\text{FAC\_LAM\_AD\_BAL}[\text{NC\_LAMB\_REF}[\text{bit } x]] / 100\%))$$

% MFF correction of 1<sup>st</sup>. pulse due to injector coding, aging predictive correction and minimum fuel mass adaptation

$$\text{MFF\_SP\_1\_EXT\_COR}[x] = \text{MFF\_ADD\_BAL\_EXT}[x] * \text{IP\_FAC\_MFF\_ADD\_BAL\_EXT}(\text{MFF\_SP\_1\_S}[x])$$

+


$$\text{MFF\_ADD\_LAM\_AD\_INJ}[x] * \text{IP\_FAC\_MFF\_ADD\_LAM\_AD\_INJ}(\text{MFF\_SP\_1\_S}[x])$$

$$\text{MFF\_SP\_1\_S}[x] = \text{MFF\_SP\_1\_S}[x] * \text{FAC\_MFF\_COR\_INJ\_MOD\_S} + \text{MFF\_SP\_1\_EXT\_COR}[x]$$

**IF** (NR\_INJ\_PLS\_S\_REQ >= 2)

**THEN** second pulse is calculated in case of double or triple injection

% 2<sup>nd</sup>. pulse MFF correction

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$$\begin{aligned} \text{MFF\_SP\_2\_S}[x] &= (\text{MFF\_LAM\_ADD\_LAM\_AD\_OUT}[\text{NC\_LAMB\_REF}[\text{bit } x]] + \text{MFF\_} \\ &\text{ADD\_BAL}[x]) * \text{FAC\_2\_S\_COR}[x] + \\ &\text{MFF\_SP\_2\_S}[x] * (1 + (\text{FAC\_LAM\_AD\_BAL}[\text{NC\_LAMB\_REF}[\text{bit } x]] / 100\%)) \end{aligned}$$

$$\begin{aligned} \text{\% MFF correction of 2}^{nd} \text{ pulse due to injector, aging predictive correction and} \\ \text{minimum fuel mass adaptation} \quad \text{MFF\_SP\_2\_EXT\_COR}[x] &= \\ \text{MFF\_ADD\_BAL\_EXT}[x] * \text{IP\_FAC\_MFF\_ADD\_BAL\_EXT}(\text{MFF\_SP\_2\_S}[x]) \end{aligned}$$

+

$$\begin{aligned} &\text{MFF\_ADD\_LAM\_AD\_INJ}[x] * \\ &\text{IP\_FAC\_MFF\_ADD\_LAM\_AD\_INJ}(\text{MFF\_SP\_2\_S}[x]) \end{aligned}$$

$$\begin{aligned} \text{MFF\_SP\_2\_S}[x] &= \text{MFF\_SP\_2\_S}[x] * \text{FAC\_MFF\_COR\_INJ\_MOD\_S} + \\ &\text{MFF\_SP\_2\_EXT\_COR}[x] \end{aligned}$$
**ELSE**

$$\text{MFF\_SP\_2\_S}[x] = 0$$
**ENDIF****IF** (NR\_INJ\_PLS\_S\_REQ >= 3)**THEN** third pulse is calculated in case of triple injection
$$\text{\% 3}^{rd} \text{ pulse MFF correction}$$

$$\begin{aligned} \text{MFF\_SP\_3\_S}[x] &= (\text{MFF\_LAM\_ADD\_LAM\_AD\_OUT}[\text{NC\_LAMB\_REF}[\text{bit } x]] + \text{MFF\_} \\ &\text{ADD\_BAL}[x]) * \text{FAC\_3\_S\_COR}[x] + \\ &\text{MFF\_SP\_3\_S}[x] * (1 + (\text{FAC\_LAM\_AD\_BAL}[\text{NC\_LAMB\_REF}[\text{bit } x]] / 100\%)) \end{aligned}$$

$$\begin{aligned} \text{\% MFF correction of 3}^{rd} \text{ pulse due to injector coding, aging predictive correction} \\ \text{and minimum fuel mass adaptation} \quad \text{MFF\_SP\_3\_EXT\_COR}[x] &= \\ \text{MFF\_ADD\_BAL\_EXT}[x] * \text{IP\_FAC\_MFF\_ADD\_BAL\_EXT}(\text{MFF\_SP\_3\_S}[x]) \end{aligned}$$

+

$$\begin{aligned} &\text{MFF\_ADD\_LAM\_AD\_INJ}[x] * \\ &\text{IP\_FAC\_MFF\_ADD\_LAM\_AD\_INJ}(\text{MFF\_SP\_3\_S}[x]) \end{aligned}$$

$$\begin{aligned} \text{MFF\_SP\_3\_S}[x] &= \text{MFF\_SP\_3\_S}[x] * \text{FAC\_MFF\_COR\_INJ\_MOD\_S} + \\ &\text{MFF\_SP\_3\_EXT\_COR}[x] \end{aligned}$$

$$\text{MFF\_SP\_MPLP}[x] = 0 \quad (\text{No post injection at triple injection!})$$
**ELSE**

$$\text{MFF\_SP\_3\_S}[x] = 0$$

Post pulse is possible in case of **no** triple injection:


$$\begin{aligned} \text{MFF\_SP\_MPLP}[x] &= (\text{MFF\_LAM\_ADD\_LAM\_AD\_OUT}[\text{NC\_LAMB\_REF}[\text{bit } x]] + \text{MFF\_} \\ &\text{ADD\_BAL}[x]) * \text{FAC\_MPLP\_COR}[x] + \\ &\text{MFF\_SP\_MPLP}[x] * (1 + (\text{FAC\_LAM\_AD\_BAL}[\text{NC\_LAMB\_REF}[\text{bit } x]] / 100\%)) \end{aligned}$$

$$\begin{aligned} \text{\% MFF correction of post pulse due to injector coding, aging predictive correction} \\ \text{and minimum fuel mass adaptation} \end{aligned}$$

$$\begin{aligned} \text{MFF\_SP\_MPLP\_EXT\_COR}[x] &= \\ \text{MFF\_ADD\_BAL\_EXT}[x] * \text{IP\_FAC\_MFF\_ADD\_BAL\_EXT}(\text{MFF\_SP\_MPLP}[x]) \end{aligned}$$

+

$$\begin{aligned} &\text{MFF\_ADD\_LAM\_AD\_INJ}[x] * \\ &\text{IP\_FAC\_MFF\_ADD\_LAM\_AD\_INJ}(\text{MFF\_SP\_MPLP}[x]) \end{aligned}$$

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```
MFF_SP_MPLP[x] = MFF_SP_MPLP[x] + MFF_SP_MPLP_EXT_COR[x]
```

```
ENDIF
```

```
Endfor
```

```
ENDIF(3)
```

```
Endif(11)
```

```
If(5) LC_INJ_MOD_SP_MAN_ENA = 1
```

```
Then(5)
```

```
If (6) C_INJ_MOD_SP_MAN = 'SNGH'
```

```
or
```

```
C_INJ_MOD_SP_MAN = 'DISABLE'
```

```
Then(6)
```

```
INJ_MOD_HOM_REQ = NC_INJ_MOD_SINGLE
```

```
INJ_MOD_S_REQ = NC_INJ_MOD_SINGLE
```

```
Endif(6)
```

```
If(7) C_INJ_MOD_SP_MAN = 'MPLH'
```

```
or
```

```
C_INJ_MOD_SP_MAN = 'MPLH+PLS3'
```

```
Then(7)
```

```
INJ_MOD_HOM_REQ = NC_INJ_MOD_MULTI
```

```
INJ_MOD_S_REQ = NC_INJ_MOD_SINGLE
```

```
Endif(7)
```

```
If (8) (C_INJ_MOD_SP_MAN = 'SNGS'
```

```
or
```

```
C_INJ_MOD_SP_MAN = 'HOMS-SNG')
```

```
and
```

```
LV_S_CLC=1
```

```
Then(8)
```

```
INJ_MOD_HOM_REQ = NC_INJ_MOD_SINGLE
```

```
INJ_MOD_S_REQ = NC_INJ_MOD_SINGLE
```

```
Endif(8)
```

```
If(9) (C_INJ_MOD_SP_MAN = 'MPLS'
```

```
or
```

```
C_INJ_MOD_SP_MAN = 'MPLS+PLS3')
```

```
and
```

```
LV_S_CLC=1
```

```
Then(9)
```

```
INJ_MOD_HOM_REQ = NC_INJ_MOD_SINGLE
```

```
INJ_MOD_S_REQ = NC_INJ_MOD_MULTI
```

```
Endif(9)
```

```
If (10) (C_INJ_MOD_SP_MAN = 'HOMS'
```


```
or
```

```
C_INJ_MOD_SP_MAN = 'HOMS+PLS3')
```

```
and
```

```
LV_S_CLC=1
```

```
Then(10)
```

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```

INJ_MOD_HOM_REQ = NC_INJ_MOD_SINGLE
INJ_MOD_S_REQ = NC_INJ_MOD_MULTI

```

```

Endif(10)

```

```

Endif(5)

```

```

FAC_MFF_CST_OPM_SEL           = F_st_ba
FAC_TI_CAST_OPM_SEL           = F_nst_ba
FAC_TI_WUP_OPM_SEL            = F_wl_ba
LV_TI_COR_WF_OPM_1_ACT        = Ba_switch_uek (vice versa)
LV_ST_H_PRS                    = B_hd_start
LV_ST_INJ_AUTH                 = B_espr_start

```

### Calculation of LV\_ADD\_PULSE\_ENA

```

IF (C_ADD_PULSE_ENA = 1)
  OR
  ((C_ADD_PULSE_ENA = 2) AND (LV_ST_END = 1))
THEN
  LV_ADD_PULSE_ENA = 1
ELSE
  LV_ADD_PULSE_ENA = 0
ENDIF

```

```


/* with 10ms recurrence */

```

```

MFF_SP_HOMS_PRED              = Rk_korres_hs* C_MAF_REF * C_MFF_FAC
MFF_SP_S_PRED                  = Rk_korres_s* C_MAF_REF * C_MFF_FAC

```

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## R.27 Customer adaptation module: FUSL

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_aprail_hom	O/V	0... 1H	0 ...1	1	-
Anforderung Diagnose - Raildruck Homogen					
B_aprail_ndnotl	O/V	0... 1H	0 ...1	1	-
Anforderung Diagnose - Raildruck Niederdrucknotlauf					
B_prail_h	O/V	0... 1H	0 ...1	1	-
Request homogen					
B_prailvcv_h	O/V	0... 1H	0 ...1	1	-
Request homogen VCV open					
B_prailvfd_h	O/V	0... 1H	0 ...1	1	-
Request LIH low pressure					
FUP_H_SP_S_EXT	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint for stratified mode, high range					
FUP_SP_EXT	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint BMW					
LV_FUP_SP_EXT_REQ	O/V	0... 1H	0 ...1	1	-
External request of fuel pressure setpoint (high pressure)					
LV_SYM_FUP_ST_NO_RISE	O/V	0... 1H	0 ...1	1	-
Logical variable indicating insufficient fuel pressure increase after injection release in high pressure start					
Prail_ist	O/V	0... FFFFH	0... 39.99938	610.4e-6	MPa
Rail pressure					

### Input data:

B_prailsw {p. 8346}	B_st_hd_prail_abbr	FUP {p. 1283}	FUP_SP_EXT_ADJ {p. 7431}
LV_FUP_HOM_REQ {p. 803}	LV_FUP_LIH_HOM_REQ {p. 4001}	LV_FUP_LIH_HOM_VCV_ OPEN_REQ {p. 4001}	LV_FUP_LIH_L_PRS_ CTL_REQ {p. 4001}
LV_FUP_LIH_REQ {p. 988}	LV_FUP_SP_REQ_EXT_ ADJ {p. 7434}	Prail_out_s {p. 8165}	Prail_soll {p. 8165}

Adaptation to BMW environment.


### Application conditions

**Initialisation:** 0

**Activation:** all engine operating states  
Recurrences: 10 ms

### Formula section:

B\_aprail\_hom = LV\_FUP\_HOM\_REQ  
 B\_aprail\_ndnotl = LV\_FUP\_LIH\_REQ  
 B\_prail\_h = LV\_FUP\_LIH\_HOM\_REQ  
 B\_prailvcv\_h = LV\_FUP\_LIH\_HOM\_VCV\_OPEN\_REQ  
 B\_prailvfd\_h = LV\_FUP\_LIH\_L\_PRS\_CTL\_REQ  
 Prail\_ist = FUP

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## R.27.1 Outputs for supplier aggregates, BMW(supplier

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs can be different from the specified values due to the input data attributes.

### Application conditions

**Initialisation:** at resat: all = 0hex


**Recurrence :** 10 ms

**Activation:** every engine state  
In power latch phase:  
LV\_FUP\_SP\_EXT\_REQ = 0

### Formula section:

*Remark:* all formulas are valid in a **physical** meaning  
**Endif**

```
FUP_H_SP_S_EXT = Prail_out_s
if          LV_FUP_SP_REQ_EXT_ADJ = 0
then       FUP_SP_EXT = Prail_soll
else       FUP_SP_EXT = FUP_SP_EXT_ADJ
             LV_FUP_SP_EXT_REQ = B_prailsw
endif
LV_SYM_FUP_ST_NO_RISE = B_st_hd_prail_abbr
```

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## R.28 Customer adaptation module: IGRE

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Fu_time_zyl [NC_CYL_NR]	O/V	0... FFFFH	0... 255.99609	3.9063e-3	ms
zylinderindividuelle Funkenbrenndauer					
Stat_fofumx_ist	O/V	0... FFFFH	0... 65535	1	-
Umsetzung maximale Folgefunkten					
STATE_MPL_CYL_IGN	O/V	0... FFFFH	0... 65535	1	-
request of maximal number of follow ignition pulses ( bit coded cylinder individuel )					

### Input data:

ECU_STATE {p. 1091}	LV_ST_END {p. 1720}	NC_CYL_NR {p. 1526}	Stat_fofumx_anf {p. 8175}
V_DUR_IGC [NC_CYL_NR] {p. 920}			

### R.28.1 Outputs for BMW functions

#### FUNCTION DESCRIPTION:

Adaptations to BMW environment.

#### Application conditions

Initialisation at reset or at exit PWL: 0

Recurrence: *segment*

Activation: at every engine state

Deactivation: - -

#### Formula section:

Stat\_fofumx\_ist = 0  
Fu\_time\_zyl[NC\_CYL\_NR] = V\_DUR\_IGC[NC\_CYL\_NR]

### R.28.2 Outputs for supplier aggregates

#### FUNCTION DESCRIPTION:


Adaptations to BMW environment.

#### Application conditions

Initialisation: 0 at reset

Recurrence: **if** LV\_ST\_END = 0 or ECU\_STATE = "PWL"  
**then** recurrence is 10ms  
**else** recurrence is segment synchron

Activation: at every engine state


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**Deactivation:**            - - - -

**Formula section:**

STATE\_MPL\_CYL\_IGN = Stat\_fofumx\_anf

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## R.29 Customer adaptation module: IGSP

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_IGA_OPM_SEL	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Ignition interpolation factor for operation switch manager					
IGA_ADD_CMB_CTL [NC_CYL_NR]	O/V	80... 7FH	-48... 47.625	0.375	°CRK
ignition angle correction due to combustion control function					
IGA_AV_H_RNG_HOMS_1 [NC_CYL_NR]	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
HOMS ignition angle in wide range applied on cylinder x					
IGA_AV_H_RNG_S_1 [NC_CYL_NR]	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Ignition angle applied on cylinder CYL in stratified combustion					
IGA_BAS_COR	O/V	0... FFH	-35.625 ...60	0.375	°CRK
corrected basic ignition angle					
IGA_BAS_COR_CBK [NC_CBK_EX_NR]	O/V	0... FFH	-35.625 ...60	0.375	°CRK
corrected basic ignition angle, bank selective					
IGA_REF_COR	O/V	0... FFH	-35.625 ...60	0.375	°CRK
Corrected reference ignition angle					
IGA_REF_COR_CBK [NC_CBK_EX_NR]	O/V	0... FFH	-35.625 ...60	0.375	°CRK
corrected reference ignition angle bank selective					
IGA_REF_EGR_HOM_COR	O/V	80... 7FH	-48... 47.625	0.375	°CRK
additive reference ignition angle correction due to EGR influence in HOM					
IGA_REF_EGR_HOMS_COR	O/V	80... 7FH	-48... 47.625	0.375	°CRK
additive reference ignition angle correction due to EGR influence in HOMS					
IGA_REF_LAMB_COR	O/V	80... 7FH	-48... 47.625	0.375	°CRK
Additive lambda correction of IGA_REF					
IGA_REF_TEMP_COR	O/V	80... 7FH	-48... 47.625	0.375	°CRK
Additive temperature correction of IGA_REF					
LV_IGA_MIN_EXT	O/V	0... 1H	0 ...1	1	-
Flag to enable external IGA_MIN					
LV_IGA_ST_OPM_SEL	O/V	0... 1H	0 ...1	1	-
condition for IGA_ST operation mode, 1 = OPM_1, 0 = OPM_2					
Zw_ks	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Grundzündwinkel bei KR-Sicherheitsspätverstellung					
Zw_md [NC_CYL_NR]	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
ignition angle after torque intervention					
Zw_min	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
minimum ignition angle					
Zw_out_mw	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°CRK
Ignition angle applied on the respective cylinder (0 to 5)					
Zw_ve [NC_CYL_NR]	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
basic ignition angle, application correction and knock control included					

### Input data:

B_gdst {p. 8343}	B_zwmin_ext {p. 8348}	Dzw_agr_hs {p. 8156}	Dzw_agr_kor {p. 8156}
F_zw_hsplit {p. 8158}	IGA [NC_CYL_NR] {p. 1828}	IGA_ADJ_MAX_KNK {p. 1960}	IGA_IGC_0_5_H_RNG {p. 1559}
IGA_IGC_H_RNG [NC_CYL_NR] {p. 1876}	IGA_MIN_H_RNG {p. 1828}	LV_S_CLC {p. 1822}	NC_CBK_EX_NR {p. 1829}

NC_CYL_NR {p. 1526}	Zw_grund1 {p. 8181}	Zw_grund2 {p. 8181}	Zw_offkorrvr [NC_CYL_NR] {p. 8181}
Zw_opt1 {p. 8181}	Zw_opt2 {p. 8181}	Zw_soll_hs [NC_CYL_NR] {p. 8181}	Zw_soll_s [NC_CYL_NR] {p. 8181}

## R.29.1 Outputs for BMW functions which are defined as IGSP exported data

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

### Application conditions:

Initialisation at reset or at exit power latch phase:

$Zw\_ks = IGA\_ADJ\_MAX\_KNK$   
 $Zw\_min = 0^\circ crk$   
 $Zw\_ve[NC\_CYL\_NR] = IGA[NC\_CYL\_NR]$   
 $Zw\_md[NC\_CYL\_NR] = 0^\circ crk$   
 $Zw\_out\_mw = IGA\_IGC\_0\_5\_H\_RNG$      */\* IGA\\_IGC\\_0\\_5\\_H\\_RNG is initialized with C\\_IGA\\_INI\\_H\\_RNG \*/*

Recurrences:            segment:             $Zw\_ks, Zw\_min, Zw\_ve[NC\_CYL\_NR],$   
 $Zw\_md[NC\_CYL\_NR], Zw\_out\_mw,$

Activation:                    every engine state, except power latch phase

Deactivation:                at power latch phase

Values at deactivation:    0, except:

$Zw\_out\_mw = IGA\_IGC\_0\_5\_H\_RNG$

### Formula section:


*Remark:* all formulas are valid in a **physical** meaning

$Zw\_ks = IGA\_ADJ\_MAX\_KNK$   
 $Zw\_min = IGA\_MIN\_H\_RNG$   
 $Zw\_ve[NC\_CYL\_NR] = IGA[NC\_CYL\_NR]$   
 $Zw\_md[NC\_CYL\_NR] = IGA\_IGC\_H\_RNG[NC\_CYL\_NR]$   
 $Zw\_out\_mw = IGA\_IGC\_0\_5\_H\_RNG$

## R.29.2 Outputs for supplier aggregates

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

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*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

### **Application conditions:**

Initialisation at reset or at exit power latch phase :

all values 0 phys

Except first calculation after init of BMW-values:

IGA\_REF\_COR\_CBK[NC\_CBK\_EX\_NR], IGA\_REF\_COR,  
IGA\_BAS\_COR\_CBK[NC\_CBK\_EX\_NR], IGA\_BAS\_COR

Recurrence : segment: IGA\_AV\_H\_RNG\_S\_1[NC\_CYL\_NR],  
AV\_H\_RNG\_HOMS\_1[NC\_CYL\_NR], IGA\_ADD\_CMB\_CTL[NC\_CLY\_NR]

10ms : FAC\_IGA\_OPM\_SEL, IGA\_BAS\_COR, IGA\_REF\_COR, IGA\_REF\_LAMB\_COR,  
IGA\_REF\_TEMP\_COR, LV\_IGA\_ST\_OPM\_SEL IGA\_IGC\_HOM\_S[NC\_CYL\_NR], IGA\_REF\_COR\_1,  
IGA\_REF\_COR\_2, IGA\_BAS\_COR\_1, IGA\_BAS\_COR\_2, LV\_IGA\_MIN\_EXT, IGA\_REF\_EGR\_HOM\_COR,  
IGA\_REF\_EGR\_HOMS\_COR

Activation: at every engine state

Deactivation: --

### **Formula section:**

*Remark:* all formulas are valid in a **physical** meaning

**If** LV\_S\_CLC = 1

**then**

IGA\_AV\_H\_RNG\_S\_1[NC\_CYL\_NR] = Zw\_soll\_s[NC\_CYL\_NR]

IGA\_AV\_H\_RNG\_HOMS\_1 [NC\_CYL\_NR] = Zw\_soll\_hs[NC\_CYL\_NR]

IGA\_REF\_EGR\_HOMS\_COR = Dzw\_agr\_hs

**endif**

FAC\_IGA\_OPM\_SEL = F\_zw\_hsplit

IGA\_BAS\_COR\_CBK[1] = Zw\_grund1

IGA\_BAS\_COR\_CBK[2] = Zw\_grund2

IGA\_BAS\_COR = 0.5 \* ( IGA\_BAS\_COR\_CBK[1] + IGA\_BAS\_COR\_CBK[2] )

LV\_IGA\_ST\_OPM\_SEL= B\_gdst

IGA\_ADD\_CMB\_CTL[NC\_CLY\_NR] = Zw\_offkorrvr[NC\_CYL\_NR]

IGA\_REF\_COR\_CBK[1] = Zw\_opt1

IGA\_REF\_COR\_CBK[2] = Zw\_opt2


IGA\_REF\_COR = 0.5 \* ( IGA\_REF\_COR\_CBK[1] + IGA\_REF\_COR\_CBK[2] )

IGA\_REF\_EGR\_HOM\_COR = Dzw\_agr\_kor

IGA\_REF\_LAMB\_COR = Dzwo\_lam\_kor

IGA\_REF\_TEMP\_COR = Dzwot

LV\_IGA\_MIN\_EXT = B\_zwmin\_ext

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## R.30 Customer adaptation module: INJR

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_zylab1	O/V	0... 1H	0 ...1	1	-
Logical value for single cylinder cut off bank 1					
B_zylab2	O/V	0... 1H	0 ...1	1	-
Logical value for single cylinder cut off bank 2					
CTR_SEG_IGN_INJ_SYN_DEAC	V	0... FFH	0... 255	1	-
Segment counter until deactivation of ignition injection synchronization in HOM mode.					
EOI_2_HOM_CUS [NC_CYL_NR]	O	E200... 5A00H	-180 ...540	0.0234375	°CRK
End of the second injection for homogeneous mode, absolute value					
EOI_3_HOMS_CUS [NC_CYL_NR]	O	E200... 5A00H	-180 ...540	0.0234375	°CRK
End of the third injection for homogeneous stratified mode					
EOI_3_S_CUS [NC_CYL_NR]	O	E200... 5A00H	-180 ...540	0.0234375	°CRK
End of the third injection for stratified mode					
Espr_mod [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
Aktueller Einspritzmodus					
Eta_zyl_aus	O/V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Actual efficiency fuel cut-off					
FAC_EOI_OPM_SEL	O/V	0... FFH	0... 0.99609	3.9062e-3	-
injection phasing correction interpolation factor for operation switch manager					
INH_IV_CUS	O	0... FFH	0... 255	1	-
shut off pattern requested by customer					
LF_SOI_S_ENA	O/V	0... FFH	0... 255	1	-
Bitfield to enable SOI-based stratified injection; cylinder individual (bit 0 stands for cyl 0 ...); 0 = use EOI, 1 = use SOI					
LFT_L_IV_REQ_HOM_CUS	O	0... FFH	0... 255	1	-
Dynamic injector needle lift selection request by customer for homogeneous combustion mode					
LFT_L_IV_REQ_HOMS_CUS	O	0... FFH	0... 255	1	-
Dynamic injector needle lift selection request by customer for homogeneous-stratified combustion mode					
LFT_L_IV_REQ_S_CUS	O	0... FFH	0... 255	1	-
Dynamic injector needle lift selection request by customer for stratified combustion mode					
LV_EOI_2_DELTA_HOM_CUS	O/V	0... 1H	0 ...1	1	-
Switch between EOI_2_HOM_CUS (LV... = 0) or EOI_2_DELTA_HOM_CUS (LV = 1) for phasing of second hom. Injection pulse					
LV_HOMS_ACT	O/V	0... 1H	0 ...1	1	-
Indicates if HOMS is active					
LV_IGN_INJ_SYN_DEAC	O/V	0... 1H	0 ...1	1	-
Flag if there is no synchronisation needed between ignition and injection					
LV_LAM_AD_INJ_CUS_ACK [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Customer acknowledge flag for injection mode control handshake					
LV_MPLH_ACT	O/V	0... 1H	0 ...1	1	-
Indicates if homogeneous mode with split injection is active					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_MPLP_ACT	O/V	0... 1H	0 ...1	1	-
Indicates if stratified mode with post injection is active					
LV_MPLP_ENA	O/V	0... 1H	0 ...1	1	-
Enable post injection					
LV_PRS_COR_MPLH_ENA_CUS	O/V	0... 1H	0 ...1	1	-
Switch to enable/disable fuel rail pressure pulsation correction for homogeneous multi injection; customer provided					
LV_PRS_COR_SNGH_ENA_CUS	O/V	0... 1H	0 ...1	1	-
Switch to enable/disable fuel rail pressure pulsation correction for homogeneous single injection; customer provided					
LV_TI_LIM_ACT	O/V	0... 1H	0 ...1	1	-
1: injection time limited by cycle time (720°crk)					
SOI_1_HOM_CUS [NC_CYL_NR]	O	E200... 5A00H	-180 ...540	0.0234375	°CRK
Start of the first injection for homogeneous mode					
SOI_1_HOMS_CUS [NC_CYL_NR]	O	E200... 5A00H	-180 ...540	0.0234375	°CRK
Start of the first injection for homogeneous stratified mode					
SOI_2_MAX_CUS	O	E200... 5A00H	-180 ...540	0.0234375	°CRK
Maximum start of the second injection					
SOI_3_S_CUS [NC_CYL_NR]	O	E200... 5A00H	-180 ...540	0.0234375	°CRK
Start of the post injection during stratified mode					
SOI_MPLP_CUS [NC_CYL_NR]	O	E200... 5A00H	-180 ...540	0.0234375	°CRK
Start of the post injection during stratified mode					
SOI_S_CUS [NC_CYL_NR]	O	E200... 5A00H	-180 ...540	0.0234375	°CRK
Start of injection for last stratified pulse					
St_injad_anf [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
state of adaptations request for "Kleinstmengen"					
T_DLY_1_2_S_CUS [NC_CYL_NR]	O	0... FFFFH	0... 262.14	0.004	ms
Time delay between first and second pulse for stratified mode					
T_DLY_2_3_MIN_HOMS_CUS [NC_CYL_NR]	O	0... FFFFH	0... 262.14	0.004	ms
Minimum time delay between second and third pulse for homogeneous-stratified mode					
T_DLY_2_3_S_CUS [NC_CYL_NR]	O	0... FFFFH	0... 262.14	0.004	ms
Time delay between second and third pulse for stratified mode					
TCYL_MDL_CUS	O/V	8000... 7FFFH	-2048... 2047.9375	0.0625	K
Modelled cylinder air temperature - customer provided.					
Ti_1_homext	O/V	0... FFFFH	0... 838.848	0.0128	ms
effektive Einspritzzeit Bank 1					
Ti_2_homext	O/V	0... FFFFH	0... 838.848	0.0128	ms
effektive Einspritzzeit Bank 2					
Wese	O/V	0... FFFFH	0... 1535.97656	0.0234375	°CRK
Angle of end of injection					

**Input data:**

B_nesps_ena {p. 8345}	B_praipulskor_ee {p. 8346}	B_praipulskor_me {p. 8346}	B_temxon {p. 8347}
B_wese2h_abs {p. 8347}	Baw_ist {p. 8155}	CTR_CYL_NR_ST_CLC {p. 1754}	Dwese2_h [NC_CYL_NR] {p. 8156}
ECU_STATE {p. 1091}	EFF_SCC_AV {p. 6665}	EOI_1_HOM {p. 2122}	F_vwi_ba {p. 8158}
INJ_MOD [NC_CYL_NR] {p. 2037}	Injekt_hub_h {p. 8159}	Injekt_hub_hs {p. 8159}	Injekt_hub_s {p. 8159}

LC_MFF_MPG_NEW {p. 8246}	LF_MFF_HOM {p. 8242}	LV_S_CLC {p. 1822}	LV_SCC [NC_CBK_EX_NR] {p. 2295}
LV_ST_END {p. 1720}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_LAMB_REF [NC_CYL_NR] {p. 812}
NC_PLS_NR	St_injad_quit {p. 8172}	St_wesb_s {p. 8174}	Stat_zyl_aus {p. 8175}
STATE_LAM_AD_INJ_ACT [NC_CBK_EX_NR] {p. 3379}	Td_wese [NC_CYL_NR][2] {p. 8177}	Td_wese23min_hs [NC_CYL_NR] {p. 8177}	Tevt_mdI {p. 8177}
TI_1_HOM [NC_CYL_NR] {p. 2002}	TI_2_HOM [NC_CYL_NR] {p. 2003}	TI_3_HOM [NC_CYL_NR] {p. 2003}	Wes_soll_h [NC_CYL_ NR][NC_PLS_NR] {p. 8179}
Wesb_s [NC_CYL_NR] {p. 8179}	Wesb1_h [NC_CYL_NR] {p. 8179}	Wesb1_hs [NC_CYL_NR] {p. 8179}	Wesb2max_h {p. 8179}
Wesbkh_s [NC_CYL_NR] {p. 8180}	Wese_s [NC_CYL_NR] {p. 8180}	Wese2_h [NC_CYL_NR] {p. 8180}	Wese2_hs [NC_CYL_NR] {p. 8180}
Wese3_h [NC_CYL_NR] {p. 8180}	Wese3_hs [NC_CYL_NR] {p. 8180}		

### R.30.1 Outputs for BMW functions which are defined as INJR exported data

#### FUNCTION DESCRIPTION:

##### General information:

Adaptation to BMW environment.

##### Application conditions:

Initialisation at reset or at exit power latch phase (BMW-variables):

0 all, except: Eta\_zyl\_aus = 100 %

Recurrences: segment: B\_zylab1/2, Espr\_mod[NC\_CYL\_NR], Wese  
10 ms: Eta\_zyl\_aus, Ti\_1\_homext, Ti\_2\_homext  
100ms: St\_injad\_anf

Activation: every engine state

Deactivation: --

##### Formula section:

B\_zylab1 = LV\_SCC\_1

B\_zylab2 = LV\_SCC\_2

If ECU\_STATE = "PWL"

Then

Espr\_mod[NC\_CYL\_NR] = 0


Wese = 0

Eta\_zyl\_aus = 0

Ti\_1\_homext = 0

Ti\_2\_homext = 0

St\_injad\_anf [NC\_CBK\_EX\_NR] = 0

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**Elseif**

```

Espr_mod[NC_CYL_NR] = INJ_MOD[NC_CYL_NR]
Wese                = EOI_1_HOM
St_injad_anf [NC_CBK_EX_NR] = STATE_LAM_AD_INJ_ACT[NC_CBK_EX_NR]
Eta_zyl_aus      = EFF_SCC_AV * 100
IF NC_CBK_EX_NR > 1                                (please note physical meaning)
THEN
    Ti_1_homext = 0
    Ti_2_homext = 0
FOR x = 0 TO (NC_CYL_NR - 1)
IF (NC_LAMB_REF AND 2x) 0                        (bitwise)
THEN
    Bank 2:
        Ti_2_homext += TI_1_HOM[x] + TI_2_HOM[x] + TI_3_HOM[x]
    ELSE
        Bank 1:
            Ti_1_homext += TI_1_HOM[x] + TI_2_HOM[x] + TI_3_HOM[x]
    ENDIF
ENDFOR
    Ti_1_homext = Ti_1_homext / (NC_CYL_NR / NC_CBK_EX_NR)
    Ti_2_homext = Ti_2_homext / (NC_CYL_NR / NC_CBK_EX_NR)
ELSE
    Ti_1_homext = 0
FOR x = 0 TO (NC_CYL_NR - 1)
        Ti_1_homext += TI_1_HOM[x] + TI_2_HOM[x] + TI_3_HOM[x]
ENDFOR
    Ti_1_homext = Ti_1_homext / NC_CYL_NR
ENDIF

```

**Endif****R.30.2 Outputs for supplier aggregates****FUNCTION DESCRIPTION:****General information:**

Adaptation to BMW environment.

**Application conditions**

**Initialisation(supplier-Variables):** 0, except LV\_EOI\_2\_DELTA\_HOM\_CUS = 1  
 // SOI\_3\_S\_CUS is not valid any more for post injection. It is set to a default value to keep the interface to aggr. EXTC stable. Post injection has to be disabled for the function sample!  
 SOI\_3\_S\_CUS[NC\_CYL\_NR] = 140 (each element)


**Recurrence :**

```

10 ms:  LV_TI_LIM_ACT, FAC_EOI_OPM_SEL, LV_MPLP_ENA,
        LV_MPLH_ACT, LV_MPLP_ACT, LV_HOMS_
ACT

20ms:  LV_LAM_AD_INJ_CUS_ACK[NC_CBK_
EX_NR]

```

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```


                                if          LV_ST_END = 0 or at power latch
phase
                                then         recurrence of the following
vaules is 10ms
                                SOI_1_HOM_CUS[NC_CYL_NR],
                                EOI_3_S_CUS[NC_CYL_NR],
                                T_DLY_1_2_S_CUS[NC_CYL_NR],
                                T_DLY_2_3_S_CUS[NC_CYL_NR],
                                SOI_MPLP_CUS[NC_CYL_NR],
                                SOI_1_HOMS_CUS[NC_CYL_NR],
                                EOI_2_HOMS_CUS[NC_CYL_NR],
                                EOI_3_HOMS_CUS[NC_CYL_NR],
                                T_DLY_2_3_MIN_HOMS_CUS[NC_CYL_NR],
                                EOI_2_HOM_CUS[NC_CYL_NR],
                                EOI_3_HOM_CUS[NC_CYL_NR],
SOI_2_MAX_CUS,
                                LV_EOI_2_DELTA_HOM_CUS,
LF_SOI_S_ENA,
SOI_S_CUS[NC_CYL_NR],
INH_IV_CUS,
LFT_L_IV_REQ_S_CUS,
LFT_L_IV_REQ_HOM_CUS,
LFT_L_IV_REQ_HOMS_CUS,
LV_PRS_COR_SNGH_ENA_CUS,
LV_PRS_COR_MPLH_ENA_CUS
LV_IGN_INJ_SYN_DEAC

                                else         recurrence of the following vaules is segment
synchron
                                SOI_1_HOM_CUS[NC_CYL_NR],
                                EOI_3_S_CUS[NC_CYL_NR],
                                T_DLY_1_2_S_CUS[NC_CYL_NR],
                                T_DLY_2_3_S_CUS[NC_CYL_NR],
                                SOI_MPLP_CUS[NC_CYL_NR],
                                SOI_1_HOMS_CUS[NC_CYL_NR],
                                EOI_2_HOMS_CUS[NC_CYL_NR],
                                EOI_3_HOMS_CUS[NC_CYL_NR],
                                T_DLY_2_3_MIN_HOMS_CUS[NC_CYL_NR],
                                EOI_2_HOM_CUS[NC_CYL_NR],
                                EOI_3_HOM_CUS[NC_CYL_NR],
SOI_2_MAX_CUS,
                                LV_EOI_2_DELTA_HOM_CUS,
LF_SOI_S_ENA,
                                SOI_S_CUS[NC_CYL_NR],
INH_IV_CUS,
LFT_L_IV_REQ_S_CUS,
LFT_L_IV_REQ_HOM_CUS,
LFT_L_IV_REQ_HOMS_CUS,
LV_PRS_COR_SNGH_ENA_CUS,
LV_PRS_COR_MPLH_ENA_CUS
LV_IGN_INJ_SYN_DEAC
                                100ms:         TCYL_MDL_CUS

```

**Activation:** at every engine state

**Deactivation:** - -

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**Formula section:**

*Remark:* all formulas are valid in a **physical** meaning

```

if      LV_S_CLC = 1
then

    EOI_3_S_CUS[NC_CYL_NR]           = Wese_s[NC_CYL_NR]
    T_DLY_1_2_S_CUS[NC_CYL_NR]      = Td_wese[NC_CYL_NR][1]
    T_DLY_2_3_S_CUS[NC_CYL_NR]      = Td_wese[NC_CYL_NR][2]
    SOI_MPLP_CUS[NC_CYL_NR]          = Wesbkh_s[NC_CYL_NR]
    SOI_1_HOMS_CUS[NC_CYL_NR]        = Wesb1_hs[NC_CYL_NR]
    EOI_2_HOMS_CUS[NC_CYL_NR]        = Wese2_hs[NC_CYL_NR]
    EOI_3_HOMS_CUS[NC_CYL_NR]        = Wese3_hs[NC_CYL_NR]
    T_DLY_2_3_MIN_HOMS_CUS[NC_CYL_NR] = Td_wese23min_hs[NC_CYL_NR]
    LF_SOI_S_ENA                      = St_wesb_s
    SOI_S_CUS[NC_CYL_NR]              = Wesb_s[NC_CYL_NR]

endif

INH_IV_CUS                          = Stat_zyl_aus
FAC_EOI_OPM_SEL                      = F_vwi_ba
LFT_L_IV_REQ_S_CUS                   = Injekt_hub_s
LFT_L_IV_REQ_HOM_CUS                 = Injekt_hub_h
LFT_L_IV_REQ_HOMS_CUS                = Injekt_hub_hs


if      Bit 0 of St_injad_quit is 1
Then   LV_LAM_AD_INJ_CUS_ACK[1] = 1
Else   LV_LAM_AD_INJ_CUS_ACK[1] = 0
Endif

if      Bit 1 of St_injad_quit is 1
Then   LV_LAM_AD_INJ_CUS_ACK[2] = 1
Else   LV_LAM_AD_INJ_CUS_ACK[2] = 0
endif

LV_MPLP_ENA                          = B_nesps_ena
if      LC_MFF_MPG_NEW = 1
Then

    IF (Bit 3 of LF_MFF_HOM is set) or (Bit 4 of LF_MFF_HOM is set)
        //Note: zero based indexing is used for LF_MFF_HOM
        THEN
            LV_IGN_INJ_SYN_DEAC = 0
            CTR_SEG_IGN_INJ_SYN_DEAC = NC_CYL_NR
        ELSE
            IF CTR_SEG_IGN_INJ_SYN_DEAC > 0
                THEN
                    Decrement CTR_SEG_IGN_INJ_SYN_DEAC by 1
                ENDIF
            IF CTR_SEG_IGN_INJ_SYN_DEAC = 0
                THEN
                    LV_IGN_INJ_SYN_DEAC = 1
                ENDIF
            ENDIF
        For x = 0 to NC_CYL_NR-1 do
            SOI_1_HOM_CUS[x] = Wes_soll_h[x][0]
        if Bit 1 of LF_MFF_HOM = 1
            //Note: zero based indexing is used for LF_MFF_HOM

```

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```


Then
    EOI_2_HOM_CUS[x] = Wes_soll_h[x][1]
Else
    EOI_2_HOM_CUS[x] = Wes_soll_h[x][2]
Endif
EOI_3_HOM_CUS[x] = Wes_soll_h[x][2]
Endfor
Else - LC_MFF_MPG_NEW = 0
IF B_wese2h_abs = 0
THEN
    LV_IGN_INJ_SYN_DEAC = 0
    CTR_SEG_IGN_INJ_SYN_DEAC = NC_CYL_NR
ELSE
    IF CTR_SEG_IGN_INJ_SYN_DEAC > 0
    THEN
        Decrement CTR_SEG_IGN_INJ_SYN_DEAC by 1
    ENDIF
    IF CTR_SEG_IGN_INJ_SYN_DEAC = 0
    THEN
        LV_IGN_INJ_SYN_DEAC = 1
    ENDIF
ENDIF
For x = 0 to NC_CYL_NR-1 do
    SOI_1_HOM_CUS[x] = Wesb1_h[x]
    If B_wese2h_abs = 0
    Then
        EOI_2_HOM_CUS[x] = Dwese2_h[x]
    Else
        EOI_2_HOM_CUS[x] = Wese2_h[x]
    Endif
    EOI_3_HOM_CUS[x] = Wese3_h[x]
Endfor
Endif

If ECU_STATE = "PWL"
Then
LV_TI_LIM_ACT = 0
    LV_EOI_2_DELTA_HOM_CUS = 1
    EOI_3_HOM_CUS[NC_CYL_NR] = 0
SOI_2_MAX_CUS = 0

Elseif
    LV_TI_LIM_ACT = B_temxon
If LC_MFF_MPG_NEW = 1
Then
    LV_EOI_2_DELTA_HOM_CUS =
        (Bit 3 of LF_MFF_HOM) OR (Bit 4 of LF_MFF_HOM)
        //Note: zero based indexing is used for LF_MFF_HOM

Else
    LV_EOI_2_DELTA_HOM_CUS = NOT(B_wese2h_abs)
Endif

```

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SOI\_2\_MAX\_CUS = Wesb2max\_h

**Endif**

**If** ( Baw\_ist and 0xff ) = 66 **or** ( Baw\_ist and 0xff ) = 226 **or** ( Baw\_ist and 0xff ) = 82

**Then**

LV\_MPLH\_ACT = 1

**Elseif**

LV\_MPLH\_ACT = 0

**Endif**

**If** ( Baw\_ist and 0xff ) = 65

**Then**

LV\_MPLP\_ACT = 1

**Elseif**

LV\_MPLP\_ACT = 0

**Endif**

**If** ( Baw\_ist and 0xff ) = 19

**Then**

LV\_HOMS\_ACT = 1

**Elseif**

LV\_HOMS\_ACT = 0

**Endif**

LV\_PRS\_COR\_MPLH\_ENA\_CUS = B\_prailpulskor\_me

LV\_PRS\_COR\_SNGH\_ENA\_CUS = B\_prailpulskor\_ee

/\* with 100ms recurrence \*/

TCYL\_MDL\_CUS = Tevt\_md1 + 273.15 /\* Attention: transfer of °C to K \*/

## R.31 Customer adaptation module: INSY

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_disa_akt	O/V	0... 1H	0 ...1	1	-
Bedingung DISA aktiv					
Dpsr	O/V	8000... 7FFFH	-1280... 1279.96093	0.0390625	hPa
differential manifold pressure					
Dpsr_seg	O/V	8000... 7FFFH	-1280... 1279.96093	0.0390625	hPa
differential manifold pressure, calculated segment synchronous					
EGR_RATIO	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Air mass flow at EGR valve /air mass flow to cylinder					
FAC_MAF_AD_EGR_KWP	O/V	8000... 7FFFH	-2... 1.99993	61e-6	-
Testerwert NN PR-Adaption					
FAC_MAF_AD_THR_KWP	O/V	8000... 7FFFH	-1... 0.99996	30.5e-6	-
Testerwert NN DK-Adaption					
FAC_MAF_REL	O/V	0... BB8H	0... 300	0.1	%
relative filling					
Fho	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
altitude factor					
Ftbr	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Filtered volumetric efficiency correction factor due to temperature effects					
ISAPWM	O	0... FFFFH	0... 99.99847	1.5259e-3	%
idle speed actuator duty cycle, linearised					
ISAPWM_ISA	O	0... FFFFH	0... 99.99847	1.5259e-3	%
Idle speed actuator duty cycle					
ISAPWM_MMV	O	0... FFFFH	0... 99.99847	1.5259e-3	%
idle speed actuator duty cycle moving mean value					
LV_TPS_SUB_DIAG_NOT_VLD	O/V	0... 1H	0 ...1	1	-
Bedingung Berechnung DKWinkel aus Signal des HF-Sensors ungedrosselt					
LV_VIM_1_CUS	O/V	0... 1H	0 ...1	1	-
Setpoint disa flap 1 specified by customer					
LV_VIM_2_CUS	O/V	0... 1H	0 ...1	1	-
Request from BMW for open variable intake manifold 2					
LV_VIM_INH_CUS	O/V	0... 1H	0 ...1	1	-
Enable bit for VIM					
MAF	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
calculated mass air flow					
MAF_CYL	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Air mass flow to cylinder [kg/h]					
MAF_CYL_STK	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Air mass flow to cylinder [mg/stk]					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MAF_EGR	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Air mass flow at EGR valve					
MAF_EGR_NEUT_GAS	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Neutral Gas component of Exhaust Gas Recirculation					
MAF_KGH_FG_PRED	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Predicted fresh gas out of the manifold					
MAF_MAX_COR	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Maximum available fresh air going into the cylinder					
MAF_MDL_MV	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Model air mass flow mean value [kg/h]					
MAF_SCAV_EXT	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Delta RF					
MAF_SP	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
MAF setpoint output for inverse air path					
MAF_THR	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Air mass flow at the throttle					
MAP	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Manifold pressure					
MAP_DRV1	O/V	8000... 7FFFH	-82.91752 ...82.91499	2.5304e-3	hPa/ms
First derivative of intake manifold pressure					
MAP_SP	O/V	0... FFFFH	0... 5434	0.0829175	hPa
mainfold air pressure setpoint					
Mshfm_ist	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
measured mass air flow					
Mshfm2_ist	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Massenstrom vom HFM Bank 2					
Mslui	O/V	0... FFFFH	0... 29.12667	444.4e-6	kg
measured mass air flow integral					
PQ	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
Pressure quotient at the throttle					
PQ_EGR_SP	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
pressure quotient between exhausted branch and MAP					
PQ_SP	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
PQ-setpoint					
PRS_IM_CTL_I	O/V	8000... 7FFFH	-2... 1.99993	61e-6	-
Saugrohrdruckregler I-Anteil					
Ps_abs	O/V	0... FFFFH	0... 2559.96093	0.0390625	hPa
Absolute Pressure of manifold					
Ps_abs_t100	O/V	0... FFFFH	0... 2559.96093	0.0390625	hPa
Absolute Pressure of manifold, 100ms					
Pu	O/V	0... FFFFH	0... 2559.96093	0.0390625	hPa
ambient pressure					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Pvagr	O/V	0... FFFFH	0... 2559.96093	0.0390625	hPa
egr pressur					
Pvdkds	O/V	0... FFFFH	0... 2559.96093	0.0390625	hPa
pressure upstream throttle					
Pvdkds_t100	O/V	0... FFFFH	0... 2559.96093	0.0390625	hPa
pressure upstream throttle, 100ms					

**Input data:**

Agr_rate {p. 8154}	AMP_MES {p. 1163}	B_disa_stopp {p. 8342}	B_disa1_auf {p. 8342}
B_disa2_auf {p. 8342}	B_wdkdiag_ugd {p. 8347}	Drf_spuel {p. 8156}	ECU_STATE {p. 1091}
EFF_VOL_TEMP_COR_MMV {p. 1206}	FAC_AMP {p. 1163}	LV_ES {p. 1720}	LV_VAR_TCHA {p. 656}
LV_VIM_RLS {p. 3622}	MAF_KGH {p. 1195}	MAF_KGH_MES {p. 1192}	MAF_KGH_MES_TCHA [NC_MAF_SENS_CONF] {p. 1192}
MAP_DIP_MES_BAS {p. 1198}	MAP_DIP_MES_BAS_2SEG {p. 1198}	MAP_MES_BAS {p. 1198}	Mrnn_test_dk {p. 8162}
Msagr {p. 8163}	Msdk {p. 8163}	Mszyl {p. 8163}	Mszyl_ges {p. 8163}
N {p. 1525}	NC_MAF_FAC_CYL {p. 2889}	NC_MAF_SENS_CONF {p. 604}	Prnn_test {p. 8165}
PRS_EX {p. 1167}	PRS_EX_EGR {p. 1167}	Ps {p. 8165}	Pspvdk {p. 8166}
Pspvdk_soll {p. 8166}	PSREG	Pssol {p. 8166}	PUT {p. 1209}
PUT_MES_BAS {p. 1198}	Rf {p. 8167}	Rf_ig_ist {p. 8167}	Rf_soll {p. 8167}
Rf_vl {p. 8167}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_MAF_TCHA	-	0... FFFFH	0... 3.99993	61e-6	-
Factor for conversion of mass air flow from one to two banks					
C_FAC_MAF_TCHA_0	-	0... FFFFH	0... 3.99993	61e-6	-
Factor for conversion of mass air flow from bank one					
C_FAC_MAF_TCHA_1	-	0... FFFFH	0... 3.99993	61e-6	-
Factor for conversion of mass air flow from bank two					
C_MAF_REF	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Reference air mass flow for the calculation of MAF and MAF_MAX_COR					
LC_MAF_TCHA_MES	-	0... 1H	0...1	1	-
Switch for calculation of Mshfm_ist/m by model (0) or by sensor (1), only for N54					

**R.31.1 Outputs for BMW functions which are defined as INSY exported data****FUNCTION DESCRIPTION:**

Adaptation to BMW environment.

**Application conditions****Initialisation:** at reset: Ftbr = 1.0 , all others =0

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**Recurrence :** Ftbr : 100 ms  
 Mshfm\_ist, Mshfm2\_ist: segment  
 Mslui : 200 ms

**Activation:** every engine state

### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

Ftbr = EFF\_VOL\_TEMP\_COR\_MMV

**If** LC\_MAF\_TCHA\_MES = 0

**Then**

Mshfm\_ist = MAF\_KGH\_MES

Mshfm2\_ist = 0

**Else**

Mshfm\_ist = MAF\_KGH\_MES\_TCHA[0] \* C\_FAC\_MAF\_TCHA\_0  
 + MAF\_KGH\_MES\_TCHA[1] \* C\_FAC\_MAF\_TCHA\_1

Mshfm2\_ist = MAF\_KGH\_MES\_TCHA[1]

**Endif**

Mslui = Mslui<sub>n-1</sub> + MAF\_KGH \* **Error!** after reaching the maximum value 29.13 kg  
 the calculation of Mslui is stopped.

Pvagr = PRS\_EX\_EGR

## R.31.2 Outputs for BMW functions which are not defined as INSY exported data

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

### Application conditions

**Initialisation:** Dpsr: 0 hPa  
 Dpsr\_seg: 0 hPa  
 Ps\_abs : 0 hPa  
 Ps\_abs\_t100: 0 hPa  
 Fho: 1.0  
 Pvdks: AMP\_MES  
 Pvdks\_t100: AMP\_MES  
 Pu: AMP\_MES  
 B\_disa\_akt: 0



```

Recurrence :      segment:  Dpsr_seg
                    100ms:      Fho      Remark:  the update
                    rate of FAC_AMP is 1000 ms only
                    100 ms:      Pu      Remark:  the update
                    rate of AMP_MES is 1000 ms only
                    10ms :          B_disa_akt, Ps_abs_
t100, Pvdkds_t100
                    if          LV_VAR_TCHA = 0
                                then      Pvdkds:      100 ms
                                else      Pvdkds:      segment
                                endif
                    if          LV_ES = 1
                    then      Dpsr: 100ms, Ps_abs: 10ms
                    elseif     Dpsr, Ps_abs: segment

```

**Activation:**            *every engine state*

**Deactivation:**        - -

### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

```

Pvdkds              = PUT
Pvdkds_t100        = PUT_MES_BAS
Pu                  = AMP_MES
B_disa_akt          = LV_VIM_RLS
Ps_abs_t100        = MAP_MES_BAS
Fho                  = FAC_AMP
if          ECU_STATE= "PWL"
then      Dpsr_seg      = 0
            Dpsr          = 0
else      Dpsr_seg      = MAP_DIP_MES_BAS
            Dpsr          = MAP_DIP_MES_BAS_2SEG
            Ps_abs        = MAP_MES_BAS
endif

```

## R.31.3 Outputs for supplier aggregates

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs can be different from the specified values due to the input data attributes.


### Application conditions

**Initialisation at reset:** 0, except PQ\_EGR\_SP= 0.99998, PRS\_IM\_CTL\_I=1

```

Recurrence:      if LV_ES = 1 then 10ms
                    Endif
                    if LV_ES= 0
                    Then
                    10ms:      PQ_SP, LV_TPS_SUB_DIAG_NOT_VLD,      MAF_EGR_
NEUT_GAS, FAC_MAF_AD_THR_KWP,      FAC_MAF_AD_EGR_KWP, LV_
VIM_INH_CUS,      LV_VIM_1_CUS, LV_VIM_2_CUS , MAF_SCAV_EXT,
PRS_IM_CTL_I

```

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```

segment: other
(Hint: the update rate of the input data can
be slower )
endif

```

**Activation:** *every engine state*

### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

```

EGR_RATIO          = Agr_rate
MAF_EGR            = Msagr
MAF_EGR_NEUT_GAS  = Rf_ig_ist * C_MAF_REF
MAF_KGH_FG_PRED   = Msdk
MAF_MDL_MV        = Msdk_f
MAF_CYL            = Mszyl
MAF_CYL_STK       = Mszyl_ges * NC_MAF_FAC_CYL /N
MAP                = Ps
PQ                 = Pspvdk
PQ_SP              = Pspvdk_soll
If                LV_ES = 1
Then              MAF = 0
Else              MAF          = Rf * C_MAF_REF
Endif
MAF_SP             = Rf_soll * C_MAF_REF
FAC_MAF_REL        = Rf
MAF_MAX_COR        = Rf_vl * C_MAF_REF
ISAPWM             = 0      (init., never change)
ISAPWM_MMV         = 0      (init., never change)
ISAPWM_ISA         = 0      (init., never change)
MAP_SP             = Pssol
MAP_DRV1           = (MAP_N - MAP_{N-1}) /T_SEG_AV      recurrence: seg-
ment
PQ_EGR_SP          = MAP_SP /PRS_EX
MAF_THR            = Msdk
LV_TPS_SUB_DIAG_NOT_VLD = B_wdkdiag_ugd
FAC_MAF_AD_THR_KWP = Mrnn_test_dk
FAC_MAF_AD_EGR_KWP = Prnn_test
LV_VIM_INH_CUS     = B_disa_stopp
LV_VIM_1_CUS       = B_disa1_auf
LV_VIM_2_CUS       = B_disa2_auf
MAF_SCAV_EXT       = Drf_spuel * C_MAF_REF
PRS_IM_CTL_I       = Psreg_i

```

## R.32 Customer adaptation module: INTC

### Data definition:


Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
A_quer	O/V	8000... 7FFFH	-64... 63.99804	1.9531e-3	m/s**2
Vehicle acceleration transversal					
Acfzgl	O/V	80... 7FH	-32... 31.75	0.25	m/s**2
vehicle acceleration longitudinal					
Acfzgg	O/V	80... 7FH	-32... 31.75	0.25	m/s**2
Fahrzeugquerbeschleunigung					
B_abgasklappe	O/V	0... 1H	0 ...1	1	-
Bedingung Schaltung Abgasklappe (True = Klappe geöffnet)					
B_abliactiv	O/V	0... 1H	0 ...1	1	-
state of low beam: 0 = off, 1 = on					
B_anhang	O/V	0... 1H	0 ...1	1	-
information of trailer					
B_btvsa	O/V	0... 1H	0 ...1	1	-
condition for cam setpoint for exhaust cam via external service device (Tester)					
B_bt vse	O/V	0... 1H	0 ...1	1	-
condition for cam setpoint for inlet cam via external service device (Tester)					
B_cdigr onw	O/V	0... 1H	0 ...1	1	-
IGR-Codierdaten schreiben bzw. einlesen in die DDE/DME					
B_cdxen onw	O/V	0... 1H	0 ...1	1	-
Xenonverbau-Codierdaten schreiben					
B_ckl30	O/V	0... 1H	0 ...1	1	-
condition kl30					
B_ckl50	O/V	0... 1H	0 ...1	1	-
condition terminal 50 (via CAN) active					
B_diagigr	O/V	0... 1H	0 ...1	1	-
Flag "Diagnosejob gesetzt"					
B_dscakt	O/V	0... 1H	0 ...1	1	-
DSC Aktivität					
B_dzm_dyn	O/V	0... 1H	0 ...1	1	-
Anforderung Drehzahlmesserdynamisierung					
B_egs_khl1	O/V	0... 1H	0 ...1	1	-
condition for request of cooling stage 1 from gear box					
B_egs_khl2	O/V	0... 1H	0 ...1	1	-
condition for request of cooling stage 2 from gear box					
B_fagurt	O/V	0... 1H	0 ...1	1	-
Fahrergurtschloß geschlossen					
B_fe	O/V	0... 1H	0 ...1	1	-
Flag " Fertigungsmodus aktive"					
B_fetrawedeak	O/V	0... 1H	0 ...1	1	-
Flag " Fertigungs-, Transport- und Werkstattmodus inaktive"					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_ftauf1	O/V	0... 1H	0 ...1	1	-
Boolean for driver's door open					
B_gangwechsel_gs	O/V	0... 1H	0 ...1	1	-
Gangwechsel aktiv					
B_gen_ext	O	0... 1H	0 ...1	1	-
status for external adjustment generator					
B_hz	O/V	0... 1H	0 ...1	1	-
Increased engine heating power request by AC /INSTR3					
B_iliactiv	O/V	0... 1H	0 ...1	1	-
state of interior lighting: 0 = off, 1 = on					
B_keinhs_gs	O/V	0... 1H	0 ...1	1	-
Wenn=0 wird die Maxdrehzahl mit Prädiktion abgeregelt					
B_kupp1	O/V	0... 1H	0 ...1	1	-
St_bgkuppl					
B_ldm_ena	O	0... 1H	0 ...1	1	-
status for required torque via LDM enabled					
B_ldm_nofil	O/V	0... 1H	0 ...1	1	-
Fast torque adjustment by LDM					
B_lkpls_kl1	O/V	0... 1H	0 ...1	1	-
Anforderung LKLPS "auf" von IHKA					
B_lkpls_kl2	O/V	0... 1H	0 ...1	1	-
Anforderung LKLPS "ganz auf" von IHKA					
B_mhauf1	O/V	0... 1H	0 ...1	1	-
Boolean for engine hood open					
B_msadltgpd	O/V	0... 1H	0 ...1	1	-
Diagnose MSA-Leitung: Bit für die permanente Deaktivierung MSA					
B_msadltgtd	O/V	0... 1H	0 ...1	1	-
Diagnose MSA-Leitung: Bit für die temporäre Deaktivierung MSA					
B_msafzg	O/V	0... 1H	0 ...1	1	-
Variante MSA-Fahrzeug					
B_msataster	O/V	0... 1H	0 ...1	1	-
Boolean for MSA button pressed					
B_nosa	O/V	0... 1H	0 ...1	1	-
Fuel cutoff prohibition by LDM					
B_schalt_dkg	O/V	0... 1H	0 ...1	1	-
Drehzahlregelung aktiv					
B_schalt_ldm	O/V	0... 1H	0 ...1	1	-
Anforderung Schalthinweis über CC-Meldung vom LDM					
B_sport_schalter	O/V	0... 1H	0 ...1	1	-
Sport switch activated					
B_taleer	O/V	0... 1H	0 ...1	1	-
Bedingung Tank leer					
B_tra	O/V	0... 1H	0 ...1	1	-
Flag " Transportmodus aktive"					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_tstkvs	O/V	0... 1H	0 ...1	1	-
Bedingung Funktionsanforderung Kraftstoffsystemdiagnose					
B_we	O/V	0... 1H	0 ...1	1	-
Flag " Werkstattmodus aktive"					
Batt_class	O/V/S	0... FFH	0... 255	1	-
Classification of the vehicle battery					
Baw_tester	O/V	0... FFFFH	0... 65535	1	-
Testeranforderung von Zulieferer					
Bordnetz	O/V	1... 2H	1 ...2	1	-
=1: CAN 11Hex =2: CAN 12Hex; bordnetz2000 is present					
Bosfxid2r	O/V/S	0... FFFFH	0... 65535	1	-
ID_Funktion_BOS_Rückstellung_2					
Bosid2r	O/V/S	0... FFH	0... 255	1	-
ID_2_BOS_Rückstellung_2					
Boszielr	O/V/S	0... FFH	0... 255	1	-
Zieltermin_Monat_BOS_Rückstellung_2					
Bosmzielr	O/V/S	0... FFH	0... 255	1	-
Zieltermin_Jahr_BOS_Rückstellung_2					
Bosprog2r	O/V/S	0... FFH	0... 255	1	-
Prognose_Intervall_Zeit_BOS_Rückstellung_2					
Bosrlsmr	O	8000... 7FFFH	-32768 ...32767	1	-
Remaining milage for oil (from combi)					
Bosrw2r	O/V/S	0... FFH	0... 255000	1000	km
Prognose_Intervall_Weg_BOS_Rückstellung_2					
Bosun	O/V	0... FFH	0... 255	1	-
Einheit für Bosrlsmr					
Bosunt	O/V	0... FFH	0... 255	1	-
Einheit für Bosrlsmt					
Bosv	O/V	0... FFH	0... 255	1	-
availability of kombi					
CUR_RNG_CTL	O/V	0... FFH	0... 255	1	-
Control current path					
Dm_ab_fws	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Fahrwiderstand					
Fahrzeug	O/V	0... FFH	0... 255	1	-
Vehicle variant					
Fetrawe	O/V	0... FFH	0... 255	1	-
Implementierung Fertigungs-, Transport- und Werkstattmodus mit Tester auslesen					
GR_DT	O/V	0... FFH	0... 31.875	0.125	-
Gear ratio factor for monitoring					
GS_IDC_DISP_RAW	O/V	0... FFH	0... 255	1	-
Gearshift signal - display type					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
GS_IDC_GEAR_RAW	O/V	0... FFH	0... 255	1	-
Gearshift signal - setpoint for gear					
l_eff_gs	O/V	0... FFFFH	0... 511.992	0.0078125	1/m
Strangverstärkung					
Id_bosrst	O/V	0... FFH	0... 255	1	-
ID2_BOS_resetting					
Id_bosrtw	O/V	0... FFFFH	0... 65535	1	-
ID_function_BOS_resetting					
idfbosmg_w	O/V	0... FFFFH	0... 65535	1	-
ID for engine oil (BOS Kombi)					
lkurz_ogr	O/V/S	0... FFH	0... 2550	10	A
maximum short-current from CAS (vehicle-specific)					
lkurz_ugr	O/V/S	0... FFH	0... 2550	10	A
minimum short-current from CAS (vehicle-specific)					
lpm_typ_fp	O/V	0... FFH	0... 255	1	-
iPM-Fahrertyp zur Beeinflussung der Pedalauswertung					
lpm_typ_mdkw	O/V	0... FFH	0... 255	1	-
iPM-Fahrertyp zur Beeinflussung der Soll-Momentenbestimmung					
lwakeupgr	O/V/S	0... FFH	0... 0.255	0.001	A
No-load-current (vehicle-specific)					
Km_st	O/V	0... FFFFH	0... 655350	10	km
Kilometer reading at engine start based on last DC					
Km_st_1	O/V/S	0... FFFFFFFFH	0... 4294967295	1	-
Wegstrecke_km auf 1 km genau					
Kvaverbr	O/V	0... FFFFH	0... 65535	1	µl
fuel consumption [micro liter]					
La_soll_tester [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambdananforderung Tester					
LV_CAN_SND_MSG_PWR_MNG_0	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung POWERMANAGMENT VERBRAUCHERSTEUERUNG Sendeanforderung"					
LV_CAN_SND_MSG_PWR_MNG_1	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung POWERMANAGMENT BATTERIESPANNUNG Sendeanforderung"					
LV_GS_DOWN	O/V	0... 1H	0 ...1	1	-
Gear-shift down					
LV_GS_UP	O/V	0... 1H	0 ...1	1	-
Gear-shift up					
LV_INH_STST_CDN	O/V	0... 1H	0 ...1	1	-
Condition for Start-Stop					
LV_LDM_DRIV_ACT	O/V	0... 1H	0 ...1	1	-
Condition LDM driver active					
LV_LDM_OFF	O/V	0... 1H	0 ...1	1	-
LDM off requested by DME					
LV_OIL_CNS_WARN_1	O/V	0... 1H	0 ...1	1	-
LV warning oil consumption					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_OIL_CNS_WARN_2	O/V	0... 1H	0 ...1	1	-
LV warning oil consumption					
LV_STST_STOP	O/V	0... 1H	0 ...1	1	-
flag indicating engine is in STST(MSA)-Stop					
Md_kupp_schalt	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Kupplungsaufnahmemoment					
Md_rad_asrl	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Momentenbegrenzung ASR langsamer Pfad					
Md_rad_asrs	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Momentenbegrenzung ASR schneller Pfad					
Md_rad_msrl	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Begrenzungsmoment aus Motorschleppmomentenregelung langsamer Pfad					
Md_rad_msrs	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Begrenzungsmoment aus Motorschleppmomentenregelung schneller Pfad					
Md_rad_soll	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Soll-Radmoment					
Mdk_kupp_verl	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Kupplungslastmoment bei aktiver Drehzahlregelung					
N_ab_m	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
gemessene Abtriebsdrehzahl					
N_DISP_DYN	O/V	0... 1FE0H	0... 8160	1	rpm
dynamisated N for display in ICL (Kombi)					
N_idlms	O/V	0... FFH	0... 255	1	-
request idlespeed-increase from powermanagement					
N_rad_hl	O/V	8000... 7FFFH	-512... 511.98437	0.015625	rad/s
Raddrehzahl hnten links					
N_rad_hr	O/V	8000... 7FFFH	-512... 511.98437	0.015625	rad/s
Raddrehzahl hnten rechts					
N_rad_vl	O/V	8000... 7FFFH	-512... 511.98437	0.015625	rad/s
Raddrehzahl vorn links					
N_rad_vr	O/V	8000... 7FFFH	-512... 511.98437	0.015625	rad/s
Raddrehzahl vorn rechts					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
N_schalt_dkg	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
Vom DKG geforderte Motordrehzahl					
Nelueft_klima	O/V	0... FFH	0... 99.60937	0.390625	%
Anforderung E-Lüfter Drehzahl von IHKA als PWM-Signal					
Nelueft_lenk	O/V	0... FFH	0... 99.60937	0.390625	%
E-Lüfteranforderung von derLenkhilfe					
Nturb	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
primary gear box revolution					
Pbrems	O/V	0... FFH	0... 99.60937	0.390625	bar
brake pressure					
Pbremsu	O/V	0... FFFFH	0... 65535	1	hPa
Vacuum of brake servo unit					
Pmsv [15]	O/V/S	0... FFH	0... 255	1	-
powermanagement Standverbraucher					
POW_CTL_PARK_CNS	O/V	0... FFH	0... 255	1	-
Control park consumer					
POW_CTL_PRI_PEAK_RED	O/V	0... FFH	0... 255	1	-
Control priority peak reduction					
POW_CTL_PRI_PEAK_RED_CFT	O/V	0... FFH	0... 255	1	-
Control priority peak reduction comfort					
POW_CTL_PWR_CNS_1	O/V	0... FFFFH	0... 65535	1	-
Control power consumer					
POW_CTL_PWR_CNS_2	O/V	0... FFH	0... 127.5	0.5	%
Control power special consumer					
Prg_getr	O/V	0... FH	0... 15	1	-
State mode ETCU					
PWM_NEUT_PSN_GB	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Pulse width of the PLCD-Sensor					
Qs_anf_klima	O/V	0... FFH	0... 99.60937	0.390625	%
heat flow request					
rqpcos	O/V	0... FFH	0... 255	1	-
Request park consumer					
selspcos	O/V	0... FFH	0... 255	1	-
Selection special consumers					
St_dsc_can	O/V	0... FFH	0... 255	1	-
Status DSC					
St_dsc_mradsoll	O/V	0... FFH	0... 255	1	-
Sollwert Qualifier zum Signal Soll_Radmoment_Antriebsstrang_Summe_Stabilisierung					
St_fas_mradsoll	O/V	0... FFFFH	0... 65535	1	-
Sollwert Qualifier zum Signal Soll_Radmoment_Antriebsstrang_Summe_FAS					
St_fzg_1	O/V	0... FFFFFFFFH	0... 4294967295	1	-
carrier double-word 1 of all learned variants for customer environment					
St_fzg_2	O/V	0... FFFFFFFFH	0... 4294967295	1	-
carrier double-word 1 of all learned variants for customer environment					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_fzg_ass	O/V	0... FH	0... 15	1	-
Status Idm via CAN					
St_kupp_dkg	O/V	0... FFH	0... 255	1	-
Zustand der Anfahrkupplung					
St_kupp_smg	O/V	0... FFH	0... 255	1	-
Status Kupplung SMG-Getriebe					
st_ldstgen	O/V	0... FFH	0... 255	1	-
generator load					
St_mdrv_taster	O/V	0... FFH	0... 255	1	-
Das Signal gibt an, ob der MDrive- Taster betätigt wurde. Dieser ist in den M-Fahrzeugen fest auf die Sonderfunktion2- Taste gelegt.					
St_modus_dkg	O/V	0... FFH	0... 255	1	-
Status torque request from TCT (DKG)					
St_rennstart_dkg	O/V	0... FFH	0... 255	1	-
Statuswort Rennstart DKG					
St_wk	O/V	0... FFH	0... 255	1	-
Status converter clutch					
STATE_EGY_CNS_OFF	O/V	0... FFH	0... 255	1	-
state all electrical consumers off					
STATE_ENGG_POS	O/V	0... FFH	0... 255	1	-
Status Kraftschluss					
STATE_SPT_DISP_CAN	O/V	0H 1H 2H 3H 4... FFH undef3186d56570- 44d400H	00_SPORT_ INACTIVE01_ SPORT_ ACTIVE Not defined 11_SIGNAL_ NOT_VALID undefnot definednot defined not defined undef	-	-
Lamp status Mdrive					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_SPT_ECU_CAN	O/V	0H	0000_NO_CHANGE	-	-
		1H	0001_MAP1		
		2H	0010_MAP2		
		FH	1111_INVALID		
CAN: Mdrive ECU sport mode					
STATE_SPT_ESP_CAN	O/V	0H	000_NO_CHANGE	-	-
		1H	001_ESP_OFF		
		2H	010_ESP_ON		
		4H	100_ESP_ON_SPORT		
7H	111_INVALID				
CAN: MDrive ESP sport mode					
STATE_SPT_MOD_GB	O/V	0... 7H	0 ...7	1	-
CAN: Mdrive default transmission mode					
STATE_SPT_STEP_GB	O/V	0... FH	0... 15	1	-
CAN: Mdrive default drive-logic-level for transmission					
STATE_TQ_WHEEL	O/V	0... FFH	0... 255	1	-
state torque wheel					
STATE_TQ_WHEEL_DRIV_ASI_AV	O/V	0... FFH	0... 255	1	-
actual state of TQ_WHEEL_DRIV_ASI functionality (get from layer)					
STATE_TQ_WHEEL_TCS_AV	O/V	0... FFH	0... 255	1	-
Actual state of TQ_Wheel_TCS functionality (get from Layer)					
stpcos	O/V	0... FFH	0... 255	1	-
Status park consumers					
T_jahr	O/V	0... FFFFH	0... 65535	1	-
Borrdatum, Jahr					
T_monate	O/V	0... FFFFH	0... 65535	1	-
Borrdatum, Monat					
T_tag	O/V	0... FFFFH	0... 65535	1	-
Borrdatum, Tag					
Tn_start_kl15	O/V	0... FFFFH	0... 6553.5	0.1	s
Zeit nach Startende (ohne MSA-Restarts)					
TQ_ECU_ETCU	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Actual torque ECU/ETCU					
TQ_MAX_ACC	O/V	0... FFH	0... 127.5	0.5	Nm
air-conditioning-compressor limit torque					
TQ_MAX_WHEEL	O/V	0... FFFFH	-32000 ...33535	1	Nm
Max. Radmoment					
TQ_MIN_WHEEL_L	O/V	0... FFFFH	-32000 ...33535	1	Nm
Schleppmoment unbefeuert					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_WHEEL	O/V	0... FFFFH	-32000 ...33535	1	Nm
Ist-Moment an den Antriebsrädern					
Tvngang	O/V	0... FFFFH	0... 655.35	0.01	%
PWM of neutral gear sensor					
U_gen_ext	O/V	0... FFFFH	0... 6553.5	0.1	V
adjustment value for alternator voltage setpoint					
V_can	O/V	0... FFFFH	0... 6553.5	0.1	km/h
Vehicle speed from CAN					
V_krapu	O/V	0... FFH	0... 255	1	l/h
Required amount of fuel					
V_rad	O/V	0... FFFFH	0... 6553.5	0.1	km/h
Fahrzeuggeschwindigkeit vom DSC-Raddrehzahl					
Verbstatus [10]	O/V	0... FFH	0... 255	1	-
Verbraucherstatus					
Voltank	O/V	0... 9F6H	0... 255	0.1	l
Fuel tank level					
Vsa_btssoll	O/V	0... FFFFH	-128... 52300	0.8	°CRK
Cam setpoint for exhaust cam via external service device (Tester)					
Vse_btssoll	O/V	0... FFFFH	-128... 52300	0.8	°CRK
Cam setpoint for inlet cam via external service device (Tester)					
W_afs	O/V	8000... 7FFFH	-3276.8 ...3276.6	0.1	°
Steering wheel sensor angle					
W_dafs	O/V	8000... 7FFFH	-3276.8 ...3276.6	0.1	°/s
Steering wheel sensor angle velocity					
Zrbosr	O/V	0... FFH	0... 255	1	-
counter_resetting_BOS_resetting					
Ztageabs	O/V	0... FFFFH	0... 65535	1	-
day counter absolute (counts the days at sufficient mains voltage )					

**Input data:**

AC_VEH_LGT_TCS {p. 1561}	AC_VEH_TRV_TCS {p. 1561}	ANG_PSTE {p. 1561}	B_hschalt_komb {p. 8343}
B_ldm_akt04 {p. 8344}	B_ldm_off {p. 8344}	B_lklps {p. 8344}	B_mol_vb {p. 8344}
B_mol_vl {p. 8344}	B_msaccid2 {p. 8345}	B_msastops {p. 8345}	B_pmbdsanf {p. 8346}
B_pmvdsanf {p. 8346}	B_rschaft_komb {p. 8346}	B_verb_off {p. 8347}	Bosconf {p. 8155}
BRAKE_PRS {p. 1561}	CAM_SP_EX_EXT_ADJ {p. 7431}	CAM_SP_IN_EXT_ADJ {p. 7431}	CONF_SWI_EFP_OUT {p. 654}
CTR_KM_BN {p. 1563}	CTR_KM_CAN {p. 1563}	CTR_RST_BOS_RST {p. 1563}	Ctrcbr {p. 8155}
Ctrpcos {p. 8156}	Ctrprio {p. 8156}	Ctrprioef {p. 8156}	Ctrpwrcos {p. 8156}
Ctrpwscos {p. 8156}	CUR_SC_MAX_CAN {p. 1563}	CUR_SC_MIN_CAN {p. 1563}	CUR_WKU_CAN {p. 1563}
DIST_RESI_OIL_KM {p. 8202}	dm_ab_fws {p. 1563}	ECU_STATE {p. 1091}	EFPPWM_CAN {p. 988}
FAC_GB_GAIN {p. 1564}	FAC_IS_INC_REQ {p. 1564}	FAC_POW_MNG_VST_ CNS [15] {p. 1564}	FCO {p. 3846}

FTL {p. 1564}	HEAT_REQ_PERC {p. 1564}	l_ges {p. 8158}	ld_bosmg {p. 8159}
IDX_BAT_CAN {p. 1564}	LAMB_SP_EXT_ADJ [NC_CBK_EX_NR] {p. 7763}	LC_EFPPWM_CTL {p. 1587}	lpm_typ_fp
lpm_typ_mdkw	LV_ACT_ECRAS_EXT_ ADJ {p. 798}	LV_ALTER_CTL_ENA {p. 7680}	LV_ALTER_CTL_EXT_ADJ {p. 7482}
LV_CAM_SP_EX_EXT_ ADJ {p. 7433}	LV_CAM_SP_IN_EXT_ADJ {p. 7433}	LV_CS_2 {p. 1565}	LV_DRIV_BELT_CLOSE {p. 800}
LV_DRIV_DOOR_OPEN {p. 1565}	LV_EF {p. 3614}	LV_GS {p. 1565}	LV_GS_IDC_LDM {p. 1566}
LV_HOOD_OPEN {p. 1566}	LV_IGK_OFF_ACK_ PERM_DEAC {p. 803}	LV_IGK_OFF_ACK_TMP_ DEAC {p. 803}	LV_KEY_AUX {p. 1566}
LV_KEY_VLD {p. 1566}	LV_LDM_ENA {p. 6615}	LV_LTG_GAS_ENA {p. 7680}	LV_LTG_HDLP_L_ON {p. 1566}
LV_LTG_INL_ON {p. 1566}	LV_N_DISP_DYN {p. 1566}	LV_N_REL_CWP_SP_ EXT_ADJ {p. 7434}	LV_N_SP_TCT {p. 1566}
LV_REQ_HEAT {p. 1567}	LV_RLY_ST_CAN {p. 1567}	LV_RNG_L_REQ {p. 6570}	LV_STATE_TRL {p. 1567}
LV_STST_SWI_ACT {p. 805}	LV_TCS_CTL_ACT {p. 1567}	LV_V_ALTER_SP_EXT_ ADJ {p. 7435}	LV_VAR_BN {p. 655}
LV_VAR_DCC {p. 655}	LV_VAR_STST {p. 805}	Md_can_dmee {p. 8160}	Md_max_klima {p. 8160}
Md_rad_ist {p. 8160}	Md_rad_max {p. 8161}	Md_rad_min {p. 8161}	N_dzm {p. 8163}
N_ECF {p. 1568}	N_ECF_CAN {p. 1569}	N_GB {p. 1569}	N_GB_OUT {p. 1569}
N_SP_TCT {p. 1569}	N_WHEEL_FN_LE {p. 806}	N_WHEEL_FN_RI {p. 806}	N_WHEEL_RE_LE {p. 806}
N_WHEEL_RE_RI {p. 806}	NC_CYL_NR {p. 1526}	OPM_EXT_REQ {p. 1763}	PBSU {p. 807}
QOIL_DS_RST_CAN_1_5 {p. 1569}	QOIL_DS_RST_CAN_2_3 {p. 1569}	QOIL_DS_RST_CAN_2_5 {p. 1569}	QOIL_DS_RST_CAN_2_6 {p. 1569}
QOIL_DS_RST_KWP_9 {p. 7682}	Rqpcos {p. 8168}	Selspcos {p. 8168}	Spa_art {p. 8168}
Spa_gang {p. 8168}	St_dsc_mradist {p. 8171}	St_fas_mradist {p. 8171}	St_ldm_kupp {p. 8172}
St_ldstgen {p. 8172}	St_mdinfo_ges {p. 8172}	St_mdrv_anz {p. 8172}	St_mdrv_dsc {p. 8173}
St_mdrv_eng {p. 8173}	St_mdrv_mod_grb {p. 8173}	St_mdrv_stg_grb {p. 8173}	STATE_ACK_IGK_OFF {p. 1570}
STATE_AVL_BOS_RST {p. 1570}	STATE_CC {p. 1571}	STATE_CLU_AMT {p. 1571}	STATE_DI_PUC {p. 1572}
STATE_EGY_MIN_KWP {p. 7483}	STATE_ETCU_CLU {p. 1573}	STATE_ETCU_PROG_ INFO {p. 1574}	STATE_ID_FCT_BOS_RST {p. 1574}

STATE_ID2_BOS_RST {p. 1574}	STATE_IGK_HW {p. 1575}	STATE_LDM {p. 1575}	STATE_MAX_AC_ST {p. 1575}
STATE_SP_DYN_WHEEL {p. 1576}	STATE_SPT_SWI {p. 1576}	STATE_TCS_CAN {p. 1577}	STATE_TCT_INTV {p. 1578}
STATE_TEMP_GB {p. 1578}	STATE_TQ_WHEEL_ DRIV_ASI {p. 809}	STATE_TQ_WHEEL_TCS_ SLOW {p. 809}	STATE_VAR_DET_CUS_1 {p. 657}
STATE_VAR_DET_CUS_2 {p. 657}	STATE_VEH_CNS [10] {p. 1578}	Stpcos {p. 8175}	T_AST_BAL {p. 3261}
T_CAN {p. 1579}	T_CLK_ICL_DISP_1 {p. 1579}	T_CLK_ICL_DISP_2 {p. 1579}	T_CLK_ICL_DISP_3 {p. 1579}
TQ_SP_WHEEL {p. 6615}	TQ_TCT_CAN {p. 1582}	TQ_WHEEL_TCS_FAST {p. 810}	TQ_WHEEL_TCS_SLOW {p. 810}
V_ALTER_SP_EXT_ADJ {p. 7438}	VAR_VEH {p. 657}	VEL_ANG_PSTE {p. 1582}	VFF_EFP {p. 989}
VS_H {p. 1176}	WHEEL {p. 1582}		

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_REQ_FSD_EOL	-	0... 1H	0 ...1	1	-
Switch for external adjustment of fuel-system diagnosis					

## R.32.1 Outputs for BMW functions which are exported data from IGR (Intelligente Generatorreglung)

**FUNCTION DESCRIPTION:**

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

**Application conditions:**

*Initialisations:* first calculation at reset,

Except: Verbstatus[10] : 0

0 at reset:

Mdk\_kupp\_verl, St\_dkg\_schalt, N\_schalt\_dkg, B\_schalt\_dkg, St\_kupp\_dkg, St\_rennstart\_dkg, St\_modus\_dkg, Tn\_start\_kl15

0 at power latch phase:

Mdk\_kupp\_verl, St\_dkg, N\_schalt\_dkg, B\_schalt\_dkg, St\_kupp\_dkg, St\_rennstart\_dkg, St\_modus\_dkg, Tn\_start\_kl15

*Recurrence :* 100 ms: B\_cdigrnw, B\_cdxenonw, B\_diagigr, B\_fe, B\_fetrawedeak, B\_tra, B\_we, Fetrawe, Verbstatus[10], Tn\_start\_kl15


20ms: St\_rennstart\_dkg

10ms: Mdk\_kupp\_verl, St\_dkg, N\_schalt\_dkg, B\_schalt\_dkg,

St\_kupp\_dkg, St\_modus\_dkg

*Activation:* At every ECU state (including WakeUp)

*Deactivation:* After power latch phase

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**Formula section:**

*Remark:* all formulas are valid in a **physical** meaning

```

Verbstatus[10]      = STATE_VEH_CNS[10]
B_cdigronw         = LV_ALTER_CTL_ENA
B_cdxenonw        = LV_LTG_GAS_ENA
B_diagigr         = LV_ALTER_CTL_EXT_ADJ
Fetrawe           = STATE_EGY_MIN_KWP

```

```

If                STATE_EGY_MIN_KWP = "PASSIV"
Then             B_fetrawedeak = 1
Else             B_fetrawedeak = 0
Endif

```

```

If                STATE_EGY_MIN_KWP = "EGY_1"
Then             B_fe = 1
Else             B_fe = 0
Endif

```

```

If                STATE_EGY_MIN_KWP = "EGY_2"
Then             B_tra = 1
Else             B_tra = 0
Endif

```

```

If                STATE_EGY_MIN_KWP = "EGY_3"
Then             B_we = 1
Else             B_we = 0
Endif

```

```

Mdk_kupp_verl     =      TQ_TCT_CAN
N_schalt_dkg      =      N_SP_TCT
B_schalt_dkg      =      LV_N_SP_TCT
St_kupp_dkg       =      STATE_ETCU_CLU
St_rennstart_dkg =      STATE_MAX_AC_ST
St_modus_dkg      =      STATE_TCT_INTV
Tn_start_kl15    =      T_AST_BAL

```

**R.32.2 VVTI interface adaptation****FUNCTION DESCRIPTION:**

Adaption to BMW environment.

*Remark:* The really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

**Application conditions**

**Initialisation at reset: 0, except :**  $Vse\_btsoll = 0 \text{ } ^\circ crk$   
 $Vsa\_btsoll = 0 \text{ } ^\circ crk$

**Recurrence:** 100ms: Pbrems  
 10 ms: all other variables

**Activation:** at every engine operating state

**Deactivation:** - -

**Formula section:**

If ECU\_STATE = "PWL" then

Vse\_btsoll = 0 °crk

Vsa\_btsoll = 0 °crk

B\_btvs = 0

B\_btvs = 0

elseif

Inlet CAM: Vse\_btsoll = CAM\_SP\_IN\_EXT\_ADJ

B\_btvs = LV\_CAM\_SP\_IN\_EXT\_ADJ

Exhaust CAM: Vsa\_btsoll = CAM\_SP\_EX\_EXT\_ADJ

B\_btvs = LV\_CAM\_SP\_EX\_EXT\_ADJ

brake pressure: Pbrems = BRAKE\_PRS

endif

**R.32.3 CAN interface adaptation - Outputs to BMW- environment****FUNCTION DESCRIPTION:**

Adaption to BMW environment.

**Application conditions:**

Initialisation at reset or at exit power latch phase:

0: B\_dscakt, B\_dzm\_dyn, B\_gangwechsel\_gs, B\_keinhs\_gs, B\_hz, B\_iliactiv, B\_abliactiv, Qs\_anf\_klima, Ztageabs, B\_ckl50, B\_ckl30, B\_ldm\_nofil, B\_nosa, Acfzgg, Acfzgl, I\_eff\_gs, T\_jahr, T\_monate, T\_tag, Md\_rad\_soll, Nelueft\_klima, Nelueft\_lenk, St\_wk, N\_idlms, Bosrlsmr B\_ldm\_ena, B\_gen\_ext, V\_can, A\_quer, B\_tstkv, St\_fzg\_ass, Kvaverbr, B\_egs\_khl1, B\_egs\_khl2, Bosv, Nturb, B\_anhang, St\_kupp\_smg, V\_krapu, Bosanfsgbd, Bosun, Bosunt, B\_taleer, Dm\_ab\_fws, lpm\_typ\_fp, lpm\_typ\_mdkw, Baw\_tester, Md\_kupp\_schalt, N\_rad\_hl, N\_rad\_hr, N\_rad\_vl, N\_rad\_vr, St\_dsc\_mradsoll, St\_fas\_mradsoll, N\_ab\_m, B\_schalt\_ldm, B\_fagurt, St\_dsc\_can, B\_msadltgpd, B\_msadltgtd, Prg\_getr, V\_rad, St\_mdrv\_taster

1: B\_lkps\_kl1, B\_lkps\_kl2,

1.0: La\_soll\_tester[NC\_CBK\_EX\_NR]

32000 Nm: Md\_rad\_asrl, Md\_rad\_asrs

-32000 Nm: Md\_rad\_msrl, Md\_rad\_msrs

lkurz\_ogr = value out of non-volatile memory after reset

lkurz\_ugr = value out of non-volatile memory after reset

lwakeupgr = value out of non-volatile memory after reset

Bosfxid2r = value out of non-volatile memory after reset

Bosid2r = value out of non-volatile memory after reset

Bosprog2r = value out of non-volatile memory after reset

Bosrw2r = value out of non-volatile memory after reset

Km\_st\_1 = value out of non-volatile memory after reset

Boszielr = value out of non-volatile memory after reset


Bosmzielr = value out of non-volatile memory after reset

Batt\_class = value out of non-volatile memory after reset

U\_gen\_ext = first calculated value

Pmsv[15] = FAC\_POW\_MNG\_VST\_CNS[15]

//from non volatile memory

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```

if          LV_VAR_BN = 1
then       Bordnetz = 2
else       Bordnetz = 1
endif

```

*special values at power latch phase:*

```

0:          B_dscakt, B_dzm_dyn, _gangwechsel_gs, B_keinhs_gs, B_hz, I_eff_
gs, Md_rad_soll, Nelueft_klima, St_wk, A_quer, B_taleer, B_tstkvs, B_ldm_nofil,
B_nosa, Bosrlsmr, V_krapu, Nturb, Baw_tester, Md_kupp_schalt, N_rad_hl, N_
rad_hr, N_rad_vl, N_rad_vr, St_dsc_mradsoll, St_fas_mradsoll, N_ab_m, B_msadlt-
gpd, B_msadltgtd, Prg_getr
1:          B_lkpls_kl1, B_lkpls_kl2, B_fagurt, St_dsc_can
last valid value:      B_gen_ext, U_gen_ext
last calculated value: Acfzgl, Acfzqg
Continue calc.:        St_mdrv_taster

1.0:          La_soll_tester[NC_CBK_EX_NR]
32000 Nm:      Md_rad_asrl, Md_rad_asrs
-32000 Nm:     Md_rad_msrl, Md_rad_msrs

```

*Recurrence:*      **1000ms:**      Bosv, Qs\_anf\_klima, Ztageabs, Acfzqg, Acfzgl, Bosfxid2r, Bosid2r, Bosprog2r, Km\_st\_1, Boszielr, Bosmziel, Bosrw2r, T\_jahr, T\_monate, T\_tag, B\_anhang, Bosrlsmr, Zr-bosr, Bosun

Bosunt

**200ms**            : B\_hz , Km\_st, Kvaverbr, B\_lkpls\_kl1, B\_lkpls\_kl2

**100ms**            : B\_dscakt, lkurz\_ogr, lkurz\_ogr, lwakeupgr, Batt\_class, B\_iliac-  
tiv, B\_abliactiv, B\_ckl50, Nelueft\_klima, Nelueft\_lenk, B\_gen\_ext, U\_gen\_ext, B\_  
taleer, B\_tstkvs, lkurz\_ogr, lkurz\_ogr, lwakeupgr, N\_idlms, Prg\_getr

**10ms:** B\_dzm\_dyn, B\_gangwechsel\_gs, B\_keinhs\_gs, B\_egs\_khl1, B\_egs\_khl2, Pmsv[15], B\_ldm\_nofil, B\_nosa, I\_eff\_gs, Md\_rad\_soll, V\_krapu, Nturb, St\_wk, B\_ldm\_ena, V\_can, A\_quer, St\_fzg\_ass, St\_kupp\_smg, La\_soll\_tester[NC\_CBK\_EX\_NR], Baw\_tester, Dm\_ab\_fws, lpm\_typ\_fp, lpm\_typ\_mdkw, Md\_rad\_asrl, Md\_rad\_asrs, Md\_rad\_msrl, Md\_rad\_msrs, N\_ab\_m, N\_rad\_hl, N\_rad\_hr, N\_rad\_vl, N\_rad\_vr, St\_dsc\_mradsoll, St\_fas\_mradsoll, B\_schalt\_ldm, B\_fagurt, St\_dsc\_can, B\_msadltgpd, B\_msadltgtd, V\_rad, St\_mdrv\_taster

*Note:* B\_hz has to be updated directly after LV\_REQ\_HEAT has been calculated.

*Activation:*      After reset

*Deactivation:*    After power latch phase

### Formula section:

```

Prg_getr          = STATE_ETCU_PROG_INFO
B_msadltgpd       = LV_IGK_OFF_ACK_PERM_DEAC
B_msadltgtd       = LV_IGK_OFF_ACK_TMP_DEAC
B_dscakt          = LV_TCS_CTL_ACT
B_dzm_dyn         = LV_N_DISP_DYN
B_fagurt          = LV_DRIV_BELT_CLOSE
B_gangwechsel_gs = LV_GS
B_hz              = LV_REQ_HEAT

```




```

B_keinhs_gs      = 0
Km_st            = CTR_KM_CAN (update every 200ms)
Kvaverbr        = FCO (low word)
Md_rad_asrl     = TQ_WHEEL_TCS_SLOW
Md_rad_asrs     = TQ_WHEEL_TCS_FAST
Md_rad_msrl     = TQ_WHEEL_TCS_SLOW
Md_rad_msrs     = TQ_WHEEL_TCS_FAST
N_ab_m          = N_GB_OUT
N_rad_hl        = N_WHEEL_RE_LE
N_rad_hr        = N_WHEEL_RE_RI
N_rad_vl        = N_WHEEL_FN_LE
N_rad_vr        = N_WHEEL_FN_RI
St_dsc_mradsoll = STATE_TQ_WHEEL_TCS_SLOW
St_fas_mradsoll = STATE_TQ_WHEEL_DRIV_ASI
If STATE_SPT_SWI == 1
Then St_mdrv_taster = 2H
Else St_mdrv_taster = STATE_SPT_SWI
Endif

B_iliactiv      = LV_LTG_INL_ON
B_abliactiv     = LV_LTG_HDLP_L_ON
Zrbosr         = CTR_RST_BOS_RST
if STATE_TEMP_GB = 1H
then B_egs_khl1 = 1
else B_egs_khl1 = 0
endif
if STATE_TEMP_GB = 2H
then B_egs_khl2 = 1
else B_egs_khl2 = 0
endif
if LV_VAR_BN = 1
then Bosv = STATE_AVL_BOS_RST
else Bosv = 0
endif
Qs_anf_klima    = HEAT_REQ_PERC
Nturb           = N_GB
B_anhang        = LV_STATE_TRL
Pmsv[15]        = FAC_POW_MNG_VST_CNS[15]
Ztageabs        = T_CAN
B_ckl50         = LV_RLY_ST_CAN
B_ckl30         = LV_KEY_AUX
If Bit 1 or Bit 2 of STATE_SP_DYN_WHEEL is set to 1
then B_ldm_nofil = 1
else B_ldm_nofil = 0
endif
If STATE_DI_PUC = 1
then B_nosa = 1
else B_nosa = 0
endif
Acfzgl          = AC_VEH_LGT_TCS
Acfzgg          = AC_VEH_TRV_TCS
Bosfxid2r       = QOIL_DS_RST_CAN_2_2

```

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```

Bosid2r          =      QOIL_DS_RST_CAN_2_1
Bosrw2r          =      QOIL_DS_RST_CAN_2_3
I_eff_gs         =      FAC_GB_GAIN
Km_st_1          =      CTR_KM_BN
Boszielr         =      QOIL_DS_RST_CAN_2_5
Bosmzielr        =      QOIL_DS_RST_CAN_2_4
Bosprog2r        =      QOIL_DS_RST_CAN_2_6
T_jahr           =      T_CLK_ICL_DISP_3
T_monate         =      T_CLK_ICL_DISP_2
T_tag            =      T_CLK_ICL_DISP_1
Md_rad_soll      =      TQ_SP_WHEEL

Nelueft_klima    =      (N_ECF/14) * 100%
Nelueft_lenk     =      N_ECF_CAN
St_wk            =      STATE_CC
Bosrlsmr         =      QOIL_DS_RST_CAN_1_5
B_ldm_ena        =      LV_LDM_ENA
B_gen_ext        =      LV_V_ALTER_SP_EXT_ADJ
V_can            =      VS_H
A_quer           =      AC_VEH_TRV_TCS
U_gen_ext        =      V_ALTER_SP_EXT_ADJ
B_tstkvs         =      LC_REQ_FSD_EOL
B_iklps_kl1      =      1
B_iklps_kl2      =      1
Batt_class       =      IDX_BAT_CAN
lkurz_ogr        =      CUR_SC_MAX_CAN
lkurz_ugr        =      CUR_SC_MIN_CAN
lwakeupgr        =      CUR_WKU_CAN
ld_bosrtw        =      STATE_ID_FCT_BOS_RST
ld_bosrst        =      STATE_ID2_BOS_RST
N_idlms          =      FAC_IS_INC_REQ
St_fzg_ass       =      STATE_LDM
St_kupp_smg      =      STATE_CLU_AMT

```

```

Bosun            =      DIST_RESI_OIL_KM
Bosunt           =      QOIL_DS_RST_KWP_9

```

```

//      V_krapu      =      RQAM_FU, because RQAM_FU is not exported from CAN-spec. use:
if(1)      LV_VAR_BN = 1
Then(1)
// for BN200=, taken from 17400J03.00x:
if      CONF_SWI_EFP_OUT      =      !1
Then
if      LC_EFPPWM_CTL = 0
Then      V_krapu      =      VFF_EFP
Else      V_krapu      =      EFPPWM_CAN
Endif
Else(1)
// for CAN11, taken from 17400J02.00x:
V_krapu      =      VFF_EFP
Endif(1)

```

```

Dm_ab_fws          = dm_ab_fws
lpm_typ_fp         = ipm_typ_fp
lpm_typ_mdkw       = ipm_typ_mdkw
La_soll_tester[NC_CBK_EX_NR] = LAMB_SP_EXT_ADJ[NC_CBK_EX_NR]
Baw_tester         = OPM_EXT_REQ

```

```

if                (LV_FTL_CAN_ERR==0 and LV_FTL_OBD_INH_L==1)
then              B_taleer = 1
else              B_taleer = 0
endif

```

```

B_schalt_ldm       = LV_GS_IDC_LDM
St_dsc_can         = STATE_TCS_CAN
V_rad              = WHEEL

```

## R.32.4 CAN interface adaptation - Inputs from BMW- environment

### FUNCTION DESCRIPTION:

Adaption to BMW- environment


### Application conditions

**Initialisation:** 0  
*Except:*  
 st\_ldstgen = 2

**Recurrence:** 100 ms except:  
 1000 ms: idfbosmg\_w, LV\_OIL\_CNS\_WARN\_1, LV\_OIL\_CNS\_WARN\_2  
 10 ms: St\_mdinfo\_ges, TQ\_WHEEL, TQ\_MAX\_WHEEL, TQ\_MIN\_WHEEL\_L, STATE\_ENGG\_POS, LV\_LDM\_OFF, LV\_GS\_UP, LV\_GS\_DOWN, LV\_LDM\_DRIV\_ACT, GR\_DT, STATE\_TQ\_WHEEL, TQ\_MAX\_ACC, STATE\_TQ\_WHEEL\_DRIV\_ASI\_AV, STATE\_TQ\_WHEEL\_TCS\_AV, LV\_INH\_STST\_CDN, GS\_IDC\_GEAR\_RAW, GS\_IDC\_DISP\_RAW, TQ\_ECU\_ETCU, N\_DISP\_DYN, LV\_STST\_STOP, STATE\_SPT\_DISP\_CAN, STATE\_SPT\_ESP\_CAN, STATE\_SPT\_ECU\_CAN, STATE\_SPT\_MOD\_GB, STATE\_SPT\_STEP\_GB

**Activation:** After reset  
**Except:**  
 0 : St\_mdinfo\_ges, TQ\_WHEEL, TQ\_MAX\_WHEEL, TQ\_MIN\_WHEEL\_L, STATE\_ENGG\_POS  
**Value at PWL**  
 0: LV\_LDM\_OFF, LV\_GS\_UP, LV\_GS\_DOWN, LV\_LDM\_DRIV\_ACT, GR\_DT, STATE\_TQ\_WHEEL, GS\_IDC\_GEAR\_RAW, GS\_IDC\_DISP\_RAW, TQ\_ECU\_ETCU  
**Last calculated value:** LV\_OIL\_CNS\_WARN\_1, LV\_OIL\_CNS\_WARN\_2  
**ECU\_STATE = WAKE\_UP:**  
**Continue calc.:** STATE\_SPT\_DISP\_CAN, STATE\_SPT\_ESP\_CAN, STATE\_SPT\_ECU\_CAN, STATE\_SPT\_MOD\_GB, STATE\_SPT\_STEP\_GB

**Deactivation:** After power latch phase

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**Formula section:****All formulas are valid in a physical meaning!**

```

TQ_MAX_ACC                =      Md_max_klima
LV_OIL_CNS_WARN_1        =      B_mol_vb
LV_OIL_CNS_WARN_2        =      B_mol_vl
CUR_RNG_CTL              =      Ctrcbr
POW_CTL_PARK_CNS         =      Ctrpcos
POW_CTL_PRI_PEAK_RED     =      Ctrprio
POW_CTL_PRI_PEAK_RED_CFT =      Ctrprioef
POW_CTL_PWR_CNS_1        =      Ctrpwracos
POW_CTL_PWR_CNS_2        =      Ctrpwspacos
idfbosmg_w               =      Id_bosmg
rqpcos                   =      Rqpcos
selspcos                  =      Selspcos
stpcos                    =      Stpcos
st_ldstgen                =      St_ldstgen

```

```

IF          B_verb_off = 1
THEN       STATE_EGY_CNS_OFF = 1
ELSE       STATE_EGY_CNS_OFF = 0
ENDIF

```

```

TQ_WHEEL                =      Md_rad_ist
STATE_TQ_WHEEL          =      St_mdinfo_ges
TQ_MAX_WHEEL            =      Md_rad_max
TQ_MIN_WHEEL_L          =      Md_rad_min
STATE_ENGG_POS          =      St_ldm_kupp
If(1)                   St_mdrv_anz = 1          /* If Sport switch is inactive */
Then(1)                  STATE_SPT_DISP_CAN = 0    /* Set M-Drive display to OFF */
Else(1)
  If(2)                   St_mdrv_anz = 2          /* If Sport switch is active */
  Then(2)                  STATE_SPT_DISP_CAN = 1    /* Set M-Drive display to ON */
  Else(2)                  STATE_SPT_DISP_CAN = 3    /* Else set no value for "not valid" */
  Endif(2)
Endif(1)

```

```

STATE_SPT_ESP_CAN       =      St_mdrv_dsc
STATE_SPT_ECU_CAN       =      St_mdrv_eng
STATE_SPT_MOD_GB        =      St_mdrv_mod_grb
STATE_SPT_STEP_GB       =      St_mdrv_stg_grb

```

```

If          B_pmvsdanf = 1
Then       LV_CAN_SND_MSG_PWR_MNG_0      =      B_pmvsdanf
endif

```

//check if transition in STATE\_ACK\_IGK\_OFF, if yes set LV\_CAN\_SND\_...\_1 = 1 for 3 recurrences (300ms):

```

If          STATE_ACK_IGK_OFF 0->1
or STATE_IGK_HW 2->0
or STATE_IGK_HW 1->0
or STATE_IGK_HW 1->2

```

```

Then      counter_ack = 3
Else      counter_ack = counter_ack -1
Endif

```

```

If          B_pmbstdanf = 1      or      counter_ack > 0
Then      LV_CAN_SND_MSG_PWR_MNG_1      = 1
Endif

```

```

LV_LDM_OFF      = B_Idm_off
If          LV_VAR_DCC = 1 or (B_hschalt_komb = 1 and B_rschalt_komb = 1)
Then      LV_GS_UP      =      0
Else      LV_GS_UP      =      B_hschalt_komb
Endif

```

```

If          LV_VAR_DCC      =      1      or
            (B_hschalt_komb      =      1      and
            B_rschalt_komb      =      1)
Then      LV_GS_DOWN      =      0
Else      LV_GS_DOWN      =      B_rschalt_komb
Endif

```

```

LV_LDM_DRIV_ACT      =      B_Idm_akt04
GR_DT      =      l_ges
STATE_TQ_WHEEL_TCS_AV      =      St_dsc_mradist
STATE_TQ_WHEEL_DRIV_ASI_AV      =      St_fas_mradist
LV_INH_STST_CDN      =      B_msaccid2

```

```

GS_IDC_GEAR_RAW      = Spa_gang
GS_IDC_DISP_RAW      = Spa_art
TQ_ECU_ETCU      = Md_can_dmee (conversion!)
N_DISP_DYN      = N_dzm
LV_STST_STOP      = B_msastops

```

## R.32.5 Common variables adaptation

### FUNCTION DESCRIPTION:

Adaption to BMW environment.

### General information:

The variable Fahrzeug is updated only during ECU initialization.


### Application conditions:

*Initialisation at reset:*

```

IF  VAR_VEH = 1 THEN  Fahrzeug = 65
IF  VAR_VEH = 2 THEN  Fahrzeug = 90
IF  VAR_VEH = 3
THEN Fahrzeug = 46
ELSE Fahrzeug = 60
ENDIF

```

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*Recurrence:*

*Activation:* at every engine operating state

*Deactivation:* -

### Formula section:

## R.32.6 Outputs for BMW functions which are defined as MISC exported data

### R.32.6.1 Import Actions

#if (NC_CYL_NR = 4)
<b>ACTION_INFR_GetPwmNgs(OUT &lt;pwm_neut_psn_gb&gt;)</b>
This action reads the PWM value of the PLCD-Sensor (NGS)
#endif

### Application conditions:

*Initialisation at reset:* 0

except first calculation B\_msafzg = LV\_VAR\_STST,

First calculation: B\_sport\_schalter

*Recurrence:* 10ms

*Activation:* every engine state

*Deactivation:* -

Special values at PWL:

Last calc. value: B\_sport\_schalter

### Formula section:

```

B_kupp1           = LV_CS_2
B_msafzg          = LV_VAR_STST
B_sport_schalter  = LV_RNG_L_REQ
St_fzg_1          = STATE_VAR_DET_CUS_1
St_fzg_2          = STATE_VAR_DET_CUS_2
if      ECU_STATE = PWL
then
    Tvngang      = 0
Elseif
    B_abgasklappe = not(LV_EF)
    Voltank       = FTL
    W_afs         = ANG_PSTE
    W_dafs        = VEL_ANG_PSTE
    B_ftauf1      = LV_DRIV_DOOR_OPEN
    B_mhauf1      = LV_HOOD_OPEN
    B_msataster   = LV_STST_SWI_ACT
    Pbremsu       = PBSU
If      NC_CYL_NR      = 4
then

```

```


ACTION_INFR_GetPwmNgs(PWM_NEUT_PSN_GB)
  Tvngang      = PWM_NEUT_PSN_GB
else        PWM_NEUT_PSN_GB = 0
  Tvngang      = 0
endif

```

```

endif

```

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## R.33 Customer adaptation module: KNCK

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_clradkr	O/V	0... 1H	0 ...1	1	-
Reset of the stored knock adaption value by service tool					
B_klopfen	O/V	0... 1H	0 ...1	1	-
Knock event					
B_krakt	O/V	0... 1H	0 ...1	1	-
Knock control activation (=0 inactive; 1=active)					
B_krdws	O/V	0... 1H	0 ...1	1	-
Max spark retard for knock control limb home value active (=0 inactive; 1=active)					
B_krndy	O/V	0... 1H	0 ...1	1	-
Condition engine speed dynamic for knock control					
B_warml_zykl	O/V	0... 1H	0 ...1	1	-
Warmlaufzyklus abgeschlossen					
B_zwkraa	O/V	0... 1H	0 ...1	1	-
Spark retard caused by torque request activ (0=active; 1=inactive)					
Dzw_kr [NC_CYL_NR]	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
spark retard due to knock control					
Dzw_mkr	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Spark retard by knock control without adaptation (average value)					
IGA_IS_TQ_KNK	O/V	0... 80H	-48 ...0	0.375	°CRK
Torque reserve for knockcontrol in idle speed					
IGA_MV_ADJ_KNK_CUS	O/V	0... 80H	-48 ...0	0.375	°CRK
Mean spark retard of knock control incl. knock- and fuel quality adaptation by customer					
IGA_MV_ADJ_KNK_ROM	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Mean spark retard of knock control incl. knock- and fuel quality adaptation for RON quantification.					
LV_AD_CLR_ROM	V	0... 1H	0 ...1	1	-
toggle bit for resetting of RON-adaption value					
LV_IGA_TRA_KNK	O/V	0... 1H	0 ...1	1	-
Flag for instationary correction active					
St_knk	O/V	0... FFH	0... 255	1	-
Injection shut off by knock pre-ignition					
Zyl_akt	O/V	0... FFH	0... 255	1	-
Spark retard by knock					

### Input data:

B_zwdyn {p. 8348}	CYL_ID_KNK {p. 1960}	Dzw_annm {p. 8156}	Dzw_krkorll {p. 8156}
ECU_STATE {p. 1091}	IGA_BAS_COR {p. 8266}	IGA_IGC_H_RNG [NC_CYL_NR] {p. 1876}	IGA_KNK [NC_CYL_NR] {p. 1960}
IGA_MV_KNK {p. 1960}	INH_IV_KNK {p. 1960}	KNK_CTL_DIS {p. 1952}	LC_AD_CLR_ROM {p. 527}
LV_KNK {p. 1961}	LV_KNK_CTL_ENA {p. 1961}	LV_KNK_TRA_N {p. 1962}	LV_TQ_IGA_ACT {p. 1948}
LV_WUP_CYC {p. 5746}	NC_CYL_NR {p. 1526}	OPM_AV {p. 8137}	

### Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_IGA_DELTA_KNK_AD_ENA	-	0... FFH	-48... 47.625	0.375	°CRK
delta ignition angle for activation of knock adaptation					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_AD_IS_AFL_ACT	-	0... 1H	0 ...1	1	-
KRAAN-adaption in engine operation mode "AFL" ( 0 - disable, 1 - enable)					

### R.33.1 Outputs for BMW functions which are defined as KNOCK exported data

#### FUNCTION DESCRIPTION:

Adaption to BMW environment.

*Remark:* The really possible resolution and limits of the output are different to the specified values due to the input data attributes.

#### Application conditions:

Initialisation at reset or at exit power latch phase:

all output variables are initialized with 0hex

Recurrence: 10ms: B\_krakt, B\_krdws, B\_krndy, B\_warml\_zykl, B\_zwkraa, St\_knk

every segment: B\_klopfen, Zyl\_akt, Dzw\_mkr

the whole if-clause around the calculation of

Dzw\_kr[NC\_CYL\_NR]

Activation: at every engine state

Deactivation: --

#### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

```

if      ( LC_AD_CLR_RON 0 -> 1 or LC_AD_CLR 0 -> 1
or      tester request "alle Adaptionswerte löschen"
or      tester request "RON adaption löschen")

```

```

then    LV_AD_CLR_RONn = 1
endif

```

```

B_clradkr      = LV_AD_CLR_RON

```

```

B_warml_zykl   = LV_WUP_CYC

```

```

If ECU_STATE = "PWL"

```

```

Then

```

```

    Dzw_mkr      = 0

```

```

    Zyl_akt      = 0

```

```

    Dzw_kr[NC_CYL_NR] = 0

```

```

    B_krdws      = 0

```

```

    B_krndy      = 0

```

```

    B_zwkraa     = 0

```

```

    B_klopfen    = 0

```

```

    St_knk       = 0

```

```

Elseif

```

```

    Dzw_mkr      = IGA_MV_KNK

```

```

    if (0) CYL_ID_KNK = 0

```

```

    then (0)     Dzw_kr[1] = IGA_KNK[1]

```

```

    else (0)     if (1) CYL_ID_KNK = 1

```

```

                    then (1)     Dzw_kr[2] = IGA_KNK[2]

```

```

                    else (1)     if (2)CYL_ID_KNK = 2

```

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```

    then (2) Dzw_kr[3] = IGA_KNK[3]
    else (2)   if (3) CYL_ID_KNK = 3
                then (3) Dzw_kr[4] = IGA_KNK[4]
                else (3)   if (4) CYL_ID_KNK = 4
                            then (4) Dzw_kr[5] = IGA_KNK[5]
                            else (4) Dzw_kr[6] = IGA_KNK[6]
                            endif (4)
                endif (3)
    endif (2)
endif (1)
endif (0)

B_krakt      = LV_KNK_CTL_ENA
B_krdws      = KNK_CTL_DIS
B_krndy      = LV_KNK_TRA_N
Zyl_akt      = CYL_ID_KNK
B_klopfen    = LV_KNK
St_knk       = INH_IV_KNK
If LV_TQ_IGA_ACT=0
or ( OPM_AV = "AFS"
and ( ((IGA_BAS_COR - C_IGA_DELTA_KNK_AD_ENA)
≤ (IGA_IGC_H_RNG[0] - IGA_KNK[0]))
or ((IGA_BAS_COR - C_IGA_DELTA_KNK_AD_ENA)
≤ (IGA_IGC_H_RNG[1] - IGA_KNK[1]))
...
or ((IGA_BAS_COR - C_IGA_DELTA_KNK_AD_ENA)
≤ (IGA_IGC_H_RNG[NC_CYL_NR-1]- IGA_KNK[NC_CYL_NR-1])
)
)
or ( OPM_AV = "AFL" and LC_AD_IS_AFL_ACT=1 )
Then B_zwkraa = 1
Else B_zwkraa = 0
Endif

```

Endif

## R.33.2 Outputs for supplier aggregates

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

### Application conditions


**Recurrence:** *10 ms*  
**Activation:** *every engine state*

### Formula section:

```


LV_IGA_TRA_KNK      = B_zwdyn
IGA_IS_TQ_KNK       = Dzw_krkorll
IGA_MV_ADJ_KNK_CUS = Dzw_annm

```

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IGA\_MV\_ADJ\_KNK\_RON = Dzw\_anm  
variable

// same range and resolution as BMW


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## R.34 Customer adaptation module: LACO

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_lrad_akt1	O	0... 1H	0 ...1	1	-
Bit indicating KLANN Bk1 shall be activated (STATE_LAM_AD[1] == "FAC_L")					
B_lrad_akt2	O	0... 1H	0 ...1	1	-
Bit indicating KLANN Bk2 shall be activated (STATE_LAM_AD[2] == "FAC_L")					
B_lrad_deak1	O	0... 1H	0 ...1	1	-
Bit indicating KLANN Bk1 shall be deactivated due to an error					
B_lrad_deak2	O	0... 1H	0 ...1	1	-
Bit indicating KLANN Bk2 shall be deactivated due to an error					
B_zwgemad_1	O	0... 1H	0 ...1	1	-
Zwangsgemischadaption Bank 1					
B_zwgemad_2	O	0... 1H	0 ...1	1	-
Zwangsgemischadaption Bank 2					
CTR_KM_CAN_OLD	V	0... FFFFH	0... 655350	10	km
Last vehicle kilometer update					
CTR_KM_DELTA_LAM_ADJ_LAM_AD_CUS	V/S	0... FFFFH	0... 655350	10	km
Vehicle kilometer diff. between current value and the one for the last long term adaptation					
CTR_KM_LAM_ADJ_LAM_AD_CUS	V/S	0... FFFFH	0... 655350	10	km
Vehicle kilometer at the last long term customer lambda adaptation stored in NVMY					
CTR_LAM_ADJ_LAM_AD_CUS	V/S	0... FFH	0... 255	1	-
Current number of long term adaptations carried out					
EGY_LAM_ADJ_COR_LAM_AD_CUS [NC_CYL_NR]	O/V	8000... 7FFFH	-127.5019 ...127.49805	3.89105e-3	mJ
Energy value of the Long term customer Lambda Adaption					
ERR_SYM_LAM_AD_CUS [NC_CBK_EX_NR]	O/V	0... 8H	0 ...8	1	-
Detected symptom of the diagnosis for the long term adaptation					
F_LAKOR [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-100... 99.9969482422	3.05176e-3	%
Factor for the injection time correction					
F_lrad_in1	O	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Lambda Adaption initial value (Bank 1)					
F_lrad_in2	O	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Lambda Adaption initial value (Bank 2)					
FAC_LAM_AD_CUS [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Lambda Adaption carried out by customer (multiplicative share)					
FAC_LAM_AD_CUS_SHIFT [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Output value for shift of Lambda adaptation due to customer function					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LAM_ADJ_COR_LAM_AD_CUS [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Long term customer Lambda Adaption (multiplicative share) via fuel mass setpoint					
FAC_LAM_ADJ_LAM_AD_CUS [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Long term customer Lambda Adaption (multiplicative share)					
FAC_LAM_ADJ_LIM_LAM_AD_CUS [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Long term customer Lambda Adaption (multiplicative share) limited					
FAC_LAM_ADJ_MAX_LAM_AD_CUS [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Maximun value from the Lambda Adaption as input to Long term customer Lambda Adaption					
FAC_LAM_ADJ_ST_LAM_AD_CUS [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Long term customer Lambda Adaption during engine start (multiplicative share)					
FAC_LAM_ADJ_TMP_LAM_AD_CUS [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Temporary value of the Long term customer Lambda Adaption (multiplicative share)					
FAC_LAM_CYL_SEL_LAM_AD_CUS [NC_CYL_NR]	V/S	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Cylinder individual long term customer Lambda Adaption (multiplicative share)					
FAC_LAM_TMP_ST_LAM_AD_CUS [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Temporary value of the Long term customer Lambda Adaption for the engine start(multiplicative share)					
FAC_LAM_UPD_LAM_AD_CUS [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
New update value to the Long term customer Lambda Adaption					
LV_CDN_DIAG_LAM_AD_CUS [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Condition of the diagnosis for the long term adaptation fullfiled					
LV_END_DIAG_LAM_AD_CUS [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End of the diagnosis for the long term adaptation					
LV_ERR_LAM_AD_CUS [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag that indicates that the long term adaptation exceeds its limits					
LV_FAC_LAM_AD_CUS_SHIFT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag to request shift of Lambda adaptation due to customer function					
LV_FAC_LIM_MAX_LAM_AD_CUS [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that the customer lambda adaptation is over the max threshold					
LV_FAC_LIM_MIN_LAM_AD_CUS [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flga indicating that the customer lambda adaptation is under the min threshold					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_LSCL_CUS [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
-					
LV_LAM_ADJ_LAM_AD_CUS_ENA	V	0... 1H	0 ...1	1	-
Conditions to carry out the long term adaptations are fulfilled					

**Input data:**

B_la_stopp1 {p. 8344}	B_la_stopp2 {p. 8344}	B_lradap1_mn {p. 8344}	B_lradap1_mx {p. 8344}
B_lradap2_mn {p. 8344}	B_lradap2_mx {p. 8344}	CTR_KM_CAN {p. 1563}	ERR_INH_LAM_AD_ACT [NC_CBK_EX_NR] {p. 1014}
F_lradap1 {p. 8157}	F_lradap2 {p. 8157}	FAC_L_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	FAC_LAM_LIM_FIL [NC_CBK_EX_NR] {p. 1014}
FAC_LAM_MV_MMV [NC_CBK_EX_NR] {p. 2462}	FAC_LAM_PCTL_CUS [NC_CBK_EX_NR] {p. 1014}	Klann_mw1 {p. 8159}	Klann_mw2 {p. 8159}
Klann_test1 {p. 8159}	Klann_test2 {p. 8159}	LC_AD_CLR_LONG_LAM_1 {p. 527}	LC_AD_CLR_LONG_LAM_2 {p. 527}
LV_AD_CLR_LONG_LAM_EXT_ADJ [NC_CBK_EX_NR] {p. 7482}	LV_FAC_LAM_AD_SHIFT_END [NC_CBK_EX_NR] {p. 2642}	LV_LAM_AD_DEAC_ERR [NC_CBK_EX_NR] {p. 2721}	LV_LAM_AD_EXT {p. 1016}
LV_LAM_LIM_LAM_AD [NC_CBK_EX_NR] {p. 6141}	LV_PWL {p. 988}	LV_ST {p. 1720}	LV_ST_END {p. 1720}
NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_LAMB_REF [NC_CYL_NR] {p. 812}	STATE_IV_CHG {p. 7683}
STATE_LAM_AD [NC_CBK_EX_NR] {p. 2643}	TCO_ST {p. 1100}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_LAM_AD_CUS	-	0... FFH	0... 255	1	-
Anti bounce counter increment of the diagnosis for the long term adaptation					
C_ABC_INC_LAM_AD_CUS	-	0... FFH	0... 255	1	-
Anti bounce counter increment of the diagnosis for the long term adaptation					
C_ABC_MAX_LAM_AD_CUS	-	0... FFH	0... 255	1	-
Anti bounce counter increment of the diagnosis for the long term adaptation					
C_CRLC_LAM_ADJ_LAM_AD_CUS	-	0... FFH	0 ...1	3.92157e-3	-
Correlation constant for the long term adaptation					
C_CRLC_LAM_ADJ_MAX_LAM_AD_CUS	-	0... FFH	0 ...1	3.92157e-3	-
Correlation constant to calculate the maximum input to the long term adaptation					
C_CTR_KM_THD_LAM_AD_CUS	-	0... FFFFH	0... 655350	10	km
Distance to carry out next long term customer lambda adaptation					
C_CTR_MAX_LAM_ADJ_LAM_AD_CUS	-	0... FFH	0... 255	1	-
Number of maximum allowed long term adaptations (if LC_CTR_MAX_LAM_ADJ_LAM_AD_CUS = 1)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EGY_LAM_ADJ_LAM_AD_CUS	-	0... FFFFH	0... 255	3.89105e-3	mJ
Conversion factor for the long term adaptation from % MFF to mJ					
C_FAC_LAM_ADJ_MAX_LAM_AD_CUS	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Maximum limit of the long term customer lambda adaptation					
C_FAC_LAM_ADJ_MIN_LAM_AD_CUS	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Minimum limit of the long term customer lambda adaptation					
C_FAC_LAM_ADJ_ST_MAX_LAM_AD_CUS	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Maximum limit of the long term customer lambda adaptation during engine start					
C_FAC_LAM_ADJ_ST_MIN_LAM_AD_CUS	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Minimum limit of the long term customer lambda adaptation during engine start					
C_FAC_LAM_ERR_MAX_LAM_AD_CUS	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Upper threshold value of the long term customer lambda adaptation for the diagnosis					
C_FAC_LAM_ERR_MIN_LAM_AD_CUS	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Lower threshold value of the long term customer lambda adaptation for the diagnosis					
IP_FAC_COR_ST_LAM_AD_CUS	-	0... FFH	0 ...1	3.92157e-3	-
LDP_TCO_ST_LAM_AD_CUS	8	0... FEH	-48... 142.5	0.75	°C
Weighting factor for the long term adaptation during engine start					
LC_CTR_MAX_LAM_ADJ_LAM_AD_CUS	-	0... 1H	0 ...1	1	-
Logical switch to enable a limitation in the number of long term adaptations					
LC_EGY_LAM_AD_CUS_ENA	-	0... 1H	0 ...1	1	-
Logical switch to enable long term adaptation via injector needle lift correction					
LC_EGY_LAM_AD_CUS_ST_ENA	-	0... 1H	0 ...1	1	-
Logical switch to enable long term adaptation via injector needle lift correction during engine start					
LC_LAM_AD_CUS_CLR	-	0... 1H	0 ...1	1	-
Logical switch to reset the anti bounce counter for the long term adaptation diagnosis					
LC_LAM_ADJ_LAM_AD_CUS_ENA	-	0... 1H	0 ...1	1	-
Logical switch to enable the long term lambda adaptation					

**Configuration data:**

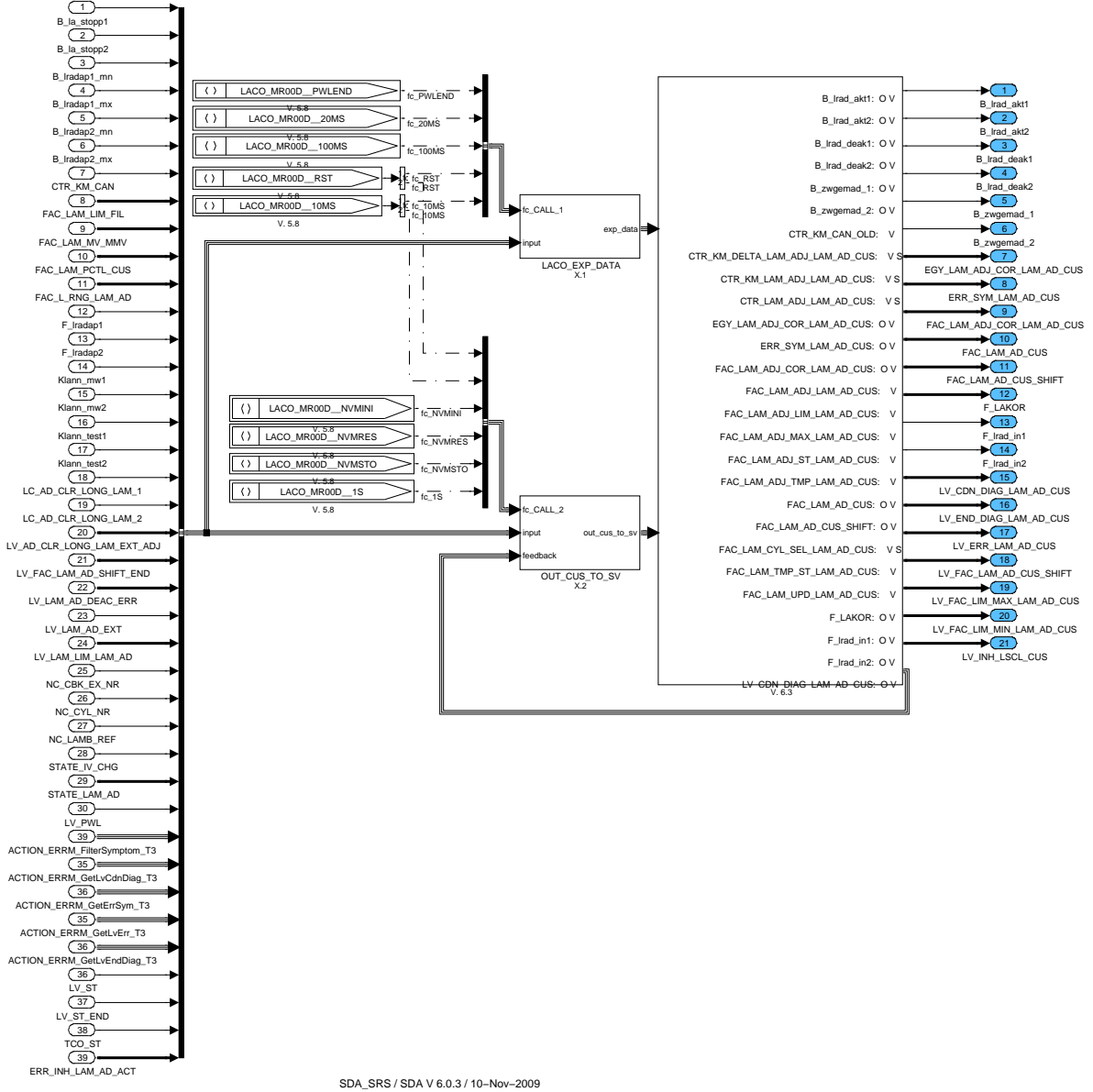
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_DIAG_LAM_AD_CUS	-	0... FFFFH	0... 65535	1	-
Failure index for diagnostic instance LAM_AD_CUS					

**Import actions:**

<b>ACTION_ERRM_FilterSymptom</b> (IN<PRM_IDX_DIAG>,IN<PRM_LV_CDN_DIAG>,IN<PRM_ERR_SYM>,IN<PRM_C_ABC_INC>,IN<PRM_C_ABC_DEC>,IN<PRM_C_ABC_MAX>,OUT<PRM_LV_ERR>)
<b>ACTION_ERRM_GetErrSym</b> (IN<IDX_DIAG>,OUT<ERR_SYM>)
<b>ACTION_ERRM_GetLvCdnDiag</b> (IN<IDX_DIAG>,OUT<LV_CDN_DIAG>)
<b>ACTION_ERRM_GetLvEndDiag</b> (IN<IDX_DIAG>,OUT<LV_END_DIAG>)
<b>ACTION_ERRM_GetLvErr</b> (IN<IDX_DIAG>,OUT<LV_ERR>)

**General information:**

**Signal flow diagram:**



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SDA\_SRS / SDA V 6.0.3 / 10-Nov-2009

Figure R.34.1: :


**R.34.1 Outputs for BMW functions which are defined as LACO exported data**

**General information:**

**FUNCTION DESCRIPTION:**

Adaptation to BMW environment.

Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Released by Tettenborn Frank		Date 2013-02-13	File 76R00D02.00B
	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 8312 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11



**Application conditions:**

*Initialisation:* RST, PWLEND, Deactivation  
*Recurrence:* 10MS, 20MS, 100MS  
*Activation:* LV\_PWL==0  
*Deactivation:* LV\_PWL==1

**Function description:**

**Formula section:**

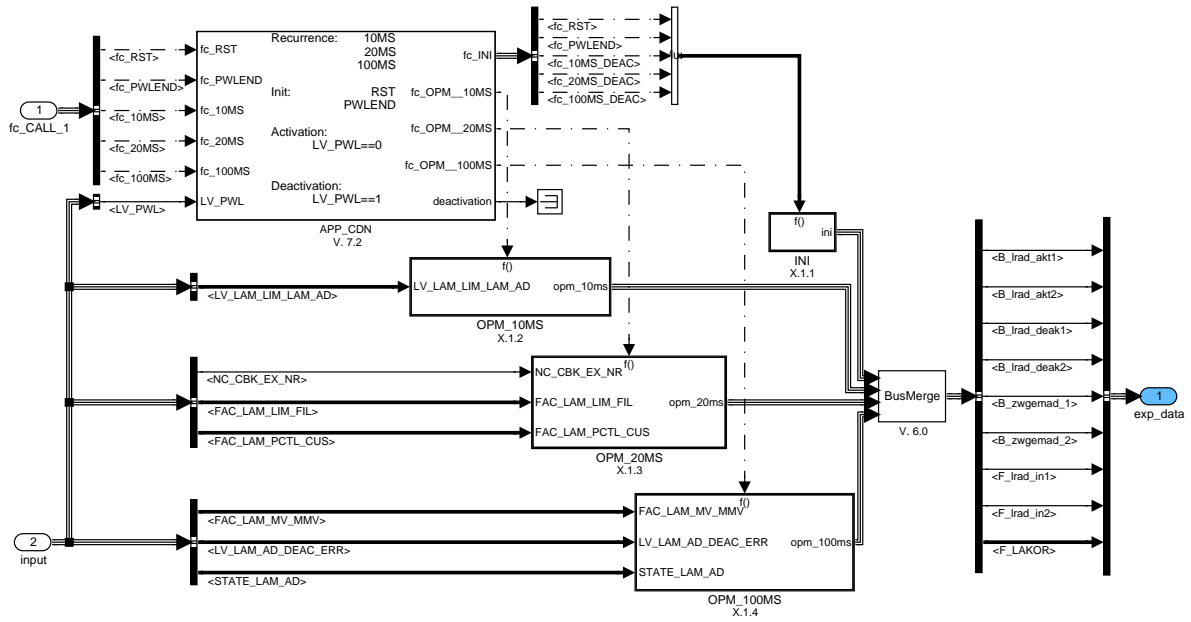


Figure R.34.2: :

**R.34.1.1 Initialisation at reset or at exit power latch phase:**

Initialized to 0 at reset or at exit power latch.

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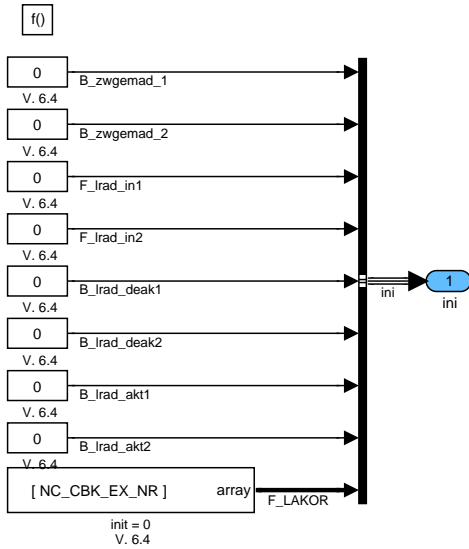


Figure R.34.3: :

### R.34.1.2 Calculation of B\_zwgemad\_1 and B\_zwgemad\_2

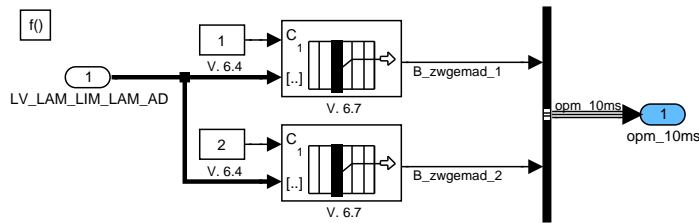


Figure R.34.4: :

### R.34.1.3 For loop

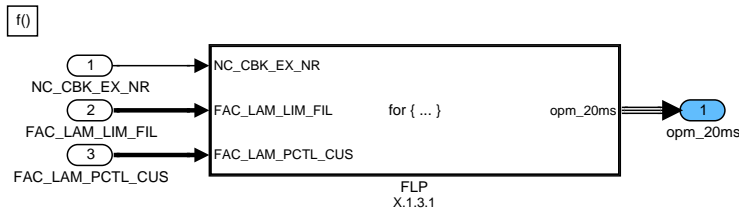


Figure R.34.5: :

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### R.34.1.3.1 Calculation of F\_LAKOR

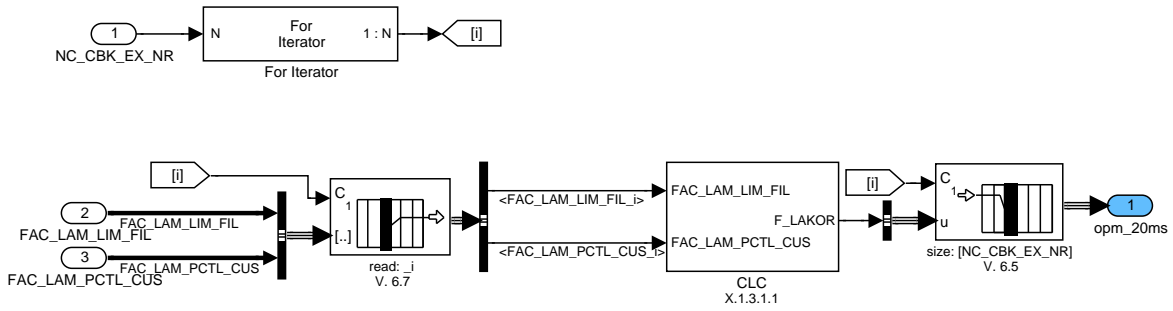


Figure R.34.6: :

#### R.34.1.3.1.1 F\_LAKOR is the sum of FAC\_LAM\_LIM\_FIL and FAC\_LAM\_PCTL\_CUS

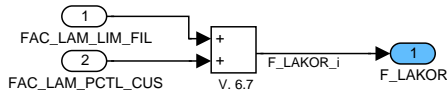


Figure R.34.7: :

### R.34.1.4 Calculation at 100ms recurrence.

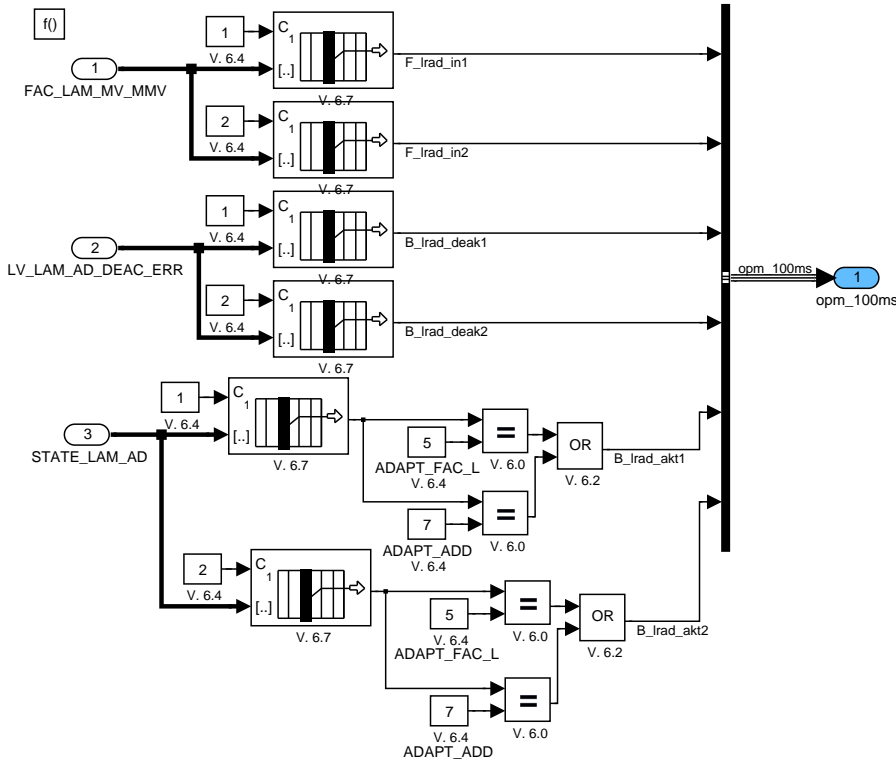


Figure R.34.8: :

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### R.34.2 Outputs of customer to SV functions

**General information:**

**FUNCTION DESCRIPTION:**

Adaptation to BMW environment.

Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

**Application conditions:**

*Initialisation:* RST, NVMINI, NVMRES, NVMSTO  
*Recurrence:* 10MS, 1S  
*Activation:* always  
*Deactivation:* never

**Function description:**

**Formula section:**

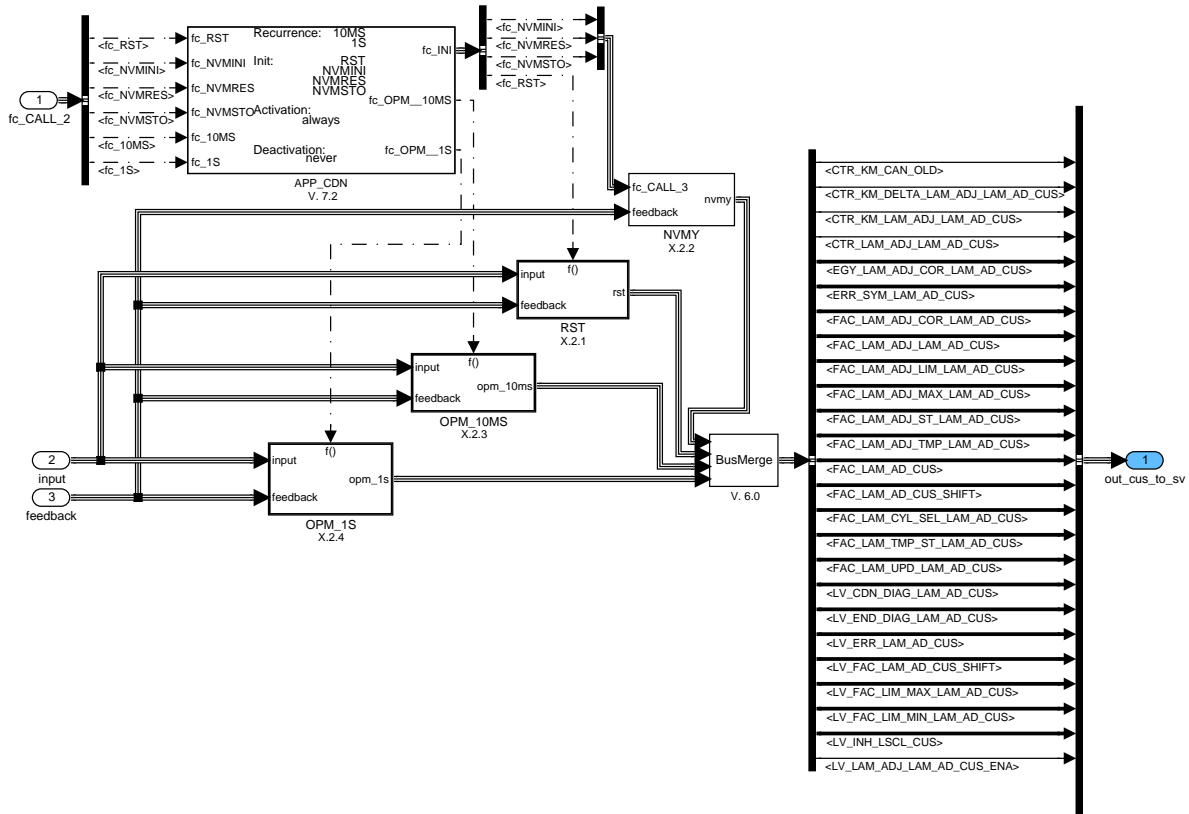


Figure R.34.9: :

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**R.34.2.1 Except FAC\_LAM\_ADJ\_LAM\_AD\_CUS all others variables shall be initialized with 0.**

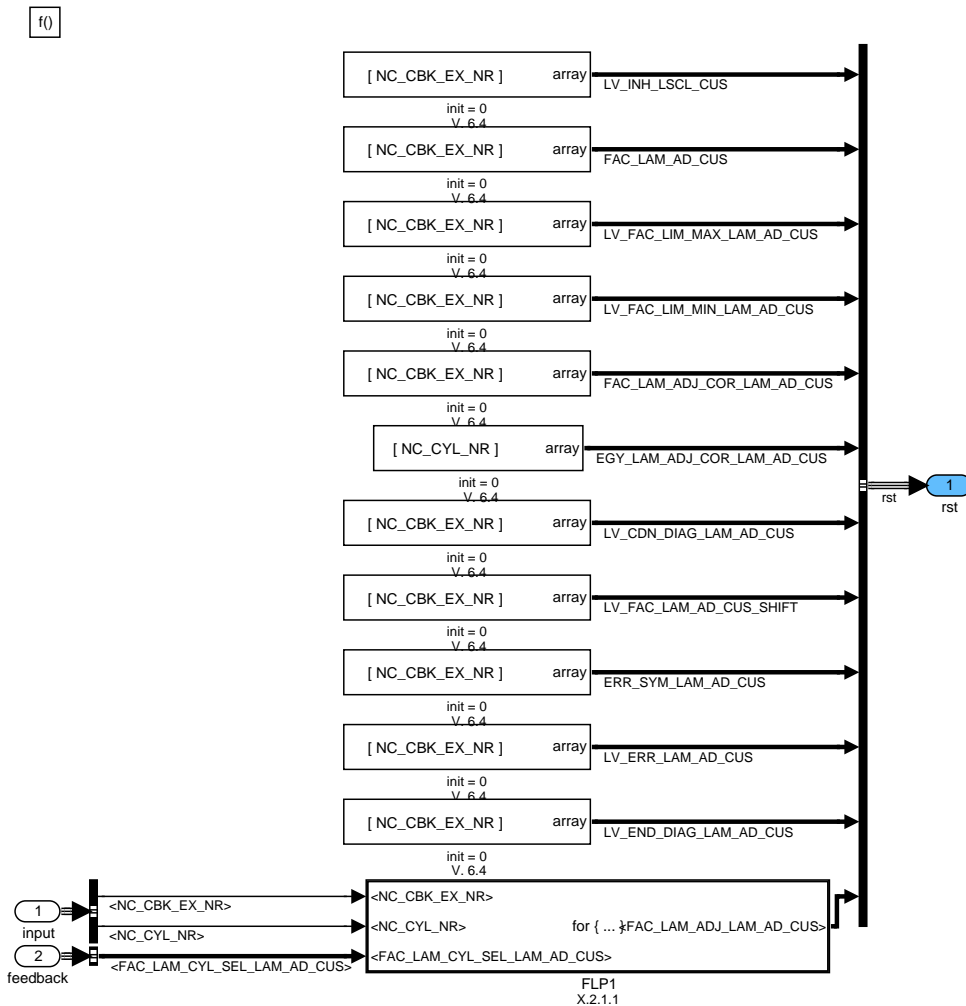


Figure R.34.10: :

**R.34.2.1.1 // The sum below shall be done for each exhaust gas bank over the cylinders belonging to it.**

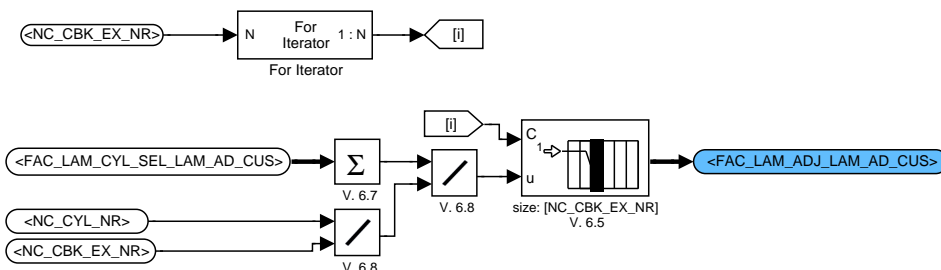


Figure R.34.11: :

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### R.34.2.2 Non volatile data

FAC\_LAM\_CYL\_SEL\_LAM\_AD\_CUS[x], CTR\_KM\_LAM\_ADJ\_LAM\_AD\_CUS CTR\_KM\_DELTA\_LAM\_ADJ\_LAM\_AD\_CUS and CTR\_LAM\_ADJ\_LAM\_AD\_CUS shall be initialised with their stored values in NVMY.

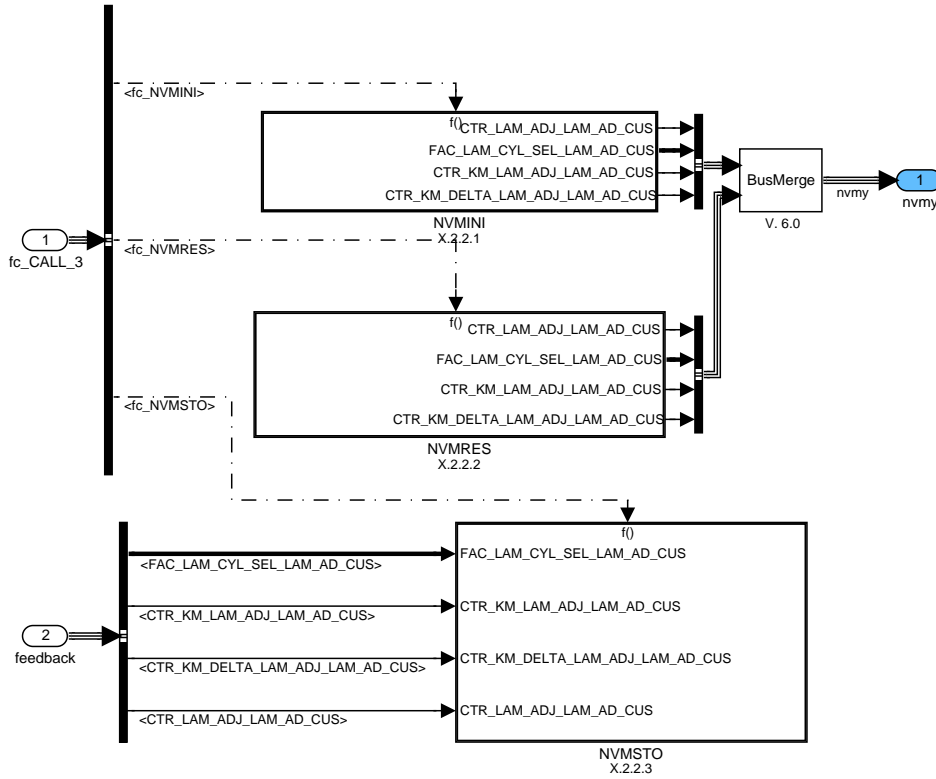


Figure R.34.12: :

#### R.34.2.2.1 Initialization of NVMY variables

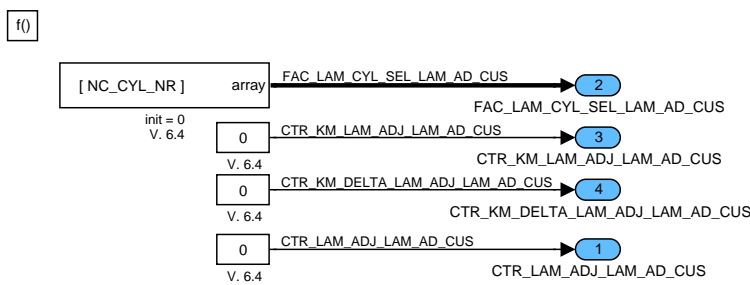


Figure R.34.13: :

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### R.34.2.2.2 Read NVMY variables

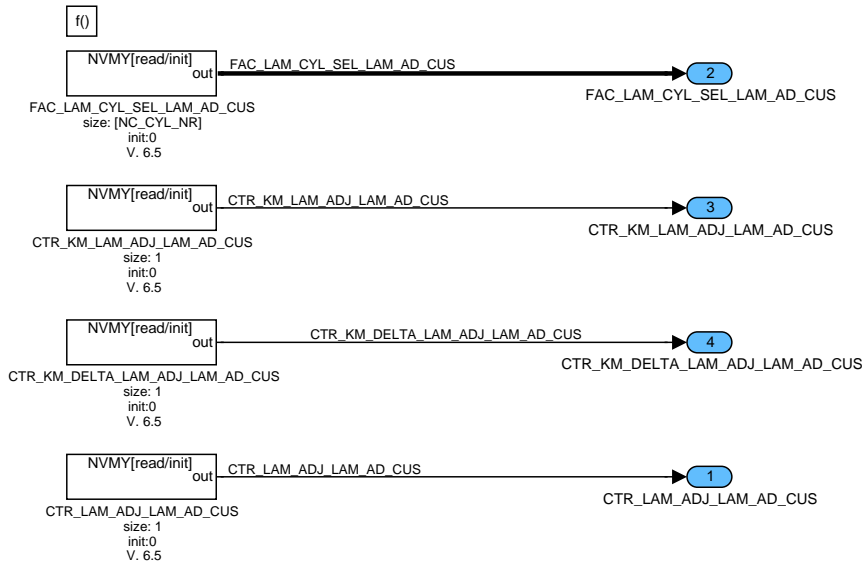


Figure R.34.14: :

### R.34.2.2.3 Store NVMY variables

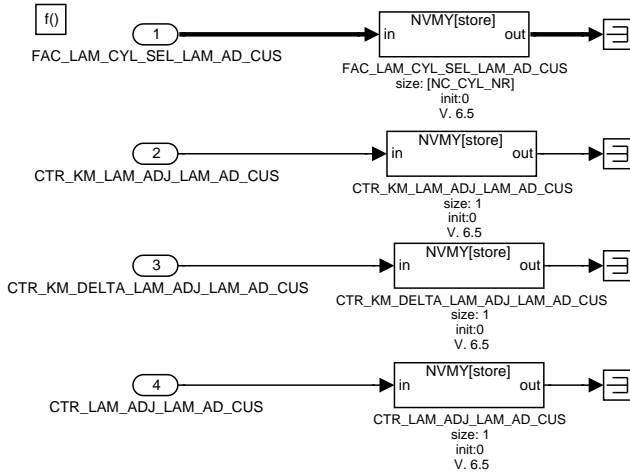


Figure R.34.15: :

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### R.34.2.3 Calculation

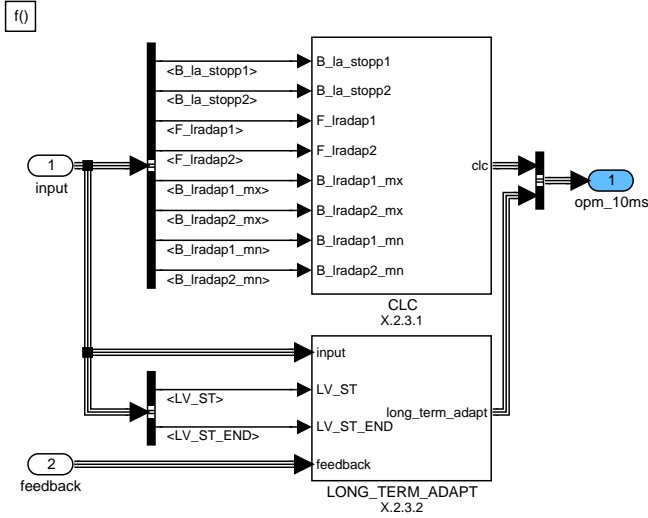


Figure R.34.16: :

#### R.34.2.3.1 % Continuously update of current customer Lambda Adaptation value

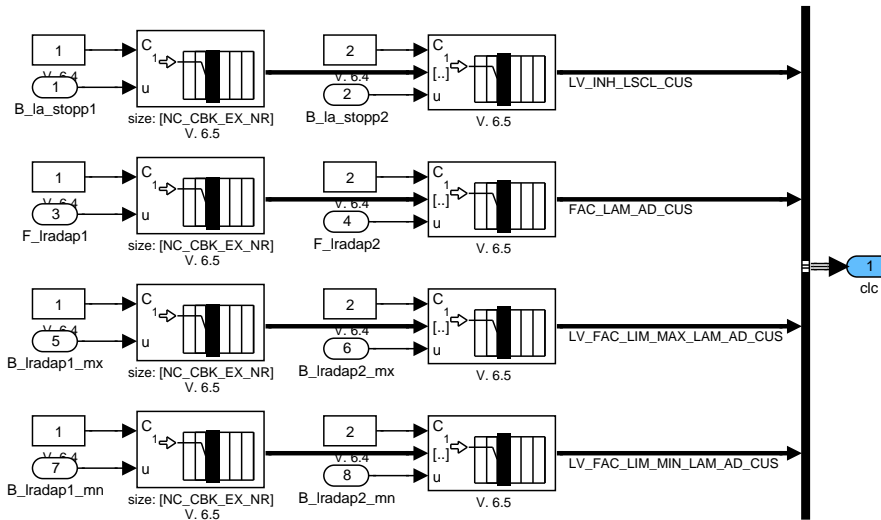


Figure R.34.17: :

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### R.34.2.3.2 % Long term Lambda Adaptation

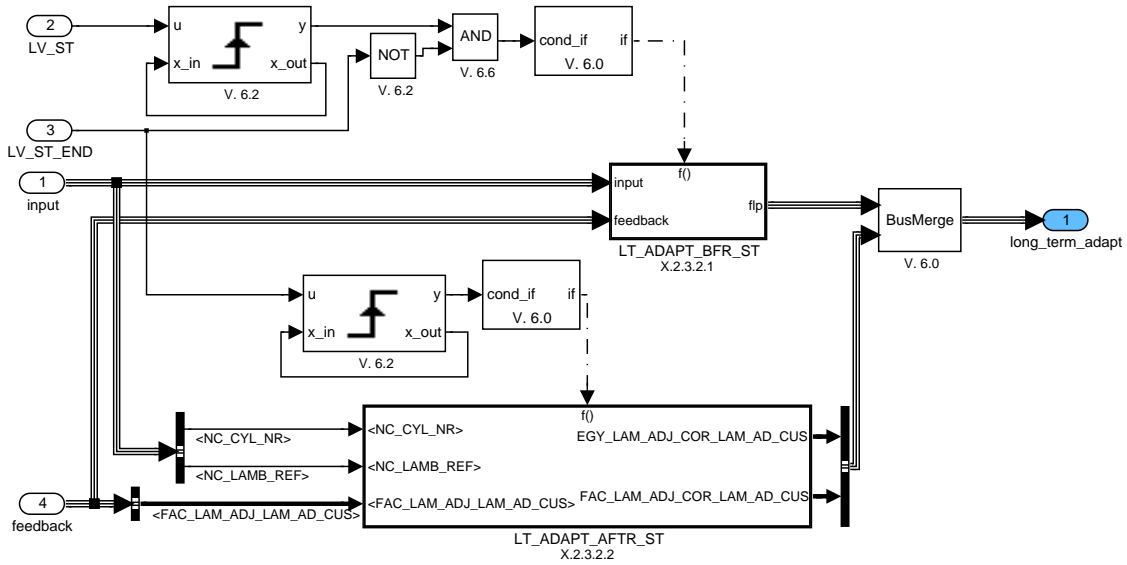


Figure R.34.18: :

#### R.34.2.3.2.1 // case: no update being carry out // calculation below shall be done once

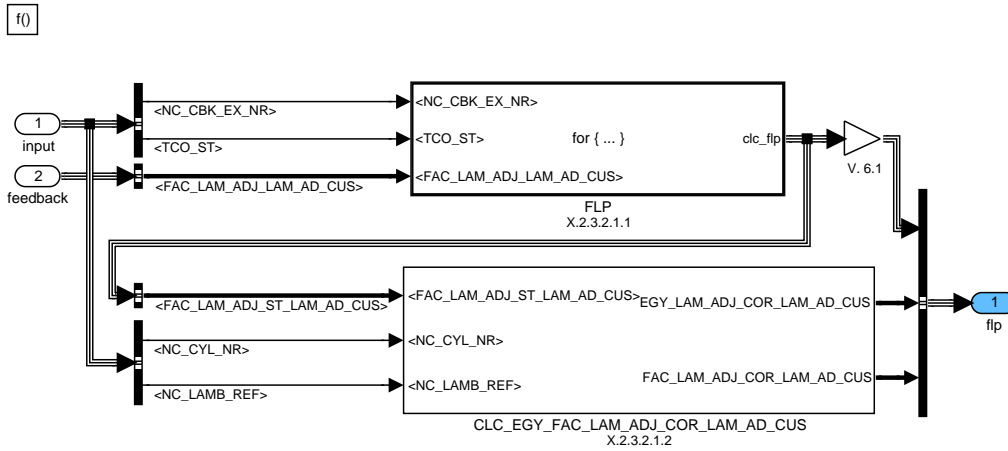


Figure R.34.19: :

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### R.34.2.3.2.1.1 Calculation

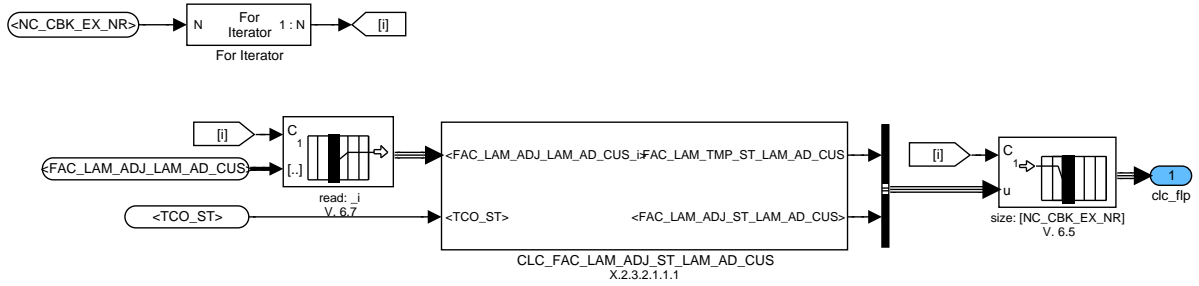


Figure R.34.20: :

#### R.34.2.3.2.1.1.1 Calculation of FAC\_LAM\_TMP\_ST\_LAM\_AD\_CUS and FAC\_LAM\_ADJ\_ST\_LAM\_AD\_CUS

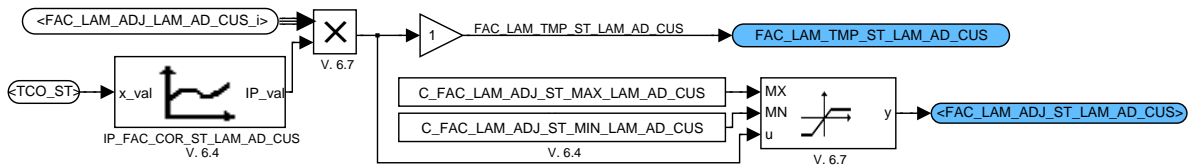


Figure R.34.21: :

#### R.34.2.3.2.1.2 Calculation of EGY\_LAM\_ADJ\_COR\_LAM\_AD\_CUS and FAC\_LAM\_ADJ\_COR\_LAM\_AD\_CUS using LC\_EGY\_LAM\_AD\_CUS\_ENA as switch

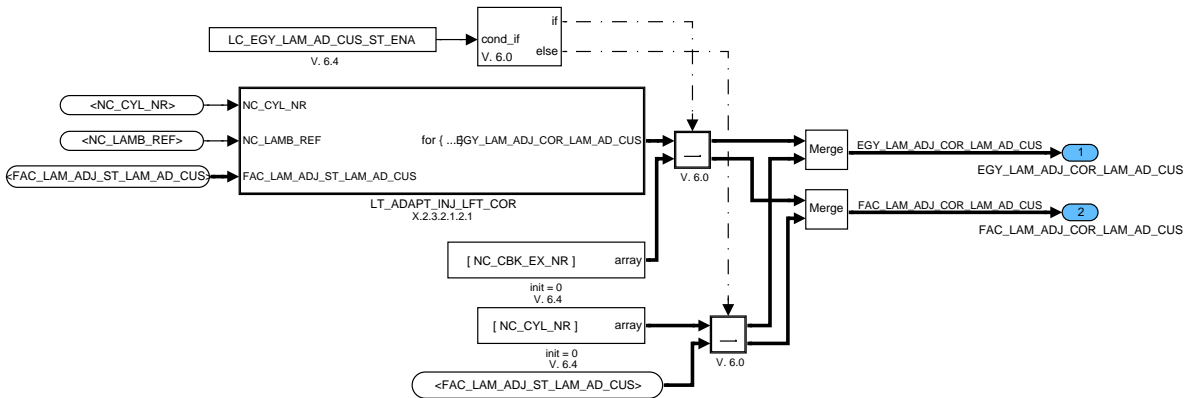


Figure R.34.22: :

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### R.34.2.3.2.1.2.1 Calculation of EGY\_LAM\_ADJ\_COR\_LAM\_AD\_CUS

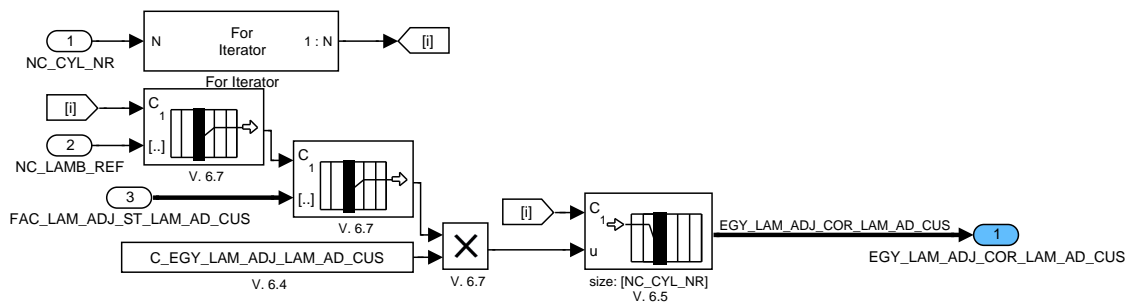


Figure R.34.23: :

### R.34.2.3.2.2 // case: no update being carry out // calculation of long term adaptation after start

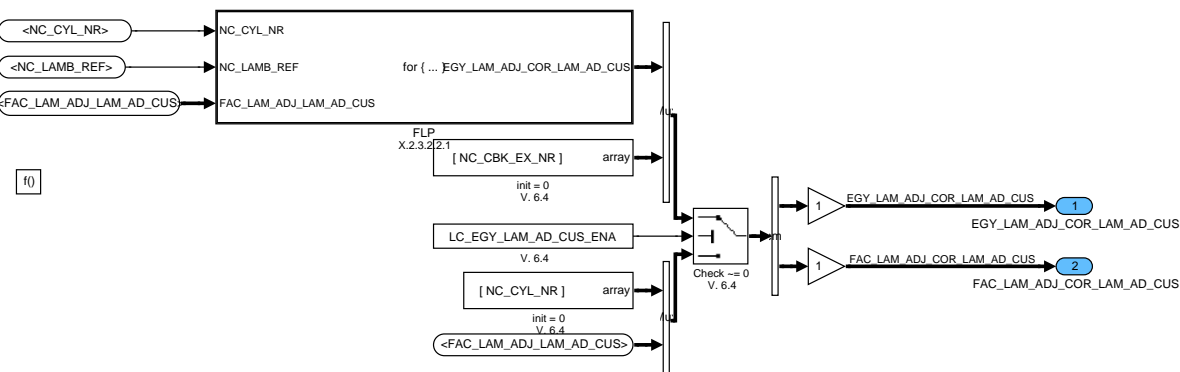


Figure R.34.24: :

### R.34.2.3.2.2.1 EGY\_LAM\_ADJ\_COR\_LAM\_AD\_CUS Calculation of EGY\_LAM\_ADJ\_COR\_LAM\_AD\_CUS

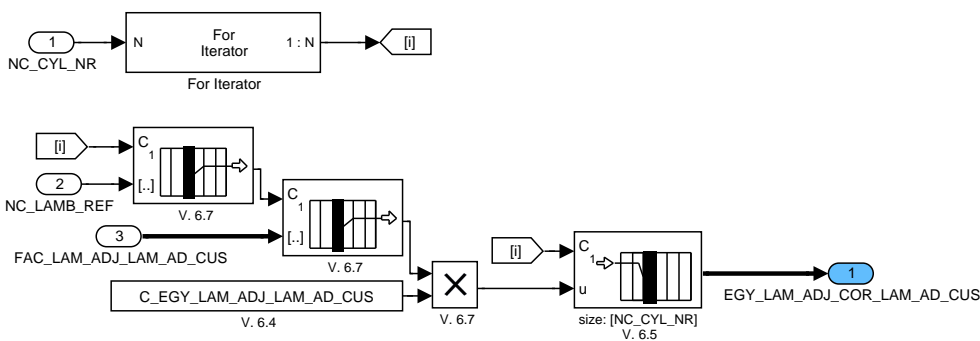


Figure R.34.25: :

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### R.34.2.4 Formula section

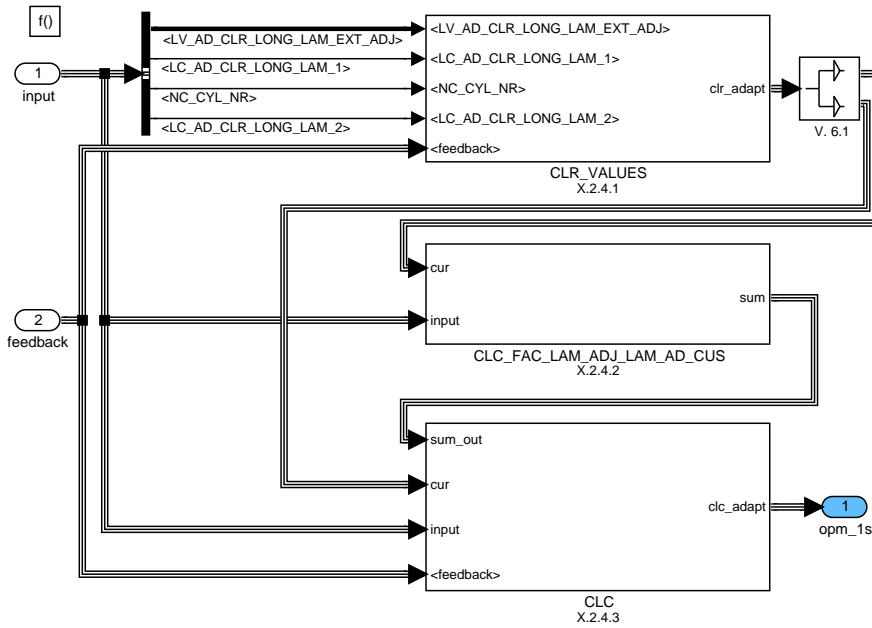


Figure R.34.26: :

#### R.34.2.4.1 Clear adaptations value

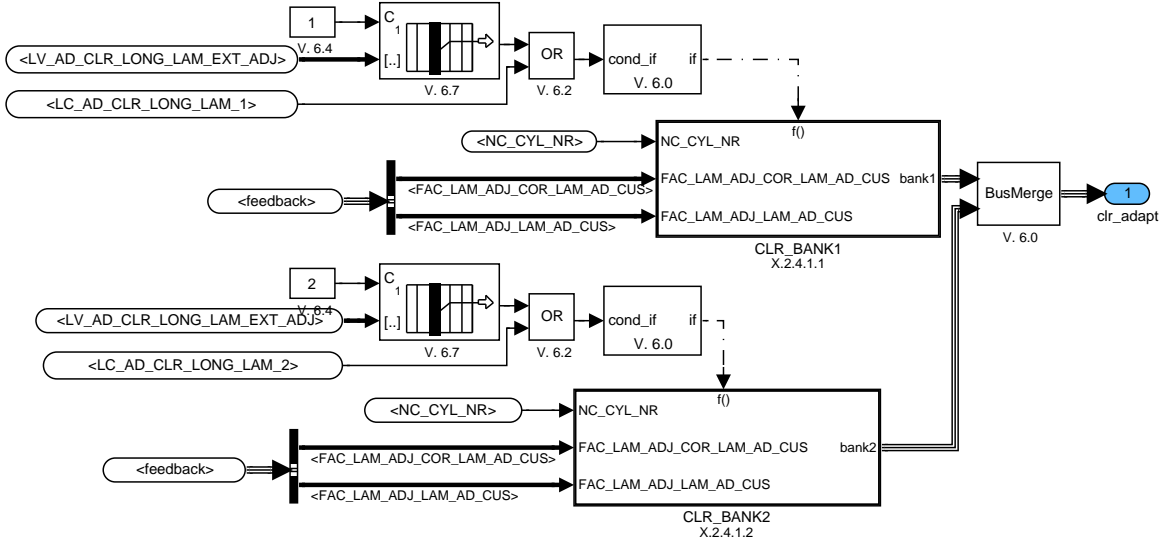


Figure R.34.27: :

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**R.34.2.4.1.1 // case: clear adaption value for bank 1 by external request:**

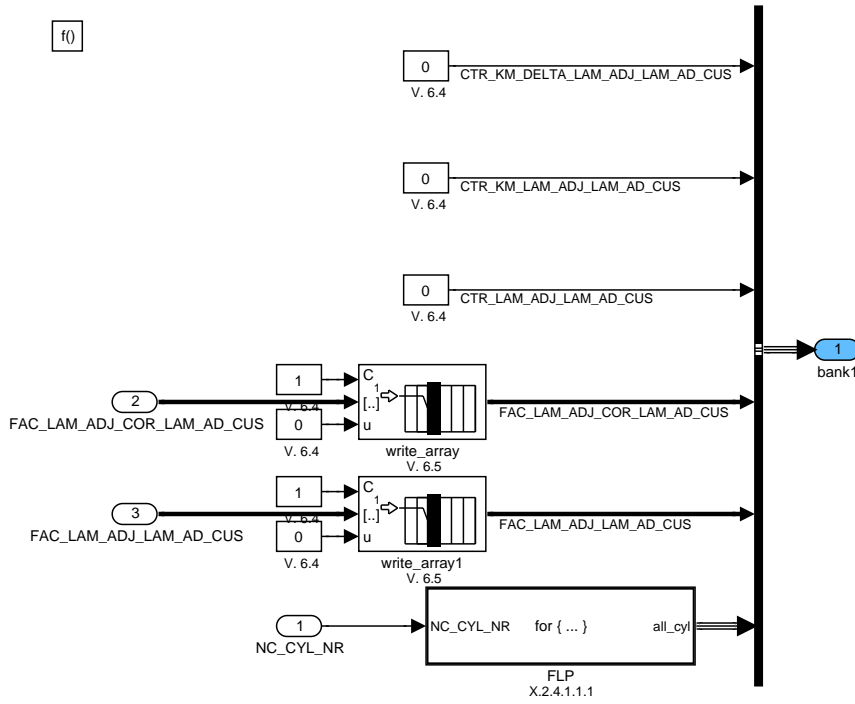


Figure R.34.28: :

**R.34.2.4.1.1.1 Clear values for bank1**

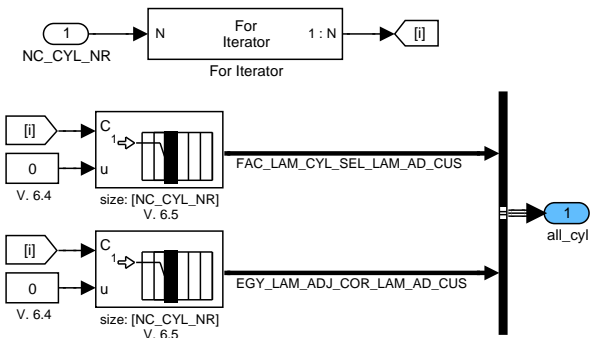


Figure R.34.29: :

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**R.34.2.4.1.2 // clear adptions value for bank 2 by external request:**

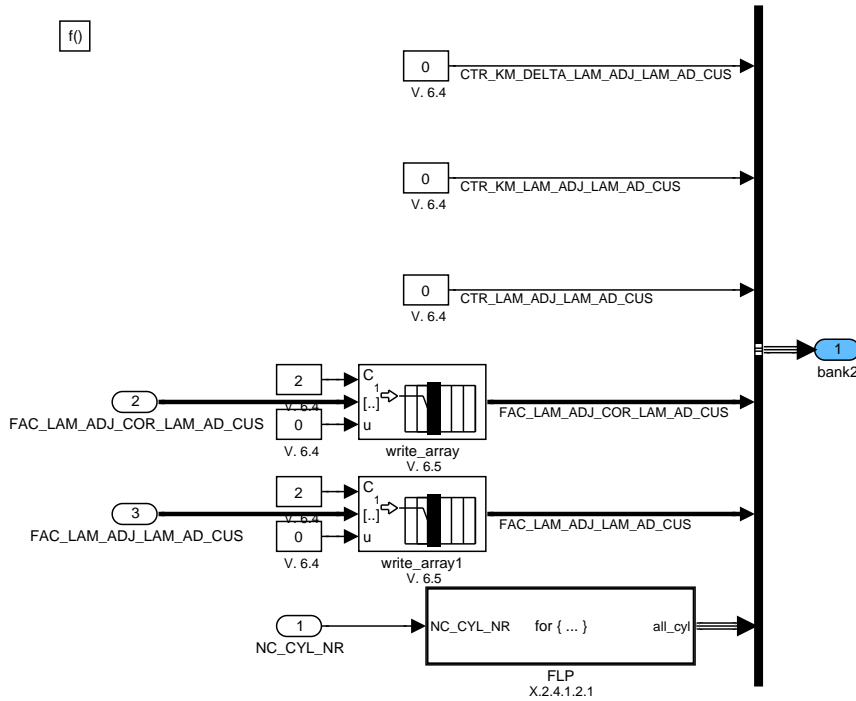


Figure R.34.30: :

**R.34.2.4.1.2.1 Clear values for bank2**

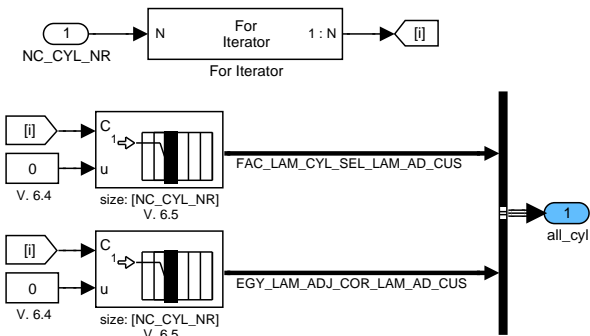


Figure R.34.31: :

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### R.34.2.4.2 Calculation

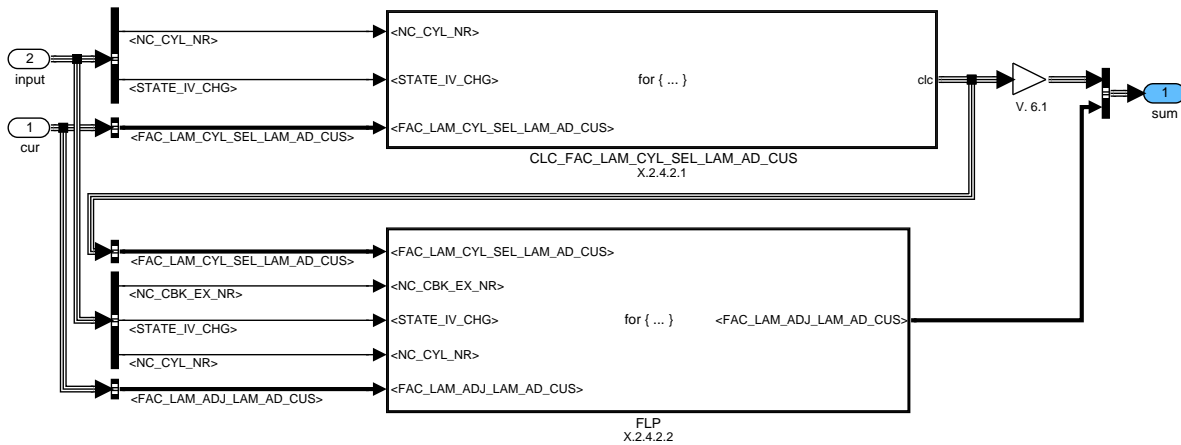


Figure R.34.32: :

#### R.34.2.4.2.1 Calculation of FAC\_LAM\_CYL\_SEL\_LAM\_AD\_CUS

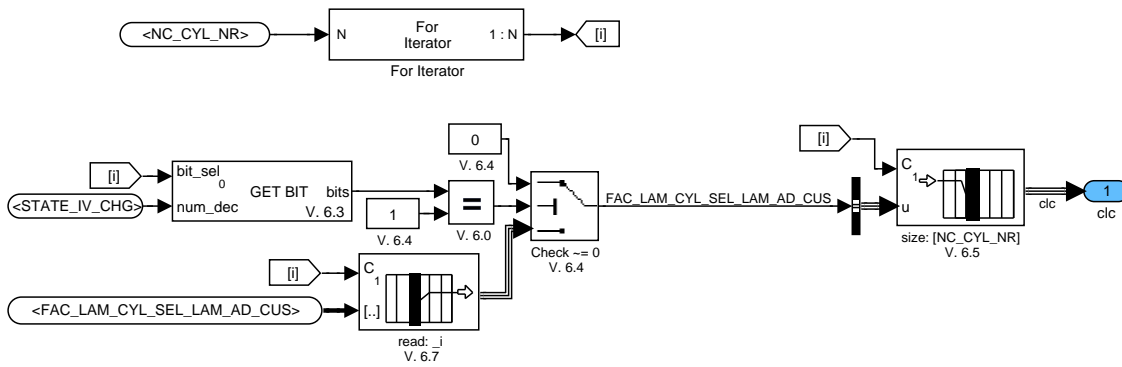


Figure R.34.33: :

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### R.34.2.4.2.2 Calculation of FAC\_LAM\_ADJ\_LAM\_AD\_CUS

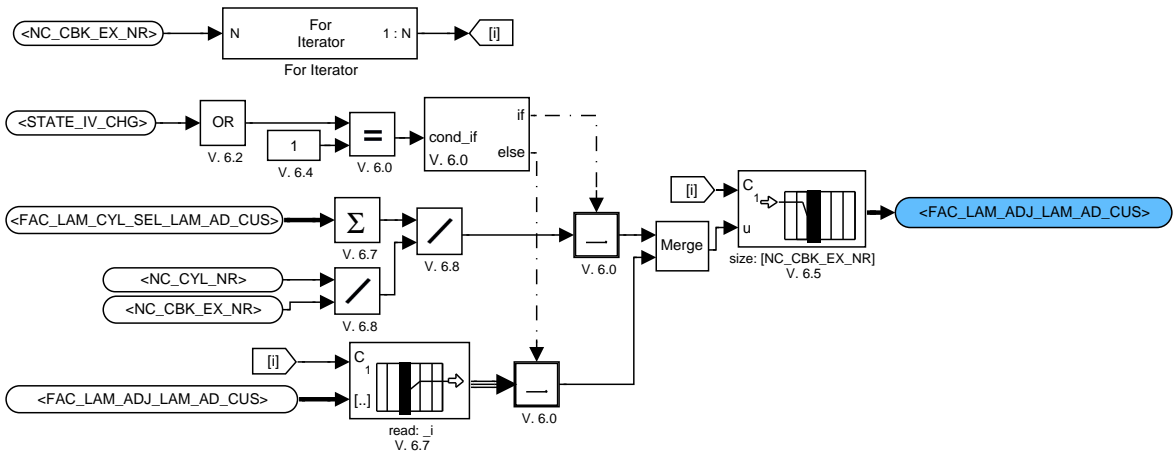


Figure R.34.34: :

### R.34.2.4.3 Calculation

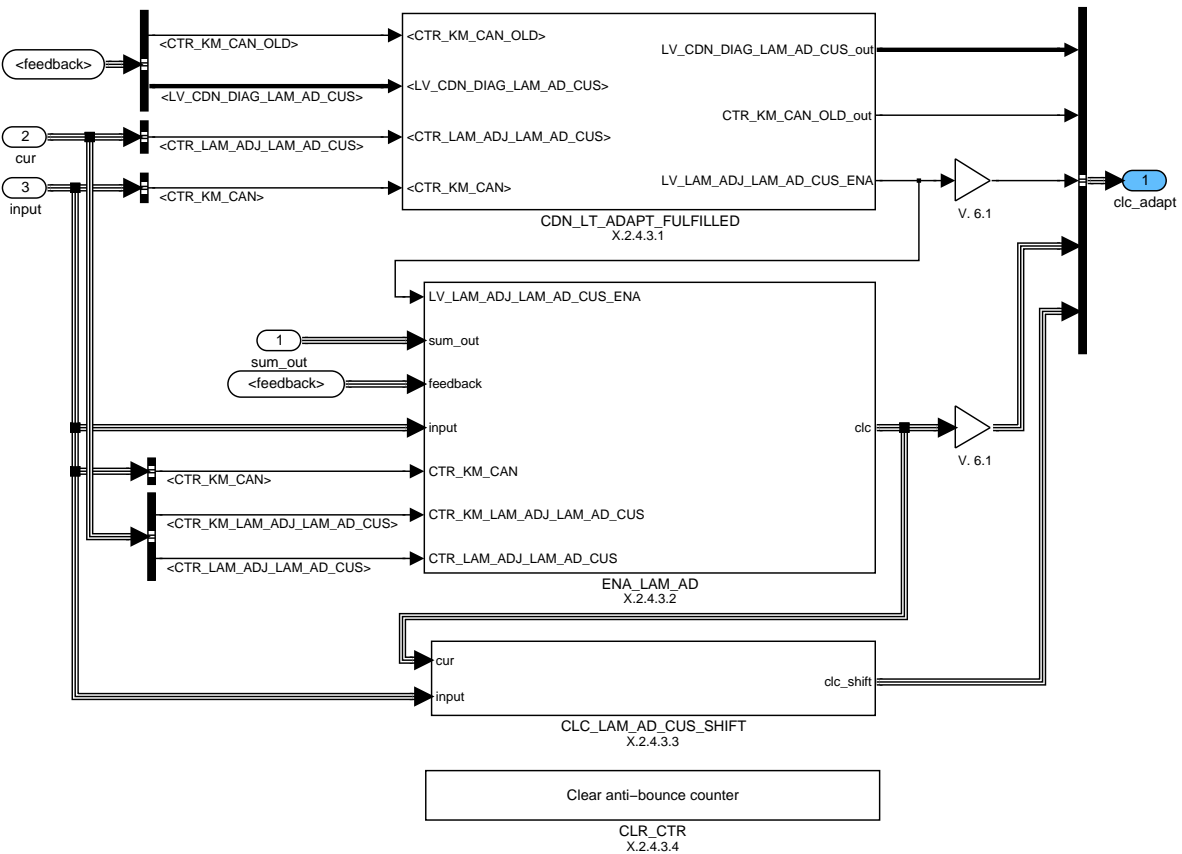


Figure R.34.35: :

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### R.34.2.4.3.1 Calculation of CTR\_KM\_CAN\_OLD, LV\_LAM\_ADJ\_LAM\_AD\_CUS\_ENA.

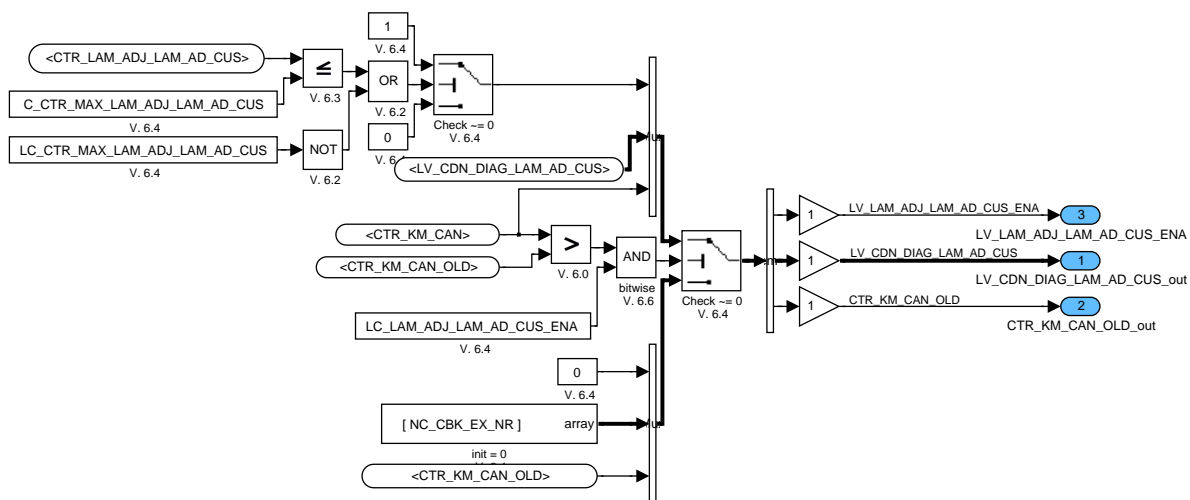


Figure R.34.36: :

### R.34.2.4.3.2 Update long term adaptation

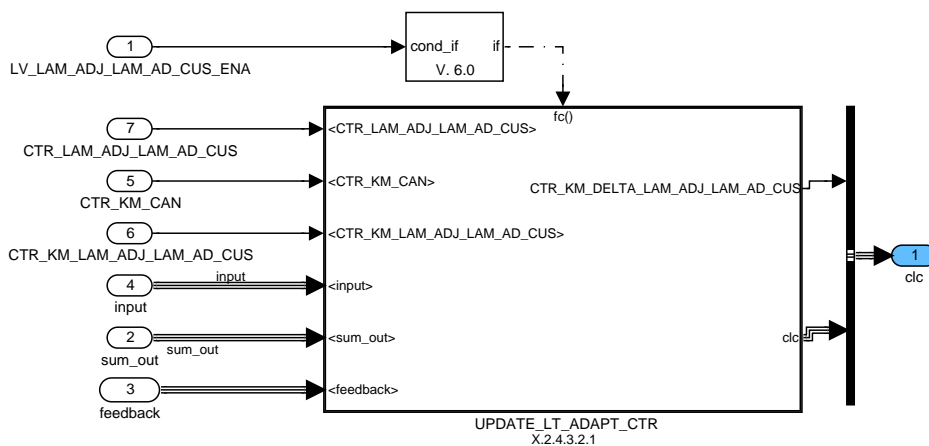


Figure R.34.37: :

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**R.34.2.4.3.2.1 %update long term adaptation temporary counter**

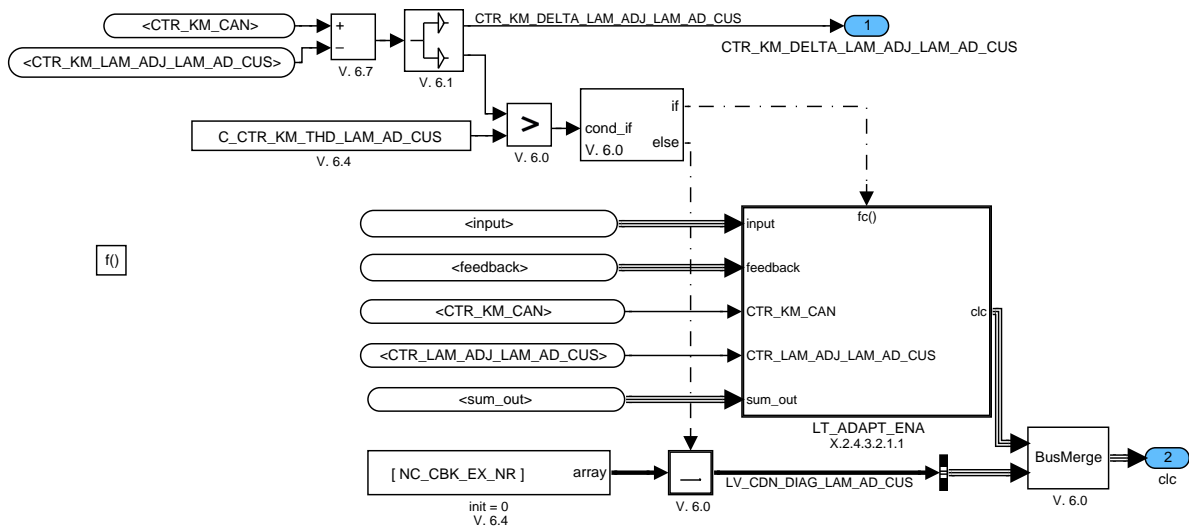


Figure R.34.38: :

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R.34.2.4.3.2.1.1 Long term adaptation enabled

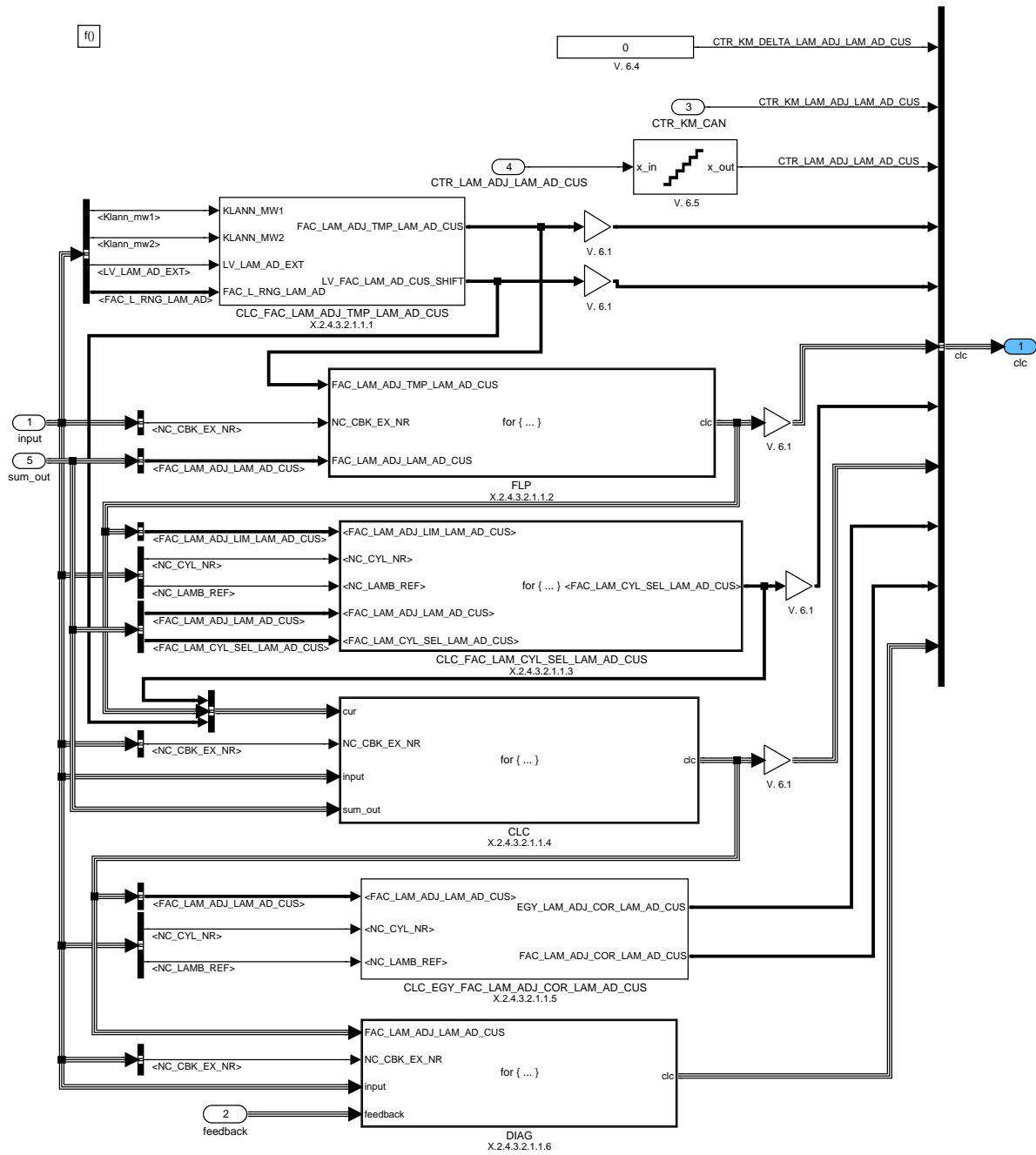


Figure R.34.39: :

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**R.34.2.4.3.2.1.1.1 Calculation**

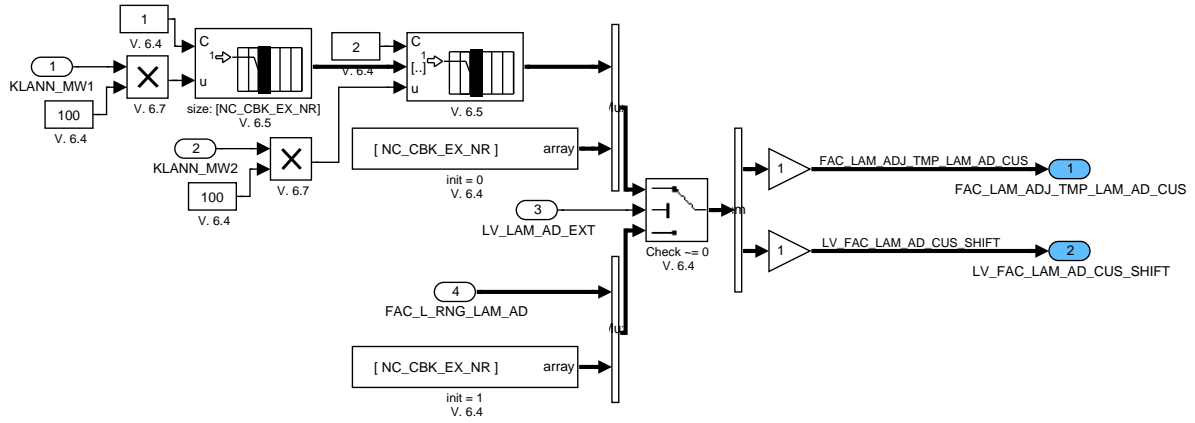


Figure R.34.40: :

**R.34.2.4.3.2.1.1.2 Calculation**

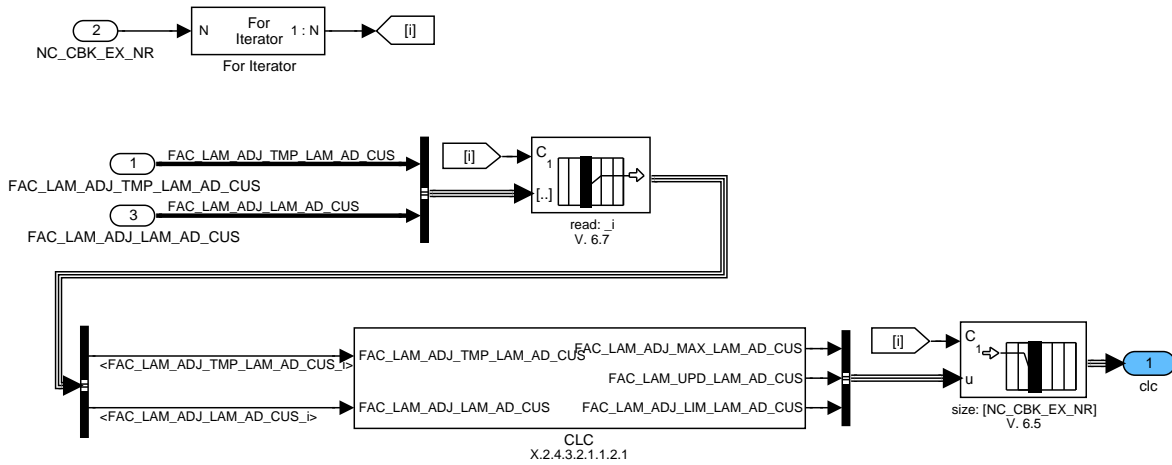


Figure R.34.41: :

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### R.34.2.4.3.2.1.1.2.1 Calculation of FAC\_LAM\_ADJ\_MAX\_LAM\_AD\_CUS, FAC\_LAM\_UPD\_LAM\_AD\_CUS and FAC\_LAM\_ADJ\_LIM\_LAM\_AD\_CUS

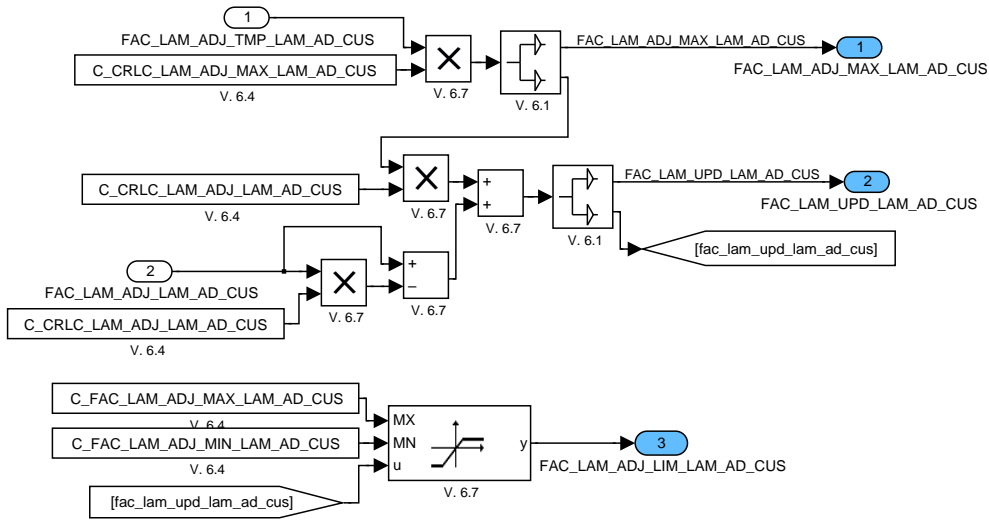


Figure R.34.42: :

### R.34.2.4.3.2.1.1.3 Calculation of FAC\_LAM\_CYL\_SEL\_LAM\_AD\_CUS

long term adaptation based on the BMW KLANN adaptation values  
 long term adaptation based on the SiemensVDO adaptation values

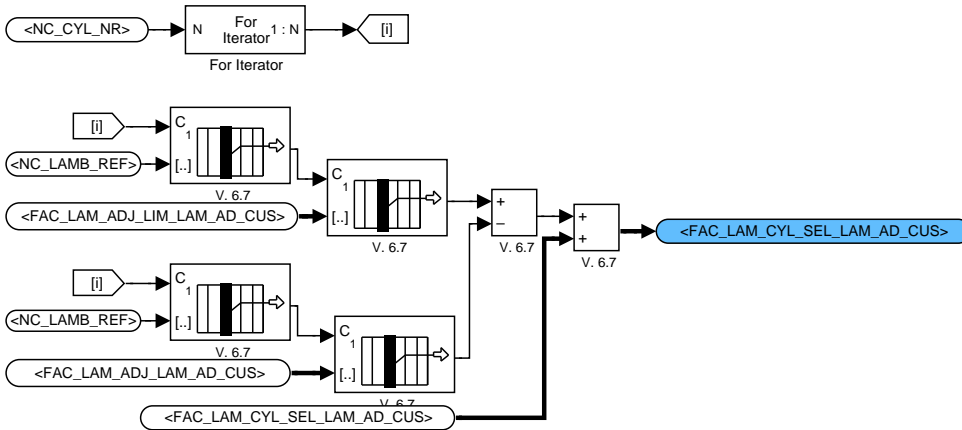


Figure R.34.43: :

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**R.34.2.4.3.2.1.1.4 Calculation**

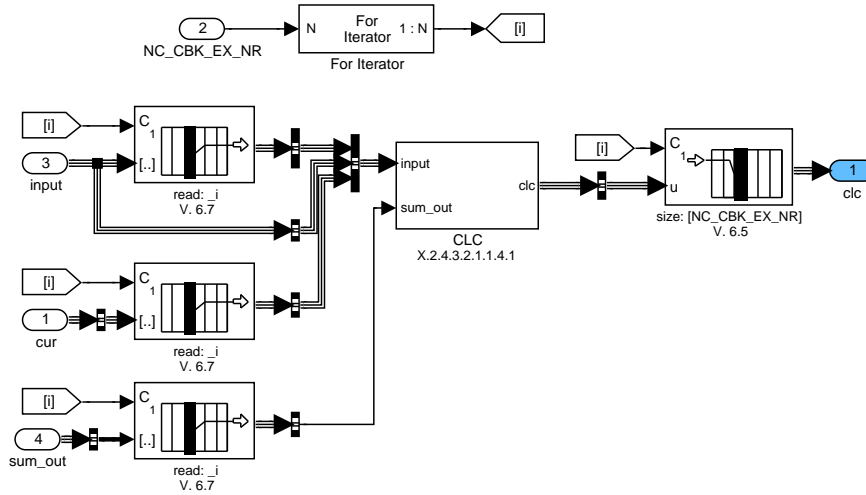


Figure R.34.44: :

**R.34.2.4.3.2.1.1.4.1 Calculation of FAC\_LAM\_AD\_CUS\_SHIFT and FAC\_LAM\_ADJ\_LAM\_AD\_CUS**

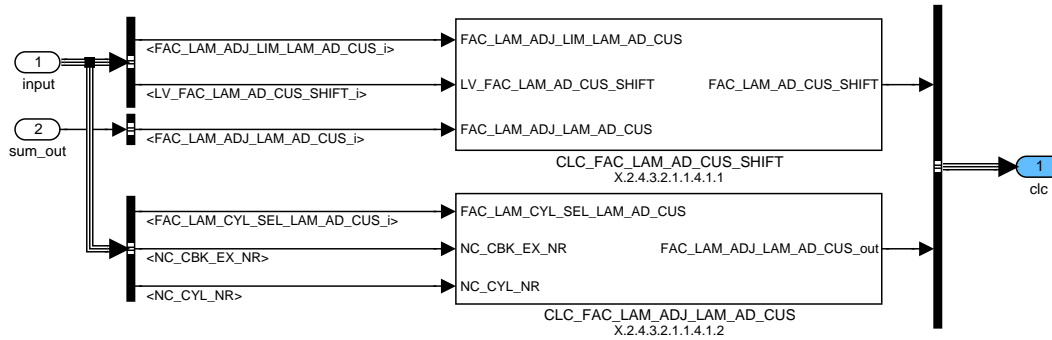


Figure R.34.45: -:

**R.34.2.4.3.2.1.1.4.1.1 Calculation of FAC\_LAM\_AD\_CUS\_SHIFT**

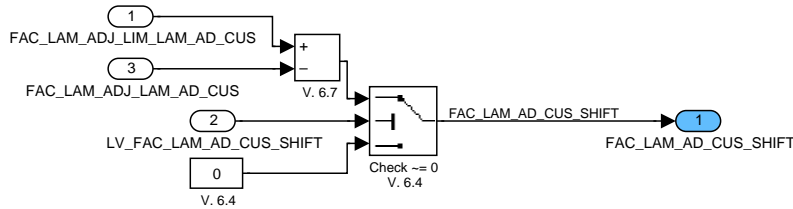


Figure R.34.46: :

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**R.34.2.4.3.2.1.1.4.1.2 Calculation of FAC\_LAM\_ADJ\_LAM\_AD\_CUS**

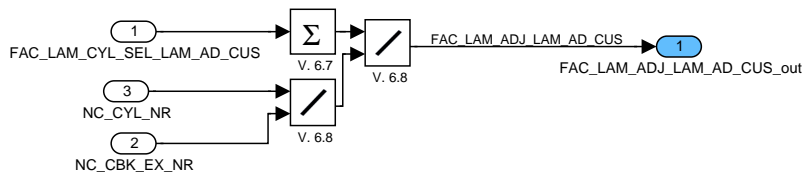


Figure R.34.47: :

**R.34.2.4.3.2.1.1.5 Long term adaptation via injector needle lift correction Long term adaptation via fuel mass setpoint correction**

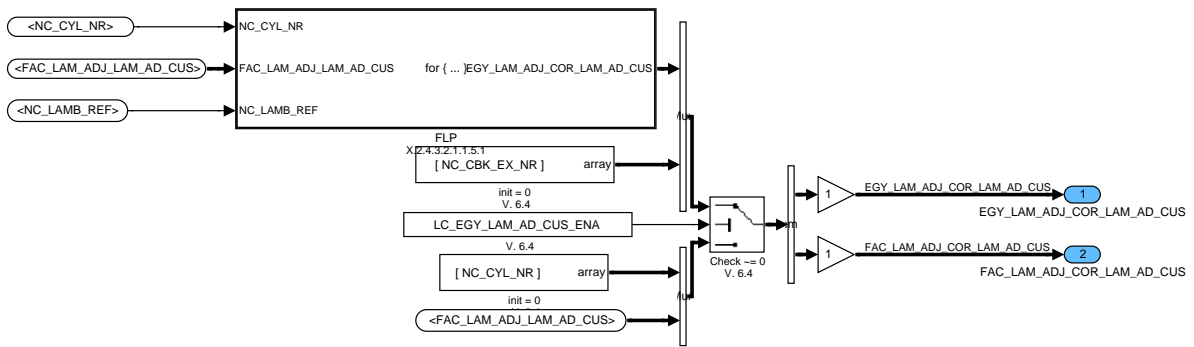


Figure R.34.48: :

**R.34.2.4.3.2.1.1.5.1 Calculation of EGY\_LAM\_ADJ\_COR\_LAM\_AD\_CUS**

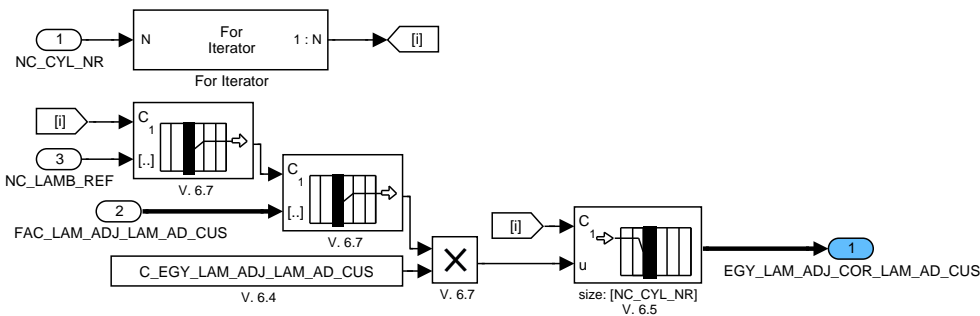


Figure R.34.49: :

**R.34.2.4.3.2.1.1.6 Diagnosis of long term adaptation**

Configuration for diagnostic symptoms:

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Diagnostic GS	Symptom description	Symptom	Filter type
Diagnosis for the Long Term Adaptation	-	SYM_0	STD
	Long term adaptation too high	SYM_1	
	-	SYM_2	
	-	SYM_3	

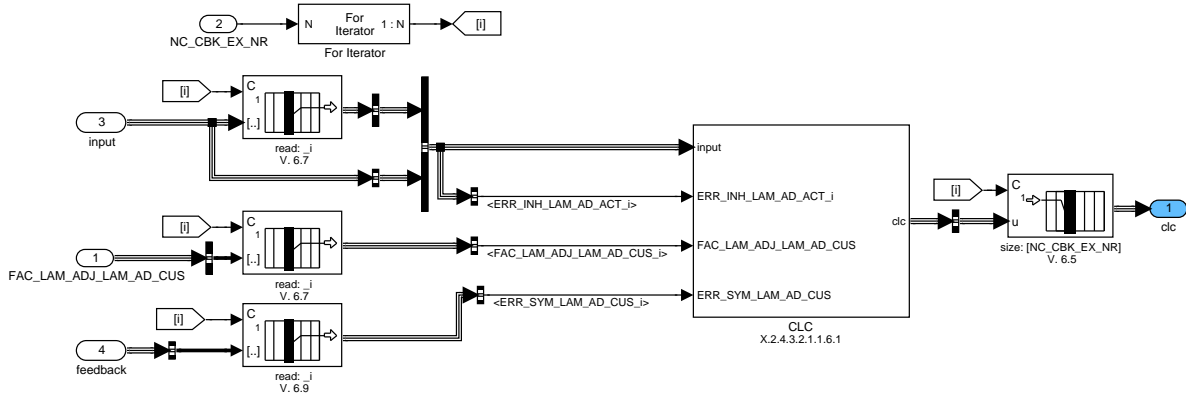


Figure R.34.50: :

R.34.2.4.3.2.1.1.6.1 Calculation

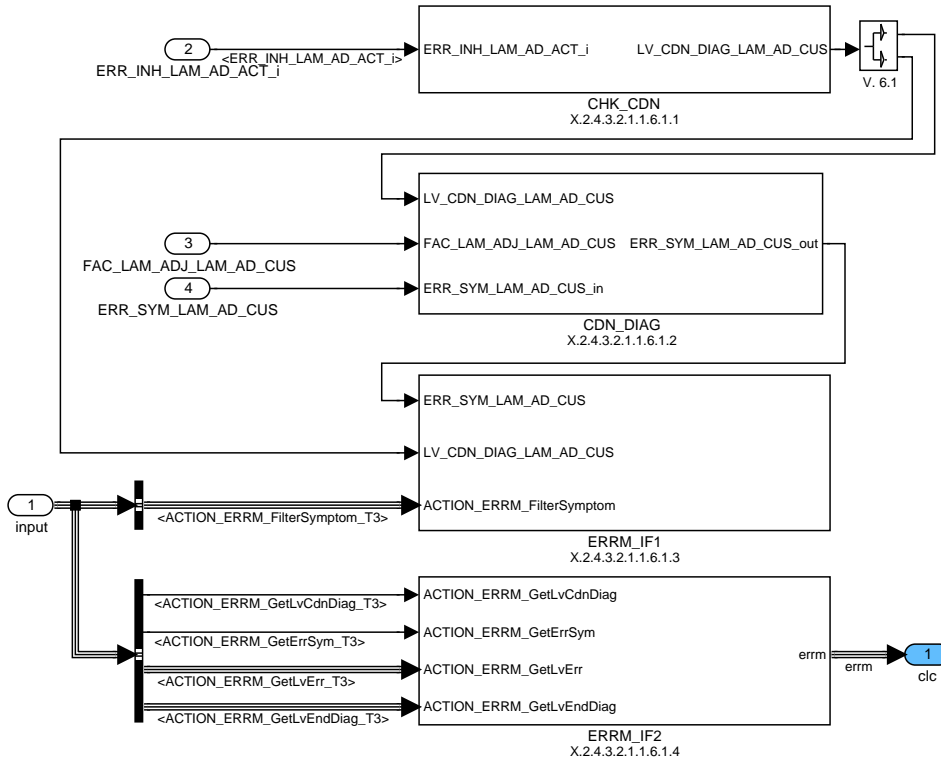


Figure R.34.51: :

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**R.34.2.4.3.2.1.1.6.1.1 Calculation of Condition flag**

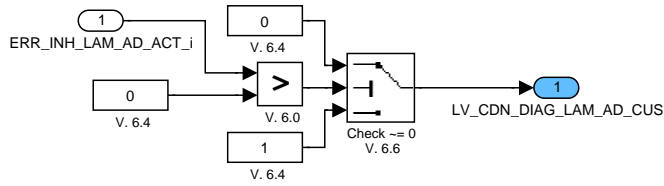


Figure R.34.52: :

**R.34.2.4.3.2.1.1.6.1.2 Check Condition**

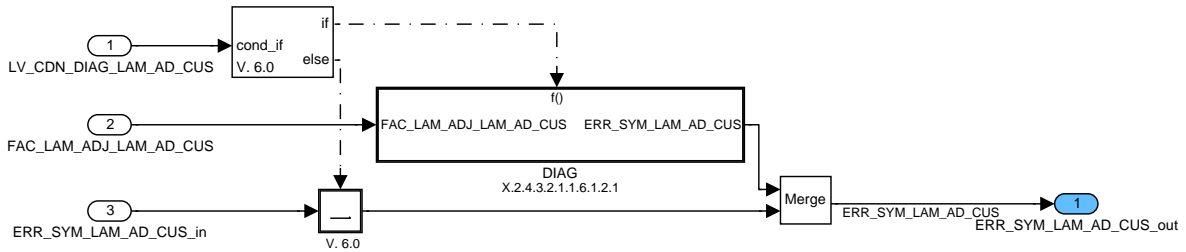


Figure R.34.53: :

**R.34.2.4.3.2.1.1.6.1.3 Condition fulfilled: Symptom Evaluation**

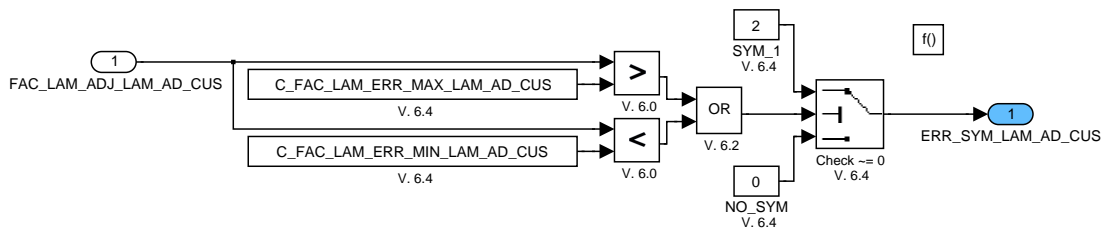


Figure R.34.54: :

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**R.34.2.4.3.2.1.1.6.1.4 ERRM filter**

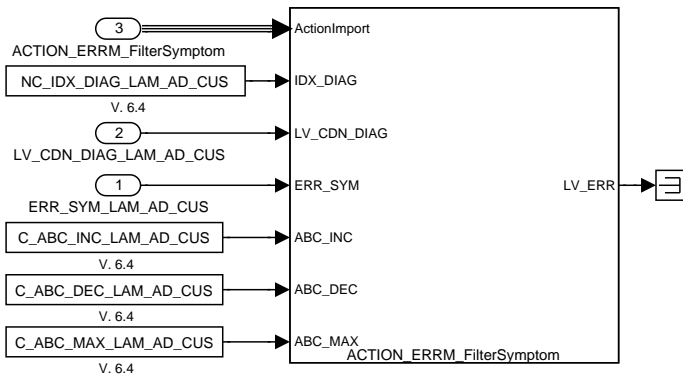


Figure R.34.55: :

**R.34.2.4.3.2.1.1.6.1.5 Outputs from ERRM**

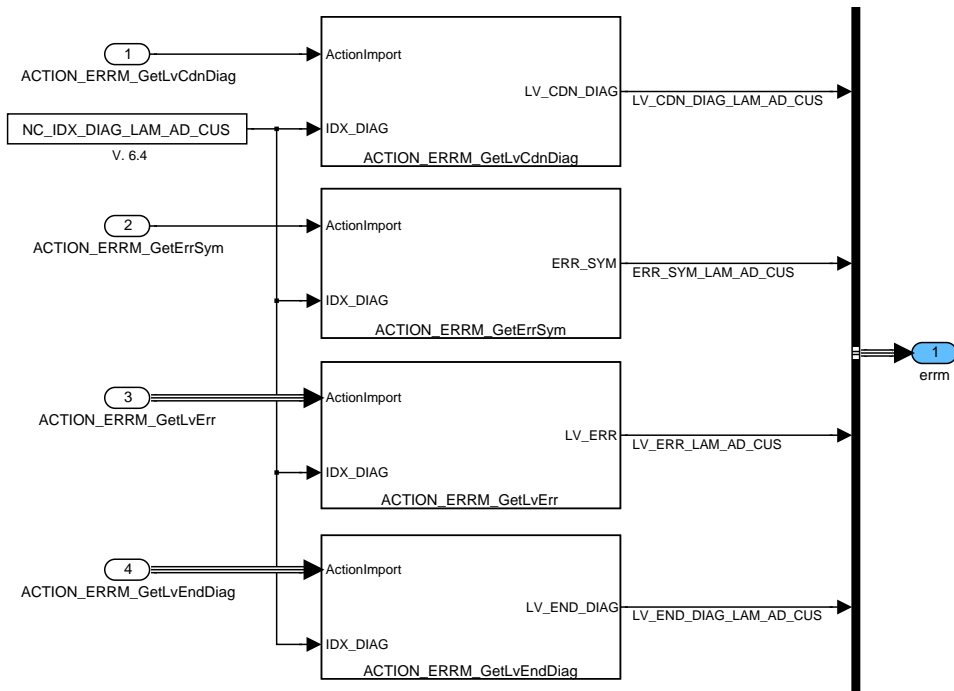


Figure R.34.56: :

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### R.34.2.4.3.3 For loop

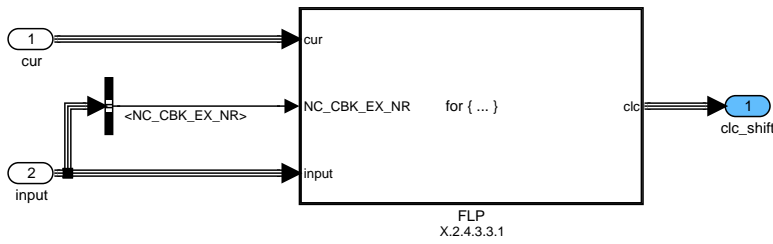


Figure R.34.57: :

### R.34.2.4.3.3.1 Calculation

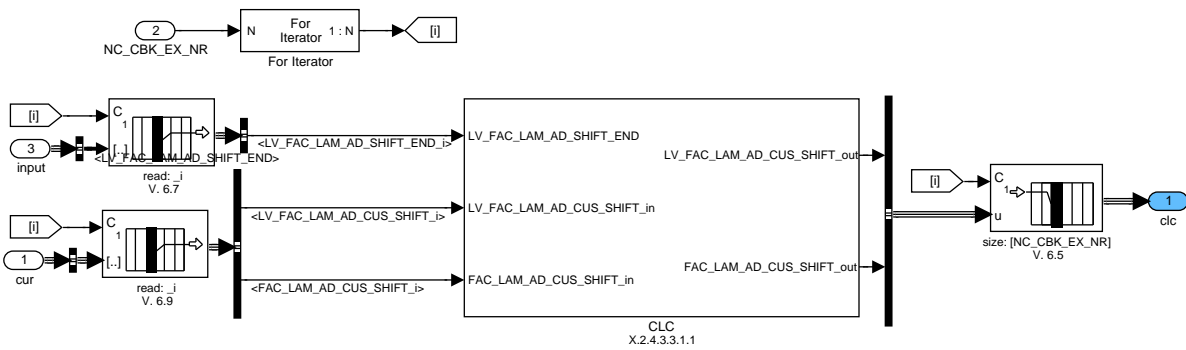


Figure R.34.58: :

### R.34.2.4.3.3.1.1 Calculation of LV\_FAC\_LAM\_AD\_CUS\_SHIFT and FAC\_LAM\_AD\_CUS\_SHIFT

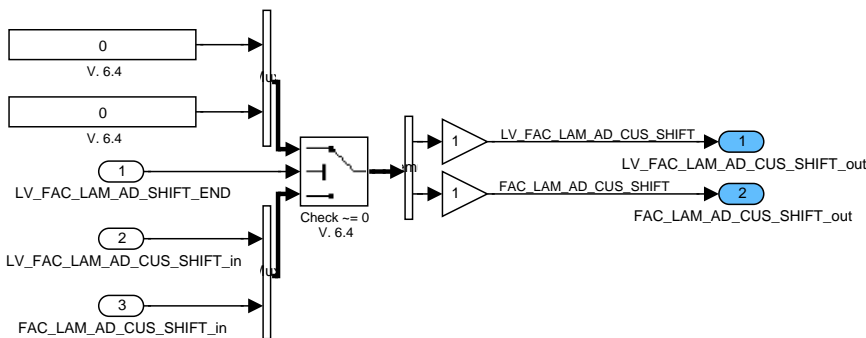


Figure R.34.59: :

### R.34.2.4.3.4 Clear anti-bounce counter if LC\_LAM\_AD\_CUS\_CLR is true

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## R.35 Customer adaptation module: LASP

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_BAS [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Bank selective basic lambda setpoint					
LAMB_BAS_H_RES [NC_CBK_EX_NR]	O/V	0... 7FFFFH	0... 31.99993	61e-6	-
Bank selective basic lambda setpoint with high resolution					
LAMB_HOM_AFL	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda setpoint for homogeneous lean combustion					
LAMB_SP	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda setpoint					
LAMB_SP [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda setpoint					
LAMB_SP_HOM [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 1.99993	61e-6	-
Lambda setpoint with high resolution					

### Input data:

Dla_soll_puls [NC_CBK_EX_NR] {p. 8156}	La_bas1 {p. 8160}	La_bas2 {p. 8160}	La_ref_homm {p. 8160}
La_sollreg [NC_CBK_EX_NR] {p. 8160}	NC_CBK_EX_NR {p. 1829}		

### R.35.1 Outputs for BMW for supplier aggregates

#### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs can be different from the specified values due to the input data attributes.

#### Application conditions

**Activation:** LV\_ST\_END = 1

**Deactivation:** LV\_ST\_END = 0

**Initialisation :** 1

**Recurrence:** 10 ms


Except LAMB\_HOM\_AFL: 20 ms

Except LAMB\_SP\_HOM[1] and LAMB\_SP\_HOM[2], which shall be segment synchronous; LAMB\_SP\_HOM[1] shall be synchronised with the update rate of La\_sollreg1 and similarly LAMB\_SP\_HOM[2] with La\_sollreg2.

Except LAMB\_SP[1], LAMB\_SP[2], LAMB\_SP: segment synchronous

**Formula section:**

$$\begin{aligned}
\text{LAMB\_SP\_HOM}[1] &= \text{La\_sollreg}[1] - \text{Dla\_soll\_puls}[1] \\
\text{LAMB\_SP\_HOM}[2] &= \text{La\_sollreg}[2] - \text{Dla\_soll\_puls}[2] \\
\text{LAMB\_SP}[1] &= \text{La\_sollreg}[1] - \text{Dla\_soll\_puls}[1] \\
\text{LAMB\_SP}[2] &= \text{La\_sollreg}[2] - \text{Dla\_soll\_puls}[2] \\
\text{LAMB\_SP} &= (\text{LAMB\_SP}[1] + \text{LAMB\_SP}[2]) / 2 \\
\text{LAMB\_HOM\_AFL} &= \text{La\_ref\_homm} \\
\text{LAMB\_BAS\_H\_RES}[\text{NC\_CBK\_EX\_NR}] &= \text{La\_ref\_homm} \\
\text{LAMB\_BAS}[1] &= \text{La\_bas1} \\
\text{LAMB\_BAS}[2] &= \text{La\_bas2}
\end{aligned}$$

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## R.36 Carrierbyte bitmasking

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_aekh_akt	O/V	0... 1H	0 ...1	1	-
Flag indicating " BMW seitige Aussetzererkennung im Katheizbetrieb aktiv"					
B_ar_akt	O/V	0... 1H	0 ...1	1	-
Flag indicating "Anti jerk active"					
B_atlsvc	O/V	0... 1H	0 ...1	1	-
Diagnosefunktion der Abgasturbolader aktiv					
B_atlsvc_khm	O/V	0... 1H	0 ...1	1	-
Anforderung Katheizmanager während der Turboladerdiagnose					
B_bns	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Bordnetzstabilität"					
B_bosmsgc	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung für Sendung der BOS Meldung"					
B_bs1	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung bauteilschutz aktiv 1"					
B_bs2	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung bauteilschutz aktiv 2"					
B_ccbtnach	O/V	0... 1H	0 ...1	1	-
Flag indicating "Batterie nachladen"					
B_ccbttdfk	O/V	0... 1H	0 ...1	1	-
Flag indicating "Batterie prüfen"					
B_ccbtknt	O/V	0... 1H	0 ...1	1	-
Flag indicating "Batteriekontakt /-anschlüsse prüfen!"					
B_ccpmerr	O/V	0... 1H	0 ...1	1	-
Flag indicating "Batterieüberwachung ausgefallen"					
B_ccprio	O/V	0... 1H	0 ...1	1	-
Flag indicating "Komfortverbraucher eingeschränk"					
B_ccruhver	O/V	0... 1H	0 ...1	1	-
Flag indicating "Erhöhte Batterieentladung im Stand"					
B_cdxenonr	O/V	0... 1H	0 ...1	1	-
Xenonverbau-Codierdaten lesen					
B_codierpm	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Sendeanforderung Anfrage Codierung PWM"					
B_dash	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Dashpozündungsbegrenzung aktiv"					
B_disa_stopp	O/V	0... 1H	0 ...1	1	-
Flag indicating "DISA Ventil schliessen"					
B_disa1_auf	O/V	0... 1H	0 ...1	1	-
Anforderung Disa 1 öffnen aus BMW-Modul					
B_disa2_auf	O/V	0... 1H	0 ...1	1	-
Anforderung Disa 2 öffnen aus BMW-Modul					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_ecobusy	O/V/S	0... 1H	0 ...1	1	-
Ecos Ruhestrommessung busy					
B_esp_h1	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Einspritzung homogen Bank 1"					
B_esp_h2	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Einspritzung homogen Bank 2"					
B_esp_hs1	O/V	0... 1H	0 ...1	1	-
Injection homogeneous-stratified mode bank 1					
B_esp_hs2	O/V	0... 1H	0 ...1	1	-
Injection homogeneous-stratified mode bank 2					
B_espr_start	O/V	0... 1H	0 ...1	1	-
Flag indicating "Einspritzung wird ausgeführt"					
B_ext_zylstop	O/V	0... 1H	0 ...1	1	-
Bedingung CILC und CYBL stoppen					
B_gangnull	O/V	0... 1H	0 ...1	1	-
Bedingung MSA bis zum nächsten Zündungswechsel deaktivieren					
B_gdst	O/V	0... 1H	0 ...1	1	-
Flag indicating " Schnelle Rampe fuer VollhubEinstellung "					
B_genoff	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Generator ausgeschaltet"					
B_hd_start	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Einspritzung wird ausgeführt"					
B_hlsh1_off	O/V	0... 1H	0 ...1	1	-
Bedingung Sondenheizung LSU Nachkat Bank 1 ausschalten					
B_hlsh2_off	O/V	0... 1H	0 ...1	1	-
Bedingung Sondenheizung LSU Nachkat Bank 2 ausschalten					
B_hlsu1_off	O/V	0... 1H	0 ...1	1	-
Bedingung Sondenheizung LSU Vorkat Bank 1 ausschalten					
B_hlsu2_off	O/V	0... 1H	0 ...1	1	-
Bedingung Sondenheizung LSU Vorkat Bank 2 ausschalten					
B_hmm_akt	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung homogen mager aktiv"					
B_hnox_off	O/V	0... 1H	0 ...1	1	-
Bedingung Heizung Nox-Sensor ausschalten					
B_hom_akt	O/V	0... 1H	0 ...1	1	-
Flag indicating "Homogenbetriebsberechnung aktiv"					
B_hschalt_komb	O/V	0... 1H	0 ...1	1	-
Upshift request to instrument cluster (CC message)					
B_hstoech	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Homogenstoechiometrisch angefordert"					
B_kl61	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Klemme 61"					
B_kupp	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Kupplung"					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_la_stopp1	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Lambdaregler Bank 1 stopp"					
B_la_stopp2	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Lambdaregler Bank 2 stopp"					
B_ldm_akt04	O/V	0... 1H	0 ...1	1	-
LDM active					
B_ldm_off	O/V	0... 1H	0 ...1	1	-
Shut off of LDM by ECU					
B_lklps	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Luftklappensteuerung Zu"					
B_lklps1	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Luftklappensteuerung down Zu"					
B_llrein	O/V	0... 1H	0 ...1	1	-
Logical variable for coordination engine start torque and minimum torque and clutch					
B_lradapt1_mn	O/V	0... 1H	0 ...1	1	-
Gemischadaption am min. Anschlag, Bank1					
B_lradapt1_mx	O/V	0... 1H	0 ...1	1	-
Gemischadaption am max. Anschlag, Bank1					
B_lradapt2_mn	O/V	0... 1H	0 ...1	1	-
Gemischadaption am min. Anschlag, Bank2					
B_lradapt2_mx	O/V	0... 1H	0 ...1	1	-
Gemischadaption am max. Anschlag, Bank2					
B_lroff	O/V	0... 1H	0 ...1	1	-
Flag indicating "Drehzahlschwelle für LR-Funktion Generator 1aktiv"					
B_lsd	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Lastschlagdämpfungsänderungsbegrenzung aktiv"					
B_maregdk_ad	O/V	0... 1H	0 ...1	1	-
Adaption Massenstromregler auf DK erstmalig erfolgt					
B_mdimin_sa	O/V	0... 1H	0 ...1	1	-
Bedingung minimal mögliches Moment eingestellt für Freigabe Schubabschalten					
B_mol_sf	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bed. Ölzustands-Sensorfehler"					
B_mol_vb	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Ölverbrauchswarnung"					
B_mol_vl	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Ölverbrauchswarnung"					
B_mrmslam	O/V	0... 1H	0 ...1	1	-
Bedingung MS-Abgleich soll über Lambda passieren					
B_msaakt	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung MSA aktiv"					
B_msaaktber	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung MSA aktiv und bereit"					
B_msaanz1	O/V	0... 1H	0 ...1	1	-
Flag indicating "MSA-Anzeige bei Abschaltverhinderer"					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_msaan2	O/V	0... 1H	0 ...1	1	-
Flag indicating "MSA-Anzeige bei Einschaltverhinderer"					
B_msaccid2	O/V	0... 1H	0 ...1	1	-
Bedingung MSA deaktiviert					
B_msaerr	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Fehler MSA"					
B_msaprestopp	O/V	0... 1H	0 ...1	1	-
Preliminary MSA engine stop request					
B_msastart	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Startanforderung MSA"					
B_msastartf	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Startfreigabe MSA"					
B_msastarts	O/V	0... 1H	0 ...1	1	-
Motor wegen MSA gestartet					
B_msastopp	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Stoppanforderung MSA"					
B_msastops	O/V	0... 1H	0 ...1	1	-
Flag indicating "MSA-Stopstatus für Powermanagement"					
B_mslam1_diag	O/V	0... 1H	0 ...1	1	-
not used flag					
B_mslam2_diag	O/V	0... 1H	0 ...1	1	-
not used flag					
B_nesps_akt	O/V	0... 1H	0 ...1	1	-
Flag indicating "Nacheinspritzung Schicht wird ausgeführt"					
B_nesps_ena	O/V	0... 1H	0 ...1	1	-
Flag indicating "Nacheinspritzung Schicht möglich"					
B_nggelernt	O/V	0... 1H	0 ...1	1	-
Flag indicating "Nullgangposition gelernt"					
B_ngimlf	O/V	0... 1H	0 ...1	1	-
Flag indicating "Nullgangsignal im Lernfenster"					
B_nmax_ba_cc	O/V	0... 1H	0 ...1	1	-
Bedingung CC Meldung durch Drehzahlbegrenzung aus MDBA					
B_notafu	O/V	0... 1H	0 ...1	1	-
Getriebe Not-Anfahrunterstützung					
B_nplmslam_mn	O/V	0... 1H	0 ...1	1	-
not used flag					
B_nplmslam_mx	O/V	0... 1H	0 ...1	1	-
not used flag					
B_nplmslam2_mn	O/V	0... 1H	0 ...1	1	-
not used flag					
B_npmlslam2_mx	O/V	0... 1H	0 ...1	1	-
not used flag					
B_nsub	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Solldrehzulanhebung bei niedriger Ladebilanz"					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_ntlkws	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Notlauf Kühlkreislauf"					
B_oeltemp	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung gültiger Öltemp Messwert"					
B_oelverb	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung für ausgelöste Ölverbrauchswarnung"					
B_oelverl	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung für ausgelöste Ölverlustswarnung"					
B_oztemic	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung QLT-Temic-verbaut"					
B_pmbsdanf	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung POWERMANAGMENT BATTERIESPANNUNG Sendeanforderung"					
B_pmvsdanf	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung POWERMANAGMENT VERBRAUCHERSTEUERUNG Sendeanforderung"					
B_poel_gelb	O/V	0... 1H	0 ...1	1	-
Bedingung Öldruckkontrolllampe gelb (CC ID 427)					
B_poel_rot	O/V	0... 1H	0 ...1	1	-
Bedingung Öldruckkontrollleuchte rot (CC ID 212)					
B_prailpulskor_ee	O/V	0... 1H	0 ...1	1	-
Druckpulsationskorrektur für homogene Einfacheinspitzung ein-/ausgeschaltet					
B_prailpulskor_me	O/V	0... 1H	0 ...1	1	-
Druckpulsationskorrektur für homogene Mehrfacheinspitzung ein-/ausgeschaltet					
B_prailsw	O/V	0... 1H	0 ...1	1	-
External fuel pressure setpoint request					
B_prsoll_h	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Raildruckkennfeld"					
B_psragr_ad	O/V	0... 1H	0 ...1	1	-
Adaption AGR					
B_psrhub_ad	O/V	0... 1H	0 ...1	1	-
Flag indicating "Adaption Druckregler auf Hub erstmalig erfolgt"					
B_qvch2o	O/V	0... 1H	0 ...1	1	-
Bit für zu hohen Wasserverlus					
B_rkkor_kva	O/V	0... 1H	0 ...1	1	-
Anforderung Verbrauchsberechnung mit korrigierter Kraftstoffmasse					
B_rschaft_komb	O/V	0... 1H	0 ...1	1	-
Downshift request to instrument cluster (CC message)					
B_safast_egs	O/V	0... 1H	0 ...1	1	-
Flag indicating "Schnelles Schubabschalten nach EGS-Schaltungen erlaubt"					
B_sch_akt	O/V	0... 1H	0 ...1	1	-
Flag indicating "Schichtberechnung aktiv"					
B_schicht	O/V	0... 1H	0 ...1	1	-
Flag indicating "Motor läuft im Schichtbetrieb"					
B_sleepwait	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung einschlafen verhindern"					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_spa_cist	O/V	0... 1H	0 ...1	1	-
Zurückgemeldete Codierung SPA					
B_temxon	O/V	0... 1H	0 ...1	1	-
Flag indicating "Begrenzung der Einspritzzeit"					
B_tev_stopp	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Stop Tev"					
B_tmmi_warn1	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Warnlampe Stufe 1 (gelb) an MMI"					
B_tmmi_warn2	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Warnlampe Stufe 2 (rot) an MMI"					
B_tmmi_warn3	O/V	0... 1H	0 ...1	1	-
Flag indicating "Ansteuerung der MMI-Meldung "bitte hochschalten""					
B_ums_vbsa	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Schubabschaltung verboten"					
B_urst	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Urstart is aktiv"					
B_vb_sa	O/V	0... 1H	0 ...1	1	-
Flag indicating "Schubabschalten verboten wg. niedriger KatTemp."					
B_vb_sa_nk	O/V	0... 1H	0 ...1	1	-
Prohibition of clinder cut off due to high underfloor temperature					
B_vbkhm_notl	O/V	0... 1H	0 ...1	1	-
Bedingung Verbot Katheizen					
B_verb_h	O/V	0... 1H	0 ...1	1	-
Flag indicating "Verbot Homogen"					
B_verb_off	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung elektrische Verbraucher aus"					
B_verb_s	O/V	0... 1H	0 ...1	1	-
Flag indicating "Verbot Schicht"					
B_vlschalt	O/V	0... 1H	0 ...1	1	-
Flag indicating "Lader Status"					
B_vsa_an	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Vanos Auslass im Anschlag"					
B_vsaadp	O/V	0... 1H	0 ...1	1	-
Flag indicating "Anschlagadaption Auslassspreizung variable NWS"					
B_vse_an	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Vanos Einlass im Anschlag"					
B_vseadp	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Vanos Einlass im Anschlag"					
B_vsean_loc	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Vanos Einlass im Anschlag beim letzten abstellen"					
B_wdkdiag_ugd	O/V	0... 1H	0 ...1	1	-
Bedingung Berechnung DKWinkel aus Signal des HF-Sensors ungedrosselt					
B_wese2h_abs	O/V	0... 1H	0 ...1	1	-
Winkel für 2. Einspritzung Homogen aus Wese2_h[Anz_Zyl] benutzen					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_zw_dynman	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Dynamik"					
B_zwdyn	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Dynamik für Modul zwgrund"					
B_zwmin_ext	O/V	0... 1H	0 ...1	1	-
Bedingung minimaler Zündwinkel von extern					
St_abgasklappe	O/V	0... FFH	0... 255	1	-
Statuswort für Abgasklappe					
St_agr	O	0... FFH	0... 255	1	-
Carrierbyte for status exhaust gas recirculation					
St_anf_prail	O/V	0... FFH	0... 255	1	-
Carrierbyte for status pressure request					
St_anman1	O/V	0... FFH	0... 255	1	-
carrierbyte for status of anman					
St_atldiag2_in	O/V	0... FFH	0... 255	1	-
Statusbyte Interface Eingang					
St_auss	O/V	0... FFH	0... 255	1	-
Status Aussetzerschwellen					
St_ba	O/V	0... FFH	0... 255	1	-
carrierbyte for status of operating mode					
St_bgkuppl	O/V	0... FFH	0... 255	1	-
Carrierbyte for status of clutch					
St_bls	O/V	0... FFH	0... 255	1	-
carrierbyte for status of brake light switch					
St_blsdisa1	O/V	0... FFH	0... 255	1	-
carrierbyte for status of ???					
St_btvn	O/V	0... FFH	0... 255	1	-
carrierbyte for status of VANOS					
St_ckl15	O/V/S	0... FFH	0... 255	1	-
carrierbyte for status of terminal signals via CAN					
St_clc	O/V	0... FFH	0... 255	1	-
carrierbyte for status of combustion mode					
St_cybl	O/V	0... FFFFH	0... 65535	1	-
Carrierword for Gleichstellung					
St_cybl2	O/V	0... FFH	0... 255	1	-
Statuswort für Bits					
St_desul	O/V	0... FFH	0... 255	1	-
carrierbyte for status of desulfuration					
St_devxdetec	O/V/S	0... FFH	0... 255	1	-
Ergebnis BSD-Lernfunktion					
St_dk_diag	O/V/S	0... FFH	0... 255	1	-
carrierbyte for status of TPS diagnosis					
St_dkg	O/V	0... FFH	0... 255	1	-
Anforderungsmodus					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_dkheiz	O/V	0... FFH	0... 255	1	-
Statuswort für Drosselklappenheizung					
St_dkratio	O/V	0... FFH	0... 255	1	-
carrierbyte for status of TPS ???					
St_dtev	O/V	0... FFH	0... 255	1	-
Status TEV-Diagnose					
St_dyndzm	O/V	0... FFH	0... 255	1	-
Statuswort					
St_ecostat1	O/V	0... FFH	0... 255	1	-
Ecos Statusbyte 1					
St_egs	O/V	0... FFH	0... 255	1	-
carrierbyte for status of AT (automatic transmission)					
St_ekp	O/V	0... FFH	0... 255	1	-
carrierbyte for status of electronic fuel pump					
St_elu	O/V/S	0... FFH	0... 255	1	-
carrierbyte for status of electrical cooling fan					
St_fdc	O/V	0... FFH	0... 255	1	-
carrierbyte for status of driving dynamics control units					
St_fgr	O/V	0... FFH	0... 255	1	-
carrierbyte for status of cruise control					
St_fi_nsobd	O/V	0... FFH	0... 255	1	-
Container für Bits					
St_gen_ext	O	0... FFH	0... 255	1	-
Carrierbyte for status external adjustment generator					
St_genallg	O/V	0... FFH	0... 255	1	-
carrierbyte for status of general alternator input values					
St_generator	O/V	0... FFH	0... 255	1	-
carrierbyte for status of alternator					
St_genll	O/V	0... FFH	0... 255	1	-
carrierbyte for status of 'LR' inputs (infos from alternator)					
St_gentester	O/V	0... FFH	0... 255	1	-
Statusbyte Generatortest					
St_getrdaten	O/V	0... FFH	0... 255	1	-
Status Getriebedaten					
St_getriebe	O/V	0... FFH	0... 255	1	-
carrierbyte for status of gearbox					
St_gglsu2	O/V	0... FFH	0... 255	1	-
carrierbyte for status of WRAF sensors					
St_igrin	O/V	0... FFH	0... 255	1	-
Carrierbyte for St_igrin					
St_igrinnv	O/V/S	0... FFH	0... 255	1	-
Carrierbyte " St_igrinnv"					
St_katueb	O/V	0... FFH	0... 255	1	-
carrierbyte for status of catalyst monitoring					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_kl15	O/V	0... FFH	0... 255	1	-
carrierbyte for status of ignition key					
St_klopfen	O/V	0... FFH	0... 255	1	-
carrierbyte for status of knock					
St_kr	O/V	0... FFH	0... 255	1	-
carrierbyte for status of knock control					
St_kr1	O/V	0... FFH	0... 255	1	-
carrierbyte for status of knock control (1)					
St_ksdiag	O/V	0... FFH	0... 255	1	-
Carrierbyte for status "Testeranforderung für Fuel-System-Diagnose"					
St_lam_ad_1	O/V	0... FFH	0... 255	1	-
Status Lambdaadaption Bank1					
St_lam_ad_2	O/V	0... FFH	0... 255	1	-
Status Lambdaadaption Bank2					
St_lamson	O/V	0... FFH	0... 255	1	-
Statuswort Lambdasonden					
St_ll	O/V	0... FFH	0... 255	1	-
carrierbyte for status of idle speed					
St_llr	O/V	0... FFFFH	0... 65535	1	-
carrierwords for status of idle speed control					
St_loadresp	O/V	0... FFH	0... 255	1	-
carrierbyte for status of loadresp					
St_lvs_in	O/V	0... FFH	0... 255	1	-
Statuswort für LVS Eingangsgrößen					
St_lvs_in_nv	O/V/S	0... FFH	0... 255	1	-
Statuswort für LVS Eingangsgrößen nichtflüchtig					
St_mdba_in	O/V	0... FFH	0... 255	1	-
Statuswort für Eingang MDBA					
St_mdbaprio_in	O/V	0... FFH	0... 255	1	-
Statusbyte Bit-Layereingänge Mdbaprio					
St_mkwchn	O/V	0... FFH	0... 255	1	-
carrierbyte for status of 'master crankshaft					
St_motmsa	O/V	0... FFH	0... 255	1	-
Statuswort Motorzustand					
St_motzustd	O/V	0... FFFFH	0... 65535	1	-
carrierword for status of engine state					
St_msae	O/V	0... FFFFH	0... 65535	1	-
carrierword for msae					
St_msae2	O/V	0... FFH	0... 255	1	-
Statuswort msae 2					
St_msaklima	O/V	0... FFH	0... 255	1	-
carrierbyte MSA-Beeinflussung with KLIMA					
St_msasiko	O/V	0... FFH	0... 255	1	-
Statuswort MSA-Plausi					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_oz	O/V	0... FFH	0... 255	1	-
carrierbyte for status of OEZS					
St_oz [_i]	O/V	0... FFH	0... 255	1	-
carrierbyte for status of OEZS					
St_pmcbsin	O/V	0... FFH	0... 255	1	-
Carrierbyte for ???					
St_pmi	O/V/S	0... FFH	0... 255	1	-
carrierbyte for status of inputs for low cost power management					
St_pmi_nv	O/S	0... FFH	0... 255	1	-
Carrierbyte for status of "Eingänge LCP non volatile"					
St_poel	O/V	0... FFH	0... 255	1	-
carrierbyte for oil switch					
St_poelreg1	O/V	0... FFH	0... 255	1	-
Status Öldruckregelung 1					
St_pruef	O/V	0... FFH	0... 255	1	-
carrierbyte for status of lambda request for plausibility test					
St_pwf	O/V	0... FFH	0... 255	1	-
Carrierbyte for status of power fail					
St_rail_tester	O/V	0... FFH	0... 255	1	-
Statuswort Raildruckregler					
St_sawe	O/V	0... FFH	0... 255	1	-
carrierbyte for status of fuel cut-off /restart fuel feed					
St_siko	O/V	0... FFH	0... 255	1	-
carrierbyte for status of ETC monitoring					
St_sk	O/V	0... FFH	0... 255	1	-
Carrierbyte for status of HOM_AFS					
St_slp	O/V	0... FFH	0... 255	1	-
carrierbyte for status of secondary air pump					
St_sls	O/V	0... FFH	0... 255	1	-
carrierbyte for status of secondary air system					
St_spa2	O/V/S	0... FFH	0... 255	1	-
Status SPA					
St_start	O/V	0... FFH	0... 255	1	-
Carrierbyte for status of start					
St_szboost	O/V	0... FFH	0... 255	1	-
Carrierbyte for status of dwell time prolongation					
St_tank	O/V	0... FFH	0... 255	1	-
Carrierbyte for status tank					
St_tevanst	O/V	0... FFH	0... 255	1	-
carrierbyte for status of canister purge control					
St_tevein	O/V	0... FFH	0... 255	1	-
carrierbyte for status of canister purge valve					
St_ti	O/V	0... FFH	0... 255	1	-
carrierbyte for status of injection					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_tp	O	0... FFH	0... 255	1	-
Statuswort					
St_tum	O/V	0... FFH	0... 255	1	-
Carrierbyte for status of tum					
St_vbrzyl_ein	O/V	0... FFFFH	0... 65535	1	-
Status Zylindergleichstellung					
St_wdkdiag	O/V	0... FFH	0... 255	1	-
Carrierbyte for status "Status 3. Poti"					
St_wm	O/V	0... FFH	0... 255	1	-
carrierbyte for status of WM-coordinator input					
St_wuerg	O/V	0... FFH	0... 255	1	-
Statuswort für Abwürgererkennung					
St_zwbts	O/V	0... FFH	0... 255	1	-
carrierbyte for status of catalyst overheating prevention					
St_zwgemad	O/V	0... FFH	0... 255	1	-
Statuswort für Bits					
St_zwktibs	O/V	0... FFH	0... 255	1	-
carrierbyte for status of IBS communication					
St_zylab	O/V	0... FFH	0... 255	1	-
carrierbyte for status of cylinder shut-off					
Status_kwnot	O/V	0... FFH	0... 255	1	-
carrierbyte for status of crankshaft limp-home					

## Input data:

B_abgasklappe {p. 8283}	B_abgewuergt {p. 8220}	B_agr_ktrl {p. 8197}	B_atlsvc_if {p. 8232}
B_auss_b1 {p. 8360}	B_cdigronw {p. 8283}	B_cdxenonw {p. 8283}	B_crashgen {p. 8366}
B_dc_new {p. 8220}	B_desu_fett {p. 8199}	B_desu_puls {p. 8199}	B_dev0detec {p. 8366}
B_dev1detec {p. 8366}	B_dev2detec {p. 8366}	B_dev3detec {p. 8366}	B_dev4detec {p. 8366}
B_dev5detec {p. 8366}	B_dev6detec {p. 8366}	B_dev7detec {p. 8366}	B_disa_akt {p. 8277}
B_dkheiz_ende {p. 8377}	B_dkratio_h {p. 8377}	B_dscakt {p. 8283}	B_dzm_dyn {p. 8283}
B_ecojob1 {p. 7482}	B_ecojob2 {p. 7482}	B_eol_tev {p. 8229}	B_fagurt {p. 8283}
B_fe {p. 8283}	B_fetrawedeak {p. 8283}	B_fgr_akt {p. 8390}	B_fi_nsobd1 {p. 8363}
B_fi_nsobd2 {p. 8363}	B_ftauf1 {p. 8284}	B_gang_rueck {p. 8394}	B_gangwechsel_gs {p. 8284}
B_gen_ext {p. 8284}	B_gentestanf {p. 7763}	B_gl_ad {p. 8187}	B_gl_adder {p. 8187}
B_gl_adz {p. 8187}	B_gl_adz_offset1 {p. 8187}	B_gl_adz_offset2 {p. 8187}	B_gl_hz {p. 8187}
B_gl_wg1 {p. 8187}	B_gl_wg2 {p. 8187}	B_gl_zsk {p. 8187}	B_gl_zswz {p. 8187}
B_injad_anf {p. 8187}	B_jumpstart {p. 8367}	B_kath {p. 8232}	B_keinhs_gs {p. 8284}
B_kupp1 {p. 8284}	B_lamson_ok1 {p. 8195}	B_lamson_ok2 {p. 8195}	B_lamzylact_1 {p. 8187}
B_lamzylact_2 {p. 8187}	B_ldm_ena {p. 8284}	B_ldm_nofil {p. 8284}	B_lklps_kl1 {p. 8284}
B_lklps_kl2 {p. 8284}	B_lklps_ln {p. 8225}	B_lklps_ln1 {p. 8225}	B_lrad_akt1 {p. 8308}
B_lrad_akt2 {p. 8308}	B_lrad_deakt1	B_lrad_deakt2	B_lurzylact {p. 8187}
B_lvs_neustart {p. 7482}	B_mhauf1 {p. 8284}	B_motlaeuft {p. 8220}	B_msacanerr {p. 8220}
B_msadeakt {p. 8220}	B_msadltgpd {p. 8284}	B_msadltgtd {p. 8284}	B_msadxav {p. 797}
B_msahfreset {p. 7679}	B_msaklimaav {p. 8220}	B_msaklimaea {p. 8220}	B_msaled



B_msalederr	B_msastopp_siko	B_msastopt {p. 8220}	B_msasw {p. 7679}
B_msataster {p. 8284}	B_msavadapt {p. 8220}	B_msaverh {p. 8220}	B_nglern {p. 7482}
B_nosa {p. 8284}	B_nsadap_anf {p. 8363}	B_nsdiaq_anf {p. 8363}	B_pmrestore {p. 7679}
B_poel {p. 8202}	B_poelsoltst {p. 8202}	B_rgnkat_hla1 {p. 8199}	B_safast {p. 8379}
B_schalt_dkg {p. 8284}	B_schalt_ldm {p. 8284}	B_schlok {p. 8220}	B_siko_rechnet {p. 8193}
B_sk_homla1 {p. 8136}	B_spa_csoll {p. 7679}	B_sta {p. 8367}	B_start {p. 8209}
B_taleer {p. 8284}	B_td_og {p. 8202}	B_td_ogok {p. 8202}	B_teblg {p. 8229}
B_testpoelsys {p. 7763}	B_toel {p. 8202}	B_tra {p. 8284}	B_tstkvs {p. 8285}
B_warml_zykl {p. 8304}	B_we {p. 8285}	B_wst {p. 8241}	B_zrlvs_clr {p. 7679}
B_zwgemad_1 {p. 8308}	B_zwgemad_2 {p. 8308}	ECU_STATE {p. 1091}	KNK_CTL_DIS {p. 1952}
LV_AD_CLR_RON {p. 8304}	LV_AFL_CLC {p. 1822}	LV_ALTER_BSD_PROT_2 {p. 4094}	LV_ALTER_ERR_EL {p. 4094}
LV_ALTER_ERR_MEC {p. 4094}	LV_ALTER_ERR_TEMP {p. 4094}	LV_ALTER_IF_ACT {p. 4094}	LV_ALTER_RD_TBL_6 {p. 799}
LV_AT {p. 654}	LV_BRAKE_DET {p. 4209}	LV_CAM_SP_CH {p. 799}	LV_CAM_SP_EX_EXT_ ADJ {p. 7433}
LV_CAM_SP_IN_EXT_ADJ {p. 7433}	LV_CS_CUS {p. 1419}	LV_CWP_BLOCK_DEAC {p. 4094}	LV_DRI {p. 1302}
LV_ERR_BSD {p. 4834}	LV_FAN_VAR_AD {p. 803}	LV_GS_ACT {p. 6658}	LV_IGK {p. 906}
LV_INH_AFL {p. 1822}	LV_INH_DPS_REG_ CPSDIAG {p. 803}	LV_INH_LSCL [NC_CBK_EX_NR] {p. 2544}	LV_INH_S {p. 1822}
LV_KEY_AUX {p. 1566}	LV_KNK_CTL_ENA {p. 1961}	LV_KNK_TRA_N {p. 1962}	LV_LAMB_CH {p. 803}
LV_LOAD_RESP_ALTER_ CND_1 {p. 4094}	LV_LOAD_RESP_ALTER_ THD_ACT_SP {p. 8368}	LV_LTG_HDLP_L_ON {p. 1566}	LV_LTG_INL_ON {p. 1566}
LV_MFF_S_POST_CH {p. 804}	LV_N_MON_CWP_DEAC {p. 4095}	LV_NT_AFS_REQ {p. 2982}	LV_REQ_HEAT {p. 1567}
LV_REQ_ISC {p. 3501}	LV_RGN_NT_REQ {p. 2983}	LV_RLY_ST_CAN {p. 1567}	LV_S_CLC {p. 1822}
LV_SENS_BAT_SMT_DET {p. 4095}	LV_SO2P_ACT {p. 3129}	LV_SOF_SWI {p. 3851}	LV_TI_CH {p. 1775}
LV_TQ_CRU_ACT {p. 6706}	LV_TQ_IGA_ACT {p. 1948}	LV_TQ_MIN_CLU {p. 8379}	NC_CBK_EX_NR {p. 1829}
St_aekh {p. 8168}	St_ar1 {p. 8169}	St_atldiag2_out {p. 8169}	St_atloutif_out
St_atlstat {p. 8169}	St_ba_agf {p. 8169}	St_blshub {p. 8169}	St_bns {p. 8169}
St_deavns2 {p. 8169}	St_dgen0 {p. 8169}	St_dibs0 {p. 8171}	St_disa_bmw {p. 8171}
St_dps {p. 8171}	St_ecostat2 {p. 8171}	St_eisy_hfm {p. 8171}	St_eisyad_read {p. 8171}
St_eisydiag1 {p. 8171}	St_eisydiag2 {p. 8171}	St_es_urstart {p. 8171}	St_gl_adapt {p. 8172}
St_hhs {p. 8172}	St_igroutnv {p. 8172}	St_imdgen0 {p. 8172}	St_kath_ena {p. 8172}
St_ldstgen {p. 8172}	St_llranh0 {p. 8172}	St_mdar0 {p. 8172}	St_mdar1 {p. 8172}
St_mdar2 {p. 8172}	St_mdbafak {p. 8172}	St_mdbanl_pwgll {p. 8172}	St_mdbanl2 {p. 8172}

St_mdk {p. 8172}	St_mini {p. 8173}	St_msaa {p. 8173}	St_msaanz {p. 8173}
St_msabs {p. 8173}	St_ngang0 {p. 8173}	St_nmax_ba {p. 8173}	St_oz_o {p. 8173}
St_ozbg0 {p. 8173}	St_pmdiag0 {p. 8173}	St_pmdiag1 {p. 8173}	St_pmprsvcalc1 {p. 8173}
St_poelreg2 {p. 8173}	St_pr {p. 8173}	St_prestoppmsa {p. 8173}	St_qvc1 {p. 8173}
St_rail {p. 8174}	St_sa {p. 8174}	St_sleep {p. 8174}	St_sondenheiz {p. 8174}
St_statmkor1 {p. 8174}	St_ti_b {p. 8174}	St_tiausgang {p. 8174}	St_ugenkor0 {p. 8174}
St_vbrzyl_aus {p. 8174}	St_vsa {p. 8174}	St_vse {p. 8174}	St_wm1 {p. 8174}
St_zwbts1 {p. 8174}	St_zwgrund {p. 8174}	Stat_sv_reg1 {p. 8175}	Stat_sv_reg2 {p. 8175}
STATE_CH {p. 1777}	STATE_CLU_AMT {p. 1571}	STATE_ETC_LIH {p. 4982}	STATE_TEMP_GB {p. 1578}
STATE_TPS_DIAG {p. 4982}	Stpcos {p. 8175}		

### R.36.1 Carrierbytes St\_.. which are defined as supplier outputs

#### FUNCTION DESCRIPTION:

##### General information:

Adaptation to BMW environment

##### Application conditions

**Initialisation at reset or at exit ECU\_STATE "PWL":** all variables St\_.. are initialised with 0 except:

```

St_abgasklappe = 1
St_blsdisal      = last calculated value
St_devxdetec    = last valid value
St_dk_diag      = first valid value
St_dkheiz       = 1
St_elu          = first value
St_elu(0)       = last stored value
St_fdc          = first valid value
St_fdc(0)       = first measured value
St_getriebe     = first valid value
St_getriebe(0) = first measured value

```

```

If LV_VAR_BN = 0
then St_kl15(0) = 1
else St_kl15(0) = 0
endif


```

```

St_pmi_nv(0) = last stored value
St_pmi_nv(1) = last stored value
St_pmi_nv = last value from nonvolatile memory
St_spa2     = last value from nonvolatile memory
St_lvs_in_nv = last value from nonvolatile memory

```

**Recurrence:** seg: St\_zylab, (if LV\_ST\_END = 1),  
St\_szboost ( if LV\_ES = 0 )


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Status\_kwnot, St\_ti

5ms: St\_dk\_diag, St\_klopfen, St\_dkratio  
 10 ms: St\_zylab. (if LV\_ST\_END = 0),  
       St\_szboost ( if LV\_ES = 1 )  
       St\_anman1, St\_ba, St\_bgkuppl, St\_btvns, St\_clc,  
 St\_dtev, St\_egs, St\_ekp, St\_fdc, St\_fgr, St\_generator, St\_  
 getriebe, St\_katueb, St\_kr, St\_kr1, St\_ll, **St\_llr (wird beim  
 ersten LL-Regler ein gesetzt und nicht mehr geändert)**, St\_  
 loadresp, St\_motzstd, St\_slp, St\_sls, St\_start, St\_tevein,  
 St\_tevanst, St\_pmi, St\_pmi\_nv, St\_agr, St\_sk, St\_anf\_prail,  
 St\_cybl, St\_blstdisal , St\_poelregl, St\_msae, St\_dkg, St\_auss,  
 St\_lamson, St\_zwgemad, St\_abgasklappe, St\_dyndzm, St\_getrdaten,  
 St\_spa2, St\_fi\_nsobd, St\_motmsa, St\_wuerg, St\_msae2, St\_mdba\_  
 in, St\_msasiko, St\_mdbaprio\_in, St\_siko, St\_rail\_tester  
 20 ms: St\_desul, St\_kl15, St\_sawe, St\_zwktibs (via BSD call)  
 100 ms: St\_atldiag2\_in, St\_bls, St\_ckl15, St\_elu, St\_genallg,  
 St\_genll, St\_gglsu2, St\_gen\_ext, St\_tank, St\_ksdiag, St\_pruef,  
 St\_tum, St\_pmi\_nv, St\_tum, St\_oz\_i, St\_entlast\_loc, St\_igrin,  
 St\_igrinnv, St\_poel, St\_gentester, St\_ecostat1, St\_dkheiz,  
 St\_vbrcycl\_ein, St\_msaklima, St\_lam\_ad\_1, St\_lam\_ad\_2, St\_lvs\_  
 in, St\_lvs\_in\_nv, St\_cybl2  
 200 ms: St\_zwbts, HKWBits2\_1000ms, St\_wm, St\_tp,  
 1000 ms: St\_oz  
 Once at ECU init: St\_devxdetec, St\_pwf  
 BSD: St\_zwktibs  
 Activation:           after reset

During power latch phase: all variables are zero, except:


St\_atldiag2\_in = last calculated value  
 St\_abgasklappe = last calculated value  
 St\_blstdisal = last calculated value  
 St\_ckl15 is calculated in the PWL phase  
 St\_ckl15(0) = received value  
 St\_ckl15(1) = received value  
 St\_devxdetec = last valid value  
 St\_dk\_diag = last calculated value  
 St\_dkheiz = last calculated value  
 St\_ecostat1 = last calculated value  
 St\_egs = last value  
 St\_egs(0) = last valid value  
 St\_egs(1) = last valid value  
 St\_egs(2) = last valid value  
 St\_ekp(3) = last valid value  
 St\_elu = last calculated value  
 St\_fdc = last valid value  
 St\_fdc(0) = last measured value  
 St\_genallg = last value  
 St\_genallg(0) = last value  
 St\_genallg(2) = last value  
 St\_genallg(3) = last value  
 St\_genallg(4) = last value  
 St\_generator = last calculated value  
 St\_generator(0) = last valid value  
 St\_generator(2) = last valid value  
 St\_generator(3) = last valid value  
 St\_generator(4) = last valid value

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```

St_generator(5) = last valid value
St_generator(6) = last calculated value
St_genll = last value
St_genll(0) = last value
St_genll(2) = last value
St_getriebe = last valid value
St_getriebe(0) = last valid value
St_gglsu2(0) = 1
St_gglsu2(1) = 1
St_katueb(0) = 1
St_katueb(1) = 1
St_loadresp = last value
St_loadresp(0) = last value
St_mdba_in = last calculated value
St_msae = last value
St_oz(0) = last calculated value
St_oz(1) = last calculated value
St_oz_i(0) = last value
St_oz_i(1) = last value
St_oz_i(4) = last calculated value
St_pmi(0) is calculated in the PWL phase
St_pmi(1) is calculated in the PWL phase
St_pmi(2) is calculated in the PWL phase
St_pmi(3) is calculated in the PWL phase
St_pmi(4) is calculated in the PWL phase
St_poel = last value
St_slp(0) = last valid value
St_slp(2) = last valid value
St_sls(0) = last value
St_start = last calculated value
St_zylab(0) is calculated in the PWL phase
St_zylab(1) is calculated in the PWL phase
St_zwktibs(0) is calculated in the PWL phase
St_tum(0) = last calculated value
St_pmi_nv is calculated in the PWL phase
St_wm = last value
St_tum = last calculated value
St_gen_ext is calculated in the PWL phase
St_sk = last value
St_tank = last calculated value
St_wdkdiag = last calculated value
St_igrin is calculated in the PWL phase
St_gentester = last calculated value
St_zwgemad = last calculated value
St_szboost is calculated in the PWL phase
St_vbrcycl_ein = last calculated value
St_msa_klima = last calculated value
St_spa2 = last calculated value
St_fi_nsobd = last calculated value
St_wuerg = last calculated value
St_lvs_in = last calculated value
St_msae2 = last calculated value
St_mdbaprio_in = last calculated value
St_lvs_in_nv = last calculated value
St_cybl2 = last calculated value
St_rail_tester = Last calculated value

```

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**Deactivation:** after power latch phase

Formula section:

As the applied bitmasks are automatically generated by a script file, there is no separate arrangement stated in this specification.

## R.36.2 Carrierbytes B\_.. which are defined as BMW outputs

### FUNCTION DESCRIPTION:

#### General information:

Adaptation to BMW environment

#### Application conditions:

Initialisation at reset or at exit power latch phase:

*All values B\_.. are initialised with 0, except for:*

```

B_bns    = last stored value
B_dash   = first measured value
B_lsd    = first measured value
B_safast_egs = first measured value
B_vsa_an = last calculated value
B_vse_an = last calculated value
B_lklps  = last valid value
B_lklps1 = last valid value
B_disa1_auf = 1
B_disa2_auf = 1
B_maregdk_ad = last calculated value
B_mrmslam = first valid value
B_diagigr = last stored value
B_ecobusy = from nonvolatile memory
B_spa_cist = from nonvolatile memory
B_nmax_ba_cc = 1
B_psrhub_ad = last calculated value
B_psragr_ad = last calculated value

```

Recurrence:

10 ms: B\_ar\_akt, B\_bns, B\_dash, B\_disa\_stopp, B\_esp\_h1, B\_esp\_h2, B\_espr\_start, B\_prailsw, B\_hd\_start, B\_hmm\_akt, B\_hom\_akt, B\_hstoech, B\_kupp, B\_la\_stopp1, B\_la\_stopp2, B\_lroff, B\_lsd, B\_nesps\_akt, B\_nesps\_ena, B\_prsoll\_h, B\_sch\_akt, B\_schicht, B\_temxon, B\_tev\_stopp, B\_ulv, B\_verb\_h, B\_verb\_s, B\_vsa\_an, B\_vsaadp, B\_vse\_an, B\_vseadp, B\_zw\_dynman, B\_zwdyn, St\_fup\_bmw, B\_gdst, B\_esp\_hs1, B\_esp\_hs2, B\_hschalt\_komb, B\_ldm\_akt04, B\_ldm\_off, B\_rschalt\_komb, B\_prailsw, B\_disa1\_auf, B\_disa2\_auf, B\_msaakt, B\_msaaktber, B\_msaerr, B\_msastart, B\_msastartf, B\_msastopp, B\_msastops, B\_gangnull, B\_poel\_gelb, B\_poel\_rot, B\_vlschalt, B\_mdimin\_sa, B\_zwmin\_ext, B\_msaprestopp, B\_spa\_cist, B\_msastarts, B\_nmax\_ba\_cc, B\_notafu, B\_msaccid2, B\_vbkhm\_notl, B\_msaan1, B\_msaan2, B\_nggelernt, B\_ngimlf

20 ms: B\_wdkdiag\_ugd


100 ms: B\_atlsvc\_khm, ccbtnach, B\_ccbttdfk, B\_ccbtktnt, B\_ccpmerr, B\_ccprio, B\_ccruhver, B\_codierpm, B\_diagigr, B\_genoff, B\_kl61, B\_pmbsdanf, B\_pmvsdanf, B\_ums\_vbsa, B\_verb\_off, B\_maregdk\_ad, B\_ecobusy, B\_lradap1\_mn, B\_lradap1\_mx, B\_lradap2\_mn, B\_lradap2\_mx, B\_ext\_zylstop, B\_psrhub\_ad, B\_psragr\_ad, B\_hlsh1\_off, B\_hlsh2\_off, B\_hlsu1\_off, B\_hlsu2\_off, B\_hnox\_off, B\_atlsvc

200 ms: B\_bs1, B\_bs2, B\_ewp\_swsp, B\_lkpls, B\_lkpls1, B\_ntlkws, B\_tmmi\_warn1, B\_tmmi\_warn2, B\_tmmi\_warn3, B\_vb\_sa\_nk  
 1000 ms: B\_bosmsgc, B\_mol\_sf, B\_mol\_vb, B\_mol\_vl, B\_nsub, B\_oeltemp, B\_oelverb, B\_oelverl, B\_oztemic, B\_vb\_sa, B\_qvch2o  
 by event: B\_sleepwait  
 seg: B\_mrmslam, B\_wese2h\_abs, B\_aekh, B\_prailpulskor\_ee, B\_prailpulskor\_me, B\_rkkor\_kva, B\_urst  
 ini2: B\_vsean\_loc

Activation: after reset

Deactivation: During power latch phase: all variables B\_.. are 0, except for:


B\_atlsvc = last calculated value  
 B\_atlsvc\_khm = last calculated value  
 B\_bns is calculated in the PWL phase  
 B\_bosmsgc = last calculated value  
 B\_ccbtnach is calculated in the PWL phase  
 B\_ccbttdfk is calculated in the PWL phase  
 B\_ccbttknt is calculated in the PWL phase  
 B\_ccpmerr is calculated in the PWL phase  
 B\_ccprio is calculated in the PWL phase  
 B\_ccruhver is calculated in the PWL phase  
 B\_codierpm is calculated in the PWL phase  
 B\_dash = last valid value  
 B\_ext\_zylstop = last valid value  
 B\_ewp\_swsp = last value  
 B\_genoff = last valid value  
 B\_kl61 = last calculated value  
 B\_lkpls is calculated in the PWL phase  
 B\_lkpls1 is calculated in the PWL phase  
 B\_lroff = last value  
 B\_lsd = last valid value  
 B\_safast\_egs = last valid value  
 B\_mol\_sf = last calculated value  
 B\_mol\_vb = last calculated value  
 B\_mol\_vl = last calculated value  
 B\_msaakt = last valid value  
 B\_msaaktber = last valid value  
 B\_msaerr = last valid value  
 B\_msastart = last valid value  
 B\_msastartf = last valid value  
 B\_msastopp = last valid value  
 B\_nggelernt = last calculated value  
 B\_ngimlf = last calculated value  
 B\_nsub = last calculated value  
 B\_ntlkws = last calculated value  
 B\_oeltemp = last calculated value  
 B\_oelverb = last calculated value  
 B\_oelverl = last calculated value  
 B\_oztemic = last calculated value  
 B\_pmbsdanf is calculated in the PWL phase  
 B\_pmvsdanf is calculated in the PWL phase  
 B\_sleepwait is calculated in the PWL phase

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B\_verb\_off = last calculated value  
 B\_vsa\_an = last calculated value  
 B\_vsaadp = last calculated value  
 B\_vse\_an = last calculated value  
 B\_vseadp = last calculated value  
 B\_disa1\_auf = last calculated value  
 B\_disa2\_auf = last calculated value  
 B\_maregdk\_ad = last calculated value  
 B\_mrmslam = last valid value  
 B\_poelanz = last calculated value  
 B\_diagigr is calculated in the PWL phase  
 B\_gangnull = last calculated value  
 B\_poel\_gelb = last calculated value  
 B\_poel\_rot = last calculated value  
 B\_vlschalt = last calculated value  
 B\_qvch2o = last calculated value  
 B\_spa\_cist = last calculated value  
 B\_lradap1\_mn = last calculated value  
 B\_lradap1\_mx = last calculated value  
 B\_lradap2\_mn = last calculated value  
 B\_lradap2\_mx = last calculated value  
 B\_msastarts = last valid value  
 B\_nmaxc\_ba\_cc = last calculated value  
 B\_psrhub\_ad = last calculated value  
 B\_psragr\_ad = last calculated value  
 B\_hlsh1\_off = last valid value  
 B\_hlsh2\_off = last valid value  
 B\_hlsu1\_off = last valid value  
 B\_hlsu2\_off = last valid value  
 B\_hnox\_off = last valid value  
 B\_msaccid2= last calculated value  
 B\_vbkhm\_notl= last calculated value  
 B\_prailpulskor\_ee = last calculated value  
 B\_prailpulskor\_me = last calculated value  
 B\_rkkor\_kva = last calculated value  
 B\_msastops = last valid value

### Formula section:

As the applied bitmasks are automatically generated by a script file, there is no separate arrangement stated in this specification.

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## R.37 Customer adaptation module: MISF

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_auss_b1	O/V	0... 1H	0 ...1	1	-
Bedingung 1. 1000er Intervall					
LV_ER_CLC_MIS_DET_CUS_SPC	O/V	0... 1H	0 ...1	1	-
Enable engine roughness and misfire detection based on customer specific algorithm					
MIS_DET_ENA_CUS_SPC	O/V	0... FFH	0... 255	1	-
Misfire detection enabling condition based on customer specific algorithm, Carrier structure					
MIS_STATE_CUS_SPC	O/V	0... FFH	0... 255	1	-
Status carrier byte of actual detected misfire through customer specific algorithm					
Zr_auss_a	O/V	0... FFFFH	0... 65535	1	-
Aussetzer CARB A					
Zr_auss_b [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Aussetzer CARB, zylinderindividuell					
Zr_auss_suma	O/V	0... FFFFH	0... 65535	1	-
Aussetzer Summe CARB A					
Zr_auss_sumb	O/V	0... FFFFH	0... 65535	1	-
Aussetzer Summe CARB B					
Zr_ausszyk_b4	O/V	0... FFH	0... 255	1	-
CARB B4 Zyklen mit Aussetzern					
Zrbk_auss_a [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Aussetzer CARB A, bankweise					
Zrbkmx_auss_a [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Schwelle Aussetzer CARB A, bankweise					
Zrmx_auss_a	O/V	0... FFFFH	0... 65535	1	-
Schwelle Aussetzer CARB A					
Zrmx_auss_b1	O/V	0... FFFFH	0... 65535	1	-
Schwelle Aussetzer CARB B1					
Zrmx_auss_b4	O/V	0... FFFFH	0... 65535	1	-
Schwelle Aussetzer CARB B4					


### Input data:

B_aekh_akt {p. 8342}	C_MIS_SUM_A_CBK_THD_AT {p. 6240}	C_MIS_SUM_A_CBK_THD_MT {p. 6240}	C_MIS_SUM_A_THD_AT {p. 6240}
C_MIS_SUM_A_THD_MT {p. 6240}	C_MIS_SUM_B4_THD_AT {p. 6240}	C_MIS_SUM_B4_THD_MT {p. 6240}	ECU_STATE {p. 1091}
MIS_CTR_B [NC_CYL_NR] {p. 6238}	MIS_SUM_A {p. 6238}	MIS_SUM_A_CBK [NC_CBK_EX_NR] {p. 6238}	MIS_SUM_B {p. 6238}
St_aekh {p. 8168}	St_aekh_ae {p. 8169}		

### R.37.1 Outputs for BMW functions

#### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

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*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

### Application conditions:

*Initialisation at reset or at exit powerlatch:* 0

*Recurrence :* 10ms

*Activation:* every engine state

### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

**If(1)** ECU\_STATE = "PWL"

**Then(1)**

B\_auss\_b1 = 0

**Elseif(1)**

B\_auss\_b1 = not(LV\_END\_MIS\_B1)  
 Zr\_auss\_a = MIS\_SUM\_A  
 Zr\_ausszyk\_b4 = CTR\_DET\_MIS\_B4  
 Zrbk\_auss\_a[NC\_CBK\_EX\_NR] = MIS\_SUM\_A\_CBK[NC\_CBK\_EX\_NR]  
 Zr\_auss\_b[NC\_CYL\_NR] = MIS\_CTR\_B[NC\_CYL\_NR]  
 Zr\_auss\_suma = MIS\_SUM\_A  
 Zr\_auss\_sumb = MIS\_SUM\_B

**If(2)** LV\_AT = 1

**Then(2)**

Zrbkmx\_auss\_a[NC\_CBK\_EX\_NR] = C\_MIS\_SUM\_A\_CBK\_THD\_AT  
 Zrmx\_auss\_a = C\_MIS\_SUM\_A\_THD\_AT  
 Zrmx\_auss\_b1 = C\_MIS\_SUM\_B1\_THD\_AT  
 Zrmx\_auss\_b4 = C\_MIS\_SUM\_B4\_THD\_AT

**Elseif(2)**

Zrbkmx\_auss\_a[NC\_CBK\_EX\_NR] = C\_MIS\_SUM\_A\_CBK\_THD\_MT  
 Zrmx\_auss\_a = C\_MIS\_SUM\_A\_THD\_MT  
 Zrmx\_auss\_b1 = C\_MIS\_SUM\_B1\_THD\_MT  
 Zrmx\_auss\_b4 = C\_MIS\_SUM\_B4\_THD\_MT

**Endif(2)**

**Endif(1)**

## R.37.2 Outputs for supplier MISF Aggregate

### FUNCTION DESCRIPTION:

Adaptation to BMW environment

### Application conditions

**Initialisation:** *at reset or at exit powerlatch:* 0

**Recurrence:** *Segment*

**Activation:** *every engine state*

**Formula section:**

$$LV\_ER\_CLC\_MIS\_DET\_CUS\_SPC = B\_aekh\_akt$$

$$MIS\_STATE\_CUS\_SPC = St\_aekh\_ae$$


$$MIS\_DET\_ENA\_CUS\_SPC = St\_aekh$$
**Important Note for the calling sequence :**

**R.37.3 The following calling sequence should be maintained only for the segment task which**

**R.37.4 calculates outputs for supplier MISF Aggregate. That is the segment task for this function should be called only after the following calculation**

1. Misfire calculation functions from supplier.
2. VRAMO - Misfire calculation from BMW

After VRAMO, copying BMW variables to supplier variables is done, and hence used in next segment raster of supplier misfire functions.

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## R.38 Customer adaptation module: NOXD

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_fi_nsobd1	O/V	0... 1H	0 ...1	1	-
Summenfehler Nox Sensor OBD1					
B_fi_nsobd2	O/V	0... 1H	0 ...1	1	-
Summenfehler Nox Sensor OBD2					
B_nsadap_anf	O/V	0... 1H	0 ...1	1	-
Status Anforderung Noxsensoradaption					
B_nsdiag_anf	O/V	0... 1H	0 ...1	1	-
Status Anforderung Noxsensordiagnose					
Baw_nsadap	O/V	0... FFFFH	0... 65535	1	-
Betriebsarten-Anforderung Noxsensoradaption					
Baw_nsdiag	O/V	0... FFFFH	0... 65535	1	-
Betriebsarten-Anforderung Noxsensordiagnose					

### Input data:

ECU_STATE {p. 1091}	LV_ERR_NS_OBD_1 [NC_NOX_SENS_CONF] {p. 4915}	LV_ERR_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}	LV_NS_AD_REQ {p. 3189}
LV_NS_SHIFT_CMB_INT_ REQ {p. 6426}	NC_NOX_SENS_CONF {p. 643}	STATE_NS_SHIFT_CMB_ REQ {p. 6427}	STATE_OPM_REQ_NS_ AD {p. 3189}

### R.38.1 Outputs for BMW functions which are not defined as NOXD exported data

#### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

#### Application conditions

Initialisation at reset and at exit "PWL": 0

Recurrence : 10 ms


Activation: *every engine state*

#### Formula section:

```

B_fi_nsobd1      = LV_ERR_NS_OBD_1[1]
B_fi_nsobd2      = LV_ERR_NS_OBD_2[1]
If          ECU_STAT = "PWL"
Then        B_nsadap_anf = 0
                B_nsdiag_anf = 0
                Baw_nsadap = 0
                Baw_nsdiag = 0
Else        B_nsadap_anf = LV_NS_AD_REQ
                B_nsdiag_anf = LV_NS_SHIFT_CMB_INT_REQ

```


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```

Baw_nsadap = STATE_OPM_REQ_NS_AD
Baw_nsdiag = STATE_NS_SHIFT_CMB_REQ

```

**Endif**

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## R.39 Customer adaptation module: NOXM

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
F_grad_katalt	O/V	8000... 0H	-0.1 ...0	3.0518e-6	1/km
Nox-Kat-Alterungsgradient					
F_katalt	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
Nox-Kat-Alterung					
F_katalt_tabg	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
Thermische Nox-Kat-Alterung					

### Input data:

ECU_STATE {p. 1091}	FAC_NT_AGI_LIM {p. 3072}	NT_AGI_THERMO {p. 3073}	NT_AGI_THERMO_GRD {p. 3107}
---------------------	-----------------------------	----------------------------	--------------------------------

### R.39.1 Outputs for BMW functions

#### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

#### Application conditions:

*Initialisation* at reset or at exit powerlatch:

```

F_grad_katalt      = NT_AGI_THERMO_GRD
F_katalt           = FAC_NT_AGI_LIM
F_katalt_tabg     = NT_AGI_THERMO
  
```

*Recurrence* : 200ms  
*Activation*: every engine state

#### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

```

If          ECU_STATE = not("PWL")
Then
    F_grad_katalt      = NT_AGI_THERMO_GRD
    F_katalt           = FAC_NT_AGI_LIM
    F_katalt_tabg     = NT_AGI_THERMO
end
  
```

## R.40 Customer adaptation module: PWSL

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_bsdprot1	O/V	0... 1H	0 ...1	1	-
condition for BSD protocol controller type 1					
B_bsdprot2	O/V	0... 1H	0 ...1	1	-
condition for BSD protocol controller type 2					
B_crashgen	O	0... 1H	0 ...1	1	-
condition alternator shut off at crash					
B_dev0detec	O/V	0... 1H	0 ...1	1	-
bit 0 of learned LF_BSD_CPT_AVL					
B_dev1detec	O/V	0... 1H	0 ...1	1	-
bit 1 of learned LF_BSD_CPT_AVL					
B_dev2detec	O/V	0... 1H	0 ...1	1	-
bit 2 of learned LF_BSD_CPT_AVL					
B_dev3detec	O/V	0... 1H	0 ...1	1	-
bit 3 of learned LF_BSD_CPT_AVL					
B_dev4detec	O/V	0... 1H	0 ...1	1	-
bit 4 of learned LF_BSD_CPT_AVL					
B_dev5detec	O/V	0... 1H	0 ...1	1	-
bit 5 of learned LF_BSD_CPT_AVL					
B_dev6detec	O/V	0... 1H	0 ...1	1	-
bit 6 of learned LF_BSD_CPT_AVL					
B_dev7detec	O/V	0... 1H	0 ...1	1	-
bit 7 of learned LF_BSD_CPT_AVL					
B_fabtreg	O/V	0... 1H	0 ...1	1	-
condition note battery change					
B_fahirst	O/V	0... 1H	0 ...1	1	-
condition reset histogram					
B_fapmss	O/V	0... 1H	0 ...1	1	-
condition measure method PM					
B_genactiv	O/V	0... 1H	0 ...1	1	-
condition alternator interface activ					
B_genfbsd	O/V	0... 1H	0 ...1	1	-
communication fault BSD-alternator (old: LV_GEN_IF_OFF)					
B_genfel	O/V	0... 1H	0 ...1	1	-
electrical fault alternator					
B_genfht	O/V	0... 1H	0 ...1	1	-
(excess) temperature fault alternator					
B_genfme	O/V	0... 1H	0 ...1	1	-
mechanical fault alternator					
B_ibsactiv	O/V	0... 1H	0 ...1	1	-
Bedingung IBS erkannt					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_jerr_ext	O/V	0... 1H	0 ...1	1	-
Anforderung Grenzerregerstrom vom Tester					
B_jumpstart	O/V	0... 1H	0 ...1	1	-
Bedingung Jumpstart					
B_kl15_ep	O/V	0... 1H	0 ...1	1	-
1: ignition on					
B_kl15_vorab	O/V	0... 1H	0 ...1	1	-
active during delayed ignition switch off					
B_loadre_ext	O/V	0... 1H	0 ...1	1	-
Anforderung Loadresponse vom Tester					
B_lrloff	O/V	0... 1H	0 ...1	1	-
shut of the load response threshold for alternator (copy)					
B_lrreg1ak	O/V	0... 1H	0 ...1	1	-
load response condition (for register 1) alternator activ					
B_rd_gentyp	O/V	0... 1H	0 ...1	1	-
read alternator type and manufacturer					
B_sta	O/V	0... 1H	0 ...1	1	-
flag indicating that automatic starter function is active					
B_ulcp	O/V	0... 1H	0 ...1	1	-
Ultra-low-cost powermanagement enabled					
Batt_coort	O	0... FFH	0... 255	1	-
position battery (read out of coding)					
Bsdcontrol	O	0... FFH	0... 255	1	-
Communication coordination byte					
Bsddata	O	0... FFH	0... 255	1	-
Content of register					
Bsdgencv	O	0... FFH	0... 255	1	-
chip version alternator					
Bsdgenregv	O	0... FFH	0... 255	1	-
controller version alternator					
Bsdregadr	O	0... FFH	0... 255	1	-
Actual register number					
CTR_BSD_ERR_CHK_SUM_2	O	0... FFFFH	0... 65535	1	-
Fehlerzähler EBSD Checksumme					
CTR_IBS_ERR_1	-	0... FFH	0... 255	1	-
Dibs Fehlerzähler BSD					
CTR_IBS_ERR_2	-	0... FFFFH	0... 65535	1	-
Dibs Fehlerzähler EBSD					
CTR_PWR_ERR_PREV_DIV_2	-	0... FFH	0... 255	1	-
Vorteiler für lbsderrs2					
CUR_ALTER_EXCT_LIM_SP	O	0... 1FH	0... 7.75	0.25	A
Setpoint alternator exciting current limitation					
CUR_ALTER_MAX	O/V	0... FFH	0... 255	1	A
maximum current alternator					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CUR_GEN	O/V	0... FFH	0... 255	1	A
Short term solution for satisfaction of CAN, representing the alternator current (will be replaced by CUR_GEN)					
Dfgrob	O	0... FFH	0... 255	1	-
DF rough value (occupancy factor) from alternator					
Dfsiggen	O	0... FFH	0... 99.60937	0.390625	%
occupancy of alternator					
Gen_manufak	O	0... FFH	0... 255	1	-
manufacturer identifier alternator					
Gen_typkenn	O	0... FFH	0... 255	1	-
type identifier alternator alternator					
IBS_COD	O	0... FFH	0... 255	1	-
IBS Hardwareversion					
IBS_SW_BASE	O	0... FFH	0... 255	1	-
IBS Softwarebaseline					
Ierr	O	0... FFH	0... 31.875	0.125	A
exciting current alternator					
Ierr_grenz_ext	O	0... FFH	0... 31.875	0.125	A
Grenzerregerstrom vom Tester					
Ierrfgrenz	O	0... FFH	0... 31.875	0.125	A
actual value exciting current limitation alternator					
LOAD_BAT	O/V	0... FFH	0... 99.60937	0.390625	%
DF-Monitor for accumulator charge in %					
LOAD_CDN_BAT	O/V/S	0... FFH	0... 99.60937	0.390625	%
condition of battery load (for serial communication)					
LV_ALTER_SWI_OFF	O/V	0... 1H	0 ...1	1	-
Logical variable indicating 'alternator switched off =1'					
LV_LOAD_RESP_ALTER_THD_ACT_SP	O/V	0... 1H	0 ...1	1	-
shut of the load response threshold for alternator (setpoint)					
LV_N_SP_IS_POW_ACT	O/V	0... 1H	0 ...1	1	-
1: idle speed increase due to low accumulator charge					
LV_N_SP_IS_PWR_STAB	O/V	0... 1H	0 ...1	1	-
request for idle speed setpoint due to power management request for power supply stability					
N_ALTER	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
alternator speed					
N_ST_POW_MOD	O/V	0... FFH	0... 8160	32	rpm
engine speed at start for power modul					
NR_ADD_IBS	O	0... FFFFFFFFH	0... 4294967295	1	-
Zusbaummer					
NR_IBS	O	0... FFFFFFFFH	0... 4294967295	1	-
Seriennummer IBS					
POW_REL_ALTER_CLC	O/V	0... FFH	0... 99.60937	0.390625	%
calculated DF-signal from alternator					
STATE_ALTER	O/V	0... FFH	0... 255	1	-
Alternator status					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_CUR_ENG_CNS	O/V	8000... 7FFFH	-32768 ...32767	1	A
current consumption of engine					
STATE_IBS_SW_CHG	O	0... FFH	0... 255	1	-
IBS SW-Änderungsstatus					
T_LOAD_RESP_ALTER_SP	O/V	0... 3H	0... 15	5	s
Setpoint for alternator 1 load response time					
Tchip	O	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
chip temperature alternator					
Td_f_ierr	O	0... FFH	0... 2.55	0.01	s
calibratable filter time for exciting current (alternator powermanagement)					
Td_rdggenreg2	O	0... FFH	0... 25.5	0.1	s
calibratable time period for reading register 2 (alternator powermanagement)					
TEMP_ALTER	O/V	0... FEH	-48... 142.5	0.75	°C
Temperature alternator (for environmental fault memory)					
Tlrfgen	O	0... FFH	0... 25.5	0.1	s
actual value alternator load response time					
Tlrgen_ext	O	0... FFH	0... 25.5	0.1	s
Loadresponse vom Tester					
TQ_LOSS_ALTER	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque consumption of alternator at crankshaft *					
U_fgen	O	0... FFFFH	0... 6553.5	0.1	V
received voltage alternator (copy of voltage setpoint send to the bus)					
U_gensollpm	O	8000... 7FFFH	-128... 127.99609	3.9062e-3	V
Alternator voltage setpoint from power module					
Ub	O	0... FFFFH	0... 6173.397	0.0942	V
battery voltage					
Uregnom	O	0... FFFFH	0... 6553.5	0.1	V
nominal voltage alternator					
V_ALTER_SP	O/V	0... 3FH	10.6 ...16.9	0.1	V
setpoint alternator 1 voltage					
V_LEVEL	O/V	0... FFH	0... 255	1	-
voltage level					
VB_POW_MNG	O/V	0... FFFH	0... 61.425	0.015	V
current battery voltage					
W_ub	O	0... FFH	0... 24.021	0.0942	V
battery voltage raw value					

**Input data:**

ALTER_COD_0 {p. 4093}	ALTER_COD_1 {p. 4093}	ALTER_COD_2 {p. 4093}	ALTER_COD_3 {p. 4093}
B_bns {p. 8342}	B_genoff {p. 8343}	B_lroff {p. 8344}	B_nsub {p. 8345}
B_sleepwait {p. 8346}	BSD_SENS_BAT_SMT_ ADR {p. 4093}	BSD_SENS_BAT_SMT_ INFO {p. 4093}	C_T_RD_PER_ALTER_ TBL_2 {p. 4097}
CUR_ALTER_EXCT {p. 4093}	CUR_ALTER_EXCT_LIM {p. 4093}	Dffgen {p. 8156}	Dfmonitor {p. 8156}
ECU_STATE {p. 1091}	I_craweng {p. 8158}	I_gen {p. 8158}	I_genmax {p. 8158}

lbhwversi {p. 8159}	lbsderrs1 {p. 8159}	lbsderrs2 {p. 8159}	lbspreco2 {p. 8159}
lbswbase {p. 8159}	lbswchang {p. 8159}	lerrgrenz {p. 8159}	Ktupscctr {p. 8159}
LF_BSD_CPT_AVL {p. 4093}	LF_BSD_SENS_BAT_ SMT_CTL {p. 4093}	LV_ALTER_BSD_PROT_2 {p. 4094}	LV_ALTER_ERR_IF {p. 4094}
LV_ALTER_ERR_MEC {p. 4094}	LV_ALTER_ERR_TEMP {p. 4094}	LV_ALTER_IF_ACT {p. 4094}	LV_IGK {p. 906}
LV_IGK_PREL {p. 906}	LV_LOAD_RESP_ALTER_ CND_1 {p. 4094}	LV_LOAD_RESP_ALTER_ THD_ACT {p. 4095}	LV_POW_MNG_BAT_CHG {p. 7483}
LV_POW_MNG_HIS_RST {p. 7680}	LV_POW_MNG_MES_ MOD {p. 7483}	LV_PWL_LOCK_CDN_ CUS_INH {p. 7483}	LV_SENS_BAT_SMT_ACT {p. 4095}
LV_SENS_BAT_SMT_DET {p. 4095}	LV_ST {p. 1720}	LV_VAR_BN {p. 655}	LV_VAR_VEH {p. 656}
LV_VB_JUMP {p. 1185}	Md_gennm_na {p. 8160}	N_gen {p. 8163}	N_nstart {p. 8163}
NC_PWL_LOCK_CDN_ CUS {p. 3778}	POW_REL_ALTER {p. 4095}	POW_REL_ALTER_L_RES {p. 4096}	PWL_LOCK_CDN {p. 3776}
Snibs {p. 8168}	St_gen {p. 8171}	STATE_EFP_CRASH_CAN {p. 1573}	T_FIL_CUR_EXCT_ALTER {p. 4096}
T_LOAD_RESP_ALTER {p. 4096}	TEMP_ALTER_MC {p. 4096}	Tgen {p. 8177}	Tlrgen {p. 8177}
U_gen {p. 8178}	Ubt {p. 8179}	Ulev {p. 8179}	V_ALTER {p. 4096}
V_ALTER_NOM {p. 4096}	V_GEN_TAR {p. 1582}	VB {p. 1185}	VB_BAS {p. 831}
Zbibs {p. 8180}			

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_BAT_PSN	-	0... FFH	0... 255	1	-
Position of battery in vehicle					
ID_ALTER_EXCT_LIM_SP	-	0... 1FH	0... 7.75	0.25	A
LDP_ALTER_COD_0	8	0... 7H	0 ...7	1	-
Setting of CUR_ALTER_EXCT_LIM_SP in dependence of ALTER_COD_0					
LC_ALTER_EXCT_LIM_SP	-	0... 1H	0 ...1	1	-
logical constant: software switch to choose BSD					
LC_PWSL_ENA	-	0... 1H	0 ...1	1	-
Ultra-low-cost powermanagement enabled					

**R.40.1 Outputs for BMW functions which are not defined as PWSL exported data****FUNCTION DESCRIPTION:**

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the output are different from the specified values due to the input data attributes.

**General information:**

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	Baseline 4DCKM1Y0_4CC3KM0S	Project BMW MSD81 6 Cyl	
	Document key 10171571 SPE 000 AO	Pages Page 8370 of 8404	
Regensburg (RGB)	Copyright ( C ) Continental AG,2007		A4: 2007-11

In case of vehicle variant E60 the DME takes over certain functionalities of the former Powermodul -ECU. If no IBS is implemented in the car these functionalities are calculated by the ultra-low-cost-powermanagement (an add-on to the actual powermanagement).

### Application conditions

**Initialisation:** all 0 after reset

#### except:

```

ALTER_COD_0 = 7 H // initialisation to max value
ALTER_COD_1 = 1F H // initialisation to max value

If LV_VAR_BN = 0 then // for CAN 11
    B_kl15_ep = 1
    B_kl15_vorab = 1
endif
Ub = Batt_coort = W_ub = 1st valid ADC-value
U_fgen x = 1st calculated value
Gen_manufak = Gen_typkenn = 255
B_rd_gentyp = 1
B_dev0..7detec = LF_BSD_CPT_AVL

```

*Recurrence :* all BSD driver timing

#### except:

Batt\_coort = once at ECU init

10 ms: B\_crashgen, W\_ub, B\_kl15\_vorab, B\_sta, B\_jumpstart

20 ms: B\_kl15\_ep, Ub

50 ms: Gen\_typkenn, Gen\_manufak

100 ms: VB\_POW\_MNG, ulev, B\_fabttreg, B\_fahisrst, B\_fapmmess,  
U\_gensollpm, B\_ulcp, Cur\_gen, B\_dev0..7detec

Once only,  
never changed: lerr\_grenz\_ext = 31.87 A  
Tlrgen\_ext, B\_ierr\_ext, B\_loadre\_ext = 0

*Activation:* every ECU - State (including Wakeup)

### Formula section:

*Remark:* all formulas are valid in a physical meaning

```

B_dev0..7detec = LF_BSD_CPT_AVL
B_kl15_ep      = LV_IGK
B_kl15_vorab   = LV_IGK_PREL
B_lrrreg1ak    = LV_LOAD_RESP_ALTER_CND_1
B_genactiv     = LV_ALTER_IF_ACT
B_genfel       = LV_ALTER_ERR_EL
B_genfme       = LV_ALTER_ERR_MEC
B_genfht       = LV_ALTER_ERR_TEMP
B_genfbsd      = LV_ALTER_ERR_IF
B_sta          = LV_ST

```

```

B_ierr_ext          = 0
B_loadre_ext       = 0
B_fabttreg         = LV_POW_MNG_BAT_CHG
B_fahisrst         = LV_POW_MNG_HIS_RST
B_fapmness         = LV_POW_MNG_MES_MOD
B_ibsactiv         = LV_SENS_BAT_SMT_ACT

```

```

If LV_ALTER_BSD_PROT_2      = 1
Then   B_lrff              = ! LV_LOAD_RESP_ALTER_THD_ACT(n-1)
Else   B_lrff              = ! LV_LOAD_RESP_ALTER_THD_ACT
Endif

```

```

Batt_coort         = C_BAT_PSN
Bsddata           = BSD_SENS_BAT_SMT_INFO
Bsdregadr         = BSD_SENS_BAT_SMT_ADR
Bsdcontrol        = LF_BSD_SENS_BAT_SMT_CTL
Bsdgenregv        = ALTER_COD_2
Bsdgencv          = ALTER_COD_3
Dfsiggen          = POW_REL_ALTER
Dfgrob            = POW_REL_ALTER_L_RES
Gen_manufak       = ALTER_COD_0
Gen_typkenn       = ALTER_COD_1

```

```

If ECU_STATE = "PWL"
Then  lerr = 0
Else  lerr = CUR_ALTER_EXCT
        B_jumpstart = LV_VB_JUMP

```

```

endif
lerrfgrenz        = CUR_ALTER_EXCT_LIM
Tchip             = TEMP_ALTER_MC
Td_f_ierr         = T_FIL_CUR_EXCT_ALTER
Td_rdggenreg2    = C_T_RD_PER_ALTER_TBL_2
U_fgen           = V_ALTER
U_gensollpm      = V_GEN_TAR
Uregnom          = V_ALTER_NOM
VB_POW_MNG       = Ubt
Ub               = VB
ulev             = Ulev
W_ub             = VB_BAS * 5,747

```

Hint: Conversion from 0...5V (10 bit) of VB\_BAS to 0...24V (8 bit) of W\_ub.  
(HW potential divider 28.7 V /26 V; 5,747 = 28.7 V /5 V)

```

If STATE_EFP_DRASH_CAN = 2
then   B_crashgen      = 1
else   B_crashgen      = 0
endif

```

```

If     LV_VAR_BN = 1      and     LV_VAR_VEH = 0      and
        (LV_SENS_BAT_SMT_DET = 0 or LC_PWSL_ENA = 1)
then   B_ulcp = 1
else   B_ulcp = 0
endif

```

```

if          LV_ALTER_BSD_PROT_2          = 1
then       B_bsdprot1                    = 0    and
            B_bsdprot2                    = 1
else       B_bsdprot1                    = 1    and
            B_bsdprot2                    = 0
endif

```

Tlrfgen = T\_LOAD\_RESP\_ALTER (according the translation tablebelow)  
for writing into register 1 (three bit s for information reserved)

ID_KFTLRGEN2_INV	n=0	n=1	n=2	n=3	n=4	n=5	n=6	n=7	output data: T_lrfgen
tn [sec]	0	0,2	0,4	3	6	9	12	15	input data: T_LOAD_RESP_ALTER

Depending on ALTER\_COD\_0 and ALTER\_COD\_1 the load response should be read/written out/into register 1 (see fkt-LR-write). tn [sec] can t be send by BSD directly because the number of protocoll bits are limited. This bit combination has to be translated according the tables. Translation from bit combination to tn [sec] and vice versa. If the input data is between two break points, then the minimum break point must be used.

## R.40.2 Outputs for supplier Aggregates, customer(supplier)

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

### Application conditions

**Initialisation:** all 0 after reset

### Except:

V\_ALTER\_SP = 1<sup>st</sup> calculated value  
T\_LOAD\_RESP\_ALTER\_SP = 1<sup>st</sup> calculated value

**Recurrence:** 1000ms: LV\_N\_SP\_IS\_POW\_ACT, LOAD\_BAT, LOAD\_CDN\_BAT, hwversi, ibswbase, ibswchang, snibs, zbibs, B\_sleepwait  
100ms: V\_ALTER\_SP, T\_LOAD\_RESP\_ALTER\_SP, LV\_ALTER\_SWI\_OFF, STATE\_CUR\_ENG\_CNS, LV\_LOAD\_RESP\_ALTER\_THD\_ACT\_SP, st\_i\_gen, STATE\_ALTER, st\_gen, CUR\_ALTER\_MAX, TEMP\_ALTER, , ibsderrs1, ibsderrs2, ibspreco2, ktupcsctr  
10ms: N\_ST\_POW\_MOD, TQ\_LOSS\_ALTER, POW\_REL\_ALTER\_CLC, CUR\_ALTER\_EXCT\_LIM\_SP, T\_LOAD\_RESP\_ALTER\_SP, LV\_N\_SP\_IS\_PWR\_STAB, N\_ALTER

**Activation:** every ECU - State (including Wakeup)

### Formula section:

**Remark:** all formulas are valid in a **physical** meaning

```

LV_ALTER_SWI_OFF                = B_genoff
CUR_ALTER_EXCT_LIM_SP           = lerrgrenz
If          CUR_ALTER_EXCT_LIM_SP == 0 and LC_ALTER_EXCT_LIM_SP == 1
Then       CUR_ALTER_EXCT_LIM_SP = ID_ALTER_EXCT_LIM_SP
Else       CUR_ALTER_EXCT_LIM_SP = CUR_ALTER_EXCT_LIM_SP
Endif
CUR_ALTER_MAX                   = I_genmax
LOAD_CDN_BAT                    = Dfmonitor
LOAD_BAT                        = Dfmonitor
LV_N_SP_IS_POW_ACT              = B_nsub
LV_LOAD_RESP_ALTER_THD_ACT_SP   = ! B_lroff
N_ALTER                          = N_gen
N_ST_POW_MOD                    = N_nstart
POW_REL_ALTER_CLC               = Dffgen
STATE_ALTER                      = St_gen
st_gen                           = STATE_ALTER      (short time solution
                                                    for satisfact. of CAN)

STATE_CUR_ENG_CNS                = I_craweng
CUR_GEN                          = I_gen
TQ_LOSS_ALTER                    = Md_genm_na
TEMP_ALTER                       = Tgen
V_ALTER_SP                       = U_gen
T_LOAD_RESP_ALTER_SP             = Tlrgen      (according the translation
                                                    tables below)

```

for writing into register 0 (two bit s for information reserved)

ID_KFTLRGEN1	n=0	n=1	n=2	n=3	input data: T_lrgen
tn [sec]	0	3	6	9	output data: T_LOAD_RESP_ALTER_SP

for writing into register 1 (three bit s for information reserved)

ID_KFTLRGEN2	n=0	n=1	n=2	n=3	n=4	n=5	n=6	n=7	input: T_lrgen
tn [sec]	0	0,2	0,4	3	6	9	12	15	output data: T_LOAD_RESP_ALTER_SP

Depending on ALTER\_COD\_0 and ALTER\_COD\_1 the load response should be read/written out/into register 0 or register 1 (see fkt-LR-write). tn [sec] can t be send by BSD directly because the number of protocoll bits are limited. This bit combination has to be translated according the tables. Translation from bit combination to tn [sec] and vice versa. If the input data is between two break points, then the minimum break point must be used.

```

ibhwversi                       = Ibhwersi
ibsderrs1                       = Ibsderrs1
ibsderrs2                       = Ibsderrs2
ibspreco2                       = Ibspreco2
ibswbase                        = Ibswbase
ibswchang                       = Ibswchang
ktupcsctr                       = Ktupcsctr
snibs                           = Snibs
zbibs                           = Zbibs
LV_N_SP_IS_PWR_STAB             = B_bns

```


```

IF          B_sleepwait = 1      and
LV_PWL_LOCK_CDN_CUS_INH = 0
THEN       PWL_LOCK_CDN[NC_PWL_LOCK_CDN_CUS] = 1
              //"set power-latch lock condition corresponding to
              NC_PWL_LOCK_CDN_CUS in PWL_LOCK_CDN"

ELSE       PWL_LOCK_CDN[NC_PWL_LOCK_CDN_CUS] = 0
              //"reset power-latch lock condition corresponding to
              NC_PWL_LOCK_CDN_CUS in PWL_LOCK_CDN"

ENDIF

```

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	Baseline <b>4DCKM1Y0_4CC3KM0S</b>	Project <b>BMW MSD81 6 Cyl</b>	
	Document key <b>10171571 SPE 000 AO</b>	Pages <b>Page 8375 of 8404</b>	
Regensburg (RGB)		Copyright ( C ) Continental AG,2007	A4: 2007-11

## R.41 Customer adaptation module: SAIR

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_fasls	O/V	0... 1H	0 ...1	1	-
1: activation of secondary air pump is possible					
B_genslp	O/V	0... 1H	0 ...1	1	-
1: secondary air pump is active (condition for voltage request SAP)					
B_sls	O/V	0... 1H	0 ...1	1	-
1: secondary air pump is active					
Md_na_sls	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
torque losses secondary air pump					
Ms_sl	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Massenstrom Sekundärluft					

### Input data:

SAF_KGH {p. 807}			
------------------	--	--	--

### R.41.1 Outputs for BMW functions which are not defined as SAIR exported data

#### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

#### Application conditions

**Initialisation:** all variables are initialised with 0

**Recurrence:** 200 ms : Ms\_sl

**Activation:** every engine state  
*In the power latch phase:*  
 0: Ms\_sl

#### Formula section:

B\_fasls = 0

B\_genslp = 0

B\_sls = 0

Md\_na\_sls = 0 Nm

Ms\_sl = SAF\_KGH



## R.42 Customer adaptation module: THRO

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_dkerr_2pot	O/V	0... 1H	0 ...1	1	-
Bedingung beide DK-Potis defekt					
B_dkheiz_ende	O/V	0... 1H	0 ...1	1	-
Bedingung Heizturnus Drosselklappe beendet					
B_dkratio_h	O/V	0... 1H	0 ...1	1	-
Homogener Betrieb angefordert					
TPS_SP_MDL	O/V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Desired throttle angle based on customer intake model					
TPS_SUB_DIAG	O/V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Substitute TPS_AV value calculated out of IMM					
Wdk_ist	O/V	8000... 7FFFH	-800... 799.97558	0.0244141	%
Actual throttle angle					

### Input data:

C_TPS_SP_MAX {p. 6555}	LV_MTC_HEAT_READY {p. 6531}	STATE_TPS_DIAG {p. 4982}	TPS_AV {p. 1169}
Wdk_diag {p. 8179}	Wdk_soll {p. 8179}		

### FUNCTION DESCRIPTION:

#### General information:

Adaption to BMW environment.

*Remark:* The really possible resolution and limits of the output are different to the specified values due to the input data attributes.

#### Application conditions:

*Initialisation at reset or at exit power latch phase*

0

except:

Wdk\_ist = TPS\_AV after first valid sampling

B\_dkheiz\_ende = 1

*Recurrence:*

10ms

Except:

5ms:

B\_dkratio\_h

100ms:

B\_dkheiz\_ende

segment:


Wdk\_ist

*Note:* Wdk\_ist has to be updated directly after TPS\_AV has been calculated. Wdk\_ist have to be hold on last calculated value during power latch phase.

*Activation:* at every engine stat

*Deactivation:* at power latch phase

*Values at deactivation:* B\_dkratio\_h: 0

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B\_dkerr\_2pot, TPS\_SUB\_DIAG, TPS\_SP\_MDL, Wdk\_ist, B\_dkheiz\_ende : un-  
changed

### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

$TPS\_SP\_MDL = (Wdk\_soll/100\%) \cdot C\_TPS\_SP\_MAX$

$Wdk\_ist = (TPS\_AV / C\_TPS\_SP\_MAX) \cdot 100\%$

**If** STATE\_TPS\_DIAG = TPS\_DBL\_ERROR //8H

**Then** B\_dkerr\_2pot = 1

**Else** B\_dkerr\_2pot = 0

**Endif**

**If** STATE\_TPS\_DIAG = 1 or 2 or 4


**Then** B\_dkratio\_h = 1

**Else** B\_dkratio\_h = 0

**Endif**

$TPS\_SUB\_DIAG = (Wdk\_diag/100\%) \cdot C\_TPS\_SP\_MAX$

B\_dkheiz\_ende = LV\_MTC\_HEAT\_READY

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## R.43 Customer adaptation module: TQDR

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_safast	O/V	0... 1H	0 ...1	1	-
Bedingung schnelles Schubabschalten					
EFF_LAMB_AV	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Actual lambda efficiency					
EFF_LAMB_AV_CBK [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Actual lambda efficiency, bank specific					
EFF_LAMB_BAS_COR	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Basic lambda efficiency					
EFF_LAMB_SP_BAS	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Basic lambda setpoint efficiency					
Eta_zw_ist1	O/V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Ignition efficiency actual ignition angle bank selective					
Eta_zw_ist2	O/V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Ignition efficiency actual ignition angle bank selective					
Eta_zw_min	O/V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Ignition efficiency minimum ignition angle					
Eta_zw_mint	O/V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Ignition efficiency					
Eta_zwve_m	O/V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Mean value ignition angle efficiency					
Eta_zylausbas	O/V	0... FFFFH	0... 199.99694	3.0518e-3	%
Basic efficiency fuel cut-off pattern					
F_wnwkhk_sw	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Überblendfaktor (warm/kalt) für Spreizung und Zündhaken während Katheizen von Zulieferer					
FAC_CAM_CH	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Factor for weighting FAC_EFF_IGA at Catalyst heating					
FAC_EFF_IGA_CH	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Factor for fading ignition angle efficiency in case of catalyst heating					
FAC_EFF_IGA_SCAV	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Factor for fading ignition angle efficiency in case of scavenging operation					
FAC_EFF_IGA_SECU	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Factor for fading ignition angle efficiency in case of cold/warm engine					
LV_GS_ACT_FL	O/V	0... 1H	0 ...1	1	-
Logical bit which indicates gear shift at full load condition					
LV_TQ_IGA_ENA	O/V	0... 1H	0 ...1	1	-
Torque intervention for ignition released					
LV_TQ_MIN_CLU	O/V	0... 1H	0 ...1	1	-
Logical variable for coordination engine start torque and minimum torque and clutch					
LV_TQI_BOL_SET	O/V	0... 1H	0 ...1	1	-
Logical variable it is set if TQI_SP falls below TQI_BOL					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Mdi_bas	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
Basic indicated engine torque					
Mdi_katschutz	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
torque limitation for catalyst protection					
Mdi_vmax	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
torque limitation for vehicle speed limitation					
Mdk_ist	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
minimum torque at clutch					
Mdk_ist_lm	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Ist-Moment aus Luftmasse ohne externe Eingriffe					
Mdk_max_gs	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Begrenzung maximales Kupplungsmoment durch EGS-Notlauf					
TQ_MAX_CLU	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum torque at clutch					
TQ_MIN_CLU	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Minimum torque at clutch					
TQI_AV_HOM	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Actual indicated engine torque for homogeneous mode					
TQI_AV_S	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Actual indicated engine torque in stratified mode					
TQI_MAX	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum indicated torque					
TQI_MIN_HOMS	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Min Reference indicated engine torque for HOMS					
TQI_MIN_S	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Min Reference indicated engine torque for stratified mode					
TQI_REF	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Reference indicated engine torque					
TQI_REF_MAX	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum indicated torque from IP_TQI_REF at MAF_MAX_COR					
TQI_REF_S	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Indicated reference engine torque for stratified mode					
TQI_SP_MAF	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Indicated engine torque for determination of air mass flow setpoint in homogeneous mode					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
------	------	-------------	--------------	--------	------

**Input data:**

B_llrein {p. 8344}	B_mdimin_sa {p. 8344}	B_vlschalt {p. 8347}	B_zw_dynman {p. 8348}
ECU_STATE {p. 1091}	EFF_IGA_AV_CBK [NC_CBK_EX_NR] {p. 1845}	EFF_IGA_BAS_COR_ KNK_FIL {p. 1845}	EFF_IGA_MIN {p. 1845}
EFF_IGA_MIN_TEG {p. 1845}	EFF_SCC_BAS {p. 6665}	Eta_labas {p. 8157}	Eta_labas_sol {p. 8157}
Eta_lambda_1 {p. 8157}	Eta_lambda_2 {p. 8157}	Eta_zw_minres {p. 8157}	F_atldyn {p. 8157}
F_sicher_zw {p. 8158}	F_wnwkh {p. 8158}	F_wnwkhk {p. 8158}	FAC_EFF_IGA_CH_SP {p. 3601}
LV_FCUT_FAST {p. 6675}	LV_TQ_LIM_INTV {p. 6692}	Mdi_ist_m {p. 8161}	Mdi_max {p. 8161}
Mdi_max_l1 {p. 8161}	Mdi_min_hs {p. 8161}	Mdi_min_s {p. 8161}	Mdi_ml_soll {p. 8161}
Mdi_opt_l1 {p. 8161}	Mdi_opt_s {p. 8161}	Mdi_s_istm {p. 8162}	Mdk_max {p. 8162}
Mdk_min {p. 8162}	NC_CBK_EX_NR {p. 1829}	STATE_TCT_INTV {p. 1578}	TQ_AV {p. 6656}
TQ_GS_SLOW_BN {p. 1581}	TQ_MAF {p. 1581}	TQI_BAS {p. 6661}	TQI_CAT_PROT {p. 6659}

**R.43.1 Outputs for BMW functions which are defined as TQDR exported data****FUNCTION DESCRIPTION:**

Adaptation to BMW environment.

**Application conditions**

**Initialisation at reset or at exit power latch phase:** Mdi\_bas, B\_safast , F\_wnwkhk\_sw, Mdk\_ist\_lm = 0

Mdi\_vmax = 1000 Nm  
Eta\_zylausbas, Eta\_zw\_min = 100%  
Mdk\_ist : first calculation  
Mdk\_max\_gs = +3276.7 Nm

**Recurrence:** 10 ms: Mdi\_bas, Mdi\_vmax, Mdk\_ist, Mdk\_ist\_lm, Eta\_zw\_min, Eta\_zylausbas, F\_wnwkhk\_sw, Mdk\_max\_gs  
20ms: B\_safast

**Activation:** every engine state

**Deactivation:** - -

**Formula section:**

*Remark:* all formulas are valid in a **physical** meaning

Mdi\_vmax = TQI\_VS\_MAX


**If(1)** ECU\_STATE = "PWL"

**Then(1)**

B\_safast = 0

Eta\_zw\_min = 0 %

Mdi\_bas = 0

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```

Eta_zylaus_bas = 100%
Mdk_ist_lm      = 0 Nm
Mdk_max_gs     = +3276.7 Nm

```

**Elseif(1)**

```

    B_safast      =      LV_FCUT_FAST
    Eta_zw_min    =      EFF_IGA_MIN * 100%
    Mdi_bas      =      TQI_BAS
    Mdk_ist      =      TQ_AV
    Eta_zylausbas =      EFF_SCC_BAS * 100%
    F_wnwkhk_sw =      FAC_EFF_IGA_CH_SP
    Mdk_ist_lm   =      TQ_MAF
    If (2)        STATE_TCT_INTV = "TQ_DEC" /* BMW: ST_MOD_DKG */

```

```

Then(2)      Mdk_max_gs   = TQ_GS_SLOW_BN
                                     /* CAN value TORQ_TAR_ADJR_POS_EGS */

```

**Else(2)**

```

    If (3)      STATE_TCT_INTV = " NO_INTERVENTION"
                or      STATE_TCT_INTV = " INVALID"

```

```

    Then(3)    Mdk_max_gs   = +3276.7 Nm

```

```

    Endif(3)

```

```

Endif(2)

```

```

Endif(1)

```

## R.43.2 Outputs for BMW functions which are not defined as TQDR exported data

### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

### Application conditions:

Initialisation at reset or exit Power Latch Phase:

```

Eta_zw_ist1 = Eta_zw_ist2 =
Eta_zwve_m = Eta_zw_mint = 100 %
Mdi_katschutz = 1000 Nm

```

Recurrence : 10 ms , except Eta\_zwve\_m segment

Activation: every engine state

Deactivation: --

### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

```

Eta_zw_ist1      =      EFF_IGA_AV_CBK[1] * 100%
Eta_zw_ist2     =      EFF_IGA_AV_CBK[2] * 100%
Eta_zw_mint     =      EFF_IGA_MIN_TEG * 100%

```

```

If          ECU_STATE = "PWL"

```

```

Then

```

```

Eta_zwve_m      = 0%
Mdi_katschutz  = 1000 Nm

Elseif
Eta_zwve_m      = EFF_IGA_BAS_COR_KNK_FIL * 100%
Mdi_katschutz  = TQI_CAT_PROT

Endif

```

### R.43.3 Outputs for supplier aggregates, BMW(supplier)

#### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Initialisation at reset:

```

0.0:          TQI_AV_HOM ,TQI_MIN_S , TQI_MIN_HOMS,TQI_
REF_MAX,TQI_SP_MAF,TQI_REF,TQI_AV,TQI_AV_S ,TQI_REF_S ,FAC_EFF_IGA_CH,TQ_MAX_
CLU,FAC_EFF_IGA_SECU,TQ_MIN_CLU,FAC_EFF_IGA_SCAV
0: LV_TQ_IGA_ENA , LV_TQI_BOL_SET, LV_GS_ACT_FL , LV_TQ_MIN_CLU
1.0:  EFF_LAMB_AV, EFF_LAMB_AV_CBK[NC_CBK_EX_NR],
      EFF_LAMB_BAS_COR , EFF_LAMB_SP_BAS
1023.96875 Nm: TQI_MAX

```

```

Recurrence : 10 ms          TQI_REF, TQI_REF_MAX, TQI_SP_MAX, TQI_AV_HOM, TQI_REF_
S, LV_TQ_IGA_ENA, TQI_MIN_HOMS
      EFF_LAMB_AV, EFF_LAMB_BAS_COR, TQI_AV_S, EFF_LAMB_SP_BAS, FAC_CAM_CH, TQ_
MAX_CLU, TQI_MIN_S , EFF_LAMB_AV_CBK[NC_CBK_EX_NR], LV_TQI_BOL_SET, LV_GS_ACT_
FL , FAC_EFF_IGA_SECU, LV_TQ_MIN_CLU, TQ_MIN_CLU, FAC_EFF_IGA_SCAV, TQI_MAX
bgn FAC_EFF_IGA_CH

```

Activation: at every engine state

Deactivation: -

#### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

```


TQI_REF          = Mdi_opt_l1
EFF_LAMB_AV_CBK[1] = Eta_lambda_1 /100%
EFF_LAMB_AV_CBK[2] = Eta_lambda_2 /100%
EFF_LAMB_AV      = 0.5 * ( EFF_LAMB_AV_CBK[1] + EFF_LAMB_AV_CBK[2] )
EFF_LAMB_BAS_COR = Eta_labas /100%
TQI_AV_S        = Mdi_s_istm
TQI_AV_HOM      = Mdi_ist_m
TQI_MAX         = Mdi_max
TQI_REF_S       = Mdi_opt_s
EFF_LAMB_SP_BAS = Eta_labas_sol /100%
TQI_REF_MAX     = Mdi_max_l1
TQI_SP_MAF      = Mdi_ml_soll

```

```

TQI_MIN_S          = Mdi_min_s
if      LV_TQ_LIM_INTV = 1
then    LV_TQ_IGA_ENA      = 1
else    LV_TQ_IGA_ENA      = B_zw_dynman
endif
FAC_CAM_CH          = F_wnwkh
FAC_EFF_IGA_CH      = F_wnwkhk
TQ_MAX_CLU          = Mdk_max
TQI_MIN_HOMS        = Mdi_min_hs
LV_TQI_BOL_SET      = B_mdimin_sa
LV_GS_ACT_FL        = B_vlschalt
FAC_EFF_IGA_SECU    = F_sicher_zw
LV_TQ_MIN_CLU       = B_llrein
TQ_MIN_CLU          = Mdk_min
FAC_EFF_IGA_SCAV    = F_atldyn

```

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## R.44 Customer adaptation module: TQLO

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_LOSS_OPM_SEL	O/V	0... FFH	0... 0.99609375	0.00390625	-
Torque loss interpolation factor for opeartion switch manager					
Md_na_defrost	O/V	8000... 7FFFH	0... 3276.7	0.1	Nm
torque losses for defroster means					
Md_na_mlad	O/V	8000... 7FFFH	0... 3276.7	0.1	Nm
torque losses for mechanical charger					
Md_na_thermo	O/V	8000... 7FFFH	0... 3276.7	0.1	Nm
torque losses for thermostat					
TQ_LOSS	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Overall torque losses (unfiltered value)					
TQ_LOSS_ADD	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
total torque losses for additive engine devices					
TQ_LOSS_REQ_CLU	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Overall torque losses (filtered value)					

### Input data:

Md_na_ges {p. 8160}	Md_reib_sa {p. 8161}	Mdi_reib {p. 8161}	TQ_LOSS_SCHA {p. 6658}
TQ_LOSS_THERMO {p. 6659}	TQ_LOSS_WIN_HEAT {p. 6659}		

### General Information

Adaptation to BMW environment.

Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

### Application Condition

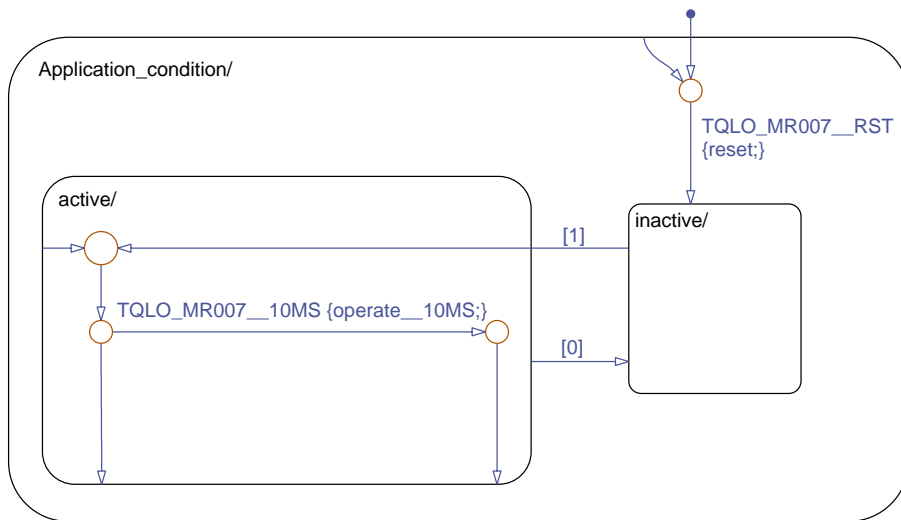



Figure R.44.1: TQLO\_MR007/APP\_CDN/APPCND

**Function Description**

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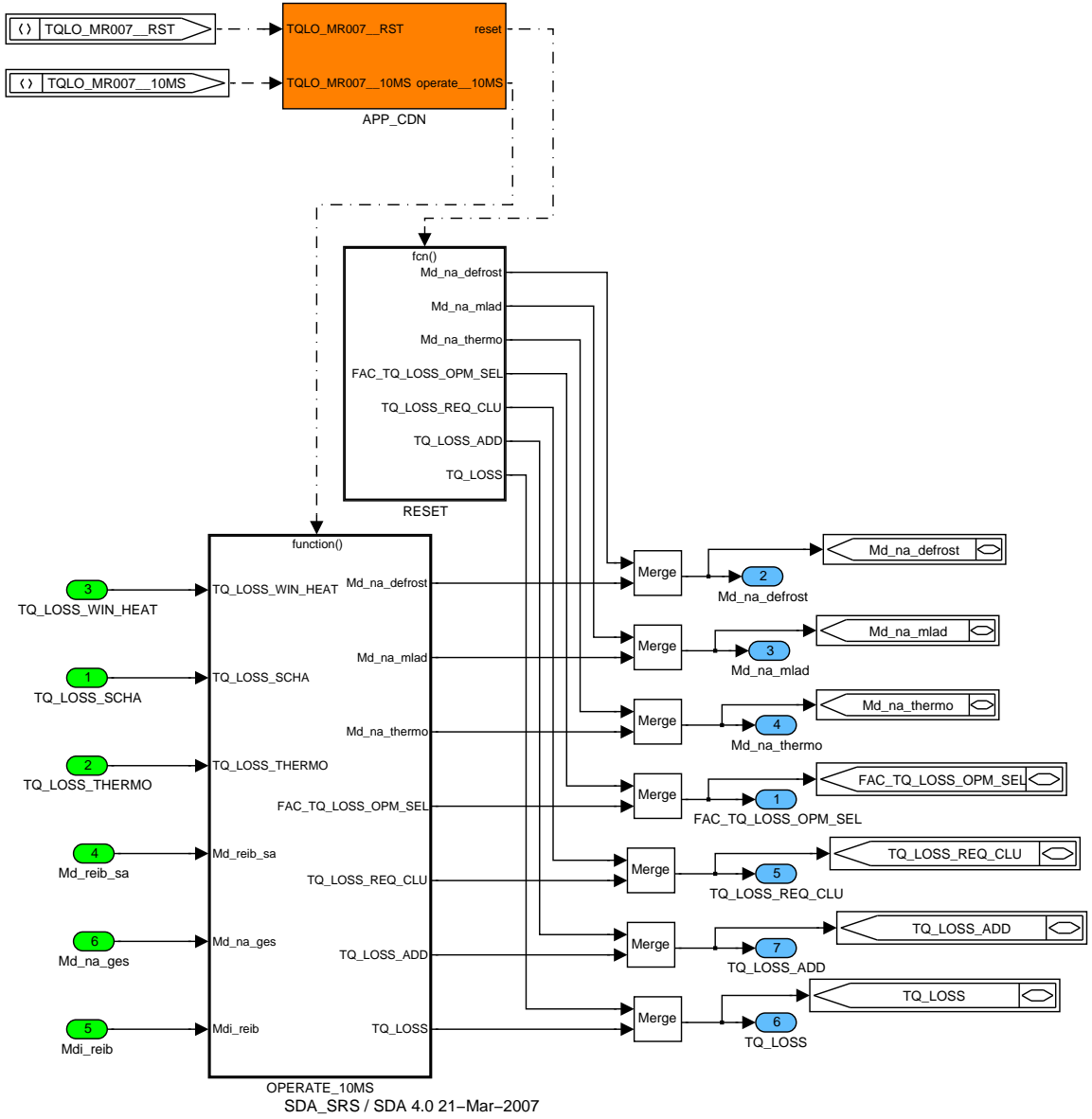


Figure R.44.2: TQLO\_MR007

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### R.44.1 Recurrence: 10 ms

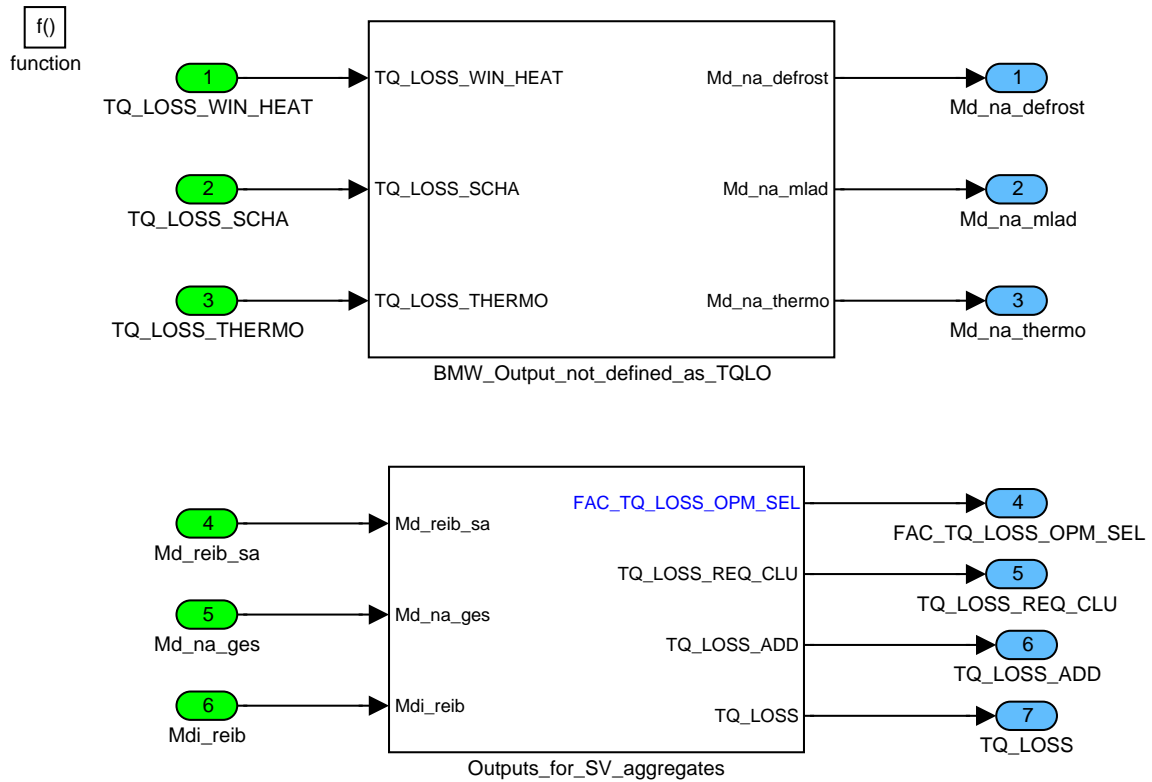


Figure R.44.3: TQLO\_MR007/OPERATE\_10MS

#### BMW output not defined as TQLO

Outputs for BMW functions which are not defined as TQLO exported data

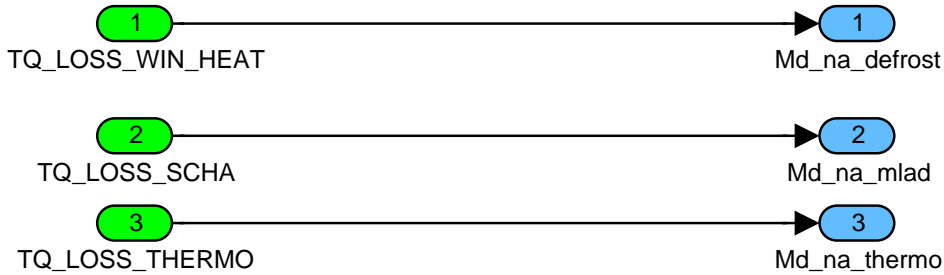


Figure R.44.4: TQLO\_MR007/OPERATE\_10MS/BMW\_Output\_not\_defined\_as\_TQLO

#### Outputs for SV aggregates

Remark: all formulas are valid in a physical meaning.

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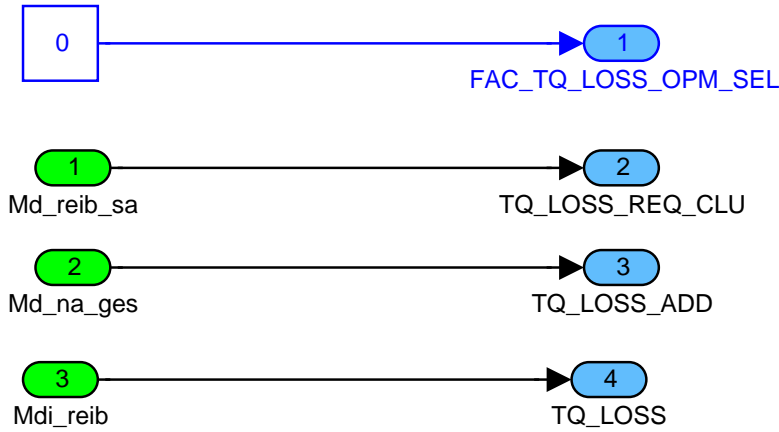


Figure R.44.5: TQLO\_MR007/OPERATE\_10MS/Outputs\_for\_SV\_aggregates

### R.44.2 Reset

All outputs are set to zero.

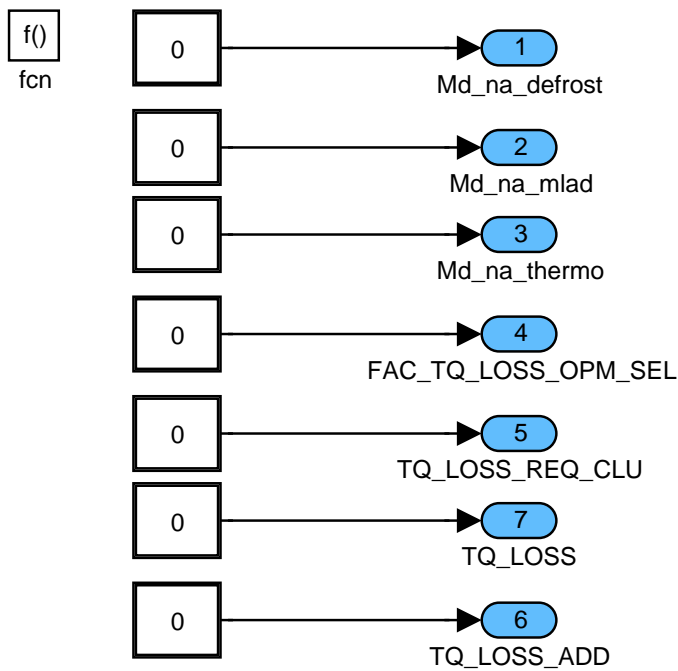


Figure R.44.6: TQLO\_MR007/RESET

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## R.45 Customer adaptation module: TQSP

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_fgr_akt	O/V	0... 1H	0 ...1	1	-
cruise control active					
B_ll_roh	O/V	0... 1H	0 ...1	1	-
Condition idle speed (raw value)					
B_vl	O/V	0... 1H	0 ...1	1	-
condition full load					
EFF_IGA_MIN_ADD_MAX	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Minimum possible ignition efficiency for catalyst heating					
LOAD_THD_FL	O/V	0... FFFFH	0... 3.99993	61e-6	-
load threshold for Full load recognition					
MAF_ADD_MAX	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Maximum possible engine load for catalyst heating - mg/Stk					
MAF_KGH_ADD_MAX	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Maximum possible engine load for catalyst heating - kg/h					
MAF_SP_TQI	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
mass air flow setpoint for torque intervention					
Mdi_fsb	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
Momentenbegrenzung bei aktivierter Feststellbremse					
Mdi_pmax	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
indicated engine torque for power limitation					
Mdi_res_st	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
torque reserve at engine start					
Mdi_siko_l	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
torque limitation monitoring, slow path					
Mdi_siko_s	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
torque limitation monitoring, fast path					
Mdr_wunsch	O/V	0... FFFFH	0... 255.99609	3.9063e-3	%
scaling factor requested torque at clutch					
TQ_ADD_MAX	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
maximum torque reserve at clutch					
TQ_REQ_CLU	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Driver requested torque at clutch after IS-PL transition					
TQ_REQ_IPM	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Torque request for IPM					
TQI_ADD_MAX	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum possible indicated engine torque inclusive torque reserve at IGA_MIN and ISC reserve limitation					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQI_ADD_MAX_TOL	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum possible indicated engine torque inclusive torque reserve at IGA_MIN					
TQI_EMS	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Requested indicated engine torque without external interventions					
TQI_REQ_FAST	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
limited torque request for fast path					
TQI_REQ_FAST_SEL	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
fast indicated engine torque request selected					
TQI_REQ_SLOW	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
limited torque request for slow path					
TQI_REQ_SLOW_SEL	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
slow indicated engine torque request selected					
TQI_REQ_TRA_FAST	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
requested indicated torque for fast path					
TQI_SP	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque setpoint fast path					
TQI_SP_CAN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
setpoint indicated engine torque for CAN calculations					
TQI_SP_CBK [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque setpoint for ignition path (bank selective)					
TQI_SP_S	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque setpoint for stratified combustion mode without interventions of ISC and AJC					

**Input data:**

C_MAF_REF {p. 8279}	ECU_STATE {p. 1091}	Eta_zw_minres {p. 8157}	F_vl_aus {p. 8158}
FAC_TQ_REQ_CLU {p. 6706}	LV_CT {p. 1442}	LV_FL_RAW {p. 1759}	LV_TQ_CRU_ACT {p. 6706}
Mdi_fzdyn {p. 8161}	Mdi_res_max {p. 8161}	Mdi_res_maxll {p. 8162}	Mdi_soll {p. 8162}
Mdi_soll_l {p. 8162}	Mdi_soll_lk {p. 8162}	Mdi_wunsch {p. 8162}	Mdi_zw_soll {p. 8162}
Mdi_zw_soll_l [NC_CBK_EX_NR]	Mdi_zw_sollcan {p. 8162}	Mdk_wunsch {p. 8162}	Mdk_wunsch_ipm {p. 8162}
Ms_res_max {p. 8163}	N_32 {p. 1525}	Rf_res_max {p. 8167}	Rf_soll {p. 8167}
TQ_ADD_ST {p. 810}	TQI_P_MAX {p. 6697}	TQI_PBR_MAX {p. 6697}	TQI_REQ_LIM_FAST {p. 6692}
TQI_REQ_LIM_SLOW {p. 6692}			






```

MAF_ADD_MAX           = Rf_res_max * C_MAF_REF
MAF_SP_TQI           = Rf_soll * C_MAF_REF
TQ_ADD_MAX           = Md_res_max
TQ_REQ_CLU           = Mdk_wunsch
TQI_ADD_MAX           = Mdi_res_maxll
TQI_ADD_MAX_TOL       = Mdi_res_max
TQI_EMS               = Mdi_wunsch
TQI_REQ_FAST          = Mdi_soll
TQI_REQ_FAST_SEL      = Mdi_soll_k
TQI_REQ_SLOW_SEL      = Mdi_soll_lk
TQI_REQ_TRA_FAST      = Mdi_fzdyn
TQI_SP                = Mdi_zw_soll
TQI_SP_CBK[NC_CBK_EX_NR] = Mdi_zw_soll_i[NC_CBK_EX_NR]
TQI_SP_CAN            = Mdi_zw_sollcan
TQI_REQ_SLOW          = Mdi_soll_l
MAF_KGH_ADD_MAX       = Ms_res_max
If          ECU_STATE = "PWL"
Then
    TQI_SP_S = 0 Nm
    TQ_REQ_IPM = 0 Nm
Else
    TQI_SP_S   = Mdi_zw_soll
    TQ_REQ_IPM = Mdk_wunsch_ipm
Endif

```

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## R.46 Customer adaptation module: TRSM

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_outget	O/V	0... 1H	0 ...1	1	-
Automatic transmission recognized					
B_fs	O/V	0... 1H	0 ...1	1	-
Logic variable for gear engaged					
B_gang_rueck	O/V	0... 1H	0 ...1	1	-
Logic variable for reverse gear					
B_kupp_ext	O/V	0... 1H	0 ...1	1	-
Clutch switch information from BMW					
Gangi	O/V	0... FFH	0... 255	1	-
Actual gear					
LV_CS	O/V	0... 1H	0 ...1	1	-
Clutch switch information from Siemens					
Md_getriebe	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
gear box torque					
Mdi_gsl_minus	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
GS torque intervention slow decrement					
Mdi_gsl_plus	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
GS torque intervention slow increment					
Mdi_gss_minus	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
GS torque intervention fast decrement					
Mdi_gss_plus	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
GS torque intervention fast increment					
Mdi_res_gs	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
GS torque intervention fast increment					

### Input data:

B_kupp {p. 8343}	ECU_STATE {p. 1091}	GEAR {p. 1302}	GR_AT {p. 1302}
LV_AT {p. 654}	LV_CS_CUS {p. 1419}	LV_DRI {p. 1302}	LV_VAR_TCT {p. 656}
STATE_GEAR_REV_CAN {p. 1574}	TQ_ADD_TRANS {p. 6710}	TQ_CONV {p. 6710}	TQI_GS_FAST_DEC {p. 6718}
TQI_GS_FAST_INC {p. 6718}	TQI_GS_SLOW_DEC {p. 6719}	TQI_GS_SLOW_INC {p. 6719}	

### R.46.1 Outputs for BMW functions which are defined as TRSM exported data

#### FUNCTION DESCRIPTION:


Adaptation to BMW environment.

#### Application conditions

**Initialisation :** 0  
Except: B\_outget = first measured Value

**Recurrence :** 10 ms

**Activation :** every engine state

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**Formula section:**

```

If          ECU_STATE != "PWL"
Then       B_fs = LV_DRI
              B_autget = LV_AT
Endif
If STATE_GEAR_REV_CAN = 0 or ECU_STATE = "PWL"
Then
      B_gang_rueck = 0
Else
      B_gang_rueck = 1
Endif

```

**R.46.2 Outputs for BMW functions which are not defined as TRSM exported data****DESCRIPTION:**

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

**Application conditions:**

*Initialisation at reset:*

```

Mdi_xxx_minus = 1000 Nm
Mdi_xxx_plus, Mdi_res_gs, Md_getriebe = 0 Nm
B_kupp_ext = first measured Value
Gangi = 0

```

```

Recurrence :      10 ms
Activation:       every engine state
Deactivation:     --

```

**Formula section:**

*Remark:* all formulas are valid in a **physical** meaning

```

B_kupp_ext          = LV_CS_CUS
Md_getriebe         = TQ_CONV

```

```

If ECU_STATE = "PWL"
then

```

```

Mdi_gsl_minus      = 1000 Nm
Mdi_gsl_plus       = 0 Nm
Mdi_gss_minus      = 1000 Nm
Mdi_gss_plus       = 0 Nm
Mdi_res_gs         = 0 Nm


```

**else**

```

Mdi_gsl_minus      = TQI_GS_SLOW_DEC
Mdi_gsl_plus       = TQI_GS_SLOW_INC
Mdi_gss_minus      = TQI_GS_FAST_DEC

```

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```

Mdi_gss_plus          = TQI_GS_FAST_INC
Mdi_res_gs           = TQ_ADD_TRANS
If (LV_AT = 1 & GR_AT = 0 & LV_DRI=1) or
(LV_VAR_TCT = 1 & GR_MT = 0 & LV_DRI = 1)
then

    Gangi = 255 {Rückwärtsgang}

else

    Gangi = GEAR

Endif

```

### R.46.3 Outputs for supplier aggregates

#### FUNCTION DESCRIPTION:


Adaptation to BMW environment.

#### Application conditions

**Initialisation :**           LV\_CS = 0  
**Recurrence :**               10 ms  
**Activation :**                *every engine state*

#### Formula section:

LV\_CS = B\_kupp

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## R.47 Customer adaptation module: VHSC

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Mdi_accl_plus	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
torque increase for slow torque intervention during DCC					
Mdi_accs_plus	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Torque increase for fast torque intervention during DCC					
Mdr_fgr	O/V	0... FFFFH	0... 255.99609	3.9063e-3	%
Relatives Wunschmoment vom Fahrgeschwindigkeitsregler					

### Input data:

FAC_TQ_REQ_CRU {p. 6737}	TQI_DCC_FAST_INC {p. 6731}	TQI_DCC_SLOW_INC {p. 6731}	
-----------------------------	-------------------------------	-------------------------------	--

### R.47.1 Outputs for BMW functions which are not defined as VHSC exported data

#### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

*Remark:* The really possible physical limits of the outputs are different to the specified values due to the input data attributes.

#### Application conditions

**Initialisation:** *0 at reset*

**Recurrence :** 10 ms

**Activation:** *every engine state*

#### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

Mdi\_accl\_plus = TQI\_DCC\_SLOW\_INC

Mdi\_accs\_plus = TQI\_DCC\_FAST\_INC

Mdr\_fgr = FAC\_TQ\_REQ\_CRU \* 100 %

## R.48 Customer adaptation module: VIMA

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Disa_ist	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
actual position variable intake manifold					

### Input data:

VIM_AV {p. 3622}			
------------------	--	--	--

### R.48.1 Outputs for BMW functions which are not defined as VIMA exported data

#### FUNCTION DESCRIPTION:

Adaptation to BMW environment.

*Remark:* the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

#### Application conditions:

*Initialisation at reset or at exit power latch phase:* 0 %

*Recurrence :* 10 ms

*Activation:* every engine state,

*Deactivation:* --

#### Formula section:

*Remark:* all formulas are valid in a **physical** meaning

Disa\_ist = VIM\_AV

## R.49 Customer adaptation module: VVTI

### Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CAM_DYN_IVVT_EX_SAE [NC_NR_CBK_IVVT]	O/V	0... FFFFH	0... 655.35	0.01	°
Camshaft position change during dynamic diagnosis at symptom setting - diagnostic tester information; exhaust					
CAM_DYN_IVVT_EX_TOL_SAE [NC_NR_CBK_IVVT]	O/V/S	0... FFFFH	0... 655.35	0.01	°
Camshaft position change during dynamic diagnosis at symptom setting - diagnostic tester information max value; exhaust					
CAM_DYN_IVVT_IN_SAE [NC_NR_CBK_IVVT]	O/V	0... FFFFH	0... 655.35	0.01	°
Camshaft position change during dynamic diagnosis at symptom setting - diagnostic tester information; inlet					
CAM_DYN_IVVT_IN_TOL_SAE [NC_NR_CBK_IVVT]	O/V/S	0... FFFFH	0... 655.35	0.01	°
Camshaft position change during dynamic diagnosis at symptom setting - diagnostic tester information max value; inlet					
CAM_EX [NC_NR_CBK_IVVT]	O/V	0... FFH	-40.125 ...-135.75	-0.375	°CRK
Current position of exhaust camshaft as engine quantity					
CAM_IN [NC_NR_CBK_IVVT]	O/V	0... FFH	60... 155.625	0.375	°CRK
Actual position inlet CAM VVTI					
CAM_SP_IVVT_EX	O	0... FFH	-40... -135.625	-0.375	°CRK
Exhaust CAM setpoint for VVTI					
CAM_SP_IVVT_IN	O	0... FFH	60... 155.625	0.375	°CRK
Inlet CAM setpoint for VVTI					
CAM_SP_REF_EX	O	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Exhaus camshaft target spread at reference conditions (warm engine)					
CAM_SP_REF_IN	O	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Inlet camshaft target spread at reference conditions (warm engine)					
LV_CAM_LOCK_IVVT_EX [NC_NR_CBK_IVVT]	O/V	0... 1H	0 ...1	1	-
VVT on exhaust camshaft in locked position at engine start					
LV_CAM_LOCK_IVVT_IN [NC_NR_CBK_IVVT]	O/V	0... 1H	0 ...1	1	-
VVT on intake camshaft in locked position at engine start					
LV_DI_AD_REF_CAM_IVVT_EX	O/V	0... 1H	0 ...1	1	-
Adaptation of exhaust camshaft reference position: 0 = enabled, 1 = disabled					
LV_DI_AD_REF_CAM_IVVT_IN	O/V	0... 1H	0 ...1	1	-
Adaptation of inlet camshaft reference position: 0 = enabled, 1 = disabled					
Nwa1_pos	O	0... FFFFH	0... 6553.5	0.1	°CRK
New exhaust camshaft edge (el. falling)					
Nwa1_time	O/V	0... 7FFFFFFFH	0... 2147483647	1	ms
Time stamp at new exhaust camshaft edge (el. falling)					

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Nwe1_pos	O	0... FFFFH	0... 6553.5	0.1	°CRK
New inlet camshaft edge (el. falling)					
Nwe1_time	O/V	0... 7FFFFFFFH	0... 2147483647	1	ms
Time stamp at new inlet camshaft edge (el. falling)					
Vsa_sprs_kh	O	0... FFFFH	0... 6553.5	0.1	°CRK
Cam setpoint for exhaust cam via catalyst heating					
Vse_sprs_kh	O	0... FFFFH	0... 6553.5	0.1	°CRK
Cam setpoint for inlet cam via catalyst heating					

**Input data:**

Aspr {p. 8154}	B_vsa_an {p. 8347}	B_vsaadp {p. 8347}	B_vse_an {p. 8347}
B_vseadp {p. 8347}	CAM_SP_CH_EX {p. 3601}	CAM_SP_CH_IN {p. 3601}	Espr {p. 8157}
IDX_EDGE_CAM_EX [NC_NR_CAM_CBK] {p. 871}	IDX_EDGE_CAM_IN [NC_NR_CAM_CBK] {p. 871}	LV_END_DIAG_MEC_ IVVT_EX {p. 1059}	LV_END_DIAG_MEC_ IVVT_IN {p. 1059}
LV_ES {p. 1720}	LV_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 872}	LV_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 872}	LV_SYN_VLD {p. 1506}
LV_VLD_PSN_CAM_EX [NC_NR_CAM_CBK] {p. 872}	LV_VLD_PSN_CAM_IN [NC_NR_CAM_CBK] {p. 872}	NC_NR_CAM_CBK {p. 1507}	NC_NR_CBK_IVVT {p. 604}
NC_NR_EDGE_CAM_EX {p. 874}	NC_NR_EDGE_CAM_IN {p. 874}	NC_PSN_EDGE_CAM_EX [NC_NR_EDGE_CAM_ EX][NC_NR_CAM_CBK] {p. 874}	NC_PSN_EDGE_CAM_IN [NC_NR_EDGE_CAM_ IN][NC_NR_CAM_CBK] {p. 874}
PSN_CAM_EX [NC_NR_CAM_CBK] {p. 1533}	PSN_CAM_IN [NC_NR_CAM_CBK] {p. 1533}	Vsa_spri {p. 8179}	Vsa_sprn {p. 8179}
Vsaw_md6_mx {p. 8179}	Vsaw_md6_tst {p. 8179}	Vse_spri {p. 8179}	Vse_sprn {p. 8179}
Vsedw_md6_mx {p. 8179}	Vsedw_md6_tst {p. 8179}		

**Calibration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CAM_INI_EX	-	0... FFH	-40... -135.625	-0.375	°CRK
Initialization value for exhaust camshaft					
C_CAM_INI_IN	-	0... FFH	60... 155.625	0.375	°CRK
Initialization value for inlet camshaft					
LC_NOT_ADJ_CAM_IVVT_EX [NC_NR_CBK_IVVT]	-	0... 1H	0 ...1	1	-
Camshaft_EX_i: 0 = with adjustment, 1 = without adjustment					
LC_NOT_ADJ_CAM_IVVT_IN [NC_NR_CBK_IVVT]	-	0... 1H	0 ...1	1	-
Camshaft_IN_i: 0 = with adjustment, 1 = without adjustment					

**Configuration data:**

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_IVVT_EX	-	0... 1H	0 ...1	1	-
Exhaust side configuration: 0 = without actuator, 1 = with actuator					



Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_IVVT_IN	-	0... 1H	0 ...1	1	-
Inlet side configuration: 0 = without actuator, 1 = with actuator					

## R.49.1 Interfaces served by customer OBJ Files

### FUNCTION DESCRIPTION:

Adaption to BMW environment.

*Remark:* The really possible resolution and limits of the output are different to the specified values due to the input data attributes.

NC\_NR\_CBK\_IVVT indicates the number of camshaft cylinder banks and it is set to 1 in this project.

NC\_NR\_CAM\_CBK indicates whether camshaft sensor(s) is present in one or both cylinder banks.

### Application conditions

#### Initialisation:

```

at reset
  CAM_EX [1] = C_CAM_INI_EX
  CAM_IN [1]= C_CAM_INI_IN
  CAM_SP_IVVT_EX = C_CAM_INI_EX
  CAM_SP_IVVT_IN = C_CAM_INI_IN
  CAM_SP_REF_EX = C_CAM_INI_EX
  CAM_SP_REF_IN = C_CAM_INI_IN
  LV_DI_AD_REF_CAM_IVVT_IN = 1
  LV_DI_AD_REF_CAM_IVVT_EX = 1
  Vsa_sprs_kh = - C_CAM_INI_EX; Vse_sprs_kh = C_CAM_INI_IN
  LV_CAM_LOCK_IVVT_EX[i] = B_vsa_an (out of NVMY)
  LV_CAM_LOCK_IVVT_INEX[i] = B_vse_an (out of NVMY)
  NLC_IVVT_IN = 1
  NLC_IVVT_EX = 1
  Restored from NVMY:
  CAM_DYN_IVVT_EX_SAE[NC_NR_CBK_IVVT]
  CAM_DYN_IVVT_IN_SAE[NC_NR_CBK_IVVT]
  CAM_DYN_IVVT_EX_TOL_SAE[NC_NR_CBK_IVVT]
  CAM_DYN_IVVT_IN_TOL_SAE[NC_NR_CBK_IVVT]
  At clearing error memory
  CAM_DYN_IVVT_EX_SAE[NC_NR_CBK_IVVT] = 0
  CAM_DYN_IVVT_EX_TOL_SAE[NC_NR_CBK_IVVT] = 0
  CAM_DYN_IVVT_IN_SAE[NC_NR_CBK_IVVT] = 0
  CAM_DYN_IVVT_IN_TOL_SAE[NC_NR_CBK_IVVT] = 0

```


#### Special values at PWL:

Last valid value: CAM\_DYN\_IVVT\_EX\_SAE[NC\_NR\_CBK\_IVVT]  
 CAM\_DYN\_IVVT\_EX\_TOL\_SAE[NC\_NR\_CBK\_IVVT]  
 CAM\_DYN\_IVVT\_IN\_SAE[NC\_NR\_CBK\_IVVT]  
 CAM\_DYN\_IVVT\_IN\_TOL\_SAE[NC\_NR\_CBK\_IVVT]

*Recurrence:* segment synchronous

Except :

10ms: LV\_DI\_AD\_REF\_CAM\_IVVT\_IN,  
 LV\_DI\_AD\_REF\_CAM\_IVVT\_EX,

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```

LV_CAM_LOCK_IVVT_EX[NC_NR_CBK_IVVT], LV_CAM_LOCK_IVVT_IN[NC_
NR_CBK_IVVT]
100ms:    CAM_DYN_IVVT_EX_SAE[NC_NR_CBK_IVVT]
          CAM_DYN_IVVT_EX_TOL_SAE[NC_NR_CBK_IVVT]
          CAM_DYN_IVVT_IN_SAE[NC_NR_CBK_IVVT]
          CAM_DYN_IVVT_IN_TOL_SAE[NC_NR_CBK_IVVT]

```

**Activation:**

LV\_ES = 1 0

**Deactivation:**

LV\_ES = 0 1

**Formula section:**

**Remark:** all formulas are valid in a **physical** meaning

```

CAM_EX[1] = - Vsa_spri
CAM_IN[1]  = Vse_spri
CAM_SP_IVVT_EX = - Aspr
CAM_SP_IVVT_IN  = Espr
CAM_SP_REF_EX  = - Vsa_sprn
CAM_SP_REF_IN  = Vse_sprn

```

With  $i = 1 \dots NC\_NR\_CAM\_CBK$ :

```

If          LV_SYN_CAM_IN[i] = 1
And        LV_SYN_VLD = 1
And        IDX_EDGE_CAM_IN[i] = 2 /3 /5 /6 /*relevant edge on intake camshaft ?*/
Then

    Nwe1_pos = NC_PSN_EDGE_2 /3 /5 /6_CAM_IN[i] + PSN_CAM_IN[i]
    Nwe1_time is updated by calling the Makro  getSystemTime1ms()

Else
    do nothing

Endif

If          LV_SYN_CAM_EX[i] = 1
And        LV_SYN_VLD = 1
And        IDX_EDGE_CAM_EX[i] = 2 /3 /5 /6 /* relevant edge on exhaust camshaft ?*/
Then

    Nwa1_pos = NC_PSN_EDGE_2 /3 /5 /6_CAM_EX[i] + PSN_CAM_EX[i]
    Nwa1_time is updated by calling the Makro  getSystemTime1ms()

Else
    do nothing

Endif

```

**Remark:** Starting with the SW releases 4DB7100S only engines with a 3-teeth-target-wheel are supported ! Older engines with a 4-teeth-target-wheel have to use older SW !

Vsa\_sprs\_kh = - CAM\_SP\_CH\_EX  
 Vse\_sprs\_kh = CAM\_SP\_CH\_IN

```

If                LV_VLD_PSN_CAM_IN[i] = 1          and                /*sensor self adaptation
ended*/
                    B_vseadp = 1                      /*adaptation enabled by BMW*/
Then              LV_DI_AD_REF_CAM_IVVT_IN = 0      /*inlet ref.-pos.-adap. enabled*/
Else              LV_DI_AD_REF_CAM_IVVT_IN = 1      /*inlet ref.-pos.-adap. disabled*/
Endif

If                LV_VLD_PSN_CAM_EX[i] = 1          and                /*sensor self adaptation
ended*/
                    B_vsaadp = 1                      /*adaptation enabled by BMW*/
Then              LV_DI_AD_REF_CAM_IVVT_EX = 0      /*inlet ref.-pos.-adap. enabled*/
Else              LV_DI_AD_REF_CAM_IVVT_EX = 1      /*inlet ref.-pos.-adap. disabled*/
Endif
LV_CAM_LOCK_IVVT_EX[i] = B_vsa_an
LV_CAM_LOCK_IVVT_IN[i] = B_vse_an
If                LV_END_DIAG_MEC_IVVT_IN[1] = 1
Then              CAM_DYN_IVVT_IN_SAE[1] = Vsedw_md6_tst
                    CAM_DYN_IVVT_IN_TOL_SAE[1] = Vsedw_md6_mx
Else              keep old value
Endif
If                LV_END_DIAG_MEC_IVVT_EX[1] = 1
Then              CAM_DYN_IVVT_EX_SAE[1] = Vsadw_md6_tst
                    CAM_DYN_IVVT_EX_TOL_SAE[1] = Vsadw_md6_mx
Else              keep old value
Endif

```